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SERVICE MANUAL

Jeep® UNIVERSAL

4-WHEEL DRIVE

CJ-3B CJ-5A

CJ-5 CJ-6

CJ-6A

2-WHEEL DRIVE

DJ-5 DJ-6

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SM-1046

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IMPORTANT DEALER INFORMATION

This manual, SM-1046, covers current 'Jeep' Universal Series vehicles, and past models, except as noted hereinafter:

SM-1037 should be retained in your service library for information related to the 6-volt electrical system, or the single brake system.

SM-1002-R5 (no longer available) should be retained for information related to the CJ-2A, CJ-3A or DJ-3A models equipped with the L4-134 engine.

The above three manuals provide full service coverage since inception of the 'Jeep' Universal and 'Jeep' Dispatcher model vehicles.

GENERAL DATA

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A-1. GENERAL

This manual is provided for the guidance of all automotive service men, vehicle owners, and service salesmen who repair, maintain, or adjust the 'Jeep' Universal Series vehicles. The information herein was prepared from the service man's viewpoint to give him the accurate and concise data he may need to service the entire vehicle. The information is not elementary as it is intended for automotive service men who are familiar with automotive construction and repair in general. It is not intended, nor would it be possible in such limited space, to cover every possible repair that he may encounter. All specifications are in accord with Engineering Specifications and should be adhered to in all work on the vehicle.

The manual sections follow logical division into major components of the vehicles. The first page of each section has a detailed index of the contents of that section. Subject matter covers all models included in this manual unless an exception for a particular model is specifically mentioned.

Specifications and components covered were for standard production models of 'Jeep' vehicles current at the time the manual was approved for printing. 'Jeep' Corporation reserves the right to discontinue models at any time or change specifications or design of any of its models without notice and without incurring any obligation.

A-2. Vehicle Description

This manual covers all standard production 'Jeep' Universal models currently being produced at the time this manual was approved for publication. Significant changes made in each model since it was first produced are included in the manual.

A description of each model follows. General specifications for each model are listed in Par. A-8. Detailed specifications covering major vehicle units are listed at the end of each section of the manual.

CJ-3B — This is a 4-wheel-drive 'Jeep' Universal model, equipped with the four-cylinder Hurricane F4-134 engine. Wheelbase is 80".

CJ-5

CJ-5A — These are 4-wheel-drive 'Jeep' Universal models, equipped with either the Dauntless V-6 engine, or the four-cylinder Hurricane F4-134 engine. Wheelbase is 81".

CJ-6

CJ-6A — These are 4-wheel-drive 'Jeep' Universal models, equipped with either the Dauntless V-6 engine, or the four-cylinder Hurricane F4-134 engine. Wheelbase is 101".

DJ-5

DJ-6 — These are 2-wheel-drive 'Jeep' Universal models, equipped with the four-cylinder Hurricane F4-134 engine. DJ-5 wheelbase is 81". DJ-6 wheelbase is 101".

A-3. Vehicle Identification

Each 'Jeep' vehicle model series has one or more serial number prefixes to identify it. Complete identification of a specific vehicle requires the prefix plus the serial number. Serial numbers are consecutive for each prefix grouping. Prefix information following will identify the 'Jeep' models shown by serial number prefix from model inception to date.

Note: Vehicles with a serial number prefix of five (5) or more digits that have an S, 5, or 7 as the last digit are equipped with Exhaust Emission Control. A number 1 in the sixth (6th) digit within a seven (7) digit vehicle serial number prefix indicates Left Hand Drive; a 2 indicates Right Hand Drive; a 3 indicates Left Hand Drive California Exhaust Emission Control Engine; a 4 indicates Right Hand Drive California Exhaust Emission Control Engine.

A

GENERAL DATA

'Jeep' Model	Serial No. Prefix	'Jeep' Model	Serial No. Prefix
CJ-3B	453-GB2	CJ-6	57648
	454-GB2		8405
	57348		8405A
	8105		8405S
	8105014		8405AS
CJ-5	57548	CJ-6A	8405014
	8305		8405015
	8305A		8405016
	8305S		8405017
	8305AS		8422
	8305014		8422A
	8305015		8422S
	8305016		8422AS
CJ-5A	8322	DJ-6	8605
	8322A		8605A
	8322S		8605S
	8322AS		8605AS
DJ-5	8505		
	8505A		
	8505S		
	8505AS		
	8505014		
	8505015		
	8505016		
	8505017		

Any prefix not given here for one of the listed models indicates a special vehicle whose differences from standard are not covered in this manual.

A-4. IDENTIFICATION NUMBER LOCATION

All 'Jeep' vehicles and some of their major components have identifying numbers. Paragraphs following will describe the location of identifying numbers.

A-5. Vehicle Serial Number

The vehicle serial number is stamped on a metal plate located on the dash under the hood. It is on the left side of the vehicle for models CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5 and DJ-6 as shown in Fig. A-1. It is on the right side of the vehicle for model CJ-3B, as shown in Fig. A-2. Refer to Par. A-3 for specific information on codes.

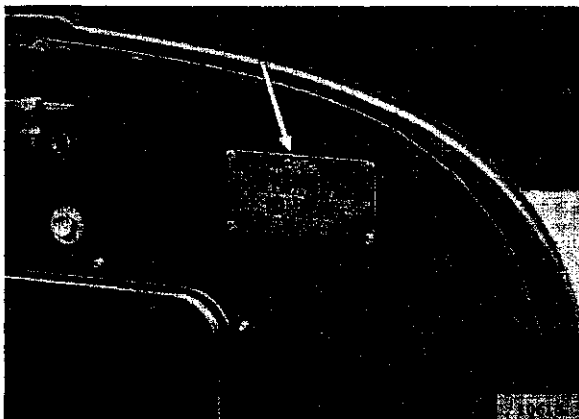


FIG. A-1—CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6 VEHICLE SERIAL NUMBER LOCATION

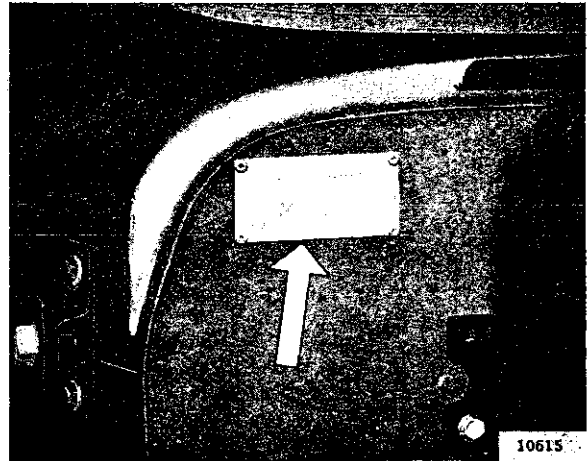


FIG. A-2—CJ-3B VEHICLE SERIAL NUMBER LOCATION

A-6. Engine Code Number

The engine identification number consists of a prefix followed by a five-digit or six-digit code number. The prefix identifies the particular engine. The F4-134 engine code number is stamped on the

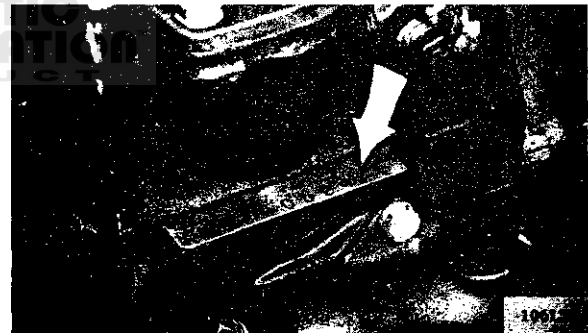


FIG. A-3—ENGINE CODE NUMBER LOCATION HURRICANE F4-134

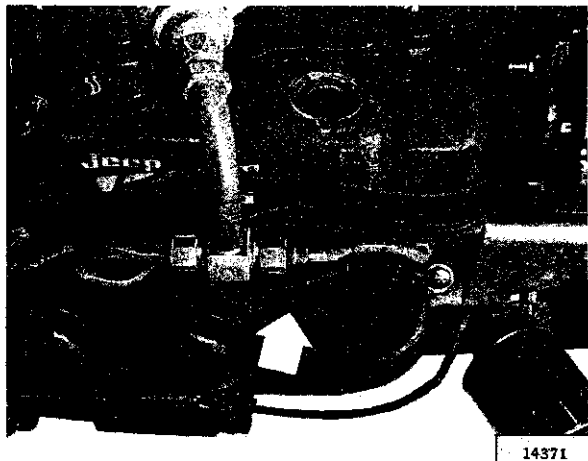


FIG. A-4—ENGINE CODE NUMBER LOCATION DAUNTLESS V-6

water pump boss at the front of the engine, as shown in Fig. A-3. The Dauntless V-6 code number is stamped on the right front face of the cylinder block, just below the rocker arm cover as shown in Fig. A-4.

A-7. Paint-and-Trim Option Plate

A Paint-and-Trim Option Plate is installed on late production 'Jeep' vehicles. The paint code on the plate identifies the paint colors. The trim code on the plate identifies the color of all trim parts in the interior of the vehicle.

To identify paint or trim on vehicles manufactured before the Paint-and-Trim Option Plate was installed, see your 'Jeep' dealer.

'Jeep' Universals have the plate located on the right hand side of the dash under the hood, as shown in Fig. A-5.

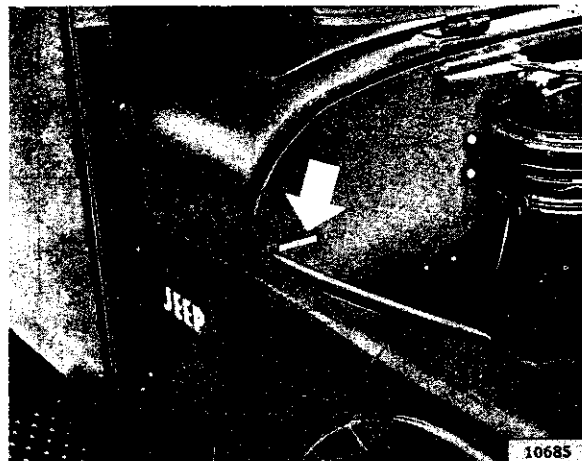


FIG. A-5—PAINT AND TRIM OPTION PLATE LOCATION



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A-8. GENERAL SPECIFICATIONS

MODEL:	CJ-3B	CJ-5, CJ-5A DJ-5	CJ-6, CJ-6A DJ-6		
Engine:	F-4	F-4	F-4		
Number of Cylinders	4	4	4		
Bore	3.125 [7,93 cm.]	3.125 [7,93 cm.]	3,125 [7,93 cm.]		
Stroke	4.375 [11,11 cm.]	4.375 [11,11 cm.]	4.375 [11,11 cm.]		
Displacement	134.2 cu. in. [2,20 ltr.]	134.2 cu. in. [2,20 ltr.]	134.2 cu. in. [2,20 ltr.]		
Compression Ratio:					
Late Production — Standard	.....	6.7:1	6.7:1	
— Optional	.....	7.1:1	7.1:1	
— Optional	.....	6.3:1	6.3:1	
Early Production — Standard	7.4:1	7.4:1	7.4:1		
— Optional	7.8:1	7.8:1	7.8:1		
— Optional	6.9:1	6.9:1	6.9:1		
Compression Pressure	120 to 130 psi. [8,4 a 9,2 kg-cm ²]	120 to 130 psi. [8,4 a 9,2 kg-cm ²]	120 to 130 psi. [8,4 a 9,2 kg-cm ²]		
Horsepower (max. Brake)	75 @ 4000 rpm.	75 @ 4000 rpm.	75 @ 4000 rpm.		
Horsepower (SAE)	15.63	15.63	15.63		
Torque (Max. at 2000 rpm.)	114 lb.-ft. [15,8 kg-m.]	114 lb.-ft. [15,8 kg-m.]	114 lb.-ft. [15,8 kg-m.]		
Engine:		V-6	V-6		
Number of Cylinders		6	6		
Bore		3.750" [9,525 cm.]	3.750" [9,525 cm.]		
Stroke		3.400" [8,636 cm.]	3.400" [8,636 cm.]		
Displacement		225 cu. in. [3,69 ltr.]	225 cu. in. [3,69 ltr.]		
Compression Ratio		9.0:1	9.0:1		
Horsepower (max. Brake)		160 @ 4200 rpm.	160 @ 4200 rpm.		
Horsepower (SAE)		33.748	33.748		
Torque (Max. at 2400 rpm.)		235 lb.-ft. [32,49 kg-m.]	235 lb.-ft. [32,49 kg-m.]		
Wheelbase	80" [2,03 m.]	81" [2,06 m.]	101" [2,57 m.]		
Tread (front and rear)	48 ⁷ / ₁₆ " [1,23 m.]	48 ⁷ / ₁₆ " [1,23 m.]	48 ⁷ / ₁₆ " [1,23 m.]		
Height (Over all)	66 ¹ / ₂ " [1,68 m.]	67" [1,70 m.]	67" [1,70 m.]		
Length (Over all)	129 ²⁹ / ₃₂ " [3,30 m.]	138 ³ / ₁₆ " [3,51 m.]	158 ³ / ₁₆ " [4,02 m.]		
Width (Over all)	68 ⁷ / ₈ " [1,75 m.]	71 ³ / ₄ " [1,82 m.]	71 ³ / ₄ " [1,82 m.]		
Ground Clearance	8" [20,32 cm.]	8" [20,32 cm.]	8" [20,32 cm.]		
CAPACITIES:	U.S.	Imperial	Metric		
Fuel Tank (Approximate):					
Early Models	10.5 gal.	8.8 gal.	39,75 ltr.		
Late Models	16 gal.	13.3 gal.	60,57 ltr.		
Cooling System					
F4 Models	12 qt.	10 qt.	11,4 ltr.		
V-6 Models	10 qt.	8 qt.	9,5 ltr.		
Note: If not equipped with heater deduct	1 qt.	.8 qt.	0,9 ltr.		
	CJ-3B	CJ-5	CJ-6	DJ-5	DJ-6
	lb. kg.	lb. kg.	lb. kg.	lb. kg.	lb. kg.
WEIGHTS (Approximate):					
Gross Vehicle Weight (GVW)	3500 1587	3750 1701	3900 1769	3200 1451	3200 1451
Shipping — V6 Engine	— —	2240 1016	2302 1044	1900 862	2033 922
F4 Engine	2132 967	2163 981	2225 1009	1796 814	1858 842
Curb — V6 Engine	— —	2351 1066	2413 1094	2011 912	2144 972
F4 Engine	2243 1017	2274 1031	2336 1060	1907 865	1969 893
For Canvas Half-Top Model, add	35 17	38 17	38 17	38 17	38 17
For Canvas Full-Top Model, add	56 25	56 25	60 27	56 25	60 27
For Hard Top Model, add	— —	340 154	— —	340 154	— —

LUBRICATION AND PERIODIC SERVICES

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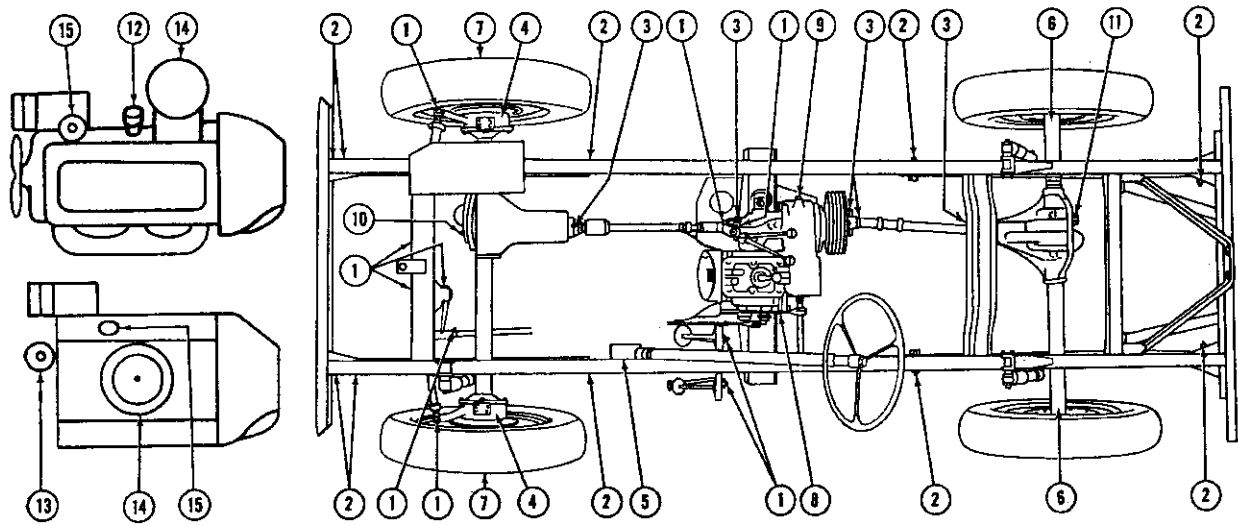
B-1. GENERAL

All 'Jeep' Universal vehicles require periodic lubrication and other maintenance services for normal vehicle usage and application to promote satisfactory operation and prevent excessive wear. Under severe operating or atmospheric conditions these services should be performed more often than under normal conditions. It should also be remembered that common short trips and stop-and-go driving are more severe on lubrication points than

constant speed driving on highways, and even more intensified in extreme cold or hot weather; therefore, vehicles driven under these conditions must be lubricated and serviced more often than normally operated vehicles. The specifications of types and amounts of lubricant given in the Lubrication Chart and text of this section should be closely followed. The off-highway operation lubrication notes, given in the last part of the section, should be followed when applicable.

B

LUBRICATION



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FIG. B-1—LUBRICATION CHART—4-WHEEL DRIVE VEHICLES

CHART NO.	ITEM TO BE LUBRICATED	FREQUENCY 1000 miles = 1.600 km.	QUANTITY		LUBRICANT		
			U.S. Imperial Metric		TYPE	GRADE	
			Summer	Winter			
1.	Chassis Bearings	Each 2,000 miles	As required		Chassis Lubricant	No. 1	No. 1
2.	Spring Shackles and Pivot Bushings	With Lube Fitting: Each 2,000 miles Without Lube Fittings: No Lubrication	As required		Chassis Lubricant	No. 1	No. 1
3.	Universal Joints	Each 2,000 miles	As required		Chassis Lubricant	No. 1	No. 1
4.	Propeller Shaft Front Axle	Check each 2,000 miles Change each 12,000 miles	As required		GL3	SAE-140	SAE-140
5.	Steering Gear Housing	Check each 2,000 miles	As required		MIL-L-2105-B	SAE-80	SAE-80
6.	Rear Wheel Bearings	With Lube Fittings: Sparingly each 2,000 miles Without Lube Fitting: Disassemble to lubricate each 12,000 miles	As required		Wheel Bearing Lubricant	No. 2	No. 2
7.	Front Wheel Bearings	Disassemble to lubricate each 12,000 miles	As required		Wheel Bearing Lubricant	No. 2	No. 2
8.	Transmission: 3 Speed	Check each 2,000 miles Change each 12,000 miles	2 1/2 pts.	2 pts. 1,2 ltrs.	GL4	SAE-90	SAE-80
	4 Speed	Check each 2,000 miles Change each 12,000 miles	6 1/2 pts.	5 1/2 pts. 3,2 ltrs.	GL4	SAE-90	SAE-80
9.	Transfer Case	Check each 2,000 miles Change each 12,000 miles	3 1/2 pts.	3 pts. 1,5 ltrs.	GL4	SAE-90	SAE-80
	Differentials						
10.	Front	Check each 2,000 miles	2 1/2 pts.	2 pts. 1,2 ltrs.	MIL-L-2105-B	SAE-80	SAE-80
11.	Rear	Change each 12,000 miles	2 1/2 pts.	2 pts. 1,2 ltrs.	MIL-L-2105-B+++	SAE-80	SAE-80
	Speedometer Cable	Disassemble to lubricate each 12,000 miles	As required		Graphite Grease	Light	
12.	Generator — F4	Each 2,000 miles	Several Drops		Engine Oil	Same as engine	
	Distributor — F4						
	Oil	Each 2,000 miles	Several Drops		Engine Oil	Same as engine	
	Wick	Each 2,000 miles	One Drop		Engine Oil	Same as engine	
	Pivot	Each 2,000 miles	One Drop		Engine Oil	Same as engine	
	Cam	Each 2,000 miles	2 c.c.		Cam Lubricant		
13.	Distributor Cam — V6	At each breaker point replacement	As required		Cam Lubricant		
14.	Air Cleaner — F4	Each 2,000 miles	1 1/2 pts.	1 pt. 0,6 ltrs.	Engine Oil	SAE-40 or 50	SAE-20
	— V6	Each 6,000 miles					
15.	Engine — F4	Change each 2,000 miles or 60 days	4 qt. 3 1/2 qt.	3,8 ltrs.	Engine Oil		
	Engine — V6	Change each 6,000 miles or 60 days	4 qt. 3 1/2 qt.	3,8 ltrs.	Engine Oil		

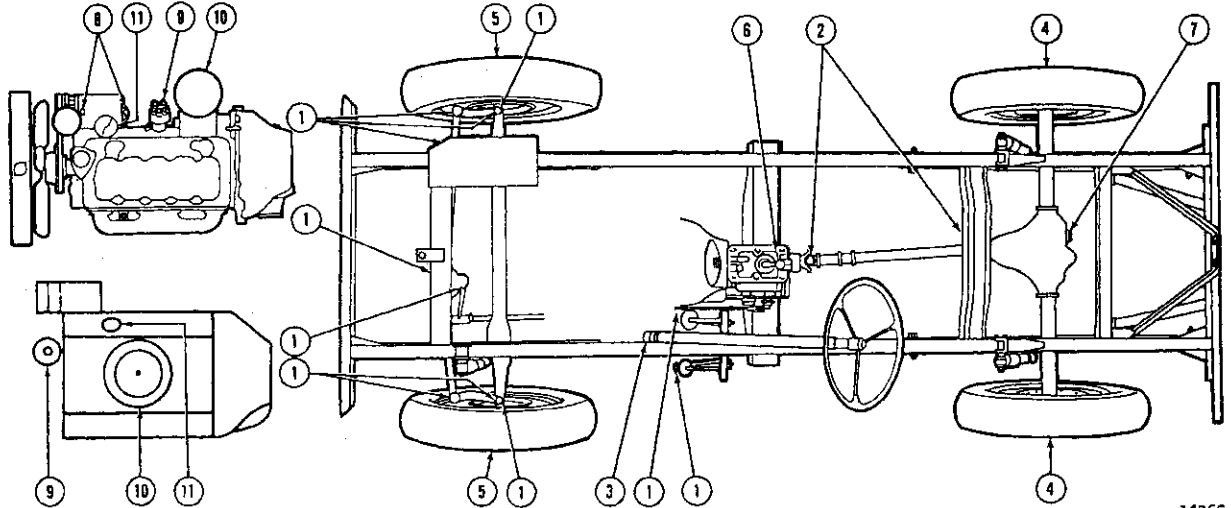
☐ ☐ Above 90°F. use SAE 30 or 10W-30 Between +10°F. and 90°F. use SAE 20W or 10W-30 Between -10°F. and +10°F. use SAE 10W or 10W-20 Below -10°F. use SAE 5W or 5W-20
 ☐ ☐ ☐ Not lower than 32°F. [0°C.] use SAE 20W or SAE 10W-30 Between 32°F. [0°C.] and 0°F. [-17°C.] use SAE 10W or SAE 10W-30 Below 0°F. [-17°C.] use SAE 5W or SAE 5W-20

*4-Speed transmission and transfer case require separate lubrication of each unit.

+++For Powr-Lok and Trac-Lok differential use only 'Jeep' Differential Oil, Part No. 94557.

☐ When filter is changed at the same time, add one quart.

☉ Do not mix lithium and sodium base lubricants. Use lithium base lubricant as specified



14366

FIG. B-2—LUBRICATION CHART — 2-WHEEL DRIVE VEHICLES

CHART NO.	ITEM TO BE LUBRICATED	FREQUENCY 1000 miles = 1.600 km.	QUANTITY		LUBRICANT		
			U.S.	Imperial Metric	TYPE	GRADE	
						Summer	Winter
1.	Chassis Bearings	Each 2,000 miles	As required		Chassis Lubricant	No. 1	No. 1
2.	Universal Joints	Each 2,000 miles	As required		Chassis Lubricant	No. 1	No. 1
3.	Steering Gear Housing	Check each 2,000 miles	As required		MIL-L-2105-B	SAE-80	SAE-80
4.	Rear Wheel Bearings	With Lube Fittings: Sparingly each 2,000 miles Without Lube Fittings: Disassemble to lubricate each 12,000 miles	As required		Wheel Bearing Lubricant	No. 2	No. 2
5.	Front Wheel Bearings	Disassemble to lubricate each 12,000 miles	As required		Wheel Bearing Lubricant	No. 2	No. 2
6.	Transmission	Check each 2,000 miles Change each 20,000 miles	1 1/2 pts.	1 1/4 pts. 0,7 ltrs.	GL4	SAE-90	SAE-80
7.	Differential	Check each 2,000 miles Change each 12,000 miles	2 pts.	1 3/4 pts. 0,9 ltrs.	MIL-L-2105-B*	SAE-80	SAE-80
	Hand Brake Control Handle Cable	Each 12,000 miles	As required		Graphite Grease	Medium	Medium
	Hand Brake Control Cable Rear	Each 12,000 miles	As required		Graphite Grease	Medium	Medium
8.	Generator — F4	Each 2,000 miles	2 to 4 Drops		Engine Oil	Same as engine	
	Speedometer Cable	Disassemble to lubricate each 12,000 miles	As required		Graphite Grease	Light	
9.	Distributor — F4	Each 2,000 miles	Several Drops		Engine Oil	Same as engine	
	Oil	Each 2,000 miles	One Drop		Engine Oil	Same as engine	
	Pivot	Each 2,000 miles	One Drop		Engine Oil	Same as engine	
	Cam	Each 2,000 miles	2 c.c.		Cam Lubricant	—	
	Distributor Cam — V6	At each breaker point replacement	As required		Cam Lubricant	—	
10.	Air Cleaner — F4	Each 2,000 miles	1 1/4 pts.	1 pt. 0,6 ltrs.	Engine Oil	SAE-40	SAE-20
	— V6	Each 6,000 miles					
11.	Engine — F4	Change each 2,000 miles or 60 days	4 qt.**	3 1/2 qts. 3,8 ltrs.	Engine Oil	Ⓜ	
	Engine — V6	Change each 6,000 miles or 60 days	4 qt.**	3 1/2 qts. 3,8 ltrs.	Engine Oil	Ⓜ	

Ⓜ Above 90°F. use SAE 30 or 10W-30 Between +10°F. and 90°F. use SAE 20W or 10W-20 Between -10°F. and +10°F. use SAE 10W or 10W-20 Below -10°F. use SAE 5W or 5W-20

Ⓜ Ⓜ Not lower than 32°F. [0°C.] use SAE 20W or SAE 10W-30 Between 32°F. [0°C.] and 0°F. [-17°C.] use SAE 10W or SAE 10W-30 Below 0°F. [-17°C.] use SAE 5W or SAE 5W-20

*For Powr-Lok and Trac-Lok differential use only 'Jeep' Differential Oil, Part No. 94557.

**When oil filter is changed at the same time, add one quart [one ltr.].

Ⓜ Do not mix lithium and sodium base lubricants. Use lithium base lubricants as specified.

B-2. Special Lubricants

Special lubricants are required for certain lubrication points on the 'Jeep' Universal vehicles. The special lubricants are necessary for proper functioning and maintenance of the vehicle. The Lubrication Chart (Fig. B-1 and B-2) designates the special lubricating points and identifies them by type or part number.

B-3. Applying Fresh Lubricant

When servicing or lubricating the vehicle, it is important that all old lubricant and dirt be removed from the fitting and/or plugs before servicing and that the recommended type of lubricant be used for the particular item being serviced.

Force lubricant through the lube fittings until the lubricant being forced out of the joint is fresh lubricant, indicating that all old lubricant has been removed.

B-4. Engine Lubrication System — Hurricane F4 Engine

- Refer to Fig. B-3.

The engine oil pressure system is designed to provide adequate lubrication to all working parts of the engine. The gear-type oil pump is driven from the engine camshaft. The pump is provided with a

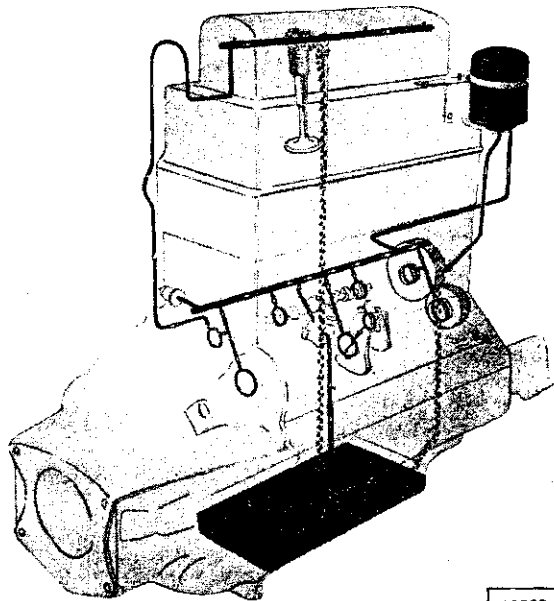


FIG. B-3—ENGINE LUBRICATION SYSTEM — HURRICANE F4 ENGINE

floating, screened intake that prevents the circulation of any sediment that might accumulate in the oil pan. By means of this pump, the main bearing journals and crankpins are efficiently lubricated

through an oil gallery and passages in the cylinder block. Oil is forced under pressure to the main bearings and through the cheeks of the crankshaft to the connecting rod bearings. Oil is also force-fed to the camshaft bearings, timing gears, and intake valve rocker arms. The oil pressure is controlled by relief valve located in the oil pump. The valve is designed to open when excessive pressure develops in the system, relieving the pressure and returning the excess oil to the oil pan. The cylinder walls, piston pins, and tappets are supplied with oil from spurt holes in the connecting rods. A portion of the oil is continually passed through an oil filter which effectively removes any foreign matter suspended in the oil. A flanged section on the rear of the crankshaft acts as an oil slinger and, in combination with the rear main bearing upper and lower oil seal, prevents the leakage of oil from the rear end of the cylinder block. Leakage of oil from the front end of the cylinder block is controlled by the crankshaft oil slinger and the front oil seal installed in the timing gear cover. The oil pressure indicator light in the instrument panel and the oil level gauge or dip stick in the side of the engine provide a means for checking the oil pressure and oil level.

B-5. Oil Pressure Gauge or Indicator

On early CJ-3B vehicles an oil pressure gauge is mounted on the instrument panel. This gauge indicates the oil pressure within the engine lubricating system.

On Models CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6 and later production vehicles of Model CJ-3B a red telltale lamp, which operates when the ignition switch is turned on, is lit when there is insufficient oil pressure to properly lubricate the engine. When it goes out, operating pressure is achieved. In normal operation, the light is lit when the ignition is first turned on. It goes out after the vehicle is in motion.

Failure of the gauge or indicator to register normal oil pressure may indicate insufficient supply of oil in the engine crankcase, low or no oil pump pressure, or a fault in the gauge or indicator electrical circuit. The engine must be stopped immediately to prevent possible damage to engine bearings and the fault corrected before restarting the engine.

B-6. Engine Lubrication System — Dauntless V-6 Engine

The engine lubrication system (Fig. B-4) is the force feed type in which oil is supplied under pressure to the crankshaft, connecting rods, camshaft bearings and valve lifters. Oil is supplied under controlled volume to the rocker arm bearings and push rods. All other moving parts are lubricated by gravity flow or splash.

The supply of oil is carried in the oil pan which is filled through a filter opening in the right rocker arm cover. A removable oil gauge rod on the left side of the crankcase is provided to check oil level. The oil pump is located in the timing chain cover

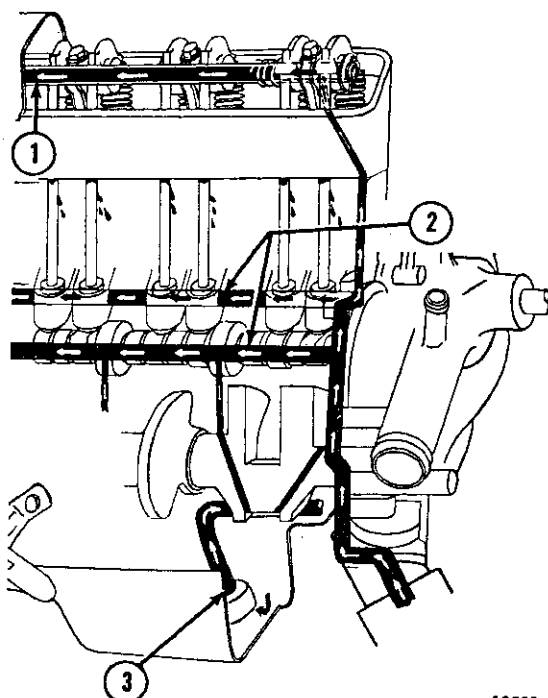


FIG. B-4—ENGINE LUBRICATION SYSTEM—
DAUNTLESS V-6 ENGINE

- 13330
- 1—Rocker Arm Shaft
2—Main Oil Line
3—Oil Inlet

where it is connected by a drilled passage in the cylinder crankcase to an oil screen housing and pipe assembly. The screen is submerged in the oil supply and has ample area for all operating conditions. If the screen should become clogged for any reason, oil may be drawn into the system over the top edge of the screen, which is held clear of the sheet metal screen housing.

Oil is drawn into the pump through the screen and pipe assembly and a drilled passage in the crankcase, which connects to drilled passages in the timing chain cover. All oil is discharged from the pump to the oil pump cover assembly. The cover assembly consists of an oil pressure relief valve, an oil filter bypass valve and a nipple for installation of an oil filter. The spring loaded oil pressure relief valve limits the oil pressure to a maximum of 30 pounds [13.607 kg.] per square inch. The oil filter bypass valve opens when the filter has become clogged to the extent that 4½ to 5 pounds [2.04 a 2.27 kg.] pressure difference exists between the filter inlet and exhaust to bypass the oil filter and channel unfiltered oil directly to the main oil galleries of the engine.

A full flow oil filter is externally mounted to the oil filter cover nipple on the right side of the engine, just below the alternator. Normally, all engine oil passes through the filter element; however, if the element becomes restricted, a spring loaded bypass valve opens as mentioned above. The main oil galleries run the full length of the crankcase and cut into the valve lifter guide holes to supply oil at full pressure to the lifters. Connecting pas-

sages drilled in the crankcase permit delivery of oil at full pressure to all crankshaft and camshaft bearings.

Holes drilled in the crankshaft carry oil from the crankshaft bearings to the connecting rod bearings. Pistons and cylinder walls are lubricated by oil forced through a small notch in the bearing parting surface on the connecting rod, which registers with the hole in the crankpin once in every revolution. Piston pins are lubricated by splash.

Drilled holes in the camshaft connect the front camshaft bearing journal to the keyslot in the front of the camshaft. Oil flows from the journal into the keyslot over the woodruff key in the space between the key and the camshaft sprocket and fuel pump eccentric.

The forward end of the fuel pump eccentric incorporates a relief which allows the oil to escape between the fuel pump eccentric and the camshaft distributor gear. The oil stream strikes the distributor shaft gear once each camshaft revolution, and provides ample lubrication of the timing chain and sprockets by splash.

The rocker arms and valves on each cylinder head are supplied with oil from the oil galleries through holes drilled in the front of the cylinder block and cylinder head. The hole drilled in the cylinder head ends beneath the front rocker arm shaft bracket. A notch cast in the base of the rocker arm shaft bracket allows the oil to flow up inside the bracket in the space between the bracket and bolt, to the hollow rocker arm shaft which is plugged at both ends. Each rocker arm receives oil through a hole in the underside of the shaft. Grooves in the rocker arm provide lubrication of the bearing surface. Oil is metered to the push rod seat and valve stem through holes drilled in the rocker arm. Excess oil drains off and returns to the oil pan through passages in the cylinder head and block. Refer to the Lubrication Chart for lubrication frequency and lubrication type and grade.

B-7. Chassis Lubrication

Chassis and engine should be serviced at periodic intervals. Most chassis lubricating points, whether long-life or conventional, have standard lubrication fittings. Refer to the Lubrication Specifications and Service Maintenance Schedule for specific points and lubricating time intervals. It is not necessary to disassemble prepacked joints to lubricate them. Merely add new lubricant, as described in Par. B-3, to remove all old lubricant.

At the appropriate interval, clean each lubrication fitting indicated on the Lubrication Chart and Service Maintenance Schedule. Use a pressure gun to lubricate. Be sure the grease channels are open to provide complete lubrication of bearing surfaces. In some cases it may be necessary to disassemble to clear plugged channels.

When vehicles are driven primarily in abnormally dusty or wet areas or when a vehicle is subject to severe operating conditions, perform these services more frequently. Under these conditions, no definite interval can be recommended because of the great variety of uses and conditions of use.

B

LUBRICATION

B-8. SERVICE MAINTENANCE SCHEDULE

Perform the following operations at the mileage shown. Two thousand miles equals 3,200 km.

SERVICE MAINTENANCE SCHEDULE

OPERATION	VEHICLE MILEAGE IN THOUSANDS							
	2	4	6	8	10	12	24	30
Check Wheel Nut Torque*	X	X	X	X	X	X		
Check Fluid Level in Battery	X	X	X	X	X	X		Continuing each 2,000 miles
Check Fluid Level in Brake Master Cylinder*	X	X	X	X	X	X		" " " " " "
Service Cooling System	X	X	X	X	X	X		" " " " " "
Service Tires	X	X	X	X	X	X		" " " " " "
Lubricate Distributor Cam Lubricator (F4-134)	X	X	X	X	X	X		" " " " " "
Lubricate Steering Linkage	X	X	X	X	X	X		" " " " " "
Lubricate Propeller Shaft Universal Joints	X	X	X	X	X	X		" " " " " "
Lubricate Propeller Shaft Slip Joints	X	X	X	X	X	X		" " " " " "
Lubricate Tie Rod and Drag Link Sockets	X	X	X	X	X	X		" " " " " "
Change Engine Oil and Filter, and Service Air Cleaner (F4 134 Engine)**	X	X	X	X	X	X		" " " " " "
Change Engine Oil and Filter, and Service Air Cleaner (V6-225 Engine)**	X	X	X	X	X	X		" " " " " "
Check Brake Operation and Pedal Free Play	X							Continuing each 6,000 miles
Check Clutch Pedal Free Play	X							" " " " " "
Check all V-Belt Tensions	X							" " " " " "
Check Exhaust Emission System (If so equipped)**	X							" " " " " "
Service Positive Crankcase Vent Valve and Breather	X							" " " " " "
Road Test Including a Check of all Instrument Lights and Controls	X							" " " " " "
Tune-up Engine								" " " " " "
Check Operation of Manifold Heat Control Valve								" " " " " "
Clean Exterior of Radiator								" " " " " "
Align Headlights								" " " " " "
Check Brake Linings								" " " " " "
Check Exhaust System for Leaks								" " " " " "
Replace Canister Air Filter (F. E. E. C. System)								" " " " " "
Check Axle U-Bolt Torque								" " " " " "
Check Lubricant Level of Front Axle Universal Joints								" " " " " "
Check Shock Absorber Mountings and Bushings								" " " " " "
Check Front and Rear Spring Bushings								" " " " " "
Lubricate Distributor (V6-225)								" " " " " "
Replace Spark Plugs								" " " " " "
Check Charging and Starting Circuits								" " " " " "
Lubricate Tailgate Latch, Supports and Hinges								" " " " " "
Lubricate Door and Hood Hinge Pivots								" " " " " "
Lubricate Glove Compartment Door Latch								" " " " " "
Lubricate Heater Controls								" " " " " "
Lubricate Windshield Wiper and Washer Controls								" " " " " "
Clean, Repack and Adjust Wheel Bearings								" " " " " "
Change Transmission and Transfer Lubricant								Continuing each 24,000 miles
Replace Dry-Type Air Cleaner								" " " " " "
Check Lubricant Level of Differential								" " " " " "
Lubricate Transfer Case Shift Lever Control Case								X Continuing each 30,000 miles

*Check after the first 200 miles (320 km.) of operation.

If wheel or wheels are changed for any reason, have wheel nut torque rechecked after an additional two hundred miles of operation

**Service mileage shown or every 60 days, whichever occurs first.

***Maintenance check on emission system must be performed per information in this manual.

*See text for brakes.

Miles	Kilometers
2,000	3,200
6,000	9,600
12,000	19,200
18,000	28,800
24,000	38,400
30,000	48,000

B-9. Engine Oil

For maximum engine protection under all driving conditions encountered during the recommended oil change intervals, it is necessary to use only "MS" certified sequence-tested oils. The term "MS" must appear on the oil container singly or in conjunction with other designations. "MS" designated oils are heavy-duty detergent oils that are formulated to withstand all service conditions in modern powerplants. Engine oils designated only as "ML" and/or "MM" are not recommended and should not be used except in an emergency when "MS" oil is not available. Certified sequence-tested engine oils are described on their containers by such phrases as: meets, exceeds, excels, or has proven superior in the test requirements, test sequences, MS Service tests, standards, and service requirements, of automotive manufacturers, auto-makers, or car manufacturers for MS service or Service MS.

It may be necessary to change engine oil more frequently than normally recommended, depending upon the type and quality of oil used, the severity of operation conditions, if the engine is used for short periods in cold weather, or if the engine is allowed to idle for excessive periods.

Always drain the crankcase while the engine is hot since dirt and contaminants are then more likely to be held in suspension and therefore will drain out more completely. Drain the crankcase as follows:

- Position the drain receptacle under the drain plug.
- Remove the drain plug using the correct size wrench. Be careful of hot oil.
- Carefully clean the drain plug. Inspect and replace the gasket, if deteriorated.
- When the oil has drained, replace and tighten the crankcase drain plug.

e. Check for the presence of excess water in the oil that might indicate an internal leak from the cooling system.

f. Pour oil into the oil filler tube. Replace the oil filler cap.

B-10. Engine Oil Filter Service — Hurricane F4 Engine

The engine oil filter assembly should be replaced at each 2000 miles [3.200 km.] of normal engine use. To remove the filter, use oil filter wrench C-4065. To install a new filter, wipe the gasket—contact surface with engine oil, screw on the unit until gasket contacts the sealing surface, and then tighten at least one half turn more. **DO NOT USE TOOLS.** Turn by hand only. When refilling the engine crankcase after filter has been changed be sure to add one extra quart [1 ltr.] of oil to fill filter and oil passages. Run engine to make sure there is no leak at oil filter.

B-11. Engine Oil Filter Service — Dauntless V-6 Engine

To replace the oil filter, use oil filter wrench, Tool C-4065, to remove the filter. After the filter has been removed from the oil pump housing located on the right front side of the engine, wipe the housing surface clean and oil the gasket on the base of the new filter to make a good seal. Screw the new filter in position until its gasket contacts the pump housing surface, then tighten at least one-half turn until filter fits snug.

Note: Tighten by hand only, do not use a tool to tighten.

Replace oil filter each 6000 miles [9.600 km.] at engine oil change.

B-12. Exhaust Manifold Heat Control Valve — Dauntless V-6 Engine

A thermally-actuated heat control valve is located at rear of the right exhaust manifold of the Dauntless V-6 engine. This valve has a bimetal thermostatic spring which holds the valve closed when the engine is cold.

Each time the vehicle is lubricated place a few drops of penetrating oil on the valve shaft bushings and then work the valve by hand making sure that the lubricant is worked into the bushings.

Note: If the valve shaft does not operate freely penetrating oil should be used to free the shaft.

B-13. Positive Crankcase Ventilation System

Service the ventilation system of the engine each multiple of 6000 miles [9.600 km.] on the odometer after initial 2000 miles [3.200 km.] service. Replace the ventilation valve each 12,000 miles [19.200 km.].

For information on servicing the positive crankcase ventilation system on the Hurricane F4 engine and the Dauntless V-6 engine, refer to the Tune-up Section.

B-14. Distributor — Hurricane F4 Engine

The distributor shaft is lubricated through an oiler mounted on the side of the housing. Place three or

four drops of light engine oil in the oiler each 2,000 miles [3.200 km.]. Also place one drop of light engine oil on the wick located on the top of the shaft, which is made accessible by removing the rotor arm. Sparingly apply cam lubricant to the breaker arm cam and place a drop of oil on the breaker arm pivot.

B-15. Distributor — Dauntless V-6 Engine

The distributor has a lubricant reservoir that carries sufficient lubricant for the life of the distributor. When servicing breaker points, place one drop of light engine oil on the wick located on the top of the shaft. Also, apply cam lubricant sparingly to the breaker arm cam, and place a drop of oil on the breaker arm pivot.

B-16. Generator

On early production vehicles oilers are provided at each end of the generator, for lubrication purpose. On late production vehicles one oiler is provided at the rear (bushing end) of the generator for lubrication purpose. Place two to four drops of light engine oil in each oiler every 2,000 miles [3.200 km.].

B-17. Spark Plugs

Replace spark plugs. Refer to Section C.

B-18. Starting Circuit

Check the starting circuit. Refer to Section H.

B-19. Charging Circuit

Check the charging circuit. Refer to Section H.

B-20. Engine Tune-Up

Refer to Section C of this manual.

B-21. Adjust Fan Belt

Refer to Section C.

B-22. Exhaust Emission Control System or Controlled Combustion System

- Refer to the appropriate section in this manual.

B-23. Exhaust System

Check the exhaust system for leaks. Refer to Section F.

B-24. Fuel Evaporative Emission Control Canister Air Filter

The only service required for the F.E.E.C. system is cleaning the air cleaner filter mounted at the bottom of the canister. The filter requires replacement at 12,000 mile intervals. Refer to Section E, Par. E-9 for service procedure.

B-25. Oil Bath Air Cleaner

Some 'Jeep' Universal vehicles are equipped with an oil bath type air cleaner. This type air cleaner thoroughly removes all dust from the air before it enters the carburetor, if it is properly serviced. When the vehicle is operated under normal conditions the air cleaner must be serviced at regular intervals as care of the air cleaner is extremely

vital to the life of the engine. When the vehicle is operated under abnormal conditions, (for example when driven on secondary roads or through fields) then service of the air cleaner must be more frequent.

Note: Under extreme continually dusty and dirty conditions where the vehicle operates in clouds of dust and dirt, service the air cleaner daily.

a. To service the air cleaner on vehicles equipped with the Hurricane F4 engine (Fig. B-5) unscrew the eye bolt on the oil cup clamp and remove the oil cup from the cleaner body. Remove the oil from the cup and scrape all dirt from the inside, wash cup clean using a cleaning solution if necessary. In summer refill the oil cup with 1½ pints [0,6 ltrs.] of SAE-40 or 50 grade engine oil. In winter refill using grade SAE-20 engine oil. For servicing the air cleaner body (less oil cup), loosen hose clamp and remove hose from the cleaner. Remove the two wing screws and lift the cleaner from the vehicle. Agitate the cleaner body thoroughly in cleaning solution to clean the filtering element. Dry element with low pressure compressed air. Reinstall the cleaner body and replace the oil cup. Service the air cleaner every 2000 miles [3.200 km.].

b. To service the oil bath air cleaner on vehicle equipped with the Dauntless V-6 engine (Fig. B-6), first remove the air cleaner from the carburetor by unscrewing the wing nut. Remove the oil cup

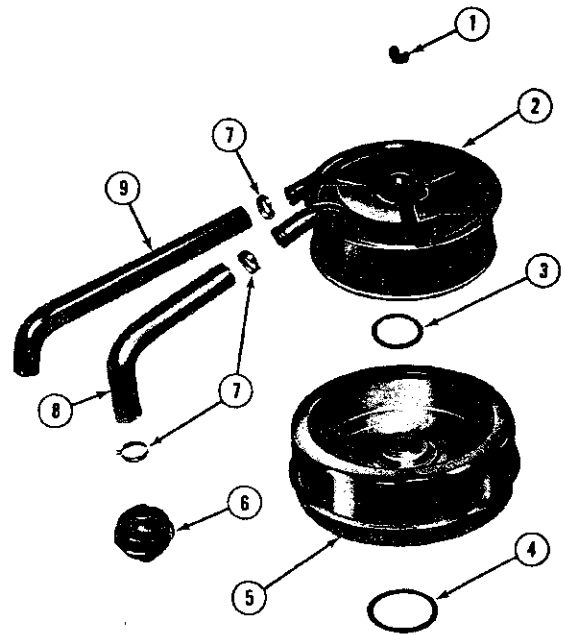


FIG. B-6—OIL BATH AIR CLEANER — DAUNTLESS V-6 ENGINE

- | | |
|-----------------|-----------------|
| 1—Wing Nut | 6—Breather |
| 2—Cover | 7—Clamp |
| 3—Rubber Gasket | 8—Vent Tube |
| 4—Cork Gasket | 9—Air Pump Hose |
| 5—Oil Cup | |

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from cleaner body and remove the oil from the cup, scrape all dirt from the inside. Clean oil cup thoroughly, wash filter element in a solvent that will leave it clean and dry. Fill oil cup to indicated level with clean S.A.E. 40 or 50 grade engine oil (S.A.E. 20 grade in winter.) Assemble cleaner filter element to oil cup making sure that gasket is in place between the two pieces. Assemble air cleaner assembly to carburetor making sure the gasket between air cleaner and carburetor is in place. Secure air cleaner to carburetor with wing nut. Service the air cleaner every 6000 miles [9.600 km.].

c. Carefully check the hose clamps and fittings on the breather hoses at frequent intervals. Loose connections will affect proper operation of the crankcase ventilating system.

B-26. Dry-Type Air Cleaner

Service the air cleaner on Dauntless V-6 engines at each oil change under normal driving conditions. If the vehicle is operated under dusty conditions, check the condition of the air cleaner element more frequently and service if dirty.

Servicing the air cleaner consists of cleaning or replacing the air cleaner element and replacing the crankcase ventilation filter (breather assembly). See Fig. B-7.

The air cleaner element assembly consists of a paper element and a polyurethane element. The paper element cannot be cleaned.

To clean the polyurethane element, first carefully remove it from the paper element. Then wash it in

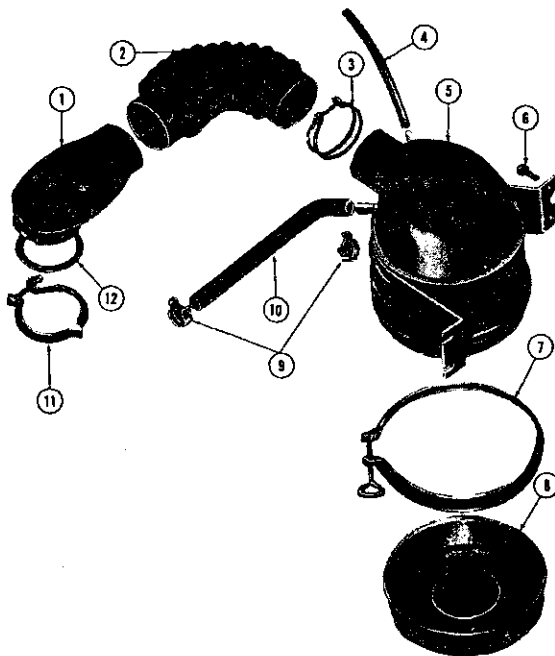


FIG. B-5—OIL BATH AIR CLEANER — HURRICANE F4 ENGINE

- | | |
|-------------------------|-----------|
| 1—Horn | 7—Clamp |
| 2—Flexible Connector | 8—Oil Cup |
| 3—Hose Clamp | 9—Clamp |
| 4—Carburetor Vent Tube | 10—Hose |
| 5—Body | 11—Clamp |
| 6—Screw and Lock Washer | 12—Gasket |

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solvent. Wrap the polyurethane element in a clean dry cloth and squeeze to remove all possible solvent. Do not wring the element or it may become torn. After cleaning, oil the polyurethane element liberally with engine oil (SAE 10W30) and squeeze to evenly distribute the oil through the element and to remove excess oil. The element should be damp with oil, not dripping. Install the polyurethane element on the paper element, taking care to have edges of the polyurethane element over the plastic end plates of the paper element.

Replace the complete air cleaner element assembly every 24,000 miles [38,400 km.]. Replace more frequently if there is any apparent damage or evidence of plugging.

The crankcase ventilation filter should be replaced, not cleaned, every 6,000 miles [9,600 km.]. The filter is located inside the air cleaner housing.

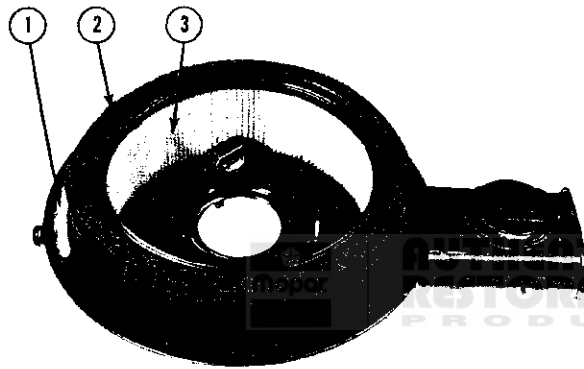


FIG. B-7—DRY-TYPE AIR CLEANER DAUNTLESS V-6 ENGINE

- 1—Crankcase Ventilation Filter
- 2—Polyurethane Element
- 3—Paper Element

B-27. Steering Gear

Check that the steering gear lubricant is at the level of the fill-hole. If not, add lubricant to the level of the fill-hole with the lubricant recommended in the Lubrication Specifications. If abnormally low, check the steering gear for possibility of leaks.

B-28. Cooling System

Check the coolant level in the radiator. It should be half an inch below the neck. If not, fill the radiator to half inch below the neck with the proper coolant. Refer to Section G.

If the level of the coolant is abnormally low, check the radiator, hoses and water pump for possible leaks. If a leak is suspected, refer to Section G.

B-29. Clean Exterior of Radiator

For proper cooling efficiency the radiator should be cleaned of foreign objects. Refer to Section G.

B-30. Transmission and Transfer Case Lubricant Level Check

- Refer to Par. B-31 through B-33 as applicable.

B-31. General

All transfer cases and transmissions should be serviced separately even though drilled passages are provided for oil circulation between some transmission and the transfer case housings. Procedure from the appropriate Par. below should be followed to check the lubricant level of the various types of transfer cases and transmissions.

If the transfer case or transmission fluid levels are found to be abnormally low, check both units for any possible leaks.

B-32. Transfer Case

The transfer case fill-hole is located on the right side of the transfer case housing. To check the lubricant level, remove the fill plug. Lubricant should be level with this fill-hole. If not, bring up to level by adding make-up lubricant as specified in the Lubrication Specifications.

B-33. Transmission

The transmission fill-hole is located on the right side of the transmission housing. To check the lubricant level, remove the fill plug. Lubricant should be level with this fill-hole. If not, bring up to level by adding make-up lubricant as specified in the Lubrication Specifications.

B-34. Transmission and Transfer Case Lubricant Change

- Refer to Par. B-35 through B-37 as applicable.

B-35. General

Transfer case and transmission lubricants should be changed at the same time.

B-36. Transfer Case

To drain the transfer case, first remove the transfer case fill-hole plug and then the transfer case drain-hole plug. Let all fluid drain from case. Then install the transfer case drainhole plug, and refill the transfer case through the fill-hole using the correct lubricant as specified in the Lubrication Specifications.

At 30,000 mile [48,000 km.] intervals lube the transfer case shift levers with Lubriplate No. 130AA. Late models have a lube fitting. To lube older models, (without lube fitting) remove the bottom cover of the case, clean thoroughly and pack case full of lubricant.

B-37. Transmission (3-Speed)

To change the lubricant on all vehicles equipped with a three speed synchromesh transmission, drain the old fluid by first removing the fill-hole plug and then removing the drainhole plug. Since on some transmissions there are drilled passages between the transmission and transfer case that allow oil to circulate between the two units, the transfer case should be drained before refilling the transmission.

When all the fluid is completely drained, replace the drainhole plugs only. For the correct specifications and quantity, refer to the Lubrication Specifications.

Note: Hard shifting of the transmission gear in cold weather is a positive indication that the lubricant is of the wrong viscosity or of poor quality which allows it to congeal.

B-38. Optional 4-Speed Transmission and Transfer Case

The four-speed transmission and transfer case require separate lubrication for each unit as they have no cross-over oil passage. At each transmission service check, the fill plugs of *both* four-speed transmission and transfer case should be pulled and the lubricant refilled to level if necessary.

B-39. Transfer Case Linkage

The transfer case shift linkage should be lubricated periodically. All bearing surfaces that are assembled with studs and cotter pins should be disassembled, cleaned, and coated with a good waterproof grease. The bearing surfaces that cannot be disassembled should be lubricated with a lubricant that will penetrate the bearing area. These bearings include the two on the cross shaft assembly and the threaded stud.

The type of penetrating lubricant recommended is DuPont "PM 7", No. 2911, or its equivalent.

B-40. Brake Master Cylinder

Clean the top of the fill cap and also the housing area around it. Remove the cap and observe the fluid level. It should be half an inch below the top of the fill-hole. If not, add brake fluid to half inch [1,3 cm.] below the top of the fill-hole. Use only heavy-duty brake fluid conforming to specification SAE-J-1703. Be sure to handle the brake fluid in clean dispensers and containers that will not introduce even the slightest amount of other liquids or foreign particles. Replace and tighten the fill cap.

B-41. Adjust Brakes

Refer to Section P.

B-42. Brake Linings

Refer to Section P.

B-43. Adjust Clutch

Refer to Section I.

B-44. Clutch Cross Shaft (Lever Type)

Lubricate the clutch cross shaft in accordance with specifications given in the Lubrication chart: see Item 1. Chassis Bearings.

B-45. Tie Rod and Drag Link Sockets

The tie rod and drag link sockets are equipped with lubrication fittings and should be lubricated per specifications given in the Lubrication chart: see Item 1. Chassis Bearings.

B-46. Front and Rear Spring Bushings

The condition of the spring bushings is indicated by the alignment of the spring pivot and spring

shackle bolts. Check the alignment of these bolts, and check that nuts are tightened securely.

B-47. Spring Shackles

Rubber bushings are provided on the spring shackles. These rubber bushings have no lubrication fitting and it is very important that they never be lubricated.

B-48. Shock Absorbers

Visually check for broken mounts or bolts, worn or missing bushings on the shock absorbers. Refer to Section S.

B-49. Front and Rear Axle U-Bolts

Torque the front and rear axle U-bolts. Refer to Section S.

B-50. Front and Rear Axle Differentials — Lubricant Levels

The lubricant level of all front and rear differentials should be at the level of the fill-hole.

B-51. Front and Rear Axle Differentials — Changing Lubricant

B-52. Conventional Differentials

To remove the lubricant from the front or rear differential, it is necessary to remove the housing cover. Let the lubricant drain out, and then flush the differential with a flushing oil or light engine oil to clean out the housing (except Powr-Lok or Trac-Lok Differentials). Do not use water, steam, kerosene, or gasoline for flushing.

Reinstall the housing cover, replacing the gasket whenever necessary, torquing the cover bolts to 15 to 25 lb-ft. [2,1 a 3,4 kg-m.].

Remove the filler plug, and refill the differential housing as specified in the Lubrication Specifications.

B-53. Powr-Lok or Trac-Lok Differential

Some vehicles may be equipped with the Powr-Lok or Trac-Lok Differential as optional equipment. Special lubricant and ordinary multipurpose gear lubricants *must not* be used. Use only 'Jeep' Differential Oil, Part No. 94557.

Powr-Lok or Trac-Lok differentials may be cleaned only by disassembling the unit and wiping with clean rags. Do not flush the unit. Refer to Section N.

B-54. Front Axle Universal Joint — Lube

Check the level of the front axle universal joint lubricant at each front wheel by removing the fill-hole plug. The lubricant should be level with the fill-hole. If required, add lubricant as specified in Lubrication Specifications.

B-55. Front Axle Universal Joint — Service

On all 4-wheel drive vehicles the front axle universal joint should be serviced by removing the shaft and thoroughly cleaning the universal joints and housing. For the correct procedures, refer to Section M.

Reinstall the axle shafts, and refill the housings to plug level using the universal joint lubricant specified in Lubrication Specifications.

B-56. Front Axle Wheel Bearings

To lubricate the wheel bearings, it is necessary to remove, clean, repack, and adjust them. When front wheel hubs and bearings are removed for lubrication, they should be thoroughly washed in a suitable cleaning solvent. The bearings should be carefully dried and then given a thorough cleaning and inspection. Use a clean brush to remove all particles of old lubricant from bearings and hubs. After the bearings are cleaned, inspect them for pitted races and rollers. Also, check the hub oil seals.

Note: Wheel bearing lithium base lubricants are used at the factory for initial fill of these bearings. When lithium base and sodium base lubricants are mixed, the result is a thinned-out mixture that can bleed through seals. It is therefore important that lubricants with the correct base be used when lubricating the wheel bearings.

Should leaks occur at wheel bearing seals, the leaks may be caused by a mixture of two types of lubricants. In such cases, the old lubricant should be completely removed before new lubricant is added. Wheel bearings should be thoroughly cleaned, lubricated with lithium base and reinstalled.

Repack the bearing cones and rollers with grease and reassemble hub in the reverse order of the disassembly. Test the bearing adjustment as outlined in Section Q.

B-57. Rear Axle Wheel Bearings

The Rear wheel bearings on early models equipped with lubrication fittings with a vent opening through the housings above each fitting should be lubricated sparingly, each 2,000 miles [3,200 km.]. Use a hand compressor and wheel bearing grease, forcing the grease through each lubrication fitting until it flows from the vent. Vent should be kept clear of obstruction or grease will back up into the brakes. Do not add grease after it flows from the vent for it may be forced through the wheel keyway onto the outside of the wheel and possibly onto the brake linings. Rear wheel bearings that do not have lubrication fittings should be removed each 12,000 miles [19,200 km.] and the bearing cleaned, inspected and repacked. Refer to procedure in Par. B-56.

Note: When servicing the Flanged Axle Unit Bearing Assembly, refer to Section N, Par. N-5 for proper lubrication procedures.

B-58. Propeller Shafts and Universal Joints

The propeller shaft slip joints and universals should be lubricated with a hand compressor grease gun so as to not damage the bearing seals. The units should be lubricated with a good quality grease. Refer to the Lubrication Chart for lubrication frequency and lubricant type and grade.

B-59. Lights and Controls

- a. Check all interior and exterior lights and light switches for proper operation, including: parking lights, headlamps (high beam and low beam), tail lights, brake lights, directional lights, and instrument panel lights.
- b. Check all instrument panel controls and instruments for proper operation.

B-60. Speedometer Cable

Remove the speedometer cable from its housing every 12,000 miles [19,300 km.]. Clean it thoroughly and coat it with a good quality light graphite grease.

B-61. Headlights

Refer to Section H.

B-62. Heater Controls

Apply Lubriplate 130-A to all friction points and pivot points on the heater controls panel unit as well as the pivot points at the dashpot. Apply a few drops of penetrating oil all along the Bowden cable. This oil will penetrate into the center wire.

B-63. Windshield Wiper and Washer Controls

Lubricate the friction points and the pivot points on the windshield wiper transmission and linkage arms with a slight amount of Lubriplate 130-A.

B-64. Rotate Tires

Refer to Section Q for the correct method of rotating the tires.

B-65. Body Lube Points

- Refer to Par. B-66 through B-68.

B-66. Hood Hinge Pivot Points

Lubricate the frictional points of the hood hinge pivot points with a few drops of light-weight engine oil.

B-67. Glove Compartment Door Latch

Sparingly wipe Lubriplate 130-A on the glove compartment door latch.

B-68. Tailgate Hinges

Lubricate the friction points of the tailgate hinges with a few drops of light-weight engine oil.

B-69. LUBRICATION OF OPTIONAL EQUIPMENT

B-70. Pintle Hook

When lubricating the vehicle, place a few drops of oil on the pintle hook and safety latch pivot pins.

B-71. Centrifugal Governor

Check the oil level in the governor housing at each vehicle lubrication. Use the same seasonal grade oil as is used in the engine and change oil at each engine oil change. Do not fill the housing above the level indicating plug opening. Keep the vent in the filler plug open at all times.

B

LUBRICATION

B-72. Powr-Lok or Trac-Lok Differential

Refer to Par. B-53.

B-73. PARTS REQUIRING NO LUBRICATION

B-74. Water Pump Bearing, Clutch Release Bearing

The water pump and clutch release bearings are prelubricated for life when manufactured and cannot be relubricated.

B-75. Starter Motor Bearings

The starting motor bearings are lubricated at assembly to last between normal rebuild periods.

B-76. Alternator Bearings

The alternator bearings are lubricated at assembly and require no further lubrication.

B-77. Springs

The vehicle springs should not be lubricated. At assembly the leaves are coated with a long-lasting special lubricant which is designed to last the life of the springs. Spraying with the usual mixture of oil and kerosene has a tendency to wash this lubricant from between the leaves, making it necessary to relubricate often to eliminate squeaking.

B-78. Shock Absorbers

Hydraulic direct-action shock absorbers are permanently sealed and require no periodic lubrication service. Shock absorber mounting bushings are not to be lubricated.

B-79. LUBRICATION REQUIREMENTS FOR 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.

B-80. Engine Oil

It is important, that the oil in a new or rebuilt engine be changed after the first eight or ten hours of operation, and for heavy, dusty work, every 50 hours thereafter. Watch the condition of the oil closely and change it immediately if it appears to be contaminated.

B-81. Engine Oil Filter

Replace the oil filter at the end of the first 100 hours of service. Under extreme operating conditions, more frequent replacement may be required. The condition of the oil is a reliable indicator of the condition of the filter element.

If the oil becomes discolored and shows evidence of contamination, change the filter without delay. (Refer to Par. B-10, B-11 for the correct procedure for replacing the oil filter.)

B-82. 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 scheduled maintenance period. 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 where the vehicle operates in clouds of dust and dirt, service the air cleaner daily. (Refer to Par. B-24 thru B-26 for service procedures.)

B-83. Chassis Lubrication

The period of lubrication depends entirely upon the type of work being done. Using the specified interval given in the Service 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 lift linkage as dirt will accumulate to form an abrasive mixture. It is best to simply wipe these parts clean with a cloth.

B-84. Front Axle Shaft Universal Joints

For off-highway use remove the universal joints twice yearly, thoroughly clean both the housings and joints with a suitable solvent, and refill the housings to the fill plug opening levels with the correct lubricant as given in the Lubrication Specifications.

B-85. Transmission and Transfer Case

The combined capacity of the two housings is small for economy, making it important that the lubricant be changed at regular intervals. For off-highway use drain both housings every 300 hours of operation and refill to the fill plug opening levels. Refer to B-35 through B-37 when changing lubricant.

B-86. Front and Rear Axle Differentials

Because of the higher pressure developed in the axle assemblies with heavy duty operation, drain, flush, and refill the differential assemblies each 300 hours of operation. Use only flushing oil or light engine oil to clean out the housings (except Powr-Lok and Trac-Lok differentials). Refer to Par. B-52 and B-53 for draining and flushing differential.

TUNE-UP

Contents

SUBJECT	PAR.	SUBJECT	PAR.
GENERAL	C-1	Fuel Pump	C-23
TUNE-UP	C-2	Heat Control Valve.....	C-7
Air Cleaner	C-21	Ignition Cables	C-19
Battery	C-3	Ignition Timing	C-14
Carburetor Adjustments	C-25	Ignition Wires	C-18
Coil	C-20	Manifold	C-5
Crankcase Ventilation	C-6	Manifold Vacuum	C-24
Cylinder Compression	C-9	Point Dwell	C-17
Cylinder Head(s)	C-5	Primary Circuit Tests	C-15
Dash Pot Adjustments	C-26	Spark Plugs	C-4
Distributor Service	C-10 thru C-13	Tappets	C-8
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Fan Belt	C-27	SERVICE DIAGNOSIS	C-29
Fuel Lines and Screens.....	C-22	TUNE-UP SPECIFICATIONS.....	C-30

C-1. GENERAL

An engine tune-up should be performed for all Jeep Vehicles each 6000 miles [9.600 km.] or at the end of each 250 hours off-the-road operation, to ensure best possible performance at all times. The tune-up should follow the sequence given in this section.

Because of federal laws limiting exhaust emissions, it is even more important that the engine tune-up is done accurately, using the specifications listed on the tune-up sticker found in each engine compartment.

Note: To ensure proper operation and effectiveness of the exhaust emission control system, and to comply with Federal and State requirements, a recheck of ignition timing, idle speed and idle mixture and necessary adjustments must be performed after the first 2,000 miles [3.200 km.] of vehicle operation.

A minor engine tune-up should be performed every 6,000 miles [9.600 km.] or at the end of 250 hours of off-the-road use. Major engine tune-up should be performed every 12,000 miles [19.300 km.].

The parts of units which affect power and performance may be divided into three groups:

- (1) Units affecting compression
- (2) Units affecting ignition
- (3) Units affecting carburetion

The tune-up procedure should cover these groups in the order given. While the items affecting compression and ignition may be handled according to personal preference, correction of items in the carburetion group should not be attempted until all items affecting compression and ignition have been satisfactorily corrected.

Note: To make sure hydro-carbon and carbon monoxide emissions will be within limits, it is very important that the adjustments be followed exactly as listed on the sticker found in each engine compartment.

Minor engine tune-up consists of the following.

- Inspect and correct as required:
- Battery cables and connections.
 - Alternator and regulator wiring.
 - Primary—Secondary wiring, distributor cap.
 - Cylinder head torque.
 - Contact point dwell.
 - Vacuum and centrifugal advance.
 - Ignition timing.
 - Spark plugs for correct air gap.
 - Adjust idle speed and idle air mixture.
 - Adjust all drive belt tensions.
 - Clean carburetor air cleaner.
 - Lubricate exhaust manifold damper.

Major engine tune-up includes the following.

- Inspect and correct as required:
- Battery condition and charging circuit. Clean, lubricate and tighten battery cable connections.
 - Ignition system.
 - Spark plugs; replace if necessary or clean and gap.
 - Compression check.
 - Primary—Secondary wiring, distributor cap.
 - Replace contact points and condenser.
 - Lubricate distributor cam with cam grease.
 - Adjust contact points.
 - Check vacuum and centrifugal advance.
 - Set ignition timing.
 - Torque cylinder head.
 - Adjust idle speed and idle air mixture.
 - Replace fuel filter element (every 12,000 miles [19.300 km.]).
 - Adjust all drive belt tensions.

IMPORTANT: SPECIFICATIONS FOR ENGINE RPM, DISTRIBUTOR POINT DWELL, AND IGNITION TIMING GIVEN IN TUNE-UP SECTION C REFER TO VEHICLES WITH AND WITHOUT EXHAUST EMISSION CONTROL SYSTEMS.

FOR VEHICLES EQUIPPED WITH EXHAUST EMISSION CONTROL SYSTEMS ALSO REFER TO SECTION F1 (F4-134 ENGINE) AND F2 (V6-225 ENGINE).

C-2. TUNE-UP SEQUENCE

The following Pars. C-3 through C-27 give the sequence and describe the services to be performed when tuning the engine.

C-3. Clean and Check Battery

Inspect battery and cables. If the battery is not satisfactory, install a fully-charged battery to allow completion of the tune-up.

Note: If the battery fails any of the following tests, remember that the cause may be other electrical trouble, and not necessarily only a defective battery. Refer to Section H for electrical troubleshooting and tests.

- a. Check the specific gravity of the electrolyte in each cell of the battery. A hydrometer reading of 1.260 indicates that the battery is fully charged. If the reading is 1.225 or below, the battery needs recharging. If one or more cells is 25 "points" (.025) or more lower than the other cells, this indicates that the cell is shorted, the cell is about to fail, or there is a crack in the battery partition in the case. Unless the battery is repaired or replaced, battery trouble will soon be experienced.
- b. Check the electrolyte level in each cell, add distilled water to maintain the solution $\frac{3}{8}$ " [9.5 mm.] above the plates. Avoid overfilling. Replace the filler caps and tighten securely. It is important to keep the electrolyte level above the plates at all times because plates that are exposed for any length of time will be seriously damaged.
- c. Check the wing nuts on the hold-down frame for tightness. Tighten them only with finger pressure, never with pliers or a wrench. Excessive pressure could damage the battery case.
- d. Clean the battery terminals and cable connec-

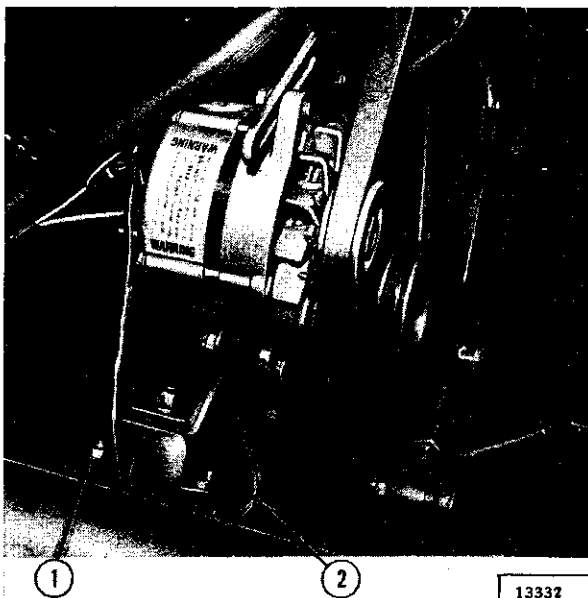


FIG. C-1—FRAME GROUND STRAP —
HURRICANE F4

1—Right Front Engine Mount
2—Frame Ground Strap

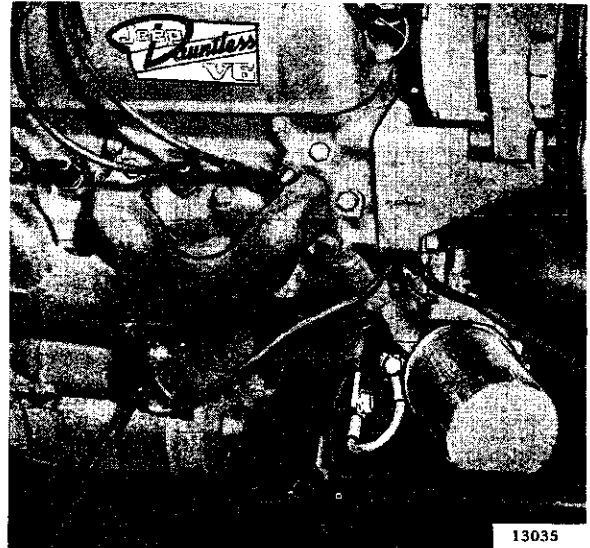


FIG. C-2—FRAME GROUND CABLE —
DAUNTLESS V-6

tors. Prepare a strong solution of baking soda and water and brush it around the terminals to remove any corrosion that is present. The cell caps must be tight and their vents sealed to prevent cleaning solution entering the cells. After cleaning install cable connectors on terminals and coat the terminals and connectors with heavy grease.

e. Inspect the battery cables and replace if badly corroded or frayed. Check tightness of terminal screws to ensure good electrical connections. Check the tightness of the negative ground cable connection at the engine to ensure a good ground connection.

f. Load test the battery. Connect a voltmeter across the battery. Run the starting motor for 15 seconds. If the voltage does not drop below 10 volts on a 12 volt battery the battery is satisfactory. If the voltage falls below these values, yet the specific gravity is above 1.225, the condition of the battery is questionable.

g. Make sure the engine to frame ground strap or cable connections are tight. If these connections are loose, corroded or dirty, hard starting or failure of the vehicle electrical system may result. Refer to Fig. C-1 for location of the Hurricane F4 engine to frame ground strap and its connections. Refer to Fig. C-2 for location of the Dauntless V-6 engine to frame ground cable.

C-4. Clean and Adjust Spark Plugs

Clean, inspect, and gap spark plugs. Do not install spark plugs until completion of compression tests.

a. Use a Spark Cable and Installing Plier Tool, W-274, to remove the leads from the spark plugs.

Caution: Pulling on the cables to remove them from the spark plugs can cause internal breaks in the leads that will cause ignition failure.

b. Using a spark plug wrench, loosen each spark plug one or two turns to break loose any carbon deposits on the plug base.

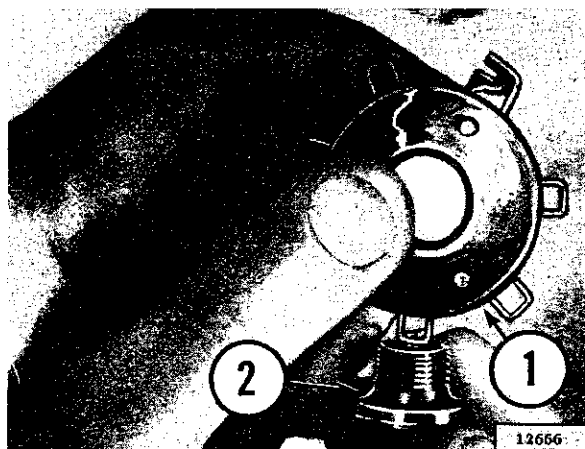


FIG. C-3—SETTING SPARK PLUG GAP
1—Wire Gauge 2—Spark Plug

c. Blow out all carbon and dirt from each spark plug hole with compressed air. If compressed air is not available, start the engine and accelerate to 1000 rpm. to blow out the carbon and dirt. Stop the engine.

d. Remove the plugs carefully with a spark plug wrench.

e. Inspect the plugs for serviceability. Especially check for burned and eroded electrodes, blistering of porcelain at the firing tip, cracked porcelain, or black deposits and fouling. These conditions indicate that the plugs have not been operating at the correct temperature. Replace bad or worn plugs in sets.

f. Measure the electrode gap of each new or existing plug with a wire gauge as shown in Fig. C-3. Adjust each electrode gap to the specific gap by bending the outer electrode mounted in the plug shell.

g. Clean the plugs on a sand blast cleaner. Avoid too much abrasive blast as it will erode the insulator. Clean the threads with a wire brush. Deposits will retard heat flow to the cylinder head.

h. Clean the electrode surfaces with a small flat file. Dress the electrodes to secure flat parallel surfaces on both the center and side electrode.

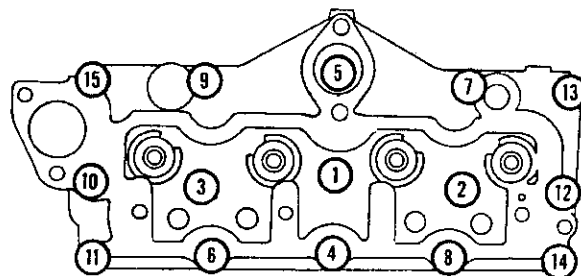
i. Champion J-8 are the replacement spark plugs recommended for the F4-134 engine. Adjust electrode gap to .030" [0,762 mm.] and should be torqued to 25 to 33 lb-ft. [3,5 a 4,6 kg-m.].

j. For the V6-225 engine, AC 44S or Champion UJ12Y spark plugs are the replacement spark plugs recommended. The spark plugs should be gapped to .035" [0,889 mm.] and should be torqued to 25 to 33 lb-ft. [3,5 a 4,6 kg-m.].

C-5. Torque Cylinder Head(s) and Manifold

a. Hurricane F4 Engine.

Torque the cylinder head bolts with a torque wrench to 60 to 70 lb-ft. [8,3 a 9,7 kg-m.]. Follow the sequence shown in Fig. C-4. Do not overlook tightening the cylinder head bolt, No. 5, in the intake manifold directly under the carburetor opening.

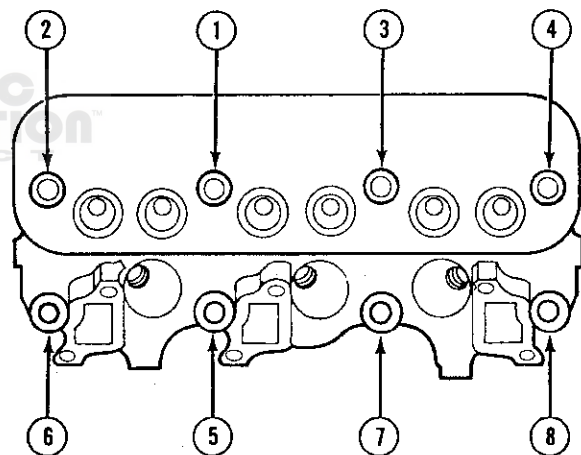


10102
FIG. C-4—HURRICANE F4 ENGINE CYLINDER HEAD BOLT TIGHTENING SEQUENCE

Torque all manifold attaching nuts evenly to 29 to 33 lb-ft. [4,0 a 4,6 kg-m.].

b. Dauntless V-6 Engine.

Torque cylinder head bolts 65 to 85 lb-ft. [9,0 a 11,8 kg-m.]. Follow the sequence shown in Fig. C-5. Torque all intake manifold bolts 45 to 55 lb-ft. [6,2 a 7,6 kg-m.]. Torque all exhaust manifold bolts 15 to 20 lb-ft. [2,1 a 2,8 kg-m.]. Refer to Fig. D1- for tightening sequence.



14203
FIG. C-5—DAUNTLESS V-6 ENGINE CYLINDER HEAD BOLT TIGHTENING SEQUENCE

C-6. Service Crankcase Ventilating System

● Refer to Fig. C-6 and C-7.

Positive crankcase ventilation is accomplished by utilizing the vacuum created in the intake manifold to draw clean air through the crankcase and valve chamber. A valve, in the vacuum line to the intake manifold, varies the air flow through the crankcase to meet changing conditions at all engine speeds and loads. The system will work effectively as long as all component parts are clean and free from sludge and carbon. Improper operation of the ventilating system can contribute to rough idling, power loss, and the formation of sludge and varnish in the engine.

The system also prevents crankcase vapors from entering the atmosphere. Engine vapors are drawn into the carburetor through the ventilation valve and burned with the normal fuel mixture.

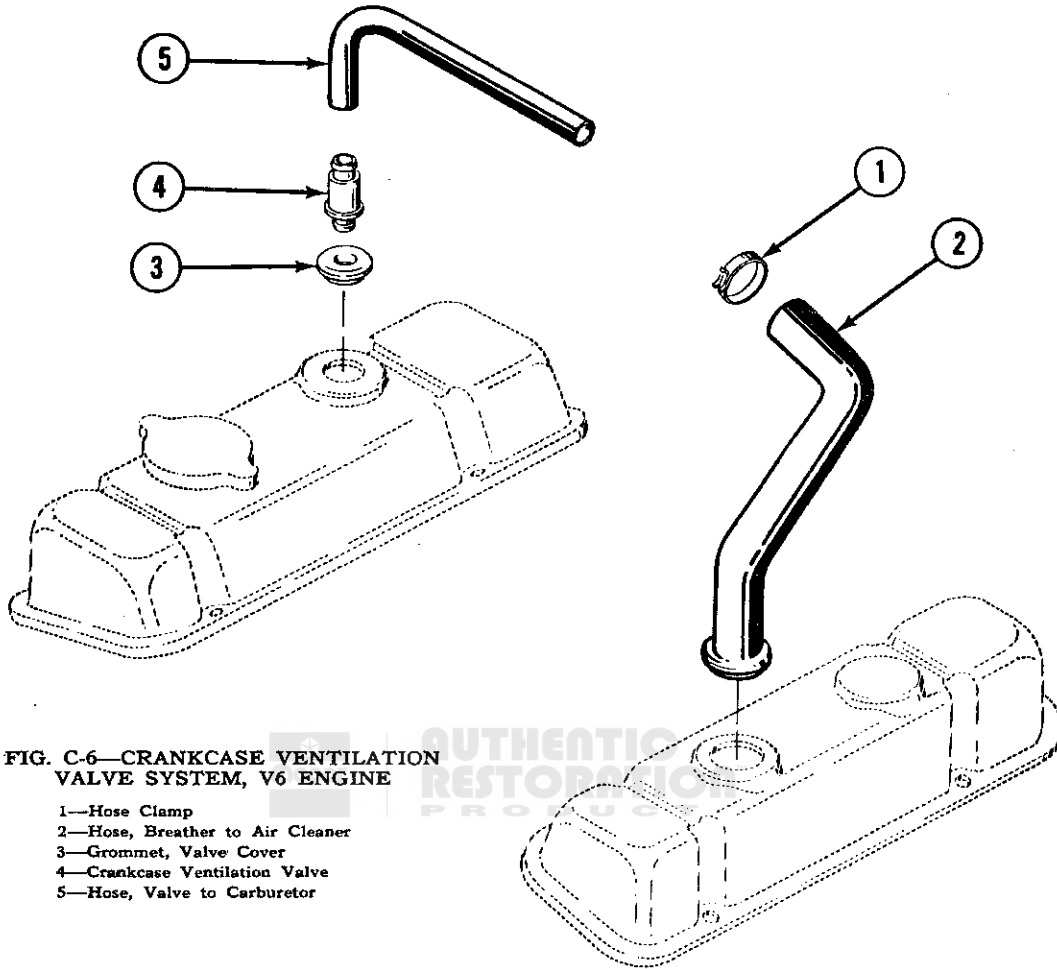


FIG. C-6—CRANKCASE VENTILATION VALVE SYSTEM, V6 ENGINE

- 1—Hose Clamp
- 2—Hose, Breather to Air Cleaner
- 3—Grommet, Valve Cover
- 4—Crankcase Ventilation Valve
- 5—Hose, Valve to Carburetor

14377

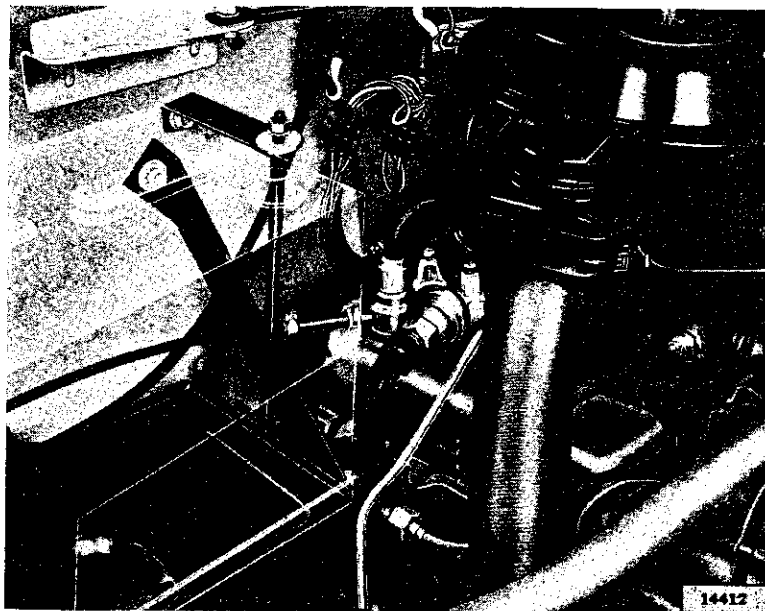


FIG. C-7—POSITIVE CRANKCASE VENTILATION VALVE LOCATION—DAUNTLESS V-6 ENGINE

- 1—Hose on Engines with Fuel Evaporization Emission Control System Only

The valve, connecting pipes, and hoses must be inspected and serviced at intervals of 2,000 [3,200 km.], 6,000 [9,600 km.] and 12,000 [19,300 km.] miles, continuing each 6,000 miles [9,600 km.] of vehicle operation thereafter. It may be necessary to inspect and clean the system more frequently under adverse driving or weather conditions. Replace the valve each 12,000 miles [19,300 km.].

a. Dauntless V-6 Engine.

Filtered air from the carburetor air cleaner enters the engine crankcase through a hose. The ventilation valve is mounted on the right cylinder bank

rocker arm cover (Fig. C-7) and is connected by a hose to a fitting at the base of the carburetor at the intake manifold opening. The valve varies the air flow through the crankcase to meet changing conditions at all engine speeds and loads. To check the operation of the system, remove the valve with the hose attached from the rocker arm cover. With the engine running at fast idle, a vacuum must be felt at the open end of the ventilation valve. If no vacuum is present, the valve and hose should be inspected and cause of the restriction determined. To check the valve disconnect it from the air

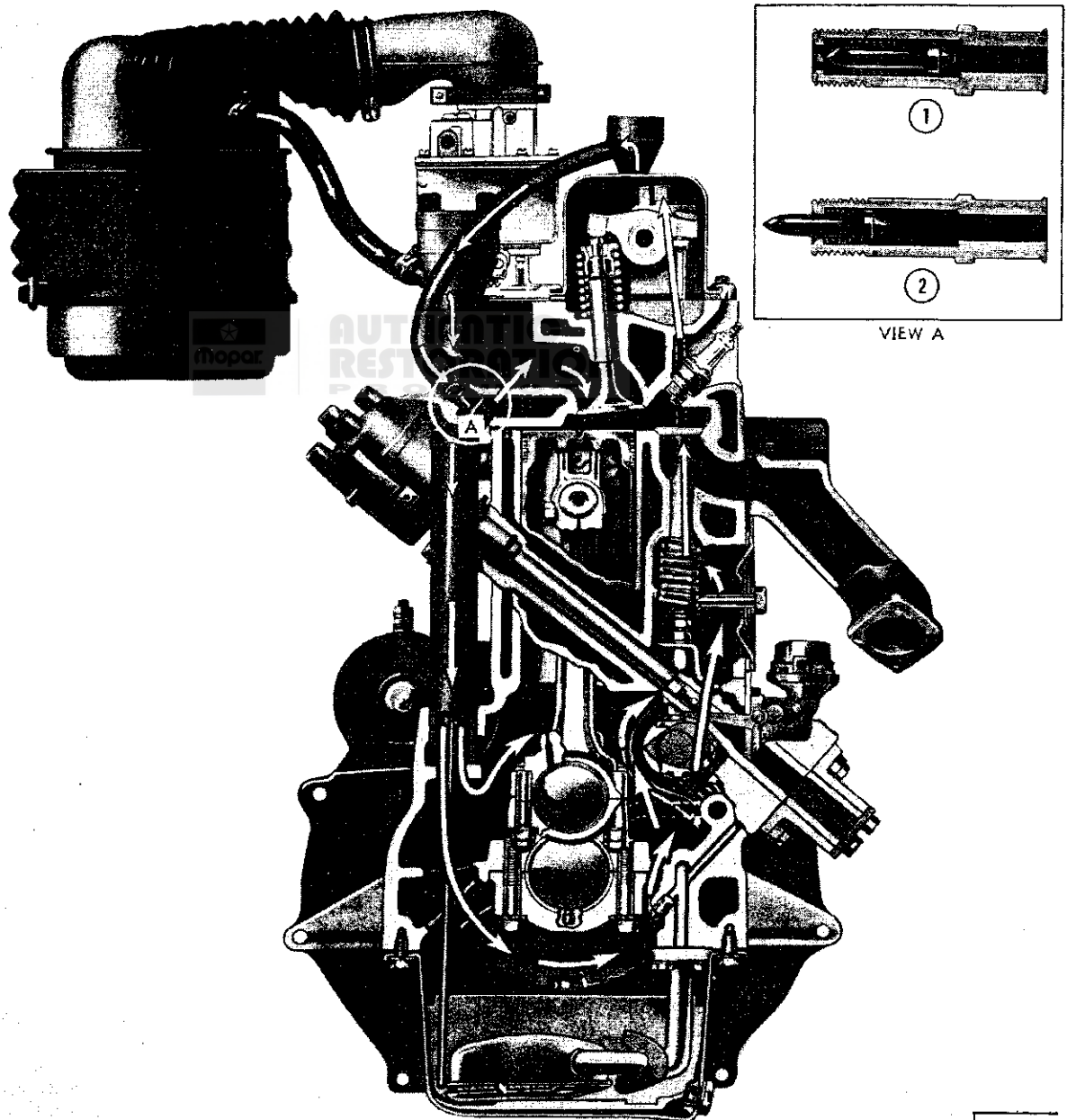


FIG. C-9—POSITIVE CRANKCASE VENTILATION SYSTEM — F4 ENGINE (TYPICAL)
 1—Valve Open 2—Valve Closed

13334

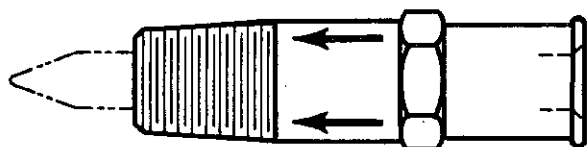


FIG. C-8—POSITIVE CRANKCASE VENTILATION VALVE

14011

vacuum hose and insert a stiff wire into the valve body and observe whether or not the plunger can be readily moved (Fig. C-8). The valve may be cleaned, by soaking in a reliable carburetor cleaning solution and drying with low pressure dry air.

b. Hurricane F4 Engine.

Ventilation of the Hurricane F4 engine is accomplished in the same manner as the Dauntless V-6 engine described above, the differences being that clean air enters the crankcase through a hose connected between the top cover of the air cleaner and the oil filler tube of the engine. The ventilation valve is screwed to a pipe fitting mounted in the center of the intake manifold between number two and three cylinder inlet. A hose connects the ventilation valve to a vapor dome on the rocker arm cover. Service procedures are the same as those used on the Dauntless V-6 engine. The valve may be checked for vacuum pull by removing the hose from the valve while running the engine at fast idle speed and placing a finger on the valve opening to check the vacuum. (Refer to Fig. C-9).

C-7. Service Manifold Heat Control Valve

The Dauntless V-6 engine is equipped with a manifold heat control valve (Fig. F-6). Test the valve for free operation. Place a few drops of penetrating oil at each end of the shaft where it passes through the manifold. Then move the valve up and down a few times to work the oil into the bushing. When the engine is cold, the valve should be in the closed position to ensure a fast warm-up of the intake manifold for better fuel vaporization. When the valve is closed, the counterweight is in its counterclockwise position. As the engine warms the counterweight slowly rotates clockwise until the valve is fully open.

C-8. Check Valve Tappet Clearance

a. Hurricane F4 Engine.

