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Jeep®

NINETEEN SEVENTY-FOUR TECHNICAL SERVICE MANUAL

cj·5/cj·6 • cherokee • wagoneer • truck

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FOREWORD

This manual contains the latest service information for all 1974 Jeep vehicles. Diagnosis, disassembly, repair, assembly, and installation procedures along with specifications and torque references are included in each group.

The Group Index on the opposite page allows you to quickly locate any desired group. At the beginning of each group is an index which gives the page number on which major subjects begin. An alphabetical index is also included in the back of the manual.

All information and specifications in this manual are based on the latest data available at the time of publication. Jeep Corporation reserves the right to discontinue models and change specifications or design without notice or incurring obligation.

Brand names mentioned in this manual are for convenience only and are not intended as a recommendation to use a specific brand of product. They are indicative of a class or type and may be substituted by their equivalent.

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1974 Technical Service Manual

CJ-5/CJ-6 Cherokee Wagoneer Truck

Jeep Corporation

World's Largest and Most Experienced Manufacturer of 4-Wheel Drive Vehicles

Service Communications

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Group Index

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VEHICLE IDENTIFICATION - GENERAL INFORMATION

GENERAL

This publication contains the essential removal, installation, adjustment, and maintenance procedures for servicing all domestically marketed 1974 AMC Jeep vehicles. Details of new and revised components, systems, and service procedures are covered herein.

Nine models comprise the 1974 Jeep vehicle product lineup. The two-wheel drive DJ Series and the Commando Models have been canceled for 1974. All lines now carry the four-wheel drive capability.

A new model line - Cherokee - is introduced as a two-door vehicle with major unique body components. The chassis and body mechanical systems are essentially common with Wagoneer throughout.

J42680

Fig. A-1 1974 Cherokee

Wagoneer and Truck body styles are distinguished by minor appearance changes. Major changes in these lines have been confined to improving ride and handling characteristics, brake performance, and in chassis upgrading. Truck models have been rerated to comply with standard industry gross vehicle weight ratings.

A 401 CID V-8 engine is now available with Cherokee, Wagoneer, and Truck. Eight-cylinder engine upgrading includes new induction hardening of exhaust valve seats (was six-cylinder only) for greater service life. All engines can now operate with any type of normal fuel (gasoline) . . . regular grade, low-lead, or no-lead fuels.

Energy-absorbing bumpers are optional on all models (except trucks), and aluminum-styled wheels are available on all Jeep vehicles except J-20 Trucks.

CJ-5 AND CJ-6 MODELS

As in 1973, two four-wheel drive models are being offered - the open body CJ-5 (84-inch wheelbase) and CJ-6 (104-inch wheelbase). The two-wheel drive models, DJ-5 and DJ-6, are no longer available. The sporty CJ-5 Renegade, formerly available on a limited basis, is now a regular production package. New upgraded drum brakes include new drums, linings, master cylinder, and the addition of a proportioning valve.

J42681

Fig. A-2 1974 CJ-5 Renegade

CHEROKEE MODELS

The new Cherokee line consists of two new four-wheel drive models . . . the two-door Cherokee Model 16, and the two-door Cherokee S Model 17.

Cherokee is a strong new entry in the extremely fast-growing sport-utility market, having roominess, ruggedness, and ride and handling comparable to or better than its competition. Cherokee has many unique features to accent its youthful, sporty appeal plus Wagoneer quality. Chassis, mechanical components, and most sheet metal are common with Wagoneer. Front disc brakes and Quadra-Trac (full time four-wheel drive) with automatic transmission are among the many quality options available.

WAGONEER MODELS

As in 1973, two Wagoneer models are available, both with the 109-inch wheelbase.

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For 1974, Quadra-Trac with automatic transmission is standard, and the 401 CID, 4 barrel V-8 engine is available as an option. The standard axle ratio is 3.07 (was 3.31); optional ratio is 3.54 (was 3.73).

Power train combinations are listed on a chart included in this section.


J42682

Fig. A-3 1974 Wagoneer

Mechanically, Wagoneers now have open-end type front axles, optional energy-absorbing front and rear bumpers, and an upgraded brake system including front disc brakes, new rear drums and linings, and a new master cylinder and combination valve. Optional variable-ratio power steering is available to replace the constant-ratio type, and to provide better cornering and maneuverability. A new windshield wiper system with articulating arms provides an improved wiper pattern. Other features include stronger steering connecting rods and sockets, a heavier-gauge gas tank with new center support straps, improved air conditioner output and distribution, longer front and rear multileaf springs for smoother ride.

TRUCK MODELS

Three models are available for 1974:

- Series J-10, Model 25, 119-inch wheelbase
- Series J-10, Model 45, 131-inch wheelbase
- Series J-20, Model 46, 131-inch wheelbase


J42683

Fig. A-4 1974 Truck

These models are now aligned by Gross Vehicle Weight Rating (GVWR) to conform to industry practice. Two basic series, J-10 and J-20, with optional GVW ratings, replace the 1973 lineup of six models with no GVWR options. Wheelbases are shortened by one inch due to relocation of the front axle. Following are the 1974 GVW ratings.

Series	Model Number	Wheelbase (Inches)	Gross Vehicle Weight Rating		
			Standard	Option 1	Option 2
J-10	25	119	5200	5600	– –
J-10	45	131	5200	5600	– –
J-20	46	131	6500	7200	8000

Quadra-Trac with automatic transmission is now standard or optional (see Power Train Combinations Chart) for all models and engines. Previously, Quadra-Trac was optional only for 5000 and 6000 GVW models with 360 CID V-8 engines.

The Dana 20, manual shift, four-wheel drive system continues standard except with 360-4V and 401-4V engines on J-10 models.

The 401-4V engine is a new option for all models.

The standard axle ratio is 3.54, which replaces the 3.73 axle formerly used on J-10 models with V-8 engines.

VEHICLE IDENTIFICATION

Federal Safety Certification

A non-removable plastic label (fig. A-5) is affixed to all vehicles to certify compliance with federal motor vehicle safety standards. It lists the Vehicle Identification Number (VIN), the month and year built, Gross Vehicle Weight Rating (GVWR), and Gross Axle Weight Rating (GAWR).

On CJ-5 and CJ-6 models, the label is located on the instrument panel. On Cherokee, Wagoneer, and Truck models, it is located on the door lock pillar on the driver's side.

J41028

Fig. A-5 Certification Label

Special Sales Request and Order (SSR&O) Number

Certain Jeep vehicles are built to special order with other than standard parts or equipment. To assist the dealer in procuring the correct replacement part(s), an SSR&O number is assigned, and a permanent record of the deviation is maintained by the factory. The SSR&O number is embossed on the Vehicle Identification Plate as shown in figure A-6.

Parts ordering procedure for SSR&O parts is detailed in the Jeep Parts Catalogs.

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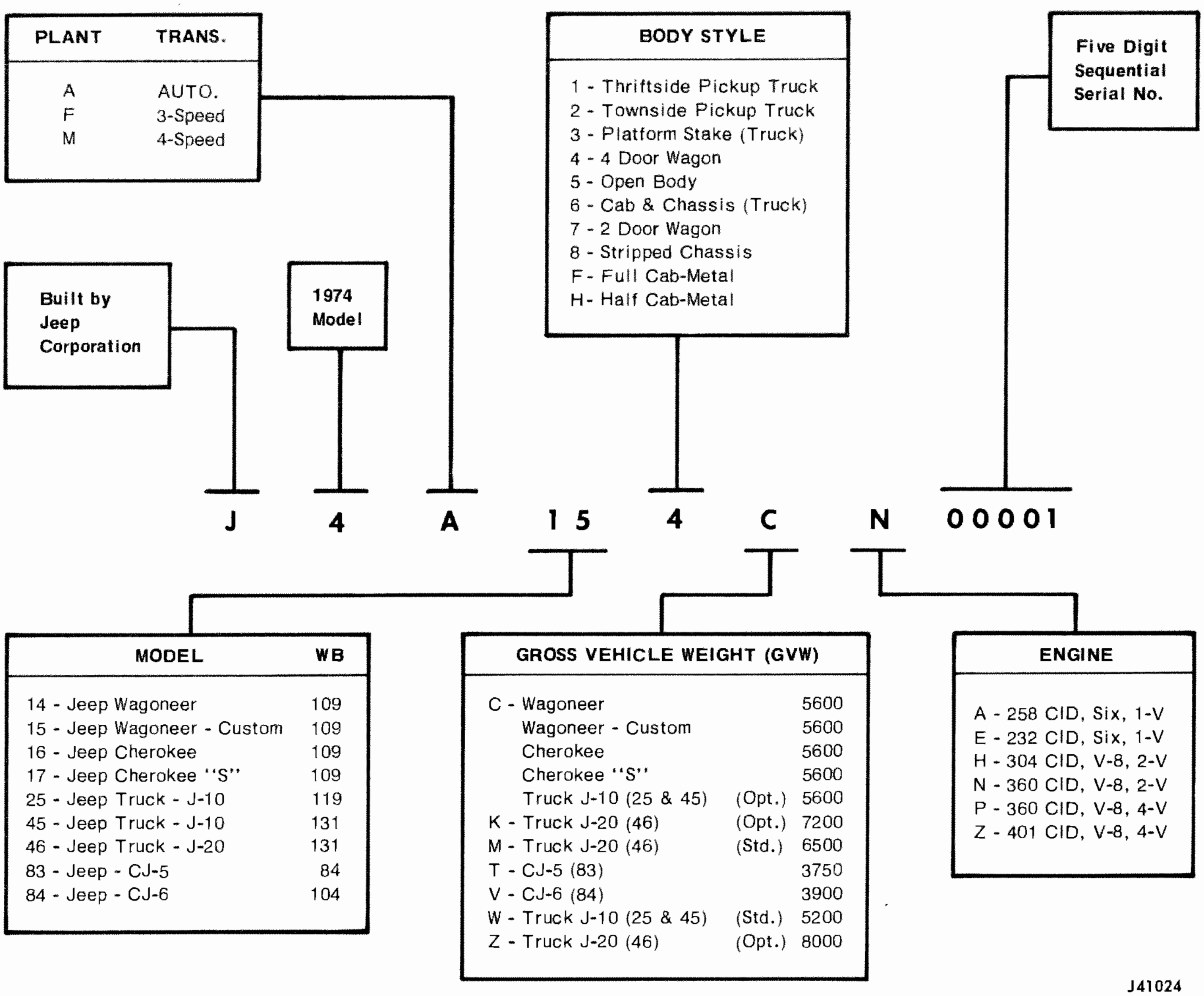
VEHICLE IDENTIFICATION NUMBER (VIN) DECODING CHART



Vehicle Identification Number (VIN)

All vehicle identification numbers contain 13 characters or digits. These digits are a combination of letters and numbers providing specific information about the vehicle. For an explanation of the VIN, refer to the decoding chart shown above.

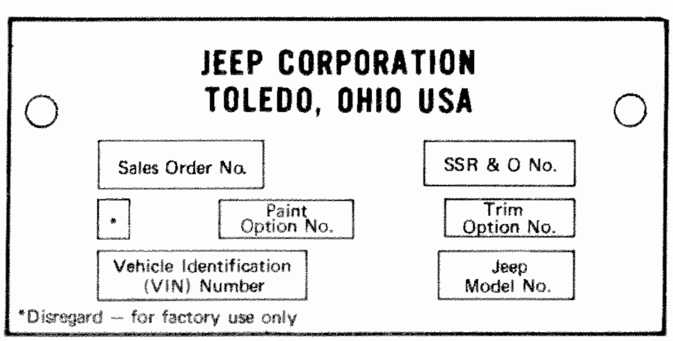


Fig. A-6 Vehicle Identification Plate J73030

Vehicle Identification Plate

A metal Vehicle Identification Plate (fig. A-6) is affixed to the left side of the firewall under the hood. The plate indicates the Vehicle Identification Number (VIN), the Sales Order Number, Special Sales Request and Order (SSR&O) Number, Paint and Trim Option Numbers, and the Jeep Model Number.

Paint Option Number

The Paint Option Number is embossed on the Vehicle Identification Plate as shown in figure A-6.

All colors are available from Ditzler or duPont jobbers by requesting the paint intermix formula. Option number 999 indicates special paint. To obtain information on special paint, obtain the SSR&O Number from the Vehicle Identification Plate and contact the National Parts Distribution Center for the correct paint under that sales order number.

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Trim Option Number

The Trim Option Number is embossed on the Vehicle Identification Plate as shown in figure A-6. Consult your Jeep Parts Catalogs for trim ordering procedure. Special trim is indicated by trim option number 999. To obtain information on special trim, contact your Jeep Parts Distribution Center and provide the Vehicle Identification Number (VIN).

KEYS AND LOCKS

Two square-headed and two oval-headed keys are provided, as applicable, with each vehicle. The square-headed (code D) keys operate the ignition switch, front door locks, and Wagoneer and Cherokee tailgates. The oval-headed (code E) keys operate the glove box locks. The keys have a code number stamped on the knockout plug. In the event a key is lost, a new key can be made by converting the key code number to a key bitting number. Key bitting numbers can be obtained from a key cutting machine manufacturer's cross-reference list or by contacting your Zone office.

If a key is lost and the key code number is unknown, the correct number can be identified by the Zone office from the vehicle identification number (VIN).

If the ignition key is lost and the key code number is not available, a new key can be made by removing a door lock and taking it to a locksmith (for CJ models, remove ignition switch). The locksmith can determine the key bitting by inserting a blank key into the lock cylinder and cutting the blank to match the tumbler.s

If a glove box key is lost, the lock cylinder can be removed and the tumblers rearranged to match the ignition key. Refer to the procedures outlined in Section 14 of this manual for installing new tumblers.

If the ignition switch lock is defective and the key is available, the cylinder and individual tumblers can be ordered and matched to the existing key. To determine the tumbler arrangement, place the key over the template (fig. A-7). Starting with the number 1 position, read across the visible line and record first digit of the key code. Continue this process for subsequent numbers 2 through 5.

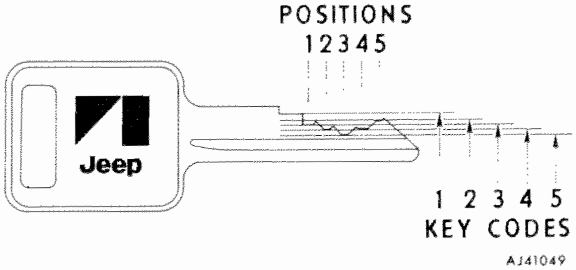

Fig. A-7 Key Coding Template

NOTE: *The template shown in figure A-7 may be used to determine th key bitting code of a key for which the key code number is unknown.*

SERVICE MANUAL IMPROVEMENTS

You are encouraged to report errors, omissions, or recommendations for improving this publication. A form provided for this purpose is included at the back of this manual.

SPECIAL TOOLS

Special tools are required for some service operations. When such tools are required, reference is made in the service procedure to the tool name and number. In addition, all special tools are illustrated throughout the text, where possible, or at the end of the section in which they are referenced.

WARNING: *Use of tools or procedures other than those recommended in this service manual could be detrimental to the safe operation of the vehicle serviced, as well as to the safety of the person or persons servicing the vehicle.*

CONVERSION OF ENGLISH AND METRIC MEASURES

Cubic Centimeters to Inches: To change cubic centimeter to cubic inches, multiply cubic centimeters times 0.061 to obtain cubic inches (cc x 9.061 = cubic inch).

Cubic Inches to Centimeters: To change cubic inches to cubic centimeters, multiply cubic inches times 16.39 to obtain cubic centimeters (cubic inch x 16.39 = cc).

Liters to Cubic Inches: To change liters to cubic inches, multiply liters times 61.02 to obtain cubic inches (liters x 61.02 = cubic inch).

Cubic Inches to Liters: To change cubic inches to liters, multiply cubic inches times 0.01639 to obtain liters (cubic inch x 0.01639 = liters).

Cubic Centimeters to Liters: To change centimeters to liters, divide by 1000 (simply move the decimal point three figures to the left).

Liters to Centimeters: To change liters to cubic centimeters, move the decimal point three figures to the right.

Miles to Kilometers: To change miles to kilometers, multiply miles times 1.609 to obtain kilometers (miles x 1.609 = kilometers).

Kilometers to Miles: to change kilometers to miles, multiply kilometers times 0.6214 to obtain miles (kilometers x 0.6214 = miles).

Pounds to Kilograms: 1 lb. = 0.04536 kg.

Kilograms to Pounds: 1 Kg = 2.2046 lb.

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METRIC SYSTEM

LENGTH

Unit	abbreviation	number of meters	approximate U.S. equivalent
myriameter	mym	10,000	6.2 miles
kilometer	km	1,000	0.62 miles
hectometer	hm	100	109.36 yards
decameter	dkm	10	32.81 feet
meter	m	1	39.37 inches
decimeter	dm	0.1	3.94 inches
centimeter	cm	0.01	0.39 inches
millimeter	mm	0.001	0.04 inches

AREA

unit	abbreviation	number of square meters	approximate U.S. equivalent
square kilometer	sq km *or* km^2	1,000,000	0.3861 square miles
hectare	ha	10,000	2.47 acres
are	a	100	119.60 square yards
centare	ca	1	10.76 square feet
square centimeter	sq cm *or* cm^2	0.0001	0.155 square inches

VOLUME

unit	abbreviation	number of cubic meters	approximate U.S. equivalent
decastere	dks	10	13.10 cubic yards
stere	s	1	1.31 cubic yards
decistere	ds	0.10	3.53 cubic feet
cubic centimeter	cu cm *or* cm^3 *also* cc	0.000001	0.061 cubic inches

CAPACITY

unit	abbreviation	number of liters	approximate U.S. equivalent		
			cubic	*dry*	*liquid*
kiloliter	kl	1,000	1.31 cubic yards		
hectoliter	hl	100	3.53 cubic feet	2.84 bushels	
decaliter	dkl	10	0.35 cubic feet	1.14 pecks	2.64 gallons
liter	l	1	61.02 cubic inches	0.908 quarts	1.057 quarts
deciliter	dl	0.10	6.1 cubic inches	0.18 pints	0.21 pints
centiliter	cl	0.01	0.6 cubic inches		0.338 fluidounces
milliliter	ml	0.001	0.06 cubic inches		0.27 fluidrams

MASS AND WEIGHT

unit	abbreviation	number of grams	approximate U.S. equivalent
metric ton	MT *or* t	1,000.000	1.1 tons
quintal	q	100,000	220.46 pounds
kilogram	kg	1,000	2.2046 pounds
hectogram	hg	100	3.527 ounces
decagram	dkg	10	0.353 ounces
gram	g *or* gm	1	0.035 ounces
decigram	dg	0.10	1.543 grains
centigram	cg	0.01	0.154 grains
milligram	mg	0.001	0.015 grains

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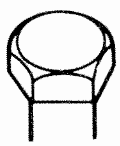
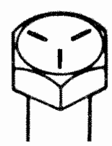
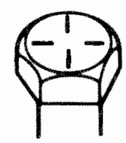
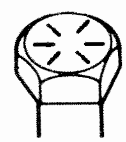
CAPACITY CONVERSION - U.S. GALLONS TO LITERS

Gallons	0	1	2	3	4	5
	Liters	Liters	Liters	Liters	Liters	Liters
1		3.7853	7.5707	11.3560	15.1413	18.9267
10	37.8533	41.6387	45.4240	49.2098	52.9947	56.7800
20	75.7066	79.4920	83.2773	87.0626	90.8480	94.6333
30	113.5600	117.3453	121.1306	124.9160	128.7013	132.4866
40	151.4133	155.1986	158.9840	162.7693	166.5546	170.3400

All critical torque specifications are listed at the end of each section, where appropriate. Where no torque reference is given, refer to the accompanying chart, Standard Torque Specifications and Capscrew Markings. Note that torques given in the chart are based on use of clean and dry threads. Reduce torque by ten percent when threads are lubricated with engine oil, and by twenty percent if new plated capscrews are used.

CAUTION: *Capscrews threaded into aluminum may require reductions in torque of thirty percent or more unless inserts are used.*

STANDARD TORQUE SPECIFICATIONS AND CAPSCREW MARKINGS

SAE Grade Number	1 or 2	5	6 or 7	8
Capscrew Head Markings Manufacturer's marks may vary. Three-line markings on heads shown below, for example, indicate SAE Grade 5. 				
Usage	**Used Frequently**	**Used Frequently**	**Used at Times**	**Used at Times**
Capscrew Diameter and Minimum Tensile Strength psi (Kg/sq cm)	To 1/2 - 69,000 (4850.7) To 3/4 - 64,000 (4499.2) To 1 - 55,000 (3866.5)	To 3/4 - 120,000 (8436.0) To 1 - 115,000 (8084.5)	To 5/8 - 140,000 (9842.0) To 3/4 - 133,000 (9349.9)	150,000 (10545.0)
Quality of Material	**Indeterminate**	**Minimum Commercial**	**Medium Commercial**	**Best Commercial**

Capscrew Body Size (Inches) - (Thread)	Torque (1 or 2) Ft-Lb	kg m	Torque (5) Ft-Lb	kg m	Torque (6 or 7) Ft-Lb	kg m	Torque (8) Ft-Lb	kg m
1/4-20 -28	5 6	0.6915 0.8298	8 10	1.1064 1.3830	10	1.3830	12 14	1.6596 1.9362
5/16-18 -24	11 13	1.5213 1.7979	17 19	2.3511 2.6277	19	2.6277	24 27	3.3192 3.7341
3/8-16 -24	18 20	2.4894 2.7660	31 35	4.2873 4.8405	34	4.7022	44 49	6.0852 6.7767
7/16-14 -20	28 30	3.8132 4.1490	49 55	6.7767 7.6065	55	7.6065	70 78	9.6810 10.7874
1/2-13 -20	39 41	5.3937 5.6703	75 85	10.3725 11.7555	85	11.7555	105 120	14.5215 16.5960
9/16-12 -18	51 55	7.0533 7.6065	110 120	15.2130 16.5960	120	16.5960	155 170	21.4365 23.5110
5/8-11 -18	83 95	11.4789 13.1385	150 170	20.7450 23.5110	167	23.0961	210 240	29.0430 33.1920
3/4-10 -16	105 115	14.5215 15.9045	270 295	37.3410 40.7985	280	38.7240	375 420	51.8625 58.0860
7/8- 9 -14	160 175	22.1280 24.2025	395 435	54.6285 60.1605	440	60.8520	605 675	83.6715 93.3525
1- 8 -14	235 250	32.5005 34.5750	590 660	81.5970 91.2780	660	91.2780	910 990	125.8530 136.9170

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BODY STYLES AND GENERAL DIMENSIONS (Inches)

Model Code Number and Body Style		Wheelbase and Tread Width				Exterior Dimensions						Interior Dimensions			
		Wheel-Base	Min. Turning Circle	Front Tread	Rear Tread	Overall Length	Height	Width	Front Over-hang	Rear Over-hang	Min. Ground Clearance	Head-room (Front)	Leg Room (Front)	Shoulder Room (Front)	Hip Room (Front)
83	CJ-5 Open Body	84	32.9	51.5	50.0	138.9	69.5	59.9	22.9	32.0	8.0	40.0	41.0	55.40	55.40
84	CJ-6 Open Body	104	37.6	51.5	50.0	158.9	68.3	59.9	22.9	32.0	8.0	40.0	41.0	55.40	55.40
16	Cherokee Std. 2-Dr. Wagon	109	38.4	59.0	57.5	183.7	65.3	75.6	29.7	45.0	8.0	38.6	45.0	58.12	61.00
17	Cherokee 'S' Cust. 2-Dr. Wagon	109	38.4	59.0	57.5	183.7	65.3	75.6	29.7	45.0	8.0	38.6	45.0	58.12	61.00
14	Wagoneer Std. 4-Dr. Wagon	109	38.4	59.0	57.5	183.7	65.3	75.6	29.7	45.0	8.0	38.6	45.0	58.12	61.00
15	Wagoneer Custom Cust. 4-Dr. Wagon	109	38.4	59.0	57.5	183.7	65.3	75.6	29.7	45.0	8.0	38.6	45.0	58.12	61.00
25	Truck J-10 Pickup Std. 5200 GVW Opt. 5600 GVW	119 119	41.9 41.9	*62.9 *62.9	63.8 63.8	193.6 193.6	69.5 71.3	78.9 78.9	29.5 29.5	45.1 45.1	8.0 8.9	38.3 38.3	45.0 45.0	60.12 60.12	60.62 60.62
45	Truck J-10 Pickup Std. 5200 GVW Std. 5600 GVW	131 131	45.4 45.4	*62.9 *62.9	64.4 64.4	205.6 205.6	69.5 71.3	78.9 78.9	29.5 29.5	45.1 45.1	8.0 8.9	38.3 38.3	45.0 45.0	60.12 60.12	60.62 60.62
46	Truck J-20 Pickup Std. 6500 GVW Opt. 7200 GVW Opt. 8000 GVW	131 131 131	45.4 45.4 45.4	64.5 64.5 64.5	64.4 64.4 64.6	205.6 205.6 205.6	69.5 71.3 72.4	78.9 78.9 78.9	29.5 29.5 29.5	45.1 45.1 45.1	8.9 8.9 8.9	38.3 38.3 38.3	45.0 45.0 45.0	60.12 60.12 60.12	60.62 60.62 60.62

***63.0 Inches with Disc Brakes**

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POWER TRAIN COMBINATIONS

Vehicle	Engine	Comp. Ratio	Carb.	Transmission			Transfer Case		Clutch Size (Inches)	Axle Ratio		Trac-Loc (NA with QT)	Axle Model		Brake Size (4) (Inches)		Wheels	Tires
				3 Spd	4 Spd	Auto	Dana 20	QT		Std.	Opt.		Front	Rear	Front	Rear		
CJ-5 Model 83 (84'' WB) 3750 GVW	232	8.0:1	1V	S	O		S	NA	10.5	3.73	4.27	O	Dana 30 Open End	Dana 44	Bendix 11 x 2 Drum	Bendix 11 x 2 Drum	15 x 6.00 5 Bolt 5.50 BC	F78 x 15
	258	8.0:1	1V	S	O													
	304	8.4:1	2V	S														
CJ-6 Model 84 (104'' WB) 3900 GVW	232	8.0:1	1V	S			S	NA	10.5	3.73	4.27	O	Dana 30 Open End	Dana 44	Bendix 11 x 2 Drum	Bendix 11 x 2 Drum	15 x 6.00 5 Bolt 5.50 BC	F78 x 15
	258	8.0:1	1V	S														
	304	8.4:1	2V	S														
Cherokee Models 16 & 17 (109'' WB) 5600 GVW	258	8.0:1	1V	S		O	S		10.5	3.54	4.09	O (3)	Dana 44 Open End	Dana 44	Delco 11 x 2 Drum Std. 12 Disc Opt.	Delco 11 x 2 Drum	15 x 6.00 6 Bolt 5.50 BC	F78 x 15 H78 x 15
	360	8.25:1	2V	S	O	O	S	S (1)	11.0	3.07	3.54	O						
	360	8.25:1	4V			S		S										
	401	8.35:1	4V			S		S										
Wagoneer Models 14 & 15 (109'' WB) 5600 GVW	360	8.25:1	2V		O	S	S	S (1)	11.0	3.07	3.54	O	Dana 44 Open End	Dana 44	Delco 12 Disc. Std.	Delco 11 x 2 Drum	15 x 6.00 6 Bolt 5.50 BC	F78 x 15 H78 x 15
	360	8.25:1	4V			S		S										
	401	8.35:1	4V			S		S										
J-10 Truck Model 25 (119'' WB) Model 45 (131'' WB) 5200 GVW 5600 Opt.	258	8.0:1	1V	S	O	O	S	O (2)	10.5	4.09	NA	O	Dana 44 Open End	Dana 44	Delco 11 x 2 Drum Std. 12 Disc Opt.	Delco 11 x 2 Drum	15 x 6.00 6 Bolt 5.50 BC	G78 x 15 (5200 GVW) H78 x 15 (5600 GVW)
	360	8.25:1	2V	S	O	O	S	O (2)	11.0	3.54	4.09							
	360	8.25:1	4V			S		S										
	401	8.35:1	4V			S		S		3.54	NA							
J-20 Truck Model 46 (131'' WB) 6500 GVW 7200 Opt. 8000 Opt.	360	8.25:1	2V	S	O	O	S	O (2)	11.0	3.73	4.09	O	Dana 44 Open End	Dana 60 Full Floating	Delco 12.5 Disc	Delco 12 x 2.5 Drum	16.5 x 6.00 (6500 GVW) 16.5 x 6.75 (7200 & 8000 GVW) 8 Bolt 6.50 BC	8.00 x 16.5 (6500 GVW) 8.75 x 16.5 (7200 GVW) 9.50 x 16.5 (8000 GVW)
	401	8.35:1	4V		S	O	S	S (5)	11.0	3.73	NA							

Legend:
- S - Standard Equipment
- O - Optional
- NA - Not Available
- BC - Bolt Circle
- WB - Wheelbase
- GVW - Gross Vehicle Weight Rating
- QT - Quadra-Trac

(1) Quadra-Trac is standard and required with automatic transmission.
(2) Quadra-Trac is required with automatic transmission.
(3) Trac-Loc not available with 4.09 axle.
(4) Power not available with standard drum brakes (except CJ-5 with V-8), standard with disc brakes.
(5) Auto/Quadra-Trac standard with 8000 GVW/401-4V.

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MAINTENANCE

GENERAL

Mechanical Maintenance and Lubrication recommendations have been developed to provide the owner with optimum performance of his vehicle and maximum protection under reasonable driving conditions.

The intervals at which the various lubrication and maintenance services should be performed are detailed in this manual section and in the Mechanical Maintenance Schedule provided with each vehicle. The schedule is designed to advise the owner of what is expected of him in continuance of the quality performance designed and engineered into his Jeep vehicle.

Detailed service procedures and specifications are listed in the respective sections of this manual.

Maintenance is service that is required through everyday driving of any vehicle. Maintenance services are specified by the Jeep Engineering Staff. Some are required for best operation on a mileage or time basis, as outlined in the Mechanical Maintenance Schedule.

The services outlined are those which experience and testing have indicated are most likely needed, at the intervals shown. However, driving conditions may vary the interval; for example, a brake inspection may be needed more often in stop and go use than in highway driving. Maintenance performed at regular intervals is the key to long and trouble-free vehicle life.

The Mechanical Maintenance Schedule will serve as a quick reference to the periodic maintenance and lubrication intervals required and recommended for Jeep vehicles.

Fuel

All 1974 Jeep engines will operate efficiently on regular grade leaded fuel or unleaded fuel of 91 research octane or higher. The use of unleaded fuel helps in the reduction of hydrocarbon emissions.

Road Test

The owner will usually outline the nature of conditions that may exist in the vehicle. However, a road test may indicate the exact condition. It may also indicate the probable reason for the condition.

If at all possible, the road test should be performed with the owner driving and outlining the condition reported. This will provide an insight as to whether or not the condition might, perhaps, be a result of the type of driving.

SERVICES SCHEDULED BY MILEAGE OR TIME INTERVALS

Engine Oil Change

The initial change of oil should be made at 5,000 miles. As periods for subsequent drains are affected by a variety of conditions, no single mileage figure can apply to all types of driving (refer to Engine Oil and Oil Filter Change - Mechanical Maintenance Schedule).

Under normal favorable conditions, draining at 5,000 mile intervals or every five months, whichever occurs first, is required. When changing oil, drain crankcase after engine has reached normal operating temperature to ensure complete removal of used oil.

Engine Oil Quality

For maximum engine protection under all driving

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1974 MECHANICAL MAINTENANCE SCHEDULE

Engine Oil and Oil Filter	Engine Coolant	Tires
Change required (R) every 5,000 miles or 5 months, whichever comes first. If most vehicle uses involve trips under 6-8 miles, change oil once in between the oil-and-filter changes. Change Heavy-Duty (HD) every 3,000 miles or 3 months, whichever comes first.	Change required (R) at 25,000 miles or 25 months and then at the start of every winter season. **Wheel Nuts** Torque (R) after first 200 miles.	Tires and tire services are excluded from both the New Vehicle Guarantee and this maintenance schedule. Tires are warranted directly by their manufacturers. Their normal maintenance recommendations appear as guides under Tire Condition and Tire Rotation.

SERVICES SCHEDULED by ACCUMULATED MILEAGE

HD – If you operate your Jeep vehicle under heavy-duty conditions such as off-road or dusty driving conditions for over 30% of use; extended idling during normal uses; towing heavy trailers (over 2,000 lbs.); or short run uses (most trips under 6-8 miles); more frequent servicing intervals are required. HD service intervals are in addition to others indicated.

R – Required for function and durability.

E – Required to help assure compliance with U.S. National Emission Control Standards.

	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Fluids (including battery) – inspect/correct level (a) Chart 1	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
COMPLETE BODY LUBRICATION AND BRAKE INSPECTION (b) Chart 2	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD
Front Suspension – inspect/correct caster and toe	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD
Manual Transmission Clutch – inspect/correct adjustment			R			R			R			R			R			R		
Automatic Transmission – adjust linkage			R			R			R			R			R			R		
COMPLETE CHASSIS LUBRICATION (Chart 3) – CJ	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
COMPLETE CHASSIS LUBRICATION (Chart 3) – Cherokee/Wagoneer /Truck	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD
Shock Absorber Mountings and Bushings – inspect	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD
Spring Bushings – inspect	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD	R	HD	HD
Exhaust System – inspect	R	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD	HD
U.S. EMISSION CONTROL SERVICES (Chart 4) – Scheduled routine service	E	E		E	E		E	E		E	E		E	E		E	E		E	E
U.S. EMISSION CONTROL SERVICES (Chart 4) – E.G.R. valve service*		E		E		E		E		E		E		E		E		E		E
U.S. EMISSION CONTROL SERVICES (Chart 4) – Complete precision tune-up			E			E			E			E			E			E		

a. Check engine oil level at each gasoline fill.

b. Immediately after operating in sand, mud, water, etc., inspect the brake assemblies and clean if necessary

*Service at 10,000-mile intervals if leaded fuel is used. Service at 25,000-mile intervals if lead-free is used.

conditions, use only engine oil meeting API Engine Oil Service Classification "SE". The term "SE" must appear on the oil container singly or in conjunction with other designations. SE engine oils provide more protection against oil oxidation, high-temperature engine deposits, rust and corrosion.

Engine Oil Viscosity

Multi-viscosity or single-viscosity types of oil are equally acceptable if refined and sold by reputable oil companies. However, multi-viscosity oil is your best choice since it covers a broader range of operating temperatures and driving conditions. Oil viscosity should be determined by the lowest air temperature anticipated before your next oil change, as follows:

ENGINE OIL VISCOSITY

Lowest Temperature Anticipated	Recommended Single Viscosity	Recommended Multi-Viscosity
Above + 32° F	SAE 20W-20	SAE 10W-30 or 10W-40
Above 0° F	SAE 10W*	SAE 10W-30 or 10W-40
Below 0° F	SAE 10W*	SAE 5W-20 or 5W-30

*Sustained high speeds (above 65 mph) should be avoided when using SAE 10W engine oil since oil consumption may be greater.

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CHART 1 FLUIDS

INSPECT AND CORRECT LEVELS:

Normal Service - Every 5,000 Miles*
Heavy Duty Service - Every 3,000 Miles*

Transmission
Transfer Case - Model 20 only**
Differentials - Front and Rear
Steering Gear Housing
Power Steering Reservoir
Brake Master Cylinder

Engine Oil Level, Radiator Coolant, Windshield Washer Solvent, Battery — at each fuel tank fill

DRAIN AND REFILL:

At Mileage Indicated

Transmission	
Automatic	
Normal Service	25,000
Heavy Duty Service	10,000
Manual	30,000
Transfer Case - Model 20 only**	30,000
Differentials - Front and Rear	30,000

*Except as otherwise indicated
**Quadra-Trac transfer case does not require scheduled lubricant level check or drain and refill

CHART 2 COMPLETE BODY LUBRICATION AND BRAKE INSPECTION

NORMAL SERVICE – Every 15,000 miles
HEAVY DUTY SERVICE – Every 5,000 miles

Inspection, and correction as needed, of brake linings and other parts
Hood latch and hinges
Door latches, lock cylinders and door hinges*
Tailgate hinges and latches*
Front seat tracks
Ash tray slides
Glove box door latch and hinge
Courtesy light switch buttons*
Apply silicone lubricant to all door, window, tailgate and liftgate rubber weather seals

*Where applicable

CHART 3 COMPLETE CHASSIS LUBRICATION

	CJ-5/CJ-6	Cherokee-Wagoneer-Truck
NORMAL SERVICE	Every 5,000 miles	Every 15,000 miles
HEAVY-DUTY SERVICE	Every 3,000 miles	Every 5,000 miles

Inspection and/or lubrication of . . .

Steering linkage ball joints (with replacement of suspension and steering system seals and components as necessary)
Steering shaft U-joint

Lubricate every 25,000 miles
Front wheel bearings – All Models
Transfer case shift linkage – CJ-5/CJ-6
Transfer case shift control lever assembly – Cherokee, Wagoneer & Truck

Normal Service – Every 50,000 Miles
Heavy Duty Service – Every 25,000 Miles
Front and Rear Propeller Shafts – All Models

NOTE: Rear wheel bearings do not require periodic or scheduled lubrication; only at time of overhaul or other service.

CHART 4 U.S. EMISSION CONTROL SERVICES

A precision electronic diagnosis should be purchased whenever questionable engine performance occurs between the scheduled complete precision tune-up.

SCHEDULED ROUTINE SERVICES

At 5-10-20-25-35-40-50-55-65-70-80-85-95-100,000 miles
Heat Valve (exhaust manifold) – inspect and lubricate
Drive Belts – inspect condition and tension and correct if required
Air Cleaner Element – clean (more often if conditions are dusty)

EXHAUST GAS RECIRCULATION VALVE SERVICES

At 10-20-30-40-50-60-70-80-90-100,000 miles
Exhaust Gas Recirculation Valve – inspect and clean*
Exhaust Gas Recirculation Discharge Port (6 cylinder) – inspect and clean if required*
*Service every 10,000 miles if leaded fuel is used
Service every 25,000 miles if lead-free fuel is used

COMPLETE PRECISION TUNE-UP

at 15-30-45-60-75-90,000 miles
Engine Oil Filler Cap (filter type) – clean
Heat Valve (exhaust manifold) – inspect and lubricate
Drive Belts – inspect condition and tension and correct if required
Carburetor Air Cleaner Element – replace paper cartridge, clean polyurethane element, unless plugged or damaged, then replace
Fuel Filter Element – replace
PCV Valve – replace
PCV Filter (6 cylinder) – clean
PCV Hoses – inspect and replace if required
Coil and Spark Plug Wires – inspect and replace if required
Spark Plugs – clean, inspect, regap and test (replace if required)
Ignition Points and Condenser – inspect and replace if required (check dwell and set if required)
Distributor Cam Lubricator – replace
Ignition Timing – check and set if required
Distributor Advance Mechanisms – check and correct if required
Distributor Cap and Rotor – Inspect and replace if required
Idle Speed and Mixture – check and reset if required
Choke Linkage – inspect for free movement (correct if required)
Transmission Controlled Spark System – inspect and correct if required
Fuel System: Cap, Tank, Lines and Connections – inspect for integrity and correct if required
Fuel Vapor Inlet Filter at Charcoal Canister – replace
Air-Guard System Hoses – inspect and correct if required
TAC System – inspect and correct if required
Vacuum Fittings, Hoses and Connections – inspect and correct if required

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Engine Oil Filler Cap

The filler-type V-8 oil filler cap should be cleaned every 15,000 miles with kerosene and compressed air.

Oil Filter

A full flow oil filter is mounted on the lower front right side on V-8 engines and on the lower center right side of six-cylinder engines.

The throw-away filter unit can be removed from the adapter with use of Oil Filter Removal Tool J-22600. The replacement unit is turned on by hand until the gasket contacts the seat and is then tightened an additional half to full turn.

The oil filter should be changed (under normal driving conditions) every 5,000 miles or five months whichever occurs first. An additional quart of oil is required at this time.

Engine Coolant

Change at 25 months or 25,000 miles and at the start of every winter season.

Coolant level should be maintained at its original concentration and at 1/2 to 1-inch (hot) and 1-1/2 to 2 inches (cold) below the rear of the filler neck seal surface. If coolant level is low, add a mixture of equal parts of All-Season Coolant (or equivalent) and pure water. In an emergency, plain water may be used. Check the freeze protection at the earliest opportunity, as the addition of plain water will reduce the antifreeze protection afforded by the coolant.

Battery

Add distilled water to bring level to the bottom of filler wells. Check specific gravity with a reliable hydrometer. Coat connections with light mineral grease or petrolatum. Refer to the Electrical Section for detailed maintenance information.

Steering Gear (Non-Power)

Lubricant should be level with the fill-hole (fig. B-1). If lubricant level is abnormally low, check for leaks.

Use special lubricant, Jeep Part No. 94656 (or equivalent).

Power Steering

Use Dexron Automatic Transmission Fluid (or equivalent).

To check, remove the power steering pump filler cap and observe the fluid level. Fluid level should be at correct dipstick level. If not, fill to proper level.

If abnormally low, the power steering system should be checked for possible leaks.

Drain and refill is not required.

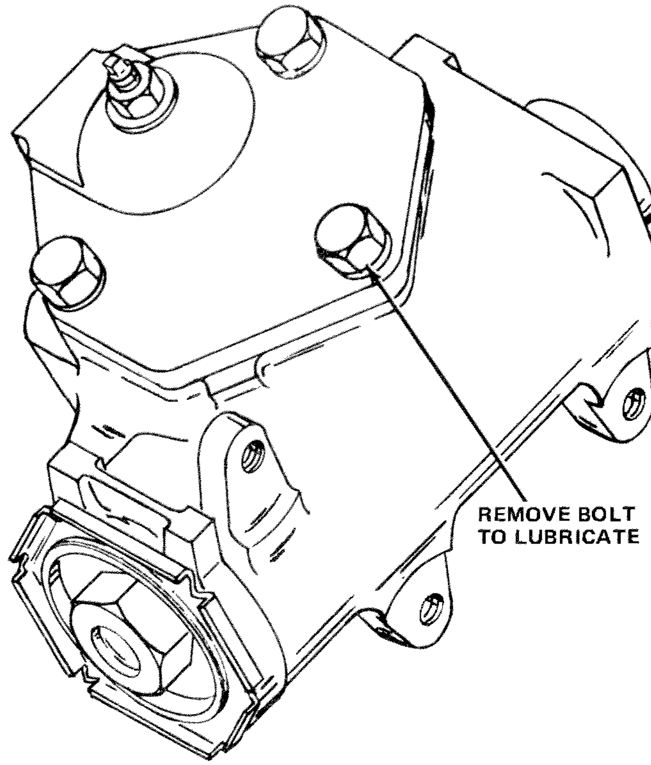

Fig. B-1 Steering Gear Lubrication

Brake Master Cylinder

Add or fill to 1/2-inch from top. Use only Jeep Part No. SF8992656, Heavy Duty Automotive Brake Fluid (or equivalent) SAE Standard J1603, and Federal Standard No. 116.

Automatic Transmission

The correct oil and oil level is of utmost importance for smooth operation, proper shifting, and longevity of the unit. Avoid using nonauthorized oils which may cause trouble.

Fluid Level Condition

Low fluid level can cause a variety of conditions because it allows the pump to take in air along with the fluid. As in any hydraulic system, air bubbles make the fluid spongy; therefore, pressures will be low and build up slowly.

Improper filling can also raise the fluid level too high. When the transmission has too much fluid, the gears churn up foam and cause the same conditions which occur with a low fluid level.

In either case, the air bubbles can cause overheating, fluid oxidation, and varnish which can interfere with normal valve, clutch, and servo operation. Foaming can also result in fluid escaping from the transmission vent where it may be mistaken for a leak.

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Along with fluid level, it is important to check the condition of the fluid. When the fluid is dark, smells burned, and is full of metal or friction material particles, a complete transmission overhaul is needed. Be sure to examine the fluid on the dipstick closely. If there is any doubt about its condition, drain out a sample for a doublecheck.

After the fluid has been checked, seat the dipstick fully to seal out water and dirt.

Use Dexron automatic transmission fluid (or equivalent).

With:

- Engine running.
- Vehicle on level surface,
- Brakes applied.

Move shift lever through all ranges. Place transmission in Park.

Check fluid level (dipstick is located in the filler pipe at the right rear of the engine).

The fluid level should be between the ADD and FULL marks at normal temperature (170° F). This temperature is obtained after at least 15 miles of expressway driving or equivalent in city driving.

If the transmission is not at operating temperature, the fluid level should be approximately 1/4-inch below the ADD mark with the fluid at approximately 75° F. If the oil level is correctly established at room temperature (75 degrees F, it should be at the FULL mark on the dipstick when the transmission reaches normal operating temperature 170 degrees F).

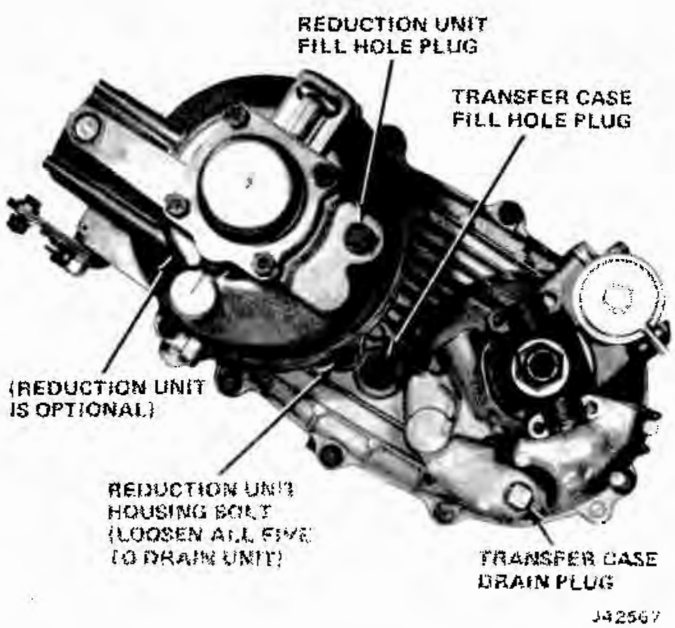

Fig. B-2 Quadra-Trac

Quadra-Trac Transfer Case

Cherokee-Wagoneer-Truck

The Quadra-Trac transfer case does not require periodic or scheduled lubrication (fig. B-2) (refer to Section 8 — Transfer Case).

Manual Transmission Transfer Case

Use SAE 80 Gear Lubricant of API, GL-4 quality.

Manual transmission and transfer case lube must be checked and/or changed at the same time. Check both units.

- Normal Driving (R) - Every 5,000 miles
- Severe driving (HD) - Every 3,000 miles

The fill hole is located on the right of the three-speed transmission and transfer case and on the left-hand side of the four-speed transmission. To check lube level(s), remove the transmission and transfer case fill plug(s). Lube should be level with each fill hole.

Lube Change CJ Models

- Every 15,000 miles.

Wagoneer and Truck

- Every 30,000 miles

Remove fill plug(s) and drain completely. Replace drain plug(s). Full to level of fill hole(s). Replace fill plug(s).

Shift Control Lever Assembly and Linkage

Use Chassis Lubricant NLGI No. 2 (or equivalent).

Lubricate at lube fitting every 25,000 miles (40,200 km).

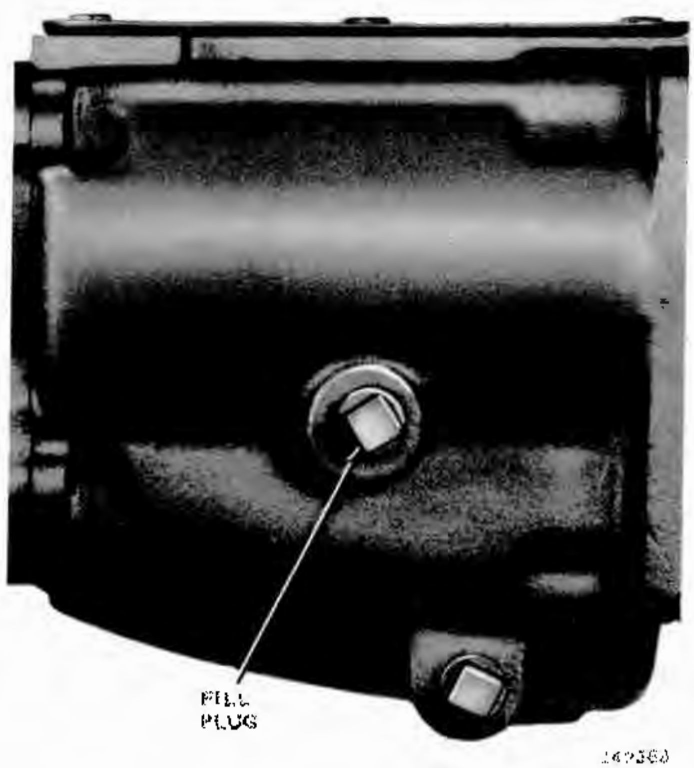

Fig. B-3 Manual Transmission

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Linkage Pivot Points-All Models

Lubricate pivot points periodically with penetrating lubricant - DuPont PM6, No. 2911, or its equivalent.

Propeller Shafts Lubrication

Lubrication Frequency-

- Normal Driving (R)-Every 50,000 miles (80,400 km).
- Severe Driving (HD) - Every 25,000 miles (40,200 km).

Sleeve Yokes (Splines)

Use Chassis Lubricant NLGI No. 2 (or equivalent)

Apply grease gun pressure to sleeve yoke lubrication fitting until lubricant appears at pressure relief hole in welch plug at sleeve yoke end of spline. At this point, cover pressure relief hole with finger and continue to apply pressure until grease appears at sleeve yoke seal. This will ensure complete lubrication of spline.

Single Cardan Joints

Use Chassis Lubricant NGLI No. 2

These assemblies are sometimes referred to as "not re-lubrical" joints because they lack a grease fitting on the journal cross.

They must be disassembled for lubrication.

Double Cardan Joint Constant Velocity

Use only special lubricant, Jeep Part No. 999633.

Mark the front propeller shaft and pinion yoke to assure proper alignment during assembly.

Disconnect the front universal joint from the front axle. Move the front end of the shaft to the right as far as possible. Rotate the shaft until the lubrication hole plug in the center bearing can be easily seen. Remove the plug. Use an extended point lubrication adapter such as Alemite Adapter, Number 6683 (or equivalent) to lube the joint. Install the hole plug.

Align the marks on the propeller shaft and pinion yoke. Connect the front universal joint to the front axle.

Axle Differentials

Use Gear lubricant Mil-L-2105B, Grade SAE-80 for all differentials except Trac-Lok, which requires special lubricant, Jeep Part No. 94556.

The Axle Model Number is cast on the axle housing (fig. B-4).

Lubricant Level

- Normal Driving (R) - 5,000 miles
- Severe Driving (HD) - Every 3,000 miles

Remove fill plug (fig. B-5). The lubricant level should be at the level of the fill hole.

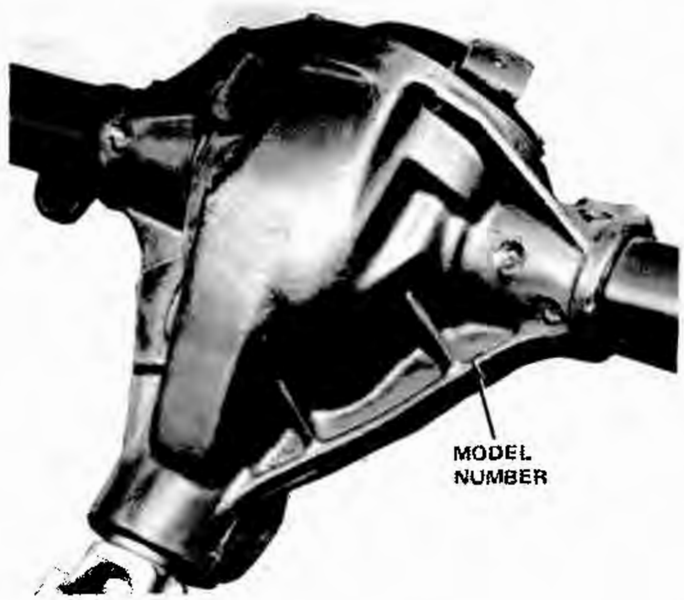

Fig. B-4 Axle Differential Model Number Location

J42570

Fig. B-5 Rear Axle Filler Plug Location (Front Axle Similar)

Lube Change - All Models

Every 30,000 miles

(1) Remove the axle differential housing cover.

(2) Allow lubricant to drain out.

(3) On all differentials (except Trac-Lok) flush the differential with a flushing oil or light engine oil to clean out the housing (do not use water, steam, kerosene or gasoline for flushing).

(4) Check condition of the differential housing cover gasket. Replace if necessary.

(5) Install gasket and differential housing cover.

(6) Tighten the cover bolts 15 to 25 foot-pounds.

(7) Remove the fill plug and add new lubricant to fill-hole level.

(8) Replace fill plug.

CAUTION: *Trac-Lok differentials may be cleaned only by disassembling the unit and wiping with clean rags. Do not flush the unit.*

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Front Wheel Bearings

Use Wheel Bearing Lubricant NLGI No. 2 with a lithium base (EP Type or equivalent).

Lube every 25,000 miles

To lubricate front and rear wheel bearings it is necessary to remove, clean, inspect, repack and adjust them.

Adjustment

Adjustment of wheel bearings is critical because it establishes the running clearance of the wheel bearings. Adjustment that is too tight preloads the bearings and causes them to run hot. Loose bearings permit the drum hub to shift its position on the bearings as the thrust loads vary with acceleration, braking and cornering. Loose bearings can also cause erratic steering.

Rear wheel bearings on the J-20 Truck (Model 60 Full Floating Rear Axle) are adjustable. Rear wheel bearings on all other models (Model 44 rear Axles) do not require adjustment.

Steering Gear (Non-Power)

Lubrication Frequency - Every 5,000 miles (8,000 km)

Left-Hand-Drive Vehicles-

Use special lubricant, Jeep Part No. 940657.

Check and/or fill by removing the side cover bolt (opposite the adjuster screw). Lubricant should be to level at the bolt hole (fig. B-1). If lubricant level is abnormally low, check for leaks.

Steering Linkage

CJ Models

Use Chassis Lubricant NGLI No. 2 (or equivalent).

Lubrication Frequency-

- Normal Driving (R) -Every 5,000 miles (8,000 km)
- Severe Driving (HD)-Every 3,000 miles (4,900 km)

Cherokee - Wagoneer - Truck

- Normal driving (R) - Every 15,000 miles (24,100 km)
- Severe Driving (HD) - Every 5,000 miles (8,000 km)

A lubricating hand gun is required. Always wipe fitting clean before lubricating (fig. B-6). Remove excess lubricant from fittings after lubrication is completed.

SERVICE-WHILE VEHICLE IS BEING REFUELED

Battery

Check level. If necessary, add distilled water to bring level to the bottom of filler wells.

A visual check may indicate further service is required, refer to the Electrical Section for complete information.

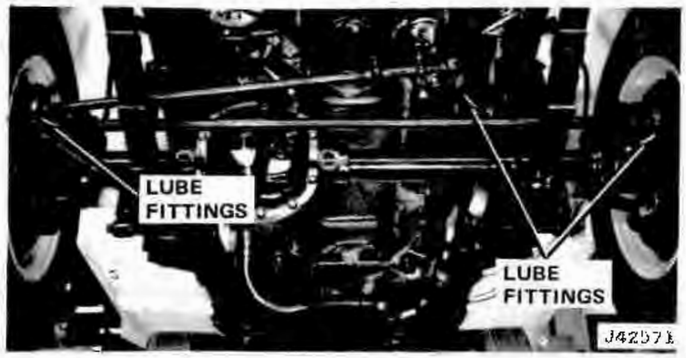

Fig. B-6 Steering Linkage Lubrication Points

Radiator Coolant

The factory installed antifreeze coolant should provide satisfactory protection for two years if the 50 percent concentration is maintained. However, after the factory fill is drained, the cooling system should be drained, flushed, and refilled annually, preferably in early fall. All-Season Coolant or other high-quality ethylene glycol antifreeze coolant should be used in the system year round. Fill with antifreeze coolant and water in 50-50 proportions to provide -34 degrees F freezing protection. The 50-50 mixture should be maintained throughout the year to provide good corrosion inhibition as well as antiboil protection, so essential during summer.

Radiator coolant level should be checked when the engine is cold, if at all possible. If the radiator cap is removed when the system is at a high operating temperature, the coolant may boil and spurt out, due to the release of pressure. Coolant lost in this manner must, of course, be replaced. If coolant should be needed, fill radiator to approximately one-half inch to one inch below the filler neck when hot or 1-1/2 inch to 2 inches when cold, add a mixture of equal parts of All-Season Coolant or another quality brand permanent antifreeze (ethylene glycol) and pure water. In an emergency, plain water may be used. Check the freeze protection at the earliest opportunity, as the addition of plain water will reduce the antifreeze protection afforded by the coolant. Do not overfill, as loss of coolant due to expansion will result.

Drive Belts

Visually inspect the drive belts used for the cooling system fan, alternator, water pump, air pump, and engine driven accessories for frayed, cracked, or deteriorated condition, and replace if required.

Refer to the Cooling section for detailed maintenance information.

Engine Oil

Prior to checking the oil level, provide sufficient time to allow the oil to drain back into the oil pan. Adding oil between changes may be necessary not only if the level is below the lower mark on the dip stick.

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NOTE: *Oil level should only be checked when the engine is warm, as cold oil drains back to the oil pan very slowly.*

Wiper Blades

Long exposure to heat and road splash tend to harden the wiper blade rubber, thus destroying efficiency and adding to the possibility of scratching the windshield. When the wipers smear or do not clean the windshield, replacement is recommended.

Windshield Washer Solution

The windshield washer solution container is located under the hood. This container must be refilled periodically with water and, if desired, a washer solvent.

OFF-HIGHWAY OPERATION

Adequate lubrication becomes increasingly important when vehicles are used in off-highway operation. Under these conditions, all operating parts of both the engine and chassis are subjected to unusual pressures. At the same time, such operation is usually under abnormal dust and dirt conditions, making additional precautions necessary. The importance of correct lubrication for the conditions of operation cannot be overestimated.

Engine Oil

It is important, that the oil be changed after 3,000 miles or 3 months. Watch the condition of the oil closely and change it immediately if it appears to be contaminated.

Air Cleaner

Care of the air cleaner is extremely vital to the life of the engine. Pay particular attention to the amount of dust and dirt in the air taken into the engine through the air cleaner. When dust is not noticeable in the air, service the air cleaner each 5,000 miles. Whenever the air is noticeably dusty (for example when the vehicle is driven on secondary roads or through fields) then service the air cleaner more frequently. Under extreme continually dusty and dirty conditions, such as when the vehicle is operated in clouds of dust and dirt, service the air cleaner daily.

A thermostatically-controlled air inlet housing for the carburetor air cleaner (TAC) is used on all Jeep models. TAC requires no service, except to be sure all vacuum line connections are tight.

Chassis Lubrication

The period of lubrication depends entirely upon the type of work being done. Using the specified interval given in the Mechanical Maintenance Schedule as a guide, lubricate at safe intervals required for the particular type of operation. Under extremely dusty conditions lubricate these points daily. Be sure to force enough lubricant into each fitting to force out the old lubricant which might be contaminated with grit and which would cause rapid wear if allowed to remain.

Do not place lubricant on the various ball and socket joints or pivot points of the hydraulic lift linkage as dirt will accumulate to form an abrasive mixture. It is best to simply wipe these parts clean with a cloth.

Manual Transmission and Transfer Case

For economy, the combined capacity of the two housings is small which makes it important that the lubricant be changed at regular intervals. For off-highway use, drain both every 30,000 miles and fill to the fill plug opening levels.

Axle Differentials

Because of the higher pressure developed in the axle assemblies with heavy-duty operation, drain, flush, and refill the differential assemblies every 30,000 miles. Use only flushing oil or light engine oil to clean out the housings.

CAUTION: *Trac-Lok differentials may be cleaned only by disassembling the unit and wiping with clean rags. Do not flush the unit.*

NONSCHEDULED MAINTENANCE SERVICES

A Jeep vehicle is a fairly complicated piece of machinery. Most maintenance needs are taken care of on a scheduled basis as listed in the Mechanical Maintenance Shedule chart. And, while constant improvements by Jeep Corporation engineers have extended the intervals between major chassis lubrication periods, the vehicle will need a number of nonscheduled services and maintenance replacements. Need for these is determined by road, load, weather, terrain and other variable operating conditions.

HEAVY-DUTY DRIVING

Heavy-duty usage refers primarily to farming, police, Government, and commercial load-carrying applications as well as the towing of trailers weighing over 2,000 pounds loaded.

In all types of load-carrying applications and trailer towing, owners should be advised to avoid overloading and severe-condition operation which might cause

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brake, engine, axle, steering, suspension, tire, or other failure.

Special driving conditions - cold weather short trips, high-speed trips, driving in heavy-dust - also call for more frequent air cleaner service, oil and filter changes, plus other heavy-duty (HD) services as outlined in the Mechanical Maintenance Schedule Chart.

CLUTCH INSPECTION AND ADJUSTMENT

The clutch pedal must have free play to prevent premature release of the throwout bearing and resultant clutch failure.

Manual transmission clutch adjustment should be verified at 15,000 mile intervals. Refer to Clutch section for detailed service information.

Emission Control Services

Periodic maintenance consisting of inspection and required services is necessary to keep the Emission Controls operating at satisfactory control levels.

Refer to Emission Control - Section 4A for complete detailed procedures and specifications.

TIRES

Tire Condition

Inspect tires often for visible signs of underinflation and uneven wear, which may indicate need for front-end alignment, tire rotation, and wheel balancing. Five-thousand mile service intervals are recommended.

Mud and Snow Tires

A Jeep 4-wheel drive vehicle, and especially vehicles with Quadra-Trac drive, must be equipped with the same size tires of equal circumference on all four wheels. Therefore, should mud and snow tires be required they must be installed on all four wheels.

These tires should be operated at full-load inflation pressures. Sustained speeds over 75 mph for one hour or more are not recommended for mud and snow tires.

Traction

The driver can spray both rear tires with Jeep Liquid Tire Chain (aerosol can), or equivalent, to improve traction on snow or ice. A mild rocking action will help free the car from snow, mud, or sand by moving the automatic transmission lever from D (drive) to R (reverse) in a repeated pattern while applying accelerator moderately (shift from 1st gear to reverse for manual transmission). Do not race engine, avoid spinning tires, and limit rocking time.

On wet or slushy roads, a water wedge can build up between the tire and road. This hydroplaning action could cause loss of traction, adversely affecting control and braking. Slow down in rainstorm or when roads are wet or slushy, and by all means take advantage of 4-wheel drive traction.

Repair

If it becomes necessary to repair a tire due to puncture, the tire should be removed from the rim and a combination vulcanized plug and patch should be applied from the inside. Externally applied plugs, blowout patches, and aerosol-type sealants should be considered only as emergency repair. Tires with emergency repairs should not be driven over 50 mph, nor for more than a distance of 100 miles before permanent repairs are made.

Pressures

Correct tire pressures depend on tire size, tire ply, gross vehicle weight rating (GVWR), vehicle load, and the type of driving.

For satisfactory 4-wheel drive operation, a Jeep 4-wheel drive vehicle MUST be equipped with the same size tires of equal circumference on all four wheels. The tires then must be inflated to the pressure recommended by Jeep Corportion - at all times.

Tire inflation should be checked and adjusted to recommeded pressures periodically (at least monthly), especially when extreme changes (20° F.) in average seasonal temperatures occur. Tire inflation pressures should be checked and adjusted when the tires are cold-driven less than two miles at moderate speeds of less than 40 mph after the vehicle has been at rest for at least six hours.

Do not reduce inflation pressure if the tires are hot - driven over 10 miles in excess of 60 mph - as tire pressure may increase as much as 6 psi over cold pressures. If tire pressure must be adjusted while hot, temporarily set pressure at 6 psi (10 psi for sustained high speeds) greater than specified until such time cold inflation pressure can be checked and adjusted.

The correct tire inflation pressures, under any given set of driving conditions, may now be determined by referring to the Tire Inflation Pressure (psi) Table. Cold inflation pressures are those measured with the tires at approximately the prevailing atmospheric temperature and do not include any inflation buildup caused by heat from vehicle operation. Pressures specified are precisely measured for the tire sizes recommended for each Jeep vehicle model at the GVW rating.

Rotation

Rotating tires every 5,000 miles is recommended to assure longer overall tire life by equalizing wear. If no spare tire is used, follow the four-tire rotation diagram (fig. B-7). If uneven tire wear should occur

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sooner than 5,000 mile intervals, the tires should be rotated more often. Whenever tires are rotated, the inflation pressure should be readjusted, and if the tires were balanced on the vehicle, they should be rebalanced.

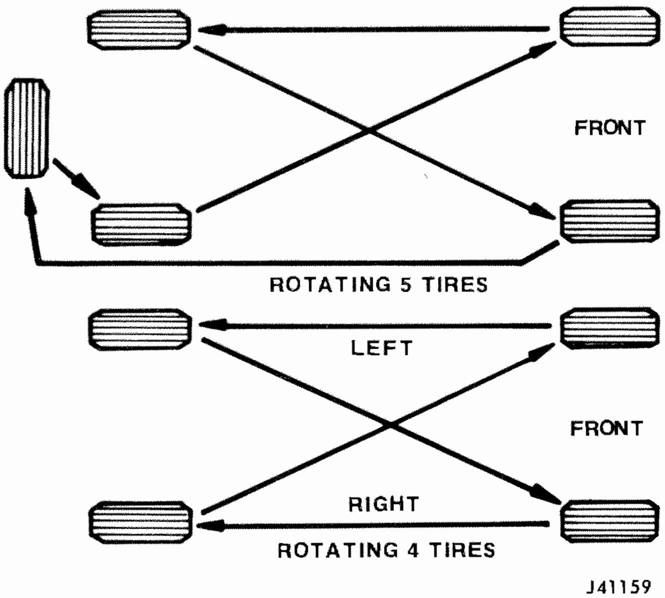

Fig. B-7 Tire Rotation

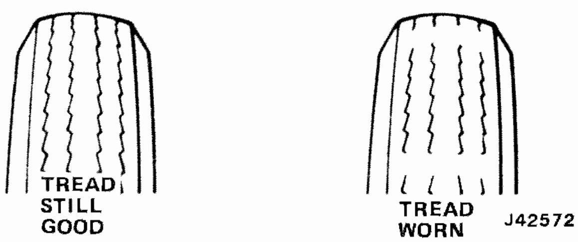

Fig. B-8 Tire Condition

GLASS - CARE AND HANDLING

Clean windshield and windows promote safety and comfort in driving. However, care in cleaning should be exercised.

Do not clean glass with a chamois or cloth which has been used to wash the car or has collected dirt and fine grit or sand. Such foreign materials will cause scratches in the glass and, in some cases, may obstruct vision.

The windshield is subject to severe road splashes when following other vehicles. These splashes may contain various types of oils and other substances that will stain and streak the glass by use of the windshield wipers.

To remove this foreign substance, use POWDERED BON AMI or equivalent on a cloth dampened with water to clean the glass and wiper blades. Then wash these parts and rinse with water.

The wiper blades should always be cleaned prior to cleaning the windshield glass.

INTERIOR TRIM CARE

The fabrics and vinyls used for interior trim are selected for their durability, fade-resistance and colorfastness. Frequent dusting with a whiskbroom or vacuum, and wiping with a damp cloth followed by toweling dry, will help keep upholstery and interior trim clean and attractive.

Imbedded dust and grease, oil, lipstick and other stains may be removed from fabrics with fabric cleaner or Jeep All-Purpose Cleaner, or equivalent. Plastic and leather cleaner is specifically recommended for vinyl trim.

Removing Stains

When using cleaning fluids, dampen a clean cloth with a fluid and start rubbing lightly around the outside of the spot, gradually working to the center. This method keeps the spot from spreading and is less likely to leave a ring. The following suggestions will be helpful in removing stains:

Battery Acid

Pour household ammonia directly on the spot and allow it to remain for one minute. Rinse with cold water. It is essential that such treatment be applied at once as the acid will permanently damage the fabric within a few hours.

Grease and Oil Stains

Use fabric cleaner. If the fabric is saturated with oil, pour cleaning fluid directly on the spot. Then soak it up by pressing a white blotter on the spot. Do this before cleaning with a cloth dampened with cleaning fluid.

Milk Stains

Use warm soapsuds. Sponge the stained area until stain is removed. Brush with a whiskbroom, with fiber pile when wet and against the pile when dry.

Water Spots

Sponge entire panel with a cloth dampened with cold water and then sponge the spots with fabric cleaner.

Chewing Gum and Tar

Cool the spot with ice cube to make the tar or gum brittle, then carefully remove with dull knife. Remove any residue with fabric cleaner.

Blood Stains

Use cold water. If this does not remove the entire stain, pour ammonia on the spot; then rub with a clean cloth.

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NOTE: *Never use hot water on blood stains as this will only set the stain.*

Candy Stains

Use hot water on all candy stains that do not contain chocolate. If a chocolate stain, first rub out the stain with a clean cloth dampened with fabric cleaner. Then scrape with a dull knife and rinse with cold water. In either case, after the spot has dried it is advisable to use fabric cleaner

Fruit Stains

Rub vigorously with a cloth dampened in hot water; when dry, use fabric cleaner.

Ice Cream

Follow the same procedure as for fruit stains.

Lipstick

Pour a small quantity of fabric cleaner directly on the spot. Press a clean white blotter over the stain. Repeat this process, using a new blotter each time until the stain is removed.

Floor Coverings

Nylon pile carpeting will resist wear and retain its depth of pile for a much longer time if it is vacuumed frequently to prevent dust and dirt from being ground into the fibres.

Rubber or vinyl mats may be washed with soap and water.

Headliner

Headliners with vinyl-coated surfaces can be cleaned easily using light pressure with a clean cloth or sponge and mild soap.

CAUTION: *Never use volatile cleaning solvents, such as gasoline, naphtha, turpentine, paint thinner or carbon tetrachloride in the interior of your vehicle. Nor should laundry soaps, bleaches, tints or caustic cleaners be used. They may injure or fade trim material. If you choose to use them they should be tested on an obscure area before use.*

CAPACITIES

Capacities, Approximate Refill	U.S. Measure	Imp. Measure
Engine Oil (includes 1 quart for filter change)		
• 232 CID & 258 CID engines	6 quarts	5.0 quarts
• 304 CID, 360 CID & 401 CID engines	5 quarts	4.2 quarts
Cooling System (Includes 1 quart for heater)		
• 232 CID & 258 CID engines	10.5 quarts	8.7 quarts
• 304 CID engine	13 quarts	11.6 quarts
• 360 CID & 401 engines	14 quarts	10.8 quarts
Transfer Case		
• Model 20	3.25 pints	2.7 pints
• Quadra-Trac (1)	3.5 pints	2.9 pints
• Quadra-Trac with Reduction Unit (1)	4.5 pints	3.7 pints
Transmission		
• Manual 3-Speed – 6 cyl.	2.5 pints	2.1 pints
• Manual 3-Speed – V-8	2.75 pints	2.2 pints
• Manual 4-Speed	6.5 pints	5.5 pints
• Automatic – Change Only	5.0 quarts	4.2 quarts
• Automatic – At Overhaul	11.0 quarts	9.2 quarts
Differential		
• Model 30 – Front Axle	2.5 pints	2.1 pints
• Model 44 – Front or Rear Axle (2)	3.0 pints	2.5 pints
• Model 60-3 (FF) Rear Axle (2)	6.0 pints	5.0 pints
Fuel Tank (Approximate Gallons)		
• CJ-5 & CJ-6	15.5 gallons	12.9 gallons
• Cherokee & Wagoneer	22 gallons	18.3 gallons
• Truck	19 gallons	15.8 gallons

(1) Quantities listed are for SAE 30 (good quality) Non-Detergent Motor Oil (Ashland Valvoline Preferred). Add eight ounces of Concentrate, Jeep Part Number 8123004.

(2) Capacities of conventional and Trac-Lok rear axles are identical.

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TIRE INFLATION PRESSURES (PSI)

Inflate tires cold, before running. Do NOT reduce pressure if tires are warm.

MODEL	GVW RATING	TIRE	LOAD RANGE	NORMAL LOAD (1) SUSTAINED DRIVING OVER 65 M.P.H.(3) FRT.	RR.	NORMAL LOAD (1) UNDER 65 M.P.H. FRT.	RR.	MAXIMUM LOAD (2) SUSTAINED DRIVING OVER 65 M.P.H.(3) FRT.	RR.	MAXIMUM LOAD (2) UNDER 65 M.P.H. FRT.	RR.
CJ-5 & CJ-6	3750 (3900 CJ-6)	E78x15	B	24	24	20	20	28	28	24	24
		F78x15	B	24	24	20	20	28	28	24	24
		H78x15	B	24	24	20	20	28	28	24	24
		7.00x15	D	40	40	30	30	45	45	35	35
		6.00x15	C	40	40	30	30	45	45	35	35
WAGONEER & CHEROKEE	5600	F78x15	B	31	31	27	27	32*	32*	32	32
		H78x15	B	25	25	21	21	28	28	24	24
WAGONEER & CHEROKEE	6000	H78x15	B	26	26	22	22	32	32	28	28
TRUCK 25/45	5200	G78x15	B	32	32	28	28	32*	32*	32	32
	5600	H78x15	B	28	28	24	24	32	32	28	28
		7.00x15	D	45	45	35	35	45	45	35	35
TRUCK 46	6500	8.00x16.5	D	45	45	35	35	55	65	45	60
		7.50x16	C	40	40	30	30	45	55	35	45
	7200	8.75x16.5	D	45	45	35	35	65	70	45	60
		7.50x16	D	40	40	30	30	55	70	45	60
	8000	9.50x16.5	D	45	45	35	35	55	70	45	60
		7.50x16	E	40	40	30	30	55	85	45	75

*Speed limited to 75 M P H

(1) **Normal Load** — Frequently selected accessories plus driver & two passengers (with CJ models, driver and one passenger)

(2) **Maximum Load** — Gross Vehicle Weight Rating (GVWR)

(3) Sustained driving over 75 M P H for Cherokee and Wagoneer

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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SIX-CYLINDER ENGINE

GENERAL

The 232 and 258 CID are six-cylinder, in-line, overhead valve engines. Cylinders are numbered from front to rear. Firing order is 1-5-3-6-2-4. Crankshaft rotation is counterclockwise, viewed from the rear. The crankshaft is supported by seven (two-piece) bearings. The camshaft is supported by four one-piece (line bored) bearings. Due to the similarity of these engines, service procedures have been consolidated and typical illustrations are used, except where specific procedures and illustrations are needed to clarify the operation (fig. 1A-1 and 1A-2).

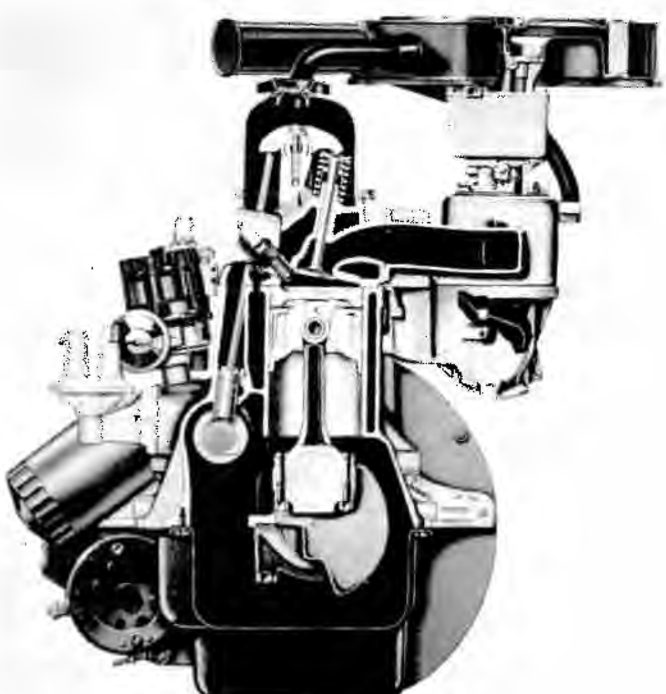

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Fig. 1A-1 Engine Assembly-Sectional View

Service procedures for the 232 and 258 CID engines are basically the same. Procedures that differ are noted in the text.

Identification

Build Date Code

The engine Build Date Code is located on a machined surface on the right side of the block between the number two and three cylinders (fig. 1A-3).

The numbers of the code identify the year, month and day that the engine was built and are decoded as follows:

ENGINE BUILD DATE CODE EXPLANATION

	1st Character (year)	2nd & 3rd Character (month)	4th Character (engine type)	5th Character (day)
	7—1974	January	258 CID	21st Day
Example:	7	01	A	21

The letter (4th Character) contained in the code identifies the engine cubic inch displacement, carburetor type and compression ratio. The letters are decoded as follows:

Code	CID	Carburetor	Comp. Ratio
A	258	1V	8.0:1
E	232	1V	8.0:1

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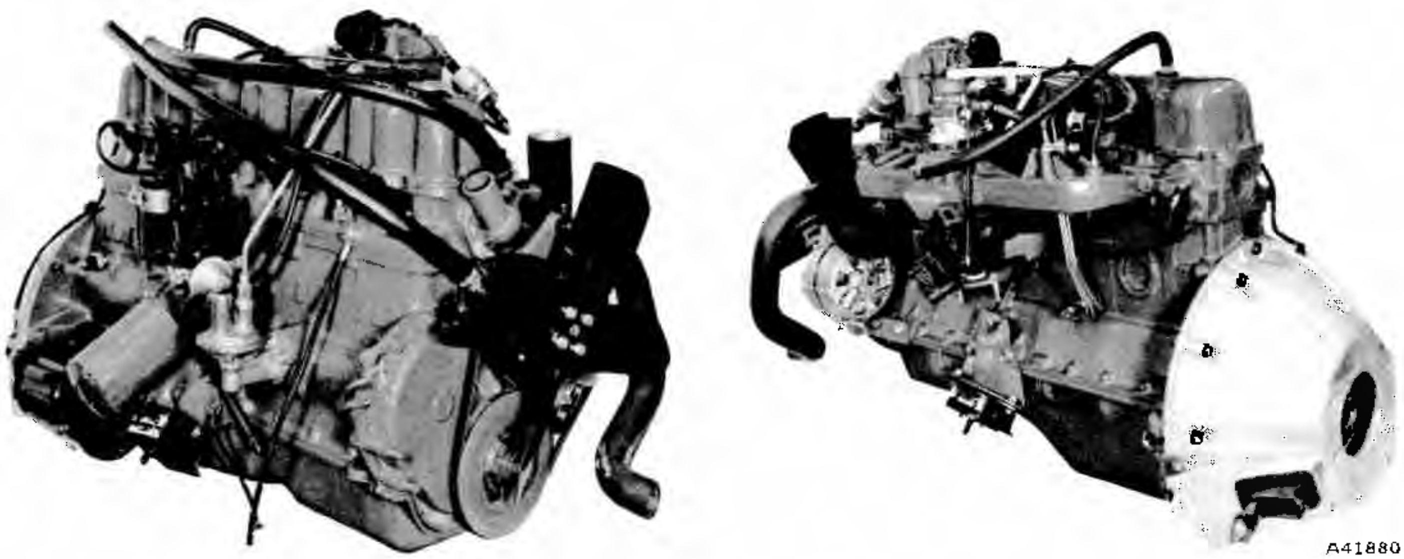

Fig . 1A-2 Engine Assembly

Oversize or Undersize Components

Some engines may be built with oversize or undersize components such as oversize cylinder bores, undersize crankshaft main bearing journals, undersize connecting rod journals or oversize camshaft bearing bores. These engines are identified by a letter code stamped on a boss (between the ignition coil and distributor) (fig. 1A-4). The letters are decoded as follows.

Code Letter	Definition	
B	All cylinder bores	— 0.010-inch oversize
M	All crankshaft main bearing journals	— 0.010-inch undersize
P	All connecting rod bearing journals	-- 0.010-inch undersize
C	All camshaft bearing bores	— 0.010-inch oversize

Example: The code letters PM mean that the crankshaft main bearing journals and connecting rod journals are 0.010-inch undersize.

LUBRICATION SYSTEM

A gear-type positive displacement pump is mounted at the underside of the block opposite to the number four main bearing. The pump draws oil through the screen and inlet tube from the sump at the rear of the oil pan. The oil is driven between the drive and idler gears and the pump body, then is forced through the outlet to the block. An oil gallery in the block channels the oil to the inlet side of the full flow oil filter. After passing through the filter element, the oil passes from the center outlet of the filter through an oil gallery that channels the oil up to the main oil gallery which extends the entire length of the block.

Galleries extend downward from the main oil gallery to the upper shell of each main bearing. The crankshaft is cross-drilled and internally passes oil from the main bearing journals to the connecting rod journals. Each connecting rod bearing cap has a small squirt hole; oil passes through the squirt hole and is thrown off as the rod rotates. This oil throwoff lubricates the camshaft lobes, distributor drive gear, cylinder walls, and piston pins.

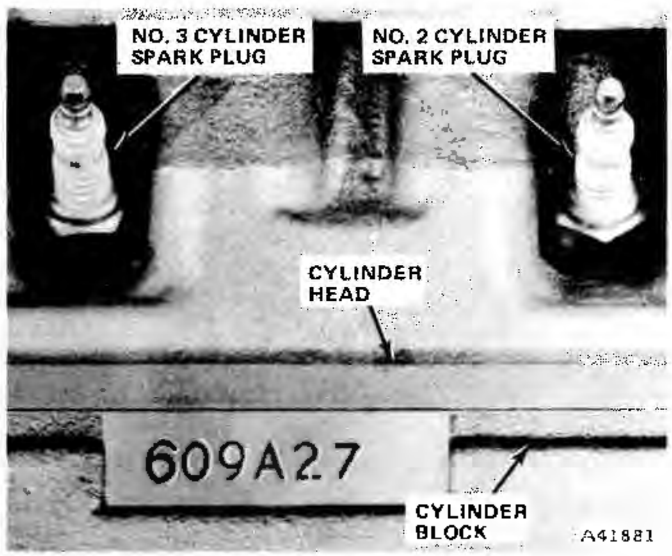

Fig. 1A-3 Build Date Code Location

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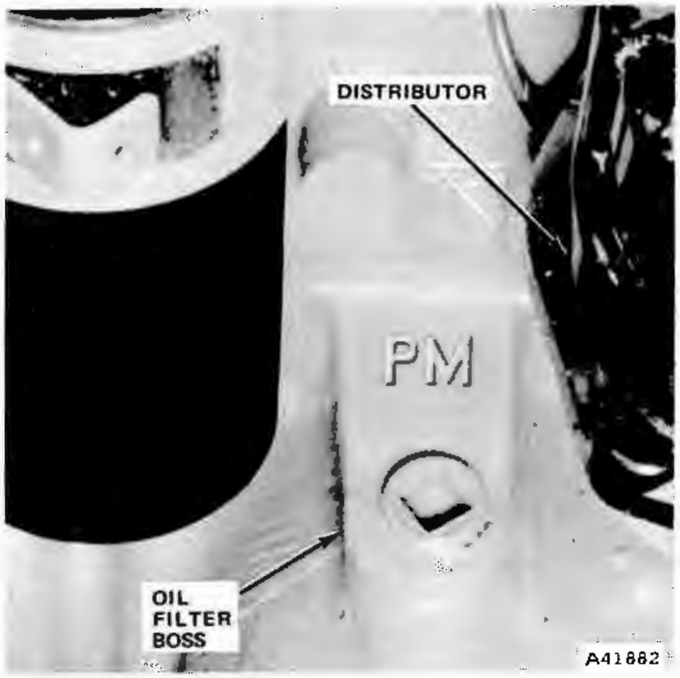

Fig. 1A-4 Oversize/Undersize Letter Code

The hydraulic valve tappets receive oil directly from the main oil gallery. Oil is provided to the camshaft bearings through galleries. The front camshaft bearing journal passes oil through the camshaft sprocket to the timing chain. Rotation of the sprocket lubricates the crankshaft sprocket and chain. Oil drains back to the oil pan under the number one main bearing cap.

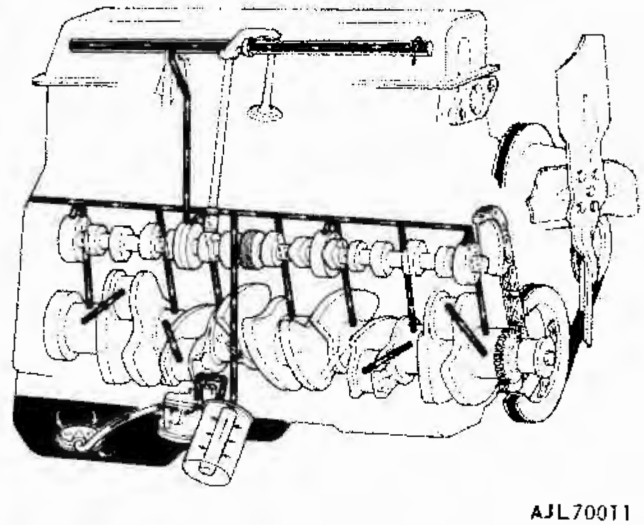

Fig. 1A-5 Lubrication System

The oil supply for the rocker arms and push rods is obtained from the number three cam bearing where oil is channeled from a groove in the camshaft bearing surface to a gallery extending upward and through the cylinder head gasket. At this point, the head gasket forms a seal joining the cylinder block gallery with the adjoining gallery in the cylinder head. Commencing at the number five rocker arm shaft support, the oil then flows into the rocker arm shaft to supply lubrication to the rocker arms and push rods. The push rod guide holes in the cylinder head return the oil to the crankcase through the valve tappet area (fig. 1A-5).

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
EXTERNAL OIL LEAK	(1) Fuel pump gasket broken or improperly seated.	(1) Replace gasket.
	(2) Cylinder head cover gasket broken or improperly seated.	(2) Replace gasket: check cylinder head cover gasket flange and cylinder head gasket surface for distortion.
	(3) Oil filter gasket broken or improperly seated.	(3) Replace oil filter.
	(4) Oil pan side gasket broken or improperly seated.	(4) Replace gasket; check oil pan gasket flange for distortion.
	(5) Oil pan front oil seal broken or improperly seated.	(5) Replace seal; check timing chain cover and oil pan seal flange for distortion.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
EXTERNAL OIL LEAK (Continued)	(6) Oil pan rear oil seal broken or improperly seated.	(6) Replace seal; check oil pan rear oil seal flange; check rear main bearing cap for cracks, plugged oil return channels, or distortion in seal groove.
	(7) Timing chain cover oil seal broken or improperly seated.	(7) Replace seal.
	(8) Oil pan drain plug loose or has stripped threads.	(8) Repair as necessary and tighten.
	(9) Rear oil gallery plug loose.	(9) Use appropriate sealant on gallery plug and tighten.
	(10) Rear camshaft plug loose or improperly seated.	(10) Seat camshaft plug or replace and seal, as necessary.
EXCESSIVE OIL CONSUMPTION	(1) Oil level too high.	(1) Lower oil level to specifications.
	(2) Oil too thin.	(2) Replace with specified oil.
	(3) Valve stem oil seals are damaged, missing, or incorrect type.	(3) Replace valve stem oil seals.
	(4) Valve stems or valve guides worn.	(4) Check stem-to-guide clearance and repair as necessary.
	(5) Piston rings broken, missing.	(5) Replace missing or broken rings.
	(6) Piston rings incorrect size.	(6) Check ring gap, repair as necessary.
	(7) Piston rings sticking or excessively loose in grooves.	(7) Check ring side clearance, repair as necessary.
	(8) Compression rings installed upside down.	(8) Repair as necessary.
	(9) Cylinder walls worn, scored, or glazed.	(9) Repair as necessary.
	(10) Piston ring gaps not properly staggered.	(10) Repair as necessary.
	(11) Excessive main or connecting rod bearing clearance.	(11) Check bearing clearance, repair as necessary.
NO OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Section 3, Oil Pressure Gauge and Sending Unit Test.
	(3) Oil pump malfunction.	(3) Refer to Oil Pump in this section.
	(4) Oil pressure relief valve sticking.	(4) Remove and inspect oil pressure relief valve assembly.
	(5) Oil passages on pressure side of pump obstructed.	(5) Inspect oil passages for obstructions.
	(6) Oil pickup screen or tube obstructed.	(6) Inspect oil pickup for obstructions.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
LOW OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil excessively thin due to dilution, pour quality, or improper grade.	(2) Drain and refill crankcase with recommended oil.
	(3) Oil pressure relief spring weak or sticking.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pickup tube and screen assembly has restriction or air leak.	(4) Remove and inspect oil inlet tube and screen assembly. (Fill pickup with lacquer thinner to find leaks.)
	(5) Oil pump malfunctioning.	(5) Refer to Oil Pump in this section.
	(6) Excessive main, rod, or camshaft bearing clearance.	(6) Measure bearing clearances, repair as necessary.
HIGH OIL PRESSURE	(1) Improper grade oil.	(1) Drain and refill crankcase with correct grade oil.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Section 3, Oil Pressure Gauge and Sending Unit Test.
	(3) Oil pressure relief valve sticking closed.	(3) Remove and inspect oil pressure relief valve assembly.
MAIN BEARING NOISE	(1) Insufficient oil supply.	(1) Check for oil low level or low oil pressure.
	(2) Main bearing clearance excessive.	(2) Check main bearing clearance, repair as necessary.
	(3) Crankshaft end play excessive.	(3) Check end play, repair as necessary.
	(4) Loose flywheel or torque converter.	(4) Tighten flywheel or converter attaching bolts.
	(5) Loose or damaged vibration damper.	(5) Repair as necessary.
CONNECTING ROD BEARING	(1) Insufficient oil supply.	(1) Check for low oil level or low oil pressure.
	(2) Bearing clearance excessive or bearing missing.	(2) Check clearance, repair as necessary.
	(3) Crankshaft connecting rod journal out-of-round.	(3) Check journal measurements, repair or replace as necessary.
	(4) Misaligned connecting rod.	(4) Repair as necessary.
	(5) Connecting rod bolts tightened improperly.	(5) Tighten bolts to specified torque.
PISTON NOISE	(1) Piston-to-cylinder wall clearance excessive.	(1) Check clearance, repair as necessary.
	(2) Cylinder walls excessively tapered or out-of-round.	(2) Check cylinder wall measurements, repair as necessary.
	(3) Piston ring broken.	(3) Replace ring.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
PISTON NOISE (Continued)	(4) Loose or seized piston pin.	(4) Check piston-to-pin clearance, repair as necessary.
	(5) Connecting rods misaligned.	(5) Check rod alignment, repair as necessary.
	(6) Piston ring side clearance excessively loose or tight.	(6) Check ring side clearance, repair as necessary.
	(7) Carbon build-up on piston is excessive.	(7) Clean carbon from piston.
	NOTE: *A clicking noise, upon starting the engine, reducing in level and disappearing after a short period of time is normal. This noise is due to a slight oil leak-down condition caused by valve spring pressure exerted on the tappets.*	
VALVE TRAIN NOISE	(1) Insufficient oil supply.	(1) Check for: (a) Low oil level. (b) Low oil pressure. (c) Plugged rocker arm shaft. (d) Wrong hydraulic tappets. (e) Plugged oil gallery in block.
	(2) Push rods worn or bent.	(2) Replace worn or bent push rods.
	(3) Rocker arms or shaft worn.	(3) Replace worn rocker arms or shaft.
	(4) Dirt or chips in hydraulic tappets.	(4) Clean tappets.
	(5) Excessive tappet leak-down.	(5) Replace valve tappet.
	(6) Tappet face worn.	(6) Replace tappet; check corresponding cam lobe for wear.
	(7) Broken or cocked valve springs.	(7) Properly seat cocked springs; replace broken springs.
	(8) Stem-to-guide clearance excessive.	(8) Check stem-to-guide clearance, repair as necessary.
	(9) Valve bent.	(9) Replace valve
	(10) Loosen rocker arms and shaft assembly bolts.	(10) Tighten bolts to specified torque.
	(11) Valve seat runout excessive.	(11) Regrind valve seat/valves.

ENGINE ASSEMBLY

Resilient rubber cushions support the engine and transmission at three points: at each side on the centerline of the engine and at the rear between the transmission extension housing and the rear support crossmember. Replacement of a cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion (fig. 1A-6).

If it is necessary to remove the front engine mounts and front crossmember to perform service such as oil pan removal, an engine holding fixture may be fabricated as illustrated in figure 1A-7.

ENGINE REMOVAL

The engine is removed without the transmission and bell housing.

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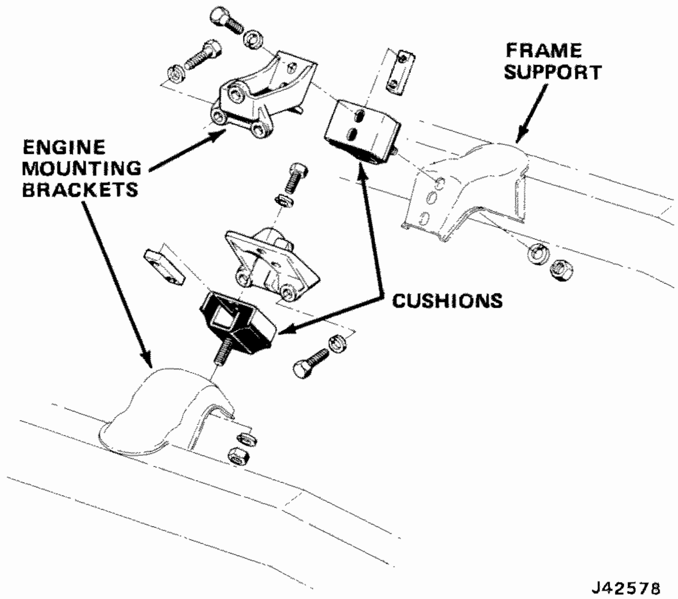

Fig. 1A-6 Engine — Front Mounts

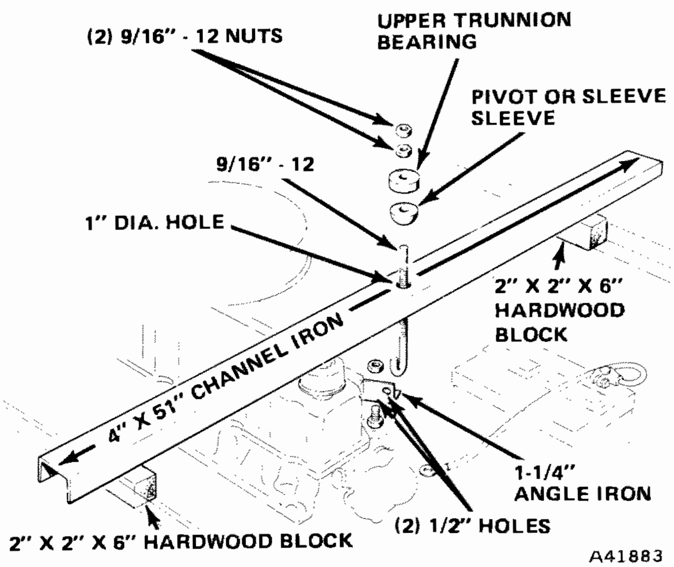

Fig. 1A-7 Engine Holding Fixture — Typical

(1) On the Cherokee, Wagoneer and Truck the hood must be removed. Mark hinge locations at hood panel for alignment during installation. Remove hood from hinges.

(2) Remove air cleaner assembly.

(3) Drain cooling system.

(4) Disconnect upper and lower radiator hoses.

(5) If equipped with automatic transmission, disconnect cooler lines from radiator.

NOTE: *If vehicle is equipped with a radiator shroud, it is necessary to separate the shroud from the radiator to facilitate removal of the radiator and engine fan.*

(6) Remove radiator.

(7) Remove engine fan.

(8) If so equipped, remove power steering pump and drive belt from the engine and place aside. Do not disconnect the power steering hoses.

(9) If equipped with air conditioning:

(a) Turn both service valves clockwise to the front seated position.

(b) Bleed refrigerant charge from compressor by slowly loosening service valve fittings.

(c) Disconnect condenser and evaporator lines from compressor.

(d) Disconnect receiver outlet at disconnect coupling.

(e) Remove condenser and receiver assembly.

(10) Disconnect the following wires (if equipped).

- Starter motor
- Coil positive terminal
- Alternator
- Temperature gauge sending unit
- Oil pressure gauge sending unit
- Solenoid vacuum valve
- Solenoid control switch
- Throttle stop solenoid

(11) Disconnect the following lines (if equipped):

- Fuel line from tank at fuel pump
- Vacuum line for power brake unit at intake manifold
- Vacuum line for full vapor storage canister at air cleaner snorkel
- Vacuum line for heater damper doors at intake manifold

(12) Disconnect accelerator linkage at engine.

(13) Disconnect transmission linkage.

(14) Disconnect exhaust pipe at support bracket and exhaust manifold.

(15) Remove the oil filter.

(16) Remove both engine front support cushion-to-frame retaining nuts.

(17) Disconnect exhaust pipe at support bracket and exhaust manifold.

(18) Support the weight of the engine with a lifting device.

(19) Remove front support cushion and bracket assemblies from engine.

(20) Remove transfer case shift lever boot, floor mat (if so equipped) and transmission access cover.

(21)
- If equipped with automatic transmission, remove upper bolts securing transmission bell housing to engine.
- If equipped with manual transmission, remove upper bolts securing clutch housing to engine.

(22) Remove starter motor.

(23) If equipped with automatic transmission:

- Remove the engine adapter plate inspection covers.
- Mark assembled position of converter and flex plate and remove converter-to-flex plate cap screws.

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- Remove remaining bolts securing transmission bell housing to engine.

If equipped with manual transmission:

- Remove clutch housing lower cover and remaining bolts securing the clutch housing to engine.

(24) Support transmission with a floor jack.

(25) Remove engine by pulling forward and upward.

ENGINE INSTALLATION

(1) Lower engine slowly into engine compartment and align with the transmission bell housing (automatic transmission) or clutch housing (manual transmission).

NOTE: *On manual transmissions, make certain the clutch shaft is aligned properly with the splines of the clutch driven plate.*

(2) Install transmission bell housing-to-engine (automatic transmission) or clutch housing-to-engine bolts (manual transmission). Tighten the bolts to specified torque (automatic transmission — 28 foot pounds; manual transmission — top - 27, bottom - 43 foot pounds).

(3) Remove floor jack which was used to support transmission.

(4) If equipped with automatic transmission, align marks previously made on converter and flex plate, install converter to flex plate cap screws and tighten to 33 foot-pounds torque.

(5) Install inspection covers (automatic transmission) or the clutch housing lower cover (manual transmission).

(6) Install starter motor.

(7) Install front support cushion and bracket assemblies to engine; tighten retaining bolts to 28 foot-pounds torque.

(8) Lower engine onto frame supports, remove lifting device and install front support cushion retaining nuts. Tighten nuts to 33 foot-pounds torque.

(9) Connect exhaust pipe to support bracket and exhaust manifold using a new seal, if required.

(10) Install oil filter.

(11) Connect all wires, lines, linkage and hoses which were previously disconnected from engine.

(12) If removed, install air conditioning condenser and receiver assembly. Connect receiver outlet to the disconnect coupling. Connect condenser and evaporator lines to compressor. Purge compressor of air as outlined in Air Conditioning section.

CAUTION: *Both service valves must be open before the air conditioning system is operated.*

(13) If removed, install power steering pump and drive belt; tighten belt to specified tension.

(14) Install engine fan and tighten retaining bolts to 18 foot-pounds torque.

(15) Install radiator and connect upper and lower hoses. If equipped with automatic transmission, connect the cooler lines.

(16) Fill cooling system to specified level.

(17) Inspect engine oil level and add oil as required.

(18) Install the air cleaner assembly.

(19) Start engine. Check all hose connections for leaks. Stop engine.

(20) If removed, install and align hood assembly.

(21) Install the transmission access cover, floor mat and transfer case shift lever boot.

CYLINDER HEAD COVER AND GASKET

Removal

(1) Remove air cleaner and PCV molded hose.

(2) Disconnect fuel and distributor vacuum advance lines at carburetor; bend as required to allow removal of the cylinder head cover.

(3) Disconnect PCV valve from grommet in cylinder head cover.

(4) Remove cylinder head cover screws, cover, and gasket from engine.

Installation

(1) Position gasket on cylinder head cover flange. Gasket tabs are to be positioned in cut-out openings in flange of cover.

(2) Position cylinder head cover and gasket on engine and install screws. Tighten to 50 inch-pounds torque.

(3) Connect fuel and distributor vacuum advance line to carburetor.

(4) Connect PCV valve to grommet in cylinder head cover.

(5) Install air cleaner and connect PCV molded hose.

ROCKER ARMS AND SHAFT ASSEMBLY

The intake and exhaust rocker arms pivot on a common shaft. The shaft is secured to the cylinder head by six bolts. The rocker arms are designed to accommodate either ordinary valve spring retainers or exhaust valve rotators. Solid steel push rods with hardened ends actuate the rocker arms.

Removal and Disassembly

(1) Remove cylinder head cover and gasket.

(2) Loosen shaft assembly retaining bolts from the cylinder head and remove rocker arm and shaft assembly, including retaining bolts.

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(3) Remove roll pin and spring washer from one end of the rocker arm shaft.

(4) Remove rocker arms, spacers, retainers, retaining bolts, and oil deflector and place on a bench in same order as removed.

Cleaning and Inspection

Clean all parts with solvent while retaining the order in which they were removed from rocker arm shaft.

Inspect rocker arm valve stem contact surface. If minor pitting has occurred, reface surface; if deeply pitted replace rocker arm.

Assembly and Installation

(1) Assemble rocker arms, spacers, retainers, retaining bolts, and oil deflector on rocker arm shaft in same order as removed (fig. 1A-8).

NOTE: *The rocker arm shaft oil holes must face toward the cylinder head.*

(2) Use two rubber bands to hold rocker arms in position as shown in figure 1A-8 and install rocker arm and shaft assembly to cylinder head. Make certain push rods are correctly aligned with rocker arms.

(3) Work from center of rocker arm shaft outward, and tighten to 21 foot-pounds torque.

(4) Install cylinder head cover and gasket.

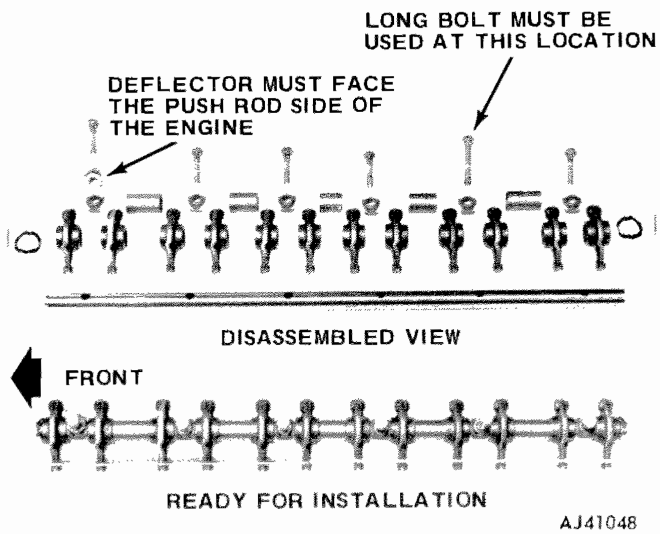

Fig. 1A-8 Rocker Arms and Shaft Assembly

VALVE SPRING—VALVE STEM OIL SEAL

Nylon valve stem oil seals are installed on each valve stem to prevent oil used for rocker arm lubrication from entering the combustion chamber through the valve guides. The oil seals should be replaced whenever valve service is performed or if the seals have deteriorated.

The valve spring is held in place on the valve stem by a retainer or an exhaust valve rotator and a set of valve locks. The locks can be removed only by compressing the valve spring.

NOTE: *Exhaust valve springs used with rotators are shorter than standard valve springs. Also, these springs use a removable spring seat that fits under the spring on the cylinder head. Refer to Specifications at the end of this section.*

Exhaust Valve Rotator

The 232 CID and 258 CID engines equipped with an EGR system, but without an Air Guard system use exhaust valve rotators. Exhaust valve rotators perform two functions. Like ordinary valve spring retainers, they hold the valve spring in place. However, the second function is to positively induce rotation of the exhaust valve to increase durability of the valve seat and face.

The outer housing of the rotator rides on the exhaust valve spring and remains stationary. The inner retainer with valve locks retains the exhaust valve and outer housing. In addition, the inner retainer rotates slightly when the exhaust valve is off its seat. This rotation is caused by the inner spring being crushed between the retainer and the inner washer when pressure is applied to the assembly during exhaust valve opening (fig. 1A-9).

Valve Spring Removal

(1) Remove cylinder head cover and gasket.

(2) Remove rocker arm and shaft assembly.

(3) Remove push rods.

NOTE: *Retain push rods in same order as removed.*

(4) Remove spark plug from cylinder.

(5) Install a 14 mm (thread size) air adapter in spark plug hole.

NOTE: *An adapter can be made by attaching an air hose connection to a spark plug from which the porcelain has been removed.*

(6) Connect an air hose to adapter and maintain at least 90 psi in cylinder to hold the two valves against their seats.

(7) Use Valve Spring Remover and Installer Tool J-21931; compress valve spring, and remove valve locks (fig. 1A-10).

(8) Remove valve spring and retainer or rotator.

(9) Remove oil deflector (if necessary).

(10) Remove exhaust valve spring seat (if equipped with rotators).

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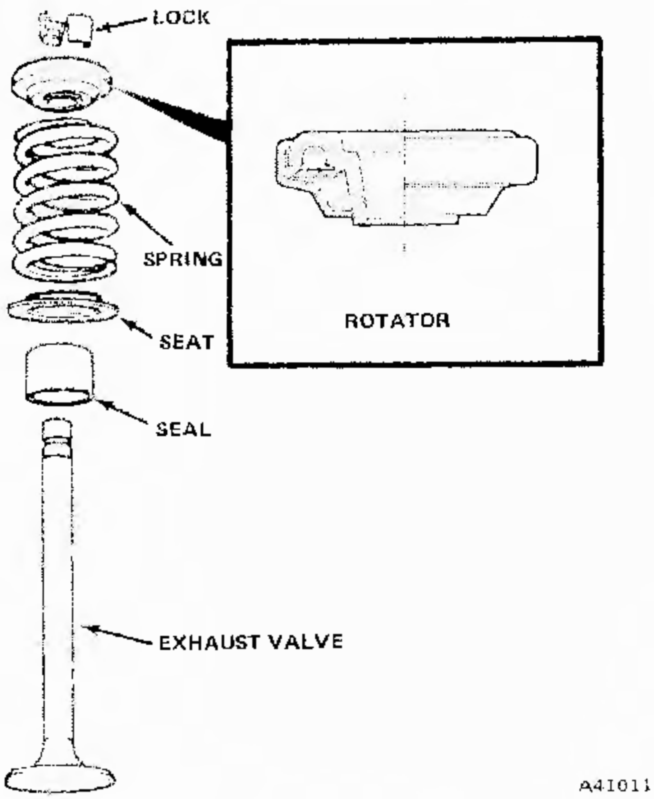

Fig. 1A-9 Exhaust Valve Rotator

Fig. 1A-10 Valve Spring Removal

Installation

(1) Install exhaust valve spring seat, if so equipped.
(2) Install oil deflector on valve stem (if removed).
(3) Install valve spring and retainer or rotator.
(4) Compress valve spring with Tool J-21931 and insert valve locks. Release spring tension and remove tool.

NOTE: *Tap spring from side-to-side to be certain spring is seated properly at cylinder head.*

(5) Disconnect air hose, remove adapter from spark plug hole, and install spark plug.
(6) Install rocker arm and shaft assembly.
(7) Install cylinder head cover and gasket.

Valve Spring Tension Test

Use Valve Spring Tester J-8056 to test each valve spring for the specified tension value (fig. 1A-11). Replace valve springs that are not within specifications.

Fig. 1A-11 Valve Spring Tester

INTAKE AND EXHAUST MANIFOLDS

The intake and exhaust manifolds are attached to the cylinder head on the left side of the engine. A gasket is used between the intake manifold and the cylinder head; none is used between the exhaust manifold and cylinder head. An asbestos gasket is used at the mating surfaces of the intake manifold to exhaust manifold and also between the exhaust manifold and exhaust pipe (fig. 1A-12).

On certain engine applications, an exhaust gas recirculation valve (and back-pressure sensor on California cars) is mounted on the side of the intake manifold.

NOTE: *California intake manifolds differ from Nationwide. They have a metal plate rather than a cast floor above the exhaust manifold heat valve in order to improve driveability.*

Removal and Cleaning

(1) Remove air cleaner and carburetor.

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(2) Disconnect accelerator cable from accelerator bellcrank.

(3) Disconnect PCV vacuum hose from intake manifold.

(4) Disconnect TCS solenoid vacuum valve and bracket from intake manifold.

(5) Disconnect vacuum hoses from EGR valve.

(6) Disconnect compressor and bracket assembly from intake manifold (if equipped with air conditioning).

(7) Disconnect exhaust pipe from manifold flange.

(8) Remove manifold attaching bolts, nuts and clamps and remove intake and exhaust manifold as an assembly. Discard gasket.

(9) Separate manifolds at riser area.

(10) Clean mating surfaces of manifolds and cylinder head.

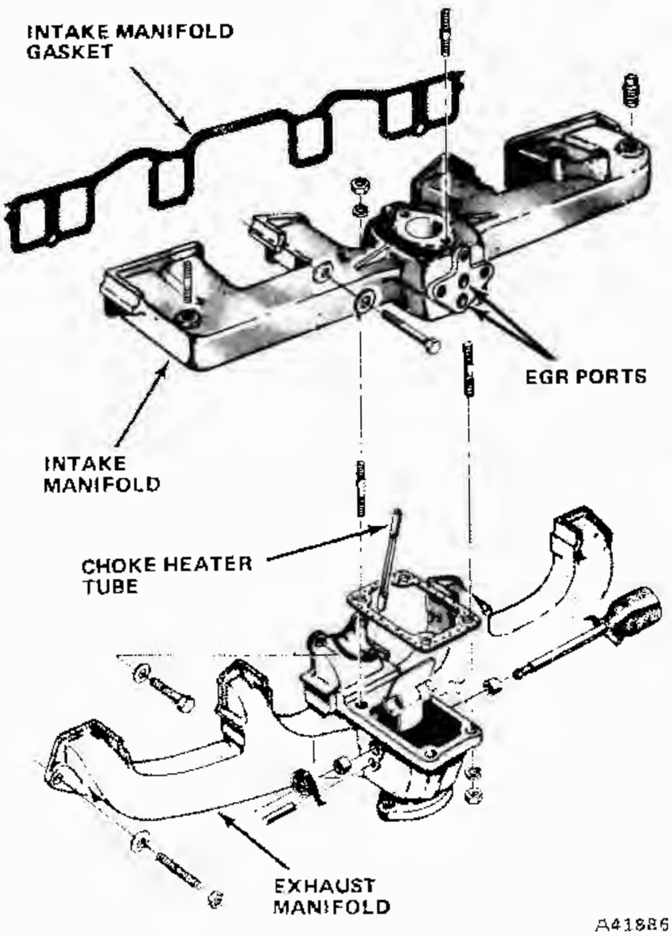

Fig. 1A-12 Intake and Exhaust Manifold Assembly

Installation

(1) Assemble manifolds and finger-tighten heat riser retaining nuts.

(2) Position new intake manifold gasket on cylinder head and install manifold assembly. Tighten manifold attaching bolts and nuts in sequence (fig. 1A-13) to 23 foot-pounds torque.

(3) Install flange gasket and connect exhaust pipe to manifold flange.

(4) Install carburetor.

(5) Install air conditioning compressor and bracket assembly to intake manifold (if equipped).

(6) Install drive belt and tighten to specified tension.

(7) Install TCS solenoid vacuum valve and bracket to intake manifold.

(8) Connect vacuum hoses to the EGR valve.

(9) Connect accelerator cable and PCV hose.

(10) Install air cleaner.

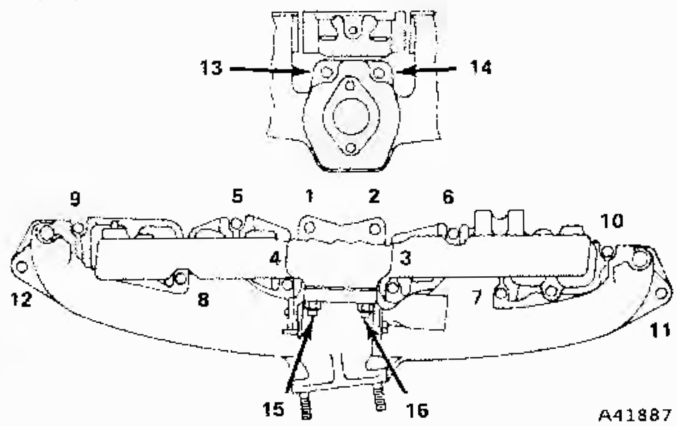

Fig. 1A-13 Intake Manifold Torque Sequence

NOTE: *Transmission throttle linkage must be adjusted after completing the manifold installation. Refer to Section 7 — Automatic Transmission.*

CYLINDER HEAD AND GASKET

Cylinder heads incorporating exhaust valve rotators do not differ from heads without rotators. These heads are interchangeable. The exhaust valve assemblies are the only difference. They have hardened exhaust valve seats and are used on either 232 or 258 CID engines.

Removal

(1) Drain cooling system system and disconnect hoses at thermostat housing.

(2) Remove cylinder head cover and gasket.

(3) Rocker arm and shaft assembly and push rods.

NOTE: *Retain push rods in the same order as removed.*

(4) Remove intake and exhaust manifold assembly from cylinder head.

(5) Disconnect spark plug wires and remove plugs.

(6) Disconnect temperature sending unit wire, battery ground cable, and ignition coil and bracket assembly.

(7) Remove cylinder head bolts, cylinder head, and gasket.

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Cleaning and Inspection

(1) Thoroughly clean machined surface of cylinder head and block. Remove all dirt and gasket cement.

(2) Remove carbon deposits from combustion chambers and top of pistons.

(3) Use a straightedge and feeler gauge to check the flatness of the cylinder head and block mating surfaces. Refer to specifications.

Installation

(1) If cylinder head is to be replaced and the original valves re-used, remove valves and measure stem diameter. Replace valves if oversize as only standard size valves are to be used with a service replacement head. If original valves are standard size, remove all carbon buildup and reface as outlined under Valve Refacing.

(2) Install valves in cylinder head using new valve stem oil seals.

(3) Transfer all attached components from the original head which are not included with replacement head.

(4) Apply an even coat of Perfect Seal sealing compound or equivalent to both sides of new head gasket and position gasket on block with the word TOP facing upward.

CAUTION: *Do not apply sealing compound on head and block surfaces. Do not allow sealer to enter cylinder bore.*

(5) Install cylinder head. Tighten bolts (in sequence) to 105 foot-pounds torque (fig. 1A-14).

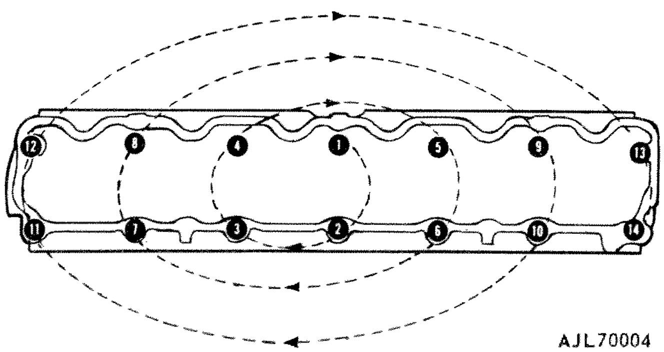

Fig. 1A-14 Cylinder Head Torque Sequence

(6) Connect temperature sending unit wire and battery ground cable.

(7) Install ignition coil and bracket assembly.

(8) Install spark plugs and connect plug wires.

(9) Install intake and exhaust manifold assembly. (Refer to Intake and Exhaust Manifold Installation for the correct torque tightening sequence.)

(10) Install push rods in the order removed.

(11) Install rocker arm and shaft assembly; tighten bolts to 21 foot-pounds torque. Install cylinder head cover and gasket.

(12) Connect hoses to thermostat housing and fill cooling system to specified level.

NOTE: *Transmission throttle linkage must be adjusted after completing the cylinder head installation. Refer to Section 7 — Automatic Transmission.*

CYLINDER HEAD RECONDITIONING

NOTE: *The following procedures apply after the cylinder head has been removed from the engine.*

Disassembly

(1) Compress each valve spring with a C-clamp type spring compressor tool and remove valve locks, retainers or rotators, springs, valve stem oil seals, and exhaust valve spring seats, if so equipped.

(2) Remove the valves.

NOTE: *Place valves in a rack in the same order as removed from cylinder head.*

Cleaning and Inspection

(1) Clean all carbon buildup from the combustion chambers, valve ports, valve stems and head.

(2) Clean all dirt and gasket cement from the cylinder head machined surface.

(3) Inspect for cracks in combustion chambers and valve ports.

(4) Inspect for cracks in gasket surface at each coolant passage.

(5) Inspect valves for burned or cracked heads. Inspect for damaged valve stems.

Valve Reconditioning

Use a valve refacing machine to reface the intake and the exhaust valves to the specified angle. Replace bent or warped valves. After refacing, at least 1/32-inch margin must remain or the valve must be replaced. Examples of correct and incorrect valve refacing are shown in figure 1A-15.

The valve stem tip can be resurfaced and rechamfered when worn. Do not remove more than 0.010 inch.

Valve Seat Refacing

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.

Tapered stones should be used to obtain the specified seat widths when required.

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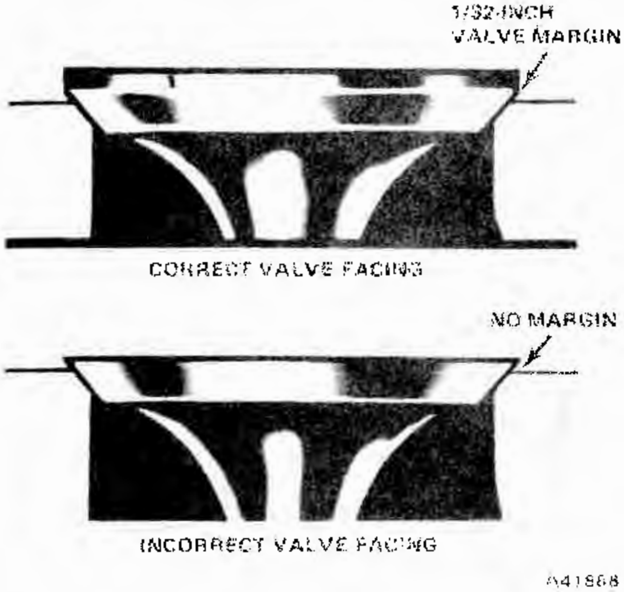

Fig. 1A-15 Valve Refacing

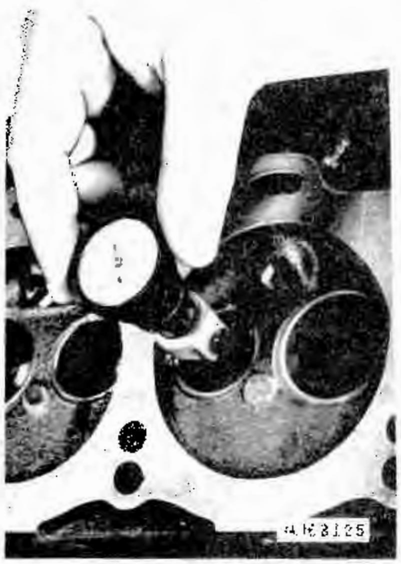

Fig. 1A-16 Checking Valve Seat Runout

Control seat runout to a maximum of 0.0025-inch (fig. 1A-16).

Valve Guides

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, the valve guides must be reamed to the next larger size to obtain proper clearance. Oversize service valves are available in 0.003-inch, 0.015-inch and 0.030-inch sizes.

The following oversize valve guide reamers may be used.

Reamer	Size
J-6042-1	0.003-inch
J-6042-5	0.015-inch
J-6042-4	0.030-inch

NOTE: *Valve guides must be reamed in steps, starting with the 0.003-inch oversize reamer and progressing to the size required.*

Valve Stem-to-Guide Clearance

Valve stem-to-guide clearance may be checked by either of the following two methods.

- Measure the valve stem diameter with a caliper micrometer midway between the valve head and tip and then select a pilot from a valve refacing kit which fits snugly in the valve guide bore.

NOTE: *Make certain the valve stem and guide bore are thoroughly cleaned before measuring.*

The valve stem-to-guide clearance can be determined by subtracting the diameter of the valve stem from the size of the pilot selected.

- Use a dial indicator to measure the lateral movement of the valve stem with the valve installed in its guide and just off the valve seat (fig. 1A-17). Refer to specifications.

Fig. 1A-17 Checking Stem-to-Guide Clearance

Assembly

(1) Thoroughly clean valve stems and valve guide bores.

(2) Install valve in same valve guide from which it was removed.

(3) Install exhaust valve spring seat (if equipped).

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(4) Install new valve stem oil seal on valve stem.

(5) Position valve spring and retainer (or rotator) on the cylinder head and compress valve spring with compressor tool. Install valve locks and release tool.

(6) Tap valve spring from side-to-side with a light hammer to be certain the spring is properly seated at cylinder head.

HYDRAULIC VALVE TAPPETS

The hydraulic valve tappet consists of a body, plunger, plunger return spring, check valve assembly metering disc, cap, and lock ring (fig. 1A-18).

The tappet operates in a guide bore which has an oil passage drilled into the adjoining main oil gallery.

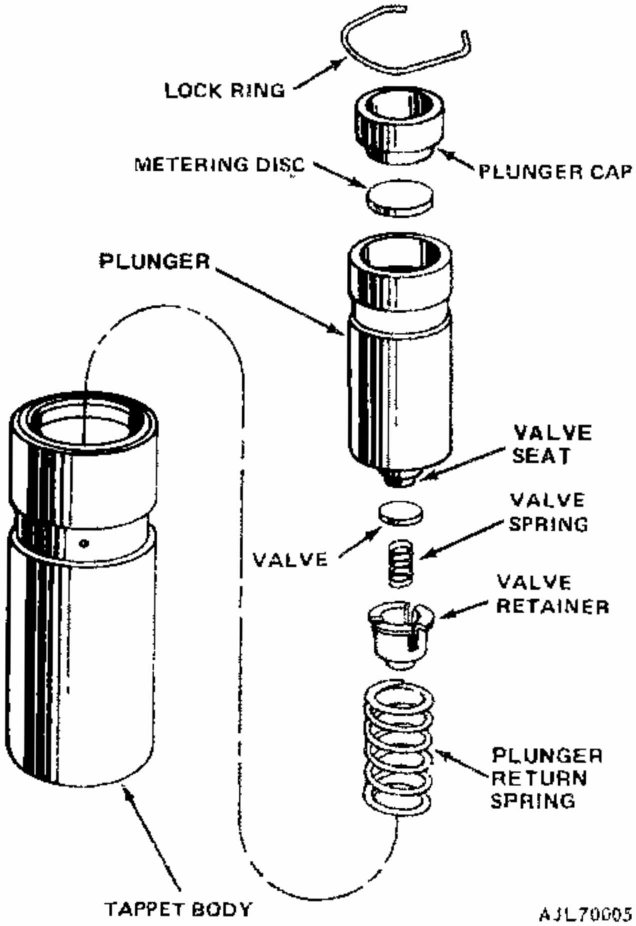

Fig. 1A-18 Hydraulic Tappet Assembly

When the tappet is on the heel of the cam lobe, the plunger return spring indexes with an oil hole undercut in the plunger and allows the oil supply to be admitted through the tappet body. Oil under pressure flows into the body through the check valve assembly, maintaining the tappet fully charged (fig. 1A-19). This cycle occurs when the tappet leaks oil during normal valve opening. Contact with the cam lobe causes tappet body movement, closing the check valve and transmitting zero-lash movement of the push rod to open the intake or exhaust valve.

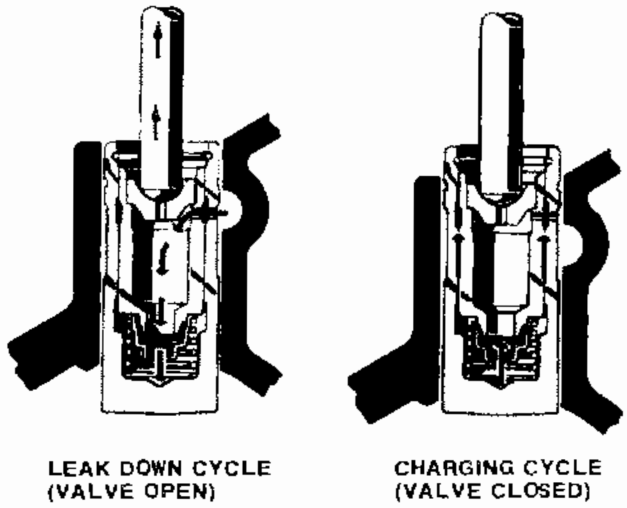

Fig. 1A-19 Hydraulic Tappet Operation

Removal and Disassembly

(1) Remove cylinder head cover and gasket.

(2) Remove rocker arms and shaft assembly.

(3) Remove push rods.

NOTE: *The push rods should be retained in the same order as removed.*

(4) Remove cylinder head and gasket.

(5) Remove tappets through push rod openings of block with Hydraulic Valve Tappet Remover and Installer Tool J-21884 as shown in figure 1A-20.

NOTE: *Tappet components must be retained in the same order as removed.*

(6) Release lock ring and remove plunger cap, plunger assembly, and plunger return spring from tappet body.

Cleaning and Inspection

Clean components of the hydraulic tappet assembly in a good cleaning solvent to remove all varnish or gum deposits.

Check for signs of scuffing on the barrel and face of the tappet.

Inspect tappet face for concave wear by laying a straightedge across the face. If the face is concave, the corresponding lobe on the camshaft is worn, and the replacement of the camshaft and tappets is necessary.

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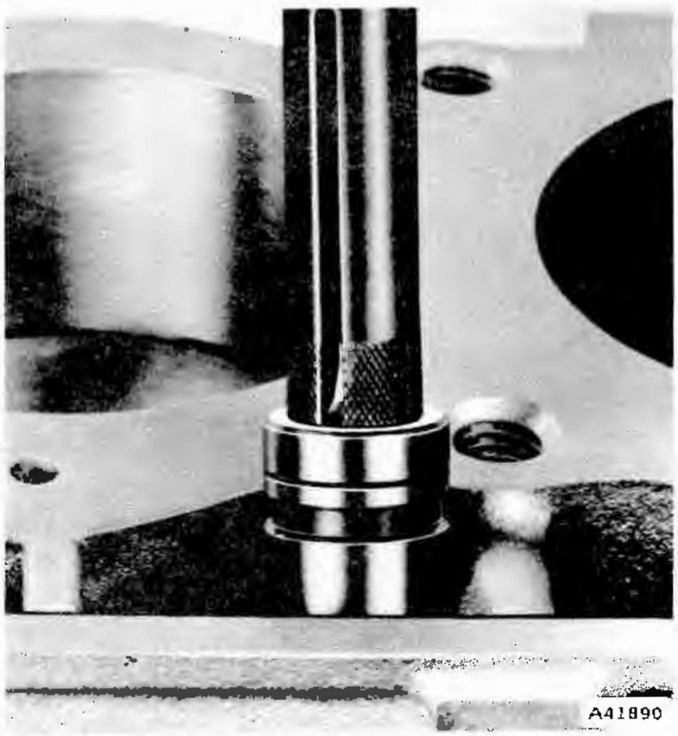

Fig. 1A-20 Hydraulic Tappet Removal

Hydraulic Tappet Leak-Down Test and Assembly

After cleaning and inspection, the tappet must be "leak-down" tested to ensure its "zero-lash" operating ability. Figure 1A-21 illustrates Tool J-5790 used to test tappet "leak-down" accurately.

(1) Fill tappet body with Valve Tappet Test Oil J-5268.

(2) Install plunger return spring, plunger assembly, and plunger cap in tappet body. Do not install lock ring for test.

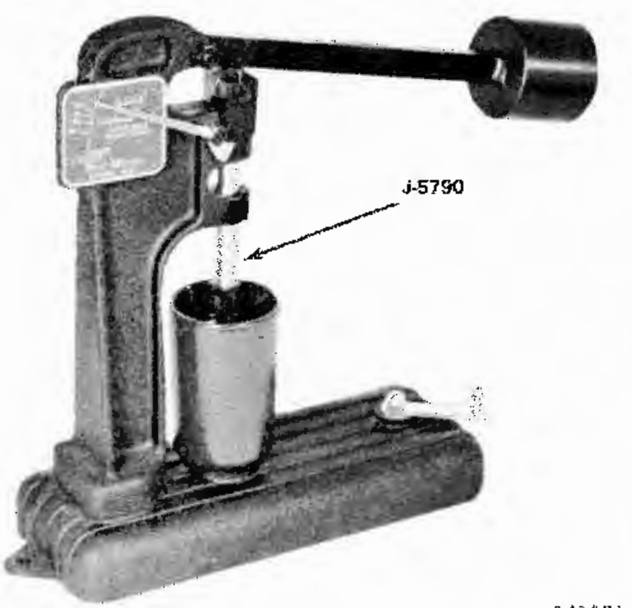

Fig. 1A-21 Hydraulic Tappet Leak-Down Test

(3) Place a 0.312 to 0.313-inch diameter ball bearing on plunger cap.

(4) Place tappet in tester.

(5) Lift weighted arm, place tester push rod on ball bearing in plunger cap, adjust push rod to set tester gauge to Start.

(6) Release weighted arm and time tappet leak-down.

(7) A good tappet will take 20 to 110 seconds to leak-down with a load travel of 0.125-inch as indicated on tester gauge.

(8) Install lock rings on acceptable tappets. Discard unacceptable tappets.

NOTE: *Do not charge the tappet assemblies with engine oil. They will charge themselves within 3 to 8 minutes of engine operation.*

Installation

(1) Dip tappet assembly in Jeep Engine Oil Supplement (EOS) or equivalent.

(2) Use Hydraulic Valve Tappet Remover and Installer Tool J-21884 and install tappets in same bores from which they were removed.

(3) Install push rods in same order as removed.

(4) Install rocker arms and shaft assembly and tighten retaining bolts to torque.

(5) Pour remaining EOS over entire valve train.

NOTE: *The EOS must remain in the engine for at least 1,000 miles but need not be drained until the next scheduled oil change.*

(6) Install cylinder head and gasket and tighten bolts to torque.

(7) Install cylinder head cover and gasket.

VIBRATION DAMPER

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

Do not attempt to duplicate original damper balance holes when installing a service replacement. The vibration damper is not repairable and is serviced only as a complete assembly.

Removal

(1) Remove drive belt(s).

(2) Remove three retaining capscrews and separate accessory pulley from vibration damper, if so equipped.

(3) Remove the vibration damper retaining bolt and washer.

(4) Use Vibration Damper Remover Tool J-21791 to remove damper from the crankshaft as shown in figure 1A-22.

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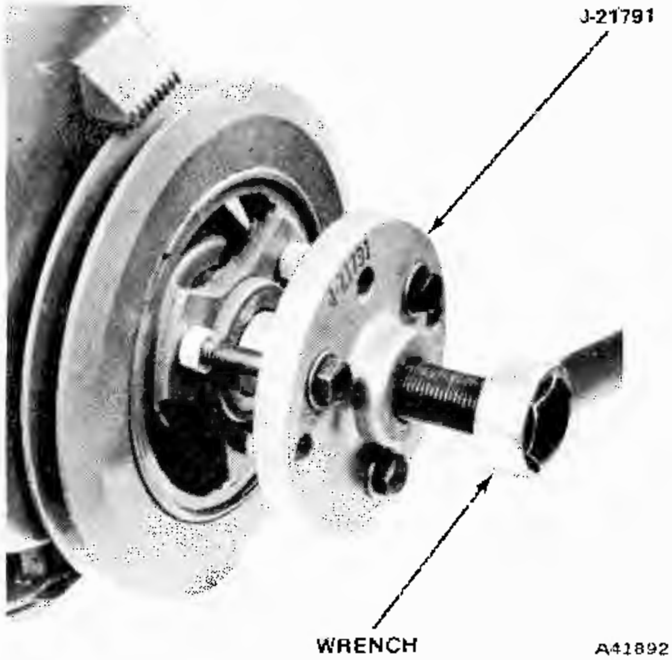

Fig. 1A-22 Vibration Damper Removal

Installation

(1) Align key slot of the vibration damper with crankshaft key and tap damper onto crankshaft.

(2) Install vibration damper retaining bolt and washer; tighten to 55 foot-pounds torque.

(3) If removed, install accessory pulley and retaining capscrews; tighten the screws to 23 foot-pounds torque.

(4) Install drive belt(s) and tighten to the specified tension.

TIMING CHAIN COVER

The timing chain cover is provided with a seal and oil slinger to prevent oil leakage at the vibration damper hub (fig. 1A-23).

It is important that the timing chain cover be properly aligned with the crankshaft to prevent eventual damage to the oil seal. The oil seal may be replaced without removing the timing chain cover.

Removal

(1) Remove drive belt(s), engine fan and hub assembly, accessory pulley (if equipped) and vibration damper.

(2) Remove oil pan-to-timing chain cover screws and cover-to-block screws.

(3) Raise timing chain cover enough to detach retaining nibs of oil pan seal from bottom side of cover (this must be done to prevent pulling the seal end tabs away from the tongues of the oil pan gaskets which would cause an oil leak and necessitate removal of the oil pan to correct).

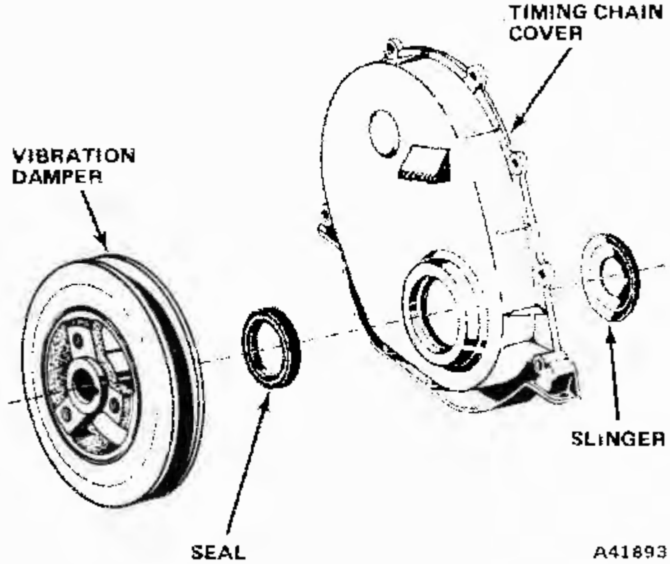

Fig. 1A-23 Timing Chain Cover

(4) Remove timing chain cover and gasket from engine.

(5) Cut off oil pan seal end tabs flush with front face of cylinder block and remove seal.

(6) Clean timing chain cover, oil pan, and cylinder block gasket surfaces.

(7) Remove crankshaft oil seal from the timing chain cover.

Installation

(1) Apply sealing compound, Perfect Seal or equivalent, to both sides of new timing cover gasket and position gasket on cylinder block.

(2) Cut end tabs of a new oil pan seal same as was cut off original seal.

(3) Coat seal end tabs generously with Permatex No. 2 (or equivalent) and position seal on timing chain cover (fig. 1A-24).

Fig. 1A-24 Oil Pan Front Seal Installation

(4) Position timing chain cover on engine. Place Timing Chain Cover Alignment Tool and Seal Installer J-22248 on crankshaft and seal opening of cover (fig. 1A-25).

(5) Install cover-to-block screws and oil pan-to-cover screws. Tighten cover-to-block screws to 5 foot-pounds torque and oil pan-to-cover screws to 11 foot-pounds torque.

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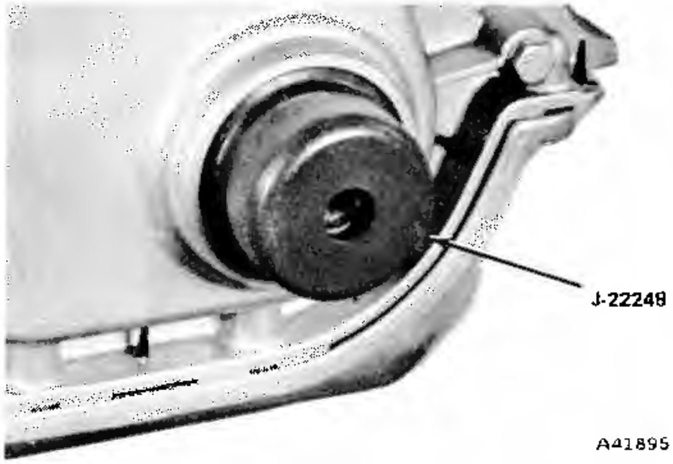

Fig. 1A-25 Timing Chain Cover Alignment

(6) Remove cover aligning tool and place a new oil seal on tool with the seal lip facing cover. Apply a light film of Perfect Seal or equivalent on the outside diameter of the seal.

(7) Insert draw screw from Tool J-9163 into seal installing tool and press seal into cover until bottomed in cover opening (fig. 1A-26).

(8) Remove tools, and apply a light film of engine oil on the seal lip.

(9) Install vibration damper and tighten retaining bolt to 55 foot-pounds torque.

(10) Install accessory pulley (if equipped).

(11) Install engine fan and hub assembly.

(12) Install drive belt(s) and tighten to specified tension.

Fig. 1A-26 Timing Chain Cover Oil Seal Installation

Timing Chain Cover Oil Seal Replacement (Cover not Removed)

(1) Remove drive belts.

(2) Remove accessory drive pulley (if equipped).

(3) Remove vibration damper.

(4) Remove oil seal with Tool J-9256 as shown in figure 1A-27.

Fig. 1A-27 Timing Chain Cover Oil Seal Removal

(5) Place new oil seal on Timing Chain Cover Alignment Tool and Seal Installer J-22248 with seal lip facing outward. Apply a light film of Perfect Seal or equivalent on outside diameter of seal.

(6) Insert draw screw from Tool J-9163 into seal installing tool and press the seal into cover until bottomed in cover opening.

(7) Remove tools; apply light film of engine oil on seal lip.

(8) Install vibration damper and tighten retaining bolt to 55 foot-pounds torque.

(9) Install accessory pulley (if equipped).

(10) Install drive belt(s) and tighten to specified tension.

TIMING CHAIN

Installation of the timing chain with the timing marks of the crankshaft and camshaft sprockets properly aligned assures correct valve timing. A worn timing chain will adversely affect valve timing. If the timing chain deflects more than 1/2 inch, it should be replaced.

Checking Valve Timing

(1) After disconnecting wires, remove spark plugs.

(2) Remove cylinder head cover and gasket.

(3) Rotate crankshaft until No. 6 piston is at TDC on compression stroke.

(4) Rotate crankshaft counterclockwise (viewed from front of engine) 90°.

(5) Install dial indicator with end of push rod touching No. 1 cylinder intake rocker arm at push rod end. Set dial indicator to zero.

(6) Rotate crankshaft clockwise (viewed from front of engine) until dial indicator shows 0.016 inch lift.

(7) Timing mark on vibration damper should index with TDC mark on timing chain cover. If timing mark is more than 1/2 inch off TDC in either direction, valve timing is incorrect.

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Removal

(1) Remove drive belt(s).
(2) Remove engine fan and hub assembly.
(3) Remove accessory pulley (if equipped).
(4) Remove vibration damper.
(5) Remove timing chain cover.
(6) Remove oil seal from timing chain cover.
(7) Remove camshaft sprocket retaining bolt and washer.
(8) Rotate crankshaft until "0" timing mark on the crankshaft sprocket is closest to and on a centerline with timing pointer of camshaft sprocket (fig. 1A-28).
(9) Remove crankshaft sprocket, camshaft sprocket and timing chain as an assembly. Disassemble chain and sprockets.

Installation

(1) Assemble timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned as shown in figure 1A-28.
(2) Install assembly to the crankshaft and camshaft.
(3) Install camshaft sprocket retaining bolt and washer and tighten to specified torque.

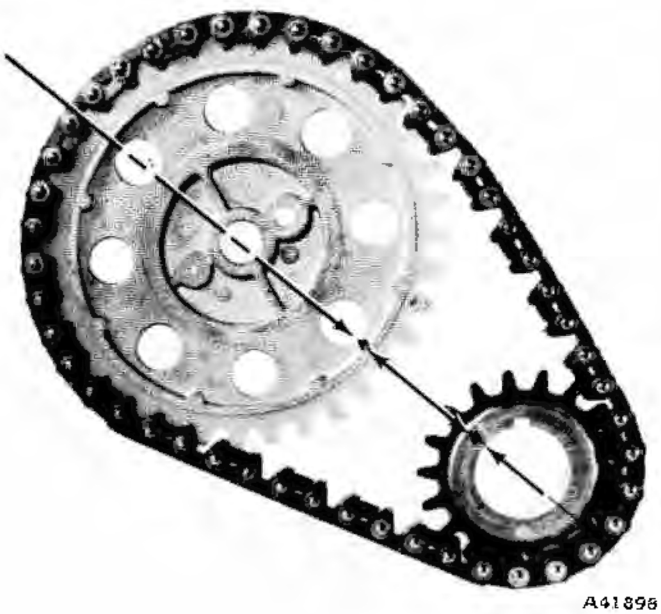

Fig. 1A-28 Timing Sprockets Alignment

NOTE: *To assure correct installation of the timing chain, locate timing mark of the camshaft sprocket at approximately one o'clock position. This should place timing mark of crankshaft sprocket where it meshes with chain (fig. 1A-29). Count number of chain pins between timing mark of both sprockets. There should be 15 pins.*

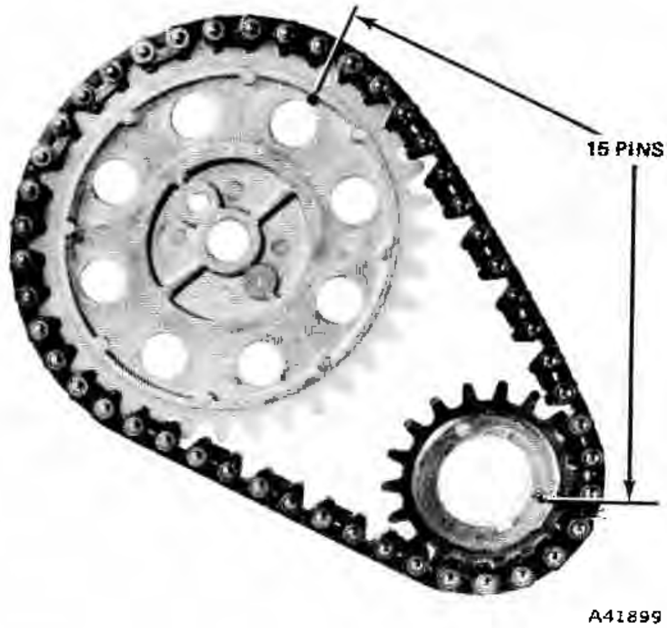

Fig. 1A-29 Timing Chain Installation

(4) Install timing chain cover and a new oil seal.
(5) Install vibration damper.
(6) Install accessory pulley (if equipped).
(7) Install engine fan and hub assembly.
(8) Install drive belt(s) and tighten to specified tension.

CAMSHAFT AND BEARINGS

The camshaft is supported by four steel-shelled, babbitt-lined bearings pressed into the block and line reamed. Camshaft bearing bores are step-bored, being larger at the front bearing than at the rear, to permit easy removal and installation of the camshaft. Camshaft bearings are lubricated under pressure.

NOTE: *It is not advisable to replace camshaft bearings unless equipped with special removing, installing, and reaming tools.*

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear. The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face. Therefore, camshaft end play is zero during engine operation.

Measuring Cam Lobe Lift

(1) Remove cylinder head cover and gasket.
(2) Remove rocker arms and shaft assembly.
(3) Remove spark plugs.
(4) Install a dial indicater on end of push rod (use piece of rubber tubing between dial indicator plunger and push rod (fig. 1A-30)).

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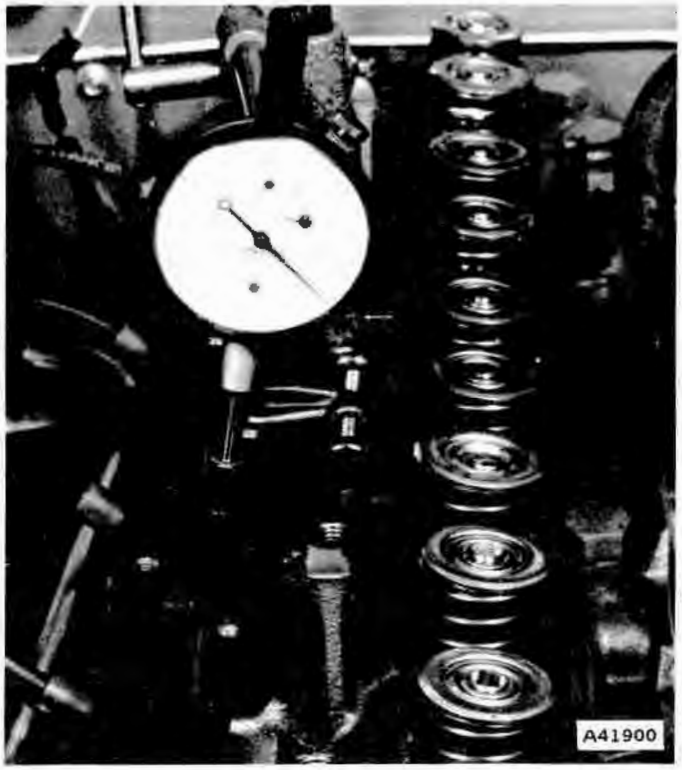

Fig. 1A-30 Cam Lobe Lift Measurement

(5) Rotate crankshaft until cam lobe base circle (push rod down) is under valve tappet. Set dial indicator to zero.

(6) Rotate crankshaft until push rod reaches its maximum upward travel. Read travel at dial indicator. If the measurement is less than 0.248 inch, the camshaft is defective.

Removal

(1) Drain cooling system.
(2) Remove the radiator.
(3) Remove air conditioning condenser and receiver assembly as a charged unit (if equipped). Refer to section 13A—Air Conditioning.

CAUTION: *Both service valves must be closed before air conditioning system is operated.*

(4) Remove cylinder head cover and gasket.
(5) Remove rocker arms and shaft assembly.
(6) Remove push rods.

NOTE: *Keep push rods and tappets in the same order as removed.*

(7) Remove cylinder head and gasket.
(8) Remove hydraulic tappets.
(9) Remove drive belt(s).
(10) Remove fan and hub assembly.
(11) Remove accessory pulley (if equipped).
(12) Remove vibration damper.
(13) Remove timing chain cover.
(14) Remove timing chain cover oil seal.
(15) Remove fuel pump.
(16) Remove distributor and ignition wires.
(17) Rotate crankshaft until "0" timing mark of crankshaft sprocket is closest to and on a centerline with timing pointer of camshaft sprocket (fig. 1A-28).
(18) Remove crankshaft sprocket, camshaft sprocket and timing chain as an assembly.
(19) Remove grille as required and remove camshaft.

Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. Replace if either condition exists.

Inspect the distributor drive gear for damage or excessive wear. Replace if necessary.

Inspect each cam lobe and the matching hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave and the matching camshaft lobe(s) is also worn, both the camshaft and the tappet(s) must be replaced.

Installation

(1) Lubricate camshaft with Jeep Engine Oil Supplement (or equivalent).
(2) Install camshaft carefully.
(3) Install timing chain, crankshaft sprocket and camshaft sprocket with timing marks aligned (fig. 1A-28).
(4) Install camshaft sprocket retaining bolt and tighten to 50 foot-pounds.
(5) Install timing chain cover with new oil seal.
(6) Install vibration damper.
(7) Install accessory pulley (if equipped).
(8) Install engine fan and hub assembly.
(9) Install drive belt(s) and tighten to the specified tension.
(10) Install fuel pump.
(11) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.
(12) Install the distributor cap and ignition wires.

NOTE: *Install the distributor so that the rotor is aligned with the No. 1 terminal of the cap when fully seated on block.*

(13) Install the hydraulic tappets.
(14) Install cylinder head and gasket.
(15) Install push rods.
(16) Install rocker arm and shaft assembly.
(17) Install cylinder head cover and gasket.

NOTE: *The hydraulic valve tappets and all valve train components should be lubricated with Jeep Engine Oil Supplement (EOS) or equivalent during installation. The EOS must remain in the engine for at least 1,000 miles but need not be drained until the next scheduled oil change.*

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(18) Install air conditioning condenser and receiver assembly (if equipped). Refer to section 13A—Air Conditioning.

CAUTION: *Both service valves must be opened before the air conditioning system is operated.*

(19) Install radiator, connect hoses, and fill cooling system to specified level.

(20) Install grille (if removed).

OIL PAN

Removal

(1) Raise vehicle and drain engine oil.

(2) Remove the starter motor.

(3) On CJ Models:

Place a jack under the transmission bell housing.

Disconnect engine right support cushion bracket from block and raise the engine to allow sufficient clearance for oil pan removal.

(4) Remove oil pan.

(5) Remove oil pan front and rear neoprene oil seals and side gaskets.

(6) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.

Installation

(1) Install a new oil pan front seal to timing chain cover and apply a generous amount of "Permatex" No. 2, or equivalent, to the end tabs.

(2) Cement new oil pan side gaskets into position on engine block and apply a generous amount of Permatex No. 2 or equivalent to the gasket ends.

(3) Coat inside curved surface of a new oil pan rear seal with soap and apply a generous amount of Permatex No. 2 or equivalent to side gasket contacting surface of seal end tabs.

(4) Install seal in recess of the rear main bearing cap making certain it is fully seated.

(5) Apply engine oil to oil pan contacting surface of the front and rear oil pan seals.

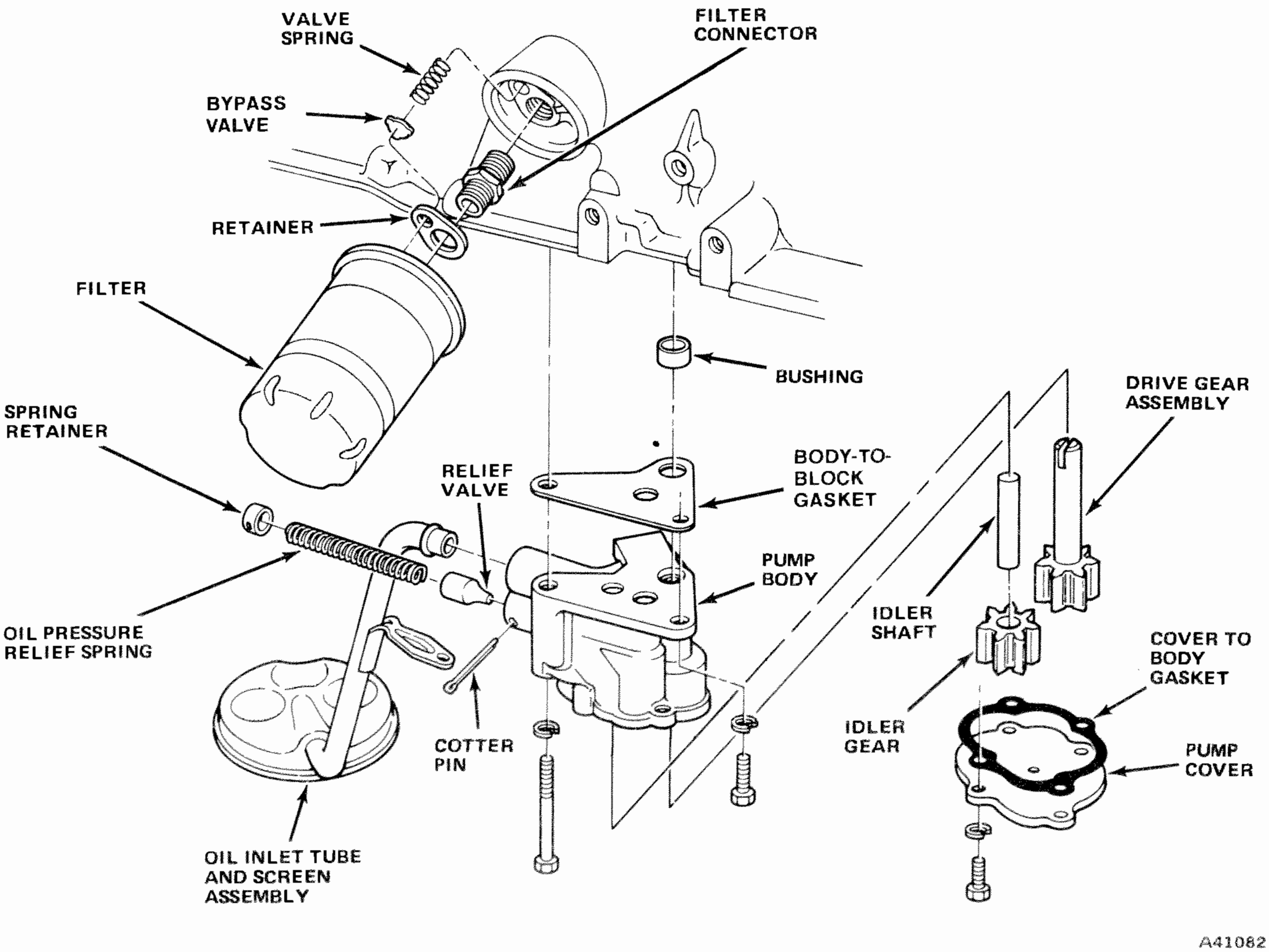

Fig. 1A-31 Oil Filter and Oil Pump Assembly

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(6) Install oil pan and tighten drain plug securely.

(7) If disconnected, lower engine and connect right support cushion bracket to block. Remove the jack.

(8) Install starter motor.

(9) Lower vehicle and fill the crankcase with new oil.

OIL FILTER

A full flow oil filter, mounted on the lower right hand side of the engine, is accessible through the hood opening. A bypass valve incorporated in the filter mounting boss provides a safety factor if the filter becomes inoperative as a result of dirt or sludge accumulation (fig. 1A-31). Tool J-22700 will facilitate removal of the oil filter.

Before installation apply a thin film of oil to the new filter gasket. Install filter until gasket contacts the seat of the adapter. Then tighten securely, by hand only. Operate engine at fast idle and check for leaks.

OIL PUMP

A positive displacement gear type oil pump is used and is driven by the distributor shaft, which in turn is driven by a gear on the camshaft. Crankcase oil enters the pump through a inlet tube and screen assembly which is a press fit in the pump body (fig. 1A-31). The pump incorporates a pressure relief valve to regulate maximum pressure. It is not adjustable. A setting of 75 pounds maximum pressure is built into the tension of the spring. In the relief position, the valve permits oil to bypass through a passage in the pump body to the inlet side of the pump.

NOTE: *Oil pump removal or replacement will not affect distributor timing as the distributor drive gear remains in mesh with the camshaft gear.*

Removal

(1) Drain engine oil.

(2) Remove oil pan.

(3) Remove oil pump retaining screws, oil pump and gasket.

CAUTION: *Do not disturb position of oil inlet tube and screen assembly in pump body. If tube is moved within pump body, a new tube and screen assembly must be installed to assure an airtight seal.*

Disassembly and Inspection

(1) Remove cover-retaining screws, cover and gasket from pump body.

(2) Measure gear end clearance by placing a straightedge across gears and pump body. Select a feeler gauge which will fit snugly but freely between straight edge and oil pump body (fig. 1A-32). Refer to specifications for correct clearance.

If gear end clearance is less than specified, replace the oil pump assembly.

(3) Measure gear-to-body clearance by inserting a feeler gauge between gear tooth and pump body inner wall directly opposite the point of gear mesh. Select a feeler gauge which fits snugly but freely (fig. 1A-33). Rotate gears to check each tooth in this manner. Refer to specification for correct clearance.

If gear-to-body clearance is more than specified, replace idler gear, idler shaft, and drive gear assembly.

(4) Remove cotter pin and slide spring retainer, spring and oil pressure relief valve out of pump body. Check for sticking condition. Clean or replace as necessary.

NOTE: *The oil inlet tube must be moved to allow removal of the relief valve; therefore, the pickup tube assembly must be replaced upon installation.*

Fig. 1A-32 Oil Pump Gear End Clearance Measurement

Assembly and Installation

(1) Install oil pressure relief valve, spring, retainer, and cotter pin.

(2) If position of the inlet tube in the pump body has been disturbed, install new tube and screen assembly. Apply a light film of Permatex No. 2 or equivalent around end of tube. Using tool J-21882 (fig. 1A-34) drive tube into body making sure that support bracket is properly aligned.

(3) Install idler shaft, idler gear and drive gear assembly.

NOTE: *To ensure self-priming of the oil pump, the pump must be filled with petroleum jelly prior to the installation of the oil pump cover. Do not use grease.*

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Fig. 1A-33 Oil Gear-to-Body Clearance Measurement

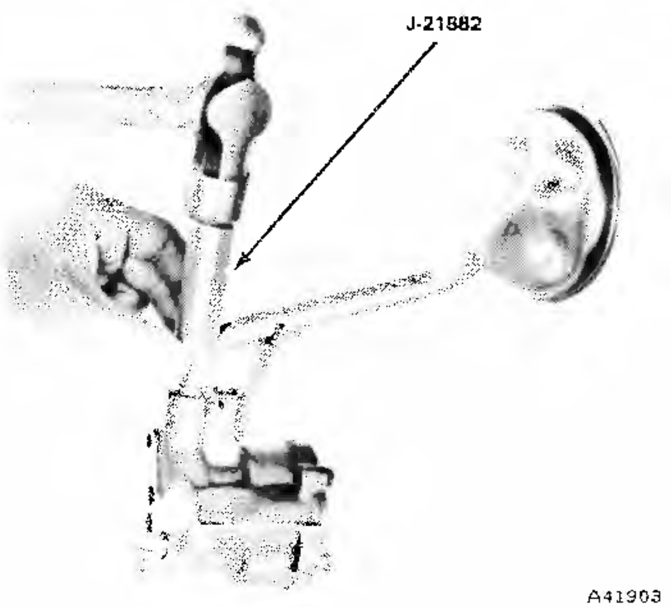

Fig. 1A-34 Oil Pump Inlet Tube Installation

(4) Install pump cover and new gasket. Tighten screws to specified torque.

NOTE: *Check operation prior to installing the oil pump.*

(5) Install oil pump and a new gasket. Tighten short screws to 10 foot-pounds torque, and long screws to 17 foot-pounds torque.

(6) Install oil pan using new gaskets and seals. Fill crankcase with new oil to specified dipstick level.

REAR MAIN BEARING OIL SEAL

The rear main bearing crankshaft oil seal consists of two pieces of neoprene with a single lip that effectively seals the rear of the crankshaft. To ensure leak-free operation, the upper and lower seal halves must be replaced in pairs.

Removal

(1) Drain engine oil.
(2) Remove oil pan.
(3) Remove rear main bearing cap and discard lower seal.
(4) Loosen all remaining main bearing capscrews.
(5) With a brass drift and hammer, tap upper seal until sufficient seal is protruding to permit pulling it out completely.

Installation

(1) Remove oil pan front and rear neoprene oil seals and oil pan side gaskets.
(2) Clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from the oil pan sump.
(3) Clean main bearing cap thoroughly to remove all sealer.
(4) Wipe seal surface of crankshaft clean and lightly coat with engine oil.
(5) Coat block contacting surface of the upper seal with soap.
(6) Coat lip of seal with engine oil.
(7) Install upper seal into engine block.

NOTE: *Lip of seal must face toward front of engine.*

(8) Coat both sides of lower seal end tabs with Permatex No. 2 or equivalent, being careful not to apply sealer to lip of seal.
(9) Coat outer curved surface of lower seal with soap and the lip of the seal with engine oil.
(10) Install seal into cap recess and seat it firmly.
(11) Coat Permatex No. 2 or equivalent on both chamfered edges of the rear main bearing cap (fig. 1A-35).
(12) Install rear main bearing cap and inserts.
(13) Tighten all main bearing capscrews to 80 foot-pounds torque.
(14) Install oil pan using new gaskets and seals. Tighten drain plug securely.
(15) Fill the crankcase with new oil to the specified dipstick level.

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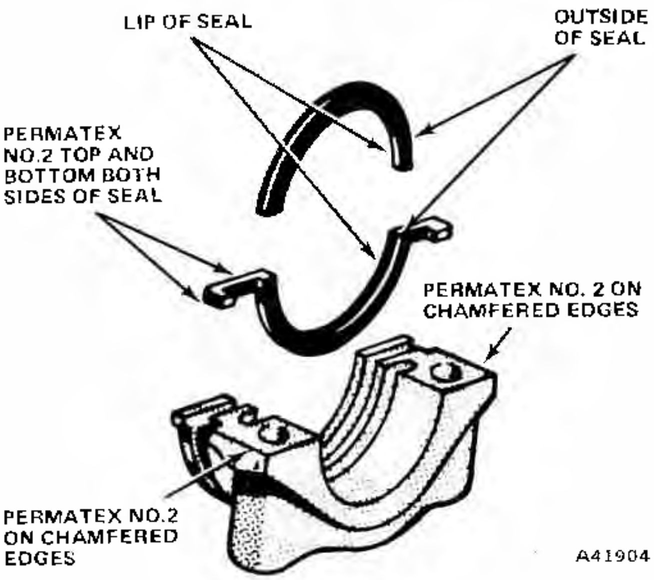

Fig. 1A-35 Rear Main Oil Seal and Cap Installation

CYLINDER BLOCK

Disassembly

(1) Remove engine as outlined under Engine Removal.
(2) Separate transmission from engine assembly. Refer to appropriate Transmission Section.
(3) Place engine assembly on engine stand.
(4) Remove intake and exhaust manifolds.
(5) Remove cylinder head cover and gasket.
(6) Remove rocker arms and shaft assembly.
(7) Remove push rods.
(8) Remove cylinder head and gasket.
(9) Remove valve tappets.
(10) Remove drive pulley and vibration damper.
(11) Remove timing chain cover.
(12) Remove timing chain and sprockets.
(13) Remove camshaft.
(14) Position pistons (one at a time) near bottom of stroke and use a ridge reamer to remove any ridge from top end of cylinder walls.
(15) Remove oil pan and gaskets.
(16) Remove oil pump.
(17) Remove connecting rod bearing caps and inserts and retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.*

(18) Remove piston and connecting rod assemblies through top of cylinder bores.

NOTE: *Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls.*

(19) Remove main bearing caps and inserts.
(20) Remove crankshaft.

Assembly

(1) Install upper main bearing inserts in cylinder block.
(2) Install crankshaft.
(3) Install main bearing caps and inserts. Tighten bolts to 80 foot-pounds torque.
(4) After thoroughly cleaning cylinder bores, apply a light film of clean engine oil to bores with a clean lint-free cloth, or paper towel.
(5) Position piston rings on piston as follows:
(a) No. 1 compression ring gap is 180° from No. 2 compression ring gap.
(b) Oil control ring spacer expander gap is at least 90° from No. 2 compression ring gap.
(c) Oil control ring gaps are 90° from expander gap with at least 30° between each ring gap.
(6) Lubricate piston and rings with clean engine oil.
(7) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through the top of the cylinder bores (fig. 1A-36).

NOTE: *Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls.*

Fig. 1A-36 Piston-to-Bore Installation

NOTE: *Lengths of rubber hose over the connecting rod bolts will provide protection during installation.*

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(8) Install connecting rod bearing caps and inserts in the same order as removed. Tighten retaining nuts to 28 foot-pounds torque.
(9) Install oil pump.
(10) Install engine oil pan using new gaskets and seals. Tighten drain plug securely.
(11) Install camshaft.
(12) Install timing chain cover.
(13) Install vibration damper and drive pulley.
(14) Install valve tappets.
(15) Install gasket and cylinder head.
(16) Install push rods.
(17) Install rocker arms and shaft assembly.
(18) Install cylinder head cover and gasket.
(19) Install intake and exhaust manifolds.
(20) Remove engine from engine stand.
(21) Reconnect transmission to engine assembly.
(22) Install engine assembly as outlined under Engine Installation.

Cylinder Bore Reconditioning

(1) Check cylinders for taper with an inside micrometer (from top to bottom).
(2) Check for an out-of-round condition by measuring across cylinder bores at two points (parallel to crankshaft and perpendicular to crankshaft).
(3) If cylinder taper does not exceed 0.005 inch and out-of-round does not exceed 0.003 inch, cylinder bore may be trued by honing. If cylinder taper or out-of-round condition exceeds these limits, cylinder must be bored and then honed for an oversize piston.

NOTE: *When finish-honing the cylinder bores, move the hone up and down at sufficient speed to produce a uniform cross hatch pattern on the cylinder walls.*

(4) Removal of glaze from the cylinder wall for faster ring seating can be accomplished by various methods. When an expanding type hone is used, do not use more than ten strokes to recondition a cylinder wall (a stroke is one down and up movement). The engine bearings and lubrication system must be protected from abrasives.

NOTE: *Rigid type hones are not to be used to remove cylinder glaze since a slight amount of taper always exists in cylinder walls after the engine has been in service.*

(5) Prior to fitting pistons, the cylinder bores should be scrubbed clean with a hot water and detergent solution. Immediately after cleaning, apply light engine oil to the cylinder walls and then wipe with a clean lint-free cloth or paper towels.

CONNECTING ROD AND PISTON ASSEMBLIES

NOTE: *The following procedures may be used to service connecting rod and piston assemblies with engine in the vehicle.*

Removal

(1) Remove cylinder head cover and gasket.
(2) Remove rocker arms and shaft assembly.
(3) Remove push rods.
(4) Remove cylinder head and gasket.
(5) Position pistons one at a time near bottom of stroke and use a ridge reamer to remove any ridge from top end of cylinder walls.
(6) Drain the engine oil.
(7) Remove oil pan and gaskets.
(8) Remove connecting rod bearing caps and inserts and retain in same order as removed.

NOTE: *Connecting rods and caps are stamped with the corresponding cylinder number.*

(9) Remove connecting rod and piston assemblies through top of cylinder bores.

NOTE: *Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls.*

Installation

(1) After thoroughly cleaning cylinder bores, apply a light film of clean engine oil to bores with a clean lint-free cloth or paper towel.
(2) Position piston rings on pistons as follows:
(a) No. 1 compression ring gap is 180° from No. 2 compression ring gap.
(b) Oil control ring spacer expander gap is at least 90° from No. 2 compression ring gap.
(c) Oil control ring gaps are 90° from expander gap with at least 30° between each ring gap.
(3) Lubricate piston and rings with clean engine oil.
(4) Use Piston Ring Compressor Tool J-5601 to install connecting rod and piston assemblies through the top of the cylinder bores (fig. 1A-36).

NOTE: *Be careful that connecting rod bolts do not scratch the connecting rod journals or cylinder walls.*

NOTE: *Lengths of rubber hose over the connecting rod bolts will provide protection during installation.*

(5) Install connecting rod bearing caps and inserts in the same order as removed. Tighten retaining nuts to 28 foot-pounds torque.
(6) Install engine oil pan using new gaskets and seals. Tighten drain plug securely.
(7) Install gasket and cylinder head.
(8) Install push rods.
(9) Install rocker arms and shaft assembly.
(10) Install cylinder head cover and gasket.
(11) Fill the crankcase with new oil to the specified dipstick level.

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CONNECTING RODS

The connecting rods are cast iron, balanced assemblies with bearing inserts at the crankshaft journal end.

The piston pin is assembled into the rod with 2,000 lbs. pressure (press-fit). Replace any rod that does not require such a press-fit.

Misaligned or bent connecting rods will cause abnormal wear on pistons, piston rings, cylinder walls, connecting rod bearing, or crankshaft connecting rod journals. If wear patterns or damage to any of the above mentioned components indicate the probability of a misaligned connecting rod, check rod alignment. Misaligned or bent rods must be replaced.

Side Clearance Measurement

(1) Slide snug-fitting feeler gauge between connecting rod and crankshaft rod journal flange.

(2) Refer to specifications. Replace connecting rod if side clearance is not to specifications.

Connecting Rod Bearings

The connecting rod bearings are steel-backed, sintered copper, lead-alloy precision type.

Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. In production the select fit is obtained by using various sized, color coded bearing inserts as shown in the bearing fitting chart.

The rod journal size is identified in production by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. The color codes used to indicate journal size are shown in the bearing fitting chart.

When required, different sized upper and lower bearing inserts may be used as a pair; therefore, a standard size insert is sometimes used in combination with a 0.001 inch undersize insert to reduce clearance 0.0005 inch.

NOTE: *Never use a pair of bearing inserts with more than 0.001 inch difference in size.*

Example:

	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001 inch undersize	0.002 inch undersize

Service replacement bearing inserts are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize.

Removal

(1) Drain engine oil.

(2) Remove oil pan and gaskets.

(3) Rotate crankshaft as required to position two connecting rods at a time at bottom of stroke.

(4) Remove connecting rod bearing caps and then remove lower bearing insert.

(5) Remove upper bearing insert by springing it out of connecting rod.

NOTE: *Do not mix bearing caps. Each connecting rod and its matching cap is stamped with the cylinder number on a machined surface which faces the camshaft side of the engine block.*

(6) Inspect bearing inserts for abnormal wear or damage. Bearing inserts with either condition should be replaced.

(7) Wipe connecting rod journals clean and use a micrometer to check for out-of-round condition. Refer to specifications. If any rod journal is not within specifications, it must be reconditioned and fitted with new undersize bearing inserts.

Measuring Bearing Clearance With Plastigage

(1) Wipe journal clean.

(2) Place a strip of Plastigage across full width of lower insert at the center of bearing cap.

(3) Install bearing cap to connecting rod and tighten retaining nuts to 28 foot-pounds torque.

(4) Remove bearing cap and determine amount of clearance by measuring the width of the compressed Plastigage with the scale furnished (fig. 1A-37).

CONNECTING ROD BEARING FITTING CHART

CRANKSHAFT CONNECTING ROD JOURNAL COLOR CODE AND DIAMETER	BEARING COLOR CODE — UPPER INSERT SIZE	BEARING COLOR CODE — LOWER INSERT SIZE
YELLOW — 2.0955 TO 2.0948 INCHES	YELLOW — STANDARD	YELLOW — STANDARD
ORANGE — 2.0948 TO 2.0941 INCHES	YELLOW — STANDARD	BLACK — .001-INCH UNDERSIZE
BLACK — 2.0941 TO 2.0934 INCHES	BLACK — .001-INCH UNDERSIZE	BLACK — .001-INCH UNDERSIZE
RED — 2.0855 TO 2.0848 INCHES	RED — .010-INCH UNDERSIZE	RED — .010-INCH UNDERSIZE

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Fig. 1A-37 Bearing Clearance Measurement with Plastigage

Measuring Bearing Clearance with Micrometer

(1) Wipe connecting rod journal clean.

(2) Use micrometer to measure maximum diameter of rod journal.

(3) Compare reading obtained with journal diameters listed in connecting rod Bearing Fitting Chart and select inserts required to obtain specified bearing clearance.

Installation

(1) Lubricate bearing surface of each insert with clean engine oil.

(2) Install bearing inserts, cap, and retaining nuts. Tighten to 28 foot-pounds torque.

CAUTION: *Care must be exercised when rotating the crankshaft with bearing caps removed. Be sure the connecting rod bolts do not accidentally come in contact with the rod journals and scratch the finish. Bearing failure would result.*

(3) Install oil pan using new gaskets and seals. Tighten drain plug securely.

(4) Fill crankcase with new oil to specified dipstick level.

PISTONS

Aluminum alloy Autothermic pistons, steel reinforced for strength and controlled expansion, are used. The ring belt area above the piston pin provides for three piston rings: two compression and one oil control ring.

The piston pin boss is offset from the centerline of the piston to place it nearer the thrust side of the piston.

A notch in the top perimeter of the piston ensures correct installation in the bore. Notch must face front of engine when installed (fig. 1A-38).

Fitting Pistons

Pistons are fitted to their respective bores by measuring the inside diameter of the cylinder bore at a point 2-5/16-inches below the top of bore, and the outside diameter of the piston. Pistons are cam ground and must be measured at right angles to piston pin at centerline of pin (fig. 1A-39). The difference between cylinder bore diameter and piston diameter is piston-to-bore clearance.

Piston Rings

The compression rings (two) are made of cast iron. The oil control ring is a three-piece steel design.

Ring Fitting

(1) Clean carbon from all ring grooves. The oil drain openings in the oil ring grooves and pin boss must be open. Be careful not to remove metal from the grooves or lands since this will change the ring groove clearances and destroy ring-to-land seating.

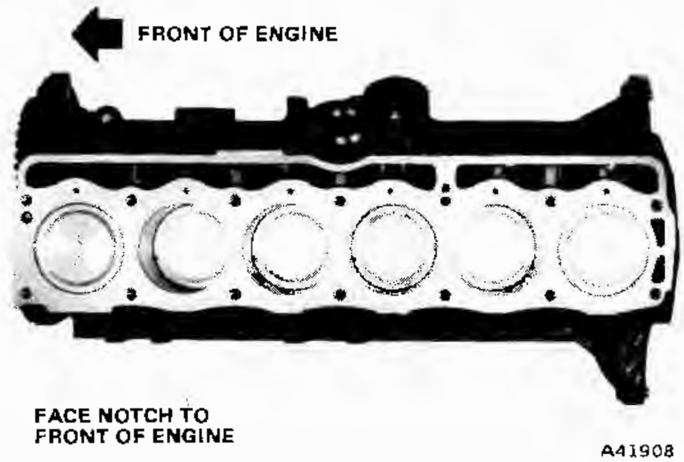

Fig. 1A-38 Pistons Correctly Positioned in Bores

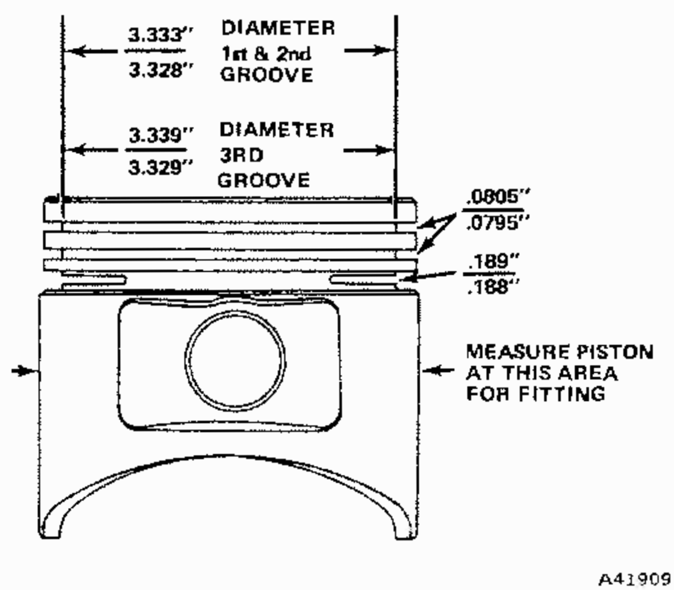

Fig. 1A-39 Piston Measurements

(2) Check ring side clearance with feeler gauge fitted snugly between ring land and ring. Rotate ring in groove; it must move freely at all points (fig. 1A-40).

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Side clearance between land and rings should be as listed in the specifications.

Fig. 1A-40 Ring Side Clearance

(3) Place ring in bore and push down with an inverted piston to a position near lower end of ring travel. Measure ring gap or joint clearance with feeler gauge fitted snugly in ring opening (fig. 1A-41).

Fig. 1A-41 Ring Gap Clearance

NOTE: *When other than standard ring sizes are used, rings should be individually fitted to their respective bores.*

Installation

(1) Install oil control rings as indicated by instructions in package. It is not necessary to use a tool to install upper and lower rails (fig. 1A-42).

(2) Install lower compression ring using ring installer to expand ring around piston (fig. 1A-43).

NOTE: *Make certain upper and lower compression rings are installed properly. Figure 1A-44 shows typical ring markings indicating the top side of the ring.*

(3) Install upper compression ring using ring installer to expand ring around piston (fig. 1A-43).

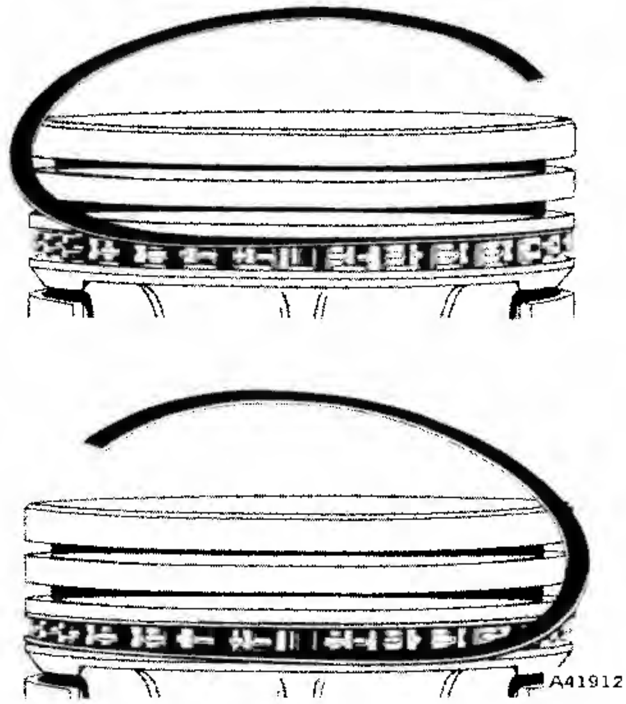

Fig. 1A-42 Oil Control Ring Rail Installation

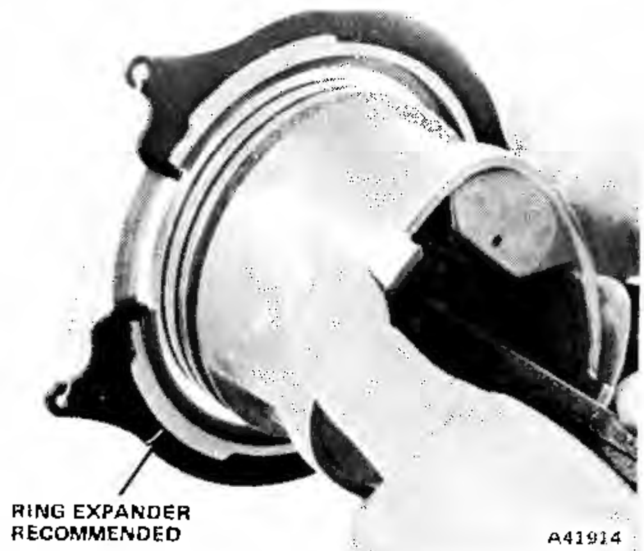

Fig. 1A-43 Compression Ring Installation

Piston Pins

Piston pins are press fit into the connecting rod and require no locking device.

Removal

(1) Using Piston Pin Remover J-21872 and an arbor

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press, place piston on remover support J-21872-1 (fig. 1A-45).

Fig. 1A-44 Typical Piston Ring Markings

(2) Using piloted driver J-21872-3, press pin completely out of piston. Note position of pin through gauge window of remover support (fig. 1A-45).

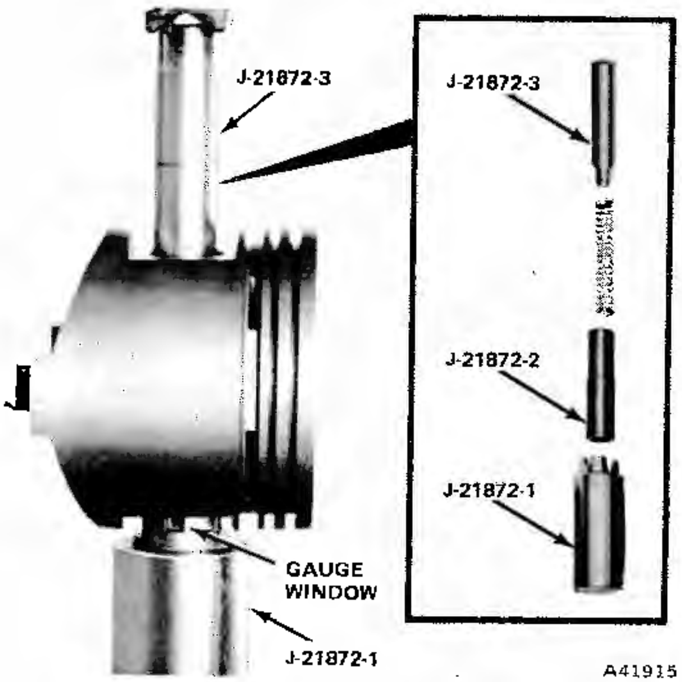

Fig. 1A-45 Piston Pin Removal or Installation

Pin Fitting

(1) Inspect pin and pin bore for nicks and burrs; remove as necessary.

(2) With pin removed from piston, clean and dry piston pin bore and piston pin.

(3) Position piston so that pin bore is in a vertical position. Insert pin in bore. At room temperature, pin should slide completely through pin bore without pushing it.

(4) Replace piston and pin if pin jams in pin bore.

Installation

(1) Insert pin pilot J-21872-2, through piston and connecting rod pin bores (fig. 1A-45).

(2) Position pin pilot, piston, and connecting rod on support J-21872-1.

(3) Insert piston pin through upper piston pin bore and into connecting rod pin bore.

(4) Position piloted driver, J-21872-3, inside piston pin.

(5) Using arbor press, press piston pin through connecting rod and piston until pin pilot indexes with mark on support (fig. 1A-45).

NOTE: *The piston is a 2,000 lb. press-fit. If little effort is required to install piston pin in connecting rod, or if rod moves along pin, a new connecting rod is required.*

(6) Remove piston and connecting rod assembly from press. Pin should be centered in rod, plus or minus 0.0312 inch.

CRANKSHAFT

The crankshaft is cast-iron and is counterweighted and balanced. The 232 CID engine crankshaft has eight counterweights, and the 258 CID engine crankshaft has twelve counterweights. Both have seven main bearings and six connecting rod journals.

An oil slinger is provided at the rear main journal, inboard of the rear oil seal. The component parts and crankshaft are individually balanced; then the complete assembly is balanced as a unit.

NOTE: *On engines equipped with automatic transmissions, the torque converter and converter flexplate must be marked prior to removal and re-installed in the same position.*

Service replacement dampers, crankshafts, flywheels, torque converters, and clutch components are balanced individually and may be replaced as required without rebalancing the complete assembly.

Removal or Replacement

If the crankshaft is damaged to the extent that reconditioning is not feasible, it must be replaced. Removal and installation involves following the procedures outlined under Cylinder Block.

Crankshaft End Play Measurement

The crankshaft end play is controlled at the No. 3 main bearing insert which is flanged for this purpose.

(1) Attach a dial indicator to cylinder block adjacent to No. 3 main bearing.

(2) Pry shaft forward with a flat bladed screwdriver, set dial indicator, push rod on face of crankshaft counterweight, and set to zero.

(3) Pry shaft fore and aft. Read dial indicator (fig. 1A-46).

(4) The correct crankshaft end play is listed in Specifications. Replace thrust bearing if end play is not to specifications.

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NOTE: *When replacing the thrust bearings, it is recommended to pry the crankshaft fore and aft to align the faces of the thrust bearings.*

Measuring Main Bearing Journal With A Micrometer (Crankshaft Removed)

(1) Clean main bearing journal.

(2) Measure maximum diameter of journal with a micrometer.

(3) Compare reading obtained with journal diameters listed in the Main Bearing Fitting Chart and select inserts required to obtain the specified bearing clearance.

Crankshaft Main Bearings

The main bearings are steelbacked, sintered copper, lead alloy precision type. Each bearing is selectively fitted to its respective journal to obtain the desired operating clearance. In production the select fit is obtained by using various sized color coded bearing inserts as shown in the Main Bearing Fitting Chart.

The main bearing journal size is identified (in production) by a color coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft, except for the rear main journal which is on the crankshaft rear flange.

When required, different sized upper and lower bearing inserts may be used as a pair. A standard size insert is sometimes used in combination with a 0.001 inch undersize insert to reduce clearance by 0.005 inch.

Fig. 1A-46 Crankshaft End Play Measurement

Example:

	Correct	Incorrect
Upper	Standard	Standard
Lower	0.001 inch undersize	0.002 inch undersize

CAUTION: *Never use bearing inserts in pairs with greater than 0.001 inch difference in size. When replacing inserts, all the odd size inserts must be either on the top or the bottom.*

Service replacement bearing inserts are available as pairs in the following sizes: standard, 0.001-, 0.002-, 0.010- and 0.012-inch undersize. The size is stamped on the back of the inserts.

Removal and Inspection

(1) Drain the engine oil.

(2) Remove oil pan.

(3) Remove main bearing cap and insert.

(4) Inspect bearing insert for abnormal wear or damage. If either condition exists, both upper and lower inserts must be replaced. Refer to Measuring Bearing Clearance With Plastigage to select bearing inserts required to obtain the specified bearing clearance.

(5) Inspect crankshaft main journal. If damaged, it must be either reconditioned or replaced.

(6) Remove upper insert by loosening all of other bearing caps and inserting a small cotter pin in the crankshaft oil hole (head of pin should be large enough that it will not fall into oil hole, yet thinner than the thickness of the bearing).

(7) With pin in place, rotate crankshaft so that upper bearing insert will rotate in the direction of its locating tongue.

(8) Remove and inspect remaining bearings one at a time in the same manner.

Measuring Bearing Clearance With Plastigage (Crankshaft Installed)

(1) Support weight of crankshaft with a jack or stand place under counterweight (adjacent to main bearing being checked).

NOTE: *Check clearance one bearing at a time. All other bearings must remain tightened.*

(2) Remove main bearing cap and insert.

(3) Clean insert and exposed portion of the crankshaft journal.

(4) Place a strip of Plastigage across full width of the bearing insert.

(5) Install bearing cap and tighten bolts to 80 foot-pounds torque.

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MAIN BEARING FITTING CHART

CRANKSHAFT MAIN JOURNAL COLOR CODE AND DIAMETER	BEARING COLOR CODE	
	UPPER INSERT SIZE	LOWER INSERT SIZE
YELLOW – 2.5001 TO 2.4996 INCHES	YELLOW – STANDARD	YELLOW – STANDARD
ORANGE – 2.4996 TO 2.4991 INCHES	YELLOW – STANDARD	BLACK – .001-INCH UNDERSIZE
BLACK – 2.4991 TO 2.4986 INCHES	BLACK – .001-INCH UNDERSIZE	BLACK – .001-INCH UNDERSIZE
GREEN – 2.4986 TO 2.4981 INCHES	BLACK – .001-INCH UNDERSIZE	BLACK – .002-INCH UNDERSIZE
RED – 2.4901 TO 2.4896 INCHES	RED – .010-INCH UNDERSIZE	RED – .010-INCH UNDERSIZE

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(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with the scale furnished (fig. 1A-47).

Installation

(1) Lubricate bearing surface of each insert with clean engine oil.

(2) Loosen all main bearing caps and install main bearing upper insert(s).

(3) Install main bearing cap(s) and lower insert(s). Tighten bolts evenly to 80 foot-pounds torque.

(4) After installation, turn crankshaft by hand to check for free operation.

(5) Install oil pan (using new gaskets and seals). Tighten drain plug securely.

(6) Fill crankcase with new oil to dipstick level.

FLYWHEEL AND STARTER RING GEAR ASSEMBLY

The starter ring gear can be replaced only on vehicles with manual transmission. The starter ring gear is welded to and balanced as part of the converter drive plate on vehicles with automatic transmission. The entire drive plate/ring gear assembly must be replaced on automatic transmission equipped vehicles.

Removal (Manual Transmission)

(1) Position flywheel on an arbor press with steel blocks equally spaced under gear.

(2) Press flywheel through ring gear.

NOTE: *Ring gear can also be removed by breaking it with a chisel.*

Installation (Manual Transmission)

(1) Apply heat to expand inside diameter of ring gear.

(2) Press flywheel onto ring gear.

NOTE: *On manual transmission equipped cars, the flywheel is balanced as an individual component and also as part of the crankshaft assembly.*

Do not attempt to duplicate original flywheel balance holes when installing a service replacement. Service flywheels are balanced during manufacture.

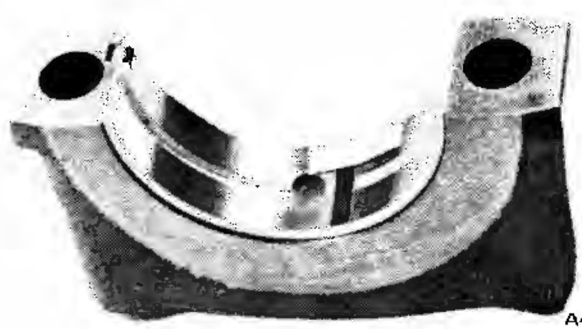

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Fig. 1A-47 Checking Main Bearing Clearance With Plastigage

SHORT ENGINE ASSEMBLY (Short Block)

A service replacement short engine assembly (short block) may be installed whenever the original engine block is worn or damaged beyond repair. It consists of engine block, piston and rod assemblies, crankshaft, camshaft, timing gears and chain.

Installation includes transfer of component parts from the worn or damaged original engine. Follow the appropriate procedures for cleaning and torque tightening as outlined in this section.

NOTE: *Always install a new engine oil pump inlet tube and screen assembly when installing a short engine assembly.*

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SPECIFICATIONS
(232 and 258 CID Engines)

Type	In-Line, OHV, 6-cylinder
Bore	3.75 inches
Stroke	
232	3.50 inches
258	3.395 inches
Displacement	
232	232 cubic inches
258	258 cubic inches
Compression Ratio	8.0:1
Compression Pressure	
232	140 psi
258	150 psi
Maximum Variation Between Cylinders	20 psi
Firing Order	1-5-3-6-2-4
Net Brake Horsepower	
232	100 at 3600 rpm
258	110 at 3500 rpm
Net Torque	
232	185 at 1800 rpm
258	195 at 2000 rpm
Taxable Horsepower	33.75
Fuel	regular, low lead, or no-lead

CAMSHAFT

Fuel Pump Eccentric Diameter	1.615 to 1.625 inches
Tappet Clearance	Zero Lash (Hydraulic tappets)
End Play	Zero (engine operating)
Bearing Clearance	0.001 to 0.003 inch
Bearing Journal Diameter	
No. 1	2.029 to 2.030 inches
No. 2	2.019 to 2.020 inches
No. 3	2.009 to 2.010 inches
No. 4	1.999 to 2.000 inches
Base Circle Runout	0.001 inch (max)
Cam Lobe Lift	0.254 inch
Intake Valve Timing	
Opens	12.5° BTDC
Closes	66.5° ABDC
Exhaust Valve Timing	
Opens	53.5° BBDC
Closes (With EGR)	25.5° ATDC
Valve Overlap	
With EGR	38°
Intake Duration	259°
Exhaust Duration	259°

CONNECTING RODS

Total Weight (Less Bearings)	
232	557 to 665 grams
258	695 to 703 grams
Total Length (Center-to-Center)	
232	6.123 to 6.127 inches
258	5.873 to 5.877 inches
Piston Pin Bore Diameter	0.9288 to 0.9298 inches
Bearing Clearance	0.001 to 0.003 inch (0.0025 inch preferred)
Side Clearance	0.005 to 0.014 inch
Maximum Twist	0.001 per inch
Maximum Bend	0.0005 per inch

CRANKSHAFT

End Play	0.0015 to 0.0065 inch
Main Bearing Journal Diameter	2.4986 to 2.5001 inches
Main Bearing Journal Width	
No. 1	1.086 to 1.098 inches
No. 3	1.271 to 1.273 inches
No. 2-4-5-6-7	1.182 to 1.188 inches
Main Bearing Clearance	0.001 to 0.003 inch (0.0025 inch preferred)
Connecting Rod Journal Diameter	2.0934 to 2.0955 inches
Connecting Rod Journal Width	1.070 to 1.076 inches
Connecting Rod Bearing Clearance	0.001 to 0.003 inch (0.0025 inch preferred)
Maximum Out-of-Round	0.0005 inch
Maximum Taper	0.0005 inch

CYLINDER BLOCK

Deck Height	9.528 to 9.534 inch
Deck Clearance	
232	0.575 inch (below block)
258	0.110 inch (below block)
Cylinder Bore (standard)	3.7501 to 3.7533 inches
Maximum Cylinder Taper	0.005 inch
Maximum Cylinder Out-of-Round	0.003 inch
Tappet Bore Diameter	0.905 to 0.906 inch
Cylinder Block Flatness	0.001/1 inch, 0.002/6 inch; 0.008 inch (max)

CYLINDER HEAD

Combustion Chamber Volume	62.5 to 65.5 cc
Valve Arrangement	EI-IE-IE-EI-EI-IE
Valve Guide ID (Integral)	0.3735 to 0.3745 inch
Valve Stem-to-Guide Clearance	0.001 to 0.003 inch
Intake Valve Seat Angle	30°
Exhaust Valve Seat Angle	44.5°
Valve Seat Width	0.040 to 0.060 inch
Valve Seat Runout	0.0025 inch
Cylinder Head Flatness	0.001/1 inch; 0.002/6 inch; 0.008 inch (max)

LUBRICATION SYSTEM

Engine Oil Capacity	5 quarts (Add 1 quart with filter change)

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Normal Operating Pressure. . . . . 13 psi at 600 rpm; 37 psi at 1600 rpm; 75 psi maximum
Oil Pressure Relief. . . . . 75 psi (max)
Gear-to-Body Clearance. . . . . 0.0025 to 0.0005 inch (0.0005 inch preferred)
Gear End Clearance. . . . . 0.002 to 0.006 inch (0.006 inch preferred)

PISTONS

Weight (less pin). . . . . 481 to 485 grams
Piston Pin Bore Centerline-to-Piston
  Top. . . . . 1.599 to 1.603 inches
Piston-to-Bore Clearance. . . . . . . 0.0009 to 0.0017 inch (0.0012 to 0.0013 inch preferred)
Piston Ring Gap Clearance—
  Compression (Both). . . . . 0.010 to 0.020 inch
Piston Ring Gap Clearance—
  Oil Control Steel Rails. . . . . 0.010 to 0.025 inch
Piston Ring Side Clearance
  No. 1 Compression. . . . . 0.0015 to 0.003 inch (0.0015 preferred)
  No. 2 Compression. . . . . 0.0015 to 0.003 inch (0.0015 preferred)
  Oil Control. . . . . 0.001 to 0.008 inch (0.003 preferred)
Piston Ring Groove Height
  Compression (both). . . . . 0.0795 to 0.0805 inch
  Oil Control. . . . . 0.188 to 0.189 inch
Piston Ring Groove Diameter
  No. 1 and No. 2. . . . . 3.328 to 3.333 inches
  Oil Control. . . . . 3.329 to 3.339 inches
Piston Pin Bore Diameter. . . . . . . 0.9308 to 0.9313 inch
Piston Pin Diameter. . . . . 0.9304 to 0.9309 inch
Piston-to-Pin Clearance. . . . 0.0003 to 0.0005 inch loose (0.0005 inch preferred)
Piston Pin-to-Connecting Rod. . . . . . 2000 lb. press-fit

ROCKER ARMS, PUSH RODS and TAPPETS

Rocker Arm Ratio. 1.5:1
Rocker Arm Shaft Diameter. . . . . 0.8575 to 0.8585 inch
Rocker Arm Bore Diameter. . . . . 0.8615 to 0.8625 inch
Push Rod Length. . . . . 9.656 to 9.666 inches
Push Rod Diameter. . . . . 0.294 to 0.303 inch
Hydraulic Tappet Diameter. . . . . . 0.904 to 0.9045 inch
Tappet-to-Bore Clearance. . . . . 0.001 to 0.002 inch

VALVES

Valve Length
  (Tip-to-Gauge Dim. Line). . . . 4.7895 to 4.8045 inches
  With Rotator. . . . . 4.8095 to 4.8245 inches
Valve Stem Diameter. . . . . 0.3715 to 0.3725 inch
Stem-to-Guide Clearance. . . . . 0.001 to 0.003 inch
Intake Valve Head Diameter. . . . . 1.782 to 1.792 inches
Intake Valve Face Angle. 29°
Exhaust Valve Head Diameter. . . 1.401 to 1.411 inches
Exhaust Valve Face Angle. . . . . 44°
Maximum Allowable Removed for
  Tip Refinishing. 0.010 inch

VALVE SPRINGS

Free Length. . . . . 2.234 inches approx.
  With Rotators. . . . . 2.00 inches approx.
Spring Tension
  Valve Closed. . . . . 95 to 105 lbs at 1-13/16 inches
    (With Rotators). . . . . . . 80 to 88 lbs at 1-5/8 inches
  Valve Open. . . . . 188 to 202 lbs at 1-7/16 inches
    (With Rotators). . . . 210 to 226 lbs at 1-3/16 inches
Inside Diameter. . . . . 0.948 to 0.968 inch
    (With Rotators). . . . . 1.000 to 1.020 inches

TORQUE SPECIFICATIONS

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item.

All Torque values given in foot-pounds with dry fits unless otherwise specified.

	Service Set-To Torque	Service In-Use Recheck Torque
Accessory Drive Pulley Screws.	18	12 to 25
Air Injection Tube-to-Manifold.	15	10 to 18
Air Pump-to-Bracket.	20	15 to 22
Air Pump Brackets-to-Engine (A.C. Compressor or Pedestals). . . .	25	18 to 28
Air Pump Adjusting Strap-to-Pump. . .	20	15 to 22
Alternator Pivot Bolt or Nut.	28	20 to 35
Alternator Adjusting Bolt.	18	15 to 20
Alternator Mounting Bracket-to-Engine.	28	23 to 30
Alternator Pivot Mounting Bolt to Head.	33	30 to 35
Block Heater Nut.	20 in-lb	17 to 25 in-lb
Camshaft Sprocket Screw.	50	45 to 55
Carburetor Hold-Down Nuts.	14	12 to 15
Coil Bracket-to-Cylinder Head.	14	10 to 18
Connecting Rod Bolt Nuts.	28	26 to 30
Cylinder Head Capscrews.	105	95 to 115
Cylinder Head Cover Screws.	50 in-lb	42 to 58 in-lb
Pulley-to-Damper Crankshaft.	23	18 to 28
Clutch Housing Spacer to Block Screws.	12	9 to 15
Clutch Housing-to-Block Screws (top)	27	22 to 30
Clutch Housing-to-Block Screws (bottom).	43	37 to 47

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TORQUE SPECIFICATIONS (Continued)

	Service Set-To Torque	Service In-Use Recheck Torque
Distributor Clamp Bracket Screw. . . .	13	10 to 18
EGR Valve.	13	9 to 18
Exhaust Manifold Bolts.	23	18 to 28
Exhaust Pipe-to-Manifold.	23	18 to 28
Fan and Hub Assembly Bolts.	18	12 to 25
Drive Plate-to-Converter Screw.	22	20 to 25
Flywheel or Drive Plate-to-Crankshaft	105	95 to 120
Front Crossmember-to-Sill.	65	55 min.
Front Support Bracket-to-Block.	28	22 to 38
Front Support Cushion-to-Bracket. . . .	33	27 to 38
Front Support Cushion-to-Crossmember.	37	30 to 45
Fuel Pump Screws.	16	13 to 19
Idler Arm Bracket-to-Sill.	50	35 to 60
Idler Pulley Bracket to Front Cover Nut.	7	4 to 9
Idler Pulley Bearing Shaft-to-Bracket Nut.	33	28 to 38
Intake Manifold Screws.	23	18 to 28
Main Bearing Capscrews.	80	75 to 85
Oil Pump Cover Screws.	70 in-lb	60 to 80 in-lb
Oil Pump Attaching Screws (Short). . .	10	8 to 13

	Service Set-To Torque	Service In-Use Recheck Torque
Oil Pump Attaching Screws (Long). . .	17	12 to 20
Oil Pan Screws—1/4-inch—20.	7	5 to 9
Oil Pan Screws—5/16-inch—18.	11	9 to 13
Oil Filter Adapter.	48	42 to 55
Power Steering Pump Adapter Screw	23	18 to 28
Power Steering Pump Bracket Screw	43	37 to 47
Power Steering Pump Mounting Screw	28	25 to 35
Power Steering Pump Pressure Line Nut.	38	30 to 45
Power Steering Pump Pulley Nut.	58	40 to 65
Rear Crossmember-to-Side Sill Nut. . .	30	20 to 35
Rear Support Cushion-to-Bracket. . . .	48	40 to 55
Rear Support Bracket-to-Transmission	33	27 to 38
Rear Support Cushion-to-Crossmember.	18	12 to 25
Rocker Arm Assembly-to-Cylinder Head.	21	18 to 26
Spark Plugs.	28	22 to 33
Timing Chain Cover-to-Block Screws	5	4 to 8
Thermostat Housing Screw.	13	10 to 18
Vibration Damper Screw.	55	48 to 64
Water Pump Screws.	13	9 to 18

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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Fig. 1A-48 Six-Cylinder Engine Tools

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V-8 ENGINE

ENGINE ASSEMBLY

Description

The 304, 360 and 401 CID engine are V-8 designs incorporating overhead valves. Service procedures for all V-8 engines are essentially the same.

Bridged pivot assemblies control movement of intake and exhaust rocker arms that are paired by cylinders (fig. 1B-1 and 1B-2). The cylinders are numbered from front to rear 1-3-5-7 on the left bank and 2-4-6-8 on the right bank. The cylinder firing order is 1-8-4-3-6-5-7-2.

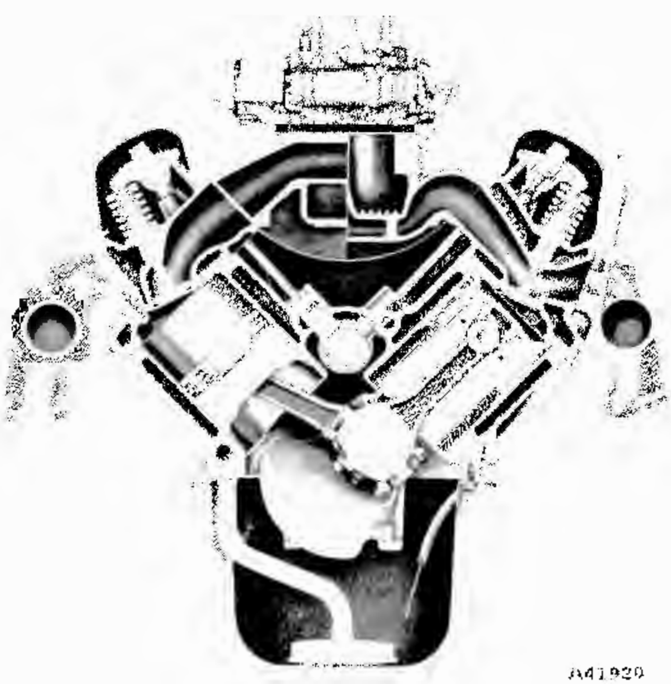

Fig. 1B-1 Sectional View of V-8 Engine Assembly

The crankshaft, supported by five two-piece main bearings, rotates in a counterclockwise direction as viewed from the rear. The camshaft is supported by five one-piece, line-bored bearings.

Identification

Build Date Code

The engine Build Date Code is located on a tag attached to the right bank cylinder head cover (fig. 1B-3).

The code numbers identify the year, month, and day that the engine was built. The code letter identifies the cubic inch displacement, carburetor type, and compression ratio.

The letters are coded as follows:

Code	CID	Carburetor	Compression Ratio
H	304	2V	8.4:1
N	360	2V	8.25:1
P	360	4V	8.25:1
Z	401	4V	8.25:1

Engine Build Date Code Explanation

1st Character (year)	2nd and 3rd Character (month)	4th Character (engine type)	5th Character (day)
6 — 1973 7 — 1974	01-12	H, N, P or Z	01-31
Example: 7	03	P	18

The example code identifies a 360 CID with 4V carburetor and 8.25:1 compression ratio built on March 18, 1974.

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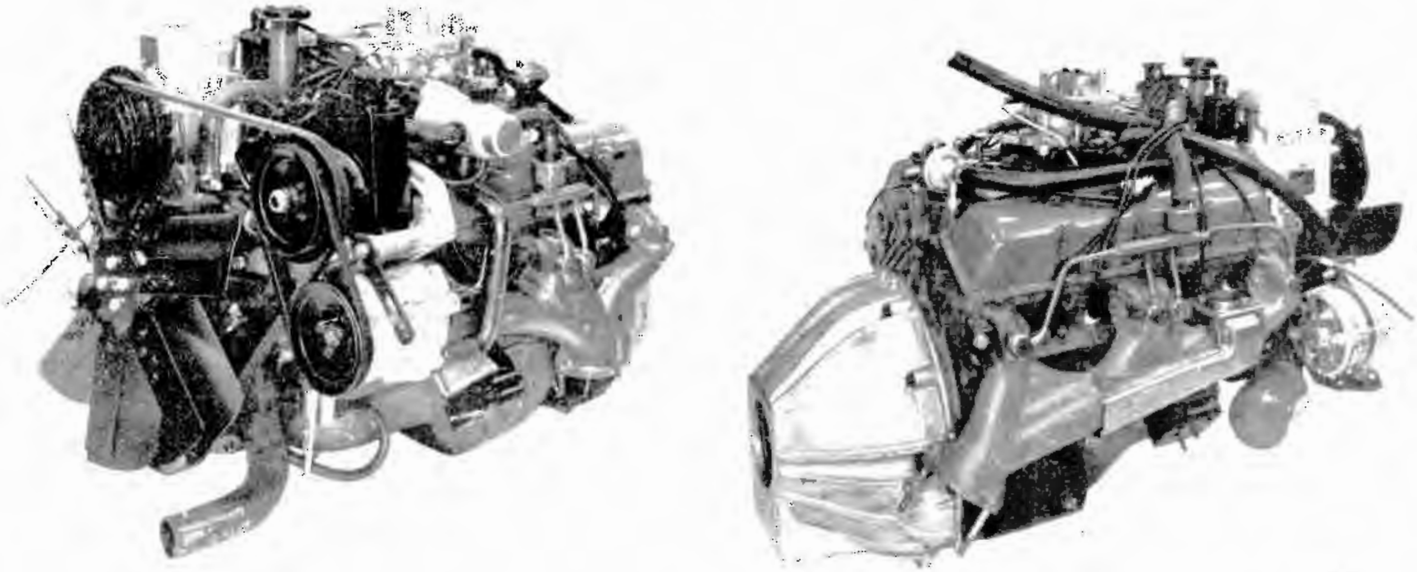

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Fig. 1B-2 Typical V-8 Engine Assembly

NOTE: *360-401 CID engines in heavy duty-trucks are painted red. These engines do not use exhaust valve rotators. Otherwise they are the same as all other 360-401 CID engines. Refer to Exhaust Valve Rotator for details.*

Odd Size Engines

On vehicles equipped with odd-sized engines, it is sometimes necessary to machine all cylinder bores to 0.010 inch oversize, all crankshaft main bearing journals, all connecting rod journals to 0.010 inch undersize, or all camshaft bearing bores 0.010 inch oversize. These engines have a single or double letter code stamped adjacent to the Build Date Code on the tag attached to the right bank cylinder head cover. The letters are coded as follows:

Single letter B . . . . cylinder bore 0.010-inch oversize

Single letter M . . . . main bearings 0.010-inch undersize

Single letter P . . . . connecting rod bearings 0.010-inch undersize

Double letters PM . . . . . main and connecting rod bearings 0.010-inch undersize

Single letter C . . . . camshaft bearing bores 0.010-inch oversize

Lubrication System

A gear-type, positive displacement oil pump is incorporated in the timing chain cover. A cavity in the cover forms the body of the pump while drive and idler gears rotate within the cavity. The drive gear shaft is driven by the distributor.

The oil filter adapter body seals the end of the oil pump cavity and also mounts the oil filter. The oil pressure relief valve assembly is located in the adapter body (fig. 1B-4).

Fig. 1B-3 Build Date Code Location V-8

Oil is drawn from the sump area of the oil pan through a tube and screen assembly to a horizontal oil gallery located at the lower right side of the engine block. A passage in the timing chain cover channels oil into the oil pump. Pressure is developed when oil is driven between the gears and pump body.

The oil is forced from the pump through a passage in the oil filter adapter body to the oil filter (fig. 1B-5).

The oil passes through the filtering elements and on to an outlet passage in the adapter body. From the adapter body passage, the oil enters an adjoining passage in the timing chain cover and then is channeled into a gallery which extends up the left front of the cylinder block. This gallery channels oil directly to the right main oil gallery which intersects with a short passage that channels oil to the left main oil gallery.

The left and right main oil galleries extend the

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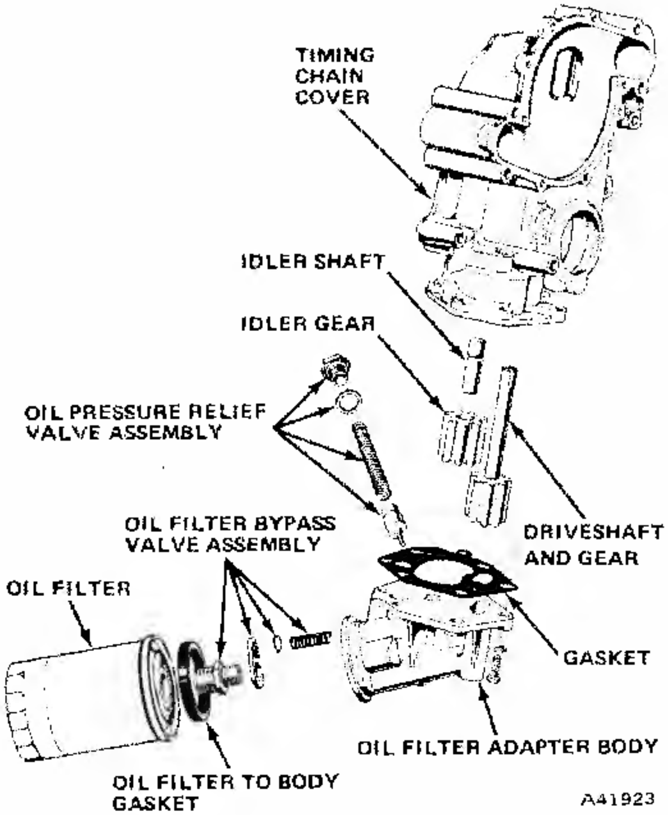

Fig. 1B-4 Oil Pump and Filter Assembly

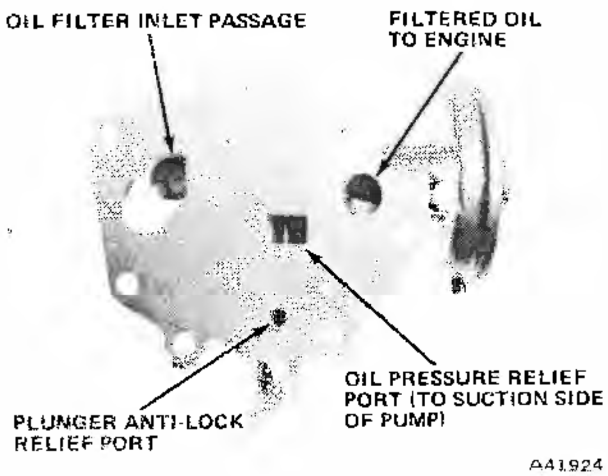

Fig. 1B-5 Oil Filter Adapter Body

length of the cylinder block. The left oil gallery channels oil to each hydraulic tappet on the left bank. The right oil gallery channels oil to each hydraulic tappet on the right bank. In addition, five passages extend down from the right oil gallery to each camshaft bearing and on to each upper main bearing insert. The crankshaft is cross-drilled which allows oil to flow from each main journal to the adjacent connecting rod journals. A squirt hole in each connecting rod bearing cap distributes oil on the cylinder walls, pistons and piston pins as the crankshaft rotates.

A small passage in the front camshaft bearing journal channels oil to the timing chain cover area where the chain and sprockets throw off oil to lubricate the

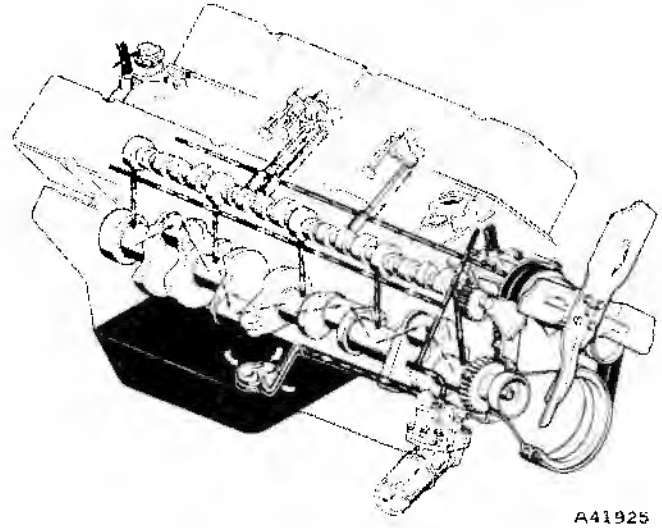

Fig. 1B-6 Lubrication System

distributor gears and fuel pump eccentric. This oil returns to the oil pan by passing under the front main bearing.

The oil supply for the rocker arm assemblies is metered through the hydraulic valve tappets and routed through hollow push rods to the rocker arms. A squirt hole in the rocker arm directs oil to the valve train. This oil returns to the oil pan through channels in the cylinder head (fig. 1B-6).

Mounting

Resilient rubber mounting cushions support the engine and transmission at three points. A cushion is located at each side on the centerline of the engine with the rear supported by a cushion between the transmission extension housing and the rear support crossmember (fig. 1B-7).

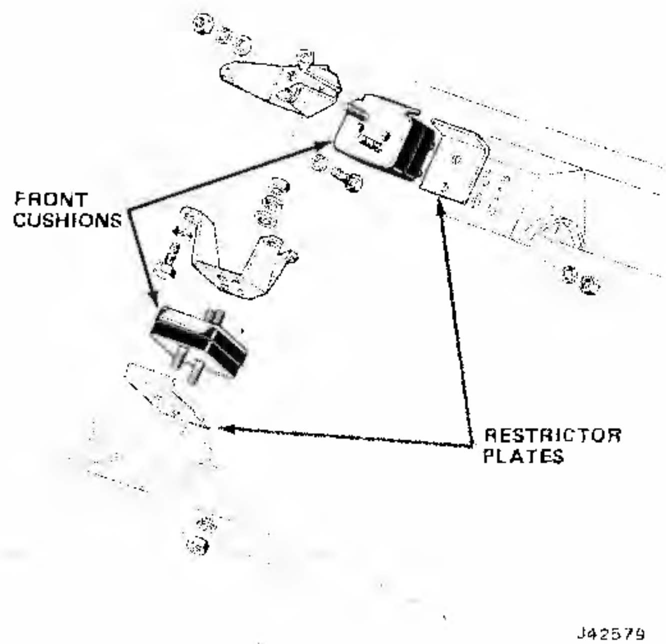

Fig. 1B-7 V-8 Engine Mounting—Typical

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Removal or replacement of any cushion may be accomplished by supporting the weight of the engine or transmission at the area of the cushion.

If necessary to remove the front engine mounts and front crossmember to perform service such as oil pan removal, an engine holding fixture may be fabricated as illustrated in figure 1B-43 at the end of this section.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
EXTERNAL OIL LEAKS	(1) Fuel pump gasket broken or improperly seated.	(1) Replace gasket.
	(2) Cylinder head cover gasket broken or improperly seated.	(2) Replace gasket; check cylinder head cover gasket flange and cylinder head gasket surface for distortion.
	(3) Oil filter gasket broken or improperly seated.	(3) Replace oil filter.
	(4) Oil pan side gasket broken or improperly seated.	(4) Replace gasket; check oil pan gasket flange for distortion.
	(5) Oil pan front oil seal broken or improperly seated.	(5) Replace seal; check timing chain cover and oil pan seal flange for distortion.
	(6) Oil pan rear oil seal broken or improperly seated.	(6) Replace seal; check oil pan rear oil seal flange; check rear main bearing cap for cracks, plugged oil return channels, or distortion in seal groove.
	(7) Timing chain cover oil seal broken or improperly seated.	(7) Replace seal.
	(8) Oil pan drain plug loose or stripped threads.	(8) Repair as necessary and tighten.
	(9) Rear oil gallery plug loose.	(9) Use appropriate sealant on gallery plug and tighten.
	(10) Rear camshaft plug loose or improperly seated.	(10) Seat camshaft plug or replace and seal, as necessary.
EXCESSIVE OIL CONSUMPTION	(1) Oil level too high.	(1) Lower oil level to specifications.
	(2) Oil too thin.	(2) Replace with specified oil.
	(3) Valve stem oil seals are damaged, missing, or incorrect type.	(3) Replace valve stem oil seals.
	(4) Valve stems or valve guides worn.	(4) Check stem-to-guide clearance and repair as necessary.
	(5) Piston rings broken, missing.	(5) Replace missing or broken rings.
	(6) Piston rings incorrect size.	(6) Check ring gap, repair as necessary.
	(7) Piston rings sticking or excessively loose in grooves.	(7) Check ring side clearance, repair as as necessary.
	(8) Compression rings installed upside down.	(8) Repair as necessary.
	(9) Cylinder walls worn, scored, or glazed.	(9) Repair as necessary.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
EXCESSIVE OIL CONSUMPTION (Continued)	(10) Piston ring gaps not staggered.	(10) Repair as necessary.
	(11) Excessive main or connecting rod bearing clearance.	(11) Check bearing clearance, repair as necessary.
NO OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Section 3, Oil Pressure Gauge and Sending Unit Test.
	(3) Oil pump malfunction.	(3) Refer to Oil Pump.
	(4) Oil pressure relief valve sticking.	(4) Remove and inspect oil pressure relief valve assembly.
	(5) Oil passages on pressure side of pump obstructed.	(5) Inspect oil passages for obstructions.
	(6) Oil pickup screen or tube obstructed.	(6) Inspect oil pickup for obstructions.
LOW OIL PRESSURE	(1) Low oil level.	(1) Add oil to correct level.
	(2) Oil excessively thin due to dilution, poor quality, or improper grade.	(2) Drain and refill crankcase with recommended oil.
	(3) Oil pressure relief spring weak or sticking.	(3) Remove and inspect oil pressure relief valve assembly.
	(4) Oil pickup tube and screen assembly has restriction or air leak.	(4) Remove and inspect oil pickup tube and screen assembly. (Fill pickup with lacquer thinner to find leaks.)
	(5) Oil pump malfunctioning.	(5) Refer to Oil Pump.
	(6) Excessive main, rod, or camshaft bearing clearance.	(6) Measure bearing clearances, repair as necessary.
HIGH OIL PRESSURE	(1) Improper grade oil.	(1) Drain and refill crankcase with correct grade oil.
	(2) Oil pressure gauge or sending unit inaccurate.	(2) Refer to Section 3, Oil Pressure Gauge and Sending Unit Test.
	(3) Oil pressure relief valve sticking closed.	(3) Remove and inspect oil pressure relief valve assembly.
MAIN BEARING NOISE	(1) Insufficient oil supply.	(1) Check for low oil level or low oil pressure.
	(2) Main bearing clearance excessive.	(2) Check main bearing clearance, repair as necessary.
	(3) Crankshaft end play excessive.	(3) Check end play, repair as necessary.
	(4) Loose flywheel or torque converter.	(4) Tighten flywheel or converter attaching bolts.
	(5) Loose or damaged vibration damper.	(5) Repair as necessary.
CONNECTING ROD BEARING	(1) Insufficient oil supply.	(1) Check for low oil level or low oil pressure.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
CONNECTING ROD BEARING (Continued)	(2) Bearing clearance excessive or bearing missing.	(2) Check clearance, repair as necessary.
	(3) Crankshaft connecting rod journal out-of-round.	(3) Check journal measurements, repair or replace as necessary.
	(4) Misaligned connecting rod.	(4) Repair as necessary.
	(5) Connecting rod bolts tightened improperly.	(5) Tighten bolts to specified torque.
PISTON NOISE	(1) Piston-to-cylinder wall clearance excessive.	(1) Check clearance, repair as necessary.
	(2) Cylinder walls excessively tapered or out-of-round.	(2) Check cylinder wall measurements, repair as necessary.
	(3) Piston ring broken.	(3) Replace ring.
	(4) Loose or seized piston pin.	(4) Check piston-to-pin clearance, repair as necessary.
	(5) Connecting rods misaligned.	(5) Check rod alignment, repair as necessary.
	(6) Piston ring side clearance excessively loose or tight.	(6) Check ring side clearance, repair as necessary.
	(7) Carbon build-up on piston is excessive.	(7) Clean carbon from piston.
VALVE TRAIN NOISE *NOTE: A clicking noise, upon starting the engine, reducing in level and disappearing after a short period of time is normal. This noise is due to a slight oil leak-down condition caused by valve spring pressure exerted on the tappets.*	(1) Insufficient oil supply.	(1) Check for: (a) Low oil level. (b) Low oil pressure. (c) Plugged rocker arm shaft. (d) Wrong hydraulic tappet. (e) Plugged oil gallery in block.
	(2) Push rods worn or bent.	(2) Replace worn or bent push rods.
	(3) Rocker arms worn.	(3) Replace worn rocker arms.
	(4) Dirt or chips in hydraulic tappets.	(4) Clean tappets.
	(5) Excessive tappet leak-down.	(5) Replace valve tappet.
	(6) Tappet face worn.	(6) Replace tappet; check corresponding cam lobe for wear.
	(7) Broken or cocked valve springs.	(7) Properly seat cocked springs; replace broken springs.
	(8) Stem-to-guide clearance excessive.	(8) Check stem-to-guide clearance, repair as necessary.
	(9) Valve bent.	(9) Replace valve.
	(10) Loosen rocker arms.	(10) Tighten capscrews to specified torque.
	(11) Valve seat runout excessive.	(11) Regrind valve seat/valve.

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ENGINE REMOVAL

The engine is removed without the transmission and bell housing.

(1) On Cherokee, Wagoneer and Truck the hood must be removed. Mark hinge locations at hood panel for alignment during installation. Remove hood from hinges.

(2) Remove air cleaner assembly.

(3) Drain cooling system and disconnect upper and lower radiator hoses.

(4) If equipped with automatic transmission, disconnect cooler lines from radiator.

NOTE: *If vehicle is equipped with a radiator shroud, it is necessary to separate the shroud from the radiator to facilitate removal and installation of the radiator and engine fan.*

(5) Remove radiator.

(6) Remove engine fan.

If equipped with power steering, remove fluid from pump reservoir and disconnect hoses.

(7) If equipped with air conditioning, turn both service valves clockwise to the front seated position. Bleed compressor refrigerant charge by slowly loosening service valve fittings.

(8) Disconnect condenser and evaporator lines from compressor.

(9) Disconnect receiver outlet at the disconnect coupling.

(10) Remove condenser and receiver assembly.

(11) Remove the battery and tray if required.

(12) On Wagoneer, Cherokee, and Truck models, remove the heater core housing and charcoal canister from firewall.

(13) Disconnect the following wires (if so equipped) at:

- starter motor
- coil positive terminal
- temperature gauge sending unit
- alternator
- oil pressure gauge sending unit
- solenoid vacuum valve
- solenoid control switch
- throttle stop solenoid

(14) Disconnect the following lines (if so equipped):

- fuel line from tank at fuel pump
- vacuum line for power brake unit at intake manifold
- vacuum line for heater damper doors at intake manifold

(15) If equipped with automatic transmission, disconnect the transmission filler tube bracket from right cylinder head. Do not remove filler tube from the transmission.

(16) Remove both engine front support cushion-to-frame retaining nuts.

(17) Support weight of engine with a lifting device.

(18) On CJ models, remove transfer case shift lever boot, floor (if so equipped) and transmission access cover.

(19) On vehicles equipped with automatic transmission, remove upper bolts securing the transmission bell housing-to-engine.

If equipped with manual transmission, remove upper bolts securing clutch housing-to-engine.

(20) Disconnect exhaust pipes at exhaust manifolds and support bracket.

(21) Remove starter motor.

(22) Support transmission with a floor jack.

(23) If equipped with automatic transmission, remove engine adapter plate inspection cover. Mark assembled position of converter and flex plate and remove the converter to flex plate cap screws.

(24) Remove remaining bolts securing transmission bell housing to engine.

If equipped with manual transmission, remove clutch housing lower cover and remaining bolts securing clutch housing to engine.

(25) Remove engine by pulling upward and forward.

CAUTION: *If equipped with power brakes, care must be taken to avoid damaging the power unit while removing the engine.*

ENGINE INSTALLATION

(1) Lower engine slowly into engine compartment and align with transmission bell housing (automatic transmission) or clutch housing (manual transmission). On manual transmissions, make certain clutch shaft is aligned properly with splines of clutch driven plate.

(2) Install the transmission bell housing-to-engine bolts (automatic transmission) or the clutch housing-to-engine bolts (manual transmission). Tighten bolts to specified torque (Automatic Trans: 28 foot-pounds; Manual Trans: 27 foot-pounds).

(3) Remove floor jack which was used to support transmission.

(4) If equipped with automatic transmission, align marks previously made on converter and flex plate, install converter-to-flex plate cap screws and tighten to torque.

(5) Install inspection cover (automatic transmission) or the clutch housing lower cover (manual transmission).

(6) Install starter motor.

(7) Lower engine onto frame supports, remove the lifting device.

(8) Install front support cushion retaining nuts. Tighten the nuts to 33 foot-pounds torque.

(9) Connect exhaust pipes at exhaust manifolds and support bracket.

(10) If equipped with automatic transmission, connect transmission filler tube bracket to right cylinder head.

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(11) On Wagoneer, Cherokee, and Truck models, install the heater core housing and charcoal canister to firewall.

(12) If removed, install battery and tray.

(13) Connect all wires, lines, linkage and hoses which were previously disconnected from engine.

(14) If removed, install air conditioning condenser and receiver assembly.

(15) Connect receiver outlet to the disconnect coupling. Connect the condenser and evaporator lines to the compressor.

(16) Purge the compressor of air as outlined in the Section 13 - Air Conditioning.

CAUTION: *Both service valves must be open before the air conditioning system is operated.*

(17) If equipped with power steering, connect hoses and fill pump reservoir to specified level.

(18) Install engine fan and tighten the retaining bolts to 18 foot-pounds torque.

(19) Install radiator and connect upper and lower hoses. If equipped with automatic transmission, connect cooler lines.

(20) Fill the cooling system to specified level.

(21) Install air cleaner assembly.

(22) Start engine. Check all connections for leaks. Stop engine.

(23) If removed, install and align hood assembly.

(24) If removed, install transmission access cover, floor mat and transfer case shift lever boot.

CYLINDER HEAD COVER AND GASKET

Removal

(1) Remove air cleaner assembly.

(2) Disconnect air delivery hose at air distribution manifold, if so equipped.

(3) Left side:

(a) Disconnect power brake vacuum hose at intake manifold.

(b) Disconnect throttle stop solenoid wire, if so equipped.

Right side:

(a) Remove Thermostatically Controlled Air Cleaner (TAC) hot air hose.

(b) Remove heater hose from choke cover clamp.

(4) Disconnect spark plug wires and remove plastic wire separator from cylinder head cover bracket.

(5) Remove retaining screws and washers, separate cylinder head cover and gasket from cylinder head.

Installation

(1) Place gasket on cylinder head cover flange (make certain gasket tabs are positioned in cut out openings of the cover).

(2) Position cylinder head cover and gasket on engine.

(3) Install retaining screws and washers. Tighten screws to 50 inch-pounds torque.

(4) Connect spark plug wires and install plastic wire separator to cylinder head cover bracket.

(5) Right side:

(a) Install heater hose to choke cover clamp.

(b) Install TAC hot air hose.

Left side:

(a) Connect power brake vacuum hose at intake manifold.

(b) Connect throttle stop solenoid wire, if so equipped.

(6) Connect air delivery hose to air distribution manifold.

(7) Install air cleaner assembly.

ROCKER ARM ASSEMBLY

The intake and exhaust rocker arms of each cylinder, pivot on a bridged pivot assembly which is secured to the cylinder head by two capscrews as shown in figure 1B-8.

The push rods are hollow and serve as oil galleries to lubricate the rocker arm assemblies. The push rods also serve as guides to maintain correct rocker arm-to-valve stem relationship; therefore, a pattern on the push rods where they contact the cylinder head is normal.

Fig. 1B-8 Rocker Arm Assembly—V-8 Engine

Removal

(1) Remove cylinder head cover and gasket.

(2) Remove capscrews from bridged pivot assemblies.

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(3) Remove bridged pivot assembly.
(4) Remove rocker arms.
(5) Remove push rod.

NOTE: *Keep all parts in the same order as they are removed from the engine.*

Cleaning and Inspection

Clean all parts with a good cleaning solvent and use compressed air to clean out the oil passages in the rocker arms and push rods.

Inspect the pivot surface of each rocker and pivot assembly, replace any parts which are scuffed, pitted or excessively worn. Inspect the valve stem contact surface of each rocker arm and replace any rocker arm which is deeply pitted. Inspect each push rod end for scuffing or excessive wear, replace as required.

NOTE: *If any push rod is excessively worn due to lack of oil, the push rod as well as the matching hydraulic valve tappet and rocker arm must be replaced.*

Installation

(1) Install push rods. **Make certain the bottom end of each rod is centered in the plunger cap of hydraulic valve tappet.**
(2) Install the rocker arms.
(3) Install bridged pivot assemblies.
(4) Install capscrews and tighten to 19 foot-pounds torque.
(5) Install cylinder head cover and gasket.
(6) Install retaining screws and washers. Tighten screws to specified torque.

VALVE SPRING—VALVE STEM OIL SEAL

Nylon valve stem oil seals are installed on each valve stem to prevent the oil used for rocker arm lubrication from entering the combustion chamber through the valve guides. Replace oil seals whenever valve service is performed or if the seals become deteriorated.

Each valve spring is held in place on the valve stem by a retainer and a set of valve locks. On the exhaust valves of the 360 and 401 CID (except red engines used in heavy duty trucks) engines a valve rotator is used. Remove valve locks by compressing the valve spring.

NOTE: *Exhaust valve springs used with rotators are shorter than standard valve springs. Refer to Specifications.*

Valve springs and oil seals can be removed without removing the cylinder head. Refer to Cylinder Head Reconditioning for removal procedure with the cylinder head removed.

Exhaust Valve Rotator

Exhaust valve rotators perform two functions; they hold the valve spring in place and they positively induce rotation of the exhaust valve which increases durability of the valve seat and face.

The outer housing of the rotator rides on the exhaust valve spring and remains stationary. The inner retainer with valve locks retains the exhaust valve and outer housing. In addition, the inner retainer rotates slightly when the exhaust valve is off its seat. This rotation is caused by the spring being crushed between the inner retainer and the washer when pressure is applied during exhaust valve opening (fig. 1B-9).

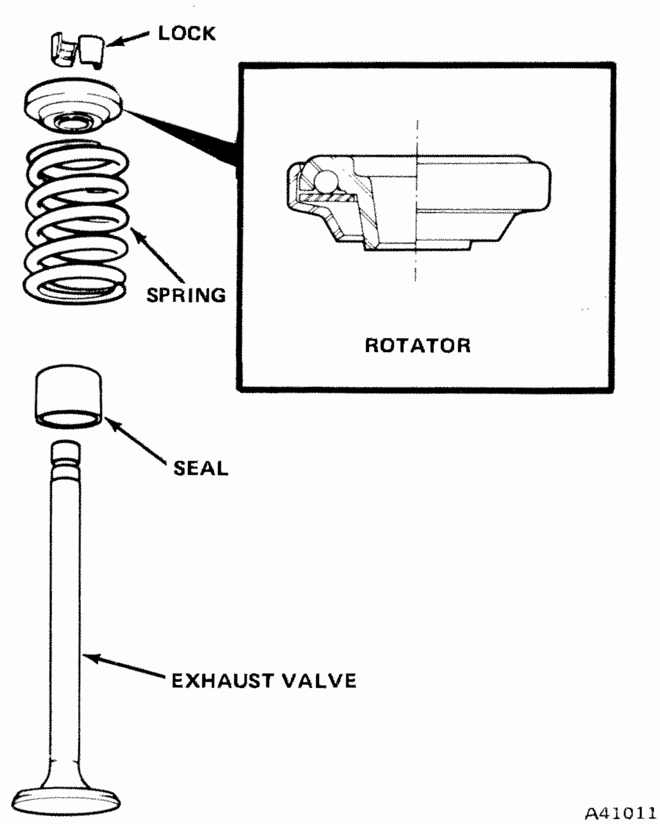

Fig. 1B-9 Exhaust Valve Rotator

NOTE: *The red 360-401 engines in heavy duty trucks do not use exhaust valve rotators. The exhaust valve spring and retainer is the same as the intake valve spring and retainer.*

Removal

(1) Remove cylinder head cover and gasket.
(2) Remove rocker arm assemblies and push rods.

NOTE: *Keep rocker arm assemblies and push rods in the same order as removed.*

(3) Remove spark plug from cylinder which requires valve spring or oil seal removal.
(4) Install a 14 mm thread size air adapter in spark plug hole.

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NOTE: *Fabricate an adapter from the body of a spark plug from which the porcelain has been removed and fasten an air hose connection to the body of the plug.*

(5) Connect air hose to adapter and maintain at least 90 psi in the cylinder to hold valves against their seats.

(6) Use Valve Spring Remover and Installer Tools J-21931-2, J-22534-1 and J-22534-2 to compress the valve spring and allow removal of the valve locks (fig. 1B-10).

(7) Remove valve spring and retainer or rotator from cylinder head.

(8) Remove oil seal if replacement is required.

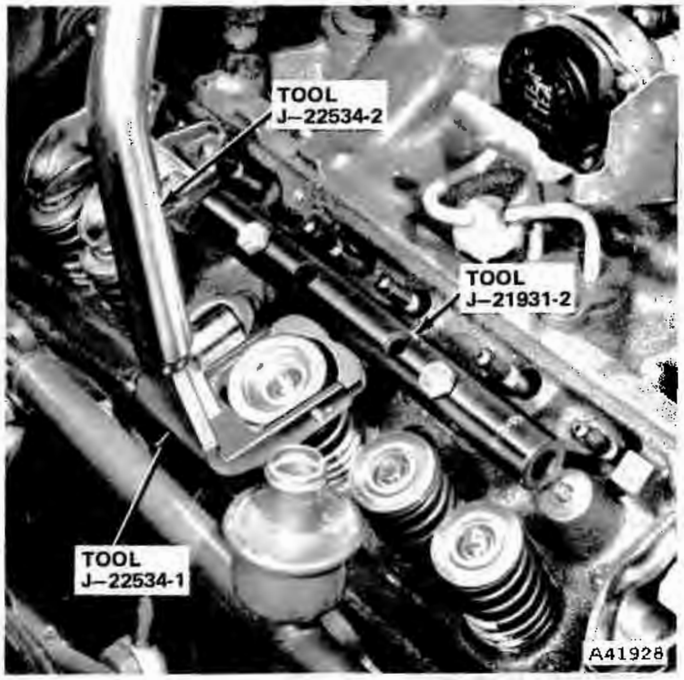

Fig. 1B-10 Valve Spring Removal

Valve Spring Tension Test

Use Valve Spring Tester J-8056 to test each removed valve spring from the specified tension values, if required (fig. 1B-11). Replace all valve springs which are not within specifications.

Installation

(1) If removed, install oil seal on valve stem.

IMPORTANT: *A close-coiled valve spring is used on all valves except the exhaust valves with rotators on the 360 and 401 CID engines which are equipped with evenly spaced spring coils. The close-coiled end, identified by paint stripes, must face the cylinder head when installing the springs.*

(2) Install valve spring and retainer or rotator.

(3) Compress valve spring with Valve Spring Remover and Installer Tools J-21931-2, J-22534-1 and J-22534-2.

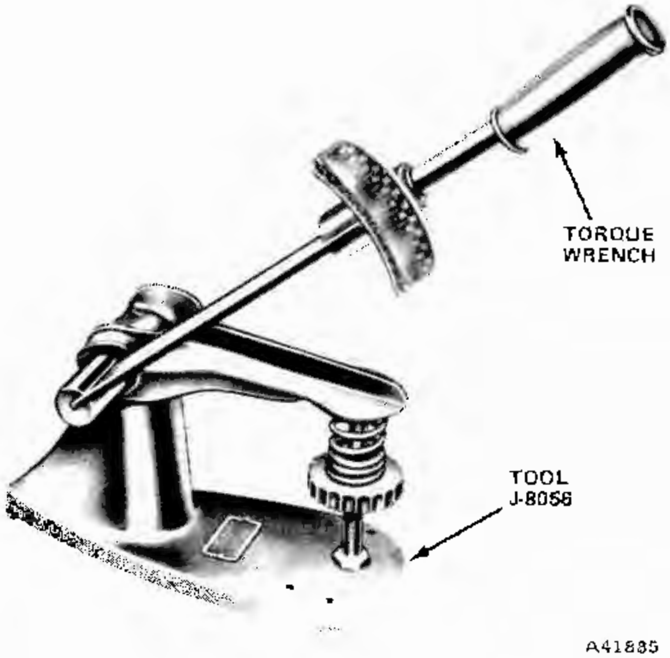

Fig. 1B-11 Valve Spring Tester

(4) Release spring tension and remove tool.

(5) Tap valve spring from side to side with a light hammer to be certain spring is seated properly at cylinder head.

(6) Disconnect air hose and remove air adapter from spark plug hole.

(7) Install spark plug.

(8) Install push rods making certain bottom end of each rod is centered in plunger cap of hydraulic valve tappet.

(9) Install rocker arm assembly. Tighten capscrews to 19 foot-pounds torque.

(10) Install cylinder head cover and gasket.

(11) Install retaining screws and washers. Tighten screws to specified torque.

INTAKE MANIFOLD

The cast iron intake manifold is designed to enclose and seal the tappet area between the two cylinder heads. A one-piece metal gasket, used to seal the intake manifold to the cylinder heads and block, also serves as an oil splash baffle.

The intake manifold contains coolant passages, a crankcase ventilator passage, an exhaust crossover passage, and induction system passages to uniformly distribute the fuel and air mixture to the combustion chamber of each cylinder. Exhaust passages are also incorporated within the intake manifold for the Exhaust Gas Recirculation (EGR) system.

The left bore(s) of the carburetor supply fuel-air mixture through passages in the intake manifold to numbers 1, 7, 4 and 6 cylinder intake ports. The right bore supplies 3, 5, 2 and 8.

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Removal

(1) Drain coolant from radiator.
(2) Remove air cleaner assembly.
(3) Disconnect spark plug wires.
(4) Remove spark plug wire plastic separators from the cylinder head cover brackets.
(5) Disconnect radiator upper hose and bypass hose from intake manifold.
(6) Disconnect ignition coil bracket and lay the coil and bracket assembly aside.
(7) Remove TCS solenoid vacuum valve and solenoid control switch, if so equipped, from right side cylinder head cover.
(8) Disconnect all hoses, lines, linkages and wires from the carburetor and intake manifold.
(9) Disconnect air delivery hoses at the air injection manifold.
(10) Disconnect diverter valve from air pump output hoses and lay valve and delivery hoses aside.
(11) Remove carburetor.
(12) Remove intake manifold, metal gasket and end seals.
(13) Clean mating surfaces of engine block, cylinder heads and intake manifold.

Installation

(1) Apply Perfect Seal compound, or equivalent, to both sides of new manifold gasket.
(2) Position gasket by aligning two rear locators at the rear of the cylinder head, then while holding the rear in place, align the two front locators.
(3) Install the two end seals and apply Permatex No. 2, or equivalent, to seal ends.
(4) Install intake manifold and retaining bolts, Tighten bolts to 43 foot-pounds torque.
(5) Install carburetor. Tighten nuts to 14 foot-pounds torque.
(6) Install diverter valve and connect air pump output hose.
(7) Connect air delivery hoses to air injection manifolds.
(8) Connect all previously disconnected hoses, lines, linkages, and wires to intake manifold and carburetor.
(9) Install TCS solenoid vacuum valve and solenoid control switch, if so equipped, to right side cylinder head cover.
(10) Install ignition coil and bracket assembly.
(11) Connect radiator upper hose and bypass hose.
(12) Install spark plug wire plastic separators to cylinder head cover brackets.
(13) Connect spark plug wires.
(14) Install air cleaner assembly.

EXHAUST MANIFOLD

The swept flow design of the cast iron exhaust manifold provides efficient removal of exhaust gases and minimizes cylinder back pressure. The mating surface of the exhaust manifold and the cylinder head are machined smooth to eliminate the need for a gasket.

Vehicles equipped with Air Guard Systems have air injection manifolds attached at number 1, 3, and 5 exhaust ports of the left exhaust manifold and number 2, 4, 6 and 8 of the right exhaust manifold.

Removal

(1) Disconnect spark plug wires.
(2) Disconnect air delivery hose at the injection manifold.
(3) Remove air injection manifold and injection tubes.
(4) Disconnect exhaust pipe at exhaust manifold.
(5) Remove exhaust manifold retaining nuts.
(6) Separate exhaust manifold from cylinder head.

Installation

(1) Clean mating surfaces of exhaust manifold and cylinder head. **Do not nick or scratch.**
(2) Install exhaust manifold and retaining bolts. Tighten bolts to 25 foot-pounds torque.
(3) Connect exhaust pipe using a new asbestos seal if required. Tighten nuts to 23 foot-pounds torque.
(4) Place new gaskets on each air injection tube and install air injection manifold and injection tubes.
(5) Connect the air delivery hose to air injection manifold.
(6) Connect spark plug wires.

CYLINDER HEAD AND GASKET

Removal

(1) Drain cooling system.
(2) Remove cylinder head cover and gasket.
(3) Remove rocker arm assemblies and push rods.

NOTE: *Keep rocker arm assemblies and push rods in the same order as removed.*

(4) Remove spark plugs.
(5) Remove intake manifold.
(6) Remove exhaust manifold.
(7) Loosen all drive belts.
(8) Right Side:

(a) If equipped with air conditioning, remove compressor mount bracket and battery negative cable from cylinder head.

(b) Disconnect alternator support brace from cylinder head.

Left side: Disconnect air pump and/or power steering pump bracket from cylinder head (if so equipped).

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(9) Remove cylinder head retaining bolts.
(10) Remove cylinder head and gasket.

Cleaning and Inspection

Thoroughly clean the gasket surface of the cylinder head and block to remove all dirt and gasket cement. Remove the carbon deposits from the combustion chambers and the top of each piston.

Use a straight edge and feeler gauge to check the flatness of the cylinder head and block mating surfaces.

Refer to Specifications for surface flatness tolerances.

If the cylinder head is to be replaced and the original valves reused, remove the valves and measure the stem diameter. Replace oversize valves. **Only standard size valves may be used with a service replacement head.**

If the original valves are standard size, remove all carbon buildup and reface the valves as outlined under Valve Refacing. Install the valves in the cylinder head using new valve stem oil seals. Transfer all attached components from the original head which are not included with the replacement head.

Installation

NOTE: *The 304 CID engine utilizes an aluminum coated embossed steel gasket and the 360 and 401 CID engines utilize an aluminum coated laminated steel and asbestos gasket. Retorqueing is not necessary with either gasket.*

(1) Apply an even coat of Perfect Seal sealing compound or equivalent to both sides of new head gasket.

NOTE: *Do not apply sealing compound on head and block surfaces or allow sealer to enter cylinder bores.*

(2) Position gasket on block with stamped word TOP facing upward.
(3) Install cylinder head and retaining bolts.

NOTE: *Wire brush the threads of bolts prior to installation as dirt will affect the torque readings.*

(4) Cylinder head capscrews must be tightened evenly to 80 foot-pounds torque following the sequence outlined in figure 1B-12. Then follow the sequence again and tighten screws to 110 foot-pounds torque.

(5) Left side: connect air pump mount bracket to cylinder head and/or power steering pump, if so equipped.

(6) Right side:

(a) Connect alternator support bracket to cylinder head.

(b) Install air conditioning compressor mounting bracket and battery negative cable to cylinder head, if so equipped.

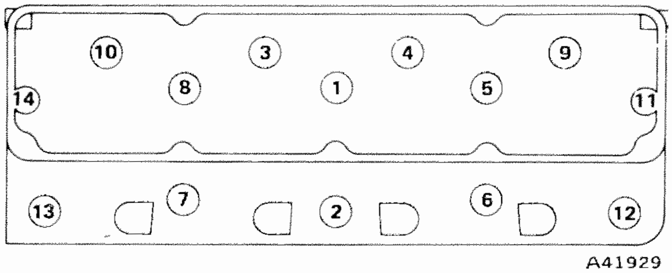

Fig. 1B-12 Cylinder Head Torque Sequence—V-8

(7) Adjust all drive belts to specified tension.

(8) Install the exhaust manifold and tighten retaining bolts to 25 foot-pounds torque.

(9) Install intake manifold. Tighten manifold retaining bolts to 43 foot-pounds torque.

(10) Install all lines, hoses, linkages, and wires previously disconnected.

(11) Install rocker arm assemblies and push rods in the same order as removed. Tighten capscrews to 19 foot-pounds torque.

(12) Install cylinder head cover and gasket and tighten retaining screws to specified torque.

(13) Install spark plugs and connect the spark plug wires.

(14) Fill the cooling system to specified level.

CYLINDER HEAD RECONDITIONING

The following procedures apply after the cylinder head has been removed from the engine.

Diassembly

(1) Compress each valve spring with C-clamp type spring compressor tool and remove the valve locks, and retainers or rotators.

(2) Release compressor and remove valve spring.

(3) Remove valve stem oil seals.

(4) Remove valves one at a time and place them in a rack in the same order as in cylinder head.

Cleaning and Inspection

Clean all carbon buildup from the combustion chambers, valve ports, valve stems, and heads.

Remove all dirt and gasket cement from the cylinder head gasket mating surface.

Inspect for cracks in the combustion chambers and valve ports and in the gasket surface at each coolant passage.

Inspect for burned or cracked valve heads and damaged valve stems.

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Reconditioning

Use a valve refacing machine to reface intake and exhaust valves to specified angle. Replace any valve which is bent or warped. After refacing, at least 1/32-inch margin must remain or the valve must be replaced. Examples of correct and incorrect valve refacing are shown in figure 1B-13.

Resurface and rechamber the valve stem tip when worn. **Never remove more than 0.010 inch.**

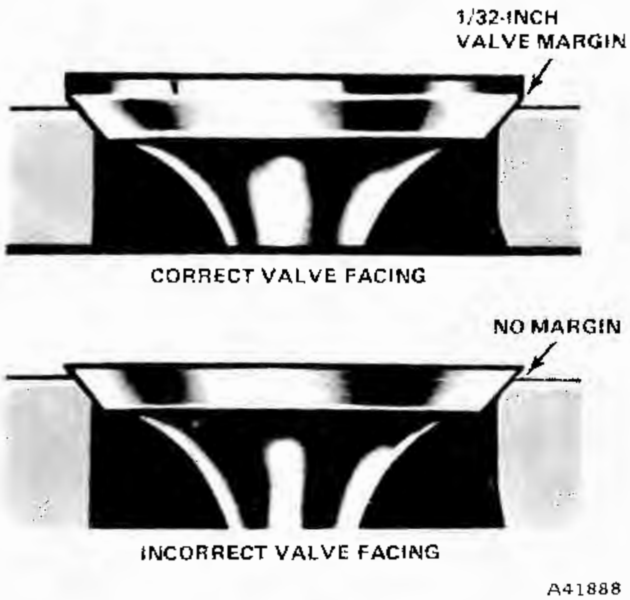

Fig. 1B-13 Valve Refacing

Valve Seat Refacing

Install a pilot of the correct size in the valve guide and reface the valve seat to the specified angle with a good dressed stone. Remove only enough metal to provide a smooth finish. Use tapered stones to obtain the specified seat widths when required. Maximum seat runout is 0.0025 inch (fig. 1B-14).

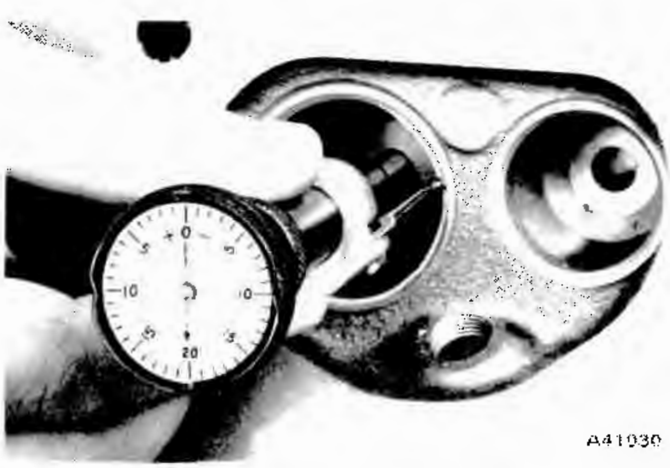

Fig 1B-14 Valve Seat Runout

Valve Guides

The valve guides are an integral part of the cylinder head and are not replaceable. When the stem-to-guide clearance is excessive, ream the valve guides to the next larger size so that proper clearance can be obtained. Oversize service valves are available in 0.003 inch, 0.005 inch and 0.030 inch.

The following oversize valve guide reamers may be used.

J-6042-1	0.003 inch
J-6042-5	0.015 inch
J-6042-4	0.030 inch

NOTE: *Ream guides in steps. Start with the 0.003 inch oversize reamer and progress to the size required.*

Valve Stem-to-Guide Clearance

Check valve stem-to guide clearance by two methods:

NOTE: *Make certain the valve stem and guide bore are thoroughly cleaned before measuring.*

(1) (a) Measure valve stem diameter with a caliper micrometer midway between valve head and tip.

(b) Select a pilot from a valve refacing kit which fits snugly in valve guide bore.

(c) Determine valve stem-to-guide clearance by subtracting diameter of valve stem from size of the pilot selected.

(2) (a) Mount a dial indicator adjacent to valve guide to be checked.

(b) Position valve slightly off its seat, with valve stem push laterally away from dial indicator.

(c) Set dial indicator push rod on stem of valve near tip and set gauge to zero (fig. 1B-15).

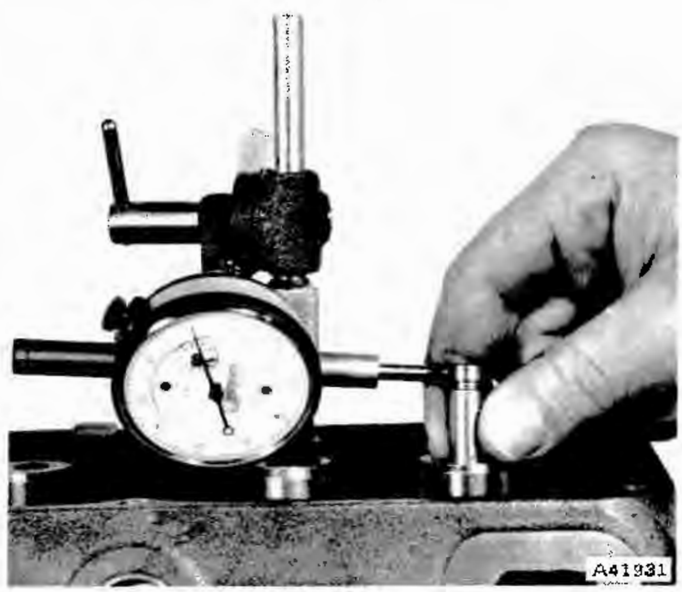

Fig. 1B-15 Valve Stem-to-Guide Clearance Measurement

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(d) Rear dial indicator while moving valve stem laterally toward dial indicator. Stem-to-guide clearance is indicated on gauge.

Assembly

(1) Thoroughly clean valve stems and valve guide bores.

(2) Install each valve in the same valve guide from which it was removed.

(3) Install new valve stem oil seal on each valve stem.

(4) Position each valve spring and retainer or rotator on cylinder head and compress the valve spring with compressor tool.

(5) Install valve locks and release tool.

(6) Tap each valve spring from side-to-side with a light hammer to seat the spring properly at cylinder head.

HYDRAULIC VALVE TAPPETS

The hydraulic valve tappet consists of a body, plunger, plunger return spring, check valve assembly, metering disc, plunger cap, and lockring (fig. 1B-16).

The tappet operates in a guide bore which has an oil passage drill into the adjoining oil gallery.

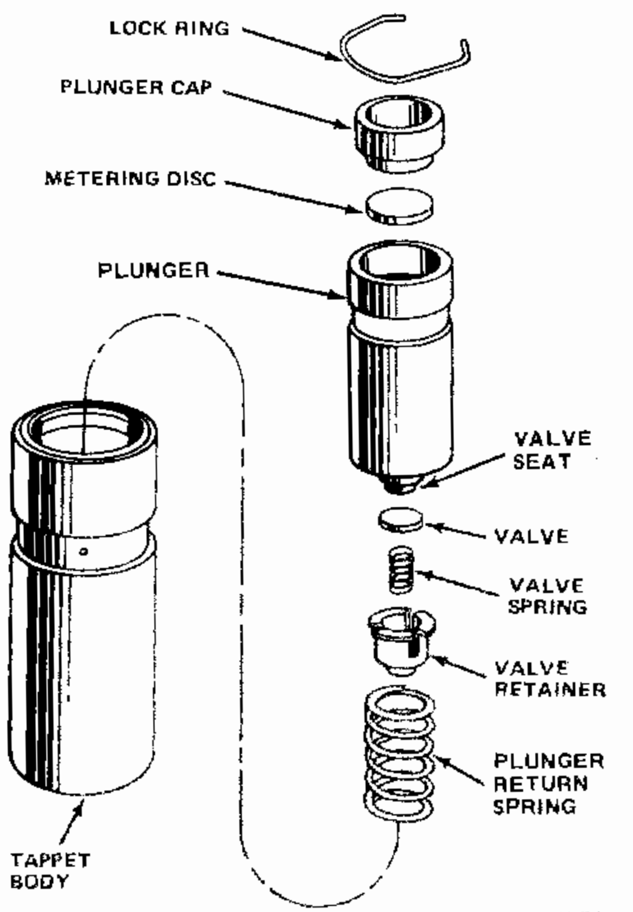

Fig. 1B-16 Typical Hydraulic Tappet Assembly

When the tappet is on the heel of the cam lobe, the plunger return spring indexes with an oil hole undercut in the plunger and allows the oil supply to be admitted through the tappet body. Oil under pressure flows into the body through the check valve assembly maintaining the tappet fully charged (fig. 1B-17). This cycle of operation occurs when the tappet leaks off some oil during the normal valve opening events. Contact with the cam lobe causes tappet body movement, closing the check valve and transmitting zero-lash movement of the push rod to open the intake or exhaust valve.

In addition, oil under pressure in the plunger also flows through the metering disc, plunger cap, and hollow push rod to the rocker arm assembly.

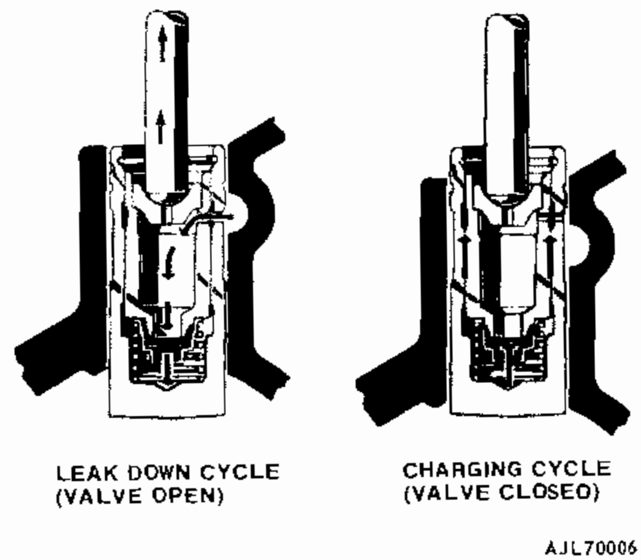

Fig. 1B-17 Hydraulic Tappet Operation Cycles

Removal

(1) Remove cylinder head cover and gasket.

(2) Remove rocker arms and bridged pivot assemblies.

(3) Remove push rods.

NOTE: *Keep rocker arm assemblies and push rods in the same order as removed.*

(4) Remove intake manifold, metal gaskets and end seals.

(5) Remove tappet from guide bore in engine block.

Disassembly

(1) Release the lock ring.

(2) Remove the plunger cap, plunger assembly, and plunger return spring from tappet body.

NOTE: *Keep the tappets and all components in the same order as removed.*

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Cleaning and Inspection

Clean all components of the hydraulic tappet assembly in a good cleaning solvent to remove all varnish or gum deposits.

A visual inspection of each tappet assembly is required.

The inspection should include checking for signs of scuffing on the barrel and face of the tappet. Inspect tappet face for wear using a straight edge across the tappet face. If the tappet face is concave, the corresponding lobe on the camshaft is worn and the replacement of the camshaft and tappets is necessary.

If any components of a tappet assembly are noticeably worn or damaged, replace the entire assembly.

Hydraulic Tappet Leak-Down Test and Assembly

After cleaning and inspection, the tappet must be leak-down tested to ensure its zero-lash operating ability. Figure 1B-18 shows Tool J-5790 used to accurately test tappet leak-down.

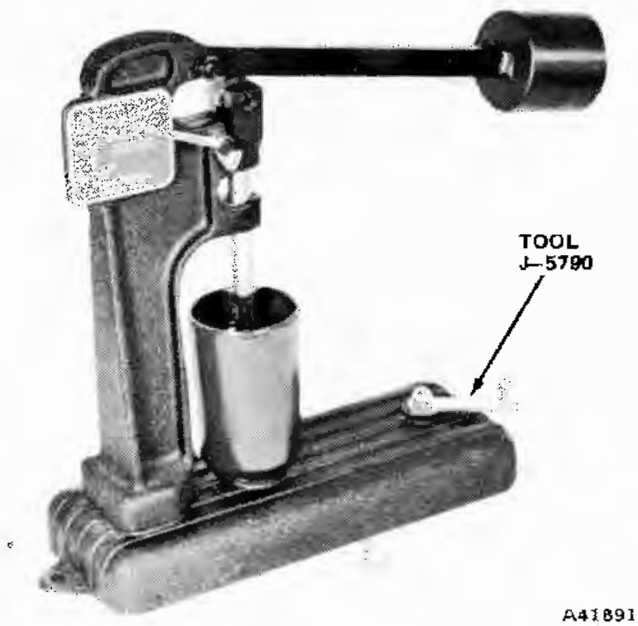

Fig. 1B-18 Hydraulic Tappet Leak-Down Tester—J-5790

(1) Fill tappet body with Valve Tappet Test Oil J-5268.

(2) Install plunger return spring, plunger assembly, and plunger cap in tappet body. Do not install lockring for test.

(3) Place a 0.312 to 0.313-inch diameter ball bearing on plunger cap.

(4) Place tappet in tester.

(5) Lift weighted arm, place tester push rod on ball bearing in plunger cap, adjust push rod to set tester gauge to START.

(6) Release weighted arm and time tappet leak down.

(7) A good tappet will take 20 to 110 seconds to leak-down with a load travel of 0.125 inch as indicated on tester gauge.

(8) Install lockrings on those tappets which passed test. Discard those that failed and replace with new tappet assemblies.

NOTE: *Do not charge the tappet assemblies with engine oil as they will charge themselves within three to eight minutes of engine operation.*

Installation

(1) Dip each tappet assembly in Jeep Engine Oil Supplement (EOS) or equivalent, and install tappet in same bore from which it was removed.

(2) Install the push rods in the same order as removed.

(3) Install the rocker arm and bridged pivot assemblies. Tighten screws to 19 foot-pounds torque.

(4) Pour remaining EOS over entire valve train mechanism.

NOTE: *Do not drain the EOS from the engine for at least 1,000 miles or until the next scheduled oil change.*

(5) Install cylinder head cover and gasket. Tighten retaining screws to specified torque.

(6) Install the intake manifold and new gasket and end seals. Tighten manifold retaining bolts to 43 foot-pounds torque.

(7) Install all lines, hoses, linkages, and wires previously disconnected from intake manifold.

VIBRATION DAMPER

The vibration damper is balanced independently and then rebalanced as part of the complete crankshaft assembly.

Do not attempt to duplicate original damper balance holes when installing a service replacement. The vibration damper is not repairable and is serviced only as a complete assembly.

Removal

(1) Loosen alternator drive belt.

(2) Loosen air conditioning drive belt and move aside, if so equipped.

(3) Loosen power steering drive belt and move aside, if so equipped.

(4) Remove drive pulley retaining bolts and drive pulley from damper.

(5) Remove damper retaining bolt.

(6) Use Vibration Damper Removal Tool J-21791 to remove damper from crankshaft as shown in figure 1B-19.

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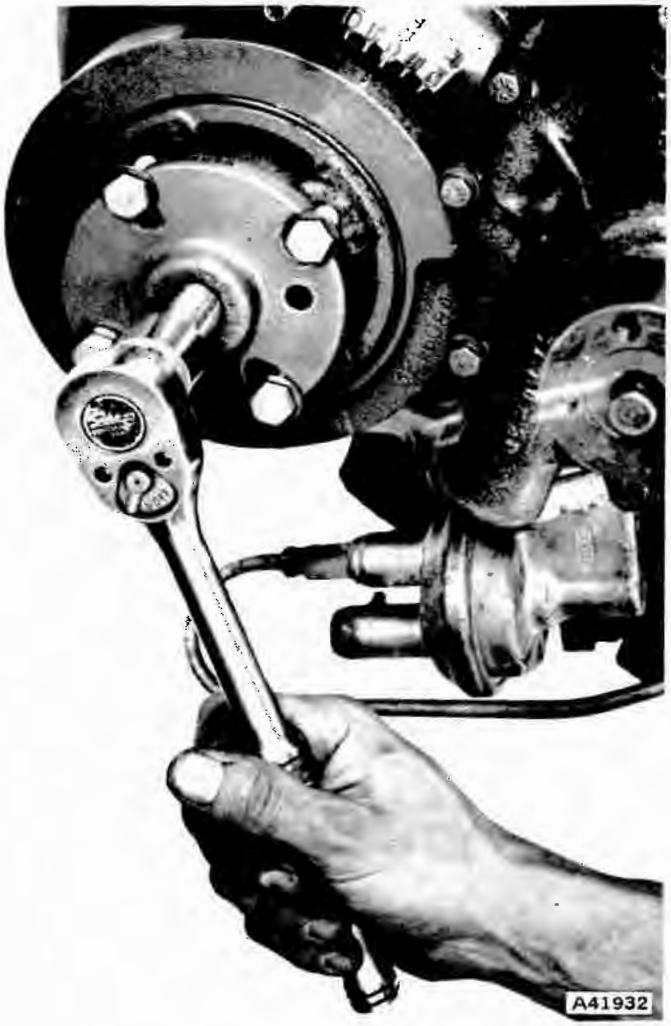

Fig. 1B-19 Vibration Damper Removal

Installation

(1) Apply a light film of engine oil to seal contacting surface of vibration damper.

(2) Align key slot of vibration damper with crankshaft.

(3) Tap damper onto crankshaft with hammer.

(4) Install damper retaining bolt and tighten to 55 foot-pounds torque.

(5) Install drive pulley and retaining bolts. Tighten bolts to 23 foot-pounds torque.

(6) Install drive belts and tighten to specified torque.

TIMING CHAIN COVER

The timing chain cover is die-cast aluminum with a crankshaft oil seal to prevent oil leakage at the vibration damper hub (fig. 1B-20). The oil seal is installed from the back side of the timing chain cover; therefore, it is necessary to remove the cover whenever oil seal replacement is required.

The engine oil pump, oil passages and coolant passages are incorporated within the timing chain cover casting. The timing chain cover casting is also used to mount the fuel pump, distributor and water pump.

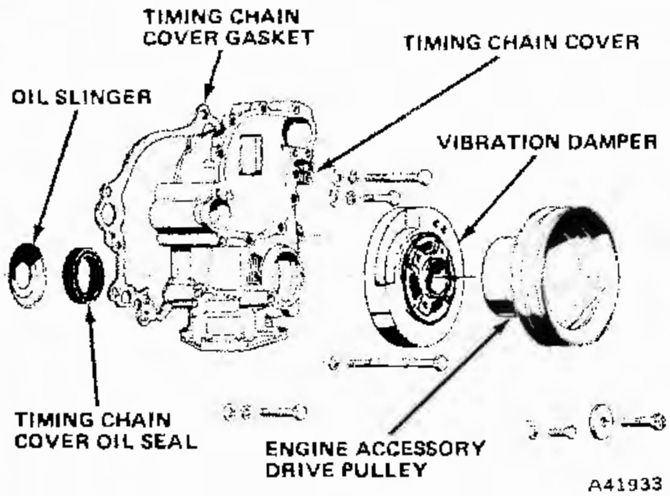

Fig. 1B-20 Timing Chain Cover Assembly—Exploded View

Removal

(1) Drain cooling system.

(2) Disconnect radiator hoses and bypass hose.

(3) Remove all drive belts.

(4) Remove fan and hub assembly.

(5) If equipped with air conditioning, remove compressor and bracket assembly from engine and move aside. **Do not disconnect the air conditioning hoses.**

(6) Remove air conditioning back idler pulley assembly, if so equipped.

(7) Remove alternator and front portion of alternator mount bracket as an assembly from the engine.

(8) Disconnect heater hose at water pump.

(9) Remove power steering pump and/or air pump and mount bracket as an assembly. Do not disconnect power steering hoses.

(10) Remove distributor cap and note the rotor position.

(11) Remove distributor.

(12) Remove fuel pump.

(13) Remove drive pulley and retaining bolts.

(14) Remove vibration damper.

(15) Remove the two front oil pan bolts.

(16) Remove bolts which secure timing chain cover to engine block.

NOTE: *The cover retaining bolts vary in length and must be installed in the same location as removed.*

(17) Remove cover by pulling forward until free of the locating dowel pins.

(18) Clean gasket surface of cover.

(19) Remove oil seal.

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NOTE: *The oil seal should always be replaced whenever the timing chain cover is removed, refer to Oil Seal Replacement later in this section for procedure.*

Installation

(1) Remove lower locating dowel pin from engine block.

NOTE: *The dowel pin is required for correct cover alignment and must be either reused or a replacement dowel installed after the cover is in position.*

(2) Use a sharp knife or razor blade to cut both sides of oil pan gasket flush with engine block.

(3) Using the old gasket as a guide, trim a new gasket to correspond to the amount cut off at the oil pan (fig. 1B-21).

(4) Apply cement to both sides of new gasket and install gasket on the timing chain cover.

(5) Install new front oil pan seal.

(6) Align tongues of new oil pan gasket pieces with oil pan seal and cement into place on cover (fig. 1B-21).

(7) Apply a stripe of Permatex No. 2, or equivalent, to cut-off edges of original oil pan gaskets.

(8) Place timing chain cover into position and install the two front oil pan bolts.

(9) Tighten bolts slowly and evenly until cover aligns with upper locating dowel.

(10) Install lower dowel through cover and drive into corresponding hole in engine block.

(11) Install cover retaining bolts in the same location as removed. Tighten to 25 foot-pounds torque.

(12) Install vibration damper. Tighten retaining bolt to 55 foot-pounds torque.

(13) Install drive pulley and retaining bolts.

(14) Install fuel pump.

(15) Install distributor with the rotor in the same position as it was prior to removal.

(16) Install the distributor cap. Connect the heater hose.

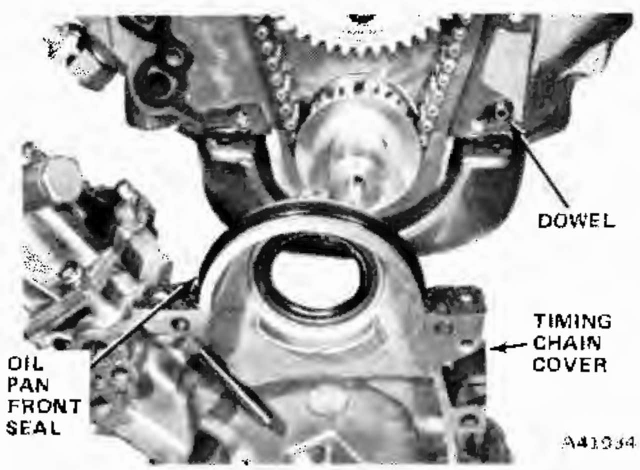

Fig. 1B-21 Oil Pan Front Seal Installation

(17) Install the power steering pump and/or air pump and bracket (if equipped).

(18) Install alternator and front portion of alternator bracket.

(19) Install air conditioning back idler pulley assembly (if equipped).

(20) If removed, install air conditioning compressor and bracket assembly.

(21) Install fan and hub assembly.

(22) Install all drive belts and tighten to the specified tension.

(23) Connect radiator hoses and bypass hose.

(24) Fill cooling system to specified level.

(25) Start engine and check for oil or coolant leaks.

(26) Adjust initial ignition timing to specified setting.

Fig. 1B-22 Timing Chain Cover Oil Seal Replacement

Oil Seal Replacement

Timing chain cover must be removed to replace seal.

(1) Pry out original seal from inside timing chain cover and clean seal bore.

(2) Apply a light coat of perfect Seal compound, or equivalent, to outer surface of a new seal.

(3) Drive the seal into place from inside the cover with Seal Installer Tool J-22533 until it contacts the outer flange of the cover (fig. 1B-22).

(4) Apply a light film of engine oil to the lips of neoprene seal.

TIMING CHAIN

To ensure correct valve timing, install the timing chain with the timing marks of the crankshaft and

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camshaft sprockets properly aligned. A worn timing chain will adversely affect valve timing. If the timing chain deflects more than 1/2 inch, it should be replaced.

Checking Valve Timing

(1) Remove spark plugs.

(2) Remove cylinder head covers and gaskets.

(3) Remove rocker arms and bridged pivot assemblies from No. 1 cylinder.

(4) Rotate crankshaft until No. 6 piston is at Top Dead Center (TDC) on compression stroke (this places No. 1 Piston at TDC on the exhaust stroke in valve overlap position).

(5) Rotate crankshaft counterclockwise 90° as viewed from front.

(6) Install a dial indicator on No. 1 intake valve rocker arm push rod end.

(7) Set dial indicator to zero.

(8) Crank the engine slowly in direction of rotation (clockwise) until dial indicator indicates 0.020 inch for 304 and 360 CID engines, and 0.025 inch for 401 CID engines.

(9) At this point, milled timing mark on vibration damper should be in line with TDC or zero marking on timing chain cover.

If more than 1/2 inch variation in either direction exists, remove timing chain cover and inspect timing chain installation.

Removal

(1) Remove timing chain cover and gasket.

(2) Remove crankshaft oil slinger.

(3) Remove camshaft sprocket retaining bolt and washer.

(4) Remove distributor drive gear and fuel pump eccentric.

(5) Rotate the crankshaft until the "0" timing mark on the crankshaft sprocket is closest to and in a centerline with the "0" timing mark on the camshaft sprocket as shown in figure 1B-23.

(6) Remove crankshaft sprocket, camshaft sprocket and timing chain as an assembly.

Installation

(1) Assemble timing chain, crankshaft sprocket, and camshaft sprocket with the timing marks aligned as shown in figure 1B-23.

(2) Install assembly to crankshaft and camshaft.

(3) Install fuel pump eccentric and distributor drive gear.

(4) Install camshaft sprocket, washer, and retaining bolt. Tighten bolt to 30 foot-pounds torque.

NOTE: *The fuel pump eccentric must be installed with the stamped word REAR facing the camshaft sprocket.*

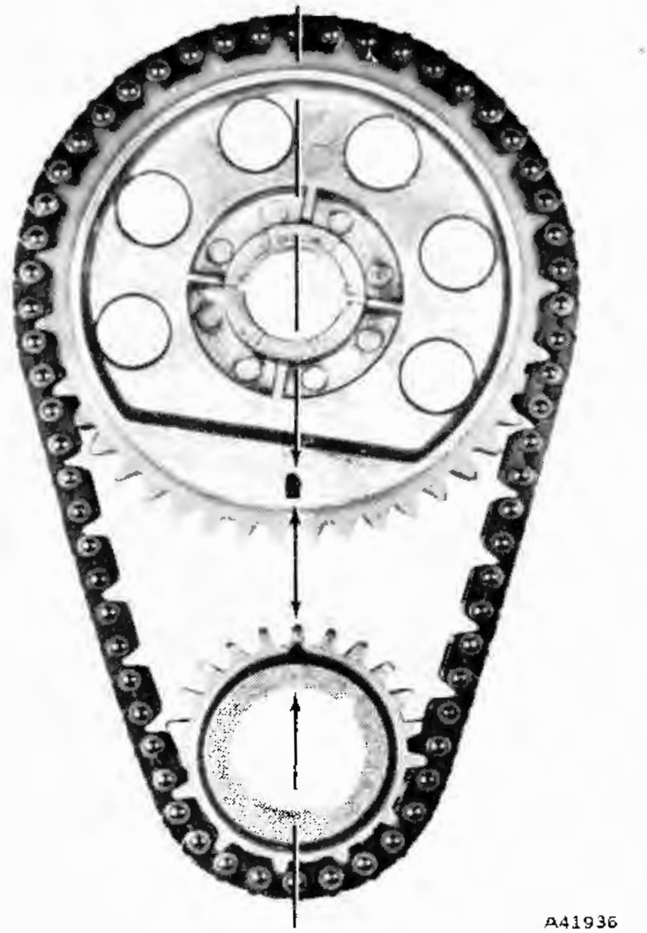

Fig. 1B-23 Timing Chain and Sprockets Alignment

(5) To ensure correct installation of timing chain:

(a) Rotate crankshaft until timing mark on camshaft sprocket is on a horizontal line at 3 o'clock position.

(b) Beginning with pin directly adjacent to camshaft sprocket timing mark, count number of pins downward to timing mark on crankshaft sprocket.

(c) There should be 20 pins between these two points. **The crankshaft sprocket timing mark must be between pins 20 and 21** (fig. 1B-24).

(6) Install crankshaft oil slinger.

(7) Install the timing chain cover using a new gasket, tighten retaining bolts to 25 foot-pounds torque.

CAMSHAFT AND BEARINGS

The camshaft is supported by five steel-shelled, babbitt-lined bearings which have been pressed into the block and line reamed. The camshaft bearings are step bored, being larger at the front bearing than at the rear, to permit easy removal and installation of

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the camshaft. All camshaft bearings are lubricated under pressure.

NOTE: *Do not replace camshaft bearings unless equipped with special removing, installing and reaming tools.*

Camshaft end play is maintained by the load placed on the camshaft by the oil pump and distributor drive gear.

The helical cut of the gear holds the camshaft sprocket thrust face against the cylinder block face to hold camshaft end play to zero during engine operation.

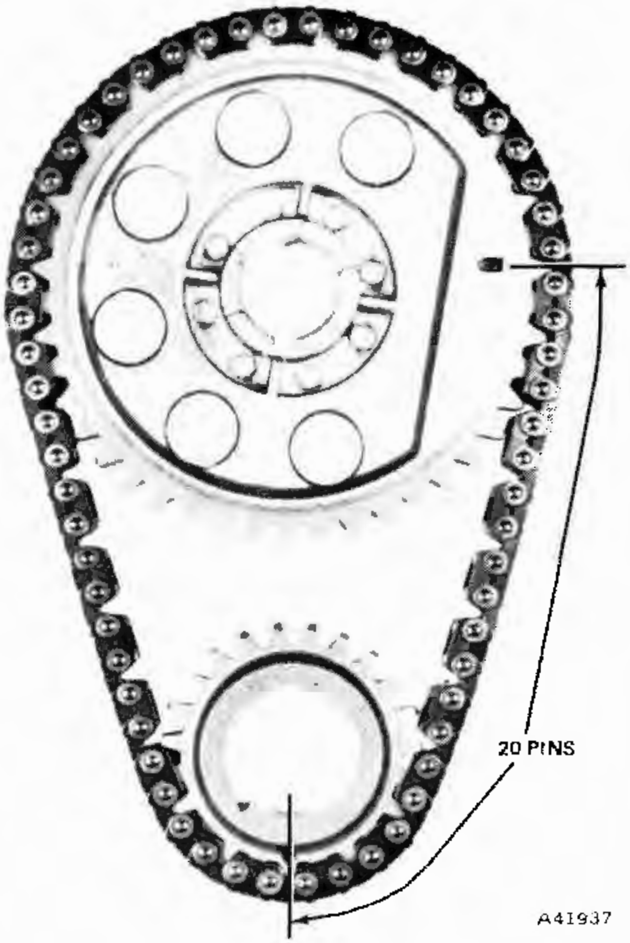

Fig. 1B-24 Correct Timing Chain Installation

Camshaft Identification

All 401 CID engine camshafts, different from the 304 and 360 CID camshafts, are identified by white paint marks between the number 4 and 5 camshaft bearings. The 304 and 360 CID engine camshafts, which are the same, have no identifying paint marks.

Cam Lobe Lift Measurement

Cam lift may be checked with a dial indicator.

(1) Remove cylinder head cover and gasket.

(2) Remove spark plugs.

(3) Install dial indicator on push rod end of rocker arm (fig. 1B-25).

(4) Rotate crankshaft until cam lobe base circle (push rod down) is under the valve tappet.

(5) Set dial indicator to zero.

(6) Rotate crankshaft until point of maximum push rod upward movement occurs.

(7) Read travel at dial indicator. (An excess of minus 0.006 inch from specified dimensions indicates defective cam.)

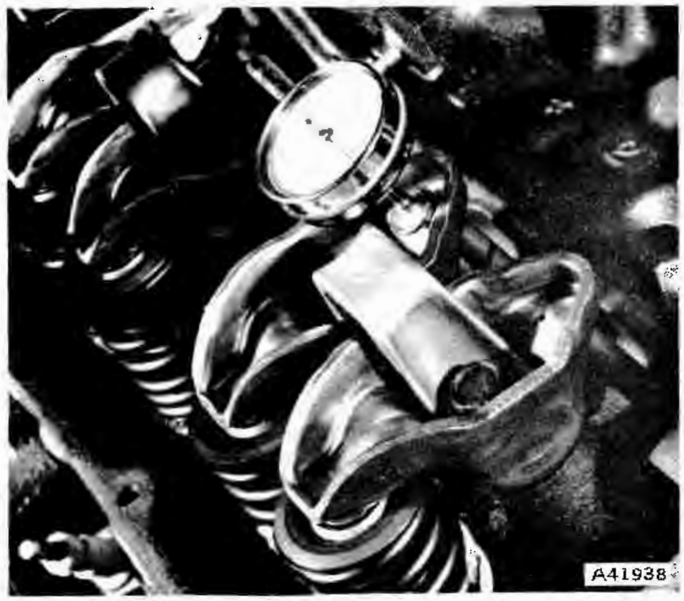

Fig. 1B-25 Cam Lobe Lift Measurement

Removal

(1) Drain cooling system.

(2) Remove radiator assembly.

(3) If equipped with air conditioning, remove condenser and receiver assembly as charged unit. Refer to Section 13A - Air Conditioning for detailed procedure.

(4) Remove cylinder head covers and gaskets.

(5) Remove rocker arms and bridged pivot assemblies.

(6) Remove push rods.

NOTE: *Keep the push rods, rocker arm assemblies, and tappets in the same order as removed.*

(7) Remove intake manifold assembly.

(8) Remove drive belts.

(9) Remove fan and hub assembly.

(10) Remove distributor.

(11) Remove drive pulley.

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(12) Remove vibration damper.
(13) Remove timing chain cover.
(14) Remove timing chain cover oil seal.
(15) Rotate the crankshaft until "0" timing mark on crankshaft sprocket is closest to and in a centerline with "0" timing mark on camshaft sprocket.
(16) Remove retaining bolt from camshaft.
(17) Remove crankshaft sprocket, camshaft sprocket and timing chain as an assembly.
(18) Remove distributor drive gear and fuel pump eccentric from the camshaft.
(19) Remove hood latch support bracket upper retaining screws and move bracket, as required, to allow removal of camshaft.
(20) Remove front bumper or grille, as required, and remove camshaft.

Inspection

Inspect the camshaft bearing journals for an uneven wear pattern or rough finish. Either condition will necessitate camshaft replacement.

Inspect the distributor drive gear for damage or excessive wear.

Inspect fuel pump eccentric for excessive wear.

Inspect each cam lobe and the matching hydraulic valve tappet for wear. If the face of the tappet(s) is worn concave and the matching camshaft lobe(s) is also worn, both the camshaft and the tappet(s) must be replaced.

Installation

(1) Lubricate entire camshaft generously with Jeep Engine Oil Supplement (EOS), or equivalent.
(2) Carefully install camshaft into engine block.
(3) Install fuel pump eccentric and distributor drive gear to camshaft.
(4) Assemble timing chain, crankshaft sprocket and camshaft sprocket with the "0" timing marks aligned as during removal.
(5) Install chain and sprockets assembly to engine. (Recheck installation as shown in figure 1B-24.)
(6) Install new timing chain cover gasket, refer to Timing Chain Cover described earlier in this section. Install a new oil seal and apply light film of engine oil to the lips of seal.
(7) Install timing chain cover.
(8) Install vibration damper.
(9) Install drive pulley and retaining bolts, tighten bolts in specified torque.
(10) Install hydraulic valve tappets lubricated with EOS.

NOTE: *The hydraulic valve tappets and all valve train components should be lubricated with Jeep engine Oil Supplement, or equivalent, during installation. Do not drain the EOS from the engine for at least 1,000 miles or until the next scheduled oil change.*

(11) Install intake manifold assembly.
(12) Install push rods.
(13) Install rocker arms and bridged pivot assemblies.
(14) Install cylinder head covers and gaskets.
(15) Install fuel pump.
(16) Rotate crankshaft until No. 1 piston is at TDC position on compression stroke.
(17) Install distributor so that rotor is aligned with No. 1 terminal of the cap when fully seated on block.
(18) Install distributor cap.
(19) Install spark plug wires.
(20) If removed, install air conditioning condenser and receiver assembly. Refer to Section 13A—Air Conditioning for procedure to purge compressor of air.

CAUTION: *Both service valves must be open before the air conditioning system is operated.*

(21) Install hood latch support bracket retaining screws and tighten securely.
(22) If removed, install front bumper or grille.
(23) Install radiator.
(24) Fill cooling system to specified level.

OIL PAN

Removal

(1) Drain engine oil.
(2) Remove starter.
(3) Remove oil pan.
(4) Remove oil pan front and rear neoprene oil seals. Thoroughly clean the gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan sump.

Installation

(1) Install new oil pan front seal to timing chain cover and apply a generous amount of Permatex No. 2, or equivalent, to end tabs.
(2) Cement new oil pan side gaskets into position on engine block and apply a generous amount of Permatex No. 2, or equivalent, to gasket ends.
(3) Coat inside curved surface of new oil pan rear seal with soap and apply a generous amount of Permatex No. 2, or equivalent, to side gasket contacting surface of seal end tabs.
(4) Install seal in the recess of rear main bearing cap making certain it is fully seated.
(5) Apply engine oil to oil pan contacting surface of front and rear oil pan seals.
(6) Install oil pan and tighten drain plug securely.
(7) Install starter.
(8) Fill crankcase to specified level with new oil.

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OIL FILTER

A full flow oil filter mounted on the lower right hand side of the engine is accessible from below the chassis.

A bypass valve, incorporated in the filter mounting base, provides a safety factor in the event the filter becomes inoperative as a result of dirt or sludge accumulation. Oil Filter Remover Tool, J-22700 will facilitate removal.

Before installation, apply a thin film of oil to the filter gasket. **Do not use grease.** Install filter until gasket contacts the seat of the adapter. Tighten by hand only, following instructions on replacement filter. Operate engine at fast idle and check for leaks.

OIL PUMP

A positive displacement gear type oil pump is used and is driven by the distributor shaft, which in turn is driven by a gear on the camshaft. The pump, which is part of the timing chain cover, incorporates a pressure relief valve to regulate maximum pressure.

Crankcase oil enters the pump after being drawn through the pick-up tube and screen assembly, the horizontal main oil gallery and the connecting passage in the timing chain cover.

Oil pump removal or replacement will not affect distributor timing as the distributor drive gear remains in mesh with the camshaft gear.

Oil Pressure Relief Valve

The oil pressure relief valve is not adjustable. A setting of 75 pounds maximum pressure is built into the tension of the spring.

In the relieved position, the valve permits oil to bypass through a passage in the pump cover to the inlet side of the pump.

Removal

(1) Remove retaining screws and separate the oil pump cover, gasket and oil filter as an assembly from pump body (timing chain cover).

(2) Remove drive gear and shaft, and driven or idler gear by sliding them out of body.

(3) If required, oil pressure relief valve may be removed from pump cover for cleaning by removing cap from pump cover.

Gear End Clearance Measurement

(1) Place straightedge across gears and pump body.

(2) Select a feeler gauge which will fit snugly but freely between straightedge and pump body (fig. 1B-26).

Fig. 1B-26 Gear End Clearance Measurement

NOTE: *Make certain gears are up as far as possible into body. Refer to Specifications pages for correct clearance.*

If gear end clearance is less than specified, replace timing chain cover and gear and shaft assemblies.

Gear-to-Body Clearance

(1) Insert a feeler gauge between gear tooth and pump body inner wall directly opposite the point of gear mesh. Select a feeler gauge which fits snugly but freely (fig. 1B-27).

Fig. 1B-27 Gear-to-Body Clearance Measurement

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(2) Rotate gears to check each tooth in this manner. Refer to the Specifications pages for the correct clearance.

(3) If gear-to-body clearance is more than specified, replace idler gear, idler shaft, and drive gear assembly.

Installation

(1) If removed, install oil pressure relief valve in the pump cover.

(2) Install idler shaft, idler gear, and drive gear assembly.

NOTE: *To ensure self-priming of the oil pump, the pump must be filled with petroleum jelly prior to the installation of the oil pump cover.* **Do not use grease of any type.**

(3) Install pump cover and oil filter assembly with a new gasket. Tighten retaining screws to 55 inch-pounds torque.

REAR MAIN BEARING OIL SEAL

The rear main bearing oil seal consists of a two piece, neoprene, single lip seal to seal the rear of the crankshaft. Correct installation of the seal will ensure leak-free engine operation (fig. 1B-28).

Removal

(1) Drain engine oil.

(2) Remove oil pan.

(3) Remove oil pan front and rear neoprene oil seals.

(4) Remove oil pan side gaskets.

(5) Thoroughly clean gasket surfaces of oil pan and engine block. Remove all sludge and dirt from oil pan.

(6) Remove rear main bearing cap.

(7) Remove and discard lower seal.

NOTE: *To ensure leak-free operation, the upper and lower seal halves must be replaced in pairs.*

(8) Clean main bearing cap thoroughly to remove all sealer.

(9) Loosen all remaining main bearing capscrews.

(10) With a brass drift and hammer, tap the upper seal until sufficient seal is protruding to permit pulling seal out completely.

Installation

(1) Wipe seal surface of the crankshaft clean and then oil lightly.

(2) Coat block contacting surface of the new upper seal with soap, and lip of seal with engine oil.

(3) Install upper seal into engine block.

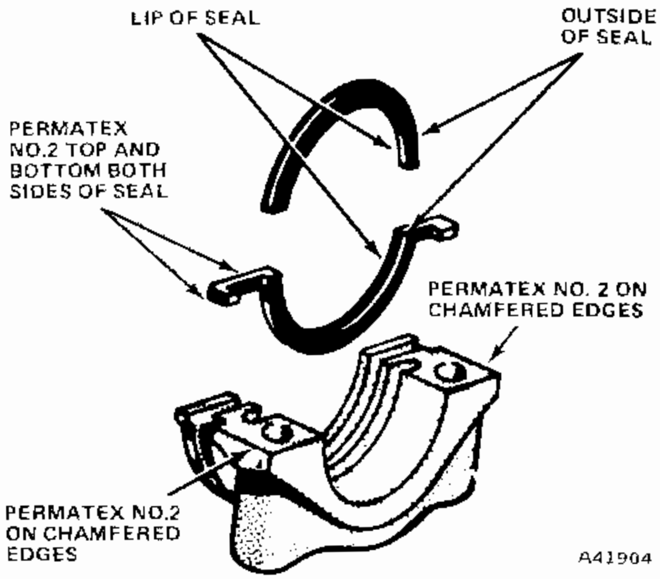

Fig. 1B-28 Rear Main Oil Seal Installation

NOTE: *The lip of the seal must face to the front of the engine.*

(4) Coat both sides of new lower seal end tabs with Permatex No. 2 or equivalent being careful not to apply sealer to lip of seal.

(5) Coat outer curved surface of lower seal with soap and lip of seal with engine oil.

(6) Install seal into cap recess and seat firmly.

(7) Place Permatex No. 2 or equivalent on both chamfered edges of rear main bearing cap.

(8) Install rear main bearing inserts.

(9) Tighten all main bearing capscrews to 100 foot-pounds torque.

(10) Install oil pan using new gaskets and seals. Tighten drain plug securely.

(11) Fill the crankcase to specified level with new oil.

CYLINDER BLOCK

Disassembly

(1) Remove engine assembly as outlined earlier in this section.

(2) Use engine stand to support engine assembly.

(3) Remove the cylinder head covers and gasket.

(4) Remove rocker arms and bridged pivot assemblies.

(5) Remove push rods.

(6) Remove intake manifold assembly.

(7) Remove valve tappets.

(8) Remove cylinder heads and gaskets.

(9) Position pistons one at a time near bottom of their stroke and use ridge reamer to remove any ridge from top end of cylinder walls.

(10) Remove drive pulley and vibration damper.

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(11) Remove timing chain cover.

(12) Drain engine oil and remove oil pan.

(13) Remove camshaft.

(14) Remove connecting rod bearing caps and inserts and keep in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.*

(15) Remove connecting rod and piston assemblies through top of cylinder bores. **Be careful that connecting rod bolts do not scratch connecting rod journals or cylinder walls.**

(16) Remove oil pickup tube and screen assembly.

(17) Remove main bearing caps and inserts.

(18) Remove crankshaft.

Cylinder Bore Reconditioning

Inspect the cylinder bores for scoring, taper, and out-of-round. Check with an inside micrometer or telescope gauge from the top to the bottom of the cylinders for taper. Check for an out-of-round condition by measuring across the cylinder bores at two points; parallel to the crankshaft and perpendicular to the crankshaft.

If cylinder taper does not exceed 0.005 inch and out-of-round does not exceed 0.003 inch, the cylinder bore may be corrected by honing.

If the cylinder taper or out-of-round condition exceeds these limits, the cylinder must be bored and then honed for an oversize piston.

After honing the cylinder bores, move the hone up and down at sufficient speed to produce a uniform crosshatch pattern on the cylinder walls.

Removal of glaze from the cylinder wall for quicker ring seating can be accomplished by various methods. When an expanding type hone is used, do not use more than ten strokes (each stroke down and return) to recondition a cylinder wall.

Successful ring installation depends upon cleanliness during the honing operation and careful handling of parts. The engine bearings and lubrication system must be protected from abrasives.

Rigid type hones are not to be used to remove cylinder glaze as there is always a slight amount of taper in cylinder walls after the engine has been in service.

Prior to fitting pistons, the cylinder bores should be scrubbed clean with a hot water and detergent solution. After cleaning, apply light engine oil to the cylinder walls and then wipe with a clean lint-free cloth.

NOTE: *If crankshaft remains in block, cover the connecting rod journals with clean cloths during the cleaning operation.*

Assembly

(1) Install upper main bearing inserts.

(2) Install crankshaft.

(3) Install main bearing cap and inserts.

(4) Install new oil pickup tube and screen assembly.

(5) Install camshaft.

(6) After thoroughly cleaning cylinder bores, apply a light film of clean engine oil to bores with a clean lint-free cloth.

(7) Prior to installing the connecting rod and piston assemblies into cylinder block, arrange piston ring gaps so that:

(a) No. 1 compression ring gap is 180° from No. 2 compression ring gap.

(b) Oil control ring spacer expander gap is at least 90° from No. 2 compression ring gap.

(c) Oil control ring gaps are 90° between each ring gap (fig. 1B-29).

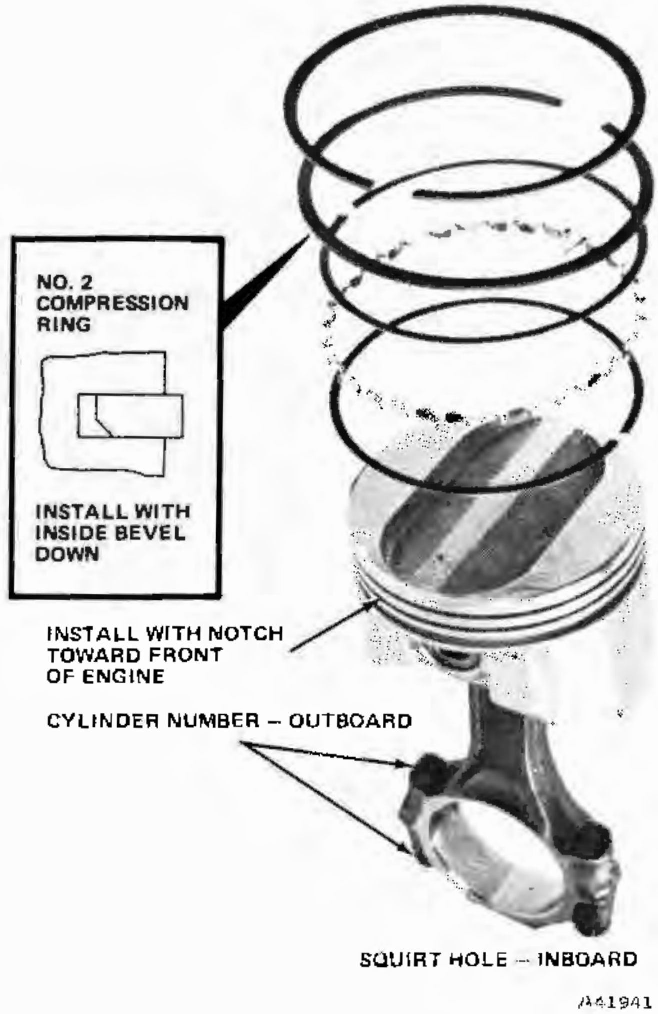

Fig. 1B-29 Piston Ring Sequence

(8) Lubricate piston and ring surfaces with clean engine oil.

(9) Use a piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. **Be careful that connecting rod bolts do not scratch connecting rod journals or cylinder walls.**

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NOTE: *Place lengths of rubber hose over the connecting rod bolts for protection during installation.*

(10) Install connecting rod bearing caps and inserts in same order as removed. On vehicles equipped with 304 and 360 CID engines, tighten nuts to 28 foot-pounds torque. Vehicles equipped with 401 CID engines tighten nuts to 38 foot-pounds torque.

(11) Install engine oil pan using new gaskets and seals. Tighten drain plug securely.

(12) Install timing chain cover and gaskets, refer to Timing Chain Cover as detailed earlier in this section.

(13) Install vibration damper and drive pulley.

(14) Install cylinder head and new gaskets.

(15) Install valve tappets.

(16) Install intake manifold and new gaskets.

(17) Install push rods.

(18) Install rocker arms and bridged pivot assemblies.

NOTE: *Install valve train components in same order as removed.*

(19) Install transmission to engine.

(20) Remove engine from stand.

(21) Install engine assembly as outlined earlier in this section.

CONNECTING ROD AND PISTON ASSEMBLIES

Use these procedures to service connecting rods and pistons with the engine in the car.