With the engine cold, check and adjust the intake valve to .018" [0,460 mm.] clearance and the exhaust valves to .016" [0,406 mm.] clearance. The intake valves are adjusted by removing the rocker arm cover mounted on the cylinder head. Turn the engine over until No. 1 cylinder piston is on top dead center on its compression stroke, then using a feeler gauge check the clearance between the valve stem and the toe of the rocker arm. If clearance is less or greater than .018" [0,460 mm.] the valve must be adjusted by turning the rocker arm nut clockwise to decrease and counterclockwise to increase the clearance. When No. 1 cylinder intake valve has been properly set use the same procedures to check and reset, if necessary, the remaining three cylinder valves. The exhaust valves are ad-

justed by removing the tappet cover located on the right side of the engine. Place the cylinder to be adjusted on top dead center (compression stroke) and check the clearance between the valve stem and tappet screw with a feeler gauge. If the clearance is less or greater than .016" [0,406 mm.] the valve must be adjusted by loosening the tappet screw locknut and turning the screw until the proper clearance is obtained, then tighten the locknut.

Note: Always recheck the valve clearance after tightening the locknut.

b. Dauntless V-6 Engine.

The valve tappet clearance of the Dauntless V-6 engine needs no adjustment as the lifters are hydraulic and require no lash adjustment at time of assembly or while in service.

C-9. Check Engine Cylinder Compression

a. Hurricane F4 Engine.

To take the compression readings of the engine cylinders remove all the spark plugs and disconnect the high tension wire from the coil. With the throttle and choke open turn the engine with the starter motor while firmly holding the compression gauge in the spark plug port of the cylinder to be checked. Allow at least four compression strokes when checking each cylinder and record the first and fourth stroke reading of the gauge.

When pressure quickly comes up to specified pressure and is uniform between all cylinders within 10 psi. [0,7 kg-cm²] it indicates that the engine is operating normally with satisfactory seating of rings, valves, valve timing, etc.

When pressure is low on the first stroke and builds up to less than specified pressure it indicates compression leakage usually attributable to rings or valves. To determine which is responsible, pour ½ oz. [15 cm³] of tune-up oil into each cylinder. Allow a few minutes for the oil to leak down past the rings and then again test compression. If compression pressures improve over the first test, the trouble is probably worn piston rings and bores. If compression pressures do not improve, the trouble is probably caused by improper valve seating. If this condition is noticed on only two cylinders that are adjacent, it indicates that there is a possible gasket leak between these cylinders. If inspection of the spark plugs from these cylinders disclosed fouling or surface cracking of electrodes, gasket leakage is probable.

When pressure is higher than normal it indicates that carbon deposits in the combustion chamber have reduced the side of the chamber enough to give the effect of a raised compression ratio. This will usually cause a pinging sound in the engine when under load that cannot be satisfactorily corrected by timing. The carbon must be cleaned out of the engine cylinders to correct this trouble.

Reinstall the spark plugs. Torque with a wrench to proper setting.

Advise the vehicle owner if compression is not satisfactory.

COMPRESSION PRESSURE LIMIT CHART

Maximum Pressure		Minimum Pressure		Maximum Pressure		Minimum Pressure	
psi.	kg-cm ²	psi.	kg-cm ²	psi.	kg-cm ²	psi.	kg-cm ²
134	9,42	101	7,10	188	13,22	141	9,91
136	9,56	102	7,17	190	13,36	142	9,98
138	9,70	104	7,31	192	13,50	144	10,12
140	9,84	105	7,38	194	13,64	145	10,19
142	9,98	107	7,52	196	13,78	147	10,33
144	10,12	108	7,59	198	13,92	148	10,40
146	10,26	110	7,73	200	14,06	150	10,55
148	10,40	111	7,80	202	14,20	151	10,62
150	10,55	113	7,94	204	14,34	153	10,76
152	10,68	114	8,01	206	14,48	154	10,83
154	10,83	115	8,08	208	14,62	156	10,97
156	10,97	117	8,23	210	14,76	157	11,04
158	11,11	118	8,30	212	14,90	158	11,11
160	11,25	120	8,44	214	15,04	160	11,25
162	11,39	121	8,51	216	15,18	162	11,39
164	11,53	123	8,65	218	15,32	163	11,46
166	11,67	124	8,72	220	15,46	165	11,60
168	11,81	126	8,86	222	15,61	166	11,67
170	11,95	127	9,83	224	15,75	168	11,81
172	12,09	129	9,07	226	15,89	169	11,88
174	12,23	131	9,21	228	16,03	171	12,02
176	12,37	132	9,28	230	16,17	172	12,09
178	12,51	133	9,35	232	16,31	174	12,23
180	12,65	135	9,49	234	16,45	175	12,30
182	12,79	136	9,56	236	16,59	177	12,44
184	12,94	138	9,70	238	16,73	178	12,51
186	13,08	140	9,84				

b. Dauntless V-6 Engine.

To check the engine cylinder compression use the following procedures:

Firmly insert compression gauge in spark plug port (Fig. C-10). Crank engine through at least four compression strokes to obtain highest possible reading.

Check compression of each cylinder. Repeat compression check and record highest reading obtained on each cylinder during the two pressure checks.

Note: The recorded compression pressures are to be considered normal if the lowest reading cylinder is more than seventy-five percent of the highest reading cylinder. See the following example and the "Compression Pressure Limit Chart".

Example:

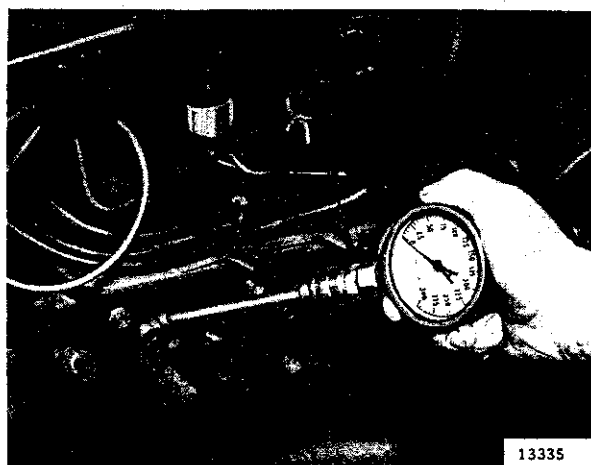
Cylinder No.	1	2	3	4	5	6
Pressure (psi.)	129	135	140	121	120	100

Seventy-five percent of 140 (highest) is 105. Thus, Cylinder No. 6 is less than seventy-five percent of Cylinder No. 3. This condition, accompanied by low speed missing, indicates an improperly seated valve or worn or broken piston ring.

If one or more cylinders read low, inject about a tablespoon of engine oil on top of pistons in low reading cylinders through spark plug port. Repeat compression check on these cylinders.

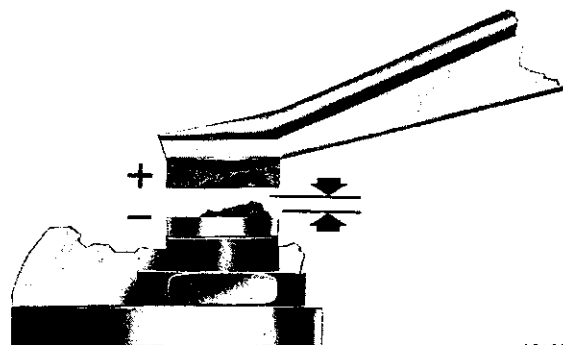
If compression improves considerably, rings are worn. If compression does not improve, valves are sticking or seating poorly.

If two adjacent cylinders indicate low compression and injecting oil does not increase compression, the cause may be a head gasket leak between the cylinders. Engine coolant and/or oil in cylinders could result from this defect.



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FIG. C-10—CHECKING ENGINE CYLINDER COMPRESSION—DAUNTLESS V-6 ENGINE



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FIG. C-11—CONTACT POINTS MATERIAL TRANSFER

C-10. Distributor Service

The distributor cap should be inspected for cracks, carbon runners and evidence of arcing. If any of these conditions exists, the cap should be replaced. Clean any corroded high tension terminals. Inspect the rotor for cracks or evidence of excessive burning at the end of the metal strip. After a distributor rotor has had normal use the end of the rotor will become burned. If burning is found on top of the rotor it indicates the rotor is too short and needs replacing. Usually when this condition is found the distributor cap segment will be burned on the horizontal face and the cap will also need replacing.

Check the condenser lead for broken wires or frayed insulation. Clean and tighten the connections on the terminal posts. Be sure the condenser is mounted firmly on the distributor for a good ground connection.

Should a condenser tester be available the capacity should be checked. In the absence of a tester check by substituting a new condenser.

Examine the distributor points (Fig. C-11). If they show wear, poor mating, transferred metal, or pitting, then new ones should be installed. Clean the points with a suitable solvent and a stiff bristled brush.

Check the alignment of the point for a full, square contact. If not correctly aligned, bend the stationary contact bracket slightly to provide alignment.

a. Hurricane F4 Engine (Prestolite).

The contact gap of the distributor point on the Hurricane F4 engine should be set at .020" [0,508 mm.], measured with a wire gauge. Adjustment of the gap is accomplished by loosening the lock screw and turning adjusting eccentric screw (Fig. C-12) until correct gap is secured. Be sure that the fiber block on the breaker arm is resting on the highest point on the cam while the adjustment is

being made. Recheck the gap after locking the adjustment.

Apply a thin film of cam lubricant to the cam to lessen fiber block wear.

Should a condenser tester be available the capacity should check from .21 to .25 microfarads. In the absence of a tester check by substituting a new condenser.

Check point contact spring pressure, which should be between 17 and 20 ounces [0,487 a 0,56 kg.]. Check with a spring scale hooked on the breaker arm at the contact and pull at right angle to the breaker arm. Make the reading just as the points separate. Adjust the point pressure by loosening the stud holding the end of the contact arm spring and slide the end of the spring in or out as necessary. Retighten the stud and recheck the pressure. Too low a pressure will cause engine missing at high speeds. Too high a pressure will cause rapid wear of the cam, block, and points.

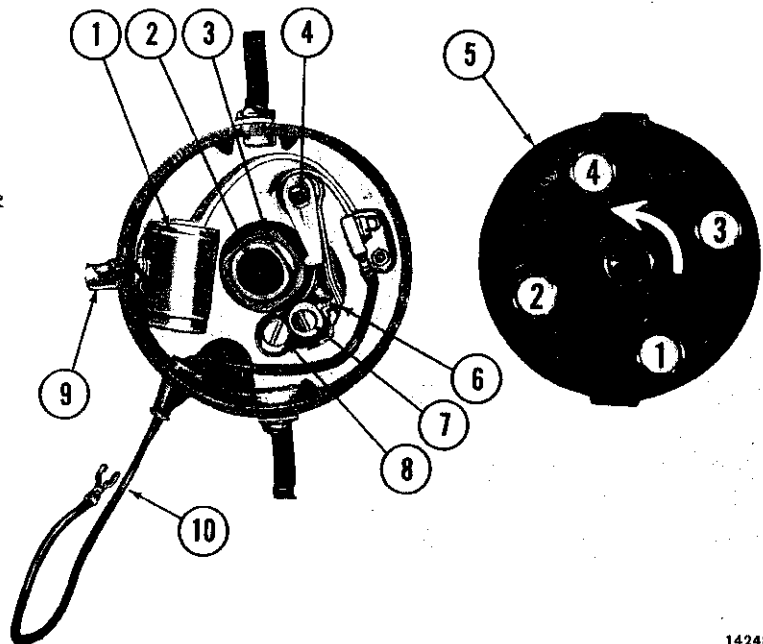
b. Dauntless V-6 Engine (Delco).

The spark advance is fully automatic being controlled by built-in centrifugal weights, and by a vacuum advance system (Fig. C-13). The same checking procedures are used as (a) above except, the capacity of the condenser must be .18 to .23 microfarads and the contact gap should be set at .016" [0,406 mm.]. Adjustment of the gap is made by rotating the socket head adjustment screw with a 1/8" [3,86 mm.] Allen wrench (Fig. C-14).

The contact spring pressure must be 19 to 23 ozs. [0,538 a 0,652 gr.] and the cam dwell angle is 30°, with distributor vacuum line disconnected. The preferred method of adjusting cam dwell requires turning of the adjusting screw until the specific dwell angle is obtained as measured by a dwell angle meter. Refer to Par. C-17. To adjust the cam dwell by an alternate method, turn the adjusting screw in (clockwise) until the engine

FIG. C-12—PRESTOLITE DISTRIBUTOR
HURRICANE F4 ENGINE

- 1—Condenser
- 2—Lubricating Wick
- 3—Breaker Cam
- 4—Breaker Arm Pivot
- 5—Distributor Cap (Rotation & Firing Order)
- 6—Distributor Points
- 7—Adjustment Lock Screw
- 8—Adjusting Eccentric Screw
- 9—Oiler
- 10—Primary Wire



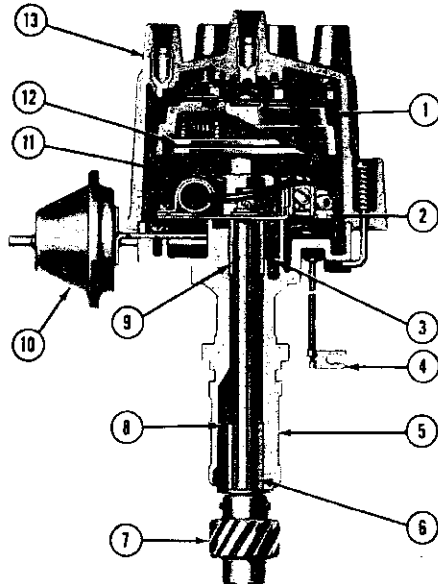


FIG C-13— DELCO DISTRIBUTOR — DAUNTLESS V-6 ENGINE

- | | |
|--------------------------|--------------------|
| 1—Rotor | 8—Access Passage |
| 2—Breaker Plate Assembly | 9—Shaft Bushing |
| 3—Lubrication Reservoir | 10—Vacuum Assembly |
| 4—Primary Terminal | 11—Cam |
| 5—Distributor Housing | 12—Weight Assembly |
| 6—Shaft Bushing | 13—Cap |
| 7—Gear | |

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begins to misfire, then give the wrench one-half turn in the opposite direction (counterclockwise), thus giving the approximate cam dwell angle requirement.

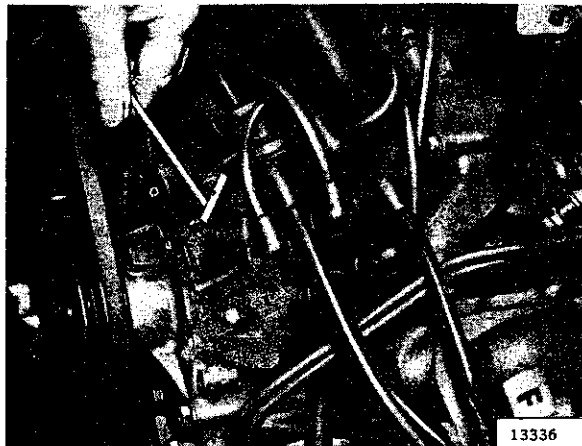
Note: Prestolite and Delco distributors are interchangeable on V-6 engine equipped vehicles.

c. Dauntless V-6 Engine (Prestolite).

● Refer to Fig. C-15.

The Prestolite distributor installed on the V-6 engine is similar in construction to the distributor installed on the F4 engine except for the addition of a vacuum advance mechanism.

The spark advance is fully automatic being con-



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FIG. C-14—ADJUSTING CONTACT POINT GAP — DAUNTLESS V-6 ENGINE (DELCO)

trolled by built-in centrifugal weights, and by a vacuum advance system. The same service checking procedure outlined in Par. C-10a, are used for the Prestolite V-6 distributor with exception of specifications.

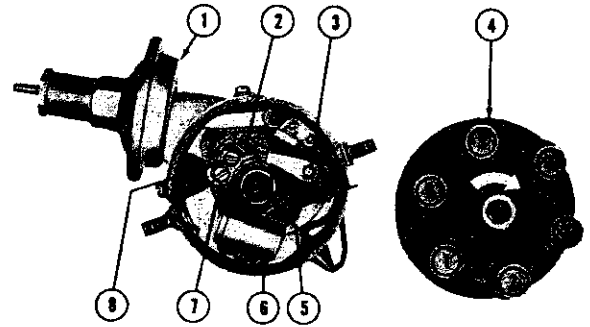


FIG. C-15—PRESTOLITE DISTRIBUTOR V-6 ENGINE

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- | | |
|---------------------------|-----------------------------|
| 1—Vacuum Advance Unit | 5—Lubricating Wick |
| 2—Distributor Points | 6—Condenser |
| 3—Breaker Arm Pivot | 7—Adjusting Eccentric Screw |
| 4—Distributor Cap | 8—Adjusting Lock Screw |
| (Rotation & Firing Order) | |

Specifications for the V-6 Prestolite distributor are as follows. The condenser capacity must be .25 to 28 mfd., contact breaker arm tension 17 to 22 ounces [482 a 624 gr.], and breaker point gap .016" [0,406 mm.]. The cam angle must be set at 29° ± 3° with distributor vacuum line disconnected.

C-11. Replacement and Adjustment of Prestolite Distributor Point Set — V-6 Engine

Replace the Prestolite distributor contact set as follows:

- Remove the distributor cap from the distributor. Remove the rotor.
- The condenser and primary leads are retained by breaker point spring tension. Refer to Fig. C-12 and C-15. Relieve spring tension to remove the leads.
- Remove the contact set retaining screw and remove the contact set.
- Remove the condenser screw and remove the condenser.
- Install new parts by reversing the removal procedure. Relieve spring tension of the breaker point spring to install the primary and condenser leads.
- Rotate the crankshaft until the distributor cam holds the distributor points to a wide-open position. Check the gap between the points. Then slightly loosen the contact set mounting screw and adjust the contact point gap to the proper dimension. Tighten the mounting screw when correct gap is attained.

C-12. Breaker Lever Spring Tension

One of the most important items to check is the breaker lever spring tension. This is checked with a spring scale hooked immediately behind the breaker lever contact. Spring tension required to open the contact points are given in Par. C-10.

C-13. Replacement and Adjustment of Delco Distributor Point Set

When inspection of the contact points show replacement to be advisable, the following procedure should be used. See Fig. C-13.

Note: The service replacement contact point set has the breaker spring tension and point alignment adjusted at the factory.

Removal of Contact Point Set.

a. Remove distributor cap by inserting a screwdriver in upper slotted end of cap retainers, press down and turn 90° counterclockwise. Push distributor cap aside and remove rotor. Disconnect the condenser and primary leads from their terminal by loosening the retaining screw. If there is no retaining screw, simply slip leads out.

b. Loosen two screws and lock washers which hold the contact point set in place. Then remove point set.

Installation of Contact Point Set.

a. Slide contact point set over boss on breaker plate and under the two screw heads. Tighten two screws and lock washers.

b. Install condenser and primary leads.

Note: Leads must be properly positioned so they will not come in contact with bottom of weight base or rotor.

c. If engine does not start readily, position contact arm rubbing block on peak of cam lobe, insert $\frac{1}{8}$ " [3,86 mm.] Allen wrench in adjusting screw and turn screw in (clockwise) until contact points just close. Then back screw out (counterclockwise) $\frac{1}{2}$ turn (180°) to obtain a point gap of approximately .016" [0,406 mm.] for a preliminary setting.

Adjustment of Contact Points—Engine Running

Note: When adjusting contact point dwell angle, always follow the instructions which come with the dwell meter.

a. Connect dwell tester leads: red to distributor side of coil, black to ground.

b. Turn selector switch to position for 6-lobe cam. Turn ignition switch on.

c. Start engine. Lift adjustment window and insert $\frac{1}{8}$ " [3,86 mm.] Allen wrench in adjusting screw. Set dwell angle at 30 degrees. See Fig. C-14.

d. After adjusting dwell angle, always check ignition timing.

C-14. Check Ignition Timing

a. Hurricane F4 Engine.

If a neon timing light is available, use it to check ignition timing following the instructions of the timing light manufacturer.

In the absence of a timing light, remove No. 1 spark plug and turn the engine over until No. 1 piston is on compression stroke as indicated by air being forced from No. 1 spark plug opening. Turn the engine slowly until the specified degree mark on the timing gear cover is in alignment with

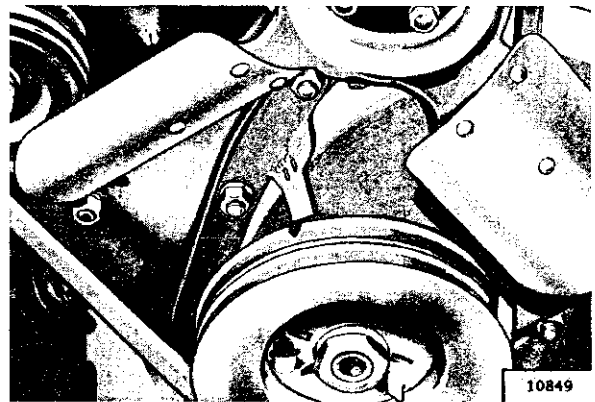


FIG. C-16—HURRICANE F4 ENGINE TIMING MARKS

the notch on the crankshaft pulley. Fig. C-16 shows the timing pointer arrangement of the Hurricane F4 engine. Refer to Ignition Timing Specifications Par. C-30. When the piston is positioned 5° BTC, timing is correctly set if the distributor rotor arm points to No. 1 terminal in the distributor cap and the distributor points are just ready to break. See Fig. C-12. Timing may be altered by loosening the distributor mounting clamp and turning the distributor. Turn the distributor clockwise to advance the timing and counterclockwise to retard the timing. Do not overtighten the mounting clamp screw.

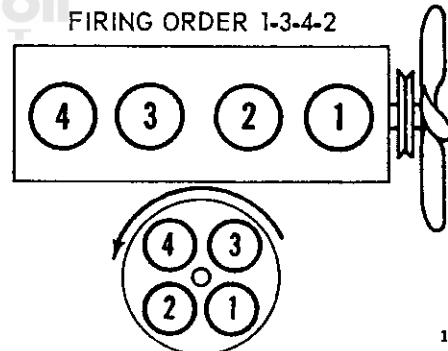


FIG. C-17—DISTRIBUTOR ROTATION AND FIRING ORDER, F4 ENGINE

b. Dauntless V-6 Engine.

Check timing with a timing light connected to the spark plug of No. 1 cylinder (front cylinder, left bank). Yellow timing mark on the vibration damper must align with the specified degree mark on the timing indicator (Fig. C-18). Refer to Ignition Timing Specifications Par. C-30. With the engine running at correct idle speed and the vacuum advance hose disconnected from the distributor and the line plugged, check for correct timing setting. If necessary, loosen the distributor clamp bolt and rotate the distributor until proper alignment of timing marks is attained. Tighten mounting screw. After correct setting is made, unplug the vacuum line and reconnect it, operate the engine and check operation of the vacuum advance.

Note: Turn the distributor counterclockwise to advance timing; turn clockwise to retard timing.

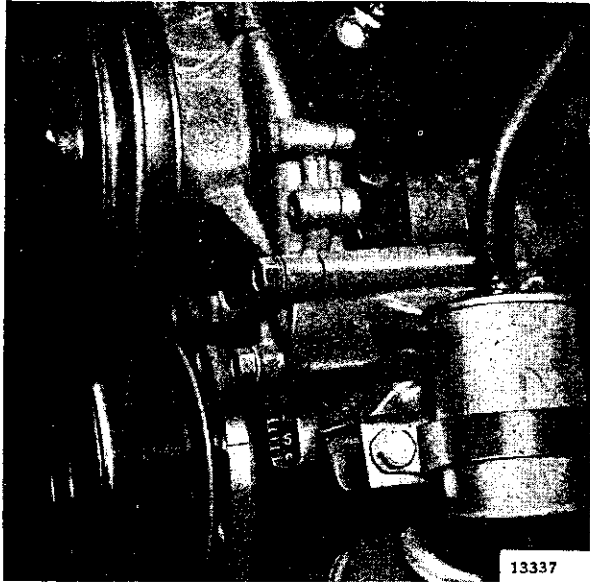


FIG. C-18—DAUNTLESS V-6 ENGINE TIMING MARKS

C-15. 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. Inspect all primary wiring for loose or corroded terminals, worn insulation, and broken strands.

a. Connect voltmeter positive (+) lead to the positive battery terminal, as shown in Fig. C-20. The negative lead (-) is connected to the ignition side of the resistor on Dauntless V-6 engine. The negative lead (-) is connected to the ignition primary of the coil on Hurricane F4 engine. Connect a jumper wire from the distributor primary terminal of the coil to the ground. Be sure all lights and accessories are off.

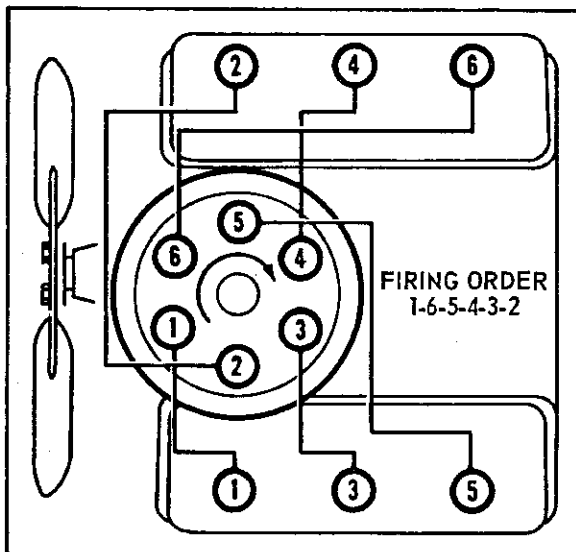


FIG. C-19—DISTRIBUTOR ROTATION AND FIRING ORDER, V-6 ENGINE

b. With the ignition switch on, the voltage should not exceed .4 volts. More than .4 volts indicates excessive resistance exists in the battery cable, ignition switch wiring, or the ignition switch. The excessive resistance may be located with voltmeter checks across each section of the circuit.

c. Remove the jumper wire from the coil. Connect the voltmeter positive (+) lead to the distributor terminal of the ignition coil. Ground the negative (-) lead of the voltmeter.

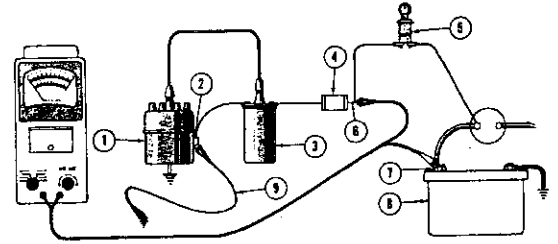


FIG. C-20—IGNITION PRIMARY CIRCUIT RESISTANCE CHECK

- 1—Distributor
- 2—Distributor Primary Terminal
- 3—Coil
- 4—Ignition Resistor
- 5—Ignition Switch
- 6—Ignition Switch Side of Resistor
- 7—Positive Battery Terminal
- 8—Battery
- 9—Jumper Wire

d. Note the voltage with the ignition switch on. If battery voltage is indicated, the distributor breaker points are open. Rock the engine to close the points. Voltage less than .2 volt indicates the points are satisfactory. Voltage more than .2 volt indicates burned or high resistance in the ignition points or a poor distributor ground.

C-16. Distributor Resistance Test

A dwell tester is used for the following tests. 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 the dwell

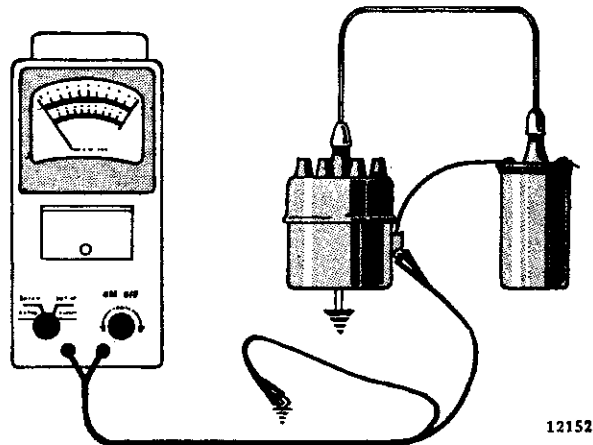


FIG. C-21—DISTRIBUTOR RESISTANCE CHECK

meter during this test. Connect the red lead to distributor primary lead at the coil as shown in Fig. C-21. Connect black lead to the ground. Turn ignition switch on; with engine stopped, observe dwell meter. If the 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. Distributor resistance is high, if dwell meter pointer is not within the black bar. Remove test lead from distributor terminal of coil and connect to each of the following points to determine where the excessive resistance is:

Distributor primary terminal
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 the necessary correction and repeat the test.

C-17. Distributor Point Dwell

Using a dwell tester, connect red lead to the distributor terminal at coil. Connect black lead to ground. Set selector switch to the number of cylinders in the engine being tested. Operate engine speed at specified rpm. and note readings. Cam dwell angle must be 30° for the Dauntless V-6 Delco equipped engine, $29^\circ \pm 3^\circ$ Prestolite equipped engine and 42° for the Hurricane F4 engine. If the dwell reading is not to specifications, trouble could be improper point spacing, point rubbing, defective block or breaker arm, or misaligned and worn distributor cam. Adjust dwell as shown in Fig. C-14 for the Delco equipped Dauntless V-6 engine. For cam dwell adjustment of the Prestolite equipped V6 and Hurricane F4 engine, refer to Par. C-10, step a.

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 same test hookup 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 3° . If dwell variation exceeds 3° between idle speed and 1750 rpm., probable wear in the distributor shaft, bushings, or breaker plate is indicated. Distributor should then be checked more thoroughly.

C-18. Check Ignition Wires and Connections

Examine and clean the insulation on all ignition wires and check all connections. Wires should be firm, flexible, and free from roughness and minute cracks. Bend wires to check for brittle, cracked, or loose insulation. Since defective insulation will permit crossfiring or missing of the engine, defective wires should be replaced.

C-19. Test Ignition Cables

To remove cables from spark plugs, use Spark

Plug Cable Remover Tool W-274. Twist the boot slightly to break the seal and, grasping the rubber protector boot, lift straight up with a steady even pull. Do not grasp the cable and jerk the cable off; this will damage the cables. Do not use a probe on these wires; puncturing them may cause a separation in the conductor. To remove ignition cables from the distributor cap or coil tower, loosen the nipple first, then grasp the upper part of the nipple and the cable and gently pull straight up. Test the cable with an ohmmeter. Resistance value per foot is 3000-7000 ohms. The ignition cables can be checked for circuit continuity by removing the cable from the spark plug and holding the cable end $\frac{1}{4}$ " [6,35 mm.] from the engine. A strong spark indicates good conductor continuity.

When connecting the cable to the spark plug, be certain a good connection is made and that the protector boot fits tight on the spark plug. A partially seated cable creates an additional gap in the circuit and the resulting spark jump will cause terminal corrosion and cable damage.

C-20. Coil

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.

Note: The ignition coil and ballast resistor for the V-6 engine must be of the same manufacturer. Ballast resistors and ignition coils of one manufacturer are interchangeable with both units of the other.

C-21. Service Air Cleaner

Refer to Par. B-22 for the correct service of the air cleaner.

C-22. Check Fuel Lines and Screens

Check all fuel line connections to guard against leakage. Check fuel pump filter F4 engine and fuel line filter V-6 engine. Replace fuel filter if necessary.

C-23. Check Fuel Pump

a. Fuel pump pressure is important, for low pressure will seriously affect engine operation and high pressure will cause excessive fuel consumption and possibly flood the carburetor. Should there be any doubt of normal operation, check the pressure with a gauge as shown in Fig. C-22. The minimum and maximum allowable pressures are $2\frac{1}{2}$ to $3\frac{3}{4}$ lbs. [0,176 a 0,264 kg-cm²], for the Hurricane F4 engine. Fuel pump pressure at carburetor (inlet) on the Dauntless V6-225 engine should be $3\frac{3}{4}$ lbs. [0,264 kg-cm²] minimum at specified R.P.M. idle with the vapor return hose squeezed off. With the vapor return hose open pump pressure should be $2\frac{1}{2}$ lbs. [0,176 kg-cm²] minimum.

b. Test for volume, as a pump may build up sufficient pressure but fail to produce sufficient volume. Turn down the carburetor fuel line fitting on the pump and with the tank line connected, pump out

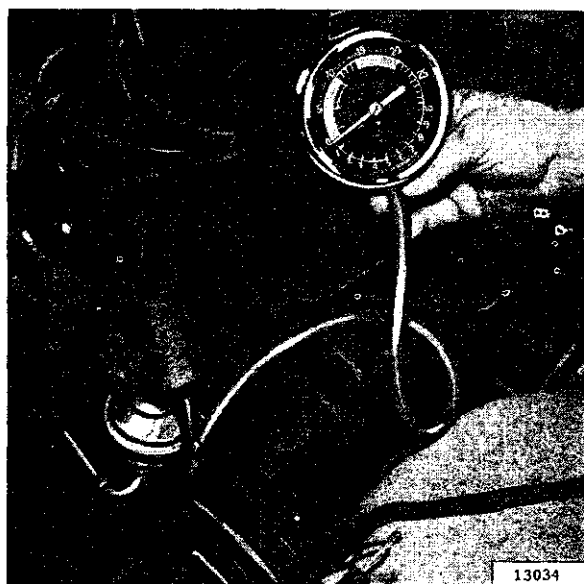


FIG. C-22—CHECKING FUEL PUMP PRESSURE—
DAUNTLESS V-6 ENGINE

a couple of strokes to be sure the pump is primed. Using a half-pint bottle or similar measure, pump ½ pint [0,24 lt.] of fuel by cranking the engine with the starter motor. Count the strokes necessary to fill the measure. If more than 20 strokes are required, the fuel pump is inefficient, the tank line is leaking air, or the fuel supply is restricted. Check fuel filter in the fuel tank if line is restricted.

C-24. Check Manifold Vacuum

To check the intake manifold vacuum on the Hurricane F4 engine, remove the ventilation valve and L fitting from the manifold and install special adapter. On the Dauntless V-6 engine remove the pipe plug located in the right rear of the intake



FIG. C-23—CHECKING MANIFOLD VACUUM—
HURRICANE F4 ENGINE

manifold and install special adapter. Connect the vacuum gauge tube to the special adapter as shown in Fig. C-23 for the Hurricane F4 engine.

Start the engine. Connect a Tachometer Tool, C-3896, from the distributor primary terminal to ground and set the engine speed at the specified rpm. given in Par. C-30. Observe the vacuum reading and interpret as follows:

a. A steady reading from 18" to 20" [457 a 508 mm.] of mercury is a normal reading, indicating that valve and spark timing, valve seating, and piston ring sealing are all satisfactory.

b. A steady but below normal reading indicates a condition common to all cylinders such as a leak at the carburetor gasket, late ignition or valve timing, or uniform piston ring and bore wear.

c. A slowly fluctuating or drifting reading indicates that the carburetor idle mixture is incorrect. Look for the cause in the fuel system.

d. A rhythmic pulsating reading is caused by a condition affecting one or more cylinders, but not all, and indicates leaky valve, gasket blowby, restricted intake port, or an electrical miss.

e. An intermittent pulsating reading is caused by an occasional malfunction, such as a sticking valve (all valves may be erratic in operation if the valve springs are weak), electrical miss caused by insufficient distributor point tension or low coil voltage coupled with inconsistent spark plug gaps or fouled plugs, or dirt in the fuel system finding its way into passages of critical size or valve seats in the carburetor.

f. A normal reading that quickly falls off (with engine running at 2000 rpm.) indicates exhaust back pressure caused by a restriction in the exhaust system.

g. Make indicated corrections to bring vacuum to 18" to 20" [457 a 508 mm.] of mercury normal reading.

C-25. Carburetor Adjustments

● Refer to Fig. C-24, C-25 and C-26.

Carburetor adjustments should not be attempted until it is known that engine ignition and compression are in good order. Any attempt to adjust or alter the carburetor to compensate for faulty conditions elsewhere will result in reduced economy and overall performance.

Caution: If an engine is idling too slow or rough, this may be caused by a clogged ventilator valve or hose; therefore, never adjust the carburetor idle without first checking the crankcase ventilator check valve and hose.

The air cleaner must be left in place while making idle speed and mixture adjustments. All lights and accessories, must be turned off. The positive crankcase ventilator system should also be in good operating condition when making carburetor adjustments. Either of these items noticeably affects the air fuel ratio at idle.

● Hurricane F4 Engine.

Note: The idle mixture adjustment procedure for the late model YF-4941S and YF-6115S Carter

Carburetor equipped with the External Idle Mixture Limiter Cap is the same as outlined below in Pars. "A" through "D"; however, because of the Idle Limiter Cap, the idle mixture screw CANNOT be adjusted in the counter-clockwise (rich) direction. The adjustment is made from the rich stop position and the mixture screw is turned in (clockwise) approximately $\frac{3}{4}$ turn to "Lean Best Idle." Refer to Fig. C-25.

The "Lean Best Idle" method of idle setting is as follows:

- a. Any scheduled service of ignition system should precede this adjustment.
- b. Connect tachometer or vacuum gauge to engine.
- c. Warm up engine and stabilize temperatures.
- d. Adjust engine idle to speed desired, using throttle idle speed adjusting screw.
- e. Carburetors without Idle Limiter Cap turn idle mixture screws out (counterclockwise) until a loss of engine speed is indicated; then, slowly turn mixture screw in (clockwise-leaner) until maximum speed (RPM) is reached. Continue turning in (clockwise) until speed begins to drop; turn mixture adjustment back out (counterclockwise-richer) until maximum speed is just regained at a "lean as possible" mixture adjustment. Refer to Fig. C-24.

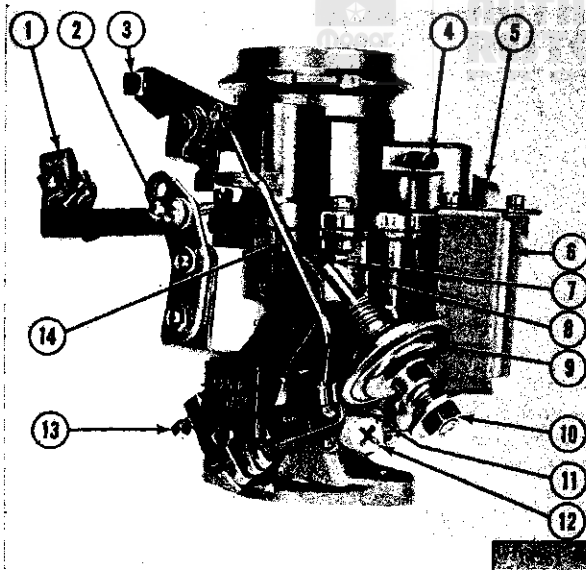


FIG. C-25—CARBURETOR—
F4 ENGINE, LATE MODEL

- | | |
|----------------------------|-------------------------------|
| 1—Choke Clamp Bracket | 8—Dash Pot Plunger |
| 2—Throttle Lever and Shaft | 9—Dash Pot Assembly |
| 3—Choke Shaft and Lever | 10—Lock Nut |
| 4—Fuel Vent Tube | 11—Stop Pin |
| 5—Fuel Inlet Elbow | 12—Idle Mixture Limiter Cap |
| 6—Dash Pot Bracket | 13—Idle Speed Adjusting Screw |
| 7—Throttle Lever | 14—Fast Idle Connecting Rod |

Note: The Carter YF-6115S Carburetor has a throttle return spring attached from the carburetor main body to the carburetor throttle shaft. The purpose of this spring is to return the throttle to idle speed position should a linkage failure occur.

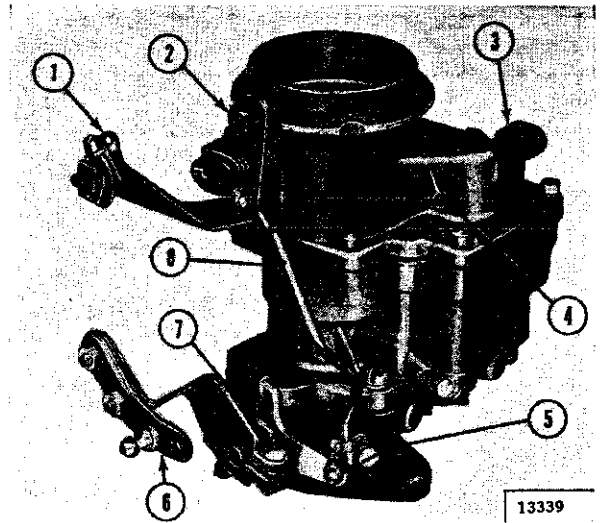


FIG. C-24—CARBURETOR—
HURRICANE F4 ENGINE, EARLY MODEL

- | |
|-------------------------------------|
| 1—Choke Clamp Bracket |
| 2—Choke Shaft and Lever Assembly |
| 3—Fuel Inlet Elbow |
| 4—Bowl Vent Tube |
| 5—Idle Air Adjusting Needle |
| 6—Throttle Lever and Shaft Assembly |
| 7—Idle Speed Adjusting Screw |
| 8—Fast Idle Connector Rod |

Note: When adjusting the mixture screw never seat the screw tight during the adjustment procedure as this can damage the screw needle.

● Dauntless V-6 Engine.

The "Lean Best Idle" method of idle setting is as follows:

- a. Any scheduled service of ignition system should precede this adjustment.
- b. Connect tachometer to engine.
- c. Warm up engine and stabilize temperatures.
- d. Adjust engine idle to speed desired, using throttle idle speed adjusting screw.

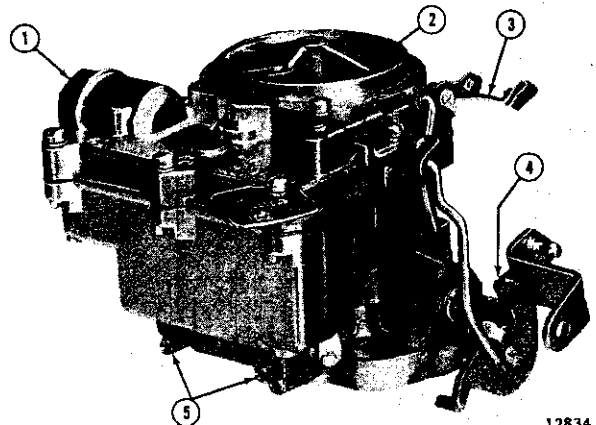
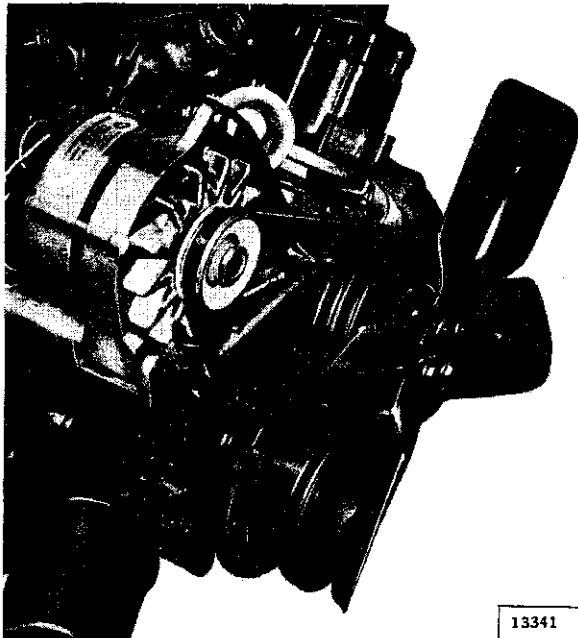


FIG. C-26—CARBURETOR—
DAUNTLESS V-6 ENGINE

- | |
|--------------------------------|
| 1—Fuel Inlet |
| 2—Choke Housing |
| 3—Choke Cable Bracket |
| 4—Idle Speed Adjusting Screw |
| 5—Idle Fuel-Air Mixture Screws |



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FIG. C-27—FAN BELT — DAUNTLESS V-6 ENGINE

e. Adjust mixture by turning idle mixture screws out (counterclockwise) until a loss of engine speed is indicated; then, slowly turn both mixture screws in clockwise (leaner) until maximum speed (RPM) is reached. Continue turning in (clockwise) until a slight drop in speed (RPM) is noted. Make certain both mixture screws are adjusted equally. This will ensure a "lean as possible" mixture adjustment. Readjust idle stop screw to idle engine at the specified R.P.M.

Note: This method of adjusting idle mixture must be used to keep hydrocarbon and carbon monoxide emissions to a minimum.

Note: No fast idle speed adjustment is required. Fast idle is controlled by the curb idle speed adjustment screw. If the curb idle speed is correctly set, the fast idle speed will be correct.

C-26. Dash Pot Adjustment

Refer to Section E, Par. E-44 for proper carburetor dash pot adjustment procedure.

C-27. Check Fan Belt

The fan belt drives the fan, alternator, and water pump. See Fig. C-27.

Inspect the fan belt for serviceability and proper tension. The tension should be checked with the Belt Tension Gauge, W-283. The correct tension on a used belt is 70 to 80 pounds [31,7 a 36,2 kg.] and on a new belt 110 to 120 pounds [49,8 a 54,5 kg.]. When preparing for delivery of new car, the belt strand tension should be 80 to 110 pounds [36,2 a 49,8 kg.]. When installing a new belt, adjust the strand tension 110 to 120 pounds [49,8 a 54,5 kg.].

Adjust the fan belt tension by loosening the clamp bolt on the alternator brace and swinging the alternator away from the engine until proper belt tension is obtained. Then tighten the clamp bolt.

Note: If no gauge is available approximate correct tension is obtained when the thumb pressure midway between the pulleys causes the belt to flex $\frac{1}{2}$ inch [1 $\frac{1}{4}$ cm.].

C-28. ROAD TEST VEHICLE

After completing the tune-up, road test the vehicle for power and overall performance. Make necessary adjustments.

Note: Engine run on or "dieseling" is a condition in which combustion continues to take place after the normal ignition spark from the distributor has been shut off by turning off the ignition switch. It is generally caused by excessive engine idle speed in combination with retarded ignition timing, engine heat soak or the use of low octane fuel. Should engine dieseling (engine running after ignition key is turned off) be experienced on V-6 engine equipped vehicles, installation of Idle Stop Valve Kit Part No. 991722 will correct the difficulty.

C-29. SERVICE DIAGNOSIS

POOR FUEL ECONOMY

Ignition Timing Slow or Spark Advance Stuck
 Carburetor Float High
 Accelerator Pump Not Properly Adjusted
 High Fuel Pump Pressure
 Fuel Leakage
 Leaky Fuel Pump Diaphragm
 Loose Engine Mounting Causing
 High Fuel Level in Carburetor
 Low Compression
 Valves Sticking
 Spark Plugs Bad
 Spark Plug Cables Bad
 Weak Coil or Condenser
 Improper Valve Tappet Clearance
 Carburetor Air Cleaner Dirty
 High Oil Level in Air Cleaner
 Dragging Brakes
 Front Wheels Out of Alignment
 Tires Improperly Inflated
 Inaccurate Odometer
 Faulty Fuel Tank Cap
 Clogged Muffler or Bent Exhaust Pipe
 Sticking Exhaust Manifold Valve

LACK OF POWER

Low Compression
 Ignition System (Timing Late)
 Improper Functioning Carburetor
 or Fuel Pump
 Fuel Lines Clogged
 Air Cleaner Restricted
 Engine Temperature High
 Improper Tappet Clearance
 Sticking Valves
 Valve Timing Late
 Leaky Gaskets
 Muffler Clogged
 Bent Exhaust Pipe
 Sticking Exhaust Manifold Valve —
 Dauntless V-6 Engine

LOW COMPRESSION

Leaky Valves
 Poor Piston Ring Seal
 Sticking Valves
 Valve Spring Weak or Broken
 Cylinder Scored or Worn
 Tappet Clearance Incorrect
 Piston Clearance too Large
 Leaky Cylinder Head Gasket

BURNED VALVES AND SEATS

Sticking Valves or too Loose in Guides
 Improper Timing
 Excessive Carbon Around Valve Head and Seat
 Overheating
 Valve Spring Weak or Broken
 Valve Tappet Sticking
 Valve Tappet Clearance Incorrect
 Clogged Exhaust System
 Defective Valve Lifter — Hydraulic

VALVES STICKING

Warped Valve
 Improper Tappet Clearance
 Carbonized or Scored Valve Stems
 Insufficient Clearance Valve Stem to Guide
 Weak or Broken Valve Spring
 Valve Spring Cocked
 Contaminated Oil

OVERHEATING

Inoperative Cooling System
 Thermostat Inoperative
 Improper Ignition Timing
 Improper Valve Timing
 Excessive Carbon Accumulation
 Fan Belt too Loose
 Clogged Muffler or Bent Exhaust Pipe
 Oil System Failure
 Scored or Leaky Piston Rings
 Sticking Exhaust Manifold Valve —
 Dauntless V-6 Engine

POPPING-SPITTING-DETONATION

Improper Ignition
 Improper Carburetion
 Excessive Carbon Deposit in
 Combustion Chambers
 Poor Valve Seating
 Sticking Valves
 Broken Valve Spring
 Tappets Adjusted too Close
 Spark Plug Electrodes Burned
 Water or Dirt in Fuel
 Clogged Lines
 Improper Valve Timing
 Clogged Fuel Filter
 Sticking Exhaust Manifold Valve —
 Dauntless V-6 Engine

EXCESSIVE OIL CONSUMPTION

Piston Rings Stuck in Grooves, Worn or Broken
 Piston Rings Improperly Fitted or Weak
 Piston Ring Oil Return Holes Clogged
 Excessive Clearance, Main and
 Connecting Rod Bearings
 Oil Leaks at Gaskets or Oil Seals
 Excessive Clearance, Valve Stem
 to Valve Guide (Intake)
 Cylinder Bores Scored, Out-of-
 Round or Tapered
 Too Much Clearance, Piston to Cylinder Bore
 Misaligned Connecting Rods
 High Road Speeds or Temperature
 Crankcase Ventilator Not Operating

BEARING FAILURE

Crankshaft Bearing Journal Out-of-Round
 Crankshaft Bearing Journal Rough
 Lack of Oil
 Oil Leakage
 Dirty Oil
 Low Oil Pressure or Oil Pump Failure
 Drilled Passages in Crankcase
 or Crankshaft Clogged
 Oil Screen Dirty
 Connecting Rod Bent

C-30. TUNE-UP SPECIFICATIONS

ITEM	HURRICANE F4	DAUNTLESS V-6
BATTERY:		
Voltage.....	12 Volts	12 Volts
Terminal Ground.....	Negative	Negative
Specific Gravity:		
Fully Charged.....	1.260	1.260
Recharge at.....	1.225	1.225
Load Test, minimum:		
12-Volt Battery.....	10 Volts	10 Volts
SPARK PLUGS:		
Make and Model.....	AC 45 or Champion J-8	AC 44S or Champion UJ12Y
Gap.....	.030" [0,762 mm.]	.035" [0,889 mm.]
Tightening Torque.....	25 to 33 lb.-ft. [3,5 a 4,6 kg-m.]	25 to 35 lb.-ft. [3,5 a 4,8 kg-m.]
COMPRESSION PRESSURE		
CRANKING:	120 to 130 psi. [8,4 a 9,2 kg-cm ²]	
VALVES:		
Tappet Clearance Cold:		
Intake:.....	.018" [0,460 mm.]	Zero (Hydraulic Lifters)
Exhaust:.....	.016" [0,406 mm.]	Zero (Hydraulic Lifters)
Timing (Intake Opens).....	9° BTC	
DISTRIBUTOR:	PRESTOLITE	DELCO-REMY PRESTOLITE
Model.....	IAY-4012 IAY-4401A IAY-4401 IAY-4401B	1110376 IAT-4501 IAT-4502A IAT-4502
Dwell Angle.....	42°	30° 29° ± 3°
Point Gap.....	.020" [0,508 mm.]	.016" [0,401 mm.]
Arm Spring Tension.....	17 to 20 oz. [0,482 @ 0,567 gr.]	19 to 23 oz. [0,538 @ 0,652 gr.] 17 to 22 oz. [0,482 @ 0,624 gr.]
Firing Order and Direction.....	1-3-4-2 Counterclockwise	1-6-5-4-3-2- Clockwise
IGNITION TIMING:	5° BTC 0° TDC	5° BTC 0° TDC
Mark Location.....	Vibration Damper or Timing Cover	Timing Cover
ENGINE IDLE SPEED:		
W/O Exhaust Emission Control.....	600 rpm.	650/700 rpm.
With Exhaust Emission Control:		650/700 rpm.
F4 W/Dist. IAY-4401A.....		700/750 rpm.
F4 W/Dist. IAY-4401B.....		
FIRING ORDER:	1-3-4-2	1-6-5-4-3-2

NOTE: FOR VEHICLES EQUIPPED WITH EXHAUST EMISSION CONTROL, ALSO REFER TO SECTION F1 (F4-134 ENGINE) AND SECTION F2 (V6-225 ENGINE).

HURRICANE F4 ENGINE

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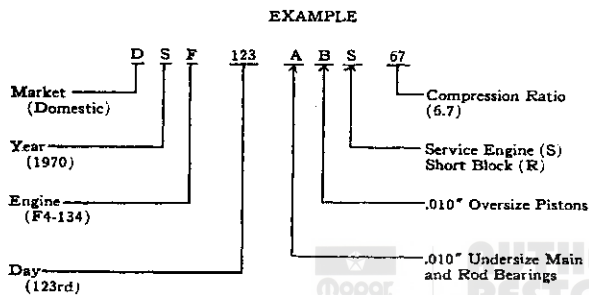
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D-1. GENERAL

This section describes service and repair of the F4 engine. The engine code number shown in Fig. A-3 is provided to identify the four cylinder engine. The meaning of the coded letters and numbers that are stamped on the water pump boss, at the front of the cylinder block, is given below.

Letter to Designate Market	Letter to Designate Year Built	
M — Military	R — 1969	U — 1972
E — Export	S — 1970	V — 1973
D — Domestic	T — 1971	W — 1974
I — Industrial & Marine		

Letter to Designate Engine	Numbers to Designate Compression Ratio
F — F4-134 Engine	63 — 6.3 to 1
	67 — 6.7 to 1
	71 — 7.1 to 1



All disassembly and assembly procedures are presented in logical order, assuming a complete engine overhaul with engine removed from the vehicle. However, many of these procedures can also be performed as on-vehicle services if vehicle or engine components are removed to gain access to parts involved.

Note: Some engines are equipped with an exhaust emission control system. Service information on the components of this system is given in Section F-1.

D-2. Description

The Hurricane F4-134 engine is an F-head, four-cylinder engine of combination valve-in-head and valve-in-block construction. Large intake valves mounted in the head allow rapid, unobstructed flow of fuel and air to the combustion chambers through short, water-jacketed intake passages. The intake valves are operated by push rods through rocker arms. The exhaust valves are mounted in the block with through water jacketing to provide effective cooling. The exhaust valves are operated by conventional valve tappets.

The engine is pressure lubricated. An oil pump driven from the camshaft forces the lubricant through oil channels and drilled passages in the crankshaft to efficiently lubricate the main and connecting rod bearings. Lubricant is also forced to the camshaft bearings, rocker arms, timing gears, etc. Cylinder walls and piston pins are lubricated from spurt holes in the "follow" side of the connecting rods.

Circulation of the coolant is controlled by a thermostat in the water outlet elbow cast as part of the cylinder head.

The cylinder head assembly when installed on the engine consists of the inlet valve guides, inlet valves, inlet valve springs, rocker arm and shaft assemblies, spark plugs, temperature indicator fitting, water outlet fitting, and other assembled parts. The carburetor and air cleaner assembly bolt to the top of the cylinder head. The rocker arm cover is attached to the top of the head to enclose the inlet valve mechanism.

The engine is equipped with a fully counterbalanced crankshaft supported by three main bearings. To better control balance, the counterweights are independently forged and permanently attached to the crankshaft with dowels and cap screws that are tack-welded. Crankshaft end play is adjusted by shims placed between the crankshaft thrust washer and the shoulder on the crankshaft.

The exhaust manifold is a separate unit. The intake manifold is cast as an integral part of the cylinder head and is completely water jacketed. This construction transfers heat from the cooling system to the intake passages and assists in vaporizing the fuel when the engine is cold. Therefore, there is no heat control valve required in the exhaust manifold. Individual exhaust ports in the cylinder block direct gases into the exhaust manifold for unobstructed flow through the exhaust system.

The pistons have an extra groove directly above the top ring which acts as a heat dam or insulator.

As is common practice with manufacturers, some engines are built with oversize cylinder bores or undersize crankshaft journals. These engines are considered standard as replacement parts of the correct sizes are supplied. Before ordering parts or doing any work with a particular engine, it is important to check the engine code number to determine if oversize or undersize parts are required. Definite identification is given by a letter stamped after the engine code number. See Fig. A-5 for location. The letters used and their meanings are given here:

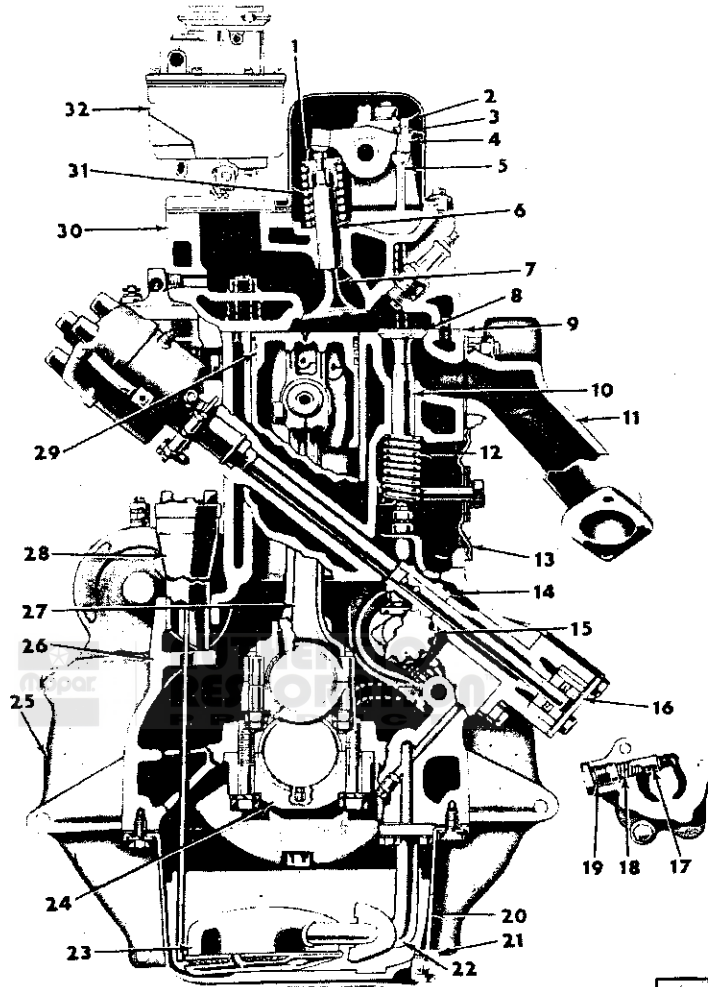
- | | |
|----|---|
| A | — .010" [0,254 mm.] undersize main and connecting rod bearings. |
| B | — .010" [0,254 mm.] oversize pistons. |
| AB | — Combination of A and B. |
| S | — Service engine. |
| R | — Short Block. |

Detailed specifications for the Hurricane F4 engine are at the end of this section. Torque specifications for engine service are at the end of this manual in Section U. When adjustments are necessary, refer to these specifications so that factory clearances are maintained.

D-3. Engine Mountings

The front of the engine is supported by two rubber

Text continued on page 41.



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FIG. D-1—HURRICANE F4-ENGINE — END SECTION VIEW

- | | |
|--------------------------------|---------------------------|
| 1—Intake Valve Spring Retainer | 17—Relief Plunger |
| 2—Adjusting Screw | 18—Relief Plunger Spring |
| 3—Nut | 19—Relief Spring Retainer |
| 4—Rocker Arm | 20—Oil Pan |
| 5—Push Rod | 21—Drain Plug |
| 6—Intake Valve Guide | 22—Oil Float Support |
| 7—Intake Valve | 23—Oil Float |
| 8—Exhaust Valve | 24—Crankshaft |
| 9—Cylinder Head Gasket | 25—Engine Rear Plate |
| 10—Exhaust Valve Guide | 26—Cylinder Block |
| 11—Exhaust Manifold | 27—Connecting Rod |
| 12—Exhaust Valve Spring | 28—Oil Filler Tube |
| 13—Valve Spring Cover | 29—Piston |
| 14—Oil Pump Gear | 30—Cylinder Head |
| 15—Camshaft | 31—Intake Valve Spring |
| 16—Oil Pump | 32—Carburetor |

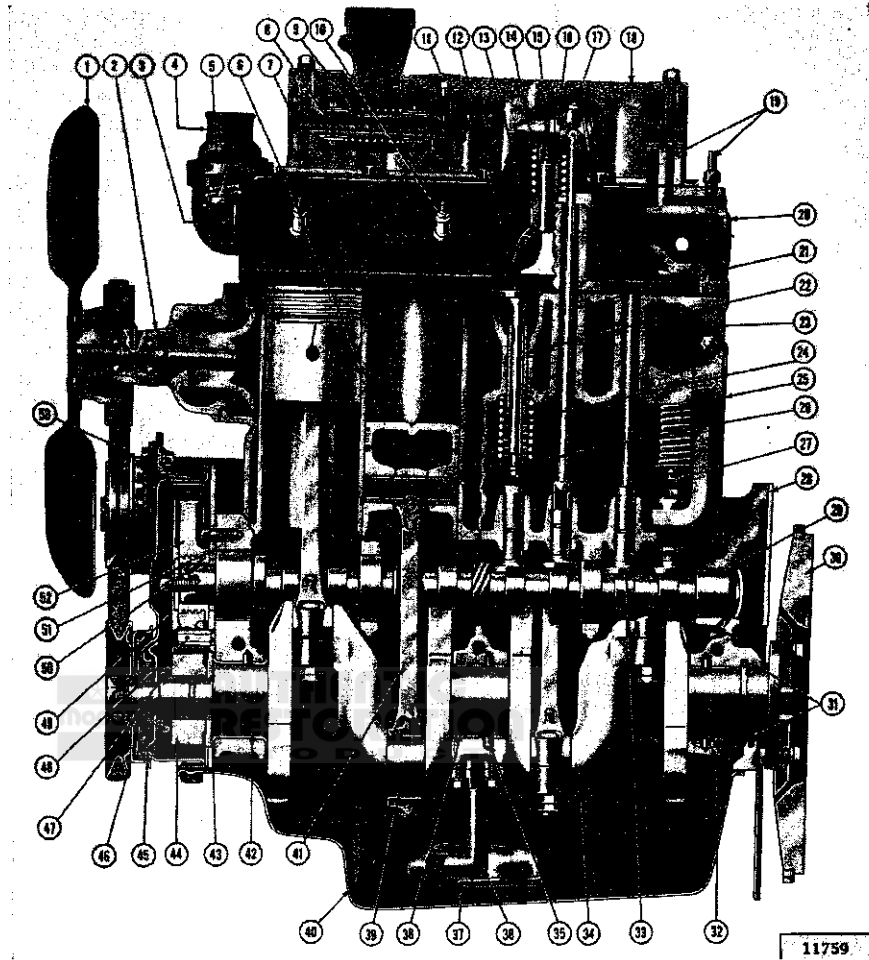


FIG. D-2—HURRICANE F4-ENGINE — SIDE SECTIONAL VIEW

- | | |
|-----------------------------------|--------------------------------------|
| 1—Fan | 28—Engine Rear Plate |
| 2—Water Pump | 29—Camshaft |
| 3—Pipe Plug | 30—Flywheel |
| 4—Water Outlet Fitting | 31—Crankshaft Rear Bearing Seal |
| 5—Thermostat | 32—Crankshaft Rear Bearing |
| 6—Piston | 33—Intake Valve Tappet |
| 7—Rocker Shaft Bracket | 34—Crankshaft |
| 8—Rocker Arm Shaft | 35—Crankshaft Bearing Dowel |
| 9—Rocker Shaft Spring | 36—Oil Float Support |
| 10—Spark Plug | 37—Oil Float |
| 11—Rocker Shaft Lock Screw | 38—Crankshaft Center Bearing |
| 12—Exhaust Valve | 39—Connecting Rod Bearing |
| 13—Intake Valve | 40—Oil Pan |
| 14—Intake Valve Spring | 41—Connecting Rod |
| 15—Intake Valve Guide | 42—Crankshaft Front Bearing |
| 16—Rocker Arm | 43—Engine Front Plate |
| 17—Intake Tappet Adjusting Screw | 44—Crankshaft Gear |
| 18—Rocker Arm Cover | 45—Crankshaft Oil Seal |
| 19—Oil Line | 46—Drive Pulley |
| 20—Cylinder Head | 47—Crankshaft Gear Spacer |
| 21—Intake Valve Push Rod | 48—Oil Jet |
| 22—Exhaust Valve Guide | 49—Bolt |
| 23—Exhaust Manifold | 50—Camshaft Gear Thrust Plate Spacer |
| 24—Exhaust Valve Spring | 51—Camshaft Thrust Plate |
| 25—Cylinder Block | 52—Camshaft Gear |
| 26—Piston Pin | 53—Fan and Generator Belt |
| 27—Exhaust Tappet Adjusting Screw | |

insulator mountings attached to the frame side rail brackets. The rear of the engine-transmission assembly is supported by a rubber insulator mounting under the rear of the transmission on the frame center cross member. This cross member is bolted to the frame side rails so that it can be dropped when removing the transmission or engine-transmission assembly. The rubber insulators allow free side and vertical oscillation to effectively neutralize engine vibration at the source.

The rubber insulator mountings should be inspected for separation and deterioration by jacking the power plant away from the frame, near the supports. Vibration cannot be effectively absorbed by separated or worn insulators. They should be replaced if faulty.

D-4. Engine Ground Strap

To be sure of an effective ground for the electrical circuits, a ground strap bridges the right front engine support to the chassis. The connections of this strap must be kept clean and tight for proper operation of the electrical system.

D-5. ENGINE REMOVAL

Should the engine require overhauling, it is necessary to remove it from the vehicle. The following procedure covers removal of the engine only.

The engine, transmission and transfer case may be removed as a unit by removing (in addition to the following procedure) the radiator guard and the access plates in the floor pan.

- a. Drain the cooling system by opening the drain cocks at the bottom of the radiator and lower right side of the cylinder block.
- b. Disconnect the battery at the positive terminal to avoid the possibility of short circuit.
- c. Remove the air cleaner horn from the carburetor and disconnect the breather hose at the oil filler pipe.
- d. Disconnect the carburetor choke and throttle controls by loosening the clamp bolts and set screws.
- e. Disconnect the fuel-tank-to-fuel-pump line at the fuel pump by unscrewing the connecting nut.
- f. Plug the fuel line to prevent fuel leakage.
- g. Remove the radiator and radiator grille support rods.
- h. Remove the upper and lower radiator hoses by loosening the hose clamps and slipping the clamps back on the hose. If so equipped, remove the heater hoses (one to the water pump, one to the rear of the cylinder head) in the same manner.
- i. Remove the four bolts from the fan hub and remove the fan hub and fan blades.
- j. Remove the four radiator attaching screws. Remove the radiator and shroud as one unit.
- k. Remove the starting motor cables. Remove the starting motor.
- l. Disconnect the wires from the alternator or generator. Disconnect the ignition primary wire at the ignition coil.

NOTE: ON ENGINES EQUIPPED WITH EXHAUST EMISSION CONTROL, REMOVE THE AIR PUMP, AIR DISTRIBUTION MANIFOLD, AND ANTI-BACKFIRE (DIVERTER) VALVE. SEE SECTION F1 FOR PROCEDURE.

- m. Disconnect the oil pressure and temperature sending unit wires at the units.
- n. Disconnect the exhaust pipe at the exhaust manifold by removing the stud nuts.
- o. Disconnect the spark plug cables at the plugs and remove the cable bracket from the rocker arm cover stud.
- p. Remove the rocker arm cover by removing the attaching stud nuts.
- q. Attach a lifting bracket to the engine using existing head bolt locations. Be sure the bolts selected will hold the engine with the weight balanced. Attach lifting bracket to a boom hoist, or other lifting device, and take up all slack.
- r. Remove the two nuts and bolts from each front engine support. Disconnect the engine ground strap. Remove the engine supports. Lower the engine slightly to permit access to the two top bolts on the flywheel housing.
- s. Remove the bolts which attach the flywheel housing to the engine.
- t. Pull the engine forward, or roll the vehicle backwards, until the clutch clears the flywheel housing. Lift the engine from the vehicle.

D-6. ENGINE DISASSEMBLY

Engine disassembly is presented in the sequence to be followed when the engine is to be completely overhauled after removal from the vehicle. Some of the operations of the procedure are also applicable separately with the engine in the vehicle, provided that wherever necessary the part of the engine to be worked on is first made accessible by removal of engine accessories or other parts.

When the disassembly operations are performed with the engine out of the vehicle, it is assumed, in this procedure, that all of the accessories have been removed prior to starting the disassembly and the oil has been drained.

In addition to the instructions covering operations for disassembling the engine out of the vehicle, special instructions are given to cover different operations required when disassembly is done with the engine installed.

During disassembly operations, the engine should be mounted in a suitable engine repair stand. Where practicable, modify or adapt an existing repair stand as necessary to accommodate the engine. If an engine repair stand is not used, take care to perform disassembly operations in a manner that will protect personnel against an accident and the engine and its parts against damage.

NOTE: If the engine is being disassembled because of possible valve failure, check the valve tappet clearance before disassembly. Improper valve clearance could be the possible cause of valve failure, indicating a need for more frequent valve checks and adjustments.

D

HURRICANE F4 ENGINE

D-7. Remove Water Pump

Remove the bolts and lockwashers that attach the water pump to the cylinder block. Remove the water pump.

D-8. Remove Exhaust Manifold

Remove the five nuts from the manifold studs. Pull the manifold off the mounting studs. Remove the center and two end gaskets from the cylinder block. See Section F1 for exhaust emission controlled engines.

D-9. Remove Oil Filler Tube

Loop a piece of wire several times around the tube below the top and make a loop through which a pry bar may be used to pry over the top of the engine water outlet fitting. Pull on the tube, tapping it just above where it enters the crankcase.

D-10. Remove Water Outlet Fitting

Remove the nuts and lockwashers that attach the water outlet fitting to the cylinder head. Lift the outlet fitting from the cylinder head.

D-11. Remove Thermostat

With the water outlet fitting removed, the thermostat can be lifted from the water outlet elbow on the cylinder head.

D-12. Remove Crankshaft Pulley

Remove the crankshaft nut. Install a puller and pull the pulley from the crankshaft.

D-13. Remove Distributor

a. Remove spark plug cables from the distributor cap, noting the order in which they are assembled to ensure correct reassembly. No. 1 spark plug terminal is in the 5 o'clock position. Starting with this tower the cables are installed in a counter-clockwise direction in 1-3-4-2 firing order.

b. Remove the primary lead from the terminal post at the side of the distributor.

c. Remove the screw holding the distributor to the crankcase and lift the assembly from the engine.

D-14. Remove Oil Pump

The oil pump is located externally on the left side of the engine. If only the oil pump is being removed with the engine in the vehicle, set No. 1 piston at TDC for reference for reinstalling the oil pump without greatly disturbing the ignition timing.

First remove the distributor cover and note the position of the distributor rotor.

If the distributor is already removed, sight through the distributor hole before removing the oil pump. The slot should be near vertical. Remove the capscrews and lockwashers attaching the oil pump to the cylinder block. Carefully slide the oil pump and its drive shaft out of the cylinder block.

D-15. Remove Crankcase Ventilation Valve

To remove the crankcase ventilation valve from the elbow fitting screwed into the inlet manifold

of the cylinder head, first remove the hose and clamp from the valve (Fig. D-32), then using a $\frac{9}{16}$ " wrench carefully unscrew the valve from the elbow.

D-16. Remove Rocker Arm Assemblies

The rocker arm cover was previously removed as a step of the engine removal (Par. D-5).

Remove the nuts from the rocker arm shaft support studs, and lift the rocker arm assembly off the studs. Lift the intake valve push rods out of the cylinder block.

D-17. Remove Cylinder Head

a. Removal.

Disconnect the oil line from the flared tube connector and remove the rocker arm attaching stud nuts, and rocker arm shaft assembly if not previously removed. Two end head bolts cannot be removed until the rocker arm shaft is removed. Remove the cylinder head bolts. There is one cylinder head bolt located below the carburetor mounting, inside the intake manifold, that must not be overlooked.

Carefully lift the cylinder head off the block.

Remove the valve push rods and the valve lifters.

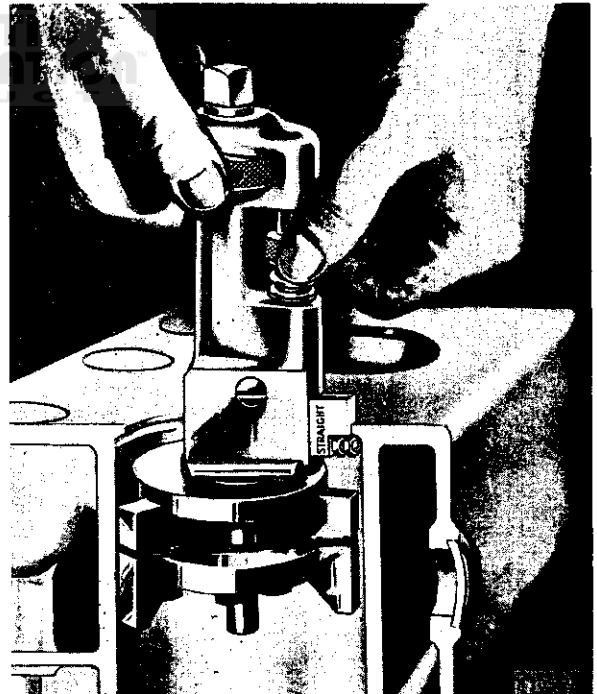


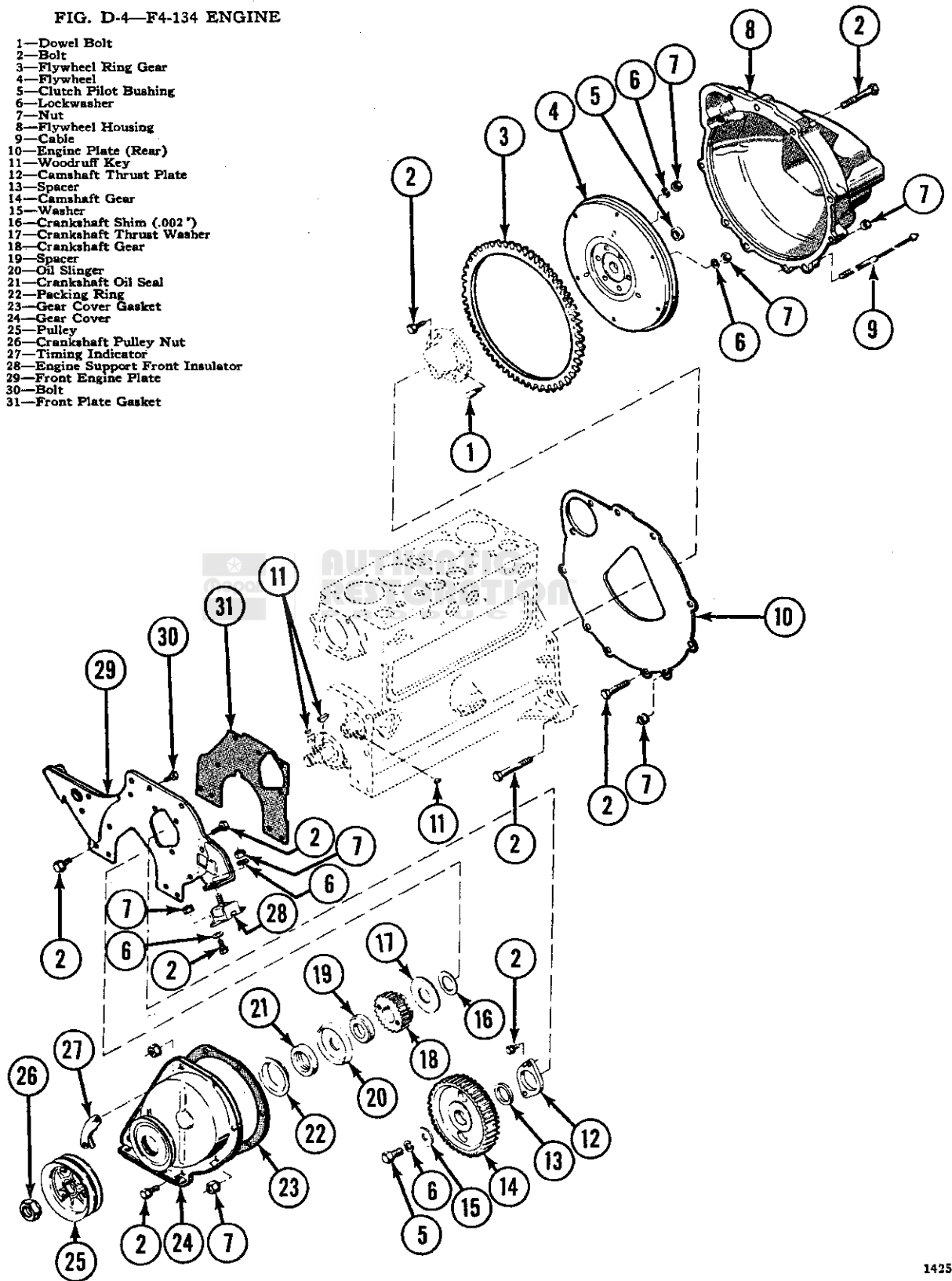
FIG. D-3—REMOVING RIDGE WITH REAMER

Remove and discard the cylinder head gasket.

b. Disassembly.

Disassemble the parts of the cylinder head as follows: With a spring compressor tool remove the two-piece locks recessed in the valve spring retainers. Pull the O-ring, valve spring, and valve out of the cylinder head. Identify the valves for return to the same guides from which they are removed.

FIG. D-4—F4-134 ENGINE



D

HURRICANE F4 ENGINE

Note: Check the condition of the rubber O-rings. Defective O-rings could be the major cause of oil leakage into cylinders. Always discard and replace all O-rings removed as only new O-rings should be installed at reassembly.

D-18. Ream Cylinder Bore Ridges

To prevent breaking the piston lands, the ridge at the top of each cylinder bore must be removed first. To remove this ridge, use a cylinder ridge reamer, as shown in Fig. D-3 following the instructions furnished by the reamer manufacturer. Use care not to cut below the top of the upper ring travel in the bore. Keep each piston top covered with an oil-soaked cloth to prevent cuttings from falling into the cylinder.

Note: This operation should be performed at this time before the engine is rotated for the sequence steps following.

D-19. Remove Oil Pan

Rotate the engine to the upside down position. Remove the screws and lockwashers that attach the oil pan to the cylinder block. Remove the oil pan and gasket. Discard the gasket.

D-20. Remove Piston and Connecting Rod Assemblies

Remove the stamped locking nuts from the lower end of each connecting rod bearing bolt. Remove the connecting rod nuts. Remove the bearing cap evenly. Push the connecting rod and piston assembly out of the cylinder block with the handle end of a hammer until the piston rings are free from the cylinder bore.

Remove the piston and connecting rod assembly from the top of the cylinder block. Reassemble the connecting rod bearing cap with the bearings in place in the rod from which it was removed. Rotate the crankshaft and follow the same procedure until all the piston and connecting rod assemblies are removed.

Pistons and connecting rod assemblies may be removed for repair with the engine in the vehicle after draining the cooling system, removing the oil pan and the cylinder head, and reaming the ridges as previously described.

D-21. Remove Timing Gear Cover

Remove the bolts, nuts, and lockwashers, that attach the timing gear cover to the engine. Remove the cover, timing pointer, and cover gasket. Discard the gasket. Remove the crankshaft oil seal from the timing gear cover and discard the seal. Remove the oil slinger and spacer from the crankshaft.

D-22. Remove Timing Gears

Use puller W-172 for pulling both the crankshaft and the camshaft gears. With the threaded cap-screws supplied, adapt the puller to the crankshaft

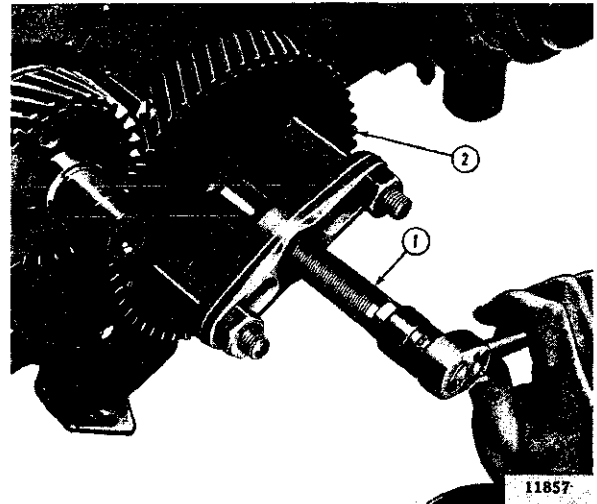


FIG. D-5—PULLING TIMING GEARS

1—Puller W-172
2—Camshaft Gear

gear and pull the gear. With the special hook-type puller bolts that fit behind the camshaft gear flange, pull the camshaft gear. Remove the Woodruff Keys.

D-23. Remove Front End Plate

Remove the screws and lockwashers that attach the front end plate to the cylinder block. Remove the front end plate and gasket. Discard the gasket.

D-24. Remove Clutch

Remove four bolts and lockwashers diagonally opposite that attach the clutch assembly to the flywheel, leaving two opposed bolts to be loosened alternately until the clutch spring pressure is relieved. Then, support the clutch assembly with one hand while removing the two remaining bolts. For information on disassembly, inspection, repair and assembly of the clutch refer to Section I. Instructions for removing the clutch when the engine is in the vehicle are also given in Section I.

D-25. Remove Flywheel

The flywheel is attached to the crankshaft with two tapered dowel bolts and four special bolts. Remove these attaching parts. Use a pry bar between the flywheel and the back of the engine and carefully loosen the flywheel from the crankshaft. If the flywheel is to be removed with the engine in the vehicle, the transmission and clutch must first be removed as detailed in Section I.

D-26. Remove Crankshaft

Slide the crankshaft thrust washer and all end-play adjusting shims off the front end of the crankshaft. Pull the two pieces of rear main bearing cap packing out of position between the side of the bearing cap and the cylinder block.

Note the marks on the bearing caps and cylinder block for bearing number and position.

Remove the screws and lockwashers that attach the main bearing caps to the cylinder block. Use a lifting bar beneath the ends of each bearing cap. Be careful not to exert too much pressure to cause damage to the cap or dowels and pry the caps free.

CAUTION: If main bearing caps are not removed carefully by raising both sides of each cap evenly until free of the dowels, the dowels may be bent. A bent main bearing cap dowel can cause misalignment of the cap and resultant rapid bearing wear necessitating replacement. Therefore, remove each main bearing cap carefully. If there is reason to believe any of the dowels have been bent during the bearing cap removal, remove them and install new dowels as detailed in Par. D-34c.

Remove the upper half of the rear main bearing oil seal from the cylinder block and the lower half from the oil seal groove in the rear main bearing cap. Install the main bearing caps and bearings on the cylinder block in their original positions.

Note: Removal of the crankshaft may be accomplished only with the engine out of the vehicle.

D-27. Remove Exhaust Valves and Springs

Access to the valve chamber is obtained by removing the attaching parts and the valve spring cover and gasket from the cylinder block. Use cloths to block off the three holes in the exhaust valve chamber to prevent the valve retaining locks falling into the crankcase, should they be accidentally dropped.

With a valve spring compressor, compress the valve springs on those valves which are in the closed position (valve seated against cylinder block). Remove the exhaust valve spring retainer locks, the exhaust valve spring retainer, and the exhaust valve spring. Close the other valves by rotating the camshaft and repeat the above operation for the other valves in the same manner. Lift out all the exhaust valves and tag or place them in a rack to indicate the location where each was removed from the cylinder block. If a valve sticks in the guide and cannot be easily lifted out, pull the valve upward as far as possible and remove the spring. Lower the valve and remove any carbon deposits from the valve stem. This will permit removal of the valve.

For intake valve and spring removal, see Par. D-17.

D-28. Remove Camshaft

- a. Push the intake and exhaust valve tappets into the cylinder block as far as possible so the ends of the tappets are not in contact with the camshaft.
- b. Secure each tappet in the raised position by installing a common clip-type clothes pin on the shank of each tappet or tie them up in the valve chamber.
- c. Remove the camshaft thrust plate attaching screws. Remove the camshaft thrust plate and spacer.
- d. Pull the camshaft forward out of the cylinder block using care to prevent damage to the camshaft bearing surfaces.

D-29. Remove Valve Tappets

Remove the intake and exhaust valve tappets from the bottom or crankshaft side of the cylinder block after the camshaft has been removed. Tag each tappet or place them in a marked rack so they may be reassembled in their original positions.

D-30. Remove Oil Gallery Plugs

Remove the plug at each end of the oil gallery in the cylinder block. This operation is only applicable when the engine is out of the vehicle and will allow access to the oil gallery so it may be cleaned.

D-31. ENGINE INSPECTION AND REPAIR

The inspection and repair procedures detailed herein are recommended to be followed when a complete engine overhaul is to be made with the engine out of the vehicle. These instructions can generally be applied individually with the engine in the vehicle. Wherever the procedure differs due to the engine being in the vehicle, the necessary special instructions are provided. Inspection and repair instructions are included to cover the cylinder block, cylinder head, crankshaft and bearings, connecting rods and bearings, oil pump, valves and tappets, pistons and rings, flywheel, timing gears, and the camshaft and bearings. In addition, fitting operations for these engine components are included.

Important: Before the inspection and repair procedures listed below are begun, the engine serial number must be checked for the presence of code letters denoting undersize bearings or oversize pistons. Refer to Par. D-2.

D-32. Cylinder Block

The cylinder block must be thoroughly cleaned, inspected and repaired as detailed in the following paragraphs.

D-33. Cleaning

The cylinder block may be steam cleaned or cleaned with a suitable solvent. A scraper is recommended to remove hard deposits, except on highly finished surfaces. Special attention must be directed to the cleaning of the oil passages, valve chamber, crankcase, and cylinder walls to remove all sludge, dirt and carbon deposits. After cleaning, use air pressure to dry the block thoroughly.

D-34. Inspection

Examine the cylinder block for minute cracks and fractures. Rusted valve springs or evidence of rust in the valve chamber or the cylinder walls is a good indication of a possible crack in the block.

- a. Examine all machined surfaces of the cylinder block for burrs and scores. Check for cylinder block distortion by placing a straight edge along the length of the cylinder head surface of the block. With a feeler gauge, check for clearance between the straight edge and the block, particularly between adjacent cylinders. Maximum permissible out of line for service is .010" [0,254 mm.] over the full length of the block.

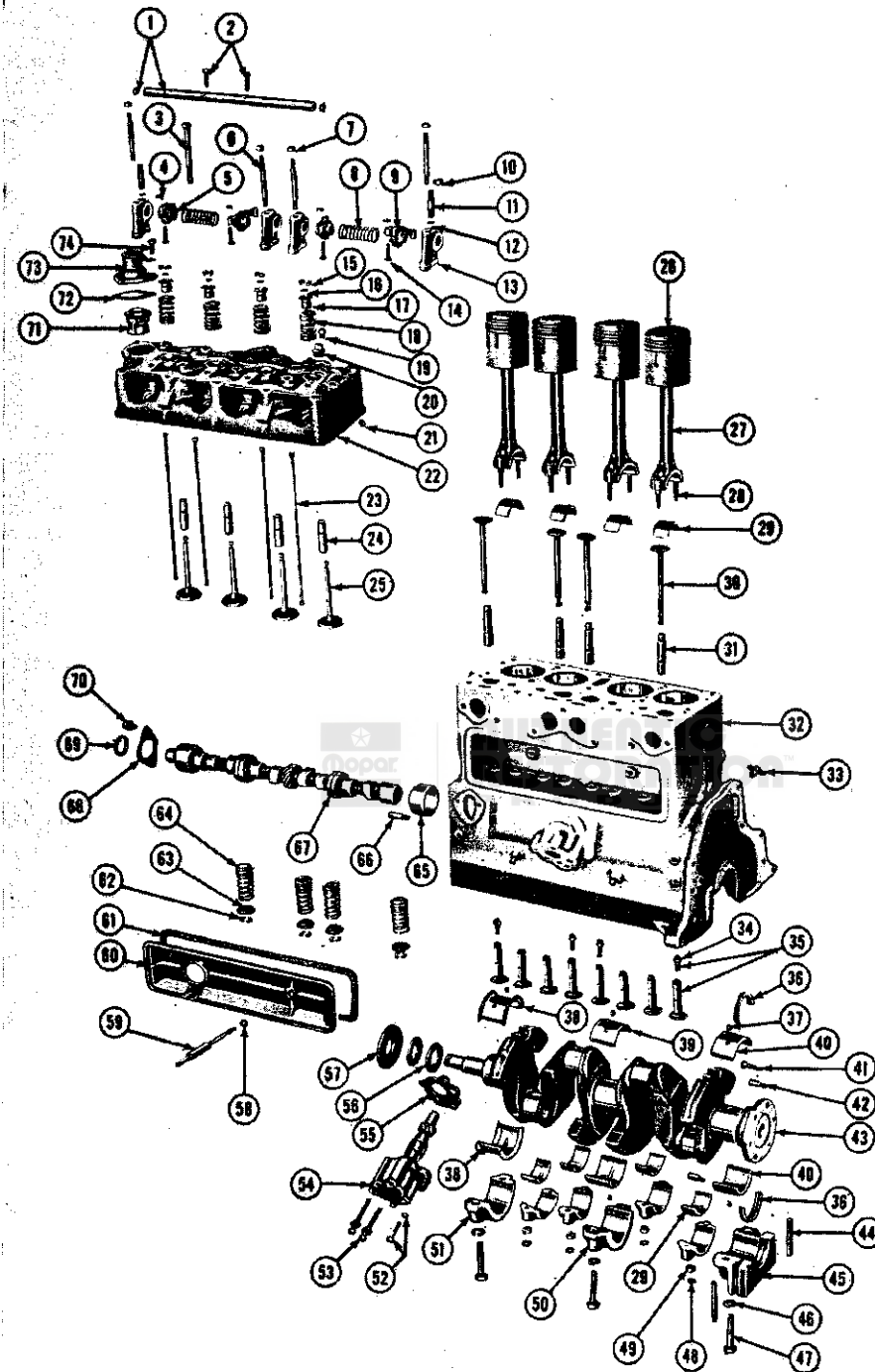


FIG. D-6—F4-134 ENGINE

- 1—Rocker Arm Shaft and Plug
- 2—Rocker Shaft Lock Screw
- 3—Cylinder Head Bolt
- 4—Nut
- 5—Left Rocker Arm
- 6—Rocker Shaft Support Stud
- 7—Nut
- 8—Rocker Arm Shaft Spring
- 9—Right Rocker Arm
- 10—Nut
- 11—Rocker Arm Cover Stud
- 12—Plain Washer
- 13—Rocker Arm Shaft Bracket
- 14—Intake Valve Tappet Adjusting Screw
- 15—Intake Valve Spring Retainer Lock
- 16—Oil Seal
- 17—Intake Valve Spring Retainer
- 18—Intake Valve Spring
- 19—Flared Tube Connector
- 20—Pipe Plug 3/4"
- 21—Pipe Plug 1/2"
- 22—Cylinder Head
- 23—Intake Valve Push Rod
- 24—Intake Valve Guide
- 25—Intake Valve
- 26—Piston
- 27—Connecting Rod
- 28—Connecting Rod Cap Bolt
- 29—Connecting Rod Bearing Set
- 30—Exhaust Valve
- 31—Exhaust Valve Guide
- 32—Cylinder Block
- 33—Cylinder Block Drain Lock
- 34—Tappet Adjusting Screw
- 35—Exhaust Valve Tappet
- 36—Crankshaft Rear Bearing Seal
- 37—Crankshaft Bearing Dowel
- 38—Front Bearing Set
- 39—Center Bearing Set
- 40—Rear Bearing Set
- 41—Bolt
- 42—Dowel
- 43—Crankshaft
- 44—Rear Bearing Cap Packing
- 45—Rear Main Bearing Cap
- 46—Lockwasher
- 47—Bolt
- 48—Lock Nut
- 49—Connecting Rod Cap Nut
- 50—Center Main Bearing Cap
- 51—Front Main Bearing Cap
- 52—Screw and Lockwasher
- 53—Screw and Lockwasher
- 54—Oil Pump
- 55—Gasket
- 56—Crankshaft Shim
- 57—Crankshaft Thrust Washer
- 58—Gasket
- 59—Stud
- 60—Exhaust Valve Spring Cover
- 61—Gasket
- 62—Valve Spring Retainer Lower Lock
- 63—Roto-Cap
- 64—Exhaust Valve Spring
- 65—Camshaft Front Bushing
- 66—Timing Gear Oil Jet
- 67—Camshaft
- 68—Camshaft Thrust Plate
- 69—Spacer
- 70—Bolt and Lockwasher
- 71—Thermostat
- 72—Gasket
- 73—Water Outlet Fitting
- 74—Screw and Lockwasher

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Inspect tapped openings. Repair any damaged threads. Replace any broken studs.

b. Check the cylinder bores for out-of-round and taper to determine if the bores require honing or reboring. For detail information refer to Par. D-35.

c. If there is any reason to believe that any of the main bearing cap dowels have been bent during bearing cap removal, install new ones. The dowels

must fit tightly to ensure cap alignment and as they are hardened they may be difficult to grip and remove. To simplify the operation, file a notch on each side of the dowel to accommodate a pair of diagonal cutters. Using a piece of bar stock under the diagonals for leverage, work the dowel out. Before installing a new dowel in the cylinder block, make sure the dowel hole is clean. Start the dowel

straight in the hole, then tap the dowel lightly with a hammer until it bottoms.

d. When installing bearing caps, be sure to tighten the bolts evenly in each cap to pull it into place without bending the dowels or distorting the bearing cap.

e. Other parts of the block which require inspection and possible repair, but which are directly related to other engine components (such as tappets, pistons, camshaft, valves, crankshaft, and oil pump) are covered later in this section.

D-35. Cylinder Bores

The cylinder bores may be reconditioned by honing or reboring. Use oil-soaked rags to protect crankshaft journals and other engine parts from abrasive dust during all reconditioning operations.

Both honing and reboring of the cylinders must be done carefully to fit the pistons and to obtain specified clearances. If reboring of the cylinder bores is not required but the walls are glazed, use a finishing hone to remove the glaze. Reboring the cylinders must not be attempted unless adequate facilities and experienced service technicians are available. The amount of material to be removed is determined from the original diameter of the cylinder bores (3.125" to 3.127") [79,375 a 79,426 mm.] plus the amount of oversize in diameter of the oversize pistons to be fitted. Pistons are available in the following oversizes.

.010" [0,254 mm.]	.030" [0,762 mm.]
.020" [0,508 mm.]	.040" [1,016 mm.]

The largest cylinder bore will determine the oversize to which all cylinders must be rebored, since the size and weight of all pistons must be uniform to maintain proper engine balance. The maximum rebore should not exceed .040" [1,016 mm.] from standard.

Measure the cylinder diameters by making measurements both parallel to and at right angles to crankshaft over entire piston travel and at bottom of cylinder. Proceed as follows:

a. If bores are scored; if out-of-round exceeds .005" [0,127 mm.]; if diameters differ more than .005"; or if taper exceeds .005" on diameter, it is generally recommended that cylinders be reconditioned by reboring and honing to the next oversize using new pistons of the proper size.

Note: If reboring is performed, allow .0015" [0,0381 mm.] for final honing. All cylinder bore diameters must be within .002" [0,0508 mm.] after reconditioning.

b. If bore measurements are within the above limits, but indicate hollows or waviness, cylinders should be honed with 250 grit stone hone. Pump hone up and down in cylinder while it is rotating to produce a satin-finish, diamond cross-hatched pattern approximately 30° with horizontal. Hone only enough to correct waviness.

c. If cylinder bore correction is unnecessary, break the glaze on cylinder walls with a 250 grit stone hone or with a suitable deglazing tool. Operate the

hone or deglazer to obtain diamond cross-hatched pattern previously mentioned.

d. Regardless of type of correction on cylinder walls, wash out bores thoroughly afterwards and apply a light coat of engine oil. If cylinders have been rebored or honed heavily, measure cylinder diameters again to assure proper selection of piston size.

D-36. Pistons, Rings, and Connecting Rods

Pistons are each fitted with three rings, two compression rings and one oil control ring. The pistons have an extra groove above the top ring which acts as a heat dam or insulating groove to protect against sealing of the top ring in the ring groove with hard carbon. The piston pin is secured by the lock screw.

The pistons and connecting rods were removed from the engine as assemblies. If cylinders were rebored, new oversized pistons and rings will have to be installed.

Disassemble the pistons and rods. Remove the two compression rings, the oil control ring, and the oil control ring expander from each piston. Do not remove the bolts from the lower end of the connecting rods unless the bolts are damaged. Clamp each connecting rod and piston assembly in a padded bench vise and remove the piston pin lock screw and lockwasher. Press the piston pin out of the piston and connecting rod. Clean all carbon, gum, and lacquer deposits from both the inner and outer surfaces of each piston, connecting rod, and piston pin. Use a ring groove cleaner or a broken ring filed to a sharp square edge to clean the carbon from the piston ring grooves and the insulator groove. Use care not to scrape metal from the sides of the grooves or make burrs on ring groove surfaces. Run a length of wire through the oil spray hole near the lower end of the connecting rod to clear the hole of hardened oil deposits or foreign matter. Carefully inspect the pistons and replace any that are broken or cracked. Replace pistons if any of the ring lands are chipped, broken, or rounded on the edges; or if the piston is scored, scratched, or burned so seriously that the imperfections cannot be removed with a hand honing stone or crocus cloth.

Replace the pistons as follows:

a. After cylinder bores have been carefully checked for out-of-round and taper (Par. D-35), check fit of each piston to cylinder bore with block and pistons clean and dry and at approximately 70°F. [21°C.] by using Piston Fitting Gauge And Scale Tool No. C-690 as shown in Fig. D-7. Use a .003" [0,0762 mm.] thickness gauge 3/4" [19 mm.] wide. The piston is fitted upside down in the block to facilitate the operation. The gauge must extend the full length of the piston on the thrust side (opposite side from slot in piston skirt). Scale should register 5 to 10 pounds [2,3 a 4,5 kg.] pull to remove the thickness gauge from between cylinder wall and piston. Excessive pull indicates need for a slightly smaller piston or additional honing of cylinder. Insufficient pull indicates need for fitting a larger piston.

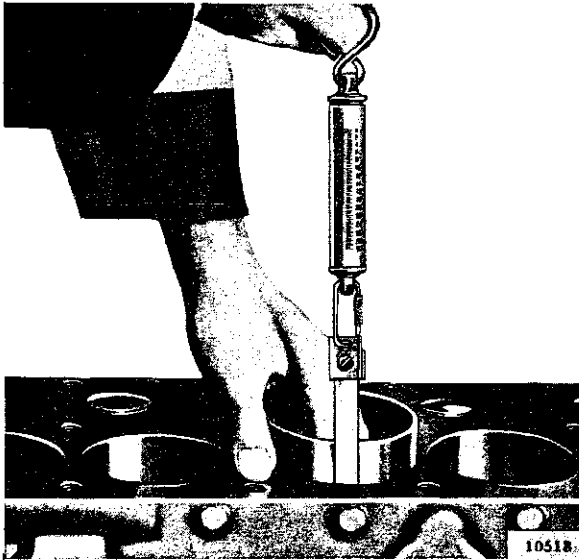


FIG. D-7—PISTON FITTING

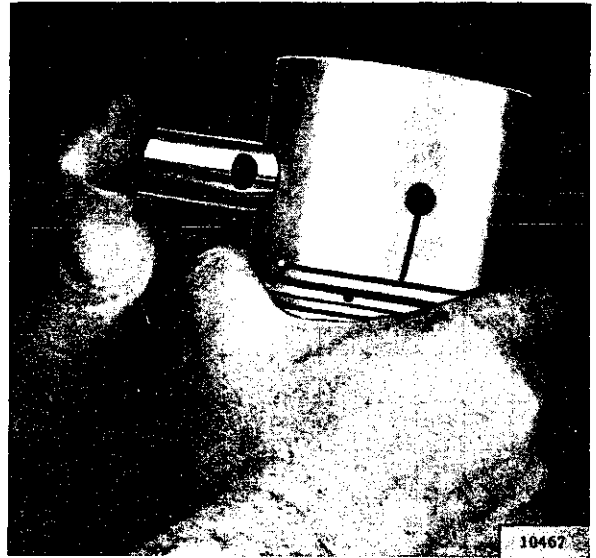


FIG. D-9—PISTON PIN FITTING

b. Check and if necessary correct connecting rod alignment using a connecting rod aligning fixture, such as the one shown in Fig. D-8, in accordance with the instructions furnished with the fixture.

c. Check the piston pin fit. The piston pins are fitted with a clearance of .0001" to .0003" [0,0025 a 0,0076 mm.] which approximates a light thumb push fit at room temperature. See Fig. D-9. The piston pins are anchored in the rods with lock screws. Installation of oversize pins in this engine is not recommended as experience has shown that should a pin be worn sufficiently to require replacement, the piston should also be replaced.

Clamp the connecting rod in a vise using jaw shields of soft metal or two pieces of hardwood, one on each side of the rod and positioned approximately 3" [76 mm.] from the piston pin end. Start

the piston pin in the piston with the lock screw groove facing down. Assemble piston to connecting rod with the piston skirt T-slot on

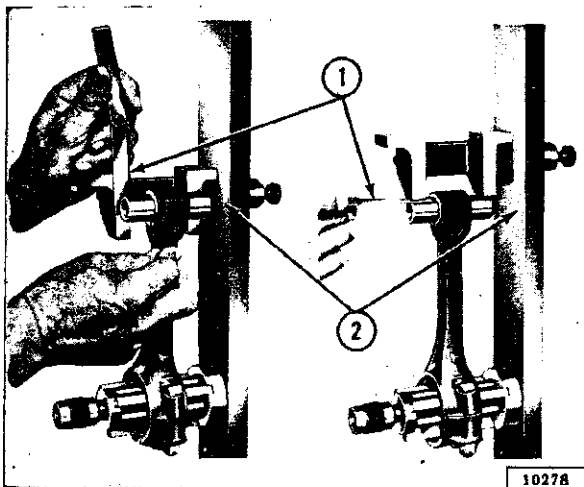


FIG. D-8—CHECKING CONNECTING ROD ALIGNMENT

1—Feeler Gauge 2—Fixture

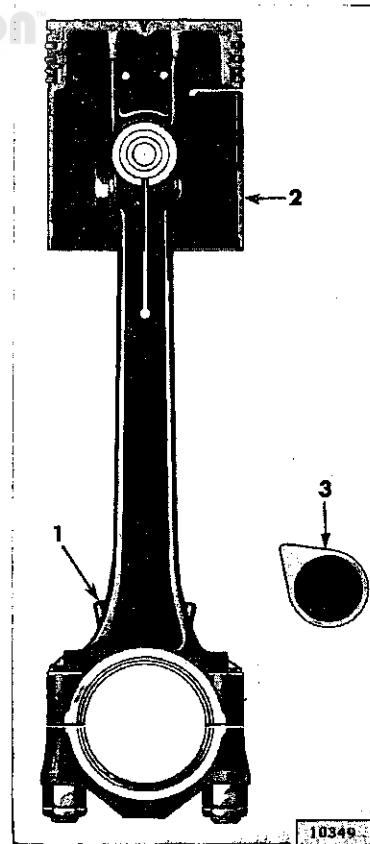


FIG. D-10—CONNECTING ROD AND PISTON

1—Oil Spray Hole
2—Piston Skirt T-slot
3—Relative Position of Camshaft

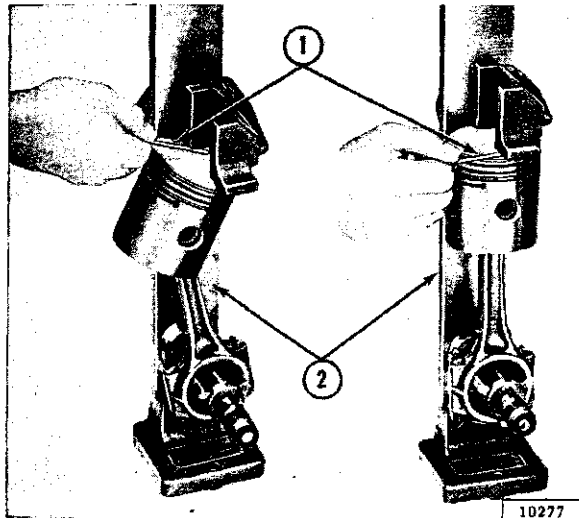


FIG. D-11—CHECKING PISTON AND CONNECTING ROD ALIGNMENT

1—Feeler Gauge
2—Fixture

the opposite side from the oil spray hole in the bearing end of the connecting rod. See Fig. D-10. Install the piston pin lock screw and torque 35 to 41 lb-ft. [4,8 a 5,7 kg-m.].

d. Place piston and rod assembly in a connecting rod aligning fixture and check alignment of the assembly as shown in Fig. D-11. Follow instructions furnished with the fixture.

e. Using a feeler gauge and new piston rings, check the width of the two compression ring grooves and the oil ring groove. Replace the piston if the widths of the grooves are not with the limits given in the specifications.

Insert feeler gauge between ring and piston to back of groove. Replace piston if ring grooves are not within allowable tolerances. If a feeler gauge larger

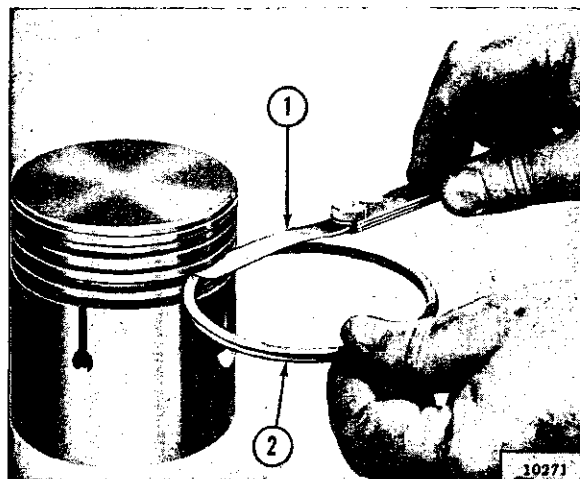


FIG. D-12—CHECKING PISTON RING SIDE CLEARANCE

1—Feeler Gauge
2—Piston Ring

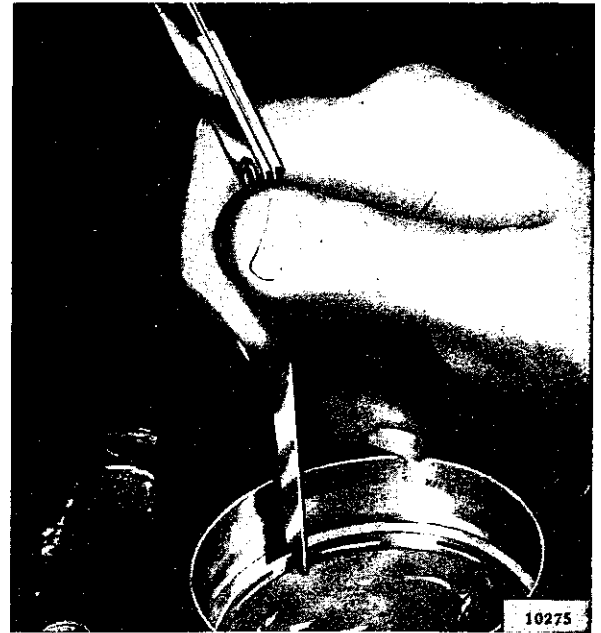


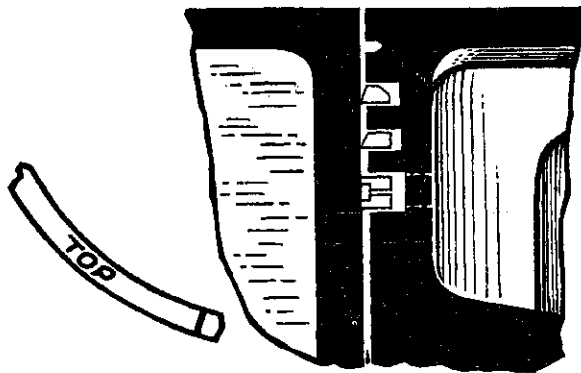
FIG. D-13—PISTON RING GAP

than .006" [0,152 mm.] can be inserted $\frac{1}{16}$ " [1,6 mm.] between piston and upper compression ring, groove is worn excessively bell-mouthed and piston should be replaced.

f. Check piston ring end gap by placing compression ring in cylinder bore below ring travel using head of an inverted piston as a plunger to push ring in squarely. End gap must be as shown in Par. D-37 for all rings. If less, file ends to obtain minimum gap. With cylinders bored to an exact ring oversize of $+.020$ ", $+.030$ ", or $+.040$ " [0,508-0,762-1,016 mm.] the proper end clearance as given in Par. D-37 will result. If end gaps are not within the limits given in Par. D-37, rings are of the wrong size or were incorrectly filed for fitting.

g. Install a new ring set using either production replacement rings or service type oil control rings. Production type replacement piston rings are the same as the original factory-installed rings while service oil control ring sets have different components, notably the oil ring expander. Follow instructions of manufacturer for proper installation. Use a piston ring expander to install rings on pistons. Do not expand rings more than necessary to install, also be careful not to burr the piston with ends of rings. Install bottom (oil) ring first, center ring second, and top ring last.

The width of the compression rings is $\frac{3}{32}$ " [2,38 mm.] and that of the oil control ring is $\frac{3}{16}$ " [4,78 mm.]. While the compression rings are of the same size, they are different in construction and must not be interchanged. Install these rings as shown in Fig. D-14. The upper compression ring has an inside beveled edge which must be installed toward the piston top. The face of the lower compression ring is tapered approximately .001" [0,025 mm.]. The letters T or TOP on the upper edge indicate how the ring is to be installed.



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FIG. D-14—PISTON RING INSTALLATION

D-37. Piston Ring Application Chart

Cylinder Bore Oversize	Correct Ring Size	Ring Gap Fitting	End Gap
Std. to .008" [a 0,228 mm.]	Std.	None	.007" to .045" [0,1778 a 1,1430 mm.]
.010" to .019" [0,254 a 0,4826 mm.]	-.020"	File fit	.007" to .017" [0,1778 a 0,4318 mm.]
.020" to .024" [0,508 a 0,6096 mm.]	-.020"	None	.007" to .028" [0,1778 a 0,7366 mm.]
.025" to .029" [0,635 a 0,7366 mm.]	-.030"	File fit	.007" to .017"
.030" to .034" [0,762 a 0,8636 mm.]	-.030"	None	.007" to .028"
.035" to .039" [0,8890 a 0,9906 mm.]	-.040"	File fit	.007" to .017"
.040" [1,016 mm.]	-.040"	None	.007" to .017"

D-38. Crankshaft

The crankshaft is machined from a heat-treated carbon steel forging and is carefully balanced both dynamically and statically. The crankshaft is supported by three replaceable main bearings. The front main bearing is flanged to take the end

thrust of the crankshaft. A flanged section on the rear of the crankshaft acts as an oil slinger. While the crankshaft is out of the engine, handle it carefully to prevent damage to the connecting rod crankpins and the main bearing journals. Refer to Fig. D-15.

D-39. Crankshaft Inspection and Repair

Clean out the drilled oil passages in the crankshaft journals with a small rifle brush making sure to get rid of all sludge or gum deposits. Blow out the passages with compressed air after cleaning. Clean the crankshaft thoroughly with a suitable cleaning solvent. Inspect the crankshaft for cracks, alignment, and condition of the crankpins and the main bearing journals. Use magnaflux equipment, if available, to check for cracks or structural flaws. Cracks, misalignment, and scored or worn journals and crankpins necessitate crankshaft repair or replacement.

Check crankshaft counterweights to be sure they are not loose.

D-40. Checking Crankshaft Alignment

To check alignment, mount the crankshaft in the cylinder block with the front and rear bearings in place but with the intermediate bearing removed. With a dial indicator mounted on the crankcase and the indicator button resting on the intermediate bearing journal, slowly rotate the crankshaft and note the reading on the indicator dial. Install the intermediate bearing and remove first the front and then the rear bearings to repeat the operation with the dial indicator, checking the front and rear bearing journals. The maximum allowable run-out is .002" [0,0508 mm.].

D-41. Checking Main Bearing Journals

An ordinary 3" [7,62 cm.] micrometer may be used. The standard journal diameter is 2.334" to 2.333"

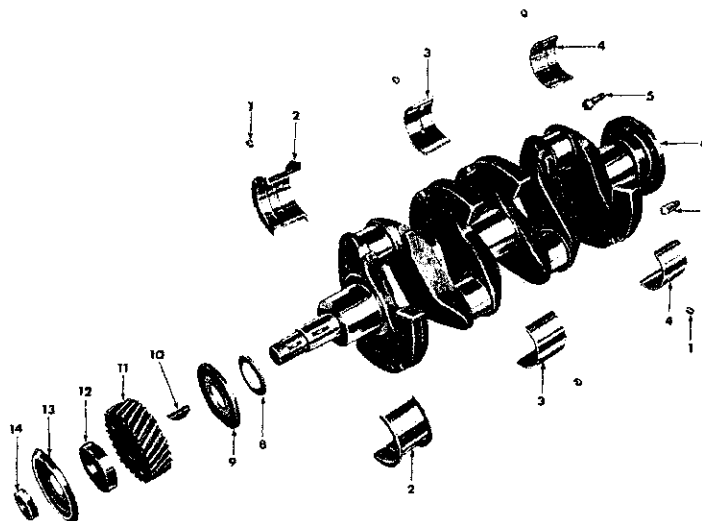


FIG. D-15—CRANKSHAFT AND BEARINGS

- 1—Bearing Dowel
- 2—Front Bearing
- 3—Center Bearing
- 4—Rear Bearing
- 5—Flywheel Bolt
- 6—Crankshaft
- 7—Flywheel Dowel-Bolt
- 8—Crankshaft Shim
- 9—Thrust Washer
- 10—Woodruff Key No. 9
- 11—Crankshaft Gear
- 12—Gear Spacer
- 13—Oil Slinger
- 14—Oil Seal

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[5,928 a 5,926 cm.] for all main bearings. Allowable taper or out-of-round of the journals is .001" [0,0254 mm.].

D-42. Checking Connecting Rod Crankpins

Check the crankpin diameters with a micrometer to ensure that they are not out-of-round or tapered more than .001" [0,0254 mm.]. The standard crankpin diameter is 1.9383" to 1.9375" [4,9233 a 4,9213 cm.].

D-43. Crankshaft Main Bearings

The crankshaft rotates on three main bearings with a running clearance of .0003" to .0029" [0,0076 a 0,0736 mm.].

These bearings are positioned and prevented from rotating in their supports in the cylinder block by dowel pins. Dowel pins are used in both the center and the rear bearing caps. No dowel pins are used in the front bearing cap because the bearing has a flange. The front main bearing takes the end thrust of the crankshaft. The main bearings are of premium type which provides long bearing life. They are replaceable and when correctly installed, provide proper clearance without filing, boring, scraping, or shimming. Crankshaft bearings can be removed from this engine only with the engine out of the vehicle. Crankshaft bearings must be replaced as a complete set of three bearings, each bearing consisting of two halves. Main bearings are available in the standard size and the following undersizes:

.001" [0,025mm.]	.012" [0,305 mm.]
.002" [0,051mm.]	.020" [0,508 mm.]
.010" [0,254mm.]	.030" [0,762 mm.]

The .001" and .002" undersize main bearings are for use with standard size crankshafts having slightly worn journals. The .010", .020", and .030" undersize bearings are for use with undersize crankshafts in those sizes. The .012" undersize bearings are for use with .010" undersize crankshafts having slightly worn journals. Bearing sizes are rubber stamped on the reverse side of each bearing half.

D-44. Crankshaft Main Bearing Inspection

The crankshaft journals must be carefully inspected as detailed previously in Par. D-41. Worn journals will require undersize bearings. Scored, flaked, or worn bearings must be replaced. Measure the main bearing bores in the cylinder block using a telescope gauge and micrometer. Measure the bores at right angles to the split line and at 45° to the split line. The bores should not be over .001" [0,0254 mm.] out-of-round or .001" in taper from end to end. Also, the bores should not be more than .001" oversize, considering the average diameter of the bore.

D-45. Fitting Crankshaft Main Bearings Using Plastigage

After wiping and carefully inspecting the bearing

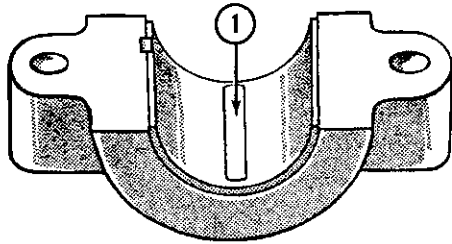
bore, install the proper bearing. See that the oil hole in the bearing upper half registers properly with the oil hole in the block, and that the bearing lock fits properly in the notch in the block. Install the crankshaft if replacing bearings with the engine out of the vehicle. The desired running fit (difference between the diameter of the crankshaft journal and the inside diameter of the fitted bearing) for a main bearing is .0003" to .0029" [0,0076 a 0,0736 mm.]. With a dimension in excess of this standard running fit, a satisfactory bearing replacement cannot be made and it will be necessary to regrind the crankshaft. Install the bearing lower half and the bearing cap and draw the nuts down equally and only slightly tight. Rotate the crankshaft by hand to be sure it turns freely without drag. Pull the nuts tighter, first one then the other, a little at a time, intermittently rotating the crankshaft by hand until the recommended torque of 35 to 45 lb-ft. [4,8 a 6,2 kg-m.] is reached. If the bearings are of the correct size, and lubricated with light oil before installation, the crankshaft should turn freely in the bearings. If the crankshaft cannot be turned, a larger bearing is required. If there is no binding or tightness, it is still necessary to check clearance to guard against too loose a fit. Never file either the bearing cap or the bearing to compensate for too much clearance. Do not use shims under a bearing cap or behind a bearing shell. Do not run a new bearing half with a worn bearing half. The use of "Plastigage" of the proper size to measure .001" [0,025 mm.] clearance is recommended for checking crankshaft main bearing clearance. The method of checking clearance is as follows:

- Remove the bearing cap and carefully wipe all oil from the bearing and the journal.
- Lay a piece of "Plastigage" $\frac{1}{8}$ " [3 mm.] shorter than the width of the bearing across the journal (lengthwise of the crankshaft).
- Install the bearing and cap and tighten first one nut, then the other, a little at a time to the specified torque. As the bearing tightens down around the journal, the "Plastigage" flattens to a width that indicates the bearing clearance.
- Remove the cap and measure the width of the flattened "Plastigage," using the scale printed on the edge of the envelope. The proper size "Plastigage" will accurately measure clearance down to .001".
- If the flattened "Plastigage" tapers toward the middle, or toward the end, or both ends, there is a difference in clearance, indicating a taper, a low spot, or other irregularity of the bearing or journal.

D-46. Fitting Crankshaft Main Bearings Using Shim Stock

Thin feeler or shim stock may be used instead of "Plastigage" to check bearing clearances. The method is simple, but care must be taken to protect the bearing metal surface from injury by too much pressure against the feeler stock.

- Cut a piece of .001" [0,025 mm.] thick, by $\frac{1}{2}$ " [12,7 mm.] wide, feeler stock $\frac{1}{8}$ " [3 mm.] shorter than the width of the bearing. Coat this



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FIG. D-16—SHIM STOCK IN POSITION ON MAIN BEARING

1—.001" Feeler Stock 1/2" Wide

feeler stock with light engine oil and lay it on the bearing in the cap, as shown in Fig. D-16. With the shim in this position, install the bearing and cap on the crankshaft.

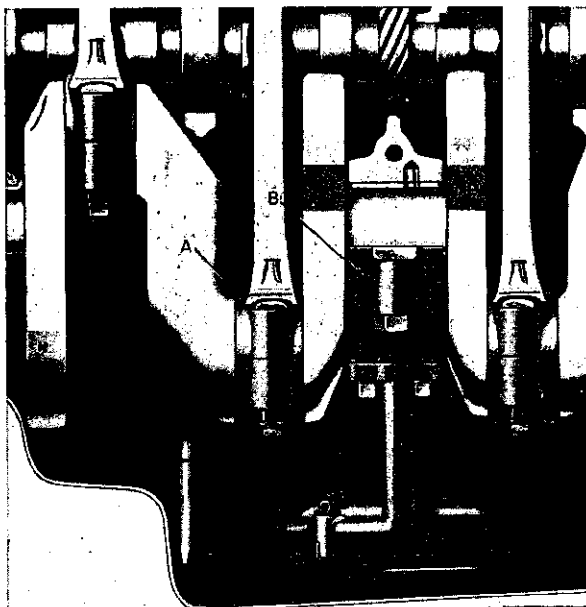
b. Tighten the bearing cap nuts, first one and then the other, a little at a time to 35 to 45 lb-ft. torque [4,8 a 6,2 kg-m.].

c. Turn the crankshaft by hand not more than one inch in either direction.

Caution: Turning the crankshaft more may imbed the shim stock in the bearing, giving a false indication of fit and damaging the bearing.

If the bearing clearance is correct, the piece of .001" feeler stock should produce a light to heavy drag. If there is little or no drag the bearing fit is too loose. If the crankshaft will not turn there is not enough clearance. In either case another bearing must be selected to provide the proper fit.

d. After the bearing has been correctly fitted, remove the shim stock, wipe the bearing and journal carefully and apply clean engine oil to the surfaces. Replace the cap and tighten the nuts first one, then the other, a little at a time, to the prescribed torque. The crankshaft should now turn freely without drag.



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FIG. D-17—CONNECTING ROD OFFSET

D-47. Connecting Rod Bearings

The connecting rod bearings, like the crankshaft main bearings, are of the replaceable type. When correctly installed, the bearings provide proper clearance without filing, boring, scraping, or shimming.

Main bearings with maximum wearing surfaces are obtained through the use of offset connecting rods. When the rods are installed, the offset "A" in Fig. D-17 is placed away from the nearest main bearing "B".

The oil spray hole should be on the "follow" side or away from the camshaft, toward the right side of the vehicle. Because of the offset and oil spray hole, No. 1 and 2 or No. 3 and 4 connecting rods cannot be interchanged for if they are reversed, the oil spray hole will be on the wrong side. No. 1 and 3 or No. 2 and 4 can be interchanged.

Connecting rod bearings should be replaced as a complete set. Each bearing consists of two halves. Connecting rod bearing sets are available in standard size and the following undersize:

.001" [0,025 mm.]	.012" [0,305 mm.]
.002" [0,051 mm.]	.020" [0,508 mm.]
.010" [0,254 mm.]	.030" [0,762 mm.]

The .001" and .002" undersize bearings are for use with standard size crankshafts having slightly worn crankpins that do not require grinding. The .012" undersize bearings are for use with slightly worn crankshafts that have been previously ground for .010" undersize bearings.

Should it be necessary to replace the bearings due to wear, replacement of piston rings and piston pins is also recommended.

NOTE: Should it be necessary to replace a scored or burned No. 1 connecting rod bearing, see Par. D-92 regarding timing gear oil jet.

D-48. Connecting Rod Bearing Inspection

The bearing fits may be roughly checked by shaking the connecting rod by hand, prior to removal of the bearing cap, to determine if it is loose on the crankshaft. The crankpins must be carefully inspected as detailed previously in Par. D-41. Worn crankpins will require undersize bearings. Scored, flaked, or worn bearings must be replaced.

D-49. Installing Connecting Rod Bearings

New bearings must be installed so that the oil spray hole in the upper bearing half aligns with the oil spray hole in the connecting rod. Each bearing cap must be installed to seat evenly on the connecting rod from which it was removed, and in the same position. After wiping and carefully inspecting the bearing bore in the connecting rod, install the proper bearing. Never file either the bearing cap or the bearing to compensate for too much clearance. Do not use shims under a bearing cap or behind a bearing shell. Do not run a new bearing half with a worn half.

The desired running fit (difference between the diameter of the crankpin and the inside diameter of the fitted bearing) for a connecting rod bearing is .0003" to .0025" [0,0076 a 0,0635 mm.]. With a dimension in excess of this standard running fit, a

satisfactory bearing replacement cannot be made and it will be necessary to regrind the crankshaft. Install the bearing lower half and the connecting rod cap and draw the cap bolt nuts down equally and only slightly tight. Move the connecting rod endwise, one way or the other, on the crankshaft to be sure the bearing is not tight. Pull the nuts tighter, first one then the other, a little at a time, and keep trying the fit of the rod on the crankshaft by hand until the recommended torque of 35 to 45 lb-ft. [4,8 a 6,2 kg-m.] is reached. If the bearings are of the correct size, and have been properly lubricated with light engine oil before installation, the connecting rod should be easy to slide back and forth parallel to the crankpin.

If the connecting rod is tight on the crankshaft, a larger bearing is required. If there is no binding or tightness, it is still necessary to check clearance to guard against too loose a fit. The use of "Plastigage" or shim stock of the proper size to measure .001" [0,025 mm.] clearance is recommended for checking connecting rod bearing clearances. This is the same material recommended for checking crankshaft main bearings and the method of checking is similar. Refer to Par. D-45 or D-46. Connecting rod bearings are fitted to the same clearance as the main bearings but the torque specified for connecting rod cap bolts is different.

D-50. Connecting Rod Side Play

Check the connecting rod side play with a feeler gauge as shown in Fig. D-18. The side clearance is .004" to .010" [0,101 a 0,254 mm.].

D-51. Camshaft and Bearings

The camshaft is supported at four points in the cylinder block. The front is supported in a replaceable, steel-shell, babbitt-lined bearing. The bearing is pressed into place. The other three bear-

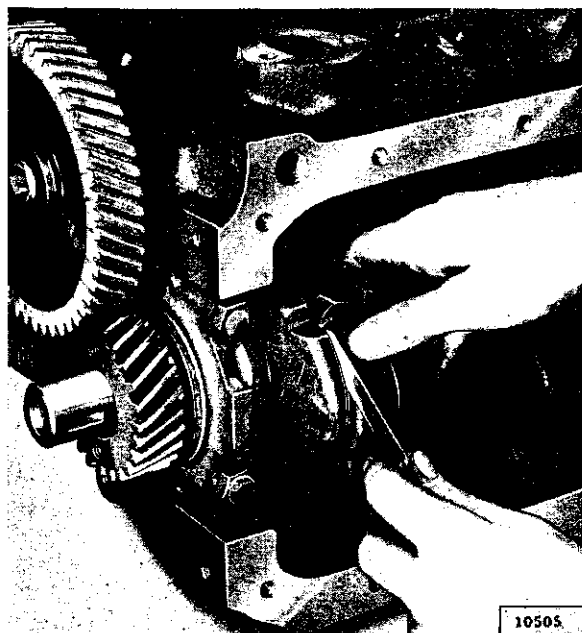


FIG. D-18—CONNECTING ROD SIDE PLAY

ing surfaces are precision machined in the cylinder block. The camshaft bearings are pressure lubricated through drilled passages in the crankcase. End thrust of the camshaft is taken by a thrust plate bolted to the crankcase. The camshaft is driven by a silent helical-cut tooth timing gear at the front of the engine. A worm gear, integral with the camshaft, drives the oil pump and distributor. The fuel pump is actuated by an eccentric forged onto the camshaft.

Clean the camshaft thoroughly in cleaning solvent. Inspect all camshaft bearing surfaces to determine if they are scored or rough. The cam faces must be perfectly smooth throughout their contact face and must not be scored or worn.

D-52. Camshaft Front Bearing Replacement

Use a suitable driver to remove the camshaft front bearing from the cylinder block. To install a new bearing, align the oil hole in the bearing with the bored oil hole in the cylinder block and drive the bearing in until the front end of the bearing is flush with the front surface of the cylinder block. Make sure the oil hole is open and clear. It is not necessary to line-ream the bearing after installation because bearings for replacement are precision reamed to the finished size. Do not stake the bearing.

D-53. Camshaft End Play

End play of the camshaft is determined by running clearance between the rear face of the camshaft gear and the thrust plate and is established by the spacer thickness. The standard clearance is .004" to .007" [0,101 a 0,178 mm.] and can be measured by a dial indicator. As a general rule this clearance will change but little through wear or when a new gear is installed. To predetermine the correct end float with the gear, spacer, and thrust plate removed, measure the thickness of both the thrust plate and spacer with a micrometer. The thickness of the spacer should be approximately .006" [0,152 mm.] greater than that of the thrust plate. When this is correct and the parts are assembled and drawn tightly together by the gear retaining screw, the end play should come within standard limits.

D-54. Timing Gears and Cover

The timing gears are mounted at the front of the engine. Camshaft drive is through helical-cut timing gears; a steel gear on the crankshaft and a pressed fiber gear on the camshaft. The gears are keyed to their respective shafts. The camshaft driven gear is secured on the front end of the camshaft by means of a capscrew and a plain washer. The crankshaft gear is secured on the front end of the crankshaft by a nut threaded onto the front end of the crankshaft holding the crankshaft pulley, crankshaft oil slinger, and the crankshaft drive gear spacer. The timing gears are lubricated through a jet threaded into the crankcase directly above the gear contact and oil supplied through a drilled passage from the front main bearing. The timing gears are enclosed by the sealed timing cover. The oil seal in the cover bears

against the hub of the crankshaft pulley. Timing gears are accessible for inspection or replacement with the engine installed in the vehicle after removing the radiator, belt drive pulley, and timing cover.

Should it be necessary to replace the timing gears, attention must be given to the end float of both the camshaft and crankshaft and to the running clearance of both gears. It is also advisable to check both the oil jet and oil passage to the crankshaft front bearing to be sure that they are clear.

D-55. Inspection and Repair

Check the general condition of both gears and inspect for evidence of excessive wear. Replace excessively worn or damaged gears. Inspect the cover and replace if bent or damaged. It is recommended that the crankshaft oil seal in the cover be replaced when the cover is removed to ensure a good seal around the crankshaft. To replace this seal with the engine in the vehicle requires removing the radiator and water pump.

D-56. Valves, Springs, and Guides

The exhaust valves seat on the top of the cylinder block with the stems extending down through replaceable valve guides. The exhaust valves are actuated by the camshaft through exhaust valve tappets. The exhaust valve springs are assembled and locked on the lower end of the exhaust valve stems. The retaining locks are the split type, which fit in a recess on the valve stems and into the taper in the valve spring retainers.

Adjustment of exhaust valves is by means of the adjusting screw threaded into the upper end of the exhaust valve tappets. An exhaust valve rotator used as a valve spring retainer is installed on the lower end of the exhaust valve. This valve rotator, known as "Roto Cap", is a spring-loaded ball bearing device. On each lift, or opening stroke of a valve, the rotator gives the valve a slight positive clockwise rotation.

The intake valves operate in valve guides in the cylinder head and are actuated by rocker arms. The rocker arms are actuated by valve push rods and the intake valve tappets. The intake valve springs, the intake valve spring retainers, and the intake valve spring retainer locks make up the remainder of the valve operating parts. An intake valve spring retainer oil seal which encircles the upper end of the intake valve between the valve locks and the upper end of the valve spring retainer, controls the passage of oil along the valve stem and guide.

Note: When engine trouble indicates defective valves as a possible source of trouble, also check all vacuum line connections for possible leaks.

D-57. Inspection of Valves, Springs, and Guides

Clean the valves on a wire wheel, making sure that all carbon is removed from the top and the underside of the heads and that all gum and varnish deposits are removed from the stems.

Polish the valve stems with steel wool or crocus cloth. Visually inspect all valves for warpage, cracks, or excessive burning and discard if one of these conditions exists. Replace any worn, pitted, or corroded valves that cannot be cleaned with a wire brush. Replace any valves when seats are pitted, burned, or corroded so badly that they cannot be cleaned up with a light refacing on a valve refacing machine.

Replace valves with marks of scoring or abrasion visible on the stem. Replace any valves with bent stems which will be apparent when the valve is mounted in the valve refacing machine.

Note: Use only hard-face exhaust valves for replacement.

Examine the stems of valves which employ the ball bearing rotators. Wear marks around the circumference of the stems indicates that the valve is rotating satisfactorily. Vertical heavy pressure areas indicate that the valve is not rotating and the valve spring retainer (Roto Cap) should be replaced if at fault. Check the diameter of the valve stem at two or three places along the length of the stem with a micrometer. The intake valve stem diameter is .3733" to .3738" [9,482 a 9,495 mm.]. The exhaust valve stem diameter is .371" to .372" [9,423 a 9,449 mm.].

Note: Exhaust and intake valve springs are similar in appearance. They must not be interchanged as they have different spring characteristics.

Wash the valve springs thoroughly in solvent. Visually examine the springs and replace any that are deformed or obviously damaged. Examine for corrosion from moisture or acid etching which might

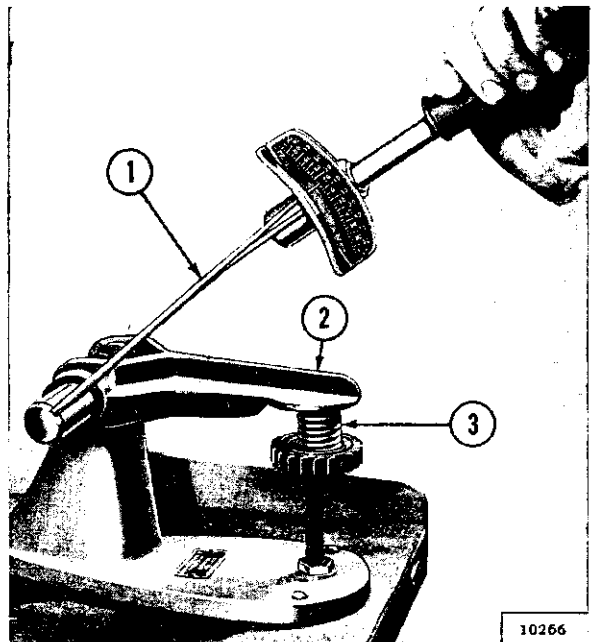


FIG. D-19—TESTING VALVE SPRING

1—Torque Wrench
2—Spring Testing Fixture
3—Valve Spring

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develop into surface cracks and cause failure. Measure the over all free length of the springs and replace any that do not measure to standard: $1\frac{3}{32}$ " [35,7 mm.] for intake valve springs and $2\frac{1}{2}$ " [63,5 mm.] for exhaust valve springs. If possible, check each valve spring in a valve spring testing fixture C-647 or equivalent as shown in Fig. D-19. Test each spring when compressed to the two different spring lengths given (representing valve closed and valve open spring length). If any spring fails to register spring tension equal to or greater than the minimum load limit in pounds specified for that spring length, replace the spring.

	Length	Minimum Load
Intake valve spring . . .	1.660" [4,216 cm.]	66 lb. [29,9 kg.]
	1.400" [3,556 cm.]	140 lb. [63,5 kg.]
Exhaust valve spring . . .	2.109" [5,356 cm.]	47 lb. [21,3 kg.]
	1.750" [4,445 cm.]	110 lb. [49,9 kg.]

Note: When using a spring checking fixture C-647 or equivalent as shown in Fig. D-19, it is necessary to convert the torque wrench reading which is in pounds-feet to the static pound pressure specified above according to the instructions furnished with the wrench. For example, should the torque wrench reading be 50 lb.-ft. and the wrench is two feet long the static pressure of the spring will be 50 x 2 or 100 lbs.

Clean the valve guides with a standard valve guide cleaner or a wire brush. Check the valve guides in the cylinder block. Replace valve guides which are broken or worn enough to cause excessive valve stem-to-guide clearance. See Par. D-61. Standard intake valve clearance is .0007" to .0022" [0,0178 a 0,0559 mm.] and the exhaust valve clearance is .0025" to .0045" [0,0635 a 0,1143 mm.]. Excessive clearance between the valve stems and guides will cause improper seating and burned valves. When there is a tendency to draw oil vapor through the guide causing excessive oil consump-

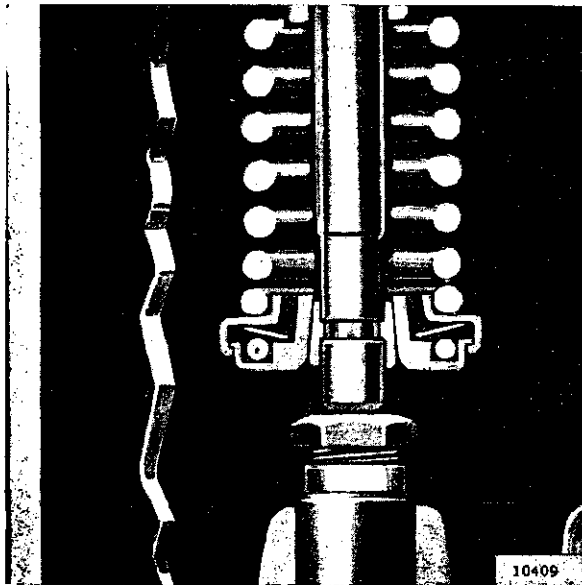


FIG. D-20—VALVE WITH ROTO CAP

tion, fouled spark plugs, and poor low-speed performance. To check the clearance of the valve stem to the valve guide, take a new valve and place in each valve guide. Check the clearance with a suitably mounted dial indicator or feel the clearance by moving the valve stem back and forth. If this check shows excessive clearance it will be necessary to replace the valve guide.

D-58. Refacing Valves

Reface the valves with a valve refacer. The valve refacer manufacturer's instructions should be followed carefully to ensure a valve face concentric with the valve stem. Reface both intake and exhaust valves to an angle of 46°. Take off only the minimum of metal required to clean up the valve faces.

If the thickness of the edge of the valve head is reduced to less than $\frac{1}{32}$ " [0,8 mm.] replace the valve.

Note: Cocked or deformed valve springs or improperly installed or missing locks can be responsible for valve problems.

D-59. Valve Seat Inspection and Refacing

Inspect the valve seats for cracks, burns, pitting, ridges, or improper angle. During any general engine overhaul it is advisable to reface the valve seats in both the cylinder block and head regardless of their condition. If the valve guides are to be replaced, this must be done before refacing the valve seats. Note that later engines have hardened exhaust valve seat inserts.

Valve seat inserts must be concentric with finish ream of valve stem guides (exhaust) within .002" [0,051 mm.] total indicator reading.

When necessary to reface the valve seats, use a valve seat grinder in accordance with the grinder manufacturer's instructions. Any grinding of valve seats should be preceded by touching up the grinding stone so that their angles are accurate and the stone is not clogged. Grind each valve seat to a true 45° angle. Never grind any more than is necessary to clean up pits, grooves, or to correct the valve seat runoff. Check the valve seats with

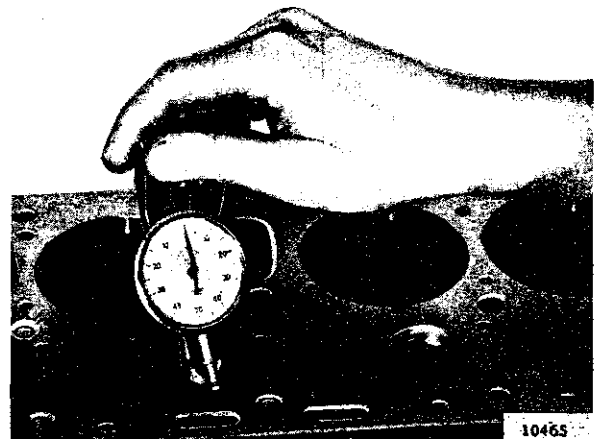


FIG. D-21—GAUGING VALVE SEATS

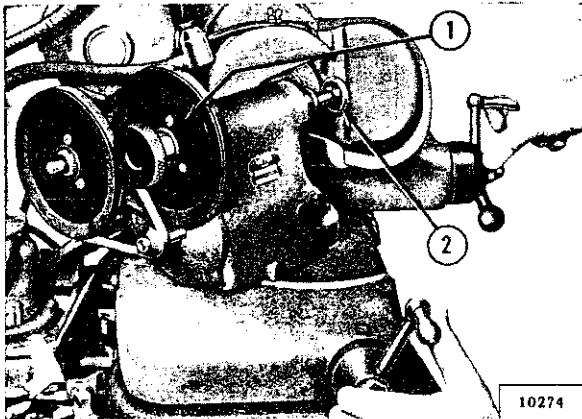


FIG. D-22—REFACING VALVES

1—Valve Refacer
2—Valve

a dial indicator as shown in Fig. D-21 after refacing. The valve seat should not be out of round more than .002" [0,051 mm.]. A simple check can be made in the absence of a dial indicator by spreading a thin coat of pencil lead or bearing-fitting blue on the valve face and then inserting the valve into the valve seat. With hand pressure, rotate the valve a quarter turn and then remove the valve and observe the transfer of blue (or pencil lead) to the valve seat. An uneven transfer will indicate an inaccurate valve and valve seat refacing operation. After the seat is ground, check its width with a seat width scale or a steel scale placed across the face of the seat. The valve seat width after refacing should measure $\frac{3}{32}$ " [2,3 mm.] and not wider than $\frac{1}{8}$ " [3,2 mm.]. Valve seat width is vital. Too wide a seat can cause seat burning as it tends to trap and hold carbon particles. Seats that are too narrow will not transfer heat to the coolant rapidly enough to keep the valves in proper operating condition. When a valve seat has been refaced several times or where it must be cut deeply for adequate reconditioning, the seat may become too wide for efficient operation. Narrow the seat without changing its position in relation to the valve face by using a valve seat relief counterbore above the seat and a valve seat narrowing cutter below the seat. These operations are performed only after the valve seats have been refaced and then only when necessary. The finished valve seat should contact the approximate center of the valve face. Check by applying an extremely thin coat of pencil lead or bearing-fitting blue to the seat. Then install and rotate the valve with light pressure. Blue (or pencil marks) will transfer to the face of the valve. If the blue is near the top edge of the valve face, lower the valve seat by using the valve seat relief counterbore. If the blue is transferred to the bottom edge of the valve face, raise the seat by using the valve seat narrowing cutter.

When the valve seat can no longer be corrected, it is advisable to investigate installing seat inserts.

D-60. Exhaust Valve Seat Insert Replacement

Hardened valve seat inserts for exhaust valves will seldom require replacement. To avoid damaging

the block, remove an insert with a tool designed for this purpose.

When installing a new insert, make certain the counterbore is clean and smooth. Use a driver that will keep the insert in true alignment with the bore. Cool the insert and the installing tool with dry ice for 30 minutes.

Note: The insert should be sufficiently cooled to permit installation with light taps; excessive driving of the insert may cock it in the counterbore or crack the insert.

Make certain the valve seat is facing out. Drive in the insert with the tool until it bottoms in the counterbore. After installation, grind the valve seat at an angle of 45° and then check with a dial indicator as shown in Fig. D-21.

D-61. Valve Guide Replacement

Damaged, loose, or worn valve guides must be replaced. Use valve guide driver W-238 or equivalent to drive out the old guides. When replacing valve guides, maximum engine performance can be secured only when the guide is positioned correctly.

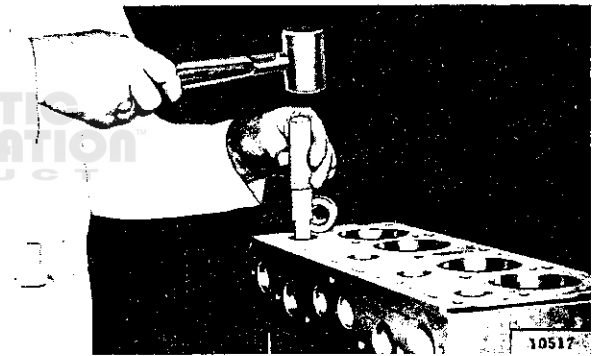


FIG. D-23—VALVE GUIDE DRIVER

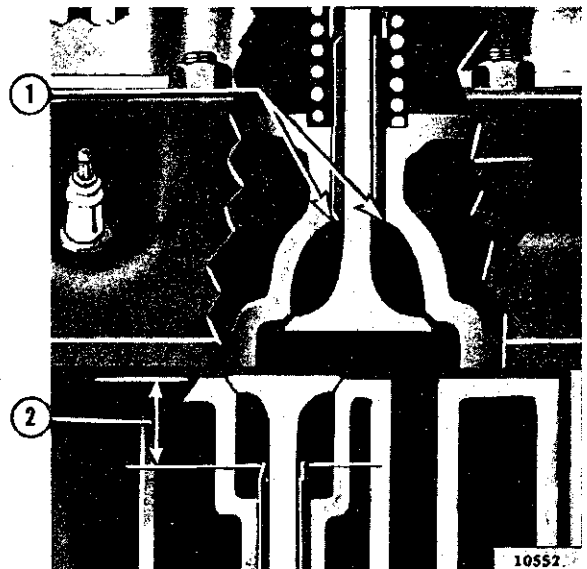


FIG. D-24—VALVE GUIDE POSITIONS

1—Flush at this point

2—One Inch [25 mm.]

Driver W-238 is equipped with an adapter ring which correctly positions the guides. See Fig. D-23. Start a new exhaust valve guide, blunt (nontapered) end first, into the valve guide bore in the top of the cylinder block. When properly positioned, the top end of the guide is exactly 1" [25,4 mm.] below the level of the top of the block as shown in Fig. D-24. Start a new intake valve guide, tapered end first, into position from the bottom of the cylinder head. When properly positioned, the end of the guide is just flush with the end of the valve guide bore in the cylinder head as shown in Fig. D-24. Run a reamer (Tool C-38) through the new guides after they have been correctly positioned.

D-62. Tappets and Cover

The valve tappets are lubricated through oil troughs cast in the crankcase. The troughs are filled by oil sprayed from the connecting rod ends and passages are drilled through the tappet guides to carry the oil to the tappets. A groove around the center of the tappet shank carries the oil up and down the guide.

Check the threads and fit of the exhaust valve adjusting screw in the exhaust valve tappets. The fit of a screw should be such that a wrench is required to turn it into or out of the tappet as these are of the self-locking type. Replace the worn part, either the screw or the tappet, or both, if there is looseness between the parts.

D-63. Crankshaft Rear Bearing Seal

Oil leakage through the rear main bearing is prevented by a metal supported neoprene lip type seal which can readily be installed without removing the crankshaft.

Should trouble be experienced with oil leaking from the rear main bearing there are several points which should be checked.

- a. Be sure that the identifying paint daub on the bearing cap is the same as that appearing on the center bearing web.
- b. The bearing to crankshaft clearance must not exceed .0029" [0,0736 mm.].
- c. Place sealer on the faces of the rear bearing cap from the rear oil groove to the oil seal grooves.
- d. Be sure the rubber oil seals extend about $\frac{1}{4}$ " [6 mm.] below the bottom face of the cap.
- e. Be sure the oil pan gasket is not leaking.
- f. Check to be sure the oil leak is not at the camshaft rear bearing expansion plug or from the crankcase.

D-64. Floating Oil Intake

- Refer to Fig. D-25 and D-26.

The floating oil intake is attached to the bottom of the crankcase with two screws. The float and screen causes it to ride, raise and lower with the amount of oil in the pan. This prevents water or dirt, which may have accumulated in the bottom of the oil pan, from circulating through the engine because the oil is drawn horizontally from the top surface. Whenever removed, the float, screen, and tube should be cleaned thoroughly to remove any

accumulation of dirt. Also clean the oil pan. Fluctuating oil pressure can usually be traced to an air leak between the oil float support and the crankcase.

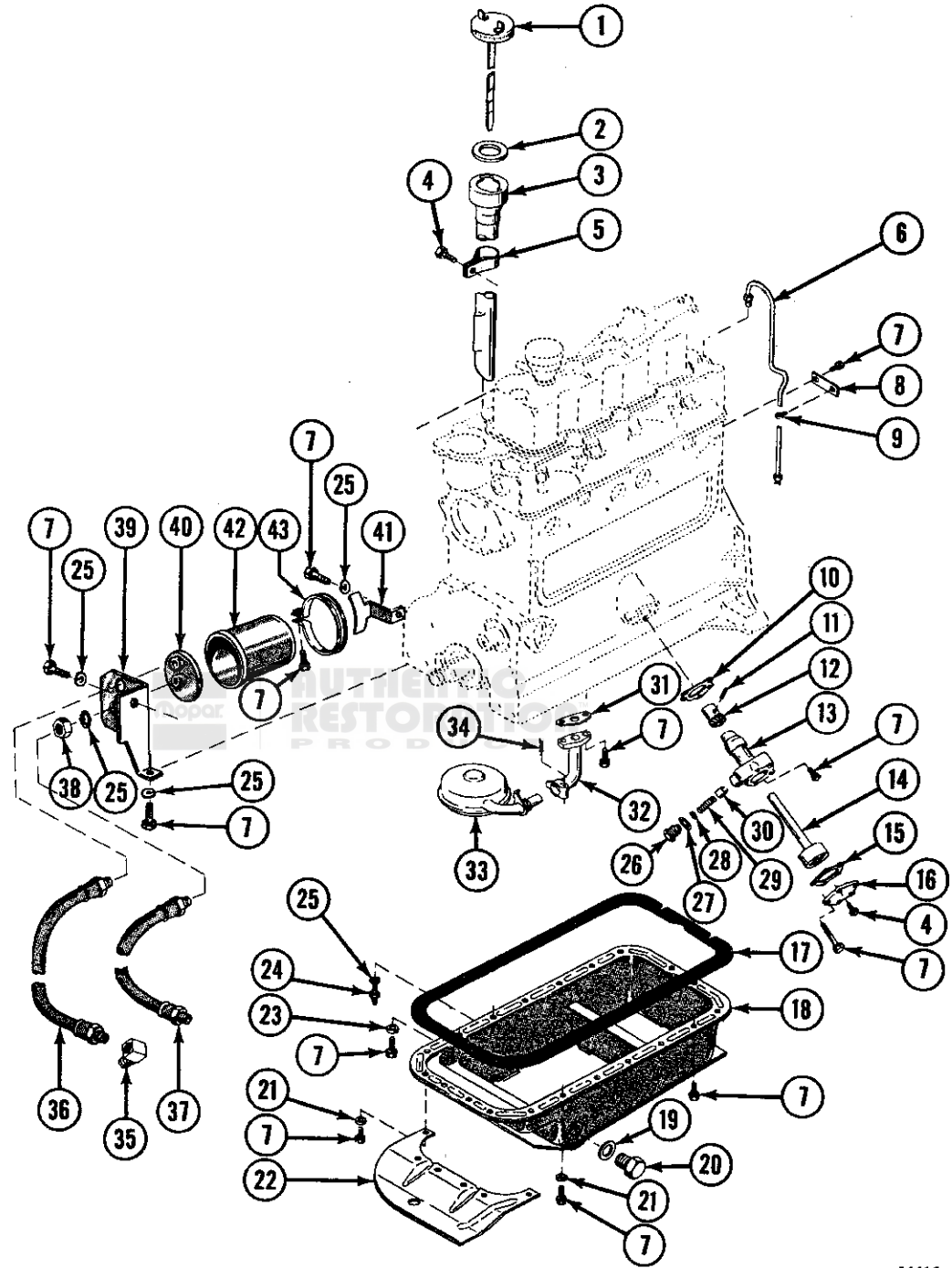
Be sure the float support flange is flat. Clean both the flange and the crankcase surfaces thoroughly before installing a new gasket. Be sure the retaining screws are tight.

D-65. Oil Pump

The oil pump is located externally on the left side of the engine. In operation oil is drawn from the crankcase through the floating oil intake then passes through a drilled passage in the crankcase to the pump from which it is forced through drilled passages to the crankshaft and camshaft bearings. When it is necessary to remove an oil pump, first remove the distributor cover and note the position of the distributor rotor so that the pump may be reinstalled without disturbing the ignition timing. To install the pump without disturbing the timing, the pump gear must be correctly meshed with the camshaft driving gear to allow engagement of the key on the distributor shaft with the pump shaft slot, without changing the position of the distributor rotor. Distributor can be installed only in one position as the slot and driving key are machined off-center.

The oil pump consists of an inner and outer rotor within the pump body. An oil relief valve is mounted in the pump body which controls the oil pressure. To disassemble the pump, Fig. D-27, first remove the gear which is retained by straight pin. It will be necessary to file off one end of the pin before driving it out with a small drift. By removing the cover the outer rotor and the inner rotor and shaft may be removed through the cover opening. Failure of the pump to operate at full efficiency may usually be traced to excessive end float of the rotors or excessive clearance between the rotors. The clearance between the outer rotor and the pump body should also be checked. Match the rotors together with one lobe of the inner rotor pushed as far as possible into the notch of the outer rotor. Measure the clearance between the lobes of the rotors as shown in Fig. D-28. This clearance should be .010" [0,254 mm.] or less.

If more, replace both rotors. Measure the clearance between the outer rotor and the pump body as shown in Fig. D-29. Should this clearance exceed .012" [0,305 mm.] the fault is probably in the pump body and it should be replaced. End float of the rotors is controlled by the thickness of the cover gasket which is made of special material that can be only slightly compressed. Never use other than a standard factory gasket. Check the cover to be sure the inner surface is not rough or scored and that it is flat within .001" [0,025 mm.] tested with feeler gauges, Fig. D-30. Measure thickness of the rotors which must be within .001" [0,025 mm.] of each other. Assemble the rotors in the pump body and install the cover without the gasket. When the cover screws are tightened to normal tension, there should be interference between the rotors and the cover making it impossible to turn the pump shaft by hand. Remove the cover and re-



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FIG. D-25 — OIL FILTER, OIL PAN, OIL PUMP AND LINES

- | | | |
|---|------------------------------|-----------------------------|
| 1—Oil Filler Cap | 15—Cover Gasket | 30—Plunger |
| 2—Gasket | 16—Cover (Oil Pump) | 31—Gasket |
| 3—Oil Filler Tube | 17—Oil Pan Gasket | 32—Oil Float Support |
| 4—Bolt | 18—Oil Pan | 33—Oil Float Assy. |
| 5—Bracket | 19—Drain Plug Gasket | 34—Cotter Pin |
| 6—Oil Line (Crankcase to Cylinder Head) | 20—Oil Pan Drain Plug | 35—Elbow Fitting |
| 7—Screw | 21—Lockwasher | 36—Oil Filter Tube (Inlet) |
| 8—Oil Line Bracket | 22—Fan Pulley Shield | 37—Oil Filter Tube (Outlet) |
| 9—Fastener | 23—Spacer | 38—Jam Nut |
| 10—Gasket | 24—Stud (Oil Filter Bracket) | 39—Bracket |
| 11—Pin | 25—Lockwasher | 40—Oil Filter Base |
| 12—Driven Gear (Oil Pump) | 26—Retainer | 41—Oil Filter Assy. |
| 13—Oil Pump | 27—Gasket | 42—Oil Filter Assy. |
| 14—Shaft and Rotors | 28—Shim | 43—Clamp |
| | 29—Spring | |

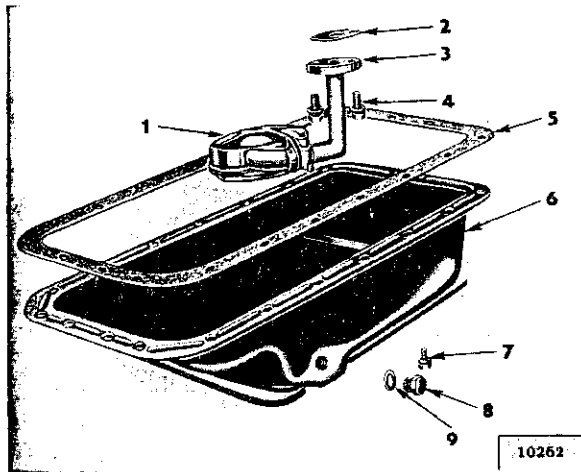


FIG. D-26—FLOATING OIL INTAKE AND PAN

- 1—Oil Float
- 2—Gasket
- 3—Oil Float Support
- 4—Screw and Lockwasher
- 5—Oil Pan Gasket
- 6—Oil Pan
- 7—Bolt and Lockwasher
- 8—Drain Plug
- 9—Drain Plug Gasket

place it with the gasket in position. The rotors should then rotate freely, providing that end float of the rotors is less than the thickness of the gasket when compressed or .004" [0,102 mm.]. After assembling the gear on the pump shaft, check the running clearance between the gear and pump body with a feeler gauge. This clearance should be from .022" to .051" [0,559 a 1,295 mm.]. Pump output is controlled by a pressure relief valve.

CAUTION: The oil pressure relief spring is calibrated. Never stretch this spring to alter the relief valve pressure setting. Adjust this setting by the

use of shims only. Shims are available that can be added between the retainer and the spring to increase pressure. When shims are present, removing shims will decrease pressure.

This adjustment will change the pressure at higher speeds but not at idle speed. Safe minimum pressure is 6 psi. [0,4 kg-cm²] at idle, at which point the oil pressure light goes out; and 20 psi. [1,4 kg-cm²] at 2000 rpm. (32 mph. [51 kph.]).

D-66. Oil Pan

Examine the oil pan carefully for evidence of corrosion, dents, or other damage. Special attention should be given to the mounting flange to be sure of proper alignment and a tight seal at the cylinder block, oil pan, and engine front plate. Whenever the oil pan is removed, it is best to install a new oil pan gasket.

D-67. Flywheel

The flywheel is mounted on the rear flange of the crankshaft. The crankshaft, flywheel, and clutch assembly are statically and dynamically balanced separately and as a unit; therefore, these components should be assembled in their original relative positions to maintain this balance.

D-68. Flywheel Inspection

Clean the flywheel thoroughly with cleaning solvent. Inspect the clutch face of the flywheel for a burned or scuffed condition or rivet grooves. Check the flywheel for run-out or improper mounting according to the installation procedure given in Par. D-87.

If the inner ends of the flywheel ring gear teeth are only slightly burred or snubbed, remove the burrs and reshape the teeth using a small emery wheel.

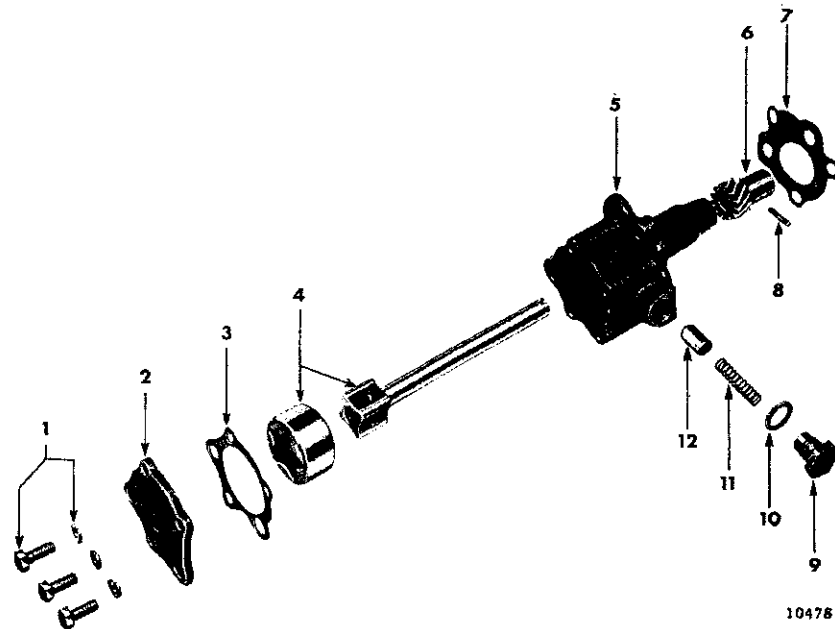


FIG. D-27—OIL PUMP

- 1—Cover Screw
- 2—Cover
- 3—Cover Gasket
- 4—Shaft and Rotors
- 5—Body Assembly
- 6—Driven Gear
- 7—Pump Gasket
- 8—Gear Retaining Pin
- 9—Relief Valve Retainer
- 10—Relief Valve Retainer Gasket
- 11—Relief Valve Spring
- 12—Relief Valve Plunger

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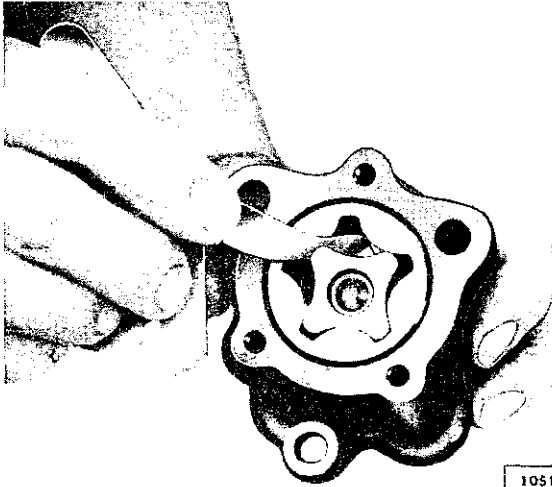


FIG. D-28—CHECKING OIL PUMP ROTORS

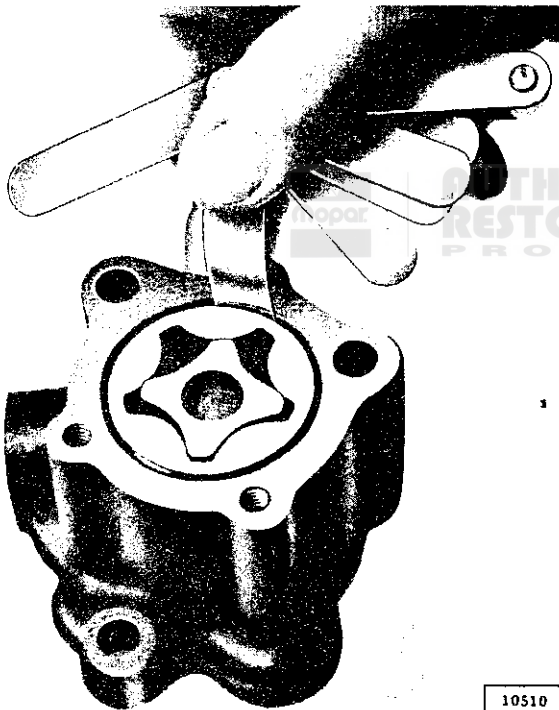


FIG. D-29—CHECKING OUTER ROTOR TO OIL PUMP BODY

If, however, the teeth are broken, cracked, or seriously burred, the ring gear should be replaced.

D-69. Ring Gear Replacement

The ring gear is secured on the flywheel by a shrink fit. Before starting the operation of replacing the ring gear, place the new ring gear against the old gear to make certain both have the same number of teeth.

To remove the ring gear from the flywheel, drill a $\frac{3}{8}$ " [9,5 mm.] hole through the ring gear and cut through any remaining metal with a cold chisel. Remove the ring gear from the flywheel. Thorough-

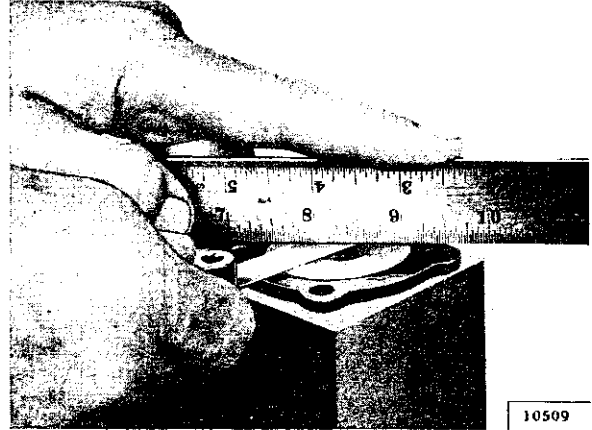


FIG. D-30—CHECKING OIL PUMP COVER

ly clean the ring gear surface of the flywheel. Heat the new ring gear evenly to a range of 650°F. to 700°F. [343°C. a 371°C.] and place it on the cold flywheel, making certain that the chamfer on the teeth is on the crankshaft side of the flywheel. Be sure that the ring gear is firmly seated on the flywheel. Allow the ring gear to cool slowly to shrink it onto the flywheel. Do not quench the ring gear; allow it to slowly air cool.

D-70. Flywheel Pilot Bushing

Inspect the flywheel pilot bushing in the flywheel. For procedure on replacing the bushing, refer to Par. I-8.

D-71. Flywheel Housing

The flywheel housing, which encloses the flywheel and clutch is bolted to the engine rear plate and cylinder block. The rear of the housing provides the front support for the transmission. Examine the housing for cracks and distortion of the machined surfaces. The front face must seat evenly against the engine rear end plate without evidence of warpage. The rear face must be parallel to the front face. Improper alignment may cause transmission gear disengagement. In addition, the opening in the rear of the housing, which serves as a pilot for the transmission, must be concentric with the crankshaft. The flywheel housing should be checked for alignment after it is installed on the engine. Refer to Par. D-88.

D-72. Core Hole Expansion Plug

Any evidence of coolant leakage around any of the core hole expansion plugs will require replacement of the plug. The expansion plug at the rear end of the cylinder block can be driven out with a 24" [60 cm.] length of half-inch bar stock carefully inserted through the camshaft bore in the cylinder block. The other core hole expansion plugs in the cylinder block and cylinder head can be removed by piercing the center with a sharp tool and prying them out. Before attempting to install a new plug, clean the hole thoroughly. Apply a thin coat of sealer on the new plug and install the plug with a driver.

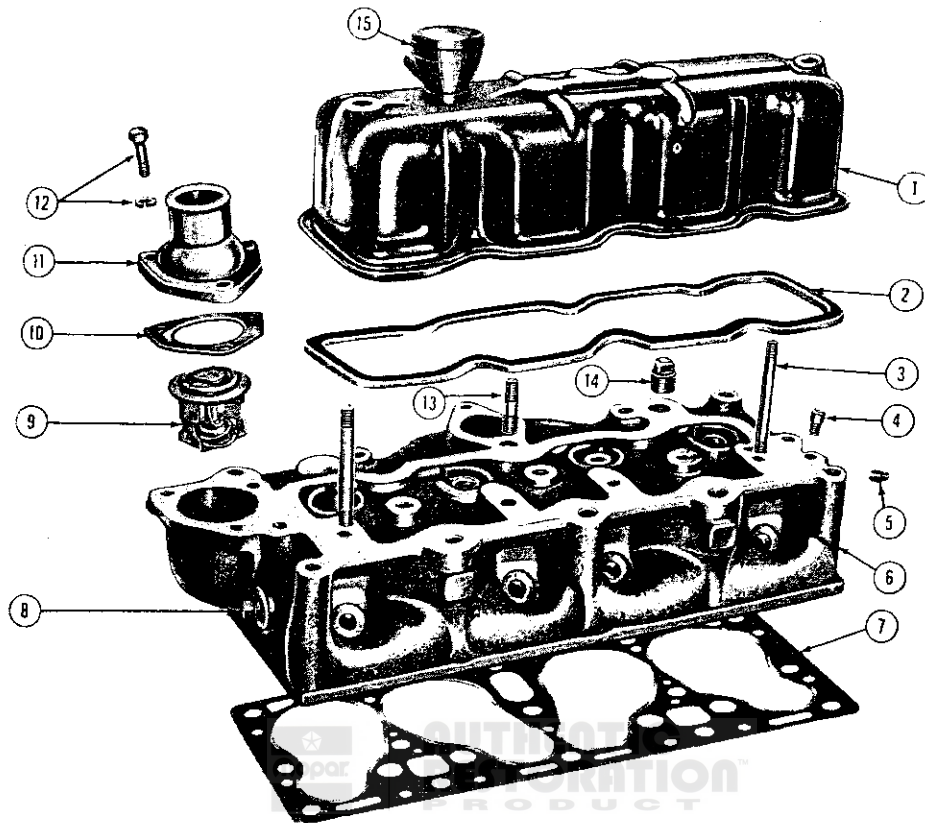


FIG. D-31 — CYLINDER HEAD

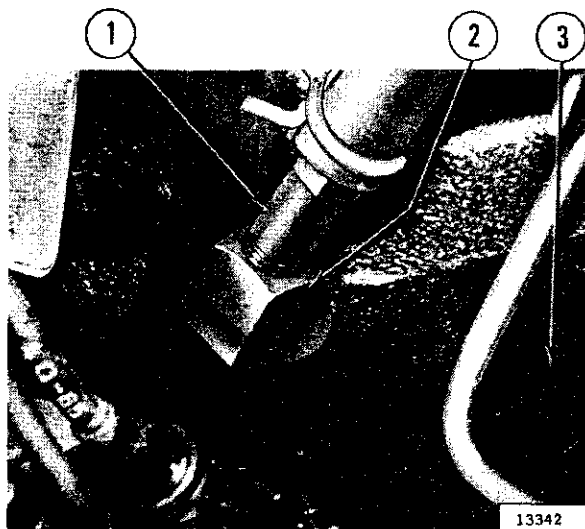
- 1—Rocker Arm Cover
- 2—Gasket
- 3—Cover Stud
- 4—Connector
- 5—Pipe Plug
- 6—Cylinder Head
- 7—Gasket
- 8—Pipe Plug 1/4"
- 9—Thermostat
- 10—Gasket
- 11—Water Outlet Fitting
- 12—Screw and Lock Washer
- 13—Carburetor Mounting Stud
- 14—Pipe Plug 1/2"
- 15—Crankcase Vent

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D-73. Cylinder Head

Be sure that water passages are open and that all carbon is removed. Inspect all tapped openings. Repair any damaged threads or broken studs. Run a tap in the threaded holes to clean up rough or damaged threads. Before using a tap, squirt

penetrating oil on the threads. Discard or repair cracked cylinder heads, also those warped .010" [0,254 mm.] or more over the full length of the head. The right side of the cylinder head has an elbow screwed into the intake manifold which mounts the crankcase ventilation valve. Refer to Par. D-15 and Fig. D-32 for removal of the valve and elbow.



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FIG. D-32—CRANKCASE VENTILATION VALVE
1—Ventilation Valve 2—90° Elbow 3—Cylinder Head

D-74. Rocker Arms

The rocker arms and their related parts are mounted on the top of the cylinder head and enclosed by the rocker arm cover. The rocker arm shaft, supported in four rocker arm shaft brackets, carries the rocker arms and the rocker arm shaft springs. The intake valve adjusting screws and locknuts provide the means for adjusting these valves.

D-75. Rocker Arm Shaft Disassembly

- a. Remove the two studs in the rocker arm shaft brackets at the ends of the rocker arm shaft.
- b. Slide the rocker arm shaft brackets, the four rocker arm assemblies, and the two rocker arm shaft springs off the rocker arm shaft. Remove the two rocker arm shaft lock screws from the two remaining rocker arm shaft brackets and slide the brackets off the shaft.
- c. Insert a screwdriver under the edge of the rocker arm shaft plugs at each end of the rocker arm shaft, and pry the plugs out of the shaft.

d. Remove the intake valve adjusting screw locknuts from each of the rocker arm valve lash adjusting screws. Remove the screws from the rocker arms.

D-76. Inspection and Repair

Run a round wire brush through the bore of the rocker arm shaft and clean out the drilled oil holes. Clean out the oil holes in the rocker arm shaft brackets, and the oil holes and grooves in the bores of the rocker arm.

Inspect the diameter of the shaft at the rocker arm bearing areas. Replace the shaft if there are scores or abrasion marks along the length of the shaft.

Check the shaft for alignment by rolling it across a smooth level surface. If the shaft will not roll freely, or if it rolls with a bumping motion, the shaft is out of alignment and must be replaced. Inspect the threads of the adjusting screw hole in the rocker arms and if necessary clean with a proper size tap. Replace the adjusting screw locknut or the adjusting screw if either part is damaged or deformed.

Inspect the threads in the tapped hole in the top of the rocker arm shaft brackets and if necessary clean with a proper size tap. Replace the bracket if either side is worn or scored.

D-77. Reassembly

a. Install two rocker arm shaft plugs, one in each end of the shaft. Slide two rocker arm shaft brackets onto the center of the shaft. Align the tapped holes in the brackets with the drilled holes in the top of the shaft and install the rocker arm shaft lock screws, making sure the points of the screws enter the drilled holes in the shaft.

b. Screw the intake valve adjusting screws into the rocker arms and install the locknuts.

c. The rocker arms are paired; that is, two of the arms are angled to the right and two are angled to the left. One of each type is used on each end of the rocker arm shaft. Slide a rocker arm with the adjusting screw end of the rocker arm angling away from the bracket onto the shaft so that the adjusting screw is on the same side of the shaft as the mounting hole in the bracket.

d. Temporarily secure the end bracket in place by installing a rocker arm cover stud in the tapped opening in the top of the support.

e. Assemble the parts on the opposite end of the rocker arm shaft repeating steps c and d above.

D-78. ENGINE REASSEMBLY

The engine reassembly procedure in the following paragraphs is given in the sequence to be followed when the engine is being completely overhauled. Individual inspection, repair, and fitting operations previously covered in detail are made throughout the reassembly procedure. The reassembly procedure does not cover accessories. If a new cylinder block fitted with pistons is used, many of the operations will not be required.

Mount the cylinder block in an engine repair stand. If an engine stand is not available, perform the following reassembly operation in a manner designed

to protect personnel against an accident and the engine and its parts against damage.

Note: During engine reassembly, use Perfect Seal Aerosol Spray Sealer Part No. 994757 on all engine gaskets to ensure against vacuum, oil, gasoline and water leaks. Apply to head gaskets, valve covers, water pumps, oil pan gaskets, radiator and heater hose connections, felt gaskets, gasoline and oil line connections, stud bolts, spark plug threads, and grease retainer washers. Refer to manufacturer's instructions on container for proper application procedure.

D-79. Install Oil Gallery Plug

Coat plug threads with a suitable sealing compound and install the plugs in the front and rear ends of the oil gallery in the cylinder block and the rear end of the cylinder head. Torque the plugs 20 to 25 lb-ft. [2,8 a 3,4 kg-m.].

There is also a pipe plug ($\frac{1}{8}$ " [3,2 mm.] slotted, headless) in the opening in the main oil gallery inside the cylinder block at No. 2 cylinder and another pipe plug ($\frac{1}{8}$ " square-head) in the opening in the oil passage directly below the oil pump intake passage. If these two pipe plugs were removed, make certain they are reinstalled in the locations described above or the counterweight of the crankshaft might strike the projecting head of the square-head plug.

D-80. Install Tappets

Turn the block upside down. Beginning at the rear end of the cylinder block, install the intake and exhaust valve tappets in the tappet bores in the cylinder block in the following order: one exhaust, two intake, two exhaust, two intake, and finally one exhaust valve tappet.

Check the tappet to bore fit of each tappet as it is installed in the block. If the stem-to-block clearance tolerance of .0005" to .002" [0,0127 a 0,051 mm.] is exceeded install a new tappet fitting within this tolerance or ream the bore to accommodate the next oversize tappet which is available in .004" oversize.

D-81. Install Camshaft and Thrust Plate

Lubricate all camshaft bearings and cam surfaces generously with clean, light engine oil. Carefully, so not to damage or score the camshaft front bearing, install the camshaft, locating it properly in the bearings. Do not allow the rear end of the camshaft to strike sharply against the expansion plug installed in the rear end of the bore.

Install the camshaft thrust plate. Slide the thrust plate spacer onto the end of the camshaft with the beveled inner edge of the spacer facing the camshaft. If the same camshaft is being reinstalled, install any shims previously removed. These shims are placed between the camshaft shoulder and the spacer. Torque the thrust plate attaching bolts 20 to 26 lb-ft. [2,8 a 3,6 kg-m.].

End play of the camshaft is determined by running clearance between the rear face of the camshaft gear and the thrust plate. The standard clearance

is .004" to .007" [0,102 a 0,178 mm.] as measured by a dial indicator. Should a check show too little end play, place a shim of suitable thickness between the camshaft shoulder and the spacer. Too much end play may be corrected by removing shims or dressing off the spacer a slight amount. See Fig. D-33.

D-82. Install Crankshaft and Bearings

Fit the three upper main bearings into their respective locations in the cylinder block. Fit the three lower main bearings into their respective bearing caps.

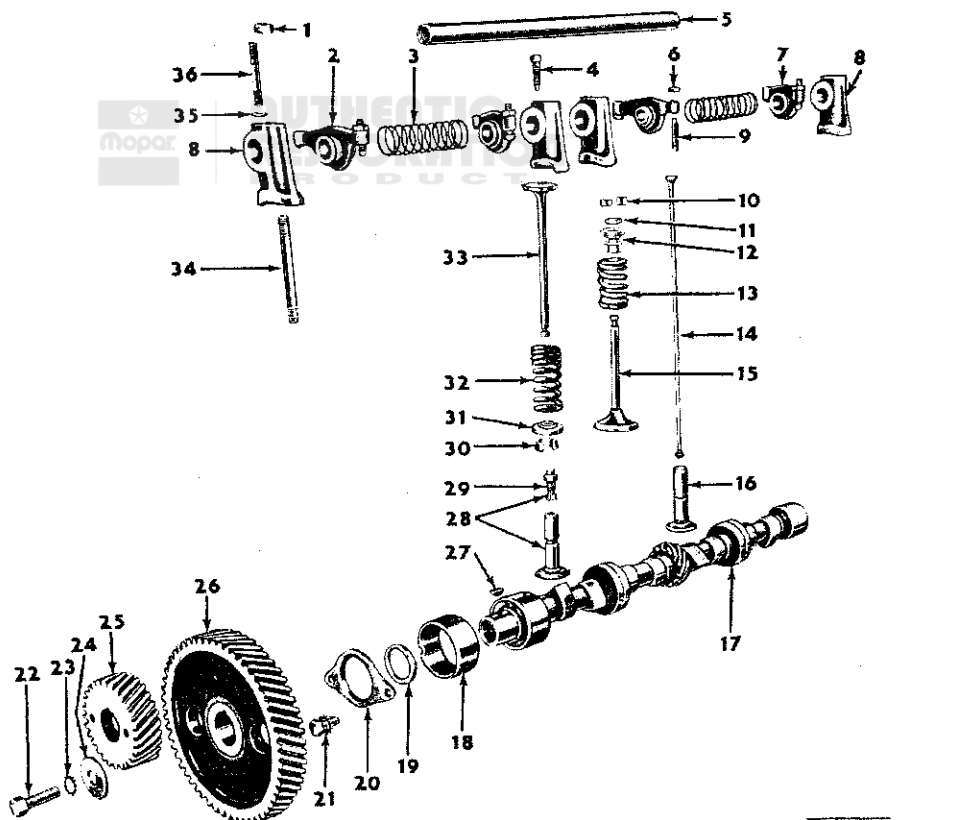
NOTE: It is possible to incorrectly install the front main bearing. The bearing is properly installed in the cap with the narrower of the two radial oil grooves toward the front edge of the cap. If this bearing is not properly installed, the oil grooves in the two halves of the bearing will not match at the parting line and premature failure of the bearing will result.

Lubricate all bearing surfaces generously with clean, light engine oil. Place the crankshaft in position in the cylinder block and install the main bearing caps. Torque the bolts 65 to 75 lb-ft. [9,0 a 10,4 kg-m.] rotating the crankshaft after each bearing cap is tightened

D-83. Check Crankshaft End-Play

End play of the crankshaft is set by the running clearance between the crankshaft thrust washer and the front face of the front main bearing. The standard end play is .004" to .006" [0,102 a 0,152 mm.] which is controlled by .002" [0,051 mm.] shims placed between the thrust washer and the shoulder on the crankshaft. Check the end play with a dial indicator as shown in Fig. D-34. If clearance is incorrect, adjustment is made by adding or removing shims.

Install the thrust washer with the beveled inner edge toward the front bearing.



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FIG. D-33—VALVES, CAMSHAFT, AND TIMING GEARS

- | | | |
|---------------------------------------|---------------------------------|------------------------------|
| 1—Nut | 13—Intake Valve Spring | 25—Crankshaft Gear |
| 2—Left Rocker Arm | 14—Intake Valve Push Rod | 26—Camshaft Gear |
| 3—Rocker Arm Shaft Spring | 15—Intake Valve | 27—Woodruff Key No. 9 |
| 4—Rocker Shaft Lock Screw | 16—Intake Valve Tappet | 28—Exhaust Valve Tappet |
| 5—Rocker Shaft | 17—Camshaft | 29—Tappet Adjusting Screw |
| 6—Nut | 18—Camshaft Front Bearing | 30—Spring Retainer Lock |
| 7—Right Rocker Arm | 19—Camshaft Thrust Plate Spacer | 31—Roto Cap Assembly |
| 8—Rocker Arm Shaft Bracket | 20—Camshaft Thrust Plate | 32—Exhaust Valve Spring |
| 9—Intake Valve Tappet Adjusting Screw | 21—Bolt and Lockwasher | 33—Exhaust Valve |
| 10—Intake Valve Upper Retainer Lock | 22—Bolt | 34—Rocker Shaft Support Stud |
| 11—Oil Seal | 23—Lockwasher | 35—Washer |
| 12—Intake Valve Spring Upper Retainer | 24—Camshaft Gear Washer | 36—Rocker Arm Cover Stud |

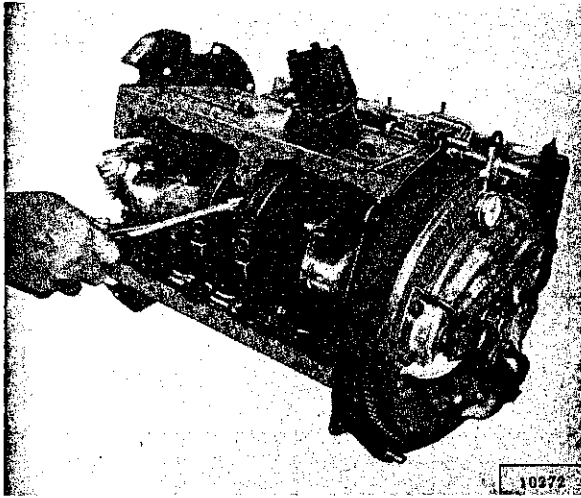


FIG. D-34—GAUGING CRANKSHAFT END PLAY

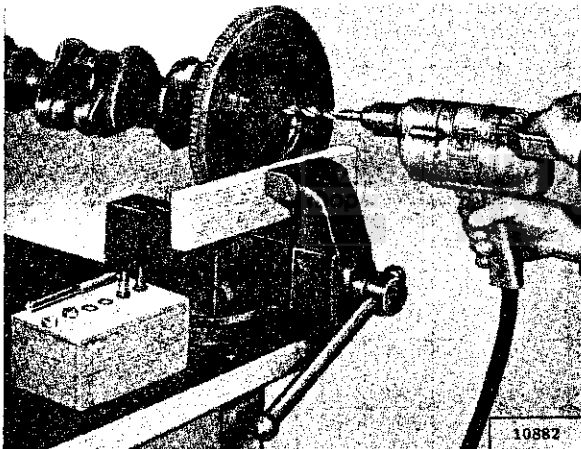


FIG. D-35—DRILLING FLYWHEEL

D-84. Install Crankshaft Timing Gear

Install the woodruff key in the longer of the two keyways on the front end of the crankshaft. Install the crankshaft timing gear on the front end of the crankshaft with the timing mark facing out, away from the cylinder block. Align the keyway in the gear with the woodruff key and then drive or press the gear onto the crankshaft firmly against the thrust washer.

D-85. Install Crankshaft Rear Bearing Seal

When installing the crankshaft rear bearing seal around the crankshaft, apply a thin coat of light cup grease to both halves of the seal except for the ends which are already treated with sealing compound. When installing the rear main bearing cap in the crankcase, place a small amount of plastic-type gasket cement on both sides and face of the cap to prevent oil leakage. Insert the rubber packings shown in Fig. D-37 into the holes between the bearing cap and the case. Do not trim these packings. The packings are of a predetermined length that will cause them to protrude approxi-

mately $\frac{1}{4}$ " [6 mm.] from the case. When the oil pan is installed, it will force them tightly into the holes and effectively seal any opening between the bearing cap and the crankcase.

D-86. Install Front End Plate

Assemble the gasket to the front end plate making certain that it is positioned properly down to the bottom of the crankcase. Install the front end plate on the cylinder block and tighten in place.

D-87. Install Flywheel

Be sure the crankshaft flange and flywheel mating surfaces are clean to permit proper flywheel alignment. With the crankshaft in the cylinder block,

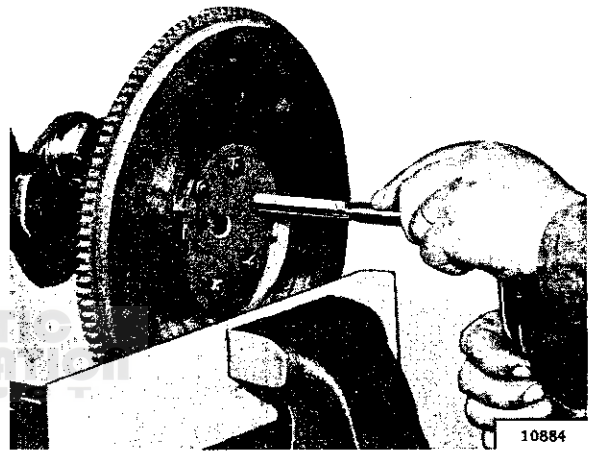


FIG. D-36—REAMING FLYWHEEL

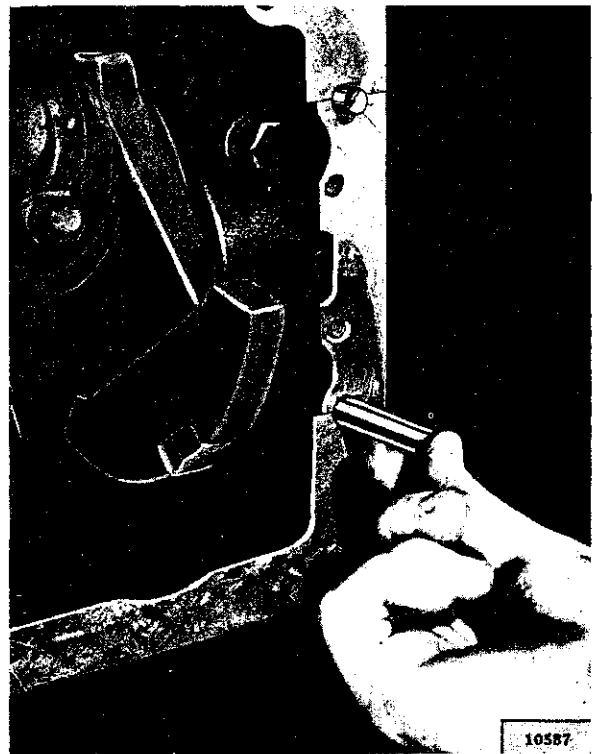


FIG. D-37—REAR BEARING CAP PACKING

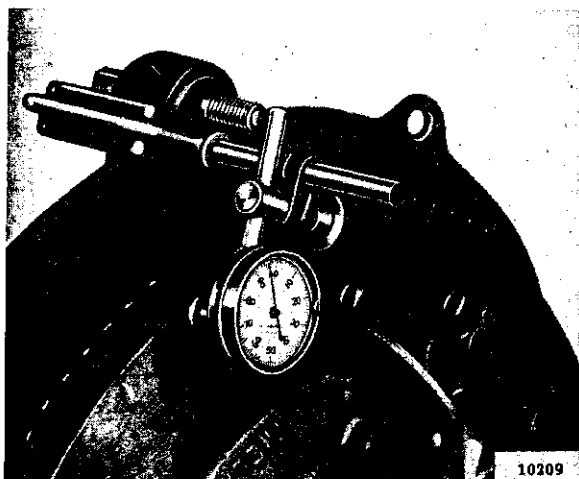


FIG. D-38—CHECKING FLYWHEEL RUN-OUT

place the flywheel on the mounting bolts in the crankshaft. When installing a new crankshaft or flywheel, replace the tapered dowel bolts with straight snug-fitting special bolts provided using Flywheel Dowel Bolt Installing Tool Kit W-231 as shown in Fig. D-35 and D-36. Assemble the crankshaft and flywheel in proper relation; then install the straight bolts previously used and tighten securely. Next, use the $\frac{35}{64}$ " [13,9 mm.] drill to enlarge the tapered holes. Ream the holes with the $\frac{1}{16}$ " [1,43 mm.] straight reamer and install the two special flywheel bolts with nuts and lockwashers in place of the two tapered dowel bolts formerly used. This procedure overcomes the necessity of reaming special tapered holes.