Removal

(1) Remove cylinder head covers and gaskets.

(2) Remove rocker arms and bridged pivot assemblies.

(3) Remove push rods.

(4) Remove intake manifold assembly.

(5) Remove cylinder head and gasket.

(6) Position pistons one at a time near bottom of their stroke and use a ridge reamer to remove any ridge from top end of cylinder walls.

(7) Drain engine oil.

(8) Remove the oil pan.

(9) Remove connecting rod bearing caps and inserts. Keep in same order as removed.

NOTE: *Connecting rods and caps are stamped with the number of the cylinder to which they were assembled.*

(10) Remove connecting rod and piston assemblies through the top of cylinder bores. **Be careful that connecting rod bolts do not scratch connecting rod journals or cylinder walls.**

Installation

(1) After thoroughly cleaning cylinder bores, apply a light film of clean engine oil to bores with a clean lint-free cloth.

(2) Prior to installing the connecting rod and piston assemblies into engine, arrange piston ring gaps so that:

(a) No. 1 compression ring gap is 180° from the No. 2 compression ring gap;

(b) Oil control ring spacer expander gap is at least 90° from the No. 2 compression ring gap;

(c) Oil control ring gaps are 90° from the spacer gap with as least 30° between each ring gap (fig. 1B-29).

(3) Lubricate the piston and ring surfaces with clean engine oil.

(4) Use piston ring compressor tool to install connecting rod and piston assemblies through top of cylinder bores. **Be careful that connecting rod bolts do not scratch connecting rod journals or cylinder walls.**

NOTE: *Place lengths of rubber hose over the connecting rod bolts for protection during installation.*

(5) Install the connecting rod bearing caps and inserts in same order as removed. Tighten retaining nuts to 28 foot-pounds torque on 304 and 360 CID equipped vehicles and 38 foot-pounds for 401 CID equipped vehicles.

(6) Install the engine oil pan using new gaskets and seals. Tighten drain plug securely.

(7) Install cylinder heads and new gaskets.

(8) Install push rods.

(9) Install rocker arms and bridged pivot assemblies.

(10) Install intake mainfold.

(11) Install cylinder head covers and gaskets.

(12) Fill crankcase to specified level with new oil.

CONNECTING RODS

The connecting rods for 304 and 360 CID engines are cast-iron, while 401 CID engines have forged steel connecting rods. Both types are independently balanced. The crankshaft end of the connecting rods incorporates a two-piece bearing insert. The removable bearing cap has a number from 1 through 8 stamped on it and the adjacent machined surface of the rod to identify the cylinder in which the rod was assembled. The piston end of the rod is a 2000 pound press-fit to the piston pin.

Have the connecting rod alignment checked by a competent machine shop whenever engine wear patterns or damage indicate probable rod misalignment. Always replace bent connecting rods.

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Connecting Rod Bearings

The connecting rod bearings are steel-backed, sintered copper, lead alloy precision type.

Each bearing is select fit to its respective journal to obtain the desired operating clearance. In production the select fit is obtained by using various sized color coded bearing inserts as shown in the bearing fitting chart.

The rod journal size is identified in production by a color coded paint mark on the adjacent cheek or counterweight toward the flanged (rear) end of the crankshaft. Use color codes shown in the bearing fitting chart to identify journal size and select the correct bearing inserts to obtain proper clearance.

When required, different sized upper and lower bearing inserts may be used as a pair; therefore, a standard size insert is sometimes used in combination with a 0.001 inch undersize insert to reduce clearance by 0.005 inch (1/2 thousandth of an inch).

CAUTION: *Never use bearing inserts with greater than 0.01 inch difference in size in pairs.*

Example:

Correct	Incorrect
Upper—Standard	Standard
Lower—0.001-inch undersize	0.002-inch undersize

Service replacement bearing inserts are available in pairs in the following sizes: standard, 0.001-inch undersize, 0.002-inch undersize, 0.010-inch undersize and 0.012-inch undersize. The size is stamped on the back of the inserts.

Removal

Use this procedure to service connecting rod bearing with the engine in car.

(1) Drain engine oil.

(2) Remove oil pan.

(3) Rotate crankshaft as required to position two pistons at a time at bottom of their stroke.

(4) Remove bearing caps and lower inserts.

(5) Remove upper insert by spinning it out of connecting rod.

NOTE: Do not mix bearing caps. *Each connecting rod and matching cap is stamped with the cylinder number on a machined surface which faces the camshaft side of the engine block. The numbers are located on a machined surface opposite the squirt holes (fig. 1B-30).*

(6) Inspect bearing inserts and replace if worn or damaged.

Measuring Connecting Rod Journal With Micrometer

(1) Wipe connecting rod journals clean.

(2) Using a micrometer, measure journal diameter at a number of points. Note difference between maximum and minimum diameters.

(3) Refer to specifications for maximum allowable taper and out-of-round. If any rod journal is beyond specifications, it must be reconditioned and fitted with new undersize bearing inserts.

(4) Compare maximum reading obtained with journal diameters listed in bearing fitting chart.

(5) Select inserts required to obtain specified bearing clearance.

Measuring Bearing Clearance With Plastigage

(1) Wipe bearing inserts and rod journal clean.

(2) Place a strip of Plastigage across full width of lower insert at center of bearing cap.

(3) Install bearing cap to connecting rod and tighten retaining nuts to 28 foot-pounds torque on 304

CONNECTING ROD BEARING FITTING CHART

Crankshaft Connecting Rod Journal Color Code and Diameter	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow - 2.0955 to 2.0948 inches	Yellow - Standard	Yellow - Standard
Orange - 2.0948 to 2.0941 inches	Yellow - Standard	Black - .001-inch undersize
Black - 2.0941 to 2.0934 inches	Black - .001-inch undersize	Black - .001-inch undersize
Red - 2.0855 to 2.0848 inches	Red - .010-inch undersize	Red - .010-inch undersize
	401 CID ENGINE	
Yellow - 2.2485 to 2.2478 inches	Yellow - Standard	Yellow - Standard
Orange - 2.2478 to 2.2471 inches	Yellow - Standard	Black - .001-inch undersize
Black - 2.2471 to 2.2464 inches	Black - .001-inch undersize	Black - .001-inch undersize
Red - 2.2385 to 2.2378 inches	Red - .010-inch undersize	Red - .010-inch undersize

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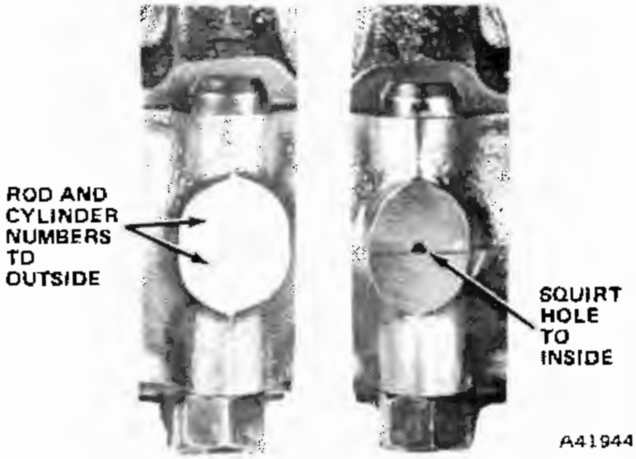

Fig. 1B-30 Rod Number and Squirt Hole Location

and 360 CID equipped vehicles and 38 foot-pounds torque on 401 CID equipped vehicles.

(4) Remove bearing cap and determine amount of clearance by measuring width of the compressed Plastigage with scale furnished as shown in figure 1B-31.

Connecting Rod Side Clearance Measurement

(1) Rotate crankshaft until connecting rod journal is at bottom of stroke.

(2) Insert snug fitting feeler gauge between connecting rods (fig. 1B-32).

Fig. 1B-31 Connecting Rod Bearing Clearance Measurement With Plastigage

(3) Compare feeler gauge measurement to clearance specified. Replace rods not to specifications.

Installation

(1) Rotate crankshaft to rod journal at bottom of stroke.

(2) Lubricate bearing surface of each insert with clean engine oil.

(3) Install bearing inserts, cap and retaining nuts. Tighten to 28 foot-pounds torque on 304 and 360 CID equipped vehicles and 38 foot-pounds on 401 CID equipped vehicles.

CAUTION: *Exercise care when rotating the crankshaft with bearing caps removed. Be sure the connecting rod bolts do not accidentally come in contact with the rod journals and scratch the finish, which can cause bearing failure.*

(4) Install oil pan using new gaskets and seals. Tighten drain plug securely.

(5) Fill crankcase to specified level with new oil.

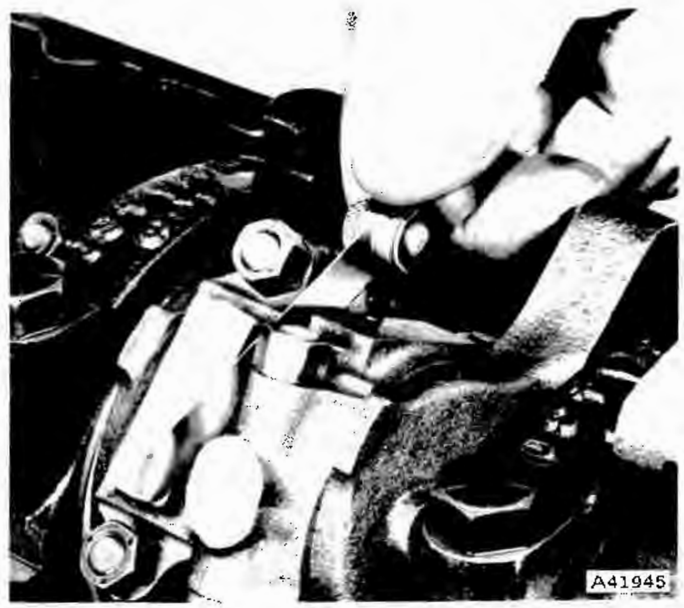

Fig. 1B-32 Connecting Rod Side Clearance Measurement

PISTONS

Aluminum alloy autothermic pistons, steel reinforced for strength and controlled expansion are used.

The pistons are cam-ground and therefore, not perfectly round. The ring belt area contains three piston rings, two compression and one oil control ring above the piston pin.

The piston pin boss is offset from the piston centerline to place it nearer the thrust side of the piston.

To ensure correct installation of the pistons in the bore, two notches are cast in the top perimeter of the piston heads on 304 and 360 CID engines and one notch on the 401 CID engine. The notches must face forward (fig. 1B-33).

Piston Fitting

(1) Using an inside micrometer, measure cylinder bore inside diameter at a point 2-5/16 inch below top of bore.

(2) Using an outside micrometer, measure diameter of piston at right angles to piston pin at centerline of pin as shown in figure 1B-34.

(3) The difference between cylinder bore diameter and piston diameter dimensions is the piston-to-bore clearance.

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Fig. 1B-33 Installing Piston Assembly Into Bore

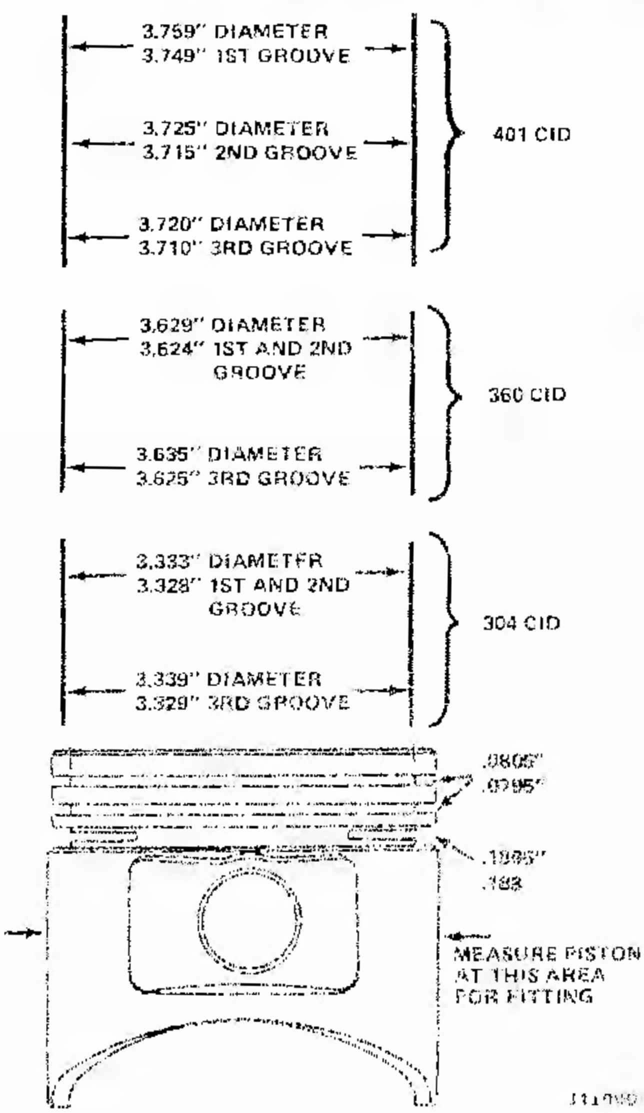

Fig. 1B-34 Piston Measurements

Piston Pins

The piston pins are a 2000 pound press-fit into the rods and require no locking device. The piston pins for 304 and 360 CID engines are the same diameter, while the piston pin for 401 CID engines is larger in diameter. Two different tools are required to service piston pins; J-21872 is used on 304 and 360 pins and J-23194 is used on 401 pins.

Removal

(1) Using Piston Pin Remover (J-21872 or J-23194) and an arbor press, place piston on remover support (J-21872-1 or J-23194 or J-23194-3) as shown in figure 1B-35.

(2) Using piloted driver (J-21872-3 or J-23194-3), press pin completely out of piston. Note position of pin through gauge window of remover support (fig. 1B-35).

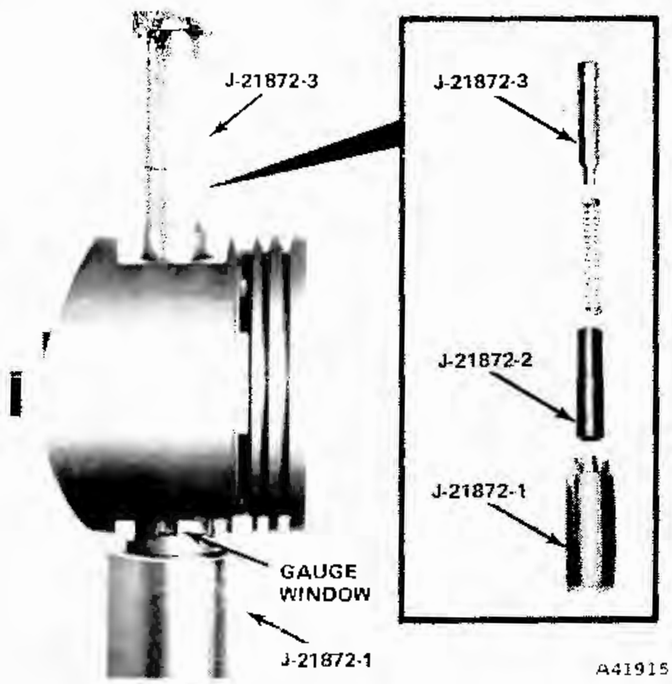

Fig. 1B-35 Piston Pin Removal and Installation

Pin Fitting

(1) Inspect pin and pin bore for nicks and burrs; remove as necessary.

(2) With pin removed from piston, clean and dry piston pin bore and piston pin.

(3) Position piston so that pin bore is in a vertical position. Insert pin in bore. At room temperature, pin should slide completely through pin bore without pushing.

(4) Replace piston and pin if pin jams in bore.

Installation

(1) Place pin pilot (J-21862-2 or J-23194) through piston and connecting rod pin bores (fig. 1B-35).

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(2) Place pin pilot, piston, and connecting rod an support (J-21872-1 or J-23194-1).

(3) Place piston pin through upper piston pin bore and into connecting rod pin bore (fig. 1B-35).

(4) Place piloted driver (J-21872-3 or J-23194-3) inside piston pin (fig. 1B-35).

(5) Using arbor press, press piston pin through connecting rod and piston until pin pilot indexes with mark on support (fig. 1B-35).

NOTE: *The piston is a 2000 pound press-fit. If little effort is required to install piston pin in connecting rod, or if rod moves along pin, a new connecting rod is required.*

(6) Remove piston and connecting rod assembly from press. Pin should be centered in rod plus or minus 1/32 inch.

Piston Rings

Both compression rings are made of cast iron while the oil control is a three-piece steel design.

Ring Fitting

(1) Clean carbon from all ring grooves. The oil drain openings in the oil ring grooves and pin boss must be cleared. Be careful not to remove metal from the grooves or from the lands since this will change the ring groove clearances and destroy ring-to-land seating.

(2) Check ring side clearance with a feeler gauge fitted snugly between ring land and ring. Roll ring around groove in which it is to operate. It must fit freely at all points (fig. 1B-36). Side clearance between land and rings should be as listed in the Specifications.

Fig. 1B-37 Ring Gap Measurement

(3) Place ring in bore. With an inverted piston, push ring down near lower end of ring travel area. Measure ring gap or joint clearance with feeler gauge fitted snugly in ring opening (fig. 1B-37).

NOTE: *When using other than standard ring sizes, fit rings individually into their repective bores.*

Fig. 1B-36 Ring Side Clearance Measurement

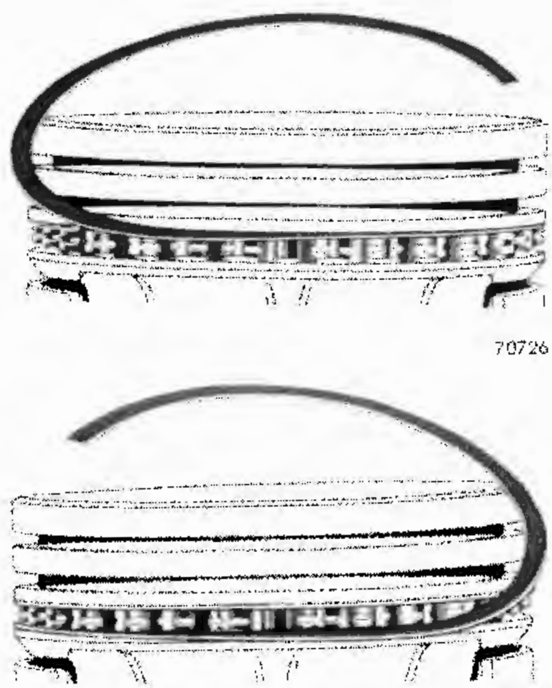

Fig. 1B-38 Installing Upper and Lower Rails.

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Installation

(1) Install oil control rings as indicated by instructions in package. It is not necessary to use a tool to install upper and lower rails. They are rolled into place as shown in figure 1B-38.

(2) Install lower compression using ring installer to expand ring around piston.

NOTE: *Make certain upper and lower compression rings are not installed upside down. Figure 1B-39 shows typical ring markings to indicate the top side of the ring.*

(3) Install upper compression ring using ring installer to expand ring around piston (fig. 1B-40).

Fig. 1B-39 Typical Piston Ring Markings

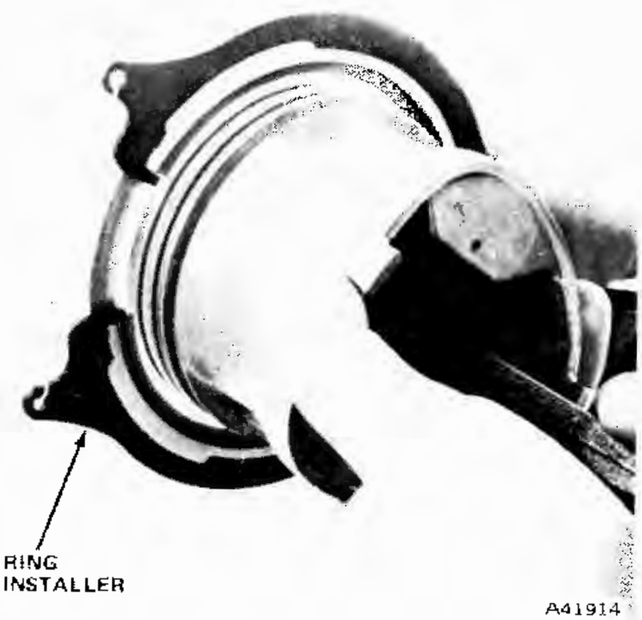

Fig. 1B-40 Compression Ring Installation

CRANKSHAFT

The crankshaft is counterweighted and balanced independently. The component parts of the crankshaft assembly are individually balanced, and then the complete assembly is balanced as a unit; therefore, service replacement dampers, crankshafts, flywheels, torque converters, and clutch components may be replaced without rebalancing the assembly.

There are five main bearings and four connecting rod journals. The end thrust is controlled by No. 3 main bearing.

The rear main bearing oil seal is protected from excessive oil by a slinger which is a machined part of the crankshaft.

NOTE: *On automatic transmission equipped engines, the torque converter and converter flexplate must be marked prior to removal and installed in this position upon assembly.*

Replacement

If the crankshaft is damaged beyond reconditioning, it must be replaced. Use the procedures outlined under Cylinder Block in this section to replace the crankshaft.

Checking End Play

The crankshaft end play is controlled at the No. 3 main bearing which is flanged for this purpose.

(1) Attach a dial indicator to crankcase adjacent to No. 3 main bearing.

(2) Set dial indicator push rod on face of an adjacent counterweight (fig. 1B-41).

(3) Pry crankshaft fore and aft.

(4) Read dial indicator. End play is different on high and low indications.

(5) If end play is incorrect, according to Specifications, replace thrust bearing.

NOTE: *When replacing the thrust bearings, pry the crankshaft fore and aft to align the thrust faces of the bearings.*

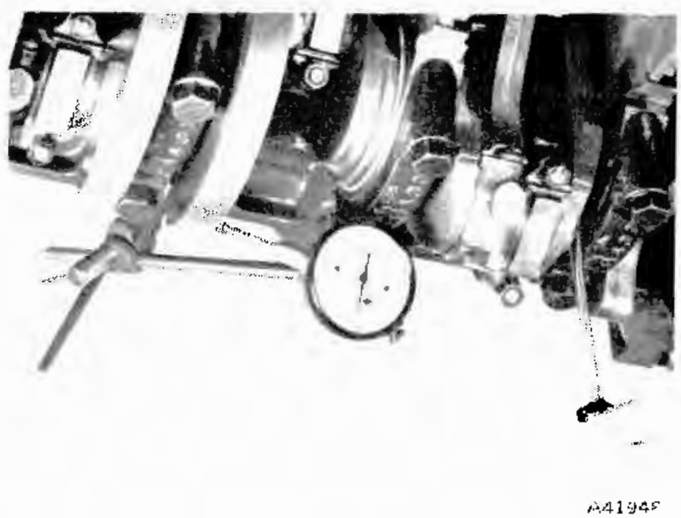

Fig. 1B-41 Crankshaft End Play Measurement

Measuring Main Bearing Journal with a Micrometer (Crankshaft Out of Block)

(1) Wipe main bearing journal clean.

(2) Using a micrometer, measure journal diameter at a number of points. Note difference between maximum and minimum diameters.

(3) Refer to Specifications for maximum allowable taper and out-of-round.

(4) Compare maximum reading obtained with jour-

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nal diameters listed in bearing fitting chart.

(5) Select inserts required to obtain specified bearing clearance.

Crankshaft Main Bearings

The main bearings are steel-backed, sintered-copper, lead-alloy precision type. The main bearing caps are numbered (front to rear) from 1 through 5 with an arrow to indicate forward position.

Each bearing is selective fit to its respective journal to obtain the desired operating clearance. In production the select fit is obtained by using various sized color coded bearing inserts as shown in the Main Bearing Fitting Chart.

The main bearing journal size is identified in production by a color coded paint mark on the adjacent cheek toward the flanged (rear) end of the crankshaft except for the rear main journal. The paint mark for the rear main journal is on the crankshaft rear flange.

Use the Bearing Fitting Chart to select proper bearing inserts to obtain the specified bearing clearance.

When required, different sized upper and lower bearing inserts may be used as a pair; therefore, a standard size upper insert may be used in combination with a 0.001 inch undersize lower insert to reduce clearance by 0.0005 inch (1/2 thousandth of an inch).

Example:

Correct	Upper—Standard Lower—0.001 inch undersize
Incorrect	Standard 0.002 inch undersize

NOTE: *Replace inserts of the same size either all on the top or all on the bottom. Never use bearing inserts with greater than 0.001 inch difference in pairs.*

Service replacement bearing inserts are available as pairs in the following sizes: standard, 0.001-inch undersize, 0.002-inch undersize, 0.010-inch undersize and 0.012-inch undersize. The size is stamped on back of inserts.

Removal and Inspection

This procedure may be used to check main bearing with engine in vehicle.

(1) Drain engine oil and remove pan.

(2) Remove main bearing cap and insert.

(3) Inspect bearing insert for abnormal wear or damage.

(4) If either condition exists, both upper and lower inserts must be replaced. (Refer to Measuring Bearing Clearance with Plastigage, as described in this section, to select bearing inserts required to obtain specified bearing clearance.)

(5) Inspect the crankshaft main journal. If damaged, either recondition or replace crankshaft.

(6) Remove upper insert by loosening all of the other bearing caps and inserting a cotter pin about 1/2-inch long in the crankshaft oil hole (head of pins should be large enough so that it will not fall into oil hole, yet thinner than bearing).

(7) With pin in place, rotate shaft so that upper bearing insert will rotate in the direction of its locating tongue.

(8) Remove and inspect the remaining bearings in same manner.

Measuring Main Bearing Clearance with Plastigage (Crankshaft in Block)

(1) Support weight of the crankshaft with a jack placed under counterweight which is adjacent to main bearing being checked.

NOTE: *Check each bearing clearance one at a time. All other bearings must remain tightened.*

(2) Remove main bearing cap and insert.

(3) Wipe insert and exposed portion of the crankshaft journal clean.

MAIN BEARING CHART

Crankshaft Main Bearing Journal Color Code and Diameter	Bearing Color Code	
	Upper Insert Size	Lower Insert Size
Yellow - 2.7489 to 2.7484 inches	Yellow - Standard	Yellow - Standard
Orange - 2.7484 to 2.7479 inches	Yellow - Standard	Black - .001-inch undersize
Black - 2.7479 to 2.7474 inches	Black - .001-inch undersize	Black - .001-inch undersize
Green - 2.7474 to 2.7469 inches	Black - .001-inch undersize	Green - .002-inch undersize
Red - 2.7389 to 2.7384 inches	Red - .010-inch undersize	Red - .010-inch undersize

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(4) Place a strip of Plastigage across full width of bearing insert.

(5) Install bearing cap and tighten retaining bolts to 100 foot-pounds torque.

(6) Remove bearing cap and determine amount of clearance by measuring width of compressed Plastigage with scale furnished as shown in figure 1B-42.

Fig. 1B-42 Main Bearing Clearance Measurement

Installation

(1) Lubricate bearing surface of each insert with clean engine oil.

(2) Loosen all main bearing caps.

(3) Install main bearing upper insert(s).

(4) Install main bearing cap(s) and lower insert(s). Tighten retaining bolts evenly to 100 foot-pounds torque.

(5) After installation, turn crankshaft by hand to check for free operation.

(6) Install oil pan using new gaskets and seals. Tighten drain plug securely.

(7) Fill crankcase to specified level with new oil.

FLYWHEEL AND STARTER RING GEAR ASSEMBLY

Replace the starter ring gear on vehicles with manual transmission only. The starter ring gear is welded to and balanced as part of the converter drive plate on vehicles with automatic transmission.

Removal

(1) Place flywheel on an arbor press with steel blocks equally spaced under the gear.

(2) Press flywheel through ring gear.

NOTE: *The ring gear can also be removed by breaking it with a chisel.*

Installation

(1) Apply heat to expand inside diameter of ring gear.

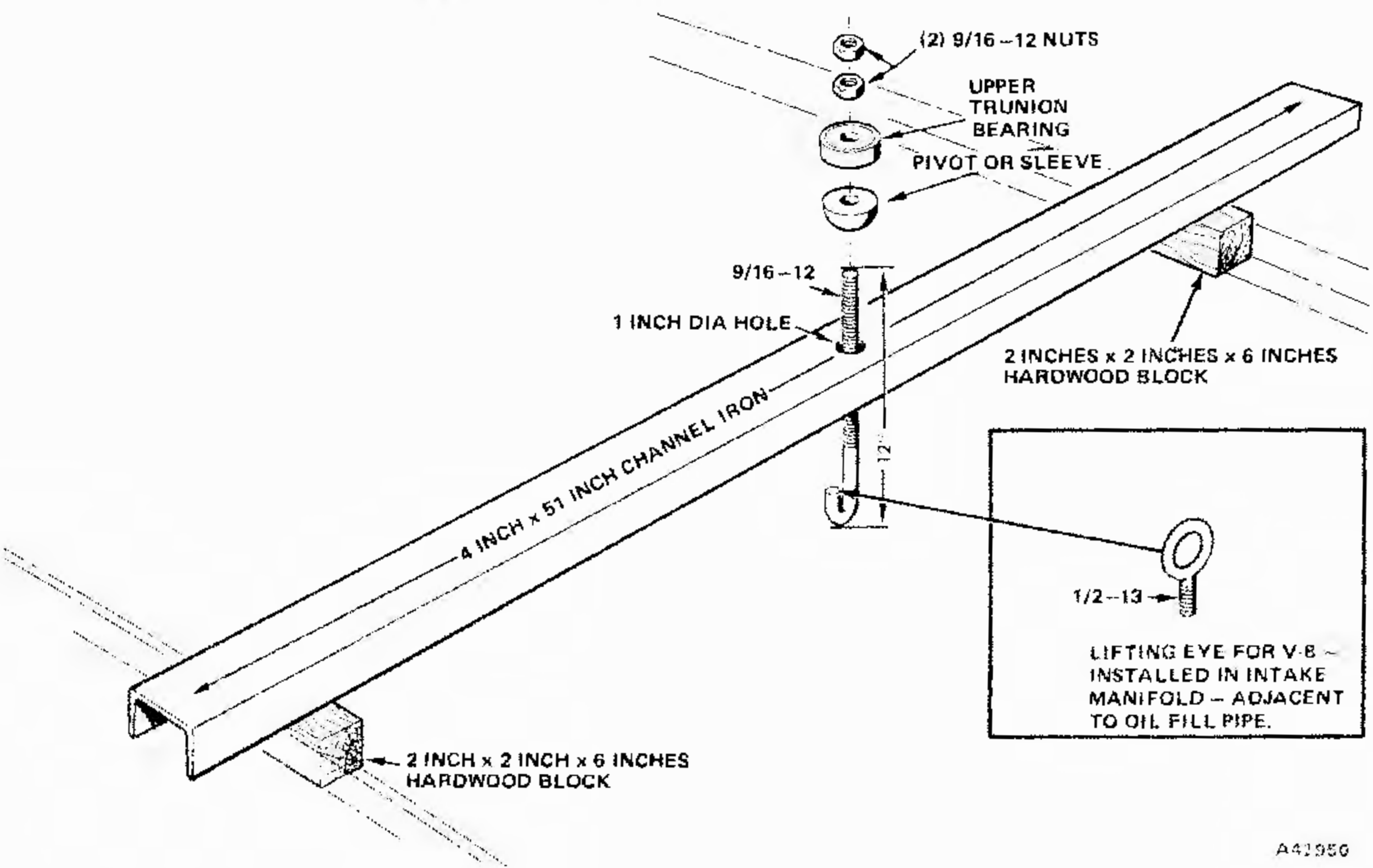

Fig. 1B-43 Engine Holding Fixture

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(2) Press ring gear over flywheel.

NOTE: *On manual transmission, the flywheel is balanced as an individual component and also as part of the crankshaft assembly.* **Do not attempt to duplicate original flywheel balance holes when installing a service replacement.**

SHORT ENGINE ASSEMBLY

A service replacement short engine assembly may be installed whenever the original engine block is damaged beyond repair. The short engine assembly consists of engine block, piston and rod assemblies, crankshaft, camshaft, timing gears and chain.

NOTE: *Whenever installing a short engine assembly, always install a new engine oil pump pickup tube and screen assembly.*

Transfer component parts from the original engine and clean and torque tightening as required. Follow the appropriate procedure outlined.

V-8 ENGINE SPECIFICATIONS

Bore	
304	3.75 inches
360	4.08 inches
401	4.17 inches
Stroke	
304	3.44 inches
360	3.44 inches
401	3.68 inches
Displacement	
304	304 cu. inches
360	360 cu. inches
401	401 cu. inches
Compression Ratio	
304	8.40:1
360 (2V or 4V)	8.25:1
401	8.25:1
Compression Pressure	
304	140 psi
360 (2V or 4V)	140 psi
401	140 psi
Maximum Variation Between Cylinders	20 psi
Net Brake Horsepower	
304	150 at 4200 rpm
360 (2V)	175 at 4000 rpm
360 (4V)	195 at 4400 rpm
401	215 at 4200 rpm
Net Torque	
304	245 at 2500 rpm
360 (2V)	285 at 2400 rpm
360 (4V) Single Exhaust	295 at 2900 rpm
401	320 at 2800 rpm
Taxable Horsepower	
304	45.00
360	53.27
401	55.51
Fuel	Regular, low lead, or no lead
CAMSHAFT	
Fuel Pump Eccentric Diameter	2.182 inch to 2.192 inch
Tappet Clearance	Zero lash (hydraulic tappets)
End Play	Zero (engine operating)
Bearing Clearance	0.001 inch to 0.003 inch

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V-8 ENGINE SPECIFICATIONS (Continued)

Bearing Journal Diameter	
No. 1	2.1195 inch to 2.1205 inch
No. 2	2.0895 inch to 2.0905 inch
No. 3	2.0595 inch to 2.0605 inch
No. 4	2.0295 inch to 2.0305 inch
No. 5	1.9995 inch to 2.0005 inch
Base Circle Runout	0.001 inch maximum
Cam Lobe Lift	
304/360	0.266 inch
401	0.286 inch
Intake Valve Timing	
Opens 304/360	14.75° BTDC
401	25.57° BTDC
Closes 304/360	68.75° BTDC
401	90.75° BTDC
Exhaust Valve Timing	
Opens 304/360	56.75° BBDC
401	80.80° BBDC
Closes 304/360	26.75° ATDC
401	42.75° ATDC
Valve Overlap	
304/360	41.50°
401	68.32°
Intake Duration	
304/360	263.50°
401	296.32°
Exhaust Duration	
304/360	263.50°
401	303.55°

CONNECTING RODS

Total Weight (Less Bearings)	
304/360	681 to 689 grams
401	794 to 802 grams
Total Length (Center-to-Center)	
304/360	5.873 inch to 5.877 inch
401	5.856 inch to 5.860 inch
Bearing Clearance	0.001 inch to 0.003 inch (0.0025 inch preferred)
Side Clearance	0.006 inch to 0.018 inch
Maximum Twist	0.0005 inch per inch
Maximum Bend	0.001 inch per inch

CRANKSHAFT

End Play	0.003 inch to 0.008 inch
Main Bearing Journal Diameter	
No. 1, 2, 3, 4	2.7474 inch to 2.7489 inch
Rear Main	2.7464 inch to 2.7479 inch
Main Bearing Journal Width	
304/360	
No. 1	1.2635 inch to 1.2695 inch
No. 2	1.246 inch to 1.248 inch
No. 3	1.273 inch to 1.275 inch
No. 4	1.246 inch to 1.248 inch
No. 5	1.215 inch to 1.217 inch

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V-8 ENGINE SPECIFICATIONS (Continued)

401
No. 1 . . . . . 1.244 inch to 1.269 inch
No. 2 . . . . . 1.222 inch to 1.232 inch
No. 3 . . . . . 1.273 inch to 1.275 inch
No. 4 . . . . . 1.222 inch to 1.232 inch
No. 5 . . . . . 1.202 inch to 1.217 inch
Main Bearing Clearance . . . . . 0.001 inch to 0.003 inch (0.0025 inch preferred)
Rear Main . . . . . 0.001 inch to 0.003 inch (0.003 inch preferred)
Connecting Rod Journal Diameter
304/360 . . . . . 2.0934 inch to 2.0955 inch
401 . . . . . 2.2464 inch to 2.2485 inch
Connecting Rod Journal Width
304/360 . . . . . 1.998 inch to 2.004 inch
401 . . . . . 1.846 inch to 1.852 inch
Connecting Rod Bearing
Clearance . . . . . 0.001 inch to 0.003 inch (0.0025 inch preferred)

CYLINDER BLOCK
Deck Height . . . . . 9.205 inch to 9.211 inch
Deck Clearance
304/360 . . . . . 0.0145 inch (below block)
401 . . . . . 0.0045 inch (below block)
Maximum Cylinder Taper . . . . . 0.005 inch
Maximum Cylinder Out-of-Round . . . . . 0.003 inch
Tappet Bore Diameter . . . . . 0.9055 inch to 0.9065 inch
Cylinder Block Flatness . . . . . 0.001/1 inch; 0.002/6 inch: 0.008 inch maximum

CYLINDER HEAD
Combustion Chamber Volume
304 . . . . . 57.42 to 60.42 cc
360/401 . . . . . 58.62 to 61.62 cc
Valve Arrangement . . . . . EI-IE-EI-IE
Valve Guide ID (Integral) . . . . . 0.3735 inch to 0.3745 inch
Valve Stem-to-Guide Clearance . . . . . 0.001 inch to 0.003 inch
Intake Valve Seat Angle . . . . . 30°
Exhaust Valve Seat Angle . . . . . 44.5°
Valve Seat Width . . . . . 0.040 inch to 0.060 inch
Valve Seat Runout . . . . . 0.0025 inch maximum
Cylinder Head Flatness . . . . . 0.001/1 inch: 0.002/6 inch: 0.008 inch maximum

LUBRICATION SYSTEM
Engine Oil Capacity . . . . . 4 quarts (add 1 quart with filter change)
Normal Operating Pressure . . . . . 13 psi at 600 rpm; 37 psi at 1600 rpm; 75 psi maximum
Oil Pressure Relief . . . . . 75 psi maximum
Gear-to-Body Clearance . . . . . 0.0005 inch to 0.0025 inch (0.0005 inch preferred)
Gear End Clearance . . . . . 0.002 inch to 0.006 inch (0.006 inch preferred)

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V-8 ENGINE SPECIFICATIONS (Continued)

PISTONS

Weight (Less Pin)	
304	506 to 510 grams
360	601 to 105 grams
401	590 to 594 grams
Piston Pin Bore CL - to Piston Top	
304/360	1.599 inch to 1.603 inch
401	1.506 inch to 1.510 inch
Piston-to-Bore Clearance	
304/401	0.0010 inch to 0.0018 inch
360	0.0012 inch to 0.0020 inch
All V-8	0.0014 inch preferred
Piston Ring Gap Clearance	
No. 1 and No. 2	0.010 inch to 0.020 inch
Oil Control Steel Rail	
304	0.010 inch to 0.025 inch
360	0.015 inch to 0.045 inch
401	0.015 inch to 0.055 inch
Piston Ring Side Clearance	
304	
304	
No. 1	0.0015 inch to 0.0035 inch (0.0015 inch preferred)
No. 2	0.0015 inch to 0.003 inch (0.0015 inch preferred)
Oil Control	0.0011 inch to 0.008 inch
360/401	
No. 1	0.0015 inch to 0.003 inch (0.0015 inch preferred)
No. 2	0.0015 inch to 0.0035 inch (0.0015 inch preferred)
Oil Control	0.000 inch to 0.007 inch
Piston Ring Groove Height	
No. 1 and No. 2	0.0795 inch to 0.0805 inch
Oil Control	0.1880 inch to 0.1895 inch
Piston Ring Groove Diameter	
304	
No. 1 and No. 2	3.328 inch to 3.333 inch
Oil Control	3.329 inch to 3.339 inch
360	
No. 1 and No. 2	3.624 inch to 3.629 inch
Oil Control	3.624 inch to 3.635 inch
401	
No. 1	3.749 inch to 3.759 inch
No. 2	3.715 inch to 3.725 inch
Oil Control	3.710 inch to 3.720 inch
Piston Pin Diameter	
304/360	0.9308 inch to 0.9313 inch
401	1.0009 inch to 1.0012 inch
Piston Pin Bore Diameter	
304/360	0.9288 inch to 0.9298 inch
401	0.9988 inch to 0.9998 inch
Piston-to-Pin Clearance	0.0003 inch to 0.0005 inch

ROCKER ARMS, PUSH RODS, AND TAPPETS

Rocker Arm Ratio	1.6:1

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V-8 ENGINE SPECIFICATIONS (Continued)

Push Rod Length. . . . . 7.790 inch to 7.810 inch
Push Rod Diameter. . . . . 0.312 inch to 0.315 inch
Hydraulic Tappet Diameter. . . . . 0.9040 inch to 0.9045 inch
Tappet-to-Bore Clearance. . . . . 0.001 inch to 0.0025 inch

VALVES
Valve Length
(Tip-to-Gauge Dim. Line). . . . . 4.7895 inch to 4.8045 inch
360/401 Exhaust Valve
With Rotator. . . . . inch to 4.8245 inch
Valve Stem Diameter. . . . . inch to 0.3725 inch
Stem-to-Guide Clearance. . . . . inch to 0.003 inch
Intake Valve Head Diameter
304. . . . . 1.782 inch to 1.792 inch
360/401. . . . . 2.020 inch to 2.030 inch
Intake Valve Face Angle. . . . . 29°
Exhaust Valve Head Diameter
304. . . . . 1.401 inch to 1.411 inch
360/401. . . . . 1.675 inch to 1.685 inch
Exhaust Valve Face Angle. . . . . 44°

VALVE SPRINGS
Free Length. . . . . 2.200 inch
(with Rotators). . . . . 2.000 inch
Spring Tension
Valve Closed. . . . . 80 to 88 pounds at 1-13/16 inch
(with Rotators). . . . . 80 to 88 pounds at 1-5/8 inch
Valve Open. . . . . 210 to 216 pounds at 1-23/64 inch
(with Rotators). . . . . 210 to 216 pounds at 1-3/16 inch
Inside Diameter (All). . . . . 1.000 inch to 1.020 inch

TORQUE SPECIFICATIONS

Service Set-To Torques should be used when assembling components. Service In-Use Recheck Torques should be used for checking a pre-torqued item. All torque values given in foot-pounds with dry fits unless otherwise specified.

	Service Set-To Torque	Service In Use Recheck Torque
Air Injection Tube-to-Manifold	38	30 to 45
Air Pump-to-Bracket	20	15 to 22
Air Pump Brackets-to-Engine-AC Compressor or Pedestals	25	18 to 28
Air Pump Adjusting Strap-to-Pump	20	15 to 22
Alternator Pivot Bolt or Nut	28	20 to 35
Alternator Adjusting Bolt	18	15 to 20
Alternator Mounting Bracket Bolt-to-Engine	28	23 to 30
Alternator Pivot Mounting Bolt-to-Head	33	30 to 35
Camshaft Gear Retainer Screw	30	25 to 35
Carburetor Adapter-to-Manifold Screws-2V	14	12 to 15
Carburetor Holddown Nuts	14	12 to 15
Clutch Housing Spacer-to-Block Screws	12	9 to 15
Clutch Housing-to-Block Screws	27	22 to 30
Connecting Rod Bolt Nuts	28 (304 & 360) 38 (401)	26 to 30 (304 & 360) 35 to 40 (401)

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TORQUE SPECIFICATIONS (Continued)

	Service Set-To Torque	Service In-Use Recheck Torque
Crankshaft Pulley-to-Damper	23	18 to 28
Cylinder Head Capscrews	110	100 to 120
Cylinder Head Cover Screws	50 in-lb	42 to 58 in-lb
Distributor Bracket Screw	13	10 to 18
Drive Plate-to-Converter Screw	22	20 to 25
EGR Valve-to-Manifold	13	9 to 18
Exhaust Manifold Bolts	25	20 to 30
Exhaust Pipe-to-Manifold Nuts	23	18 to 28
Fan and Hub Assembly Bolts	18	12 to 18
Flywheel or Drive Plate-to-Crankshaft	105	95 to 120
Front Support Cushion Bracket-to-Block	28	22 to 38
Front Support Cushion-to-Bracket	33	27 to 38
Front Support Cushion to Frame	33	27 to 37
Fuel Pump Screws	16	13 to 19
Idler Pulley Bearing Shaft-to-Bracket Nut	33	28 to 38
Idler Pulley Bracket-to-Front Cover Nut	7	4 to 9
Intake Manifold Screws	43	37 to 47
Main Bearing Capscrews	100	90 to 105
Oil Pump Cover Screws	55 in-lb	45 to 65 in-lb
Oil Pan Screws		
1/4 inch - 20	7	5 to 9
5/16 inch - 18	11	9 to 13
Oil Release Valve Cap	28	22 to 35
Power Steering Pump Adapter Screw	23	18 to 28
Power Steering Pump Bracket Screw	43	37 to 47
Power Steering Pump Mounting Screw	28	25 to 35
Rear Insulator Bracket-to-Trans. Stud Nut	33	27 to 38
Rear Support Insulator-to-Bracket Nut	48	40 to 55
Rear Support Cushion-to-Crossmember Screw Nut	18	12 to 25
Rocker Arm Capscrew	19	16 to 26
Spark Plugs	28	22 to 33
Thermostat Housing Screw	13	10 to 18
Timing Chain Cover-to-Block	25	18 to 33
Automatic Transmission to Block	28	22 to 38
Vibration Damper Screw	55	48 to 64
Water Pump Screws	48 in-lb	40 to 55 in-lb

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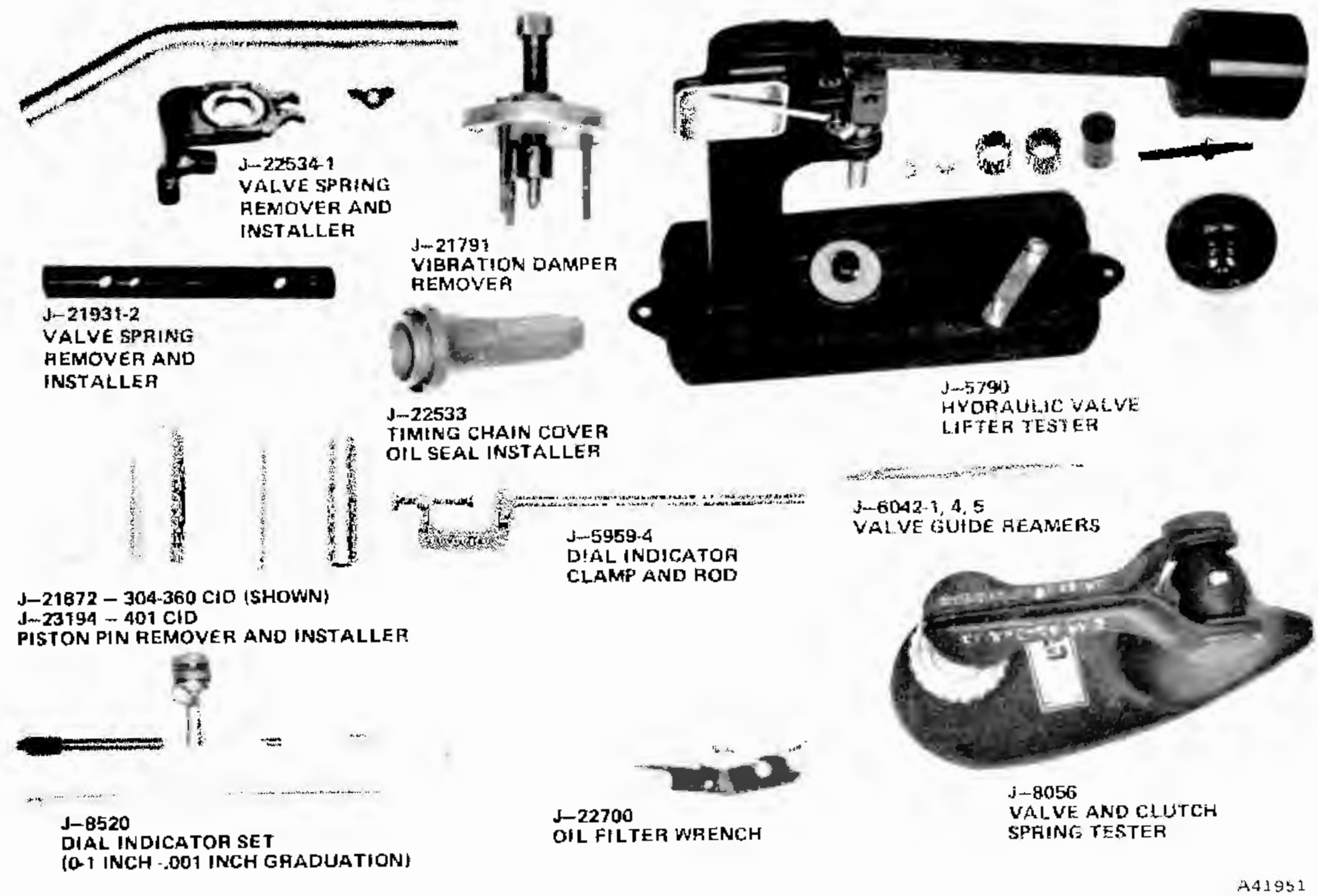

Fig. 1B-44 Special Tools

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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COOLING

DESCRIPTION

The cooling system, sometimes referred to as the engine temperature control system, allows the engine to reach normal operating temperature as quickly as possible and maintains operating temperatures to prevent engine overheating. These functions are required to prevent engine damage and to provide temperature control for desired cylinder combustion. The cooling system also provides a means to heat the passenger compartment.

The cooling system is a pressure type using a centrifugal water pump to circulate coolant throughout the system. It consists of the following components:

Coolant: Absorbs heat from engine.
Water Passages, Water Jackets, and Hoses: Surround hot areas and provide passageways for coolant.
Radiator: Removes heat from coolant.
Water Pump: Circulates coolant.
Drive Belt: Operates water pump and fan.
Fan: Increases airflow through radiator.
Thermostat: Regulates operating temperature of coolant.
Radiator Pressure Cap: Pressurizes system and prevents coolant loss from spillage.
Temperature Indicating System: Informs driver of operating temperature.
Shroud (see Cooling System Component Chart): Funnels air more directly through radiator.

OPERATION

As the engine turns, the belt-driven fan and water pump also turn. The pump vanes receive coolant from the pump inlet and force coolant to circulate into the block and throughout the cooling system.

Six-Cylinder Engine

Coolant flows through the cylinder block back through the cylinder head to the thermostat housing. Below 205 degrees F the thermostat is closed, so coolant flows through a bypass port to recirculate within the engine. Above 205 degrees F the thermostat opens and allows coolant flow through the upper radiator hose to the radiator (fig. 2-1).

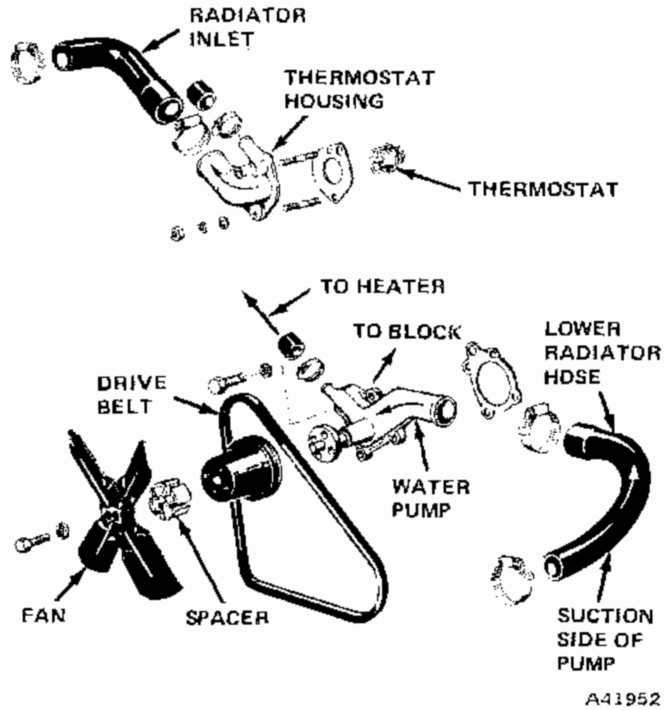

Fig. 2-1 Six-Cylinder Pump Components

V-8 Engine

The pump impeller housing is cast integrally with the water distribution manifold and the engine front cover (fig. 2-2). The water pump discharges coolant into the distribution manifold where dual outlets supply a balanced flow of coolant into both cylinder banks. The coolant flows through the block and back through the cylinder heads to the intake manifold.

Below 195 degrees F the thermostat is closed and coolant flows out a bypass port to the pump inlet for recirculation. Above 195 degrees F the thermostat is open and allows coolant flow through the upper radiator hose to the radiator.

Running warm coolant through the intake manifold aids in quick warmup, better fuel vaporization when

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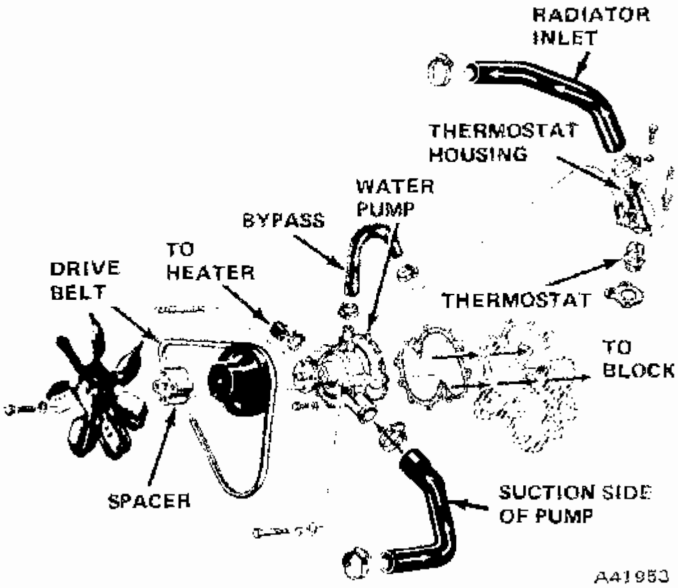

Fig. 2-2 V-8 Pump Components

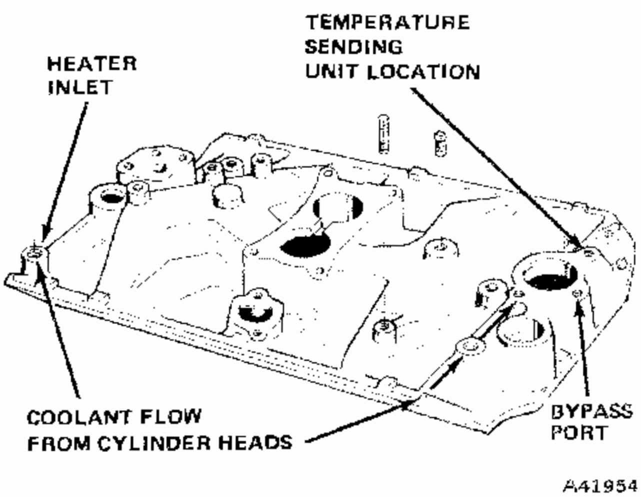

Fig. 2-3 Intake Manifold V-8 Engine

cold, and a more even engine temperature when warm (fig. 2-3).

All

Hot coolant enters the radiator top tank and flows down through tubes to the bottom tank. As it flows, the fan-pulled air flows across the tubes and fins, thus carrying heat away from the coolant. With the pump turning, coolant flows out the lower radiator hose at a cooler temperature, and flows into the pump to restart the cooling cycle.

COOLANT

All-Season Coolant is factory-installed to offer protection against freezing, overheating, and corrosion. All vehicles are protected from freezing to -34 degrees F (36.7 degrees C) by a mixture of 50 percent antifreeze and 50 percent water.

There are important limits to protection levels. A minimum of 44 percent antifreeze (-20 degrees F freezing protection) is desirable for adequate and lasting corrosion protection. A maximum of 68 percent antifreeze affords the lowest possible freezing temperature (-90 degrees F). Freeze protection should be within these limits for maximum year-round protection. A higher percentage will actually raise the freezing temperature. A 100 percent solution of ethylene glycol will freeze at -8 degrees F.

The purpose of using antifreeze in the summer time (especially on cars equipped with air conditioning) is to raise the boiling point for a better heat transfer. Antifreeze does not transfer heat as well as plain water; however, the boiling point of water is raised with the addition of antifreeze and improves overall ability of the cooling system to dissipate heat. Antifreeze solution also provides better circulation than pure water at higher temperatures and during severe operating conditions. The lack of antifreeze allows internal boiling of coolant at low pressure areas throughout the cooling system. This results in reduced flow and cavitation, which is harmful to engine parts.

If coolant level is low, add a mixture of antifreeze and water sufficient to meet local temperature requirements. Plain water may be used in an emergency, but the coolant should be checked as soon as possible for the proper freeze protection. Any time water is used, it should be of low mineral content to resist corrosion and deposits.

The cooling system should be drained, flushed, and the coolant changed at 25,000 miles or 25 months, and then at the start of every winter season. At the same time, the system should be inspected and pressure tested for leaks.

A dark, oily, rust inhibitor is also installed in the coolant. If too much inhibitor is installed, it collects in the radiator upper tank. If overheating does not occur, siphon excess out of the radiator and replenish the level with the correct coolant solution. If overheating occurs, be certain all other units are functioning properly, then drain the cooling system and refill with the proper mixture of coolant.

All-Season Coolant contains lubricant for the water pump seals and corrosion preventive inhibitors. Plain water, methanol, or alcohol-type antifreeze should not be used in the cooling system except in emergencies.

CAUTION: *Coolant additives which are claimed to improve engine cooling are not recommended and should not be used. Some of these additives are not compatible with the foam depressant and other additives already in All-Season Coolant and may actually lower the efficiency of the cooling system.*

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Coolant Level

Radiator coolant level should be checked when the engine is cold (before running). When cold, maintain coolant level 1-1/2 inches to 2 inches below the rear of the filler-neck surface (1/2 inch to 1 inch when hot). **Maintain level with mixture of AMC All-Season Coolant and water.**

If the radiator cap must be removed when the engine is hot, let the engine cool down by letting it idle for a few moments before removing the cap. Then turn the cap slowly to the first notch to let any pressure escape before removing the cap. When doing so, use a heavy rag or towel wrapped over the cap.

If the engine is overheated, exercise extreme care. Let the engine idle for a period above normal idle speed with the hood up unless all coolant has been lost. Shut off the engine and let it cool for 15 minutes before removal of the cap.

FAN

Fan blade assemblies are balanced within 0.25 in.-oz. and, therefore, should not be altered in any way. Refer to the Cooling System Components Chart for fan applications.

Power Flex Fan

Heavy-duty or air conditioning cooling packages use a fan having seven flexible blades which automatically change pitch relative to engine rpm. As rpm increases, blade pitch decreases, saving power and decreasing noise level. At slow speed, the pitch increases and the airflow rate increases to effectively cool the engine. Refer to Cooling System Components Chart for fan applications.

CAUTION: *Fans are designed to fit certain applications only. Therefore, DO NOT attempt to increase cooling capacity by installing a fan not intended for a given engine. Otherwise noise and fan damage may result.*

Tempatrol - Viscous Fan Drive

The Tempatrol fan drive is a torque and temperature-sensitive clutch unit which automatically increases or decreases fan speed to provide adequate cooling (fig. 2-4).

A bimetal thermostatic coil at the front of the clutch unit reacts to changing radiator air temperatures and regulates the flow of silicone fluid into the drive chamber. The amount of fluid flowing into the chamber provides automatic fan speed control in proportion to the cooling demands of the engine.

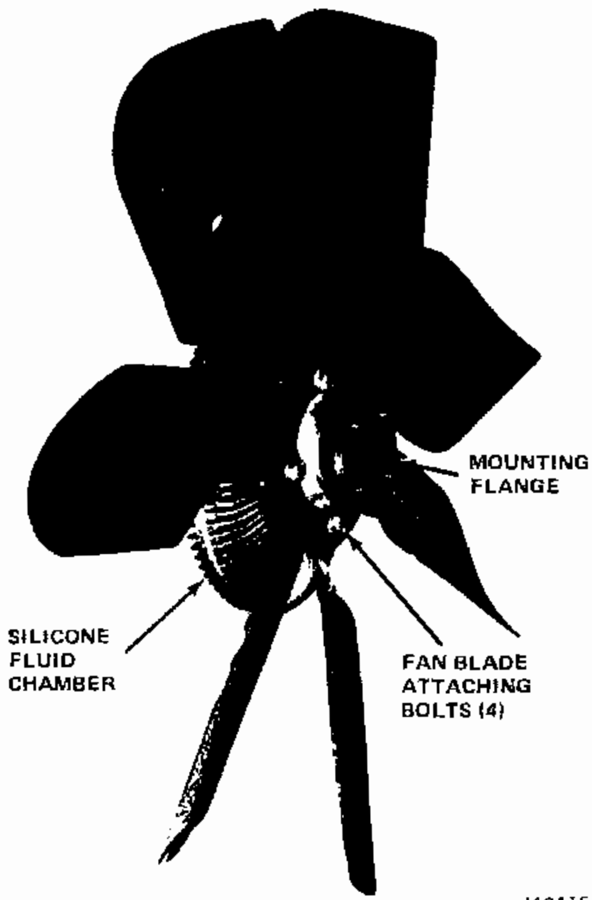

Fig. 2-4 Tempatrol - Viscous Fan

THERMOSTAT

The thermostat assists quick engine warmup by keeping coolant flow within the engine until sufficient temperature relaxes the bimetallic spring and allows coolant to flow to the radiator. This occurs at 205 degrees F (±3 degrees) on six-cylinder engines, and 195 degrees F (±3 degrees) on V-8 engines. The six-cylinder thermostat is fully open at 228 degrees F; the V-8 thermostat is fully open at 218 degrees F.

Engines should not be operated (except for servicing or testing procedures) without a thermostat installed. This causes longer engine warmup time, poor warmup performance, and slower heater warmup.

It is not necessary to change thermostats with a change in season. Use the same thermostat for winter and summer.

NOTE: *The thermostat should be checked whenever the cooling system is serviced, particularly at the time of installation of antifreeze solution.*

When installing the thermostat, the pellet, which is encircled by a coil spring, must face the engine. All thermostats are marked on the outer flange to indicate proper installed position.

The thermostat on six-cylinder engines **must be installed with the air bleed hole up** (fig. 2-5). This prev-

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vents air being trapped in the block which could cause a sudden burping of the coolant when the thermostat opens.

Also during installation, observe the recess on the intake manifold (V-8) or cylinder head (six) and fit the thermostat in that groove (fig. 2-6 and 2-7). Then install the gasket and thermostat housing.

CAUTION: *Tightening the housing unevenly or with the thermostat out of its recess, will result in a cracked housing.*

RADIATOR

The radiator is a fin and tube type with a top and bottom tank soldered to a section of coolant tubes and cooling fins. The bottom tank contains the oil cooler for cars with automatic transmissions

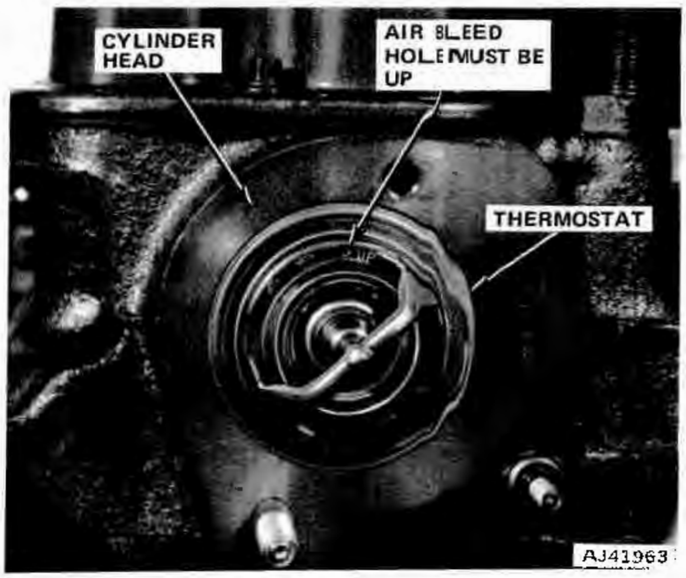


Fig. 2-5 Thermostat Installation - Six-Cylinder

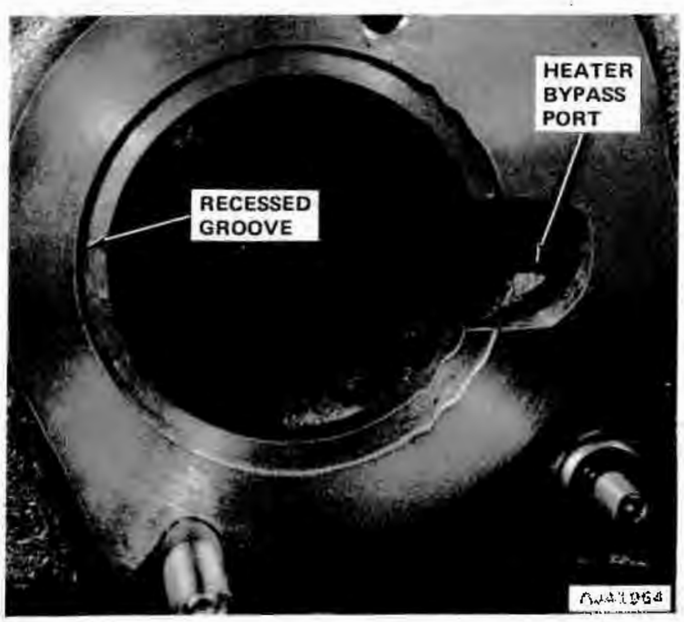


Fig. 2-6 Thermostat Recess - Six-Cylinder

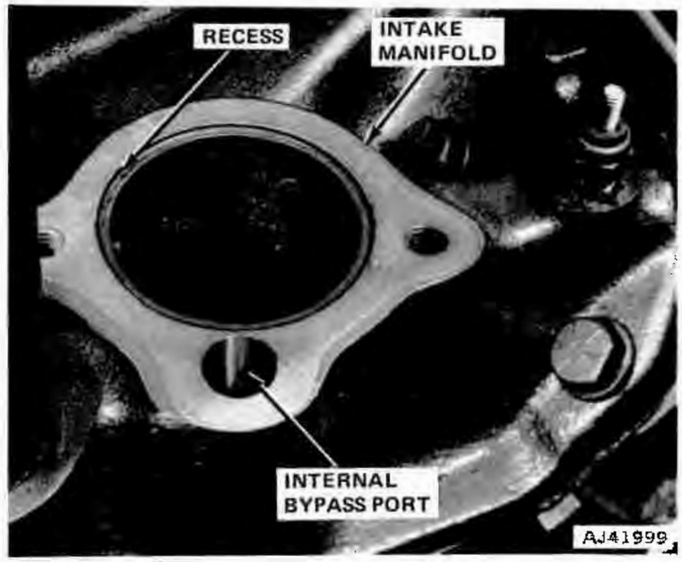


Fig. 2-7 Thermostat Recess - V-8

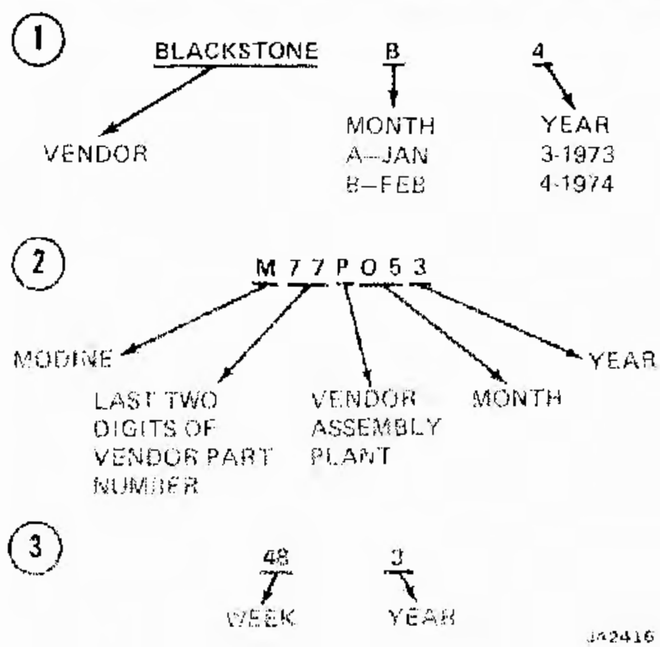
The filler neck on the top tank has an overflow tube attached to provide a passage for escaping coolant. This tube routes boilover to the road on all models.

The radiator is designed to operate at 12 to 15 psi. A 14-psi pressure cap, fitted to the filler neck, controls operating pressure.

NOTE: *For testing radiator for leaks or pressure loss, see Cooling System Pressure Test.*

The bottom tank is fitted with a drain cock to provide a convenient means of draining the radiator. The drain cock should be finger-tight to prevent leaks.

NOTE: *Radiators are identified by a date code stamped on the upper tank following the part number and the vendor's name or, on some J-Series vehicles, the code is on the radiator right side support. Examples:*



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RADIATOR CAP

The radiator cap performs several functions:

- It prevents loss of coolant when the car is in motion and it keeps impurities and excess air out of the cooling system.
- It seals the cooling system up to 12 to 15 psi pressure. This raises the boiling point of the coolant which results in less coolant loss, more efficient engine operating temperature, and better passenger compartment heating.

NOTE: *Pressurizing the cooling system increases the boiling point approximately 2-1/2 degrees F for each pound of pressure. The 14-psi cap raises the coolant boiling point 42 degrees F.*

- It allows atmospheric pressure to enter the cooling system to equalize pressure during cool-down when a cooling system vacuum occurs.

Operation

The cap consists of a pressure release valve and a vacuum vent valve. With the system cold, the pressure valve is spring-loaded, providing a seal between the filler neck and the cap (fig. 2-8). The vacuum valve is suspended and hangs freely, so no pressure can build at this time. As coolant temperature rises, vapors begin to form and flow through the vacuum valve. When this flow reaches 0.4 to 0.7 cubic feet per minute, the vacuum valve seats and pressure begins to rise. When pressure exceeds the cap rating (14 psi nominal, 12 to 15 psi OK range), pressure overcomes the spring tension, unseats the valve, and allows pressure and coolant to flow out the overflow tube.

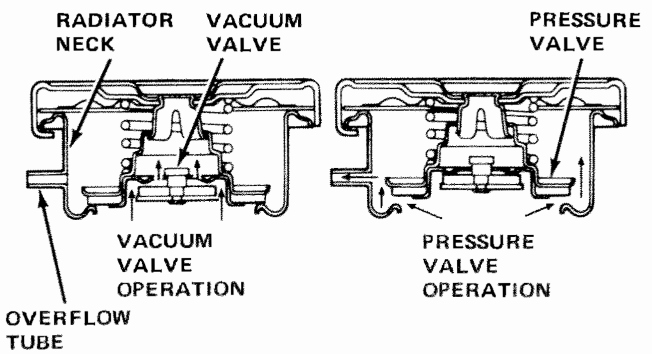

Fig. 2-8 Pressure Radiator Cap

After shutdown, the coolant temperature drops and the coolant contracts. This shrinking within the closed system creates a low pressure. Atmospheric pressure above the vacuum valve pushes the vacuum valve open, allowing pressure to equalize.

If the pressure valve did not release, pressure would eventually build to a point that would burst hoses or the radiator. If the vacuum valve did not allow pressure to equalize, the weaker parts in the cooling system (heater core, radiator, and hoses) would collapse.

TEMPERATURE GAUGE

The temperature gauge is an electrical instrument that indicates coolant temperature.

Temperature indication should be interpreted as shown in the Temperature Gauge Calibration Chart. Temperatures in the range between 171 degrees F and 242 degrees F are considered normal. During extreme cold weather operation, temperature indication will be lower. During extreme load conditions, high ambient temperature, high altitude, or in slow moving traffic, temperature indications may reach the higher end of the scale. This is normal providing there is no coolant loss.

TEMPERATURE GAUGE CALIBRATION (ALL MODELS)

C (Cold)	130 degrees F
Beginning of Band	171 degrees F
Top of Band	242 degrees F
H (Hot)	270 degrees F

COOLING SYSTEM SERVICE DIAGNOSIS

Cooling system problems generally involve engine overheating, running too cold, or the loss of coolant. Any of these problems should be serviced promptly to avoid engine damage or driver discomfort. An engine running too cold may suffer from crankcase oil dilution or excess sludge deposits. A hot engine can cause thinning of the oil, premature wear, increased oil consumption, and pre-ignition.

Cooling system trouble is often related to a gauge reading. If operating properly, the gauge only indicates what temperature actually exists. For complaints of high or low temperature indications that are not accompanied with coolant loss or poor heater performance, verify the reading by checking the coolant temperature with a thermometer. If the temperature corresponds with the gauge, test the cooling system; if not, test the gauge.

The cooling system is designed to function properly through a range of temperatures. Temperatures within the band on the temperature gauge are considered normal. The usual running temperature encountered will depend on ambient temperature, driving and load conditions, and gauge and sending unit tolerances.

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SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
HIGH TEMPERATURE INDICATION — OVERHEATING	(1) Coolant level low	(1) Replenish coolant level
	(2) Fan belt loose	(2) Adjust fan belt
	(3) Radiator hose(s) collapsed	(3) Replace hose(s)
	(4) Radiator blocked to airflow by debris or special equipment	(4) Remove restriction
	(5) Faulty radiator cap	(5) Replace cap
	(6) Vehicle overloaded	(6) Reduce load
	(7) Defective Tempatrol fan	(7) Replace fan
	(8) Ignition timing incorrect	(8) Adjust ignition timing
	(9) Idle speed low	(9) Adjust idle speed
	(10) Air trapped in cooling system	(10) Purge air
	(11) Vehicle in heavy traffic	(11) Operate at fast idle intermittently to cool engine
	(12) Incorrect cooling system component(s) installed	(12) Install proper component
	(13) Faulty thermostat	(13) Replace thermostat
	(14) Water pump shaft broken or impeller loose	(14) Replace water pump
	(15) Radiator tubes clogged	(15) Flush radiator
	(16) Cooling system clogged	(16) Flush system
	(17) Casting flash in cooling passages.	(17) Repair or replace as necessary. Flash may be visible by removing cooling system components or removing core plugs.
	(18) Brakes dragging.	(18) Repair brakes.
	(19) Excessive engine friction.	(19) Repair engine
	(20) Vehicle working beyond cooling system capacity	(20) Install heavy-duty cooling or use special-duty vehicle

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
HIGH TEMPERATURE INDICATION—OVERHEATING (Continued)	(21) Antifreeze concentration over 68%	(21) Lower antifreeze content
LOW TEMPERATURE INDICATION	(1) Improper fan being used	(1) Install proper fan
	(2) Improper radiator	(2) Install proper radiator
	(3) Thermostat stuck open	(3) Replace thermostat
	(4) Improper fan pulley (too small)	(4) Install proper pulley
COOLANT LOSS BOILOVER	Refer to Overheating Causes in addition to the following:	
	(1) Overfilled cooling system	(1) Reduce coolant level to proper specification.
	(2) Quick shutdown after hard (hot) run	(2) Allow engine to run at fast idle prior to shutdown.

NOTE: *Immediately after shutdown, the engine enters a period known as "heat soak." This occurs when the cooling system is inoperative and engine temperature is still high. If coolant temperature rises about the boiling point, it may push some coolant out of the radiator overflow tube. If this does not occur frequently, it is considered normal.*

Condition	Possible Cause	Correction
	(3) Air in system resulting in occasional burping of coolant	(3) Purge system
	(4) Insufficient antifreeze allowing coolant boiling point to be too low	(4) Add antifreeze to raise boiling point
	(5) Antifreeze deteriorated because of age or contamination	(5) Replace coolant
	(6) Leaks due to loose hose clamps, loose nuts, bolts, drain plugs, faulty hoses, or defective radiator.	(6) Pressure test system to locate leak then repair as necessary.
	(7) Faulty head gasket	(7) Replace head gasket.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
COOLANT LOSS BOILOVER (Continued)	(8) Cracked head, manifold, or block	(8) Replace as necessary
COOLANT ENTRY INTO CRANKCASE OR CYLINDER	(1) Faulty head gasket	(1) Replace head gasket
	(2) Crack in head, manifold or block	(2) Replace as necessary
NOISE	(1) Fan contacting shroud	(1) Reposition shroud and check engine mounts
	(2) Loose water pump	(2) Replace pump
	(3) Dry fan belt	(3) Apply belt dressing or replace belt
	(4) Loose fan belt	(4) Adjust fan belt
	(5) Rough surface on drive pulley	(5) Replace pulley
	(6) Water pump bearing worn	(6) Remove belt to isolate. Replace pump
NO COOLANT FLOW THROUGH HEATER CORE	(1) Plugged return pipe in water pump	(1) Remove obstruction
	(2) Heater hose collapsed or plugged	(2) Remove obstruction or replace hose
	(3) Plugged heater core	(3) Remove obstruction or replace core
	(4) Plugged outlet in thermostat housing	(4) Remove flash or obstruction
	(5) Heater bypass hole in cylinder head plugged (six-cylinder).	(5) Remove obstruction

ADJUSTMENTS

Drive Belts

The cooling system fan, alternator, and water pump are driven by a V-type drive belt from a pulley on the vibration damper. In addition, such engine-driven accessories as the power steering pump and air conditioning compressor also employ a similar V-type drive belt.

It is important that the proper tension of the belt be maintained to ensure efficient operation of the cooling system. Overtightening will cause excessive wear on the water pump, alternator, and accessory bearings.

The belts can be checked for proper adjustment by using a belt strand tension gauge on the longest accessible span of belt between two pulleys (see Engine Drive Belt Tension chart).

When using the gauge on a notched belt, the middle finger of the gauge should be in the notched cavity of the belt.

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NOTE: *New belt tension specifications apply only to service replacement belts. Once a belt has been tensioned and run, it is considered a used belt and should be adjusted to used belt specifications.*

Make adjustments at the mounting brackets of each unit.

NOTE: *Consult Specifications for proper tensions.*

Fan and Alternator Belt Adjustment

(1) Loosen alternator pivoting mount bolt.

(2) Loosen alternator adjusting bolt.

(3) Adjust belt using pry bar or 1/2-inch square drive bar. Snug adjusting bolt (fig. 2-9 and 2-10).

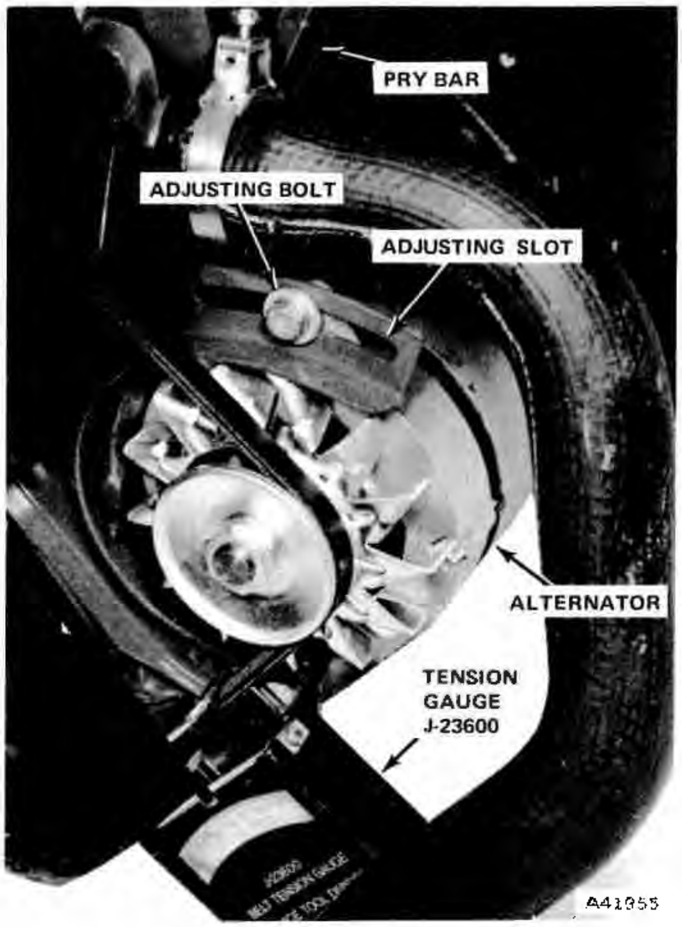

Fig. 2-9 Adjusting Fan Drive Belt - Six-Cylinder

(4) Check belt tension using Tension Gauge J-23600 (fig. 2-11).

(5) Tighten adjusting bolt to 18 foot-pounds torque and mounting bolts to 28 foot-pounds torque.

Hose Position

In places where hoses do not have specific routing clamps, make sure hoses are moved to clear exhaust pipes, fan blades, and drive belts. Otherwise hoses will be damaged resulting in coolant loss and overheating.

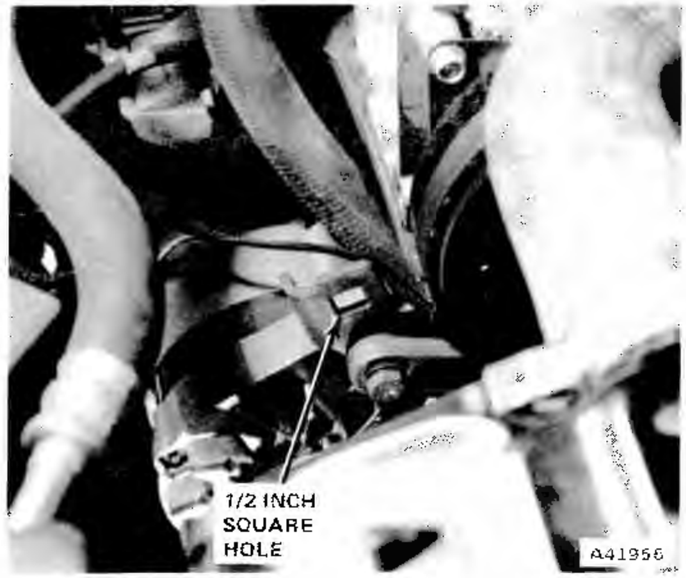

Fig. 2-10 Alternator Adjustment Bracket - V-8

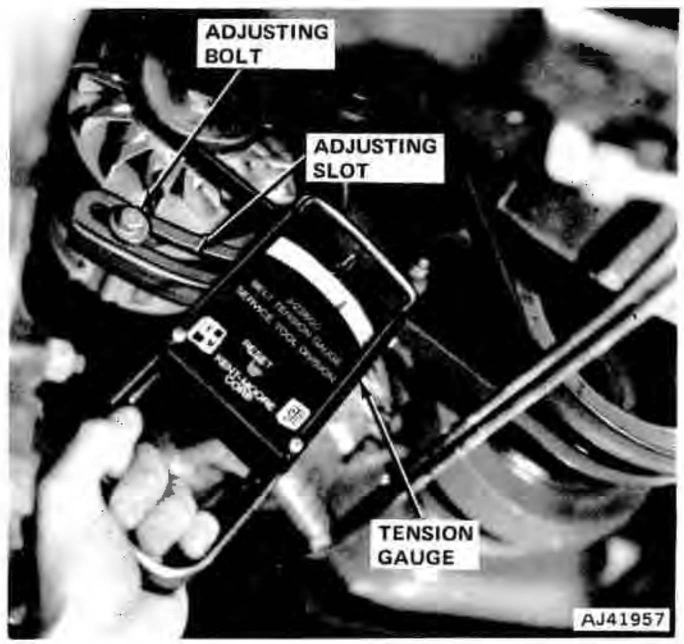

Fig. 2-11 Checking Fan Drive Belt Tension

Shroud Position

In some extreme cases, the engine fan may contact the shroud. An examination of proper engine mounting should locate the trouble. If not, examine the shroud position. To compensate for normal engine movement, loosen the shroud mounting screws and relocate shroud to prevent fan-to-shroud contact.

DIAGNOSIS TESTS

Freeze Protection

Cooling system freeze protection should be checked with an antifreeze hydrometer to determine protection level.

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Water Pump Test

To test a water pump for a loose impeller, proceed as follows:

(1) Position clean bucket beneath water pump.

(2) Loosen fan belt.

(3) Disconnect lower radiator hose from water pump.

WARNING: *Engine should be cooled prior to this test to avoid burns.*

(4) Bend a stiff clothes hanger or welding rod as shown in figure 2-12.

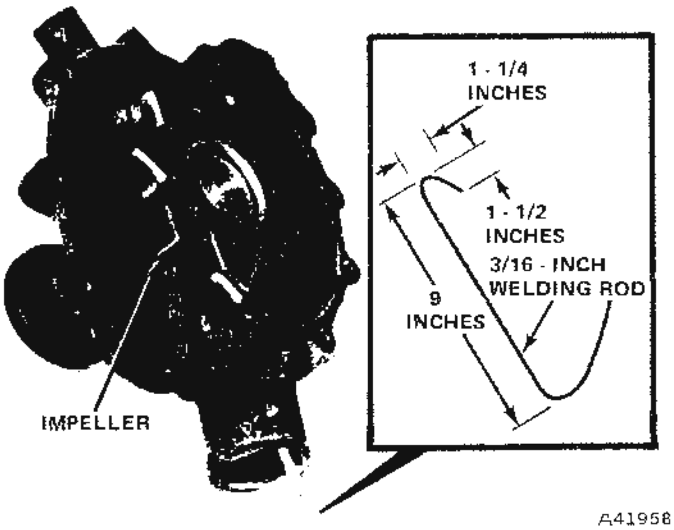

Fig. 2-12 Checking Water Pump for Loose Impeller

(5) Position rod in water pump inlet and try to turn fan. If impeller is loose and can be held with rod while fan is turning, pump is defective. If impeller turns, pump is OK.

(6) Reconnect hose and replenish coolant, or proceed with further repairs.

Tempatrol Fan - Test

Start the engine and allow it to warm up to operating temperature. From under the hood, gradually increase the engine speed until a definite decrease of the audible fan airflow is heard. Maintain this engine speed until a definite increase of the audible fan airflow is heard.

The Tempatrol unit is operating satisfactorily if the time interval between decrease and increase of the audible fan airflow does not exceed three minutes.

NOTE: *The cooling system must be in good condition prior to performing the above test to ensure against excessively high radiator air temperatures.*

Thermostat Test

(1) Remove thermostat.

(2) Insert 0.003-inch feeler gauge, with wire or string attached, between valve and its seat (fig. 2-13).

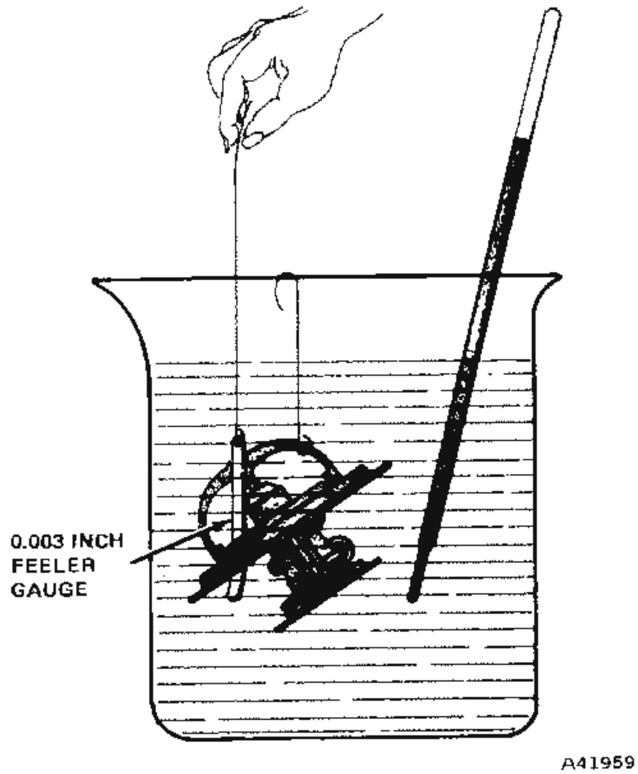

Fig. 2-13 Testing Thermostat

(3) Submerge thermostat in a container of antifreeze solution, suspend it so it does not touch sides or bottom of container.

(4) Suspend a thermometer in solution so it does not touch container.

(5) Heat solution.

(6) Apply slight tension on feeler gauge while solution is heated. The moment valve opens 0.003 inch, feeler gauge will slip free from valve. Note temperature at which this occurs. Valve must open 0.003 inch at its rated temperature (±3 degrees F). It must be fully open as follows:

	Thermostat Rating	Fully Open
V-8 Engine	195 degrees F	218 degrees F
Six-Cylinder Engine	205 degrees F	228 degrees F

(7) Install thermostat.

Cooling System Pressure Test

NOTE: *Engine should be at operating temperature.*

(1) Carefully remove the radiator pressure cap from filler neck.

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(2) Check coolant level.

(3) Wipe inside of filler neck. Examine lower inside sealing seat of filler neck for nicks, dirt, and solder bumps.

(4) Inspect overflow tube for dents or internal obstruction. Run a wire through tube to be sure it is clear.

NOTE: *Pressure released by pressure cap during operation must pass through this tube. An obstructed tube may cause the radiator or some portion of cooling system to burst from excessive pressure.*

(5) Inspect the cams on outside of filler neck. If cams are bent, seating of pressure cap valve and tester seal will be affected. Bent cams can be reformed if done carefully.

(6) Attach pressure tester to filler neck with locking ears in line with entrance notches of filler neck (fig. 2-14). Press down slightly and rotate clockwise until locking ears are stopped by stop lugs on filler neck. DO NOT FORCE.

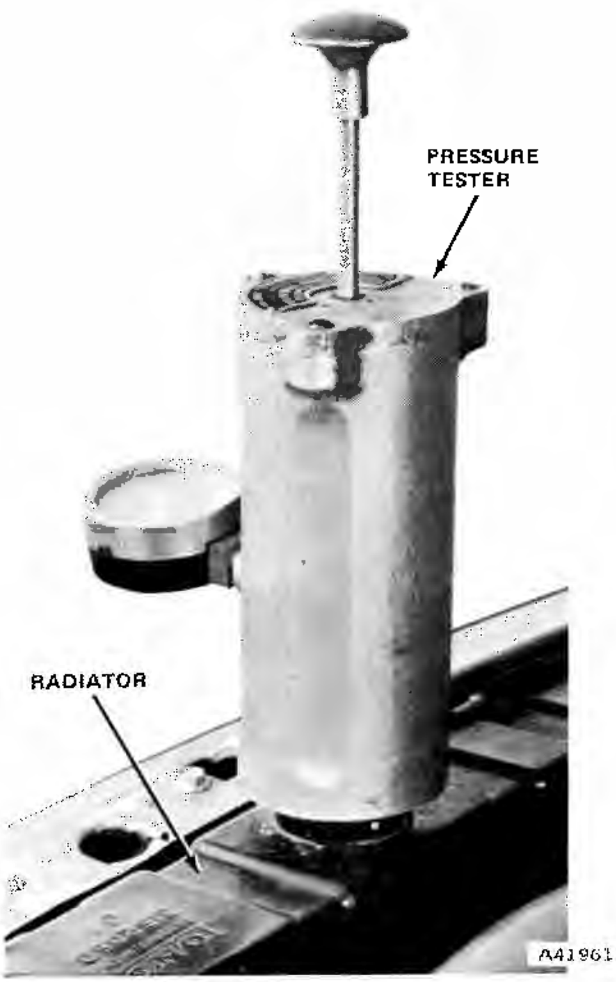

Fig. 2-14 Cooling System Pressure Test

(7) Operate tester pump to apply 15 psi pressure to system.

(8) Observe needle.

(a) **Holds Steady:** If needle holds steady for two minutes, there are no serious leaks in system. Examine all points for seepage or slight leakage with a flashlight.

(b) **Drops Slowly:** Indicates presence of small leaks or seepage. Check radiator, hose, gaskets, and heater. Seal tiny leaks in radiator core with AMC Sealer Lubricant (part number 8990040). Repair leaks and recheck system for minor leaks. If radiator hose swells excessively while testing, replace hose.

(c) **Drops Quickly:** Indicates that serious leakage is present. Large radiator leaks should be repaired by a reputable radiator repair shop.

(9) Check for interior leakage.

(a) Gauge shows pressure drop and there is no visible leakage.

1. Remove tester and replace pressure cap.

2. Run engine to churn oil, then examine dipstick for water gobules or remove crankcase drain plug and drain a small amount of oil (water, being heaviest, should drain first).

3. Check transmission dipstick for water globules.

4. Check transmission intercoolers for leakage.

(b) Compression or combustion leakage into cooling system.

1. Run engine at normal operating temperature with pressure cap on radiator.

CAUTION: *Do not allow pressure buildup over 15 psi. Release pressure by turning engine off and removing tester.*

2. Remove pressure cap carefully and apply Pressure Tester to filler neck. If pressure builds up quickly, a leak exists as a result of a blown gasket or crack. Repair as necessary.

3. Operate Pressure Tester, if there is no immediate pressure increase, until gauge reads within system range. Gauge hand vibration indicates compression or combustion leak into cooling system.

4. Isolate compression leak by shorting each spark plug. Gauge hand stops or decreases vibration when spark plug of leaking cylinder is shorted. Retest with Pressure Tester after repair.

(10) Remove tester from radiator neck.

Combustion Leakage Test (Without Pressure Tester)

(1) Drain coolant.

(2) Disconnect water pump drive belt.

(3) Disconnect thermostat housing from engine and remove thermostat.

(4) Add coolant and water mixture to engine to bring level above bottom surface.

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(5) Start engine and accelerate rapidly three times while watching coolant.

CAUTION: *Do not run engine too long to avoid overheating.*

NOTE: *If any internal engine leaks to the cooling system exist, bubbles will appear in the coolant. If bubbles do not appear, there are no internal leaks.*

Hose and Belt Inspection

Check hoses at regular intervals by squeezing. If a cool hose is firm when squeezed, it is OK. If a hose is cracked or feels brittle when squeezed, it should be replaced to prevent later trouble. Inspect V-belts frequently for similiar defects.

Radiator Cap Test

(1) Remove cap from radiator.
(2) Make sure sealing surfaces are clean.
(3) Wet rubber gasket with water and install cap on tester (fig. 2-15).

NOTE: *It may be necessary to install cap several times to ensure tight seal.*

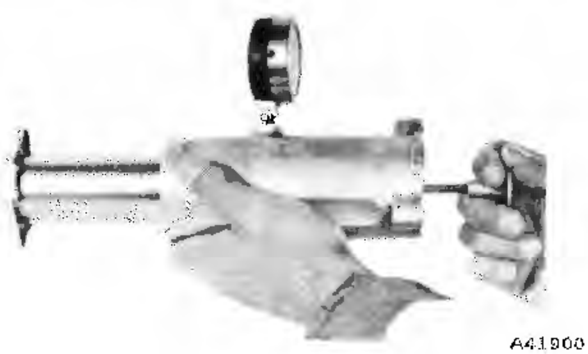

Fig. 2-15 Radiator Pressure Cap Test

(4) Operate tester pump and observe needle at its highest point. Cap release pressure should be 12 to 15 pounds.

NOTE: *Cap is OK when pressure holds steady or holds within the 12 to 15 pound range for 30 seconds or more. If needle drops quickly, replace cap.*

Temperature Gauge and Sending Unit Tests

On-vehicle tests of the sending unit are limited to temperatures up to the boiling point. Install a thermometer in radiator filler neck opening to determine coolant temperature.

Touch one prod of an ohmmeter to sending unit terminal and other prod to outer portion of sender.

CAUTION: *Do not connect ohmmeter with sender unit wire connected and key in on position. Damage to ohmmeter may result.*

Ohmmeter reading should coincide with coolant temperature (fig. 2-16). To check temperatures over boiling point, remove sending unit and put it in a pan of pure antifreeze or oil. Check using a thermometer and ohmmeter.

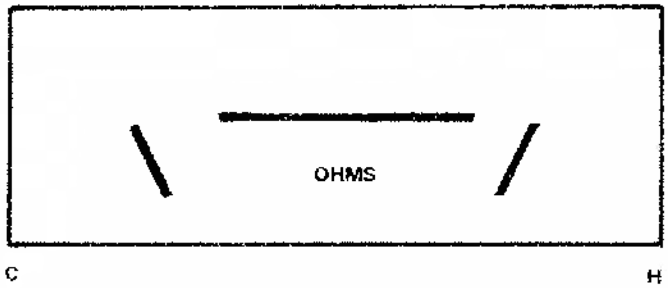

Fig. 2-16 Coolant Temperature Gauge

TEMPERATURE GAUGE CALIBRATION (ALL MODELS)

C (COLD): 130 Degrees - 73 Ohms
Beginning of Band: 171 Degrees - 36 Ohms
Top of Band: 242 Degrees - 13 Ohms
H (HOT): 270 Degrees - 9 Ohms

Use Gauge Tester J-22344-0 to test the temperature gauge.

Connect one test lead to ground and other lead to sender unit wire. Adjust tester to 9 and turn ignition on. Gauge needle should be on hot mark after several seconds of warmup time. If gauge does not register correctly through entire tester range, gauge is defective. If gauge does not register at all or registers high or low through its entire range, refer to the Electrical Section - Instrument Cluster Component Tests for further testing.

SERVICE PROCEDURES

Draining Coolant

NOTE: *DO NOT WASTE usable coolant. If solution is clean and is being drained only to service the cooling system (i.e., remove radiator), collect coolant in a clean container and re-use it.*

The coolant can be drained from the radiator by loosening the drain cock on the bottom tank.

Coolant can be drained from the engine block by removing the drain plugs.

Six-Cylinder: Two located on left side of block. May have one or two CTO switches in them.

V-8: Centrally located on each side of block.

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WATER PUMP SERVICE

The water pump is the centrifugal type and is serviced only as an assembly.

Removal - Six-Cylinder Engine

(1) Disconnect battery negative cable.

(2) Drain cooling system at radiator.

(3) Disconnect radiator and heater hoses from water pump.

(4) Loosen alternator adjustment strap screw and remove drive belt.

NOTE: *If vehicle is equipped with a radiator shroud, it is necessary to separate shroud from radiator to facilitate removal and installation of engine fan and hub assembly.*

(5) Remove fan and hub assembly.

(6) If equipped with air conditioning, disconnect compressor mount bracket from water pump housing and loosen remaining mount bracket nuts, do not remove nuts.

(7) Remove front half of alternator bracket. Support weight of alternator by inserting lower pivot bolt through rear half of alternator bracket.

(8) Remove water pump and gasket from engine.

(9) Clean all old gasket material from gasket surface of engine, and remove any foreign material which may have accumulated in impeller cavity.

Installation

(1) Install new water pump and gasket to engine.

(2) Tighten retaining bolts to specified torque.

(3) Install front half of alternator bracket.

(4) Install alternator drive belt and tighten to specified tension.

(5) If disconnected, connect compressor mount bracket to water pump housing, and tighten remaining mount bracket nuts.

(6) Tighten air conditioning drive belt to specified tension.

(7) Connect radiator and heater hoses to water pump.

(8) Reconnect battery.

(9) Fill radiator with a 50 percent Jeep All-Season Coolant and 50 percent water mixture. Start engine and open heater control valve to remove air bubbles from heater core. Operate engine long enough for thermostat to open, and recheck coolant level.

Removal - V-8 Engine

(1) Disconnect battery negative cable.

(2) Drain radiator and disconnect upper radiator hose at radiator.

(3) Loosen all drive belts.

(4) Remove fan and hub assembly.

NOTE: *If vehicle is equipped with a radiator shroud, it is necessary to separate it from radiator to facilitate removal and installation of engine fan and hub assembly.*

(5) If equipped with a viscous fan, remove fan assembly (do not unbolt fan blades) and shroud all at the same time. There is sufficient room to move viscous fan assembly toward radiator and clear water pump.

NOTE: *Studs in water pump may back out of water pump when nuts are removed preventing fan assembly from clearing water pump. In the event this happens, install a double nut on stud(s) and remove stud(s).*

(6) If vehicle is equipped with air conditioning, install a double nut on air conditioning compressor bracket to water pump stud and remove stud (fig. 2-17).

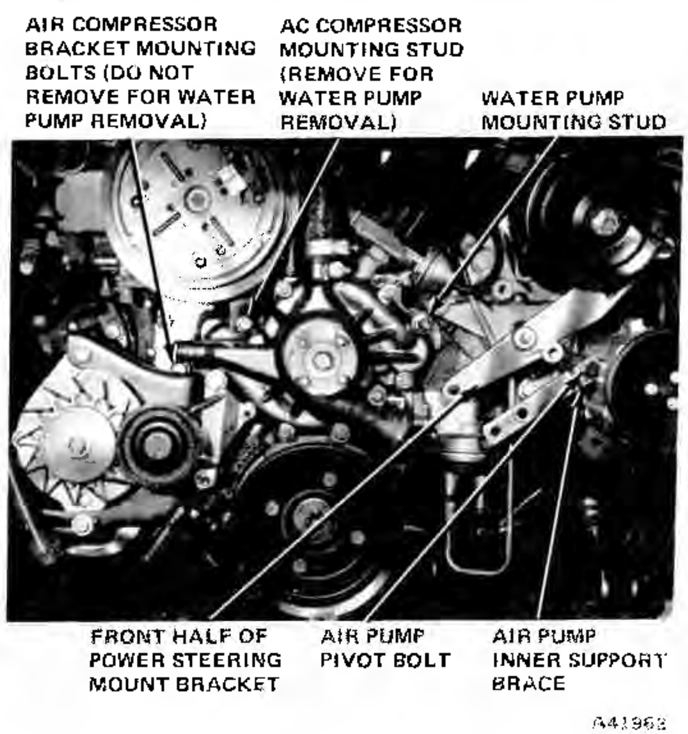

Fig. 2-17 Water Pump Mounting - V-8 Engine

NOTE: *Removal of this stud eliminates removing compressor mounting bracket.*

(7) Remove alternator and mount bracket assembly and place aside. Do not disconnect wires.

(8) If equipped with power steering, remove two nuts that attach power steering pump to rear half of pump mounting bracket.

(9) Remove two bolts that attach front half of bracket to rear half.

(10) Remove remaining upper bolt from inner air pump support brace, loosen lower bolt and drop brace away from power steering front bracket (fig. 2-17).

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(11) Remove front half of power steering bracket from water pump mounting stud.

NOTE: *If vehicle is equipped with a radiator shroud, it is necessary to separate it from radiator to facilitate removal and installation of engine fan and hub assembly.*

(12) Disconnect heater hose, bypass hose, and lower radiator hose at water pump.

(13) Remove water pump and gasket from timing chain cover.

(14) Clean all old gasket material from gasket surface of timing chain cover.

Installation

(1) Install new water pump and gasket to timing chain cover.

(2) Tighten retaining bolts to specified torque.

(3) If removed, install front section of power steering mount bracket, power steering pulley and drive belt.

(4) Tighten drive belt to specified tension, then tighten pulley retaining nut to 55 to 60 foot-pounds torque.

(5) If removed, install air pump drive belt and tighten to specified tension.

(6) Install alternator and mount bracket assembly.

(7) Connect heater hose, bypass hose, and lower radiator hose to water pump.

NOTE: *Vehicles with a shroud should have radiator removed previously as bolts that attach shroud also retain radiator.*

CAUTION: *Check to be sure the wire coil is installed in the lower radiator hose. Failure to install this coil will result in the hose collapsing during high engine rpm.*

(8) Install engine fan and hub assembly and tighten retaining bolts to specified torque.

(9) If equipped with a viscous fan, install shroud and fan assembly at same time.

(10) Install alternator drive belt and tighten to specified tension.

(11) Connect upper radiator hose to radiator.

(12) Connect battery negative cable.

(13) Fill cooling system with a 50 percent Jeep All-Season Coolant and 50 percent water mixture. Operate engine with heater control valve open until thermostat opens. Shut off engine and recheck coolant level.

Radiator Maintenance

The radiator should be free from any obstruction to airflow. This includes bugs, leaves, mud, emblems, flags, improperly mounted license plates, or collision damage.

NOTE: *Dirt may be removed by blowing shop air from the engine side of the radiator through the fins.*

Several problems may affect the ability of the radiator to perform properly:

- Bent or damaged tube.
- Corrosive deposits restricting coolant flow.
- Tubes blocked due to improper soldering.

Damaged tubes which affect proper operation must be repaired. Leaks can be detected by applying 3 to 5 psi air pressure to the radiator while it is submerged in water. Tubes should be repaired with solder.

A clogged radiator can be restored by reverse flushing or by solvent cleaning.

Solvent Cleaning

In some cases, installing a radiator cleaner (AMC Radiator Kleen, part number 8990397) prior to flushing will soften scale and deposits and reinforce the flushing operation.

CAUTION: *Be sure to follow directions on container.*

Reverse Flushing Radiator

CAUTION: *The cooling system normally operates at 12 to 15 psi pressure. Exceeding this pressure may damage the radiator, heater core, or hoses.*

(1) Disconnect radiator.

(2) Attach a piece of radiator hose to radiator bottom outlet and insert flushing gun.

(3) Connect water supply hose and air supply line to flushing gun.

(4) Allow radiator to fill with water.

(5) When radiator is filled, apply air in short blasts, allowing radiator to refill between blasts.

Continue this reverse flushing until clean water flows through top hose. If flushing fails to clear radiator passage, the radiator will have to be cleaned more extensively by a radiator repair shop.

Engine Flushing

(1) Remove thermostat and reinstall thermostat housing.

(2) Attach flushing gun to upper radiator hose.

(3) Attach leadaway hose to water pump inlet.

(4) Connect water supply hose and air supply line to flushing gun.

(5) Allow engine to fill with water.

(6) When engine is filled, apply air in short blasts, allowing system to fill between air blasts. Continue until clean water flows through leadaway hose.

(7) Install thermostat.

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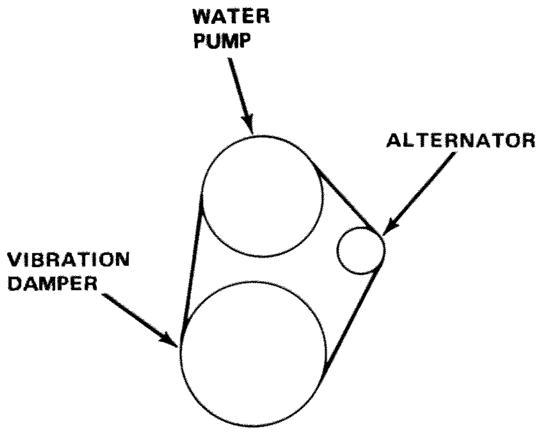
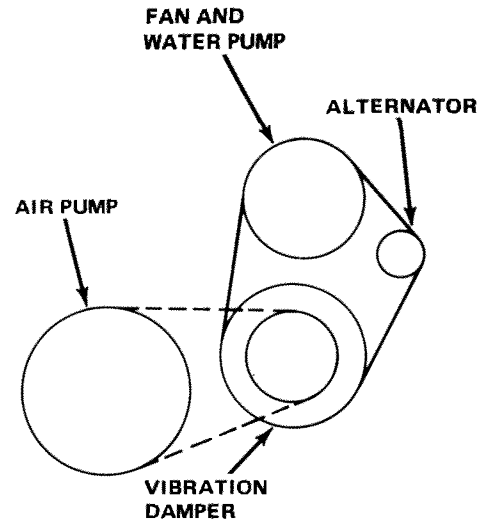
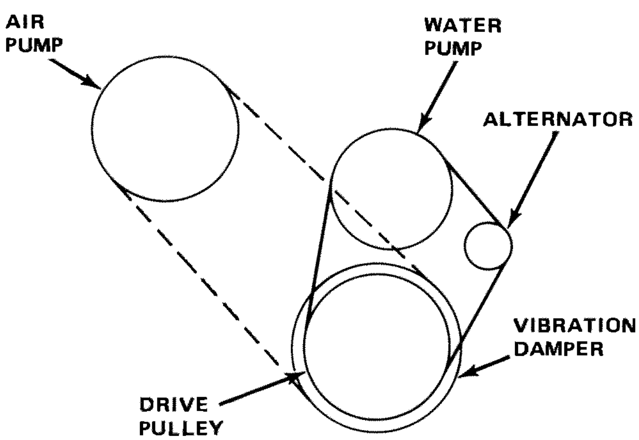


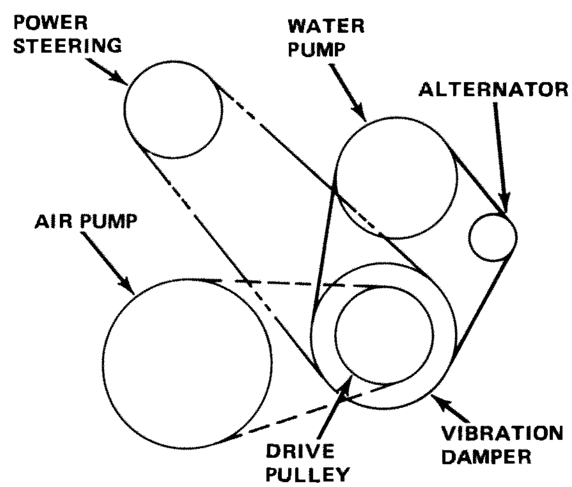
BELT ARRANGEMENT - CJ SIX-CYLINDER - WO/AGE, WO/PS, WO/AC



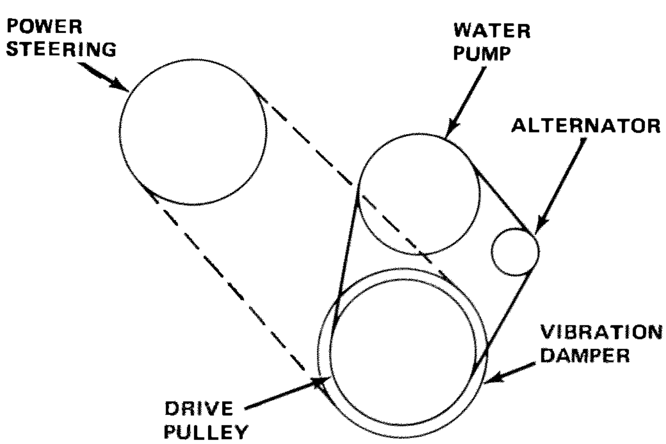
BELT ARRANGEMENT - CHEROKEE AND TRUCK SIX-CYLINDER - W/AGE (WO/PS, WO/AC)



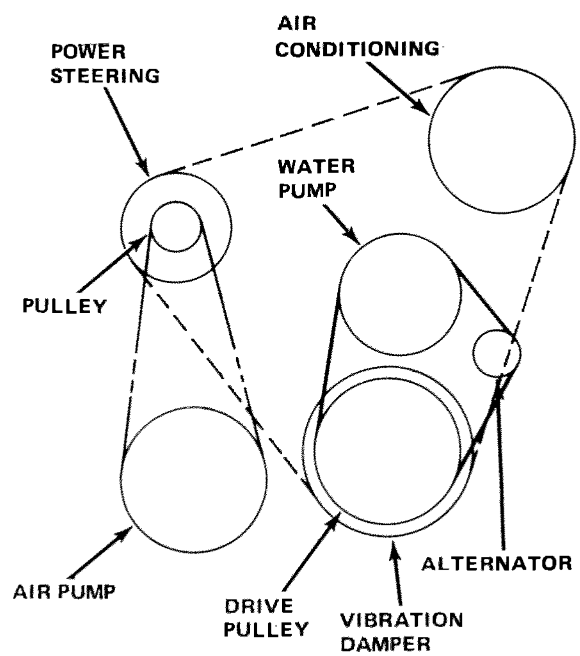
BELT ARRANGEMENT - CHEROKEE AND TRUCK SIX-CYLINDER - W/AGE (WO/PS, WO/AC)



BELT ARRANGEMENT - CHEROKEE AND TRUCK- SIX-CYLINDER - W/PS, W/AGE, (WO/AC)



BELT ARRANGEMENT - CJ SIX-CYLINDER - W/PS, (WO/AGE, WO/AC)



BELT ARRANGEMENT - CHEROKEE AND TRUCK SIX-CYLINDER - W/PS, W/AC, W/AGE J42418

Fig. 2-18 Drive Belt Arrangement - Six-Cylinder Engines

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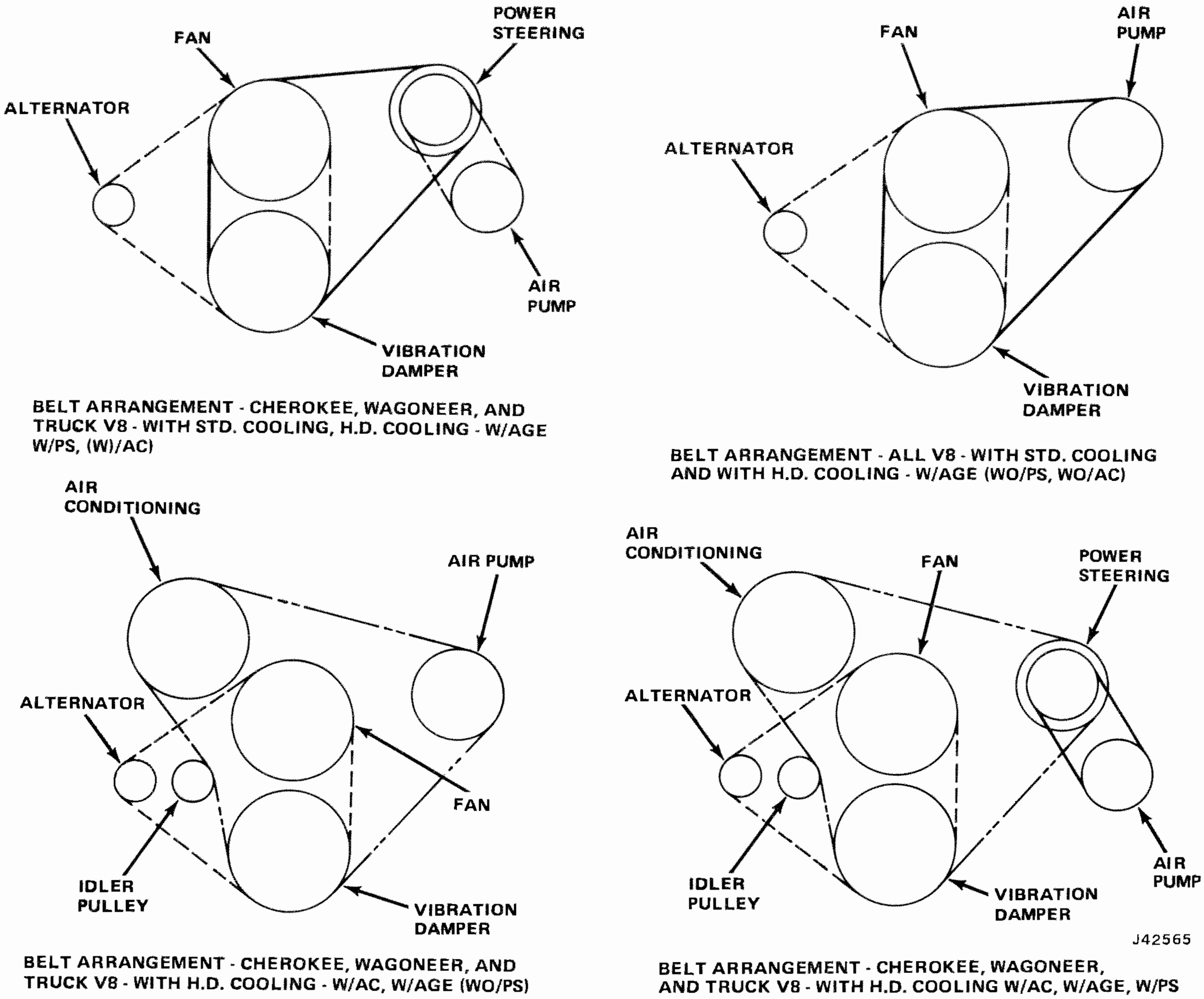

Fig. 2-19 Drive Belt Arrangement - V-8 Engines

(8) Connect radiator hoses.
(9) Refill cooling system.

OIL COOLER

An oil cooler is incorporated in the lower tank of the radiator on all vehicles equipped with an automatic transmission. Hot oil from the transmission is pumped through the cooler where the heat transfers to the coolant in the radiator. Two lines connect the transmission to the lower radiator tank.

Should a leak in the oil cooler occur, it can be detected by the presence of oil in the coolant. If oil appears in the coolant, check the oil level of the automatic transmission. If the oil level is low, check the oil cooler for leaks as follows:

(1) Remove transmission-to-cooler lines at radiator.

(2) Plug one fitting.

(3) Remove radiator cap and fill radiator so bubbles can be seen.

(4) Apply shop line air pressure (50 to 200 psi) to other fitting.

Bubbles in coolant at filler neck indicate a leak in oil cooler. Should a leak in oil cooler occur, radiator must be removed and repaired.

NOTE: *Because of high pressure oil cooler may be subjected to, soldering is not allowed for oil cooler repair.* **All repairs must be silvered soldered or brazed.**

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Bleeding Air from System

It may be necessary to bleed trapped air from the cooling system. Trapped air will hamper or stop coolant flow or cause burping of engine coolant out of radiator.

Bleed air by operating the engine with a properly filled cooling system with the radiator cap off until coolant has completely circulated throughout the engine, or until normal operating temperature is reached. The heater temperature control must be in the full HEAT position.

Replenish coolant level, if necessary, and reinstall radiator cap.

COOLING SYSTEM COMPONENTS APPLICATION CHART

Models									Engines						Cooling System			Radiator Specifications					Fan				Shroud
14	15	16	17	25	45	46	83	84	232	258	304	360-2V	360-4V	401	Std.	H. Duty	A/C	Core Size (Inches) Width	Core Size (Inches) Thickness	Core Size (Inches) Height	① Fins per Inch	Rows of Tubes	Viscous	No. of Blades	Fan Diam. (Inches)	Fan Spacer Thickness (Inches)	
●	●	●	●	●	●	●						●			●			26.05	1.50	15.88	13	2	No	4	19.00	1.00	No
●	●	●	●	●	●								●		●			26.05	1.50	15.88	13	2	Yes	7	19.50		No
●	●	●	●	●	●	●								●	●			26.05	1.50	15.88	13	2	Yes	7	19.50		No
●	●	●	●	●	●	●						●				●	●	26.05	2.25	15.88	15	3	Yes	7	19.50		Yes
●	●	●	●	●	●								●			●	●	26.05	2.25	15.88	15	3	Yes	7	19.50		Yes
●	●	●	●	●	●	●								●		●	●	26.05	2.25	15.88	15	3	Yes	7	19.50		Yes
		●	●	●	●					●					●			24.42	1.27	16.58	13	2	No	4	15.62	1.77	No
		●	●	●	●					●						●	●	24.34	1.95	16.33	13	3	No	7	15.62	1.13	Yes
							●	●			●				●			24.34	1.25	15.60	15	2	No	4	19.00	1.88	No
							●	●	●	●					●			24.34	1.25	15.60	9	2	No	4	15.62	1.00	No
							●	●			●					●		24.34	1.94	15.60	15	3	Yes	7	19.50		Yes
							●	●	●	●						●		24.34	1.25	15.60	9	2	No	7	15.62	1.00	No

J41010

ENGINE DRIVE BELT TENSION SPECIFICATIONS

	Initial Pounds New Belt	Reset Pounds Used Belt
Air Conditioner		
Six-Cylinder	125-155	90-115
V-8	125-155	105-130
Air Pump		
All except six-cylinder w/AC	125-155	90-115
Six-cylinder w/AC (1/4 inch belt)	40-50	35-45
Fan	125-155	90-115
Idler Pulley	125-155	90-115
Power Steering Pump	125-155	90-115

J42421

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TORQUE SPECIFICATIONS

Component	Set-To	In-Use
Accessory Drive Pulley Screws (Six-Cylinder)	18	12-25
Alternator Adjusting Bolt	18	15-20
Alternator Mounting Bracket Bolt to Engine	28	23-30
Alternator Pivot Bolt or Nut	28	20-35
Alternator Pivot Mounting Bolt to Head	33	30-35
Crankshaft Pulley to Damper Screw	23	18-28
Fan Blades and Pulley to Hub Screw	18	12-25
Oil Cooler Line Flared Fitting Nuts	25	15-30
Oil Cooler Line Radiator Fitting	15	10-30
Thermostat Housing	13	10-18
Water Pump to Front Block Screws (Six-Cylinder)	13	9-18
Water Pump to Front Cover Screws (V-8)	48 in-lb.	40-55 in-lb.

J42422

COOLING SYSTEM SPECIFICATIONS

	Six-Cylinder	V-8
Radiator Cap		
Relief Pressure	15 psi	15 psi
Thermostat		
Rating	205°F	195°F
Must be open 0.003 inch	+3° of 205°F	+3° of 195°F
Fully open	228°F	218°F
Water Pump		
Type	Centrifugal	Centrifugal
Drive	V-Belt	V-Belt
Radiator		
Type	Tube & Fin	Tube & Fin
Cooling System Capacities (Includes 1 quart for heater)		
232 and 258 CID Engines	10.5 qts. U.S. 8.7 qts. Imp.	
304 CID Engine		13.0 qts. U.S. 11.6 qts. Imp.
360 and 401 CID Engines		14.0 qts. U.S. 10.8 qts. Imp.
Fan		
Number of blades	Refer to Cooling System Component Chart	
Diameter	Refer to Cooling System Component Chart	
Drive Belt		
Angle of V	38°	38°
Width — top of groove	0.391-0.453	0.391-0.453
Type (plain or cogged)	plain	plain

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ELECTRICAL

GENERAL

A 12-volt, negative ground, dc system is used which utilizes the frame and body for the ground return circuit.

CAUTION: *Burns or other damage may be caused by accidentally grounding circuits through careless use of tools or by not tightening connections in energized circuits.*

A 12-volt electrical system can generate an arc that can ignite gasoline that has been spilled or seeped from the fuel system. Disconnect the battery ground cable before removing any electrical component.

GROUND CONNECTIONS

First check for a poor or no ground condition when checking for electrical malfunctions such as erratic temperature and fuel gauge readings, directional lights glowing when headlights are operated, windshield wiper motor attempting to operate when some other electrical component is operated.

All models have the battery grounded directly to the engine and to the right front fender inner panel.

To complete the ground return circuit from the load (bulb, gauge, etc.) back to the battery, the ground connections and their locations are as follows:

Instrument Panel - The hi-beam lamp, turn signal indicator lamps, panel lighting lamps and the constant voltage regulator (CVR) for the fuel and temperature gauges ground at the instrument cluster or panel for all models.

Frame - to - Engine Ground - All models utilize a ground strap. Six-cylinder engines have a strap attached to the left motor mount; V-8 engine strap is attached at the right motor mount.

CJ Models

The instrument cluster is grounded by the four mounting studs welded to the instrument panel (fig. 3-1).

Note the ground contact for the CVR (fig. 3-2). The regulator is part of the fuel gauge and depends on this ground to regulate voltage to the gauges.

The Hazard, Wiper Washer, and Lights panel lights are grounded by a ground wire attached to a screw at the lower lip of the instrument panel.

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Cherokee-Wagoneer-Truck

The cluster is grounded from pin terminal on the cluster to a mounting screw on the lower lip of the instrument panel at the extreme left-hand side.

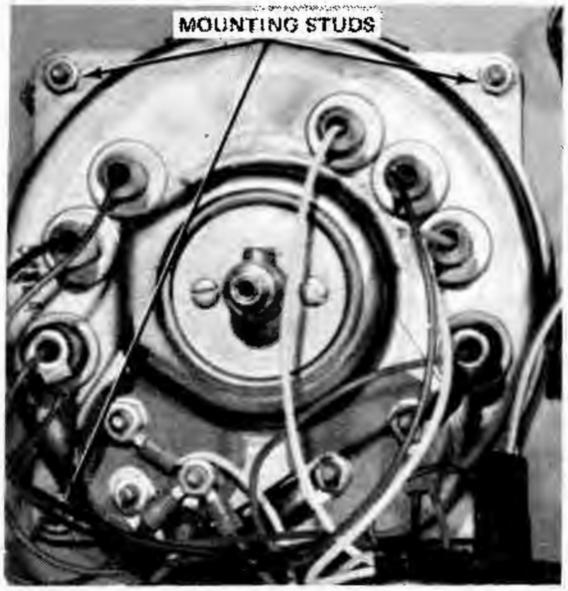

Fig. 3-1 Instrument Cluster Ground - CJ Models

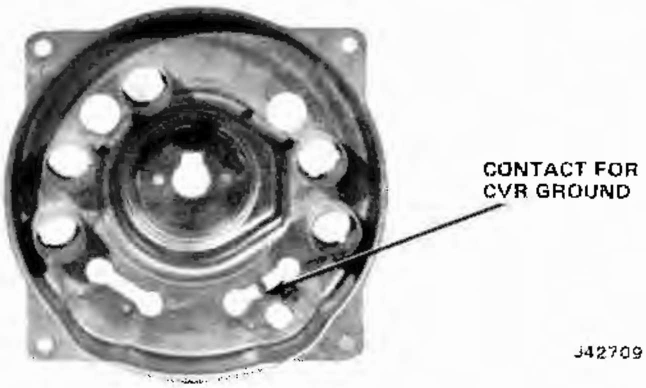

Fig. 3-2 Constant Voltage Regulator Ground - CJ Models

MAIN HARNESS CONNECTOR

The Cherokee, Wagoneer and Truck models have a main wiring harness connector located at the left upper corner of the toeboard (dashboard).

The connector can be removed from the dash panel by removing the center bolt from the engine compartment side and the two fuse block attaching screws from the driver's side. Be careful not to bend the male spade terminals when removing or installing the connector.

If any wires are replaced on the engine compartment side, the terminal opening must be resealed with a durable sealer.

NOTE: *Do not use string-type body caulk as a sealer.*

Located near the left upper corner of the main harness connector is a connector for the frame harness and the electrical tailgate window. On models without the electric tailgate, one of the terminals of the 3-way connector may be used to supply power for other accessories if desired by installing a 30-amp fuse or circuit breaker in the power tailgate position on the fuse block located next to the 4-way flasher.

CAUTION: *This circuit is live regardless of the ignition switch position.*

BATTERIES

Three models are used, each having a different ampere-hour rating to provide the starting power needed for various engine applications. All batteries used are 12-volt lead-acid units. Batteries with cells anchored in epoxy are used to prevent damage from vibration encountered in off the road use. Replacement batteries should meet utility vehicle specifications. A regular passenger car battery would have a relatively short life if used in a utility vehicle.

The negative post of a wet-charged battery is color coded to indicate ampere hour capacity as follows:

- Green - 50 Ampere Hour
- Yellow - 60 Ampere Hour
- Black - 70 Ampere Hour

Positive identification of the battery as to ampere hour rating can be made by referring to the catalog number on the battery cover decal (fig. 3-3).

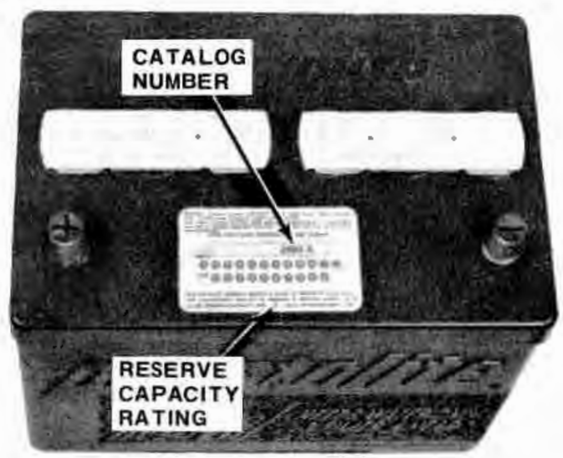

Fig. 3-3. Battery Code Information

Build Code Information

Reserve capacity is defined as the number of minutes a new, fully charged battery at 80 degrees F (26.7 degrees C) can be discharged at a steady rate of 25 amperes and maintain a voltage of 1.75 volts per cell (10.50 volts total battery voltage) or higher. Jeep batteries have a reserve capacity rating as follows:

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Amp Hr Rating	Catalog Number	Reserve Cap. (Minutes)
50	2480X	73
60	2488X	93
70	2495X	106

Starting Procedure - Discharged Battery

The correct method for starting a car with a discharged battery is with either a portable starting unit or a booster battery. **When using either method, it is essential that connections be made correctly or serious damage to the electrical system may occur.**

When using a portable starting unit, **The voltage must not exceed 16 volts or damage to the battery, alternator, or starter may result.** Because of the accompanying high voltage, **a fast charger must not be used for booster starting.** Before connecting jumper cables to a discharged battery, remove the vent cap and cover the cap openings with a cloth.

CAUTION: *Battery action generates hydrogen gas which is flammable and explosive. Hydrogen gas is present within a battery at all times even when a battery is in a discharged condition. Keep open flames and sparks (including cigarettes, cigars, pipes) away from the battery. Always wear eye protection when working with a battery.*

WARNING: *During cold weather, if fluid is not visible or ice is evident, do not attempt to jump start as the battery could rupture or explode.*

The battery must be brought up to 40 degrees F and water added (if necessary) before it can be safely jump started or charged.

Remove the vent caps from the booster battery and cover the cap openings with a cloth.

CAUTION: *If the car is being jump started by a battery in another car, the cars must not contact each other.*

Connect a jumper cable between the positive posts of the two batteries. The positive post may be identified by the POS embossed on the battery cover in 1/4 inch letters adjacent to the battery post.

Make certain the clamps are making good contact. DO NOT CONNECT THE OTHER END OF THE JUMPER CABLE TO THE NEGATIVE TERMINAL OF THE DISCHARGED BATTERY. **Connect to a bolt or nut on the engine. Do not connect the jumper to the carburetor, air cleaner, or fuel line. Keep the cable clear of belts and pulleys.**

When removing the jumper cables, disconnect the clamp on the engine first.

Discard the cloth used to cover the cap openings as they have been exposed to sulfuric acid.

Install the vent caps.

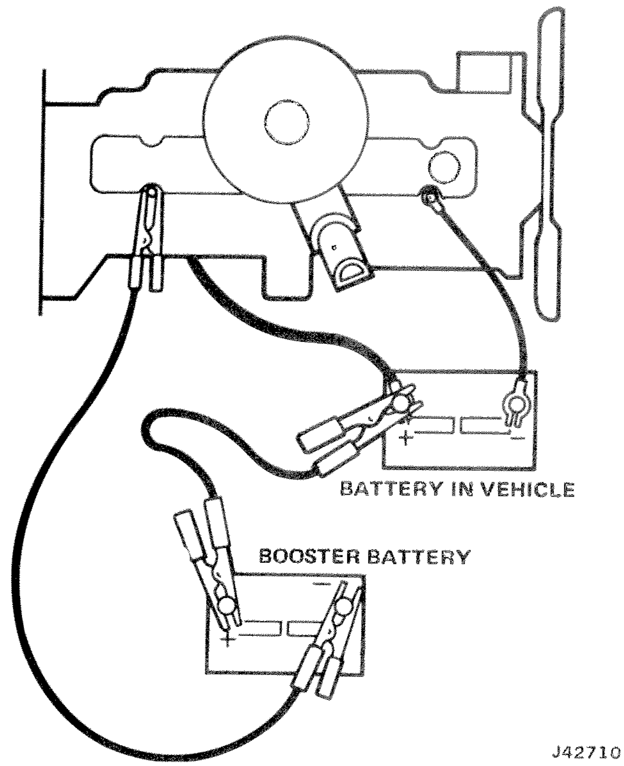

Fig. 3-4 Battery Jumper Cable Connections

BATTERY CHARGING

Slow Charge

Slow charging is the preferred method of recharging a battery. The slow charge method may be safely used, regardless of charge condition of the battery provided the electrolyte is at the proper level in all cells and is not frozen.

CAUTION: *Do not attempt to charge or use a booster on a battery with frozen electrolyte as it may cause the frozen battery to explode.*

The normal charging rate for a battery is one amp per positive plate per cell. For example, a 54-plate battery has nine plates per cell (54 divided by 6). There is always one more negative plate per cell than positive. The charging rate should be four amps. A 70-amp hour battery has 66 plates or 11 plates per cell.

The charging rate for this battery would be five amps (5 positive and 6 negative plates per cell). A minimum period of 24 hours is required when using this method.

The battery may be fully charged by this method unless it is not capable of accepting a full charge. A **battery is in a maximum charged condition when**

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all cells are gassing freely and three corrected specific gravity readings, taken at hourly intervals, indicate no increase in specific gravity.

Fast Charge

Always disconnect one battery cable before using a fast charger.

A battery may be charged at any rate which does not cause the electrolyte temperature of any cell to exceed 125 degrees F and which does not cause excessive gassing and loss of electrolyte.

A fast charger cannot be expected to fully charge a battery within an hour, but will charge the battery sufficiently so that it may be returned to service and then be fully charged by the vehicle charging system, provided the vehicle is operated a sufficient length of time.

Frozen Electrolyte

A 3/4-charged automotive battery is in no danger of damage from freezing. Therefore, **keep the batteries at 3/4 charge or more, especially during winter weather.**

A battery in which the electrolyte is either slushy or frozen should be replaced. Batteries with this condition, depending on the severity of the freeze, may accept and retain a charge and even perform satisfactorily under a load test. However, after 120 to 150 days in service, a reduction in capacity and service life will become apparent as the individual plates lose their active material.

FREEZING TEMPERATURE CHART

Specific Gravity (Corrected to 80° F)	Freezing Temperature (°F)
1.270	-84° F
1.250	-62° F
1.200	-16° F
1.150	+ 5° F
1.100	+19° F

Discharge Chemical Action

A cell is discharged by completing an external circuit such as cranking a starter motor. Sulfuric acid, acting on both positive and negative plates, forms a new chemical compound called lead sulfate. The sulfate is supplied by the acid solution (electrolyte). The acid becomes weaker in concentration as the discharge continues. The amount of acid consumed is in direct proportion to the amount of electricity removed from the battery. When the acid in the electrolyte is partially used up by combining with the plates and can no longer deliver electricity at a useful voltage, the battery is said to be discharged.

The gradual weakening of the electrolyte in proportion to the electricity delivered is a helpful action in that it allows the use of a hydrometer to measure how much unused acid remains with the water in the electrolyte. This information then can be used to determine approximately how much electrical energy is left in each cell.

Charge Chemical Action

The lead sulfate in the battery is decomposed by passing a current through the battery in a direction opposite to that of the discharge. The sulfate is expelled from the plates and returns to the electrolyte, thereby gradually restoring it to its original stength. Hydrogen and oxygen gasses are given off at the negative and positive plates as the plates approach the full charged condition. This is caused by an excess of charging current not totally accepted by the plates.

BATTERY MAINTENANCE

CAUTION: *Always observe the correct polarity. Reversed battery connections may damage the alternator diodes.*

The NEGATIVE battery terminal is connected to the engine and to the fender inner panel.

It is very important that the battery be in a fully charged condition when a new car is delivered or a replacedment battery is installed. The continual operation of a partially charged battery could shorten its life.

Fluid level in the battery should be checked periodically and replenished with distilled water, if possible. However, drinking water free of high mineral content may be used. In extremely hot weather, check more frequently. Add water to each cell until the liquid level reaches the bottom of the vent well. DO NOT OVERFILL.

The engine should be operated immediately after adding water, particularly in cold weather, to assure proper mixing of the water and acid.

The external condition of the battery and the cables should be checked periodically.

The holddown should be kept tight enough to prevent the battery from shaking to prevent damage to the battery case. It should not be tightened to the point where the battery case will be placed under a severe strain.

Particular care should be taken to see that the top of the battery is free of acid film and dirt between the battery terminals. For best results when cleaning the battery, wash with a diluted ammonia or soda solution to neutralize any acid present and then flush with clean water. Care must be taken to keep

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vent plugs tight so that the neutralizing solution does not enter the cells.

To ensure good contact, the battery cables should be tight on the battery posts. **Check to be sure the terminal clamp has not stretched.** This could cause the clamp ends to become butted together without actually being tight on the post. If the battery posts or cable terminals are corroded, the cables should be disconnected by loosening the terminal clamp bolt and removing the clamp with the aid of a puller. **Do not twist or pry on the cable to free it from the battery post.** Clean the terminals and clamps with a soda solution and a wire brush. After the cables are connected to the battery posts, a thin coat of grease should be applied. The battery ground cable and engine-to-crossmember ground strap also should be inspected for a good connection and condition.

CAUTION: *Explosive gases are present within the battery at all times. Avoid open flames and sparks.*

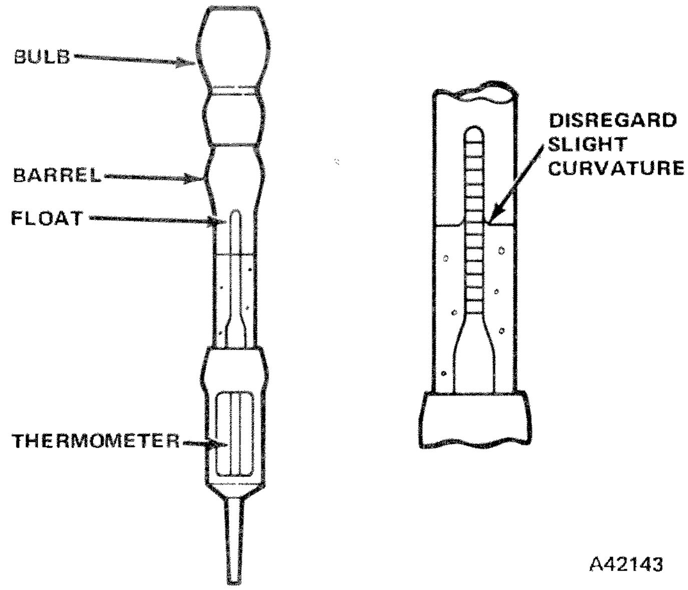

Fig. 3-5 Hydrometer and Proper Method of Reading

BATTERY TESTING

When testing a battery, perform the following steps in the sequence listed.

(1) Take hydrometer reading - if specific gravity indicates below 75 percent full charge, battery must be charged before any further testing can be done.

(2) Charge battery - a battery which does not accept a charge is defective and no further testing is required.

NOTE: *A sulfated battery may require an overnight slow charge to determine if the sulfation is light enough to be broken down by a charge.*

(3) Perform heavy load test as outlined in this section - a battery which is over 75 percent charged and does not pass the heavy load test is defective.

(4) In rare cases, where a battery goes dead and no apparent cause can be found, the battery should be fully charged and allowed to stand on a shelf for three to seven days to determine if self-discharge is excessive. The Self-Discharge Data Chart shows allowable self-discharge for the first ten days of standing after a battery has been fully charged. A fully charged battery is a battery which does not increase the electrolyte specific gravity after three continuous hours of charging.

Example: a battery is tested at 10 degrees F and has a specific gravity of 1.240. The actual specific gravity is found as follows:

Number of degrees above or below 80 degrees F equals 70 degrees (80 degrees minus 10 degrees).

70 degrees divided by 10 degrees (Each 10 degree difference) equals 7.

7 x 0.004 (temperature correction factor) equals 0.028.

Temperature is below 80 degrees F, so temperature correction is subtracted.

Temperature-corrected specific gravity equals 1.240 minus 0.028 equals 1.212.

A fully charged battery should have a specific gravity of 1.250 to 1.265.

SPECIFIC GRAVITY CHART

State of Charge	Specific Gravity as Used in Cold and Temperate Climates	Specific Gravity as Used in Tropical Climates
Fully Charged	1.265	1.225
75% Charged	1.225	1.185
50% Charged	1.190	1.150
25% Charged	1.155	1.115
Discharged	1.120	1.080

If the specific gravity of all cells is above 1.235 (1.196 tropical climate), but the variation between cells is more than 30 points (0.030), it is an indication of an unserviceable battery, and the unit should be removed from the car for further testing.

NOTE: *A fully charged tropical climate battery will have specific gravity of 1.225 at 80 degrees F.*

If the specific gravity of one or more cells is less than 1.235, recharge the battery at approximately 5 amperes until three consecutive hourly readings are constant.

At the end of the charge period, if the cell variation is more than 30 points (0.030), replace the battery.

When the specific gravity of all cells is above 1.235 and variation between cells is less than 30 points, the battery may be tested under load.

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SELF-DISCHARGE RATE CHART

Temperature	Approximate Allowable Self-Discharge Per Day For First Ten Days
100° F (37.8° C)	0.0025 specific gravity
80° F (26.7° C)	0.0010 specific gravity
50° F (10° C)	0.0003 specific gravity

Hydrometer Test

Prior to testing, visually inspect the battery for any damage (broken container, cover, loose post, etc.) that would make the battery unserviceable. The correct method of reading a hydrometer is to have the liquid in the hydrometer at eye level (fig. 3-5). Disregard the curvature of the liquid where the surface rises against the float due to surface tension. Draw only enough liquid in to keep the float off the bottom of the hydrometer barrel with the bulb released. The hydrometer must be kept vertical while drawing in liquid and taking the reading. **Care should be taken when inserting the tip of the hydrometer into the cell, to avoid damage to separators.** Broken separators could result in premature battery failure.

Hydrometer floats are generally calibrated to indicate correctly only at one fixed temperature - 80 degrees F. The temperature correction amounts to approximately 0.004 specific gravity, referred to as 4 points of gravity. For each 10 degrees F above 80 degrees F, add 4 points; for each 10 degrees F below 80 degrees F, subtract 4 points. Always correct the readings for temperature variation. Test the specific gravity of the electrolyte in each battery cell.

Perform the hydrometer test as follows:

(1) Clean outside of battery with a solution of baking soda and water. Make a visual inspection of container, covers, and terminal posts. Remove vent plugs.

(2) Add water if necessary to bring electrolyte to the proper level and apply a fast boosting charge of approximately 35 amperes for 10 minutes. Then take and record **temperature corrected** hydrometer readings. Proceed to step (3).

(3) Apply a fast boosting charge of approximately 35 amperes for 30 minutes. Record temperature corrected hydrometer readings. If cells show a slight or no increase in hydrometer reading, proceed to step (4); otherwise determine replacement as follows:

(a) If the variation in **temperature corrected** hydrometer readings found in step (3) is 30 points or more for the individual cells within a battery, replace battery.

(b) If one cell lags behind in gravity and its electrolyte when drawn into the hydrometer is discolored with the remaining cells relatively clear, replace battery.

(c) If the electrolyte in more than one cell is discolored, replace battery. A battery in this condition has been damaged in service by heavy cycling or electrolyte has been frozen.

NOTE: *When replacing a battery with damage caused by heavy cycling, the alternator should be checked to determine if it has sufficient output to satisfy the electrical demands of that particular vehicle. Also the next larger size battery should be installed, if possible.*

(d) If all cells show a more than slight increase in **temperature corrected** gravities (with variation **within** 30 points) and have clear electrolyte, battery is probably only discharged and can be returned to service.

(4) Sulphated batteries may be brought back to serviceable condition by a slow charge (3 to 4 amperes) for 48 to 72 hours. After this charge, all cells should read at least 1.250 corrected gravity and have clear electrolyte; if not, the battery is not serviceable. If the variation in hydrometer readings is more than 30 points, replace battery.

Heavy Load Test

NOTE: *The following instructions refer to amserv Battery-Alternator-Regulator Tester, Model 21-307.*

(1) Before performing a heavy load test, battery must be fully charged (refer to Slow Charge).

(2) Turn carbon pile knob of battery tester to OFF position.

(3) Turn selector knob to AMP position.

(4) Connect test leads as shown in figure 3-6.

(5) Turn carbon pile knob clockwise until ammeter reading is equal to three times the ampere hour rating of the battery:

150 amperes for 50 amp hr battery

180 amperes for 60 amp hr battery, etc.

(6) Maintain load for 15 seconds, turn selector switch to VOLTS and read the scale.

If the voltmeter reading was 9.6 volts or higher with the battery temperature at a minimum of 70 degrees F, the battery has good output capacity. If less than 9.6 volts, replace the battery.

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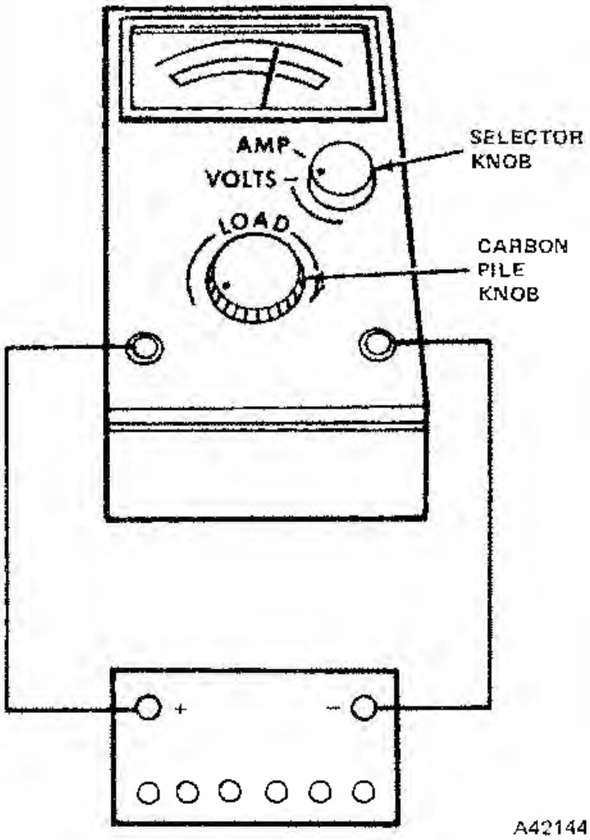

Fig. 3-6 Heavy Load Test

Battery Storage

All automotive wet batteries will discharge slowly when stored. Batteries discharge faster when warm than when cold. For example: at 100 degrees F (37.8 degrees C), a normal self-discharge of 0.0025 specific gravity per day could be expected. At 50 degrees F (10 degrees C), a discharge of 0.0003 specific gravity would be normal.

Before storage, clean the battery case with a baking soda solution and wipe the case dry. When storing a battery, charge fully (no change in specific gravity after three readings taken one hour apart) and then store in as cool and dry a place as possible (refer to Freezing Temperature Chart).

ALTERNATOR

An alternator is an electro-mechanical device producing alternating current (ac), which is changed into direct current (dc) by rectifier diodes.

The alternator employs a three-phase stator winding. The rotor consists of a field coil encased between six poled interleaved sections, producing a 12-pole magnetic field with alternating north and south poles. By rotating the rotor inside the stator, an alternating current is induced in the stator windings. This alternating current is changed to direct current by diodes and conducted to the output terminal and regulator terminals.

Only a small amount of current (approximately 2 amperes) passes through the brushes to excite the field windings in the rotor. For this reason, brush life is considerably longer than in a generator.

Alternators used in conjunction with 4V carburetors have an extra terminal on the rear housing which provides approximately seven volts of alternating current to a heating element located in the carburetor choke cover (fig. 3-7).

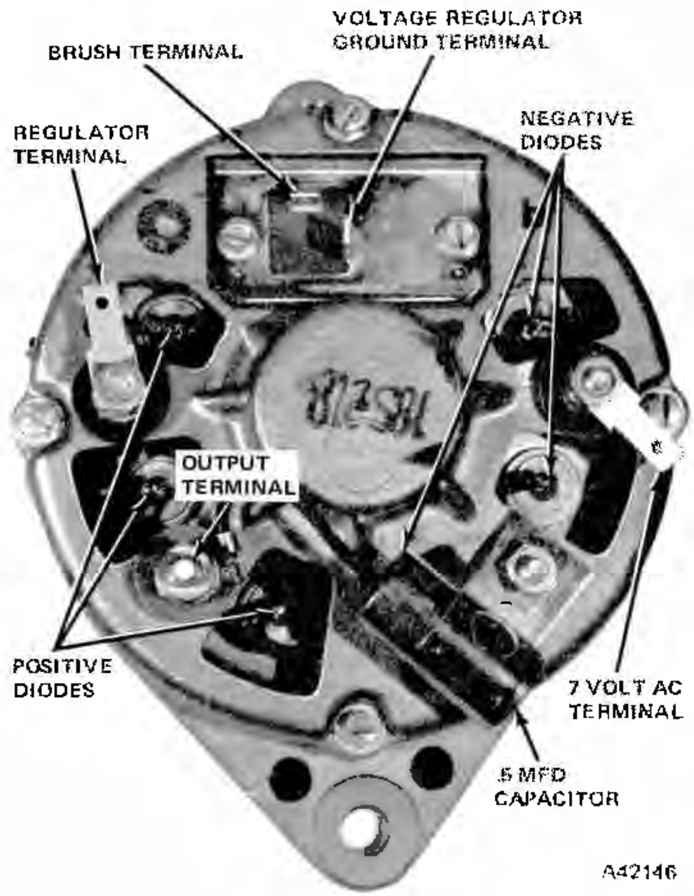

Fig. 3-7 Alternator - Rear View

Alternator Identification

The nameplate, riveted to the rear housing, contains voltage, type of ground, serial number, amperage rating, and model number information.

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The alternator code is stamped on the end of the rear housing in large black numbers:
Example:

185	3	18
Vendor	Year	Week
(Motorola)	(3-1973, 4-1974)	

Maintenance

When the engine is serviced, check the wiring for damage from accumulation of ice or mud. Check the drive belt for proper tension and other defects such a glazing, cracking, fraying, etc.

Check for misalignment of pulleys possibly caused by a broken mounting bracket or loose mounting bracket bolts.

Lubrication is not necessary since the bearings are sealed.

Alternator brush life depends primarily on the amount of dust and dirt encountered. Replace brushes when wear exceeds one-half the original length of the brush.

Check for clean and tight cable connections at the battery posts, engine block and starter relay.

Alternator Belt Adjustment

A belt which has been in service for some time should be checked first for general condition before attempting an adjustment. If it is severely cracked or oil soaked, it should be replaced.

Install Belt Strand Tension Gauge W-283 or J-23600 on the longest accessible span, midway between pulleys (fig. 3-8).

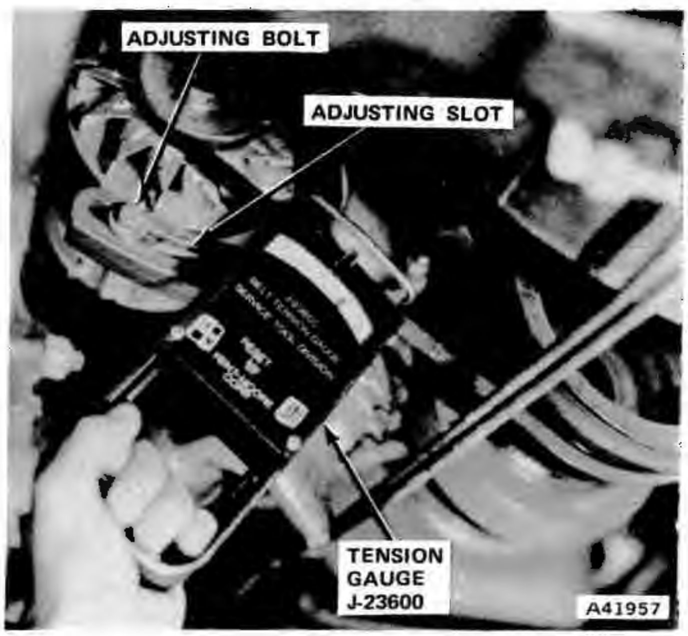

Fig. 3-8 Checking Belt Tension with Gauge J-23600

NOTE: *When using W-283 on a notched belt, the middle finger of the gauge should be in the notched cavity of the belt.*

Loosen the alternator mount bolt and the adjusting strap screw. Move the alternator away from the engine by applying pressure at the front housing with a suitable tool (fig. 3-9 and 3-10).

Tighten the adjusting strap screw and mount bolt while maintaining the specified tension.

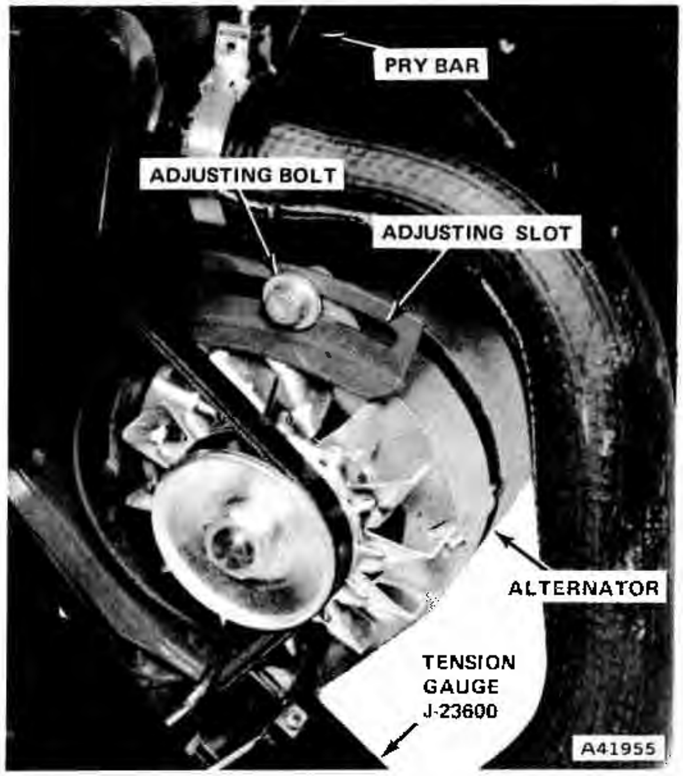

Fig. 3-9 Adjusting Belt Tension - Six-Cylinder Engine

Field Excitation and Indicator Bulb Circuit

Figure 3-11 illustrates the four connections required for regulated alternator operation: ground, field, regulator and output. The ground wire is required for voltage regulator operation only. The alternator is grounded through the mounting bracket on the engine and does not require an exterior ground. The ground and field terminals of the alternator connect to a two-terminal female connector of the wire harness.

Since there is little residual magnetism in the alternator, it is necessary to supply a small amount of excitation current to the alternator rotor (field) winding. The current is approximately 0.25 amperes and will cause the indicator light to operate when the ignition switch is turned on. See figures 3-11 and 3-12.

All models have basically the same method of lighting the alternator indicator bulb and providing the initial current to the alternator field brush. The follow-

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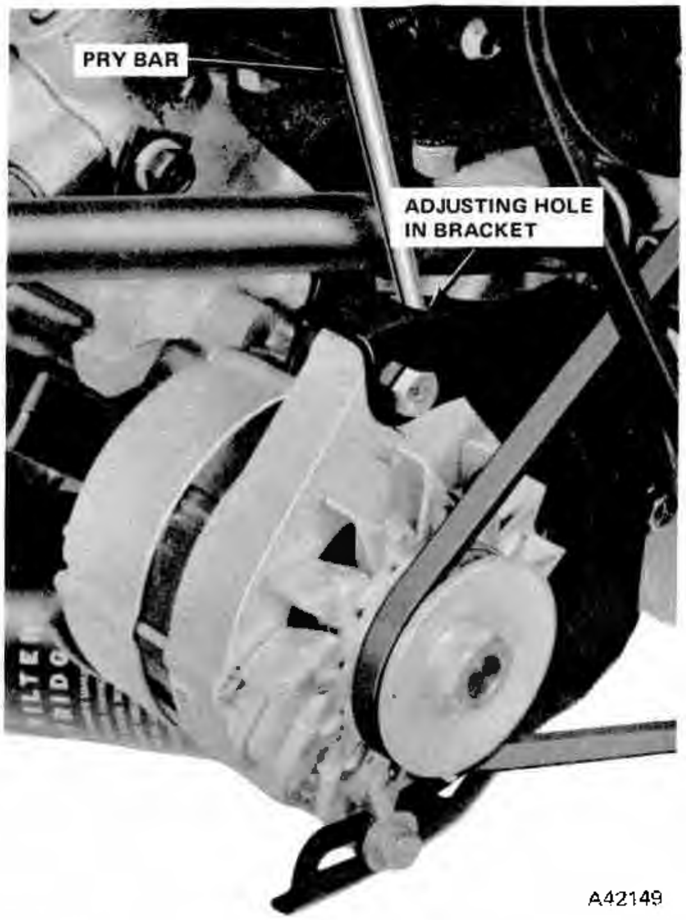

Fig. 3-10 Adjusting Belt Tension - V-8 Engine

ing description is of the circuit applicable to CJ models. The principles of operation are the same as for other series of Jeep vehicles, although there are some differences in color coding and instrument cluster.

When the ignition is turned on, current is supplied from the ignition switch IGN terminal (green with tracer) to the fuel gauge I-terminal of the instrument cluster (fig. 3-11).

From the fuel gauge I-terminal, the current is routed to the alternator bulb and then continues through the bulb to the alternator voltage regulator (grey wire). The circuit is completed through the voltage regulator to the field terminal (green with tracer wire) of the alternator, then through the field windings to the ground brush.

An 82-ohm resistor, located within the voltage regulator, is connected in parallel with the alternator indicator bulb. In the event of indicator bulb failure, defective bulb socket or wire, field current will be supplied through this resistor by the yellow wire from the I-terminal of the starter relay when the ignition is turned on. The resistor also prevents voltage feedback through the ignition switch to the battery when the alternator is charging.

When the alternator is operating, the voltage regulator senses voltage at the regulator terminal (grey wire) and automatically provides the correct current to the field terminal (green with tracer wire) of the alternator (fig. 3-12).

This same voltage, through a junction at the voltage regulator harness connector, is applied to one side of the alternator indicator bulb.

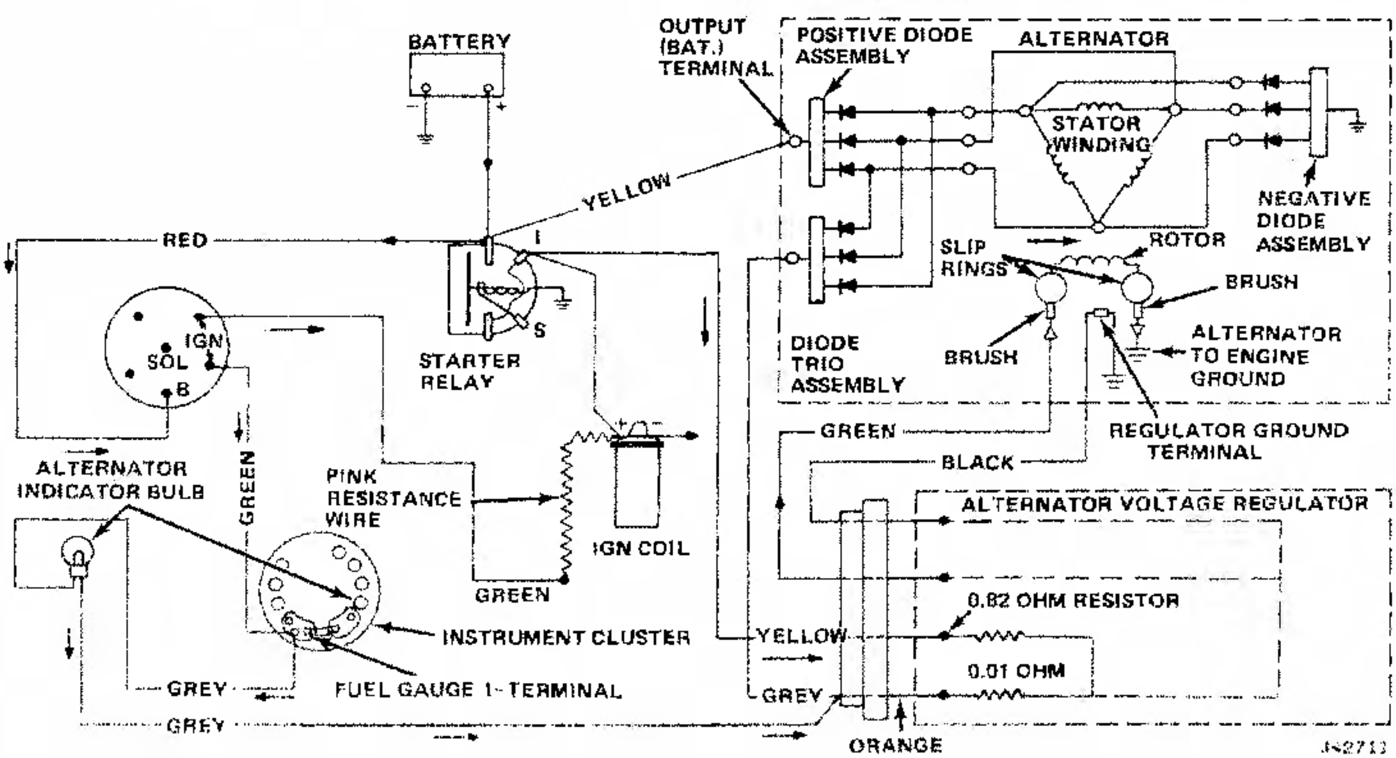

Fig. 3-11 Alternator Excitation and Indicator Bulb Circuit - Key On - Engine Not Running - CJ Models

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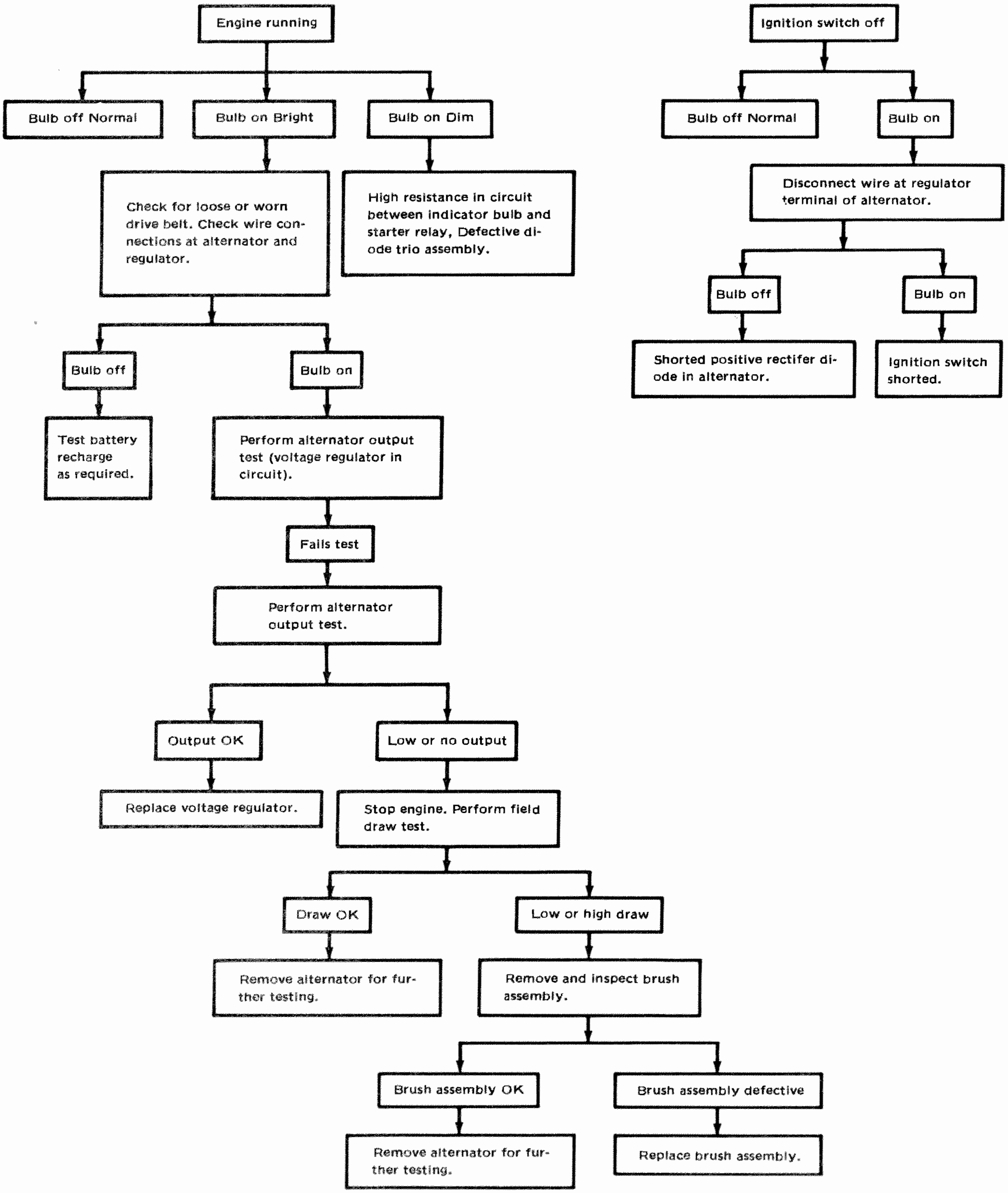
CHARGING SYSTEM DIAGNOSIS GUIDE

ALTERNATOR INDICATOR BULB OPERATION



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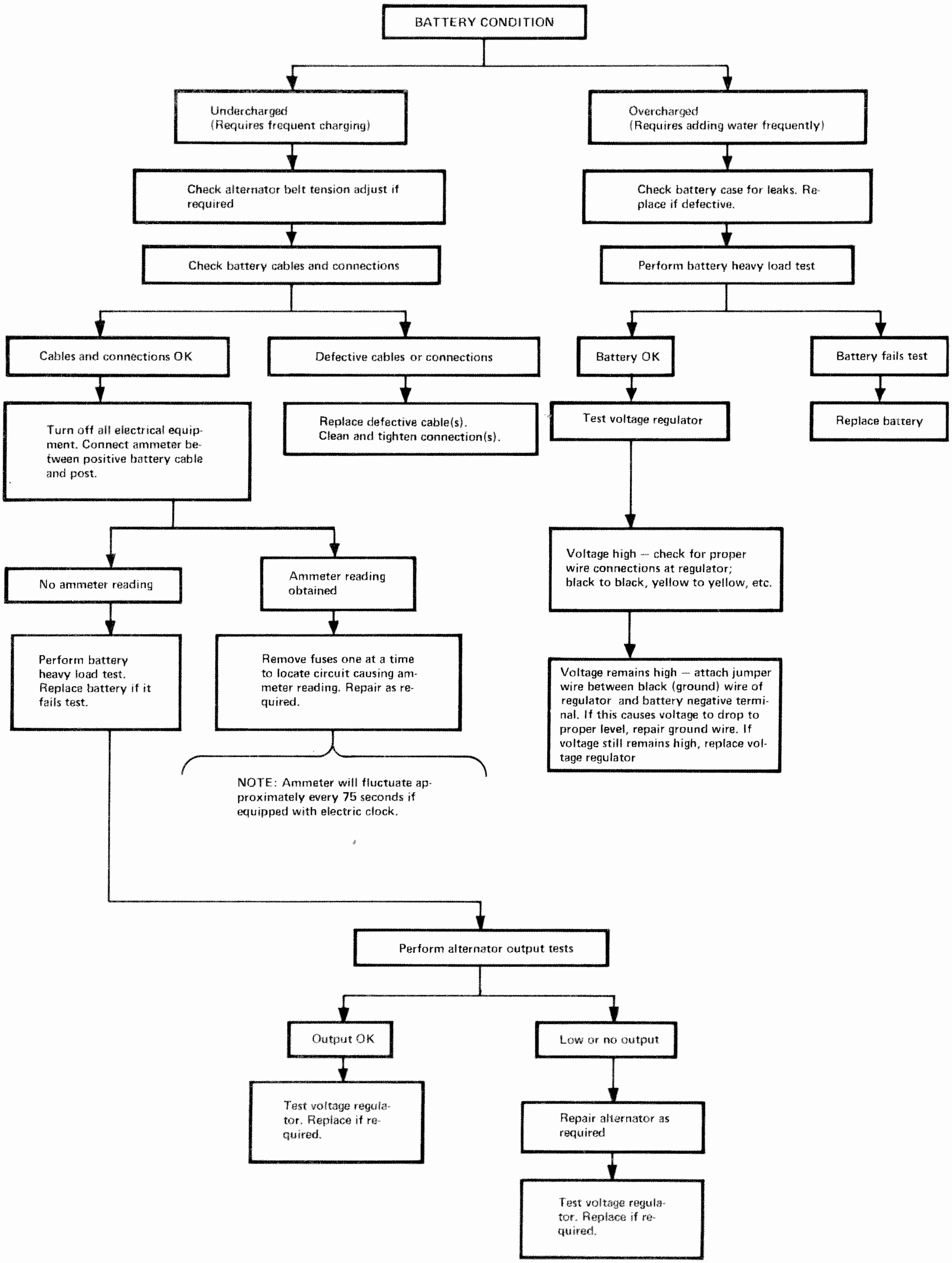

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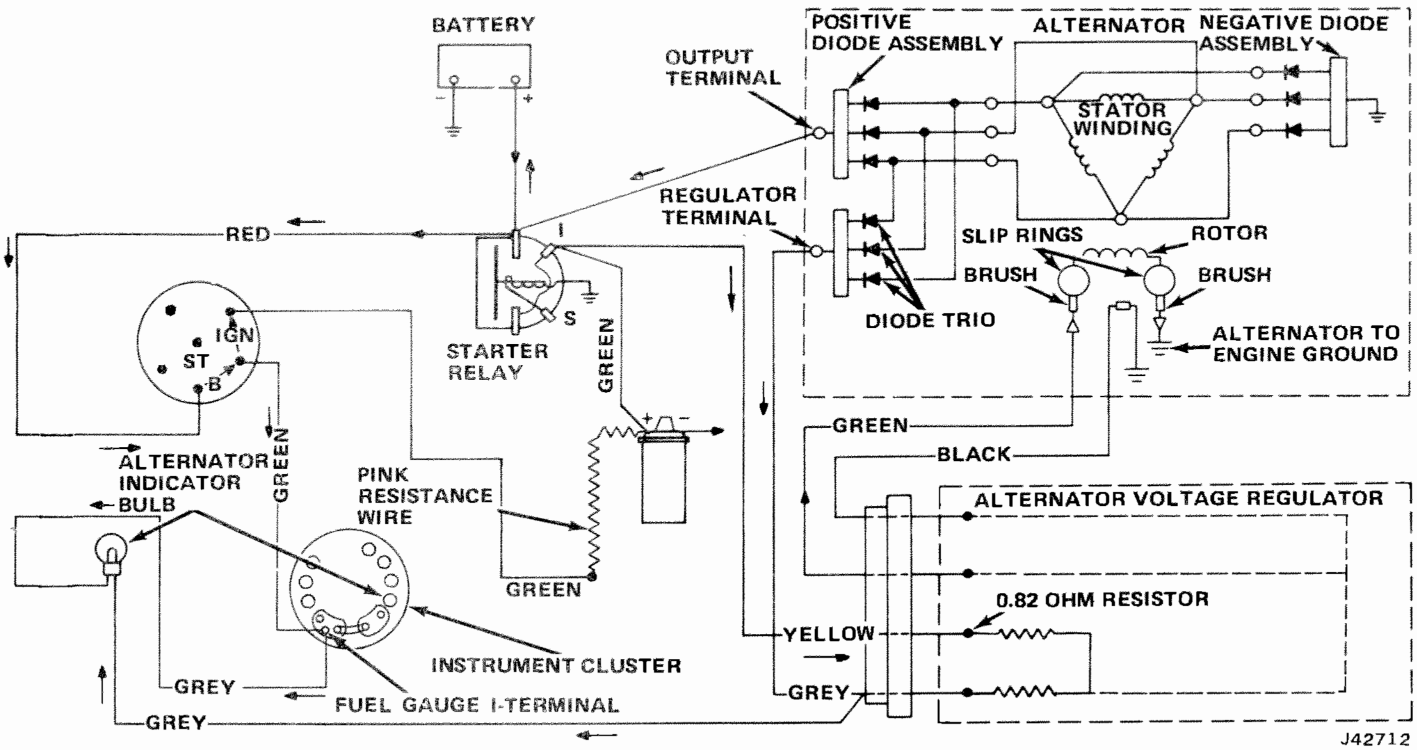

Fig. 3-12 Alternator Excitation and Indicator Bulb Circuit Engine Running - CJ Models

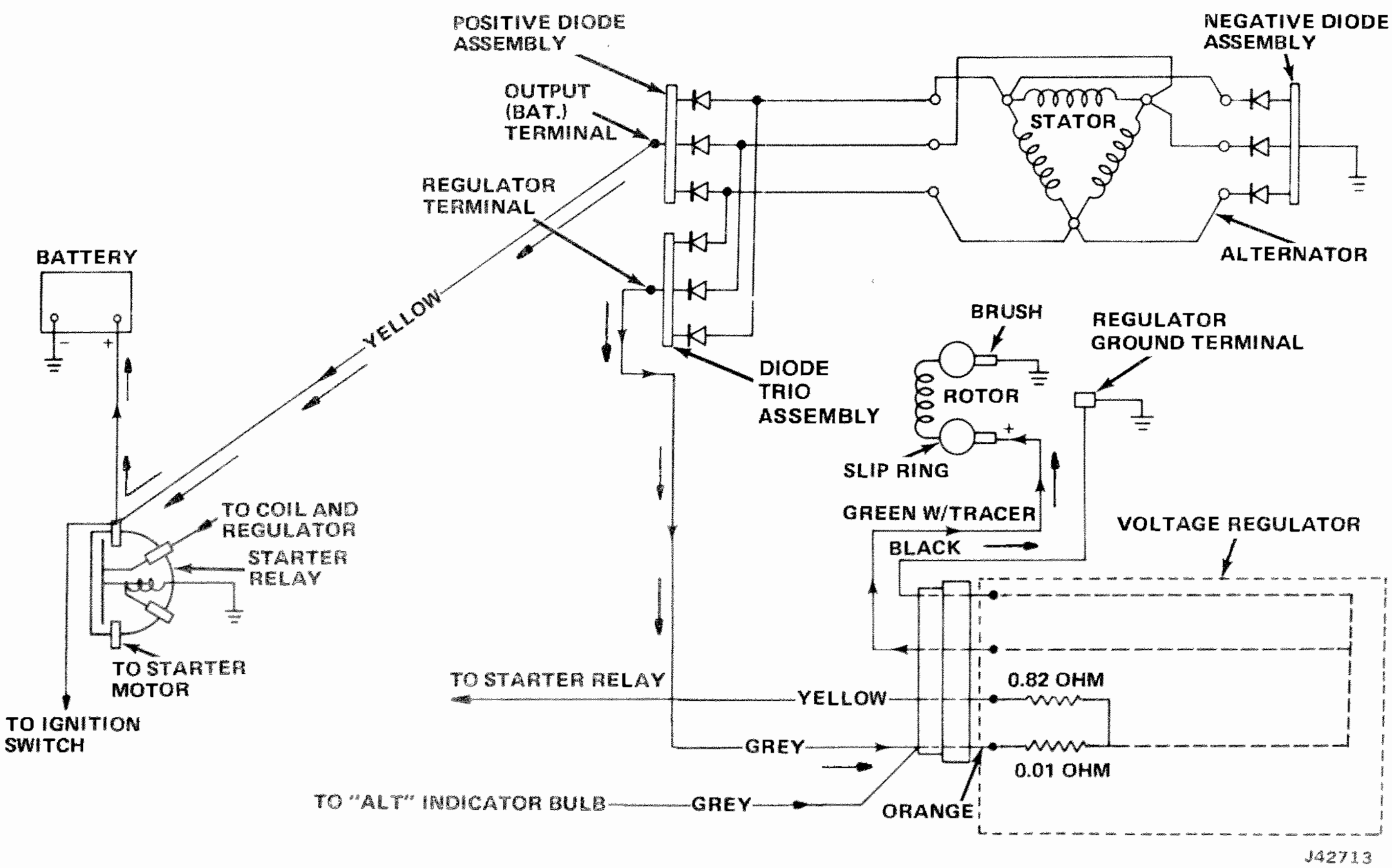

Fig. 3-13 Charging Circuit

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Alternator output voltage is applied through the ignition switch to the opposite side of the indicator bulb. The output and sensing voltages are nearly equal; therefore, the bulb will go out since little or no current will flow through the bulb.

Charging Circuit

The charging circuit consists of three main components: alternator, battery and the voltage regulator (fig. 3-13).

Charging of the battery is accomplished by supplying current directly from the alternator output terminal (heavy yellow wire) to the battery, using the starter relay as a junction point. The positive (+) battery cable joins the heavy yellow wire at the relay. The alternator is grounded to the engine to complete the return circuit to the negative (-) side of the battery. The amount of charge the battery receives depends upon the state of charge and internal condition of the battery, proper operation of the voltage regulator and the amount of current consumed by other loads such as heater, lights, etc.

The remainder of the charging circuit, that is, voltage regulation and field current control is outlined under Voltage Regulator.

Alternator Noise Diagnosis

Alternator noise is usually caused by one of the following conditions: Loose or misaligned pulley, worn bearings or a shorted rectifier diode (indicated by high pitched whine).

Diode Trio Assembly

The diode trio assembly incorporates three small rectifier diodes (fig. 3-14). The input leads of the diodes are connected to the stator windings in parallel with the positive rectifier diodes. The output leads of the diodes are connected to the regulator terminal stud which is insulated from the positive diode heat sink and the alternator end housing.

When the alternator is operating, a portion of the ac current and voltage developed in the stator windings is rectified by the diode trio assembly and appears as dc current and voltage at the regulator terminal. This voltage is sensed by the voltage regulator to provide excitation current to the rotor (field) winding.

Alternator output will be affected if more than one of the diodes in diode trio assembly becomes opened or shorted.

If one of the diodes in the diode trio assembly becomes degraded, but not opened or shorted, the total resistance of the assembly will increase and cause the alternator indicator bulb to glow dimly. The diode trio assembly can be tested for this condition without removing the alternator from the engine. Refer to Diode Trio Test in this section.

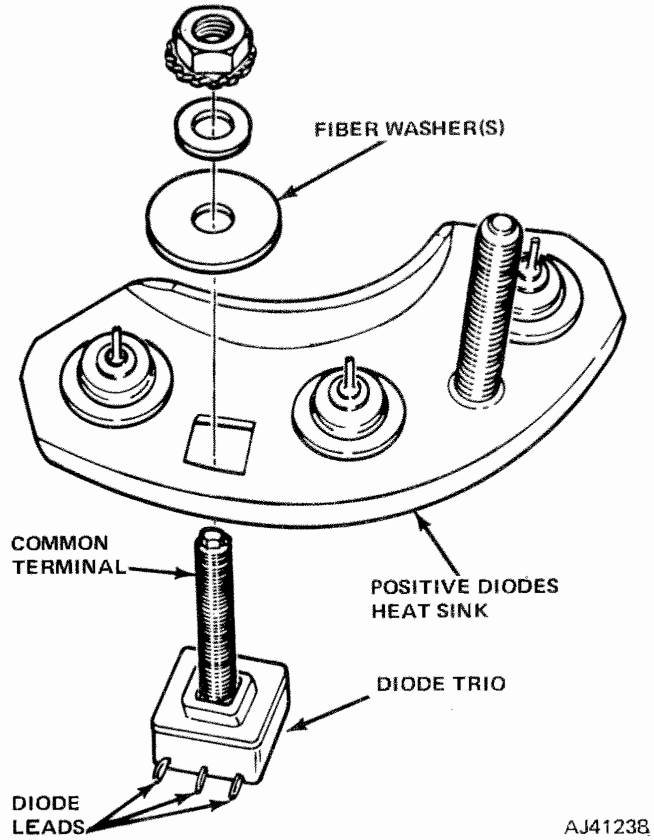

Fig. 3-14 Potted Diode Trio Assembly

CAUTION: *The regulator terminal is used solely for field excitation and should never be used as a source for running lights or other accessories, as operation of the voltage regulator would be adversely affected.*

Positive and Negative Diode Assemblies

The positive and negative diode assemblies incorporate three silicon rectifier diodes which change the three-phase alternating current (ac), produced in the stator windings, to direct current (dc).

This is accomplished by the characteristic of the diodes to allow current to flow in one direction only.

Since the diode(s) will pass current from the alternator to the battery or load, but will not pass current from the battery to the alternator, the alternator does not require the use of a cutout relay.

The electrical circuits of the 37- and 51-ampere alternators differ only in the type of stator winding used. The main circuit drawing of figure 3-15 illustrates the Delta Wound stator winding used in the 51-ampere alternators. The Wye Wound stator winding of the 37-ampere alternator is illustrated in the inset.

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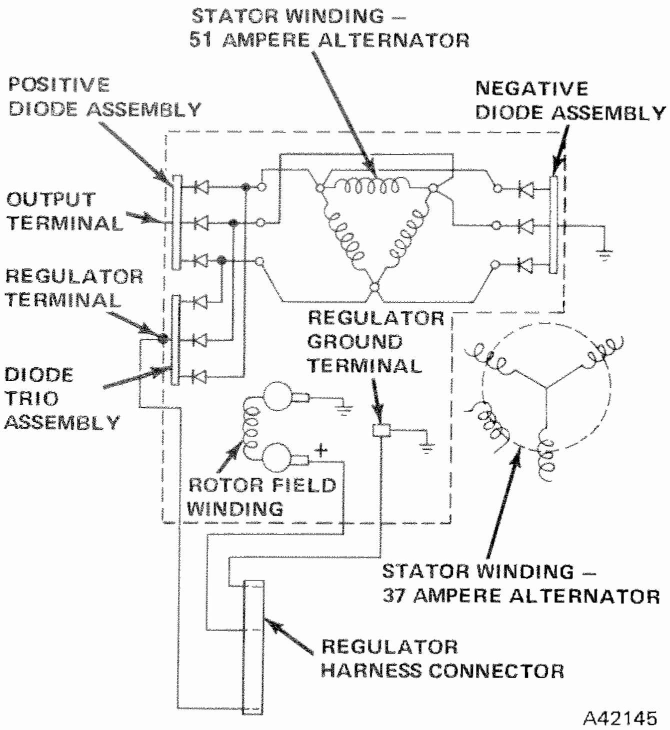

Fig. 3-15 Alternator Circuit

ALTERNATOR CHARGING TESTS

Various types of charging testers are available to perform the alternator and regulator tests outlined in the following paragraphs. Identical results may be obtained regardless of which type is used. For illustrative purposes, amserv test equipment is shown. If another type tester is used, follow the particular manufacturer's operating instructions.

The following tests are made with all wires connected including the voltage regulator.

CAUTION: *Do not disconnect alternator output lead while alternator is operating.*

CAUTION: *Do not disconnect voltage regulator while alternator is operating.*

CAUTION: *Do not ground field terminal.*

Alternator Output Test - In Vehicle

For most complaints, this test is all that is required for a pass-fail test.

(1) Connect voltmeter to battery, negative to negative, positive to positive.

(2) Start engine.

(3) Turn on headlamps (low beam).

(4) Operate engine at 1000 rpm and observe voltmeter reading for approximately two minutes. If voltage remains above 13 volts, alternator and regulator are performing satisfactorily.

(5) If alternator fails this test, perform Field Draw Amperage Test and Regulator Bypassed Test.

Field Draw (Amperage) Test

This test will determine if there is an open or short circuit in the brush circuit.

(1) Disconnect voltage regulator.

(2) Connect an ammeter between the battery positive post and the green wire leading to the insulated brush terminal (+) of the alternator. The black wire is connected to the grounded (-) terminal.

(3) The ammeter should indicate no less than 1-1/2 ampere and no more than 3 amperes.

(4) Turn the alternator rotor slowly by hand. If the reading varies, the slip rings require cleaning. Remove brush assembly and clean with a fine crocus cloth. If amperage is too high, remove brush assembly and perform continuity and isolation test as outlined under Alternator Disassembly in this section.

NOTE: *If the field draw remains too high or too low after determining that the brush assembly and slip rings are in good condition, remove the alternator for further testing of the rotor field windings.*

Regulator Bypassed Test

To determine which component, the alternator or the voltage regulator, is at fault for a low or no charge condition.

(1) Disconnect voltage regulator.

(2) Perform Field Draw (Amperage) Test. Disconnect ammeter after test.

(3) Connect voltmeter to battery: negative to negative, positive to positive.

(4) Start engine and operate at idle speed.

(5) Connect ammeter between battery positive (+) post and alternator insulated brush.

(6) Observe voltage reading while slowly increasing engine rpm.

(7) If 16 volts can be obtained, the alternator is not defective.

CAUTION: *Do not exceed 16 volts or damage to electrical components may occur.*

NOTE: *A dead battery may require charging for two to three minutes to obtain 16 volts.*

Voltage Regulator In Circuit

(1) Prior to testing, check the alternator belt for proper tension.

(2) Turn off all electrical equipment prior to performing test.

(3) Connect amserv Tester Model 21-317 as outlined in tester instruction booklet.

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(4) Turn selector knob to ALT TEST.

(5) Start engine and hold speed between 1000 to 2000 rpm.

(6) Observe the GOOD-DEFECTIVE ALT scale. If defective, repair or replace alternator.

(7) Turn the selector knob to VOLTS and observe the regulator limit zone. The needle should slowly move into the shaded area. If defective, repair or replace voltage regulator.

Diode Trio Test (On Car)

A diode trio assembly with one or more of its diodes completely opened or shorted will cause reduced alternator output and necessitate alternator disassembly to unsolder the diode leads for testing.

This test is designed to check the diode trio assembly for marginal defects which are not affecting alternator output but may be the cause of alternator indicator bulb glowing dimly.

Before testing the field diode assembly, perform an alternator output test to determine if the alternator is operating at its rated output.

Select a tester incorporating a multirange voltmeter (amserv Battery-Starter Tester, Model 16-30 or equivalent) and adjust the meter to the low range. Refer to figure 3-16 for proper connection sequence.

(1) Start engine and operate at idle speed.

(2) Connect voltmeter to alternator. If no reading is indicated, switch test leads.

(3) Turn on headlights and place blower motor on high speed. This electrical load will heat up diode trio after approximately two minutes of operation. Turn off headlamps and blower motor.

(4) Note reading on voltmeter. A good diode trio will read from zero volts to 0.2 volt. A reading above 0.2 volt means the diode trio is becoming degraded. It is not necessary to replace a diode trio unless it indicates a 0.6 voltage drop.

If meter begins to pulsate, either the diode trio, a positive diode or one of the soldered connections connecting the positive diode to the diode trio is beginning to break down under heat. In either case, the alternator will have to be disassembled, the diode trio unsoldered and a heavy load test performed on the positive diodes and the diode trio.

If the voltmeter reading is over 0.6 volt and alternator output was determined satisfactory in an earlier test, remove the diode trio assembly for bench test. The bench test is necessary to determine whether the diode assembly or the solder joints are the cause of the problem. Refer to Diode Test for bench test procedures.

If the voltmeter reading is less than 0.6 volt, the diode trio assembly is functioning properly. If the alternator indicator bulb continues to glow, inspect for loose or corroded connections in the bulb circuit at the following locations:

- Alternator output (battery) terminal
- Starter relay battery terminal
- Main wiring harness connector
- Ignition switch
- Fuse panel
- Instrument harness connector
- Instrument cluster printed circuit
- Alternator indicator bulb socket

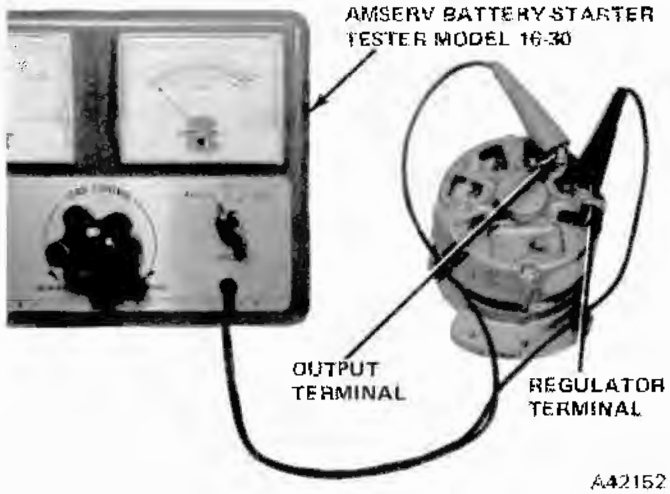

Fig. 3-16 Diode Trio Test - On Car (Alternator Removed for Clarity)

AC Terminal Test

To check the voltage at the ac terminal, connect a dc voltmeter from the terminal to a known good ground. Start the engine. The voltmeter reading should be approximately seven volts.

NOTE: *The maximum amount of current that the 7-volt terminal will be expected to deliver is 5 amps.*

ALTERNATOR - COMPONENT TEST AND REPLACEMENT

Brush Assembly - Replacement

The brush assembly can be removed with the alternator on the vehicle.

(1) Remove the two self-tapping screws and cover.

(2) Pull the brush assembly back just enough to clear the locating pins and then tip brush assembly away from housing.

NOTE: *Do not attempt to pull the brush assembly straight away from the alternator as one of the brushes may break and drop down between the slip rings.*

The complete brush assembly is available for replacement (fig. 3-17).

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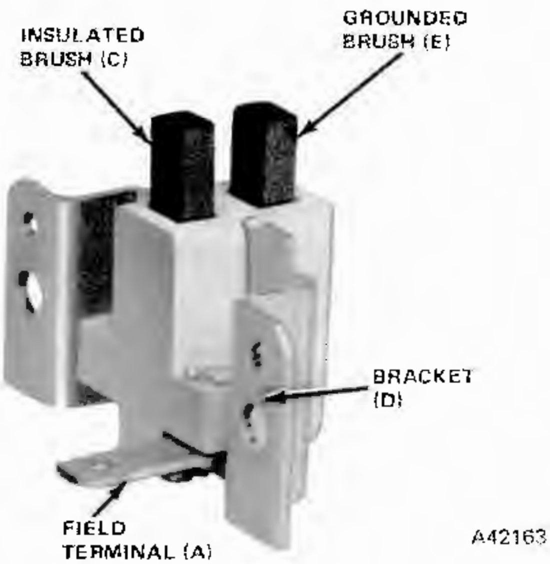

Fig. 3-17 Brush Assembly

Brush Assembly Insulation Test

(1) Connect an ohmmeter or a test light to field terminal and bracket.

(2) Resistance should be high (infinite) or test bulb should not light. If resistance is low or test bulb lights, brush assembly is shorted and must be replaced.

Continuity Test

(1) Connect an ohmmeter to field terminal and insulated brush. Use an alligator clip to assure good contact to brush at test points A and C (fig. 3-17). Resistance reading should be zero.

CAUTION: *Do not chip brush.*

(2) Move brush and brush lead wire to make certain that the brush lead wire connections are not intermittent. Resistance reading should not vary when brush and lead wire are being moved.

(3) Connect ohmmeter to bracket and grounded brush, test points E and D (fig. 3-17). Resistance reading should be zero.

Rear Housing Removal

Refer to figure 3-18.

To ensure correct housing alignment during assembly, scribe a line across the front housing, stator, and rear housing.

(1) Remove brush assembly.

(2) Remove four through-bolts and nuts.

(3) Very carefully separate rear housing by using two screwdrivers to pry stator from front housing at two opposing through-bolts slots.

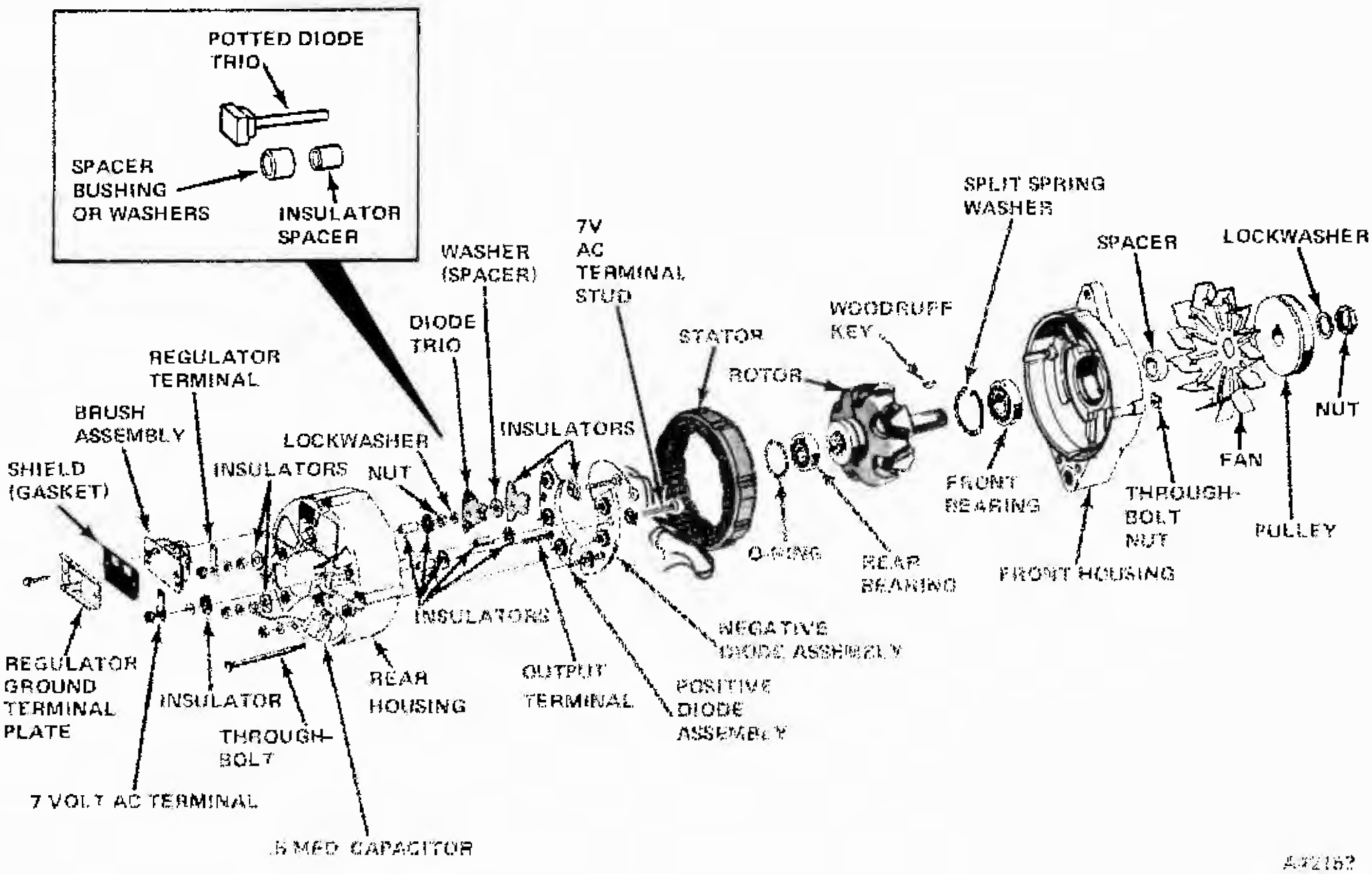

Fig. 3-18 Alternator - Disassembled View

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NOTE: *Do not burr the stator core to avoid difficulty during assembly.*

CAUTION: *Do not insert screwdriver blades deeper than 1/16 inch (to avoid damaging stator windings).*

Rear Housing Installation

(1) Align scribe marks previously marked on front housing and stator assembly.

(2) Check that insulating washers are installed on regulator and battery post terminals. Attaching posts on negative diode assembly are not insulated.

(3) Install rear housing. Install four through-bolts and tighten securely.

(4) Install nylon bushings, insulating washers and holddown nuts on the battery and regulator terminal studs.

NOTE: *The regulator stud also receives a spade connector and another holddown nut.*

(5) Turn rotor and check for free movement.

NOTE: *Before installing the brush assembly, check the slip rings for grease or grime and clean if necessary.*

Stator and Diode Assembly Removal

(1) Remove brush assembly and rear housing.

(2) Remove four locknuts and insulating washers.

NOTE: *The insulating washers and nylon sleeves are used to insulate the positive plate studs from the housing. With these four nuts removed, the stator can be separated from the rear housing.*

NOTE: *Do not unsolder any stator-to-diode wire junction.*

(3) Remove stator and diodes as an assembly.

NOTE: *Avoid bending stator wires at each junction when removing positive and negative diode assembly from housing.*

Stator In-Circuit Test

When making the in-circuit stator leakage test, some consideration must be given to the rectifier diodes that are connected to the stator winding. The rectifier diode assemblies will conduct in one direction when properly polarized. A shorted diode in the rectifier diode assembly would make the stator appear to be shorted. For this reason, the rectifier diode plate assembly and stator must be checked individually after alternator has been disassembled, if the test shows a defect.

CAUTION: *Use Diode Continuity Light Tool J-21008 or a dc test lamp. Do not use a 120-volt test lamp as diodes will be damaged.*

(1) Connect the test lead to diode terminal and ground other test lead (fig. 3-19).

(2) Reverse test probes. The test bulb should light in one direction but not in the other direction.

(a) If test bulb does not light in either direction, this indicates that all three rectifiers in the negative diode assembly are open.

(b) If the test bulb lights in both directions, the stator winding is shorted to stator, or one of the negative rectifier diodes is shorted. Check stator again when stator is unsoldered from diode assemblies.

(3) Remove stator and diode assemblies from rear housing after removing rear housing. Note the diode assembly-to-stator wire connections, being certain replacement diodes are connected to the same wires. The positive diode assembly has red markings and negative has black markings. Do not interchange.

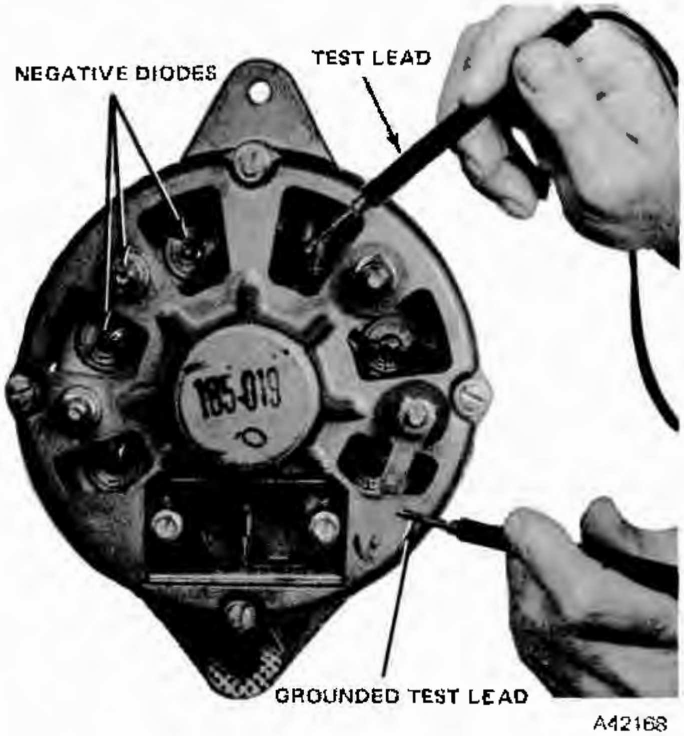

Fig. 3-19 Stator In-Circuit Test

Stator Short Test

This test checks for shorts to ground for the stator coil windings. To make the test, the winding junctions must be separated as shown in figure 3-20. An ohmmeter or test lamp may be used.

Stator Load Test

This test is used to detect shorts or resistance between the stator coil windings.

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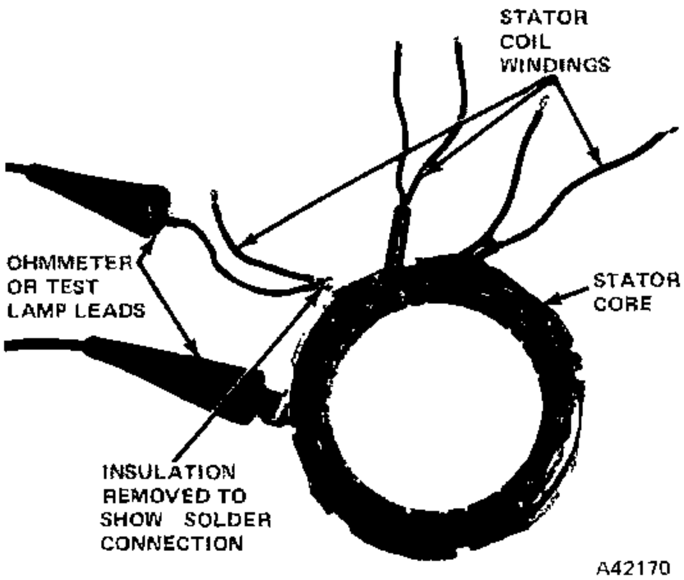
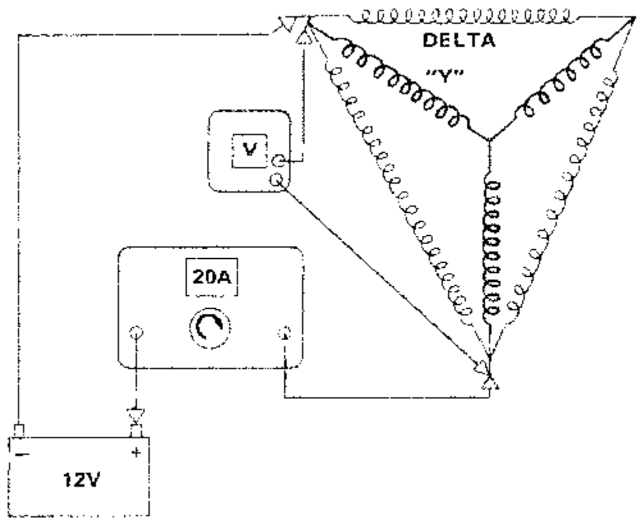


Fig. 3-20 Stator Coil Short Test - Coil to Core

This test is performed with the diodes unsoldered from the stator leads.

Tools required are a voltmeter, ammeter, a variable load control and a fully charged 12-volt battery. Refer to figure 3-21 for the test.



ALTERNATOR	LOAD	MAXIMUM VOLTAGE DROP	MAXIMUM VARIANCE BETWEEN WINDINGS
37	20A	7.2 – 8.2	.7
51	20A	5.5 – 6.5	.6

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Fig. 3-21 Stator Load Test

(1) Connect negative battery lead to any one of three stator winding leads.

(2) Connect positive battery lead to variable load control.

(3) Connect remaining load control lead to either of the other two stator leads.

(4) Connect voltmeter to same two stator leads and adjust load control to draw 20 amps. Allow windings to heat up for approximately 15 seconds, then note voltmeter reading. It should not exceed 8.2 volts or a 37-ampere alternator, or 6.5 volts for a 51-ampere alternator.

(5) Reduce amperage draw to zero, disconnect voltmeter and load control test leads from stator lead and connect to other remaining stator lead.

(6) Apply 20-amp draw, and note voltmeter reading. Variance between each winding must not exceed 0.7 volt for the 37-ampere alternator, or 0.6 volt for the 51-ampere alternator.

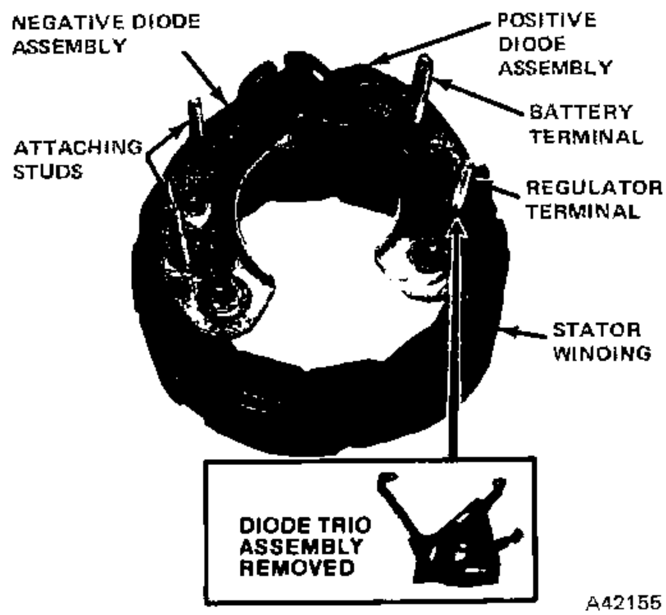

Fig. 3-22 Stator and Diode Assembly

AC Terminal Removal and Installation

The ac terminal stud is located in the negative diode assembly heat sink (fig. 3-18). Removal of the stud is accomplished by removing the rear housing and the ac terminal attaching nut. The stud then can be dropped through the heat sink and removed. When installing the stud, be certain that all insulators are properly installed.

Diode Trio

There are two types of diode trios used. One is a board type (fig. 3-22) and the other is a potted type which is encased in epoxy. The potted type will eventually supersede the board type.

Board Type

Removal

(1) Remove diode assembly attaching nuts.

(2) Separate stator from end housing.

(3) Unsolder leads at each positive diode.

(4) Remove diode trio attaching nut and remove diode trio.

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Installation

(1) Install diode trio on stud. Refer to disassembled view for parts assembly sequence. Be sure ceramic insulator is not cocked in the diode heat sink when tightening down the diode trio attaching nut.

(2) Install pliers or wet cotton between solder point and positive diode to act as a heat sink (fig. 3-23).

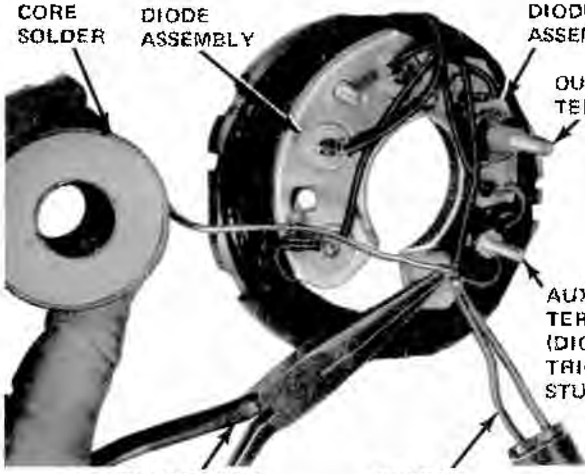

Fig. 3-23 Soldering Diodes

(3) Solder three diode trio leads to positive diodes. Use only rosin core solder and use no more heat than necessary to obtain a good bond.

(4) Install stator to rear housing. Each positive diode terminal stud should have a fiber washer on each side of the end housing and a plastic sleeve over the stud.

Potted Type

Removal

(1) Separate stator and diode assemblies from rear housing.

(2) Unsolder leads at diode trio and remove assembly (fig. 3-24).

NOTE: *Use no more heat than necessary to unsolder connections.*

Installation

(1) Position diode trio with solder connections toward outside of alternator.

(2) Solder wires to diode assembly. Use only rosin core solder and use no more heat than necessary to make a good solder connection.

(3) Install stator and diode assemblies to rear housing.

NOTE: *For diode test procedures, refer to Diode Trio and Rectifier Diode - Bench Tests.*

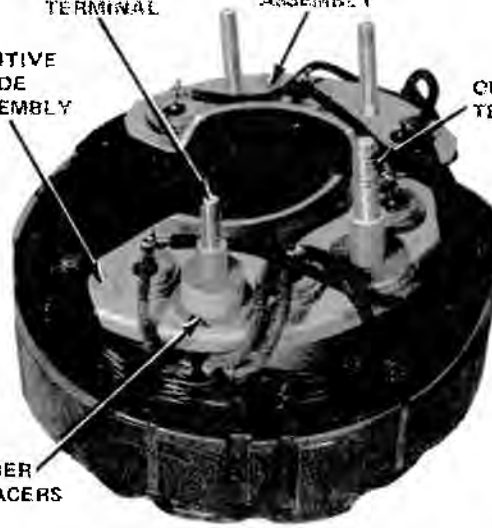

Fig. 3-24 Potted Diode Trio - Installed

Diode Trio and Rectifier Diode - Bench Tests

A continuity test lamp (self-powered) is not recommended for testing alternator diodes as there is not enough of a load to check for diode breakdown caused by heat.

The difference in checking a diode trio and a rectifier diode is the load. A one-amp load is used on the diode trio and a 15-amp load is used on a rectifier diode.

When a test load is connected to a diode, it must be connected so that the test bulb is lighted. If a test lamp lights for one diode, it must light for all three when current is flowing in the same direction for each diode. Leave the load on the diode for at least one minute to detect a heat failure.

If the test lamp does not light for one diode, it must not light for the remaining diodes. Reverse the test leads and test again. The diode is good if the test lamp lights in one direction only.

NOTE: *A shorted stator coil or a poorly soldered connection will appear to be a shorted negative rectifier diode assembly. Check stator for shorts and the connections for poor solder joints after disassembly.*

Diode Trio Test (Rear Housing Removed)

A testing device that draws a one-amp load (maximum) at 12 volts should be used. An ohmmeter will show whether a diode is open or shorted but the heat of the one-amp load is necessary for testing diodes that show intermittent failures (such as alternator indicator bulbs that glow intermittently).

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(1) Unsolder wires at diode trio. Use test apparatus as shown in figure 3-25.

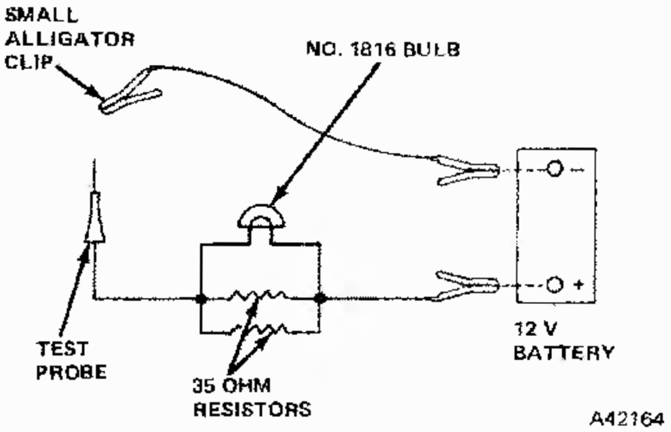

Fig. 3-25 Diode Heavy Load Tester

(2) Attach tester to a 12-volt battery.

(3) Attach negative clip of tester to common terminal (threaded stud) of diode trio.

(4) Attach positive clip to one of diode trio terminals (fig. 3-26).

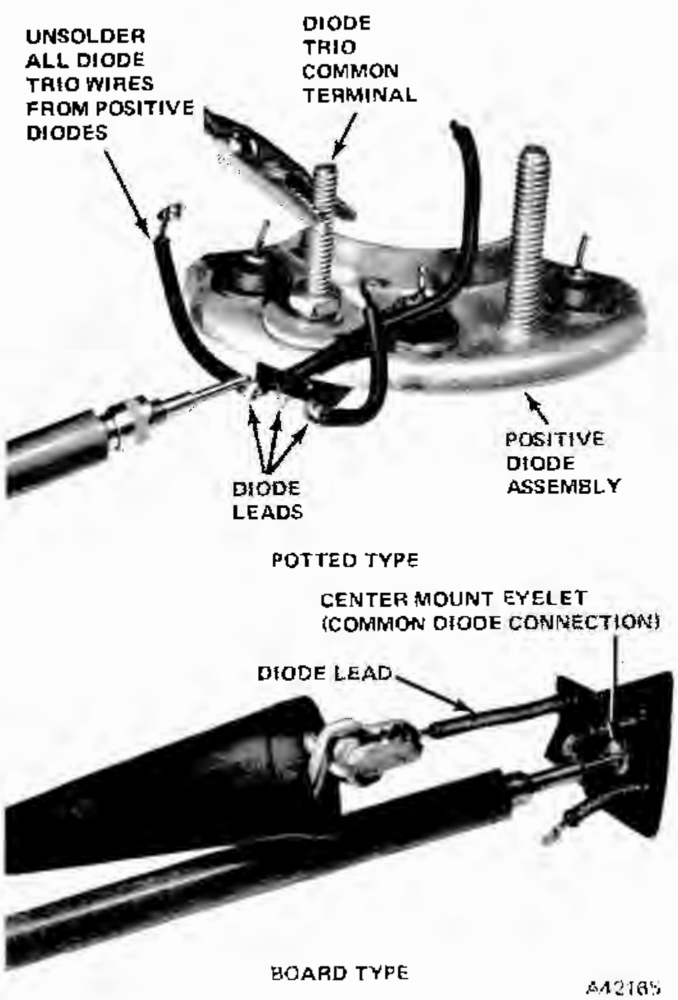

Fig. 3-26 Diode Trio Bench Test

(5) Test lamp should light. Keep load on diode for one to three minutes. If light flickers or goes out, diode is defective.

(6) After one to three minutes with test lamp on, immediately reverse leads. If test lamp lights, diode is defective.

(7) Test second and third diodes in the same manner.

Rectifier Diode Test (Rear Housing Removed)

(1) Attach a needlenose pliers or some other type of heat absorber between diode and diode wire solder joint.

(2) Unsolder wire(s) from each diode. Use a test apparatus as shown in figure 3-27. This apparatus places about a 15-ampere load on diode.

(3) Attach tester to a fully charged 12-volt battery.

(4) Connect one test lead to diode heat sink.

(5) Connect remaining test lead to diode lead (fig. 3-28). Connect test leads so that test lamp lights.

(6) Maintain test load on diode for one to three minutes. If light flickers or goes out, diode is defective.

(7) After one to three minutes with test lamp on, immediately reverse leads. If test lamp lights, diode is defective.

(8) Test each remaining diode in the same manner.

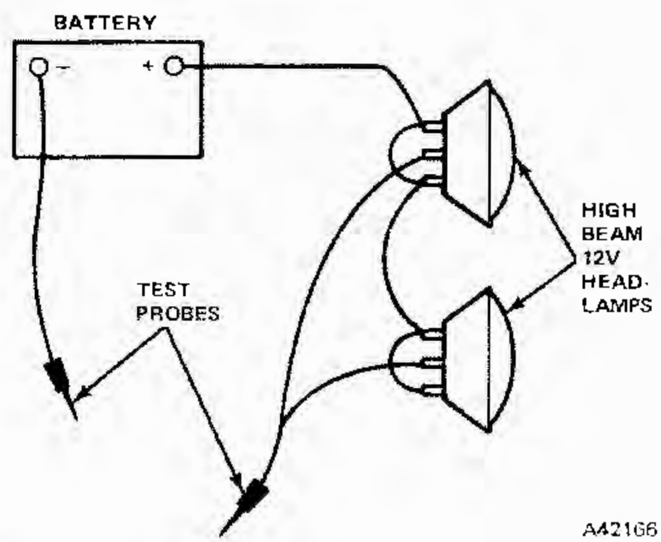

Fig. 3-27 Rectifier Heavy Load Tester

Rotor Removal

The rotor requires removal from the front housing only if there is a defect in the field coil itself or in the front bearing.

Front and rear bearings are permanently lubricated and sealed. If the rotor must be removed, use a double-jaw puller to remove the pulley. Remove the woodruff key and spacer. The split ring washer must be unseated by inserting Tool J-21157 through the op-

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ening in the front housing and compressing the washer while exerting pressure toward the rotor (fig. 3-28). Remove the washer only after the rotor and front bearing have been removed. The rotor and front bearing can be removed from the front housing by tapping the rotor shaft lightly.

NOTE: *The split ring washer must be removed from its retaining groove before attempting to remove the front bearing from the front housing.*

Fig. 3-28 Removing Spit Ring Washer

Rotor - Bench Test (Field Coil Test)

Test the rotor for grounds and shorted turns in the winding. The ground test is made with the test probes connected in series with a 110-volt test lamp. Place one test probe on a slip ring and the other on the rotor core. If the bulb lights, the rotor winding is grounded.

To test for shorted turns, check rotor field current draw (fig. 3-29). Slowly reduce resistance of rheostat to zero. With full battery voltage (12.6 plus, minus 0.2 volts) applied to field coil (rotor), the field current should be 1.8 amperes minimum to 2.5 amperes maximum. Excessive current draw indicates shorted turns in the field windings. Less than minimum indicates open windings.

Front and Rear Bearing Removal

The bearings are removed from the rotor as shown in figures 3-30 and 3-31 using Tool J-21155.

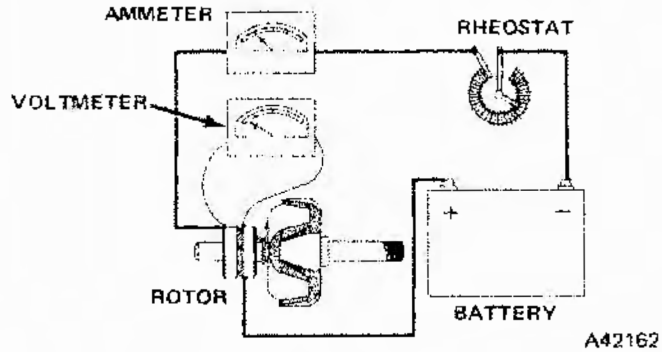

Fig. 3-29 Rotor Test

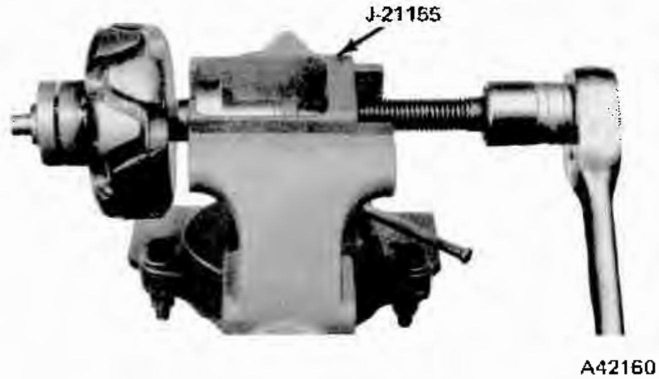

Fig. 3-30 Front Bearing Removal

Fig. 3-31 Rear Bearing Removal

ALTERNATOR ASSEMBLY

(1) Clean bearing and inside of bearing hub of front housing.

(2) Support front housing and using Drive Tool J-21154, J-8092, or J-8592 Driver Handle, apply sufficient pressure to outside race of bearing to seat bearing as shown in figure 3-32. A 1-1/8-inch socket also can be used to seat bearing in front housing.

(3) Insert split ring washer into hub of front housing and use Tool J-21154 to seat washer into groove of hub.

CAUTION: *Do not use a screwdriver or any small object to compress washer that can slip off and damage bearing seal.*

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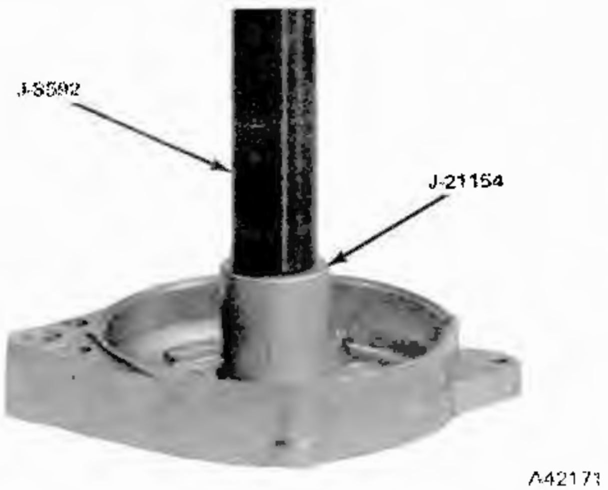

Fig. 3-32 Installing Front Bearing

NOTE: *Make certain that split ring washer has been installed prior to assembling front housing and rotor.*

(4) Before installing rotor into front housing, clean any rust or corrosion from shaft. Lightly lubricate rotor shaft.

(5) Use Tool J-21156 and apply sufficient pressure to seat front bearing against shoulder on rotor shaft. Bearing drive tool must fit inner race of bearing (fig. 3-33).

NOTE: *A small press also can be used to install rotor or rotor can be installed by tapping on end of rotor shaft with soft-faced hammer.*

(6) Install fan and pulley spacer, woodruff key, fan, and pulley.

(7) Use a 7/16-inch socket, or equivalent tool, to fit inside race of rear bearing and apply sufficient pressure to drive bearing against shoulder of rotor shaft.

Stator Installation

(1) Install flat fiber washers on positive diode attaching studs. If alternator has a 7-volt ac terminal, install a fiber washer on ac stud.

(2) Install stator assembly into rear housing.

(3) Install plastic sleeves on all insulated terminals.

(4) Install flat fiber washers, metal flat washers, and locknuts.

NOTE: *The ac terminal (if so equipped) has a polarizing blade. This blade is identified by a short protruding tab that prevents the regulator terminal harness connector from being accidentally installed on the ac (electric heated choke) terminal blade. Before tightening the ac terminal, check that the diode wire end does not contact the heat sink.*

(5) Install two terminal blades, tighten securely.

Fig. 3-33 Assembling Front Housing and Rotor

Rear Housing Installation

Before installing the rear housing assembly, check the slip rings for grease or grime and clean if necessary.

(1) Align scribe marks previously marked on front housing and stator assembly.

(2) Check that insulating washers are installed on regulator and battery post terminals.

NOTE: *When equipped with a 7-volt ac terminal, the ac terminal also serves as one of the negative diode assembly attaching studs. This is the only negative diode assembly stud that must be insulated from the rear housing assembly.*

(3) Install four through-bolts and tighten securely.

(4) Turn rotor and check for free movement.

VOLTAGE REGULATOR

The voltage regulator is an electronic switching device, which senses voltage at the alternator regulator terminal. The regulator automatically provides the amount of field current required by the alternator to maintain the specified system voltage at the alternator output (Bat.) terminal under all electrical load conditions. If high voltage occurs with a known good battery and the regulator grounded to the battery, the

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voltage regulator is defective. Refer to the specifications at the rear of this section for the acceptable voltage range for various regulator temperatures.

Voltage Regulator Test

(1) Connect voltmeter to battery, negative to negative, positive to positive.

(2) Turn headlamps on (low beam).

(3) Start engine and operate for several minutes to bring regulator up to operating temperature.

(4) Set engine at 1000 rpm and note voltage.

(5) Voltage reading should be within specification for temperature of regulator. If an overcharge or undercharge is experienced, refer to Overcharging or Alternator Output tests in this section.

IMPORTANT: The voltage setting of the regulator will vary due to high or low underhood temperatures. It is the temperature of the regulator, not the outside air temperature, that determines the voltage setting. Refer to Specifications at the rear of this section.

Out-of-Circuit Test

A commerical tester is available for testing transistor voltage regulators on or off the vehicle. The tester shown in figure 3-34 will register internal defects and show maximum voltage regulator setting.

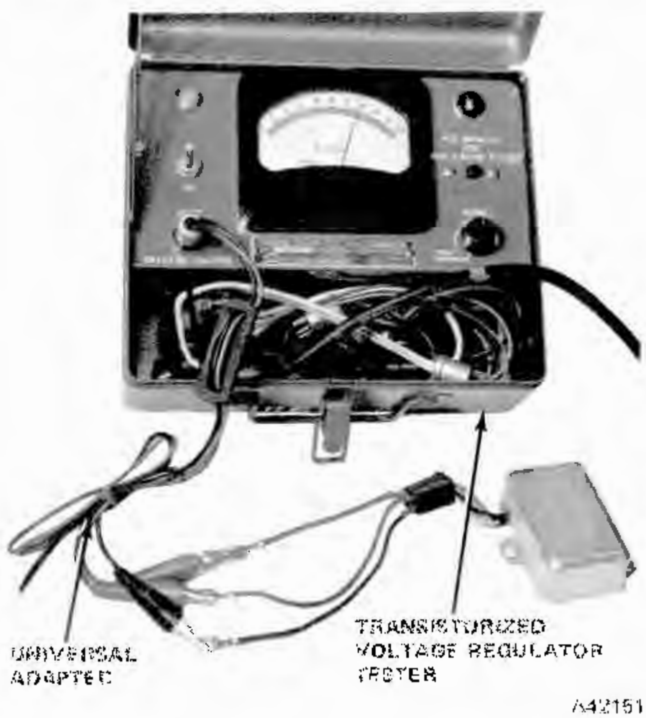

Fig. 3-34 Voltage Regulator Test - Out-of-Circuit

Overcharging

Overcharging results in excessive battery water usage and a shortened life for all electrical components. Any time an overcharge is experienced, it is due to excessive voltage applied to the alternator insulated brush terminal. Three conditions will cause an overcharge:

- Voltage regulator loss of ground
- Defective battery
- Defective voltage regulator

To check for a regulator ground problem, connect a jumper wire from the regulator case to the battery negative post. If the voltage drops, the regulator ground requires repair. Be sure the black wire of the regulator is connected to the black wire of the engine compartment harness. A battery can be checked by applying a heavy load test or a light load test. Refer to Battery in this section.

GENERATOR

A 35-ampere capacity generator is available as an option with the 258 CID engine on Truck Models.

The generator is an air-cooled, two-brush unit; output cannot be adjusted. For replacement, voltage regulator and generator must be matched for voltage and capacity, polarity, and common source of manufacture. Otherwise, either a loss of ampere capacity or a burned-out generator will result. Generators for these vehicles are 12 volt.

The circuit breaker, voltage regulator, and current-limiting regulator are built into one combination unit. Because the regulator and battery are part of the generator circuit, the output of the generator depends upon the state of charge and temperature of the battery. With a discharged battery, the output will be high, decreasing proportionally as the battery becomes charged.

Generator Maintenance

A periodic inspection should be made of the charging circuit. The interval between these checks will vary depending upon type of service. Dust, dirt, and high-speed operation are factors which contribute to increased wear of bearings and brushes.

Under normal conditions, a check should be made each 5,000 miles.

A visual inspection should be made of all wiring to be sure there are no broken or damaged wires. Check all connections to be sure they are tight and clean.

If the commutator is rough or worn, the armature should be removed and the commutator turned and undercut.

The brushes should slide freely in their holders. If they are oil soaked one-half their original length, they should be replaced. When new brushes are installed, they should be sanded to provide full contact with the commutator. Generators should not be checked for output until the brushes are seated.

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Brush spring tension is important. High tension causes rapid brush and commutator wear; low tension causes arcing and reduced output. Test the tension with a spring scale. Refer to Specifications at the end of this section for correct spring tension.

Preliminary Inspection

Wiring - Check the wiring to see that it is properly connected to the generator.

Generator Performance - Make sure the generator operates without the regulator in the circuit. Remove the armature and battery leads from the regulator and connect an ammeter between them. Remove the field lead from the regulator and, while operating at idle speed, touch the field lead to the regulator base. Increase the speed slowly, noting the charging rate.

CAUTION: *Do not increase the output above the rated output of the generator.*

If the generator output will not build up, inspect the wiring harness for shorts and opens and remove the generator for an overhaul. To check the generator circuit when a suitable ammeter is unavailable, disconnect the armature cable at the regulator. Connect one lead of a 12-volt test lamp to the regulator terminal marked Armature and, with the engine running, ground the other lead. Should test lamp fail to light, there is a fault either in the generator or regulator. To localize the fault, disconnect both the field and armature cables at the generator. Connect a wire from the field terminal and use a 60-watt, 110-volt test lamp to ground the armature terminal. If the generator is charging satisfactorily, the test lamp will glow at approximately 1500 rpm engine speed and the fault will be localized in the regulator.

Incorrect Regulator - Make sure the regulator is the correct type for use with the generator.

Battery - Check the specific gravity and terminal voltage of the battery. If the battery is not up to specifications, substitute, temporarily for test purposes, a fully charged battery of the same type and capacity.

High Resistance Connections - Inspect the wiring between the generator, regulator and battery for broken wires and high resistance connections. Pay special attention to the ground connections at all three units. Connect an ammeter with one ampere graduations in series with the regulator B-terminal and the lead removed from this terminal. Run the generator at a medium speed and turn on the lights or accessories until the ammeter shows a 10-ampere charging rate. At this charging rate, measure the voltage drop between the following points using an voltmeter graduated in 0.1-volt divisions. The voltmeter should not show a reading above the maximum noted.

- Generator A-terminal to regulator A-terminal - 0.1-volt maximum.
- Generator F-terminal to regulator F-terminal - 0.05-volt maximum.
- Battery terminal to regulator B-terminal - 0.1-volt maximum.
- Regulator ground screw to generator frame - 0.03-volt maximum.
- Regulator ground screw to generator post - 0.03-volt maximum.
- Generator frame to battery ground post - 0.03-volt maximum.

Disassembly

Refer to figure 3-35.

(1) Remove two frame screws in the commutator end plate and remove end plate assembly.

(2) Pull the armature and drive head completely from the generator housing.

(3) Remove generator pulley from armature by removing nut and washer.

NOTE: *Do not lose the woodruff key when pulley is removed.*

(4) Remove drive end head assembly which includes oil seal and bearing.

(5) Remove three screws and lockwashers in grease retainer and remove retainer and felt washer.

(6) Remove bearing, oil guard and felt washer.

Armature

If the commutator is rough and worn, turn it down in a lathe. After turning, the mica insulation between the segments should be undercut to a depth of 1/32-inch (0,8 mm).

To test the armature for a ground, connect one prod of a test lamp to the core or shaft (not on bearing surface) and touch each commutator segment with the other prod. If the lamp lights, the armature segment is grounded and the armature must be replaced.

To test for short in armature coils, a growler (fig. 3-36) is necessary. Place the armature on the growler and lay a thin steel strip on the armature core. The armature is then rotated slowly by hand and if a coil is shorted, the steel strip will vibrate. If a coil is shorted, the armature must be replaced.

NOTE: *If precision test equipment is available, accurate tests can be made in accordance with instructions furnished with the testing equipment.*

Field Coils

Inspect the field coils for chafed wires, and using

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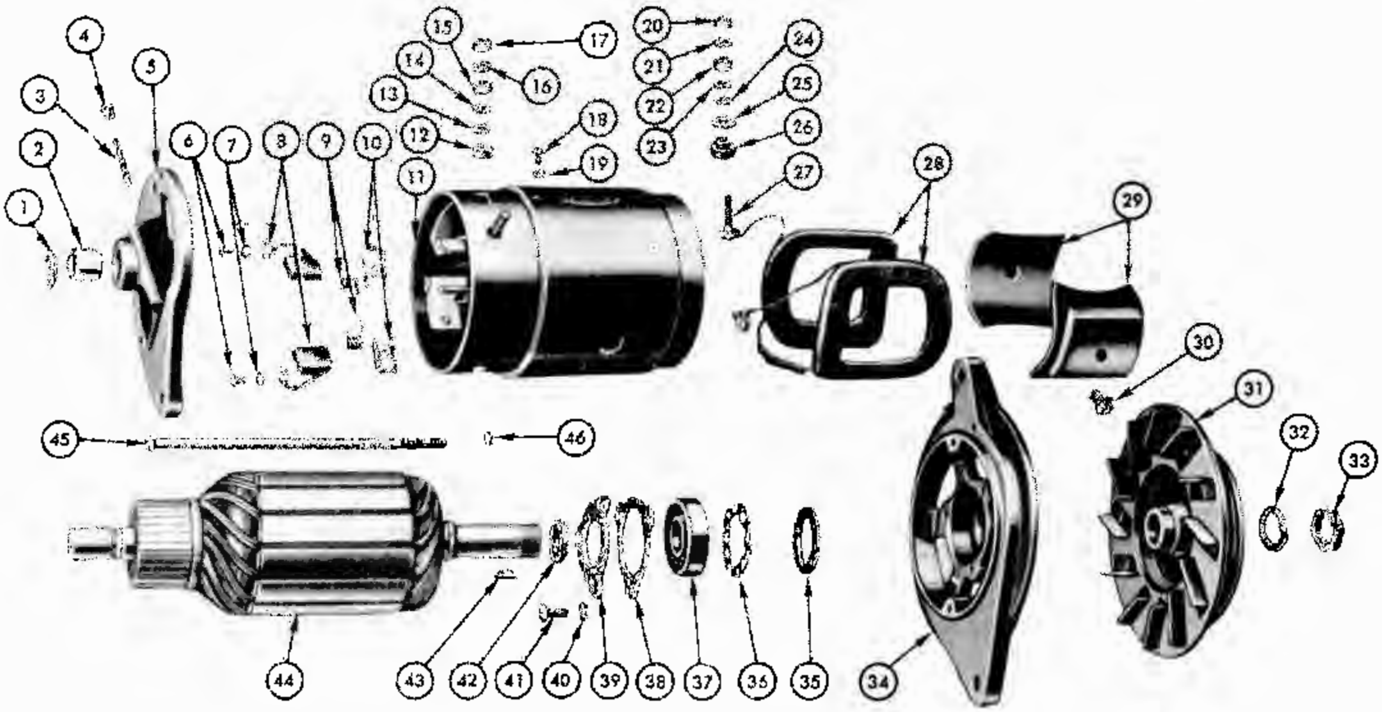

1. OIL RETAINER
2. BEARING
3. FELT WICK
4. OILER
5. COMMUTATOR END HEAD
6. BRUSH LEAD SCREW
7. LOCKWASHER
8. BRUSH SET
9. BRUSH SPRING
10. BRUSH ARM
11. FRAME
12. INSULATING BUSHING
13. WASHER
14. LOCKWASHER
15. HEX NUT
16. LOCKWASHER
17. HEX NUT
18. GROUND SCREW
19. LOCKWASHER
20. HEX NUT
21. LOCKWASHER
22. HEX NUT
23. LOCKWASHER
24. WASHER
25. INSULATING WASHER
26. INSULATING BUSHING
27. STUD
28. LEFT AND RIGHT FIELD COIL
29. POLE SHOES
30. POLE SHOE SCREW
31. DRIVE PULLEY AND FAN ASSEMBLY
32. LOCKWASHER
33. SHAFT NUT
34. DRIVE END HEAD
35. FELT WASHER
36. FELT WASHER RETAINER
37. BALL BEARING
38. GASKET
39. BEARING RETAINER
40. LOCKWASHER
41. RETAINER SCREW
42. FELT WASHER
43. WOODRUFF KEY
44. ARMATURE
45. THROUGH-BOLT
46. LOCKWASHER

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Fig. 3-35 Generator - Prestolite 35-Ampere

test lamp prods, check for both open and grounded circuits. To test for open coil, connect the prods to the two leads from each coil. If the lamp fails to light, the coil is open and must be repaired or replaced.

To test for ground, place one prod on ground and the other on the field coil terminal. If a ground is present, the lamp will light and the coil must be repaired or replaced.

NOTE: *If accurate test equipment is available, check the field coils for current draw which should be within the limits of 1.2 to 1.8 amperes at 10 volts for both coils.*

A shorted coil will show a much higher draw, while an open coil will show no draw. In either case, the generator output will be below normal.

To replace a field coil, disconnect the field terminals, use a heavy screwdriver to remove the field pole piece screws, then the coils together with the pole pieces may be removed. When replacing the coils, set the pole piece screws by staking with a center punch.

Brush Holders

With test prods, check the insulated brush holder to be sure it is not grounded. Touch the brush holder with one prod and the frame with the other prod. If the lamp lights, a grounded brush holder is indicated.

Inspect the brush holders for cracks, distortion, and improper alignment. The brushes should slide freely and should be in perfect alignment with the commutator segments.

Assembly

(1) Install felt grease retainer and washer in drive end head (fig. 3-35).

(2) Check bearing to be sure it is clean and fill it one-half full with a high melting point grease.

(3) Install bearing and inside felt washer and attach the bearing retainer with lockwashers and screws.

(4) Place drive end head over front end of armature shaft.

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Fig. 3-36 Testing Armature for Shorted Winding

(5) Install the woodruff key in armature shaft and install drive pulley, being sure key is in position.

(6) Secure in position with washer and nut.

(7) Place assembly on end so it rests on pulley with commutator end up.

(8) While holding brushes clear of commutator, place generator housing and field coils assembly in position.

(9) Turn front end bracket so dowel pin in housing enters hole in end head.

(10) Place commutator end plate on shaft and install long frame screws.

NOTE: *When installing the generator on the engine, tighten the bracket bolt to 25 to 35 foot-pounds torque.*

CURRENT-VOLTAGE REGULATOR (GENERATOR)

For replacement, a voltage regulator must be matched for voltage and capacity, polarity, and common source of manufacture. Otherwise, either a loss of ampere capacity or a burned out generator will result.

These regulators are used with shunt-type generators and have three units each with a separate function to perform. These units are the circuit breaker unit, the voltage regulator unit, and the current limiting regulator unit (fig. 3-37).

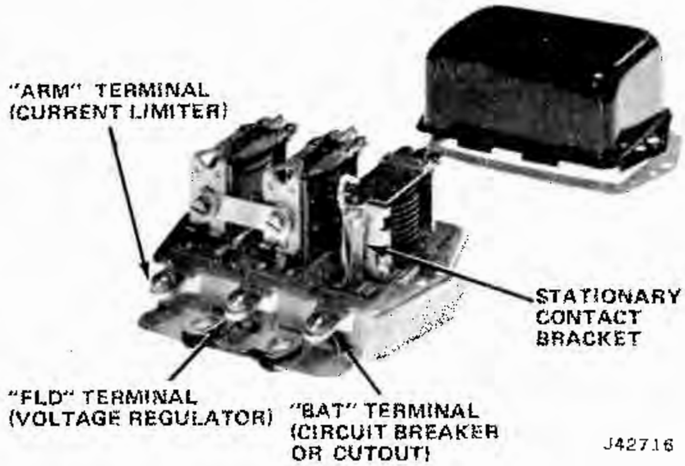

Fig. 3-37 Voltage Regulator - Prestolite

Circuit Breaker - Cutout

Consists of an electromagnet and a set of contacts. The contacts are mounted with one on a stationary bracket, and the other on a movable armature, which is controlled by the electromagnet. The movable contact is mounted on a spring arm so that as the contacts open and close a slight wiping action is produced.

The electromagnet of the circuit breaker has two windings: one, the shunt coil which is connected across the generator output (like a voltmeter),and the other a series coil connected in series with the generator output (like an ammeter). These coils are wound in the same direction so that when the generator is charging the battery, the magnetism of the series coil increases the total magnetism. When the battery discharges back through the generator, the magnetism of the series coil is reversed and the magnetism of the two coils is opposed. This results in a decreased pull on the armature and spring action opens the contacts.

The sequence of operation of the circuit breaker is as follows:

When the generator is not running, the contacts are open. When the generator is started, the voltage builds up at the armature terminal and in the shunt coil. As soon as it reaches the value for which the circuit breaker is calibrated, there is sufficient magnetism created by the shunt coil to pull down the armature, closing the contacts which automatically connects the generator to the battery. With the contacts closed, the current in the series coil flows from the generator to the battery or in the same direction as the current in the shunt coil, so that the pull on the armature is increased by the magnetism of the series coil.

When the engine is stopped and the generator loses speed, the voltage falls. As the generator voltage drops below the battery terminal voltage, the current flows

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from the battery to the generator, reversing the direction of current in the series coil so that the magnetism created by the series coil opposes and reduces the magnetism of the shunt coil. This reduces the pull on the armature to a point where spring action opens the contacts.

Voltage Regulator

The function of the voltage regulator is to hold the generated voltage at a predetermined value as long as the circuit values allow the voltage to build up to the operating voltage.

The electromagnet of the voltage regulator unit has a winding of many turns of fine wire. It is connected across the charging circuit so that the system voltage controls the amount of magnetism. The contacts of the voltage regulator unit are connected in the generator field circuit. The field circuit is completed through the contacts when they are closed and through a resistor when the contacts are opened.

When the voltage rises to a predetermined value, there is sufficient magnetism created by the regulator winding to pull the armature down. This opens the contacts and inserts resistance in the field circuit of the generator reducing the field current. The generated voltage immediately drops, reducing the pull on the armature to the point where the spring closes the contacts. The output again rises and the cycle is repeated.

These cycles occur at high enough frequencies to hold the generated voltage at a constant value. They will continue as long as the voltage of the circuit is high enough to keep the voltage regulator unit in operation. With the addition of a current load great enough to lower the battery voltage below the operating voltage, the contacts will remain closed and the generator will maintain a charging rate as limited by its speed of the current limiting regulator.

Due to the effect of heat on the operating characteristics of regulator windings, it is necessary to compensate for the changes in coil resistance. This is accomplished through the use of a nickel iron magnetic bypass on the voltage regulator unit. This shunt bypasses some of the magnetic flux when the unit is cold, allowing most of the flux to act on the armature when the unit is hot. When the coil is hot and not as efficient, the magnetic shunt reduces the amount of flux needed to vibrate the armature.

The compensation is usually more than enough to offset the changes in regulator coil resistance due to heat. The excess allows the regulator to operate at higher voltage under cold operating conditions than under hot conditions. This is necessary as it requires a higher voltage to charge a battery with its internal resistance increased by low temperatures.

Current-Limiting Regulator

The function of the current-limiting regulator is to limit the output of the generator to its maximum safe output.

The electromagnet consists of a winding of heavy wire connected in series with the generator output. When the output reaches a predetermined value, the current in the winding produces enough magnetism to overcome the spring tension, pulling the armature down. This opens the contacts and inserts resistance in the field circuit of the generator. With the field current reduced by the resistance, the generator output falls and there is no longer enough magnetism to hold the contacts open. As soon as the spring closes the contacts, the output rises and the cycle is repeated. These cycles occur at high enough frequencies to limit the output to a minimum fluctuation.

VOLTAGE REGULATOR TEST AND ADJUSTMENT

Circuit Breaker

(1) Connect an ammeter in series between regulator B-terminal and lead wire removed from that terminal.

(2) Connect a voltmeter between regulator A-terminal and regulator mounting base.

(3) Disconnect field lead from regulator F-terminal and insert a variable resistance (3-amp, 50-ohm capacity) between lead and regulator terminal.

(4) Run generator at approximately 1000 generator rpm.

(5) Insert all resistance in field circuit, then slowly reduce resistance, noting the voltage reading just before change caused by closing of circuit breaker.

(6) Increase charging rate to figure specified for regulator being tested, then reduce charging rate by inserting resistance in field circuit. Note voltmeter and ammeter readings just before the circuit breaker opens and ammeter reading drops to zero.

NOTE: *The closing voltage and the opening voltage or current should be within the limits specified.*

(7) Adjust closing voltage by changing armature spring tension. Bend the hanger at the lower end of spring to increase spring tension and raise closing voltage. To decrease tension, lower closing voltage.

(8) Adjust opening voltage by raising or lowering stationary contact. Increasing contact gap lowers opening voltage. Change contact gap by expanding or contracting stationary contact bracket.

NOTE: *Do not adjust the gap between the contacts to less than the specified minimum.*

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Voltage Regulator

(1) Connect ammeter.

(2) Connect voltmeter between regulator B-terminal and regulator base.

(3) Remove variable resistance from field circuit.

(4) Run generator at half output for 15 minutes to bring regulator to normal operating temperature.

NOTE: *Keep the cover on the regulator during the warmup period and also when taking readings.*

(5) Stop engine, then bring it up to approximately 2500 generator rpm.

(6) Adjust amperage to half maximum output by turning on lights or accessories and then note voltmeter reading. This reading should be within limits specified for the voltage regulator operation.

(7) To adjust operating voltage, change armature spring tension by bending hanger at lower left end of armature spring.

NOTE: *After each adjustment, stop the engine then restart. Bring engine up to speed and adjust the current before taking a reading.*

NOTE: *Contacts should be flat and not burned and should be aligned to make full face contact.*

Current Regulator

(1) Connect regulator and test equipment.

NOTE: *With the generator running at approximately 3000 generator rmp, turn on lights and accessories so that the generator must charge at maximum rate.*

(2) To adjust opening amperage, change armature spring tension by bending hanger at lower end of armature spring.

NOTE: *After each adjustment, stop the engine, then restart. Bring the engine up to speed and take an ammeter reading. Keep the cover on the regulator when taking these readings.*

NOTE: *Contacts should be flat and not burned excessively and should be aligned to make full face contact.*

Contacts

(1) Inspect contacts on all three units. In normal use, contacts will become greyed.

(2) If contacts are burned, dirty, or rough, file with a No. 6 American Swiss cut equalling file.

(3) File parallel and lengthwise to the armature. File just enough so that contacts present a smooth surface toward each other.

(4) After filing, dampen a piece of linen or lintless band tape in refined carbon tetrachloride and draw tape between contacts.

(5) Repeat with a dry piece of tape. Use clean tape for each set of contacts.

Low Charging Rate Check

A fully charged battery and a low charging rate indicates normal regulator operation.

A further check of the regulator operation can be made by using the starting motor for 5 to 10 seconds with the coil wire disconnected. Then connect the coil wire and start the engine and operate at a generator speed of 2500 to 3000 rpm. The charging rate should rise to its maximum value then taper off to a minimum charge as the battery becomes charged.

High Charging Rate Check

This is usually an indication that the voltage regulator is not operating correctly. The high voltage will cause the battery to gas excessively and will shorten the life of the ignition contacts and, in general, will have a detrimental effect on all connected loads.

Connect an ammeter in series with the regulator B-terminal and the lead removed from the terminal. Run the generator at a medium speed and perform the following operation. After each test is completed, reconnect whatever leads have been opened.

(1) Disconnect field lead at generator.

(a) Output drops to zero - shorted field circuit in regulator or in wiring harness. See step (2).

(b) Output does not drop - shorted field circuit in generator. Inspect generator.

(2) Disconnect field lead at regulator.

(a) Output drops to zero - shorted field in regulator. (See step (3)).

(b) Output does not stop - shorted wiring harness. Repair or replace wiring harness.

(3) Remove regulator cover and hole voltage regulator contacts open.

(a) Output drops to zero - regulator contacts sticking, regulator out of adjustment or regulator inoperative. Check for high resistance (step (4)) and clean contacts.

(b) Output does not drop - shorted field circuit in regulator. Clean regulator contacts and inspect regulator visually for incorrect wiring between units and shorted leads.

(4) Operate units at 10 amperes output and measure voltage drop from regulator base to generator frame.

(a) Voltage reading below 0.03 volts - ground circuit is satisfactory. See step (5).

(b) Voltage reading above 0.03 volts - inspect ground circuit for poor connections and eliminate high resistance.

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No Charging Rate - Low Battery

(1) Check all wiring for loose connections, frayed insulation and high resistance connections and correct any fault.

(2) Make sure generator operates correctly without regulator in the circuit.

(3) Remove A and B leads from regulator and connect an ammeter between them.

(4) Remove field lead from regulator and, while operating at idle speed, touch field lead to regulator base. Increase speed slowly, noting charging rate.

NOTE: *Do not increase the output above the rated output of the generator.*

(5) If generator output will not build, inspect wiring harness for shorts and opens and remove generator for an overhaul.

(6) Connect an ammeter between battery lead and regulator B-terminal.

(7) Connect field lead to regulator F-terminal and connect armature lead to regulator A-terminal.

(8) Connect a voltmeter from regulator A-terminal to regulator base. Operate generator at a medium speed.

(9) Read voltmeter.

(a) Voltage builds up - open series circuit. See step (10).

(b) Voltage does not build up - regulator out of adjustment, field circuit open, grounded series circuit. See step (11).

(10) Remove regulator cover and, with generator operating at a medium speed, hold circuit breaker contacts closed.

(a) Ammeter shows no charge - open circuit breaker shunt winding, incorrect setting of circuit breaker, or dirty contacts. Clean contacts and reset circuit breaker. If circuit breaker cannot be set, shunt coil is open and regulator should be replaced.

(b) No generator output - clean circuit breaker contacts and try test again. If there is still no charge, series windings are open and regulator should be replaced.

(11) Run generator at idle speed and momentarily connect a jumper from F-terminal to the regulator base.

(a) Voltage builds up - open field circuit or regulator out of adjustment. See step (12).

(b) Voltage does not build up - grounded series circuit. Replace regulator.

(12) Operate at a medium speed with jumper removed. Remove regulator cover and hold voltage regulator contacts closed.

(a) Voltage builds up - voltage regulator contacts burned, dirty, or incorrect regulator setting. Clean contacts and adjust regulator.

(b) Voltage does not build up - clean contacts and repeat test. If voltage still does not build up, see step (13).

(13) Remove regulator cover and hold current contacts closed.

(a) Voltage builds up - current regulator contacts burned, dirty, or incorrect regulator setting. Clean contacts and adjust regulator.

(b) Voltage does not build up - clean contacts and repeat test. If voltage still does not build up, replace regulator.

STARTER SYSTEM

The starting system includes the starter motor and drive, battery, starter relay, starter switch (ignition switch), and the necessary cables and wiring to connect the components. A starter safety switch, on vehicles equipped with automatic transmissions, prevents operation of the starter in all selector positions except N (neutral) and P (park).

NOTE: *All models equipped with an automatic transmission have a combination neutral-start backup light switch mounted on the steering column. When equipped with a manual transmission, the neutral-start wires are connected together, resulting in a direct connection between the ignition switch and the starter motor relay S-terminal.*

A low and high current circuit make up the starting system and is shown in figure 3-38. The low current is the control circuit and includes the connections and wires from the ignition switch to the S-connection at the starter relay. This circuit activates the pull-in winding in the starter solenoid and closes the switch to complete the high current circuit. The high current circuit is from the battery through the starter relay switch to the starter motor to ground.

The Starter Motor Diagnosis Guide may be used to trace the source of the problem when the starter will not crank the engine or cranks slowly.

If the starter motor cranking speed is normal and the engine does not start, the problem usually can be found in the fuel or ignition system.

STARTER MOTOR

The starter has an integral positive engagement drive. When the starter is not in use, one of the field coils is connected directly to ground through a set of contacts (fig. 3-39). When the starter is first engaged, a heavy current flows through the grounded field coil actuating a movable pole shoe. The pole shoe is attached to the starter drive actuating lever, thus the drive is engaged with the flywheel.

When the movable pole shoe is fully seated, it opens the field coil grounding contacts and is connected in

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parallel with the other pole shoes while the armature is rotating. A holding coil is used to maintain the movable pole shoe in the fully seated position during the time that the starter is cranking the engine.

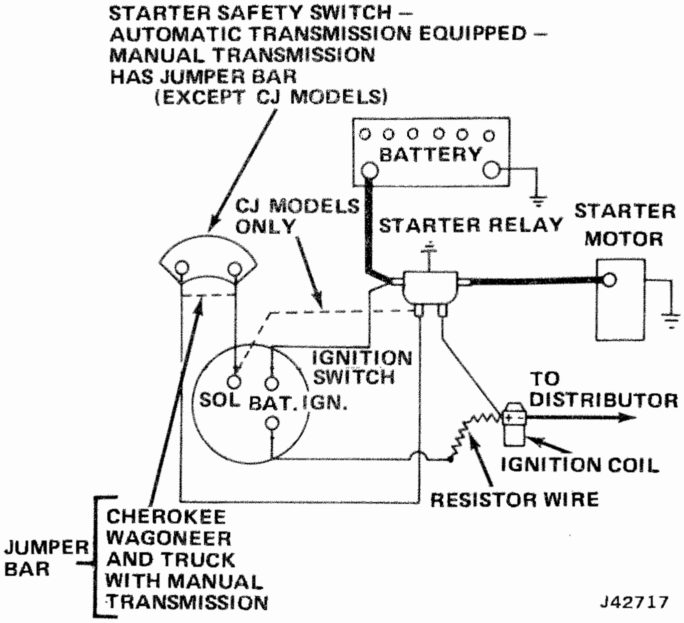

Fig. 3-38 Starter Circuit Wiring Diagram

Identification

The starter motor identification code is stamped on the frame, below the American Motors part number, at the time of manufacture.

Example:

4	F	C	A
Year	Month	Week	Work
(1974)	(June)	(3rd Week)	Shift

The letter I is never used in starter coding.

Current Draw Test - On Vehicle

(1) Prior to performing a current draw test, battery must be fully charged as described under Hydrometer Tests in this section.

NOTE: *The lower the voltage, the higher the amperage draw.*

(2) Disconnect and ground ignition coil secondary wire.

(3) Connect a remote control starter switch between positive battery terminal and S-terminal of the starter solenoid.

(4) Connect battery-starter tester leads as shown in figure 3-40. Operate remote control starter switch and read voltage indicated on voltmeter while starter is cranking engine.

CAUTION: *Do not operate for more than 15 seconds.*

(5) Turn remote control starter switch off.

(6) Turn load control knob clockwise or to Increase until the voltmeter reading is exactly the same as it was when the starter was cranking.

Read the current draw on the ammeter scale. This is the current being used by the starter under full load

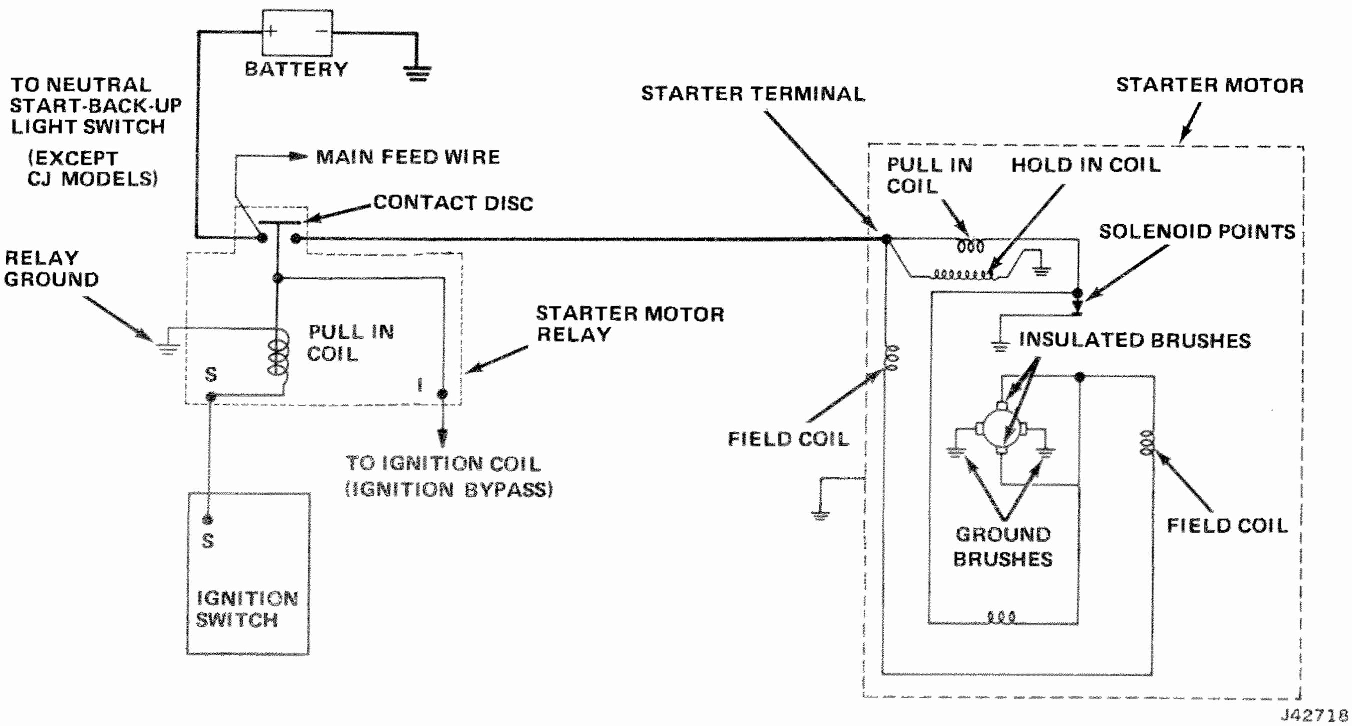

Fig. 3-39 Starter Motor - Wiring Diagram

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conditions. If the current draw is not 180 to 220 amperes at room temperature, remove the starter motor from the engine for bench testing.

NOTE: *Do not take ampere draw reading until starter motor has obtained maximum rpm.*

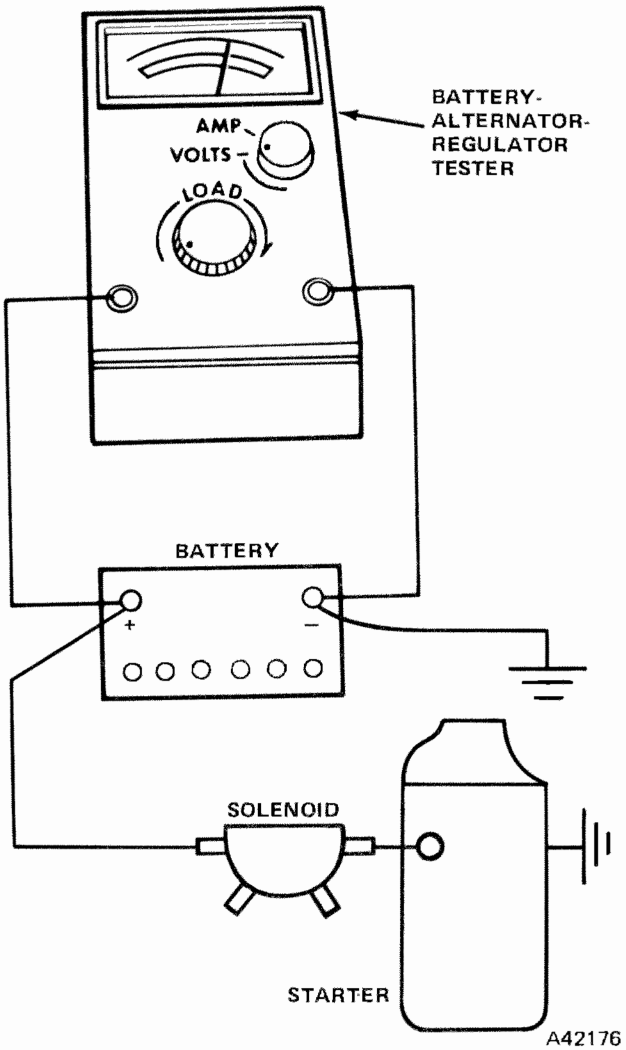

Fig. 3-40 Starter Motor Current Draw Test

No-Load Test - Out of Vehicle

The starter motor no-load test will indicate such faults as open or shorted windings, worn bushings (rubbing armature), or bent armature shaft. This test is run with the starter on the bench.

NOTE: *The tester load control knob must be in the Decrease or extreme counterclockwise position.*

(1) Operate starter with test equipment connected as shown in figure 3-41. Note voltage reading.

(2) Determine exact starter rpm using a mechanical tachometer (not shown).

NOTE: *To use a mechanical tachometer, remove seal from drive end housing and clean grease from end of armature shaft.*

(3) Disconnect starter from battery.

(4) Turn load control knob clockwise (Increase) until voltmeter reading is exactly the same as it was with the starter connected to the battery.

(5) If ammeter reading at no-load speed is below specifications, starter has high electrical resistance and should be repaired or replaced.

(6) If ammeter reading is higher than specifications and starter is running slower than it should, starter should be disassembled, cleaned, inspected, and tested as outlined in the following paragraphs.

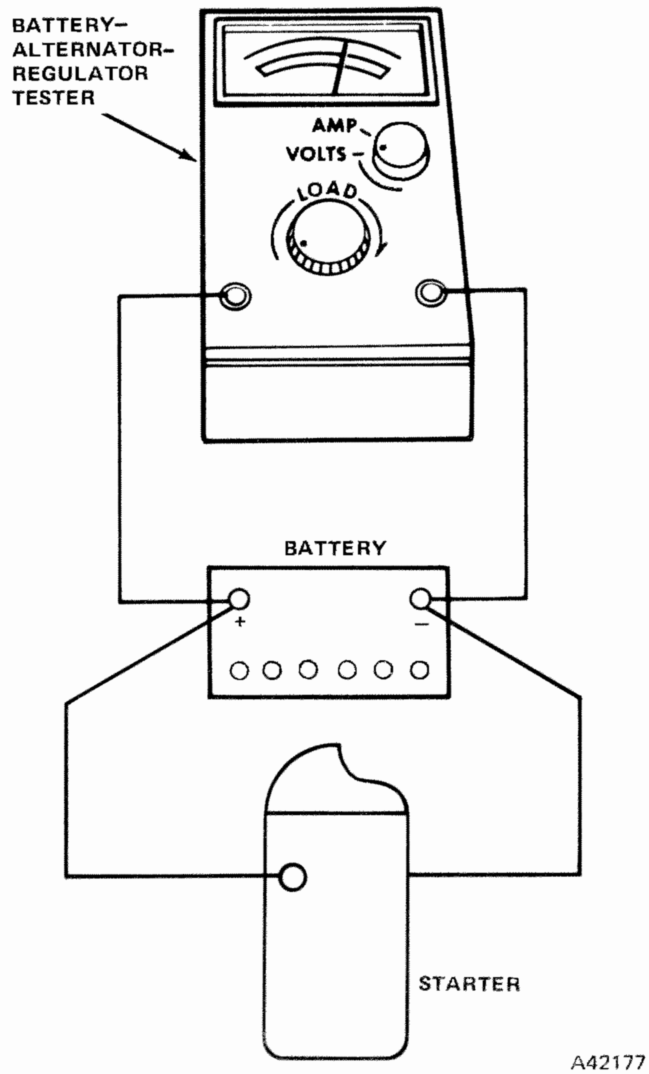

Fig. 3-41 Starter Motor No-Load Test

Disassembly

Refer to figure 3-42 for parts identification.

(1) Remove brush cover band and protective tape, drive yoke cover and gasket.

(2) Remove brushes from brush holders.

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(3) Remove through-bolts, drive end housing and drive yoke return spring.

(4) Remove through-bolts, drive end housing and drive yoke return spring.

(5) Remove pivot pin and starter drive yoke.

(6) Remove armature and drive assembly.

(7) Remove brush end plate.

Cleaning and Inspection

(1) Use a brush or air to clean starter frame, field coils, armature, drive assembly, and drive end housing.

(2) Wash all other parts (except field coils) in solvent and dry parts.

(3) Inspect armature windings for broken or burned insulation and unsoldered connections.

(4) Check armature for open circuits and grounds as outlined in Armature Test Procedure.

(5) If the commutator is dirty, it may be cleaned with No. 00 or 000 sandpaper.

NOTE: *Never use emery cloth to clean the commutator.*

(6) If armature commutator is worn, out-of-round (0.005 inch or more), or has high insulation, it should be turned down on a lathe.

(7) Inspect armature shaft and two bushings for scoring and excessive wear.

(8) Inspect drive assembly pinion gear for damage.

NOTE: *The entire circumference of the ring gear must be inspected for damage when the teeth of the drive assembly pinion gear are damaged.*

NOTE: *An engine that has repeated starter motor pinion failures should be checked for proper ring gear location (fig. 3-42), missing or improper parts or misaligned bell housing. For wobbling ring gear, the maximum allowable runout is 0.030 inch. Check for broken welds or broken flex plate.*

(9) Check drive assembly clutch by grasping and rotating pinion gear. Gear should rotate freely in one direction and lockup in opposite direction.

(10) Check brush holders for broken springs and insulated brush holders for shorts to ground. Tighten

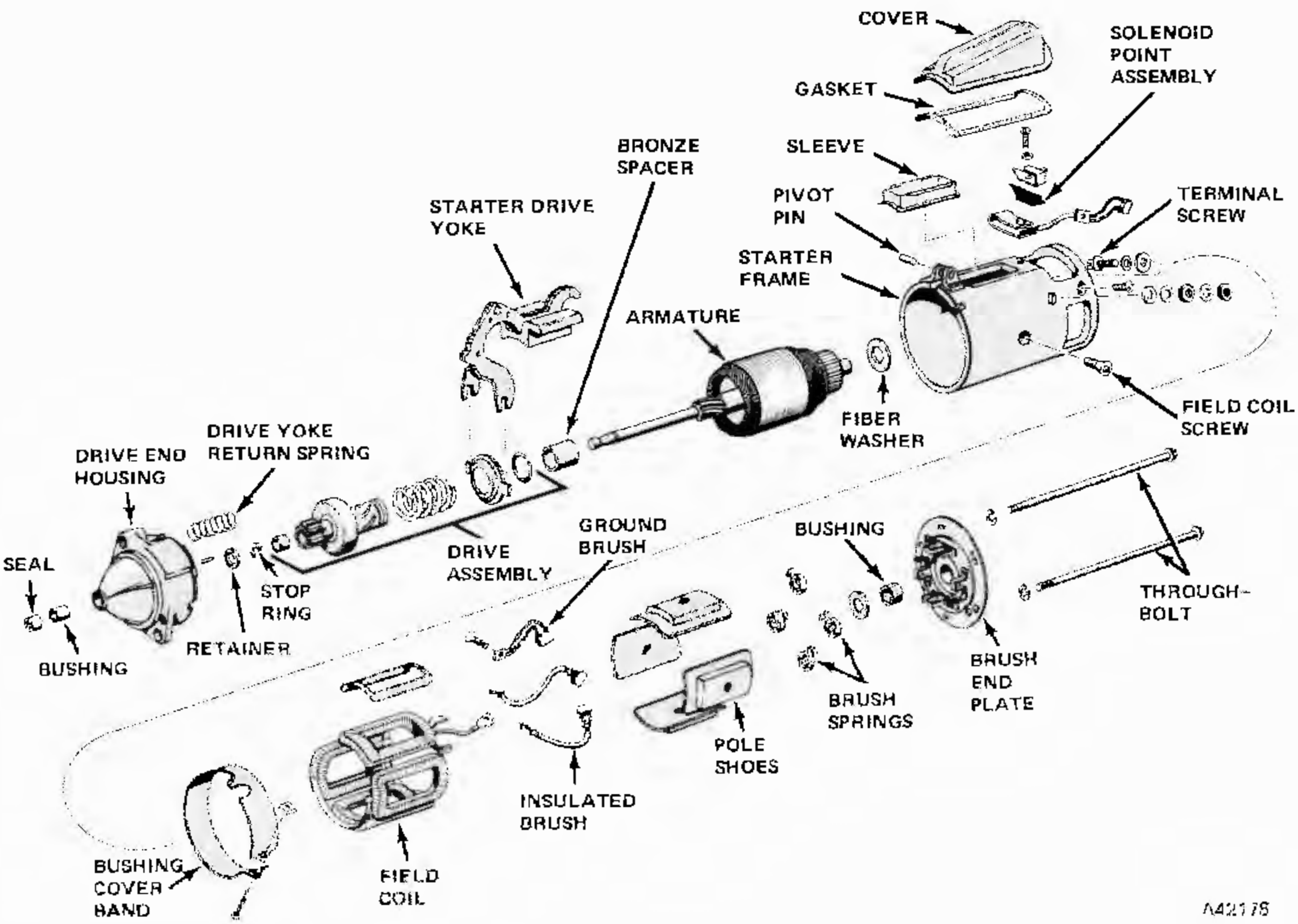

Fig. 3-42 Stater Motor - Disassembled View

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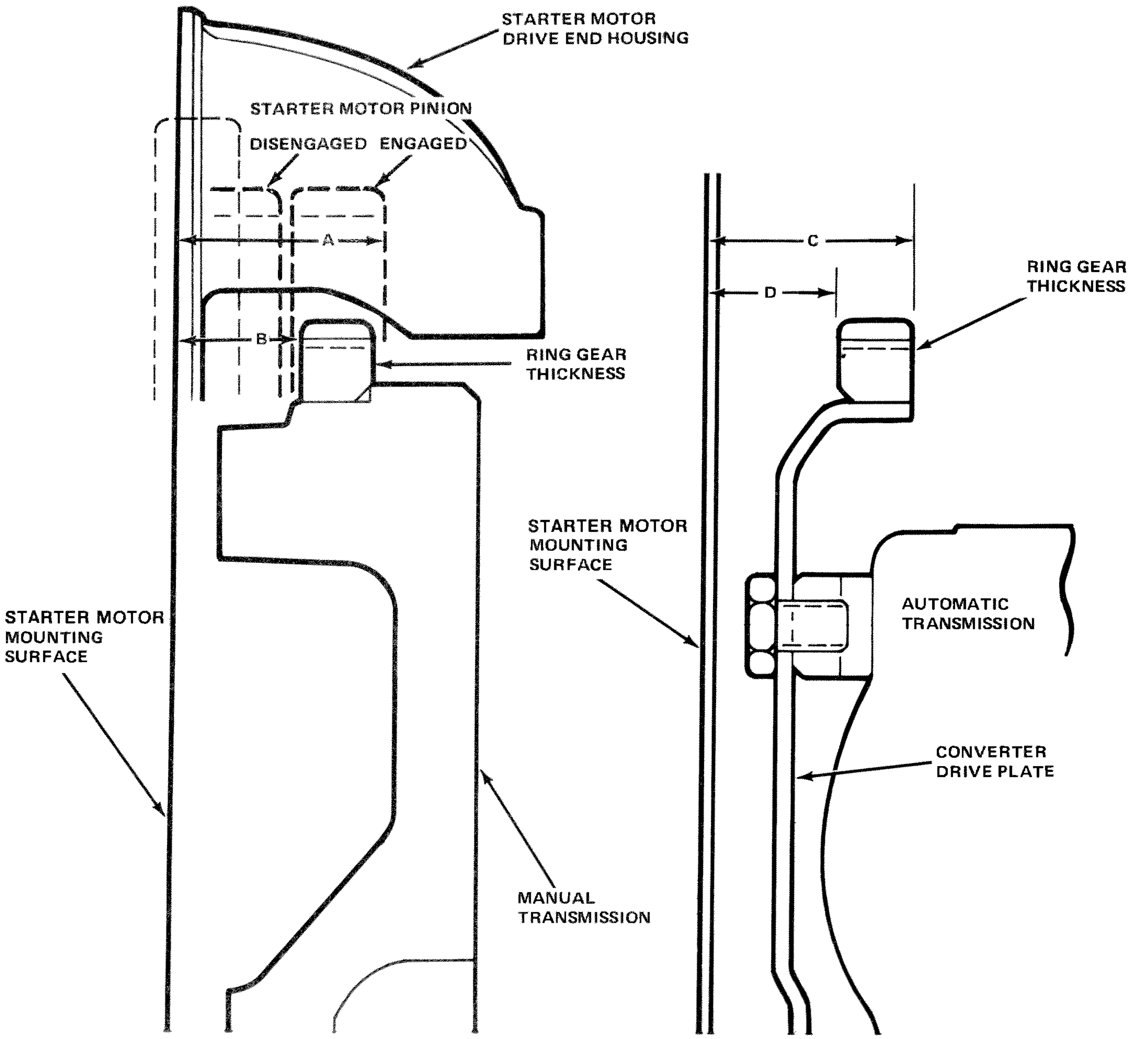
any rivets that may be loose. Replace brushes if worn to 1/4 inch in length.

(11) Check brush spring tension. Replace springs if tension is not within specified limits (40 ounces minimum).

(12) Inspect field coils for burned or broken insulation and for broken or loose connections. Check field brush connections and lead insulation.



ENGINE	FLYWHEEL (INCHES)				DRIVE PLATE (INCHES)			
	A		B		C		D	
6 CYLINDER 232 & 258	1.2465 1.2060	1-1/4 1-13/64	0.8365 0.7660	27/32 49/64	1.2875 1.1870	1-9/32 1-3/16	0.8305 0.7700	53/64 49/64
V-8 304 360 401	1.2465 1.2035	1-1/4 1-13/64	0.8365 0.7635	27/32 49/64	1.2875 1.1875	1-9/32 1-3/16	0.8305 0.7675	53/64 49/64

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Fig. 3-43 Ring Gear Location

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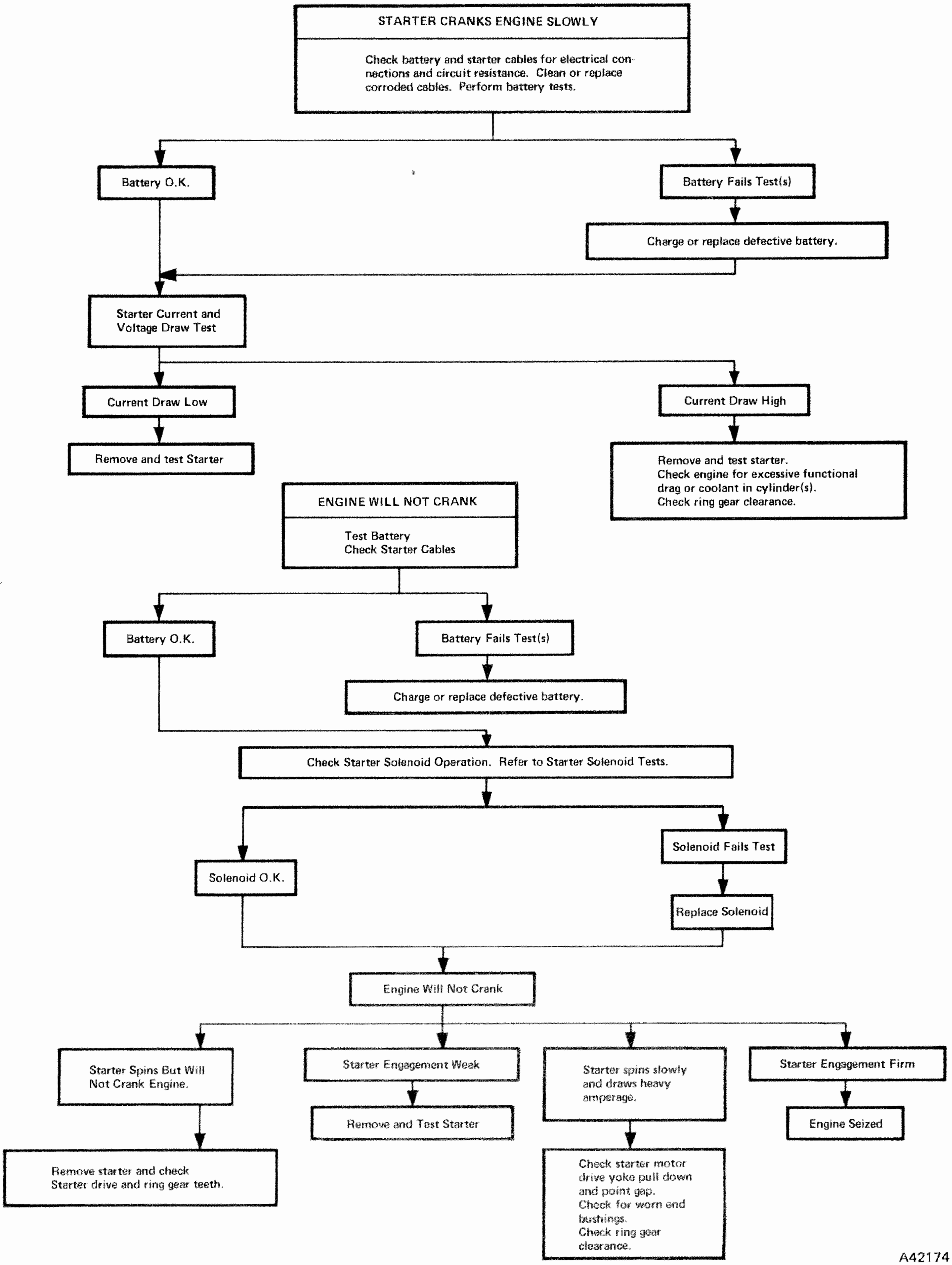
STARTER MOTOR DIAGNOSIS GUIDE



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Field Ground Circuit Test (On Test Bench)

This test will determine if the field winding insulation has failed permitting a conductor to touch the frame.

(1) Place insulated brushes aside so that brushes do not touch any part of starter.

(2) Remove screw that attaches solenoid point assembly brush lead to frame.

NOTE: *Do not allow ground brush to contact starter.*

(3) Insert a piece of paper between solenoid points. Starter is now ready for testing (fig. 3-44).

(4) Connect one test prod to terminal screw and the other prod to starter frame. Test lamp should not light. If lamp lights, field windings are shorted and must be replaced.

NOTE: *Check for a loose rivet on solenoid point assembly which could also cause a short to ground.*

(5) Touch one prod to terminal and the other prod to brushes (not single ground brush). Test lamp should light. If lamp does not light, check for poor or broken connections.

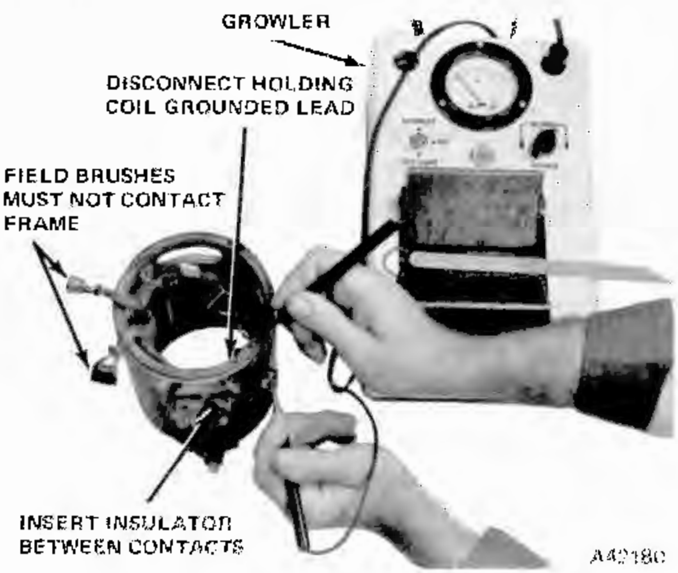

Fig. 3-44 Field Grounded Circuit Test

Field Coil Replacement

(1) Remove retaining screw and ground brushes from starter frame.

(2) Straighten tabs of solenoid coil retaining sleeve and remove sleeve.

(3) Remove three field coil retaining screws using Tool J-22516 and an arbor press.

(4) Unsolder field coil leads at terminal screw and at solenoid connection.

NOTE: *A considerable amount of heat is required to unsolder the leads. A heavy-duty soldering iron or a propane torch with a small flame is recommended.*

(5) Remove field coils and pole shoes from starter frame.

(6) Cut insulated brush leads as close to field coil connection as possible.

NOTE: *The solenoid point assembly need not be removed unless defective.*

(7) Solder new insulated brush lead clip to field coil connecting strap (use rosin core solder).

(8) Position field coils in starter frame, install retaining screws and tighten securely using Tool J-22516 and an arbor press.

(9) Solder field coil leads to starter terminal screw and solenoid connection (use rosin core solder).

(10) Install lower ground brush lead and retaining screw.

(11) Cut upper ground brush lead as close to threaded terminal block as possible.

(12) Place unthreaded terminal of replacement ground brush under threaded terminal of solenoid ground lead and install longer retaining screw contained in the brush kit.

(13) Install solenoid coil retaining sleeve and bend tabs to properly secure coil.

Solenoid Contact Assembly Replacement

To replace the contact assembly with the replacement kit, proceed as follows: Refer to figure 3-45 for parts identification.

(1) Unsolder contact post from field coil connecting strap.

NOTE: *A considerable amount of heat is required to unsolder leads. A heavy-duty soldering iron or a propane torch with a small flame is recommended.*

(2) Cut off head of contact spring retaining rivet with small, sharp chisel and discard contact spring. Use a 8-32 thread tap to cut threads in rivet hole.

(3) Remove contact post retaining screw and insulating washer. Discard contact post and paper insulator.

(4) Place new contact spring and ground brush assembly, paper insulator, and contact post into position on starter frame.

(5) Install insulating washer and retaining screw. Center contact points and tighten retaining screw.

(6) Stake threaded end of screw from inside starter frame.

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(7) Clean end of field connecting strap and slotted area of contact post with fine sandpaper to ensure good solder joint.

(8) Insert end of field connector strap through slot of contact post. Bend and crimp end of connector strap against cleaned surface of contact post.

(9) Solder connection using rosin core solder.

(10) Remove upper ground brush retaining screw and discard brush.

(11) Place field ground lead terminal and new ground brush terminal block together and install original retaining screw.

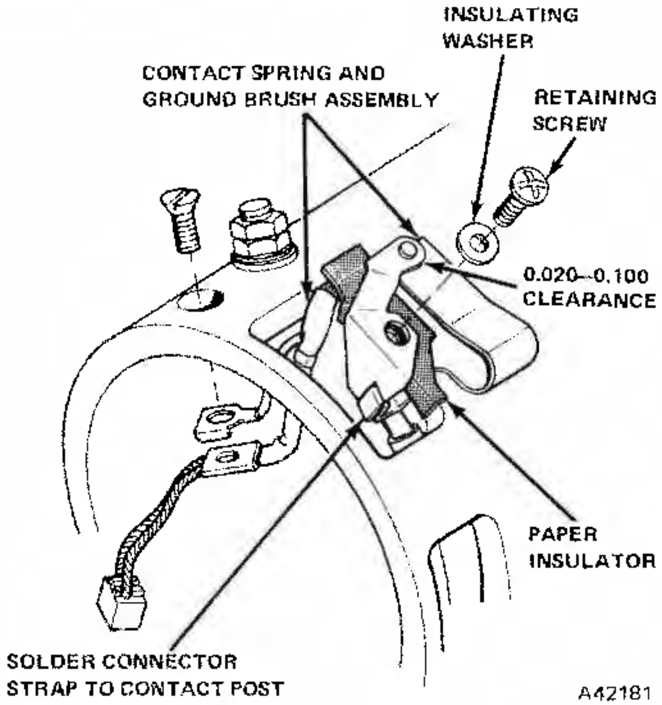

Fig. 3-45 Starter Motor Contact Kit

(12) Install armature and drive assembly, drive yoke and drive yoke pivot pin. Apply a few drops of 10W-30 motor oil to both ends of armature.

(13) Slide stop ring retainer into place on armature shaft.

(14) Position drive yoke return spring in drive end housing and install housing to starter frame.

(15) Install end plate.

(16) Install through-bolts and tighten.

(17) Insert brushes into their holders.

(18) Press down firmly on starter drive yoke until movable pole shoe is bottomed and check clearance between new contact points. Bend upper contact post, if required, to obtain a minimum 0.020-inch to a maximum 0.100-inch clearance (0.508 to 2.54 mm).

(19) Install a protective tape over brush openings of starter frame.

(20) Install drive yoke cover, gasket, and brush cover band.

(21) Tighten brush cover band retaining screw.

Armature Test Procedure

The armature should be tested for grounds, shorts, and balance whenever the starter motor is overhauled. Follow the test equipment manufacturer's procedure for the following.

Ground Test

(1) Place armature in growler jaws.

(2) Turn power switch to test position.

(3) Touch one test lead to armature core and other lead to each commutator bar one at a time and observe the test light. Test light should not glow. If test light glows on any bar, armature is grounded and must be replaced (fig. 3-46).

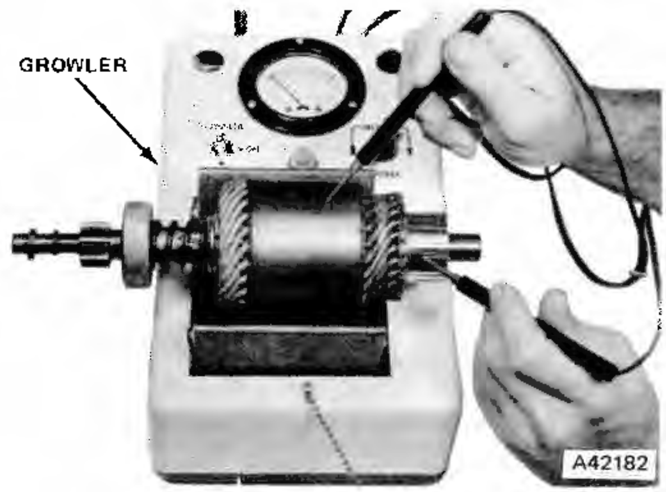

Fig. 3-46 Armature Ground Test

Short Test

CAUTION: *Never operate the growler in the test position without an armature in the jaws.*

(1) Place armature in growler jaws.

(2) Turn power switch to growler position.

(3) Using steel blade, hold blade parallel with and touching armature core. Slowly rotate armature one or more revolutions in growler jaws. If steel blade vibrates on any position of core, area is shorted and armature must be replaced (fig. 3-47).

Balance Test

(1) Place armature in growler jaws.

(2) Turn power switch to growler position.

(3) Place contact fingers of meter test cable across adjacent commutator bars at side of commutator.

(4) Adjust voltage control until needle is at highest reading on scale.

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(5) Test each commutator bar with adjacent bar until all bars have been checked. A reading of zero indicates an open circuit in the particular pair (fig. 3-48).

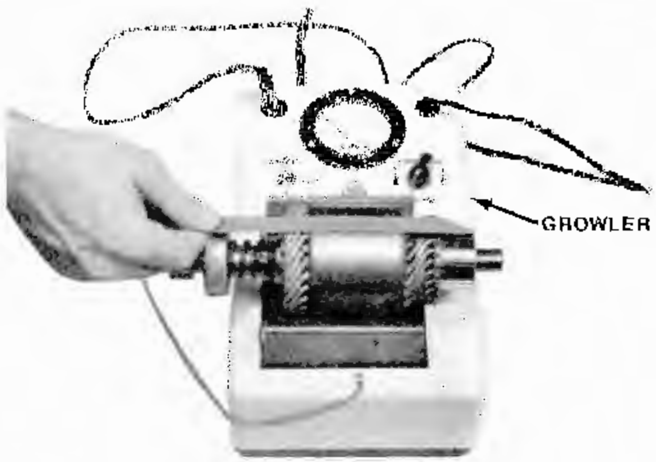

Fig. 3-47 Armature Short Test

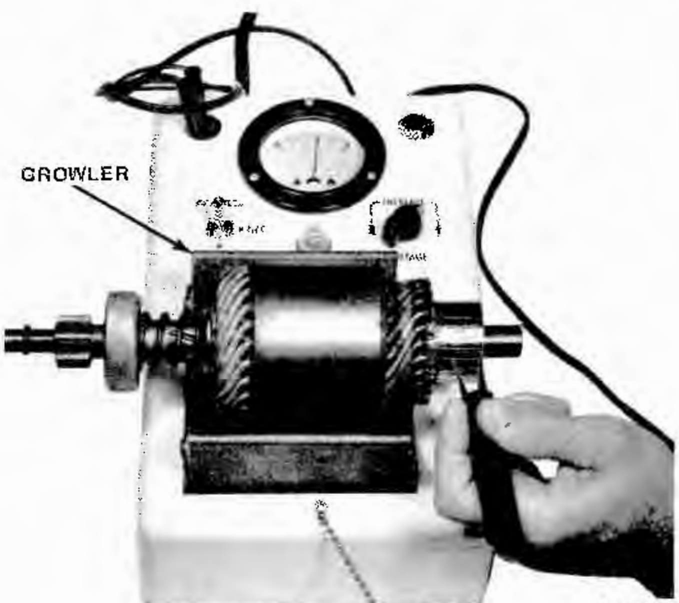

Fig. 3-48 Armature Balance Test

Assembly

Refer to figure 3-42 for parts identification.

Bushing Replacement

Drive End

(1) Support drive end housing.

(2) Remove original bushing and seal.

(3) Install new bushing using a suitable tool.

NOTE: *Do not install drive end housing seal at this time.*

Commutator End

(4) Remove old bushing by threading through bushing cavity with suitable size tap.

(5) Secure tap in vise and separate end frame from bushing.

(6) Press new bushing into place using suitable bushing installer.

Drive Assembly Replacement

(1) Pry stop ring off and remove starter drive from armature shaft.

NOTE: *The service replacement drive assembly is prelubricated. Apply a few drops of 10W-30 motor oil to the armature shaft and end bushings.*

(2) Apply thin coating of Dow Corning 33 Silicone Lubricant (or equivalent) on armature shaft splines.

(3) When installing drive assembly, check snap ring for tight fit on shaft. Slide drive assembly over shaft and install stop ring and original retainer.

Drive End, Armature, End Plate Installation

(1) Position fiber thrust washer on commutator end of armature shaft.

(2) Apply a few drops of 10W-30 motor oil to both bearing surfaces of shaft.

(3) Insert armature into starter frame and install starter drive yoke and pivot pin.

NOTE: *The drive yoke must engage the starter drive assembly.*

NOTE: *All brushes should be out of their retainers and hanging outside of the starter frame before installing the armature.*

(4) Place starter drive yoke return spring into recess of drive end housing and install housing to starter frame.

(5) Install brush end plate with end plate boss aligned with starter frame slot.

(6) Install through-bolts and tighten.

NOTE: *Be sure snap ring retainer is properly seated in drive end housing.*

(7) Use hook to pull back on brush springs and insert brushes into holders.

(8) Cover brush openings with waterproof tape and install drive yoke cover and gasket.

(9) Install brush cover band and tighten retaining screw.

(10) Apply a generous amount of Lubriplate to drive end of armature shaft and install drive end housing seal using a socket or other suitable tool.

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(11) Connect starter to battery and check operation, refer to No-Load Test in this section.

STARTER SOLENOID TEST (ON CAR)

Engine Will Not Crank

(1) Verify battery and cable conditions as outlined under Battery Maintenance to assure correct cranking voltage.

(2) Inspect and tighten battery and starter cable connections at starter relay.

(3) Disconnect wires at solenoid S and I terminals.

CAUTION: *Place transmission in Neutral or Park position and apply park brake prior to conducting solenoid test.*

(4) Connect jumper wire from battery positive post to solenoid S-terminal. If engine cranks, solenoid is not defective.

(5) If engine does not crank, connect another jumper wire from battery negative terminal to solenoid mount bracket. Make certain a good connection is made. If solenoid now can be made to operate, relay was not properly grounded. Remove rust or corrosion and attach solenoid to fender with cadmium-plated screws.

(6) If engine does not crank, remove the two jumper wires and connect a heavy jumper cable between battery and starter motor terminals of solenoid. If engine cranks, solenoid is defective and must be replaced.

(7) If engine does not crank, solenoid is not defective; check starter motor.

STARTER CABLE TEST (VOLTAGE DROP)

General

The starter cable tests will determine if there is excessive resistance in the circuit (fig. 3-39). When performing these tests, it is important that the voltmeter be connected to the terminals that the cables are connected to instead of to just the cables. For example, when checking from the battery to the solenoid, the voltmeter probes must be touching the battery post and the solenoid threaded stud.

Before performing tests

(1) Remove coil secondary wire from distributor and ground coil wire.

(2) Place transmission in Neutral or Park and apply park brake.

(3) Be sure battery is fully charged.

Battery to Starter Motor Voltage Drop Tests

(V-1, Fig. 3-49)

(1) Connect voltmeter positive lead to battery positive post.

(2) Connect voltmeter negative lead to starter motor terminal.

(3) Crank engine and note voltmeter reading while cranking (V-1). Reading should be 0.5 volt or less. If reading is more than 0.5 volt, move test lead to starter cable at the starter and retest. If voltage reading is 0.5 or less, remove cable from starter and clean connections. If reading is more than 0.5 volt, perform tests on each cable and the solenoid to locate problem area.

Battery to Solenoid Voltage Drop Tests

(V-2, Fig. 3-49)

(1) Connect voltmeter positive lead to battery positive post.

(2) Connect voltmeter negative lead to battery terminal (threaded stud) of solenoid.

(3) Crank engine and note voltmeter reading while cranking. Reading should be 0.2 volt or less. If reading is above 0.2 volts, remove cable, clean connections and retest. If reading is still above 0.2 volt, replace cable.

Solenoid Voltage Drop Test (V-3, Fig. 3-49)

(1) Connect voltmeter positive lead to battery positive post.

(2) Connect voltmeter negative lead to starter cable at solenoid.

(3) Crank engine and note voltmeter reading while cranking. Reading should be less than 0.3 volt.

(4) If reading is over 0.3 volt, move voltmeter connections from cable connections to solenoid starter terminal and retest. If voltage drop is now 0.3 or less, remove cables and clean connections. If voltage drop is still in excess of 0.3 volt, replace solenoid.

(5) If battery to starter circuit voltage drop was more than 0.5 volt but battery through solenoid voltage drop is 0.3 volt or less, replace solenoid to starter cable.

Starter Motor Ground Voltage Drop Test (V-4, Fig. 3-49)

(1) Connect voltmeter negative lead to starter motor housing.

(2) Connect voltmeter positive lead to battery negative post.

(3) Crank engine and note voltmeter reading while cranking. Reading should be 0.2 volt or less.

(4) If reading is more than 0.2 volt, move positive voltmeter lead to ground cable attaching bolt at engine and retest.

(5) If voltmeter is less than 0.2 volt when checking at battery ground cable, check starter motor for loose mounting bolts, corrosion, or dirt on the mounting surface.

(6) If voltage drop is more than 0.2 volt when checking at ground cable, connect voltmeter leads to ground cable leads and retest.

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(7) If voltage drop is now less than 0.2 volt, clean connections between engine block and cable. If voltage drop is more than 0.2 volt, move voltmeter negative lead to battery negative post clamp and retest. If more than 0.1 volt, clean terminals. If 0.1 volt or less, replace ground cable.

Starter Motor Solenoid Pull-In Winding Test

This test determines if solenoid pull-in winding is shorted or open.

(1) Remove S-terminal wire from solenoid.

(2) Connect one ohmmeter lead to S-terminal.

(3) Connect remaining ohmmeter lead to solenoid case or mounting bracket-ohmmeter should indicate 3 to 5 ohms. If solenoid is not within these limits, replace solenoid.

NOTE: *A poor solenoid ground can be determined by moving one ohmmeter lead to the battery negative terminal. If an increase in resistance is shown, the solenoid has a poor ground.*

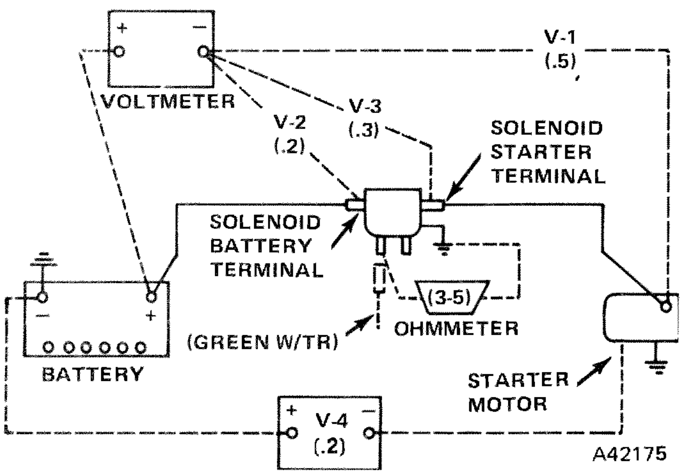

Fig. 3-49 Starter Cranking Circuit Test

IGNITION SYSTEM

The ignition spark must occur at the correct time and with sufficient intensity to ignite the compressed fuel-air mixture. All components of the ignition system must function properly for satisfactory and economical operation.

The coil must be able to transform the low primary voltage to a secondary voltage high enough to supply sufficient spark for all conditions of load and speed. The ignition distributor must perform two functions. It must distribute the high tension secondary voltage to the spark plugs in proper sequence. It must also open the ignition points at the proper time to fire the spark plugs at just the right instant for the engine to develop full power.

At high speeds, the spark must occur at the plug earlier in the compression stroke in order to give the fuel-air mixture ample time to ignite, burn, and apply its power to the piston as it starts down on the power stroke. Spark timing must vary in relation to changes in engine speed. This is accomplished by the centrifugal advance mechanism of the distributor.

During part throttle operation or cruising speed, the fuel mixture is drawn into the cylinder through a restricted opening and is less dense. The less dense mixture will burn slower and additional advance is necessary for good economy. This additional advance is furnished by the vacuum advance unit. The vacuum advance unit is controlled by carburetor ported vacuum. The centrifugal advance will advance engine timing with increases in engine speed and the vacuum advance operates in relation to throttle position and engine load.

Engine Spark Knock (Ping)

Spark knock in some engines can be attributed to a number of causes. The most common is the intermittent spark knock which is a result of climatic factors such as temperature, air density, and humidity.

- Underhood temperatures are increased by the use of air conditioning (especially during long periods of idling), overloading (trailer pulling, operating in too high a gear), and the installation of accessories that restrict airflow.
- Air density is determined by barometric pressure and air temperature. Air becomes denser as barometric pressure rises and as temperature drops. A dense mixture of air drawn into a cylinder has the same effect as raising the compression ratio which in turn increases the possibility of spark knock.
- Low humidity also increases the tendency to spark knock. High humidity decreases spark knock.

Other causes of spark knock to be considered are:

- *Fuel Octane Rating* - All six and eight-cylinder engines are designed to operate on commercial regular fuels. (The required octane rating varies with each model year vehicle.) Fuels of equivalent research octane rating may vary in their knocking characteristics in a given engine. It may be necessary to reduce initial timing (not more than two degrees from specifications) or select an alternate source of fuel.
- *Ignition Timing* - Ignition timing should be checked to be sure it is set within specifications.