Tighten the nuts alternately and evenly until each is tightened 35 to 41 lb-ft. [4,8 a 5,7 kg-m.].

After installation check the run-out of the flywheel with a dial indicator attached to the engine plate as illustrated in Fig. D-38. Mount the dial indicator with the contact button of the indicator resting against the clutch face of the flywheel. Set the indicator at zero and rotate the flywheel. Maximum allowable run-out is .008" [0,203 mm.] near the outer edge of the rear face of the flywheel.

With the flywheel housing installed temporarily, the alignment can be checked with a dial indicator. Without the clutch installed on the flywheel, a dial indicator can be mounted on one of the flywheel bolts. Set the dial indicator with the button resting against the rear face of the flywheel housing. Rotate the flywheel, noting the run-out on the indicator. Maximum allowable run-out is .005" [0,127 mm.]. Relocate the dial indicator so that the button is against the side of the rear opening to check the radial run-out. Rotate the flywheel and note the run-out which should not exceed .006" [0,152 mm.].

D-88. Install Flywheel Housing

Be certain that the mating surfaces of the flywheel housing and cylinder block are clean and smooth. Place the flywheel housing in position and attach to the cylinder block and engine rear plate. The long bolts through the lugs on the engine crankcase

and those below are installed with the nuts on the flywheel housing side. Install the other bolts from the rear except the screw used to attach the top side of the starting motor. Tighten securely.

D-89. Install Clutch

To install the clutch assembly with the engine out of the vehicle use a clutch plate aligning arbor. Place the clutch driven plate in position against the flywheel. Insert the arbor into the clutch driven plate and clutch shaft bushing and expand the arbor in the bushing to hold it in place. Hold the clutch pressure plate assembly in position against the clutch driven plate and install the attaching bolts and washers, tightening the bolts alternately and evenly. Remove the arbor.

D-90. Install Valves and Springs

Oil the valve stems. Insert all intake and exhaust valves in the valve guides from which they were removed.

Install one exhaust valve spring and exhaust valve spring retainer (Roto Cap) for each exhaust valve. Slip the top end of the spring onto the bottom end of the valve guide and, with a large screwdriver, snap the spring and retainer over the tappet adjusting screw. Make certain that the two closely wound coils of each spring are at the top (placed up to seat against the block.) See Fig. D-39.

Turn the crankshaft as necessary to bring each exhaust valve tappet to its lowest position. Using a valve spring lifter, compress each exhaust valve spring, while holding the valve down, so that the stem extends through the valve spring retainer far enough to permit installation of the valve spring locks. Heavy lubricating oil or grease placed on the inside surface of the valve locks will help to hold the locks on the valve stem until the valve spring lifter can be removed. When installation of exhaust valves is complete, remove any cloths used to block the valve compartment floor openings. Install the intake valves and springs in the cylinder head placing the ends of the springs having the closed coils down against the cylinder head.

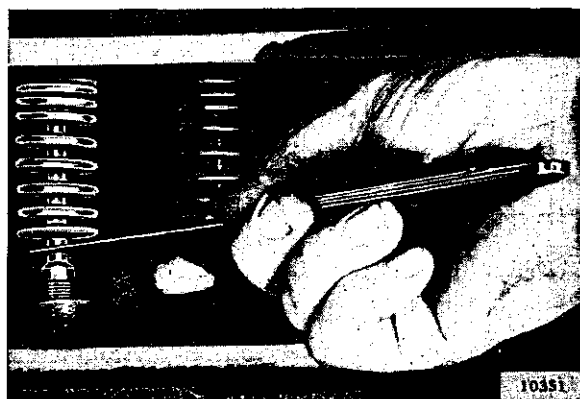


FIG. D-39—VALVE TAPPETS AND SPRINGS

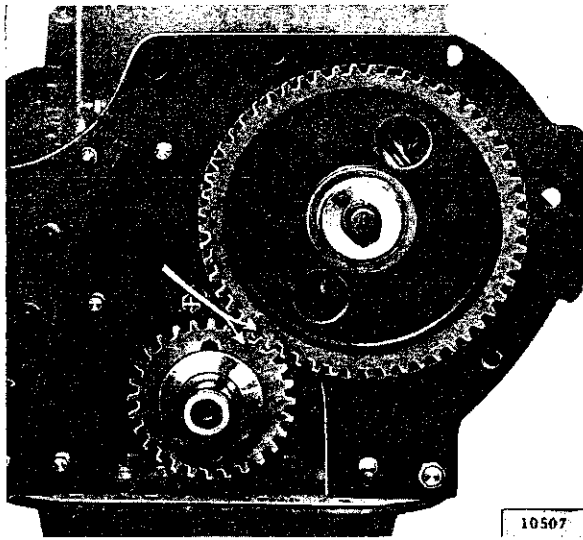


FIG. D-40—TIMING GEARS

Be sure to install a new rubber oil seal ring on each intake valve stem before installing the retainer locks. With the retainer and spring compressed position a seal ring on the valve stem just above the lock recess, then install the locks and release the spring.

Adjust the valve tappets to the proper specified clearance. Refer to Par. D-108, and specifications at the end of this section for specifications and adjustment procedure.

D-91. Install Camshaft Timing Gear

Turn the camshaft or crankshaft as necessary so that the timing marks on the two gears will be together after the camshaft timing gear is installed. Refer to Fig. D-40. Install the woodruff key in the keyway on the front end of the camshaft. Start the large timing gear on the camshaft with the timing mark facing out. Do not drive on the camshaft gear, or the camshaft may dislodge the plug at the rear of the cylinder block causing an oil leak. Install the camshaft gear retaining screw and torque it 30 to 40 lb-ft. [4,1 a 5,5 kg-m.] drawing the gear onto the camshaft in the process. Standard running tolerance between the timing gears is .000" to .002" [0 a 0,051 mm.] which should be checked with a dial indicator.

D-92. Install Timing Gear Oil Jet

Install the timing gear oil jet in the tapped hole in the front of the cylinder block. Position the oil hole in the side of the oil jet so that it will direct the oil stream against the camshaft driven gear just ahead of the point of engagement with the crankshaft drive gear.

D-93. Install Oil Pump

The oil pump is driven from the camshaft by means of a spiral (worm) gear. The distributor, in turn, is driven by the oil pump by means of a tongue on the end of the distributor shaft which engages a slot in the end of the oil pump shaft. Because the tongue and the slot are both machined

off center, the two shafts can be meshed in only one position. Since the position of the distributor shaft determines the timing of the engine, and is controlled by the oil pump shaft, the position of the oil pump shaft with respect to the camshaft is important.

Turn the crankshaft to bring together the timing marks on the crankshaft and camshaft gears. See Fig. D-40. Install the oil pump mounting gasket on the pump. With the wider side of the shaft on top (nearer the top of the cylinder block), start the oil pump drive shaft into the opening in the left side of the cylinder block with the mounting holes in the body of the pump in alignment with the holes in the cylinder block. Insert a long-blade screwdriver into the distributor shaft opening in the opposite side of the block and engage the slot in the oil pump shaft. Turn the shaft so that the slot is positioned at what would be roughly the nine-thirty position on a clock face.

Remove the screwdriver and, looking down the distributor shaft hole with a flashlight, observe the position of the slot in the end of the oil pump shaft to make certain it is properly positioned. Replace the screwdriver and, while turning the screwdriver clockwise to guide the oil pump drive shaft gear into engagement with the camshaft gear, press against the oil pump to force it into position. Remove the screwdriver and again observe the position of the slot. If the installation was properly made, the slot will be in a position roughly equivalent to eleven o'clock position on a clock face with the wider side of the shaft still on the top. If the slot is improperly positioned, remove the oil pump assembly and repeat the operation.

Coat the threads of the capscrews with gasket cement and secure the oil pump in place with two lockwasher-equipped capscrews installed through the body of the oil pump and into the cylinder block and one lockwasher-capscrew installed through the oil pump mounting flange.

D-94. Install Timing Gear Cover

Apply a thin coat of gasket paste to the timing gear cover. Position the gasket on the cover and carefully locate the cover on the front of the front mounting plate. Attach the cover and timing indicator and tighten the bolts.

D-95. Install Pistons and Connecting Rods

Before installing each piston and connecting rod assembly in the cylinder block, generously lubricate the entire assembly with engine oil. Space the ring gaps around the piston so that no two gaps are aligned vertically and are not located over the T-slot in the piston skirt. Insert the assembly in the correct cylinder with the connecting rod identifying number toward the camshaft side of the cylinder block. When installing each assembly, rotate the crankshaft so that the crankpin is in the down position. Fit a piston ring compressor tightly around the piston rings. Reach up from the bottom of the cylinder block and guide the end of the connecting rod over the crankshaft journal as the piston is tapped down into the cylinder bore with hammer handle.

Lubricate the connecting rod bearing surfaces generously with engine oil and install the bearing cap with the numbered side matched to the numbered side of the connecting rod. Torque the nuts evenly 35 to 45 lb-ft. [4,8 a 6,2 kg-m.]. The connecting rod cap nuts are locked with stamped nuts. Used stamped nuts should be discarded and replaced with new ones. These locking stamped nuts should be installed with the flat face toward the connecting rod nut. Turn the locking nut finger tight and then $\frac{1}{2}$ turn more with a wrench. Refer to Par. D-36 for detailed information on fitting pistons and rings in the cylinder bores.

D-96. Install Crankshaft Pulley

Align the keyway in the pulley with the woodruff key installed in the crankshaft. Drive the pulley onto the crankshaft and secure it in place with the crankshaft pulley nut. Insert a block of wood between one of the counterweights on the crankshaft and the side of the cylinder block to prevent the crankshaft from turning, then tighten the nut.

D-97. Install Oil Pan

Before installing the oil pan, make a final internal inspection particularly making certain that the inside of the cylinder block is clean. Apply a thin coat of gasket paste on the oil pan. Place the new oil pan gasket in position. Set the oil pan in position on the cylinder block and install the oil pan. Torque the attaching bolts 12 to 15 lb-ft. [1,7 a 2,1 kg-m.]. Install the oil pan drain plug and gasket and tighten the plug securely.

D-98. Install Cylinder Head

Make certain that the entire top of the cylinder block assembly, the lower surface of the cylinder head, and the cylinder head gasket are clean. Blow all dirt or carbon out of the blind tapped bolt holes in the cylinder block before the cylinder head and gasket are installed. Using aerosol spray sealer Part No. 994757, spray a thincoat on both surfaces of the head gasket, position the new cylinder head gasket with the crimped edges of the gasket metal down (See Fig. D-31). This gasket position allows a positive seal along the narrow surfaces of the cylinder head between the combustion chambers and eliminates the possibility of burning combustion

gases reaching an asbestos portion of the cylinder head gasket. Install the cylinder head bolts. Tighten the bolts with a torque wrench to 60 to 70 lb-ft. [8,3 a 9,7 kg-m.] in the sequence shown in Fig. D-41. Do not overlook installing the cylinder head bolt in the intake manifold directly under the carburetor opening.

D-99. Install Rocker Arm Assembly

a. Insert ball ends of the intake valve push rods through the cylinder head and cylinder block and seat them in the cupped head of the intake valve tappets.

b. Install the rocker-arm assembly on the four rocker-arm-mounting studs. Align the rocker arms so that the ball ends of the intake valve tappet adjusting screws fit into the cup ends of the push rods.

c. Install the four rocker-arm-attaching nuts. Thread each nut down evenly in sequence, one turn at a time, until the torque is 30 to 36 lb-ft. [4,1 a 5,0 kg-m.].

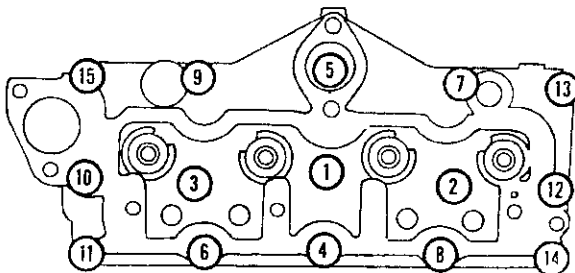
d. Cement a new gasket on the rocker arm cover. Install the cover placing an oil seal then a flat washer and nut on each cover stud. Cement a new gasket on the exhaust valve cover. Install the cover and crankcase ventilation fittings using a new gasket back of the vent cover and new copper ring gaskets under the attaching screw heads. Torque the valve tappet cover nuts 7 to 10 lb-ft. [1,0 a 1,4 kg-m.].

D-100. Install Distributor and Spark Plugs

To correctly install the distributor, it will be necessary to place No. 1 piston in the firing position. To locate the firing position of No. 1 piston, first turn the engine until No. 1 piston is moving up on the compression stroke as indicated by compression pressure being forced through the spark plug opening. Turn the engine slowly until the 5° before top center mark on the timing gear cover is in alignment with the mark on the crankshaft pulley. Oil the distributor housing where it bears on the cylinder block and install the distributor. Mount the rotor on distributor shaft and turn the shaft until the rotor points towards No. 1 spark plug terminal tower position (when cap is installed, about 5 o'clock) with the contact points just breaking. Move the rotor back and forth slightly until the driving lug on the end of the shaft enters the slot cut in the oil pump gear and slide the distributor assembly down into place. Rotate the distributor body until the contact points are just breaking. Install the hold down screw.

Connect the core primary wire to the distributor. Clean and adjust the spark plugs, setting the electrode gaps at .030" [0,762 mm.]. Install the plugs to prevent any foreign matter entering the combustion chambers during the remaining operations. Torque the spark plugs 25 to 30 lb-ft. [3,5 a 4,6 kg-m.].

Install spark plug cables, placing them in the distributor cap terminal towers starting with No. 1 and installing in a counter clockwise direction of the firing order sequence (1-3-4-2).



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FIG. D-41—CYLINDER HEAD BOLT TIGHTENING SEQUENCE

D-101. Install Manifold

If manifold studs were removed for replacement, apply sealer on the stud threads before installing a new stud.

See Section F1 for exhaust emission controlled engines.

Make certain that no foreign objects are inside the manifold and that all passages are clear. Place a new set of manifold gaskets in position on the side of the cylinder block. Then, carefully slide the manifold onto the studs and against the cylinder block being careful not to damage the gaskets. Torque all manifold attaching nuts evenly 29 to 35 lb-ft. [4,0 a 4,8 kg-m.].

D-102. Install Oil Filler Tube

When installing the oil filler tube, be sure that the beveled lower end is away from the crankshaft. Place a piece of hard wood over the top of the tube to prevent damage to the cap gasket seat.

D-103. Install Water Pump

Make certain that the mating surfaces of the water pump and the cylinder block are clean and smooth. Install the gasket on the flange of the pump and install the pump in position on the cylinder block. Torque the water pump attaching bolts alternately and evenly 12 to 17 lb-ft. [1,7 a 2,3 kg-m.].

D-104. Install Water Outlet Fitting

Install the thermostat and the water outlet fitting. Torque the water outlet fitting attaching bolts 20 to 25 lb-ft. [2,8 a 3,4 kg-m.].

D-105. ENGINE INSTALLATION

a. Install lifting sling to engine and using suitable hoist raise the engine from its blocking or stand and then slowly lower it into the engine compartment of the vehicle.

Note: When installing the Hurricane F4 Engine, two 3/8 x 4 inch guide bolts or dowels should be used to properly guide and align the engine to the flywheel housing (See Fig. D-42).

b. Slightly tilt the engine downward and at the same time slide the engine rearward while lining up the transmission main gear shaft with the clutch throw-out bearing and disc spline.

Note:The engine crankshaft may have to be turned slightly to align the transmission main gear shaft with the clutch disc spline.

c. Remove the guide bolts or dowels and secure the engine to the housing.

d. Secure the front engine mounts to the frame brackets and bolt ground cable to engine.

e. Remove lifting sling from engine.

f. Connect exhaust pipe to engine manifold flange.

g. Connect throttle and choke cables to carburetor.

h. Install fan to water pump pulley.

i. Connect fuel pump line to main fuel line.

j. Replace starting motor assembly.

k. Connect engine wiring harness connectors at front of cowl.

l. Connect wires to starting motor assembly, water temperature and oil pressure sending units and alternator.

NOTE: ON ENGINES EQUIPPED WITH EXHAUST EMISSION CONTROL, REPLACE THE AIR PUMP, AIR DISTRIBUTOR MANIFOLD, AND ANTI-BACKFIRE (DIVERTER) VALVE. SEE SECTION F1.

m. Replace radiator and radiator grille support rods and connect coolant hoses to engine.

Note: Replace heater hoses if vehicle is equipped with hot water heater.

n. Fill radiator with coolant and engine with oil (see Lubrication Chart).

o. Install air cleaner and connect carburetor air hose.

p. Connect battery cables and start engine.

q. Install hood and road test vehicle.

D-106. FINAL IN-VEHICLE ADJUSTMENTS

a. Clean battery terminals and check battery.

b. Check ignition terminals and check battery.

c. Service carburetor air cleaner.

d. Service positive crankcase ventilation valve.

e. Check fuel lines.

f. Gap and install new spark plugs.

g. Check distributor points and capacitor; replace if necessary.

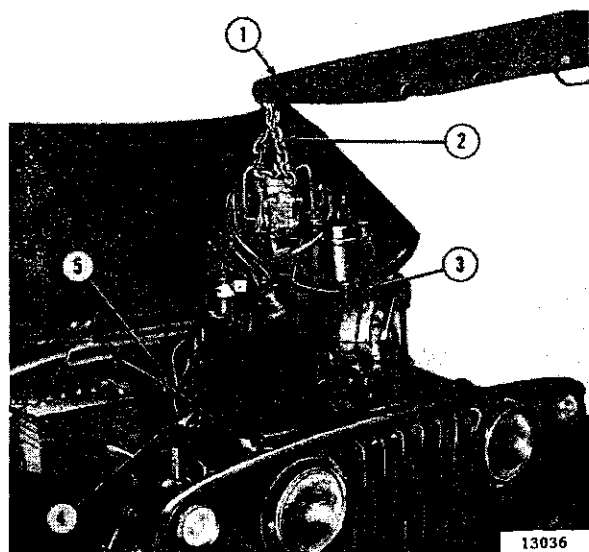


FIG. D-42—INSTALLING HURRICANE F4 ENGINE IN VEHICLE

- 1—Lifting Sling
- 2—Hoist Cable
- 3—Hurricane F4 Engine
- 4—Dowel Bolt
- 5—Flywheel Housing

- h. Check ignition (distributor) timing; reset if necessary.
- i. Check carburetor adjustments; reset if necessary.
- j. With engine fully warmed up, tighten cylinder head and manifold bolts and nuts to specified torque. Check cylinder head gaskets and bolts for air or coolant leaks.

Note: Tightness of cylinder head bolts should be checked and corrected after 500 to 600 miles [800 a 960 km.] of normal operation.

- k. Check fan belt tension; adjust if necessary.
- l. Check for and correct any oil leak, fuel leak or coolant leak.

D-107. VALVE ADJUSTMENT

Proper valve adjustment is important to prevent burning of valves and poor engine performance. This adjustment consists of obtaining a specified lash in the valve mechanism. The exhaust valve tappets and the intake valve rocker arms should be adjusted to the proper clearance with the engine cold (at room temperature). Valve clearance can be properly adjusted only when the tappet is on the heel or low portion of the cam.

D-108. Valve Adjustment Procedure

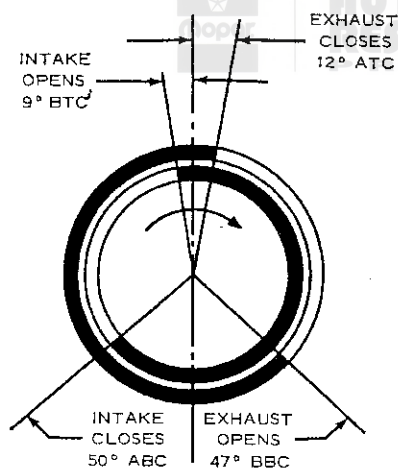
The exhaust valve tappets are adjusted by turning the adjusting screw in or out of the tappet as necessary to obtain the proper clearance. Where special wrenches can be obtained, they should be used to facilitate the adjustment. The proper clearance is .016" [0,406 mm.] between the end of the adjusting screw and the bottom of the exhaust valve.

Crank the engine over to close a valve and check the clearance with a feeler gauge. To adjust, hold the tappet with one wrench and turn the adjusting screw, with the other. Check and adjust each of the tappets in proper sequence.

Adjust each intake valve by adjusting the rocker arm screw at the push rod to obtain .018" [0,457 mm.] clearance between the rocker arm and the valve stem with tappet on the heel of the cam.

D-109. Check Valve Timing

To check the valve timing, carefully set the intake valve rocker arm adjustment for No. 1 cylinder to .026" [0,6604 mm.] between the rocker arm and the valve stem. Rotate the crankshaft clockwise until the piston in No. 1 cylinder is ready for the intake stroke. The intake valve opens 9° before top center (BTC). Note the distance between the "TC" and "5°" marks on the indicator on the timing gear cover and estimate the 9° before top center position. See Fig. D-43. With the crankshaft in this position, timing is correct if the rocker arm is just tight against the intake valve stem. Do not overlook resetting the rocker arm adjustment to the correct running clearance.



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FIG. D-43—VALVE TIMING

D-110. Positive Crankcase Ventilation

Be sure there are no air leaks at the tube connections between the air cleaner and the oil filler tube, and that the oil filler tube cap gasket is in good condition. Always keep the cap locked securely in place. When tuning the engine or grinding valves, remove the control valve and clean it thoroughly. If the valve is blocked with carbon, the ventilating system will not operate and, should the valve fail to seat, it will be impossible to make the engine idle satisfactorily. Refer to Par. C-6 for servicing.

D-111. Oil Filter

The engine is equipped with a throw-away type oil filter. This oil filter must be serviced periodically as outlined in the Lubrication Section.

D-112. SERVICE DIAGNOSIS

Poor Fuel Economy

Ignition Timing Slow or Spark Advance Stuck
 Carburetor Float High
 Accelerator Pump Not Properly Adjusted
 High Fuel Pump Pressure
 Fuel Leakage
 Leaky Fuel Pump Diaphragm
 Loose Engine Mounting Causing High Fuel Level
 in Carburetor
 Low Compression
 Valves Sticking
 Spark Plugs Bad
 Spark Plug Cables Bad
 Weak Coil or Condenser
 Improper Valve Tappet Clearance
 Carburetor Air Cleaner Dirty
 High Oil Level in Air Cleaner
 Dragging Brakes
 Front Wheels Out of Alignment
 Tires Improperly Inflated
 Inaccurate Odometer
 Faulty Fuel Tank Cap
 Clogged Muffler or Bent Exhaust Pipe

Lack of Power

Low Compression
 Ignition System (Timing Late)
 Improper Functioning Carburetor or Fuel Pump
 Fuel Lines Clogged
 Air Cleaner Restricted
 Engine Temperature High
 Improper Tappet Clearance
 Sticking Valves
 Valve Timing Late
 Leaky Gaskets
 Muffler Clogged
 Bent Exhaust Pipe
 Defective Spark Plugs—Clean or Replace
 Defective Breaker Points—Replace Points
 Incorrect Breaker Point Gap—Reset Points
 Defective Condenser or Coil—Replace
 Loose Electrical Connections—Locate and
 Tighten
 Broken Valve Spring—Replace Spring
 Broken Piston or Rings—Replace
 Defective Head Gasket—Replace Gasket
 Cracked Distributor Cap—Replace Cap

Low Compression

Leaky Valves
 Poor Piston Ring Seal
 Sticking Valves
 Valve Spring Weak or Broken
 Cylinder Scored or Worn
 Tappet Clearance Incorrect
 Piston Clearance too Large
 Leaky Cylinder Head Gasket

Burned Valves and Seats

Sticking Valves or too Loose in Guides
 Improper Timing
 Excessive Carbon Around Valve Head and Seat
 Overheating
 Valve Spring Weak or Broken

Burned Valves and Seats—Continued

Valve Tappet Sticking
 Valve Tappet Clearance Incorrect
 Clogged Exhaust System

Valves Sticking

Warped Valve
 Improper Tappet Clearance
 Carbonized or Scored Valve Stems
 Insufficient Clearance Valve Stem to Guide
 Weak or Broken Valve Spring
 Valve Spring Cocked
 Contaminated Oil

Overheating

Inoperative Cooling System
 Thermostat Inoperative
 Improper Ignition Timing
 Improper Valve Timing
 Excessive Carbon Accumulation
 Fan Belt too Loose
 Clogged Muffler or Bent Exhaust Pipe
 Oil System Failure
 Scored or Leaky Piston Rings

Popping-Spitting-Detonation

Improper Ignition
 Improper Carburetion
 Excessive Carbon Deposit in Combustion Cham-
 bers
 Poor Valve Seating
 Sticking Valves
 Broken Valve Spring
 Tappets Adjusted too Close
 Spark Plug Electrodes Burned
 Water or Dirt in Fuel
 Clogged Lines
 Improper Valve Timing

Excessive Oil Consumption

Piston Rings Stuck in Grooves, Worn or Broken
 Piston Rings Improperly Fitted or Weak
 Piston Ring Oil Return Holes Clogged
 Excessive Clearance, Main and Connecting Rod
 Bearings
 Oil Leaks at Gaskets or Oil Seals
 Excessive Clearance, Valve Stem to Valve Guide
 (Intake)
 Cylinder Bores Scored, Out-of-Round or Tapered
 Too Much Clearance, Piston to Cylinder Bore
 Misaligned Connecting Rods
 High Road Speeds or Temperature
 Crankcase Ventilator Not Operating

Bearing Failure

Crankshaft Bearing Journal Out-of-Round
 Crankshaft Bearing Journal Rough
 Lack of Oil
 Oil Leakage
 Dirty Oil
 Low Oil Pressure or Oil Pump Failure
 Drilled Passages in Crankcase or Crankshaft
 Clogged
 Oil Screen Dirty
 Connecting Rod Bent

D-113. HURRICANE F4 ENGINE SPECIFICATIONS

MODEL:	ENGLISH	METRIC
ENGINE:		
Type.....	F-Head	
Number of Cylinders.....	4	
Bore.....	3 1/8"	7,937 cm.
Stroke.....	4 3/8"	11,112 cm.
Piston Displacement.....	134.2 cu. in.	2199 cm ³
Bore Spacing (center to center):		
1 and 2, 3 and 4.....	3.437"	8,729 cm.
2 and 3.....	4.938"	12,542 cm.
Firing Order.....	1-3-4-2	
Compression Ratio.....	6.7:1	
Compression Pressure.....	120 to 130 psi.	8,4 a 9,2 kg-cm ²
Number of Mounting Points:		
Front.....	2	
Rear.....	1	
Horsepower (SAE).....	15.63	
Horsepower (Max Brake).....	75 @ 4000 rpm.	
Maximum Torque @ 2000 rpm.....	114 lb-ft.	15,77 kg-m.
PISTONS:		
Material.....	Aluminum Alloy	
Description.....	Cam Ground, T-slot, Tin Plated	
Length.....	3 3/4"	9,525 cm.
Diameter (near bottom of skirt).....	3.1225" to 3.1245"	7,9311 a 7,9362 cm.
Weight.....	13.5 oz.	382,7 gr.
Clearance Limits:		
Piston-To-Cylinder Bore.....	Selective Feeler Fit	
Ring Groove Depth:		
No. 1 and 2 Ring.....	.1593" to .1655"	4,046 a 4,203 mm.
No. 3 Ring.....	.1693" to .1755"	4,300 a 4,457 mm.
Ring Groove Width:		
No. 1 Ring.....	.0955" to .0965"	2,4257 a 2,4511 mm.
No. 2 Ring.....	.095" to .096"	2,413 a 2,438 mm.
No. 3 Ring.....	.1875" to .1885"	4,7625 a 4,7879 mm.
Piston Pin Hole Bore.....	.760" to .770"	19,304 a 19,558 mm.
Cylinder Bore — Standard.....	3.125" to 3.127"	7,9375 a 7,9425 cm.
— max. out of round.....	.005"	0,1270 mm.
— max. taper.....	.005"	0,1270 mm.
— max. rebore.....	.040"	1,0160 mm.
PISTON RINGS:		
Function:		
No. 1 and 2.....	Compression	
No. 3.....	Oil	
Material:		
No. 1.....	Cast Iron, Chrome-plated Face	
No. 2 and 3.....	Cast Iron	
Width:		
No. 1 and 2.....	3/32"	2,38 mm.
No. 3.....	3/16"	4,76 mm.
Gap (Std. to .009 Cyl. Bore).....	.007" to .017"	0,178 a 0,432 mm.
Thickness:		
No. 1 and No. 2 Rings.....	.134" to .144"	3,403 a 3,657 mm.
No. 3 Ring.....	.115" to .125"	2,821 a 3,175 mm.
Side Clearance in Groove:		
No. 1 Ring.....	.002" to .004"	0,051 a 0,102 mm.
No. 2 Ring.....	.0015" to .0035"	0,038 a 0,088 mm.
No. 3 Ring.....	.001" to .0025"	0,025 a 0,063 mm.
PISTON PINS:		
Material.....	SAE 1016 Steel	
Length.....	2.781"	70,637 mm.
Diameter.....	.8119"	20,6223 mm.
Type.....	Locked in Rod	
Clearance in Piston (selective fit).....	.0001" to .0003"	0,0025 a 0,0076 mm.

D-113 HURRICANE F4 ENGINE SPECIFICATIONS (Continued)

MODEL:	ENGLISH	METRIC
CONNECTING RODS:		
Material.....	SAE 1141 Forged Steel	
Weight.....	32 oz.	907 gr.
Length (center to center).....	9.187"	23,33 cm.
Bearing:		
Type.....	Removable	
Material.....	Steel-backed Babbitt	
Length Over All.....	1.089" to 1.099"	2,766 a 2,791 cm.
Clearance Limits.....	.001" to .0019"	0,025 a 0,0483 mm.
Undersize Bearings Available.....	.001"	0,025 mm.
	.002"	0,051 mm.
	.010"	0,254 mm.
	.012"	0,305 mm.
	.020"	0,508 mm.
	.030"	0,762 mm.
End Play.....	.004" to .010"	0,102 a 0,254 mm.
Installation.....	From Above	
Bore:		
Upper.....	.8115" to .8125"	20,612 a 20,637 mm.
Lower.....	2.0432" to 2.0440"	5,1897 a 5,1917 cm.
CRANKSHAFT:		
Material.....	SAE 1040 Forged Steel	
End Thrust.....	Front Bearing	
End Play.....	.004" to .006"	0,102 a 0,152 mm.
Main Bearings:		
Type.....	Removable	
Material.....	Steel-backed Babbitt	
Clearance.....	.0003" to .0029"	0,0076 a 0,0736 mm.
Undersize Bearings Available.....	.001"	0,025 mm.
	.002"	0,051 mm.
	.010"	0,254 mm.
	.012"	0,305 mm.
	.020"	0,508 mm.
	.030"	0,762 mm.
Journal Diameter.....	2.333" to 2.334"	5,9261 a 5,9286 cm.
Bearing Length:		
Front.....	1.64"	4,16 cm.
No. 2.....	1.72"	4,36 cm.
No. 3.....	1.66"	4,21 cm.
Out of round and out of taper limits.....	.001"	0,025 mm.
Direction of Cylinder Offset.....	Right	
Amount of Cylinder Offset.....	.125"	3,175 mm.
Crankpin Journal Diameter.....	1.9375" to 1,9383	4,9213 a 4,9233 cm.
Flywheel Run Out (max.).....	.005"	0,127 mm.
CAMSHAFT:		
Bearings:		
Material.....	Steel-backed Babbitt (Front only)	
Number.....	4	
Clearance.....	.001" to .0025"	0,025 a 0,063 mm.
Journal Diameter:		
Front.....	2.1860" to 2.1855"	5,5524 a 5,5511 cm.
Front Intermediate.....	2.1225" to 2.1215"	5,3911 a 5,3886 cm.
Rear Intermediate.....	2.0600" to 2.0590"	5,2324 a 5,2298 cm.
Rear.....	1.6230" to 1.6225"	4,1224 a 4,1211 cm.
Bearing Diameter:		
Front.....	2.1870" to 2.1890"	5,5549 a 5,5600 cm.
Front Intermediate.....	2.125" to 2.126"	5,3975 a 5,4000 cm.
Rear Intermediate.....	2.0625" to 2.0635"	5,2387 a 5,2412 cm.
Rear.....	1.625" to 1.626"	4,1275 a 4,1300 cm.
End Play.....	.004" to .007"	0,101 a 0,178 mm.
Drive:		
Type.....	Helical Gear	
Crankshaft Gear.....	Cast Iron	
Camshaft Gear.....	Pressed Fiber-Steel Hub	
VALVE SYSTEM:		
Valve Rotators.....	On Exhaust Valve	
Tappets:		
Clearance — Cold:		
Intake.....	.018"	0,461 mm.
Exhaust.....	.016"	0,406 mm.
Clearance for Timing (intake).....	.026"	0,660 mm.

D-113. HURRICANE F4 ENGINE SPECIFICATIONS (Continued)

MODEL:	ENGLISH	METRIC
VALVE SYSTEM: (Continued)		
Timing:		
Intake:		
Opens	9° BTC	
Closes	50° ABC	
Duration	239°	
Exhaust:		
Opens	47° BBC	
Closes	12° ATC	
Duration	239°	
Valve Opening Overlap	21°	
Valves:		
Intake:		
Material	SAE 5150	
Length Over All	4.781"	12,14 cm.
Head Diameter	2"	5,08 cm.
Angle of Seat	46°	
Stem Diameter .....	.3733" to .3738"	9,481 a 9,494 mm.
Stem-to-Guide Clearance .....	.0007" to .0022"	0,0178 a 0,0559 mm.
Lift .....	.260"	6,604 mm.
Exhaust:		
Material	Uniloy 21-12	
Length Over All	5.909"	15,008 cm.
Head Diameter	1.47"	3,733 cm.
Angle of Seat	46°	
Seat Inset Material	Eatonite EMS 58	
Stem Diameter .....	.371" to .372"	9,423 a 9,449 mm.
Stem-to-Guide Clearance .....	.0025" to .0045"	0,0635 a 0,1143 mm.
Lift .....	.351"	8,915 mm.
Springs:		
Intake:		
Free Length	1.97"	5,003 cm.
Standard:		
Pressure @ Length:		
Valve Closed	73 lb. @ 1.66"	33,1 kg. @ 4,216 cm.
Valve Open	153 lb. @ 1.40"	69,4 kg. @ 3,556 cm.
Service Minimum:		
Pressure @ Length:		
Valve Closed	66 lb. @ 1.66"	29,9 kg. @ 4,216 cm.
Valve Open	140 lb. @ 1.40"	63,5 kg. @ 3,556 cm.
Exhaust:		
Free Length	2½"	6,350 cm.
Pressure @ Length:		
Standard:		
Valve Closed	53 lb. @ 2.109"	24 kg. @ 5,356 cm.
Valve Open	120 lb. @ 1.750"	54,3 kg. @ 4,445 cm.
Service Minimum:		
Valve Closed	47 lb. @ 2¼"	21,3 kg. @ 5,356 cm.
Valve Open	110 lb. @ 1¾"	49,9 kg. @ 4,445 cm.
LUBRICATION SYSTEM:		
Type of Lubrication:		
Main Bearings	Pressure	
Connecting Rods	Pressure	
Piston Pins	Splash	
Camshaft Bearings	Pressure	
Tappets	Splash	
Timing Gears	Nozzle	
Cylinder Walls	Nozzle	
Oil Pump:		
Type	Internal Rotor	
Drive	Camshaft Gear	
Minimum Safe Oil Pressure:		
At Idle	6 psi.	0,4 kg-cm ²
At 2000 rpm. (35 mph.)	20 psi.	1,4 kg-cm ²
Relief Valve Opens	40 psi.	2,8 kg-cm ²
Normal Oil Pressure	35 psi. @ 2000 rpm.	2,4 kg-cm ² @ 2000 rpm.
Oil Pressure Sending Unit	Electric	
Oil Intake	Floating	
Oil Filter System	Partial Flow	

DAUNTLESS V-6 ENGINE

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D1-1. GENERAL

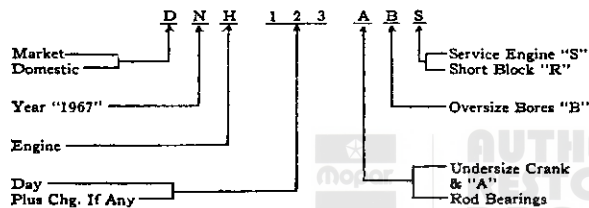
This section describes service and repair of the Dauntless V-6 engine. The engine code number shown in Fig. A-4 is provided to identify the Dauntless V6-225 engine. The meaning of the coded letters and numbers that are stamped on the right front face of the crankcase, just below the rocker arm cover, between exhaust manifold ports, is given below.

Letter to Designate Market	Letter to Designate Year Built
M — Military	N — 1967
E — Export	P — 1968
D — Domestic	R — 1969
	S — 1970
	T — 1971

Letter to Designate Engine and Compression Ratio

H—V6-225 9.0 to 1 C.R. (2 Bbl. Carb.)
 Y—V6-225 9.0 to 1 C.R. Marine (Low Profile) (2 Bbl. Carb.)
 Z—V6-225 9.0 to 1 C.R. Marine (High Profile) (2 Bbl. Carb.)
 K—V6-225 7.6 to 1 C.R. (2 Bbl. Carb.)
 L—V6-225 7.4 to 1 C.R. (2 Bbl. Carb.)

EXAMPLE



The identifying letter or letters follow the engine letters are decoded as follows:

- A—.010" Undersize Main and Connecting Rod Bearings
- B—.010" Oversize Pistons
- AB—Combination of A and B
- S—Service Engine
- R—Short Block

All disassembly and assembly procedures are presented in logical order, assuming a complete engine overhaul with engine removed from the vehicle. However, many of these procedures can also be performed as on-vehicle services if vehicle or engine components are removed to gain access to parts involved.

Note: Some engines are equipped with an exhaust emission control system. Service information on the components of this system is given in section F2.

D1-2. ENGINE DESCRIPTION

The Dauntless V-6 engine has a displacement of 225 cubic inches. It has a compression ratio of 9.0 to 1, which permits use of regular-grade gasoline. See Figs. D1-1 and D1-2.

The cylinder block is made of cast iron. Two banks of cylinders (three cylinders per bank) are cast at a 90-degree angle. The lower part of the cylinder-block extends below the centerline of the crankshaft, forming a continuous flat surface with the rear crankshaft main bearing cap and the timing chain cover. This design allows installation of an

oil pan with a one-piece gasket. The cylinders in the left bank (as viewed from the driver's seat) are numbered 1-3-5, from front to rear. The cylinders in the right bank are numbered 2-4-6, from front to rear.

The crankshaft is supported in the cylinder block by four steel-backed full-precision bearings, all of which have an identical diameter. Crankshaft main bearings are numbered 1 to 4, front to rear. The thrust bearing is flanged to maintain crankshaft position and to compensate against crankshaft end thrust. The No. 2 bearing is the thrust bearing. The crankshaft is counterbalanced by weights, which are cast integral with the crank cheeks. The weights are shaped to a contour which gives minimum clearance with cylinder barrels and piston skirts to conserve space.

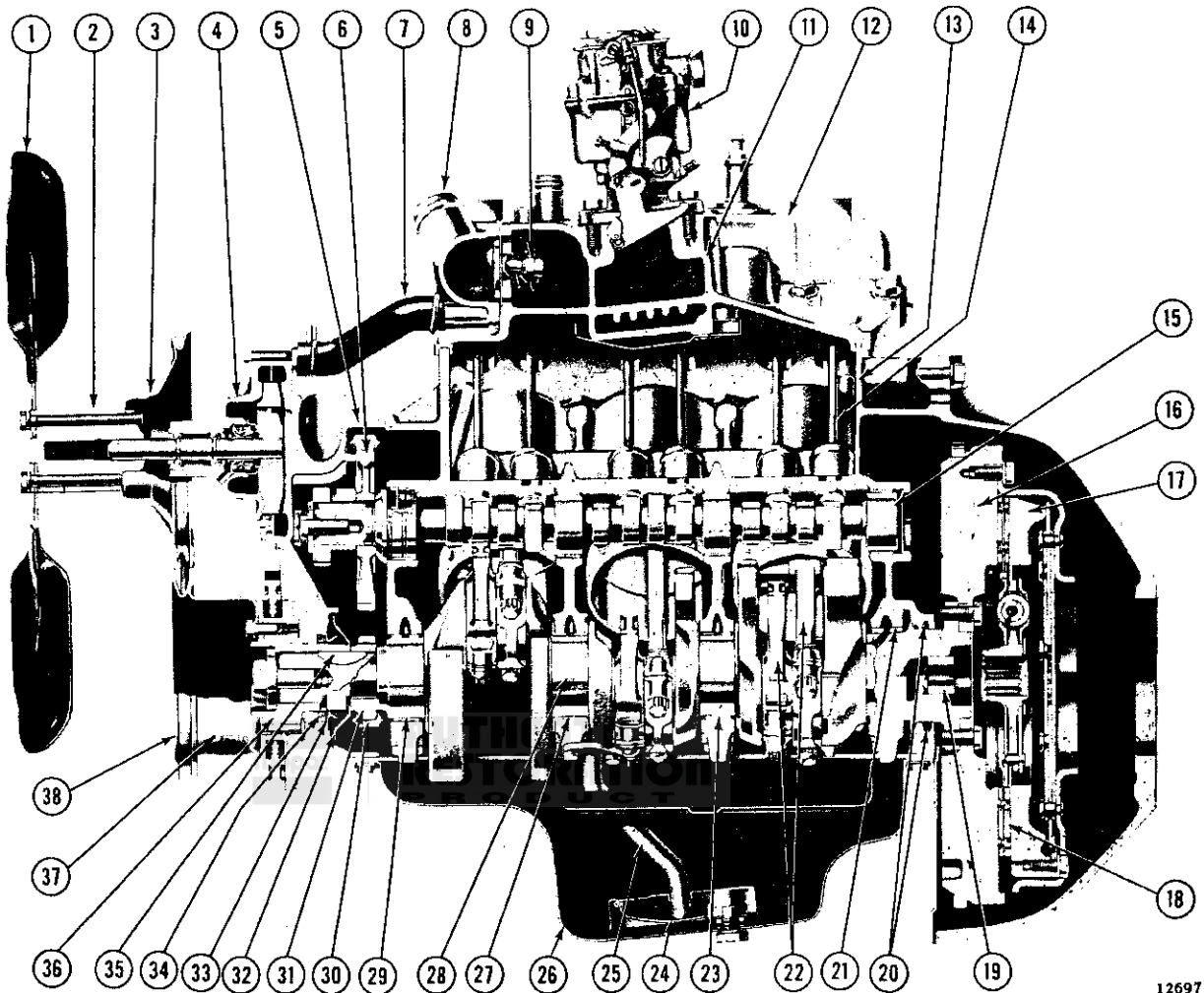
Connecting rods have I-beam sections with bosses on each side. Metal is removed, as required, to secure correct weight and balance. The lower end of each connecting rod has a steel-backed precision bearing. The piston pin is a press fit into the upper end. The outer ends of the piston pin are a slide fit in the piston bosses.

The full-skirted, aluminum alloy pistons are cam ground and tin plated. Two compression rings and one oil control ring are installed above the piston pin. The cast iron compression rings in the two upper grooves of the piston have a groove or bevel cut around the inner edge on one side. The top compression ring is installed with this groove or bevel up. The lower compression ring is installed with bevel down. The oil ring, in the lower groove, consists of two thin steel rails separated by a spacer. It is backed by a hump-type spring-steel expander.

V-6 engine cylinder heads are made of cast iron. Their valve guides are cast integrally. Right and left cylinder heads are identical and interchangeable. In service, however, it is good practice to install the cylinder heads on the side from which they were removed.

The valves are in line in each head, at an angle 10° above the centerline of the cylinder bores. Each valve has a spring strong enough to ensure positive valve seating throughout the operating speed range of the engine. The valve rocker arm mechanism is protected by a sheet metal cover. This cover is seated on a raised surface of the cylinder head. It is gasketed to prevent oil leaks. The rocker arms for each bank of cylinders are mounted on a tubular steel shaft, supported on the cylinder head by brackets. The rocker arms are made of aluminum. They have inserts at the push rod socket and the valve stem contact face. The camshaft is located above the crankshaft between the two cylinder banks; it is supported in four steel-backed babbitt-metal bearings. The camshaft is driven at one-half crankshaft speed by sprockets and a single outside-guide type chain. Hydraulic valve lifters and one-piece push rods operate overhead rocker arms and valves of both banks of cylinders from a single camshaft. This system requires no lash adjustment during assembly or in service.

In addition to its normal function of a cam follower, each hydraulic valve lifter also serves as an auto-



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FIG. D1-1—DAUNTLESS V-6 ENGINE, SIDE SECTIONAL VIEW

- | | | |
|--------------------------|-----------------------------------|------------------------------------|
| 1—Fan Blade | 14—Push Rod | 27—Front Center Main Bearing Shell |
| 2—Fan Spacer | 15—Camshaft | 28—Crankshaft |
| 3—Fan Pulley | 16—Flywheel | 29—Front Main Bearing Shell |
| 4—Water Pump | 17—Clutch Pressure Plate | 30—Timing Chain |
| 5—Timing Chain Cover | 18—Clutch Driven Plate | 31—Crankshaft Sprocket |
| 6—Camshaft Sprocket | 19—Clutch Pilot Bearing | 32—Oil Slinger |
| 7—Thermostat Bypass Hose | 20—Oil Seal Packing | 33—Oil Shedder |
| 8—Thermostat Housing | 21—Rear Main Bearing Shell | 34—Oil Shedder Packing |
| 9—Thermostat | 22—Connecting Rods | 35—Woodruff Key |
| 10—Carburetor | 23—Rear Center Main Bearing Shell | 36—Vibration Damper |
| 11—Intake Manifold | 24—Oil Screen | 37—Crankshaft Pulley |
| 12—Rocker Arm Cover | 25—Oil Screen Pipe and Housing | 38—Fan Belt |
| 13—Cylinder Block | 26—Oil Pan | |

matic adjuster, to prevent lash in the valve operating linkage. Hydraulic valve lifters also provide a cushion of oil to absorb operating shocks. As shown in Fig. D1-3, all parts of a hydraulic lifter are housed in the body, which is the cam follower. At the beginning of valve operation, the valve lifter body rests on the camshaft base circle. Plunger spring tension prevents lash clearances in the valve linkage.

As the camshaft forces the valve lifter body upward, both oil in the lower chamber and check ball spring tension firmly seat the check ball against the plunger to prevent appreciable loss of oil from the lower chamber. Oil pressure forces the plunger upward, with the body, to operate the valve linkage. As the camshaft rotates to closed-valve position,

the valve spring forces the linkage and lifter downward. When the engine valve seats, the linkage parts and plunger stop, but the plunger spring forces the body downward .002" to .003" [0,050 a 0,076 mm.] until it again rests on the camshaft base circle. Oil pressure then forces the check ball away from its seat and allows passage of oil past the check ball into the lower chamber. This replaces the slight amount of oil lost by leakage. During the valve opening and closing operation, a very slight amount of oil escapes between plunger and body, and returns to the crankcase. This slight loss of oil (leak-down) is beneficial. It provides a gradual change of oil in the valve lifter; fresh oil enters the lower chamber at the end of each cycle of operation.

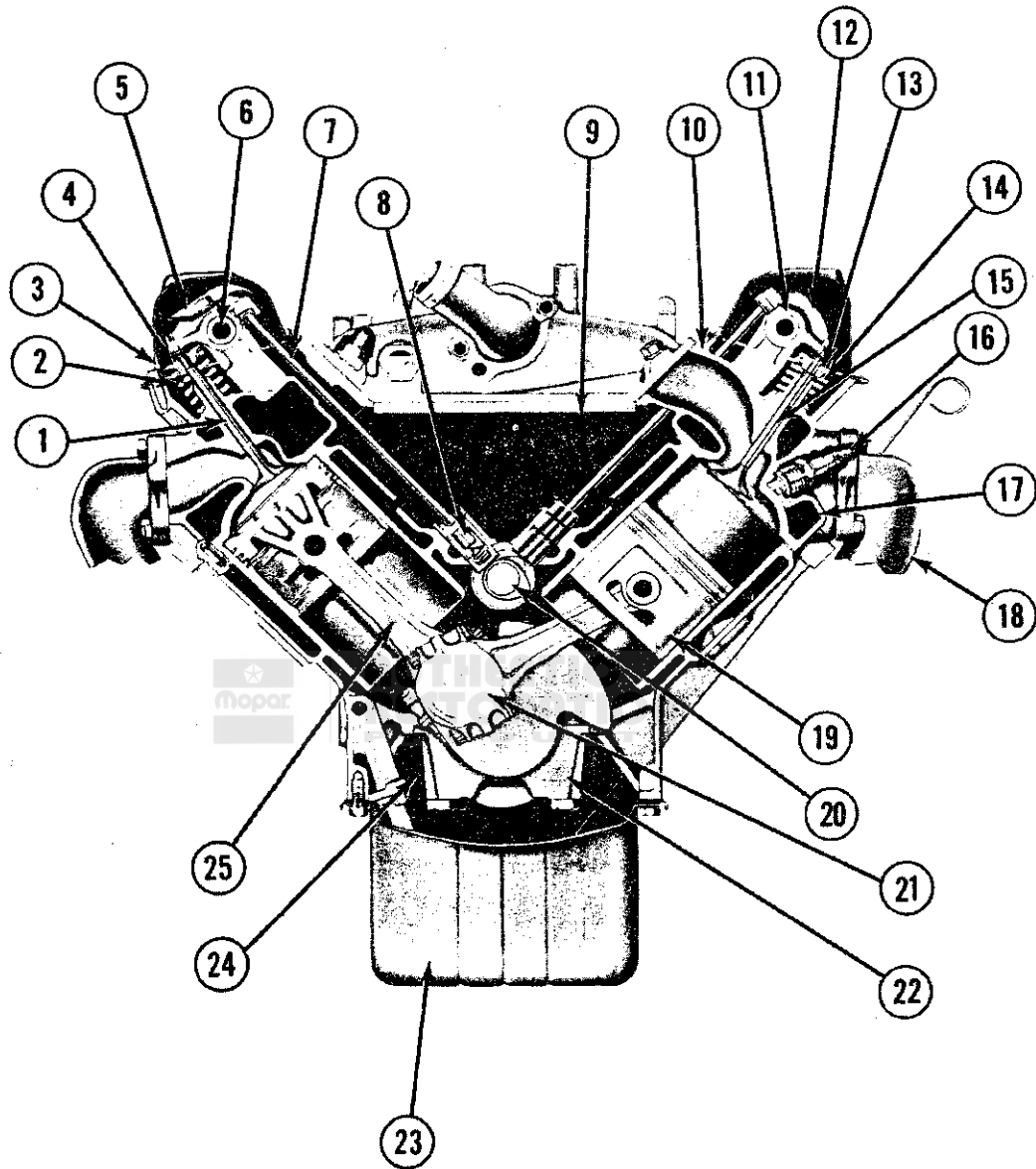


FIG. D1-2—DAUNTLESS V-6 ENGINE, FRONT SECTIONAL VIEW

- | | | |
|---------------------------------|---------------------------------|---------------------|
| 1—Exhaust Valve | 10—Cylinder Head | 19—Piston |
| 2—Exhaust Valve Spring | 11—Rocker Arm Shaft | 20—Camshaft |
| 3—Rocker Arm Cover | 12—Intake Rocker Arm | 21—Crankshaft |
| 4—Exhaust Valve Spring Retainer | 13—Intake Valve Spring Retainer | 22—Main Bearing Cap |
| 5—Exhaust Rocker Arm | 14—Intake Valve Spring | 23—Oil Pan |
| 6—Rocker Arm Shaft | 15—Intake Valve | 24—Crankcase |
| 7—Push Rod | 16—Spark Plug | 25—Connecting Rod |
| 8—Tappet | 17—Water Passages | |
| 9—Tappet Cover | 18—Exhaust Manifold | |

The engine is pressure lubricated. The oil pump is located on the timing chain cover and discharges oil through an oil filter into main oil galleries in the crankcase to deliver oil to all crankshaft and camshaft bearings. Piston pins are lubricated by

splash. The timing chain is lubricated by splash of an oil stream from which oil is directed to the distributor drive gear from the fuel pump eccentric on the camshaft. Rocker arms are lubricated from the oil galleries in the cylinder block through pas-

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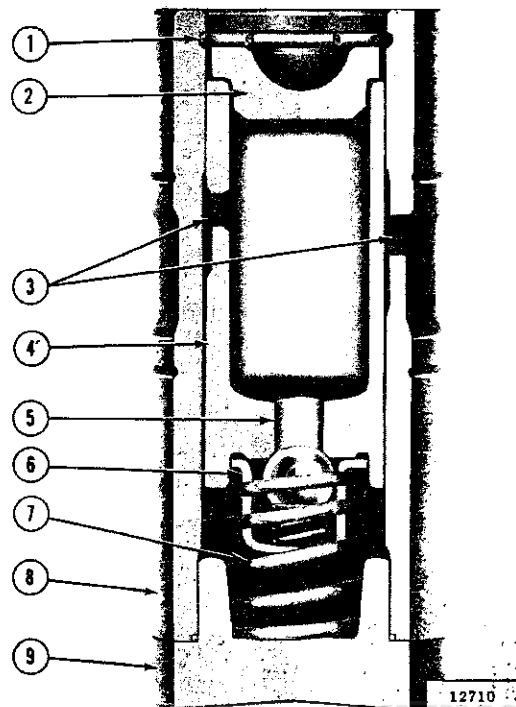


FIG. D1-3—HYDRAULIC VALVE LIFTER ASSEMBLY, CROSS-SECTIONAL VIEW

- | | |
|--------------|------------------|
| 1—Snap Ring | 6—Ball Retainer |
| 2—Rod Seat | 7—Plunger Spring |
| 3—Oil Inlets | 8—Lifter Body |
| 4—Plunger | 9—Bronzed Cap |
| 5—Feed Hole | |

sages in the block and cylinder head.

The water cooled system is pressurized to provide efficient engine cooling. It consists of a centrifugal-type water pump, mounted on the timing chain cover, and is driven by the engine fan pulley. The pump provides coolant flow equally to both cylinder banks under control of a thermostat. Coolant flow is around the cylinders and through the cylinder head to dispel the heat of combustion in the engine.

D1-3. Engine Mounts

The engine-transmission unit is mounted to the chassis at three points by rubber pads. The two front mounts are bolted to the engine cylinder block and the frame members. These mounts support most of the engine weight, and absorb vibration which would otherwise be caused by changes in engine output torque. The single rear mount is placed between the transmission and the transmission support. It supports part of the engine and transmission weight, and locates the rear of the engine with respect to the centerline of the vehicle.

D1-4. ENGINE REMOVAL

To remove the engine from the vehicle follow the procedures listed below:

- a. Remove hood.
- b. Disconnect battery cables from battery and engine.

- c. Remove air cleaner.
 - d. Drain coolant from radiator and engine.
 - e. Drain engine oil.
 - f. Disconnect alternator wiring harness from connector at regulator.
 - g. Disconnect the fuel evaporative purge line connected to the P.C.V. valve.
 - h. Disconnect upper and lower radiator hoses from the engine.
 - i. Remove right and left radiator support bars.
 - j. Remove radiator from the vehicle.
 - k. Disconnect engine wiring harnesses from connectors located on engine firewall.
 - l. On engines equipped with exhaust emission control, remove the air pump, air distribution manifold, and anti-backfire (gulp) valve. See Section F2 for procedure.
 - m. Disconnect battery cable and wiring from engine starter assembly.
 - n. Remove engine starter assembly from engine.
 - o. Disconnect engine fuel hoses from fuel lines at right frame rail.
 - p. Plug fuel lines.
 - q. Disconnect choke cable from carburetor and cable support bracket mounted on engine.
 - r. Disconnect exhaust pipes from right and left engine manifolds.
 - s. Place jack under transmission and support transmission weight.
 - t. Remove bolts securing engine to front motor mounts.
 - u. Attach suitable sling to engine lifting eyes and, using hoist, support engine weight.
 - v. Remove bolts securing engine to flywheel housing.
 - w. Raise engine slightly and slide engine forward to remove transmission main shaft from clutch plate spline.
- Note:** Engine and transmission must be raised slightly to release the main shaft from the clutch plate while sliding the engine forward.
- x. When engine is free of transmission shaft raise engine and remove from vehicle.
 - y. Place engine on suitable blocking or engine stand and remove sling from engine.

D1-5. ENGINE DISASSEMBLY

Engine disassembly is presented in the sequence to be followed when the engine is to be completely overhauled after removal from the vehicle. Some of the operations of the procedure are also applicable separately with the engine in the vehicle, provided that wherever necessary the part of the engine to be worked on is first made accessible by removal of engine accessories or other parts. When the disassembly operations are performed with the engine out of the vehicle, it is assumed, in this procedure, that all of the accessories have been removed prior to starting the disassembly and the oil has been drained.

In addition to the instructions covering operations for disassembling the engine out of the vehicle, special instructions are given to cover different operations required when disassembly is done with the engine installed.

During disassembly operations, the engine should be mounted in a suitable engine repair stand. Where practicable, modify or adapt an existing repair stand as necessary to accommodate the engine. If an engine repair stand is not used, take care to perform disassembly operations in a manner that will protect personnel against an accident and the engine and its parts against damage.

D1-6. Mounting Engine On Engine Stand

Refer to Fig. D1-4.

- a. With the engine supported by a hoist, remove the clutch housing and clutch. Match mark the flywheel and the clutch cover before disassembly to assure proper reassembly.
- b. Position the engine on the engine stand.
- c. Release some tension of the hoist cables and secure engine to stand.
- d. Make sure the position lock on the engine stand is tight to prevent the engine from accidentally inverting.
- e. Release the hoist cables.

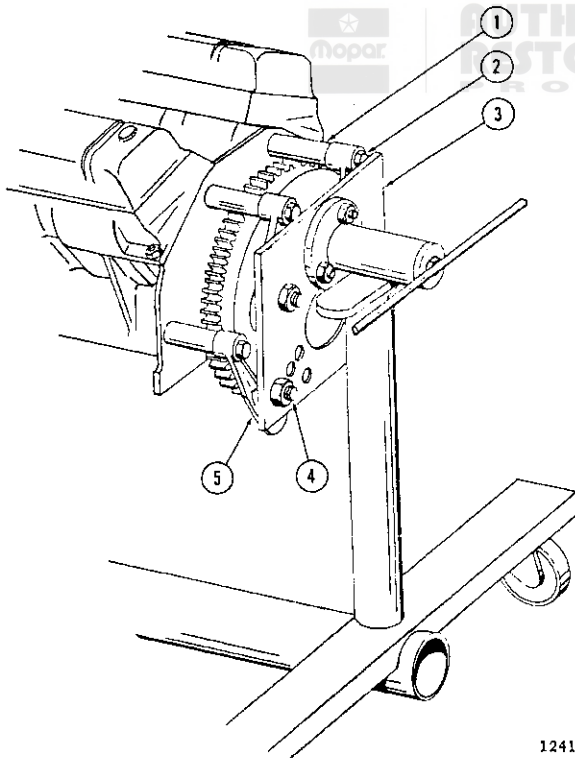


FIG. D1-4—ENGINE MOUNTED ON STAND

- | | |
|-------------------------|-------------------------|
| 1—Spacer J-8690-6 | 4—Bolt, 1/2-NC x 3 1/2" |
| 2—Bolt, 3/8-NC x 4 1/2" | 5—Adapter 21316-1 |
| 3—Engine Mounting Stand | |

D1-7. Remove Intake Manifold and Carburetor Assembly

Disconnect crankcase vent hose, distributor vacuum hose, and fuel line from carburetor. Disconnect

two distributor leads from ignition coil. Disconnect wiring harness from coolant temperature sending unit. Remove ten cap bolts which attach intake manifold to cylinder heads. Remove intake manifold assembly and gaskets from engine.

D1-8. Remove Exhaust Manifold

The engine has two exhaust manifolds. Remove five attaching screws, one nut, and exhaust manifold from each cylinder head.

D1-9. Remove Distributor

Disconnect vacuum hose and wiring harness from distributor. Disconnect spark plug cables from spark plugs. Remove spark plugs from engine. Pull spark plug cable retainers from brackets on rocker arm covers. Remove mounting screw, retainer bracket, and distributor from timing chain cover. If timing chain and sprockets are not to be removed from engine, note position of distributor rotor so that it can be installed in identical position.

D1-10. Remove Fuel Pump

Disconnect output fuel line from fuel pump. Remove two mounting bolts, fuel pump, and gasket from timing chain cover.

D1-11. Remove Alternator and Fan Belt

Disconnect wiring harness from alternator. Remove nut and flat washer which fasten alternator to adjustment bracket. Pivot alternator inward, toward engine cylinder block, to relieve fan belt tension. Remove fan belt from pulleys. Remove two attaching screws, mounting bracket, and alternator from right cylinder head of engine.

D1-12. Remove Cooling Fan and Water Pump

Refer to Fig. D1-5.

Remove four cap screws, lock washers, cooling fan, fan hub, and fan drive pulley from flange of water pump shaft. Remove nine attaching screws, water pump, alternator adjustment bracket, and water pump from timing chain cover.

D1-13. Remove Oil Filter

Unscrew oil filter from engine oil pump.

D1-14. Remove Starter Motor

Disconnect wiring harness from starter motor and solenoid. Remove two attaching screws, starter motor, solenoid, and motor attaching bracket from engine flywheel housing and cylinder block.

D1-15. Remove Oil Pressure Sending Unit

Disconnect wiring harness from oil pressure sending unit. Remove oil pressure sending unit from engine cylinder block.

D1-16. Remove Oil Dipstick

Withdraw and remove oil level dipstick and dipstick tube from engine cylinder block.

D1-17. Remove Crankshaft Pulley

Remove six attaching screws and crankshaft pulley from crankshaft vibration damper.

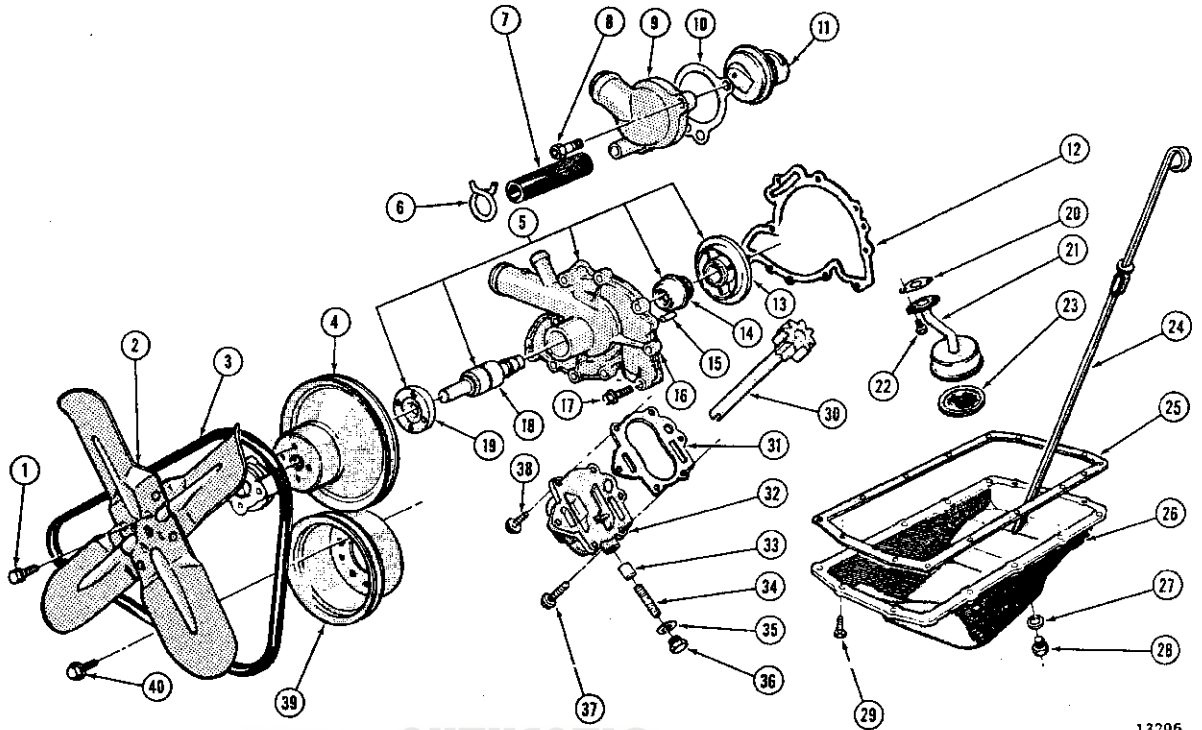


FIG. D1-5—ENGINE LUBRICATION AND COOLING PARTS

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- | | | |
|------------------------------------|---|---|
| 1—Bolt and Lock Washer | 15—Dowel Pin 1/4 x 1/2" | 29—Screw and Lock Washer 5/16-18 x 3/8" |
| 2—Fan Assembly | 16—Water Pump Cover | 30—Oil Pump Shaft and Gear |
| 3—Fan and Alternator Belt | 17—Bolt, 1/4-20 x 1" | 31—Oil Pump Cover Gasket |
| 4—Fan Driven Pulley | 18—Water Pump Shaft and Bearing | 32—Valve Bypass and Cover Assembly |
| 5—Water Pump Assembly | 19—Fan Hub | 33—Oil Pressure Valve |
| 6—Hose Clamp | 20—Oil Suction Pipe Gasket | 34—Valve Bypass Spring |
| 7—Thermostat Bypass Hose | 21—Oil Suction Housing, Pipe and Flange | 35—Oil Pressure Valve Cap Gasket |
| 8—Hex Head Bolt | 22—Bolt, 1/4-20 x 3/8" | 36—Oil Pressure Valve Cap |
| 9—Water Outlet Elbow | 23—Oil Pump Screen | 37—Screw 1/4-20 x 1 3/8" |
| 10—Water Outlet Elbow Gasket | 24—Oil Dipstick | 38—Screw 1/4-20 x 1 1/8" |
| 11—Thermostat | 25—Oil Pan Gasket | 39—Fan Driving Pulley |
| 12—Water Pump Gasket | 26—Oil Pan Assembly | 40—Hex. Head Bolt, 5/16 x 1" |
| 13—Impeller and Insert, Water Pump | 27—Drain Plug Gasket | |
| 14—Water Pump Seal | 28—Drain Plug | |

D1-18. Remove Crankshaft Vibration Damper

Refer to Fig. D1-6.

Remove cap screw and flat washer which attach crankshaft vibration damper to crankshaft. Tap vibration damper with a soft-headed hammer to remove it from crankshaft.

D1-19. Remove Oil Pump

Remove five screws, oil pump cover, and gasket from right side of timing chain cover. Remove two oil pump gears.

D1-20. Remove Timing Chain Cover

Refer to Fig. D1-6.

Remove two bolts which attach oil pan to timing chain cover. Remove five mounting bolts, timing chain cover, and gasket from cylinder block of engine.

Note: Water pump must be removed from timing chain cover before timing chain cover is removed from cylinder block.

D1-21. Remove Crankshaft Front Oil Seal

Refer to Fig. D1-6.

Use timing cover aligner and oil seal remover tool J-22248 to remove oil seal.

D1-22. Remove Timing Chain and Spocket

a. Temporarily install vibration damper (Fig. D1-6) bolt and washer in end of crankshaft. Turn crankshaft so sprockets are positioned with index marks aligned as shown in Fig. D1-7. This will make it easier to install parts. Remove vibration damper bolt and washer; rap the wrench handle sharply to start the bolt without changing position of sprockets.

Note: It is not necessary to remove timing chain dampers unless they are worn or damaged and require replacement.

b. Remove front crankshaft oil slinger.

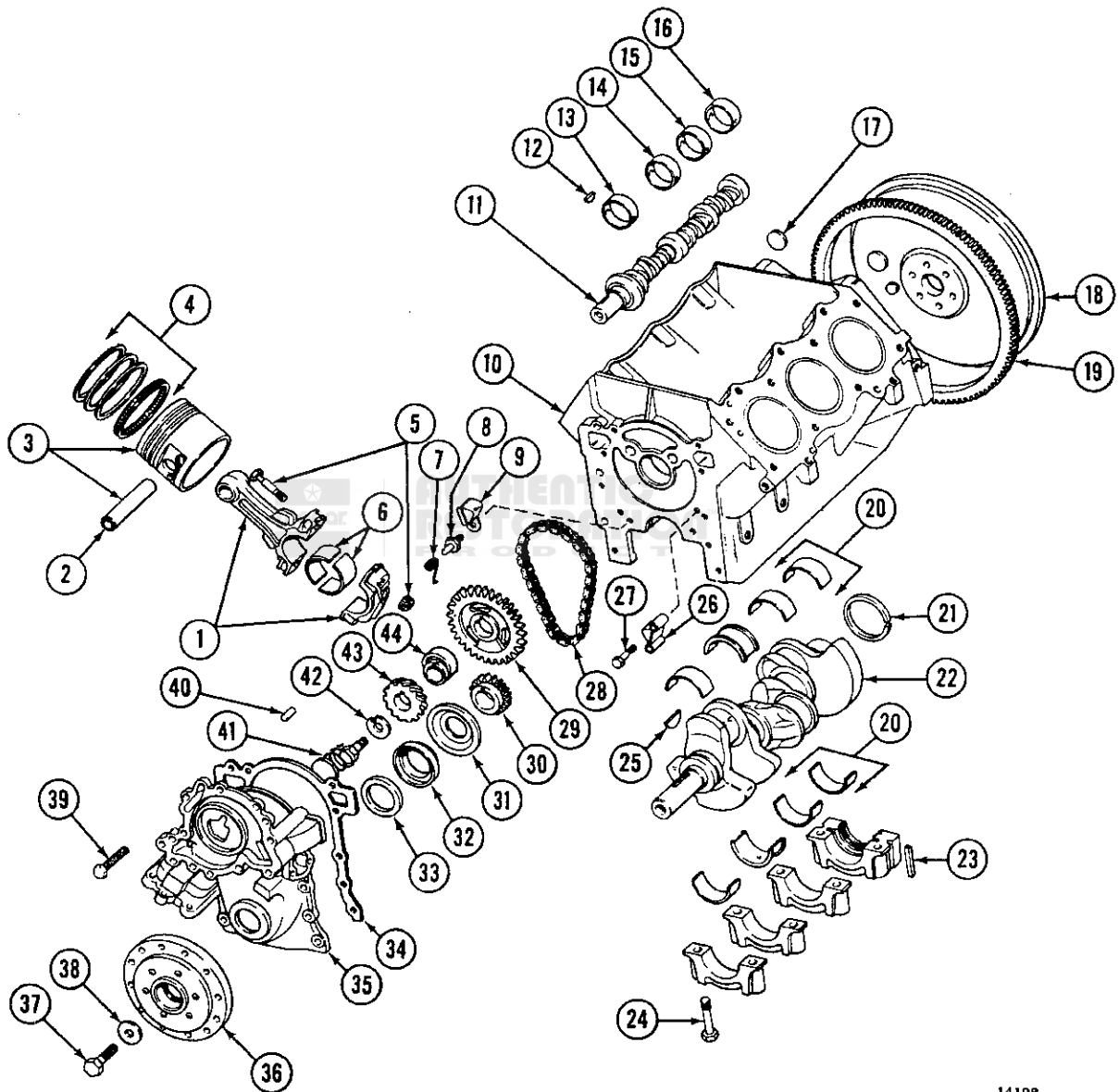
c. Remove bolt and special washer which retain camshaft distributor drive gear and fuel pump eccentric at forward end of camshaft. Remove gear and eccentric from camshaft.

d. Use two large screwdrivers to alternately pry forward the camshaft sprocket and then the crankshaft sprocket, until the camshaft sprocket is pried from the camshaft. Remove the camshaft sprocket, sprocket key, and timing chain from the engine; then pry the crankshaft sprocket from the crankshaft.

D1-23. Remove Rocker Arm Cover

Refer to Fig. D1-8.

Remove positive crankcase ventilator valve from right rocker arm cover. Remove four screws which attach each rocker arm cover to cylinder head. Remove each rocker arm cover and gasket from cylinder head.



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FIG. D1-6—ENGINE CRANKCASE PARTS

- | | | |
|-----------------------------------|---|--------------------------------------|
| 1—Connecting Rod Assy. | 16—Camshaft Bearing (No. 4 Rear) | 31—Crankshaft Slinger |
| 2—Piston Pin | 17—Camshaft Plug (Rear) | 32—Crankshaft Shedder |
| 3—Piston and Pin Assy. | 18—Flywheel | 33—Crankshaft Packing (Front) |
| 4—Ring Set | 19—Ring Gear | 34—Timing Gear Cover Gasket |
| 5—Connecting Rod Bolt and Nut | 20—Crankshaft Bearing Set | 35—Timing Gear Cover |
| 6—Connecting Rod Bearing | 21—Main Bearing Oil Seal (Rear) | 36—Vibration Damper |
| 7—Damper Spring | 22—Crankshaft | 37—Bolt |
| 8—Damper Bolt | 23—Main Bearing Packing Oil Seal (Rear) | 38—Washer |
| 9—Timing Chain Damper (Right) | 24—Bearing Cap Bolt | 39—Bolt |
| 10—Cylinder Block | 25—Woodruff Key | 40—Dowel Pin |
| 11—Camshaft | 26—Timing Chain Damper (Left) | 41—Camshaft Thrust Retainer and Bolt |
| 12—Woodruff Key | 27—Damper Bolt | 42—Washer |
| 13—Camshaft Bearing (No. 1 Front) | 28—Timing Chain | 43—Distributor Drive Gear |
| 14—Camshaft Bearing (No. 2) | 29—Camshaft Sprocket | 44—Fuel Pump Eccentric |
| 15—Camshaft Bearing (No. 3) | 30—Crankshaft Sprocket | |

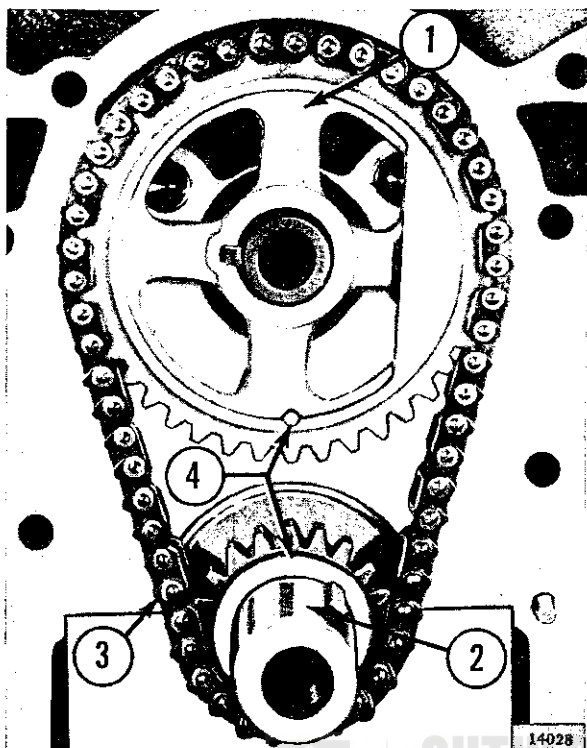


FIG. D1-7—TIMING CHAIN AND SPROCKET ALIGNMENT

- 1—Camshaft Sprocket
- 2—Crankshaft
- 3—Timing Chain
- 4—Timing Marks

D1-24. Remove Cylinder Head Assembly

- a. Unscrew, but do not remove, three bolts (Fig. D1-8) which attach rocker arm assembly to cylinder head. Remove rocker arm assembly, with bolts, from cylinder head. See Section F2 for engines equipped with exhaust emission control.
- b. Remove eight cylinder head bolts, cylinder head, and gasket from cylinder block.

D1-25. Remove Push Rod and Valve Lifter

Refer to Fig. D1-8.

Remove push rods and valve lifters from the cylinder block. Mark, or otherwise identify, each valve lifter according to its cylinder and valve position.

Note: If valve lifters are not to be serviced, cover valve lifters and camshaft with a clean cloth to protect them from dirt.

D1-26. Remove Camshaft

Refer to Fig. D1-6.

Carefully withdraw camshaft forward from bearing bores; avoid marring the bearing surfaces. Remove camshaft from cylinder block.

D1-27. Remove Flywheel Housing and Clutch

- a. If flywheel housing and clutch was not previously removed, remove six mounting bolts and flywheel housing from cylinder block.
- b. Mark clutch cover and flywheel to assure that

clutch will be installed in identical position when engine is assembled.

- c. Remove six attaching screws and clutch assembly from flywheel.

D1-28. Remove Flywheel

Refer to Fig. D1-6.

Remove six attaching bolts and flywheel from engine crankshaft.

D1-29. Remove Oil Pan

Refer to Fig. D1-5.

To gain access to oil pan mounting bolts, invert the engine. Remove mounting bolts, oil pan, and gasket from engine cylinder block.

D1-30. Remove Oil Pump Intake Pipe and Screen

Refer to Fig. D1-5.

Remove two attaching screws, and oil pump intake pipe and screen assembly from engine cylinder block.

D1-31. Remove Piston and Connecting Rod Assembly

- a. Examine the cylinder bores. If bores are worn so that shoulder or ridges exist at the top of piston ring travel, remove the ridges with a ridge reamer.

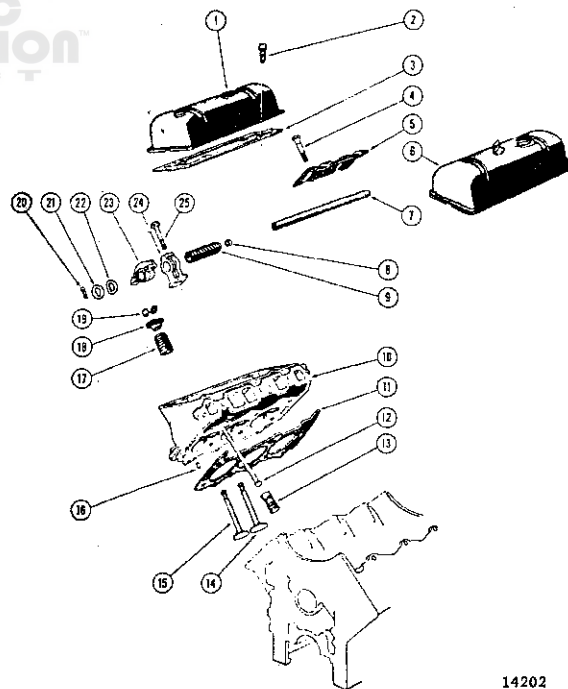


FIG. D1-8—CYLINDER HEAD, ROCKER ARM AND COVER

- 1—Right Rocker Arm Cover
- 2—Rocker Arm Cover Bolt
- 3—Gasket
- 4—Bolt
- 5—Baffle
- 6—Left Rocker Arm Cover
- 7—Rocker Arm Shaft
- 8—Plug
- 9—Rocker Arm Spring
- 10—Cylinder Head
- 11—Head Gasket
- 12—Push Rod
- 13—Valve Lifter
- 14—Intake Valve
- 15—Exhaust Valve
- 16—Dowel Pin
- 17—Valve Spring
- 18—Valve Spring Cap
- 19—Valve Spring Cap Key
- 20—Cotter Pin
- 21—Rocker Arm Shaft End Washer
- 22—Rocker Arm Shaft Spring
- 23—Rocker Arm
- 24—Rocker Arm Shaft Bracket
- 25—Bolt

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This will prevent damage to piston rings or cracking piston lands during removal.

b. Use a silver pencil or quick-drying paint to mark the cylinder number on all pistons, connecting rods, and caps. Starting at the front end of the crankcase, the cylinders in the right bank are numbered 2-4-6 and in the left bank are numbered 1-3-5.

c. Remove cap and lower connecting rod bearing half from No. 1 connecting rod.

d. Push the piston and rod assembly away from the crankshaft and remove it from top of cylinder bore. Then install cap and lower bearing half on connecting rod.

e. Remove each connecting rod and piston assembly as described in c and d, above.

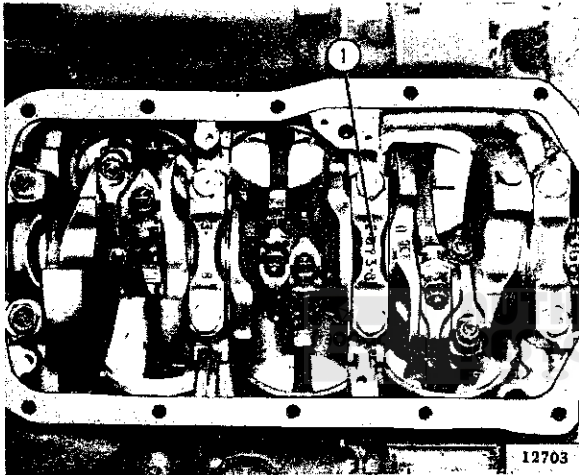


FIG. D1-9—CRANKSHAFT MAIN BEARING CAPS

1—Thrust Bearing

D1-32. Remove Main Bearing and Crankshaft

a. This engine has four crankshaft main bearings. Front to rear, they are numbered 1 to 4. Refer to Fig. D1-9. With a silver pencil or quick-drying paint, mark the bearing number on each main bearing cap.

b. Remove two bolts which secure first (front) main bearing cap to engine cylinder block. With a lifting bar, carefully pry the cap from the crankshaft and block. Be careful not to damage the cap, block or crankshaft. Remove the bearing cap, with lower main bearing half, from the cylinder block. Keep bearing half and cap together. Similarly, remove the next two main bearing caps with lower main bearing halves. To remove rear main bearing cap, use rear main bearing remover bolt W-323.

c. Remove the fabric seal from inside diameter of fourth (rear) main bearing cap, and remove neoprene composition seal from outer surface of this bearing cap. Discard both seals.

d. Lift and remove the crankshaft from engine cylinder block. Do not remove upper main bearing halves from block or lower main bearing halves from caps at this time. Mount main bearing caps in their original positions.

D1-33. ENGINE CLEANING, INSPECTION, AND REPAIR

The cleaning, inspection, and repair procedures detailed herein are recommended to be followed when a complete engine overhaul is to be made with the engine out of the vehicle. These instructions can generally be applied individually with the engine in the vehicle. Wherever the procedure differs due to the engine being in the vehicle, the necessary special instructions are provided. Inspection and repair instructions are included to cover the cylinder block, cylinder head, crankshaft and bearings, connecting rods and bearings, oil pump, valves and tappets, pistons and rings, flywheel, timing gears, and the camshaft and bearings. In addition, fitting operations for these engine components are included.

D1-34. Cylinder Block

The cylinder block must be cleaned thoroughly, inspected, and repaired as necessary, as described below.

D1-35. Cylinder Block Cleaning

Steam-clean the cylinder block, or clean it with a suitable cleaning solvent. A scraper can be used to remove hard deposits, but do not score machined surfaces. Be certain that oil passages, valve chambers, crankcase, and cylinder walls are free from sludge, dirt, and carbon deposits. After cleaning, dry the cylinder block carefully with compressed air.

D1-36. Cylinder Block Inspection

a. Inspect cylinder walls visually for scoring, roughness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gauge. Measure each bore at top, middle and bottom, both parallel to and at right angles to the centerline of the engine. The diameter of the cylinder bores at any point

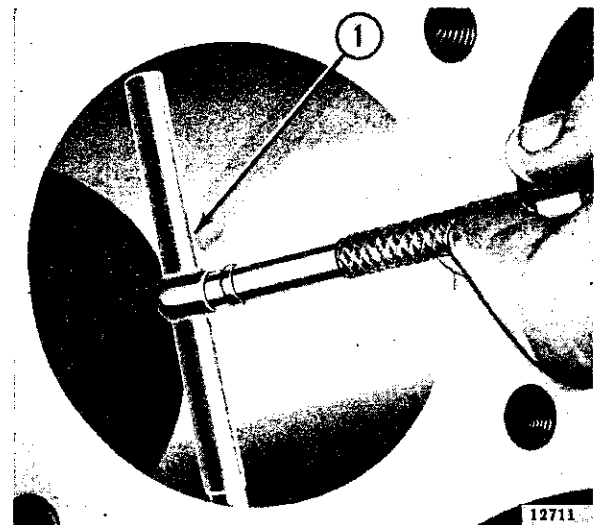
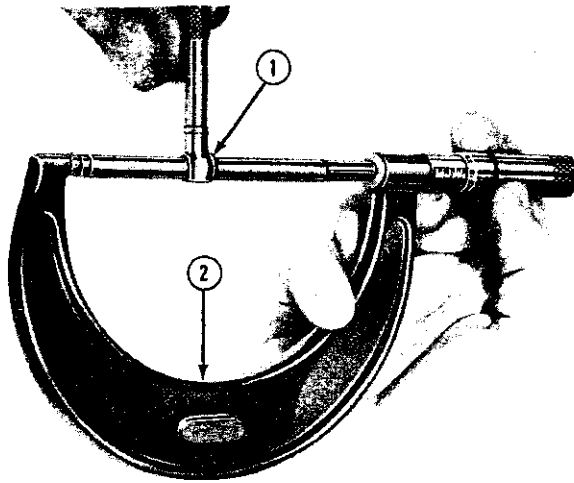


FIG. D1-10—MEASURING CYLINDER BORE

1—Telescope Gauge [90° From Piston Pin]



12713

FIG. D1-11—MEASURING TELESCOPE GAUGE

1—Telescope Gauge
2—Micrometer

may be measured with an inside micrometer or by setting the cylinder gauge dial at zero and measuring across the gauge contact points with an outside micrometer while the gauge is at same zero setting. Refer to Figs. D1-10 and D1-11.

b. If a cylinder bore is moderately rough or slightly scored, but is not out-of-round or tapered, it is usually possible to remedy the situation by honing the bore to fit a standard service piston, since standard service pistons are high-limit production pistons. If cylinder bore is very rough or deeply scored, it may be necessary to rebore the cylinder to fit an oversize piston in order to ensure satisfactory results.

c. If cylinder bore is tapered .005" [0,127 mm.] or more or is out-of-round .003" [0,076 mm.] or more, it is advisable to rebore for the smallest possible oversize piston and rings.

d. Carefully inspect the cylinder block for small cracks or fractures, and for porosity. Rust in any cylinder bore may indicate a leak.

e. Inspect all machined surfaces for scoring and burrs. With a straight edge and feeler gauge, check each machined surface for distortion.

D1-37. Cylinder Block Repair

If one or more cylinder bores are rough, scored, or worn beyond prescribed limits, it will be necessary to correct bores and fit new pistons.

If relatively few bores require correction, it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance, since all oversize pistons are held to the same weights as standard-size pistons. If conditions justify replacement of all pistons, however, all new pistons should be the same nominal size.

Standard-size service pistons are high-limit, or maximum diameter; therefore, they can usually be installed after a slight amount of honing has been done to correct slight scoring or excessive clearances. This applies primarily to engines which have relatively low mileage. Service pistons are

also furnished in .010" [0,254 mm.] oversize. All service pistons are diamond bored, and selectively fitted with piston pins; pistons are not furnished without pins.

Caution: Do not attempt to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearance.

Before honing or reboring cylinders, measure all new pistons with a micrometer, on an axis perpendicular to the piston pin. Select the smallest piston for the first fitting. The slight variation usually found between pistons in a set may provide for correction in case the first piston tried is too small.

If wear at top of cylinder does not exceed .005" [0,127 mm.] excess diameter, or exceed .003" [0,076 mm.] out-of-round, honing is recommended. If wear or out-of-round exceeds these limits, the bore should be reground with a boring bar of the fly cutter type, then finish-honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When boring, leave the diameter .001" [0,025 mm.] undersize, then finish hone to obtain the required clearance.

When honing cylinders, use clean sharp stones of proper grade for the amount of metal to be removed. Refer to instructions supplied by the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones, leave sufficient metal so that all stone marks can be removed with the fine stones used to finish-hone to proper clearance.

When finish-honing, pass the hone through the entire length of cylinder at a rate of approximately 60 cycles per minute. This should produce the desired 45-degree cross hatch pattern on cylinder walls. A proper pattern will ensure maximum ring life and minimum oil consumption.

After final honing and before the piston is checked for fit, each cylinder bore must be washed thoroughly to remove all traces of abrasive, then dried completely. The dry bore should be brushed clean with a power-driven fibre brush. If all traces of abrasive are not removed, rapid wear of new pistons and rings will result.

Note: Wipe cylinder bores with a clean white cloth, moistened with SAE 10 oil. Cleaning should continue until this test shows no sign of dirt.

It is of the greatest importance that refinished cylinder bores be true, with .0005" [0,013 mm.] or less out-of-round or taper. Each bore must have a smooth surface, without stone or cutter marks. After final honing and cleaning, each piston must be fitted individually to the bore in which it will be installed. Once fitted, each piston should be marked with its cylinder number to assure correct installation.

D1-38. Crankshaft Cleaning

Clean the crankshaft thoroughly with a suitable cleaning solvent. Clean drilled oil passages in its journals with a small rifle brush to remove all sludge or gum deposits; dry passages with compressed air.

D1-39. Crankshaft Inspection and Repair

If the crankshaft has not been removed from the cylinder block for inspection, disconnect two connecting rods at a time from crankshaft. Inspect the bearings and crankpin journals. While turning crankshaft, it is necessary to temporarily reconnect the rods to crankshaft to avoid possibility of damaging the journals through contact with unconnected rods.

Inspect the crankpins visually for excessive or irregular wear, and for scoring. Use an outside micrometer to check crankpins for out-of-round. Standard crankpin diameter is 2.0000" [5,080 cm.]. If crankpins are more than .0015" [0,0381 mm.] out-of-round, new bearings cannot be expected to have satisfactory life.

If the crankshaft has been removed from the cylinder block for inspection support it on V-blocks at its main bearing journals 1 and 4. Inspect the main bearing journals visually for excessive or irregular wear, and for scoring. Standard main bearing journal diameter is 2.4995" [6,349 cm.]. Total indicator readings at each journal should not exceed .003" [0,076 mm.].

Check run out at all four journals and note high spot (maximum eccentricity) of each journal. High spot of each journal should come at the same angular location. If high spots do not coincide, crankshaft is misaligned and unsatisfactory for service.

If crankpin or main bearing journals are scored, ridged, or out-of-round, the crankshaft must be replaced or reground to a standard undersize bearing diameter to ensure satisfactory life of bearings. Slight roughness can be removed with a fine grit polishing cloth thoroughly wetted with engine oil. Burrs can be honed with a fine oil stone, so long as bearing clearances will remain within specified limits.

D1-40. Crankshaft Main Bearings

A crankshaft bearing consists of two halves which are neither alike nor interchangeable. One half is carried in the corresponding main bearing cap; the other half is located between the crankshaft and cylinder block. The upper (cylinder block) half of the bearing is grooved to supply oil to the connecting rod bearings, while the lower (bearing cap) half of the bearing is not grooved. The two bearing halves must not be interchanged. All crankshaft bearings except the thrust bearing and the rear main bearing are identical. The thrust bearing (No. 2) is longer and it is flanged to take crankshaft end thrust. When the bearing halves are placed in cylinder block and bearing cap, the ends extend slightly beyond the parting surfaces. When cap bolts are tightened, the halves are clamped tightly in place to ensure positive seating and to prevent turning. The ends of bearing halves must

never be filed flush with parting surface of crankcase or bearing cap.

Crankshaft bearings are the precision type which do not require reaming to size or other fitting. Shims are not provided for adjustment since worn bearings are readily replaced with new bearings of proper size. Bearings for service replacement are furnished in standard size and undersizes. Under no circumstances should crankshaft bearing caps be filed to adjust for wear in old bearings.

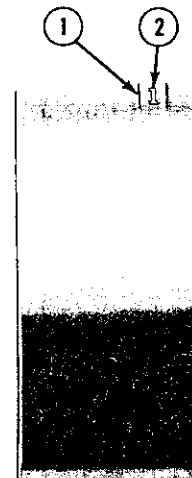
D1-41. Crankshaft Main Bearing Cleaning and Inspection

Clean main bearing surfaces. Inspect the bearings visually for excessive or uneven wear, scoring, and flaking. Visibly worn or damaged bearings must be replaced. It is necessary to check radial clearance of each new or used crankshaft main bearing before installation. This can be done by either of two methods, which are described in Pars. D1-42 and D1-43.

a. The desired radial clearance of a new bearing is .0005" to .0021" [0,0127 a 0,0534 mm.].

b. Replacement bearings are furnished in standard size, and in several undersizes, including undersizes for reground journals. If a new bearing is to be installed, try a standard size; then try each undersize in turn until one is found that meets the specified clearance limits.

Note: Each undersize bearing half has a number stamped on its outer surface to indicate amount of undersize. Refer to Fig. D1-12.



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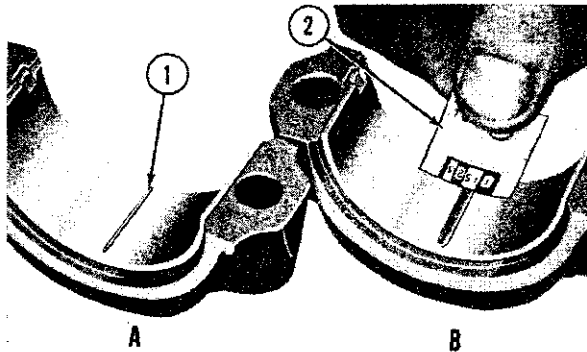
FIG. D1-12—LOCATION OF UNDERSIZE MARK ON BEARING SHELL

1—Tang
2—Undersize Mark

D1-42. Main Bearing Fitting, Plastigage

Bearing clearance can be checked by use of Plastigage, Type PG-1 (green) which has a range of .001" to .003" [0,025 a 0,076 mm.]. Refer to Fig. D1-13.

a. Place a piece of Plastigage lengthwise along the bottom center of the lower bearing half, then



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FIG. D1-13—USING PLASTIGAGE TO MEASURE BEARING CLEARANCE

- 1—Plastigage
- 2—Scale
- A—Start
- B—Flattened

install cap with shell and tighten bolts 80 to 110 lb-ft. [11,1 a 15,2 kg-m.] torque.

Caution: Do not turn crankshaft with Plastigage in bearing.

b. Remove bearing cap with bearing half. The flattened Plastigage will adhere either to the bearing half or the journal. Do not remove it.

c. Using the scale printed on the Plastigage envelope, measure Plastigage width at its widest point. The number within the graduation which most closely corresponds to the width of Plastigage indicates the bearing clearance in thousandths of an inch.

D1-43. Main Bearing Fitting, Feeler or Shim Stock

A small strip of feeler or shim stock can be used to check main bearing clearance. The method is simple, but care must be taken to avoid damage to the bearing surface from excessive pressure against the strip.

a. Cut a rectangular piece of feeler or shim stock, .001" [.0254 mm.] thick, 1/2" [12,70 mm.] wide, and 1/8" [3,175 mm.] shorter than the bearing width. Position the bearing cap to the crankshaft journal and cylinder block, and install two cap bolts loosely.

b. Tighten alternate cap bolts, a little at a time, until both have been tightened to 35 to 45 lb-ft. [4,8 a 6,2 kg-m.] torque.

c. Turn the crankshaft by hand, no more than one inch [2,5 cm.] in either direction.

Caution: If the crankshaft is turned too far, it will embed the strip in the bearing surface. This will damage the bearing and also cause a false indication of bearing clearance.

If bearing clearance is correct, the strip should cause a light to heavy drag, or resistance to rotation. If there is little or no drag, clearance is too great; if the crankshaft cannot be turned, clearance is insufficient. In either case, a different main bearing must be selected to obtain proper clearance.

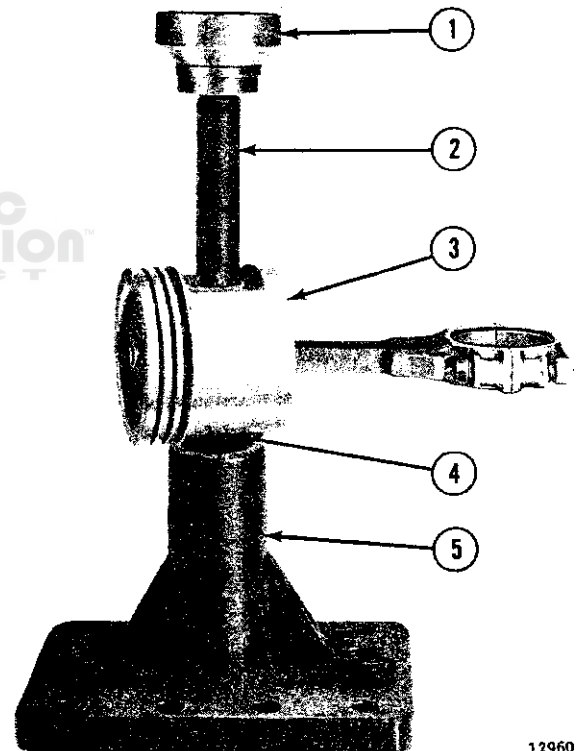
d. Repeat steps a, b, and c, as necessary, to select proper main bearing size. After a bearing has been selected, remove the test strip from bearing on

crankshaft journal surface; wipe both surfaces carefully, and apply clean engine oil to both surfaces. Position the bearing cap to the crankshaft journal and cylinder block, and install two cap bolts loosely. Tighten alternate cap bolts, a little at a time, to final specified torque of 80 to 110 lb-ft. [11,1 a 15,2 kg-m.]. The crankshaft should now rotate freely.

D1-44. Piston and Connecting Rod Disassembly

a. Remove two compression rings with a piston ring expander. To remove oil ring, remove the two rails and spacer-expander, which are separate pieces in each piston third groove.

b. From Tool Set W-338 use support base J-6047-1 with collar J-6047-5 and driver J-6047-4 with an arbor press to press piston pin from piston and connecting rod. Mount support base and collar in press. Set driver in position and press out pin. Refer to Fig. D1-14.



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FIG. D1-14—PISTON PIN REMOVAL

- 1—Arbor Press
- 2—Driver
- 3—Piston and Rod Assembly
- 4—Collar
- 5—Support Base

D1-45. Piston and Connecting Rod Cleaning and Inspection

a. Clean carbon from piston surfaces and underside of piston heads, and remove all pistons rings. Clean carbon from ring grooves with a suitable tool. Remove any gum or varnish from piston skirts with a suitable solvent.

b. Carefully examine pistons for rough or scored bearing surfaces, cracks in skirt or head, cracked or broken ring lands, chipping and uneven wear

which would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced.

c. Inspect bearing surfaces of piston pins and check for wear by measuring worn and unworn surfaces with a micrometer. Rough or worn pins should be replaced. Test fit the piston pins in piston bosses. Occasionally, a pin will be tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent. If piston bosses are worn out-of-round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical, since the pin must be a press fit in the connecting rod bore. Piston pins must fit the piston with an easy finger push at 70°F. [21°C.]. They should have .0004" to .0007" [0,0178 a 0,0102 mm.] clearance.

D1-46. Piston Fitting

If cylinder bores are rebored or heavily honed, new and possibly oversize diameter pistons must be installed. A new piston must be fitted to its cylinder bore. A satisfactory method of fitting pistons is as follows.

a. Expand a telescope gauge to fit the cylinder bore at right angles to the piston pin and between 1½" to 2" [3,7 a 5,1 cm.] from the top.

b. Measure diameter of the piston to be fitted, as shown in Fig. D1-15. The piston must be measured at right angles to the piston pin, ¼" [6,3 mm.] below the oil ring groove. The piston must be be-

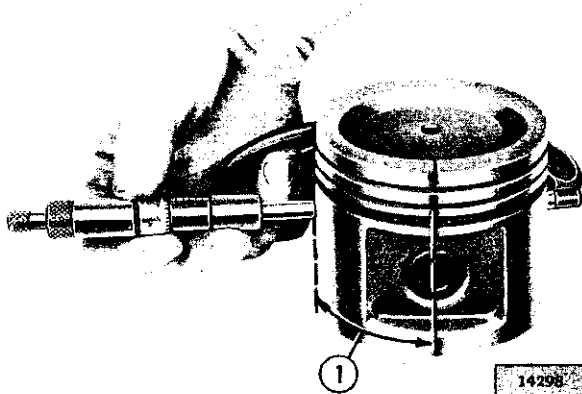


FIG. D1-15—MEASURING PISTON

1—90°

tween .001" and .0015" [0,025 a 0,038 mm.] smaller than the cylinder bore.

Note: Both cylinder block and piston must be at very nearly the same temperature when measurements are made or errors due to expansion will occur. A difference of 10°F. [5,6°C.] between parts is sufficient to produce a variation of .0009" [0,0023 mm.].

The pistons are cam-ground, which means that the diameter at a right angle to the piston pin is greater than the diameter parallel to the piston pin. When a piston is checked for size, it must be

measured with a micrometer applied to the skirt along a line perpendicular to axis of the piston pin.

D1-47. Piston Ring Fitting

When new piston rings are to be installed without reboring cylinders, the glazed cylinder walls should be slightly dulled. However, cylinder bore diameter should not increase more than necessary. Cylinder walls should be honed with the finest grade of stone to remove any glaze.

New compression rings must be checked for clearance in piston grooves and for gap in cylinder bores; however, the flexible oil rings are not checked for gap. The cylinder bores and piston grooves must be clean, dry, and free of carbon and burrs.

With rings installed on piston, check clearance in grooves by inserting feeler gauge between each ring and its lower land. Any ring groove wear will form a step at inner portion of the lower land. If the piston grooves have worn enough that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with proper operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

When fitting new rings to new pistons, the side clearance of the compression rings should be .002" to .0035" [0,051 a 0,089 mm.] for number one (1) ring, .003" to .005" [0,076 a 0,127 mm.] for number two (2) ring, and side clearance of the oil ring should be .0015" to .0085" [0,038 a 0,220 mm.].

To check the end gap of a compression ring, place it in the cylinder in which it will be used, square it in the bore by tapping with the lower end of a piston, then measure the gap with a feeler gauge. A compression ring should not have less than .015" [0,381 mm.] gap when placed in cylinder bore. If gap is less than specified value, file the end of the ring carefully with a fine file to obtain proper gap.

D1-48. Piston and Connecting Rod Assembly

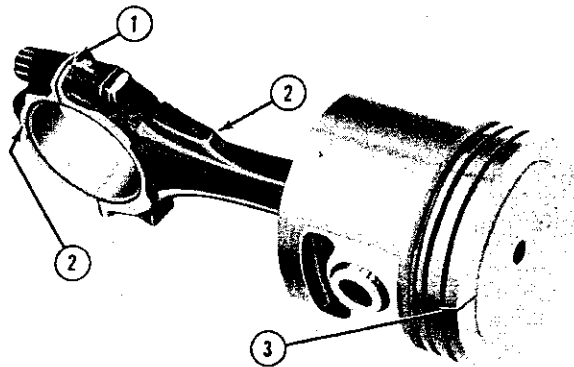
Note: A connecting rod can spring out of alignment in shipping or handling. Always check a new connecting rod for misalignment before installing piston and pin.

a. If a new connecting rod is to be installed, check its alignment with an accurate rod alignment fixture.

b. If the piston and connecting rod assembly is to be installed in the left cylinder bank, it must be assembled as shown in Fig. D1-16. If the piston and connecting rod assembly is to be installed in the right cylinder bank, it must be assembled as shown in Fig. D1-17. Note that these two assemblies are mirror-images of each other.

c. Lubricate piston pin to avoid damage when pressing through the connecting rod.

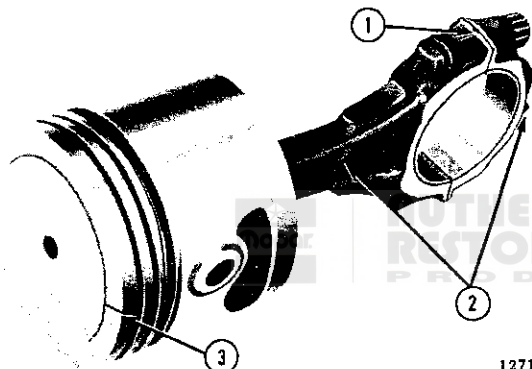
d. To install piston pin in piston and connecting rod, use Tool Set W-338. Install collar J-6047-5, spring J-6047-3, and pilot J-6047-20 into the base support J-6047-1 and place in arbor press. Using driver J-6047-4 press piston pin into piston and



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FIG. D1-16—LEFT BANK PISTON AND ROD ASSEMBLY (No. 1-3-5)

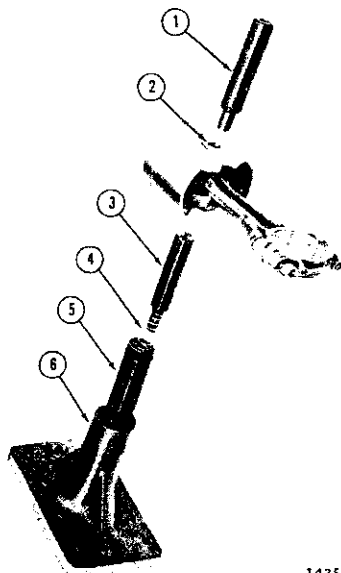
- 1—Oil Spurt Hole Up
- 2—Boss on Rod and Cap Rearward
- 3—Notch on Piston Forward



12716

FIG. D1-17—RIGHT BANK PISTON AND ROD ASSEMBLY (No. 2-4-6)

- 1—Oil Spurt Hole Up
- 2—Boss on Rod and Cap Forward
- 3—Notch on Piston Forward



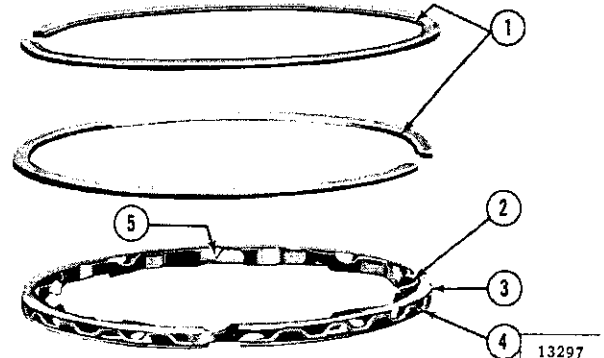
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FIG. D1-18—PISTON PIN INSTALLATION

- 1—Driver
- 2—Piston Pin
- 3—Pilot
- 4—Spring
- 5—Collar
- 6—Support Base

connecting rod until pin bottoms. Refer to Fig. D1-18.

e. Remove piston and connecting rod assembly from press. Rotate piston on pin to be certain that pin was not damaged during the pressing operation.



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FIG. D1-19—PISTON RINGS

- 1—Compression Rings
- 2—Expander
- 3—Rail
- 4—Spacer
- 5—Oil Ring

f. Install piston rings on piston as follows. Refer to Fig. D1-19. Position ends of piston ring expander over piston pin. Install oil ring rail spacer and oil ring rails. Position gaps in rails upward on same side of piston as oil spurt hole in connecting rod. Install compression rings in upper two grooves. If a single chrome-plated compression ring is used, the chrome ring must be installed in the top groove.

Note: All compression rings are marked with a dimple, a letter "T", a letter "O", or word "TOP" to identify the side of the ring which must face toward the top of the piston. If a single chrome-plated compression ring is used, the chrome ring must be installed in the top groove.

D1-49. Connecting Rod Bearing Inspection and Fitting

a. If connecting rod bearings are chipped or scored, they should be replaced. If bearings appear to be in good condition, check for proper radial clearance on crankpin. If radial clearance exceeds .003" [0,076 mm.], it is advisable to install a new bearing. However, if bearing appears to be in good condition and does not cause noise, it will not be mandatory to replace it. Radial clearance can be checked either with Plastigage, as described in Par. D1-42, or with a strip of feeler or shim stock, as described in Par. D1-43. Connecting rod bearings differ from crankshaft main bearings in that their desired radial clearance is .0002" to .0023" [0,005 a 0,0585 mm.] and their cap bolts and nuts are to be hand torqued to a 30 to 40 lb-ft. [4,1 a 5,5 kg-m.] torque.

b. After each connecting rod bearing has been properly fitted, attach bearing cap loosely with two cap bolts and nuts to keep parts of each assembly together until installation.

Note: The rib on edge of cap and the conical boss on web of connecting rod must be toward rear of engine in all connecting rod assemblies of left cylinder bank and toward front of engine in all connecting rod assemblies of right cylinder bank.

D1-50. Oil Pump Intake and Screen Cleaning

- a. Pry screen from housing and examine for clogging due to deposit of sludge or other foreign material.
- b. Clean the screen and housing thoroughly in solvent; dry with compressed air.
- c. Install screen in housing.

D1-51. Oil Pan Cleaning and Inspection

Inspect the oil pan for corrosion, dents, leaks, and other damage. Inspect its mounting flange carefully for damage or distortion to be certain that it will give a good seal.

D1-52. Flywheel Cleaning and Inspection

Clean the flywheel with suitable cleaning solvent; dry with compressed air. Inspect clutch face for burned or scuffed condition and for rivet grooves. Inspection for run out or improper mounting is described in installation procedure.

Inspect teeth of the flywheel ring gear for burrs, nicks, and minor distortion. If necessary and possible, use a small emery wheel to remove burrs and reshape teeth. If gear teeth are broken, cracked, seriously burred or deformed, the ring gear must be replaced.

D1-53. Ring Gear Replacement

- a. Drill a hole between two ring gear teeth; then split the gear with a cold chisel. Be careful not to damage ring gear shoulder or seat surfaces of flywheel.
- b. Polish several spots on the new ring gear to be installed. With a hot plate or slowly moving torch, heat the new ring gear until polished spots become blue, about 600°F. [312°C.].

Caution: Do not heat the ring gear to a temperature greater than 800°F. [424°C.]. Excessive heat will destroy heat treatment given to ring gear during manufacture.

- c. Quickly install ring gear on flywheel. Chamfered edge of ring gear must be toward ring gear shoulder of flywheel. Be certain that ring gear is seated properly. Allow ring gear to cool slowly, so that it will be held tightly in place.

D1-54. Flywheel Housing Cleaning and Inspection

Both flywheel and clutch are enclosed by a flywheel housing. Its front surface is bolted to the engine cylinder block, and its rear surface acts as front support to the transmission. Clean the flywheel housing with a suitable cleaning solvent; dry with compressed air. Inspect front and rear surfaces for distortion and improper alignment with each other; these planes must be parallel to assure proper alignment between engine and transmission.

D1-55. Camshaft Cleaning and Inspection

Clean both camshaft and camshaft bearing surfaces with a suitable cleaning solvent; dry with compressed air.

Note: The steel-backed babbitt-lined camshaft bearings are pressed into the crankcase. From front to rear, each bearing is .030" [0,76 mm.] smaller in diameter than the preceding bearing. From front to rear, each camshaft journal is correspondingly smaller in diameter.

The camshaft bearings must be line reamed to proper diameter after being pressed into crankcase. Since this operation requires special reaming equipment, the original bearings should be retained unless they are severely damaged. Slightly scored camshaft bearings are satisfactory if the surfaces of camshaft journals are polished, bearings are polished to remove burrs, and radial clearance between camshaft and bearings is within .0015" to .004" [0,038 a 0,102 mm.].

D1-56. Valve Lifter and Push Rod Cleaning and Inspection

- a. Examine the cam contact surface at lower end of each valve lifter body. If surface is excessively worn, galled, or otherwise damaged, discard the valve lifter. Also examine the mating camshaft lobe for excessive wear or damage.
- b. Disassemble one or two valve lifters, as described below, and inspect them for dirt or varnish. If they are dirty or have a varnish deposit, clean and inspect all twelve valve lifters. Otherwise, service only those valve lifters which do not operate properly.
- c. To disassemble each valve lifter, depress the push rod seat with a push rod, and remove the plunger retainer from the valve lifter body with a retainer remover. Remove push rod seat and plunger from valve lifter body. If plunger sticks in valve lifter body, place body in large end of a plunger remover tool, with plunger downward. While holding lifter with thumb, rap the open end of remover against a block of wood with just enough force to jar the plunger from body. Refer to Figs. D1-20, D1-22 and D1-23.
- d. Drain oil from valve lifter and remove the check valve retainer, ball, valve spring, and plunger spring.
- e. Keep all parts of each valve lifter separated during part cleaning and inspection. The valve lifter body and plunger are selectively fitted to each other and must not be interchanged with parts of other valve lifters.
- f. Rinse all valve lifter parts in kerosene to remove as much oil as possible. This will reduce contamination of the cleaning solvent. Immerse all parts in cleaning solvent for approximately one hour. The time required will depend on varnish deposits and effectiveness of the solvent. After the varnish has dissolved or has softened sufficiently to permit removal by wiping, allow parts to drain. Varnish can then be cleaned from the valve lifter body with a brush. Rinse the parts in kerosene to dissolve

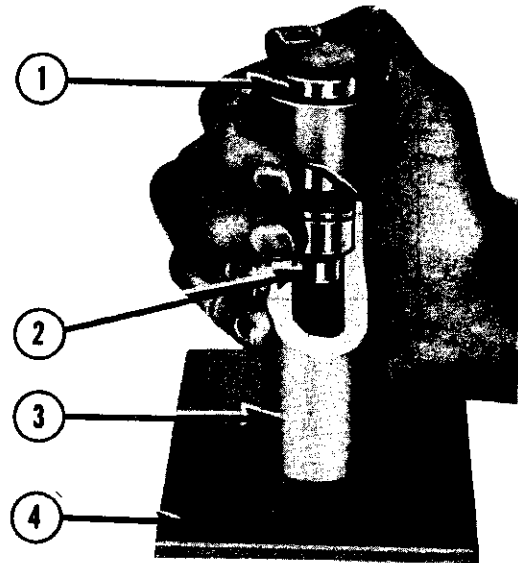


FIG. D1-20—REMOVING PLUNGER FROM VALVE LIFTER BODY

- 1—Body
- 2—Plunger
- 3—Support Tool
- 4—Wood Block

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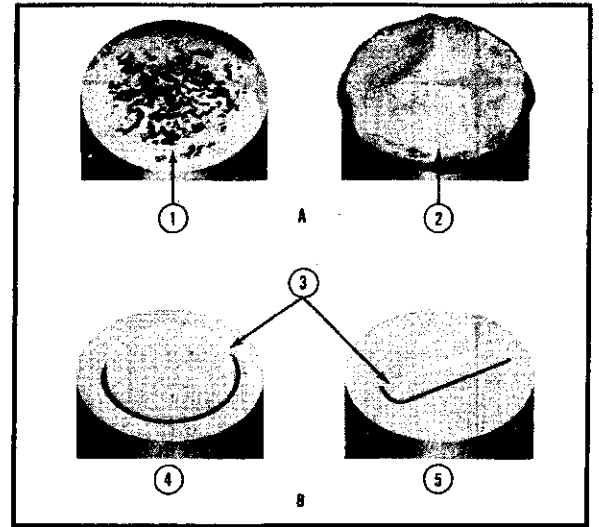
the cleaning solvent. Wipe all parts, as necessary, to dry them and remove any traces of varnish.

Note: To promote cleanliness, it is advisable to inspect and assemble each valve lifter before cleaning the next valve lifter.

g. Inspect inner and outer surfaces of valve lifter body for blow holes and scoring. Replace valve lifter assembly if body is roughly scored or grooved, or if it has a wall blow hole which would permit oil leakage from lower chamber. The prominent wear pattern just above lower end of body is not a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the lifter moves vertically in its guide. A valve lifter body which has rotated in its guide will have a horizontal wear pattern, while a non-rotating body will have a square wear pattern with a very slight depression near the center. Inspect the cam contact surface on lower end of lifter body. Replace the valve lifter assembly if this surface is excessively worn, galled or otherwise damaged.

Note: Fig. D1-21 illustrates the wear pattern of the rotating and non-rotating valve lifters. The two illustrations shown under B, "Normal Wear Patterns" are the conditions encountered under general use and replacement is not warranted unless the depth of the groove formed by the cam lobe is in excess of .020" [0,51 mm.] or the lifters do not operate properly. The two illustrations shown under A, "Incorrect Wear Patterns" are normally accompanied by excessive wear or scoring of the respective camshaft lobe. This type of wear is unsatisfactory and lifter replacement is necessary.

h. Inspect outer surface of plunger for scratches or score marks. Small score marks with rough satiny finish will cause the plunger to seize when



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FIG. D1-21—HYDRAULIC VALVE LIFTER WEAR PATTERNS

- | | |
|---------------------------|------------------------|
| A—Incorrect Wear Patterns | B—Normal Wear Patterns |
| 1—Galled and Pitted | 3—Wear .020" Maximum |
| 2—Soft | 4—Rotating |
| | 5—Non-Rotating |

hot but operate normally when cool. Using a magnifying glass, inspect the check ball seat for defects. Defects in check ball seat, or scores or scratches on outer surface of plunger which can be felt with a fingernail, are reason to replace the valve lifter assembly. This does not apply to the slight edge which may sometimes be present when the lower end of plunger extends below the ground inner surface of the body. This edge is not detrimental unless it is sharp or burred. A blackened appearance is not necessarily a defective condition. Sometimes such a discoloration gives the outer surface of plunger a ridged or fluted appearance. If the condition does not cause improper operation, it may be disregarded.

i. Replace the push rod seat if the area contacted by the push rod is rough or otherwise damaged. Replace any push rod which has a rough or damaged ball end.

j. Using a magnifying glass, carefully examine the check valve ball for nicks, imbedded material or other defects which would prevent proper seating. Such defects would cause intermittently noisy operation. Even though no defects are found, it is always advisable to discard the old ball and use a new one when reassembling the valve lifter.

k. Examine check valve spring for wear or damage. Replace spring if it is distorted or shows evidence of wear.

l. Replace a check valve retainer if cracked or if it has heavily pounded area between the two holes. A small bright spot where the ball contacts the retainer is the normal condition.

m. Replace the plunger spring only if it is distorted or damaged. Tests have shown the plunger springs seldom break down in service.

n. Rinse lifter plunger in kerosene. Hold plunger in vertical position with feed hole upward, then

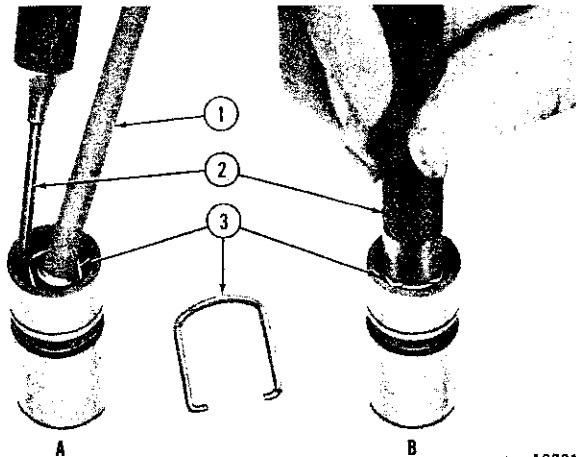


FIG. D1-22—REMOVAL AND INSTALLATION OF VALVE LIFTER RETAINER RING

- | | |
|------------|----------------|
| A—Removal | 3—Retainer |
| 1—Push Rod | B—Installation |
| 2—Tool | |

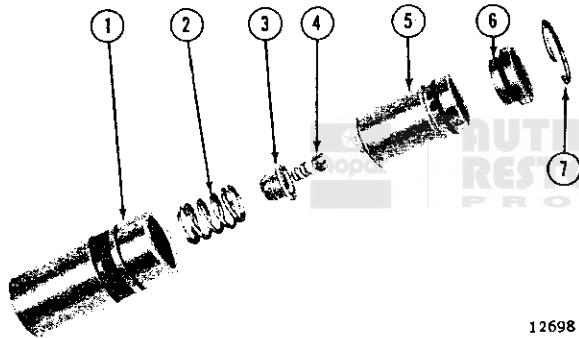


FIG. D1-23—HYDRAULIC VALVE LIFTER

- | | |
|-----------------|-----------------|
| 1—Body | 5—Plunger |
| 2—Spring | 6—Push Rod Seat |
| 3—Ball Retainer | 7—Retainer |
| 4—Ball | |

rinse and install the check valve ball, check valve spring, check valve retainer, plunger spring, and valve lifter body over the plunger. Rinse push rod seat and retainer ring in kerosene. Place these parts in end of body and depress with a suitable tool to cause retainer to engage groove in valve lifter body.

o. Wrap the valve lifter in clean paper, or otherwise protect it from dirt, during cleaning and inspection of the other valve lifters.

D1-57. Hydraulic Valve Lifter Leak-down Test

Check leak-down rate of hydraulic valve lifters with valve lifter pliers W-324 or equivalent. Immerse the valve lifter in kerosene and grasp the valve lifter with the pliers, as shown in Fig. D1-24, so that the push rod of the pliers engages the push rod socket of the lifter. Squeeze and hold the pliers, checking the time required for leak-down. Leak-down should take between 12 and 60 seconds. Check a doubtful valve lifter three or four times. Replace valve lifters that do not have a proper leakdown rate.

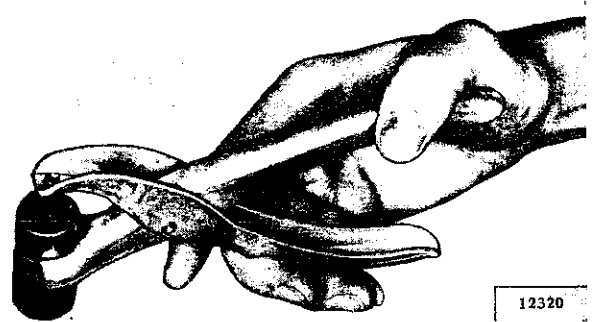


FIG. D1-24—VALVE LIFTER TEST

D1-58. Rocker Arm Disassembly

This engine has two rocker arm assemblies, each of which is associated with one of its two cylinder banks. Each rocker arm assembly is disassembled as follows:

- a. Remove cotter pin, flat washer, spring retaining ring, and one rocker arm from each end of the rocker arm shaft.
- b. Withdraw two bolts from outer shaft supports and rocker arm shaft. Remove outer supports, two rocker arms, two spacer springs, and two remaining rocker arms from shaft. Withdraw bolt from center support and remove support from shaft.

D1-59. Rocker Arm Cleaning and Inspection

- a. With a wire brush and suitable cleaning solvent, clean any sludge or dirt from hollow core and oil ports of the rocker arm shaft, from bores of shaft supports, and from oil passage in each rocker arm. Dry these parts with compressed air. Clean all other parts with cleaning solvent and dry with compressed air.
- b. Inspect the rocker arm shaft for scoring or abrasion at the rocker arm bearing areas and, with a surface plate, check for bent or distorted condition. Inspect the rocker arms for excessive wear, scoring, or abrasion of bearing surfaces. Check for loose or damaged valve stem or push rod inserts. Inspect the spacer springs for breaks, deformity, and loss of tension. Replace any visibly worn or damaged parts. Inspect the mounting bolts for damage. Repair damaged threads or replace as necessary.
- c. Measure rocker arm shaft diameter and bore diameters of rocker arms. This clearance should be .0017" to .0032" [0,0432 a 0,0812 mm.]. If necessary, replace worn rocker arms, shaft, or both.

D1-60. Rocker Arm Assembly

Note: All three shaft supports of each rocker arm assembly are identical and interchangeable. In the description to follow, "center" and "outer" refer only to their position on the shaft.

Caution: There are two different types of rocker arms, three of each type, in each rocker arm shaft assembly. They are not interchangeable. One face of each rocker arm has a notch; when installed on the shaft, this notched face must touch a shaft support.

Caution: Oil ports of the rocker arm shaft must coincide with oil return passages of the rocker arms. If they do not, engine oil has no return path from the cylinder head to the crankcase; in that case, engine oil flows down the valve stems and burns in the cylinders. There is a notch at one end of each rocker arm shaft. When rocker arms are properly installed on the shaft, this notch will be at front of right rocker arm shaft and at rear of left rocker arm shaft. Refer to Figs. D1-25 and D1-26.

- a. Position center support on rocker arm shaft; insert one shaft assembly attaching bolt through support and shaft to hold support in position.
- b. Install center pair of rocker arms with notched faces touching support. Install front and rear spacer

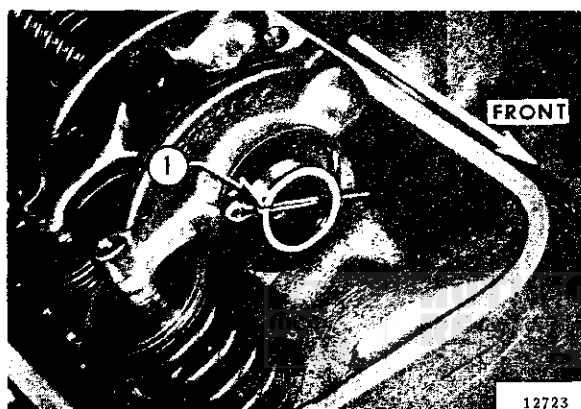


FIG. D1-25—FRONT OF RIGHT ROCKER ARM SHAFT

1—Alignment Notch



FIG. D1-26—REAR OF LEFT ROCKER ARM SHAFT

2—Alignment Notch

springs and one rocker arm each of front and rear rocker arm pairs on shaft. Be certain that notched faces of rocker arms are outward. Install outer shaft supports on shaft; compress spacer springs to position supports. Insert one shaft assembly bolt through each support and shaft to hold supports in position.

- c. Install remaining rocker arms of front and rear pairs, each with notched face touching shaft support. Install a spring retaining ring and flat washer

at each end of shaft; secure each of these with a new cotter pin.

D1-61. Valve Removal

- a. Place cylinder head on clean, smooth surface.
- b. Remove each valve assembly from cylinder head as follows. Using suitable spring compressor, compress valve spring and remove two valve retainers from valve stem. Release spring compressor, and remove spring retainer and valve spring from valve stem. Refer to Fig. D1-27.

Note: Valve retainers are copper-colored for identification purposes only.

- c. Withdraw valve from bottom of cylinder head. Valves should be identified so they can be installed in original location.

D1-62. Cylinder Head and Valve Cleaning and Inspection

- a. Remove carbon from combustion chamber of cylinder heads, using care to avoid scratching the head of valve seat surfaces. A soft wire brush is suitable for this purpose.
- b. Clean carbon and gum deposits from valve guide bores with a standard-size valve guide reamer. Refer to Fig. D1-28.
- c. Clean valves with a wire brush. Inspect valve faces and seats for pits, burned spots or other evidence of poor seating.

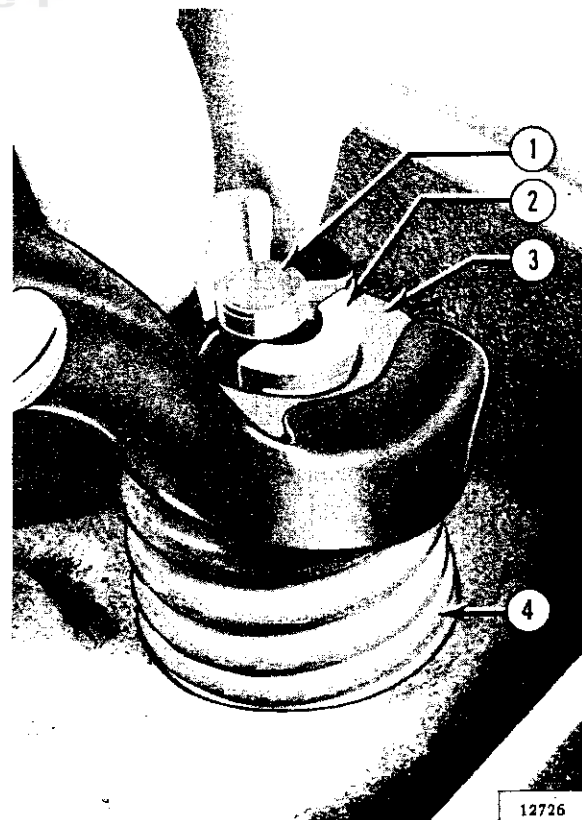


FIG. D1-27—REMOVING VALVE RETAINERS

1—Valve Stem 3—Valve Spring Retainer
2—Valve Lock 4—Valve Spring

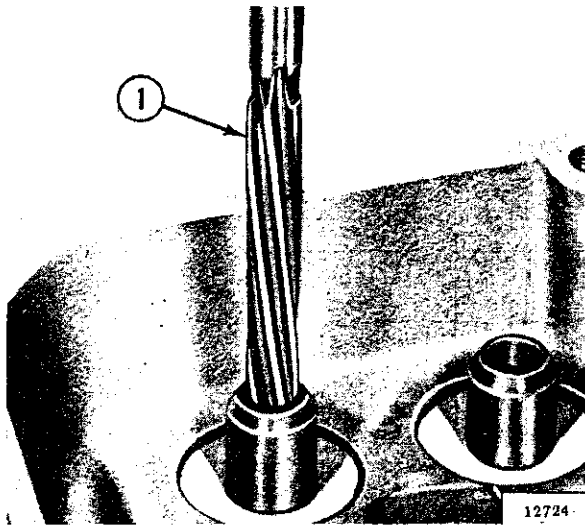


FIG. D1-28—CLEANING OR ENLARGING VALVE GUIDE

1—Reamer

d. Measure clearance of each valve stem in corresponding valve guide. For intake valves, this clearance should be .0012" to .0032" [0,0305 a 0,0813 mm.]. For exhaust valves, this clearance should be .0015" to .0035" [0,0381 a 0,0889 mm.] at top of guide and .002" to .004" [0,051 a 0,102 mm.] at bottom of guide. If this clearance is excessive, valve guides must be reamed with .004" [0,102 mm.] oversized reamer J-5830-1 and valves replaced by new valves with oversize stems.

D1-63. Cylinder Head and Valve Repair

a. If a valve stem has excessive clearance in its guide, the guide must be reamed .004" [0,102 mm.] oversize. Valves are available with oversize stems to fit this valve guide diameter.

b. Grind valve faces or replace valves if necessary. Valve faces must be ground at an angle of 45 degrees. If a valve head must be ground to a knife edge to obtain a true face, the valve should be replaced.

c. If necessary, grind valve seats at an angle of 45 degrees. Grinding a valve seat decreases valve spring pressure and increases the width of the seat. The nominal width of the valve seat is $\frac{1}{16}$ " [1,59 mm.]. If a valve seat is wider than $\frac{3}{4}$ " [1,98 mm.] after grinding, it should be narrowed to specified width by the use of 20-degree and 70-degree stones. Improper operation of a hydraulic valve lifter may result if valve and seat are refinished to the extent that the valve stem is raised more than .050" [1,27 mm.] above normal height. In this case, it is necessary to grind off the end of the valve stem or replace parts.

Note: The normal height of the valve stem above the valve spring seat surface of the head is 1.925" [4,889 cm.].

d. Lightly lap the valves into seats with fine grinding compound. The refacing and reseating should leave the refinished surfaces smooth and true so

that a minimum of lapping will be required. Excessive lapping will groove the valve face and prevent good valve seating.

e. Test valve seats for concentricity with guides, and for proper valve seating. Coat a small segment of the valve face lightly with Prussian blue pigment. Insert the valve stem into its guide and turn the valve face against the seat. If the valve seat is concentric with the valve guide, a mark will be made all around the seat. If the seat is not concentric with the guide, a mark will be made on only one side of the seat.

Clean all pigment from both valve and seat. Next, coat a small segment of the valve seat lightly with Prussian blue pigment. Again insert the valve stem into its guide and rotate the valve face against the seat. If the valve face is concentric with the valve stem, and if the valve is seating all the way around, pigment will coat the valve face with a uniform band around its entire perimeter. Both of these tests are necessary to prove that proper valve seating is obtained.

f. Inspect the valve springs visually for corrosion, breaks, and distortion. With a valve spring tester check each valve spring for proper tension. When a valve spring is compressed to a length of 1.640" [4,166 cm.] (closed-valve condition), it should have a tension of 64 lb. [29,03 kg.]. When a valve spring is compressed to a length of 1.260" [3,200 cm.] (open-valve condition), it should have tension of 168 lb. [76,205 kg.]. Replace any valve spring which is visibly damaged or does not meet tension specifications.

D1-64. Valve Installation

Lubricate valve stems with engine oil. Install valves, valve springs, spring retainers, and valve retainers on the cylinder head. Use the same equipment and reverse procedure used for removal. Install valve springs with closely wound coils toward the cylinder head. Refer to Fig. D1-29.

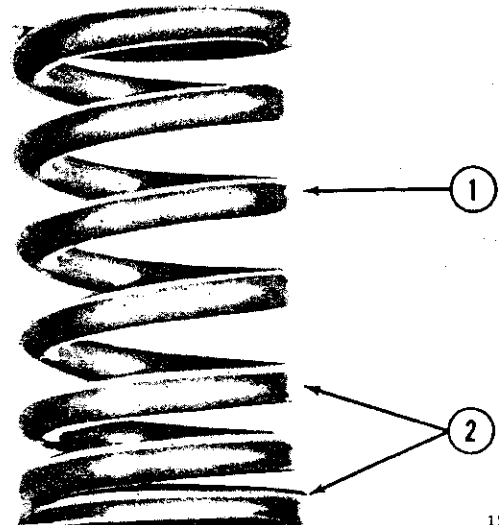


FIG. D1-29—VALVE SPRING

1—Spring
2—Close Wound Coils Toward Head

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D1-65. Rocker Arm Cover Cleaning and Inspection

- a. Clean both rocker arm covers with suitable cleaning solvent and dry thoroughly.
- b. Inspect each rocker arm cover visually for scratches, bends, dents, and tears. Replace cover if unserviceable.

D1-66. Timing Chain and Sprocket Inspection

Inspect the timing chain and both sprockets for damage or excessive wear. Replace unserviceable parts.

D1-67. Timing Chain Cover Cleaning and Inspection

- a. Clean the timing chain cover with suitable cleaning solvent and dry with compressed air.
- b. Inspect the cover visually for breaks, cracks, and other damage. With a straightedge, check cylinder block, water pump, and oil pump faces for bends and distortion.
- c. Install oil pump gears in oil pump cavity of timing gear cover. With a straightedge and feeler gauge, check gear and clearance. Refer to Fig. D1-30. Clearance should be between .0023" [0,0584 mm.] and .0058" [0,1358 mm.]. If it is lower than .0018" [0,0457 mm.], inspect thrust surfaces of cover which touch gears for wear.
- d. Replace the timing chain cover if unserviceable.

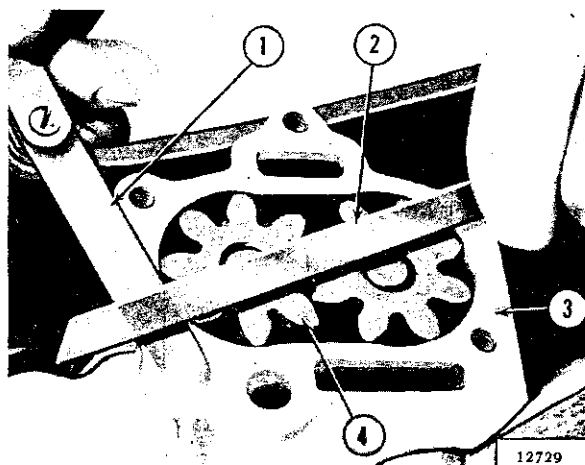


FIG. D1-30—CHECKING OIL PUMP GEAR END CLEARANCE

- 1—Feeler Gauge
- 2—Straight Edge
- 3—Pump Body
- 4—Pump Gears

D1-68. Oil Pump Cleaning and Inspection

- a. Clean gears with suitable cleaning solvent and dry thoroughly. Inspect for wear, scoring, and other damage. Replace either or both gears if unserviceable.
- b. Remove the oil pressure relief valve cap, spring and plunger. Refer to Fig. D1-31. Oil filter bypass valve plunger and spring are staked in place and should not be removed.

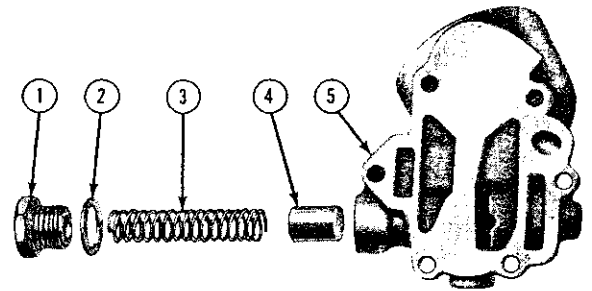


FIG. D1-31—OIL PUMP PRESSURE RELIEF VALVE

- 1—Valve Cap
- 2—Gasket
- 3—Spring
- 4—Valve
- 5—Oil Pump Cover

- c. Wash valve parts thoroughly. Inspect the relief valve plunger for wear or scoring. Check the spring to see that it is not worn or collapsed. Replace any relief valve spring that is questionable. Thoroughly clean the screen staked in the cover.
- d. Insert the relief valve plunger into its bore in the cover. The plunger should have no more clearance than an easy slip fit. If there is any perceptible sideways movement, the plunger and/or the cover should be replaced.
- e. Check oil filter bypass valve plunger for cracks, nicks, or warping. The plunger should be flat and free of nicks or scratches.
- f. Lubricate and install pressure relief valve plunger and spring in bore of oil pump cover. Install cap and gasket. Torque cap to 30 to 40 lb-ft. [4,1 a 5,5 kg-m.]. Do not over-tighten.

Note: Pressure relief valve cap has no tapped hole for installation of oil pressure switch.

D1-69. Crankshaft Vibration Damper Inspection

Inspect the crankshaft vibration damper for cracked, broken, distorted, or otherwise damaged condition. If damaged, replace.

D1-70. Crankshaft Pulley Inspection

Inspect the crankshaft pulley for damage or excessive wear. Replace if visibly worn or damaged.

D1-71. ENGINE REASSEMBLY

The engine assembly procedure in the following paragraphs is given in the sequence to be followed when the engine is being completely overhauled. Individual inspection, repair, and fitting operations previously covered in detail are made throughout the assembly procedure. The assembly procedure does not cover accessories. If a new cylinder block fitted with pistons is used, many of the operations will not be required.

Mount the cylinder block in an engine repair stand. If an engine stand is not available, perform the following assembly operation in a manner designed to protect personnel against an accident, and the engine and its parts against damage.

Note: During engine reassembly, use Perfect Seal Aerosol Spray Sealer Part No. 994757 on all engine gaskets to ensure against vacuum, oil, gasoline and water leaks. Apply to head gaskets, valve covers, water pumps, oil pan gaskets, radiator and heater hose connections, felt gaskets, gasoline and oil line connections, stud bolts, spark plug threads, and grease retainer washers. Refer to manufacturer's instructions on container for proper application procedure.

D1-72. Cylinder Block and Crankshaft Rear Oil Seals

Braided fabric seals are pressed into grooves of cylinder block and rear main bearing cap, to rear of the oil collecting groove, to seal against oil leakage at the crankshaft. Refer to Fig. D1-32.

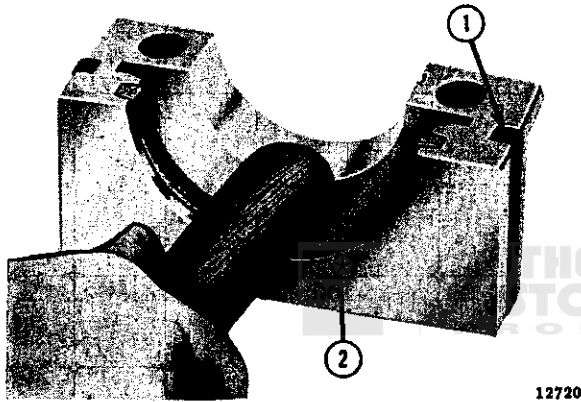


FIG. D1-32—INSTALLING CRANKSHAFT REAR OIL SEAL

1—Neoprene Seal 2—Fabric Seal

A neoprene composition (stick) seal is installed in grooves in the sides of the rear main bearing cap to seal against leakage in the joints between the cap and cylinder block. The neoprene composition expands in the presence of oil and heat. This seal is undersize when newly installed. Refer to Fig. D1-32.

a. The braided fabric seal can be installed in the cylinder block only when the crankshaft is removed; however, the seal in the cap can be replaced whenever the cap is removed. Remove oil seal and place new seal in groove, with both ends projecting above parting surface of cap. Force seal into groove by rubbing down with hammer handle or smooth stick until seal projects above the groove not more than $\frac{1}{16}$ " [1,59 mm.]. Cut ends off flush with surface of cap, using sharp knife or razor blade. Lubricate the seal with heavy engine oil just before installation.

Caution: The engine must be operated at slow speed when first started after new braided seal has been installed.

b. The neoprene composition seal is slightly longer than the grooves in the bearing cap. The seal must not be cut to length. The seals are installed after the bearing cap is installed in the block and torqued

firmly in place. Dip the neoprene seals in kerosene approximately $1\frac{1}{2}$ minutes, then install seals into bearing cap grooves. The protruding ends of the seals are, again, squirted with kerosene, wiped off, and peened over with a hammer to be sure of a seal at the upper parting line between the cap and cylinder block.

D1-73. Main Bearing and Crankshaft Installation

Refer to Fig. D1-6.

This procedure assumes that crankshaft main bearings have been inspected and proven satisfactory, or that new crankshaft main bearings of appropriate size have been selected. If necessary, check or select main bearings as described in Par. D1-41 and Pars. D1-42 and D1-43.

a. Install four upper main bearing halves in seats of cylinder block so that prong of each bearing half fits into corresponding notch of seat. Flanged thrust bearing must be installed in the second seat from front of engine. Install a new upper crankshaft rear oil seal in the cylinder block as described in Par. D1-72.

Caution: Upper main bearing halves have an oil groove, while lower halves are plain. They must not be interchanged.

b. Apply engine oil to upper bearing surfaces. Install the crankshaft so that its four journals rest in the upper bearing halves.

c. Seat all four lower main bearing halves in corresponding bearing caps. Install a new lower crankshaft rear oil seal and cylinder block rear oil seal described in Par. D1-72, a and b. Lubricate all lower main bearing surfaces with engine oil. Position bearing caps to cylinder block and crankcase journals. Install two cap bolts, loosely, at each cap.

d. It is necessary to align thrust surfaces of the second main bearing whenever it has been removed from the engine. To do this, pry the crankshaft back and forth several times, throughout its entire end travel, with cap bolts of second main bearing only finger tight.

e. Tighten alternate cap bolts of each main bearing cap, a little at a time, until they have been tightened to 80 to 110 lb-ft. [11,1 a 15,2 kg-m.] torque.

D1-74. Crankshaft End Play Check

To measure crankshaft end play, mount a dial indicator on the cylinder block and index its plunger to either a front or rear face of one crankshaft counterweight. Pry the crankshaft to one limit of its end travel and adjust the dial indicator to zero. Pry the crankshaft to its opposite end travel limit and note end play as indicated by the dial indicator. Crankshaft end play tolerances are .004" to .008" [0,102 a 0,204 mm.]. If end play is too great, it can be corrected only by replacement of the second main (thrust) bearing.

D1-75. Piston and Connecting Rod Installation

This procedure assumes that connecting rod bearings have been inspected and proven satisfactory, or that new connecting rod bearings of appropriate

size have been selected. If necessary, check or select connecting rod bearings as described in Par. D1-49.

Note: When a piston and connecting rod assembly is properly installed, the oil spurt hole in the connecting rod will face the camshaft. The rib on the edge of the bearing cap will be on the same side as the conical boss on the connecting rod web; these marks (rib and boss) will be toward the other connecting rod on the same crankpin. The notch on the piston will face the front of the engine.

- a. Be certain that cylinder bores, pistons, connecting rod bearings and crankshaft journals are absolutely clean. Coat all bearing surfaces with engine oil.
- b. Before installing a piston and connecting rod assembly into its bore, rotate the crankshaft so that the corresponding crankpin is moved downward, away from the cylinder bore.
- c. Remove bearing cap from connecting rod. With upper bearing half seated in connecting rod, install connecting rod guides. These guides hold the upper bearing half in place and prevent damage to the crankshaft crankpin during installation of the connecting rod and piston assembly.
- d. Be certain that the gap in the oil ring rails faces upward, toward center of engine. Gaps of the compression rings shall not be aligned with each other or with the oil ring rails.
- e. Lubricate the piston and rings. Compress the rings with a suitable piston ring compressor; install the piston and connecting rod assembly from top of cylinder bore. Refer to Fig. D1-33.
- f. Install bearing cap, with lower bearing half, on connecting rod. Torque bolt nuts to 30 to 40 lb-ft. [4,1 a 5,5 kg-m.].
- g. Install all other piston and connecting rod assemblies in same manner.
- h. Check end clearance between connecting rods on each crankpin with a feeler gauge. Clearance should be .005" to .012" [0,127 a 0,305 mm.].

D1-76. Install Oil Pump Intake Pipe and Screen Assembly

Check mating surfaces of oil pump intake pipe and engine cylinder block to be certain that they are clean. Secure the pipe and screen assembly, with a new gasket, to engine cylinder block with two attaching screws. See Fig. D1-34. Torque screws 6 to 9 lb-ft. [0,83 a 1,24 kg-m.].

D1-77. Install Oil Pan

Refer to Fig. D1-35.

Be certain the flange surface of oil pan and corresponding surface of engine cylinder block are clean. Install a new oil pan gasket on the cylinder block. Secure oil pan to cylinder block with mounting bolts. Torque bolts 10 to 15 lb-ft. [1,4 a 2,1 kg-m.].

D1-78. Install Flywheel

Refer to Fig. D1-7.

- a. Check flywheel flange of engine crankshaft and corresponding surface of flywheel to be certain that

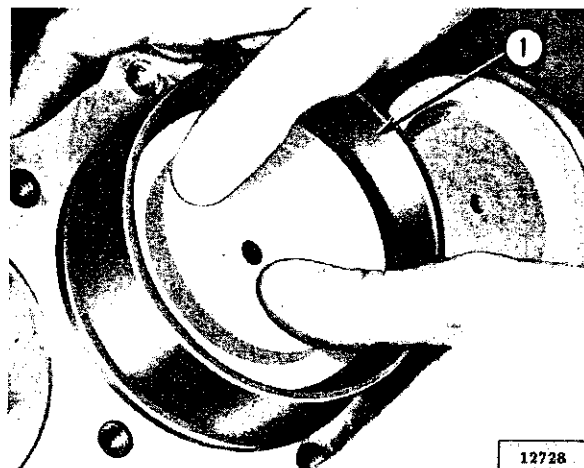


FIG. D1-33—INSTALLING PISTON AND CONNECTING ROD ASSEMBLY

1—Ring Compressor

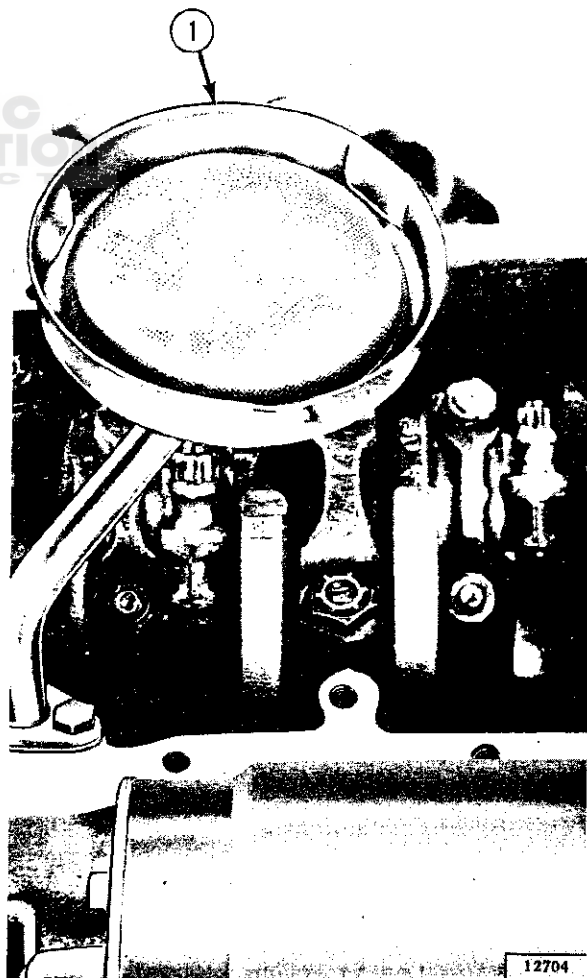


FIG. D1-34—OIL PUMP INTAKE PIPE AND SCREEN INSTALLATION

1—Pipe and Screen

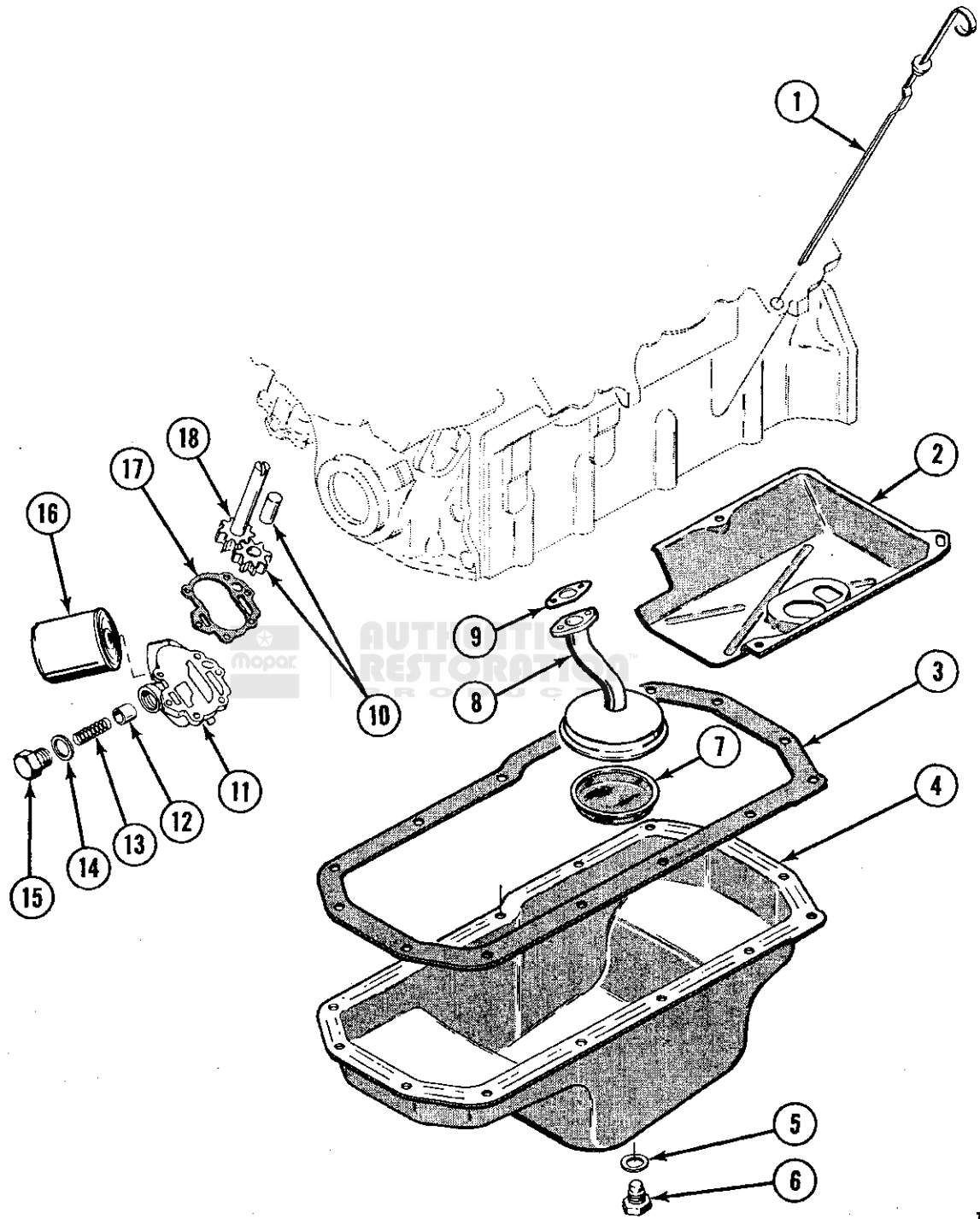


FIG. D1-35—OIL PAN AND PUMP ASSEMBLY

- | | |
|--|----------------------------------|
| 1—Oil Dipstick | 10—Oil Pump Idler Gear |
| 2—Oil Pan Baffle | 11—Valve By-Pass and Cover Assy. |
| 3—Oil Pan Gasket | 12—Oil Pressure Valve |
| 4—Oil Pan | 13—Spring |
| 5—Drain Plug Gasket | 14—Gasket |
| 6—Drain Plug | 15—Oil Pressure Valve Cap |
| 7—Oil Pump Screen | 16—Oil Filter |
| 8—Oil Suction Housing, Pipe and Flange | 17—Oil Pump Cover Gasket |
| 9—Oil Suction Pipe Gasket | 18—Oil Pump Shaft and Gear |

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both are clean. Any foreign material on either of these surfaces will cause flywheel run out and engine vibration. Position flywheel to crankshaft and secure with six mounting bolts. Torque mounting bolts 50 to 65 lb-ft. [6,91 a 8,98 kg-m.].

Note: Flywheel mounting bolts are unevenly spaced so that flywheel can be installed in only one position. This assures correct balance of flywheel and crankshaft.

b. Mount a dial indicator on flywheel housing flange of cylinder block and index its plunger to the flywheel surface. Measure flywheel run out. Maximum allowable run out is .015" [0,381 mm.].

D1-79. Install Clutch and Flywheel Housing

a. Note marks made on clutch assembly and flywheel during engine disassembly. Position clutch assembly to flywheel, according to marks, and fasten loosely with six attaching bolts. Torque bolts in rotation, one turn at a time, to 30 to 40 lb-ft. [4,1 a 5,5 kg-m.].

b. Engage fork of clutch linkage to clutch and position flywheel housing to engine cylinder block. Secure housing to block with six mounting bolts. Torque bolts 30 to 40 lb-ft. [4,1 a 5,5 kg-m.].

D1-80. Install Camshaft

Insert camshaft into camshaft bearings of engine cylinder block carefully to avoid damage to bearing surfaces. Make certain camshaft journals are properly seated in bearings.

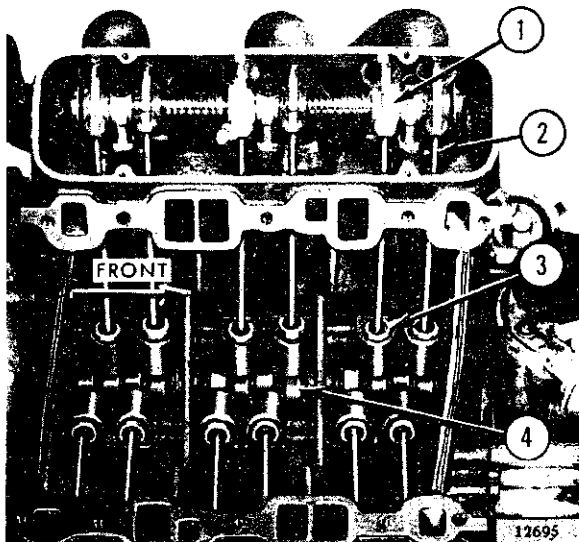


FIG. D1-36—CAMSHAFT AND VALVE LINKAGE

- 1—Rocker Arm
- 2—Push Rod
- 3—Valve Lifter
- 4—Camshaft

D1-81. Install Valve Lifter and Push Rod

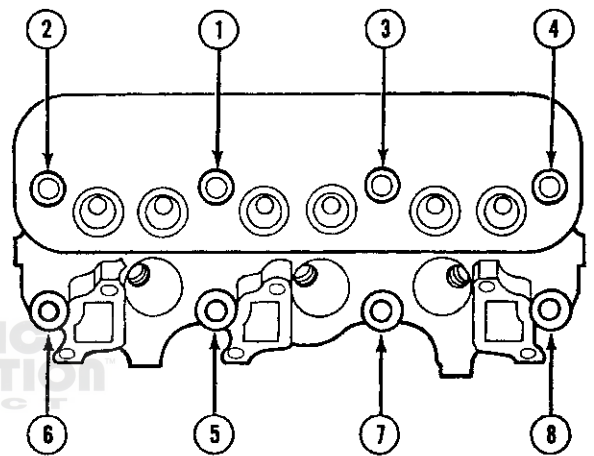
Make certain valve lifter guide holes and adjacent area of cylinder block are clean. Liberally lubricate the camshaft and valve lifter bores with engine oil, and install valve lifters. Each valve lifter must slide freely in its guide hole. See Fig. D1-36.

D1-82. Install Cylinder Head Assembly

Refer to Fig. D1-9.

a. Wipe cylinder head face of engine cylinder block, and be certain no foreign material has fallen into the cylinder bores, bolt holes, or in the valve lifter area. It is good practice to clean out bolt holes with compressed air.

b. Install a new cylinder head gasket on the cylinder block. Dowels in the block will hold the gasket in position. Always handle gaskets carefully to avoid kinking or damage to the surface treatment of the gasket. Apply Perfect Seal Aerosol Spray Sealer Part No. 994757 on cylinder head gaskets.



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FIG. D1-37—CYLINDER HEAD BOLT TIGHTENING SEQUENCE

c. Clean gasket surface of cylinder head and carefully place on the engine block dowel pins.

d. Clean and lubricate the cylinder head bolts with a sealing compound (Part No. 994757, or equivalent).

e. Install, and alternately tighten the head bolts, a little at a time, in the sequence shown in Fig. D1-37. Torque bolts 65 to 85 lb-ft. [9,0 a 11,8 kg-m.].

f. Tilt the rocker arms toward the push rods and locate the top of each push rod in its rocker arm seat.

g. Mount the rocker arm and shaft assembly, tightening the bracket bolts a little at a time. Torque the bracket bolts 25 to 35 lb-ft. [3,5 a 4,8 kg-m.]. Do not overtighten.

h. See Section F1 and F2 for engines equipped with exhaust emission control.

D1-83. Install Rocker Arm Cover

Install a new gasket on each rocker arm cover. Secure each rocker arm cover to corresponding cylinder head with four attaching screws. Install the positive crankcase ventilation valve on right rocker arm cover.

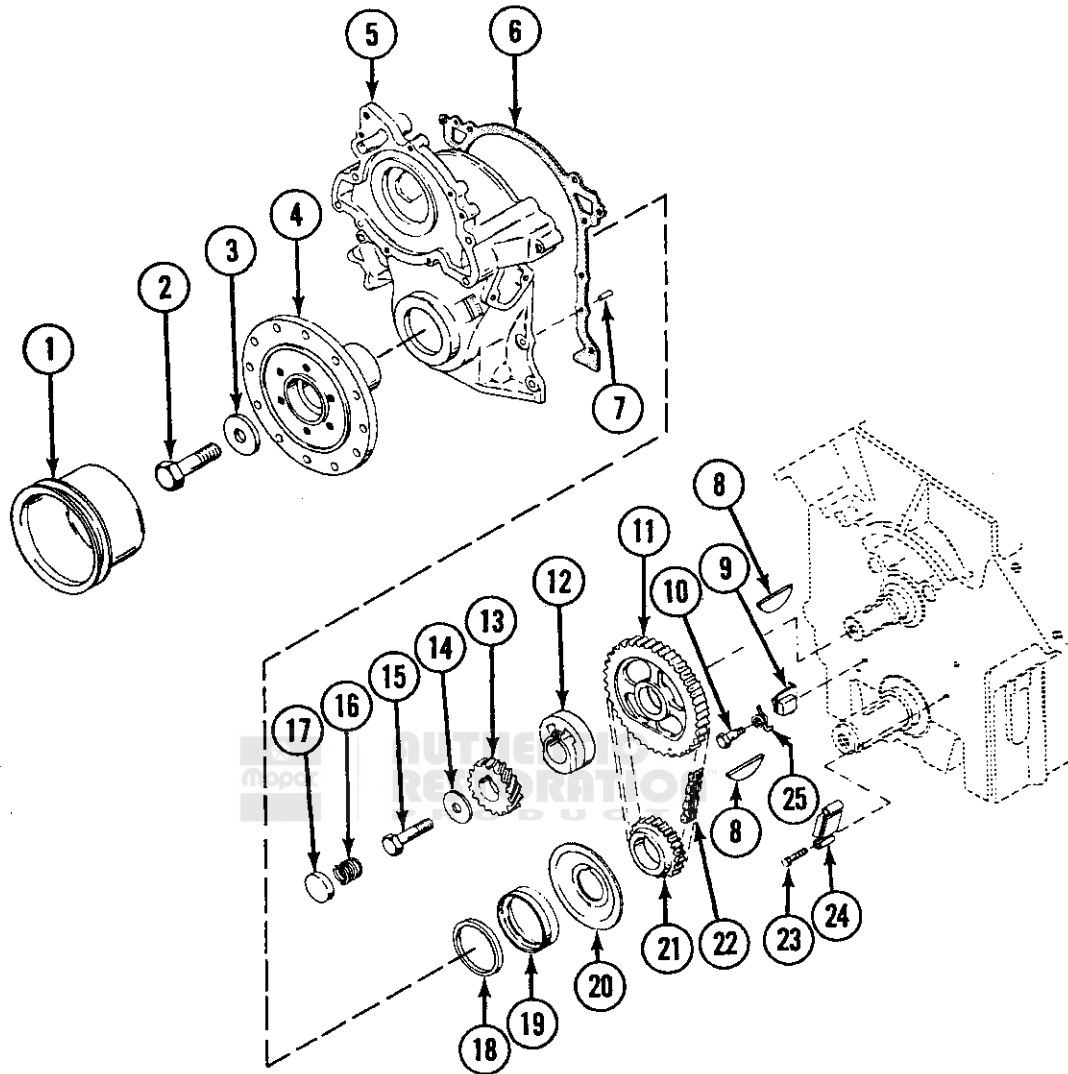


FIG. D1-38—TIMING CHAIN, TIMING GEARS AND COVER

- | | | |
|-------------------------------|------------------------------|-------------------------------|
| 1—Crankshaft Pulley | 10—Damper Bolt | 18—Oil Shedder (Crankshaft) |
| 2—Crankshaft Pulley Bolt | 11—Camshaft Sprocket | 19—Crankshaft Packing (Front) |
| 3—Washer | 12—Fuel Pump Eccentric | 20—Crankshaft Slinger |
| 4—Vibration Damper | 13—Distributor Camshaft Gear | 21—Crankshaft Sprocket |
| 5—Timing Gear Cover | 14—Washer | 22—Timing Chain |
| 6—Gasket | 15—Special Bolt | 23—Damper Bolt |
| 7—Dowel Pin | 16—Thrust Spring | 24—Timing Chain Damper (Left) |
| 8—Woodruff Key | 17—Thrust Button | 25—Spring |
| 9—Timing Chain Damper (Right) | | |

D1-84. Install Timing Chain and Sprocket

- a. Turn crankshaft so that No. 1 piston is at top center.
- b. Temporarily install sprocket key and camshaft sprocket on camshaft. Turn camshaft so that index mark of sprocket is downward. Remove key and sprocket from camshaft.
- c. Assemble timing chain and sprockets. Install keys, sprocket, and chain assembly on the camshaft and crankshaft so that index marks of both sprockets are aligned as shown in Fig. D1-39.

Note: It will be necessary to hold spring-loaded timing chain damper out of the way while installing timing chain and sprocket assembly.

- d. Install front oil slinger on crankshaft with inside diameter against sprocket (concave side toward front of engine).
- e. Install fuel pump eccentric on camshaft and key with oil groove of eccentric forward. See Fig. D1-40.
- f. Install distributor drive gear on camshaft. Secure gear and eccentric to camshaft with retaining washer and bolt. Torque bolt 40 to 55 lb-ft. [5,53 a 7,6 kg-m.]. Install camshaft thrust retainer assembly onto camshaft retaining bolt. Refer to items 16 and 17 Fig. D1-38.

D1-85. Install Crankshaft Front Oil Seal

From rear of timing chain cover, coil new packing around crankshaft opening at cover so that ends

of packing are at top. Drive in a new shedder with a suitable punch. Stake the shedder in at least three places to secure it in position. Size the pack-

ing by rotating a hammer handle, or similar smooth tool, around it, as necessary, to obtain clearance for the crankshaft vibration damper hub.

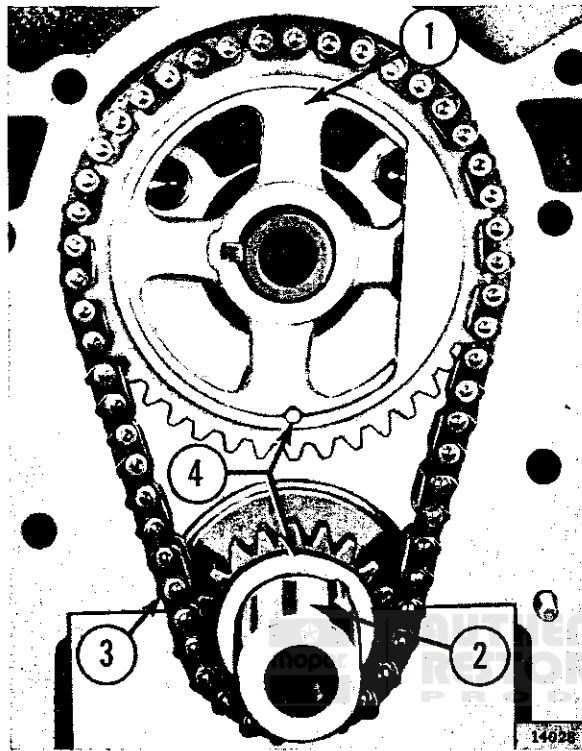


FIG. D1-39—INSTALLATION OF TIMING CHAIN AND SPROCKET

- | | |
|-----------------------|----------------|
| 1—Camshaft Sprocket | 3—Timing Chain |
| 2—Crankshaft Sprocket | 4—Timing Marks |

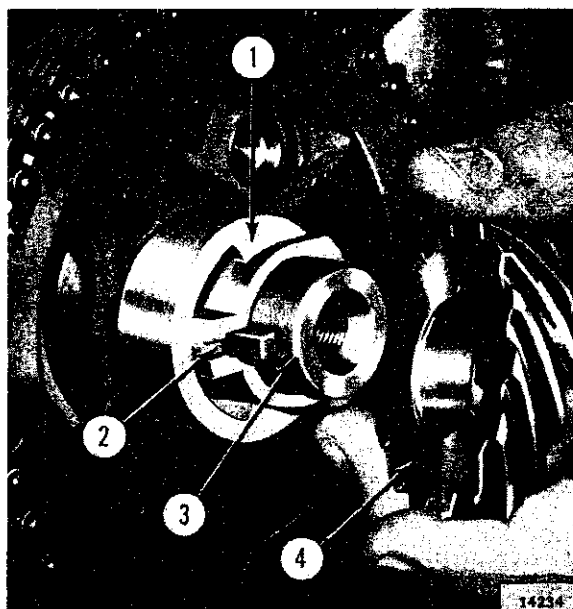


FIG. D1-40—FUEL PUMP ECCENTRIC AND DISTRIBUTOR DRIVE GEAR

- | | |
|-----------------------|--------------------------|
| 1—Fuel Pump Eccentric | 3—Camshaft |
| 2—Oil Groove | 4—Distributor Drive Gear |

D1-86. Install Timing Chain Cover

Note: There are five bolts which attach the timing chain cover directly to the cylinder block, and seven bolts which attach both the timing chain cover and water pump to the cylinder block.

a. If oil pump has not been removed from timing chain cover, remove fine slotted attaching screws, oil pump cover, gasket from timing chain cover. Completely pack the space around the oil pump gears with petroleum jelly. There must be no air space left inside the pump. Secure oil pump cover and a new gasket to timing chain cover with five slotted attaching screws. Torque screws, alternately and evenly, 8 to 12 lb-ft. [1,10 a 1,66 kg-m.].

Note: Unless oil pump gears are packed with petroleum jelly, pump may not prime itself when engine is started.

b. The gasket surfaces of the cylinder block and timing chain cover must be smooth and clean. Install a new timing chain cover gasket and position it correctly on the cylinder block.

Note: Two different timing chain cover gaskets have been installed in production on V-6 engines. At any time the timing chain cover gasket is replaced, make sure the correct gasket is installed.

c. Position timing chain cover to cylinder block. Use timing cover aligner and oil seal remover tool J-22248. Be certain that dowel pins engage dowel pin holes before installing bolts.

d. Lubricate bolt threads before installation. Install the mounting bolts and torque 25 to 33 lb-ft. [3,5 a 4,6 kg-m.].

Note: Some timing chain covers have two additional bolts, one in each upper corner. If the timing chain cover being installed on a crankcase with these two holes does not have matching holes, the holes in the crankcase must be plugged with two hex socket screw plugs. The plug should be driven past the face of the case to prevent interference with the timing chain cover. These bolts are not shown in Fig. D1-41.

D1-87. Install Oil Pump

a. Pack oil pump gear pocket of timing chain cover with petroleum jelly. Do not use chassis lubricant.

b. Install gears so that petroleum jelly is forced into every cavity of gear pocket and between the teeth of the gears. Install a new oil pump cover gasket.

Note: Unless the pump is packed with petroleum jelly, it may not prime itself when the engine is started.

c. Mount oil pump cover on timing gear cover with five slotted attaching screws. Torque screws

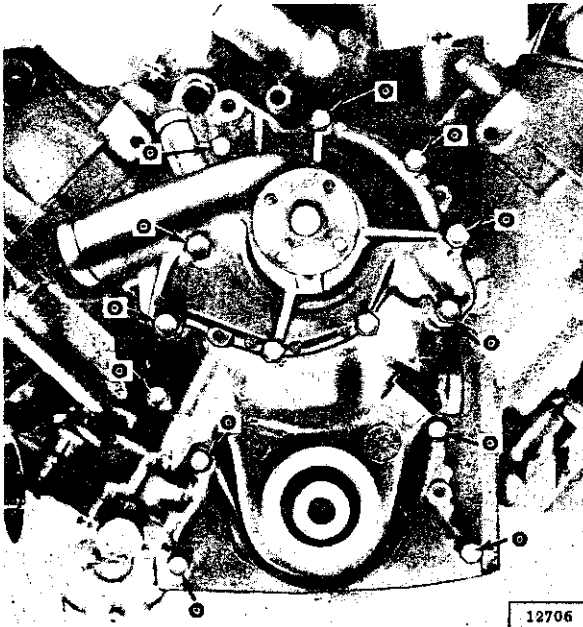


FIG. D1-41—WATER PUMP AND TIMING CHAIN COVER BOLT LOCATION

Cover Bolts

alternately and evenly 8 to 12 lb-ft. [1,10 a 1,66 kg-m.].

D1-88. Install Crankshaft Vibration Damper

a. Lubricate the vibration damper hub before installation to prevent damage to the crankshaft front oil seal during installation and when the engine is first started.

b. Install the vibration damper on the crankshaft. Secure it with its attaching flat washer and screw. Torque the screw to a minimum of 140 lb-ft. [19,35 kg-m.].

D1-89. Install Crankshaft Pulley

Secure the crankshaft pulley to the crankshaft vibration damper with six screws. Torque screws 18 to 25 lb-ft. [2,5 a 3,4 kg-m.].

D1-90. Install Oil Level Dipstick

Insert oil level dipstick into the dipstick tube.

D1-91. Install Oil Pressure Sending Unit

Install oil pressure sending unit in cylinder block. Connect electrical wiring harness to unit.

D1-92. Install Starting Motor

Secure starting motor and solenoid assembly to the flywheel housing and cylinder block with two attaching screws. Torque screw, which attaches this assembly to the flywheel housing, 30 to 40 lb-ft. [4,1 a 5,5 kg-m.]. Torque screw, which attaches bracket to cylinder block, 10 to 12 lb-ft. [1,4 a 1,7 kg-m.].

D1-93. Install Oil Filter

Install a new oil filter element at oil filter nipple, at left side of timing chain cover. Torque 10 to 15 lb-ft. [1,38 a 2,07 kg-m.].

D1-94. Install Water Pump

Be certain that mating surfaces of the water pump and timing chain cover are clean. Install a new gasket on the pump flange. Secure the pump and alternator adjustment bracket to the cover with nine attaching bolts. Torque bolts 6 to 8 lb-ft. [0,83 a 1,10 kg-m.]. Refer to Fig. D1-41.

D1-95. Install Cooling Fan

Secure the cooling fan, fan hub, and fan drive pulley to the water pump shaft flange with four attaching screws. Torque screws 17 to 23 lb-ft. [2,35 a 3,18 kg-m.].

D1-96. Install Alternator and Fan Belt

Mount the alternator and bracket assembly on right cylinder head with two attaching screws. Torque screws 30 to 40 lb-ft. [4,1 a 5,5 kg-m.]. Fasten the alternator loosely to its adjustment bracket with attaching flat washer and nut. Install the fan belt on its pulleys. Pivot the alternator outward, away from cylinder block, to apply fan belt tension. Adjust fan belt tension to 80 lb. [36,2 kg.]; tighten alternator-to-adjustment bracket nut to secure adjustment setting. Connect wiring harness to alternator.

D1-97. Install Fuel Pump

Install two mounting bolts and new gasket on flange of fuel pump. Secure pump to timing chain cover with screws; torque screws 17 to 23 lb-ft. [2,35 a 3,8 kg-m.]. Connect output fuel line to pump.

D1-98. Install Exhaust Manifold

Secure each of two exhaust manifolds to corresponding cylinder head with five attaching screws, and one nut. Torque screws and nut 15 to 20 lb-ft. [2,07 a 2,8 kg-m.]. See Fig. D1-42.

D1-99. Install Distributor

Insert distributor drive gear into distributor mount-

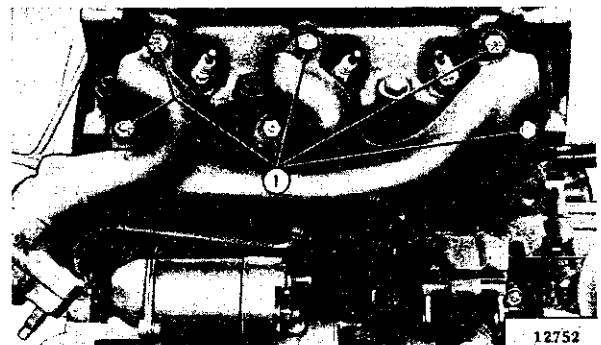


FIG. D1-42—EXHAUST MANIFOLD INSTALLATION

1—Torque Bolts — 15 to 20 lb-ft. [2,07 a 2,8 kg-m.]

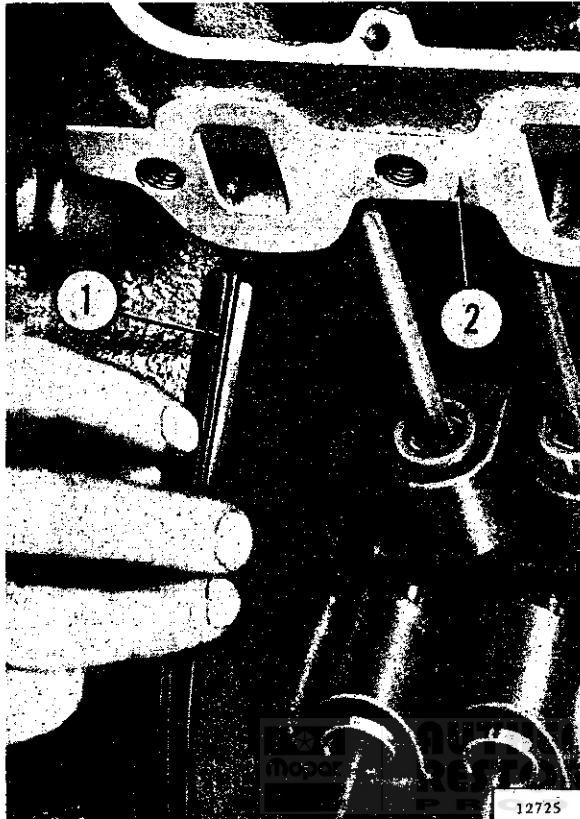


FIG. D1-43—INTAKE MANIFOLD SEAL INSTALLATION
1—Seal 2—Cylinder Head

ing hole at left side of timing chain cover. If timing chain and sprockets have not been removed from engine, install distributor with rotor in position noted during distributor removal. Fasten distributor to timing chain cover with retaining bracket and mounting screws. If distributor is aligned, torque screw 18 to 20 lb-ft. [2,5 a 2,8 kg-m.].

D1-100. Install Spark Plugs

Install spark plugs in cylinder heads. Torque 25 to 33 lb-ft. [3,5 a 4,6 kg-m.]. Install spark plug cable retainers on brackets welded to rocker arm covers. Fit cables into retainers and connect to spark plugs, as indicated by cable numbers molded into distributor cap and by spark plug firing order pressed into each rocker arm cover.

D1-101. Install Intake Manifold and Carburetor Assembly

a. Install a new rubber intake manifold seal at front and rear rails of cylinder block. Be sure pointed ends of seals fit snugly against block and cylinder heads. See Fig. D1-43.

b. Set intake manifold in place on cylinder block between cylinder heads. Thread two cap bolts through manifold into each cylinder head as guide bolts. Lift the manifold slightly and insert each of two gaskets into position between manifold and corresponding cylinder head. Be certain that the gasket is installed with its three apertures

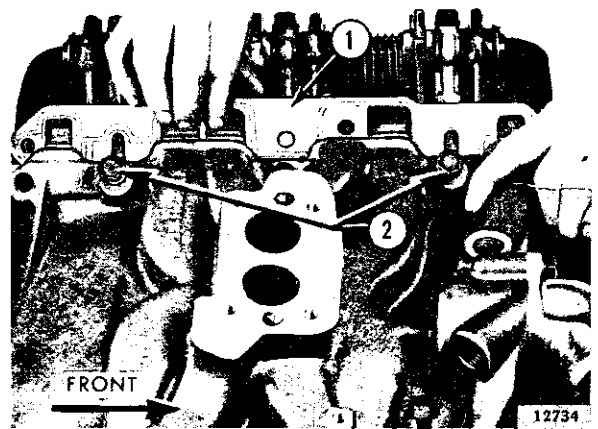


FIG. D1-44—INTAKE MANIFOLD GASKET INSTALLATION
1—Gasket 2—Guides Bolts

aligned with ports of the head and manifold. One gasket should be installed in position on the left side, as shown in Fig. D1-44, and its counterpart reversed for right side installation.

c. Install manifold attaching bolt in open bolt hole at right side of intake manifold. See Fig. D1-46. Open bolt hole is held to close tolerances, so that the bolt in this location serves to locate the manifold front and rear.

d. Install remaining manifold-to-cylinder head bolts, with longer bolts at forward location. Beginning with the number 1 and 2 bolts, see Fig. D1-45, tighten gradually and equally until both bolts are snug. This will prevent the manifold from shifting due to full torque being applied to only one bolt. Then continue in the sequence illustrated in Fig. D1-45 until the rest of the bolts are also snug. Finally, using the same sequence, torque all bolts to 45 to 55 lb-ft. [6,2 a 7,6 kg-m.].

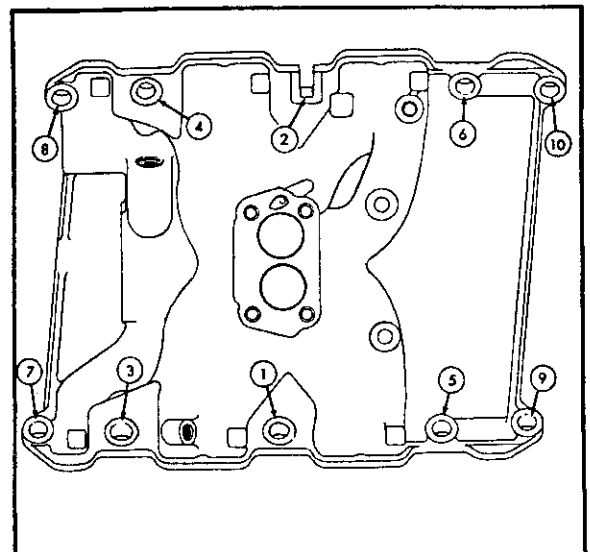


FIG. D1-45—INTAKE MANIFOLD BOLT TIGHTENING SEQUENCE

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e. Connect electrical wiring harness to coolant temperature sending unit. Connect two distributor leads to ignition coil. Connect fuel line between fuel pump and carburetor, vacuum hose between distributor and carburetor, and crankcase vent hose to intake manifold below rear of carburetor.

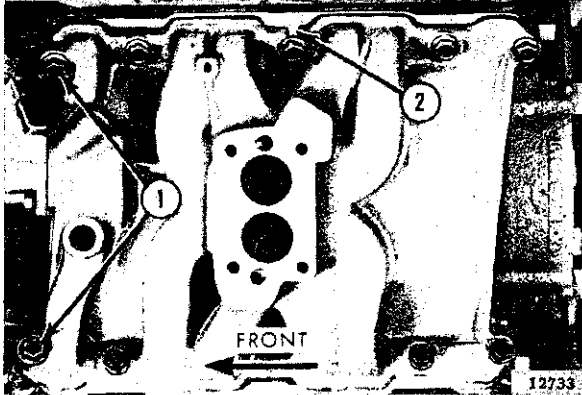


FIG. D1-46—INTAKE MANIFOLD INSTALLATION

1—Long Bolt

2—Open Bolt Hole

D1-102. ENGINE INSTALLATION

Install the engine in the vehicle in the following procedure listed below:

- a. Attach suitable sling to engine lifting eyes and, using a hoist, lift the engine from blocks or engine stand.
- b. When engine is free of the stand lower it slowly into the engine compartment of the vehicle.

Note: The engine and transmission must be lined up to engage the main shaft and clutch plate spline while sliding the engine rearward into the mounting position.

- c. Install and tighten up bolts securing engine to flywheel housing.
- d. Install and tighten front engine mounting bolts.
- e. Remove sling from the engine.
- f. Connect exhaust pipes to right and left engine manifolds.
- g. Connect choke cable support bracket to carburetor.
- h. Connect engine fuel hoses and fuel lines at right frame rail.
- i. Connect fuel lines.
- j. Mount engine starter motor assembly to engine.

k. Connect battery cable and wiring to engine starter motor.

l. Connect engine wiring harnesses to connectors located on engine firewall.

Note: On engines equipped with exhaust emission control, replace the air pump, air distributor manifold, and anti-backfire (gulp) valve. See Section F2.

m. Replace radiator, and secure with bolts.

n. Replace and tighten right and left radiator support rods.

o. Connect upper and lower radiator hoses to the engine.

p. Connect alternator wiring harness from connector at regulator.

q. Replace air cleaner.

r. Connect battery ground cable from the battery to the engine and the engine ground strap.

s. Replace the hood.

After the engine is installed in the vehicle, fill radiator with coolant and engine with oil (Refer to Lubrication Section B), then perform an engine Tune-up and road test (Refer to Tune-up Section C).

D1-103. FINAL IN-VEHICLE ADJUSTMENTS

- a. Clean battery terminals and check battery.
- b. Check ignition wires and connections.
- c. Service carburetor air cleaner.
- d. Service positive crankcase ventilation valve.
- e. Check fuel lines.
- f. Gap and install new spark plugs.
- g. Check distributor points and capacitor; replace if necessary.
- h. Check ignition (distributor) timing; reset if necessary.
- i. Check carburetor adjustments; reset if necessary.
- j. With engine fully warmed up, tighten cylinder head and manifold bolts and nuts to specified torque. Check cylinder head gaskets and bolts for air or coolant leaks.

Note: Tightness of cylinder head bolts should be checked and corrected after 500 miles [800 km.] of normal operation and again at 1000 miles [1600 km.].

k. Check fan belt tension; adjust if necessary.

l. Check for and correct any oil leak, fuel leak or coolant leak.

D1-104. SERVICE DIAGNOSIS

Poor Fuel Economy

- Ignition Timing Late or Spark Advance Inoperative
- Carburetor Float Setting Too High
- Accelerator Pump Improperly Adjusted
- Fuel Pump Pressure High
- Fuel Line Leakage
- Fuel Pump Diaphragm Leakage
- Cylinder Compression Low
- Valves Do Not Seat Properly
- Spark Plugs Defective
- Spark Plug Cables Defective
- Ignition Coil or Capacitor Defective
- Carburetor Air Cleaner Dirty
- Brakes Drag
- Wheel Alignment Incorrect
- Tire Pressure Incorrect
- Odometer Inaccurate
- Fuel Tank Cap Clogged or Defective
- Muffler or Exhaust Pipe Clogged or Bent

Lack of Power

- Cylinder Compression Low
- Ignition Timing Late
- Carburetor or Fuel Pump Clogged or Defective
- Fuel Lines Clogged
- Air Cleaner Restricted
- Engine Temperature High
- Valves Do Not Seat Property
- Valve Timing Late
- Intake Manifold or Cylinder Head Gasket Leaks
- Muffler or Exhaust Pipe Clogged or Bent
- Spark Plugs Dirty or Defective
- Breaker Point Gap Incorrect
- Breaker Points Defective
- Ignition Coil or Capacitor Defective
- Electrical Connection Loose
- Broken Valve Spring
- Broken Piston Ring or Piston
- Cylinder Head Gasket Defective
- Distributor Cap Cracked

Low Compression

- Valves Not Seating Properly
- Piston Rings Seal Poorly
- Valve Spring Weak or Broken
- Cylinder Scored or Worn
- Piston Clearance Too Great
- Cylinder Head Gasket Leaks

Burned Valves and Seats

- Valves Stick or Are Too Loose in Guides
- Valve Timing Incorrect
- Valve Head and Seat Have Excessive Carbon
- Engine Overheats
- Valve Spring Weak or Broken
- Valve Lifter Seized or Collapsed
- Exhaust System Clogged

Valves Sticking

- Valve Stem Warped
- Valve Stem Carbonized or Scored
- Valve Stem Clearance Insufficient in Guide
- Valve Spring Weak or Broken
- Valve Spring Distorted
- Oil Contaminated

Overheating

- Cooling System Inoperative
- Thermostat Inoperative
- Ignition Timing Incorrect
- Valve Timing Incorrect
- Carbon Accumulation Excessive
- Fan Belt Loose
- Muffler or Exhaust Pipe Clogged or Bent
- Oil System Failure
- Piston Rings Worn or Scored

Popping, Spitting, Detonation

- Ignition Timing Incorrect
- Carburetion Improper
- Carbon Deposit in Combustion Chambers Excessive
- Valves Not Seating Properly
- Valve Spring Broken
- Spark Plug Electrodes Burned
- Water or Dirt in Fuel
- Fuel Line Clogged
- Valve Timing Incorrect

Excessive Oil Consumption

- Piston Rings Stuck in Grooves, Weak, Worn, Broken, or Incorrectly Fitted
- Crankshaft Main Bearings or Connecting Rod Bearings Have Excessive Clearance
- Gaskets or Oil Seals Leak
- Cylinder Bores Worn, Scored, Out-of-Round or Tapered
- Pistons Have Too Great Clearance to Cylinder Bores
- Connecting Rods Misaligned
- High Road Speed
- High Temperature
- Crankcase Ventilation System Inoperative

Bearing Failure

- Crankshaft Bearing Journal Rough or Out-of-Round
- Oil Level Low
- Oil Leakage
- Oil Dirty
- Oil Pressure Low or Lacking (Oil Pump Failure)
- Drilled Passages in Crankshaft or Crankcase Clogged
- Oil Screen Dirty
- Connecting Rod Bent

E-105. DAUNTLESS V-6 ENGINE SPECIFICATIONS

	English	Metric
ENGINE:		
Type	90° V-6	
Number of Cylinders	6	
Valve Arrangement	In head	
Bore	3.750"	9,525 cm.
Stroke	3.400"	8,636 cm.
Piston Displacement	225 cu. in.	3,69 ltr.
Firing Order	1-6-5-4-3-2	
Compression Ratio	*9.0:1	
Number of Mounting Points:		
Front	2	
Horsepower (SAE)	33,748	
Horsepower (max. brake)	160 @ 4200 rpm.	
Torque (max. 2400 rpm.)	235 lb.-ft.	32,49 kg-m.
Cylinder Numbers, Front to Rear:		
Right Bank	2, 4, 6	
Left Bank	1, 3, 5	
Cylinder Block Material	Cast Iron	
Cylinder Head Material	Cast Iron	
PISTONS:		
Material	Cast Aluminum Alloy	
Description	Cam Ground, Tin Plated	
Clearance Limits:		
Top Land	.0125" to .0295"	0,318 a 0,749 mm.
Skirt Top	.0005" to .0011"	0,0127 a 0,0279 mm.
Skirt Bottom	.0005" to .0011"	0,0127 a 0,0279 mm.
Ring Groove Depth:		
No. 1	.1880" to .1995"	4,775 a 5,067 mm.
No. 2, 3	.1905" to .1980"	4,839 a 5,029 mm.
Cylinder Bore:		
Out-of-Round (max.)	.003"	0,076 mm.
Taper (max.)	.005"	0,127 mm.
PISTON RINGS:		
Function:		
No. 1 and No. 2 Ring	Compression	
No. 3 Ring	Oil Control	
Location	Above Piston Pin	
Material:		
No. 1	Iron, Chrome Plated	
No. 2	Iron, Pre-lubricated	
No. 3	Steel	
Oil Ring Type	Dual Rail, With Spacer	
Oil Ring Expander	Humped Ring	
Width:		
No. 1	.0785" to .0790"	1,993 a 2,007 mm.
No. 2	.0770" to .0780"	1,956 a 1,981 mm.
No. 3	.181" to .187"	4,60 a 4,75 mm.
Gap:		
No. 1 and No. 2	.010" to .020"	0,25 a 0,51 mm.
No. 3	.015" to .035"	0,38 a 0,89 mm.
Side Clearance in Groove:		
No. 1	.002" to .0035"	0,051 a 0,089 mm.
No. 2	.003" to .005"	0,076 a 0,127 mm.
No. 3	.0015" to .0085"	0,038 a 0,220 mm.
PISTON PINS:		
Material	Steel, SAE 1018, SAE 1118	
Length	3.060"	7,772 cm.
Diameter	.9394" to .9397"	23,861 a 23,868 mm.
Type	Pressed in Connecting Rod	
Clearance in Piston	.0004" to .0007"	0,0102 a 0,0178 mm.
Clearance in Connecting Rod	.0007" to .0017"	0,0178 a 0,0431 mm.
Distance Offset Toward High-Thrust Side of Piston	.040"	1,016 mm.