NOTE: *The white paint mark on the timing degree scale represents the specified spark setting at idle speed, not TDC (Top Dead Center).*

- *Combustion Chamber Deposits* - An excessive buildup of deposits in the combustion chamber may be caused by not using recommended fuels

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and lubricants, prolonged engine idling, or continuous low speed operation. The occasional use of Carburetor and Combustion Area Cleaner, Part Number 8992352 (Group 15.410) or operating the car at turnpike speeds will reduce deposits.

- *Distributor Advance Mechanism* - The centrifugal and vacuum advance units should be checked to be sure the mechanism is operating freely.

Ignition System Diagnosis and Testing

Refer to Ignition System Diagnosis Guide.

Ignition system diagnosis can be accomplished by means of an ignition system scope analyzer or by individual test equipment designed to perform a specific function check, such as Tach-Dwellmeter, VAT (Volts-Ampere-Tester), Ohmmeter, Timing Light, etc.

Ignition system problems are caused by a failure in the primary or second circuit, incorrect ignition timing, or incorrect distributor advance. Circuit failures may be caused by shorts, loose primary connections, loose or corroded secondary terminals, faulty wire insulation, cracked rotor or distributor cap, defective contact points or incorrect dwell angle, fouled or worn spark plugs.

Ignition Primary Circuit Tests

Excessive voltage drop in the primary circuit will reduce the secondary output of the ignition coil resulting in hard starting and poor performance. The input (primary) voltage to output (secondary) voltage ratio is approximately 2000:1. That is, a one-volt drop in primary voltage to the coil will result in approximately a 2000-volt drop (secondary) to the spark plugs. Inspect all primary wiring for loose or corroded terminals, worn insulation, and broken strands.

(1) Connect an ammeter in series between the positive ignition coil terminal and the ignition lead (fig. 3-50).

(2) Remove high tension lead from coil and ground to engine.

(3) Turn vehicle ignition on.

(4) Using a remote control starter switch, crank engine until distributor points are closed. Ammeter reading should be 3 to 3.5 amps.

(5) If reading is less than 3 amps, connect jumper wire from negative ignition coil terminal to ground. If ammeter reading increases to at least 3 amps, check distributor point or ground condition.

(6) If ammeter reading does not increase to at least 3 amps, resistance is excessive in primary circuit. If ammeter reading is over 3.5 amps, circuit resistance is too low.

An ohmmeter is used to check the resistance of the primary resistance wire. Connect one end of the ohmmeter to the positive side of the ignition coil (fig. 3-50). To make a connection at the other end of the resistance wire, perform the following:

CJ Models - Disconnect the six-way connector (in the engine compartment) and connect to the coil feed wire (refer to Wiring Diagram at the rear of the Manual).

Cherokee, Wagoneer, and Truck - Unfasten the bulkhead connecting screw from the engine compartment side and separate the connector. Touch the ohmmeter probe to the BY terminal (see Wiring Diagram at the rear of this manual) and note the ohmmeter reading.

The meter should indicate 1.8 ohms for a six-cylinder and 1.35 (plus or minus 0.05 ohms) for a V-8 engine.

If the ohmmeter test results indicate that the resistance of the resistor wire is within specifications, connect a voltmeter (V-1) between the battery positive post and the ignition switch side of the resistor wire. The voltmeter reading should not exceed 0.4 volt.

If the voltmeter reading exceeds 0.4 volt, resistance is excessive between the resistor wire and the battery. The maximum allowable resistance between any two connected terminals of the ignition switch is 12.5 mil-

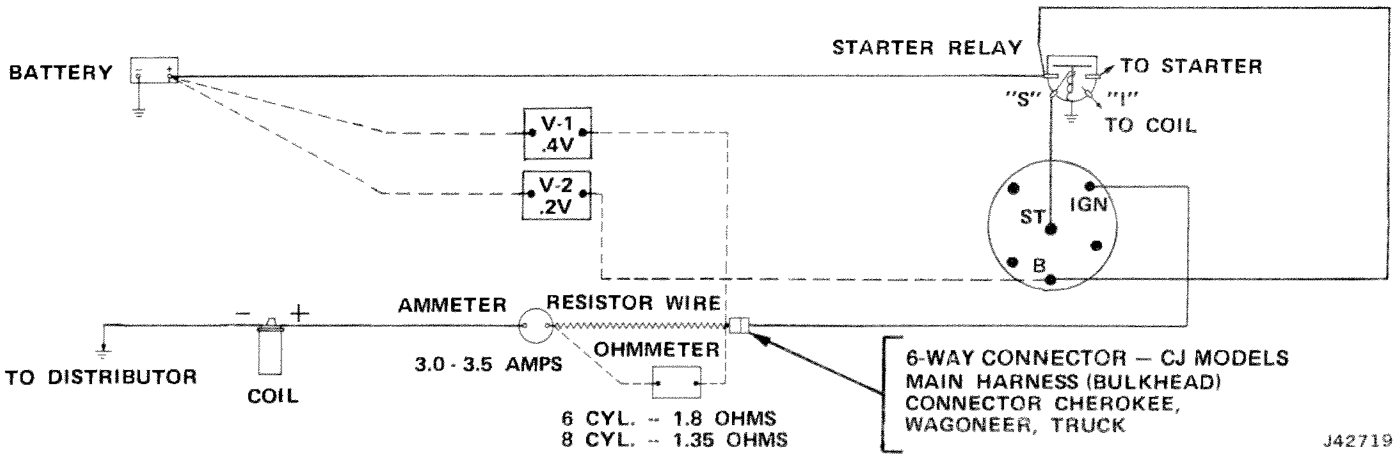

Fig. 3-50 Ignition Circuit Tests

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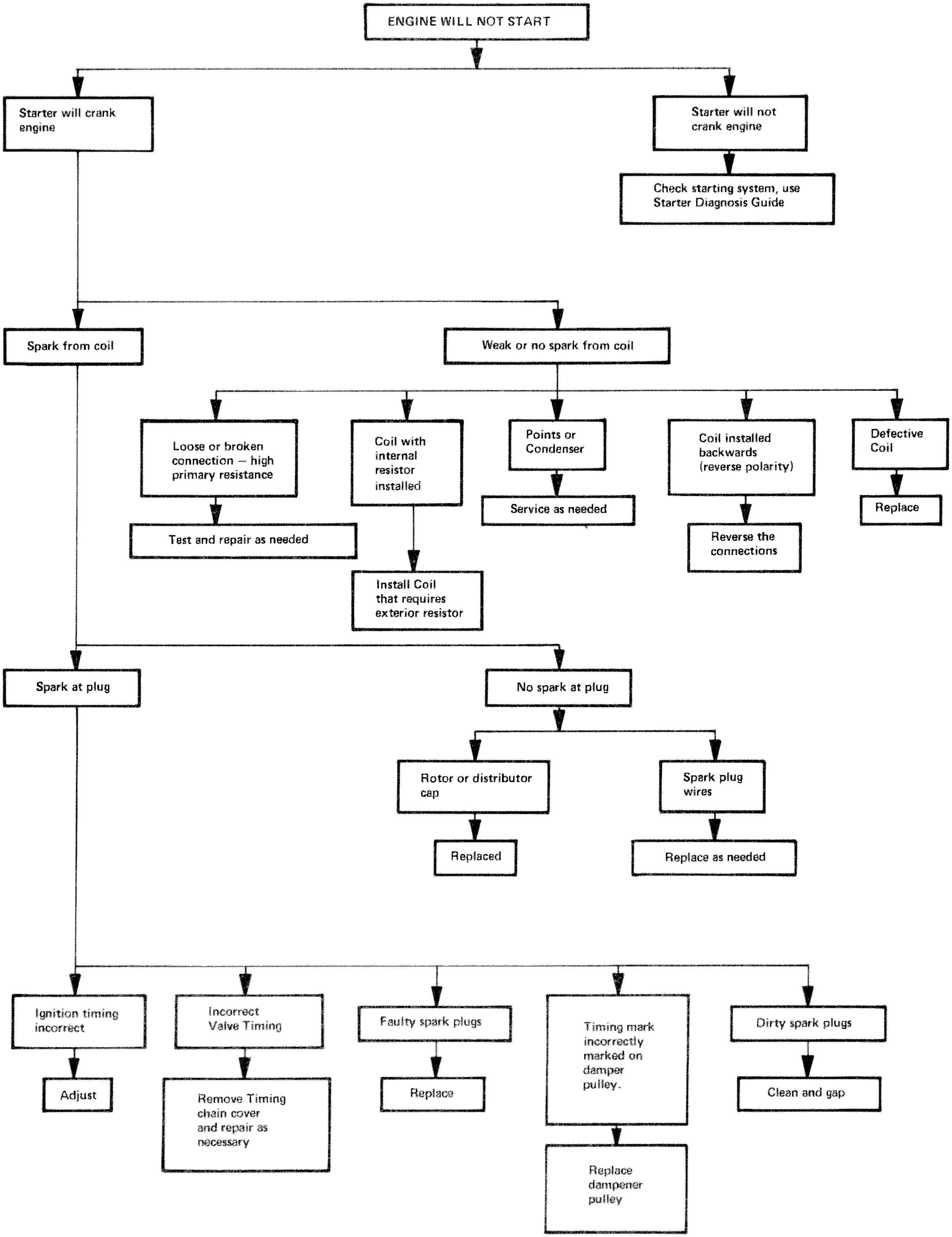
IGNITION SYSTEM DIAGNOSIS GUIDE



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livolts per ampere. A voltmeter with a millivolt scale is required to accurately check for resistance in the ignition switch.

Connect a voltmeter between the battery positive post and the battery terminal of the ignition switch. The voltmeter reading should not exceed 0.2 volt. If the voltmeter reading does not exceed 0.2 volt and V-1 exceeded 0.4 volt, resistance is too high through the ignition switch or the wiring between the ignition switch and the resistor wire. If the voltmeter reading exceeds 0.2 volt, resistance is too high in the circuit between the battery terminal of the ignition switch and the battery positive post. Be sure to check the wire connections at the starter relay for looseness or corrosion while observing the voltmeter reading.

Ignition System Bypass

To obtain greatly improved starting performance at low temperature, the primary resistance wire is bypassed during cranking, thereby connecting the ignition coil directly to the battery. This provides full battery voltage to the coil, keeping ignition voltage as high as possible during cranking. The bypassing of the resistance wire during cranking is accomplished by the use of a contact within the starter solenoid. As the contact closes, the coil is connected directly to the battery from the I-terminal of the solenoid.

Secondary Ignition Wires

The operating characteristics of ignition systems are such that during normal operation certain high frequency electrical signals are produced. These signals tend to interfere with vehicle radio and television reception. One of the most common methods of suppression is the use of secondary ignition suppression wire. This type of wire serves the dual purpose of conducting current at required voltages to the spark plugs and at the same time, because of sufficient resistance incorporated over its entire length, eliminates radio interference. Calibrated reistance required in the secondary ignition circuit does not affect spark plug firing voltage.

Supression type wire is also used in the coil high tension lead. The wires consists of a rayon braid over linen core impregnated with carbon to form a conductor. The conductor is covered with a high quality rubber insulation. Wire pins are used to connect the conductor with the terminals.

NOTE: *It is recommended that carbon core wire not be repaired. Replace the entire wire if the end is damaged.*

IGNITION COIL

The ignition coil is an oil-filled, hermetically-sealed unit. Ignition coils do not require special service other than keeping terminals and connections clean and tight.

All six-cylinder and V-8 engines require coils with an external resistance. The use of a coil with an internal resistor would result in hard starting and loss of engine power.

The function of the ignition coil (fig. 3-51) is to transform the low voltage, supplied by the battery or charging circuit, into the high voltage necessary to produce a spark at the spark plug gap.

The ignition coil has two windings on a soft iron core, the primary winding which consists of a comparatively few turns of heavy wire and the secondary winding which consists of many turns of very fine wire.

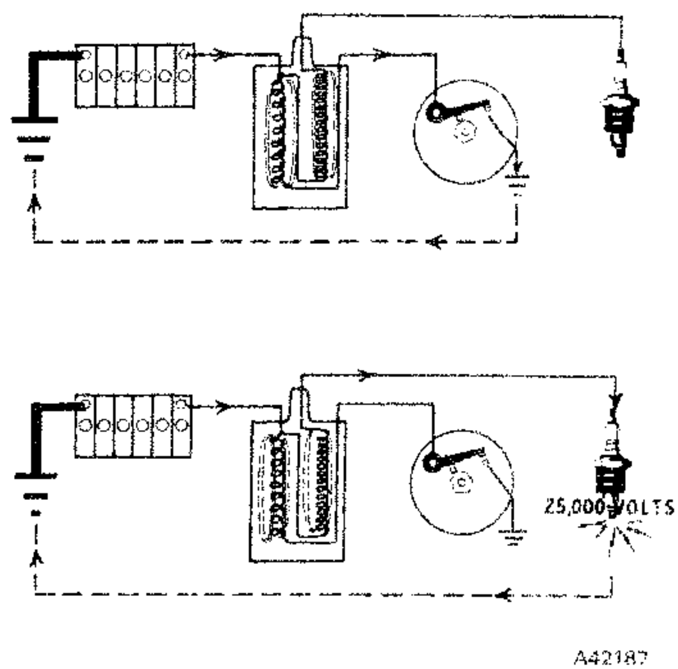

Fig. 3-51 Ignition Coil Buildup and Discharge

To keep the required voltage as low as possible, the coil must be connected for correct polarity so that electron flow across the spark plug gap will be from center electrode to ground. This negative spark polarity requires a lower voltage since electrons will more readily leave the hotter center electrode.

For correct polarity, the coil primary terminal should be corrected to correspond to the battery polarity of the vehicle, with the distributor connection considered as ground.

The polarity can be checked on the car by connecting the negative lead of a voltmeter to any spark plug terminal and the positive lead to ground at the engine. Start the engine. If the voltmeter reads up-scale, the polarity is correct. If the voltmeter reads downscale, the polarity is incorrect and the coil primary connections should be reversed.

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When an ignition coil is suspected of being defective, it should be checked on the car. A coil may break down after it has reached operating temperature; **it is important that the coil be at operating temperature when tests are made.** Perform the tests following the instructions of the test equipment manufacturer.

Refer to the Emission Control Section for ignition coil specifications.

DISTRIBUTOR

The distributor is permanently lubricated. At the time of contact point replacement or overhaul, apply a trace of high melting point lubricant to the breaker cam.

All distributors are equipped with cam lubricators and should be replaced at recommended intervals (refer to Emission Control Secton).

Diaphragm Vacuum Unit

A single vacuum unit containing one enclosed spring-loaded diaphragm is used on the distributor.

The advance section is linked mechanically to the movable breaker plate assembly. The airtight advance diaphragm is connected by a hose to the carburetor vacuum spark port above the throttle valve(s). Under part-throttle operation, the ported vacuum is sufficient to actuate the advance diaphgram and cause the breaker plate to move opposite distributor rotation, advancing the spark and increasing the fuel economy. During acceleration or when the engine is pulling heavily, the ported vacuum is not sufficient to actuate the advance diaphragm.

NOTE: *If equipped with a coolant temperature override switch at the thermostat housing, the distributor vacuum hose is connected to a port of the switch rather than the carburetor vacuum spark port. Refer to the Emission Control Section for an operation description.*

Centrifugal Advance

The centrifugal advance mechanism consists of a cam actuated by two spring-controlled centrifugal weights. As the speed of the distributor shaft increases with engine speed, the weights are thrown outward against the pull of the springs. This advances the cam, causing the contacts points to open earlier and advancing the spark (fig. 3-52).

Removal of Vacuum Control Unit

The vacuum control unit is removed by removing the screws which hold the vacuum unit to the distributor body.

NOTE: *During assembly, the clip of the plate ground lead must be placed under the head of one of the attaching screws on V-8 distributors.*

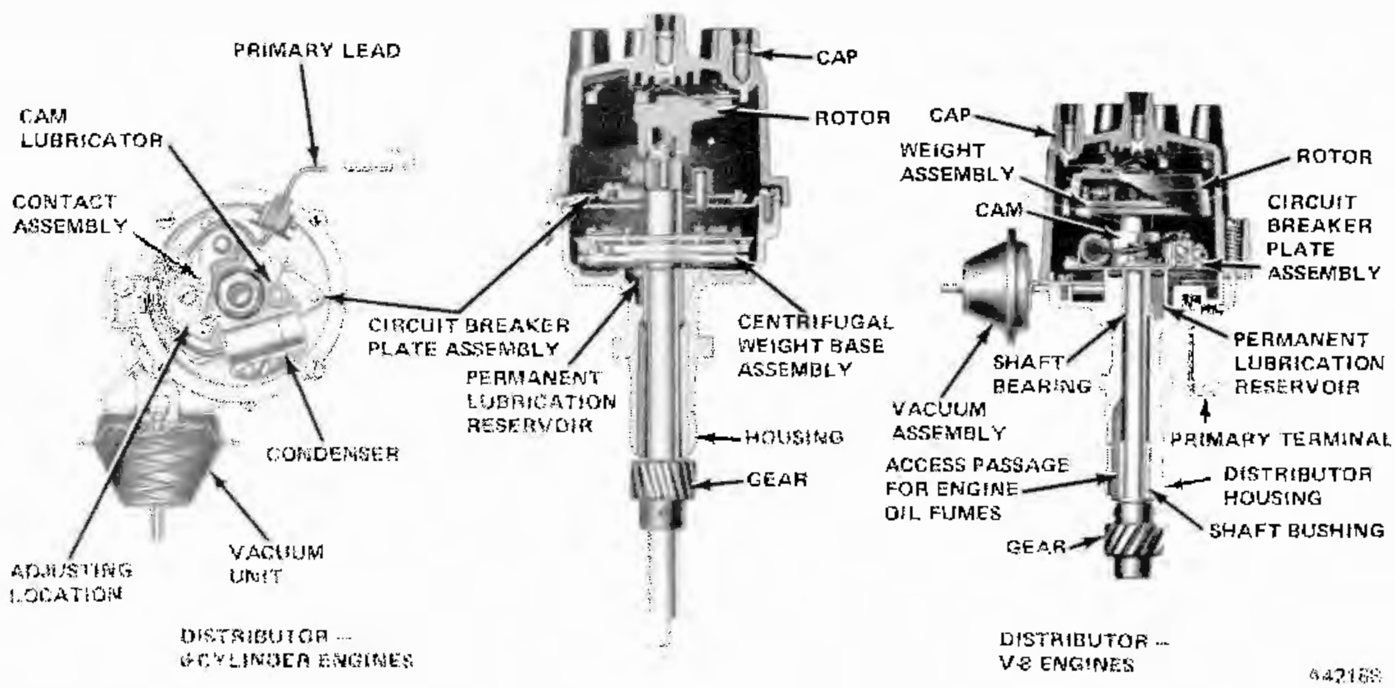

Fig. 3-52 Distributor

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(1) Disconnect primary lead and vacuum hose, and remove the distributor cap. Note motor position for proper location during installation.

(2) Remove holddown bolt, clamp, and distributor assembly.

(3) Install distributor with rotor positioned in the same location as noted during removal.

NOTE: *If the engine has been cranked with the distributor removed or the rotor position was not noted during removal, proceed as follows:*

(4) Positon No. 1 piston at TDC on the compression stroke. To determine if the piston is on compression stroke, remove No. 1 spark plug, place thumb or compression gauge over the spark plug hole, and crank the engine slowly until compression pressure begins to build up. Continue to crank the engine until the timing mark on the vibration damper is aligned with the TDC mark of the timing degree scale as shown in figures 3-53 and 3-54.

NOTE: *The timing mark on the vibration damper also will be aligned with the TDC mark when No. 6 cylinder is on exhaust stroke. Therefore, it is important to be sure No. 1 cylinder is on compression stroke when installing the distributor.*

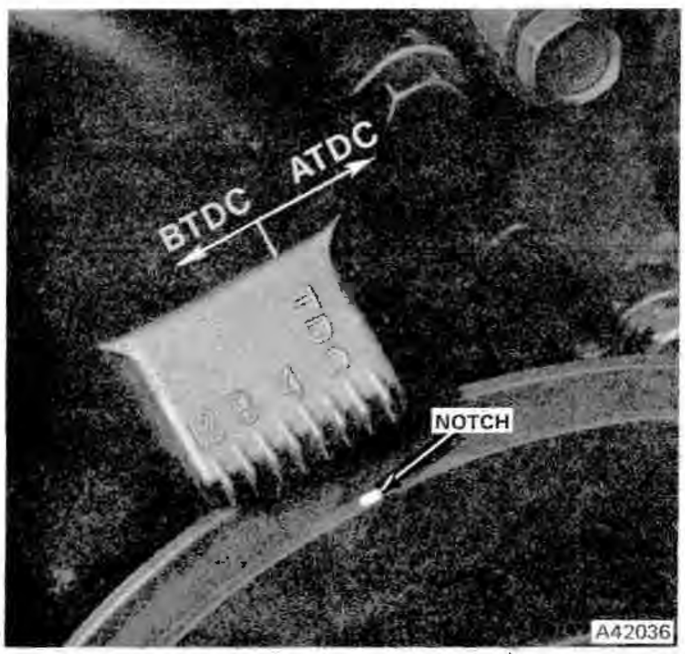

Fig. 3-53 Ignition Timing Marks - Six-Cylinder

(5) Mesh distributor drive gear with camshaft mating drive gear in such a position that rotor points to the (No. 1 cylinder) terminal of distributor cap.

NOTE: *If spark plug wires have been removed from the distributor cap, refer to figure 3-55 for proper positioning.*

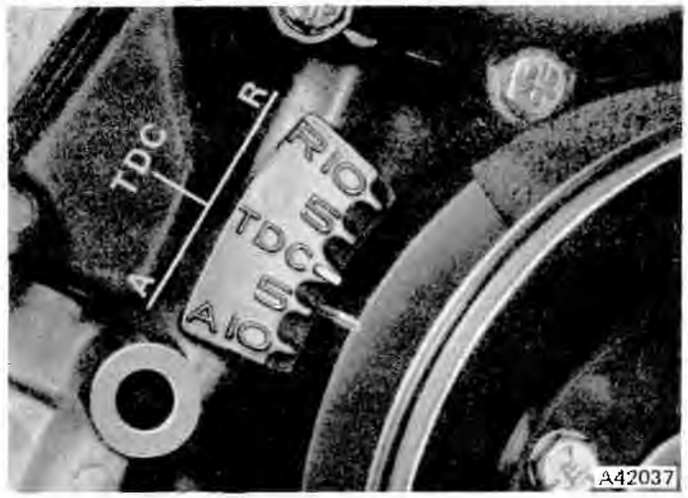

Fig. 3-54 Ignition Timing Marks - V-8

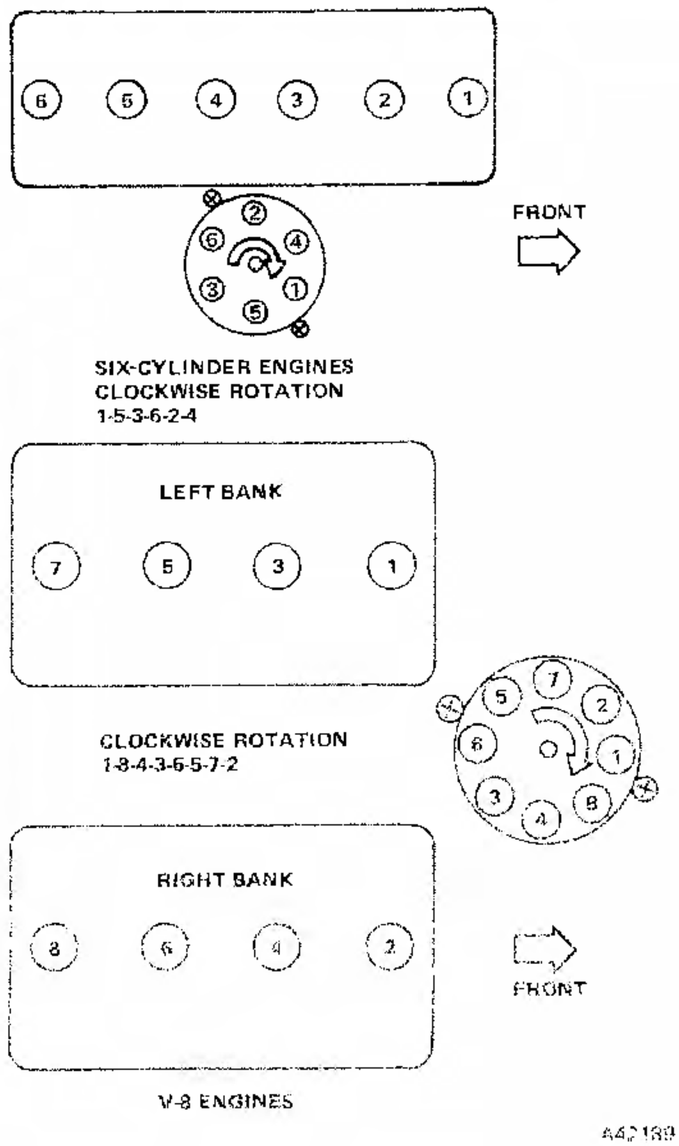

Fig. 3-55 Distributor Wiring Sequence and Firing Order

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INSTRUMENT CLUSTER

CJ Models

The instrument cluster is composed of the speedometer housing, panel lighting bulbs, hi-beam indicator, turn signal indicators, amp (alternator) and oil warning lights, temperature gauge and combination fuel gauge and constant voltage regulator (CVR) (fig. 3-56 and 3-57).

Removal and Installation

(1) Disconnect one battery cable.

(2) Separate speedometer cable from speedometer head.

(3) Remove two attaching screws and allow heater control bracket to drop down.

(4) Remove four attaching nuts and pull cluster off of mounting studs.

(5) Remove gauge wires and cluster lamps and remove cluster assembly.

(6) After installing cluster, connect battery and check all lights and gauges for proper operation.

NOTE: *The connector link (fig. 3-57) is not serviced. In the event a connector link has to be replaced, manufacture a connector out of 16 gauge (or larger) insulated wire.*

Fig. 3-56 Instrument Panel CJ Models

(3) Disconnect speedometer cable at cluster.

(4) Disconnect cluster pin terminal plug by pulling straight away from cluster.

(5) Disconnect four terminal plug.

(6) Disconnect fan switch connector plug.

(7) Disconnect vacuum hoses from heater control.

NOTE: *Tag each hose according to its numbered location to ensure the proper connection when installing the cluster.*

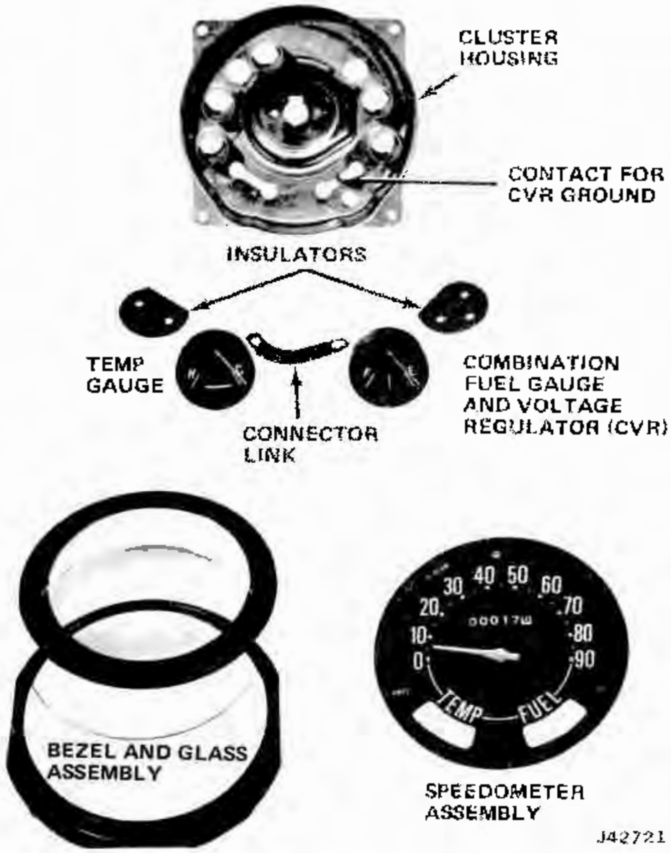

Fig. 3-57 Instrument Cluster Assembly - CJ Models

Cherokee, Wagoneer, and Truck

The instrument cluster (fig. 3-58) is composed of the instrument cluster case (speedometer housing), panel lighting bulbs, hi-beam indicator, turn signal indicators, ammeter, oil pressure gauge, temperature and fuel gauges, constant voltage regulator (CVR) (part of the temperature gauge), brake failure warning bulb, lockout warning bulbs (Quadra-Trac), heater control lights, wiper-washer and heater control lights, and the blower motor fan switch.

Removal

(1) Disconnect battery.

(2) Remove six cluster retaining screws.

(8) Remove two heater control panel lights.

(9) Disconnect temperature control wire from lever.

(10) Remove cluster assembly.

Installation

(1) Connect harness plugs and heater control identification bulbs.

(2) Connect temperature control wire to operating lever.

(3) Connect vacuum hoses.

(4) Install cluster.

(5) Connect speedometer cable.

(6) Connect battery cable.

(7) Check all gauges, controls, and lights.

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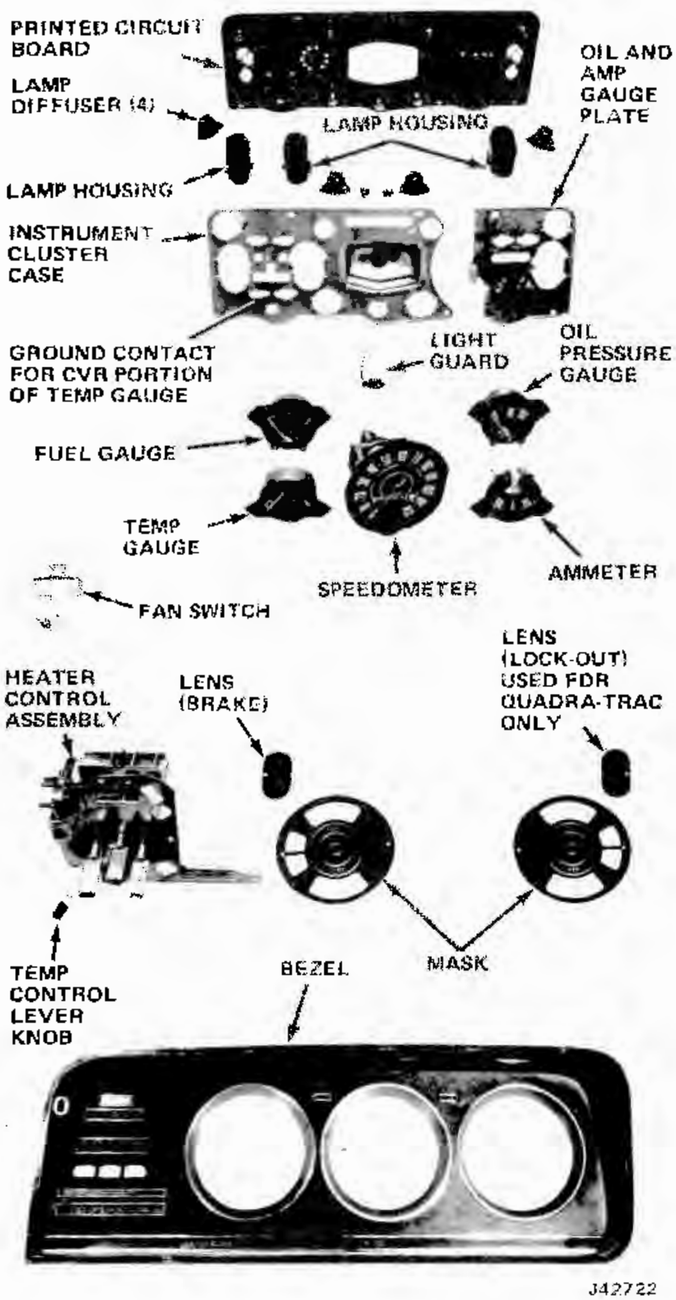

Fig. 3-58 Instrument Cluster - Cherokee, Wagoneer and Truck

Component Tests and Replacement

Printed Circuit Test

(1) Remove instrument cluster. Do not disassemble cluster.

(2) Remove all bulbs.

NOTE: *An ohmmeter or Test Lamp J-21008 should be used. When using an ohmmeter, use low scale and adjust meter to 0 reading.*

NOTE: *Refer to figure 3-56 for pin terminal identification.*

(3) Connect test lamp or ohmmeter lead to correct pin plug terminal for circuit to be tested. Follow each circuit from pin to each uncoated position up to bulb of indicator in that circuit. Bulb should light or ohmmeter should read 0 resistance at these positions.

(4) Check all uncoated positions on opposite side of bulb or indicator circuit. Circuit must go to either a pin terminal or a grounding screw. Bulb should light or ohmmeter should read 0 resistance.

(5) Connect test lamp or ohmmeter lead to ground pin terminal and other lead to cluster metal case. Bulb should light or the ohmmeter should read 0 resistance. When bulb fails to light or ohmmeter reads resistance on any test, replace printed circuit.

(6) Check for shorting between circuits. With a lead connected to correct pin for circuit to be tested, move other lead to all other pin terminals in cluster. There should be no light or resistance indication between circuits.

Instrument Illumination

CJ Models

Two bulbs and three molded lamps provide instrument panel illumination and identification. Current and protection for the panel bulbs and lamps are provided by the 20-amp circuit breaker located internally in the headlamp switch. This circuit breaker is not serviceable. It is an integral part of the headlamp switch.

Do not pull on the bulb wires to remove the bulb socket; grasp the socket and pull down.

To remove the molded lamps, remove the wire connectors. Squeeze the lamp together at each end to release the small retaining tabs. Push the lamp through the panel (toward the steering wheel). To install the molded lamps, push into the panel until the retaining tabs snap into place.

Cherokee, Wagoneer, and Truck

Four bulbs provide lighting for the instrument cluster and two bulbs illuminate the heater control panel. Panel lights are fed from the fuse panel through an adjustable headlight switch rheostat. To replace instrument cluster bulbs, reach up behind the cluster, twist the bulb socket counterclockwise (viewed from the rear) and pull out. To replace the heater control panel bulb, pry the bulb socket down until the spring clip which attached the socket to the panel is free.

Charge Indicator (Amp)

The charge indicator bulb should be off when the key is off or when the engine is operating. If the indicator is on when the key is off, a positive diode in the alternator is defective.

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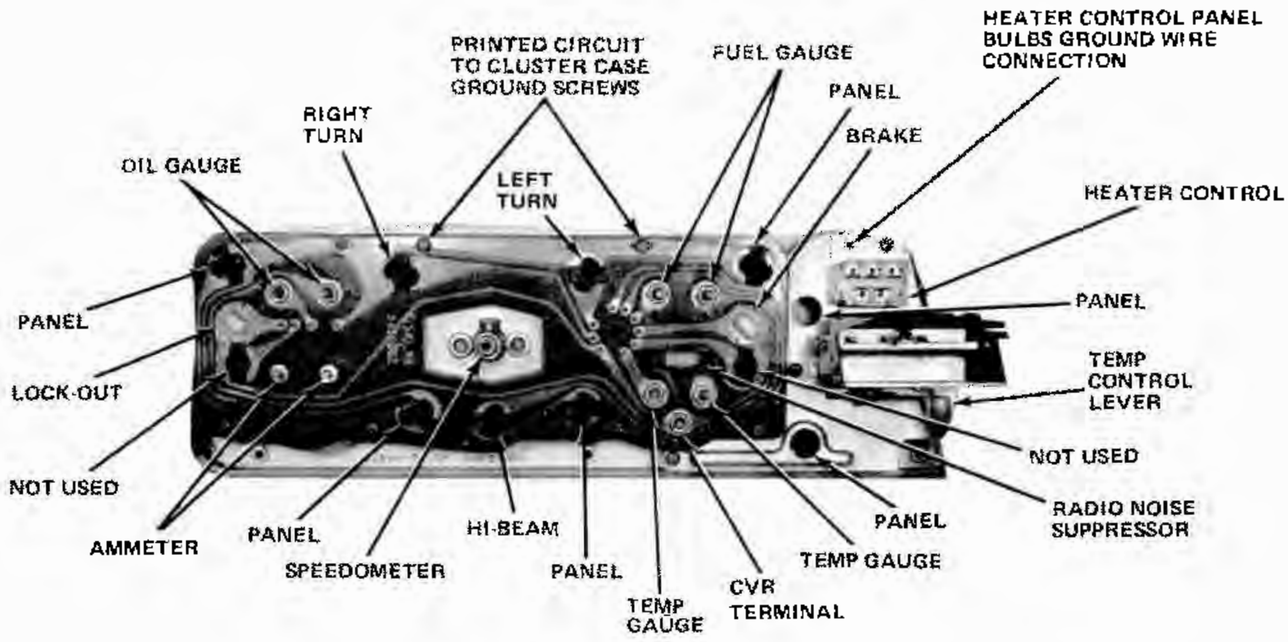

Fig. 3-59 Instrument Cluster - Rear View - Cherokee, Wagoneer, and Truck

The indicator should glow brightly when the key is on and the engine is not operating. If the indicator light is defective, it can be replaced by pulling the bulb socket down and out from the instrument cluster.

The charge indicator **does not** indicate that the battery is receiving a charge. If the alternator is producing 20 amps and there is a 30-amp load, the indicator bulb will not light unless the battery voltage drops sufficiently below the alternator voltage to cause current to flow through the indicator bulb. For a more complete diagnosis of the indicator bulb circuit, refer to the alternator section, Excitation and Bulb Circuit.

Oil Pressure Warning Light and Sending Unit Test

The low oil pressure indicator light is wired in series with the oil pressure sending unit on the engine block. This sending unit contains a diaphragm, spring, linkage, and electrical contacts. When the ignition switch is in the on position, the indicator circuit is energized and the circuit is completed to ground through the closed contacts in the sending unit. Upon starting the engine, oil pressure compresses the diaphragm and opens the contact points, thereby opening the circuit to the indicator light.

No light is used on systems utilizing an oil pressure gauge.

With the ignition switch in the IGN position and the engine not running, the oil pressure indicator should light. If the indicator does not light, ground the oil pressure sending unit wire to the engine. If the indicator does not light, either the bulb or wiring is defective.

If the indicator does light with the wire grounded, the oil sending unit switch is defective and must be replaced.

NOTE: *If the oil pressure warning light remains on constantly when the engine is operating, check the engine oil pressure by removing the sender unit and installing a direct reading oil pressure gauge.*

Oil Pressure Gauge and Sending Unit Test

To test the accuracy of the oil pressure gauge and the sending unit, the following procedure may be used.

Equipment Required: Tester J-22344-01, direct reading oil gauge and tee fitting (Automatic Transmission Gauge W-320 can be used).

Gauge Test

(1) Disconnect wire from sending unit located on engine.

(2) Turn ignition switch to the on position.

(3) Connect one lead of tester to a good ground and other lead to sending unit wire, gauge should read as follows:

PSI	Resistance (Ohms)
0	68 - 78
40	21 - 25
80	7 - 13

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Check all circuit connections before replacing the gauge.

Sending Unit Test

After verifying a proper operating gauge, remove the oil sending unit and install a tee fitting between the block fitting and the sender. Connect a direct reading oil pressure gauge to the tee fitting. Connect the sending unit wires; start the engine and compare the readings between the two gauges. Replace sending unit if defective.

Temperature Gauge and Sending Unit

The temperature gauge circuit is comprised of a sending unit, connecting wiring, and gauge. On the Cherokee, Wagoneer, and Truck, it also includes the instrument cluster printed circuit.

The sending unit is threaded into the cylinder head on six-cylinder engines and into the intake manifold coolant crossover on V-8 engines. The indicator, located in the instrument cluster, is grounded through the variable resistance of the sending unit.

Changes in the coolant temperature vary the resistance of the sending unit, thereby increasing or decreasing the temperature indication.

Fuel Gauge and Sending Unit

The fuel level gauge circuit is comprised of a sending unit, connecting wiring, and gauge. On the Cherokee, Wagoneer, and Truck, it also includes the instrument cluster printed circuit.

The sending unit is located in the fuel tank and the gauge in the instrument cluster. The gauge is grounded through the variable resistance of the sending unit.

A float attached to a slide rheostat follows the level of the fuel. Changes in the fuel level vary the slide rheostat resistance, thereby increasing or decreasing the fuel level indication.

Attitude of the body of the vehicle while parked or making starts and stops will effect the fuel indication.

The fuel gauge on CJ models is a combination gauge and constant voltage regulator (CVR). This CVR provides approximately 5 volts to both the fuel and temperature gauges.

The temperature gauge on the Cherokee, Wagoneer, and Truck is also a combination gauge and CVR. It provides approximately 5 volts to the fuel gauge.

Fuel or Temperature Gauge Tests

The use of Universal Gauge Tester J-22344-01 is recommended for gauge testing. The tester is to be used on the ground side of a gauge to simulate the operation of a sending unit.

Sending Unit Test - All Models

(1) Disconnect sending wire at sending unit.

(2) Connect one lead of tester to disconnected wire and the other lead to a known good ground.

(3) Turn ignition switch to on positon.

(4) Turn tester controls to select each ohm value listed on chart and observe gauge.

(5) If gauge reading is accurate for each ohm value selected, the trouble is in sending unit or sending unit ground circuit (includes sending unit-to-body ground connections).

(6) After verifying a good sending unit ground connection, replace sending unit if gauge is accurate.

(7) If gauge reading is not accurate for each ohm value selected, no gauge reading is obtained or gauge needle reading is pegged above the full or hot position.

(a) Disconnect test leads and reconnect sending unit wire.

(b) Proceed to Fuel or Temperature Gauge Tests at the instrument cluster.

TEMPERATURE GAUGE CALIBRATION - ALL MODELS

C (COLD)	130° - 73 ohms
Beginning of Band	171° - 36 ohms
Top of Band	242° - 13 ohms
H (HOT)	270° - 9 ohms

FUEL GAUGE CALIBRATION - ALL MODELS

73 Ohms @ Empty
23 Ohms @ 1/2
10 Ohms @ Full

NOTE: *Fuel and temperature gauges are 5 per cent meters, that is, they must be accurate within 5 per cent of a specific ohm value.*

Example: 5 percent of 60 ohms is 3 ohms or 60 (plus or minus 3 ohms).

Testing at the Instrument Cluster - CJ Models

CAUTION: *Be sure tester leads are properly connected before turning ignition switch on.*

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Refer to figure 3-60.

(1) Disconnect sender unit wire (output terminal) from terminal.

(2) Connect one tester lead to output terminal of gauge and other lead to a known good ground (T-1).

(3) Turn ignition switch on. Observe gauge reading while selecting ohm values listed in chart.

(4) If gauge reads correctly, wire leading to sender unit is defective.

(5) If no reading is obtained, check input voltage to gauge (I-terminal) with test light or voltmeter (fig. 3-60).

(6) When checking input voltage, check fuel gauge first. The I-terminal of the fuel gauge is fed battery voltage. This terminal voltage can be checked by placing the positive lead of a voltmeter on the I-terminal and contacting a known good ground with the negative lead (V-1).

(7) If no voltage or a drop of more than 0.2 voltage (as compared to battery voltage) is indicated at V-1, check connections at the ignition switch and red wire back to starter motor relay for loose connections, corrosion, or broken wires.

NOTE: *I-terminal voltage at the fuel gauge is regulated internally to approximately 5 volts.*

(8) To check this voltage, attach voltmeter, V-2, to the CVR terminal as shown. The voltmeter should pulsate about once every second or less.

(9) A steady reading of battery voltage indicates that the CVR is defective or does not have a ground.

(10) No reading at all indicates a defective CVR. The CVR and fuel gauge are integral. The entire fuel gauge must be replaced if the CVR is defective.

The fuel gauge CVR terminal feeds the temperature gauge. A defective CVR will cause both gauges to read too high, too low, or not at all.

If the fuel gauge operation is satisfactory, check the temperature gauge by connecting the gauge tester (T-2) as shown in figure 3-60.

If the gauge now reads correctly, the wire leading to the sender unit is defective.

Refer to the CJ Fuel and Temperature Gauge Diagnosis Guide.

NOTE: *Do not test gauges removed from the instrument cluster unless the fuel gauge is grounded by an extra ground wire attached to the gauge housing.*

Testing at the Instrument Cluster - Cherokee, Wagoneer, and Truck

(1) Disconnect battery negative cable.

(2) Remove instrument cluster and disconnect all electrical connections.

(3) Connect a jumper wire from cluster ground terminal to known good ground (fig. 3-61).

CAUTION: *Do not attempt to test gauges with the printed circuit removed from the cluster housing, as this would remove the ground for the CVR resulting in high voltage to the gauges.*

(4) Connect an ignition feed wire protected by a 3-amp fuse to E-pin terminal. This applies voltage through radio noise suppressor to I-terminal of temperature gauge.

NOTE: *Be sure there are no open circuits between the E-terminal and the temperature gauge I-terminal.*

(5) Ground one lead of Gauge Tester J-22344-01 to known good ground.

(6) Connect battery and turn ignition on.

(7) To check fuel gauge, touch remaining lead of Gauge Tester to L-terminal.

(8) To check temperature gauge, touch C-terminal.

(9) Dial resistance required as shown in Fuel and Temperature Gauge Ohm Value Chart and observe gauge.

(10) Check full range of gauge. If gauge is not correct through entire range, it should be replaced.

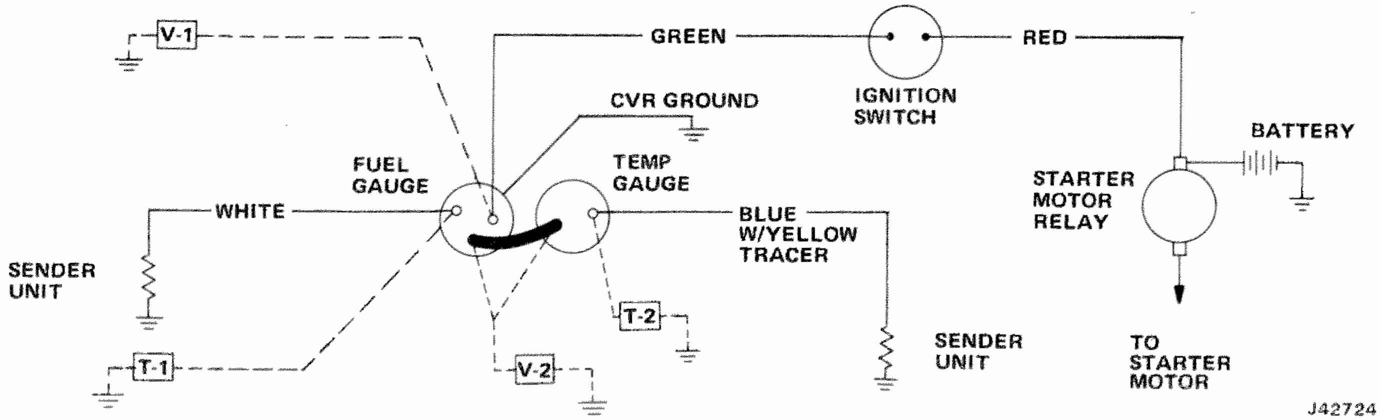

Fig. 3-60 Fuel and Temperature Gauge Circuitry - CJ Models

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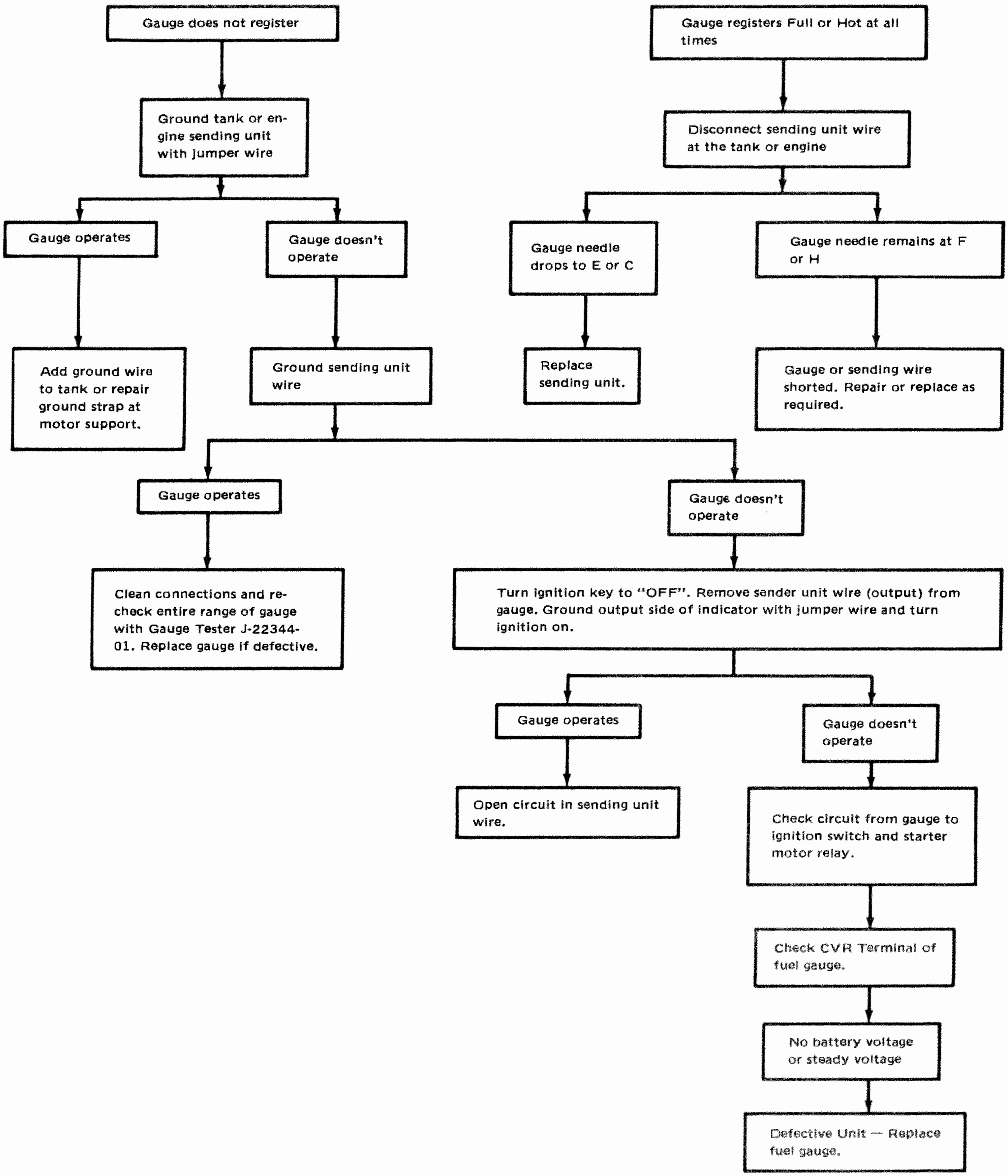
FUEL AND TEMPERATURE GAUGE DIAGNOSIS GUIDE - CJ MODELS

CAUTION: Gauges do not have fused or circuit breaker protected circuits.



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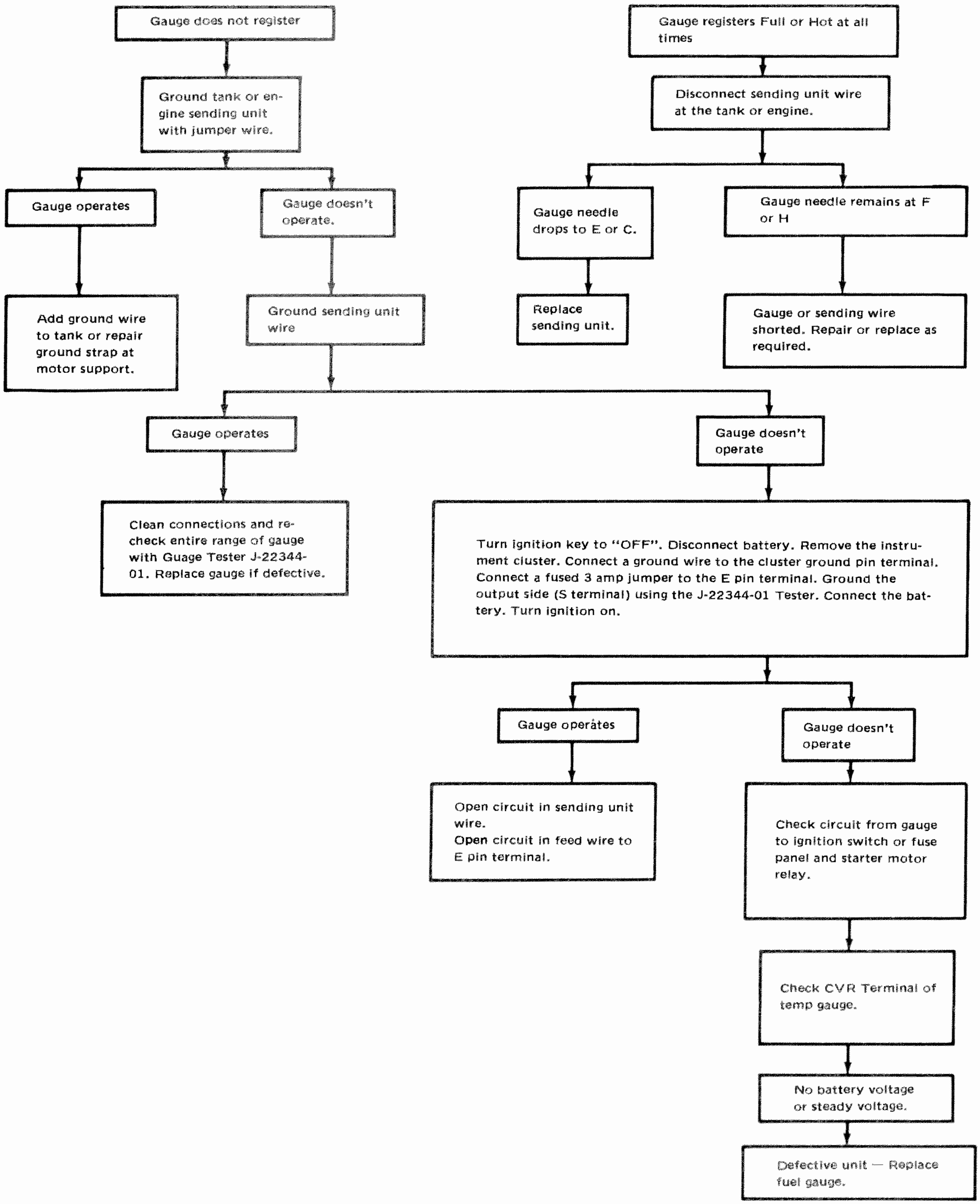
FUEL AND TEMPERATURE GAUGE DIAGNOSIS GUIDE - CHEROKEE, WAGONEER, AND TRUCK



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NOTE: *Make sure the battery is fully charged.*

(11) If both gauges read too high through entire range, check for good contact between temperature gauge and cluster case.

NOTE: *Be sure two printed circuit-to-cluster case ground screws are tight.*

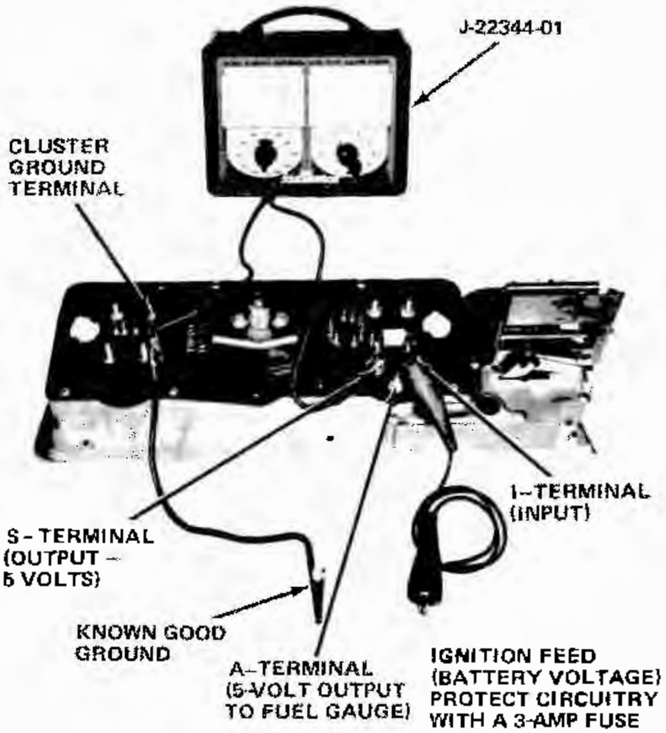

Fig. 3-61 Testing Temperature Gauge - Cherokee, Wagoneer, and Truck

TEST RESULTS With Tester Connected as Shown in Figure 3-61	POSSIBLE LOCATION OF TROUBLE
Gauge reading satisfactory at each Ohm value selected (Gauge was defective as installed in vehicle)	Gauge output terminal to printed circuit connection. Printed circuit between gauge output terminal and gauge (indicator pin terminal. Sending wire or wire harness connections. Ignition terminal of instrument harness connector.
No gauge reading	Gauge terminals to printed circuit connections. Printed circuit between gauge input terminal and ignition pin terminal. Gauge.
Gauge reads Full or Hot at all Ohm values selected	Gauge or defective CVR.
Temperature and fuel gauges both read too low or too high	CVR unit. CVR case ground connection.
CAUTION: Upon completing tests, do not disconnect the ground jumper wire until the battery voltage source jumper wire has been disconnected and the ignition switch is in the OFF position.	

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(12) If all ground connections are good and both gauges still read too high or too low, replace the temperature gauge.

(13) If only one gauge reads high or low, replace just that gauge.

Fuel and Temperature Gauge Replacement (Cluster Removed)

All models require the cluster to be removed in order to service the gauges.

CJ Models

(1) Carefully uncrimp lip of outer bezel and remove outer bezel, glass and glass retaining bezel.

(2) Remove two attaching screws from speedometer housing and remove housing and face plate.

(3) Either gauge can be removed by removing attaching nuts.

(4) When installing gauges, be sure gauges are properly centered in gauge openings in the face plate.

NOTE: *If fuel gauge is being replaced, burnish the metal to remove any corrosion at the contact (CVR) ground area.*

Cherokee, Wagoneer, and Truck

(1) Remove six printed circuit retaining screws and remove instrument cluster case (fig. 3-58).

(2) Remove gauge mask.

(3) Remove pal nuts (machine nuts on the ammeter) and remove gauge.

(4) When installing gauges, be sure gauges are centered. If installing the temperature gauge, be sure the CVR ground contact area is burnished clean (fig. 3-58). Be sure printed circuit ground screws are tight.

Fuel Tank Sender Unit Replacement

On all models, the fuel tank must be dropped down out of the mounting brackets in order to service the sender unit. Refer to the Fuel - Carburetor - Exhaust Section for fuel tank mounting information.

IGNITION SWITCH

CJ Models

The ignition switch has four positions: (1) Accessory, (2) off, (3) on, and (4) start. The key must be in the switch to turn it to any position. The key can be removed only in the off position.

In accessory, a connection is made from the battery terminal to the accessory terminal of the switch to allow the radio, blower and windshield wiper to be op-

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erated with the ignition fuel gauge and indicator light circuits off.

If off, no accessory supplied through the ignition switch can be operated.

In on, a connection is made from the battery terminal to the accessory terminal so that all ignition switch supplied accessories can be operated. Also, the battery is connected to the resistance wire leading to the ignition coil (IGN). From this same terminal, a lead into the instrument cluster energizes the fuel gauge, oil, and alternator lights.

In start, all ignition switch supplied accessories are temporarily disconnected. A connection is made to the starter solenoid relay. The charge and oil indicator lamps will light until the engine is started.

Cherokee, Wagoneer, and Truck

The ignition switch is mounted on the lower section of the steering column and is connected to the key lock assembly by a remote lock rod.

The ignition switch has five positions: (1) Accessory, (2) Off-LOCK, (3) Off, (4) On, and (5) start.

In accessory position, current is available to those loads connected to the accessory terminals on the fuse panel and to the electric tailgate switch mounted on the instrument panel.

In off-LOCK and off position, no current flows through the switch.

In on position, current is available to all accessories, the primary ignition system and the instrument cluster.

In start position, all accessories are disconnected. The wire connected to the solenoid S-terminal is energized and the brake warning light grounds through the ignition switch ground (bulb check) terminal.

Two different types of ignition switches are used, one for standard columns and one for Tilt columns. The actuator rod moves down on the standard column and up (toward the steering wheel) on the Tilt column when the ignition key is turned to start position.

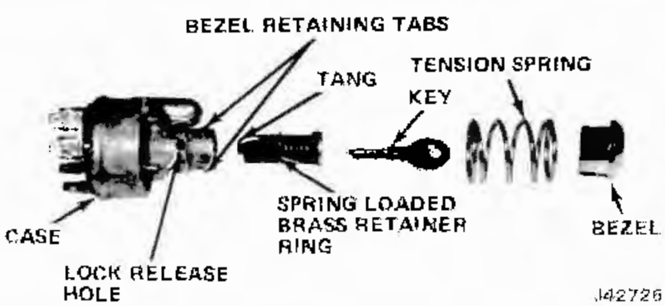

Fig. 3-62 Ignition Switch - CJ Models

Removal

CJ Models

Refer to figure 3-62.

(1) Press main switch body toward instrument panel compressing spring until notched bezel is free to be turned counterclockwise, releasing it off notch pins.

(2) Remove bezel and pull back main switch body, releasing spring tension.

(3) Lower switch body from under instrument panel so wiring harness plug can be removed from prong connection.

Installation

CJ Models

(1) Place main compression spring on main switch body.

(2) Install main switch body into instrument panel opening from rear.

(3) To make sure that switch is in its correct position, install ignition key in off position. Turn switch body until key is straight up and down.

(4) Remove key and push on main switch body so that notched bezel can be installed freely with notches in line with notch pins.

(5) Turn bezel clockwise to lock in position. The word Starter should be on top when correctly assembled.

Cylinder Replacement

CJ Models

(1) Remove ignition switch from vehicle.

(2) A spring-loaded brass retainer holds cylinder in switch case. The cylinder can be removed with the key in or out of the cylinder and in any position except accessory position.

(3) Turn switch to the on position. This is the easiest position to depress the brass retainer. Insert a heavy-duty type paper clip through cylinder release hole and depress retainer ring until it clears retaining ridge and allows cylinder to be withdrawn.

(4) Line up male tang on cylinder with female slot in case.

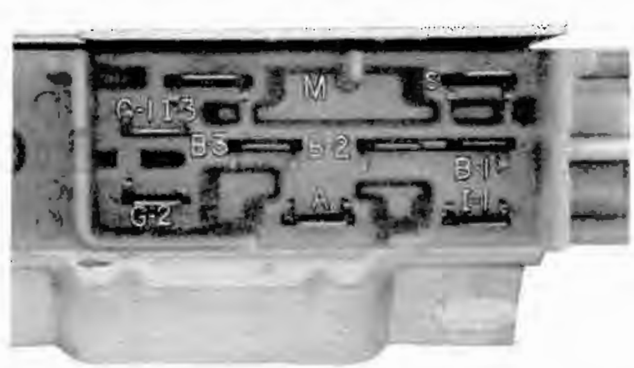

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Fig. 3-63 Ignition Switch Terminals

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(5) Depress spring-loaded brass retainer and insert cylinder until retainer snaps into position.

(6) Install ignition switch.

Removal

Cherokee, Wagoneer, and Truck

(1) Place key lock in off LOCK position and remove two switch mounting screws.

(2) Disconnect switch from remote rod.

(3) Remove harness connector and remove switch.

Installation

Cherokee, Wagoneer, and Truck

(1) With actuator rod disconnected, position switch as shown in figure 3-64.

(2) Move slider to extreme left (accessory position).

NOTE: *The left side of the ignition switch is toward the steering wheel.*

(3) Positon actuator rod in slider hole and install switch to steering column being careful not to move slider out of detent.

(4) Tighten retaining screws securely.

Tilt Column

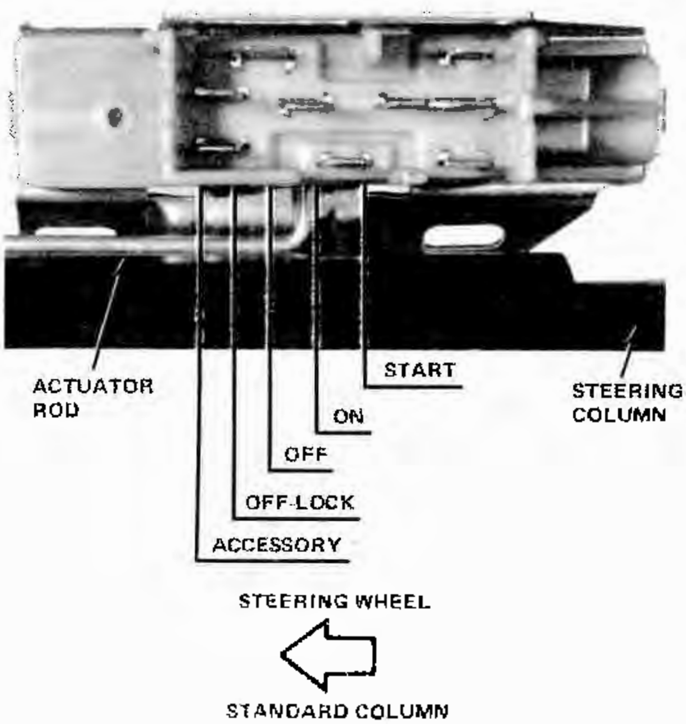
(1) With actuator rod disconnected, position switch as shown in figure 3-64.

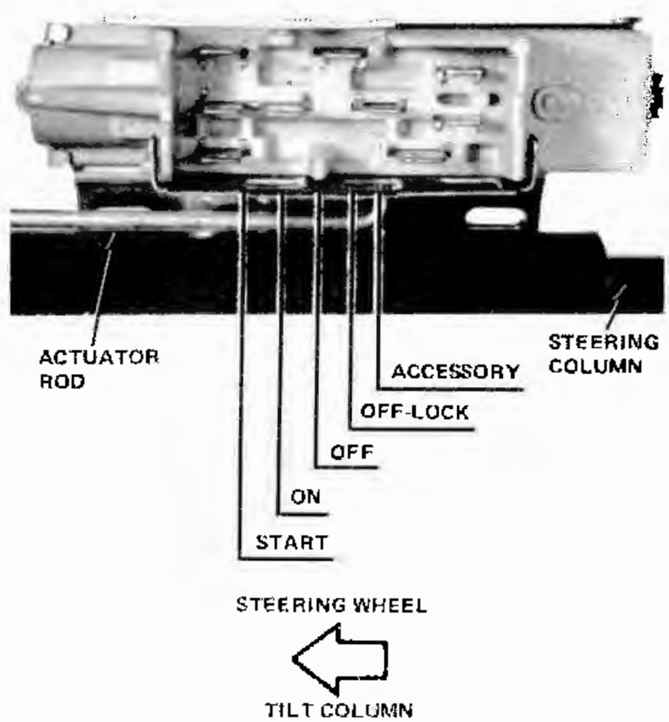
(2) Move slider to extreme left (accessory position).

NOTE: *The right side of the ignition switch is downward from the steering wheel.*

(3) Position actuator rod in slider hole.

(4) Install switch to steering column but do not tighten retaining screws.





IGNITION SWITCH

POSITION	CIRCUIT	
START	I-1, B-1 & S G-1, G-2	CONNECTED GROUNDED
ON	I-1 & B-1 A & B-2 I-3 & B-3	CONNECTED CONNECTED CONNECTED
OFF	OPEN	
OFF-LOCK	OPEN	
ACCESSORY	A & B-2	CONNECTED

B-1, B-2 & B-3 (COMMON CONNECTION)

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Fig. 3-64 Ignition Switch Positions - Cherokee, Wagoneer, and Truck

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(5) Lightly push switch down column (away from steering wheel) to remove lash in actuator rod. Be careful not to move slider out of detent.

(6) Tighten retaining screws securely.

Cherokee, Wagoneer, and Truck

For ignition switch cylinder service, refer to Steering, Section 11, under Column Shift - Upper Section.

Ignition Switch Test

Although an ohmmeter can be used to check continuity between common connections, a better method is to place a load across the switch (heater, ignition, etc.) which will heat the switch and show it under normal operation. Insert paper clip into the ignition feed wire connector at the back of the switch. Insert another paper clip into any other terminal that is carrying the load. Connect a voltmeter to the two paper clips and note the reading. The maximum voltage drop (the voltage indicated on the voltmeter) is 0.0125 (12.5 millivolts) volts per amp. This means that a 10-amp load would allow 10 x 0.0125 volt to appear on the scale. A reading of 0.2 (two tenths) volt, for example, would mean that the switch is defective.

On the Cherokee, Wagoneer, and Truck, ignition switch slide bar positions can be easily identified by first locating the alignment hole in the flat portion of the switch adjacent to the terminals.

LIGHTING SYSTEM

The wiring of the lighting systems is shown in the wiring diagrams, which indicate the various units in relation to their positions in the vehicle. The wires in the various circuits are different colors or are marked by tracers.

All models have a 20-amp circuit breaker built into the switch for light system protection.

The upper and lower headlight beams are controlled by a foot switch located on the toeboard.

Headlamps

All models are equipped with a single headlamp system.

The type 2 headlamp used with the single system is identified by the number 2 embossed on the sealed beam face. The lamp contains two elements: one low beam and one high beam.

Headlamp Aiming Procedure

Lamps must be aimed on the low beam. They may be aimed either with mechanical aimers or by using a screen. If Mechanical Aimers C-3674 are used, follow instructions supplied with the aiming equipment. If a screen is to be used, preparation for aiming is as follows:

(1) Locate vehicle in a darkened area with a level floor and with a screen (wall) having a nonreflecting white surface.

(2) A reference line should be marked on floor 25 feet away from and parallel to the screen.

(3) Position vehicle perpendicular to screen and with front headlamps directly over reference line.

(4) Locate middle tape on screen so it is aligned with centerline of vehicle.

(5) Equalize all tire pressures.

(6) Rock vehicle from side to side to equalize springs and shock absorbers.

(7) Measure distance between vehicle headlamp centers.

(8) Position marker tapes vertically on screen to right and left of middle tape at half this distance.

(9) Measure distance from center of each lamp to surface on which vehicle rests.

(10) Position marker tape horizontally on screen to cross vertical tapes at measured height of each lamp center respectively.

(11) Remove headlamp doors.

(12) Clean headlamps.

(13) Turn headlamps on low beam.

NOTE: *Cover the lamp not being aimed. Be sure to use the horizontal reference line on the screen that is the same dimension as the vehicle lamp height.*

(14) Turn vertical aiming screw counterclockwise until lamp beam is considerably lower than horizontal reference line on screw (fig. 3-65).

(15) Turn screw clockwise until top edge of high intensity area is even with horizontal line.

(16) Turn horizontal aiming screw counterclockwsie until beam is off centering tape.

(17) Turn same screw clockwise until left edge of high intensity area is 2 inches to right of lamp centerline (fig. 3-66).

(18) Cover lamp that has been aimed and aim other lamp using same procedure.

Headlamp Replacement

Each sealed beam headlamp can be replaced only as a complete unit.

NOTE: *Headlamps have a figure 2 molded into the glass at the top of the lens.*

The only difference in the replacement procedure between models is the removal of the headlamp door. The remainder of the headlamp assembly is the same as for all models.

To remove the door on the CJ models, remove the

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Fig. 3-65 Headlamp Adjustment

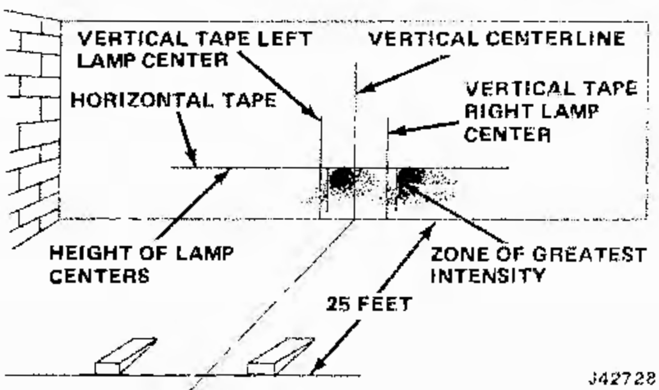

Fig. 3-66 Headlamp Aiming Chart

one lower attaching screw. Pull the door out slightly at the bottom and push up to disengage the upper retaining tab. The Cherokee, Wagoneer, and Truck have three screws retaining the headlamp door.

(1) Remove screws and remove door.

(2) Remove three screws in retaining ring.

(3) Pull headlamp out and disconnect wire harness.

(4) Install headlamp with the number 2 at the top of the lamp.

(5) Check lamp aim following procedures under Headlamp Aiming Procedure when replacing headlamps.

Headlamp Switch

The switch is a two-position switch containing a rheostat for controlling instrument panel light brightness (fig. 3-67). Rotating the knob clockwise dims the panel lights. Rotating the knob fully counterclockwise turns on the dome and courtesy lights.

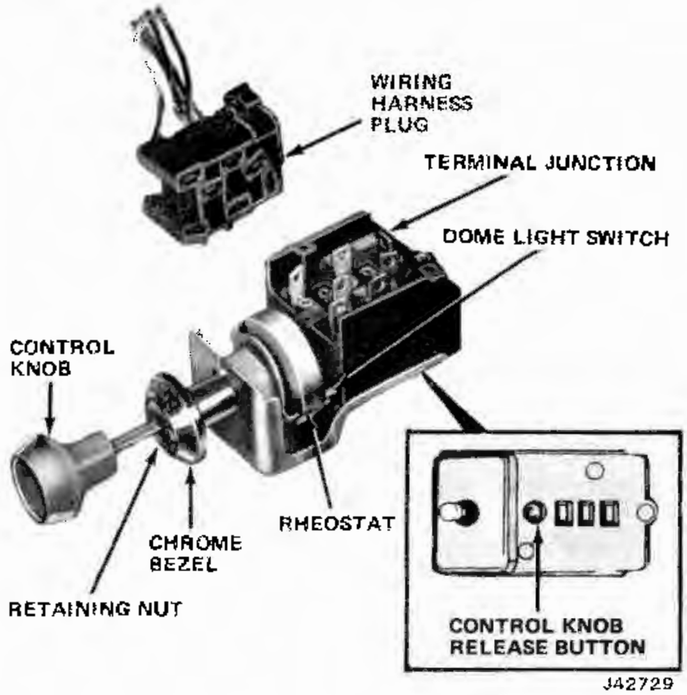

Fig. 3-67 Headlamp Switch

(1) To remove switch, first disconnect wire connector plug from switch.

(2) Pull control knob out to second position.

(3) From behind instrument panel, depress knob release button (as shown in figure 3-67 inset) and pull knob out of switch.

(4) Remove retaining nut and bezel.

(5) Remove switch through rear of instrument panel.

(6) When replacing switch, make sure wire terminal plug on switch is tight on connections.

Dimmer Switch Replacement

Refer to figure 3-68

(1) Remove wire plug from switch.

(2) Remove two capscrews that hold dimmer switch to floorboard.

(3) Remove plug.

(4) Check operation of dimmer switch with a test light. A circuit across two different pairs of contacts (one to headlights, the other to the high-beam indicator light) should alternately light test lamp when switch is operated.

Parking, Side Marker, and Directional Lights

CJ Models

The parking lights are mounted in the radiator guard panel just below the headlights. These lights are

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on when the headlamp switch knob is pulled out (fig. 3-69).

Fig. 3-68 Headlight Dimmer Switch

(1) Remove three screws, allowing lens to be removed.

(2) Replace lamp.

If the complete parking light assembly is to be removed for service or replacement, remove the headlamp assembly to gain access to the rear of the park lamp.

(1) Disconnect wire connector from harness.

(2) Remove nuts and lockwashers securing parking light assembly.

(3) Remove through the front of panel.

To replace front side marker bulbs, reach under the fender and pull down on the socket assembly. To install the bulb and socket assembly, line up the retaining tabs on the socket with the openings on the marker light. Push the assembly in and twist the socket 1/4 turn. The bulb is a wedge base type. Pull straight out to remove.

Cherokee, Wagoneer, and Truck

The Cherokee and Trucks have the parking lamps mounted in the headlamp panel just above the bumper (fig. 3-70).

The Wagoneer has the parking lamps mounted in the radiator grill panel (fig. 3-71).

The side marker light will flash in unison with the front turn indicator bulb. Side marker and parking lights come on when the headlamp switch is pulled out to any position.

To replace parking lamp bulbs on the Wagoneer, remove the park lamp lens.

To replace parking lamp bulbs on Cherokee and

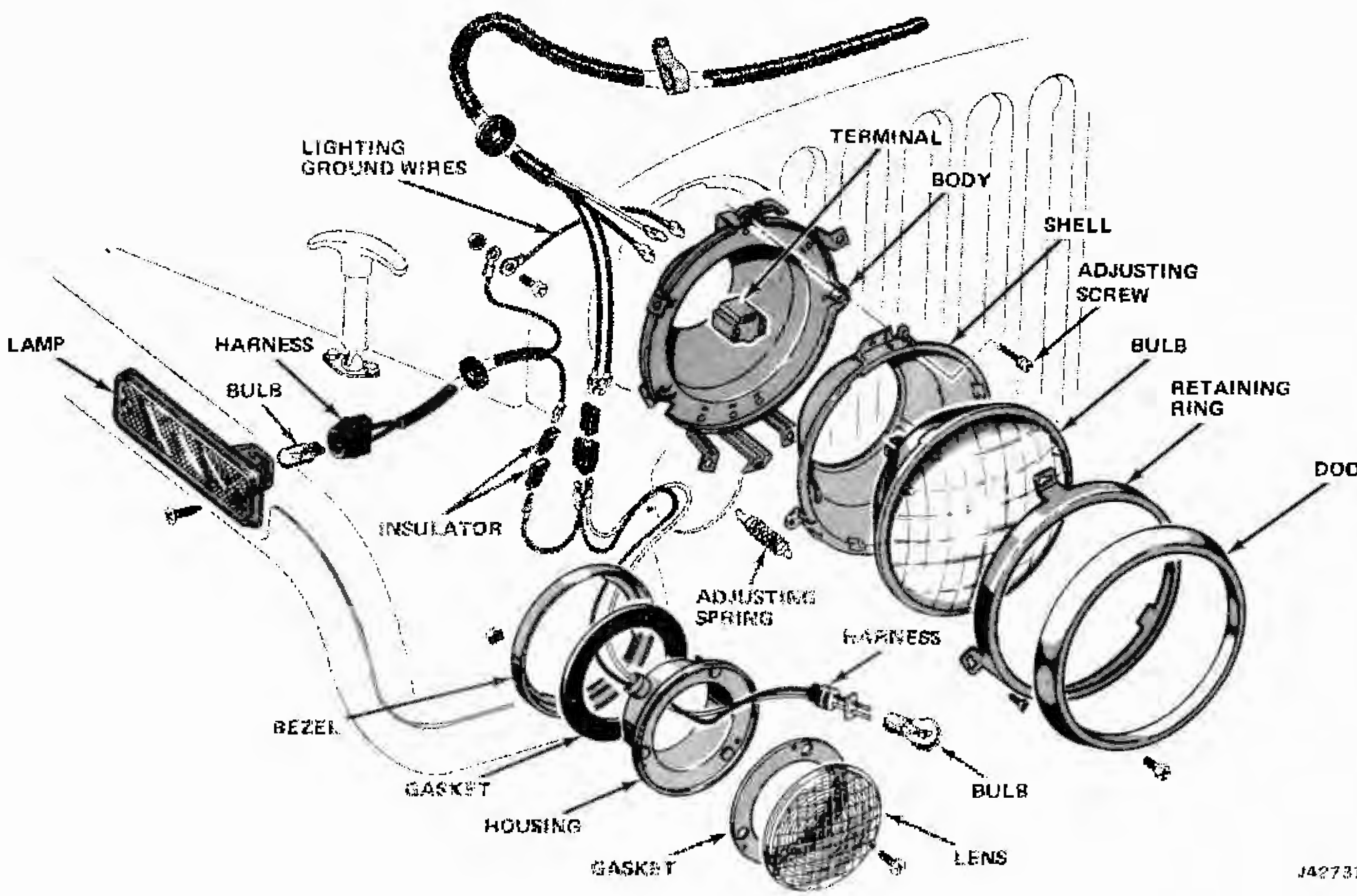

Fig. 3-69 Headlamp, Parking, Directional and Side Marker Lamps - CJ Models

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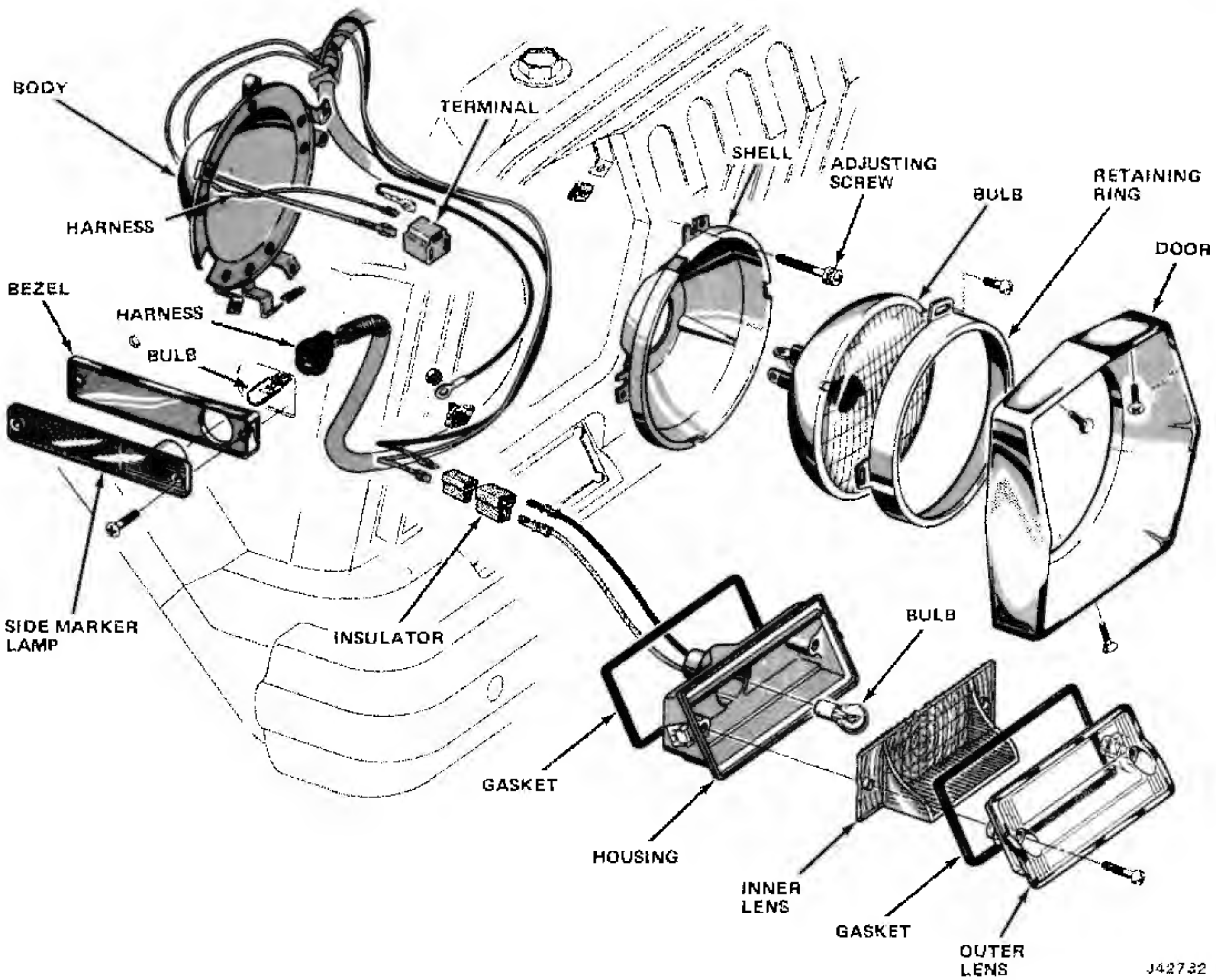

Fig. 3-70 Headlamp, Parking, Directional and Side Marker Lamps - Cherokee and Truck

Truck models, remove the lens and colored reflector.

To remove the entire park lamp assembly, remove the lens. Insert a narrow blade screwdriver between the lamp and the body sheet metal. Pry the sheet metal away from the lamp assembly until the spring clip on the side is disengaged. Pull out the lamp assembly to disconnect the wires. Before installing the lamp assembly, bend the retaining sheet metal lip back to its original position.

To replace side marker lights, remove the lamp assembly. Twist the socket 1/4 turn to remove. Pull straight out to remove the bulb.

Rear Directional, Side Marker, Stop and Taillights

CJ Models

Refer to figure 3-72.

Taillamp Bulb Replacement - Remove lens screws, lens, and gasket. Clean lens and reflector before replacing.

Taillamp Housing Replacement - Disconnect wiring, remove the two nuts and lockwashers securing taillight assembly to body and remove from rear of body.

Side Marker Bulb Replacement - Turn the bulb socket 1/4 turn counterclockwise and remove the bulb and socket.

Cherokee-Wagoneer

Refer to figures 3-73 and 3-74.

Wagoneer Taillamp Bulb Replacement - Remove four screws and remove the lens. The white reflector is held in position by one capscrew which, when removed with the reflector, allows the bulb to be removed and replaced. Clean lens and reflector before replacing.

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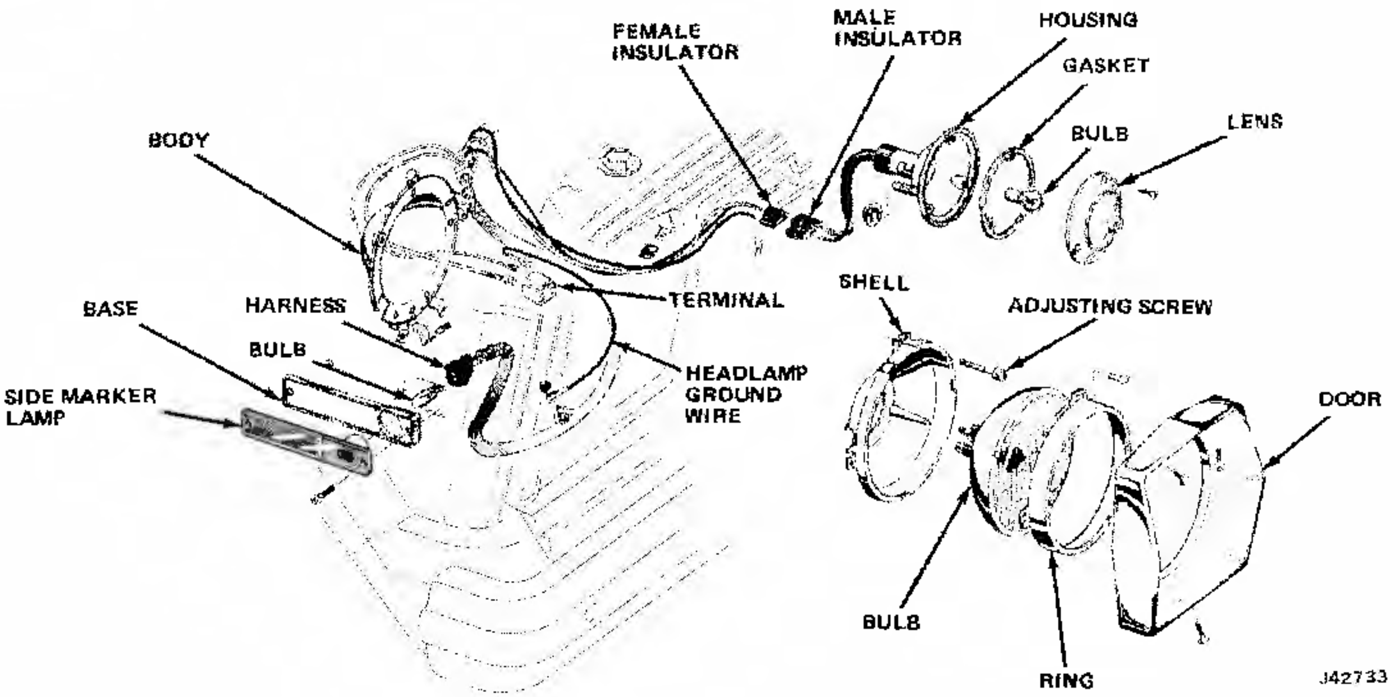

Fig. 3-71 Headlamp, Parking, Directional and Side Marker Lamps - Wagoneer

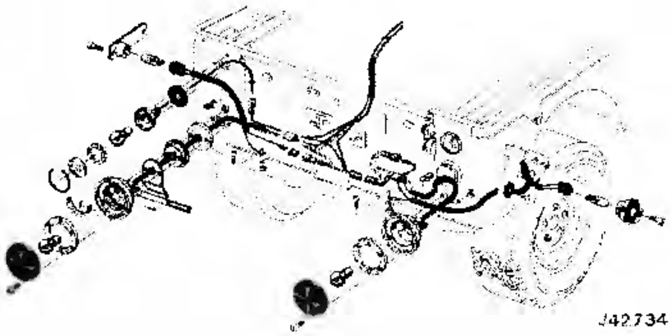

Fig. 3-72 Rear Directional, Stop, Backup, Taillights and Side Marker Lights - CJ Models

Cherokee and Truck

Refer to figures 3-73 and 3-74.

Taillamp Bulb Replacement - Remove the taillamp lens and remove the bulb. Clean the lens and housing before replacing lens.

Cherokee and Wagoneer

Taillight Housing Replacement

(1) Remove interior rear quarter trim panel. On right side, pull panel out of top and remove (this section of body contains jack and tire wrench). On left side, trim panel is held by expanding clips. Use care in prying these clips out of their recesses so panel is not bent or damaged.

(2) Disconnect taillamp harness connectors.

(3) Remove four attaching nuts and push housing out from corner posts.

Truck

On these vehicles, the light is mounted to brackets located on the outside rear of the pickup box side panel.

Taillamp Bulb Replacement - Remove lens and remove the bulb. Clean lens and reflector before replacing.

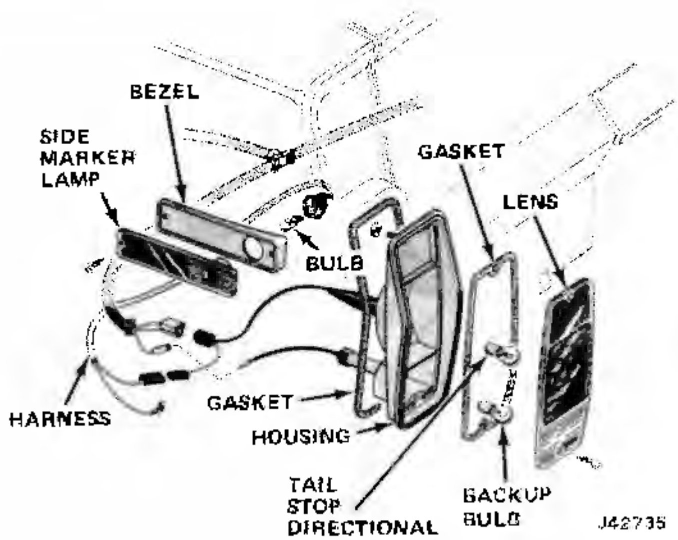

Fig. 3-73 Rear Directional, Stop, Backup and Taillight - Cherokee

Taillamp Housing Replacement

(1) Disconnect lamp harness.

(2) Remove attaching nuts.

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Townside Pickup Truck - On these vehicles, the light assemblies are mounted in the pickup box end caps.

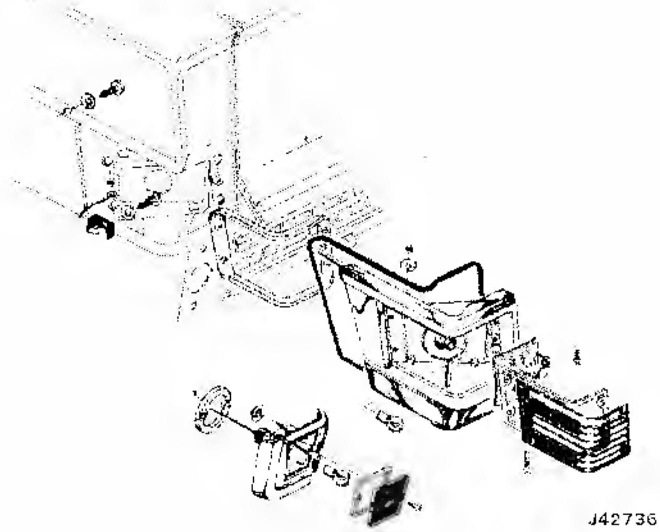

Fig. 3-74 Rear Directional, Stop, Backup and Taillight Wagoneer

Taillamp Bulb Replacement - Remove lens and remove bulb. Clean lens and reflector before replacing.

Taillamp Housing

(1) Remove lens.

(2) Remove two 1/4-20 screws.

(3) Remove housing and disconnect lamp harness.

License Plate Light

CJ Models

The left taillight illuminates the license plate. Refer to figure 3-72.

NOTE: *When installing a rear step bumper on the CJ and all truck models, the license plate lamp wiring must be disconnected from the original lamp. The lamp wiring from the step bumper must be spliced into the taillight harness.*

Truck Models

The lamp wiring is connected to the step bumper license lamp extension wire.

Cherokee and Wagoneer

The license plate lamp is attached to the tailgate and is a sealed unit. The lamp is removed by removing the lamp attaching screws and disconnecting the attaching wire.

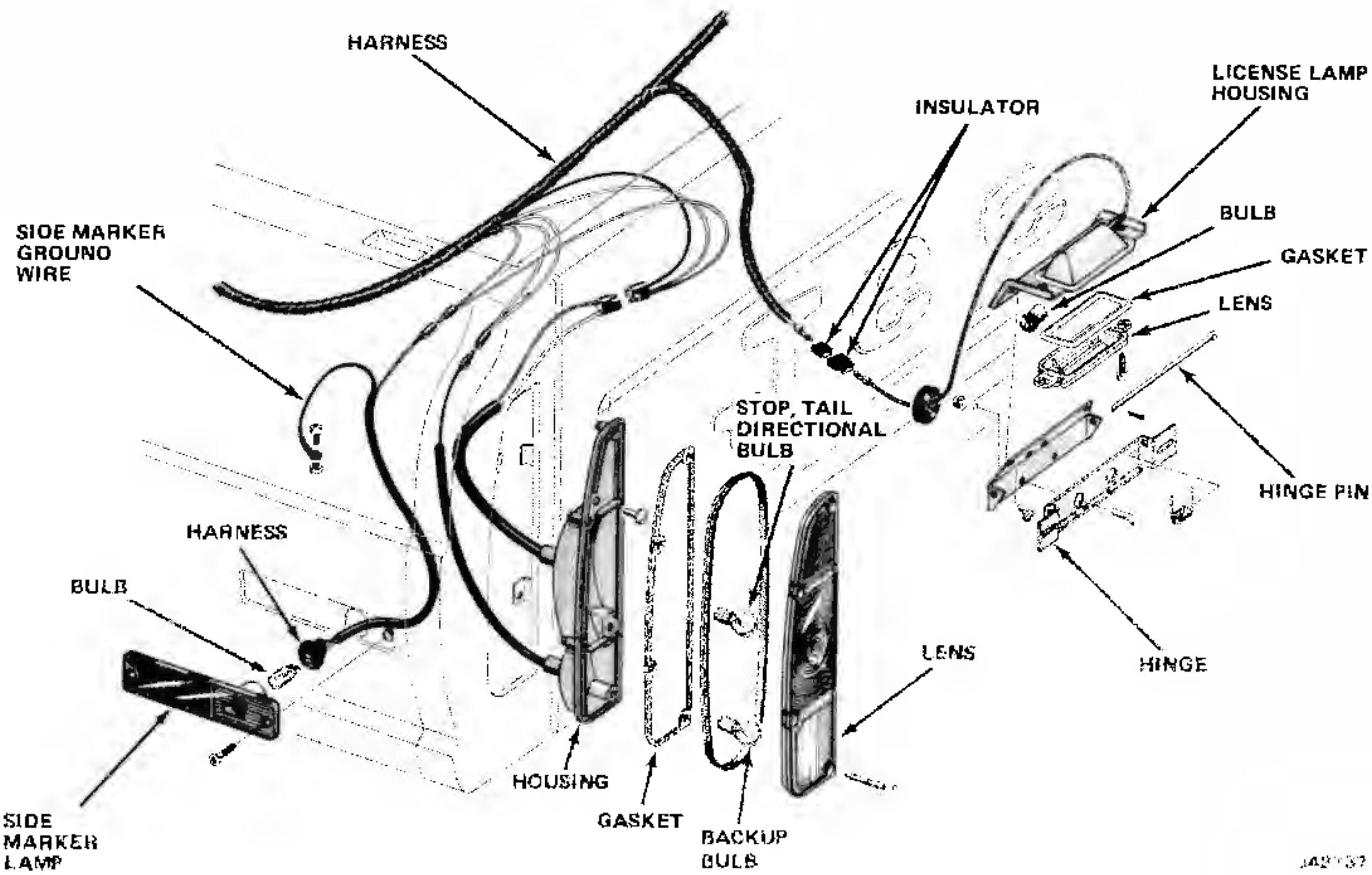

Fig. 3-75 Rear Directional, Stop, Backup, Taillight and Side Marker - Truck

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Truck

The license plate lamp is attached to the rear frame crossmember. Bulb replacement is accomplished by removing the bulb lens. The ground for the license plate bulb depends upon metal-to-metal contact between the bulb bracket, license plate bracket and the frame.

Backup Lights and Switch Replacement or Adjustment

CJ Models

The backup lights are located on the rear of the vehicle directly below the taillight. The backup lights are actuated by the movement of the reverse shift rail when the ignition is on. The backup light switch is threaded into the right rear corner of the transmission cover housing.

The backup light switch is not repairable and must be replaced if defective.

Bulbs can be replaced by removing the snap ring, lens, and gasket from the assembly.

Circuitry for the backup lights is as follows:

A green with white tracer is connected to the ignition terminal of the ignition switch. A 9-amp fuse is inserted in the circuit behind the ignition switch.

The instrument harness connects to the frame harness. The green with tracer wire continues back to two connectors (one on each side of the vehicle) where the backup light wires are connected. The backup lights depend on the lamp mounting studs for completion of the ground circuit to the body.

Cherokee, Wagoneer, and Truck

To replace a bulb, remove the backup light lens.

Backup light switch adjustment is as follows:

Manual (Floor Shift) Transmission - The backup light switch is threaded into the right rear corner of the transmission cover housing. The backup light switch is actuated by the reverse shift rail.

The backup light switch is not serviceable or adjustable and must be replaced as a unit.

Automatic Transmission - A combination backup and neutral safety switch is mounted on the steering column. This switch is adjustable. If defective, the switch must be replaced.

To adjust the backup light switch, place the transmission shift lever in the R position. Loosen (do not remove) the two switch attaching screws. Turn the ignition switch to the on position. Rotate the switch one direction or the other until the backup lights operate. Tighten the attaching screws. Check the switch for an engine start in the N and P positions. The engine must not start in R, D, 2, or 1 position.

As an aid to adjusting the backup light switch, install a test lamp to the lamp side of the switch and ground one side of a test lamp. When the test lamp lights, the backup lights are operating.

Courtesy and Dome Lights

Cherokee, Wagoneer, and Truck

The courtesy and dome lights operate when the front doors are opened, being actuated by the door pillar switch which provides a ground for the circuit.

Battery feed is from the headlight switch through a rheostat. When the doors are closed, the dome and courtesy lights are operated by rotating the headlamp switch knob counterclockwise to the stop. The ground for the lights is then through the headlamp switch. The dome light lens can be removed by squeezing the lens together to disengage the retaining tab (fig. 3-76).

A cargo lamp is offered on some truck models (fig. 3-77). The cargo lamp bulb is replaced by removing the outer lens.

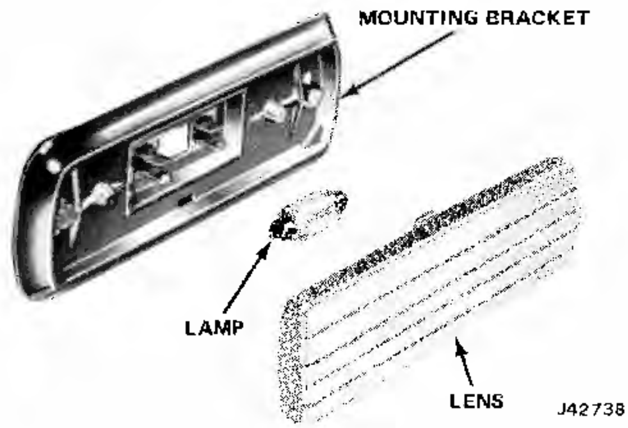

Fig. 3-76 Dome Light

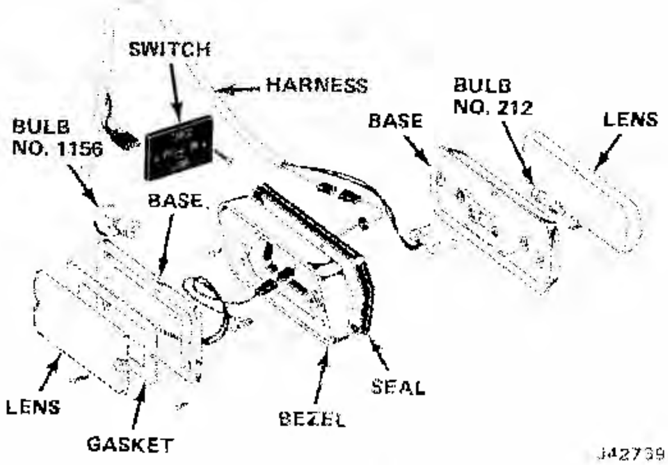

Fig. 3-77 Cargo Light - Truck

The lamp assembly can be removed after removing two attaching screws. The dome light bracket in the cab of Truck body styles is centrally located above the rear window.

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DIRECTIONAL SIGNAL SWITCH

The most frequent causes of failure in the directional signal system are loose connections and burned out bulbs. A flashing rate approximately twice the normal rate usually indicates a shorted out bulb in the circuit.

If a three-lamp flasher is installed in a vehicle having only two lamp bulbs per side, the lights will light but will not flash. Conversely, if a two-lamp flasher is used on a vehicle having three lamps, the too high current draw will cause the lights to flash too fast.

If there is no signal at any front, rear, or indicator light, first check the fuse.

If fuse checks OK, next eliminate flasher unit by substituting a known good flasher. If a new flasher does not cure trouble, check signal system wiring connections at fuse and at steering column connector.

NOTE: *If brake stoplights function properly, rear signal light bulbs are OK.*

CJ Models

The turn signal flasher is mounted to the lower lip of the instrument panel to the left of the steering column.

The switch is a self-canceling unit clamped to the steering column with two allen head screws. The battery feed is through a 9-amp fused red wire connected to an accessory terminal of the ignition key switch. The fused lead connects directly to the flasher unit located behind the instrument panel. From the flasher unit, a white wire leads to the directional signal switch.

To determine if the directional signal switch is defective, disconnect the switch at the six-wire connector. Use a jumper wire from the white (battery feed) wire to the other wires. Circuitry is as follows:

- White to Orange - Right Rear
- White to Black - Right Front
- White to Yellow - Left Front
- White to Blue - Left Rear

Cherokee, Wagoneer, and Truck

The directional flasher is mounted directly to the fuse panel. Refer to the wiring diagram at the rear of the manual for circuitry.

Switch Removal

(1) Disconnect negative battery cable.

(2) Remove horn contact trim cover by loosening bottom attaching screws.

(3) Disconnect horn wire from switch in steering wheel cavity by gently pulling quick-disconnect connector.

(4) Remove steering wheel nut. Note alignment of steering wheel to steering shaft index marks for later installation.

(5) Remove steering wheel with Steering Wheel Puller C-3428-B.

(6) Loosen anti-theft cover retaining screws and lift cover from column. It is not necessary to completely remove these screws as they are held on the cover by plastic retainers.

(7) Use Lock Plate Compressor Tool J-23653 to depress lock plate (Fig. 3-78).

(8) Once lock plate is depressed, pry round wire snap ring from steering shaft groove.

(9) Remove Lock Plate Compressor Tool, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring and thrust washer from steering shaft.

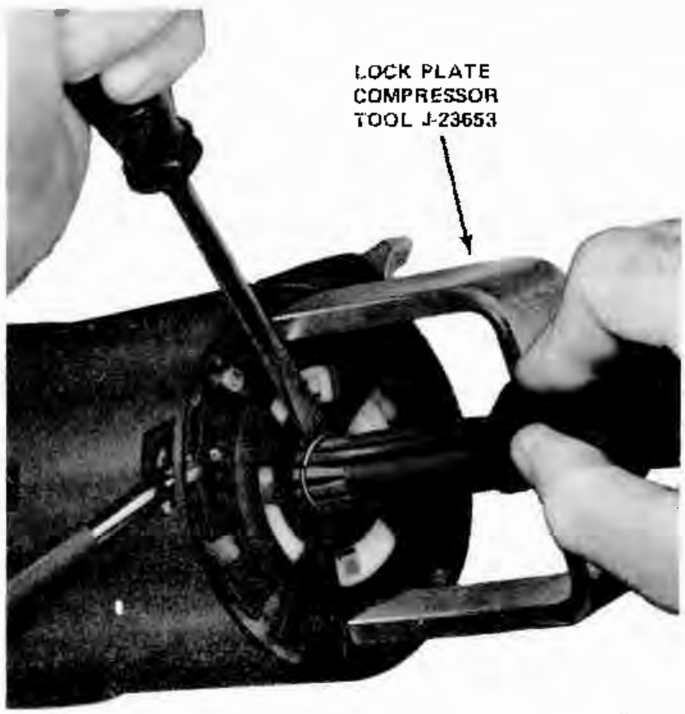

Fig. 3-78 Lock Plate Snap Ring Removal

(10) Place directional signal actuating lever in right turn position and remove lever.

(11) Depress hazard warning light switch, located on right side of column adjacent to the key lock, and remove button by turning in a counterclockwise direction.

(12) Remove directional signal wire harness connector block from its mounting bracket on right side of lower column.

NOTE: *On vehicles equipped with automatic transmission, use a stiff wire, such as a paper clip, to depress the lock tab which retains the shift quadrant light wire in the connector block.*

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(13) Remove directional signal switch retaining screws and pull directional signal switch and wire harness from column (fig. 3-79).

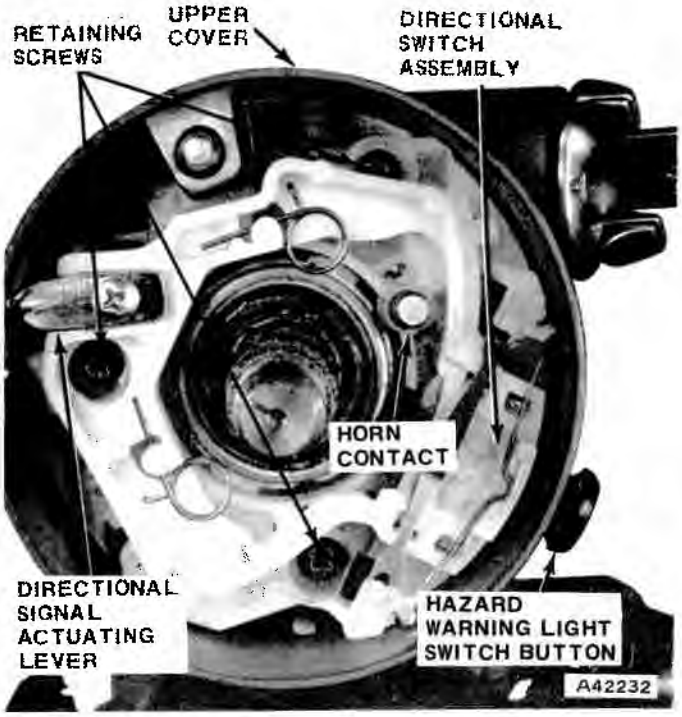

Fig. 3-79 Directional Switch

Switch Installation

(1) Guide wire harness into position and carefully align switch assembly.

NOTE: *Assure that actuating lever pivot is correctly aligned and seated in the upper housing pivot boss prior to installing the retaining screws.*

(2) Install directional signal lever and actuate directional signal switch to assure correct operation.

(3) Place thrust washer, spring, and directional signal canceling cam on upper end of steering shaft.

(4) Align lock plate splines with steering shaft splines and place lock plate in position with directional signal canceling cam shaft protruding through dog leg opening in lock plate.

(5) Install snap ring.

(6) Install anti-theft cover.

4-WAY EMERGENCY FLASHER

(Hazard Warning)

All models are equipped with a four-way emergency flasher system. With the switch activated, the two front and two rear turn signal lights flash on and off simultaneously as do both turn signal indicator lights on the instrument clusters.

This system makes use of the regular turn signal wiring and light bulbs, but has a separate supply wire, flasher unit and off-on switch. This makes it possible, when leaving a vehicle with the four-way flasher operating, to lock the ignition switch and car doors. When the four-way flasher is turned on, the normal directional signal supply is disconnected at the directional signal switch and a new supply circuit is connected into the switch directly from the battery. This four-way flasher circuit comes through a special heavy-duty flasher. Since the four-way warning flasher is of the heavy-duty type, it will flash any number of bulbs (from one to six bulbs) at a constant rate. Therefore, flashing indicator lights do not necessarily mean that *all* signal bulbs are flashing.

CJ Models

The switch is located on the instrument panel at the right of the steering column. To activate the system, pull the switch knob out. The switch does not cancel out when turning the steering wheel.

Battery feed is through a 14-amp fuse.

To remove the switch, remove the switch knob.

To remove the knob:

(1) Insert a small allen wrench or screwdriver in the detent on knob and exert pressure toward knob (fig. 3-80).

(2) Remove retaining nut and lower switch for access to wires.

(3) Remove wires and switch.

Fig. 3-80 4-Way Flasher Switch Knob

Cherokee, Wagoneer, and Truck

The four-way emergency flasher switch is a part of the directional signal switch.

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To operate the system, push in on the switch button.

The four-way flasher can only be canceled by pulling out on the flasher switch knob.

As the four-way flasher switch is part of the directional signal switch assembly, refer to Directional Signal Switch for removal or replacement procedure.

The battery feed for the four-way flasher system is from the fuse panel.

HORNS AND HORN RELAY

CJ Models

A single horn is mounted on the left fender under the hood. Battery feed is directly to the horn; no relay is used. A black with yellow tracer wire leads back to the steering column where it is connected to a plastic connector. From the plastic connector, the ground wire leads up to a terminal plate that is attached to the column with two screws. A rubbing block bears against a brass collar which is grounded when the horn button is depressed (fig. 3-81).

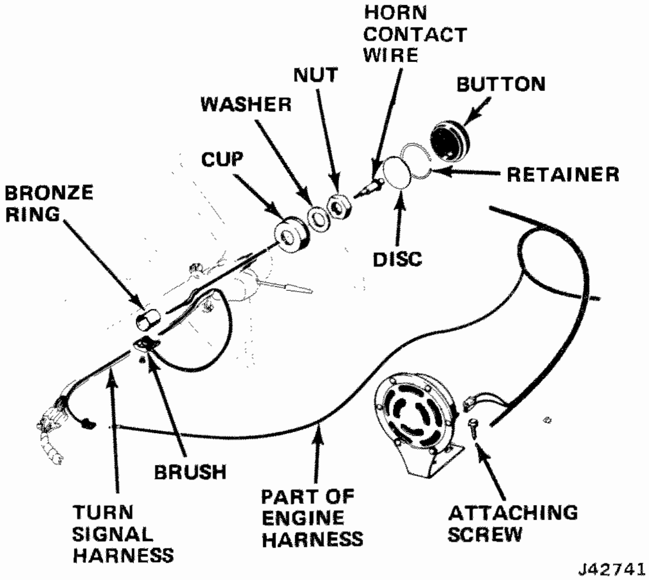

Fig. 3-81 Horn and Horn Button - CJ Models

Test

If the horn does not operate, test for battery feed at the horn (red wire) with a test lamp or voltmeter. If battery voltage is available, ground the black with yellow tracer wire. If the horn does not blow, the horn is defective. If the horn operates, proceed to the connector at the steering column and then to the terminal plate close to the steering wheel if necessary.

Wagoneer and Truck

A dual set of horns is mounted to the left front fender under the hood. Battery feed is unfused from the bulkhead connector.

Test

If the horn does not operate, check for battery voltage to the red wire with tracer connected to the horn relay No. 1 terminal. If voltage is not present, refer to the wiring diagram and trace the red wire with tracer back to the voltage source.

If voltage is present at the relay No. 1 terminal, disconnect the wire from the horn and touch the horn terminal with the hot wire. If the horn does not blow, it is defective or has a bad ground.

If the horn blows, reconnect all the wires and ground the horn button wire (No. 2 terminal). If the horn does not blow, the relay is defective.

If the horn blows, there is an open circuit to the horn button.

Ground the horn wire at the steering column connector. If the horn operates, the open circuit is in the steering column. If the horn does not operate, the open circuit is between the horn relay and the steering column connector.

CLOCK

Cherokee, Wagoneer, and Truck

The clock is attached to the instrument panel with two nuts.

If the vehicle is not equipped with air conditioning, the clock may be removed by reaching up behind the instrument panel and removing the nuts.

If the vehicle is equipped with air conditioning, access to the clock can be obtained by removing the glove box liner attaching screws and pulling down the top portion.

To reset the hands of the clock, pull out the adjustment knob. Hands of a *fast-running* clock should be turned *backward*, *slow-running* clocks *forward*. Clock speed will then be corrected automatically after one or two adjustments.

SPEEDOMETER

A magnetic type speedometer is used on all models.

All speedometers are equipped with a ratchet device to prevent turning the odometer backward.

The following data is supplied for testing and calibrating the speedometer heads.

Shaft Speed rpm	Indication mph
167	9to 11
500	30 to 32.5
1000	60 to 63
1500	90 to 94

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Speedometer Head Replacement

Speedometer head replacement includes resetting the replacement odometer to the same mileage as the one removed, unless such setting conflicts with local ordinances.

CJ Models

(1) Carefully uncrimp lip of outer bezel and remove glass and bezel.

(2) Remove two screws and separate speedometer head from housing.

(3) Unhook odometer retaining clip. Twist and push down to disengage clip.

(4) Remove odometer and set to proper mileage. Refer to Odometer Setting Procedures.

(5) Install odometer.

NOTE: *Check anti-backup spring for proper positioning.*

(6) Install retaining spring clip using needlenose pliers. Do not force clip against dial face.

(7) Install speedometer head into speedometer housing.

(8) Install bezel and glass assembly.

Cherokee, Wagoneer, and Truck

(1) Remove printed circuit board attaching screws and separate cluster case from bezel.

(2) Remove two speedometer attaching screws and speedometer.

(3) Remove odometer retaining clip.

(4) Remove odometer.

(5) Install odometer assembly.

NOTE: *Check anti-backup spring for proper positioning.*

(6) Install retaining spring clip.

(7) Install speedometer head.

(8) Install printed circuit board.

Odometer Setting Procedure

This procedure applies with the odometer removed from the speedometer head.

Refer to figure 3-82

Hold the fifth separator and rotate the last five numerals in their normal direction until the desired sixth digit is obtained. When the desired sixth digit is obtained, align the fourth separator in line with the fifth separator. Rotate the last four numerals, repeating the process until the desired total mileage is obtained. When installing the odometer, the separators must straddle a cross bar to maintain proper number alignment.

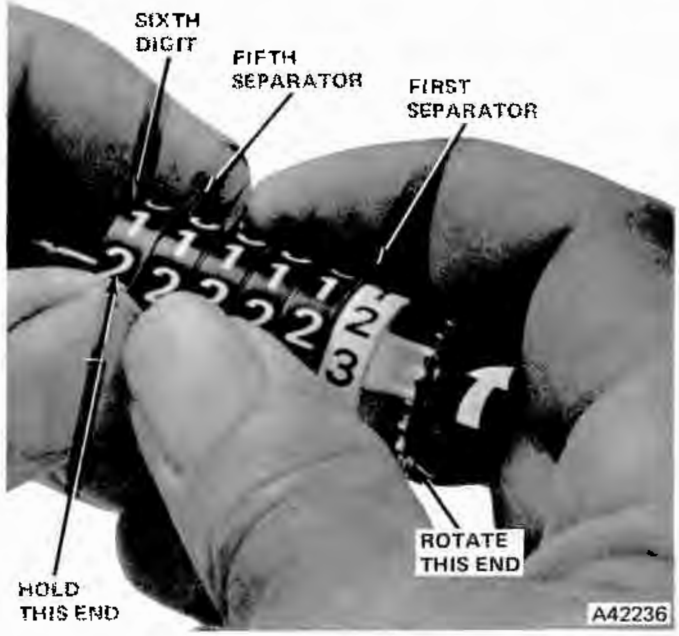

Fig. 3-82 Advancing Odometer Reading (for Replacement Only)

Speedometer Cable Inspection

Always inspect the speedometer cable and core for kinks or sharp bends.

Place the core on a flat surface in the form of an inverted U and then cross the open ends. Hold one end in the left hand, the other in the right hand.

Twist one end, applying light finger pressure to the other end. If the core is satisfactory, the turning action will be smooth.

On a damaged core, the turning action will be jerky and, in a severe case, the core will leap or jump.

The speedometer cable requires a graphite grease lubrication.

CIGAR LIGHTER

The cigar lighter is mounted to the instrument panel (all models).

The lighter can be removed by removing the battery feed wire and unscrewing the shell that surrounds the lighter.

CJ models have an in-line 14-amp fuse for circuit protection.

Cherokee, Wagoneer, and Truck models protect the lighter circuit with a 20 amp fuse located at the fuse block.

RADIO

Transistorized pushbutton AM and AM-FM monaural radios are optional for the Cherokee, Wagoneer, and Truck models (fig. 3-83).

All radios are protected by an in-line 5-amp fuse connected to a lead from the ignition switch or fuse panel.

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There are two fuses protecting the radio. A 5-amp fuse is connected to a terminal on the fuse block which is protected by a 10-amp fuse.

Stations may be preselected by means of five pushbuttons or manually tuned.

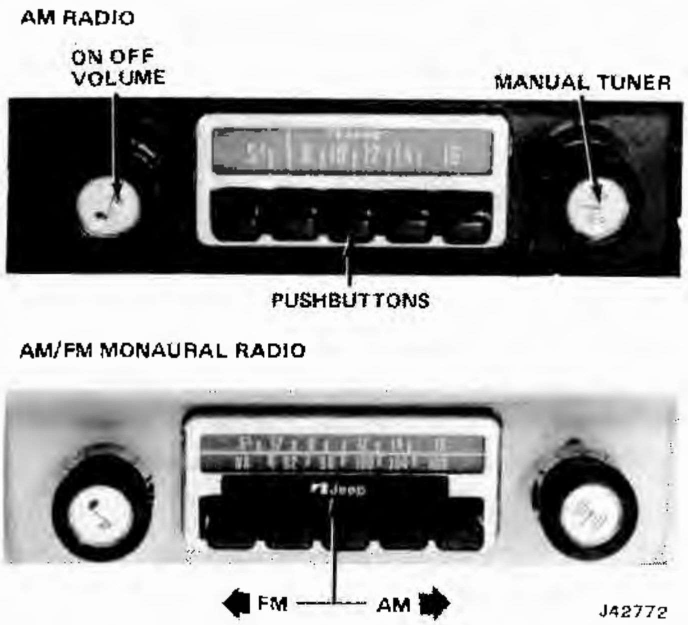

Fig. 3-83 AM and AM-FM Radio

Antenna Trimmer Adjustment

An antenna trimmer adjustment is necessary to match the radio to the antenna. The adjustment always must be made after installation of a radio and antenna, or after any repairs to a radio.

The adjustment should also be checked whenever radio reception is unsatisfactory.

The trimmer adjustment is located just above the tuning control.

The trimmer adjustment may be made anywhere. It is not necessary to be able to receive an understandable station. The object is to obtain the most amount of noise possible while the volume control is left in a medium volume setting. Adjust the trimmer as follows:

(1) Raise antenna to maximum height.

(2) Remove inner and outer tuning control knobs.

NOTE: *AM-FM radios must be switched to the AM position.*

(3) Turn radio and allow it to warm up for several seconds.

(4) Turn tuning control knob to 1400 KC range and obtain a signal (a station or just plain static). Turn volume control to medium level.

(5) Insert a common blade screwdriver through small hole above tuning control.

(6) Turn screw left or right until most volume is obtained *(without touching volume control)*.

(7) Install inner and outer tuning control knobs.

Setting Pushbuttons

(1) Move vehicle outside and away from high tension power lines.

(2) Lower antenna to one half its maximum height.

(3) Pull button out (approximately one-half inch) to unlock tuner.

(4) Select station with tuning knob. Tune for clearest reception.

(5) Push button in as far as possible (to lock tuner) and release. This station is now set for automatic tuning.

(6) Follow same procedure for remaining buttons.

Radio Polarity

When servicing the radio, the A (Red) lead must be connected to the positive side of the power source. If connected otherwise, the receiver will not operate and damage will result.

The radio is grounded internally. The ground return circuit is completed by grounding the chassis to the instrument panel. When bench testing, a ground jumper wire must be attached between the radio chassis and the negative terminal of a 12-volt battery to complete the power circuit.

DEFINITIONS
OF FREQUENTLY USED TERMS

AM (Amplitude Modulation): Common system of radio broadcasting (520 to 1610 kHz).

Antenna: Device used for transmitting and receiving radio signals.

Circular Polarization: A technique of transmitting radio signals to minimize the affects of fading.

Distortion: False reproduction of the original transmitted signal.

FM (Frequency Modulation): Another system of radio broadcasting (88 to 108 mHz) with the added advantage of wider audio frequency response.

Fading: Variation of intensity of received radio signals.

Flutter: Momentary loss of received radio station; sometimes referred to as picket fencing.

Hertz: Current term for cycles per second.

Ignition Noise: Undesirable noise from the ignition components of the vehicle itself or an adjacent vehicle.

Interference: Undesirable radio signals or noise that interfere with the reception of the desired radio signal. Examples include the adjacent channel interference, cross-modulation, and intermodulation.

Monaural: A system utilizing a single signal on a single radio frequency (station) as distinguished from a dual channel system (FM stereo).

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Multipath Reception: Signal loss or reduction due to a direct signal and a reflected signal arriving at the antenna simultaneously.

Selectivity: The ability of a radio receiver to accept the signal of one station while rejecting signals of undesirable adjacent stations.

Sensitivity: The ability of the radio receiver to receive weak stations.

RADIO RECEPTION CHARACTERISTICS

AM and FM have different reception characteristics. The following information will help explain the normal operational characteristics of these radios.

Signal Transmission

The range of normal hearing is approximately 30 Hz to 15,000 Hz. AM has a range of 50 to 5000 Hz; FM on the other hand, covers the entire range of normal hearing. Both AM and FM are received on a regular radio as a monaural (single) signal.

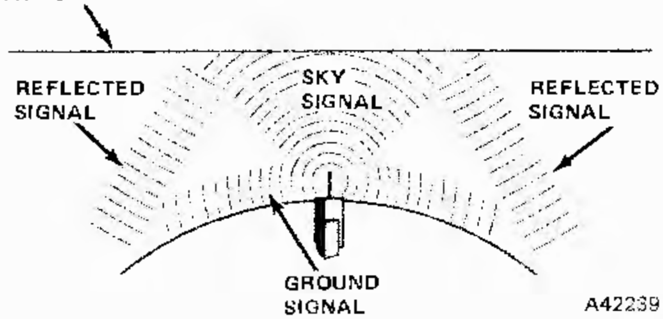

Fig. 3-84 AM Reception - Long Distance, Follows Curvature of Earth and is Reflected by Upper Atmosphere

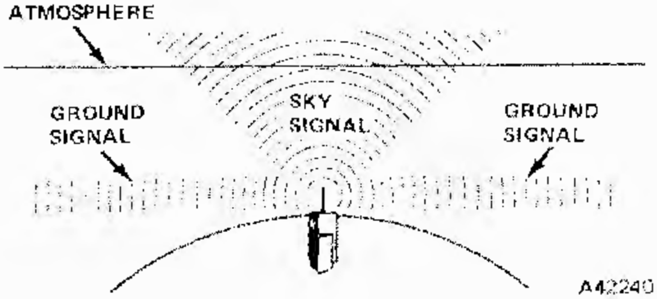

Fig. 3-85 FM Reception - Shorter Distance, Does Not Follow Curvature of Earth and Is Not Reflected By Upper Atmosphere

Fading

Fading is not usually a problem with AM because of its long distance reception capability (fig. 3-84). FM is limited, however, to line-of-sight reception (25 to 40 miles) under average conditions of terrain and transmitted power. (fig. 3-85). Figure 3-86 illustrates fading of an FM signal due to differences in terrain. Reception behind hills may be noisy (hissing or popping). This noisy reception is sometimes called flutter or picket fencing.

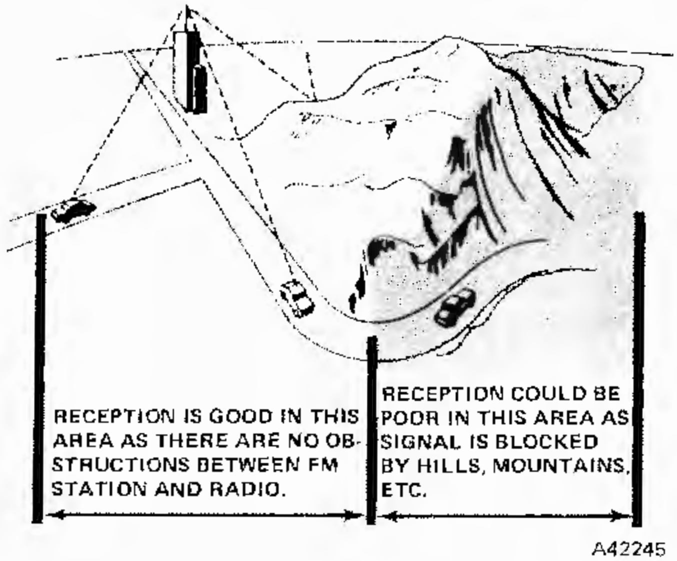

Fig. 3-86 FM Fading

Metropolitan Reception

Transmitted FM signals are easily reflected by solid objects such as buildings. This is why FM can be received under bridges and between tall buildings, whereas AM reception under the same conditions would either be reduced or nonexistent.

Multipath Reception

The fact that FM can be received quite well between tall buildings can unfortunately cause a detrimental side effect, namely multipath reception (fig. 3-87). It is caused by a direct signal and a reflected signal arriving at the vehicle antenna, causing distortion. This type of interference is usually of short duration since the area of interference is usually only a few inches or feet across. It is mostly encountered in downtown areas.

Some FM stations use a technique known as circular or vertical polarization. This technique can improve radio performance in areas encountering multipath reception.

AM Interference

Interference and Ignition Noise

AM reception is susceptible to electrical inter-

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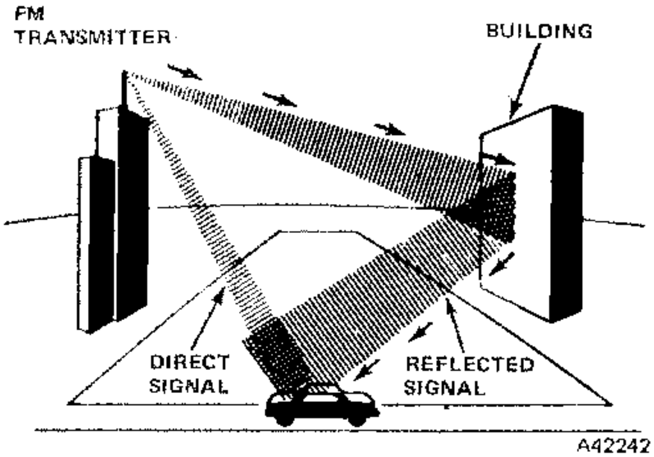

Fig. 3-87 Multipath Reception

ference such as power lines, thunderstorms, and other situations where electrical charges in the air cause disturbance. This electrical interference can result in buzzing and static. AM, however, does not usually suffer from ignition interference of nearby vehicles because suppression equipment installed on the vehicle (resistive ignition wire, noise suppression capacitors) prevents ignition noise in the radio.

FM Interference

Ignition Noise Interference

FM usually does not suffer from the electrical disturbances that affect an AM receiver. FM is slightly sensitive to ignition noise generated by engines of adjacent vehicles, especially those not containing radio suppression equipment. This ignition noise is more prevalent when listening to a weaker station while driving in heavy traffic. The noise will also occur if the radio is tuned off-station slightly. To improve reception, make sure the radio is tuned for minimum noise.

Other FM Interference

Occasionally when listening to a station while driving in the vicinity of another station, especially a strong station, the possibility of receiving both stations simultaneously exists. The phenomenon is called adjacent channel interference or cross-modulation (fig. 3-87).

Using Controls Effectively

Proper use of radio controls will enhance your listening pleasure.

(1) Although pushbutton tuning may be used for stations, always fine-tune the radio manually for clearest sound and minimum noise.

(2) If noise-free reception cannot be attained, set the tone control to the bass (counterclockwise) position to reduce noise level. When noise-free reception can be attained, reset control to its normal position.

Antennas

Although vehicle radio reception is outstanding, it is not the same as the continuous reception found in the home radio. The best AM antenna is a long antenna, the longer the better reception. However the antenna design is restricted in size, height, direction and must receive both AM and FM stations. This means there will be a compromise in reception because an FM radio has the best reception at an antenna height of approximately 32 inches.

RADIO NOISE DIAGNOSIS

The object of this diagnosis is to present a systematic approach to troubleshoot noise problems:

- Determine if the noise is normal (refer to Radio Reception Characteristics)
- Determine point of entry
- Eliminate the noise

Determine Point of Entry

There are five different ways for noise to enter a radio:

(1) Antenna

(2) A-line (battery feed wire to the radio)

(3) Speaker leads (by themselves or from noise radiated from the other car wires)

(4) Defective radio

(5) Enter directly into the radio

Antenna

Disconnect the antenna. If this causes the noise to stop, the problem is reduced to three possibilities:

(1) A defective antenna (refer to Radio Antenna Ohmmeter Tests).

(2) Noise radiated upward from the dash.

(3) Noise radiated from the engine compartment.

Noise Radiated Upward from Dash: Can be determined be improvising a tool made from a piece of aluminum or copper screen approximately 36 inches by 12 inches (fig. 3-88).

Lay the screen across the top of the dash and attach the clips to good body ground.

To determine exactly where the noise source is, another useful tool can be improvised from an antenna lead-in cable.

To make the tool, cut or remove the lead-in from the antenna at the antenna. Remove approximately 2 inches of the outer plastic covering and the woven shield (fig. 3-89).

(1) Disconnect original antenna lead-in and plug-in test probe.

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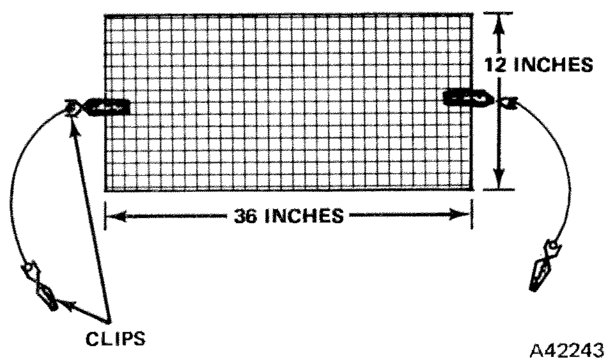

Fig. 3-88 Noise Suppression Tool

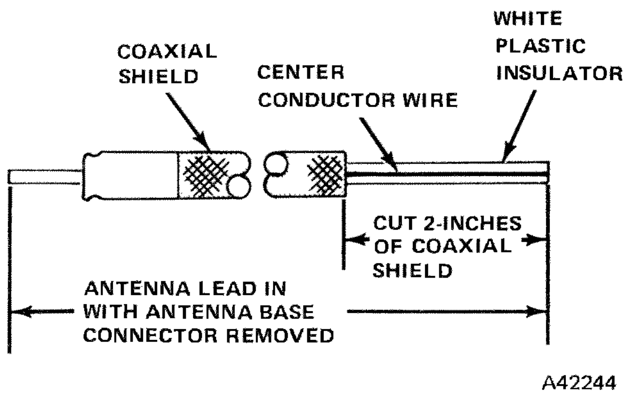

Fig. 3-89 Noise Probe

(2) Turn radio on and use probe to discover the hot spot. Do not touch end of probe with your hand, as this will give a wrong indication. As probe comes closer to noise source, loudness of noise will increase.

(3) If source is found to be a switch, connect a 0.5 mfd capacitor from battery feed side of switch to a good chassis ground.

(4) Gauges and sender units generally can be silenced by installing 0.5 mfd capacitors at their terminals.

(5) If source is found to be a wire, try rerouting wire. If this is not successful, a 0.5 mfd capacitor can be connected from wire to ground or wrap a piece of screen around wire or harness and attach one or more ground lead to screen. It also may be possible to screen off the area found to be radiating noise and ground screen.

(6) If noise is found to be a motor, install a 0.25 mfd coaxial (feed through) capacitor.

Noise Radiated From the Engine Compartment: These noises can be separated into three areas:

- Primary Ignition Noise
- Secondary Ignition Noise
- Alternator Whine (Antenna)

Primary Ignition Noise: Generally affects the AM band and usually appears as:

- Frequency varying with rpm
- Loudness varying with rpm

It stops instantly when ignition key is shut off and turned to accessory position.

The first two classifications are usually the result of poor grounds on the points and coil capacitors, defective points, or a wire routing problem.

A new set of points or cleaning of the condenser pigtail and ground may solve the problem. Install a 0.5 mfd capacitor on the coil as shown in figure 3-90.

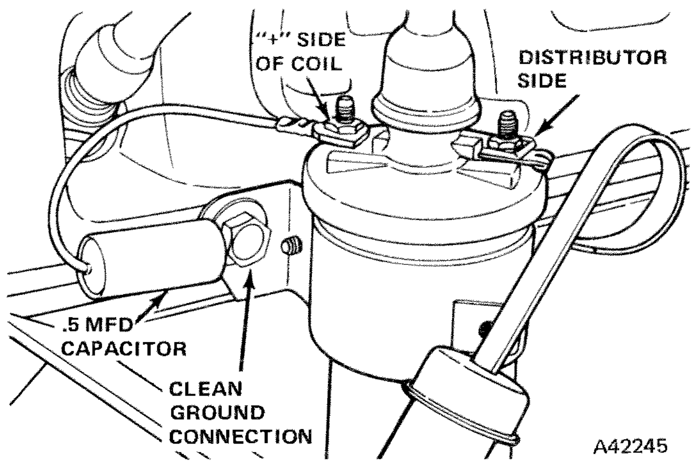

Fig. 3-90 Installing Ignition Coil Noise Suppression Capacitor

An extra long antenna lead-in may be prepared as shown in figure 3-89. and used as a hot-spot probe.

Remove the ignition coil and its mounting bracket. Clean the paint off the bracket and the engine block, then reassemble tightly (fig. 3-91). In many cases, this helps reduce the amount of interference radiated from the ignition system.

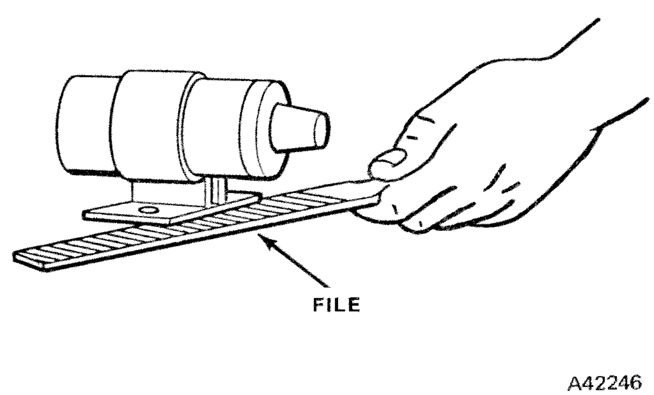

Fig. 3-91 Cleaning Coil Bracket

Be sure to check the coil polarity. The distributor must be connected to the negative side of the coil.

In some rare cases, extra suppression may be required if the vehicle is operating in fringe areas. For those special cases, perform the following steps:

(1) Install an 0.1 mfd coaxial capacitor as closely as possible to the coil battery terminal - not the distributor terminal. Do not use an ordinary bypass capacitor.

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(2) Install a 0.005 mfd, 1000-volt ceramic disc capacitor at the coil distributor terminal (fig. 3-92).

(3) Install a 0.5 mfd coaxial capacitor at the alternator output terminal. Be sure it is rated to handle the maximum alternator current.

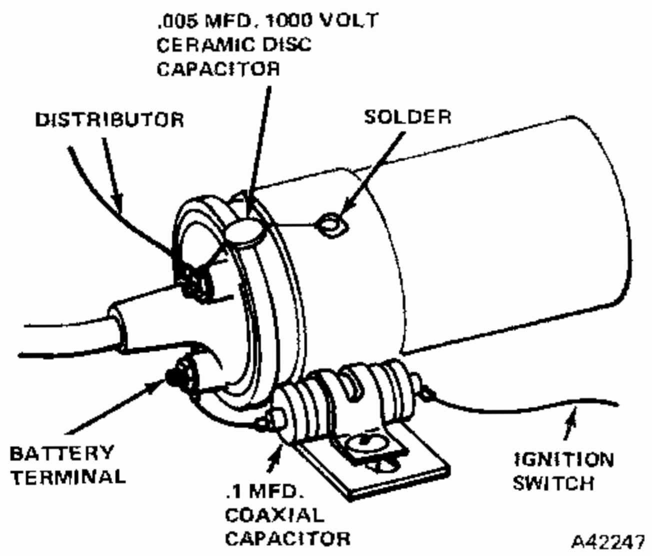

Fig. 3-92 Special Noise Suppression

Secondary Ignition Noise: Will always affect FM but, if severe, it may also affect AM. Normally one of the following conditions will be found in the radio:

- Motor noise across FM band (and possibly on AM)
- Motor noise (loud) off station but not on a strong station

NOTE: *When these conditions exist in the radio, the problem is more than likely a result of:*

- Distributor cap carbon ball, eroded away, or cracked or loose cap
- A rotor with a burned carbon contact spot
- A secondary wire not seated in the coil or distributur
- A defective coil
- An oily film on some of the lead terminals
- Copper core secondary wiring
- Defective or improper spark plugs.

If a wire was found not seated, remove the wire and check for a carboned end. It is not advisable to repair an end terminal on carbon core wire, replace the entire cable.

A tuneup may cure most of the problems.

If the noise in questions sounds like one or two cylinders and definitely not all of them, then the problem is after the coil. Once again, use the probe which plugs into the radio. Have someone sit in the vehicle and listen to the radio while going from plug to plug with the probe. The person in the vehicle should notice an appreciable increase in the plug noise when the defective plug is reached.

It is a good idea to install resistor spark plugs when experiencing spark plug noise. The resistor equivalent of the Champion N-12Y plug is the XN-12Y or RN-12Y plug. If the vehicle has copper core secondary wiring, these wires should be replaced with carbon core resistor wire.

Alternator Whine: Can be described as an annoying high pitched whistle or a siren that increases and decreases with engine rpm.

Methods of getting rid of alternator whine are:

(1) Provide a good fender ground (fig. 3-93).

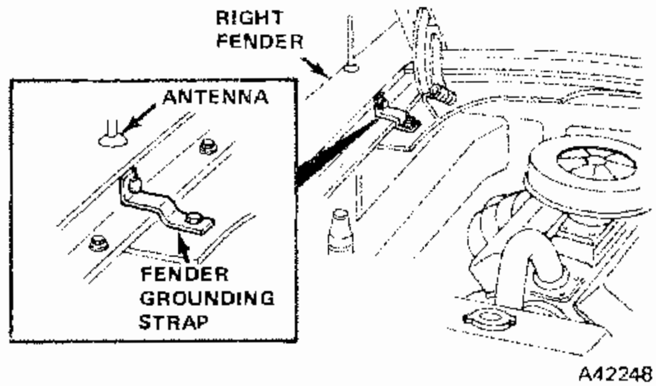

Fig. 3-93 Fender Ground Strap Installation

(2) Install good grounding strap.

(3) Run offending wire through a shielded (grounded) cable.

(4) Clean sliprings and make sure brushes are making good contact.

(5) Align hood to keep fender-to-hood gap as close as possible.

A-Line (Battery Feed Wire to Radio)

If disconnecting the antenna did not rid the radio of the noise, the noise is probably on the A-line.

Motor noise on the A-line is usually the result of voltage spikes on this line being so large that the input filter circuit in the radio cannot handle them. There are two ways to handle this problem.

- Find out what is causing the noise on the line and eliminate it.
- Add external filters to reduce the spikes to a point where the radio filter can handle the spikes.

A grounded capacitor touched to all hot electrical connections will often identify the offenders (fig. 3-94). The antenna probe (fig. 3-90) also can be used to find hot spots.

In general, any adjacent metal parts which are separated by mastic or paint must be connected together electrically.

Effective bonding requires more than physically clean surfaces and self-tapping screws. Tooth-type lockwasher must be used to cut into the surface layers of metal. Grounding straps must be as short and as heavy as possible.

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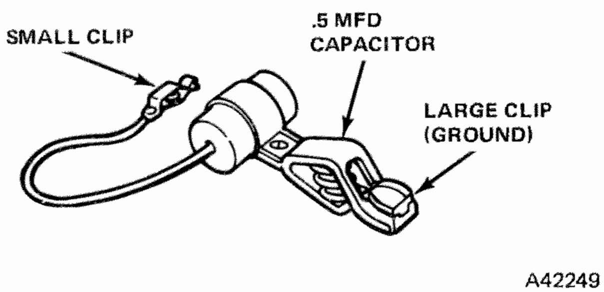

Fig. 3-94 Noise Eliminator Test Device

A-line noise is normally the result of:
Alternator whine
Wiring harness too close to igniton wiring
Radio noise suppressor
Poor radio ground

Alternator Whine: Does not stop instantly when the key is turned quickly to the accessory position at fast idle. It is a high pitched whine which increases with rpm. Correct alternator whine as follows:

(1) Install 0.5 to a 2 mfd bypass capacitor from alternator output terminal to ground (fig. 3-95).

(2) Install coaxial capacitor in alternator output wire (fig. 3-95).

(3) Install noise suppressor kit.

(4) Install 0.5 mfd capacitor to alternator regulator terminal (fig. 3-95).

(5) Replace alternator diodes.

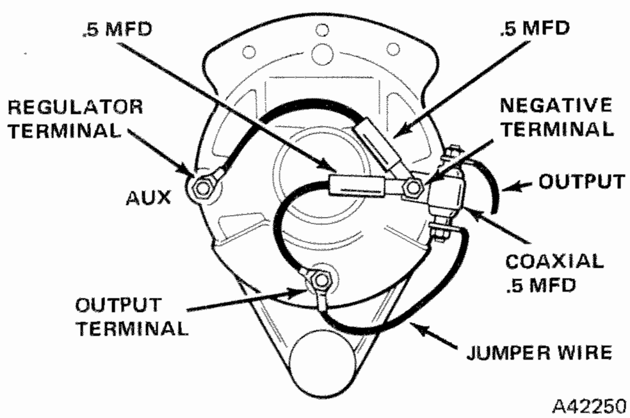

Fig. 3-95 Alternator Noise Suppression

Wiring Harness: Noise normally can be corrected as follows:

(6) Relocate wiring away from ignition wires.

(7) Install 0.5 mfd capacitors on each fuse panel lead. Be sure capacitor is grounded (fig. 3-96).

(8) Relocate wiring away from tachometer and ammeter wiring.

(9) Remove loops from harness wires.

Radio Noise Suppressor: A noise suppressor must be installed on every vehicle equipped with a radio. This suppressor (choke) is plugged into the back of the printed circuit board. Be sure the choke has not been installed over the copper strip that is installed on vehicles not originally equipped with a radio.

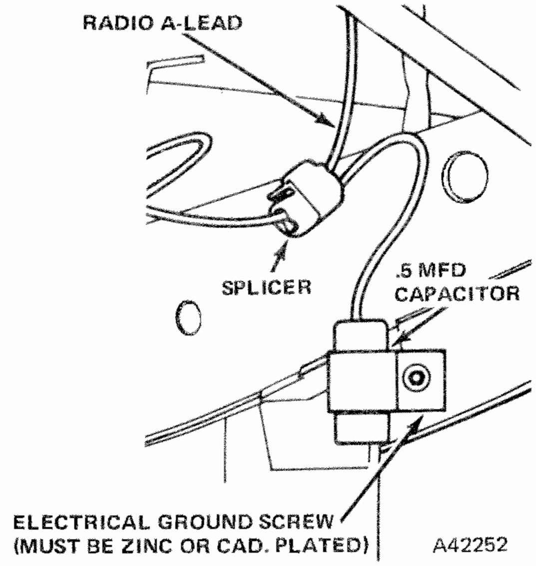

Fig. 3-96 Wiring Harness Noise Suppression

Tap on the dash with the ignition on and in the accessory position. If noise only occurs in the on position:

(1) Remove radio choke.

(2) Remove plastic covering.

(3) Unsolder one end of coil wire and remove approximately 6-1/2 inches of wire.

(4) Resolder wire end.

(5) Wrap coil with several turns of electricians tape and install choke.

Poor Radio Ground: To check for a poor ground, attach a jumper wire to the radio case and ground to a good chassis ground. If there is no change in radio noise, the radio has a good ground. Check for loose mounting screws.

Speaker Leads

To determine if speaker leads are inducing or picking up noise, perform one or both of the following:

(1) Separate the speaker coil wires by installing a loom over each wire.

(2) Install a 0.001 mfd thumbnail type capacitor across the speaker.

Speaker-induced noise normally will not occur on front mounted one or two speaker systems.

Defective Radio

Swap with a known good radio to determine if the radio is defective.

Enter Directly into the Radio

(1) Be sure radio has good ground.

(2) Tighten all radio chassis screws.

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(3) Center punch cover to make good electrical contact with front of case (fig. 3-97).

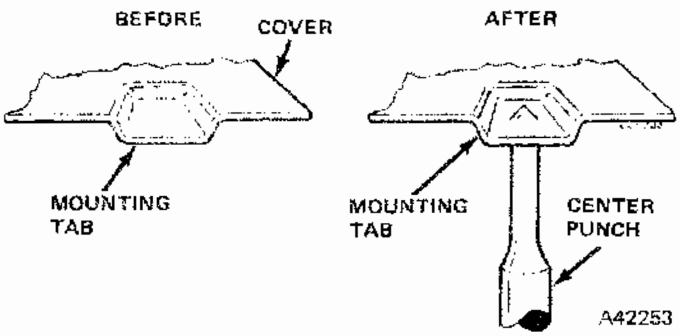

Fig. 3-97 Center Punching Covers

Wheel and Tire Static

Wheel static is another source of interference. This is a running noise most likely to be encountered when the vehicle is in motion, on a hard, dry surface road. The noise will remain when the vehicle is coasting with the engine and all electrical equipment turned off. The static occurs in the front wheels due to insulating film produced by the lubricant in the wheel bearings. The remedy is to install collector springs to dissipate the static (fig. 3-98).

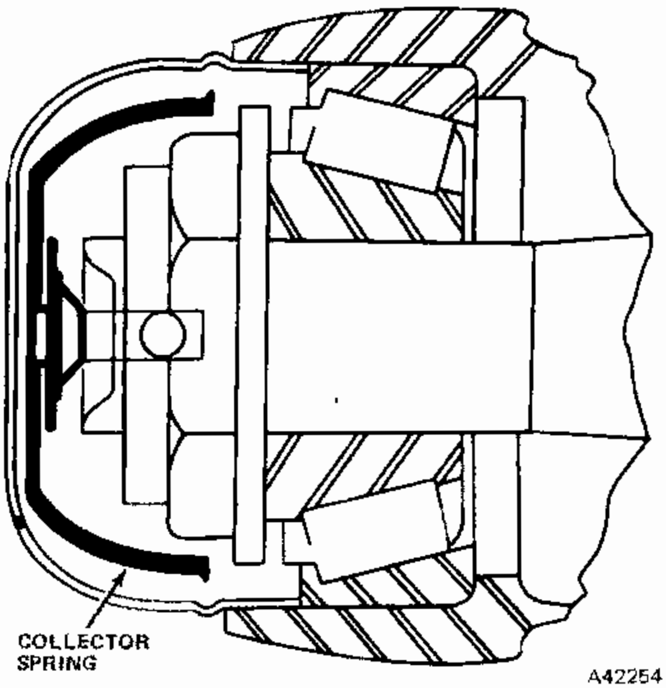

Fig. 3-98 Collector Springs

In some instances, static discharges take place between the tire and the road surface, which cannot be eliminated with collector springs. An anti-static powder kit is available from radio supply houses which applies conducting material to the inside surface of the tire to eliminate noise from this source. Tire static can be checked by washing the tire with water. The water provides a conduction path to ground for the discharge. Tire static is most likely to be encountered during hot and dry seasons.

Turn and Stop Signals

The flasher in the turn signals and the switch in the stop signal may cause popping noises in the radio. In most cases, the noises are interference due to arcing at the contacts. The cure is a 0.5 mfd bypass capacitor installed at the battery connection of the switch or the flasher. It is less likely, but possible, that the low frequency components of the interruptions are reaching the audio stages of the radio. The test, of course, is to check if the noise is present with the volume control turned down. If so, install a 1000 mfd capacitor.

Horn Noise

The diagnosis and cure for a growling noise in the radio when the horn is operated is the same as for turn and stop signals. The suppressor capacitors are installed at the point where the battery lead feeds the horn relay.

Be sure the horn relay cover is not loose.

Accessories

Electric windshield wipers, blowers, or fans, window openers, or any brush-type motors generally can be supressed by installing 0.25 mfd capacitors at their terminals.

RADIO BULB REPLACEMENT

Cherokee, Wagoneer, and Truck

Removal

(1) Remove radio knobs, attaching nuts, and bezel.
(2) Remove dial cover retainers and cover.
(3) Rotate manual tuning control to move pointer to extreme left or right.
(4) Remove dial light deflector clips and remove deflector.
(5) Remove no. 1893 bulb and bulb diffuser.

Installation

(1) Install diffuser on bulb and install bulb.
(2) Install dial light deflector.
(3) Install dial cover.
(4) Install bezel, attaching nuts, and knob.

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RADIO ANTENNA

All antennas must have good ground to eliminate static noises. The mast of the antenna is not grounded except through the radio. The base of the antenna is grounded to the vehicle sheet metal. The coaxial shield (the wire mesh) surrounding the center conductor wire of the antenna lead-in cable is grounded to the radio and the antenna base.

There are three antenna tests to be made with the use of an ohmmeter:

- Mast to ground
- Tip of mast to tip of conductor
- Body ground to battery ground

Refer to figure 3-99.

Mast-to-Ground Test

This test verifies that the antenna is making electrical contact with the radio and that the mast is insulated from the base.

(1) Touch one ohmmeter prod to tip of antenna mast and other prod to antenna base (0-1). With antenna installed in radio, there should be continuity (approximately 15 ohms).

(2) Disconnect antenna from radio and repeat step (1). There should not be any continuity with antenna disconnected from radio.

Tip of Mast to Tip of Conductor Test

This test verifies that the antenna does not have an open circuit.

(1) Disconnect antenna from radio.

(2) Touch one ohmmeter prod to mast tip and other prod to tip of lead-in (part inserted into the radio) (0-2). There should be continuity (fraction of an ohm).

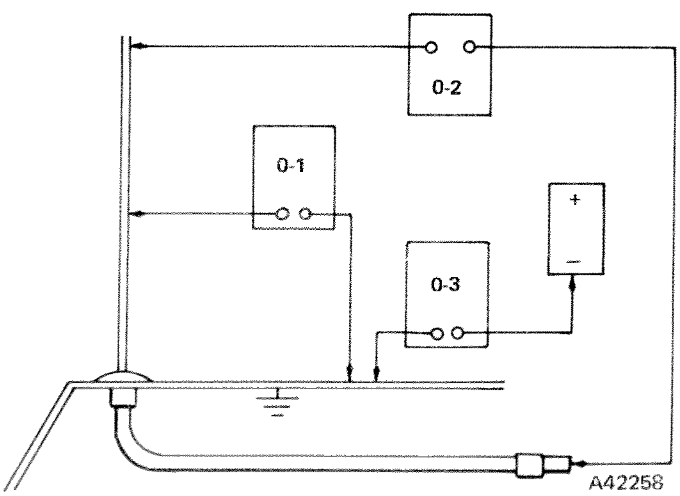

Fig. 3-99 Antenna Ohmmeter Tests

Body Ground to Battery Ground Test

This test verifies that the antenna base has a good ground. Touch one ohmmeter lead to the fender and the remaining prod to the battery post (0-3). The resistance should be extremely low (less than one ohm).

Radio Speakers

All speakers have an impedance of 3.2 ohm. A speaker should be replaced with the proper part number speaker. If the exact replacement is not available, select a speaker which matches the ohm value stamped on the radio chassis.

Speaker Repairs

The most common speaker problem is a loose mounting. Another common problem is screws or other objects stuck to the back of the magnet. If a speaker is removed, it also should be checked for a loose magnet by attempting to turn the magnet by hand.

A speaker once it has been damaged is usually not repairable and should be replaced. Replacement speakers should be of the same ohm value. Defective speakers usually have one or more of the following symptoms:

- Audio distortion, particularly on the low frequency notes and at high volume.
- Rattles and fuzzes caused by foreign material hitting or rubbing against the speaker cone.
- Raspy noises caused by foreign matter inside the speaker restricting free movement of the speaker cone.
- Muffled sound caused by speaker opening obstruction.

Use a light to check the speaker openings.

If the entire speaker is not visible through the speaker grille openings, remove the grille.

NOTE: *Be sure the speaker mounting screws are tightened securely.*

Speaker Feed Wire Connection and Short to Ground

Check speaker feed wire for a short to ground:

(1) Disconnect speaker harness at radio.

(2) Connect one lead of an ohmmeter to speaker feed wire and other lead to a good ground. No resistance reading should be indicated.

(3) Check each individual speaker wire in this manner.

(4) If resistance is indicated on meter, wire being checked or matching speaker(s) is shorted to ground.

(5) Speakers may be isolated and checked for a short to ground by disconnecting speaker harness at the speaker and connecting an ohmmeter as outlined above.

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(7) Electrical shorts in speaker harness are generally caused by screws pierced through wire harness. Repair shorted wire or replace shorted speaker, as required.

NOTE: *When reconnecting the speaker harness to the radio, be sure the antenna lead-in cable is fully engaged in the radio socket.*

Radio Speaker Removal

Cherokee, Wagoneer, and Truck

The speaker is located above the radio.

(1) Remove radio.

(2) Remove four attaching nuts from mounting studs and remove speaker.

TRAILER TOWING PACKAGES

The schematics for the light and heavy-duty towing packages are shown at the rear of this manual.

CAUTION: *If a trailer is equipped with a fully charged battery and the battery on the tow vehicle is dead, do not attempt to start the tow vehicle unless the trailer connector is disconnected. Attempting to use the trailer battery for starting will damage the trailer connector.*

Class 1 and 2 Package.

The trailer connector is connected into the existing frame harness. This type of package requires the use of heavy-duty flashers for both turn and hazard warning flashers. The maximum amount of bulbs to be used on the trailer are:

- Four taillamp bulbs
- One license plate lamp bulb
- One set of directional signal lamp bulbs

All bulbs are to be the same size as the tow vehicle. The original equipment flashers must be installed when the trailer is not in use.

Class 3 and 4 Package

This type of package does not require the use of heavy-duty flashers. Three relays, fed through a 10-amp circuit breaker, carry the load to the trailer. The left and right turn and taillight circuits are used only to trigger the relays and do not carry any of the trailer load.

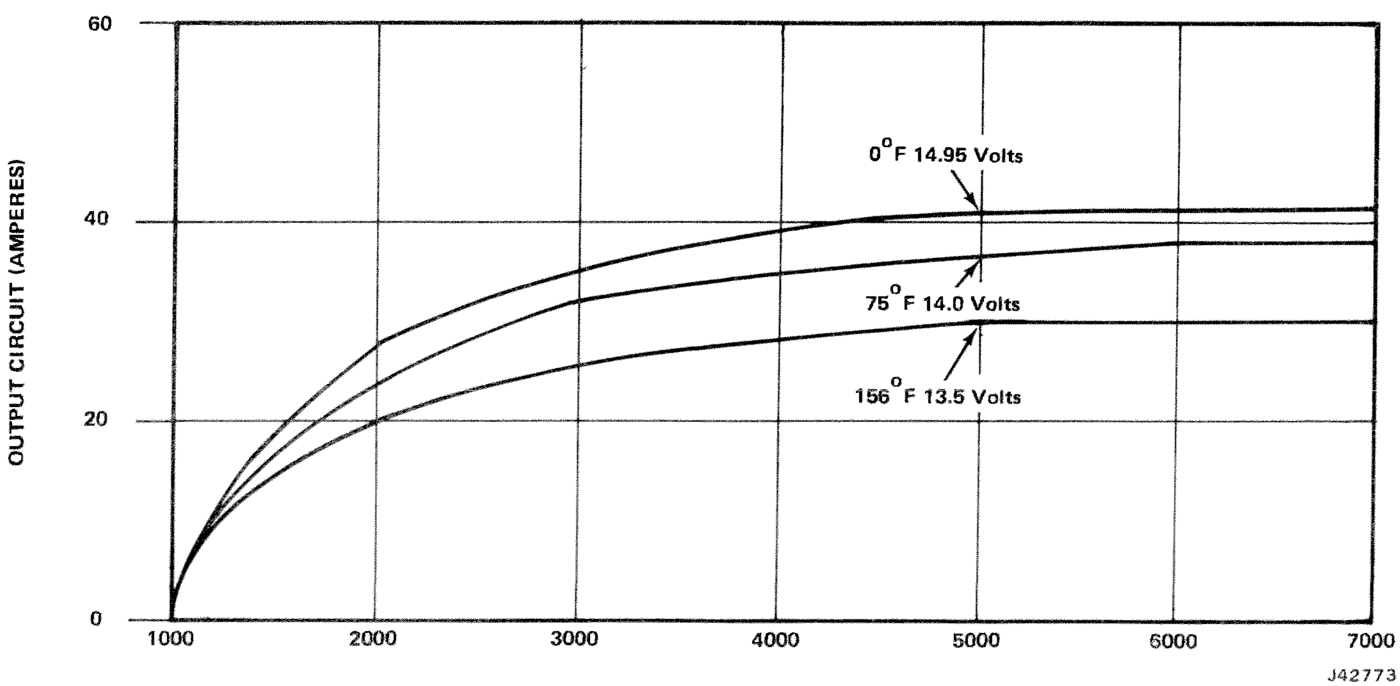

Fig. 3-100 Temperature-Output Relationship (Motorola 37-Amp Alternator Shown)

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SPECIFICATIONS

ALTERNATOR

Make	Motorola
Standard — All except Camper 4800	37 amp
— Camper Truck 4800	51 amp
Optional — (Mandatory with Air Conditioning and 4V Carburetor)	51 amp
Rotation	CW @ Drive End
Field Current	1.8-2.5 amp

VOLTAGE REGULATOR (ALTERNATOR)

Make	Motorola
Model	8RH 2003
Type	Solid State
Adjustment	None

Regulator Temperature	Acceptable Voltage Range
0 - 50° F.	15.3 - 14.2
50 - 100° F.	14.8 - 13.7
100 - 150° F.	14.3 - 13.1
150 - 200° F.	13.8 - 12.7

GENERATOR

Make	Prestolite
Model	GJP-7402B
Ground Polarity	Negative
Controlled Output	35 amp
Control	CV Regulator
Armature End Play	0.003 to 0.010 inch
Brushes	2
Brush Spring Tension	18 to 36 oz

REGULATOR (GENERATOR)

Make	Prestolite
Model	VBO-4201E-4A
Type	Vibrator
Cutout Relay:	
Closing Voltage @ Generator rpm	12.6 to 13.6 @ 1325
Reverse Current to Open	3 to 5 amp
Regulated Voltage	14.2 to 14.4
Regulated Current	36 amp max

BATTERY	232-258-304 Engines	Optional	Optional
Make	Prestolite	Prestolite	Prestolite
Rating	50 amp hr	60 amp hr	70 amp hr
Total No. of Plates	54	66	66
Catalog Number	2480X	2488X	2495X

STARTER MOTOR

Brush Length	0.50 inch
Wear Limit	0.25 inch
Brush Spring Tension	40 oz
Free Speed (No Load Test)	
Volts	12.0
Amperes	65
RPM	9250 max
Lock Test — pounds (max)	
600 Amperes @ 3.4 Volts	13 foot-pounds min
Minimum Voltage to Seat Pole Shoe and Complete Pinion Engagement	7.2 volts
Contact Point Clearance	0.020 - 0.100 inch (0.060 desired)

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STARTER MOTOR

TORQUE SPECIFICATIONS:

Starter to Engine Bolt	30-35 foot-pounds
Starter to Bell Housing	15-20 foot-pounds
Starter Relay Terminal Nuts	50-60 inch-pounds
Starter Motor Through Bolts	55-75 inch-pounds

FUSE CHART

	CJ MODELS	CHEROKEE-WAGONEER-TRUCK
Air Conditioner	—	25 amp*
Backup Lights	9 amp	10 amp
Brake Failure	9 amp	—
Cigar Lighter	14 amp	20 amp
Cluster Feed	—	3 amp**
Control Panel (Lights, Wiper-Washer, Heater) (Circuit Breaker on CJ)	25 amp	3 amp
Directional Signal	9 amp	9 amp
Electric Tailgate Window	—	(2) Circuit Breaker (30 amp)
Hazard (4-Way Flasher)	14 amp	15 amp
Headlights Circuit Breaker	25 amp	25 amp
Heater	15 amp	25 amp
Horn	—	—
Parking Brake Warning and Brake Failure	—	3 amp**
Radio	—	5 amp (In Line)
Windshield Wiper-Washer	Circuit Breaker (6)	10 amp

*One fuse for Wagoneer and Truck air conditioner and heater

**One fuse for Wagoneer and Truck parking brake and brake failure light and the cluster feed

BULB CHART

	CJ MODELS	CHEROKEE-WAGONEER-TRUCK
FRONT LAMPS:		
Headlamp	6014	6014
Marker and Reflector	194	194
Parking and Directional	1157 NA	1157
REAR LAMPS:		
Backup Lamp	1156	1156
License Lamp	1155	1155
Marker and Reflector	194	194
Stop, Tail and Directional	1157	1157
INDICATOR LAMPS:		
Brake Failure	57	158
Charge or Amp Warning	53	—
Directional Signals	53	158
High Beam	53	158
Oil Pressure Warning	53	—
Parking Brake Warning	—	158
Quadra-Trac Lockout	—	158
VEHICLE INTERIOR:		
Ammeter, Direct-Read	57	158
Clock	—	1816
Column Light (Auto. Trans.)	—	1816
Courtesy	—	89

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Directional Signal Flasher	144	144
Dome	—	212
Glove Box	—	1891
Hazard Warning	170	170
Heater Controls	57	1815
Instrument Cluster	57	158
Oil Pressure Gauge, Direct-Read	57	158
Radio	—	1893

TORQUE SPECIFICATIONS

All torques given in foot-pounds unless otherwise noted.

Alternator Mounting Bracket Bolt to Engine	25-30
Alternator Pivot Bolt or Nut	25-30
Battery Hold-Down Bolt	60-70 inch-pounds
Belt, Fan (Alternator)	New — 125-155
	Used — 90-115
Directional Signal Switch	
Handle	20-30 inch-pounds
Screw	10-15
Hazard Warning Knob	
Mounting Screws	2-5 inch-pounds
Horn Bracket Screw	10-15
Speedometer Cable to TCS Switch	120-130 inch-pounds
Spark Plug	25-30
Starter Motor to Bell Housing	15-20
Starter Solenoid Terminal Nuts (5/16 Stud Nut)	50-60 inch-pounds
Steering Wheel Nut	
CJ Models	32-38
Cherokee, Wagoneer, and Truck	35-36

Fig. 3—101 Tools

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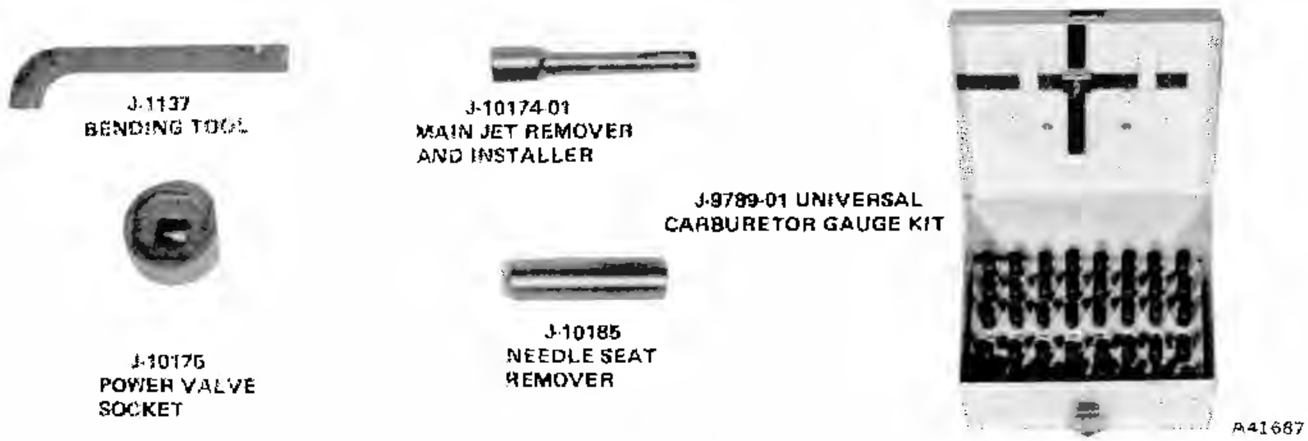

Fig. 4-77 Carburetor Tools

EXHAUST SYSTEM

GENERAL

Exhaust systems used with V-8 engines now use larger diameter exhaust and tailpipes and a new muffler to provide more efficient power with minimum noise level (fig. 4-80,-81). New exhaust pipe brackets and a new steel-reinforced manifold-to-exhaust pipe seal ("donut" gasket) added to these system do not substantially affect servicing operations.

When replacing exhaust manifold seals and gaskets on models equipped with V-8 engines, unfasten the cross-pipe at the manifolds, disconnect the exhaust pipe brackets, and move the entire exhaust system to the rear. Refer to figures 4-78, -79, -80, and -81 for exhaust system components.

If the exhaust pipe-to-manifold studs are removed with the attaching nuts, the front pipe bracket may be removed to obtain clearance for removal of the exhaust manifold gasket.

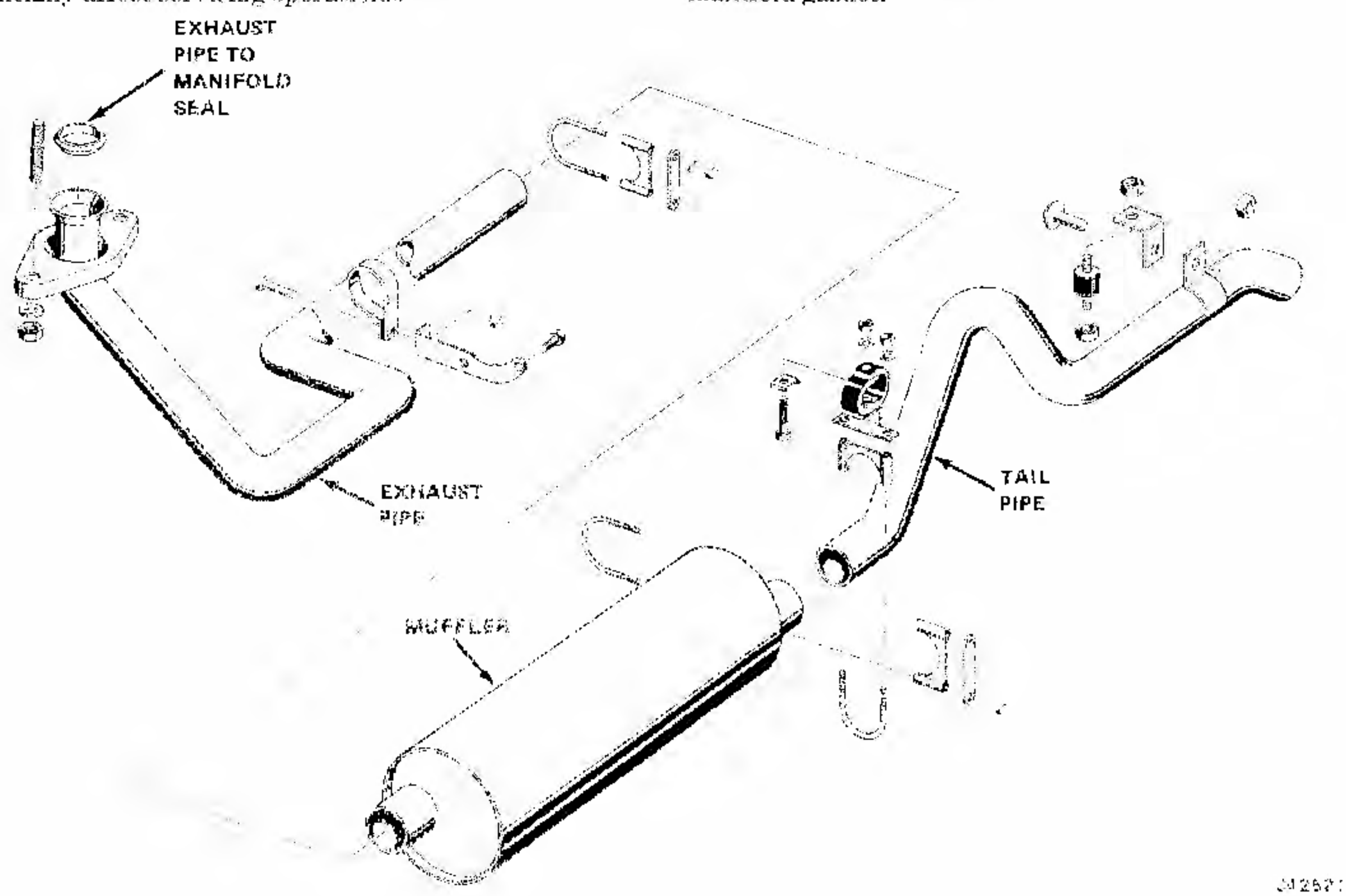

Fig. 4-78 Exhaust System - Wagoneer, Cherokee, Truck - 6 Cylinder Engine

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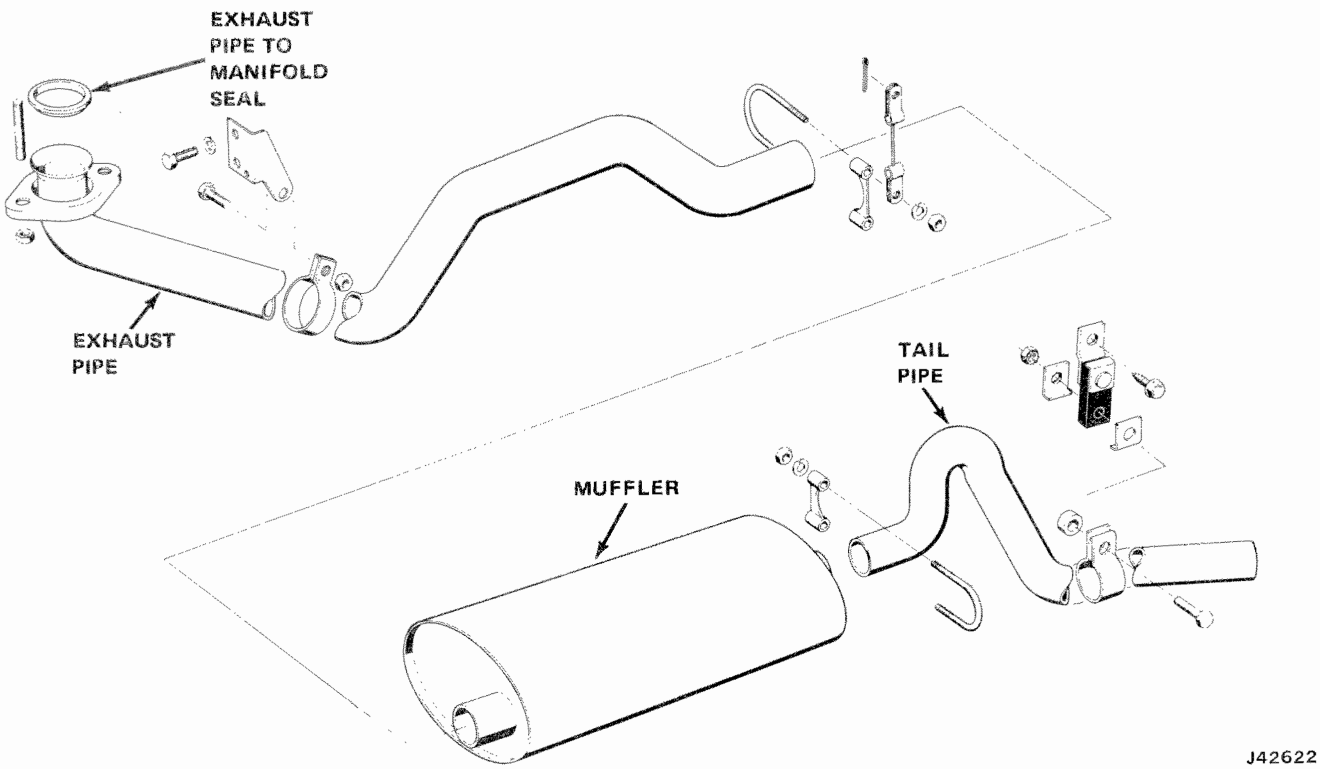

Fig. 4-79 Exhaust System -CJ-5/CJ-6 Six-Cylinder Engine

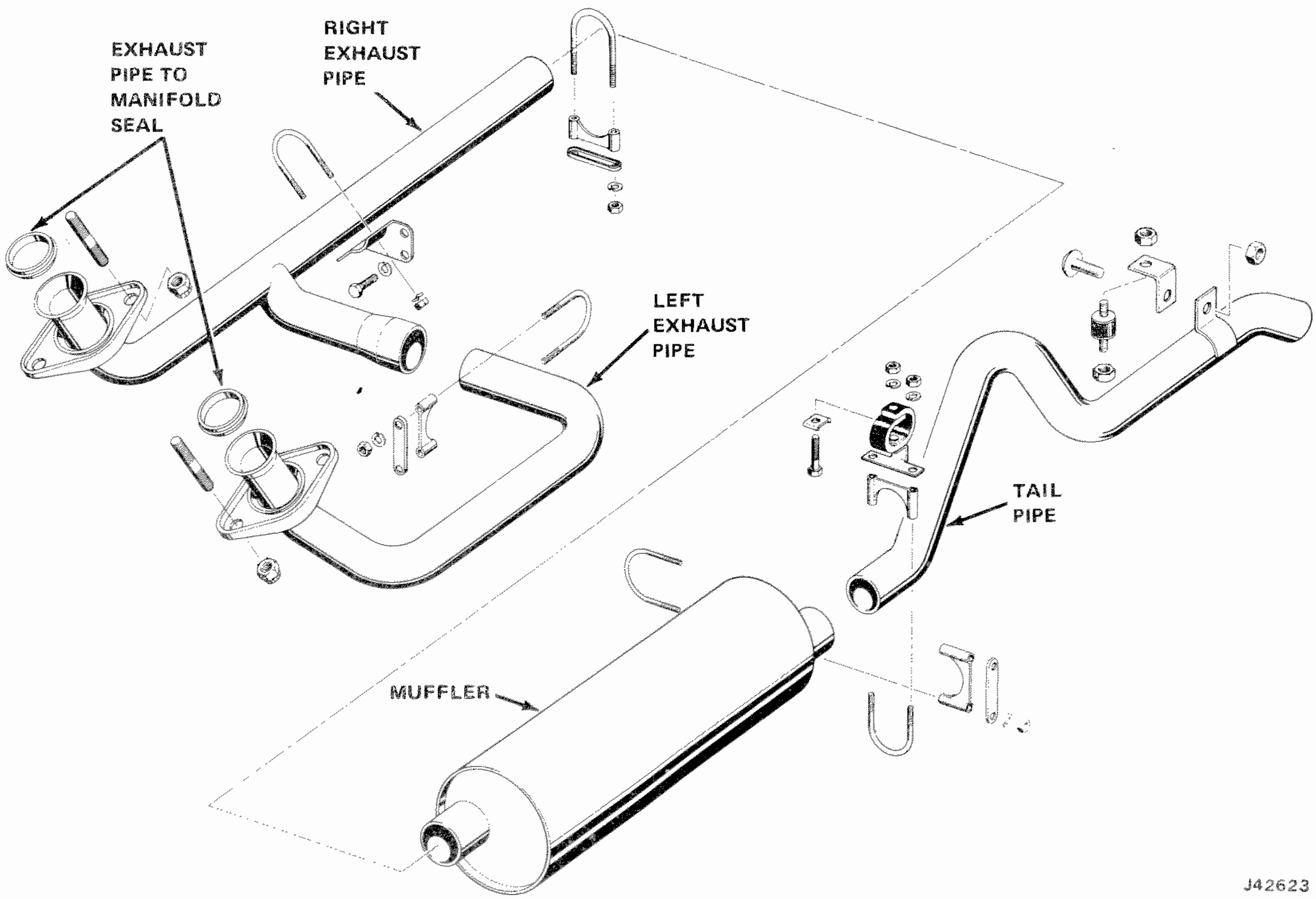

Fig. 4-80 Exhaust System—Wagoneer, Cherokee, Truck—V-8 Engine

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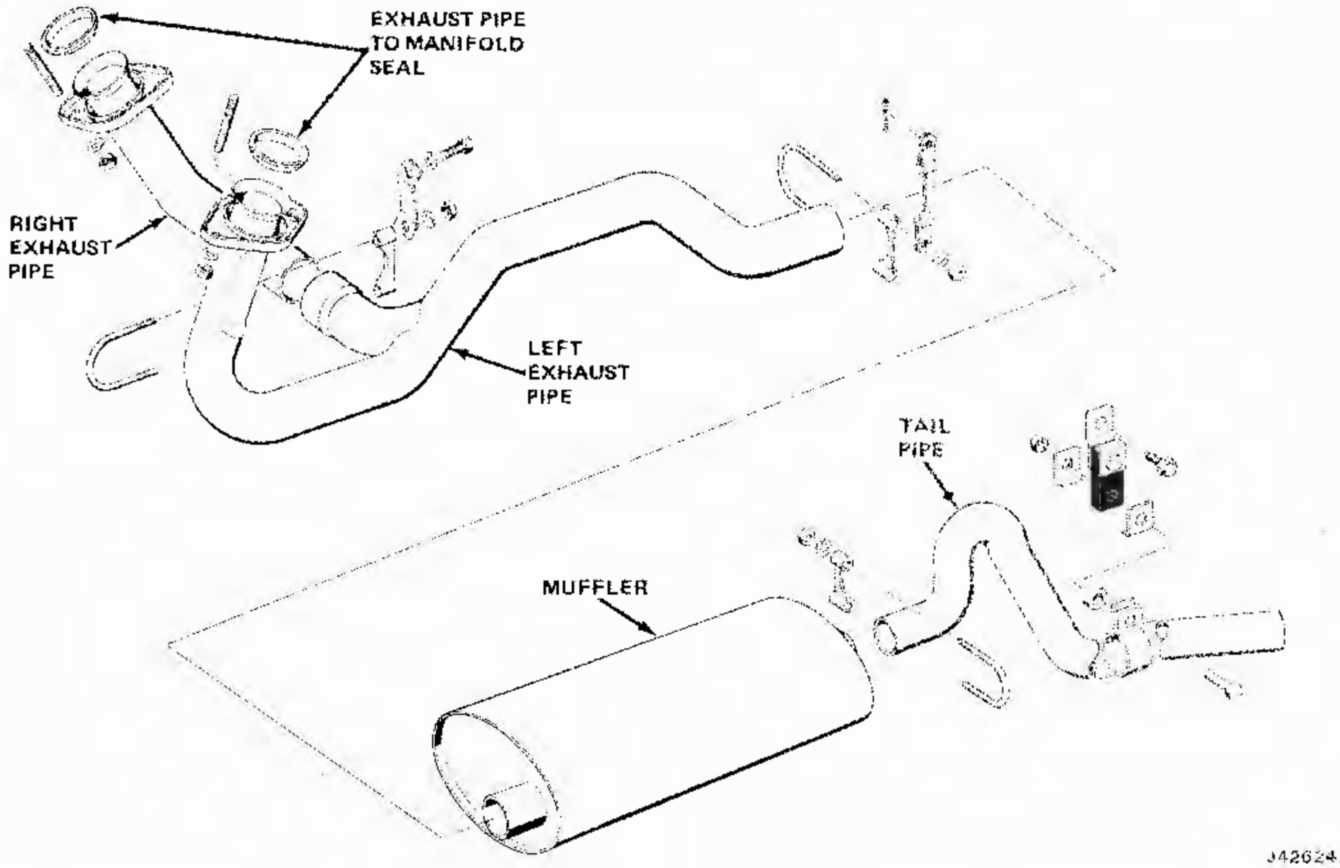

Fig. 4-81 Exhaust System — CJ-5/CJ-6—V-8 Engine

EXHAUST MANIFOLD HEAT VALVE

Six-Cylinder Engine

A thermostatically controlled heat valve in the exhaust manifold directs exhaust heat to the floor of the intake manifold for rapid fuel vaporation during engine warmup. The valve is closed, directing exhaust heat to the intake manifold, when the counterweight is in the extreme counterclockwise position when viewed from the counterweight end (fig. 4-82, -83). As the engine reaches operating temperature, the thermostatic spring heats up and loses tension, allowing the counterweight to open the valve.

The manifold heat valve must operate freely and should be checked and lubricated every 5,000 miles with American Motors Heat Valve Lubricant or equivalent.

Replacement

(1) Separate intake and exhaust manifold.

(2) Remove manifold heat valve assembly by cutting heat valve shaft on both sides of valve.

(3) Lift valve from manifold and drive out remaining shaft sections and bushings.

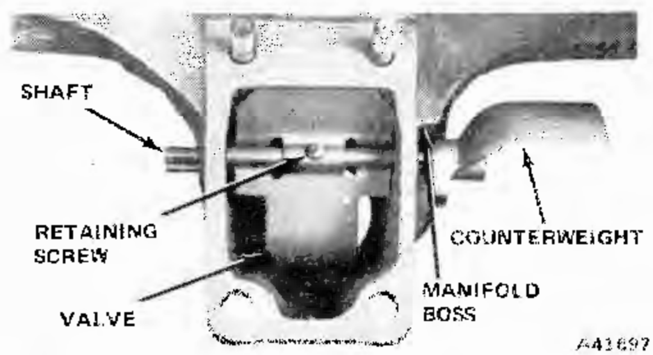

Fig. 4-82 Heat Valve in Open Position

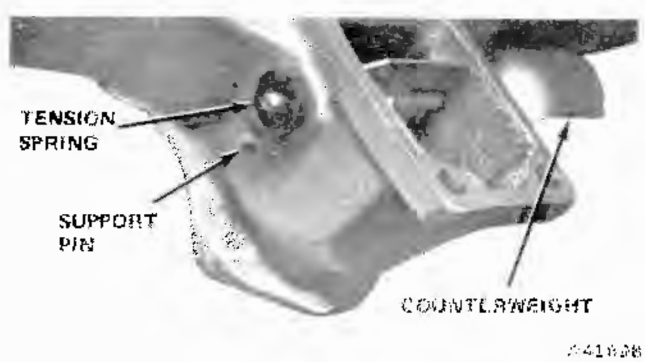

Fig. 4-83 Heat Valve in Closed Position

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(4) Install new bushings using heat valve shaft as a guide pin.

(5) Ream out new bushings with a 5/16-inch drill bit to remove all burrs.

(6) Position heat valve as shown in figure 4-82 and install shaft and counterweight assembly. Rotate counterweight until spring stop contacts bottom of manifold boss.

(7) Align hole in valve with screw threads in shaft and install but do not tighten retaining screw.

(8) Close heat valve and install tension spring with hook end up and pointing away from manifold. Hook spring under support pin as shown in figure 4-83.

(9) Operate heat valve several times to allow shaft to center. Hold shaft and move valve as far as possible from counterweight. Tighten retaining screw.

(10) Check operation of valve.

(11) Install intake and exhaust manifolds.

Eight-Cylinder Engine

A thermostatically controlled heat valve mounted between the right exhaust manifold and exhaust pipe directs exhaust heat to the intake manifold for rapid fuel vaporation during engine warmup. The valve is closed, directing exhaust heat through the intake manifold crossover passage when the counterweight is in the extreme downward position (fig. 4-84). The exhaust heat crosses through the intake manifold and discharges into the left exhaust manifold until the engine reaches operating temperature. At this time the thermostatic spring loses its tension, opens the valve, and allows exhaust heat to discharge through the right exhaust pipe.

The manifold heat valve must operate freely and should be checked and lubricated every 5,000 miles with American Motors Heat Valve Lubricant or equivalent.

Replacement

(1) Disconnect and lower exhaust pipe(s).

(2) Replace the manifold heat valve and gaskets.

(3) Replace exhaust pipe gaskets.

(4) Position exhaust pipe(s) and connect to exhaust manifold.

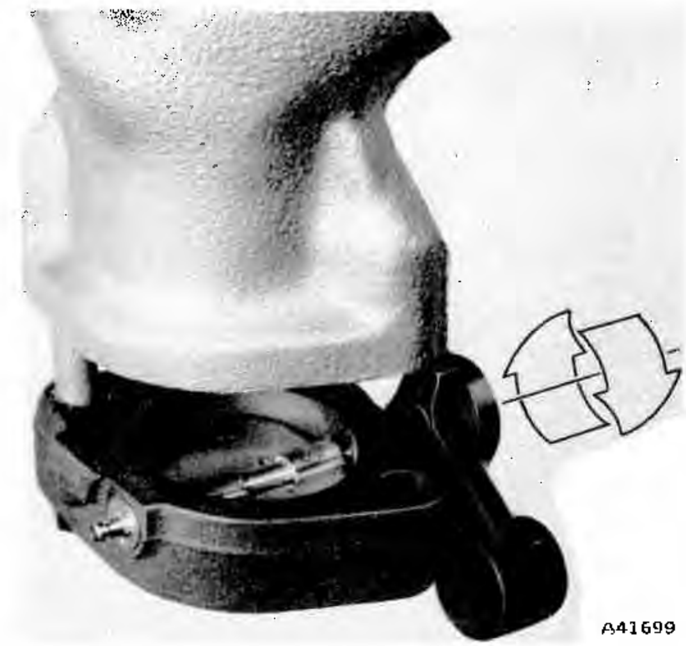

Fig. 4-84 Exhaust Manifold Heat Valve — V-8

TORQUE SPECIFICATIONS

Service Set-To torques should be used when assembling components. Service In-Use recheck torques should be used for checking a pretorqued item.

	Service Set-To Torque	Service In-Use Recheck Torque
Carburetor Holddown Nuts	14	12-15
Exhaust Manifold Bolts — V-8	25	20-30
Exhaust-Pipe-to-Manifold Nuts	23	18-28
Intake and Exhaust Manifold Bolts and Nuts—6 Cyl	23	18-28
Intake Manifold Bolts—V-8	43	37-47
Fuel Pump Screw	16	13-19
Air Cleaner Stud (2100 Carb.)	10	7-12
Air Pump Mounting Bolts	20	15-22
Air Injection Tubes — V-8	38	30-45
6 Cyl	15	10-18

All torque values given in Foot-Pounds with dry fits unless otherwise specified.

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DRILL SIZES

Letter Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches	Wire Gage Sizes	Drill Diam. Inches
Z	0.413	1	0.2280	28	0.1405	55	0.0520
Y	0.404	2	0.2210	29	0.1360	56	0.0465
X	0.397	3	0.2130	30	0.1285	57	0.0430
W	0.386	4	0.2090	31	0.1200	58	0.0420
V	0.377	5	0.2055	32	0.1160	59	0.0410
U	0.368	6	0.2040	33	0.1130	60	0.0400
T	0.358	7	0.2010	34	0.1110	61	0.0390
S	0.348	8	0.1990	35	0.1100	62	0.0380
R	0.339	9	0.1960	36	0.1065	63	0.0370
Q	0.332	10	0.1935	37	0.1040	64	0.0360
P	0.323	11	0.1910	38	0.1015	65	0.0350
O	0.316	12	0.1890	39	0.0995	66	0.0330
N	0.302	13	0.1850	40	0.0980	67	0.0320
M	0.295	14	0.1820	41	0.0960	68	0.0310
L	0.290	15	0.1800	42	0.0935	69	0.0292
K	0.281	16	0.1770	43	0.0890	70	0.0280
J	0.277	17	0.1730	44	0.0860	71	0.0260
I	0.272	18	0.1695	45	0.0820	72	0.0250
H	0.266	19	0.1660	46	0.0810	73	0.0240
G	0.261	20	0.1610	47	0.0785	74	0.0225
F	0.257	21	0.1590	48	0.0760	75	0.0210
E	0.250	22	0.1570	49	0.0730	76	0.0200
D	0.246	23	0.1540	50	0.0700	77	0.0180
C	0.242	24	0.1520	51	0.0670	78	0.0160
B	0.238	25	0.1495	52	0.0635	79	0.0145
A	0.234	26	0.1470	53	0.0595	80	0.0135
		27	0.1440	54	0.0550		

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EMISSION CONTROL

GENERAL

Emission control systems are required to meet existing standards for exhaust, crankcase and raw fuel vapor emissions. The systems are designed to control the emission of hydrocarbons, carbon monoxide, and oxides of nitrogen at the levels specified by Federal or California Standards.

For 1974, Nationwide Federal Standards and the standards which apply in the State of California differ. This necessitates a number of differences between emission control systems on vehicles built for sale in California and Nationwide. The following general descriptions of emission control systems apply to Nationwide vehicles. Deviations from Nationwide, which apply to the California vehicles only, will follow the general description.

Emission control system usage varies in relation to engine, transmission, and series aplication. The Emission Control Systems Application Chart (at the end of this section) may be used to determine the current system usage for any particular vehicle.

NOTE: *Engines in heavy-duty trucks are painted red to distinguish them from standard engines. The emission control systems used on these red engines differ from standard engines because of the weight classification of heavy-duty trucks.*

This section outlines service procedures for all Jeep Emission Control Systems. In addition, tuneup specifications and procedures as prescribed by the U. S. Emission Control Services Maintenance Chart are also included.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
ROUGH IDLE OR STALLING	(1) Improper idle mixture adjustment	(1) Adjust idle mixture
	(2) Damaged tip on idle mixture screws	(2) Replace mixture screw
	(3) Clogged air bleed or idle passages	(3) Clean passages
	(4) Vacuum leak	(4) Check manifold vacuum and repair as necessary
	(5) Improper fuel level	(5) Adjust fuel level
	(6) Restricted air cleaner	(6) Clean or replace air cleaner
	(7) Improper choke setting	(7) Adjust choke
	(8) Choke binding	(8) Locate and eliminate binding condition
	(9) Exhaust manifold heat valve inoperative	(9) Lubricate or replace heat valve as necessary
	(10) Secondary throttle valves not closing (4300 Model, 4V carburetor)	(10) Locate and eliminate binding condition

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
ROUGH IDLE OR STALLING (Continued)	(11) Improper fast idle cam adjustment	(11) Adjust
	(12) Faulty ignition points	(12) Adjust or replace points
	(13) Faulty distributor rotor	(13) Replace rotor
	(14) Leaking engine valves	(14) Check compression and repair as necessary
	(15) Incorrect ignition wiring	(15) Check wiring and correct as necessary
	(16) Faulty coil	(16) Test coil and replace as necessary
	(17) Faulty EGR valve operation	(17) Test EGR system and replace as necessary
	(18) Faulty PCV valve airflow	(18) Test PCV valve and replace as necessary
	(19) Faulty TAC unit	(19) Repair as necessary
FAULTY LOW-SPEED OPERATION	(1) Clogged idle transfer slots	(1) Clean transfer slots
	(2) Restricted idle air bleeds and passages	(2) Clean air bleeds and passages
	(3) Restricted air cleaner	(3) Clean or replace air cleaner
	(4) Improper fuel level	(4) Adjust fuel level
	(5) Faulty spark plugs	(5) Clean or replace spark plugs
	(6) Dirty, corroded, or loose secondary circuit connections	(6) Clean or tighten secondary circuit connections
	(7) Faulty ignition cable(s)	(7) Replace ignition cable(s)
	(8) Faulty distributor cap	(8) Replace cap
	(9) Incorrect ignition point gap	(9) Adjust gap
FAULTY ACCELERATION	(1) Improper pump stroke	(1) Adjust
	(2) Inoperative pump discharge check ball or needle	(2) Clean or replace as necessary
	(3) Worn or damaged pump diaphragm or piston	(3) Replace diaphragm or piston
	(4) Leaking main body cover gasket	(4) Replace gasket
	(5) Engine cold and choke too lean	(5) Adjust choke
	(6) Improper metering rod adjustment (YF Model carburetor)	(6) Adjust metering rod
	(7) Faulty spark plug(s)	(7) Clean or replace spark plug(s)
	(8) Incorrect ignition timing	(8) Adjust timing
	(9) Leaking engine valves	(9) Check compression, repair as necessary
	(10) Faulty coil	(10) Test coil and replace as necessary

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
FAULTY HIGH SPEED OPERATION	(1) Low fuel pump volume	(1) Replace fuel pump
	(2) Clogged vacuum passages	(2) Clean passages
	(3) Improper size or obstructed main jets	(3) Clean or replace as necessary
	(4) Faulty choke operation	(4) Adjust choke
	(5) Clogged secondary metering passages (4300 4V carburetor)	(5) Clean passages
	(6) Restricted air cleaner	(6) Clean or replace as necessary
	(7) Secondary linkage, throttle valves, or shaft binding (4300 4V carburetor)	(7) Locate and eliminate binding condition
	(8) Partially restricted exhaust manifold, exhaust pipe, muffler, or tailpipe	(8) Eliminate restriction
	(9) Auxiliary inlet valve not adjusted properly	(9) Adjust inlet valve
	(10) Improper spark plug gap	(10) Adjust gap
	(11) Worn distributor shaft	(11) Replace shaft
	(12) Faulty distributor rotor	(12) Replace rotor
	(13) Faulty coil	(13) Test coil and replace as necessary
	(14) Incorrect ignition timing	(14) Adjust timing
	(15) Excessive ignition point gap	(15) Adjust point gap
	(16) Breaker arm binding	(16) Replace ignition point assembly
	(17) Improper breaker arm tension	(17) Test breaker arm tension and replace as necessary
	(18) Leaking engine valve(s)	(18) Check compression and repair as necessary
	(19) Faulty valve spring(s)	(19) Inspect and test valve spring tension and replace as necessary
	(20) Faulty distributor centrifugal advance	(20) Check centrifugal advance and repair as necessary
	(21) Faulty distributor vacuum advance	(21) Check vacuum advance and repair as necessary
	(22) Incorrect valve timing	(22) Check valve timing and repair as necessary
	(23) Intake manifold restricted	(23) Pass chain through passages
	(24) Defective TCS system	(24) Test TCS system; repair as necessary
MISFIRE AT ALL SPEEDS	(1) Faulty spark plug(s)	(1) Clean or replace spark plug(s)
	(2) Faulty spark plug cable(s)	(2) Replace as necessary

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
MISFIRE AT ALL SPEEDS (Continued)	(3) Incorrect ignition point gap	(3) Adjust point gap
	(4) Faulty condenser	(4) Replace condenser
	(5) Faulty distributor cap or rotor	(5) Replace cap or rotor
	(6) Faulty coil	(6) Test coil and replace as necessary
	(7) Primary circuit shorted or open intermittently	(7) Trace primary circuit and repair as necessary
	(8) Leaking engine valve(s)	(8) Check compression and repair as necessary
	(9) Faulty hydraulic tappet(s)	(9) Clean or replace tappet(s)
	(10) Faulty valve spring(s)	(10) Inspect and test valve spring tension, repair as necessary
	(11) Worn lobes on camshaft	(11) Replace camshaft
	(12) Vacuum leak	(12) Check manifold vacuum and repair as necessary
	(13) Improper carburetor settings	(13) Adjust carburetor
	(14) Fuel pump volume or pressure low	(14) Replace fuel pump
	(15) Blown cylinder head gasket	(15) Replace gasket
	(16) Intake or exhaust manifold passage(s) restricted	(16) Pass chain through passages
POWER NOT UP TO NORMAL	(1) Incorrect ignition timing	(1) Adjust timing
	(2) Faulty distributor rotor	(2) Replace rotor
	(3) Worn distributor shaft	(3) Replace shaft
	(4) Incorrect spark plug gap	(4) Adjust gap
	(5) Faulty fuel pump	(5) Replace fuel pump
	(6) Incorrect valve timing	(6) Check valve timing and repair as necessary
	(7) Faulty coil	(7) Test coil and replace as necessary
	(8) Faulty ignition	(8) Test cables and replace as necessary
	(9) Leaking engine valves	(9) Check compression and repair as necessary
	(10) Blown cylinder head gasket	(10) Replace gasket
	(11) Leaking piston rings	(11) Check compression and repair as necessary
INTAKE BACKFIRE	(1) Improper ignition timing	(1) Adjust timing
	(2) Improper dwell	(2) Adjust dwell
	(3) Faulty accelerator pump discharge	(3) Repair as necessary
	(4) Improper choke operation	(4) Repair as necessary
	(5) Defective EGR CTO	(5) Replace EGR CTO

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
EXHAUST BACKFIRE	(1) Vacuum leak	(1) Check manifold vacuum and repair as necessary
	(2) Faulty diverter valve	(2) Test diverter valve and replace as necessary
	(3) Faulty choke operation	(3) Repair as necessary
	(4) Exhaust leak	(4) Locate and eliminate leak
PING OR SPARK KNOCK	(1) Incorrect ignition timing	(1) Adjust timing
	(2) Vacuum leak	(2) Check manifold vacuum and repair as necessary
	(3) Excessive combustion chamber deposits	(3) Use combustion chamber cleaner
	(4) Carburetor set too lean	(4) Adjust carburetor
	(5) Distributor centrifugal or vacuum advance malfunction	(5) Check advance and repair as necessary
	(6) Excessively high compression	(6) Check compression and repair as necessary
	(7) Fuel octane rating excessively low	(7) Try alternate fuel source
HARD STARTING (ENGINE CRANKS NORMALLY)	(1) Binding linkage, choke valve or choke piston	(1) Repair as necessary
	(2) Restricted choke vacuum and hot air passages	(2) Clean passages and inspect heat choke tube for leaks
	(3) Improper fuel level	(3) Adjust float level
	(4) Dirty, worn or faulty needle valve and seat	(4) Repair as necessary
	(5) Float sticking	(5) Repair as necessary
	(6) Exhaust manifold heat valve stuck closed (hard hot start only)	(6) Repair as necessary
	(7) Faulty fuel pump	(7) Replace fuel pump
	(8) Incorrect choke bimetal adjustment	(8) Adjust bimetal
	(9) Inadequate unloader adjustment	(9) Adjust unloader
	(10) Faulty ignition coil	(10) Test and replace as necessary
	(11) Wet ignition cables, coil or distributor cap	(11) Repair as necessary
	(12) Improper spark plug gap	(12) Adjust gap

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
HARD STARTING (ENGINE CRANKS NORMALLY)(Continued)	(13) Incorrect initial timing.	(13) Adjust timing.
	(14) Incorrect valve timing.	(14) Check valve timing; repair as necessary.
	(15) Carburetor percolation (hot)	(15) Repair as necessary.
	(16) Improper dwell	(16) Adjust dwell.
	(17) Improper fast idle speed	(17) Adjust fast idle
SURGING (CRUISING SPEEDS TO TOP SPEEDS)	(1) Clogged main jet(s)	(1) Clean main jet(s)
	(2) Undersize main jet(s)	(2) Replace main jet(s)
	(3) Low fuel level	(3) Adjust fuel level
	(4) Low fuel pump pressure or volume	(4) Replace fuel pump
	(5) Blocked air bleeds	(5) Clean air bleeds
	(6) Clogged fuel filter screen	(6) Replace fuel filter
	(7) Restricted air cleaner	(7) Clean or replace air cleaner
	(8) Metering rod not adjusted properly (YF Model Carburetor)	(8) Adjust metering rod
	(9) Improper PCV valve air flow	(9) Test PCV valve and replace as necessary
	(10) Vacuum leak	(10) Check manifold vacuum and repair as necessary

AIR GUARD SYSTEM

GENERAL

This system incorporates a belt driven air pump, diverter (bypass) valve, air injection manifold(s), air injection tubes, and connecting hoses (fig. 4A-1 and 4A-2).

Air is discharged from the air pump to the diverter valve where it is directed to the air distribution manifold(s) or dumped through a bypass port depending on engine operation conditions. The system air pressure is regulated at approximately five psi by a relief valve which is incorporated in the diverter valve. The air is routed through the air injection manifold tubing to injection tubes and then introduced to the engine exhaust ports. As the air is discharged from the injection tubes, it mixes with the hot unburned gases entering the exhaust ports during the exhaust stroke. This results in further burning of the combustion mixture and reduces hydrocarbon and carbon monoxide emission to the atmosphere.

AIR PUMP

The air pump used for V-8 and six-cylinder engines is the same. The major components of the air pump are enclosed in a die-cast aluminum housing. A filter fan assembly, rotor shaft and drive hub are visible on the pump exterior (fig. 4A-3).

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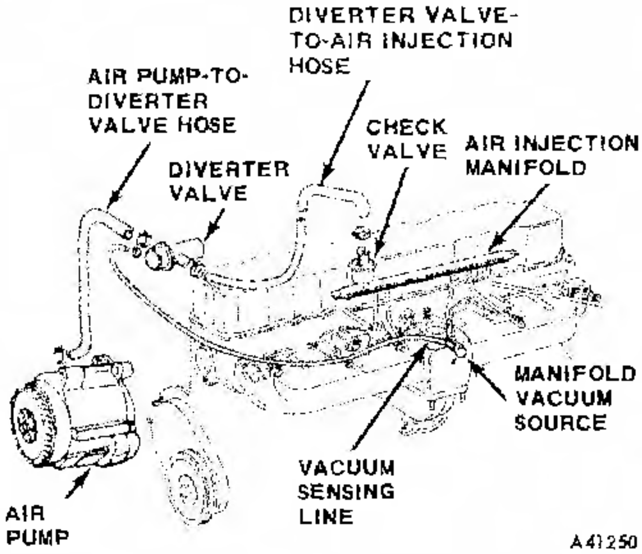

Fig. 4A-1 Air Guard System - Six-Cylinder

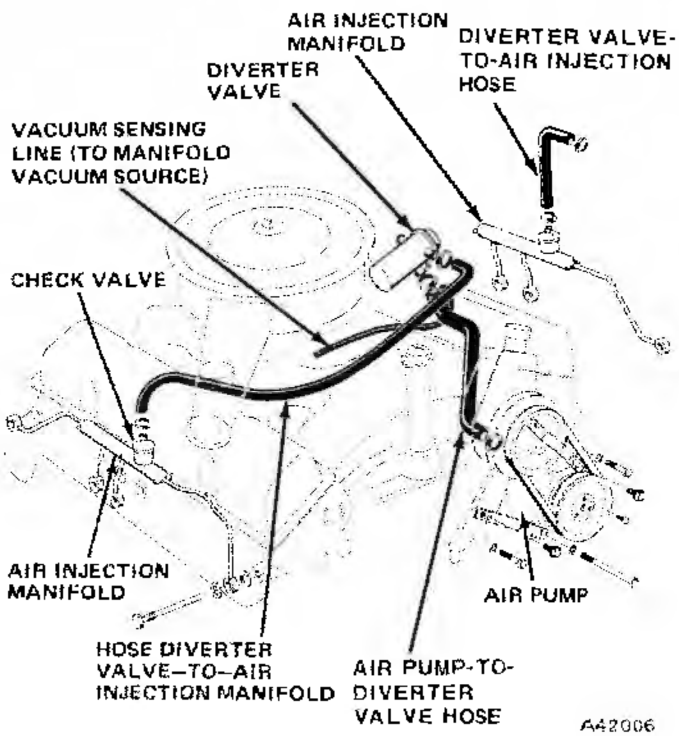

Fig. 4A-2 Air Guard System - V-8

The pump is designed to be relatively service free. The only serviceable item is the filter fan assembly. It is not recommended that the rear housing cover be removed for any reason, since the internal components of the pump are not serviceable.

The aluminum housing has cavities for air intake, compression, and exhaust and a bore for mounting the front bearing. The housing also includes cast metering areas that reduce the noise of intake and compression. Mounting bosses are located on the housing exterior.

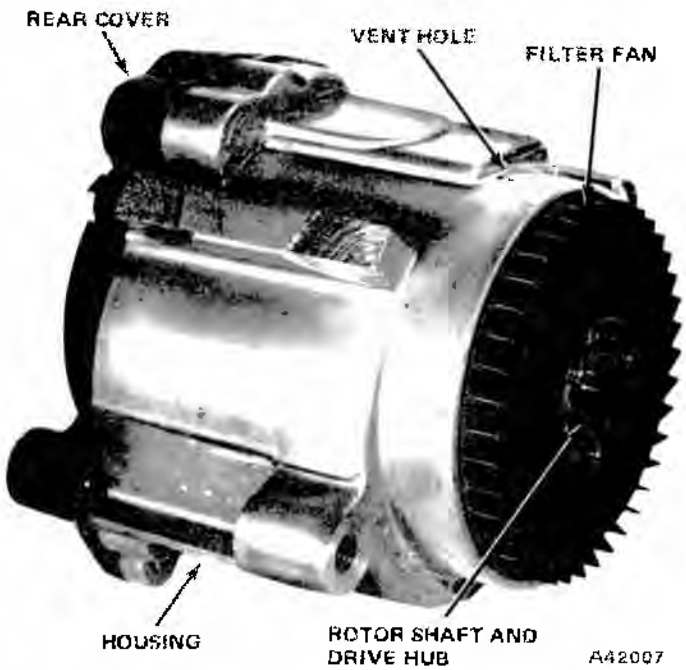

Fig. 4A-3 Air Pump

NOTE: *The relief valve assembly is incorporated in the diverter valve. If defective, the diverter valve assembly must be replaced.*

The front bearing supports the rotor shaft; the bearing is secured in position by plastic, injected around grooves in the housing and bearing outer race.

The rear cover supports the vane pivot pin, rear bearing inner race, and exhaust tube. Dowel pins pressed into the housing correctly position the end cover which is fastened by four bolts.

The rotor positions and drives the two vanes. A stamped steel liner supports carbon shoes and shoe springs which seal the vanes and rotor. The two plastic vanes are molded to hubs which support bearings that rotate on the pivot pin. The pulley drive hub is pressed on the rotor shaft, and bolt holes in the hub provide for attachment of a pulley.

The pump vanes are located 180 degrees apart and rotate around the pivot pin which is located on the centerline of the pump housing. The rotor which drives the vanes rotates off the centerline of the pump housing (fig. 4A-4). This creates changes in the distance between the outside of the rotor and the inner wall of the pump housings during rotor rotation. As the leading vane moves past the intake opening, it is moving from a small area to a large area (defined by the rotor-to-pump housing clearance). This forms a vacuum which draws air into the pump. As the vanes and rotor continue to rotate, the trailing vane passes the intake and traps the air between the vanes. The vanes and rotor move into small area and the entrapped air begins to be compressed. The compression con-

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tinues until the leading vane passes the exhaust opening where the compressed air passes out of the pump and on to the rest of the Air Guard System.

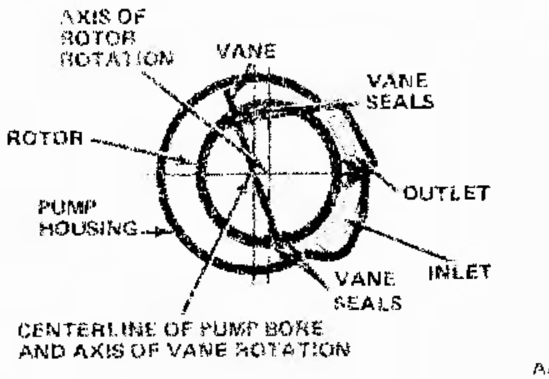

Fig. 4A-4 Air Pump Operation

Removal - Six-Cylinder

(1) Disconnect air pump output hose at back of air pump.

(2) Loosen adjustment bolt and remove drive belt.

(3) Remove front mount bracket-to-engine attaching bolts.

(4) Remove rear mount bracket-to-pump attaching bolts.

(5) Loosen rear mount bracket-to-power steering attaching bolts.

(6) Pull pump down and forward to remove.

Installation - Six-Cylinder

(1) Position pump and install rear mount bracket-to-pump attaching bolts.

(2) Install front mount bracket-to-engine attaching bolts.

(3) Tighten attaching bolts to specified torque.

(4) Adjust power steering drive belt to specified tension.

(5) Connect air pump output hose to back of pump.

(6) Adjust air pump drive belt to specified tension (hand tighten).

Removal - V-8

(1) Disconnect air pump output hose at pump.

(2) Loosen mount bracket-to-pump attaching screws and remove drive belt.

(3) Remove mount bracket-to-pump attaching bolts.

(4) Remove pump.

Installation - V-8

(1) Position pump at mounting location and install mount bracket-to-pump attaching bolts (do not tighten).

(2) Install drive belt and adjust to the specified tension.

(3) Tighten mounting bolts and adjusting strap screw to 20 foot-pounds torque.

NOTE: *If air pump is driven by the air conditioning belt, adjust the belt to the tension specified for the air conditioning belt. Pry only against the cast iron cover when adjusting the belt. Do not pry on the aluminum housing. For all other air pump applications, adjust the belt tension by hand only.*

Fan Replacement

Pry outer disc loose and remove remaining portion as illustrated in figure 4A-5.

NOTE: *It is almost impossible to remove the fan without destroying it. Be careful to prevent fragments from entering the air intake hole. Do not attempt to remove the metal drive hub.*

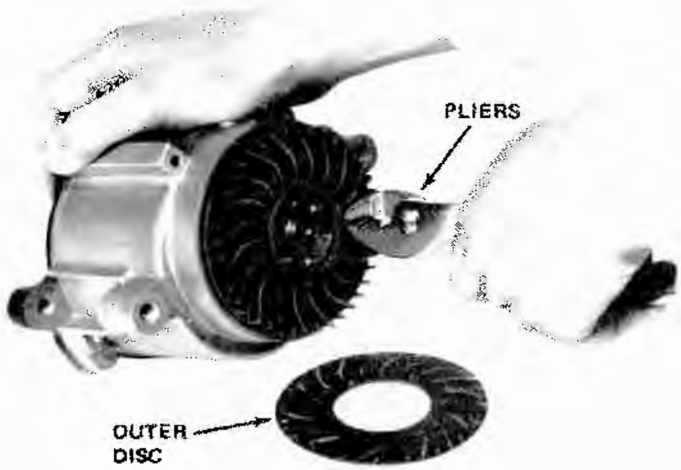

Fig. 4A-5 Centrifugal Filter Fan Removal

Install new filter fan into position by using pulley and bolts as tools.

Draw fan down evenly by alternately torquing bolts. Be sure that outer edge of fan slips into housing. A slight amount of interference with housing bore is normal.

NOTE: *Do not attempt to install a fan by hammering or pressing it on.*

After a new fan is installed, it may squeal upon initial operation until its outside diameter lip has worn in. This may require 20 to 30 miles of operation.

Exhaust Tube Replacement

Grasp exhaust tube in a vise or with suitable pliers and pull out with a twisting motion.

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NOTE: *Do not clamp the pump body in a vise.*

Support pump as shown in figure 4A-6.

Insert new exhaust tube into hole and tap into place using a block of wood until approximately 7/8 inch of tube extends above the cover.

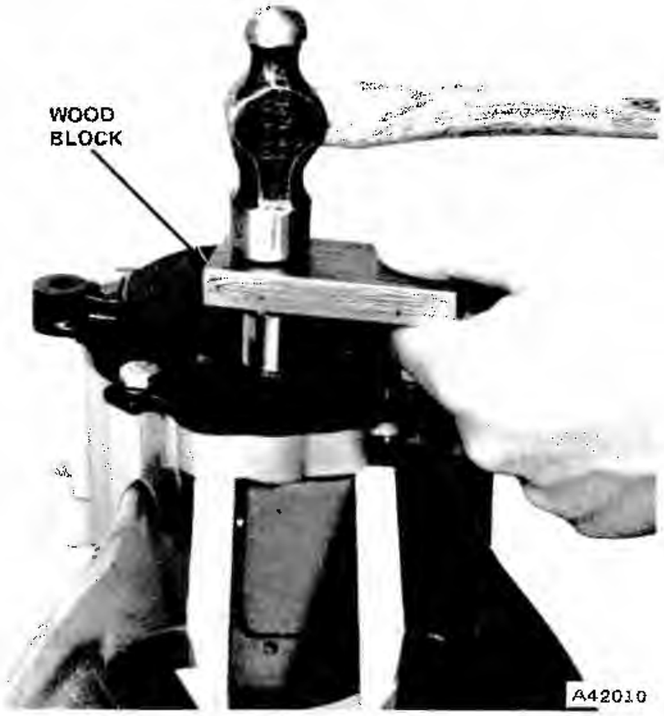

Fig. 4A-6 Exhaust Tube Installation

Air Pump Diagnosis

The air pump is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. Allow for normal break-in wear of the pump prior to replacement for excessive noise.

First check the drive belt tension and tighten as specified. Do not pry on the aluminum housing. Check hoses to be sure they are properly connected and are in good condition. Check that the pump mounting bracket is securely fastened.

Air pump noise can be confused with other engine noise. Remove the drive belt and check the pump to be sure it is operative. A seized pump will not rotate and noise could be caused by the belt slipping.

A chirping or squeaking noise is most likely associated with the vane rubbing in the housing bore and is noticeable at low speed and is heard intermittently. Frequently, vane chirping may be eliminated by increasing pump speed, or allowing the vanes additional wear-in time.

Bearing noise is easily distinguished from vane chirping. Bearing noise is a rolling sound and is noticeable at all speeds. This sound does not necessarily indicate bearing failure. If bearing noise increases to an objectionable level at certain speeds, the pump may have to be replaced.

Failure of a rear bearing is identified by a continuous knocking noise and replacement of the pump is required.

If it is determined that the air pump is not delivering air (determine presence of airflow by removing an exhaust hose), the pump must be replaced.

NOTE: *The pump is equipped with a centrifugal fan-type air filter, located behind the drive pulley. In the event that the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the filter should be masked off to prevent liquids from entering the pump.*

Service Procedures

The following is a list of service precautions to prevent damage to the air pump. **DO NOT:**

- Attempt to prevent pulley from rotating by inserting tools into the centrifugal filter fan.
- Operate engine with pump belt removed or disconnected.
- Attempt to lubricate.
- Clean centrifugal filter.
- Replace filter by driving or hammering in position.
- Remove drive hub when replacing filter.
- Disassemble pump or remove rear cover.
- Exceed 20 foot-pounds torque on mounting bolts.
- Pry on aluminum housing to adjust belt tension.
- Clamp pump in vise.

DIVERTER (BYPASS) VALVE

A diverter valve is used in all Air Guard applications. The valves for V-8 and six-cylinder engines differ only in the number of outlets. The V-8 diverter valve has two outlets and the six-cylinder diverter valve has only one. The valve momentarily diverts air pump output from reaching the exhaust during rapid deceleration and acts as a pressure release when air pump output is excessive. An internal silencer is incorporated in the diverter housing to muffle the airflow.

In a rapid deceleration condition, high intake manifold vacuum is applied to the diaphragm in the diverter. When the vacuum signal is 20 inches of mercury or more, the spring tension of the diaphragm is overcome. This moves the metering valve down against its upper seat and away from its lower seat, forcing air pump output to vent to atmosphere (fig. 4A-7). Air pump output is diverted only momentarily because of a bleed hole in the diaphragm. This hole allows vacuum to quickly equalize on both sides of the diaphragm and the diaphragm spring returns the metering valve to its normal position.

If the air pump develops excessive output pressure, this pressure will overcome the diaphragm spring ten-

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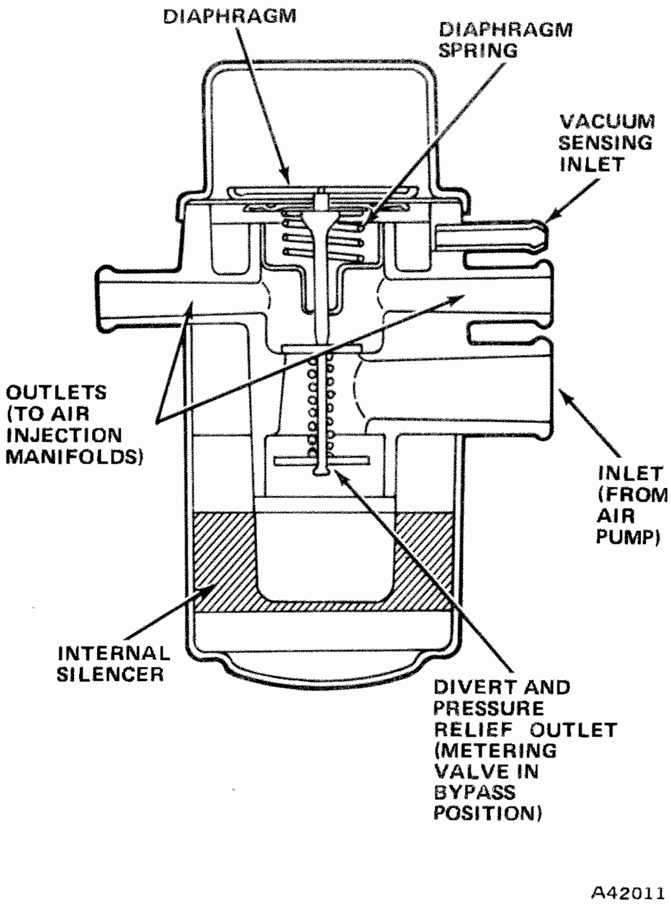

Fig. 4A-7 Diverter Valve (V-8 Shown)

sion, pushing the metering valve down and venting pump output pressure to the atmosphere. When pump output pressure returns to normal, the metering valve will move up and away from the upper seat and against the lower seat, returning to its normal open position, allowing air pump pressure to flow to the exhaust manifold(s).

Diverter Test

(1) Start engine and let idle.

(2) Check diverter vents. Little or no air should flow from vents.

(3) Accelerate engine to 2000 to 3000 rpm and rapidly close throttle. A strong flow of air should pass from the diverter vents. If air does not flow or if backfire occurred, make certain vacuum sensing line has vacuum and is not leaking.

NOTE: *The diverter valve diverts air pump output when 20 inches of Hg or more is applied at vacuum sensing line or pump output exceeds 5 psi.*

(4) Slowly accelerate engine. Between 2500 and 3500 rpm air should begin to flow from diverter vents.

Diverter Replacement

The diverter valve is not serviceable and must be replaced if defective. The valve is suspended by the hoses between the air pump and air injection manifold(s) (fig. 4A-1 and 4A-2). Removal involves disconnecting the hoses and the vacuum sensing line. Installation entails reconnecting the hoses and vacuum line.

AIR INJECTION MANIFOLDS AND TUBES

The air injection manifold(s) are constructed of cold rolled steel with a zinc plating and distributes air from the pump to each of the injection tubes.

A check valve, incorporating a stainless steel spring plunger and an asbestos seat, is integral with the air injection manifold. Its function is to prevent the reverse flow of exhaust gases to the pump should output cease. Reverse flow would damage air pump and connecting hoses.

The air injection tubes project into the exhaust ports, directing air into the vicinity of the exhaust valve seats. The injection tubes, which are made of stainless steel, are inserted through the distribution tubes of the air injection manifold and threaded into the exhaust manifold on V-8 engines. On six-cylinder engines, the injection tubes are inserted into machined bosses of the exhaust manifold. The air injection manifold distribution tubes extend into the injection tubes and are secured to the exhaust manifold by retaining nuts.

Air injection tubes are used for all cylinders except No. 7 on V-8 engines and No. 1 on six-cylinder engines. Two different length injection tubes are used on six-cylinder engines. The shorter tubes are used for No. 3 and No. 4 cylinders.

Removal - Six-Cylinder

NOTE: *Intake and exhaust manifold assembly must be removed to prevent bending or damaging the air distribution manifold during removal.*

(1) Remove intake and exhaust manifold assembly. Refer to Section 1A - Six-Cylinder Engine.

(2) Position manifold in vise and loosen air injection manifold tube retaining nuts at each cylinder exhaust port.

(3) Tap injection tubes lightly and pull away from exhaust manifold.

NOTE: *If tubes are seized, apply heat to the injection tube-to-manifold joint and rotate injection tubes with pliers being careful not to damage tubes.*

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Installation - Six-Cylinder

(1) Position injection tube in exhaust manifold openings.

NOTE: *Two different length injection tubes are used on six-cylinder engines. The shorter length injection tubes must be inserted into cylinders 3 and 4.*

(2) Install intake and exhaust manifold assembly. Refer to Section 1A - Six-Cylinder Engine.

(3) Install air inejction manifold and tighten retaining nuts to 15 foot-pounds torque.

Removal - V-8

(1) Disconnect air delivery hose at check valve.

(2) Loosen injection tubes.

(3) Remove air injection manifold and injection tubes as an assembly.

NOTE: *Some inteference to removal may be encountered due to carbon buildup on the tubes.*

(4) Remove the injection tubes and sealing gaskets from the air injection manifold.

Installation - V-8

(1) Install injection tubes through the air injection manifold openings using a new sealing gasket at either side of each opening.

(2) Assemble air injection manifold and injection tubes to exhaust manifold; tighten the tubes to 38 foot-pounds torque.

(3) Connect air delivery hose.

Check Valve Test

To check the air injection manifold valve for proper operation, disconnect the air supply hose at the injection manifold. With the engine running above idle speed, listen and feel for exhaust leakage at the check valve. A slight leak is normal.

ENGINE MODIFICATIONS

The design of certain engine components is directly related to emission standards. The operation of such items as the camshaft, carburetor, ignition distributor and cylinder head affects the amount of emissions. Therefore, the correct combination of engine components, as prescribed by government certification, must be used in service. Refer to the appropriate sections of this manual for servicing these components.

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

GENERAL

The EGR System consists of a diaphragm-actuated flow control valve (EGR valve), coolant temperature override switch (EGR CTO), and connecting hoses (fig. 4A-8 and 4A-9).

Oxides of nitrogen (NOx) are formed by high heat created during combustion. The purpose of the EGR system is to limit the formation of oxides on nitrogen by diluting the intake charge with a metered amount of exhaust gas, thereby reducing the peak temperatures of the gases in the engine combustion chambers.

Exhaust gas enters the combustion chamber with the intake charge. The exhaust gas introduced is inert, and much cooler than combustion temperature. Since it will not burn, peak combustion temperature is lowered.

EGR VALVE

The EGR valve is mounted on a machined surface at the rear of the intake manifold on V-8 engines and on the side of the intake manifold on six-cylinder engines. Valves used with automatic transmissions are calibrated differently than those used with manual transmissions. Calibration is accomplished by the use of differently shaped pintles (fig. 4A-10).

The valve is held in a normally closed position by a coiled spring located above the diaphragm (fig. 4A-11). A special fitting is provided at the carburetor to route ported (above the throttle plate) vacuum through hose connections to a fitting on the valve which is located above the diaphragm. A passage in the intake manifold directs exhaust gas from the exhaust cross over passage (V-8 engine) or from below the heat riser area (six-cylinder engine) to the EGR valve.

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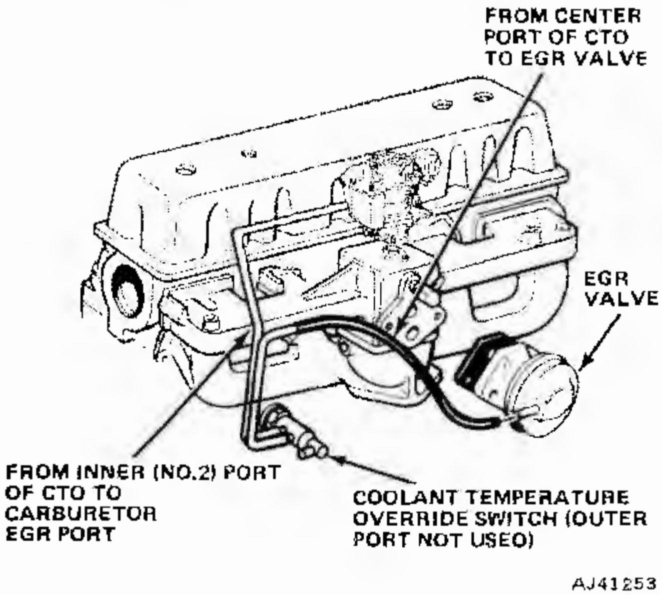

Fig. 4A-8 EGR System - Six-Cylinder

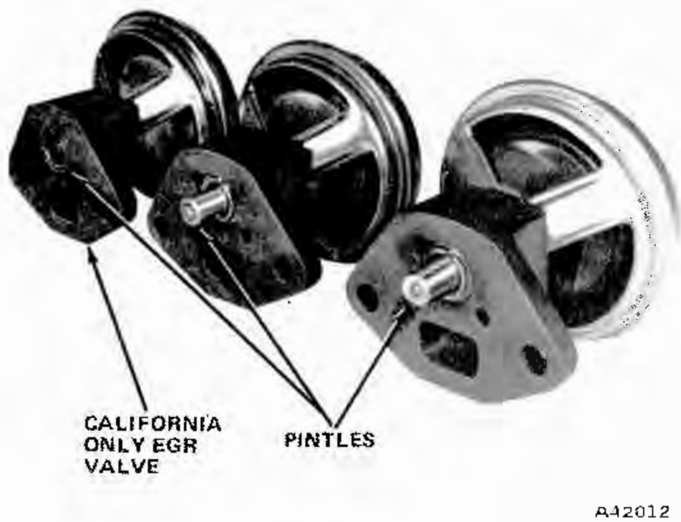

Fig. 4A-10 EGR Valve Pintles

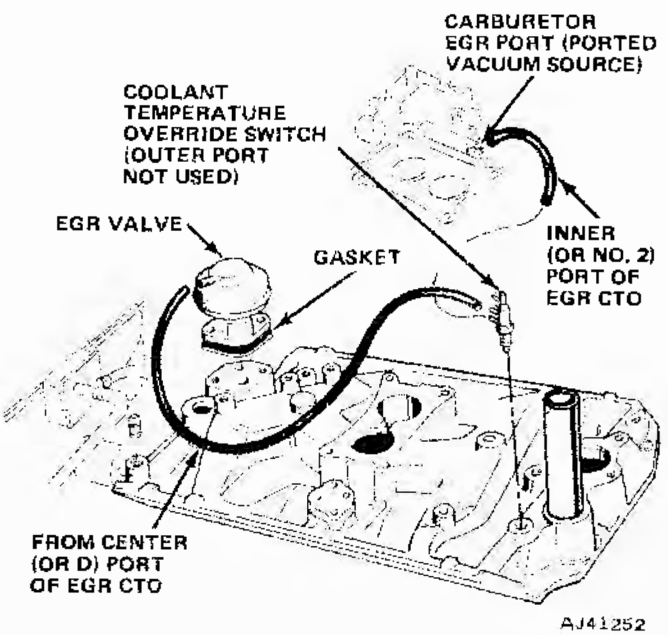

Fig. 4A-9 EGR System - V-8

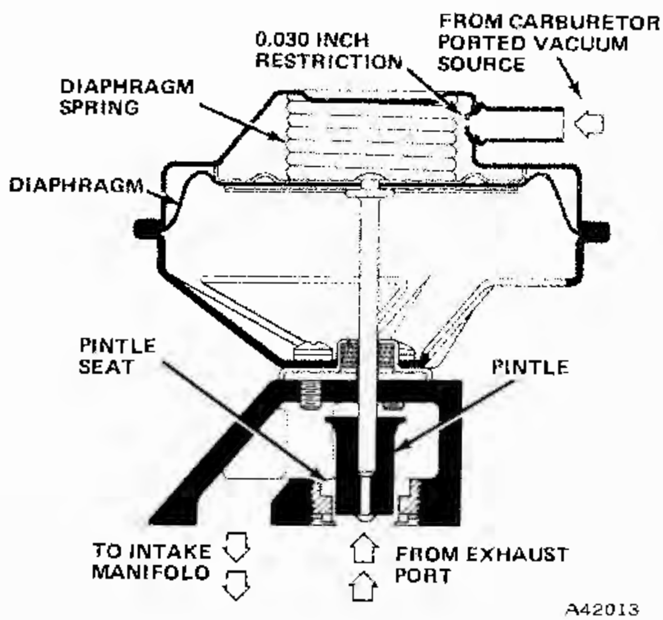

Fig. 4A-11 EGR Valve

When the diaphragm is actuated by vacuum, the pintle is pulled off its seat and exhaust gas is metered through another passage in the intake manifold (V-8 engine) to the floor of the manifold below the carburetor (six-cylinder engine) or to the sidewall of the manifold below the carburetor.

EGR Valve Test

(1) With the engine at operating temperature and running at curb idle speed, manually compress EGR diaphragm, lifting the pintle off its seat. This should cause a sudden drop in engine rpm (approximately 200 rpm) indicating that the EGR valve is closing off the exhaust from the intake passages when no vacuum is applied.

If there is no change in engine rpm but the engine idles properly, the EGR passage to the intake manifold is blocked.

If the engine is idling very poorly, and lifting the pintle off of its seat does not affect idle rpm, there is probably full time EGR caused by the EGR valve sticking open, a defective EGR valve, or a flaw in the intake manifold.

(2) Install a tee in the EGR vacuum signal line near the EGR valve and connect a vacuum gauge to the tee.

(3) Place fingers against the EGR valve diaphragm and slowly accelerate the engine.

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(4) While accelerating engine, notice the amount of vacuum indicated when the EGR valve diaphragm first begins to move. Refer to EGR Valve Vacuum Signal Values.

EGR Valve Vacuum Signal Values

Vendor Part Number (Located on Valve)		AMC Part Number	Vacuum Required (Inches) Open Start	Open (max)
7040176	Nationwide	3219052	2.8 to 3.2	5.3 to 5.7
7030881	& California	3218739	2.8 to 3.2	6.9 to 7.3
17050472	California Only	3223981	1.8 to 2.2	3.8 to 4.2

(5) Continue accelerating engine, until vacuum required to achieve maximum recirculation is obtained. Diaphragm should be deeply depressed with no leakage indicated.

Removal

(1) On V-8 engines, remove air cleaner assembly.
(2) Disconnect vacuum line from EGR valve.
(3) Remove two retaining bolts from manifold.
(4) Remove EGR valve and gasket.
(5) Clean EGR pintle if required.
(6) Clean manifold and EGR valve mating surfaces.

Installation

(1) Install new EGR valve gasket.
(2) Install EGR valve.
(3) Install EGR valve retaining bolts and tighten to 13 foot-pounds torque.
(4) Connect vacuum line to EGR valve.
(5) Install air cleaner assembly, if removed.

EGR Valve Maintenance

Remove all lead or carbon deposits from the stainless steel metering pintle of the valve using a wire brush. After cleaning, cap the vacuum inlet and repeatedly open the EGR valve manually by pressing down on the pintle and releasing. Pintle should remain retracted; if it does not, diaphragm has a leak. If the valve does not return to the fully closed position, it must be replaced.

On six-cylinder engines, lead or carbon deposits will build most rapidly in the exhaust gas discharge passage (upper hole). If the deposits cannot be removed with a spiral type wire brush, a 9/16-inch drill may be used. Coat the tip of the drill with heavy grease and use pliers (Vise-Grip) to rotate the bit in the discharge passage.

EGR CTO SWITCH

The EGR CTO switch is located at the coolant passage of the intake manifold (adjacent to oil filler tube) on V-8 engines or at the left front side of the cylinder block on six-cylinder engines. The outer port (No. 1) of the switch is open and not used. The inner port (No. 2) is connected by a hose to the EGR port at the carburetor. The center port (D) is connected to the EGR valve.

When the coolant temperature is below 115 degrees F, no vacuum signal is applied to the EGR valve; therefore, no exhaust gas will flow through the valve. When the coolant temperature reaches 115 degrees F, both the inner port and center port of the switch are open and a vacuum signal is applied to the EGR valve.

EGR CTO Test

NOTE: *Engine coolant temperature must be below 100 degrees F (C mark of temperature gauge).*

(1) Check vacuum lines for leaks and correct routing (fig. 4A-8 and 4A-9).
(2) Disconnect vacuum line at EGR valve and connect vacuum gauge to line.
(3) Operate engine at approximately 1500 rpm; no vacuum should be indicated on gauge. If vacuum is indicated, replace the EGR CTO switch.
(4) Operate engine until coolant temperature exceeds 115 degrees F (temperature gauge needle halfway between cold mark and beginning of band).
(5) Accelerate engine to 1500 rpm; carburetor ported vacuum should be indicated on vacuum gauge. If not, replace EGR CTO switch.

Removal - Six-Cylinder

(1) Drain coolant from radiator.
(2) Disconnect vacuum lines from EGR CTO switch.
(3) Place drain pan under engine below CTO switch.
(4) Using a 7/8-inch open end wrench, remove switch from block.

WARNING: *Be careful of scalding hot water leaking from the block when removing the switch.*

Installation - Six-Cylinder

(1) Install EGR CTO switch in block.
(2) Connect vacuum lines to switch.
(3) Install coolant.
(4) Purge cooling system of air.

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Removal - V-8 Engine

(1) Drain coolant from radiator.

(2) Remove air cleaner assembly.

(3) Remove coil bracket attaching screw and tip coil away from EGR CTO switch.

(4) Disconnect vacuum lines from CTO switch.

(5) Using a 7/8-inch open end wrench, remove switch from intake manifold.

Installation - V-8 Engine

(1) Install EGR CTO switch in intake manifold.

(2) Install coil and bracket with attaching screw.

(3) Connect vacuum lines to switch.

(4) Install air cleaner assembly.

(5) Install coolant.

(6) Purge cooling system of air.

CALIFORNIA EXHAUST GAS RECIRCULATION SYSTEM

GENERAL

The major deviation in California EGR systems is the exhaust back-pressure sensor used on 360 CID engines equipped with automatic transmissions (except heavy-duty trucks). The exhaust back-pressure sensor, usage, and operation is explained below.

EGR Hose Routing

California EGR systems with a back-pressure sensor use different vacuum sources and connections. California EGR systems on 360 CID engines with a back-pressure sensor obtain a vacuum signal at the carburetor spark port, rather than at the EGR port (fig. 4A-12).

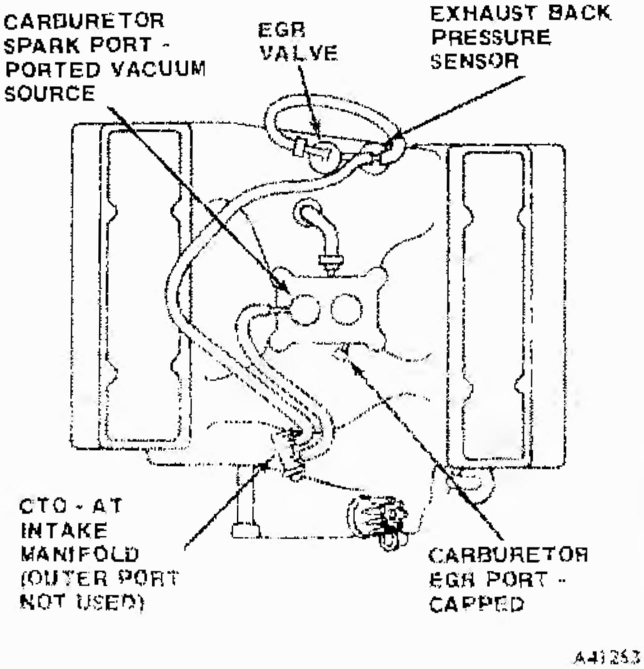

Fig. 4A-12 EGR Vacuum Lines - 360 CID Engines with Back-Pressure Sensor

EXHAUST BACK-PRESSURE SENSOR

This device (fig. 4A-13) consists of a diaphragm valve, spacer and metal tube. The metal tube connects the valve to the spacer. The EGR valve is mounted to the spacer portion of the sensor, and is modulated by the sensor.

The vacuum signal passes through the EGR CTO switch (when coolant temperature exceeds 115 degrees F) to the valve portion of the sensor where it is modulated by exhaust back-pressure.

NOTE: *The inlet nipple of the valve has a 0.030-inch restriction. The vacuum line from the EGR CTO must be connected to this nipple.*

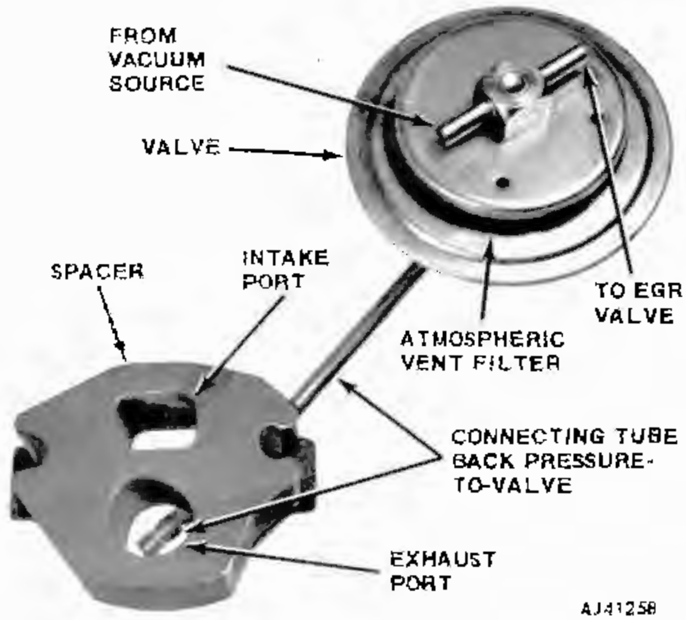

Fig. 4A-13 Exhaust Back-Pressure Sensor - V-8

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The metal tube which connects the valve to the spacer projects into the exhaust port of the back-pressure sensor. When exhaust back-pressure is relatively high, as during acceleration and some cruising conditions, back-pressure traveling up through the metal tube overcomes spring tension on the diaphragm within the valve and closes the atmospheric vent.

When the back-pressure sensor valve is not vented to the atmosphere, the vacuum signal passes through the back-pressure sensor valve, and on to the EGR valve. With a vacuum signal to the valve, exhaust gas begins recirculating.

When exhaust back-pressure is too low to overcome diaphragm spring tension, the vacuum signal between the sensor and the EGR valve is vented to the atmosphere at the sensor valve. With no vacuum signal applied to the EGR valve, exhaust gas does not recirculate.

NOTE: *EGR valves used with back-pressure sensors have shorter and more tapered pintles than those used without the back-pressure sensors. The shorter pintles are necessary to match the exhaust gas metering to the back-pressure sensor operation.*

Removal

(1) Remove vacuum lines from exhaust back-pressure sensor valve and EGR valve.

(2) Remove self-tapping screws that attach support bracket to valve portion of back-pressure sensor.

(3) Remove two attaching bolts from EGR valve.

(4) Remove EGR valve and exhaust back-pressure sensor assembly.

(5) Clean all mating surfaces and intake manifold and back-pressure sensor ports.

Installation - V-8 Engine

(1) Install new gasket on intake manifold and position exhaust back-pressure sensor on top of gasket.

NOTE: *Exhaust back-pressure sensor assembly should extend toward the left side on V-8 engines.*

(2) Install new gasket on exhaust back-pressure sensor spacer and install EGR valve.

(3) Install support bracket to valve portion of sensor and tighten screws.

(4) Install two attaching bolts and tighten to 13 foot-pounds torque.

(5) Attach vacuum lines to exhaust back-pressure sensor valve and EGR valve.

EXHAUST BACK-PRESSURE SENSOR TEST

(1) Inspect all EGR vacuum lines for leaks and correct routing.

NOTE: *Be sure vacuum line from EGR CTO is connected to nipple with 0.030-inch restriction.*

(2) Install a tee in vacuum line between EGR valve and exhaust back-pressure sensor.

(3) Attach a vacuum gauge to tee.

(4) Start engine and allow to idle. No vacuum should be indicated.

NOTE: *If vacuum is indicated at idle speed, verify correct line connections. Be sure manifold vacuum is not being used as a source. If carburetor is providing ported vacuum, inspect for partially open throttle plate, which could apply premature ported vacuum to back-pressure sensor.*

(5) Accelerate engine to 2000 rpm and observe vacuum gauge for the following:

- If coolant temperature is below 115 degrees F, no vacuum should be indicated.
- If coolant temperature is above 115 degrees F, carburetor ported vacuum should be indicated.
- If no vacuum was indicated during test, be sure vacuum is being applied to inlet side of back-pressure sensor. Then remove back-pressure sensor and inspect spacer port and tube for restrictions. Restrictions caused by carbon or lead deposits can be removed with spiral wire brush. Otherwise, replace back-pressure sensor.

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ELECTRIC ASSIST CHOKE

GENERAL

An electric assist choke is used with all 4V carburetors to match choke operations to engine requirements. It provides supplemental heat to the choke bimetal to speed up choke valve opening after choke cover interior reaches modulating temperature (see Modulating Temperature Chart). The purpose of the electric assist is to reduce emission of carbon monoxide (CO) during the engine warmup period. A special ac terminal is provided at the alternator to supply a seven-volt power source for the electric assist. A thermostatic switch (bimetallic disc) within the choke cover closes when the choke cover interior reaches modulating temperature, allowing current to flow to the heating element (fig. 4A-14). The circuit is completed through the choke cover ground strap and choke housing to engine. As the heating element warms up, heat is absorbed by an attached metal plate which heats the choke bimetal coil.

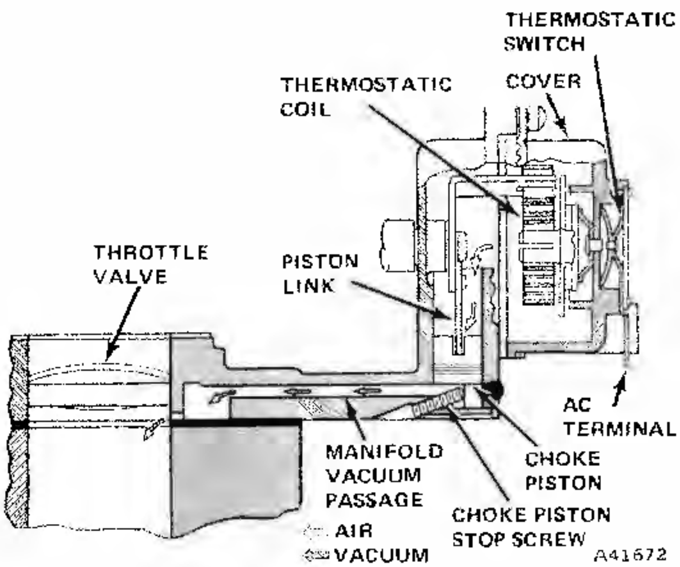


Fig. 4A-14 Electric Assist Choke

After engine shutdown, the thermostatic switch remains closed until the choke cover interior modulating temperature is reached. If the engine is restarted before modulating temperature is reached, current flow will immediately begin warming up the heating element to open the choke.

Once the choke cover interior temperature falls below the modulating temperature, the thermostatic switch opens and current flow to the heating element is shut off. If the engine is restarted at this time, the electric assist will not operate until choke cover interior reaches its modulating temperature.

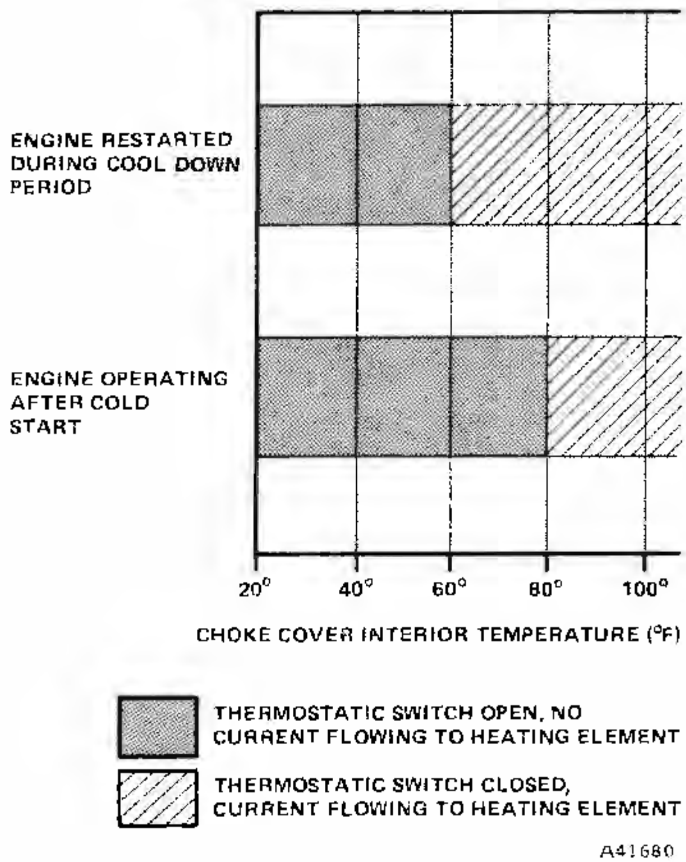
ELECTRIC ASSIST CHOKE TEST

(1) Disconnect electric assist choke wire from choke housing.

(2) Connect one lead of test lamp to spade terminal on choke housing.

(3) Connect other lead of test lamp to connector of choke wire.

THERMOSTATIC SWITCH MODULATION CHART



(4) Using a small thermometer, tape bulb end of thermometer to oval boss on back of bimetal cap assembly.

(5) Start engine.

(6) Read thermometer and observe test lamp. Refer to Thermostatic Switch Choke Modulation Chart.

(7) Read thermometer and observe test lamp. Lamp should be out when 60 degree F to 80 degree F is reached on thermometer. The lamp should light at temperatures above these temperatures.

Once modulating temperature is reached (test lamp lit), choke should fully open within 1 to 1-1/2 minutes.

NOTE: *If test lamp did not light, check 7-volt source from alternator.*

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FUEL TANK VAPOR EMISSION CONTROL SYSTEM

GENERAL

A closed fuel tank vent system is used which routes raw fuel vapor into the intake system where it is burned along with the fuel-air mixture preventing raw fuel vapors from entering the atmosphere (fig. 4A-15).

NOTE: *The charcoal canister is not used on 7000 and 8000 GVW Trucks except those built for sale in the state of California.*

FUEL TANK

All vehicles use a woven Saran sleeve-type fuel filter which is attached to the end of the fuel outlet tube inside the fuel tank. This filter is rated at 65 micron and repels water. Under normal conditions it requires no maintenance or service.

FUEL TANK FILLER CAP

The filler cap incorporates a two-way relief valve which is closed to atmosphere under normal operating conditions. The relief valve is calibrated to open only when a pressure of 0.75 to 1.5 psi or a vacuum of 0.25 to 0.5 inches occurs within the tank. When the pressure or vacuum is relieved, the valve returns to the normally closed position. The cap is identified by a black relief valve housing.

NOTE: *It is normal to occasionally encounter an air pressure release when removing the filler cap.*

LIQUID CHECK VALVE

The liquid check valve incorporates a float and Viton needle assembly. In the event that liquid fuel enters the check valve, the float will rise and force the needle upward to close the vent passage; thereby preventing liquid fuel from flowing through the valve (fig. 4A-16).

After passing through the check valve, the fuel vapor is routed through a vent line to the vapor storage canister in the engine compartment.

FUEL VAPOR STORAGE CANISTER

The fuel-resistant nylon body of the canister contains activated charcoal granules which absorb and store the fuel tank vapors until they are drawn into the intake manifold through the carburetor air cleaner (fig. 4A-17).

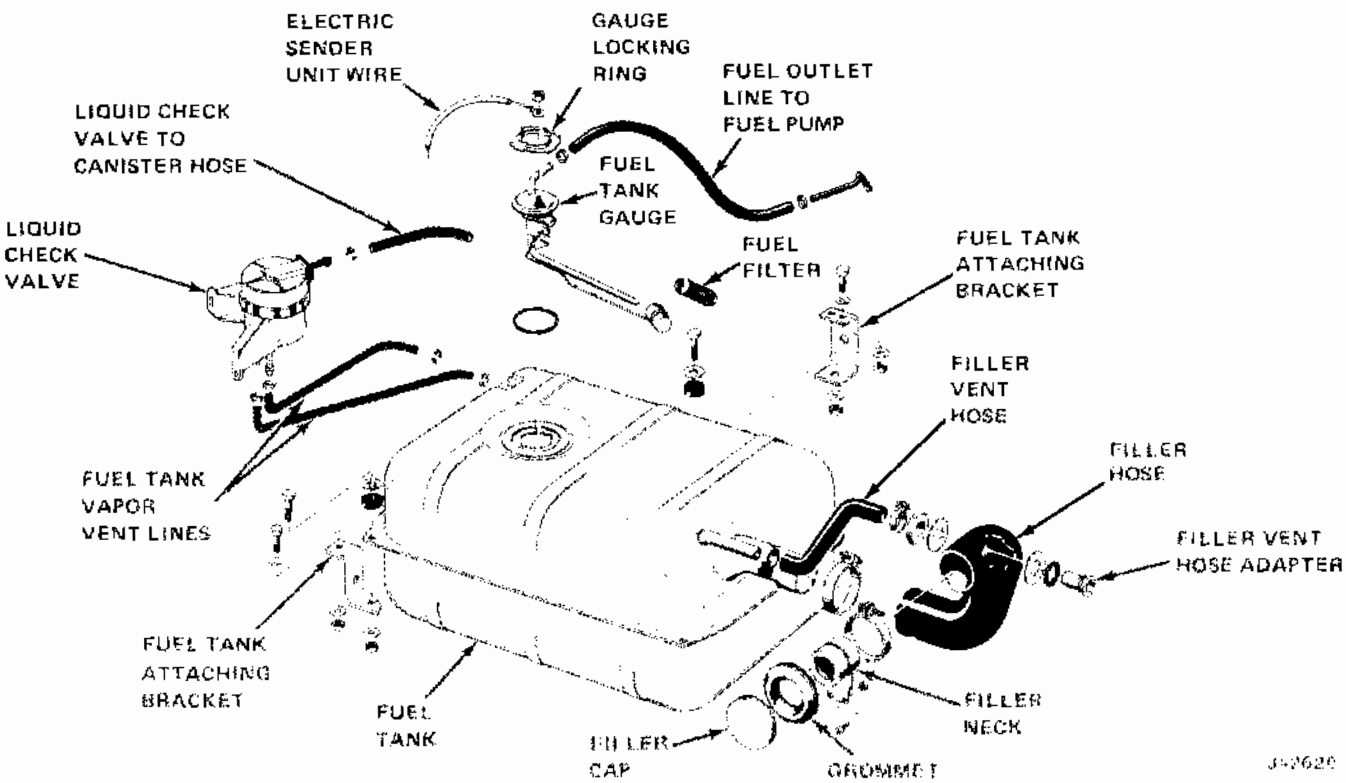

Fig. 4A-15 Fuel Tank Vapor Emission System (Typical)

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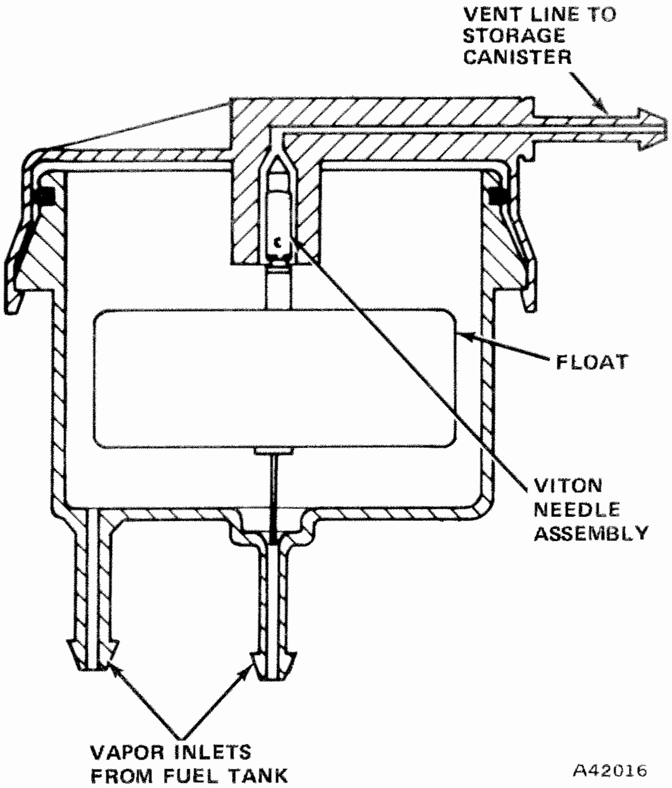

Fig. 4A-16 Liquid Check Valve (Typical)

The canister has two hose connections. One is for the fuel tank vapor vent line and has a metering plug. The other connects to a hose which attaches to a tube at the underside of the air cleaner snorkel. This tube projects into the incoming air stream of the snorkel. Air passing over the tube creates a vacuum that draws fuel vapor from the canister The amount of vapor drawn from the canister is relative to the air velocity passing through the air cleaner snorkel. Higher air velocity creates higher vacuum and an increase in vapor drawn from the canister.

Outside air is drawn into the canister through a replaceable filter pad which is accessible through the bottom of the canister body. The filter pad should be replaced at the recommended mileage intervals listed in the Mechanical Maintenance Schedule.

MAINTENANCE

The fuel tank, filler cap, fuel lines, and vent lines must be maintained in good condition to prevent raw fuel vapors (hydrocarbons) from entering the atmosphere.

Inspect the filler cap for evidence of fuel leakage (stains) at the filler neck opening. Remove the cap and check the condition of the sealing gasket. Replace the filler cap if the gasket is damaged or deteriorated.

Inspect the fuel tank for evidence of fuel leakage (stains). Trace any stain back to its origin and repair or replace the tank as required.

Inspect the fuel and vent lines for leakage or damage, repair or replace as required. Be sure all connections are tight.

If liquid fuel is present at the fuel vapor storage canister, inspect the liquid check valve and replace if necessary.

The filter pad located at the bottom of the canister is the only serviceable item of the canister assembly. It should be replaced at 15,000-mile intervals as prescribed in the Mechanical Maintenance Schedule, located in Section B of this manual.

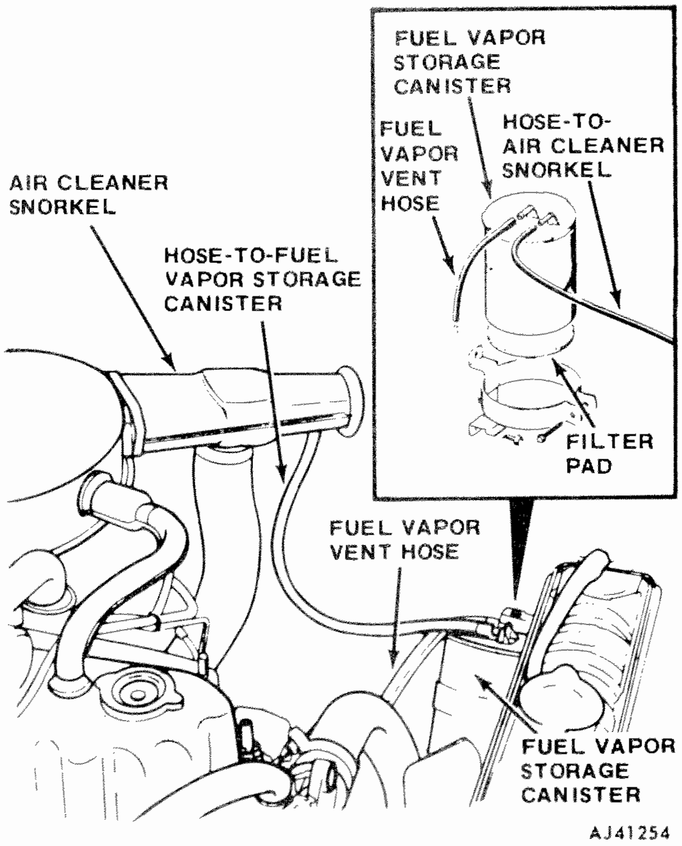

Fig. 4A-17 Fuel Vapor Storage Canister (Six-Cylinder Shown)

POSITIVE CRANKCASE VENTILATION (PCV) SYSTEM

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GENERAL

This system incorporates a calibrated airflow PCV valve connected between an intake manifold vacuum source and the engine. Crankcase vapors are drawn through the PCV valve into the intake manifold where they are burned along with the fuel-air mixture (fig. 4A-18). The oil filler cap is closed in this system to prevent any crankcase vapors from entering the atmosphere.

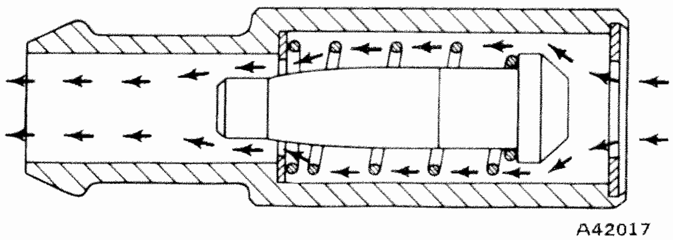

Fig. 4A-18 Positive Crankcase Ventilation Valve Flow

During periods of relatively high manifold vacuum, such as idle or cruise speeds, outside air is drawn from the air cleaner into the crankcase. On six-cylinder engines, the air passes through a polyurethane foam filter located in the oil filler cap. The filler cap is connected by a hose to the air cleaner (fig. 4A-19 and 20).

If crankcase vapor pressures (blow-by) exceed the flow capacity of the PCV valve, airflow in the system will reverse. Crankcase vapors are drawn through the air cleaner element and carburetor and burned along with the fuel-air mixture.

The positive crankcase ventilation system performs two functions:

- Prevents combustion blow-by from entering the atmosphere.
- Ventilates the crankcase with clean air to help prevent the formation of sludge.

Positive Crankcase Ventilation (PCV) Valve

A common PCV valve (colored black) is used on all V-8 and six-cylinder engines.

The PCV valve must be replaced at 15,000-mile intervals as specified in the Mechanical Maintenance Schedule. All hoses in the PCV system should be inspected at this time for leaks or restrictions and cleaned or replaced as required. PCV valve replacement may be required more often under adverse operating conditions.

PCV VALVE TEST

The valve may be tested at idle speed for correct flow rate (cfm) providing the engine manifold vacuum is at least 14 inches Hg. When checking vacuum, connect the gauge to a fitting which is as centrally

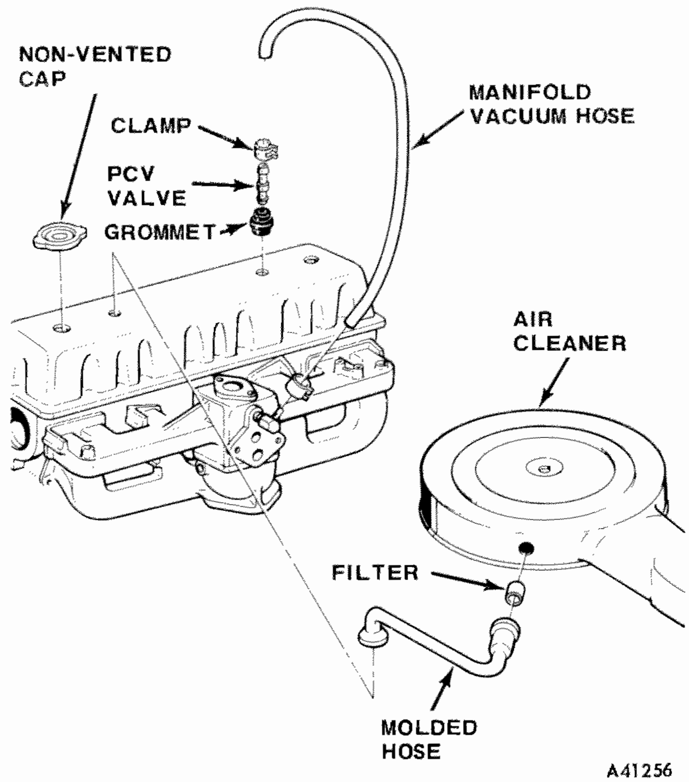

Fig. 4A-19 PCV System - Six-Cylinder

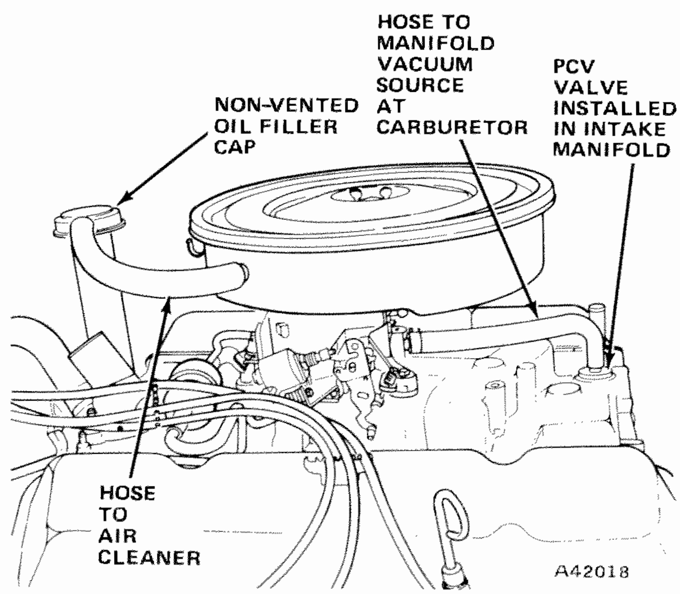

Fig. 4A-20 PCV System - V-8

located as possible on the intake manifold.

Remove the valve from the grommet in the intake manifold (V-8) or cylinder head cover (Six-Cylinder) and connect the plastic hose of PCV Valve Tester J-23111 to the valve (fig. 4A-21).

NOTE: *The PCV valve must be held in a horizontal position and tapped lightly during the test. Hold the tester in a vertical position.*

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Start the engine and allow it to idle and observe the flow rate (cfm). Refer to PCV Valve Flow Chart.

A valve which flows above or below specification must be replaced. The correct PCV valve should be used for replacement.

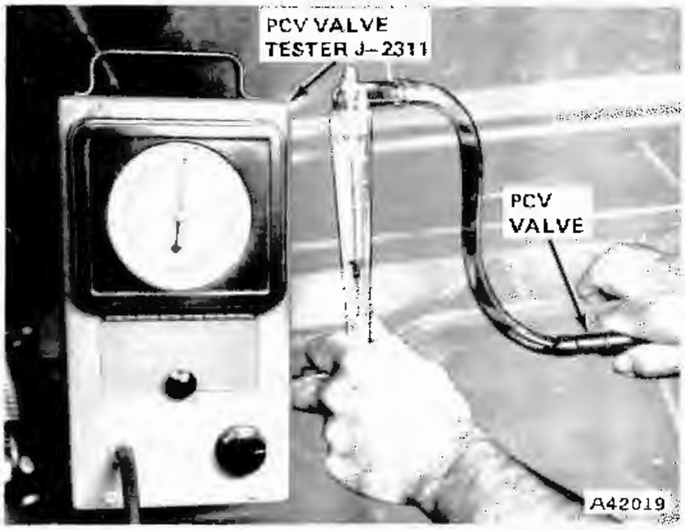

Fig. 4A-21 PCV Valve Test

PCV AIR INLET FILTER - SIX-CYLINDER

The wire gauze air inlet filter is located within the air cleaner end of the moulded rubber hose which is connected between the air cleaner and cylinder head cover (fig. 4A-22). It must be cleaned in kerosene at the mileage intervals recommended in the Mechanical Maintenance Schedule.

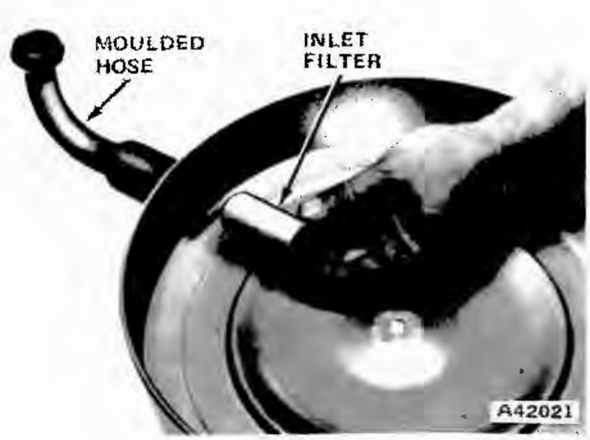

Fig. 4A-22 PCV Air Inlet Filter - Six-Cylinder

PCV VALVE FLOW CHART

ENGINE MANIFOLD VACUUM (In. Hg.)	AIRFLOW (cfm)
20	1.35-1.65
18	1.35-1.65
16	1.35-1.65
14	1.35-1.65
12	1.35-2.2
10	1.8 -2.9
8	2.5 -3.5
6	2.9 -4.0
3	3.3 -4.4

THERMOSTATICALLY CONTROLLED AIR CLEANER (TAC) SYSTEM

SIX-CYLINDER ENGINE

This system consists of a two-piece heat shroud positioned exhaust manifold, a hot air hose, and an air duct and valve assembly which is located in the air cleaner snorkel (fig. 4A-23).

The air duct and valve assembly incorporates an air valve, a thermostat unit and two springs.

The temperature of the air entering the air cleaner is thermostatically controlled by the air duct and valve assembly. Air from the engine compartment, or heated air from the shrouded exhaust manifold is supplied to the engine.

The thermostat unit in the air duct is exposed to incoming air. The spring-loaded air valve is connected to the thermostat unit through linkage. The spring holds the air valve in the closed position (heat on) until the thermostat unit overcomes the spring tension.

During the engine warmup period when the air temperature entering the air duct is less than 105 degrees F. the thermostat is in the retracted position and the air valve is held in the closed position (heat on) by the spring, thus shutting off the air from the engine compartment. Air is then drawn from the shroud at the exhaust manifold.

As the temperature of the air passing the thermostat unit rises, the thermostat starts to open and pulls the air valve down. This allows cooler air from the engine compartment to enter the air cleaner. When the temperature of the air reaches 130 degrees F, the air valve is in the open position (heat off) so that only engine compartment air is allowed to enter the air cleaner.

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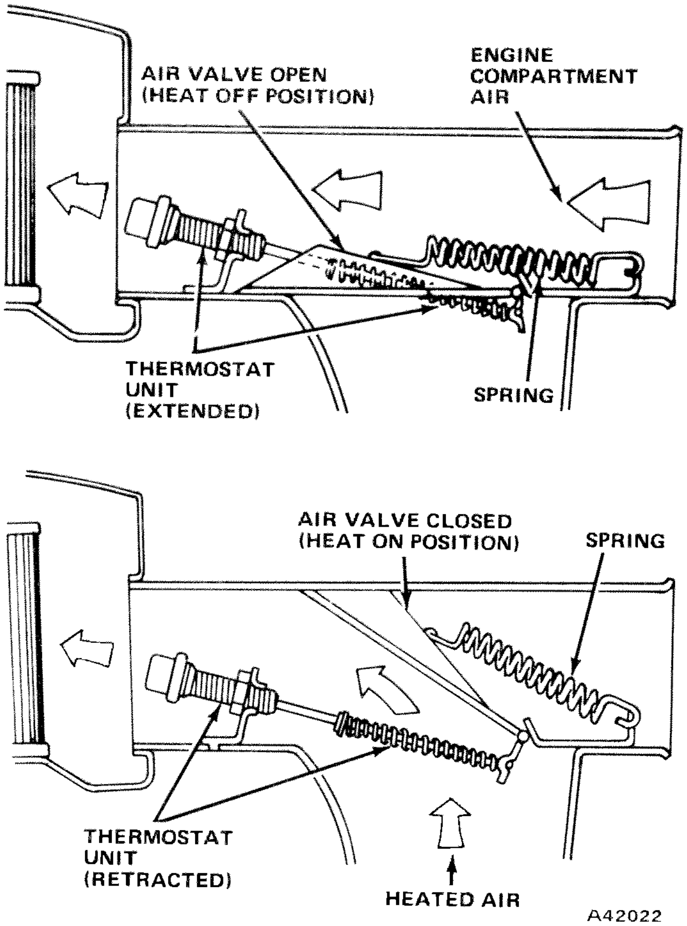

Fig. 4A-23 TAC System - Six-Cylinder

TAC Operational Test - Six-Cylinder

(1) Remove air cleaner top half and immerse snorkel in cold water making certain thermostat unit is covered.

(2) Place a thermometer in water and observe the temperature while heating water slowly.

NOTE: *With water temperature at 105 degrees F or less, air valve must be in closed (heat on) position.*

(3) Heat water until temperature reaches 130 degrees F; air valve must be in fully open (heat off) position.

NOTE: *If air valve does not open and close at temperatures specified, check valve mechanism for a binding condition or a disconnected or defective spring. If valve mechanism is in satisfactory condition, thermostat unit is defective and air cleaner assembly must be replaced.*

V-8 ENGINE

This system consists of a heat shroud which is integral with the right-hand exhaust manifold, a hot air hose, a special air cleaner assembly (equipped with a thermal sensor), and a vacuum motor and air valve assembly.

The thermal sensor incorporates an air bleed valve which regulates the amount of vacuum applied to the vacuum motor, thereby controlling the air valve position to supply either heated air from the exhaust manifold or air from the engine compartment (fig. 4A-24).

During the warmup period when underhood air temperatures are low, the air bleed valve is closed and sufficient vacuum is applied to the vacuum motor to hold the air valve in the closed (heat on) position.

As the temperature of the air entering the air cleaner approaches approximately 115 degrees F, the air bleed valve opens to decrease the amount of vacuum applied to the vacuum motor. The diaphragm spring in the vacuum motor then moves the air valve into the open (heat off) position, allowing only underhood air to enter the air cleaner.

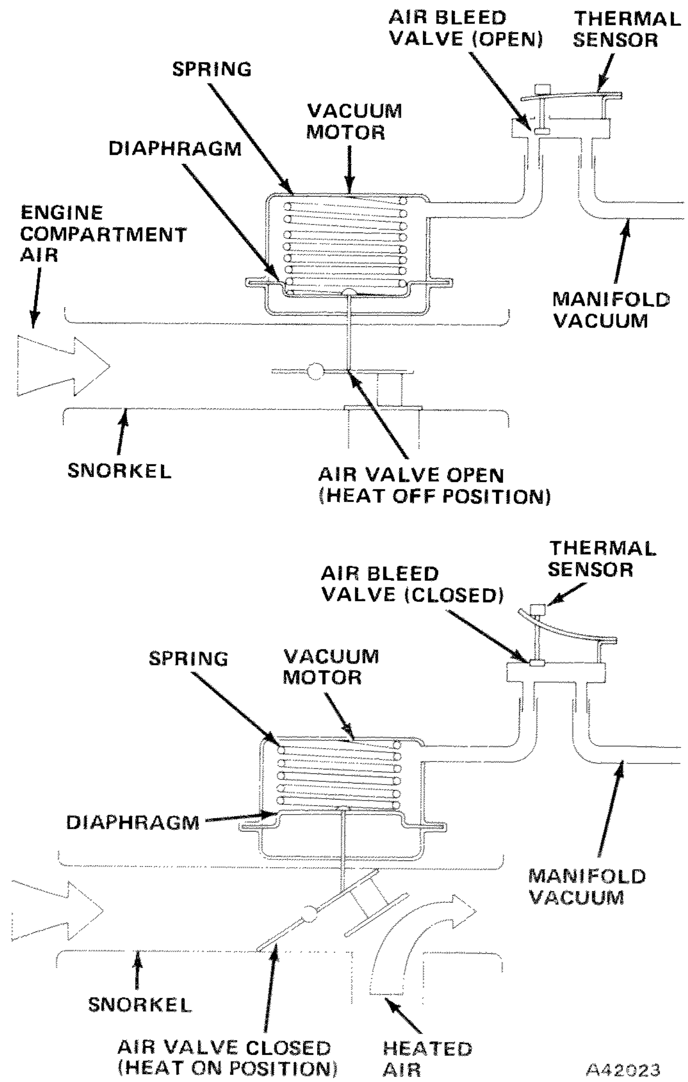

Fig. 4A-24 TAC System - V-8

The air valve in the air cleaner snorkel will also open, regardless of air temperature, during heavy

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acceleration operation to obtain maximum airflow through the air cleaner.

TAC Operational Test - V-8

(1) Remove air cleaner assembly from engine and allow to cool at room temperature.

(2) After cooling, sight through air cleaner snorkel to observe position of air valve; it should be fully open to outside air.

(3) Install air cleaner assembly to engine and connect hot air tube and manifold vacuum hose.

(4) Start engine and observe position of air valve, it should be fully closed to outside air.

(5) Move the throttle lever rapidly to approximately 1/2 to 3/4 opening and release, air valve should open and then close again.

(6) Allow engine to warm to operating temperature and observe position of air valve; it should be fully open to outside air.

If air valve does not close at room temperature with vacuum applied, check for a mechanical bind in the snorkel, vacuum motor linkage disconnected, vacuum leaks in hoses or connections at the vacuum motor, thermal sensor, and intake manifold.

If air valve mechanism is operating freely and no vacuum leaks are detected, connect a hose from an intake manifold vacuum source directly to vacuum motor.

If air valve now closes, thermal sensor is defective and must be replaced.

If air valve does not close, vacuum motor is defective and must be replaced.

VACUUM THROTTLE MODULATING SYSTEM (VTM)

This system is designed to reduce the emission of hydrocarbons (HC) during rapid throttle closure at high speeds.

The system consists of a deceleration valve located at the right front side of the intake manifold and a throttle modulating diaphragm located at the carburetor base. The deceleration valve is connected by one hose to a manifold vacuum source and by another hose to the throttle modulating diaphragm (fig. 4A-25).

During high speed deceleration, when manifold vacuum reaches approximately 21 to 22 inches, the deceleration valve triggers a vacuum signal to the throttle modulating diaphgram and causes a plunger to move out and open the throttle slightly. The increased throttle opening allows more air to enter the combustion chambers and lean out the overrich mixture, thereby reducing the emission of hydrocarbons.

The deceleration valve calibration is preset at time of manufacture and normally does not require adjustment. To check and adjust the throttle modulating diaphgram, proceed as follows:

(1) With engine not running and curb idle speed previously set, position throttle lever against curb idle adjusting screw.

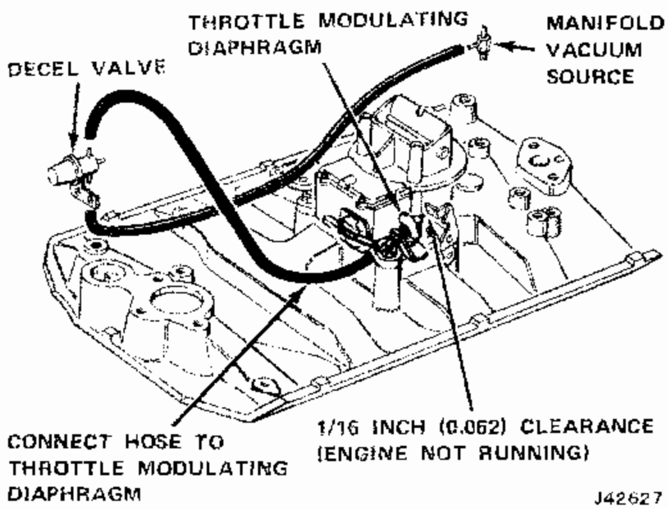

Fig. 4A-25 Vacuum Throttle Modulating System

(2) Measure clearance between the throttle modulating diaphragm plunger and the throttle lever. It should be 1/16 inch (0.062 inch).

(3) Adjust by loosening the jamnut and turning the diaphragm assembly.

VACUUM ADVANCE MODULATION (VAM) SYSTEMS

Jeep engines use all of the following components in various combinations to modulate the vacuum signal applied to the distributor vacuum advance unit. The method of operation of the components is described later in this section.

Transmission Controlled Spark System (TCS) includes:

- Solenoid Vacuum Valve
- Solenoid Control Switch (Manual or Automatic
- Transmission)

Coolant Temperature Override Switch (Spark CTO)

Thermal Vacuum Switch (TVS) - V-8 engines with standard cooling system only.

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Six different combinations of these components are used on V-8 engines to control vacuum advance to the distributor. Six-cylinder engines use only one combination. All vacuum advance modulation systems make use of the 160 degrees F CTO switch located at the thermostat housing, although all ports on the switch are not used in every application. Other components and vacuum line routings differ for each of the six different V-8 engine systems currently in use. These systems are shown in figures 4A-26 through 4A-32 and are identified by the components used in each. To find the applications of each system, refer to the Vacuum Advance Modulation (VAM) Usage Chart.

VACUUM ADVANCE MODULATION (VAM) USAGE CHART

VACUUM ADVANCE MODULATION SYSTEM	APPLICATION
Spark CTO (All Ports Used)	401 CID with Heavy-Duty Cooling (except Heavy-Duty Truck) - Nationwide 360/401 CID, Heavy-Duty Truck (except with Heavy-Duty Cooling) - Nationwide and California
Spark CTO (No. 2 Port Not Used)	304 CID - California 360/401 CID with Heavy-Duty Cooling (except Heavy-Duty Truck) - California
Spark CTO (No. 2 Port Not Used) and TVS	360/401 CID with Standard Cooling (except Heavy-Duty Truck) - California
Spark CTO (All Ports Used) and TVS	401 CID with Standard Cooling (except Heavy-Duty Truck) - Nationwide 360/401 CID, Heavy-Duty Truck with Standard Cooling Nationwide and California
Spark CTO (All Ports Used), TVS, TCS	360 CID with Standard Cooling (except Heavy-Duty Truck) - Nationwide
Spark CTO (All Ports Used), TCS	304 CID - Nationwide 360 CID with Heavy-Duty Cooling (except Heavy-Duty Truck) - Nationwide All six-cylinder engines - Nationwide and California

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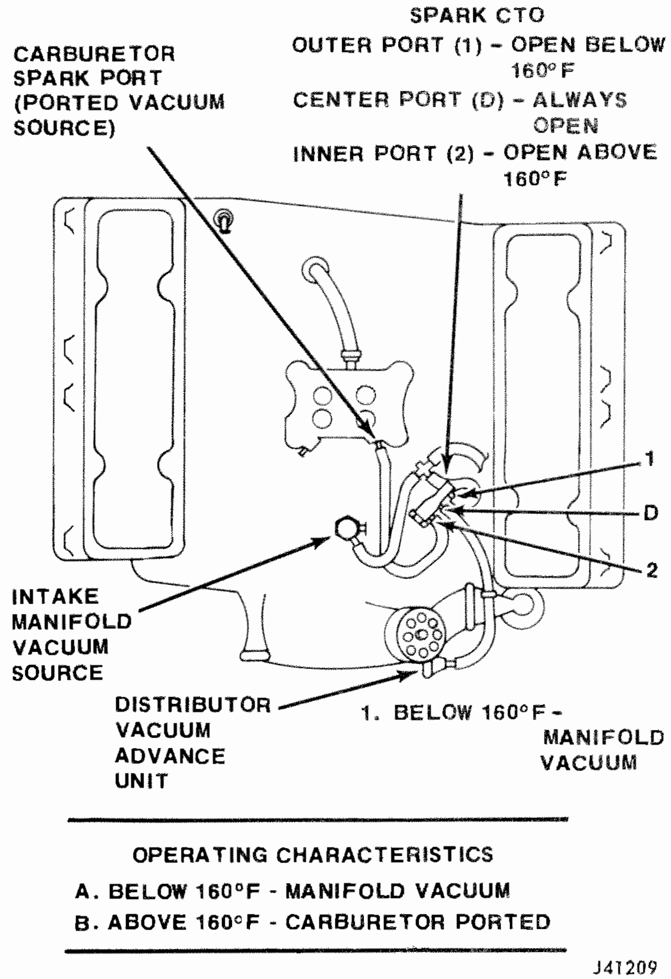

Fig. 4A-26 Spark CTO (All Ports Used)

VAM TEST

NOTE: *Coolant temperature should be below 160 degrees F (at or below the C mark of temperature gauge) to begin test.*

(1) Check for proper hose connections and leaks.

(2) Disconnect vacuum line from distributor vacuum advance mechanism.

(3) Using a tee fitting, connect tee into distributor vacuum line.

(4) Connect a vacuum gauge to open port of tee fitting.

(5) Locate correct illustration of VAM system being tested (fig. 4A-26 through 4A-32). The correct VAM illustration identifies the operating characteristics of the system according to vacuum supply and coolant temperature.

(6) Start engine. Verify vacuum available at temperature indicated on illustration.

(7) If vacuum indications are inaccurate, each component of the VAM system must be tested as outlined later in this section. Begin with the Spark CTO Test.

NOTE: *A ported vacuum source can be distinguished from manifold vacuum source by engine rpm. At idle, a ported vacuum source should have little or no vacuum, while a manifold vacuum source should have about 16 to 20 inches of mercury (Hg) indicated.*

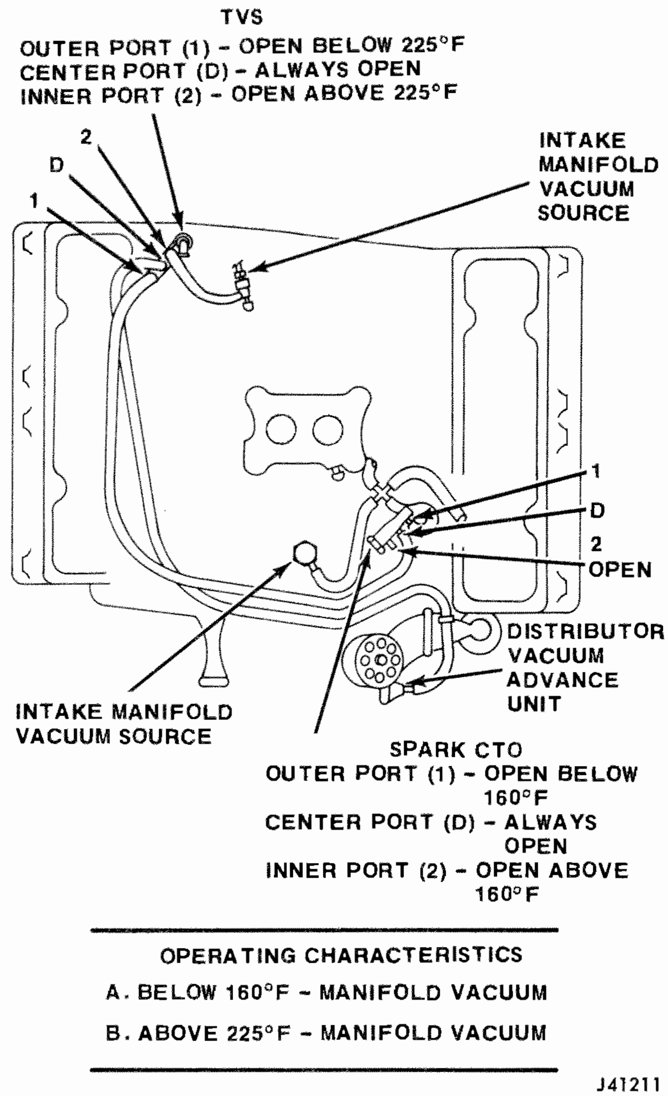

Fig. 4A-27 Spark CTO (No. 2 Port Not Used)

THERMAL VACUUM SWITCH (TVS)

This switch, which is located on the heater coolant outlet at the right rear of the intake manifold, is used on all Cherokees, Wagoneers, and Trucks equipped with 360 or 401 CID engines and standard cooling.

When engine coolant temperature reaches 225 degrees F, port No. 1 closes and port No. 2 opens. This allows intake manifold vacuum to be routed through ports No. 2 and D. Port D is connected by a hose either to port No. 2 of the coolant temperature override switch or directly to the distributor vacuum advance unit. Therefore, intake manifold is applied to the distributor vacuum advance diaphragm resulting

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in full vacuum advance. The full vacuum advance causes the engine speed to increase approximately 220 rpm.

When the coolant temperature drops below 225 degrees F, port No. 2 of the TVS switch closes and vacuum is again routed through ports No. 1 and D. Engine speed decreases due to reduced distributor vacuum advance.

NOTE: *The operation and outward appearance of the TVS and coolant temperature override switches are identical. However, they can be identified by the part number stamped on the switch body.*

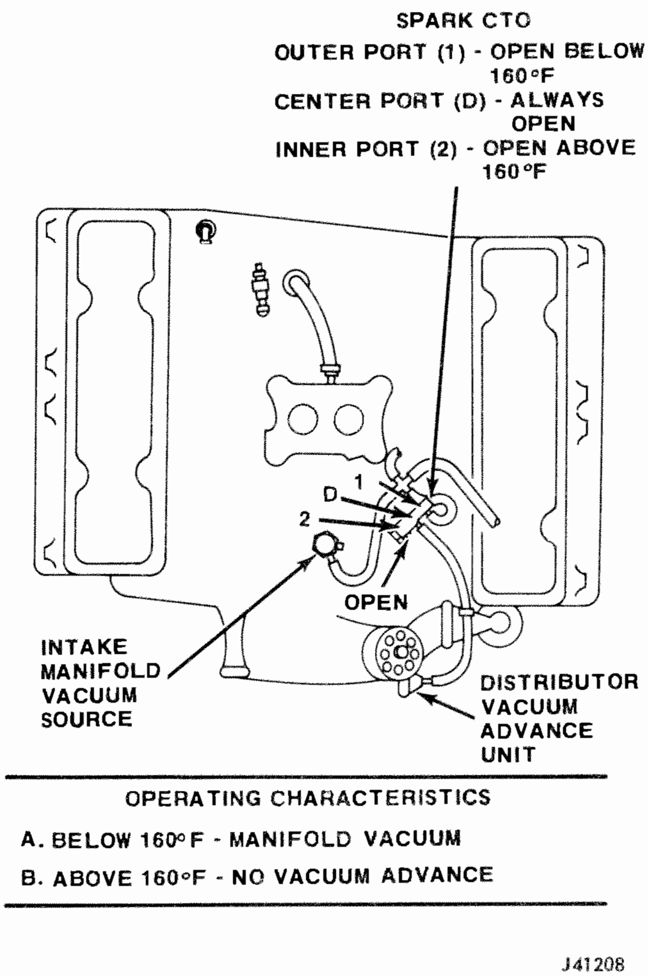

Fig. 4A-28 Spark CTO

TVS TEST

NOTE: *Begin test with coolant temperature below 225 degrees F.*

(1) Remove all vacuum lines from TVS switch. Plug those lines that will create a vacuum leak.

(2) Connect a vacuum line from a manifold vacuum source to port No. 1 (outer) of the TVS.

(3) Connect a vacuum gauge to port D (center) of TVS.

(4) Start engine. Manifold vacuum should be indicated on vacuum gauge; if not, replace TVS.

(5) With engine still running and coolant temperature **below** 225 degrees F, disconnect vacuum line from port No. 1 (outer) of TVS and connect to port No. 2 (inner).

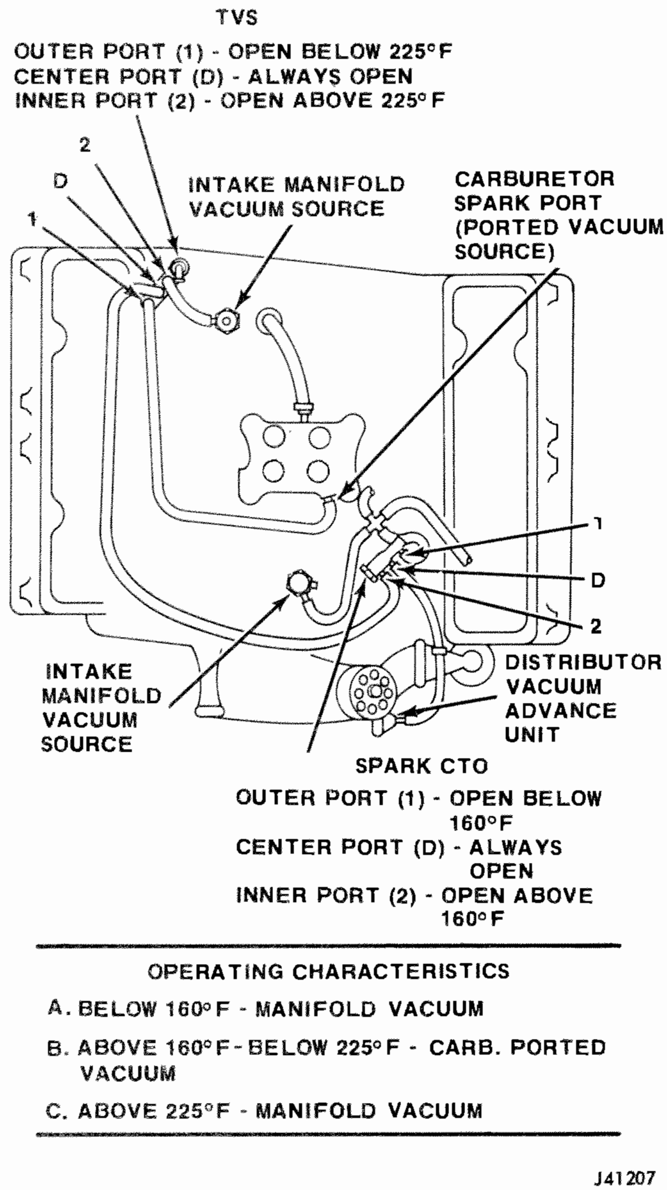

Fig. 4A-29 Spark CTO (All Ports Used) and TVS

(6) No manifold vacuum should be indicated on vacuum gauge. Replace TVS if vacuum is indicated.

(7) Keep engine running until coolant temperature exceeds 225 degrees F (approximately the end of the temperature gauge band). Manifold vacuum should be indicated; if not, replace TVS.

NOTE: *It may be necessary to block the radiator with cardboard to bring coolant temperature up to 225 degrees F.*

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(8) Disconnect line from port No. 2 and connect it to No. 1. No vacuum should be indicated, otherwise replace TVS.

(9) Reconnect vacuum lines to TVS.

Removal - V-8 Engine

(1) Drain coolant from radiator.
(2) Remove air cleaner assembly.
(3) Remove heater hose if necessary.
(4) Disconnect vacuum lines from TVS.
(5) Using a 7 8-inch, open-end wrench, remove switch from coolant outlet.

Installation - V-8 Engine

(1) Install TVS on heater outlet.
(2) Install heater hose if removed.
(3) Connect vacuum lines to switch.
(4) Install ir cleaner assembly.
(5) Install coolant.
(6) Purge cooling system of air.

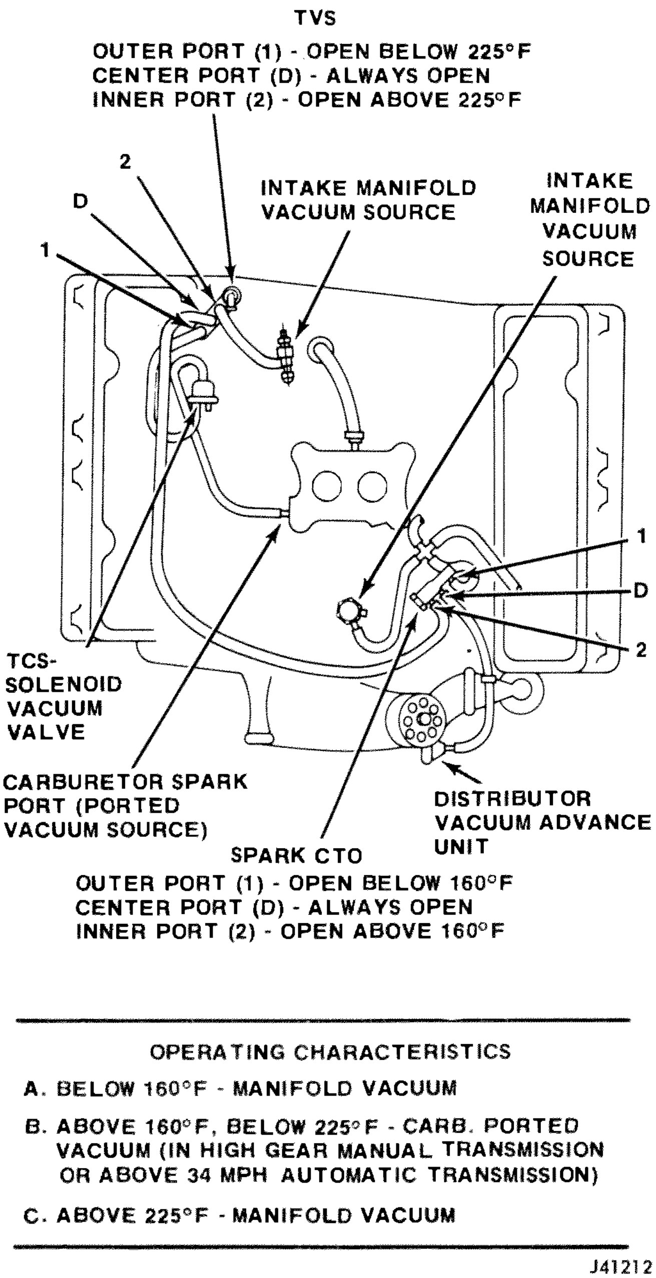

Fig. 4A-30 Spark CTO (All Ports Used), TVS, TCS

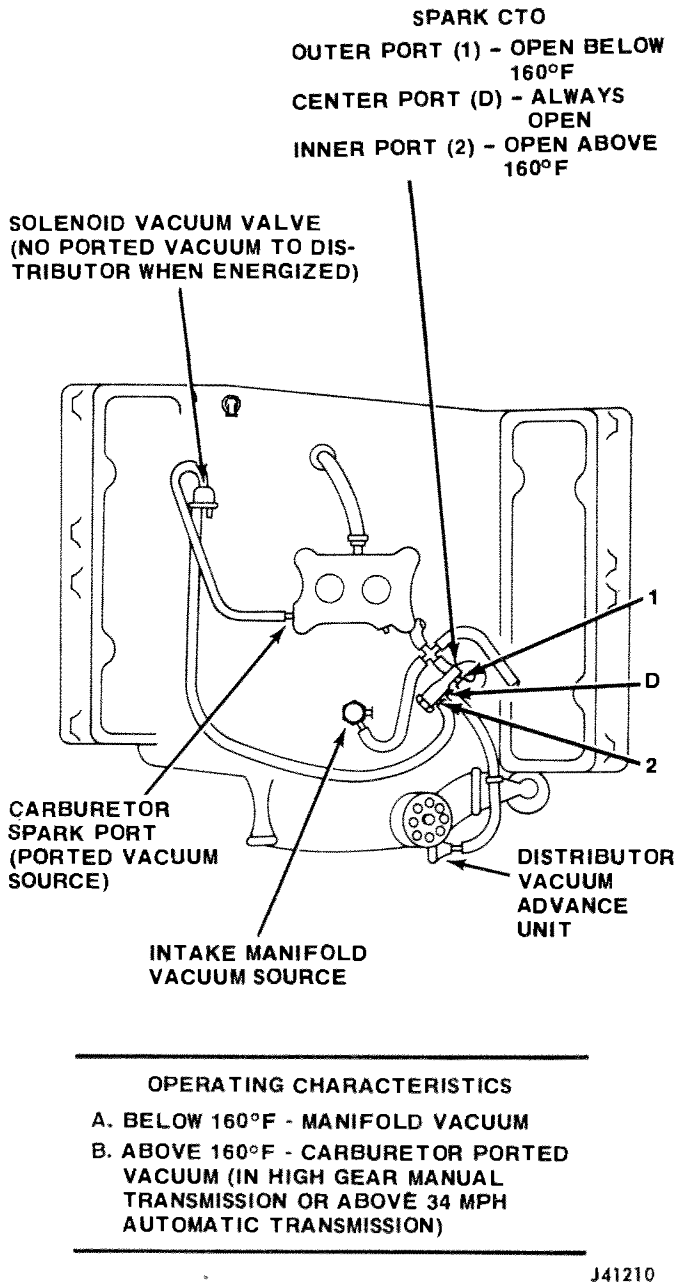

Fig. 4A-31 Spark CTO (All Ports Used) TCS

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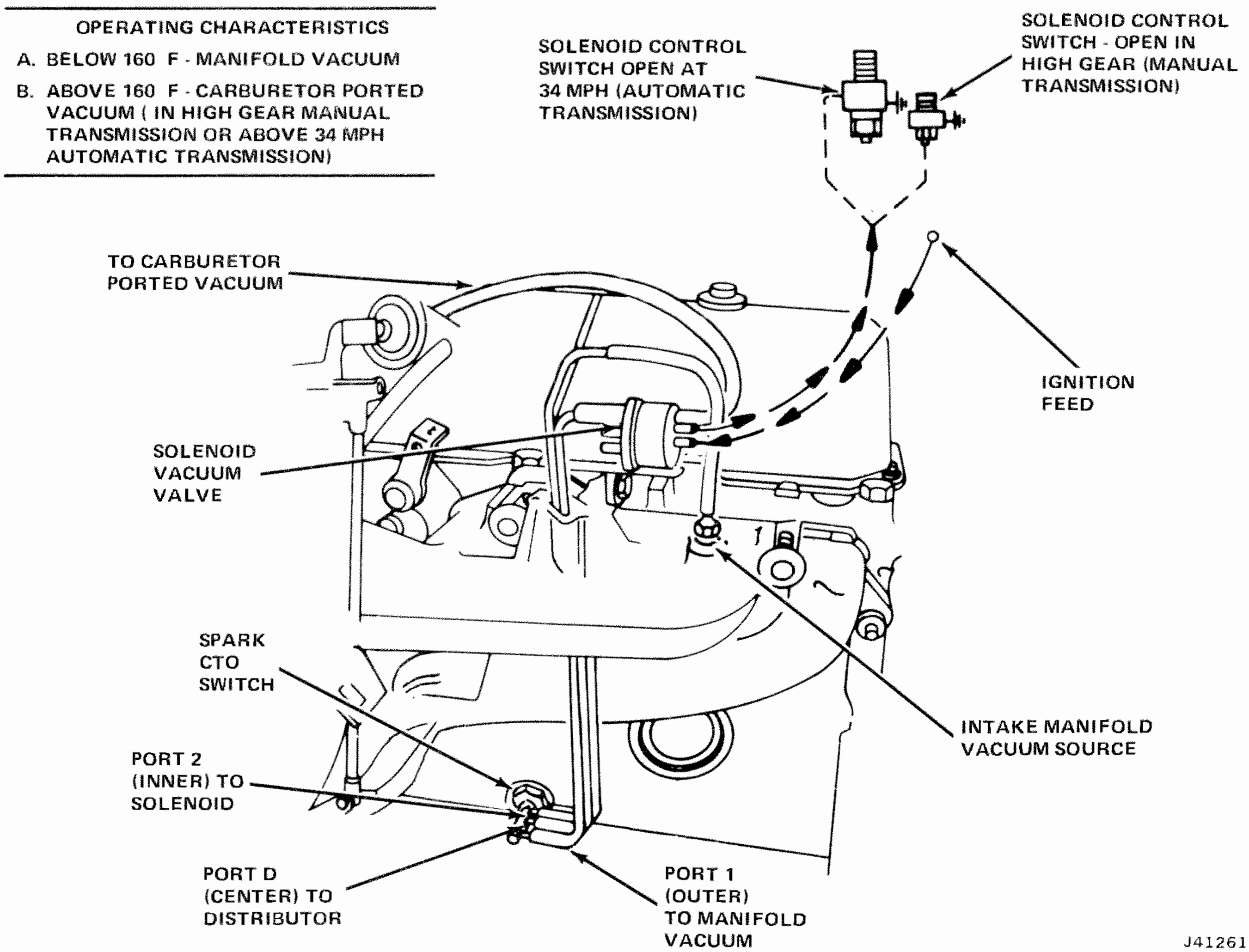

Fig. 4A-32 Spark CTO (All Ports Used), TCS-Six-Cylinder

TRANSMISSION CONTROLLED SPARK (TCS) SYSTEM

GENERAL

The purpose of this system is to reduce the emission of oxides of nitrogen by lowering the peak combustion temperature during the power stroke. The system incorporates a solenoid vacuum valve, a solenoid control switch, and related wiring and vacuum lines (fig. 4A-33).

SOLENOID VACUUM VALVE

This valve is attached to the intake manifold at the rear right side of the intake manifold (V-8 engines) or to a bracket at the rear of the intake manifold (six-cylinder engines). When the valve is energized (ground circuit complete), carburetor ported vacuum is blocked and the distributor vacuum line is vented to atmosphere through a port in the valve, resulting in no vacuum advance. When the valve is de-energized (ground circuit open), ported vacuum is applied to the distributor resulting in normal vacuum advance.

SOLENOID CONTROL SWITCH

This switch opens or closes in relation to vehicle speed or gear range. At speeds above 32 to 36 mph (automatic transmission) or high gear (manual transmission), the switch opens and breaks the ground circuit to the solenoid vacuum valve.

At speeds under 32 to 36 mph (automatic transmission) or lower gear ranges (manual transmission), the switch is closed and completes the ground circuit to the solenoid vacuum valve.

On manual transmissions, the switch is operated by the shifter shaft, which is screwed into the transmission case.

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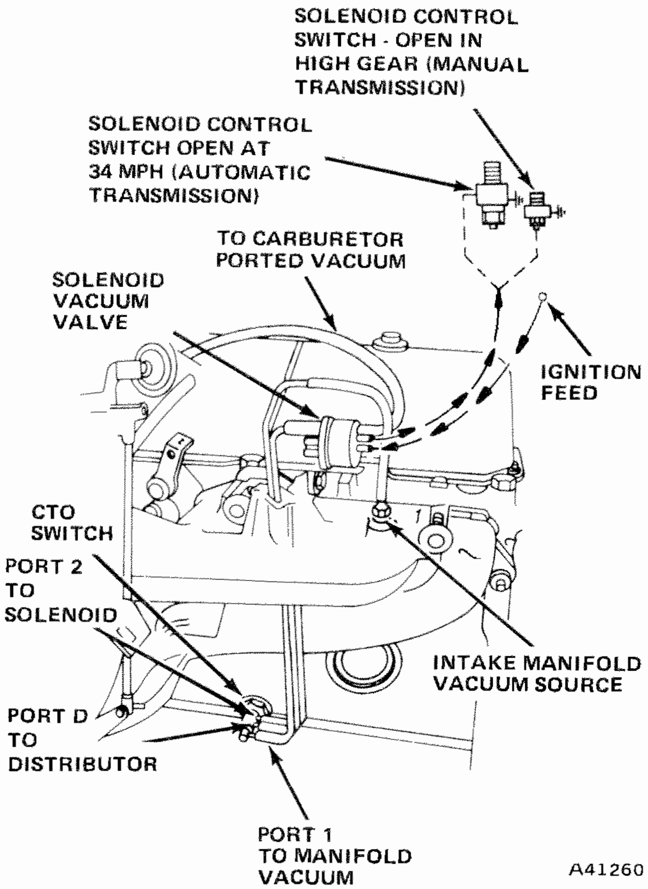

Fig 4A-33 Typical TCS System - Six-Cylinder Shown

On automatic transmissions, the switch is located along the speedometer cable on the firewall. The switch is operated by speedometer cable rpm. The cable attaches to both ends of the switch. At 32 to 36 mph (533 to 599 cable rpm), the switch will open the ground circuit.

TCS TEST

A vacuum gauge, probe type test lamp, and a jumper wire are used to check the operation of the TCS system.

(1) Turn ignition switch on.

(2) Disconnect wire connector from solenoid vacuum valve.

(3) Connect wire lead of test lamp to ground.

(4) Touch probe end of test lamp to each terminal of connector. Test lamp should light at one of the terminals; if not, ignition feed portion of TCS system is defective.

(5) Connect wire lead of test lamp to battery positive post.

NOTE: *Manual transmission equipped vehicles must be in neutral to begin step (6).*

(6) Touch probe end of test lamp to solenoid vacuum valve ground wire terminal at connector (opposite the terminal which caused test lamp to light in step (4)). Test lamp should light; if not, use the following procedure:

(a) Disconnect wire at solenoid control switch.

(b) Using a jumper wire, connect one end to switch wire connector and other end to ground.

(c) If test lamp lights when solenoid control switch wire is grounded with jumper wire, solenoid control switch is defective. If test lamp does not light, solenoid control switch wire is defective.

(7)

(a) Disconnect vacuum line from vent side of solenoid vacuum valve.

(b) Using a vacuum gauge, connect gauge to solenoid vacuum valve where hose was disconnected.

(c) Start engine. With solenoid vacuum valve attached, no vacuum should be indicated; otherwise, replace solenoid vacuum valve.

(d) Disconnect wires from solenoid vacuum valve. Ported vacuum should be indicated; if not, replace solenoid vacuum valve.

(8) Manual transmission equipped:

(a) Place gear selector in high gear.

(b) Test lamp should go out; if not, solenoid control switch is defective.

(9) Automatic transmission equipped:

(a) Raise and support vehicle so that rear wheels are free to rotate.

(b) Disconnect solenoid control switch wire. Connect wire lead of test lamp to solenoid control switch wire male connector. Touch probe end of test lamp to switch wire female connector.

(c) Start engine. Test lamp should light; if not, solenoid control switch is defective.

(d) Slowly accelerate engine 32 to 36 mph, test lamp should go out. If the test lamp goes out at a speed outside of this range, switch should be replaced.

NOTE: *With decreasing speed, the solenoid control switch will close the ground circuit at 22 to 28 mph (366 to 466 cable rpm). Make tests while increasing speed or accelerating engine only.*

(10) Stop engine.

(11) Reconnect wire connector to solenoid control switch and lower vehicle.

SPARK COOLANT TEMPERATURE OVERRIDE SWITCH (SPARK CTO)

This switch is threaded into the thermostat housing on V-8 engines and into the left rear side of the block on six-cylinder engines. Its purpose is to improve driveability during the warmup period by providing full distributor vacuum advance until the engine coolant temperature has reached 160 degrees F. The switch incorporates a thermal unit which reacts to

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coolant temperatures and moves a check ball inside the switch up or down to open or close the switch ports. Either intake manifold or carburetor ported vacuum is thereby routed to the distributor vacuum advance diaphragm (fig. 4A-34).

When the coolant temperature is below 160 degrees F, ports No. 1 and D are open and port No. 2 is closed. When the coolant temperature reaches 160 degrees F, port No. 1 closes and ports No. 2 and D are open.

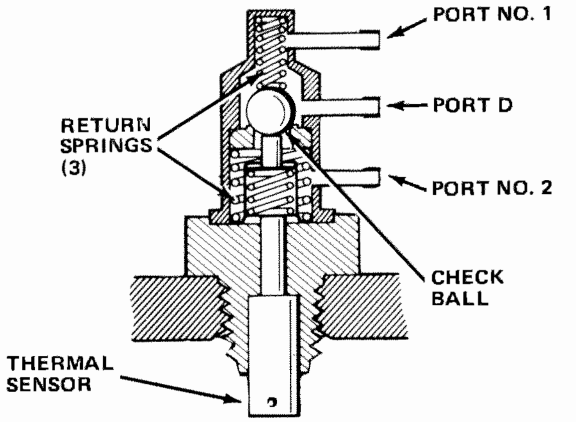

Fig. 4A-34 Spark CTO

SPARK CTO TEST

NOTE: *Begin test with coolant temperature below 160 degrees F.*

(1) Remove all vacuum lines from CTO switch. Plug those lines that will create a vacuum leak.

(2) Connect a vacuum line from a manifold vacuum source to port No. 2 (outer) of the CTO.

(3) Connect a vacuum gauge to port D (center) of CTO.

(4) Start engine. Manifold vacuum should be indicated on vacuum gauge; if not, replace CTO.

(5) With engine still running and coolant temperature **below** 160 degrees F, disconnect vacuum line from port No. 1 (outer) of CTO and connect to port No. 2 (inner).

(6) No manifold vacuum should be indicated on vacuum gauge. Replace CTO if vacuum is indicated.

(7) Keep engine running until coolant temperature exceeds 160 degrees F (approximately the beginning of the temperature gauge band). Manifold vacuum should be indicated, if not, replace CTO.

(8) Disconnect line from port No. 2 and connect it to port No. 1. No vacuum should be indicated; otherwise, replace CTO.

(9) Reconnect vacuum lines to CTO.

Removal - Six-Cylinder

(1) Drain coolant from radiator.

(2) Disconnect vacuum lines from spark CTO switch.

(3) Place a drain pan under the engine below CTO switch.

(4) Using a 7 8-inch, open-end wrench, remove switch from block.

WARNING: *Be careful of scalding hot water leaking from block when removing the switch.*

Installation - Six-Cylinder

(1) Drain coolant from radiator.

(2) Connect vacuum lines to switch.

(3) Install coolant.

Removal - V-8 Engine

(1) Drain coolant from radiator.

(2) Remove air cleaner assembly.

(3) Disconnect vacuum lines from CTO switch.

(4) Using a 7/8-inch, open-end wrench, remove switch from thermostat housing.

Installation - V-8 Engine

(1) Install spark CTO switch in thermostat housing.

(2) Install coil and bracket with attaching screw.

(3) Connect vacuum lines to switch.

(4) Install air cleaner assembly.

(5) Install coolant.

(6) Purge cooling system of air.

EMISSION CONTROL MAINTENANCE

GENERAL

The procedures that follow outline scheduled maintenance items identified in the U. S. Emission Control Service, but not outlined in the previous Emission Control System descriptions. Service procedures for components of particular Emission Control Systems are outlined under that system. However, emission

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control also relies upon overall engine performance for efficiency. If engine performance is questionable, refer to the Engine Performance Diagnosis Guide and Diagnosis with Scope Analyzer at the end of this section.

U.S. EMISSION CONTROL SERVICES

A precision electronic diagnosis should be performed whenever questionable engine performance occurs between the scheduled complete precision tune-ups.

SCHEDULED ROUTINE SERVICES

At 5-10-[illegible]-100,000 miles
Heat Valve (exhaust manifold) - inspect and lubricate
Drive Belts - inspect condition and tension and correct if required

EXHAUST GAS RECIRCULATION VALVE SERVICES

At 10-20-30-40-50-60-70-80-90-100,000 miles
Exhaust Gas Recirculation Valve - inspect and clean*
Exhaust Gas Recirculation Discharge Port (6 cylinder) - inspect and clean if required*
*Service every 15,000 miles if leaded fuel is used
Service every 25,000 miles if lead-free fuel is used

COMPLETE PRECISION TUNE-UP

At 15-30-45-60-75-90,000 miles
Engine Oil Filler Cap (filter type) - clean
Heat Valve (exhaust manifold) - inspect and lubricate
Drive Belts - inspect condition and tension and correct if required
Carburetor Air Cleaner Element - inspect and clean if required
Fuel Filter Element - replace
PCV Valve - replace
PCV Hoses - inspect and replace if required
PCV Filter (6 cylinder) - clean
Coil and Spark Plug Wires - inspect and replace if required
Spark Plugs - clean, inspect, regap and test (replace if required)
Ignition Points and Condenser - inspect and replace if required
(check dwell and set if required)
Distributor Cam Lubricator - replace
Ignition Timing - check and set if required
Distributor Advance Mechanisms - check and correct if required
Distributor Cap and Rotor - inspect and replace if required
Idle Speed and Mixture - check and reset
Choke Linkage - inspect for free movement (correct if required)
Transmission Controlled Spark Systems - inspect and correct if required
Fuel System, Cap, Tank, Lines and Connections - inspect for integrity and correct if required
Fuel Vapor Inlet Filter at Charcoal Canister - replace
Air-Guard System Hoses - inspect and correct if required
TAC System - inspect and correct if required
Vacuum Fittings, Hoses and Connections - inspect and correct if required

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IGNITION SYSTEM

Spark Plug Wires

To remove wires from spark plugs, twist the boot slightly to break the seal. Grasp the rubber protector boot and lift straight up with a steady, even pull. Do not pull on the wire itself as this will damage the wire.

To remove wires from the distributor cap or coil tower, loosen the boot first, then grasp the upper part of the boot and the wire and gently pull straight up.

Wire Test

Do not puncture the spark plug wires with a probe while performing any test. This may cause a separation in the conductor. The preferred method is to remove the suspected wire(s) and use an ohmmeter to test for resistance according to the length of the particular wire.

Resistance Values

When installing each spark plug wire or the coil high tension wire, be certain a good tight connection is made at the spark plug, distributor cap tower, or coil tower. The protector boots at the spark plugs and distributor cap must fit tightly. A partially seated wire creates an additional gap in the circuit and the resulting spark jump will cause terminal corrosion and wire damage.

Spark Plugs

The spark plugs should be removed from the engine and examined for burned electrodes and dirty, fouled, cracked, or broken procelains. Plugs should be replaced at the mileage intervals recommended in the U. S. Emission Control Service Chart. Plugs with low mileage may be cleaned. After cleaning, the center electrode should be filed flat with a point file. The gaps must be set to 0.033 to 0.037 inch (fig. 4A-35).

Fig. 4A-35 Spark Plug Gap Check

Always use a torque wrench when installing spark plugs. Distortion from overtightening will change the gap clearance of the plug. Tighten to 25 to 30 foot-pounds torque.

Spark Plug Condition

Refer to figure 4A-36.

Gap Bridging - (A) - May be traced to flying deposits in the combustion chamber. In a few cases, fluffy deposits may accumulate on the plugs during

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in-town driving; when the engine is suddenly put under heavy load, this material can melt and bridge the gap.

Scavenger Deposits - (B) - Fuel scavenger deposits shown may be white or yellow. They may appear to be harmful but this is a normal appearance with certain brand fuels. Such materials are designed to change the chemical nature of deposits to lessen misfire tendencies. Notice that accumulation on the ground electrode and shell areas may be unusually heavy, but the material is easily removed. Such plugs can be considered normal in condition, and can be cleaned with standard practices.

Chipped Insulator - (C) - Usually results from bending the center electrode during regapping of the plug. Under certain conditions, severe detonation can also split insulator firing ends.

Pre-ignition Damage - (D) - Caused by excessive temperatures, produces melting of the center electrode and, somewhat later, the ground electrode. Insulators will appear relatively clean of deposits. Check for correct plug heat range, overadvanced ignition timing and similar reasons for overheating.

Cold Fouling (or Carbon Fouled) - (E) - Dry, black appearance of one or two plugs in a set. Check for sticking valves or bad ignition leads. Fouling of the entire set may be caused by a clogged air cleaner, a sticking exhaust manifold heat valve, or a faulty choke.

Overheating - (F) - Indicated by a dead white or gray insulator which appears blistered. Electrode gap wear rate will be considerably in excess of 0.001 inch per 1000 miles. This may suggest that a cooler heat range should be used; however, overadvanced ignition timing, detonation, and cooling system stoppages can also cause overheating.

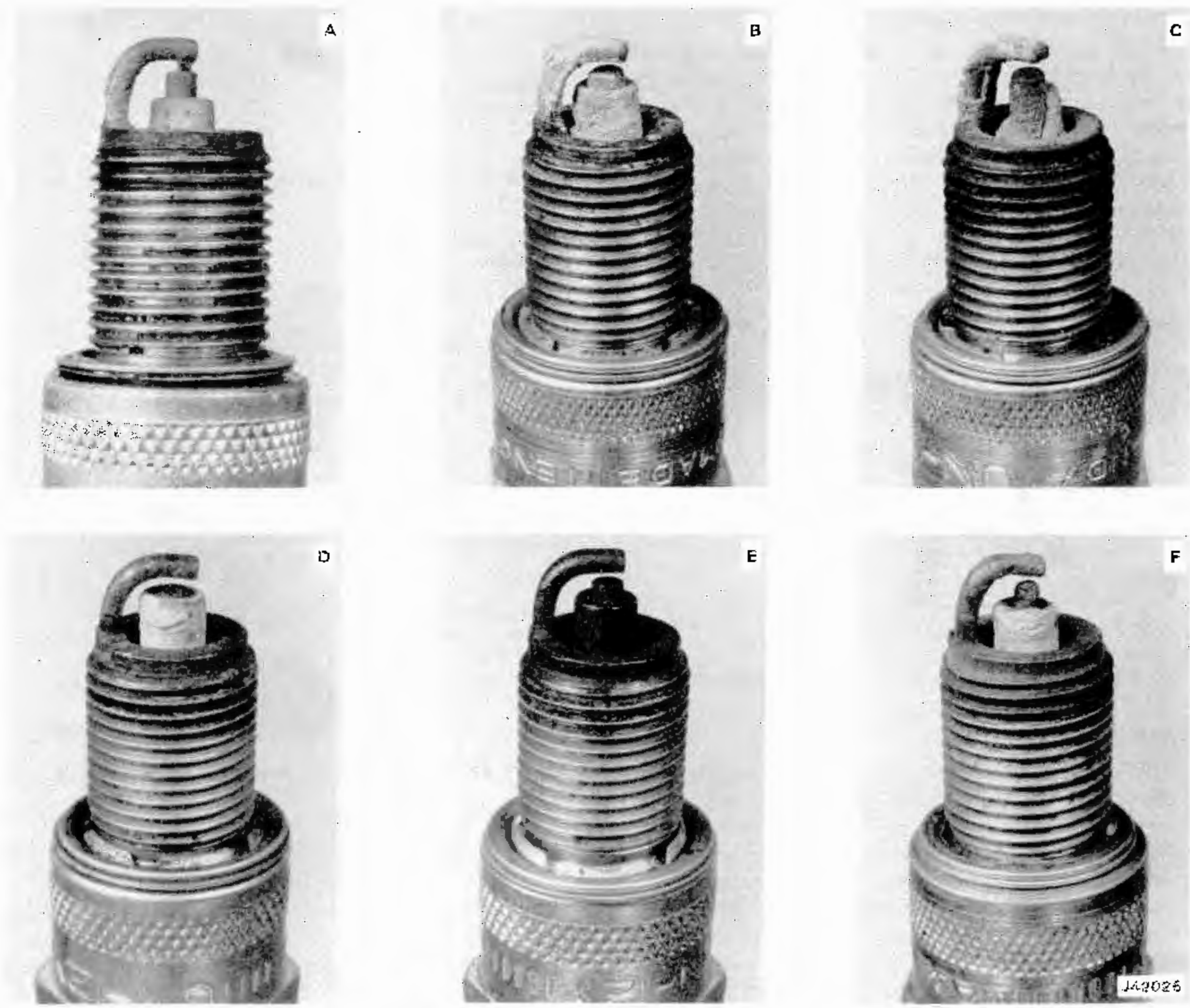

Fig. 4A-36 Spark Plug Conditions

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Ignition Coil

When an ignition coil is suspected of being defective, it should be checked on the vehicle. A coil may break down after it has reached operating temperature. It is important that the coil be at operating temperature when tests are made. Perform the tests following the instructions of the test equipment manufacturer.

Distributor Contact Points

The distributor contact points should be replaced at the mileage intervals specified in the Mechanical Maintenance Schedule, or oftener if they become badly burned or pitted.

Burned contact points may be caused by high resistance or loose connections in the primary circuit, oil or foreign materials on the contact surfaces or high breaking current. Check for these conditions when burned contacts are encountered.

After considerable use, contact surfaces may not appear bright and smooth but this is not necessarily an indication that they are malfunctioning. Rough contacts which are grayish in color have a greater area of contact than new contacts and will perform satisfactorily until most of the tungsten is worn off. Pitted or transferred contacts is a normal condition and the contacts need not be replaced until the transfer has exceeded 0.020 inch (fig. 4A-37).

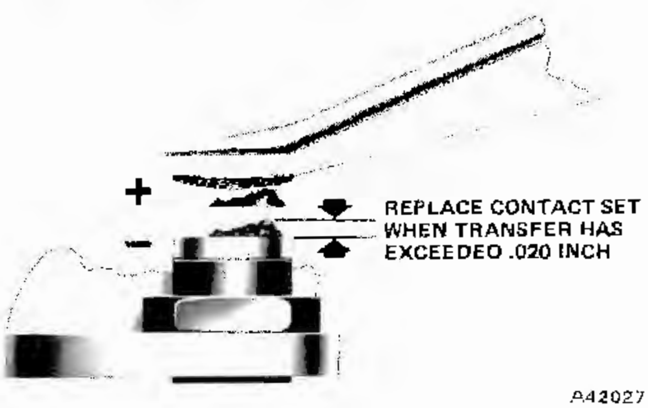

Fig. 4A-37 Distributor Contact Point Condition

Replacement

The contact points are replaced as a complete assembly. The service replacement contact assembly has the breaker lever spring and point alignment preadjusted at the factory. Normally, only the dwell angle (point opening) requires adjustment after replacement. However, in some cases the points may require alignment. Use a point aligning tool to align the point contact surfaces.

The condenser and primary leads are retained by tension of the breaker point spring against a nylon insulator. Remove the leads by pulling straight upward.

Remove the six-cylinder contact point assembly by removing the attaching screw (fig. 4A-38). Remove the V-8 contact point assembly by loosening the two attaching screws (fig. 4A-39).

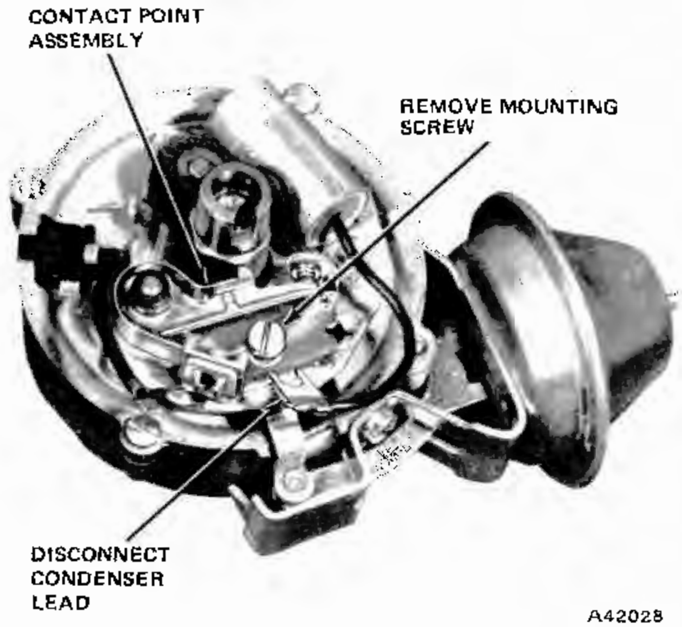

Fig. 4A-38 Contact Point Assembly Removal - Six-Cylinder

Fig. 4A-39 Contact Point Assembly Removal - V-8

CAUTION: *Six-Cylinder - Make sure the locating dowel on the contact set enters the locating hole in the breaker plate.*

V-8 - Make sure pilot hole in the contact base is positioned over the locating dowel on the breaker plate. Observe the location of condenser lead, primary lead, and the plate ground lead (fig. 4A-40). Leads must be properly located to eliminate interference with cam, weight base and breaker advance plate.

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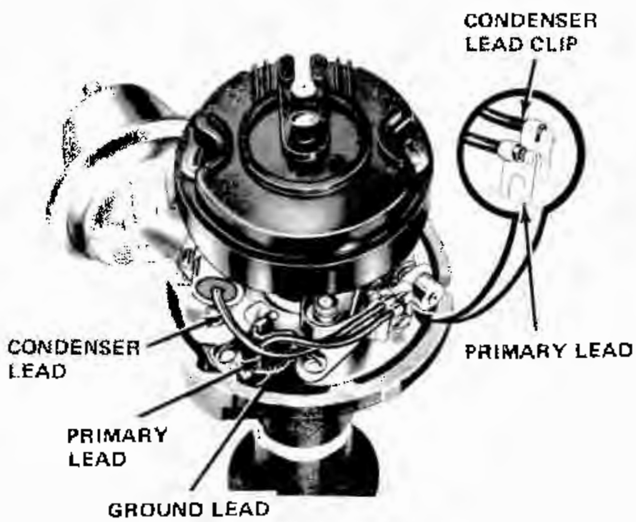

Fig. 4A-40 Primary and Condenser Lead Attachment - V-8

Distributor Point Dwell

Dwell is the period during which the distributor points remain closed for each ignition cycle. The dwell meter electrically measures this period and registers the average for each cylinder in terms of degrees of distributor cam rotation.

The total number of degrees for each ignition cycle is 360 divided by the number of cylinders. Figure 4A-41 shows 60 degrees (between dotted lines) for each cylinder of a six-cylinder engine and 32 degrees as the dwell. A study of this illustration shows that a wider point setting will result in less dwell and a closer point setting will increase the dwell.

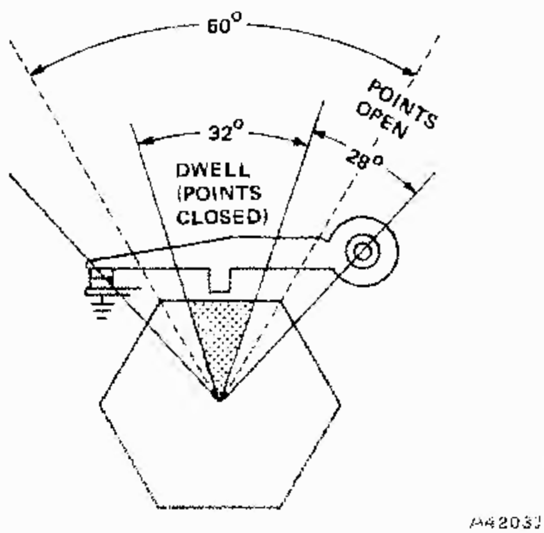

Fig. 4A-41 Point Dwell - Six-Cylinder Shown

To check point dwell, connect the red lead of a dwell meter to the distributor terminal at the coil.

(1) Connect black lead to ground.

(2) Set selector switch to position which corresponds to the number of cylinders in the engine being tested.

Operate engine at idle speed and note readings, refer to Specifications.

If the dwell reading is not to specification, the trouble could be incorrect point spacing, defective point rubbing block or breaker arm, or a misaligned or worn distributor cam.

Dwell Variation

Dwell variation is determined by noting any dwell change as the engine is operated at different speeds. Excessive variation indicates a change in point opening that can result from shaft or bushing wear, or from the distributor plate shifting because of wear or looseness.

Measure dwell variation at idle speed using the same test setup as for checking dwell. Increase speed to 1750 rpm; note dwell reading. Then slowly reduce speed to idle while observing dwell meter. Dwell variation should not exceed three degrees.

If dwell variation exceeds three degrees between idle speed and 1750 rpm, wear in the distributor shaft bushings or breaker plate is indicated. Distributor should then be checked more thoroughly on a distributor tester.

Dwell Angle Adjustment - Six-Cylinder

Remove distributor cap and rotor and loosen contact assembly retaining screw slightly. Connect a dwell meter positive lead to ignition coil negative terminal and negative lead to ground.

CAUTION: *Place transmission in Neutral or Park position. Apply brake firmly.*

Turn car ignition on and crank engine with remote control starter switch while observing the dwell meter reading. Adjust dwell angle by inserting a screwdriver blade in the adjusting slot of the breaker plate and

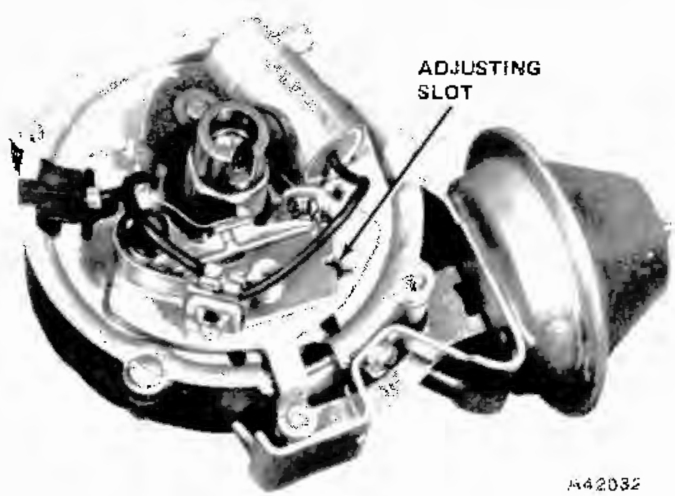

Fig. 4A-42 Adjusting Dwell (Point Spacing) - Six-Cylinder

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moving the plate until the specified setting is indicated on the dwell meter (fig. 4A-42). Tighten retaining screw and recheck dwell angle. Install distributor rotor and cap, verify dwell angle with the engine running.

Dwell Angle Adjustment - V-8

With the engine running at idle, the dwell angle is adjusted by raising the window provided in the cap and inserting an allen wrench into the head of the adjusting screw as shown in figure 4A-43

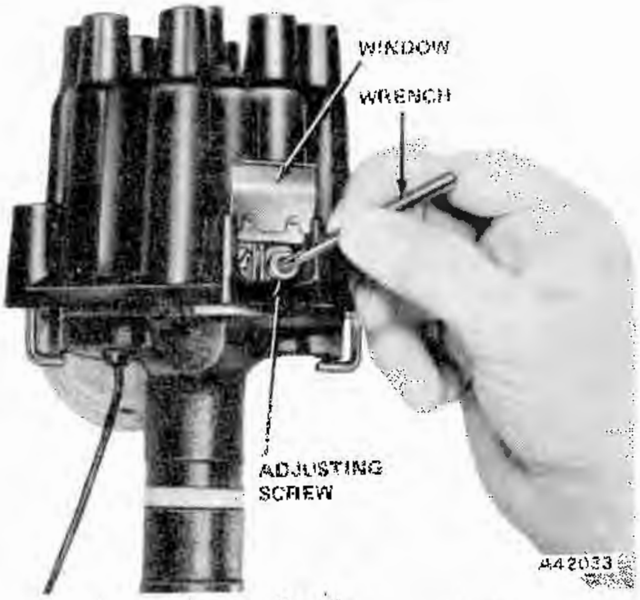

Fig. 4A-43 Adjusting Dwell (Point Spacing) V-8

Breaker Arm Spring Tension

One of the most important items to check is the breaker arm spring tension. This is checked with a spring scale hooked immediately behind the breaker lever contact (fig. 4A-44). Spring tension should be 17 to 21 ounces. The breaker arm on a new set may produce a tension exceeding that specified.

Condenser

The purpose of the condenser in the ignition system is to prevent arcing and pitting at the breaker points and to aid in collapsing the magnetic field of the ignition coil. In order to function properly and to assure good ignition, the condenser must have three important characteristics:

- Minimum Series Resistance
- Correct Capacity
- Minimum Insulation Leakage

The condenser should be checked at the same time as the points. A capacity, leakage, and series resistance test should be made on the condenser.

For a complete check of the condenser follow the instructions of the manufacturer's test equipment being used.

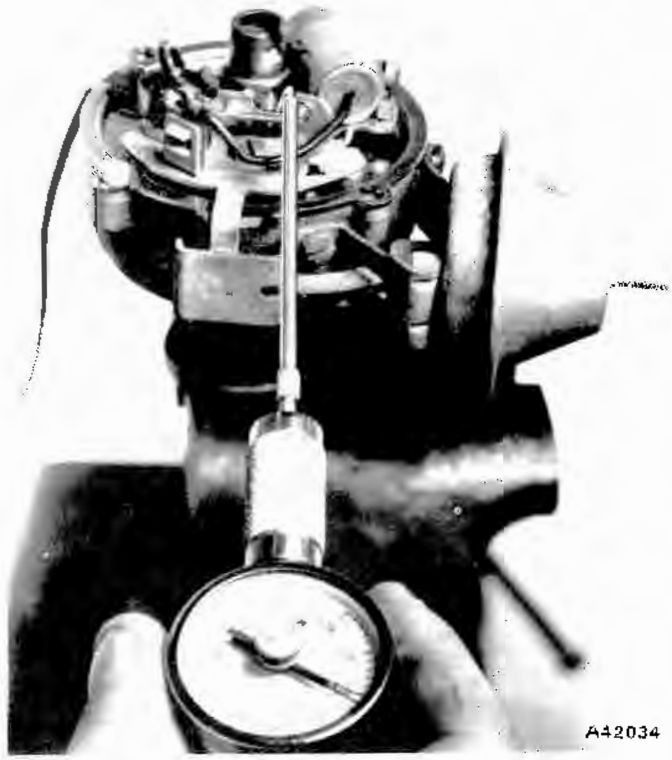

Fig. 4A-44 Breaker Arm Spring Tension - Six-Cylinder Shown

Distributor Cam Lubricator

All distributors are equipped with a cam lubricator. Never oil the lubricator; replace at recommended mileage intervals

Distributor Rotor

The rotor should be visually inspected for cracks, evidence of burning on the top of the metal strip, or evidence of mechanical interference with the cap. If any of the above conditions are found, the rotor should be replaced. Some burning is normal on the end of the metal strip. **This should never be filed.**

Distributor Cap

The distributor cap should be removed and wiped clean with a dry rag. A visual inspection should be made for cracks, carbon runners, and corroded high tension terminals. If any of these conditions are found, the cap should be replaced. In replacing the cap, be sure that the high tension wires are installed in the same towers from which they were removed and that they are pushed down firmly in place.

If the inserts inside the cap are excessively burned, the cap should be replaced. However the vertical face of the insert will show some evidence of burning through normal operation. The inserts should also be checked for evidence of mechanical interference with the rotor tip.

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Distributor Resistance Test

Excessive resistance in the ignition primary circuit from the distributor side of the coil through the points, and to the distributor ground will prevent the coil from producing sufficient output for good overall ignition. Any resistance in this portion of the ignition system will be indicated on a dwell meter during this test (fig. 4A-45).

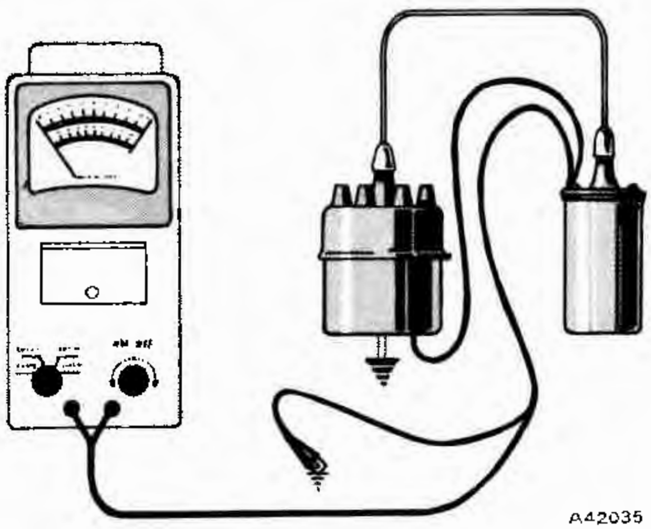

Fig. 4A-45 Distributor Resistance Test

A tach-dwell tester is used for the following tests. Follow the manufacturer's operating instructions.

Test Procedure

(1) Connect red lead to distributor primary lead at coil.

(2) Connect black lead to ground.

(3) Turn ignition switch on but do not start engine; observe dwell meter.

NOTE: *If meter reads zero, crank the engine a fraction of a revolution to close the breaker points.*

Distributor resistance is normal if dwell meter pointer is within range of black bar.

(4) If dwell meter pointer is not within black bar, remove test lead from distributor terminal of coil and connect to each of the following points to determine cause of excessive resistance.

- Distributor primary terminal in the distributor
- Breaker point bracket
- Ground side of points
- Distributor housing

Where a noticeable change occurs in the meter reading in these steps, make necessary correction and repeat test.

Initial Ignition Timing

A graduated degree scale located on the timing chain cover is used for timing the ignition system. A milled notch on the vibration damper is used to reference the No. 1 firing position of the crankshaft with the timing marks on the scale as shown in figures 4A-46 and 4A-47.

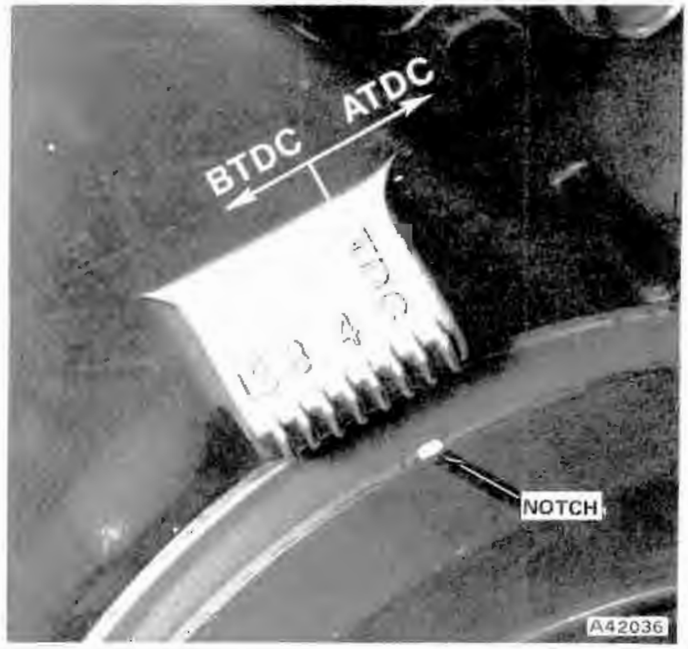

Fig. 4A-46 Timing Mark Location - Six-Cylinder

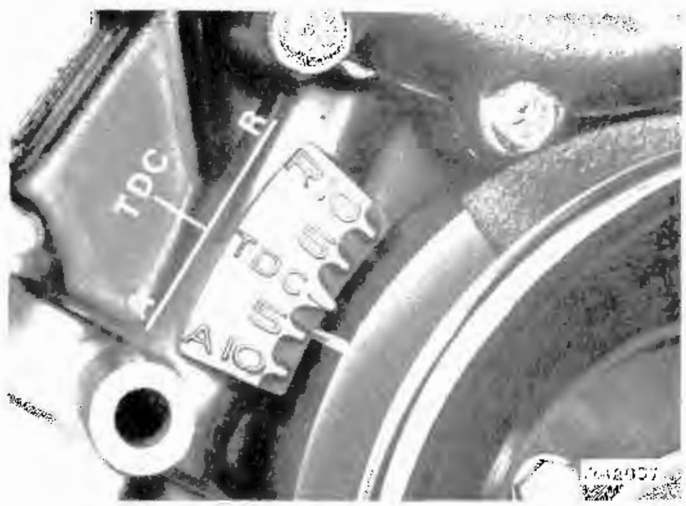

Fig. 4A-47 Timing Mark Location - V-8

Timing Procedure

(1) Disconnect distributor vacuum hose.

(2) Connect an ignition timing light and a properly calibrated tachometer.

NOTE: *If a timing light incorporating an advance control feature is used, the control must be in the off position.*

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(3) Start engine.

(4) Adjust idle speed to 500 rpm.

(5) Adjust initial ignition timing to setting specified on the Tuneup Specifications (On Vehicle) Chart by loosening the distributor holddown clamp and rotating the distributor.

(6) Verify ignition timing after tightening distributor holddown clamp.

Distributor Advance Test Procedure

NOTE: *Distributor advance may also be tested with the distributor out of the vehicle. Follow testing equipment manufacturer's instructions. Refer to Distributor Specifications (On Distributor Tester).*

Adjustable Advance Control Timing Light Procedure

(1) Disconnect the TCS solenoid vacuum valve wires.

(2) Increase engine speed to 2000 rpm.

(3) Turn advance control of ignition timing light until the ignition timing has returned to the initial setting.

NOTE: *The degree reading on the advance meter should be as specified in the Tuneup Specification (On Vehicle) Chart.*

(4) If the total advance at 2000 rpm is less than specified, disconnect vacuum advance hose at distributor.

(5) Check maximum centrifugal degrees advance at engine rpm specified.

If the centrifugal advance degrees are as specified, the vacuum unit must be replaced.

CARBURETION

Engine Idle Speed and Mixture Setting Procedures

The engine and related systems must be performing properly prior to marking carburetor idle speed and mixture adjustments. The idle speed and mixture adjustments must be made with the engine at operating temperature and air cleaner in place (fig. 4A-48, -49, and -50).

Plastic idle limiter caps are installed over the idle mixture screw(s) on all carburetors. The limiters are designed to regulate the adjustment range of the idle mixture screw(s), thereby effectively controlling the exhaust emission level at idle speeds to comply with Federal Standards for emission control. The limiter caps must be removed in order to perform the lean drop idle setting using the tachometer procedure. The infrared analyzer procedure does not normally require limiter cap removal.

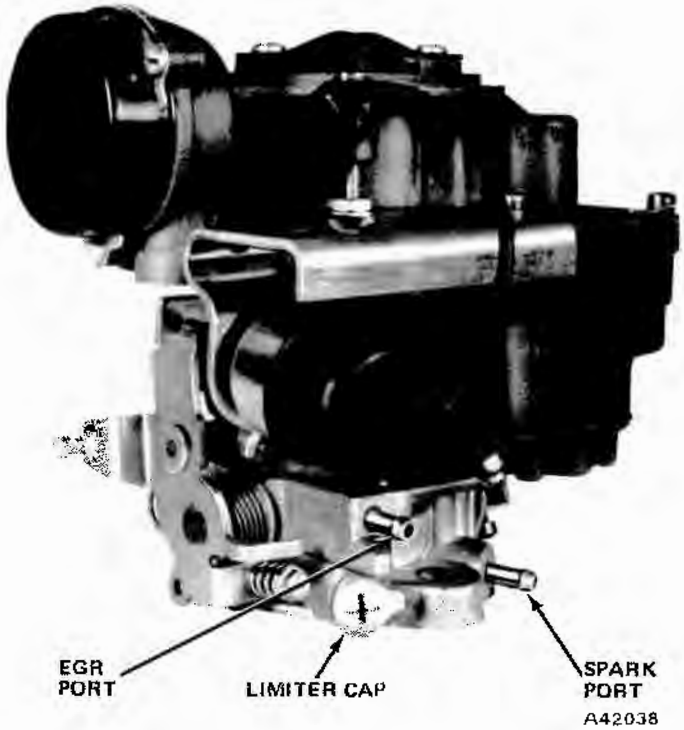

Fig. 4A-48 Model YF Carburetor

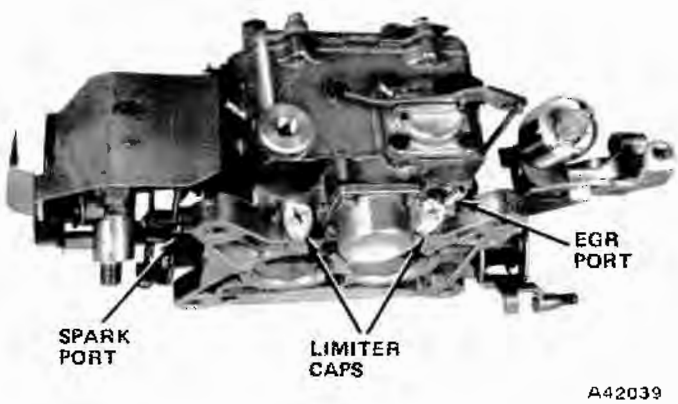

Fig. 4A-49 Model 2100 Carburetor

Proper idle speed and mixture adjustments can be made by following a standard tachometer procedure, in which the idle mixture is adjusted to a lean drop idle setting. A preferred infrared (IR) analyzer procedure, in which the idle mixture is adjusted to obtain a specified carbon monoxide level, may also be used. When following the tachometer procedure, adjustments must be made in the exact detailed sequence outlined to obtain lean drop idle settings and satisfactory idle quality.

WARNING: *Set park brake firmly. Do not accelerate.*

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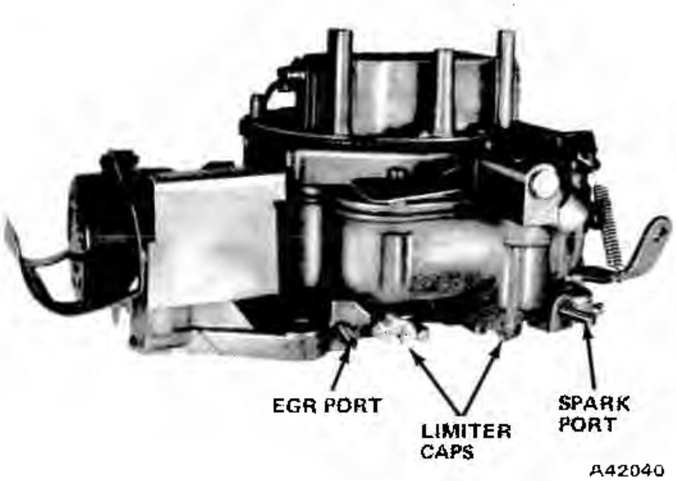

Fig. 4A-50 Model 4300 Carburetor

Tachometer Procedure

NOTE: *To compensate for fuel and temperature variations while performing the idle mixture adjustment:*

(a) Do not idle engine over three minutes at a time.

(b) If the idle mixture adjustment is not completed within three minutes, run engine at 2000 rpm for one minute.

Recheck the idle mixture adjustment at the specified rpm and adjust as required. If the idle mixture adjustment is not completed within three minutes, repeat step (b).

(1) Adjust idle screw(s) to the full rich stop(s). Note position of screw head slot inside limiter cap slots.

(2) Carefully remove idle limiter cap(s) by installing a sheet metal screw in center of cap and turning clockwise. Discard the cap(s).

(3) Reset idle screw(s) to the approximate position noted before the limiter cap(s) was removed (step 2).

NOTE: *The tachometer used should have an expanded scale of 400 to 800 to 0 to 1000 rpm. The instrument should be periodically inspected and calibrated to allow not more than two percent error.*

(4) Start engine and warm to operating temperature.

(5) Adjust idle speed to 30 rpm above the following specified rpm.

Six-Cylinder: Automatic - 550 rpm
Six-Cylinder: Manual - 600 rpm
V-8 Engine: Automatic - 700 rpm
V-8 Engine: Manual - 750 rpm

NOTE: *On all V-8 engines with automatic transmissions, the throttle-stop solenoid is used to adjust curb idle speed. Use the following procedure for idle speed adjustment.*

(a) With solenoid wire connected, loosen solenoid locknut and turn solenoid in or out to obtain specificied idle rpm.

(b) Tighten solenoid bracket.

(c) Disconnect solenoid wire and adjust curb idle speed screw to obtain specified idle rpm.

(d) Connect solenoid wire.

Engine	Transmission	RPM Drop
232-258	Automatic	20 rpm
232-258	Manual	35 rpm
All V-8's	All	40 rpm

(6) Starting from full rich stop position (as established before limiter(s) was removed) turn mixture screw(s) clockwise (leaner) until a loss of engine rpm is indicated.

(7) Turn mixture screw(s) counterclockwise until the highest rpm reading is obtained at lean best idle setting. On carburetors incorporating two mixture screws, turn both screws equally unless the engine demands otherwise.

NOTE: *If the idle speed changed more than 30 rpm during the mixture adjustment, reset to 30 rpm above the specified rpm and repeat the adjustment.*

(8) As a final adjustment, turn mixture screw(s) clockwise until specified drop in engine rpm is obtained.

(9) If rough idle is experienced, the mixture screw(s) may be adjusted independently providing the specified carbon monoxide level is maintained.

(10) If unable to obtain specified carbon monoxide level at either stop, remove limiter cap(s) and adjust idle speed mixture as outlined above.

(11) Install new (blue) service idle limiter cap(s) over idle mixture screw(s) with limiter cap ear(s) positioned against the full rich stop(s). Be careful not to disturb idle mixture setting while installing the cap(s). Press cap(s) firmly and squarely into place.

Infrared (IR) Analyzer Procedure (Preferred)

NOTE: *To compensate for fuel and temperature variations while performing the idle mixture adjustment:*

(a) Do not idle engine over three minutes at a time.

(b) If the idle mixture adjustment is not completed within three minutes, run engine at 2000 rpm for one minute.

(c) Recheck the idle mixture adjustment at the specified rpm and adjust as required. If the idle mixture adjustment is not completed within three minutes, repeat step (b).

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NOTE: *The IR analyzer to be used must be periodically inspected and calibrated to assure accurate readings.*

(1) Connect IR analyzer by precisely following the instructions of the manufacturer.

(2) Start engine and allow sufficient warmup time for engine and analyzer to stabilize.

(3) Recalibrate IR analyzer before proceeding to adjust carburetor.

(4) Insert probe of analyzer at least 18 inches into tailpipe. If car is equipped with dual exhaust, insert probe into the side opposite exhaust manifold heat valve.

NOTE: *The exhaust system and the test equipment must be free of leaks to prevent erroneous readings.*

(5) Adjust idle speed to 30 rpm above the following specified rpm.

Six-Cylinder: Automatic - 550 rpm
Six-Cylinder: Manual - 600 rpm
V-8 Engine: Automatic - 700 rpm
V-8 Engine: Manual - 750 rpm

NOTE: *On all V-8 engines with automatic transmissions, the throttle stop solenoid is used to adjust curb idle speed. Use the following procedure for idle speed adjustment.*

(a) With solenoid wire connected, loosen solenoid locknut and turn solenoid in or out to obtain specified idle rpm.

(b) Tighten solenoid locknut.

(c) Disconnect solenoid wire and adjust curb idle speed screw to obtain specified idle rpm.

(d) Connect solenoid wire.

(6) Observe CO level and compare to following table.

Engine Idle CO Level

Six-Cylinder less Air Guard	1.0 - 1.5%
Six-Cylinder with Air Guard	0.5 - 1.0%
V-8 with Air Guard	0.5 - 1.0%

(7) If less than specified, turn screws counterclockwise 1/16 turn at a time, until specified CO reading is obtained.

(8) If greater than specified, turn screw(s) clockwise until specified CO reading is obtained.

(9) Allow ten seconds for meter to stabilize after each adjustment.

NOTE: *If the idle speed changed more than 30 rpm during the mixture adjustment, reset to the specified rpm and repeat the adjustment until the specified carbon monoxide level is obtained.*

Choke Linkage

All choke linkage including the fast idle cam should be checked for free movement at the mileage intervals specified in the Mechanical Maintenance Schedule.

Free carburetor linkage by applying Jeep Carburetor and Combustion Area Cleaner, or equivalent. Never use oil to lubricate carburetor linkage.

For correct choke system adjustments, refer to Fuel - Carburetion - Exhaust section of this manual.

Exhaust Manifold Heat Valve

An often overlooked, but highly important emission related component is the exhaust manifold heat valve. This valve can affect the gas mileage, performance, driveability and especially emission levels.

This valve is to be inspected for correct operation and lubricated with Jeep Heat Valve Lubricant or equivalent, every 5000 miles. Refer to the Fuel - Carburetion - Exhaust section for service procedures.

DIAGNOSIS WITH SCOPE ANALYZER

General

The scope analyzer is an ignition tester that provides a quick, convenient, and accurate means of measuring ignition system performance quality. Display of all phases of the ignition cycle is graphically shown on the oscilloscope (cathode ray tube) of the test equipment at the very same instant in which they occur while the engine is operating. The pattern (waveform) displayed on the oscilloscope is an easy-to-interpret picture of the ignition system operations.

Most engine performance problems are due to ignition system condition; thus a fundamental understanding of the principles of operation of an ignition system simplifies the interpretation of oscilloscope (Scope Analyzer) patterns.

The following are the key items which must be to factory specifications and in satisfactory condition to assure that the ignition system will operate normally:

- Distributor contact point dwell
- Ignition timing
- Dwell variation
- Distributor cam lobe accuracy
- Available voltage
- Required voltage
- Wiring insulation and quality
- Secondary (high tension) resistance with limits
- Distributor contact point condition and operation

The ignition system can be completely tested with an area-type procedure by the use of a scope analyzer and timing light.

The scope analyzer test can lead directly to the trouble and save valuable time in diagnosis and repair.

If trouble is indicated, detailed tests must be made

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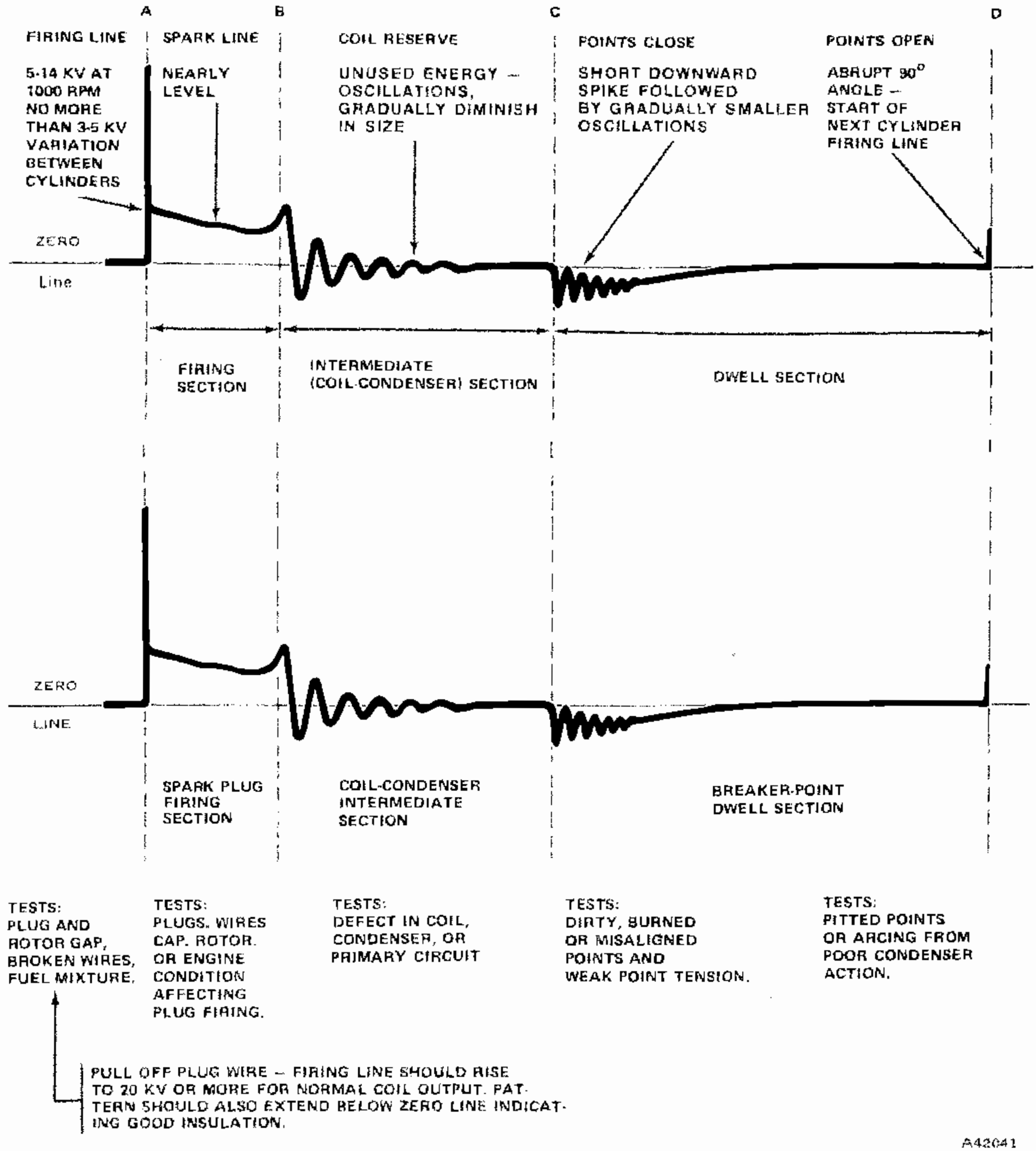

Fig. 4A-51 Individual Scope Tests

to pinpoint the problem. The specific part(s) to be further tested are indicated by the results of the area tested such as is accomplished with the use of a scope analyzer.

A scope analyzer also serves as a final check to assure that whatever repair work has been performed has corrected the problem and that the system is functioning properly.

Each manufacturer provides thorough and detailed description of the numerous capabilities and test procedures possible with their test equipment. In the case of scope analyzers, typical patterns reflecting various

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conditions are clearly defined in the manufacturer's manuals. A good number of scope analyzers also combine in a single unit most of the equipment necessary to perform a complete test of an operating engine.

The scope cannot automatically diagnose the operating performance of an engine; the technician must interpret the display pattern and relate it to the part(s) causing the problem.

Oscilloscope test equipment can show the technician a great deal of information. Spark plug operation is more accurately checked by using a scope analyzer as it indicates exactly how the plugs are firing during actual engine operation.

Without the aid of a scope, extensive testing is usually required to detect bad secondary wiring or reversed coil polarity. Poor or borderline condensers do not show up unless tested separately. Weak coils with shorted windings must be separately tested. Yet, all of these items and many more are checked quickly and accurately by observing the pattern on a scope. The dwell adjustment can be done with meter equipment. However, is the dwell the same for all cylinders? Is the distributor firing each cylinder at the same crankshaft degrees as the No. 1 cylinder? These problems are indicated quickly on the scope.

Most scopes use the same basic cylinder display pattern. Connections, procedures, and controls may vary from one to the other. Various modes of cylinder pattern display are possible: stacked, parade, superimposed, or individual. Simultaneous comparisons can be made to detect the particular cylinder having the problem; the cylinder then can be shown individually for further diagnosis.

The scope pattern (waveform) illustrates voltage in relationship to time. All vertical movement of the pattern trace represents voltage, one polarity when the trace is above the zero line and the opposite polarity when the trace is below the zero line; thus the oscillating pattern waveform above and below the zero line represents ac voltage. This vertical movement (voltage) can be measured by comparing the pattern to the graduations on the vertical scale of the scope screen, calibrated in kv (thousands of volts). Firing line height can be read directly in kv.

Horizontal movement of the pattern trace represents time. The scope screen horizontal scale is graduated in terms of distributor degrees of rotation. If the scope trace is adjusted so that the ignition cycle starts at zero degrees and ends as the proper degree (45 degrees, V-8 or 60 degrees, six-cylinder) on the dwell scale of the scope, this would then represent one complete ignition cycle.

Any portion of the pattern then can be accurately measured in the distributor degrees of rotation. For example, the length of the Dwell Section (described later) would indicate the time in distributor degrees that the distributor points are closed.

Once a basic pattern (waveform) of ignition system operation is understood, the use of the scope analyzer is relatively simple. It is the ignition system itself that will determine the shape of the pattern waveform because the pattern represents actual ignition system operation. Therefore, the only subject that really requires any study to become proficient in the use of the scope analyzer is subject scope pattern (waveform) interpretation.

The pattern displayed on the oscilloscope is a simple one, having just five signals to remember. Figure 4A-51 illustrates the five basic signals and the three sections of an ignition cycle.

Scope Pattern Interpretation

Primary and secondary circuits are interrelated through common ground and coil windings. This permits analysis of both sections when viewing secondary action on the scope.

Although primary waveforms are not as informative as the secondary type, ignition system problems that affect either the Intermediate (Coil-Condenser) or Dwell (Breaker Point) section of the patterns will be indicated in both types of waveforms.

Each part of the waveform represents a specific phase of ignition system operation. For the purpose of understanding and analyzing the scope analyzer pattern, it is divided into three sections: The Firing Section, the Intermediate Section (coil-condenser), and the Dwell Section.

Each section of the complete ignition cycle should be studied individually for particular problems; overall review of the complete cycle can be confusing. Scope manufacturer's manuals are quite thorough in describing and illustrating various conditions that cause the pattern to vary from the normal operating ignition cycle.

Firing Section

This portion of the pattern illustrates the actual firing of the spark plug and is composed of only two lines:

Firing Line - A vertical line indicating the voltage (peak or spike) required to overcome the spark plug and rotor gaps.

Spark Line - A horizontal line indicating the voltage required to maintain the spark.

Two separate events involve the firing of the spark plug. The first is the creation of the firing or ionization voltage. The second event is the arc maintaining voltage or spark line.

Point A in the typical pattern (fig. 4A-51) represents the instant at which the breaker points have separated causing a magnetic field to collapse through the coil windings. The discharge or resulting high voltage is indicated by the vertical rise or spike in the pattern. The height of A indicates the voltage

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required to fire the spark plug and bridge the rotor gap, sometimes referred to as the firing or ionization voltage.

Firing voltage is the amount of voltage required to establish a spark across the electrodes of a spark plug. In a running engine, the actual amount of voltage required to fire a particular spark plug at a particular instant depends on the net result of many factors such as rotor gap, breaks in the secondary wires, spark plug gap, spark plug electrode shape, improperly connected wire terminals, temperature, compression, air-fuel ratio, engine speed, and load.

Since current does not flow in the secondary until the arc is formed across the plug, the peak voltage is created with no current flowing in the secondary. In order to detect resistance in a circuit, current must be passed through the circuit. Therefore, peak voltage readings do not indicate resistance in the secondary.

Actual firing voltages can be easily measured at any reasonable engine speed by observing the height of the firing line on the secondary pattern of each cylinder. At any given engine speed, the firing voltage of all cylinders of an engine should be fairly uniform and within a normal range for that particular engine. engine.

Available voltage is the maximum voltage an ignition system is able to produce under a given operating condition. The ignition coil will produce its maximum secondary voltage whenever it attempts to fire an impossible gap, such as when a spark plug wire is removed from a spark plug and held at a distance from ground. Available voltage is always greater than the voltage requirements generally encountered under normal operating conditions. The difference in available voltage and that actually required to fire the spark plugs is the Ignition Reserve.

The maximum secondary voltage available from the ignition system depends on the combined effect of coil design, coil condition, applied primary voltage, primary circuit resistance, distributor contact condition, dwell angle and engine speed. The normal functioning ignition system is capable of producing well over 20,000 volts and may even produce as high as 30,000 volts. However, should any of the factors involved in the operation of the ignition system deteriorate from their normal condition or adjustment, it will usually result in a change in available voltage values. Therefore, measuring the available voltage or coil reserve provides a quick means of determining the overall efficiency of any particular system.

Once the plug fires, there is a noticeable drop in secondary voltage to point B. As the spark continues to bridge the gap, the spark voltage remains at a fairly constant low value until the spark extinguishes at point C.

A normal spark line is 4 degrees to 7 degrees (read on horizontal scale of scope) at 1000 rpm. If the spark line is not normal, then the spark plug is not firing correctly, probably due to condition of spark plugs, secondary wiring, rotor, cap, or combustion chamber problems.

Once the arc has been formed across the spark plug gap, the voltage reduces to a value needed to maintain the arc across the plug. As long as the coil can supply the lower voltage, the arc will remain. The duration of this spark forms the spark line.

The spark will burn as long as the coil can supply the proper energy. The spark line ends only because the coil has run out of energy. The spark line length is a measure of the reserve of the coil. If the coil has very little reserve after ionizing the gap, all spark lines will be short. If the reserve is high, all spark lines will be long. This will not indicate the maximum reserve of the coil due to its built-in capacity, but does indicate the voltage left in the coil after the plug gap is fired. This reserve or remaining voltage is basically controlled by degrees of dwell and resistance in the secondary circuit.

Intermediate (Coil-Condenser) Section

This portion of the pattern, which immediately follows the Firing Section, is seen as a series of gradually diminishing oscillations which disappear or nearly disappear by the time the Dwell Section begins. Beginning at Point B, the remaining coil energy dissipates itself as an oscillating current which gradually dies out as it approaches Point C. The oscillation results from the combined effects of the coil and the condenser in dissipating energy.

The Intermediate Section represents the dissipation of the energy remaining in the coil after the spark plug has ceased firing and can be observed when each cylinder's pattern is displayed individually.

The number of oscillations that can be observed depends on a number of factors such as dwell angle, engine speed, duration of spark, degree of coil saturation and coil and condenser condition. There must be at least 4 oscillations in this section (at 1000 rpm). Usually there are 5 or 6. Note the rate at which these oscillations diminish. Normally, they should diminish gradually, but should the system contain a weak coil or leaky condenser, they will dimish to zero rapidly. In this case, probably only one or two oscillations will be seen at an engine speed of 1500 rpm, providing the dwell angle and firing section are normal.

Under operating conditions where the firing line is quite long or the dwell angle is greater than specified, the intermediate section may be shortened by the closing of the breaker points before all of the coil energy has been dissipated. Under these conditions, fewer than normal oscillations having a fairly high amplitude at the instant of point closing may be displayed.

This indicates that the energy level in the coil is

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still quite high at the time of point close and does not necessarily mean that the coil or condenser are defective.

Dwell Section

This portion represents the period of time during the ignition cycle in which the distributor contact points are closed. The Dwell Section begins at point C when the contact points close. Closing the points causes a short downward line followed by a series of small rapidly diminishing oscillations. These oscillations represent the buildup of the magnetic field around the coil that occurs when the contact points are closed. The dwell section continues until the points open at the beginning of the next waveform (point D).

In analyzing this section of the pattern, the point close and the point open portions should be carefully observed. Normally, when the points close, this action is seen as a short vertical line followed by a series of diminishing oscillations. The first line should be higher than any of the oscillations following. If the first line is not as long as one or more of the following, it indicates poor point contact. If the oscillations start to die out and then start again, it indicates a point bounce condition.

When the contact points open, the end of the dwell section should appear as a clean right angle formed by the horizontal dwell line and the vertical firing line of the next cylinder pattern. Point arcing upon opening of the contact points will be seen at the right end of the dwell section just prior to the firing line of the next pattern. This will appear as a false start to firing, followed later by the actual firing line, or by a hook at the end of the point close signal.

Proper distributor point dwell is important to the overall operation and efficiency of the ignition system. It should be set to assure adequate coil saturation to meet the firing requirements at all engine speeds. Dwell angle can be accurately measured on most scopes.

The accuracy of the distributor cam determines the ignition timing relationship of all cylinders. Should one or more lobes of the distributor cam become worn or should the distributor shaft be bent, uneven timing of the various cylinders would result.

Cam lobe accuracy can be checked by superimposing all of the cylinders on parade type pattern scopes. On a multiline raster scope, the vertical alignment of all of the point open signals shows immediately any condition that affects timing from one cylinder to the next.

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JEEP TUNE-UP SPECIFICATIONS (ON VEHICLE)

Engine CID	Trans.	Spark Plugs	Break Arm Tension	Condenser Capacity	Point Gap	Cam Dwell Angle	Initial Timing - @700 RPM or Less With Vacuum Hose Disconnected		Curb Idle Speed (RPM)		Distributor Model Number	Vacuum Unit Number	Total ② Advance @2000 RPM	Centrifugal Advance	
							Set-To	OK Range	Set-To	OK Range				Degrees	RPM
232	Man.	N-12Y Gap — .033 - .037 Inches	17-21 oz.	18-23 Mfd.	.016 Inch.	31°-34°	5°	4°-6°	600	550-650	110529	449	27°-36°	0-4 9-14 14-18 14-19	1000 1600 2000 3000
258	Man.						3°	2°-4°	600	550-650					
	Auto.								550 ①	500-600					
304	Man.					29°-31°	5°	4°-6°	750	700-800	1112179	448	29.5°-37.5°	0-2 9-13 16-19.5 21.5-25.5	800 1500 2000 3000
360 (2V)	Man.								750	700-800	1112112	448	28.5°-37°	0-3.5 7-11 15-19 19.5-23.5	1000 1500 2000 3000
	Auto.								700 ①	650-750	1112215	450	26.5°-35.5°	0-3 10-14.5 13-17 18.5-23	800 1500 2000 3000
360 (4V)/401	Man.								750	700-800					
	Auto.								700 ①	650-750					
401 Heavy Duty (Painted Red)	Man.						2.5°	1.5°-3.5°	650	600-700					
	Auto.								600 ①	550-650					

① Idle To Be Set With Transmission In Drive and Park Brake Applied. Do Not Accelerate Engine. Air Conditioning Must Be 'Off' For Final Idle Setting.

② Disconnect TCS Wires At Solenoid Vacuum Valve

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JEEP DISTRIBUTOR SPECIFICATIONS (ON DISTRIBUTOR TESTER)

Distributor Model Number	Vacuum Unit Number	Distributor Degrees and RPM				
		Centrifugal Advance		Vacuum Advance (Inches of Mercury)		Full Vacuum Advance Degrees
		Degrees	RPM	Start	Full	
1110529	449	0-2 4.5-7 7-9 7-9.5 10-13 12-14	500 800 1000 1500 2000 2300	5-7	12.75-13	6.5-9
1112179	448	0.1 4.5-6.5 8-9.75 12.5-13.5 15-17	400 750 1000 1600 2200	5-7	11.25-12.75	6.75-8.25
1112112	448	0-1.75 4.5-6.5 7.5-9.5 9.75-11.75 12-14	500 800 1000 1500 2000	5-7	11.25-12.75	6.75-8.25
1112215	450	0-1.5 4-6.75 6.5-8.5 10-12 14-16	400 600 1000 1600 2200	4-6	11.5-13	6.75-8.25

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SPECIFICATIONS

Accelerator Pump - Snap throttle
from 1000 rpm . . . . 1 to 1-1/2 AFR Enrichment

Belt Tension
Predelivery or belt with previous service (Except V-8, W/AC) . . . . . . 90-115 lb
V-8, W/AC . . . . . . 105-130 lb
New Belt . . . . . . 125-155 lb
Air Pump*
Hand-tighten (50 lbs. maximum – new belt) . . . . . . 35-45 lb
*If driven by AC belt, use tension specified for W/AC

Cam Lobe Variation - At 1000 rpm . . . . . . 2° max.

Carbon Monoxide Level at Idle
Six-cylinder w/o Air Guard 1.0-1.5%
Six-cylinder with Air Guard 0.5-1.0%
V-8 with Air Guard 0.5-1.0%

Carbon Monoxide Level at 1000 RPM
Six-cylinder 0.5%
V-8, 2V - automatic 0.7%
V-8, 2V - manual 0.3%
V-8, 4V - all 0.5%

Cranking Vacuum - This test must have operating battery voltage, completely closed throttle valve(s), PCV valve completely closed . . . . . . 9 inches/min.

Cranking Voltage - Engine at operating temperature . . . . . . 9.6 v/min.

Dwell Variation - From idle to 1000 rpm
(on dwell meter) . . . . . . 3° max.

Ignition Coil

Engine	Six Cylinder	V-8	
Manufacturer	Delco-Remy or AMC	Delco-Remy	AM
Primary Resistance (Ohms)	1.40-1.65 @75° F	1.77-2.05 @75° F	1.64-1.80 @75° F
Secondary Resistance (Ohms)	3,000-20,000 @75° F	3,000-20,000 @75° F	9,300-11,800 @75° F

Coil Output - When cranking, coil H.T. lead removed from dist., battery, voltage of 9.6 min. . . . . . . 24 kv min.

Maximum Starter Draw . . . . . . 180-220 amps max.
Rotor Air Gap - At 1000 rpm . . . . . . 5-8 kv
Spark Plug - Firing Voltage at 1000 rpm . . . . . . 5-14 kv

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1974 JEEP EMISSION CONTROL SYSTEMS APPLICATION CHART

Jeep Model	CJ-5/6				Cherokee										Wagoneer						Truck																	
Model Code	83 and 84				16 and 17										14 and 15						25 and 45										46 (Heavy Duty)							
Engine CID	232/258		304		258		360 (2V)				360 (4V)		401		360 (2V)		360 (4V)		401		258		360 (2V)				360 (4V)		401		360 (2V)				401			
Transmission	M				M	A	M	A	M	A	A		A		A		A		A		M	A	M	A	M	A	A		A		M	A	M	A	M	A	M	A
Emission Control System	NW	Cal.	NW	Cal.	NW		NW		Cal.		NW	Cal.	NW	Cal.	NW	Cal.	NW	Cal.	NW	Cal.	NW		NW		Cal.		NW	Cal.	NW	Cal.	NW		Cal.		NW		Cal.	
Air Guard			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Engine Mod	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
EGR	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TAC	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
TCS	●	●	●		●	●	●	●							●		●				●	●	●	●			●											
TVS							← Standard Cooling Only →								← Standard Cooling Only →								← Standard Cooling Only →								← Standard Cooling Only →							
Spark CTO	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PCV	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
FTVEC	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●			●	●
BPS										●		●				●		●								●		●										
Electric Choke											●	●	●	●			●	●									●	●	●	●								
VTM				●					●																●						●	●	●	●	●	●	●	●

Engine Mod - Emission Calibrated Distributor, Carburetor, Camshaft
Air Guard - Air Injection System
EGR - Exhaust Gas Recirculation System
TAC - Thermostatically Controlled Air Cleaner
TCS - Transmission Controlled Spark System
TVS - Thermal Vacuum Switch
Spark CTO - Coolant Temperature Override Switch (160°)
PCV - Positive Crankcase Ventilation System

FTVEC - Fuel Tank Vapor Emission Control System
Electric Choke - Electric Assist Choke
BPS - Back Pressure Sensor
VTM - Vacuum Throttle Modulator
M - Manual Transmission
A - Automatic Transmission
NW - Nationwide application
Cal. - California only

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CLUTCH

GENERAL

The clutch is a single plate, dry disc type. A steel cover assembly bolted to the flywheel contains the clutch driven plate, release levers and springs.

Two types of clutch covers are used, a 10-1/2 inch diameter direct spring pressure type and an 11-inch diameter semicentrifugal type. The direct spring pressure type and semicentrifugal type are similar. Both apply direct spring pressure to the pressure plate to provide engagement. However, the semicentrifugal cover utilizes six rollers that are forced outward by centrifugal action to apply extra force to the pressure plate and positive clutch action at high engine rpm (fig. 5-1).

Although no internal adjustment is provided for wear of the disc, release lever height should be checked and adjusted

The operating linkage components are shown in figures 5-2 and 5-3.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
CLUTCH CHATTER	(1) Grease on driven plate (disc) facing	(1) Replace disc
	(2) Binding clutch linkage	(2) Check for worn, bent, broken parts. Replace as required.Lube linkage.
	(3) Loose, damaged facings on driven plate (disc)	(3) Replace disc
	(4) Engine mounts loose	(4) Tighten mounts. Replace if damaged.
	(5) Incorrect height adjustment of pressure plate release levers	(5) Adjust release lever height
	(6) Clutch housing or housing to transmission adapter misalignment	(6) Check bore and face run out. Correct as required.
	(7) Loose driven plate hub	(7) Replace driven plate
CLUTCH GRABBING	(1) Oil, grease on driven plate (disc) facing	(1) Replace driven plate
	(2) Broken pressure plate	(2) Replace pressure plate

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
CLUTCH GRABBING (Continued)	(3) Warped or binding driven plate. Driven plate binding on clutch shaft	(3) Replace warped driven plate. Replace clutch shaft if defective, scored, worn.
CLUTCH SLIPS	(1) Lack of lubrication in clutch linkage (linkage binds, causes incomplete engagement)	(1) Lubricate linkage
	(2) Incorrect pedal, or linkage adjustment.	(2) Adjust as required
	(3) Broken pressure plate springs	(3) Replace pressure plate.
	(4) Weak pressure plate springs	(4) Replace pressure plate.
	(5) Grease on driven plate facings (disc)	(5) Replace driven plate (disc)
INCOMPLETE CLUTCH RELEASE	(1) Incorrect pedal or linkage adjustment or linkage binding	(1) Adjust as required. Lubricate linkage.
	(2) Incorrect height adjustment on pressure plate release levers	(2) Adjust release lever height
	(3) Loose, broken facings on driven plate (disc)	(3) Replace driven plate
	(4) Bent, dished, warped driven plate caused by overheating	(4) Replace driven plate
GRINDING, WHIRRING GRATING NOISE WHEN PEDAL IS DEPRESSED	(1) Worn or defective throwout bearing	(1) Replace throwout bearing
	(2) Starter drive teeth contacting flywheel ring gear teeth	(2) Look for milled or polished teeth on ring gear. Align clutch housing, replace starter drive or drive spring as required.
SQUEAL, HOWL, TRUMPETING NOISE WHEN PEDAL IS BEING RELEASED (OCCURS DURING FIRST INCH TO INCH AND ONE-HALF OF TRAVEL)	(1) Pilot bushing worn or lack of lubricant	(1) Replace worn bushing. If bushing appears OK, polish bushing with emery, soak lube wick in oil, lube bushing

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
SQUEAL, HOWL, TRUMPETING NOISE WHEN PEDAL IS BEING RELEASED (OCCURS DURING FIRST INCH TO INCH AND ONE-HALF OF TRAVEL) (Continued)		with oil, apply film of chassis grease to clutch shaft pilot hub, reassemble. NOTE: Bushing wear may be due to misalignment of clutch housing or housing to transmission adapter
VIBRATION OR CLUTCH PEDAL PULSATION WITH CLUTCH DISENGAGED (PEDAL FULLY DEPRESSED)	(1) Worn or defective engine or transmission mounts (2) Flywheel run out, or damaged or defective clutch components	(1) Inspect and replace as required (2) Replace components as required. (Flywheel run out at face not to exceed 0.005)

CLUTCH LINKAGE ADJUSTMENT

(1) Adjust bellcrank outer support bracket to provide approximately 1/8 inch bellcrank end play.

(2) Lift clutch pedal up against pedal stop.

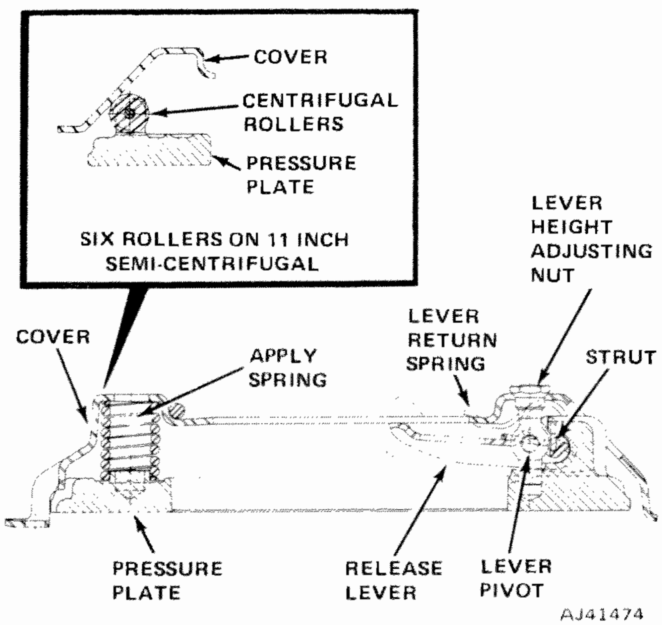

Fig. 5-1 Direct Spring Pressure and Semicentrifugal Type Clutches

(3) On clutch push rod (pedal-to-bellcrank), adjust lower ball pivot assembly on or off of rod as required to position bellcrank inner lever parallel to front face of clutch housing (slightly forward from vertical).

(4) Adjust clutch fork release rod (bellcrank to release fork) to obtain maximum specified clutch pedal free play.

CLUTCH REMOVAL

(1) Remove transmission and transfer case.

(2) Remove starter, throwout bearing and sleeve assembly and clutch housing.

(3) Align mark clutch cover, pressure plate and flywheel to ensure correct alignment during assembly.

CAUTION: *When removing the clutch cover from the flywheel, loosen the attaching screws in rotation, one or two turns at a time, until spring tension on the cover is released. The clutch cover is a steel stamping which could be warped by improper removal procedure, resulting in clutch chatter when re-used.*

(4) Inspect crankshaft pilot bushing, flywheel, transmission clutch shaft, throwout bearing and sleeve assembly, driven plate, clutch cover, and clutch housing alignment.

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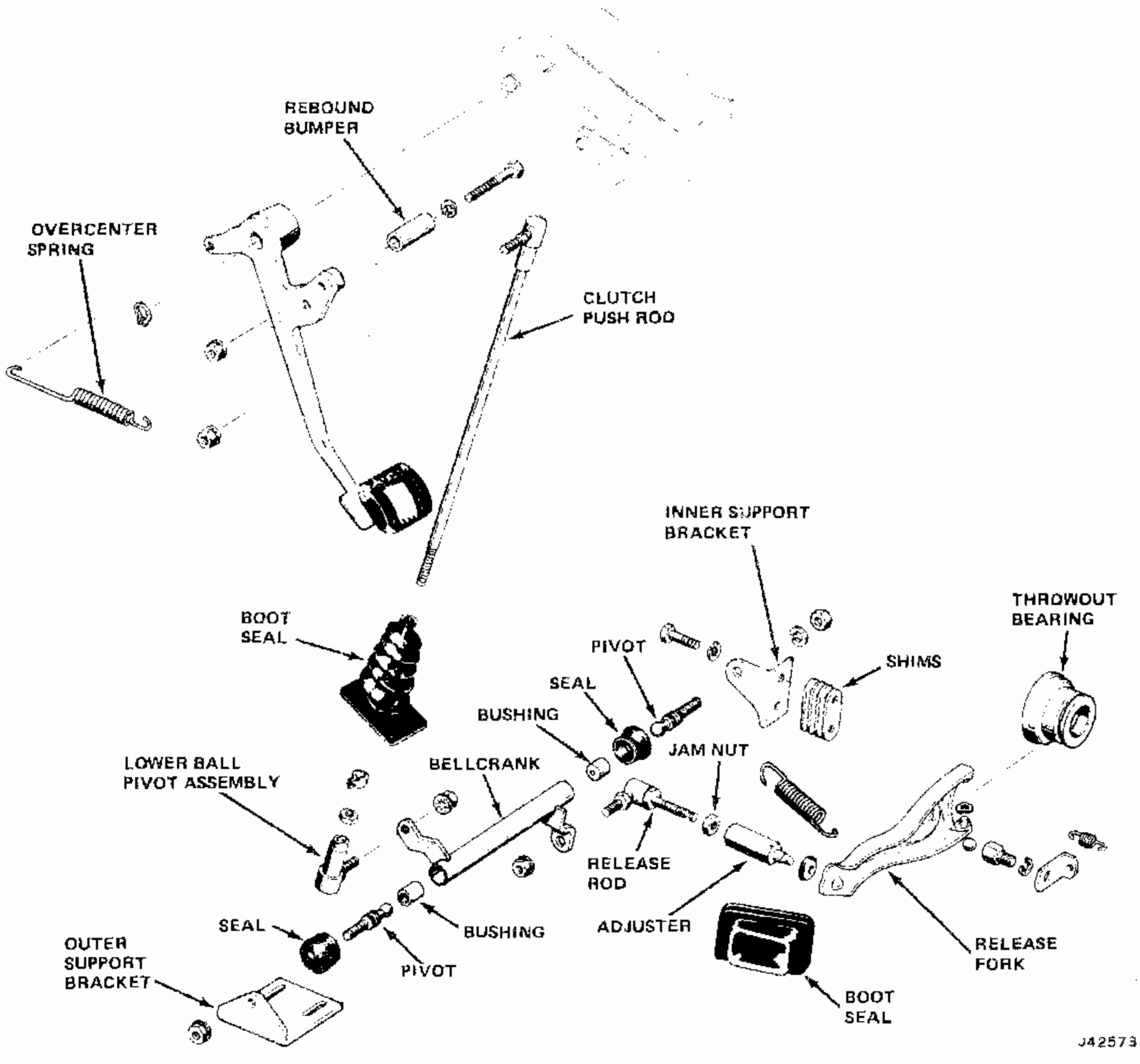

Fig. 5-2 Clutch Operating Linkage Components - CJ Models

DRIVEN PLATE

No repair of the clutch driven plate is recommended. A new plate should be installed if the plate or cushion springs are defective. The cushion springs must not be bent out of shape or flattened, but may be loose in the hub

THROWOUT RELEASE BEARING

The clutch throwout or release mechanism consists of a forked lever which pivots on a ball pivot threaded into the clutch housing. A clutch fork return spring (fig. 5-2 and 5-3) is anchored to a clip under the ball pivot and holds the lever in contact with the ball pivot. The clutch throwout bearing and sleeve, which is a prelubricated unit, is attached to the forked end of the throwout lever with a wave washer on the lower pin.

Never wash the clutch throwout release bearing in any solvent that will dissolve the lubricant. It is neither necessary nor possible to lubricate this bearing.

CRANKSHAFT PILOT BUSHING

Inspection

When the clutch assembly is removed from the flywheel, inspect the pilot bushing for wear, scoring, and looseness. Replace any damaged bushings.

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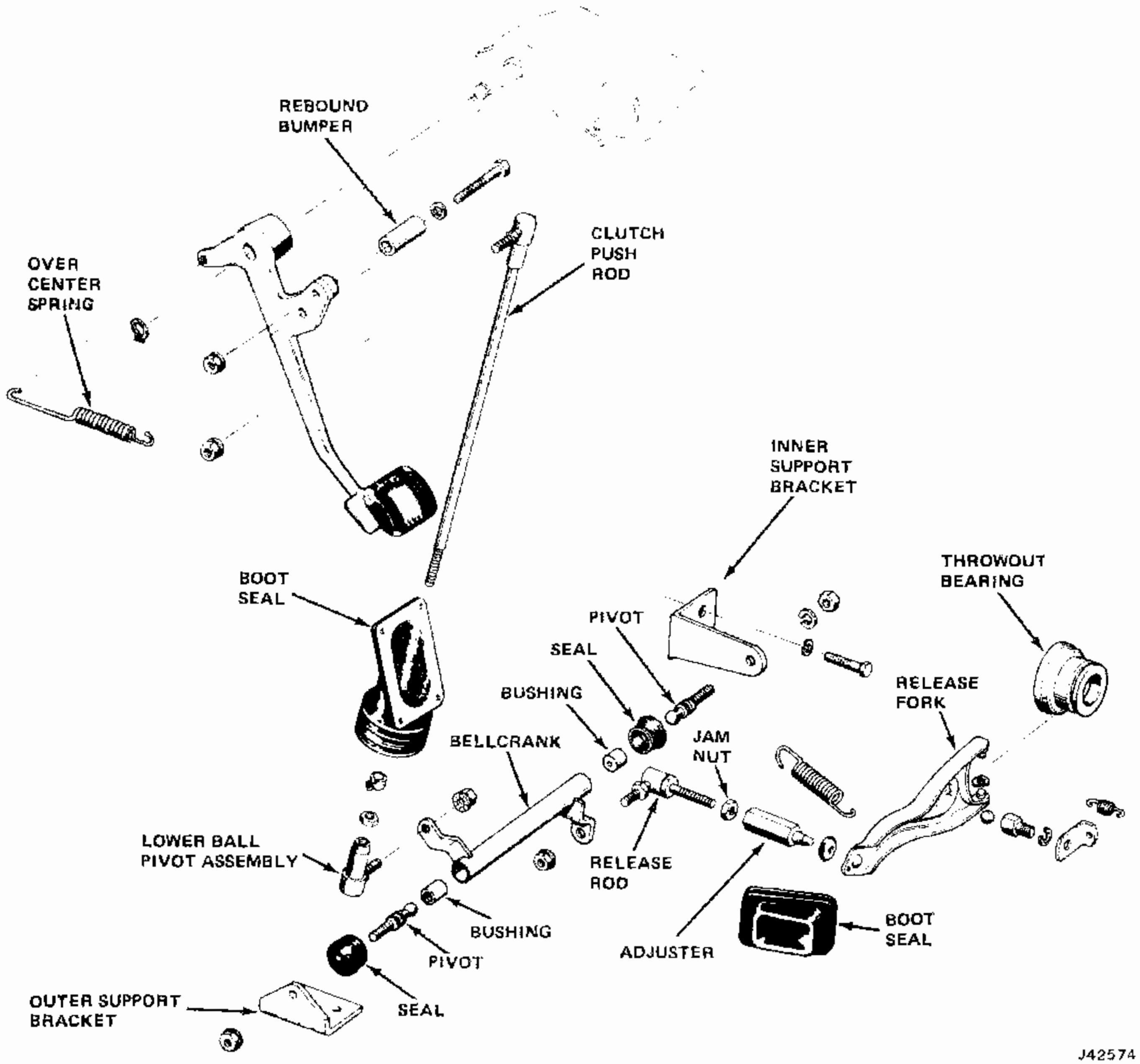

Fig. 5-3 Clutch Operating Linkage Components - Cherokee, Wagoneer, and Truck

Removal

(1) Fill crankshaft cavity and pilot bushing bore with an all-purpose lubricant.

(2) Insert clutch aligning tool straight into bushing and tap end of tool with a lead or brass hammer. Hydraulic pressure will force the bushing out of crankshaft without damaging bushing.

Installation

(1) Clean all grease from the crankshaft cavity.

(2) Soak bushing in engine oil. Soak lubrication wick in engine oil. Apply film of chassis grease to clutch shaft pilot hub.

(3) Use clutch aligning tool as a bushing driver and install bushing straight into crankshaft until bushing is seated.

FLYWHEEL

Inspect the condition of the flywheel as well as the pressure plate for any roughness. Check all flywheel capscrews for tightness. Tighten the capscrews to 105 foot-pounds.

TRANSMISSION CLUTCH SHAFT

Slide the clutch driven plate onto the transmission clutch shaft to make sure that it is free on the splines. If the splines on the transmission clutch shaft are bur-

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red, remove the burrs with a file or stone. If the clutch drive plate is not free to move on the splines. incomplete release will result and cause hard shifting of the transmission.

CLUTCH HOUSING ALIGNMENT PROCEDURE

A misaligned clutch housing can cause improper clutch release, driven plate failure, front transmission bearing failure, uneven wear in the crankshaft pilot bushings, clutch cackle noise, vibration, and in extreme cases of misalignment, jumping out of gear on deceleration. Should any of these malfunctions occur, the rear face of the flywheel housing should be checked for alignment.

Without Transmission Adapter

Use the following procedure to check clutch housing alignment when the vehicle is not equipped with a clutch housing-to-transmission adapter.

(1) Remove transmission as outlined in Section 6 - Manual Transmission.

(2) Remove clutch housing and clutch assembly.

(3) Remove one flywheel attaching bolt.

(4) Use a four-inch long 1/2 -20 bolt and a nut for a dial indicator support.

(5) Install nut on bolt so that 10 or 12 threads are exposed and install bolt in crankshaft.

(6) Tighten nut so bolt is held securely in place.

(7) Install clutch housing on engine and tighten attaching bolts to specified torque.

(8) Install a dial indicator so that it contacts rear face of clutch housing approximately 1/8 inch from edge of rear opening (fig. 5-4).

(9) Check squareness of face of housing by turning crankshaft.

(10) Total indicator reading should not exceed 0.010 inch.

NOTE: ***Crankshaft end play must be held to zero when checking face alignment.***

(11) The following procedure may be used to correct indicated mislignment of clutch housing.

(12) Install shims between clutch housing and engine to clutch housing spacer.

(13) Refer to figure 5-5. Shims should be installed at points A to correctly align top with bottom of housing. Shims installed at points B and D or C and E will correct misalignment at either side of clutch housing. Shims installed at points D and E will correctly align bottom to top.

(14) To install shims, loosen clutch housing assembly.

(15) Locate shims where necessary by loosening bolts and inserting shims in place.

(16) Tighten bolts and recheck face alignment.

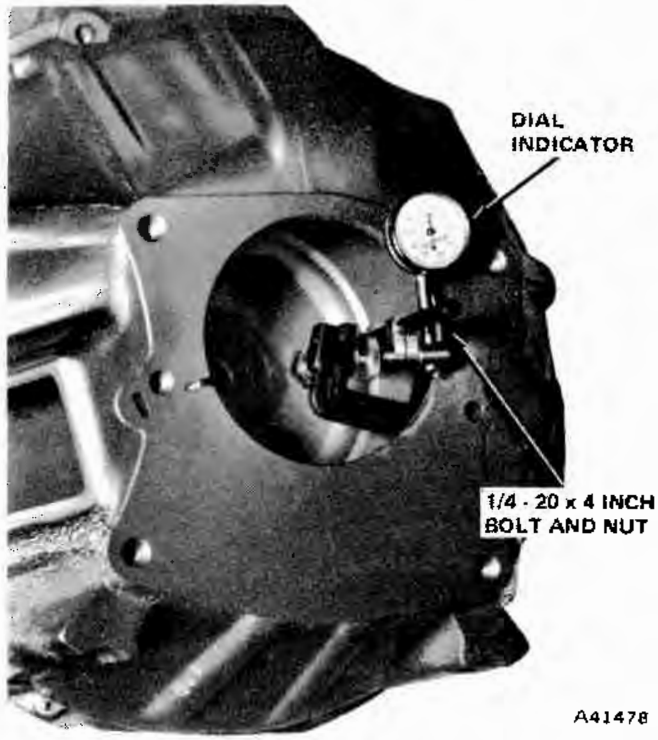

Fig. 5-4 Location of Dial Indicator

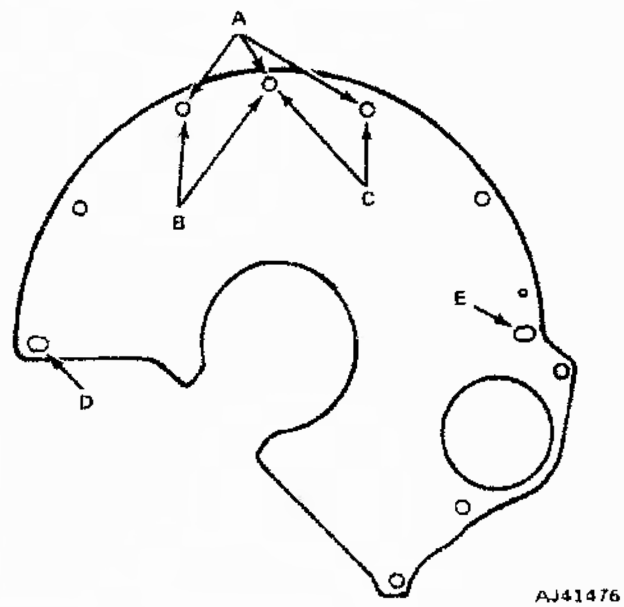

Fig. 5-5 Shim Locations - 232 CID Engine Shown

(17) Total indicator reading on face of flywheel housing should not exceed 0.010 inch. Relocate shims if necessary to bring reading within limits.

(18) To check bore alignment, locate dial indicator on inside diameter of rear opening of clutch housing.

(19) Rotate crankshaft and note indicator reading at four equally spaced points. Total indicator reading must not exceed 0.010 inch.

(20) Any change in face alignment will change bore alignment. Therefore, it may be possible to correct

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bore alignment by changing face alignment. Where it is impossible to correct bore alignment to within a maximum of 0.010 inch runout with change of face alignment (not to exceed 0.010 inch), replace housing.

CLUTCH HOUSING ALIGNMENT

With Transmission Adapter

Use the following procedure to check clutch housing-to-transmission adapter for proper alignment.

(1) Remove transmission as outlined in Section 6 - Manual Transmission.

(2) Remove clutch housing, with adapter attached, and remove clutch assembly.

(3) Remove one flywheel attaching bolt.

(4) Obtain a 1/2 -20 by 5-inch long bolt and one 1/2 -20 nut. Bolt and nut will serve as support for dial indicator.

(5) Thread nut onto bolt so that 10 to 12 threads are exposed. Install bolt in flywheel and tighten nut securely.

(6) Install clutch housing, with adapter attached, onto engine. Tighten upper bolts to 35 foot-pounds torque, and lower bolts to 45 foot-pounds torque.

(7) Install dial indicator on 1/2 -20 bolt. Position indicator so it contacts transmission mating face of adapter about 1/8 inch in from edge of adapter bore.

(8) Turn dial indicator to zero and rotate crankshaft to check runout at adapter face. Runout should not exceed 0.010 inch at any point through 360 degrees of rotation.

NOTE: *Crankshaft end play must be held at zero while checking face runout.*

(9) Position dial indicator so it contacts bore surface of adapter at approximately center of bore.

(10) Turn dial indicator to zero and rotate crankshaft to check runout of adapter bore. Runout should not exceed 0.010 inch at any point through 360 degrees of rotation.

NOTE: *Crankshaft end play must be held to zero while checking bore runout.*

(11) Correct adapter misalignment as follows:

(a) If runout at adapter bore is OK but out of tolerance at face, shim clutch housing as required to obtain runout of 0.010 inch or less. Shim housing as described under Clutch Housing Alignment (fig. 5-5).

(b) If runout at adapter face is OK but out of tolerance at bore, proceed as follows:

1. Back off adapter-to-clutch housing bolts one turn.

2. Tap adapter lightly with hammer to reposition. Move adapter up, down, or side to side as required to obtain runout of 0.010 inch or less.

3. When runout is corrected, tighten adapter bolts to 35 foot-pounds torque. Recheck runout and readjust if required.

(c) If runout at adapter face or bore cannot be brought within tolerance, replace adapter and clutch housing.

(12) After correcting alignment, remove dial indicator and clutch housing with adapter attached.

NOTE: *If clutch housing was shimmed, note location of shims for correct assembly.*

(13) Remove 1/2 -20 by 5-inch bolt from flywheel and install flywheel bolt removed previously. Tighten bolt to 100 to 110 foot-pounds torque. Install clutch assembly. Tighten clutch cover bolts to 40 foot-pounds torque.

(14) Install clutch housing with adapter attached. Tighten upper bolts to 35 foot-pounds torque, and lower bolts to 45 foot-pounds torque.

(15) Install transmission as outlined in Section 6 - Manual Transmission.

CLUTCH RELEASE LEVER ADJUSTMENT

NOTE: *Always inspect release lever height adjustment before installing clutch cover assembly.*

(1) Place Clutch Gauge Plate, Tool J-1048 on flywheel in position normally occupied by driven plate.

(2) Position cover assembly over gauge plate. Release levers should be directly over machined lands of gauge plate and gauge plate hub should be centered between ends of release levers (fig. 5-6).

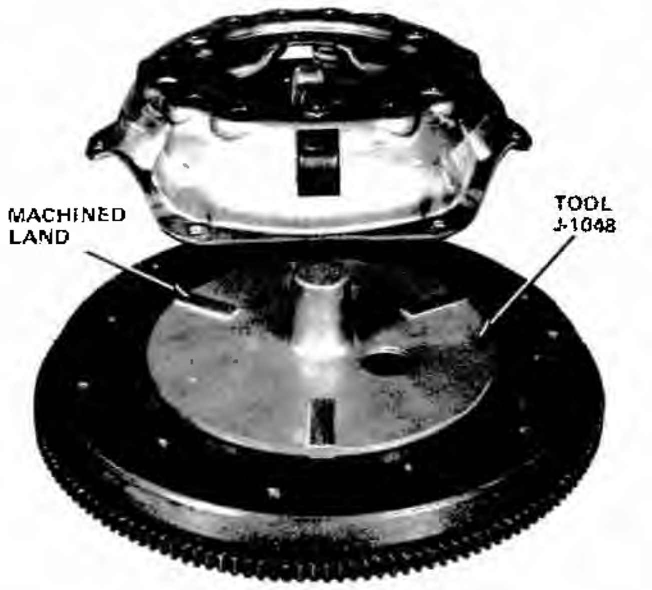

Fig. 5-6 Clutch Gauge Plate J-1048

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Fig. 5-7 Depressing Clutch Levers

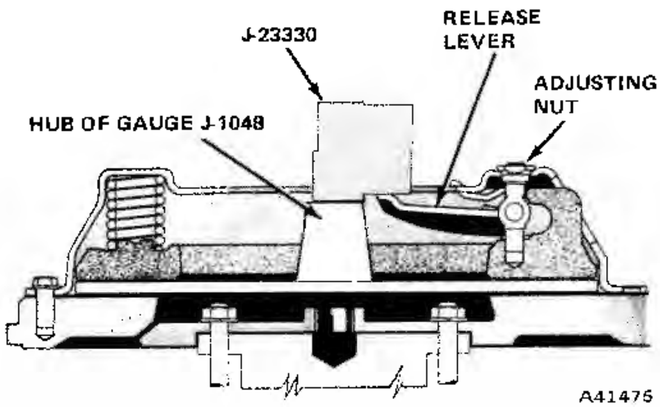

Fig. 5-8 Clutch Release Lever Height Adjustment

(3) Attach cover assembly to flywheel. Tighten cover attaching screws in rotation, one or two turns at a time, to avoid distortion of cover.

(4) Depress each release lever several times to seat levers in their operating positions (fig. 5-7).

(5) Measure height of each lever relative to gauge hub. Clutch Lever Height Gauge, Tool J-23330 has four different dimensional settings which can be used for measuring above and below hub (fig. 5-8).

(6) Adjust release levers by turning lever height adjusting nuts until lever is at specified height.

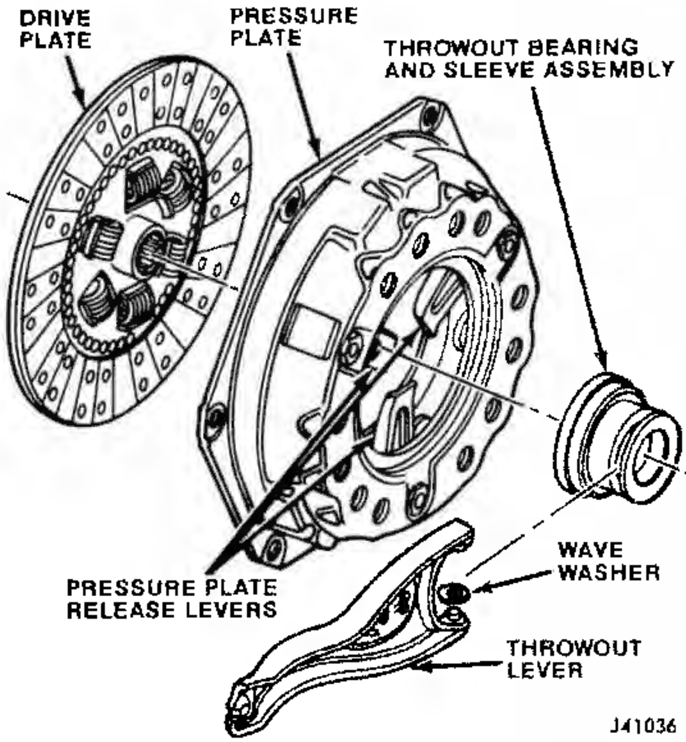

Fig. 5-9 Clutch Components - Assembly Relationship

(7) After each lever has been adjusted, work lever down and up several times and recheck adjustment, if correct, firmly stake nut with a dull punch.

CLUTCH INSTALLATION

(1) Inspect clutch release lever height.

NOTE: *Use Aligning Tool J-22056 to align driven plate during installation. A transmission clutch shaft may be used if proper tool is not available.*

(2) Align driven plate and loosely attach cover assembly to flywheel.

(3) Tighten cover attaching screws in rotation to prevent cover distortion.

(4) Install clutch housing, starter, throwout bearing and sleeve assembly (fig. 5-9).

CAUTION: *Be certain the clutch pedal is not depressed until the transmission has been installed.*

(5) Install transmission and transfer case (refer to Section 6 - Manual Transmission).

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SPECIFICATIONS

MODEL	ENGINE (CID)	CLUTCH DIA. (Inches)	RELEASE LEVER HEIGHT (Inches Above Gauge Hub)	PEDAL FREE PLAY (Inches)
CJ-5/CJ-6	232,258,304	10.5	3/32 to 7/64	0.75 to 0.50
Cherokee, Wag-	258	10.5	3/32 to 7/64	0.62 to 0.38
oneer, Truck	360	11.0	3/16	0.62 to 0.38

TORQUE SPECIFICATIONS

Clutch cover bolt 40
Clutch housing to engine dowel bolt nut 45
Clutch housing to starter motor bolt 45
Clutch housing to engine block bolt
232-258 CID Engines
 Top 35
 Bottom 45
304-360 Engines
 Top 30
 Bottom 30
Clutch housing spacer to block bolt (304-360 CID engines)........ 15
Clutch throwout lever pivot 35
Transmission case to clutch housing bolt 55
Clutch pedal shaft hug locknut........ 25 to 40
Clutch pedal rebound bumper, bolt,nut, and lockwasher
 assembly to pedal........ 30 to 50
Clutch bellcrank bracket to side rail bolt .... 12 to 15

CLUTCH HOUSING ALIGNMENT SPECIFICATIONS

(Inches)

Clutch housing bore to crankshaft centerline .... 0.010 max.
Clutch housing transmission mounting face to crankshaft centerline .... 0.010 max.
Clutch housing to transmission adapter bore to crankshaft centerline .... 0.010 max.
Clutch housing to transmission adapter face to crankshaft centerline .... 0.010 max.
Flywheel runout at face .... 0.005 max.

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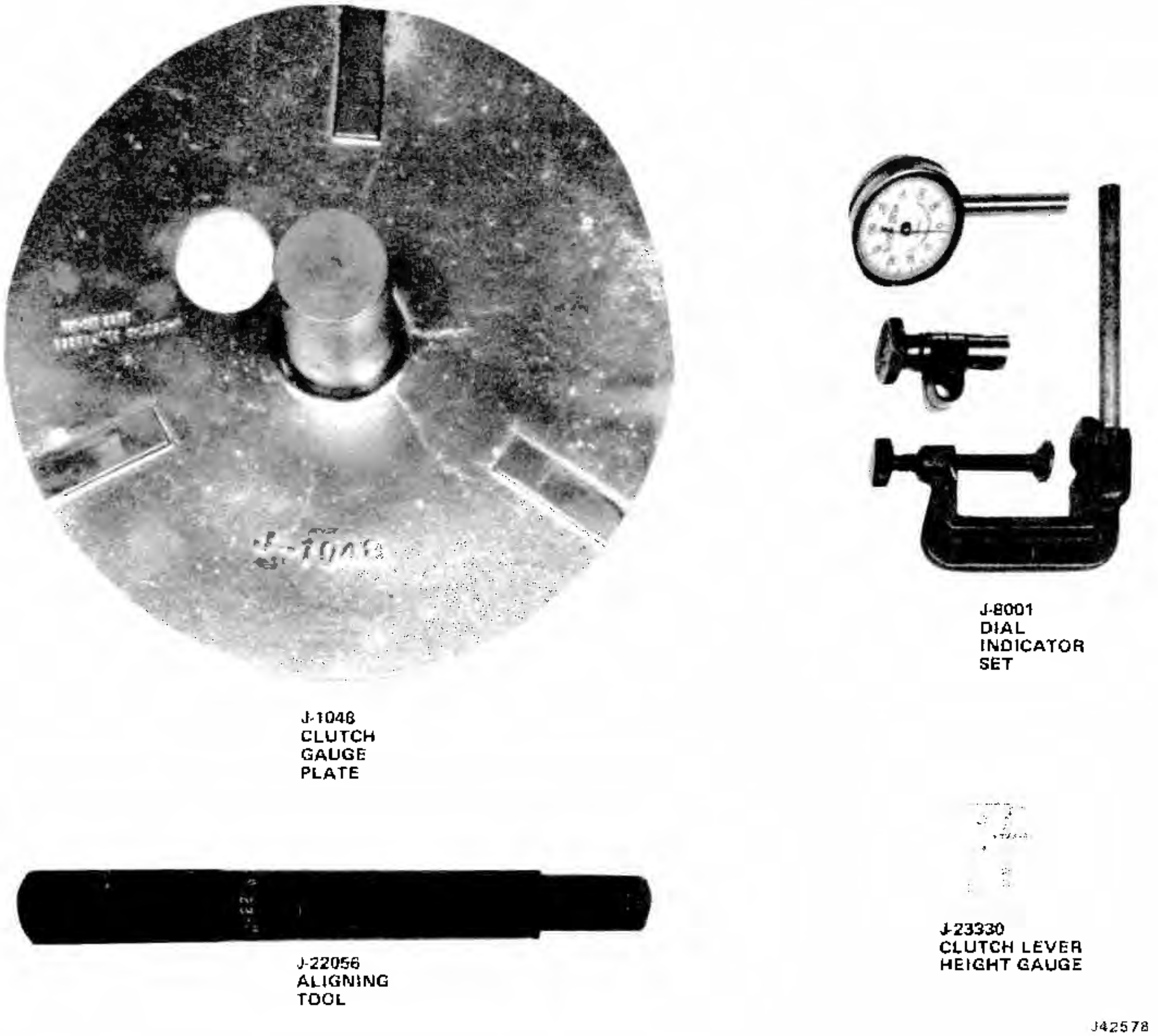

Fig. 5-10 Clutch Tools

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MANUAL TRANSMISSIONS

GENERAL

Transmission Models T-14A and T-15A have three speeds forward and one in reverse. Model T-18 has four speeds forward and one in reverse.

Models T-14A and T-15A provide synchromesh engagement in all forward speeds. Model T-18 provides synchromesh engagement in second, third, and fourth speeds.

IDENTIFICATION

An identification tag, which displays the vendor part number and Jeep part number, is attached to the upper left side of the transmission at the case cover or shift control. The information on the tag is necessary to obtain correct components for replacement purposes.

NOTE: *During assembly, make certain that the identification tag is attached to the transmission in its original position.*

TRANSMISSION REMOVAL (ALL MODELS)

(1) Remove floor lever knob, trim ring, and boot.

(2) Remove floor covering and floorpan section from above transmission.

(3) On three-speed models, remove transmission shift control lever housing assembly from transmission (fig. 6-1).

(4) On four-speed models, remove shift control housing cap, spring retainer, spring, shift lever, and pin (fig. 6-2).

(5) Remove transfer case shift lever and bracket assembly.

(6) Raise vehicle.

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
LOCKS IN TWO GEARS	(1) Worn poppet components	(1) Replace
HARD SHIFTING	(1) Improper Clutch linkage adjustment (2) Synchro-Clutch wear or failure (3) Incorrect lubricant	(1) Adjust (2) Replace (3) Replace
SLIPS OUT OF GEAR	(1) Synchro-Clutch wear or failure (2) Incorrect lubricant (3) Gear teeth worn or tapered (4) Insufficient inter-lock spring tension (5) Misaligned or loose clutch housing or clutch housing to transmission adapter (6) Excessive transmission end play (7) Worn or loose engine mounts (8) Damaged main drive gear needle bearings (9) Damaged or worn crankshaft pilot bushing	(1) Replace (2) Replace (3) Replace (4) Replace parts (5) Align and tighten (6) Adjust (7) Tighten or replace (8) Replace (9) Replace
NOISE IN LOW GEAR	(1) Gear teeth worn or broken (2) Shifting fork bent (3) Lack of lubrication	(1) Replace gears (2) Replace shoe (3) Drain and refill
GREASE LEAKS INTO FLYWHEEL HOUSING	(1) Gasket leaking at front bearing cap or cap oil seal leaking. Oil slinger broken or missing.	(1) Inspect cap oil seal gasket, and oil slinger. Replace as required.

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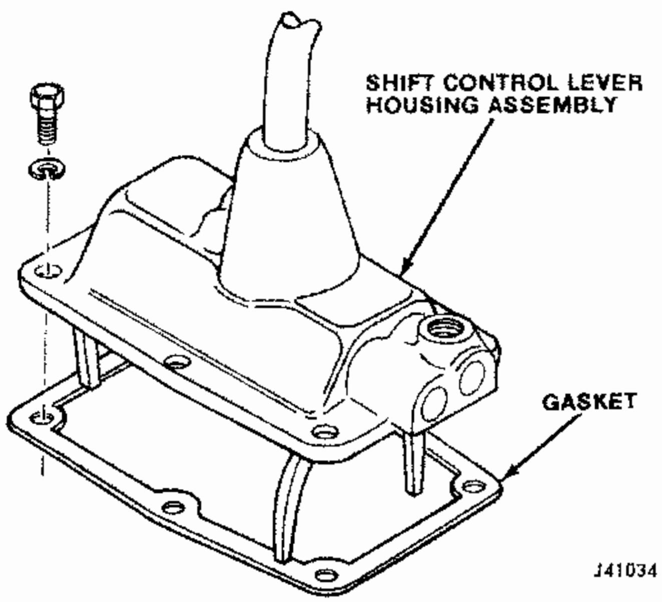

Fig. 6-1 Shift Control Lever Housing Assembly Removal - 3-Speed Transmission

(7) Index propeller shafts prior to removal to ensure proper alignment at installation.

(8) Remove front propeller shaft and disconnect front end of rear propeller shaft from transfer case.

(9) Disconnect speedometer cable, backup light switch wires, transmission controlled spark (TCS) advance and parking brake cable (if connected to crossmember).

(10) On models equipped with V-8 engines, remove nuts securing exhaust pipes to manifolds and lower exhaust pipes.

(11) Support transmission and engine.

(12) Disconnect rear support crossmember from side sill.

(13) Remove bolts attaching transmission to clutch housing.

(14) Lower transmission slightly, and move transmission, transfer case, and crossmember rearward sufficiently for transmission clutch shaft to clear clutch housing.

(15) Remove assembly from vehicle.

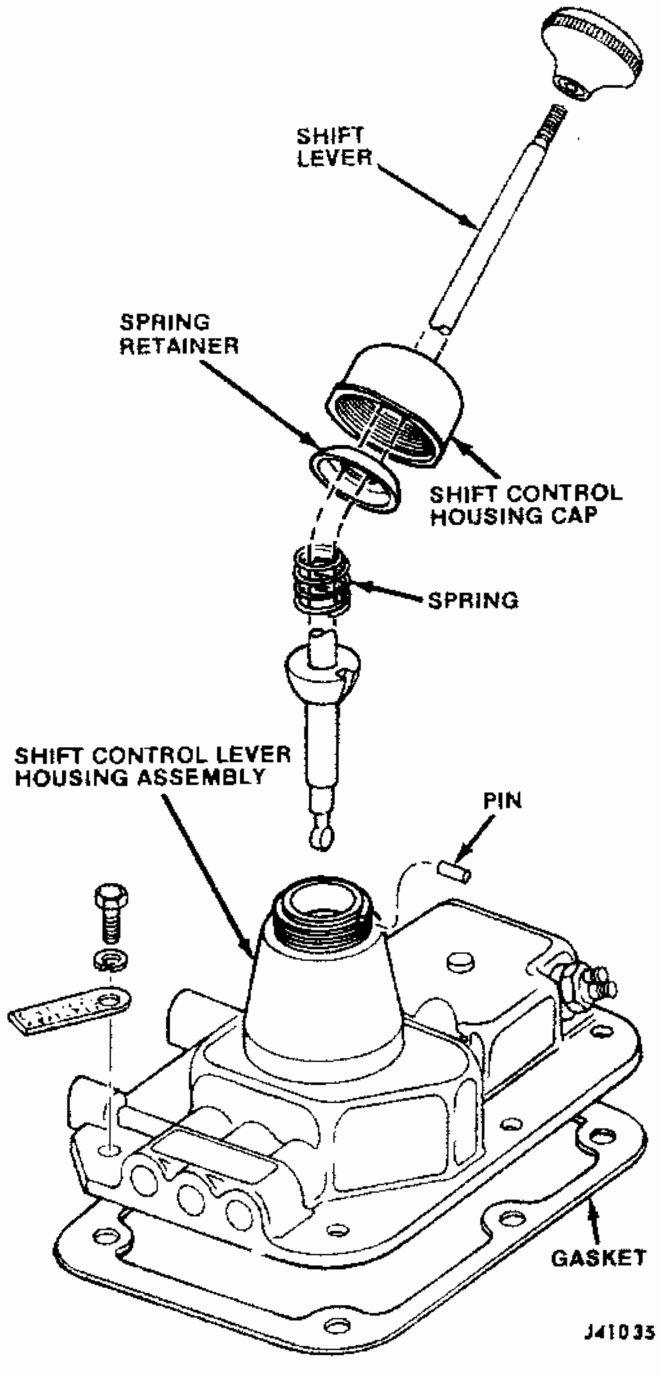

Fig. 6-2 Shift Control Lever Housing Assembly Removal - 4-Speed Transmission

TRANSMISSION INSTALLATION

(1) Position wave washer, throwout bearing, and sleeve assembly in throwout lever fork. Center throwout bearing over pressure plate release lever.

CAUTION: *Exercise caution to protect splines and preserve throwout bearing alignment while installing transmission.*

(2) Slide transmission slowly into position. Some maneuvering may be required in order to align transmission input shaft splines and clutch-driven plate splines.

(3) Install bolts which attach transmission to clutch housing.

(4) Attach support crossmember to side sills.

(5) Remove transmission jack and engine support.

(6) On models equipped with V-8 engines, connect exhaust pipes to manifolds.

(7) Connect speedometer cable, backup light switch wires, and transmission controlled spark (TCS) advance.

(8) Install front propeller shaft, align index mark made at disassembly, and connect front end of rear propeller shaft. Check for proper alignment.

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(9) Lower vehicle.

(10) Install transfer case shift lever and bracket assembly.

(11) On four-speed models, install pin, shift lever, spring, spring retainer, and shift control housing cap.

(12) On three-speed models, install shift control lever housing assembly (fig. 6-1). Position transmission gear train and shift lever in neutral and enter shifter forks into clutch sleeves.

(13) Align cover, case, and gasket holes and install capscrews and lockwashers. Tighten capscrews to 8 to 15 ft-lb torque.

(14) Install floorpan section and floor covering.

(15) Install floor trim boot, trim ring, and shift lever knob.

(16) Check transmission for proper shifting.

TOWING INSTRUCTIONS

All Jeep vehicles can be towed at reasonable and safe speeds (such as specified by state law) for any distance by following the procedures given below. **Should it be necessary to lift the rear wheels and tow the vehicle in reverse, be sure to remove the front axle shaft driving flanges to prevent the front differential from rotating.** If the steering wheel on Cherokee, Wagoneer, and Truck Models cannot be unlocked, use a dolly under the front axle.

CJ Models

Shift the transfer case and transmission into NEUTRAL. The vehicle can then be towed forward or backward with all four wheels on the ground, or forward with the front end raised.

Cherokee-Wagoneer-Truck

With Ignition Key

With the anti-theft ignition key in the off position (to unlock the steering wheel), shift the transfer case and transmission into neutral. The vehicle can now be towed forward or backward with all four wheels on the ground, or forward with the front end raised.

Without Ignition Key

If able to shift manual transmission and Model 20 transfer case into neutral, the vehicle can be towed **with the front end raised**. Steering is locked.

If vehicle is locked and manual transmission and Model 20 transfer case cannot be shifted, remove rear propeller shaft or use a dolly under the rear wheels and tow **with the front end raised.**

Should the driving flanges be removed, a cover should be improvised that will prevent dirt from entering the wheel bearings.

If the vehicle is equipped with free-wheeling selective drive hubs, there are no drive flanges to be removed, and it is only necessary to lock the hubs in the free-wheeling position.

MODELS T-14A AND T-15A 3-SPEED TRANSMISSIONS

DISASSEMBLY

(1) Remove screws which attach transfer case to transmission.

(2) Separate transfer case and transmission.

(3) Remove nut and flat washer which attach transfer case drive gear to main shaft.

(4) Remove gear, adapter, and spacer (fig. 6-3).

(5) Remove main drive gear bearing cap and gasket. gasket.

(6) Remove main drive gear bearing snap ring and main shaft bearing snap ring.

(7) Remove main drive gear bearing and main shaft bearing. Use Bearing Puller Set W-329 (fig. 6-4 and 6-5).

(8) Remove main drive gear from case.

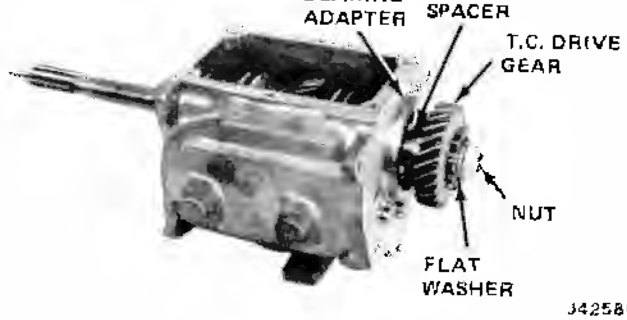

Fig. 6-3 Transfer Case Drive Gear

NOTE: *T-15A must be shifted into second gear position to permit removal of main shaft and gear assembly.*

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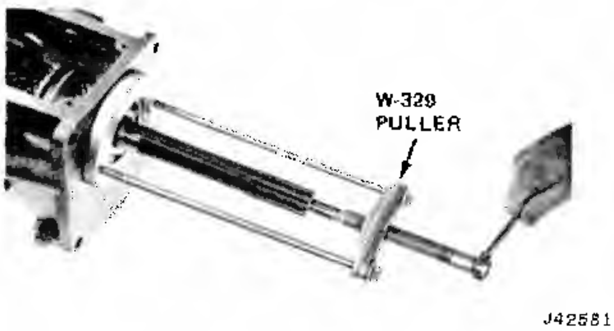

Fig. 6-4 Main Drive Gear Bearing Removal

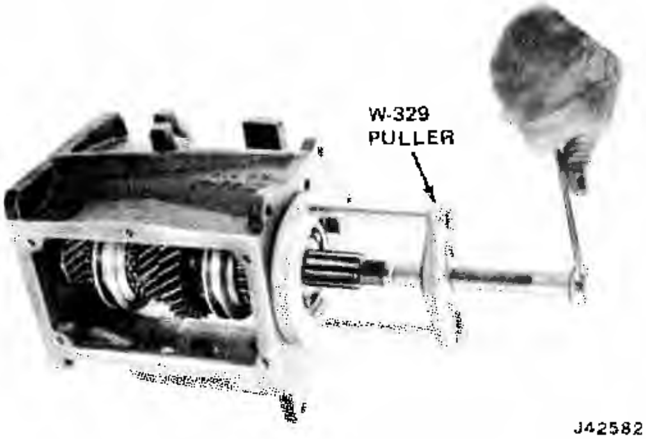

Fig. 6-5 Main Shaft Bearing Removal

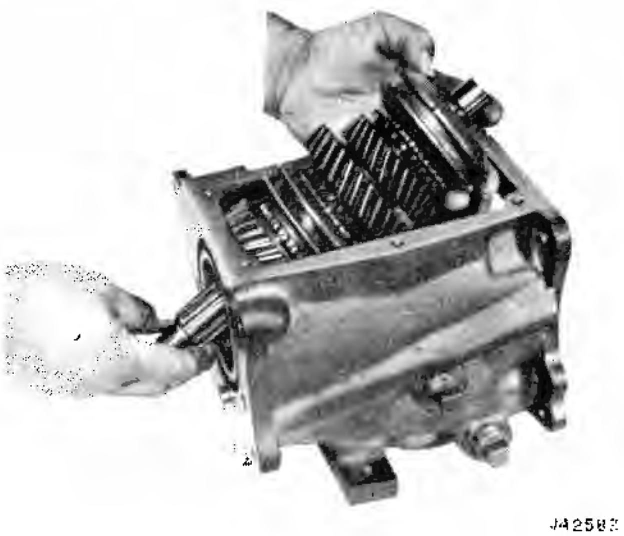

Fig. 6-6 Mainshaft Gear Assembly - Removal and Installation

(9) Remove main shaft and gears as an assembly through case cover opening as shown in figure 6-6.

(10) Remove lock plate by tapping lightly on front end of countershaft and reverse idler shaft.

(11) Remove lock plate from slots in shafts (fig. 6-7).

(12) Using Arbor Tool W-335 with T-14A or Arbor

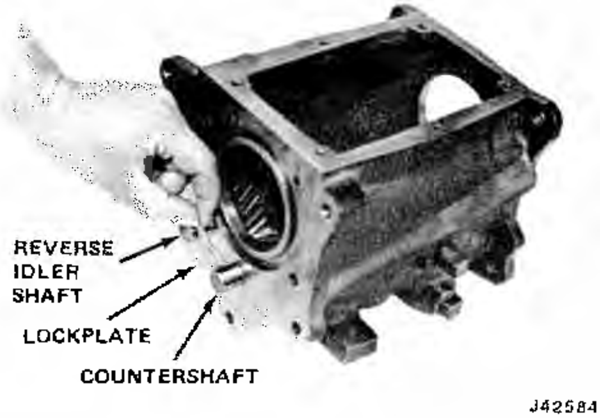

Fig. 6-7 Lock Plate Removal and Installation

Tool W-332 with T-15A transmission, drive countershaft rearward, out of case, as shown in figure 6-8.

NOTE: *Countershaft gear assembly drops to bottom of case. Using Special Arbor Tool ensures that roller bearings remain in countershaft gear hub and may be removed as an assembly.*

(13) Remove countershaft gear assembly and two thrust washers.

(14) Remove spacer washers, bearing rollers, and spacer from counter gear hub assembly for inspection.

(15) Using Arbor Tool W-336 with T-14A or Arbor Tool W-337 with T-15A transmission, drive reverse idler shaft rearward, out of case (fig. 6-8).

(16) Remove reverse idler gear, washers, and roller bearings as an assembly (fig. 6-9).

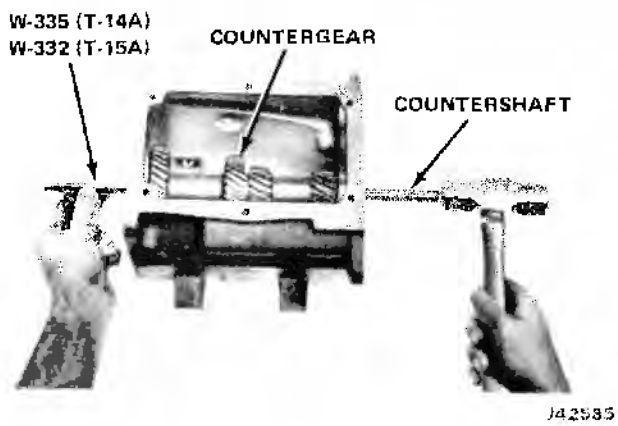

Fig. 6-8 Countershaft Removal and Installation

(17) Remove clutch hub snap ring and second-third synchronizer assembly from main shaft (fig. 6-10).

(18) Remove second-speed gear from main shaft.

(19) Remove reverse gear from main shaft.

(20) Remove clutch hub snap ring and low synchronizer assembly from main shaft (fig. 6-11).

(21) Remove low speed gear from main shaft.

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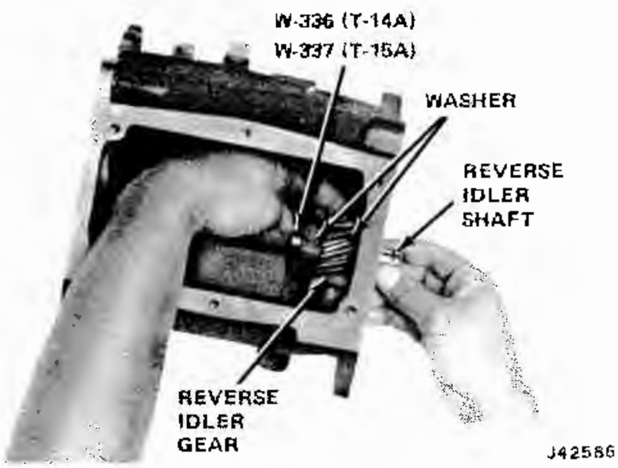

Fig. 6-9 Reverse Gear Idler Gear Removal and Installation

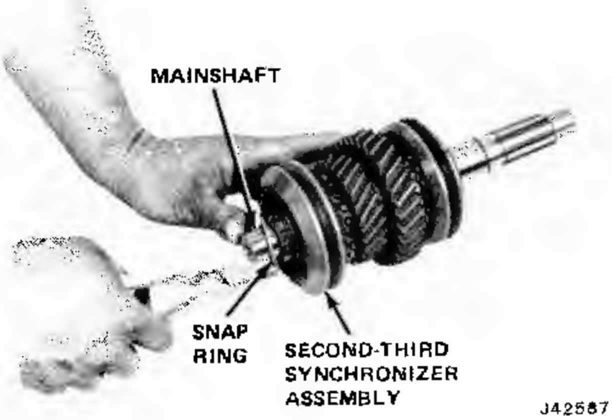

Fig. 6-10 Second-Third Clutch Hub Snap Ring Removal and Installation

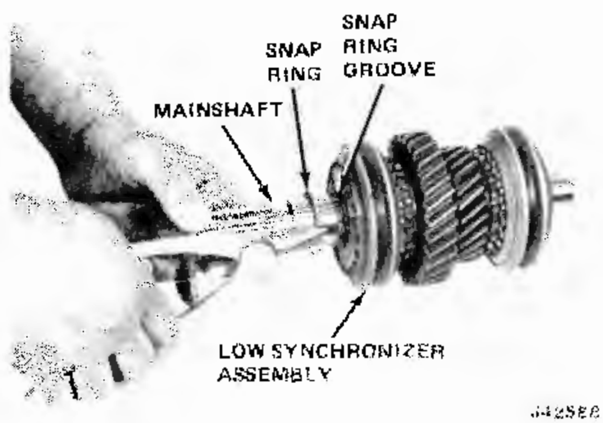

Fig. 6-11 Low Clutch Hub Snap Ring Removal and Installation

Synchronizer Assemblies

Second-Third Synchronizer Unit - Disassembly

(1) Remove springs (one on each side of unit).

(2) Mark sleeve and hub before separating to ensure proper installation at assembly.

(3) Remove hub from sleeve.

(4) Remove three synchronizer plates from third-speed side of hub.

(5) Clean and inspect synchronizer assembly parts.

(6) Assemble synchronizer in reverse order of disassembly, **making certain the two synchronizer spring openings are installed 120 degrees opposite each other, with spring tension opposed** (fig. 6-12).

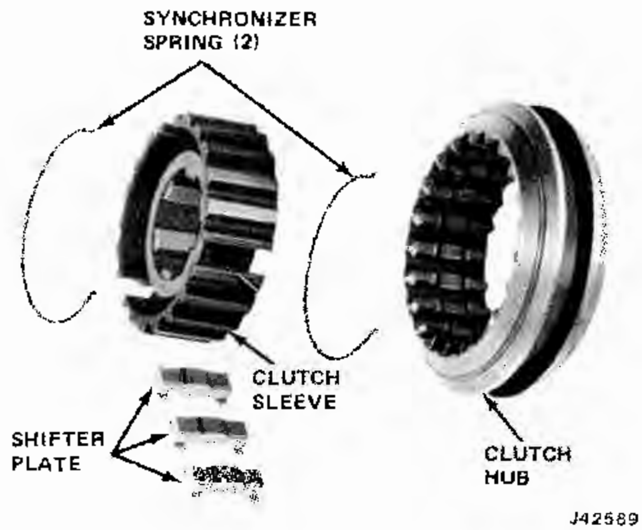

Fig. 6-12 Second-Third Synchronizer Assembly

Low Synchronizer Unit - Disassembly

The low synchronizer assembly is serviced in the same manner as second-third with the exception of one synchronizer spring (fig. 6-13).

NOTE: *Should a synchronizer assembly (either low-and-reverse or second-and-high) be replaced for any reason on a floor shift transmission, the shift fork that operates the synchronizer being replaced must have an identifying letter A appearing just under the shaft hole on the side opposite the pin. If the letter A does not appear on the existing fork, it must be replaced with a letter A fork.*

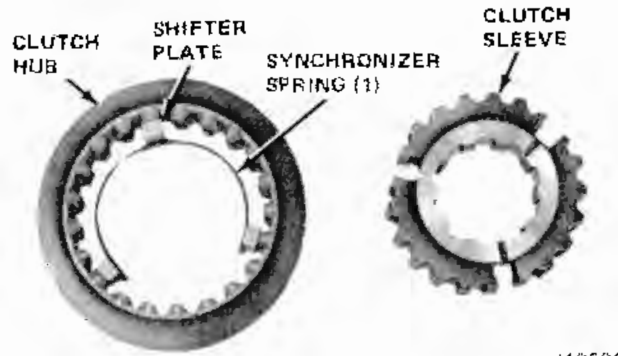

Fig. 6-13 Low Synchronizer Assembly

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CLEANING AND INSPECTION

Wash transmission case inside and outside with cleaning solvent.

Check bearing and shaft bores. Inspect the case for cracks. Check the front and rear faces and dress off any burrs with a fine mill file. If cracks are found and bores are not true, replace the case.

Clean and inspect all gears and bronze blocking rings for cracks, chipped or cracked teeth, or excessive tooth wear.

NOTE: *Whenever any transmission gear requires replacement, the gear with which it meshes should also be replaced.*

Inspect all bearings or bushings for wear or damage.

Make certain that the second-third and low synchronizer clutch sleeve slide freely on the clutch hub.

ASSEMBLY

NOTE: *Lubricate all internal transmission parts before assembly using SAE 80 Gear Lubricant of API, GL-4 quality.*

(1) Position reverse idler gear with Arbor Tool W-336 with T-14A or T-337 with T-15A transmission, roller bearing, and thrust washers in case.

(2) Install reverse idler shaft forcing out Arbor Tool. Make certain slot end of idler shaft is correctly aligned to receive lock plate (fig. 6-9).

(3) Assemble countershaft center spacer, four bearing spacers, and countershaft bearing rollers in countershaft gear hub assembly.

(4) Using Arbor Tool W-335 with T-14A or Tool W-332 with T-15A transmission, place center spacer inside hub and insert Arbor Tool in spacer.

(5) Place a bearing at each end of center spacer and load bearing roller set.

(6) Place a bearing spacer at each end to complete assembly (fig. 6-14 and 6-15).

(7) Install large countergear thrust washer in front of case.

Fig. 6-14 Countershaft Gear Bearing Arbor

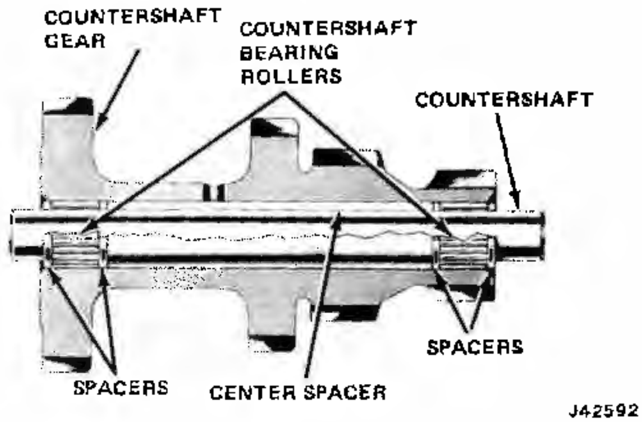

Fig. 6-15 Countershaft Bearing and Spacers Installed

(8) Position small thrust washer on countershaft gear hub with lip facing groove in case.

(9) Holding countershaft gear assembly in position, begin installation of countershaft in rear of case with lock plate slot toward rear and slot aligned with slot in reverse idler gear shaft.

(10) Press shaft through gear hub assembly and into case front, forcing out Arbor Tool (fig. 6-15).

(11) Locate lock plate in slots or reverse idler shaft and countershaft.

(12) Tap two shafts alternately until lock plate is tight against case (fig. 6-16).

(13) When assembling main shaft, first install main shaft low gear and bronze blocking ring.

(14) Install low synchronizer assembly, then install select-fit snap ring (fig. 6-11).

NOTE: *Main shaft snap rings are select-fit to eliminate clutch hub and main drive gear bearing end play. Make certain correct snap ring is installed at assembly.*

(15) Install main shaft second gear and bronze blocking ring.

(16) Install second-third synchronizer assembly, then install select-fit snap ring (fig. 6-10).

(17) Install reverse gear on main shaft.

(18) Install main shaft and gear assembly as a unit, through top cover opening of transmission case (fig. 6-6).

(19) Install bronze blocking ring onto second-third synchronizer assembly.

(20) Install main drive gear roller bearings using petroleum jelly to hold bearings in place (fig. 6-17).

(21) Install main drive gear and oil retainer washer (slinger) into case with cutaway portion of gear positioned downward toward countergear assembly.

(22) Guide main drive gear onto main shaft using care not to drop roller bearings (fig. 6-18).

(23) Install main drive gear and main shaft bearings using Bearing Installer Set W-331 together with Thrust Yoke Tool W-334 with T-14A or W-333 with

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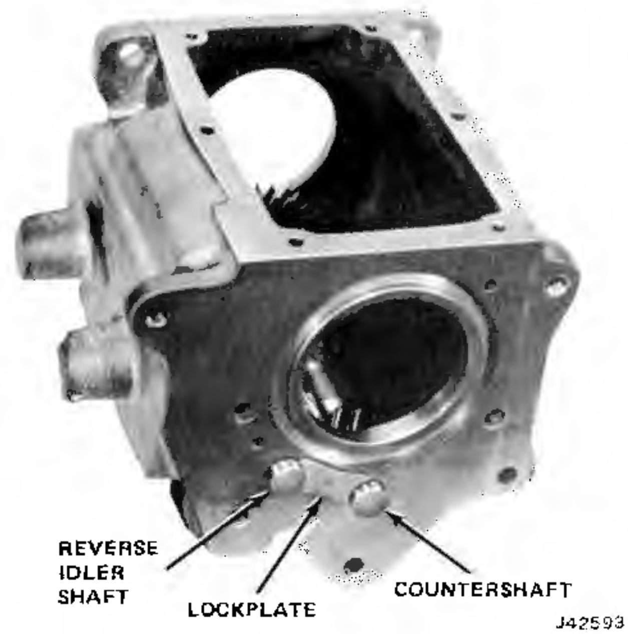

Fig. 6-16 Lock Plate Installation

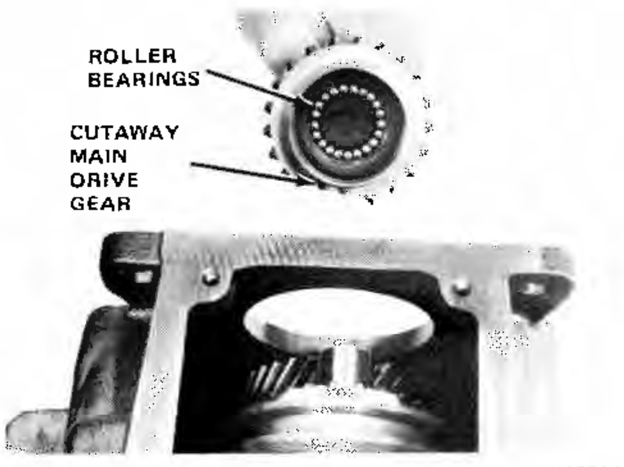

Fig. 6-17 Main Drive Gear Roller Bearing Installed

T-15A to prevent damage to synchronizer clutch.

(24) Install thrust yoke tool into second speed gear groove and between main drive gear (steel) clutch teeth and bronze synchronizer ring. Use both bearing drivers and a backup block when driving bearings into position (fig. 6-19 and 6-20).

(25) Install main drive gear and main shaft bearing snap rings.

NOTE: *The main shaft bearing snap ring is 0.010 inch thicker than the main drive gear bearing snap ring. Take care to install proper snap ring at these locations.*

(26) Install main shaft rear bearing adapter, spacer, transfer case drive gear, flat washer, and nut. Tighten nut to 130 to 170 ft-lb (fig. 6-9).

(27) Check the main drive bearing retainer oil seal.

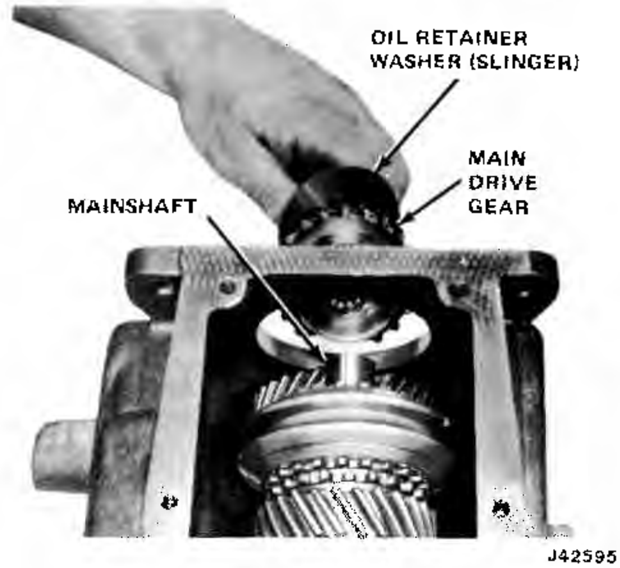

Fig. 6-18 Main Drive Gear Assembly Installation

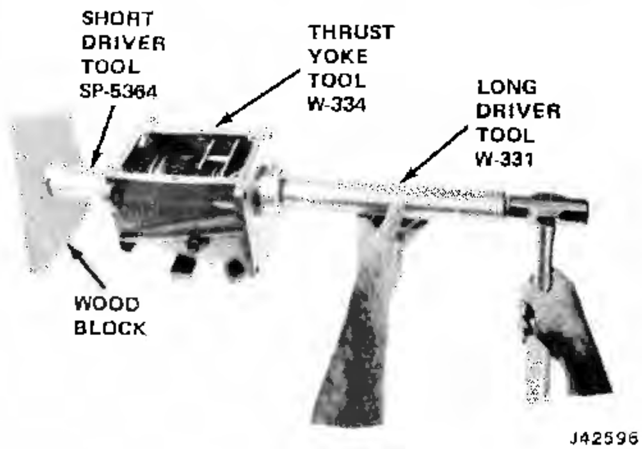

Fig. 6-19 Main Drive Gear Bearing Installation

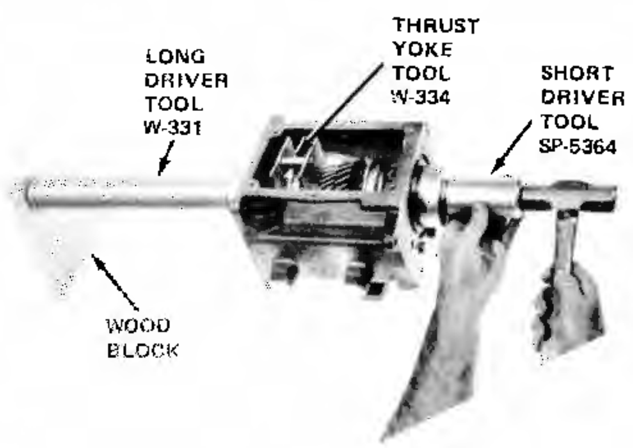

Fig. 6-20 Main Shaft Bearing Installation

If seal is worn or damaged, it must be replaced (fig. 6-21).

(28) Install main drive gear bearing retainer gasket and retainer assembly. Make certain oil drain hole slot

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Fig. 6-21 Main Drive Gear Bearing Retainer Oil Seal

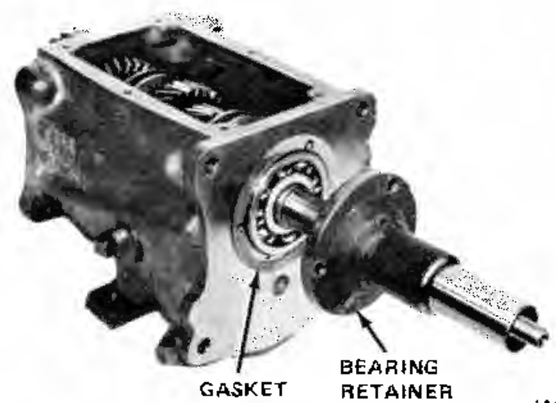

Fig. 6-22 Main Drive Gear Bearing Retainer Installation

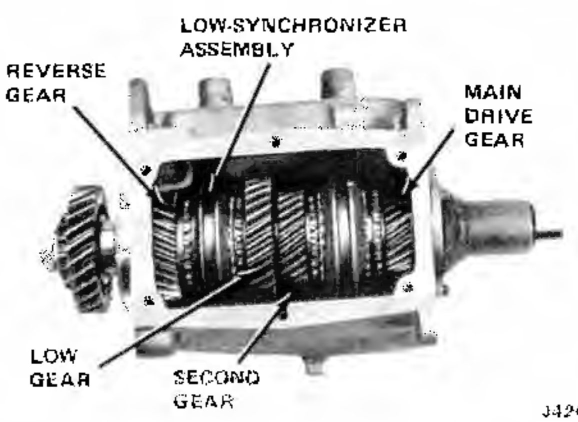

Fig. 6-23 Main Shaft Gear Train Neutral Position

in the retainer housing and gasket are aligned.

(29) Install ferry-type screws and washers (fig. 6-22).

(30) Install transmission case cover gasket and gasket.

(31) Install transfer case drive gear spacer, drive gear, washer, and retaining nut.

(32) Assemble transfer case to transmission using new gasket.

SHIFT CONTROL HOUSING

Disassembly

(1) Remove TCS switch and backup light switch.

(2) Remove shift rail sealing plugs from rear of control housing. Plugs may be easily removed by driving them sideways in bore then prying them out.

(3) Place first and reverse shift rail in first gear position.

(4) Remove roll pin from first and reverse shift fork and rail.

(5) Slide first and reverse fork rearward sufficiently to expose roll pin hole in rail.

(6) Insert a tapered punch in roll pin hole in shaft.

(7) Rotate first and reverse rail toward second and third rail to align groove at rear of first and reverse rail with interlock plunger. Slide first and reverse rail forward as far as possible.

(8) Remove interlock plunger.

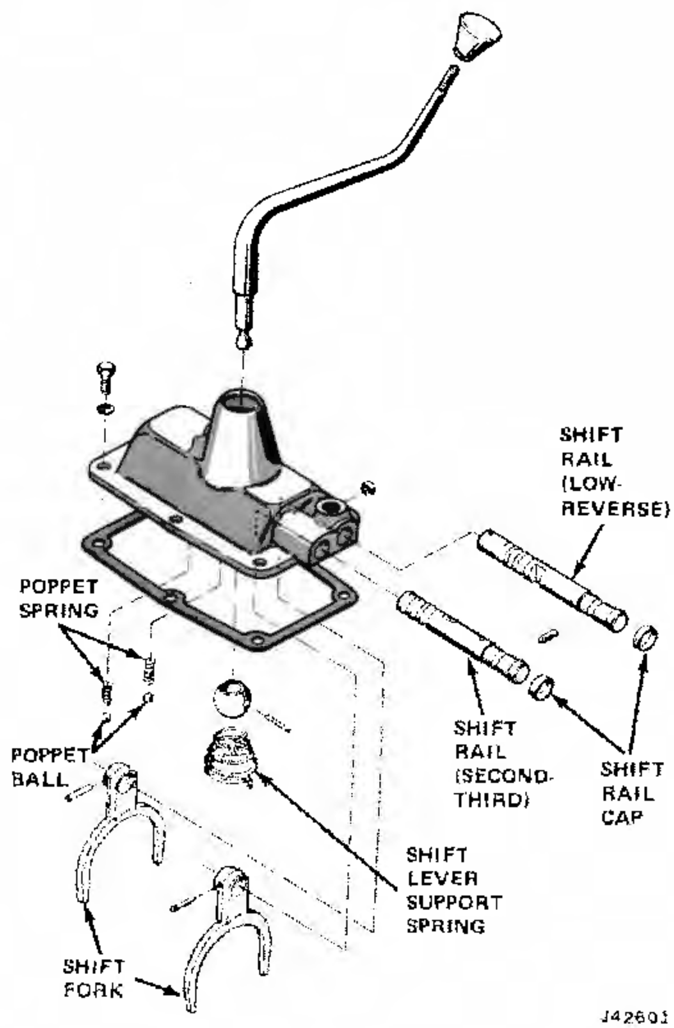

Fig. 6-24 Three-Speed Transmission Shift Control Housing Assembly Sequence

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NOTE: *Before removing the rail, cover the poppet ball holes with a cloth to prevent loss of ball and spring.*

(9) Rotate first and reverse rail away from second and third rail and, at the same time, push rail rearward out of control housing.

(10) Remove roll pin from second and high shift fork and rail.

NOTE: *Before removing the rail, cover the poppet ball holes with cloth to prevent loss of ball and spring.*

(11) Remove second and third shift rail.

(12) Remove shift lever retainer spring and shift lever.

Assembly

(1) Install shift lever and retainer spring.

NOTE: *Small end of spring cone should be against lever ball. Be sure spring is snapped in behind shoulders in cover.*

(2) Slide second and third shift rail into housing to poppet boss.

(3) Insert poppet spring and ball.

(4) Compress ball and spring and slide rail just through boss.

(5) Rotate rail to position shift lever slot toward center of housing.

(6) Install second and high fork with flanged side of fork toward front of housing.

(7) Install roll pin.

(8) Hold first and second shift fork in position, with flange side of fork toward rear of housing.

(9) Slide first and second shift rail into housing, through fork, to poppet boss.

(10) Insert and compress poppet spring and ball.

(11) Push shift rail as far forward as possible.

(12) Install interlock plunger. Be sure second and high shift rail is in neutral position and that interlock plunger contacts rail.

(13) Rotate first and reverse shift rail until notch in interlock end of rod faces away from housing.

(14) Move rail backward until end of rail contacts interlock plunger.

(15) Rotate rail to align notch with interlock plunger, then move rail as far backward as possible.

(16) Rotate rail to align roll pin holes in rail and fork.

(17) Install roll pin.

(18) Install shift rail sealing plugs, backup light switch, and TCS switch.

MODEL T-18 4-SPEED TRANSMISSION

DISASSEMBLY

NOTE: *Refer to figure 6-25 for Model T-18 4-Speed Transmission parts relationship.*

(1) If transfer case is attached, separate it from transmission by removing attaching screws and lockwashers.

(2) Remove shift control housing from top of transmission.

(3) Control housing can be disassembled at this point. Refer to Shift Control Housing Disassembly at the end of this subsection.

(4) Remove nut, washer, transfer case drive gear, and spacer from output shaft.

(5) Remove transmission-to-transfer case adapter and gasket.

(6) Remove oil seal from adapter and, if damaged, discard seal.

(7) Mark direct- and third-clutch hub and direct-and-third clutch sleeve to make certain these two blocking rings will be assembled in their original relationship. Also mark blocking ring, low-and-second clutch hub and low- and second-speed gear (fig. 6-26).

(8) Slide low- and second-speed gear toward rear of transmission case.

(9) Disengage reverse shifting arm and reverse shifting shoe from reverse idler gear.

(10) Remove arm from reverse shifting arm pivot.

(11) Move low- and second-speed gear into neutral position.

(12) Remove front bearing retainer and gasket.

(13) Remove snap rings from main drive gear and outer race of ball bearing.

(14) Remove main drive gear ball bearing using Bearing Puller Set W-329 (fig. 6-27).

(15) Remove oil slinger.

(16) Remove snap ring from outer bearing race of transmission main shaft ball bearing.

(17) Remove main shaft ball bearing using a bearing puller.

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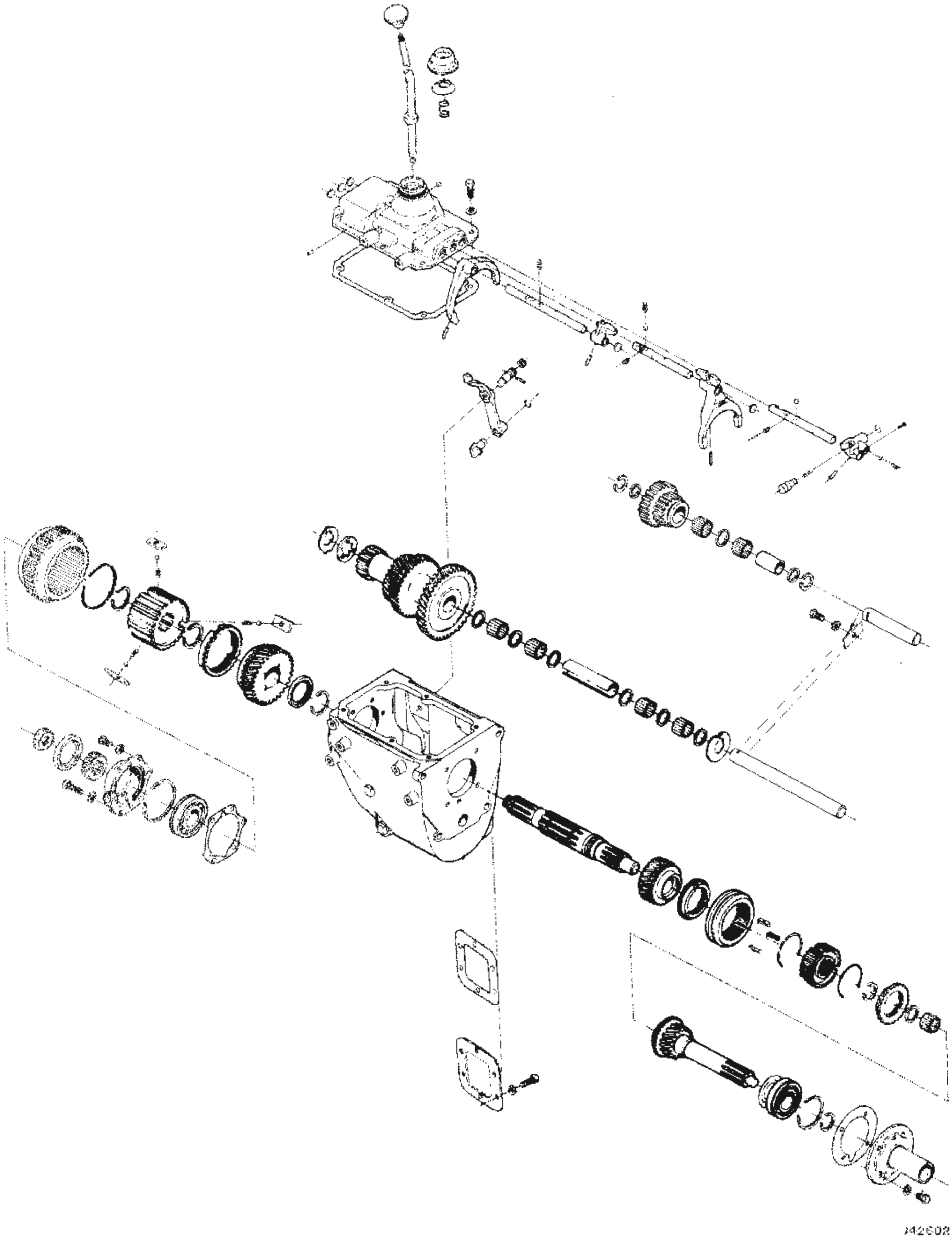

Fig. 6-25 Model T-18 4-Speed Transmission Exploded View

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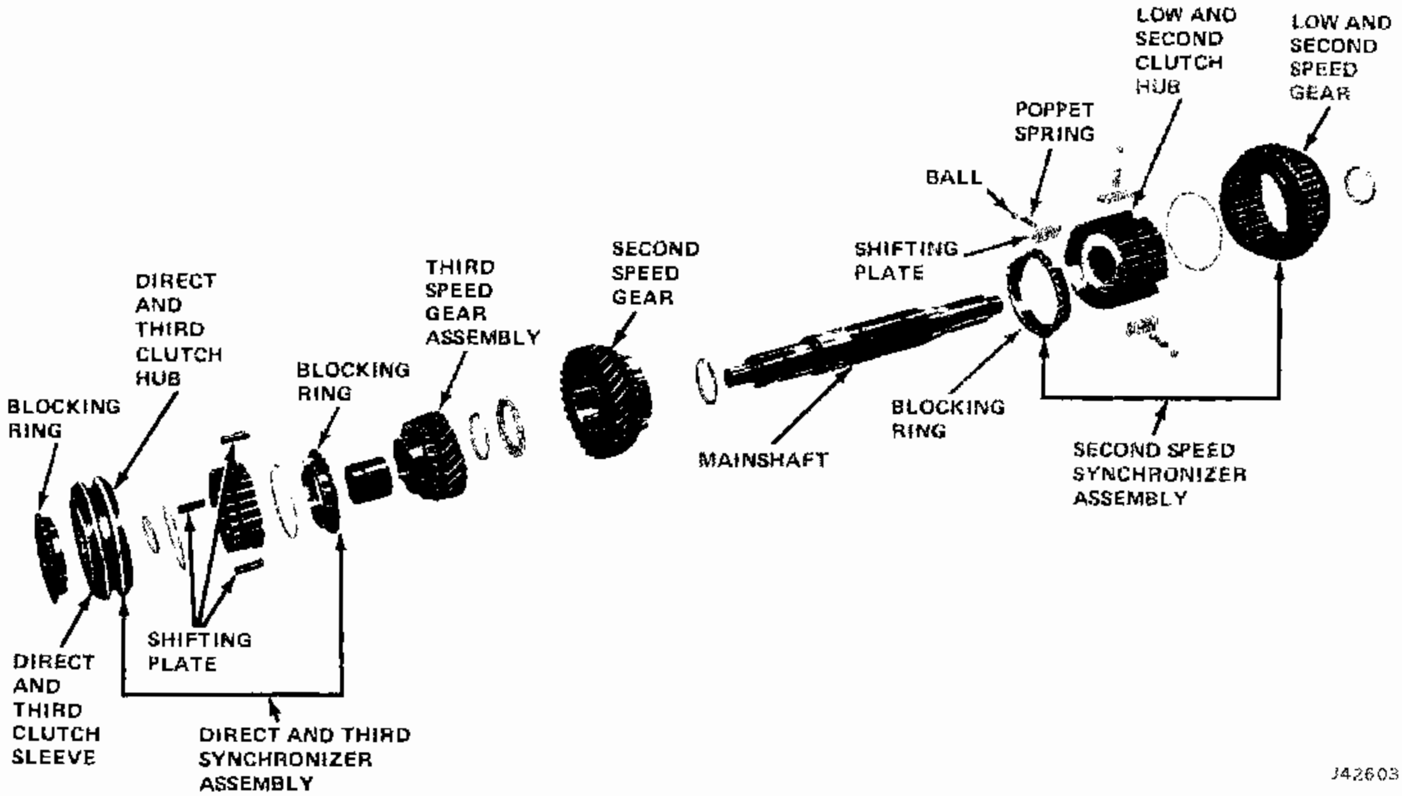

Fig. 6-26 Main Shaft Assembly

NOTE: *It may be necessary to drive the main shaft rearward by striking the end of the main drive gear with a lead hammer to get sufficient clearance to install the bearing puller plates.*

(18) Slide direct- and third-clutch sleeve to rear (third-speed) position.

(19) Separate main shaft assembly from main drive gear. Be careful not to loosen any main shaft pilot bearing rollers.

(20) Lift main shaft assembly out of transmission case.

(21) Remove main drive gear from transmission case.

(22) Remove main shaft bearing rollers from gear.

(23) Mark relationship between synchronizer hubs and splines on main shaft.

(24) Begin disassembly of main shaft assembly by removing snap ring which holds direct- and third-synchronizer assembly on main shaft.

(25) Remove front block ring from front of shaft.

(26) Slide direct- and third-synchronizer assembly and third-speed gear assembly off main shaft.

(27) Remove snap ring at rear of main shaft.

(28) Slide second synchronizer assembly and blocking ring off main shaft.

(29) If synchronizer assemblies are to be disassembled and serviced, proceed as follows:

(a) Wrap second-speed synchronizer assembly in a cloth to prevent losing lock balls and springs.

(b) Push clutch hub out of low- and second-speed gear in opposite direction of shift fork groove.

(30) Remove cloth and lift balls, springs, and plates out of hub.

(31) Remove lock plate for countershaft and reverse idler gear shaft.

(32) Use pry bar in slot of reverse idler gear shaft to loosen shaft. Slip reverse idler gear shaft out of housing and gear.

(33) Lift reverse idler gear assembly from transmission case.

(34) Drive countershaft toward rear of transmission case using a heavy brass drift.

(35) When countershaft end is approximately even with inside of transmission case, use a dummy shaft to force it completely out. Since a dummy shaft is required for assembly, make one at this time.

(a) Cut steel rod to 9.85 inches long.

(b) Break sharp edges with a mill file.

(c) Keep dummy shaft in contact with countershaft at all times to prevent dropping bearing rollers or thrust washers.

(36) Place dummy shaft in position and place transmission case on its side. Carefully roll countershaft gear cluster out of case.

(37) Complete disassembly by removing dummy shaft, thrust washers, four sets of bearing rollers, and spacers.

(38) Remove one of snap rings and tap out washers, both sets of bearing rollers, center spacer, and sleeve to disassemble reverse idler gear assembly.

(39) Remove remaining snap ring.

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CLEANING AND DISASSEMBLY

Transmission case and all component parts should be carefully cleaned so they can be thoroughly examined. Whenever any transmission gear requires replacement, the gear with which it meshes should also be replaced. Always use new gaskets, oil seals, and snap rings when assembling the transmission.

Inspect transmission case for cracks, bearing bosses for wear or scoring which would indicate that the bearing has been revolving in its housing. Examine ball bearings for cracked races and worn balls, for press fit on the shafts and for tight fit in the case bores. Inspect teeth of all gears for cracks, chips, or spots where case hardening is worn through. Main shaft gears should slide on and off smoothly without excessive play. Inspect synchro-blocking rings for excessive wear or a pitted condition on the tapered area of the ring. If the condition of the thrust washers is doubtful, replace washers.

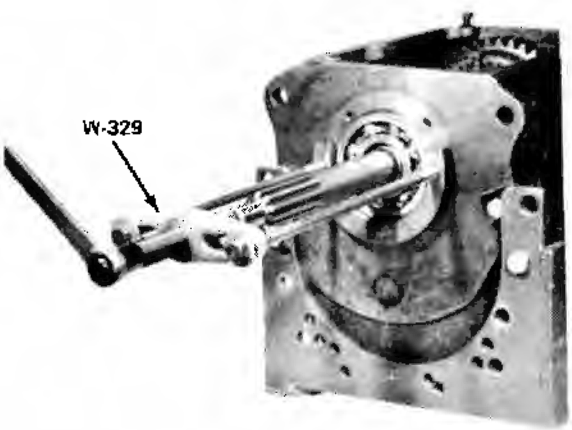

Fig. 6-27 Front Bearing Removal

ASSEMBLY

Reverse Idler Gear

NOTE: *A small amount of petroleum jelly will aid assembly and provide initial lubrication.*

(1) Install snap ring in one end of reverse idler gear.

(2) With installed snap ring end down, place thrust washer into gear bore and against snap ring.

(3) Install sleeve into gear bore and insert one set (37) of roller bearings, then install spacer, 37 more roller bearings, second thrust washer, and snap ring into gear.

Countershaft Gear

(1) Assembly of countershaft components and installation of countershaft into transmission case is accomplished with a dummy shaft of 1-1/8 inch diameter by 9-1/2 inch length.

(2) Lubricate bearing spacer sleeve, and install sleeve and dummy shaft into countershaft gear.

(3) Insert one spacer over dummy shaft against spacer.

(4) Insert 22 roller bearings.

(5) Insert second bearing spacer and 22 more roller bearings, followed with a third spacer.

(6) Repeat this operation at the opposite end of the countershaft gear.

Second-Speed Synchronizer

NOTE: *Use third- and fourth-speed synchronizer hub to aid in assembly of second-speed synchronizer.*

(1) Place hub flat on work bench.

(2) Place second-speed synchronizer sleeve over third-and-fourth speed hub with shift fork groove down.

(3) Insert second-speed synchronizer hub into sleeve with poppet ball holes up (fig. 6-28).

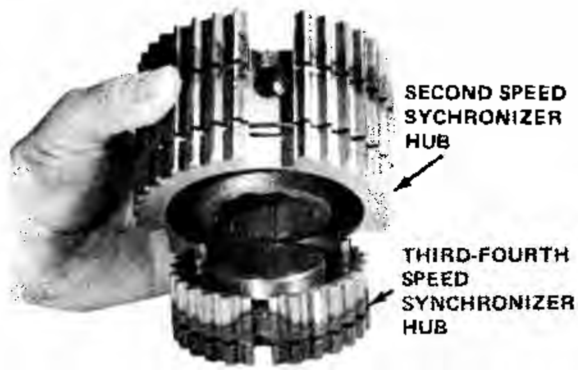

Fig. 6-28 Supporting Second-Speed Synchronizer Hub

Fig. 6-29 Assembling Second-Speed Synchronizer

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(4) Insert shifting plates in slots of hub.

(5) Install poppet spring through shifting plate.

(6) Compress spring with poppet ball while pressing on shifting plate until poppet ball is held in position by synchronizer sleeve. Repeat this operation until three shifting plates, poppet springs, and balls are started into sleeve.

(7) Complete assembly by pressing down on hub and pulling up on sleeve (fig. 6-29).

Third- and Fourth-Speed Synchronizer

(1) Assemble third- and fourth-speed synchronizer hub and sleeve.

(2) Align marks previously painted or etched before disassembly.

(3) Insert three shifting plates in slots of hub. Install retaining rings so that one end of each ring is hooked into the same shifting plate (fig. 6-30).

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Fig. 6-30 Synchro-Plate and Retainer Installation

Main Drive Gear

(1) Install 22 roller bearings with petroleum jelly into bore of main drive gear.

(2) Coat blocking ring with petroleum jelly and install on main drive gear.

Main Shaft Assembly

(1) Install second-speed gear from front of main shaft.

(2) Install thrust washer with step bore toward the front of main shaft.

(3) Install snap ring. Be certain step bore of thrust washer fits over snap ring (fig. 6-31).

(4) From rear of main shaft, install second-speed gear rear snap ring, blocking ring, second-speed synchronizer unit and snap ring.

NOTE: *Second-speed synchronizer sleeve shift fork groove must be toward rear of main shaft (fig. 6-32).*

J42608

Fig. 6-31 Second-Speed Gear and Washer Installation

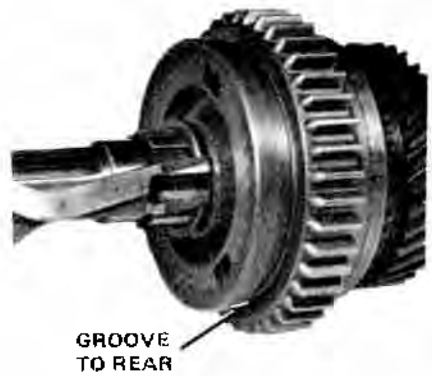

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Fig. 6-32 Second-Speed Synchronizer Installation

(5) From front of main shaft, install third-speed gear, blocking ring, third- and fourth-speed synchronizer assembly, snap ring and main drive gear roller bearing thrust washer.

NOTE: *Third- and fourth-speed synchronizer unit must be installed with chamfered side of hub toward front of main shaft (fig. 6-33).*

J42610

Fig. 6-33 Third- and Fourth-Speed Synchronizer Installation

Transmission Case

(1) Install countershaft thrust washers. Coat two thrust washers with petroleum jelly. Index tab of large bronze faced washer in recessed area of front of case. Index notch of smaller steel washer with lug at rear of case.

(2) Lower countershaft gear assembly into transmission case.

(3) Insert remaining countershaft thrust washer between end of countershaft gear and rear thrust washer.

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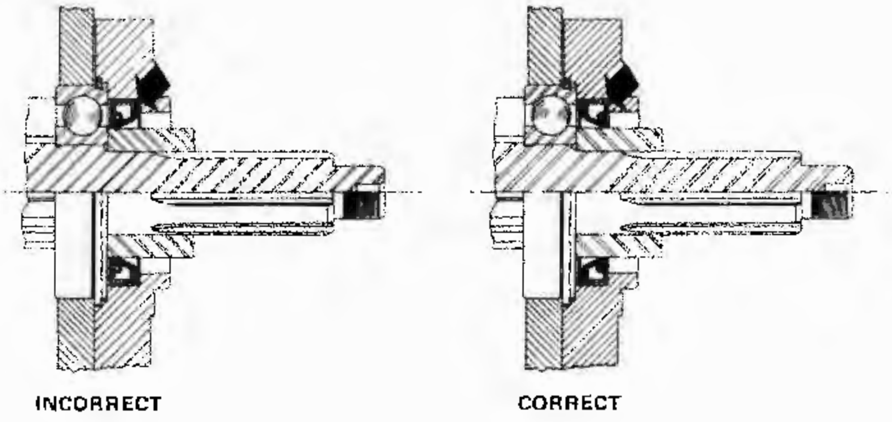

Fig. 6-34 Oil Seal Position

(4) Insert countershaft from rear of case, keeping countershaft and dummy shaft into contact to prevent dropping bearing rollers or washers.

(5) Tap countershaft lightly into position in front of case, but do not seat it until reverse idler gear and shaft have been installed into case.

(6) Position reverse idler gear into transmission case with **larger gear** toward rear of case.

(7) Insert reverse gear idler shaft from rear of case, and tap forward until lock plate slot is adjacent to slot of countershaft.

(8) Insert lock plate in slots of shafts making sure plate ends are square with slots.

(9) Install lock plate to act as a guide while tapping shafts alternately into position. Install and tighten lock plate screw securely.

(10) Insert main drive gear, with roller bearings and fourth gear blocking ring through transmission case into front bearing bore.

(11) Install main shaft assembly into transmission case by placing rear end down and through case rear bearing bore.

(12) Be sure main drive gear roller bearing spacer is on main shaft pilot. Install main shaft pilot into bore of main drive gear, making sure roller bearings are not knocked out of place and fourth gear blocking ring notches are aligned with synchronized plates.

(13) Temporarily install main drive gear bearing retainer to support drive gear.

(14) Install snap ring on main shaft bearing. Drive bearing onto main shaft and into the rear case bore. Seat snap ring against case.

(15) Install rear oil seal in transfer case adapter plate.

NOTE: *It is important that the 4-speed transmission adapter plate oil seal be correctly installed to prevent flow of lubricant from the transfer case to the transmission. Correctly positioned, the lip of the oil seal is toward the transfer case (fig. 6-34).*

(16) Position new gasket on rear of transmission and apply thin coat of lubricant to lip of oil seal.

(17) Install adapter plate on rear of transmission.

(18) Apply nonhardening sealer to capscrews and install. Tighten to specified torque.

(19) Remove main drive gear bearing retainer.

(20) Install oil slinger on main drive gear with **dished side** toward rear of transmission.

(21) Install snap ring on main drive gear bearing and position bearing on drive gear.

(22) Using a piece of pipe or driver sleeve, drive bearing over main drive gear and into case bore until snap ring is flush against case (fig. 6-35).

(23) Install the thickest of the four available snap rings that will fit into the groove on main drive gear shaft.

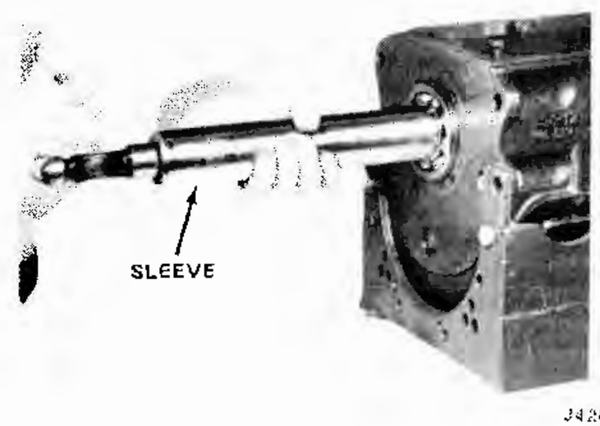

Fig. 6-35 Front Bearing Installation

(24) Slide main drive gear bearing retainer onto shaft and hold tightly against transmission. With a feeler gauge, measure distance between retainer and case. Select gaskets that will be 0.003 inch to 0.005 inch thicker than space between retainer and case.

(25) Position new gasket on main drive gear bearing retainer. Coat threads of capscrews with a nonhardening sealing compound. Align oil return hole of

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retainer with oil return hole located in front face of transmission case. Install capscrews and tighten to 8 to 15 ft-lb torque.

(26) Install reverse shifting arm. Move first- and second-speed synchronizer sleeve toward rear of transmission case to provide clearance.

(27) For installation of reverse shifting arm, install O-ring seal on reverse shifting arm pivot pin.

(28) Place reverse shifting arm into transmission case, indexing shoe of arm with groove in reverse idler gear.

(29) Hold reverse shifting arm in position and install pivot pin into case and through arm. Install tapered pin from rear of pivot pin boss and tap in with hammer until snug.

(30) Position new gasket on power takeoff cover and with nonhardening sealer applied to capscrews, install to transmission case. Tighten capscrews to 8 to 15 ft-lb torque.

(31) Install transmission and drain and fill plugs. Pour a pint of recommended gear lubricant over all gears in case while rotating main drive gear. Position synchronizer units in neutral position.

(32) Place new gasket on top of transmission case. Lower shift control housing down on top of case making sure shift forks are started into synchronizer sleeves and reverse shifting arm upper end engages flat portion of reverse shift rail. Install capscrews and tighten alternately and evenly to 8 to 15 ft-lb torque.

(33) Check operation of transmission by shifting gears in all ranges.

(34) Install transfer case drive gear spacer, drive gear, washer and retaining nut.

(35) Using a new gasket, assemble transfer case to transmission.

SHIFT CONTROL HOUSING

Disassembly

The rear shift lever, spring, seat and pivot are removed during transmission removal.

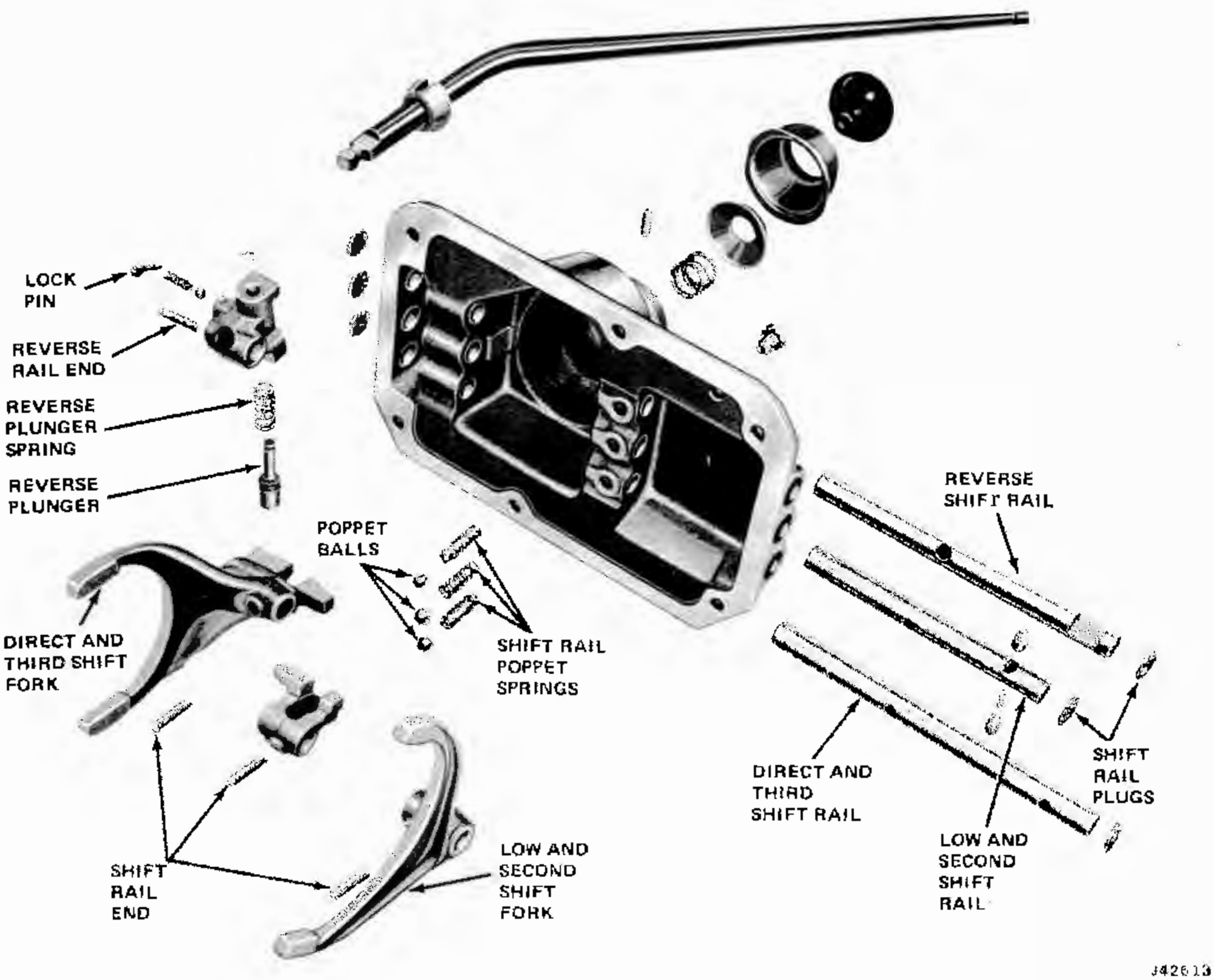

Fig. 6-36 4-Speed Transmission Shift Control Housing

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(1) Remove lockpins from gear shift forks and gear shift rod ends.

(2) Remove expansion plugs from front and rear of control housing.

(3) Remove backup light switch and TCS switch.

(4) Remove center (third and high) shift rail first.

(5) Drive rail rearward out of housing. As rail is withdrawn from housing, remove interlock pin from crossover hole in rail. Before rail is removed from center section of housing, place a finger over hole to prevent loss of ball and spring.

(6) Remove first-second shift rail in same manner.

(7) Remove shift rail detent balls and springs and, with a piece of wire, push two interlock plungers out of pockets in center section of housing.

(8) In reverse shift, rail end is a spring-loaded plunger which prevents accidental engagement of reverse gear. Should this part require servicing, proceed as follows:

(a) Remove cotter pin from rail end assembly and, at the same time, hold a finger over hole to prevent loss of spring.

(b) Shake spring and ball.

(c) Compress plunger and spring until C-washer just clears end of casting. Remove C-washer.

Assembly

(1) Prior to assembly, inspect transmission breather assembly for damage, and replace if necessary.

(2) Place reverse plunger spring on plunger. Insert plunger through casting and install C-washer.

(3) Insert ball and spring into rail end. Compress spring and install a new cotter pin.

(4) Position interlock plungers in pockets in center of housing.

(5) Place reverse shift rail detent spring and ball in housing. Compress ball and spring into rail end. Compress spring and install new cotter pin.

(6) Position interlock plungers in pockets in center section of housing.

(7) Place reverse shift rail detent spring and ball in housing. Compress ball and spring into bore and slide shift rail into housing just through center section.

(8) Slide rail into reverse rail end and install lockpin.

(9) Install first-second shift rail detent spring, ball, shift fork, rail end, shift rail, and lockpin in same manner.

(10) Insert interlock pin into center (third and high) shift rail.

(11) Install shift rail detent spring, ball, shift fork, shift rail, and lockpin.

(12) The rear shift lever pivot pin, lever, spring, seat and cap should be installed after transmission assembly is installed.

SPECIFICATIONS

	THREE-SPEED		FOUR-SPEED
Model	T-14A	T-15A	T-18
Type	Synchromesh	Synchromesh	Synchromesh
Speeds	3 Forward - 1 Reverse	3 Forward - 1 Reverse	4 Forward - 1 Reverse
Ratios:			
First	3.100 to 1	2.997 to 1	4.02 to 1
Second	1.612 to 1	1.832 to 1	2.41 to 1
Third	1.000 to 1	1.000 to 1	1.41 to 1
Fourth	-------	-------	1.00 to 1
Reverse	3.100 to 1	2.997 to 1	4.73 to 1

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Fig. 6-37 Manual Transmission Tools

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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AUTOMATIC TRANSMISSION

GENERAL

This section carries information on theory of operation, including detailed description of the mechanical functions, maintenance and adjustments, and overhaul. It is most important that vehicles having a combination automatic transmission and 4-wheel drive use the proper terminology when describing various operational terms. To avoid possible confusion, it is suggested the following terminology be used.

Automatic Transmission Gear Selections: Park, Reverse, Neutral, Drive, Drive 2, and Drive 1.

Each automatic transmission has its own serial number, stamped on a plate, at the right side of the transmission case.

Any communication concerning an automatic transmission should include the serial number.

TOWING THE VEHICLE

All Jeep vehicles can be towed at reasonable and safe speeds (such as specified by state law) by following the procedures given below.

With Ignition Key

With the anti-theft ignition key in the off position (to unlock the steering wheel and the selector linkage), shift the transfer case and automatic transmission into NEUTRAL. On models equipped with Quadra-Trac, Full Time 4-Wheel Drive, the rear propeller shaft **must** be removed. Tow the vehicle forward or backward with all four wheels on the ground, or forward with the front end raised (see Towing in Reverse).

Without Ignition Key

Steering and automatic transmission are locked. Remove rear propeller shaft or use a dolly under the rear wheels and tow **with the front end raised.**

Towing in Reverse — All 4-Wheel Drive Models

When towing the vehicle in reverse, **remove** the front axle shaft driving flanges to prevent the front differential from rotating. If the steering wheel cannot be unlocked on Cherokee, Wagoneer, and Truck Models use a dolly under the front axle.

If the vehicle is equipped with free-wheeling selective drive hubs, lock the hubs in the free-wheeling position.

DESCRIPTION

The automatic transmission is a fully automatic unit consisting primarily of a three-element hydraulic torque converter and a compound planetary gear set (fig. 7-1). Three multiple-disc clutches, two roller clutches, and two bands provide the friction elements required to obtain the desired function of the compound planetary gear set.

The torque converter couples the engine to the planetary gears through oil and provides hydraulic torque multiplication when required. The compound planetary gear set produces three forward speeds and reverse (fig. 7-2).

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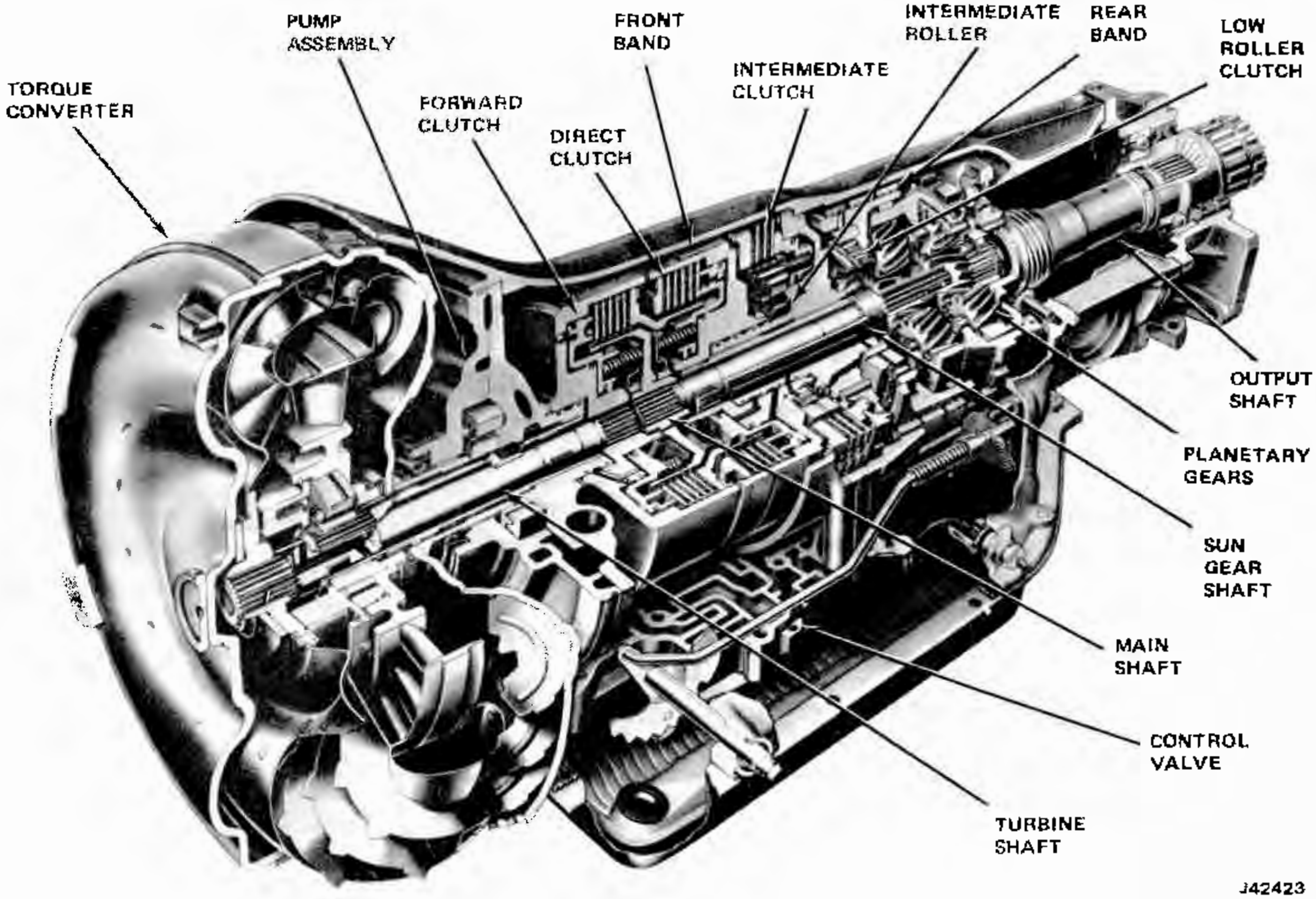

Fig. 7-1 Automatic Transmission-Cross Sectional View

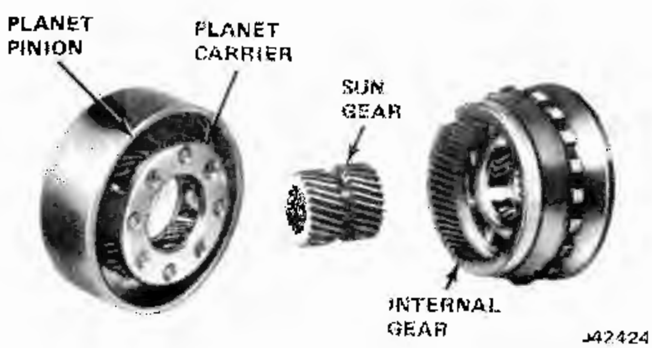

Fig. 7-2 Planetary Gear Arrangement

The three-element torque converter consists of a pump or driving member, a turbine or driven member, and a stator assembly. The stator when viewed from the front is mounted on a one-way roller clutch which will allow the stator to turn clockwise, but not counterclockwise (Fig. 7-3).

As the oil passes through the turbine it travels in such a direction that if it were not redirected by the stator it would hit the rear of the converter pump blades and impede its pumping action (fig. 7-3). So at low turbine speeds, the oil is redirected by the stator to the converter pump which actually assists the converter pump to deliver power or multiply engine torque.

As turbine speed increases, the direction of the oil leaving the turbine changes and flows against the rear side of the stator vanes in a clockwise direction. Since the stator is now impeding the smooth flow of oil, its roller clutch releases and it revolves freely on its shaft. Once the stator becomes inactive there is no further multiplication of engine torque within the converter. At this point, the converter is merely acting as a fluid coupling as both the converter pump and turbine are being driven at approximately the same speed — or at a one-to-one ratio.

A hydraulic system pressurized by a gear-type pump provides the working pressure required to operate the friction elements and automatic controls.

External control connections to transmission are:

Manual Linkage—To select the desired operating range.

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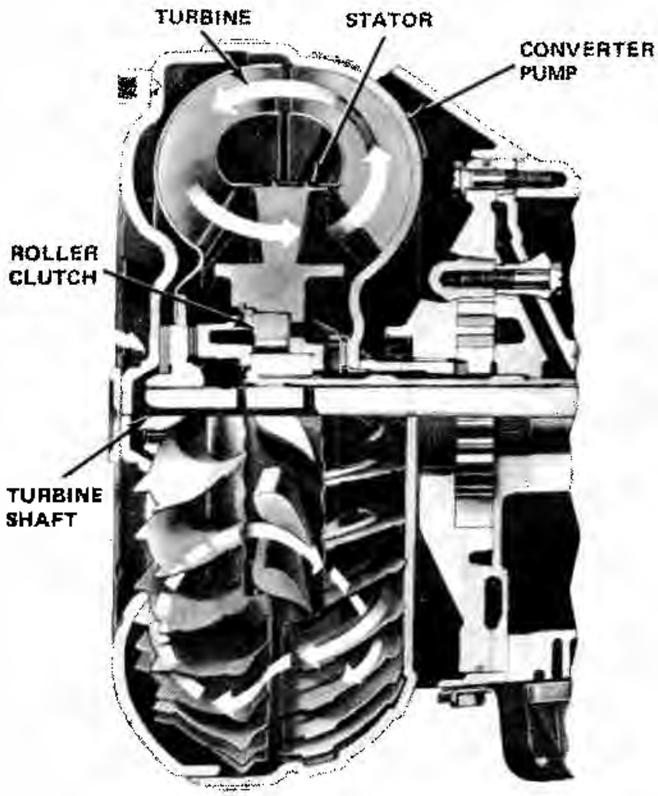

Fig. 7-3 Converter Components

Engine Vacuum—To operate a vacuum modulator unit.
12-Volt Electrical Signal—To operate an electrical detent solenoid.

Approximate gear or torque ratios of the transmission are:

- First — 2.5:1
- Second — 1.5:1
- Third — 1:1
- Reverse — 2.08:1

NOTE: *Second and third are also multiplied.*

A vacuum modulator is used to automatically sense any change in the torque input to the transmission. The vacuum modulator transmits this signal to the pressure regulator for line pressure control to the 1-2 accumulator valve and to the shift valves. This meets all torque and shift speed requirements of the transmission and smooth shifts are obtained at all throttle openings.

The detent solenoid is activated by the detent switch on the accelerator pedal. When the throttle is fully opened, the switch is closed, activating the detent solenoid causing the transmission to downshift at speeds below approximately 70 mph.

Planetary Gear Train

Gear ratios are obtained through planetary gears in the automatic transmission. A planetary gear train consists of three members: sun gear, a planet carrier with four planet pinion gears, and an internal gear. The gear is surrounded by and meshes with the planet pinion gears, which rotate freely on pins attached to a common support called the planet carrier. A part with gear teeth machined on the inside circumference surrounds the assembly and meshes with the planet pinion gears. This is called the internal gear, because of its internal teeth.

Roller Clutches

A one-way roller clutch allows rotation of a unit in one direction and locks the unit from rotating in the opposite direction. Roller clutches are used to lock one member of each planetary gear set for reduction. In direct drive the roller clutches allow free rotation.

HYDRAULIC SYSTEM

Pressure Control

The transmission is automatically controlled by a hydraulic system. Hydraulic pressure is supplied by the transmission gear-type oil pump, which is engine driven. Main line pressure is controlled by a pressure regulator valve train located in the pump. This regulator controls line pressure automatically, in response to a pressure signal from a modulator valve. The torque requirements of the transmission are met and smooth shifts are obtained at all throttle openings.

Vacuum Modulator

The engine vacuum signal is provided by the vacuum modulator, consisting of an evacuated metal bellows, a diaphragm, and springs. These are so arranged that the bellows and one spring apply a force which acts on the modulator valve to increase modulator pressure. Engine vacuum and the other spring act in the opposite direction to decrease modulator pressure. Low engine vacuum results in high modulator pressure; while high engine vacuum results in low modulator pressure.

Governor Assembly

The vehicle speed signal to the modulator valve is supplied by the transmission governor, which is driven by the output shaft. The governor consists of two sets of flyweights, two springs, and a regulator valve. Centrifugal force on the flyweights is imposed on the regulator valve, causing it to regulate a pressure signal that increases with increasing speed.

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SERVO OPERATION

Front Servo

The front servo applies the second overrun band to provide engine braking in second gear in DRIVE-2 and DRIVE-1. It is also used as an accumulator for the apply of the direct or third clutch and, in conjunction with a series of check balls and controlling orifices, is a part of the timing for the release of the direct or third clutch.

To prevent the apply of the second overrun band in Neutral, Drive and Reverse ranges, oil is directed from the manual valve to the release side of the servo piston.

In the drive range, the servo-release oil from the manual valve is used to charge the servo in preparation for the apply of the direct clutch.

Direct clutch oil is directed to the front servo accumulator piston where spring force (plus third clutch pressures) strokes the piston up against the force of servo release oil. This lowers the clutch apply pressure for a smooth engagement.

The release of the direct clutch and the exhausting of the front servo accumulator is slowed down by three check balls and three orifices. This permits a soft return of the drive load to the intermediate sprag. It also allows engine rpm to increase during a detent 3-2 downshift in preparation for the lower gear ratio, which results in a smooth shift and better acceleration.

Reverse — Neutral — Drive — First Speed

Servo oil from the manual valve in Drive range charges the accumulator by stroking the servo and accumulator pistons against the accumulator spring. This prepares the accumulator for the controlled apply of the direct clutch on a 2-3 shift. The charging of the accumulator in Drive range, first gear, also makes it possible to have a controlled 1-3 let-up shift as the accumulator is prepared for direct clutch apply in first gear.

Servo oil and the servo release spring prevent the apply of the band in second gear Drive range when intermediate clutch apply oil is directed between the servo and accumulator pistons.

Servo oil in Reverse and Neutral ranges is incidental.

Drive Range — Second Speed

Servo oil charging the accumulator is present in first and second gears and has the servo and accumulator pistons stroked against the accumulator spring.

In second gear, intermediate clutch oil is directed between the servo and accumulator pistons but does not separate the pistons. The force of servo oil holding the piston down is equal to the force in intermediate clutch oil attempting to stroke the servo piston.

Drive Range—Third Speed

Direct clutch pressure rises to a value such that the force from it, plus the accumulator spring force, overcomes the force from the servo pressure and moves the accumulator piston to the stop on the accumulator piston pin. This strokes the servo piston at the same amount of travel, which allows it to just contact the band-apply washer on the servo pin, but it will not move the pin and apply the band.

The stroking of the accumulator piston absorbs some direct clutch oil and permits the direct clutch to apply at reduced pressure for a smooth 2-3 shift.

Drive Range—3-2

The release of the direct clutch is softened by the front servo, three orifices, and three check balls to allow a smooth transfer of the drive load to the intermediate sprag. The controlled release pressure lets the engine increase its rpm during detent downshifts to prepare for the lower gear ratio of second gear, which results in a smooth shift and better acceleration.

Servo oil seats a check ball, intermediate clutch oil seats another check ball, and oil must pass through the two orifices which slows the stroking of the servo and accumulator pistons. The exhausting direct clutch oil from the accumulator and the direct clutch seats a third check ball. The exhausting direct clutch oil passes through an orifice which controls the clutch pressure during the direct clutch release.

DRIVE-D-2 — Second Speed

Intermediate clutch oil from the 1-2 shift valve seats the check ball, passes through an orifice, and applies the front band. The pressure applying the band is reduced by the action of the accumulator piston, which is moved by orificed flow of intermediate clutch oil and resisted by the accumulator spring and exhausting orificed direct clutch oil in a manual downshift 3-2 for a smoothing apply of the band for DRIVE-2 range engine braking.

Rear Servo

The rear servo applies the rear band for overrun engine braking in DRIVE-1 range first gear. It applies the band in Reverse to hold the reaction carrier to provide the reverse gear ratio.

On the 1-2 shift in Drive and DRIVE-2 ranges, it serves as an accumulator for the intermediate clutch to provide a smooth shift.

Drive-1—First Speed

In first gear Drive and Intermediate ranges, 1-2 accumulator oil is directed to the rear servo accumulator piston in preparation for the 1-2 shift.

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DRIVE-2 — Second Speed

Intermediate clutch apply oil is directed to the rear servo accumulator piston, stroking the piston against 1-2 accumulator oil and the accumulator spring. This action absorbs some intermediate clutch apply oil and permits the intermediate clutch to apply at reduced pressure for a smooth 1-2 shift.

DRIVE-1 — First Speed

Overrun engine braking in DRIVE-1 range first gear is provided for by the rear servo applying the band to hold the reaction carrier from clockwise rotation, viewed from front of the car.

The 1-2 accumulator oil is directed to the accumulator piston, which attempts to prevent the servo from applying.

Low range oil directed to the servo piston, which has the larger area, applies the band. Because 1-2 accumulator oil is present, the force applying the band is lowered. This provides a smooth apply.

DRIVE-2 — Second Speed

In second gear, the rear band is released. Intermediate clutch oil is directed to the release side of the servo piston which, with 1-2 accumulator oil, balances out the low range oil on the apply side of the servo piston, and the servo release spring strokes the servo piston to the released position.

Reverse

In reverse, the rear band is applied to hold the reaction carrier. Reverse oil is directed to the servo piston to apply the band. To ensure the band holding the reaction carrier for the reverse gear ratio, line pressure is increased in Reverse and no other oil pressures are present in the servo to resist the apply of the servo piston.

1-2 Accumulator

The 1-2 accumulator oil charges the rear servo accumlator in first gear in preparation for the apply of the intermediate clutch on the 1-2 shift. The 1-2 accumulator oil pressure is used to obtain greater flexibility in attaining the desired curve for various engine requirements. Drive oil is directed to the 1-2 accumulator valve and is regulated to become 1-2 accumulator oil. Modulator pressure is directed to the 1-2 accumulator valve. This results in 1-2 accumulator pressure being engine-torque conscious and adjusts for smooth shifts according to engine-torque output.

Detent oil is directed to the 1-2 accumlator valve to raise 1-2 accumulator pressure during detent 1-2 shifts for clutch durability. DRIVE-1 range oil is directed to the 1-2 accumulator valve during DRIVE-1 range operation to raise 1-2 accumulator pressure to line pressure; this increased pressure, directed to the rear servo accumulator piston, resists servo apply pressure and slows down the apply of the rear band for a smooth manual shift to DRIVE-1 range first gear, or for a 2-1 shift in DRIVE-1 range.

DETENT AND DETENT REGULATOR VALVES

When the accelerator pedal is depressed all the way to the floor, the detent valve train replaces the modulator as a controller of shift points. Line pressure is fed through a small orifice to one end of the detent valve. In normal throttle operation, the cavity at this end of the valve is sealed by a needle valve in the detent solenoid assembly. This line pressure holds the detent valve train in an inoperative or normal position.

When the throttle is opened wide, the detent switch on the accelerator pedal is closed, energizing the detent solenoid. The needle valve is opened by the solenoid, causing a pressure drop on the end of the detent valve. The detent regulator valve spring then shifts the detent valve, and causes the detent regulator to regulate detent oil to a fixed pressure of approximately 60 psi. When the detent valve shifts, it routes this fixed or detent pressure into the modulator passages. The detent valve train also routes detent pressure into the detent passages to the shift valve train. The detent upshift points are controlled by detent pressure in the modulator passages, and the detent downshifts by detent pressure in the detent passages. The shift points are fixed at relatively high speeds.

Detent pressure is directed to the 1-2 accumulator valve to increase 1-2 accumulator pressure for clutch durability during detent shifting. Detent pressure is directed to the modulator valve to prevent modulator pressure from dropping below approximately 60 psi which , in turn, prevents line pressure from dropping below approximately 105 psi.

In DRIVE-1 range operation, oil is directed to the detent regulator valve and spacer; the spring then moves the detent and regulator valves to the opposite end of the valve bore. Low oil is also directed to the detent regulator valve, to passage which is used as an exhaust when the valve is regulating. Low oil in these two areas prevents the detent valve from regulating, and drive oil passes through the detent regulator valve into the detent and modulator passages at DRIVE-1 range pressure of 150 psi. This increase in detent and modulator pressures will downshift the 1-2 valve at speeds below approximately 40 mph, and will prevent the transmission from upshifting out of first gear regardless of vehicle speed.

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TRANSMISSION LINKAGE ADJUSTMENT

The adjustment on vehicles equipped with automatic transmission is accomplished by adjusting the length of the shift-rod, with the transmission shift lever and selector lever in their neutral positions. Procedure for making the adjustment is given below:

Make sure the transmission shift lever is in the neutral detent position.

Place the selector lever in the neutral position and hold it firmly forward against the stop.

Loosen the lock nut at the bellcrank end of the adjusting rod, and position the block on the shift rod so it may be freely inserted on the transmission shift lever without moving the lever. Tighten the nuts to 6-12 Foot Pounds torque.

Operate selector lever to be sure transmission detents are engaging in their respective positions.

ROAD TEST

Shift Pattern Check

Drive Range

Position selector lever in DRIVE RANGE and accelerate the vehicle from zero mph. A 1-2 and 2-3 shift should occur at all throttle openings. (The shift points will vary with the throttle opening). As the vehicle decreases in speed to zero mph, the 3-2 and 2-1 shifts should occur.

Drive-2 Range

Position the selector lever in DRIVE-2 and accelerate the vehicle from zero mph. A 1-2 shift should occur at all throttle openings. (No 2-3 shift can be obtained in this range). The 1-2 shift point will vary with throttle opening. As the vehicle decreases in speed to zero mph, a 1-2 shift should occur. Note: The 1-2 shift in DRIVE 2 is somewhat firmer than in DRIVE RANGE. This is normal.

Drive-1 Range

Position the selector lever in DRIVE-1 RANGE and accelerate the vehicle from zero mph. No upshift should occur in this range, except in some vehicles which have a high numerical axle ratio and/or high engine rpm.

2nd Gear — Overrun Braking

Position the selector in DRIVE RANGE, and with the vehicle speed at approximately 35 mph, move the selector lever in DRIVE-2. The tranmission should downshift to 2nd. An increase in engine rpm and an engine braking effect should be noticed. Line pressure should change from approximately 70 psi to approximately 150 psi in 2nd.

1st Gear — Overrun Braking

Position the selector lever in DRIVE-2 at approximately 30 to 40 mph, with throttle closed. Move the selector lever to DRIVE-1. A 2-1 downshift should occur in the speed range of approximately 40 to 20 mph, depending on axle ratio and valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine rpm and an engine braking effect should be noticed. Line pressure should be approximately 150 psi. Stop vehicle.

Reverse Range

Position the selector lever in REVERSE POSITION and check for reverse operation.

DIAGNOSIS GUIDES

Causes of Oil Leaks

Transmission Oil Pan Leaks

- Attaching bolts not correctly torqued.
- Improperly installed or damaged pan gasket.
- Oil pan gasket mounting face not flat.

Case Extension Leak

- Attaching bolts not correctly torqued.
- Rear seal assembly — damaged or improperly installed (propeller shaft yoke damaged).
- Gasket or seal - (extension to case) damaged or improperly installed.
- Porous casting.
- Damaged O-ring on output shaft (oil leak at yoke).

Case Leak

- Filler pipe O-ring seal damaged or missing; misposition of filler pipe bracket to engine — loading one side of the O-ring.
- Modulator assembly O-ring seal — damaged or improperly installed.
- Connector O-ring seal — damaged or improperly installed.
- Governor cover, gasket, and bolts — damaged, loose; case face damaged or porosity.
- Leak at speedometer driven-gear housing or seal. Leak at speedo hole plug.
- Manual shaft seal — damaged, improperly installed.
- Line pressure tap plug — stripped, shy sealer compound.
- Vent pipe.
- Porous case, or cracked at pressure plug boss.

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Front End Leak

- Front seal — damaged (check converter necks for nicks, etc., also for pump bushing moved forward), garter spring missing.
- Pump attaching bolts, and seals — damaged, missing, bolts loose.
- Converter — leak in weld.
- Pump O-ring seal — damaged. (Also check pump oil ring groove and case bore.)
- Porous casting (pump or case).
- Pump — drain-back hole not open.

Oil comes out vent pipe

- Transmission overfilled.
- Water in oil.
- Filter O-ring damaged or improperly assembled causing oil to foam.
- Foreign material between pump and case or between pump cover and body, or variable stator solenoid screws too long — holding pump halves apart.
- Case — porous, pump face improperly machined.
- Pump — shy of stock, porous.
- Pump breather hole blocked or missing.
- Hole in intake pipe.
- Check ball in forward clutch housing stuck open or missing.

Oil Cooler Lines

- Connections at radiator loose or stripped.
- Connections at case loose or stripped.

Modulator Assy.

- Diaphragm defective.

Causes of Burned Clutch Plates

Forward Clutch

- Check ball in clutch housing damaged, stuck or missing.

(Continued on page 7-13).

TRANSMISSION MALFUNCTION RELATED TO OIL PRESSURE

(Pressures Obtained By The Preliminary Checking Procedures)

Malfunction	Drive Brakes Applied 1000 rpm	Reverse Brakes Applied 1000 rpm	D-2 or D-1 Brakes Applied 1000 rpm	Neutral Brakes Applied 1000 rpm	Drive 30 mph Closed Throttle	Drive Idle	Pressure Drop Occurs While Engine rpm Increases From 1000 to 3000 rpm Wheels free to Move*	Possible Cause of Malfunction
	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure	Oil Pressure		
No 1-2 Upshift and/or Delayed Upshift	Normal	Normal	Normal	Normal	Normal	Normal	Drop	Malfunction in Control Valve Assy.
	Normal	Normal	Normal	Normal	Normal	Normal	No Drop	Malfunction in Governor or Governor Feed System
	High	Normal	Normal	Normal	High	—	—	Malfunction in Detent System
	High	High	Normal	High	—	—	—	Malfunction in Modulator or Vacuum Feed System to Modulator
Slipping — Reverse	Normal	Low	Normal	Normal	Normal	—	—	Oil Leak in Feed System to The Direct Clutch
Slipping — 1st Gear	Low	Normal	Low to Normal	Normal	Low to Normal	—	—	Oil Leak in Feed System to The Forward Clutch
Downshift With Zero Throttle and No Engine Braking In Drive	Normal	Normal	Normal	Normal	High	High	—	Stator and Detent Wires Switched

*Drive Range, Vacuum Line Disconnect to Modulator.

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PRELIMINARY CHECKING PROCEDURE

Check Trans. Oil Level

↓

Check Outside Manual Linkage and Correct

↓

Check Engine Tune

↓

Install Oil Pressure Gage

↓

Connect Vacuum Gage with T Fitting into Modulator Line and Tachometer to Engine

↓

Check Oil Pressures In Following Manner		
Range	**Oil Pressure**	**Normal psi**
Drive — Brakes Applied Engine at 1000 rpm		60 TO 90
Drive-2 or Drive-1 — Brakes Applied Engine at 1000 rpm		135 TO 160
Reverse — Brakes Applied Engine at 1000 rpm		95 TO 150
Neutral — Brakes Applied Engine at 1000 rpm		55 TO 70
Drive Idle Set Engine Idle To Specifications		60 TO 85
Drive — 30 mph Closed Throttle or On Hoist*		55 TO 70

CAUTION: Total running time for this combination not to exceed 2 minutes.

*The Drive-30 mph closed throttle pressure reading may be taken during a road test or:

1. Vehicle on hoist — driving wheels off ground, foot off brake, in drive range.
2. Engine 2000 rpm.
3. Close throttle (foot off accelerator) and take pressure reading engine 2000-1200 rpm.

NOTE: With closed throttle and driving wheels off the ground, engine rpm will drop rapidly. Pressure reading must be taken within rpm's indicated and with closed throttle.

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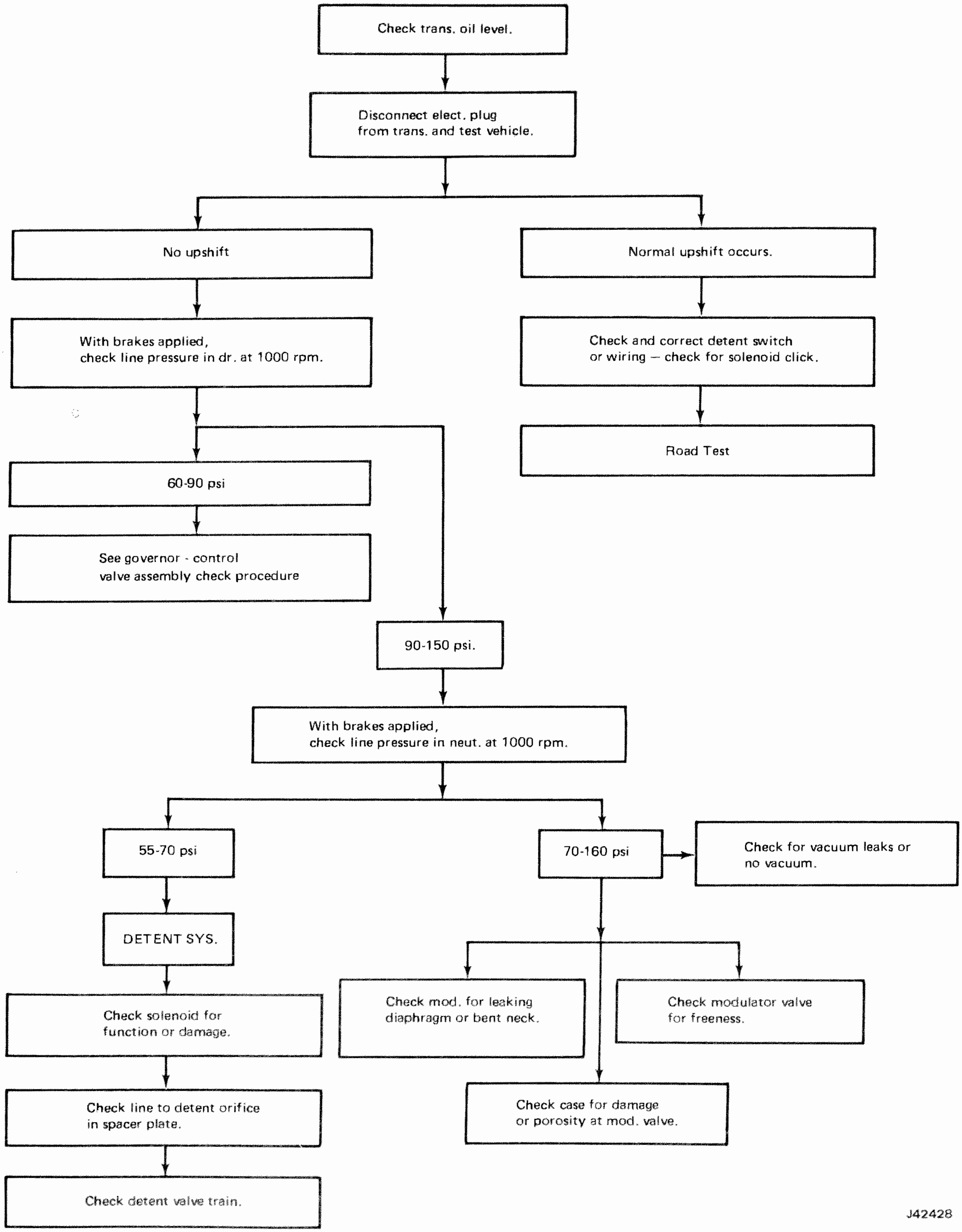
NO 1-2 UPSHIFT AND/OR DELAYED UPSHIFT OR 1-2 & 2-3 UPSHIFT — FULL THROTTLE ONLY



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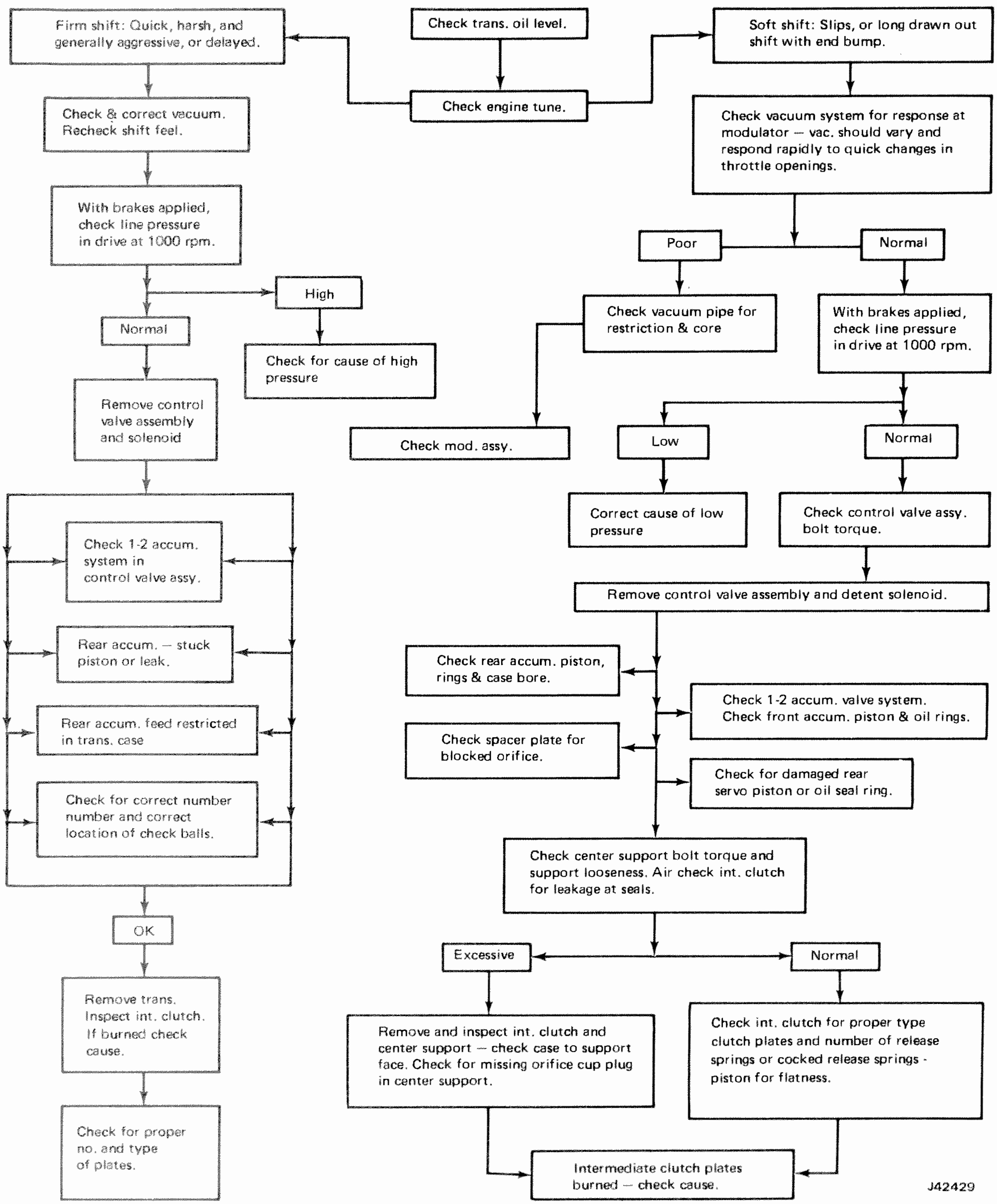
1-2 SHIFT COMPLAINT



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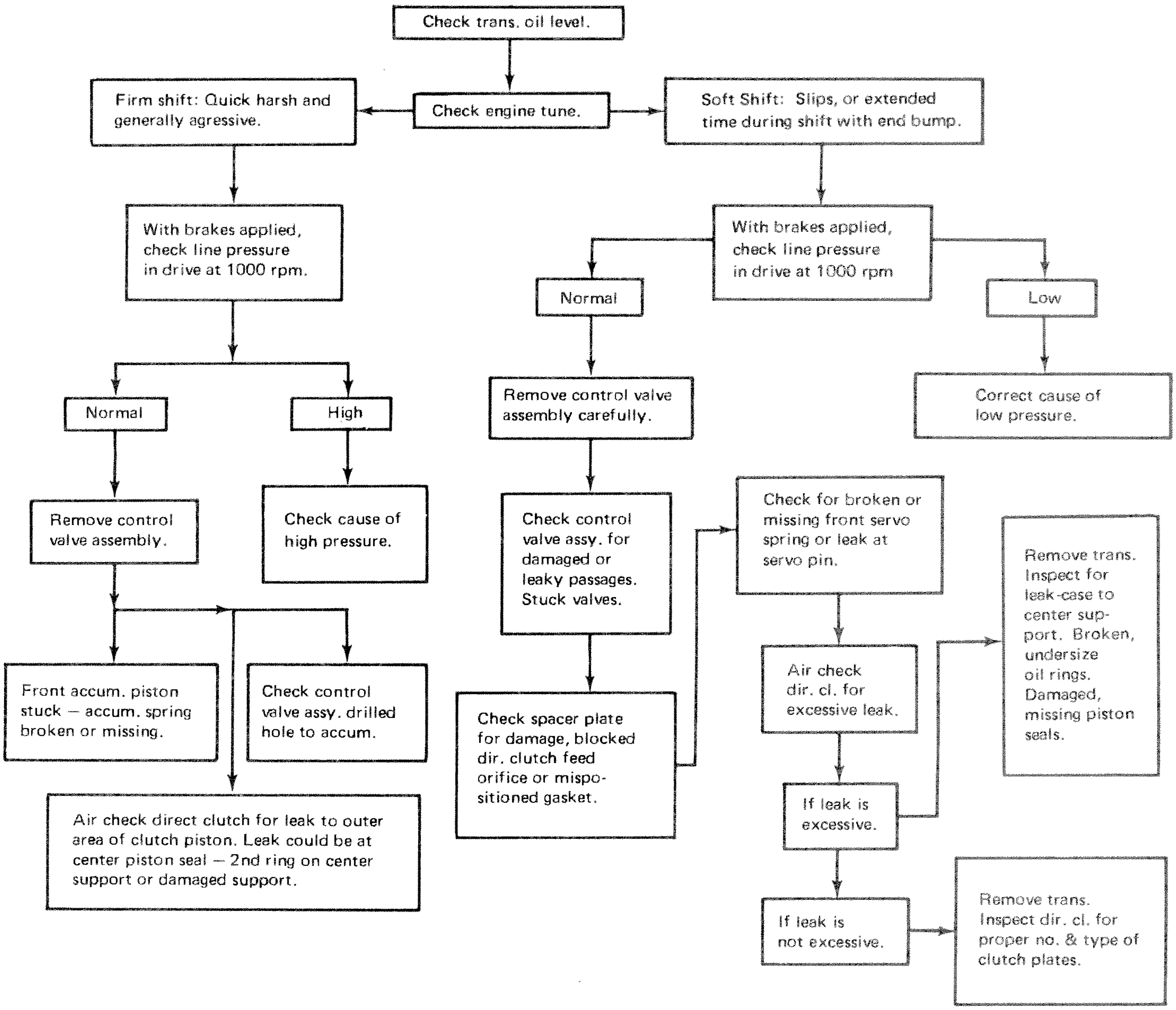
2-3 SHIFT COMPLAINT



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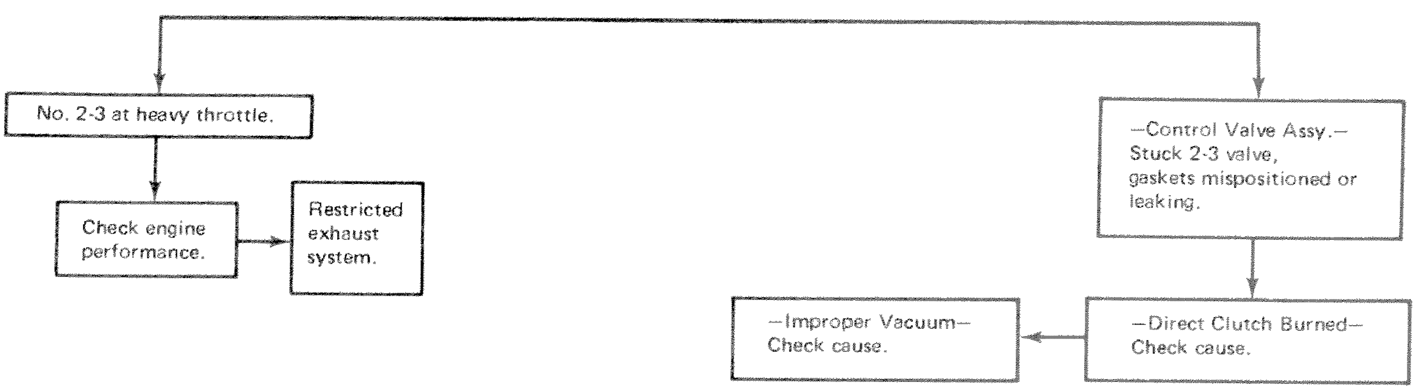
1ST & 2ND SPEEDS ONLY, NO 2-3



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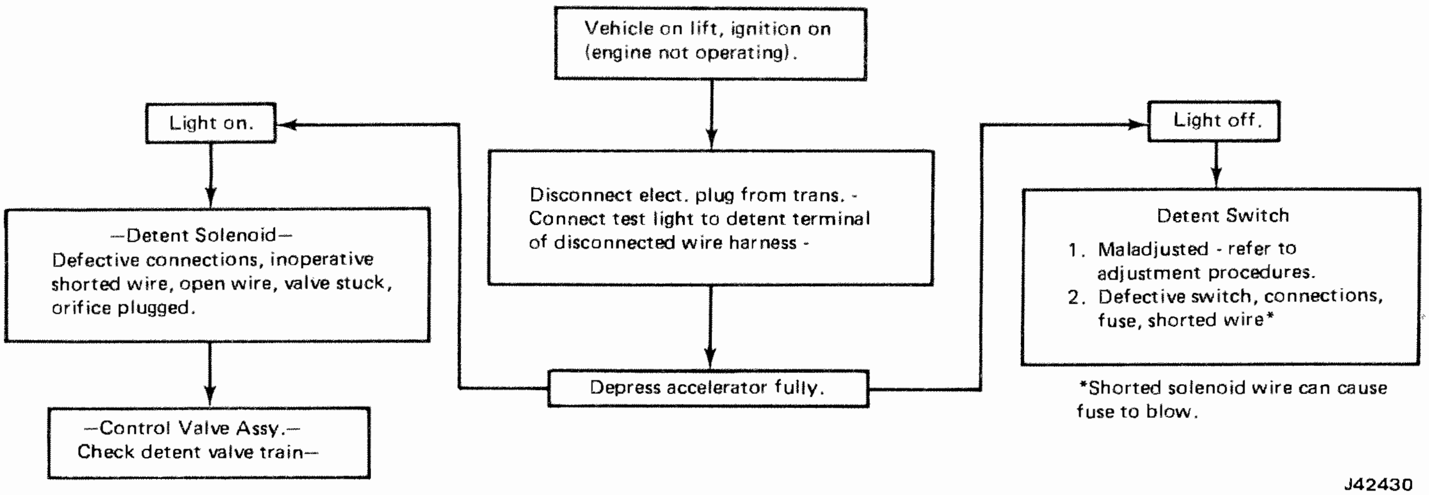
NO DETENT DOWNSHIFTS



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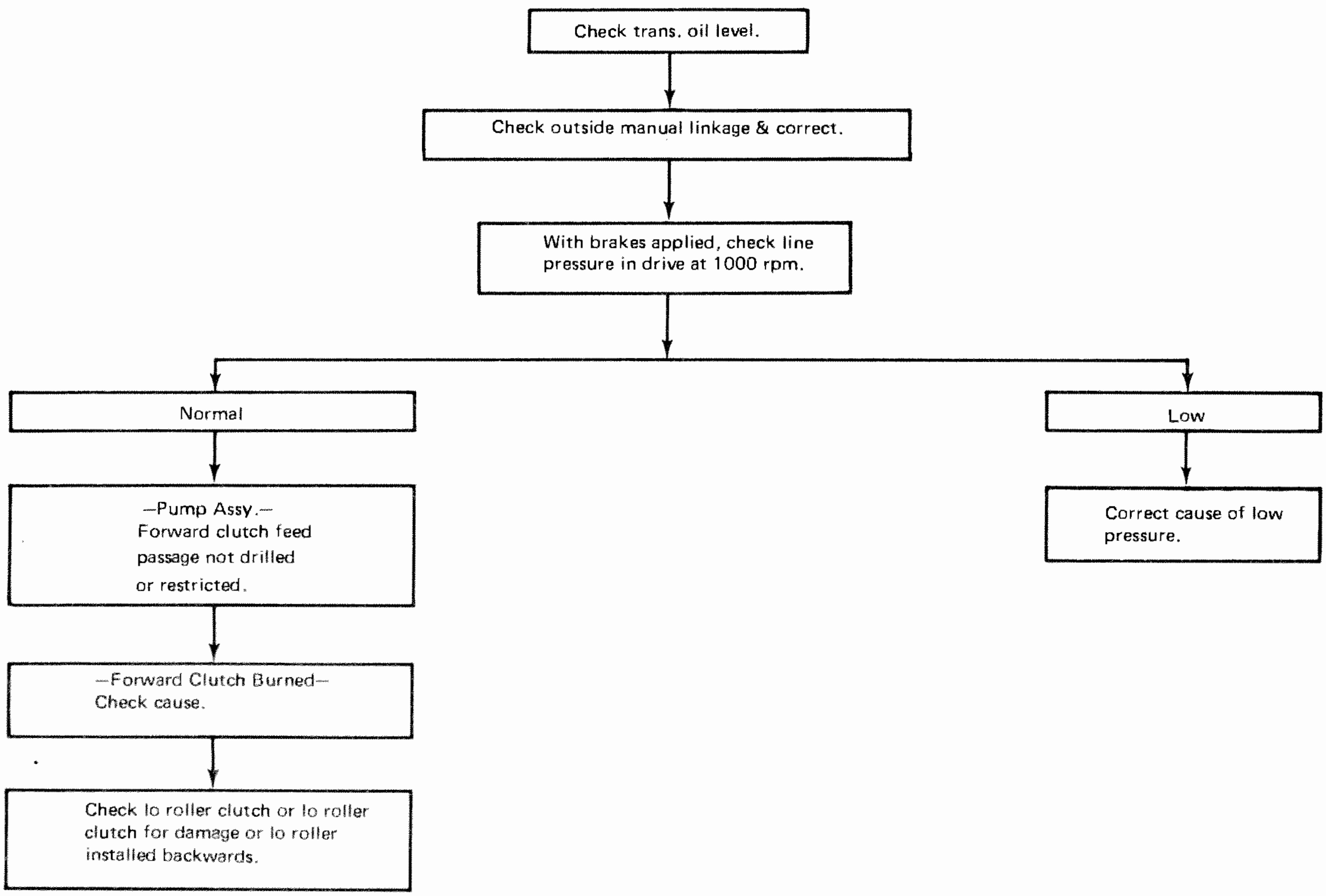
NO DRIVE IN DRIVE RANGE



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Causes of Burned Clutch Plates (Cont'd)

Forward Clutch

- Clutch piston cracked, seals damaged or missing.
- Low line pressure.
- Manual valve mispositioned.
- Restricted oil feed to forward clutch (examples: clutch housing to inner and outer areas not drilled, restricted or porosity in pump).
- Pump cover oil seal ring missing, broken or undersize; ring groove oversize.
- Case valve body face not flat or porosity between channels.
- Manual valve bent and center land not ground properly.

Intermediate Clutch

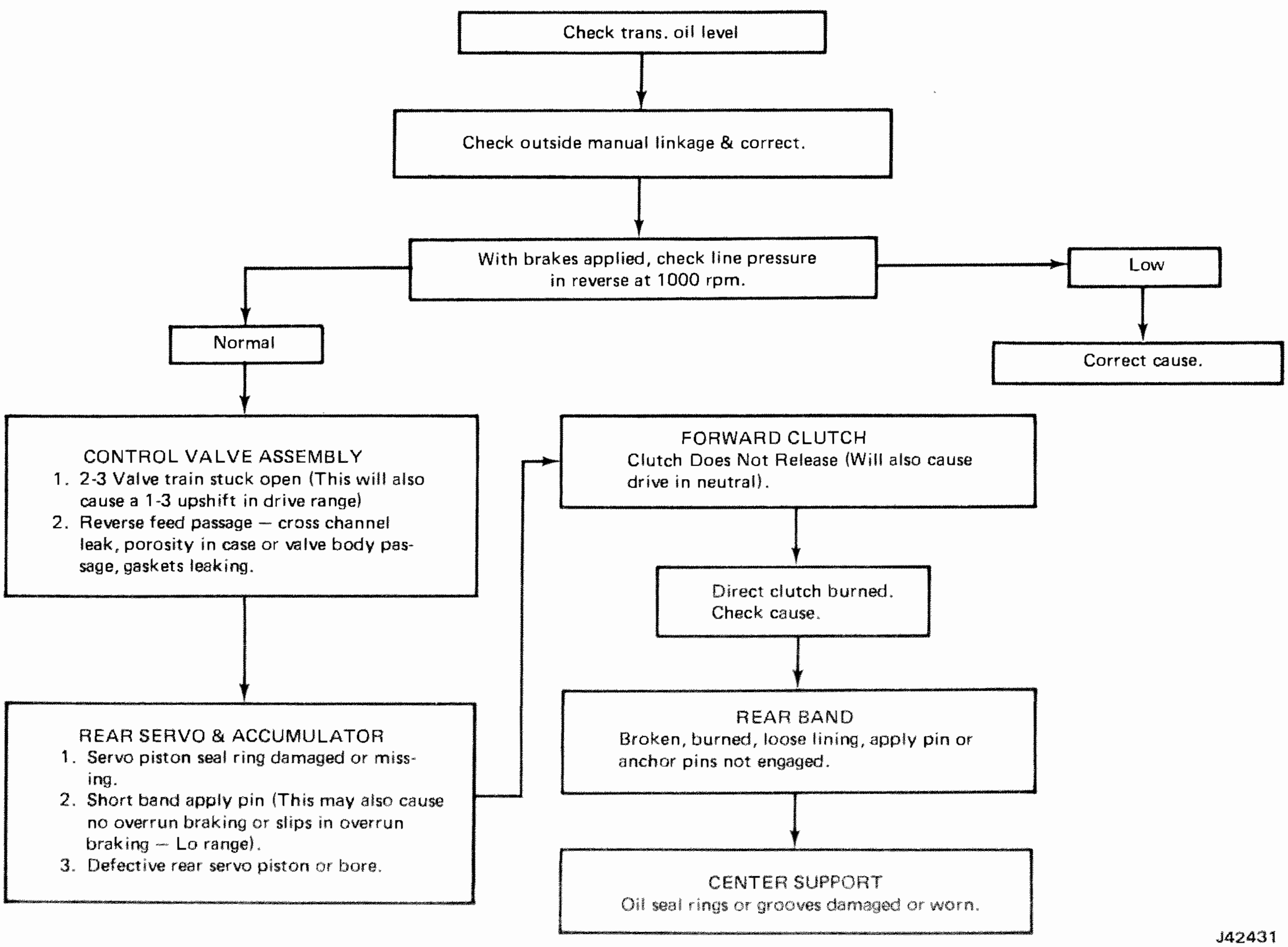
- Constant bleed orifice in center support missing.
- Rear accumulator piston oil ring damaged or missing.
- 1-2 accumulator valve stuck in control valve assembly.
- Intermediate clutch piston seals damaged or missing.
- Center support bolt loose.
- Low line pressure.
- Intermediate clutch plug in case missing.
- Case valve body face not flat or porosity between channels.
- Manual valve bent and center land not ground properly.

Direct Clutch

- Restricted orifice in vacuum line to modulator (poor vacuum response).
- Check ball in direct clutch piston damaged, stuck or missing.
- Defective modulator bellows.
- Center support bolt loose. (Bolt may be tight in support but not holding support tight to case.)
- Center support oil rings or grooves damaged or missing.
- Clutch piston seals damaged or missing.
- Front and rear servo pistons and seals damaged.
- Manual valve bent and center land not cleaned up.

(Continued on page 7-16.)

NO REVERSE OR SLIPS IN REVERSE



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NO ENGINE BRAKING — INTERMEDIATE RANGE — SECOND GEAR

FRONT SERVO & ACCUMULATOR
Oil rings and/or bores leaking or front servo piston cocked or stuck.

↓

Incorrect combination of front servo and accumulator parts.

↓

FRONT BAND
Broken, burned (check for cause), not engaged on anchor pin and/or servo pin.

NO ENGINE BRAKING — LO RANGE — 1ST GEAR

CASE ASSEMBLY
Lo-reverse check ball mispositioned or missing. Case damaged at lo-reverse check ball area.

↓

REAR SERVO
Oil seal ring, bore or piston damaged. Rear band apply pin short, improperly assembled.

↓

REAR BAND
Broken, burned (check for cause), not engaged on anchor pins and/or servo pin.

DRIVE IN NEUTRAL

Check outside manual linkage & correct.

↓

INTERNAL LINKAGE
Manual valve disconnected or end broken, inside detent lever pin broken.

↓

PUMP ASSEMBLY
Trans. lube pressure leaking into forward clutch apply passage.

↓

FORWARD CLUTCH
Burned plates — check cause.

Incorrect clutch plate usage.

WON'T HOLD IN PARK OR WON'T RELEASE FROM PARK

Check outside manual linkage & correct.

↓

INTERNAL LINKAGE
1. Parking brake rod assy. (Check actuator for chamfer).
2. Parking pawl broken, chamfer omitted.
3. Parking brake bracket loose, burr or rough edges, or incorrectly installed.
4. Parking pawl return spring missing, broken or incorrectly hooked.

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AUTOMATIC TRANSMISSION

CAUTION: *Before checking transmission for what is believed to be transmission noise, make certain the noise is not from the water pump, alternator, air conditioner, power steering, etc. These components can be isolated by removing the proper belt and running the engine not more than two minutes at one time.*

TRANSMISSION NOISY

Park, Neutral & All Driving Ranges

PUMP CAVITATION
- Oil level low.
- Plugged or restricted filter.*
- Intake pipe O-ring damaged.
- Intake pipe split, porosity in case intake pipe bore.
- Water in oil.
- Porosity or voids at trans. case (pump face) intake port.
- Pump to case gasket off location.

PUMP ASSEMBLY
- Gears damaged, or defective, driving gear assembled backwards.
- Crescent interference.
- Buzzing noise — orifice cup plug in pressure regulator damaged or missing.
- Seal rings damaged or worn.

CONVERTER
- Loose bolts (converter to flywheel).
- Converted damage.
- Cracked or broken flex plate.

During Acceleration — Any Gear

- Transmission or cooler lines grounded to underbody.
- Motor mounts loose or broken.

Squeal at Low Vehicle Speeds

- Speedometer driven gear shaft seal — seal requires lubrication or replacement.

First, Second and/or Reverse

PLANETARY GEAR SET
- Gears or thrust bearings damaged.
- Front internal gear ring damaged.

*If the filter is suspected of being plugged or restricted, it must be replaced.

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Causes of Burned Clutch Plates (Cont'd)

Direct Clutch

- Case valve body face not flat or porosity between channels.
- Intermediate roller clutch installed backwards.
- 3-2 valve, 3-2 spring, or 3-2 spacer pin installed in the wrong sequence in 3-2 valve bore.
- Incorrect combination of front servo and accumulator parts.

NOTE: *If direct clutch plates and front band are burned, check manual linkage.*

NOTE: *Burned clutch plates can be caused by incorrect usage of clutch plates. Also, antifreeze in transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.*

Checking Transmission Oil Level

(1) Engine running.
(2) Vehicle on level surface.
(3) Brakes applied.
(4) Move lever through all ranges.
(5) Place transmission in park.
(6) Check oil level.
(7) If oil is low, check for possible causes.

The oil level should be between the add and full marks at normal operating temperature (170° F). This temperature is obtained after at least 15 miles of expressway driving or equivalent city driving. Also, at normal operating temperature, the oil will heat the gauge end of the dipstick to a degree so that it cannot be grasped without discomfort.

If the transmission is not at operating temperature, the oil level should be approximately ¼ inch below the "add" mark with the oil at approximately 75° F (room temperature). If the oil level is correctly established at room temperture (75° F), it should be at the "full" mark on the dip stick when the transmission reaches normal operating temperature (170° F).

CAUTION: *Do not overfill transmission, as this will cause foaming and loss of oil through the vent pipe.*

Manual Linkage Adjustment

The transmission manual linkage must be adjusted so that the pointer on the indicator quadrant and linkage detents or stops corresponds with the transmission inside detent lever detents. If the linkage is not adjusted properly, an internal leak could occur at the manual valve which could cause a clutch and/or front band failure.

Cause of Low Line Pressure

Low Transmission Oil Level

Modulator Assembly

Filter

- Blocked or restricted.
- O-ring on intake pipe and/or grommet omitted or damaged.
- Split or leaking intake pipe.
- Wrong filter assembly.

Pump

- Pressure regulator or boost valve stuck.
- Gear clearance, damaged, worn (pump will become damaged if drive gear is installed backwards, or if converter pilot does not enter crankshaft freely).
- Pressure regulator spring too weak.
- Not enough spacers in pressure regulator.
- Pump to case gasket mispositioned.
- Defective pump body and/or cover.
- Mismatch pump cover/pump body.

Internal Circuit Leaks

- Forward clutch leak (pressure normal in neutral and reverse — pressure low in drive). Check pump rings or forward clutch seals.
- Direct clutch leak (pressure normal in neutral, low, int. and drive — pressure low in reverse). Check center support oil seal rings.
- Check direct clutch outer seal for damage. Check rear servo and front accum. pistons and rings for damage or missing.

Case Assembly

- Porosity in intake bore area.
- Check case for intermediate clutch plug leak or blown out plugs.
- Drive-1-Reverse check ball mispositioned or missing (this will cause no reverse and no overun braking in Drive-1 range).
- If the filter is suspected of being plugged or restricted, it must be replaced.

Causes of High Line Pressure

Vacuum Leak

- Full leak, vacuum line disconnected.
- Partial leak in line from engine to modulator.
- Improper engine vacuum.
- Vacuum-operated accessory leak (hoses, vacuum advance, etc.).

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Damaged Modulator

- Stuck valve.
- Water in modulator.
- Not operating properly.

Detent System

- Detent switch (plunger stuck, or shorted, or misadjusted).
- Detent wiring shorted.
- Detent solenoid stuck open.
- Detent feed orifice in spacer plate blocked.
- Detent solenoid loose.
- Detent valve bore plug damaged.
- Detent reg. valve pin short.

Pump

- Pressure regulator and/or boost valve stuck.
- Incorrect pressure regulator spring or valve.
- Too many pressure reg. valve spacers.
- Pump casting bad.
- Pressure boost valve installed backwards or defective.
- Aluminum bore plug has hole or otherwise defective.
- Pressure boost bushing broken or otherwise defective.

Control Valve Assembly

- Control valve assy. to spacer gasket off location.
- Gaskets installed in reverse order.

Causes of Improper Vacuum At Modulator

Engine

- Tune up.
- Loose vacuum fittings.
- Vacuum operated accessory leak (hoses, vacuum advance, etc.)
- Engine exhaust system restricted.

Vacuum Line To Modulator

- Leak.
- Loose fitting.
- Restricted orifice, or incorrect orifice size.
- Carbon buildup at modulator vacuum fitting.
- Pinched line.
- Grease in pipe (delayed or no upshift-cold).

Control Valve Assembly—Governor Line Pressure Check

(1) Install line pressure gage.

(2) Disconnect vacuum line to modulator.

(3) With car on hoist (rear wheels off ground, foot off brake, in drive) check line pressure at 1000 rpm.

(4) Slowly increase engine rpm to 3000 rpm and determine if a line pressure drop occurs (7 psi or more).

(5) If pressure drop occurs, disassemble, clean and inspect control valve assembly.

(6) If no pressure drop occurs:

Inspect Governor.

- Stuck valve.
- Weight freeness.
- Restricted orifice in governor valve.

Governor Feed System.

- Check screen in control valve assembly or case.
- Check for restrictions in governor pipe.

Modulator Assembly Diagnosis Procedure

Vacuum Diaphragm Leak Check

(1) Insert a pipe cleaner into the vacuum connector pipe as far as possible and check for the presence of transmission oil.

(2) If oil is found, replace the modulator.

(3) Transmission oil may be lost through diaphragm and burned in engine.

NOTE: *Gasoline or water condensation may settle in the vacuum side of the modulator. If this is found without the presence of oil the modulator should not be changed.*

Atmospheric Leak Check

(1) Apply a liberal coating of soap bubble solution to vacuum connector pipe seam, crimped upper-to-lower housing seam, and threaded screw seal.

(2) Use short piece of rubber tube, apply air pressure to vacuum pipe by blowing into tube and observe for leak bubbles. If bubbles appear, replace the modulator.

NOTE: *Do not use any method other than human lung power for applying air pressure, as pressure over 6 psi may damage the modulator.*

MINOR MAINTENANCE AND ADJUSTMENTS

Services outlined below can be performed without removing the transmission from the vehicle. Complete procedures are not given for all of these services, since they are covered in detail under disassembly and reassembly.

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Neutralizer Switch Adjustment

The neutralizer switch must be adjuted so that the vehicle will start in the park or neutral position, but will not start in the other positions.

Pressure Regulator Valve Removal

(1) Raise vehicle on hoist or place on jack stands. Provide container to catch oil.

(2) Remove bottom pan and gasket. Drain oil.

(3) Remove oil filter retaining bolt and lift out pump intake pipe and oil filter assembly.

(4) Remove and discard intake pipe O-ring and bottom pan gasket.

(5) Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring.

CAUTION: *Pressure regulator spring is under extreme pressure and will force valve bushing out of bore when snap ring is removed if valve bushing is not held securely.*

(6) Continue to exert pressure on valve bushing and remove snap ring, using snap ring pliers. Gradually release pressure on valve bushing until all spring force is exhausted.

(7) Carefully remove regulator boost valve bushing and valve, and pressure regulator spring. Be careful not to drop parts, as they will fall out if they are not held.

(8) Remove pressure regulator valve and spring retainer. Remove spacers if present. Be careful not to drop pressure regulator valve when removing it from bore.

Pressure Regulator Valve Installation

(1) Install spring retainer on pressure regulator spring. Install spacers if previously removed.

(2) Install pressure regulator valve on spring, stem end first.

(3) Install boost valve into bushing, stem end out, and stack parts with pressure regulator spring against valve bushing.

(4) Install complete assembly into pressure regulator valve bore, being careful not to drop parts during installation.

(5) Using a screwdriver or steel rod, compress regulator boost valve bushing against pressure regulator spring until it is beyond snap ring groove, and install snap ring.

NOTE: *To facilitate installation of snap ring, encircle it around screwdriver or steel rod, compress tangs with snap ring pliers, and slide snap ring upward into ring groove in valve bore.*

(6) Install new intake pipe O-ring onto intake pipe and install pipe and oil filter assembly into transmission case bore, retaining oil filter with retainer bolt.

(7) Install new gasket on bottom pan and install bottom pan.

(8) Install bottom pan attaching screws. Tighten screws to 10 to 13 foot pounds torque.

(9) Lower vehicle to floor and add fluid to tranmission as required.

Control Valve Body Removal

(1) Remove bottom pan and oil filter.

(2) Remove and discard intake pipe O-ring and pan gaskets.

(3) Disconnect solenoid lead from connector terminal.

(4) Remove control valve body attaching screws and detent roller spring assembly.

NOTE: *Do not remove solenoid attaching screws.*

(5) Remove control valve body assembly and governor pipes. Make certain the six check balls stay in place above the spacer plate.

CAUTION: *Do not drop manual valve.*

(6) Remove the governor pipes and manual valve from control valve body.

(7) Remove and discard control valve assembly to spacer gasket.

Control Valve Body Installation

Installation of the control valve body is the reverse of the removal, using new control valve assembly to spacer gasket, intake pipe O-ring and pan gasket. Refill, adding oil as required.

Governor Removal

(1) Remove governor cover attaching screws, cover and gasket. Discard gasket.

(2) Withdraw governor assembly from case.

Governor Installation

Installation of the governor assembly is the reverse of the removal. Use a new gasket under the governor cover. Refill, adding oil as required.

Modulator and Modulator Valve Removal

(1) Remove modulator assembly attaching screw and retainer.

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(2) Remove modulator assembly from case. Discard O-ring seal.
(3) Remove modulator valve from case.

Modulator and Modulator Valve Installation

Installation of the modulator assembly and modulator valve is the reverse of the removal. Use a new O-ring seal on the modulator assembly. Refill adding oil as required.

Parking Linkage Removal

(1) Remove bottom pan and oil filter. Discard gasket.
(2) Unthread jam nut holding detent lever to manual shaft.
(3) Remove manual shaft retaining pin from case.
(4) Remove manual shaft and jam nut from case.
(5) Remove parking actuator rod and detent lever assembly.
(6) Remove parking pawl bracket attaching screws and bracket.
(7) Remove parking pawl return spring.
(8) Remove parking pawl shaft retainer.
(9) Remove cup plug, parking pawl shaft and parking pawl.

Parking Linkage Installation

Installation of the parking linkage is the reverse of the removal. Use new seals and gasket. Refill, adding oil as required.

NOTE: *As a normal maintenance procedure it is recommended that the manual shaft be lubricated with oil at the point where it enters the transmission case.*

TRANSMISSION REMOVAL AND INSTALLATION

Removal

(1) Remove dipstick tube to engine bolt.
(2) Remove carpet trim ring.
(3) On Model 20 remove top cover and lever on transfer case.
(4) Mark and remove rear propeller shaft.
(5) Remove exhaust pipe clamp bolt, shift lever, down shift wire and speedometer cable.
(6) Position transmission jack and remove rear crossmember.
(7) Remove exhaust pipe(s).
(8) Mark and remove front propeller shaft at transfer case end.
(9) Remove oil cooler lines and vacuum line.
(10) On Quadra-Trac transfer case remove diaphragm control hoses and Lock-Out signal switch wire.
(11) Remove converter housing splash pan.
(12) Remove converter to flywheel bolts and mark the converter and flywheel for alignment during installation.
(13) Remove converter housing to engine bolts and remove transmission.

Installation

(1) Install transmission and install engine bolts.
(2) Install converter to flywheel bolts, making sure mark made during removal is in alignment.
(3) Install converter front splash pan.
(4) Install oil cooler lines and vacuum line.
(5) On Quadra-Trac transfer case install diaphragm control hoses and Lock-Out signal switch wire.
(6) Install front propeller shaft, making sure mark made during removal is in alignment.
(7) Install exhaust pipe. DO NOT TIGHTEN.
(8) Install crossmember and remove transmission jack.
(9) Tighten exhaust pipe.
(10) Install exhaust pipe clamp bolt, shift lever, speedometer cable and down shift wire.
(11) Install rear propeller shaft, making sure mark made during removal is in alignment.
(12) On Model 20 install top cover and shift lever transfer case.
(13) Install carpet trim ring.
(14) Install dip stick tube to engine bolt.

NOTE: *It will not be necessary to replace the converter assembly when a transmission failure has occurred, unless converter is defective. However, it is recommended that the transmission be properly cleaned, oil filter replaced and cooler and cooler lines flushed after any failure that generates sludge or dirt.*

Torque Converter Removal

With transmission in cradle on portable jack, remove torque converter assembly from transmission case by pulling straight out.

NOTE: *Converter contains a large amount of oil.*

Holding Fixture and Tool Base Installation

(1) Install Holding Fixture J-8763-01 on transmission case with modulator assembly located on side of holding fixture nearest bench.

NOTE: *Do not overtorque holding screw. This will bind center support.*

(2) Install fixture and transmission into Holding Tool Base J-3289-20 with bottom pan of transmission case facing upward, as shown in figure 7-4.

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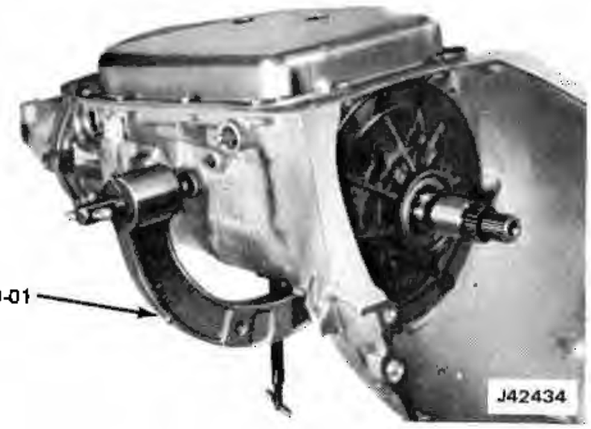

Fig. 7-4 Transmission in Holding Fixture J-8763-01

(3) Remove modulator assembly, attaching screw and retainer from transmission case.

(4) Remove modulator assembly and O-ring seal from adapter.

(5) Remove adapter from transmission case.

(6) Remove modulator valve from transmission case.

Governor, Oil Pan, Oil Filter and Intake Pipe Removal

(1) Remove attaching screws, governor cover and gasket from transmission case. Discard gasket (fig. 7-5)

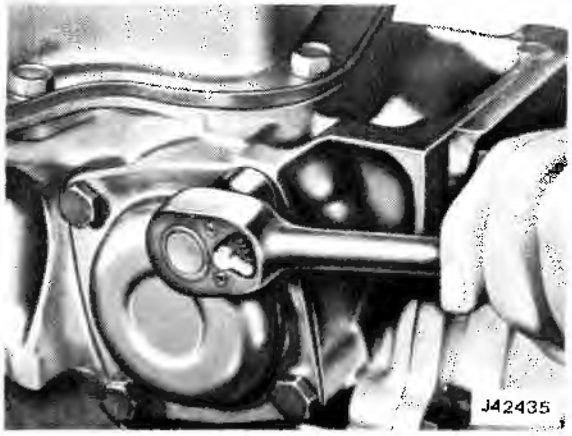

Fig. 7-5 Removing Governor Cover Attaching Screw

(2) Withdraw governor assembly from case.

(3) Remove bottom pan and gasket from transmissions case. Discard gasket. (fig. 7-6)

(4) Remove oil filter retainer bolt.

(5) Remove oil filter assembly from transmission case (fig. 7-7).

(6) Remove intake pipe-to-case O-ring from intake pipe or case. Discard O-ring.

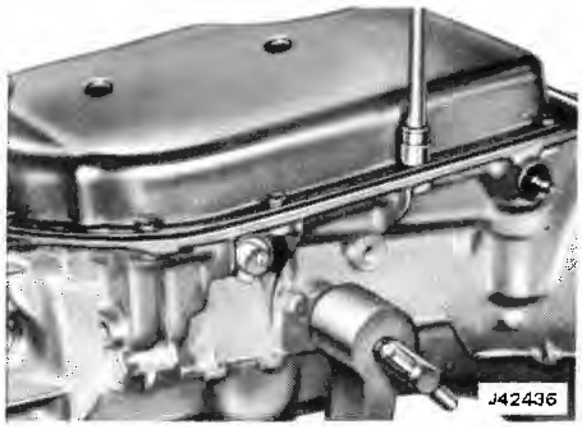

Fig. 7-6 Removing Transmission Oil Pan

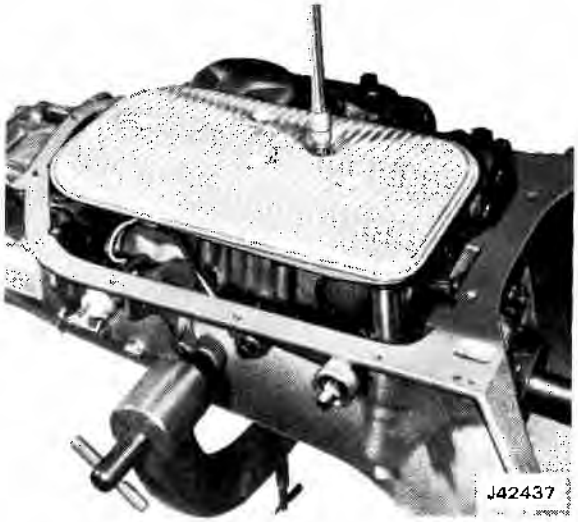

Fig. 7-7 Removing or Installing Oil Filter

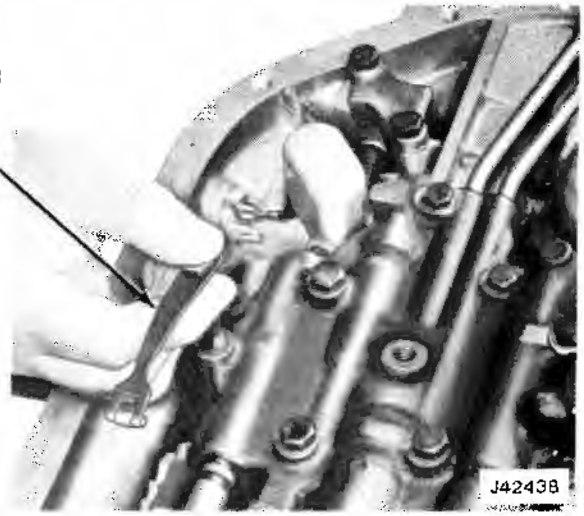

Fig. 7-8 Removing or Installing Detent Roller Assembly and Spring

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Control Valve Assembly, Solenoid Connector, Governor Pipes, and Detent Spring Assembly

Removal

(1) Remove attaching screws of control valve body and detent roller spring assembly from transmission case as shown in fig. 7-8.

(2) Disconnect solenoid lead from connector terminal.

(3) Remove control valve body assembly and governor pipes from transmission case (fig. 7-9).

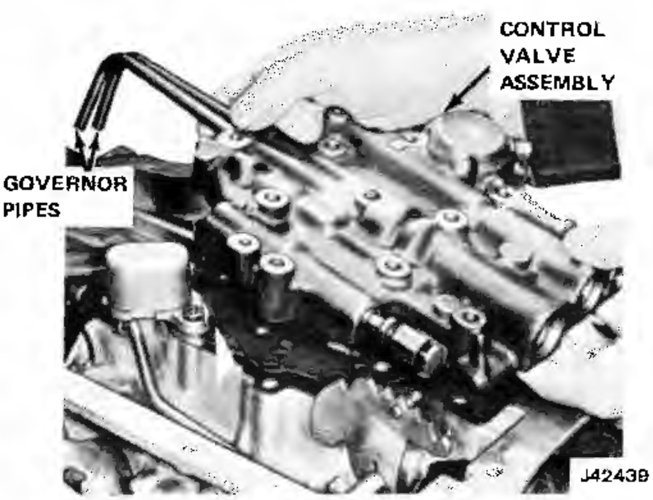

Fig. 7-9 Removing Control Valve Assembly and Governor Pipes

(4) Remove governor screen assembly from end of governor feed pipe or governor feed pipe hole in case (fig. 7-10).

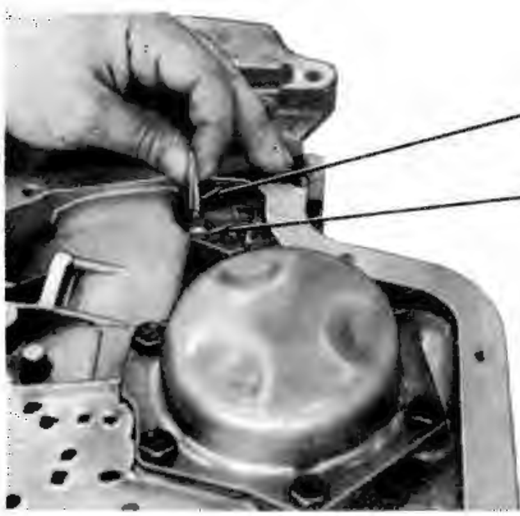

Fig. 7-10 Governor Screen

CAUTION: *Do not drop manual valve.*

(5) Remove governor pipes from control valve assembly.

(6) Remove control valve assembly to spacer gasket.

Rear Servo Removal

(1) Remove rear servo cover attaching screws, servo cover and gasket from transmission case. Discard gasket (fig. 7-11).

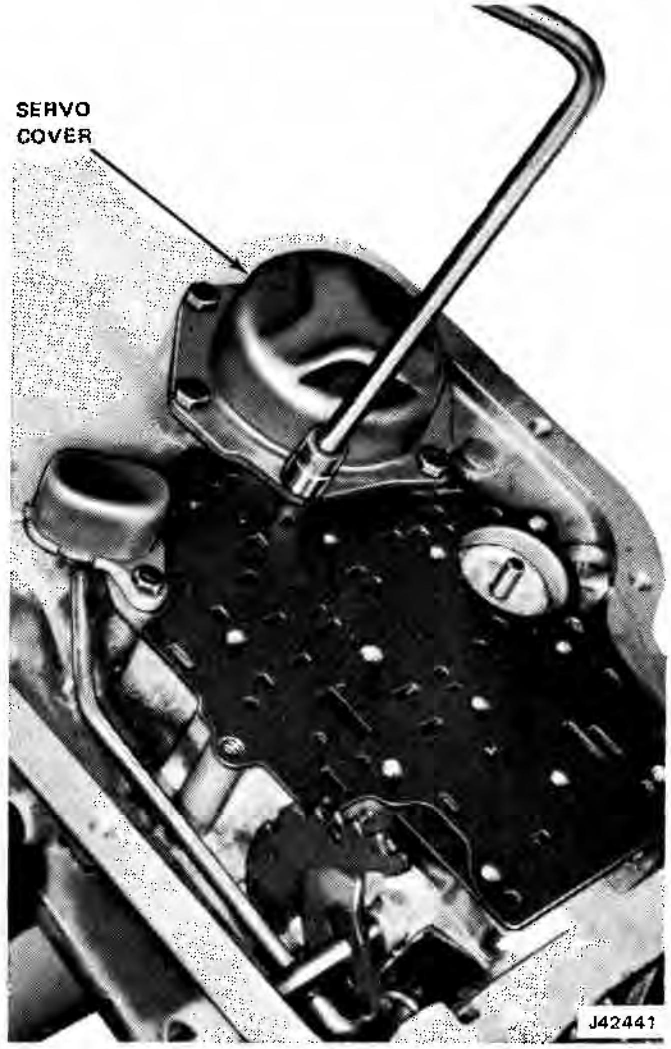

Fig. 7-11 Removing or Installing Rear Servo Cover

(2) Remove rear servo assembly from transmission case, as shown in figure 7-12.

(3) Remove rear servo accumulator spring from transmission case.

Selection of Rear Band-Apply Pin

(1) Attach Fixtures J-21370-5 and J-21370-6 to transmission case by means of rear servo assembly attaching screws, as shown in fig. 7-13. These fixtures will be used to select a band-apply pin. One of three lengths of band-apply pin must be selected, to adjust operation of rear servo.

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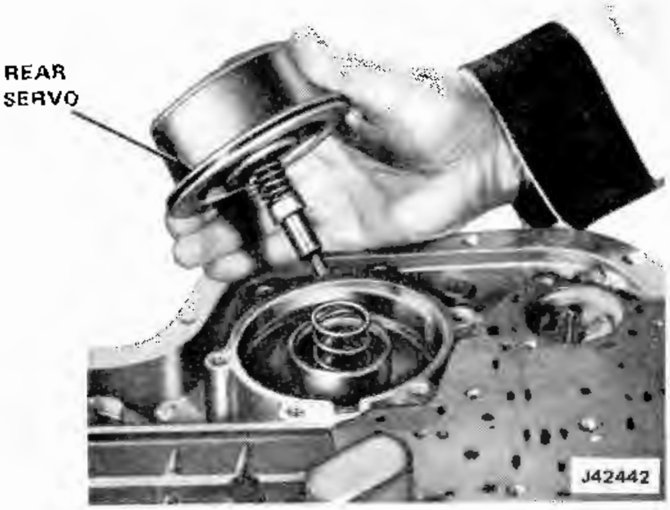

Fig. 7-12 Removing or Installing Rear Servo Assembly

(2) Apply 25 foot-pounds torque, then select proper length of band-apply pin (to be used during assembly of transmission) as follows: If both steps of J-21370-5 pin fixture are below gauge surface, select long pin, identified by three rings; if gauge surface is between steps, select medium pin, identified by two rings; if both steps are above the gauge surface, select short pin, identified by one ring. Identification ring is located on band lug end of the pin.

Detent Solenoid, Control Valve Spacer, and Front Servo Removal

(1) Remove solenoid attaching screws, detent solenoid assembly, and gasket from transmission case. Discard gasket (fig. 7-14).

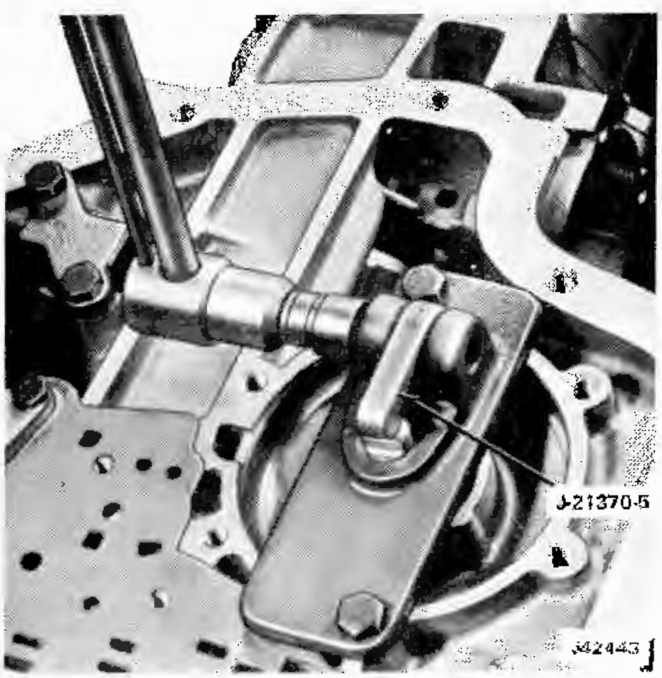

Fig. 7-13 Checking Band-Apply Pin of Rear Bands

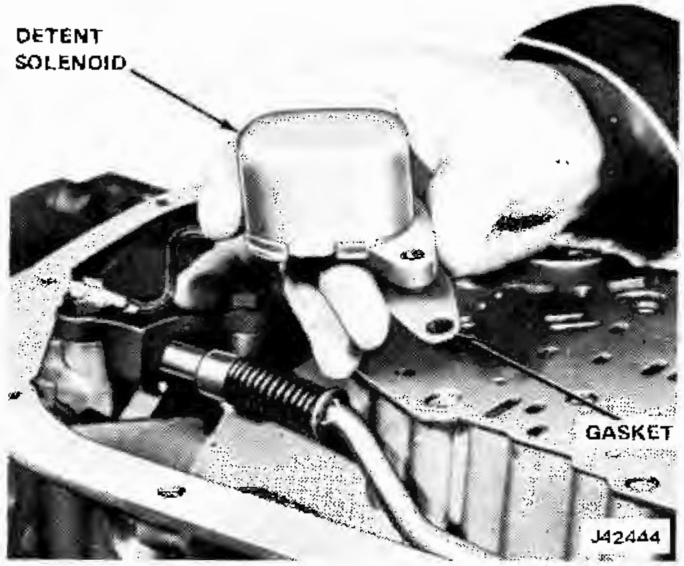

Fig. 7-14 Detent Solenoid and Gasket Removal and Installation

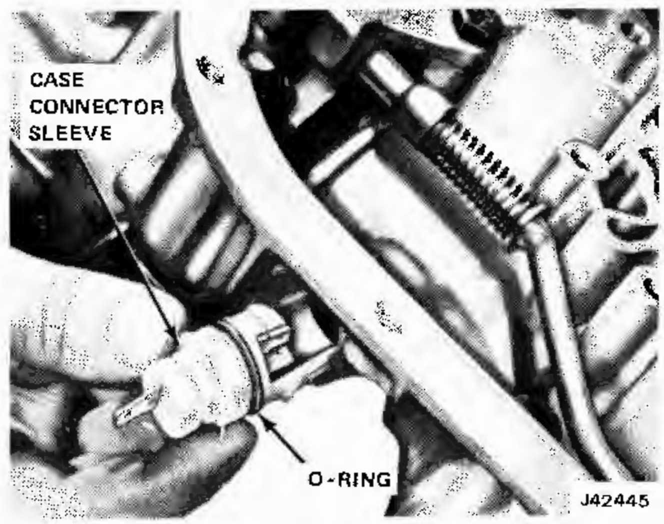

Fig. 7-15 Removing-Installing Case Connector Sleeve and O-Ring Seal

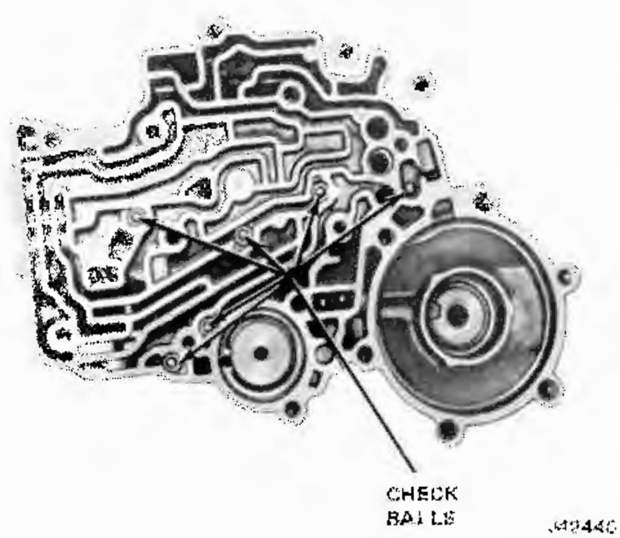

Fig. 7-16 Location of Check Balls

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(2) Withdraw detent solenoid case sleeve connector and O-ring seal from Transmission case, as shown in figure 7-15.

(3) Remove control valve assembly spacer plate and gasket.

(4) Remove six check balls from cored passages in transmission case. Refer to fig. 7-16.

(5) Remove front servo piston, washer, pin, retainer, and spring from tranmission case, as shown in fig. 7-17.

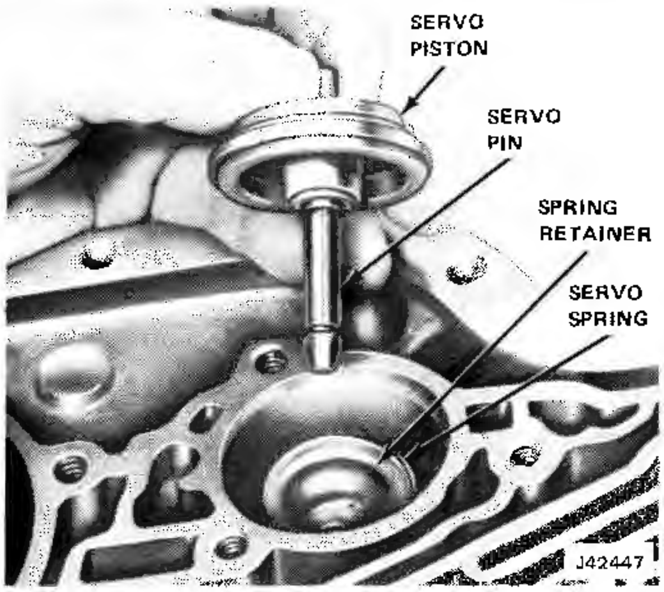

Fig. 7-17 Removing-Installing Front Servo Piston

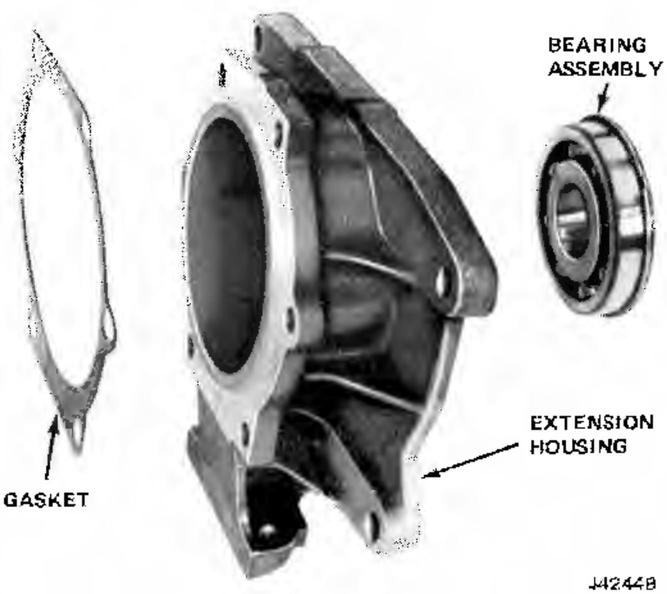

Fig. 7-18 Extension Housing Assembly

Rear Oil Seal and Extension (Housing) Removal

(1) Remove snap ring from output shaft sleeve.

(2) Remove gear.

(3) Remove output shaft sleeve-to-bearing snap ring.

(4) Remove output shaft sleeve from bearing.

(5) Remove bearing-to-case extension snap ring and remove bearing.

(6) Remove the two seals if necessary. Refer to fig. 7-18.

(7) Inspect sleeve, splines, and snap ring groove for damage. Inspect bearing.

Front Unit End Play

(1) Remove one front pump attaching bolt and washer from either 5 or 10 o'clock position.

(2) Install a ⅜ inch - 16 threaded slide hammer bolt, into bolt hole.

(3) Mount a dial indicator on rod, then index indicator to register with end of turbine shaft, as shown in fig. 7-19.

(4) Push turbine shaft rearward.

(5) Push output shaft forward.

(6) Set dial indicator to zero.

(7) Pull turbine shaft forward.

(8) Read resulting travel, or end play, which should be 0.003 to 0.024 inch.

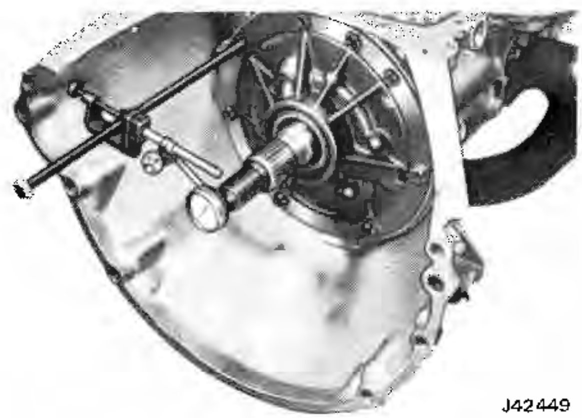

Fig. 7-19 Front Unit End Play

Important:

Selective washer controlling this end play is the thrust washer, located between pump cover and forward clutch housing. If more or less washer thickness is required to bring end play within specifications, select proper washer from the following chart:

0.060 to 0.064	Yellow
0.071 to 0.075	Blue
0.082 to 0.086	Red
0.093 to 0.097	Brown
0.104 to 0.108	Green
0.115 to 0.119	Black
0.126 to 0.130	Purple

NOTE: *An oil-soaked washer may tend to discolor, so it will be necessary to measure washer for its actual thickness.*

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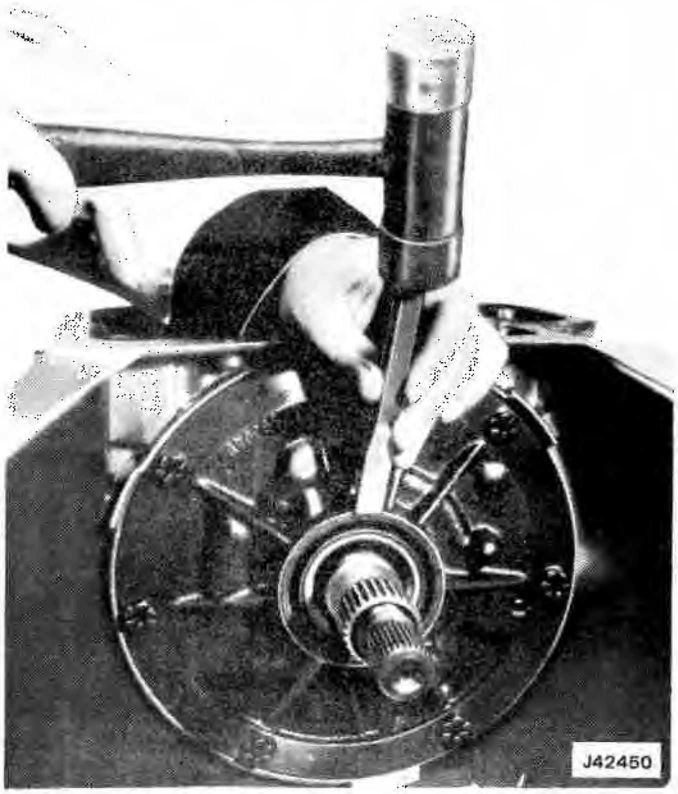

Fig. 7-20 Removing Front Seal

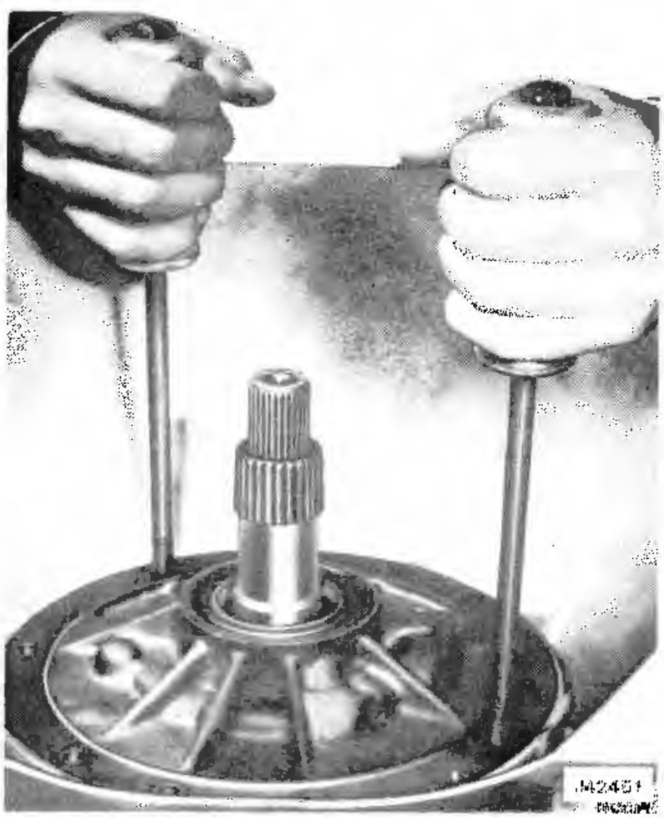

Fig. 7-21 Removing Oil Pump Assembly

Oil Pump, Forward Clutch, Turbine Shaft, and Direct Clutch Removal

(1) If necessary to replace, pry front seal from oil pump (fig. 7-20).

(2) Remove pump attaching bolts and bolt washers.

(3) Install 3/8-16 inch threaded slide hammers into threaded holes in pump body at 5 and 10 o'clock positions.

(4) Remove pump assembly from case (fig. 7-21).

(5) Remove and discard pump-to-case seal ring and gasket from oil pump.

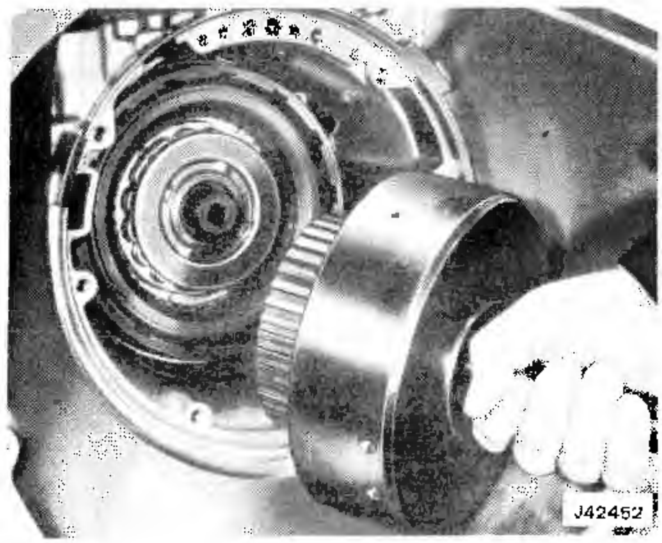

Fig. 7-22 Removing-Installing Forward Clutch Assembly

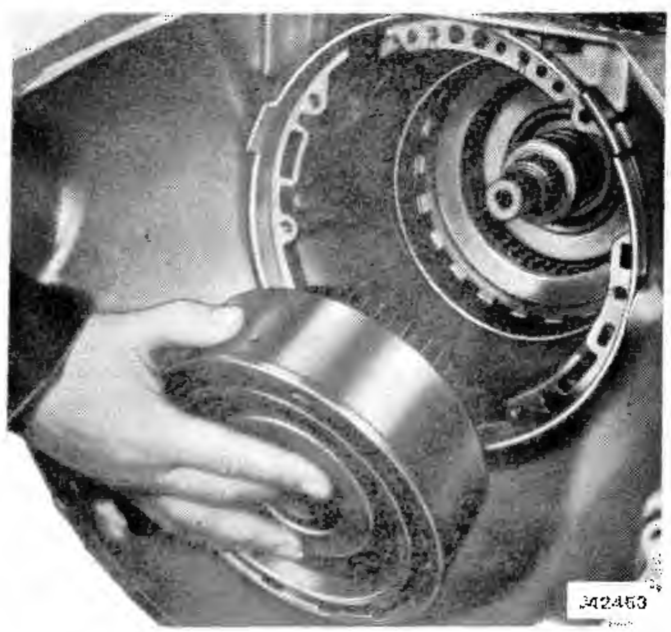

Fig. 7-23 Removing-Installing Direct Clutch Assembly

(6) Remove forward clutch assembly and turbine shaft from transmission case, as shown in fig. 7-22.

(7) Remove forward clutch hub to direct clutch hous-

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ing thrust washer, if it did not come out with forward clutch housing assembly.

Remove direct clutch assembly from transmission case (fig. 7-23).

Manual Linkage Removal

(1) Unthread jam nut holding detent lever to manual shaft.

(2) Remove manual shaft retaining pin from transmission case, as shown in fig. 7-24.

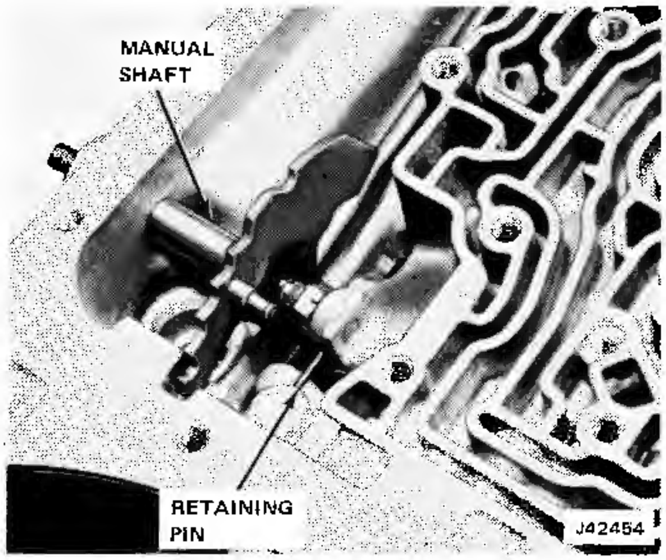

Fig. 7-24 Manual Shaft and Retaining Pin

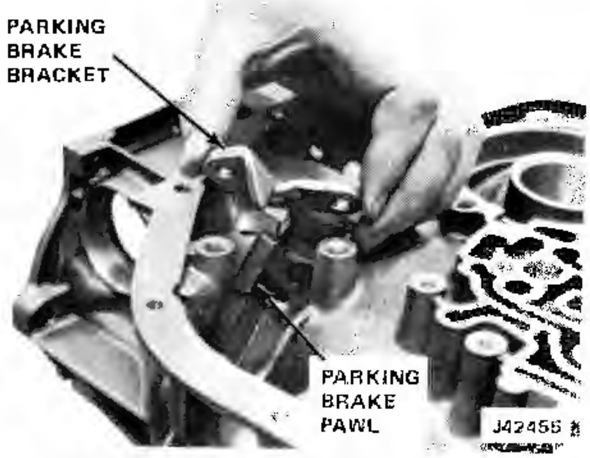

Fig. 7-25 Removing Parking Braket

CAUTION: *Do not lose jamnut as it becomes free from manual shaft.*

(3) Remove jamnut, manual shaft, and seal from transmission case.

(4) Remove parking actuator rod and detent lever assembly from transmission case.

(5) Remove attaching screws and parking bracket from transmission case (fig. 7-25).

(6) Remove parking pawl return spring from pawl and transmission case, as shown in fig. 7-26.

(7) Remove retainer spring from parking pawl shaft (fig. 7-27).

(8) Remove parking pawl shaft cup plug, parking pawl shaft, and the parking pawl from transmission (fig. 7-28).

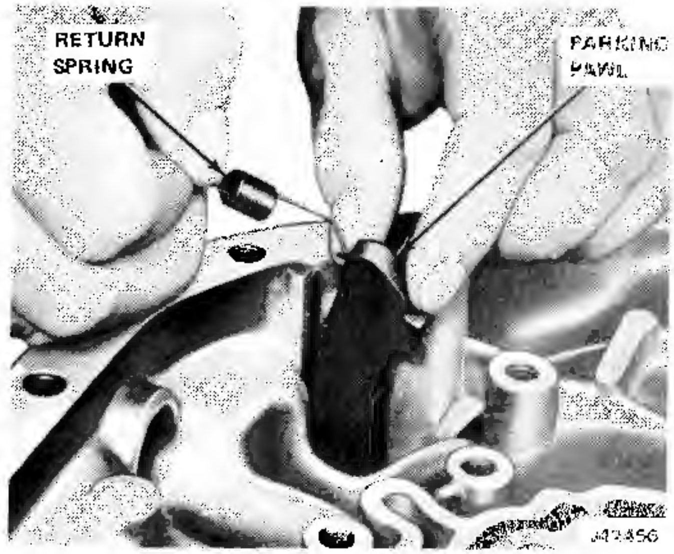

Fig. 7-26 Removing-Installing Return Spring From Parking Brake Pawl

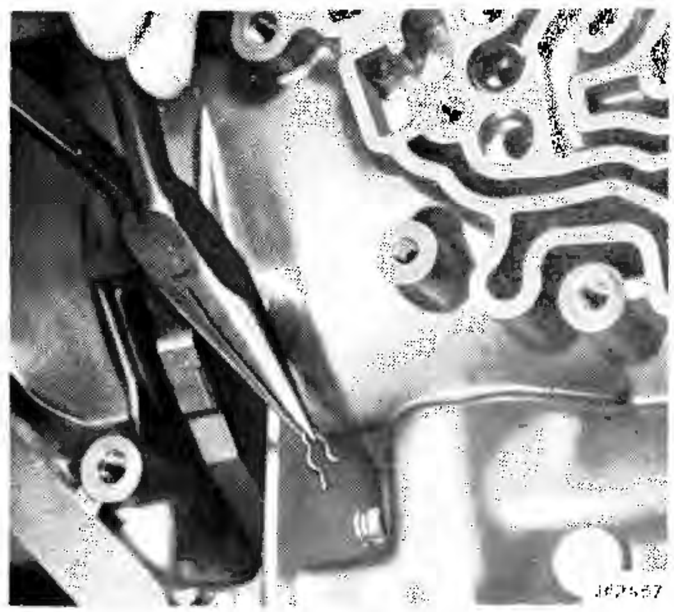

Fig. 7-27 Removing-Installing Retainer Spring From Parking Pawl Shaft

Front Band Assembly and Sun Gear Shaft Removal

(1) Remove front band assembly from transmission case (fig. 7-29).

(2) Remove sun gear shaft as shown in fig. 7-30.

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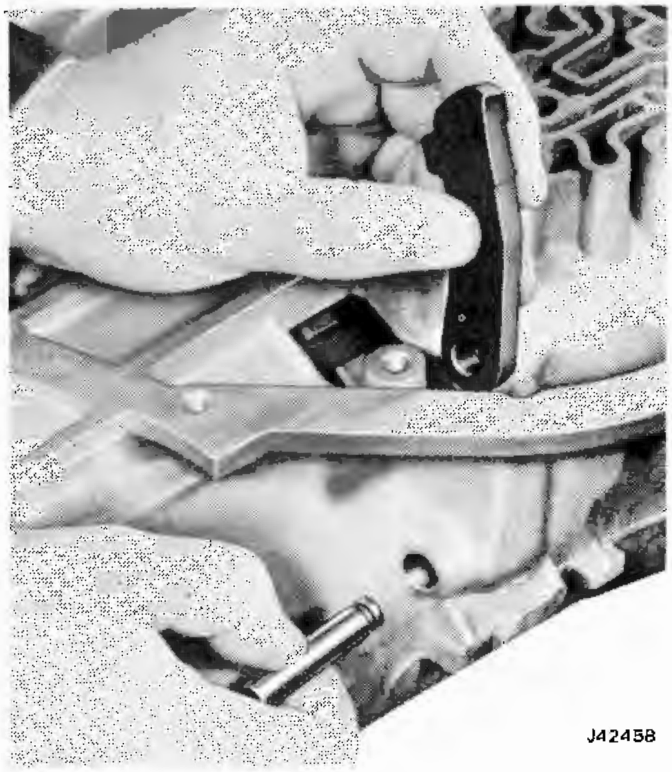

Fig. 7-28. Removing-Installing Parking Brake Pawl and Pawl Shaft

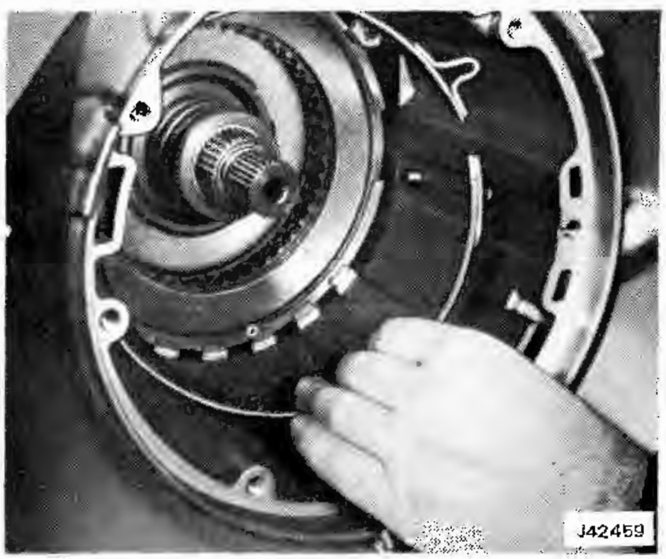

Fig. 7-29 Removing-Installing Front Band Assembly

Rear End Play Check

(1) Install rod from Tool C-3752 into an extension housing attaching bolt hole.

(2) Mount the Dial Indicator on the rod and index with the end of the output shaft (fig. 7-31).

(3) Move the output shaft in and out to read the end play.

(4) End play should be from 0.007 to 0.019 inch.

(5) The selective washer controlling this end play is

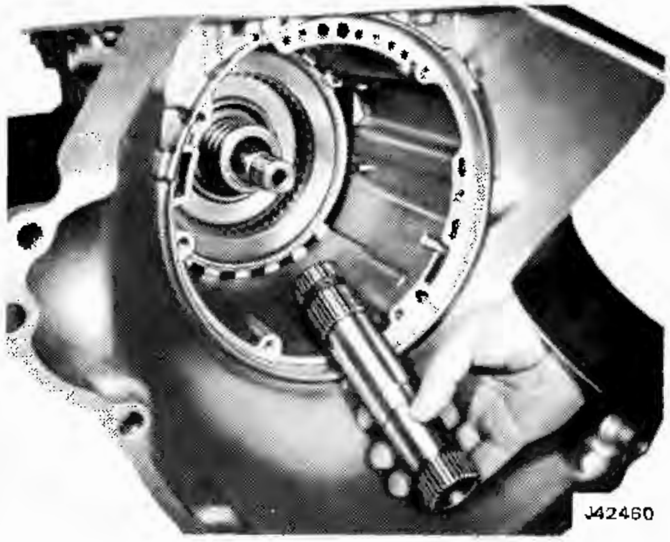

Fig. 7-30. Removing Sun Gear Shaft

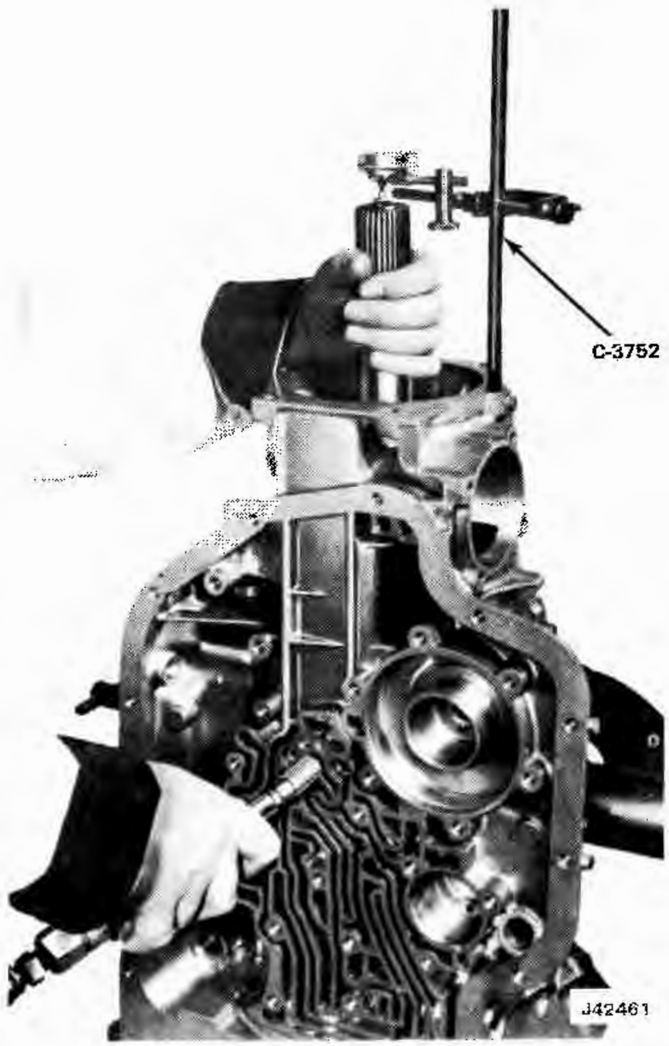

Fig. 7-31 Rear Unit End Play

the steel washer having three lugs that is located between the thrust washer and the rear face of the transmission case. If a different washer thickness is required

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to bring the end play within specification, it can be selected from the following chart.

Thickness (Inch)	Notches and/or Numeral	
0.074 to 0.078	None	1
0.082 to 0.086	1 Tab Side	2
0.090 to 0.094	2 Tabs Side	3
0.098 to 0.102	1 Tab OD	4
0.106 to 0.110	2 Tabs OD	5
0.114 to 0.118	3 Tabs OD	6

Intermediate Clutch Removal

(1) Remove bolt which secures center support to case, using a ⅜ inch 12-point thin wall deep socket (fig.7-32).

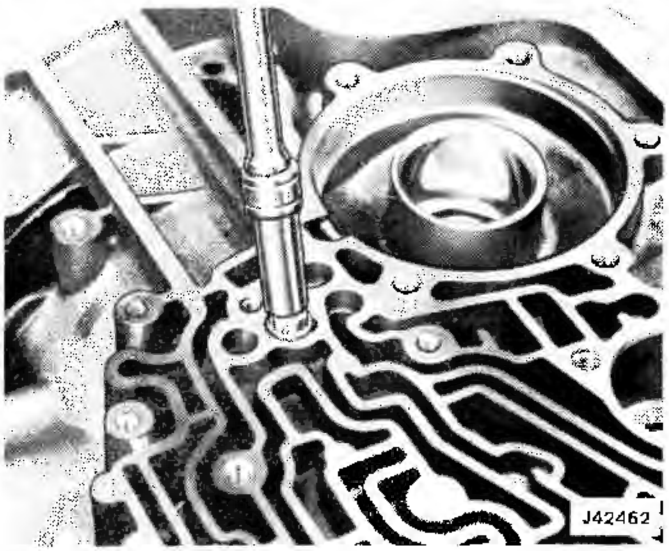

Fig. 7-32 Removing Center Support Bolt

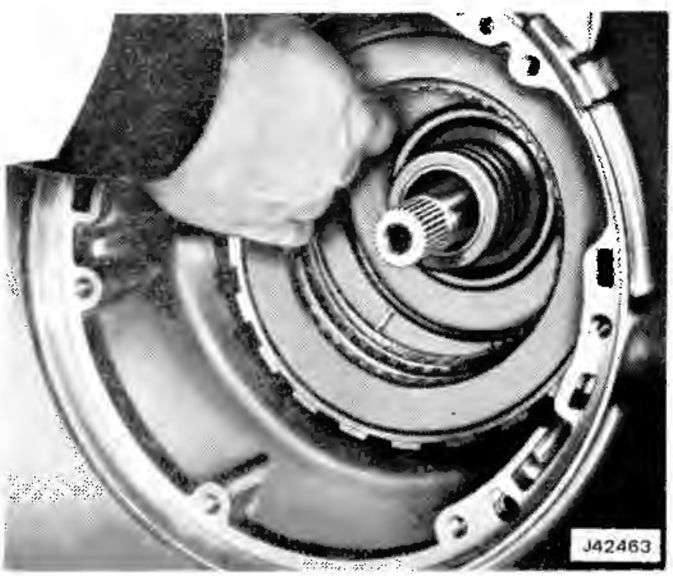

Fig. 7-33 Intermediate Clutch

(2) Remove intermediate clutch backing plate to case snap ring.