*State of California Exhaust Emission Control Engine 7.4 Compression Ratio.

D1-105. DAUNTLESS V-6 ENGINE SPECIFICATIONS—Continued

	English	Metric
CONNECTING RODS:		
Material	Pearlitic Malleable Iron	
Installation	From Top of Cylinder Bore	
Bearings:		
Type	Removable, Steel-Backed	
Material	Aluminum	
Length	.737"	18,72 mm.
Clearance	.0020" to .0023"	0,0508 a 0,0584 mm.
End Play (total for two connecting rods)	.006" to .014"	0,153 a 0,356 mm.
CRANKSHAFT:		
Material	Pearlitic Malleable Iron	
End Thrust	Second Main Bearing	
End Play	.004" to .008"	0,102 a 0,203 mm.
Main Bearings:		
Number	4	
Type	Removable	
Material	Moraine 100	
Length, Over-All:		
No. 1, No. 3, and No. 4	.864"	21,95 mm.
No. 2	1.057"	2,685 cm.
Clearance	.0005" to .0021"	0,0127 a 0,0533 mm.
Main Journal Diameter	2.4995"	6,349 cm.
Crankpin Journal Diameter	2.0000"	5,080 cm.
Flywheel Run Out, max.	.015"	0,381 cm.
CAMSHAFT:		
Material	Cast Iron Alloy	
Bearings:		
Number	4	
Material	Steel-Backed Babbitt	
Clearance	.0015" to .0040"	0,0381 a 0,1016 mm.
Journal Diameter:		
No. 1	1.755" to 1.756"	4,458 a 4,460 cm.
No. 2	1.725" to 1.726"	4,382 a 4,384 cm.
No. 3	1.695" to 1.696"	4,305 a 4,307 cm.
No. 4	1.665" to 1.666"	4,229 a 4,231 cm.
Location	In Cylinder Block, at Center of V	
Camshaft Drive	Chain and Sprocket	
Chain Links	54	
Camshaft Sprocket Material	Aluminum, Nylon Coated	
Crankshaft Sprocket Material	Sintered Iron	
VALVE SYSTEM:		
Valve Lifters		
Diameter	Hydraulic .8422" to .8427"	21,39 a 21,40 mm.
Clearance in Cylinder Block	.0015" to .0030"	0,0381 a 0,0762 mm.
Leak-down Time (seconds)	12 to 60	
Rocker Arms:		
Ratio	1.6:1	
Clearance on Shaft	.0017" to .0032"	0,0432 a 0,0812 mm.
Valves:		
Intake:		
Material	Steel, SAE 1041	
Head Diameter	1.625"	4,128 cm.
Seat Angle	45°	
Stem Diameter	.3415" to .3427"	8,674 a 8,704 mm.
Stem Clearance in Guide	.0012" to .0032"	
Exhaust:		
Material	GM-N82152 (21-4N)	
Head Diameter	1.3750"	3,4925 cm.
Seat Angle	45°	
Stem Diameter	.3402" to .3412"	8,641 a 8,666 mm.
	.3397" to .3407"	8,628 a 8,653 mm.
Stem Clearance in Guide	.0015" to .0035" (top) .002" to .004" (bottom)	0,0381 a 0,0889 mm. 0,051 a 0,102 mm.
Valve Springs — Pressure at Length:		
Valve Closed	1.640" at 59 - 64 lb. 1.260" at 168 lb.	4,16 cm. at 26,76 - 29,03 kg. 3,20 cm. at 76,20 kg.

D1-105. DAUNTLESS V-6 ENGINE SPECIFICATIONS—Continued

	English	Metric
LUBRICATION SYSTEM:		
Type of Lubrication:		
Main Bearings	Pressure	.....
Connecting Rod Bearings	Pressure	.....
Piston Pins	Splash	.....
Camshaft Bearings	Pressure	.....
Rocker Arms	Pressure	.....
Timing Chain	Splash and Nozzle	.....
Cylinder Walls	Splash and Nozzle	.....
Oil Pump:		
Type	Gear	.....
Drive	Camshaft Gear	.....
Normal Oil Pressure	33 psi. at 2400 rpm.	2,32 kg-cm ² at 2400 rpm.
Oil Pressure Sending Unit	Electrical	.....
Oil Intake	Screened Tube	.....
Oil Filter System	Full Flow Type	.....
Filter Type	Throwaway Element and Can	.....
Crankcase Capacity:		
Without Filter	4 qt.	3,8 ltr.
With Filter	5 qt.	4,7 ltr.



**AUTHENTIC
RESTORATION[™]
PRODUCT**

FUEL SYSTEM

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E-1. GENERAL

The fuel system of the Jeep Universal vehicle, whether equipped with a Hurricane F4 or Dauntless V-6 Engine, consists of the fuel tank, fuel lines, fuel pump, carburetor and air cleaner. Fig. E-1, E-2. Vehicles equipped with a Fuel Evaporative Emission Control System also include a non-vent pressure and vacuum sensitive gas cap, a liquid expansion and vapor separator tank, a carbon filled vapor storage canister, and a vapor purge line. Service information pertaining to the Fuel Evaporative Emission Control System is outlined in Par. E-2 through E-9. Refer to Figs. E-3 and E-4. The most important attention necessary to the fuel system is to keep it clean and free from water. It should be periodically inspected for leaks.

CAUTION—Whenever a vehicle is to be stored for an extended period, the fuel system should be completely drained, the engine started and allowed to run until the carburetor is emptied. This will avoid oxidization of the fuel, resulting in the formation of

gum in the units of the fuel system. Gum formation is similar to hard varnish and may cause the fuel pump valves or the carburetor float valve to become stuck or the filter screen blocked. Acetone or commercial fuel system cleaners will dissolve gum formation. In extreme cases it will be necessary to disassemble and clean the fuel system. In most cases, however, a good commercial fuel system solvent used in accordance with the manufacturer's instructions or one pint [0,6 ltr.] of acetone placed in the fuel tank with about one gallon [4,5 ltr.] of gasoline will dissolve any deposits as it passes through the system with the gasoline.

E-2. FUEL EVAPORATIVE EMISSION CONTROL SYSTEM

Description and Operation

- Refer to Figs. E-3 and E-4.

The Fuel Evaporative Emission Control System is designed to reduce fuel vapor emission that

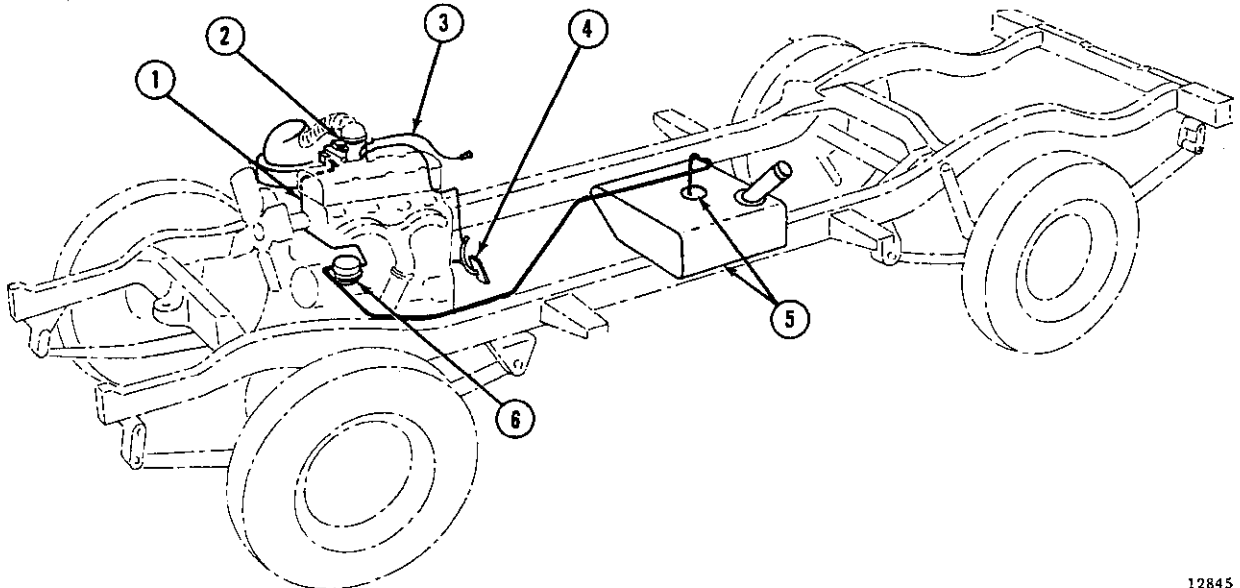


FIG. E-1—FUEL SYSTEM—EARLY MODEL—F-4 ENGINE

- | | |
|---------------------------|-----------------------|
| 1—Fuel Line To Carburetor | 4—Accelerator Treadle |
| 2—Carburetor | 5—Fuel Tank and Gauge |
| 3—Choke Cable | 6—Fuel Pump |

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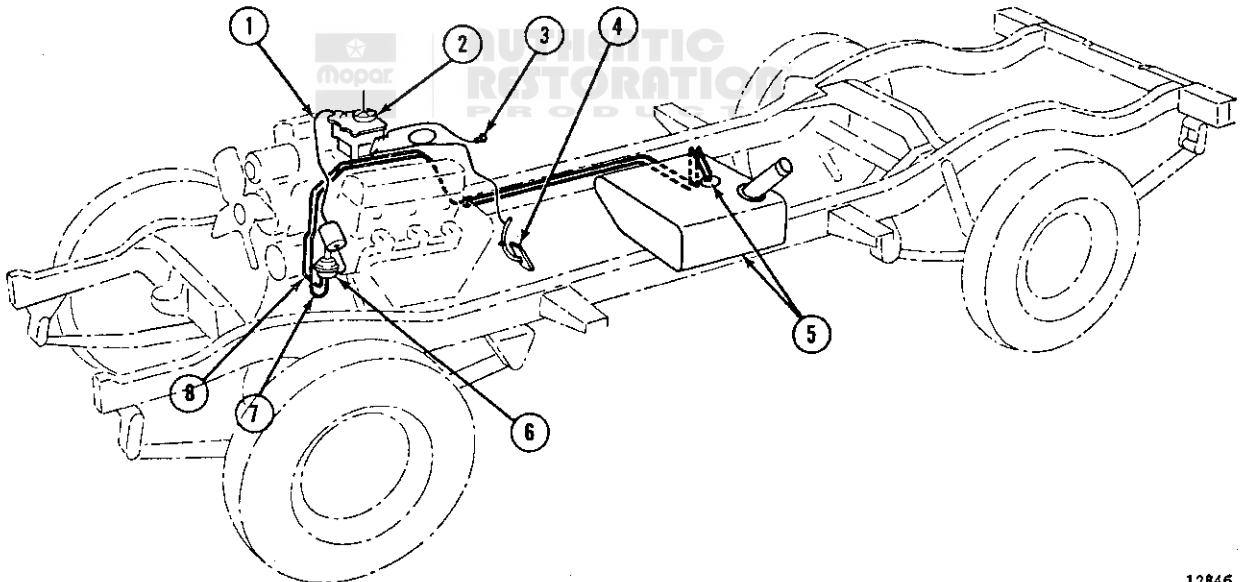


FIG. E-2—FUEL SYSTEM—EARLY MODEL—V-6 ENGINE

- | | |
|---------------------------|--------------------------|
| 1—Fuel Line To Carburetor | 5—Fuel Tank and Gauge |
| 2—Carburetor | 6—Fuel Pump |
| 3—Choke Cable | 7—Fuel Line To Fuel Pump |
| 4—Accelerator Treadle | 8—Fuel Return Line |

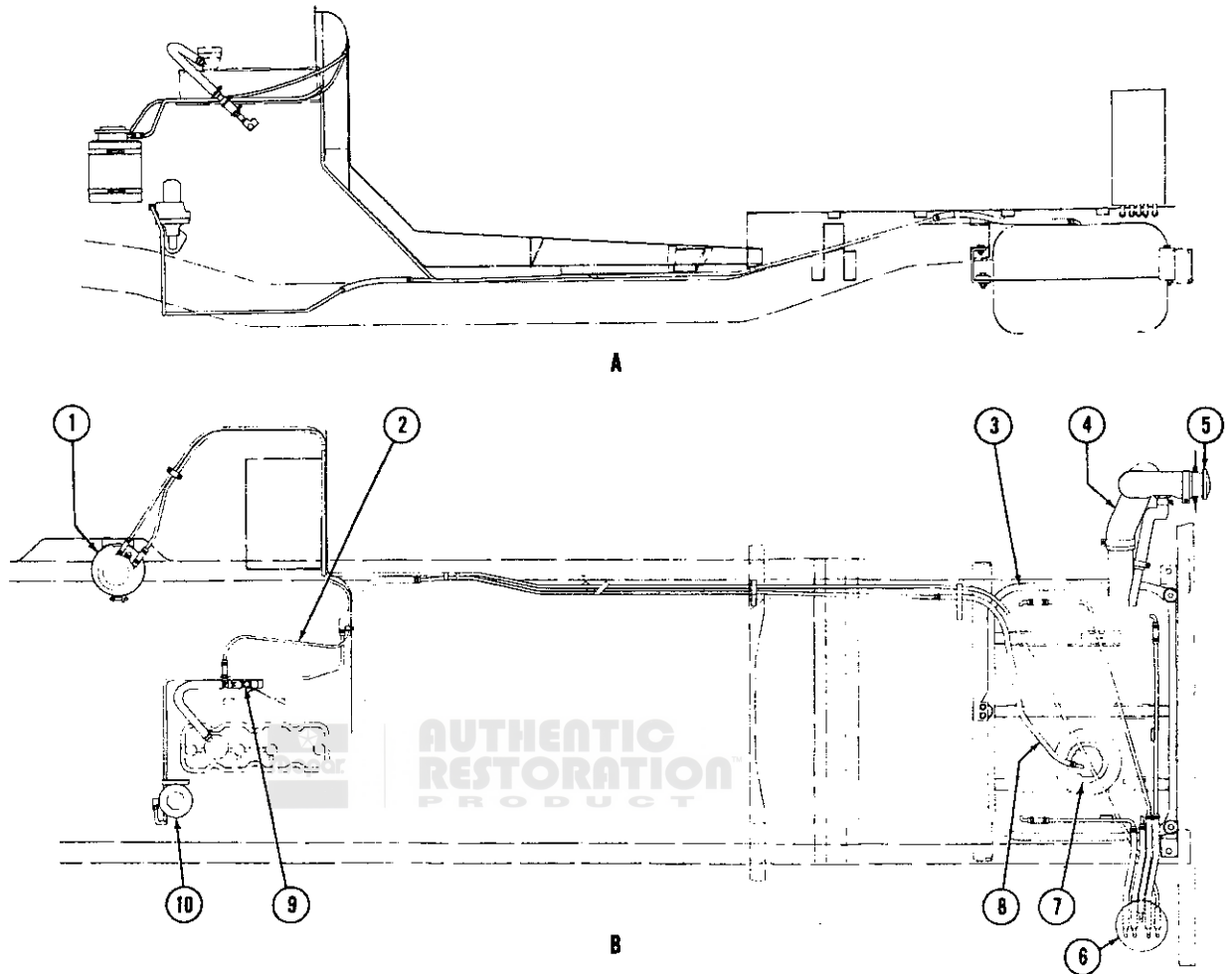
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normally vents to the atmosphere from the vehicle fuel system.

The fuel vapor system consists of internal fuel tank venting, a vacuum/pressure fuel tank cap, a vapor separator or expansion tank, vapor canister, and closed external carburetor venting. The same basic system is used on all 'Jeep' vehicles, as shown in Fig. E-3.

This system involves means of trapping the fuel vapors through the use of a charcoal canister which absorbs the vapor and stores it until it can be re-

moved to be burned in the engine. This removal is performed by drawing these vapors through the purge line into the crankcase ventilation system which in turn enters the intake manifold. In addition to the canister, the fuel tank requires a sealed gas cap and extra vents to a liquid separator or expansion tank. This prevents liquid gasoline from entering the vapor system. Thus, as vapors are generated in the fuel tank, they flow through the liquid separator or expansion tank to the canister and are routed to the intake manifold through the



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FIG. E-3—FUEL EVAPORATIVE EMISSION CONTROL SYSTEM—
HURRICANE F4 ENGINE

- A—Side View
- 1—Charcoal Canister
 - 2—Purge Line
 - 3—Fuel Tank
 - 4—Fuel Filler Hose
 - 5—Non-Vented Gas Cap

- B—Plan View
- 6—Vapor Separator or Expansion Tank
 - 7—Fuel Gauge
 - 8—Fuel Line-to-Fuel Pump
 - 9—P.C.V. Crankcase Valve
 - 10—Fuel Pump

crankcase vent system. The charcoal canister incorporates an integral demand valve which regulates vapors entering the canister as well as a limit fill valve to control air trapping during tank fill. The Fuel Evaporative Emission Control System incorporates the following new or modified parts:

E-3. Canister

The canister used for the vapor control system has provisions for containing activated charcoal granules. The material used for the canister body is a special, fuel resistant, heat stabilized nylon. At the top of the canister there is the demand valve which has connections; one vents the vapor to the canister while the other connection joins the canister to the purge system. These tubes enter the canister on opposite sides of a baffle which permits uniform vapor distribution throughout the canister. The

bottom of the canister is fitted with a filter element that allows fuel tank venting to atmosphere after vapors are trapped in the activated charcoal.

E-4. Demand Valve

The demand valve is integral with the canister. It is essentially a combination pressure regulator and vacuum relief valve. This valve regulates the rate of vapor flowing from the fuel tank into the canister. The valve consists of a housing, a spring loaded diaphragm, a diaphragm cover, and a vacuum relief valve. The operation of the unit is such that as tank vent pressure increases the diaphragm lifts, permitting vapor to enter the canister. The pressure under which this occurs is 4" to 6" H₂O. This action regulates the flow of vapors into the canister under severe soak and operation conditions (temp. changes), but generally prohibits the flow of vapor

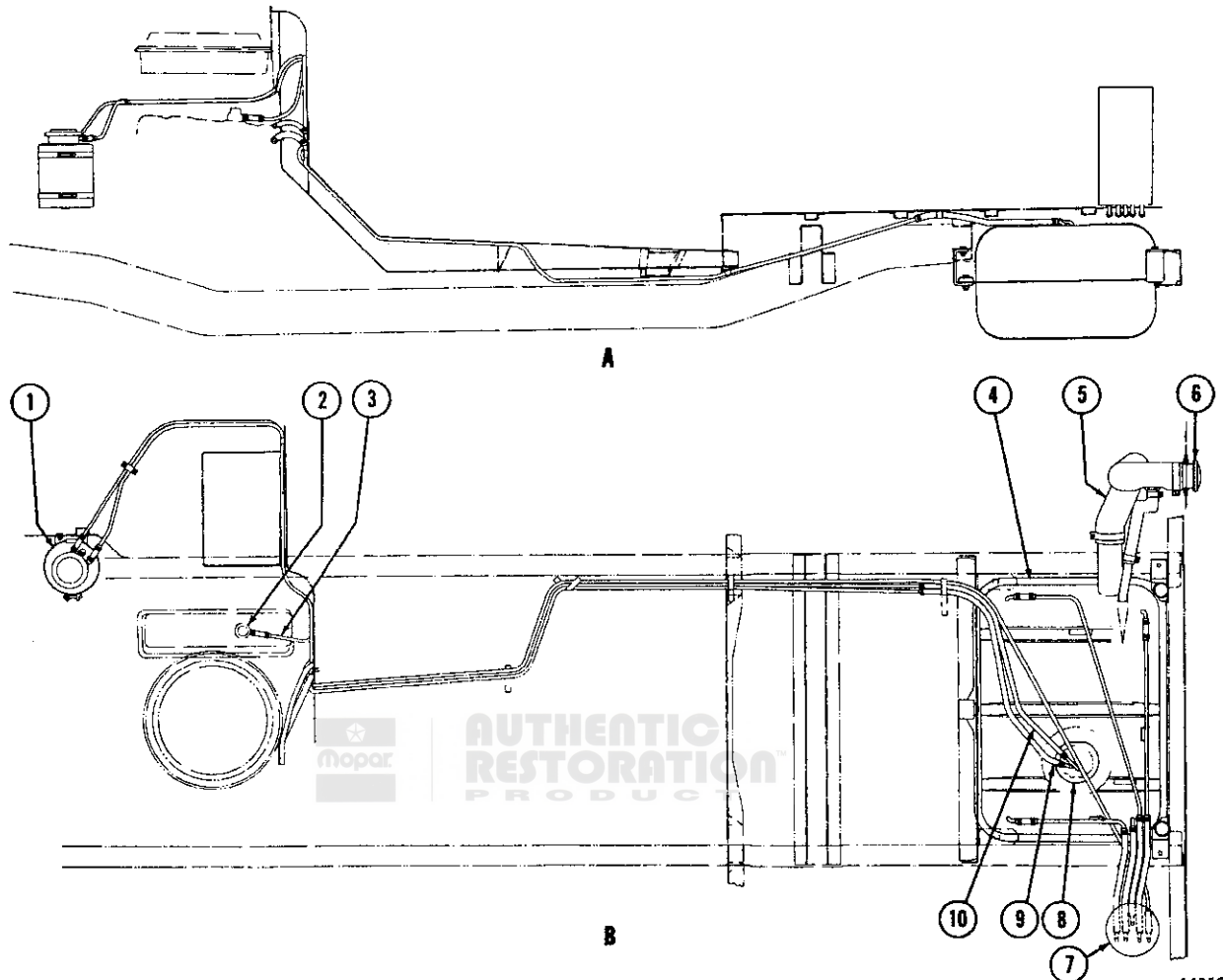


FIG. E-4—FUEL EVAPORATIVE EMISSION CONTROL SYSTEM—
DAUNTLESS V-6 ENGINE

A—Side View
1—Charcoal Canister
2—P.C.V. Crankcase Valve
3—Purge Line
4—Fuel Tank
5—Fuel Filler Hose

B—Plan View
6—Non-Vented Gas Cap
7—Vapor Separator or Expansion Tank
8—Fuel Gauge
9—Fuel Line-to-Fuel Pump
10—Fuel Return Line

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during normal temperature vehicle operation, thus minimizing driveability problems. An additional feature of this valve is a built-in vacuum relief which allows inward air flow under negative fuel tank pressure conditions. The valve housing contains the normal tank vent and purge connections.

E-5. Fuel Tank

The fuel tank is external expansion type. Fuel tank venting is accomplished by several vapor lines which lead to the vapor separator or expansion tank. The vapor lines which lead from the fuel tank are located at the front and rear so that during any inclination of the vehicle, at least one line will be open to vent at all times.

E-6. Vapor Separator or Expansion Tank

The vapor separator is chambered so that the rear

fuel tank vent lines lead into a separate chamber with a fuel shutoff valve. This prevents solid fuel from flowing from the fuel tank to the vapor canister during uphill operation or parking of the vehicle. A single vapor vent line leads from the fuel vapor separator to the vapor collection canister where fuel vapors are stored until they can be drawn into the engine and burned.

The expansion tank allows expansion of the fuel as required during temperature changes and simultaneously becomes a liquid trap that only allows vapors to pass.

E-7. Sealed Gas Cap

The sealed gas cap is designed to allow no vapors to discharge into the atmosphere under normal operation of the system. If the system becomes plugged or a failure of the demand valve occurs

there is a relief valve that opens to reduce high (dangerous) pressures in the fuel tank. In conjunction with the pressure relief valve there is a vacuum relief valve to stop collapse of the fuel tank in case of a plugged system or failure of the demand valve. When replacing the gas cap, the same type must be used as originally installed.

E-8. System Inspection Test

The fuel emission vent system should be checked carefully to ensure the absence of any leaks to the atmosphere of either liquid or vapor which might affect the accuracy, safety, or performance of the control system.

To assure that the sealed system has been properly installed, the following test procedure has been developed.

Disconnect the vent line from the fuel tank system to the activated charcoal canister, induce 1/4 p.s.i. air pressure. If this pressure can be maintained for a few seconds the vent system is assured to be sealed. **DO NOT** add air pressure to the canister because damage can occur to the demand valve if care is not taken.

E-9. Servicing the System

Periodic Maintenance — Replace carbon canister filter at 12,000 miles [19,200 km.] or 12 month intervals (more often for operation in dusty areas). This is the only regular maintenance service required.

Canister Filter Replacement — Disconnect hoses from top of canister, remove canister from mount-

ing bracket. Remove cover from bottom of canister by pulling it down to disengage clips. Remove and discard polyurethane filter element (squeeze element out from under retainer bar). Install new filter by squeezing element under retainer bar and positioning it evenly around entire bottom of canister with edges tucked under canister lip, snap bottom cover in place, reinstall canister on bracket and reconnect hoses.

Vapor line hoses used in this system are made of special rubber material. Bulk hoses are available for parts service. Ordinary rubber hose should not be used to service vapor lines as they are subject to deterioration and may clog the system. Liquid vapor separators or expansion tanks and canisters are serviced as complete units only. Canister air filters, however, are serviced separately.

E-10. CARBURETOR — HURRICANE F4 ENGINE

A single-barrel manual choke, down-draft carburetor (Fig. E-6) is used on the Hurricane F4 engine. The carburetor is internally vented by a tube opening located in the air horn body of the carburetor. This opening is connected by a rubber tube to the air outlet horn of the air cleaner thus allowing only filtered atmospheric pressure air to enter the float chamber for balance pressure of the carburetor fuel.

Note: A carburetor with a specific flow characteristic is used for exhaust emission control. The carburetor is identified by a number, and the correct carburetor must be used, when replacement is necessary.

Early production models CJ-3B, CJ-5, CJ-5A, CJ-6, and CJ-6A have a Carter YF-938SD carburetor superseding the earlier YF-938SC, YF-938SA, or YF-938S models.

Note: Conversion kits for changing earlier models to SD models are available. See Par E-23. It is recommended that when a carburetor is converted that a tag be fashioned stamped with the new model number and installed under one of the air horn screws. Look for such a tag to determine if the carburetor has previously been converted.

Carburetors listed above are all in the same YF series and have only minor differences. Descriptions and repair procedures given in the following paragraphs apply equally to all YF-series carburetors. YF-series carburetors employ manual and vacuum control of the metering rod and accelerator pump. The carburetor controls and vaporizes the fuel through five separate systems: float system, low-speed system, high-speed system, choke system, and accelerating-pump system. A description of the function and operation of each system provides an over all description of the carburetor.

For identification, the series designation is stamped on the body under the name Carter and the model designation is stamped on a flange protruding from the body.

Note: When checking for carburetor icing causes, also check the vacuum-pump-to-manifold vacuum line connector.

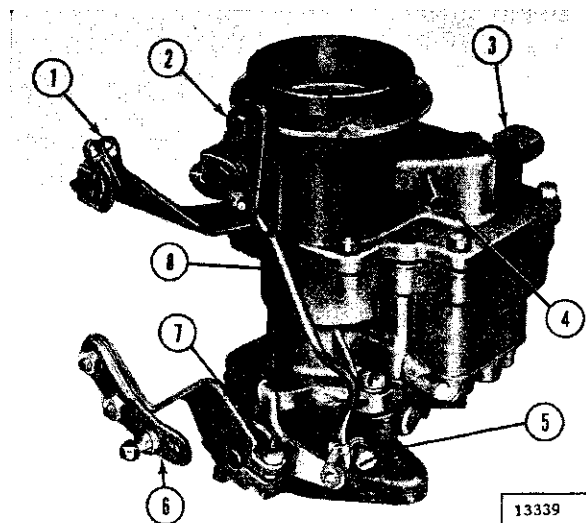


FIG. E-5—CARBURETOR—F4 ENGINE, EARLY MODEL

- 1—Choke Clamp Bracket
- 2—Choke Shaft and Lever Assembly
- 3—Fuel Inlet Elbow
- 4—Bowl Vent Tube
- 5—Idle Air Adjusting Needle
- 6—Throttle Lever and Shaft Assembly
- 7—Idle Speed Adjusting Screw
- 8—Fast Idle Connector Rod

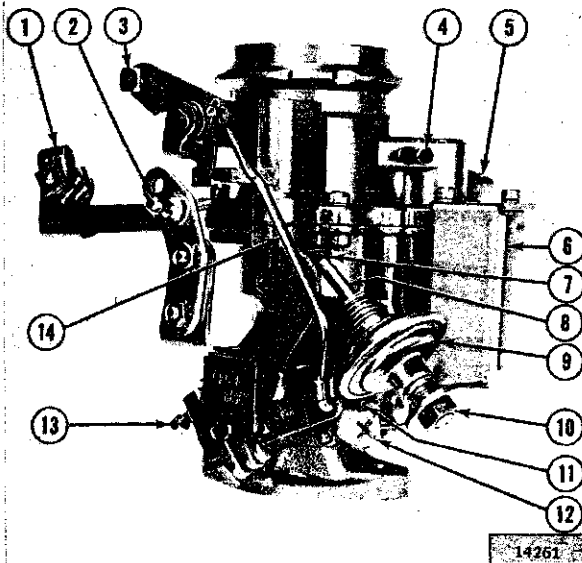


FIG. E-6—CARBURETOR—
F4 ENGINE, LATE MODEL

- | | |
|----------------------------|-------------------------------|
| 1—Choke Clamp Bracket | 8—Dash Pot Plunger |
| 2—Throttle Lever and Shaft | 9—Dash Pot Assembly |
| 3—Choke Shaft and Lever | 10—Lock Nut |
| 4—Bowl Vent Tube | 11—Stop Pin |
| 5—Fuel Inlet Elbow | 12—Idle Mixture Limiter Cap |
| 6—Dash Pot Bracket | 13—Idle Speed Adjusting Screw |
| 7—Throttle Lever | 14—Fast Idle Connecting Rod |

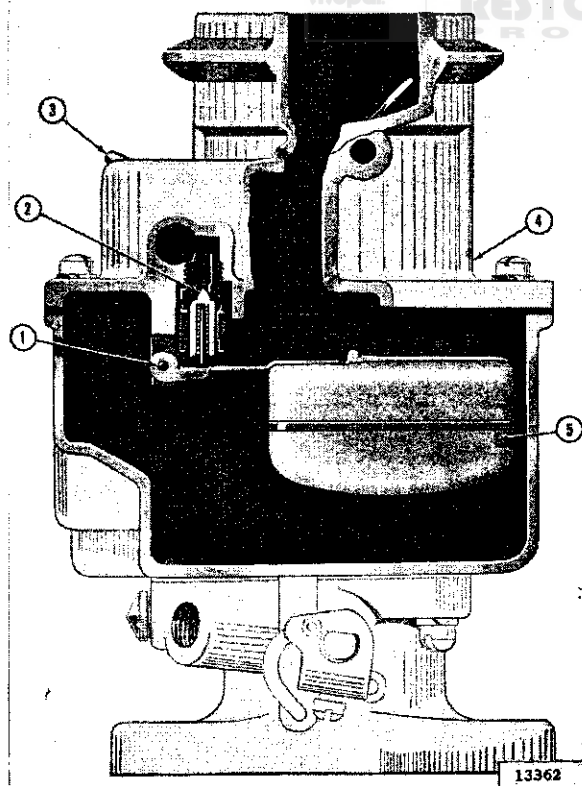


FIG. E-7—FLOAT SYSTEM

- | |
|----------------------------------|
| 1—Float and Lever Assembly |
| 2—Needle Valve and Seat Assembly |
| 3—Vent |
| 4—Float Bowl Cover |
| 5—Float |

E-11. Float System

The float system, Fig. E-7, consists of a float, float pin, air horn gasket and the needle and seat assembly. These parts control the fuel level in the carburetor bowl, a supply being maintained for all systems under all operating conditions. To prevent float vibration from affecting the fuel level, the inlet or float valve is spring loaded. Should the needle and seat become worn, they must be replaced with a matched set, including the spring, which is the only way they are supplied. When reinstalling the float, be sure to install the float pin with the stop shoulder on the side away from the bore of the carburetor.

E-12. Float Adjustment

Correct float level setting is required for accurate metering of fuel in both low- and high-speed jets. To set the float, remove and invert the bowl cover. Remove the bowl cover gasket. Allow the weight of the float to rest on the needle and spring. Be sure there is no compression of the spring other than the weight of the float. Adjust the level by bending the float arm lip that contacts the needle (not the arm) to provide specified clearance between the float and cover. The specified clearance of the float is $\frac{1}{64}$ " [6,74 mm.] on current models (including Exhaust Emission Control) and $\frac{5}{16}$ " [7,93 mm.] on early models shown as A in Fig. E-8.

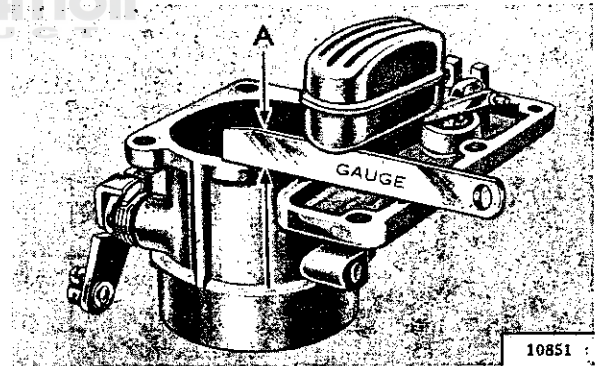


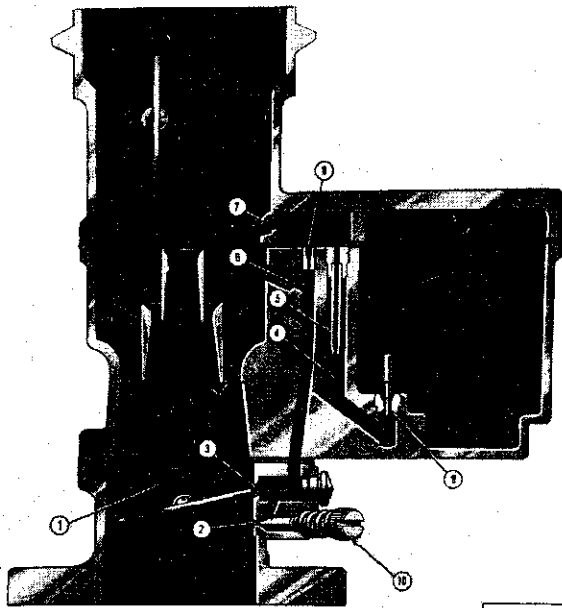
FIG. E-8—FLOAT LEVEL GAUGING

E-13. Low-Speed System

Fuel for idle and early part-throttle operation is metered through the low-speed system. The low-speed system is illustrated in Fig. E-9. Liquid fuel enters the idle well through the metering rod jet. Low-speed jet measures the amount of fuel for idle and early part-throttle operation. Air-by-pass, economizer, and idle air bleed are carefully calibrated orifices which serve to break up the liquid fuel and mix it with air as it moves through the passage to the idle port and idle adjustment screw port.

E-14. Idle Mixture Adjustment

Note: The idle mixture adjustment procedure for the late model YF-4941S and YF-6115S Carter Carburetor equipped with the External Idle Mixture Limiter Cap is the same as outlined below



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FIG. E-9—LOW-SPEED SYSTEM

- | | |
|------------------------------|--------------------------|
| 1—Body Flange | 6—Idle Air Bleed |
| 2—Idle Adjustment Screw Port | 7—Air By-pass |
| 3—Idle Port | 8—Economizer |
| 4—Idle Well | 9—Metering Rod Jet |
| 5—Low Speed Jet | 10—Idle Adjustment Screw |

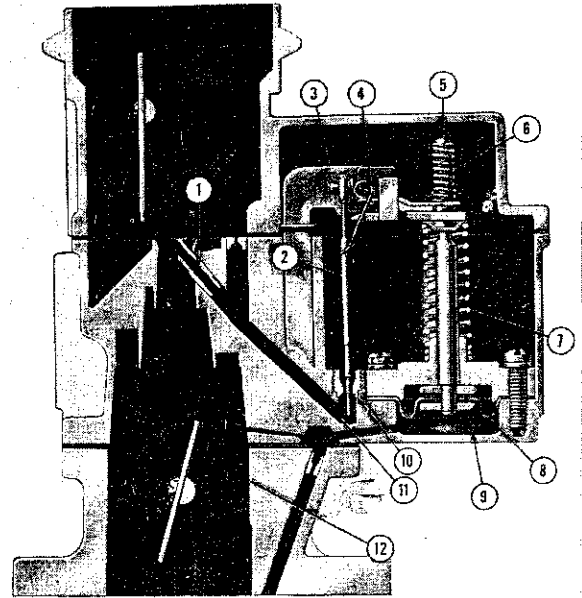
in Pars. "A" through "D"; however, because of the Idle Limiter Cap, the idle mixture screw CANNOT be adjusted in the counter-clockwise (rich) direction. The adjustment is made from the rich stop position and the mixture screw is turned in (clockwise) approximately $\frac{3}{4}$ turn to "Lean Best Idle." Refer to Fig. E-6.

The "Lean Best Idle" method of idle setting is as follows:

- a. Any scheduled service of ignition system should precede this adjustment.
- b. Connect tachometer or vacuum gauge to engine.
- c. Warm up engine and stabilize temperatures.
- d. Adjust engine idle to speed desired, using throttle idle speed adjusting screw.
- e. Carburetors without Idle Limiter Cap turn idle mixture screws out (counterclockwise) until a loss of engine speed is indicated; then slowly turn mixture screw in (clockwise-leaner) until maximum speed (RPM) is reached. Continue turning in (clockwise) until speed begins to drop; turn mixture adjustment back out (counterclockwise-rich) until maximum speed is just regained at a "lean as possible" mixture adjustment.

E-15. High-Speed System

Fuel for part-throttle and full-throttle operation is supplied through the high-speed system shown in Fig. E-10. A metering rod and metering rod jet control the amount of fuel admitted through the nozzle for high-speed operation. The lower end of the metering rod is calibrated in size to accurately meter the fuel required. As the rod



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FIG. E-10—HIGH-SPEED SYSTEM

- | | |
|-----------------------------|-------------------------|
| 1—Nozzle | 7—Pump Diaphragm Spring |
| 2—Metering Rod | 8—Diaphragm Assembly |
| 3—Pump Lifter Link | 9—Chamber |
| 4—Metering Rod Arm Assembly | 10—Metering Rod Jet |
| 5—Diaphragm Shaft | 11—Carburetor Casting |
| 6—Upper Pump Spring | 12—Carburetor Bore |

is automatically raised and lowered in the jet, the opening in the jet is varied in size to supply fuel proportionate to the requirements through the higher speed and power range. The metering rod is both mechanically and vacuum controlled and is attached to the metering rod arm assembly. During part-throttle operation, vacuum in chamber pulls diaphragm down, holding metering arm assembly against pump lifter link.

Movement of the metering rod is controlled by the pump lifter link which is attached to the carburetor throttle shaft. At all times vacuum in the chamber is strong enough to overcome the tension of pump diaphragm spring. Upper pump spring serves as a bumper upon deceleration and as a delayed action spring upon acceleration. Under any operating condition, when the pump diaphragm spring overcomes vacuum in the chamber, the metering rod will move toward the wide throttle (power) position.

Note: Nozzle is pressed in and should not be removed.

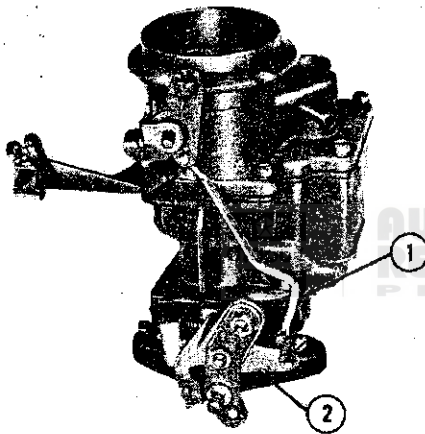
E-16. Metering Rod Adjustment

Check metering rod adjustment each time the carburetor is reassembled. Before adjustment is made, be sure that the flat of metering rod arm is parallel to the flat of pump lifter link as shown (Fig. E-10.). With the throttle valve seated in carburetor bore, press down on the upper end of diaphragm shaft until the diaphragm bottoms in the vacuum chamber. The metering rod should now seat on casting with the metering rod arm flat against the pump lifter link. If the metering rod does not seat on the casting (check by

pressing downward on metering rod) or seats before the metering rod arm makes flat contact with the pump lifter link, make adjustment by bending the lip on the metering rod arm.

E-17. Choke System

The choke system consists of a manually-operated choke valve, a fast-idle connecting rod, and a fast-idle arm. The choke valve is offset-spring loaded to prevent over-choking during the starting warm-up period. When the choke valve is moved to a closed position for starting, the fast idle connector rod in Fig. E-11 revolves the fast idle link. This action increases the engine idle speed to prevent stalling during the warm-up period. A fast-idle connector rod return spring prevents partial closing of the choke valve.



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FIG. E-11—FAST IDLE ADJUSTMENT

1—Fast Idle Connector Rod

2—Fast Idle Link

E-18. Fast Idle Adjustment

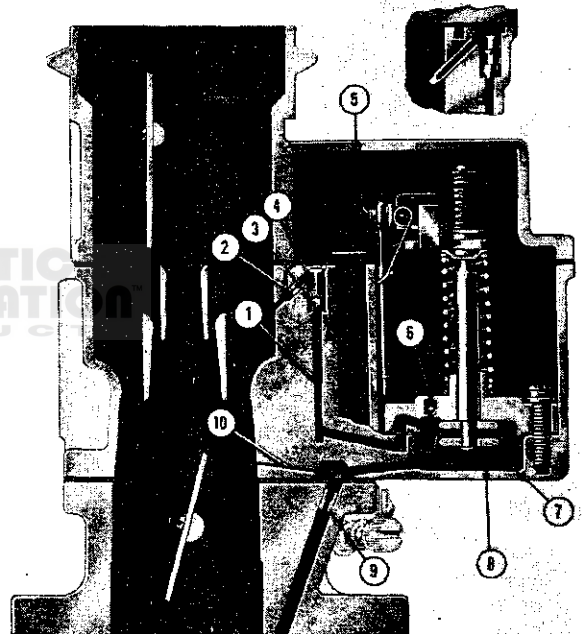
With the choke held in wide open position, lip (No. 1) (Fig. E-11) on the fast-idle rod should contact the boss on the body casting. Adjust by bending the fast-idle link at offset as shown by (No. 2).

E-19. Accelerating Pump System

The accelerating pump system shown in Fig. E-12 provides a measured amount of fuel for rapid acceleration and smooth engine operation when the throttle is opened at lower speeds. In operation, vacuum is applied to the underside of diaphragm at all times when the engine is running. Lower and more uniform vacuum is provided by vacuum restriction and vacuum bleed passage. When the diaphragm is in its maximum down position at low throttle resulting from high vacuum in chamber the chamber above the diaphragm is full of fuel which has been admitted through intake passage. When the throttle is opened, vacuum drops in the chamber and the diaphragm is initially forced upward by the spring on the diaphragm shaft. The upward motion is picked up by accelerator

pump lifter which is connected to the throttle. This movement forces fuel from the chamber above the diaphragm through discharge pump check valve and discharge pump jet. This auxiliary discharge of fuel supplies engine requirements for quick acceleration and heavy loads. When the throttle is closed, the diaphragm is again pulled down by high vacuum and another measured charge of fuel enters the chamber above the diaphragm through the intake passage to be available for the next cycle of operation.

Note: The pump jet (see insert drawing in Fig. E-12) projecting into the air stream is permanently pressed into the carburetor body and should not be removed. Also, carburetor design makes it impossible to adjust the pump stroke.



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FIG. E-12—ACCELERATING PUMP SYSTEM

1—Pump Fuel Passage
2—Discharge Pump Jet
3—Pump Check Valve Ball
4—Ball Check Weight
5—Pump Lifter Arm

6—Intake Passage
7—Diaphragm
8—Vacuum Chamber
9—Vacuum Restriction Jet
10—Vacuum Bleed Passage

E-20. Accelerating Pump Maintenance

If engine acceleration is unsatisfactory, remove the pump diaphragm and check the diaphragm for wear or damage. Then remove the pump check retainer ring located directly above the pump check weight and pump ball check. Pump ball check must seat properly as a leak will cause poor acceleration performance. Inspect and replace all worn or damaged parts. Clean and blow out all passages with compressed air. Note that when testing the pump for discharge volume with the carburetor off the engine, only half of the maximum pump capacity will be discharged. When the engine is operating, vacuum controls the balance of discharge.

Note: The Carter YF-6115S Carburetor has a throttle return spring attached from the carburetor main body to the carburetor throttle shaft. The purpose of this spring is to return the throttle to idle speed position should a linkage failure occur.

E-21. Carburetor Disassembly

- Refer to Fig. E-13.
- a. Pry pin spring and clevis clip free and remove fast-idle connector rod.
- b. Remove air horn and bowl cover attaching screws and lockwashers. Remove choke tube clamp assembly.
- c. Remove air horn assembly and gasket.
- d. Remove ball check valve retainer ring. Invert

the unit and tap lightly to remove ball check valve retainer and ball check valve.

e. Loosen the screw locking the throttle shaft arm to the throttle shaft. Remove the throttle shaft arm and pump connector link.

f. Remove diaphragm housing screws. Entire assembly can now be lifted out of the body. This assembly can easily be disassembled and reassembled if necessary.

g. On early models carefully remove pump intake strainer housing using tip of knife blade.

h. With the air horn in an upside-down position, remove pin and float. Invert the air horn and catch needle pin and needle pin spring.

i. Remove metering rod jet. Remove low-speed jet.

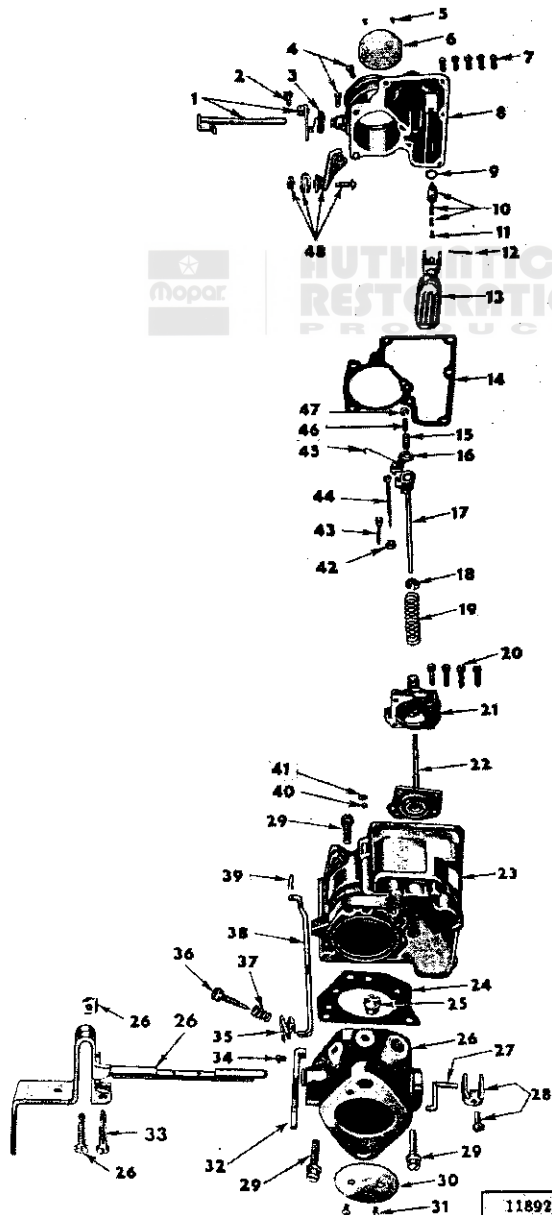


FIG. E-13—CARBURETOR

- 1—Choke Shaft and Lever
- 2—Screw
- 3—Choke Lever Spring
- 4—Screw and Washer
- 5—Choke Valve Screw
- 6—Choke Valve
- 7—Screw and Washer
- 8—Air Horn
- 9—Needle Seat Gasket
- 10—Needle Spring and Seat
- 11—Needle Pin
- 12—Float Pin
- 13—Float
- 14—Gasket
- 15—Pump Spring
- 16—Metering Rod Arm
- 17—Pump Link
- 18—Pump Spring Retainer
- 19—Vacuum Diaphragm Spring
- 20—Screw and Washer
- 21—Diaphragm Housing
- 22—Diaphragm
- 23—Body
- 24—Gasket
- 25—Idle Port Plug
- 26—Throttle Body Lever and Shaft Assembly
- 27—Pump Link Connector
- 28—Throttle Shaft Arm
- 29—Screw and Washer
- 30—Throttle Valve
- 31—Throttle Valve Screw
- 32—Fast Idle Arm
- 33—Adjusting Screw
- 34—Body Flange Plug
- 35—Clevis Clip
- 36—Idle Adjusting Screw
- 37—Idle Screw Spring
- 38—Fast Idle Connector Rod
- 39—Pin Spring
- 40—Ball Check Valve
- 41—Ball Check Valve Retainer Ring
- 42—Metering Rod Jet
- 43—Low Speed Jet
- 44—Metering Rod
- 45—Metering Rod Spring
- 46—Inner Pump Spring
- 47—Pump Spring Retainer
- 48—Bracket and Clamp Assembly (Choke and Throttle)

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FUEL SYSTEM

Note: Do not remove pressed-in parts such as nozzle, pump jet, or antipercolator air bleed.

j. Remove body flange attaching screws, body flange assembly, and gasket.

k. Remove idle-adjustment screw, spring, idle port rivet, throttle lever assembly, washer, fast idle arm, throttle plate screws, throttle plate, and throttle shaft.

l. Remove throttle shaft seal by prying out seal retainer.

Note: Do not remove pressed-in vacuum passage orifice.

m. Remove choke valve screws and choke valve. Unhook choke spring and slide shaft from housing.

n. Wash all parts in carburetor cleaning solution and blow out passages with compressed air. Do not immerse diaphragm or seals in cleaning solution. Inspect all parts for wear or damage. Always use new gaskets when reassembling.

E-22. Carburetor Reassembly

- Refer to Fig. E-13.

To expedite reassembly, it is advisable to group all related parts by the circuit to which they belong.

a. Install throttle shaft seal and retainer in flange casting.

b. Install fast-idle arm, washer, and lever assembly on throttle shaft. Slide shaft into place and install throttle valve.

c. Install idle port rivet plug and idle adjusting screw and spring.

d. Attach flange assembly to body casting. Use new gasket.

e. Install low-speed jet assembly.

f. Early production models install pump intake strainer in pump diaphragm housing and carefully press into recess.

Note: If strainer is even slightly damaged, a new one must be installed.

g. Install pump diaphragm assembly in diaphragm housing. Then, install pump diaphragm spring (lower) and retainer.

h. Install pump lifter link, metering rod arm, upper pump spring, and retainer.

i. Install metering rod jet.

Note: No gasket is used with this jet.

j. Install diaphragm housing attaching screws in the diaphragm housing, making sure that the edges of the diaphragm are not wrinkled. Lower into place and tighten screws evenly and securely.

k. Install throttle shaft seal, dust seal washer, and shaft seal spring.

l. Install pump connector link in the throttle arm assembly. Install throttle shaft arm assembly on throttle shaft guiding connector link in pump lifter link hole.

CAUTION: Linkage must not bind in any throttle position. If binding occurs, loosen clamp screw in throttle arm, adjust slightly, then retighten screw.

m. Install pump check disc, disc retainer, and lock ring.

n. Install metering rod and pin spring. Connect metering rod spring.

o. Check and if necessary correct metering rod adjustment. Follow procedure of Par. E-16.

p. Install needle seat and gasket assembly, needle, float and float pin. The stop shoulder on the float pin must be on the side away from the bore of the carburetor.

q. Set float level to specifications. Follow procedure of Par. E-12.

r. Install air horn gasket and air horn assembly. Install attaching screws, lock washers, and choke tube clamp assembly. Tighten center screws first.

s. Slide choke shaft and lever assembly into place and connect choke lever spring. Install choke valve. Center the valve by tapping lightly, then hold in place with fingers when tightening screws.

t. Install fast-idle connector rod with offset portion of rod on top and pin spring on outside. Install fast-idle connecting rod spring.

E-23. Correcting Acceleration Flat Spot

Early production Carburetor Models 938-S, 938-SA, 938-SC

Inasmuch as a flat spot on acceleration or low speed stumble can come from causes other than carburetor malfunction, it is recommended that engine tuning be thoroughly checked before attempting any actual carburetor work. Make sure that ignition, compression, and timing are correct and that fuel pump is supplying enough gas. Also, the F-head engine employs a water-heated intake manifold. Proper vaporization of the fuel depends on correct intake manifold temperature. Since this temperature is controlled by the cooling system thermostat, include an operational check of the thermostat when diagnosing the stumble. Operating temperatures consistently below 155°F. can cause stumble.

If the stumble persists, a YF-938-S, YF-938-SA, or YF-938-SC carburetor can be converted to a YF-938-SD carburetor by installing Special Kit 924161, consisting of a pump discharge check needle, a metering rod, and a metering rod jet. If this kit is installed, the pump discharge check needle replaces the original ball, weight, and retainer and the small wire-type retainer used with the ball check assembly must not be reinstalled.

When installing the kit, check the size of the pump discharge jet, No. 2, Fig. E-14. Early production YF-938S and YF-938SA carburetors have a .025" [0.635 mm.] jet installed. If the carburetor being converted has a .025" jet it must be opened up to .031" [0.787 mm.] by running a No. 68 drill through the jet as shown in Fig. E-14. The jet must be drilled as it is a pressed in part and cannot be replaced.

Upon completing the installation of the conversion kit, mark or tag the carburetor to indicate that it is a YF-938SD.

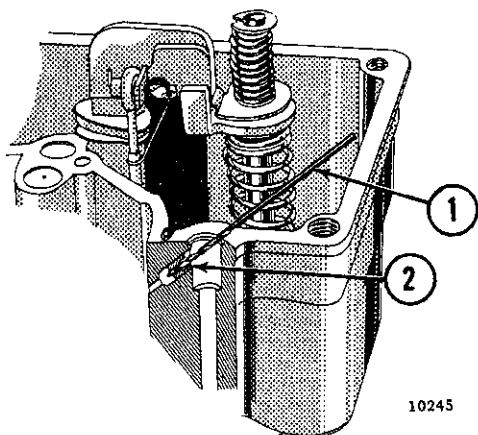


FIG. E-14—DRILLING CARBURETOR JET
1—Drill (#68 size)
2—Accelerator Pump Discharge Jet

E-24. Steep-Grade Carburetor Kit

In the field where a vehicle equipped with Carter carburetor 938-S is required to idle on steep slopes, flooding of the carburetor sometimes results. A steep-grade carburetor kit is available that will allow satisfactory idle operation under this condition. This kit (Part No. #94481, Carter #75-960U) contains a metering rod, a metering rod jet, and a plug.

To install this kit, replace the standard metering rod and metering rod jet with those contained in the kit. Place the small brass plug in the accelerator pump well. **Exert finger pressure only** when installing this plug. Forcing the plug in too far will damage the accelerator jet. Make certain the metering rod and float level are set to specifications.

When reworking the carburetor to include this steep-grade kit, check to determine if the seal (Carter #121-172) and retainer (Carter #136-152) are installed. If these parts are not present, they should be installed.

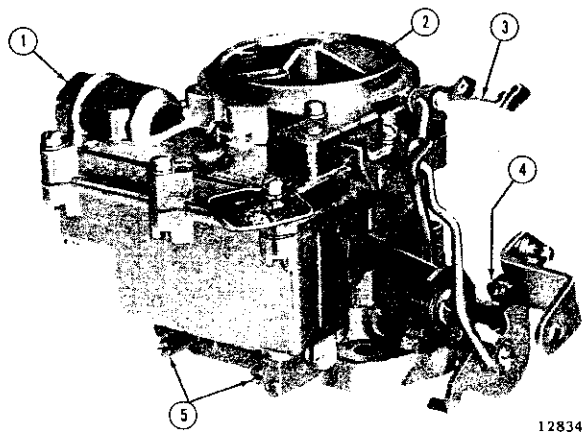


FIG. E-15—CARBURETOR—DAUNTLESS V-6 ENGINE
1—Fuel Inlet
2—Choke
3—Choke Cable Bracket
4—Idle Speed Adjusting Screw
5—Idle Fuel-air Mixture Screws

E-25. CARBURETOR — DAUNTLESS V-6 ENGINE

A double-barrel, manual choke, down-draft carburetor (Fig. E-15) is used on the Dauntless V-6 engine.

Note: A carburetor with a specific flow characteristic is used for exhaust emission control. The carburetor is identified by a number, and the correct carburetor must be used, when replacement is necessary.

The carburetor fuel bowl is located forward of the main bores. The carburetor is compact in design in that all of the fuel metering is centrally located. See Fig. E 16.

This carburetor uses a calibrated cluster design with main well tubes, idle tubes, mixture passages, air bleeds and pump jets in one removable assembly. This cluster assembly can be easily removed for cleaning and inspection purposes. It is mounted on a flat portion of the carburetor bowl in front of the main venturi. The idle and main well tubes are precision pressed fit in the cluster body. They cannot be serviced separately. The main nozzles and idle tubes are suspended in the main wells of the float bowl.

The main metering jets are of the fixed type. A system of calibrated air bleeds gives correct fuel-air mixture throughout all operational ranges.

This carburetor has a vacuum-operated power system which supplies extra fuel when needed. Power mixtures are regulated by drop in engine manifold vacuum, regardless of throttle opening. Thus, additional fuel is supplied for power mixtures according to engine demands.

The accelerator pump plunger has a vapor vent ball in its head. This ball and its seat form a valve to vent any fuel vapors which form in the pump well to the fuel bowl during hot-engine operation. This ensures that the pump well and passages will be primed with solid fuel at all times and improves accelerator pump action.

The carburetor is internally vented through a hole in the air horn.

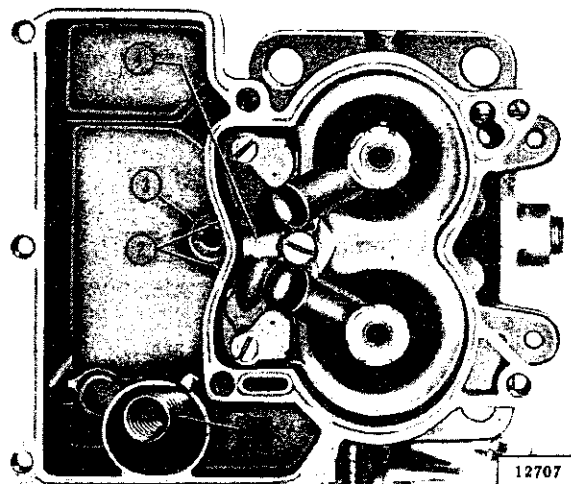


FIG. E-16—FUEL BOWL BODY—TOP VIEW
1—Pump Return Spring
2—Main Metering Jets
3—Power Valve
4—Cluster Assembly

There are six adjustments: curb idle speed, curb idle mixture, float level, float drop, accelerator pump, and fast idle.

This carburetor has six basic systems: float, low speed, main metering, power, accelerator pump and choke.

E-26. Float System

The float system controls fuel level in the carburetor fuel bowl. It maintains constant fuel level to assure proper metering through all operating ranges.

Fuel enters the carburetor through the inlet screen and inlet valve. It flows past the valve needle and into the fuel bowl. Fuel continues to flow until increasing fuel level raises the float to a position in which it forces the inlet valve needle into its seat. This closes the inlet valve. As fuel is used from the bowl, the float moves downward slightly. This allows the valve needle to move away from its seat. This again allows fuel to enter the fuel bowl to maintain fuel level. In this manner, float level maintains fuel level constant. See Fig. E-17.

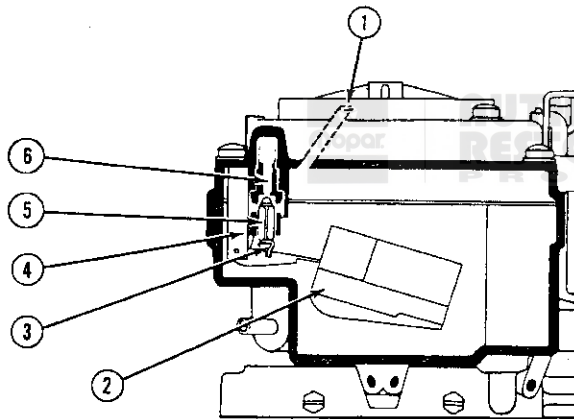


FIG. E-17—FLOAT SYSTEM

- | | |
|----------------------|----------------|
| 1—Internal Bowl Vent | 4—Float Tang |
| 2—Float | 5—Float Needle |
| 3—Needle Pull Clip | 6—Needle Seat |

A float prong, at the rear of the float arm between the float hangers, prevents the float from moving too far downward, yet allows it to move downward far enough to allow maximum fuel flow into the bowl. A pull clip connects the float arm to the valve needle. This keeps the needle from sticking in the seat because of dirt or gum formation.

E-27. Idle System

During engine idle operation, air flow through the carburetor venturi is very low. It is insufficient to cause fuel to flow from the main discharge nozzles. Therefore, the idle system supplies fuel-air mixture during idle and low-speed operation.

The idle system consists of the idle tubes, idle passages, idle air bleeds, idle mixture adjustment needles, off-idle discharge slots and idle discharge ports. See Fig. E-18.

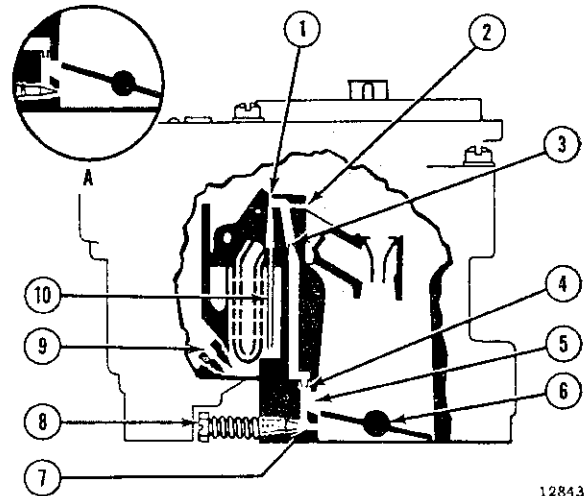


FIG. E-18—IDLE SYSTEM

- | | |
|---------------------------|---------------------------------------|
| 1—Idle Air Bleed | 6—Throttle Valve |
| 2—Idle Air Bleed | 7—Idle Needle Hole |
| 3—Idle Restriction | 8—Adjustment Needles |
| 4—Lower Idle Restriction | 9—Main Metering Jets |
| 5—Off Idle Discharge Port | 10—Idle Tube |
| | A—Throttle Valve in Off Idle Position |

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In idle speed position, each throttle valve is slightly open. This allows a small amount of air to pass between the carburetor bore wall and the throttle valve. Since there is not enough air flow for venturi action, manifold vacuum draws fuel directly from the fuel bowl through the idle system.

Fuel from the float bowl passes through each main metering jet into the main well. A metered amount of fuel flows through the idle tube restriction. It then passes up the idle tube to a passage where it is mixed with air drawn through two calibrated idle air bleeds. Fuel-air mixture then flows through a calibrated restriction into a vertical passage. It passes through another calibrated restriction to the off-idle discharge slot just above each throttle valve. This injects additional air. It then flows through the idle discharge port. The idle mixture needle controls the amount of fuel-air mixture which enters the carburetor bore at curb-idle position of the throttle valve.

As the throttle valve opens farther, more and more of the off-idle discharge slot is exposed to manifold vacuum. This slot supplies additional fuel-air mixture to meet off-idle engine requirements.

E-28. Main Metering System

As the throttle valve continues to open, its edge moves away from the carburetor bore wall. This reduces vacuum applied to the idle discharge port and off-idle discharge slot, so that the idle system ceases to supply fuel-air mixture.

With increased throttle opening, air velocity through the venturi increases. This causes a decrease of pressure in the carburetor bore, which is multiplied in the venturi. See Fig. E-19.

Since the low air pressure (vacuum) is in the venturi at this time, fuel flows as follows:

Fuel from the float bowl passes through the main metering jets into the main well and rises into the main well tubes. Air enters the main well through the main well air bleeds and mixes with

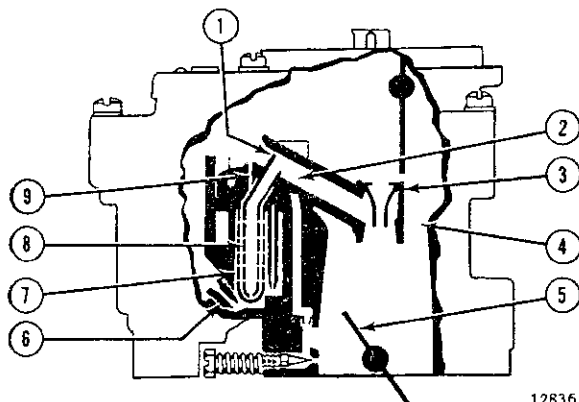


FIG. E-19--MAIN METERING SYSTEM

- | | |
|--------------------|------------------------|
| 1--Main Nozzle | 6--Main Metering Jet |
| 2--Mixture Passage | 7--Main Well Insert |
| 3--Boost Venturi | 8--Main Well Tube |
| 4--Main Venturi | 9--Main Well Air Bleed |
| 5--Throttle Valve | |

fuel through calibrated holes in the main well tube. Fuel-air mixture then moves upward into a channel where another calibrated amount of air is injected through the main air bleed. It then flows downward through the channel to the venturi, where it is discharged into the air stream, and then to the intake manifold.

E-29. Power System

A vacuum-operated power piston in the air horn and a power valve in the bottom of the float bowl enrich fuel-air mixture when more power is desired. This system also operates during extreme high speed driving. Through a vacuum passage from the carburetor base to the power cylinder, the power piston is exposed to manifold vacuum. See Fig. E-20.

During idle and part throttle operation, relatively high vacuum holds the power piston in upward

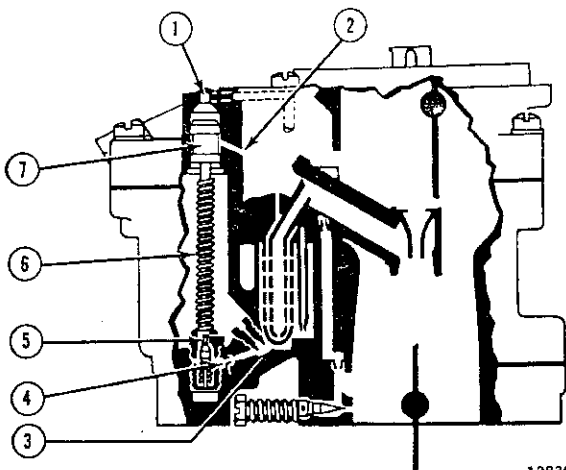


FIG. E-20--POWER SYSTEM

- | | |
|--------------------------|------------------------|
| 1--Piston Vacuum Chamber | 5--Power Valve |
| 2--Vacuum Relief Passage | 6--Power Piston Spring |
| 3--Main Well | 7--Power Piston |
| 4--Power Restrictions | |

position against spring tension so that the power valve remains closed.

Increase in engine load decreases manifold vacuum. When vacuum decreases sufficiently, the spring overcomes vacuum and the power piston moves downward. This opens the power valve to allow additional fuel to flow through calibrated restrictions into the main well.

As the engine load decreases, resulting higher vacuum overcomes spring tension on the power piston and draws the power piston upward. This closes the power valve.

This carburetor has a two-stage power valve. In the first stage, fuel is metered by the valve itself. This stage occurs under light load. During heavy load, the valve is fully opened to the second stage; in this position, the power valve supplies fuel to be metered by power restrictions in the fuel channel to the fuel bowl.

The power piston cavity is connected to the main air flow passage by a vacuum relief passage. This passage prevents transfer of vacuum to fuel in the float bowl. Any leakage of air past the piston will be compensated for by this relief passage; hence it will not affect carburetor metering.

E-30. Accelerator Pump System

When the throttle valve opens rapidly, air flow and manifold vacuum change almost instantaneously. However, heavier fuel-air mixture does not flow immediately. Thus, momentarily, the engine does not have sufficient fuel. The accelerator pump provides additional fuel necessary for engine operation during acceleration.

A double-spring loaded pump plunger supplies fuel for acceleration. Top and bottom springs move the plunger to furnish a smooth, sustained charge of fuel for acceleration. See Fig. E-21.

Fuel is drawn into the pump well past the inlet check ball during the plunger intake (upward) stroke.

Downward motion of the pump plunger seats the inlet check ball and forces fuel through the discharge passage. This unseats the pump discharge check ball. Fuel then sprays through the discharge

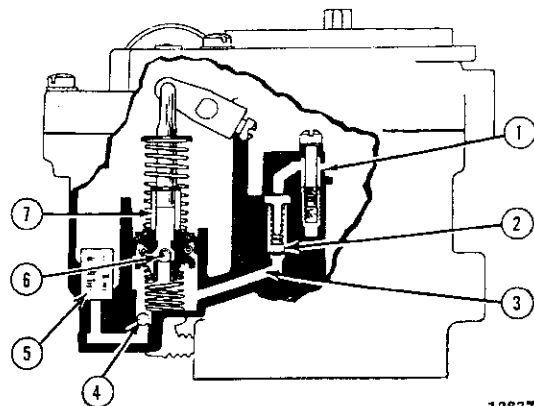


FIG. E-21--ACCELERATOR PUMP SYSTEM

- | | |
|-------------------------|--------------------------|
| 1--Pump Jets | 5--Inlet Screen |
| 2--Discharge Check Ball | 6--Vapor Vent Check Ball |
| 3--Discharge Passage | 7--Pump Plunger |
| 4--Inlet Check Ball | |

port into the venturi.

The check ball in the pump plunger head is a vapor vent for the pump well. Without this vent, vapor pressure in the pump would force fuel from the pump system into the engine manifold, causing hard starting when the engine is hot.

There is another hole in the pump lever, into which the accelerator pump rod can be inserted to provide quicker pump action. This adjustment setting is used only in extreme cold temperature conditions. The pump discharge check ball in the discharge passage prevents discharge of fuel from the pump nozzles when the accelerator pump is inoperative.

E-31. Choke System

The choke system consists of a manually-operated choke valve, a fast-idle connecting rod, and a fast-idle arm. The choke valve is offset-spring loaded to prevent over-choking during the starting warm-up period. When the choke valve is moved to a closed position for starting, the fast idle connector rod revolves the fast idle link. This action increases the engine idle speed to prevent stalling during the warm-up period. A fast-idle connector rod return spring prevents partial closing of the choke valve.

E-32. Carburetor Removal

- a. Remove attaching wing nut and air cleaner from carburetor.
- b. Remove throttle cable from ball stud on throttle lever adapter.
- c. Disconnect fuel line from carburetor inlet fitting.
- d. Disconnect positive crankcase ventilator hose from nipple on carburetor body.
- e. Disconnect distributor vacuum line from throttle body of carburetor.
- f. Remove four attaching cap screws, carburetor, and gasket from intake manifold.

E-33. Air Horn Body Removal and Disassembly

- a. Remove attaching screws, and carefully lift air horn body upward to remove from fuel bowl body.
- b. Place air horn body in inverted position on bench. Remove float hinge pin and lift float assembly from cover. Remove inlet valve needle from float arm. Remove needle seat, fiber gasket and seat screen from air horn body; discard gasket. See Fig. E-22.
- c. Depress shaft and allow spring to snap repeatedly to remove power piston from air horn body. This will force power piston retaining washer from air horn body.
- d. Remove retainer from end of accelerator pump plunger shaft. Remove pump assembly from pump inner arm. Loosen set screw on inner arm and remove outer lever and shaft from plunger. Remove gasket from air horn body or fuel bowl body and discard.
- e. Remove two retaining screws and choke valve plate from choke shaft. Withdraw choke shaft from air horn body. Remove choke lever and collar from choke shaft. Note position of choke lever in relation

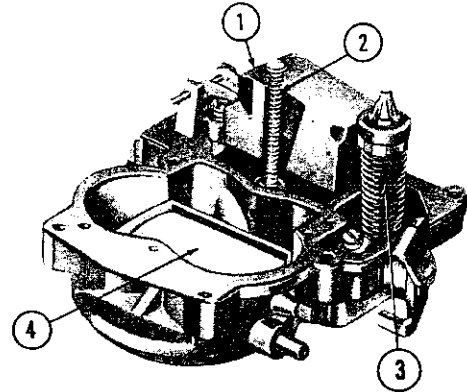


FIG. E-22—AIR HORN BODY

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- 1—Float
- 2—Power Piston
- 3—Pump Plunger
- 4—Choke Valve

to choke trip lever at end of the choke shaft for ease in reassembly.

E-34. Fuel Bowl Body Disassembly

- a. Remove return spring of pump plunger and pump well from fuel bowl body. Remove small aluminum check ball from bottom of pump well by inverting fuel bowl body and shaking into hand. Remove pump inlet screen from bottom of fuel bowl.
- b. Remove main metering jets from fuel bowl body using Tool C-3748.
- c. Remove power valve and fiber gasket from fuel bowl body; discard gasket.
- d. Remove three attaching screws, venturi cluster assembly, and gasket from fuel bowl body. Center screw has smooth shank and fiber gasket for the accelerator pump fuel bypass and seal.
- e. Using a pair of long nosed pliers, remove T-shaped retainer, accelerator pump discharge spring and steel discharge ball from fuel bowl body.
- f. Remove two inserts from main well.

E-35. Throttle Body Removal and Disassembly

- a. Invert fuel bowl body; remove three attaching screws, throttle body and gasket; discard gasket.
- b. Remove idle mixture adjustment needles and springs from throttle body.

Note: No further disassembly of the throttle body is required. The throttle valves should never be removed, as the idle and spark holes are drilled in direct relation to the location of the throttle valves and shaft. Removal of the throttle valves will upset this alignment. The throttle body assembly is serviced only as a complete assembly with throttle valves intact.

E-36. Carburetor Cleaning and Inspection

Dirt, gum, water, or carbon contamination on the

exterior moving parts of a carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection while servicing.

a. Thoroughly clean carburetor castings and metal parts in carburetor cleaning solvent.

Caution: Accelerator pump plunger and any fiber or rubber parts should never be immersed in carburetor cleaner. Wash pump plunger in cleaning solvent.

b. Blow out all passages in the castings with compressed air. Dry all parts with compressed air. Make sure all jets and passages are clean. Do not use wire to clean fuel passages or air bleeds.

c. Check inlet valve needle and seat for wear. If wear is noted, the assembly must be replaced.

d. Check float hinge pin for wear and check float for damage.

e. Check throttle and choke shaft bores for wear and out-of-round.

f. Inspect idle mixture adjustment needles for burrs or grooves; replace if damaged.

g. Inspect cup of accelerator pump plunger; replace if damaged, worn, or hardened. Inspect pump well in bowl for wear or scoring.

h. Check filter screens for dirt or lint. Clean, and if they remain clogged, replace.

i. If for any reason parts have become loose or damaged in the cluster assembly, the assembly must be replaced.

Note: Use new gaskets whenever the carburetor is disassembled.

E-37. Throttle Body Assembly

a. Install idle mixture adjustment needles and springs in throttle body. Tighten finger-tight, then unthread one turn as a preliminary adjustment setting.

Caution: Do not force idle mixture adjustment needles against seats or damage may result.

b. Invert fuel bowl body and place new throttle body gasket on bowl. Fasten throttle body to bowl body with three screws and lockwashers; tighten securely.

E-38. Fuel Bowl Body Assembly

a. Drop steel discharge check ball of accelerator pump into discharge hole. Install pump discharge spring and T-shaped retainer. Stake retainer in place.

Note: Top of retainer must be flush with flat surface of fuel bowl body.

b. Install two inserts in main well. Align surface on lip of insert with flat surface in recess on top of main well. Install venturi cluster with gasket, and tighten mounting screws evenly and securely. Be certain that center screw is fitted with fiber gasket, and that a special smooth shank screw is used.

c. Install two main metering jets, power valve gasket and power valve.

d. Install small aluminum inlet check ball in accelerator pump inlet at bottom of pump well. Insert pump return spring into well, and center by pressing spring downward with finger.

e. Install pump inlet screen in bottom of fuel bowl.

E-39. Air Horn Body Assembly

a. Install choke lever and collar on choke shaft. Prong on choke lever must face away from air horn body and be on top of choke trip lever.

b. Install choke shaft and lever assembly into the air horn. Choke rod hole in the choke lever must face fuel inlet side of carburetor.

c. Install choke valve plate in choke shaft so that letters RP will face upward in finished carburetor. Install two new valve plate attaching screws, but do not tighten securely until valve plate is centered. To center choke valve plate on choke shaft, hold choke valve tightly closed, then slide choke shaft inward to obtain approximately .020" [0,508 mm.] clearance between choke trip lever and choke lever and collar assembly. Tighten choke valve screws securely, and stake lightly in place. Choke valve will be perfectly free in all positions when installed correctly.

d. Insert outer accelerator pump lever and shaft assembly into air horn body, with lever pointing toward choke shaft. Install inner pump arm, with plunger hole inward, and tighten set screw securely. Position pump plunger assembly on inner pump arm, with pump shaft pointing inward, and install retainer.

e. Install needle seat screen on inlet valve seat. Install seat and gasket in air horn body. Tighten seat securely with a wide-blade screwdriver.

f. Install power piston into vacuum cavity. Lightly stake piston retainer washer in place. Piston should travel freely in cavity.

g. Install air horn gasket on air horn body, fitting gasket over guide pin.

h. Attach inlet valve needle to float. Carefully position float and insert float hinge pin. Drop tang at rear of float arm downward toward air horn.

i. Install fuel inlet fitting, if removed.

j. With air horn assembly inverted, measure the distance from the air horn gasket to top of float at toe $1\frac{3}{32}$ " [27,78 mm.] for standard carburetors and $1\frac{5}{32}$ " [29,36 mm.] for exhaust emission control equipped carburetors, as shown in Fig. E-23. Use float level gauge J-5127-2. Bend float arm as required to adjust float level.

k. With air horn body held upright, measure distance from gasket to bottom of float pontoon at outer end. Use a $1\frac{1}{8}$ " [47,625 mm.] float drop gauge. Bend float tang, as required, to adjust float drop. See Fig. E-24.

l. Carefully place air horn body on fuel bowl body, making certain that the accelerator pump plunger is properly positioned in the pump well. Lower the cover gently, straight down; install air

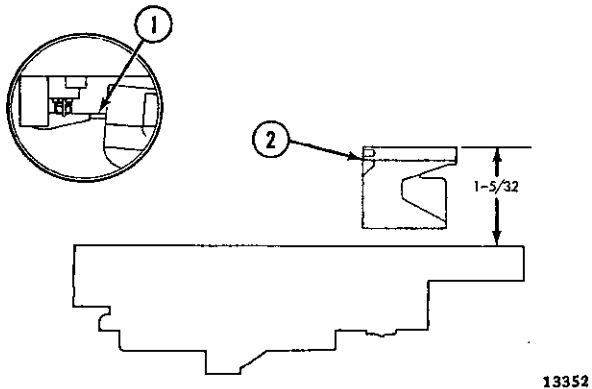


FIG. E-23—FLOAT LEVEL ADJUSTMENT

1—Float Arm 2—Float Scum

horn to fuel bowl with attaching screws. Tighten screws evenly and securely.

Note: Longest air horn attaching screw goes in top of pump housing.

m. Install choke rod into choke lever and fast-idle cam. Install fast-idle cam screw and tighten securely. See Fig. E-25 for proper installation.

n. Insert accelerator pump rod through outer hole and into throttle lever; fasten with retainer.

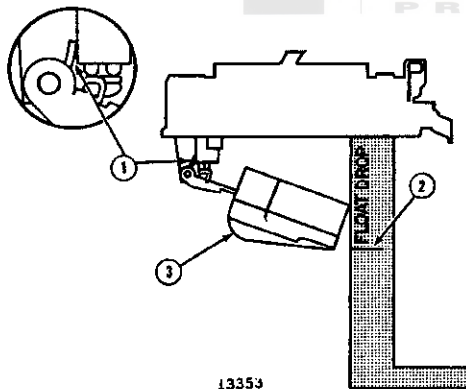


FIG. E-24—FLOAT DROP ADJUSTMENT

1—Float Tang 2—Float Drop Gauge 3—Float

E-40. External Carburetor Adjustment

All adjustments on the carburetor, except for float adjustments, are made externally. For float level and drop adjustments, see steps j and k of Par. E-38, above.

E-41. Accelerator Pump Adjustment

Unthread curb-idle speed adjustment screw and completely close throttle valves in bore. Place pump gauge across top of carburetor air horn ring, as shown, with $1\frac{5}{16}$ " [29,369 mm.] leg of gauge pointing downwards, towards top of pump rod. Lower edge of gauge leg should just touch the top of the pump rod. Bend the pump rod, as required, to obtain the proper setting. See Fig. E-26.

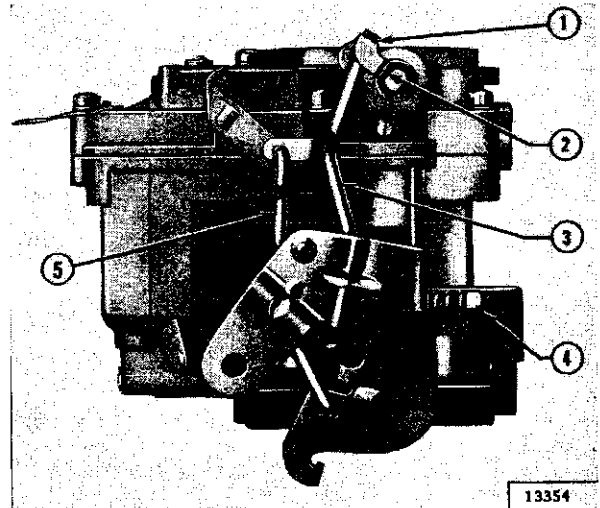


FIG. E-25—CHOKE LINKAGE—INSTALLED VIEW

1—Choke Lever
2—Trip Lever
3—Choke Rod
4—Throttle Stop Screw
5—Pump Rod

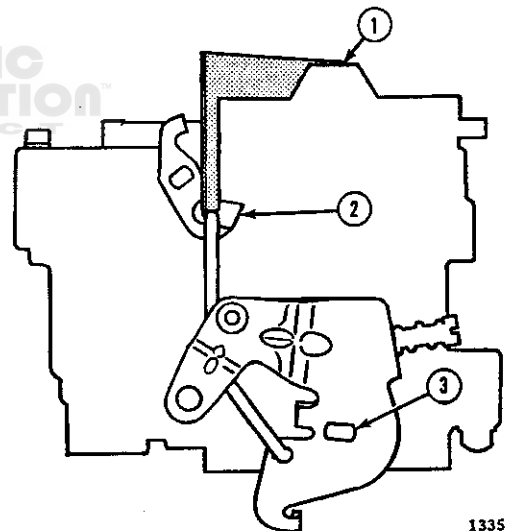


FIG. E-26—ACCELERATOR PUMP ADJUSTMENT

1—Pump Gauge
2—Pump Rod
3—Throttle Shaft — Closed Position

E-42. Curb Idle Speed and Mixture Adjustments

Adjust curb idle speed adjustment screw to obtain engine idle speed as specified in Par. E-79. See Fig. E-15.

When engine is at normal operating temperatures, adjust idle mixture needle screws to obtain smoothest engine idle; readjust idle speed if necessary.

Note: Engine run on or "dieseling" is a condition in which combustion continues to take place after the normal ignition spark from the distributor has been shut off by turning off the ignition switch. It

is generally caused by excessive engine idle speed in combination with retarded ignition timing, engine heat soak or the use of low octane fuel. Should engine dieseling (engine running after ignition key is turned off) be experienced on V-6 engine equipped vehicles, installation of Idle Stop Valve Kit Part No. 991722 will correct the difficulty.

E-43. Fast Idle Adjustment

No fast idle speed adjustment is required. Fast idle is controlled by the curb idle speed adjustment screw. If curb idle speed is correctly set and the choke rod is properly adjusted, fast idle speed will be correct;

E-44. Dash Pot Adjustment — F4 and V-6 Engine

• Refer to Figs. E-27 and E-28.

Before adjusting the dash pot, the engine idle speed and mixture should be correctly adjusted. With the engine idling at normal operating temperature, adjust the dash pot as follows:

The dash pot adjustment is made with the throttle set at curb idle (not fast idle). Loosen dash pot lock nut and turn the dash pot assembly until dash pot plunger contacts the throttle lever without the plunger being depressed. Then turn the dash pot assembly $2\frac{1}{2}$ turns against the throttle lever, depressing the dash pot plunger. Tighten the lock nut securely. As a final check, open carburetor and allow throttle to snap closed. Time dash pot delaying action from the point where the throttle lever hits the dash pot to the point where the lever stops moving. The dash pot should delay or cushion closing action for two seconds by saying, "One thousand and one, one thousand and two."

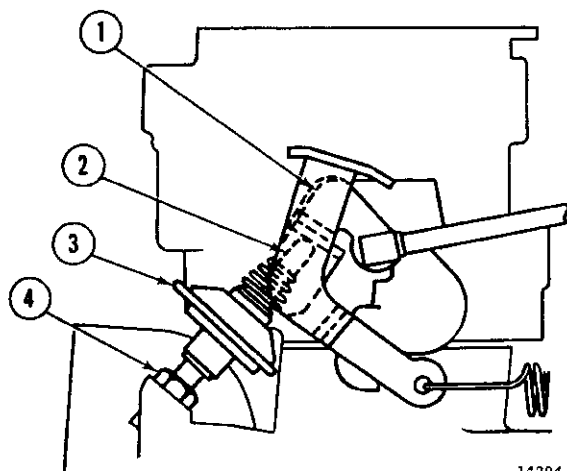


FIG. E-27—DASH POT ADJUSTMENT—V6 ENGINE

1—Throttle Lever 3—Dash Pot
2—Plunger 4—Lock Nut

E-45. FUEL PUMP (DOUBLE-ACTION) — HURRICANE F4 ENGINE

• Early Models

The double-action fuel pump consists of a metal body, a rubber diaphragm, rocker arm, valves,

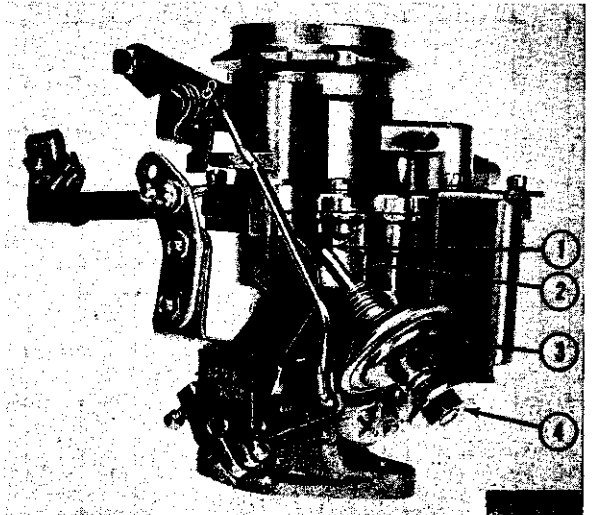


FIG. E-28—DASH POT ADJUSTMENT—F4 ENGINE

1—Throttle Lever 3—Dash Pot
2—Plunger 4—Lock Nut

springs, gaskets, and a glass sediment bowl complete with strainer. The metal pump body provides a working housing for the diaphragm, lever, valves, and springs. The fuel pump is mounted on the left side of the engine and is actuated by an eccentric on the camshaft. An air dome is cast into the metal cover to relieve the carburetor needle valve and the fuel pump diaphragm of excessive pressure when the carburetor needle valve is closed.

Tracing pump operation from the beginning, the camshaft eccentric forces the diaphragm up, overcoming spring pressure. This action creates a partial vacuum in the pump chamber. Fuel from the main tank is forced into the low-pressure pump chamber through the open disc valve. Incoming fuel supplies the force necessary to open the valve, which is a one-way check valve. As the engine camshaft continues to rotate, spring pressure forces the diaphragm downward as the pump rocker arm follows the camshaft eccentric to its low spot. The downward action of the diaphragm closes the intake valve and forces fuel to the carburetor reservoir through the pump outlet valve. Both intake and outlet valves are one-way check valves opened and closed by fuel flow. No mechanical components are required in the control of valve operation.

Fuel is delivered to the carburetor only when the float needle is off its seat. When the fuel level in the carburetor bowl is high enough for the float to force the needle against its seat, pressure backs up to the fuel pump air dome and causes the diaphragm to stop pumping. In this position, the pump is said to be balanced because the pressure in the pump-to-carburetor line equals that of the diaphragm spring. In this way, fuel from the pump to the carburetor is always under pressure. The carburetor uses fuel, causing the float to drop and pull the carburetor needle valve off its seat. Pressure in the pump immediately drops as fuel is delivered to the carburetor reservoir. Almost instantaneously the diaphragm again starts operating to pump more

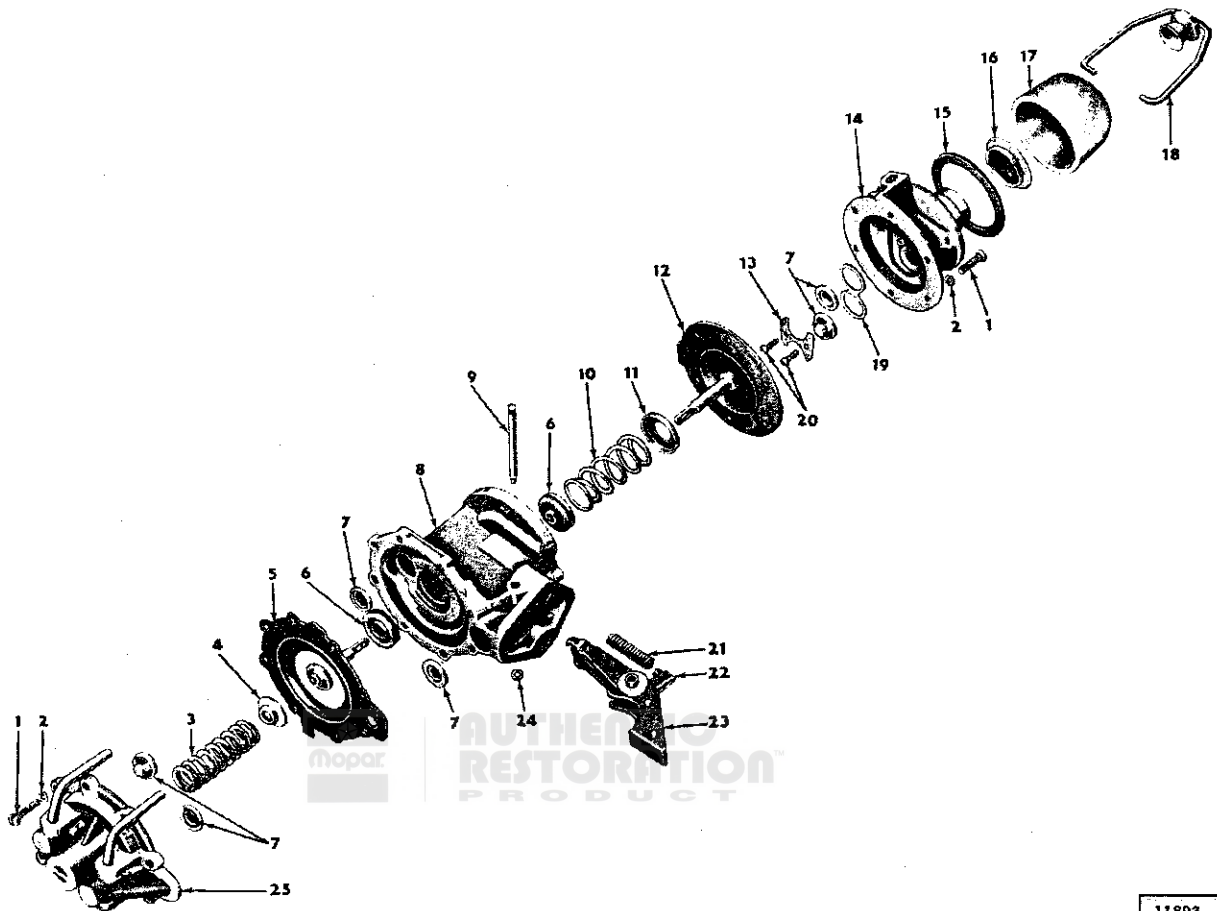


FIG. E-29—FUEL AND VACUUM PUMP—F4 ENGINE, EARLY MODELS

- | | | | |
|---------------------|-------------------------|-------------------|----------------------|
| 1—Cover Screw | 7—Valve Assembly | 13—Valve Retainer | 19—Gasket |
| 2—Lockwasher | 8—Body | 14—Cover | 20—Screw |
| 3—Diaphragm Spring | 9—Rocker Arm Pin Spring | 15—Gasket | 21—Rocker Arm Spring |
| 4—Spring Seat | 10—Fuel Diaphragm | 16—Screen | 22—Link Spacer |
| 5—Diaphragm and Rod | 11—Oil Seal Retainer | 17—Bowl | 23—Rocker Arm |
| 6—Oil Seal | 12—Diaphragm and Rod | 18—Ball | 24—Washer |
| | | | 25—Body |

fuel. The diaphragm can start and stop many times in each mile of vehicle operation, but the pump actuating linkage is always in operation while the engine is running. The fuel pump incorporates a pulsator and pulsator chamber to dampen the effect of pump pressure pulsations on the carburetor needle valve. This prevents high fuel level in the reservoir that would result from the needle being jarred away from its seat. Also, operating economy would be affected because a high fuel level usually results in an over-rich mixture.