(3) Remove intermediate clutch backing plate, three composition, and three steel clutch plates from transmission case (fig. 7-33).

Center Support and Gear Unit Assembly, Support-to-Case Spacer, Rear Band Assembly Removal

(1) Remove center support to case snap ring as shown in fig. 7-34.

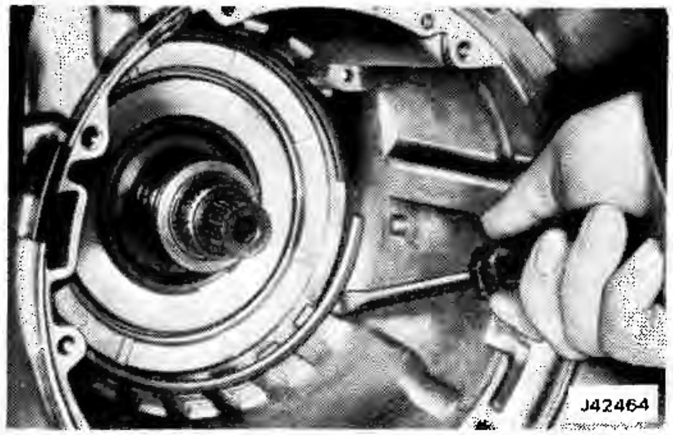

Fig. 7-34 Removing Center Support Snap Ring

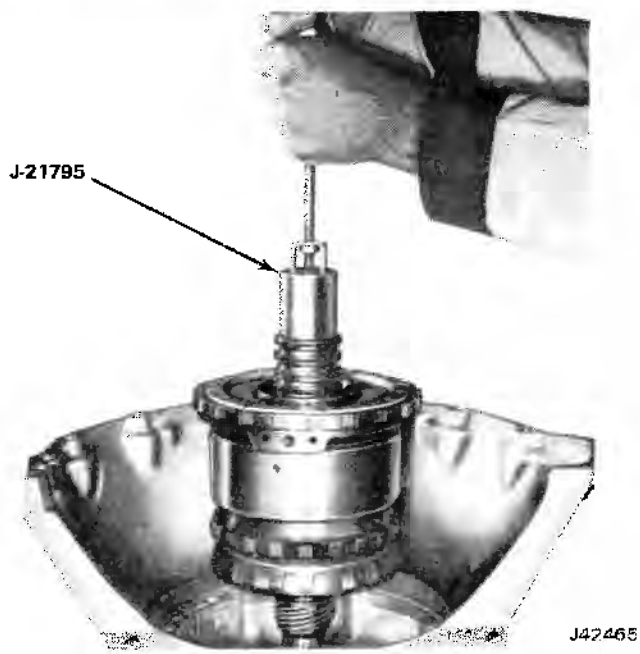

Fig. 7-35 Removing Center Support and Gear Unit

(2) Remove entire gear unit assembly from transmission case by lifting with Gear Assembly Installing and Removing Tool J-21795, with Slide Hammer C-3752 (fig. 7-35).

(3) Remove output shaft-to-case thrust washer from rear of output shaft or inside case.

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(4) Place gear unit assembly, with output shaft facing down, in work bench hole and Holding Fixture J-21364.

(5) Remove rear unit selective washer from transmission case, as in fig. 7-36.

(6) Remove support to case spacer ring (fig. 7-36).

(7) Remove rear band assembly from transmission case (fig. 7-37).

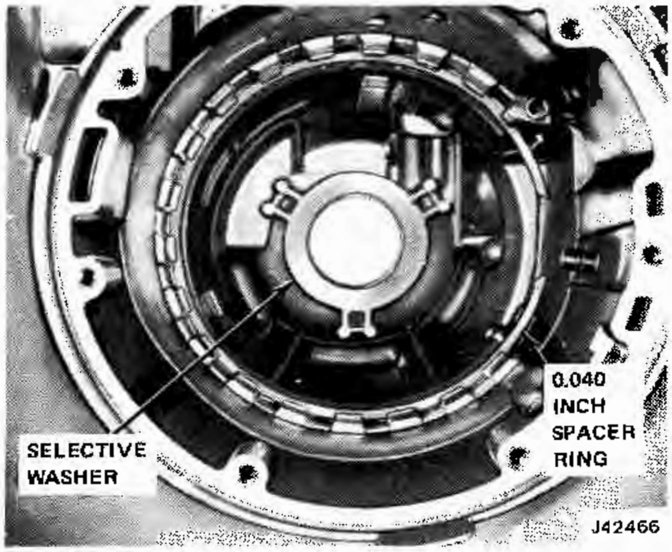

Fig. 7-36 Selective Washer and Spacer Ring

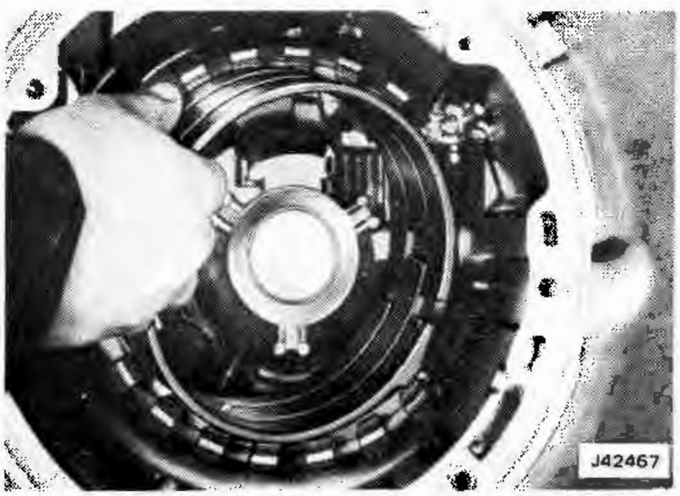

Fig. 7-37 Removing Rear Band

SUBASSEMBLY OVERHAUL

Gear Unit Disassembly

(1) Remove case center support assembly from gear unit assembly (fig. 7-38).

(2) Remove thrust washer which is normally between center support and reaction carrier, as shown in fig. 7-39.

(3) Remove center support-to-sun gear races and thrust bearing.

Fig. 7-38 Removing Center Support from Gear Unit

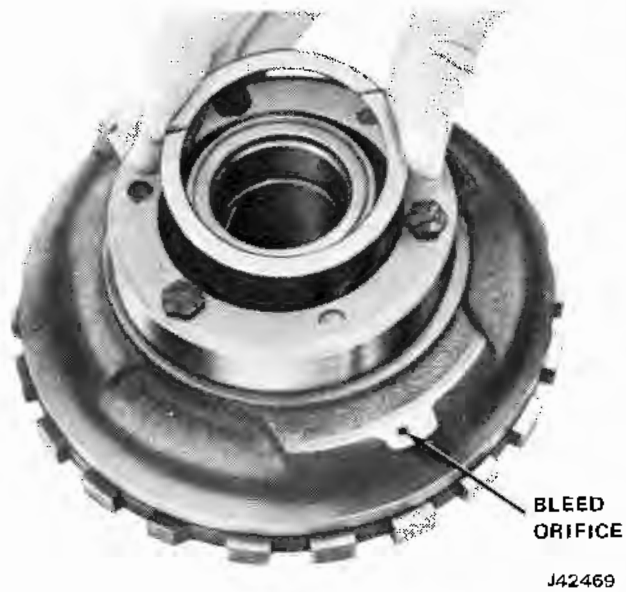

Fig. 7-39 Removing-Installing Center Support Thrust Washer

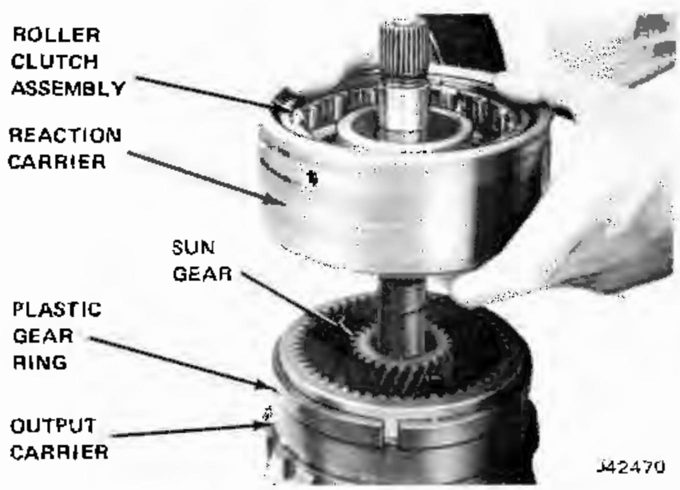

Fig. 7-40 Removing Reaction Carrier and Roller From Output Carrier Clutch

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(4) Remove reaction carrier and roller clutch assembly from output carrier assembly, as shown in fig. 7-40.

(5) Remove front internal gear ring from output carrier assembly.

(6) Remove sun gear from output carrier assembly. Refer to fig. 7-41.

(7) Remove plastic or metal thrust washer, located between reaction carrier and output carrier.

(8) Turn assembly over.

(9) Remove snap ring which fastens output shaft to output carrier.

(10) Withdraw shaft from carrier.

(11) Remove output shaft-to-rear internal gear thrust bearing and two races from rear internal gear and main shaft.

(12) Remove rear internal gear and main shaft from output carrier assembly (fig. 7-42).

(13) Remove rear internal gear to sun gear thrust bearing and two races from main shaft.

(14) If necessary, remove rear internal gear-to-main shaft snap ring to remove gear from shaft, as shown in fig. 7-42.

Fig. 7-41 Removing Sun Gear

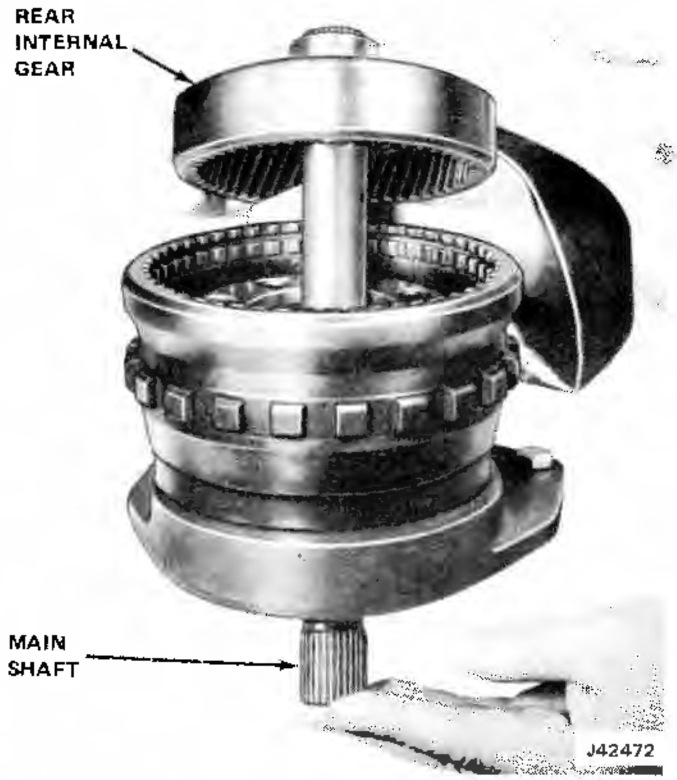

Fig. 7-42 Removing Rear Internal Gear and Main Shaft From Output Carrier Assembly

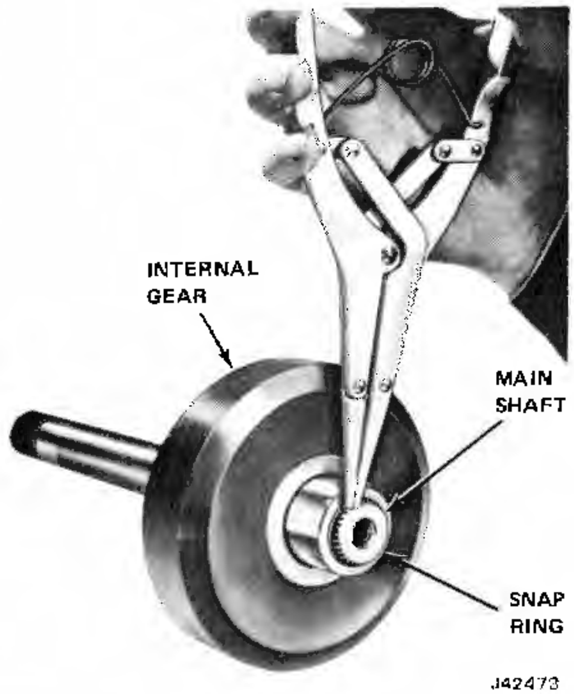

Fig. 7-43 Removing Main Shaft Snap Ring

GOVERNOR

All components of governor assembly, with exception of driven gear, are a select-fit and each assembly is calibrated. **The governor, including the driven gear, is serviced as a complete assembly**. However, the driven gear can also be serviced separately.

It is necessary to disassemble governor assembly in order to replace driven gear. Disassembly may also be necessary due to foreign material causing improper operation.

Disassembly

(1) Cut off one end of each governor weight pin and remove pins, governor thrust cap, governor weights and

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springs. Governor weights are interchangeable from side to side and need not be indentified (fig. 7-44.)

(2) Remove governor valve from governor sleeve. Be careful not to damage valve.

Cleaning and Inspection

Wash all parts in cleaning solvent, air dry, and blow out all passages.

Inspect governor sleeve for nicks, burrs, scoring, or galling.

Check governor sleeve for free operation in bore of transmission case.

Inspect governor valve for nicks, burrs, scoring or galling.

Check governor valve for free operation in bore of governor sleeve. Inspect governor driven gear for nicks, burrs, or damage.

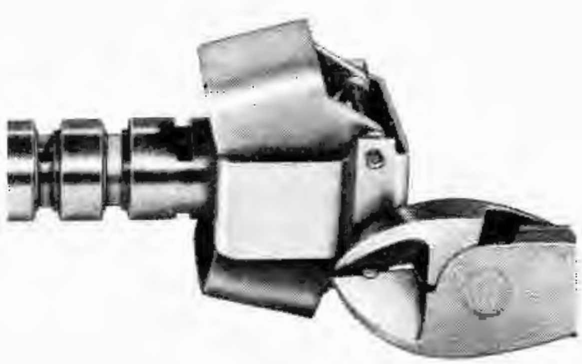

Fig. 7-44 Removing Weight Pin From Governor

Check governor driven gear for looseness on governor sleeve.

Inspect governor weight springs for distortion or damage.

Check governor weights for free operation in their retainers.

Check valve opening at entry and exhaust (0.020-inch minimum).

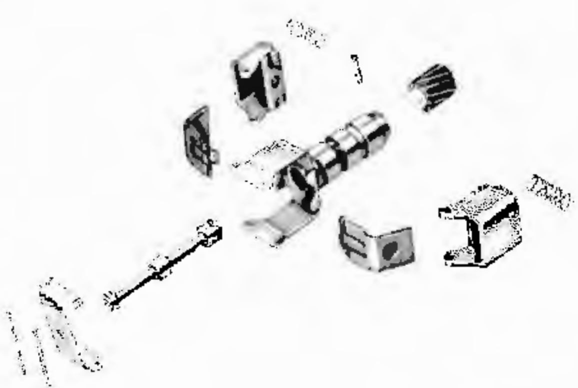

Fig. 7-45 Governor Assembly

Driven Gear Replacement

To facilitate governor repair in the field, a governor driven gear and replacement pins are available for service use.

The service package contains a nylon driven gear, two governor weight retaining pins and one governor gear retainer split pin. Replacement of gear must be performed with care in the following manner:

(1) Drive out split pin, which retains governor gear on governor sleeve, using small punch (fig. 7-46.)

(2) Support governor on 7/64-inch plates installed in exhaust slots of governor sleeve.

(3) Place in arbor press. Then with a long punch, press gear out of sleeve.

(4) Carefully clean governor sleeve of chips that remain from original gear installation.

(5) Support governor on 7/64-inch plates installed in exhaust slots of sleeve.

(6) Position new gear in sleeve.

(7) With a suitable socket, press gear into sleeve until nearly seated.

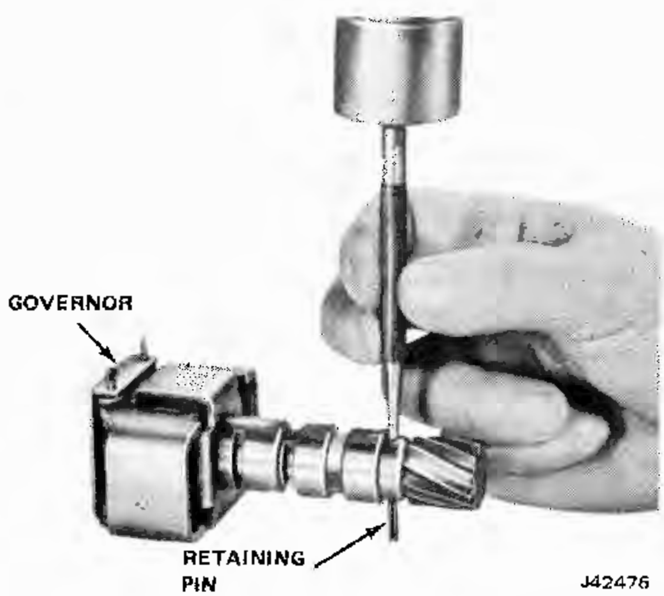

Fig. 7-46 Governor Retaining Pin

(8) Carefully remove any chips that may have shaved off gear hub and press gear in until it bottoms on shoulder.

(10) A new pinhole must be drilled through sleeve and gear.

(10) Locate hole position 90° from existing hole, center punch and then, while supporting governor in press, drill new hole through sleeve and gear using a standard 1/8-inch drill.

(11) Install retaining pin to secure gear to sleeve

(12) Wash governor assembly thoroughly to remove any chips that may have collected.

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Assembly

(1) Install governor valve in bore of governor sleeve.

(2) Install governor weights and springs, then thrust cap on governor sleeve.

(3) Align pin holes in thrust cap, governor weight assemblies, and governor sleeve, then install new pins. Crimp both ends of pins to prevent them from falling out.

(4) Check governor weight assemblies for free operation on pins.

REAR SERVO

Inspection

Inspect servo pin for damage.

Inspect piston for damaged oil ring groove. Check freedom of ring in groove (fig. 7-47).

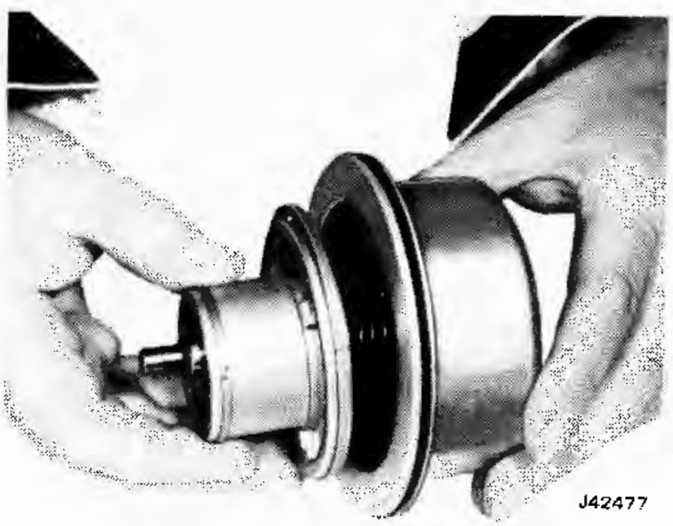

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Fig. 7-47 Inspecting Rear Servo

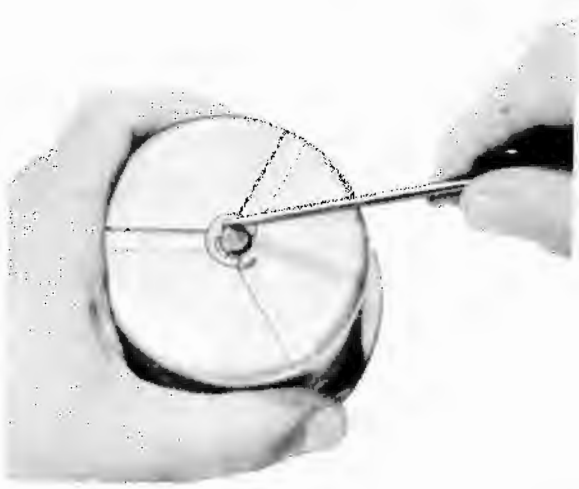

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Fig. 7-48 Removing E-Type Retainer Ring

Disassembly

(1) Remove rear accumulator piston from rear servo piston.

(2) Remove E-ring retaining rear servo piston to servo pin. (fig. 7-48).

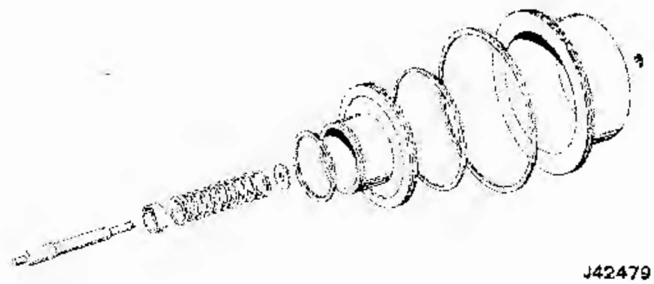

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Fig. 7-49 Rear Servo Assembly

(3) Remove rear servo piston and seal from servo pin (fig. 7-49).

(4) Remove washer, spring and retainer.

Inspection

Inspect freedom of accumulator piston in servo piston.

Inspect fit of servo pin for scores or cracks.

Inspect accumulator and servo piston for cracks and porosity.

Assembly

(1) Install spring retainer (with cap down), spring, and flat washer on servo pin.

(2) Insert servo pin into bore of servo piston and secure with E-type retaining ring.

NOTE: *Do not remove the teflon oil seal rings from the rear accumulator piston unless the oil seal rings require replacement. If the teflon inner oil seal ring (small diameter) requires replacement for service, use the aluminum oil seal ring. The rear accululator piston, large diameter ring groove depth is machined shallower to take the large teflon oil seal ring; if this requires replacement, use only the teflon oil seal ring.*

(3) Install outer and inner oil rings on accumulator piston, if removed.

(4) Assemble into bore of servo piston.

CONTROL VALVE

Disassembly

(1) Position control valve assembly with cored face up and accumulator pocket nearest operator.

(2) Remove manual valve from upper bore.

(3) With Ring Remover and Installer Tool J-22269-01, remove retaining ring at accumulator piston (fig. 7-50).

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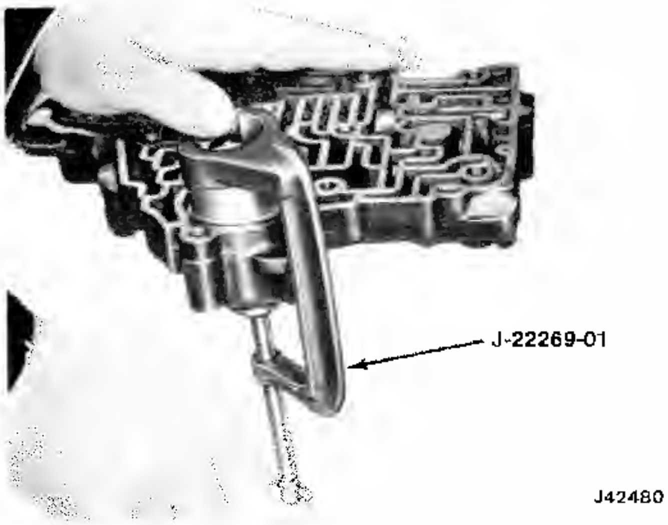

Fig. 7-50 Removing S-Type Retaining Ring

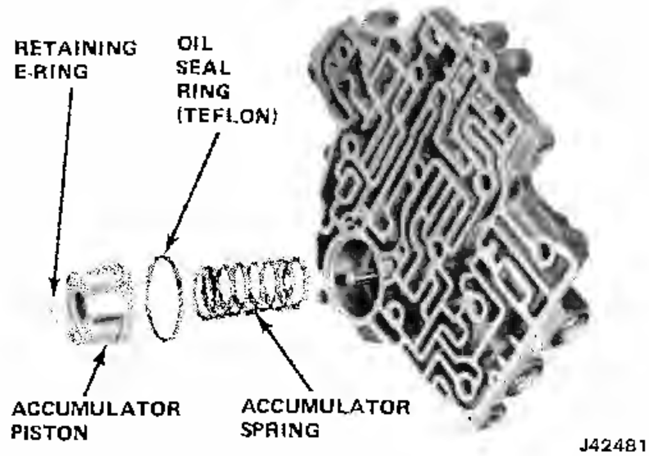

Fig. 7-51 Accumulator Piston and Spring

(4) Remove accumulator poston and spring from valve assembly (fig. 7-51).

(5) At right side of valve assembly, adjacent to manual valve, remove retaining pin, bushing, 1-2 regulator valve, spring, 1-2 detent valve, and 1-2 shift valve from valve body. Refer to fig. 7-53.

(6) From next bore down, remove retaining pin, modulator valve bushing, 2-3 shift valve spring. 2-3 modulator valve, 3-2 intermediate spring, and 2-3 shift valve from valve body.

(7) From next bore down, remove retaining pin, bore plug, spring, spacer, and 3-2 valve from valve body.

(8) At other end of valve body, top bore, remove retaining pin, bore plug, detent valve, detent regulator valve, spring, and spacer from valve body.

(9) From the next bore down, remove the grooved retaining pin, bore plug, and the 1-2 accumulator valve. Refer to fig. 7-52.

Inspection

Inspect all valves for scoring, cracks, and free movement in their respective bores.

Inspect bushings for cracks, scratches or distortion.

Inspect valve body for cracks or scored bores.

Check all springs for distortion or collapsed coils.

Clean governor oil screen in cleaning solvent.

Assembly

(1) Install front accumulator spring and piston into valve body (fig. 7-51).

(2) Compress spring and piston, install Special Tool

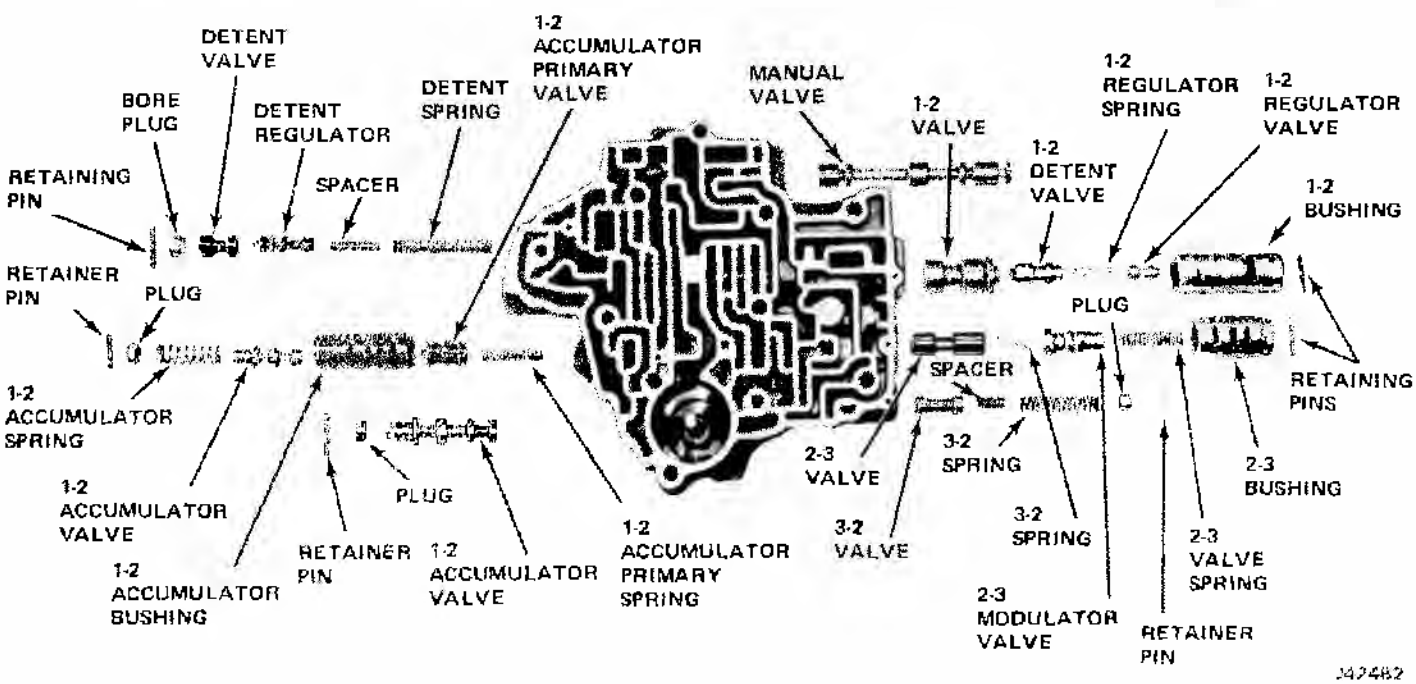

Fig. 7-52 Control Valve Assembly

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J-22269-01, and secure piston with E-type retaining ring as shown in figure 7-50.

(3) Install 1-2 accumulator valve (stem end out) in lower left bore.

(4) Install bore plug.

(5) Install grooved retaining pin from cast surface side of the valve body, with the grooves entering the pin hole last. Tap pin with hammer until flush with cast surface.

(6) Into next bore up, insert detent spring and spacer. Compress spring, then retain spring and spacer with small screwdriver (fig. 7-53). Insert detent regulator valve, wide land first, then detent valve, narrow land first.

(8) Install bore plug (hole out).

(9) Pressing plug inward to compress spring, secure plug in valve body with retaining pin, then withdraw screwdriver from valve body.

(10) In lower right hand bore of valve body, insert 3-2 valve, 3-2 valve spring, spacer, and bore plug (hole out). Refer to figure 7-52.

(11) Press plug into valve body to compress spring, then secure plug in body with retaining pin.

(12) Into next bore of valve body, insert 2-3 shift valve (stem end out) and 3-2 intermediate spring.

(13) Install 2-3 modulator valve in bushing and insert both parts into valve body bore.

(14) Insert 2-3 shift valve spring into valve body, compress, then secure with retaining pin.

(15) Into next bore of valve body insert 1-2 shift valves (stem end out).

(16) Install 1-2 regulator valve, 1-2 regulator valve spring, and detent valve into bushing.

(17) Align spring in bore of detent valve; then insert parts into valve body bore.

(18) Press bushing into valve body to compress spring; then secure bushing in valve body with retaining pin.

(19) Install manual valve in valve body, with detent pin groove to the right.

OIL PUMP

Disassembly

(1) Place oil pump assembly in hole in bench and Adapter J-21364.

(2) Compress pressure boost valve bushing against pressure regulator spring and remove snap ring from pump cover (fig. 7-54).

(3) Remove pressure boost valve bushing and valve; then remove pressure regulator spring from pump cover.

(4) If furnished, remove spring retainer washer, pressure regulator spacer, and pressure regulator valve from pump cover.

(5) Remove attaching bolts and pump cover from pump body.

(6) Remove retaining pin and remove bore plug from pressure regulator bore of pump cover (fig. 7-55).

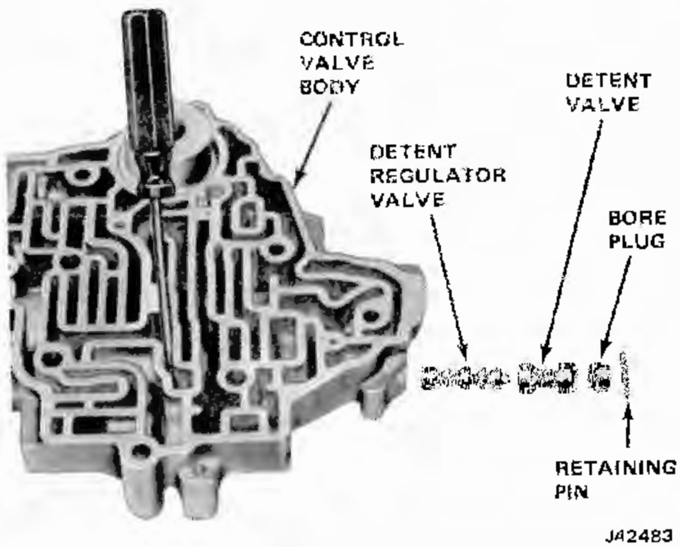

Fig. 7-53 Detent and Regulator Valve

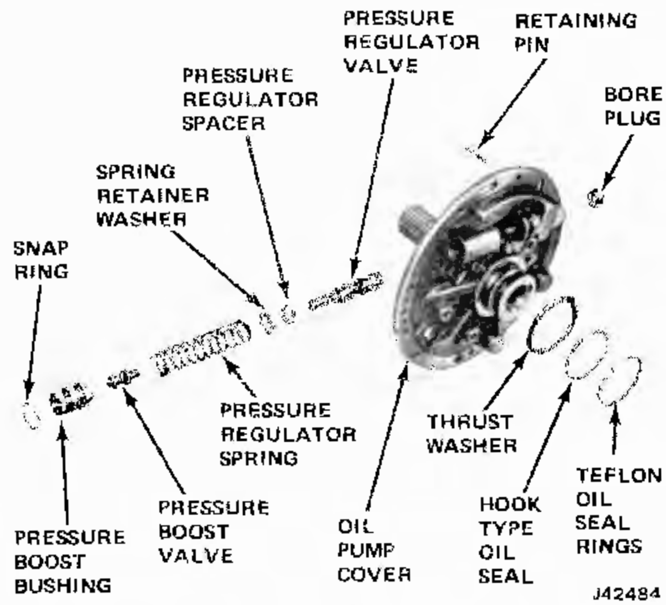

Fig. 7-54 Oil Pump Cover Assembly

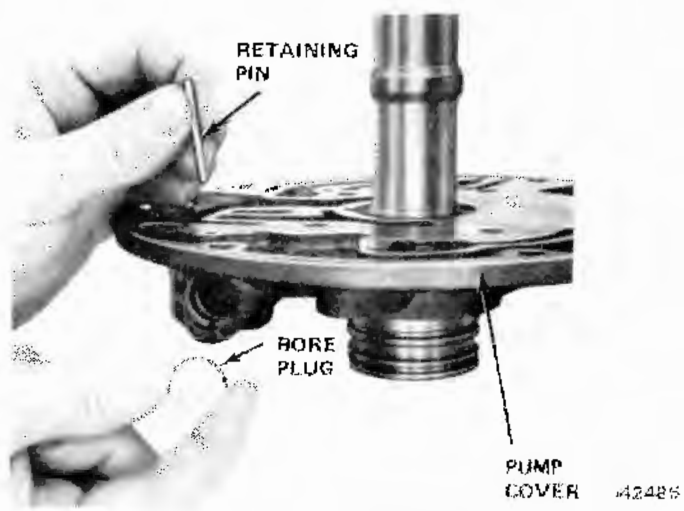

Fig. 7-55 Pressure Regulator Plug and Retaining Pin

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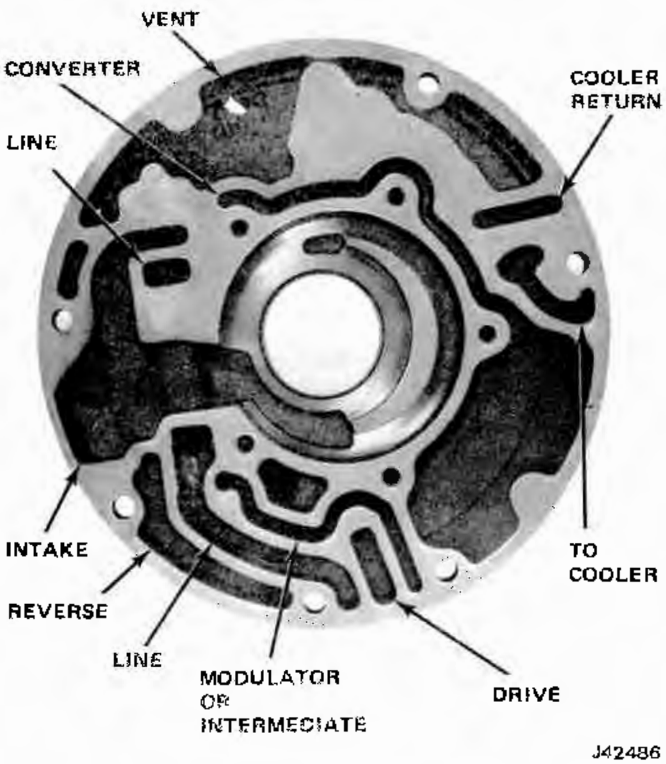

Fig. 7-56 Pump Body Oil Passages

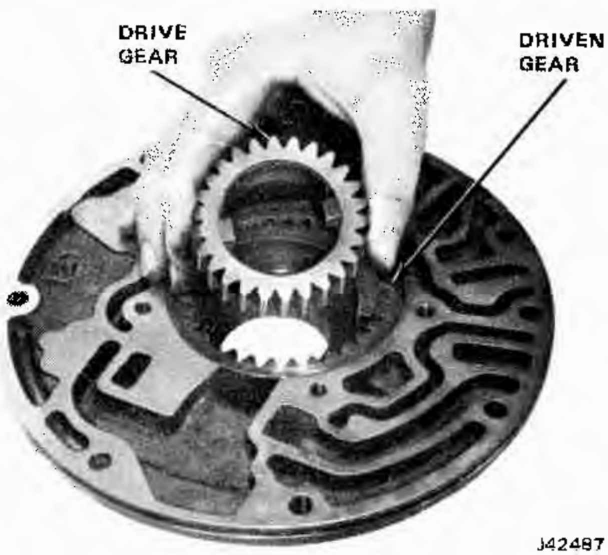

Fig. 7-57 Removing-Installing Pump Gears

(7) Remove hook type oil rings and thrust washer from pump cover (fig. 7-54).

(8) Mark drive and driven gears in oil pump body for alignment, and remove gears from pump body (fig. 7-57).

Inspection

Inspect drive gear, driven gear, gear pocket, and crescent for scoring, galling, or other damage.

Position pump gears in pump body and check pump body face-to-gear clearance; it should be 0.0008 to 0.0035 inch (fig. 7-59).

Check face of pump body for scores or nicks. Inspect oil passages. Check for damaged cover bolt attaching threads. Check for overall flatness of pump body face. Check bushing for scores or nicks (fig. 7-56).

Inspect pump attaching bolts for damage and replace if necessary.

Inspect pump cover face for overall flatness. Check for scores or chips in pressure regulator bore. Check that all passages are open and not interconnected. Check for scoring or damage at pump gear face. Inspect stator shaft for damaged splines, or scored bushings. Inspect oil ring grooves for damage or wear. Inspect selective thrust washer face for wear or damage. In-

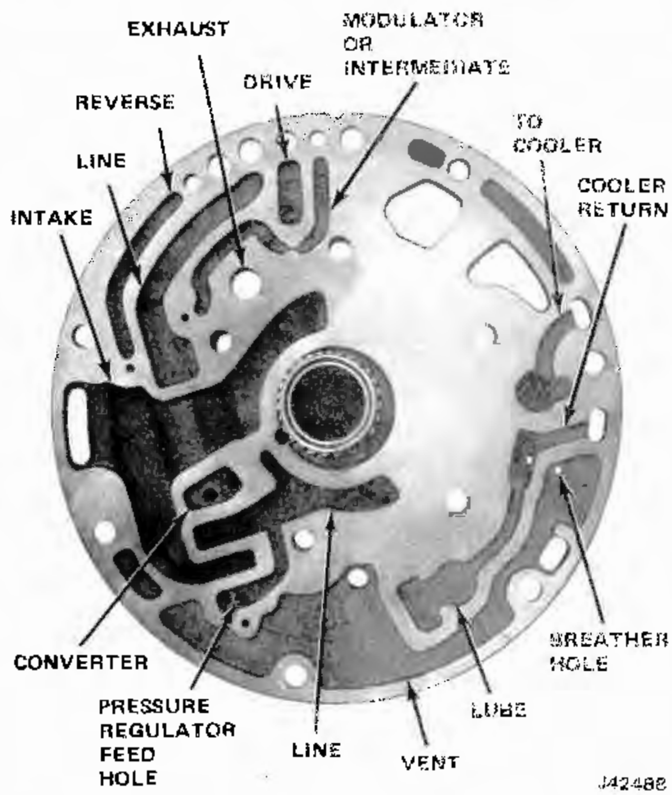

Fig. 7-58 Pump Cover Oil Passages

Fig. 7-59 Checking Clearance Pump Body Face to Gear

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spect pressure regulator and boost valve for free travel through bore pump cover.

Inspect pump cover for open ⅛-inch diameter breather hole. Refer to figure 7-58.

Assembly

(1) Install drive and driven pump gears in pump body, with alignment marks up (fig. 7-57).

NOTE: *Position drive gear with drive tangs upward.*

(2) With stator shaft protected, clamp pump cover in vise.

(3) Insert spacer(s), if used, spring retainer washer and spring into pressure regulator bore of pump cover (fig. 7-54).

(4) Install pressure regulator valve from opposite end of bore, stem end first.

(5) Install boost valve into bushing, stem end out; then insert both parts into pump cover.

(6) Compress bushing against spring, and secure into pump cover with retaining snap ring.

(7) Install pressure regulator valve bore plug at opposite end of bore, and secure with retaining pin.

(8) Install selective thrust washer and one hook type oil seal ring and one teflon oil seal ring on delivery sleeve of pump cover.

NOTE: *A forward clutch failure can occur if the bore that the oil seal rings on the pump cover go into, is oversize.*

(9) Secure pump cover to pump body with attaching bolts.

NOTE: *Leave bolts one turn loose at this time.*

(10) Place pump Aligning Strap J-21368 over pump body and cover, and tighten tool (fig. 7-60). Tighten the pump cover bolts 15 to 20 foot-pounds torque.

(11) Remove Aligning Strap J-21368.

(12) Install pump-to-transmission case O-ring oil seal in pump assembly, with chamfer outward.

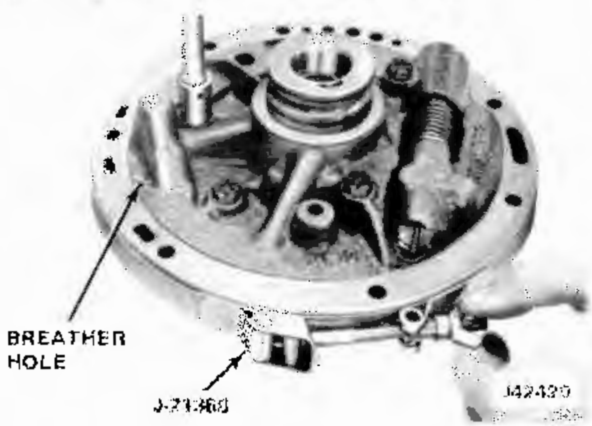

Fig. 7-60 Alignment of Oil Pump Cover to Body

FORWARD CLUTCH

Disassembly

(1) Place forward clutch and turbine shaft in hole in bench, and remove snap ring which fastens forward clutch housing to direct clutch hub (fig. 7-61).

(2) Remove hub from housing.

(3) Remove forward clutch hub and thrust washers from clutch assembly (fig. 7-62).

(4) Remove four composition and four steel clutch plates from forward clutch housing.

(5) Place forward clutch and turbine shaft in arbor press, and press turbine shaft from clutch housing (fig. 7-63).

Fig. 7-61 Removing Forward Clutch Housing Snap Ring

Fig. 7-62 Removing Hub and Thrust Washers From Forward Clutch Assembly

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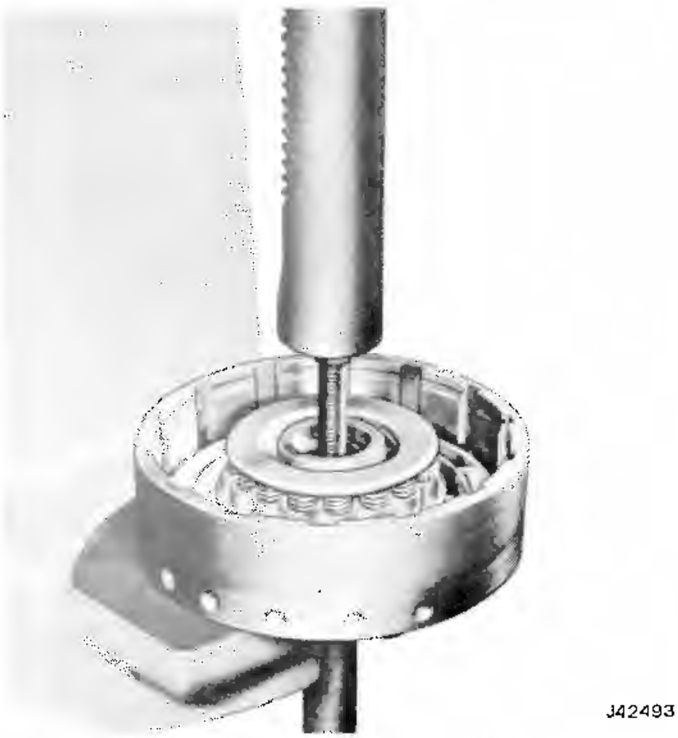

Fig. 7-63 Pressing Turbine Shaft from Forward Clutch Housing

(6) Using Clutch Spring Compressor W-306 and arbor press, compress spring retainer and remove snap ring which fastens spring retainer to clutch piston.

(7) Remove snap ring, spring retainer, and sixteen clutch release springs from clutch piston.

(8) Remove forward clutch piston from clutch housing. Remove inner and outer clutch piston seals from piston (fig. 7-64).

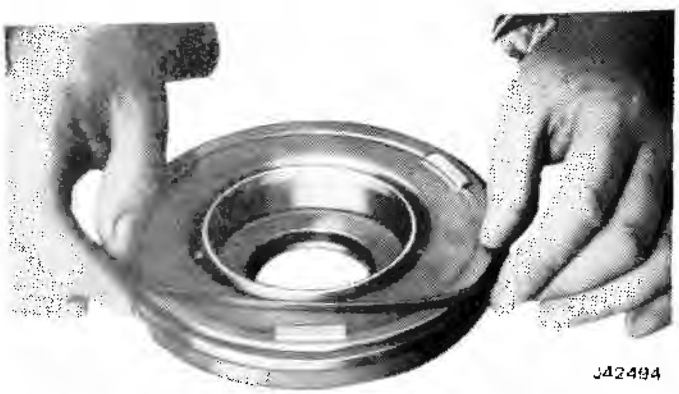

Fig. 7-64 Removing Forward Clutch Piston Outer Seal

(9) Remove center piston seal from forward clutch housing (fig. 7-65).

Inspection

Inspect composition-faced and steel clutch plates for burning, scoring, or wear.

Inspect sixteen springs for collapsed coils or signs of distortion.

Fig. 7-65 Forward Clutch Housing with Center Piston Seal

Inspect direct clutch hub and forward clutch hub for worn splines, proper lubrication holes, and scored thrust faces.

Inspect clutch piston for cracks.

Inspect clutch housing for wear, scoring, open oil passages, and free operation of ball check.

Inspect turbine shaft for open lubrication passages at each end, damaged splines, damaged ground bushing journals, and for cracks or distortion.

NOTE: *Turbine shaft and clutch housing are serviced separately. Shaft may be removed from housing by using a suitable size bolt in an arbor press (fig. 7-63).*

Assembly

NOTE: *Apply automatic transmission oil to all seals and clutch plates before reassembly.*

(1) Install new inner and outer oil seals on clutch piston; lips face away from spring pockets (fig. 7-64).

(2) Install a new center seal in clutch housing, lip face upward (fig. 7-65).

NOTE: *The forward and direct clutch pistons have identical inside and outside diameters. It is possible to reverse the pistons during assembly; therefore care should be exercised to make certain the proper piston is installed in the clutch assemblies.*

(3) The forward clutch piston can be identified by the blind hole in the clutch apply face of the piston as shown in fig. 7-66.

(4) Place Seal Protector Tool J-21362 over clutch hub, and install outer clutch piston seal protector into clutch housing. Fit piston to housing; then rotate piston in housing until seated (fig. 7-67).

(5) Install sixteen clutch release springs into pockets in piston, and place spring retainer over spring.

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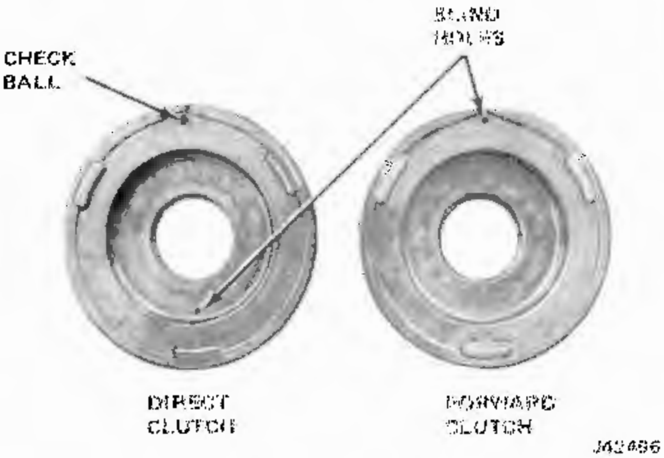

Fig. 7-66 Forward and Direct Clutch Parts Identification

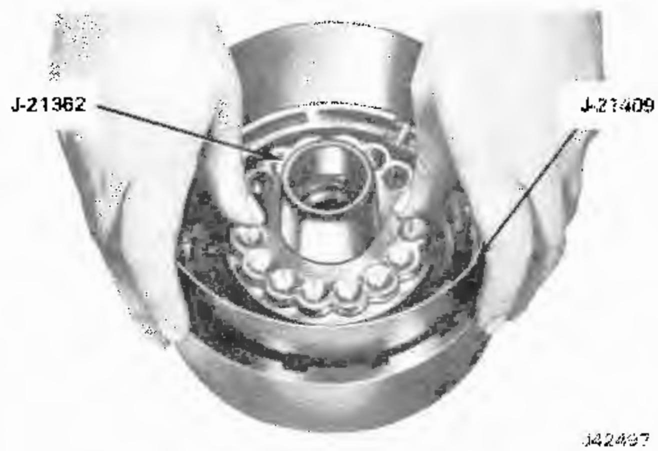

Fig. 7-67 Installing Forward Clutch Piston

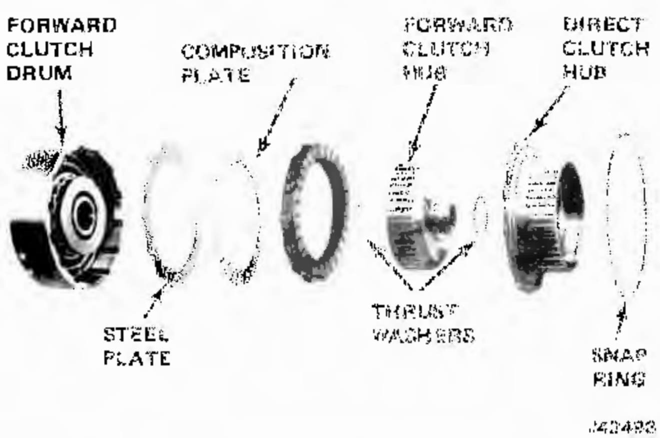

Fig. 7-68 Forward Clutch Assembly

(6) Use Clutch Spring Compressor W-306 and arbor press to compress springs; then fasten spring retainer to piston with snap ring.

(7) If removed, press short-spline end of turbine shaft into forward clutch housing, using arbor press.

(8) Place thrust washers on forward clutch hub. Retain with petroleum jelly or equivalent.

(9) Install hub and washers in clutch housing, as shown in fig. 7-70.

(10) Oil and install four composition, three flat steel, and one waved steel clutch plate (plate with U-notches) in clutch housing; install waved steel plate first, then install alternately composition plates and steel plates (figs. 7-68, -69).

CAUTION: *Do not confuse the flat steel clutch plate (plate with V-notch) with the waved steel clutch plate (plate with U-notch). See fig. 7-73.*

NOTE: *Radially grooved composition clutch plates are installed at the factory only. All service composition plates have the smooth surface configuration.*

(11) Install direct clutch hub in clutch housing and secure with snap ring (fig. 7-61).

(12) Place forward clutch assembly on delivery sleeve of oil pump, and apply compressed air to check clutch operation (fig. 7-71).

Fig. 7-69 Installing Forward Clutch Plates

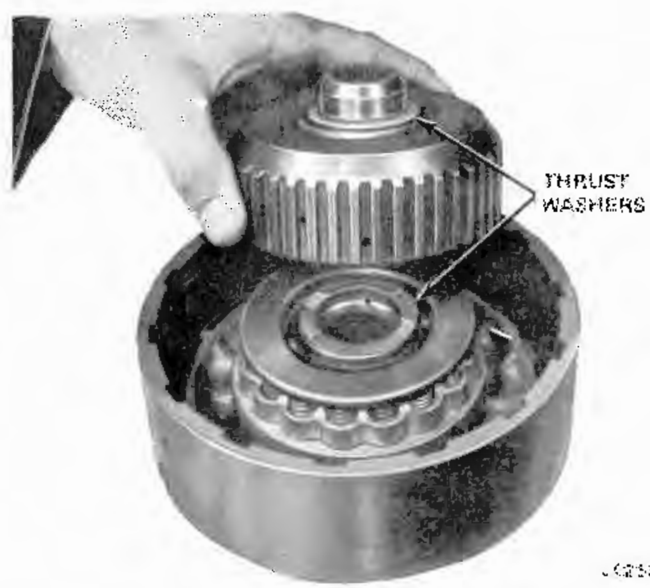

Fig. 7-70 Installing Thrust Washers On Forward Clutch Hub

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DIRECT CLUTCH AND INTERMEDIATE CLUTCH SPRAG

Disassembly

(1) Remove snap ring which fastens intermediate clutch retainer to direct clutch housing (fig. 7-72).

(2) Remove retainer, intermediate clutch outer race, and intermediate clutch roller assembly, from direct clutch housing (fig. 7-74).

(3) From other side of clutch assembly, remove snap ring which fastens backing plate to direct clutch housing (fig. 7-75).

(4) Remove backing plate, four composition, and four steel clutch plates from direct clutch assembly (fig. 7-76).

Fig. 7-71 Checking Forward Clutch Operation

Fig. 7-72 Removing Intermediate Clutch Roller Snap Ring

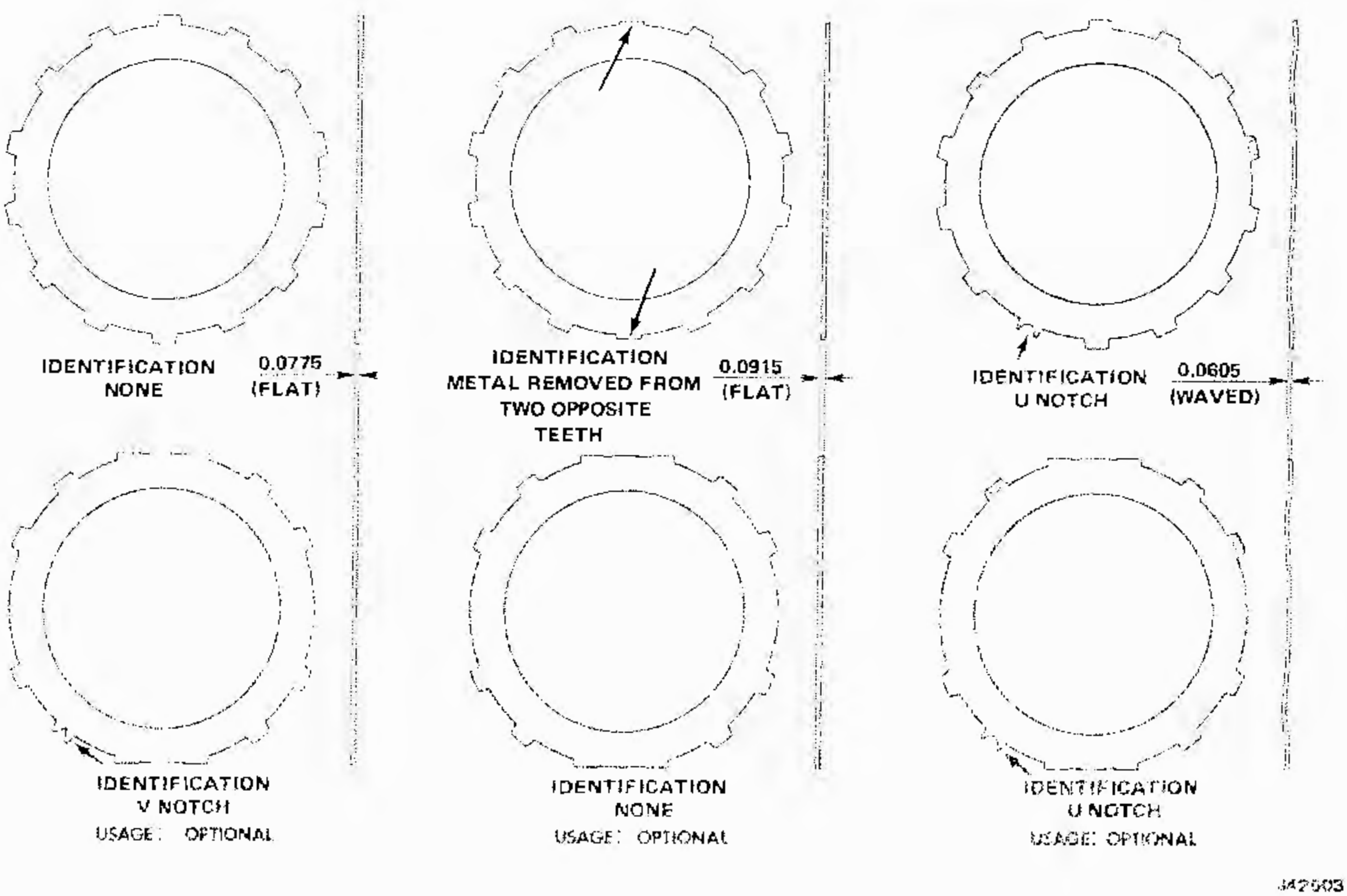

Fig. 7-73 Direct Clutch Plate Identification

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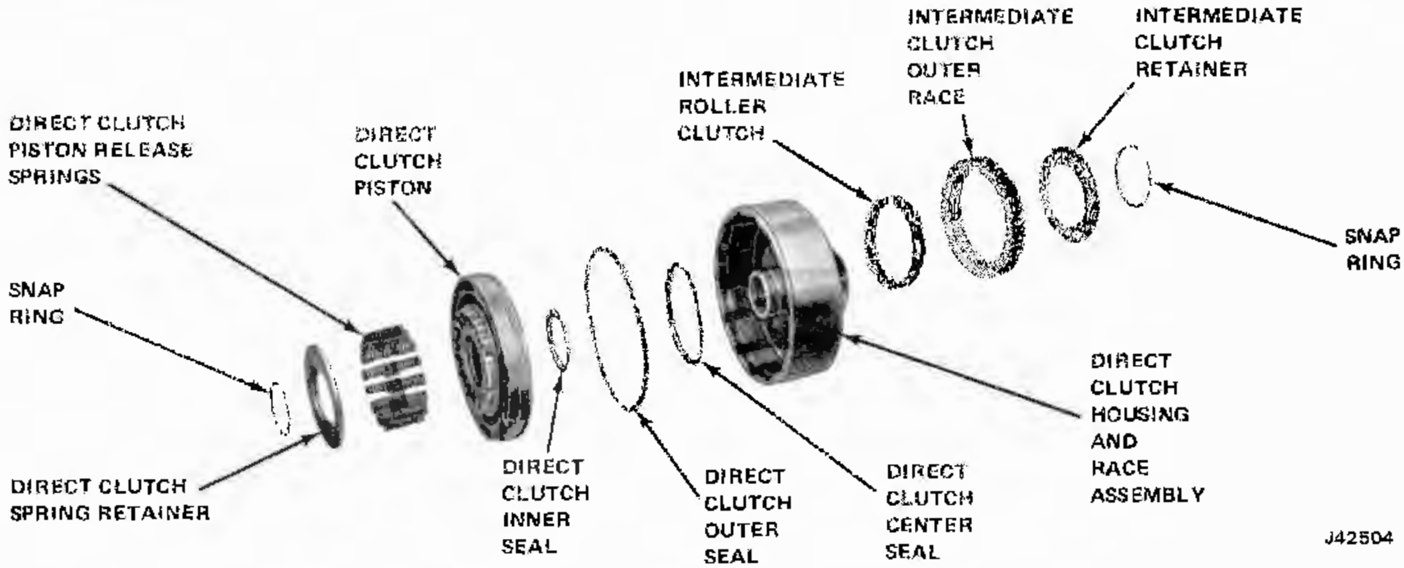

Fig. 7-74 Intermediate Clutch, Roller, and Direct Clutch Components

Fig. 7-75 Removing Direct Clutch Snap Ring

press, compress spring retainer and remove snap ring which fastens spring retainer to direct clutch housing (fig. 7-74).

(6) Remove spring retainer, release springs, and piston from direct clutch housing (fig. 7-77).

(7) Remove outer seal and inner seal from piston (fig. 7-74).

(8) Remove center seal from direct clutch housing.

Fig. 7-76 Direct Clutch Assembly

NOTE: *The fourteen direct clutch release springs are not serviced. If one or more of these springs require replacement, discard all of them and install the sixteen service direct clutch springs.*

Inspection

Inspect roller assembly for damaged roller. Inspect inner cam and outer races of roller assembly (inner cam on clutch housing) for scratches or wear.

Inspect direct clutch housing for cracks, wear, proper opening of oil passages or wear on clutch plate drive lugs. Inspect composition faced and steel plates for sign of wear or burning. Inspect backing plate for scratches or other damage. Inspect piston for cracks and free operation of ball check.

Assembly

NOTE: *Apply Automatic Transmission oil to all seals. Make certain piston has ball check. Refer to fig. 7-79.*

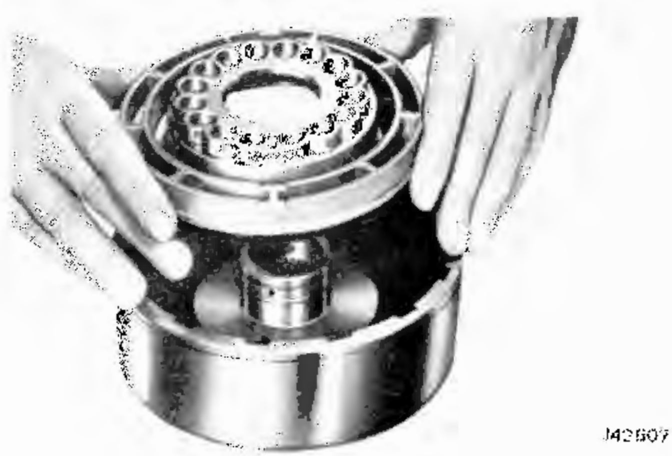

Fig. 7-77 Removing Piston From Direct Clutch Housing

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(1) Install a new inner seal on piston of direct clutch, with lip of seal facing away from spring pockets (fig. 7-78).

Fig. 7-78 Installing Inner Seal on Direct Clutch Piston

(2) Install a new outer direct clutch piston seal with lip facing away from spring pocket (7-79).

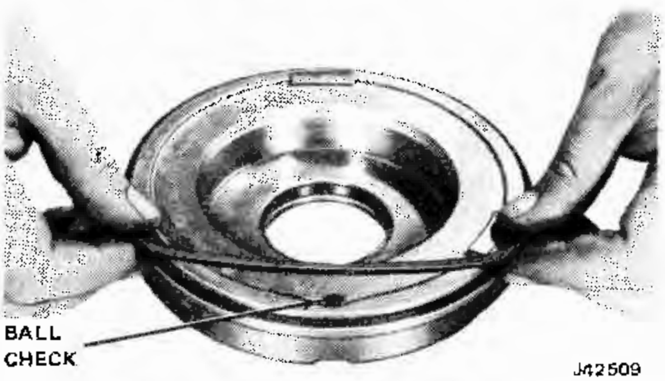

Fig. 7-79 Installing Outer Seal on Direct Clutch Piston

(3) Install a new center seal in clutch housing, with lip of seal facing upward (fig. 7-80)

Fig. 7-80 Installing Center Seal in Direct Clutch Housing

(4) Place Inner Seal Protector J-21362 and Outer Seal Protector J-21409 over hub and clutch housing.

(5) Install direct clutch piston in housing with a rotating motion (fig. 7-81).

(6) Place fourteen release springs into recesses of piston and install spring retainer over springs (fig. 7-74).

(7) Use Spring Compressor W-307 and arbor press to compress springs, then install snap ring to fasten spring retainer to clutch housing.

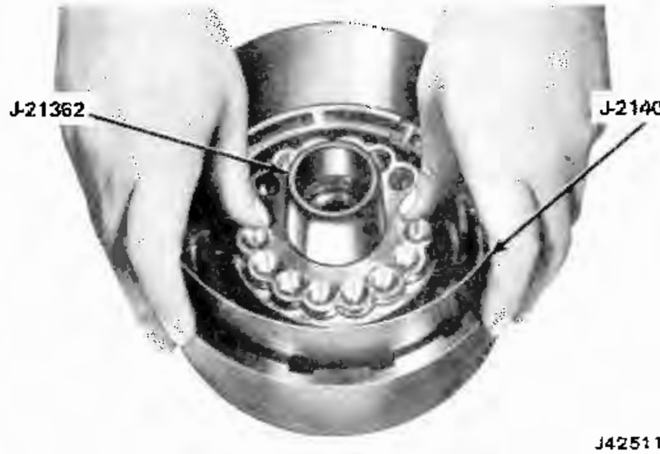

Fig. 7-81 Installing Piston in Direct Clutch Housing

NOTE: *Make certain clutch release springs are not leaning. If necessary, straighten springs, using a small screwdriver.*

(8) Lubricate with transmission oil and install flat, waved steel and composition clutch plates, starting with the waved steel plate and alternating composition and steel plates. Refer to fig. 7-82.

Fig. 7-82 Direct Clutch Assembly

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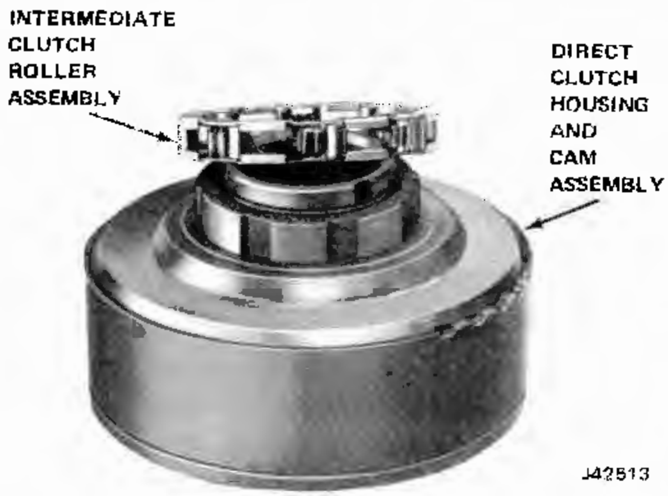

Fig. 7-83 Installing Roller Assembly

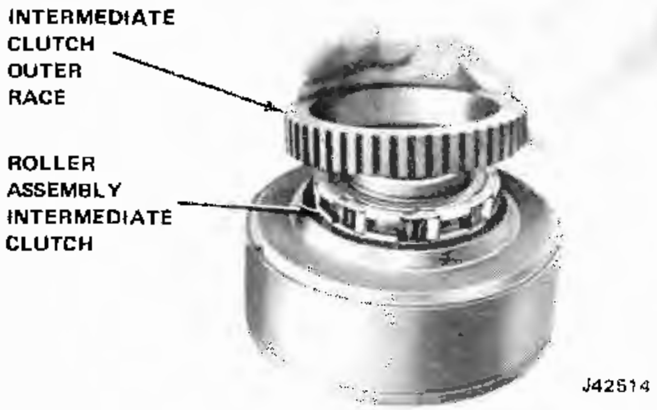

Fig. 7-84 Installing Outer Race

Fig. 7-85 Installing Retainer

NOTE: *Do not use radial grooved composition plates here.*

(9) Install backing plate in clutch housing (fig. 7-75). Secure backing plate to housing with snap ring.

Fig. 7-86 Checking Operation of Direct Clutch Assembly

(10) On opposite side of clutch assembly, install one roller assembly on inner cam of clutch housing (fig. 7-74).

(11) Place roller assembly and outer race on housing with a clockwise rotary motion (fig. 7-83, -84).

NOTE: *When installed, outer race should not turn counterclockwise.*

(12) Install retainer over intermediate clutch roller components (fig. 7-85), and secure to direct clutch housing with snap ring (fig. 7-72).

(13) Position direct clutch assembly on center support assembly, and apply compressed air to check operation of direct clutch (fig. 7-86).

NOTE: *If air is applied through reverse passage (right oil feed hole) it will escape from direct clutch passage. This is considered normal. Apply air through left oil feed hole to actuate piston and move direct clutch.*

CENTER SUPPORT

Disassembly

(1) Remove four Teflon oil seal rings from center support assembly (fig. 7-87).

(2) Compress spring retainer to center support assembly, remove snap ring, and carefully release pressure on spring retainer.

(3) Remove spring retainer three release springs and intermediate clutch spring guide and piston from center support.

(4) Remove inner seal and outer seal from intermediate clutch piston.

NOTE: *Do not remove three screws which mount roller clutch inner race to center support.*

Inspection

Inspect inner race of roller clutch assembly (on center support) for scratches or indentations. Be sure lubrication hole is open.

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NOTE: *Be sure constant bleed plug orifice (approx. 0.020 inch dia.) is open as shown in fig. 7-87.*

Inspect for scoring, wear, or galling.

Check oil ring grooves of clutch piston for damage. Check oil passages with compressed air, to be sure they are not interconnected. Inspect piston sealing surfaces for scratches. Inspect piston seal grooves for nicks or other damage. Inspect piston for cracks.

Inspect release springs for breaks, fatigue, and distortion.

Inspect support to case spacer for burrs or raised edges. If present, remove with a stone or fine sandpaper.

Assembly

(1) Install new inner seal on intermediate clutch piston, with lip of seal facing away from spring pocket (fig. 7-88).

(2) Install new outer seal on piston with lip of seal facing away from spring pocket (fig. 7-89).

(3) Place Inner Seal Protector J-21363 on hub of center support.

(4) Install intermediate clutch piston on center support, indexing spring pockets of piston into cored areas of center support (fig. 7-90). Wipe outer seal with smooth screwdriver blade while installing.

(5) Install three release springs into spring holes of spring guide (fig. 7-92). Space springs equally during assembly.

(6) Place spring retainer over springs. Compress spring retainer to center support assembly and secure with snap ring.

(7) Install spring retainer and snap ring as shown in figures 7-93, -94.

(8) Install four Teflon oil rings on center support assembly.

(9) Apply compressed air to check operation of intermediate clutch (fig. 7-95).

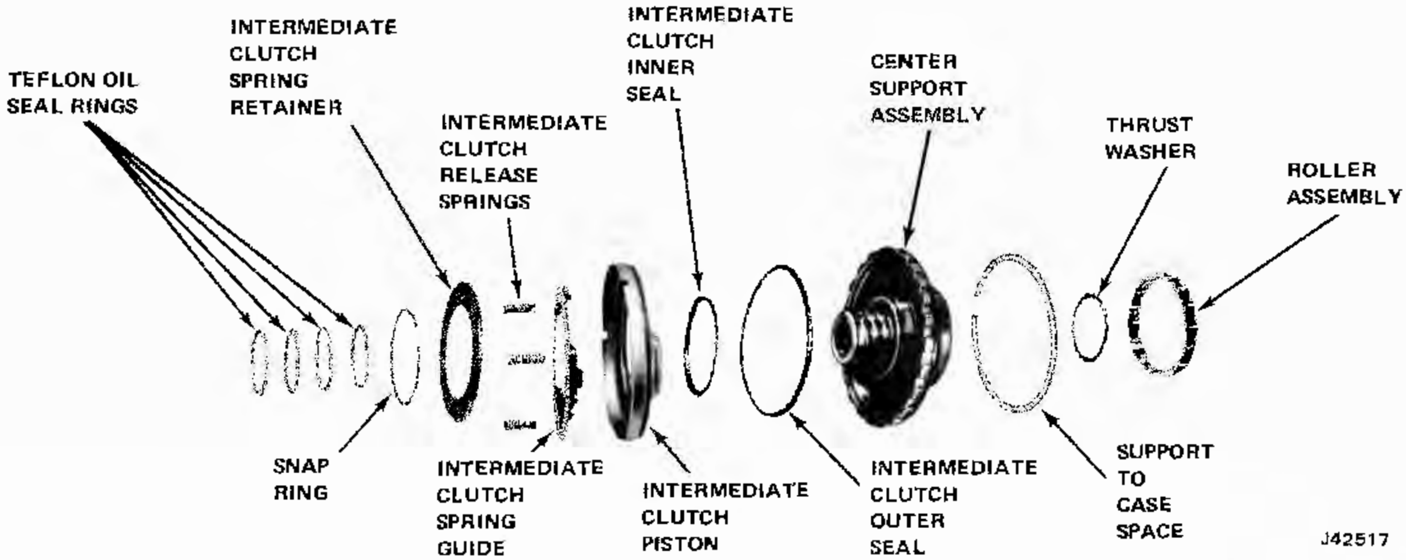

Fig. 7-87 Center Support Components

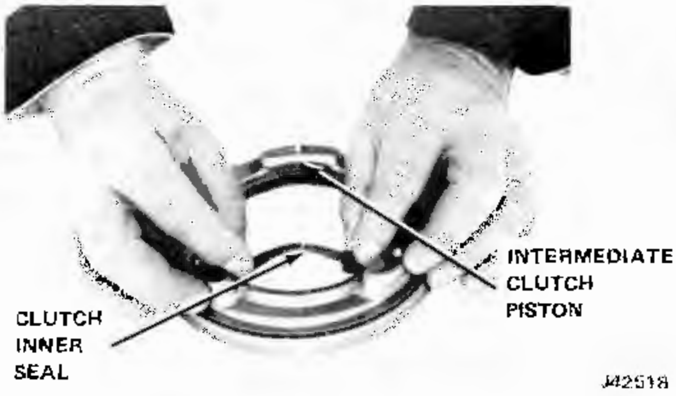

Fig. 7-88 Installing Inner Seal on Intermediate Clutch Piston

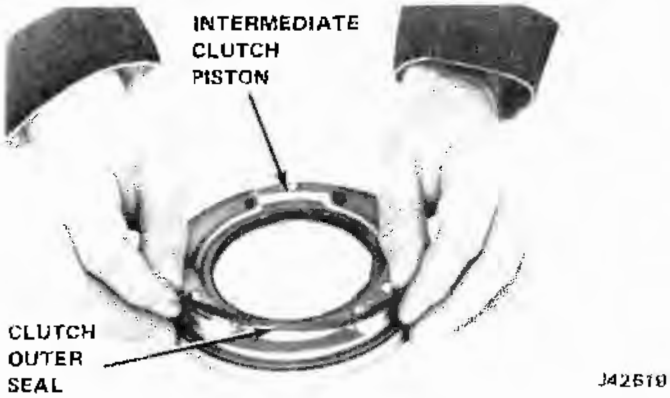

Fig. 7-89 Installing Outer Seal on Intermediate Clutch Piston

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Fig. 7-90 Intermediate Clutch Piston Installation

Fig. 7-91 Installing Spring Guide

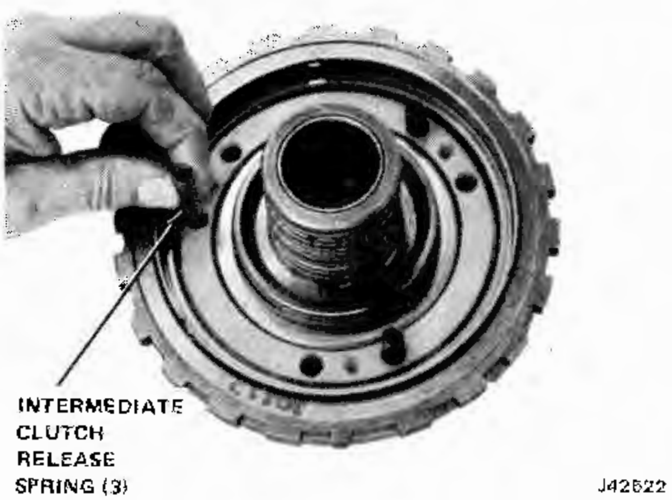

Fig. 7-92 Intermediate Clutch Release Springs

REACTION CARRIER, ROLLER CLUTCH, AND OUTPUT CARRIER

Inspection

Inspect band surface of reaction carrier for signs of burning or scoring.

Inspect roller clutch outer race for scoring or wear. Inspect thrust washer surfaces for signs of scoring or wear. Inspect roller clutch for damaged members. Inspect roller clutch cage and retaining spring for damage. Inspect front internal gear ring for flaking. Inspect bushings for damage.

NOTE: *If bushing is damaged, reaction carrier must be replaced.*

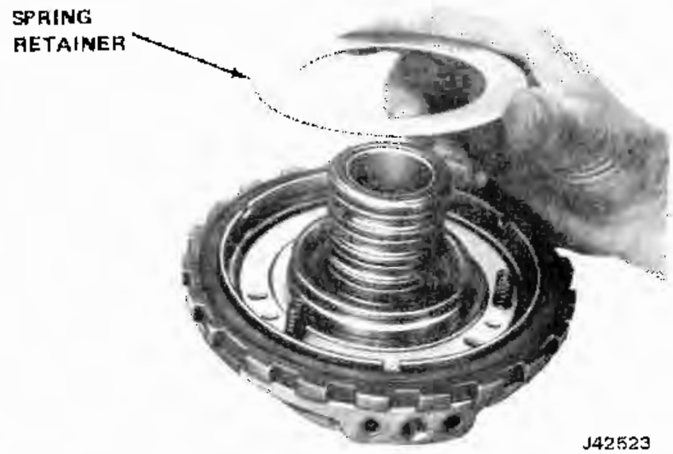

Fig. 7-93 Installing Spring Retainer

Fig. 7-94 Installing Spring Retainer Snap Ring

Fig. 7-95 Checking Operation of Intermediate Clutch Assembly

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Inspect reaction carrier pinions for damage, rough bearings, or excessive tilt. Check pinion end play. Pinion end play should be 0.009 to 0.024 inch (fig. 7-96). Inspect frontal internal gear (output carrier) for damaged teeth.


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Fig. 7-96 Checking End Play of Pinions

Inspect output carrier pinions for damage, rough bearings or excesive tilt. Check pinion end play. Pinion end play should be 0.009 to 0.024 inch (fig. 7-97). Inspect parking pawl lugs for cracks or damage Inspect output locating splines for damage.


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Fig. 7-97 Checking End Play of Pinions in Output Carrier

Pinion Replacement, Reaction Carrier, and Output Carrier

(1) Support carrier assembly on its front face. Using a ½ inch diameter drill, remove stake marks from end of the pinion pin or pins to be replaced. This will reduce the probability of cracking the carrier when pinion pins are pressed out.

CAUTION: *Do not allow drill to remove any stock from the carrier as this this will weaken the part and future failure would be probable.*

(2) Using a tapered punch, press pinion pins out of carrier (fig. 7-98)

(3) Remove pinions, thrust washers and roller needle bearings (fig. 7-99), from carrier.

(4) Inspect thrust faces of pinion pockets in carrier for burrs. Remove any burrs.

(5) Install eighteen needle bearings into each pinion, using petroleum jelly to hold bearings in place. Use pinion pin as guide (fig. 7-99)

(6) Place one bronze and one steel washer on each side of pinion, so steel washer is against pinion; hold washers in place with petroleum jelly.

(7) Position pinion assembly in carrier; then install a pilot shaft through rear face of assembly to hold parts in place.

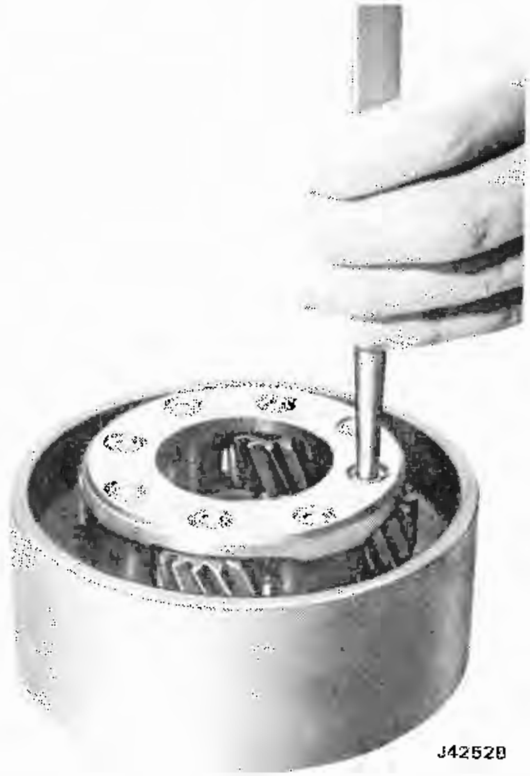
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Fig. 7-98 Removing Planet Pinion Pins


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Fig. 7-99 Planet Pinion Components

(8) While rotating pinion from front press a new pinion pin into place being sure that headed end is flush or below face of carrier (fig. 7-100).

NOTE: *Headed end of pin should be upward when pin is pressed into carrier.*

(9) Place a large punch in a bench vise, to be used as an anvil, and stake opposite end of pinion pin in three places, as shown in fig. 7-101

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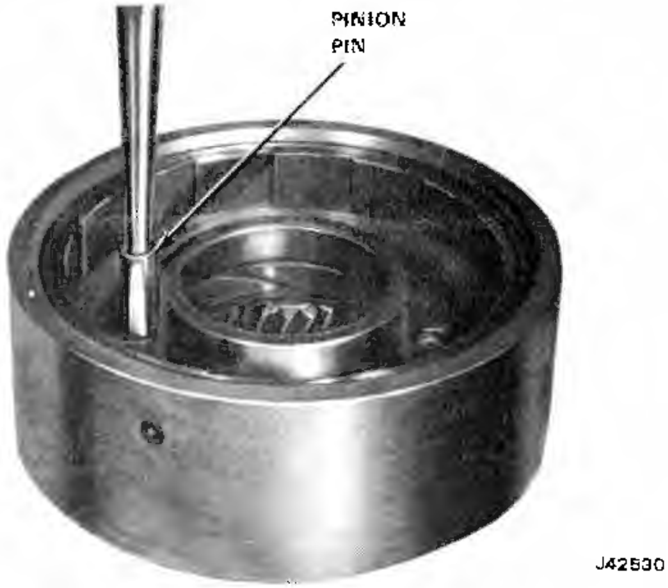

Fig. 7-100 Installing Planet Pinion Pin

Fig. 7-101 Staking Pinion Pin

NOTE: *Both ends of pinion pin must lie below face of carrier or interference may occur.*

OUTPUT SHAFT

Inspection

Inspect the bearing and thrust washer surfaces for damage, the governor drive gear for rough or damaged teeth, the splines for damage, the orificed cup plug in lubrication passage for clogged condition, and the drive lugs for damage. Inspect bushing for wear or galling.

REAR INTERNAL GEAR

Inspection

Inspect the gear for cracks, the gear teeth for damage or wear, and the splines for damage.

SUN GEAR AND SHAFT

Inspection

Inspect the gear teeth for damage or wear and check the splines for damage. Be sure that oil lubrication hole is not clogged.

Inspect the shaft for cracks or splits, the splines for damage, and the ground bushings journals for damage. Inspect bushing for scoring or galling. Be sure that oil lubrication hole is not clogged.

MAINSHAFT

Inspection

Inspect the shaft for cracks or distortion, the splines for damage, the ground bushing journals for damage, and the snap ring groove for damage. Inspect orificed cup plug pressed into one end of main shaft. Be sure it is not clogged.

FRONT AND REAR BAND

Inspection

Inspect the lining for cracks, flaking, burning, or looseness; the band for cracks or distortion; and the end for damage at anchor lugs or apply lugs.

CASE EXTENSION

Inspection

Be sure that the drain located between the two seals is not obstructed. In event of leakage from drain hole: oil with red dye indicates that transmission seal leaks; black grease indicates that transfer case seal leaks. Inspect bushing for excessive wear or damage. Inspect housing for cracks or porosity.

MODULATOR AND VALVE

Inspection

NOTE: *Check for vacuum diaphragm leak by turning the modulator so the vacuum line stem points downward. If transmission oil comes out, the vacuum diaphragm is defective and the modulator must be replaced.*

Gasoline or water vapor may settle in the vacuum side of the modulator. If found, without the presence of oil, the modulator must not be changed.

Inspect modulator assembly for any signs of bending or distortion (fig. 7-102).

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Fig. 7-102 Modulator Assembly

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Fig. 7-103 Modulator O-Ring and Valve

Inspect seat of O-ring seal for damage (figs. 7-102 and -104).

Apply suction to vacuum tube and check for diaphragm leaks.

Check modulator bellows (modulator plunger is under pressure — 16 lbs). If bellows is damaged, plunger will have very little pressure.

Inspect modulator valve for nicks or damage. The second spool, on small end of valve, has a flat spot to bleed or allow some oil to pass and to obtain more constant line pressure, resulting in smoother shifting.

Check freeness of valve operation in case bore.

MANUAL AND PARKING LINKAGE

Inspection

Inspect parking actuator rod for cracks, or broken spring retainer lugs (fig. 7-105).

Inspect spring of parking brake actuator assembly for damage. Inspect actuator for free fit on actuator rod.

Inspect parking pawl for cracks or wear. Inspect pawl shaft for damaged retainer groover. Inspect pawl return spring for deformed coils or ends.

Inspect manual shaft for damaged threads or loose lever.

Inspect inside detent lever for cracks or a loose pin.

Inspect parking brake bracket for cracks or wear.

Inspect detent roller and spring assembly for damage.

Fig. 7-104 Modulator Reaction Lever

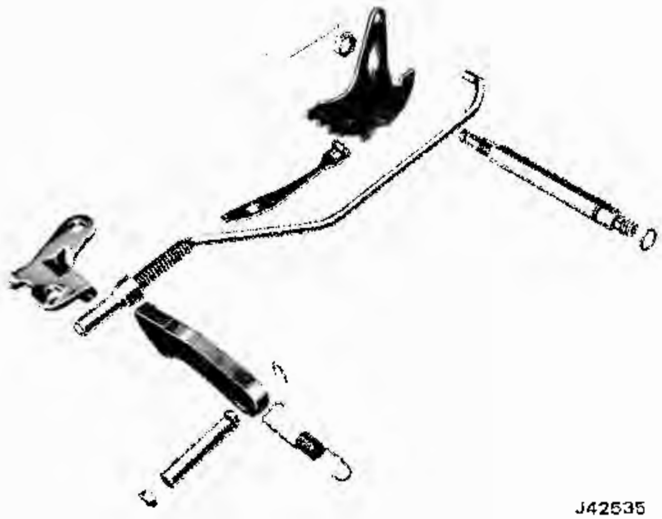

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Fig. 7-105 Manual and Parking Linkage

J-21369

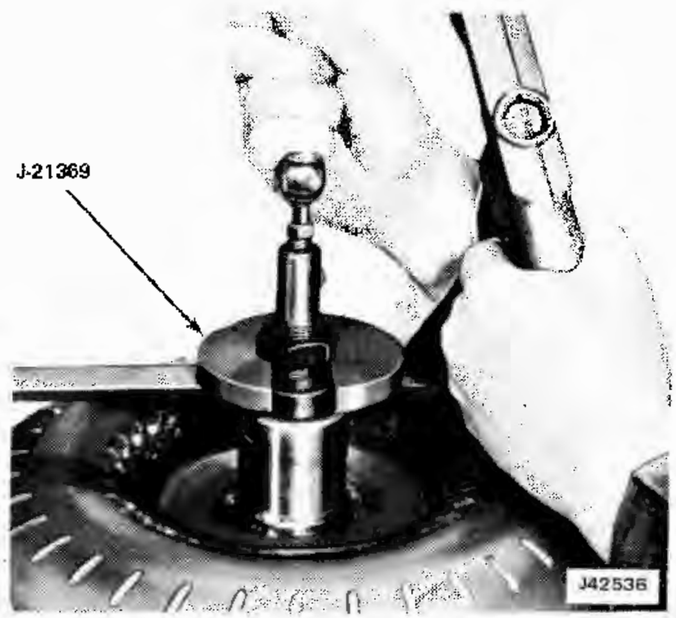

Fig. 7-106 Air-Checking Converter

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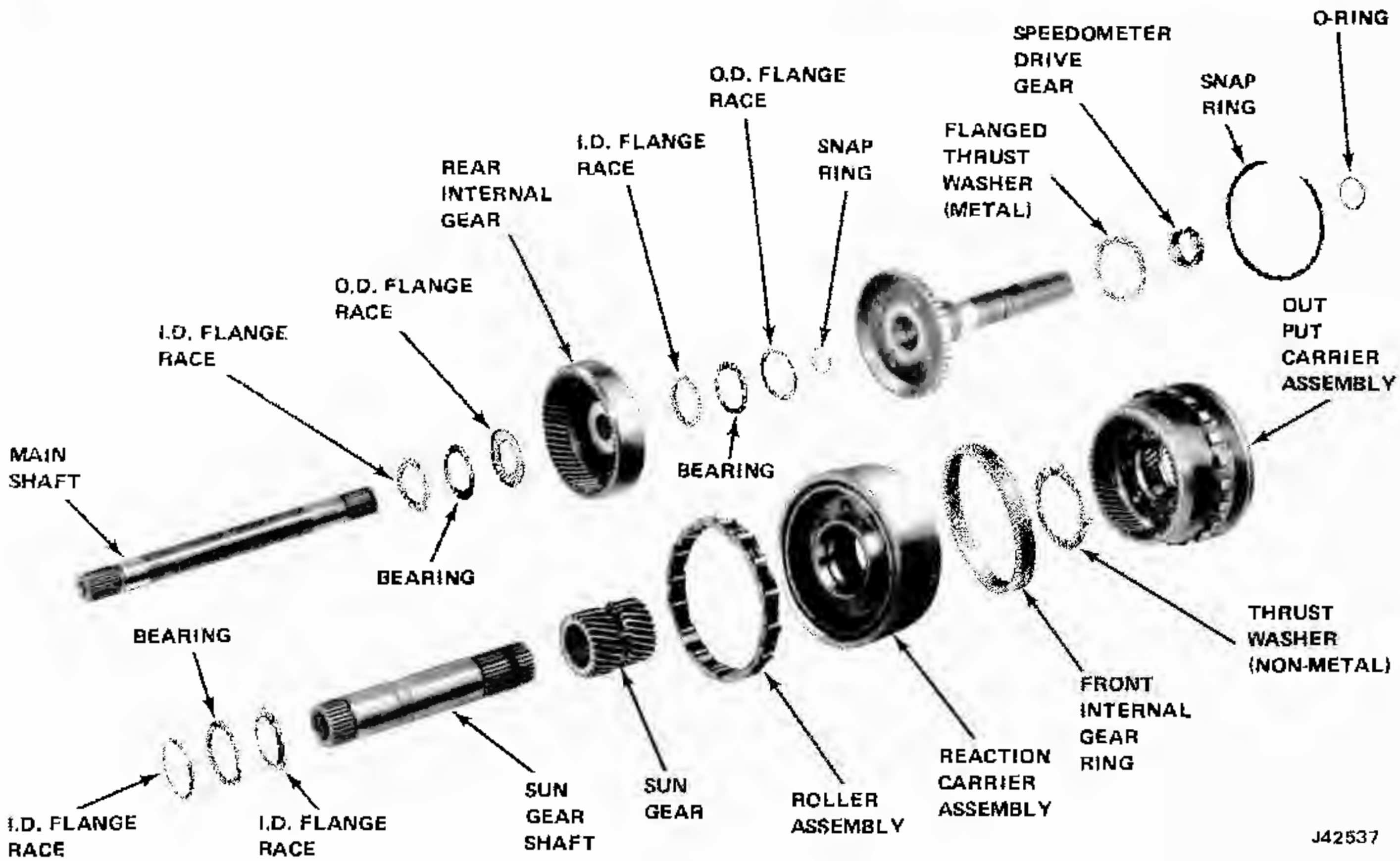

Fig. 7-107 Gear Unit Assembly

TRANSMISSION CASE

Inspection

Inspect case assembly for cracks, porosity, or interconnected or clogged oil passages.

Check for good retention of band anchor pins.

Inspect all threaded holes for thread damage.

Inspect intermediate clutch driven plate lugs for damage or signs of wear.

Inspect two snap ring grooves for damage.

Inspect bore of governor assembly for scratches or scoring.

Inspect modulator valve bore for scoring or damage.

Inspect cup plug inside case for good staking and sealing.

Inspect case bushing for wear or galling.

TORQUE CONVERTER

Inspection

Check hub surfaces of torque converter for scoring or wear. Check drive lugs for damage. Check torque converter housing for leaks as follows:

Install and tighten Leak Detecting Fixture J-21369 on torque converter housing (fig. 7-106).

Apply 80 psi air pressure to fixture.

Submerge housing in water and check for leaks.

GEAR UNIT

Assembly

(1) If rear internal gear has been removed from mainshaft, insert rear spline of shaft into gear, then secure gear to shaft with snap ring (fig. 7-107).

2) Install sun gear-to-internal gear races and thrust bearings against inner face of rear internal gear as follows retaining with petroleum jelly: place large race against internal gear with flange facing forward or

Fig. 7-108 Mainshaft and Bearing

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upward as shown in fig. 7-108, install thrust bearing in race, and place small race against bearing with inner flange facing into bearing, or downward.

(3) Install output carrier over main shaft so that pinions of carrier mesh with rear internal gear.

(4) Reposition components thus far assembled so that main shaft extends downward through hole in bench and back face of rear internal gear is upward.

(5) Install rear internal gear-to-output shaft races and thrust bearing and retain with petroleum jelly as shown in fig. 7-109.

(6) Place small race against internal gear with center flange facing upward.

(7) Install thrust bearing in race, and place large race over small race, with outer flange cupped over bearing.

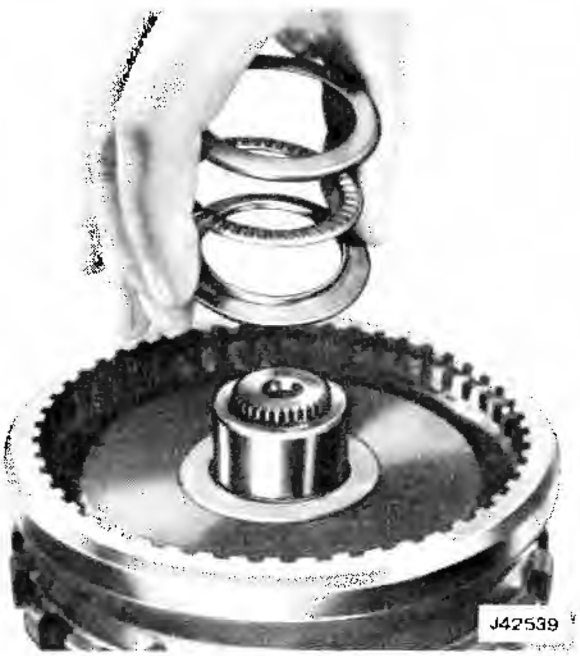

Fig. 7-109 Rear Internal Races and Thrust Bearing

(8) Install output shaft into output carrier assembly as shown in fig. 7-110, then secure shaft to carrier with snap ring, as indicated in fig. 7-107.

(9) Reposition and support components thus far assembled so that output shaft extends downward.

(10) Install reaction carrier-to-output carrier thrust washer on output carrier, with tabs of washer faced downward into corresponding pockets of carrier and retain with petroleum jelly.

(11) Insert sun gear into output carrier, splines with chamfer downward, so that it meshes with planet gears.

(12) Insert rear spline of (long spline) sun gear shaft into spline of sun gear.

(13) Position front internal gear ring on output carrier, as shown in fig. 7-111, then install reaction carrier assembly on output carrier and ring, so that planet gears of carrier mesh with sun gear (fig. 7-112).

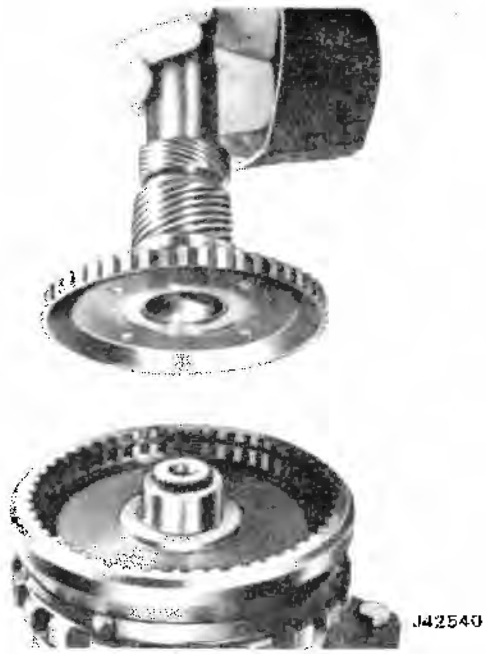

Fig. 7-110 Installing Output Shaft Into Output Carrier Assembly

NOTE: *When a new output carrier and/or reaction carrier is being installed and if the front internal gear ring prevents assembly of the carriers, replace the front internal gear ring with the SERVICE ring.*

(14) Install center support-to-sun gear thrust bearing and races retaining with petoleum jelly.

(15) Install large race over sun gear shaft, with center flange of race upward, and seat against sun gear; seat thrust bearing over race; seat remaining race, with center flange upward, on washer. Refer to fig. 7-113.

Fig. 7-111 Positioning Front Internal Gear Ring

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Fig. 7-112 Installing Reaction Carrier Assembly

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Fig. 7-113 Center Support to Sun Gear Thrust Bearing and Races

(16) Install rollers that have come out of the roller cage by compressing the energizing spring with forefinger and inserting roller from the center outer side. Refer to fig. 7-115

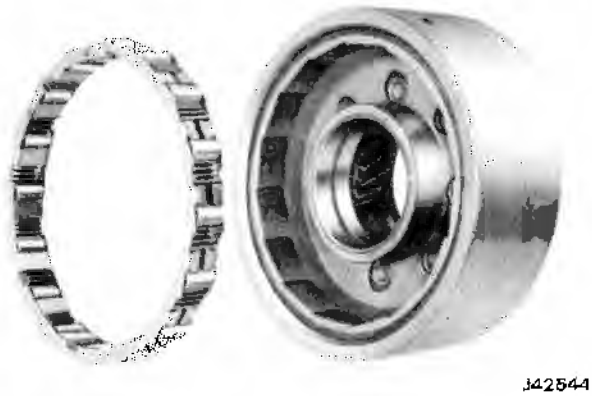

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Fig. 7-114 Roller Clutch Assembly

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Fig. 7-115 Installing Roller in Roller Clutch

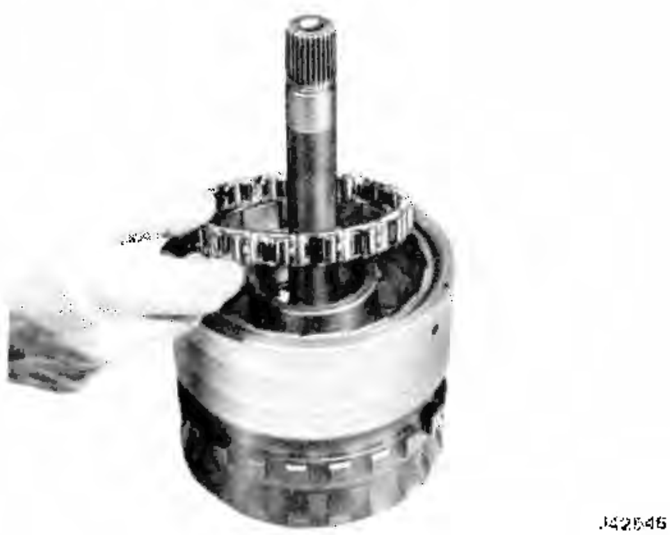

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Fig. 7-116 Installing Roller Clutch

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(17) Install roller clutch assemly into reaction carrier outer race. Refer to figure 7-116.

(18)Install center support to reaction carrier thrust washer into recess in center support assembly and retain with petroleum jelly.

(19) Install case center support into reaction carrier and roller clutch assembly as shown in figure 7-117.

Fig. 7-117 Installing Center Support

NOTE: *With reaction carrier held, center support should turn counterclockwise only.*

(20) Use Gear Assembly Clamp Set J-21795 to clamp gear unit assembly together until it can be installed in transmission case.

(21) Install output shaft-to-case thrust washer and seat so that tabs of washers are inserted into corresponding indents of shaft, and retain with petroleum jelly. Do not use plastic washers here (fig. 7-118).

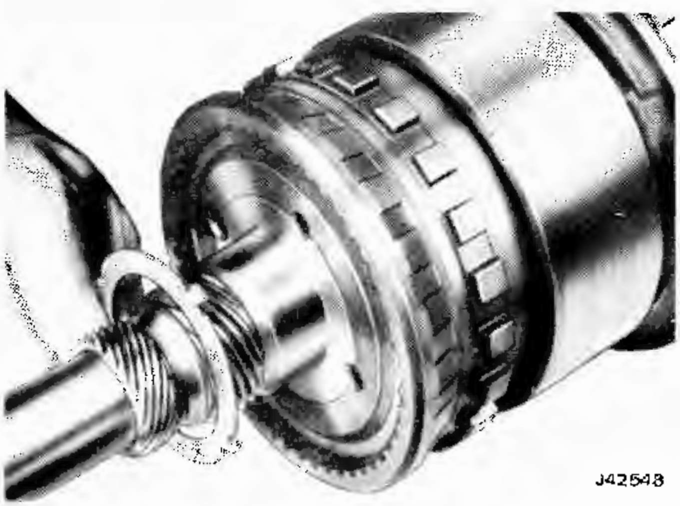

Fig. 7-118 Installing Output Shaft to Case Thrust Washers

ASSEMBLY

NOTE: *When reassembling the transmissions, it is important that bearing surfaces be given an initial lubrication.*

Bushings can be lubricated with petroleum jelly, or the part and bushing dipped in transmission oil.

Thrust washers should be lubricated on both surfaces with petroleum jelly before installation.

Lubrication in this recommended manner will prevent damage to thrust washers and bushings due to running dry on the initial start up.

Gear Unit and Intermediate Clutch Installation

(1) Install parking brake pawl with tooth toward inside of case and parking pawl shaft.

(2) Install parking pawl shaft retainer clip.

(3) Install new cup plug, using a ⅜-inch diameter rod, and drive into transmission case until parking pawl shaft bottoms on case rib. Refer to figure 7-119.

(4) Install parking pawl return spring, square end hooked on pawl, and other end of case.

(5) Install parking brake bracket guides over pawl, using two attaching bolts; tighten bolts to 15 to 20 foot-pounds (fig. 7-122).

(6) Install rear band assembly in transmission case, so that two lugs index with two anchor pins. Check band to make sure band is seated on lugs.

Fig. 7-119 Installing Cup Plug

(7) Install support to case spacer against shoulder at bottom of case splines and gap located adjacent to band anchor pin.

CAUTION: *Do not confuse this spacer (0.040-inch thick and both sides flat) with either the center support to case snap ring (one side beveled) or the backing plate to case snap ring (0.093-inch thick and both sides flat). Do not attempt to install the early type center support with the 0.040-inch spacer ring in the case, and do not install the new center support without the 0.040-inch spacer ring in the case.*

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(8) Install proper rear unit selective washer (proper washer determined by previous end play check) into corresponding slots inside rear of transmission case.

(9) Install complete center support and gear unit assembly into case making certain center support bolt hole is properly aligned with hole in case. Use Tool Kit J-21795.

(10) Install center support-to-case retaining snap ring, **with bevel side up and locating gap adjacent to band anchor pin** to secure center support in case. **Make certain ring is properly seated in case.**

(11) Install case-to-center-support bolt by placing center support locating tool into case direct clutch passage, with handle of tool pointing to right as viewed from front of transmission and parallel to bell housing mounting face.

(12) Apply pressure downward on tool handle which will tend to rotate center support counter-clockwise as viewed from front of transmission.

(13) While holding center support firmly counterclockwise against case splines, tighten case to center support bolt to 20 to 25 foot-pounds using a 3/8-inch, 12-point thin-wall deep socket. Refer to figure 7-120.

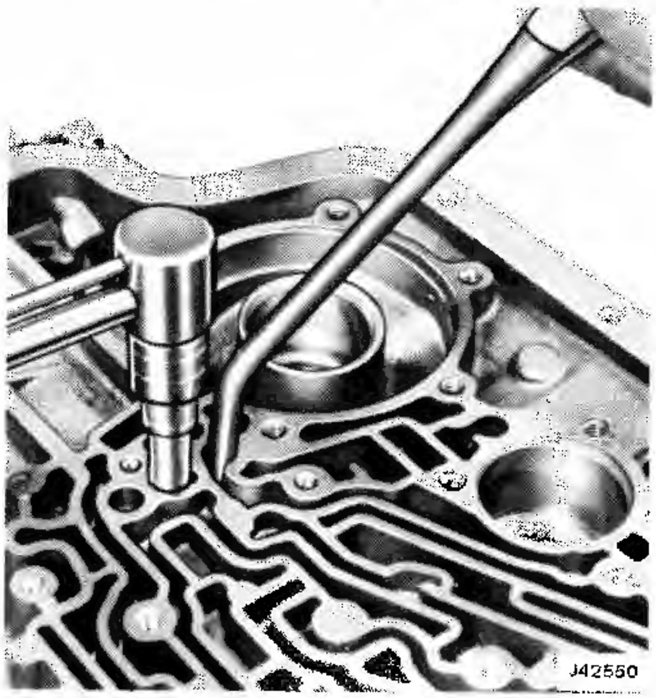

Fig. 7-120 Installing Center Support Screw

CAUTION: *When using the locating tool, care should be taken not to raise burrs on the case valve body mounting face.*

NOTE: *Piston in center support applies intermediate clutch. If piston seals leak, clutch failure, slipping, or loss of second speed may result.*

(14) Lubricate with transmission oil two flat and one waved steel plates and three composition intermediate clutch plate assemblies and install, starting with waved steel plate and alternating composition and steel plates.

(15) Install intermediate clutch backing plate, ridge upward or forward, and fasten in case with backing plate-to-case snap ring. **This snap ring is flat on both sides. Locate gap of snap ring opposite band anchor pin. Refer to figure 7-121.**

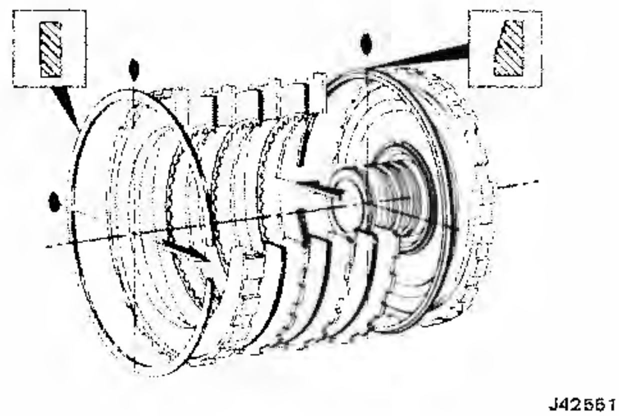

Fig. 7-121 Snap Ring Installation

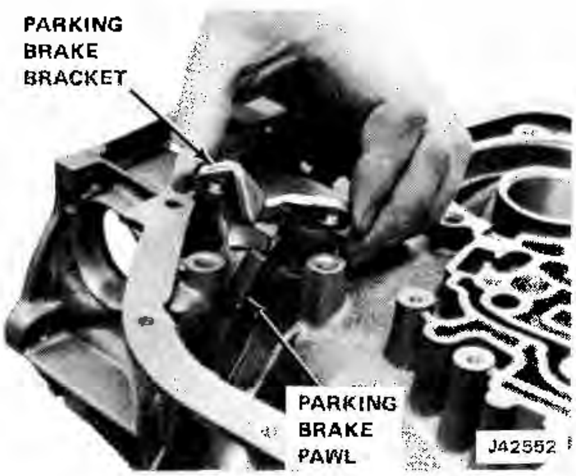

Fig. 7-122 Installing Parking Bracket

Rear End Play Check

Refer to figure 7-123.

(1) Install Slide Hammer C-3752 into an extension housing attaching bolt hole.

(2) Mount Dial Indicator on rod and index with end of output shaft.

(3) Apply air pressure to apply intermediate clutch (center oil passage) while moving output shaft in and out to read end play.

(4) End play should be from 0.007 to 0.019-inch. The selective washer controlling this end play is the steel washer having 3 lugs that is located between the thrust washer and the rear face of the transmission case.

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If a different washer thickness is required to bring the end play within specification, it can be selected from the following chart.

Thickness	Notches	And/Or Numeral
0.074 to 0.078	None	1
0.082 to 0.086	1 Tab Side	2
0.090 to 0.094	2 Tabs Side	3
0.098 to 0.102	1 Tab O.D.	4
0.106 to 0.110	2 Tabs O.D.	5
0.114 to 0.118	3 Tabs O.D.	6

Front Band Installation

Install front band, with anchor hole placed over band anchor pin, and apply lug facing servo hole.

Manual Linkage Installation

(1) Install new O-ring on manual shaft.
(2) If removed, insert actuator rod into manual detent lever from side opposite pin.
(3) Install actuator rod plunger under parking bracket and over parking pawl, as shown in figure 7-124.
(4) Insert manual shaft assembly through case and detent lever, and secure with jamnut and retaining pin.
(5) Tighten nut to 15 to 20 foot-pounds. Index mark on pin should coincide with groove on shaft.

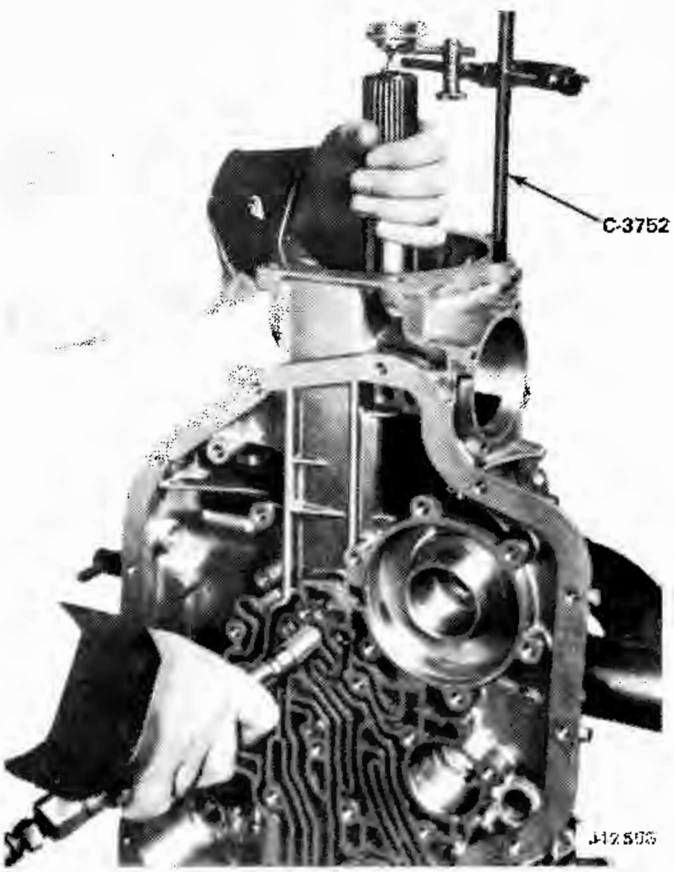

Fig. 7-123 Rear Unit End Play

Fig. 7-124 Manual Shaft Installation

(6) Rotate transmission to vertical position, and remove Tool Kit J-21795.

Direct Clutch and Forward Clutch Installation

(1) Install direct clutch and intermediate sprag assembly, in transmission case, to front of intermediate clutch.
(2) Rotate housing of direct clutch, causing outer race of sprag assembly to meet plates of intermediate clutch, which, in turn, will cause hub of clutch housing to touch sun gear shaft.

NOTE: *It may be helpful to remove composition plates and steel plates from direct clutch assembly while seating assembly.*

(3) Install forward clutch hub-to-direct clutch housing thrust washer on hub of forward clutch. Retain with petroleum jelly.
(4) Install forward clutch and turbine shaft, indexing direct clutch hub so end of mainshaft will bottom on end of forward clutch hub. When forward clutch is seated, it will be approximately 1/4-inch from pump face in case.

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Oil Pump Installation

(1) Guide pins can be fabricated by grinding heads from two valve body bolts.

(2) Install guide pins in two pump mounting bolt holes of transmission case.

(3) Position oil pump gasket to pump face of transmission case.

(4) Apply petrolatum to hold gasket in place.

(5) Install pump assembly in transmission case and fasten with all but one pump attaching bolt and washer; bolt and washer should be omitted from either 5 or 10 o'clock position. Tighten bolts to 20 to 25 foot-pounds.

NOTE: *If turbine shaft cannot be rotated as pump is being pulled into place, forward or direct clutch housings have not been properly installed to index with all clutch plates. This condition must be corrected before pump is pulled fully into place.*

(6) If necessary to install a new front seal, use a non-hardening sealer on outside of seal body and using Seal Driver J-21359, drive seal in place, as shown in figure 7-125.

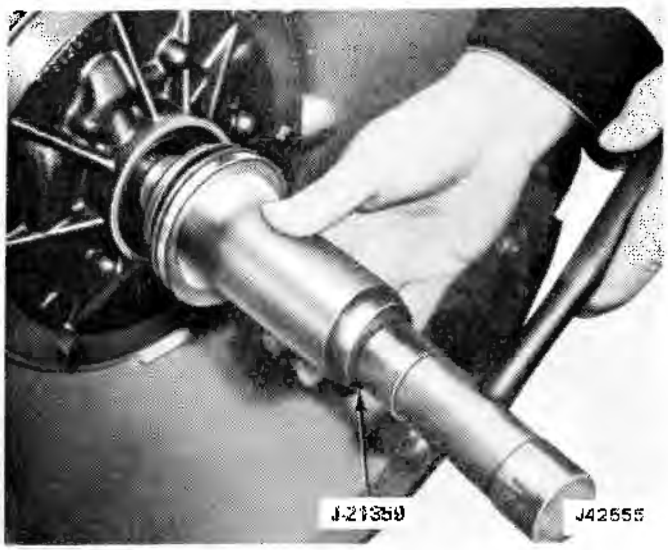

Fig. 7-125 Installing Pump Seal

(7) Check front unit end play, and replace selective washer if necessary.

(8) Install remaining oil pump attaching bolt and washer. Tighten to 20 to 25 foot-pounds torque.

Check Ball, Front Servo, Gasket, Spacer, and Solenoid Installation

(1) Install front servo spring and retainer into transmission case.

(2) Install flat washer on front servo pin at end opposite taper, then install pin into transmission case so that tapered end is contacting band.

(3) Install oil seal ring on front servo piston, if removed, and install piston on servo pin so that identification numbers on shoulders are exposed. Check freeness of piston by stroking piston in bore.

(4) Install two guide pins and gasket. Install six check balls into transmission case pockets, then install valve body spacer to case gasket (gasket with extension for solenoid). See fig. 7-16 for check ball location.

(5) Install valve body to case spacer plate.

(6) Install detent solenoid assembly and gasket in transmission case with electrical connector facing outer edge of case.

(7) Install bolts, but do not tighten.

(8) Install O-ring oil seal on electrical connector sleeve.

(9) Lubricate sleeve and insert into transmission case with lock tabs facing into case, positioning locator tabs in notch at side of case.

(10) Connect detent solenoid wire to connector terminal.

Rear Servo Installation

(1) Select proper length of band-apply pin.

(2) Install rear accumulator spring in transmission case, as shown in figure 7-126.

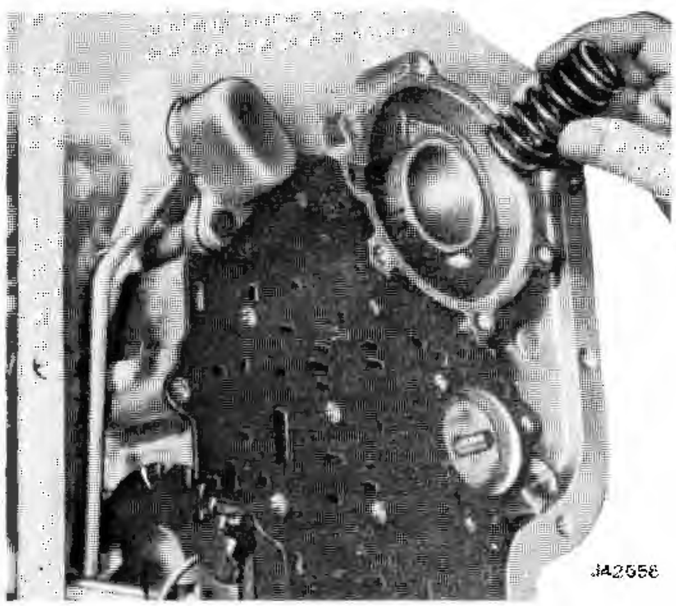

Fig. 7-126 Rear Accumulator Spring Installation

(3) Lubricate and install rear servo assembly into transmission case.

(4) Install rear servo and gasket cover on transmission case as shown in figure 7-127, and secure with attaching screws. Tighten screws 15 to 20 foot-pounds.

Control Valve Assembly and Governor Pipe Installation

(1) Install control valve-to-spacer gasket on spacer, as shown in figure 7-128.

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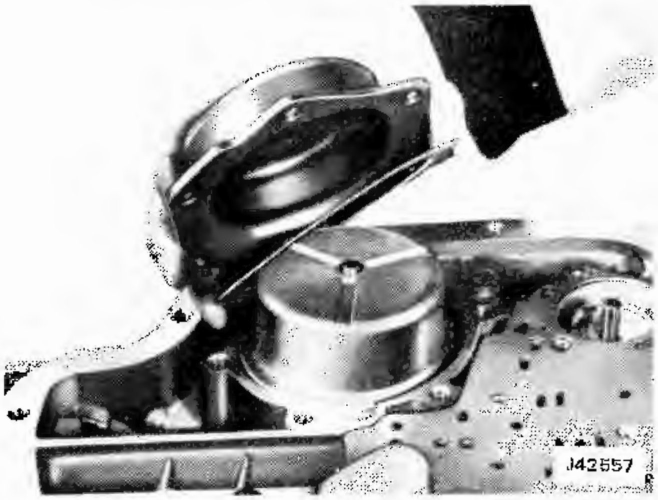

Fig. 7-127 Installing Cover and Gasket Over Rear Servo Assembly

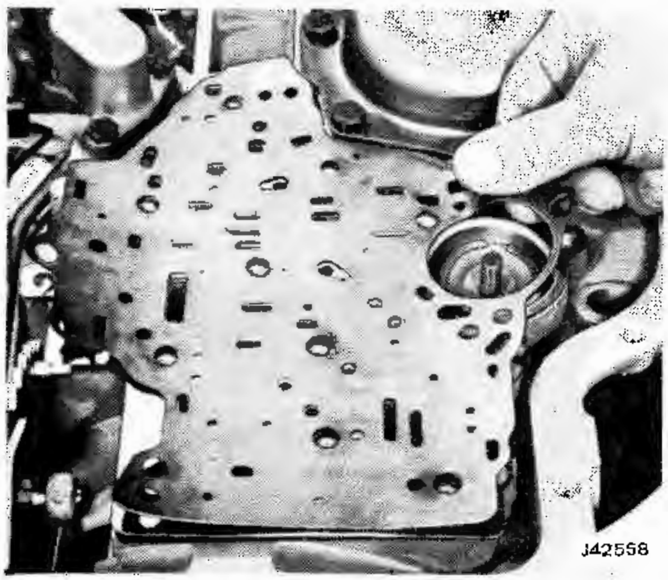

Fig. 7-128 Installing Control Valve Spacer Gasket

(2) Insert governor pipes into valve body.

(3) Install control valve assembly and governor pipes on transmission case, as shown in figure 7-129.

Fig. 7-129 Installing Control Valve Assembly

NOTE: *Be sure manual valve is properly indexed with pin on manual detent lever and governor pipes are properly installed in case.*

(4) Install control valve assembly attaching bolts, manual detent, and roller assembly in transmission case.

(5) Tighten detent solenoid and control valve attaching bolts. Tighten valve body bolts to 6 to 10 foot-pounds torque and solenoid bolts 4 to 10 foot-pounds torque.

Oil Filter Oil Pan Installation

(1) Install case to intake pipe O-ring seal on intake pipe and assemble new filter to intake pipe.

(2) Install filter and intake pipe assembly, attaching filter to control valve assembly with retainer bolt.

NOTE: *After any major repair the oil filter must be replaced.*

(3) Install new bottom pan gasket and bottom pan with attaching screws. Tighten screws to 10 to 13 foot-pounds torque.

Modulator Valve, Vacuum Modulator Installation

(1) Insert modulator valve into transmission case, stem end outward.

(2) Install adapter at valve, then mount retainer on transmission case with attaching screws. Tighten screws 15 to 20 foot-pounds.

(3) Install O-ring oil seal on vacuum modulator, then insert into adapter.

(4) Secure retainer to transmission case with attaching screws. Tighten screws 15 to 20 foot-pounds.

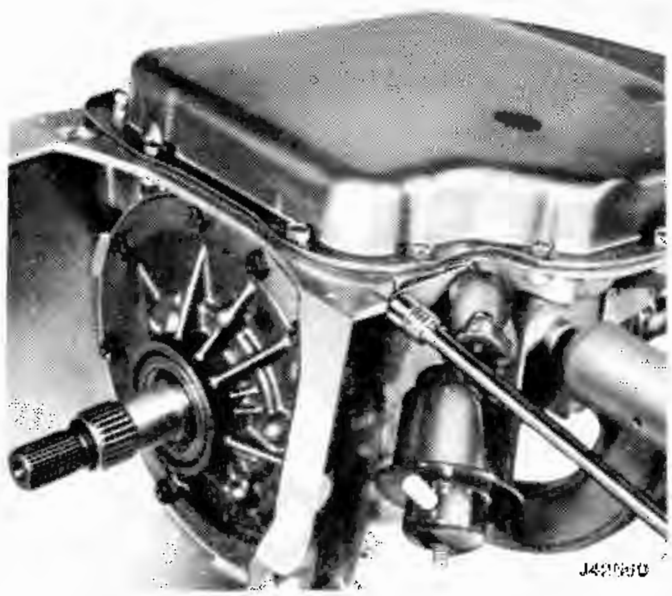

Fig. 7-130 Installing Modulator Retainer

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Governor Installation

(1) Insert sleeve of governor assembly into transmission case, so that driven gear of governor meshes with drive gear in case (fig. 7-131).

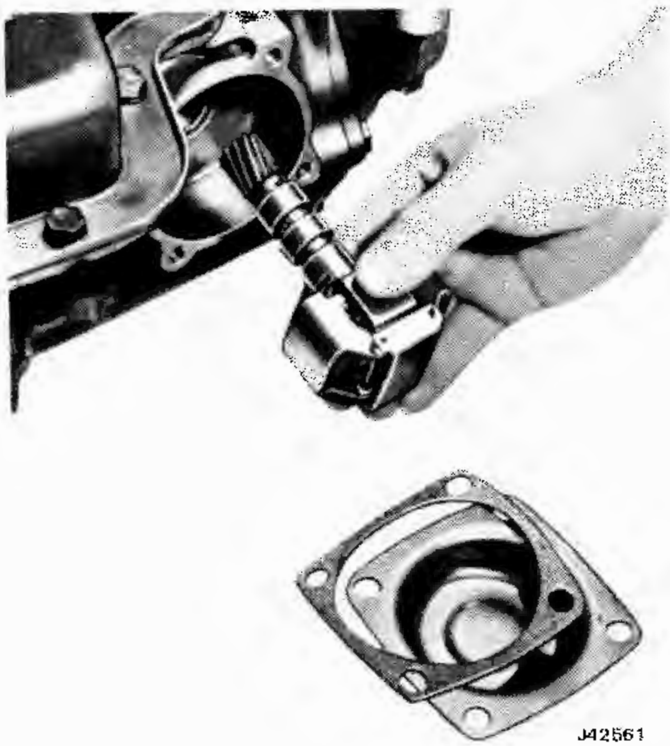

Fig. 7-131 Installing Governor Assembly

(2) Install a new gasket on governor cover and mount cover on transmission case with attaching bolts. Tighten bolts 15 to 20 foot-pounds torque.

TRANSMISSION SPECIFICATIONS

Model	400
Ratios:	
Low	2.4815 to 1
Intermediate	1.4815 to 1
High	1 to 1
Reverse	2.0769 to 1
Converter Stall Ratio	2.4 to 1
Oil Capacity	22 pt.
Modulator	Vacuum Control
Converter Elements	3
Cooling	Water
Carrier Pinion End Play	0.009 to 0.024 inch
Pump Face to Rotor End Play	0.0008 to 0.0035 inch
Front Unit End Play	0.003 to 0.024 inch
Rear Unit End Play	0.007 to 0.019 inch

TORQUE SPECIFICATIONS

	Foot-Pounds
Bottom Pan Attaching Screws	12
Case Center Support Bolt	23
Case Center Support Screw	5
Control Valve Body Bolts	8
Converter Dust Shield Screws	8
Converter to Flywheel Bolts	33
Detent Solenoid Bolts	7
Extension Housing Bolts	23
Governor Cover Bolts	18
Linkage Swivel Clamp Nut	4
Manual Lever To Manual Shaft Nut	8
Manual Shaft to Inside Detent Lever	18
Modulator Retaining Bolt	18
Parking Pawl Bracket Bolts	18
Pump Cover Bolts	18
Pump to Case Attaching Bolts	18
Rear Servo Cover Bolts	18
Transmission to Engine Mounting Bolts	28

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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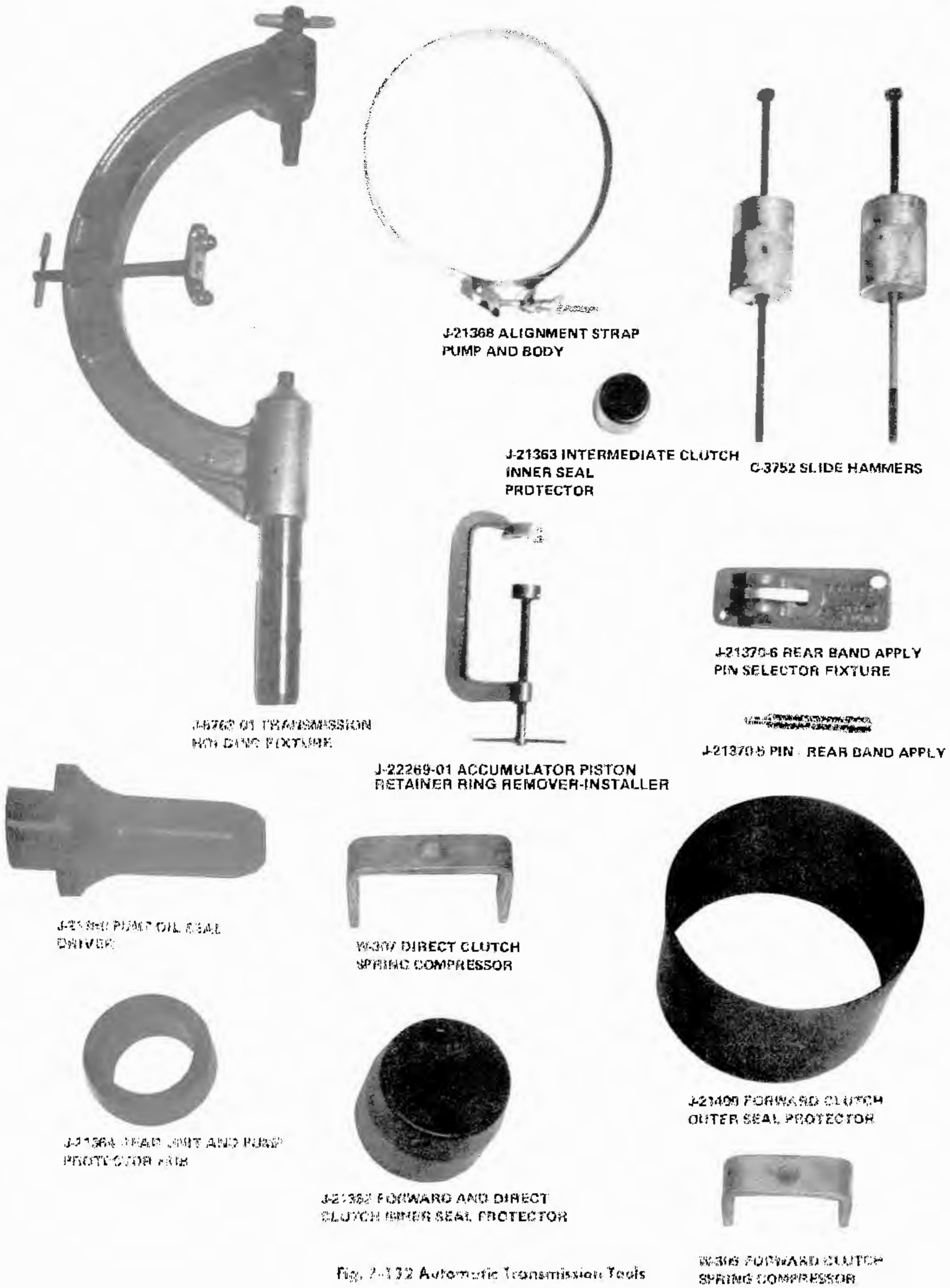

Fig. 7-132 Automatic Transmission Tools

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TRANSFER CASE

MODEL 20 TRANSFER CASE

GENERAL

The Model 20 transfer case provides two gear ratios in 4-wheel drive (high and low), a 2-wheel drive, and a neutral position.

When the vehicle is driven in 2-wheel drive, the gear that drives the front propeller shaft is freewheeling on the output shaft. Power flow in 2-wheel drive is shown in figure 8-1, and power flow in 4-wheel drive high range is shown in figure 8-2.

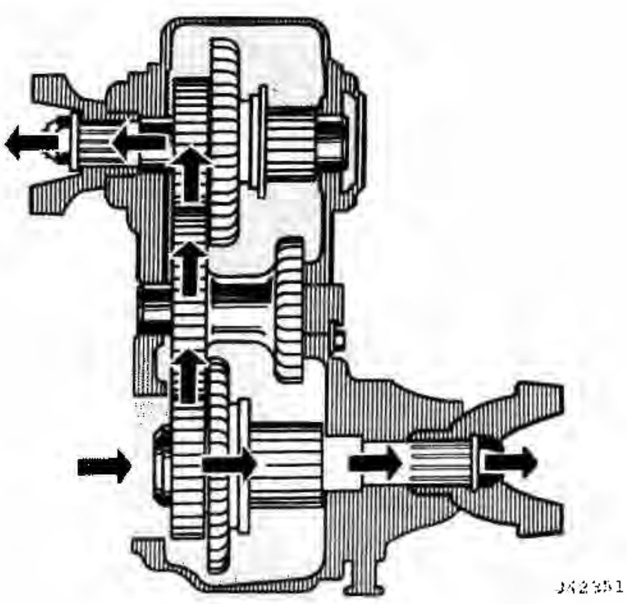

Fig. 8-1 Silent Transfer Case in 2-Wheel Drive

Transfer case gears and drives are controlled by a single lever located forward and just to the right of the transmission shift lever. This lever is connected through linkage to the shift rods on the transfer case.

Lubricant circulates between the transfer case and the transmission on manual 3-speed transmission only.

All vehicles have a transfer case shift diagram located on the top face of the shift lever knob (fig. 8-3).

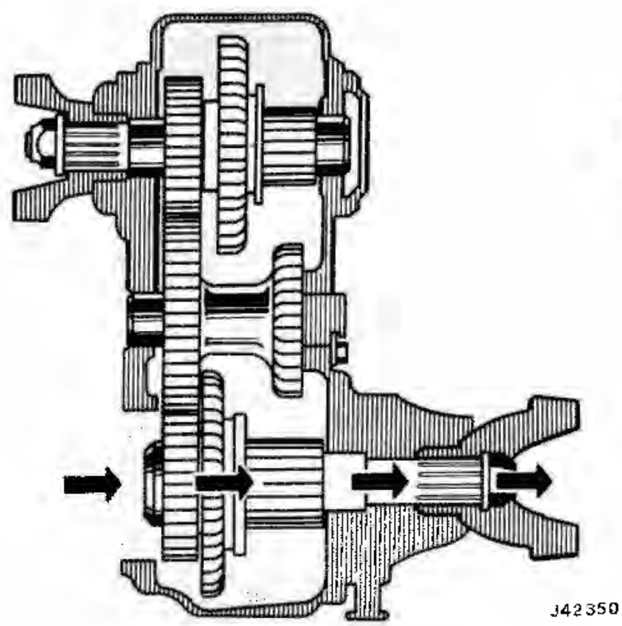

Fig. 8-2 Silent Transfer Case in 4-Wheel Drive

Fig 8-3 Transfer Case Shift Knobs

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CJ MODELS

The transfer case shift lever has four positions: 4H (4-wheel drive high), 2H (2-wheel drive high), N (neutral), and 4L (4-wheel drive low).

The forward position of the lever (4H) provides high range 4-wheel drive. The first rear position (2H) disengages the 4-wheel drive and allows rear wheel drive only for regular highway and road travel. The second rear position (N) disengages all power to the wheels and is used for stationary power takeoff applications. The last rear position (4L) provides low range 4-wheel drive for the extreme adverse conditions.

CHEROKEE AND TRUCK

The transfer case shift lever has four positions: 2WD, 4WD-HIGH, NEUTRAL and 4WD-LOW. The left-hand forward position of the lever 2H (2WD) allows the rear wheel drive only for regular highway and city road travel. The left-hand rear position 4H (4WD-HIGH) provides high range 4-wheel drive. The right-hand center position (NEUTRAL)disengages all power to the wheels and is used for stationary power takeoff operations, or when towing the vehicle. The right-hand forward position 4L (4WD-LOW) provides low range 4-wheel drive for the toughest going (fig. 8-3).

DIAGNOSIS

Cherokee and Truck

Outlined below is information on the operation of the transfer case and the shift lever control case to aid in diagnosis of service problems with these assemblies.

Figure 8-4 shows the position of the shift lever and rails in the shift lever control case in the 2WD HIGH, 4WD High and 4WD Low positions.

2WD High - In this position, the inner rail of the control case is all the way forward, the pawl on the outer rail is to the rear of the slot in the inner rail, and the legs of the torsion spring are in the two notches in the inner rail. The ball on the end of the shift lever is to the rear. The pin on the shift lever is engaged in the slot of the pawl. The outside rail is in the midposition.

4WD High - In this position, the inner rail is all the way forward. The pawl is to the front of the slot in the inner rail. The spring legs are in the notches. The shift lever ball is forward. The pin on the shift lever is still engaged in the slot in the pawl. The outside rail is in the forward position.

4WD Low - In this position, both rails are all the way to the rear, the pawl is to the front of the slot, the shift lever ball is in (and to the rear of) the slot, and the spring legs are out of the notches. The pin on the shift lever is disengaged from the slot in the pawl.

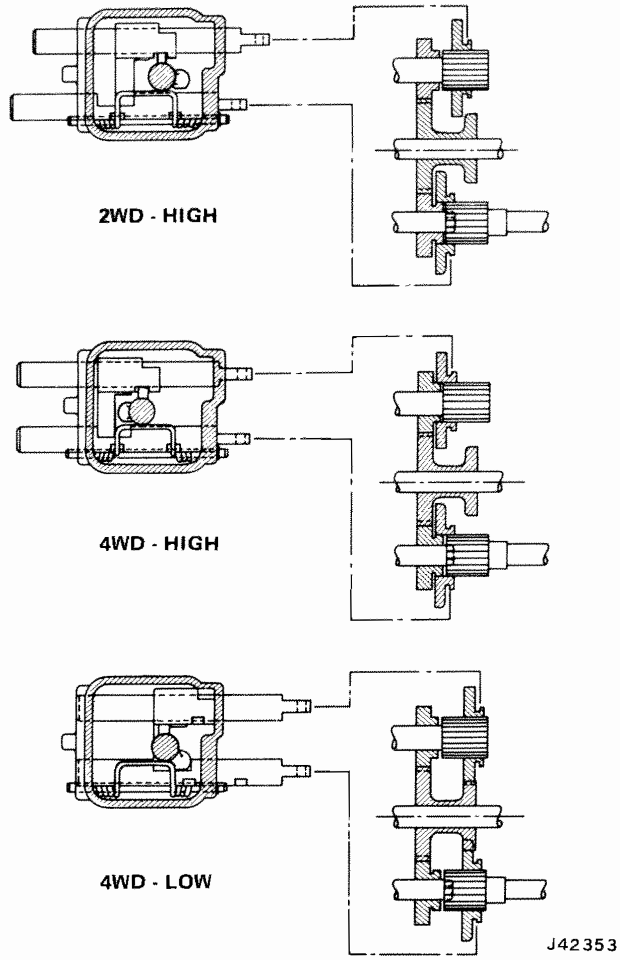

Fig. 8-4 Shift Positions

Spring Operation - In the 2WD High and 4WD High positions, the spring legs are in the notches in the inner rail, and the shank of the shift lever (between the pivot ball and the end ball) just touches the horizontal section of the spring (fig. 8-5). When the shift lever is in the normal 4WD High position and the crossover is made moving the manually operated end of the shift lever to the right to the 4WD High - Neutral - 4 WD Low range, the shank of the shift lever pushes the spring out of the notches, allowing the inner rails, as well as the outer rail, to be moved to the rear.

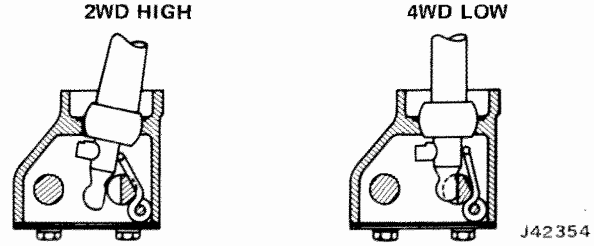

Fig. 8-5 Lever and Spring Positions

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Service Problems

If the transfer case walks out of the 2WD High, the shift lever does not move. The mainshaft sliding gear has disengaged from the transmission mainshaft gear and there is no driving connection to either front or rear wheels (fig. 8-6).

If the transfer case walks out of 4WD High, the shift lever will move. Either the front output shaft sliding gear will disengage from the front output shaft gear, leaving the vehicle in the 2WD High, or the mainshaft sliding gear will disengage from the mainshaft gear and cause the front output shaft sliding gear to disengage at the same time. In this case, there is no driving connection to either front or rear wheels (fig. 8-6).

Correction - Walking Out of 2WD High

Remove the shift lever control case.

Move the shift lever into the 2WD High position of the control case. Tap the front end of the inner rail with a hammer four or five blows. The legs of the torsion spring in the slots should keep the rail from moving. If the rail moves, install a new shift lever torsion spring. Repeat the above tests.

Correction - Walking Out of 4WD High

Follow the procedure outlined above for walking out of 2WD High.

Road test the vehicle. If the transfer case still walks out of 4WD High, replace the outer rail poppet spring in shift rod housing of the transfer case.

Check the transmission mainshaft gear and front output shaft gear for damage to the clutching teeth. Check the front output shaft sliding gear and mainshaft sliding gear for damage to the splines. Replace if damaged. Check the transmission mainshaft nut for proper torque (refer to Torque Specifications).

TRANSFER CASE REMOVAL

(1) Remove the transfer case shift lever knob and trim boot.

(2) Remove transfer case shift lever.

(3) Lift and support vehicle.

(4) Drain transfer case lubricant.

(5) Disconnect front propeller shaft from transfer case. Disconnect rear propeller shaft from transfer case.

(6) Install transfer case drain plug.

(7) Disconnect parking brake cable at equalizer and mounting bracket.

(8) Disconnect speedometer cable.

(9) Remove screws which attach transfer case to transmission. Install two 3/8-16 x 4 inch dowel pins, one on each side of case.

(10) Remove transfer case.

(11) Remove gasket between transmission and transfer case.

TRANSFER CASE INSTALLATION

(1) Place a new gasket on dowel pins in transmission case

(2) Shift transfer case to 4WD low position.

(3) Position transfer case on dowel pins.

(4) Rotate transfer case output shaft until gears engage with output gear on transmission. Slide transfer case forward to transmission.

CAUTION: *Be sure the transfer case fits flush against the transmission. Severe damage will result if the transfer case balls are tightened while the transfer case is binding.*

(5) Install one attaching screw. Remove dowel pins and install all remaining attaching screws.

(6) Connect speedometer cable and parking brake cable.

(7) Install proper amount of lubricant into transfer case.

(8) Lower vehicle.

(9) Install transfer case lever, trim boot and lever knob.

TRANSFER CASE DISASSEMBLY

NOTE: *Refer to figure 8-6 for parts relationship.*

(1) Remove bolts which attach rear bearing cap assembly to transfer case and remove bearing cap assembly.

NOTE: *The rear bearing cap assembly may be serviced without further disassembly of the transfer case. Refer to Rear Bearing Cap Inspection.*

(2) Remove case bottom cover.

(3) Remove intermediate shaft lock plate bolt, lockwasher, and lock plate.

(4) Drive intermediate shaft out of rear of case using Arbor Tool W-280 (fig. 8-7).

NOTE: *This tool allows the two sets of needle bearings and three spacers to remain in position as the shaft is removed. Align the tool in the center of the intermediate gear assembly for removal.*

(5) Remove intermediate gear assembly through bottom of case.

(6) Remove front output shaft yoke and washer (fig. 8-8) using Yoke Holding Wrench Tool C-3281.

(7) Remove front output shaft yoke using Puller Tool W-172 (fig. 8-9).

(8) Remove felt oil seal and oil seal gasket.

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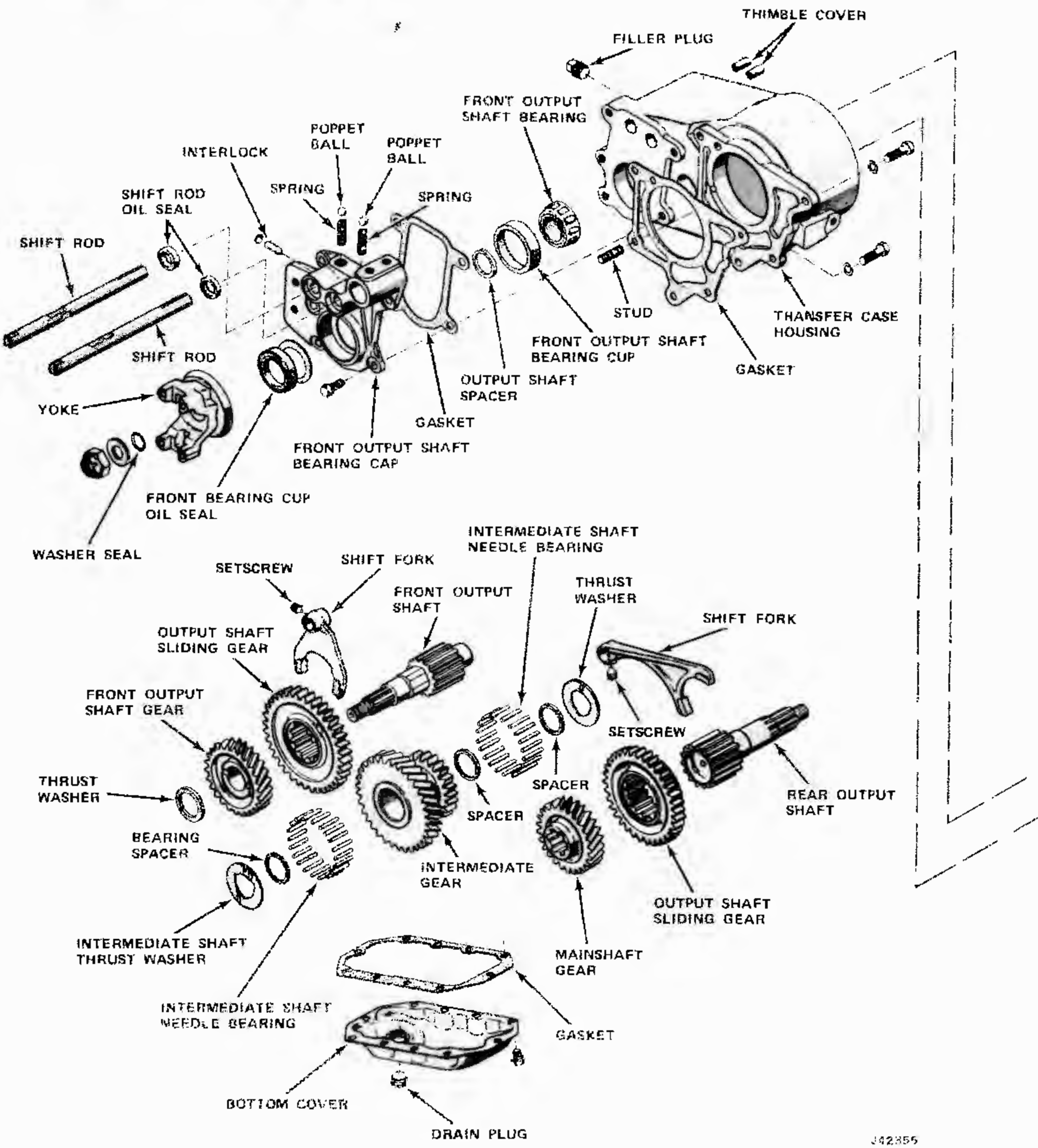

Fig. 8-6 Model 20 Transfer Case Components (Sheet 1 of 2)

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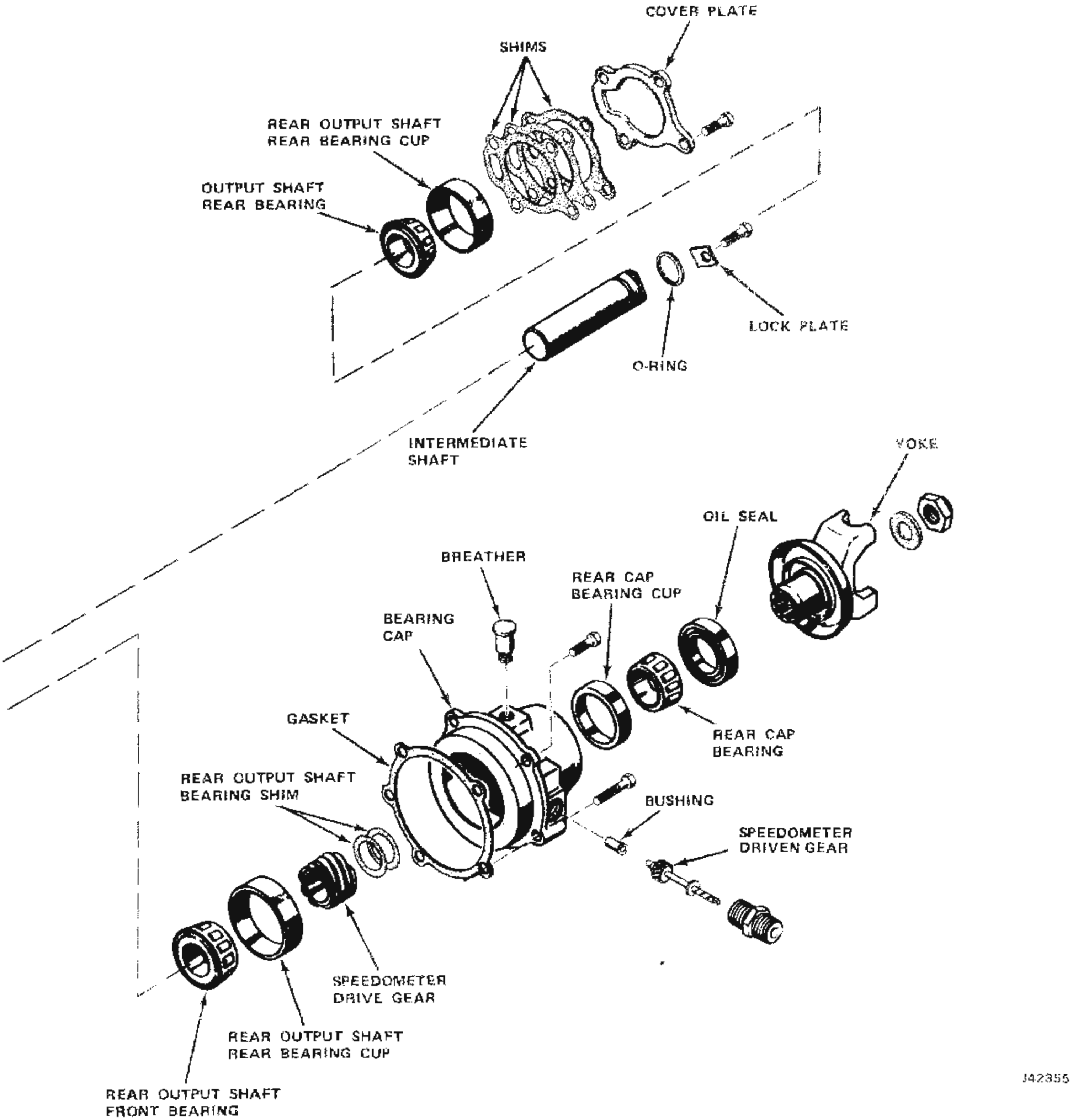

Fig. 8-6 Model 20 Transfer Case Components (Sheet 2 of 2)

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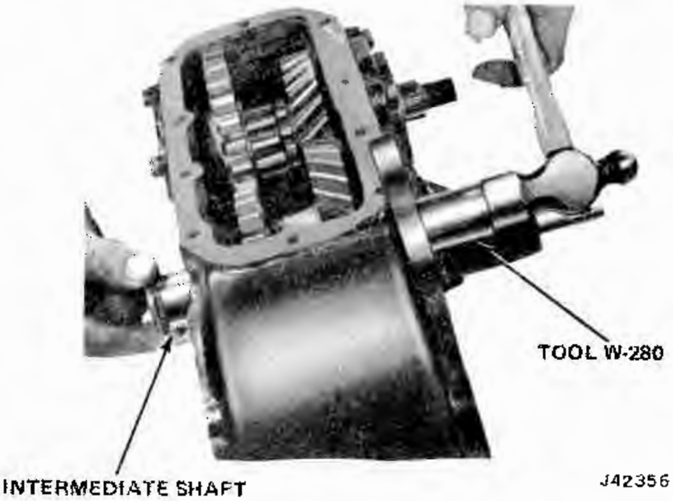

Fig. 8-7 Intermediate Shaft Needle Bearing Aligner

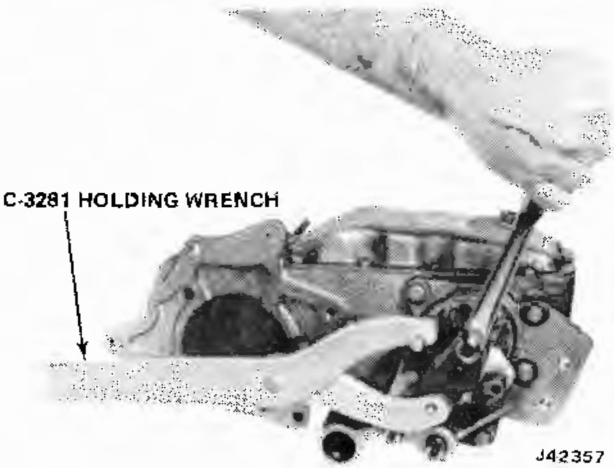

Fig. 8-8 Removing Front Output Shaft Nut

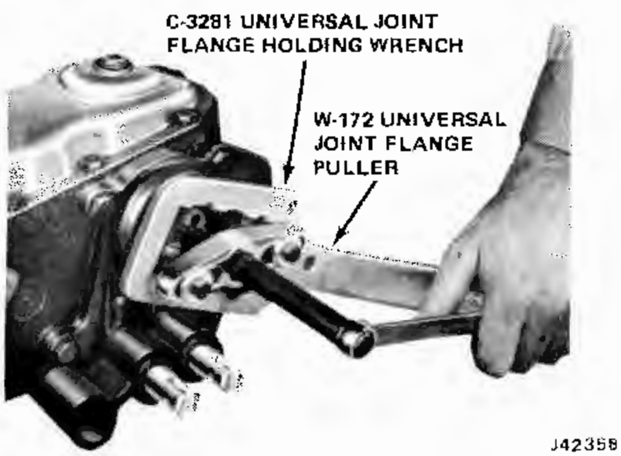

Fig. 8-9 Universal Joint Flange Puller

(9) Remove front yoke oil seal using Puller Tool W-251 (fig. 8-10).

(10) Remove screws attaching the rear bearing cover and remove cover.

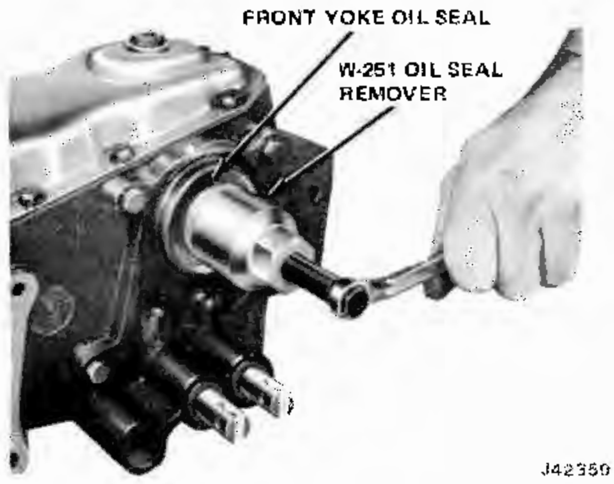

Fig. 8-10 Front Yoke Oil Seal Removal

CAUTION: *When removing rear bearing cover, take care to avoid damage to the gaskets and shims between the cover and case.*

(11) Position both shift rails in neutral.

(12) Remove left fork setscrew.

(13) Rotate left shift rail 1/4-turn counterclockwise. Hold shift fork and use a punch through rail pin hole as a handle to pull shift rail from case.

NOTE: *When the shift fork is free of rail, use hand to catch poppet ball and spring under shift rail.*

(14) Remove screws attaching front shift rod housing. Slide housing from remaining shift rail.

REAR BEARING CAP INSPECTION

Disassembly

NOTE: *The rear bearing cap assembly may be removed without disassembly of the transfer case.*

(1) Remove rear output shaft nut and washer by using Yoke Holding Wrench C-3281. Remove rear output shaft yoke by using Puller Tool W-172 (fig. 8-9).

(2) Remove rear output shaft seal with Puller Tool W-251 (fig. 8-10).

(3) Remove speedometer driven gear and sleeve from rear bearing cap.

(4) Remove output shaft by tapping it with a soft mallet.

(5) Remove bearing cone and roller assembly from shaft by lightly tapping rear face of roller assembly.

(6) Remove speedometer drive gear and shims from shaft.

(7) If necessary, remove speedometer driven pinion bushing.

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Assembly

(1) If removed, install a new speedometer driven pinion bushing using Bushing Installer Tool W-133.

(2) Tap front cone and roller assembly onto output shaft. Slide speedometer gear and original spacers onto output shaft.

(3) Insert output shaft through housing. Place front end of output shaft on a firm surface.

(4) Place rear cone and roller assembly on output shaft.

(5) Tap bearing onto shaft to seat against inner spacers.

(6) Use Driver Tool W-143 to install yoke seal. Install felt seal, propeller shaft yoke, flat washer, and retaining nut. Tighten nut (refer to Torque Specifications).

(7) Measure rear bearing cap assembly end play (fig. 8-11). End play should be 0.001 inch to 0.003 inch. If end play is incorrect, it can be corrected by installing or removing shims adjacent to speedometer drive gear.

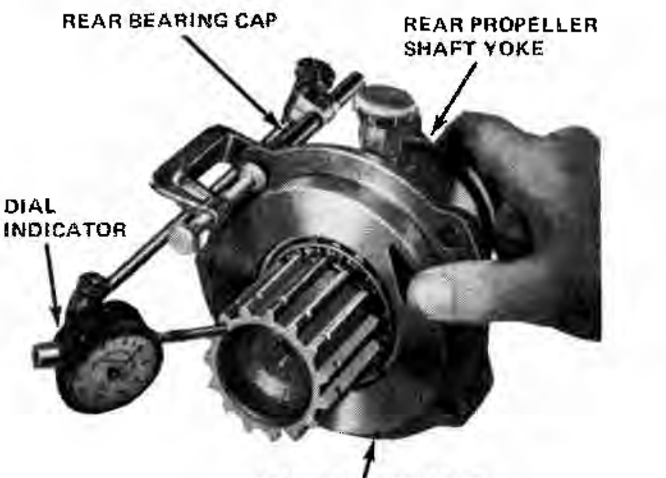

Fig. 8-11 Checking Rear Output Shaft Bearing Adjustment

SHIFT ROD HOUSING SEAL REPLACEMENT

(1) Remove seals using Puller Tool W-176 (fig. 8-12).

(2) Use Thimble and Driver Tool W-130 to replace seals (fig. 8-13).

FRONT YOKE OIL SEAL REPLACEMENT

(1) Remove front propeller shaft nut and washer using Yoke Holding Wrench Tool C-3281.

(2) Remove front propeller shaft yoke with Puller Tool W-172 (fig. 8-9).

(3) Remove felt seal, oil seal gasket, and oil seal. Use Puller Tool W-251 to remove oil seal (fig. 8-10).

(4) Use Driver Tool W-143 to install seal. Install oil seal gasket and felt seal.

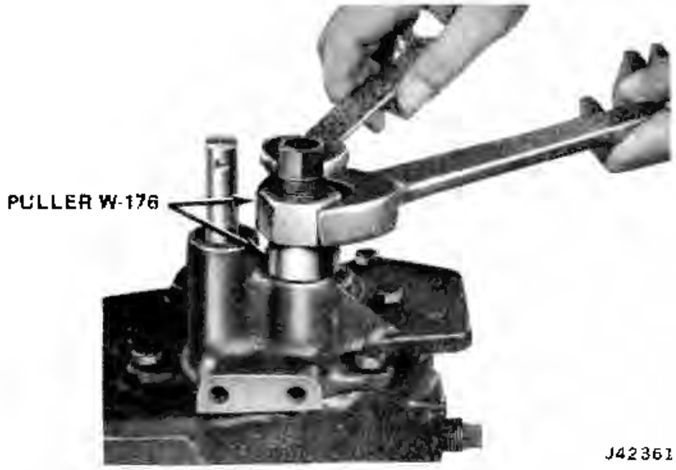

Fig. 8-12 Shift Rail Oil Seal Removal

(5) Install yoke, washers, and nut. Tighten nut (refer to Torque Specifications).

(6) Use a rawhide or lead mallet to drive front of output shaft through gears and out of case.

(7) With shaft removed, output shaft sliding gear can be lifted from front wheel drive fork. Fork can then be turned and shift rod fork bolt removed.

CLEANING AND INSPECTION

Wash the transfer case and all the components in solvent. Dry with compressed air. Clean all of the old gasket material and dirt from all gasket surfaces.

Inspect all thrust washers for scoring and excessive wear. Inspect all bearings and cups for pitting or scoring. Inspect the intermediate shaft for wear or other damage. Remove Arbor Tool W-280 from the intermediate gear. Remove and inspect bearing spacers and needle bearings. If the needle bearings are faulty, inspect the intermediate gear bore. Inspect all gears for chipped or broken teeth. If any of the above conditions are experienced, replace the parts involved.

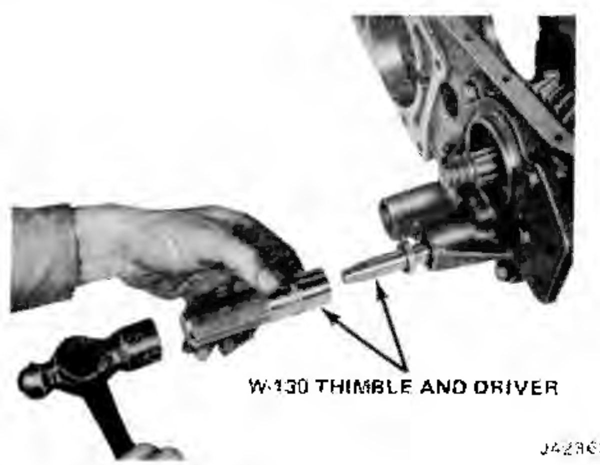

Fig. 8-13 Shift Rail Oil Seal Replacement

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TRANSFER CASE ASSEMBLY

NOTE: *Refer to figure 8-6 for parts relationship.*

(1) If removed, slide right shift rod partially into case. Place right shift fork on rod with bolt hole aligned with countersunk hole in rod. Install shift rod fork bolt. Tighten bolt (refer to Torque Specifications).

(2) Place right shift fork in proper position in case. Set front output shaft sliding gear in shift fork with slot in gear facing rear of case.

(3) Install rear cone and roller on front output shaft.

(4) Insert front output shaft gear and thrust washer in place and slide output shaft through both gears.

(5) Install front thrust washer.

(6) Install front cone and roller assembly on output shaft.

(7) Install front and rear bearing cups.

(8) Install shift rod housing gasket, housing, lockwashers, and bolts. Tighten bolts (refer to Torque Specifications).

(9) Install rear bearing cover shim set, cover plate, lockwashers, and bolts. Tighten bolts (refer to Torque specifications).

(10) Use a dial indicator to check output shaft bearing adjustment (fig. 8-14).

(a) Pry shaft to the extreme rear position.

(b) Set indicator to zero.

(c) Pry shaft forward and read indicator.

(d) Shaft end play should be 0.001 inch to 0.003 inch.

(e) End play can be adjusted by changing rear bearing cover shims. Shims are available in various thicknesses.

(11) Position right shift rod in neutral position to allow shift rod interlocks to enter detents in rod. Move interlocks into right shift rod.

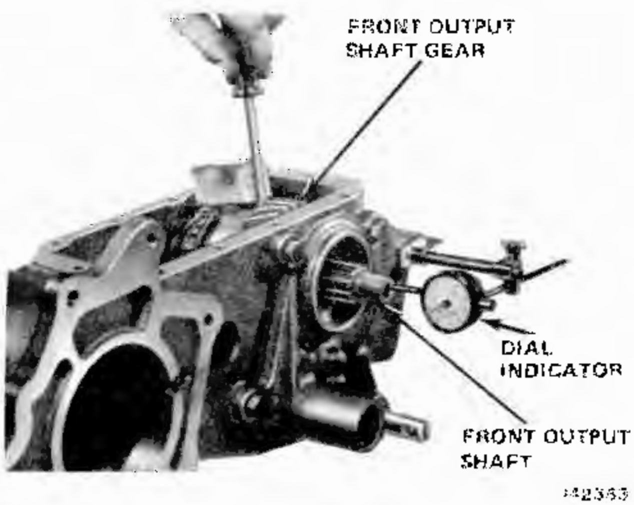

Fig. 8-14 Checking Output Shaft Bearing Adjustment

(12) Remove left shift rod detent cap plug.

(13) Insert detent spring and ball. Compress detent and start rod into case just far enough to retain ball. Position left rod so countersunk hole in rod is up, then rotate it 1/4 turn counterclockwise.

(14) Position and hold shift fork in case. Push shift rod through fork. Rotate shift rod 1/4 turn clockwise and align countersunk hole in rod with hole in shift fork. Install setscrew and tighten (refer to Torque Specifications).

(15) Assemble intermediate gear, rollers and spacers using Arbor Tool W-280.

(16) Place intermediate gear thrust washers in case with tangs aligned with grooves in case. The rear washer can be held in place by starting intermediate shaft into case. Hold front washer in position with heavy grease.

(17) Position intermediate gear in case. Using a soft-faced hammer, drive intermediate shaft into intermediate gear, forcing Arbor Tool W-280 out of front of case. Install intermediate shaft lock plate, lockwasher, and bolt. Tighten bolts (refer to Torque Specifications).

(18) Install rear bearing cap assembly using a new gasket. Tighten bolts (refer to Torque Specifications).

(19) Using new gasket, install lower cover. Tighten bolts (refer to Torque Specifications).

(20) Use Driver Tool W-143 to install front and rear yoke seals. Install oil seal gasket and felt oil seal.

(21) Install front and rear propeller shaft yokes. Tighten nuts (refer to Torque Specifications).

SHIFT CONTROL CASE

Disassembly (Cherokee and Truck)

(1) Remove control case from support tube.

(2) Remove retainer screws, retainer, and shift lever.

(3) Remove lower cover. Remove lock screw from pawl and remove 2WD-4WD High shift rod and pawl (fig. 8-15).

(4) Pry tension spring from notches in 4WD High and Low shift rod and remove rod.

(5) Remove two clips from torsion spring retainer rod and remove rod and spring.

Assembly

(1) Insert torsion spring, retaining rod and retainer clips.

(2) Install 4WD High and Low shift rod. Set tension spring in notches in rod.

(3) Position 2WD-4WD High shift pawl in case. Insert shift rod through pawl and install setscrew. Be sure holes are aligned to permit setscrew to bottom in rod.

(4) Install lower cover.

(5) Install case onto support tube and connect shift rods to transfer case rods.

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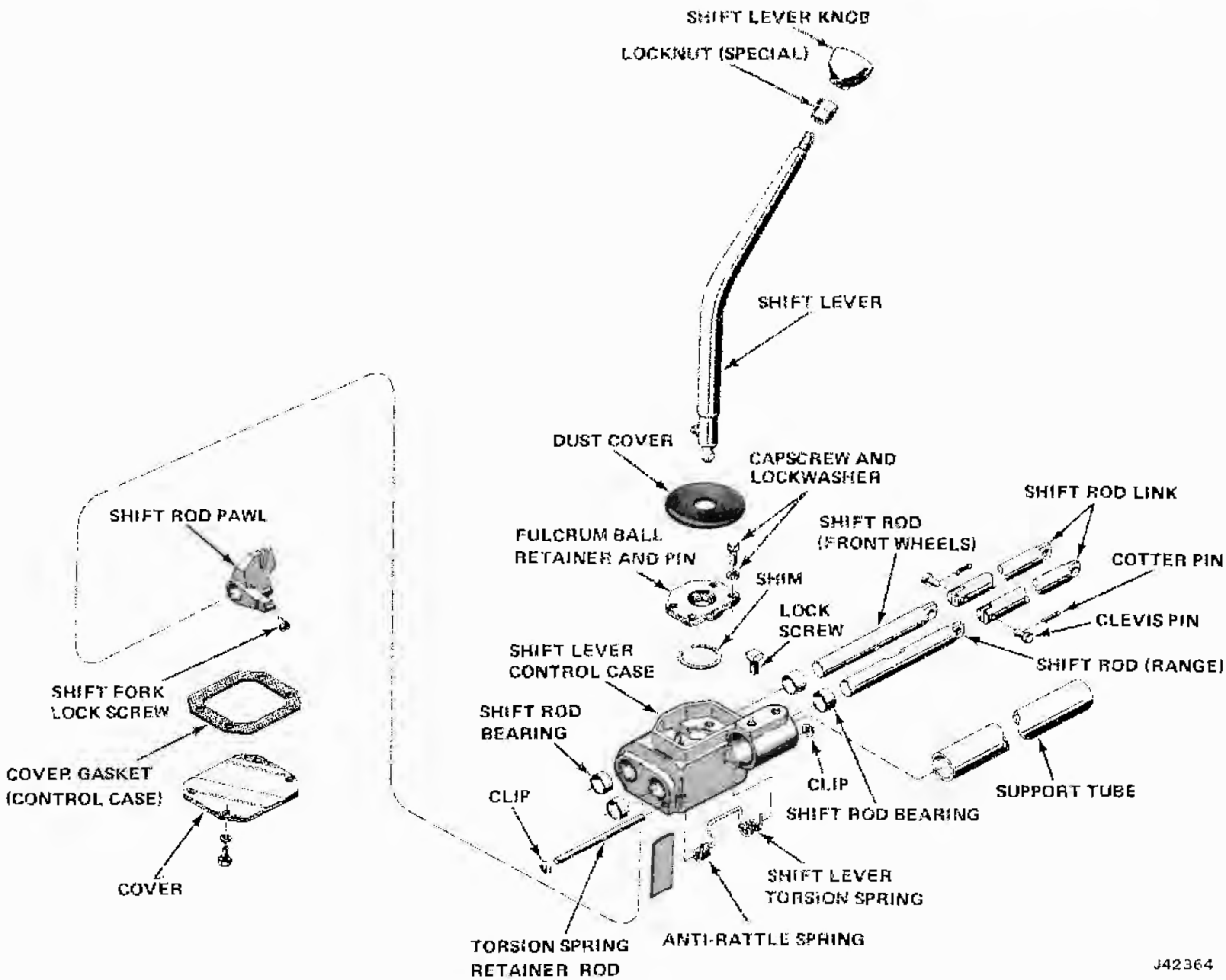

Fig. 8-15 Transfer Case Shift Control Lever - Cherokee and Truck

TRANSFER CASE SHIFT LINKAGE

Shifter rods from the shift control case or lever connect to the shifter rods of the transfer case either directly or through nonadjustable links. The lever assembly mounts in a support tube on the transfer case. Two square head capscrews secure the support tube to the transfer case, and another two square-head capscrews secure the lever assembly to the support tube. Holes are drilled in the support tube for the four capscrews so that mounting positions cannot be altered.

Removal

(1) Remove cotter pins and clevis pins or nuts that connect shifter rods of lever assembly to shifter rods of transmission or to links.

(2) Remove the square-head capscrews that secure shift lever assembly to support tube. Slide lever assembly from support tube.

Installation

(1) To install lever assembly, position both shifter rods in extreme forward detent position.

(2) Shift shift lever assembly to 4H (4WD High) position.

(3) Position shifter lever assembly on support tube, but do not install square-head capscrews.

(4) Connect shifter rods of shift lever assembly to shifter rods of transfer case, using clevis pins and cotter pins.

(5) Install square-head capscrews that secure shift lever assembly to support tube.

NOTE: *The transfer case shift linkage should be lubricated periodically.*

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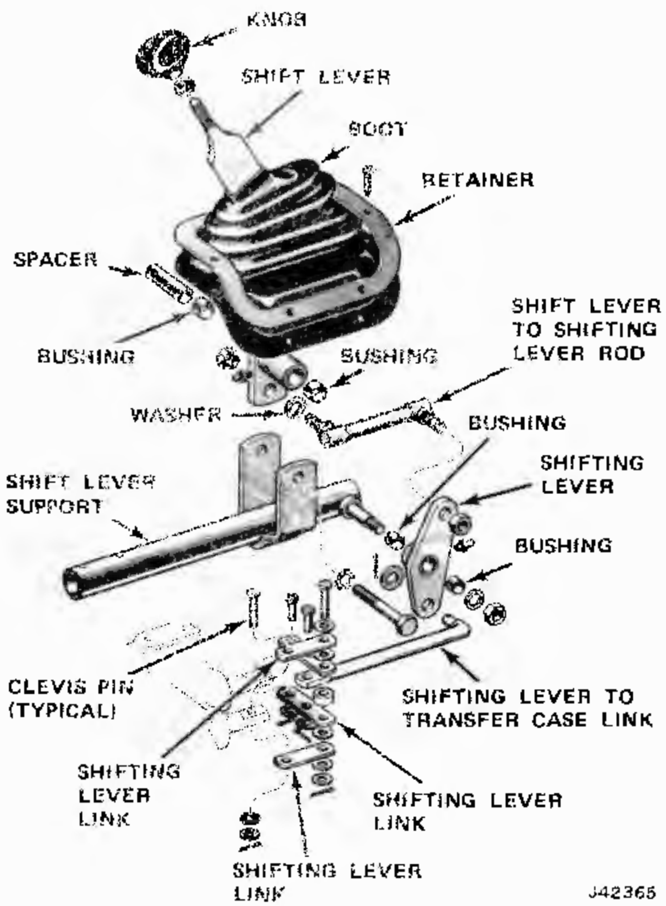

Fig. 8-16 Transfer Case Shift Control Lever CJ Models

TRANSFER CASE SPECIFICATIONS

Type	Four-Position
Make	Spicer
Model	20
Gear Ratio:	
High	1:1
Low	2.03:1
Two-Wheel Drive	1:1

J42366

TORQUE SPECIFICATIONS

Torque Specifications	Foot-Pounds
Front and Rear Output Shaft Yoke Nuts	225-250
Right and Left Shift Fork Setscrews	12-15
Shift Rod Housing to Case Bolts	28-30
Front Output Shaft Rear Bearing Cover to Case Bolts	28-32
Intermediate Shaft Lock Plate to Case Bolts	12-15
Rear Bearing Cap Assembly to Case Bolts	28-32
Lower Cover to Case Bolts	12-15
Transfer Case to Transmission Bolts	28-32

J42367

QUADRA-TRAC

GENERAL

The Quadra-Trac system provides full-time 4-wheel drive operation in all driving conditions. It is ideally suited for 4-wheel drive operation in normal, dry road conditions or in situations with mixed dry and slippery surface conditions. The big safety plus is that it provides 4-wheel drive tractive response at all times resulting in optimum handling under all highway conditions and under all off-road conditions. A controlled-type differential allows the front and rear axles to operate at their own speed, and smoothly delivers continuous power to all four wheels in the proper proportion to match the vehicle to the road surface in forward or reverse.

LOCKOUT DEVICE

A lockout device, which locks the front and rear wheel drives together resulting in undifferentiated 4-wheel drive, is provided for use under extreme situations - such as is sometimes encountered in rough terrain.

CAUTION: *In situations where you are attempting to move the vehicle out of a particular position, do not spin the wheels excessively unless Lockout device is engaged.*

Should loss of a front or rear propeller shaft assembly or front axle shaft failure occur, activation of the

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lockout device will permit 2-wheel drive operation until repair or replacement can be made. To engage the lockout device, slow the vehicle to under 5 mph and turn the control knob inside the glove box counterclockwise.

The Lockout reminder light in the instrument panel cluster will come on immediately after Lockout occurs, and will glow continuously until disengaged.

NOTE: *A slight delay may occur until front and rear axles become synchronized.*

To disengage the lockout device, turn the control knob clockwise. If the lockout light does not go off, back the vehicle in an S pattern for approximately 15 feet.

As the lockout device is infrequently used, it is recommended that the system be activated and deactivated at least once a month.

LOW RANGE - REDUCTION UNIT OPERATION

For operation under unusually severe on- or off-road conditions, the low gear reduction unit provides maximum braking and maximum torque at low speed.

To engage LOW RANGE drive:

- Take foot off accelerator.
- Come to a rolling stop - under 5 mph.
- Shift automatic transmission into neutral with vehicle moving.
- Pull firmly out on the LOW RANGE lever (located just below the instrument panel to the right of the steering column).

To disengage LOW RANGE Drive:

- Shift automatic transmission into neutral at low speed - under 5 mph.
- Push LOW RANGE lever in firmly.

If low Range Drive is infrequently used, it is recommended that it be engaged and exercised for at least five minutes each month.

REDUCTION UNIT SHIFT CABLE ADJUSTMENT

Clamp-Type Attachment

(1) Loosen nut which clamps cable to shift lever pivot. Be sure cable can move freely in pivot.

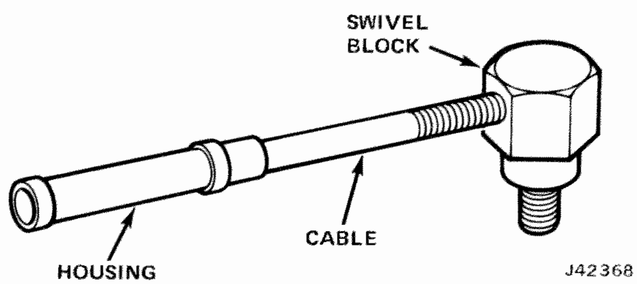

Fig. 8-17 Low Range Swivel Block

(2) Move reduction shift lever to most rearward detent position (Hi-Range position).

(3) Push LOW RANGE lever inward until lever stops.

(4) Push LOW RANGE lever inward until lever stops. Pull LOW RANGE lever out slightly; no more than 1/16 inch.

(5) Tighten cable clamp nut.

(6) Check operation of reduction unit.

Swivel-Type Attachment

(1) Remove swivel block from control lever.

(2) Move reduction unit control lever to most forward position.

(3) Thread swivel block in or out on cable end to obtain free fit in reduction unit control lever (fig. 8-17).

(4) Secure swivel block to control lever.

(5) Check operation of reduction unit.

STICK-SLIP CONDITION

When the clutch elements of the Quadra-Trac drive system stick, it is under a torque windup condition as in a conventional transfer case. Sudden release of the clutch under this condition results in a constant, pulsating, grunt-like or rasping noise. This is a low-frequency stick-slip noise that, if it occurs, is evident to the driver at slow speeds, such as when slowly turning a corner, or when maneuvering to park.

The stick-slip noise will not occur when the vehicle is driven in a straight-ahead position. If a noise similar to stick-slip, but much louder, occurs in the straight-ahead position, the chain should be inspected for excessive looseness.

Lubricant plays a major role in preventing stick-slip noise; therefore, detergent and heavy-duty (10W-30) type motors oils are not recommended. Vehicles experiencing stick-slip due to the usage of improper lubricants, may be corrected by completely draining the units, and refilling with the specified lubricants.

NOTE: *If a vehicle is not driven for a week or more, the stick-slip condition may occur when the vehicle is first driven. This is considered normal and should be of no concern, as the noise will disappear with continued driving.*

LUBRICATION

The Quadra-Trac transfer case does not require periodic or scheduled lubrication. However, should a stick-slip condition occur in the transfer case, a full eight fluid ounces of concentrate, Jeep Part Number 8123004, should be added (this applies to the Quadra-Trac transfer case with or without the reduction unit). It may be necessary to drain a slight amount (minimum) of lubricant at the transfer case drain plug to

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permit addition of the full amount of concentrate through the transfer case fill plug.

If the addition of the concentrate does not correct the stick-slip condition, the unit(s) should be drained and refilled.

After adding the lubricant or concentrate, the vehicle must be driven in a figure eight for 8 to 10 minutes with the steering one-half turn off the stops. This must be done to circulate the lubricant through the differential assembly in the Quadra-Trac unit.

Lube Change - Without Reduction Unit

Lubricant Blend:

- Concentrate, Jeep Part No. 8123004. Use eight ounces.
- SAE 30 (good quality) nondetergent motor oil (Ashland Valvoline preferred). Requirement is 3.5 pints (2.9 Imperial pints or 1.7 liters).

Remove fill plug and drain plug and allow the transfer case to drain completely. Replace drain plug. Install concentrate, then fill to fill-hole level with lubricant blend, as specified above. Replace fill plug (fig. 8-18).

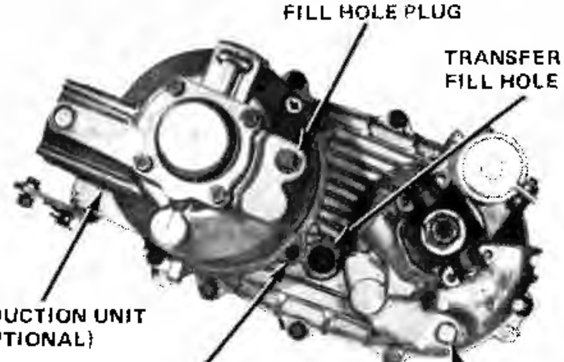

Fig. 8-18 Quadra-Trac Drain and Fill Plug Locations

Lube Change - With Reduction Unit

Use Lubricant Blend:

- Concentrate, Jeep Part No. 8123004. Use eight ounces.
- SAE 30 (good quality) nondetergent motor oil (Ashland Valvoline preferred). Requirement is 4.5 pints (3.7 Imperial pints or 2.1 liters).

(1) Remove fill plugs from transfer case and reduction unit.

(2) Remove transfer case drain plug. After it has drained completely, replace drain plug.

(3) Loosen five bolts on reduction unit housing (no drain plug), so that the unit can be pulled back far enough to permit the unit to drain. After it has drained completely, move the housing back into position and tighten bolts (refer to Torque Specifications).

First fill the reduction unit to fill-hole level with motor oil, as specified previously. Replace the fill plug. Next, fill the transfer case to fill-hole level with the specified lubricant blend. Replace fill plug (fig. 8-18).

CAUTION: *Fill plugs, drain plugs, and reduction housing bolts should not be overtightened. Torque values are 15 to 25 foot-pounds for the plugs and the 3/8-16 bolts. Torque for the 5/16-18 bolts is 10 to 20 foot-pounds.*

NOTE: *Overtightening may result in thread stripping or breakage of the aluminum unit(s).*

Torque Bias Check

(1) Be sure Quadra-Trac lockout is not engaged. The differential must be free to operate and not locked.

(2) Place transmission in P (Park).

(3) Lift and support vehicle in a manner which will allow front wheels to turn freely.

(4) Disconnect rear propeller shaft front universal joint from transfer case rear yoke.

(5) Use a socket and torque wrench to apply torque in tightening direction (clockwise) to transfer case rear yoke retaining nut. Differential cone clutches should slip when 110 to 270 foot-pounds of torque is applied.

NOTE: *Slippage with torques below 110 foot-pounds indicates the need for differential unit replacement. If the unit will not slip by applying 270 foot-pounds torque or less, improper lubricant may be the cause. Refer to Stick-Slip Condition and to Lubrication Change - With Reducton Unit in this Section. If addition of concentrate or changing lubricant does not correct the condition after reasonable mileage, the differential unit should be replaced.*

Drive Chain Tension Inspection

(1) Remove transfer case drain plug and drain lubricant. Install drain plug.

(2) Remove chain inspection plug.

(3) Thread Chain Tension Gauge, Tool Number W-363, into inspection hole until tool shoulders against case just finger-tight.

(4) The tool plunger should protrude past the outer end of the checking tool (fig. 8-19). If tool plunger is flush or below the end of the tool, the chain should be replaced.

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Fig. 8-19 Chain Tension Guage Installed

REDUCTION UNIT

Removal

(1) Lift and support vehicle.

(2) Loosen all bolts attaching reduction unit to transfer case cover (fig. 8-20).

(3) Move reduction unit rearward just far enough to allow oil to drain from unit.

(4) Loosen low range cable retaining bolt at shift control lever and remove the control cable.

(5) When oil has drained, remove bolts attaching reduction unit to transfer case cover.

(6) Move reduction unit rearward to clear transmission output shaft and pinion cage which is attached to transfer case drive sprocket.

NOTE: *The pinion cage should not be removed if the transfer case cover assembly is to be removed, but may be removed for inspection or replacement if the transfer case cover assembly is to remain in the vehicle. Pinion cage removal only involves removing the snap ring which secures the cage to the sprocket and sliding the cage rearward.*

An oil baffle, used only with reduction units, can be seen on the back of the transfer case cover. This baffle need not be removed except for replacement.

Installation

(1) If removed, place reduction oil baffle and tube assembly on rear of transfer case cover (fig. 8-21).

(2) If removed, install pinion cage onto transfer case drive sprocket splines.

(3) Install retaining snap ring. Be sure snap ring is seated completely in groove (fig. 8-22).

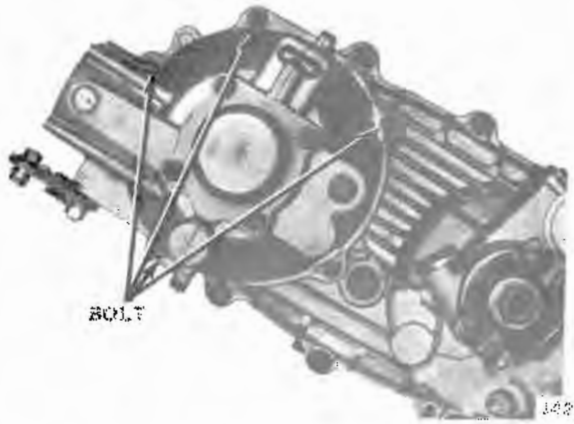

Fig. 8-20 Reduction Unit Attaching Bolts

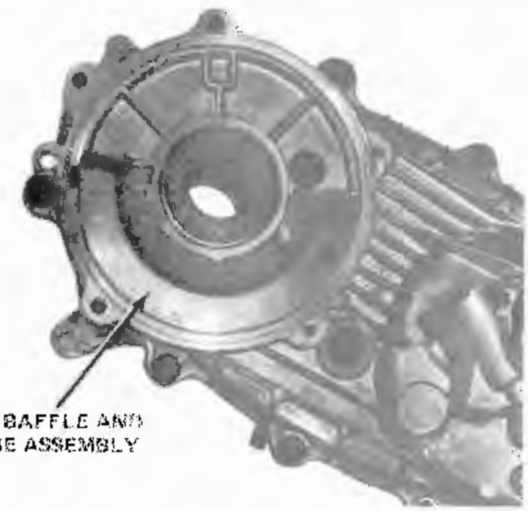

Fig 8-21 Reduction Oil Baffle and Tube Assembly Installed

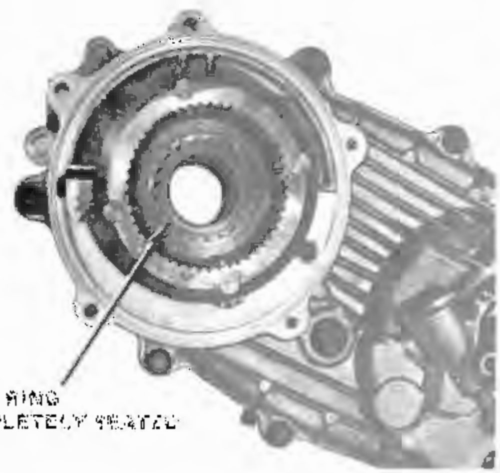

Fig 8-22 Reduction Pinion Cage Installed

(4) Clean sealing ring groove in transfer case cover and install sealing ring.

(5) Lift reduction unit and mesh caged pinions with sun gear and ring gear, and align sun gear inner splines with transmission output shaft splines.

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(6) Move reduction unit forward until it contacts sealing ring.

(7) Loosely install attaching screws. Alternately tighten screws to specified torque (refer to Torque Specifications).

(8) Connect and adjust shift control cable (refer to Control Cable Adjustment for procedure).

(9) Fill reduction unit and transfer case assembly with proper quantities and types of lubricants. Refer to Lubrication for quantity, type, and procedure.

Disassembly

(1) Remove power takeoff cover and gasket (fig. 8-23).

(2) Remove snap ring and spacer from rear end of reduction mainshaft (fig. 8-24).

(3) Remove reduction mainshaft and sun gear assembly by sliding it forward.

(4) Remove needle bearing (fig. 8-25).

(5) Grasp ring gear and remove ring gear, reduction collar plate, pinion cage lock plate, shift collar hub and reduction collar hub as an assembly (fig. 8-26).

(6) With a plastic hammer or soft mallet, tap shift collar hub from pinion cage lock plate (fig. 8-27).

(7) Remove pinion cage lock plate and needle bearing, ring gear, reduction collar plate, and shift collar hub, reduction collar hub, and needle bearing from shift collar hub.

NOTE: *If necessary, reduction collar plate hub and ring gear can be separated from reduction collar plate by removing snap rings.*

(8) Remove needle bearing and direct drive sleeve from reduction shift collar.

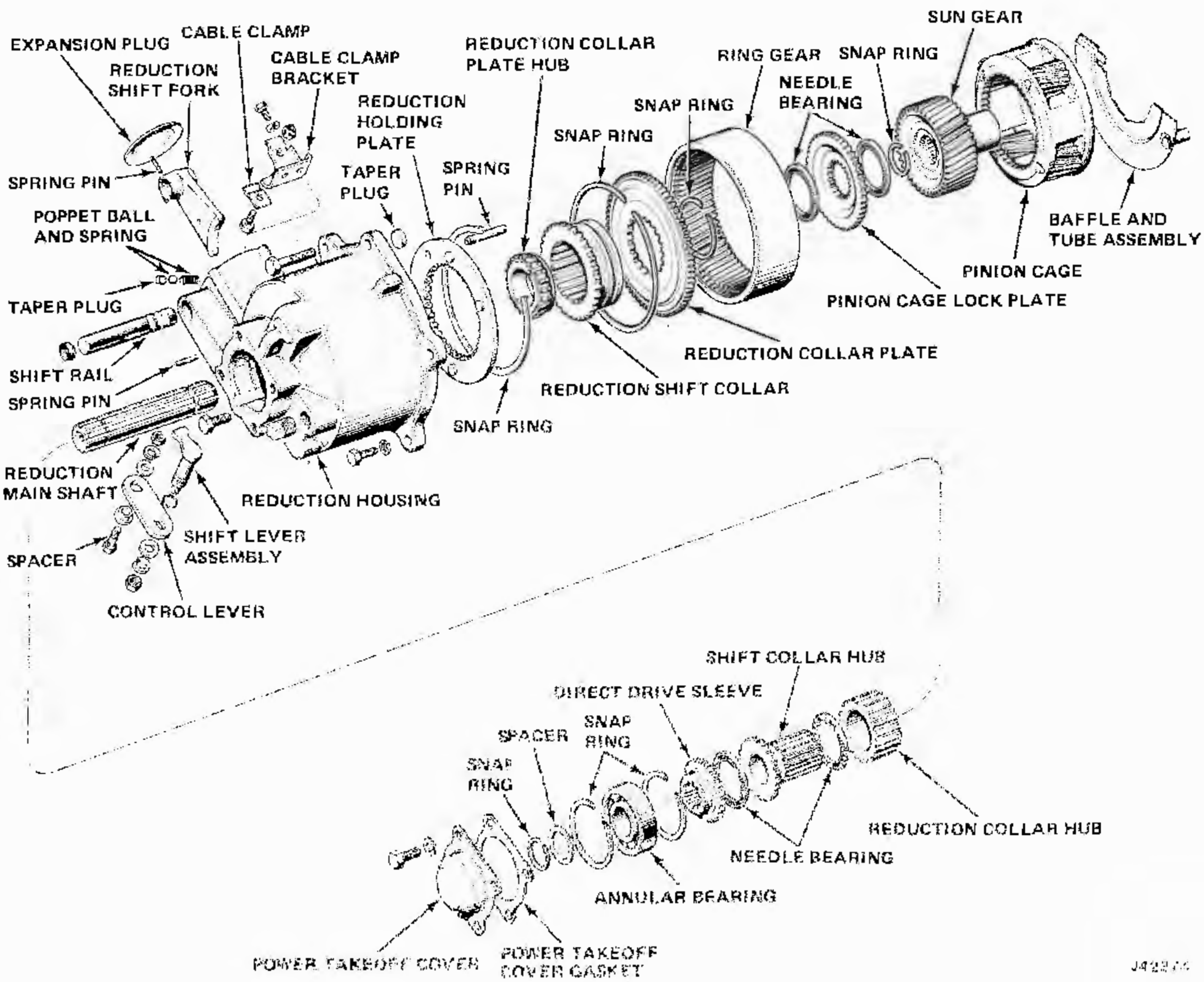

Fig. 8-23 Reduction Unit Components

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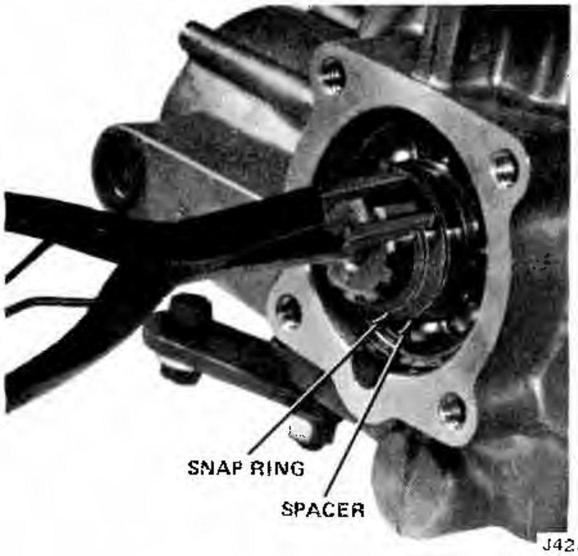

Fig. 8-24 Removing Snap Ring and Spacer

Fig. 8-25 Removing Mainshaft and Sun Gear Assembly

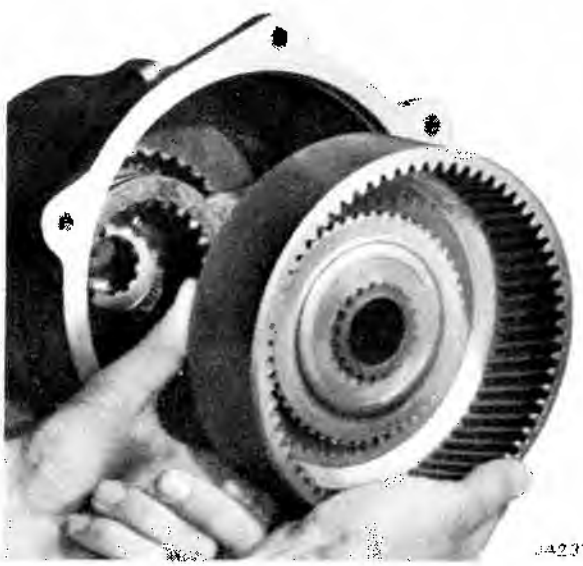

Fig. 8-26 Removing Ring Gear Assembly

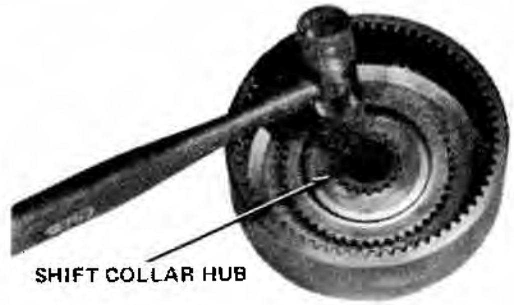

Fig. 8-27 Removing Shift Collar Hub

Shift Collar Removal

(1) Using control lever, shift collar to center or neutral detent.

(2) Move collar away from shift fork to disengage fork.

(3) Shift fork rearward to direct drive detent.

(4) Move collar toward fork to align outer teeth on collar with inner teeth in reduction holding plate.

(5) Shift fork and collar forward to reduction detent.

(6) Remove reduction shift collar.

Annular Bearing Replacement

(1) Remove rear snap ring and annular bearing (fig. 8-28). The rear snap ring is select-fit and available in thickness ranges of 0.086 to 0.088 inch, 0.089 to 0.091 inch, 0.092 to 0.094 inch, 0.095 to 0.097 inch, and 0.098 to 0.100 inch. The front snap ring should be 0.086 to 0.088 inch.

(2) Install front snap ring and bearing, then install thickest rear snap ring that will seat completely.

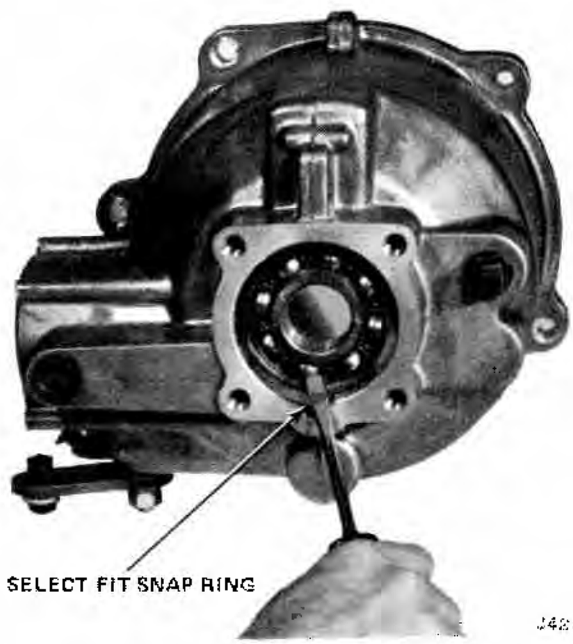

Fig. 8-28 Removing Rear Annular Bearing Snap Ring

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Reduction Housing Disassembly

(1) Remove shift fork locating spring pin by pulling and rotating with pliers (fig. 8-29).

(2) Remove large expansion plug.

(3) Remove shift rail taper plugs.

(4) Remove control lever from shift lever assembly.

(5) Use a 3/16-pin punch and drive spring pin from shift fork and shift rail (fig. 8-30).

(6) Slide shift rail forward out of shift fork. Remove shift fork.

(7) Remove shift rail poppet ball.

(8) Drive poppet taper plug into shift rail bore and remove plug and poppet spring.

(9) Remove shift lever retaining pin and shift lever assembly.

(10) Remove reduction holding plate retaining snap ring and reduction holding plate.

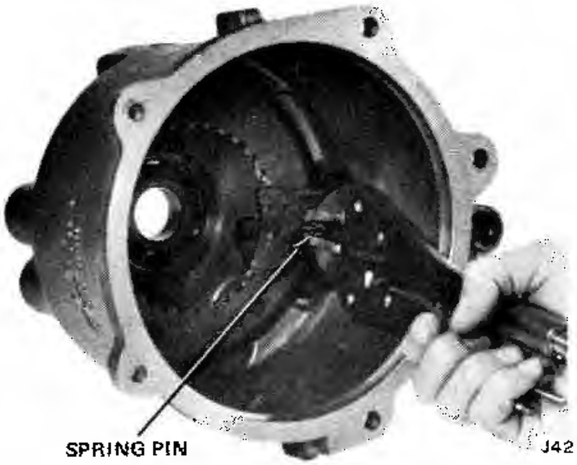

Fig. 8-29 Removing Shift Fork Locating Spring Pin

Fig. 8-30 Removing Spring Pin

Assembly

(1) Install reduction holding plate.

NOTE: *The locating pins should index in case, and shift fork locating spring pin holes in holding plate and housing must align (fig. 8-31).*

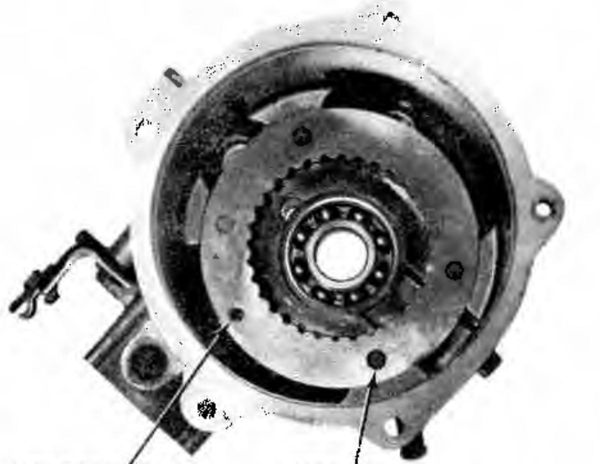

Fig. 8-31 Reduction Holding Plate Indexed Properly in Case

Fig. 8-32 Shift Lever O-Ring Installation

(2) Install holding plate retaining snap ring. Snap ring tabs should face forward. Be sure snap ring seats completely in groove and clears shift fork.

(3) Without an O-ring, insert shift lever assembly fully into housing with lever end facing rearward.

(4) Place O-ring seal in exposed groove in shift lever shaft (fig. 8-32).

(5) Move shift lever assembly inward just far enough to allow installation of shaft locating taper pin.

(6) Install taper pin.

(7) Insert shift rail, grooved end first, into shift rail rear bore in case.

(8) Rotate rail so flat side will be adjacent to poppet spring.

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(9) Slide rail far enough to allow shift fork to be meshed with shift lever assembly and on rail.

(10) Move rail through shift fork until end of rail is even with edge of poppet bore.

(11) Place poppet ball on end of spring.

(12) Use a spring pin as a tool to depress poppet ball (fig. 8-33).

Fig. 8-33 Installing Shift Rail and Poppet

(13) Slide shift rail over poppet ball as far as spring pin will allow.

(14) Remove spring pin and slide shift rail to first detent position.

(15) Rotate shift rail until flat side is facing shift lever assembly and spring pin bore is aligned with spring pin bore in shift fork.

(16) Slide shift fork on shift rail to align spring pin holes.

(17) Install spring pin flush with outside surface of shift fork (fig. 8-34).

(18) Install shift rail taper plugs, poppet bore taper plug and shift rail cover expansion plug.

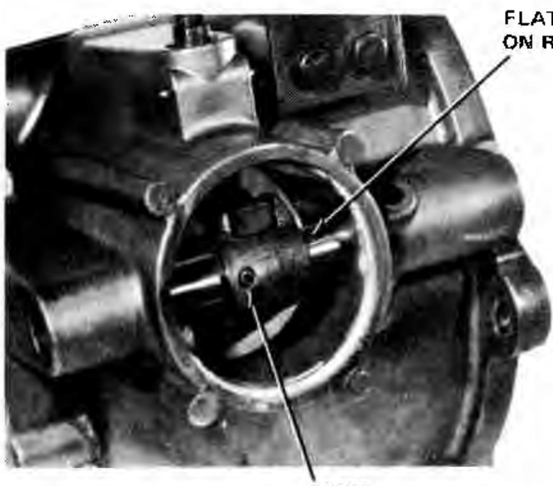

Fig. 8-34 Shift Rail

(19) Install shift fork locating spring pin.

(20) Install control lever.

(21) Install reduction shift collar as follows.

(a) Position shift fork in center (neutral) detent.

(b) Place reduction shift collar outer teeth in mesh with reduction holding plate inner teeth. The shift collar fork groove should be just forward of the shift fork.

(c) Shift fork to rear (direct drive) detent.

(d) Move shift collar away from fork and rearward until groove in collar aligns with fork.

(e) Move collar toward fork to engage collar groove with shift fork.

(22) Install direct drive sleeve into reduction shift collar.

(23) Needle bearing surface and pointed ends of outer teeth should be forward.

(24) Lubricate and install needle bearing against direct drive sleeve (fig. 8-35).

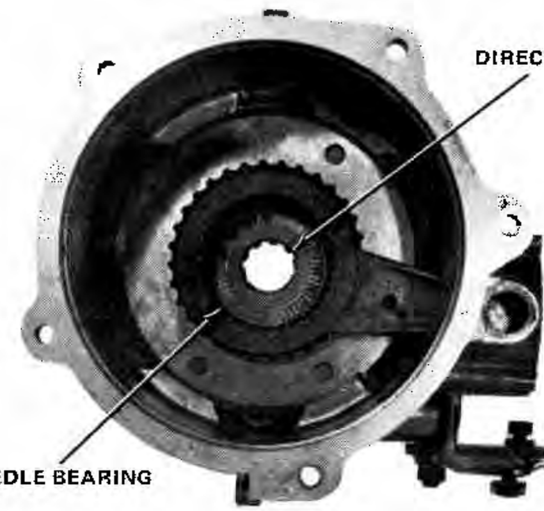

Fig. 8-35 Direct Drive Sleeve and Needle Bearing Installed

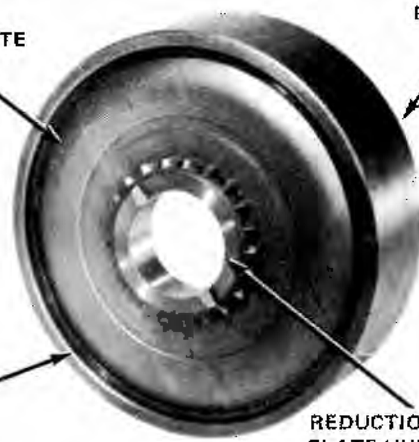

Fig. 8-36 Reduction Collar Plate

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(25) If separated, assemble reduction collar plate hub and ring gear to reduction collar plate as shown. Be sure snap rings seat completely in their grooves (fig. 8-36).

(26) Place needle bearing and reduction collar hub on shift collar hub (fig. 8-37).

(27) Place ring gear, reduction collar plate and hub assembly onto shift collar hub (fig. 8-38). No needle bearing is used between reduction collar plate hub and reduction collar hub.

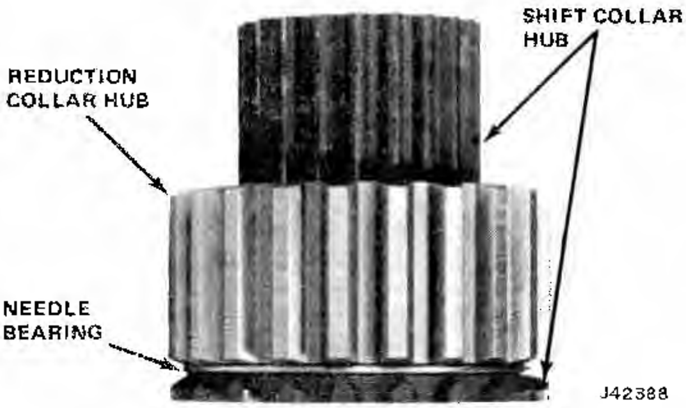

Fig. 8-37 Needle Bearing and Reduction Collar Hub Assembled with Shift Collar Hub

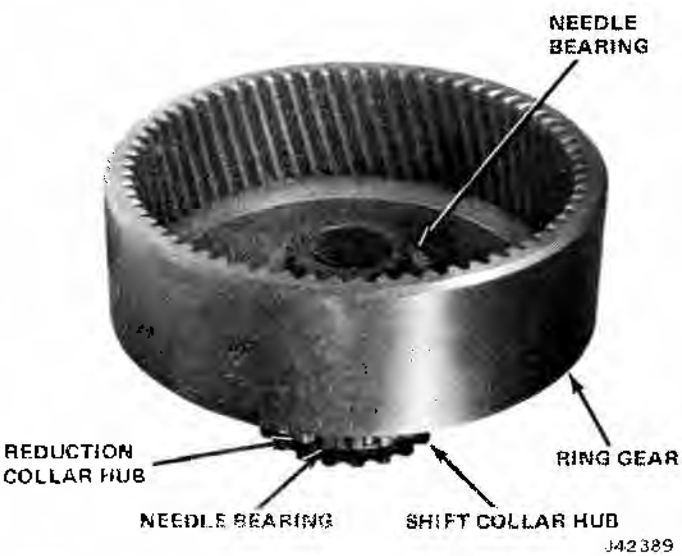

Fig. 8-38 Ring Gear

(28) Install a needle bearing onto shift collar hub and reduction collar plate hub.

(29) Install pinion cage lock plate onto shift collar hub.

NOTE: *The pinion cage lock plate should be tapped gently with a plastic hammer or soft mallet until the lock plate is snug against the needle bearing.*

(30) Place assembly into the housing.

NOTE: *It may be necessary to rotate ring gear or pinion cage lock plate to align various sets of splines.*

(31) Install needle bearing onto shift collar hub and pinion cage lock plate.

(32) Insert reduction mainshaft and sun gear assembly into shift collar hub and through direct drive sleeve and annular bearing (fig. 8-39).

NOTE: *Rotation of the sun gear may be necessary to align mainshaft splines with direct drive sleeve and annular bearing.*

Fig. 8-39 Installing Mainshaft and Sun Gear Assembly

(33) Using only a brass drift, gently tap the reduction mainshaft rearward as far as possible.

(34) Install rear spacer and snap ring. The snap ring is select-fit and is available in thickness ranges of 0.089 to 0.091 inch, 0.092 to 0.094 inch, 0.095 to 0.097 inch, 0.099 to 0.101 inch, and 0.103 to 0.105 inch. Install the thickest ring possible to provide 0.004 to 0.099 inch spacer clearance. Be sure snap ring fits securely in groove.

(35) Install power takeoff cover and gasket. Tighten cover attaching screws to specified torque.

TRANSFER CASE COVER

Removal

(1) Lift and support vehicle.

(2) If equipped with reduction unit, refer to Reduction Unit Removal for procedure.

NOTE: *The pinion cage will remain with the transfer case assembly.*

(3) Remove transfer case drain plug and allow unit to drain.

(4) Mark rear output shaft yoke and universal joint to provide alignment reference to be used during

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assembly. Disconnect rear propeller shaft front universal joint from transfer case rear yoke.

(5) Mark diaphragm control vacuum hoses for identification during assembly, then disconnect diaphragm control vacuum hoses, lockup indicator switch wire and speedometer cable. Remove indicator switch.

(6) Disconnect park brake cable guide from pivot on right frame side.

(7) Remove bolts which attach case cover assembly to case (front housing).

(8) Carefully slide cover assembly backward off front output shaft and transmission output shaft.

Disassembly

(1) Remove rear output shaft yoke.

(2) If not equipped with reduction, remove power takeoff cover from rear of transfer case cover. Remove sealing ring from transfer case cover (fig. 8-40).

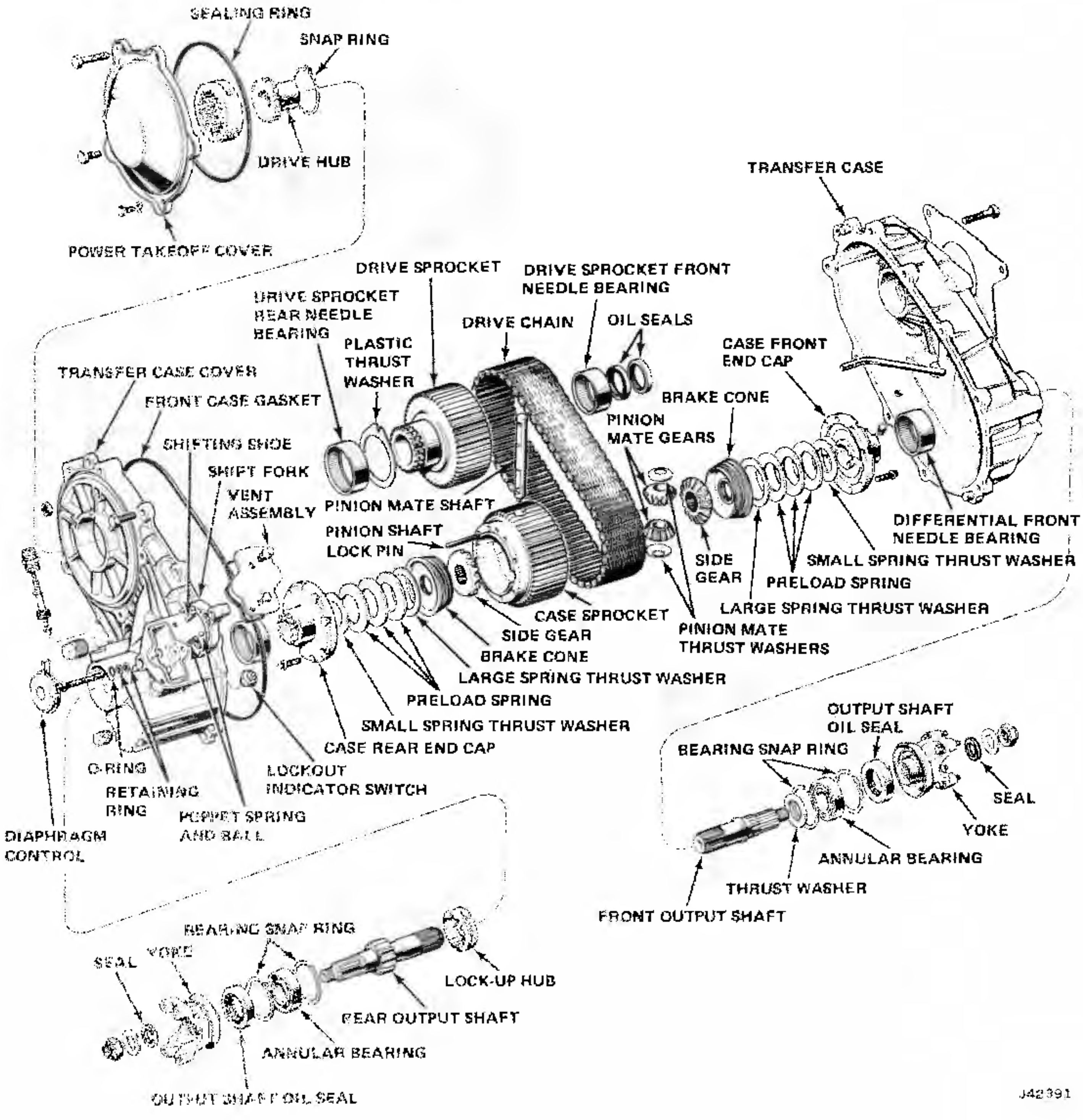

Fig. 8-40 Quadra-Trac Transfer Case Components

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(3) Using a piece of wood 2 by 4 by 6 inches long, position cover and sprocket (fig. 8-41).

(4) If not equipped with reduction unit, remove drive hub and sleeve from drive sprocket rear splines by expanding internal snap ring (the ring expanding tabs are accessible through a slot in the outside edge of the drive sleeve).

(5) If equipped with reduction unit, remove pinion cage snap ring and carrier.

(6) Lift case cover from drive sprocket and differential. The cover, rear output shaft, bearings and seal, drive sprocket rear needle bearing, and lockup hub may be serviced without disassembly of other units. Refer to appropriate headings in Subassembly Service for detailed procedures.

(7) Slide drive sprocket toward differential unit and remove chain.

NOTE: *The differential unit may be serviced without disassembly of other units. Refer to Differential Inspection for detailed procedures.*

Assembly

(1) Position drive sprocket on a piece of wood 2 by 4 by 6 inches long.

(2) Place differential assembly about 2 inches from drive sprocket and with front end of differential on bench (fig. 8-42).

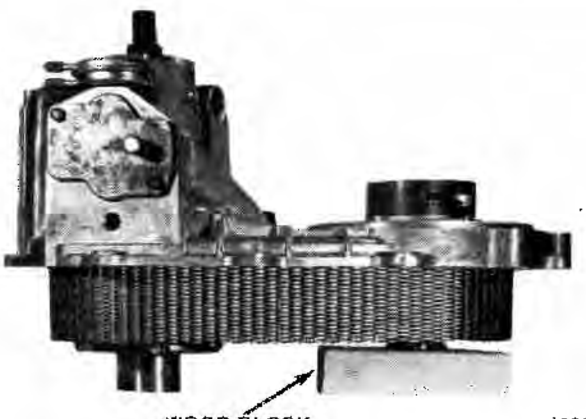

Fig. 8-41 Transfer Case Cover Positioned for Disassembly

Fig. 8-42 Differential and Drive Sprocket Positioned for Chain Installation

(3) Position drive chain around drive sprocket and differential assembly as shown (fig. 8-43).

NOTE: *Be sure chain is properly engaged with sprocket and differential teeth and that slack is removed from chain.*

(4) Insert rear output shaft into differential.

(5) Shift lockup hub rearward in case cover. Lubricate drive sprocket thrust washer and stick it in position on case cover (fig. 8-44).

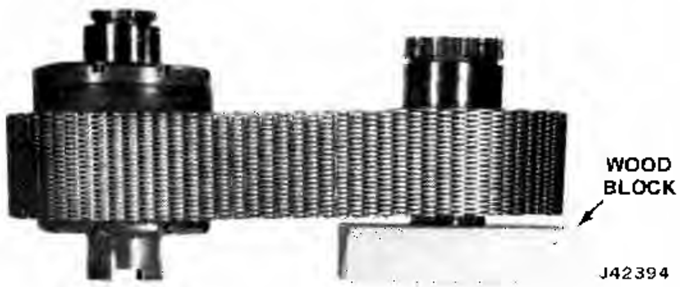

Fig. 8-43 Drive Chain Positioned Around Differential and Drive Sprocket

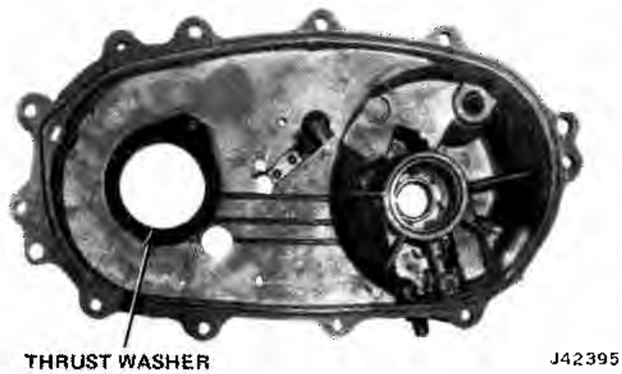

Fig. 8-44 Drive Sprocket Thrust Washer in Position on Case Cover

(6) Carefully align and position case cover onto drive sprocket and differential. Output shaft may require slight rotation to align with lockup hub. Be sure drive sprocket thrust washer does not become mispositioned.

(7) If equipped with reduction, install pinion cage onto drive sprocket rear splines. Be sure snap ring seats completely in groove.

(8) If not equipped with reduction unit, assemble drive hub, drive sleeve, and snap ring; then install onto drive sprocket rear splines. Be sure snap ring seats completely in groove.

(9) Rotate drive sleeve or pinion cage to be sure drive sprocket thrust washer did not become mispositioned. The unit should turn easily with no binding.

(10) If not equipped with reduction, install power takeoff sealing ring and cover. Tighten attaching screws (refer to Torque Specifications).

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(11) Install speedometer gear on rear output shaft (fig. 8-45).

(12) Use Seal Drive W-360 to install rear output shaft oil seal (fig. 8-46).

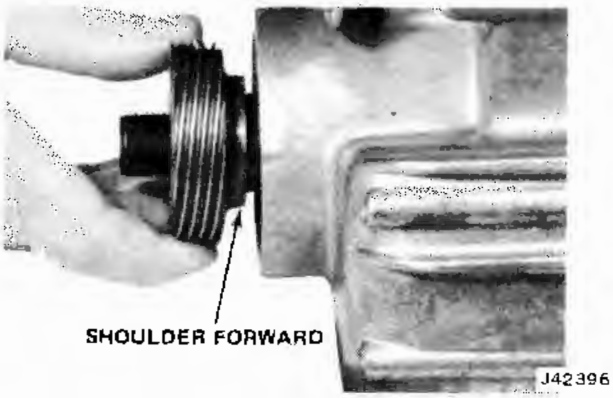

Fig. 8-45 Installing Speedometer Drive Gear

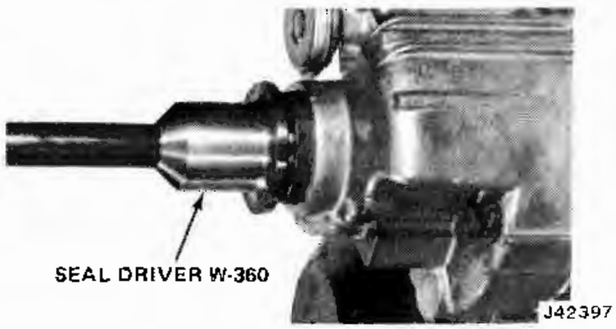

Fig. 8-46 Installing Rear Output Shaft Oil Seal

(13) Install rear yoke and nut. Tighten nut (refer to Torque Specifications).

Installation

(1) Clean oil seal groove and install seal ring.

(2) Install two 3/8-16 x 2 inch long pilot studs into transfer case (front housing).

(3) Insert oil tube into case bore at front output shaft bearing boss. Insert a 6-inch length of 5/16 inch drill rod into tube. Rod will be used as a pilot to align tube with case cover (fig. 8-47).

(4) Lift cover assembly and align tube pilot with hole in cover. Move assembly forward over pilot studs.

(5) Move cover assembly forward to mesh with front output shaft and transmission output shaft.

NOTE: *It may be necessary to slightly rotate the rear output shaft to allow two sets of splines to engage.*

(6) After cover assembly has been moved forward and evenly touches the case, remove pilot studs and install cover to case attaching bolts. Alternately and evenly tighten bolts (refer to Torque Specifications).

Fig. 8-47 Aligning Oil Tube for Cover Assembly Installation

(7) Install lockout indicator switch. Connect Lockout switch wire, diaphragm control vacuum hoses and speedometer cable.

(8) Connect rear propeller shaft front universal joint to rear output shaft. It may be necessary to lift rear wheels free of hoist to allow proper alignment for installation.

(9) Connect parking brake cable guide to pivot on right frame side.

(10) If equipped with reduction unit, install reduction unit and adjust cable. Refer to Reduction Unit Installation for procedure.

(11) Install proper amount of specified lubricant. Refer to Lubrication for quantity, type, and procedure.

(12) Lower vehicle.

TRANSFER CASE ASSEMBLY

Removal

Complete assembly removal is normally not required except when the front output shaft, front annular bearing, transmission output shaft seals or the transfer case (front housing) require service. For chain, drive sprocket, differential unit, diaphragm control system, needle bearing, thrust washer, or rear output shaft service, refer to Transfer Case Cover - Removal.

(1) Lift and support vehicle.

(2) Mark front and rear output shaft yokes and universal joints to provide alignment references to be

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used during assembly. Disconnect front propeller shaft rear universal joint from transfer case front yoke.

(3) Disconnect rear propeller shaft front universal joint from transfer case rear yoke.

(4) Remove bolts which attach exhaust pipe support bracket to transfer case.

(5) Mark diaphragm control vacuum hoses for identification during assembly, then disconnect diaphragm control vacuum hoses, lockout indicator switch wire, and speedometer cable.

(6) Disconnect park brake cable guide from pivot on right frame side.

(7) Remove two transfer case to transmission bolts which enter from front side. Install a 7/16-14 x 5 inch guide pin into upper hole.

(8) Remove two transfer case to transmission bolts which enter from the rear. Install a 7/16-14 x 5 inch guide pin into upper hole.

(9) Move transfer case assembly backward until unit is free of transmission output shaft and guide pins. Lower assembly from the vehicle.

(10) Remove all gasket material from rear of transmission.

Installation

(1) Position a new gasket onto rear of transmission.

(2) Install 7/16-14 x 5 inch guide pins in upper threaded holes in transmission adapter and transfer case.

(3) Lift transfer case assembly and move it forward to transmission. Drive hub splines must align with transmission output shaft. Slight rotation of transfer case rear output shaft yoke may be necessary.

NOTE: *Do not install any attaching bolts until transfer case assembly is positioned against transmission gasket.*

(4) Install rear and front attaching bolts. Tighten bolts (refer to Torque Specifications).

(5) Attach exhaust pipe support bracket to transfer case.

(6) Align and attach front propeller shaft.

(7) Connect lockout indicator switch wire and diaphragm control vacuum hoses. Connect park brake cable guide to pivot bracket on right frame side.

(8) Install proper amount of specified lubricant. Refer to Lubrication for quantity, type, and procedure.

(9) Lower vehicle.

Drive Sprocket Oil Seal Replacement

(1) Drive sprocket oil seals may be replaced without disassembling transfer case.

(2) Use a standard J-type puller or a smooth-ended pry bar to remove seals. Do not damage case bore.

(3) Install rear seal (lip to rear) by using Seal Installer W-358 and Sleeve W-358-1 as driver. Install seal until driver shoulder touches case front surface.

(4) Remove Sleeve W-358-1. Install front seal (lip forward) by using Seal Installer W-358 less Sleeve W-358-1. Install seal until driver shoulder touches case front surface (fig. 8-48).

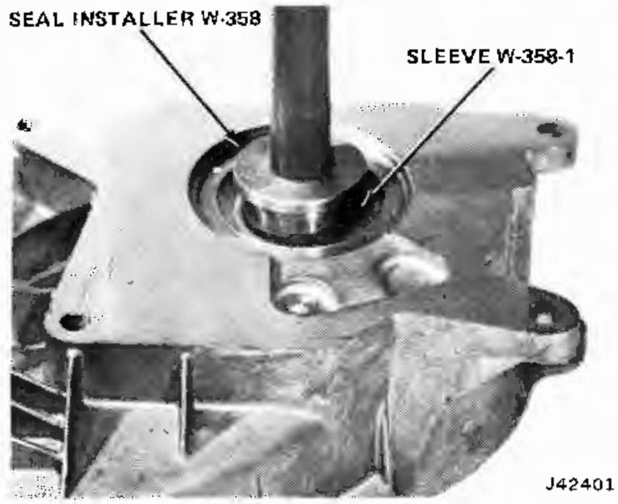

Fig. 8-48 Installing Drive Sprocket Front and Rear Oil Seals

Dissassembly

(1) Remove front and rear output shaft yokes.

(2) If not equipped with reduction unit, remove power takeoff cover from rear of transfer case cover.

(3) Remove sealing ring from transfer case cover.

(4) Remove screws retaining transfer case cover to transfer case. Slide case from the cover. This will leave chain, drive sprocket, differential unit and output shafts resting in case cover.

NOTE: *The case, front output shaft, bearings, and seals may be serviced at this time without disassembly of the chain, sprocket, differential, etc.*

(5) Using a piece of wood 2 by 4 by 6 inches long, position cover and sprocket (fig. 8-41).

(6) If not equipped with reduction unit, remove drive hub and sleeve from drive sprocket rear splines by expanding internal snap ring.

NOTE: *Ring expanding tabs are accessible through a slot in outside edge of drive sleeve.*

(7) If equipped with reduction unit, remove pinion cage from drive sprocket rear splines.

(8) Lift case cover from drive sprocket and differential. Cover rear output shaft, bearings and seal, drive sprocket rear needle bearing, and lockup hub may be serviced without disassembly of other units. Refer to Subassembly Service for detailed procedures.

(9) Slide drive sprocket toward differential unit and remove chain.

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NOTE: *Differential unit may be serviced without disassembly of other units. Refer to Differential Inspection for detailed procedures.*

Subassembly Service

Differential Inspection

The differential unit is a Belleville preloaded, unloading cone, limited-slip type. The unit is serviced only as an assembly; however, it may be disassembled for component inspection and cleaning purposes.

During disassembly, take care to ensure that the side gears, brake cones, preload springs, and thrust washers are identified and kept together as matched sets. The side gears, brake cones, preload springs, and thrust washers must be placed in their original order in the case sprocket during assembly.

Disassembly

(1) Use small paint marks on case sprocket and both end caps to identify rear end cap, front end cap, and proper orientation of both caps on case sprocket (fig. 8-49).

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Fig. 8-49 Case Sprocket and End Caps Identified for Orientation

(2) Remove screws which attach front end cap to case sprocket. Remove end cap.

NOTE: *It may be necessary to gently tap the end cap with a plastic hammer or soft mallet.*

(3) Remove thrust washers, preload springs, brake cone and side gear from case sprocket.

NOTE: *Keep these pieces together and identify them as a matched set.*

(4) Invert case sprocket and remove screws which attach rear end cap. Remove rear end cap from case sprocket.

NOTE: *It may be necessary to gently tap the end cap with a plastic hammer or soft mallet.*

(5) Remove thrust washers, preload springs, brake cone and side gear from case sprocket.

NOTE: *Keep these pieces together and identify them as a matched set.*

(6) Lift case sprocket from bench.

(7) Pinion shaft lockpin should fall out; however, it may be necessary to push pin out with a 1/4-inch pin punch.

(8) Use a brass drift and hammer to drive pinion mate shaft from case sprocket.

CAUTION: *Be careful not to damage pinion mate thrust washers.*

Cleaning

Clean all parts in petroleum solvent. Be sure that all metal contaminated lubricant is removed from all surfaces of every component. The side gears, brake cones, preload springs, and thrust washers must be maintained as matched sets.

Component Inspection

Case Sprocket

The tapered clutch surfaces and pinion gear thrust surfaces will be highly polished. Very small but smooth score marks and original machining marks are permissible; rough score marks or severe wear are not, and replacement is required.

The pinion mate shaft bores may be polished. The shaft should fit snugly in the bores.

The sprocket teeth will show a polished wear pattern. Measurable ridges and valleys across the teeth indicate excessive wear.

Pinion Mate Gears, Washers, and Shaft

The teeth should be free of chip marks but a rough machined look is normal. The thrust surfaces and shaft bores may be highly polished with some slightly tarnished spots. Galling or measurable wear is unacceptable.

The thrust washers should be smooth and should conform to their mating surfaces. Washer distortion or galling is unacceptable.

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The shaft should be straight and fit snugly into the case sprocket. A polished wear pattern will be noticed. Galling or shouldered-wear on the shaft is unacceptable.

Side Gears

The teeth should be free of chip marks but a rough machined look is normal. The thrust surfaces and shaft splines may be highly polished with some slightly tarnished spots. Galling or measurable wear is unacceptable.

Brake Cones

The spiral tapered braking surfaces will be highly polished. Very small but smooth score marks and original machining marks are permissible; rough score marks or severe wear are not, and replacement is required.

Preload Springs and Thrust Washers

The thrust washers should be flat and smooth. Light scratches and circular wear pattern are acceptable; severe wear, warping and galling are not, and replacement is required.

The preload springs should be dished approximately 3/4 inch and should be smooth. Light scratches and circular wear pattern are normal. Severe wear, warping, galling, and flatness indicate that replacement is required.

End Caps

The bearing and end thrust surfaces must be polished and smooth. Deep pitting, galling and scoring indicate that replacement is required.

Assembly

NOTE: *During assembly, all bearing and thrust surfaces must be prelubricated with Concentrate, part number 8123004.*

(1) Slide pinion mate shaft into case sprocket about three inches.

(2) Place pinion mate thrust washers and gears on shaft in proper order.

(3) Align pinion mate shaft lockpin hole with lockpin hole in case sprocket. Lightly drive pinion mate shaft into case sprocket until lockpin holes are exactly aligned.

NOTE: *This can be determined by looking through the lockpin hole in the case sprocket.*

(4) Slide pinion mate gears apart until gears are pressing washers against case sprocket (fig. 8-50).

(5) Mesh appropriate (front or rear) side gear into pinion mate gears.

(6) Position appropriate brake cone over gear and into case sprocket.

(7) Place large thrust washer on brake cone.

(8) Place preload springs against thrust washer with concave side of all springs facing brake cone.

(9) Lubricate small thrust washer and position it on appropriate end cap.

(10) Place end cap and thrust washer onto end of case sprocket.

NOTE: *Be sure cap is centered in preload springs and that cap is rotated to its original alignment on case sprocket.*

(11) Loosely install attaching screws. Alternately and evenly tighten all screws to 24 to 30 inch-pounds torque.

(12) Invert case sprocket and end cap.

(13) Install pinion shaft lockpin into case sprocket and through pinion mate shaft.

(14) Mesh remaining side gear into pinion mate gears.

(15) Position remaining brake cone over side gear and into case sprocket.

(16) Place large thrust washer on brake cone.

(17) Place preload springs against thrust washer with concave side of all washers facing brake cone.

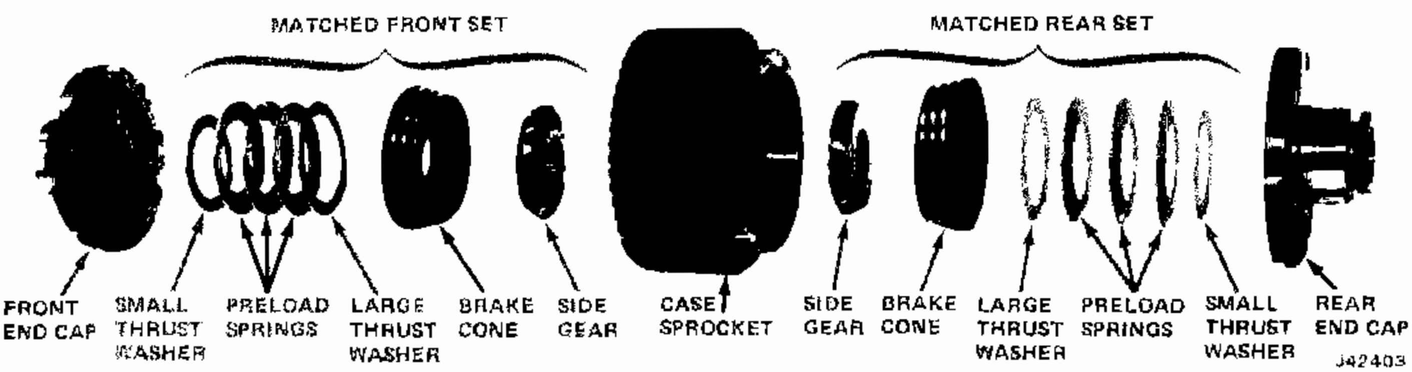

Fig. 8-50 Differential Unit Assembly Sequence

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(18) Lubricate remaining small thrust washer and position it on appropriate end cap.

(19) Place end cap and thrust washer onto end of case sprocket.

(20) Be sure cap is centered in preload springs and that cap is rotated to its original alignment on case sprocket. Loosely install attaching screws.

(21) Using front and rear output shafts as assembly tools, insert shafts into differential and rotate shafts until both have aligned and entered brake cone splines and side gear splines.

(22) Alternately and evenly tighten end cap attaching screws to 24 to 30 inch-pounds torque.

Bearing Replacement

Needle Bearings

On the differential front and rear needle bearings and drive sprocket front needle bearing, use Bearing Remover Tool W-356 for bearing removal (fig. 8-51).

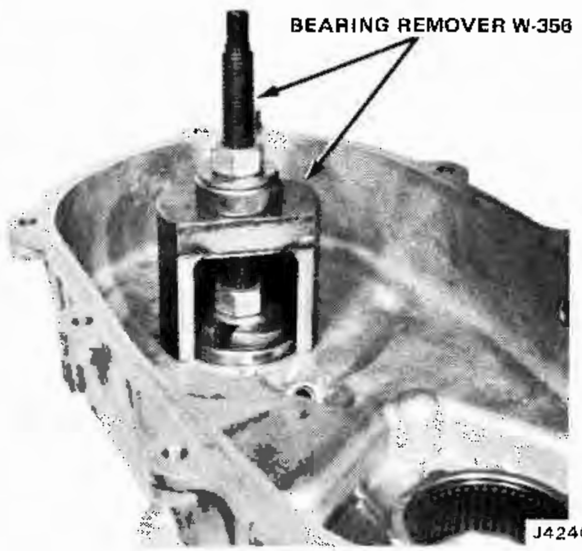

Fig. 8-51 Removing Differential Front or Rear Needle Bearing

Use Bearing Installer Tool W-357 less Pilot Adapter W-357-1 to install the differential front and rear needle bearings (fig. 8-52).

Use Bearing Installer Tool W-357 with Pilot Adapter W-357-1 inserted into the case bore to install the drive sprocket front needle bearing. The drive sprocket oil seals must be removed to allow the pilot adapter to enter the case bore (fig. 8-53).

The drive sprocket rear needle bearing may be removed using Bearing Remover and Installer Tool W-361 and Pilot W-361-1. The cover must be supported on the side opposite the driver when the bearing is being removed (fig. 8-54).

Use Bearing Driver Tool W-361 with Pilot W-361-1 inserted into the case bore to install the drive sprocket rear needle bearing. The cover must be supported on the side opposite the driver when the bearing is being installed (fig. 8-55).

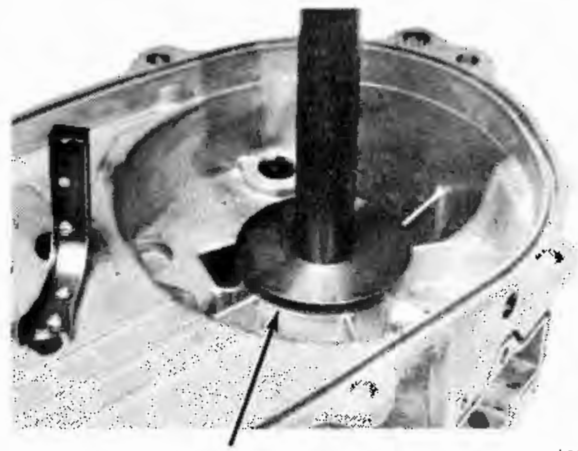

Fig. 8-52 Installing Differential Rear Needle Bearing

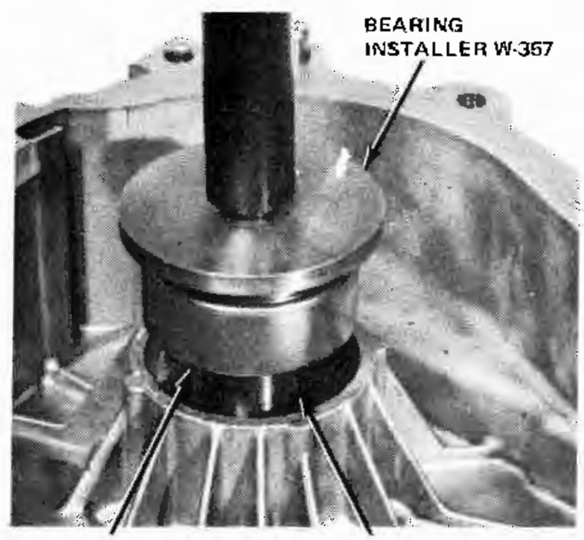

Fig. 8-53 Installing Drive Sprocket Front Needle Bearing

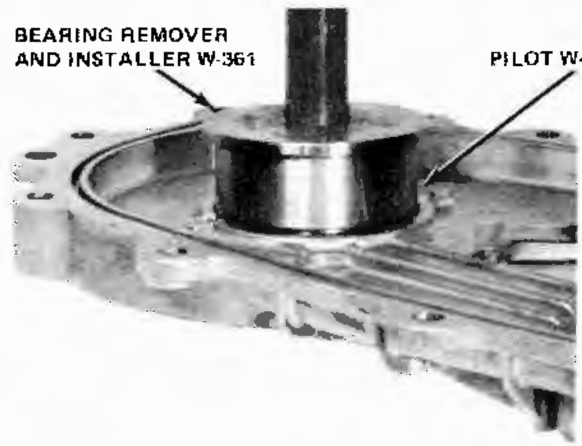

Fig. 8-54 Removing Drive Sprocket Rear Needle Bearing

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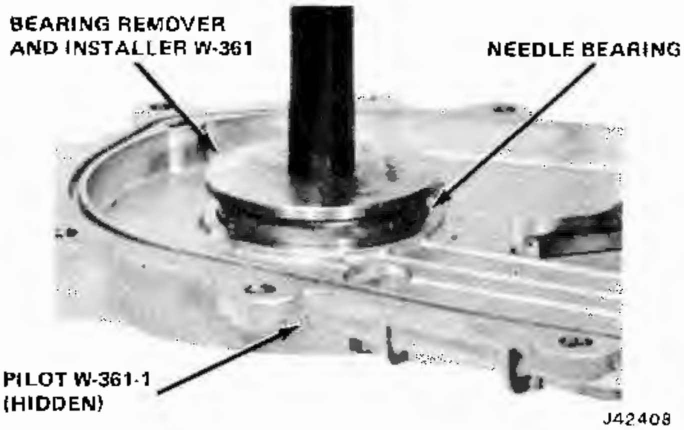

Fig. 8-55 Installing Drive Sprocket Rear Needle Bearing

Annular Bearings

The front and rear output shaft annular bearings are retained in the transfer case and case cover by snap rings. The outer snap ring for each bearing is select-fit and available in four thickness ranges: 0.060 to 0.063 inch, 0.064 to 0.066 inch, 0.067 to 0.069 inch, and 0.070 to 0.072 inch. The inner snap ring for the bearings should always be 0.060 to 0.063 inch thick.

(1) Remove output shaft yoke seal.

NOTE: *If rear bearing is being replaced, remove speedometer gear.*

(2) Remove outer snap ring.

(3) Annular bearing fits just snugly in bore and may be removed by hand. If bearing is tight or if bore is scratched, use a brass drift and tap bearing from bore. It will seldom be necessary to remove inner snap ring.

(4) If removed, install inner (0.060 to 0.063-inch) snap ring. Insert bearing - shielded side to inside - into bore and tap in to stop against inner snap ring. Use Snap Ring Groove Gauge Tool W-364 to determine snap ring thickness needed. Install thickest snap ring possible to provide 0.001 to 0.003 inch bearing end play.

Diaphragm Control, Shift Fork, and Lockup Hub

(1) Remove vent cover and sealing ring.

(2) Remove retaining rings which position shift fork on diaphragm control rod.

NOTE: *Shift fork may be gently pried forward or rearward to gain access to retaining rings.*

(3) Remove the spring. A magnet may be used.

CAUTION: *The diaphragm control rod is being held in position by a spring-loaded detent ball.*

(4) Insert magnet into opening prior to removing diaphragm control (fig. 8-56).

(5) Pull diaphragm control from case cover.

(6) Remove detent ball and spring.

(7) Remove shift fork and plastic shifting shoes.

(8) Remove lockup hub.

(9) Lubricate and position shifting shoes in shift fork. Place lockup hub into shift fork (fig. 8-57).

Fig. 8-56 Removing Diaphragm Control

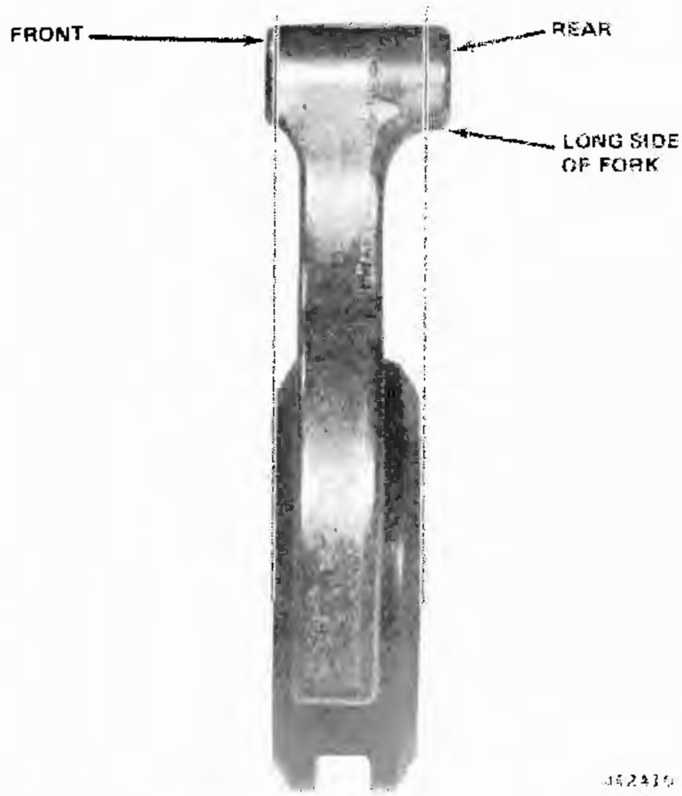

Fig. 8-57 Lockup Hub Assembly with Shift Fork

(10) With long side of fork to rear, insert fork and hub assembly into case cover.

NOTE: *Reach through differential needle bearing to keep lockup hub from separating from shift fork.*

(11) Slide diaphragm control rod into case cover, through shift fork but not past detent ball hole.

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(12) Deposit detent spring and ball into hole. Use a 1/4-inch pin punch to depress detent ball and slide diaphragm control rod past ball.

(13) Install shift fork retaining clips.

(14) Install the diaphgram control retaining spring. The spring should go into hole deeper than flush. Install vent cover sealing ring and vent cover.

Assembly

NOTE: *During assembly, all bearing and thrust surfaces must be prelubricated with Concentrate, part number 8123004.*

(1) Position drive sprocket on a block of wood 2 by 4 by 6 inches long (fig. 8-42).

(2) Place differential assembly about 2 inches from drive sprocket and with front end of differential on bench.

(3) Position drive chain around drive sprocket and differential assembly as shown.

(4) Be sure chain is properly engaged with sprocket and differential teeth and that slack is removed from chain (fig. 8-43).

(5) Insert rear output shaft into differential.

(6) Shift lockup hub rearward in case cover. Lubricate drive sprocket thrust washer and place it in position on case cover (fig. 8-44).

(7) Carefully align and position case cover onto drive sprocket and differential. Output shaft may require slight rotation to align with lockup hub. Be sure drive sprocket thrust washer does not become mispositioned.

(8) If disassembled, assemble drive hub, drive sleeve, and snap ring (fig. 8-58).

Fig. 8-58 Drive Hub and Sleeve Installed

(9) If not equipped with reduction unit, install drive sleeve and hub onto drive sprocket. Be sure snap ring seats completely.

(10) If equipped with reduction unit, be sure oil baffle is in position, then install pinion cage and snap ring.

(11) Tip case cover assembly to position as shown. Insert front output shaft, output shaft thrust washer and front case gasket.

(12) Insert oil tube into case bore at front output shaft bearing boss. Insert a 6-inch length of 5/16-inch drill rod into tube. Rod will be used as pilot to align tube with case cover (fig. 8-59).

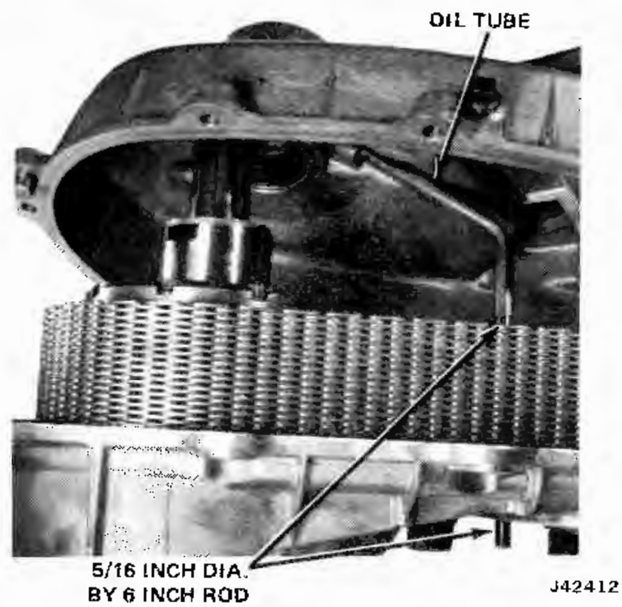

Fig. 8-59 Aligning Oil Tube for Case Installation to Cover Assembly

(13) Carefully align and install case onto differential and drive sprocket. Loosely install case-to-cover attaching screws. Alternately and evenly tighten screws (refer to Torque Specifications).

NOTE: *Do not exceed the maximum specified torque.*

(14) Rotate drive sleeve to be sure drive sprocket thrust washer did not become mispositioned. The sleeve should turn easily with no binding.

(15) Install power takeoff sealing ring and cover.

(16) Install speedometer gear on rear output shaft (fig. 8-45).

(17) Use Seal Driver W-360 to install rear output shaft oil seal (fig. 8-46).

(18) Install rear yoke and nut. Tighten nut (refer to Torque Specifications).

(19) Use Seal Driver W-360 to install front output shaft oil seal.

(20) Install front yoke and nut. Tighten nut (refer to Torque Specifications).

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SPECIFICATIONS

Type	Automatically differentiated constant 4-Wheel drive
Make	Warner Gear
Model	Quadra-Trac
Gear Ratio:	
High	1:1
Low (with Reduction Unit)	2.57:1

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TORQUE SPECIFICATIONS

Transfer Case	Foot-Pounds
Breather	6-10
Chain Measuring Access Hole Plug	6-14
Drain Plug	15-25
Fill Plug	15-25
Lock-Out Cover to Transfer Case	8-10
Lock-Out Indicator Switch	10-15
Output Shaft Nut	90-150

	Foot-Pounds
Power Takeoff Cover to Transfer Case Bolt:	
3/8 - 16	15-25
5/16 - 18	10-20
Speedometer Adapter	20-30
Transfer Case Cover to Transfer Case	15-25
Differential End Capscrews	24-30
Transfer Case to Transmission Extension Bolt	30-50
Reduction Unit	
Cable Housing Clamp Nut	7-12
Fill Plug	15-25
Shift Lever Cable Clamp Nut	10-20
Shift Lever to Shaft Nut	15-25
Reduction Power Takeoff Cover to Case	15-25
Reduction Unit to Transfer Case Bolt:	
3/8 - 16	15-25
5/16 - 18	8-10

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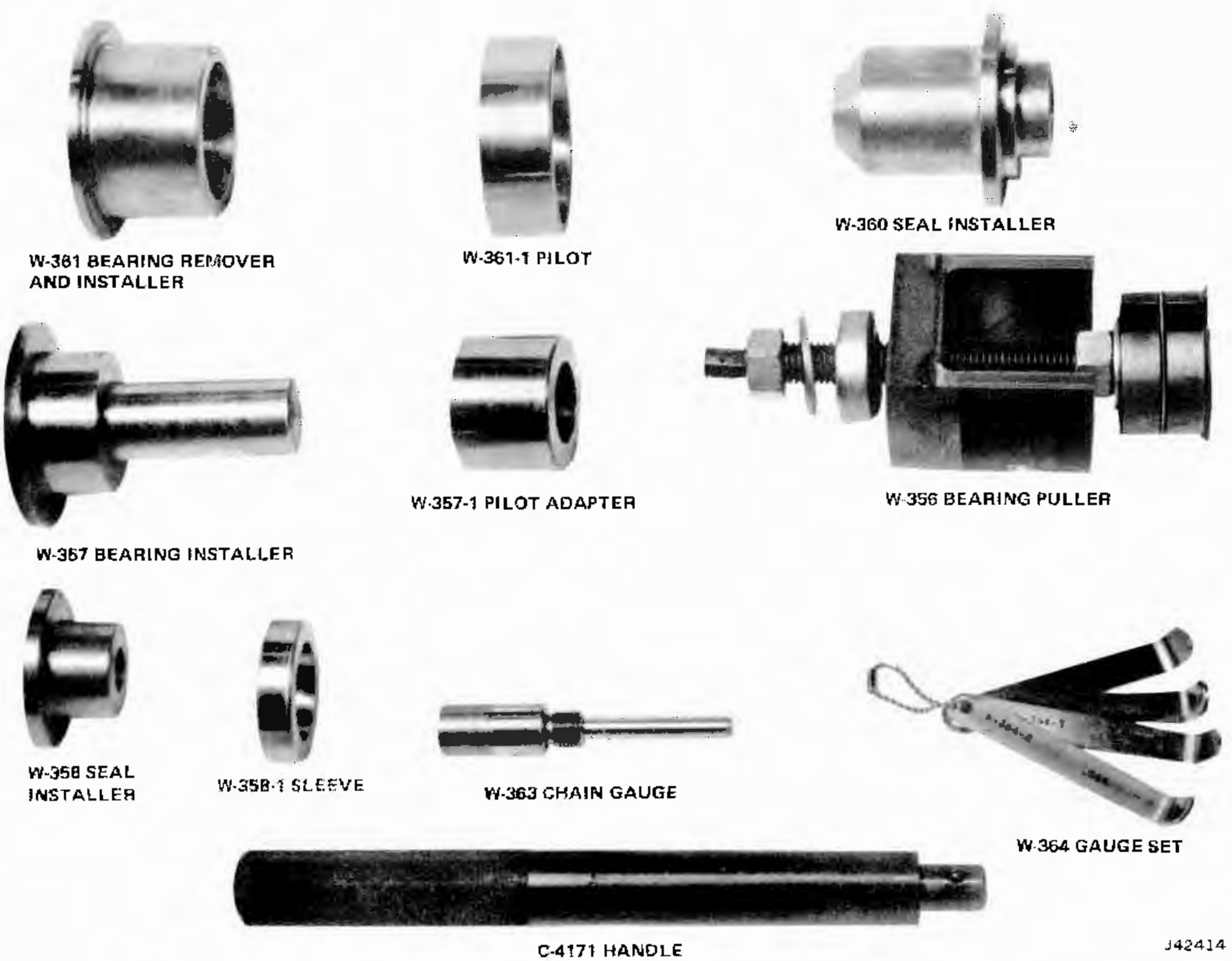

Fig. 8-60 Tools (Sheet 1 of 2)

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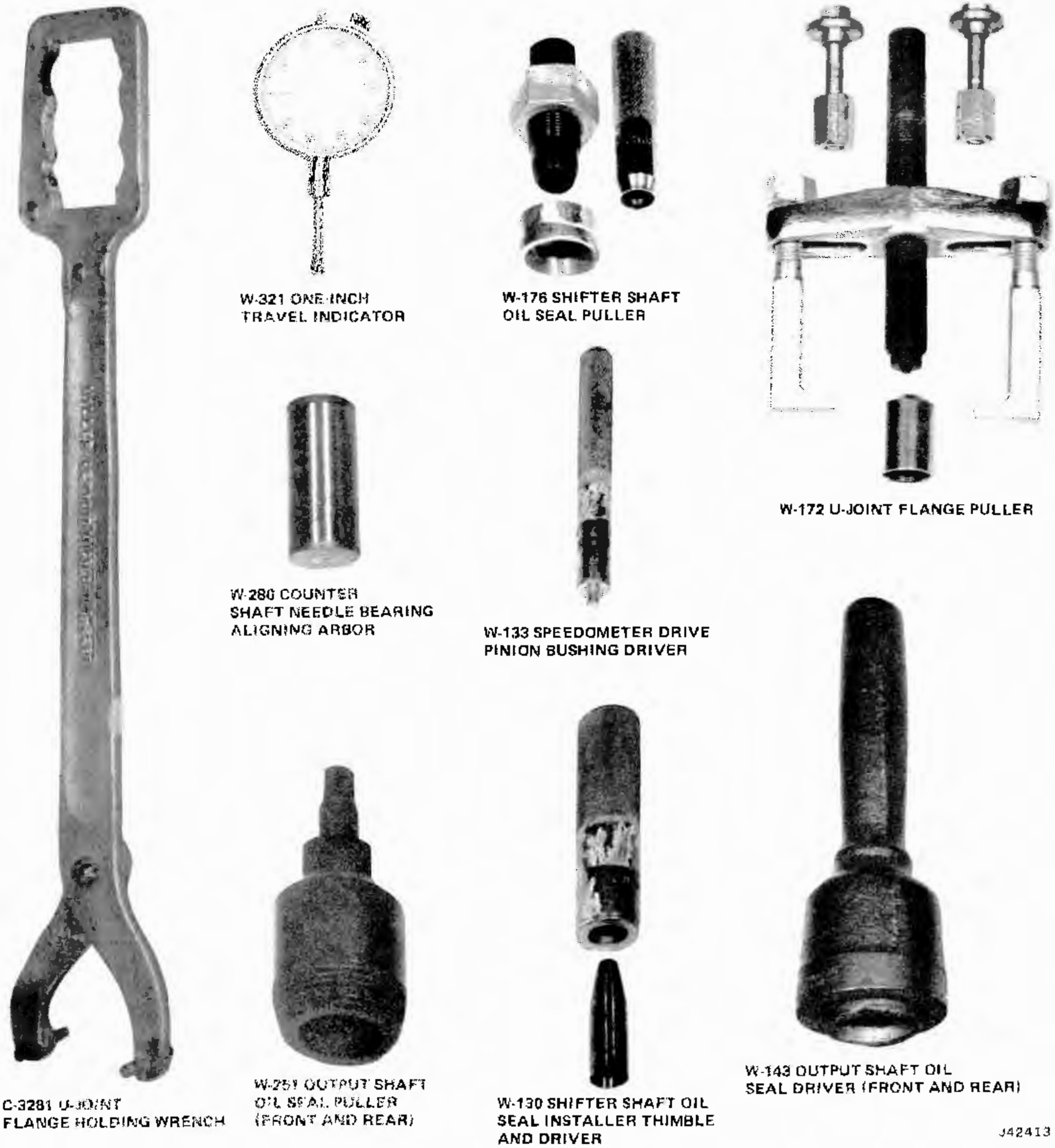

Fig. 8-60 Tools (Sheet 2 of 2)

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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BRAKES AND WHEELS

BRAKE DIAGNOSIS CHARTS

In most instances, the customer will describe the difficulty as one or more of the conditions listed in the Brake Diagnosis Chart. Road test the vehicle with the customer to confirm the difficulty and obtain additional information.

Vibration Diagnosis

Vibrations can be divided into two categories: mechanical and audible. Mechanical vibrations are those which are felt through seats, floorpan, or steering wheel or which may also be visible and sensed by fender, mirror, or dash panel motion. Audible vibrations are heard above normal background noise and may or may not be accompanied by a mechanical vibration.

Mechanical and audible vibrations are torque sensitive, vehicle speed sensitive, or engine speed sensitive:

Torque Sensitive means that the condition can be made better or worse when accelerating, decelerating, coasting, or maintaining a steady speed.

Vehicle Speed Sensitive vibrations occur at the same speed regardless of which transmission gear is selected or how much torque is applied.

Engine Speed Sensitive vibrations occur at different car speeds when a different transmission gear is selected, and can sometimes be isolated by increasing or decreasing engine speed with the transmission in neutral or by stall-testing with the transmission in gear.

Road Test

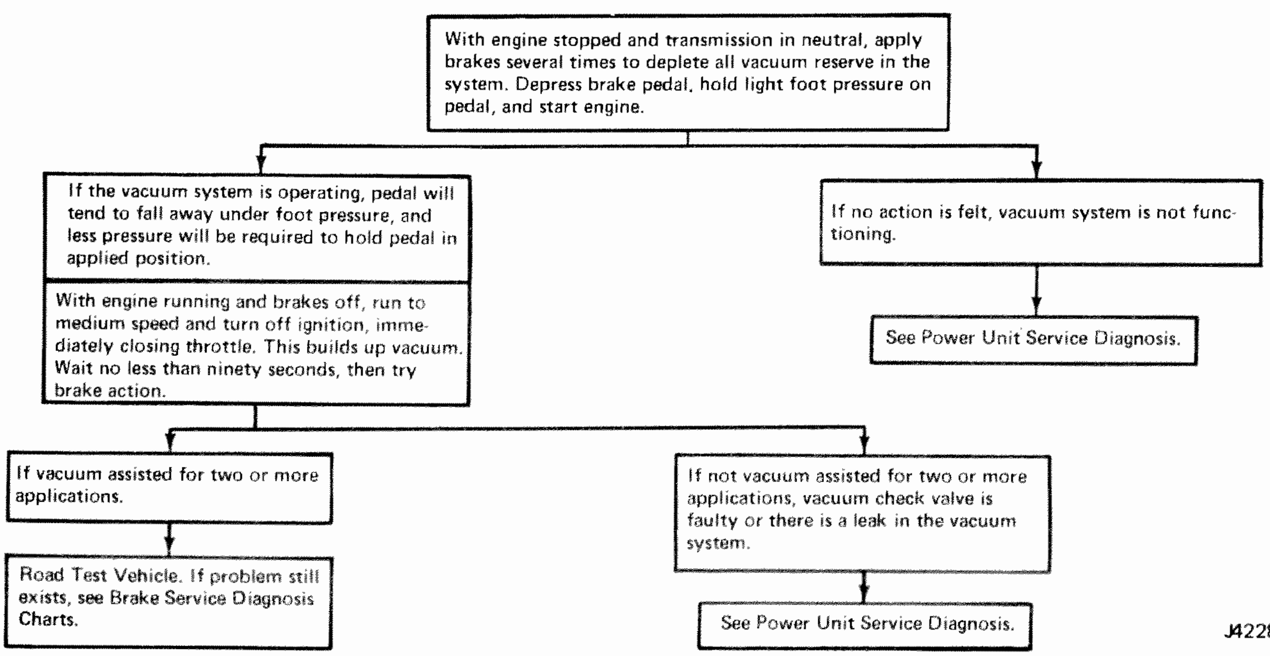
Road test vehicle on a smooth road. If vibration is apparent:

(1) Determine speed ranges at which disturbance occurs.

(2) At each speed range, determine whether vibration is mechanical or audible.

(3) At each speed range, determine whether vibration is torque sensitive, speed sensitive, or engine speed sensitive.

POWER BRAKE DIAGNOSIS PROCEDURE



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POWER UNIT SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
HARD PEDAL (NO BOOST)	(1) Refer to EXCESSIVE PEDAL EFFORT.	(1) Refer to EXCESSIVE PEDAL EFFORT.
	(2) Loss of vacuum to booster.	(2) Check for loose hose or check valve seal. Check for collapsed or damaged hose. Inspect vacuum check valve for damage or leak. Replace parts as required.
	(3) Internal malfunction in booster.	(3) Replace booster.
SLOW RETURN OF BRAKE PEDAL	(1) Pedal linkage bind. See PULLS and GRABBING BRAKES in Drum or Disc Brake Service Diagnosis Chart.	(1) Check and correct as required. Lube all pivot points.
	(2) Internal malfunction in booster.	(2) Replace booster.
GRABBING OR DRAGGING BRAKES	(1) Refer to PULLS and GRABBING BRAKES in Brake Service Diagnosis Charts.	(1) See PULLS and GRABBING BRAKES in Brake Service Diagnosis Charts.
	(2) Push rod (in power unit) binding due to corrosion or burrs on push rod.	(2) Check and correct as required. Do not lube push rod. Clean push rod with brake fluid and clean cloth only.
	(3) Incorrect push rod height (CJ model power unit only)	(3) Check and adjust as required.
	(4) Internal malfunction in booster.	(4) Replace booster.

DRUM BRAKES SERVICE DIAGNOSIS — ALL MODELS

Condition	Possible Cause	Correction
LOW PEDAL OR PEDAL GOES TO TOE BOARD	(1) Low fluid level.	(1) Fill reservoir with approved brake fluid.
	(2) Excessive clearance between lining and drums.	(2) Adjust brakes.
	(3) Automatic adjusters not working.	(3) Make forward and reverse stops; if pedal stays low, repair faulty adjusters.
	(4) Leaking brake lines.	(4) Repair or replace faulty parts.
	(5) Leaking wheel cylinders.	(5) Overhaul wheel cylinder.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
LOW PEDAL OR PEDAL GOES TO TOEBOARD (Continued)	(6) Leaking master cylinder.	(6) Overhaul master cylinder.
	(7) Air in system.	(7) Bleed system.
	(8) Power unit push rod improperly adjusted (CJ models only)	(8) Adjust push rod height.
	(9) Plugged master cylinder filler cap.	(9) Clean filler cap vent holes; bleed system.
	(10) Drums thin, cracked, beyond 0.060 inch oversize specification.	(10) Replace drum(s) as required.
	(11) Improper brake fluid.	(11) Flush system and refill with approved fluid.
SPRINGY, SPONGY PEDAL	(1) Air trapped in hydraulic system.	(1) Remove air by bleeding.
	(2) Improper brake fluid.	(2) Flush and bleed system; use approved brake fluid.
	(3) Improper lining thickness or location.	(3) Install new lining or replace shoe and lining.
	(4) Drums worn too thin, (beyond 0.060 inch oversize specification).	(4) Replace drum(s) as required.
	(5) Master cylinder filler vent clogged.	(5) Clean vent or replace cap; bleed brakes.
	(6) Hoses-lines collapsed, kinked, leaking.	(6) Replace as required.
	(7) Check valve in master cylinder outlet port faulty, or compensator port blocked.	(7) Disassemble master cylinder. Repair as required.
EXCESSIVE PEDAL PRESSURE REQUIRED TO STOP VEHICLE	(1) Brake adjustment not correct.	(1) Adjust brakes.
	(2) Incorrect lining.	(2) Install new linings.
	(3) Grease or fluid-soaked lining.	(3) Repair grease seal or wheel cylinder. Install new linings.
	(4) Improper fluid.	(4) Flush system; use approved brake fluid.
	(5) Frozen master or wheel cylinder pistons.	(5) Overhaul master or wheel cylinders.
	(6) Brake pedal binding on shaft.	(6) Lubricate pivot points.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
EXCESSIVE PEDAL PRESSURE REQUIRED	(7) Glazed linings.	(7) Sand surface of linings.
	(8) Bell-mouthed, barrel-shaped, or scored drums.	(8) Replace or resurface drums in left and right hand pairs.
	(9) Support plate ledges rusted or grooved.	(9) Polish and lubricate ledges if rusty. Replace support plate if ledges are grooved.
LIGHT PEDAL PRESSURE-BRAKES TOO SEVERE	(1) Brake adjustment not correct.	(1) Adjust the brakes.
	(2) Loose support plate on front axle.	(2) Tighten plates.
	(3) A small amount amount of grease or fluid on linings.	(3) Replace the linings.
	(4) Pedal linkage binding.	(4) Lube linkage and pivot points.
	(5) Charred linings.	(5) Replace the linings.
	(6) Incorrect lining.	(6) Install new linings.
	(7) Wheel bearings loose.	(7) Adjust wheel bearings.
	(8) Lining loose on shoe.	(8) Replace lining or shoe and lining.
	(9) Excessive dust and dirt in drums.	(9) Clean and sand drums and linings.
	(10) Bell-mouthed, barrel-shaped, or scored drums.	(10) Turn drums in pairs or replace.
	(11) Combination valve faulty.	(11) Replace combination valve.
PULSATING BRAKE PEDAL	(1) Drums out-of-round.	(1) Refinish drums.
	(2) Loose brake drum on hub.	(2) Tighten.
	(3) Worn or loose wheel bearings.	(3) Replace or adjust.
	(4) Bent shoes or linings.	(4) Replace shoe-lining assembly as required.
	(5) Bent rear axle.	(5) Replace axle.
	(6) Loose or bent support plate.	(6) Tighten or replace support plate.
BRAKES FADE	(1) Incorrect lining.	(1) Replace with new lining.
	(2) Thin drum.	(2) Replace drums.
	(3) Air in lines or improper brake fluid.	(3) Bleed system. Drain and flush if fluid is improper type.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
BRAKES FADE (Continued)	(4) Master cylinder primary piston worn, or bore scored, corroded.	(4) Disassemble master cylinder. Repair as required.
ALL BRAKES DRAG (ADJUSTMENT IS KNOWN TO BE CORRECT)	(1) Pedal linkage or power unit linkage binding (if equipped with power brakes).	(1) Lubricate linkage, pivot points.
	(2) Improper fluid.	(2) Replace rubber parts and fill.
	(3) On power brakes (CJ only) push rod height is incorrect.	(3) Adjust push rod height.
	(4) Compensating or bypass port of master cylinder closed.	(4) Open with compressed air.
	(5) Use of inferior hydraulic fluid or rubber parts. (Swollen cups, corroded wheel or master cylinder bores.	(5) Overhaul wheel and/or master cylinder.
BRAKE PEDAL TRAVEL DECREASING	(1) Master cylinder compensating port plugged.	(1) Use compressed air to unplug.
	(2) Power unit linkage binding or pedal linkage binding on manual brakes.	(2) Lube linkage.
	(3) Swollen cup in master cylinder.	(3) Replace rubber parts. Flush system.
	(4) Master cylinder piston not returning.	(4) Overhaul master cylinder.
	(5) Weak shoe retracting springs.	(5) Replace springs.
	(6) Wheel cylinder pistons sticking.	(6) Overhaul wheel cylinder.
ONE WHEEL DRAGS	(1) Weak or broken shoe retracting.	(1) Replace the defective brake shoe springs and lubricate the brake shoe ledges.
	(2) Power unit linkage binding, or pedal linkage binding (on manual brakes).	(2) Lube linkage, pivot points.
	(3) Brake shoe-to-drum clearance too small or the brake shoe eccentric is not adjusted properly.	(3) Adjust.
	(4) Loose wheel bearings.	(4) Adjust wheel bearings.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
ONE WHEEL DRAGS (Continued)	(5) Wheel cylinder pistons cups swollen and distorted or brake shoe pistons stuck.	(5) Overhaul cylinders.
	(6) Pistons sticking in wheel cylinder.	(6) Clean or replace pistons; clean cylinder.
	(7) Drum out-of-round.	(7) Grind or turn drum.
	(8) Restriction in line.	(8) Clean out or replace.
	(9) Loose anchor pin.	(9) Adjust and tighten lock nut.
	(10) Distorted shoe.	(10) Replace.
	(11) Defective lining.	(11) Replace with new lining.
ONE WHEEL LOCKS	(1) Contaminated linings.	(1) Replace the linings.
	(2) Tire tread slick.	(2) Replace tire or, match up tire treads from side to side.
BRAKES GRAB OR WON'T HOLD IN WET WEATHER	(1) Linings water-soaked.	(1) Dry out linings by driving with brakes lightly applied.
	(2) Dirty brakes.	(2) Clean.
	(3) Bent support plate opening allowing excessive water to enter drum.	(3) Replace support plate.
	(4) Scored drums.	(4) Grind or turn in pairs.
BRAKES SQUEAK	(1) Support plate bent or shoes twisted.	(1) Replace damaged parts.
	(2) Metallic particles or dust imbedded in lining.	(2) Sand the surfaces of the linings and drums. Remove all particles of metal that may be found in the surface of the linings.
	(3) Lining rivets loose or lining not held tightly against the shoe at the ends.	(3) Replace rivets. Replace shoe lining assemblies if damaged.
	(4) Drums not square or distorted.	(4) Turn, grind, or replace drums.
	(5) Shoes scraping on support plate ledges.	(5) Lubricate.
	(6) Weak or broken hold-down springs.	(6) Replace defective parts.
	(7) Loose wheel bearings.	(7) Tighten to proper setting.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
BRAKES SQUEAK (Continued)	(8) Loose shoe links.	(8) Tighten.
	(9) Loose support plate, anchor, drum wheel cylinder.	(9) Tighten.
	(10) Linings located wrong on shoes.	(10) Install linings correctly.
REAR BRAKES DRAG	(1) Maladjustment.	(1) Adjust brake shoes and parking brake mechanism.
	(2) Parking brake cables frozen.	(2) Lubricate or replace as required.
	(3) Dirty lining.	(3) Clean lining.
	(4) Wheel cylinder caps swollen or pistons sticking.	(4) Overhaul cylinders.
	(5) Weak retracting springs.	(5) Replace springs.
	(6) Shoes binding on support plate.	(6) Lubricate support plate ledges.
VEHICLE PULL TO ONE SIDE	(1) Grease or fluid-soaked lining.	(1) Locate and correct leakage; replace with new linings.
	(2) Adjustment not correct.	(2) Adjust the brakes.
	(3) Loose wheel bearings, loose support plate on rear axle or loose spring bolts.	(3) Adjust the wheel bearing; tighten the rear and front axles and tighten spring bolts.
	(4) Linings not of specified kind or primary and secondary shoes reversed.	(4) Install new linings.
	(5) Power unit linkage or pedal linkage (on manual brakes) binding.	(5) Lube linkage, pivot points.
	(6) Tires not properly inflated or unequal wear of tread. Different tread design side to side.	(6) Inflate the tires to recommended pressures. Rotate tires so that a pair of non-skid tread surfaces of similar design and equal wear will be installed on the front wheels.
	(7) Linings charred.	(7) Replace with new lining.
	(8) Water, mud, or foreign matter in brakes.	(8) Remove any foreign material from all of the brake parts and the inside of the drums. Lubricate the shoe ledges and the rear brake cable ramps.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
VEHICLE PULLS TO ONE SIDE (Continued)	(9) Wheel cylinder sticking.	(9) Overhaul or replace wheel cylinder.
	(10) Weak or broken retracting springs.	(10) Check springs. Replace bent, open-coiled or cracked springs.
	(11) Out-of-round drums.	(11) Resurface or replace drums in left and right hand pairs (both front and both rear).
	(12) Brake dragging.	(12) Check for loose lining. Repair or replace as required.
	(13) Weak chassis springs or loose U-bolts.	(13) Replace springs or tighten U-bolts.
	(14) Loose steering.	(14) Repair and adjust.
	(15) Unequal camber.	(15) Replace axle housing.
	(16) Clogged or crimped hydraulic line.	(16) Repair or replace line.
	(17) Wheel cylinder incorrect size.	(17) Replace with correct cylinders.
	(18) Worn steering knuckle bearings.	(18) Replace.
	(19) Bad drum.	(19) Refinish drums in pairs.
BRAKES CHATTER	(1) Incorrect lining-to-drum clearance.	(1) Readjust to recommended clearances.
	(2) Loose support plate.	(2) Tighten securely.
	(3) Grease, fluid, road dust on lining.	(3) Clean out dust; replace grease and fluid-soaked lining.
	(4) Weak or broken retractor spring.	(4) Replace.
	(5) Loose wheel bearings.	(5) Readjust.
	(6) Drums out-of-round.	(6) Grind or turn drums in pairs.
	(7) Cocked or distorted shoes.	(7) Straighten or replace.
	(8) Tapered or barrel-shaped drums.	(8) Grind or turn in pairs.
SHOE CLICK	(1) Shoes lift off support plate and snap back.	(1) Change drums side to side or grind drums (in pairs).
	(2) Holddown springs weak.	(2) Replace springs.
	(3) Shoe bent.	(3) Replace shoes on both sides.
	(4) Grooves in support plate ledges.	(4) Replace support plate.

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DRUM BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
SNAPPING NOISE IN FRONT END	(1) Grooved support plate ledges.	(1) Replace support plate.
	(2) Lack of lubrication on moving parts.	(2) Lubricate all rubbing points.
	(3) Loose drums or support plates.	(3) Tighten.
	(4) Loose or worn front end parts.	(4) Tighten or replace defective parts.
THUMPING NOISE WHEN BRAKES ARE APPLIED	(1) Too much clearance between shoes and anchors.	(1) Adjust.
	(2) Retractor springs unequal or weak.	(2) Replace springs.

DISC BRAKES SERVICE DIAGNOSIS — CHEROKEE, WAGONEER, TRUCK

Condition	Possible Cause	Correction
BRAKE CHATTER OR ROUGHNESS. BRAKE PEDAL PULSATES	(1) Excessive rotor lateral runout.	(1) Check rotor runout. Refinish if not to specs (refer to Rotor Measurements). Replace if unable to refinish.
	(2) Rotor out-of-parallel.	(2) Check parallelism. Refinish if out of spec. Replace if unable to refinish.
	(3) Loose or worn wheel bearings.	(3) Adjust to specs. Replace if worn or damaged.
	(4) Rear drums out-of-round.	(4) Check runout. If not to specs turn drum. Do not remove more than .060 inch.
	(5) Brake shoes reversed (steel side of shoe riding on rotor).	(5) Replace rotor and shoes.
	(6) Shoes bent or linings worn.	(6) Replace shoes.
EXCESSIVE PEDAL EFFORT REQUIRED	(1) Malfunction in power brake booster.	(1) Check booster operation. Refer to Power Brake Units.
	(2) Failure in front or rear brake system (dual master cylinder) such as: wheel cylinder leaks, defective brake lines, caliper piston seal leak, master cylinder. Piston cups not holding pressure.	(2) Check both brake systems and correct as required. Check for failed brake warning light if brake failure occurred and light did not operate.
	(3) Excessive lining wear.	(3) Check and replace linings as required.

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DISC BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
EXCESSIVE PEDAL EFFORT REQUIRED (Continued)	(4) Caliper piston(s) sticking.	(4) Rebuild caliper(s).
	(5) Brake fade caused by incorrect or non-recommended linings.	(5) Replace with correct or recommended lining.
	(6) Incorrect master cylinder.	(6) Check and replace if required.
EXCESSIVE PEDAL TRAVEL	(1) Low fluid level.	(1) Add fluid as required.
	(2) Leak in system due to failure in front or rear brake system.	(2) Inspect and correct as required.
	(3) Air in system.	(3) Bleed brakes.
	(4) Rear brakes not adjusting properly.	(4) Adjust rear brakes and repair automatic adjusters.
	(5) Worn lining.	(5) Replace linings. If wear is excessive or premature, check for incorrect lining, sticking caliper pistons, binding park brake cables, shoe drag on support plate, weak return springs or drum brakes, improper rear brake adjustment.
	(6) Bent or broken shoe.	(6) Replace as required.
	(7) Master cylinder mounting bolts loose.	(7) Check and retighten.
	(8) Rotor thickness or drum diameter below spec.	(8) Inspect, measure and replace as required.
	NOTE: *A very light drag occurring after releasing the brake pedal is a characteristic of disc brakes.*	
DRAGGING BRAKES	(1) Master cylinder pistons not returning properly.	(1) Remove cover, check for spurt of fluid at compensator holes as brake pedal is depressed. Rebuild master cylinder if fluid spurt is not observed. Inspect compensator ports for blockage, use compressed air to clear passages.
	(2) Restrictions in brake lines or hoses.	(2) Check for kinks or dents in steel lines. Check rubber hoses for swelling or restrictions inside hose.
	(3) Incorrect parking brake adjustment.	(3) Check and readjust to spec. Inspect cables for bind or frayed conditions.

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DISC BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
DRAGGING BRAKES (Continued)	(4) Rear shoes not returning to normal position.	(4) Return springs weak. Shoes dragging on support plate due to lack of lube or ridges on support plate ledges. Wheel cylinder cups swollen or pistons sticking. Repair or replace faulty parts as required.
	(5) Caliper pistons not releasing. Pistons stuck due to piston scoring or corrosion or piston cocking in bore.	(5) Repair or replace pistons or caliper as required.
	(6) Lines to combination valve installed incorrectly.	(6) Check and correct as required. Port marked inlet goes to master cylinder; port marked outlet goes to calipers.
	(7) Bind in brake pedal and booster linkage.	(7) Check and correct as required.
	(8) Push rods too long.	(8) Replace with proper parts.
	(9) Check valve installed in master cylinder outlet to disc brake calipers.	(9) Check outlet. Remove valve if present. Bleed brakes.
GRABBING BRAKES	(1) Refer to all conditions listed under PULLS WHEN BRAKES ARE APPLIED.	(1) See PULLS WHEN BRAKES ARE APPLIED.
	(2) Power brake unit malfunction.	(2) Check operation and replace or repair as required. Refer to POWER UNIT SERVICE DIAGNOSIS Chart.
	(3) Combination valve malfunction.	(3) Replace valve and bleed system.
	(4) Brake pedal or power unit linkage binding.	(4) Check and correct as required. Lube all pivot points.
	(5) Incorrect power unit.	(5) Check and replace as required.
PULLS WHEN BRAKES ARE APPLIED	(1) Incorrect tire pressures.	(1) Inflate to spec.
	(2) Mismatched tires on same axle.	(2) Install equal size, type tires.
	(3) Wheel bearings misadjusted or worn.	(3) Adjust or replace as required.
	(4) Malfunction in caliper.	(4) Check for stuck piston.

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DISC BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
PULLS WHEN BRAKES ARE APPLIED (Continued)	(5) Damaged or contaminated shoe and lining (grease on lining or bent shoe).	(5) Replace shoe and lining on both sides. Replace axle seals, wheel cylinder cups, or caliper piston seals, if leaking.
	(6) Rear brake problem: automatic adjusters inoperable, contaminated lining, defective wheel cylinders, seized or improperly adjusted park brake cables, shoes binding on support plate, linings worn, linings charred or cracked, bent support plate, weak retracting springs, drums out-of-round.	(6) Inspect and repair or replace malfunctioning parts. Check for equal size wheel cylinders on rear brakes.
	(7) Loose calipers.	(7) Check mounting bolt torque, inspect threads on bolts for galling or stripped threads, check support plate for broken welds.
	(8) Loose suspension parts.	(8) Inspect and correct as required.
	(9) Front end out of alignment.	(9) Check and correct as required.
	(10) Lining soaked with water after operation in heavy rains, or flooding conditions.	(10) Allow lining to air dry, or while driving, keep brakes lightly applied to warm up lining and evaporate water.
	(11) Disc brake rotor out of tolerance.	(11) Check and refinish or replace as required.
REAR DRUM BRAKES SKID PREMATURELY ON HARD BRAKE APPLICATION	(1) Combination valve proportioner section malfunctioning.	(1) Replace valve and bleed brakes.
	(2) Check items listed under PULLS and GRABBING.	(2) See PULLS and GRABBING.
SPONGY PEDAL	(1) Air in system.	(1) Bleed brakes. Inspect for broken lines, loose fittings, leaking caliper pistons, or wheel cylinders; check rubber seal on master cylinder cover. Check cover itself for distortion or cracks, check all bleed valves for proper torque.
	(2) Rear drums thin or cracked.	(2) Inspect and correct as required.
	(3) Calipers loose.	(3) Check mounting bolt torque.
	(4) Loose master cylinder or brake booster attaching parts.	(4) Check and correct as required.

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DISC BRAKES SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
SPONGY PEDAL (Continued)	(5) Brake hoses expanding under pressure.	(5) Hoses soft and weak.
	(6) Compensator port blocked in master cylinder.	(6) Check and correct as required.
	(7) Improper (low quality) brake fluid in system. Fluid boils and becomes aerated.	(7) Drain and flush system.

HYDRAULIC SYSTEM

Test for Contamination

When servicing the hydraulic system, prevent the entry of contaminants by capping all lines and ports, and by avoiding the use of mineral-oil based fluids for cleaning system components.

CAUTION: *Never use gasoline, kerosene, carbon tetrachloride, paint thinner, alcohol, nor any other fluid containing mineral oil,to clean or lubricate hydraulic system components. These materials will cause swelling, deterioration, and premature ageing of rubber parts.*

To determine if dirt, moisture, or mineral-oil based cleaners have contaminated the hydraulic fluid, drain off a sample and check for suspended particles, discoloration, or separation of the fluid into distinct layers. Layering indicates the presence of water or mineral oil content.If system contamination should occur, drain and flush the system with an approved brake fluid only.

Approved Brake Fluids

Whenever the hydraulic system must be flushed, or when filling the system, use only fluids marked SAE J1703 or those conforming to:

- Federal Specification VV-B-680, Brake Fluid, Automotive
- Federal Safety Standrd No. 116, Motor Vehicle Hydraulic Brake Fluid conforms to all of the above specifications and is available in quart and gallon containers.

CAUTION: *Never fill the hydraulic system with used or reclaimed fluid*

Hydraulic System Inspection Procedure

(1) Check master cylinder cover retaining spring (bail wire) for proper tension and fit. The spring should provide enough tension on the cover to maintain an airtight seal.

(2) Inspect rubber diaphragm seal for cracks and distortions.

(3) Check master cylinder fill level.

(4) Check for dirt and foreign material in reservoirs. Drain off a sample of brake fluid into a clean glass container and test for contamination as outlined above.

(5) Inspect all fittings and brake lines for leakage, kinks, or other damage.

(6) Inspect condition of front brake hoses. Replace if cut, cracked, swollen, or leaking.

(7) Check for evidence of fluid leakage at all wheel cylinders and front calipers (if equipped with disc brakes).

Master Cylinder Fill Level

Master cylinder fluid level should be checked at least four times a year or every 5,000 miles. **The master cylinder fluid reservoirs should be filled to within 1/4 inch of the rim of each reservoir.** when checking fluid level, the rubber diaphragm seal on the master cylinder cover should be inspected for cracks, cuts, distortion, or any other condition that might allow air or foreign material to enter the master cylinder. When the cover is removed or any reason, do not allow the rubber diaphragm seal to come in contact with dirt, grease, or other foreign material.

POWER BRAKE UNITS

A 7-3/4 inch tandem-diaphragm unit (fig. 9-1) is used on CJ models equipped with power brakes while Chero-

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kee, Wagoneer, and J-10 Truck models have a 9-1/2 inch single diaphragm power unit (fig. 9-2); J-20 truck models (6500 GVW and up) use a 9-1/2 inch tandem-diaphragm power unit.

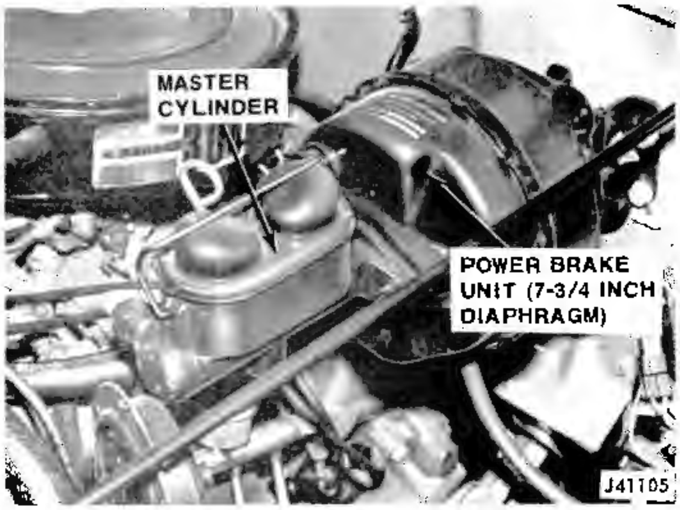

Fig. 9-1 Power Brake Unit, 7-3/4 Inch Diaphragm CJ Models

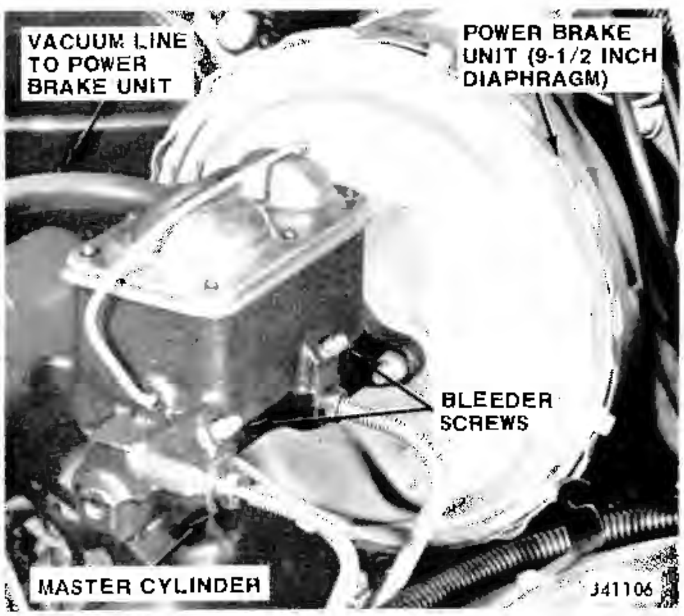

Fig. 9-2 Power Brake Unit, 9-1/2 Inch Diaphragm Cherokee, Wagoneer, Truck

Power Unit Service

All power brake units are serviced as an assembly. When diagnosis indicates a unit is defective, it should be replaced, not overhauled.

Push Rod Adjustment - 7-3/4 Inch Tandem, Diaphragm- CJ Models

The power unit push rod height must be checked or adjusted whenever the master cylinder and power units are separate, or when adjustment is indicated through diagnosis.

Push rod adjustment is very important as it ensures that the compensating ports in the master cylinder are kept open when the power unit is in the released position.

To check push rod height, a push rod height gauge must be made according to the dimensions given in figure 9-3.

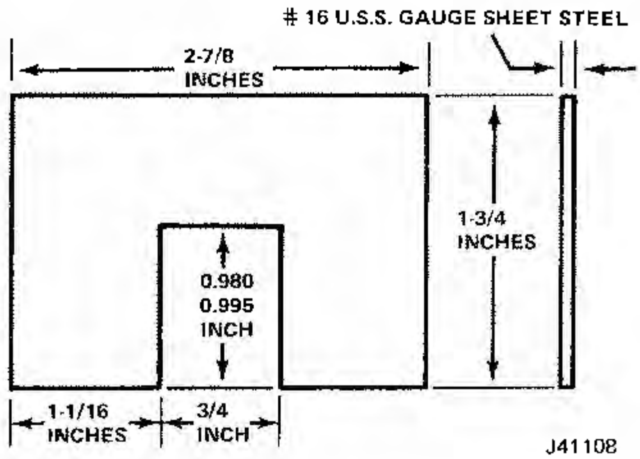

Fig. 9-3 Push Rod Height Gauge Dimensions

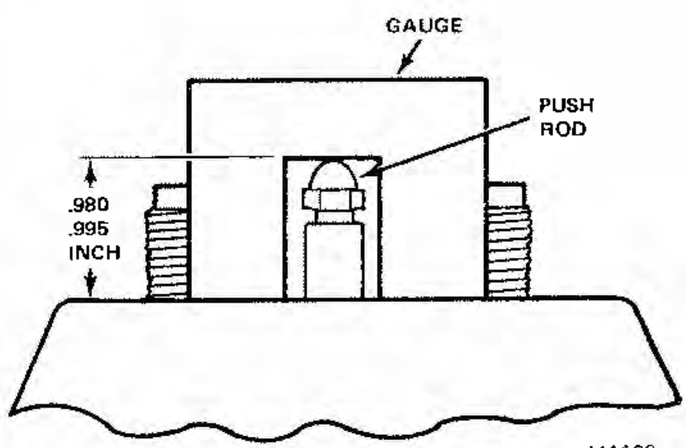

Fig. 9-4 Checking Push Rod Height with Gauge

The push rod length may increased or decreased by holding the rod serrations with pliers and turning the adjusting screw in or out to the desired length (fig. 9-5).

NOTE: *The 9-1/2 inch single and tandem power units have a single push rod (fig. 9-6) of a non-adjustable preset length. When replacing a power unit, use the push rod supplied with the new power unit as it has been properly gauged and preset to the new power unit.*

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Fig. 9-5 Adjusting Push Rod Length

DUAL MASTER CYLINDER-DOUBLE SAFETY BRAKES-ALL MODELS

In the Double-Safety brake system the hydraulic system for the front brakes is completely separate from the rear brakes. In the event of hydraulic brake failure in the front system, the rear hydraulic brakes will still operate. If a failure occurs in the rear brakes, the front brakes will still operate.

A double hydraulic cylinder with two outlets, two fluid reservoirs, and two hydraulic pistons (a primary and secondary) is operated in tandem by a single hydraulic push rod.

With the master cylinder fluid reservoirs filled and the front and rear brake systems bled, there is a solid column of fluid on the forward side of both the primary and the secondary pistons.

Upon application of the brakes, fluid is displaced by the pistons into the wheel cylinders to activate both front and rear brakes. Upon release of the brakes, fluid returns from the wheel cylinders through the residual check valve to the master cylinder bore.

MASTER CYLINDER - CJ MODELS

Disassembly and Overhaul Procedure

(1) Remove master cylinder from vehicle.

(2) Remove filler cap and empty all fluid.

(3) Remove primary piston stop, located in bottom center of master cylinder.

(4) On non-power brake vehicles, remove actuating

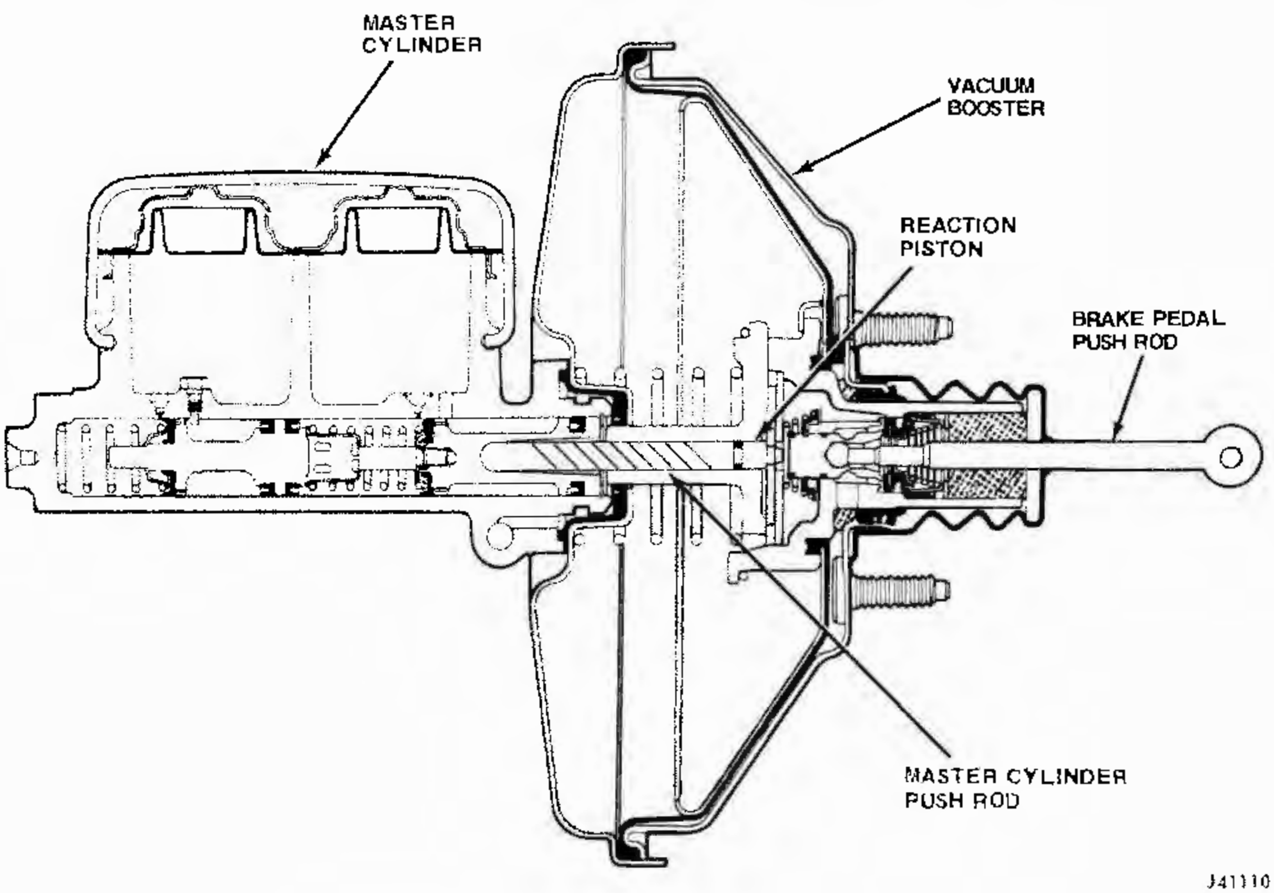

Fig. 9-6 Single Diaphragm Power Brake Unit

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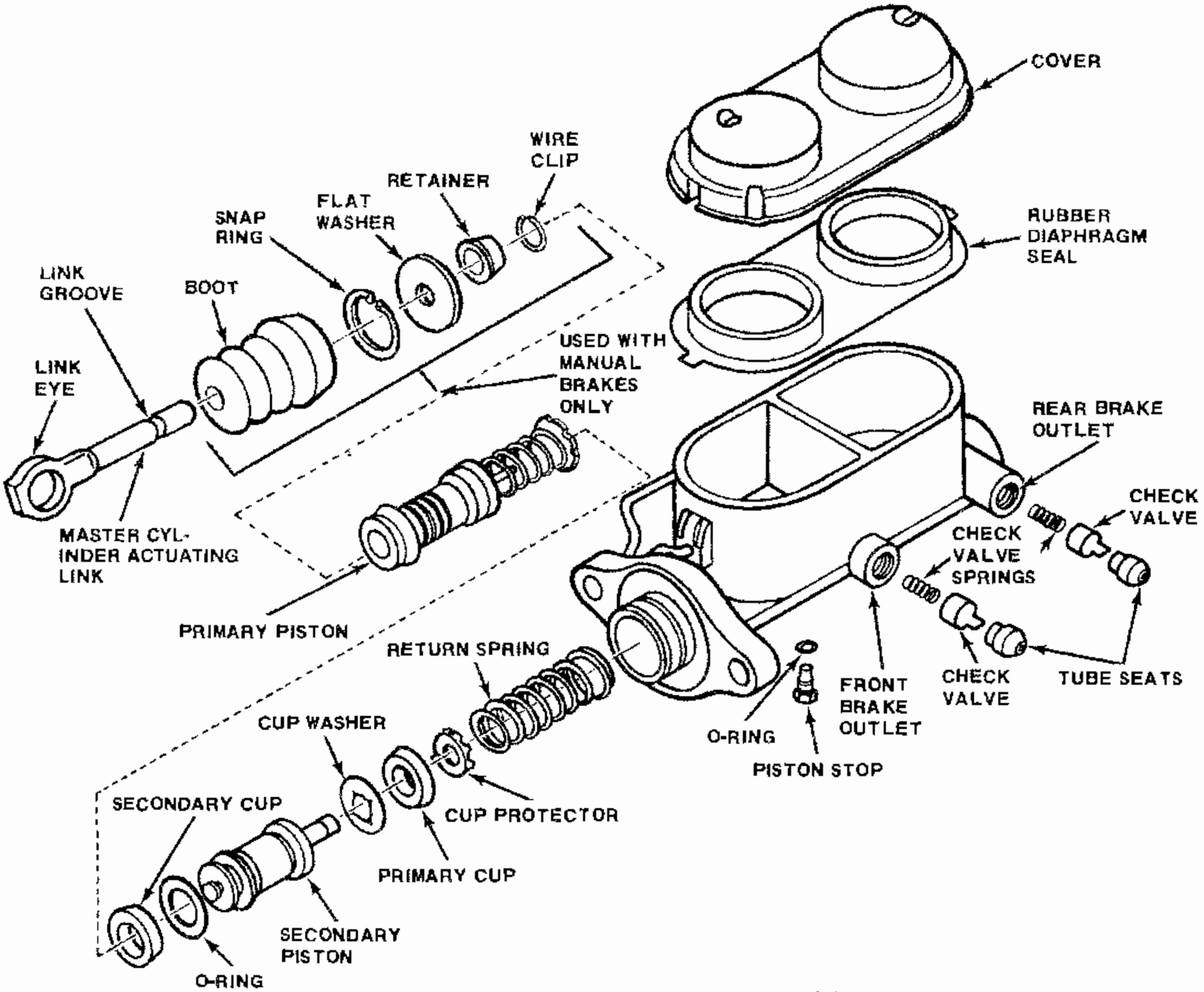

Fig. 9-7 Master Cylinder Components - CJ Models

link snap ring, flat washer, retainer, and primary and secondary piston assemblies (fig. 9-7). Air pressure applied through compensator port in front reservoir will facilitate removal of secondary piston assembly.

(5) A residual check valve is located under both front and rear fluid outlet tube seats on manual and power drum brakes. To gain access to check valves, tube seats must be removed with self-tapping screws supplied in repair kit. Install self-tapping screws into tube seats and place two screwdriver tips under screw head. Pry the screw upward as shown in figure 9-8.

(6) Remove return spring, cup protector, primary cup, primary cup washer, secondary cup and O-ring from secondary piston. Discard all old rubber parts.

NOTE: *The primary piston assembly is supplied in repair kit, therefore, it will not be necessary to retain original primary piston.*

(7) Clean and inspect master cylinder.

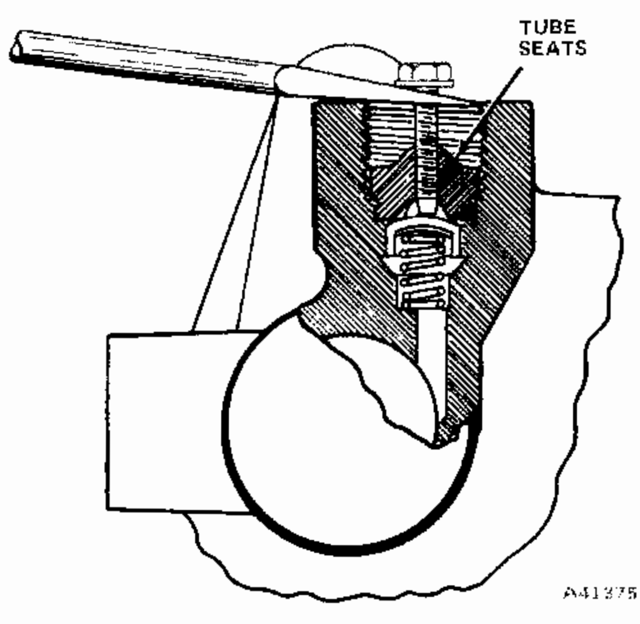

Fig. 9-8 Removing Tube Seats

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CAUTION: *Clean all metal parts in clean brake fluid or an approved brake system cleaner,.Only use air pressure to remove dirt and cleaning solvent from recesses and internal passages.*

When overhauling a master cylinder, use all parts furnished in repair kit (except push rod boot on vehicles equipped with power brake units).

After cleaning, place all hydraulic system parts on clean paper or in a clean pan.

(8) Inspect all parts for damage or excessive wear. Replace any damaged, worn, or chipped parts. Master cylinder must be replaced if hydraulic bore shows signs of scoring, rust, pitting or etching.

Assembly

(1) Prior to assembly of master cylinder, coat all components with clean brake fluid.

(2) Place primary cup washer, primary cup protector and return spring on secondary piston.

(3) Install O-ring and secondary cup on secondary piston.

NOTE: *Install primary and secondary piston with flat sides of cups facing each other.*

(4) Coat cylinder bore and piston assemblies with clean brake fluid before installing pistons in master cylinder.

(5) Install secondary piston assembly spring end first. Install primary piston assembly which is supplied in repair kit.

(7) Secure pistons in bore with snap ring.

(8) Place new O-ring on primary piston stop and install the piston stop in master cylinder.

(9) Place new rubber check valves over check valve springs and install in fluid outlet holes, spring end first.

(10) Install tube seats and press into place with tube nuts.

(11) On vehicles equipped with non-power brakes the correct assembly sequence for the actuating link retaining parts is as follow(see fig. 9-7):

(a) Install rubber dust boot on link.

(b) Install snap ring on link.

CAUTION: *Be sure that sharp edge of snap ring faces out and toward eye of link.*

(c) Install flat washer on link.

(d) Install cone-shaped retainer on link.

CAUTION: *Large end of retainer must face toward eye of link or away from master cylinder.*

(e) Install retaining clip in groove of link.

(f) Install link; be sure snap ring is fully seated in master cylinder groove.

NOTE: *Vehicles equipped with power brakes use the flat washer and snap ring only. (See fig. 9-7).*

(12) If the complete master cylinder is to be replaced on a vehicle equipped with non-power brakes, the original actuating link must be used. The service replacement master cylinder will have the snap ring, washer, retainer, and retainer clip already installed.Remove these parts and install them on the link in the assembly sequence described above.

CAUTION: *Vehicles equipped with power brakes use a different master cylinder. Be sure that correct master cylinder is installed when replacement is required.*

(13) Bleed master cylinder as follows:

(a) Support cylinder assembly in a vise and fill both fluid reservoirs with approved brake fluid.

(b) Fabricate two bleeding tubes as shown in figure 9-9. Use wooden dowel or actuating link to depress piston assembly slowly. Allow pistons to return under pressure of springs.

(c) Repeat until all air bubbles cease to appear.

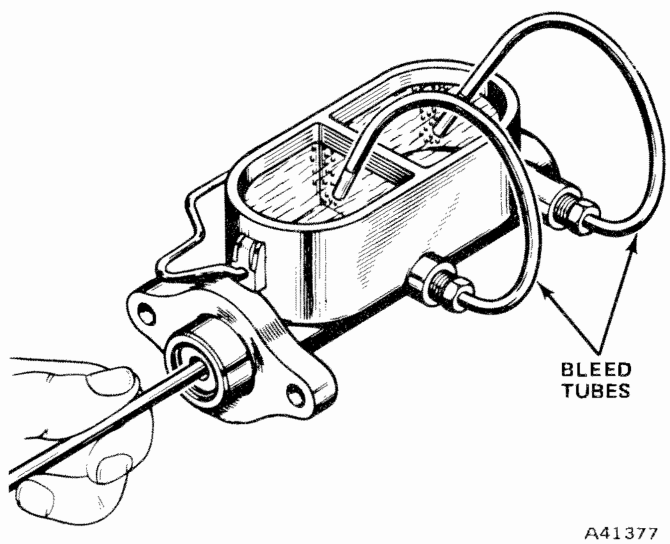

Fig. 9-9 Bleeding Master Cylinder

(14) Install master cylinder on vehicle. Fill reservoirs to within 1/4 inch of reservoir rim.

(15) Bleed Brake system as outlined under Brake system Bleeding

MASTER CYLINDER - CHEROKEE- WAGONEER-TRUCK

A dual master cylinder is used on Cherokee, Wagoneer, and Truck models (fig. 9-10) . The large front reservoir controls the front brakes and the smaller rear

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reservoir controls the rear brakes, a bleeder screw is provided at each reservoir outlet to facilitate master cylinder bleeding. The master cylinder used on Cherokee and J-10 Truck models with drum brakes has a 1-inch bore. On Wagoneer and J-20 Truck models with disc brakes, the master cylinder has a 1-1/8 inch bore. The outlet ports on both of these master cylinders do not have check valves.

Disassembly and Overhaul Procedure

(1) Remove master cylinder from vehicle.

(2) Remove cover and empty all fluid. Remove rubber diaphragm seal from cover.

(3) Remove piston stop from bottom of front reservoir. A 5/16-inch socket is required for removal.

(4) Place master cylinder in vise. Use only enough-tension to hold cylinder in vise. Push in on primary piston with phillips screwdriver to relieve spring tension on piston, and remove snap ring. Remove both piston assemblies.

NOTE: *Remove secondary piston by applying pressure on piston through piston through piston stop hole in bottom of reservoir.*

(5) Clean and inspect master cylinder. Replace if bore is scored, corroded, or pitted. Replace if cylinder body is cracked, porous, or has sustained other damage. Ensure that bypass and compensating ports in bottom of reservoirs are clean and open. Use air pressure to perform this check. Do not use wire as the wire may raise a burr in the port or push a burr into the cylinder bore.

CAUTION: *Clean master cylinder with brake fluid or approved cleaning solvent only. Do not use any solvent containing mineral oil such as gasoline, kerosene, alcohol, or carbon tetrachloride. Mineral oil is very harmful to the rubber piston cups and seals.*

(6) Inspect the brass tube fitting inserts in the outlet ports. **Do not replace** these inserts unless they are loose, cocked in the outlet bore, badly scored, cracked, or damaged in some other fashion. If removal is required proceed as follows:

(a) Thread a 6-32 x 5/8-inch long self-tapping screw into the insert.

(b) Remove insert by prying on self-tapping screw with a claw hammer.

(7) Discard all rubber piston cups and seals, and discard the master cylinder cover seal if damaged or defective.

Assembly

(1) Place master cylinder in vise. Do not overtighten. If tube fitting inserts were removed, install new inserts as follows:

(a) Place new inserts in outlet ports.

(b) Thread a spare brake line tube nut into outlet. Be sure new inserts are not cocked in outlet bore.

(c) Turn brake line tube nut down until inserts are bottomed.

(d) Remove nut and inspect threaded hole in outlet. Remove any brass particles or burrs that may have been raised during installation of inserts. Reclean master cylinder with brake fluid and blow out all passages with dry, filtered compressed air.

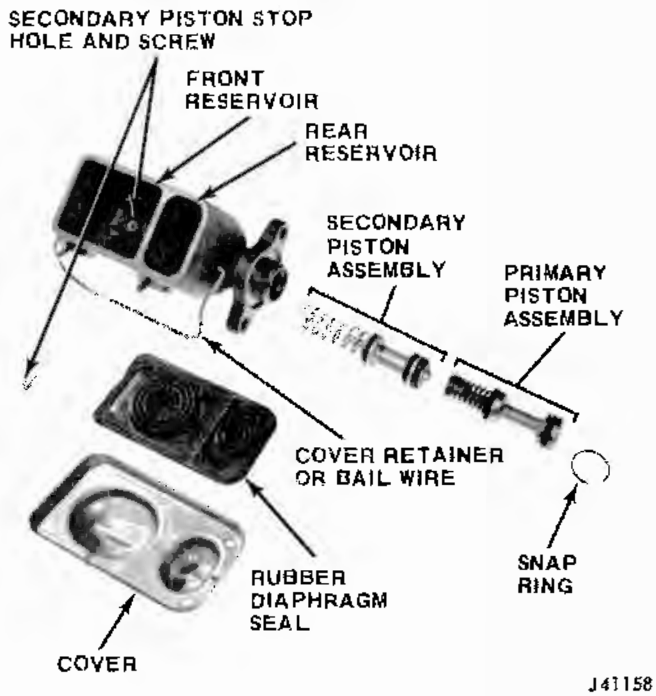

Fig. 9-10 Master Cylinder Components - Cherokee, Wagoneer, Truck

(2) Lubricate all parts thoroughly with clean brake fluid, particularly the master cylinder bore, and piston seals.

(3) Install both piston assemblies in cylinder bore in reverse order of disassembly. Be careful not to cut or crimp piston cups and seals during installation.

(4) Use phillips screwdriver to depress primary piston and install snap ring. Be sure snap ring is fully seated in its groove.

(5) Depress both pistons and install piston stop in front reservoir. Make sure secondary piston is pushed back far enough to clear the piston stop. Tighten stop to 25 to 40 inch-pounds torque.

(6) Install rubber diaphragm seal on reservoir cover.

(7) Install master cylinder on vehicle. Fill reservoirs to within 1/4 inch of rim and install cover.

(8) Bleed brake system as outlined under Brake System Bleeding.

COMBINATION VALVE

All models are equipped with a combination valve (figs. 9-11 and 9-12) which is attached to the inner side of the left frame rail.

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Description and Operation - CJ Models

The combination valve used on CJ models contains a brake pressure differential warning section and a proportioning section which are combined into a single assembly. The valve also serves as the front junction block for the brake system.

Pressure Differential Warning Switch Section

The switch in the valve is activated when a hydraulic pressure loss occurs in either the front or rear brake systems. when the switch is activated it completes the

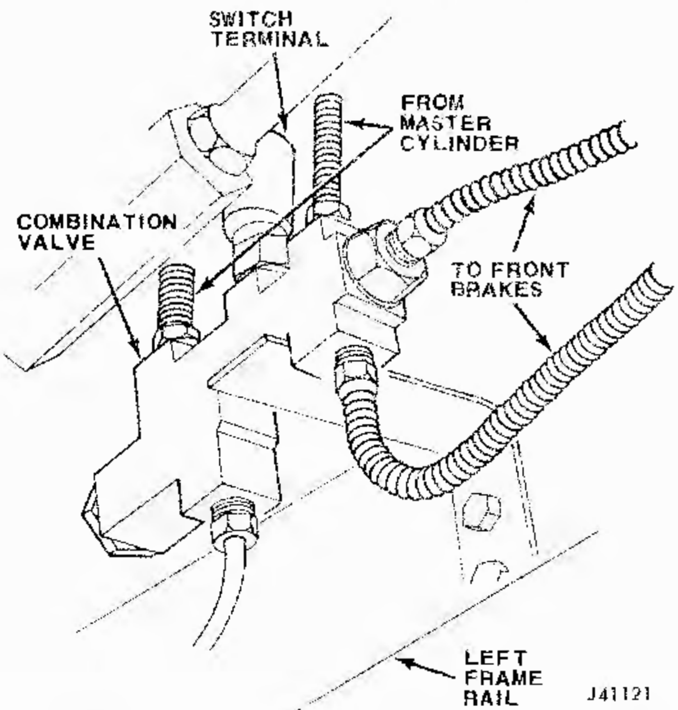

Fig. 9-11 Combination Valve - CJ Models

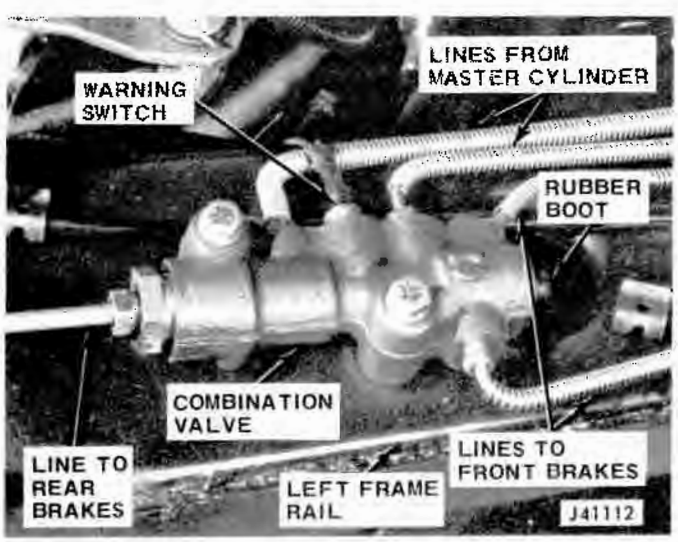

Fig. 9-12 Combination Valve - Cherokee, Wagoneer, Truck

electrical circuit to the brake warning light on the dash.

Should a failure occur in the rear brake system, the switch piston is forced to the rear of the valve by pressure form the good front brake system. As the piston moves, the piston ramp contacts the switch pin forcing it up into the switch, making contact, and completing the electrical circuit to the warning light on the dash. In the event of front brake failure, the switch is activated in the same manner except that the piston moves in the opposite direction.

NOTE: *The presence of air in either the front or rear brake system can produce a pressure differential causing the switch to activate the warning light on the dash. bleeding the system will correct this condition.*

Proportioner Section

The proportioner section provides balanced front-to-rear braking during high speed stops. At high deceleration, rear weight is transferred to the front wheels and must be conpensated for to avoid early rear wheel skid. The proportioner section of the valve reduces initial line pressure to the rear wheels, delaying rear brake lockup and avoiding early rear wheel skid.

The proportioner does not operate during normal or light brake application.

Combination Valve Service - CJ Models

The valve is not repairable. If any section of the valve is found defective, the entire assembly must be replaced.

When bleeding the brake system, the pressure differential switch wire, switch terminal, and contact plunger-spring assembly must be removed. Refer to Brake System Bleeding.

NOTE: *If any leakage is evident at the switch terminal after reinstallation following brake bleeding, replace the entire valve assembly.*

Description and Operation - Cherokee, Wagoneer, Truck

The combination valve used on Cherokee, Wagoneer, and Truck models (fig. 9-13) contains a metering valve section, a pressure differential warning switch section, and a proportioner valve section. The combination valve also serves as the front junction block for the brake system.

Metering Valve Section

The metering valve holds off (delays) full hydraulic fluid pressure to the front brakes until the rear brakes overcome retracting-spring tension and tension and the rear linings make contact with the rear drums.

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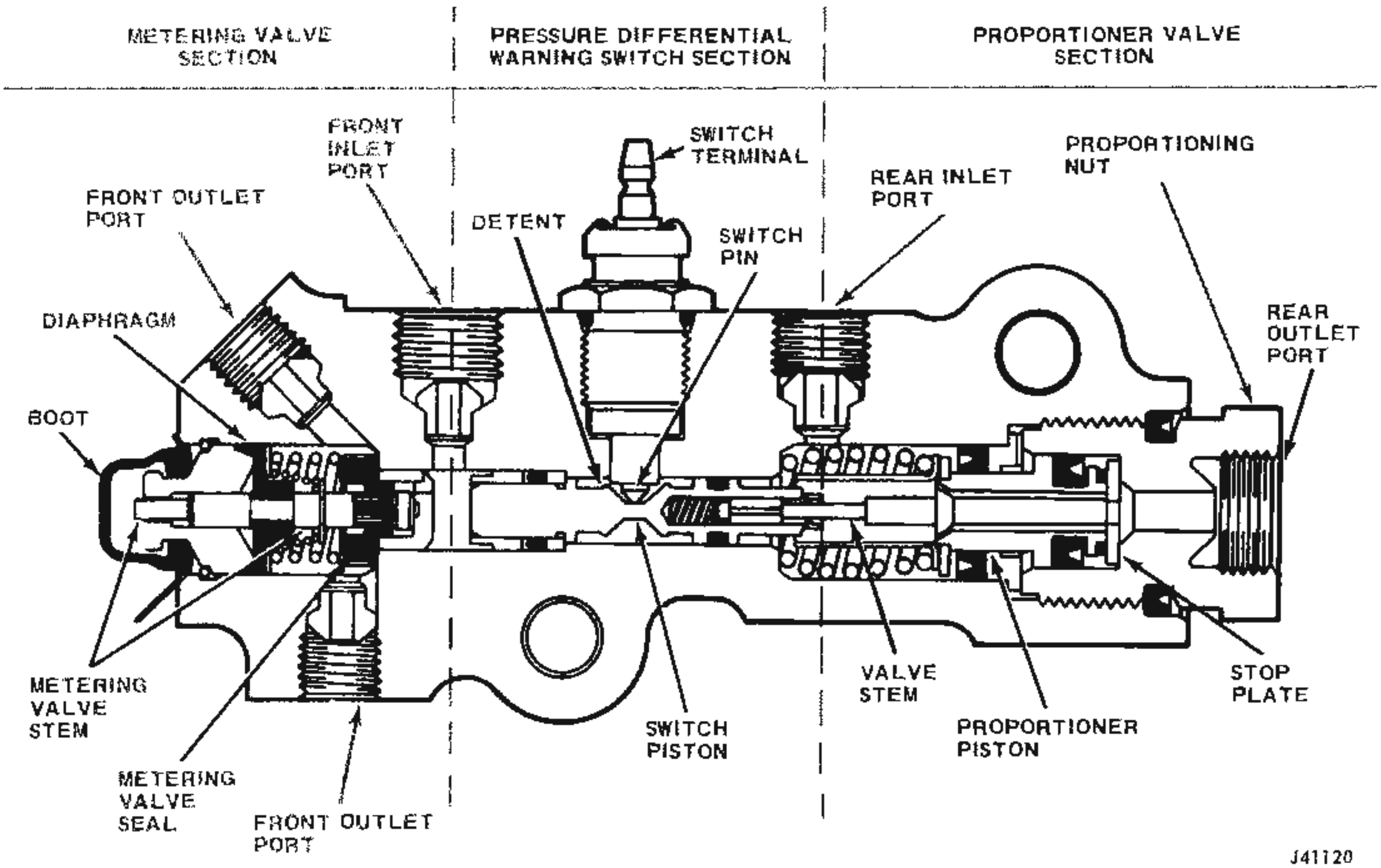

Fig. 9-13 Combination Valve Cross Section - Cherokee, Wagoneer, Truck

When the brakes are not applied (fig. 9-14) the metering valve permits free flow of brake fluid. This feature allows the fluid to expand and contract with changes in temperature (fig. 9-14)

During initial application of the brakes, the metering valve stem is moved to the left by hydraulic line pressure. At 4 to 30 psi, the smooth end of the stem will seal against the metering valve seal lip. When this seal is completed, the metering valve has reached its shut-off point (fig. 9-15).

After reaching the shut-off point on initial brake application, the metering valve stem continues to the left until it stops at the knurl at the metal reatiner. The metering valve spring then holds the retainer against the seal until a predetermined fluid pressure is developed at the valve inlet.

When the pressure at the valve inlet becomes great enough, it overcomes the metering valve spring tension and allows fluid pressure to flow through the valve to the front brakes. This step in valve operation is referred to as the hold-off and blend pressure point(fig. 9-16).

As fluid pressure into the valve is increased, it is metered through the valve seal to the front brakes and produces an increased force on the diaphragm (fig. 9-16). The diaphragm then pulls the pin, which in turn pulls the retainer, thereby decreasing spring load on the metering valve seal. When pressure on the diaphragm reaches the point where the sping is pulled away completely, fully pressurized fluid passes unrestricted through the valve seal and to the front brakes

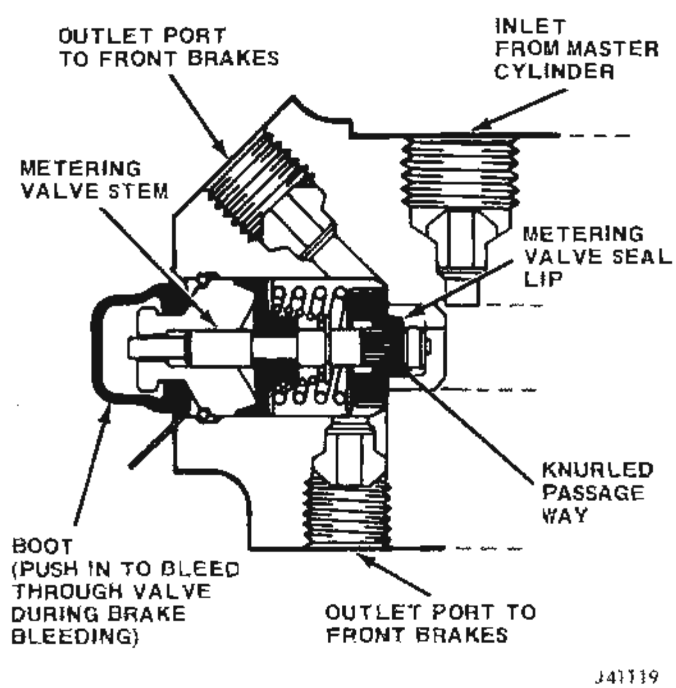

Fig. 9-14 Brakes Not Applied

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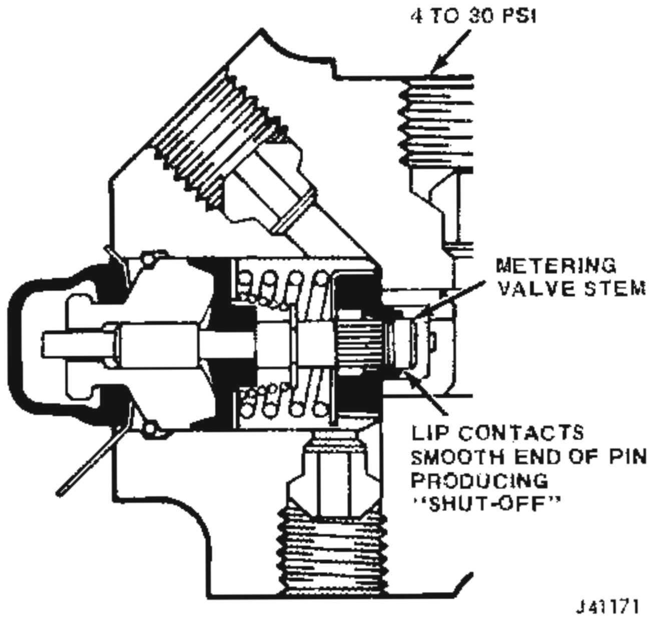

Fig. 9-15 Shut-Off Point

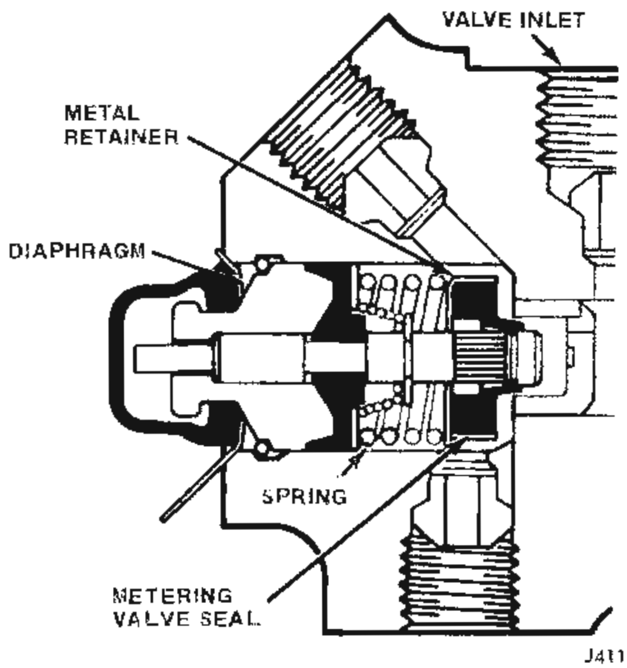

Fig. 9-16 Holdoff and Blend Pressure

Pressure Differential Warning Switch Section

The warning switch in the valve is activated when a hydraulic pressure loss occurs in either the front or rear brake systems and when activated, completes the electrical circuit to the brake warning light on the dash.

Should a failure occur in the rear brake system (fig. 9-17), the switch piston is forced to the right (toward the rear brake outlet port in the valve) by pressure from the good front system. As the piston moves, the piston ramp forces the switch pin up into the switch, making

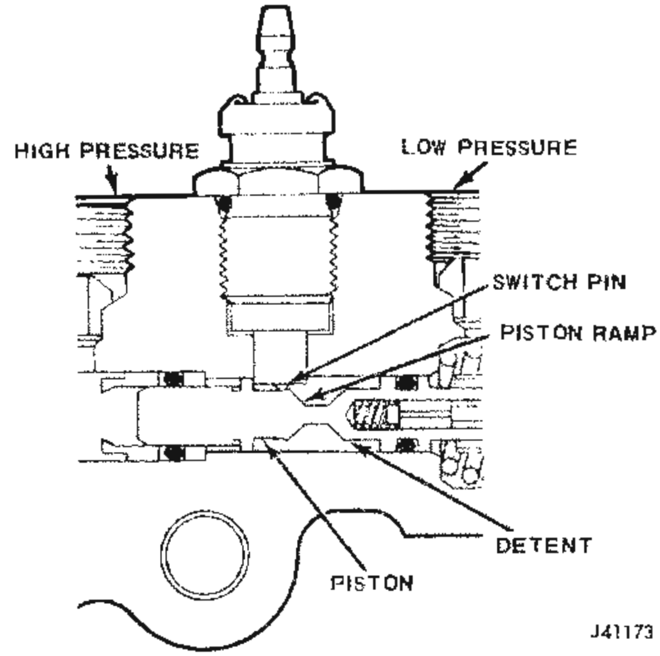

Fig. 9-17 Rear System Failure

contact, and completing the electrical circuit which activates the dash light. In the event of a front brake system failure, the switch is activated in the same manner except that the switch pistons will move to the left.

Proportioner Section

The proportioner section provides balanced front-to-rear braking action during high pedal pressure stop. During light pedal pressure application, the proportioner does not operate (fig. 9-18). Brake fluid normally flows into the proportioner through the space between the piston center hole and valve stem, then through the stop plate and the rear brakes. Spring pressure loads the piston, holding it against the stop plate for normal brake pressures.

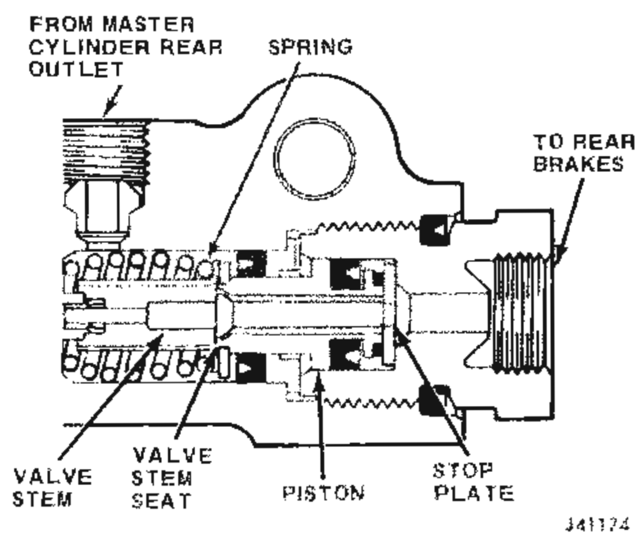

Fig. 9-18 Light Pedal Pressure Application

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During high pedal pressure application, pressure developed within the valve pushes against the large end of the piston. When this pressure becomes high enough, it overcomes spring pressure on the piston and moves the piston to the left. The piston contacts the valve stem seat and begins proportionally by restricting fluid pressure through the valve and to the rear brakes (fig. 9-19).

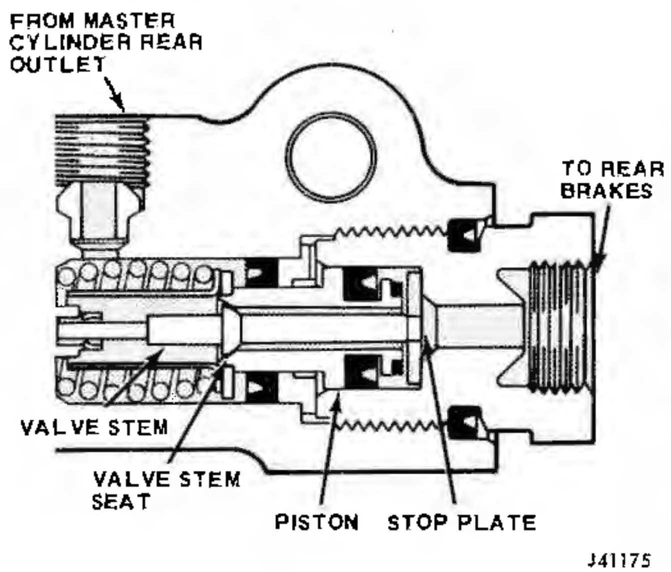

Fig. 9-19 High Pedal Pressure Application

Combination Valve Service - Cherokee, Wagoneer, Truck

The combination valve is not repairable. If any section of the valve is found defective, the entire valve assembly must be replaced.
When bleeding the brake system, the metering section of the valve must be held open. Refer to Brake System Bleeding for procedure.

BRAKE SYSTEM BLEEDING

All Models

The hydraulic system must be bled whenever a line has been disconnected or if air has entered the system. Brake system bleeding can be performed manually or with pressure equipment. Bleeder screws are provided at the calipers, wheel cylinders, and at the master cylinder on Cherokee, Wagoneer, and Truck models.

Manual Bleeding Procedure

(1) Clean any accumulated dirt from master cylinder cover.

(2) Remove master cylinder cover.

(3) Fill master cylinder if required and reinstall cover.

(4) Hold combination metering valve open as follows: on Cherokee, Wagoneer, and Truck models, loosen the front mounting bolt on the combination valve and insert the slotted end of tool J-23709 under the mounting bolt. Push in on the metering valve pin to hold it open and retighten the mounting bolt to hold tool J-23709 in (fig. 9-20). On CJ models, remove the brake warning switch wire, switch terminal, plunger and spring from the combination valve.

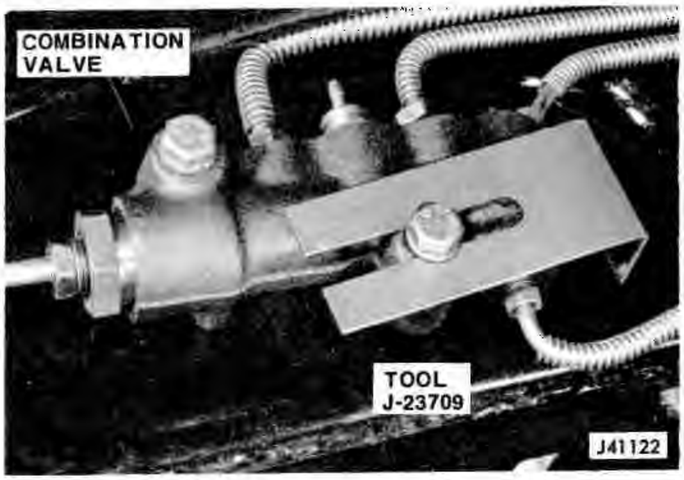

Fig. 9-20 Metering Section Hold-Open Tool Installed

(5) Bleed brake system in following sequence:
(a) Master cylinder (Cherokee - Wagoneer - Truck)
(b) Left front wheel
(c) Right front wheel
(d) Left rear wheel
(e) Right rear wheel

NOTE: *Correct bleeding procedure is as follows. Place wrench on bleeder screw. Install rubber hose on screw with free end of hose* **submerged** *in a transparent container that is partially filled with clear brake fluid. Open screw 3/4 of a turn. Have helper depress brake pedal. Close bleeder screw before pedal reaches end of travel. Have helper pump up pedal each time bleeder screw is closed to ensure a good surge of fluid at the bleeder screw when valve is reopened. Repeat bleed process until fluid comes out in a solid stream without the presence of air bubbles.*

CAUTION: *Do not allow master cylinder to exhaust its supply of brake fluid. Check fluid level frequently while bleeding, and refill as required. Do not bleed two wheels at a time, and do not bleed system with calipers or drums not in place.*

(6) Remove master cylinder cover and refill as required. Fill reservoir to within 1/4 inch of reservoir rim. Install cover. Make sure cover retainer is in place.

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(7) For Cherokee, Wagoneer, and Truck, remove combination valve tool. On CJ models, reinstall plunger, spring, and terminal in valve.

(8) Test brake operation before moving vehicle.

Pressure Bleeding Procedure

(1) Clean any accumulated dirt from master cylinder cover.

(2) Remove cover and rubber diaphragm seal. Place cover on work bench or on lint-free cloth. Do not allow diaphragm to contact dirt or foreign material.

(3) Fill master cylinder if required.

(4) Install brake bleeder adapter cover on master cylinder (fig. 9-21). Connect hose from pressure bleeder to fitting on adapter and open release valve on pressure bleeder.

(5) Hold combination metering valve open. On Cherokee, Wagoneer, and Truck models, install tool J-23709 as described in step (4) of Manual Bleeding Procedure (fig. 9-20). On CJ models, remove the brake warning switch wire, switch terminal, plunger, and spring from the combination valve.

(6) Bleed brake system in folling sequence.

(a) Master cylinder (Cherokee—Wagoneer—Truck).

(b) Left front wheel

(c) Right front wheel

(d) Left rear wheel

(e) Right rear wheel

NOTE: *When using pressure equipment, bleeding procedure is the same as outlined in step (5) of Manual Bleeding Procedure except that a helper is not required to depress the brake pedal. The pressure bleeder develops enough system pressure to permit bleeding without the use of the brake pedal.*

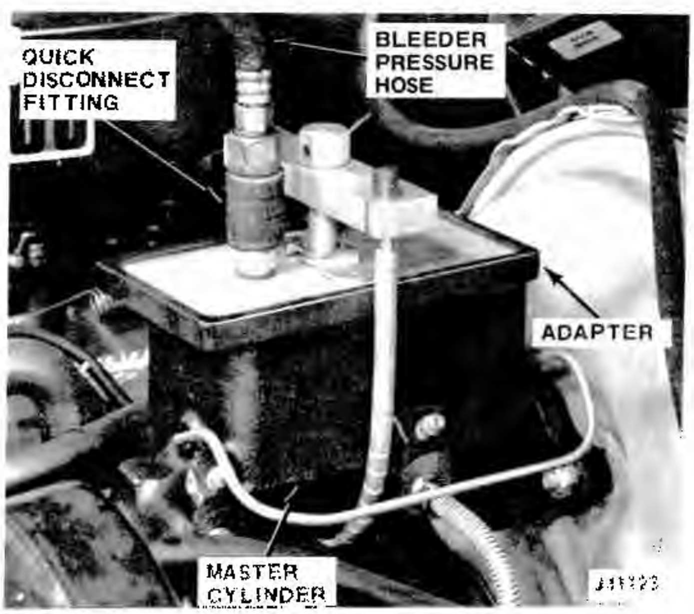

Fig. 9-21 Pressure Bleeder Adapter Installed

(7) When the system has been purged of all air, turn off the pressure bleeder and close the release valve.

(8) Disconnect the pressure bleeder hose at the adapter fitting and remove the master cylinder cover adapter.

(9) Refill master cylinder reservoirs to within 1/4 inch of reservoir rim.

(10) Install cover and rubber diaphragm. Make sure cover retainer is in place.

(11) On Cherokee, Wagoneer, and Truck remove combination valve tool and tighten mounting bolt. On CJ models reinstall plunger, spring, and terminal in valve.

(12) Test brake operation before moving vehicle.

DRUM BRAKES: ALL MODELS

Description:

The drum brake units consist of a support plate, two brake shoes, brake shoe return springs, adjuster operation parts, and a wheel cylinder (fig. 9-22, -23, -26).

The automatic adjuster continuously maintains correct operating clearance between the brake linings and the drums by adjusting the brakes in small increments in direct proportion to lining wear. This continuous adjustment prevents gradual increase in the brake pedal travel as the linings wear. The adjuster adds the safety feature of maintaining adequate pedal reserve during the service life of the lining.

After the lining wears enough to require adjustment, the adjusting cable (CJ Models) or actuating lever (J-models) will lift the lever into engagement with the next tooth of the star wheel when the brakes are applied. When the brake is released, the shoes return to the anchor.

The automatic-adjuster utilizes movement of the secondary shoes in a reverse brake application to actuate the adjuster mechanism.

This action will repeat on subsequent brake applications until the shoe-to-lining clearance is reduced to a point at which the shoe movement is not enough to cause the automatic adjuster to lift the lever to the next tooth.

The adjusting lever and adjusting screw assembly are left hand or right hand parts, **not** interchangeable, and **must** be kept separated.

DRUM BRAKE SERVICE-CJ MODELS

Disassembly

(1) Raise vehicle with hoist or floor jack. Support vehicle with frame stands if floor jack is used.

(2) Remove wheels and drums.

(3) Grasp adjusting lever with pliers and remove tang from hole in secondary shoe.

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(4) Place Brake Cylinder Clamps C-416 over wheel cylinders to hold pistons in place while shoes are being removed.

(5) Remove return springs with brake spring remover, Tool C-3785.

(6) Remove secondary return spring, adjuster cable, primary return spring, cable guide, adjuster lever, and adjuster springs.

(7) Remove holddown springs and brake shoes. On rear brakes, disengage parking brake cable from parking brake lever. (parking brake strut is removed with brake shoe assemblies).

CLEANING AND INSPECTION

Cleaning

For grease contamination, clean all parts, except the brake drums, with a suitable solvent.

For brake fluid contamination clean all parts with alcohol.

If type of contamination cannot be determined clean first with mineral spirits and then with alcohol. Final cleaning of all parts, especially the brake drums, should be done with a soap and water solution.

Inspection

Pull back wheel cylinder dust boot to inspect for leakage. If evidence of leakage is observed, the cylinder should be disassembled and inspected as described in Wheel Cylinder.

Polish ledges of the brake support plate with fine sandpaper or emery cloth. After polishing, if grooves exist which may restrict shoe movement, the brake support plate must be replaced. An attempt to remove the grooves by grinding may result in improper shoe to drum contact.

Inspect the lining wear pattern. If the wear accross the width of the lining is uneven, the drums should be checked for bell-mouthed condition, shoes inspected for correct positioning, and the support plate inspected for distortion. Inspect all springs for evidence of overheating (discoloration) and fractures. The self-adjusting cable should be inspected for kinks, fraying and an elongated eyelet.

Inspect the adjusting screw for freedom of rotation and the self-adjuster lever for wear and distortion.

Wheel Cylinders

(1) Inspect for evidence of leakage. Pull back dust boot and inspect condition of rubber piston cups and cylinder bore.

(2) Inspect bleeder screw and hydraulic line connection for evidence of leakage. Check brake lines for swelling, distortion, kinks, cracks.

(3) If wheel cylinders require overhaul proceed as follows:

(a) Disconnect brake line. Do not bend line away from wheel cylinder. When cylinder is removed from support plate, line will separate from cylinder easily.

(b) Remove cylinder mounting bolts and remove cylinder.

(c) Remove links and dust boots. Push piston cups, pistons, and expansion spring from cylinder bore. Clean all metal parts with brake fluid.

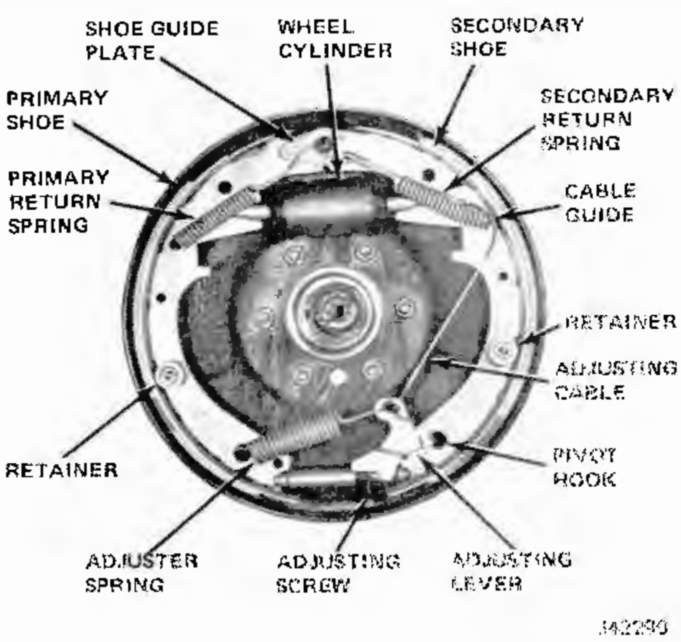

Fig. 9-22 Brake Assembly Components - Left Front

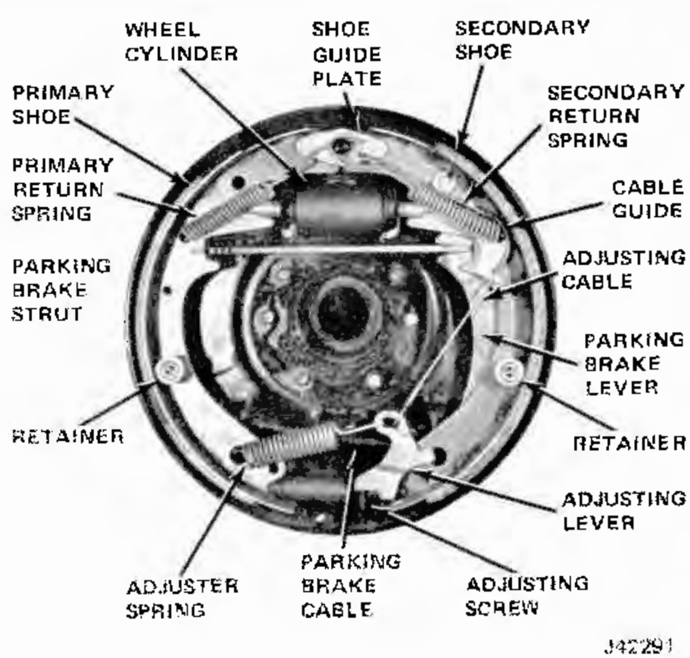

Fig. 9-23 Brake Assembly Components - Left Rear

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(d) If bore is corroded or pitted, replace wheel cylinder. If bore is only stained or discolored, it may be polished with crocus cloth. Do not polish in a lengthwise direction - polish by rotating cylinder around crocus cloth supported on fingers.

CAUTION: *Do not hone wheel cylinders. If polishing was performed, clean the cylinder thoroughly with brake fluid only.*

(e) Inspect pistons. If scored or worn replace them. If discolored or stained, pistons may be lightly polished with crocus cloth. Clean pistons thoroughly if they were polished.

(f) Coat cylinder bore with clean brake fluid. Do not lubricate pistons or cups. Reassemble wheel cylinder.

CAUTION: *Piston cups should have flat ends facing open ends of cylinder and flared ends of cups facing interior of cylinder.*

(g) Clean wheel cylinder mounting surface on support plate. Clean brake line fitting and threads.

(h) Start brake line fitting into wheel cylinder. Secure wheel cylinder to support plate and finish tightening brake line fitting. Tighten cylinder mounting bolts to 15 to 20-foot-pounds torque.

Support Plate

(1) Remove dirt using compressed air or cloth. Polish anchor pin with crocus cloth.

(2) Polish support plate ledges with emery cloth. If ledges have deep grooves or ridges which can restrict shoe movement, the support plate should be replaced. Do not attempt to reduce ridges or grooves by grinding.

(3) Inspect support plate for warpage or cracks.

(4) Check torque of support plate-to-axle flange bolts.

(5) Check anchor pin for wear or loose attaching part.

(6) Replace support plate if inspection reveals nonrepairable defect.

Brake Drums

(1) Clean dirt from drums. Compressed air and clean cloth may be used. Should drums require further cleaning, use soapy water solution only.

CAUTION: *Do not use brake fluid, gasoline, kerosene, or similar solvents to clean drums.*

(2) Inspect for scoring, cracks, heat checking, hard spots, distortion.

(3) Check drum for excess runout or bell-mouth condition. Perform this check with drum mounted on brake lathe. Use a dial indicator to obtain readings.

NOTE: *Brake drum radial runout must not exceed 0.005 inch. Lateral runout must not exceed 0.035 inch.*

(4) Based on findings of steps (1) through (3), replace or recondition drum as required.

CAUTION: *When machining drums, do not remove more than 0.060 inch. Maximum allowable oversize for any drum is 0.060 inch over original diameter.*

NOTE: *Hard spots in a drum should be removed by grinding. The normal cutting tool will ride over hard spots dulling the tool and leaving high spots on the surface.*

Assembly and Adjustment

IMPORTANT: *When it is necessary to replace brake shoes and linings on one wheel, the shoes and linings should be replaced on the opposite side (wheel) to maintain proper braking balance.*

(1) Before assembly lubricate support plate ledges, anchor pin, self-adjusting cable guide adjuster screw threads, and pivot with molydisulphide grease or chassis lubricant NLGI No. 2. Lubricate the parking brake cable lever located on the rear wheel secondary shoes.

(2) Position brake shoes on the brake support plate and install hold down springs.

(3) Place adjuster cable eyelet on anchor pin.

(4) Install primary return spring.

(5) Position cable guide and install secondary return spring (fig. 9-24).

(6) Install adjuster screw assembly. Place small hooked end of adjuster spring in large hole in primary shoe and place large hooked end of adjuster spring in adjuster lever.

(7) Place hooked end of adjuster cable over cable guide (fig. 9-22, -23).

(8) Grasp adjuster lever with pliers and hook adjuster lever tang in large hole in bottom of secondary shoe.

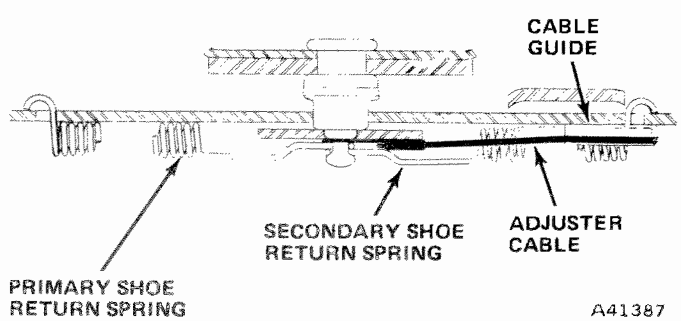

Fig. 9-24 Brake Shoe Spring Installation

(9) Perform initial brake adjustmant as follows: When the brake parts have been installed in their correct position, initially adjust adjusting screw assemblies so that approximately 3/8-inch of threads are exposed between star wheel and star wheel nut.

(10) Install Drums.

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NOTE: *If drums were installed before making initial adjustment, adjustment may be made manually by removing access slot cover and using a brake adjusting tool or screw driver to rotate star wheel until wheel is in locked position (fig. 9-25). To tighten, rotate star wheel in clockwise direction. Then back off star wheel at least 15 to 20 notches (clicks).*

To back off star wheel on brake, insert ice pick or thin blade screw driver in adjusting screw slot to hold lever away from adjusting screw. Back off on adjusting screw until wheel and drum turn freely. Replace adjusting hole cover.

CAUTION: *DO NOT attempt to back off on adjusting screw without holding adjuster lever away from screw as adjuster will be damaged.*

(11) If any brake lines were disconnected, bleed brakes as described in Brake System Bleeding.

(12) Install wheels and tires and lower vehicle.

(13) After initial adjustment and final assembly, check brake pedal height to ensure brake operation. Before moving vehicle.

(14) Drive car in reverse and forward, making 10 to 15 brake applications prior to road testing. This action balances the adjustment of the four brake units and raises the brake pedal to satisfactory height.

DRUM BRAKE SERVICE -Cherokee - Wagoneer - Truck

Disassembly

(1) Raise vehicle with hoist or floor jack. Support vehicle with frame stands if jack is used.

(2) Remove necessary wheels and drums. Release park brake and loosen locknuts at parking brake equalizer to relieve cable tension before removing rear drums.

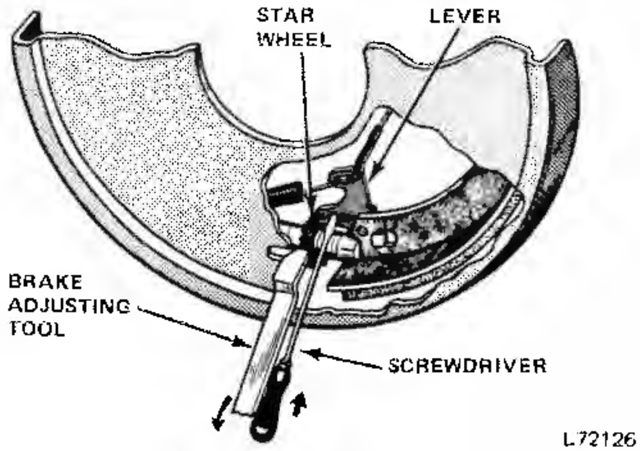

Fig. 9-25 Brake Shoe Adjustment

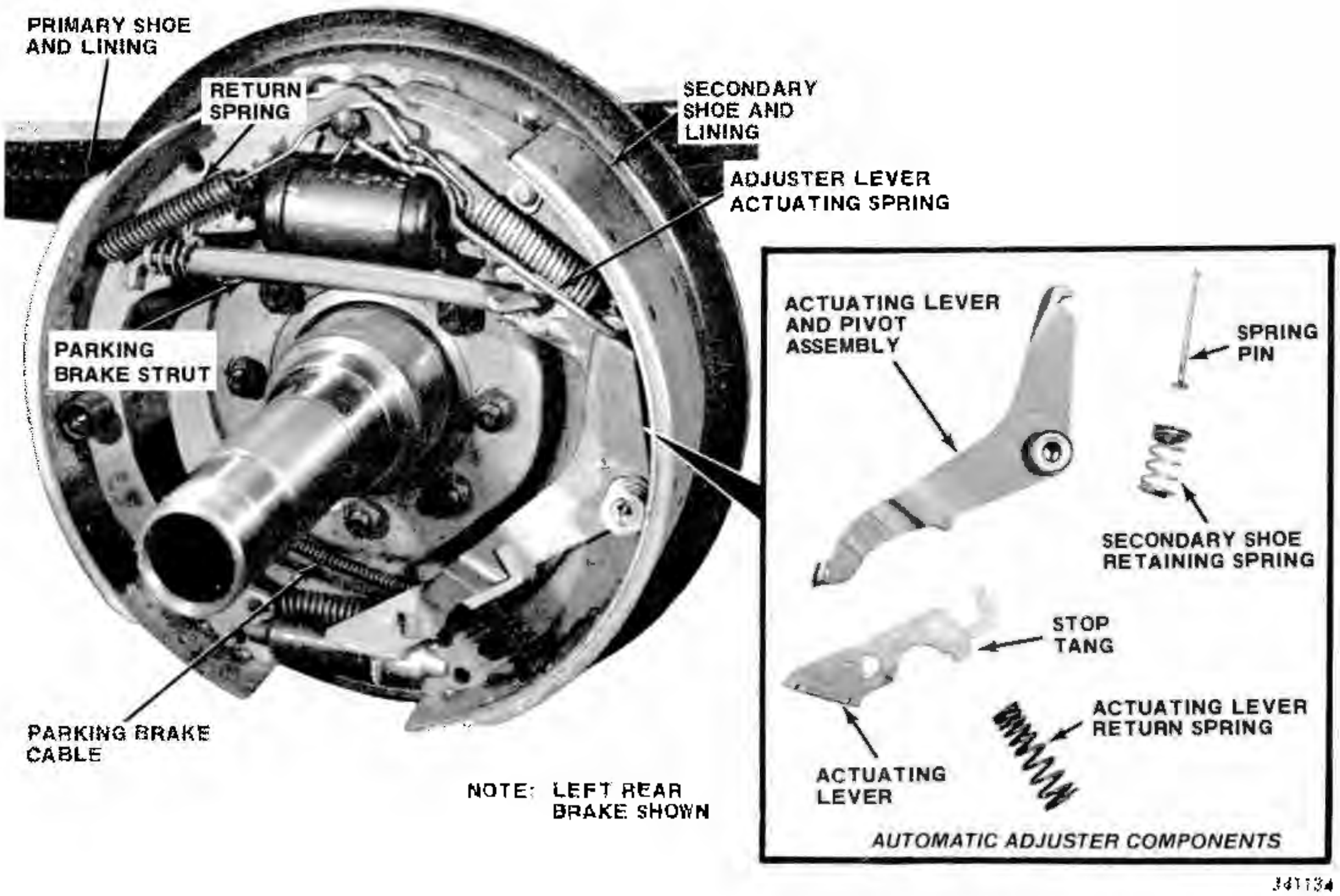

Fig. 9-26 Typical Drum Brake Assembly Cherokee, Wagoneer, Truck

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NOTE: *On trucks with Model 60 full float rear axle, the two screws that locate rear drums on hubs must be removed (fig. 9-27).*

Fig. 9-27 Locating Screw Removal - Model 60 Full Floating Axle

Remove primary shoe return spring (fig. 9-26, and 9-28). Remove automatic adjuster actuating spring and secondary shoe return spring with spring remover tool C-3785.

(4) Remove holddown springs and remove brake shoe assemblies. On rear brakes, disengage parking brake cable from parking brake lever. (Parking brake strut is removed with brake shoe assemblies) fig. 9-28.

(5) Place wheel cylinder clamps C-416 over wheel cylinders to retain pistons fig. 9-29).

Cleaning and Inspection

Brake Shoe Assembly

(1) Inspect lining wear. If worn to within 1/32 inch of rivet head, replace lining.

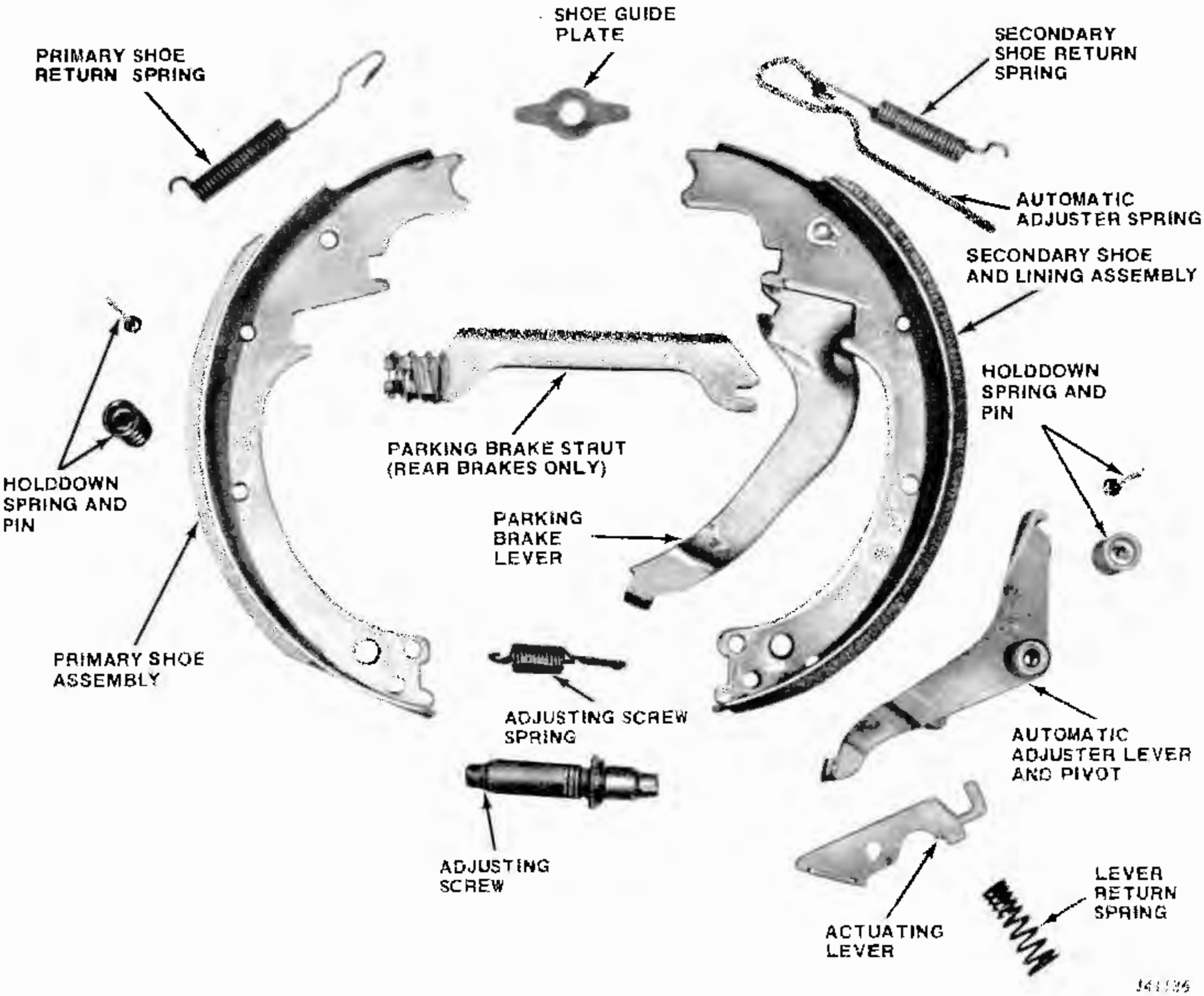

Fig. 9-28 Disassembled Drum Brake Assembly - Cherokee, Wagoneer, Truck (Rear Brake Shown)

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(2) Inspect lining wear pattern. If wear is uneven across width of lining, replace lining and check drum for bell-mouthed condition. If wear is uneven from top to bottom, replace lining and check drum excess runout.

(3) Inspect lining for cracks, charred surfaces, or broken rivets.

(4) Replace linings if throughly contaminated with brake fluid, axle lubricant, or similar contaminants.

NOTE: *Light surface contamination on reusable linings can be removed with alcohol (only).*

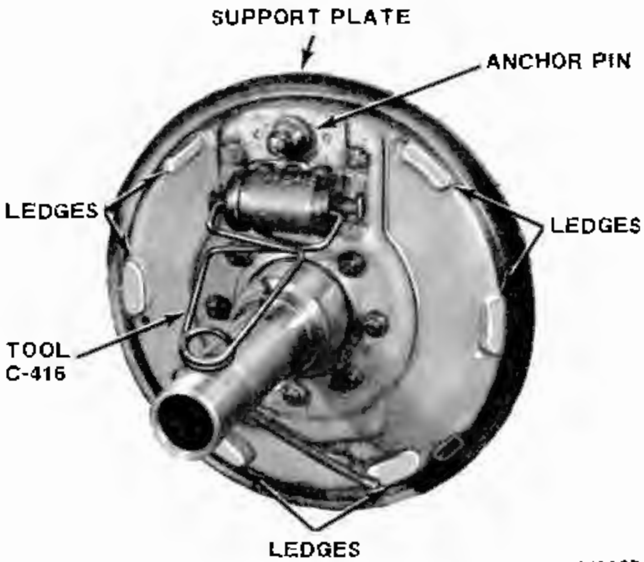

Fig. 9-29 Wheel Cylinder Clamp Installed

(5) Inspect adjusting screw spring, return springs, hold down springs, actuating lever return spring, and automatic adjuster spring. Replace springs if weak, broken or discolored (evidence of overheating causing tension loss).

(6) Inspect parking brake lever, automatic adjuster lever and pivot, and actuating lever for wear and defects. Replace levers if bent, broken, or excessively worn.

(7) Inspect adjuster screw for free operation. Screw should rotate freely. Inspect serrations on star wheel for excessive wear (which could effect proper automatic adjustment).

(8) Inspect parking brake cables for frayed condition. Check for missing or loose cable end retainer button. Inspect parking brake lever for distortion, worn pivot pin, proper cable retention, and proper cable operation.

Wheel Cylinders

(1) Inspect for evidence of leakage. Pull back dust boot and inspect condition of rubber piston cups and cylinder bore.

(2) Inspect bleeder screw and hydraulic line connection for evidence of leakage. Check brake lines for swelling, distortion, kinks, cracks.

(3) If wheel cylinders require overhaul proceed as follows:

(a) Disconnect brake line. Do not bend line away from wheel cylinder. When cylinder is removed from support plate, line will separate from cylinder easily.

(b) Remove cylinder mounting bolts and remove cylinder.

(c) Remove links and dust boots. Push piston cups, pistons, and expansion spring from cylinder bore. Clean all metal parts with brake fluid.

(d) If bore is corroded or pitted, replace wheel cylinder. If bore is only stained or discolored, it may be polished with crocus cloth. Do not polish in a lengthwise direction - polish by rotating cylinder around crocus cloth supported on fingers.

CAUTION: *Do not hone wheel cylinders. If polishing was performed, clean the cylinder thoroughly with brake fluid only.*

(e) Inspect pistons. If scored or worn replace them. If discolored or stained, pistons may be lightly polished with crocus cloth. Clean pistons thoroughly if they were polished.

(f) Coat cylinder bore with clean brake fluid. Do not lubricate pistons or cups. Reassemble wheel cylinder.

CAUTION: *Piston cups should have flat ends facing open ends of cylinder and flared ends of cups facing interior of cylinder.*

(g) Clean wheel cylinder mounting surface on support plate. Clean brake line fitting and threads.

(h) Start brake line fitting into wheel cylinder. Secure wheel cylinder to support plate and finish tightening brake line fitting. Tighten cylinder mounting bolts to 15 to 20 foot-pounds torque.

Support Plate

(1) Remove dirt using compressed air or cloth. Polish anchor pin with crocus cloth (fig. 9-29).

(2) Polish support plate ledges (fig. 9-29) with emery cloth. If ledges have deep grooves or ridges which can restrict shoe movement, the support plate should be replaced. Do not attempt to reduce ridges or grooves by grinding.

(3) Inspect support plate for warpage or cracks.

(4) Check torque of support plate-to-axle flange bolts.

(5) Check anchor pin for wear or loose attaching part.

(6) Replace support plate if inspection reveals nonrepairable defect.

Brake Drums

(1) Clean dirt from drums. Compressed air and clean

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cloth may be used. Should drums require further cleaning, use soapy water solution only.

CAUTION: *Do not use brake fluid, gasoline, kerosene, or similar solvents to clean drums.*

(2) Inspect for scoring, cracks, heat checking, hard spots, distortion.

(3) Check drum for excess runout or bell-mouth condition. Perform this check with drum mounted on brake lathe. Use a dial indicator to obtain readings.

NOTE: *Brake drum radial runout must not exceed 0.005 inch. Lateral runout must not exceed 0.035 inch.*

(4) Based on findings of steps (1) through (3), replace or recondition drum as required.

CAUTION: *When machining drums, do not remove more than 0.060 inch. Maximum allowable oversize for any drum is 0.060 inch over original diameter.*

NOTE: *Hard spots in a drum should be removed by grinding. The normal cutting tool will ride over hard spots dulling the tool and leaving high spots on the surface.*

Assembly and Adjustment

(1) Apply thin film of molydisulphide grease, or NLGI No. 2 chassis lubricant or lithium base lubricant to following parts (see fig. 9-28 and 9-29).

(a) Support plate ledges.

(b) Anchor pin.

(c) Adjuster screws threads and pivot

(d) Adjuster lever-to-secondary brake shoe contact surface.

(e) When assembling rear brakes, lubricate parking brake lever pivot and portion of lever that contacts secondary brake shoe.

(2) On rear brakes attach parking brake cable to parking brake lever on secondary shoe.

NOTE: *When installing parking brake lever on new shoe, deform (pinch) C-clip to retain lever on shoe.*

(3) Install secondary shoe and automatic adjuster lever and pivot as assembly. Secure assembly to support plate with hold-down spring.

(4) Install actuating lever and adjusting lever. Install return spring on actuating lever tang. Large end of tapered spring rests on brake shoe.

(5) Install primary shoe. Secure to support plate with holddown spring. Install guide plate on anchor pin.

(6) On rear brakes, install parking brake strut.

(7) Install adjusting screw and spring. Short hooked end of springs goes on primary shoe; long hooked end goes on secondary shoe (fig. 9-26).

(8) Install return springs and adjuster spring in the following sequence (figs. 9-26 and 9-28).

(a) Adjuster spring.

(b) Secondary shoe return spring (to shoe and adjuster spring)

(c) Primary shoe return spring.

NOTE: *After springs are installed, be sure shoes are properly located on anchor pin.*

(9) Perform initial brake adjustment as follows:

(a) Determine drum diameter with drum-to-brake shoe clearance gauge (fig. 9-30).

(b) Reverse gauge and place on brake linings (fig. 9-31). To adjust, turn star wheel on adjuster screw until gauge just slides over lining surface.

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Fig. 9-30 Using Drum-to-Shoe Clearance Gauge

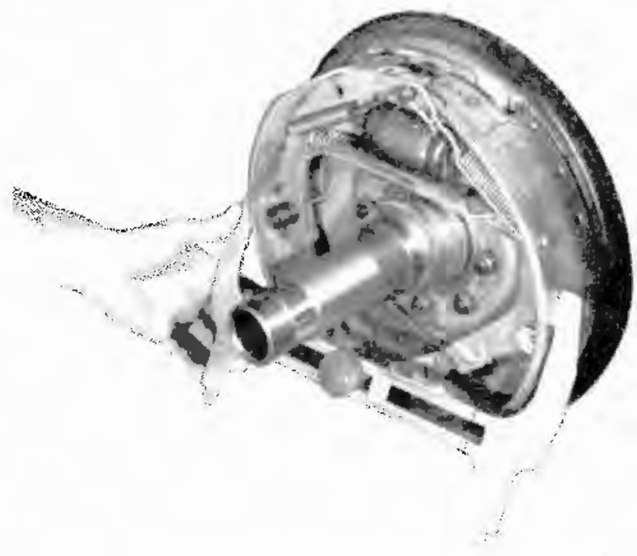

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Fig. 9-31 Checking Brake Shoe Lining Clearance

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(c) Rotate gauge around lining surface to ensure adequate clearance.

(10) If drum-to-shoe gauge is not available, initial brake adjustment may be performed as follows:

(a) Turn star wheel until drum slides over shoes with slight drag.

(b) With drum in place, back off star wheel 30 notches. Use brake adjusting tool to turn star wheel. Use screwdriver to push automatic adjuster lever away from wheel while adjusting. If access hole in support plate has a metal plug in it, knock out the plug to perform adjustment. Be sure to remove loose plug from drum and install rubber or metal plug in access hole to prevent brake contamination after adjustment is completed.

(11) Install brake drums.

(12) If any brake lines were disconnected, bleed brakes as described in Brake System Bleeding.

(13) Install wheels and tires and lower vehicle.

(14) Test brake operation before moving vehicle.

(15) Perform final brake adjustment by making a number of forward and reverse stops (using firm pedal effort) until a satisfactory brake pedal height is obtained.

CAUTION: *If vehicle has automatic transmission, do not use forward range to halt reverse motion of vehicle. This procedure will prevent the automatic adjusters from operating properly, resulting in unsatisfactory pedal heights. All stops must be completed.*

PARKING BRAKE ADJUSTMENT - All Models

NOTE: *Wheel brakes must be adjusted prior to adjusting parking brakes.*

(1) Release parking brake.

(2) Loosen lock nuts at equalizer and relieve tension on cables.

(3) Inspect all cables for binds, kinks, or frayed condition. Replace defective cables.

(4) Tighten cables until slight drag is produced at wheels.

(5) Loosen cables until wheels rotate freely and no drag is felt.

(6) Tighten locknuts at equalizer.

(7) Check operation of parking brake.

DISC BRAKES

Model Application

Floating caliper type front disc brakes (fig. 9-32) are standard on Wagoneer and heavy-duty (J-20) Trucks and are optional for Cherokee and light-duty (J-10) Trucks. A common disc brake caliper and 12.0-inch rotor are used on all models except that heavy-duty Trucks are equipped with a 12.5-inch disc brake rotor.

Description

The disc brake system consists of three assemblies: the caliper assembly, the hub and rotor assembly, and the support and shield assembly. The caliper (fig. 9-33) is a one-piece casting with the inboard side containing the single piston, the piston bore, and the bleeder screw and fluid inlet holes.

The piston bore contains the large single piston, the piston seal, and a dust boot. A groove is machined in the sidewall of the piston bore to accept the piston seal. This groove is slightly tapered, being shallower toward the bottom of the groove than at the top. The purpose of tapering the groove is to put more compression on the edge of the square-cut seal that is exposed to brake fluid pressure (fig. 9-34).

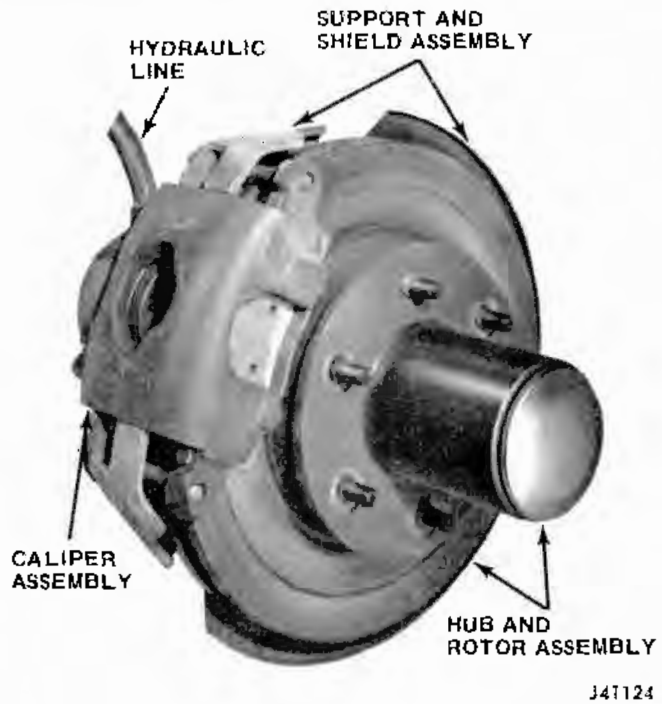

Fig. 9-32 Disc Brake Assembly

The top edge of the piston bore is counterbored to accept the dust boot seal retainer. The metal retainer part of the dust boot seal is pressed into the counterbore. The seal portion has a lip on it which fits in a groove machined in the outer surface of the piston.

The steel piston is hollow and its exterior surface is precision ground and nickle-chrome plated to provide a hard and durable surface.

CAUTION: *Do not sandpaper or machine the outer surface of the piston. Removal of the protective plating or altering the diameter could cause pitting, rusting, and eventual cocking of the piston in the bore.*

The piston bore does not contain a return spring; lining wear is automatically compensated for by the later-

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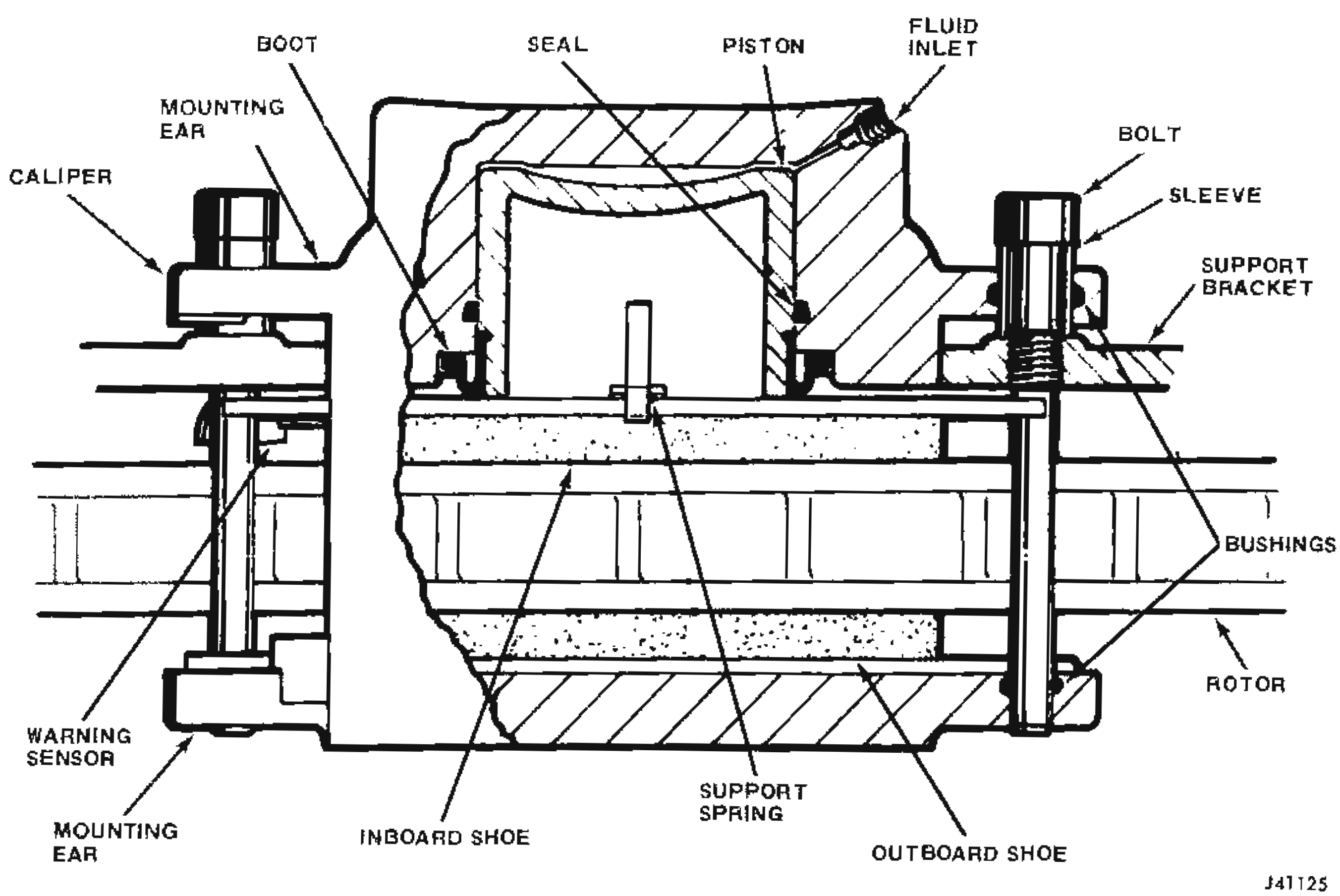

Fig. 9-33 Caliper and Rotor - Single Piston

al sliding movement of the caliper and increased piston extension (fig. 9-35).

The caliper assembly has two mounting ears at each end. Holes are machined into each of the ears, with the holes in the inboard ears being larger than the holes in the outboard ears. A groove is machined in the inside diameter of each hole to accommodate rubber bushings. A sleeve is assembled through each of the larger holes in the inboard ears (fig. 9-33). The caliper assembly is attached to the support bracket which is welded to, and is a part of, the disc brake shield. The disc brake shield and integral support bracket are bolted to the steering assembly.

Two special allen head support bolts are used to attach the caliper to the support bracket. The bolts are inserted through the sleeves (in the inboard mounting ear holes of the caliper), under the ears on the inboard shoe, and then through the outboard ears on the caliper. The threaded portion of the bolts heads are tightened against the sleeve ends. The caliper is then free to slide on the sleeves in the inboard ears and on the unthreaded portion of the bolt that fits in the outboard ears (fig. 9-33).

Each caliper contains a set of two shoe and lining assemblies, each assembly consisting of a stamped metal shoe and a lining riveted to the shoe (fig. 9-33).

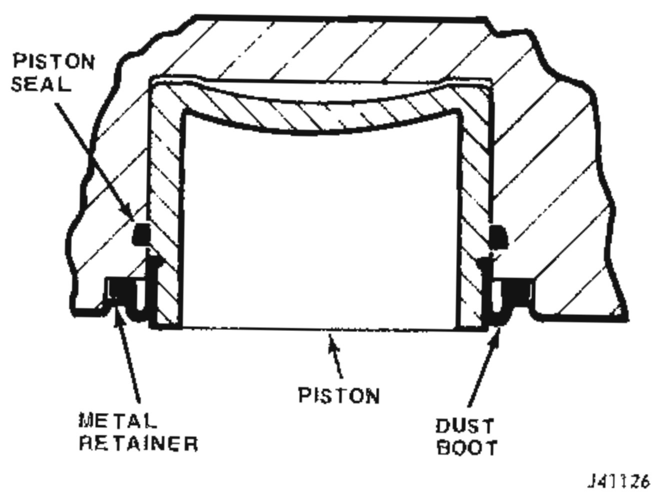

Fig. 9-34 Cross-Section of Caliper Cylinder and Piston

Installed in the caliper, the shoe and lining assemblies straddle the disc brake rotor. The inboard and outboard lining differ as follows:

(1) Inboard shoe and lining are slightly thicker.

(2) Outboard shoes have bent-over ears at top ends.

(3) Outboard shoes have large tab at bottom of shoe, bent at right angle to shoe.

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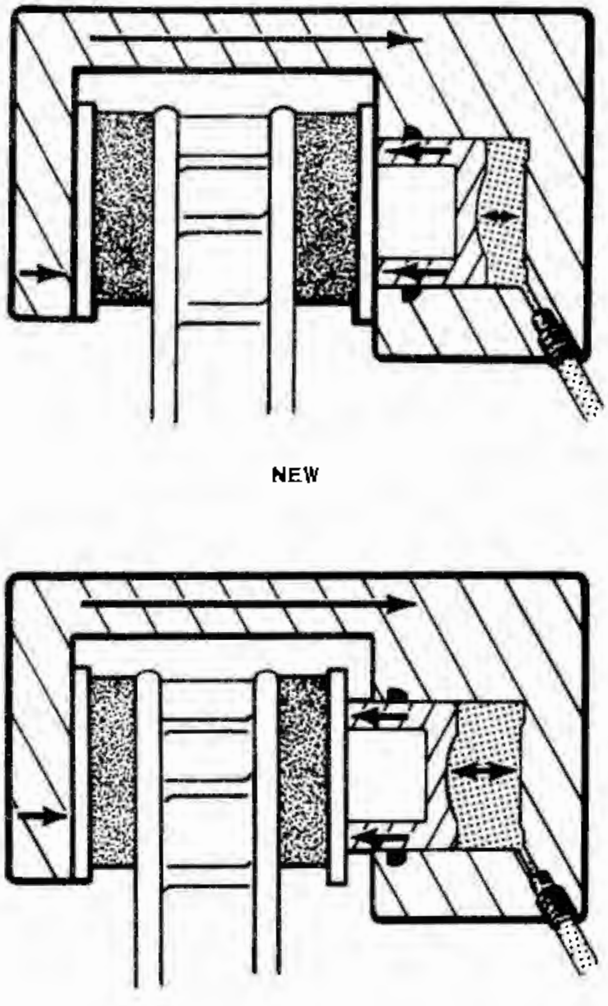

Fig. 9-35 Piston Travel - New and Worn Linings

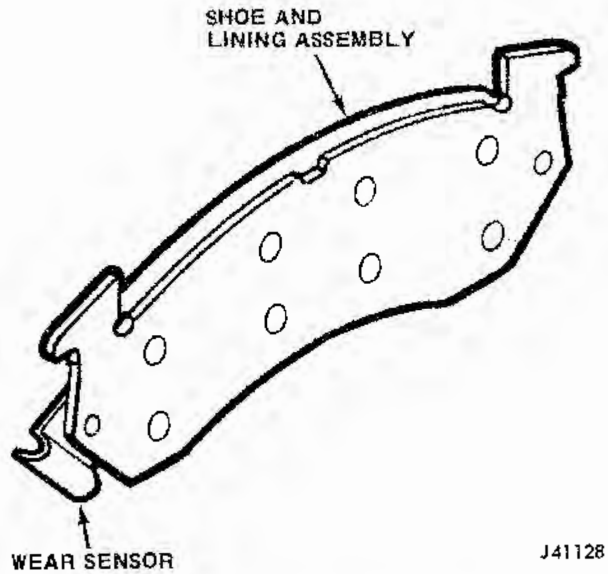

Fig. 9-36 Wear Sensor Location

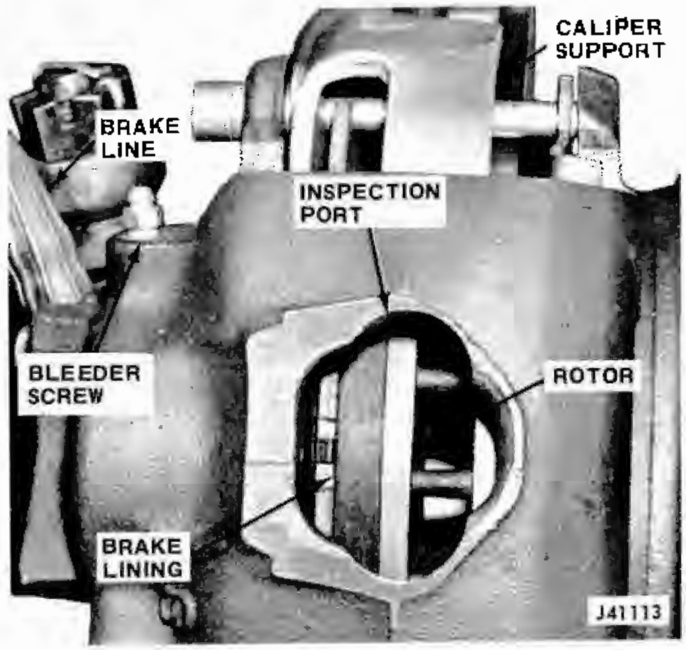

Fig. 9-37 Caliper Inspection Port

(4) Inboard shoe has ears on top which fit over retaining bolts.

(5) Inboard shoe has notch at top for support spring.

A warning (wear) sensor, a strip of flanged metal, is attached to the back of all disc brake shoes. When the lining has worn to the point of replacement, the sensor contacts the rotor surface and makes a highpitched screeching or scraping noise warning the driver that the shoe and lining assemblies are in need of replacement (fig. 9-36).

An inspection port is provided at the top middle of the caliper casting to facilitate visual inspection of lining condition and lining-to-rotor alignment (fig. 9-37).

Operation

The significant feature of the single-piston caliper operation is that it is free to slide laterally on the two mounting bolts which thread into the support bracket.

Figure 9-38 shows a simplified cross-section of the floating caliper, and the forces at work when the brakes are applied. Upon application of the brakes, the fluid pressure behind the piston increases. Pressure is exerted equally against the bottom surface of the piston and also against the bottom surface of the piston bore.

The pressure applied to the piston is transmitted to the inboard shoe and lining, forcing the lining against the inboard rotor surface. The pressure applied to the bottom of the piston bore forces the caliper to slide on the mounting bolts, toward the inboard side. This inward (toward the vehicle) movement of the caliper causes the outboard section of the caliper to apply pressure against the back of the outboard shoe and lining assembly, forcing the lining against the rotor surfaces with increasing force, bringing the vehicle to a stop.

Any application or release of pressure on the brake pedal causes only a very slight movement of the piston and caliper. Upon release of the pedal, the piston and

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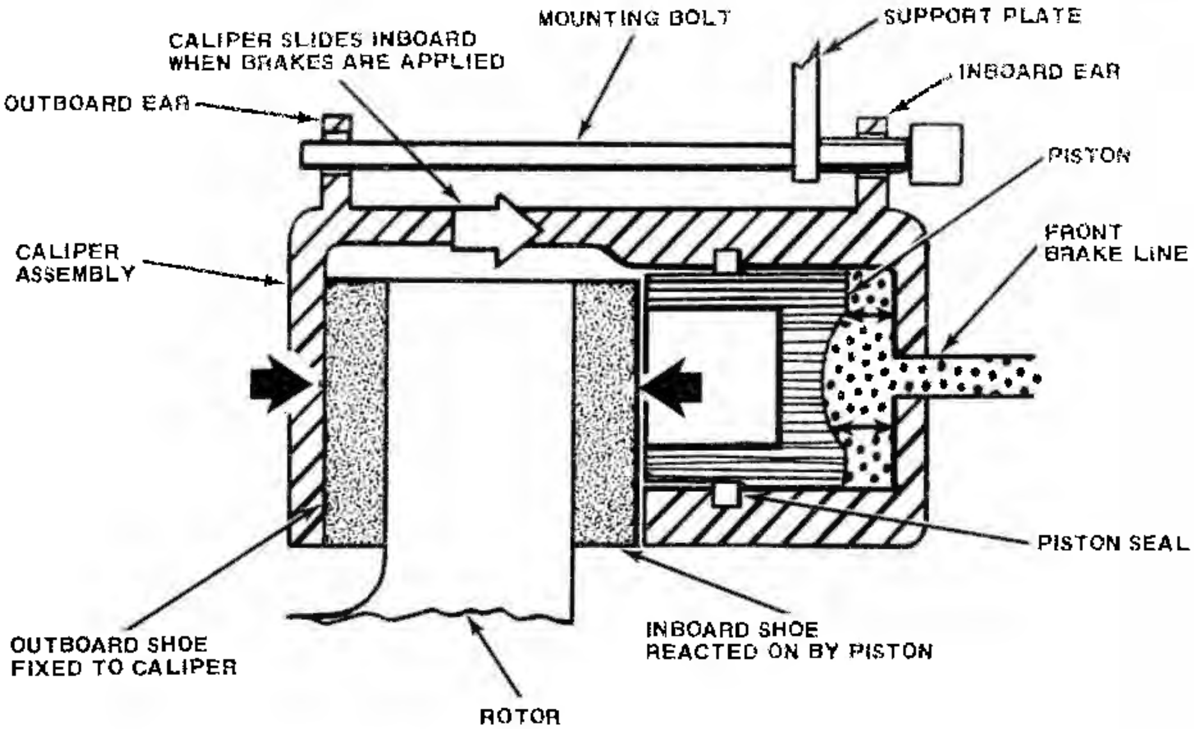

Fig. 9-38 Disc Brake Operation

caliper return to a rest position; the pads do not retract any appreciable distance from the rotor. This provides the advantages of improved brake response, reduced pedal travel, and faster generation of line pressure. Disc brakes also provide good fade resistance with fast recovery, and the shoes, being at zero clearance, wipe the rotor free of any foreign matter.

As the linings wear, the piston extends farther out of the caliper bore, and the caliper repositions itself on the mounting bolts to maintain the linings in proper relationship with the rotor. The caliper bore receives additional brake fluid to compensate for lining wear and the resulting longer extension of the piston (fig. 9-35). In this manner the caliper assembly maintains the inboard and outboard shoe and lining in the proper relationship with the rotor surface throughout the full life of the linings.

DISC BRAKE SERVICE

Disc Brake Shoe Replacement

(1) Drain two-thirds of the brake fluid out of front reservoir. Use bleeder screw at the front outlet port to drain fluid.

(2) Raise vehicle with hoist or floor jack. *If floor jack is used, support vehicle with frame stands.*

(3) Remove front wheel and tire assemblies.

(4) Place C-clamp on caliper (fig. 9-39). Solid end of clamp should contact back of caliper. Screw end should contact metal part of outboard shoes. Tighten clamp until caliper moves far enough to force piston to bottom of bore (this will back shoes off rotor surface, easing lining removal and installation). Remove C-clamp.

(5) Remove both allen head mounting bolts (fig. 9-40) and lift caliper off rotor. Rest caliper on front spring or other suitable support. Do not allow brake hose to support weight of caliper.

Fig. 9-39 Bottoming Piston with C-Clamp

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Fig.9-40 Removal of Caliper Mounting Bolts

(6) Remove both shoe and lining assemblies. Remove support spring from inboard shoe. Note spring position for correct installation later.

(7) Remove sleeves from inboard ears of caliper. Remove rubber bushings from all holes in caliper ears.

(8) Clean all mounting holes and bushing grooves in the caliper ears. Clean mounting bolts. Replace bolts if corroded or threads are damaged.

NOTE: *Do not use abrasives on bolts - they will destroy the protective plating on the bolts.*

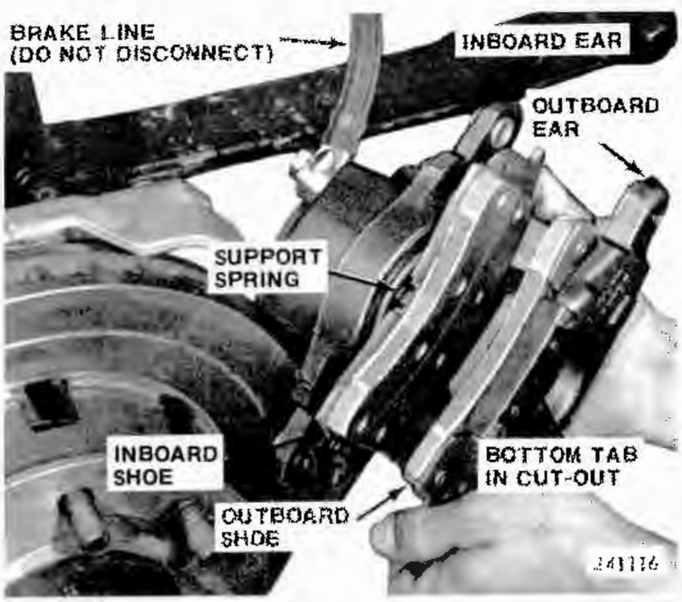

Fig. 9-41 Caliper Removal

Wipe inside of caliper clean, including exterior of dust boot. Inspect dust boot for cuts, cracks and for proper seating in piston bore. If evidence of fluid leakage is noted during inspection, the caliper should be overhauled.

NOTE: *Do not use compressed air to clean inside of caliper as it may unseat the dust boot seal.*

(9) Lubricate new bushings, sleeves, bushing grooves, and small ends of mounting bolts with a silicone lubricant. Install rubber bushings in all caliper mounting ears.

CAUTION: *Do not reuse old bushings and sleeves. Only new parts should be used to ensure that the caliper will operate properly.*

(10) Install sleeves in inboard mounting ears of caliper. Position sleeves so that sleeve end facing shoe and lining is flush with machined surface of mounting ear.

(11) Install support spring on inboard shoe. Place the single tang end of the spring over the notch in the shoe (fig. 9-42).

(12) Install inboard shoe in caliper (fig. 9-43). Shoe must lay flat against piston. Be sure support spring is fully seated in piston (fig. 9-41).

(13) Install outboard shoe in caliper. The ears on the shoe should rest on top of the ears in the caliper. The bottom tab on the shoe fits in the cutout in the caliper. Be sure shoe is fully seated (fig. 9-41).

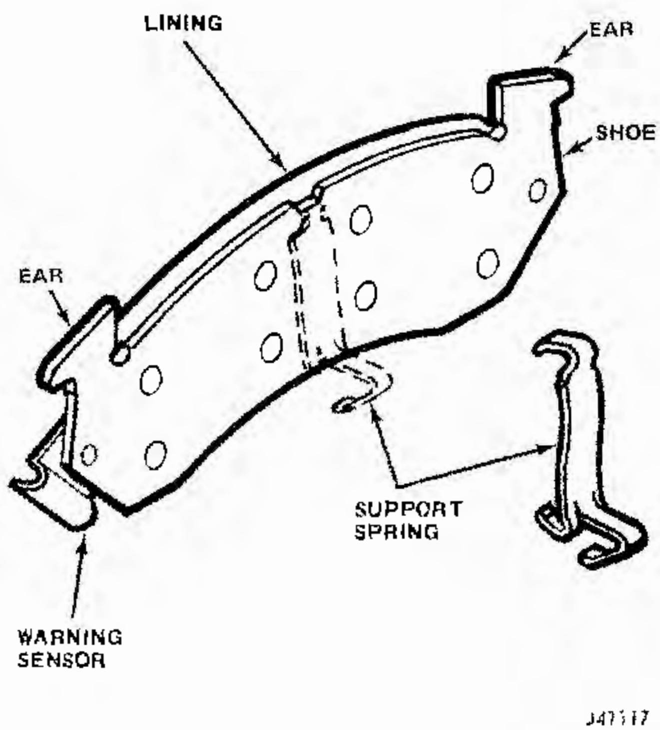

Fig. 9-42 Support Spring Installation

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(14) With shoes installed, position caliper over rotor. Line up mounting holes in caliper and support bracket and insert mounting bolts. Make sure bolts pass under retaining ears on inboard shoes. Push the bolts through until they engage holes of outboard shoe and caliper ears. Thread bolts into support bracket and tighten to 35 foot-pounds of torque.

(15) Fill master cylinder with brake fluid and pump brake pedal to seat shoes.

(16) Use channel-lock pliers to bend (clinch) both upper ears of outboard shoe until radial clearance between shoe and caliper is eliminated.

NOTE: *Outboard shoes with formed ears are designed for original installation only and are fitted to caliper. The shoes should never be relined or reconditioned for installation.*

(17) Install wheel and tire assemblies and lower vehicle.

(18) Check fill level on master cylinder. Add fluid as required to fill master cylinder to within 1/4 inch of rim on reservoir. Test brake operation before moving vehicle.

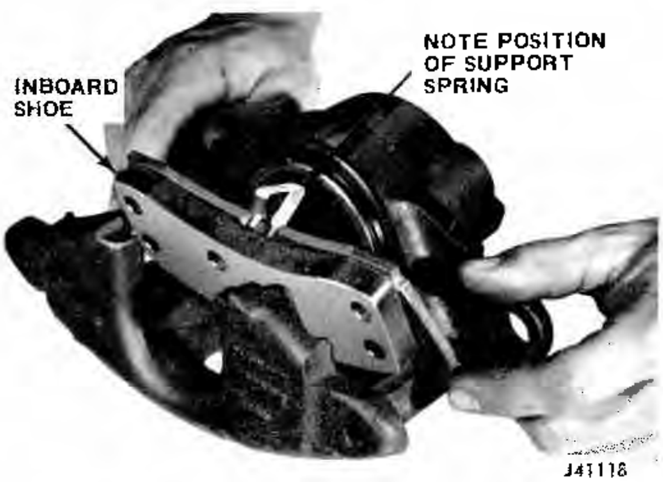

Fig. 9-43 Installation of Inboard Shoe

Caliper Overhaul

(1) Drain two-thirds of the brake fluid out of front reservoir. Use bleeder screw at outlet to drain.

(2) Raise vehicle with hoist or floor jack. If floor jack is used support vehicle with frame stands.

(3) Remove wheel/tire assemblies.

(4) Bottom caliper piston with C-clamp (fig. 9-39).

(5) Clean brake hose-to-caliper connection thoroughly. Remove hose-to-caliper bolt. Cap or tape open connections to keep out dirt. Discard copper gaskets.

(6) Remove caliper assembly and remove shoes from caliper.

CAUTION: *If shoes are to be reused, mark location on caliper.*

(7) Clean caliper exterior with clean brake fluid. Drain residual fluid from caliper. Place caliper on clean work surface.

WARNING: *Caliper piston removal requires use of compressed air. Do not, under any circumstances, place fingers in front of piston in an attempt to catch or protect it when applying compressed air to remove piston.*

(8) Pad the interior of the caliper with clean shop towels. Insert air nozzle into inlet hole in caliper and gently apply air pressure on piston to push it out of the bore (fig. 9-44).

CAUTION: *To eliminate possible piston damage, use only enough air pressure to ease piston out of bore. Do not blow piston out of bore.*

Fig. 9-44 Piston Removal

(9) Pry dust boot out of bore with screwdriver (fig. 9-45). Use caution during this operation to prevent scratching bore. Discard dust boot.

(10) Remove piston seal from piston bore and discard seal. Use only non-scratching implements such as a pencil, wooden stick, or piece of plastic to remove seal (fig. 9-46). Do not use a metal tool or similar object to remove seal as bore may be scratched.

(11) Remove bleeder screw. Remove and discard sleeves and rubber bushings from mounting ears.

(12) Clean all parts with clean brake fluid. Blow out all passages in caliper and bleeder valve. Use only dry

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and filtered compressed air. Replace mounting bolts if corroded or if threads are damaged.

CAUTION: *Do not attempt to clean bolts with abrasives, as the protective plating may be removed.*

Examine piston for defects. Replace piston if nicked, scratched, corroded, or protective plating has worn off.

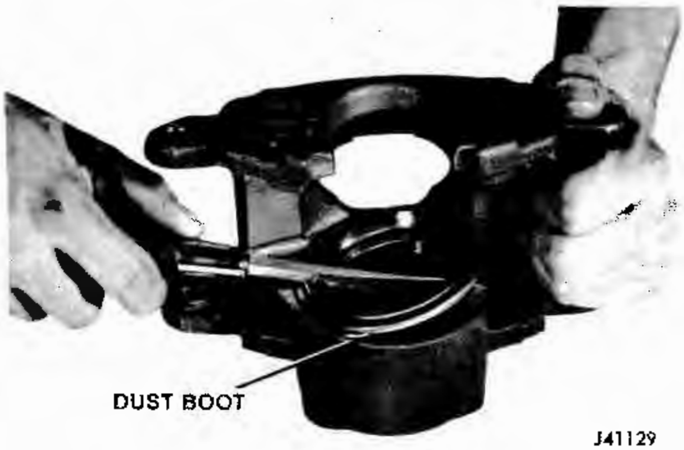

Fig. 9-45 Dust Boot Removal

Fig. 9-46 Piston Seal Removal

CAUTION: *Do not attempt to refinish piston in any way. The outside diameter is the sealing surface and is manufactured to very close tolerances; removal of the nickel-chrome plating will lead to pitting, rusting, and eventual cocking of the piston in the piston bore.*

Examine the caliper piston bore for the same defects as the piston. The bore is not plated, and minor stains or corrosion can be polished with crocus cloth.

CAUTION: *Do not use emery cloth or similar abrasives on piston bore. If bore does not clean up with crocus cloth, replace caliper. Clean caliper thoroughly with brake fluid if bore was polished with crocus cloth.*

(13) Lubricate bore and new seal with brake fluid and install seal in groove.

(14) Lubricate piston with brake fluid and install new dust boot on piston. Assemble dust boot into piston groove so that fold in boot faces open end of piston. Slide metal retainer portion of dust boot over open end of piston and push retainer toward back of piston until lip on fold seats in piston groove (fig. 9-47). Then push retainer portion of boot forward until boot is flush with rim at open end of piston and snaps into place (fig. 9-48).

(15) Insert piston in bore being careful not to unseat the piston seal. Push piston to bottom of bore (requires 50 to 100 pounds of force to bottom piston).

(16) Position dust boot retainer in counterbore at top of piston bore. Seat dust boot retainer with tool J-22904 (fig. 9-49).

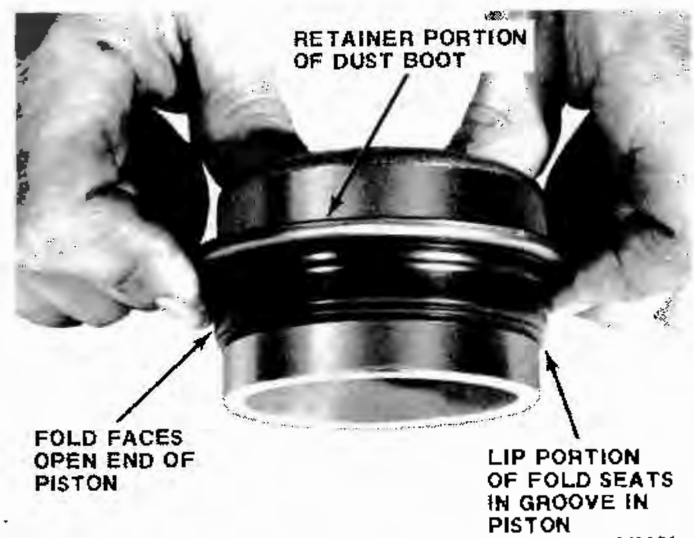

Fig. 9-47 Installing Dust Boot on Piston

Fig. 9-48 Snapping Dust Boot into Place

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Fig. 9-49 Seating Dust Boot Retainer

CAUTION: *Metal retainer portion of boot must be evenly seated in counterbore and fit below the face of the caliper.*

(17) Install bleeder screw. Tighten to 40 to 140 inch - pounds torque.

(18) Connect brake line to caliper using new copper gaksets. Tighten bolt 120 to 200 inch-pounds torque.

(19) Install shoe, sleeves, and rubber bushings as outlined under Disc Brake Shoe Replacement.

(20) Install caliper over rotor. Secure caliper to support bracket as outlined under Disc Brake Shoe Replacment. Tighten mounting bolts to 35 foot-pounds torque.

(21) Bleed brakes as outlined in Brake System Bleeding.

(22) Install wheel and tire assemblies and lower vehicle.

(23) Test brake operation before driving vehicle.

Hub and Rotor Assembly

The hub and rotor assembly is cast as a single unit. The hub section contains the wheel bearings and wheel mounting studs. The rotor section is hollow cast, with integral cooling fins, and provides the contact surface against which the disc brake shoes are applied. The integral hub and rotor are serviced as an assembly; if either section is found to be defective, the complete assembly should be replaced.

Rotor Service

Rotor service is of extreme importance since rotor tolerances must be accurate to ensure proper brake operation. Service procedure involves three basic steps:

- Inspection
- Measurement
- Refinishing (or replacement where indicated)

Rotor Inspection

Check rotor for surfaces cracks, nicks, broken cooling fins, and scoring of both contact surfaces.

NOTE: *Some scoring of the surface may occur during normal use. Scoring that is 0.015 inch deep or less is not detrimental to brake operation.*

Rotor Measurement

The rotor surfaces must meet the following specifications.

NOTE: *If rotor brake surfaces is heavily rusted or scaled, clean both surfaces on a disc brake lathe, using flat sanding discs, before attempting measurements.*

(1) **Hub-to-Rotor Squareness.** Both surfaces must be square with bearing cup centerline within 0.003 inch (total), dial indicator reading. To check, mount hub and rotor to lathe using bearing cups (fig. 9-50).

CAUTION: **Do not** *mount on hub surfaces.*

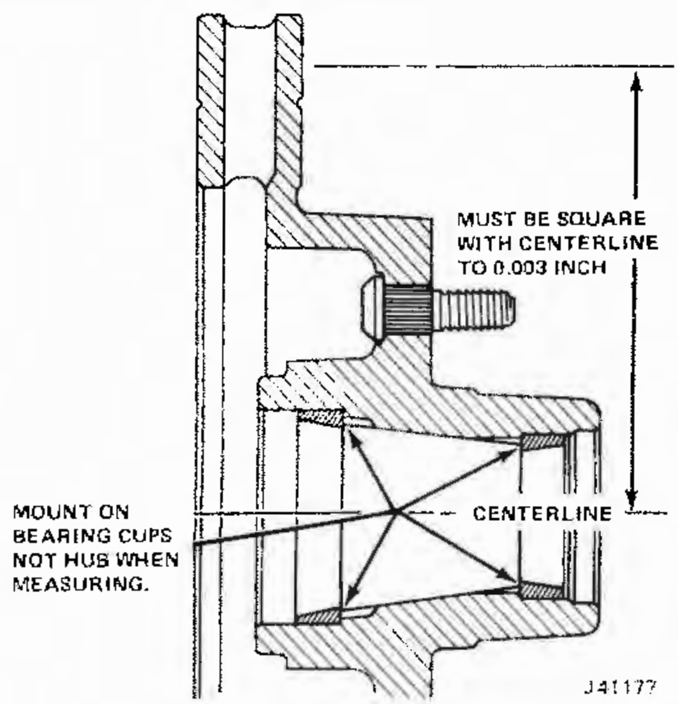

Fig. 9-50 Checking Surface Parallelism

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(2) **Surface Flatness (Taper Variation).** Both surfaces must be flat within 0.003 inch (total) dial indicator runout. Failure to meet this specification indicates surface tapering, which can cause shoes to wear on an angle (fig. 9-51).

(3) **Parallelism.** Surfaces must be parallel within .003 inch (total), dial indicator runout. Rotor surfaces not parallel within specification will cause shoes to wear on an angle (fig. 9-52).

(4) **Lateral Runout.** Lateral runout must not exceed 0.005 inch (total). Dial indicator runout, with maximum rate of change not to exceed 0.001 inch in 30 degrees (fig. 9-53).

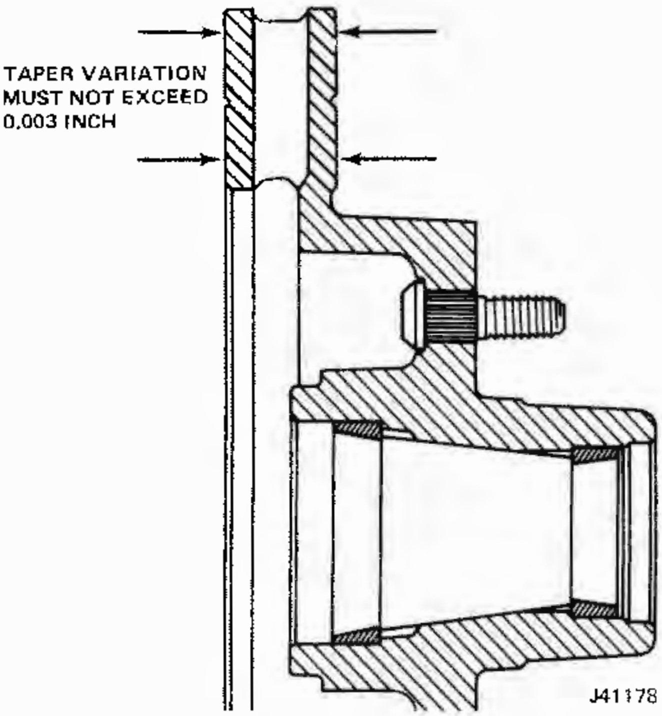

Fig. 9-51 Checking Surface Flatness (Taper Variation)

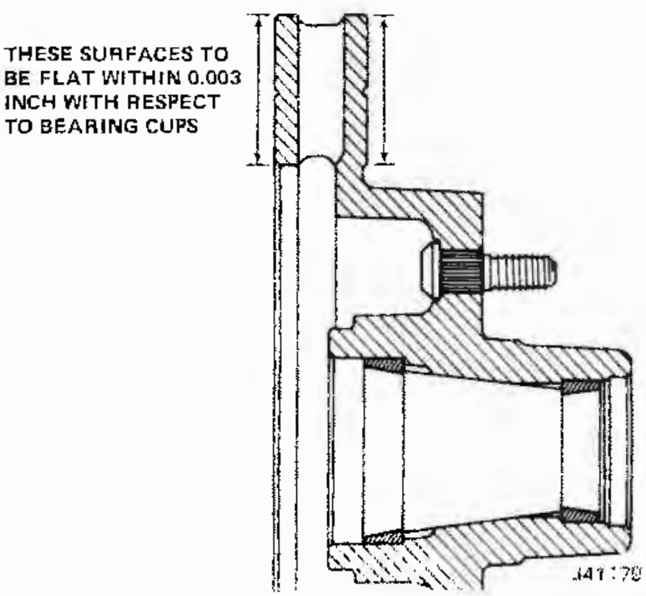

Fig. 9-52 Checking Surface Parallelism

Excessive runout will cause the rotor to wobble and knock piston back into caliper causing increased pedal travel, and also cause noise and vibration. When checking lateral runout, be sure all play is removed from wheel bearings; this applies if check is performed on vehicle or on disc brake lathe.

(5) **Thickness Variation.** Total thickness variation at any radius must not exceed .001 inch in 360 degrees. Use pair of dial indicators or micrometer to obtain reading.

Variations in rotor thickness will cause pedal pulsation. Thickness must be checked at a minimum of four points around the circumference of the rotor. All measurements must be made at same distance in from edge of rotor. See figure 9-54.

Rotor Refinishing

Resurface rotor on brake lathe using flat sanding discs only if scoring is light (0.015 inch deep or less), if rotor surfaces have heavy rust and scale, and only if rotor meets all measurement specifications listed under Rotor Measurement.

Fig. 9-53 Checking Lateral Runout

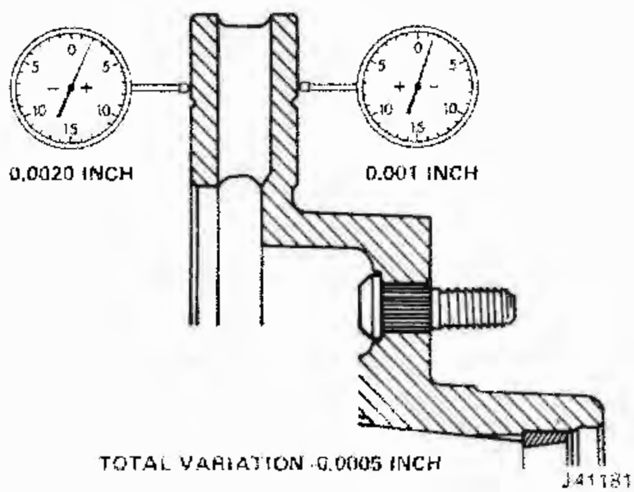

Fig. 9-54 Checking Thickness Variation

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Refinish rotor on disc brake lathe if scoring is deeper than 0.015 inch, or if runout, flatness, parallelism and thickness variation exceed specifications listed under Rotor Measurement.

NOTE: *Rotor finish should be 20 to 60 micro-inches and not be directional. After turning the rotor is a disc brake lathe, flat sanding discs should be used as a final step in the refinishing procedure to provide the desired microfinish and cross-hatch pattern on the rotor surface (fig. 9-55).*

Fig. 9-55 Correct Surface Finish - Non-Directional Cross-Hatch Pattern

Replace The rotor if refinishing will cause the rotor to fall below the minimum thickness specifications as follows:

Minimum Thickness after Refinishing	Replacement Thickness Specification
1.230 inch (Acceptable)	1.215 inch (Discard)

STOPLIGHT SWITCH-CJ MODELS

The stoplight switch is attached at the pedal lever end of the master cylinder or power unit push rod and cannot be adjusted. If, after normally releasing the pedal, the switch remains on, check for binding linkage or pivot pins. If switch is defective, replace switch as an assembly. Do not attempt to repair.

STOPLIGHT SWITCH - Cherokee, Wagoneer, Truck

The stoplight switch is mounted on a flange attached to the brake pedal support bracket (fig. 9-56). A spring loaded plunger in the switch makes and breaks the stoplight circuit.

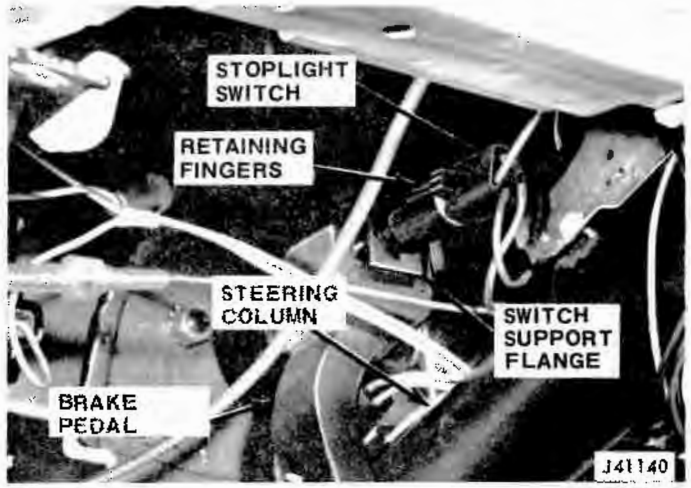

Fig. 9-56 Stoplight Switch Location

When the brake pedal is in the released position, the pedal arm contacts the switch plunger, holding it in the off position. When the brake pedal is depressed, the spring-loaded plunger extends with brake pedal movement until the switch is in the on position (fig. 9-57).

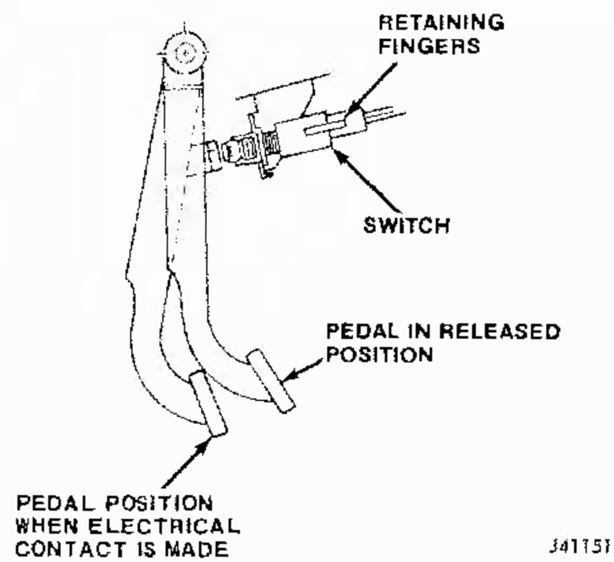

Fig. 9-57 Stoplight Switch Operation

Switch Adjustment

(1) Release brake pedal to its normal position. Unhook retaining fingers that secure wire harness plug to switch and disconnect wire harness plug at rear of switch.

(2) Adjust switch by turning in or out of mounting bracket. Switch plunger should be in ON position and activate stop lamps after 3/8 to 5/8 inch of brake pedal travel. Measure pedal travel from center of pedal pad.

(3) Connect wire harness plug.

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BRAKE PEDAL AND LINKAGE - All Models

The one-piece suspended brake pedal is connected to the under-dash support bracket by the brake pedal shaft. The shaft serves both as an attaching part and as a pivot for the brake pedal.

The brake pedal linkage to the master cylinder piston (or brake booster push rod, if equipped with power brakes) should be lubricated and inspected regularly for binding, looseness, or excess play. Lack of lubrication can cause binding and improper pedal release which can result in brake drag and rapid lining wear. Worn pedal linkage can cause low pedal or frequent need for brake adjustment.

Pedal free play should be 1/16 to 1/4 inch for standard height pedal. Too little free play can result in brake drag or grab conditions; too much free play can result in a low pedal. Pedal free play on CJ, Cherokee, Wagoneer and Truck models with non-power brakes is governed by the brake pedal push rod length which is preset at manufacture. Push rod length is not adjustable on these models, and under normal circumstances should not require further attention. Power brake equipped vehicles utilize a single push rod in the power unit which is adjustable on some CJ models and non-adjustable on Cherokee, Wagoneer, and Truck models having a preset length. When replacing power brake booster units, use the push rod supplied with the new power booster unit as it has been properly gauged and preset for use with the new power unit. Pedal free play for power brake-equipped vehicle is the same, at 1/16 to 1/4 inch, as for manual brake vehicles.

WHEELS AND TIRES

WHEEL BALANCING

Wheel balancing with the wheel on the vehicle is recommended in all cases except as follows:

If the vehicle is equipped with a Trac-Lok axle, wheels on this type axle must be removed and balanced off the vehicle.

When balancing with the wheel on a vehicle equipped with the Model 20 transfer case, shift the transmission and transfer case into the neutral position.

When balancing with the wheels on a vehicle equipped with Quadra-Trac, disconnect the front or rear propeller shafts (as required).

WHEEL BEARING SERVICE- All Models

Adjustment of the wheel bearings is critical because it establishes the running clearance of the wheel bearings. Wheel bearing adjustment that is too tight preloads the bearings and causes them to run hot. Loose wheel bearings permit the drum hub to shift its position on the bearings as thrust loads vary with acceleration, braking, and cornering.

Loose bearings also cause erratic braking. To check the wheel bearings for adjustment, brakes must be free and in fully released position.

Checking Front Wheel - All Models

Bearings

(1) Raise front end of vehicle with jack so that tires clear floor.

(2) Grip tire and test sideways shake of wheel. If bearings are correctly adjusted, shake of the wheel will be just perceptible and wheel will turn freely with no drag.

(3) If bearing adjustment is too tight, rollers may break or become over-heated. Loose bearings may cause excessive wear and noise.

(4) If this test indicates bearing adjustment is necessary, follow procedure given below.

(5) Loose bearings will cause a side-ways shake that is evident around entire circumference of wheel. A shake that is evident only when gripping wheels in a plane parallel to ground, but not evident around entire circumference, probably indicates looseness in steering linkage.

Front Wheel Bearing Adjustment - CJ Models

With vehicle on jack, use following procedure to adjust front wheel bearings on four wheel-drive vehicles.

(1) Remove hub cap, snap ring, capscrews, and washers that attach driving flange to the hub (fig. 9-58).

(2) Using Front Axle Shaft Drive Flange Puller W-163, pull driving flange.

(3) Bend lip of lockwasher so that locknut and lockwasher may be removed.

(4) Using Tool W-144 or DD-1241, rotate wheel and tighten adjustment nut until wheel binds.

NOTE: *Front tire and wheel must be rotated by hand as the adjusting nut is tightened to ensure positive seating of the bearing.*

(5) Back off adjusting nut about one-sixth turn making sure that wheel rotates freely without side-wise shake.

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(6) Replace lockwasher and locknut, bend lockwasher lip.

(7) Check adjustment.

(8) Assemble driving flange and hub cap. Make certain gasket is properly installed between hub and flange.

Front Wheel Bearing Adjustment - Cherokee, Wagoneer, Truck

(1) Remove hubcap, snap ring, drive gear, pressure spring, outer locknut, and lockwasher.

(2) Loosen inner wheel bearing adjusting nut (nut has peg on side).

(3) Tighten inner wheel bearing adjusting nut to 50 foot-pounds torque with wheel bearing wrench W-372.

(4) Rotate hub, then back off inner wheel bearing adjusting nut 1/4 turn (maximum).

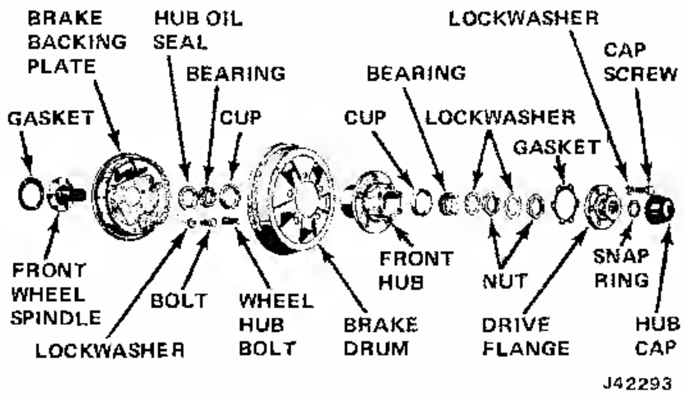

Fig. 9-58 Front Wheel Attaching Parts, CJ Models

(5) Install lockwasher with inner tab lined up with keyway in spindle and turn inner wheel bearing adjusting nut until the peg engages the nearest hole in the lockwasher.

(6) Install outer locknut and tighten to 50 foot-pounds torque (minimum) using wheel bearings wrench W-372.

Checking Rear Wheels - All Models

Place a jack under the axle housing. Shake the wheel. If bearings are correctly adjusted, shake will be just perceptible and the wheel will turn freely.

Rear Wheel Bearing

Adjustment - Flanged Axle - All Models (Except 8000 GVW Truck)

Flanged Axle Shaft - Semi-Float Axles

Vehicles equipped with the flange type rear axle (fig. 9-59) shaft require no wheel bearing adjustment. The flanged axle shaft is equipped with a single row, pre-adjusted, tapered roller unit-bearing capable of accepting thrust in either direction. The unit-bearing adjustment is built in at the factory making shimming or bearing adjustment unnecessary. Refer to Fig. 9-61.

(1) Remove axle shaft (fig. 9-60).

(2) Bend lip of lockwasher so that locknut and lockwasher may be removed.

(3) Jack up wheel so it can be rotated. Use an axle stand under axle.

(4) Rotate wheel and tighten adjusting nut with Tool DD-1245 until wheel binds. Then back off about one-sixth turn until wheel rotates freely without side shake.

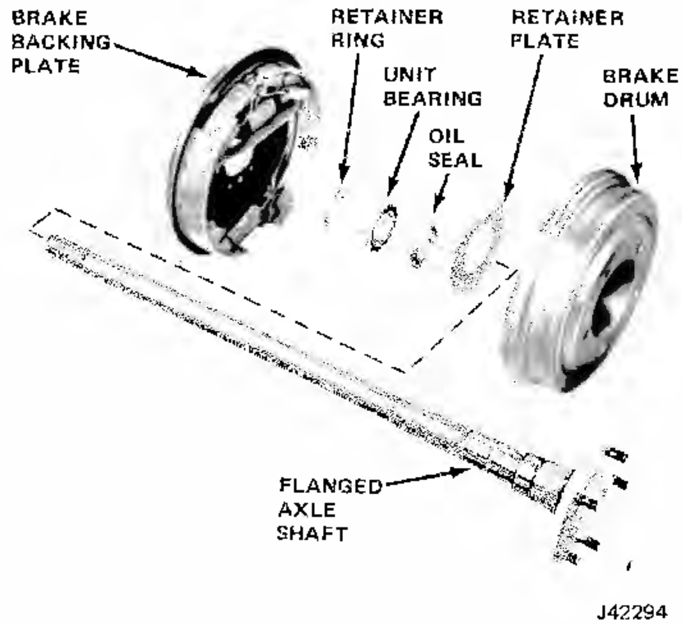

Fig. 9-59 Rear Wheel Attaching Parts - Flanged Axle

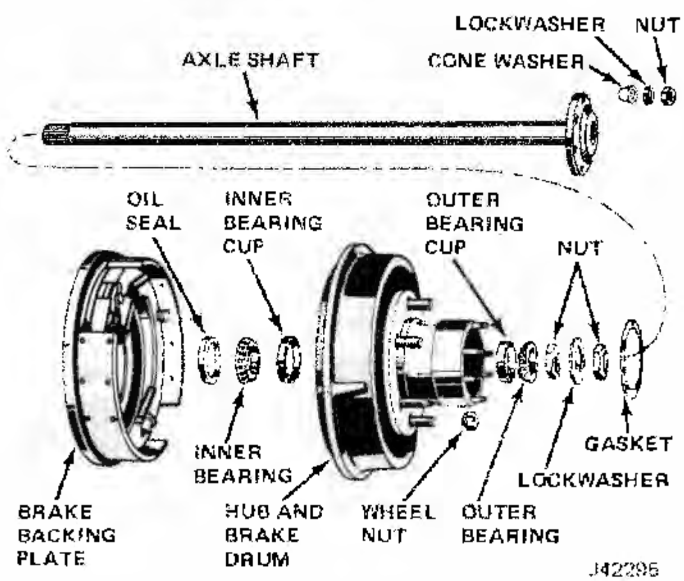

Fig. 9-60 Rear Wheel Attaching Parts - Full-Float Axle (8000 GVW Truck)

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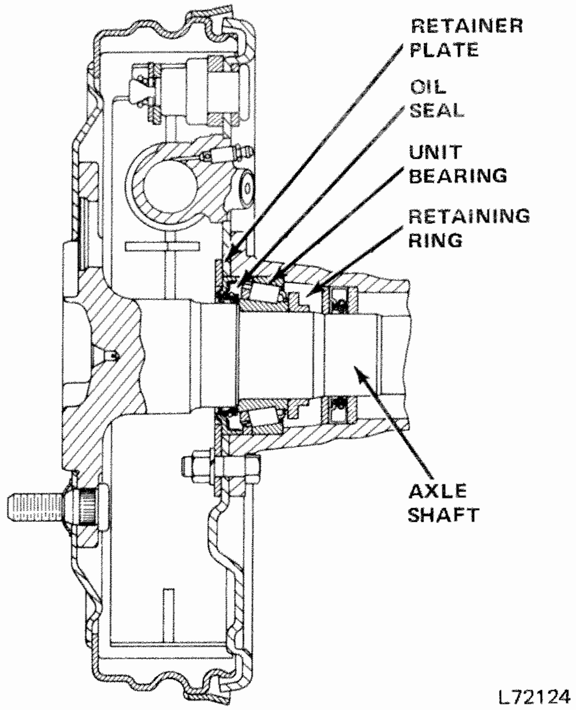

Fig. 9-61 Rear Wheel, Flanged Axle and Bearing Assy.

(5) Replace locknut and bend lockwasher lip.
(6) Recheck adjustment.
(7) Install axle shaft.

TIRES

Tire Service

One of the most important factors of safe vehicle operation is systematic and correct tire maintenance. Tires must sustain the weight of a loaded vehicle, withstand more than ordinary rough service, provide maximum safety over all types of terrain, and furnish the medium on which the vehicle can be maneuvered with ease. Although there are other elements of tire service, inflation maintenance is the most important and in many instances the most neglected. The tire pressure should be maintained for safe operation. An underinflated tire is dangerous as too much flexing can cause breakage of the casing. Overinflation will cause a harsh ride and may in time cause a blowout.

Upon careful inspection of tires, it may be found that improper wheel alignment, balance, grabbing brakes, poor driving habits, fast cornering, or other conditions are the cause of wear. Such conditions should be corrected.

Underinflation

Underinflation distorts the normal contour of the tire body and the tire bulges or "bellies out" with an extreme flexing action. This wears the tread at the edges more than the center and generates excessive internal heat, weakening the cords and resulting in bruises, broken cords, or ply separation. Underinflation also leads to rim bruises as insufficient resistance is provided to prevent the tire from being jammed against the rim and crushed or cut when the tire strikes a curb, rock, or rut.

Overinflation

When a tire is overinflated, increased tension caused by excessive pressure prevents proper deflection of the sidewalls. This results in wear in the center of the tread and the tire also loses its ability to absorb road shocks. Under this increased strain, cords in the tread area eventually snap under impact, causing a casing break.

Misalignment

Excessive wheel camber causes the tires to run at an angle to the road and results in excessive wear on one side of the tire tread.

Front wheels should be straight ahead or with a very slight toe-in. When there is excessive toe-in or any toe-out, tires will revolve with a side motion and scrape the tread off. Front tires will show wear on the outside with too great a toe-in condition and on the inside with a toe-out condition. Improper toe will also cause a featheredge to develop across the tread surface.

Balance

Cupping or bald spotting of tires is associated with wear on a vehicle driven mostly at highway speeds without the recommended tire rotation or balance.

Tire Removal and Installation

To remove a tire from a drop center rim, first deflate completely and then force the tire away from the rim throughout the entire circumference until the bead falls into the center of the wheel rim. If the vehicle is equipped with tires that use an inner tube, carefully remove the inner tube. With the inner tube removed, or on tubeless tires, a tire removing tool should be used to remove the tire from the rim.

Installation of the tire is made in the same manner first dropping one side of the tire into the center of the rim and with a tire tool raise the bead over the wheel rim. The inner tube can now be installed on vehicles so equipped.

When mounting the wheel, alternately tighten opposite stud nuts. After the nuts have been tightened with the wheel jacked up, lower the jack so wheel rests on the floor and retighten nuts. Tighten nuts to 65 to 90 foot-pounds torque.

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Tire Care

CAUTION: *For satisfactory operation, all 4-wheel drive vehicles MUST be equipped with the same size tires of equal circumference on all four wheels. The tires must then be inflated to proper factory recommended pressures at all times. The intermixing of different types of tires could cause unusual road noises or damage to drive train components.*

Tire pressure, tire rotation, wheel balance, and wheel alignment are the four vital factors that influence the extent of tire life and the ease and safety of vehicle control. Four of the most common tire troubles are:

(1) Excessive wear around the outer edges resulting from underinflation.

(2) Excessive wear around the outer edges resulting from overinflation.

(3) Tire tread worn on one side indicating wheels need realigning.

(4) Cuplike depressions on one side of the tread undicating wheels need balancing.

Correct tire pressures depend on tire size, tire ply, gross vehicle weight (GVW) rating, vehicle load, and the type of driving.

Tire inflation should be checked and adjusted to recommended pressures periodically (at least monthly) especially when extreme changes (20 degrees F) in average seasonal changes occur. Tire inflation pressures should be checked and adjusted when the tires are cold or driven less than 2 miles at moderate speeds of less than 40 mph after the vehicle has been at rest for at least six hours.

Do not reduce inflation pressure if the tires are hot or driven over 10 miles in excess of 60 mph. Hot tire pressure may increase as much as 6 psi over cold pressures. If tire pressure must be adjusted while hot, temporarily set pressure at 6 psi (10 psi for sustained high speeds) greater than those specified until such time as cold inflation pressure can be checked and adjusted.

The correct tire inflation pressures for any given set of driving conditions may now be determined by referring to the Tire Inflation Pressure (PSI) Chart. Cold inflation pressures are those measured with the tires at approximately the prevailing atmospheric temperature, and do not include any inflation build-up caused by heat from vehicle operation. Pressures specified are precisely measured for the tire sizes recommended for each Jeep vehicle model at the GVW rating.

Sustained driving above 60 mph requires, in all instances, a tire pressure different from that required for slower, intermittent driving.

Tire Rotation

Rotate tires every 5,000 miles. see Fig. 9-62 for rotation sequence.

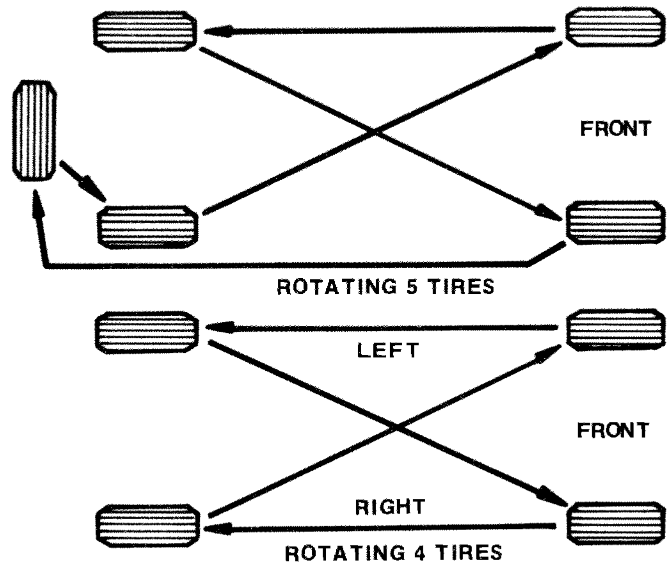

Fig. 9-62 Tire Rotation

TORQUE SPECIFICATIONS

Brake System Components

	Inch-Pounds
Bleeder Screw, Wheel Cylinder 1/4-28	30-90
Bleeder Screw, Wheel Cylinder 5/16-24	40-140
Brake Shoe or Tube-to-Wheel Cylinder 3/8-24	120-200
	Foot-Pounds
Front Brake Support Plate Mounting Bolt and Nut (CJ Models)	35-55
Brake Support Plate Mounting Bolt Front (Cherokee, Wagoneer, Truck)	20-30
Brake Support Plate Mounting Bolt and Nut, Rear (8000 GVW Truck)	45-55
Brake Support Plate Mounting Bolt and Nut, Rear (Cherokee, Wagoneer, Truck)	35-55
Power Brake Unit (Booster) to Spacer and Firewall (Cherokee, Wagoneer, Truck)	18-25
Power Brake Unit (Booster) to Spacer and Firewall (CJ Models)	20-25

Wheel-To-Hub Nuts

CJ Models	65-90
Cherokee, Wagoneer, Truck	65-80
8000 GVW Truck	110-125

SAE Inverted Flared Brass Tube Fittings

Fitting Size	Tube Size (Inch)	Half-Hard Copper Tubing (Inch-Pounds)	Double Flared Bundy Tubing (Inch-Pounds)
2	1/8	45	50
3	3/16	55	75
4	1/4	65	100
5	5/16	80	120
6	3/8	125	175
8	1/2	250	350

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TIRE INFLATION PRESSURE (PSI) CHART

Jeep Model	Model Code	GVW Rating	Tire Size	Ply Rating	Load Range	Normal Speed Driving				Sustained High Speeds (Above 60 MPH)				Wheel Size and No. of Bolts
						Normal Load		Maximum Load		Normal Load		Maximum Load		
						Front	Rear	Front	Rear	Front	Rear	Front	Rear	
CJ-5	83	3750	F78 x 15	4	B	20	20	24	24	32	32	32	32	15 x 6 5
CJ-6	84	3900	F78 x 15	4	B	20	20	24	24	32	32	32	32	15 x 6 5
CJ-5 Renegade	83	3750	H78 x 15	4	B	20	20	24	24	32	32	32	32	15 x 7 (Alum.) 5
CJ-5/6 (Opt. Tire)	83 & 84		7.00 x 15	8	D	30	30	35	35	45	45	45	45	15 x 6 5
Cherokee	16	5600	F78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
Cherokee "S"	17	5600	F78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 7 (Alum.) 6
Cherokee (Opt. Tire)	16 & 17	5600	H78 x 15	4	B	22	22	24	24	26	26	28	28	15 x 6 6
Cherokee (Opt. Tire)	16	5600	G78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
Wagoneer	14	5600	F78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
Wagoneer Custom	15	5600	F78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
Wagoneer (Opt. Tire)	14 & 15	5600/6000	H78 x 15	4	B	22	22	28	28	26	26	32	32	15 x 6 6
Wagoneer (Opt. Tire)	14 & 15	5600	G78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
J-10 Truck (120" W.B.)	25	5200	G78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
J-10 Truck (120" W.B.)	25	5600	H78 x 15	4	B	24	24	28	28	26	26	32	32	15 x 6 6
J-10 Truck (132" W.B.)	45	5200	G78 x 15	4	B	28	28	32	32	32	32	32	32	15 x 6 6
J-10 Truck (132" W.B.)	45	5600	H78 x 15	4	B	24	24	28	28	26	26	32	32	15 x 6 6
J-10 Truck (Opt. Tire)	25 & 45	5200/5600	7.00 x 15	8	D	35	35	35	35	45	45	45	45	15 x 6 6
J-20 Truck (132" W.B.)	46	6500	8.00 x 16.5	8	D	35	35	45	60	45	45	55	65	16.5 x 6.0 8
J-20 Truck (132" W.B.)	46	7200	8.75 x 16.5	8	D	35	35	45	60	45	45	65	70	16.5 x 6.75 8
J-20 Truck (132" W.B.)	46	8000	9.50 x 16.5	8	D	35	35	45	60	45	45	55	70	16.5 x 6.75 8
J-20 Truck (Opt. Tire)	46	6500	7.50 x 16	6	C	30	30	35	45	40	40	45	55	16.0 x 6.0 8
J-20 Truck (Opt. Tire)	46	7200	7.50 x 16	8	D	30	30	45	60	40	40	55	70	16.0 x 6.0 8
J-20 Truck (Opt. Tire)	46	8000	7.50 x 16	10	E	30	30	45	75	40	40	55	85	16.0 x 6.0 8

- Check pressures only when tires are cold
- Do Not reduce pressures of warm tires
- For loads not listed consult tire sticker in glove box.

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BRAKE SIZE AND APPLICATION CHART ①

Model	Master Cylinder Bore Diameter	Front Brakes		Rear Brakes		Power Brake ④ (Booster Type)
		Brake Size and Type	Caliper Piston or Wheel Cyl. Dia.	Brake Size and Type	Wheel Cyl. Dia.	
CJ-5/CJ-6	1	11 x 2 Drum	1-1/8 Wheel Cyl.	11 x 2 Drum	15/16	Tandem Diaphragm ⑤ 7-3/4
Cherokee ②	1	11 x 2 Drum	1-1/8 Wheel Cyl.	11 x 2 Drum	15/16	Single Diaphragm 9-1/2
Wagoneer	1-1/8	12.0 Disc	2-15/16 Single Piston	11 x 2 Drum	15/16	Single Diaphragm 9-1/2
Truck: 5200 GVW ②	1	11 x 2 Drum	1-1/8 Wheel Cyl.	11 x 2 Drum	15/16	Single Diaphragm ② 9-1/2
5600 GVW ③	1	11 x 2 Drum	1-1/8 Wheel Cyl.	11 x 2 Drum	15/16	Single Diaphragm ③ 9-1/2
6500 GVW	1-1/8	12.5 Disc	2-15/16 Single Piston	12 x 2.5 Drum	1-1/8	Tandem Diaphragm 9-1/2
7200 GVW	1-1/8	12.5 Disc	2-15/16 Single Piston	12 x 2.5 Drum	1-1/8	Tandem Diaphragm 9-1/2
8000 GVW	1-1/8	12.5 Disc	2-15/16 Single Piston	12 x 2.5 Drum	1-1/8	Tandem Diaphragm 9-1/2

① All dimensions are in inches.
② 12.0 disc brake optional on these models.
③ Single diaphragm type booster used with optional power disc brake application.
④ Models equipped with power booster.
⑤ Power available only on CJ-5 with V-8

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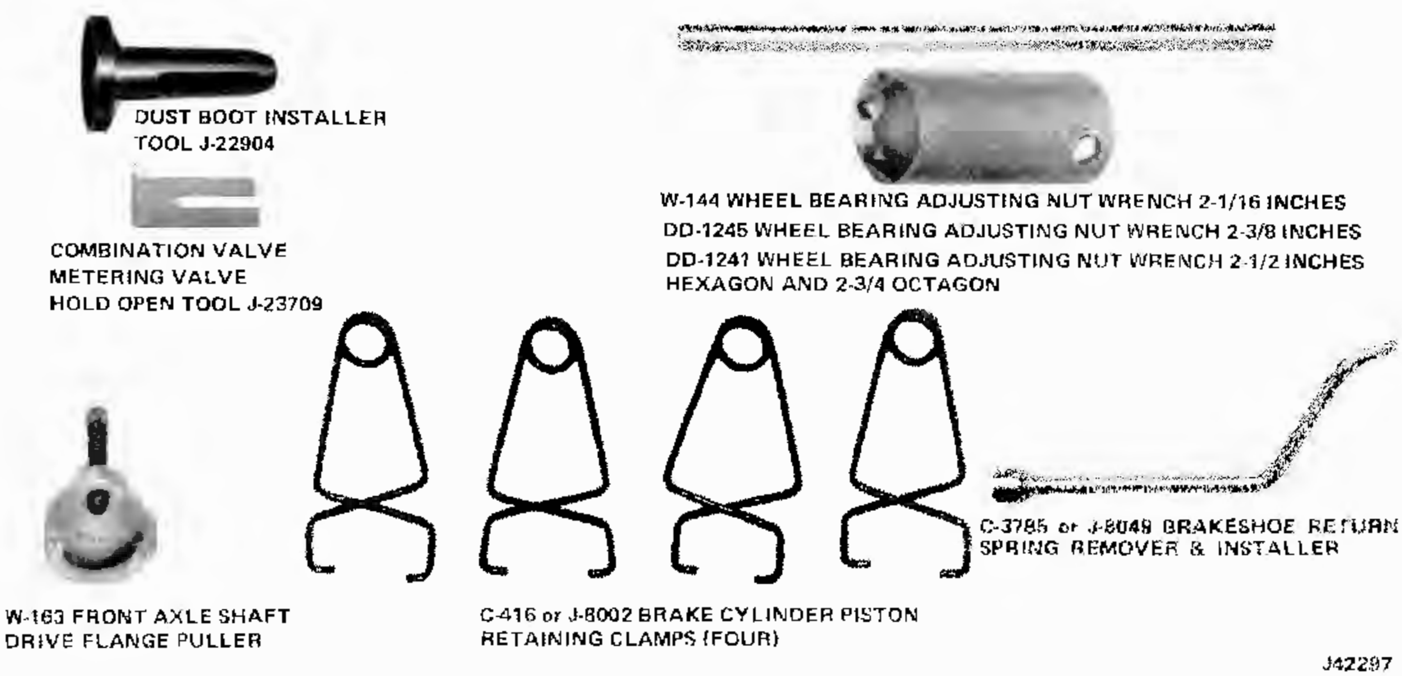

Fig. 9-63 Brake and Wheel Service Tools

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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AXLES - PROPELLER SHAFTS

AXLES

GENERAL

The front axle on all Jeep 4-wheel drive vehicles is a line driving unit with steering knuckles and hypoid driving gears. The drive is full-floating through axle shafts built integrally with universal joints which revolve in the steering knuckles. All Cherokees, Wagoneers, and Trucks are equipped with the Model 44F front axle while the CJ-5 Models are equipped with the Model 30.

On all front axles, front wheel toe-in is adjustable. However, the required caster and camber of the front wheels is built into the axles. Wheel camber cannot be changed. Wheel caster can be adjusted by placing tapered shims or wedges between the spring and spring seats.

The CJ-5/CJ-6, Cherokee, Wagoneer, and Truck (up to and including 5600 GVW) use the Model 44 semi-floating rear axle with flanged axle shafts. Trucks from 6500 GVW to 8000 GVW are equipped with the Model 60 full floating rear axle (refer to Axle Application Chart).

AXLE APPLICATION CHART

Jeep Model	Engine		Transmission			Axle Model		Axle Ratio	
	CID	Carb	3-Speed Manual Model	4-Speed Manual Model T-18	Automatic	Front	Rear	Std	Opt
CJ-5/CJ-6	232	1V	T-14A	Opt. CJ-5 Only	NA	Model 30 (Open Knuckle) Full Floating	Model 44 Semi-Floating (Flanged Shaft)	3.73	4.27
	258	1V							
	304	2V	T-15A	NA					
Cherokee	258	1V	T-14A	NA	Opt.	Model 44F (Open Knuckle) Full Floating		3.54	4.09
	360	2V	T-15A	Opt.				3.07	3.54
	360	4V	NA	NA	Std.				
	401	4V							
Wagoneer	360	2V	NA	NA	Std.				
	360	4V	NA	NA	Std.				
	401	4V							
J-10 Truck 5200 5600	258	1V	T-14A	Opt.	Opt.			4.09	NA
	360	2V	T-15A					3.54	4.09
	360	4V	NA	NA	Std.				
	401	4V							NA
J-20 Truck 6500 7200	360	2V	T-15A	Opt.	Opt.		Model 60 Full Floating	3.73	4.09
8000	401	4V	NA	Std.	Opt.				NA

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All axle housings should be checked periodically for weld cracks and other damage that may cause loss of lubricant, or affect driving characteristics, especially misalignment of the front wheels.

If the vehicle is exposed to water deep enough to cover the hubs of either the front or rear axles, it is recommended that the wheel ends be disassembled and inspected daily for water damage or contamination.

Examine, clean, and replace damaged parts, if necessary, prior to lubricating and assembling the wheel end components. Pay particular attention to the bearings on the front driving axle.

Examine, clean, and replace damaged parts, if necessary, prior to assembling the cover housing and refilling with MIL-L-2105-B (SAE 80) or equivalent for standard axles and part number 94557 for Trac-Lok Axles.

AXLE IDENTIFICATION

The axle model number is cast in the axle housing as illustrated in figure 10-1.

Fig. 10-1 Axle Model Identification

The axle build date, and the axle manufacturer's part numbers are stamped in the right-hand axle tube on the cover side (fig. 10-1). The build date of the axle is interpreted as follows: the first number is the month, second number is the day of the month, third number is the year, the alpha-letter is the shift and the last number is the assembly line. In the event there are two build dates, the latter will be the date in which the brake components were assembled. It may be necessary to wipe or scrape dirt from the tube in order to read the numbers.

The gear ratio tag indicates the Jeep manufacturing reference part number, the teeth combination of the ring gear and pinion, and also the total gear ratio.

Axles equipped with the Trac-Lok differential have a special tag specifying that special lubricant only must be used. Use only Jeep Trac-Lok lubricant, part number 94557 (fig. 10-2).

Fig. 10-2 Ratio, Build Date, and Trac-Lok Differential Identification

AXLE TESTING AND DIAGNOSIS

In diagnosing a reported axle noise condition, obtain a complete description of the noise and driving conditions when the noise occurred. A preliminary road test, with the customer demonstrating the complaint condition, is recommended.

The action of transmitting engine torque to drive the wheels will produce some noise in the axles. Slight axle noises confined to a short speed range or to a specific period are considered normal.

Noises produced by the engine, transfer case, transmission, tires, wheel bearings, exhaust system, propeller shaft, or the action of wind on the body or grille may be incorrectly diagnosed as produced by an axle. Thoroughly test the vehicle to isolate the trouble to a specific unit.

With the vehicle stopped and the transmission in neutral, run the engine at various speeds. If the noise is heard during this test, the noise is confined to the engine, exhaust system, clutch, transmission, transfer case, or engine-driven accessory equipment.

Prior to the diagnostic road test, check the tire pressure and axle lubricant levels.

Tire Noise Tests

Since some types of tire tread wear or tread patterns may produce objectionable noises, drive on various types of road surfaces and listen for a change in the noise. If the noise varies with the type of surface, tires may be the cause.

Wheel Bearing Tests

Worn, loose, or damaged wheel bearings may be confused with axle noise. Wheel bearing noise is usually more noticeable when coasting at lower vehicle speeds. Applying the brakes gently will usually change wheel bearing noise. Another test is to turn the vehicle alternately left and right, which side-loads the bearings, causing the defective bearing to become noisy.

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Axle Tests

Drive the vehicle a sufficient distance to warm the axle to the required operating temperature. Tests should then be performed using different transmission and transfer case shift combinations.

Axle noise conditions are usually related to vehicle speed rather than engine rpm or transmission gears.

Axle noises may be classified into two types: gear noise and bearing noise.

Gear noise is recognized as a whine or high-pitched resonating sound more pronounced at certain speeds and usually within a narrow speed range under a drive (accelerating load), coast (decelerating load), or float (maintained speed) condition.

Axle bearing noise is usually constant and the pitch is related to the vehicle speed.

Since the drive pinion turns faster than the drive gear, the drive pinion bearings produce a higher pitch than the differential bearings. The drive pinion bearings are usually heard at low vehicle speeds (20 to 30 mph).

Differential bearings are lower in pitch because they are turning at the same speed as the wheels when the vehicle is driven straight ahead. Differential bearing noise will not vary when the vehicle is turned alternately left to right or when the brakes are gently applied.

Axle Noisy on Pull and Coast

- Excess backlash bevel gear and pinion - adjust.
- End play pinion shaft - adjust.
- Worn pinion shaft bearing - replace.
- Pinion set too deep in bevel gear (too tight) - adjust.
- Wrong Trac-Lok differential lubricant - replace.

Axle Noisy on Pull

- Pinion and bevel gear out of adjustment - adjust.
- Pinion bearings rough - replace.
- Pinion bearings loose - adjust.

Axle Noisy on Coast

- Excessive backlash in bevel gear and pinion - adjust.
- End play in pinion shaft - adjust.
- Improper tooth contact - adjust.
- Rough bearings - replace.

Backlash

Excessive backlash in the vehicle drive line may be the result of excessive backlash in the transmission, propeller shaft spline, universal joint, ring gear and pinion, the axle shaft spline, or the differential.

Excessive backlash in the differential may be measured as follows:

(1) Jack up one rear wheel.

(2) Put the transmission in gear.

(3) Measure the travel of the jacked up wheel on a 10-inch radius from the wheel center. This total movement should not exceed 1-1/4 inch in a new unit. In order to restrict the backlash to the axle only, make sure that the yoke of the propeller shaft does not move during the check. On older vehicles, check the universal joints and replace if worn.

If all causes of backlash mentioned above have been eliminated with the exception of the differential and that still exceeds the maximum allowable movement, overhaul the differential. Generally, the assignable cause will be worn differential pinion gear washers or improper adjustment of the bevel gear and pinion.

Chatter - Trac-Lok

Differential chatter in the Trac-Lok rear differential is usually caused by improper lubricant. Change lubricant.

Drive Line Vibrations

Vibration in the drive line can be caused by a variety of conditions. The following is a checklist that can be used to isolate the most common causes.

(1) Check condition of tires. Compare differences in tread wear, side to side and front to rear. Be sure tire type and sizes are same, especially Quadra-Trac units.

(2) Check tire pressures and set to specifications.

(3) Check wheel and tire balance and correct if necessary.

(4) Check all drive line components (U-joints, engine mounts, transmission mounts, spring bushings) for tightness.

(5) Check front and rear pinion angle as follows:

(a) Place the vehicle on rail hoist (one that supports the vehicle on all four tires).

(b) Check levelness of vehicle by placing a bubble protractor on straight portion of frame side rail and reading out-of-level condition. Shim low end by placing a spacer between tire and lift rail to bring vehicle to level position.

(c) Using bubble protractor, check pinion angle by taking a reading from cover face of differential housing. Reading can be taken from cover flange; however, if desired, differential can be drained, cover removed, and reading taken from machined surface of housing. Refer to Pinion Angle Specifications Chart on page 10-4.

Other Axle Conditions

A knocking or clucking noise heard at low speed when coasting may be caused by a loose-fitting differential gear in the differential case bore. When this

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PINION ANGLE SPECIFICATIONS

	FRONT		REAR	
	OK RANGE	SET TO	OK RANGE	SET TO
WAGONEER & CHEROKEE (QUADRA-TRAC)	6° - 8°	7°	$1/2^\circ$ - $2\text{-}1/2^\circ$	$1\text{-}1/2^\circ$
CHEROKEE (DANA 20)	6° - 8°	7°	6° - 8°	7°
TRUCK MODELS 25, 45	6° - 8°	7°	4° - 6°	5°
TRUCK MODELS 26, 46	6° - 8°	7°	2° - 4°	3°

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condition is encountered, applying the brakes lightly will usually reduce the sound.

Differential gear noise is considered normal when spinning a rear wheel for on-the-vehicle wheel balancing, or when a rear wheel is spinning due to icy conditions.

When a noise has been determined to be caused by the bearings, the gears do not require replacement unless an inspection reveals signs of obvious damage.

When the noise is determined to be caused by the drive pinion and drive gears at low mileages, the need for bearing replacement is dependent upon inspection of the bearings during overhaul.

FRONT AXLE SHAFT

Removal - CJ-5 and CJ-6

(1) Remove hub cap.
(2) Remove drive flange snap ring.
(3) Remove axle flange bolts.
(4) Remove axle flange with Puller W-163.
(5) Release locking lip of lockwasher and remove outer nut, lockwasher, adjusting nut, and bearing lockwasher. Use Wrench W-144 for removal.
(6) Back off on brake adjusting starwheel adjuster and remove brake drum assembly with bearings. Be careful not to damage the oil seal.
(7) Remove brake backing plate and set in convenient place.
(8) Remove spindle and spindle bushing.
(9) Remove axle shaft and universal joint assembly.

Installation

(1) Clean all parts of dirt and foreign matter.
(2) Enter universal joint and axle shaft assembly in axle housing, taking care not to knock out the inner oil seal.
(3) Enter splined end of axle shaft into differential and push into place.
(4) Install wheel bearing spindle and bushing.
(5) Install brake backing plate.
(6) Grease and assemble wheel bearings and oil seal.
(7) Install the wheel hub and drum on the wheel bearing spindle. Install the wheel bearing washer and adjusting nut. Tighten nut with Wrench W-144 until there is a slight drag on the bearings when the hub is turned. Then back off approximately one-sixth turn.
(8) Install lockwasher and nut. Tighten nut and bend lip of lockwasher over on locknut.
(9) Install drive flange and gasket on hub and attach with capscrews. Install snap ring on outer end of axle shaft.
(10) Install hub cap.
(11) Install wheel.

Removal - Cherokee, Wagoneer, Truck

(1) Raise and support front of vehicle.
(2) Remove wheel and dust cover.
(3) Remove axle shaft snap ring, drive gear, and pressure spring. If drive gear is stuck to the shaft, use a screwdriver to pry out gear.
(4) Use Nut Wrench W-372 to remove wheel bearing locknut, lockring, and wheel bearing adjusting nut.
(5) Remove two bolts securing brake caliper assembly to disc brake shield and place caliper assembly aside.
(6) Remove rotor and hub assembly (spring retainer and outer wheel bearing will slide out as assembly is removed).
(7) Remove six nuts and one bolt securing spindle and disc brake shield.
(8) Remove spindle and disc brake shield. If necessary tap lightly with a rawhide hammer to free components from knuckle (fig. 10-3).
(9) Slide axle shaft out through the steering knuckle (fig. 10-3).

Installation - Cherokee, Wagoneer, Truck

(1) Install axle shaft, spindle, and bearing assembly.
(2) Install brake shield, rotor, and hub assembly. Install and align brake caliper assembly.
(3) Install inner wheel bearing adjusting nut (the one with the peg on the side). Tighten nut to 50 foot-pounds torque using wheel bearing wrench. Rotate hub, then back off adjusting nut 1/4-turn maximum.

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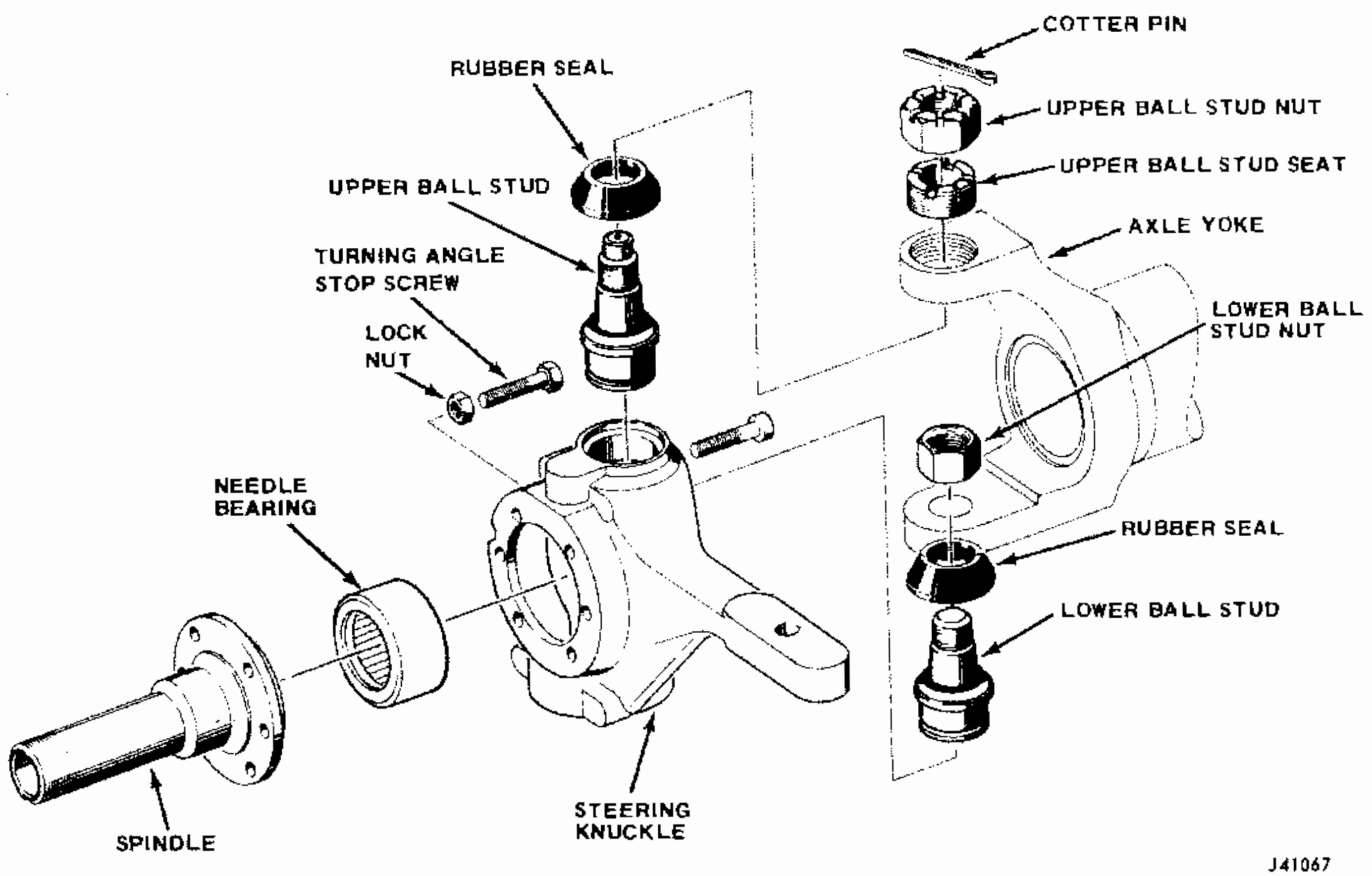

Fig. 10-3 Model 44F Steering Knuckle Assembly

Install lockwasher with inner tab lined up with keyway in spindle. Turn adjusting nut until the peg engages the nearest hole in the lockwasher. Install outer locknut and tighten to 50 foot-pounds torque (minimum) using wheel bearing wrench.

(4) Install spring retainer, spring, and drive gear.

(5) Push on gear to allow clearance for installation on axle shaft snap ring.

(6) Install wheel and dust cover.

(7) Remove support stands and lower vehicle.

UNIVERSAL JOINT REPLACEMENT

(1) Remove axle shaft.

(2) Remove snap rings from the bearing cup assemblies (fig. 10-4).

(3) Press on end of one bearing cup assembly until opposite bearing is pushed from yoke half.

(4) Turn yoke over and press first bearing back out by pressing on exposed end of journal shaft.

NOTE: *To avoid damaging the bearing, use a soft drift with a flat face about 1/32 inch smaller in diameter than the hole in the yoke arm to drive out the bearing.*

(5) Repeat step (4) for other two bearings. Then lift out bearing cross-journal by sliding it to one side.

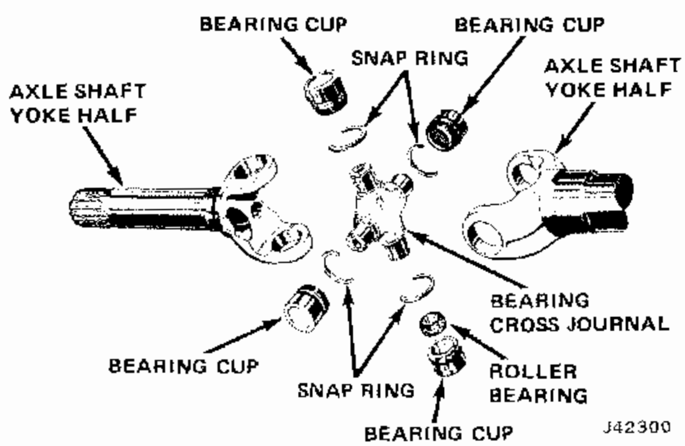

Fig. 10-4 Axle Shaft Universal Joint

(6) Wash all parts in cleaning solvent and inspect parts after cleaning. Replace any part that indicates extensive wear.

(7) Pack bearing cups one-third full of lubricant and install rollers.

(8) Insert bearings into axle shaft yoke half and seat them firmly against bearing shoulders.

(9) Insert bearing cross-journal while holding bearings in a vertical position to prevent needles from dropping out.

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(10) Press bearing cup on from opposite side until firmly seated.

(11) Repeat steps (9) and (10) on other journal.

(12) Install snap rings on bearing cup assemblies.

NOTE: *If the joint binds when assembled, tap the yoke lightly to relieve any pressure on the bearings at the end of the journal.*

(13) Install axle shaft.

Steering Knuckle Removal

NOTE: *The open-end type knuckle pivots on ball joints. Replacement of the ball joints requires removal of the axle shaft and steering knuckle.*

(1) Remove axle shaft.

(2) Disconnect steering tie-rod end from knuckle arm.

(3) Remove lower ball stud nut (fig. 10-5).

Fig. 10-5 Lower Ball Stud Nut Removal

(4) Remove cotter pin from upper stud and loosen stud nut until its top edge is flush with top of stud.

(5) Unseat upper and lower studs using a lead hammer.

(6) Remove upper nut and remove knuckle assembly.

(7) Remove upper ball stud seat using Nut Wrench W-355.

Ball Joint Replacement

(1) Remove lower ball joint snap ring.

(2) Clamp knuckle assembly securely in a vise with upper ball stud pointed downward.

(3) Attach Plate SP-5581 to spindle mating surface of knuckle assembly (fig. 10-6). Position Button SP-5583 on lower joint. Assemble and align Puller SP-5574. Press lower joint out of knuckle by tightening puller screw.

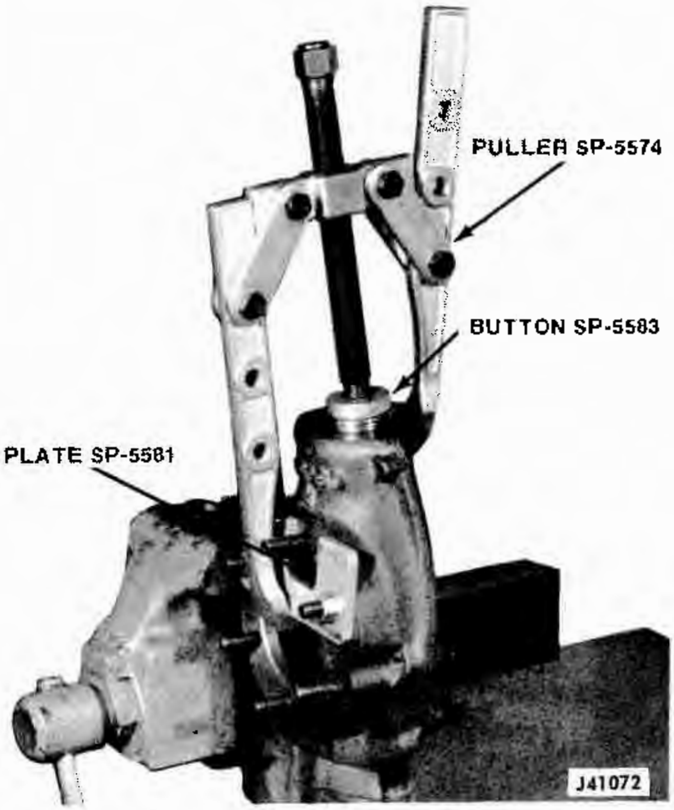

Fig. 10-6 Lower Ball Joint Removal

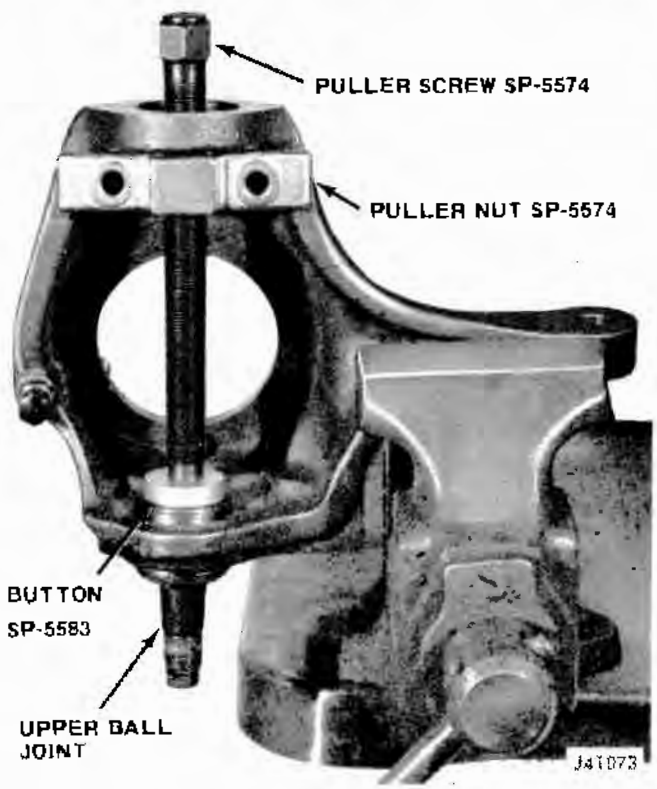

Fig. 10-7 Upper Ball Joint Removal

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(4) Disassemble Puller SP-5574. On CJ-5 and CJ-6 install Adapter SP-5584 on puller screw with adapter shoulder toward head of screw. Thread puller nut about halfway onto screw. Place Button SP-5583 on upper joint and install puller in knuckle (fig. 10-7). Tighten screw to remove upper ball joint.

(5) Invert the knuckle in the vise. Position the lower ball joint in the knuckle. Use Installer Cup SP-5582, Adapter SP-5584, and Puller SP-5574 screw and nut (fig. 10-8) to press in the lower joint. Install ball joint snap ring.

(6) Position upper ball joint on the knuckle. Use Installer Cup SP-5582 and Puller Assembly SP-5574 to press in upper joint (fig. 10-9).

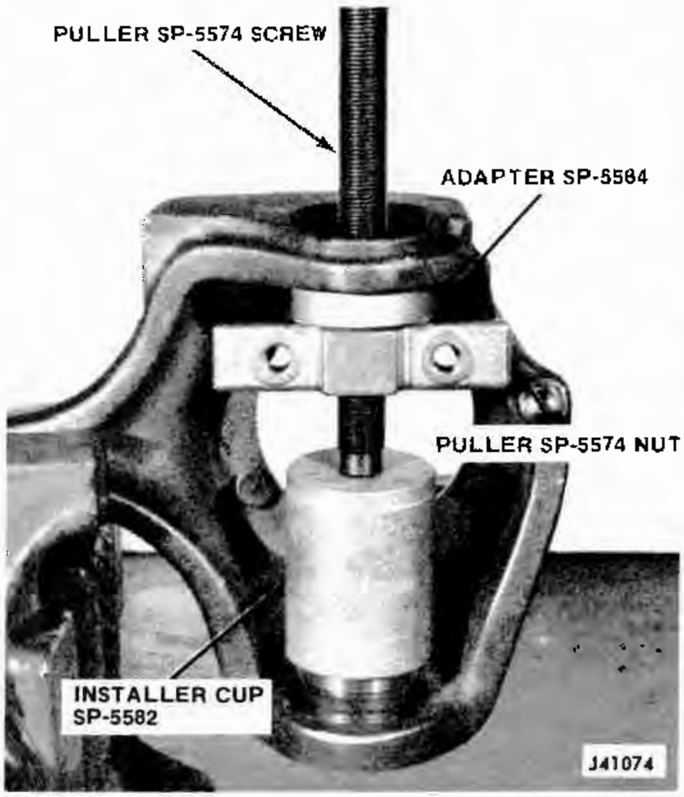

Fig. 10-8 Lower Ball Joint Installation

Steering Knuckle Installation

(1) Install upper ball stud seat into axle yoke. Top of stud seat should be flush with top of yoke.

(2) Install knuckle assembly onto axle yoke. Loosely install lower stud nut. Position and align Wrench Nut W-355, Button SP-5583, Plate SP-5581, and Puller SP-5574 as shown in figure 10-10. Tighten puller screw until lower ball stud is held firmly in its seat. Tighten lower stud nut to 70 to 80 foot-pounds torque (on CJ models, 70 to 90 foot-pounds torque). Remove the puller and plate.

(3) Use Wrench Nut W-355 to tighten upper ball joint stud seat to 50 foot-pounds torque (fig. 10-11).

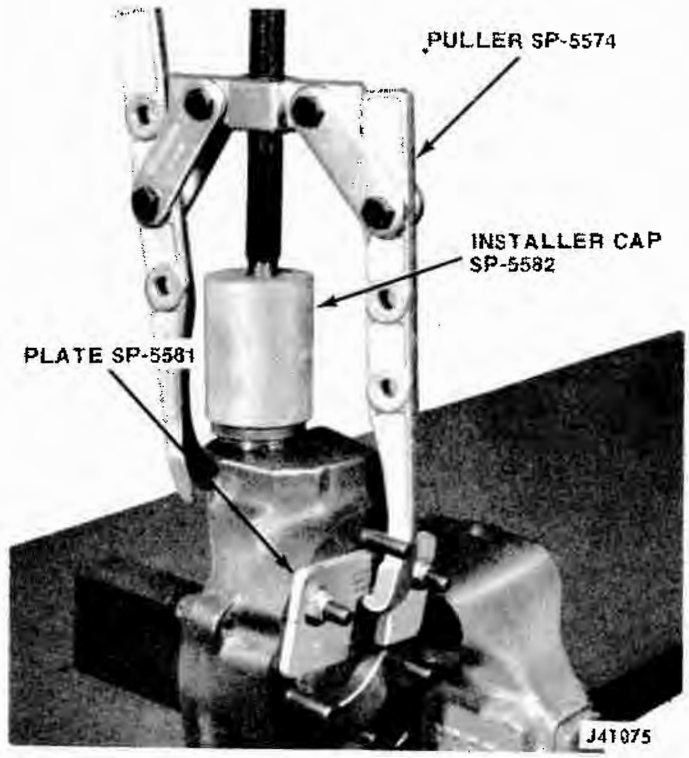

Fig. 10-9 Upper Ball Joint Installation

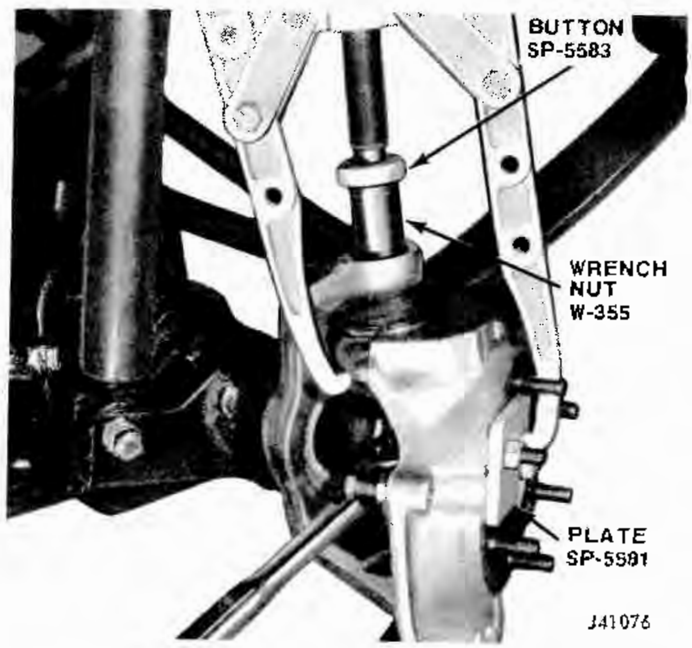

Fig. 10-10 Steering Knuckle Installation

(4) Install upper stud nut and tighten to 100 foot-pounds torque. Install cotter pin. If cotter pin holes do not align, tighten nut until the pin can be installed. Do not loosen nut to align the holes.

(5) Connect steering rod.

NOTE: *When the steering knuckle is removed or replaced, the turning angle must be checked.*

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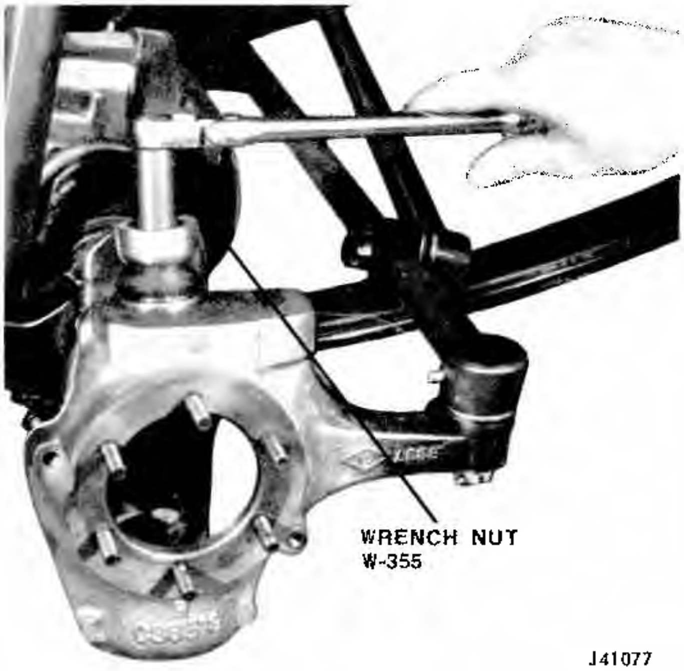

Fig. 10-11 Tightening Upper Joint Stud Seat

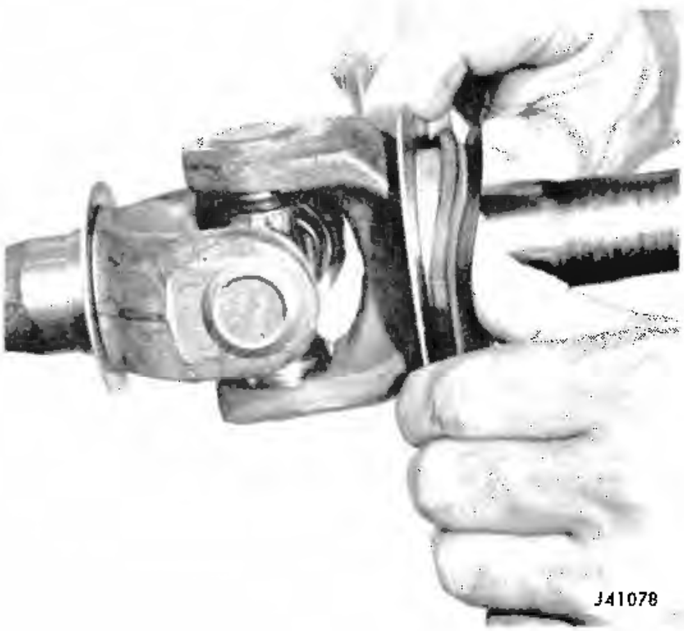

Fig. 10-12 Axle Shaft Seal Replacement

Axle Shaft Seal Replacement

Front axles are equipped with a V-seal which is installed at the axle shaft stone shield.

(1) Remove defective seal (fig. 10-12).

(2) Remove bronze thrust washer. If wear is evident, replace washer.

(3) Clean area of dirt and foreign matter.

(4) Install bronze washer with chamfered side toward the axle shaft seal.

(5) Install new seal. Direct lip of seal toward the spindle (fig. 10-12).

(6) Pack area around thrust face area of shaft and seal with grease. Fill seal area of spindle with grease (NLGI 2).

Spindle Bearing Replacement

NOTE: *Front axle spindles are equipped with a needle roller bearing located at rear spindle flange (fig. 10-13).*

(1) Place spindle in vise. Use caution and protect all machined surfaces on spindle.

(2) Use suitable internal bearing puller and remove needle bearing.

(3) Clean area of dirt and foreign matter.

(4) Use suitable bearing installer and install new bearing.

(5) Pack needle bearing area with grease (NLGI 2).

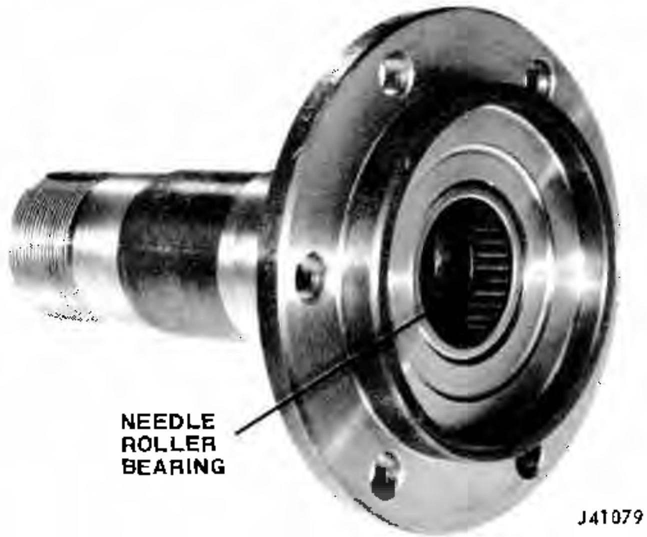

Fig. 10-13 Spindle Bearing Removal

Front Axle Assembly Removal

(1) Raise front end of vehicle and support frame behind springs.

(2) Remove wheel discs, lug nuts, and wheels.

(3) Index propeller shaft to ensure proper alignment upon installation. Disconnect propeller shaft at front universal companion flange.

(4) Disconnect steering connecting rod at ball and socket connection on steering knuckles.

(5) Disconnect shock absorbers at axle housing.

(6) Disconnect breather tube from axle housing.

(7) Remove brake calipers or backing plates and position in a convenient place.

(8) Remove spring clip plates and spring clips.

(9) Support axle assembly on a jack; raise jack slightly to remove spring tension.

(10) Loosen nuts securing upper spring shackles; do not remove bolts.

(11) Remove bolts securing lower spring shackles and rest springs on floor.

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(12) Roll jack and axle assembly from underneath vehicle.

Front Axle Assembly Installation

(1) Support axle assembly on a jack and slide assembly into position underneath vehicle.

(2) Raise springs and install bolts in lower spring shackles.

(3) Lower axle assembly on springs and rotate into position.

(4) Install spring clips and spring clip plates.

(5) Tighten upper and lower spring shackle bolts.

(6) On models with disc brakes, install and align brake calipers. On CJ-5 and CJ-6 install backing plate.

(7) Connect breather tube.

(8) Connect shock absorbers.

(9) Connect steering connecting rod at steering knuckles.

(10) Connect propeller shaft and check alignment.

(11) On CJ-5 and CJ-6, install brake drums.

(12) Install wheels and lug nuts.

(13) Remove support stands and lower vehicle.

(14) Tighten lug nuts and install wheel discs.

(15) Check front end wheel alignment.

(16) Check turning angle.

Turning Angle Adjustment

The turning angle stop screws are located in the back of the knuckle just above the axle centerline. If adjustment is necessary, proceed as follows:

(1) Loosen the locknut.

(2) Use a turntable and adjust the stop screw to permit proper turning angle (see specifications below).

(3) Tighten locknut.

NOTE: *Adjusting the screw in increases the turning angle. Adjusting the screw out decreases the turning angle.*

Turning Angle Specifications: Set turning angle stop screws at 34 degrees to 35 degrees on CJ-5 and CJ-6 equipped with standard tires (F78 x 15). This will provide the shortest turning diameter and improve vehicle maneuverability. If the vehicle is equipped with optional tires, set the turning angle stop screws at 31 degrees to provide clearance for the larger size tires. On Cherokee, Wagoneer, and Truck, set the turning angle stop screws at 36 degrees to 37 degrees.

REAR AXLE

Rear axle models and application to Jeep vehicles are outlined at the front of this section. Methods of axle identification are shown in figures 10-1 and 10-2.

Axle Shaft and Bearing Removal (Semi-Float - Flange Shaft)

(1) Jack up vehicle and remove wheels.

(2) Remove brake drum spring locknuts and remove drum.

(3) Remove axle shaft flange cup plug by piercing center with a sharp tool and prying out.

(4) Using access hole in axle shaft flange, remove nuts attaching backing plate and retainer to axle tube flange.

(5) Attach Axle Shaft Adapter Tool W-343 and Slide Hammer Handle C-637 to axle shaft flange and remove axle shaft (fig. 10-14).

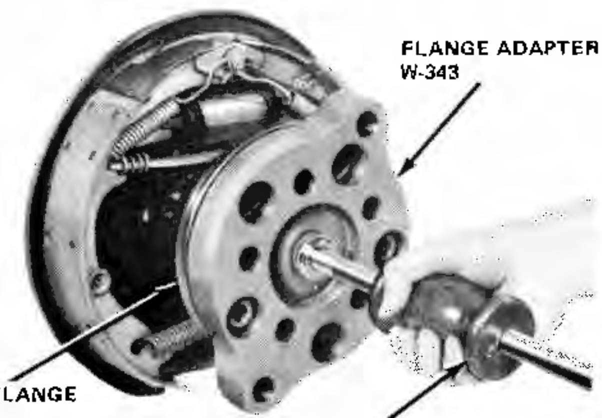

Fig. 10-14 Removing Flanged Axle Shaft

NOTE: *Make certain the old bearing cup has been removed from the axle housing.*

(6) Remove axle shaft oil seal from axle housing tube using Puller C-637.

(7) Wipe axle housing tube seal bore clean and install a new oil seal using Driver W-186.

CAUTION: *Under no circumstances should axle shaft retaining rings or bearings be removed using a torch because heat is fed into the axle shaft bearing journal weakening this area.*

(8) Position axle shaft assembly in a heavy vise.

(9) Using chisel, cut a deep groove into retaining ring. This will enlarge bore of retaining ring, or split ring and permit it to be driven off of axle shaft (fig. 10-15).

(10) Using a hacksaw, cut through oil seal, being careful not to damage seal contact surface. Remove oil seal from axle shaft.

CAUTION: *Thoroughly lubricate W-343 puller bolts and bolt contact points before attempting to remove bearing from axle shaft.* **Do not use power operated impact tools on puller bolts.**

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Fig. 10-15 Notching Bearing Retainer Ring

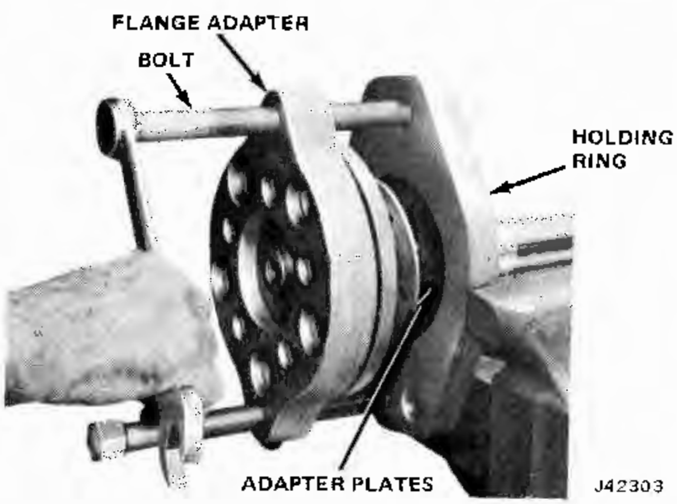

Fig. 10-16 Removing Axle Shaft Bearing

(11) Attach Puller W-343 to axle shaft using flange stud nuts. Position puller bolts against dimples of holding ring and alternately tighten until bearing is pressed from shaft (fig. 10-16).

Installation

(1) Inspect axle shaft oil seal journal for scratches and polish with fine crocus cloth if necessary.

(2) Install retainer plate on axle shaft.

(3) Apply grease to new oil seal cavity between seal lips and carefully slide seal on axle shaft seal seat. Outer face of seal must be toward axle flange.

(4) Pack bearing prior to installation using NLGI 2 Wheel Bearing Grease.

(5) Install bearing on axle shaft making certain cup rib ring is facing axle flange.

(6) Install bearing retainer ring on axle shaft.

(7) Using Puller W-343, press new axle shaft bearing and retainer ring on axle shaft simultaneously. Tighten puller bolts alternately until bearing and retainer ring are properly seated against shaft shoulder.

NOTE: *Make certain old bearing cup has been removed from axle housing before axle shaft and new unit bearing are installed into the axle housing.*

(8) Install axle shaft through backing plate using care not to damage axle housing tube inner oil seal.

(9) Apply thin coating of lubricant to outside diameter of bearing cup prior to installing in bearing bore.

(10) Tap end of flanged shaft lightly with a rawhide mallet to position axle shaft bearing in housing bearing bore.

(11) Attach axle shaft retainer and brake backing plate to axle tube flange. Secure with nuts and lockwashers (refer to Torque Specifications).

(12) Install new cup plug into axle shaft flange hole.

(13) Install brake drum, spring locknuts and rear wheel assembly.

Rear Axle Shaft Removal (Full-Floating)

Refer to Figure 10-17.

NOTE: *It is not necessary to jack up the rear wheels.*

(1) Remove axle flange nuts, lockwashers, and split washers holding axle shaft flange.

(2) Pull axle shaft free from housing.

NOTE: *A broken axle shaft that cannot be removed with a wire hook can be removed from a full-floating axle by removing the opposite axle shaft and inserting a pipe which will drive the broken axle shaft out.*

Rear Axle Shaft Installation (Full-Floating)

(1) Be sure axle flange mating area on hub and axle are clean and free of old gasket material.

(2) Install new flange gasket onto hub studs.

(3) Insert axle shaft into housing.

NOTE: *It will be necessary to rotate the axle shaft to simultaneously align the shaft splines with the differential gear splines and the flange attaching holes with the hub studs.*

(4) Install split washers, lockwashers, and flange nuts. Tighten nuts securely.

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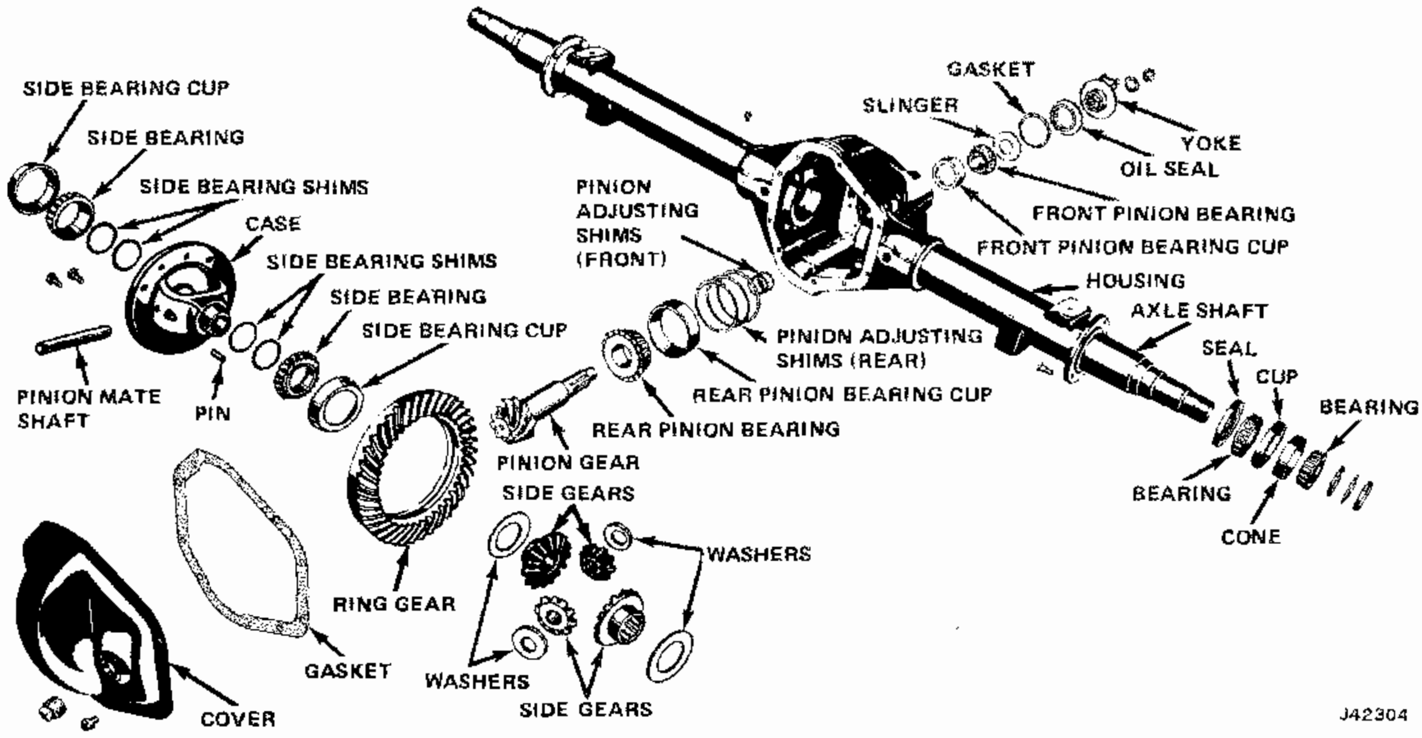

Fig. 10-17 Full-Floating Rear Axle - Model 60

NOTE: *The pinion shaft oil seal is serviced in the vehicle when replacement is necessary. For Model 60 axle, use Puller W-286; for all other models, use Puller W-251.*

INSPECTION AND SERVICING

All Axles

Refer to figures 10-17 and 10-18.

NOTE: *Before disassembling the differential, it is advisable to determine through inspection the cause of the failure.*

(1) Remove housing cover and gasket, and drain lubricant.

(2) Clean differential parts thoroughly with solvent.

(3) Carefully inspect all parts.

NOTE: *Should it be determined by inspection that the differential requires overhauling, first the axle must be removed from the vehicle.*

Rear Axle Assembly Removal

(1) Raise rear of vehicle. Support frame ahead of rear springs.

(2) Remove wheels.

(3) Index propeller shaft at rear yoke and disconnect.

(4) Disconnect shock absorbers at axle mounting.

(5) Disconnect brake hydraulic hose at tee fitting on axle just below left frame side rail. Tape ends of hose to keep out dirt.

(6) Disconnect parking brake cable at frame mounting.

(7) Support axle on jack.

(8) Remove axle U-bolts.

(9) Slide axle from under vehicle.

Rear Axle Assembly Installation

NOTE: *All service replacement axle assemblies are shipped from the factory without lubricant in the differential. Lubricant must be added to the differential before the axles are installed in vehicles. Use MIL-L-2105B (SAE 80) for standard axles or Part Number 94557 for Trac-Lok axles.*

When adding differential lubricant, suspend the axle with the axle shafts horizontal and the yoke end of the pinion housing hanging down; then, turn the pinion shaft several times to assure that the lubricant gets into the pinion shaft bearings.

(1) Position axle assembly under vehicle.

(2) Position springs to axle pads, and install spring clips and nuts.

(3) Attach brake line hose at tee fitting on top of housing.

(4) Attach parking brake cables at rear of brake backing plate.

(5) Connect shock absorbers at axle mounting pads.

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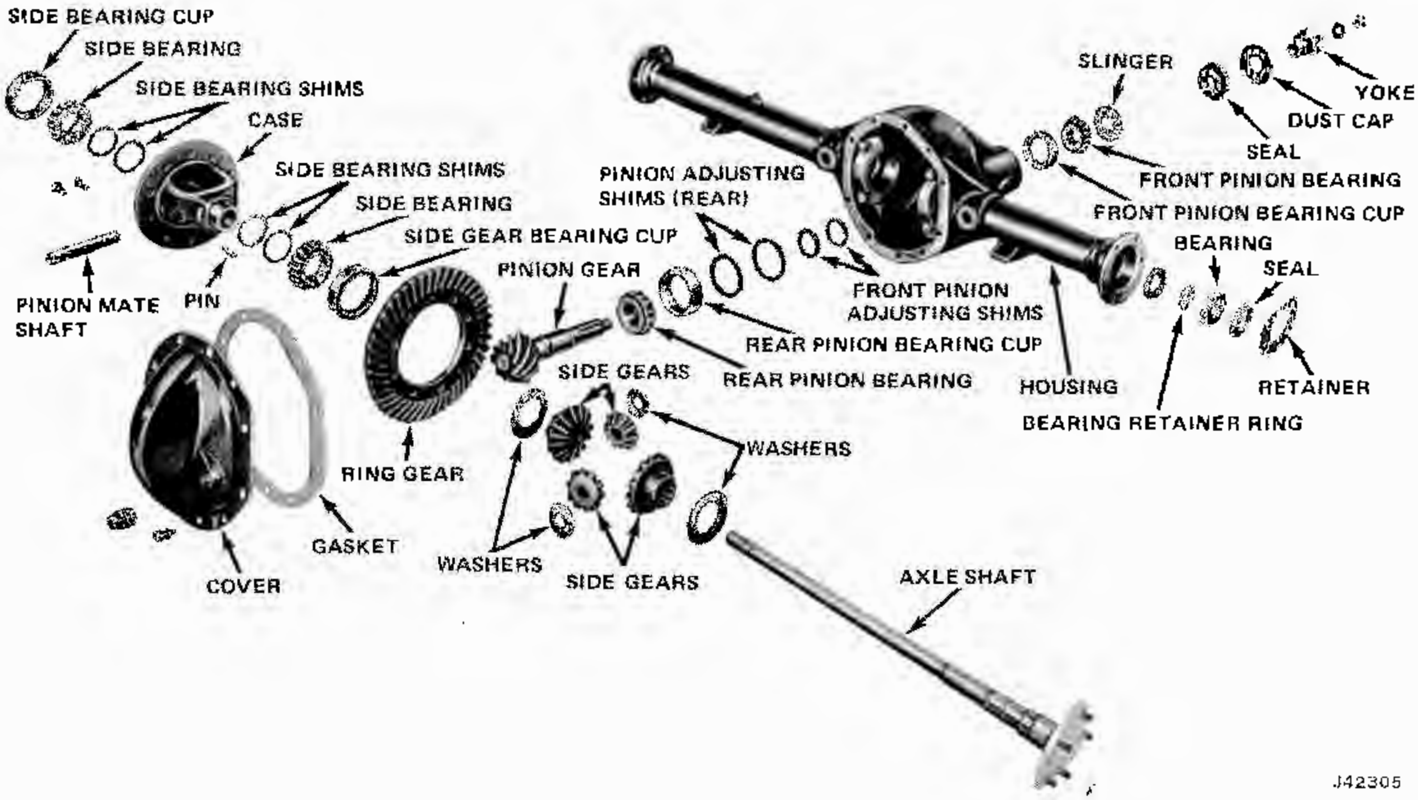

Fig. 10-18 Semi-Float Rear Axle - Flanged Shaft

(6) Connect propeller shaft at rear universal joint.
(7) Adjust and bleed brakes.
(8) Install and bleed brakes.
(9) Install wheels and lower vehicle to floor.
(10) Check parking brake.
(11) Fill axle housing with lubricant.

DIFFERENTIAL CASE DISASSEMBLY

(1) Remove axle shafts.

(2) Remove housing cover and four capscrews holding two differential side bearing caps in position.

NOTE: *Make sure there are matching letters or some type of identification marks on the caps and housing so that each cap can be installed in the same position and location from which it was removed.*

(3) Use Spreader W-129 as shown in figure 10-19 to spread housing. Install Holddown Clamps W-129-18, if available, to keep spreader in position. Clamp on dial indicator. From side, measure the carrier spread. Do not spread carrier more than 0.020 inch.

(4) Remove dial indicator.

(5) Carefully pry differential case loose, using pry bars at heads of ring gear bolts and carrier casting.

(6) Remove spreader immediately to prevent possibility of carrier taking a set.

(7) Remove screws holding ring gear to differential case.

(8) With a small punch, as shown in figure 10-20, drive out lockpin.

(9) Remove differential shaft and thrust block.

(10) Carefully, so as not to lose thrust washers, remove differential pinion gears.

(11) With Wrench C-3281 to hold yoke, remove nut. With Puller W-172, remove yoke as shown in figure 10-21.

(12) Using a rawhide hammer, drive on end of pinion shaft to force pinion out of differential housing.

NOTE: *Pinion bearing adjusting shims may remain on the pinion shaft, stick to the bearing which is still in the housing, or fall out loose. These shims should be collected and kept for assembly.*

(13) Remove outer pinion bearing cone, baffle and oil seal by using a two-inch by two-inch piece of hardwood or a length of pipe and drive out through neck of carrier housing. Discard seal.

Pinion and Differential Case Bearing Removal (Semi-Float Axle)

To remove the differential side bearings and pinion inner bearing, use Bearing Puller W-104-B as shown in figure 10-22. Use of the puller assures easy removal of bearings without damage to cone rollers, as pulling pressure is applied directly to the bearing cone.

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NOTE: *When pulling the front axle differential inner pinion bearing with an oil slinger attached, the adapter plates (two required) must be inserted, from the top, into one side of the W-104-B puller base, then repositioned 180 degrees apart.*

Pinion and Differential Case Bearing Removal (Full-Floating Axle)

To remove differential side carrier bearings on Model 60 rear axle, use Press DD-914-P, Extension DD-914-7, Button DD-914-42, Holding Ring DD-914-8 and Adapter DD-914-62 (fig. 10-24).

To remove the Model 60 rear axle pinion inner bearing, use Tool DD-914-P with Holding Ring DD-914-9 and Adapter C-C-193-37.

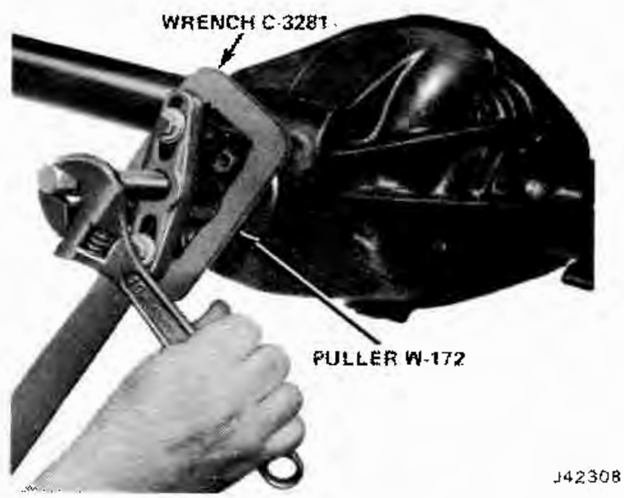

Fig. 10-21 End Yoke Puller

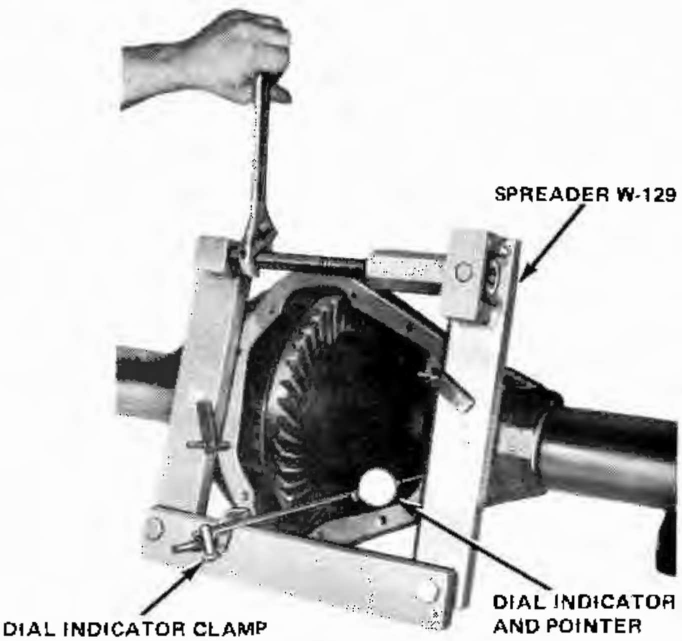

Fig. 10-19 Differential Carrier Spreader

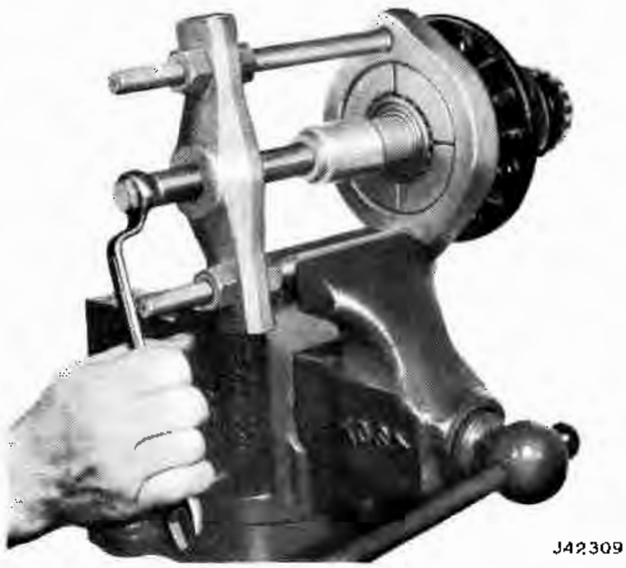

Fig. 10-22 Pulling Differential Side Carrier Bearing

Fig. 10-20 Removing Lockpin

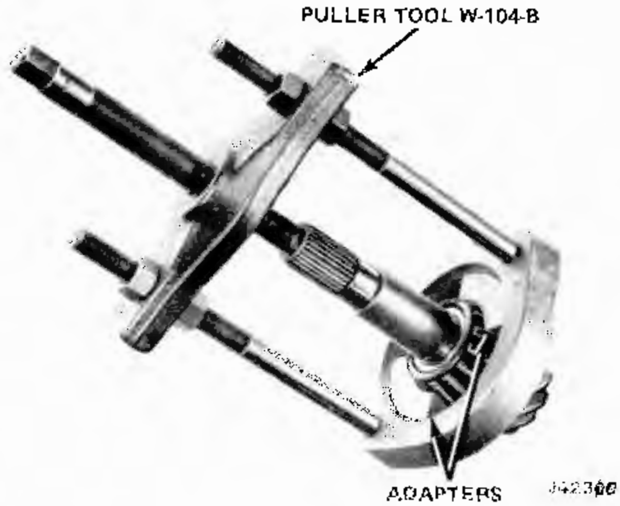

Fig. 10-23 Pulling Pinion Inner Bearing

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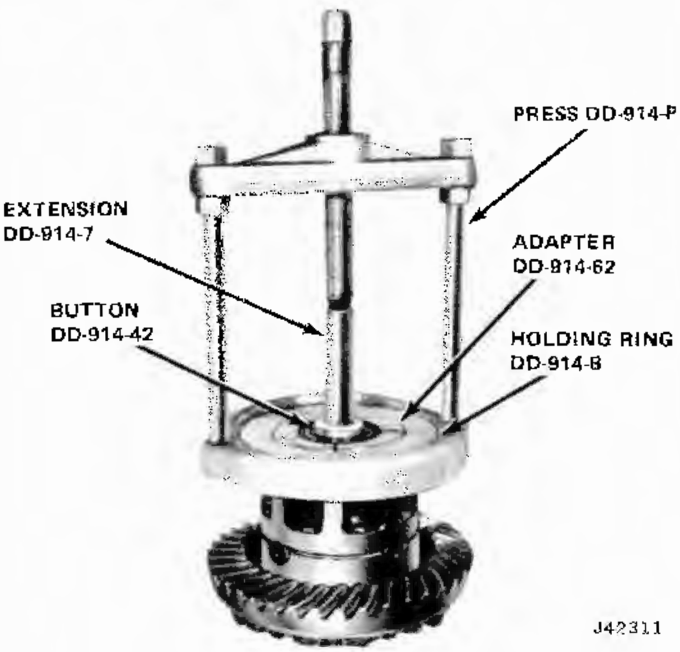

Fig 10-24 Pulling Differential Side Carrier Bearing

Pinion Bearing Cup Removal

NOTE: *The differential carrier housing has recesses in the casting to permit the use of a brass drift to drive the inner and outer cups from the housing.*

(1) Using a brass drift, drive pinion inner bearing cup and shims from housing. Even if mutilated, these shims should be kept for proper assembly of differential.

(2) Using brass drift, drive outer pinion cup from housing.

Cleaning and Inspection

Clean all parts in fast-evaporating mineral spirits or a dry cleaning solvent and, with the exception of bearings, dry with compressed air.

Inspect differential bearing cones, cups, and rollers for pitting, galling, or other visible damage.

Inspect differential case for elongated or enlarged pinion shaft hole. The machined thrust washer surface areas and counterbores must be smooth and without metal deposits or surface imperfections. If any of the above conditions exist, satisfactory correction must be made or the case replaced. Inspect case for cracks or other visible damage which might render it unfit for further service.

Inspect differential pinion shaft for excessive wear in contact area of differential pinions. Shaft should be smooth and round with no scoring or metal pickup.

Inspect differential side gears and pinions; they should have smooth teeth with a uniform contact pattern without excessive wear or broken surfaces. The differential side gear and pinion thrust washers should be smooth and free from any scoring or metal pickup.

Inspect differential pinion shaft lockpin for damage or looseness in case. Replace pin or case as necessary.

Inspect drive gear and pinion for worn or chipped teeth or damaged attaching bolt threads. If replacement is necessary, replace both the drive gear and drive pinion as they are available in matched sets only.

Inspect drive pinion bearing cones, cups and rollers for pitting, galling, excessive wear, or other visible damage. If inspection reveals that either are unfit for further service, replace both cup and cone.

Inspect differential carrier for cracks or other visible damage which would render it unfit for further service. Raised metal on the shoulder of bearing cup bores incurred in removing pinion cups should be flattened by use of a flat-nose punch.

Inspect drive pinion for damaged bearings journals and mounting shim surface or excessively worn splines. If replacement is necessary, replace both the drive pinion and drive gear as they are available in matched sets only.

Inspect companion flange for cracks, worn splines, pitted, rough or corroded oil seal contacting surface. Repair or replace companion flange as necessary.

Inspect drive pinion bearing shim pack for broken, damaged, or distorted shims. Replace if necessary during establishment of pinion bearing preload.

Pinion Installation and Adjustment

NOTE: *Front axles use an oil slinger between the bearing cone and the pinion head. If this is not replaced the pinion shim pack dimension will be incorrect.*

Adjustment of the pinion is accomplished by the use of shims placed between the inner bearing cup and the axle housing and between the pinion shaft shoulder and the outer bearing. The shims behind the inner bearing cup adjust the position of pinion in relation to the ring gear. The shims behind the outer bearing adjust the pinion inner and outer bearing preload (fig. 10-25).

(1) Install outer bearing cup using Driver W-126.

(2) Install inner bearing cup using Driver W-126 on Model 30 axles, and Installer W-344 on Model 44 and Model 60 axles to drive cup into housing.

(3) Use Sleeve C-3095 to press or drive inner bearing onto pinion shaft on axle models 44 and 60. Use Sleeve W-262 on Model 30 (fig. 10-26).

(4) Place pinion in housing and install a 0.065-inch shim, inner bearing, Sleeve SP-1997 (from Tool W-162), in place of U-joint yoke to hold pinion in position for adjustment. Install pinion nut.

(5) Select proper pinion adjusting gauge to obtain correct reading for differential model.

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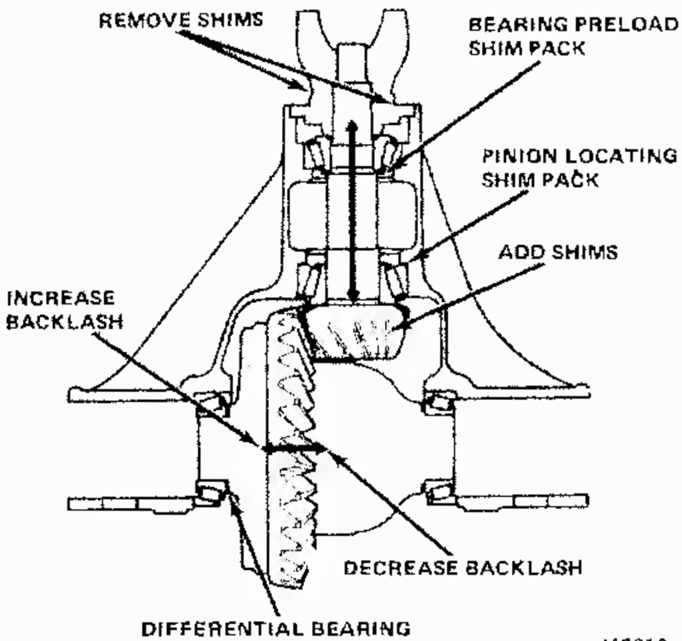

Fig. 10-25 Differential Shim Pack Locations

NOTE: *The pinion adjusting fixture must first be set by the use of a master gauge which is included in the W-99 kit. Gauge Block SP-5433 or SP-5434, stamped with the letter J is used on Model 60 axles; Gauge Block W-101-A-22 or SP-5453, stamped E is used on Model 44 axles; and Gauge Block SP-5291 stamped K is used on Model 30 axles. SP-5264 is used with the dial indicator in W-99 tool set for setting pinion depth.*

(6) Place gauge block against machined surface of dial indicator mount (fig. 10-27).

(7) Set dial indicator on zero.

(8) Install pinion adjusting fixture on pinion with stationary guide pin and adjustable guide pin seated in pinion shaft lathe centers (fig. 10-28).

NOTE: *Use the C-clamp type alignment fixture vertically as shown in figure 10-28) so that weight of jig assembly is always directly centered and supported on pinion shaft center. The function of the fixture is to accurately hold the dial indicator and its mount in alignment to the pinion shaft while it is pivoted on the stationary guide pin. If a consistent repeat dial reading cannot be obtained, look for dirty or burred pinion centers or a bent or twisted aligning jib. Keep jig flat in metal case when not in use. Do not allow other tools to rest on it. Treat the C-clamp fixture tool carefully (as a precision instrument).*

(9) Seat gauge mount firmly on pinion head and swing dial indicator through differential bearing bore (fig. 10-27).

(10) Observe reading.

The lowest reading indicates the center of the differential bearing bore. At this point, the dial indicator should read the same as mark etched on the pinion head. If the reading does not agree, add or remove shims behind the inner pinion bearing cup until the readings agree.

The end of each pinion is etched with a plus (+) number, a minus (-) number or zero (0) number to indicate the best running position for each particular gear set. This dimension is controlled by shimming behind the inner pinion bearing cup. Therefore if a pinion is etched (+2), this pinion would require 0.002 inch less shims than a pinion etched 0. By removing shims the mounting distance is **increased** which is just what a (+2) etching indicates. Or if a pinion is etched (-2), add 0.002 inch more shims than would be required if the pinion were etched 0. By adding 0.002 inch shims, the mounting distance is **decreased** which is just what a (-2) etching indicates.

NOTE: *To increase the dial reading, decrease shims; to decrease the dial reading, increase the shims. Example: With a dial reading of minus 0.001 inch and a pinion marking of plus 0.002 inch, remove 0.003 inch shims to obtain a higher dial reading of plus 0.002 inch.*

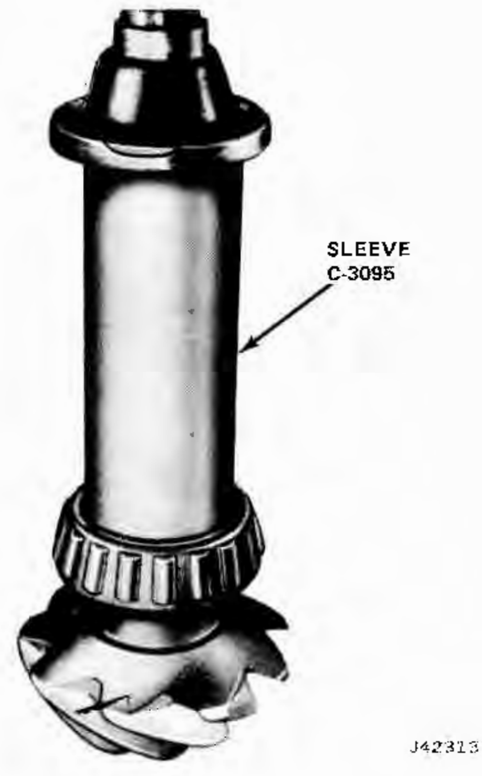

Fig. 10-26 Pinion Bearing Installing Sleeve

(1) If the original ring and pinion set is to be reused, measure the old pinion shim pack and build a new shim pack to this dimension. Collect shim pack saved from teardown. Measure each shim separately with a micrometer and add together to get total shim pack thickness from original buildup. Note the (+) or (-) etching on both the old pinion and the new one, and

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Fig. 10-27 Checking Pinion Adjustment

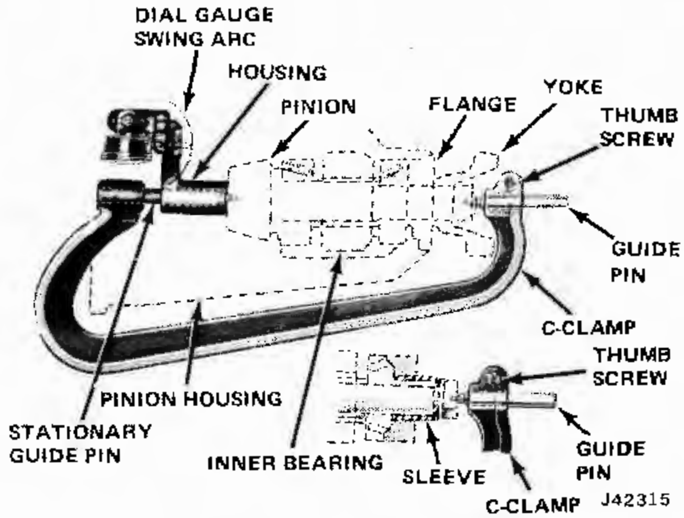

Fig. 10-28 Pinion Adjusting Fixture

PINION MARKING CHART

OLD PINION MARKING	NEW PINION MARKING								
	-4	-3	-2	-1	0	+1	+2	+3	+4
+4	+0.008	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0
+3	+0.007	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001
+2	+0.006	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003
0	+0.004	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004
-1	+0.003	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005
-2	+0.002	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006
-3	+0.001	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007
-4	0	-0.001	-0.002	-0.003	-0.004	-0.005	-0.006	-0.007	-0.008

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adjust the thickness of new shim pack to compensate for the difference between these two figures. Refer to Pinion Marking Chart for example. If the old pinion reads (+2), add 0.004-inch shims to the original pack dimension. Now build a new shim pack to this resulting dimension.

(2) When correct adjustment is reached, remove pinion adjusting fixture and sleeve SP-1997. Install outer bearing.

(3) Install only oil slinger, yoke, flat washer, and pinion nut. Holding yoke with Flange Holder C-3281, tighten nut 200 to 220 foot-pounds or 250 to 270 foot-pounds torque for full-floating rear axle.

(4) Using Inch-Pound Torque Wrench W-297 on nut, check rotating torque. The rotating torque should be 10 to 25 inch-pounds.

NOTE: *Disregard starting torque.*

(5) Add or remove shims between pinion outer bearing and pinion shaft to obtain correct torque reading (fig. 10-25).

Differential Case - Assembly

(1) Reassemble differential pinions, side gears, thrust washers, and shaft in relative position shown in figures 10-17 and 10-18. Make sure spacers are installed.

(2) Install differential shaft lockpin.

(3) Check side gear clearance.

(4) Examine contacting surfaces of ring gear and differential case for burrs or foreign matter.

(5) Assemble ring gear on differential case with assembly hole on each lined up.

(6) Tap ring gear into place with mallet.

(7) Install ring gear screws. Tighten to 45 to 65 foot-pounds torque on all except Model 60. Tighten valve 100 to 120 foot-pounds torque.

Adjustment of Differential Side Gears

Clearance between the differential side gears and differential case should be 0.000 inch to 0.006 inch.

(1) With differential positioned (fig. 10-29), tap

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differential lightly on a flat surface so differential gears settle into proper position.

(2) Measure clearance between side gear and case with leaf feeler gauge as illustrated.

(3) If clearance exceeds 0.006 inch, add shims between side gears and case.

NOTE: *If shims are required, at least one shim should be placed on each side and the shim packs kept as even as possible. After adding shims, repeat the clearance check.*

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Fig. 10-29 Checking Side Gear Clearance

Adjustment of Differential Bearing Preload and Ring Gear Backlash

The adjustment of the differential bearings is maintained by the use of shims placed between the differential case and the differential bearing.

(1) Install differential case and bearings in axle housing without shims and with bearing cups snug.

(2) Holding ring gear in contact with pinion and using a screwdriver blade to move differential bearing cups toward center, insert feeler gauge on each side between differential bearing cup and axle housing. There should be only 0.001 inch to 0.002 inch backlash remaining with feeler gauge inserted.

(3) After shim pack requirement for each bearing has been established, remove differential assembly. Make up shim packs and keep them separated.

(4) Add an additional 0.015 inch thickness of shims to pack on tooth side of ring gear.

(5) Place differential bearing shim packs on differential case under each bearing. Install bearings with Driver W-188 for Model 44 and Driver C-4025 for Model 60 (fig. 10-30).

NOTE: *When overhauling the front axle differential, check the axle inner oil seals. Should new seals be required, install them with Installer DD-1243 for Model 44 axles (fig. 10-31).*

(6) Attach Carrier Spreader W-129, install a dial indicator, and spread carrier a maximum of 0.020 inch.

(7) Remove indicator.

(8) Lubricate bearings and place differential in carrier.

(9) Tap unit carefully into place with soft mallet, making sure ring gear teeth mesh with pinion teeth.

(10) Install bearing caps, matching their markings with those on carrier.

(11) Apply sealing compound to screw threads. Tighten screws to specified torque.

(12) Install dial indicator to check ring gear backlash (fig. 10-32). Check backlash at two points. Backlash must be held between 0.005 inch to 0.010 inch. If backlash does not fall within specifications, shims should be interchanged between the two differential bearing shim packs until correct backlash is obtained.

NOTE: *Changing the position of a 0.005 inch shim from one side to the other will change the amount of backlash approximately 0.003 inch.*

(13) Check ring gear for runout. A reading in excess of 0.006 inch indicates a sprung differential case, dirt between case and gear, or loose ring gear screws.

(14) Adjust tooth contact. Paint the bevel gear teeth with red lead or prussian blue and turn the bevel gear so that the pinion will make an impression on the teeth (fig. 10-33). After the differential has

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Fig. 10-30 Differential Bearing Driver

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been assembled and adjusted, pinion shaft oil seal should be installed.

(15) Remove sleeve previously installed in place of universal joint yoke and install oil seal with Driver W-147 in all axles except Model 60. Use Driver C-359 for pinion oil seal installation on Model 60.

(16) Install universal joint yoke with Flange Installing Tool W-162 (fig. 10-34). Install pinion washer and nut.

(17) Install axle shafts and differential housing cover.

TRAC-LOK DIFFERENTIAL

Operation

A conventional differential transmits all of the ring gear torque through the differential gears to the axle shafts. Torque is at all times equal on the axle shafts, and if one wheel slips, the other wheel can only put out as much torque as the slipping wheel.

The Trac-Lok differential is similar, except that part of the torque from the ring gear is transmitted through clutch packs between the side gears and differential case. The multiple disc clutches with radial grooves on the plates and concentric grooves on the discs are engaged by a preload from Belleville springs.

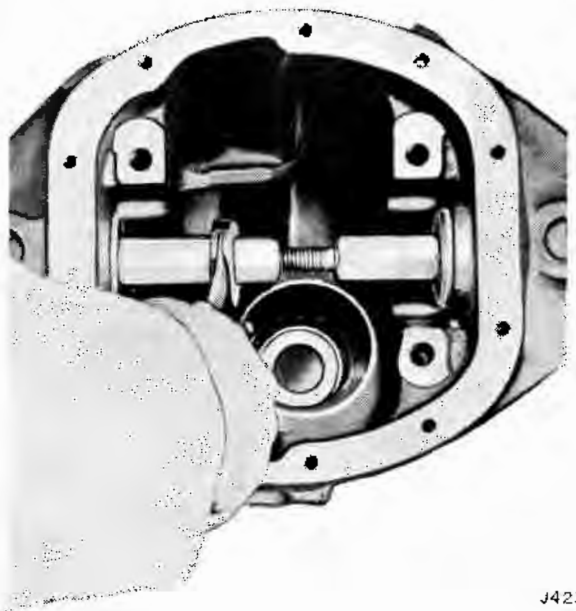

Fig. 10-31 Installing Inner Oil Seals

Fig. 10-32 Checking Ring Gear Backlash

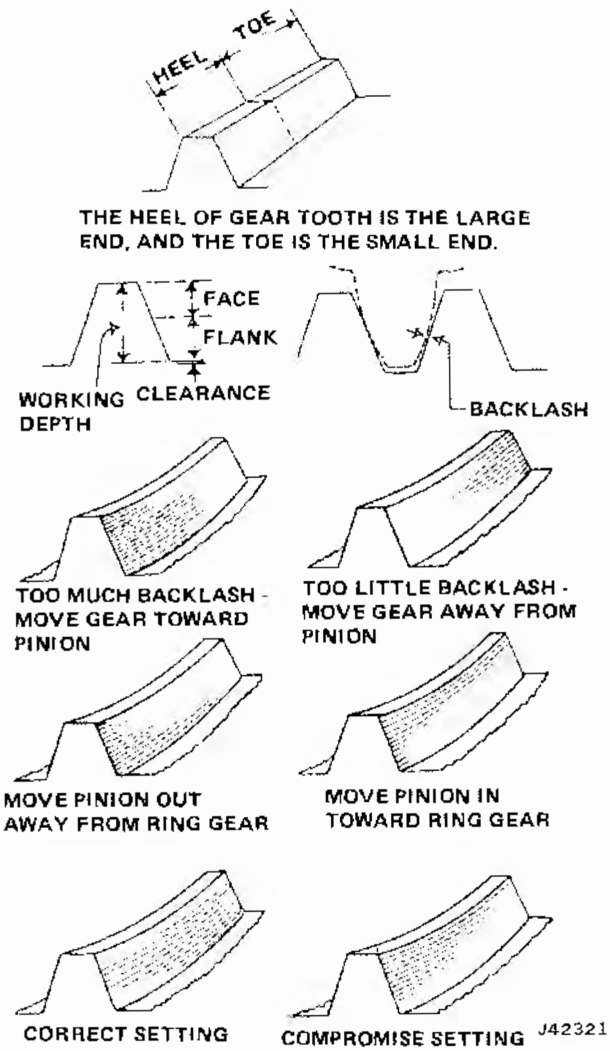

Fig. 10-33 Gear Tooth Contact

Fig. 10-34 Yoke Installing Tool

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plus separating forces from the side gears as torque is applied through the ring gear.

The Trac-Lok construction permits differential action when required for turning corners and transmits equal torque to both wheels when driving straight ahead. However, when one wheel encounters ice or leaves the ground and spins, the clutch packs automatically provide more torque to the wheel which is not spinning. The Trac-Lok differential resists wheel spin on bumpy roads and provides more pulling power when one wheel tries to slip. Pulling power will be automatically provided until both wheels start to slip. If, with unequal traction, both wheels slip, Trac-Lok operation is normal. In extreme cases of differences in traction, the wheel with least traction may spin after the Trac-Lok has transferred as much torque as possible to the nonslipping wheel.

Lubrication

The Trac-Lok differential requires a special lubricant and ordinary multipurpose gear lubricants MUST NOT be used. Use only Jeep Differential Oil, part number 94557.

Trac-Lok differential may be cleaned only by disassembling the unit and wiping with clean rags.

NOTE: *The Trac-Lok differential is serviced at the same time intervals as the standard differential.*

Trouble Symptoms

If noises or roughness such as chatter are present in turning corners, the probable cause is incorrect or contaminated lubricant.

Before any differential is removed and disassembled for chatter complaints, check to see if proper lubricant is used.

A complete lubricant drain and refill with specified Limited Slip Differential Lubricant will usually correct chatter.

Draining

(1) Warm lubricant by vehicle road operation, or 5 minutes of operation in gear at 30 mph with both wheels off ground on hoist.

WARNING: *Never place the transmission in gear with the engine running when only one wheel of a Trac-Lok equipped vehicle is raised. The vehicle might drive itself off the jack and cause damage or injury.*

(2) Drain lubricant while warm. Remove drain plug or cover to drain completely. If cover is removed, it may be necessary to replace gasket at this time.

(3) Refill axle with specified lubricant, Jeep part number 94557.

(4) Operate vehicle for approximately ten miles, making at least ten figure-eight turns to flush old lubricant out of clutch packs.

(5) Repeat three preceding steps making sure to replace cover gasket if required.

NOTE: *It is possible that slight chatter requiring additional vehicle operation may remain after step. If chatter persists after 100 miles of vehicle operation or remains severe after above procedure, disassembly and repair will be necessary.*

Operational Test

Proper performance and capabilities of Trac-Lok Differentials are often misunderstood. No precise method of measuring performance is generally available in the field. A functioning unit can be determined by a relatively simple vehicle operational test, as follows:

Place one wheel on good dry pavement, and the other on ice, mud, grease, etc.

Gradually increase engine rpm to obtain maximum traction prior to breakaway. The ability to move the vehicle effectively will demonstrate proper performance.

If extremely slick surfaces such as ice or grease are used, some question may exist as to proper performance as described above. In these extreme cases, a properly performing Trac-Lok will provide greater pulling power by lightly applying the parking brake.

Disassembly

(1) Remove Trac-Lok from housing. Procedures for removal of axle shafts and differential case from axle housing are the same as that previously outlined for conventional axles.

(2) Place axle shaft into a vise.

(3) Tighten shaft in vise firmly.

NOTE: *The spline end of the shaft is not to extend beyond 2-3/4 inch above the top of the vise. This will eliminate the shaft from fully entering into the side gear and causing interference with the step plate tool during disassembly of the pinion mate gears (fig. 10-35 and 10-36).*

(4) Assemble differential case to axle shaft with ring gear screw heads up. Assembling differential case onto shaft will serve as a holding device to remove ring gear and to disassemble internal parts of case.

(5) Remove ring gear screws and ring gear.

(6) Place a few shop towels over top of vise to protect gear teeth from becoming nicked after it is free from case.

(7) Tap ring gear with a rawhide hammer to free it from case.

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Fig. 10-35 Axle Shaft Positioned in Vise

Fig. 10-36 Differential Positioned on Axle Shaft

NOTE: *Whenever the ring gear screws are removed, they are to be replaced with new screws.*

(8) Remove differential case from axle shaft and remove ring gear.

NOTE: *All Trac-Lok differentials are identified with a manufacturing date and the complete part number stamped on the barrel of the case (fig. 10-37).*

It is recommended that when referring to the Trac-Lok, obtain the complete part number and build date. To do this, it will be necessary to wipe the lubricant from the case.

(1) Reposition differential case onto axle shaft.

(2) Remove two snap rings from cross pin.

(3) Use two screwdrivers and push rings free from cross pin. Place a shop towel behind the case to prevent snap rings from flying out of case (fig. 10-38).

Fig. 10-37 Trac-Lok Differential Identification

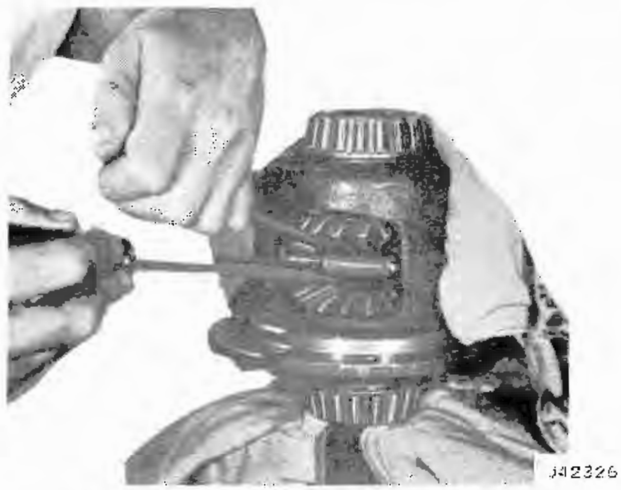

Fig. 10-38 Removing Snap Rings from Cross Pin

NOTE: *On the Model 60 Trac-Lok, the cross pin is held in the case by a roll pin. Use a 3/16-inch diameter punch to remove the roll pin.*

(4) Remove cross pin. Use a hammer and punch to remove cross pin from case.

NOTE: *Gear Rotating Tool C-4143 is required to service the Trac-Lok differential. The tool consists of four parts: handle, pawl, forcing screw and step plate.*

(5) Assemble step plate tool into bottom of side gear (fig. 10-39).

(6) Position gear rotating tool into top side gear (fig. 10-40).

(7) Insert forcing screw down through top of case and thread into gear rotating tool.

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Fig. 10-39 Installing Step Plate Tool

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Fig. 10-40 Installing Gear Rotating Tool

NOTE: *Before using the forcing screw, be sure the threads are lubricated with a fine coat of oil. Also apply a small spot of grease to the centering hole in the step plate before it contacts the forcing screw.*

(8) Thread forcing screw so that it becomes centered into step plate. Tighten forcing screw. This will move the side gears away from pinion mate gears and relieve load between gears, allowing only pinion mate gears to be loose.

(9) Remove both pinion mate spherical washers. Use a shim stock of 0.030-inch thickness or an equivalent tool to push out spherical washers. Relieve tension of Belleville spring by loosening forcing screw (fig. 10-41).

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Fig. 10-41 Removing Pinion Mate Washers

(10) Retighten forcing screw until a very slight movement of pinion mate gears is detected.

(11) Insert pawl rotating tool between one of side gear teeth as shown. Pull on handle so top side gear will rotate and also allow pinion mate gears to rotate. Continue pulling on tool until gear hits the handle.

(12) Remove pawl from between gear teeth and repeat above until pinion mate gears can be removed through large opening of case.

NOTE: *When attempting to rotate the side gear, it will probably be necessary to adjust the forcing screw by very slightly tightening or loosening until the required load is applied to the Belleville springs to allow the side gear and pinion mate gears to rotate (fig. 10-42).*

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Fig. 10-42 Removing Pinion Mate Gears

(13) Retain top side gear and clutch pack in case by holding hand on bottom of rotating tool while removing forcing screw. Remove rotating tool, top side gear, and clutch pack.

(14) Remove differential case from axle shaft. Turn case with flange or ring gear side up and allow step plate tool side gear andoved
from case. Remove the retainer clips from both clutch packs to allow separation of plates and discs (fig. 10-43).

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Fig. 10-43 Trac-Lok Unit Disassembly

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Inspection

Plates and Discs - If any one member of either stack shows evidence of excessive wear or scoring, then the complete stack is to be replaced on both sides.

Side Gears and Pinion Mate Gears - The gear teeth of these parts should be checked for extreme wear or possible cracks. The external teeth of the side gear which holds the clutch pack should also be checked for wear or cracks. If replacement of one gear is required due to wear, etc., then both side gears, pinion mate gears, and washers are to be replaced.

Cross Pin - If excessive wear is evident, then the cross pin should be replaced.

Clutch Retainer Clips - If wear is evident on any one of the retainer clips, it is suggested that all four clips be replaced.

Differential Case - If scoring, wear, or metal pickup is evident on the machined surfaces, then replacement of the case is necessary.

Examples of radial groove plate (A) and the concentric groove disc are shown in figure 10-44.

Fig. 10-44 Plate and Disc Identification

Assembly

(1) Assemble plates and discs in exactly same position as they were removed, regardless of whether they are new parts or original parts.

(2) Prelubricate thrust face of side gear, assemble plates and discs to side gear splines, prelubing each part as shown with specified lubricant. Lube stacks (fig. 10-45).

Fig. 10-45 Lubricating Trac-Lok Components

(3) Assemble retainer clips to ears of plates. Make sure both stacks are completely assembled or seated onto ears of plates.

(4) With differential case positioned as shown, assemble clutch pack and side gear into case.

NOTE: *Make sure the clutch pack stays assembled to the side gear splines and that the retainer clips are completely seated into the pockets of the case. To prevent pack from falling out of the case, it will be necessary to hold them in place by hand while assembling the case onto the axle shaft.*

(5) Assemble differential case onto the axle shaft in the position as shown in figure 10-46.

Fig. 10-46 Install Differential Case on Axle Shaft

CAUTION: *When assembling the differential case onto the axle shaft, be sure that the splines of the side gears are lined up with those of the axle shaft. Also make sure that the clutch pack is still properly assembled into the case after assembling the case onto the shaft.*

(6) Assemble step plate tool into side gear. Apply a small dab of grease into centering hole of step plate tool.

(7) Assemble other clutch pack and side gear exactly as shown. Be sure clutch pack stays assembled onto side gear splines and that retainer clips are completely seated into pockets of case (fig. 10-47).

(8) Position gear rotating tool into top side gear.

(9) Keep side gear and rotating tool in position by holding with hand. Insert forcing screw down through top of case and thread into rotating tool (fig. 10-48).

(10) Position both pinion mate gears exactly as shown. Be sure holes of gears are lined up with each other. Hold gears in place by hand (fig. 10-49).

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(11) Tighten forcing screw so that Belleville springs will compress and allow clearance between teeth of pinion mate gears and side gears.

(12) While holding pinion mate gears in place, insert pawl of rotating tool between one of side gear teeth as shown. Pull on handle so top side gear will rotate and allow pinion mate gears to rotate and enter into case.

Fig. 10-47 Installing Clutch Pack and Side Gear

Fig. 10-48 Threading Forcing Screw into Rotating Tool

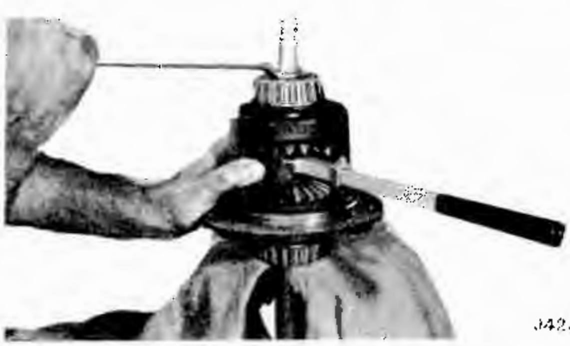

Fig. 10-49 Starting Pinion Mate Gears into Case

NOTE: *As mentioned before, it will probably be necessary to adjust the forcing screw by very slightly loosening or tightening until the required load is applied to the Belleville plates or discs to allow the side gear and pinion mate gears to rotate.*

(13) Pull on tool until handle hits gear. Remove pawl from between gear teeth, reposition handle and pawl. Repeat the same operation until holes of both pinion mate gears are lined up exactly with those of case.

(14) Prelubricate both sides of pinion mate spherical washers with specified lubricant.

(15) Apply torque to forcing screw to allow clearance to assemble spherical washers.

(16) Assemble washers into case. Use a very small screwdriver to push washers into place (fig. 10-50).

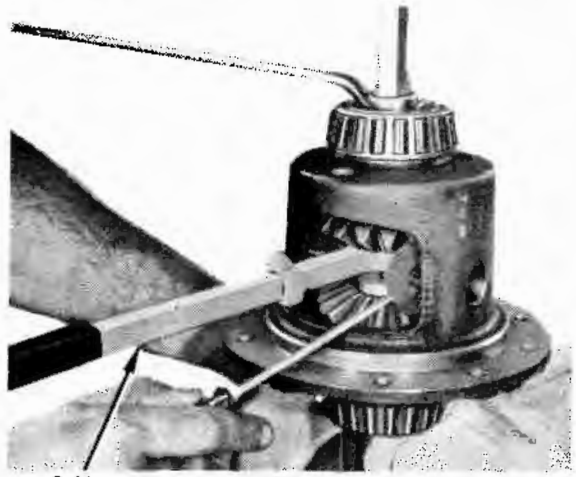

Fig. 10-50 Installing Pinion Mate Washers

CAUTION: *Be sure the holes of the washers and gears are lined up exactly with those of the case.*

(17) Remove forcing screw, rotating tool, and step plate.

(18) Prelubricate cross pin with specified lubricant. Assemble cross pin into case. Use a hammer as shown. Be sure snap ring grooves of the cross pin are exposed to allow assembly of snap rings (fig. 10-51).

(19) Assemble snap rings.

NOTE: *On the Model 60 Trac-Lok, align the hole in the cross pin with the hole in the case. Drive the cross pin into position and install the retaining roll pin. If case is positioned in vise with machine side of drive gear flange facing upward, use a 5/16-inch diameter punch to drive the roll pin until the punch bottoms in the case bore. If the case is positioned in the vise with the machined side of drive gear flange facing downward, wrap a piece of tape around a 3/16-inch diameter punch approximately 1-3/4 inch away from the end of the punch and drive the roll pin into the case until the edge of the tape is flush with the roll pin bore.*

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Fig. 10-51 Installing Cross Pin

(20) Remove case from axle shaft. Assemble ring gear to case.

(21) Line up ring gear screw holes with those of case. Assemble ring gear screws finger-tight.

(22) Reposition differential case onto axle shaft as shown. Draw screws up evenly. Tighten to specified torque (refer to Torque Specifications).

NOTE: *Use new ring gear screws.*

(23) Install Trac-Lok differential case assembly into axle housing. Follow the service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.

Assembly Replacement

If inspection reveals that the replacement of the Trac-Lok as a unit is required, the following steps should be followed.

(1) Remove both differential bearing cones and shims. Mark or tag each side bearing cone and shim pack as it is removed to indicate from which side of the case they were removed.

(2) Remove ring gear from case.

(3) Assemble ring gear to new Trac-Lok case. Make sure the gear flange on the differential case is free of nicks or burrs (refer to Torque Specifications).

(4) Inspect shims and bearings which were removed from old case. If shims and bearings show excessive wear or damage, they should be replaced. Make sure they are used on exactly the same sides of the new case as on the old case.

(5) Assemble shims and differential bearing cones. Use step plate on bottom bearing to protect bearing from becoming damaged during assembly of top bearing. To completely seat bearings, use proper bearing driver tool.

(6) Prelubricate differential bearing cones with specified lubricant and assemble case into axle housing.

(7) Follow service procedures previously outlined for conventional axles to complete differential and axle assembly servicing.

PROPELLER SHAFTS AND UNIVERSAL JOINTS

GENERAL

The drive from the transfer case to the front and rear axles is accomplished by means of tubular propeller shafts; each shaft is equipped with a universal joint at each end.

Because of the various combinations of drive line components, several types of propeller shafts are required.

Always check the replacement propeller shaft for correct part number before installation.

Both the propeller shafts and the universal joints should be checked regularly for foreign matter around shafts, dented or bent shafts, and loose attaching bolts. Refer to Section B - Maintenance for proper lubrication requirements and specifications.

Universal Joint Service

Each shaft is equipped with a splined slip joint at one end to allow for variations in length caused by vehicle spring action. The yokes at the front and rear of the shaft must be aligned in the same horizontal plane. This is necessary to avoid vibration.

NOTE: *Whenever a vehicle is undercoated, use extreme care to keep undercoating material off the propeller shafts. Undercoating on a propeller shaft can cause vibration due to imbalance.*

CARDAN CROSS-TYPE UNIVERSAL JOINT

Disassembly

NOTE: *Repair of single and double Cardan joints are similar except for the center ball and socket in the double Cardan joint (fig. 10-52). The rollers and bushings are replaceable once the joint is disassembled.*

(1) Position tube of propeller shaft, near cross-type universal joint, in a bench vise; clamp lightly.

(2) Remove two cup retainer rings, which fasten bearing cups to tube yoke. If necessary, tap ends of

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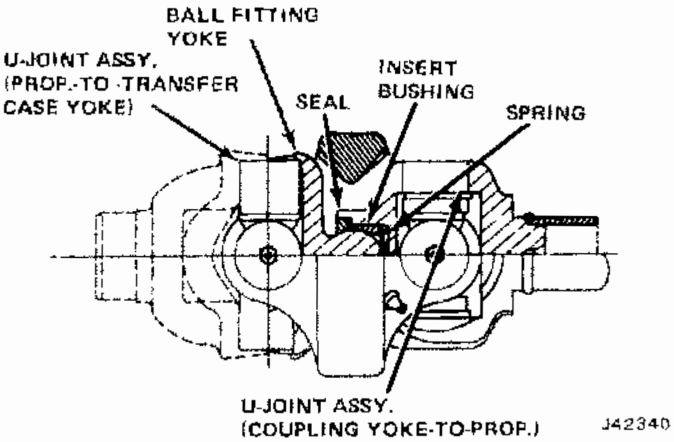

Fig. 10-52 Double Cardan Joint

bearing cups with a brass hammer to release pressure on retainer rings before removal.

(3) Place joint between open jaws of a soft-jawed vise so that ears on one yoke are supported on vise jaws.

(4) With a brass hammer, strike the ear of yoke behind bearing. This will drive out bearing. Remove opposite bearing in same manner.

(5) Remove cross from yoke.

(6) Disengage and remove tie link from two bearing block retainers. Remove retainers and two roller bearing cups from cross. Remove four bearing seals and four seal retainers from cross.

(7) Clean tube yoke of propeller shaft with a suitable cleaning solvent and dry thoroughly.

(8) Inspect yoke for wear and damage. If it is bent out of alignment with propeller shaft tube, or if its bearing bores are worn or damaged, replace propeller shaft.

Assembly

(1) If cross of universal joint has not been replaced, install four new seal retainers and bearing seals, one on each arm of cross.

(2) Install two roller bearing cup assemblies, on opposite arms of cross.

(3) Install a bearing block retainer on each bearing cup, and connect retainers with tie link to fasten bearings to cross.

(4) Thread remaining arms of cross, which do not carry bearings, into tube yoke.

(5) Position yoke in a soft-jaw vise, so that its inner surface is supported by vise jaws.

(6) With brass hammer, tap roller bearing cup assembly into bearing bore of yoke, so that bearing fits over ends of cross. Drive bearing cup downward until its retaining ring groove is fully exposed below yoke inner surface.

(7) Secure bearing to yoke with a retainer ring; be certain retainer ring is properly seated.

(8) Reverse yoke on vise and repeat steps (5) through (7) to install other bearing assembly.

MODEL 30 FRONT AXLE SPECIFICATIONS

Torque Specifications	Foot-Pounds
Axle Housing Cover	15 to 25
Pinion Yoke Nut	200 to 220
Differential Bearing Cap Screw	35 to 50
Drive Gear-to-Case Screws	45 to 65
Universal Joint U-Bolts	13 to 18
Wheel-to-Hub Nuts	65 to 90
Lower Ball Joint Nut	80
Upper Ball Joint Nut	100
Upper Ball Stud Seat	50
Adjustments	
Drive Pinion Bearing Break-Away Preload	
Original Bearings	15 to 25 in lbs
New Bearings	20 to 40 in lbs
Differential Bearing Preload	.015 inch
Drive Gear-to-Pinion Backlash	.005 to .009 inch
Differential Side Gear-to-Case Clearance	.000 to .006 inch

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MODEL 44 AXLE SPECIFICATIONS
(Full-Floating and Semi-Floating Types)

Torque Specifications	Foot-Pounds
Axle Housing Cover	15 to 25
Pinion Yoke Nut	200 to 220
Differential Bearing Cap Screw	70 to 90
Drive Gear-to-Case Screws	45 to 65
Universal Joint U-Bolts	13 to 18
Universal Joint Flange Bolts	25 to 45
Wheel-to-Hub Nuts	65 to 90
Backing Plate Mounting Bolts/Nuts	
Front Brakes	25 to 30
Rear Brakes	25 to 35
Disc Brake Shield Nuts	30 to 40
Disc Brake Shield Bolt	5 to 10
Lower Ball Joint Nut	80
Upper Ball Joint Nut	100
Upper Ball Stud Seat	50
Adjustments	
Drive Pinion Bearing Break-Away Preload	
Original Bearings	10 to 20 in-lbs
New Bearings	20 to 40 in-lbs
Differential Bearing Preload	.015 inch
Drive Gear-to-Pinion Backlash	.005 to .010 inch
Differential Side Gear-to-Case Clearance	.000 to .006 inch

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MODEL 60 AXLE SPECIFICATIONS

Torque Specifications	Foot-Pounds
Axle Housing Cover Screws	15 to 25
Pinion Yoke Nut	250 to 270
Differential Bearing Cap Screw	70 to 90
Drive Gear-to-Case Screws	100 to 110
Universal Joint U-Bolts	13 to 18
Universal Joint Flange Bolts	25 to 45
Wheel-to-Hub Nuts	110 to 125
Backing Plate Mounting Bolts/Nuts	45 to 55
Adjustments	
Drive Pinion Bearing Break-Away	
Original Bearings	10 to 20 in-lbs
New Bearings	20 to 40 in-lbs
Differential Bearing Preload	.015 inch
Drive Gear-to-Pinion Backlash	.005 to .009 inch
Differential Side Gear-to-Case Clearance	.000 to .006 inch

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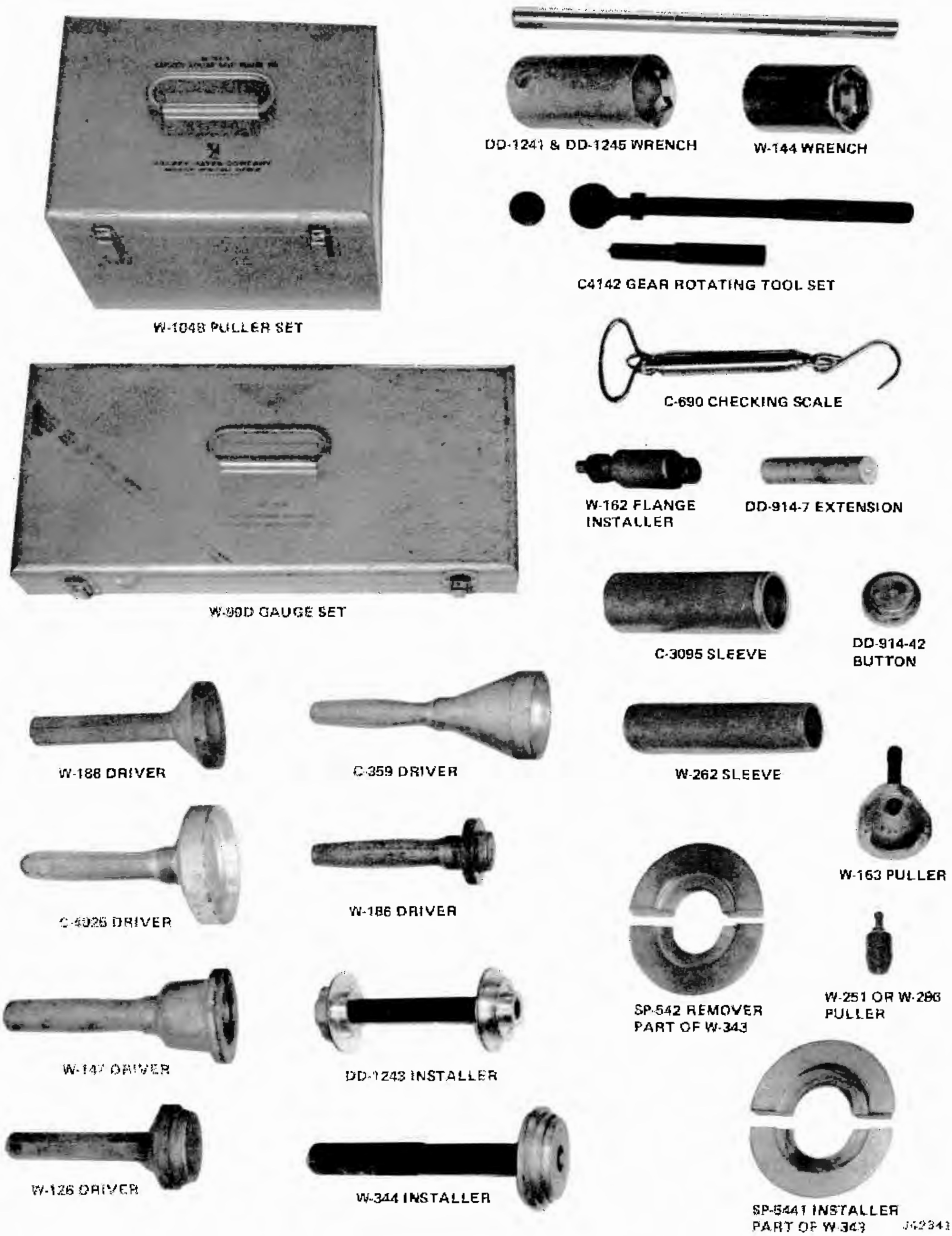

Fig. 10-53 Axle and Propeller Shaft Service Tools
(Sheet 1 of 2)

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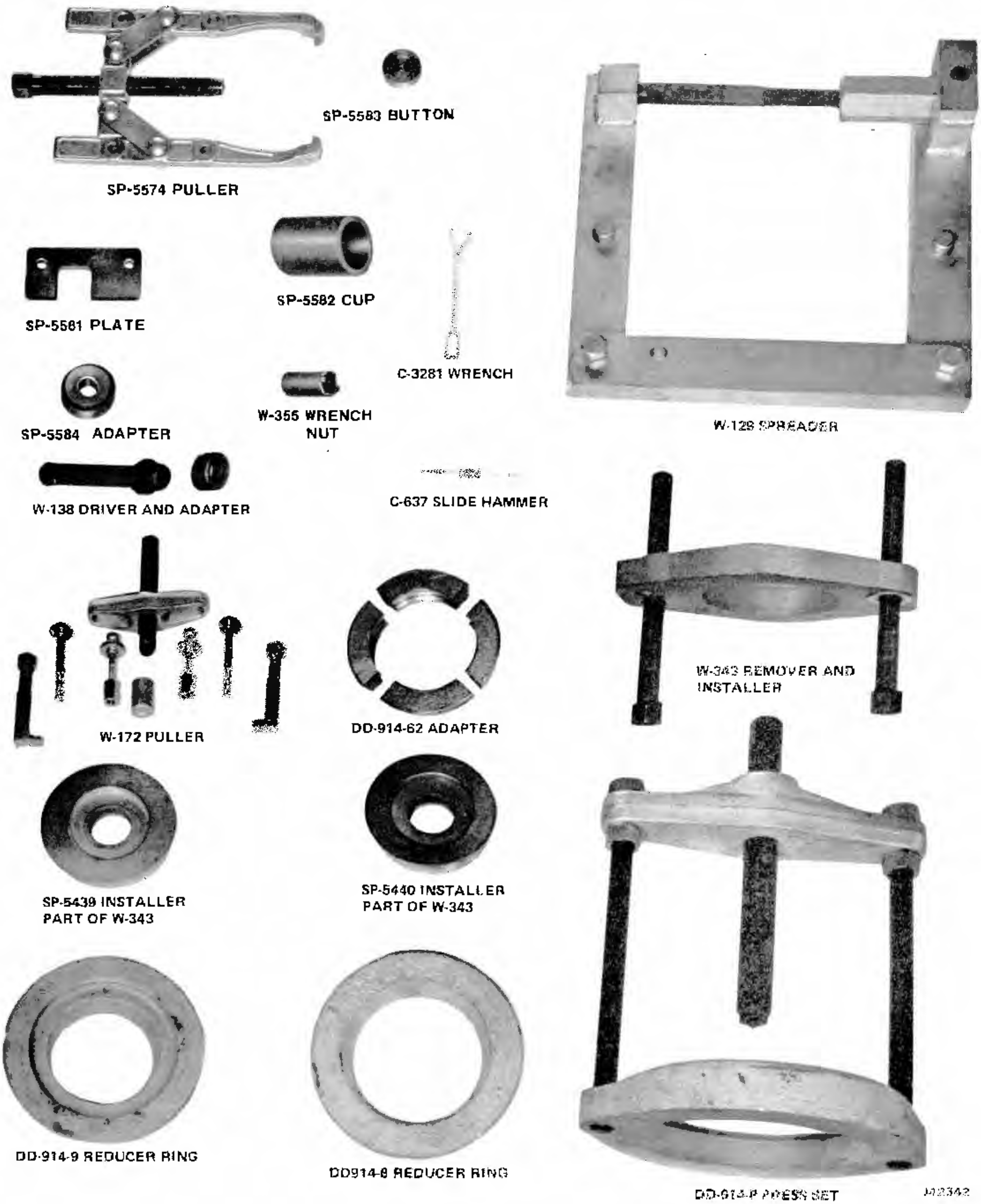

Fig. 10-53 Axle and Propeller Shaft Service Tools
(Sheet 2 of 2)

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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STEERING

STEERING COLUMNS

GENERAL

A noncompressible steering column is used in CJ Models. The solid shafts are connected by a yoke U-joint assembly. Cherokee, Wagoneer, and Truck Models are equipped with the anti-theft energy-absorbing steering column. The Adjust-O-Tilt adjustable steering steering column is optional on vehicles with automatic transmission. Like the non-tilt model, the Adjust-O-Tilt column is an energy-absorbing unit, and has an anti-theft locking feature.

Anti-Theft Energy-Absorbing Column

The anti-theft energy-absorbing steering column serves three functions:

- The column is energy-absorbing, designed to compress up to 8.25 inches in a front-end collision to minimize the possibility of injury to the driver.
- The ignition switch and lock are mounted conveniently on the column.
- With the column-mounted lock, the ignition, steering, and gear shifting operation can be locked to inhibit theft of the automobile.

WARNING: *Use only specified screws, bolts, and nuts during reassembly, and tighten to the specified torque to ensure the energy-absorbing action of the assembly. Overlength bolts must not be used as they may prevent a portion of the assembly from compressing under impact. The bolts or nuts securing the column mounting bracket to the instrument panel must be tightened to the proper torque so that the bracket will break away under impact.*

CAUTION: *When removed from the vehicle, special care must be taken in handling the column. Such actions as a sharp blow on the end of the steering shaft or shift levers, leaning on the column assembly, or dropping of the assembly, could shear or loosen the plastic fasteners that maintain column rigidity.*

Intermediate Steering Shaft

Cherokee, Wagoneer, and Truck models have a telescoping (center-slip) intermediate steering shaft (fig. 11-1). It is attached at the steering gear by a flexible coupling, and at the steering column with a non-slip cardan joint. The shaft is used for both manual and power steering applications.

The telescoping design allows the shaft to be shortened or lengthened for a total adjustment travel of 1.5 inches. When fully extended the shaft measures 22.18 inches, and 20.68 inches fully compressed. If damage to the shaft occurs it should be serviced as an assembly.

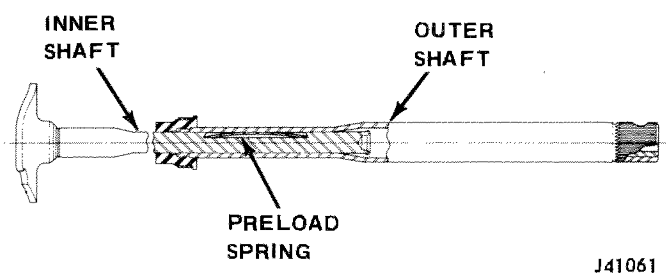

Fig. 11-1 Intermediate Steering Shaft

STEERING WHEEL

CJ Models

Removal

(1) Disconnect battery negative cable.
(2) Place front wheels in straight-ahead position.
(3) Pull horn button from steering wheel.
(4) Remove steering wheel nut and horn button contact cup.
(5) Scribe a mark on steering wheel and steering shaft to facilitate installation.
(6) Release turn signal assembly from steering post and install Puller J-25163.
(7) Remove steering wheel and spring.

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Installation

(1) Align scribe marks on steering shaft with steering wheel and secure steering wheel spring, steering wheel, and horn button contact cup with steering wheel nut. Tighten nut to 35 foot-pounds torque.

(2) Install horn button.

(3) Connect battery cable and test horn.

Cherokee-Wagoneer-Truck

Removal

(1) Disconnect battery negative cable.

(2) Place front wheels in straight-ahead position.

(3) Remove steering wheel spoke horn cover attaching screws from underside of steering wheel spoke and remove horn cover.

(4) Disconnect horn wire from switch in steering wheel cavity by gently pulling and wiggling quick-disconnect connector.

(5) Remove steering wheel nut and connector.

(6) Scribe a mark on steering wheel and steering shaft to facilitate installation.

(7) Install Puller J-25115 (fig. 11-2).

(8) Remove steering wheel.

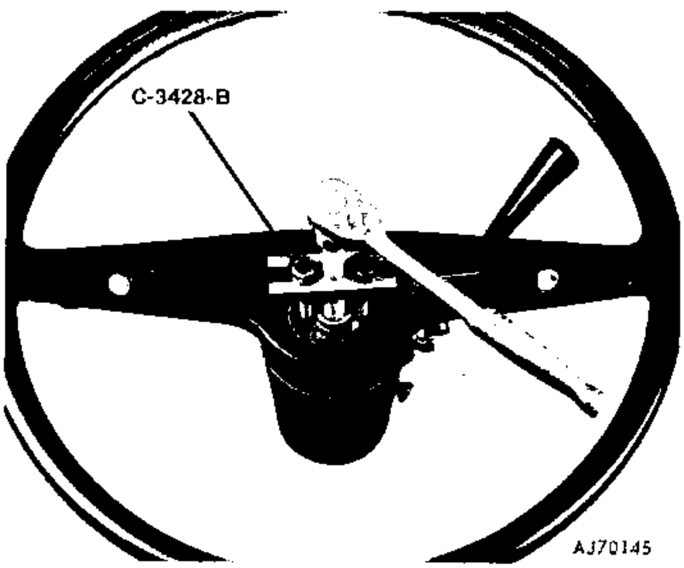

Fig. 11-2 Steering Wheel Removal

Installation

(1) Align scribe marks on steering shaft with steering wheel and secure wheel using washer and nut. Tighten nut to 20 foot-pounds torque.

(2) Connect horn wire to switch in steering wheel cavity.

(3) Install spoke horn cover.

(4) Connect battery cable and test horn.

INTERMEDIATE STEERING SHAFT

Removal

(1) Remove attaching parts at flexible coupling. Index coupling before removal to facilitate correct installation.

(2) Remove clamp bolt that secures splined end of shaft to cardan joint. Index shaft and cardan joint prior to removal of clamp.

(3) Lift flanged end of shaft and pull splined end out of cardan joint.

NOTE: *If necessary, shaft may be compressed to facilitate removal and installation.*

Installation

(1) Insert splined end of shaft into cardan joint. Use index marks to guide alignment. Do not tighten clamp bolt.

(2) Secure shaft flange to flexible coupling with attaching parts. Use index marks to guide alignment.

(3) Tighten clamp bolt at cardan joint.

NOTE: *Shaft should be neither fully extended nor fully compressed when installed.*

STEERING COLUMN SERVICE—CJ MODELS

Removal

(1) Disconnect battery negative cable.

(2) Disconnect steering column wiring connector from wiring harness located under instrument panel.

NOTE: *The steering wheel does not have to be removed to remove the steering column.*

(3) Scribe a line mark on steering shaft and upper steering shaft to lower shaft U-joint.

(4) Remove U-joint pinch bolt.

(5) Disconnect steering column toeboard to tube plate and clamp.

(6) Remove rubber grommet attaching screws.

(7) Disconnect steering column at instrument panel and remove column.

Steering U-Joint Coupling

CJ Models are equipped with a Saginaw steering gear and use a two-piece steering shaft with the sections connected by U-joint couplings. The upper U-joint connecting the intermediate and steering column shafts, is non-repairable and must be replaced with a new U-joint assembly when faulty. The lower U-joint coupling has a single spring which is placed between two bearing blocks, tending to spread them

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apart and automatically take up the wear. When servicing the lower U-joint coupling, the following procedure should be followed.

Disassembly

(1) Disconnect lower U-joint coupling at steering gear output shaft by removing pinch bolt and clamp.

(2) Loosen clamp holding U-joint coupling cover to lower shaft and remove U-joint coupling cover.

(3) Remove spring clip from cover and carefully remove cover from steering shaft. Use caution to avoid loss of small parts inside cover.

CAUTION: *Use care to prevent damage to bearing surfaces of the pin.*

(4) Remove steering shaft pivot pin bearing blocks and wave washers.

Inspection

Carefully inspect all parts for signs of wear. If pivot pin in steering shaft is not serviceable, steering shaft must be removed and replaced with a new steering shaft-pin assembly.

Assembly

(1) Install coupling cover on lower shaft, aligning slot in clamp with mark on shaft (fig. 11-3).

(2) Install clamp bolt and tighten to 40 foot-pounds torque.

(3) With steering shaft installed, place bearing blocks with wave washers in place over each end of pivot pin after first lubricating pin with chassis grease.

(4) Place retainer over end of shaft.

(5) Lubricate inside of housing with chassis grease and carefully position over pivot pin.

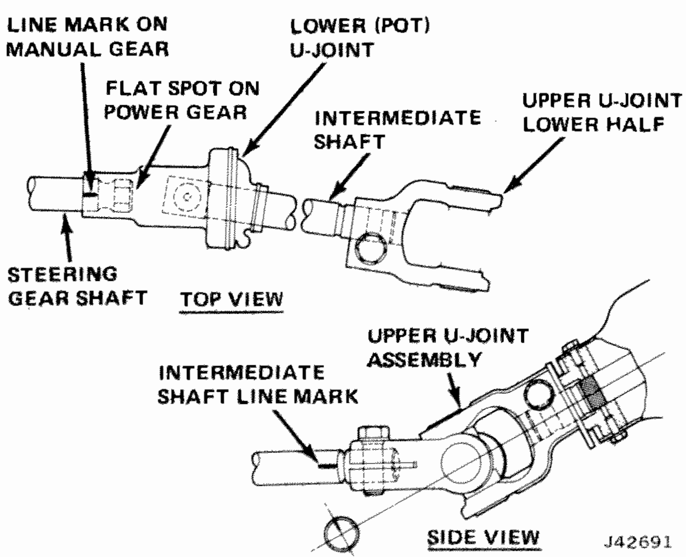

Fig. 11-3 Steering Gear-to-Steering Wheel Alignment

(6) Position retainer and boot in housing and install spring clip.

(7) Connect lower U-joint and shaft to steering gear output shaft. Install clamp pinch bolt and tighten.

Steering Column Disassembly

(1) Remove steering wheel.

(2) Remove upper steering shaft from steering column and horn wire and contact ring from shaft (fig. 11-4).

(3) Remove horn contact brush from column.

(4) Remove bearing assembly and bushing assembly from steering column ends.

(5) Inspect all parts for damage and wear. Replace worn or damaged parts.

Steering Column Assembly

(1) Install bushing assembly and bearing assembly to steering column ends.

(2) Install horn contact brush.

(3) Install steering shaft with horn wire and contact ring.

(4) Install steering wheel.

Steering Column Installation

(1) Insert steering column assembly downward, through firewall of vehicle.

(2) Position steering column assembly and install attaching bolts, nuts, and screws at instrument panel.

(3) Install and secure toeboard to tube plate clamp.

(4) Install U-joint pinch bolt.

(5) Install horn contact brush on column.

(6) Install turn signal assembly and connect turn signal and horn connectors underneath instrument panel.

STEERING COLUMN SERVICE—CHEROKEE-WAGONEER-TRUCK

Directional Signal Switch

Removal (Column in Vehicle)

(1) Disconnect battery negative cable.

(2) Release horn contact trim cover by loosening attaching screws at underside of steering wheel and remove horn button by lifting up.

(3) Remove steering wheel nut. Note alignment of steering wheel-to-steering shaft index marks for later installation.

(4) Remove steering wheel with Steering Wheel Puller C-3428-B.

(5) Loosen anti-theft cover retaining screws, lift

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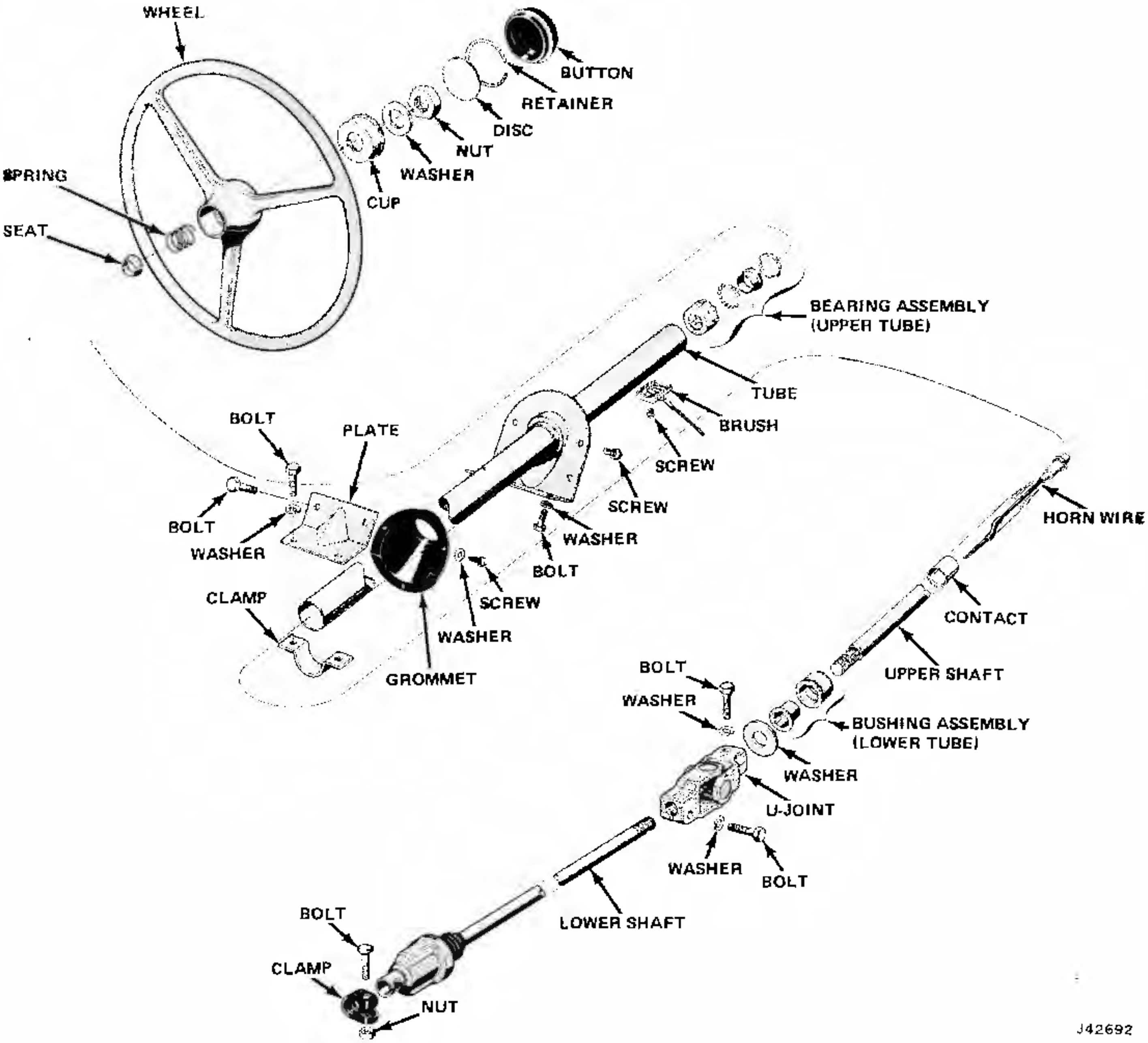

Fig. 11-4 Steering Column—CJ Models

cover from column, and remove signal switch wire protector.

(6) Use Lock Plate Compressor Tool J-23653 to depress lock plate (fig. 11-5).

WARNING: *Exercise care when removing snap ring as lock plate is under considerable spring tension.*

Once lock plate is depressed, pry the round wire snap ring from steering shaft groove. Remove Lock Plate Compressor Tool, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring, and thrust washer from the steering shaft.

(7) Place directional signal actuating lever in the right turn position and remove lever.

(8) Depress hazard warning light switch, located on right side of column adjacent to key lock, and remove button by turning counterclockwise.

(9) Remove directional signal wire harness connector block from its mounting bracket on right side of lower column. On vehicles equipped with automatic transmission, use a stiff wire such as a paper clip to depress the lock tab which retains the shift quadrant light wire in the connector block. Disconnect the wire.

(10) Remove directional signal switch retaining screws and pull directional signal switch and wire harness from the column (fig. 11-6).

Installation

(1) Guide wiring harness into position and carefully align switch assembly. Be sure that actuating

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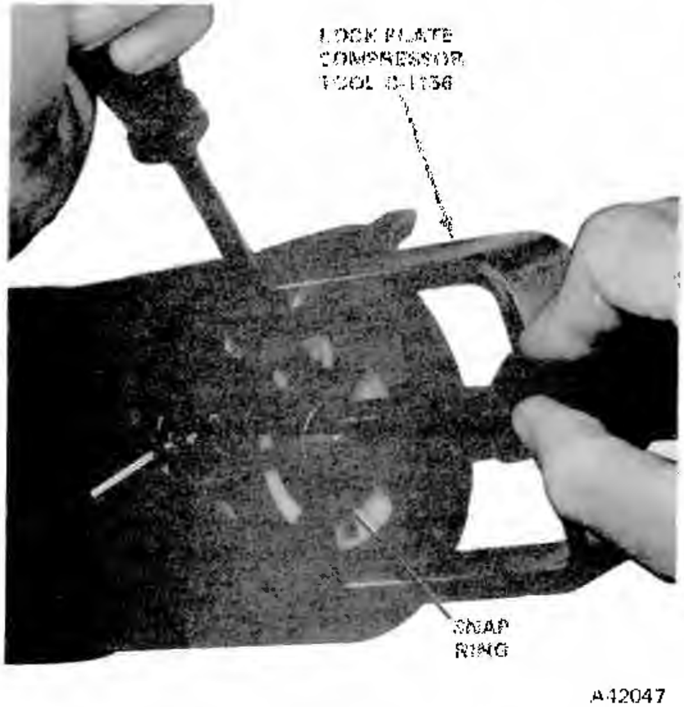

Fig. 11-5 Lock Plate Snap Ring Removal

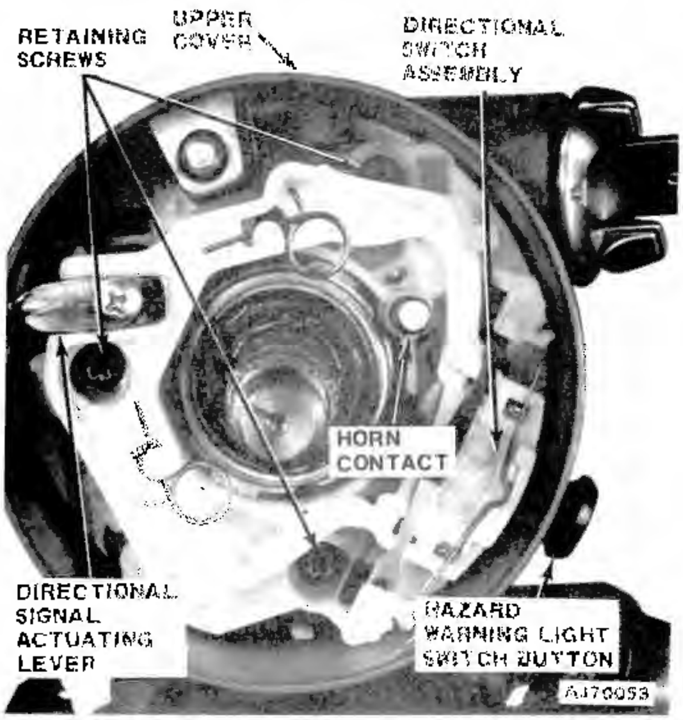

Fig. 11-6 Directional Switch

lever pivot is correctly aligned and seated in upper housing pivot boss prior to installing retaining screws.

(2) Install directional signal lever and actuate directional signal switch to assure correct operation.

(3) Place thrust washer, spring, and directional signal canceling cam on upper end of steering shaft.

(4) Align lock plate splines with the steering shaft splines and place lock plate in position, with the directional signal canceling cam shaft protruding through the dog-leg opening in the lock plate.

(5) Place steering shaft snap ring on steering shaft and use Snap Ring Installer Tool J-23653 to push the snap ring into place.

(6) Install anti-theft cover.

(7) Align directional signal cancelling cam, index marks on steering shaft and steering wheel, and install steering wheel.

(8) Tighten steering wheel nut to 20 foot-pounds torque.

(9) Install hazard warning light switch button and steering wheel trim cover.

(10) On center horn button type installations, index projection on rubber retainer ring with notch in cup. With wheel centered, cup notch is up. Tighten screws to 25 inch-pounds torque.

(11) On vehicles equipped with automatic transmission, connect the shift quadrant light wire into the connector block.

(12) Position the connector block in its mounting bracket and connect wiring harness.

Steering Column Alignment

(1) Loosen toeboard two-piece seal cover and remove lower clamp bracket.

(2) Remove instrument panel trim plate below jacket tube.

(3) Loosen mounting bracket attaching bolts which will allow column to assume an aligned position with steering gear.

(4) Pull steering column upward. Maintain upward pressure while tightening mounting bracket to column bolts 15 to 25 foot-pounds torque.

(5) Install lower clamp bracket and tighten bolts 12 to 17 foot-pounds torque.

(6) Install two-piece seal retainer.

(7) Install instrument panel trim plate below jacket tube.

NOTE: *Upon completion of steering column alignment, column shift linkage adjustment must be checked to ensure proper operation.*

Steering Column Removal

CAUTION: *Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic components which maintain column rigidity. Leaning on the mast jacket could cause the column to bend or deform. Any of the above damages could impair the collapsibility function of the column. If it is necessary to remove the steering wheel, use standard wheel puller. Do not hammer on end of shaft, as hammering could fracture plastic retainers which maintain column rigidity.*

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(1) Disconnect battery negative cable.

(2) Disconnect steering column wiring connectors from wiring harness located underneath instrument (dash) panel.

NOTE: *Steering wheel does not have to be removed to remove steering column.*

(3) On vehicles without power steering, scribe a line mark on steering shaft and upper steering shaft to lower shaft U-joint.

(4) Remove U-joint pinch bolt.

(5) On vehicles with power steering, remove two flexible coupling-to-flange bolt nuts. Note difference in size of bolt shanks and nuts to ensure correct assembly.

(6) Disconnect shift linkage from shift lever on column shift models.

(7) Remove column to toe board parts.

(8) Remove lower instrument panel crash pad trim plate, bracket capsule stud nuts (or bolt) at instrument panel.

(9) Remove bracket-to-column bolts and remove bracket.

CAUTION: *Set bracket aside to protect breakway capsules.*

NOTE: *Bracket capsules are slotted to permit column movement for adjustment.*

(10) Remove column from vehicle.

Upper Section Disassembly (Except Adjust-O-Tilt)

Column removal is not necessary if only upper section is to be repaired. However, if complete column or lower section is to be disassembled, remove column and use Steering Column Support Fixture J-23074 to mount column assembly in a vise. The following disassembly procedure applies to column shift and floor shift steering columns (except Adjust-O-Tilt columns), with minor differences noted where applicable.

(1) Disconnect battery negative cable.

(2) Cover painted areas of column.

(3) Remove instrument panel lower finish panel.

(4) Remove steering wheel.

(5) Loosen anti-theft cover retaining screws and lift cover from column. It is not necessary to completely remove these screws as they are held on cover by plastic retainers.

(6) Use Lock Plate Compressor Tool J-23653 to depress lock plate. Once lock plate is depressed, remove round wire snap ring from steering shaft groove (fig. 11-5).

WARNING: *Lock plate is under strong spring pressure.*

(7) Remove Lock Plate Compressor Tool.

(8) Remove snap ring, lock plate, directional signal canceling cam, upper bearing preload spring, and thrust washer from steering shaft.

NOTE: *Steering shaft is now free in column. During bench overhaul, steering shaft should be removed at this time by pulling out from lower end of column.*

(9) Place directional signal actuating lever in right turn position then remove lever.

(10) Depress hazard warning light switch, located on right side of column adjacent to key lock, then remove button by turning it in a counterclockwise direction.

(11) With shift lever in Park, remove shift lever pivot pin with a punch, and remove lever.

(12) Unhook directional signal wire harness connector from mounting bracket on lower right side of column, below instrument panel.

(13) Unhook plastic locking tab and disconnect turn signal harness from instrument panel harness (fig. 11-7).

(14) Use a stiff wire (paper clip) to depress lock tab retaining shift quadrant light wire in connector block.

(15) Remove plastic harness protector from column jacket.

(16) Wrap a piece of tape around upper harness connector to prevent snapping and remove harness (fig. 11-8).

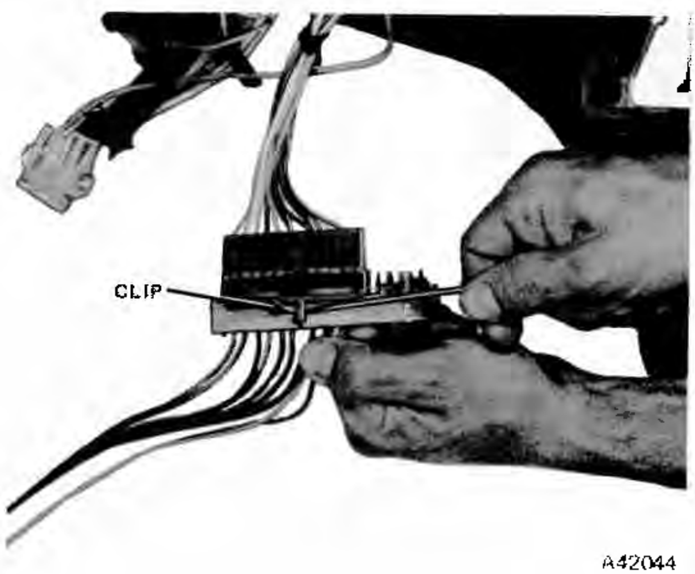

Fig. 11-7 Steering Column Harness Connector

(17) With key in on position, remove key warning buzzer contacts using a wire hook (a paper clip with a right angle bend) or needlenose pliers (fig. 11-9).

CAUTION: *Do not attempt to remove switch separately, as a clip can fall down into column assembly.*

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Fig. 11-8 Steering Column Harness Removal

(18) Place lock in LOCK position, depress lock cylinder retaining tab, and remove lock cylinder (fig. 11-10).

NOTE: *If tab is not visible through hole, scrape flashing from hole.*

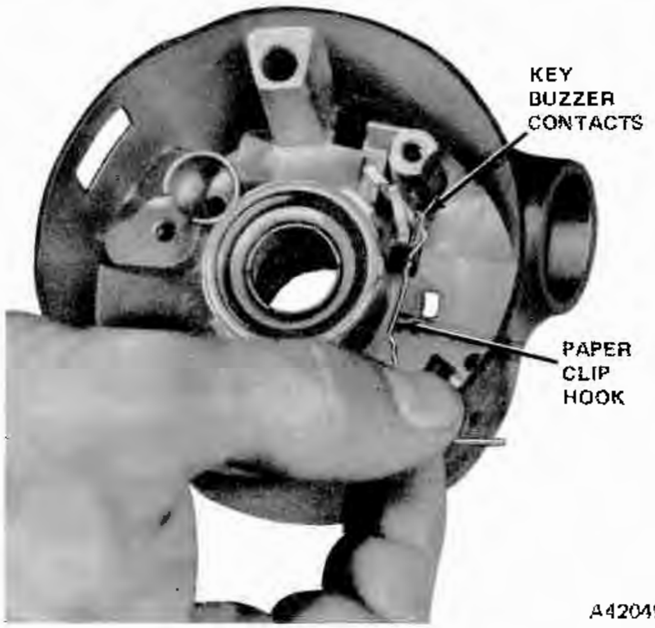

Fig. 11-9 Removal of Key Warning Buzzer Contacts

(19) Remove ignition switch from lower column.

(20) Remove four hex head screws retaining upper housing, then remove upper housing. Remote lock rod and automatic column shift quadrant light wire, if equipped, will be removed with upper housing.

NOTE: *Proceed with steps (21) through (28) for complete disassembly of column shift steering columns. To complete the disassembly of floor shift columns, skip to step (29).*

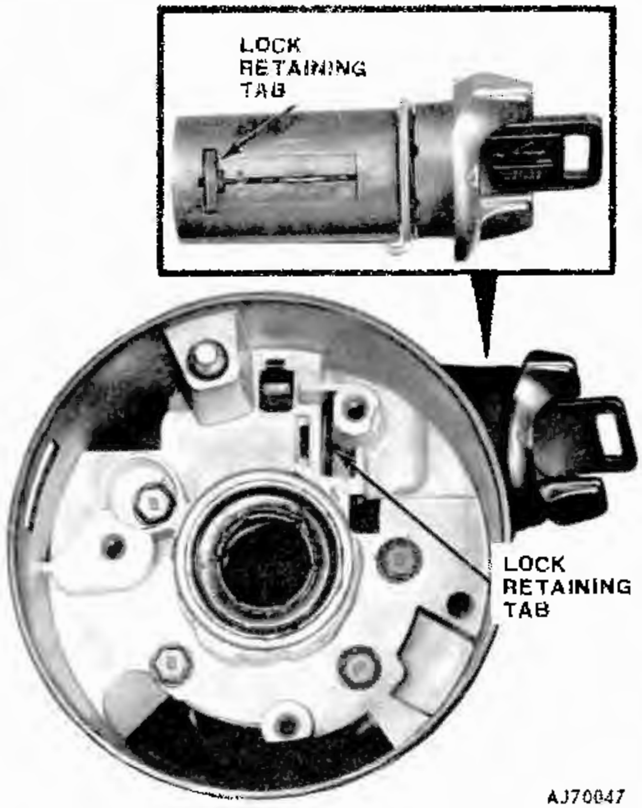

Fig. 11-10 Lock Cylinder Retainer Tab Location

(21) Remove thrust cup from upper housing (fig. 11-11).

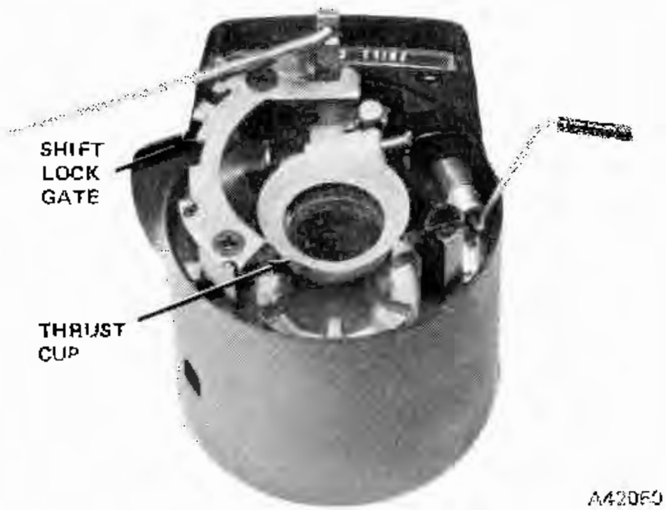

Fig. 11-11 Thrust Cup Position

(22) Remove lock bolt and rack. If rack preload spring requires service, remove at this point (fig. 11-12).

(23) If sector gear requires service, note position of sector on shaft for aid in assembly, and remove by driving it from its shaft with a suitable punch (fig. 11-12).

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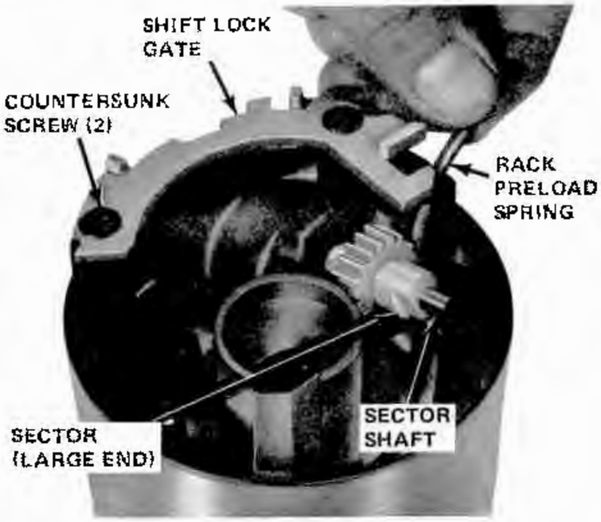

Fig. 11-12 Rack Preload Spring Removal

(24) Remove shift lock gate from upper housing. Examine shift lock gate detents for wear; replace if excessively worn.

(25) Remove shift quadrant which is retained by two retaining clips.

NOTE: *Clips must be pried out with a small punch (fig. 11-13).*

Fig 11-13 Retainer Clip Removal

(26) Remove shift quadrant light cover then remove screw which retains socket assembly, and remove assembly.

(27) Remove shift bowl from column.

(28) Remove nylon bearing from upper end of jacket tube (fig. 11-14).

NOTE: *If lower section is also being disassembled, it is easier to remove nylon bearing after shift tube is removed.*

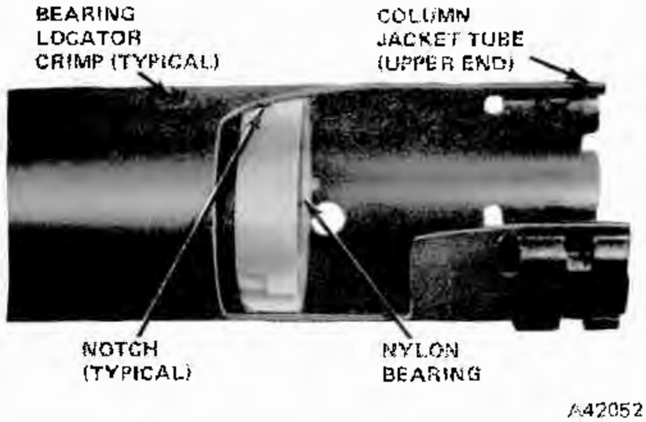

Fig. 11-14 Nylon Bearing

NOTE: *The following procedural steps are for complete disassembly of floor shift steering columns.*

(29) Remove three screws attaching shroud to signal housing.

(30) Remove shroud (fig. 11-15).

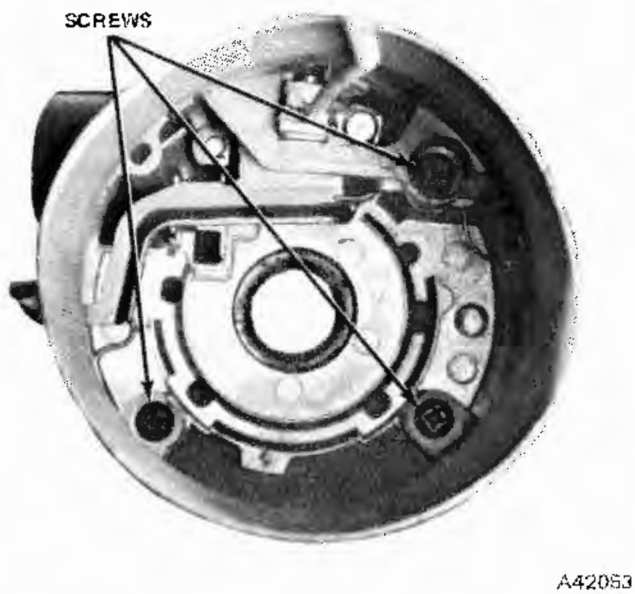

Fig. 11-15 Shroud Removal

(31) Place a rag over inhibitor lever pivot (to prevent lever spring from flying into face) and carefully remove inhibitor lever (fig. 11-16).

(32) Remove spring.

(33) Lift remote lock rod and rack assembly, and lock bolt and spring assembly out of housing. If rack preload spring requires service, remove at this time (fig. 11-12).

(34) If sector gear requires service, note position of sector on shaft for aid in assembly, and remove by driving it from its shaft with a suitable punch.

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Fig. 11-16 Inhibitor Lever Arrangement

Lower Section Disassembly

Column Shift Steering Columns

NOTE: *The following steps require steering column removal.*

(1) If lower section only is to be serviced, remove upper steering shaft snap ring, lock plate, directional signal canceling cam, upper bearing preload spring, and thrust washer as outlined in Upper Section Disassembly. Further disassembly of upper section is not necessary.

(2) Remove steering shaft by pulling out from lower end of column.

(3) On automatic column shift, remove lower bearing retainer ring, lower bearing, preload spring, and nylon washer (fig. 11-17).

(4) Remove neutral safety and back-up lamp switch.

(5) Remove low-reverse shift lever and spacer, if equipped.

(6) Remove shift tube bearing retaining screws.

(7) Remove shift tube.

NOTE: *If nylon shift tube bearing was not removed during upper section disassembly, remove it at this time.*

Floor Shift Steering Columns

NOTE: *The following steps require column removal.*

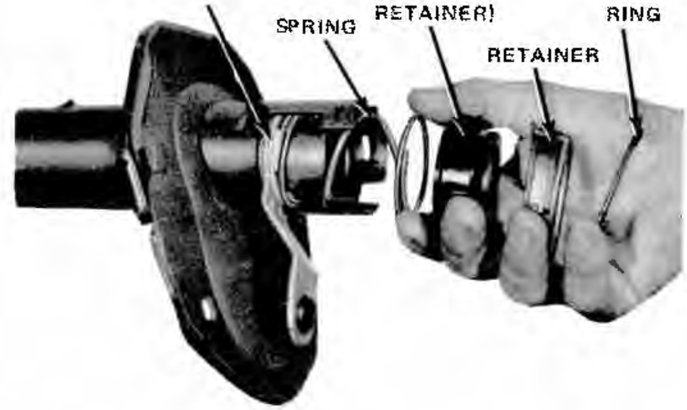

Fig. 11-17 Lower Bearing Assembly

(1) If lower section only is to be serviced, remove upper steering shaft, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring and thrust washer as outlined in Upper Section Disassembly. Further disassembly of the upper section is not necessary.

(2) Remove steering shaft by pulling out from lower end of column.

(3) Remove lower bearing retaining ring and lower bearing (fig. 11-17).

NOTE: *Refer to figure 11-18 for Standard Column Assembly Sequence.*

Lower Section Assembly

NOTE: *Apply multipurpose lubricant to all friction-bearing surfaces before assembly.*

Floor Shift Steering Columns

Install lower bearing (with metal face toward retainer), bearing retainer, and lock ring.

NOTE: *If complete column overhaul is being performed, continue with Upper Section Assembly. Otherwise, install steering shaft, upper bearing thrust washer and preload spring, upper bearing, directional signal canceling cam, lock plate, and snap ring as outlined in Upper Section Assembly.*

Column Shift Steering Columns

(1) Install shift tube.

(2) Install nylon thrust bearing on lower end of automatic column shift tube with flat side of bearing toward top end of tube (fig. 11-17).

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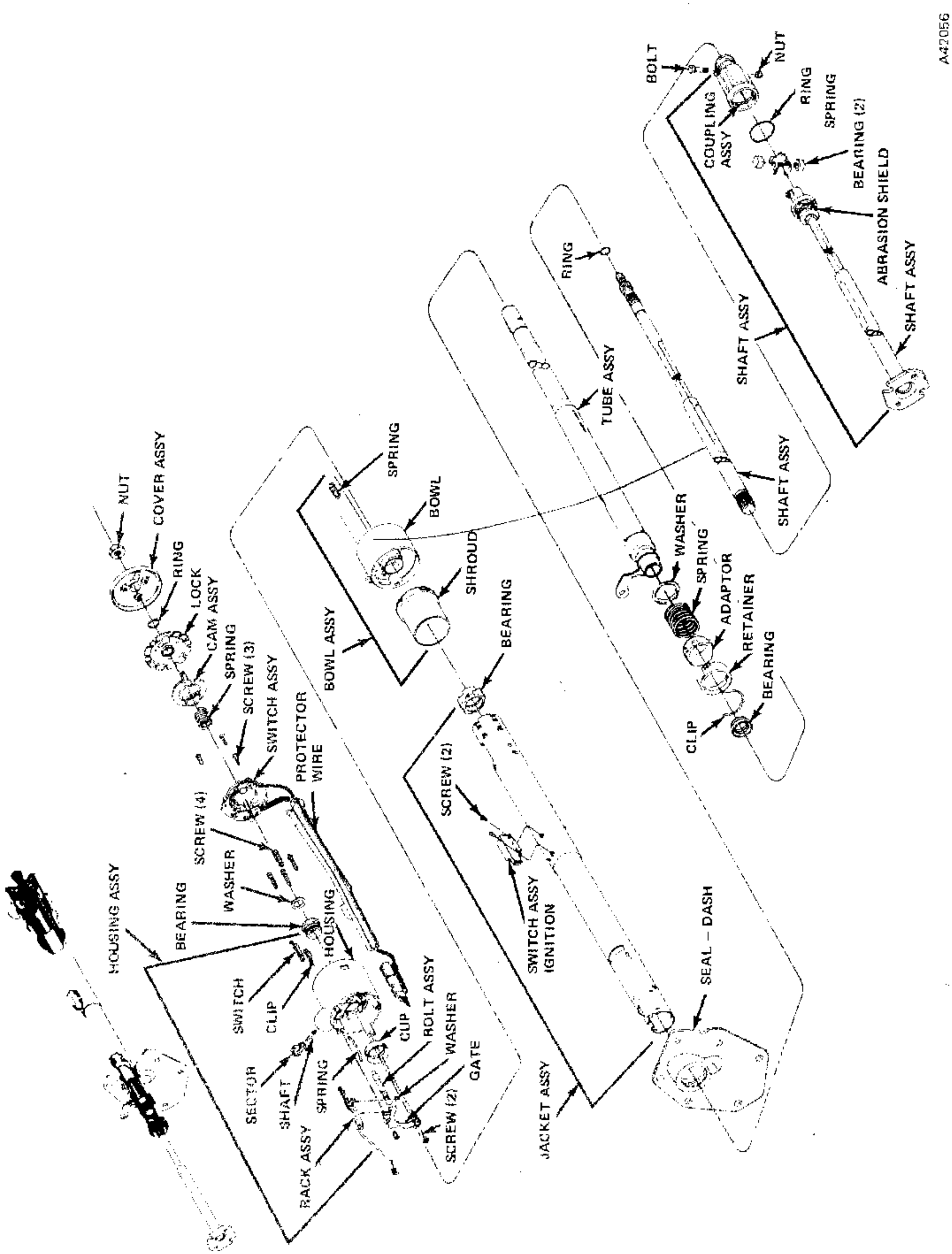

Fig. 11-18 Standard Column Assembly Sequence—Typical

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(3) Install preload spring, lower bearing (with metal face toward retainer), bearing retainer, and lock ring.

(4) Install neutral safety and back up lamp switch.

NOTE: *If complete column overhaul is being performed, continue with Upper Section Assembly. Otherwise install steering shaft, upper bearing thrust washer and preload spring, upper bearing, directional signal canceling cam, lock plate, and snap ring (outlined in Upper Section Assembly).*

Upper Section Assembly

Floor Shift Steering Columns

Apply a thin coat of Jeep All Purpose Lubricant, part number 8991230, to all friction-bearing surfaces.

(1) Install sector into upper housing. Place large end of sector through lock cylinder hole and onto sector shaft (fig. 11-12). Press sector onto shaft with a blunt tool.

(2) If removed, insert rack preload spring into housing from lower end. Hook both ends of spring onto housing.