The actuating linkage has its own spring to ensure continuous contact of the lever to the camshaft eccentric.

This fuel pump has a sediment bowl and filtering screen which is attached to the top of the pump by a wire clamp and thumb nut. The screen and sediment bowl should be cleaned at least twice yearly to prevent trouble due to a blocked screen or water freezing. The bowl should be washed and wiped dry and the screen dried and then cleaned with a stiff brush. When reassembling the bowl make certain that the cork gasket is not broken; reverse it

and position it flat on the seat, then install the bowl and tighten the thumb nut securely. After cleaning, start the engine and carefully inspect the bowl for leakage.

E-46. Disassembly

Remove the cover plate, gasket, and screen or bowl clamp, sediment bowl, gasket and screen if so equipped. Mark the two castings with a file to ensure positioning in the same relation upon assembly. Remove the screws attaching the fuel cover to the pump body. Remove the cover, diaphragm, and spring. Remove rocker arm pin, rocker arm, and rocker arm spring. Remove the valve plate screw and separate the valve plate retainer, valve gaskets, and valves.

Clean all parts in cleaning solvent and blow out with compressed air. Valves should not be removed from the valve housing assembly. Check all parts to see that they have not been cracked or broken and that screw threads have not been stripped or cross threaded. Refer to Par. E-49 for fuel pump testing.

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E-47. Reassembly

- Refer to Fig. E-29.

Install the valve gaskets, valves, valve retainer and secure them with the valve retainer screws. Make sure that the inlet and outlet valves are in their proper positions. Place the diaphragm spring retainer in position on the diaphragm pull rod and install diaphragm spring. Position the diaphragm assembly in pump body and attach the cover to pump body, with file marks aligned, with the six attaching screws. Do not draw the screws up tight. Install rocker arm spring, rocker arm pin washers, rocker arm and rocker arm pin. With rocker arm positioned on the diaphragm rod, draw the six pump body screws up evenly and securely. Install the filter screen, cork gasket and sediment bowl and secure them firmly with the thumb screw on the bowl clamp.

E-48. Vacuum Pump

The double-action fuel pump resembles two single-action pumps placed one above the other. A single fuel pump rocker arm actuates the two separate diaphragms. One diaphragm is part of the fuel delivery pump and operates as described in Par. E-45. The other diaphragm is part of the vacuum pump and operates as described here.

As the actuating lever forces the diaphragm upward against spring pressure, air is forced through the outlet port into the engine's intake manifold. On the return stroke, spring pressure forces the diaphragm downward, creating a partial vacuum and opening the inlet valve. In this manner, air is pumped out of the windshield wiper motor and into the intake manifold. When the wiper motor is shut off, manifold vacuum holds the diaphragm against its spring so that the full motion of the actuating lever is not accompanied by a complete up-and-down motion of the diaphragm.

When the windshield wiper motor is turned on, but manifold vacuum is greater than the vacuum created by the booster pump, air flows from the wiper motor through both valves of the vacuum booster. As manifold vacuum drops off as a result of the engine operating under low speed and high load, the vacuum created by the vacuum booster will be greater than engine intake manifold vacuum and the pump will operate the wiper motor when the wiper control switch is turned on.

- Refer to Fig. E-29.

Remove the eight cover attaching screws and lockwashers, and remove the cover, diaphragm spring and spring seat. Detach the diaphragm rod from the rocker arm and remove the diaphragm. The valve assemblies are pressed into the cover and body and lightly staked. They may be removed with the point of a knife blade. If installing new valves be sure the inlet and outlet valves are correctly positioned and stake them lightly with a small punch.

Assemble the vacuum pump in the reverse order of disassembly, drawing the cover attaching screws up evenly and tightly.

E-49. Fuel Pump Testing

Four tests are presented in following paragraphs to

test for proper operation of the fuel pump. In addition, check the following:

- Check for secure mounting of the fuel pump. The rocker arm may be working the entire pump up and down, rather than just the pump diaphragms.
- Remove and clean the fuel sediment bowl.
- Check all fuel lines.

E-50. Volume Check

To measure fuel pump capacity (amount of fuel delivered in a given time) disconnect the pump-to-carburetor line at the carburetor end. Place the open end of the line in a suitable container. Start the engine and operate at normal idle speed. Delivery should be one quart U.S. [1 ltr.] within one minute.

E-51. Pressure Check

To measure fuel pump pressure (force of fuel delivery) disconnect the pump-to-carburetor line at the carburetor end. Plug a pressure gauge and T-fitting into the open end of this line and into the carburetor. Start the engine and operate at normal idle speed. Pressure should be $2\frac{1}{2}$ to $3\frac{3}{4}$ psi. [0,716 a 0,264 kg-cm²] at 1800 rpm. and at 16" [406 mm.] above the outlet.

E-52. Vacuum Check

To measure fuel pump vacuum (pull of the pump at the inlet side) disconnect the pump-to-fuel-tank line at the fuel pump. Attach a vacuum gauge to the fuel pump inlet. Start the engine, accelerate to specified speed, and hold this engine speed while taking a gauge reading. Permissible gauge reading is 8" [203 mm.] of mercury [Hg] at 1200 rpm. and $10\frac{1}{2}$ " [267 mm.] at 1800 rpm.

E-53. Vacuum Booster Check

To test the condition of the vacuum booster pump, disconnect both inlet and outlet lines at the pump. Attach a vacuum gauge to the windshield wiper connection at the pump. Start the engine, accelerate to 2000 rpm., and hold this engine speed while taking a gauge reading. Permissible gauge reading is 10" to 14" [254 a 356 cm.] of mercury [Hg].

E-54. FUEL PUMP (SINGLE-ACTION) — HURRICANE F4 ENGINE

- Early Models.

Vehicles with electric windshield wiper motors are equipped with a single-action fuel pump (Fig. E-30). The fuel pump cam lever is activated by an eccentric on the engine camshaft. When the carburetor float needle valve closes, accumulation of fuel in the pump extends the diaphragm spring. This action causes the rocker arm linkage to become inoperative until the pressure on the diaphragm and spring is reduced. The fuel pump discharge pressure is thus controlled by the diaphragm spring. This provides a steady supply of fuel to the carburetor at a fairly constant pressure.

E-55. Fuel Pump Removal

To remove the fuel pump from the engine, disconnect the inlet and outlet fuel lines. Remove the two fuel pump body attaching nuts, lock washers, and washers, and pull the fuel pump and gasket free of the engine.

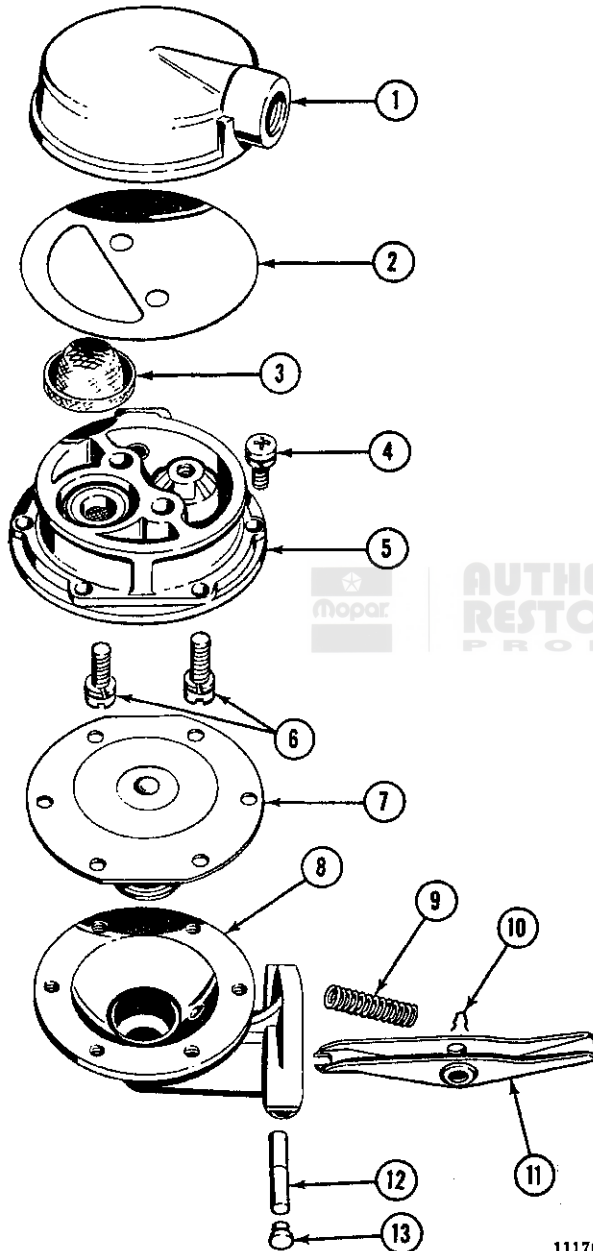


FIG. E-30--FUEL PUMP--HURRICANE
F4 ENGINE, EARLY MODELS

- 1--Housing Cover
- 2--Air Dome Diaphragm
- 3--Strainer
- 4--Screw and Washer
- 5--Housing
- 6--Cover Screw and Lock Washers
- 7--Main Diaphragm
- 8--Pump Body
- 9--Cam Lever Return Spring
- 10--Pin Retainer
- 11--Cam Lever
- 12--Cam Lever Pin
- 13--Lever Seal Shaft Plug

E-56. Fuel Pump Disassembly

Note: The fuel pump is serviced with a repair kit. Individual service parts are also available. The valves are not replaceable but are serviced as part of the valve housing.

a. Before disassembly of the fuel pump, mark the three castings (see Fig. E-30) to ensure positioning in the same relation upon assembly.

b. Remove the inlet and outlet fuel fittings from the pump.

c. Remove the screws and washers and separate the housing from the pump body.

d. Remove cover screws and lock washers and then remove housing cover, dome diaphragm and strainer.

e. Remove cam lever return spring and lever seal shaft plug.

f. Remove retainer pin, cam lever pin and cam lever.

g. Remove main diaphragm.

Note: Do not remove valves from housing as they are serviced with the housing.

Note: The oil seal (at top of spring in diaphragm assembly) seals the spring side of the fuel diaphragm from the crankcase. Any deposit, in excess of a few drops, of oil on the diaphragm, indicates leakage past the oil seal. Be sure the seat for the seal in the pump body is clean and smooth.

E-57. Fuel Pump Cleaning and Inspection

Caution: Do not immerse valves or diaphragm in cleaning solvent; wipe clean.

Clean all metal parts of the fuel pump in solvent. Brush with a stiff-bristled brush. Dry with compressed air. Check all parts to see that they are not cracked or broken and that the screw threads are not damaged.

E-58. Fuel Pump Reassembly

a. Position the new main diaphragm on pump body and hold it in position while installing cam lever in position.

b. Install cam lever pin, pin retainer and lever seal shaft plug.

c. Install cam lever return spring.

d. Position strainer, air dome diaphragm and housing cover on housing and secure with screw and lock washers.

e. Position housing on pump body and secure with screw and washers. First start all screws one or two turns: Then tighten the screws alternately and securely.

Note: Before placing housing on pump body note position of align marks made before disassembly.

f. Install the fuel inlet and outlet fittings.

Note: Lubricate forked end of cam lever and cam lever pin.

Caution: Do not overtighten screw.

E-59. Fuel Pump Installation

- a. Make certain mating surfaces of fuel pump and engine cylinder case are clean. Cement a new gasket to mounting flange of fuel pump.
- b. Position fuel pump on cylinder block, so that cam lever of pump rests on fuel pump cam of camshaft. Secure pump to block with two cap screws and lock washers.
- c. Connect intake and outlet fuel lines to fuel pump.

E-60. FUEL PUMP (SINGLE-ACTION) — HURRICANE F4 ENGINE

● Late Models.
The Hurricane F4 engine is equipped with a single-action fuel pump (Fig. E-31). The fuel pump cam lever is activated by an eccentric on the engine camshaft. When the carburetor float needle valve closes, accumulation of fuel in the pump extends the diaphragm spring. This action causes the rocker arm linkage to become inoperative until the pressure on the diaphragm and spring is reduced. The fuel pump discharge pressure is thus controlled by the diaphragm spring. This provides a steady supply of fuel to the carburetor at a fairly constant pressure.

E-61. Fuel Pump Removal

To remove the fuel pump from the engine, disconnect the inlet and outlet fuel lines. Remove the two fuel pump body attaching nuts, lock

washers, and washers, and pull the fuel pump and gasket free of the engine.

E-62. Fuel Pump Disassembly

Note: The fuel pump is serviced with a repair kit. Individual service parts are also available. The valves are not replaceable but are serviced as part of the valve housing.

- Refer to Fig. E-32.
- a. Remove filter bail assembly, bowl, element, spring, and gasket from filter cover.
- b. File a locating mark on the edges of the valve housing and the pump body. Remove the six at-

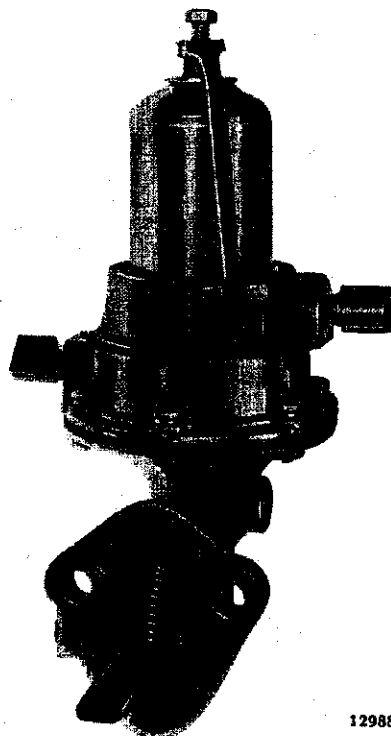
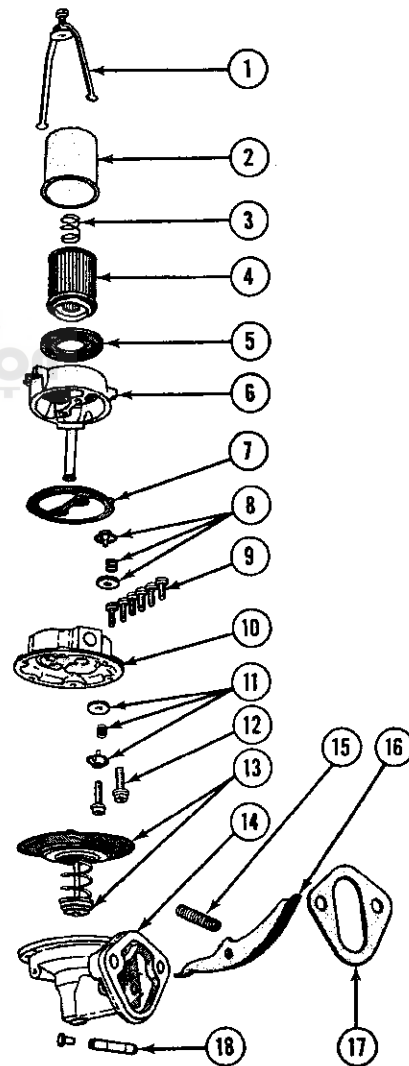


FIG. E-31—FUEL PUMP—HURRICANE F4 ENGINE, LATE MODELS



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FIG. E-32—FUEL PUMP—HURRICANE F4 ENGINE, LATE MODELS

- | | |
|------------------|---------------------------|
| 1—Bail | 10—Valve Housing |
| 2—Bowl | 11—Valve Assembly |
| 3—Spring | 12—Screws |
| 4—Filter | 13—Diaphragm and Oil Seal |
| 5—Gasket | 14—Pump Body |
| 6—Pump Body | 15—Cam Lever Spring |
| 7—Gasket | 16—Cam Lever |
| 8—Valve Assembly | 17—Gasket |
| 9—Screws | 18—Cam Lever Pin and Plug |

taching screws and valve housing from the fuel pump body.

c. Remove the two screws in the valve housing and separate the filter cover and air dome diaphragm.

d. Remove the cam lever return spring, plug, cam lever pin, and cam lever from the pump body. Tap the cam lever pin out of body, using a drift inserted through the small hole in the pump body.

e. Remove diaphragm from pump body.

f. Under normal service, the pump may be cleaned without further disassembly.

Note: The oil seal (at top of spring in diaphragm assembly) seals the spring side of the fuel diaphragm from the crankcase. Any deposit, in excess of a few drops, of oil on the diaphragm indicates leakage past the oil seal. Be sure the seat for the seal in the pump body is clean and smooth.

E-63. Fuel Pump Cleaning and Inspection

Caution: Do not immerse valves or diaphragm in cleaning solvent; wipe clean.

Clean all metal parts of the fuel pump in solvent. Brush with a stiff-bristled brush. Dry with compressed air. Check all parts to see that they are not cracked or broken and that the screw threads are not damaged.

E-64. Fuel Pump Reassembly

● Refer to Fig. E-32.

a. Assemble the valve housing and filter cover, using a new air dome diaphragm. The opening in the air dome diaphragm is located over the intake valve. The filter cover is positioned correctly when the inlet passage in the cover aligns with the inlet valve. Tighten the attaching screws alternately and securely.

b. Lubricate diaphragm assembly shaft, around oil seal, with engine oil. Position diaphragm assembly on valve housing and thread all the attaching screws through diaphragm. (This helps avoid damage to the screw holes in diaphragm.)

c. Place diaphragm assembly and valve housing in position on pump body (align marks made before disassembly). First start all screws one or two threads; then tighten the screws alternately and securely.

d. Lubricate forked end of cam lever, pin bore of body, and corresponding hole in lever, and the pin itself with engine oil.

Note: Forked end of lever goes around diaphragm shaft. Be sure loose bumper washer on diaphragm shaft is on top of lever and between lever and fixed washer on shaft.

e. Install lever and pin. To install pin, use a drift and tap pin into the hole in the body until it hits the stop on the bottom of the hole; move the lever while tapping, to align hole in lever with the pin; then install plug. Install lever return spring.

f. Install a new filter bowl gasket in filter cover.

Place bail assembly in ears on cover and swing to one side. Install spring and new filter element in bowl and install bowl on pump. Position bail assembly under bowl; tighten retainer screw.

Caution: Do not overtighten screw.

E-65. Fuel Pump Installation

a. Make certain mating surfaces of fuel pump and engine cylinder case are clean. Cement a new gasket to mounting flange of fuel pump.

b. Position fuel pump on cylinder block, so that cam lever of pump rests on fuel pump cam of camshaft. Secure pump to block with two cap screws and lock washers. Torque bolts 13 to 17 lb-ft. [1,8 a 2,3 kg-m.].

c. Connect intake and outlet fuel lines to fuel pump.

E-66. Fuel Pump Testing

Whenever the fuel pump is to be checked for pressure or volume, follow the procedure outline in Par. C-23 of this manual. Fuel pump pressure is important for low pressure will seriously affect engine operation and high pressure can cause excessive fuel consumption and flooding of the carburetor. Should there be any doubt of normal operation, check the procedure as outlined in Par. C-23. In addition to proper fuel pressure, volume of the pump is also important. When testing for proper pump pressure, be certain to also test for volume as the pump may build up sufficient pressure, but fail to produce sufficient volume.

E-67. FUEL PUMP — DAUNTLESS V-6 ENGINE

Jeep vehicles equipped with the Dauntless V6-225 engine have a special fuel pump which has a metering outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line alongside the fuel supply line. This greatly reduces any

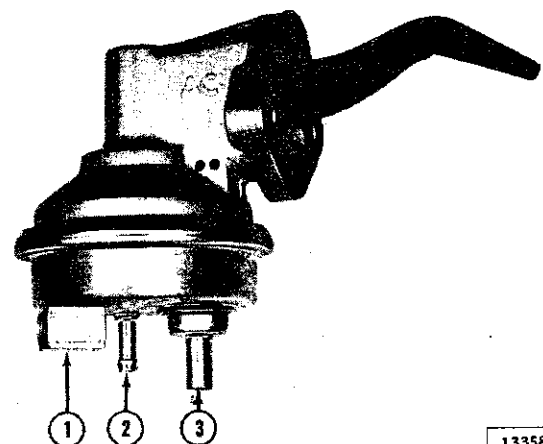


FIG. E-33—FUEL PUMP—DAUNTLESS V-6 ENGINE

1—Fuel Outlet 2—Vapor Return 3—Fuel Inlet

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possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

Fuel pump pressure at carburetor (inlet) on Dauntless V6-225 engine should be $3\frac{3}{4}$ lbs. [0,264 kgm-cm²] minimum at idle with the vapor return hose squeezed off. With the vapor return hose open pump pressure should be $2\frac{1}{2}$ lbs. [0,176 kg-cm²] minimum.

The Dauntless V-6 engine is equipped with a sealed unit, non-repairable, single-action fuel pump (Fig. E-33).

Note: All Dauntless V-6 engines are equipped with a throw-away can-type gasoline filter installed in the fuel line between the fuel pump and the carburetor. This unit must be replaced every 12,000 miles [19,200 km.] of vehicle operation.

E-68. Fuel Pump Removal

To remove the fuel pump from the Dauntless V-6 engine, disconnect the fuel inlet, fuel outlet and fuel return lines from the pump. Remove the two fuel pump body attaching cap screws and lock washers. Pull the fuel filter bracket free and remove the pump and gasket. Discard pump and gasket. Install new pump in reverse procedure of removal.

E-69. AIR CLEANER

Servicing of the air cleaner is properly taken care of as part of the periodic lubrication and servicing

of the vehicle. For this reason, air cleaner servicing information is given in the Lubrication Section. Refer to and follow the instructions given there.

E-70. ACCELERATOR LINKAGE

The accelerator linkage is properly adjusted when the vehicle leaves the factory. However, in time components parts will become worn and require re-adjustment to maintain a smooth even control of engine speed. On Models equipped with F4 engines the adjustment is made at the adjusting block, Fig. E-34. Loosen the lock nuts, and adjust the length of the accelerator rod so that when the carburetor throttle valve is wide open the accelerator treadle will just strike the toe board. After correct adjustment is made tighten both lock nuts firmly. To adjust the accelerator linkage on V6 engines loosen the lock nuts securing the accelerator rod housing to its securing bracket and adjust the length of the accelerator rod so that when the carburetor throttle valve is wide open the accelerator treadle will just strike the toe board. After correct adjustment is made, tighten lock nut firmly, see Fig. E-35 for Dauntless V-6 engine.

E-71. FUEL TANK AND FUEL LINES

The following paragraphs (E-70 through E-73) describe the removal, installation and services to be performed when replacing the fuel tank or servicing the fuel system.

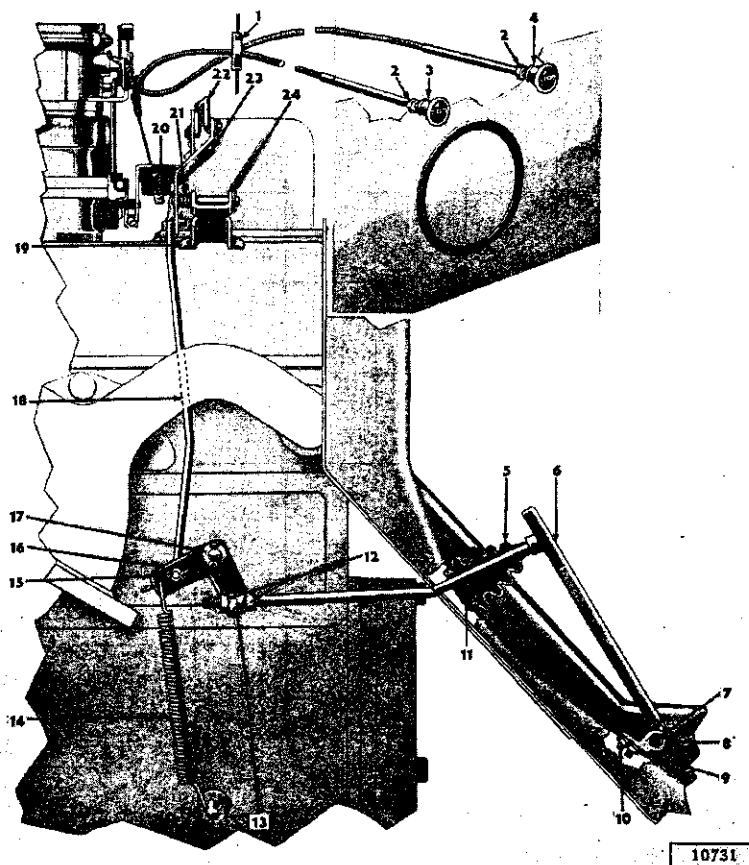


FIG. E-34—ACCELERATOR LINKAGE, F4 ENGINE

- 1—Grommet
- 2—Nut and Lockwasher
- 3—Throttle Control
- 4—Choke Control
- 5—Treadle Rod Seal
- 6—Accelerator Treadle
- 7—Treadle Hinge Pin
- 8—Treadle Hinge
- 9—Nut and Lockwasher
- 10—Screw
- 11—Accelerator Rod
- 12—Nut
- 13—Adjusting Block
- 14—Retracting Spring
- 15—Cotter Pin
- 16—Lower Bellcrank
- 17—Washer
- 18—Bellcrank Link Rod
- 19—Bracket
- 20—Throttle Wire Stop
- 21—Bellcrank Spring
- 22—Rod
- 23—Upper Bellcrank
- 24—Washer

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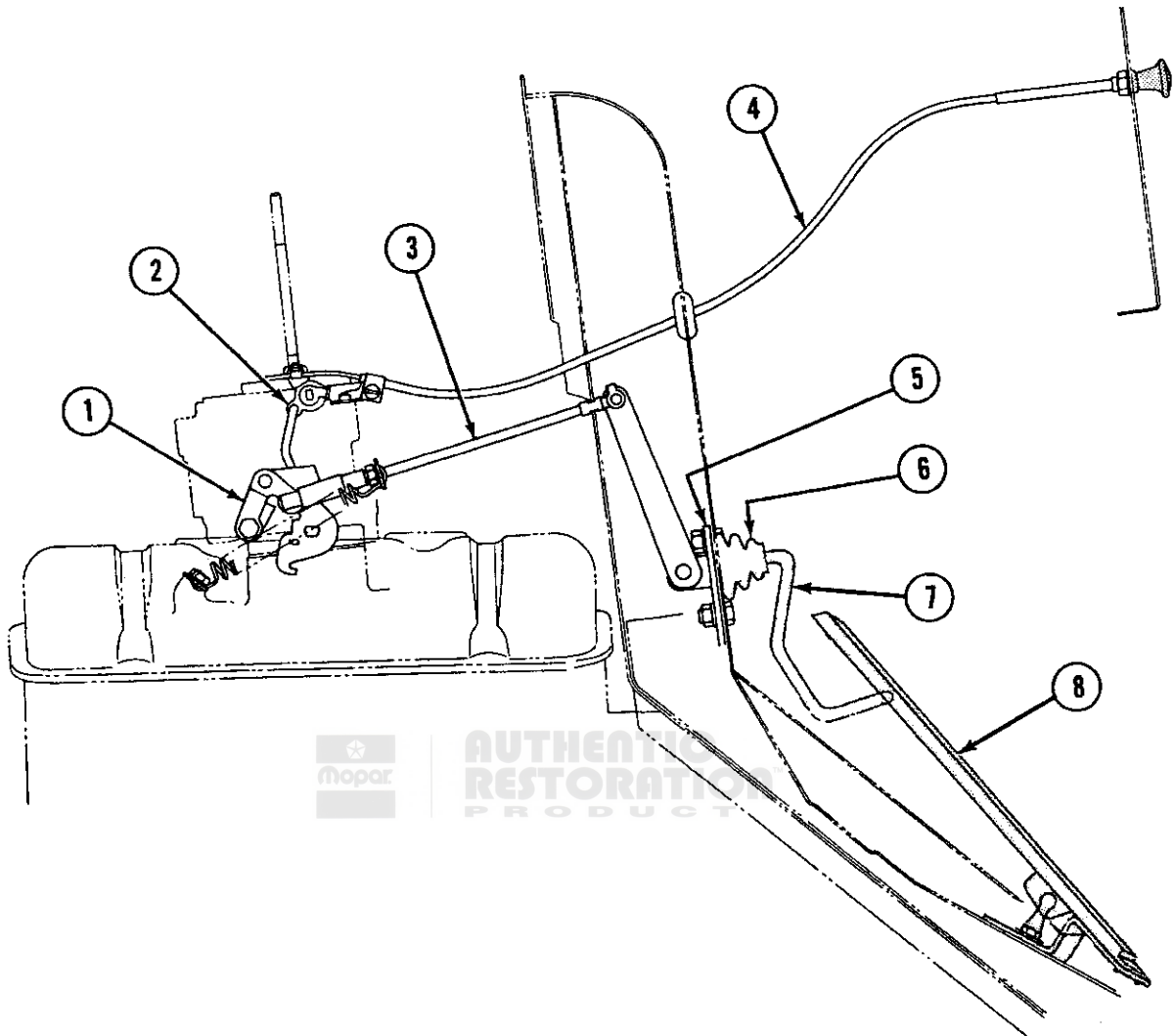


FIG. E-35—ACCELERATOR LINKAGE—V-6 ENGINE

1—Lever Assembly
 2—Choke Rod
 3—Accelerator Rod (Upper)
 4—Choke Control Cable

5—Accelerator Mounting Bracket
 6—Accelerator Boot
 7—Accelerator Rod (Lower)
 8—Accelerator Treadle

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E-72. Fuel Tank

The fuel tank on early model 'Jeep' Universal vehicles has a capacity of 10½ gals. [38,75 ltr.] and is mounted under the driver's seat. The tank is secured to the front floor panel by a hold down strap and two bolts.

The fuel tank on all late model 'Jeep' vehicles has a capacity of 16 gal. [60,56 ltr.] and is mounted to three frame rail brackets at the rear and center of the frame. The tank is secured to the brackets by three bolts and six rubber shock insulators. A fuel tank skid plate is attached to the rear frame cross-member to protect the bottom of the tank from damage.

E-73. Fuel Tank Removal

When removing the fuel tank on early model vehicles, first drain the tank of all fuel. Remove the driver's seat, then remove the tank hold down straps. Disconnect fuel line(s) and sending unit

wire from the tank. Remove the filler neck rubber grommet and remove the tank assembly from the vehicle.

When removing the fuel tank, on late model vehicles first drain the tank of all fuel, then remove the fuel tank skid plate. Loosen the filler neck and vent tube hose clamp and disconnect hoses from fuel tank. Remove the three mounting bolts and six washers and rubber insulators that secure the tank to the frame brackets. Loosen frame brackets to give clearance for tank removal. Lower tank slightly allowing space for disconnecting fuel and vent lines and sending unit wire from tank. Lower tank and remove from underside of vehicle.

E-74. Fuel Tank Installation

Note: On vehicles equipped with the Dauntless V-6 engine two fuel lines are connected to the fuel tank; a fuel out line and a fuel return line. It is im-

portant that these lines are not accidentally reversed.

When installing the fuel tank on late model vehicles, position the tank between the frame rail to allow space to connect the fuel line(s), vent hose and sending unit wire. After connecting these items, align and secure tank to frame brackets. Position filler hose on tank filler neck and tighten hose clamp. Fill tank with fuel and check for leaks. When installing the fuel tank on early model vehicles, reverse the order of removal as given in Par. E-73.

E-75. Fuel Tank Cap

A surge pressure type fuel tank filler cap is used on all models. This is necessary to prevent fuel leakage from the cap vent opening when the vehicle is on a side slope. Two spring loaded relief valves which open when venting is required are built into the cap. Should the pressure valve fail to open, pressure in the tank may force fuel by the carburetor inlet valve causing flooding. Failure of the vacuum valve may prevent flow of fuel to the carburetor. Should the valves fail to vent install a new cap.

Note: Vehicles having a Fuel Evaporative Emission System are equipped with a non-vent sealed gas cap. The sealed cap is designed to allow no vapors to discharge to the atmosphere. No other

type of cap is to be used on vehicles having this type system.

E-76. Fuel Gauge Float Unit

The fuel tank gauge float unit is mounted in the top of the fuel tank and consists of a housing enclosing a rheostat that is actuated by the float arm, and a float which moves with the fuel level in the tank. On V-6 and current production F4 engine equipped vehicles, the fuel outlet pipe is integral with the float unit. The fuel outlet pipe has a mesh filter on the inner end.

Note: Under no circumstances should a fuel tank gauge be installed without a mesh filter element.

The filter, outlet pipe, and float unit are locked as an assembly to the top of the fuel tank. To remove, turn the lock plate that secures the float unit assembly.

E-77. Fuel Lines

Check lines and connections occasionally for leaks, and for severe kinks that might restrict the flow of fuel. If an excessive amount of dirt is found in the carburetor or fuel pump, the fuel tank should be drained and the fuel lines blown out with compressed air.

All rubber fuel lines and their respective clamps should be checked occasionally to be certain they are correctly positioned and not leaking.

E-78. SERVICE DIAGNOSIS

Symptoms	Probable Remedy
Excessive Fuel Consumption:	
Tires improperly inflated	Inflate
Brakes drag	Adjust
Engine operates too cold	Check thermostat
Heat control valve inoperative	Check thermostatic spring
Leak in fuel line	Check all connections
Carburetor float level high	See "Carburetor" section
Accelerator pump not properly adjusted	Adjust
Leaky fuel pump diaphragm	Replace
Loose engine mountings causing high carburetor fuel level	Tighten
Ignition timing slow or spark advance stuck	See "Distributor" section
Low compression	Check valve tappet clearance
Air cleaner dirty	Remove and clean
Engine Hesitates on Acceleration:	
Accelerator pump does not function perfectly	Replace piston and rod or adjust
Carburetor float level	Adjust
Spark plugs	Replace or clean and adjust
Low compression	Check valves
Distributor points—dirty or pitted	Replace
Weak condenser or coil	Replace
Carburetor jets restricted	Remove and clean
Excessive engine heat	See "Engine" section
Engine Stalls—Won't Idle:	
Improper condition of carburetor	See "Carburetor" section
Low speed jet restricted	Remove and clean
Dirty fuel sediment bowl screen	Remove and clean
Air cleaner dirty	Remove and clean
Leaky manifold or gasket	Replace
Fuel pump diaphragm porous	Replace
Loose carburetor	Tighten flange nuts
Water in fuel	Drain and clean system
Improper ignition	See "Distributor" section
Spark plugs	Clean and adjust
Valves sticking	Grind valves

E-79. FUEL SYSTEM SPECIFICATIONS

CARBURETOR SPECIFICATIONS HURRICANE F4 (See Note)	Without Exhaust Emission Control	Without Exhaust Emission Control
Make	Carter	Carter
Model	YF-938SD	YF-4002-S
Throttle Bore	1 1/2" [3,81 cm.]	1 1/2" [3,81 cm.]
Main Venturi	1 1/4" [3,18 cm.]	1 1/4" [3,18 cm.]
Low Speed Jet .....	.028" [0,711 mm.]	.031" [0,794 mm.]
Main Metering Jet .....	.0935" dia. [2,375 mm.]	.091" dia. [2,311 mm.]
Idle Port .....	.184" x .030" [4,70 a 0,765 mm.]	.184" x .030" [4,70 a 0,765 mm.]
Nozzle Bleed In Body .....	.0225" [0,571 mm.]	.028" [0,713 mm.]
Pump Jet .....	.031" [0,787 mm.]	.025" [0,635 mm.]
Float Setting	5/16" [7,39 mm.]	1 1/4" [6,74 mm.]
Engine Idle RPM	600	650 — 700
Dash Pot Setting		

CARBURETOR SPECIFICATIONS HURRICANE F4 (See Note)	With Exhaust Emission Control
Make	Carter
Model	YF-4366-S, YF-4941-S, YF-6115-S
Throttle Bore	1 1/2" [3,81 cm.]
Main Venturi	1 1/4" [3,18 cm.]
Low Speed Jet .....	.035" [0,889 mm.]
Main Metering Jet .....	.089" dia. [2,261 mm.]
Idle Port .....	.184" x .030" [4,70 a 0,765 mm.]
Nozzle Bleed In Body .....	.028" [0,713 mm.]
Pump Jet .....	.024" [0,609 mm.]
Float Setting	1 1/4" [6,74 mm.]
Engine Idle RPM	700 - 750
Dash Pot Setting	1/8" [3,75 mm.]

CARBURETOR SPECIFICATIONS DAUNTLESS V-6 (See Note)	Without Exhaust Emission Control	With Exhaust Emission Control
Make	Rochester	Rochester
Model Designation	2G	2G
Code Number	7026082	7027082-7041185
Choke	Manual	Manual
Number of Barrels	2	2
Throttle Bore	1 1/16" [3,65 cm.]	1 1/16" [3,65 cm.]
Main Metering Jet:		
Production .....	.051" - 60° [1,29 mm.]	.051" - 60° [1,29 mm.]
High Altitude — over 5000 ft. ....	.049" - 60° [1,24 mm.]	.049" - 60° [1,24 mm.]
— over 10,000 ft. ....	.047" - 60° [1,29 mm.]	.047" - 60° [1,29 mm.]
Float Level Adjustment*	1 3/32" [27,78 mm.]	1 5/32" [29,36 mm.]
Float Drop Adjustment	1 1/8" [4,76 cm.]	1 1/8" [4,76 cm.]
Pump Rod Adjustment**	1 5/32" [2,94 cm.]	1 5/32" [2,94 cm.]
Engine Idle RPM	650 — 700	650 — 700
Initial Idle Speed Setting	3 turns in	3 turns in
Initial Idle Mixture Setting	2 turns out	2 turns out
Dash Pot Setting	1/8" [3,75 mm.]	1/8" [3,75 mm.]

*From air horn gasket to top of float at toe.

**From air cleaner ring to top of pump rod.

NOTE: Carburetor specifications for engines equipped with exhaust emission control are also shown in section F1 for the F4-134 Hurricane engine, and in section F2 for the V6-225 Dauntless engine.

E**FUEL SYSTEM****E-79. FUEL SYSTEM SPECIFICATIONS (Continued)**

MODEL	EARLY MODEL HURRICANE F4	EARLY MODEL DAUNTLESS V-6
AIR CLEANER: Type	Oil Bath	Oil Bath
FUEL TANK: Capacity	10½ gal. [39,75 ltr.]	10½ gal. [39,75 ltr.]
Location	Under Driver's Seat	Under Driver's Seat
FUEL PUMP: Make	AC or Carter	A.C.
Model	5594032 21955	6440515
Type	Diaphragm, serviceable unit	Disposable unit
FUEL FILTER: Location	Tank unit only	Left side of engine, plus tank unit
MODEL	LATE MODEL HURRICANE F4	LATE MODEL DAUNTLESS V-6
AIR CLEANER: Type	Oil Bath	Dry Type
FUEL TANK: Capacity	16 gal. [60,57 ltr.]	16 gal. [60,57 ltr.]
Location	Between frame rails, rear of vehicle	Between frame rails, rear of vehicle
FUEL PUMP: Make	Carter	A.C.
Model	4574-S	6440515
Type	Diaphragm, serviceable unit	Disposable unit
FUEL FILTER: Location	Left side of engine, plus tank unit	Left side of engine, plus tank unit

EXHAUST SYSTEM

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Hurricane F4 Engine Exhaust System....	F-2	Heat Control Valve Replacement.....	F-7
MAINTENANCE REQUIREMENTS.....	F-4	Muffler Replacement.....	F-9
EXHAUST SYSTEM SERVICING.....	F-5	Tail Pipe Replacement.....	F-10
		EXHAUST SYSTEM SPECIFICATIONS..	F-11

F-1. GENERAL

The major components of the exhaust system (Figs. F-1, F-2 and F-3) are the exhaust manifold(s), exhaust pipe(s), muffler and tail pipe. Differences in the exhaust system occur depending on whether the vehicle is equipped with the Hurricane F4 or Dauntless V-6 engine.

Note: For service information on exhaust emission control systems, refer to Section F1 and F2 of this manual.

F-2. Hurricane F4 Engine Exhaust System

On the Hurricane F4 engine, the exhaust and intake manifolds are separate units. The intake manifold is cast as an integral part of the cylinder head and is completely water jacketed. This construction transfers heat from the cooling system to the intake riser and assists in vaporizing the fuel when the engine is cold.

With this construction, there is no heat control valve on the engine and the only function of the exhaust manifold is to gather and direct the exhaust

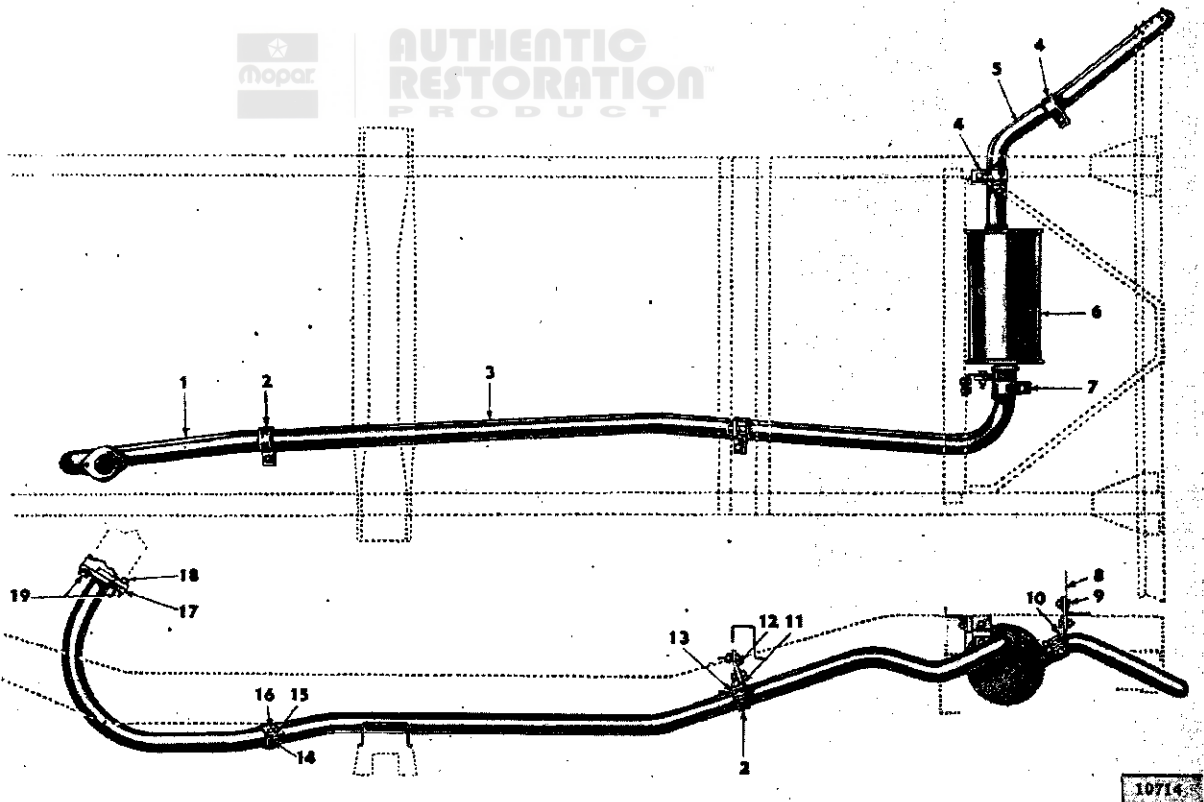


FIG. F-1—HURRICANE F4 ENGINE EXHAUST SYSTEM — EARLY MODEL

- | | |
|--------------------------|-----------------------|
| 1—Exhaust Pipe | 11—Bracket |
| 2—Clamp | 12—Insulator |
| 3—Exhaust Pipe Extension | 13—Bracket |
| 4—Clamp | 14—Nut and Lockwasher |
| 5—Tail Pipe | 15—Washer |
| 6—Muffler | 16—Bolt |
| 7—Clamp | 17—Gasket |
| 8—Support Strap | 18—Bolt |
| 9—Bolt | 19—Nut |
| 10—Support Strap | |

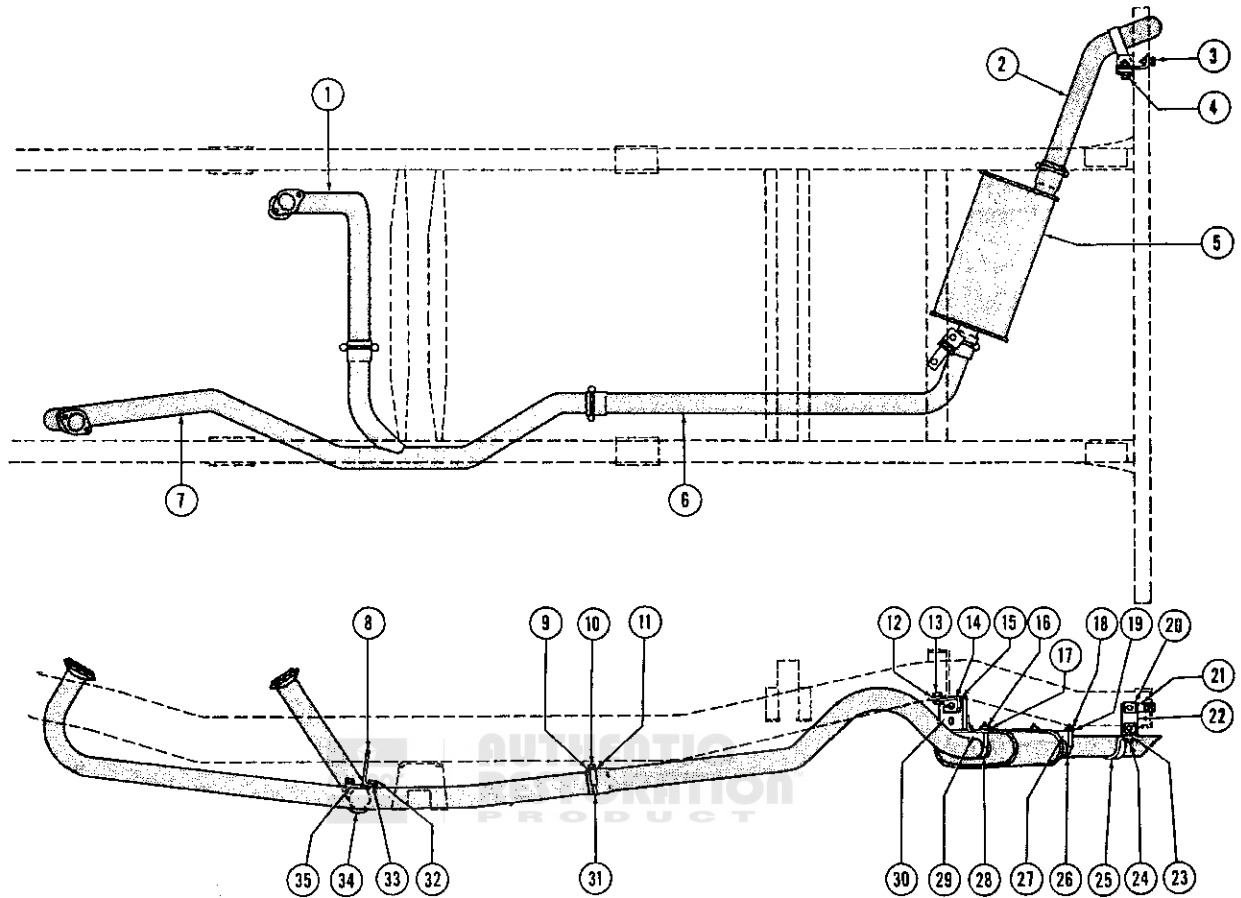


FIG. F-2—DAUNTLESS V-6 ENGINE EXHAUST SYSTEM — EARLY MODEL

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- | | |
|--------------------------|---------------|
| 1—Right Exhaust Pipe | 19—Lockwasher |
| 2—Tail Pipe | 20—Bolt |
| 3—Bolt | 21—Bracket |
| 4—Bolt | 22—Insulator |
| 5—Muffler | 23—Nut |
| 6—Exhaust Pipe Extension | 24—Bolt |
| 7—Crossover Exhaust Pipe | 25—Clamp |
| 8—Bracket | 26—U-Bolt |
| 9—Lockwasher | 27—Saddle |
| 10—Nut | 28—U-Bolt |
| 11—Saddle | 29—Saddle |
| 12—Washer | 30—Insulator |
| 13—Bolt | 31—U-Bolt |
| 14—Bracket | 32—Nut |
| 15—Reinforcement | 33—Lockwasher |
| 16—Nut | 34—U-Bolt |
| 17—Lockwasher | 35—Saddle |
| 18—Nut | |

gases into the exhaust pipe.

When assembling the manifold, to the cylinder block (Fig. F-4) new gaskets should be installed and the nuts drawn up evenly until they are tight to avoid leakage. Torque manifold nuts to 29-35 lb-ft. [4,0 a 4,84 kg-m.].

F-3. Dauntless V-6 Engine Exhaust System

Each of two cylinder banks of a Dauntless V-6 engine has an exhaust manifold. On late production engines the right exhaust manifold is equipped with a heat collector manifold which supplies heated air to the air cleaner. See Fig. F-5. Each cylinder exhausts through its own individual port into a branch of its exhaust manifold. These

branches conduct exhaust gases into the main manifold branch which connects the exhaust pipe to the muffler. A thermally-actuated heat control valve is located at the rear of the right exhaust manifold. This valve has a bimetal thermostatic spring which holds it closed when the engine is cold.

In closed position, the valve deflects exhaust gases upward through a passage in the intake manifold to the left exhaust manifold. This aids in vaporizing fuel, speeds engine warm-up, and reduces oil dilution.

Since the valve plate is offset-mounted, the valve will be forced partially open at higher engine speed and load. This prevents excessive back pressure.

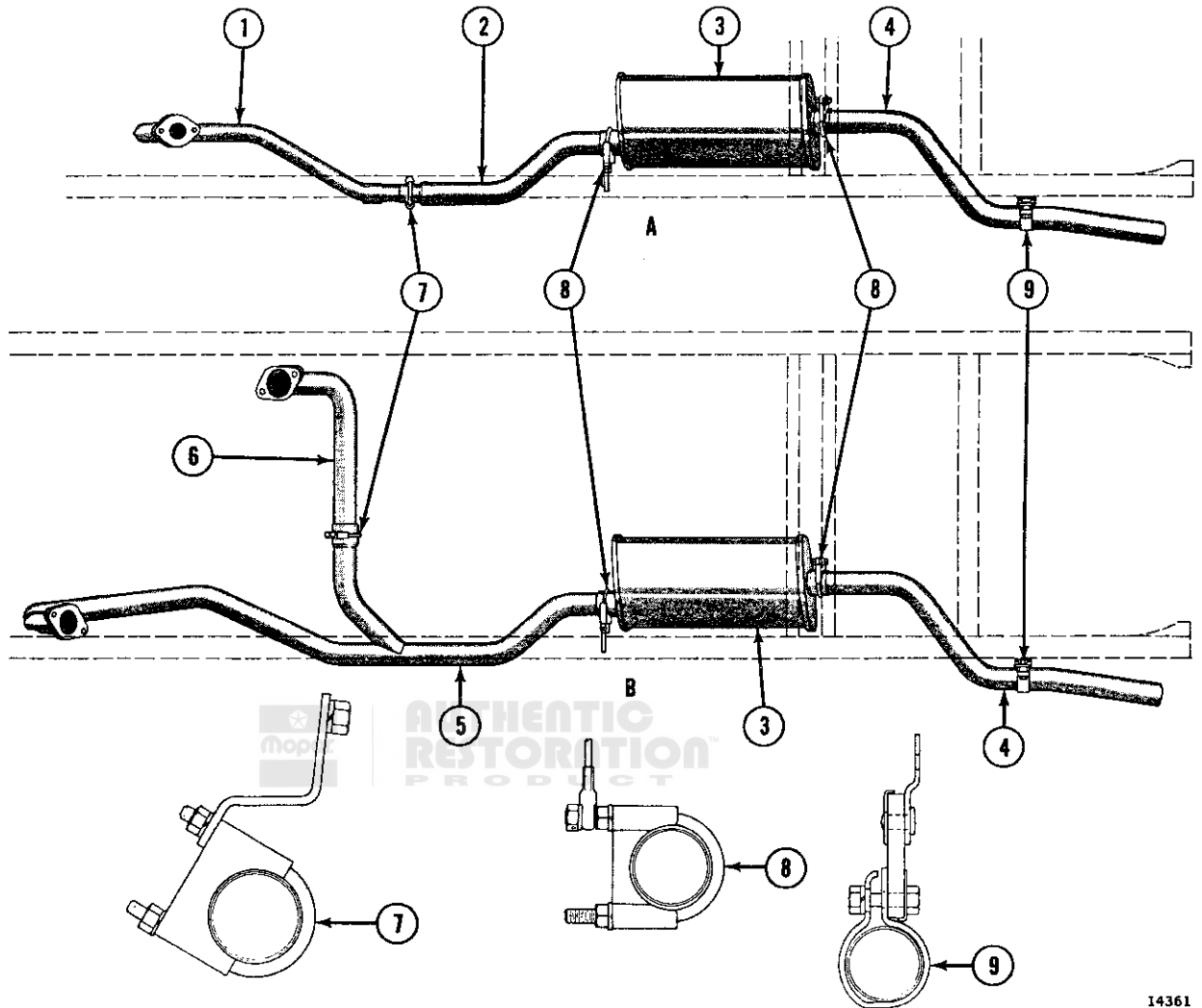


FIG. F-3—EXHAUST SYSTEM — LATE MODEL

A—Hurricane F4 Engine

B—Dauntless V6 Engine

- 1—Exhaust Pipe F4 Engine
- 2—Exhaust Pipe Extension — F4 Engine
- 3—Muffler
- 4—Tail Pipe
- 5—Right Exhaust Pipe V6 Engine

- 6—Left Exhaust Pipe V6 Engine
- 7—Exhaust Pipe Clamp
- 8—Front and Rear Muffler Clamp
- 9—Tail Pipe Clamp

As the engine increasingly warms up the thermo-static spring tension decreases until it allows the valve to open completely. That restores usual exhaust operation.

As part of regular tune-up procedure the valve operation should be checked. Valve plate should move freely, without binding or excessive play.

If necessary to replace the heat control valve (Fig. F-6), disconnect exhaust pipe from valve. Remove two attaching bolts and valve from exhaust manifold. Fasten replacement valve to manifold with two bolts. Torque bolts 15 to 20 lb-ft. [2,1 a 2,8 kg-m.]. No gasket is required between valve and manifold. Connect exhaust pipe to valve.

To remove the exhaust manifolds, disconnect the heat riser tubes and the exhaust pipe or the heat control valve from the manifold. Remove the cap screws that secure the manifold to the cylinder head; remove the manifold.

Install the exhaust manifold(s) and torque cap screws 15 to 20 lb-ft. [2,07 a 2,8 kg-m.]. Refer to Fig. D1-42.

F-4. MAINTENANCE REQUIREMENTS

The exhaust system must be free of exhaust gas leaks and vibration. The system should be checked periodically and all loose or broken hanger supports should be tightened or replaced. In addition, check for dents or restrictions in the tail pipe, exhaust pipe, or muffler as such restrictions can cause faulty engine performance. Exhaust gas leaks in the system are dangerous as well as being noisy.

Occasionally, vibrations may be the result of misaligned hanger supports. These vibrations can be eliminated by loosening the clamps and changing position so that the exhaust pipe, muffler, and tail pipe will be in proper alignment, free of contact with the frame or body.

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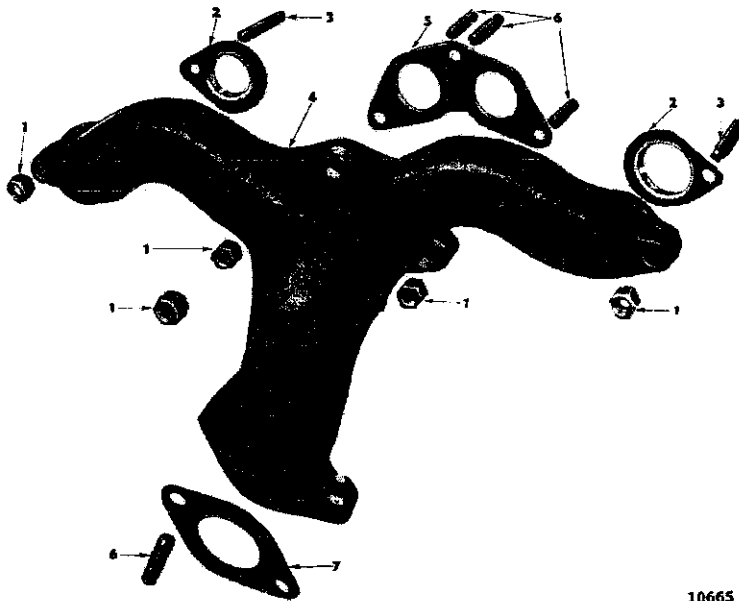


FIG. F-4—EXHAUST MANIFOLD—
HURRICANE F4 ENGINE

- 1—Stud Nut
- 2—End Gasket
- 3—Stud
- 4—Manifold
- 5—Center Gasket
- 6—Stud
- 7—Gasket

F-5. EXHAUST SYSTEM SERVICING

The following paragraphs (F-6 through F-10) describe the service that may be performed on the exhaust system on the 'Jeep' vehicles.

F-6. Exhaust Manifold Installation

When assembling the exhaust manifold to the cylinder block on the F4 engine, install a new gasket. Before installing the manifold, have the mating surfaces clean and smooth. If stud threads on the Hurricane F4 engine are damaged, correct the condition with a thread die or replace the studs.

When installing the exhaust manifold, there should be no bind between the manifold studs and stud holes. Where such a condition is experienced, the stud hole at either end of the manifold must be enlarged only enough to relieve the binding condition.

Torque exhaust manifold attaching nuts 29 to 35 lb-ft. [4,0 a 4,8 kg-m.] on F4-134 engine, 15 to 20 lb-ft. [2,1 a 2,8 kg-m.] on V-6 engine (as described in Par. C-5).

F-7. Heat Control Valve Replacement

Refer to Par. F-3.

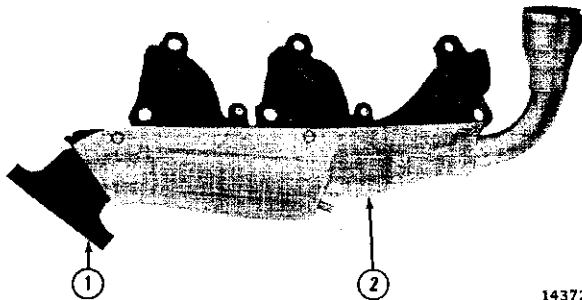
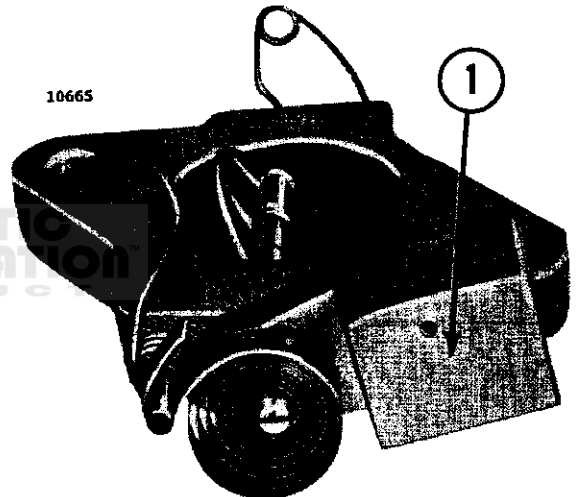


FIG. F-5—EXHAUST MANIFOLD—
LEFT SIDE V6 ENGINE

- 1—Manifold
- 2—Manifold Heat Collector

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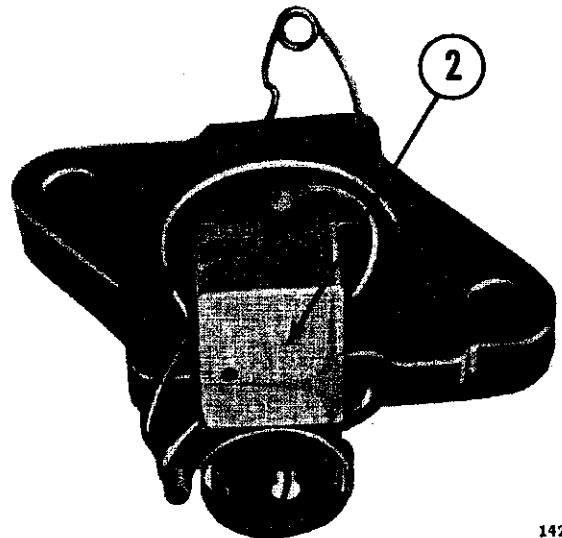


FIG. F-6—HEAT CONTROL VALVE
DAUNTLESS V6 ENGINE

- 1—Weight Forward — Valve Open
- 2—Weight Vertical — Valve Closed

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F-8. Exhaust Pipe Replacement

When replacing the exhaust pipe(s) refer to Figs. F1, F2 and F-3. Remove the nuts securing the exhaust pipe(s) to the exhaust manifold(s), loosen and disconnect mounting clamp(s) as necessary, loosen clamp securing exhaust pipe to muffler and remove exhaust pipe(s).

Note: Always use new gasket(s) between exhaust pipe(s) and exhaust manifold(s). After installation of exhaust pipe(s), check the exhaust system for alignment and leaks.

F-9. Muffler Removal and Replacement

Disconnect the support bracket and clamps on each side of the muffler. Loosen the tail pipe support

clamp bolt and pull the tail pipe to the rear until it is free of the muffler. Remove the muffler. To install the muffler, reverse the above steps and properly align the complete system, then tighten connecting support brackets securely. Operate the engine and check for possible leaks.

F-10. Tail Pipe Removal and Replacement

Refer to Figs. F-1, F-2 and F-3. Disconnect the support bracket and clamps both at the rear of the muffler and also at outlet end of the tail pipe. Free the tail pipe from the muffler. To assemble, position tail pipe to the muffler and secure clamps, being careful to align the exhaust system so it doesn't contact body or frame. Check system for exhaust gas leaks.

F-11. EXHAUST SYSTEM SPECIFICATIONS

	EARLY MODEL HURRICANE F4 ENGINE	EARLY MODEL DAUNTLESS V-6 ENGINE
TYPE:	Single	Single With Cross-Over
Muffler:	Reverse Flow	Reverse Flow
Exhaust Pipe:		
Diameter.....	1.625" [4,13 cm.]	2.00" [5,08 cm.]
Wall Thickness.....	.065" [1,6 mm.]	.065" [1,6 mm.]
Tail Pipe:		
Diameter.....	1.625" [4,13 cm.]	2.00" [5,08 cm.]
Crossover Pipe		
Diameter.....	.....	2.00" [5,08 cm.]
Wall Thickness.....	.....	.065" [1,6 mm.]
	LATE MODEL HURRICANE F4 ENGINE	LATE MODEL DAUNTLESS V6 ENGINE
TYPE:	Single	Single with Cross-Over
Muffler:	Reverse Flow	Reverse Flow
Inlet Diameter.....	2.005" [5,09 cm.]	2.005" [5,09 cm.]
Outlet Diameter.....	1.755" [4,46 cm.]	1.755" [4,46 cm.]
Exhaust Pipe:		
Diameter.....	1.625" [4,13 cm.]	2.00" [5,08 cm.]
Wall Thickness.....	.065" [1,6 mm.]	.065" [1,6 mm.]
Exhaust Pipe Extension:		
Inlet Diameter.....	1.629" [4,14 cm.]	.....
Outlet Diameter.....	2.00" [5,08 cm.]	.....
Wall Thickness.....	.065" [1,6 mm.]	.....
Crossover Pipe:		
Diameter.....	.....	2.00" [5,08 cm.]
Wall Thickness.....	.....	.065" [1,6 mm.]
Tail Pipe		
Diameter.....	1.753" [4,45 cm.]	1.753" [4,45 cm.]

EXHAUST EMISSION CONTROL SYSTEM

Contents

HURRICANE F4-134 ENGINE

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PUMP AIR FILTER	F1-3	REMOVAL PROCEDURES	F1-19
AIR DELIVERY MANIFOLD	F1-4	Air Pump	F1-20
AIR INJECTION TUBES	F1-5	Anti-Backfire Diverter Valve	F1-21
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Anti-Backfire Diverter Valve	F1-15	SPARK PLUG GAP	F1-30
Check Valve	F1-16		

F1-1. GENERAL — F4-134 Engine

The Hurricane F4-134 engine Exhaust Emission Control System consists of a belt driven air pump which directs compressed air through connecting hoses to a steel distribution manifold into stainless steel injection tubes in the exhaust port adjacent to each exhaust valve stem. This air with its normal oxygen content, reacts with the hot but incompletely burned exhaust gases and permits further combustion in the exhaust port or manifold.

F1-2. AIR PUMP

The air injection pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

The pump contains an integral relief valve which controls the air supplied to the engine exhaust ports during high speed operation to limit maximum exhaust system temperatures.

F1-3. PUMP AIR FILTER

The air filter attached to the pump is a replaceable element type constructed of conventional pleated paper with steel end plates.

The filter should be replaced every 12,000 miles [19,200 km.] under normal conditions or sooner under adverse weather or driving conditions.

F1-4. AIR DELIVERY MANIFOLD

The air delivery manifold, constructed of cold rolled steel with a zinc plating, distributes the air from the pump to each of the air delivery tubes in a uniform manner.

A check valve is attached to the air delivery

manifold. Its function is to prevent the reverse flow of exhaust gases to the pump should the pump drive fail. This reverse flow would damage the air pump and connecting hose.

F1-5. AIR INJECTION TUBES

The air injection tubes of stainless steel are inserted into machined bosses of the exhaust manifold. The tubes project into the exhaust ports directing air into the vicinity of the exhaust valve stem.

F1-6. ANTI-BACKFIRE DIVERTER VALVE

The anti-backfire diverter valve prevents engine backfire by briefly interrupting the air being injected into the exhaust manifold during periods of deceleration (rapid throttle closure).

F1-7. ENGINE COMPONENTS

The following items vary in design or specifications from those on vehicles not equipped with the Exhaust Emission Control System.

F1-8. Carburetor

A carburetor with a specific flow characteristic is used for exhaust emission control.

A carburetor dashpot is provided to control the throttle closing speed.

F1-9. Distributor

The ignition distributor used with the exhaust emission system requires a different advance curve from that used on the F4-134 engine prior to the introduction of exhaust emission systems.

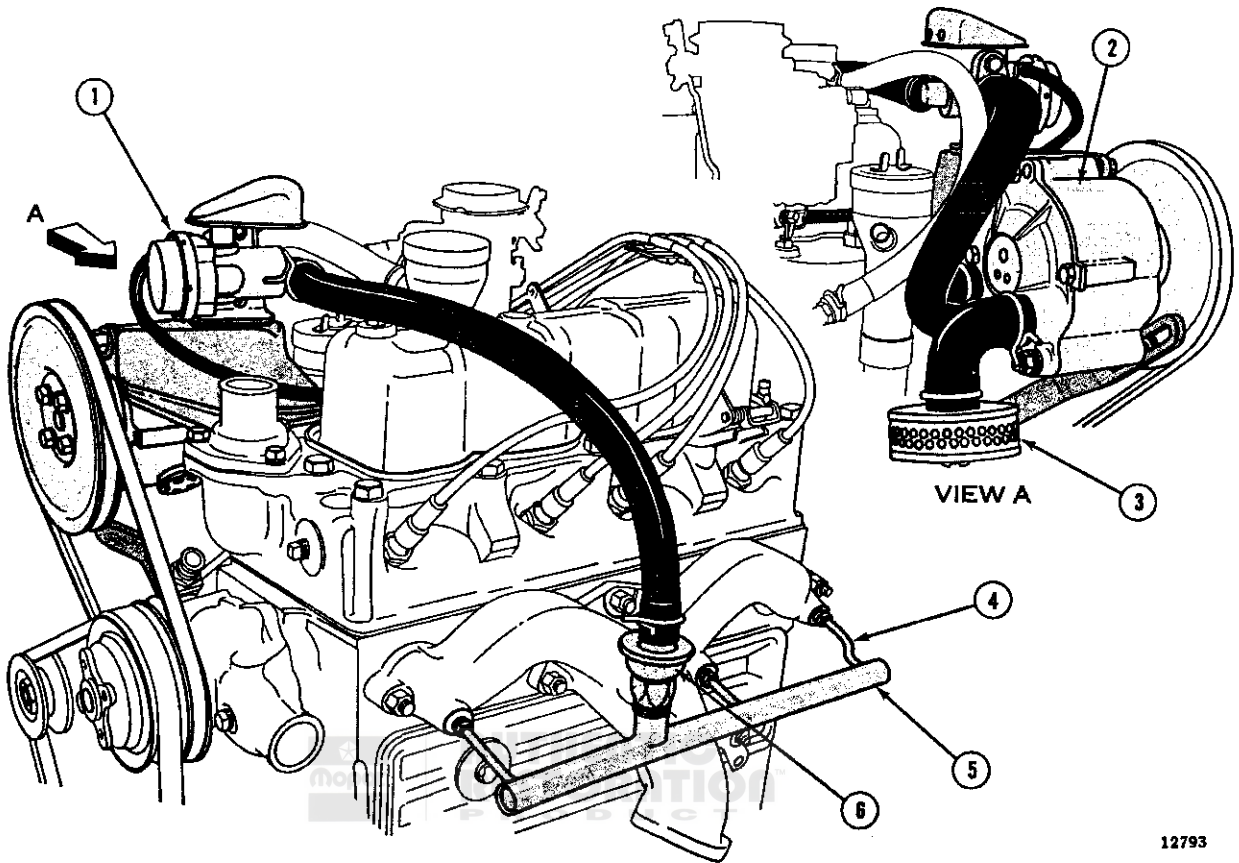


FIG. F1-1—HURRICANE F4-134 ENGINE EXHAUST EMISSION CONTROL SYSTEM

- 1—Anti-Backfire Diverter Valve
- 2—Air Pump
- 3—Pump Air Filter

- 4—Air Injection Tube(s) (Inside Manifold)
- 5—Air Delivery Manifold
- 6—Check Valve

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Ignition timing must be set at 0 or at top dead center.

F1-10. Exhaust Manifold

The exhaust manifold is provided with a boss that is drilled and tapped at each cylinder to accept the air delivery manifold and injection tubes.

F1-11. MAINTENANCE

Efficient performance of the exhaust emission control system is dependent upon precise maintenance. In addition to the air pump and connecting hoses and tubes, this system's efficiency is dependent upon special carburetor calibration, distributor centrifugal advance curve and ignition timing setting which must be adjusted at 0 or top dead center. Road test is a factory recommended optional service every 6,000 miles [9,600 km.] to evaluate overall performance.

The following procedure is recommended to assist in diagnosing performance and/or emission level problems that are peculiar to Exhaust Emission Control System equipped vehicles.

F1-12. Carburetor

Check carburetor number for proper application.

(Specifications are listed at the end of this section) Check the dash pot and adjust as required. Proper carburetor idle mixture adjustment is imperative for best exhaust emission control. The idle adjustment should be made with the engine at normal operating temperature and air cleaner in place. Adjust the throttle stop screw to idle the engine at specified RPM. All lights and accessories must be turned off.

F1-13. Carburetor Idle Setting

NOTE: The idle mixture adjustment procedure for the late model YF-4941S and YF-6115S Carter Carburetor equipped with the External Idle Mixture Limiter Cap is the same as outlined below in Pars. "A" through "D"; however, because of the Idle Limiter Cap, the idle mixture screw **CANNOT** be adjusted in the counter-clockwise (rich) direction. The adjustment is made from the rich stop position and the mixture screw is turned in (clockwise) approximately 3/4 turn to "Lean Best Idle." Refer to Section E, Fig. E-6.

The "Lean Best Idle" method of idle setting is as follows:

- a. Any scheduled service of ignition system should precede this adjustment.

- b. Connect tachometer to engine.
- c. Warm up engine and stabilize temperatures.
- d. Adjust engine idle to speed desired, using throttle idle speed adjusting screw.
- e. Carburetors without Idle Limiter Cap turn idle mixture screws out (counterclockwise) until a loss of engine speed is indicated; then, slowly turn mixture screw in (clockwise-leaner) until maximum speed (RPM) is reached. Continue turning in (clockwise) until speed begins to drop; turn mixture adjustment back out (counterclockwise-richer) until maximum speed is just regained at a "lean as possible" mixture adjustment.

F1-14. Distributor

Check the distributor number for proper application. Check the distributor cam dwell angle and point condition and adjust to specifications or replace as required. (Specifications listed at the end of this section) Check ignition timing and set at 0° or TDC.

F1-15. Anti-Backfire Diverter Valve

The anti-backfire valve remains closed except when the throttle is closed rapidly from an open position. To check the valve for proper operation, accelerate the engine in neutral, allowing the throttle to close rapidly. The valve is operating satisfactorily when no exhaust system backfire occurs. A further check to determine whether the valve is functioning can be made by removing from the anti-backfire valve the large hose which connects to the check valve. Accelerate the engine to allow the throttle to close rapidly. The valve is operating satisfactorily if a momentary interruption of rushing air is audible.

F1-16. Check Valve

The check valve prevents the reverse flow of exhaust gases to the pump in the event the pump should, for any reason, become inoperative or should exhaust pressure ever exceed pump pressure. To check this valve for proper operation, remove the air supply hose from the pump at the distribution manifold. With the engine running, listen for exhaust leakage at the check valve which is connected to the distribution manifold.

F1-17. Air Pump

Check for proper drive belt tension with belt tension gauge W-283. The belt strand tension should be 50-60 pounds on a belt with previous service, measured on the longest accessible span between two pulleys. When installing a new belt, adjust the tension to 60-80 pounds tension. **DO NOT PRY ON THE DIE CAST PUMP HOUSING.**

To check the pump for proper operation, remove the air outlet hose at the pump. With the engine running, air discharge should be felt at the pump outlet opening. The pump outlet air pressure, as determined by the relief valve, is preset and is not adjustable.

The air pump rear cover assembly, housing the pressed in inlet and discharge tubes, and the pressure relief valve are the only pump components recommended for service replacement. These parts

are to be replaced only when damaged as a result of handling or in the event the relief valve was tampered with.

F1-18. Carburetor Air Cleaner

Every 6000 miles [9,600 km.] clean the inside surface at the sump and refill to indicated oil level with SAE 40 or 50 engine oil above 32 F; SAE 20 below 32 F. Wash filter element in kerosene and drain. Reassemble the air cleaner.

More frequent cleaning and replacement is advisable when the car is operated in dusty areas or on unpaved roads. Accumulated dirt restricts air flow, reducing fuel economy and performance.

F1-19. REMOVAL PROCEDURES

The following paragraphs give the procedures for removing the major units of the Exhaust Emission Control System and the required equipment needed.

F1-20. Air Pump

Loosen the air pump adjusting strap to facilitate drive belt removal. Remove the air pump air discharge hose(s) and air filter attachment. Separate the air pump from its mounting bracket. At time of installation, torque tighten the air pump mounting bolts to 30-40 lbs-ft. [4,15 a 5,53 kg-m.]. Adjust the belt strand tension to 50-60 pounds on a belt with previous service and 60-80 pounds on a new belt.

F1-21. Anti-Backfire Diverter Valve

The anti-backfire diverter valve removal requires disconnecting the hoses and bracket to engine attaching screws.

F1-22. Air Distribution Manifold and Injection Tubes

In order to remove the air distribution manifold without bending the tubing, which could result in fractures or leakage, it is necessary to remove the exhaust manifold as an assembly from the engine. After the exhaust manifold assembly is removed from the engine, place the manifold in a vise and loosen the air distribution manifold tube retaining nuts at each cylinder exhaust port. Tap the injection tubes lightly to allow the air distribution manifold to be pulled away partially from the exhaust manifold. The stainless steel injection tubes in the exhaust manifold may have become partially fused to the air distribution manifold and, therefore, may require application of heat to the joint in order to separate. While applying heat to the joint, rotate the injection tubes with pliers being careful not to damage the tubes by applying excessive force.

At time of installation, the air injection tubes must be positioned into the exhaust manifold prior to placing the exhaust manifold assembly on the engine.

Note: Two different length injection tubes are used. The shorter length injection tubes must be inserted into cylinders 1 and 4.

The air distribution manifold should be installed after the exhaust manifold assembly is torqued to the cylinder head. The recommended procedure for exhaust manifold assembly installation is as follows: Clean the mating surface of both the manifold and cylinder head. Install the exhaust manifold to the cylinder head using a new gasket. Tighten the manifold to cylinder head, attaching bolts down evenly. Finish torque tightening to 29 to 35 ft. lbs. [3,4 a 4,8 kg-m.].

F1-23. REQUIRED EQUIPMENT

Each station licensed to perform repair and maintenance on the Exhaust Emission Control System must be equipped with that equipment necessary for major engine tune-up analysis which shall include at least the following or equivalent.

Ignition Analyzer Oscilloscope
Ammeter
Ohmmeter
Voltmeter

Tachometer
2 Vacuum Gages
Pressure Gage (0-10 psi.)
Cam Angle Dwell Meter
Ignition Timing Light
Engine Exhaust Combustion Analyzer
Compression Tester

F1-24. REPLACEMENT PARTS

Parts necessary to repair and/or maintain the Exhaust Emission Control System are available through any Jeep SALES CORPORATION warehouse.

F1-25. WARRANTY

All parts of the Exhaust Emission Control System are covered by the Manufacturer's Warranty as stated in the Warranty Service and 'Jeep' Quality Maintenance Plan booklet.

F1-26. EXHAUST EMISSION CONTROL SYSTEM DIAGNOSIS GUIDE**Pump Noisy**

Hoses Touching Other Parts of Engine or Body (Hood).

Note: The air pump is not completely noiseless. Under normal conditions, pump noise rises in pitch as engine speed increases. It is also desirable to allow for normal break-in wear of the pump prior to replacement for excessive noise.

Pump Seized

Replace pump.

Leak In Hose

Check for leaks; using soap and water—tighten clamps or replace hoses.

Pump Inoperative

Loose Belt—tighten belt—do not pry on housing.
Filter Plugged—replace.

Exhaust Backfire

Check for vacuum leaks—correct as necessary.
Check air filter for excessive restriction—replace as necessary.
Check anti-backfire valve—replace as necessary.

Induction System Backfire

Verify engine timing and distributor dwell.
Verify accelerator pump charge.

F1-27. EXHAUST EMISSION CONTROL SYSTEM MAINTENANCE CHART

Efficient performance of the Exhaust Emission Control System is dependent upon precise maintenance. As indicated in the following chart, it is

very important that all of the maintenance requirements listed are performed with extreme care at the specific intervals indicated.

OPERATION	Thousands of miles* or number of months whichever occurs first					
	2	6	12	18	24	30
Inspect engine-driven belts for condition and tension.....			R		R	
Replace positive crankcase ventilation valve (PCV).....			R		R	
Replace filter on exhaust emission control system.....			R		R	
Clean carburetor air cleaner.....		O	O	O	O	O
Engine tune-up.....			O		O	
Check engine timing.....	R	O		O		O
Adjust carburetor idle speed and mixture.....	R	O		O		O
Perform factory-recommended road test for evaluation of overall performance and handling.....		O	O	O	O	O

R — Required Services

O — Optional Services

* Miles	Kilometers
2,000	— 3,200
6,000	— 9,600
12,000	— 19,200
18,000	— 28,800
24,000	— 38,400
30,000	— 48,000

F1-28. EXHAUST EMISSION CONTROL SYSTEM CARBURETOR SPECIFICATIONS

Make.....	Carter — Single Bore
Models.....	YF YF
Part Number.....	4366S and 4941S, 6115S
Throttle Bore.....	1 1/2" [3,81 cm.]
Main Venturi.....	1 1/4" [3,18 cm.]
Low Speed Jet.....	.035" [0,889 mm.]
Main Metering Jet.....	.089" [2,26 mm.]
Idle Port.....	.184" x .030" [4,70 a 0,765]
Nozzle Bleed in Body.....	.028" [0,713 mm.]
Pump Jet.....	.024" [0,610 mm.]
Float Level.....	1 3/4" [6,74 mm.]
Dash Pot Setting.....	1/8" [3,75 mm.]
Engine Idle RPM: with Distributor Model IAY-4401A.....	650 — 700
with Distributor Model IAY-4401B.....	700 — 750

F1-29. EXHAUST EMISSION CONTROL SYSTEM DISTRIBUTOR SPECIFICATIONS

Engine.....	F4-134	
Make.....	Prestolite	Prestolite
Models.....	IAY-4401A	IAY-4401B
Rotation.....	CCW Rotor End	CCW Rotor End
Point Opening.....	.020" [0,508 mm.]	.020" [0,508 mm.]
Breaker Lever Tension.....	17 — 20 ozs. [482 a 567 gr.]	17 — 20 ozs. [482 a 567 gr.]
Cam Angle (Dwell).....	42°	42°
Condenser Capacity.....	.25 — .28 mfd.	.25 — .28 mfd.
Dist. Degrees and RPM:		
Start.....	0° — 300	0° — 450
Intermediate.....	3° — 375	4.5° — 550
Maximum.....	13.5° — 1700	13.5° — 1700
TIMING:		
Crankshaft.....	0° TDC @ Idle	0° TDC @ Idle
Mark Location.....	Crankshaft Pulley	Crankshaft Pulley
Firing Order.....	1-3-4-2	1-3-4-2

F1-30. SPARK PLUG GAP

Spark Plug Gap.....	.030" [0,765 mm.]
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IMPORTANT NOTICE

The Exhaust Emission Systems covered in this publication meet State and Federal requirements for hydrocarbon and carbon monoxide emissions.

To assure continued proper operation, these systems must be inspected regularly, parts must be replaced at factory-recommended intervals and engine tune-up services performed at intervals specified in the Exhaust Emission Control System Maintenance charts.

For the above reasons, these systems must not, under any circumstances, be altered to anything other than required specifications provided in this publication. Further, the Exhaust Emission Control System, or any of its components, must not be physically altered or modified in any respect.

DATA TAG

For the serviceman's guidance, each vehicle equipped with exhaust emission control will have data tag permanently affixed to the radiator shroud—in example:

**VEHICLE EMISSION CONTROL INFORMATION****MODEL F4-134 C.I.D.**

- ENGINE AT NORMAL OPERATING TEMPERATURE
- LIGHTS AND ALL ACCESSORIES OFF
- IDLE MIXTURE . . . LEAN BEST IDLE

- IGNITION TIMING 0° (TDC)
- SPARK PLUG GAP030
- DWELL . . . 42° (.020 POINT GAP)
- IDLE SPEED . . . 700-750 RPM

TRANSMISSION IN NEUTRAL DURING TUNE UP**SEE SERVICE MANUAL FOR ADDITIONAL INFORMATION****THIS VEHICLE CONFORMS TO U.S. DEPT. OF H.E.W. REGULATIONS
APPLICABLE TO 1971 MODEL YEAR NEW MOTOR VEHICLES****Jeep CORPORATION**

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Important: Always refer to the data tag when checking or re-adjusting ignition timing, idle speed, and idle mixture.

EXHAUST EMISSION CONTROL SYSTEM

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DAUNTLESS V-6 ENGINE

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F2-1. GENERAL — V-6 Engine

The Dauntless V-6 engine Exhaust Emission Control System consists of a belt-driven air pump which directs compressed air through connecting hoses to a steel distribution manifold into stainless steel injection tubes in the exhaust port adjacent to each exhaust valve. This air, with its normal oxygen content, reacts with the hot but incompletely burned exhaust gases and permits further combustion in the exhaust port or manifold.

The Exhaust Emission System on V6-225 engines limits the hydrocarbon and carbonmonoxide emissions from the exhaust system. The system includes an engine designed for low emissions and lean carburetor calibration at idle and part throttle.

The lean carburetion is possible because of the heated air system that is part of the Emission System. See Fig. F2-2. With the heated air system operating, inlet air temperature is around 115°F. [46°C.], after the first few minutes of operation. This makes the use of lean (hot weather) calibration possible, and the vehicle still responds and drives well in cold weather.

The engine has a "ported" spark advance, with the vacuum take-off just above the throttle valve, so that there is no vacuum advance at closed throttle, but there is vacuum advance as soon as the throttle is opened slightly. To reduce emissions at idle and at lower engine speeds, the engine timing is such that the distributor will not have centrifugal advance until about 900 RPM.

F2-2. HEATED AIR SYSTEM

The heated air system on late model V6 engines, consists of a manifold heat collector, a heated-air

pipe, a adapter elbow and an air cleaner containing temperature control doors operated by vacuum through a temperature sensor. The heat stove is a sheet metal cover, shaped to and bolted on with the right exhaust manifold. Air drawn in along the lower edge of the stove passes across the manifold surface, picking-up heat. The heated air is drawn out from the front of the manifold, through the heated air pipe and adapter elbow into the snorkel of the air cleaner.

The temperature control air cleaner is designed to mix this heated air with cold air from under the hood so that carburetor inlet air temperature averages about 115°F. [46°C.]. This mixing is done by two air doors, a cold air door and a hot air door, which move together so that when the cold air door is closed, the hot air door is open and vice versa. Most of the time, both doors will be partially open as required to control the temperature. When the underhood temperature reaches about 135°F [57°C.] the cold air door will open wide and the hot air door will close tight. See Fig. F2-3. Obviously, if underhood temperatures rise above 135°F. [57°C.] the air cleaner will no longer be able to control temperatures and the inlet air temperature will rise with underhood temperature.

The temperature doors are moved by a diaphragm type vacuum door. When there is no vacuum present in the motor, the diaphragm spring forces the cold air door open and the hot air door closed. Whenever the engine is running, the amount of vacuum present in the vacuum motor depends on the temperature sensor in the air cleaner which is located in the vacuum line between the intake manifold and the vacuum motor. In the sensor, a

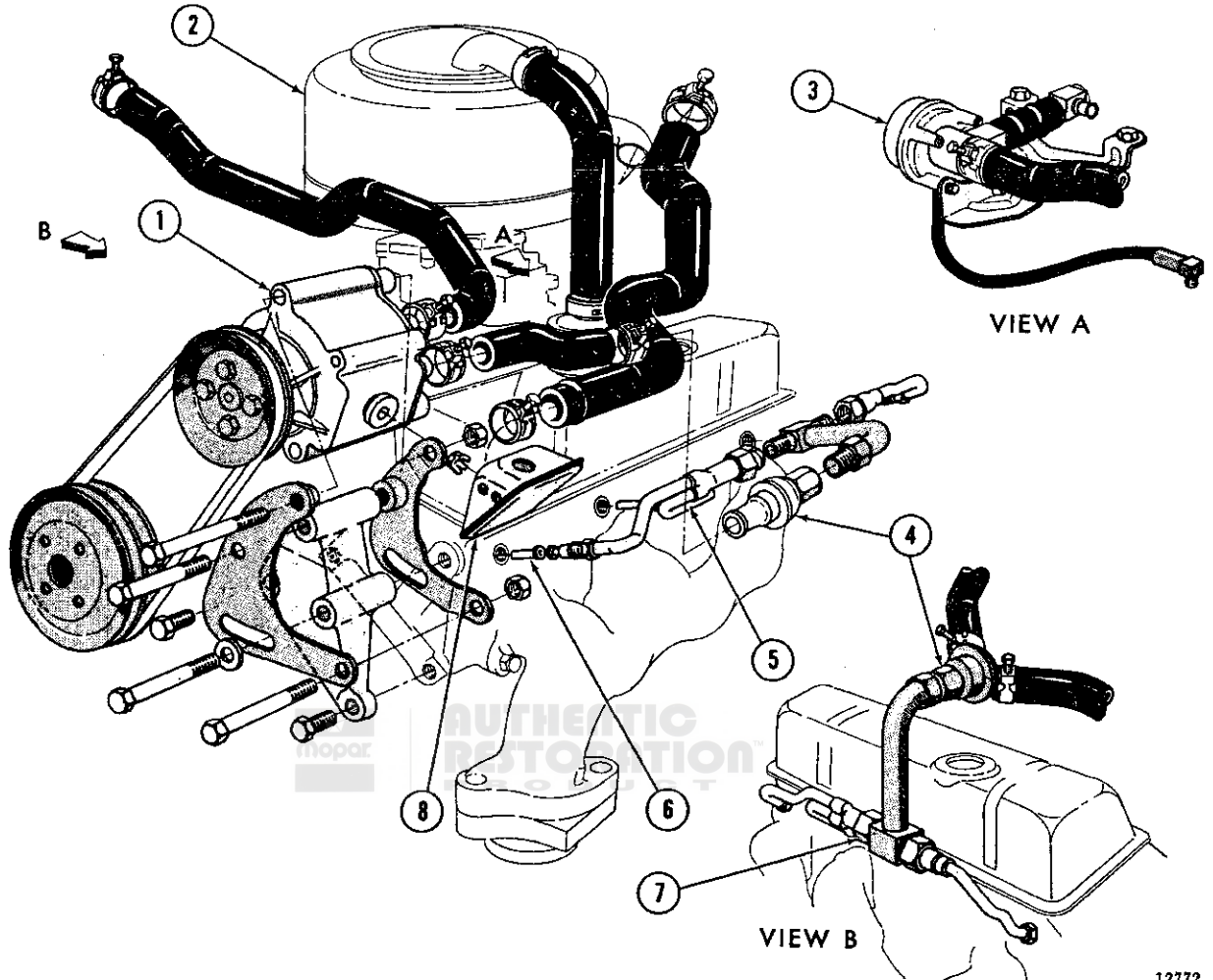


FIG. F2-1—DAUNTLESS V-6 ENGINE EXHAUST EMISSION CONTROL SYSTEM, EARLY MODEL

- A—Top Rear of Engine
- B—Right Side of Engine
- 1—Air Pump
- 2—Air Filter
- 3—Anti-Backfire Valve

- 4—Check Valve
- 5—Distribution Tube Assy (Left Side)
- 6—Injection Nozzle
- 7—Distribution Tube Assy (Right Side)
- 8—Relief Valve Muffler

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bi-metal temperature sensing spring starts to open a valve to bleed more air into the vacuum line whenever the temperature in the air cleaner rises above about 115°F. [46°C.]. Whenever the temperature falls below about 115°F. [46°C.] the sensing spring starts to close the air bleed into the vacuum line, allowing more manifold vacuum to reach the vacuum motor. Whenever there is 9 inches [22,8 cm.] or more of vacuum in the vacuum motor, the diaphragm spring is compressed, the cold air door is closed and the hot air door is opened.

When the engine is not running, the diaphragm spring will always hold the cold air door open and the hot air door closed. However, when the engine is running, the position of the doors depends on the air temperature in the air cleaner.

When starting a cold engine (air cleaner temperature under 95° F. [35° C.]), the cold air door will close and the hot air door will open immediately.

See Fig. F2-4. This is because the air bleed valve in the sensor is closed so that full manifold vacuum is applied in the vacuum line. The cold air door will remain tightly closed only a few minutes, however. As soon as the air cleaner starts receiving hot air from the heat stove, the sensor will cause the cold air door to open partially, mixing cold air with the hot air as necessary to regulate air cleaner temperature within 20° of the ideal 115°F. [46°C.] air inlet temperature. See Fig. F2-5.

If underhood air temperature rises to 135° F. [57° C.] the air to the vacuum bleed valve in the sensor will be wide open so that vacuum motor approaches zero. The diaphragm spring in the vacuum motor will hold the cold air door wide open and close the hot air door tightly. If underhood temperature rises above 135° F. [57° C.] carburetor inlet air temperature will also rise above 135° F. [57° C.].