(3) Assemble lock bolt, rack, and remote rod (fig. 11-19). Install into housing.

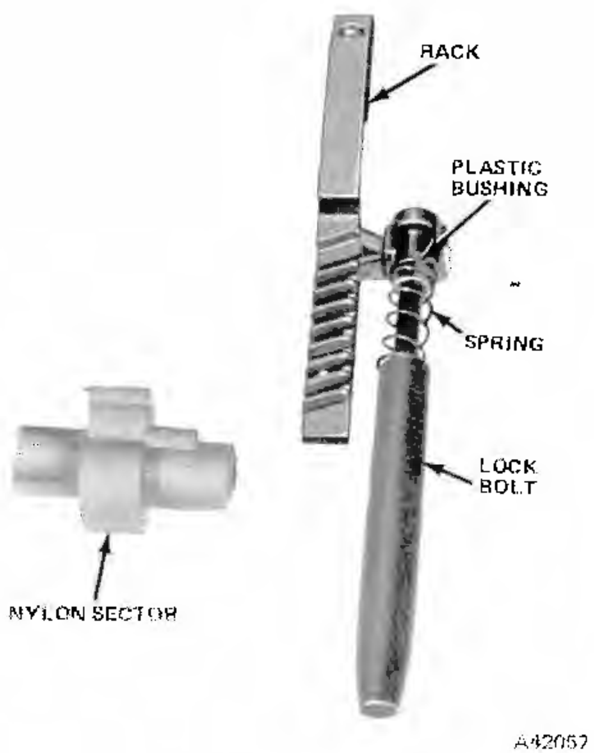

Fig. 11-19 Lock Bolt, Rack, and Sector

NOTE: *First tooth of rack must engage between first and second teeth of sector.*

(4) Place inhibitor lever spring over lever pivot on housing. Position lever on pivot with spring hooked on lever.

(5) While holding down on lever pivot, place other spring in slot in housing.

(6) Place wave washer in position on the pivot.

(7) Place shroud over remote rod and onto housing.

(8) Install three attaching screws.

Column Shift Steering Columns

(1) Insert lower bowl nylon bearing in upper end of jacket tube.

NOTE: *Bearing must be installed with smaller inside diameter toward lower end of jacket tube, and the bearing notches must engage three locator crimps in column (fig. 11-14).*

(2) Align shift bowl with shift tube spline and install bowl.

(3) Install rack preload spring into upper housing (fig. 11-12).

(4) Place large end of sector on sector shaft and press into position (fig. 11-12).

(5) Install shift lock gate using two countersunk screws (fig. 11-12).

(6) Install shift quadrant light and place light cover in position.

(7) Place shift quadrant indicator into position and press retainer clips into place with flat side towards bowl.

(8) Place lock bolt on rack (fig. 11-19) and install assembly into bowl.

NOTE: *First tooth of rack must engage between first and second teeth of sector.*

(9) Install nylon thrust cup in upper housing with flared end facing out (fig. 11-11).

Upper Section Assembly—All Series

(1) On column shift steering columns, rotate shift bowl counterclockwise to stop, and install upper housing on column. On 01-40-70 Series with automatic transmission column shift, guide shift quadrant light wire and remote lock rod into position between shift bowl and mast jacket.

(2) Install key warning buzzer switch with brass tabs pointing upwards toward shift indicator (fig. 11-9).

(3) Install directional signal switch assembly. Guide wire harness into position and carefully align switch assembly.

(4) Unsnap connector, assemble wires into protector and protector-to-column jacket, and install switch retaining screws.

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ADJUST-O-TILT COLUMN STEERING DIAGNOSIS

Condition	Possible Cause	Correction
BEARING HOUSING SCRAPES ON BOWL	(1) End of jacket not square with center line (2) Shroud portion of bowl is not concentric with hub (3) Lock plate tab holes in jacket are improper width	(1) Replace jacket (2) Replace bowl (3) Replace lock plate
STEERING WHEEL LOOSE	(1) Excessive clearance between holes in support and pivot pin diameter	(1) Replace support and pivot pin
STEERING WHEEL LOOSE IN EVERY OTHER TILT POSITION	(1) Loose fit between shoe and pivot pin	(1) Replace both shoes and pivot pin
STEERING COLUMN NOT LOCKING IN ANY TILT POSITION	(1) Shoe seized on pivot pin (2) Shoe grooves burred or dirty (3) Shoe lock spring weak or broken	(1) Replace shoe and pin (2) Clean dirt/burrs from shoe groove (3) Replace shoe lock spring
STEERING WHEEL FAILS TO RETURN TO TOP TILT POSITION	(1) Pivot pins are bound up (2) Defective wheel tilt spring	(1) Remove pin, check holes for burrs Install new pins (2) Replace tilt spring
NOISE WHEN STEERING WHEEL RETURNS TO TOP TILT POSITION	(1) Tilt wheel upper tilt bumpers have failed	(1) Replace upper tilt bumpers
NOISE WHEN TILTING COLUMN	(1) Tilt spring rubbing in bearing housing	(1) Grease all points of contact for tilt spring

NOTE: *Ensure that actuating lever pivot is correctly aligned and seated in upper housing pivot boss prior to installing retaining screws.*

(5) Install turn signal lever and actuate directional signal switch to ensure correct operation.

(6) Install steering shaft.

(7) Place thrust washer, spring, and directional signal canceling cam on upper end of steering shaft.

(8) Align lock plate splines with steering shaft splines and place lock plate in position with directional signal canceling cam shaft protruding through dogleg opening in lock plate (fig. 11-20).

(9) Place steering shaft snap ring onto Lock Plate Compressor Tool J-23653.

(10) Install tool on steering shaft and compress lock plate and push snap ring into place.

(11) Remove tools.

(12) Install anti-theft cover.

(13) Align directional signal canceling cam, index marks on steering shaft and steering wheel and install steering wheel. Tighten steering wheel nut to 20 foot-pounds torque.

(14) Install hazard warning light switch button and steering wheel trim cover.

(15) Install shift lever, if equipped.

(16) Install key lock cylinder.

(17) Install and adjust ignition switch.

(18) Adjust neutral safety and backup lamp switch.

(19) Install lower finish panel.

(20) Remove protection from column painted areas.

(21) Reconnect battery negative cable.

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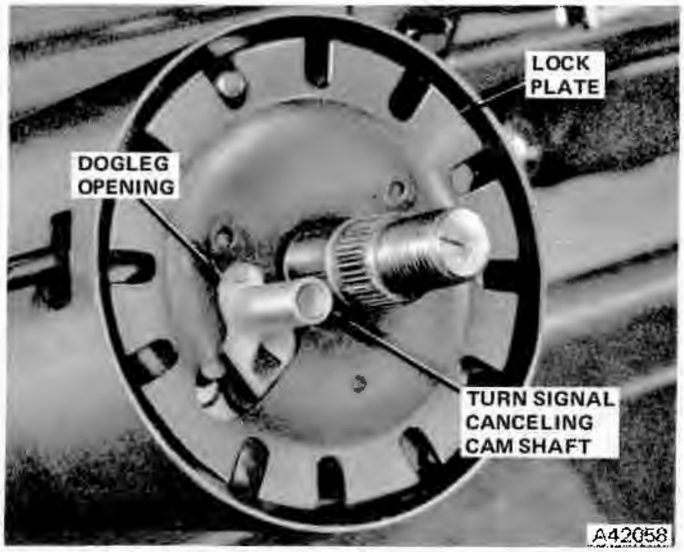

Fig. 11-20 Lock Plate

Adjust-O-Tilt Steering Column

Upper Section Disassembly

NOTE: *Although it is possible to disassemble column down to the upper bearing housing without column removal, if disassembly is to be extensive, it is suggested column be removed from the vehicle. Use Steering Column Support Fixture J-23074 to mount column assembly in a vise.*

(1) Disconnect battery negative cable.

(2) Cover painted areas of column.

(3) Remove steering wheel.

(4) Remove gearshift lever retaining pin and shift lever, if equipped.

(5) Loosen anti-theft cover screws and lift cover from column. It is not necessary to completely remove these screws as they are held on cover by plastic retainers.

(6) Use Lock Plate Compressor Tool J-23653 to depress lock plate, and remove round wire snap ring from steering shaft groove (fig. 11-5).

WARNING: *Lock plate is under strong spring pressure.*

(7) Remove lock plate compressor tool, snap ring, lock plate, directional signal canceling cam, upper bearing preload spring, bearing race seat, and bearing race.

(8) Place directional signal switch in right turn position then remove lever.

(9) Depress hazard warning light switch then remove button by turning it counterclockwise.

(10) Remove directional signal wire harness connector from mounting bracket on lower right side of column.

(11) Remove directional signal harness plastic protector from jacket.

(12) Wrap a piece of tape around harness connector to prevent snagging, and remove harness (fig. 11-8).

(13) Remove directional signal switch retaining screws and pull directional signal switch and wire harness from column.

(14) With key in on position, remove key warning buzzer contacts using a wire hook (a paper clip with a right angle bend), or needlenosed pliers (fig. 11-9).

NOTE: *Do not attempt to remove switch separately, as clip can fall down into column.*

(15) Place key lock in LOCK position.

(16) Depress lock cylinder retaining tab and remove lock cylinder (fig. 11-10).

NOTE: *If tab is not visible through hole, remove flashing from hole.*

(17) Remove shift quadrant.

NOTE: *Quadrant is retained by a spring clip which may be removed with long-nosed pliers (fig. 11-13).*

(18) Remove shift quadrant mounting bracket and light socket, if equipped.

(19) Unscrew tilt release handle.

(20) Remove three upper cover retaining screws.

(21) Gently tap upper cover from column.

(22) Remove lock sector tension spring retaining screw and remove spring.

NOTE: *Spring must be unhooked from the lock bolt.*

(23) Remove Tru-Arc snap ring from lock sector shaft then remove sector, shaft, and lock pin.

(24) Install tilt release handle and place upper housing in full up position.

(25) Insert screwdriver into slot in tilt spring retainer.

(26) Depress retainer approximately 3/16 inch, rotate 1/8-turn counterclockwise and remove retainer and spring.

WARNING: *Care should be taken when releasing tilt spring due to high compression rate of spring.*

(27) Place upper housing in straight position.

(28) Remove two pivot pins using Pivot Pin Remover Tool J-21854-1 (fig. 11-21).

(29) Lift tilt release handle to disengage lock shoes and remove bearing housing assembly.

(30) Remove tilt release lever

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Fig. 11-21 Pivot Pin Removal

(31) If lock shoes, release lever, or springs are to be serviced, remove release lever pin and lock shoe pin with a punch or Pin Remover and Installer Tool J-22635. Hold lock shoe springs in compression to relieve load on pins (fig. 11-22, -23).

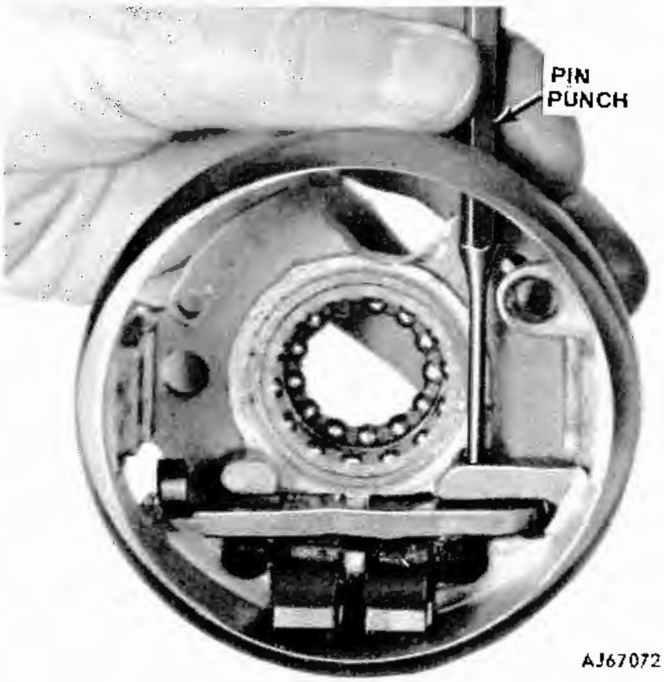

Fig. 11-22 Release Lever Pin Removal

(32) Remove steering shaft from top of column. Flexible joint may be disassembled by folding the shaft 90° (fig. 11-24).

(33) Remove ignition switch.

(34) Remove neutral safety and back up switch.

(35) Remove lock rack and rod.

(36) Remove lower bearing retainer snap ring, retainer, bearing and adapter.

(37) Remove upper support attaching screws and upper support. Remove shift gate pin and shift gate.

(38) Remove shift tube retainer ring and thrust washer.

(39) Remove shift tube using Shift Tube Remover Tool J-23072 (fig. 11-25).

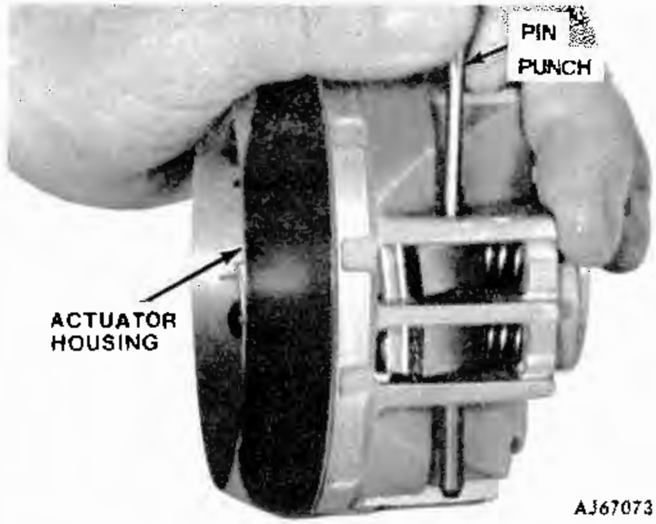

Fig. 11-23 Lock Shoe Pin Removal

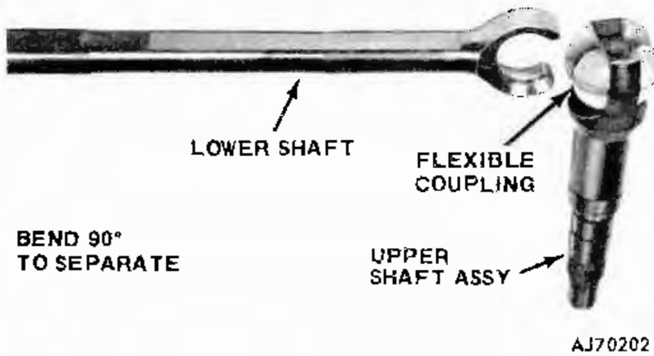

Fig. 11-24 Flexible Joint

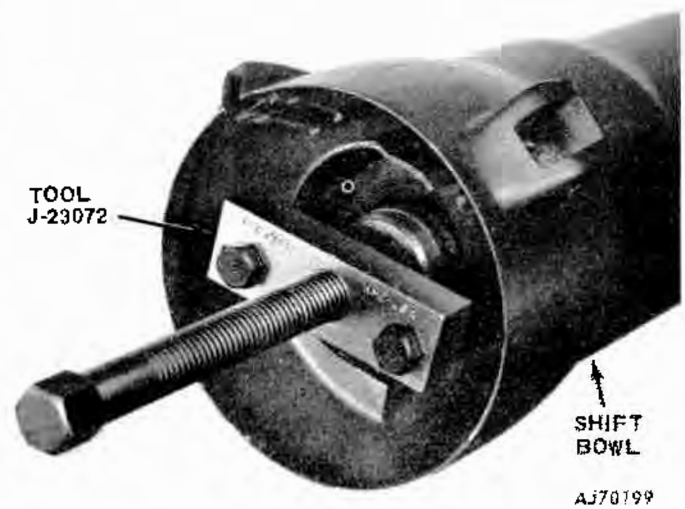

Fig. 11-25 Shift Tube Removal

(40) Remove retainer plate by rotating shift bowl clockwise, sliding plate out of jacket notches, tipping it down toward shift bowl hub at the 12 o'clock position and removing bottom side of plate first (fig. 11-26).

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(41) Remove wave washer, tube spring, and shift bowl from column.

(42) If column is in car, remove instrument panel lower finish panel.

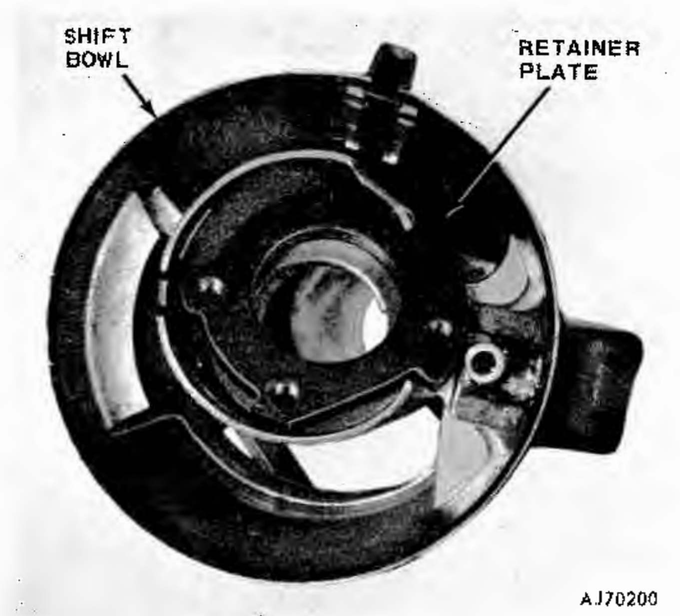

Fig. 11-26 Retainer Plate Removal

Lower Section Disassembly and Assembly

For assembly and disassembly of lower section of Adjust-O-Tilt Column, refer to procedures outlined in Steering Column Lower Section Disassembly and Assembly (except Adjust-O-Tilt).

Upper Section Assembly

(1) Apply a thin coat of lithium grease to all friction surfaces.

(2) Place shift bowl onto column.

(3) Install wave washer and retainer plate into column.

(4) Carefully install shift tube into lower end of mast jacket. Align spline on tube with keyway in shift bowl.

(5) Insert Shift Tube Installer Tool J-23073-2 and -4 into shift tube (fig. 11-28). Spring-loaded lower foot must engage tube inner shoulder and guide should seat in tube. Tighten spring tension nut to snug fit.

(6) Place Receiver Tool J-23073-3 and -4 over puller stud and tighten puller nut to pull tube into bowl (fig. 11-29).

(7) Install shift tube thrust washer and shift tube retainer snap ring.

(8) Install lower bearing (with metal face toward retainer), retainer, and snap ring.

(9) Install pin and shift gate on upper support and install upper support aligning V-notch in support with notch in column (located at 9 o'clock position).

(10) Install four retaining screws.

(11) Assemble steering shaft and slide into column.

(12) Place bearings (14 balls each) in upper housing (if removed).

(13) Install tilt handle.

(14) Insert ignition switch remote rod between shift bowl and mast jacket and into guide channel in left side of upper support.

(15) Place lock rack on rod (fig. 11-30).

(16) Carefully guide upper housing over steering shaft and lock rack, aligning lock shoes with teeth in upper support. Lift tilt lever to allow engagement of lock shoes into upper support.

(17) Align upper housing and upper support pivot pin holes and drive pivot pins into position using a fiber mallet or brass drift.

(18) Install lock shoes, lock shoe springs, tilt bumpers, and lockpin in upper housing.

(19) Install lock sector and sector shaft. Large tooth on sector must engage large slot in lock rack. Install sector shaft retaining snap ring.

(20) Hook lock sector tension spring on lockpin, engage sector, and install spring retaining screw (fig. 11-31).

(21) Place upper housing in full up position and install tilt spring and seat. Depress spring retainer approximately 3/16 inch into housing. Rotate retainer approximately 1/8 turn clockwise to secure spring.

(22) Place upper housing cover into position and install three retaining screws.

(23) Install key warning buzzer switch and tension spring. Buzzer switch brass contact should point upwards, toward shift indicator.

(24) Guide shift quadrant light wire up through upper housing and then down between shift bowl and mast jacket.

(25) Install shift quadrant mounting bracket and attach light socket.

(26) Install tilt release handle.

(27) Hook base of shift quadrant over tabs on left side of retainer and place in position.

(28) Install shift pointer into bowl and engage with quadrant.

(29) Install quadrant retainer clip with flat side of clip facing down.

(30) Install directional signal switch assembly. Guide wire harness between cover and mast jacket and carefully align switch assembly.

(31) Untape connector, assemble wires into protector and protector-to-column jacket, and install switch retaining screws. Assure that actuating lever pivot is correctly aligned and seated in upper housing pivot boss prior to installing retaining screws.

(32) Install directional switch lever and actuate switch to assure correct operation.

(33) Place upper bearing race, bearing race seat, preload spring, and directional signal canceling cam onto steering shaft.

(34) Align lock plate splines with steering shaft

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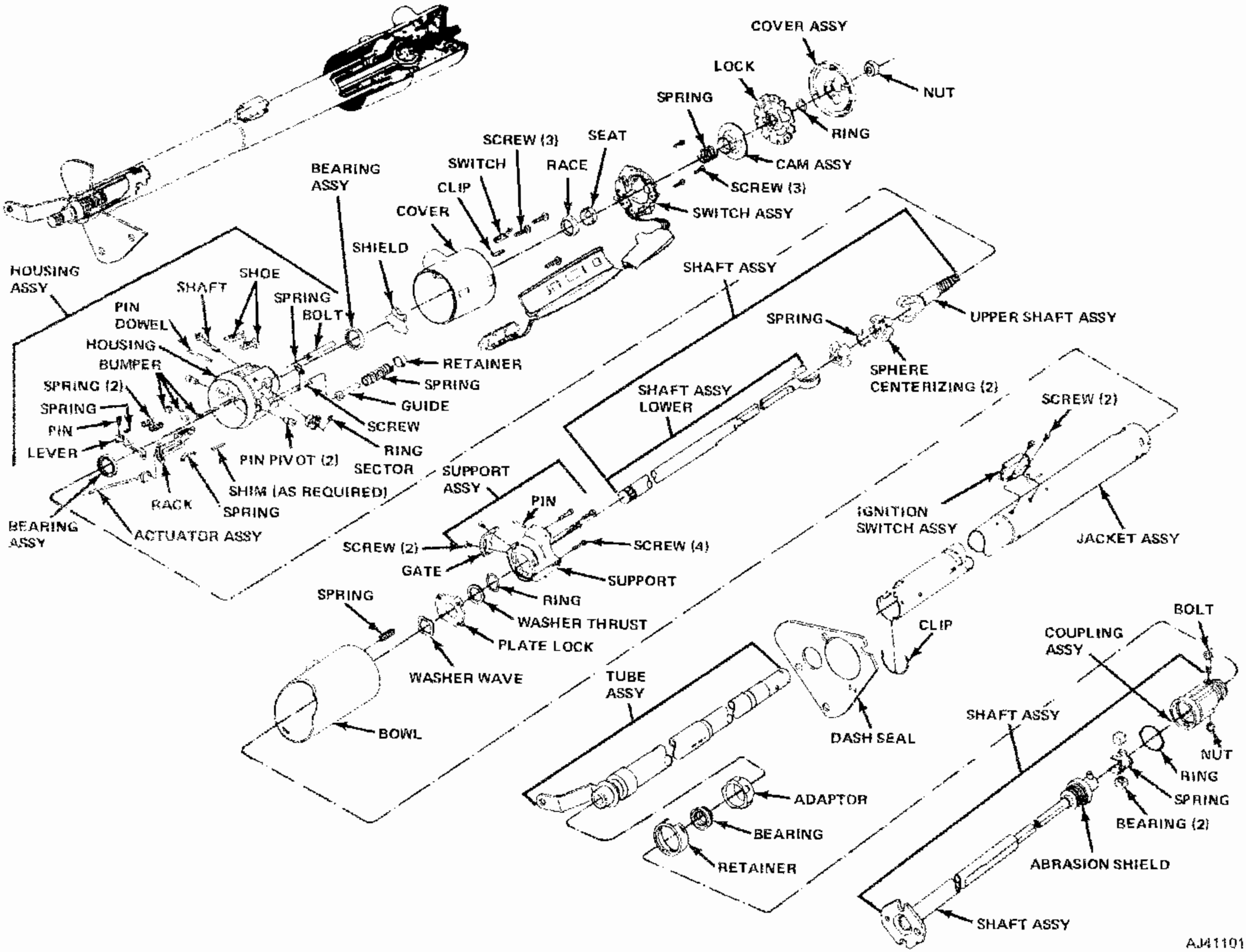

Fig. 11-27 Adjust-O-Tilt Column Exploded View

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splines and place lock plate in position with directional signal canceling cam shaft protruding through dogleg opening in lock plate (fig. 11-20).

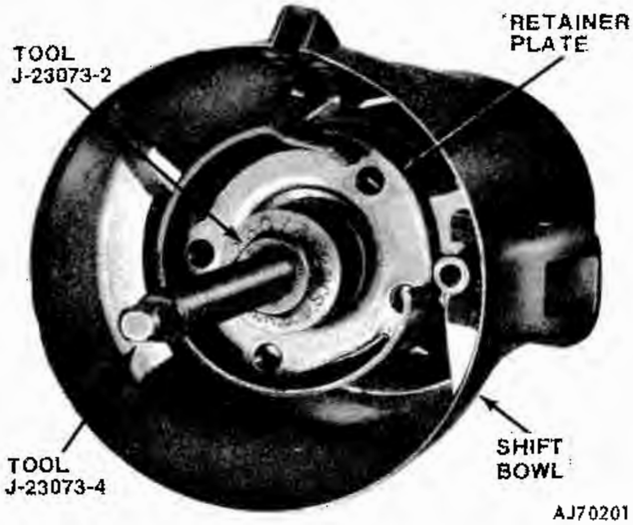

Fig. 11-28 Shift Tube Installer Seated in Tube

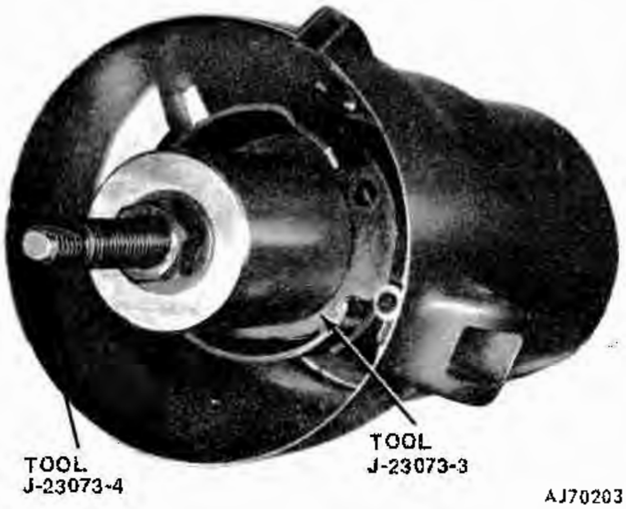

Fig. 11-29 Pulling Shift Tube Into Bowl

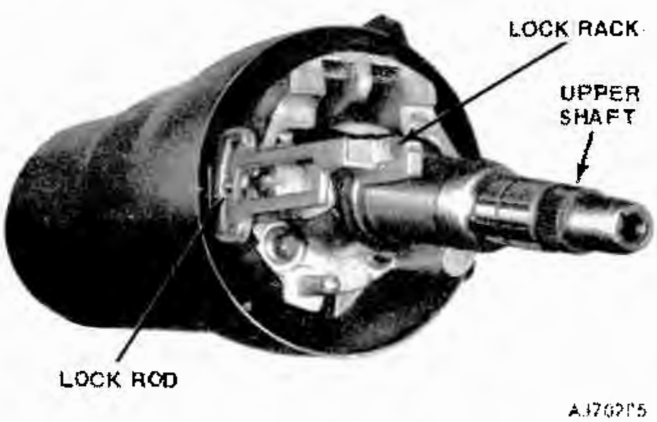

Fig. 11-30 Lock Rack and Remote Rod Position

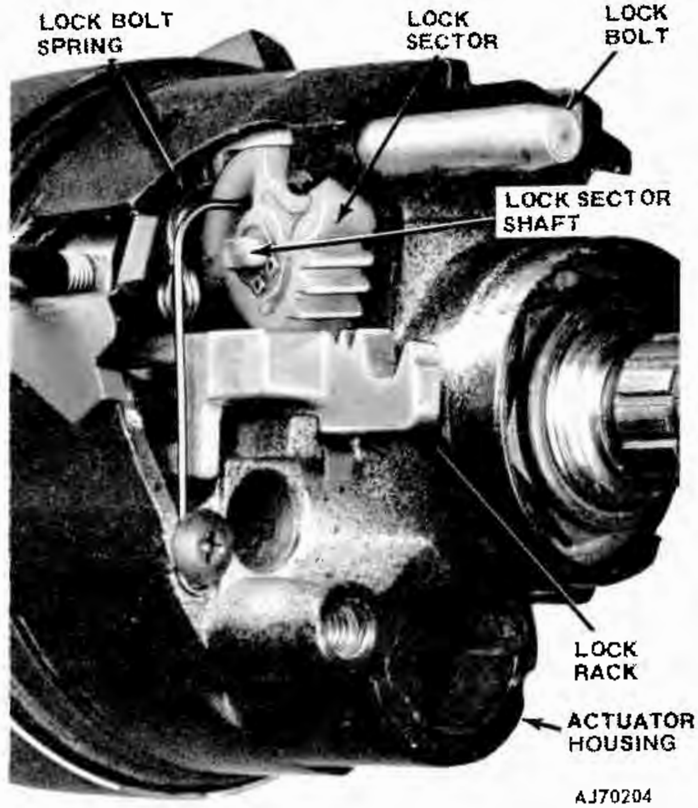

Fig. 11-31 Position of Lock Sector Tension Spring

(35) Place steering shaft snap ring onto Lock Plate Compressor Tool J-23653. Install tool onto steering shaft. Compress lock plate and push snap ring into place (Fig. 11-32).

(36) Install anti-theft cover.

(37) Carefully guide gear shift lever over tension spring and into shift bowl, aligning pivot pin holes with a suitable size punch. Drive pivot pin through lever with a fiber mallet or brass drift.

(38) Install key lock cylinder.

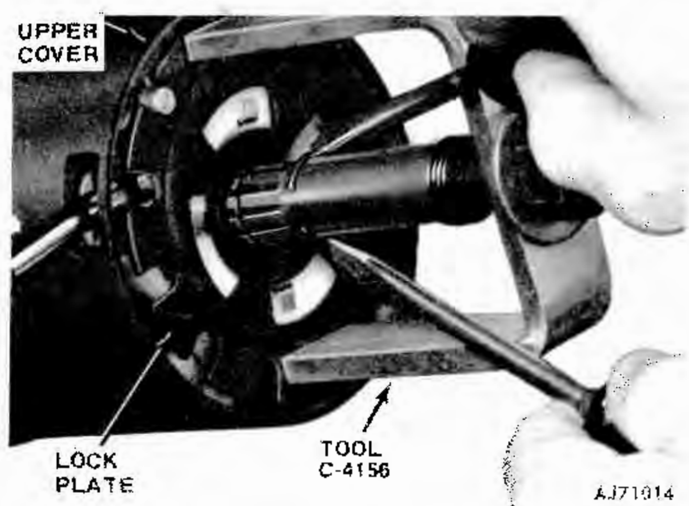

Fig. 11-32 Lock Plate Snap Ring Installation

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(39) Hold lock cylinder sleeve and rotate cylinder clockwise against stop. Insert cylinder into housing with key on cylinder sleeve aligned with housing keyway. Lightly push cylinder against sector and rotate cylinder counterclockwise until cylinder mates with sector. Push in until cylinder retainer tab snaps into place and cylinder is secured.

(40) Adjust neutral safety and backup lamp switch.

(41) Install lower finish panel, if equipped.

(42) Remove protection from column painted areas.

(43) Reconnect battery negative cable.

Installation

NOTE: *Correct steering column alignment can be obtained during installation by following, in exact sequence, procedure outlined below:*

(1) Attach lower clamp bracket to column. Tighten bolts 12 to 17 foot-pounds torque.

CAUTION: *Do not use substitute bolts. Install column into place and loosely attach column to instrument panel at mounting bracket rear attaching studs.*

WARNING: *Make certain that column instrument panel mounting is never unsupported when either dash mounting or gear mounting is connected.*

(2) On vehicles without power steering, align scribe marks on steering shaft with upper steering shaft to lower shaft U-joint. Install U-joint pinch bolt.

(3) On vehicles with power steering, position and secure flexible coupling with attaching bolts and nuts.

(4) Pull steering column upward. Maintain upward pressure while tightening the mounting bracket attaching nuts 15 to 25 foot-pounds torque.

CAUTION: *Do not overtighten fastenings. Correct torque on bolts and nuts is necessary to ensure breakaway action of bracket and capsules in the event of a collision.*

(5) Install toe board parts.

(6) Connect all electrical components and check for proper operation.

(7) Install instrument panel trim plate below jacket tube.

(8) Upon completion of steering column installation and alignment, shift linkage adjustment must be checked to ensure proper operation. For correct shift linkage adjustment refer to the respective transmission section.

(9) Reconnect battery cable.

MANUAL STEERING GEAR

SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
HARD STEERING	(1) Lack of lubrication (2) Tie rods ends worn (3) Drag link ball joints tight (4) Cross-shaft improperly adjusted (5) Steering gear parts worn (6) Frozen steering shaft bearings (7) Lower coupling flange rubbing against steering shaft (8) Steering wheel rubbing against directional switch housing (9) Steering gear adjusted too tight	(1) Lubricate all connections (2) Replace (3) Adjust (4) Adjust (5) Replace (6) Replace bearings (7) Loosen bolt and assemble properly (8) Adjust jacket endwise (9) Check adjustment by dropping pitman arm from gear or disconnect linkage from pitman arm ball Readjust if necessary

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
HARD STEERING (Continued)	(10) Front spring sagged	(10) Check front and jounce height. It should be approximately the same at both wheels. Replace front springs if sagged
	(11) Frame bent or broken	(11) Repair frame as necessary
	(12) Steering knuckle bent	(12) Install new knuckle
	(13) Ball joint galled or too tight	(13) Replace ball joint
	(14) Low or uneven tire pressure	(14) Inflate tires to recommended pressure
	(15) Steering gear or connections binding	(15) Test steering system with wheels off floor. Adjust and lubricate
LOOSE STEERING	(1) Tie rod ends worn	(1) Replace
	(2) Drag link ball sockets worn	(2) Replace
	(3) Steering gear parts worn	(3) Replace
	(4) Steering gear improperly adjusted	(4) Adjust
ROAD SHOCKS	(1) Steering drag link too tight	(1) Repair as necessary
	(2) Axle clip loose	(2) Repair as necessary
	(3) Wheel bearings loose	(3) Repair as necessary
	(4) Shock absorbers worn	(4) Replace
TURNING RADIUS SHORT ONE SIDE	(1) Center bolt in spring sheared off	(1) Repair as necessary
	(2) Axle shifted	(2) Repair as necessary
	(3) Steering arm bent	(3) Replace
	(4) Steering arm not properly located on steering side	(4) Repair as necessary

LEFT-HAND DRIVE VEHICLES

(1) Disconnect steering gear from lower steering shaft by removing bolt and nut attaching coupling to worm shaft.

(2) Disconnect steering arm from connecting rod.

(3) Remove upper steering gear-to-frame bracket bolt.

(4) Remove two lower steering gear-to-frame bracket bolts and remove steering gear.

Disassembly

(1) Rotate wormshaft until it is in center of travel. Mark along shaft, just beneath double spline, shall be centered between top and bottom of shaft when looking at shaft from side cover side (fig. 11-33).

(2) Remove adjuster locknut.

(3) Remove side cover bolts and lockwashers and turn lash adjuster screw clockwise to force side cover from housing. Remove side cover and gasket (fig. 11-34).

(4) Remove adjuster screw and shim from T-slot in pitman shaft. Keep shim with screw.

(5) Remove pitman shaft from housing, taking care not to damage seal in housing with pitman shaft splines or threads. Tap lightly on spline end if necessary.

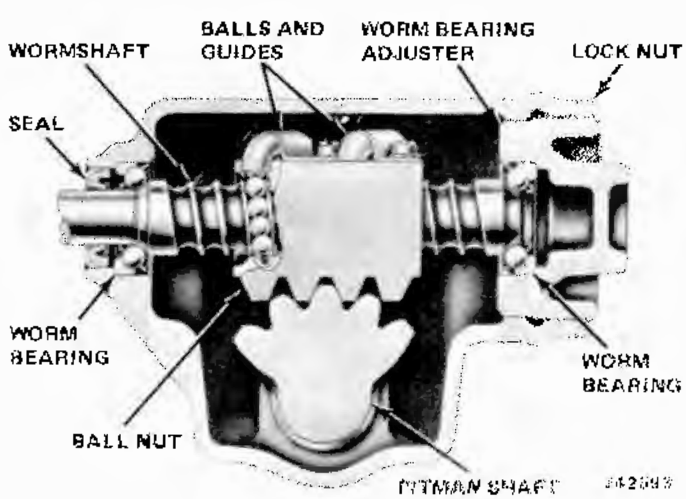

Fig. 11-33 Cross-Section of Steering Gear

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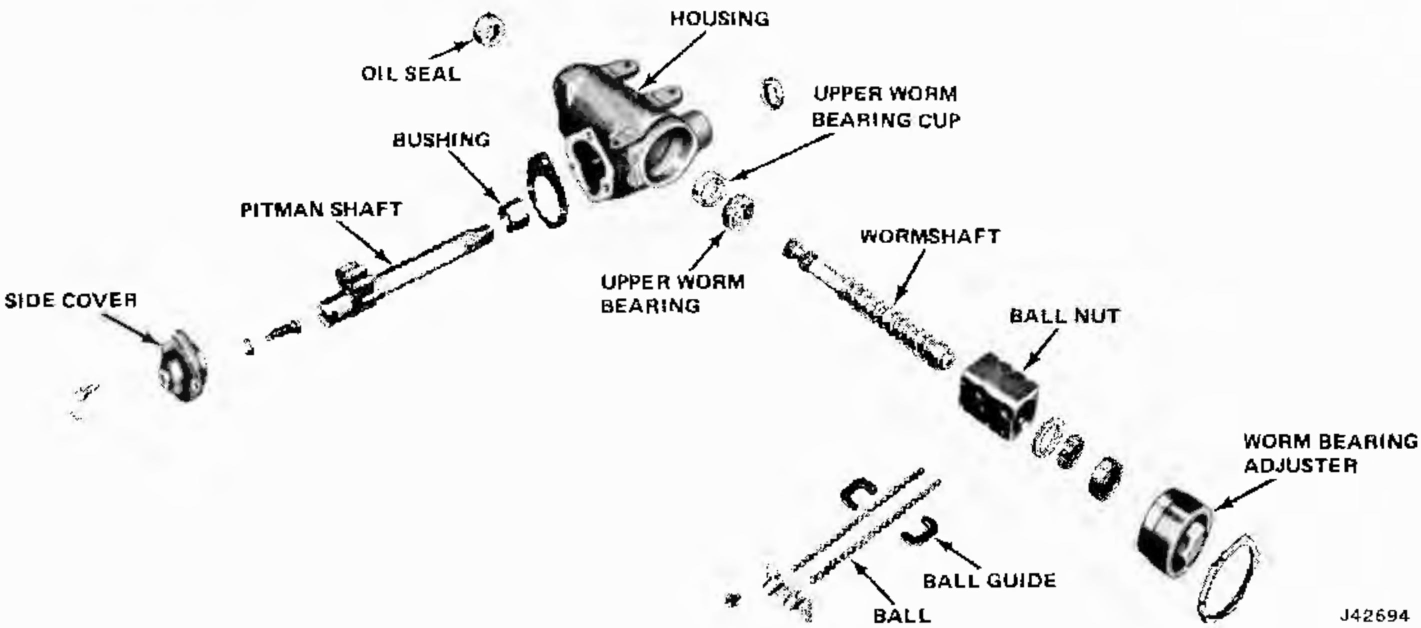

Fig. 11-34 Left-Hand Drive Manual Steering Gear

(6) Remove worm adjuster nut; remove worm adjuster and lower worm bearing.

(7) If bearing is damaged, pry retainer out with screwdriver. Remove bearing from worm adjuster.

(8) Remove assembled wormshaft, ball nut, and upper worm bearing from the housing (fig. 11-35). Do not allow ball nut to rotate freely to end of worm travel; this could damage ball return guides. Take care not to damage oil seal with worm shaft splines.

(9) Remove upper bearing from shaft.

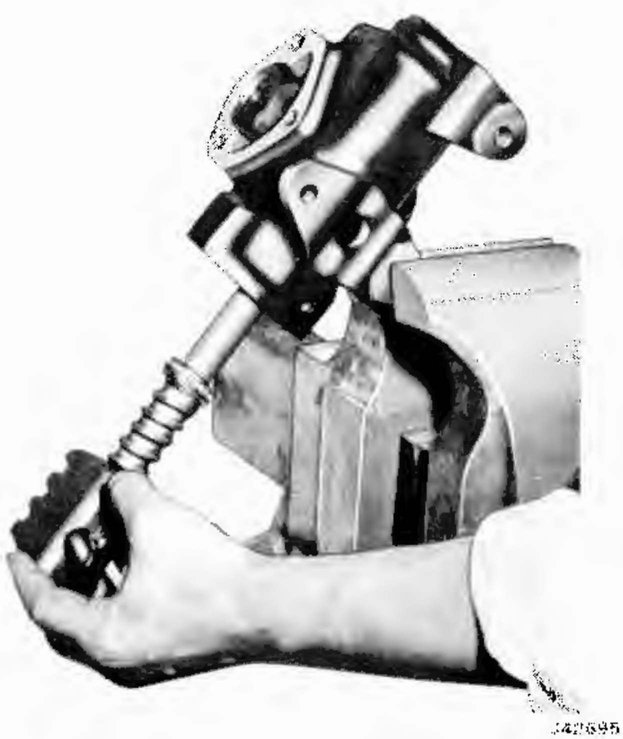

Fig. 11-35 Wormshaft and Ball Nut Removal

(10) If oil seals are damaged, pry them out of housing.

(11) Remove three screws securing clamp to ball nut; remove ball guides from nut.

(12) Turn ball nut over and rotate wormshaft back and forth until all balls drop out on a clean cloth (50 balls).

(13) Remove ball nut from shaft.

Inspection

Wash all parts in clean solvent and wipe dry with a clean cloth.

Inspect bearing cups in worm adjuster and in housing. If they are damaged remove them using worm shaft bearing cups remover tool C-3780 (fig. 11-36).

Fig. 11-36 Wormshaft Bearing Cup Removal

Inspect wormshaft, particularly in area near worm for pitting, grooving, or other damage: replace if damaged.

Inspect bushings for pitman shaft in housing and in side cover. If bushing in housing is damaged, drive

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bushing into housing with Remover and Installer Tool J-1614. If bushing in side cover is damaged, replace side cover and bushing assembly (fig. 11-37).

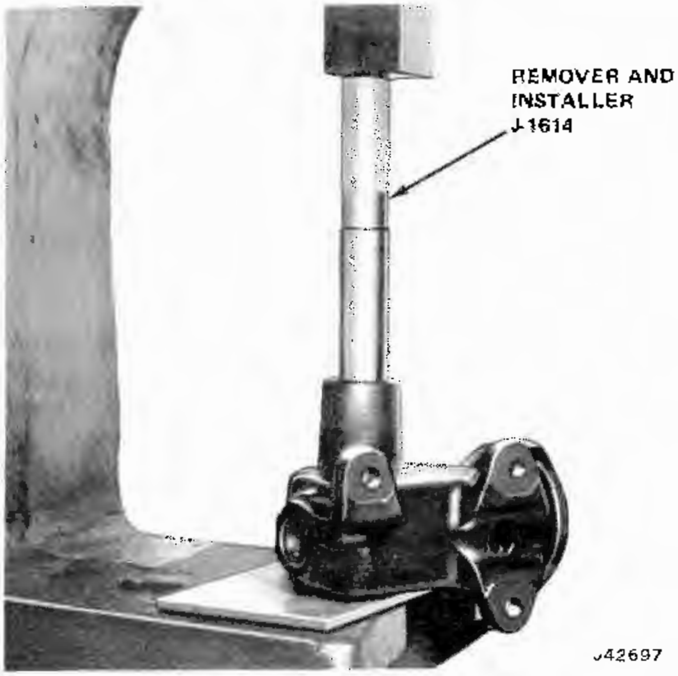

Fig. 11-37 Pitman Shaft Bushing Removal

Inspect teeth of ball nut and pitman shaft for pitting or heavy scoring, which would require replacement of ball nut or pitman shaft.

Inspect ball guides, balls, and clamp for damage; if damaged, replace with new ball kit parts.

Check fit of lash adjuster screw and shim in T-slot of pitman arm (fig. 11-38).

Lash adjuster screw must be free to turn, and end play should not exceed 0.002 inch. If end play exceeds this limit, change shim thickness to obtain correct end play. A lash adjuster shim kit is available.

Fig. 11-38 Checking Lash Adjuster End Play

Assembly

NOTE: *Lubricate all parts before assembly. Use special lubricant, Jeep Part No. 94567*

(1) Position ball nut on worm shaft so deep side of teeth will be toward side cover when shaft is installed in housing.

(2) Install 20 balls in each circuit. Rock worm shaft back and forth to aid in installation. Use a punch to install the balls (fig. 11-39)

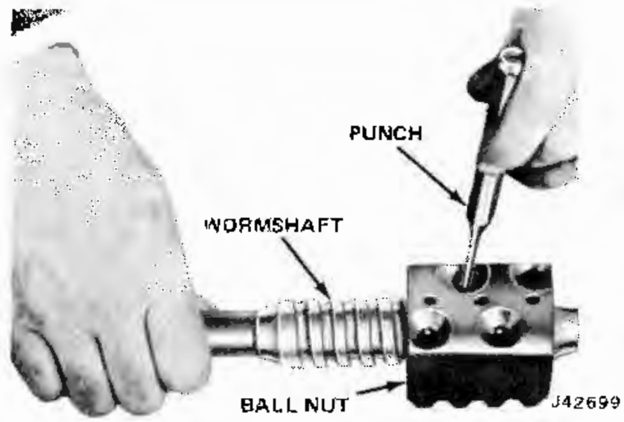

Fig. 11-39 Filling Ball Circuits

(3) Install ball guides in ball nut (fig. 11-40). Hold them in place with fingers and install 5 more balls in each circuit through window in top of ball guide.

Fig. 11-40 Installing Ball Guides

(4) Position clamp over two ball guides and secure with three bolt and washer assemblies.

(5) Rotate worm through its complete travel several times to ensure that balls are installed correctly and rotate freely. Do not allow ball nut to hit end of worm travel; this could damage ball return guides.

(6) If bearing cups were removed from worm adjuster or housing, press in a new bearing cup, using Worm Shaft Bearing Cup Installer J-5755 (fig. 11-41).

(7) Install upper worm bearing on upper part of wormshaft and center ball nut on worm.

(8) Install assembly in housing with bearing seated in bearing cup.

(9) If bearing was removed from worm adjuster, install a new bearing and retainer in worm adjuster.

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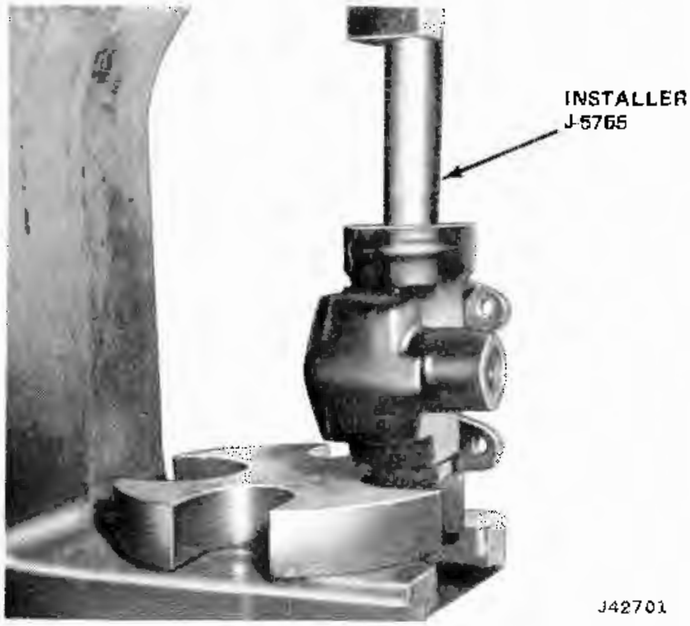

Fig. 11-41 Pressing in Bearing Cup

(10) Install adjuster in bottom of housing, seating wormshaft in lower bearing in adjuster.

(11) Install bearing adjuster locknut, but do not tighten.

Turn wormshaft until center tooth space of ball nut is centered in opening for side cover. Install correct shim, and lash adjuster screw in T-slot of pitman shaft.

(12) Install pitman shaft in housing, meshing center tooth of sector gear on shaft with center tooth space of ball nut.

(13) Position a gasket and side cover on housing; turn lash adjuster screw in threaded opening of side cover but do not tighten.

(14) Secure side cover with three lockwashers and bolts. Tighten bolts 25 to 35 foot-pounds. Install nut loosely on lash adjuster screw.

(15) If pitman shaft oil seal was removed, use Pitman Shaft Oil Seal Protector J-5787 and Pitman Shaft Oil Seal Installer J-7171 to install a new oil seal in housing over pitman shaft threads and splines.

(16) If wormshaft oil seal was removed, use Wormshaft Upper Oil Seal Installer J-7017 to install a new oil seal in housing.

(17) Fill steering gear with 11 ounces of lubricant, Jeep Part No. 940657, and adjust final torque steering gear.

Adjustments

NOTE: *Worm bearing adjustment should always precede each adjustment of steering gear.*

Worm Bearing Preload Adjustment

(1) Attach Torque Wrench J-7754 to splined end of worm shaft and turn shaft to either extreme left or right position. Do not hit travel stops.

(2) Tighten worm bearing adjuster until torque wrench registers 8 inch-pounds. Make sure adjustment is made within 1/2-turn of either extreme position of shaft.

(3) Tighten adjuster locknut to 70 to 110 foot-pounds. Recheck torque of wormshaft.

Overcenter Adjustment

(1) Turn steering gear from one extreme position to opposite position, counting number of turns.

(2) Turn back one-half total number of turns. This places steering gear on high point or straight-ahead position (total number of turns should be 6.14).

(3) With Torque Wrench J-7754 on the pitman shaft, tighten lash adjuster screw until torque registered is less than 18 inch-pounds. Make sure torque does not exceed this valve over center range.

(4) Tighten nut on adjuster screw to 18 to 27 foot-pounds. Recheck torque.

Installation

(1) Install coupling on splines of wormshaft, and secure coupling to shaft by installing attaching bolt and nut.

(2) Position steering gear against side frame rail; secure with three bolts.

(3) Check steering column alignment and adjust if necessary.

(4) Install pitman steering arm on pitman shaft; secure with lockwasher and nut. Tighten nut to 160 to 210 foot-pounds.

(5) Attach steering arm to connecting rod.

NOTE: *After gear is installed in vehicle, it may have a slight roughness. Run through 10 to 15 complete turn cycles to eliminate any roughness.*

RIGHT-HAND DRIVE VEHICLES

Removal

(1) Disconnect steering gear from steering column by removing flexible coupling-to-gear Allen-head clamping screw.

(2) Disconnect connecting rod from steering arm.

(3) Remove three bolts attaching steering gear to frame.

(4) Remove steering gear by sliding it slightly forward and to right and lifting it out of engine compartment.

Disassembly

Refer to figures 11-42 and 11-43.

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Fig. 11-42 Right-Hand Drive Steering Gear

(1) Clean exterior of steering gear.

(2) Remove filler plug from steering gear housing and drain lubricant from gear.

(3) Make index marks on roller gear and shaft assembly and on steering arm to assure correct alignment during assembly.

(4) Remove nut and lockwasher from shaft.

(5) Remove arm from shaft with a steering arm puller or gear puller.

CAUTION: *Do not use a hammer or wedge to remove steering arm from roller gear and shaft assembly. This will damage gear and shaft assembly.*

(6) With a fine file or piece of emery cloth, remove any nicks or burrs from exposed portions of roller gear and shaft assembly and from worm gear and shaft assembly.

(7) Remove four attaching capscrews, side cover, and gasket from steering gear housing. When cover is removed, attached roller gear and shaft assembly will also be withdrawn from housing.

(8) Remove locknut from adjustment screw.

(9) Turn screw clockwise until it is completely unthreaded from side cover; then remove roller gear and shaft assembly from cover.

(10) Remove four attaching capscrews and end cover from steering gear housing.

(11) Withdraw worm gear and shaft assembly from housing.

(12) Remove lower and upper bearing cups and ball bearings from shaft.

(13) Remove worm gear shaft oil seal and roller gear shaft oil seal from housing. Discard both seals.

Inspection

Clean all parts with suitable cleaning solvent and wipe dry.

Inspect the steering gear housing for cracks, breaks, leaks, or other damage. Replace if damaged.

Inspect the roller gear and shaft assembly visually for wear, scoring, or pitting. If necessary, polish lightly with a fine abrasive cloth. Inspect the roller gear to assure that it has proper freedom of movement and lacks excessive lash or roughness. Replace gear and shaft assembly if visibly worn or damaged.

Check adjustment screw of roller gear and shaft assembly for excessive end play. If end play exceeds 0.015 inch remove the retaining ring, thrust washer, and screw from the gear and shaft assembly. Replace the retaining ring if unserviceable. Secure a new adjustment screw and thrust washer in the gear and shaft assembly with a retaining ring.

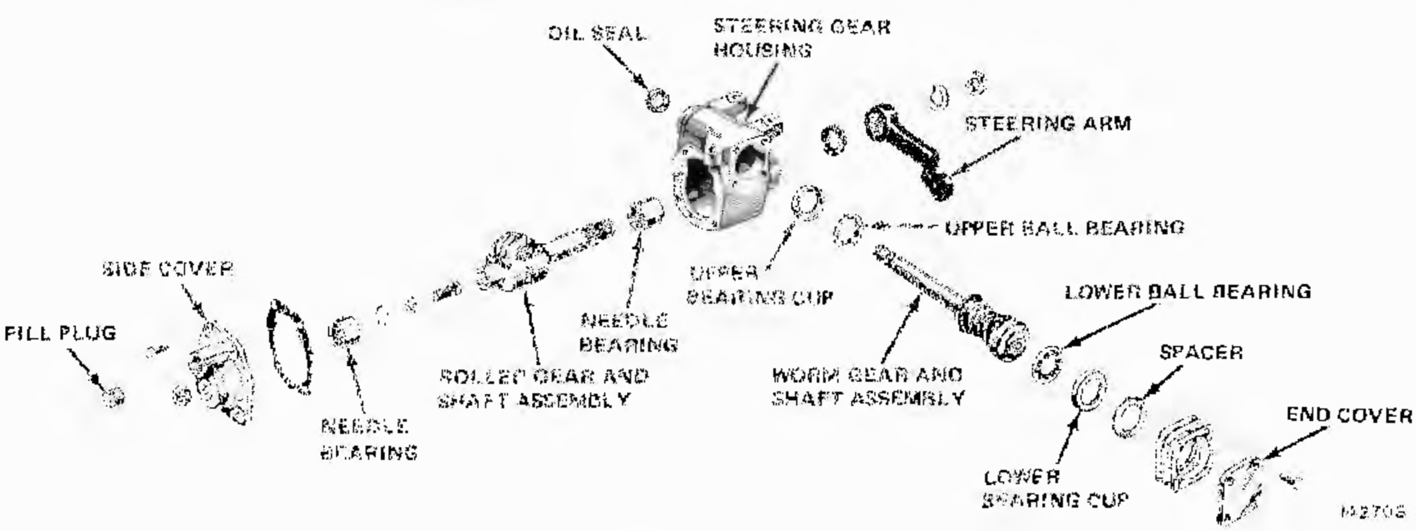

Fig. 11-43 Steering Gear Exploded View

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Inspect needle bearings, which carry roller gear and shaft assembly, in the side cover and the steering gear housing. Replace if visibly worn or damaged. Insert a shaft through each bearing and check for clearance. If clearance exceeds 0.010 inch, replace bearings.

To remove either needle bearing, press out with a piloted mandrel. To install a new needle bearing, press the bearing into the side cover or steering gear housing with a piloted mandrel so that the face of the bearing is flush with the bearing boss of the cover or housing.

Inspect the worm gear and shaft assembly visually for wear, scoring, or pitting. If necessary, polish lightly with a fine abrasive cloth. Replace assembly if it is visibly worn or damaged.

Inspect upper and lower ball bearings and cups of the worm gear and shaft assembly for wear and damage. Replace if visibly worn or damaged.

NOTE: *Bearing balls must be replaced as a full set in each bearing.*

Assembly

(1) Position new oil seals at worm gear shaft and roller gear shaft oil seal bores of steering gear housing with longer lip of each seal facing into housing.

(2) Press each seal into housing with a mandrel of suitable diameter to touch seal bore of the housing around its entire perimeter.

(3) Lubricate worm gear and shaft assembly and upper ball bearing and cup with Gear Lubricant MIL-L-2105B, Grade SAE 80.

(4) Install bearing and cup on shaft.

(5) Install shaft assembly in steering gear housing. Be certain that splined end of shaft does not damage oil seal.

(6) Lubricate lower end of worm gear and shaft assembly and lower ball bearing and cup with Gear Lubricant MIL-L-2105B, Grade SAE 80.

(7) Install bearing, cup, and spacer on shaft.

(8) Position shims and end cover to steering gear housing; attach loosely with four capscrews.

(9) Adjust bearing preload.

(10) Position tapped hole of side cover to adjustment screw of roller gear and shaft assembly.

(11) Thread screw counterclockwise into the cover until end of shaft just touches inner face of the cover.

(12) Install a locknut loosely on adjustment screw.

(13) Install a new gasket on side cover.

(14) Lubricate gear of roller gear and shaft assembly with Gear Lubricant MIL-L-2105B, Grade SAE 80.

(15) Insert gear and shaft assembly into steering gear housing. Be certain that end of shaft does not damage oil seal in housing.

(16) Roller gear and worm gear must mesh to seat side cover to housing.

(17) Secure cover to housing with four capscrews. Tighten capscrews 18 to 22 foot-pounds.

(18) Adjust gear clearance.

(19) Clamp exposed section of roller gear and shaft assembly firmly in soft jaw vise.

(20) Observe index marks made during disassembly and position steering arm to splined end of shaft.

(21) Install lockwasher and nut on shaft threads; tighten nut to draw arm into position on spline.

(22) Fill steering gear housing to required level with Gear Lubricant MIL-L-2105B, Grade SAE 80.

Adjustments

Bearing Preload Adjustment

This steering gear adjustment determines preload applied to upper and lower ball bearings which support the worm gear and shaft assembly. It is made by adding to or subtracting from the number of shims between the steering gear housing and end cover.

If necessary, loosen four capscrews which fasten the end cover to the steering gear housing (fig. 11-43).

Alternately tighten capscrews evenly, but only slightly at a time, and rotate the worm gear shaft. Tighten screws 18 to 22 foot-pounds.

Check rolling torque required to rotate the worm gear shaft. When bearing preload is correct, this torque will be 2 to 5 inch-pounds. If necessary, remove capscrews and end cover. Either add to or subtract from the number of shims, and repeat the above procedure to obtain correct bearing preload.

Steering Gear Clearance Adjustment

This steering gear adjustment sets proper backlash between the worm gear and the roller gear of the steering gear assembly. It prevents gear wear resulting from insufficient backlash, and steering play which would result from excessive backlash. Gear backlash is adjusted by an adjustment screw which determines the longitudinal position of the roller gear and shaft assembly.

(1) If necessary, loosen locknut and turn adjustment screw at the side cover counterclockwise until worm gear shaft turns freely through its entire range of travel (fig. 11-43).

(2) Count number of turns necessary to rotate worm gear shaft through its entire range of travel.

(3) Turn shaft to center of its travel.

(4) Rotate shaft back and forth through its center of travel, and tighten adjustment screw until shaft shows slight bind at center of its travel.

(5) Adjust screw to obtain a rolling torque requirement of 7 to 12 inch-pounds to rotate shaft through center of travel.

(6) Hold adjustment screw in position and torque locknut 16 to 20 foot-pounds.

(7) Recheck rolling torque necessary to rotate worm gear shaft through center of its travel. If necessary, repeat above procedure until rolling torque is correct.

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STEERING LINKAGE

GENERAL

The steering linkage consists of a pitman arm attached to the steering gear assembly, a connecting rod, a tie rod, a steering damper, and steering knuckle arm (integral with the steering knuckle). End assemblies (ball-studs) are used on the tie rod and connecting rod to maintain toe-in and good steering control (fig. 11-44).

On the steering linkage, the connecting rod attaches to the pitman arm at one end and to the tie rod at the other end. The tie-rod ends are connected to the steering knuckle arms at the wheels. The steering damper is attached to the tie rod on one end and to a bracket on the left spring tie-plate at the other end.

Tie Rod

The tie rod (fig. 11-45) consists of a solid rod threaded on one end with an integral ball-stud end assembly at the other end. A turnbuckle and a removable ball-stud end complete the tie rod assembly. The threaded end of the tie rod has right-hand threads which accept the turnbuckle. The ball-stud tie-rod end screws into the turnbuckle. A large boss is located on the tie rod about eight inches from the unthreaded right end. A tapered hole machined into the boss accepts the steering connecting-rod end. The steering damper is connected to a stud which is mounted on a bracket that is either welded or clamped at the center of the tie rod.

Connecting Rod

The connecting rod (fig. 11-46) consists of a rod threaded at the left end, with an integral ball-stud end assembly at the right end. A turnbuckle and a removable ball-stud end complete the connecting rod assembly. The end having the integral ball-stud end assembly attaches to the tie rod. The threaded end, with the turnbuckle and removable ball-stud end assembly, is attached to the pitman arm.

On Cherokee and Wagoneer models the connecting rod is 26.38 inches long, and on Truck models 28.38 inches long. The difference in length is due to the wider track of Truck models.

If damaged or worn, the connecting rod must be serviced as an assembly. However, the ball-stud end assembly can be replaced separately.

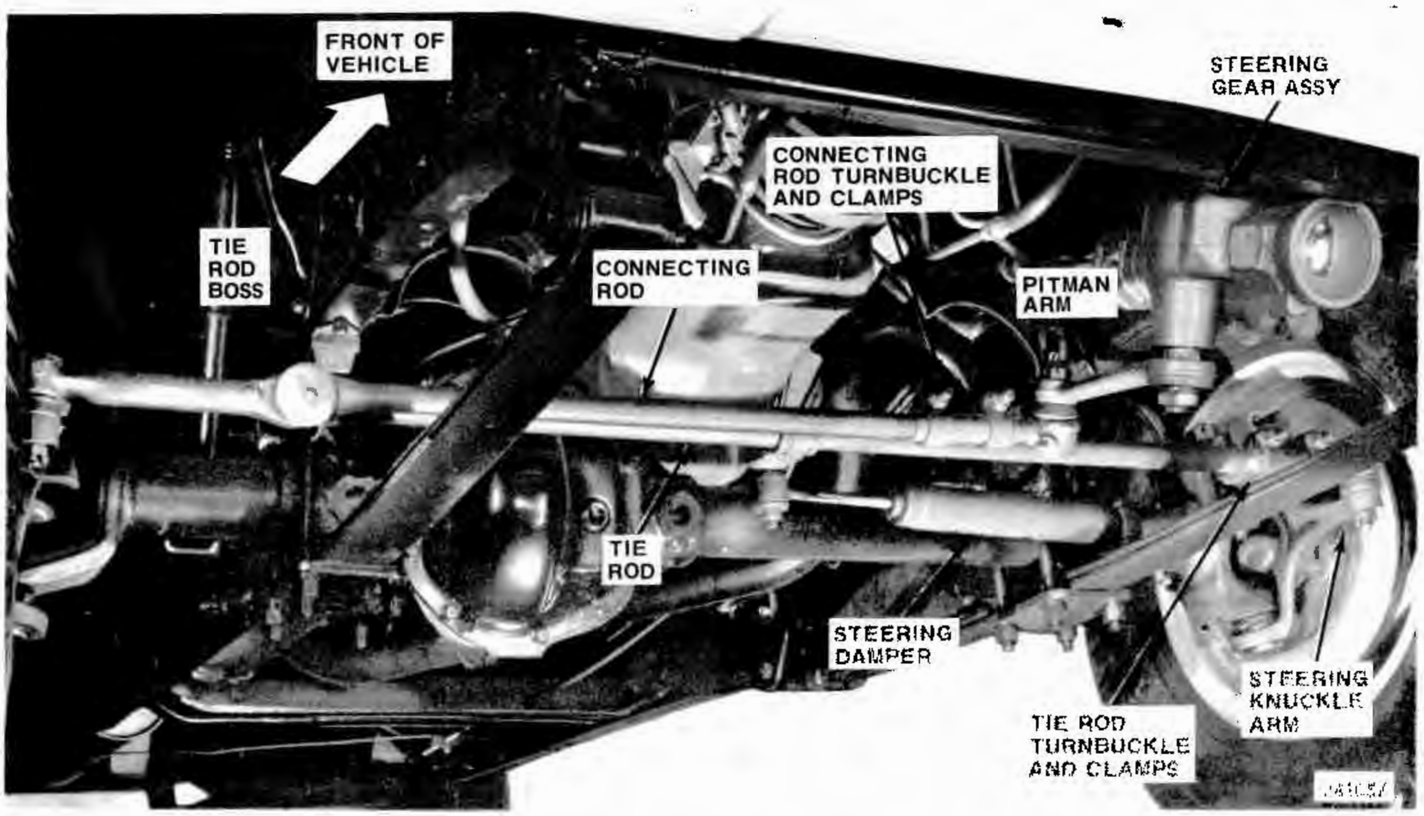

Fig. 11-44 Steering Linkage—Cherokee, Wagoneer, Truck

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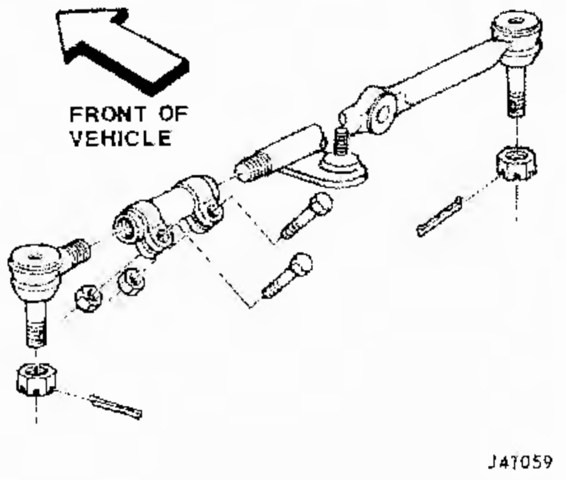

Fig. 11-45 Tie Rod Exploded View

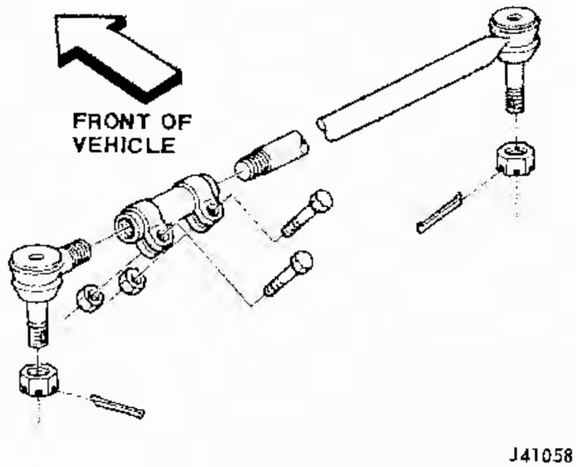

Fig. 11-46 Connecting Rod Exploded View

Steering Damper

Steering damper (fig. 11-47) mounting has been revised. The damper now has eyelets at each end for mounting on studs. Formerly, the push rod end was threaded and was attached to a bracket which was attached to the tie rod with U-bolts. The bracket is either welded or clamped to the tie rod and incorporates a stud for push rod attachment. The body end of the damper attaches to a stud on a bracket mounted between the left axle spring and the axle spring pad.

The steering damper is serviced as an assembly. If damaged or leaking, replace with a new assembly. The rubber bushings used in the damper eyelets can be replaced individually, if required.

TIE ROD

Removal

(1) Remove cotter pins and retaining nuts at both ends of tie rod, and from end of connecting rod where it attaches to tie rod.

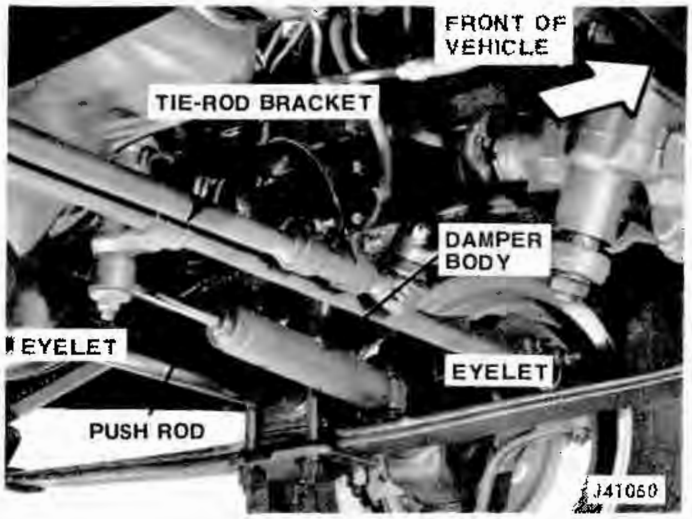

Fig. 11-47 Steering Damper Assembly

(2) Remove nut attaching steering damper push rod to tie-rod bracket and move damper aside.

(3) Remove tie-rod ends from steering arms and connecting rod using puller or expansion fork.

NOTE: *After removal, the tie-rod ends can be removed from the tie rod by loosening the turnbuckle clamp bolts and unscrewing ends.*

Installation

(1) Attach tie-rod ends to steering arms. Tighten nuts to 50 foot-pounds torque and use new cotter pins to secure nuts.

(2) Attach connecting rod to tie rod. Tighten nut to 50 foot-pounds torque and use new cotter pin to secure nut.

(3) Attach steering damper to tie-rod bracket.

(4) Adjust toe-in as necessary.

CONNECTING ROD

The steering connecting rod can be removed by removing the cotter pins and nuts from both ends, and then removing the rod. The steering connecting rod ball joints cannot be disassembled for service.

When installing the steering connecting rod, place the wheels in the straight-ahead position and place the steering arm parallel to the centerline of the vehicle. Have the steering gear steering arm properly indexed, with line marks on the steering arm and gear shaft and the steering gear on center of high point. With the steering arm so positioned, install the connecting rod.

Removal

(1) Place front wheels in a straight-ahead position.

(2) Remove locknut securing damper to bracket on tie plate and lift damper off stud (fig. 11-48).

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(3) Remove locknut securing push rod to tie rod bracket and remove damper assembly.

Installation

(1) Insert rubber bushings in damper eyelets.
(2) Secure eyelet at push rod end to stud on tie rod bracket with attaching parts.
(3) Extend push rod by pulling back on damper body until eyelet can be located on, and secured to stud on damper bracket at spring pad.
(4) Tighten all locknuts securely.

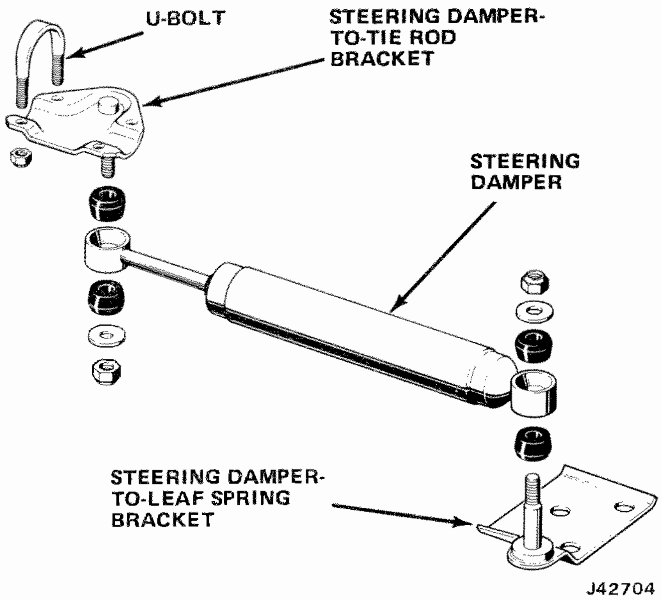

Fig. 11-48 Steering Damper

FRONT WHEEL ALIGNMENT ADJUSTMENTS

To assure correct alignment, a definite procedure for inspection of the steering system is recommended. It is suggested that the following sequence be used.

(1) Equalize tire pressures and level vehicle.
(2) Check steering-gear-to-steering column alignment.
(3) Inspect steering knuckle pivots, spindle and wheel bearing looseness.
(4) Check wheel runout.
(5) Test wheel balance and bearing adjustment.
(6) Check for spring sag.
(7) Inspect brakes and shock absorbers.
(8) Check steering gear assembly adjustment and steering connecting rod.
(9) Check caster.
(10) Check toe-in.
(11) Check toe-out on turns.
(12) Check camber.
(13) Check tracking of front and rear wheels.
(14) Check frame alignment.

The factors of alignment, caster, camber, and toe-in, are all interrelated. After an alignment job is completed, make a complete recheck of all the adjustments to be sure the settings are within the limit. Be sure all front suspension and steering system nuts and bolts are all properly torqued before taking wheel alignment readings.

Toe-In

Refer to figure 11-49.

To adjust the wheel toe-in, first raise the front of the vehicle to free the front wheels. Turn the wheels to the straight ahead position. Use a steady-rest to scribe a pencil line in the center of each tire tread as the wheel is turned by hand. A good way to do this is to first coat a strip with chalk around the circumference of the tread at the center to form a base for a fine pencil line.

Measure the distance between the scribed lines at the front and rear of the wheels using care that both measurements are made at an equal distance from the floor. The distance between the lines should be greater at the rear than the front by 3/64 inch to 3/32 inch. To make adjustment to obtain this distance, loosen the clamp bolts and turn the tie rod with a small pipe wrench. The tie rod is threaded with right and left hand threads to provide equal adjustment at both wheels. Do not overlook retightening the clamp bolts to specified torque.

It is common practice to measure between the wheel rims. This is satisfactory providing the wheels run true. By scribing a line on the tie tread, measurement is taken between the road cóntact points which will reduce error of wheel runout.

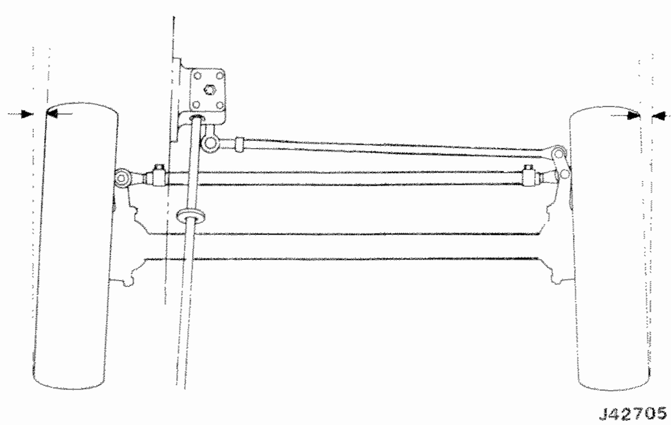

Fig. 11-49 Front Wheel Toe-In (Top View)—Typical

Camber

Refer to figure 11-50.

Correct wheel camber of 1-1/2° is set in the solid front axle at the time of manufacture and cannot be altered by any adjustment. It is important that the camber is the same on both front wheels. Caster angle should be checked using wheel aligning fixture. Heating any of these parts to facilitate straightening

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usually destroys the heat treatment given them at the factory. Cold bending may cause a fracture of the steel and is unsafe. Replacement with new parts is recommended rather than any straightening of damaged parts.

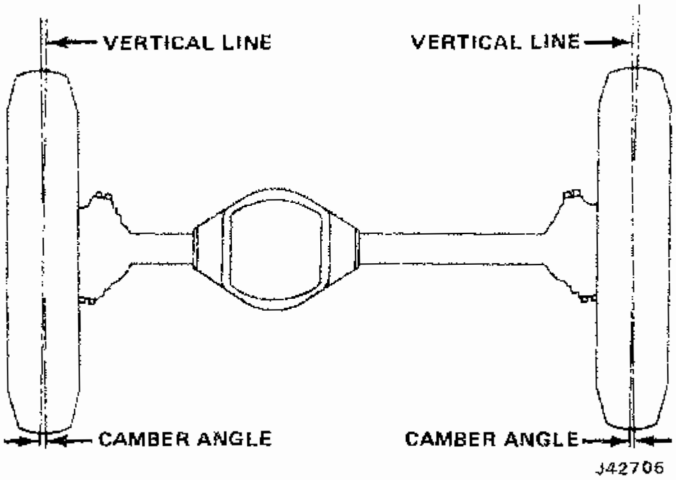

Fig. 11-50 Front Wheel Camber (Front View)

Caster

Refer to figure 11-51.

Axle caster is preset at 3°. It should be checked on a wheel alignment fixture. If found to be incorrect, correction may be made by either installing new parts or installing caster shims between the axle pad and the springs.

If the camber and toe-in are correct and it is known that the axle is not twisted, a satisfactory check may be made by testing the vehicle on the road. Before road testing, make sure all tires are properly inflated, being particularly careful that both front tires are inflated to exactly the same pressure.

If vehicle turns easily to either side but returns hard to straight-ahead position, incorrect caster is indicated. If correction is necessary, it can usually be accomplished by installing shims between the springs and axle pads to secure the desired result.

Front Wheel Shimmy

Wheel shimmy may be caused by various conditions in the wheels, axle, or steering system, or a combination of these conditions. Outlined below will be found the usual corrections of this fault:

(1) Equalize the tire pressures.

(2) Check the wheel bearings for looseness. Be sure that the inner wheel bearing race is not too loose on the spindle.

(3) Remove both steering knuckles and carefully inspect the upper and lower pivot pin bearings. Inspect the bearing cups for evidence of brinelling, pitting, or fretting. Any bearings that show the slightest imperfection must be replaced. Adjust the pivot pin

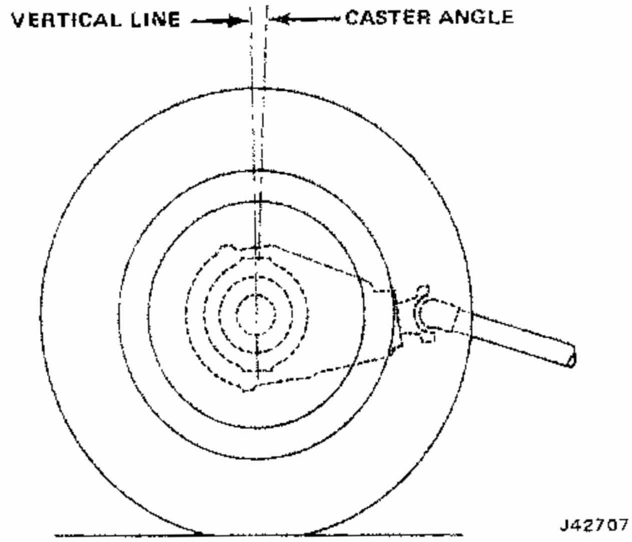

Fig. 11-51 Axle Caster (Side View)

bearings. Assemble and lubricate the front axle and steering linkage, installing new steering knuckle oil seals if present seals show any wear.

(4) Check wheel runout. This check should include radial runout and wheel looseness on the hub.

(5) Check wheel balance. Check for blowout patches, uniform tire tread, vulcanized tires, mud on inside of wheels, and tires creeping on the rims.

(6) Check for front spring sag. Also check for broken spring leaves, broken center spring bolt, loose spring clips (or tight clips), overlubrication of spring leaves, spring shackle bracket loose on frame, and loose rear spring shackle. Be sure that the shock absorbers are operating properly to eliminate bobbing of the front end.

(7) Check brakes to make sure that one does not drag.

(8) Check the steering assembly and steering connecting rod. This includes the up and down play of the steering worm shaft, end play of the lever shaft, tightness of the steering gear to the frame, tightness of steering arm, adjustment of the steering connecting rod, and condition of the steering tie rod ball joint ends.

(9) Check front axle caster. This should be the same on both sides, otherwise a locking brake may be indicated causing a twisting action of the axle.

(10) Check the front wheel toe-in.

(11) Check wheel toe-out on turns. This gives an indication of the proper angularity of the steering knuckle arms and tells whether or not they have been bent and require replacing. These may be checked by comparing them with new parts. If an arm is bent, check for a bent tie rod.

(12) Check wheel camber.

(13) Check the steering axis inclination.

(14) Check the tracking of the front axle and frame alignment, either of which may be out of alignment.

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POWER STEERING

GENERAL

Vehicles equipped with optional power steering employ a power steering system which consists of a mechanical steering gear with an integral steering valve and power cylinder, and a hydraulic pump. The engine-driven hydraulic pump circulates the oil from its integral reservoir through the pressure and return hoses, which run between the valve and the pump. The valve, in response to right or left turn, directs the oil to the integral power cylinder which operates the pitman arm shaft to cause steering. This oil under pressure is directed to either end of the power cylinder, where it builds up force to reduce the effort required at the steering wheel. The rotary valve gives a smooth transition through the range of wheel effort and allows the driver to retain the road feel necessary for effortless driving.

Under normal driving conditions, the steering wheel effort will range from one pound to two pounds. The hydraulic oil pressure in the power cylinder should not exceed 100 psi and the pressure for turning corners will not exceed 400 psi. Pressure during parking ranges from 900 psi to 1050 psi, depending upon the roadbed conditions.

If for any reason the power system should fail, the steering gear will operate manually, giving the driver full control of the vehicle. The steering gear, in this condition, operates as a typical ball-nut type manual steering gear. Hydraulic fluid is bypassed through the valve so that it does not restrict the manual operation.

DESCRIPTION AND OPERATION

Power Steering Gear

The steering gear is a low-friction, high efficiency, recirculating ball system in which steel balls act as a rolling thread between the steering worm and rack-piston nut. As the steering shaft and worm are rotated, the rack-piston nut raises and lowers, imparting this movement to the pinion of the pitman shaft. The pitman shaft mounts the pitman arm which transfers the movement to the steering linkage. The steering shaft is connected to the steering gear through a flexible coupling attached to the steering shaft flanges. The flexible coupling minimizes shocks, vibrations, and hydraulic noises, and lessens the possibility of road noise coming up through the steering column. The steering valve, power piston, and cylinder are subassemblies of the power steering gear.

Steering Valve

The steering valve is contained in the gear housing and is a four-way, three-position, open-center, rotary type valve. The movement of the spool opens the valve ports, and the fluid coming through the pressure hose from the pump is directed through the valve. It is then regulated throughout the gear housing, depending on the direction of the turn. The spool is held in neutral position by means of a torsion bar. Turning of the torsion bar allows the spool to displace in relation to the valve body, operating the valve.

Neutral Position Operation

Refer to figure 11-52.

Oil pressure from the pump passes through the open-center valve and back to the pump reservoir without traveling through the power cylinder. This open-center position of the valve reduces pump losses to a minimum. The valve is in the open-center position at all times except when steering. The power cylinder is always full of oil, which acts as a cushion to absorb road shocks so that they are not transferred to the driver. In addition, this oil lubricates all the internal components of the gear making it unnecessary to lubricate at any time.

Right-Turn Operation

Refer to figure 11-53.

Due to the resistance to turning between the front wheels and the roadbed, the torsion bar is deflected, changing the relationship between the spool grooves and the valve body grooves with each other. The right turn grooves of the spool are closed off from the return grooves and opened more to the pressure grooves. The left turn grooves of the spool are closed off from the pressure grooves and opened more to the return grooves. This causes the oil to flow into the lower half of the pressure cylinder and force the rack-piston nut upward. As the rack-piston nut moves upward, it applies turning effort to the pitman shaft. The oil in the upper end of the cylinder is simultaneously forced out through the valve and back to the pump reservoir. The higher the resistance to turning between the roadbed and the front wheels, the more the valve spool is displaced, and the higher the oil pressure on the lower end of the rack-piston nut. Since the amount of valve displacement and, consequently, the amount of hydraulic pressure built in the cylinder is dependent upon the resistance to turning, the driver is as-

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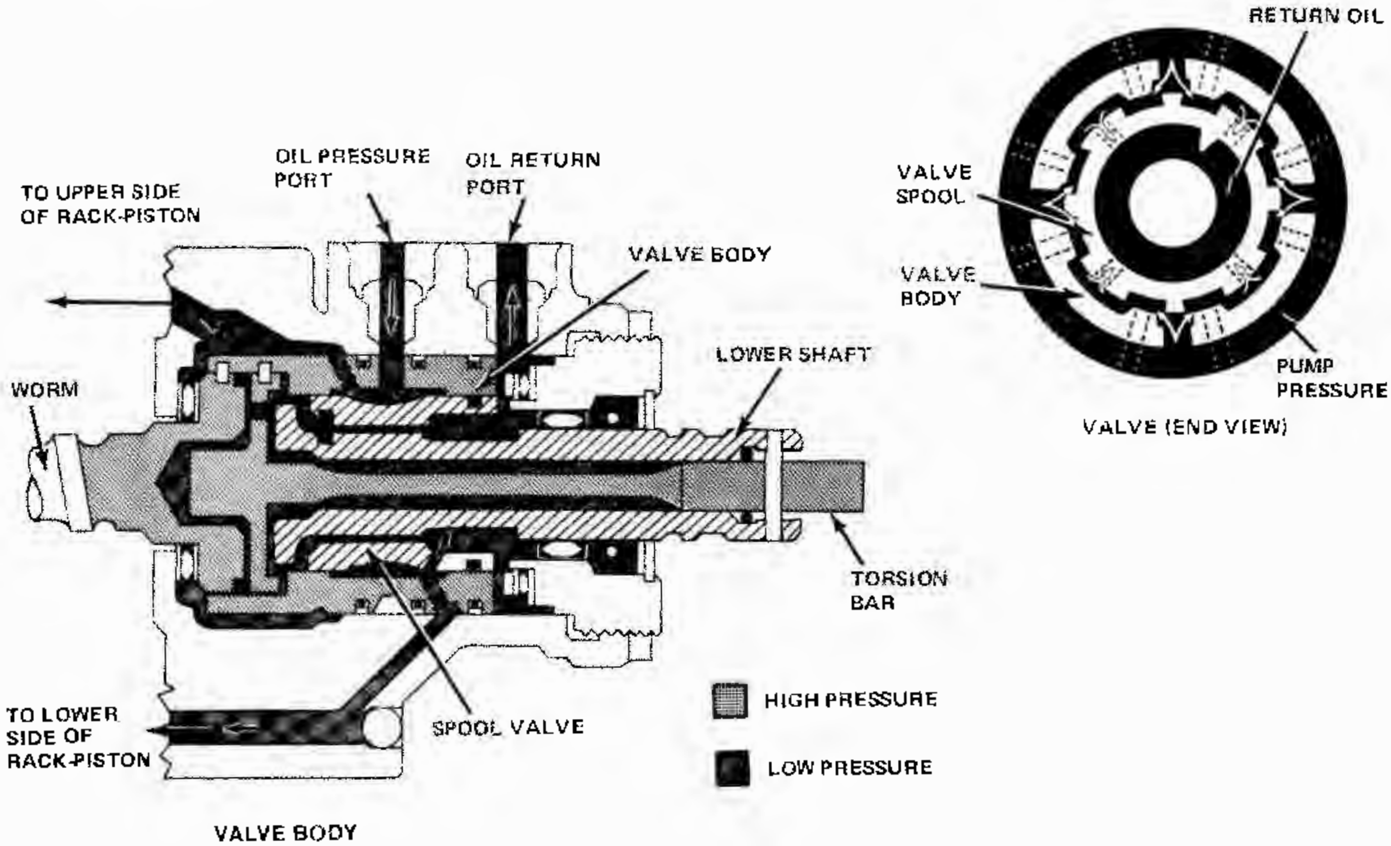

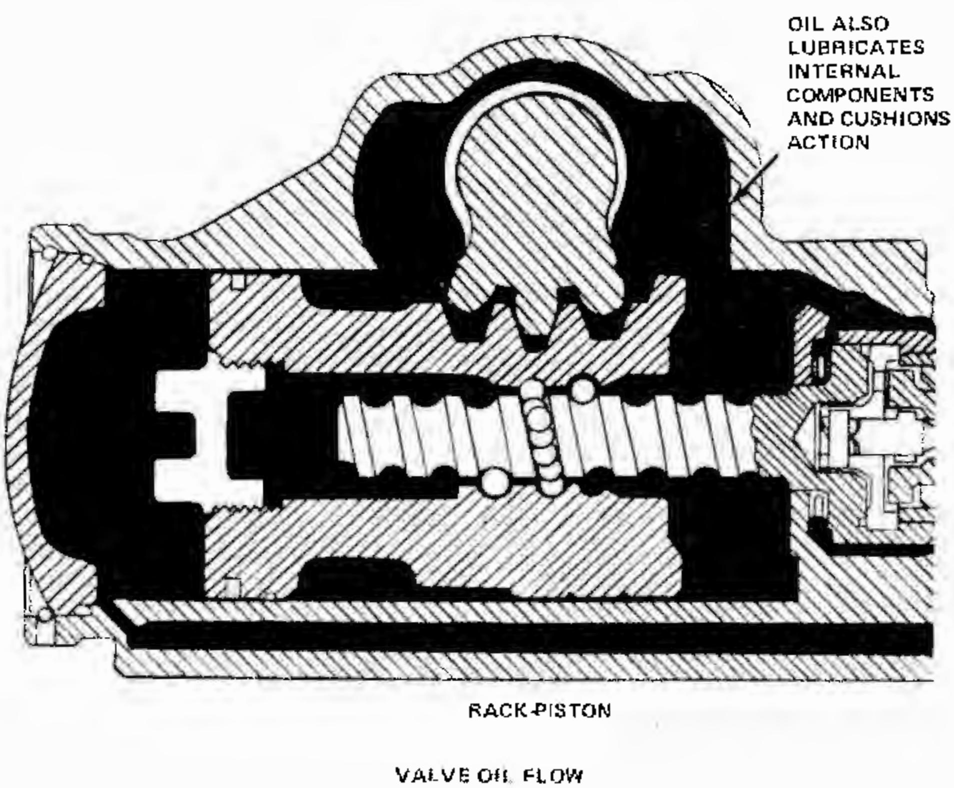

Fig. 11-52 Steering Valve Oil Flow—Neutral (Straight-Ahead) Position

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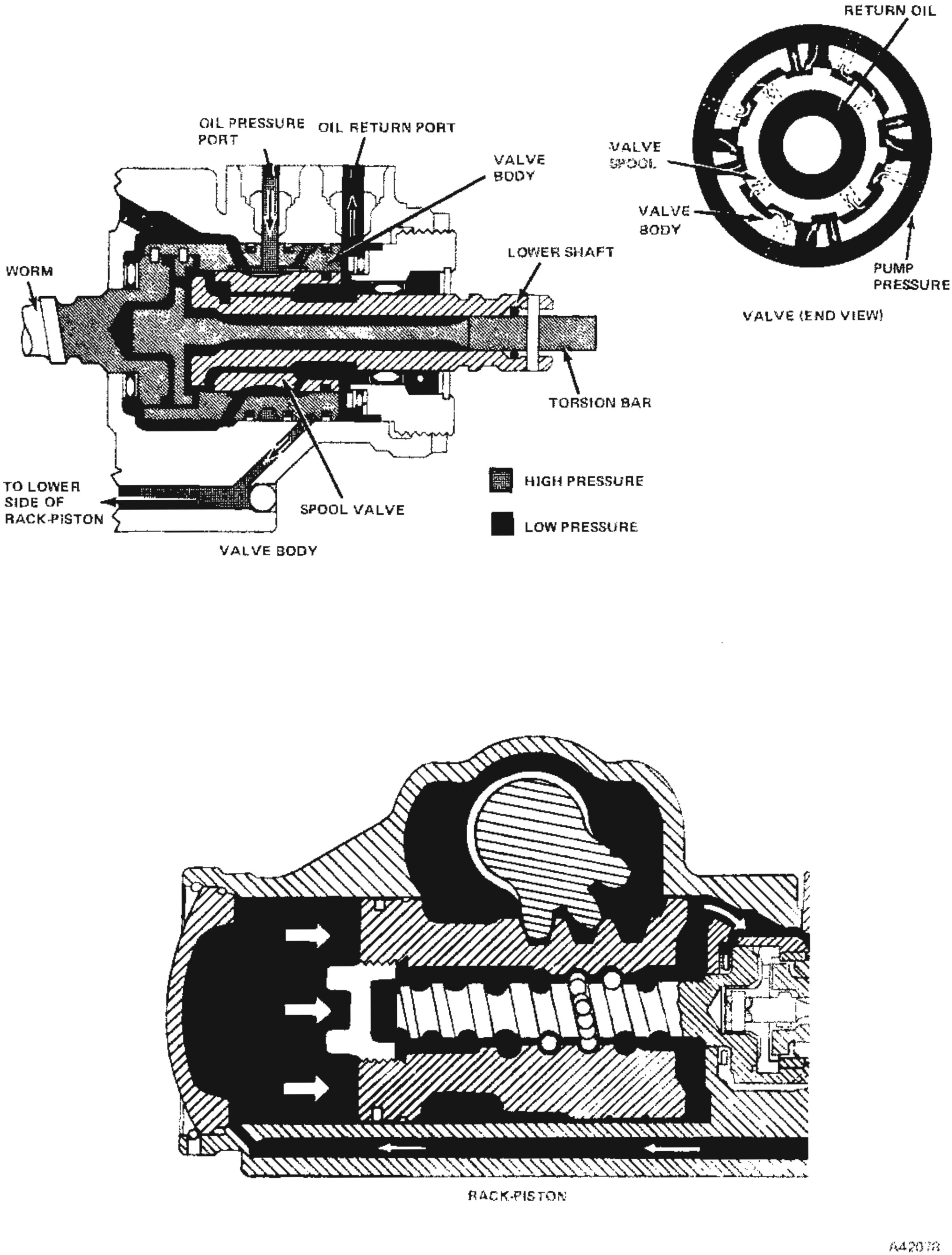

Fig. 11-53 Valve Oil Flow—Right Turn Position

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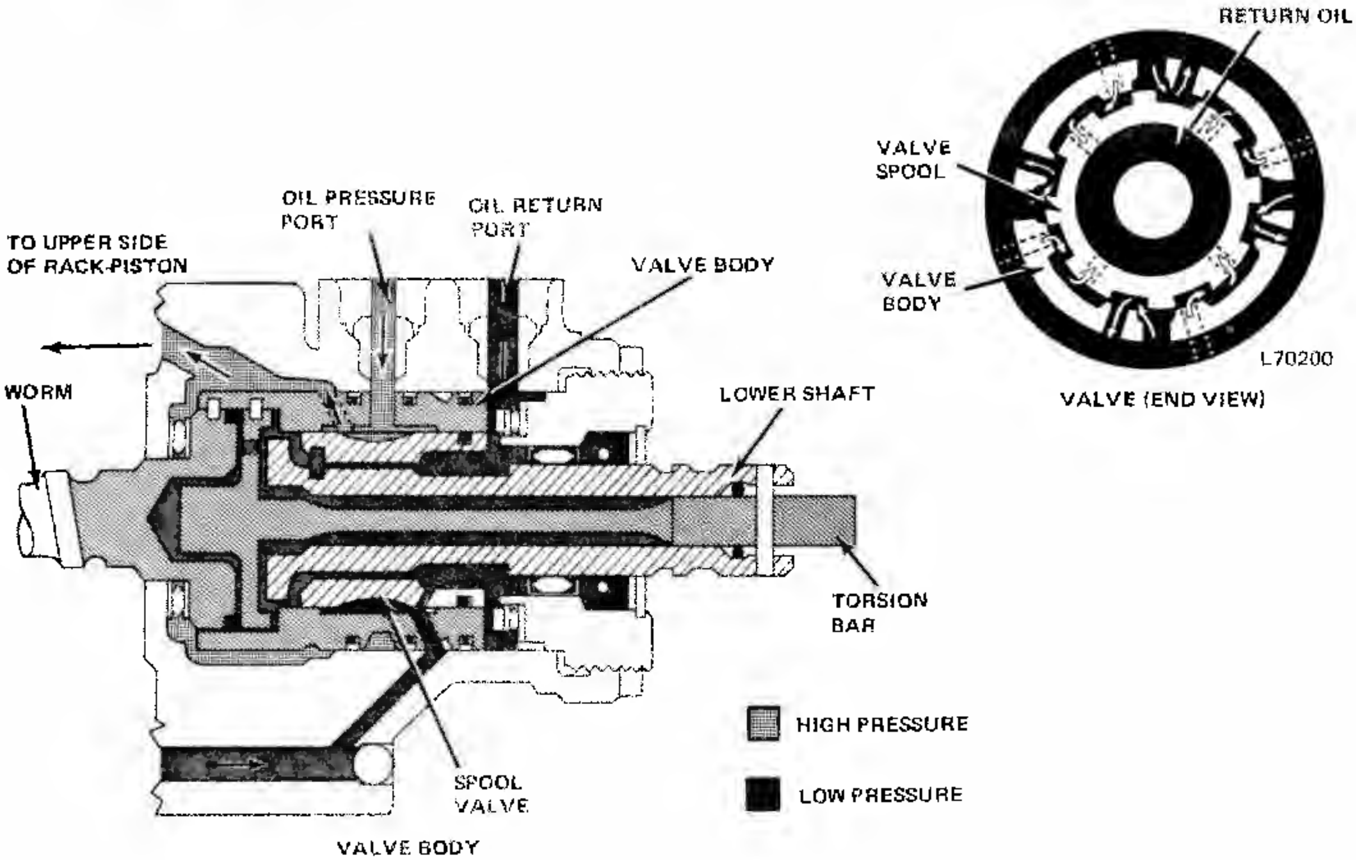

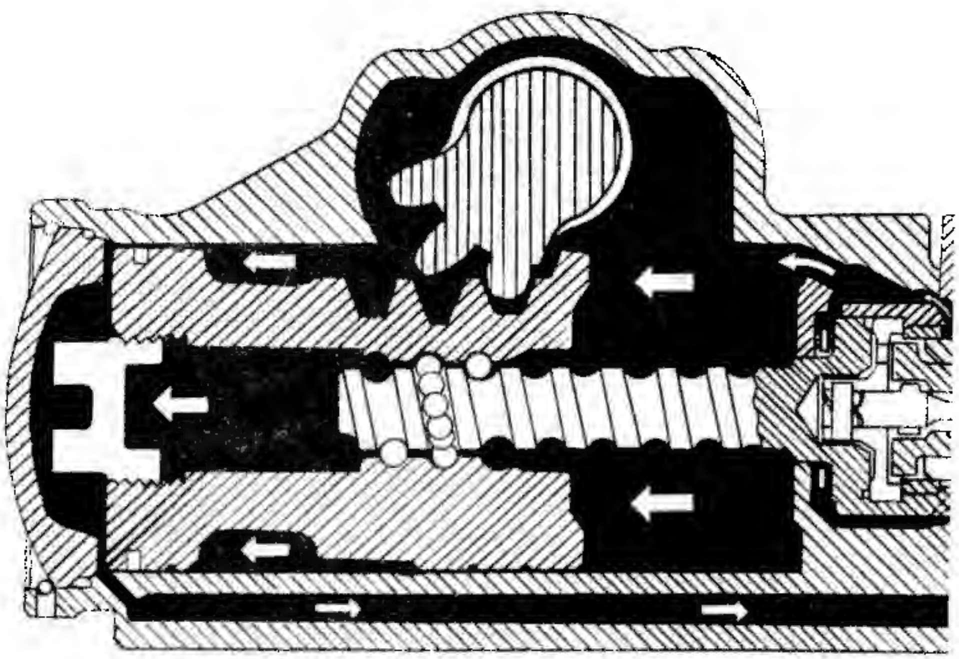

Fig. 11-54 Valve Oil Flow—Left Turn Position

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sured of the proper amount of smooth hydraulic assistance at all times.

The instant the driver stops applying steering effort to the steering wheel, the valve is forced back into its neutral position by the torsion bar. When this happens, the oil pressure is again equal on both sides of the rack-piston nut and the steering geometry of the car causes the wheels to return to the straight-ahead position.

Left-Turn Operation

Refer to figure 11-54.

The resistance to turning of the front wheels causes the torsion bar to deflect, changing the relationship between the spool grooves and the valve body grooves with each other. The grooves are reversed from the right turn position and change the flow of oil into the upper end of the pressure cylinder forcing the rack-piston nut downward and applying turning effort to the pitman shaft. The oil in the lower end of the cylinder is now forced through the valve and back to the pump reservoir. When the driver stops applying steering effort to the steering wheel, the valve returns to its neutral position and the steering geometry causes the wheels to return to the straight-ahead position.

Power Steering Pump

The oil pump converts engine power into oil pressure which is used against the rack-piston nut to rotate the pitman shaft.

The pump reservoir encloses the pump housing and provides a reserve supply of oil to assure complete filling of the hydraulic system (fig. 11-55).

The reservoir cap is vented to permit escape of any air that may be introduced into the system during assembly of the various units, and maintains atmospheric pressure in the reservoir.

The pump housing encloses the flow control valve and the rotor assembly. The flow control valve and spring are retained in the pump housing by the pressure union (fig. 11-56). This allows servicing the flow control valve without removing the pump from the engine. Inside the flow control valve is the pressure relief valve. Also in the end of the flow control valve is a filter screen which filters the oil that enters this valve. The pressure union which is the pump outlet, contains the pump oil exit hole and an orifice.

The rotor assembly consists of a drive shaft, thrust plate, rotor with ten vanes, pump ring and pressure plate.

Oil enters the rotor section of the housing through a hole which is open to the surrounding reservoir.

The rotor, which is loosely splined to the end of the drive shaft, is located adjacent to the face of the thrust plate and is enclosed by the pump ring. The rotor vanes slide radially outward to contact the hardened and ground inside cam surface of the ring (fig. 11-57).

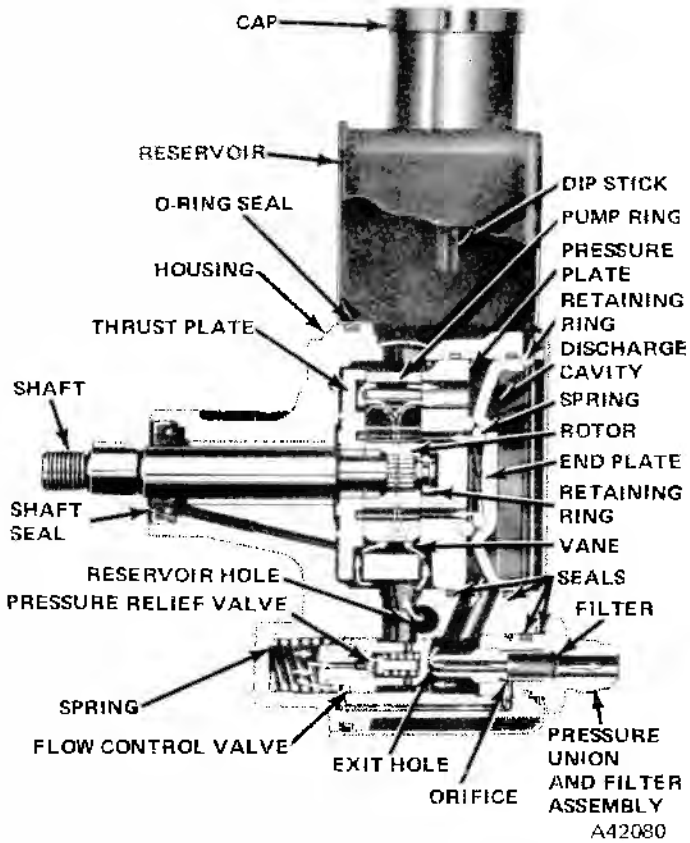

Fig. 11-55 Power Steering Pump—Cross Section

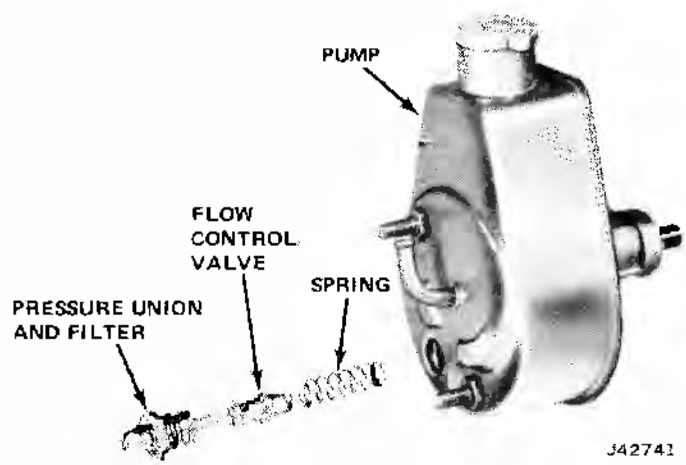

Fig. 11-56 Flow Control Valve Installation

As the shaft and rotor rotate, centrifugal force and fluid pressure against the inner ends cause the vanes to follow the cam contour of the ring. The cam surface is so shaped that two opposite pumping chambers are formed which cause a complete pumping cycle to occur every 180 degrees of rotation of the rotor. The pump ring has two crossover passages drilled in it, which transfer oil from the thrust plate into a discharge cavity located at the rear of the pressure plate.

When the engine is started, each pumping chamber picks up oil from two openings, one between the pressure plate and ring, and the other between the thrust

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plate and ring (fig. 11-58). The oil is then propelled by the decreasing pockets in each pumping chamber into the discharge cavity through an opening in the pressure plate and an opening in the thrust plate which is connected to the crossover passage in the ring. The oil flows from the discharge cavity into a passage which is open to the rear of the flow control valve and to the exit hole in one end of the pressure union. Oil flows through the outlet end of the pressure union to the steering gear assembly. Some oil flows through the orifice in the pressure union and into a passage in the pump housing which directs oil into the spring chamber located in front of the flow control valve.

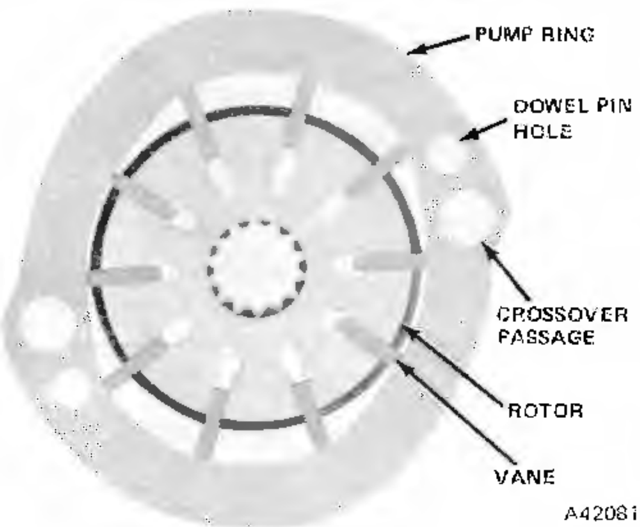

Fig. 11-57 Pump Ring and Rotor

Pressure in the discharge cavity is always greater than the pressure of the oil that has passed through the exit hole in the pressure union.

The flow control valve regulates the opening of a bypass passage through which oil may be returned to the suction and reservoir section of the pump.

When the pump is running without demand for steering pressure, pressure in the discharge cavity is great enough to push the flow control valve open against a spring load of approximately ten pounds.

The pressure in the spring chamber tends to close the valve, but since pressure in the discharge cavity is always greater than in the spring chamber, the valve is not closed. The movement of the valve is controlled by the spring tension and the difference in pressure on the front and rear side of the valve.

When power assistance is required, the steering gear rotary valve restricts free circulation of oil, and the pump pressure builds up rapidly. As the pressure increases in the discharge cavity it also increases in the spring chamber and, in turn, additional pressure is required to move the flow control valve to open the bypass passage. The maximum amount of build-up of pressure by the pump depends on the amount of restriction, controlled by the rotary valve. When power

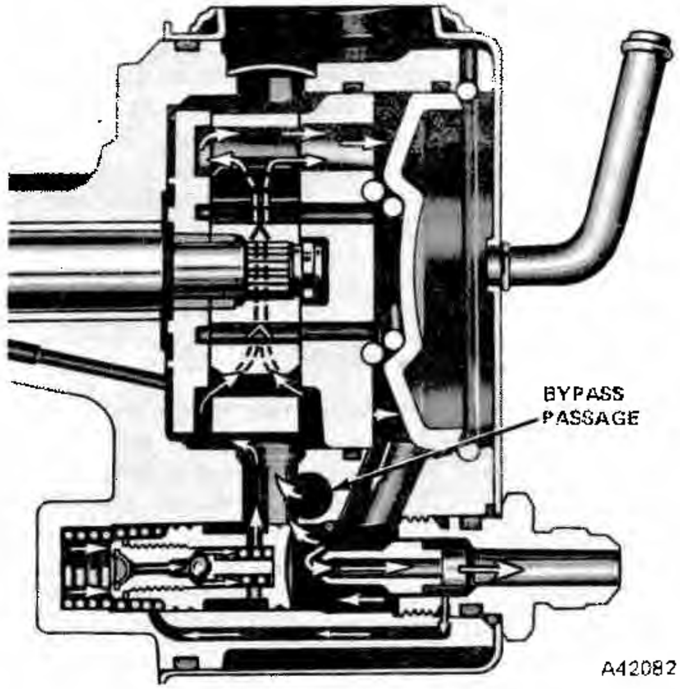

Fig. 11-58 Flow Control Valve Operation

assistance is no longer required, the restriction is reduced to a predetermined minimum. With a small amount of restriction, the pressure in the spring chamber drops to a minimum. Thus, the pressure in the discharge cavity also is reduced as this pressure is governed by the spring tension and the oil pressure present in the spring chamber of the pump.

If pump output pressure reaches 1100 to 1200 psi, the increased pressure in the spring chamber forces a pressure relief valve open and oil escapes from the spring chamber into the bypass hole around the pressure relief valve ball (fig. 11-58).

As oil pressure is relieved in the spring chamber, the high pressure in the pump discharge cavity overcomes the spring load to open the flow control valve. Because outlet pressure has to pass through an orifice to get into the spring chamber, the pressure in the spring chamber drops below outlet pressure for a fraction of a second. This allows the flow control valve to be open enough to lower line pressure to a safe level immediately. Oil is then pumped into the bypass passage until the line pressure opposing the pump drops below the relief valve setting, permitting this valve to close. The flow control valve then resumes normal operation. The flow control valve starts to open at 300-400 rpm of pump and is functioning when the pump is running 465 rpm (400 rpm of engine).

VARIABLE RATIO POWER STEERING

A variable ratio power steering gear is included in the optional power steering package offered on Cherokee, Wagoneer, and Truck models. CJ-5 and CJ-6 models are equipped with the constant ratio gear unit.

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The ratio of a steering system is the relationship of steering wheel movement to that of the front wheels, in terms of the number of degrees that the steering wheel must be moved to turn the front wheels one degree. To illustrate, the constant ratio power steering gear has a steering ratio of 17.5 to 1, which means that it is necessary to move the steering wheel 17.5 degrees in order to turn the road wheels one degree.

Variable ratio steering is more responsive, requiring fewer turns of the steering wheel to move the front wheels from stop to stop. Steering ratio varies from 16 to 1, to 13 to 1, and is dependent on the degree of steering wheel movement. In the straight-ahead position, the steering ratio remains constant at 16 to 1 for the first 40 degrees of steering wheel movement in either direction. When steering wheel movement exceeds 40 degrees of travel, the steering ratio gradually decreases with continued wheel movement, until maximum ratio variance of 13 to 1 is reached (fig. 11-59).

The low end of the ratio is achieved only near the extremes of steering wheel travel or at approximately one full turn of the wheel. Since the steering wheel is turned to its limit only when parking or backing. The lower ratio provides added maneuverability in these situations.

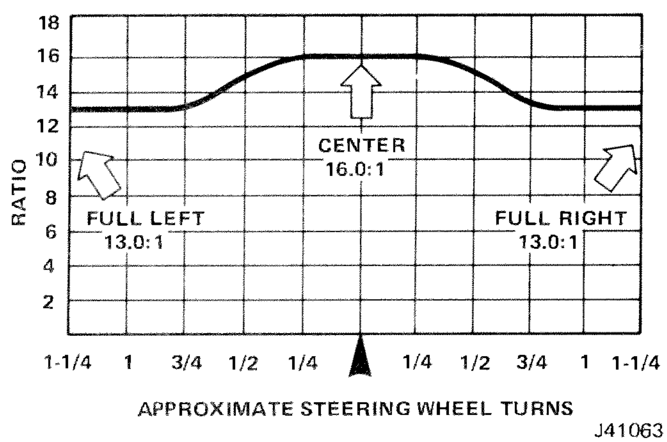

Fig. 11-59 Variable Ratio Steering

Variable ratio steering is accomplished by a pitman shaft sector incorporating a short tooth on either side of a long center tooth, rather than a sector with three teeth of equal length, as in the constant ratio gear. Companion changes are also made in the rack piston teeth (fig. 11-60).

Since the sector is basically a series of levers, any movement of the rack will cause the sector to swing the pitman arm in the same ratio; that is, it will turn the pitman arm the same number of degrees with each tooth in the sector.

To increase or decrease the ratio, it is only necessary to change the length of the sector teeth. Therefore, a low ratio, or smaller radius sector with shorter

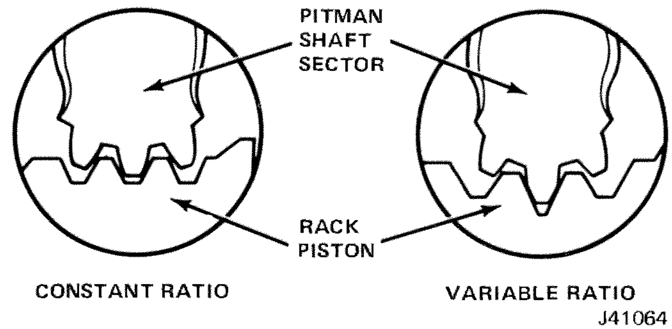

Fig. 11-60 Rack and Sector Comparison

teeth, produces greater pitman arm movement than the high ratio sector with its longer teeth and greater leverage.

On this basis, the variable ratio sector is in reality one long, high-ratio lever at the center, flanked by two lower-ratio levers for left and right turns.

Since only the tip of the long center tooth is in contact with the rack when the front wheels are straight, initial movement of the rack in either direction causes a relatively small response of the sector and pitman arm because of the high ratio that results from this long lever relationship.

As a result, the steering ratio remains a nearly constant 16.0:1 for the first forty degrees of steering wheel movement in either direction from center.

Turning the steering wheel further reduces the length of the lever. The point of contact now rolls down the side of the center tooth, to act as a shorter radius.

As a result, the steering ratio is reduced causing the pitman arm to move noticeably further for a given steering wheel movement. With the wheel turned one-half turn, the steering ratio is reduced to approximately 14.2:1.

With a three-quarter turn of the steering wheel, the leverage is further reduced to approximately 13.3:1.

This smooth reduction in steering ratio is produced by the rolling action between the rack and center tooth which constantly shortens the effective leverage by moving the contact point down the side to the root of the long, center tooth. At this time, the tip of the short tooth begins contact with the rack at the same radius and soon takes over the load.

From three-quarters to one full turn of the steering wheel, the ratio continues to diminish as the same rolling action moves the point of contact from the tip to the root of the short tooth.

This action completes the ratio reduction from 13.3 to 13.1:1. For the last quarter turn of the steering wheel, the ratio remains constant at 13.1:1 to provide greatest maneuverability for backing and parking.

NOTE: *Service procedures for constant and variable ratio steering are the same.*

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SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
HARD STEERING	(1) Lower coupling flange rubbing against adjuster plug	(1) Loosen pinch bolt and assemble properly Correct clearance between plug and flange is 1/16 inch
	(2) Steering adjustment tight	(2) Check adjustment by disconnecting pitman arm from gear
	(3) Insufficient pressure in gear power cylinder due to leak or faulty valve	(3) Replace defective parts
	(4) Gear check valve poppet incorrectly installed	(4) Check valve for proper operation
POOR RETURN OF STEERING GEAR TO CENTER	(1) Lower coupling flange rubbing against adjuster plug	(1) Loosen pinch bolt and assembly properly Correct clearance between plug and flange is 1/16 inch
	(2) Pitman sector-to rack-piston nut adjusted to tight	(2) Adjust to specification
	(3) Rack-piston nut to worm preload too tight	(3) Remove gear and replace balls as required
	(4) Thrust bearing adjustment incorrect	(4) Adjust to specification
	(5) Sticky valve spool	(5) Remove and clean valve
	(6) Steering column misalignment	(6) Realign
LACK OF PUMP ASSIST	(1) Loose drive belt	(1) Tighten belt
	(2) Low oil level	(2) Fill reservoir
	(3) Air in the oil	(3) Locate source of air leak and correct
	(4) Defective hoses	(4) Replace hose
	(5) Flow control valve stuck open	(5) Remove burrs or dirt
	(6) Loose screw in end flow control valve	(6) Tighten
	(7) Pressure plate not flat against ring	(7) Properly seat pressure plate against ring
	(8) Extreme wear of pump ring	(8) Replace part
	(9) Scored pressure plate, thrust and/or rotor	(9) Lap off light scoring Replace heavily scored parts
	(10) Vanes not installed properly	(10) Install properly
	(11) Vanes sticking in rotor slots	(11) Free up by removing burrs or dirt
	(12) Faulty flow control valve assembly	(12) Replace assembly
	(13) O-ring improperly installed on pressure union	(13) O-ring must be in groove nearest outlet of union
	(14) End plate improperly installed or seal damaged	(14) Install properly Replace seal
INCREASED EFFORT REQUIRED TO TURN WHEEL FAST	(1) Air in system	(1) Bleed gear
	(2) Low oil level in pump	(2) Check oil level in pump reservoir
	(3) High internal leakage	(3) Replace rack-piston ring and back-up O-ring, rack-piston nut end plug seal, and/or replace valve

NOTE: With engine idling, very fast movements of steering wheel may give higher effort or feel. This is a normal result and will last momentarily until the system "catches up" with position of the valve.

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
STEERING GEAR OIL LEAKS	(1) Loose hose connections (2) Damaged hose (3) Side cover O-ring seal (4) Pitman shaft seal (5) Housing end plug O-ring seal (6) Adjuster plug O-ring seal (7) Torsion bar O-ring seal (8) Pitman shaft lash adjuster nut (9) Stub shaft seal	(1) Tighten (2) Replace (3) Replace seal (4) Replace seal (5) Replace seal (6) Replace seal (7) Replace valve (8) Replace nut (9) Replace seal
PUMP OIL LEAKS	(1) Reservoir too full (2) Oil leaking at top of reservoir caused by air bubbles in oil (3) Reservoir O-ring seal damaged or improperly installed (4) Pressure union or reservoir to housing bolt and stud not tightened sufficiently (5) Pressure union or reservoir to housing bolt and stud cross threaded or damaged (6) Defective pressure fitting seat on hose end (7) Damaged reservoir to housing or pressure union O-ring seals (8) Leaks in metal parts (9) Defective shaft seal (10) Damaged shaft at seal area	(1) Remove oil to proper level (2) Locate source of air leak and correct (3) Replace O-ring (4) Tighten union and stud and bolt to 35 foot-pounds torque (5) Replace damaged parts (6) Replace hose (7) Replace seals (8) Replace defective part (9) Replace seal (10) Replace shaft
STEERING GEAR RATTLE OR CLUCK	(1) Loose overcenter adjustment	(1) Adjust to specification

NOTE: A slight rattle may occur on turns because of the increased lash when off the "high point". This is normal and the lash must not be reduced below the specified limits to eliminate this slight rattle.

	(2) Gear loose on frame	(2) Tighten mounting bolts
STEERING GEAR HISS	(1) Normal when steering wheel is at end of travel or when parking (2) Gear loose on frame	(1) Replace valve only if noise is extremely objectionable Investigate clearance around safety drive rivet pins Be sure there is no metal-to-metal contact around flexible coupling, as hiss will be transmitted through vehicle Re-align steering column if necessary (2) Tighten mounting bolts
STEERING GEAR SQUAWK WHEN TURNING OR RECOVERING FROM A TURN	(1) Cut or worn damper O-ring on valve spool	(1) Replace O-ring

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
PUMP NOISE	(1) Loose belt (2) Hose touching other parts of vehicle (3) Low oil level (4) Air in the oil (5) Excessive back pressure caused by hoses or steering gear (6) Scored pressure plate (7) Vanes not installed properly (8) Vanes sticking in rotor slots (9) Extreme wear of pump ring (10) Face of thrust plate scored (11) Scored rotor (12) Defective flow control valve	(1) Tighten belt (2) Adjust hose positions (3) Fill reservoir (4) Locate source of air leak and correct (5) Locate restriction and correct With pressure gauge installed in pressure hose between pump and gear and engine running at 1500 rpm oil warm, and no effort on the steering wheel. Pressure should not exceed specification. Check operation of check valve poppet (6) Lap out light scoring. Replace heavily scored part (7) Install properly (8) Free up by removing burrs and dirt (9) Replace part (10) Lap out light scoring Replace heavily scored part (11) Lap out light scoring Replace heavily scored part (12) Replace
EXCESSIVE WHEEL KICKBACK OR LOOSE STEERING	(1) Air in system (2) Excessive lash between pitman shaft sector and rack-piston (3) Loose thrust bearing adjustment (4) Rack-piston nut to worm preload too low (5) Incorrect installation or operation of the gear check valve poppet	(1) Add oil to pump reservoir and bleed (2) Adjust to specification (3) Remove gear and adjust to specification (4) Remove rack-piston nut and worm, and change balls (5) Check operation of valve
STEERING WHEEL SURGES OR JERKS WHEN TURNING	(1) Loose pump belt	(1) Adjust to specification
HARD STEERING WHEN PARKING	(1) Loose pump belt (2) Reservoir low (3) Steering gear adjustments tight (4) Insufficient oil pressure	(1) Adjust to specification (2) Fill to proper level If excessively low, check all lines for leaks (3) Adjust to specification (4) Refer to Pump Pressure Check Procedure
LOW OIL PRESSURE	(1) Kink, restriction, or foreign object in hose(s) (2) Leakage at steering gear side cover O-ring, housing end plug O-ring, or pitman shaft seal shaft seal	(1) Remove hose(s) and remove restricting object (2) Replace defective seals

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SERVICE DIAGNOSIS (Continued)

Condition	Possible Cause	Correction
LOW OIL PRESSURE (Continued)	(3) Steering gear piston ring worn, back-up O-ring damaged, or housing bore scored	(3) Remove and inspect steering gear
	(4) Leakage at steering gear valve rings, valve body-to-worm seal, rack-piston end plug seal	(4) Remove and inspect steering gear
	(5) Incorrect installation or operation of steering gear check valve poppet	(5) To determine if the poppet valve is installed and operating correctly, disconnect the pressure hose and install a pressure gauge between the hose and the pump. With the engine at warm idle (525 rpm) and no effort on the steering wheel oil pressure should not exceed 60 psi with warm oil If gauge indicates more than 60 psi, the poppet valve should be checked for correct installation

PERIODIC MAINTENANCE—POWER STEERING

Pump Reservoir

Oil must be maintained at a level one inch from top of reservoir. If necessary, add automatic transmission fluid to bring reservoir to correct level.

Start the engine and run it for ten minutes. Do not turn the steering wheel during this time. Raise the front wheels from the floor and perform several complete power-operated turns. Do not hold the steering wheel at maximum turn position or overheating of the pump will occur.

Recheck and, if necessary, refill reservoir to the required level. Inspect the system for external leaks. Check the fluid in the system for foam. A properly bled system will not foam.

NOTE: *Air bubbles circulating through the pump will result in noise. Prevent this condition by carefully bleeding the system at time of assembly. Refer to Fluid Level and Initial Operation at the end of this section.*

Pump Drive Belt Tension

Adjust the belt tightness so that the tension is as specified when measured with belt tension gauge J-23600. When using a belt tension gauge, make sure gauge is placed in the center of the longest belt span. When checking notched belts, make sure the middle finger of the gauge is in the notched cavity of the belt.

POWER STEERING GEAR SERVICE

Removal

(1) Disconnect hoses from return port and pressure port. Raise hoses above pump to prevent oil from draining.

(2) Remove pinch bolt from lower flange.

(3) Remove pitman arm nut, lockwasher, and pitman arm.

(4) Remove mounting bolts attaching steering gear assembly to frame, and remove steering gear assembly.

Disassembly

Pitman Gear Assembly and Side Cover

Refer to figure 11-61.

(1) Place housing assembly on a holding fixture or clamp rear portion of housing in a vise. Do not overtighten the vise. This will distort housing assembly.

(2) Place pitman shaft on center or high spot.

NOTE: *In most cases, complete disassembly of the power steering unit will not be necessary. It is suggested that only those assemblies that are faulty be disassembled. Disassembly and reassembly of the unit and the sub-assemblies must be made on a clean work bench. As in repairing any hydraulically oper-*

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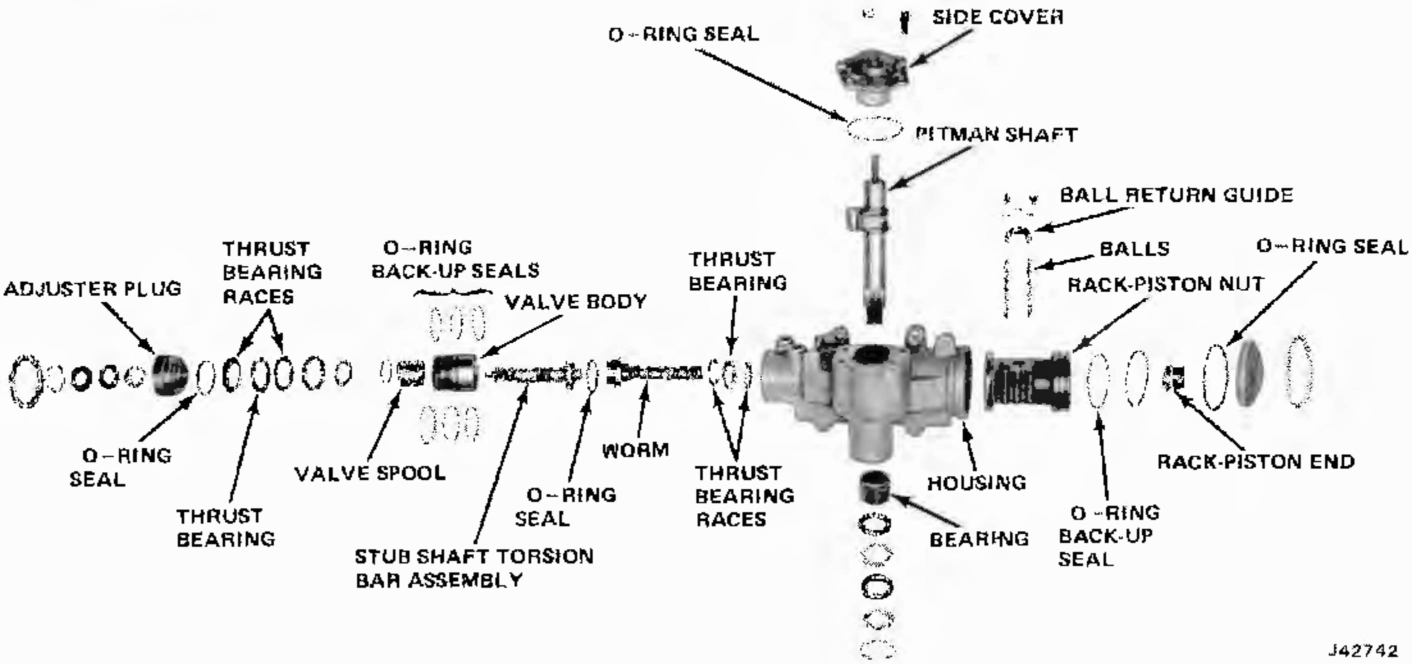

Fig. 11-61 Power Steering Gear

ated unit, cleanliness is of utmost importance. Therefore, the bench, tools, and parts must be kept clean at all times. Thoroughly clean the exterior of the unit with a suitable solvent.

(3) Drain out as much of remaining oil as possible.

(4) Rotate stub shaft torsion bar until pitman shaft gear is in center position and remove side cover retaining screws and lockwashers.

(5) Tap end of pitman shaft with a soft mallet, then slide the pitman shaft out of the housing with assembled side cover.

(6) Remove and discard the side cover O-ring seals.

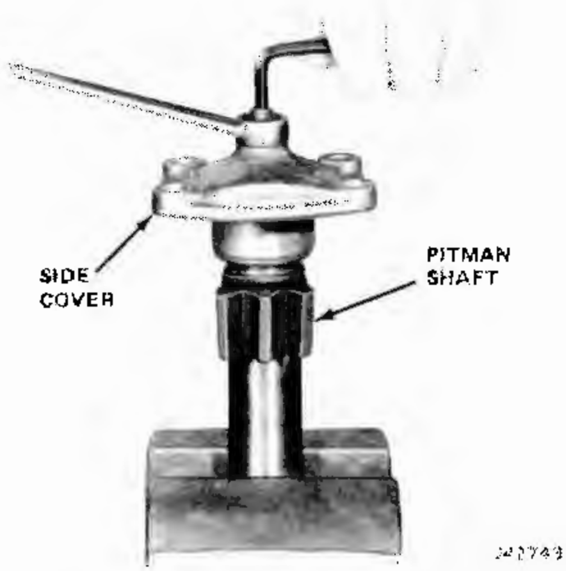

Fig. 11-62 Removing Lash Adjuster Locknut

(7) Hold lash adjuster with an Allen wrench and remove lash adjuster nut (fig. 11-62). Discard the nut.

(8) Screw the lash adjuster out of the side cover by screwing adjuster clockwise into pitman shaft. **Do not remove** adjuster from pitman shaft.

(9) Remove pitman shaft seal retaining ring, using internal snap ring pliers C-3915.

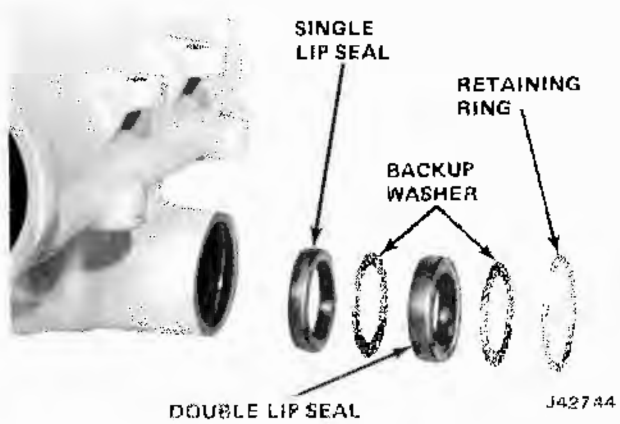

Fig. 11-63 Pitman Shaft Seal

(10) Remove the outer back-up washer. Tap screwdriver between outer seal and inner back-up washer and pry out seal (fig. 11-63).

(11) Tap screwdriver between inner seal and shoulder in gear housing and pry out second seal. Be careful not to damage the seal bore. Discard seals.

(12) Remove needle bearing from gear housing with Tool J 6657. Drive the bearing out of the housing, **not** into the housing. Discard bearing.

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Adjuster Plug Assembly

(1) Loosen adjuster plug locknut with Wrench J-25194.

(2) Loosen adjuster plug assembly with Tool J-7624 (fig. 11-64). Hold stub shaft to keep it from turning and screw out adjuster plug assembly.

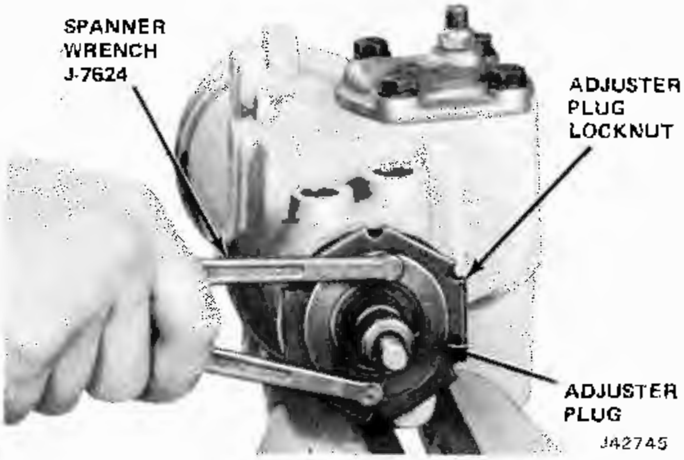

Fig. 11-64 Adjuster Plug Removal or Installation

(3) Remove thrust bearing retainer with a screwdriver (fig. 11-65) being careful not to score needle bearing bore. Discard retainer.

Fig. 11-65 Removal of Thrust Bearing Retainer

(4) Remove thrust bearing spacer, thrust bearing, and thrust bearing races (fig. 11-61).

(5) Remove adjuster plug O-ring seal and discard.

(6) Remove stub shaft seal retainer ring and stub shaft dust seal from adjuster plug.

(7) Remove stub shaft seal by prying out with screwdriver. Discard seal.

(8) If adjuster plug needle bearing rollers are broken or pitted, drive bearing from plug, using Adjuster Plug Bearing Removal and Installer Tool J-6221. Discard bearing.

Valve Assembly

Refer to figure 11-61.

The complete valve assembly in each rotary valve safety power steering gear is a precision unit with selective fitted parts and is hydraulically balanced at assembly. Only those parts which are marked as service items are replaceable and interchangeable. No other valve parts are individually interchangeable. If replacement of any nonserviceable valve part is necessary, the rotary valve assembly should be replaced completely.

NOTE: *It is very uncommon to make any service repairs of the valve assembly with the possible exception of the valve spool damper O-ring. Do not disassemble the valve unless absolutely necessary since this may result in damaging the assembly. If the valve spool damper O-ring requires replacement, remove the valve spool only, replace the O-ring, and reinstall the spool immediately. Do not disassemble farther unless it is absolutely necessary. If disassembly is required, proceed as follows:*

(1) Remove valve and stub shaft torsion bar, as an assembly, from gear by grasping stub shaft torsion bar and pulling out.

(2) Remove cap to worn O-ring seal and discard.

(3) Hold valve assembly in both hands with stub shaft pointing down. Lightly tap stub shaft against bench until shaft cap is free from valve body (fig. 11-66).

Fig. 11-66 Tapping Torsion Bar to Remove Valve Cap

(4) Pull the shaft assembly until the shaft cap clears the valve body approximately 1/4 inch.

CAUTION: *Do not pull shaft assembly out too far or spool valve may become cocked in valve body.*

(5) Carefully disengage shaft pin from valve spool and remove shaft assembly.

(6) Push spool valve out of flush end of valve body while rotating the valve. If valve becomes cocked, carefully realign valve, then remove.

(7) Remove dampener O-ring from the spool valve and discard.

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(8) Carefully cut valve rings and ring backup seals. Remove and discard, providing rings show evidence of excessive wear.

NOTE: *Valve rings are made of filled teflon, and it is very unusual that replacement is required.*

Rack-Piston and Worm Shaft

(1) Rotate end plug retainer ring so that one end of the ring is over hole in housing. Spring end of ring with a punch inserted through hole to allow screwdriver to be inserted to lift ring (fig. 11-67).

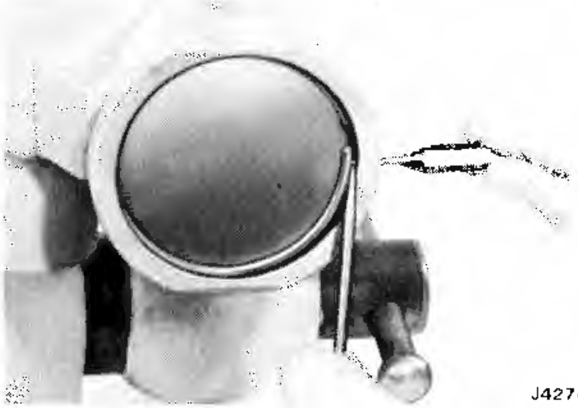

Fig. 11-67 End Plug Retaining Ring Removal

(2) Rotate stub shaft torsion bar with 3/4 inch box end of socket wrench to extreme left-turn position to force end out of housing.

CAUTION: *Do not rotate farther than necessary or the balls from rack and worm assembly will fall off end of worm.*

(3) Remove and discard housing end plug O-ring seal.

(4) Remove rack-piston end plug by inserting a 1/2 inch drive socket extension into the square hole in the plug and turning counterclockwise.

NOTE: *This can be done only with the pitman shaft in place.*

(5) Using the pitman arm shaft Rack-Piston Ball Retainer Arbor Tool J-7539-01, remove rack-piston nut (fig. 11-68). Rotate stub shaft torsion bar to left to force rack-piston nut onto the arbor. Remove rack-piston nut from gear housing.

NOTE: *The arbor prevents balls from falling out of the rack-piston nut. After removing the rack-piston nut, place it on the workbench with the ring end toward the bench. Keep the arbor tool inserted in the rack-piston nut.*

Fig. 11-68 Using Arbor Tool to Remove Rack-Piston Nut

(6) Remove valve assembly (See Valve Assembly removal in preceding paragraph).

(7) Remove worm, lower thrust bearing, and races.

(8) Cut piston ring and O-ring backup seal. Remove from rack-piston nut and discard.

(9) Remove screw and lockwasher assemblies from rack-piston nut with screwdriver.

(10) Remove return guide clamp.

(11) Place assembly on a clean cloth, and remove ball return guides and arbor to release the balls. Make sure all of the balls are caught on the cloth.

Inspection and Repair

Housing

(1) Inspect the housing bore. If it is badly scored or worn, the housing must be replaced.

(2) Check the hose connectors. If they are damaged, scored, or brinelled, remove them by tapping with a 5/16-18 thread tap as shown in figure 11-69.

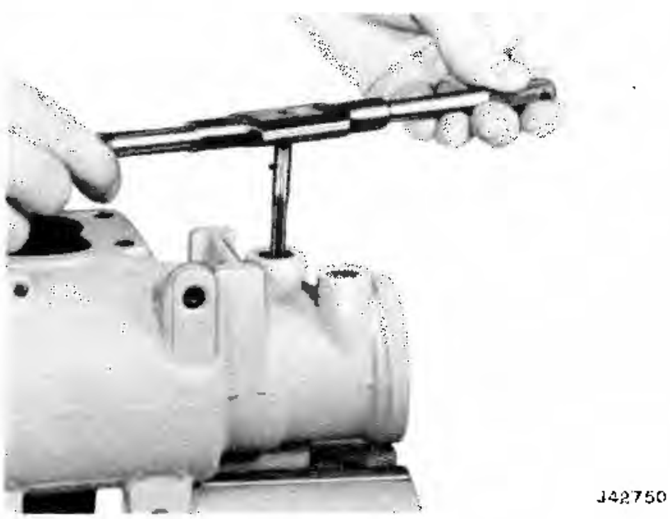

Fig. 11-69 Threading Connector with Thread Tap

(3) Thread a bolt with a nut and flat washer attached, into the threaded connectors. Hold the bolt and rotate the nut from the bolt to pull the connectors as shown in figure 11-70.

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Fig. 11-70 Using Puller Screw to Remove Connector

(4) If it is necessary to remove the poppet valve from the pressure port, use a No. 5 screw extractor. Drive a new connector into the connector port with Connector Installation Tool J-6217 as shown in figure 11-71.

NOTE: *After installing the connector, depress the poppet valve with a pencil point. The poppet valve must spring back when the pencil is removed.*

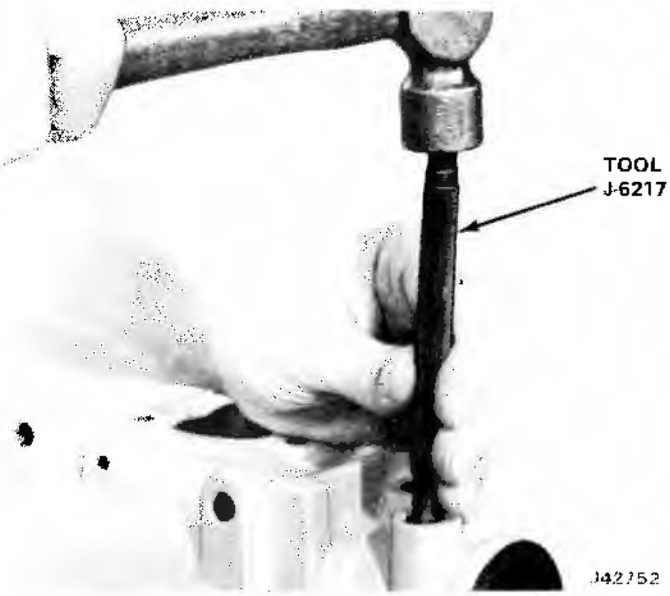

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Fig. 11-71 Driving in Connector

(5) Inspect all seal surfaces and retaining ring grooves for defects. Replace housing if defective.

(6) Inspect the ball plug in the housing. If it is leaking or if the ball is raised above the housing surface, drive it in so that it is flush with or to 1/16 inch below the surface. Tighten the ball by staking the housing. If this does not stop leakage, replace the housing.

Rack-Piston Nut, Worm, and Balls

(1) Inspect worm shaft for wear, scoring, pitting, distortion, nicked threads, or other damage.

(2) Inspect rack-piston nut for scored, pitted, or nicked ball races.

(3) Inspect the exterior diameter of the nut for wear or scoring. Make sure the seal seats are clean and free from burrs or damage.

(4) Inspect the rack teeth for chips, cracks, dents, or other damage. If either the worm shaft or the rack-piston are damaged, both must be replaced as a matched set.

(5) Carefully inspect each of the balls for dents, nicks, out-of-roundness, flaking, or other damage. Replace as necessary.

(6) Inspect ball return guides, making sure that the ends, where the balls enter and leave the guides, are not damaged.

(7) Inspect lower thrust bearing and races for wear or scoring. Replace if damaged.

Valve Assembly Components

(1) If the valve assembly leaks externally between the torsion bar and stub shaft, the entire assembly must be replaced.

(2) Check the pin in the valve body which engages the cap. If it is badly damaged, the entire valve assembly must be replaced.

(3) Check the worm pin groove in the valve body. If the smaller groove is damaged, the entire valve assembly must be replaced.

(4) Check the spool drive pin in the stub shaft. If it is worn badly, cracked, or broken, the entire valve assembly must be replaced.

(5) Examine the spool OD for nicks and burrs. If any are found, they may be removed with a very fine hone. A slight polishing is normal on the valving surfaces.

(6) Examine the valve body ID for nicks or burrs. If any are found, they can be removed with light crocus cloth until the spool turns freely in the body. Be careful not to remove any stock from the surface of the body. As on the spool, a slight polishing is normal on the valving surfaces.

Pitman Shaft, End Cover and Bearings

(1) Inspect the pitman shaft bushing in the side cover for excessive wear or scoring. If badly worn or scored, replace the side cover and bushing assembly.

(2) Check the pitman shaft sector teeth and the bearing and seal surfaces. If badly worn, pitted, or scored, replace the pitman shaft gear assembly.

(3) Inspect needle bearings for rough or catching operation, scored or worn rollers, distorted cases, or other damage. Replace faulty needle bearing.

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Assembly

Rack-Piston and Wormshaft

NOTE: *Thoroughly lubricate all internal parts with automatic transmission fluid during reassembly. Prevent entry of dirt into the assembly.*

(1) Lubricate a new back-up O-ring seal with automatic trans-mission fluid. Assemble the seal in the piston ring groove on rack-piston nut (fig. 11-72).

(2) Install new piston ring in the ring groove over the O-ring seal by carefully slipping the ring over the rack-piston.

NOTE: *The ring may be slightly loose after assembly. This is normal and it will tighten when subjected to the hot oil in the system.*

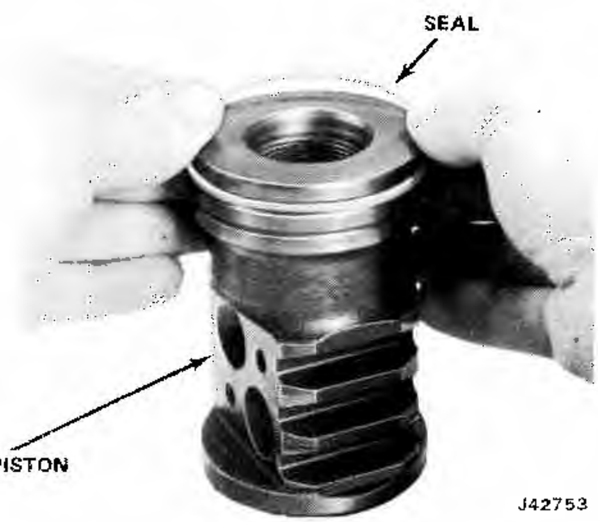

Fig. 11-72 Assembling Seal on Rack-Piston Nut

(3) Insert the worm shaft into rack-piston nut-to-bearing shoulder as shown in figure 11-73.

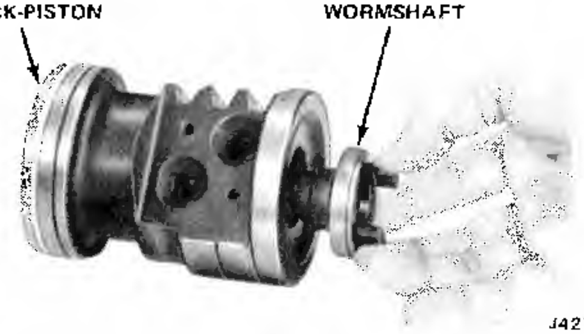

Fig. 11-73 Inserting Worm Shaft In Rack-Piston Nut

(4) Align the ball return guide holes with worm groove. Load 16 balls into guide hole nearest piston ring, while slowly rotating worm counterclockwise to feed balls through the circuit (fig. 11-74). Alternate black balls with standard balls.

Fig. 11-74 Inserting Balls in Rack-Piston Nut

(5) Fill one of the ball return guides with the remaining balls. Place the other guide over the balls and plug ends with petrolatum (fig. 11-75) to prevent balls from falling out when installing guide into the rack piston nut.

Fig. 11-75 Ball Return Guides Plugged With Grease

(6) Insert guides into guide holes of rack-piston nut as shown in figure 11-76. Guides should fit loosely.

Fig. 11-76 Installing Ball Return Guides in Rack-Piston Nut

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(7) Place return guide clamp over the guides and install two screw and lockwasher assemblies and tighten to 8 to 12 foot-pounds.

Do not allow the arbor to separate from the worm until the rack-piston nut is fully on the arbor.

Valve Assembly

(1) Lubricate three valve ring backup O-ring seals in automatic transmission fluid (Dexron or equivalent). Assemble in three ring grooves on the valve body.

(2) Assemble the valve rings in the ring grooves over the O-ring seals by carefully slipping the rings over the valve body. Refer to figure 11-77. The rings may appear loose or twisted in the grooves, but the heat of the oil after assembly will cause them to tighten.


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Fig. 11-77 Installing Valve Rings on Valve Body

(3) Install new valve spool damper O-ring seal in valve spool groove.

(4) Lubricate spool valve and valve body with automatic transmission fluid (Dexron or equivalent), and slide spool valve into valve body. Push spool valve on through valve body until shaft pin hole is visible from other end (spool valve flush with shaft cap end of valve body).

(5) Carefully install shaft assembly into spool valve until shaft pin can be placed into spool valve.

(6) Align notch in the shaft cap with the pin in the valve body and press the spool valve and shaft assembly into the valve body.

CAUTION: *Make sure that shaft cap notch is mated with valve body pin before installing valve body into gear assembly.*

(7) Lubricate a new cap-to-worm O-ring seal in automatic transmission fluid (Dexron or equivalent) and install it in valve assembly.

If, during the assembly of valve, the stub shaft and cap assembly are allowed to slip out of engagement with the valve body pin, the spool will be permitted to enter the valve body too far. The damper O-ring seal will expand into the valve body oil grooves, preventing withdrawal of the spool. Attempt to withdraw the spool with slight pull and much rotary motion. If this does not free the spool after several tries, make sure spool is free to rotate; place valve body on a flat surface with notched end up, and tap spool with wooden or plastic rod until the O-ring seal is cut and the spool can be removed. Replace damper O-ring seal and proceed with assembly as before. Make sure any cut pieces of rubber are removed.

Power Steering Gear Subassemblies

(1) Use Pitman Shaft Needle Bearing Tool J-6657 to install the needle bearing in the housing. Install the bearing from the inside of the housing toward the outside. Make sure the indentification end is toward the inside of the gear and that the tool is placed against the identification end during installation. Press the bearing into the housing until it clears the shoulder in the gear housing by 0.030 inch.

(2) Lubricate new pitman shaft seals with automatic transmission fluid (Dexron or equivalent). Install the single lip seal first, then the backup washer. Refer to figure 11-63.

(3) Use Seal Seating Tool J-6219, as shown in figure 11-78 to seat the seal and washer far enough to provide clearance for the second seal and backup washer. Make sure the seal does not bottom in the counterbore.

(4) Install the double lip seal and second backup washer. Again use Seal Seating Tool J-6219. Make sure both seals are installed with the lips toward the steering gear.

(5) Install the retaining ring.

(6) Assemble the thrust bearings and races on the worm of the assembled worm and valve.

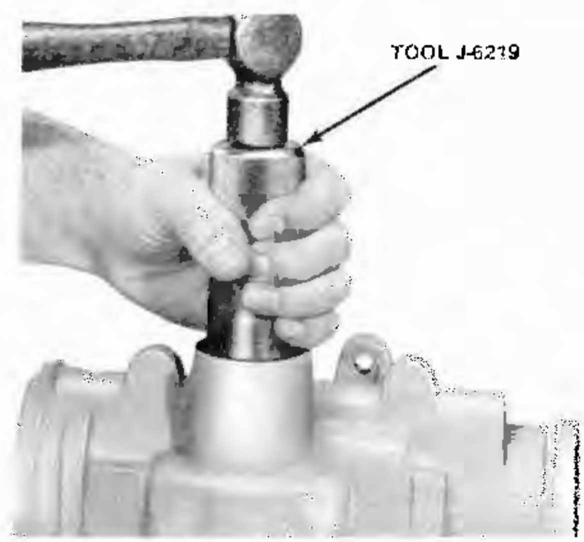

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Fig. 11-78 Seating Pitman Shaft Seal in Housing

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NOTE: *Two types of thrust bearing races may be used. Both conical races must be installed so top of cone is toward bottom of gear. Flat races can be installed in any manner as long as one is above bearing and one below.*

(7) Install the assembled valve and worm in the housing as an integral unit. Align the valve body drive pin in the worm with the narrow pin slot on the valve body. Insert the valve assembly into the gear housing as shown in figure 11-79.

NOTE: *Push only on valve body — NOT on stub shaft.*

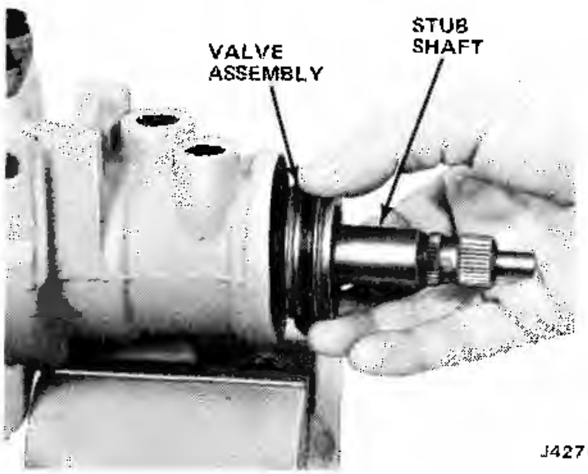

Fig. 11-79 Installing Valve Assembly in Housing

CAUTION: *Do not push against the stub shaft as this may cause the stub shaft and cap to pull out of the valve body, allowing the spool seal to slip into the valve body oil grooves. The valve assembly should be pushed in by pressing against the valve body with the fingertips (fig. 11-80). Before assembling the adjuster plug assembly, be sure the valve is properly seated. Most of the return hole in the gear housing should be fully visible at this time.*

(8) Install needle bearing in adjuster plug by pressing from thrust bearing end of adjuster plug against identification end of bearing, using Tool J-6621 (fig. 11-81). The end of the bearing must be flush with bottom surface of stub shaft seal bore.

(9) Lubricate new stub shaft seal with automatic transmission fluid (Dexron or equivalent), and using Tool J-5188 (fig. 11-82) install far enough to provide clearance for dust seal and retaining ring.

(10) Lubricate the new dust seal with automatic transmission fluid (Dexron or equivalent) and install with the rubber surface outward.

(11) Install the retaining ring, making sure that the ring is properly seated.

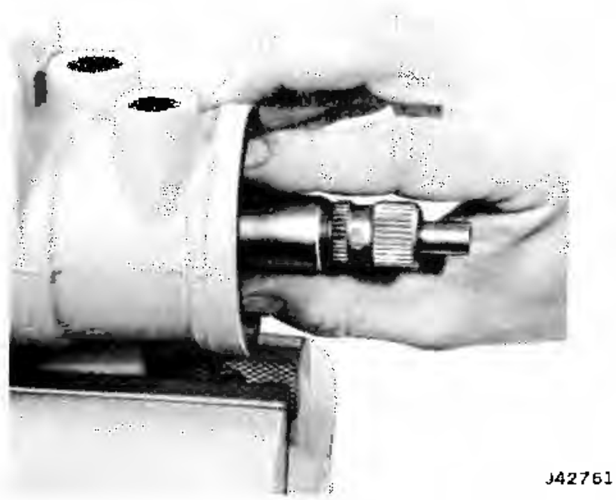

Fig. 11-80 Installing Valve Assembly Fully into Housing

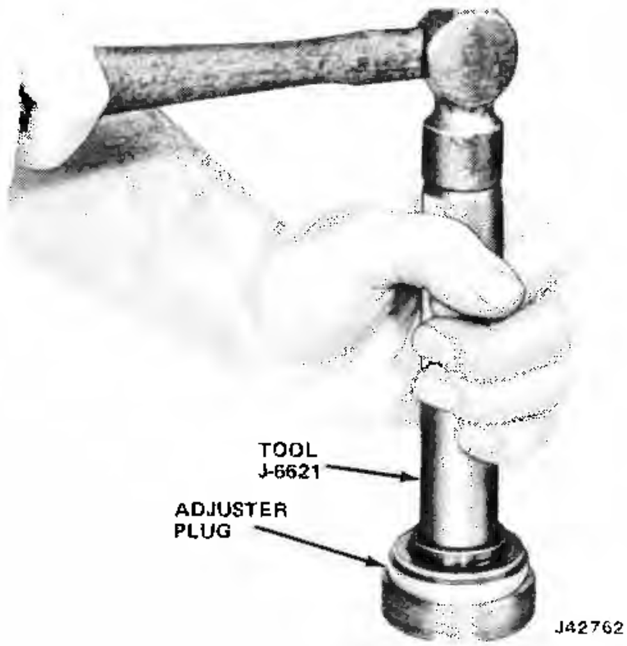

Fig. 11-81 Installing Needle Bearing in Adjuster Plug

(12) Lubricate the O-ring seal with Vaseline and install on the adjuster plug.

(13) Assemble large OD thrust bearing race, thrust bearing, small thrust bearing race, and thrust bearing spacer on adjuster plug. Do not flatten the dimples. The spacer should rotate freely after assembly. The radial location of dimples is not important.

(14) Install lash adjuster nut on lash adjuster without tightening.

(15) Place Tool J-6222 seal protector over the end of stub shaft.

(16). Install adjuster plug assembly in gear housing. Before adjusting preload, tighten the adjuster plug to 20 foot-pounds torque.

(17) Adjust thrust bearing preload as follows:

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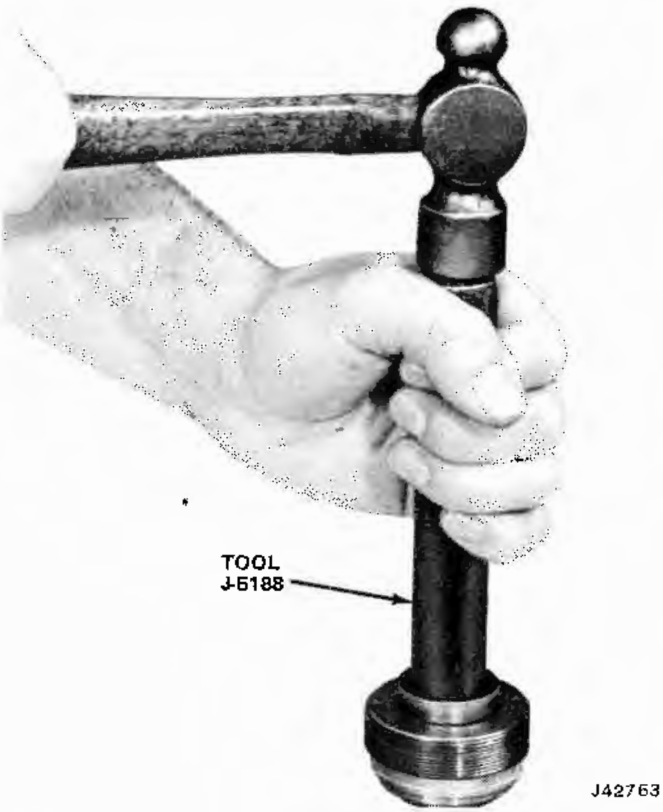

Fig. 11-82 Installing Stub Shaft Seal in Adjuster Plug

With Conical Races

(a) Mark housing opposite one of the holes in adjuster plug (fig. 11-83).

(b) Measure counterclockwise 3/16 to 1/4 inch and remark housing (fig. 11-84).

Fig. 11-83 Marking Housing

Fig. 11-84 Position of Second Mark

(c) Rotate adjuster plug counterclockwise until hole in plug is in line with second mark.

(d) Install and tighten adjuster plug locknut (80 foot-pounds torque) while holding adjuster plug in position.

(e) With an inch-pound torque wrench and a 3/4-inch deep socket, measure drag torque required to turn stub shaft, and record reading (fig. 11-85).

With Flat Races

(a) Turn adjuster plug 1/4-turn counterclockwise.

(b) With inch-pound torque wrench and a 3/4-inch deep socket, turn stub shaft and measure valve body drag torque. Record reading (fig. 11-85).

(c) Tighten adjuster plug to obtain 3 to 4 inch-pounds in addition to drag torque noted above.

(d) Tighten adjuster plug locknut securely (80 foot-pounds torque), while holding adjuster plug in position.

(e) Recheck torque and record reading.

NOTE: *Preload tends to drop when locknut is tightened.*

(18) Install Ring Compression Tool J-8947 into gear housing. Hold it tightly against shoulder in housing. Insert rack-piston nut into housing until arbor engages worm. Turn stub shaft clockwise, drawing rack-piston nut into housing. When piston ring is in housing bore, arbor may be withdrawn from rack-piston nut. Remove ring compressor tool. Move rack-piston to center position.

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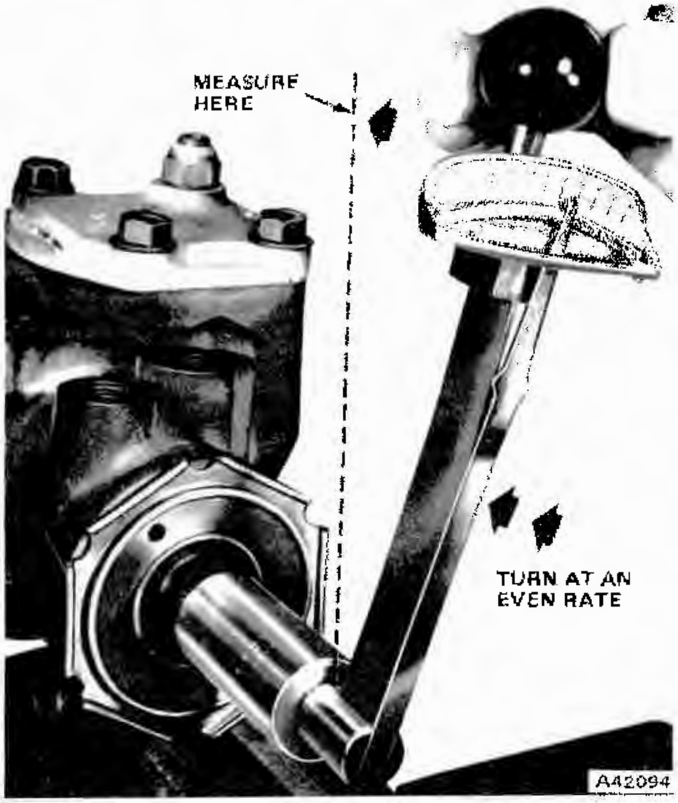

Fig. 11-85 Drag Torque Measurement

(19) Install a new rack-piston end plug by inserting a 1/2 inch drive socket extension in square hole of plug. Temporarily install pitman shaft to prevent rack-piston nut from turning. Tighten the plug to 50 to 100 foot-pounds torque.

(20) Lubricate new housing end plug O-ring with automatic transmission fluid Dexron or equivalent and install in gear housing.

(21) Insert end plug into gear housing and seat against O-ring seal. Install end plug retainer ring into place with fingers. It is necessary to install one end of the ring and work the ring into the groove until seated.

NOTE: *Slight tapping may be required to securely bottom retainer ring in gear housing. When installed, one end of retaining ring must be 1/2 inch from the hole in the body.*

(22) Assemble side cover and bushing assembly on pitman shaft gear assembly. Screw lash adjuster through side cover until side cover bottoms on pitman shaft, then back off 1/2 turn. Lubricate new side cover O-ring seal and install in groove in face of side cover. Hold O-ring in place with grease.

(23) Turn stub shaft as necessary until middle rack groove is aligned with center of pitman shaft needle bearing. Install the pitman shaft gear so that center tooth in sector meshes with center groove of rack-piston. Make sure that side cover O-ring is in place before pushing side cover down on gear housing.

(24) Install the side cover screws and lockwashers and tighten to 30 to 45 foot-pounds. Install lash adjuster nut on lash adjuster without tightening.

(25) With gear on center and pitman shaft backed off, measure total drag. With gear on center, adjust pitman shaft thrust screw so that preload is 4 to 8 inch-pounds in excess of total preload and drag (not to exceed 18 inch-pounds). Readings are to be made through an arc not exceeding 20 degrees with gear on center. Tighten locknut 20 to 30 foot-pounds torque.

POWER STEERING PUMP

Removal

NOTE: *It is not necessary to remove the oil pump to service the flow control valve. The flow control valve is retained in the pump housing by a pressure union and filter assembly.*

(1) Remove pump drive belt tension adjusting bolt and disconnect belt from pump.

(2) Disconnect return and pressure hoses from pump. Cover the hose connector and union on pump and open ends of the hoses to avoid entrance of dirt.

(3) On V-8, remove front bracket from engine.

(4) Remove two nuts securing rear of pump to bracket, and two bolts securing front of pump to bracket and remove pump.

Pump Shaft Seal Replacement (Pump Assembled)

(1) Remove pump pulley nut.

(2) Remove pump drive belt from pulley.

(3) Remove pulley from pump using a suitable puller. **Do not hammer pulley off shaft.**

(4) Remove pulley drive key from shaft.

(5) Insert a piece of 0.005-inch shim stock (approximately 2-1/2 inches long) around shaft and push it past seal until it bottoms in pump housing (fig. 11-86).

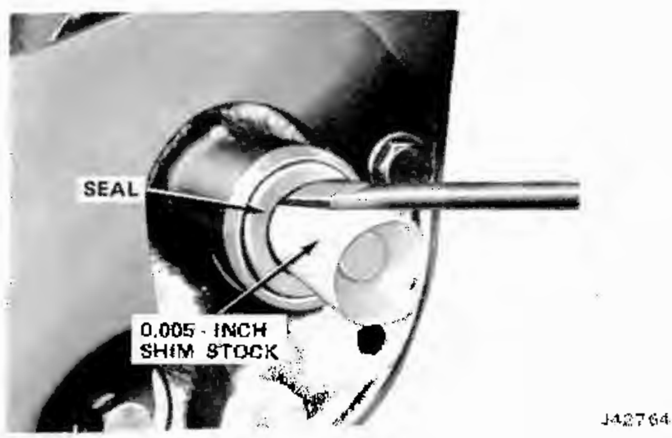

Fig. 11-86 Removing Oil Seal

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(6) Remove seal by cutting metal body of seal with a sharp tool and prying out. **Extreme care must be used to prevent damage to shaft and pump housing.**

(7) Place seal protector J-7586-01 over shaft.

(8) Lubricate new seal with power steering oil and drive in pump housing, spring side first, with installer J-7728 (fig. 11-87). Adjust bottom seal in housing. Excessive force must not be used when driving seal in place.

(9) Install pulley drive key in shaft.

(10) Install pulley and drive belt.

(11) Adjust belt tension to proper specification.

(12) Fill pump reservoir to proper level with power steering oil and bleed pump.

Fig. 11-87 Installing Oil Pump Shaft Seal

Pump Disassembly

(1) Using masking tape, cover the hose union and pipe on pump and then thoroughly clean exterior of pump.

(2) Remove pump pulley key from pump shaft.

(3) Remove reservoir cap and drain out oil in pump reservoir.

(4) Install pump in a soft jaw vise with pump shaft pointing down.

CAUTION: *Do not clamp pump too tightly in vise as this may distort bushing.*

(5) Remove two reservoir to pump housing studs and O-rings. Discard the O-rings.

(6) Remove pressure union. Remove O-ring from union and discard O-ring.

(7) Remove flow control valve and spring.

(8) Remove reservoir from housing by rocking housing back and forth while pulling upward.

(9) Remove reservoir O-ring seal on housing and discard.

(10) Remove small reservoir to housing O-ring seal from counterbore in housing and discard.

(11) Rotate end plate retaining ring until one end of ring is over hole in housing. Spring inward on one end of ring with 1/8-inch punch to allow screwdriver to be inserted and lift ring out (fig. 11-88).

(12) Remove pump from vise and remove end plate, pressure plate spring, flow control valve and spring by turning pump over. If end plate should stick in housing, lightly tap it to align and free it.

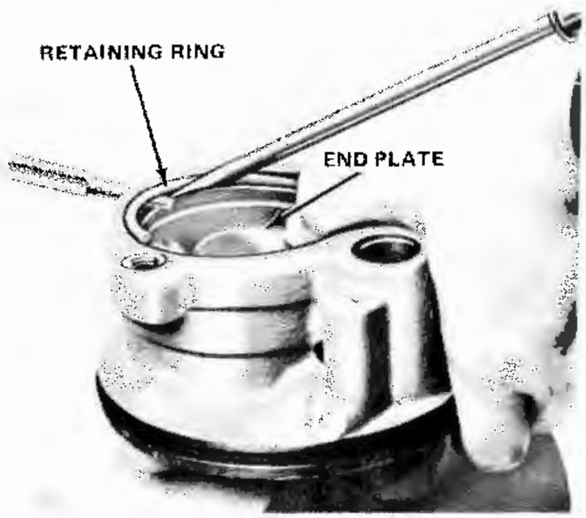

Fig. 11-88 End Plate Retaining Ring Removal

NOTE: *Do not disassemble control valve.*

(13) Remove and discard end plate O-ring seal.

(14) Place shaft end on bench and press down on housing until shaft is free.

(15) Turn housing over and remove shaft and rotor assembly, being careful not to drop parts. If the two dowel pins did not come out with assembly, remove dowel pins from housing.

(16) If it is desired to disassemble the shaft and rotor assembly use a screwdriver to remove retainer ring (fig. 11-89).

(17) Remove and discard pressure plate O-ring seal.

(18) Remove shaft seal, if defective, by prying out with small screwdriver.

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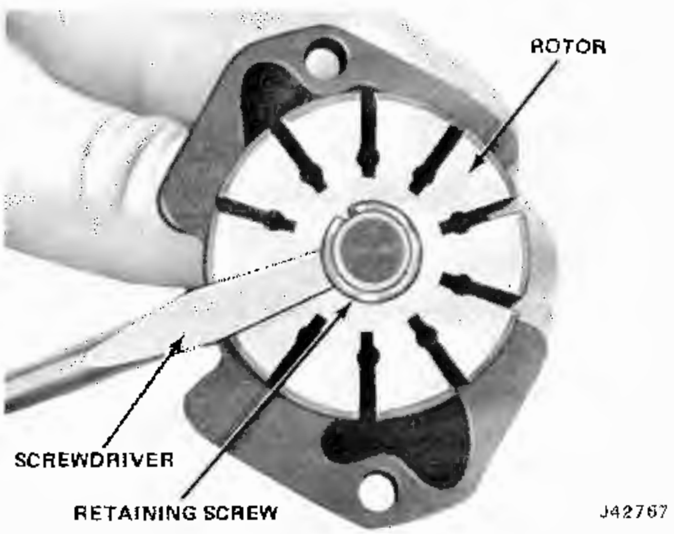

Fig. 11-89 Rotor Retaining Ring Removal

Power Steering Pump Inspection

Clean all parts thoroughly with solvent and wipe with clean, lint-free cloth before inspecting.

Inspect shaft for wear.

Check fit of the ten vanes in slots of rotor; vanes must slide freely but fit snugly in slots. Tightness may be removed by thorough cleaning or removal of irregularities using a hard Arkansas stone. Replace rotor if excessive looseness exists between rotor and vanes and replace vanes if they are irregularly worn or scored. Light scoring on the rotor can be repaired by carefully lapping surface of rotor.

Inspect all ground surfaces of the rotor ring for roughness or irregular wear. Slight irregularities may be removed with a hard Arkansas stone. Replace ring if inside cam surface is badly scored or worn and inspect outside radius of vanes very closely for damage.

Inspect the surfaces of the pressure plate and thrust plate for wear or scoring. Light scoring can be repaired by carefully lapping until surface is smooth and flat, after which all lapping compound must be thoroughly washed away.

Inspect the flow control valve bore in the housing for scoring, burrs or other damage. Hair-line scratches are normal. Inspect bushing in housing, if worn or scored, replace housing.

Inspect the surfaces of the flow control valve for cores and burrs. Hair-line scratches are normal. Replace valve if badly scored or if it is the cause of low pump pressure. Check the screw in the end of the valve; if loose, tighten being careful not to damage machined surfaces. Filter in end of screw must be clean.

Check orifice in pressure union to be sure it is not plugged.

Power Steering Pump Assembly

Refer to figure 11-90.

(1) Make sure all parts are absolutely clean. Lubricate seals and moving parts with power steering oil during assembly.

(2) If shaft seal was removed, use installer J-7017 to drive new seal into housing with spring side of seal toward housing (fig. 11-91). Adjust bottom seal in housing.

(3) Mount housing in vise with shaft end down. Install new pressure plate O-ring seal in groove in housing bore.

(4) Insert shaft into housing and press down with thumb on splined end to properly seat shaft. Be careful not to damage shaft seal in housing.

(5) Install the two dowel pins in housing and install thrust plate on the pins with ported face of plate to rear of housing.

(6) Install pump ring with small holes in ring on dowel pins and with arrow on outer edge to rear of housing.

(7) Install rotor on pump shaft with spline side of rotor to rear of housing. Rotor must be free on shaft splines.

(8) Install shaft retaining ring on pump shaft.

(9) Install ten vanes in rotor slots with radius edge toward outside and flat edge toward center of rotor.

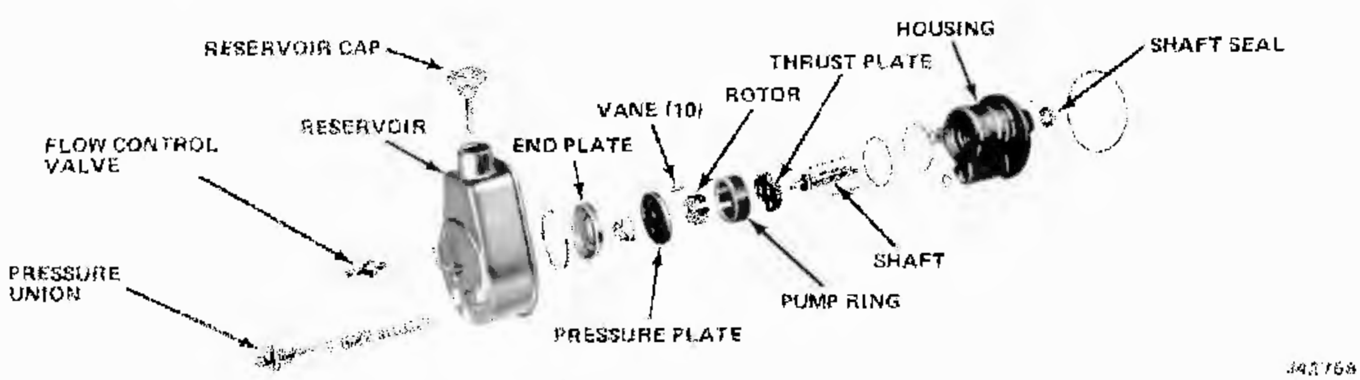

Fig 11-90 Power Steering Oil Pump

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(10) Lubricate the outside diameter and chamfer of pressure plate with petrolatum and install on dowel pins with ported face toward rotor. Dowel pins fit into slots in plate that are nearest outside diameter of plate. Use a soft plastic or wood rod and lightly tap around outside diameter of pressure plate to seat it.

Pressure plate will travel about 1/16 inch to seat.

Fig. 11-91 Installing Pump Shaft Seal

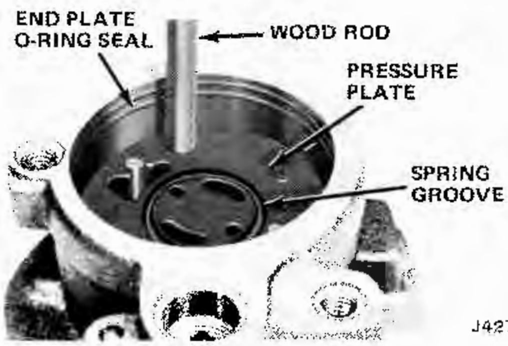

Fig. 11-92 Seating Pressure Plate in Housing

CAUTION: *Never press or hammer on the center of pressure plate as this will cause permanent distortion and result in pump failure.*

(11) Install new end plate O-ring seal in groove in bore of housing. Be sure not to install it in end plate retaining ring groove which is first groove from rear of housing (fig. 11-92).

(12) Install the pressure plate spring.

(13) Lubricate outside diameter and chamfer of end plate with petrolatum and insert in housing.

(14) Place end plate retaining ring on top of end plate. Use an arbor press to lower end plate into housing until ring groove in housing is evenly exposed. Be sure ring is completely seated in housing groove and end plate is aligned properly.

CAUTION: *Press end plate into housing only far enough to install retaining ring in groove.*

(15) Install new reservoir O-ring seal on housing.

(16) Place pressure union seal and two stud seals in proper counterbores on rear of housing.

(17) Install reservoir on housing and line up holes for studs. Tap reservoir with a soft mallet to seat it on housing and install reservoir to housing studs with short end of stud in housing. Tighten studs to 35 foot-pounds torque.

(18) Install flow control valve spring in housing, then install flow control valve with hex head of valve going in housing first. Check movement of valve.

(19) Assemble new O-ring in groove nearest outlet end of pressure union. Install union in pump and torque 35 foot-pounds.

CAUTION: *If O-ring is installed in groove on pressure union that contains the flow orifice, pump will not build up pressure.*

(20) Remove pump from vise and install shaft key on shaft. Support shaft on opposite side while installing key.

(21) Check for bind in pump by rotating drive shaft. Shaft must rotate freely by hand.

Power Steering Pump Installation

(1) Position pump in bracket and install rear attaching screws.

(2) On V-8, install front bracket.

(3) Connect hydraulic hoses.

(4) Fill reservoir with automatic transmission fluid (Dexron or equivalent).

(5) Bleed air from pump by turning pulley counterclockwise (viewed from front) until bubbles cease to appear.

(6) Install new pulley nut.

(7) Install drive belt on pulley.

(8) Using a 1-5/8-inch open-end wrench on pump housing boss, pull outward on pump to adjust belt tension, and snug pump attaching nuts.

(9) Check belt tension with Gauge J-23600. Refer to Specifications for desired belt tension.

(10) Tighten pump nuts to 30 foot-pounds torque and pulley nut to 60 foot-pounds torque.

(11) Tighten pump bracket nuts.

(12) Install and adjust air pump belt.

NOTE: *If pump or gear has been disassembled, refer to Fluid Level and Initial Operation.*

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Fluid Level and Initial Operation

(1) Replenish reservoir.

(2) Run engine until power steering fluid reaches normal operating temperature, approximately 170°F, then shut engine off. Remove reservoir filler cap and check oil level on dipstick.

(3) If oil level is low, add power steering fluid to proper level on dipstick and replace filler cap. When checking fluid level after the steering system has been serviced, air must be bled from system. Proceed as follows:

(a) With wheels turned full left, add power steering fluid to Cold mark on dipstick.

(b) Start engine, and running at fast idle, recheck fluid level. Add fluid if necessary to Cold mark on dipstick.

(c) Bleed system by turning wheels from side to side without hitting stops. Maintain fluid level just above pump housing. Fluid with air in it will have a light tan or red appearance. Air must be eliminated from fluid before normal steering action can be obtained.

(d) Return wheels to center position and continue to run engine for two or three minutes, then shut engine off.

(e) Road-test car to make sure steering functions normally and is free from noise.

(f) Recheck fluid level as described in steps (2) and (3) making sure fluid level is at Hot mark on dipstick after system has stabilized at its normal operating temperature.

Oil Pump Pressure Check

(1) Disconnect the pressure line at oil pump. Attach pressure gauge to pump. Connect the hose to end of gauge where the valve is located.

(2) With engine at hot idle and gauge valve open, note the oil pressure on the gauge while turning steering wheel from one extreme position to the other. Especially note the maximum pressure which can be built up with the wheel held in either right or left extreme position.

CAUTION: *Holding wheel in extreme position for more than five seconds will drastically increase the oil temperature and will cause undue wear on the oil pump.*

(3) With oil temperature between 150°F and 170°F, as measured with a thermometer in the reservoir, the maximum oil pressure should not be less than 1000 psi for satisfactory power steering operation.

(4) If the maximum oil pressure is less than 1000 psi, it indicates trouble in the pump, oil hoses, steering gear, or a combination of these parts. To eliminate the hoses and gear, close the gauge only with the engine at warm idle, then open the valve to avoid increasing oil temperature. A minimum pressure of 1000 psi should be present with valve closed.

(5) Compare the maximum pressure obtained in these two tests to determine source of trouble as follows: Step (2) pressure low and Step (4) pressure normal indicates faulty external oil lines or steering gear. Step (2) and Step (4) pressures equally low indicate faulty oil pump.

SPECIFICATIONS

POWER STEERING GEAR SPECIFICATIONS

Type	Recirculating Ball, Worm and Nut
Ratio	CJ - 17.5:1 Constant Ratio - All Others 13/16:1 Variable Ratio
Bearings:	
Worm - Upper	Ball
Lower	Ball
Pitman Shaft	Bushing

Torque:

Pitman Arm to Pitman Shaft	160 to 210 foot-pounds
Adjuster Plug Locknut	50 to 110 foot-pounds
Pitman Shaft Lash-Adjuster Locknut	27 to 37 foot-pounds
Pressure and Return Hose Fittings	25 to 35 foot-pounds
Rack-Piston Plug	50 to 100 foot-pounds
Return Guide Clamp Screws	3 to 6 foot-pounds
Side Cover Bolts	30 to 45 foot-pounds
Steering System Oil Capacity (Dry)	1¼ quarts

POWER STEERING PUMP SPECIFICATIONS

Capacity at 465 rpm	1.25 gpm
Flow Control Range	1.25 to 2.15 gpm
Relief Valve Setting - (V8)	1100 to 1200 psi
(Six-Cylinder)	1000 to 1100 psi

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SPECIFICATIONS (Continued)

ENGINE DRIVE BELT TENSION

	Initial Pounds New Belt	Reset Pounds Used Belt
Air Conditioner, Six-Cylinder	125 to 155	90 to 115
Air Conditioner, V-8	125 to 155	105 to 130
Air Pump (All except Six-Cylinder w/AC)	125 to 155	90 to 115
Air Pump Six-Cylinder w/AC (1/4 inch belt)	40 to 50	35 to 45
Fan	125 to 155	90 to 115
Idler Pulley	125 to 155	90 to 115
Power Steering Pump	125 to 155	90 to 115

MANUAL STEERING GEAR SPECIFICATIONS

Left-Hand Drive Vehicles:

Type	Recirculating Ball
Ratio	24:1
Bearings - Upper	Ball
Lower	Ball
Pitman Shaft	Bushing

Torque:

Worm Bearing Adjuster Nut	8 inch-pounds
Pitman Shaft Adjuster Screw	18 inch-pounds
Cover Bolts	25-35 foot-pounds
Pitman Shaft Lash-Adjustment Locknut	18-27 foot-pounds
Worm Thrust-Adjustment Locknut	70-110 foot-pounds

Right-Hand Drive Vehicles:

Type	Cam and Lever
Ratio	24:1
Bearings - Upper	Ball
Lower	Ball
Lever Shaft	Roller and Bushing

Torque:

Cam Bearing Preload	2 to 5 inch-pounds
Input Torque Over Center (Maximum)	7 to 12 inch-pounds
Cover to Housing Cap Screws	18 to 20 foot-pounds
Flexible Coupling to Flange	15 to 20 foot-pounds
Worm Gear Shaft Locknut	16 to 20 foot-pounds

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SPECIFICATIONS (Continued)

WHEEL ALIGNMENT SPECIFICATIONS

Steering Axis Inclination	8 1/2°
Caster	
CJ	+3° ± 1°
Cherokee, Wagoneer, and Truck	+4° ± 1°
Camber	+1-1/2° ± 1/2°
Toe-In	3/64 to 3/32 inch
Turning Angle	
CJ	
With Standard Tires	31°
With F78 x 15 Tires	34°
Cherokee, Wagoneer, and Truck	37 to 38°

TORQUE SPECIFICATIONS

Part Name	Foot-Pounds
Clamp bolt, flexible coupling, intermediate shaft to power steering gear 3/8-24	25-35
Clamp, intermediate shaft to steering gear	40-50
Clamp, shaft U-joint, upper shaft assembly to lower shaft assembly	45-55
Column capsule bracket to column bolt	12-17
Column capsule bracket to instrument panel nut to support rod	15-25
Connecting rod 5/8-18 (to castellated nut slot)	70 min.
Connecting rod clamp bolts (Cherokee-Wagoneer-Truck)	25-35
Connecting rod stud nuts 9/16-18 (Cherokee-Wagoneer-Truck) (to castellated nut slot)	60 min.
Intermediate shaft to steering gear coupling (power steering) 3/8-24, 5/16-24	15-25
Pitman arm to pitman shaft	160-210
Steering bracket to frame 3/8-16 bolt (CJ)	35-45
Steering bracket to frame bolt and nut 7/16-20 (CJ)	60-70
Steering bracket to frame 7/16-20 (Cherokee-Wagoneer-Truck)	60-80
Steering gear to bracket - all models	60-80
Steering wheel nut (CJ)	32-38
Steering wheel nut (Cherokee-Wagoneer-Truck)	15-25
Tie-rod clamp bolt 5/16-24 (CJ)	10-15
Tie-rod clamp bolt 3/8-24 (CJ)	20-30
Tie-rod clamp bolt 7/16-14 (Cherokee-Wagoneer-Truck)	25-35
Tie-rod stud nuts 1/2-20 (CJ) (to castellated nut slot)	40 min.
Tie-rod stud nuts (to castellated nut slot)	60 min.
Wheel to hub nuts (CJ)	90-115
Wheel to hub nuts (Cherokee-Wagoneer-Truck Models 25 and 45)	65-80
Wheel to hub nuts (Model 46 Truck)	100-150

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Fig. 11-93 Steering Tools

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes Information on Page No.

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SUSPENSION

GENERAL

All vehicles have semi-eliptical leaf springs and double-action hydraulic shock absorbers. A front axle stabilizer is standard on the 8000 GVWR Model 46 Truck.

SPRINGS

Springs are mounted parallel to the frame side rails. The forward end of the front springs and the rear end of the rear springs are attached by pivoting shackles to the

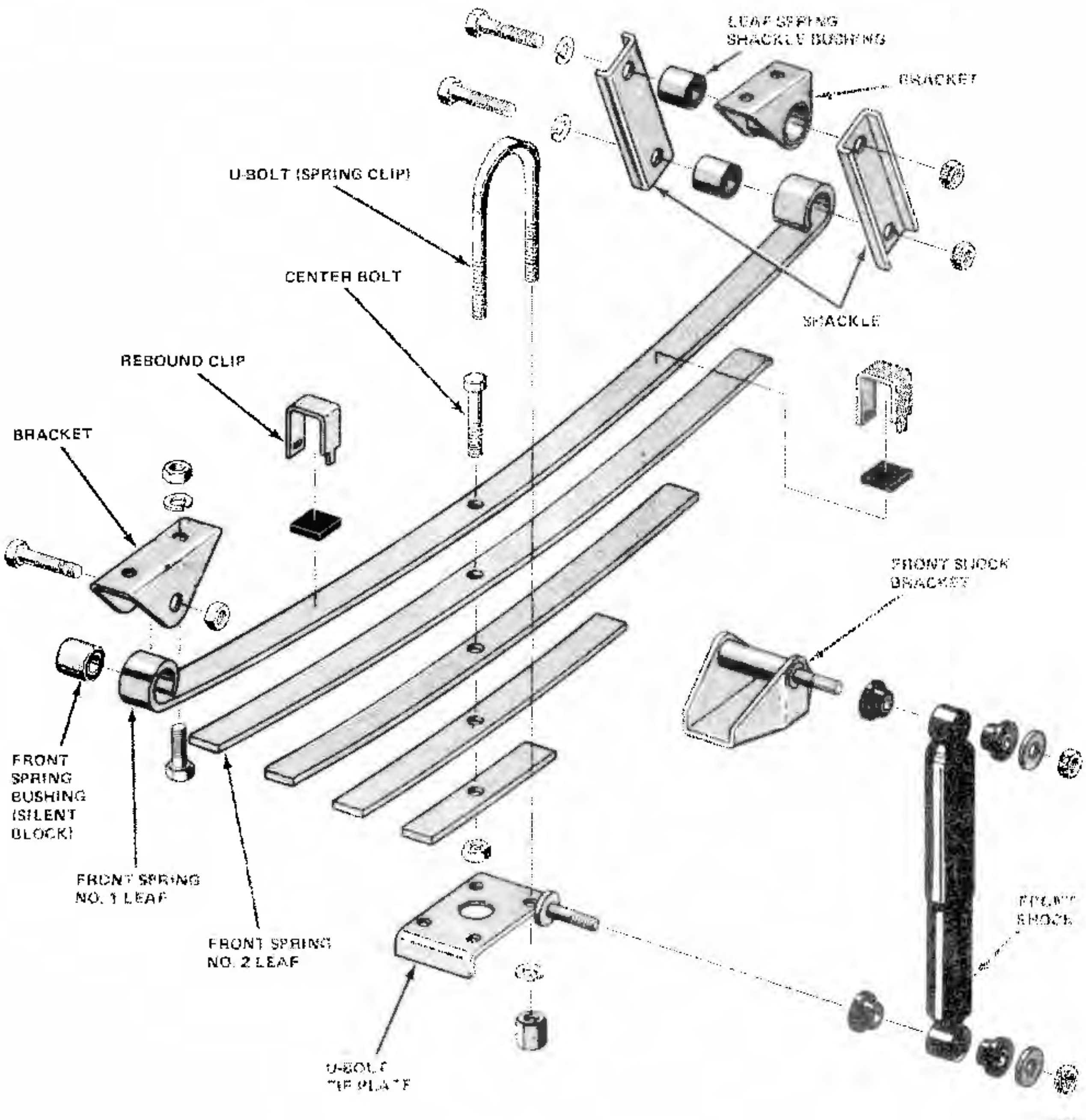

Fig. 12-1 Front Spring and Shock Absorber - CJ Models

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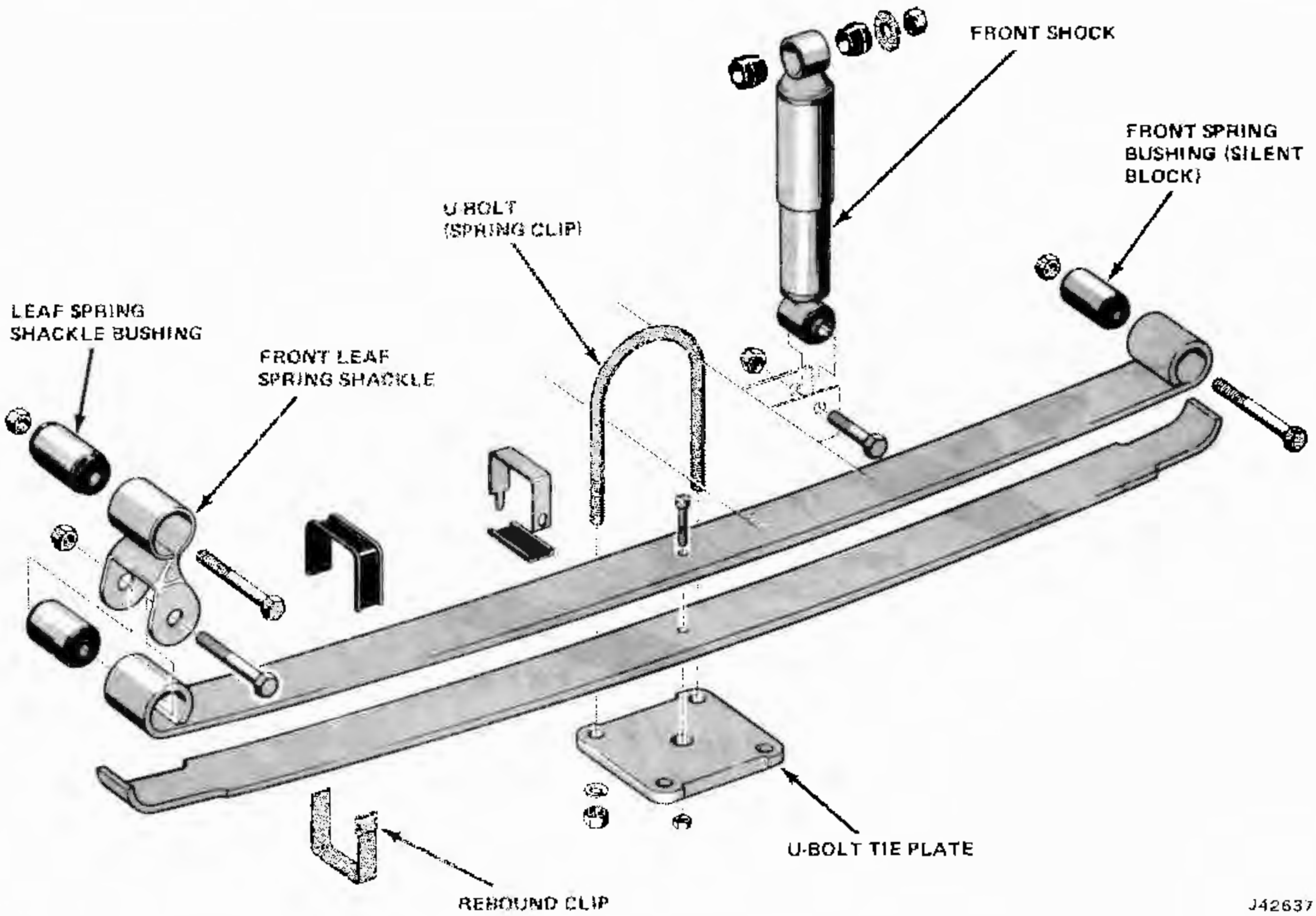

Fig. 12-2 Front Spring and Shock Absorber - Cherokee - Wagoneer-Truck

frame. The opposite ends are attached to fixed pivot points on the frame. All spring ends have silent block type rubber bushings. **These rubber bushings should never be lubricated.**

All front springs are mounted below the axle. Cherokee, Wagoneer, and Truck Models use tapered leaf springs. These leaves are made of varying thickness stock to provide a varied deflection rate as the spring operates (fig. 12-1, -2). The thinner spring sections deflect with less pressure than the thicker sections, so smooth ride and hauling capacity are possible without stacks of several leaves.

All rear springs, except those on CJ models are mounted above the axle. All CJ Model springs are stacked, multi-leaf springs (fig. 12-3). Some rear springs on Cherokee, Wagoneer, and Truck Models are stacked, multi-leaf springs, and some are tapered-leaf (fig. 12-4, -5).

These springs are attached to the axle by U-bolts (spring clips), spring saddles (welded to the axles), and U-bolt tie-plates. They should be checked at each vehicle inspection. Tighten the 7/16-inch nuts to 36 to 42 foot-pounds and the 1/2-inch nuts 45 to 65 foot-pounds torque.

Spring center-bolts are used to align and hold the leaves of the spring in position, as well as to prevent shifting on the axle. The springs should be examined periodically for broken or shifted leaves, and loose or missing rebound clips.

Springs with shifted leaves do not have their normal strength. Missing rebound clips permit the leaves to fan out and can cause leaf breakage. Broken spring leaves may make the vehicle hard to handle or permit the axles to shift out of line. Weakened springs break easily, causing difficulty in steering.

FRONT AXLE WINDUP CONTROL DEVICE

A front axle windup control device is used on Cherokee, Wagoneer, and Truck models. The control device consists of a stamped bracket with a square rubber pad affixed to it. The bracket is attached to the inner side of the right frame rail adjacent to and approximately seven inches above the front axle carrier housing. During severe operation, when extreme spring deflection and front axle travel occurs, the rubber pad on the control contacts the pad on the front axle housing and prevents excessive movement of the housing.

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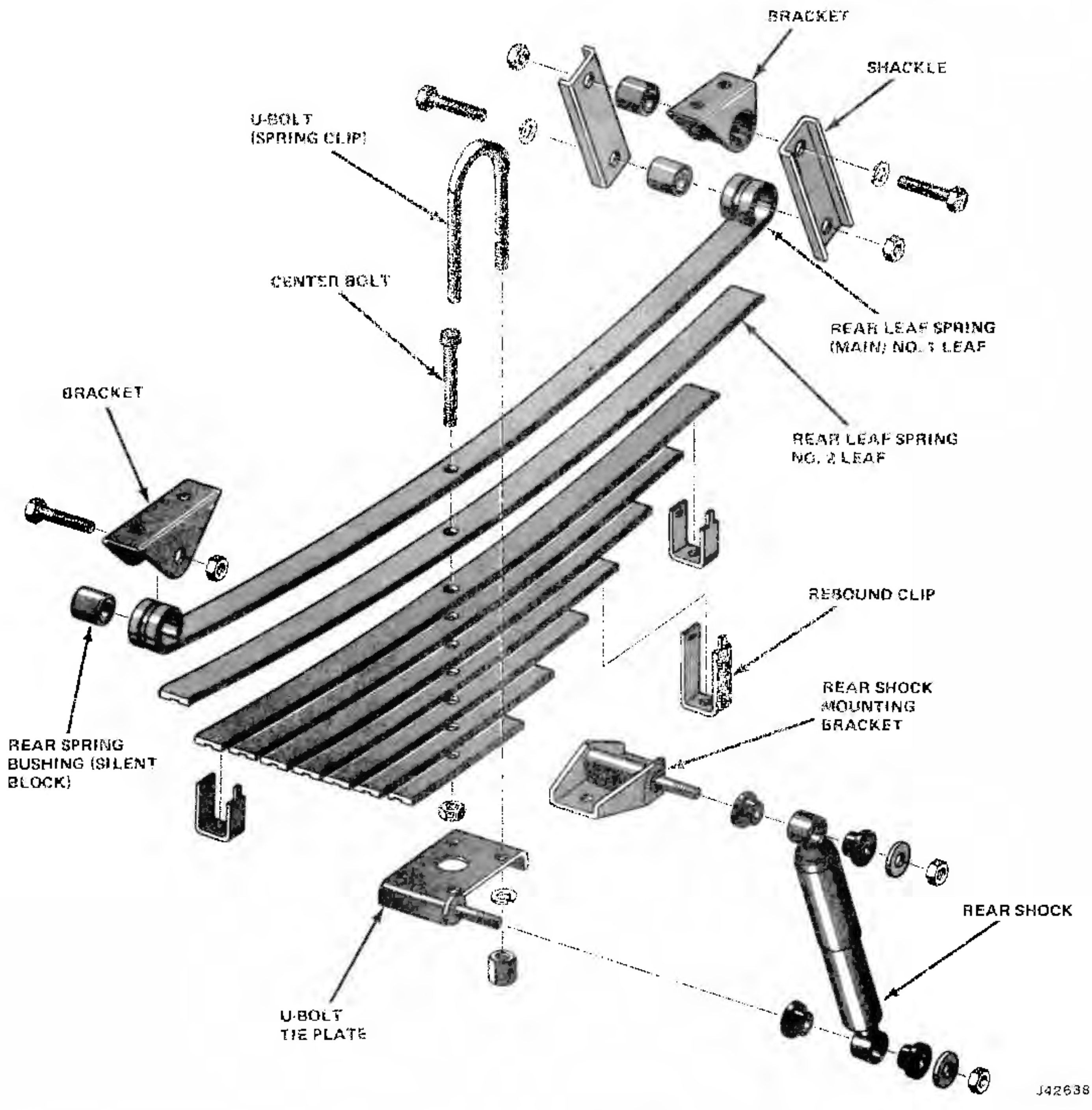

Fig. 12-3 Rear Spring and Shock Absorber - CJ Models

SHOCK ABSORBERS

The hydraulic, direct-action shock absorbers used on Jeep vehicles are designed to absorb both upward and downward motion. The upper ends of the shock are secured to the vehicle frame side rails with mounting brackets and pins. The lower ends are secured to the springs or axle. Rubber bushings are installed between the mounting pins and shock eyes. Movement at the bushings is absorbed by flexing of the rubber.

Squeaking usually occurs when movement takes place between the rubber bushings and the metal parts. The squeaking may be eliminated by placing the bushings under greater pressure. This is accomplished by tightening the locknuts. Do not use mineral lubricant to remove squeak as it will deteriorate the rubber.

The shock absorbers are not refillable and not adjustable. If trouble develops, the shock must be discarded and replaced with a new one. If a shock is removed from the vehicle and turned upside down it will lose its prime and become inoperative. To test a unit, hold it in an upright position and work the plunger up and down

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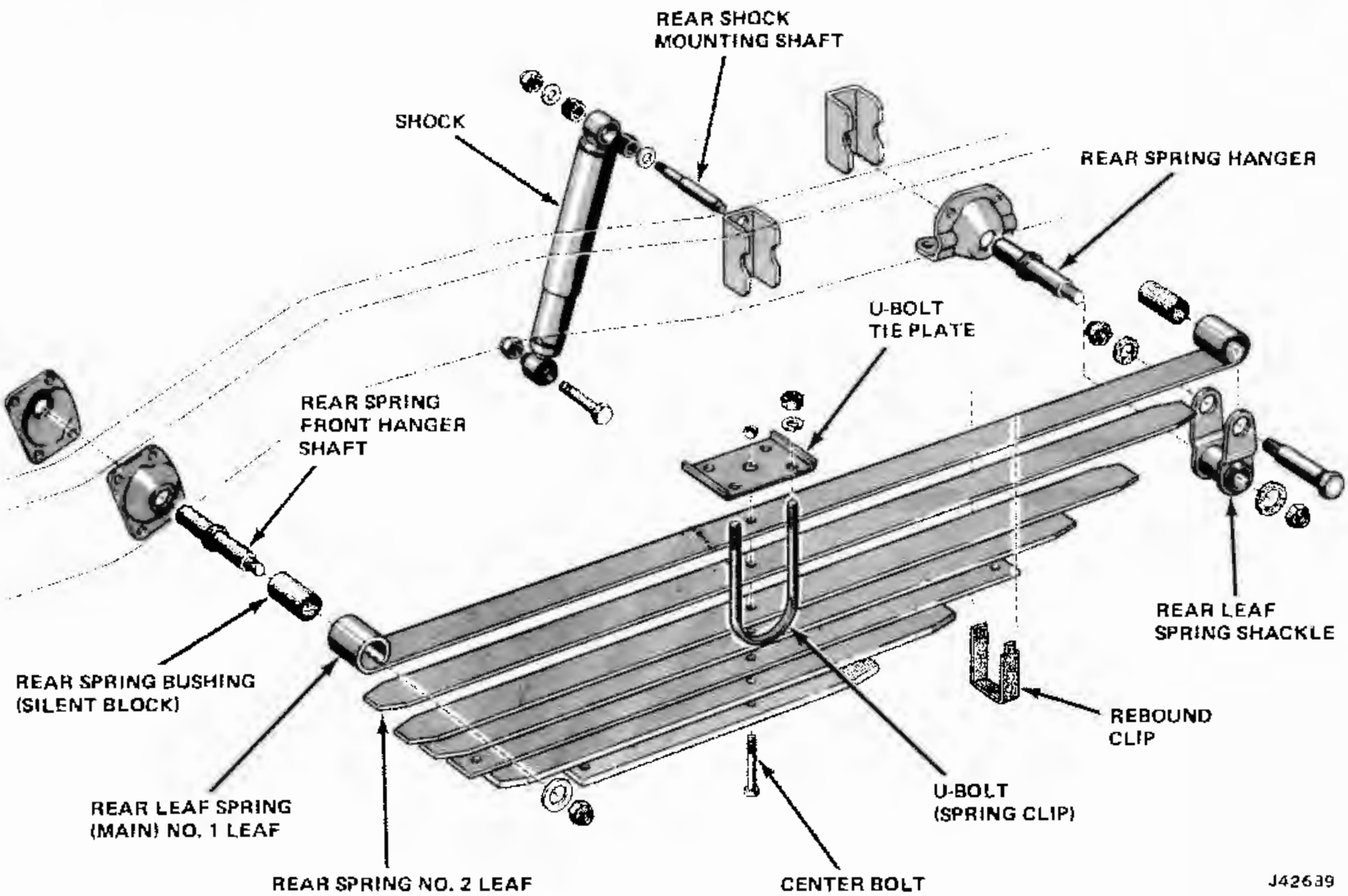

Fig. 12-4 Rear Spring and Shock Absorber - Cherokee-Wagoneer-Truck

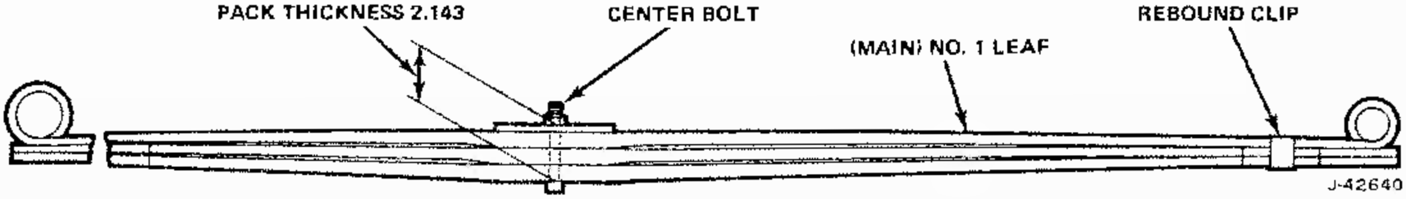

Fig. 12-5 Rear Tapered Leaf Spring Assembly-Typical

the full travel four or five times to determine whether action is positive or faulty.

NOTE: *The shock stem is smoothly machined to work through a tight seal in the upper end of the piston. Do not roughen the stem with pliers or similar tool during replacement as this will destroy the effectiveness of the seal.*

Replacement

The rubber bushings and shock eyes are held in place on the mounting pins by a flat washer and a locknut. To remove a shock, first remove the locknuts and washers. Then pull the shock eyes and rubber bushings from the mounting pins.

To install a shock, first install the rubber bushings and shock eyes on the mounting shafts. Then install the washers and locknuts. Tighten the locknuts securely.

STABILIZER BAR

The stabilizer (on the Model 46, 8000 GVWR Truck) extends across the front undersides of the frame, and is secured to the right and left frame rails by bolted clamps and rubber bushings (fig. 12-6). The ends of the bar extend rearward to a position above the front springs and are connected to the axle and springs by two rubber shock mounted connecting links (fig. 12-7).

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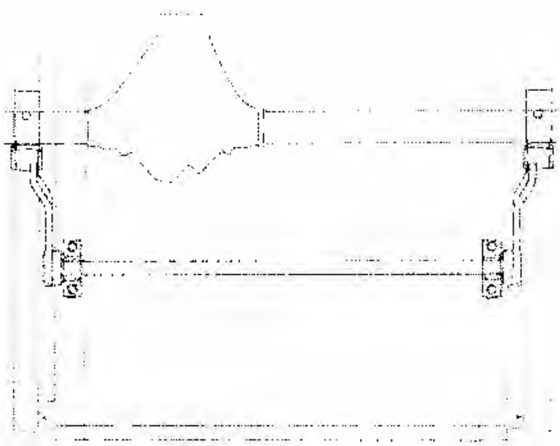

Fig. 12-6 Front Stabilizer Bar, Model 46 8000 GVWR

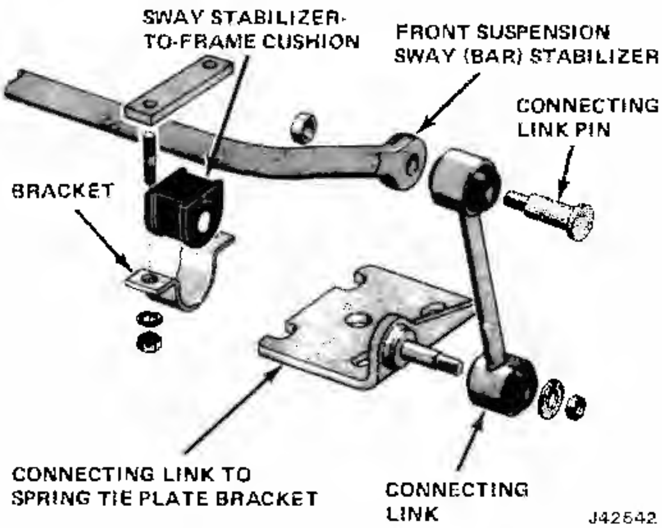

Fig. 12-7 Front Stabilizer Bar, Model 46, 8000 GVWR Exploded View

SPRING MOUNTED BELOW AXLE

Removal

(1) Raise vehicle, and support axle.

(2) Remove U-bolts (springs clips) and U-bolt tie-plate.

(3) Disconnect front and rear ends of spring.

(4) Remove spring.

NOTE: *Spring can be disassembled by removing spring rebound clips and center bolt. Bushings can be replaced by pressing out old bushings and installing new ones.*

Installation

(1) Position spring to vehicle and install but do not tighten bolts.

(2) Align spring with center bolt and install tie-plate and U-bolts. (See Specifications for torque requirements.)

(3) Remove axle support and lower vehicle.

(4) Tighten pivot bolts with weight on springs.

SPRING MOUNTED ABOVE AXLE

Removal

(1) Raise vehicle and support frame ahead of axle.

(2) Remove wheel.

(3) Support axle assembly with jack.

(4) Remove U-bolts (spring clips).

(5) Remove parking brake cable clip (rear only).

(6) Unclip axle vent hose from frame (left side), or remove brake T-fitting bolt from axle (right side).

(7) Remove lower shock bolt.

(8) Disconnect spring from pivot bolts.

(9) Lower axle enough for spring to clear backing plate, and remove spring.

NOTE: *Spring can be dissassembled by removing spring rebound clips and center-bolt. Bushing can be replaced by pressing out old bushings and installing new ones.*

Installation

(1) Position spring to frame and install bolts and nuts.

(2) Raise axle, align spring center bolt, install U-bolts.

(3) Reconnect shock.

(4) Install parking brake cable clip.

(5) Reconnect T-fitting (or axle vent hose).

(6) Install wheel.

(7) Lower vehicle.

(8) Tighten pivot bolts.

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LEAF SPRING APPLICATION CHART

	FRONT								REAR								
NUMBER OF LEAVES	2	2	3	7	9	10			2	2	2	3	5	6	10		
PACK THICKNESS (INCHES) ①	0.916	0.962	1.374						1.324	1.370	1.500	2.143					
DEFLECTION RATE ②	220	260	330	190	210	270			260	300	340	510	155 230	230	276		
MODEL							WIDTH (INCHES)	LENGTH (INCHES)								WIDTH (INCHES)	LENGTH (INCHES)
CJ-5				STD		OPT	1-3/4	39-3/4					STD		OPT	1-3/4	46
CJ-6					STD	OPT	1-3/4	39-3/4					STD		OPT	1-3/4	46
CHER WAG	STD	OPT	OPT				2-1/2	47	STD	OPT				STD		2-1/2	52
J-10 TRUCK																	
25-5200 GVW	STD	OPT	OPT				2-1/2	47	STD	OPT				STD		2-1/2	52
25-5600 GVW	STD	OPT	OPT				2-1/2	47	STD					STD		2-1/2	52
45-5200 GVW	STD	OPT	OPT				2-1/2	47			STD					2-1/2	57
45-5600 GVW	STD	OPT	OPT				2-1/2	47			STD					2-1/2	57
J-20 TRUCK																	
46-6500 GVW	STD	OPT	OPT				2-1/2	47			STD	OPT				2-1/2	57
46-7200 GVW	STD	OPT	OPT				2-1/2	47			STD	OPT				2-1/2	57
46-8000 GVW	STD	OPT	OPT				2-1/2	47				STD				2-1/2	57

① TAPERED LEAF ONLY

② AMOUNT OF POUNDS PER INCH REQUIRED TO DEFLECT A LEAF SPRING ONE INCH.

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SHOCK ABSORBER APPLICATION CHART

PISTON DIAMETER (INCHES)	1	1	1-3/16	1-3/16	1-3/16	1-3/16	1-3/8	1-3/8	1-3/8
EXTENDED LENGTH (INCHES)	17	18-3/8	16-7/8	17-3/4	19-7/8	21-3/8	17-7/16	19-9/16	21
COMPRESSED LENGTH (INCHES)	10-9/16	11-1/4	10-9/16	11	12-1/16	12-13/16	11	12-1/16	12-13/16
MODEL	FRONT	REAR	FRONT	REAR	REAR	FRONT	REAR	REAR	FRONT
C J	STD	STD	OPT		OPT				
CHEROKEE WAGONEER				STD		STD	OPT		OPT
J-10 TRUCK 25-45					STD	STD		OPT	OPT
J-20 TRUCK									
46-6500 GVW					STD	STD		OPT	OPT
46-7200 GVW					STD	STD		OPT	OPT
46-8000 GVW								STD	STD

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TORQUE SPECIFICATIONS

All torque values are given in foot-pounds with dry fits unless otherwise specified.

	Size	Torque
Shock - Lower Attachment	7/16 - 20	25-40
Shock - Upper Attachment	3/8 - 18	15-25
Spring Pivot Bolts (Silent Block)	5/8 - 18	45-65
Spring Shackle Bolts (Silent Block)	9/16 - 18	50-70
Spring Shackle Bolts - J-20 Truck	5/8 - 18	45-65
Spring Shackle and Pivot Bolt - Cherokee-Wagoneer-Truck	9/16 - 18	50-70
Spring Hanger Shaft Nut and Front Shackle Shaft	5/8 - 18	45-65
Stabilizer Bar Mounting Bracket to Side Rail	7/16 - 20	25-40
U-Bolt (Spring Clip)	9/16 - 18	85-105
U-Bolt (Spring Clip)	1/2 - 20	45-65
U-Bolt (Spring Clip)	7/16 - 20	36-42
Wheel to Hub Nuts - CJ Models	1/2 - 20	90-115
Wheel to Hub Nuts - Cherokee-Wagoneer-Truck	7/16 - 20	65-80

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HEATER AND DEFROSTER

FRESH AIR HEATER AND DEFROSTER DESCRIPTION

The fresh air heater and defroster system is designed to provide fresh air ventilation for summer driving or fresh heated air within the car for winter driving.

COWL FRESH AIR INTAKE CJ-5/CJ-6

The body ventilating system incorporates the use of an air intake ventilator grille located on top of the cowl panel (fig. 13-1). The air entering the intake ventilator grille flows through a duct shroud and hose which guides the air into the vehicle. A wing door in the outlet assembly of the duct shroud regulates the flow of air and is adjusted by the use of a cable control mounted to the underside of the instrument panel to the right of the steering column.

Water entering the air inlet grille flows down a rubber drainage hose under the instrument panel and is discharged through an opening in the dash panel.

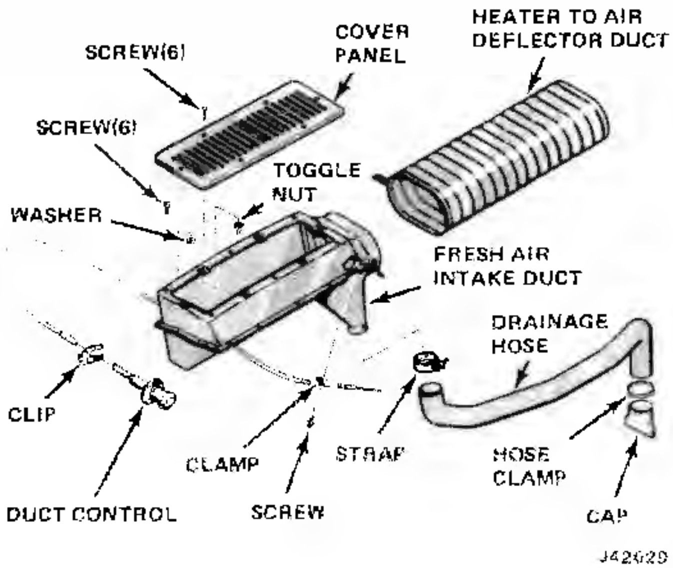

Fig. 13-1 Cowl Fresh Air Intake—CJ-5/CJ-6

Removal

(1) Remove fresh air intake system by removing fresh air heater and defroster.

(2) Remove screws from air intake ventilator grille located outside vehicle on top of cowl and remove grille and screen.

(3) Push down on ventilator grille duct shroud and remove the shroud from beneath the instrument panel.

(4) Pull out duct shroud hose from shroud and remove.

(5) Remove screw from hose clamp and remove drainage hose.

(6) Remove the cable from wing door.

(7) Remove bolt and clip from mounting bracket and remove cable from dash panel.

Installation

(1) Install cable to instrument panel and wing door.

(2) Install drainage hose and duct shroud hose to ventilator duct shroud.

(3) Place duct shroud in position under instrument panel and, using a waterproof sealer, make a positive seal where the cowl metal meets the shroud.

(4) Position screen and grille on cowl panel and secure the ventilator duct shroud to the cowl with screws.

COWL FRESH AIR DUCTS

Cherokee-Wagoneer-Truck

Fresh air ducts are located on the left and right side cowl trim panels (fig. 13-2). Fresh air entering the cowl air intake chamber is directed to the ducts.

The control knobs for the ducts are located on both sides of the steering column. The left knob controls the left duct and the right duct is controlled by the right knob.

HEATER AND DEFROSTER OPERATION

Air circulation of the heater and defroster unit is accomplished by use of a 12 volt fan motor (fig. 13-3).

Outside air is controlled by a push-pull vent control in the CJ Models (13-4) and by the HEAT button on Cherokee, Wagoneer, and Truck Models.

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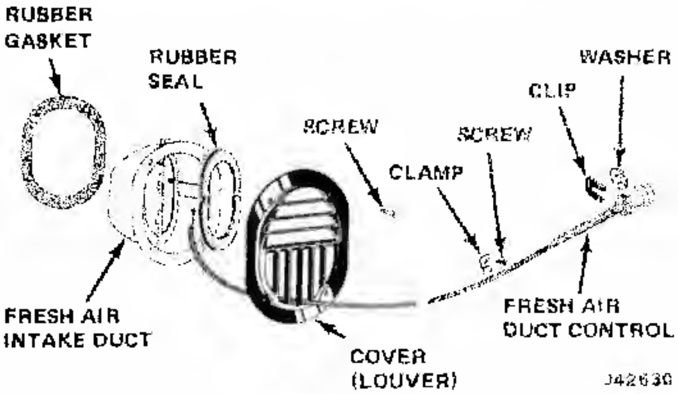

Fig. 13-2 Cowl Fresh Air Intake Duct and Control—Cherokee, Wagoneer, Truck

Outside air drawn into the vehicle by the fan motor is forced through or around the heater core. The air passing through the heater core is heated by the hot circulating coolant from the engine. The cold or unheated air passing around the core is then combined with the heated air and distributed to the defroster nozzles and/or the floor diffuser.

The heater and defroster controls are mounted in the switch panel on the instrument panel. A multiposition switch mounted in the switch panel operates the heater fan.

CJ-5/CJ-6 Models

The heater and defroster controls consist of push-pull knobs located on the heater control panel in the center of the instrument panel (13-4).

The push-pull knobs control the dampers in the heater/defroster housings.

The temperature control cable operates the blend-air door in the heater duct directing the full stream of air through the heater core when the control is pulled out to the maximum heat position. When the control is pushed into the off position, the blend-air door directs the air around the heater core (fig. 13-3) through a bypass and the air is not heated. When the control is between these two positions, some of the air is

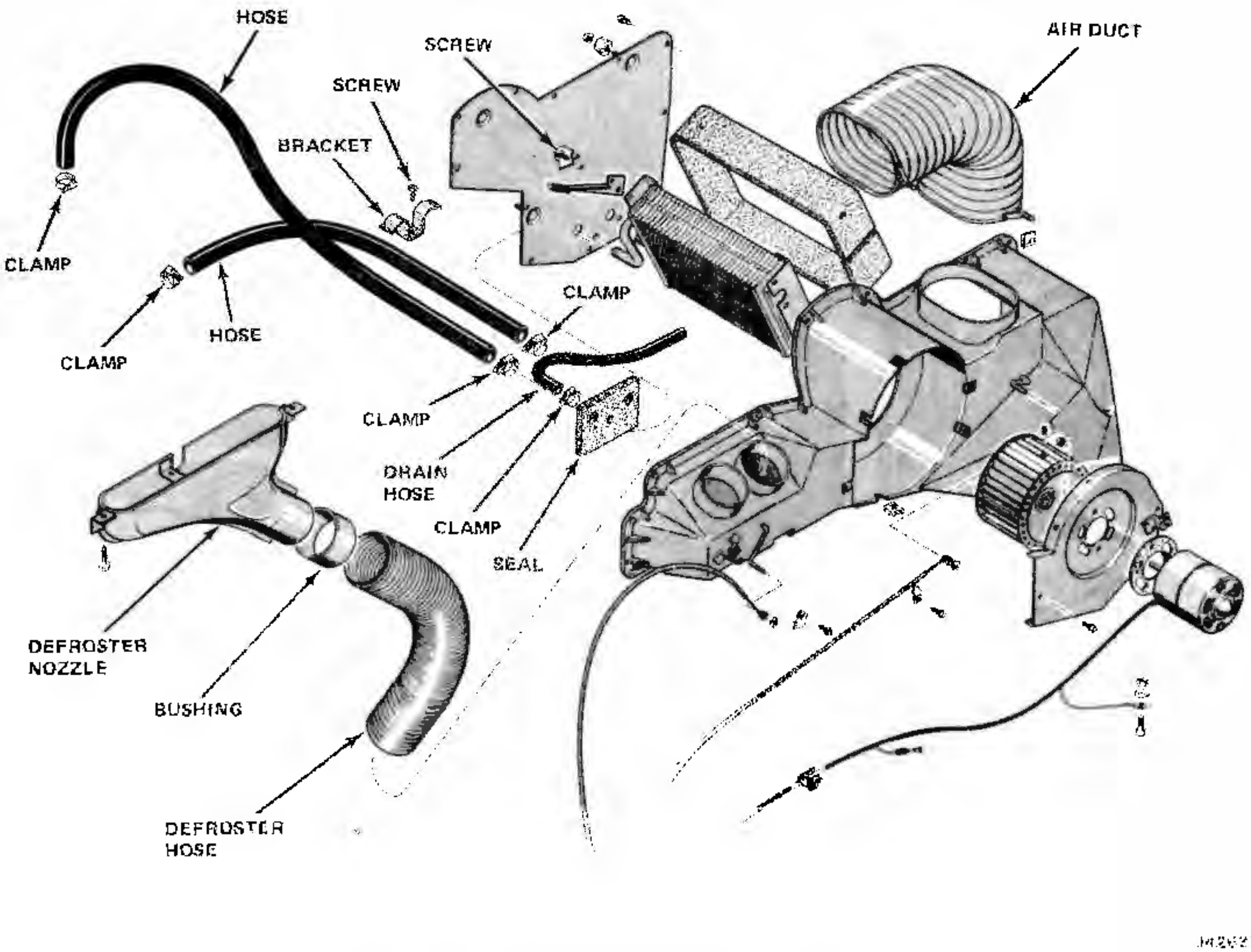

Fig. 13-3 Heater and Defroster—CJ Models

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heated and some of the air bypasses the heater. The cool air and warm air are mixed in the transition duct and the desired temperature obtained.

The defroster control operates on the same principal in that the connecting cables operate a damper door to vary the amount of air passing to the defroster outlets.

The blower switch has three positions: OFF, LOW and HIGH. It regulates the amount of current going to the blower motor through a fixed resistance, thereby regulating the blower fan speed.

Cherokee-Wagoneer-Truck

The TEMPERATURE lever on the heater control panel is connected by a cable to a blend-air in the

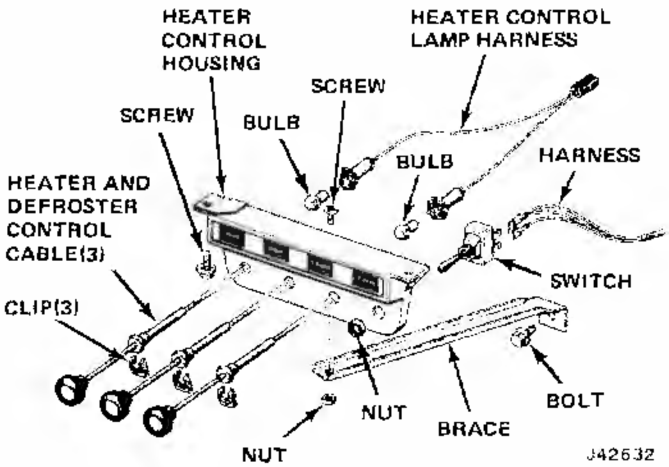

Fig. 13-4 Heater and Defroster Controls—CJ Models

heater core duct. The blend-air door directs the full air stream through the heater core when the temperature lever is on the warmest temperature position.

When the temperature lever is on the coolest position, the blend-air door directs the air stream around the heater core (fig. 13-5) and the air is not heated.

When the temperature lever is between these two positions, some of the air is heated, some of the air bypasses the heater. The air mixes in the transition duct and the desired temperature is obtained.

The OFF, HEAT, and DEFROST buttons (fig. 13-6) on the heater control panel operate a vacuum valve. When the OFF button is depressed, the vacuum valve stops the vacuum to the vacuum actuator that holds the air door in the transition duct open. A spring closes this door and no air can enter from the heater. The air door in the transition duct must be open at all times except when the OFF button is depressed.

When the HEAT button is depressed the air door in the transition duct is opened by the vacuum actuator and air comes through the transition duct and out of the floor diffuser.

When the DEF button is depressed the vacuum valve directs vacuum to the defroster vacuum actuator. Air door remains in same position.

The blower switch has four positions, OFF, LOW, MEDIUM, and HIGH, and regulates the amount of current going to the blower motor through fixed resistances, thereby regulating the blower speed.

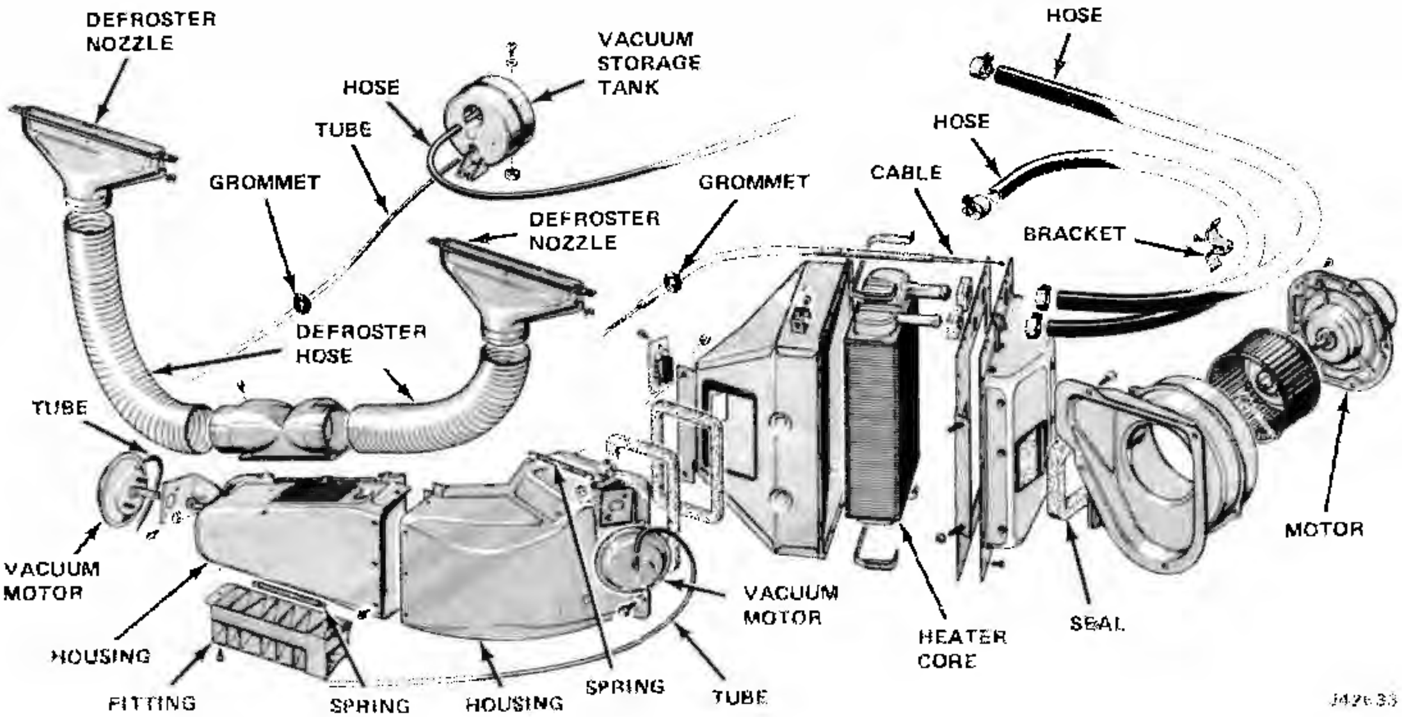

Fig. 13-5 Heater and Defroster — Cherokee-Wagoneer-Truck

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SERVICE DIAGNOSIS

Condition	Possible Cause	Correction
FAN MOTOR WILL NOT RUN AT ANY SPEED	(1) Blown fuse (2) Loose connection (3) Poor ground (4) Faulty switch (5) Faulty motor (6) Faulty resistor	(1) Replace fuse (2) Inspect and tighten (3) Clean and tighten (4) Replace switch (5) Replace motor (6) Replace resistor
FAN MOTOR RUNS AT ONE SPEED ONLY	(1) Faulty switch (2) Faulty resistor	(1) Replace switch (2) Replace resistor
FAN RUNS BUT DOES NOT CIRCULATE AIR	(1) Intake blocked (2) Fan not secured to motor shaft	(1) Clean intake (2) Tighten securely
HEATER WILL NOT HEAT	(1) Coolant does not reach proper temperature (2) Heater core blocked internally (3) Heater core air-bound (4) Blend-air door not in proper position	(1) Check and replace thermostat if necessary (2) Flush or replace core if necessary (3) Purge air from core (4) Adjust cable
WILL NOT DEFROST (EITHER OR BOTH BELLOWS NOT OPERATING -CJ MODELS ONLY)	(1) Heat vacuum door actuator not operating (2) Control inoperative (3) Vacuum actuator not operating	(1) Check for vacuum at actuator (2) Check engine vacuum at heater control (3) Check vacuum at actuator

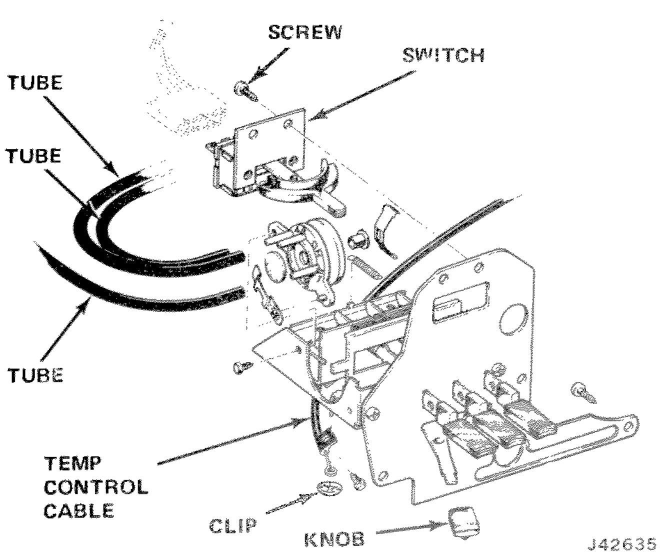

Fig. 13-6 Heater and Defroster Controls—Cherokee-Wagoneer-Truck

HEATER CORE

CJ Models

Removal

(1) Drain engine cooling system.

(2) Mark duct halves to be sure they are reassembled properly.

(3) Remove screws that fasten two halves of duct together.

(4) Remove four screws that secure heater core to the duct.

(5) Remove heater core.

Installation

(1) Install heater core in the housing and install four screws.

(2) Assemble duct halves and install heater housing.

(3) Fill cooling system to proper level.

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Cherokee-Wagoneer-Truck

Removal

(1) Drain engine cooling system.
(2) Disconnect temperature control cable at heater.
(3) Disconnect heater hoses at inlet and outlet of heater.
(4) Disconnect heater resistor wires at plug type connector on heater resistor.
(5) Remove four nuts that secure heater core and duct to fire-wall.

NOTE: *Two of the nuts are on the inside of the vehicle just to the right of the transition duct.*

(6) Remove heater core and duct.
(7) Mark duct halves to be sure they are reassembled properly.
(8) Remove screws that fasten two halves of duct together.
(9) Remove four screws that secure heater core to the duct.
(10) Remove heater core.

Installation

(1) Install heater core in housing and install four attaching screws.
(2) Assemble two halves of heater core duct and install unit in vehicle. Install all attaching nuts.
(3) Connect heater resistor wires, heater hoses, and temperature control cable.
(4) Fill cooling system to proper level.

HEATER CONTROL SWITCH AND CABLE REPLACEMENT—CJ MODELS

(1) Remove knob by inserting wire into hole at side to release spring retaining clip.
(2) Remove trim nut on face of heater control panel.
(3) Disconnect wires from fan switch which is part of center control cable.
(4) Disconnect cable at damper end and remove cable.
(5) To install, route new cable through hole in control panel and to respective damper door.
(6) Connect and adjust cable; install trim nut and knob.
(7) Connect fan control wires if center cable has been removed.

HEATER CONTROL PANEL—CHEROKEE-WAGONEER-TRUCK

Removal

(1) Remove three vacuum lines from heater control.
(2) Remove clamp and cable from temperature control lever.
(3) Unsnap lamp bulb from heater control and disconnect terminal connector located in wiring.
(4) Remove two nuts and mounting bracket from bottom of control.
(5) Remove control panel by pushing out on bottom.

Installation

(1) Install heater control panel, bulb, and cable.
(2) Replace vacuum tubes as follows:
(a) Number 1 on the vacuum control valve goes to the defroster vacuum actuator.
(b) Number 3 on the vacuum control valve goes to the vacuum storage tank.
(c) Number 4 on the vacuum control valve goes to the vacuum actuator.

BLOWER MOTOR

Blower motor can be removed for repairs as follows:
(1) Disconnect electrical connection.
(2) Remove screws that hold motor in place.
(3) Remove blower motor and fan.

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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AIR CONDITIONING

AIR CONDITIONING SYSTEM

General

When driving at normal highway speeds the Jeep air conditioning unit will provide maximum efficiency. However, when operating under stop-and-go city driving conditions a slight reduction in cooling efficiency will generally be experienced.

It is recommended that maximum temperature setting be used for average city driving, and intermediate temperature setting for highway driving.

The same air conditioning unit, as shown for the Wagoneer in Figure 13A-1 is applicable to Cherokee and Truck models.

When driving at relatively high speed for an extended period of time, the cooling coil may possibly frost over resulting in a temporary loss of cooling. Should this occur, simply turn the TEMP knob to OFF and allow the blower to operate for a few minutes to allow the cooling coil to defrost. Then turn the TEMP knob to a setting which is not as cold as the setting at which frosting occured.

To maintain maximum cooling efficiency, periodically remove bugs and foreign matter from the condenser and radiator fins. Also, DO NOT install a bug screen or other screen material in front of the condenser and radiator.

Water forming under a vehicle, at a point below the cooling case, is condensation water draining from the unit — and is considered normal.

The engine TEMP gauge pointer will indicate a slightly higher than normal temperature when the air conditioning unit is operating. However, should excessive overheating occur, check the condition of all water hoses, check the radiator for rust or scaling conditions, and make sure that the condenser is free of bugs or other foreign matter.

The air conditioner can also be employed for fast, efficient defogging of windows during cool damp weather.

The condenser is mounted ahead of the radiator and the remaining components are in the engine compartment.

The compressor is a two-cylinder engine, belt-driven type. An electro-magnetic clutch couples the compressor to the drive pulley. The drive pulley free-wheels when the air conditioner is not in use.

The start position on the ignition switch automatically disconnects all accessories including the air conditioner to reduce the battery load and provide easier starting.

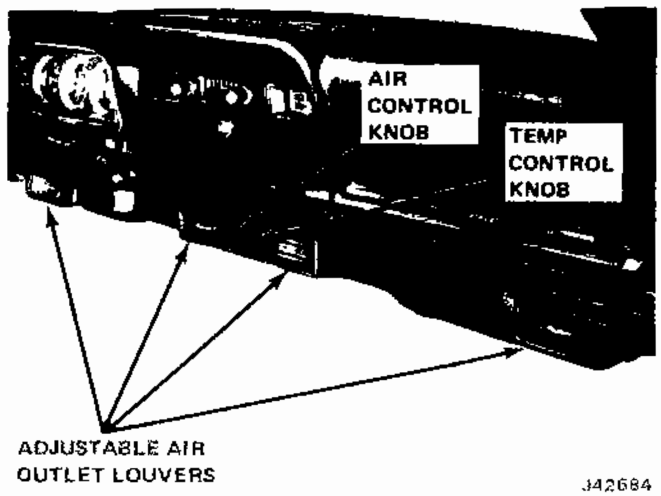

Fig. 13A-1 Air Conditioner—Cherokee-Wagoneer-Truck

Operation

For fast, maximum efficiency, purge the vehicle of hot air by driving the equivalent of two or three city blocks with at least one window open. During this time, place the TEMP control in the MAX position and the FAN control in the PC position. This permits the evaporator to pre-cool in hot weather conditions.

CAUTION: *Do not leave fan control on PC for longer than 30 seconds. Move the fan control to HI position and roll up all windows.*

Adjust the air outlets to obtain desired air flow distribution by moving the louver levers left, right, up, or down. Airflow can be adjusted for quick delivery to a specific spot or for gentle diffusion of air throughout the vehicle.

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When the interior of the vehicle has cooled down to the desired temperature, the AIR knob may be set to obtain the desired volume of air from the air outlets. The TEMP knob may be rotated to vary the temperature. It may be necessary to experiment with the TEMP knob to determine the settings best suited to various driving conditions. Generally, the MAX setting is comfortable for city driving, and a lesser setting comfortable for open road driving.

Run the engine well above idle speed for more efficient cooling under conditions where the system is operated with the vehicle standing.

PERFORMANCE DIAGNOSIS

Condition	Possible Cause	Correction
COMPRESSOR NOISE	(1) Broken valves	(1) Replace valve plate
	(2) Overcharged	(2) Discharge, evacuate, and install correct charge
	(3) Incorrect oil level	(3) Isolate compressor and check oil level. Correct as necessary.
	(4) Piston slap.	(4) Replace compressor.
	(5) Broken rings	(5) Replace compressor
EXCESSIVE VIBRATION	(1) Incorrect belt tension	(1) Set belt tension. Refer to Compressor Belt Tension
	(2) Clutch loose	(2) Tighten clutch
	(3) Overcharged	(3) Discharge, evacuate, and install correct charge
	(4) Pulley misaligned	(4) Align pulley
CONDENSATION DRIPPING IN PASSENGER COMPARTMENT	(1) Drain hose plugged or improperly positioned	(1) Clean drain hose and check for proper installation.
	(2) Insulation removed or improperly installed	(2) Replace insulation on expansion valve and hoses.
FROZEN EVAPORATOR COIL	(1) Faulty thermostat.	(1) Replace thermostat.
	(2) Thermostat capillary tube improperly installed.	(2) Install capillary tube correctly.

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PRESSURE DIAGNOSIS

Condition	Possible Cause	Correction
LOW SIDE LOW—HIGH SIDE LOW	(1) System refrigerant low.	(1) Evacuate, leak test, and charge.
	(2) Expansion valve clogged.	(2) Replace expanison valve.
	(3) Restriction in liquid line.	(3) Check line for kinks replace if necessary.
LOW SIDE HIGH—HIGH SIDE LOW	(1) Internal leak in compressor-worn	(1) Remove compressor cylinder head and inspect compressor. Replace valve plate assembly if necessary. If compressor pistons, rings, or cylinders are excessively worn or scored replace compressor.
	(2) Head gasket leaking.	(2) Install new cylinder head gasket.
	(3) Expansion valve.	(3) Replace expansion valve.
	(4) Drive belt slipping	(4) Set belt tension.
LOW SIDE HIGH—HIGH SIDE LOW	(1) Clogged condenser fins.	(1) Clean out condenser fins.
	(2) Air in system.	(2) Evacuate, leak test, and charge system.
	(3) Expansion valve	(3) Replace expanison valve.
	(4) Loose or worn fan belts.	(4) Adjust or replace belts as necessary.
LOW SIDE LOW—HIGH SIDE HIGH	(1) Expansion valve	(1) Replace expansion valve
	(2) Restriction in liquid line	(2) Check line for kinks-replace if necessary.
	(3) Restriction in receiver	(3) Replace receiver.
	(4) Restriction in condenser	(4) Replace condenser
LOW SIDE AND HIGH SIDE NORMAL (INADEQUATE COOLING)	(1) Air in system	(1) Evacuate, leak test, system
	(2) Moisture in system	(2) Evacuate, leak test, and charge system. Replace receiver/dryer if necessary

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SYSTEM COMPONENTS—FUNCTION

Compressor—The compressor is a two-cylinder, belt-driven pump used to increase the pressure of the refrigerant in the system.

Condenser—The condenser is mounted in front of the radiator to allow air to flow over the cooling fins and receive heat from the refrigerant. As the refrigerant passes through the condenser, it liquifies (condenses).

Receiver/Dryer—The receiver/dryer is a reservoir used to store the precise amount of refrigerant required by the system. The receiver capacity must be adequate to provide a steady flow of refrigerant to the expansion valve.

Expansion Valve—The thermostatic expansion valve is located at the inlet side of the evaporator. It meters the refrigerant to the evaporator. If too much refrigerant is metered, a flooding condition results and the unit will not cool. If too little refrigerant is metered, the system is starved and will not cool. The metering action of the expansion valve is controlled by the temperature sensing bulb mounted on the outlet (suction) line of the evaporator.

Evaporator—The evaporator is an air cooler and dehumidifier. As the refrigerant enters the evaporator core it begins to boil. The heat in the air passing over the evaporator transfers or gives up its heat to the boiling refrigerant. As the air cools, the moisture in the air condenses on the evaporator core and is drained off as water.

REFRIGERATION CYCLE

As the compressor increases the pressure of the system refrigerant, it also heats it (fig. 13A-2). The hot refrigerant is then pumped into the condenser where it cools by giving off heat to air passing over the condenser fins. As the refrigerant cools in the condenser, it condenses into a liquid. Still under high pressure, the refrigerant passes into the receiver. The receiver

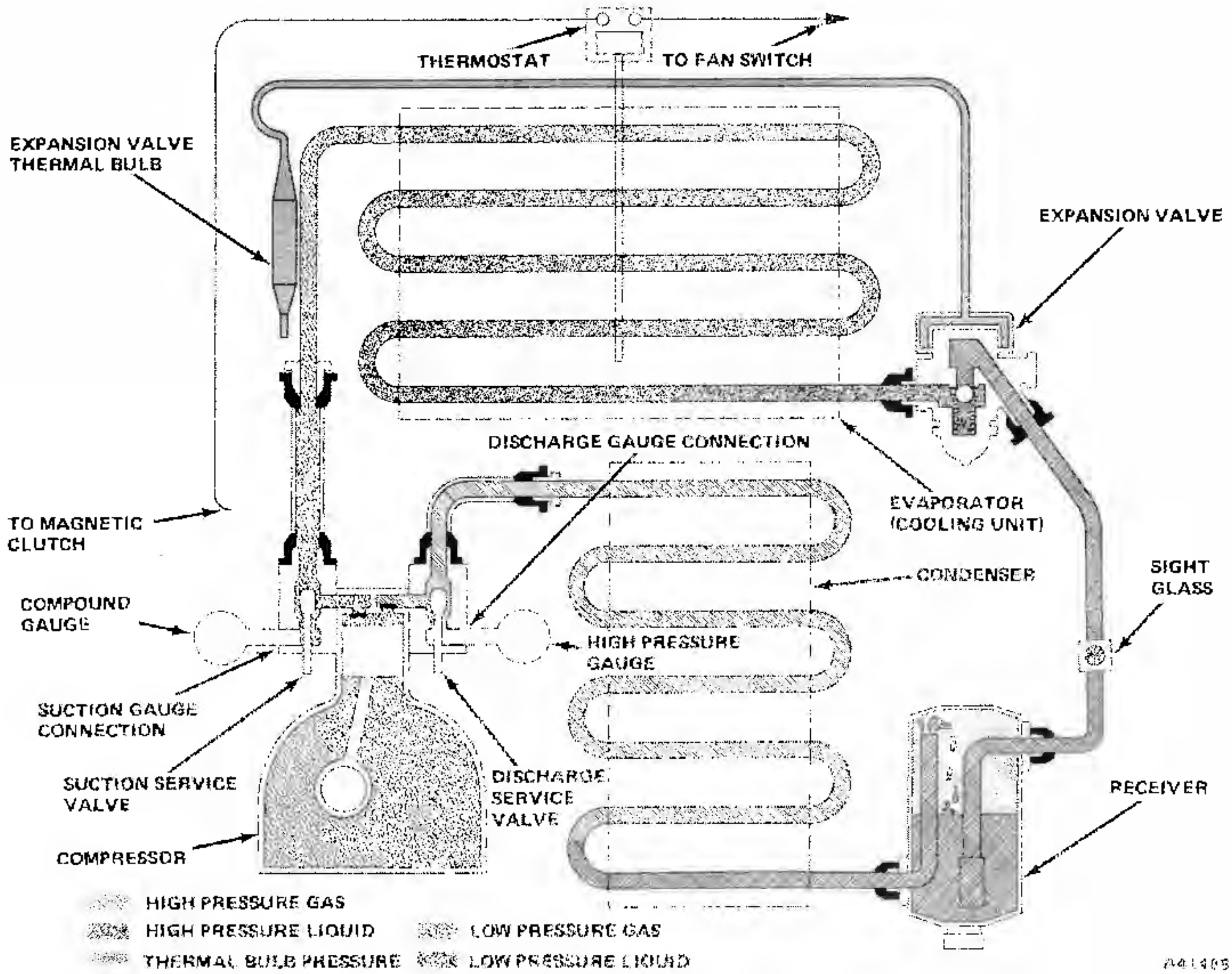

Fig. 13A-2 Refrigeration Cycle

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acts as a reservoir to furnish refrigerant to the expansion valve at all times. From the receiver, the high pressure liquid refrigerant passes to the expansion valve. The expansion valve meters refrigerant into the evaporator where a low pressure is maintained by the suction side of the compressor. As it enters the evaporator, the refrigerant immediately begins to boil by absorbing heat from the air passing over the evaporator core. Having given up its heat to boil the refrigerant, the air is cooled and passes into the passenger compartment of the vehicle. The refrigerant continues to boil in the evaporator until all the liquid has vaporized. From the evaporator the refrigerant is drawn back to the compressor to repeat the cycle.

REFRIGERANT SAFETY PRECAUTIONS

The refrigerant used in air conditioning systems is dichlorodifluoromethane, commonly known as Refrigerant 12 (or R-12). It is transparent and colorless in both the liquid and vapor state. Since it has a boiling point of **21.7°F below zero**, at atmospheric pressure, it vaporizes at all normal temperatures and pressures. The vapor is heavier than air, nonflammable and nonexplosive. It is nonpoisonous except when in direct contact with open flame, and is noncorrosive except when combined with water. Observe the following precautions when handling R-12.

R-12 evaporates so rapidly at normal atmospheric pressures and temperatures that it tends to freeze anything it contacts. For this reason, extreme care must be taken to prevent any liquid refrigerant from contacting the skin and especially the eyes.

WARNING: *Always wear safety goggles when servicing the refrigeration part of the air-conditioning system. Keep a bottle of sterile mineral oil and a weak solution of boric acid handy when working on the refrigeration system. Should any liquid refrigerant get into the eyes, use a few drops of mineral oil to wash them out (R-12 is rapidly absorbed by the oil). Next, wash the eyes with the weak solution of boric acid. Call a doctor immediately, even though irritation has ceased after first aid treatment.*

WARNING: *Do not heat R-12 above 125°F.*

In most instances, moderate heat is required to bring the pressure of the refrigerant in its container above the pressure of the system when charging or adding refrigerant. A bucket or large pan of hot water not over 125°F is all the heat required for this purpose. Do not heat the refrigerant container with a blowtorch or any other means that would raise temperature and pressure above this temperature. Do not weld or steam clean on or near the system components or refrigerant lines.

When metering R-12 into the refrigeration system, **keep the supply tank or cans in an upright position.** If the refrigerant container is on its side or upside down, liquid refrigerant will enter the system and damage the compressor.

WARNING: *Always maintain good ventilation in the working area. Always discharge the refrigerant into the service bay exhaust system or outside the building. Large quantities of refrigerant vapor in a small, poorly ventilated room can displace the air and cause suffocation.*

Although R-12 vapor is normally nonpoisonous, it can be changed into a very poisonous gas if allowed to come in contact with an open flame. Do not discharge large quantities of refrigerant in an area having an open flame. A poisonous gas is produced when using the halide torch leak detector. Avoid inhaling the fumes from the leak detector.

CAUTION: *Refrigerant will tarnish bright metal and chrome surfaces. Avoid splashing refrigerant on any surface. Refrigerant in combination with moisture is very corrosive and can cause great damage to all metal surfaces.*

SERVICE VALVES

The discharge and suction service valves are mounted on the compressor cylinder head and are used for diagnosis, charging, discharging, evacuating and component removal.

The service valves are three-position valves (fig. 13A-3). The normal operating position, shown in figure 13A-3, View B, has the valve stem turned **counter clockwise** to the **back-seated** (full-out) position.

When the valve stem is turned **clockwise to the front-seated** (full-in) position (fig. 13A-3 View A), the compressor is isolated from the system. This position is used when removing the compressor or when checking compressor oil level.

When the valve is **midpositioned** (cracked) (fig. 13A-3 View C), the gauge port is **open.** This position is used when charging, discharging, evacuating and checking system pressures.

PRESSURE GAUGE AND MANIFOLD SET

The Pressure Gauge and Manifold Set, Tool J-5725-04 (fig. 13A-4), is the most important tool used to service the air conditioning system. The gauge set is used to determine system high and low

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side gauge pressures, the correct refrigerant charge, and in system diagnosis. It is designed to provide simultaneous high and low side pressure indications, because these pressures must be compared to determine correct system operation.

Low Side Gauge

The low side gauge is a compound gauge, which means that it will register both pressure and vacuum. The compound gauge is calibrated 0 to 150 pounds pressure and 0 to 30 inches vacuum. It is connected to the suction service valve to check low side pressure or vacuum.

High Side Gauge

The high side gauge is used to check pressure in the discharge side of the air conditioning system.

Manifold

The gauges are connected into the air conditioning system through a manifold (fig. 13A-4). The manifold has three connections. The low side hose and fitting is connected directly below the low side gauge. The high side hose and fitting is connected below the high side gauge.

The center connection of the manifold is used for charging, discharging, evacuating and any other necessary service. Both the high and low side of the manifold have hand shutoff valves. The hand shutoff valves open or close the respective gauge connections to the center service connection or to each other. The manifold is constructed so that pressure will be indicated on the gauges regardless of hand valve position.

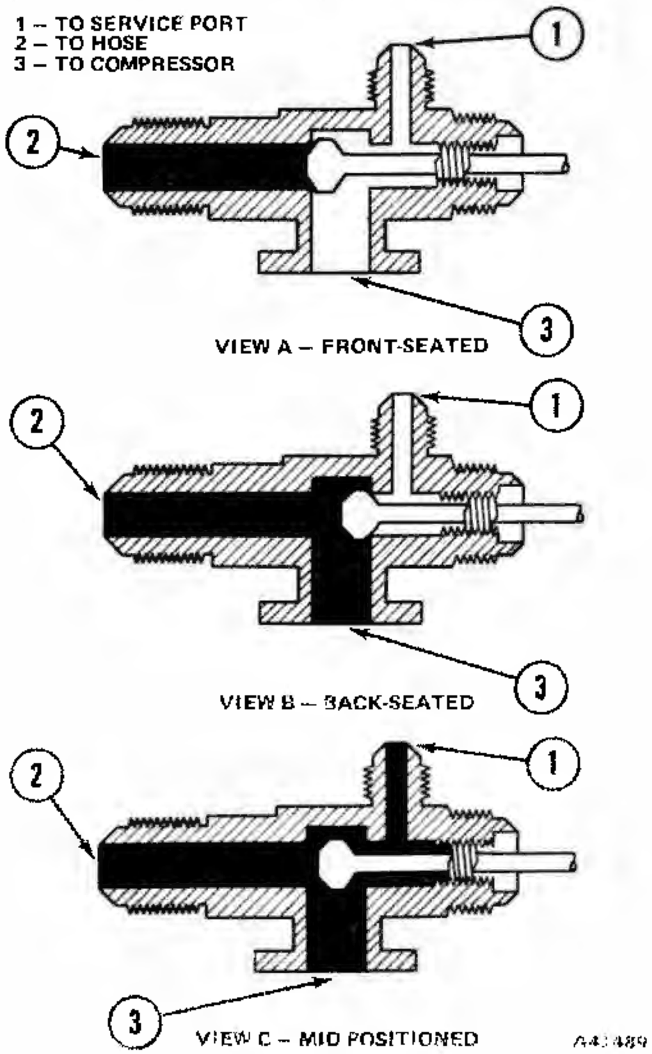

Fig. 13A-3 Service Valve Operating Positions

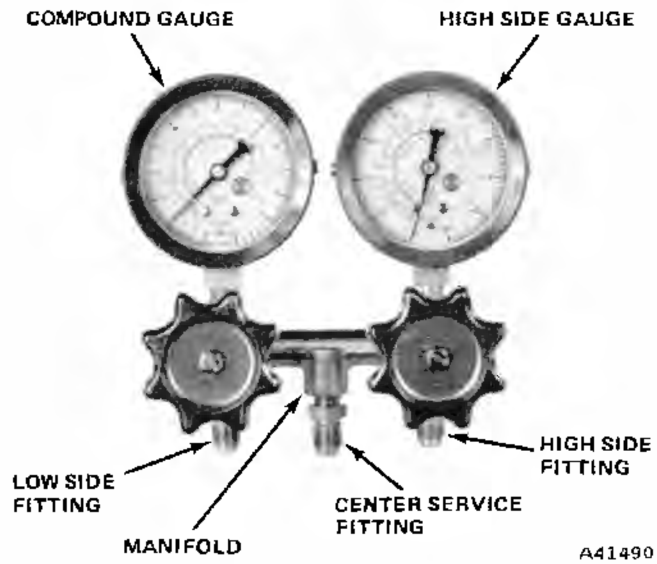

Fig. 13A-4 Pressure Gauge and Manifold Set, Tool J-5725-04

Connecting the Pressure Gauge and Manifold Set

(1) Remove protective caps from service valve gauge ports and valve stems.

(2) Close both hand valves on the gauge manifold set.

(3) Connect compound gauge hose to compressor suction service valve gauge port (low side).

(4) Connect high pressure gauge hose to discharge service valve gauge port (high side).

NOTE: *If necessary, to facilitate installation of the gauge set, loosen the service valve-to-compressor fitting and rotate the service valve slightly. Tighten the service valve-to-compressor fitting to 25 foot-pounds torque.*

(5) Set both service valve stems to mid or cracked position. The gauges will indicate the high and low side pressures respectively.

(6) Purge any air from the high side test hose by opening the high side hand valve on the manifold for 3 to 5 seconds (center connection on manifold must be open).

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(7) Purge any air from the low side test hose by opening the low side hand valve on the manifold for 3 to 5 seconds (center connection on manifold must be open).

(8) The air conditioning system may be operated with the gauge manifold set connected in this manner. The gauges will indicate the respective operative pressures.

CHECKING SYSTEM PRESSURES

The pressure developed on the high side and low side of the compressor indicate whether the system is operating properly.

(1) Attach the Pressure Gauge and Manifold Set.

(2) Close both hand valves on the Gauge and Manifold Set.

(3) Set both service hand valve stems to mid-position.

(4) Operate AC system with engine running at 1500 rpm and controls set for maximum cooling.

(5) Insert a thermometer into the discharge air outlet and observe air temperature.

(6) Observe high and low side pressures and compare with those shown in the Normal Operating Temperatures and Pressures chart. If pressures are abnormal, refer to Pressure Diagnosis chart.

SIGHT GLASS

A sight glass is incorporated into the receiver-to-evaporator hose at the quick disconnect coupling. The sight glass provides a visual check of the system refrigerant level. A continuous stream of bubbles will appear in the sight glass of a system which is not properly charged. Properly charged and completely discharged systems will appear similar through the sight glass because of a lack of bubbles. To distinguish between the two situations, cycle the magnetic clutch OFF and ON with the engine running at 1500 rpm. During the time the clutch is off, bubbles will appear if refrigerant is in the system and will disappear when the clutch is on. If no bubbles appear when cycling the magnetic clutch, there is no refrigerant in the system, since some bubbles would appear in a fully charged system. If the system is discharged, it will be necessary to leak test, repair as required, evacuate, and charge the system.

DISCHARGING THE SYSTEM

Refrigerant should be discharged from the system before replacing any part in the system except the compressor.

(1) Connect the Pressure Gauge and Manifold Set to the proper service valves.

(2) Turn both manifold hand valves to the maximum counterclockwise (open) position.

(3) Open both service valves a slight amount and allow the refrigerant to discharge slowly from the system (fig. 13A-5).

CAUTION: *Do not allow the refrigerant to rush out, as the oil in the compressor will be forced out along with it.*

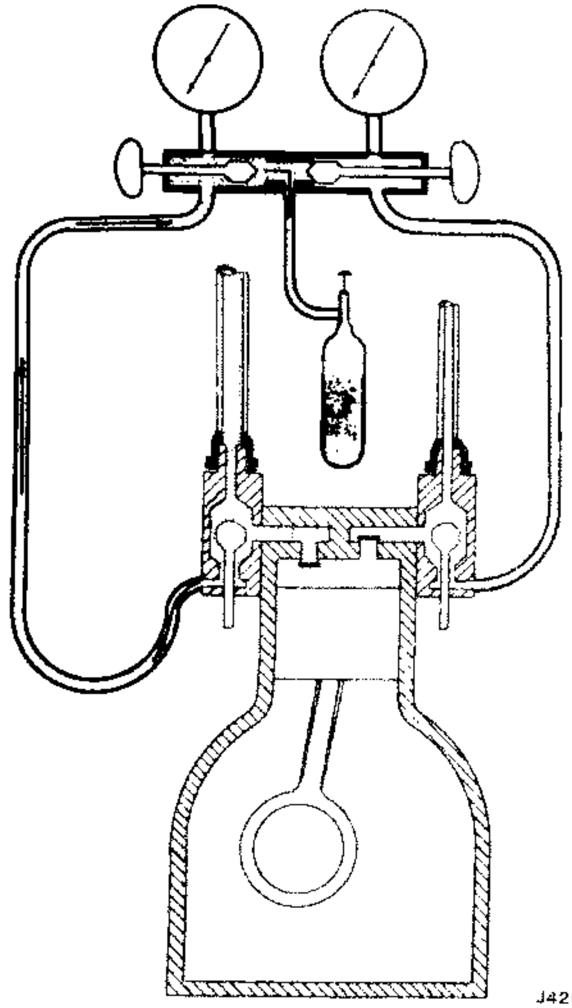

Fig. 13A-5 Valve Positions for Discharging

EVACUATING THE SYSTEM

A system that has had the refrigerant removed during repair, or that is excessively low on refrigerant, must be evacuated with a vacuum pump before new refrigerant is installed. The primary reason for evacuating a system is to remove any moisture that may have entered the system.

Moisture in any quantity is extremely harmful to the air conditioning system. Moisture may collect and freeze in the thermostatic expansion valve orifice, blocking refrigerant flow and prevent system cooling. Moisture will also react with R-12 to form hydrochloric acid which will corrode metal parts of the system. Corrosion particles may become detached and block the small passages and orifices in the system.

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Unwanted air and moisture are removed from the system by controlling the pressure, that is creating a vacuum throughout the system. A vacuum pump is used to lower the pressure sufficiently so that the moisture boiling temperature is reduced to a point where the water will vaporize and can then be evacuated from the system.

Water boils at 212°F at 14.7 psi (sea level). As the vacuum pump lowers the pressure of the closed air conditioning system, the boiling point of the moisture in the system will also be lowered. In evacuating the system, it is necessary to lower the boiling point of any moisture in the system to a point lower than the ambient (surrounding) temperature to ensure that all moisture is boiled off. At an ambient temperature of 75°F, when the desired vacuum of 29.5 inches of Hg. is reached, water will boil at approximately 72°F and a complete boiling off of all moisture in the system is assured when this vacuum reading has been reached.

At altitudes higher than sea level, it will not be possible to obtain a vacuum reading of 29.5 inches of Hg. on the low side compound gauge. For each 1,000 feet of altitude, the vacuum gauge must be corrected by one inch of Hg. to compensate for a change in the atmospheric pressure. For example, at altitudes of 1,000 feet, a gauge reading of 28.5 inches of Hg. will be the same as a gauge reading of 29.5 inches of Hg. at sea level. When this vacuum is reached, a minimum of 30 minutes should be allowed in evacuating the system to ensure complete moisture removal.

Evacuating Procedure with J-23178 Vacuum Pump

The J-23178 vacuum pump and motor is a self-contained unit equipped with a carrying handle and stand. The unit must be kept upright at all times to prevent oil from spilling.

(1) Connect Pressure Gauge and Manifold Set, Tool J-5725-04.

(2) Discharge system.

(3) Connect center service hose to inlet fitting of vacuum pump (fig. 13A-6).

(4) Open both manifold hand valves wide open.

(5) Start Vacuum pump — note compound gauge reading.

(6) Operate pump a MINIMUM of 30 minutes after reaching lowest vacuum.

(7) Test system for leaks. Close both manifold hand valves, turn off vacuum pump, and note compound gauge reading. Gauge needle should remain stationary at point where pump turned off.

(8) If gauge needle returns to zero rapidly, install a partial charge in the system and locate the leak with leak detector. Repair leak and repeat evacuation procedure.

(9) If gauge needle remains stationary and vacuum is maintained for 3 to 5 minutes, resume evacuation for minimum of 30 minutes.

(10) Close both manifold hand valves and stop vacuum pump.

(11) Disconnect center service hose from vacuum pump. The system is now ready for charging.

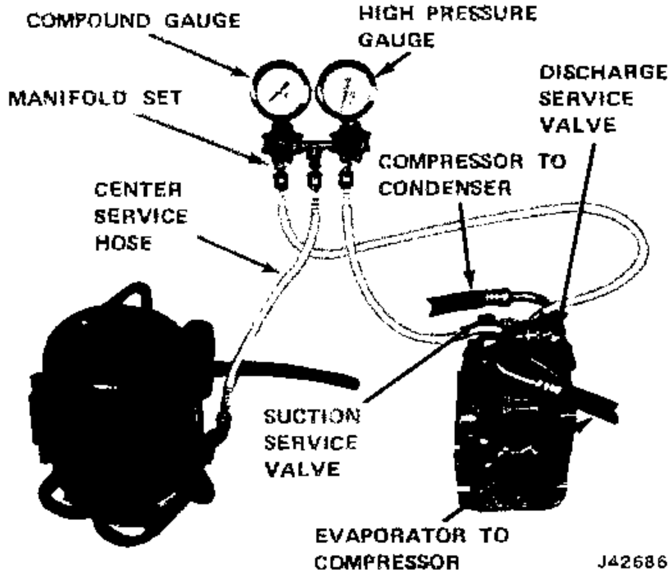

Fig. 13A-6 Evacuating System With Vacuum Pump

Evacuation Procedure with J-8393-01 Portable Air Conditioning Service Station

The J-8393-01 Portable Air Conditioning Service Station (fig. 13A-7) is a completely portable station equipped with vacuum pump, metering-charging cylinder, refrigerant supply, gauges, hoses and hand control valves.

The control switch for the vacuum pump is mounted on the rear of the charging station. It should be in the OFF position before inserting plug into the power source.

There are four hand control valves on the face of the control panel, identified and numbered as follows: low-pressure control (1), high-pressure control (2), vacuum control (3), and R-12 control (4). When not in use, keep all hand control valves in the OFF position to prevent dirt and moisture from entering.

(1) Close all hand valves.

(2) Connect high-pressure line, red hose, to discharge service port on the compressor.

(3) Connect low-pressure line, blue hose, to suction service port on the compressor.

(4) Discharge system, leaving suction and discharge service valves in the mid or cracked position.

(5) Connect vacuum pump hose to vacuum pump inlet.

(6) Open the low-pressure hand control valve (1) and the high-pressure hand control (2).

(7) Start vacuum pump — note compound gauge reading.

(8) Operate pump a minimum of 30 minutes after reaching lowest vacuum.

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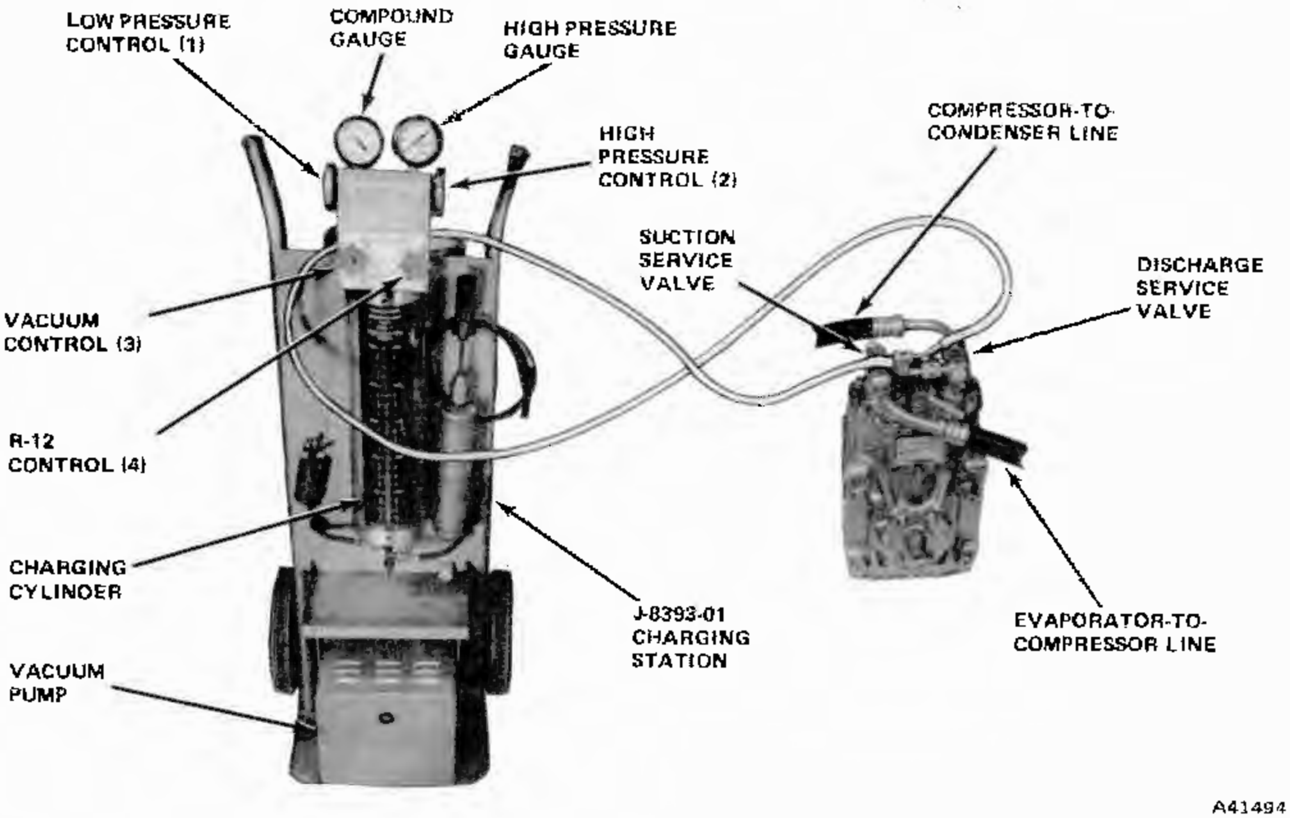

Fig. 13A-7 Portable Air Conditioning Service Station

(9) Close high-pressure (2) and low-pressure (1) hand control valves and stop vacuum pump. The system is now ready for charging.

CHECKING FOR LEAKS

Whenever a system requires more than 1/2 pound of refrigerant after a season's operation, a serious leak is indicated which must be located and repaired.

Most leaks will be located at points of connection and are caused by vehicle vibration. Correction of this type of leak may only require retightening of the connection. However, some leaks may occur only at periods of high traffic on a very warm day. This type of leak most often occurs through the compressor shaft seal or service valve gasket.

A system must contain an adequate quantity of refrigerant to be properly leak tested. If a system is completely discharged, evacuate and install 1/2 pound of refrigerant.

External leaks are detected and located with a halide torch, Tool J-6084 (fig. 13A-8). The torch burns propane fuel and is equipped with a search hose. When air is drawn into the hose by the torch, it contacts a heated copper reactor ring in the torch. If refrigerant gas is present in the air, the normally light blue flame will change color. A small refrigerant leak will change the flame color to yellow. A large refrigerant leak will change it to green or purplish-blue.

Leak Test Procedure Using Halide Torch

(1) Open torch valve and light torch, adjusting flame just high enough to heat copper reactor ring to a cherry red.

(2) Lower flame until it is about 1/4 inch above or even with the copper reactor ring. The smaller flame is more sensitive to refrigerant.

(3) Move search hose slowly **under** all connections, joints and seals. Because refrigerant is heavier than air, leaks may be more readily detected on the lower side of the areas being checked.

(4) Watch for color change or flame indicating area of leak.

WARNING: *When refrigerant comes into contact with an open flame, phosgene gas is formed. Never inhale the vapors or fumes from the halide torch -- they may be poisonous.*

(5) Repair leaks as required.

(6) Evacuate and leak-test system after all leaks are corrected.

(7) Charge system.

CHARGING THE SYSTEM

Before making a complete charge check the compressor oil level, leak test if necessary, and evacuate the system.

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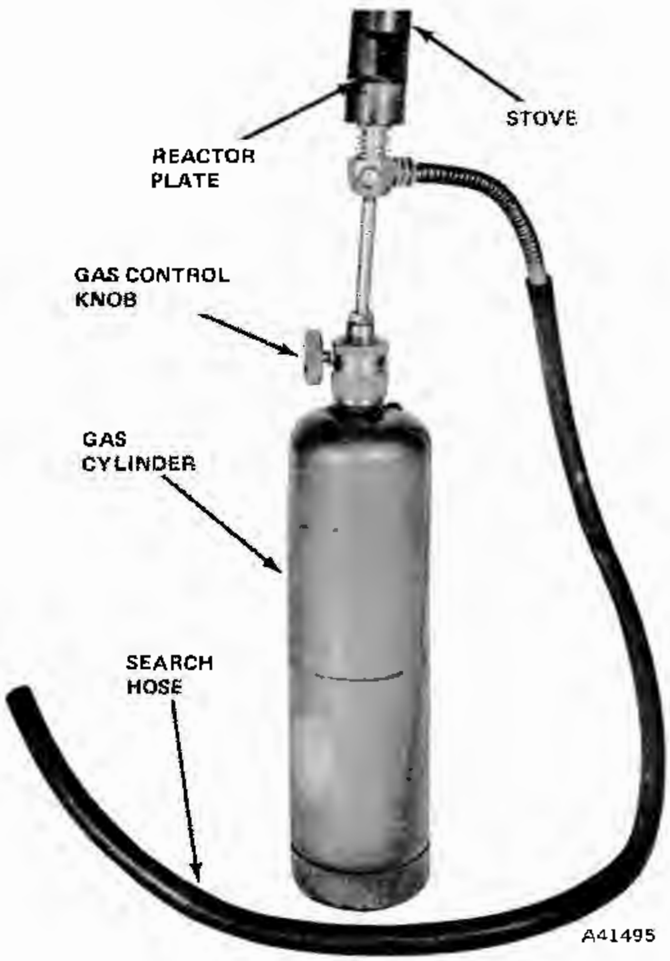

Fig. 13A-8 Halide Torch

Charge Capacity

The capacity for all models is 2-1/4 pounds of Refrigerant R-12 (dichlorodifluoromethane).

Charging Procedure With J-6272-01 No. 4 Multi-Opener Refrigerant Dispenser

The following charging procedure is based on the use of Pressure Gauge and Manifold Set (Tool J-5725-04). Charging Lines (Tool J-5418). and No. 4 Multi-Opener Refrigerant Dispenser (Tool J-6272-01). Refer to figure 13A-9.

WARNING: *Wear goggles to protect eyes.*

(1) Connect Pressure Gauge and Manifold Set J-5727-04 and evacuate system. Keep both service valves in the mid or cracked position.

(2) Close both gauge hand valves.

(3) Disconnect the service hose from the vacuum pump and connect it to the center of the No. 4 Multi-Opener Refrigerant Dispenser J-6272-01. Close the four petcock valves on the dispenser.

(4) Attach the necessary number of refrigerant cans to the dispenser. Refer to Charge Capacity for

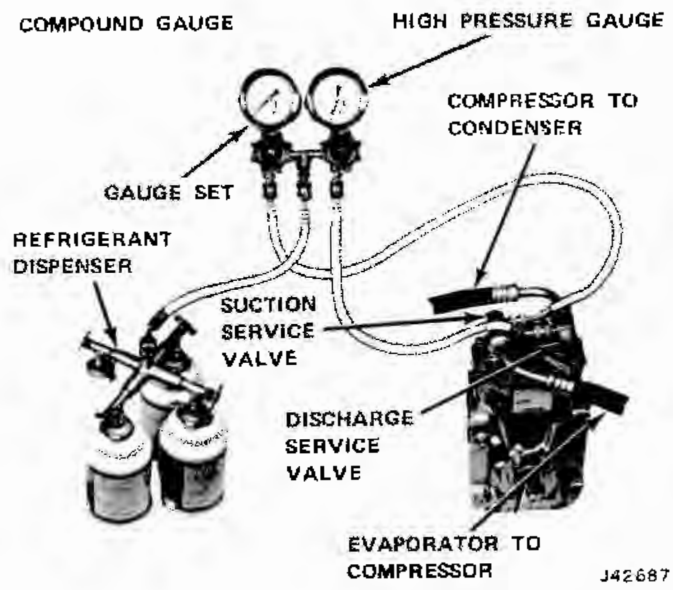

Fig. 13A-9 Charging System With Multi-Opener Refrigerant Dispenser

the proper weight of refrigerant necessary to charge the vehicle being serviced.

(5) Open one dispenser petcock valve. Loosen the center service hose at the Pressure Gauge and Manifold Set allowing refrigerant to purge air from the line. Tighten the service hose connection and close dispenser petcock valve.

(6) Open the suction (compound) gauge hand valve and one dispenser petcock valve. Do not open the discharge (high pressure) gauge hand valve.

(7) Start engine and place AC controls in the maximum cooling position. The compressor will operate and help pull refrigerant gas into the suction side of the system.

NOTE: *The refrigerant cans may be placed upright in warm water no hotter than 125°F to speed up the charging process.*

(8) When the first refrigerant can is empty, open another dispenser petcock valve to continue charging the system.

(9) Continue charging until the specified amount of refrigerant is in the system. The frost line on the refrigerant can will indicate what portion of the refrigerant in the can has entered the system. This may be used as a guide when a system requires a fraction of a full can.

NOTE: *If an accurate scale is available, weigh the refrigerant cans before and during the charging procedure to assure that the correct amount of refrigerant is being used.*

(10) When system is fully charged, close the suction (compound) gauge hand valve and all dispenser petcock valves.

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(11) Back-seat the suction and discharge service valves to their normal operating position by turning them fully counterclockwise.

(12) Loosen the Pressure Gauge and Manifold Set service hoses to allow refrigerant trapped in hoses to discharge.

(13) Remove Pressure Gauge and Manifold Set and install all dust caps on fittings.

(14) Operate the system 10 to 15 minutes to allow it to normalize and to determine if the system will cycle properly.

Charging Procedure With J-8393-01 Portable Air Conditioner Service Station

The following charging procedure is based on the use of the Portable Air Conditioning Service Station, Tool J-8393-01.

WARNING: *Wear goggles to protect eyes.*

(1) Discharge and evacuate system

(2) With all control valves on the charging station closed, open the refrigerant drum valve.

(3) Bleed the charging cylinder through valve located on the back of the control panel directly above cylinder. Close bleed valve occasionally to check level in charging cylinder. Raising the refrigerant drum above the level of the charging cylinder will speed up the filling process. When correct amount of refrigerant is in the charging cylinder, close the bleed valve.

(4) Close refrigerant drum valve.

(5) Open the low-pressure control (1) and mid-position (crack) the suction service valve.

(6) Start engine and place AC controls in maximum cooling position. Refrigerant gas will enter the low (suction) side of the system due to compressor pumping action.

(7) When the correct quantity of refrigerant is in the system, close all control valves and back-seat the suction and discharge service valves.

(8) Disconnect service hoses from suction and discharge service valves.

(9) Operate the system 10 to 15 minutes to allow it to normalize and to determine if the system will cycle properly.

COMPRESSOR

The compressor is the belt-driven, two-cylinder reciprocating type. It is attached to the engine with a mounting bracket as shown in figures 13A-10, and 11.

Compressor Valve Leak Diagnosis

The compressor should be at operating temperature to perform an accurate test.

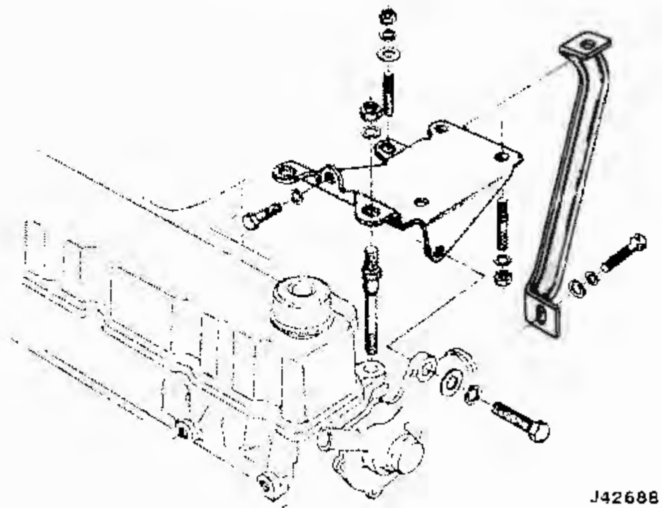

Fig. 13A-10 Compressor Mounting-Six Cylinder

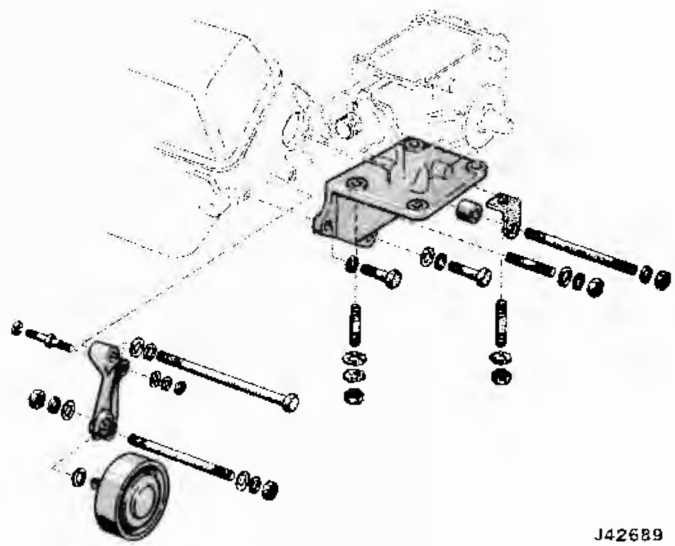

Fig. 13A-11 Compressor Mounting-V-8

(1) Install Pressure Gauge and Manifold Set, Tool J-5727-04.

(2) Front-seat the suction and discharge service valves by turning them clockwise.

(3) Discharge refrigerant remaining in compressor by opening suction gauge hand valve slowly.

(4) Open the suction gauge hand valve and close the high pressure gauge hand valve.

(5) Start engine and operate compressor. Pressure will build up rapidly. Stop compressor at 150 to 200 pounds pressure.

(6) The pressure should hold if the discharge valve is operating properly. Loss of pressure indicates leaking compressor discharge valve or head gasket.

Compressor Belt Tension

Belt tensions are important and should be inspected at time of new car pre-delivery and at subsequent scheduled maintenance intervals.

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Belt Tension Gauge, Tool J-7316, will provide accurate belt tension adjustments. Install the gauge on the longest accessible belt span. Belt tension for new car pre-delivery and all belts with previous service should be 105 to 130 pounds for V-8 engines and 90 to 115 for 6 cylinder engines.

Belt tension is adjusted by the idler or power steering pump mounting bracket.

When a new belt is installed, it should be adjusted to 125 to 155 pounds (155 preferred) tension to compensate for the initial run-in loss that occurs within the first several minutes of operation.

NOTE: *New belt tension specifications apply only to service replacement belts. Once a belt has been tensioned and run it is considered a used belt and should be adjusted to used-belt specifications.*

A characteristic of the **Dacron type belt** used to drive the AC compressor is that it tends to increase in tension—rather than stretch—when subjected to heat. The loss in belt tension which can be observed after the initial run-in is the result of wear-in which allows the belt to ride deeper in the V-groove of the pulleys.

If a belt is run with less than the specified tension, slippage can occur which can cause the belt contact surfaces to become glazed. A glazed belt has lost some of its load carrying capabilities and may slip even when adjusted to specified belt tension.

Belt **vibration**, particularly on 6 cylinder models, is usually the result of improper belt tension. When excessive belt vibration or flutter is encountered, adjust the belt tension to specifications. Adjusting to higher tensions will not stop vibration but will increase stress on the idler assembly.

Isolating the Compressor

It is not necessary to discharge the system for compressor removal. The compressor can be isolated from the remainder of the system, eliminating the need for recharging when performing compressor service.

(1) Connect Pressure Gauge and Manifold Set, Tool J-5727-04.

(2) Close both gauge hand valves and mid-position (crack) both service valves.

(3) Start engine and operate air conditioning.

(4) Turn the suction service valve slowly clockwise toward the front-seated position. When suction pressure is reduced to zero or less, stop engine and compressor and quickly finish front-seating the suction service valve. Suction pressure should be slightly above zero.

(5) Front-seat the discharge service valve.

(6) Loosen oil check plug slowly to release any internal pressure in compressor. The compressor is now isolated from the remainder of the system. Refrigerant lines and service valves can be removed from compressor as complete assemblies.

Compressor Removal

(1) Isolate compressor (see the above procedure).

(2) Remove both service valves and place protective caps over compressor head fittings.

(3) Loosen and remove compressor belt.

(4) Disconnect clutch wire.

(5) Remove compressor mounting bracket-to-engine attaching bolts and nuts.

(6) Remove compressor and mounting bracket as an assembly and place on work bench.

(7) Remove the bracket and bracket attaching studs.

Compressor Installation

(1) Bench assemble the mounting bracket to the compressor.

(2) Install compressor and bracket assembly to engine.

(3) Install compressor drive belt and adjust to proper tension.

(4) Attach compressor service valves and lines.

(5) Purge compressor of air and open service valves.

(6) Connect clutch wire.

Compressor Front Seal Replacement

The compressor front seal is serviced in kit form. Kit components are shown in figure 13A-12. All seal parts must be replaced if a leak has been detected at the seal.

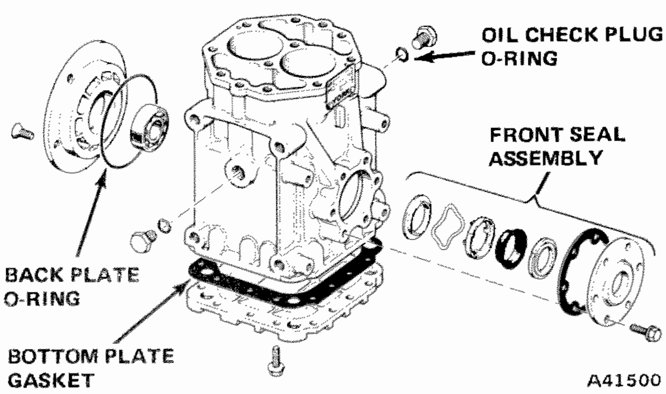

Fig. 13A-12 Compressor Seal Components and Gaskets

NOTE: *A small amount of oil around the shaft seal is normal and does not indicate a seal leak. All seal parts were dipped in oil at the time of assembly and operation may force out surplus oil.*

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(1) Discharge remaining refrigerant in system, then back-seat both service valves to prevent air, moisture, and dirt from entering system.

(2) Remove service valves from compressor and install plastic plugs in both suction and discharge compressor ports.

(3) Remove compressor for subsequent bench work.

(4) Remove clutch pulley and woodruff key from compressor shaft.

(5) Remove seal plate capscrews and washers, pry seal plate loose, and remove.

(6) Pry behind seal drive ring, that part of the seal assembly farthest back on the shaft, and remove seal assembly.

(7) Clean new seal assembly components in clean refrigeration oil.

NOTE: *Cleanliness, careful handling, and clean refrigeration oil are important elements of successful seal replacement.*

(8) Push seal assembly, less carbon ring, if loose, over compressor shaft with carbon ring retainer facing out. Move assembly in and out on shaft to seat neoprene ring on shaft. Push assembly in until seal retainer assembly contacts bearing race. If carbon ring was loose, position it in ring retainer with polished side out. Carbon ring must seat in the retainer.

(9) Coat mating surfaces of compressor and seal plate with a film of refrigeration oil. Position seal ring in groove on the compressor. Install seal plate with polished face toward carbon ring.

(10) Install seal plate capscrews and tighten evenly while rotating compressor shaft. Center seal plate on shaft by lightly tapping plate. Tighten capscrews in a diagonal pattern to 90 inch-pounds torque.

Back Plate O-Ring Seal Replacement

(1) Isolate and remove compressor.

(2) Remove four back plate attaching screws.

(3) Remove back plate by gently prying it loose from crankcase. Pry in such a manner to pull parallel to bearing surface.

(4) Remove O-ring seal from back plate.

(5) Clean back plate and apply a light film of refrigeration oil to O-ring sealing area.

(6) Position O-ring seal on back plate and install back plate over rear bearing and into the crankcase.

(7) Install four back plate attaching screws and tighten in a diagonal pattern to 9 to 17 foot-pounds of torque.

(8) Install and purge compressor of air.

(9) Leak test system. Evacuate and charge if necessary.

Head, Valve Plate, and Gasket Replacement

(1) Isolate compressor.

(2) Remove service valves from compressor. The compressor head service valve ports are identified D for discharge and S for suction.

(3) Remove compressor head attaching screws.

(4) Tap under valve plate ears (short, half-round projections on the valve plate) to remove head and valve plate (fig. 13A-13).

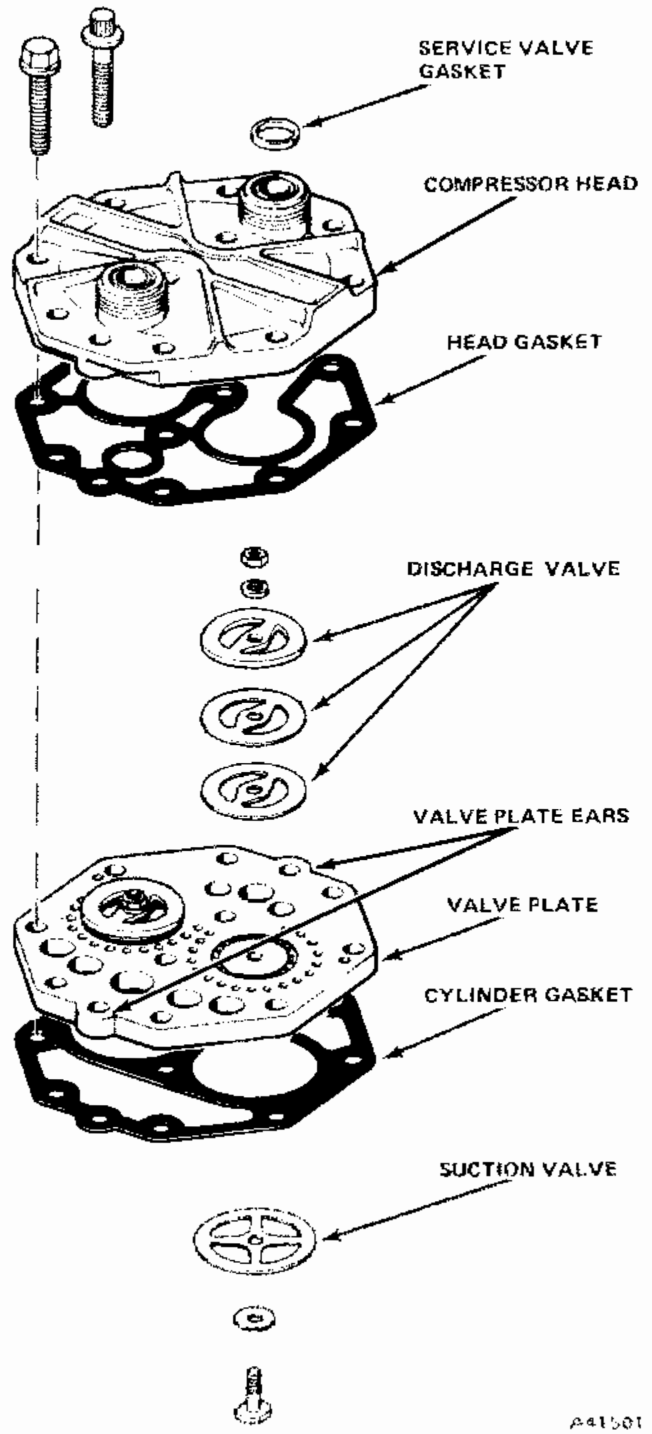

Fig. 13A-13 Head and Valve Plate Assembly Sequence

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(5) Tap the valve plate ears while holding the compressor head to separate the head from the valve plate.

(6) Clean all gasket material from head, valve plate, and compressor using care not to scratch or nick the sealing surfaces.

(7) Coat all machined sealing surfaces with a light film of refrigeration oil.

(8) Install a new valve plate cylinder gasket on the compressor body, locating the gasket on the dowel pins.

(9) Install the valve plate on the compressor, locating it on the dowel pins so that discharge valve is at top. Figure 13A-13 shows the correct assembly sequence.

(10) Install a new head gasket, locating it on the dowel pins.

(11) Install head. Tighten compressor head capscrews to 15 foot-pounds torque, following sequence outlined in figure 13A-14.

(12) Coat service valve ports with a light film of refrigeration oil and install new service valve gaskets.

(13) Install service valves.

(14) Purge compressor of air.

(15) Leak test system. Evacuate and charge if necessary.

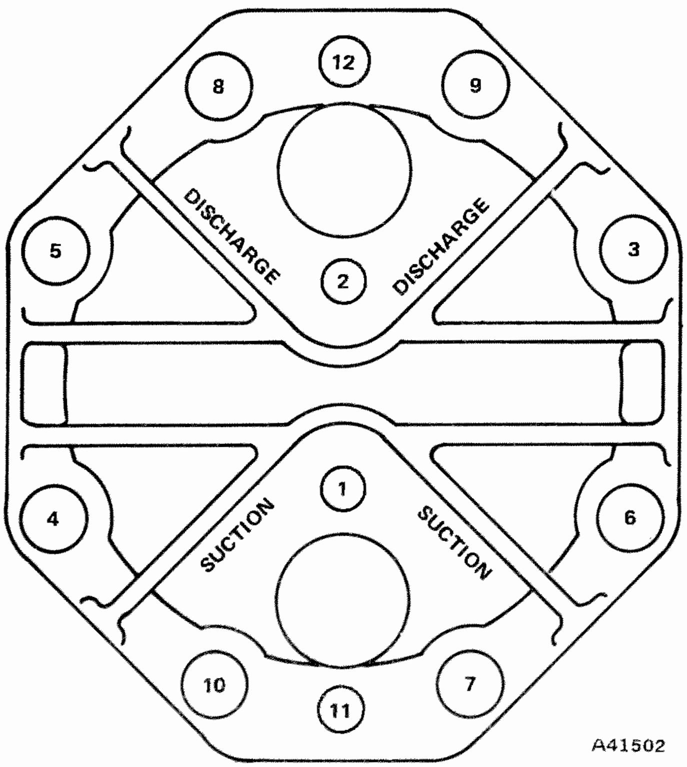

Fig. 13A-14 Compressor Head Capscrew Tightening Sequence

Bottom Plate Gasket Replacement

(1) Isolate and remove compressor.

(2) Remove bottom plate attaching screws and carefully remove bottom plate.

(3) Clean all gasket material from bottom plate and compressor using care not to scratch or nick the sealing surfaces.

(4) Coat all sealing surfaces with a light film of refrigeration oil.

(5) Install a new bottom plate gasket and install bottom plate. Tighten the bottom plate attaching screws to 150 inch-pounds torque.

(6) Install and purge compressor of air.

(7) Leak test system. Evacuate and charge if necessary.

Checking Compressor Oil Level

Initially, the compressor has 7 ounces of 280 to 300 Seybolt refrigeration oil in the crankcase. In normal operation, a small amount of oil is always circulating with the refrigerant in the system. Unless the system has developed a leak, the oil level will remain the same in the system.

CAUTION: *The oil level should be checked whenever the system is discharged for a service part replacement, and especially after a rapid loss of refrigerant has occurred because of a ruptured line, etc.*

NOTE: *Check compressor oil level with compressor in operating position, and only after the vehicle interior air has been cooled to the desired temperature. Operating the system stabilizes the oil entrained in the system, and provides an accurate oil level reading. The oil check plugs are located on either side of the compressor crankcase.*

Before installing a new compressor, check the oil level in the compressor to be replaced prior to removing it. The oil level in the replacement compressor must be adjusted to correspond with that of the replaced compressor.

(1) Isolate the compressor.

(2) Loosen crankcase oil check plug slowly to release any internal pressure in the compressor. Remove check plug when all pressure is relieved.

(3) Fabricate a dipstick rod as shown in figure 13A-15.

(4) Hold the dipstick as vertical as pissible and insert in check plug opening. The oil level should be within the specified levels indicated in figure 13A-15.

NOTE: *Refrigeration oil readily absorbs moisture. Keep the container capped until ready to use, and recap immediately after use.*

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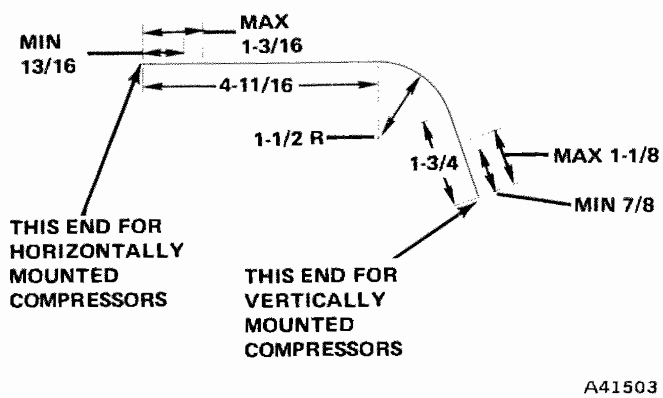

Fig. 13A-15 Oil Dipstick Fabrication Dimensions (Inches)

(6) Install oil check plug O-ring seal. Be sure O-ring is not twisted.

NOTE: *Oil filler plug leaks are usually due to a damaged O-ring or dirt on the seat.*

(7) Install plug, being careful not to overtighten it.
(8) Purge compressor of air.

Purging Compressor of Air

The compressor must be purged of air whenever it has been isolated for oil level check or other service procedures without discharging the entire system.

(1) Cap service gauge ports on both service valves.
(2) Back-seat the suction service valve to allow system refrigerant to enter compressor.
(3) Place the discharge service valve in the mid or cracked position.
(4) Loosen the discharge service valve gauge port cap to permit the refrigerant to force any air out of the compressor.
(5) Back-seat the discharge service valve and tighten the gauge port cap.
(6) The compressor is now ready for service.

MAGNETIC CLUTCH

The magnetic clutch consists of a stationary electromagnetic coil, and a rotating pulley and plate assembly.

The electromagnetic coil is mounted on four bosses on the compressor. The pulley and plate assembly is mounted on the compressor shaft. When the air conditioner is off, the pulley is free to turn on the clutch hub bearing. When the clutch is energized, the plate is magnetically attracted to the pulley and turns the compressor crankshaft.

Do not attempt to replace the bearing, pulley or clutch plate separately. These components are serviced only as a complete assembly. The coil is serviced as a separate unit.

Electrical Diagnosis

Refer to the Magnetic Clutch Troubleshooting guide when diagnosing magnetic clutch malfunctions.

Diagnosis for Noisy Clutch

Spin the pulley by hand. There must be no interference between the field and the rotor assembly. The clutch coil must be mounted properly using the special capscrews which position the field coil to the compressor.

A worn pulley bearing can be detected by the roughness felt when spinning the pulley. Do not attempt to replace the bearing.

A new clutch may emit a short squeal when initally engaged. After a few cycles of operation the noise will disappear.

Clutch Removal

(1) Remove compressor belt.
(2) Energize the clutch or use a spanner wrench to hold the clutch plate while removing the clutch-to-shaft attaching bolt and washer.
(3) Install a 5/8-inch-11 standard thread bolt in the threaded center of the clutch plate.
(4) Tighten the bolt and pull the clutch from the shaft.

CAUTION: *Do not pry on clutch to remove.*

(5) Remove four capscrews which retain the magnetic coil and disconnect coil wire. Remove coil.

Clutch Installation

(1) Install magnetic coil with the four special capscrews provided with the replacement unit. These capscrews are used to ensure the coil is positioned properly on the compressor.
(2) Tighten capscrews to 7 to 10 foot-pounds torque.
(3) Install woodruff key on compressor shaft.
(4) Align clutch assembly with key and install clutch on shaft.
(5) Install clutch-to-shaft attaching bolt and tighten to 20 foot-pounds torque. Connect clutch coil wire and energized clutch to hold unit when tightening.
(6) Install compressor belt and adjust belt tension to specifications.

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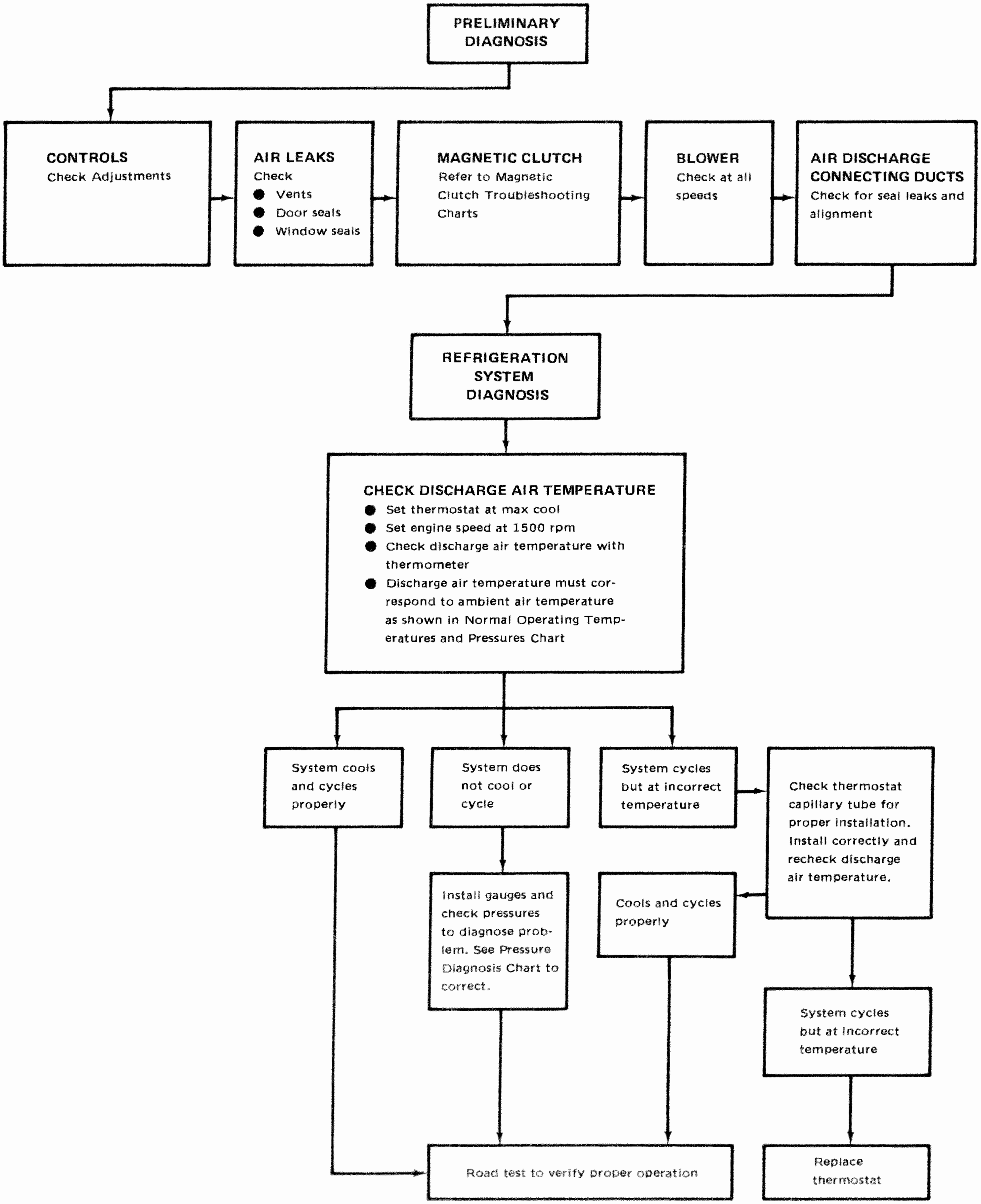
SYSTEM TROUBLESHOOTING



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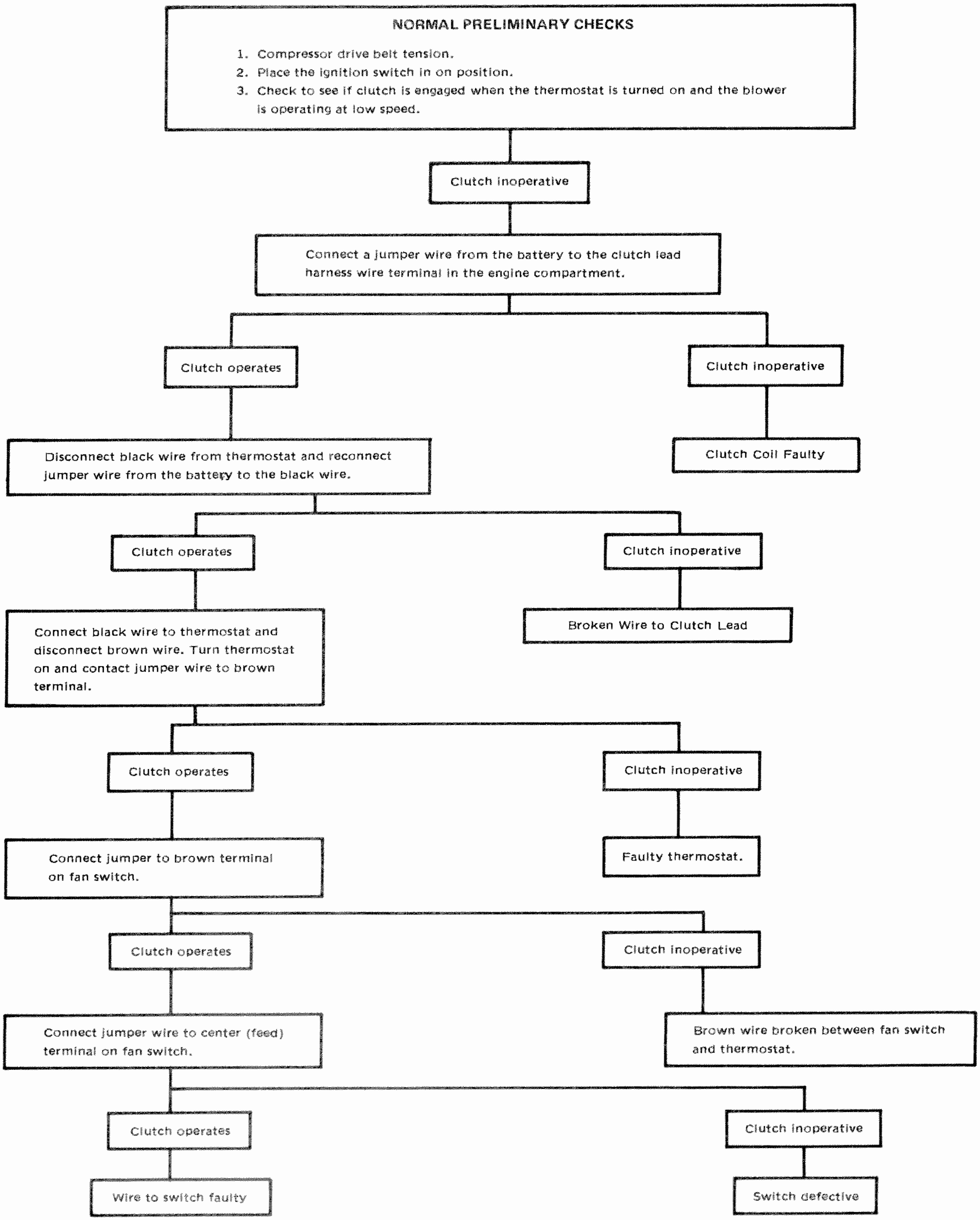
MAGNETIC CLUTCH TROUBLESHOOTING



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NORMAL OPERATING TEMPERATURES AND PRESSURES

Engine Speed (RPM)	Ambient Temperature (°F)	Average Discharge Air Temperature (°F)	Head Pressure (PSI)	Suction Pressure (PSI)
1500	60	45	110	9
1500	70	45	135	10
1500	80	46	170	11
1500	90	47	190	12
1500	100	48	220	14
1500	110	48	275	18

CONDENSER AND RECEIVER/DRYER ASSEMBLY

Removal

(1) Discharge refrigerant from system.

NOTE: *Discharge system slowly to prevent loss of compressor oil.*

(2) Drain radiator.
(3) Remove fan shroud and radiator.
(4) Disconnect pressure line at condenser.
(5) Remove four condenser attaching screws and tilt bottom of condenser toward engine.

NOTE: *Plug all open connections to prevent entry of dirt and moisture.*

(6) From underside of vehicle, disconnect receiver/dryer-to-evaporator hose at receiver/dryer.
(7) Remove condenser and receiver/dryer assembly.
(8) The receiver/dryer may now be removed from condenser, if necessary.

Installation

(1) If removed, install receiver/dryer to condenser.
(2) Place condenser in position and connect receiver/dryer-to-evaporator hose at receiver/dryer.
(3) Install condenser attaching screws.
(4) Connect pressure line at condenser.
(5) Install radiator and fan shroud.
(6) Fill radiator.
(7) Evacuate, leak test, and charge the system.

EVAPORATOR HOUSING ASSEMBLY

Removal

(1) Discharge the system.
(2) Disconnect inlet (suction) line at compressor.
(3) Disconnect receiver-to-evaporator hose at the quick disconnect coupling (fig. 13A-16).

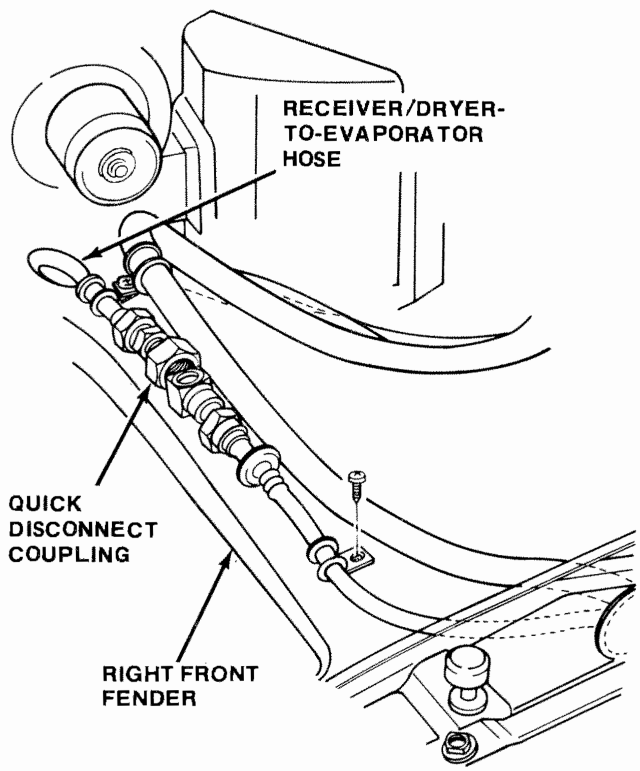

Fig. 13A-16 Quick-Disconnect Coupling

(4) Remove hose clamps and dash grommet retaining screws.
(5) Remove the eight evaporator housing-to-instrument panel retaining screws and the one evaporator housing-to-mounting bracket screw (fig. 13A-17).
(6) Lower evaporator housing and pull hoses and grommet through opening.

The blower motor, blower motor housing, and evaporator core may be serviced after the evaporator housing is removed (fig. 13A-18).

NOTE: *It is not necessary to discharge the system to service the blower motor. The evaporator housing may be lowered from the instrument panel to gain access to the blower motor attaching screws.*

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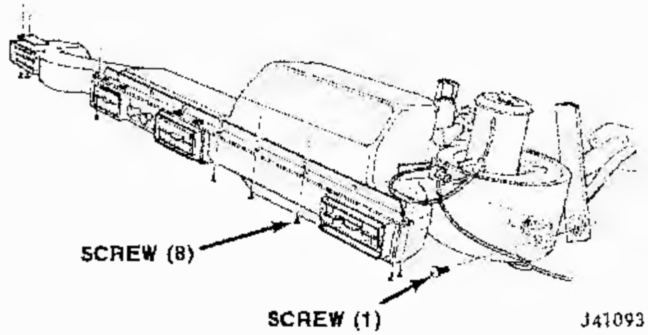

Fig. 13A-17 Evaporator Housing Mounting

Installation

(1) Push hoses through grommet opening, and install grommet by pushing toward engine compartment of vehicle.

(2) Raise evaporator and install evaporator housing-to-instrument panel retaining screws and the evaporator-to-mounting bracket screw.

(3) Install hose clamps and grommet retaining screws.

(4) Connect receiver-to-evaporator hose at quick disconnect coupling.

(5) Connect inlet (suction) line to compressor.

(6) Evacuate, leak test, and charge the system.

EXPANSION VALVE SERVICE

The valve is preset and should not be adjusted. A defective valve requires replacement.

(1) Discharge the system.

(2) Remove evaporator housing assembly.

(3) Remove insulation wrapped around suction line and expansion valve. Mark capillary tube location on suction line.

(4) Disconnect inlet and outlet connections, capillary tube clamp, and equalizer tube.

(5) Remove expansion valve.

(6) Clean suction line to provide a positive contact with replacement expansion valve capillary tube.

(7) Reconnect inlet and outlet hoses. Clamp capillary tube at marked position and connect equalizer tube.

NOTE: *Clamp capillary tube securely so that a firm contact with the suction line is formed.*

(8) Wrap expansion valve and line with insulation.

(9) Install evaporator housing assembly.

(10) Evacuate, leak test, and charge the system.

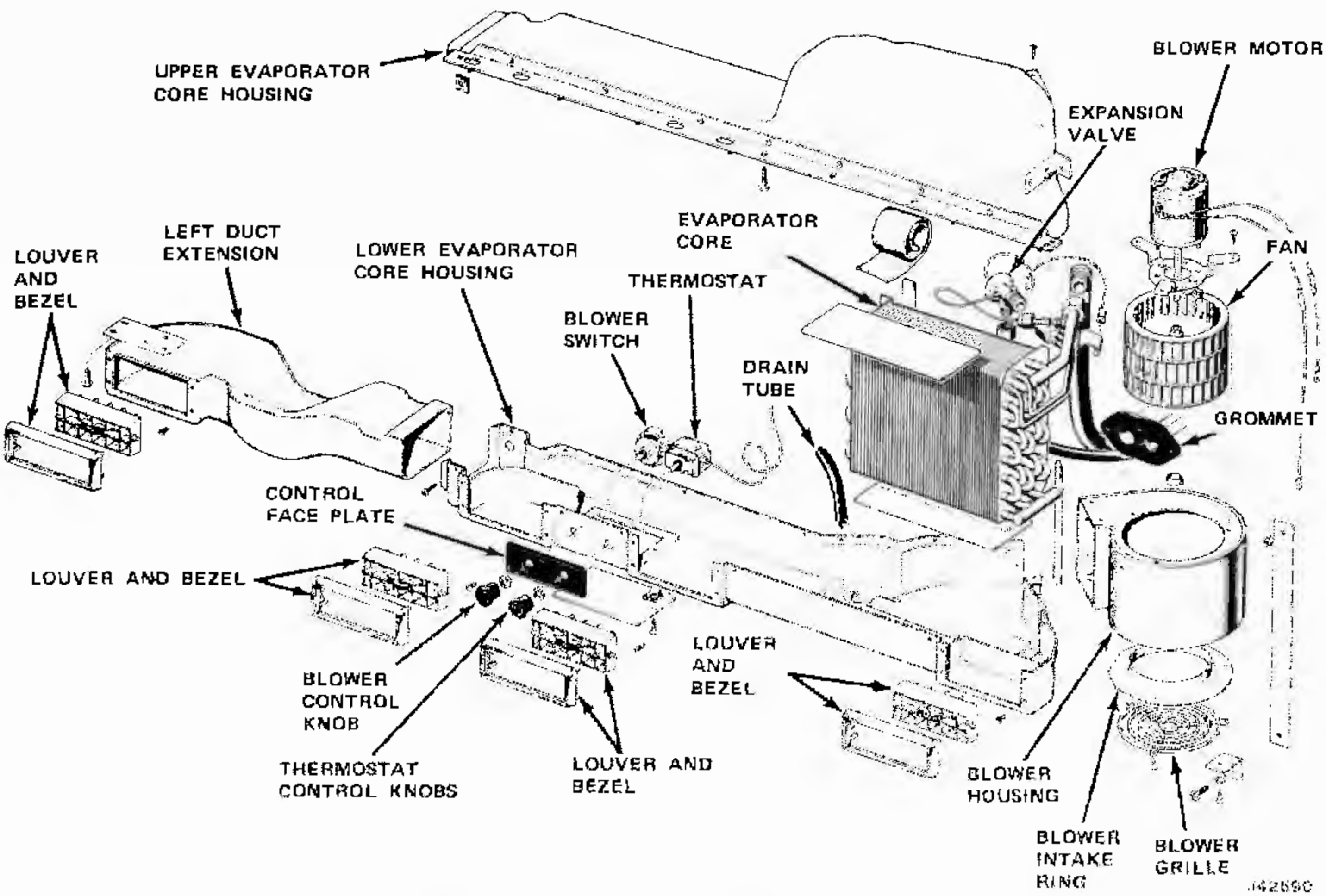

Fig. 13A-18 Evaporator Housing Assembly

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SYSTEM CONTROLS SERVICE

Fan Switch

The fan switch may be serviced by removing the access plate located on the lower evaporator case below the control panel.

Temperature Control Switch

To service the temperature control switch, the evaporator case must be disassembled.

Thermostat

When installing a new temperature control thermostat, insert the capillary tube into the evaporator coil a minimum of three inches (fig. 13A-19).

CAUTION: *Handle the tube with care to avoid bends or kinks which could cause the thermostat to malfunction.*

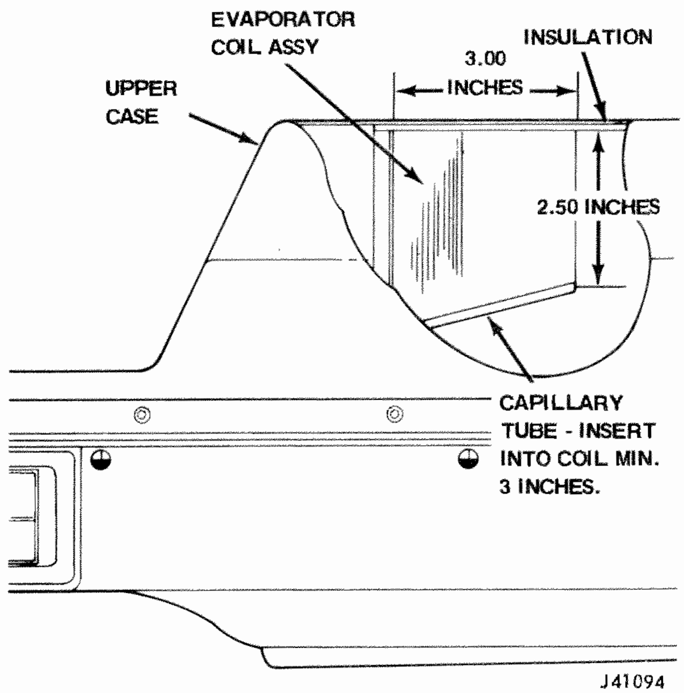

Fig. 13A-19 Capillary Tube Position

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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BODY-PANELS-FENDERS-HOOD-BUMPERS

BODY

BODY CONSTRUCTION

General

Jeep vehicles are of all-steel construction, with insulated body mounting points that provide a secure attachment to the chassis frame.

All major body panels are of heavy gauge steel, reinforced, flanged, and welded. The bodies are completely detachable from the chassis unit and are insulated from the frame by body spacers placed between the body and frame and held in position with body bolts.

Primed skeleton bodies are available in all models as replacements when the body is damaged beyond repair. Doors, trim material, hardware, and other parts may be repaired and reused.

Spacers are located between the body and chassis mounting points to insulate against vibrations and road noises.

Periodic inspection is necessary to determine the condition of body spacers and holddown bolts. Worn, loose or fatigued spacers permit the body to settle causing possible interference between the floorpan and various chassis components.

Water Test Procedure

Water testing can be performed without the need of a helper, by utilizing a suitable stand to which a water hose can be attached. The hose attachment should be adjustable to permit changing the spray direction as needed. This method will make it possible for one man to observe and detect the point of water entry while the water is being applied.

Always begin the water spray at the lowest point and allow sufficient saturation before moving the water spray upward.

To best simulate normal conditions that cause water leaks, i.e., rain or car wash, it is advisable to water test with a spray pattern rather than a heavy, solid stream of water which can create misleading symptoms.

This procedure can be used on any area suspected of having a water leak.

Correction of Leaks

The following is a list of sealing compounds best suited to correct water or dust leaks in the respective areas as described. Comply with specific instructions recommended by the manufacturer and noted on the container.

Body Joint Sealer - A heavy-bodied asphalt base compound with properties very similar to undercoating material. Used to seal body joints. Do not use where scuffing of sealer may occur. Ideal for use in wheel splash area after adequate cleaning of surface.

Undercoat spray - Undercoating material in a pressurized spray container is ideal for quick sealing of body seams and joints. A four-inch plastic tube as a nozzle extension allows access to hard-to-seal areas.

Body Caulk-String Caulk - A heavy bodied material which can easily be molded and pressed into place and remain pliable. Adjoining surfaces must be clean for good adhesion. Caulk is best suited as a gasketing material and not to be substituted for sealing which requires an adhering bond.

Plastisol or Hard-Setting Sealers - Fast curing sealers which can be used on an exposed painted surface. Surface of sealer will harden smoothly and quickly for repaint or touch-up. Use for sealing coach joints of exposed surface requiring a hard, smooth finish.

Flowable Black Sealers - Black, thin-bodied sealers with a butyl or rubber base, remain soft and tacky to

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fill voids which may occur due to flexing. When sealing the windshield or rear window area make certain the sealer being used is recommended by the manufacturer for use next to butyl tape. Some types of flowable black sealers will deteriorate the butyl tape.

FRAME CONSTRUCTION

The frame is the foundation and structural center of the vehicle. In addition to carrying the load, it mounts and supports the power unit while maintaining correct relationship and alignment of the power train. This relationship assures normal functioning of the units and freedom from excessive wear, stress and strain. The frame is constructed of heavy channel steel side rails and crossmembers. The crossmembers maintain the proper positions of the side rails in direct relationship to each other, providing maximum resistance to torsional twist and strains.

In the event of collision damage, it is important that the frame alignment be checked and realigned to frame dimensions shown on the individual dimension charts (fig. 14-1 through 14-4).

Wheel geometry and axle alignment should be checked.

FRAME ALIGNMENT

The most efficient method of checking frame alignment is with a frame alignment machine.

If a frame straightening machine is not available, frame alignment may be determined by using the "x", or diagonal method (fig. 14-5). Figures 14-1 through 14-4 provide all frame dimensions.

The most convenient method of checking frame dimensions is to mark on a level floor all dimensional points from which measurements are taken. This is known as "plumb-bobbing" the frame. If working on a cement floor, clean it so that the chalk marks will be visible underneath the frame. If working on a wooden floor, lay sheets of paper underneath the vehicle. Drop a plumb-bob from each point indicated in figure 14-5, marking the floor directly underneath the point. Satisfactory checking depends on the accuracy of the marks in relation to the frame.

To check points that have been marked, carefully move the vehicle away from the layout on the floor, and proceed as follows:

Check the frame at front and rear end using corresponding marks on the floor. If widths correspond to frame specifications, draw a centerline the full length of the vehicle, halfway between the marks indicating front and rear widths. If frame width is not correct and the centerline cannot be laid out from checking points at the end of frame, it can be drawn through intersections of any two pair of equal diagonals.

With the centerline correctly laid out, measure the distance to several opposite points over the entire length of the frame. If the frame is in proper alignment, opposite measurement should be the same.

To locate the points at which the frame is sprung, measure the diagonals marked AB, BC, and CD (fig. 14-5).

If the diagonals in each pair are within 1/8-inch, that part of the frame included between points of measurement may be considered as satisfactorily aligned. These diagonals should also intersect at the centerline. If the measurements do not agree within the above limits, it means that a frame alignment correction is necessary and will have to be made between those points that are not equal.

NOTE: *During the process of straightening the frame, be extremely careful not to overstretch the frame. This could cause the already aligned sections of the frame to become misaligned or weakened.*

FRAME STRAIGHTENING

A bent or twisted frame may be straightened, provided the extent of misalignment is not excessive. To avoid weakening the frame, straightening should be performed without the application of heat. Severely damaged frame parts should be replaced.

NOTE: *The controlled-heat technique can be utilized where a frame section is squashed and must be brought out without tearing or excessive stretch to the metal.*

AXLE ALIGNMENT

When the frame is properly aligned, the front axle alignment to the frame should also be checked. The front axle is square with the frame if the distance between the front and rear axles is the same on both sides.

The distance from the spring upper bushings to the axle on both sides should be equal. Check both axles.

NOTE: *Always inspect the springs for broken spring center-bolts when checking the frame and axle alignment.*

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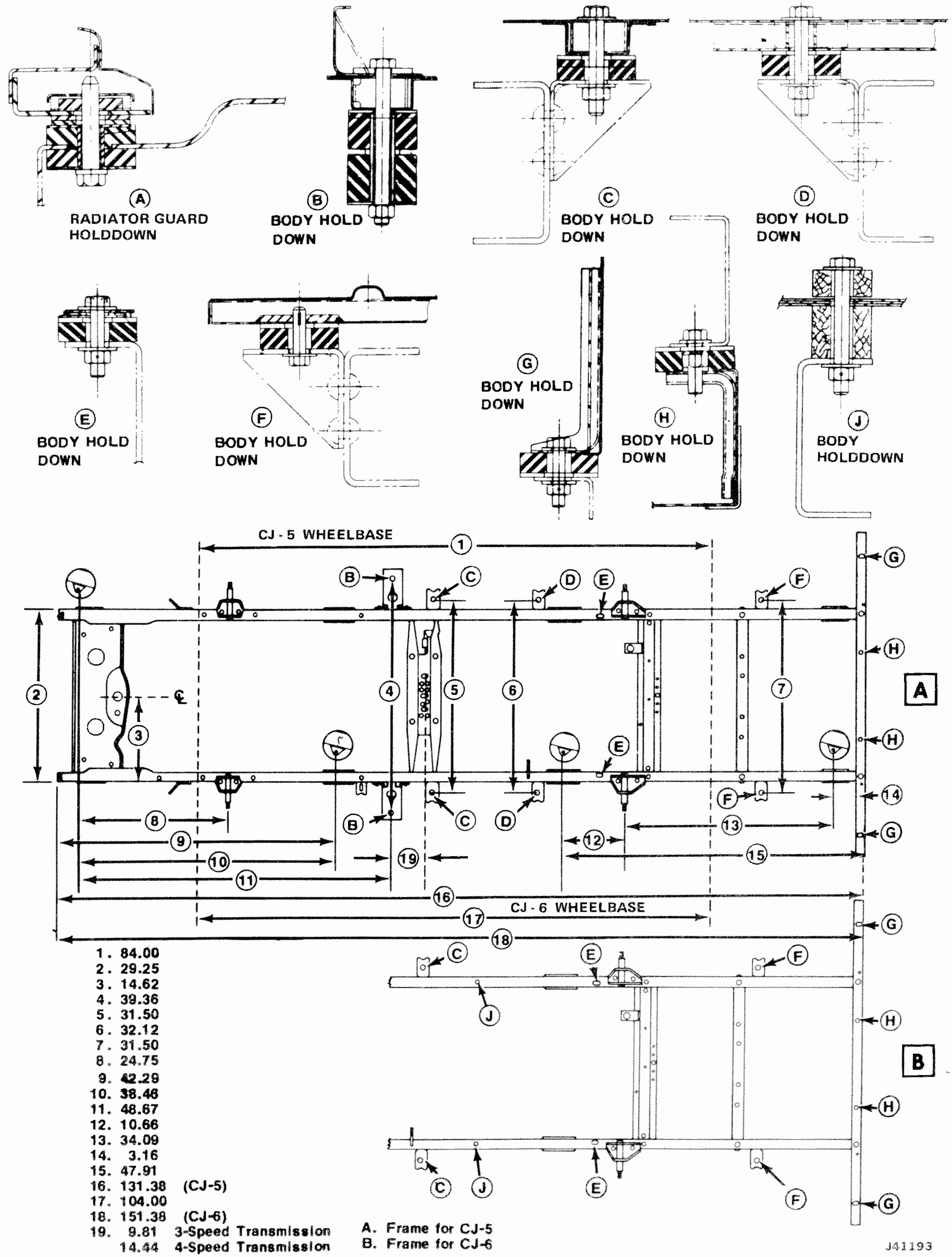

Fig. 14-1 CJ Model Frame Dimensions

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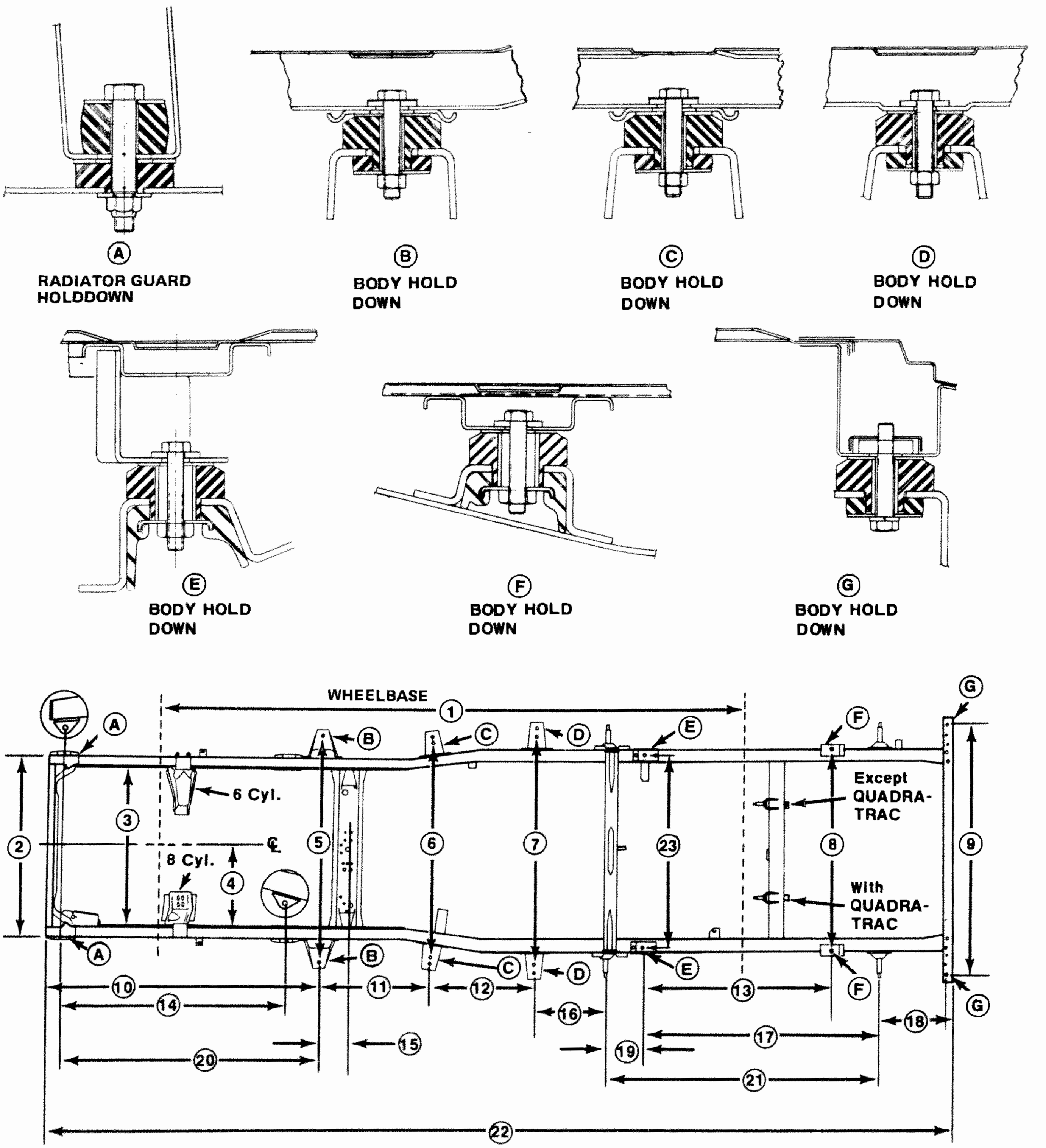

1. 108.75
2. 34.25
3. 30.00
4. 15.00
5. 42.50
6. 42.50
7. 45.88
8. 37.30
9. 46.75
10. 52.60
11. 21.12
12. 20.00
13. 36.31
14. 45.75
15. 5.13 3-Speed Transmission
    11.54 4-Speed Transmission & Automatic Transmission
16. 13.69
17. 45.31
18. 12.71
19. 7.00
20. 50.00
21. 52.36
22. 173.99
23. 36.08

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Fig. 14-2 Cherokee and Wagoneer Frame Dimensions (Inches)

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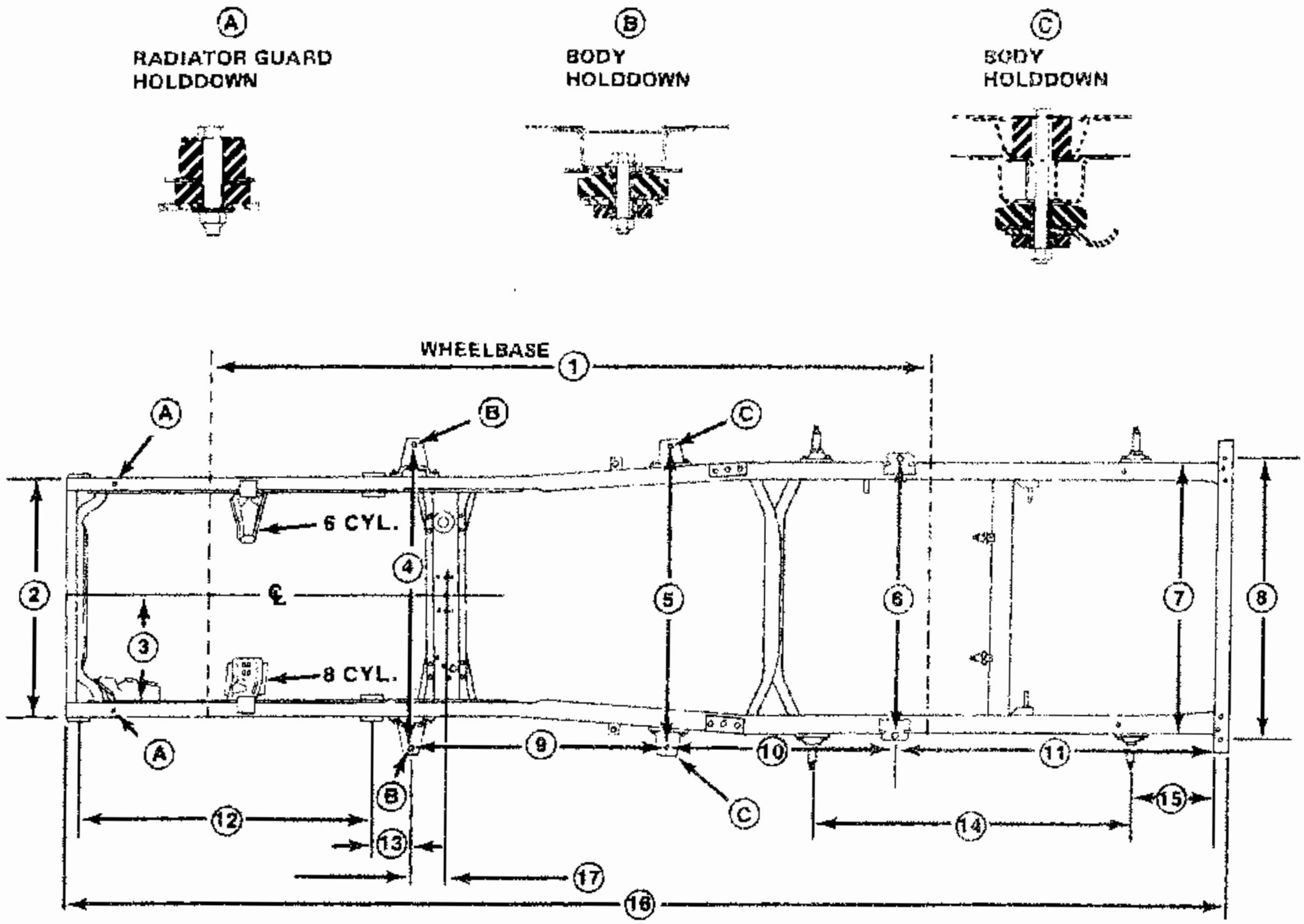

1. 118.75	11. 48.79
2. 34.38	12. 45.70
3. 17.18	13. 5.32
4. 42.56	14. 51.31
5. 45.88	15. 13.79
6. 45.72	16. 183.72
7. 44.50	17. 5.13 3-Speed Transmission
8. 46.75	11.54 4-Speed Transmission
9. 41.12	& Automatic Transmission
10. 40.00	

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Fig. 14-3 J-10 Truck Frame Dimensions (Inches)

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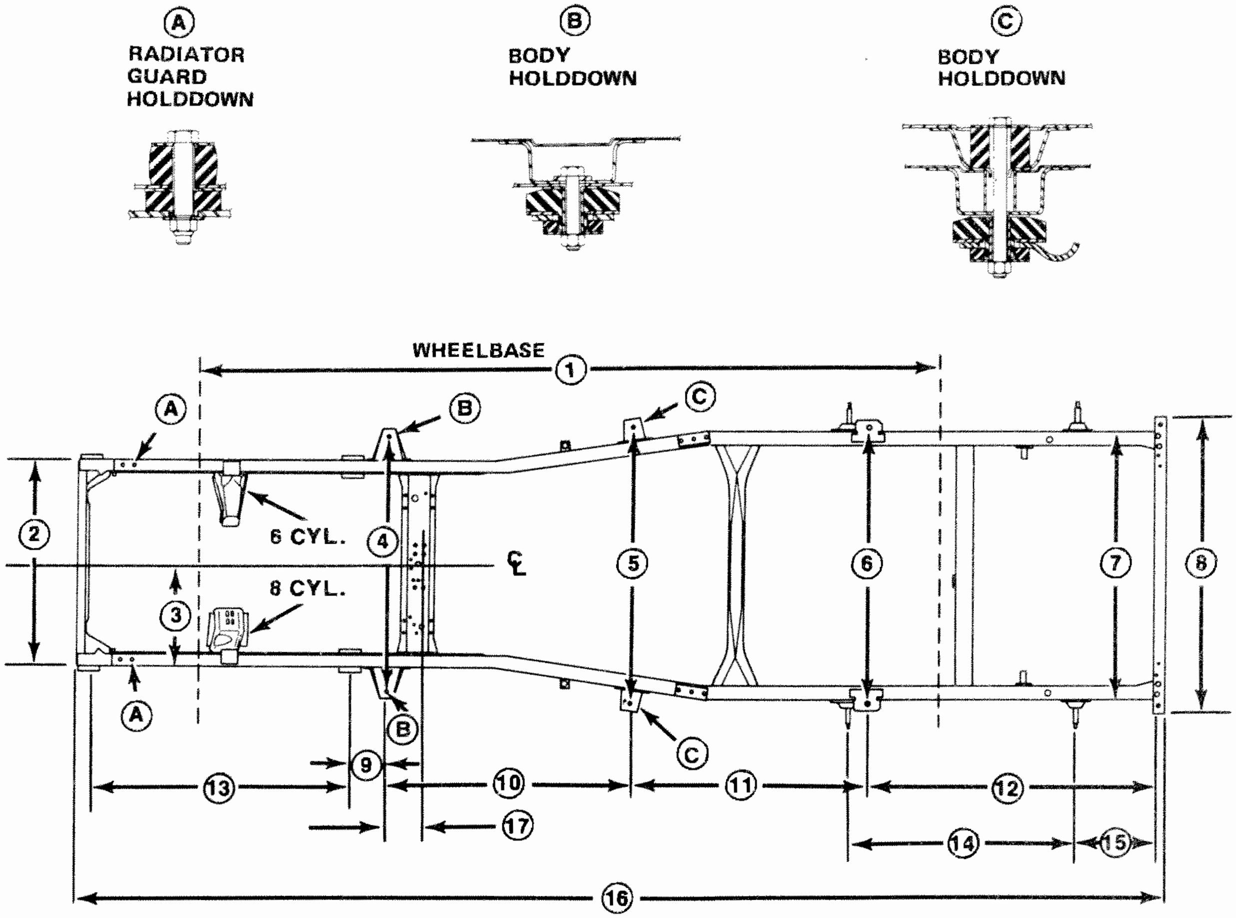

1. 130.75
2. 34.38
3. 17.19
4. 42.58
5. 45.88
6. 45.72
7. 44.50
8. 46.75
9. 5.32
10. 41.12
11. 40.00
12. 60.79
13. 45.70
14. 56.45
15. 7.89
16. 195.75
17. 5.13 3-Speed Transmission
 11.54 4-Speed Transmission & Automatic Transmission

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Fig. 14-4 J-20 Truck Frame Dimensions (Inches)

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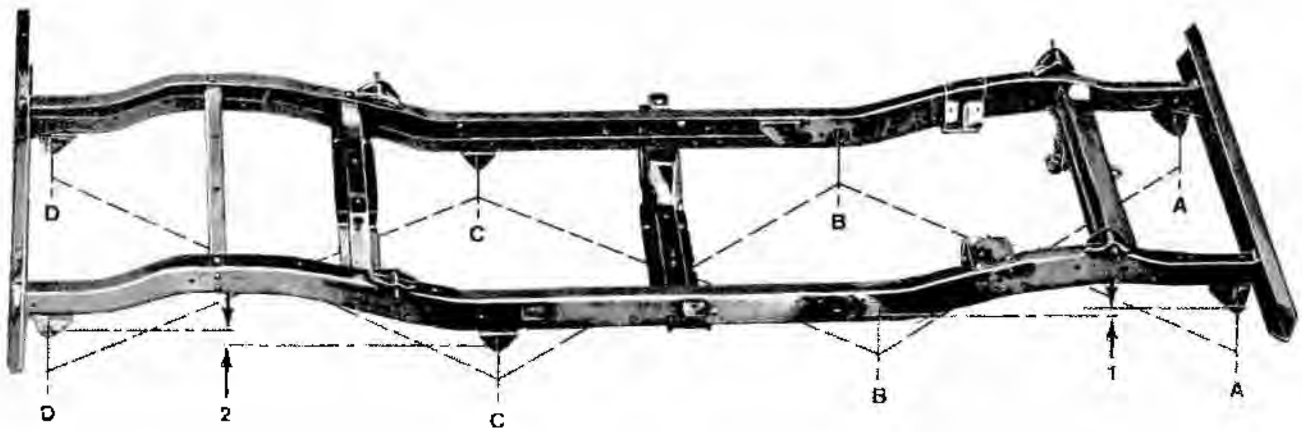

Vehicle	Spring Hanger Step Dimensions (Inches)	
	1 – Front Set	2 – Rear Set
CJ-5	4.15	3.22
CJ-6	4.27	3.34
Wagoneer & Cherokee	6.28	2.37
Truck, J-10	6.34	2.49
Truck, J-20	6.34	1.27

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Fig. 14-5 Typical Frame Assembly

PANELS

GENERAL

Replacing damaged panels with new parts is less expensive than repairing the damaged section.

Assembled sections or any of the individual panels available for replacement are complete and may be installed as a unit. When only a portion of the unit is damaged, the damaged unit may be cut from the body at the location best suited for welding, and the new unit cut to the desired size and welded in place.

Galvanized Panels

For protection against rust, all panels vulnerable to corrosion on Cherokee, Wagoneer, and Truck vehicles are galvanized. A neutralizer must be applied to these panels prior to painting to ensure good adhesion of the paint.

Replacement

Where replacement is required, careful examination should be made as to the extent of the damage to determine which panels required for replacement.

In most cases, the weld joints of one panel to another are visible and can be separated for installation of a new panel.

DOORS

The complete door, with outer and inner door panels flanged and welded together and primed, is available as well as the outer panel only.

These may be used in cases where the inner panel and pillar assemblies are not damaged, saving the extra expense of using a complete door.

REAR QUARTER PANELS

The rear quarter panels are welded to the body as indicated by dotted lines in fig. 14-6 through 14-8.

Whenever a rear quarter panel is replaced, it is very important to apply a suitable rust preventative such as a weld primer to all mating surfaces prior to welding. It is also very necessary to seal all welded joints with Jeep Metal Joint Sealer or equivalent.

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Fig. 14-6 Rear Quarter Panel - CJ

Fig. 14-7 Rear Quarter Panel - Cherokee

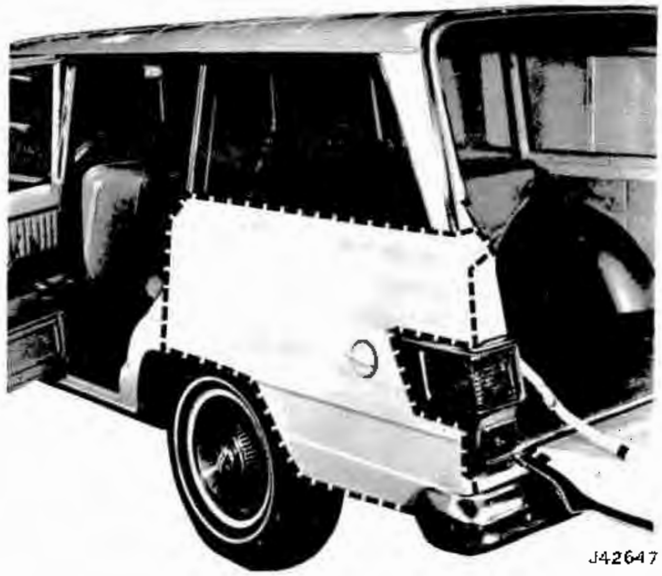

Fig. 14-8 Rear Quarter Panel- Wagoneer

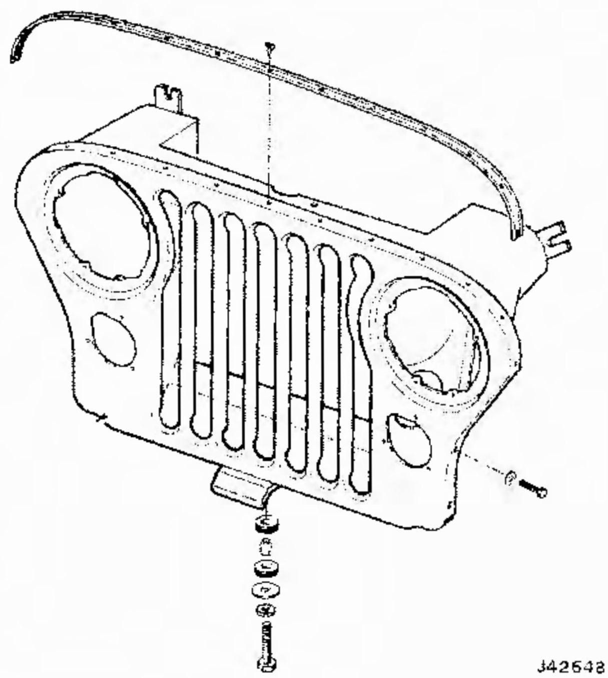

Fig. 14-9 Grille Panel - CJ Models

RADIATOR GRILLES
CJ Models

The CJ grille and the support and baffle are welded together to form a maximum-strength radiator guard (fig. 14-9).

Cherokee - Wagoneer - Truck

Wagoneers feature a new molded radiator grille insert which can be quickly replaced when damaged (fig 14-10). The grille insert is secured to the grille panel with disposable plastic fasteners to facilitate servicing

Cherokee and truck grilles are one-piece metal construction, a separate grille face panel and support and baffle are used for rigidity and service economy.

GRILLE REMOVAL

CJ Models

(1) Remove screws and washers securing radiator to radiator guard panel.

(2) Remove bolts and washers securing guard panel to fenders.

(3) Remove radiator grille to frame crossmember holddown assembly. Note sequence of parts.

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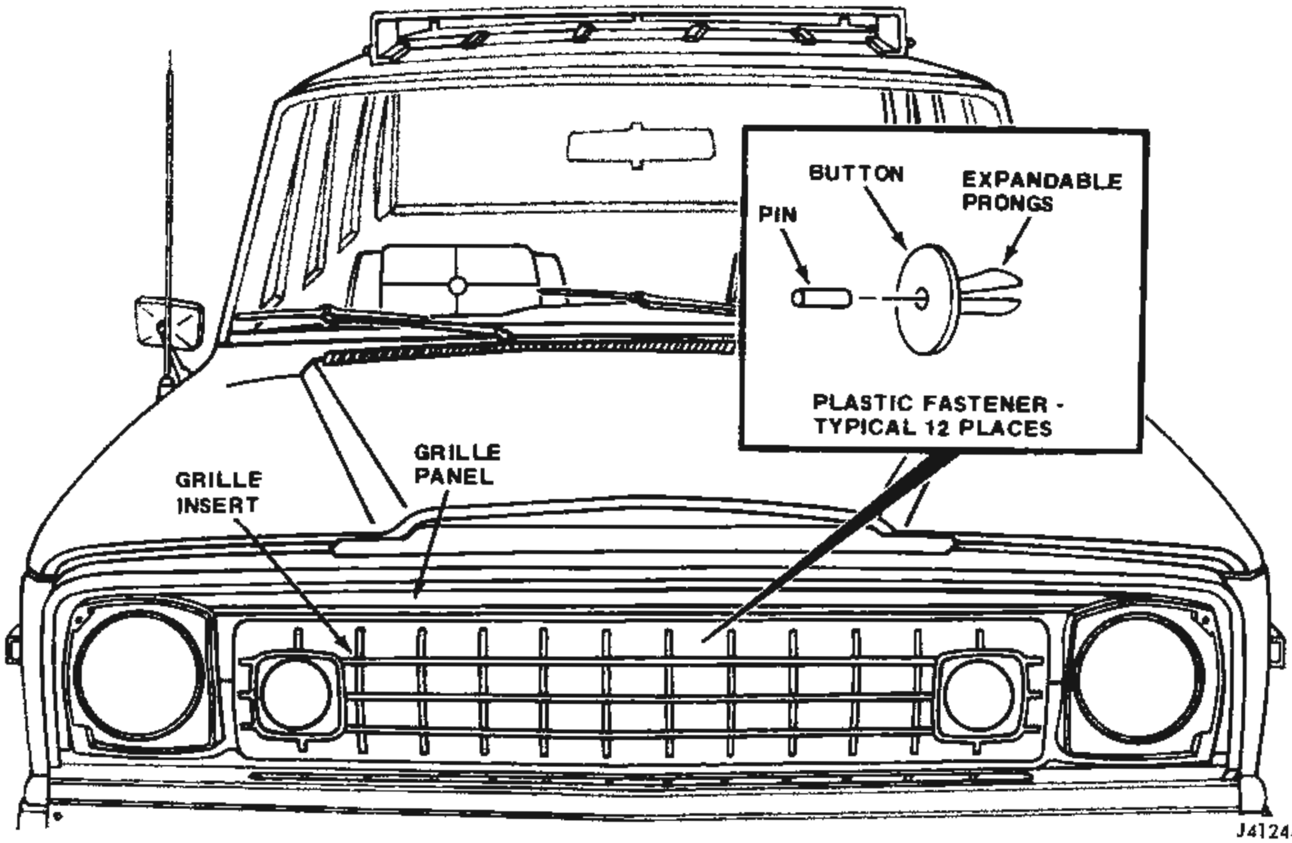

Fig. 14-10 Grille Insert and Fasteners - Wagoneer

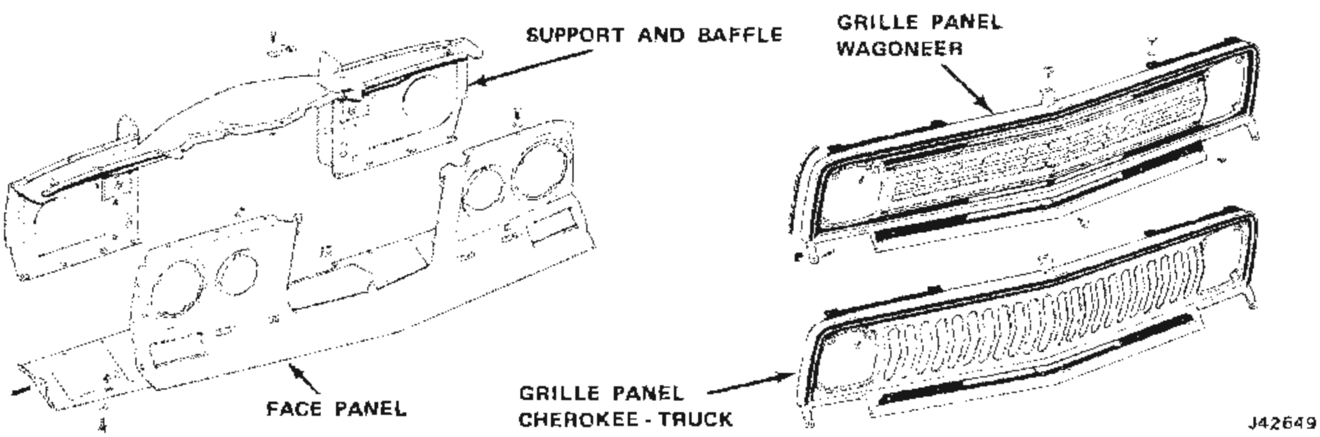

Fig. 14-11 Grille Panel - Cherokee - Wagoneer - Truck

(4) Loosen nuts securing the two radiator support rods to the radiator grille guard support brackets.

(5) Remove rods from brackets.

(6) Tilt guard panel forward and disconnect electrical wiring at head lamp sealed beam unit, and parking lamp assembly wire harness at connectors.

(7) Lift radiator guard panel from vehicle.

Cherokee - Wagoneer - Truck

(1) Remove headlamp doors, headlamp housing and disconnect headlamp wiring at sealed beam unit.

(2) Remove screws, bolts and washers securing grille.

(3) Remove grille.

WAGONEER GRILLE INSERT

Replacement

(1) Push the pin through and out the back of the button-shaped plastic fasteners using a 1/8-inch diameter tool (fig. 14-10).

(2) Remove and discard plastic fastener buttons.

(3) Remove grille insert from grille panel and disconnect parking light wiring at harness connectors.

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(4) Connect parking light wiring to harness connectors and position grille insert in grille panel.

(5) Align holes in grille insert with grille panel holes and install plastic fasteners. Push pin in flush with fastener button, expanding fastener prongs.

FENDERS

FRONT FENDER AND APRON REMOVAL

CJ Models

(1) Remove or disconnect all items attached to the apron of fender.

(2) Remove hood retaining latch and side marker light from fender.

(3) Remove bolts, washers and nuts securing fender and brace to firewall (fig. 14-12).

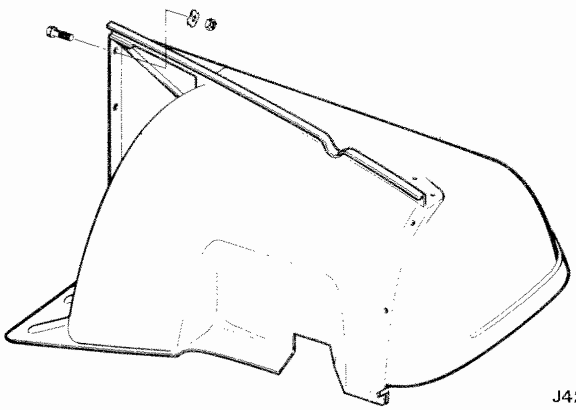

Fig. 14-12 Front Fender - CJ Models

(4) Remove bolts, washers, and nuts securing fender to radiator grille guard panel.

(5) Pull fender outboard and lift from vehicle.

Cherokee-Wagoneer-Truck

(1) Remove front bumpers.

(2) Remove headlight to gain access through opening.

(3) Reach through headlight opening and remove bolts and washers attaching fender to grille face panel.

(4) Remove side marker lamp reflector lens and disconnect lamp socket assembly from lens.

(5) Remove bolts and washers holding fender to grille face panel.

(6) Disconnect brace at fender.

(7) Remove bolts and washers attaching fender extension bracket to fender apron.

(8) Remove bolts and washers attaching fender to rocker panel just below the hinge pillars.

(9) Remove the bolts and washers that attach the top of the fender to the fender apron, the hood hinge support bracket, and the fender-to-firewall bracket.

NOTE: *The number and position of shims between fender and rocker panels so they can be reinstalled in the same way.*

(10) With the doors in the open position remove the fender from the vehicle.

(11) Remove or disconnect all items attached to the apron.

(12) Remove bolts and washers that attach the fender apron to the radiator support and to the two brackets on the firewall.

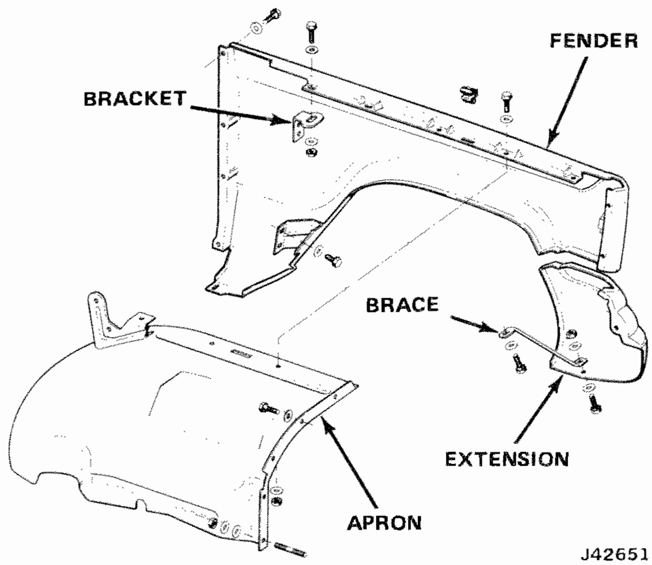

Fig. 14-13 Front Fender - Cherokee - Wagoneer - Truck

INSTALLATION

(1) Spread sealer evenly over and along surfaces where fender and apron make metal-to-metal contact with other sheet metal parts.

(2) Install apron and fender in place with finger-tightened bolts until all bolts and washers have been installed. Then secure all nuts and bolts.

(3) Install and reconnect all items removed from the fender and apron, such as wiring harness, electrical components, etc.

(4) Secure items such as headlight, grille and/or front bumper which were released or removed to facilitate removal of fender and apron.

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HOOD

GENERAL

The CJ hood consists of an outer flanged panel with inner U-channels welded at the front and rear of the hood panel.

The Cherokee, Wagoneer, and Truck hood consists of an inner and outer panel flanged and welded together at the outer edges.

(1) Mark the position of hinges on their respective mounting panels before removing hood.

(2) Detach hood panel from hinges by removing the attaching bolts, lockwashers and flat washers.

(3) Disassembly of the CJ hood is accomplished by removing the hood prop rod, hood prop rod retainer clip, hood side catch brackets, footman loop, and windshield bumpers (fig. 14-14).

(4) Disassembly of the Cherokee, Wagoneer, and Truck hood is accomplished by removing the hood lever lock assembly, left and right hood panel brace rods, and the insulation pad (Cherokee and Wagoneer) that is cemented to the hood panel (14-15).

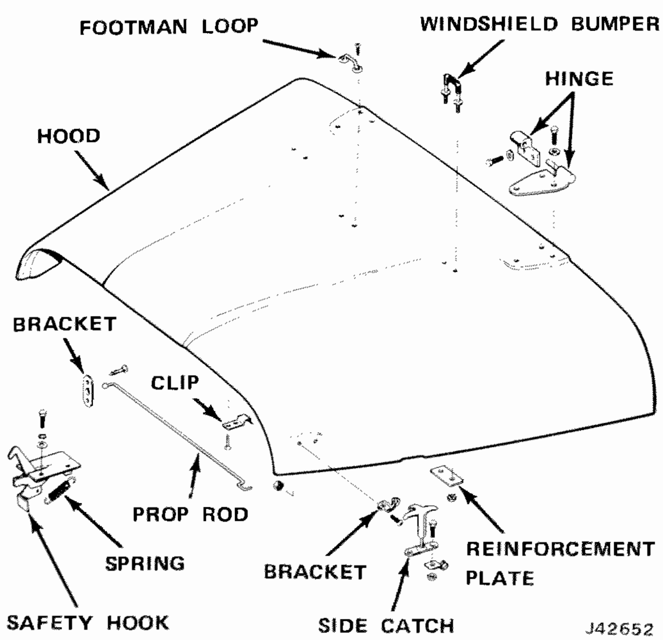

Fig. 14-14 Hood and Related Parts - CJ Models

ASSEMBLY AND INSTALLATION

(1) Finger-tighten related component parts and assemblies to hood panel.

(2) If the Cherokee or Wagoneer hood panel insulation pad has been removed, clean off all loose cement and pad particles from panel to ensure good adhesion when recemented.

(3) Position hood panel assembly and align hinges with scribe marks on the respective mounting panels. Torque all attaching bolts.

(4) Check hood alignment. If not correct, apply following procedure.

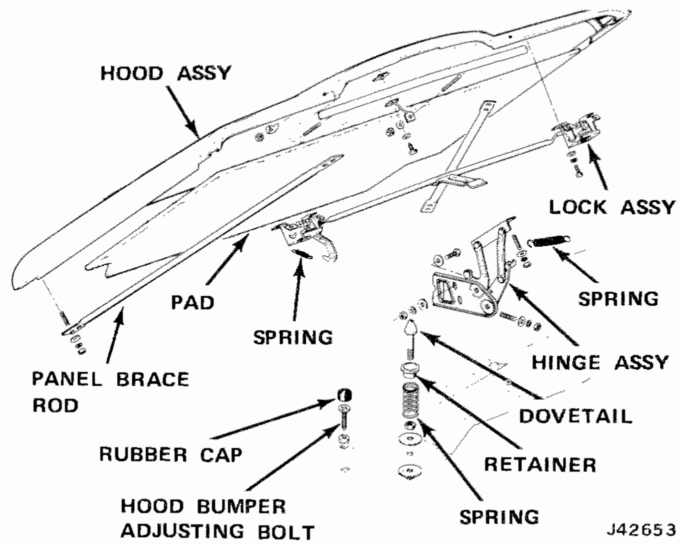

Fig. 14-15 Hood and Related Parts - Cherokee, Wagoneer, and Truck

ALIGNMENT

The hood hinge mounting holes are oversized to permit adjustment when aligning the hood.

NOTE: *If the hood must be moved to either side, the hood lock loop striker, hood lever lock, and/or the safety hook assembly, according to vehicle model, must first be loosened.*

(1) Loosen the hinge mounting bolts slightly on one side and tap hinge in the opposite direction hood is to be moved.

(2) Secure bolts.

(3) Repeat the procedure on the opposite hinge.

(4) The hook lock loop striker, hood lever lock and/or the safety hook assembly, must be moved to ensure positive locking.

(5) On the Cherokee, Wagoneer and Truck, shim between hinge and hood with caster and camber shims or flat washers at the rear bolt, if the hood is low in relation to the cowl top.

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(6) If the hood is too high at the cowl, shim at the front bolt.

HOOD LOCK

The hood lock and safety catch of the Cherokee, Wagoneer and Truck incorporates a release system, whereby the release lever operates the hood lock and the safety catch.

The CJ hood is secured to the front fenders by two hood retaining latches. To release, pull the latches straight up and turn slightly at the end of travel. The hood may now be raised with the release of the safety catch by inserting fingers between the grille bars to the right of center and by pulling to the left on the catch. To secure the hood in the raised position, remove the support bar from its retaining clip and insert the free end into the support bar bracket.

The hood lock release latch on the Cherokee, Wagoneer, and Truck is located under the front center of the hood, above the grille. To release the latch, reach under the hood, lift up and raise the hood.

The hood lock striker, hood lever lock and/or the safety hook assembly are adjustable. Lubricate all pivot points periodically.

HOOD BUMPER

A combination weatherstrip and hood bumper is located across the top of the radiator grille gaurd in a fixed position on CJ Models.

The hood bumper on the Cherokee, Wagoneer, and Truck are adjustable. Rubber caps must be removed to adjust the bumper bolts.

BUMPERS

GENERAL

Front and rear bumpers on CJ models are of one-piece construction.

Front bumpers on the Cherokee, Wagoneer, and Truck models are of three piece construction. Rear bumpers of three-piece construction are used on the Cherokee and Wagoneer. Trucks, when equipped with a rear bumper have a one piece bumper.

Bumper bar ends on the Cherokee, Wagoneer, and Truck may be removed individually.

Front and rear energy-absorbing bumpers are available as optional equipment on CJ, Cherokee, and Wagoneer models. They are not available on Trucks, nor on CJ's with rear-mounted spare tire.

Front bumper guards are available as an option on standard bumpers on all except CJ models.

ENERGY-ABSORBING BUMPER SYSTEM

Description

The energy-absorbing bumper system consists of the bumper assembly, mounting brackets, and two energy absorbers.

The energy absorbers consists of a piston tube assembly (fig. 14-16). The piston tube is charged with an inert gas, and the cylinder tube is filled with hydraulic fluid.

The piston and cylinder tube assemblies are united by crimping the cylinder tube at the piston tube stop ring. The recess in the stop ring area is filled with grease to prevent the entrance of water and other contaminants.

The piston tube assembly is attached to the vehicle bumper and the cylinder tube assembly is attached to the frame.

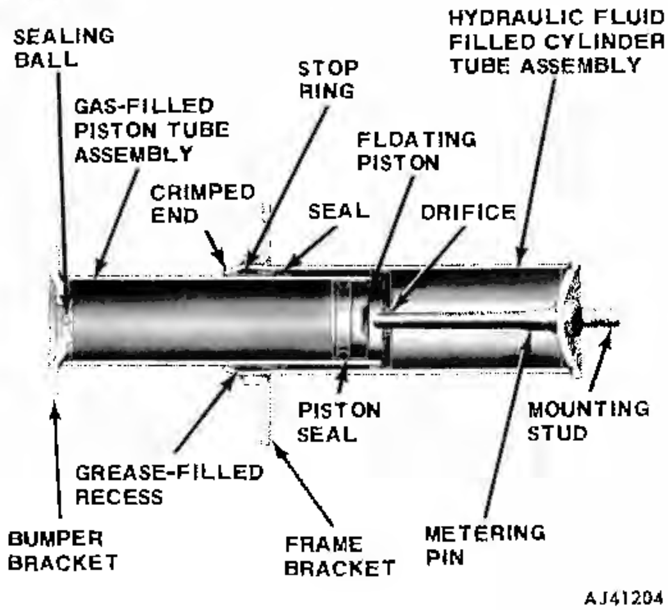

Fig. 14-16 Cross-Section of Front Energy Absorber in Extended Position

Operation

Gas pressure in the piston tube assembly maintains the unit in an extended position with sufficient rigidity to withstand normal jacking and wrecker towing stresses. Extension is limited by a stop ring on the outside of the piston tube.

Upon impact hydraulic fluid from the cylinder tube is forced into the piston tube through a metering orifice. The rate at which the hydraulic fluid passes through the orifice is controlled by a metering pin. It is this controlled passage of hydraulic fluid which dampens the impact and provides energy absorption.

Hydraulic fluid that is forced from the cylinder tube into the piston tube displaces the floating piston and

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compresses the gas behind it. After impact, the pressure of the compressed gas behind the floating piston forces the hydraulic fluid back into the cylinder tube, and returns the absorber to its extended position.

Diagnostic Procedure

CAUTION: *Energy absorbers must not be tested by driving vehicle against posts, walls, or barriers.*

NOTE: *The right and left energy absorbers should be diagnosed separately.*

Leakage

Some oil wetting may be visible due to slight seepage of the grease packed as a sealant in the recess above the crimp (fig. 14-16). Such stains or oil traces on the piston tube near the crimped end are normal. If hydraulic fluid drips continuously from the crimped end, or from the mounting stud end of the unit, a leak is indicated and the unit should be replaced.

Damage

Inspect bumper assembly, mounting brackets, and energy absorbers for evidence of collision damage. Some scuffing of the piston tube will occur and is to be considered normal. If there is obvious damage to the unit (dents, torn mounts, etc.), it should be replaced.

On-Vehicle Test

Energy absorbers can be tested on the vehicle by compressing each unit separately 3/8-inch (or more), and observing whether the bumper returns to its normal position. The ignition should be off, the transmission in park (P) position, the parking brake set, and service brake pedal depressing tool installed. A suitable barrier can be utilized, such as pillar, wall, post, or an anchorable device such as that used for body or frame repair. The jacking device can be a hydraulic or mechanical jack or a hydraulic pump-type unit. Refer to fig. 14-17 for typical test setup.

(1) Align jacking device with energy absorber being tested.

NOTE: *The jacking device should be positioned squarely with the bumper to avoid slipping.*

(2) Apply pressure to compress energy absorber at least 3/8-inch, using an indicator (such as a six-inch scale) to detect travel.

(3) Relieve pressure and allow bumper to return to original position.

(4) Repeat above procedures for each energy absorber.

If bumper returns to its original position, the energy absorber is capable of withstanding low-speed impacts. If an energy absorber fails to return to its original position, it should be replaced.

fluid drips continuously from the crimped end, or from the mounting stud end of the unit, a leak is indicated and the unit should be replaced.

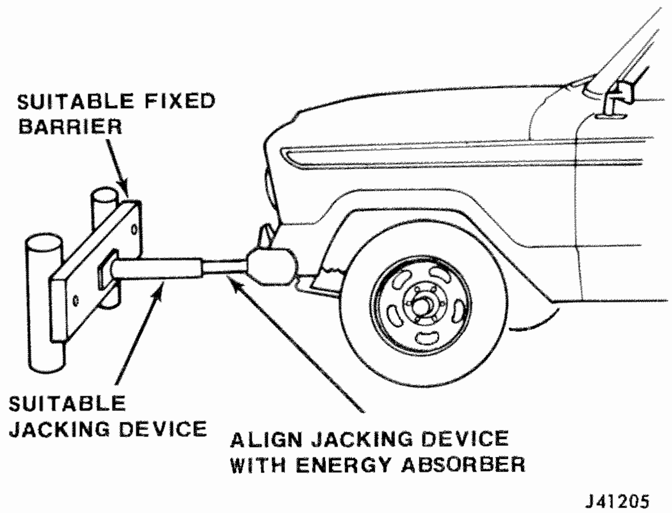

Fig. 14-17 Typical On-Vehicle Energy Absorber Test

Bench Test

Energy absorbers may be bench tested prior to installation on a vehicle or to check energy absorbers removed while making collision repairs.

Use a suitable arbor press to compress energy absorber at least 3/8-inch. Observe whether the energy absorber returns to its original position. If not, the unit should be replaced.

Disposal

Relieve gas pressure if the energy absorber is to be scrapped. Use a heavy metal punch and hammer, and break the weld at the sealing ball in the end of the piston tube (fig. 14-16).

WARNING: *Wear approved safety glasses when depressurizing an energy absorber. Never apply heat or attempt to weld or repair pressurized units.*

When an energy absorber is bound-up as a result of a collision it should be removed from the vehicle only after the gas pressure has been relieved.

Use the following procedure to depressurize the unit.

(1) Stand clear of the bumper.

(2) Provide positive restraint by securing the bumper to the frame or bumper support with a chain or cable.

(3) Relieve gas pressure by drilling a 1/16-inch hole in the piston tube near the bumper bracket end.

(4) Remove energy absorber from vehicle.

Replacement

(1) Support one end of the bumper and remove energy absorber-to-bumper bolts at supported end.

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(2) Remove energy absorber-to-bumper bolts at opposite end and remove bumper horizontally.

CAUTION: *Do not allow either end of the bumper assembly to drop. If dropped, the energy absorber at the opposite end could be turned and the crimped seal damaged.*

(3) Remove hardware attaching energy absorber to vehicle frame and remove energy absorber from vehicle.

(4) Install new energy absorber frame and install attaching hardware loosely.

(5) Position bumper assembly on energy absorbers and install attaching hardware loosely.

(6) Align bumper assembly to vehicle and tighten all attaching hardware.

TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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DOORS AND REAR QUARTER

DOOR ADJUSTMENTS

The doors are adjusted at the hinge mounting points on the body.

On rear doors, floating plates are located in the body pillars to permit adjustment up, down, in or out. To adjust foward or back, add or remove shims between the hinge and hinge pillar.

On front doors, slotted holes are provided in the hinge for in or out adjustment on the pillars, and up and down on the doors.

Prior to any door adjustment or alignment, the adjustable striker must be removed to allow the door to close freely in proper alignment without striker interference.

The door lock striker is adjustable up, down, in or out and can be shimmed forward or back to hold the door in the properly aligned position.

The door latch striker should be set so that the latch enters the striker without binding, yet provides secure retention for the lock and prevents up and down or in and out movement of the door.

The striker should also be adjusted in or out to allow the door latch to be fully engaged. The door should be flush with the adjacent body panels. Oil holes are provided in the door hinges for periodic lubrication of the door hinge pins.

NOTE: *It is possible to set the striker in so far that the door is closed tight but only the safety catch is engaged. This will prevent locking the door with the key or the pushbutton lock rod.*

DOOR TRIM PANELS

Trim panels consist of hardboard composition covered with a vinyl material. They are fastened to the door with spring clips inserted into holes in the door inner panel.

Removal

(1) Remove metal strip or plugs on armrest and remove attaching screws and armrest.

(2) Remove window regulator handle and door latch remote control handle.

(3) Remove trim panel attaching screws on bottom of trim panel.

(4) Pry trim panel-to-door clips along sides loose with tool J-2631-01 and remove panel.

Installation

(1) Position trim panel on door and install clips in holes in inner door panel.

NOTE: *To prevent creasing the trim panel cover, do not hammer or exert excessive force on the clips.*

(2) Install screws along bottom of trim panel.

(3) Install window regulator handle and door latch remote control handle.

(4) Install armrest and metal strip or plugs.

WATER SHIELD

The water shield is attached to the door inner panel with adhesive. To remove water shield use a putty knife between shield and door inner panel to loosen adhesive.

When installing water shield be sure the slit lower portion is tucked inside the door panel at the access opening and that the shield is cemented securely to the door inner panel.

OUTSIDE DOOR HANDLE

Removal

(1) Remove door trim panel and water shield.

(2) Raise window to fully closed position.

(3) Through opening in inner door panel, remove handle attaching screws and remove handle and gaskets.

Installation

(1) Position gaskets and handle on door and secure with attaching screws.

(2) Install water shield and door trim panel.

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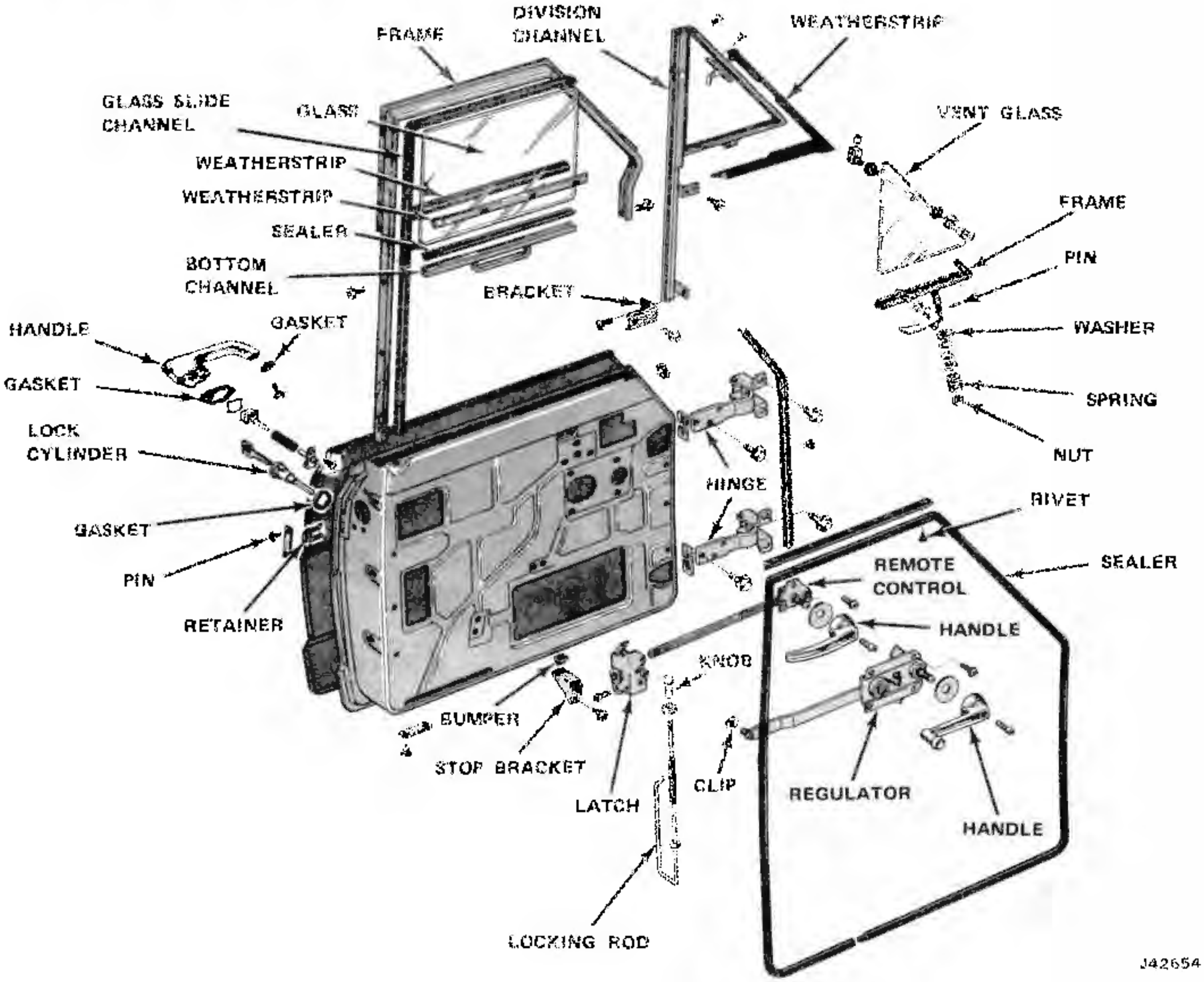

Fig. 15-1 Front Door - Wagoneer - Cherokee - Truck

KEY LOCK

Removal

(1) Remove rubber sealer along rear edge of door by prying out the retaining pins to expose lock cylinder retainer (fig. 15-1).

(2) Using flat blade screwdriver remove retainer.

(3) Remove lock cylinder and extension rod from outside of door.

Installation

(1) Position lock cylinder in door making sure extension rod is inserted in square hole in latch.

(2) Install lock cylinder retainer.

(3) Install rubber sealer with retaining pins.

LOCK CYLINDER CODING

The lock cylinder is serviced in a kit which includes an uncoded cylinder, housing and a dust cover.

Whenever a lock cylinder replacement is required, the uncoded service cylinder can be coded to match the existing key.

(1) Remove lock cylinder from door.

(2) Remove dust cover from original lock housing and remove lock cylinder and discard.

(3) Insert original key into new uncoded service lock cylinder.

(4) Press cylinder into special Door Cylinder Lock Tumbler Filing Fixture Tool J-22977, with notched side of key up and long tumbler in slot (fig. 15-2).

(5) Hold filing fixture in vise and file tumblers flush with flat side of fixture. Use a standard 5/8-inch double cut bastard file. Finish filing with smooth mill file.

(6) Remove lock cylinder from fixture and insert cylinder into opposite end of fixture with notched side of key down as shown in figure 2.

NOTE: This side of the fixture can be identified as the end without the double slot cut out (180 degrees apart).

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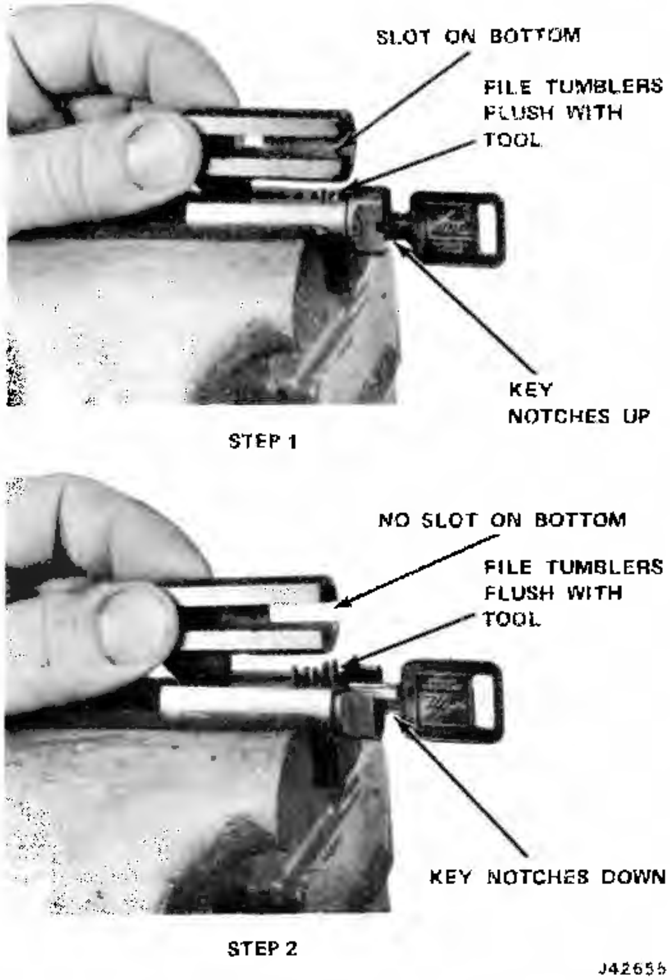

Fig. 15-2 Filing Lock Tumblers

(7) File tumblers flush with flat side of fixture.

NOTE: *Utilize the filing fixtures as a test gauge. Remove the fixture from the vise and if the tumblers are filed correctly, the lock cylinder will turn in the fixture.*

(8) Insert new lock cylinder into lock housing.
(9) Install new dust cap and crimp ends of cap over lock housing.
(10) Install lock cylinder in door.

LATCH AND REMOTE CONTROL

Removal

(1) Remove door trim panel and water shield.
(2) Remove lock cylinder.
(3) Remove screws from inside door lock remote control (fig. 15-1). Push control in and lower to bottom of door.
(4) Disconnect remote control arm from door latch and remove remote control assembly through access hole at bottom of door.
(5) Remove screws attaching door latch to door panel.
(6) Push door latch in and turn it 90° to free it from lock lever rod and remove through lower access hole.

Installation

(1) Position door latch on door panel and install attaching screws.
(2) Connect remote control arm to door latch. Position remote control on door inner panel and install attaching screws.

DOOR LOCKING ROD

Removal

(1) Remove door trim panel and water shield.
(2) Remove door lock push knobs.
(3) Push nylon bushing (on rod) off bracket.

Installation

(1) Install nylon bushing on bracket.
(2) Install door lock push knob.
(3) Install water shield and door trim panel.

FRONT DOOR GLASS

Removal

(1) Remove door trim panel and water shield.
(2) Remove glass stop bracket (fig. 15-1).
(3) Remove lower division bar attaching bracket.
(4) Remove division bar upper bracket-to-door panel attaching screws.
(5) Remove lock rod guide bushing.

NOTE: *Move lock rod aside so glass may be lowered to bottom of door.*

(6) Remove screws attaching remote control assembly to door panel and lower to bottom of door.
(7) Lower door glass and remove retaining clip.
(8) Lower glass to bottom of door.
(9) Push lower end of division bar toward front of door to release glass from channel.
(10) Move glass toward front of door to release it from rear channel.
(11) Rotate glass vertically 90° and guide it between inner and outer door panels.

Installation

(1) Position door glass in lower section of door so lifter channel has recessed portion of guide groove toward inner door panel.
(2) Position glass in rear channel and position front channel so glass can be inserted.
(3) Slide glass up in channels and crank regulator

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arm down to line up pin at end of regulator arm with slot in lifter channel.

(4) Install retainer on regulator arm.

(5) Position remote control assembly and install attaching screws.

(6) Position lock rod and install lock rod guide bushing to door panel.

(7) Install door lock push knob.

(8) Install upper and lower division bar attaching brackets.

(9) Install glass stop.

(10)Install water shield and trim panel.

FRONT DOOR VENT ASSEMBLY

Removal

(1) Remove door trim panel and water shield.

(2) Remove door window glass.

(3) Remove upper glass channel.

(4) Remove vent assembly attaching screws under weatherseal on leading edge of door frame and under base of vent weatherseal (fig. 15-1).

(5) Move vent assembly toward rear of door, tipping it to clear upper door frame.

(6) Pull ventilator assembly straight out until upper attaching bracket is above opening between outer and inner door panels.

(7) Rotate vent assembly 90 degrees to position lower attaching bracket on run channel to clear opening between door panels.

(8) Remove vent assembly.

Installation

(1) Position vent assembly in door.

(2) Install vent assembly attaching screws through door frame.

(3) Install upper glass run channel.

(4) Install door window glass.

(5) Install water shield and door trim panel.

FRONT DOOR WINDOW REGULATOR

Removal

(1) Remove door trim panel and panel and water shield.

(2) Lower glass and remove clips holding regulator arm to glass bottom channel (fig. 15-1).

(3) Remove door weatherstrip.

(4) Raise and support glass.

(5) Lower regulator arm and remove attaching screws.

(6) Remove regulator through access hole in door.

Installation

(1) Install regulator in door and secure with attaching screws.

(2) Position regulator arm in glass bottom channel.

(3) Install retainer clip on regulator arm.

(4) Install door belt weatherstrip.

(5) Remove glass support.

(6) Install water shield and door trim panel.

REAR DOOR REMOTE CONTROL AND LOCK LEVER ROD

Removal

(1) Remove trim panel and water shield.

(2) Remove door lock push nob.

(3) Remove screws attaching lock control arm to inner door panel.

(4) Remove lock lever rod.

(5) Remove door latch attaching screws.

(6) Disconnect remote control arm and turn latch 90 degrees.

(7) Remove lock lever rod and bellcrank (fig. 15-3).

Installation

(1) Position latch in door and install lock lever rod and bellcrank.

(2) Connect remote control arm to latch and turn latch 90°. Secure latch to door panel with attaching screws.

(3) Install lock lever rod.

(4) Position lock control arm on inner door panel and install attaching screws.

(5) Install door lock push knob.

(6) Install water shield and trim panel.

REAR DOOR GLASS

Removal

(1) Remove door trim panel and water shield.

(2) Remove glass stop bracket.

(3) Remove rear glass channel lower attaching bracket.

(4) Lower door glass to obtain access to retainer clip.

(5) Remove retainer clip, disengage pin from slot in channel and lower glass to bottom of door (fig. 15-3).

(6) Remove inner and outer belt weatherstrips.

(7) Remove upper glass channel.

(8)Remove stationary vent assembly attaching screws (located under door weatherstrip fig. 15-3).

(9) Tilt top of vent assembly forward approximately one inch.

(10) Push lower end of rear glass channel toward rear of door to release glass.

(11) Move glass toward rear of door to release glass from front channel.

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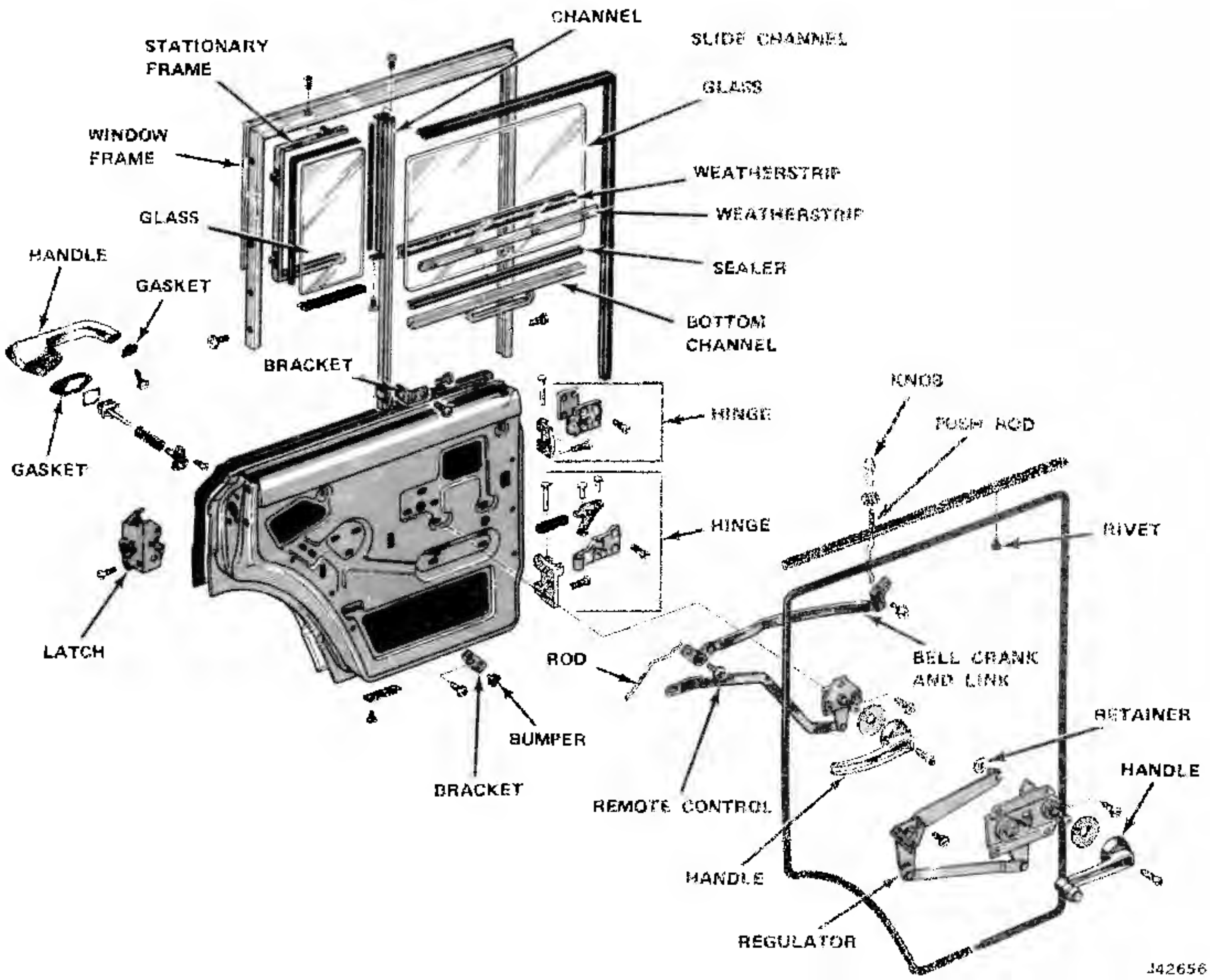

Fig. 15-3 Rear Door - Wagoneer

(12) Rotate glass 90 degrees and guide glass between inner and outer door panels.

Installation

(1) Position door glass in lower section of door so channel has recessed portion toward inner door panel.

(2) Position door glass in front run channel and push rear channel over glass.

(3) Slide glass up and crank regulator arm down until pin on regulator arm can be inserted in slot of lifter channel.

(4) Install retainer.

(5) Position stationary vent assembly and install attaching screws.

(6) Install upper glass run channel.

(7) Install inner and outer belt weatherstrip.

(8) Install rear channel attaching bracket.

(9) Install glass stop bracket.

(10) Check operation of glass.

(11) Install water shield and door trim panel

REAR DOOR VENT ASSEMBLY

Removal

(1) Remove door glass.

(2) Apply soap solution under vent weatherstrip and along inner and outer door panels.

(3) Slide vent assembly forward to center of door glass opening.

(4) Push vent assembly down through opening between inner and outer door panels to disengage assembly from upper door frame.

(5) Lower top of vent assembly down to clear upper door frame.

(6) Pull vent assembly straight up until all weatherseal is clear of door panel and vent assembly can be rotated.

(7) Rotate assembly to position lower attaching bracket on channel and pull assembly up and out between panels.

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Installation

(1) Install assembly between panels.
(2) Engage vent assembly in upper door frame and slide vent into position.
(3) Install door glass.

REAR DOOR WINDOW REGULATOR

Removal

(1) Remove trim panel and water shield.
(2) Remove regulator arm-to-glass bottom channel retaining clip.
(3) Remove door belt weatherstrip.
(4) Push regulator pin out of glass channel.
(5) Remove regulator attaching screws and remove regualtor.

Installation

(1) Position regulator on inner door panel and secure with attaching screws.
(2) Install regulator pin in glass channel and install retaining clip.
(3) Install door belt weatherstrip.
(4) Install water shield and door trim panel.

REAR QUARTER TRIM PANEL

Removal

(1) Remove ash receiver, two ash receiver holder screws, and holder (if equipped).
(2) Remove armrest metal overlay strip, two armrest screws, and armrest (if equipped).
(3) Remove the two trim panel screws at base of panel.
(4) Pry loose the trim panel attaching clips along both vertical sides of panel.

Installation

(1) Inspect all panel attaching clips; replace any that are bent.
(2) to prevent damage to trim panel, do not hammer or exert excessive force on the clips.
(3) Install trim panel attaching screws.
(4) Install armrest and armrest metal overlay strip (if equipped).
(5) Install ash receiver holder and ash receiver (if equipped).

PIVOTING VENT WINDOW (CHEROKEE)

Removal

(1) Remove mylar insert from weatherstrip.
(2) Pull weatherstrip back and remove window frame-to-body screws (fig. 15-4).
(3) Pull window frame toward outside of vehicle.

NOTE: *If weatherstrip sticks to body, use a wooden wand and pry loose at one corner.*

(4) Remove window frame and weatherstrip assembly.
(5) Inspect weatherstrip and replace if necessary.

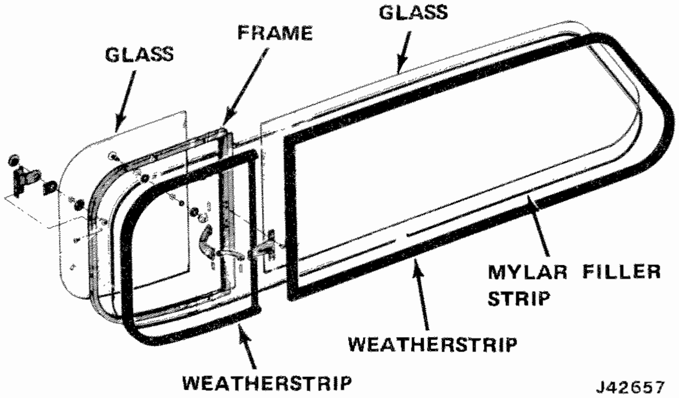

Fig. 15-4 Rear Quarter Window - Cherokee

Installation

(1) Lubricate weatherstrip with soap and water solution.
(2) Place window frame and weatherstrip assembly into position in window opening.
(3) Using wooden wand, work weatherstrip inner flange into position.

NOTE: *Apply 3M brand windshield sealer or equivalent at window frame rear corners.*

(4) Obtain proper mylar alignment with weatherstrip and work into recess in weatherstrip.

Vent Window Glass

Removal

(1) Remove four handle-to-frame attaching screws (fig. 15-4).
(2) Remove two glass hinge screws and washers.
(3) Remove glass.

NOTE: *If glass sticks to the hinges, remove glass by carefully pushing out hinge screw inserts.*

(4) To remove handle assembly from glass, carefully drive out handle assembly-to-stud roll pin.
(5) Unscrew stud nut and remove stud from glass.

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Installation

(1) Attach glass to frame using hinge screw inserts, washers, and screws.
(2) Attach handle assembly to frame.
(3) Attach stud and nut to glass, and connect stud to handle assembly with roll pin.
(4) Latch window and check for water leaks.
(5) If water leakage is evident, apply sealant in affected areas.

STATIONARY WINDOW (WAGONEER)

(1) Remove interior garnish moldings from around window and break seal loose between weatherstrip and body panels.
(2) Push glass toward inside of vehicle.
(3) Remove weatherstrip from around glass and clean old sealer from glass cavity and flange cavity.
(4) Before installing glass in weather-strip, apply a 3/16-inch bead of medium bodied sealer in glass cavity completely around weatherstrip using a pressure type applicator (fig. 15-5).
(5) With glass installed in weatherstrip and before installing glass and weatherstrip into opening, insert a 1/4-inch cord completely around weatherstrip in flange cavity.

NOTE: *The ends of the cord should hang out over the outside surface of the glass approximately in the center of the upper weatherstrip.*

(6) Place glass and weatherstrip into position in window opening with ends of cord hanging outside vehicle (fig. 15-6).

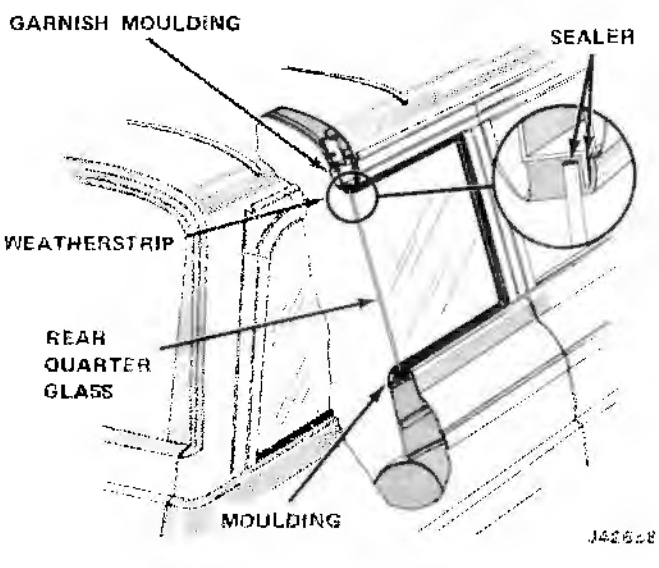

Fig. 15-5 Rear Quarter Window - Wagoneer

(7) Pull on ends of cord to pull lip of weatherstrip over body panel. With cord removed, weatherstrip should be correctly positioned.
(8) Replace interior garnish molding.
(9) Apply bead of medium-bodied sealer from outside of vehicle between weatherstrip and body panels.
(10) Clean excess sealer from glass and exterior body surface.
(11) Test window for water leaks.

Fig. 15-6 Rear Quarter Window Installation

STATIONARY WINDOW (CHEROKEE)

NOTE: *On Cherokee custom models the pivoting rear quarter vent window and frame must be removed prior to removal of the stationary window.*

(1) Using a wooden wand, free the weatherstrip-to-body flange on the inside of vehicle.
(2) Push window and weatherstrip toward the outside of the vehicle.
(3) Remove weatherstrip from glass and clean off sealer from glass cavity.
(4) Before installing glass in weatherstrip, apply a 3/16-inch bead of medium-bodied sealant in the weatherstrip glass cavity using a pressure type applicator.
(5) Lubricate weatherstrip with soapy water.
(6) Place glass and weatherstrip into position in the window opening.
(7) With weatherstrip body flange in proper position at the bottom of the window opening, use a wooden wand and "walk" the weatherstrip-to-body flange into position.
(8) Clean excess sealer from glass.
(9) Check for water leaks.
(10) If water leakage is evident, apply sealant in the affected areas and realign weatherstrip

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TECHNICAL SERVICE LETTER REFERENCE

Date	Letter No.	Subject	Changes information on Page No.

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TAILGATE - LUGGAGE RACK

TAILGATE

CJ MODELS

General

The hinged tailgate is held in the closed, up position with hooks which pass through slotted brackets on the tailgate and on the body. The hinges are designed in such a way that the tailgate can be easily removed. The body half of the hinge is slotted and the tailgate half has a matching flat surface. However, to prevent accidental dropping of the tailgate, the flat surface on the left hinge is not in line with the flat surface on the right hinge.

Removal

(1) Rotate the tailgate approximately 45° from full up position and disengage the right hinge.

(2) Rotate the tailgate an additional few degrees and then disengage the left hinge.

Installation

(1) Hold the tailgate at approximately 45° from full up position and engage the right hinge.

(2) Rotate the tailgate an additional few degrees and then engage the left hinge.

Adjustment

(1) Loosen the hinge attaching bolts and slide the body half of the hinge up, down or to the sides as needed.

(2) Tighten the bolts.

CHEROKEE AND WAGONEER

General

The tailgate is a horizontally hinged unit equipped with a manual or electrically operated window regulator. An access hole in the inner panel is for installing and servicing the window regulator and latch assemblies (fig. 16-1).

A torque rod serves as a counterbalance to assist in opening as well as closing the tailgate.

Tailgate hinges are now accessible at the body side of the hinge for easier adjustment/replacement.

Redesigned and relocated dovetail assemblies provide better tailgate closure for improved weatherproofing and rattle elimination.

Tailgate weatherseal is now body-mounted for better wind and water-leak resistance.

Adjustment

Tailgate adjustment is similar to side door adjustments: proper alignment is obtained by changing the position of the hinges relative to the body. Cherokee and Wagoneer vehicles have hinge cover plates in the body floor and tailgate for easy access to hinge bolts (fig. 16-1). The dovetail assemblies, which stabilize the tailgate and function as an overslam bumper, are adjusted by bringing the dovetail studs into alignment with the dovetail cap. The dovetail studs are located on the body pillars near the striker plates, and are adjustable. The dovetail caps are located on the tailgate and are non-adjustable.

Hinges

(1) Remove dovetail studs from body pillars.

(2) Remove the two body hinge cover plates.

(3) Loosen bolts attaching hinges to body and adjust floating plates until lower portion of tailgate closes flush or underflush with body sheet metal to ensure proper compression of the weatherseal. Tighten hinge bolts 15 to 20-foot-pounds torque.

(4) Replace body hinge cover plates.

(5) Replace and adjust dovetail studs.

Dovetail Assemblies

(1) Loosen dovetail stud locking nuts.

(2) Close the tailgate into the locks.

(3) Adjust dovetail studs into dovetail caps and tighten stud locking nuts.

(4) Check tailgate for proper alignment and adjust-

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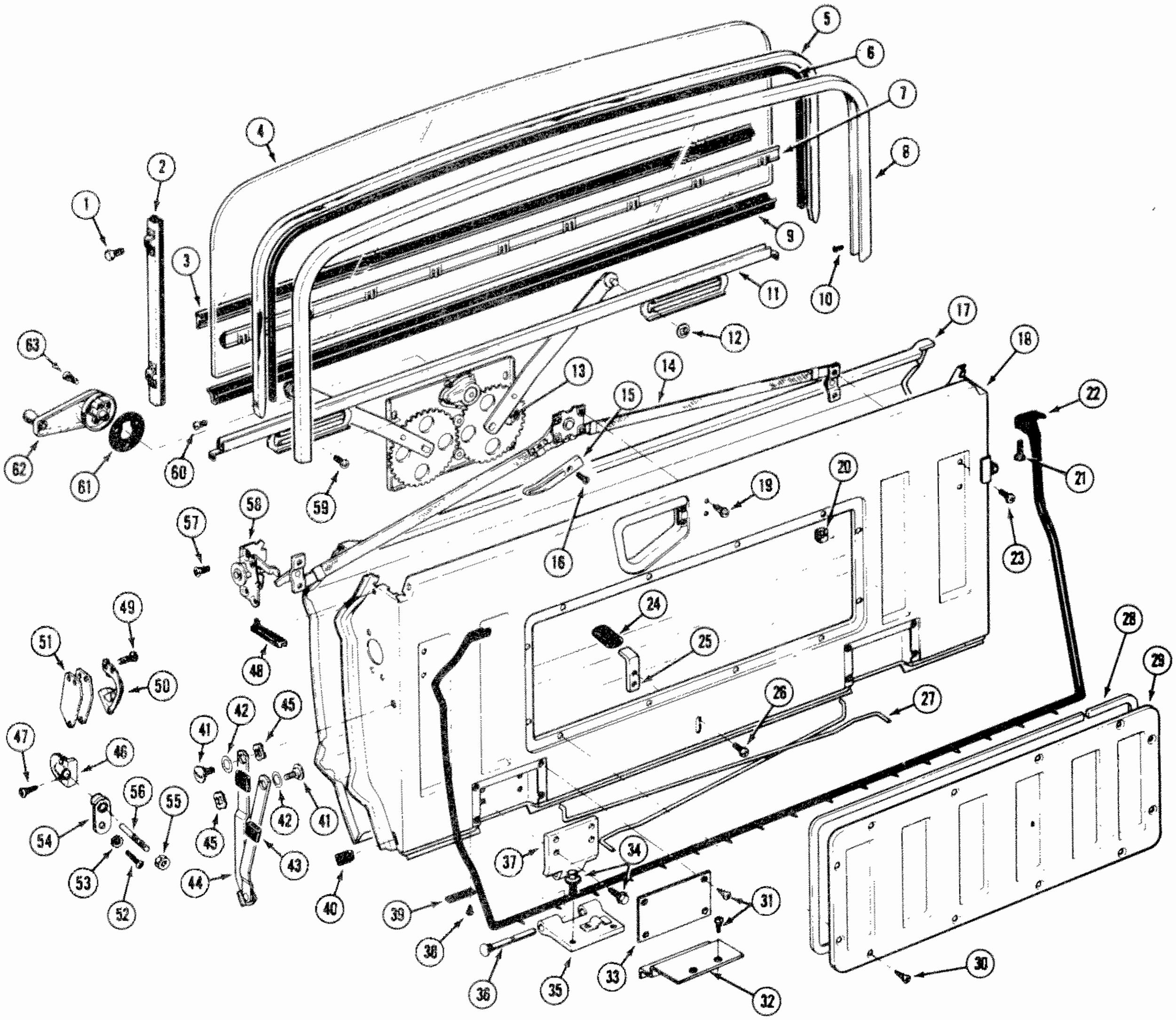

1. Hexagon Screw
2. Lower Channel
3. Weatherstrip
4. Tailgate Glass
5. Run Channel
6. Upper Cushion
7. Weatherstrip
8. Glass Frame
9. Channel Sealer
10. Tapping Screw
11. Bottom Channel
12. Stud Retainer
13. Window Regulator
14. Remote Control
15. Release Handle
16. Oval Head Screw
17. Outer Panel
18. Tailgate
19. Machine Screw
20. Speed Nut
21. Plastic Rivet
22. Tailgate Sealer
23. Machine Screw
24. Bracket Bumper
25. Stop Bracket
26. Machine Screw
27. Torque Rod
28. Cover Gasket
29. Access Cover
30. Tapping Screw
31. Tapping Screw
32. Cover Plate
33. Cover Plate
34. Hinge Screw
35. Body Half Hinge
36. Hinge Pin
37. Tailgate Half Hinge
38. Plastic Rivet
39. Dust Seal
40. Arm Bumper
41. Shoulder Bolt
42. Spring Washer
43. Arm Sleeve
44. Support Arm
45. Lock Washer
46. Dovetail Cap
47. Tapping Screw
48. End Cap
49. Machine Screw
50. Tailgate Striker
51. Striker Shim
52. Machine Screw
53. Lock Washer
54. Tailgate Dovetail
55. Hexagon Nut
56. Dovetail Stud
57. Machine Screw
58. Tailgate Latch
59. Machine Screw
60. Machine Screw
61. Handle Gasket
62. Regulator Handle
63. Machine Screw

J41006

Fig. 16-1 Cherokee-Wagoneer - Manual Regulator

ment. Be sure tailgate latches properly with strikers, and dovetails align into caps.

Striker Assemblies

(1) Loosen dovetail stud locking nuts.

(2) The latch teeth should be aligned and nest on the center of the strikers.

(3) Add or remove striker shim to obtain this adjustment.

(4) Adjust the strikers so the latches enter the strikers freely, and the tailgate provides a flush fit with adjacent panels.

(5) Perform dovetail assemblies adjustment.

Hinge Replacement

(1) Open tailgate (and, if vehicle is equipped with cargo area floor covering, remove moulding, and place floor covering aside).

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(2) Remove access hole cover plate(s) from body and tailgate.

(3) Raise tailgate to vertical position to unload counterbalance torque rods, and pry rods from clip welded to body half of each hinge.

(4) Scribe outline of existing hinge(s) on body and tailgate for reference.

(5) support tailgate in horizontal position, remove screws attaching hinge(s), and remove hinge(s).

(6) Install replacement hinge(s), being careful to align with scribe marks. Tighten screws to 15 to 20 foot-pounds torque.

(7) Raise tailgate to vertical position and install counterbalance torque rods in welded clips on body half of hinges.

(8) Check tailgate alignment and adjust if necessary.

(9) Install access hole cover plates on body and tailgate (and if so equipped, replace cargo area floor covering and moulding).

Tailgate and Torque Rod

Removal

(1) Remove tailgate access cover plate and disconnect wiring.

(2) Remove tailgate seal cover assembly.

(3) Close tailgate and drive out hinge pins.

(4) With tailgate in a vertical position, counterbalance torque rods are unloaded and can be pried from the clip which is welded to the body half of the hinge.

(5) Remove screws holding lower end of support arms to tailgate.

Installation

(1) Attach support arms to tailgate and raise tailgate to a vertical position in tailgate opening.

(2) Insert curved end of one torque rod in hole at bottom edge of tailgate and right-angle tapered end of rod in clip which is welded to body half of the hinge. Attach other torque rod in same manner.

(3) Install hinge pins with head of pin on inboard side of hinge.

(4) Install tailgate seal cover assembly.

(5) Connect wiring and replace access cover plate.

(6) Adjust tailgate.

Tailgate Lock Remote Control

Replacement

NOTE: *Should there be interference between the tailgate glass lifter channel and the tailgate remote control assembly, the remote control assembly must be replaced with a new assembly.*

(1) Lower tailgate and move tailgate glass to the extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve the stress on its lower edge.

(2) Remove access cover and tailgate latch handle from tailgate.

(3) Remove screws holding center of remote control assembly.

(4) Remove the screws on each end of the remote control rods.

(5) Release lower edge of vinyl water shield on vehicles so equipped.

(6) Pull rods down toward bottom of tailgate to obtain side clearance.

(7) Move the remote control assembly toward the side of the tailgate so as to free remote control from latch opening in tailgate. The remote control assembly is now free to be removed through the access cover opening.

Tailgate Lock Replacement

(1) Lower tailgate and move tailgate glass to the extreme out position so remote control assembly will be accessible. Tailgate glass should be supported to relieve stress on its lower edge.

(2) Remove access cover and remove screws attaching ends of remote control rods to tailgate.

(3) Remove screws attaching lock assemblies to ends of gate and remove lock assemblies.

Tailgate Glass Replacement

Tailgate glass is operated by a double-arm window regulator which is connected directly to an outside window regular handle. The complete window assembly will slide up and out of the run channels when the pins at the ends of the regulator arms are withdrawn from the slot in the lifter channel.

(1) Remove the access cover on inside tailgate panel and pry off retainers with a screwdriver.

NOTE: *Retainers can be damaged when removed and their condition should be checked. When installing retainers, the tabs must be firmly locked in groove of pin. If difficulty is experienced when installing retainers, they were probably damaged during removal and should be replaced.*

(2) When installing tailgate glass check the glass assembly and regulator separately to make sure that both operate freely before connecting the two together.

(3) Should difficulty be experienced in raising the window from its lowered position, replace the existing glass stop bumper.

(4) Push the new bumper on the bracket as far as possible.

(5) Position its free end to lay up against the outside panel.

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Tailgate Window Regulator Replacement

(1) Remove the access cover.

(2) Remove tailgate window.

(3) Remove regulator handle by sliding name plate cover aside and rotating handle until hole in handle is aligned with screws that attach handle assembly to the tailgate. Remove attaching screws and handle.

(4) Remove the screws that attach the regulator assembly to the tailgate.

(5) The regulator assembly can now be removed through access cover opening.

(6) After installation and before access cover is replaced, run window up and down to check that window fits properly. The window regulator can be adjusted by loosening the attaching screws and moving the regulator assembly in the slotted screw holes until proper window adjustment is obtained.

(7) Adjust handle to be in vertical position when window is full up.

Tailgate Glass Adjustment

The tailgate glass, when closed, must seat fully into the upper glass channel to obtain a positive seal at the horizontal weatherstrip located at the top of the tailgate. If the tailgate glass does not seat properly when closed, check the upper glass channel to be certain it is bottomed in the body opening, also check alignment of the tailgate glass to tailgate glass run channel.

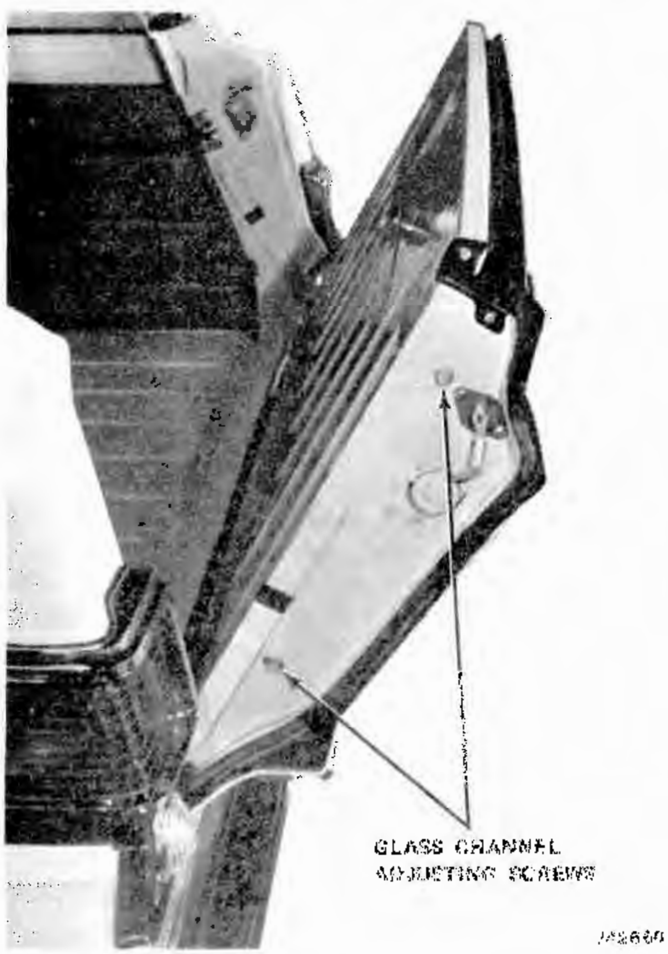

Fig. 16-2 Glass Channel Adjustment

(1) If adjustment is necessary, loosen the two capscrews on either side panel of the tailgate(fig. 16-2).

(2) Raise and lower the glass several times with the tailgate in the closed position. This will align the glass with the channel.

(3) Open the tailgate slightly and tighten the adjusting screws with the tailgate in the vertical position.

TRUCK TAILGATE

Thriftside Pickup

The tailgate on the Thriftside Pickup box is hinged at the rear, with hinges bolted to the side panel posts. The hinge attaching bolts are accessible for hinge adjustment or replacement while the tailgate is in the closed or open position.

The tailgate is held in the up position with hooks which pass through slotted brackets on the side panel posts.

Townside Pickup

The tailgate on the pickup box is hinged at both sides. It is necessary to lower the tailgate for access to the cross recess countersunk attaching bolts.

The tailgate on the pickup box is held in the up or closed position with spring-loaded latches at the top of the gate. A paddle handle, located in the center of the tailgate operates the latches at each side through connecting rods.

Pin type hinges are located on the sides of the pickup box. The hinge pin brackets are attached with countersunk attaching bolts and cage nuts for easier adjusting.

The left side hinge pin is a solid round bar. The right side pin is similar but with two flat surfaces which correspond with a notch in the tailgate half of the hinge. The notch and the two flat surfaces allow the tailgate to be quickly removed from the tailgate opening.

To remove, open and lower the tailgate. Remove the side supports and then raise the tailgate to about 45° from horizontal. Disengage the right side hinge and move the tailgate to the right to disengage the left side hinge.

ELECTRIC TAILGATE WINDOW

The ignition switch must be in either the accessory or ignition position to energize the window lift circuit.

The rear window control switch is located left of the steering column on instrument panel. The switch is spring-loaded and will return to the neutral position.

The tailgate glass can also be lowered or raised, by inserting the ignition key in the tailgate lock. Turn the

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key to the left to lower it and to the right to raise it.

After the glass has been lowered, the tailgate can be opened by lifting up on the tailgate latch release handle on the inside of the tailgate at the center.

Safety Switch

A safety switch mounted in the upper left side of the tailgate prevents raising the glass when the tailgate is in the open position to avoid possible damage to glass channels and regulators.

Circuit Breakers

The electric tailgate regulator motor and wiring harness are protected by two 30-ampere circuit breakers located in the fuse block.

Instrument Panel Switch.

The rear window switch is mounted at the lower left side of the instrument panel. The switch is retained to the instrument panel by two screws.

Wiring Harness

The tailgate circuit is a two-section wire harness: the body section, which is routed along the left side of the vehicle, and the section in the tailgate. The two harnesses are connected at the rear body crossmember.

Remove the tailgate cover plate to gain access to the wiring harness.

Tailgate Key Lock

The tailgate key lock assembly is held in place by two special screws located under the key hole cover.

Tailgate Window Switch

The tailgate window switch is mounted to the bottom side of the left regulator mounting support. It is fastened with two screws which are visible and accessible after the window regulator is removed.

Diagnosis Guide

Three colors are used for coding the wires in the tailgate electric window regulator circuit.

Refer to Cherokee and Wagoneer Wiring Diagram.

To test the tailgate wiring, switches, and motor, a 12-volt test lamp cam be used at the three-way connector located under the body at rear of the crossmember. Separate the connector 1/16-inch or just far enough to insert a thin test probe without disrupting the circuit.

Connect one probe of the test lamp to ground and the other to the individual tan, brown, or red with green tracer wires.

The red with green tracer is hot at all times to supply the tailgate key-operated switch.

When the ignition switch is in either the off or on position and both tailgate switches are in the neutral position, there is no current flow in the tan or brown wires.

When either switch is operated, current flow will be indicated in both the tan and the brown wires.

The tailgate safety switch must be closed to perform the above test. If the switch is open no current flow will be indicated in the brown wire when the tailgate switch is operated.

NOTE: *The tailgate safety switch is in series with the brown wire to prevent up operation when the tailgate is open.*

The proper assembly of all movable parts is important for satisfactory operation of the tailgate window.

The glass assembly must be in alignment in the tailgate and glass slide channels to operate with free movement.

The window regulator teeth in all gears, the coil springs, and the bottom channel slide sections, must be lubricated with Lubriplate or equivalent to ensure proper operation of the glass when it is raised or lowered.

LUGGAGE RACK

GENERAL

A new type of luggage rack is featured on 1974 Cherokees and Wagoneers. The rack (fig. 16-3) consists of side rails, adjustable end rails, adjustable load restrainers, end and center supports, and roof mounted slats. A spanner wrench, located in the vehicle glove box, facilitates securing the adjustable end rails and load restrainers.

The ends and center supports are attached to the roof top with well nuts and machine screws. The roof slats are attached with sheet metal screws and pressure sensitive tape.

Luggage rack components can be replaced without removing the entire assembly from vehicle.

NOTE: *Do not apply extreme pressure to support mounting screws during removal or installation as this may cause the well nuts to drop between the roof panel and headliner.*

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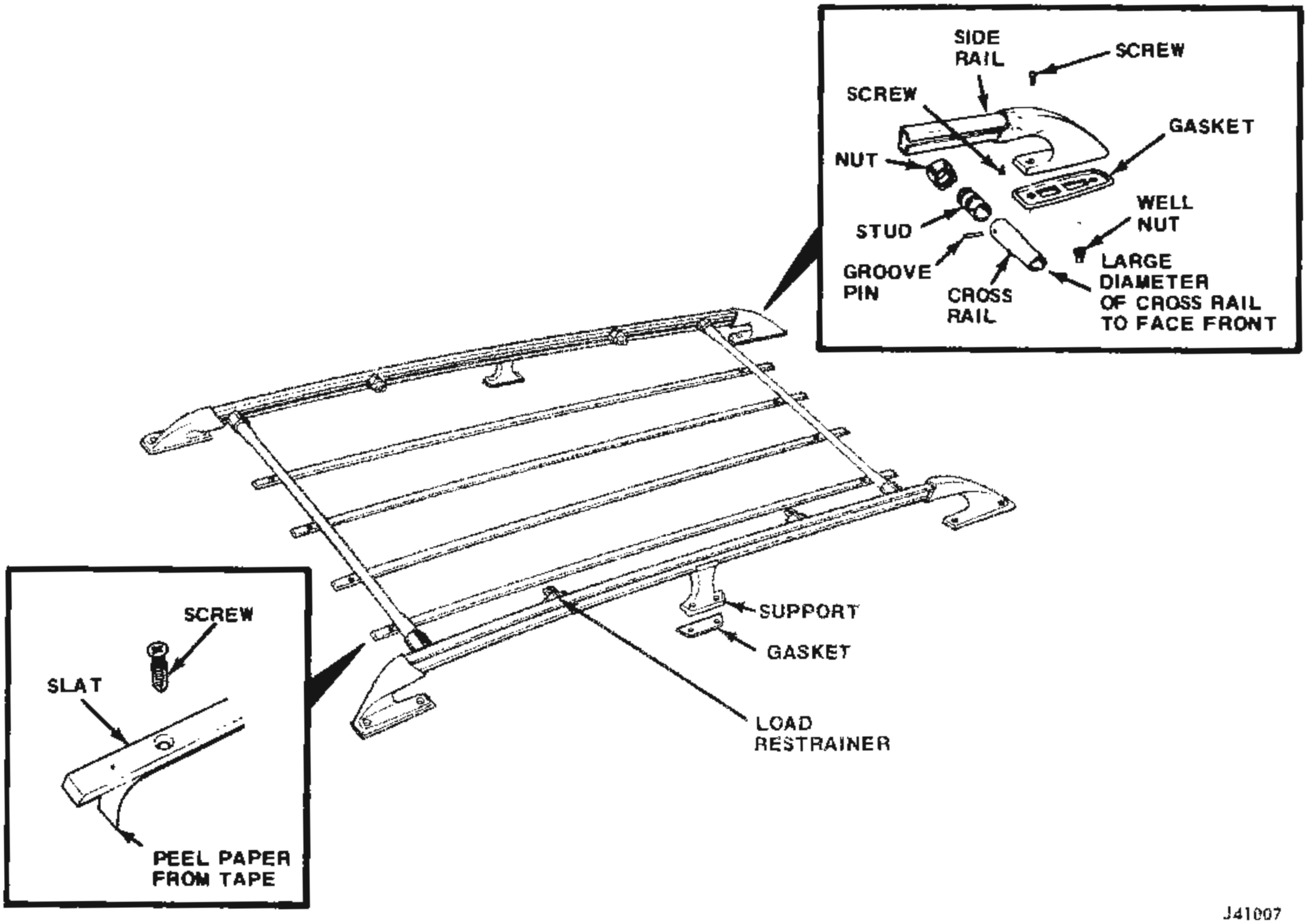

Fig. 16-3 Luggage Rack

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WINDSHIELD - REAR WINDOW - WINDSHIELD WIPER

WINDSHIELD

GENERAL

The windshields on all models consist of two sheets of glass, some flat and some curved, laminated together to form a one-piece safety glass.

All windshields are retained in their respective openings by similar lock-type rubber weatherstrips (channels).

The safety type glass is designed with adequate clearance to prevent stress and strains. When replacing cracked glass resulting from causes other than a direct blow or a known instance of temporary misalignment, it is very important that the cause of the breakage be determined and the condition corrected.

The inside rear view mirror bracket for Cherokee, Wagoneer, and Truck models is bonded directly to the windshield glass with a polyvinyl-butyral compound through a heat-induction process.

Service replacement windshield glass may have the rear view mirror bracket bonded to the windshield glass. In this case the mirror is simply transferred from the unserviceable windshield to the bracket on the replacement windshield.

If the replacement windshield does not have the mirror bracket bonded to it, or if on serviceable windshields the bracket bond has been lost, a service kit is available for bracket installation. The kit is available from your local parts distribution center and consists of a replacement bracket and firm-setting, two-component adhesive. Installation instructions are included in this section, as well as in the kit.

NOTE: *Do not attempt to remount the original bracket. For best results use a new bracket with the proper adhesive, available as a service kit.*

INSERT REMOVAL

A V-shaped rubber insert is set into a molded groove in the rubber weatherstrip on some units, to provide a snug fit to the glass and the opening flange.

On others an interlocking type lip is part of the weatherstrip as shown in figures 17-3 and 17-4.

The weatherstrip should be 75° F (24° C) or above before windshield removal is attempted.

(1) Cover adjoining painted surfaces to protect finish.

(2) Remove windshield wiper arms using a wiper arm removal tool if available. If not, use a wide blade screw-driver.

(3) On vehicles so equipped, remove the windshield insert moulding or V-shaped rubber strip from around the outside of the windshield using a screw-driver blade and carefully pry the insert from the slit in the weather-strip (fig. 17-1).

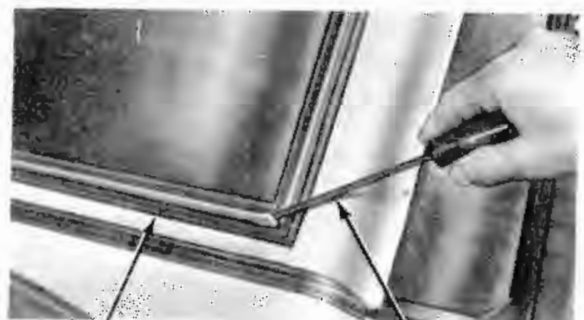

Fig. 17-1 Removing Windshield Moulding Insert from Weatherstrip

(4) On units with locking-type weatherstrip, use a wedge shaped fiber or hardwood stick or wand as shown in figure 17-2 to unlock the weatherstrip as shown in figures 17-3 and 17-4.

(5) On vehicles with the stainless steel mouldings, remove the moulding screws at the top and bottom of the side mouldings.

(6) Remove top corner moulding by lifting the bottom and pulling outboard.

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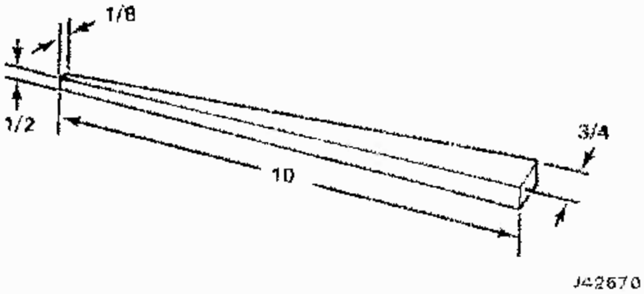

Fig. 17-2 Wooden Wand Dimensions (Inches)

(7) Side mouldings are tipped toward center of vehicle and lifted off.

(8) Remove top moulding.

(9) Slide center moulding clip to left or right and remove bottom mouldings.

(10) This will expose the locking type weatherstrip (fig. 17-3).

(11) The locking type weatherstrip without mouldings is shown in fig. 17-4.

(12) On units with or without mouldings, unlock the rubber weatherstrip starting at the bottom with a fiber stick or wand (fig. 17-5).

GLASS REMOVAL

(1) Use fiber stick to break seal between windshield glass and weatherstrip.

(2) Removal of the windshield from the weatherstrip should be performed by two men, one man pushing lower inside corner, one man lifting as windshield comes free.

(3) Remove weatherstrip from opening.

(4) Inspect weatherstrip and clean off sealer from glass cavity and flange cavity.

NOTE: *Inspect for uneven surfaces or irregularities in the windshield opening flange that could cause stress damage to the windshield glass.*

(5) If windshield has been removed for reasons other than damaged glass and is to be replaced, clean hardened sealer from glass edges.

GLASS INSTALLATION

NOTE: *Windshield installation should be accomplished in relatively warm surroundings in order that the windshield weatherstrip will remain pliable to make the installation operation easier and reduce the possibility of breaking the windshield.*

(1) Clean any old sealer from windshield opening flange.

(2) If removed weatherstrip is used, be sure glass cavity and flange cavity are clean.

(3) Using a medium body sealer in a pressure type

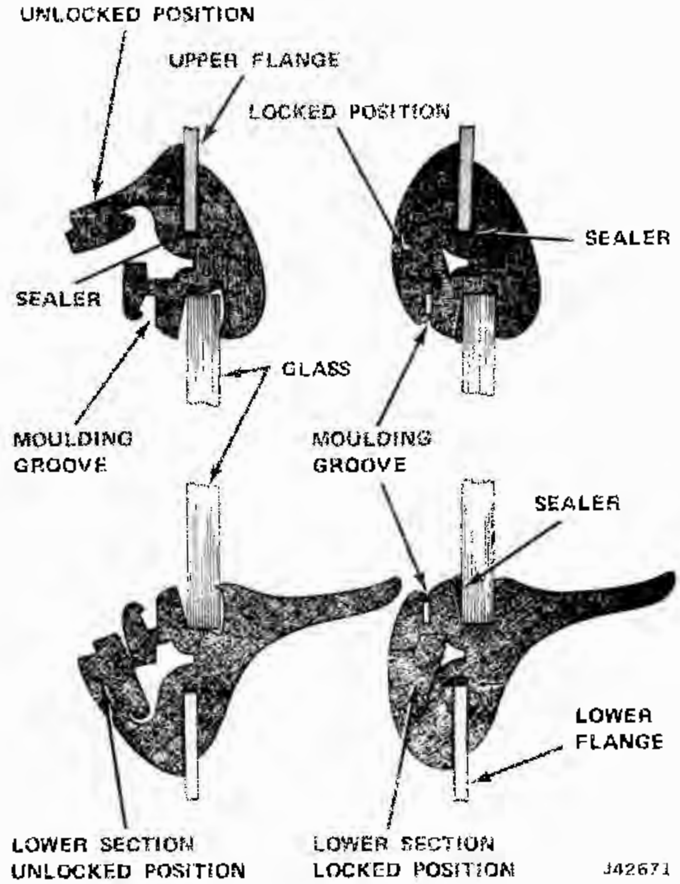

Fig. 17-3 Windshield Weatherstrip Cross-section - Moulding Removed

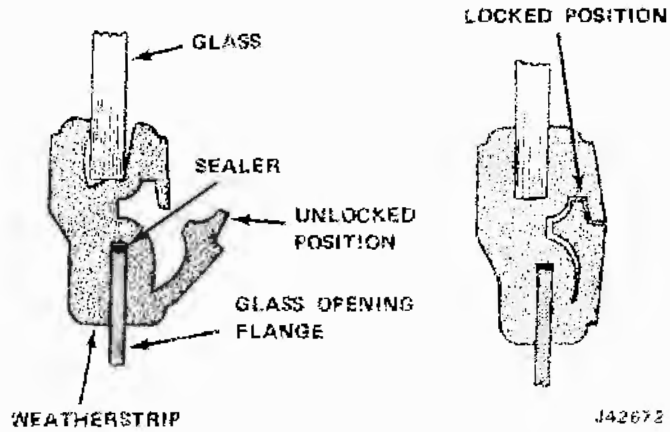

Fig. 17-4 Windshield Weatherstrip Cross-section

applicator, apply a 1/16-inch bead of sealer completely around weatherstrip in flange cavity as shown in fig. 17-3.

(4) Install the weatherstrip on the windshield opening flange.

(5) Apply a liberal amount of liquid soap solution in the glass cavity of the weatherstrip.

(6) With two men working on the outside of the vehicle, work windshield into upper glass cavity and into each side. Position wooden wand under bottom of glass

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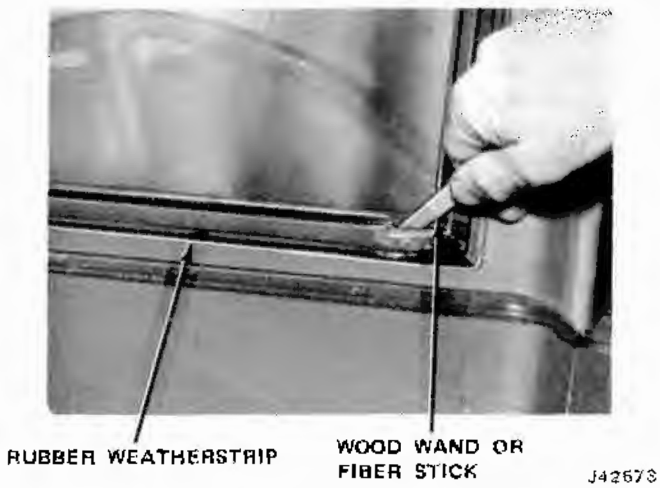

Fig. 17-5 Unlocking Rubber Weatherstrip

and lift windshield up and into lower glass cavity. Check for equal side clearance.

(7) Use the wooden wand to lock weatherstrip as shown in the locked position (fig. 17-3 and 17-4).

NOTE: *Soap solution should be removed from the weatherstrip and glass before installing sealer.*

(8) Using a pressure-type applicator, apply a medium-bodied sealer between the weatherstrip and glass on outside of glass around entire perimeter (fig. 17-3).

STAINLESS STEEL MOULDING INSTALLATION

NOTE: *Excessive soap solution should be removed from the weatherstrip before installing trim moulding.*

(1) Bottom mouldings are installed one at a time. To facilitate installation, place a 1/8-inch (0.32 cm) diameter cord in weatherstrip moulding retaining groove along entire length of weatherstrip, leaving enough cord hanging out at each end to permit a good grip on cord.

(2) Working first with either left or right bottom moulding, place moulding in groove.

(3) Starting at the outside corner of the weatherstrip, pull up on cord while lightly tapping top of moulding with rubber mallet. This will lock the moulding in the weatherstrip retaining groove. Continue process until moulding is installed in weatherstrip, and then repeat process with the other bottom moulding, again starting at the outside corner.

(4) Install center moulding clip to cover gap between left and right bottom moulding.

(5) The one-piece top moulding is installed in the same manner, except that the moulding is tapped upwards into the retaining groove.

(6) Side and upper corner mouldings can then be inserted in the retaining groove and secured by installing the upper and lower screws.

(6) Fill gap at upper outboard corner between trim moulding and body with black sealer.

(8) Clean excess sealer from windshield and moulding.

(9) Install windshield wiper arms.

(10) Test windshield for water leaks.

REAR VIEW MIRROR BRACKET INSTALLATION

Cherokee - Wagoneer - Truck

(1) At driver's side, outside of vehicle, measure 6-3/8 inches down from the lower edge of the reveal moulding (fig. 16-6). Place a wax pencil mark on the glass, alongside the vertical moulding.

(2) From the wax mark at the vertical moulding, measure 27-7/8 inches toward the center of the windshield and mark a vertical line.

(3) Measure five inches down from lower edge of reveal moulding and mark a horizontal line across the vertical line.

(4) If the vinyl pad has remained on the windshield glass, apply low heat with an electric heat gun until vinyl softens, then peel pad from glass using care not to scratch or mar the glass surface.

(5) Clean the bracket mounting area of the windshield glass thoroughly. Use a mildly abrasive cleaning powder (Ajax, Comet, or equivalent) applied to clean cloth saturated with alcohol.

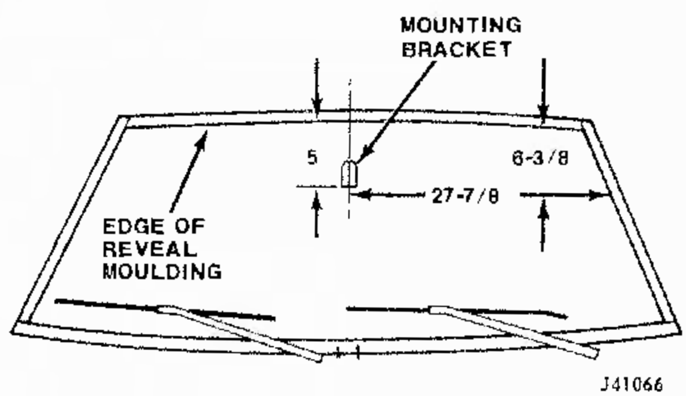

Fig. 17-6 Windshield Mounted Rear View Mirror Bracket Location Dimensions (Inches)

(6) Remove all traces of cleanser by wiping area with a paper towel moistened with alcohol.

(6) Scuff the bonding surface (the side without the 3/8-inch circular depression) of the mirror bracket with a clean piece of fine grit sandpaper. Apply alcohol to a clean towel and wipe surface clean.

(8) Apply a generous amount of the accelerator, supplied with kit, to mirror bracket mounting surface. Allow five minutes to dry.

(9) Apply a thin film of accelerator to windshield. Allow one minute to dry.

CAUTION: *Do not touch surfaces to which accelerator has been applied—an imperfect bond could result.*

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(10) Apply one drop of adhesive at the center of the mirror bracket bonding surface. Use the bottom of the adhesive tube to distribute the adhesive evenly over the entire surface.

(11) Position the bottom straight edge of the bracket on the horizontal line, while centering it on the vertical line (fig. 17-6). Press bracket to glass and hold firmly for one minute. Be sure bracket is properly located - adhesive sets quickly.

FOLDING WINDSHIELD REMOVAL

On the CJ models the windshield and frame assembly may be lowered to the hood by unlatching the two clamps at each side of the windshield. When in the lowered position, always secure the windshield by passing the strap at the top of the windshield through the loop on the hood and drawing the strap up firmly.

(1) To remove the windshield and frame as an assembly, remove the wiper control switch from the dash.

(2) Disconnect the windshield wiper motor electric wires from the switch and remove them from the grommetted hole.

(3) Unlatch the two windshield clamps on each side of the windshield.

(4) Fold the windshield forward until the slot in the windshield hinges aligns with the flat side of the pin in the body hinges.

(5) Slip windshield off the pins and remove from body.

(6) The glass can be removed from the frame, in the same manner as outlined for all windshield glass removal, after the wiper cover has been removed.

REAR WINDOW

GENERAL

The rear window is a one-piece, tempered glass. The overall size of the glass varies with the different vehicles.

Cherokee - Wagoneer

For service replacement and adjustment of tailgate window glass, refer to Section 16 - Tailgate-Luggage Rack.

TRUCK MODELS

A sliding rear window for J-10 and J-20 Truck cabs is a new option for 1974 and provides advantages of better cab ventilation and ease of communication between passengers in the truck cab and camper body when installed. The sliding rear window is replaced as an assembly using the same procedures as for the regular Truck rear window.

WINDSHIELD WIPER

GENERAL

All models are equipped with a two-speed, electric wiper motor.

On CJ models, the motor is mounted on the lower left corner of the windshield(fig. 17-7).

Cherokees, Wagoneers, and Trucks are equipped, on the driver's side, with an articulated windshield wiper arm which provides an improved wiping pattern (fig. 17-8). The wiper blade-to-wiper arm mounting has also been changed. New service procedures covering these changes are included in this section.

WIPER AND WASHER CONTROLS

The control switches are mounted on the instrument panel, to the left of the steering column.

The two-speed wiper motor is energized for continous wiping action by turning the control knob in a clockwise direction.

The electric washer pump is operated by depressing the wiper control knob or, on some models, the push button in the center of the control knob.

Wiper Control Removal

(1) Remove control knob.

(2) Remove nut and switch.

(3) Mark the wire color locations on the switch and disconnect the wires.

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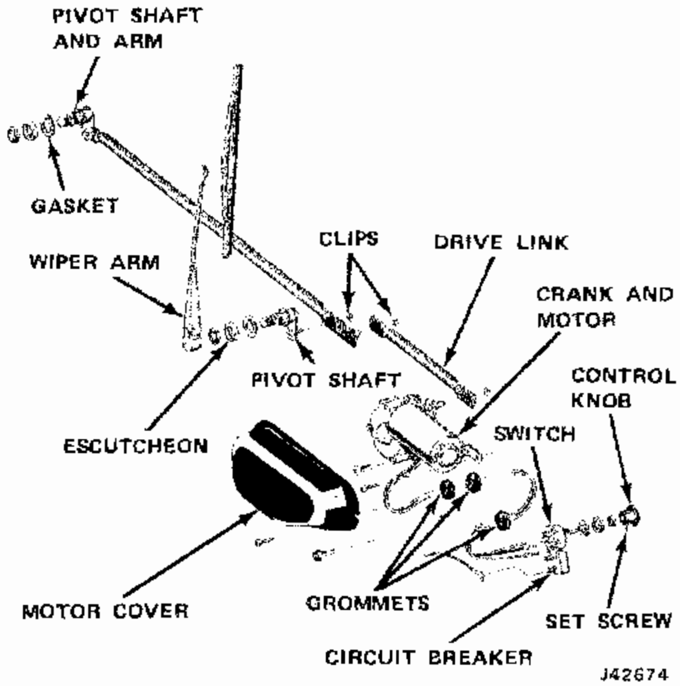

Fig. 17-7 Wiper Components - CJ Models

WIPER BLADES

Removal - CJ Models

The wiper blade assembly is removed from the wiper arm by holding the blade away from the windshield, and pushing it firmly against the tip of the arm to compress the locking spring and disengage the retaining pin. At the same time, pivot the blade clockwise to unhook it from the end of the arm

Replacement - Cherokee-Wagoneer-Truck

(1) To remove wiper blade from mounting pin on wiper arm, insert a screwdriver into spring release opening of blade saddle and depress spring clip. Pull blade from arm (fig. 17-9).

(2) To install, push blade saddle onto mounting pin so that spring clip engages pin. Be sure blade is securely attached to arm.

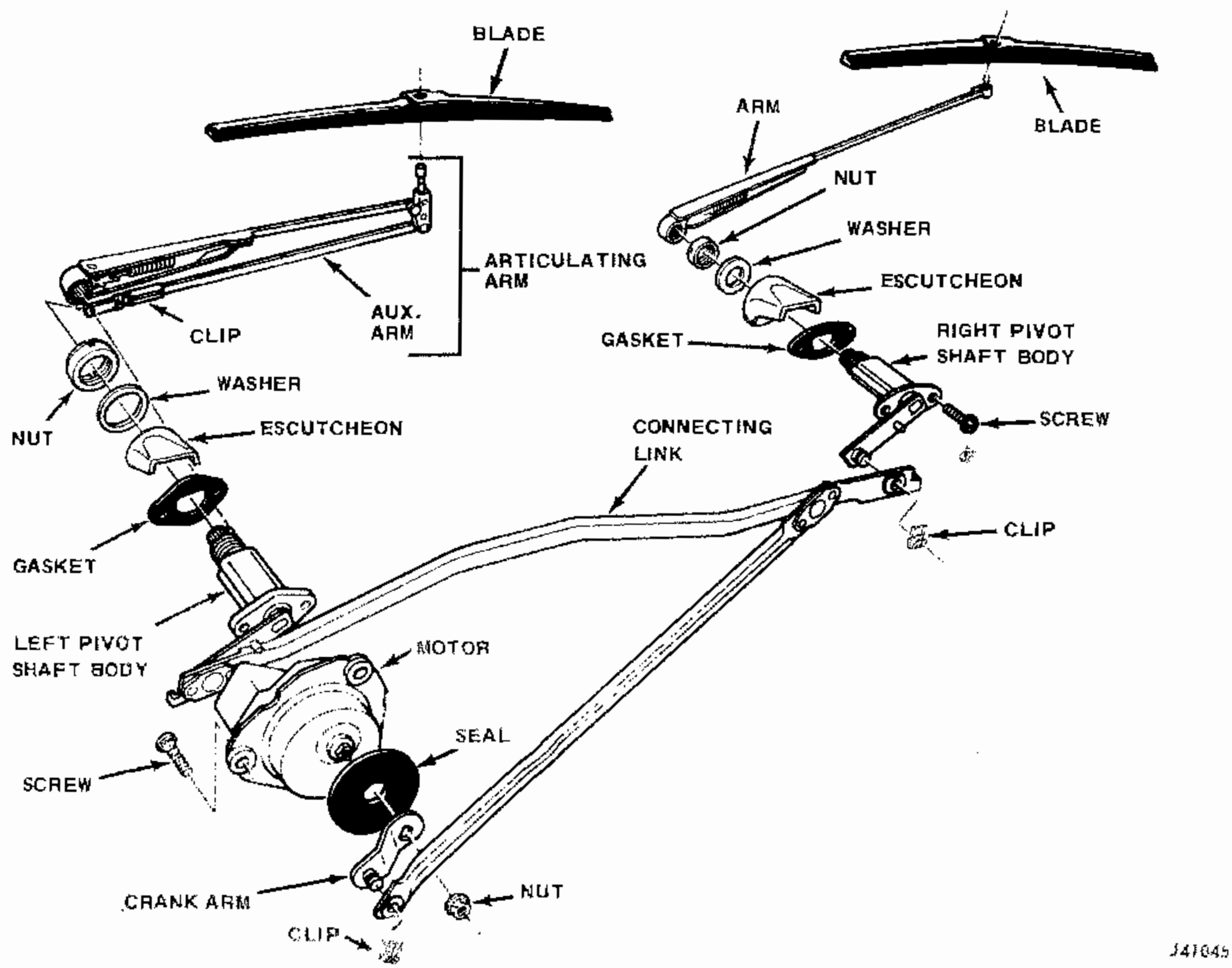

Fig. 17-8 Windshield Wiper Components - Cherokee-Wagoneer-Truck

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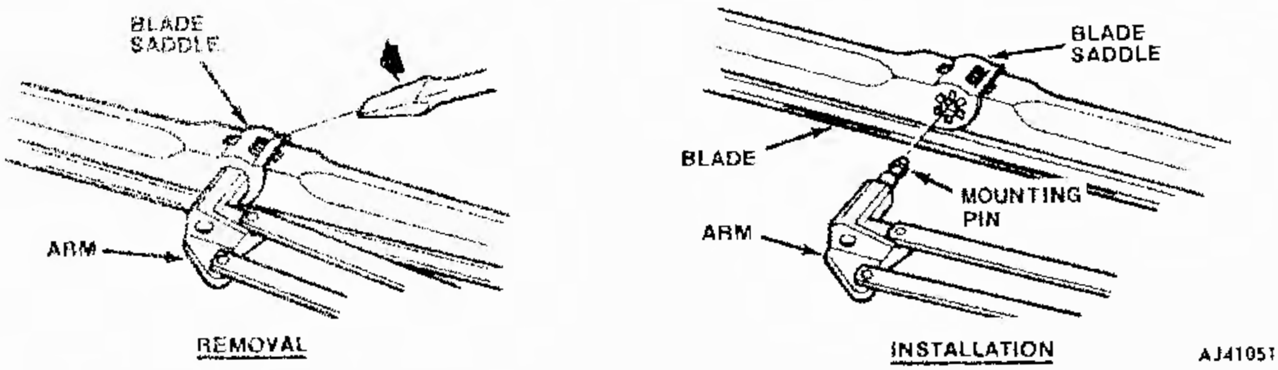

Fig. 17-9 Wiper Blade Replacement

WIPER ARM REPLACEMENT

CJ Models

(1) To remove the windshield wiper arms from the pivot body shaft, first mark the pivot shaft and arm so that the wiper arm can be reinstalled in the same position, and then pry up carefully on the wiper arm as shown in figure 17-10.

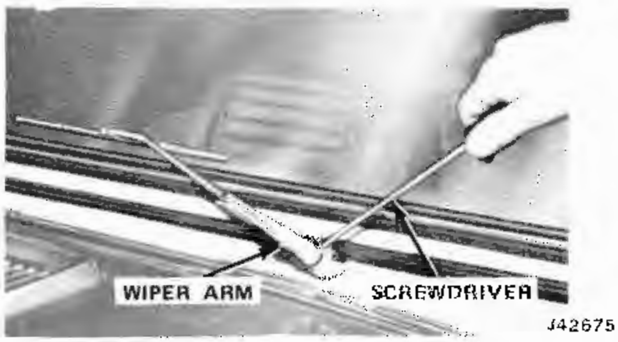

Fig. 17-10 Wiper Arm Removal

(2) Push wiper arm over pivot shaft. Be sure pivot shaft is in park position and wiper arm is positioned as shown in figure 17-11.

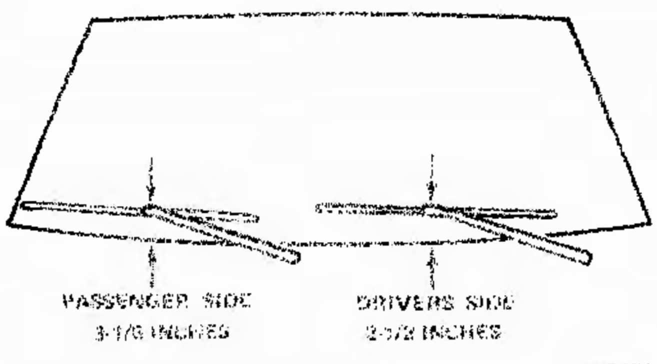

Fig. 17-11 Wiper Arm Park Position - CJ Models

Cherokee - Wagoneer - Truck

(1) Raise blade end of arm from windshield and move spring tab away from pivot shaft. Disengage auxiliary arm retainer clip (driver's side only) from pivot pin and pull wiper arm from pivot shaft (fig. 17-8).

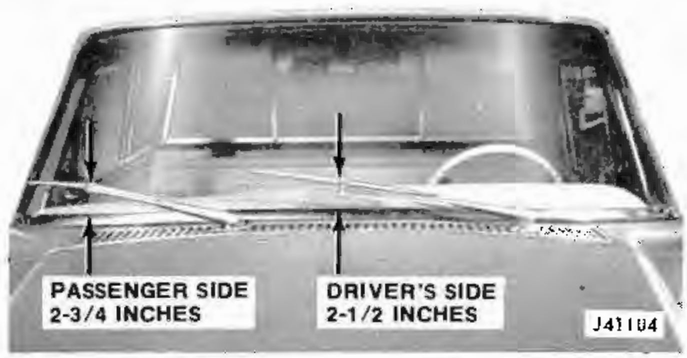

Fig. 17-12 Wiper Arm Park Position - Cherokee-Wagoneer-Truck

(2) To install, position auxilary arm (if so equipped) over pivot pin and engage retainer clip. Push wiper arm over pivot shaft. Be sure that pivot shaft is in park position and wiper arm is positioned as shown in fig. 17-12.

TWO-SPEED WIPER MOTOR

General

When the dash switch is moved to the low-speed position, current from the battery flows through a series field coil and is divided. One part passes through the shunt field coil to ground at the dash switch; the other part passes through the armature to ground at the dash switch.

Moving the dash switch to the high-speed position opens the shunt field circuit to ground at the dash switch and keeps the armature circuit closed to ground. The shunt field current must then pass through a 20-ohm resistor located on the back of the wiper terminal board and then through the same lead that connects the

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armature circuit to ground through the dash switch.

Moving the dash switch to the OFF position opens both the armature and shunt field circuits to ground at the dash switch. However, both of these circuits are still closed to ground through the parking switch. When the cam on the wiper output gear opens the park switch contacts, the wiper blades are in the parked position.

Troubleshooting Procedure

Figure 17-13 illustrates the method of connecting leads to the two-speed wiper either for bench operation or to run wiper independently of dash switch and vehicle wiring when installed in vehicle.

Typical wiper troubles are as follows: wiper inoperative; wiper will not shut off; wiper operates only on fast speed; wiper operates only on slow speed; wiper shuts off with dash switch in high-speed position; blades do not return to park position when wiper is turned OFF; wiper speed normal at low but too fast in high; intermittent operation during normal wiping cycle.

Troubleshooting procedures are divided into two categories; wiper troubleshooting in vehicle; wiper troubleshooting on bench.

Troubleshooting in Vehicle

If wiper is inoperative check the following items:

- Fuse
- Wiring harness to motor connections
- Dash switch connection and ground
- Wiper ground strap

With ignition switch on, check for 12 volts at harness terminal that connects to wiper terminal. To determine if dash switch or wiring is at fault, disconnect harness from wiper motor and try operating wiper as shown in figure 17-13. If wiper fails to operate, remove body parts as required, disconnect transmissions from wiper crank arm, and recheck wiper operation. If wiper still fails to perform correctly, remove wiper from vehicle and check wiper according to procedure under Wiper Troubleshooting on Bench.

If wiper will not shut off, determine if wiper has both low and high speeds, slow speed only or high speed only. It is important that the wiper operates at low speed during parking cycle.

Disconnect wiring harness from wiper motor and try operating wiper independently of dash switch as shown in fig. 17-13.

If wiper shuts off correctly with crank arm in park position and wiper has both speeds, check the lead between terminal 7 and dash switch ground, and check for defective dash switch. If wiper shuts off correctly but wiper has low speed only, check lead between wiper terminal 1 and dash switch ground and check for defective dash switch. If wiper shuts off correctly but has high speed only, check lead between wiper terminal and dash switch open circuit and check for defective dash switch. If wiper still fails to operate correctly, remove it

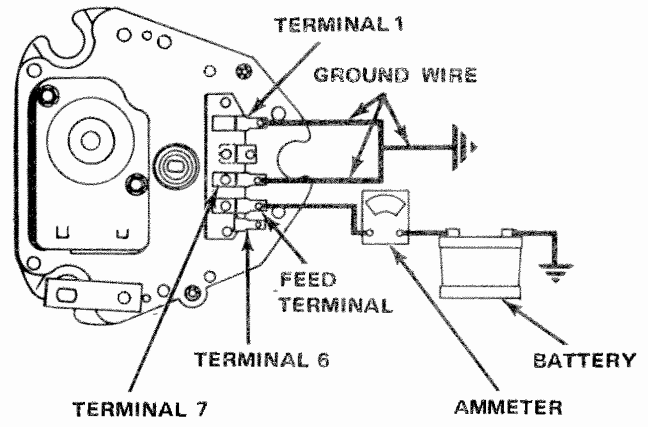

Fig. 17-13 Two-Speed Wiper Test Connections - All Models

from vehicle and check it according to instructions under Wiper Troubleshooting.

If wiper has fast speed only, check for defective dash switch or open lead between terminal 1 and dash switch.

If wiper has slow speed only and shuts off with dash switch in high speed position, reverse harness leads that connect to wiper Terminals 1 and 7 shown in fig. 17-13.

If blades do not return to park position when wiper is turned off, check wiper ground strap connection to vehicle body. Remove wiper from vehicle and check for dirty, bent, or broken park switch contacts.

If wiper speed is normal in slow, but too excessive in fast speed, remove wiper from vehicle and check for an open terminal or resistor.

If wiper operates erratically, check for loose wiper ground strap connection or loose dash switch mounting.

Troubleshooting on Bench

Refer to Fig. 17-13.

Using ammeter capable of reading at least 30 amperes check feed wire circuit shown in Fig. 17-13 for open circuit.

If wiper is inoperative, connect wiper to operate in low speed and observe current draw. If the reading is zero amps, check for loose solder connection at feed terminal or loose splice joints. If reading is 1 to 1.5 amps check for open armature, sticking brushes, or loose splice joint. If reading is 11 amps, check for broken gear, seized shaft, or some other condition that will stall the wiper.

If wiper will not shut off, this condition may exist if wiper has one or both speeds. If wiper has both speeds, check for park switch contacts not opening or internal wiper motor lead that connects to wiper Terminal 7 being grounded. If wiper has low speed only, check for grounding of internal wiper motor lead that connects to wiper Terminal 1 and check shunt field coil for grounding. If wiper has high speed only, check for open in internal wiper motor lead that connects to wiper Termi-

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nal 1 and check for shunt field open circuit.

If wiper crank arm does not return to park position when wiper is turned off, check for dirty, bent, or broken park switch contacts.

If wiper speed is normal in slow, but too excessive in fast speed, check for open circuit in the 20-ohm resistor on back of wiper terminal board.

If wiper operates erratically, check for sticky brushes or loose splice joints.

If the wiper will not shut off, or wiper crank arm fails to stop in park position when jumper wire is removed from wiper Terminal 1, check that park switch contacts are opening. Also check for ground in internal motor lead that connects to Terminal 1.

Wiper Motor Removal

CJ Models

(1) Remove the extreme left plastic hole plug from the bottom of the windshield frame air duct and disconnect the drive link from the motor crank.

(2) Loosen the wiper control switch knob slotted setscrew.

(3) Remove the control switch and mark location of wires on switch housing priop to disconnecting wires.

(4) Remove the motor cover and the motor.

NOTE: *The motor cover must be sealed when installing.*

Cherokee - Wagoneer - Truck

(1) Disconnect wiper drive link from crank under instrument panel.

(2) Mark wire locations at motor for proper assembly under the hood.

(3) Disconnect motor and washer pump wires at motor under hood.

(4) Remove motor-to-dash mounting screws.

Wiper Pivot Shaft and Linkage Removal

(1) Remove the wiper arms and pivot shaft nuts, washers, escutcheons, and gaskets.

(2) Disconnect the drive arm from the motor crank.

(3) Remove individual links where necessary, to remove pivot shaft bodies without excessive interference.

Disassembly of Two-Speed Wiper Motor and Washer

Refer to Fig. 17-14.

(1) Remove pump cover and pump.

(2) Remove vacuum motor from pump.

(3) Clamp crank arm in vise and loosen crank arm retaining nut.

(4) Remove seal cap, retaining ring, and end plate washer. Seal cap should be cleaned and repacked with a waterproof grease before reassembly.

(5) Punch out the gear box cover retaining rivets and remove cover from gear train. Mark ground strap location for reassembly purposes.

(6) Remove output gear and shaft. Then slide intermediate gear and pinion off shaft.

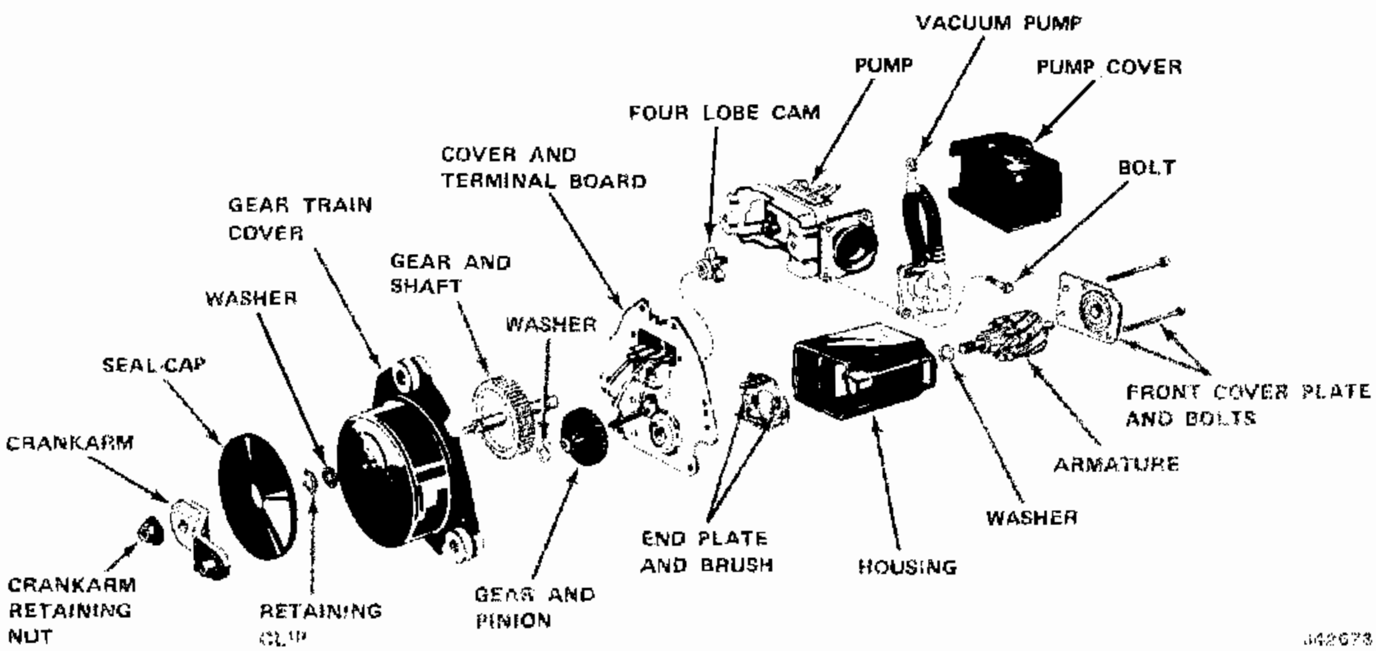

Fig 17-14 Two Speed Wiper Motor and Washer

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Assembly of Two-Speed Wiper Motor and Washer

(1) All gear teeth should be lubricated with a cam and ball bearing lubricant.

(2) When reassembling the gear box cover, be sure cover is located properly over locating dowel pins.

(3) Also be sure to install ground strap.

(4) When reassembling the crank arm, operate wiper to park position and install crank arm on output shaft so that identification marks line up with those in the cover.

(5) Clamp crank in vise before securing the retaining nut.

(6) Assemble washer pump assembly to wiper motor. Refer to Fig. 17-15 for positioning of washer pump cam drive.

WASHER PUMP

CJ Models

The electric washer pump assembly is mounted on the water reservoir. The impeller motor case is grounded to the toeboard by a black ground wire. It is energized by a yellow feed wire from the single blade terminal on the control switch.

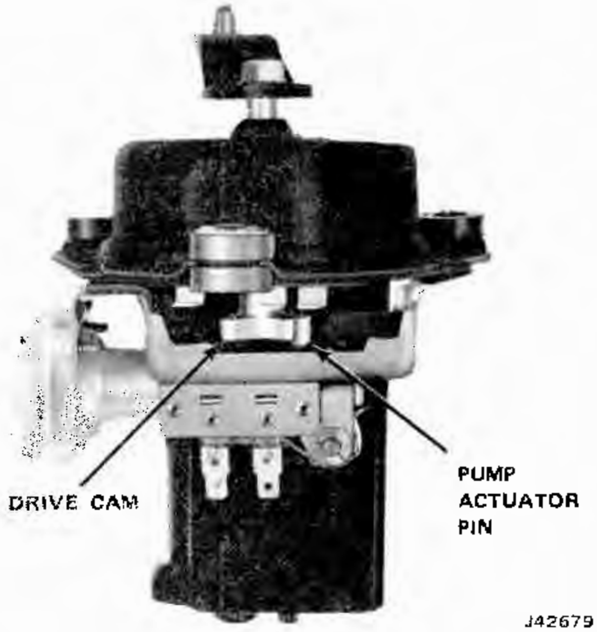

Fig. 17-15 Washer Pump Cam Drive

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TECHNICAL SERVICE LETTER REFERENCE

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INSTRUMENT PANEL AND MOUNTED ASSEMBLIES

INSTRUMENT PANEL

All instrument panels are of formed sheet metal construction reinforced with braces and fastened to adjacent body panels with welds or bolts. The instrument panels contain the instrument cluster, ignition switch, switch control panel, and/or individual switches and the glove box. Also attached to the panel are the steering column, brake and clutch pedal supports, and the hand brake.

CJ Models

The instrument panel is bolted to the cowl and dash panel area with capscrews. Eight of these capscrews are located on the face of the panel and one at each side, accessible from under the instrument panel.

Cherokee - Wagoneer - Truck

The instrument panel is bolted to the surrounding body sheet metal and to the brake and clutch support brackets. When removing the instrument panel, the windshield must be removed to obtain access to the bolts under the windshield weatherstrip that attach the instrument panel to the cowl. Other instrument panel attaching bolts must also be removed.

J42661

Fig. 18-1 Instrument Panel - CJ Models

J42562

Fig. 18-2 Instrument Panel - Wagoneer - Cherokee - Truck

Instrument Panel Overlay Pad (Crash Pad)

A vinyl-coated polyurethane safety pad is attached to the instrument panel on the Cherokee, Wagoneer, and Truck Models. A similar crash pad which attaches to the lower frame of the windshield is also available as a factory option on CJ Models.

The safety pads are fastened to the instrument panel or windshield frame with pressure type clips, studs with nuts, or sheet metal screws.

Replacement - CJ Models

(1) Remove five retaining screws along top edge of crash pad.

NOTE: *Lower edge of crash pad is retained with compression type spring retainers.*

(2) Insert a stiff putty knife between crash pad and frame at each of the four clips, and pry the pad away from the frame to release the clip.

(3) To install the crash pad, align the spring clips with the retaining holes and snap the panel into place.

(4) Install the screws along the top edge at the base of the windshield.

Replacement—Cherokee-Wagoneer-Truck

(1) Remove windshield and windshield weatherstrip to expose crash pad retaining screws at base of the windshield. Refer to Windshield Removal.

(2) Remove exposed crash pad retaining screws.

(3) Remove instrument cluster and ash receiver.

(4) Remove nuts from studs located around perimeter of crash pad. The nuts are accessible through the cluster and ash receiver openings and from under the instrument panel at the right side.

(5) When installing, start all attaching screws and nuts and tighten them evenly, beginning at the center and working toward each end.

(6) Install the windshield weatherstrip and the windshield.

GLOVE BOX

The glove box is attached to the glove box opening

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flange with sheet metal screws. Remove the screws from around the opening and move the box down and out from the rear of the instrument panel. If the air conditioning evaporator prevents lowering, the box can be carefully compressed at the crease lines, and removed through the opening.

Glove Box Door Striker

The door striker is mounted at the top of the opening with two sheet metal screws. The holes in the striker are elongated for in or out adjustment.

Glove Box Door

The glove box door hinge mounting holes are elongated to allow the door to be adjusted to fit the opening. To raise or lower the door in the opening, loosen the screws which attach the hinge to the door and adjust. To move the door in or out, loosen the screws which attach the hinge to the opening and adjust.

Glove Box Lock and Latch Assembly

The glove box lock or the latch assembly is inserted through the glove box door from the outside. The assembly is held in place by a screw through the retainer to the lock housing.

Glove Box Lock Cylinder Removal

For maintenance or lubrication, the cylinder lock may be removed from the lock housing without removing the complete assembly from the glove box door.

Open the glove box door. Insert the key and rotate the cylinder to expose the tumblers. Momentarily remove key. Depress retainer tumbler, re-insert key to depress lock tumblers, and remove the cylinder.

Installation

Depress the retainer tumbler and insert the key to depress the lock tumblers. Insert the cylinder and key. Hold the cylinder in place and remove the key.

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SEAT ASSEMBLIES AND ADJUSTERS

GENERAL

Front Bucket Seats

New bucket seats with durable knitted vinyl inserts are standard on the Cherokee and optional on Wagoneer and Truck models. The passenger side bucket seat is adjustable fore and aft and has a forward tilting seat back which permits access to the rear seat on Cherokee models and, on Truck models, provides better access to the tool storage area behind the seats. For passenger safety, the tilting seat back is equipped with a lock pawl assembly which retains the seat back in its normal upright position.

Front Bench Seats

The fore-and-aft seat adjuster mechanism for Wagoneers and Trucks has been improved by the addition of a turnbuckle to allow for slight dimensional variances during production assembly of seats and seat support components. The turnbuckle permits the seat sliding and latching components to be adjusted for trouble-free operation. Adjustment of the turnbuckle is covered in this section.

Rear Seat Assemblies

Wagoneer cargo floors have been modified to eliminate the depression under the rear seat. The flatter floor area permits easier cargo loading when the rear seat is folded forward or is removed. The rear seat mounting brackets have been redesigned for easier seat assembly removal. Cherokee cargo area and rear seat mounting are identical to Wagoneer.

Seat Belts and Shoulder Harnesses

Seat belts on Cherokee, Wagoneer, and Truck models are now equipped with integral retractors, replacing the old clip-on type. All seat belts, and the two optional front shoulder harnesses, utilize quick-release push button buckle latches. Cherokee and Wagoneer are equipped with three sets of rear seat belts; the two outboard seat belt retractors are anchored on the wheel housings.

FRONT SEAT ASSEMBLY SERVICE

Adjustment

All driver's seats, except CJ, are horizontally adjustable by means of a control lever located under the right-hand corner of the seat.

The front seat frame attaches to the seat tracks and the seat tracks, in turn, attach to brackets which are bolted to the floor. Spring-release locks are mounted on the seat tracks and positioned so the lock-stop will fall into one of the notches on the flange of the track. The locks are released by moving the front seat adjustment lever arm.

On CJ Models, additional fore or aft positioning of the driver's seat can be obtained by changing the seat mounting location to any of the three attaching holes provided in the seat support. Remove the four attaching bolts, move the seat to the desired fore or aft position and reinstall the bolts.

Adjustment (Bench Seat)

(1) Locate turnbuckle under left side of bench seat (fig. 19-1), and loosen turnbuckle wing nut.

(2) Tighten turnbuckle until slack is removed from wire.

(3) Back off turnbuckle three turns.

(4) Secure wing nut up against turnbuckle.

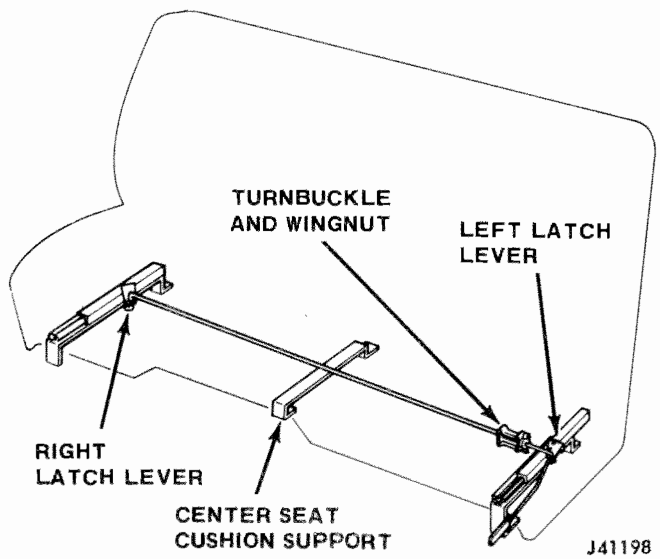

Fig. 19-1 Front Bench Seat Adjustment

(5) Check for proper seat adjustment operation. If right side of seat will not release, increase tension by tightening turnbuckle. If right side of seat will not lock in place, decrease tension by loosening turnbuckle.

Forward Tilting Seat Back Replacement - Cherokee and Truck

(1) Remove seat back pivot bolt (fig. 19-2).

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(2) Tilt the seat back forward to disengage seat back from inner pivot pin.

(3) Remove seat back.

(4) To install, position seat back to engage inner pivot pin (fig. 19-2).

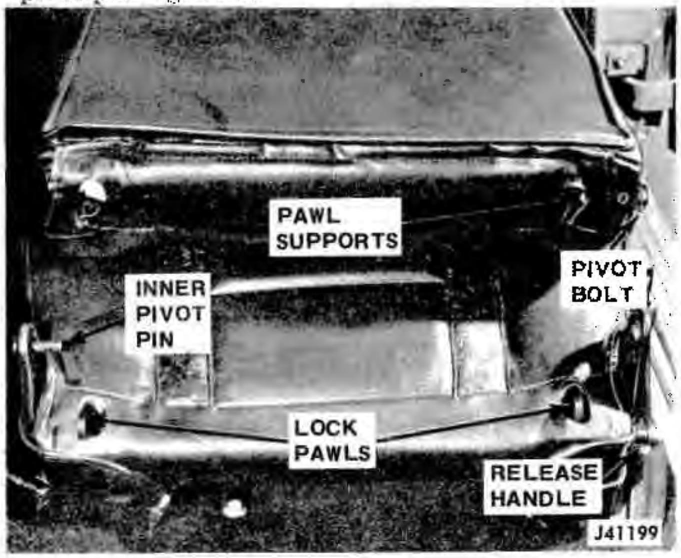

Fig. 19-2 Forward Tilting Seat Back - Cherokee and Truck

(5) Install seat back pivot bolt.

(6) Secure seat back lock.

Tilt Lock Pawl Assembly

The tilt lock pawl assembly is an integral part of the seat frame assembly and must be replaced as a unit. The release handle is serviceable with removal of the release handle screw.

Front Seat Removal

To remove the driver's seat, or a full back bench seat assembly, remove the four bolts and lockwashers that attach the front seat support bracket to the floor pan.

The passenger seat in CJ Models can be removed by tumbling the seat assembly forward, as shown in fig. 19-3. Disengage the right side hinge as the flat area on the hinge pin matches the slot opening in the bracket half of the hinge. Raise the right side of the seat and match the slotted opening and flat area of the pin on the left hinge and remove the seat.

To install, first insert the left hinge pin into the slotted half of the hinge and then engage the right side. Rotate the seat assembly to the normal upright position.

REAR SEAT ASSEMBLIES

CJ Models

The rear seat is of one-piece construction and is mounted by four bolts to two parallel brackets which, in turn, are secured to the floor of the vehicle by four retainers and two spring-loaded lockpins.

All seats are of spring design and utilize padding and foam rubber in their construction.

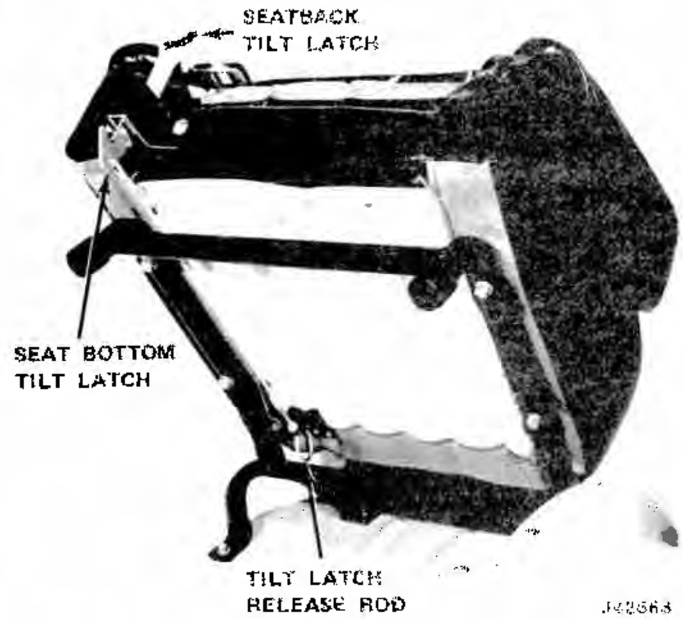

Fig. 19-3 Passenger Seat Assembly - CJ Model

Cherokee and Wagoneer

The full width rear seat is assembled to the body floor by two hinges to allow the seat to be folded up to provide maximum rear cargo loading space, as shown in fig. 19-4.

Fig. 19-4. Maximum Rear Cargo Area

A latch on each side of the rear seat back engages a striker bolted into cage nuts on the rear wheelhouse panels. The cage nuts allow movement for striker adjustment.

To tilt the seat back forward, release the latch on the right side by raising the latch lever (fig. 19-6) and simultaneously pulling the seat back forward.

A rear seat holding strap, attached to the door pillar, prevents the seat from falling backward when the seat

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is in the folded position as shown in fig. 19-6. It connects the seat frame by means of a pin on the seat frame and an eye on the strap. The strap should always be connected to the seat whenever the seat is in the folded position.

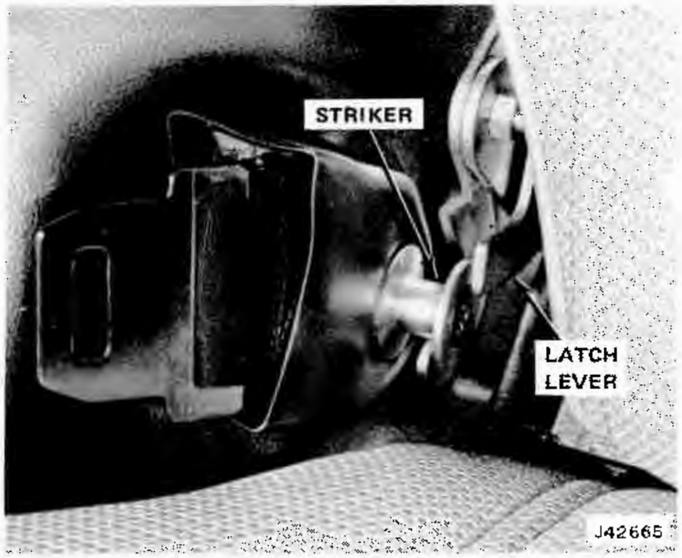

Fig. 19-5 Rear Folding Seat - Latched Position

Fig. 19-6 Rear Folding Seat, Strapped Position

Adjustment

(1) Tilt the seat back forward and loosen the striker bolt to allow forced movement of the striker.

(2) Raise the seat back to the upright position and tap the striker into position for maximum latch/striker engagement.

(3) Unlatch the seat back carefully so as not to change striker position and then tighten the striker securely.

REAR SEAT ASSEMBLY SERVICE

CJ Models

Removal

(1) Release two spring-loaded lockpins securing rear seat assembly to rear retainers.

(2) Slide rear seat assembly forward and free of four retainers.

(3) Remove rear seat assembly from vehicle.

Installation

(1) Position rear seat assembly in vehicle.

(2) Guide rear seat assembly into four retainers.

(3) Engage two spring loaded lock pins into rear retainers.

Cherokee and Wagoneer

Removal

(1) Release latch at lower right side of seat back. Raise complete seat assembly forward (fig. 19-7).

Fig. 19-7 Rear Seat Assembly

(2) Raise complete seat assembly forward (fig. 19-7).

(3) Lift complete seat assembly from two floor mounting hinges.

(4) Remove seat assembly from vehicle.

Installation

(1) Install seat assembly onto hinges.

(2) Position seat back in proper location.

(3) Secure seat back latch.

SEAT BELTS AND SHOULDER HARNESSES

Removal

(1) Remove seat belt anchor bolt with Torx bit No. 50 and ratchet handle.

(2) Remove seat belt.

(3) Obtain access to seat belt retractor and shoulder harness anchor bolt by removing trim covers.

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(4) Remove seat belt retractor and shoulder harness anchor bolts with Torx bit No. 50 and ratchet handle.

(5) Remove seat belt retractor and shoulder harness.

(6) Inspect seat belt and shoulder harness material for evidence of wear, cuts, or fraying. Replace as required.

Installation

(1) Install seat belt and seat belt retractor anchor bolts. Tighten to 25 to 35 foot-pounds torque.

(2) Replace seat belt retractor trim cover.

(3) Replace shoulder harness trim cover.

SHOULDER HARNESS SERVICE INSTALLATION

Cherokee - Wagoneer

Front Seat

A service installation of the front seat shoulder harness can be accomplished as shown in figure 19-8.

Rear Seat

A service installation of the rear seat shoulder harness can be accomplished as shown in figure 19-9.

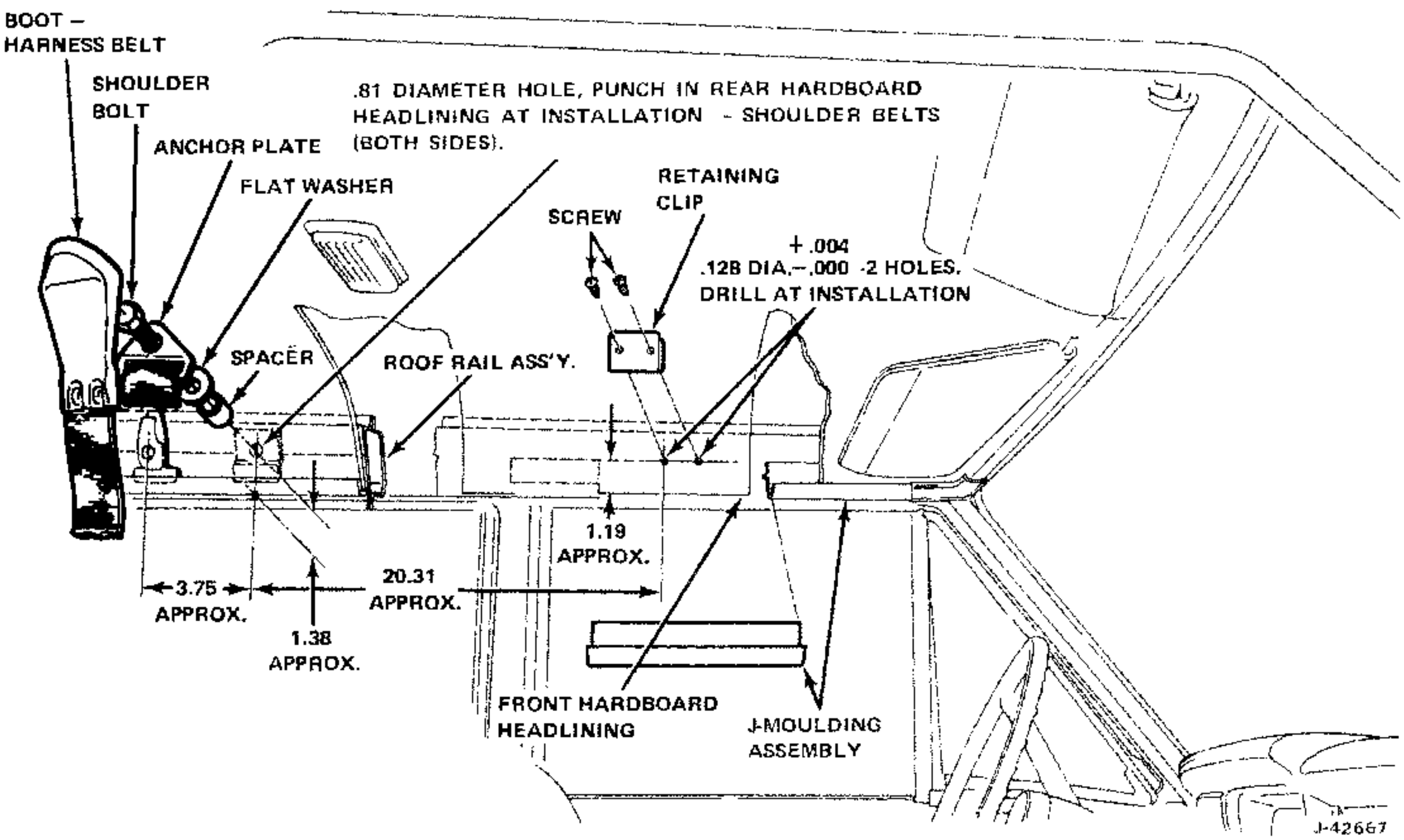

Fig. 19-8 Front Seat Shoulder Harness Installation

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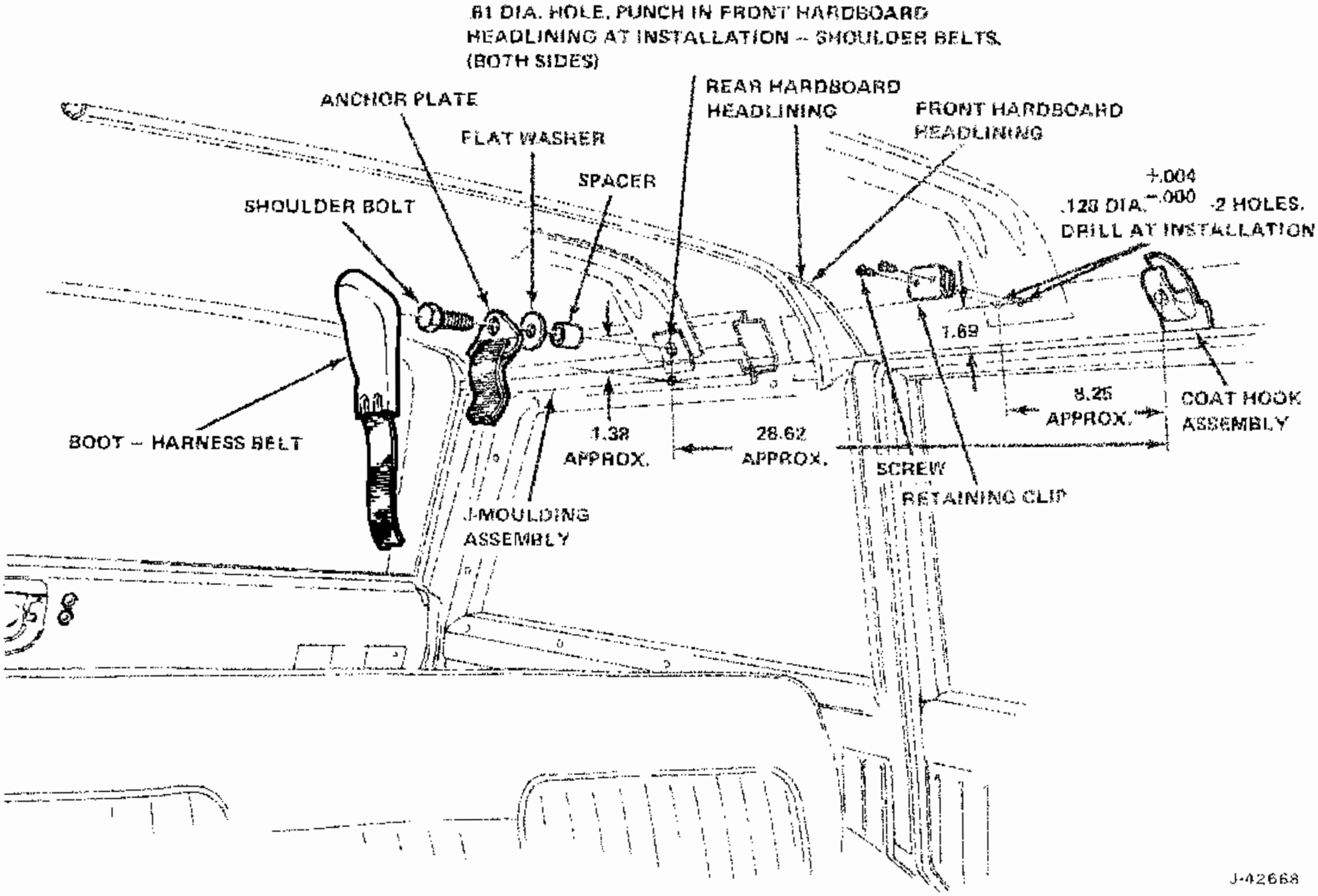

Fig. 19-9 Rear Seat Shoulder Harness Installation

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HEADLINING—EXTERIOR DECALS AND OVERLAYS

HEADLINING

GENERAL

The headlining used in Cherokee, Wagoneer, and Truck models is made of laminated polystyrene backing board which is finished, depending on the model, with either a plastic coating or a soft vinyl covering. Lines scored into the backing board allow the headlining to be shaped to fit the contour of the roof while providing added strength for self-support.

CHEROKEE - WAGONEER

Removal

(1) Remove sun visors, escutcheons, and center support.

(2) Remove windshield moulding and end caps.

(3) Remove rear opening moulding and end caps.

(4) Remove plastic trim strip and end cap retainers.

(5) Remove lens from dome lamp and cargo lamp (if equipped). Remove screws securing lamp to roof bows.

(6) Remove coat hooks.

(7) Free rear headlining from J-moulding by pulling down carefully at the center, while pushing up on either outside edge.

(8) Push cargo lamp (if equipped) through die-cut opening in headlining.

(9) Remove rear headlining through tailgate opening.

(10) Free front headlining from J-moulding by pulling down carefully at the center, while pushing up on outside edges.

Installation

(1) Position front headlining in vehicle and insert left side into J-moulding.

(2) Pull dome lamp through die-cut opening in headlining and align front headlining to vehicle roof.

(3) Pull down carefully at center of front headlining and insert right side of headlining into J-moulding.

(4) Position rear headlining in vehicle and insert left side into J-moulding.

(5) Pull cargo lamp through die-cut opening in rear headlining and align rear headlining to vehicle roof.

(6) Pull down carefully at center of rear headlining while pushing up on right edge, and insert right side of headlining into J-moulding.

(7) Check alignment of front headlining using sun visor and dome lamp holes and leading edge of headlining as guide. Adjust fore or aft as required.

(8) Check alignment of rear headlining using the trailing edge as a guide. Adjust fore or aft as required.

(9) Secure dome lamp and cargo lamp to roof bows and install lamp lenses.

(10) Install plastic trim strip and end cap retainers.

(11) Install coat hooks.

(12) Install rear opening moulding and end caps.

(13) Install windshield moulding and end caps.

(14) Install escutcheons, sun visors, and center support.

TRUCK

Removal

(1) Remove sun visors and center support.

(2) Remove lens from dome lamp. Remove screws securing dome lamp to rear window panel.

(3) Remove windshield moulding and end caps.

(4) Pull down carefully at center of headlining from J-moulding.

(5) Push dome lamp through die-cut opening in headlining.

(6) Remove headlining from vehicle.

Installation

(1) Position headlining in vehicle and insert left side into J-mouldings.

(2) Pull dome lamp through die-cut opening and align headlining to vehicle roof.

(3) Pull down carefully at center of headlining while pushing up on right edge, and insert right side of headlining into J-moulding.

(4) Check alignment of the headlining using the sun visor and dome lamp holes and headlining leading edge as guides. Adjust fore and aft as necessary.

(5) Secure dome lamp to rear window panel and install dome lamp lens.

(6) Install windshield moulding and end cap.

(7) Install sun visors and center support.

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EXTERIOR DECALS

GENERAL

Exterior decals are made from a tough, durable, weather resistant, solid vinyl with a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is easily peeled away upon installation. During shipment and storage the face is protected with an easy-release paper.

REPAIRS

Repair small nicks or scratches with touch-up paints mixed to blend with the affected area.

Repair blisters or air bubbles by piercing them with a sharp needle or pin. Work the trapped air out through the pin hole and press the decal firmly against the panel. It may be necessary to preheat the panel slightly to soften the adhesive. Heat may also be used to remove small wrinkles or irregularities.

REMOVAL AND INSTALLATION

Preparation

Workroom temperature should be between 65° and 90° F. Decals should not be replaced in temperatures below 65° F.

The following equipment and materials are necessary to make a quality decal installation.

- Liquid detergent (Joy, Vel, or equivalent).
- Wax and silicone remover (3M Adhesive Cleaner, Acrylic-Clean, Prep-Sol, Xylol, or equivalent).
- Isopropyl alcohol (rubbing alcohol).
- Squeegee - four to five inches wide (plastic or hard rubber).
- Water bucket and sponge.
- 500° F heat gun with grounding adapter, or infrared heat bulb and extension cord.
- Clean wiping rags or paper towels.
- Sharp knife, single edge razor blade, or Exacto knife.
- Scissors.
- Sharp needle or pin.
- Grease pencil.

Removal

(1) Clean repair surfaces, adjacent panels, and openings as required.

(2) Remove decal overlapping parts from affected panel.

(3) Remove decal by starting at one edge and peeling it from the painted surface. Apply heat to the decal to facilitate removal.

NOTE: *Avoid using pointed or sharp tools as they may damage the painted surface.*

(4) Remove adhesive from painted surface by wiping the area with a rag saturated with 3M Adhesive Cleaner, Xylol, Isopropyl Alcohol, or equivalent, and then scraping with a squeegee.

NOTE: *Exercise care when using solvents because of possible damage to painted surfaces. To determine if solvent is harmful to body paint, test it on a hidden area of the vehicle.*

(5) Rinse thoroughly with clean water.

Installation

(1) Clean painted surface with wax and silicone remover (3M Adhesive Cleaner, Acrylic-Clean, Prep-Sol, or equivalent). Wipe surface with clean cloth and allow to dry.

NOTE: *Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause decal to blister.*

(2) Position decal on panel surface and mark position with grease pencil (fig. 20-1). Allow 1/2-inch overlap around door and fender areas. Cut decal to approximate length using scissors.

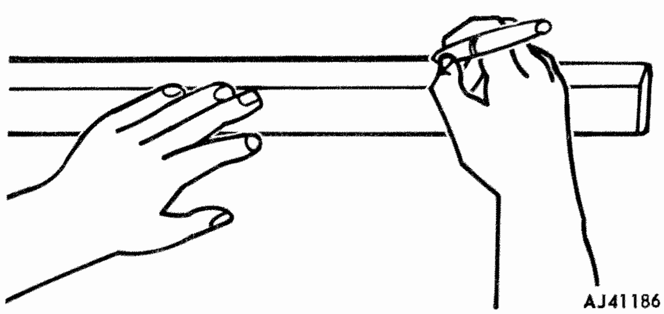

Fig. 20-1 Marking Decal Position

(3) Position decal on panel and hold in place with small strips of masking tape (fig. 20-2). Be sure decal is aligned with decal on adjacent panels.

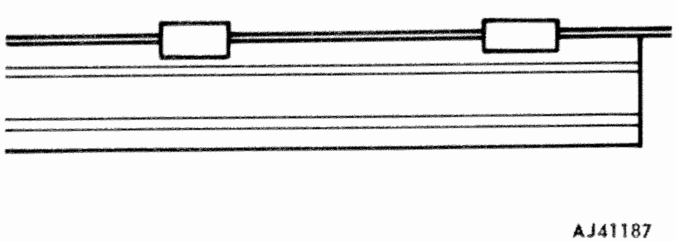

Fig. 20-2 Positioning Decal on Panel

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(4) Swing decal up using strips of masking tape as hinges (fig. 20-3).

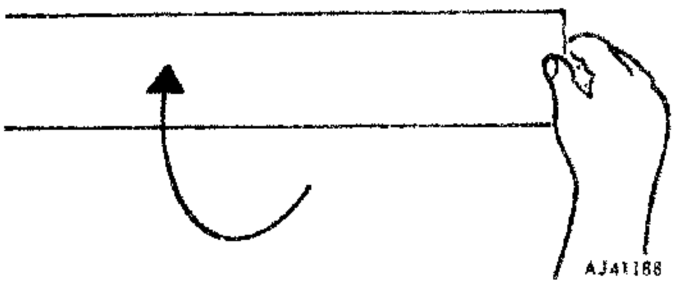

Fig. 20-3 Lifting Decal

(5) Remove approximately six inches of paper backing from one end (fig. 20-4).

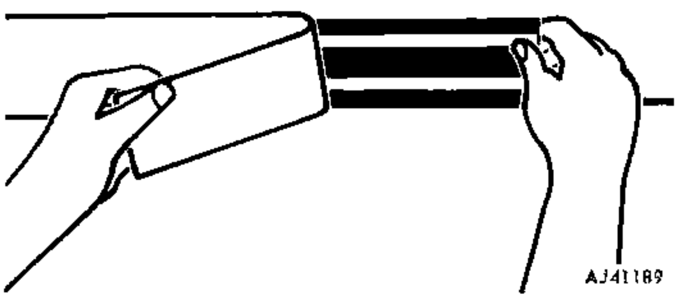

Fig. 20-4 Removing Backing Paper

(6) Swing decal back down to aligned position. Squeegee decal to panel using firm strokes while removing remainder of paper backing (fig. 20-5).

NOTE: *To avoid pre-adhesion or stretching of the decal, do not remove more than six inches of paper backing at one time.*

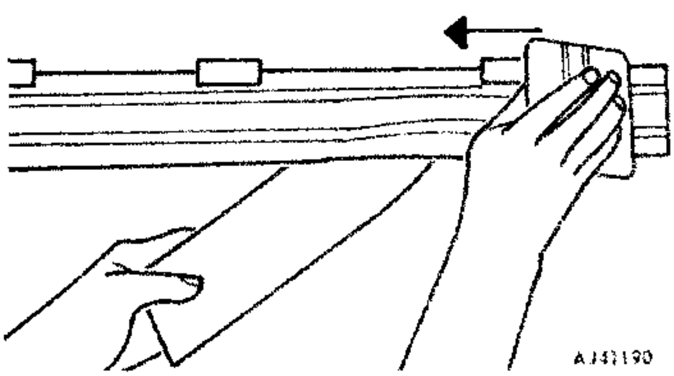

Fig. 20-5 Installing Decal with Squeegee

(7) Where possible, extend decal 1/2-inch beyond corners or edges (fig. 20-6) and wrap firmly using finger pressure and squeegee. Avoid trapping air in these areas.

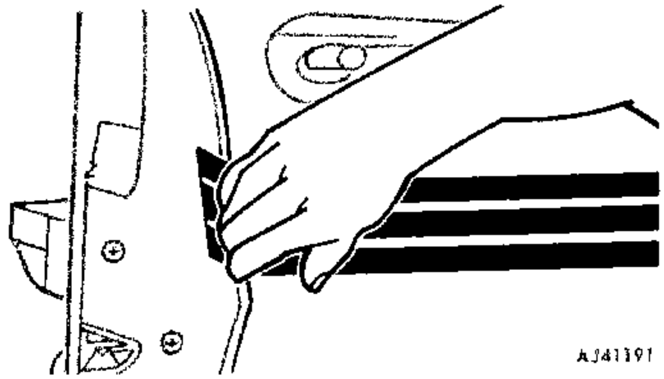

Fig. 20-6 Overlapping Decal at Corners or Edges

(8) Remove easy-release paper from face of decal (if applicable).

(9) Inspect decal installation using reflected light to detect any irregularities that may have developed during installation. Remove all air or moisture bubbles.

(10) Install previously removed parts and clean vehicle as required.

Installation of Intricate Decals

For large intricately-shaped decals, the following procedure will simplify installation.

(1) The use of wetting solution assures a better bond between decal and painted surfaces. Prepare a supply of wetting solution by thoroughly mixing two or three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water.

NOTE: *Too much detergent will reduce the effectiveness of the bond.*

(2) Place decal on clean, flat surface with paper backing side up. Bend up a corner and separate edge of paper backing from the decal. Hold decal firmly to the surface of a table and in a smooth motion, remove entire paper backing. Under hot, humid conditions, a slight jerking motion will aid in removing the paper backing.

CAUTION: *Always remove the paper backing from the decal; never the decal from the backing, as possible film stretching may result. Hold decal in corners when removing paper backing as fingerprints will adversely affect the adhesion.*

(3) Using clean sponge, apply ample wetting solution to decal adhesive and panel surface. The wetting solution permits ease of movement of the decal while positioning it on panel surface.

(4) Immediately apply wetted decal to the panel surface. Apply wetting solution to decorative face of decal to allow the squeegee to slip during application.

(5) Squeegee a short section of decal at the center. Lift right or left side of decal, position it straight and

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close to panel, and squeegee toward lifted edge. Avoid stetching decal at lifted end. Squeegee progressively from center with firm, overlapping strokes.

(a) Lift upper area of decal (up to bonded area) and, working upward from the bonded section at center, squeegee decal into place.

(b) Lift lower area of decal (up to bonded area) and, working downward from bonded section at center, squeegee decal into place.

NOTE: *If a wrinkle is trapped during squeegee operations, stop immediately. Carefully lift affected section, align the section to the panel, and progressively squeegee decal into place.*

EXTERIOR WOOD GRAIN OVERLAY PANELS

GENERAL

The opaque exterior woodgrain overlay panels are made of a tough, durable, weather-resistant, cast vinyl and have a pressure-sensitive back. The pressure-sensitive back is protected by a paper backing which is removed at installation. The simulated wood grain is embedded in the cast vinyl for a longer lasting attractive appearance.

REPAIRS

Small nicks, bruises, or scratches can be touched up with paint in much the same manner as painted surfaces. Proper color match can be obtained by blending small amounts of appropriate paint colors, and then applying to the affected area of the overlay.

Repair blisters or air bubbles by piercing them with a sharp needle or pin. Work the trapped air out through the pin hole and press the overlay firmly against the panel. It may be necessary to preheat the panel slightly to soften the adhesive. Heat may also be applied to remove small wrinkles or irregularities.

REMOVAL AND INSTALLATION

Preparation

Workroom temperature should be between 65 degrees and 90 degrees F. Overlays should not be replaced in temperatures below 65 degrees F.

The following equipment and materials are necessary to make a quality overlay installation.

- Liquid detergent (Joy, Vel, or equivalent).
- Wax and silicone remover (3M Adhesive Cleaner, Acrylic-Clean, Prep-Sol, Xylol, or equivalent).
- Isopropyl alcohol (rubbing alcohol).
- Squeegee - four to five inches wide (plastic or hard rubber).
- Water bucket and sponge.
- Sandpaper (No. 360 or No. 400, wet-or-dry type).
- 300 degree F heat gun with grounding adapter, or infrared heat bulb and extension cord.
- Clean wiping rags or paper towels.
- Sharp knife, single edge razor blade, or Exacto knife.
- Scissors.
- Sharp needle or pin.
- Grease pencil.

Prepare supply of wetting solution by thoroughly mixing two to three teaspoons of detergent (Joy, Vel, or equivalent) in one gallon of water. The use of a wetting solution will provide a better bond between overlay and painted surface. Too much detergent will reduce the effectiveness of the bond.

Removal

(1) Clean repair surfaces, adjacent panels, and openings as required.

(2) Remove overlay reveal mouldings, lock assembly, rear tail lamps, and/or other overlay overlapping parts from the affected panel.

(3) Remove overlay by starting at one edge and peeling it from painted surface. Apply heat to overlay to facilitate removal.

NOTE: *Avoid using pointed or sharp tools as they may damage the painted surface.*

(4) Remove adhesive residue from painted surface with 3M Adhesive Cleaner, Xylol, Isopropyl Alcohol, or equivalent.

Installation

(1) Scuff-sand painted surface with No. 360 or No. 400 sandpaper.

NOTE: *Freshly painted surfaces must be thoroughly dry. Residual solvents in fresh paint may cause overlay to blister.*

(2) Clean painted surface with wax and silicone remover (Acrylic-Clean, Xylol, or equivalent). Wipe surface with clean cloth, and allow to dry.

(3) Position overlay on repair panel surface, and mark approximate outline on overlay with a grease pencil. Ensure that 1/2-inch excess is allowed to be wrapped around the door and fender areas. Cut overlay to approximate size with scissors. Overlay should be cut so that upper and lower edges extend halfway into area covered by mouldings.

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(4) Place the overlay on a table or clean flat surface with protective paper backing side up. Bend up a corner of the overlay. Hold overlay firmly to the surface of the table and remove entire paper backing in a smooth motion. Under hot, humid conditions, a slight jerking motion will aid in removing paper backing.

CAUTION: *Always remove the paper backing from the overlay, never the overlay from the backing as film stretching may result. Hold overlay in corners when removing paper backing as fingerprints will adversely affect the adhesion.*

(5) Using clean sponge, apply ample wetting solution to overlay adhesive and to repair panel surface. The wetting solution permits ease of movement of the overlay while positioning it on a panel surface.

(6) Immediately apply wetted overlay to the repair panel surface. Position overlay in the center of the area to be covered with at least 1/2-inch extending beyond edges. Apply wetting solution to wood grain surface of overlay to allow squeegee to slip during application.

(7) Squeegee from the center to edges of overlay with firm strokes to remove all air bubbles and wetting solution and to assure bonding of overlay to painted surface. On large overlays, the following steps will simplify installation.

(a) Squeegee a short (4- to 6-inch) horizontal section of overlay at center of panel. Lift right or left side of overlay, position it straight and close to panel, and squeegee toward lifted edge. Avoid stretching overlay at lifted end, squeegee progressively from middle with firm, overlapping strokes.

(b) Lift upper area of overlay (up to bonded area) and, working upward from bonded section at center, squeegee overlay into place.

(c) Lift lower area of overlay (up to bonded area) and, working downward from bonded section at center, squeegee overlay into place.

NOTE: *If a wrinkle is trapped during squeegee operations, stop immediately. Carefully life affected section, realign section to panel, and progressively squeegee it into place. Do not lift overlay if only a few bubbles are trapped.*

(8) Notch corner or curved edges of overlay where necessary and trim off excess material.

(9) Allow 1/2-inch extra material beyond edges that are to be wrapped around flange areas. To activate adhesive, wipe adhesive side of overlay with isopropyl alcohol. Warm overlay at edges by passing a heat source, such as a heat gun or lamp, over the surface to soften it. Firmly press overlay into position with finger tips, a cloth, and finally a squeegee, alternately warming and pressing it until complete adhesion is obtained.

CAUTION: *Use extreme care to avoid spilling isopropyl alcohol (rubbing alcohol) on trim or painted surfaces. Wipe spills immediately as alcohol will discolor trim or painted surfaces on prolonged contact.*

NOTE: *Avoid undue pulling or stretching at ends of overlay as tearing could result.*

(10) Apply heat to overlay at lock assembly depressions. Press overlay uniformly into depression to obtain formed bond.

(11) With sharp knife, carefully cut out excess overlay from lock assembly openings in panel.

(12) Inspect overlay installation using reflected light to detect irregularities that may have developed during installation.

(13) Remove all air or moisture bubbles by piercing them with a sharp needle or pin and then press firmly until overlay adheres to the body panel.

(14) Install previously removed parts and clean up vehicle as required.

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SPECIAL EQUIPMENT

GENERAL

Special equipment, available for Jeep vehicles, is designed to provide extra versatility for all models. The service procedures outlined in this section cover only the most commonly ordered equipment.

SELECTIVE DRIVE HUBS

Selective drive hubs are used to disengage the front axles from the power train when the vehicle is in two-wheel drive. These hubs must not be used on vehicles equipped with Quadra-Trac. It is advisable to engage hubs at least five miles per month to circulate lubricant in front axle.

Removal - CJ Models

(1) Remove allen head screws attaching clutch assembly to hub body assembly and pull off clutch assembly.
(2) Remove retaining ring from end of axle shaft (fig. 21-1).
(3) Bend up lock tabs and remove screws attaching hub body assembly to front hub and remove hub body assembly.

Clutch Assembly Overhaul (Automatic Hubs)

(1) Insert punch and push out control dial.
(2) Turn unit over and push out clutch ring and disc.
(3) Clean and inspect all parts for damage. Replace U-ring and O-ring seals on control dial.
(4) Lubricate clutch cap and install control dial assembly. Lubricate O-ring and inside of cap.
(5) Install disc.
(6) Turn control dial to FREE position. Install clutch ring and thread to bottom.
(7) Turn back until holes align and install in body assembly. Turn control dial from FREE to LOCK and check for function.

Body Assembly Overhaul

(1) Remove friction shoe spring.
(2) Remove retaining ring and separate hub body from roller clutch.
(2) Remove retaining ring and separate hub body from roller clutch.
(3) Remove centering spring.
(4) Remove Spirolock ring. Cage and axle shaft hub will separate.
(5) Clean and inspect all parts and coat lightly with chassis lube.
(6) Install friction shoe on cage carefully to avoid stretching.
(7) Lubricate friction shoes liberally with chassis lube before installation.

Installation

(1) Position gasket and body assembly on wheel hub.
(2) Install tab lockwashers and screws. Tighten screws to 40 to 45 foot-pounds and bend up lockwasher tab.
(3) Install retaining ring on end of axle shaft.
(4) Place gasket and cap assembly on body assembly, install allen head screws and torque to 6 to 8 foot-pounds.

Removal - Cherokee and Truck

(1) Remove six allen screws attaching clutch assembly to body and remove clutch assembly.
(2) Remove capscrew, lockwasher, and stop-ring in end of axle.
(3) Remove retaining ring and slide off body assembly.

Overhaul - Clutch Assembly (Automatic Hubs)

(1) Remove screw.
(2) Insert punch and push out control dial. Turn assembly over and push out clutch and clutch screw (fig. 21-2).
(3) Clean and inspect all parts for damage. Replace U-ring and O-ring seals on control dial.
(4) Lubricate clutch ring. Thread clutch screw into clutch ring until ring raises slightly.
(6) Install screw and stake it when tight.
(7) If new parts are to be used, drill a 3/16-inch diameter hole through clutch screw into thick web on control dial 5/8-inch deep. Install pin and stake in place.
(8) Turn control dial from FREE to LOCK and check for function.

NOTE: *Do not pack with grease.*

Body Overhaul

(1) Remove friction shoe spring (fig. 21-2).
(2) With small screwdriver, remove retaining ring.
(3) Clean and inspect all parts
(4) Coat bearing race lightly with chassis lube.
(5) Place cage into body and pack rollers with chassis lube.
(6) Carefully place body over axle shaft hub.
(7) Replace retaining ring (fig. 21-2).
(8) Carefully install friction shoe spring and lubricate friction shoes liberally with chassis lube.

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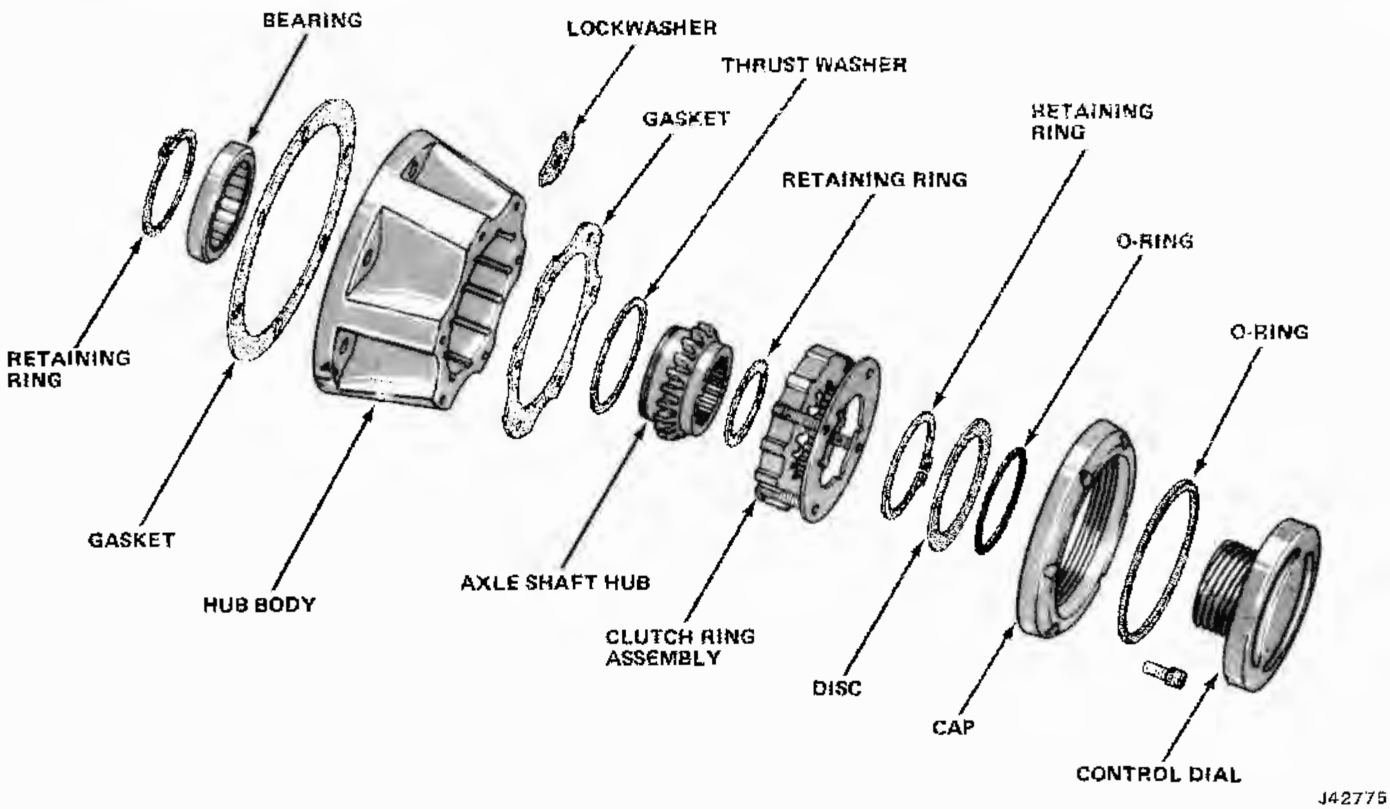

Fig. 21-1 Manual Hub - CJ Models

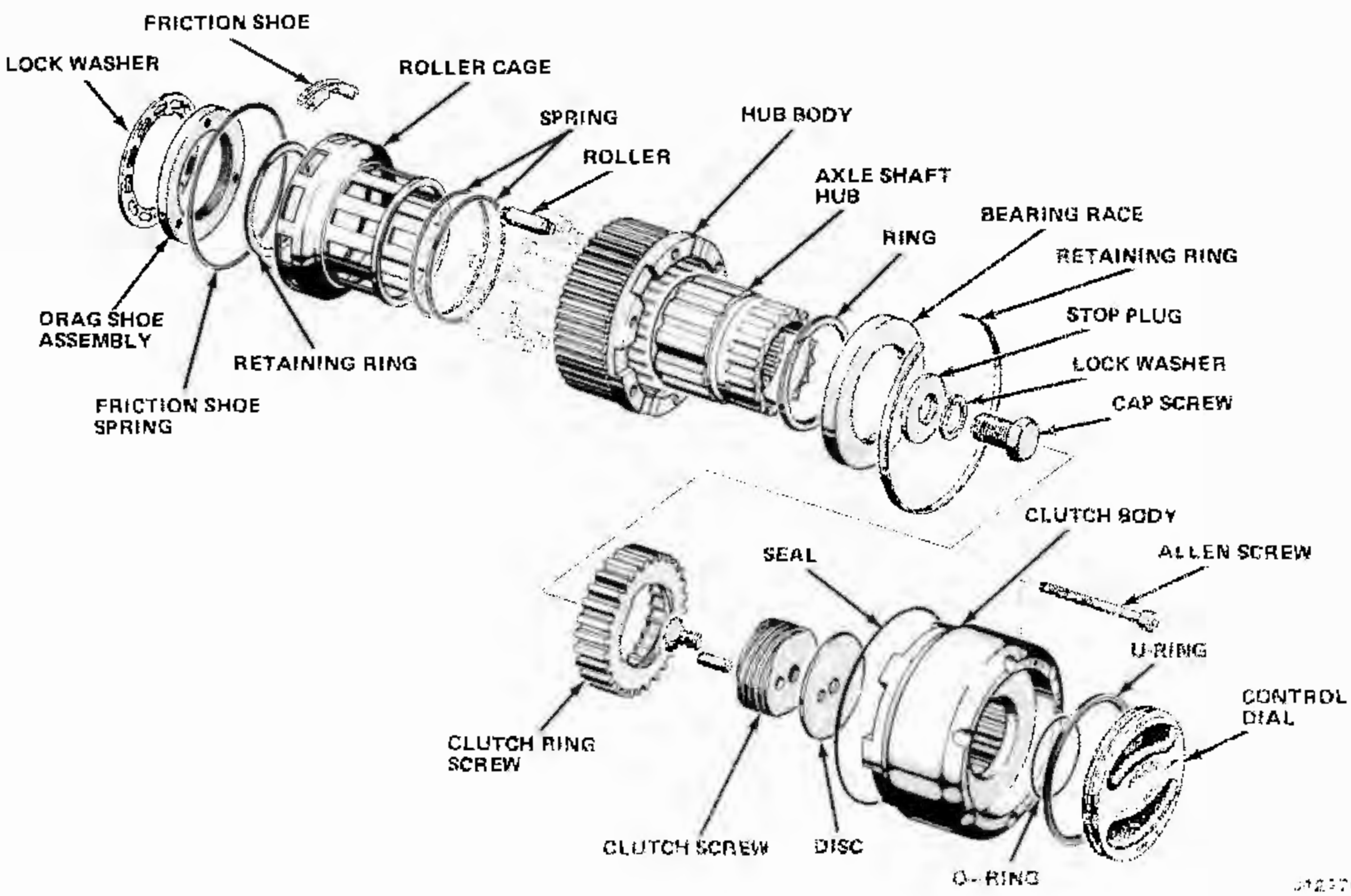

Fig. 21-2 Automatic Hub - Cherokee - Truck

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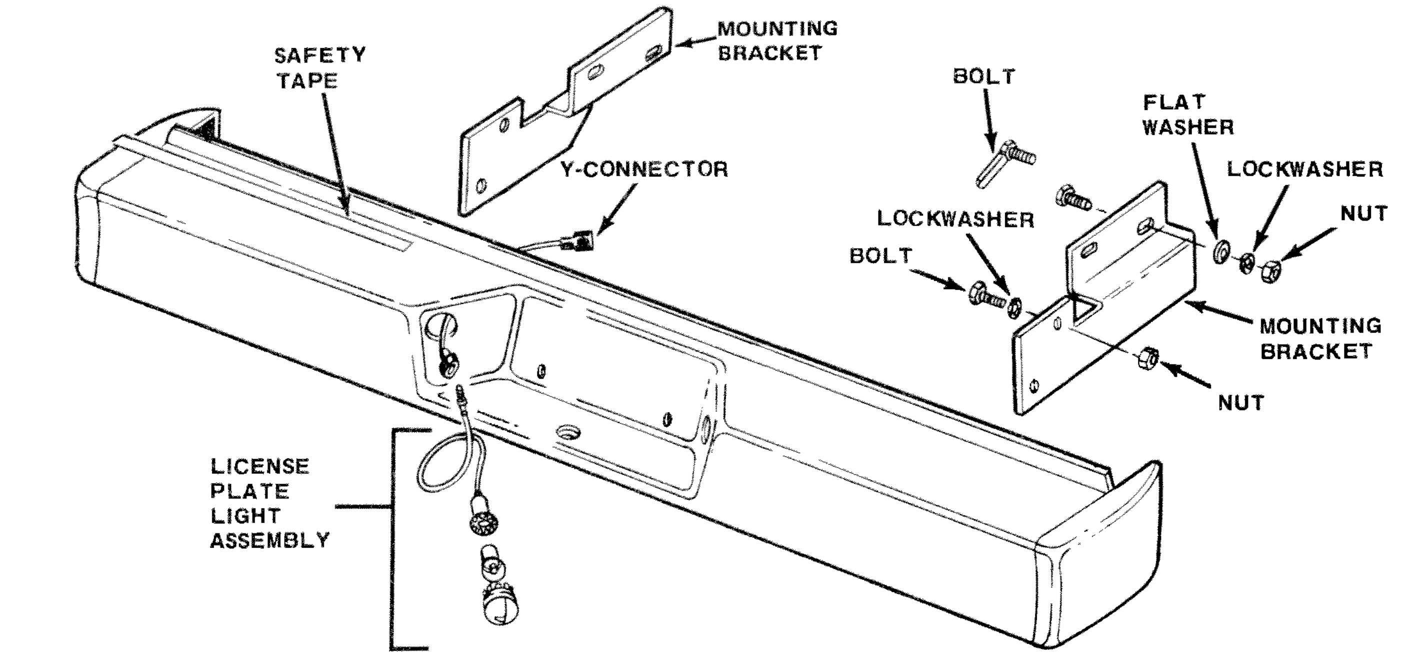


Fig. 21-3 Rear Step Bumper - Typical

Installation

(1) Slide body assembly into vehicle hub.

NOTE: *The body assembly will stop about 1/4 inch from full in position. Push to expand friction shoes over drag shoe nut and allow body to slide to full in position.*

(2) Install retaining ring to hold body assembly in vehicle hub.

(3) Install screw, lockwasher, and stop ring in end of axle and tighten to 35 to 40 foot-pounds torque.

(4) Install clutch assembly to body assembly with allen screws and tighten to 4 to 6 foot-pounds torque.

(5) Rotate wheel to check for free movement.

REAR STEP BUMPER

Rear step bumpers provide extra body protection and hitch attachment. All step bumpers are similar in construction and design, and will accommodate a long-shank, ball type hitch for towing purposes.

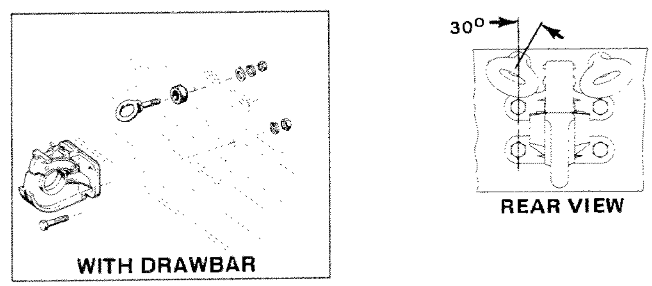
Typical bumper attaching hardware is shown in figure 21-3.

PINTLE HOOK

The standard type pintle hook affords a safe, easy-to-use device for towing a trailer or other vehicle. A safety latch locks the hook in the closed position, and two eyebolts are provided for attachment of safety chains. **The safety chains should be crossed when installed to prevent the hooks from jumping out of the eyes.** Attaching hardware is shown in figure 21-4.

DRAWBAR

The drawbar attaches to the rear frame crossmember. A reinforcement channel is mounted inside the rear crossmember to provide added strength. Typical drawbar attachment is shown in figure 21-5.



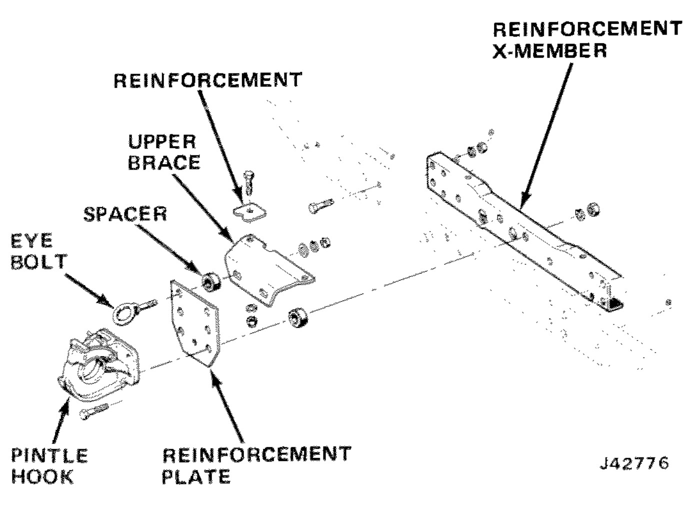


Fig. 21-4 Pintle hook

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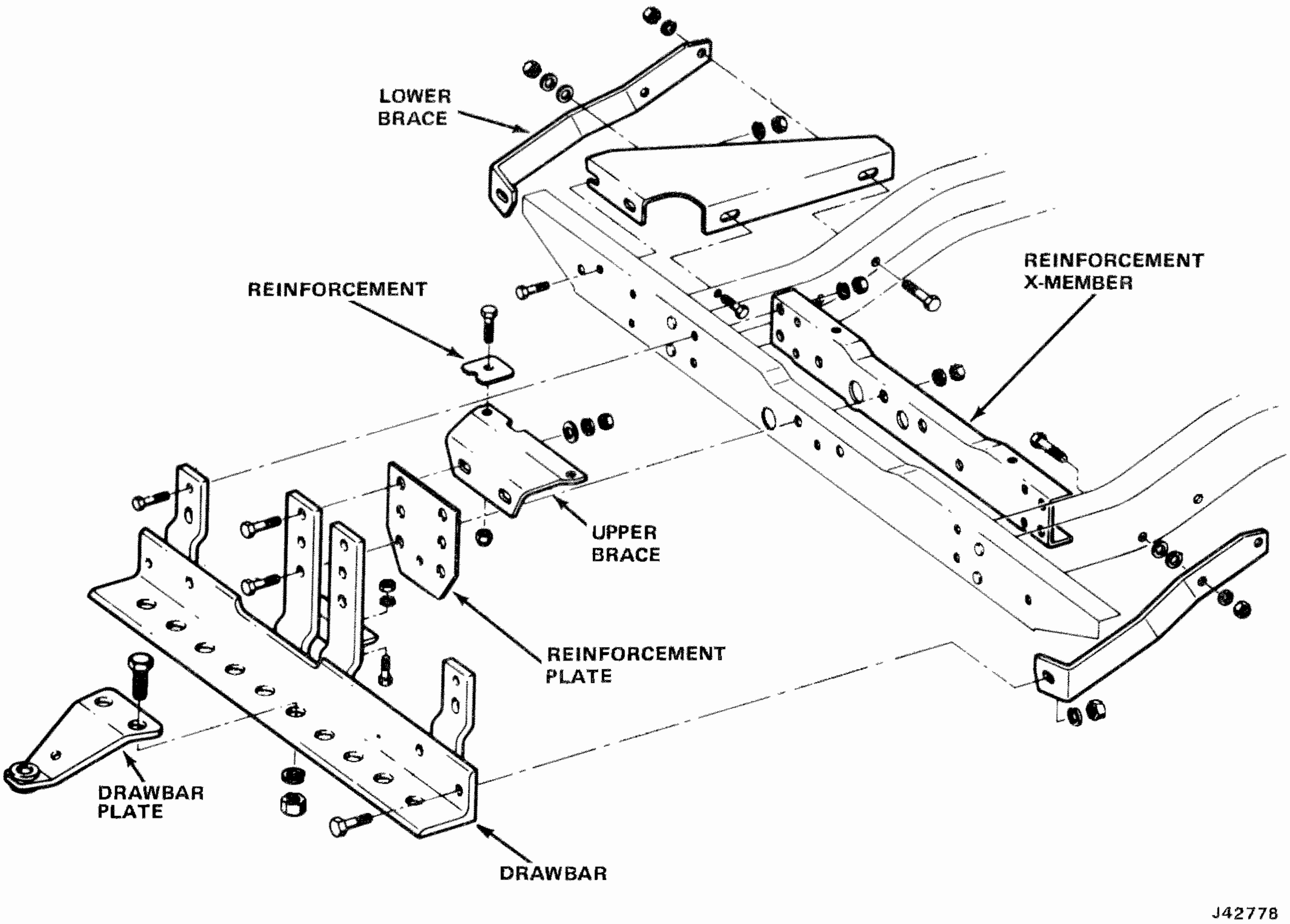

Fig. 21-5 Drawbar

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WIRING DIAGRAMS

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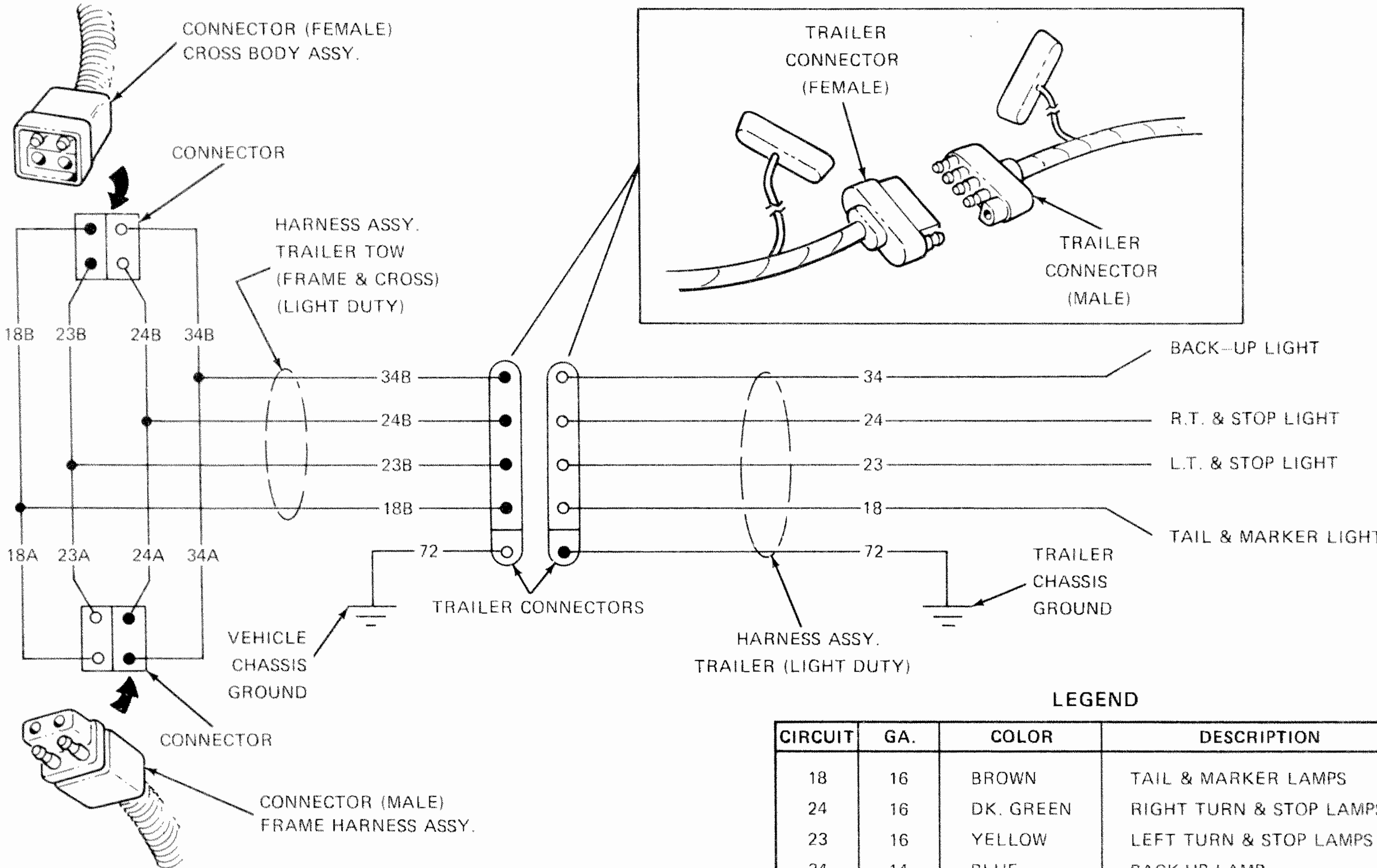

LEGEND

CIRCUIT	GA.	COLOR	DESCRIPTION
18	16	BROWN	TAIL & MARKER LAMPS
24	16	DK. GREEN	RIGHT TURN & STOP LAMPS
23	16	YELLOW	LEFT TURN & STOP LAMPS
34	14	BLUE	BACK-UP LAMP
72	14	WHITE	GROUND

LIGHT-DUTY TRAILER TOWING PACKAGE, CLASS 1 AND 2 WIRING DIAGRAM

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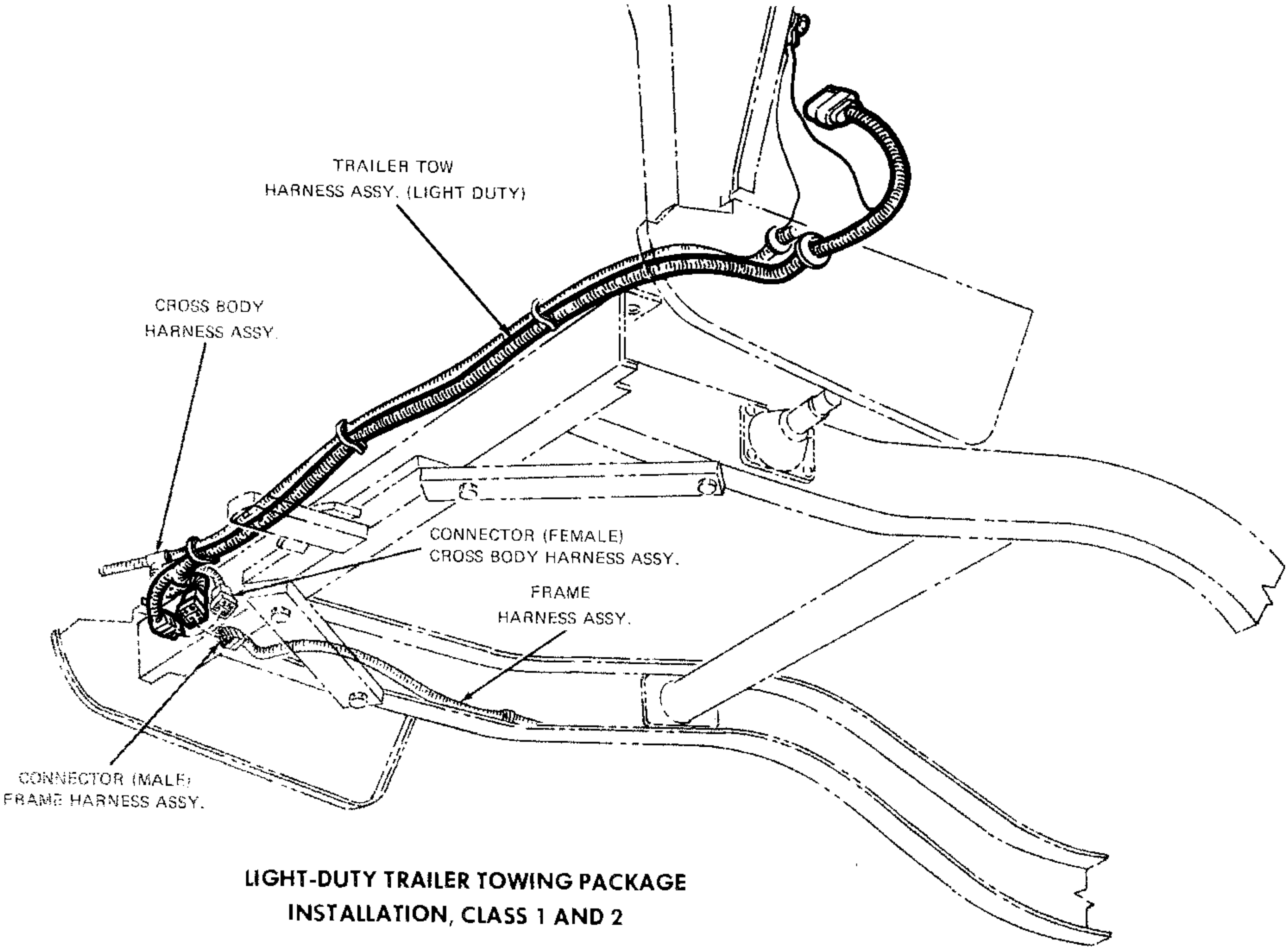

LIGHT-DUTY TRAILER TOWING PACKAGE INSTALLATION, CLASS 1 AND 2

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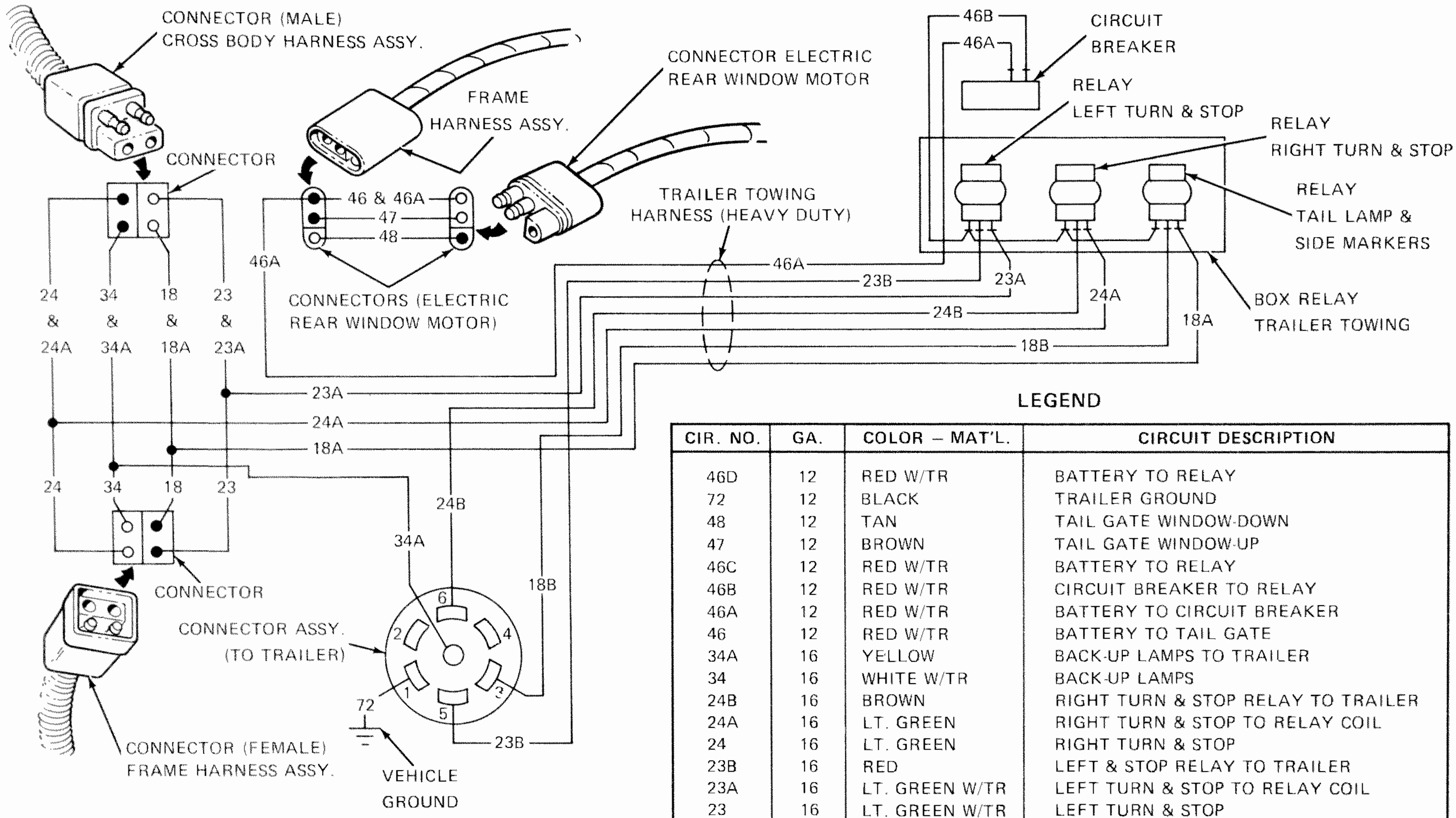

NOTE: THIS PACKAGE REQUIRES AN ELECTRIC REAR WINDOW HARNESS

LEGEND

CIR. NO.	GA.	COLOR – MAT'L.	CIRCUIT DESCRIPTION
46D	12	RED W/TR	BATTERY TO RELAY
72	12	BLACK	TRAILER GROUND
48	12	TAN	TAIL GATE WINDOW-DOWN
47	12	BROWN	TAIL GATE WINDOW-UP
46C	12	RED W/TR	BATTERY TO RELAY
46B	12	RED W/TR	CIRCUIT BREAKER TO RELAY
46A	12	RED W/TR	BATTERY TO CIRCUIT BREAKER
46	12	RED W/TR	BATTERY TO TAIL GATE
34A	16	YELLOW	BACK-UP LAMPS TO TRAILER
34	16	WHITE W/TR	BACK-UP LAMPS
24B	16	BROWN	RIGHT TURN & STOP RELAY TO TRAILER
24A	16	LT. GREEN	RIGHT TURN & STOP TO RELAY COIL
24	16	LT. GREEN	RIGHT TURN & STOP
23B	16	RED	LEFT & STOP RELAY TO TRAILER
23A	16	LT. GREEN W/TR	LEFT TURN & STOP TO RELAY COIL
23	16	LT. GREEN W/TR	LEFT TURN & STOP
18B	16	GREEN	TAIL LAMP-RELAY TO TRAILER
18A	16	WHITE	TAIL LAMP TO RELAY COIL
18	16	WHITE	TAIL & MARKER LAMPS

HEAVY-DUTY TRAILER TOWING PACKAGE, CLASS 3 AND 4 WIRING DIAGRAM

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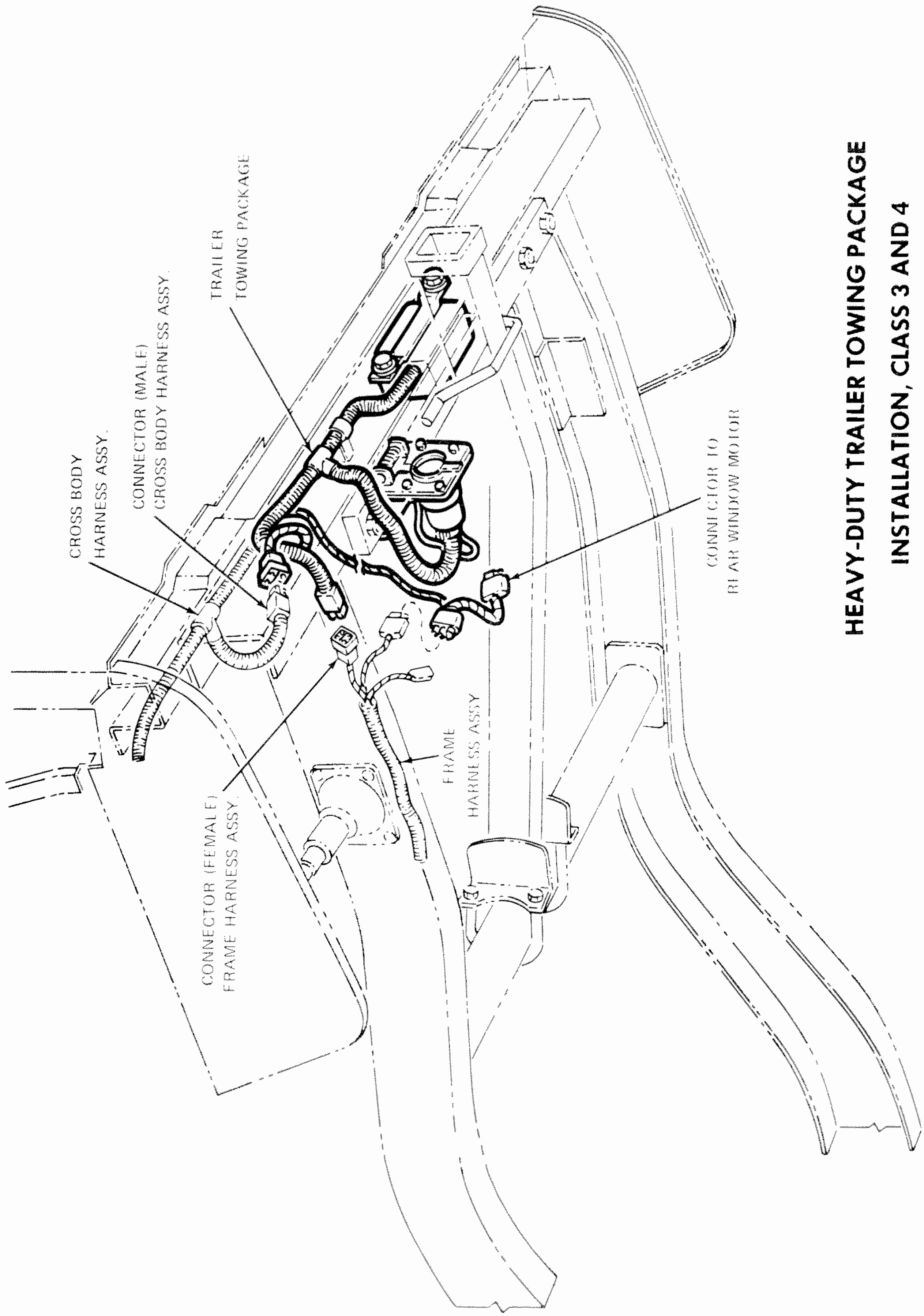

HEAVY-DUTY TRAILER TOWING PACKAGE
INSTALLATION, CLASS 3 AND 4

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LEGEND - CJ-5/CJ-6 MODELS

NO.	GA.	COLOR	INSTRUMENT AND CONTROL HARNESS
A-1	18	BLUE W/TR	CONNECTOR (TEMPERATURE SENDER) TO TEMPERATURE GAUGE INDICATOR
A-2	18	WHITE	FOOT DIMMER SWITCH (HI-BEAM) TO INSTRUMENT CLUSTER (HI-BEAM INDICATOR)
A-3	14	RED W/TR	FOOT DIMMER SWITCH (HI-BEAM) TO HEADLAMP CONNECTOR (HI-BEAM)
A-4	14	GREEN	IGNITION SWITCH (IGNITION TERMINAL) TO INSTRUMENT CLUSTER VOLTAGE REGULATOR
A-4-A	14	GREEN	IGNITION SWITCH (IGNITION TERMINAL) TO INSTRUMENT CLUSTER VOLTAGE REGULATOR TO OIL PRESSURE GAUGE INDICATOR (IGNITION TERMINAL)
A-5	18	BLACK W/TR	CONNECTOR SIGNAL LAMP FRONT RIGHT TO HAZARD WARNING SWITCH TO DIRECTIONAL SIGNAL SWITCH TO CLUSTER LAMP RIGHT TURN
A-6-A	18	GRAY	CONNECTOR (ALTERNATOR REGULATOR) TO INSTRUMENT CLUSTER TO INSTRUMENT VOLTAGE REGULATOR
A-7	18	PURPLE	CONNECTOR (OIL PRESSURE SENDER) TO OIL PRESSURE INDICATOR TO INSTRUMENT VOLTAGE REGULATOR
A-7-A	18	PURPLE	CONNECTOR (OIL PRESSURE SENDER) TO OIL PRESSURE GAUGE
A-8	18	YELLOW W/TR	CONNECTOR SIGNAL LAMP FRONT LEFT TO HAZARD WARNING SWITCH TO DIRECTIONAL SIGNAL SWITCH TO CLUSTER LAMP LEFT TURN
A-9	16	BLACK	(GROUND) FLASH MOUNTING TO LIGHT SWITCH, WIPER & HAZARD LIGHTS
A-10	18	WHITE	CONNECTOR (FRAME HARNESS-GAS GAUGE TANK UNIT) TO INSTRUMENT CLUSTER GAS GAUGE INDICATOR
A-11	18	RED W/TR	HEADLAMP SWITCH "I" TERMINAL TO INSTRUMENT CLUSTER LIGHTS TO HEATER LAMP
A-11-A	18	RED W/TR	HEADLAMP SWITCH "I" TERMINAL TO LAMPS, (LIGHTS, WIPER, HAZARD) TO INSTRUMENT CLUSTER LAMPS
A-12	10	RED	SPLICE TO CONNECTOR (STARTING MOTOR SOLENOID-BATTERY TERMINAL)
A-12-A	12	RED	SPLICE TO CONNECTOR (IGNITION SWITCH-BATTERY)
A-12-B	14	RED	SPLICE TO CONNECTOR (LIGHT SWITCH) "B-1"
A-12-C	12	RED	SPLICE TO AMMETER (+) TERMINAL
A-13	14	GREEN	IGNITION SWITCH (IGNITION TERMINAL) TO CONNECTOR COIL (+) TERMINAL
A-14	16	LT. BLUE	IGNITION SWITCH (START TERMINAL) TO CONNECTOR (STARTING MOTOR SOLENOID-START TERMINAL)
A-15	14	GREEN	FOOT DIMMER SWITCH "B" TERMINAL TO LIGHT SWITCH "H" TERMINAL
A-17	16	BROWN	LIGHT SWITCH-BATTERY "B-2" TO CONNECTOR (STOP LIGHT SWITCH)
A-18	16	YELLOW	LIGHT SWITCH "R" TERMINAL TO CONNECTOR (FRAME HARNESS-TAIL LIGHTS)
A-19	16	LT. BLUE	LIGHT SWITCH "R" TERMINAL TO CONNECTOR (PARKING TERMINAL)
A-23	16	LT. BLUE	CONNECTOR-FRAME HARNESS REAR LEFT TO HAZARD WARNING SWITCH TO DIRECTIONAL SIGNAL SWITCH (LEFT TURN)
A-24	16	ORANGE	CONNECTOR-FRAME HARNESS REAR RIGHT TO HAZARD WARNING SWITCH TO DIRECTIONAL SIGNAL SWITCH (RIGHT TURN)
A-25	16	BLACK	FOOT DIMMER SWITCH (LO-BEAM) TO HEADLAMP CONNECTOR (LO-BEAM)
A-27	18	BLACK W/TR	HORN TERMINAL TO CONNECTOR (HORN BUTTON)
A-30	18	YELLOW	WINDSHIELD WIPER SWITCH TO WINDSHIELD WASHER MOTOR
A-33	14	RED W/TR	WINDSHIELD WIPER SWITCH "B" TO IGNITION (ACCESSORY TERMINAL)
A-34	18	GREEN W/TR	CONNECTOR (BACK-UP LIGHT SWITCH) TO CONNECTOR (FRAME HARNESS-BACK-UP LIGHTS)
A-37	16	ORANGE	TRANSMISSION CONTROL SWITCH TO IGNITION TERMINAL OF IGNITION SWITCH
A-39	16	PINK	HAZARD FLASHER TO HAZARD SWITCH
A-45	14	RED W/TR	CONNECTOR (HORN TERMINAL) TO SPLICE
A-52	18	GREEN W/TR	IGNITION SWITCH (IGNITION TERMINAL) FUSED TO CONNECTOR (BACK-UP LIGHT SWITCH)
A-55	10	YELLOW	CONNECTOR (STARTING MOTOR-BATTERY SIDE) TO AMMETER (-) TERMINAL
A-65	16	BROWN	CONNECTOR (TURN SIGNAL SWITCH) TO CONNECTOR (STOP LIGHT SWITCH)
A-74	18	WHITE	CONNECTOR (TURN SIGNAL SWITCH-FLASHER TERMINAL) TO CONNECTOR (FLASHER)

NO.	GA.	COLOR	HARNESS ASSEMBLY-HEADLAMP, PARKING & SIGNAL LAMPS
B-3	14	RED W/TR	CONNECTOR (HI-BEAM) TO CONNECTOR
B-5	18	BLACK W/TR	CONNECTOR (TURN SIGNAL SWITCH-RIGHT TURN) TO CONNECTOR (DIRECTIONAL SIGNAL LAMP RIGHT TURN)
B-8	18	YELLOW W/TR	CONNECTOR (TURN SIGNAL SWITCH-LEFT TURN) TO CONNECTOR (DIRECTIONAL SIGNAL LAMP LEFT TURN)
B-19	16	LT. BLUE	CONNECTOR (PARKING TERMINAL) TO CONNECTOR
B-25	16	TAN	CONNECTOR (LO-BEAM) TO CONNECTOR
B-27	18	BLACK W/TR	CONNECTOR (STEERING COLUMN-HORN BUTTON) TO HORN TERMINAL
B-45	14	RED W/TR	CONNECTOR (TO HORN TERMINAL)
B-70	16	BLACK	HEADLAMP GROUND TO GROUND MOUNTING (2 CABLES)

NO.	GA.	COLOR	HARNESS ASSEMBLY ENGINE
C-1	18	BLUE W/TR	CONNECTOR (TEMPERATURE INDICATOR TO TEMPERATURE SENDER)
C-6	18	GRAY	CONNECTOR ALTERNATOR (REGULATOR TERMINAL) TO CONNECTOR
C-7	18	PURPLE	CONNECTOR (OIL PRESSURE INDICATOR) TO OIL PRESSURE SENDER
C-12	10	RED	STARTING MOTOR SOLENOID ("B" TERMINAL) TO CONNECTOR
C-14	16	LT. BLUE	CONNECTOR (IGNITION SWITCH START TERMINAL) TO STARTING MOTOR SOLENOID (STARTING TERMINAL)
C-35	16	BLACK	CONNECTOR TRANSMISSION SOLENOID (T.C.S.) TO VACUUM SOLENOID SWITCH
C-37	16	ORANGE	CONNECTOR (VACUUM SOLENOID SWITCH) TO CONNECTOR
C-38	20	PINK	CONNECTOR (IGNITION SWITCH-IGNITION TERMINAL) TO COIL (+) TERMINAL-RESISTANCE WIRE (6 CYLINDER, 1.80 Ω – 8 CYLINDER, 1.35 Ω MAXIMUM AT 76°F.)
C-40	16	YELLOW	STARTING MOTOR SOLENOID (IGNITION) TO ALTERNATOR REGULATOR (IGNITION)
C-42	14	GREEN	COIL (+) TERMINAL TO STARTING MOTOR SOLENOID (IGNITION)
C-43	14	BLACK	ALTERNATOR REGULATOR (GROUND TERMINAL) TO ALTERNATOR (GROUND)
C-44	18	GREEN W/TR	ALTERNATOR REGULATOR (FIELD TERMINAL) TO ALTERNATOR (FIELD TERMINAL)
C-55	10	YELLOW	STARTING MOTOR SOLENOID ("B" TERMINAL) TO ALTERNATOR (OUTPUT TERMINAL)

NO.	GA.	COLOR	CHASSIS WIRING HARNESS
E-10	18	WHITE	CONNECTOR (GAS GAUGE-INSTRUMENT UNIT) TO CONNECTOR (GAS GAUGE-TANK UNIT)
E-18	16	YELLOW	CONNECTOR (LIGHT SWITCH-"R" TERMINAL) TO CONNECTOR (TAIL LAMPS & REAR MARKER LAMPS) TO CONNECTOR
E-23	16	LT. BLUE	CONNECTOR (TURN SIGNAL SWITCH) TO CONNECTOR (LEFT STOP & SIGNAL LAMPS)
E-24	16	ORANGE	CONNECTOR (TURN SIGNAL SWITCH) TO CONNECTOR (RIGHT STOP & SIGNAL LAMPS)
E-34	18	GREEN W/TR	CONNECTOR (BACK-UP LIGHT SWITCH) TO CONNECTOR (BACK-UP LAMPS)

W/TR = WITH TRACER

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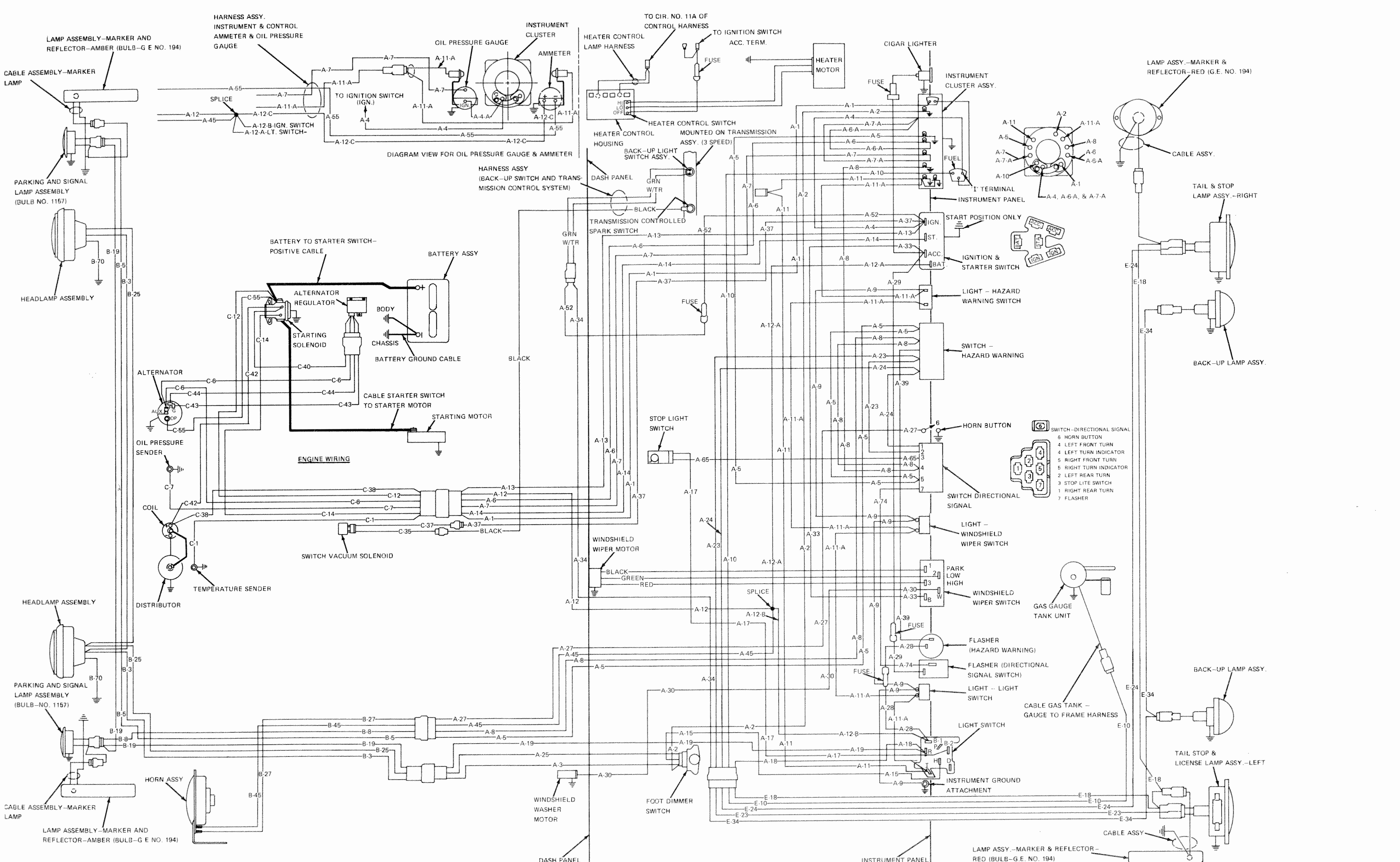

WIRING DIAGRAM—CJ

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LEGEND — Cherokee-Wagoneer Models

CIR.	GA.	COLOR	CIRCUIT DESCRIPTION
1	18	PURPLE	TEMPERATURE SENDER TO TEMPERATURE GAUGE
2	18	GRAY W/TR	HI-BEAM INDICATOR
3	14	GRAY W/TR	HEADLAMP HI-BEAM
4	18	RED	CLUSTER FEED-IGNITION
5	16	GREEN	RIGHT TURN INDICATOR & RIGHT FRONT DIRECTIONAL SIGNAL
7	18	PURPLE	OIL PRESSURE SENDER TO OIL PRESSURE GAUGE
8	16	GREEN W/TR	LEFT TURN INDICATOR & LEFT FRONT DIRECTIONAL SIGNAL
9	18	BLACK	CLUSTER GROUND
10	18	PINK	GAS TANK GAUGE
11	18	ORANGE	INSTRUMENT PANEL LIGHT & STEERING COLUMN FEED
12	10	RED	BATTERY FEED (UNFUSED ALTERNATOR OUTPUT)
13	14	RED W/TR	IGNITION FEED TO COIL & FUSE BLOCK
14	16	LT. BLUE	STARTER SOLENOID FEED
15	14	RED W/TR	DIMMER SWITCH FEED
16	18	BLACK	DOME & COURTESY LIGHT GROUND
17	16	RED W/TR	STOP LIGHT FEED (FUSED)
18	16	WHITE	TAIL LIGHTS & LICENSE LAMP
19	16	WHITE	PARKING LAMPS & MARKER LAMPS
20	14	TAN	HEATER FAN HI-SPEED
21	16	BROWN	HEATER FAN LO-SPEED
22	16	BROWN W/TR	HEATER FAN MED-SPEED
23	16	LT. GREEN W/TR	LEFT TURN SIGNAL-REAR
24	16	LT. GREEN	RIGHT TURN SIGNAL-REAR
25	16	GRAY	HEADLAMP-LO BEAM
26	14	RED W/TR	HEATER FAN SWITCH FEED
27	18	BLACK W/TR	HORN BUTTON
30	16	YELLOW	WIPER SWITCH TO WASHER MOTOR
31	14	BLUE	WIPER SWITCH TO WIPER MOTOR NO. 1
32	14	BLUE W/TR	WIPER SWITCH TO WIPER MOTOR NO. 3
33	14	RED W/TR	IGNITION ACCESSORY TO WIPER MOTOR NO. 2
34	18	WHITE W/TR	BACK-UP LIGHT
35	16	RED W/TR	VACUUM SOLENOID SWITCH FEED
37	16	ORANGE W/TR	VACUUM SOLENOID SWITCH TO TRANSMISSION CONTROL SPARK SWITCH
38	20	PINK	RESISTANCE WIRE (6 CYLINDER, 1.80 Ω – 8 CYLINDER, 1.35 Ω MAXIMUM AT 76°F.)
39	16	RED W/TR	HAZARD SWITCH TO HAZARD FLASHER
40	16	YELLOW	REGULATOR TO STARTER SOLENOID IGNITION
41	18	GRAY	ALTERNATOR (REGULATOR TERMINAL) TO REGULATOR
42	14	RED W/TR	COIL TO STARTER SOLENOID (RESISTANCE WIRE BY-PASS)
43	16	BLACK	ALTERNATOR TO REGULATOR GROUND
44	18	GREEN	ALTERNATOR TO REGULATOR FIELD
45	14	RED W/TR	HORN RELAY FEED
46	12	RED W/TR	TAILGATE SWITCH FEED (IN TAILGATE)
47	12	BROWN	TAILGATE MOTOR (UP)
48	12	TAN	TAILGATE MOTOR (DOWN)
50	16	BROWN	A/C COMPRESSOR FEED
51	18	ORANGE	DOME LIGHT FEED
52	18	RED	BACK-UP LIGHT SWITCH FEED
53	12	RED	TAILGATE SWITCH FEED (INSTRUMENT PANEL)
54	16	YELLOW	KICK-DOWN CIRCUIT TO TRANSMISSION SOLENOID
55	10	YELLOW	BULKHEAD TO AMMETER (–)
56	16	ORANGE	QUADRA-TRAC LAMP
57	18	BLACK	IGNITION SWITCH GROUND (PARK BRAKE WARNING)
57A	18	BLACK	CONNECTOR TO SPLICE (GROUND WIRE)
57B	18	BLACK	BRAKE DIFFERENTIAL PRESSURE WARNING SWITCH
57C	18	BLACK	BRAKE WARNING LAMP GROUND
57D	18	BLACK	BRAKE WARNING LAMP GROUND (IGNITION SWITCH START POSITION)
58	16	BLACK	GROUND CIRCUITS (PARK AND SIGNAL LAMP)
60	14	RED	CIGAR LIGHTER
65	18	RED W/TR	DIRECTIONAL SIGNAL SWITCH FEED FROM STOP LIGHT SWITCH
66	18	RED W/TR	LIGHT SWITCH TO FUSE BLOCK (PANEL LIGHT)
67	16	YELLOW	IGNITION (ACCESSORY & RUN)
68	16	RED	KICKDOWN SWITCH FEED
69	14	RED W/TR	GENERATOR ARMATURE
70	16	BLACK	HEADLAMP GROUND
72	16	BLACK	TAILGATE GROUND
73	16	RED W/TR	CARBBURETOR THROTTLE STOP SOLENOID
74	18	RED W/TR	DIRECTIONAL SIGNAL FEED FROM FLASHER
75	14	RED W/TR	IGNITION (3) FEED TO FUSE BLOCK

W/TR = WITH TRACER

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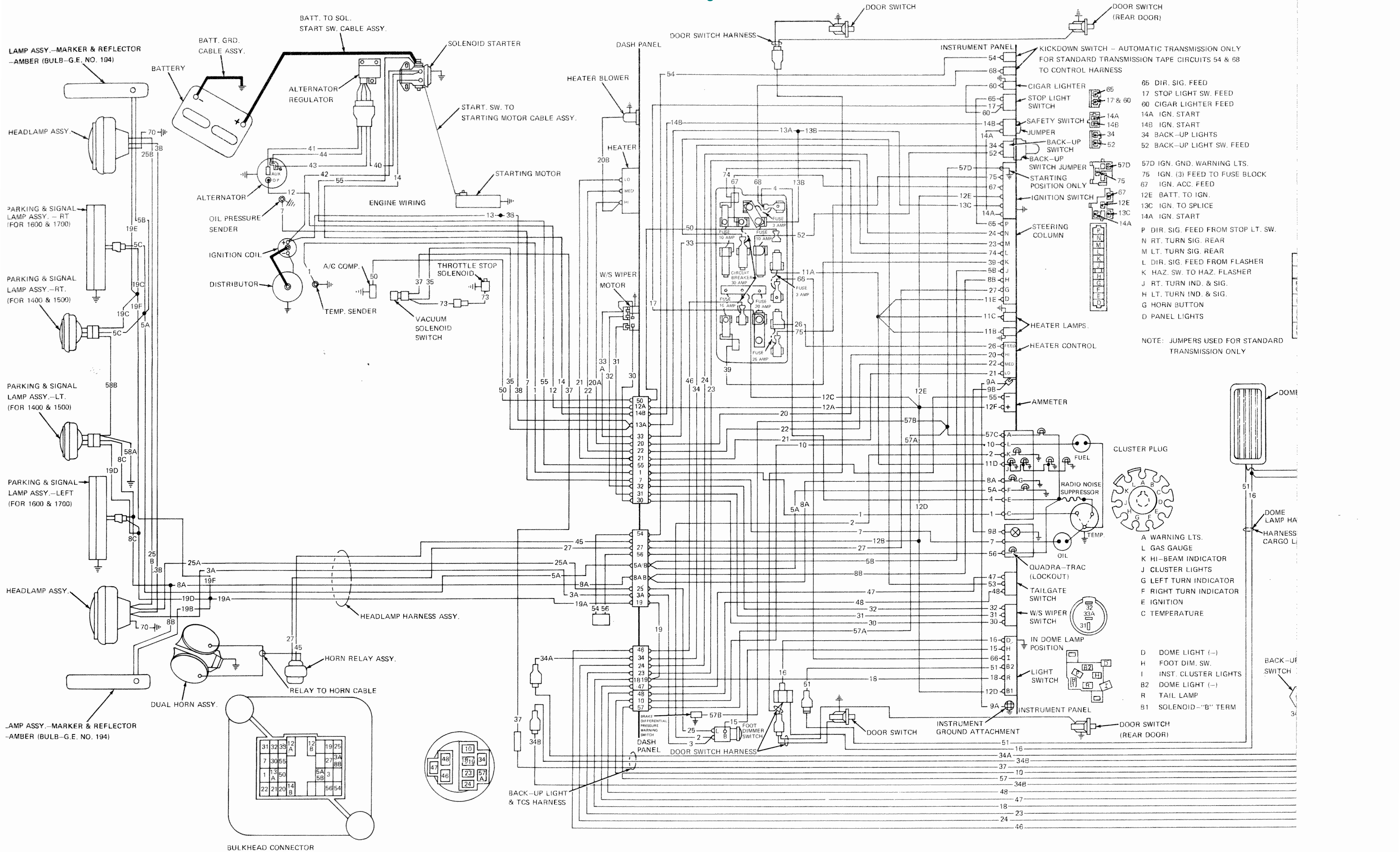

WIRING DIAGRAM—CHEROKEE—WAGONEER

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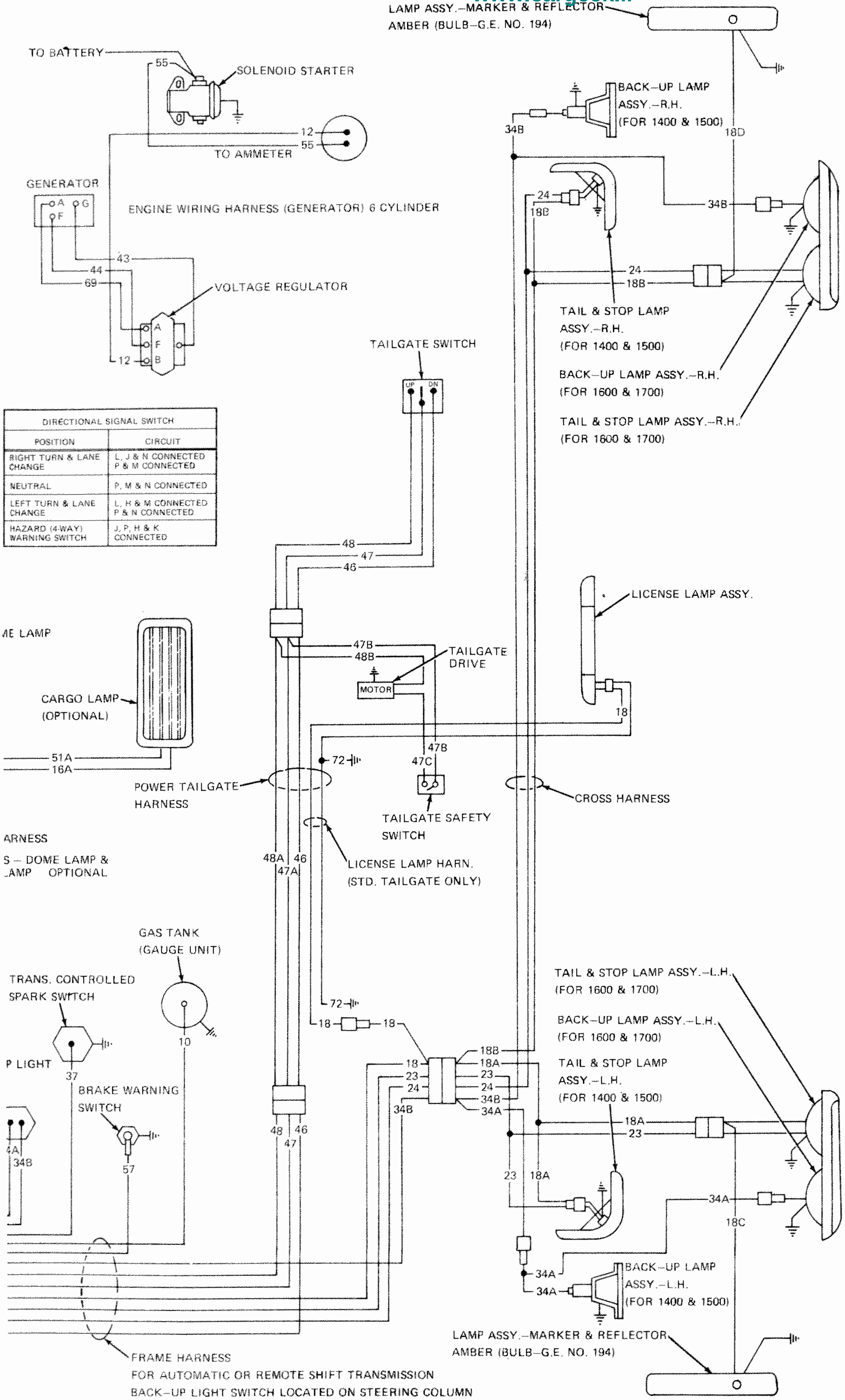

DIRECTIONAL SIGNAL SWITCH	
POSITION	CIRCUIT
RIGHT TURN & LANE CHANGE	L, J & N CONNECTED P & M CONNECTED
NEUTRAL	P, M & N CONNECTED
LEFT TURN & LANE CHANGE	L, H & M CONNECTED P & N CONNECTED
HAZARD (4-WAY) WARNING SWITCH	J, P, H & K CONNECTED

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LEGEND — Truck Models

CIR.	GA.	COLOR	CIRCUIT DESCRIPTION
1	18	PURPLE W/TR	TEMPERATURE SENDER TO TEMPERATURE GAUGE
2	18	GRAY W/TR	HI-BEAM INDICATOR
3	14	GRAY W/TR	HEADLAMP HI-BEAM
4	18	RED	CLUSTER FEED-IGNITION
5	16	GREEN	RIGHT TURN INDICATOR & RIGHT FRONT DIRECTIONAL SIGNAL
7	18	PURPLE	OIL PRESSURE SENDER TO OIL PRESSURE GAUGE
8	16	GREEN W/TR	LEFT TURN INDICATOR & LEFT FRONT DIRECTIONAL SIGNAL
9	18	BLACK	CLUSTER GROUND
10	18	PINK	GAS TANK GAUGE
11	18	ORANGE	INSTRUMENT PANEL LIGHT & STEERING COLUMN FEED
12	10	RED	BATTERY FEED (UNFUSED ALTERNATER OUTPUT)
13	14	RED W/TR	IGNITION FEED TO COIL & FUSE BLOCK
14	16	LT. BLUE	STARTER SOLENOID FEED
15	14	RED W/TR	DIMMER SWITCH FEED
16	18	BLACK	DOME & COURTESY LIGHT GROUND
17	16	RED W/TR	STOP LIGHT FEED (FUSED)
18	16	WHITE	TAIL LIGHTS & LICENSE LAMP
19	16	WHITE	PARKING LAMPS & MARKER LAMPS
20	14	TAN	HEATER FAN HI-SPEED
21	16	BROWN	HEATER FAN LO-SPEED
22	16	BROWN W/TR	HEATER FAN MED-SPEED
23	16	LT. GREEN W/TR	LEFT TURN SIGNAL-REAR
24	16	LT. GREEN	RIGHT TURN SIGNAL-REAR
25	16	GRAY	HEADLAMP-LO BEAM
26	14	RED W/TR	HEATER FAN SWITCH FEED
27	18	BLACK W/TR	HORN BUTTON
30	16	YELLOW	WIPER SWITCH TO WASHER MOTOR
31	14	BLUE	WIPER SWITCH TO WIPER MOTOR NO. 1
32	14	BLUE W/TR	WIPER SWITCH TO WIPER MOTOR NO. 3
33	14	RED W/TR	IGNITION ACCESSORY TO WIPER MOTOR NO. 2
34	18	WHITE W/TR	BACK-UP LIGHT
35	16	RED W/TR	VACUUM SOLENOID SWITCH FEED
37	16	ORANGE W/TR	VACUUM SOLENOID SWITCH TO TRANSMISSION CONTROL SPARK SWITCH
38	20	PINK	RESISTANCE WIRE (6 CYLINDER, 1.80 Ω – 8 CYLINDER, 1.35 Ω MAXIMUM AT 76°F.)
39	16	RED W/TR	HAZARD SWITCH TO HAZARD FLASHER
40	16	YELLOW	REGULATOR TO STARTER SOLENOID IGNITION
41	18	GRAY	ALTERNATOR (REGULATOR TERMINAL) TO REGULATOR
42	14	RED W/TR	COIL TO STARTER SOLENOID (RESISTANCE WIRE BY-PASS)
43	16	BLACK	ALTERNATOR TO REGULATOR GROUND
44	18	GREEN	ALTERNATOR TO REGULATOR FIELD
45	14	RED W/TR	HORN RELAY FEED
46	12	RED W/TR	TAILGATE SWITCH FEED (NOT USED)
50	16	BROWN	A/C COMPRESSOR FEED
51	18	ORANGE	DOME LIGHT FEED
52	18	RED	BACK-UP LIGHT SWITCH FEED
54	16	YELLOW	KICK-DOWN CIRCUIT TO TRANSMISSION SOLENOID
55	10	YELLOW	BULKHEAD TO AMMETER (–)
56	16	ORANGE	QUADRA-TRAC LAMP
57	18	BLACK	IGNITION SWITCH GROUND (PARK BRAKE WARNING)
57A	18	BLACK	CONNECTOR TO SPLICE (GROUND WIRE)
57B	18	BLACK	BRAKE DIFFERENTIAL PRESSURE WARNING SWITCH
57C	18	BLACK	BRAKE WARNING LAMP GROUND
57D	18	BLACK	BRAKE WARNING LAMP GROUND (IGNITION SWITCH START POSITION)
60	14	RED	CIGAR LIGHTER
65	18	RED W/TR	DIRECTIONAL SIGNAL SWITCH FEED FROM STOP LIGHT SWITCH
66	18	RED W/TR	LIGHT SWITCH TO FUSE BLOCK (PANEL LIGHT)
67	16	YELLOW	IGNITION (ACCESSORY & RUN)
68	16	RED	KICKDOWN SWITCH FEED
69	14	RED W/TR	GENERATOR ARMATURE
70	16	BLACK	HEADLAMP GROUND
73	16	RED W/TR	CARBURETOR THROTTLE STOP SOLENOID
74	18	RED W/TR	DIRECTIONAL SIGNAL FEED FROM FLASHER
75	14	RED W/TR	IGNITION (3) FEED TO FUSE BLOCK

W/TR = WITH TRACER

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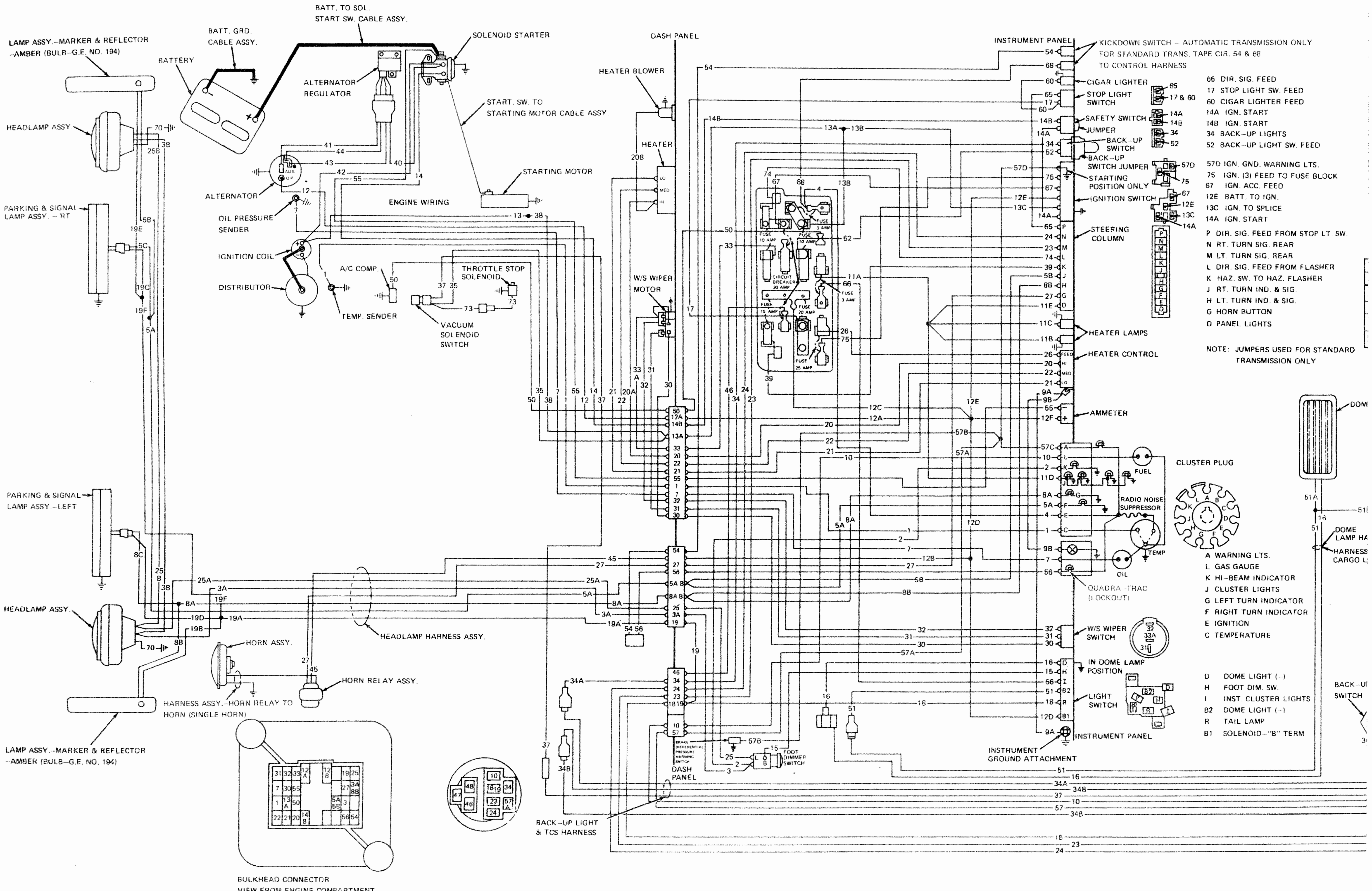

WIRING DIAGRAM—TRUCK

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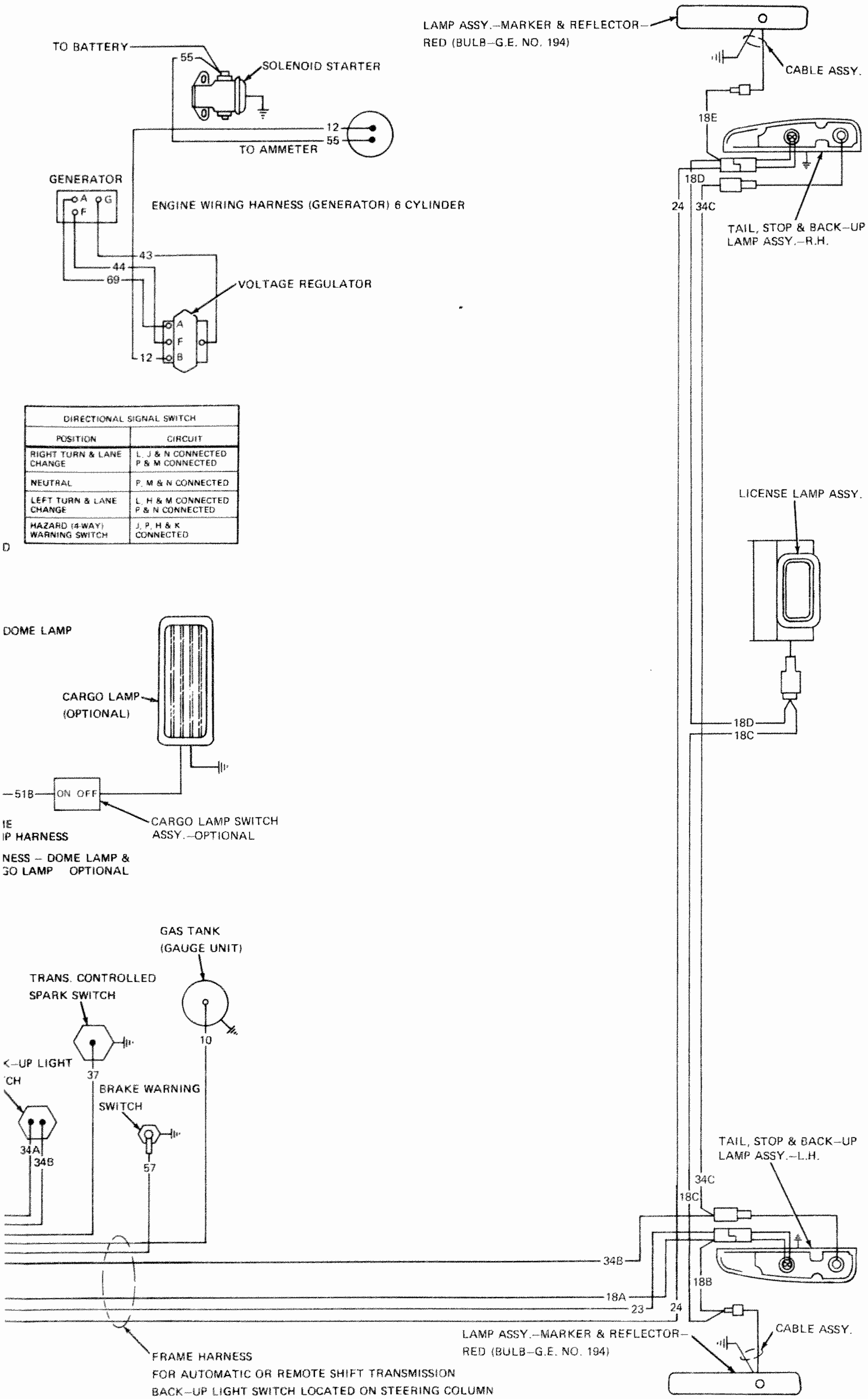

DIRECTIONAL SIGNAL SWITCH	
POSITION	CIRCUIT
RIGHT TURN & LANE CHANGE	L, J & N CONNECTED P & M CONNECTED
NEUTRAL	P, M & N CONNECTED
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HAZARD (4-WAY) WARNING SWITCH	J, P, H & K CONNECTED

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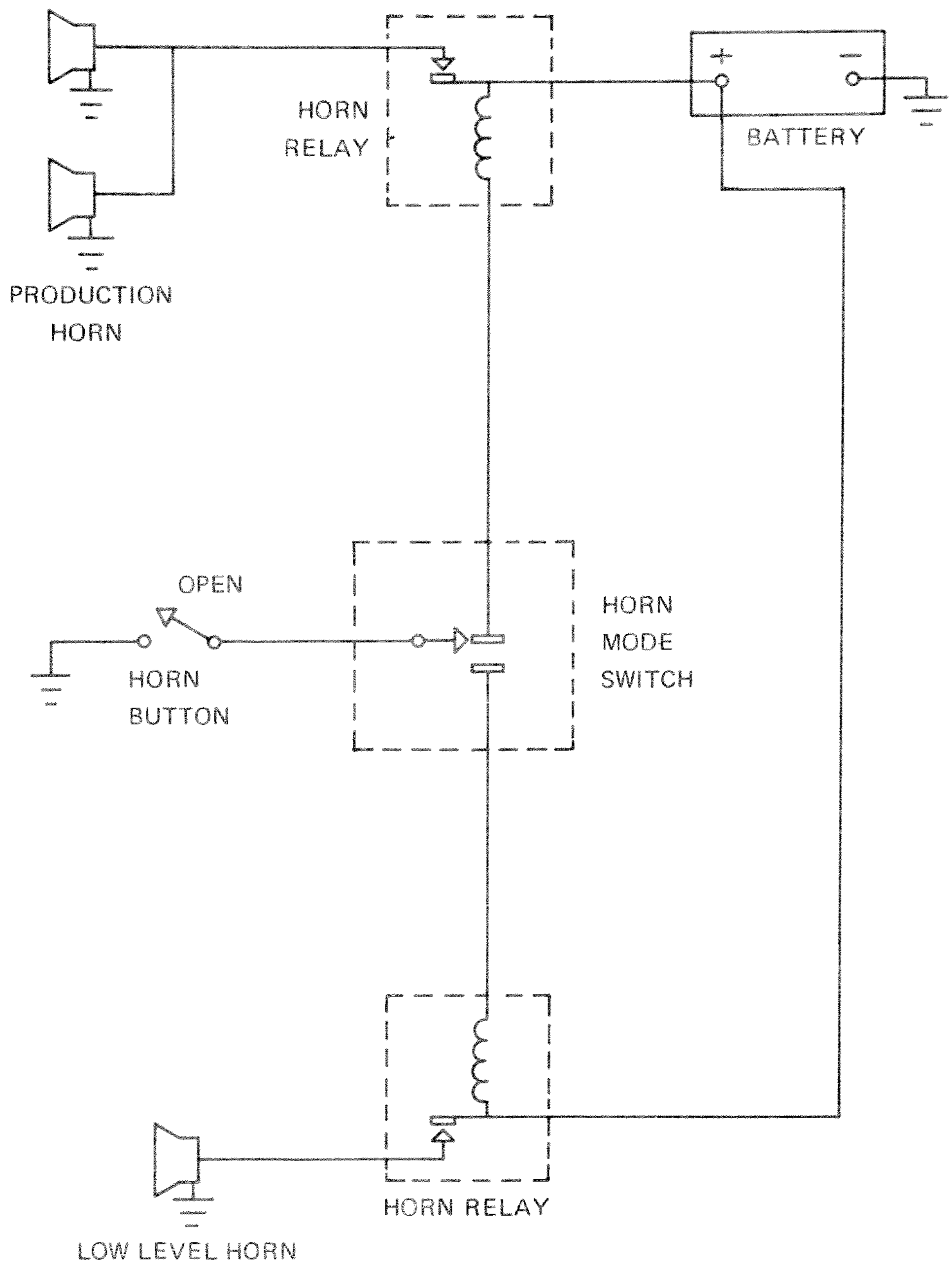

NEW YORK CITY LOW DECIBEL HORN SYSTEM

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A

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ABBREVIATIONS

A. . . . . Automatic (of Transmissions)
ABDC. . . . . After Bottom Dead Center
AC. . . . . Air Conditioning
ac. . . . . Alternating Current
ACC. . . . . Accessories
AGS. . . . . Air Guard System
AFR. . . . . Air-Fuel-Ratio
ALT. . . . . Alternator
AMC. . . . . American Motors Corporation
amp. . . . . Ampere
API. . . . . American Petroleum Institute
ATDC. . . . . After Top Dead Center
AUTO.. . . . . Automatic

B. . . . . Battery
bat.. . . . . Battery
BBDC. . . . . Before Bottom Dead Center
BC. . . . . Bolt Circle (of Wheels)
blk. . . . . Black
BTDC. . . . . Before Top Dead Center

C. . . . . Centrigrade
CARB. . . . . Carburetor
CCW. . . . . Counterclockwise
cfh. . . . . Cubic Feet Per Hour
cfm. . . . . Cubic Feet Per Minute
CID . . . . Cubic Inch Displacement
CL. . . . . Center Line
comp. . . . . Compression
conn. . . . . Connector
CVR. . . . . Constant Voltage Regulator
CW. . . . . Clockwise
cyl. . . . . Cylinder

dc. . . . . Direct Current
DIA. . . . . Diameter
DIM.. . . . . Dimension
DIST. . . . . Distributor
DR. . . . . Door

EGR. . . . . Exhaust Gas Recirculation
EOS. . . . . Engine Oil Supplement
EI. . . . . Exhaust-Intake
EPA. . . . . Environmental Protection Agency
EXH. . . . . Exhaust

F. . . . . Fahrenheit
FEC. . . . . Fuel Evaporative Control
Fig.. . . . . Figure(s)
ft-lb. . . . . Foot-Pound(s)

GAWR. . . . . Gross Axle Weight Rating
gpm. . . . . Gallons Per Minute
grn. . . . . Green
GVW. . . . . Gross Vehicle Weight
GVWR. . . . . Gross Vehicle Weight Rating

HD. . . . . Heavy Duty
HG. . . . . Mercury (Inches of)
HT. . . . . High Tension
HR . . . . Hour(s)
Hz. . . . . Hertz (electrical cycles per second)

IE. . . . . Intake-Exhaust
ign. . . . . Ignition
ID. . . . . Inside Diameter
In-Lb. . . . . Inch-Pound(s)
in.. . . . . Inch
IR. . . . . Infrared

kg m. . . . . Kilograms Metric
kv. . . . . Kilo Volt(s)

LAC. . . . . Less Air Conditioning
lb. . . . . Pound(s)
LHD. . . . . Left Hand Drive
LT. . . . . Light

M. . . . . Manual
man.. . . . . Manual
max.. . . . . Maximum
met.. . . . . Metallic
mfd. . . . . Microfarad
min. . . . . Minimum
mph. . . . . Miles Per Hour

N. . . . . Neutral
NA. . . . . Not Available
NOx. . . . . Oxides of Nitrogen
no.. . . . . Number(s)

O. . . . . Optional
OD. . . . . Outside Diameter
OHV. . . . . Over-Head Valve(s)
opt. . . . . Optional
OS. . . . . Oversize

P. . . . . Park
pass.. . . . . Passenger(s)
PCV. . . . . Positive Crankcase Ventilation
POS. . . . . Positive
psi. . . . . Pounds Per Square Inch
psig. . . . . Pounds Per Square Inch Gauge

QT. . . . . Quadra-Trac (Full Time Four Wheel Drive)

R. . . . . Regular
rev. . . . . Revolution(s), Reverse, Revision
RHD. . . . . Right Hand Drive
rpm. . . . . Revolutions Per Minute

S. . . . . Standard
SAE. . . . . Society of Automotive Engineers
SSR&O. . . . . Special Sales Request and Order (Number)
std. . . . . Standard
SW. . . . . Switch

TAC. . . . . Thermostatically Controlled Air Cleaner
TCS. . . . . Transmission Controlled Spark System
TDS. . . . . Top Dead Center
TC. . . . . Transfer Case
Trans. . . . . Transmission
TR. . . . . Tracer
TVS. . . . . Thermal Vacuum Switch

US. . . . . Undersize

V. . . . . Venturi
V. . . . . Volt(s)
VAC. . . . . Vacuum
VAT. . . . . Volts-Amperes-Tester
VIN. . . . . Vehicle Identification Number

w. . . . . With
WB. . . . . Wheel Base
w/. . . . . With
W/AC. . . . . With Air Conditioning
W/T. . . . . Wire Tracer

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DECIMAL EQUIVALENTS

1/64	.015625	33/64	.515625
1/32	.3125	17/32	.53125
3/64	.046875	35/64	.546875
1/16	.0625	9/16	.5625
5/64	.078125	37/64	.578125
3/32	.09375	19/32	.59375
7/64	.109375	39/64	.609375
1/8	.125	**5/8**	.625
9/64	.140625	41/64	.640625
5/32	.15625	21/32	.65625
11/64	.171875	43/64	.671875
3/16	.1875	11/16	.6875
13/64	.203125	45/64	.703125
7/32	.21875	23/32	.71875
15/64	.234375	47/64	.734375
1/4	.25	**3/4**	.75
17/64	.265625	49/64	.765625
9/32	.28125	25/32	.78125
19/64	.296875	51/64	.796875
5/16	.3125	13/16	.8125
21/64	.328125	53/64	.828125
11/32	.34375	27/32	.84375
23/64	.359375	55/64	.859375
3/8	.375	**7/8**	.875
25/64	.390625	57/64	.890625
23/32	.40625	29/32	.90625
27/64	.421875	59/64	.921875
7/16	.4375	15/16	.9375
29/64	.453125	61/64	.953125
15/32	.46875	31/32	.96875
31/64	.484375	63/64	.984375
1/2	.5	**1**	

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GAGES

GAGE NO.	U. S. STANDARD GAGE Approx. Thickness—Inches	AMERICAN WIRE or B & S GAGE Thickness—Inches
0000000	0.490	
000000	.460	0.5800
00000	.429	.5165
0000	.398	.4600
000	.368	.4096
00	.337	.3648
0	.306	.3248
1	.2757	.2893
2	.2604	.2576
3	.2451	.2294
4	.2298	.2043
5	.2145	.1819
6	.1991	.1620
7	.1838	.1443
8	.1685	.1285
9	.1532	.1144
10	.1379	.1019
11	.1225	.0907
12	.1072	.0808
13	.0919	.0720
14	.0766	.0641
15	.0689	.0571
16	.0613	.0508
17	.0551	.0453
18	.0490	.0403
19	.0429	.0359
20	.0368	.0320
21	.0337	.0285
22	.0306	.0253
23	.0276	.0226
24	.0245	.0201
25	.0214	.0179
26	.0184	.0159
27	.0169	.0142
28	.0153	.0126
29	.0138	.0113
30	.0123	.0100
31	.0107	.00893
32	.0100	.00795
33	.0092	.00708
34	.0084	.00630
35	.0077	.00561
36	.0069	.00500
37	.0065	.00445
38	.0061	.00397
39	.0057	.00353
40	.0054	.00314
41	.0052	
42	.0050	
43	.0048	
44	.0046	

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WEIGHTS AND MEASURES

LINEAR MEASURE

1/12 foot (ft.) . . . . = 1 inch (in.)

12 inches . . . . = 1 foot

3 feet . . . . = 1 yard (1 yd.)

AREA MEASURE

1/144 square foot (sq. ft.) . . = 1 square inch (sq. in.)

144 square inches . . . . = 1 square foot

9 square feet . . . . = 1 square yard (sq. yd.)

LIQUID MEASURE

1/16 pint (pt.) . . . . = 1 ounce (oz.)

1 pint . . . . = 16 ounces

2 pints . . . . = 1 quart (qt.) = 32 ounces

4 quarts . . . . = 1 gallon (gal.)

31½ gallons . . . . = 1 barrel (bbl.)

DRY MEASURE

1/2 quart (qt.) . . . . = 1 pint (pt.)

2 pints . . . . = 1 quart (qt.)

8 quarts . . . . = 1 peck (pk.)

4 pecks . . . . = 1 bushel (bu.)

105 quarts . . . . = 1 barrel

CUBIC MEASURE

1,728 cubic inches . . . . = 1 cubic foot

27 cubic feet . . . . = 1 cubic yard

COMMON WEIGHT

16 ounces . . . . = 1 pound

100 pounds . . . . = 1 hundred weight (cwt.)

2000 pounds . . . . = 1 ton

COMMON U.S.A. EQUIVALENTS
LENGTH

1 inch . . . . = 25.4001 millimeters

1 millimeter . . . . = 0.03937 inches

1 foot . . . . = 0.304801 meters

1 meter . . . . = 3.28083 feet

1 yard . . . . = 9.914402 meters

1 meter . . . . = 1.093611 yards

1 mile . . . . = 1.609347 kilometers

1 kilometer . . . .= 0.621370 miles

LIQUID CAPACITY

1 quart . . . . = 0.94633 liters

1 liter . . . .= 1.05671 quarts

1 gallon. = 3.78533 liters

1 liter . . . .= 0.26418 gallons

DRY CAPACITY

1 quart . . . . = 1.1012 liters

1 liter . . . . = 0.9081 quarts

1 peck . . . .= 8.810 liters

1 liter . . . .= 0.11351 pecks

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