While air cleaner temperature is being regulated,

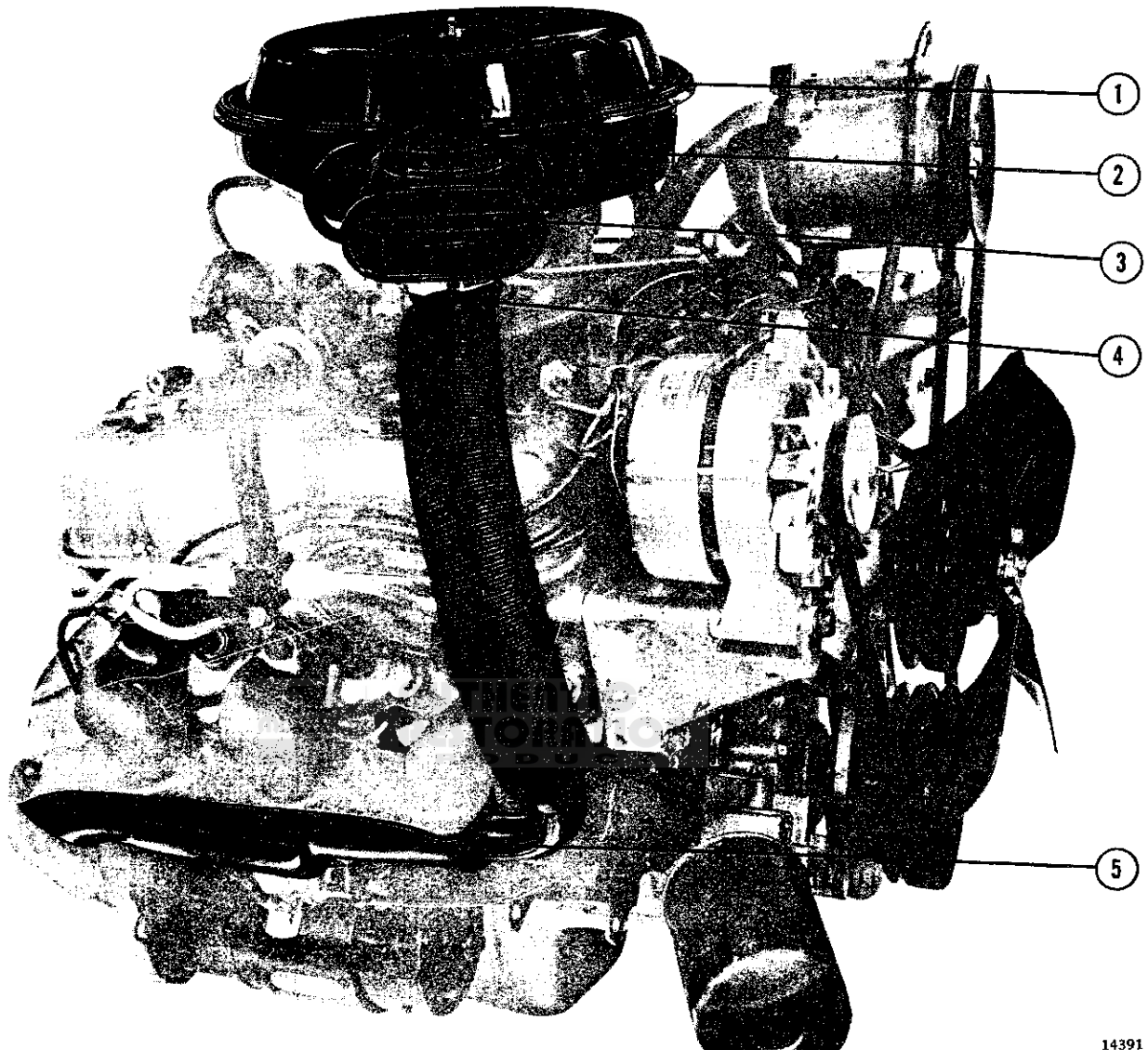


FIG. F2-2—DAUNTLESS V-6 ENGINE EXHAUST EMISSION HEATED AIR SYSTEM

1—Air Cleaner
2—Vacuum Motor
3—Control Damper and Linkage

4—Adapter Elbow and Hose
5—Manifold Heat Collector

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accelerating the engine hard will cause the vacuum level in the intake manifold and in the vacuum motor to drop. Whenever vacuum drops below 5 inches [12,7 cm.] the diaphragm spring will open the cold air door wide in order to get the maximum air flow required for maximum acceleration.

F2-3. MAINTENANCE

Efficient performance of the Exhaust Emission System is dependent on precise maintenance. In addition to the heated air system, air pump, connecting hoses and tubes, it is essential that the carburetor and ignition distributor be properly adjusted to specifications listed at the end of this section.

Road test is a factory-recommended optional service every 6,000 miles [9,600 km.] to evaluate

overall performance.

The following procedure is recommended to assist in diagnosing performance and/or emission level problems that are peculiar to Controlled Combustion Equipped vehicles.

F2-4. Testing Thermo Air Cleaner Operation

Since failure of the air cleaner will generally result in the snorkel cold air door staying open, failure will probably go unnoticed in warm or hot weather. In cold weather, however, owners will complain of leanness, hesitation, sag, surge or stalling. When any type of lean operation complaint is received, always test the heated air system for proper functioning before doing any work on the carburetor.

Note: Always perform checks in the same order as listed below.

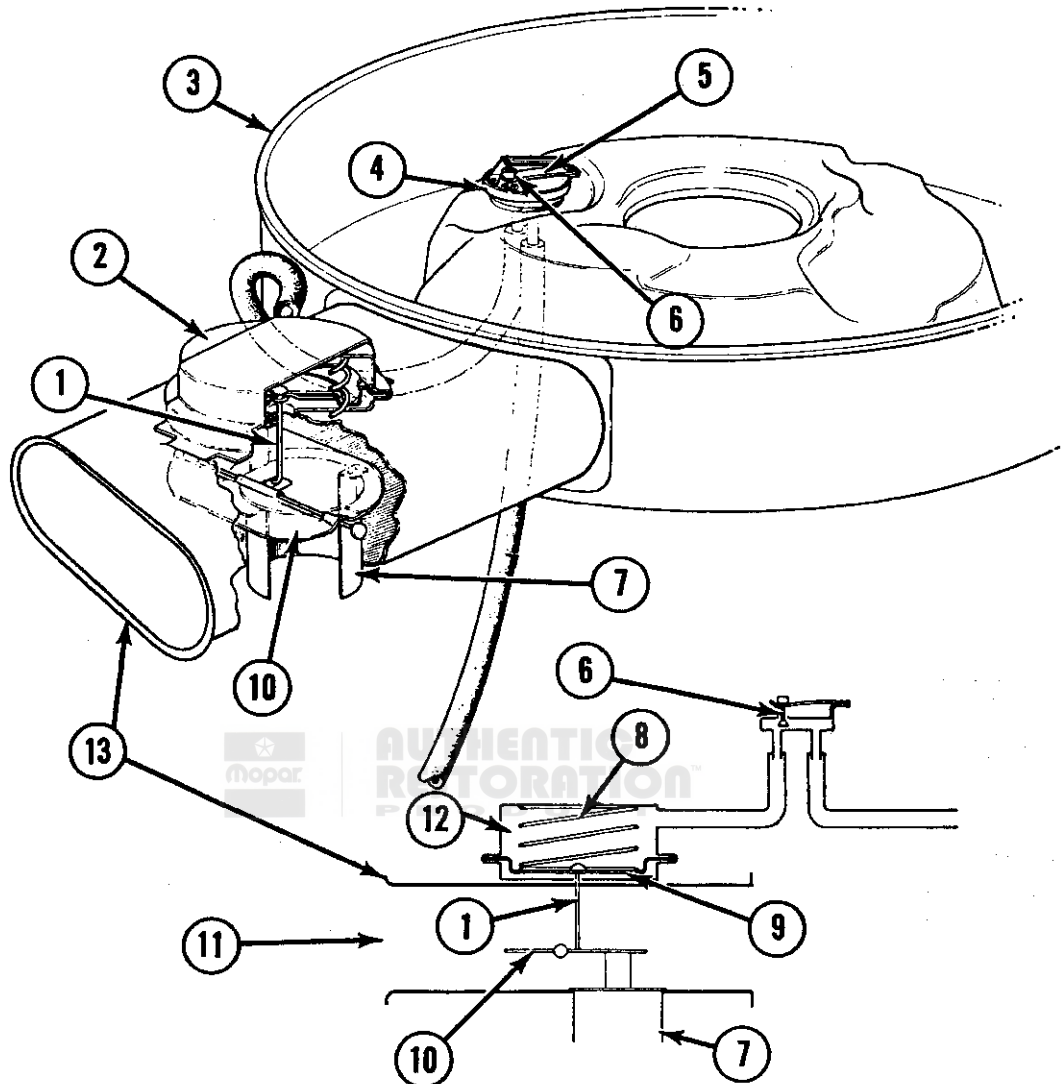


FIG. F2-3—COLD AIR DOOR OPEN

- | | |
|-----------------------|--------------------|
| 1—Linkage | 8—Diaphragm Spring |
| 2—Motor | 9—Diaphragm |
| 3—Air Cleaner | 10—Control Damper |
| 4—Sensor | 11—Air Inlet |
| 5—Temp Sensing Spring | 12—Vacuum Chamber |
| 6—Air Bleed Valve | 13—Snorkel Tube |
| 7—Hot Air Pipe | |

a. Give the system a general check as follows:

1. Check all hoses for proper hook-up. Check for kinked, plugged or damaged hoses.
2. With engine off, make sure cold air door is wide open.
3. With engine running, check operation of vacuum motor by connecting a test hose directly from intake manifold to vacuum motor. Cold air door should close. If door fails to close, determine if motor linkage is properly connected to door or if a bind is present; if linkage is satisfactory, then vacuum motor must be replaced.

b. Give the system a quick operational check as follows:

1. Start test with engines cold, air cleaner at a temperature below 85° F. [29.4° C.]. If the engine has been in recent use, allow it to cool.
2. Observe the cold air door before starting the engine; it should be wide open.
3. Start the engine and allow it to idle. Immediately after starting the engine, the cold air door should close.
4. As the engine warms up, the cold air door should start to open and the air cleaner should become warm to the hand.
5. The system is operating normally as described above. If the air cleaner fails to operate as above or if correct operation of the air cleaner is still in doubt, proceed to the thermometer check.

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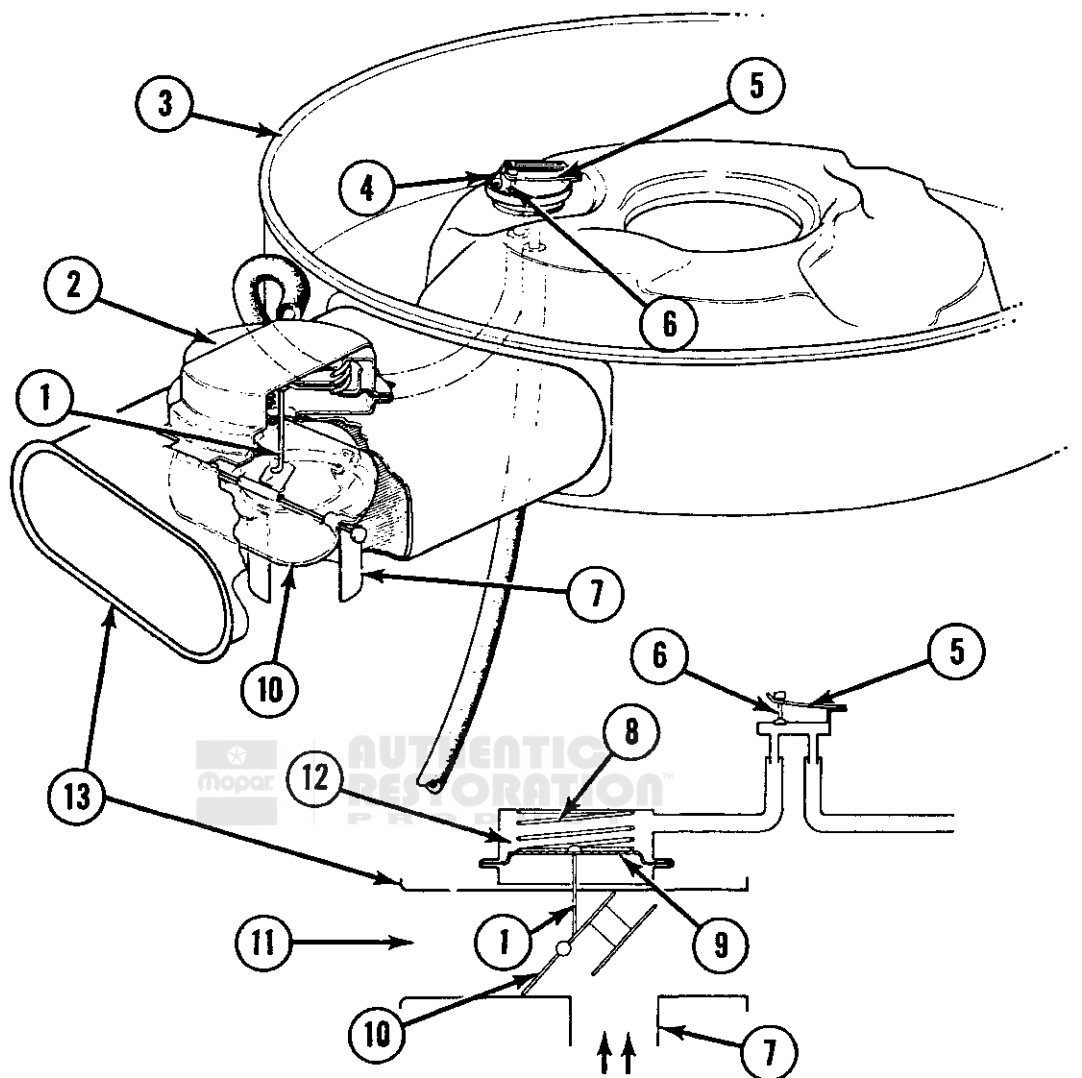


FIG. F2-4—HOT AIR DOOR OPEN

- | | |
|-----------------------|--------------------|
| 1—Linkage | 8—Diaphragm Spring |
| 2—Motor | 9—Diaphragm |
| 3—Air Cleaner | 10—Control Damper |
| 4—Sensor | 11—Air Inlet |
| 5—Temp Sensing Spring | 12—Vacuum Chamber |
| 6—Air Bleed Valve | 13—Snorkel Tube |
| 7—Hot Air Pipe | |

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c. To perform the thermometer check, proceed as follows:

1. Start test with air cleaner temperature below 85° F. [29.4° C.]. If engine has been run recently, allow it to cool down. While engine is cooling, remove air cleaner cover and install a temperature gage next to sensor. Reinstall air cleaner cover. Do not install wing nut. Let car stand idle for ½ hour or more before proceeding to step 2.
2. Start engine. Cold air door should close immediately if engine is cool enough. When cold air door starts to open (in a few minutes), remove air cleaner cover and read temperature gage. It must read 115° F. [46° C.] ±20°.

3. If cold air door does not start to open at temperature indicated, temperature sensor is defective and must be replaced.

F2-5. Carburetor Air Cleaner — Dry Type

Every 24,000 miles [38,400 km.] (or more frequently in dusty territory) replace the air cleaner element. To do this, remove the wing nut and cover from the air cleaner housing. Lift out the air cleaner element. Wipe the inside of the housing clean. Service the positive crankcase valve filler as outlined in paragraph F2-6. Make sure the air cleaner gasket is in good condition and properly located on the carburetor flange. Install a new element, the cover and wing nut. Tighten the wing nut by hand. Tighten to make sure the air cleaner remains

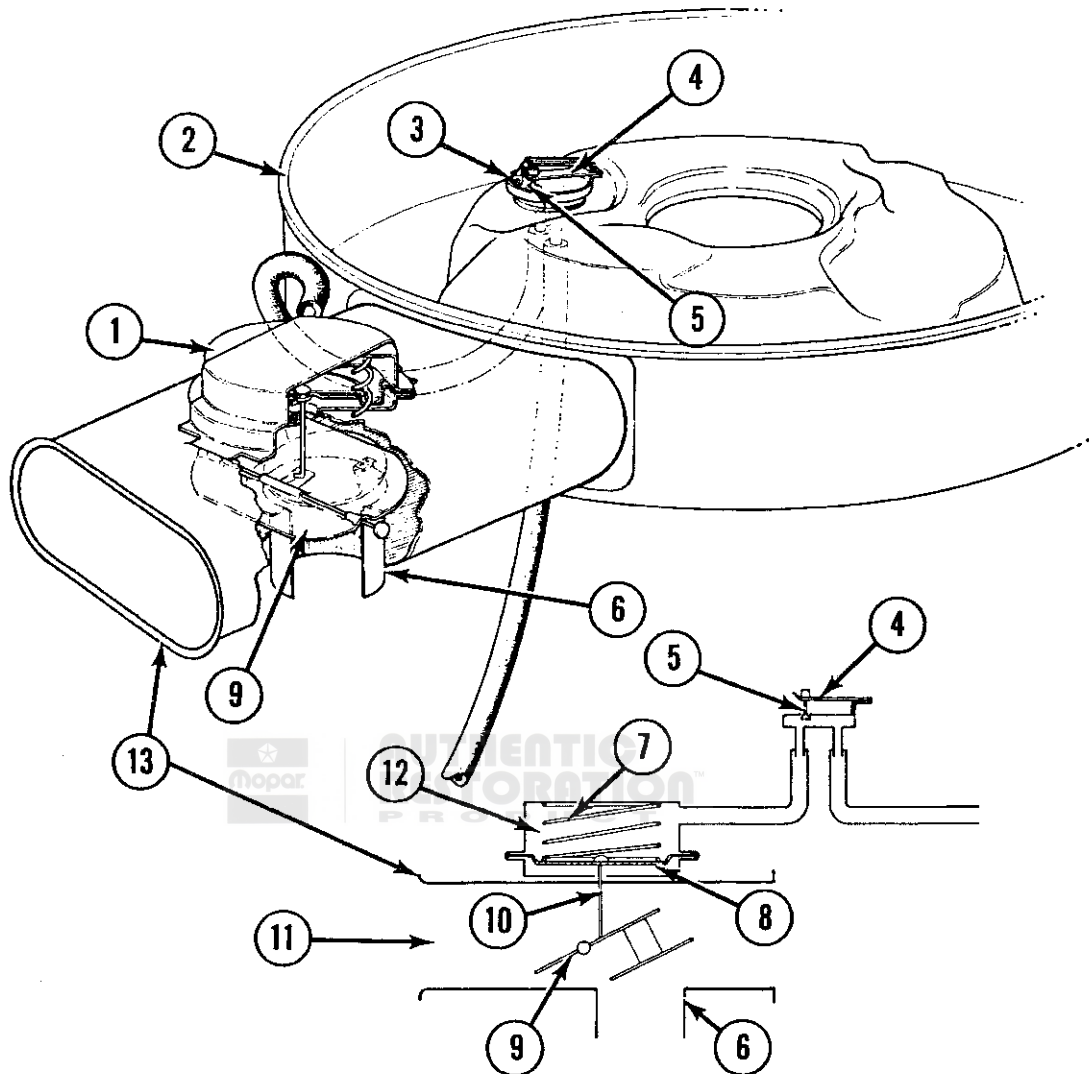


FIG. F2-5—COLD AND HOT AIR DOORS PARTIALLY OPEN

- | | |
|-----------------------|-------------------|
| 1—Motor | 8—Diaphragm |
| 2—Air Cleaner | 9—Control Damper |
| 3—Sensor | 10—Linkage |
| 4—Temp Sensing Spring | 11—Air Inlet |
| 5—Air Bleed Valve | 12—Vacuum Chamber |
| 6—Hot Air Pipe | 13—Snorkel Tube |
| 7—Diaphragm Spring | |

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stationary and to make sure the gasket seals properly.

F2-6. Positive Crankcase Ventilator Valve

Every 12,000 miles [19,200 km.] replace the positive crankcase ventilator valve. Also, remove the PCV filter from inside the air cleaner. Wash filter in suitable solvent and dry by blowing lightly with an air hose. Oil with engine oil; shake out excess oil. Reinstall the filter. After installing new valve, always readjust engine idle.

F2-7. Replacement Procedures

Should the test performed in paragraph F2-4 indicate necessary replacement of the heated air

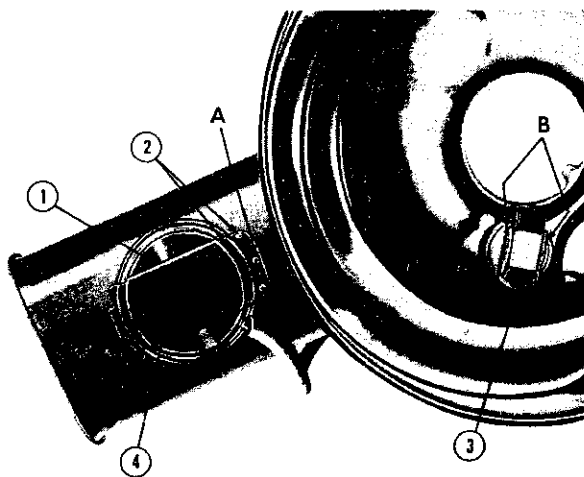
system vacuum motor or sensor, use the procedure outlined in the following paragraphs.

F2-8. Replacement of Vacuum Motor

- a. Drill center of two spot welds using a 1/16 inch [1,59 mm.] drill. Do not center punch.
- b. Enlarge two holes using a 5/32 inch [3,96 mm.] drill.

Caution: Use extreme care not to damage the air cleaner snorkel.

- c. Remove vacuum motor retainer strap. See Fig. F2-6.
- d. Lift vacuum motor, cocking it to one side to unhook motor linkage at the control door.



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FIG. F2-6—REPLACING VACUUM MOTOR ASSEMBLY

- | | |
|-------------------------------|------------------------------------|
| A—Drill $\frac{1}{64}$ " Hole | B—Sensor Unit Replacement Position |
| 1—Motor | 3—Sensor Unit |
| 2—Spot Welds | 4—Retaining Strap |

- e. Drill a $\frac{1}{64}$ inch [2,78 mm.] hole in snorkel tube at point "A" as shown in Fig. F2-6.
- f. Use the motor strap retainer and the sheet metal screw provided in the motor replacement kit to secure the retainer and motor to the snorkel tube.
- g. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.

F2-9. Replacement of Air Cleaner Sensor

- a. Remove two sensor retaining clips by prying. See Fig. F2-7.
- b. Pull vacuum hoses from sensor.
- c. Note carefully the installed position of the sensor so that you can install new sensor in same position. Then remove sensor.
- d. Install sensor and gasket assembly in air cleaner in same position as noted in step c. This is to eliminate the possibility of interference with the air filter element.
- e. Install sensor retaining clip, meanwhile supporting sensor at B around the outside rim to prevent



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FIG. F2-7—REPLACING SENSOR ASSEMBLY

- 1—Sensor Retaining Clip

damage to the temperature sensing spring. See Fig. F2-7.

- f. Reinstall vacuum hoses.

F2-10. AIR PUMP

The air injection pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance. The pump contains an integral relief valve which controls the air supplied to the engine exhaust ports during high speed operation to limit maximum exhaust system temperatures.

F2-11. AIR FILTER

The air injection system draws clean air from the carburetor air filter through an inlet hose, into the air pump and from the pump through two outlets (one for each cylinder head).

F2-12. AIR DELIVERY MANIFOLD

The air delivery manifolds constructed of cold rolled steel with a zinc plating, distribute the air from the pump to each of the air delivery tubes in a uniform manner.

Two check valves are included to prevent the reverse flow of exhaust gases to the pump should the pump drive fail. This reverse flow would damage the air pump and connecting hose.

F2-13. AIR INJECTION TUBES

The air injection tubes of stainless steel are inserted into machined bosses of the cylinder head. The tubes project into the exhaust ports directing air into the vicinity of the exhaust valve stem.

F2-14. ANTI-BACKFIRE VALVE

The anti-backfire valve is used to provide a "gulp" of air into the engine induction system during rapid throttle opening and subsequent closure. During rapid throttle closure, the valve opens for approximately one (1) second and bleeds air into the intake manifold through a fitting in the carburetor. Its function is to bleed an adequate amount of air below the carburetor throttle plate to compensate for the overrich fuel mixture normally inducted into the combustion chamber during rapid throttle closure.

Filtered air from the pump is provided to the anti-backfire valve by means of a connecting hose. An exhaust system backfire will result if the valve fails to function properly.

F2-15. ENGINE COMPONENTS

The following item varies in design or specifications from those on vehicles not equipped with the Exhaust Emission Control System.

F2-16. Carburetor

Check carburetor number for proper application. Specifications are listed in this section.

Proper carburetor idle mixture adjustment is imperative for best exhaust emission control.

The idle adjustment should be made with the engine at normal operating temperature, lights and accessories off and the air cleaner in place. Adjust

the throttle stop screw to idle the engine at 650 to 700 rpm.

F2-17. Carburetor Idle Setting

The "Lean Best Idle" Method of Idle Setting is as follows:

- a. Any scheduled service of ignition system should precede this adjustment.
- b. Connect tachometer to engine.
- c. Warm up engine and stabilize temperatures.
- d. Adjust engine idle to speed desired, using throttle idle speed adjusting screw.
- e. Turn idle mixture screws out (counterclockwise) until a loss of engine speed is indicated; then slowly turn mixture screws in (clockwise-leaner) until maximum speed (rpm) is reached. Continue turning in (clockwise) until speed begins to drop; turn mixture adjustment back out (counterclockwise-richer) until maximum speed is just regained at a "lean as possible" mixture adjustment.

F2-18. Distributor

The ignition distributor used with the Exhaust Emission Control System is the same as that used on engines without Exhaust Emission Control. Check the distributor cam dwell angle and point condition. Check ignition timing and adjust to specifications shown on the last page of this section.

F2-19. Anti-Backfire Valve

The anti-backfire valve remains closed except when the throttle is closed rapidly from an open position. To check the valve for proper operation, accelerate the engine in neutral, allowing the throttle to close rapidly. The valve is operating satisfactorily when no exhaust system backfire occurs. A further check to determine whether the valve is functioning can be made by removing from the anti-backfire valve the large hose which connects the valve to the pump. With a finger placed over the open end of the hose (not the valve), accelerate the engine and allow the throttle to close rapidly. The valve is operating satisfactorily if a momentary air rushing noise is audible.

F2-20. Check Valve

The check valves in the lines to the air distribution manifolds prevent the reverse flow of exhaust gases to the pump in the event the pump should, for any reason, become inoperative or should exhaust pressure ever exceed pump pressure. To check this valve for proper operation, remove the air supply hose from the pump at the check valve. With the engine running, listen for exhaust leakage at the check valve which is connected to the distribution manifold.

F2-21. Air Pump

Check for proper drive belt tension with belt tension gauge W-283. The belt strand tension should be 60 pounds measured on the longest accessible span between two pulleys. **DO NOT PRY ON THE DIE CAST PUMP HOUSING.**

To check the pump for proper operation, remove the air outlet hose at the pump. With the engine running, air discharge should be felt at one of the pump outlet openings. The pump outlet air pressure, as determined by the relief valve, is preset and is not adjustable.

The air pump rear cover assembly, housing the pressed in inlet and discharge tubes, and the pressure relief valve are the only pump components recommended for service replacement. These parts are to be replaced only when damaged as a result of handling or in the event the relief valve was tampered with.

F2-22. Intake Manifold

Intake manifold leaks must not be overlooked. Air leakage at the intake manifold may be compensated for by richer idle mixture setting, however, this will usually cause uneven fuel-air distribution and will always result in loss of performance and exhaust emission control. To check for air leakage into the intake manifold, apply kerosene or naphtha, on the intake manifold to cylinder head joints and observe whether any changes in engine rpm occur. If an air leak is indicated, check the manifold to cylinder head bolt torque. The correct torque is 25-35 lbs. ft. [3,46 a 4,84 kg-m.]. If the leak is still evident, loosen the manifold assembly and torque-tighten the bolts evenly. Start from the center and use proper torque values. Replace the manifold gasket if the leak still exists. Clean both mating surfaces and check for burrs or other irregularities.

Always torque the bolts evenly to the specified torque value to prevent warpage.

F2-23. Carburetor Air Cleaner — Oil Bath

Every 6,000 miles [9,600 km.] disconnect attaching hoses and unscrew the wing nut from the top of the air cleaner and lift it off the carburetor. Lift the cover and filter element off the oil sump. Clean the inside surface of the sump and refill to indicated oil level with SAE 40 or 50 engine oil above 32 F; SAE 20 below 32 F. Wash filter element in kerosene and drain. Reassemble the air cleaner and install on carburetor.

More frequent cleaning and replacement are advisable when the car is operated in dusty areas or on unpaved roads. Accumulated dirt restricts air flow, reducing fuel economy and performance.

F2-24. REMOVAL PROCEDURES

The following paragraphs give the procedures for removing the major units of the exhaust emission control system and the required equipment needed.

F2-25. Air Pump

Loosen the air pump mounting bracket bolts. Remove the air pump air hose(s). Separate the air pump from its mounting bracket. At time of installation, torque tighten the air pump mounting bolts to 30-40 lbs.-ft. [4,15 a 5,53 kg-m.]. Adjust the belt strand tension to 60 pounds.

F2-26. Anti-Backfire Valve

The anti-backfire valve removal requires disconnecting the hoses and bracket to engine attaching screws.

F2-27. Air Distribution Manifold and Injection Tubes

The air distribution manifolds can be removed from the cylinder heads without removing the cylinder head assemblies.

Disconnect the air delivery hose from the pump at the distribution manifold inlet (check valve).

Loosen the distribution manifold tube attaching nuts from the cylinder head and carefully work the distribution manifold away from the cylinder head. The air injection tubes can be removed from the cylinder head with head on the engine.

Insert an easy-out through the boss opening on the cylinder head into the injection tube and twist the tube out gradually. Some interference to removal may be encountered due to normal carbon build-up on the tubes. Injection tubes removed in this manner should be replaced.

The injection tubes used are all of the same diameter and length.

F2-28. REQUIRED EQUIPMENT

Each station licensed to perform repair and main-

tenance on the Exhaust Emission Control System must be equipped with that equipment necessary for major engine tune-up analysis which shall include at least the following or equivalent:

- Ignition Analyzer Oscilloscope
- Ammeter
- Ohmmeter
- Voltmeter
- Tachometer
- 2 Vacuum Gauges
- Pressure Gauge (0-10 psi.)
- Cam Angle Dwell Meter
- Ignition Timing Light
- Engine Exhaust Combustion Analyzer
- Compression Tester

F2-29. REPLACEMENT PARTS

Parts necessary to repair and/or maintain the Exhaust Emission Control System are available through any Jeep SALES CORPORATION warehouse.

F2-30. WARRANTY

All parts of the Exhaust Emission Control System are covered by the Manufacturer's Warranty as stated in the Warranty Service and 'Jeep' Quality Maintenance Plan booklet.



F2-31. EXHAUST EMISSION CONTROL SYSTEM DIAGNOSIS GUIDE

Pump Noisy

Hoses Touching Other Parts of Engine or Body (Hood).

Note: The Air Pump is not completely noiseless. Under normal conditions, pump noise rises in pitch as engine speed increases. It is desirable to allow for normal break-in wear of the pump prior to replacement for excessive noise.

Pump Seized

Replace pump.

Leak In Hose

Check for leaks; using soap and water, tighten clamps or replace hoses.

Pump Inoperative

Loose Belt — tighten belt — do not pry on housing.
Filter Plugged — replace.

Exhaust Backfire

Check for vacuum leaks — correct as necessary.
Check anti-backfire valve — replace as necessary.

Induction System Backfire

Verify engine timing and distributor dwell.
Verify accelerator pump charge.

F2-32. EXHAUST EMISSION CONTROL SYSTEM MAINTENANCE CHART

Efficient performance of the Exhaust Emission Control System is dependent upon precise maintenance. As indicated in the following chart, it is

very important that all of the maintenance requirements are performed with extreme care at the specific interval indicated.

OPERATION	Thousands of miles* or number of months whichever occurs first					
	2	6	12	18	24	30
Inspect engine-driven belts for condition and tension.....			R		R	
Replace positive crankcase ventilation valve (PCV).....			R		R	
Check for free operation of exhaust manifold heat control valve.....		O	O	O	O	O
Clean carburetor air cleaner — Oil Bath.....		O	O	O	O	O
Replace carburetor air cleaner element — Dry Type.....					O	
Check heated air system.....			O		O	
Engine tune-up.....			O		O	
Check engine timing.....	R	O		O		O
Adjust carburetor idle speed and mixture.....	R	O		O		O
Perform factory-recommended road test for evaluation of overall performance and handling.....		O	O	O	O	O

R — Required Services O — Recommended Services

* Miles Kilometers
 2,000 — 3,200
 6,000 — 9,600
 12,000 — 19,200
 18,000 — 28,800
 24,000 — 38,400
 30,000 — 48,000

F2-33. GENERAL SPECIFICATIONS

Air Pump Belt Tension.....	60 lb.
Rotor Ring Screw Torque.....	37 lb-in.
Housing Cover Bolt Torque.....	10 lb-ft.
Speed Ratio, Air Pump to Engine.....	1¼ to 1

F2-34. EXHAUST EMISSION CONTROL SYSTEM CARBURETOR SPECIFICATIONS

Make.....	Rochester
Model Designation.....	2G
Code Number.....	7027082 — 7041185
Choke.....	Manual
Number of Barrels.....	2
Throttle Bore.....	1⅞" [3,65 cm.]
Main Metering Jet	
Production.....	.051" - 60° [1,29 mm.]
High Altitude — over 5000 ft.....	.049" - 60° [1,24 mm.]
— over 10,000 ft.....	.047" - 60° [1,19 mm.]
Float Level Adjustment*	1⅝" [2,94 cm.]
Float Drop Adjustment.....	1⅞" [4,76 cm.]
Pump Rod Adjustment**.....	1⅝" [2,94 cm.]
Engine Idle R.P.M. (In Neutral).....	650 to 700
Initial Idle Speed-screw setting.....	3 turns in
Initial Idle Mixture-screw setting.....	2 turns out
Dash Pot Setting.....	⅞" [3,75 mm.]

*From air horn gasket to top of float at toe.
 **From air cleaner ring to top of pump rod.

**F2-35. EXHAUST EMISSION CONTROL SYSTEM
DISTRIBUTOR SPECIFICATIONS**

Distributor:			
Make.....	Delco-Remy	Prestolite	Prestolite
Model.....	1110376	IAT-4501 or IAT-4502	IAT-4502A
Breaker Point Gap.....	.016" [0,406 mm.]	.016" [0,406 mm.]	.016" [0,406 mm.]
Breaker Arm Tension.....	19 to 23 oz. [538 a 652 gr.]	17 to 22 oz. [482 a 623 gr.]	17 to 22 oz. [482 a 623 gr.]
Cam Angle.....	29° to 31°	29° ± 3°	29° ± 3°
Max. Auto Advance (Crankshaft Degrees).....	13° to 15° at 1,950 rpm.	16° @ 1800 rpm. 26° @ 4200 rpm. (Max.)	21° @ 1800 rpm. 32° @ 4200 rpm. (Max.)
Max. Vac. Advance (Distributor Degrees).....	8°	8°	8°
Condenser Capacity.....	.18 to .23 mfd.	.25 to .28 mfd.	.25 to .28 mfd.
Timing:			
Crankshaft.....	5° (BTC) @ Idle	5° (BTC) @ Idle	0° (TDC) @ Idle
Mark Location.....	Crankshaft Pulley	Crankshaft Pulley	Crankshaft Pulley
Firing Order.....	1-6-5-4-3-2	1-6-5-4-3-2	1-6-5-4-3-2

F2-36. SPARK PLUG GAP

Spark Plug Gap.....	.035" [0,889 mm.]
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IMPORTANT NOTICE

The Exhaust Emission Systems covered in this publication meet State and Federal requirements for hydrocarbon and carbon monoxide emissions.

To assure continued proper operation, these systems must be inspected regularly, parts must be replaced at factory-recommended intervals and engine tune-up services performed at intervals specified in the Exhaust Emission Control System Maintenance charts.

For the above reasons, these systems must not, under any circumstances, be altered to anything other than required specifications provided in this publication. Further, the Exhaust Emission Control System, or any of its components, must not be physically altered or modified in any respect.

DATA TAG

For the serviceman's guidance, each vehicle equipped with exhaust emission control will have data tag permanently affixed to the radiator shroud — in example:



VEHICLE EMISSION CONTROL INFORMATION

MODEL V6-225 C.I.D.

- ENGINE AT NORMAL OPERATING TEMPERATURE
- LIGHTS AND ALL ACCESSORIES OFF
- IDLE MIXTURE . . . LEAN BEST IDLE

- IGNITION TIMING 0° (TDC)
- SPARK PLUG GAP035
- DWELL . . . 30° (.016 POINT GAP)
- IDLE SPEED . . . 650-700 RPM

TRANSMISSION IN NEUTRAL DURING TUNE UP
SEE SERVICE MANUAL FOR ADDITIONAL INFORMATION

**THIS VEHICLE CONFORMS TO U.S. DEPT. OF H.E.W. REGULATIONS
APPLICABLE TO 1971 MODEL YEAR NEW MOTOR VEHICLES**

Jeep CORPORATION

14400

NOTE: The above tag applies to vehicles equipped with Distributor Model IAT-4502A. On vehicles equipped with Distributor Models 1110376, IAT-4501 and IAT-4502 the tag is the same except that Ignition Timing is 5° T.D.C. Always refer to the data tag when checking or re-adjusting ignition timing, idle speed, and idle mixture.

COOLING SYSTEM

Contents

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Draining Cooling System.....	G-3	Water Pump Disassembly.....	G-13
Engine Overheating.....	G-19	Water Pump Inspection.....	G-12
Fan Belt.....	G-18	Water Pump Reassembly.....	G-14
Filling Cooling System.....	G-2	Water Pump Removal and Replacement..	G-15
Inhibited Coolant Solution.....	G-17	SERVICE DIAGNOSIS	G-20
Temperature Sending Unit.....	G-10	SPECIFICATIONS	G-21
Thermostat	G-9	ANTIFREEZE CHART	G-22
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G-1. GENERAL

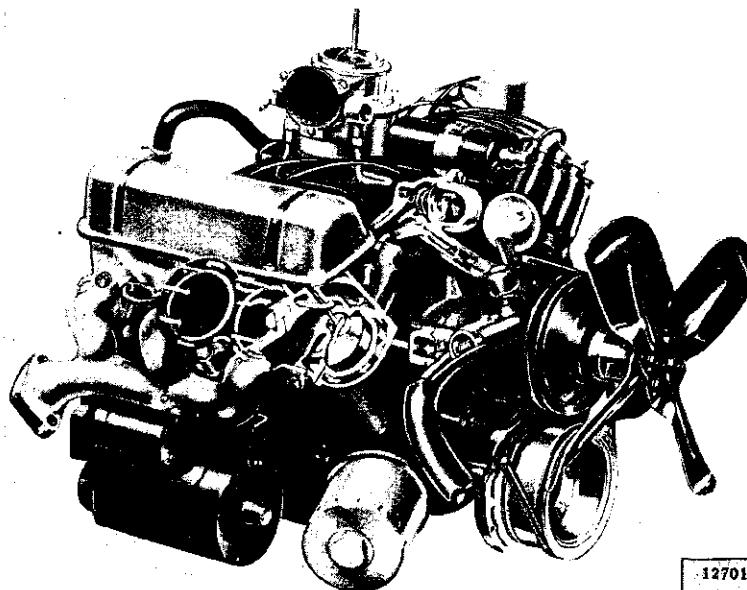
a. The satisfactory performance of the Hurricane F4 engine is controlled to a great extent by the proper operation of the cooling system. The engine block is full length water jacketed which prevents distortion of the cylinder walls. Directed cooling and large water holes, properly placed in the cylinder head gasket cause more water to flow past the valve seats (which are the hottest parts of the block) and carry the heat away from the valves, giving positive cooling of valves and seats. Minimum temperature of the coolant is controlled by a thermostat mounted in the outlet passage of the engine. When the coolant temperature is below thermostat-rated temperature, the thermostat remains closed and the coolant is directed through the radiator-bypass hose to the water pump. When

the thermostat opens, coolant flow is directed to the top of the radiator. The radiator dissipates the excess engine heat before the coolant is recirculated through the engine.

The cooling system is pressurized. Operating pressure is regulated by the rating of the radiator cap which contains a relief valve.

b. The Dauntless V-6 engine efficiency and performance is controlled to a great extent by proper operation of the cooling system. The cooling system does more than cool the engine. It also directs the flow of coolant to provide the best operating temperature range for each part of the engine.

In the Dauntless V-6 engine coolant is forced by the water pump into two main passages that run the length of the block on each side (Fig. G-1).



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FIG. G-1—COOLANT FLOW THROUGH THE DAUNTLESS V-6 ENGINE

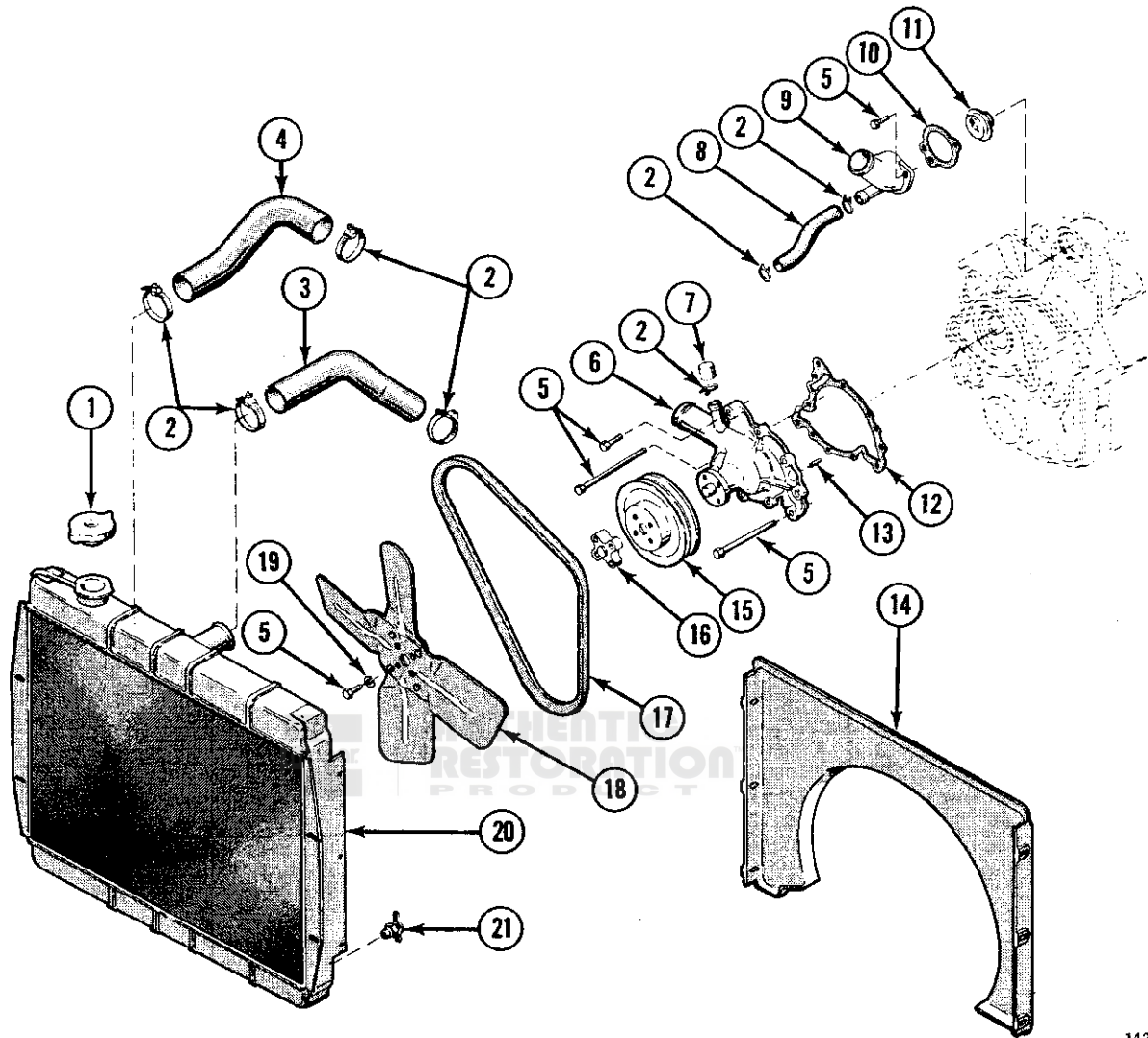


FIG. G-2—COOLING SYSTEM COMPONENTS V-6 ENGINE

14263

- | | | |
|--------------------------------|---|----------------------------|
| 1—Radiator Pressure Cap | 8—Thermostat By-Pass Hose | 15—Pulley |
| 2—Hose Clamp | 9—Water Outlet Elbow | 16—Fan Spacer |
| 3—Radiator Hose (Inlet-Upper) | 10—Gasket | 17—Fan and Alternator Belt |
| 4—Radiator Hose (Outlet-Lower) | 11—Thermostat | 18—Fan |
| 5—Bolt | 12—Water Pump Gasket | 19—Lockwasher |
| 6—Water Pump Assembly | 13—Dowel Pin | 20—Radiator |
| 7—Cap | 14—Radiator Shroud (Heavy Duty Cooling) | 21—Drain Cock |

From these main passages, the coolant flows around the full length of each combustion chamber.

After cooling the block, the coolant passes through ports between the block and each cylinder head. These ports direct most of the coolant flow around the exhaust valve area to prevent hot exhaust gases from overheating the exhaust ports.

From the cylinder heads, the water passes into a water manifold between each of the heads and the water pump. If the thermostat is closed, the coolant is ported back to the pump where it is recirculated back into the pump and into the engine. After the coolant heats enough to open the thermostat, the coolant is directed from the water manifold through a hose to the top of the radiator and then through the radiator which acts as a heat exchanger to cool

the fluid. The coolant is then ported through a hose from the bottom of the radiator to the pump, which recirculates it back to the engine.

The cooling system is pressurized. Operating pressure is regulated by a relief valve in the radiator cap.

The heater inlet hose is connected to a port on the right bank cylinder head. The outlet hose is connected to the heater adapter tube on the water pump.

c. It is recommended when using water for coolant that the cooling system be flushed and checked for leaks twice a year, preferably in the fall before antifreeze is added and in the spring when the antifreeze is drained.

Reverse flushing will aid greatly in removing rust

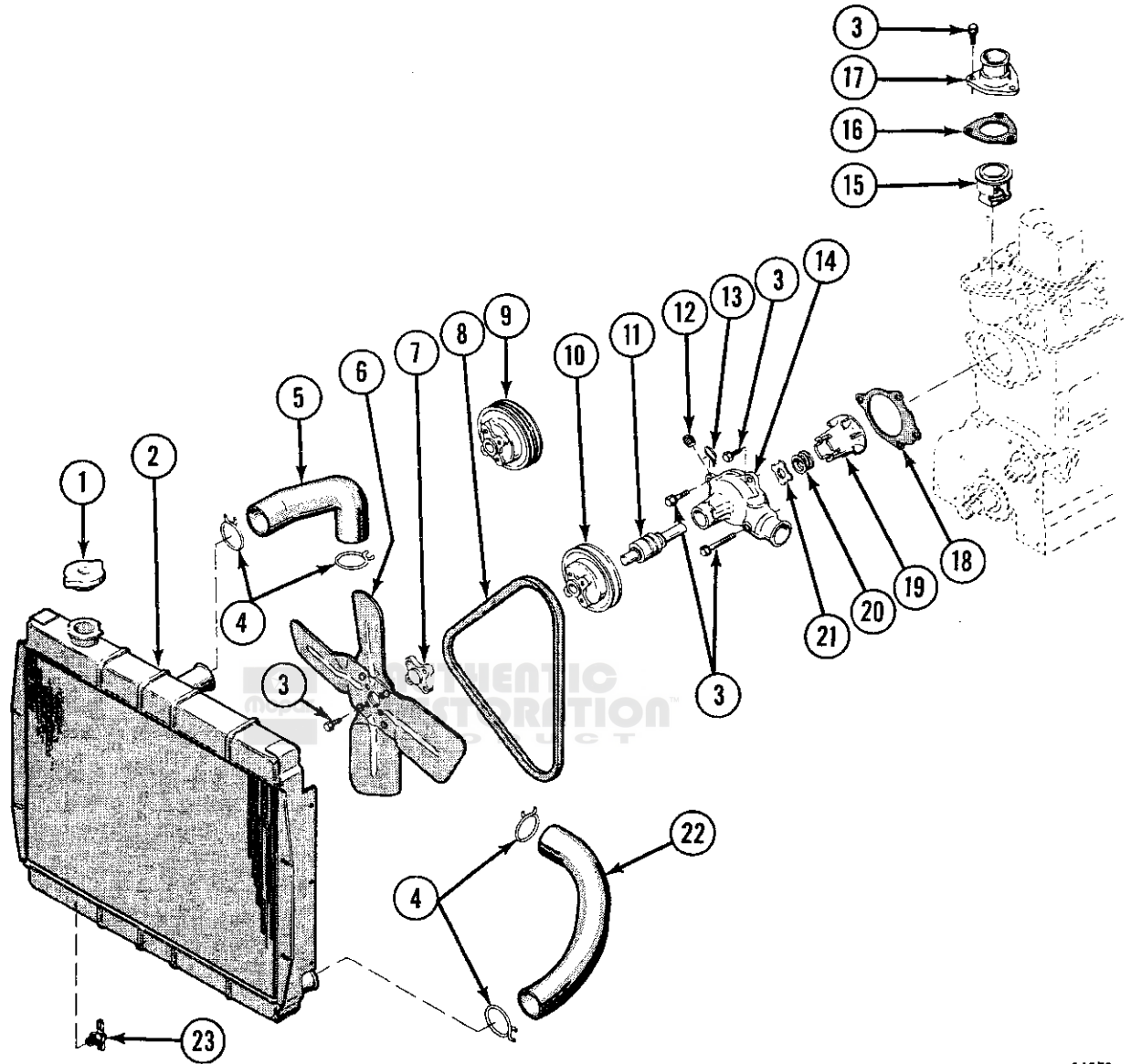


FIG. G-3—COOLING SYSTEM COMPONENTS F4-134 ENGINE

14273

- | | | | |
|-------------------------|---------------------------|----------------------------|----------------|
| 1—Radiator Pressure Cap | 7—Fan Spacer | 13—Bearing Retainer Spring | 19—Impeller |
| 2—Radiator | 8—Fan and Alternator Belt | 14—Pump Body | 20—Pump Seal |
| 3—Bolt | 9—Pulley (Double Groove) | 15—Thermostat | 21—Seal Washer |
| 4—Hose Clamp | 10—Pulley (Single Groove) | 16—Gasket | 22—Lower Hose |
| 5—Upper Hose | 11—Bearing and Shaft | 17—Water Outlet Fitting | 23—Drain Cock |
| 6—Fan | 12—Pipe Plug | 18—Gasket | |

and scale, especially when used with a flushing solution. A cleaning solution should be used to loosen the rust and scale before reverse flushing the cooling system.

Flushing is accomplished through the system in a direction opposite to the normal coolant flow. This action causes the water to get behind the corrosion deposits and force them out. To do this, remove the upper and lower radiator hoses. Then attach a drain hose at the top of the radiator. Attach a new piece of hose to the radiator outlet at the bottom and insert the flushing gun. Connect the water hose to the flushing gun to a water outlet and the air

hose to an air line. Turn on the water and when the radiator is full, apply the air in short blasts, allowing the radiator to fill between blasts. Continue this flushing operation until the water runs clear through the top hose.

With the thermostat removed, attach a leadaway hose to the water hose inlet. Also attach a length of new hose to the water outlet connection at the top of the engine. Turn the water on and fill the water jacket and then apply air in short blasts. Continue this flushing until the water runs clear. Also do the hot water heater. Remove heater water outlet hose from heater core. Remove inlet from

engine connections. Insert flushing gun and flush heater core. Care must be taken when applying air pressure to prevent damage to the heater core.

G-2. Filling Cooling System

To fill the cooling system, remove the fill cap and fill the tank to the top. Replace the cap and run the engine at medium speed for approximately one minute. Remove the cap and recheck the coolant level. Add more coolant if necessary to bring the level back to the top of the tank. If the cooling system is filled when the engine is cold, recheck the coolant level after the engine has warmed up. This will ensure that the thermostat has opened allowing complete cooling system circulation.

Always correct any cooling system leaks before installing antifreeze. A corrosion inhibitor should be used in the cooling system to prevent the formation of rust and scale. A quality brand antifreeze containing a corrosion inhibitor should be used. When the antifreeze is drained in the spring, a corrosion inhibitor should be added with the water.

Note: Cooling system components for both V6 and F4 engines are shown in Figs. G-2 and G-3.

G-3. Draining Cooling System

To completely drain the cooling system, open the drain in the bottom of the radiator and also a drain on the right side of the cylinder block on the Hurricane F4 engine. The Dauntless V-6 engine has two drain plugs, one located on each side of the cylinder block. Both plugs must be removed to completely drain the cooling system.

Remove the radiator cap to break any vacuum that may have developed.

Should the cooling solution be lost from the system and the engine become overheated do not refill the system immediately but allow the engine to cool or refill slowly while the engine is running. If cold solution is poured into the radiator while the engine is overheated there is danger of cracking the cylinder block and/or cylinder head.

G-4. Radiator Pressure Cap

All radiators are equipped with pressure caps which reduce evaporation of cooling solution and make the engines more efficient by permitting slightly higher operating temperatures. When operating properly, the pressure cap permits pressure build-up in the cooling system during periods of severe heat load. This pressure increases the boiling point of the coolant and thus reduces overflow losses. The effectiveness of the cap is limited by its opening pressure and the boiling point of the coolant (see note below). The pressure cap employs a spring-loaded, rubber-faced pressure seal which presses against a seat in the radiator top tank. Spring pressure determines the opening pressure of the valve. A typical pressure cap is shown in Fig. G-5.

Note: Refer to cooling system specifications (Par. G-21) for opening (relief) pressure when the vehicle is equipped with either the Hurricane F4 or Dauntless V-6 engine. If a new cap is required, always install a cap of the same type and pressure

rating specified. It should never be altered or replaced by a plain cap.

A vacuum release valve (Fig. G-5) is employed to prevent undesirable vacuum build-up when the system cools down. The vacuum release valve is held against its seat under light spring pressure. Vacuum in the system is relieved by the valve which opens at $\frac{1}{2}$ to 1 psi. [0,035 a 0,07 kg-cm²] vacuum. A pressure tester can be used to check and test the vacuum pressure rate (see Fig. G-6).

Although the mechanism of the pressure cap requires no maintenance, the cap should be inspected periodically for cleanliness and freedom of operation. The pressure cap gasket and radiator filler neck seat should also be inspected to be sure they are providing a proper seal. If the rubber face of the valve is defective, a new cap should be installed. Filler neck reseating tools are commercially available to correct minor defects at the surface of the seat. Follow instructions of the reseating tool manufacturer.

To remove the radiator pressure cap when the engine coolant temperature is high or boiling, place a cloth over the pressure cap and turn counterclockwise about $\frac{1}{4}$ turn until the first (pressure release) stop is reached. Keep the cap in this position until all pressure is released. Then push cap down and turn still further until cap can be removed. To install the pressure cap, place it in position and turn it clockwise as far as it will go.

Caution: Use extreme care in removing the radiator pressure cap. In overheated systems, the sudden release of pressure can cause a steam flash and this flash, or the loosened cap can cause serious personal injury.

G-5. RADIATOR

Maintenance of the radiator consists of keeping the exterior of the radiator core clean, the interior free from rust and scale, and the radiator free from leaks. Check the cooling system fluid level and for leaks each 2000 miles [3.200 km.] or every 30 days, whichever occurs first. This exterior of the radiator core should be cleaned and the radiator inspected for leaks each 6000 miles [9.600 km.] of normal service of the vehicle. Cleaning should be performed by blowing out with air stream or water stream directed from the rear of the radiator. Visual inspection is not sufficient as the accumulation of small particles of foreign material on core surfaces can restrict cooling without closing the core openings.

Radiator leakage occasionally results from corrosion perforation of the metal but most leakage results from mechanical failure of soldered joints when too much strain has been put on the joint. Fractures occur most often at the joint where the radiator inlet and outlet pipes are attached to the tanks. When the seams break, the entire soldered joint is exposed and can corrode, but breakage rather than corrosion is the primary cause of seam leakage. Examine the radiator carefully for leaks before and after cleaning. Cleaning may uncover points of leakage already existing but plugged with rust. White, rusty, or colored leakage stains indicate

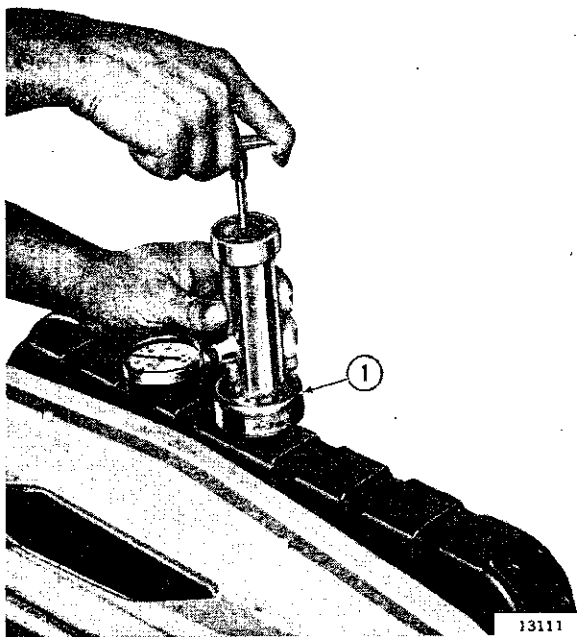


FIG. G-4—PRESSURE TESTING COOLING SYSTEM

1—Pressure Tester C-3499

previous radiator leakage. These spots may not be damp if water only or methyl-alcohol-base anti-freeze is in the cooling system since such coolants evaporate readily. An ethylene-glycol-base anti-freeze shows up existing leaks as it does not evaporate. The radiator may be tested for leaks by using a Pressure Tester Tool C-4080, as shown in Fig. G-2.

When the pressure cap opens, the sudden surge of vapor or liquid must blow out through the overflow pipe. If the overflow pipe is dented or clogged, the pressure caused by obstruction may cause damage to the radiator or hose connections in the cool-

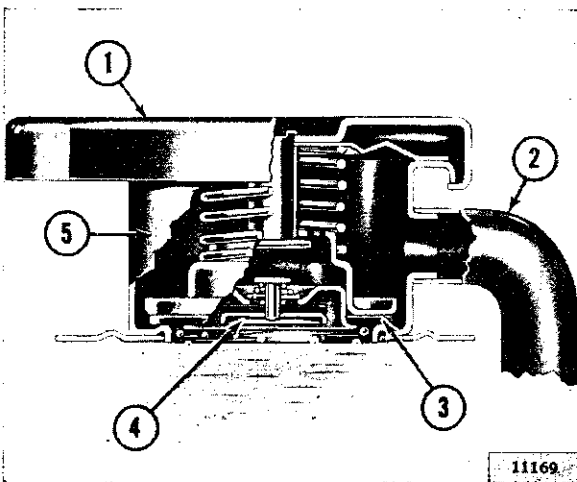


FIG. G-5—RADIATOR PRESSURE CAP

1—Pressure Cap
2—Overflow Tube
3—Pressure Seal
4—Vacuum Release Valve
5—Radiator Neck

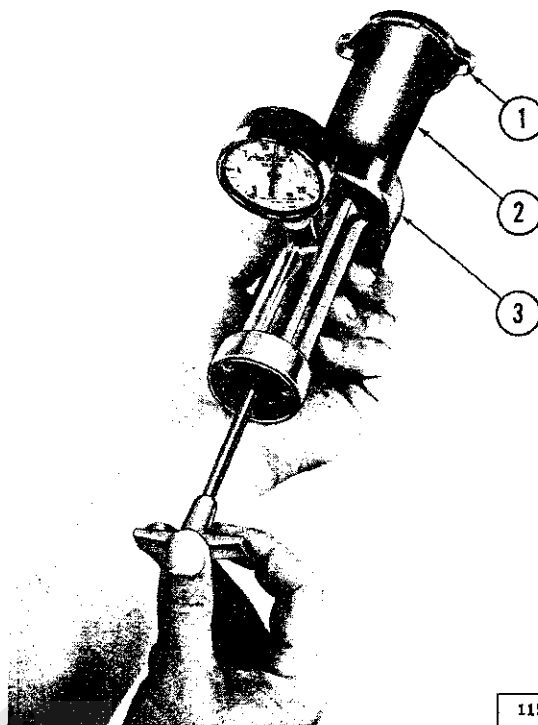


FIG. G-6—TESTING RADIATOR PRESSURE CAP

1—Radiator Pressure Cap
2—Adapter
3—Pressure Tester C-3499

ing system. To remove clogging material, run a flexible wire through the overflow pipe.

G-6. Radiator Removal and Replacement

- a. Drain the radiator by opening the drain cock and removing the radiator pressure cap.
- b. Remove the upper and lower hose clamps and hoses at the radiator.
- c. Remove the four cap screws, lock washers and flat washers that secure the radiator to the radiator body support. Remove the radiator.
- d. To replace the radiator, reverse the removal procedure.

G-7. Radiator Hoses and Heater Hoses

Air, heat, and water deteriorate radiator and heater hoses in two ways: by hardening or cracking which destroys flexibility and causes leaks; by softening and swelling which produces lining failure and hose rupture and clogging. Examine hoses spring and fall for possible need of replacement or tightening. If hoses are collapsed, cracked, or indicate a soft condition on the inside they should be replaced. Correct installation of a new heater hose is important to prevent contact between the hose and the exhaust manifold. On the Hurricane F4 engine the molded curved end of the hose connects to the hot water intake of the heater; the flexible end to the hot water valve on top of the cylinder head. On the Dauntless V-6 engine the heater inlet hose is connected to the rear of the intake manifold

and the outlet hose is connected to the water pump housing.

When installing a new hose, clean the pipe connections and apply a thin layer of nonhardening sealing compound. Hose clamps should be properly located over the connections to provide secure fastening. The pressurized cooling system pressure can blow off improperly installed hoses.

G-8. Cylinder Block

Any coolant leaks at the engine block water joints are aggravated by pump pressure in the water jacket and by pressure developed in the cooling system when the pressure cap is in place. Small leaks showing up only as moist spots often cannot be detected when the engine is hot except by the appearance of rust, corrosion, and dye stains where leakage evaporated. Also, expansion and contraction of the engine block resulting from extreme temperature changes can aggravate leaks. For these reasons, when checking for coolant leaks inspect the block when it is cold and while the engine is running.

A leaking drain cock or plug that cannot be stopped leaking by tightening should be replaced. Leaking core-hole expansion plugs should be replaced.

If tightening gasketed joints will not correct leakage, install new gaskets. Use a sealing compound where recommended.

G-9. Thermostat

a. The cooling system of the engine is designed to provide adequate cooling under most adverse conditions. However, it is necessary to employ some device to provide quick warming and to prevent overcooling during normal operation. Automatic control of engine operating temperature is provided by a water flow control thermostat installed in the water outlet of the Hurricane F4 engine. The thermostat is a heat-operated valve. It should always be maintained in working order and the vehicle should never be driven without one installed as there would then be no control of engine temperature. The temperature at which the thermostat opens is preset and cannot be altered.

b. The thermostat on the Hurricane F4 engine is located in a housing on the top front of the cylinder head. On the Dauntless V-6 engine it is located in the thermostat housing of the air intake manifold. The standard engine thermostat for the Hurricane F4 and Dauntless V-6 engine has a normal rating of 190°F. [87.8°C.] and should begin to open at a coolant temperature between 180°F. [82°C.] to 192°F. [89°C.] and be fully open at 202°F. [94°C.]. See Fig. G-7 for method of testing.

When the thermostat is not operating properly, the engine may run too hot or too cold. Overheating may damage the thermostat so that its valve will not function properly, and a cold engine will not achieve full efficiency. Rust can also interfere with thermostat operation. To test the thermostat, place it in water heated approximately 25°F. [17°C.] above the temperature stamped on the thermostat valve. Submerge the bellows completely and agitate the water thoroughly. The valve should open fully. Next, place the thermostat in water heated approxi-

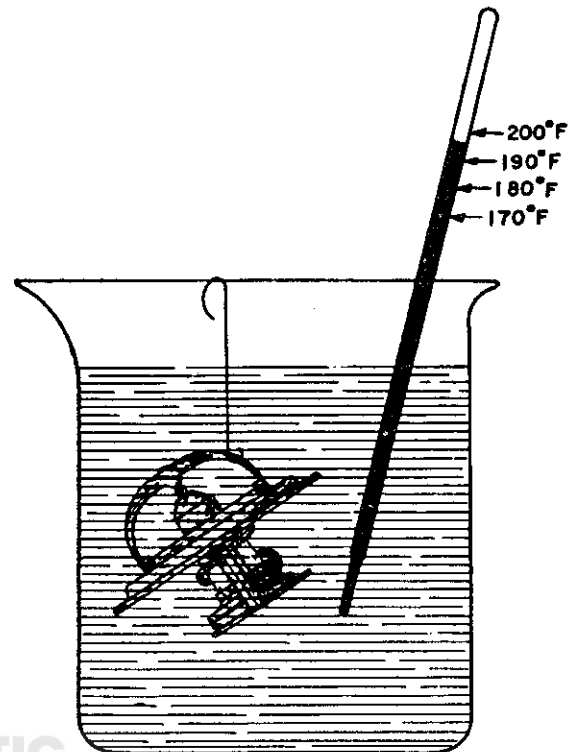


FIG. G-7—THERMOSTAT TEST

12150

mately 10°F. [11°C.] below the temperature stamped on the thermostat valve. Submerge the bellows completely and agitate the water thoroughly. The valve should close completely. If the thermostat fails either of these tests, it should be replaced with a new one of the same type and rating.

G-10. Temperature Sending Unit

The sending unit incorporates a temperature sensing element that when it is surrounded by cold engine coolant, the unit provides the highest resistance in the temperature gauge indicator circuit. Resultant low current flow in the circuit causes the indicator on the instrument panel to read at the low (C) end of the gauge. As engine coolant temperature increases, the resistance of the unit is decreased allowing an increased current flow in the circuit, making the instrument panel gauge register in proportion to the temperature of the engine coolant.

To test the sending unit, first run the engine until it has had time enough to warm up.

If no reading is indicated on the gauge, check the sending unit to gauge wire by removing the wire from the sending unit and momentarily grounding the wire. If the gauge now indicates, the sending unit is faulty. If the gauge still does not indicate, the wire is defective. Repair or replace the wire.

a. Hurricane F4 Engine.

The thermo-couple coolant temperature sending unit is mounted in the right rear of the cylinder head (Fig. G-8) and is connected by a single wire to the dash unit of the instrument cluster.

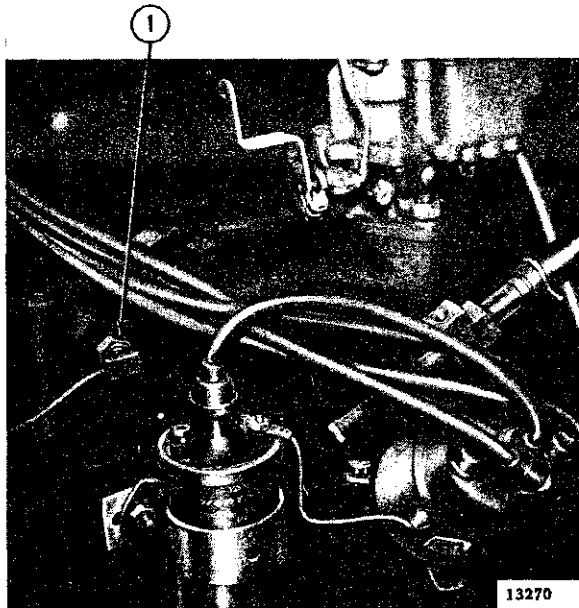


FIG. G-8—TEMPERATURE SENDING UNIT—
HURRICANE F4 ENGINE
1—Temperature Sending Unit

b. Dauntless V-6 Engine.

The thermo-couple coolant sending unit is mounted in the left rear area of the intake manifold and is connected by a single wire to the dash unit of the instrument cluster.

G-11. WATER PUMP

a. Hurricane F4 Engine.

The water pump on the Hurricane F4 engine is a centrifugal impeller type of large capacity to circulate water in the entire cooling system. The double row ball bearing (Fig. G-9), is integral with the shaft and is packed at assembly with a special high melting point grease which will last the life of the bearing. The bearing is sealed to retain the lubricant and prevent dirt and dust from entering. The bearing and shaft are retained in the water pump body by the bearing retaining wire. The water seal bears against the ground seat on the pump body and the inside of the impeller, maintaining a constant pressure against both and preventing water leakage. A drain hole in the bottom of the pump body precludes any water seepage past the seal from entering the bearing.

The impeller and the pulley hub are pressed on the shaft under high pressure.

b. Dauntless V-6 Engine.

A centrifugal-type water pump, shown in Fig. G-10, circulates coolant through the Dauntless V-6 engine and its cooling system. This pump is mounted on the timing chain cover. Similar to the engine cooling fan mounted on its hub, the pump is driven through a V-belt from the crankshaft pulley.

Coolant enters the water pump at its center. Centrifugal force then forces coolant radially outward, through vanes of the pump impeller, and backward through two discharge passages in the timing chain cover. These passages conduct an equal amount of coolant to each cylinder bank water jacket. This water pump has a sealed double row ball bearing and a ceramic water seal, neither of which can be serviced. In event of bearing or water seal failure, the entire water pump assembly must be replaced.

G-12. Water Pump Inspection

Check the water pump for leaks, and excessive end play or looseness of the shaft in the pump. A quick way to check is to work the fan blades up and down by hand. If any play is noticed, this indicates that the bearings are rough. Rough bearings should be checked to see if the water pump should be replaced or rebuilt.

**G-13. Water Pump Disassembly —
Hurricane F4 Engine**

- Refer to Fig. G-9.
- a. Remove the fan belt, fan blades, and fan pulley.
- b. Remove the bolts attaching the water pump to the block. Remove the pump.
- c. Remove the bearing retainer spring.
- d. Remove the pump impeller and pulley with a suitable puller.
- e. Remove the pump seal, bearing and shaft, and bearing slinger.

**G-14. Water Pump Reassembly —
Hurricane F4 Engine**

- Refer to Fig. G-9.
- Before assembling the water pump, examine water seal seat in the pump body and should it be rough, install a new pump body.
- To reassemble the unit, insert the long end of the shaft into the pump body from the front end until the outer end of the bearing is flush against the

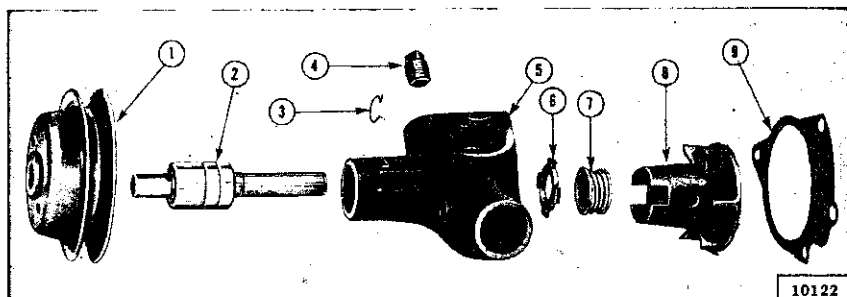
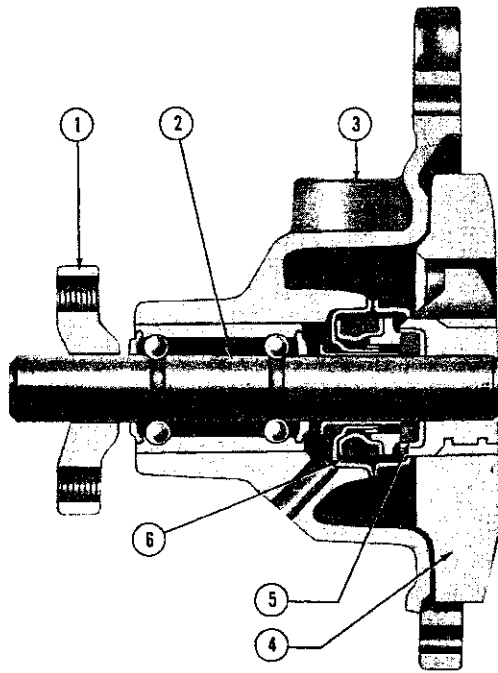


FIG. G-9—WATER PUMP—
HURRICANE F4 ENGINE

- 1—Fan and Pump Pulley
- 2—Bearing and Shaft
- 3—Bearing Retainer Spring
- 4—Pipe Plug
- 5—Pump Body
- 6—Seal Washer
- 7—Pump Seal
- 8—Impeller
- 9—Gasket



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FIG. G-10—WATER PUMP—
CROSS-SECTIONAL VIEW — DAUNTLESS V-6

- 1—Hub
- 2—Shaft and Bearing
- 3—Cover
- 4—Impeller
- 5—Ceramic Seal
- 6—Seal Assembly

front end of the pump body. Position the seal, washer, and pump seal on shaft flush against the ground seat in the water pump body. Place the impeller on an arbor press and press the long end of the shaft into the impeller until the end of the shaft is flush with the hub of the impeller. Support the assembly on the impeller end of the shaft and press the pulley hub on the shaft until the shaft end is flush with the pulley hub. Move the shaft in the pump body to align the retaining wire grooves in the bearing and pump body and place the bearing retaining wire in position.

G-15. Water Pump Removal and Replacement — Dauntless V-6 Engine

Drain the cooling system. Remove the fan belt and remove the cooling fan and pulley from the hub on the water pump. Disconnect the hoses from the water pump. Remove the cap screws that secure the water pump to the timing chain cover; remove the water pump. Do not disassemble the water pump; it is serviceable only as an assembly. When replacing the water pump, torque the water pump cap screws 6 to 8 lb-ft. [0,829 a 1,106 kg-m.].

G-16. Antifreeze Solutions

When water freezes it expands approximately 9% in volume. When water, confined in a cooling system, freezes it exerts tremendous pressures causing serious damage. To prevent freezing, antifreeze can be added to the water to lower its freezing point. The two types of antifreeze commonly used today

have either a methanol or ethylene glycol base, and contain corrosion inhibitors. The only antifreeze recommended for the cooling system of 'Jeep' vehicles is ethylene glycol (permanent type). Methanol base antifreeze evaporates with the water when the vehicle is operated at warmer temperatures and requires more attention to avoid loss of protection. Ethylene glycol base antifreeze seldom evaporates at normal operating temperatures. Methanol solution is injurious to vehicle finishes. Should any be spilled on the vehicle, it should be washed off immediately with a good supply of cold water without wiping or rubbing. Under ordinary conditions, ethylene glycol is not injurious to vehicle finishes.

Warning: Drinking ethylene glycol antifreeze or its solutions can be harmful or fatal. Do not use antifreeze containers for food or beverages.

A table in Par. G-22 gives the protection obtained by the addition of various amounts of ethylene glycol.

Before installing antifreeze, inspect the cooling system to be sure it is clean, leak-proof, and otherwise in proper operating condition. Drain the cooling system, see Par. G-3. Pour in 3 quarts [3 ltr.] of clean water, add the required quantity of antifreeze, then add clean water to within 1" [2,54 cm.] of the top of the overflow pipe to allow for expansion when hot. Run the engine until it is warm. Then recheck the solution level. Check the antifreeze protection with a hydrometer reading.

G-17. Inhibited Coolant Solutions

All 'Jeep' vehicles equipped with either the Hurricane F4 or Dauntless V-6 engine should use only inhibited year-round, permanent-type engine coolant solutions that are formulated to withstand two full calendar years of normal operation without draining or adding inhibitors. The engine cooling system should be completely drained and the recommended coolant installed every two years. Before installing the permanent-type solution, inspect the cooling system to be sure it is clean, leakproof, and in proper operating condition.

Note: Water alone, methanol, or alcohol-type antifreeze is definitely not recommended for 'Jeep' Vehicles.

G-18. Fan Belt

The fan, water pump, generator or alternator are driven by a V-belt. The drive of the V-belt is on the side of the V. A fan belt that is too tight will cause rapid wear of the alternator or generator and water pump bearings. If the belt is too loose, it may slip preventing the water pump from properly cooling the engine or the generator or alternator from properly charging the electrical circuit. Use fan belt tension gauge Tool W-283 to properly adjust belt. The fan belt is properly adjusted when it can be deflected ½" [13 mm.] with strong thumb pressure applied midway between the fan and alternator pulleys. Check this adjustment and inspect the condition of the fan belt at each engine lubri-

cation period. It is good preventive maintenance to replace a badly frayed, worn or cracked fan belt before it breaks in operation.

To replace the fan belt, loosen the attaching bolts at each generator or alternator brace-to-engine mounting and pivot the alternator or generator toward the engine to gain slack needed to install the new belt. Remove the old belt. Position the new belt over the fan pulley, over the crankshaft pulley, then over the generator or alternator pulley. Pull the generator or alternator away from the engine until belt tension is firm. Then tighten the generator or alternator mounting bolts and check the tension as indicated above. Reset the generator or alternator as necessary for correct belt tension. Finally, torque the generator or alternator mounting bolts 25 to 35 lb-ft. [3,4 a 4,8 kg-m.].

Note: On the Dauntless V-6 engine when adjusting the fan belt tension, the alternator mounting bolts should be torqued 30 to 40 lb-ft. [4,14 to 5,53 kg-m.]. If a fan belt tension gauge (W-283) is available, proper tension should be 80 pounds [36,2 kg.].

G-19. Engine Overheating

An engine will not be damaged by high coolant temperatures unless the coolant boils. The pressurized cooling system on the 'Jeep' vehicles raises

the boiling point of the coolant solution. Should overheating be encountered, and the fault is believed to be in the cooling system check for the following:

- a. Proper coolant level. See Filling Cooling System Par. G-2.
- b. Poor air flow. Check for dirty radiator core. (See Radiator Par. G-5). Check for faulty belt pulley operation, worn or loose fan belt, or damaged fan. Clean, repair, replace or adjust as necessary.
- c. Foaming coolant. Check for air leaks at water pump, hose connection and filler cap. Tighten, repair or replace as necessary.
- d. Surging or "after boil". Check pressure cap and replace if valves or gasket are faulty.
- e. External leaks. Check the following for leaks: Hoses and clamps, water pump, radiator, head gasket, core plugs and drain cocks, as well as the cylinder head or block for cracks.
- f. Internal leaks. Check for faulty head gasket, cracked cylinder head or block.
- g. Poor coolant flow. Check hose condition, water pump, fan belt, and repair or replace as necessary. Inspect block for rust or scale, and clean and flush the system, if necessary.
- h. Check the temperature gauge.



G-20. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Overheating:	
Lack of Coolant.....	Refill radiator
Thermostat inoperative.....	Replace thermostat
Water pump inoperative.....	Overhaul or replace
Incorrect ignition or valve timing.....	Set engine timing
Excessive piston blowby.....	Check pistons, rings and cylinder walls
Fan belt broken or badly worn.....	Replace belt
Radiator clogged.....	Reverse flush and clean
Air passages in core clogged.....	Clean with water and air pressure
Excessive carbon formation.....	Remove carbon from cylinder head(s)
Muffler clogged or bent exhaust pipe.....	Replace damaged part
Loss of Cooling Liquid:	
Loose hose connections.....	Tighten connections
Damaged hose.....	Replace hose
Leaking water pump.....	Overhaul or replace
Leak in radiator.....	Remove and repair
Leaky cylinder head gasket.....	Replace gasket
Crack in cylinder block.....	Small crack can be closed with Radiator or Block Sealer

G-21. COOLING SYSTEM SPECIFICATIONS

	HURRICANE F4	DAUNTLESS V-6
Radiator Cap:		
Relief Pressure.....	7 and 15 psi. [0,5 kg-cm ² and 1,05 kg cm ²]	15 psi. [1,05 kg-cm ²]
Vacuum Valve Release.....	1/2 to 1 psi. [0,04 a 0,07 kg-cm ²]	1 psi. [0,07 kg-cm ²]
Thermostat:		
Rating.....	190°F. [87,8°C.]	190°F. [87,8°C.]
Starts to Open.....	180°F. [82°C.]	180°F. [82°C.]
Fully Open.....	202°F. [94°C.]	202°F. [94°C.]
Water Pump:		
Type.....	Centrifugal	Centrifugal
Drive.....	V-Belt	V-Belt
Radiator:		
Type.....	Tube & Fin	Tube & Fin
Cooling System Capacity:		
Without Heater.....	11 qt. [10,4 ltr.]	9 qt. [8,5 ltr.]
With Heater.....	12 qt. [11,5 ltr.]	10 qt. [9,4 ltr.]
Fan:		
Number of Blades.....	4	4
Diameter.....	15" [38 cm.]	15 5/8" [39,7 cm.]
Drive Belt:		
Angle of V.....	38°	38°
Length.....	42 5/8" [108 cm.]	43,92" [111,5 cm.]
Width.....	1 1/16" [1,74 cm.]	3/8" [0,952 cm.]

G-22. ANTIFREEZE CHART

Quarts U.S.	Quarts Imperial	Liters	Fahr.	Ethylene Glycol Cent.
<i>10-Quart System</i>				
2	1 2/3	2	16°	- 8.8°
3	2 1/2	2 3/4	4°	-15.5°
4	3 1/3	3 3/4	-12°	-24.4°
5	4 1/4	4 3/4	-34°	-36.6°
6	5	5 2/3	-62°	-52.2°
<i>11-Quart System</i>				
2	1 2/3	2	18°	- 7.6°
3	2 1/2	2 3/4	8°	-13.3°
4	3 1/3	3 3/4	- 6°	-21.1°
5	4 1/4	4 3/4	-23°	-30.5°
6	5	5 2/3	-47°	-43.8°
<i>12-Quart System</i>				
2	1 2/3	2	19°	- 7.2°
3	2 1/2	2 3/4	10°	-12.2°
4	3 1/3	3 3/4	0°	-17.7°
5	4 1/4	4 3/4	-15°	-26.1°
6	5	5 2/3	-34°	-36.6°

ELECTRICAL SYSTEM

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H-1. GENERAL

All 'Jeep' Universal vehicles are equipped with 12-volt electrical systems. Use caution around the higher voltage of the 12-volt system as accidental short circuits are more capable of damaging electrical units. Also, arcs around the 12-volt battery are more apt to ignite any gas that may be escaping from it. In the following paragraphs will be found information about the battery, distributor, coil, generator, alternator, voltage regulator and starting motor. These units with the connecting wires, make up the engine electrical system. The wiring diagram will show the different circuits of the engine electrical system and the various units which make up those circuits.

With plastic-covered wiring harnesses use only rubber-insulated wiring clips.

Caution: All current production vehicles are 12-volt, negative ground. Whenever servicing a 12-volt electrical system, use caution, as an accidental short circuit is capable of damaging electrical units. Disconnect battery ground cable before changing electrical components.

H-2. Battery

The battery is a storage reservoir for electrical energy produced by the alternator or generator. The battery should store sufficient energy for operation of the entire electrical system when the alternator or generator is not producing output, such as when the ignition is first turned on. Of particular importance is maintaining the electrolyte at the correct level, regularly checking with a hydrometer, and maintaining clean, tight cable connections.

Battery service information is given in this section.

Caution: Do not allow flames or sparks to be brought near the vent openings of the battery since hydrogen gas may be present in the battery and might explode.

Note: The liquid in the battery (electrolyte) is a solution of sulphuric acid which, on contact, can injure skin or eyes, or damage clothes. If it is spilled on the skin or spattered in the eyes, promptly flush it away with quantities of clear water only. If the acid is spilled on clothes, wet it thoroughly with a weak solution of ammonia, or with a solution of sodium bicarbonate or baking soda.

Caution: When installing the battery, the negative terminal must be grounded. Reverse polarity of the battery can cause severe damage to the charging system.

Battery Inspection

a. Check the specific gravity of the electrolyte in each cell of the battery. A hydrometer reading of 1.260 indicates that the battery is fully charged. If the reading is 1.225 or below, the battery needs recharging. If one or more cells is 25 "points" (.025) or more lower than the other cells, this indicates that the cell is shorted, the cell is about to fail, or there is a crack in the battery partition in the case. Unless the battery is repaired or replaced, battery trouble will soon be experienced.

b. Check the electrolyte level in each cell, add distilled water to maintain the solution $\frac{3}{8}$ " [9.5 mm.] above the plates. Avoid overfilling. Replace the filler caps and tighten securely. It is important to keep the electrolyte level above the plates at all times because plates that are exposed for any length of time will be seriously damaged.

c. Check the wing nuts on the hold-down frame for tightness. Tighten them only with finger pressure, never with pliers or a wrench. Excessive pressure could damage the battery case.

d. Clean the battery terminals and cable connectors. Prepare a strong solution of baking soda and water and brush it around the terminals to remove any corrosion that is present. The cell caps must be tight and their vents sealed to prevent cleaning solution entering the cells. After cleaning, connect cables to battery and coat the terminals with heavy grease.

e. Inspect the battery cables and replace if badly corroded or frayed. Check tightness of terminal screws to ensure good electrical connections. Check the tightness of the negative ground cable connection at the frame to ensure a good ground connection.

f. Load test the battery. Connect a voltmeter across the battery. Run the starting motor for 15 seconds. If the voltage does not drop below 10 volts the battery is satisfactory. If the voltage falls below the figure given, yet the specific gravity is above 1.225, the condition of the battery is questionable.

g. Be sure the engine ground strap connection,

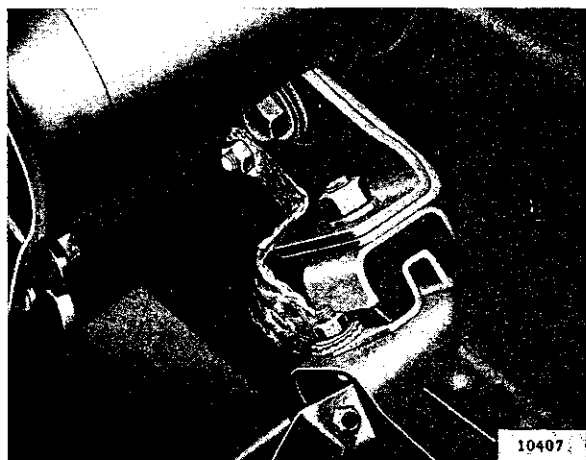


FIG. H-1—ENGINE GROUND STRAP—F4 ENGINE

Fig. H-1, is tight at both connections. If these connections are loose or dirty, hard starting or failure to start may result.

H-3. Ignition System

The ignition system consists of the battery, ignition switch, ignition coil ballast resistor (V-6 engine only), ignition coil, ignition distributor, spark plugs, and the low and high tension wiring. Electrical energy is obtained from the battery while cranking and from the alternator after the engine is running. These supply circuits must be considered part of the ignition system.

The ignition system furnishes the spark for the spark plugs. The spark must occur in each cylinder at exactly the proper time. To accomplish this, the following units are required.

- a. The battery, supplying the electrical energy.

Note: 'Jeep' vehicles equipped with Dauntless V-6 engines have a ballast resistor connected between the ignition switch and the positive (+) terminal of the coil. The ballast resistor limits to a safe maximum the primary current flow through the coil and the distributor contact points.

- b. The ignition coil, transforming the battery low tension current to high tension current that jumps the spark plug gap in the cylinders under compression.

- c. The distributor, delivering the spark to the proper cylinders and incorporates the mechanical breaker, that opens and closes the primary circuit at the exact time.

- d. The spark plugs, providing the gap in the engine cylinders.

- e. The wiring, connecting the various ignition units.

- f. The ignition switch controlling the battery current when it is desired to start or stop the engine.

- g. The firing order for the Hurricane F4 engine is 1-3-4-2. Cylinder No. 1 is the cylinder closest to the radiator.

- h. The firing order for the Dauntless V-6 engine is 1-6-5-4-3-2. Cylinders 1-3-5 are on the left bank and cylinders 2-4-6 are on the right bank.

H-4. PRIMARY CIRCUIT

Before testing the primary circuit, make certain that the battery is satisfactory or install a fully charged battery for the primary circuit tests. Also, check the starter motor for excessive voltage drop and check the starter motor itself for excessive draw.

- a. Measure the voltage at the coil primary terminals while cranking the engine with the starter motor. If the voltage is less than 9 volts the trouble will be found in the primary circuit. If there is no voltage at all, check for a break in the primary circuit, possibly in the coil primary winding.

- b. To check the primary circuit, turn the ignition on, turn the engine until the points are closed, and then measure the voltage drop across each portion of the circuit with a voltmeter.

Note: Most voltage drops will be found at the connections of wires to terminals as dirt, oxidation etc. can cause excessive resistance at these points. Measure voltage drops in wires to take this into account.

- c. Connect the voltmeter from the battery cable terminal on the starter solenoid to the battery terminal of the coil primary. If the voltmeter reads more than 0.2 volt, perform the checks given in steps, d, e, and f following.

- d. Connect the voltmeter from the solenoid terminal to the battery terminal of the ignition switch. If the voltmeter reads more than .05 volt, check and clean the connections at solenoid, light switch, and ignition switch.

- e. If the voltmeter reading in step d is less than .05 volt, connect the voltmeter from the battery terminal to the ignition terminal on the ignition switch. If the voltage drop is more than 0.1 volt, repair or replace the ignition switch.

- f. If the voltage drop in step e is not more than 0.1 volt, connect the voltmeter from the ignition terminal of the ignition switch to the battery terminal of the coil primary. If the voltmeter reads more than .05 volt, clean and tighten the connections and check again. If the voltmeter again reads more than .05 volt, replace the wire.

- g. Connect the voltmeter from the distributor primary terminal on the coil to the coil terminal on the distributor. Voltage drop should not exceed .05 volt. Clean and tighten connections if necessary.

- h. Connect the voltmeter from the coil terminal on the distributor to a clean, paint-free spot on the distributor body. The reading should not exceed .05 volt. If more, it indicates excessive resistance through the points or in the distributor internal connections. Clean and align the points and make sure the breaker arm connection to the primary terminal as well as the stationary contact point mounting in the body is clean and tight.

- i. Open the points and check the voltmeter. It should read close to peak voltage. Low voltage indicates that a circuit through the distributor (a short) exists while the points are open.

- j. Disconnect the condenser lead and open the points. A jump to full voltage indicates a short in

the condenser. Replace the condenser. If there is no jump to full voltage, overhaul or replace the distributor.

k. With the points closed, connect the voltmeter from a clean, paint-free post on the distributor body to the negative post of the battery. The voltage drop should be practically zero, a hardly readable deflection on the voltmeter. If the voltmeter registers a voltage drop, perform the checks in steps l and m following.

l. Check for voltage drop in the battery ground cable. Clean the battery post, cable terminals, and contact surface on the bellhousing, or on body if a noticeable deflection of the voltmeter occurs.

m. Check for any voltage drop between the distributor body and a clean, paint-free spot on the cylinder block. If there is any voltage drop, remove the distributor and clean the mounting surfaces of distributor body and cylinder block.

H-5. SECONDARY CIRCUIT

If satisfactory ignition is not obtainable with correct point gap and tension; satisfactory condenser; sufficient primary voltage; and correctly cleaned, gapped, and installed spark plugs; the secondary circuit should be investigated.

a. Test the coil. Bring the coil up to operating temperature using the coil heat feature of a coil tester, if available. Refer to the coil tester manufacturer's instructions for specific hook-ups for performing the checks given in steps b, c, and d following.

b. Connect the positive lead of the tester to the battery terminal of the coil primary winding. Connect the tester ground lead to the coil tower. Measure the resistance of the secondary winding. If the resistance is more than 20,000 ohms, a fault in the secondary winding is indicated.

c. Check for a grounded secondary by touching the tester ground lead to the coil cover. If resistance is not over 100,000 ohms, the secondary is grounded to the cover.

d. If the secondary winding is satisfactory, measure the primary current draw in accordance with the instructions of the test equipment manufacturer.

e. Check the secondary circuit for leakage. With the coil primary in the circuit with the breaker unit of the tester, connect a long, high-tension test lead to the coil tower. Check the secondary circuit for leakage by performing the checks given in steps f, g, h, and i following.

Note: In the following tests, a slight sparking and meter deflection will usually be seen just as contact is made. This is caused by capacitance and does not indicate defective insulation.

f. Check distributor cap. Remove the coil lead from the cap and touch the test lead to the center contact inside the cap. If the meter reading drops when the contact is touched or if sparking is seen, a leakage path is present between the center contact and one of the plug towers. This leakage path will be in the form of a crack or carbon track in the cap. Discon-

nect the spark plug wires from the cap one at a time and test each plug contact with the high-voltage lead and with all other plug wires connected. Any sparking or meter drop indicates that a leakage path exists between that particular contact and an adjacent one. Testing the adjacent contacts will determine which pair is at fault.

g. Check distributor rotor. Touch the test lead to the spring contact in the center of the distributor rotor. Any leakage in the rotor insulation between the contact and the shaft will cause a drop in the meter reading and usually sparking will be seen.

h. Check spark plug wires. Disconnect the spark plug wires from the plugs and test the plug terminal of each. The meter reading should not drop below the open secondary value (value before making contact). If it does or if a large spark occurs when the test lead and the plug wire are separated, there is a break in the insulation on that wire.

i. Check the coil tower insulation. Remove the high-tension test lead from the coil tower and touch the ground lead of the coil tester to several points around the base of the tower. Any sparking or deflection of the meter indicates a leakage path in the tower insulation.

H-6. Alternator Charging System

All Jeep Universal Series vehicles have, as standard equipment a 35-amp., 12-volt, negative ground alternator and a transistorized voltage regulator. For repairing the alternator, many of its major components are furnished as complete assemblies including: complete brush assembly which requires no soldering or unsoldering of leads; two complete rectifying diode assemblies which eliminate the need for removing and replacing individual diodes; a complete isolation diode assembly; and a rotor assembly complete with shaft, pole pieces, field coil, and slip rings.

The transistorized voltage regulator is an electronic switching device. It senses the voltage appearing at the auxiliary terminal of the alternator and supplies the necessary field current for maintaining the system voltage at the output terminal. The output current is determined by the battery electrical load; such as headlights, heater, etc.

The transistorized voltage regulator is a sealed unit, has no adjustments, and must be replaced as a complete unit.

H-7. Starting System

The operation of the starter motor is controlled by the ignition switch. The starter is made up of a frame, field coil, armature, and brushes.

The starter solenoid electrically closes the circuit between the battery and the starter motor. When the ignition key is turned to its extreme right, the solenoid is energized and closes the battery-to-starter-motor circuit.

Note: All Jeep Universal Series vehicles have the starter solenoid switch secured to the starter motor assembly. The Hurricane F4 and Dauntless V-6 engine Prestolite starter drive is of the inertia type
(text continued on page 176)

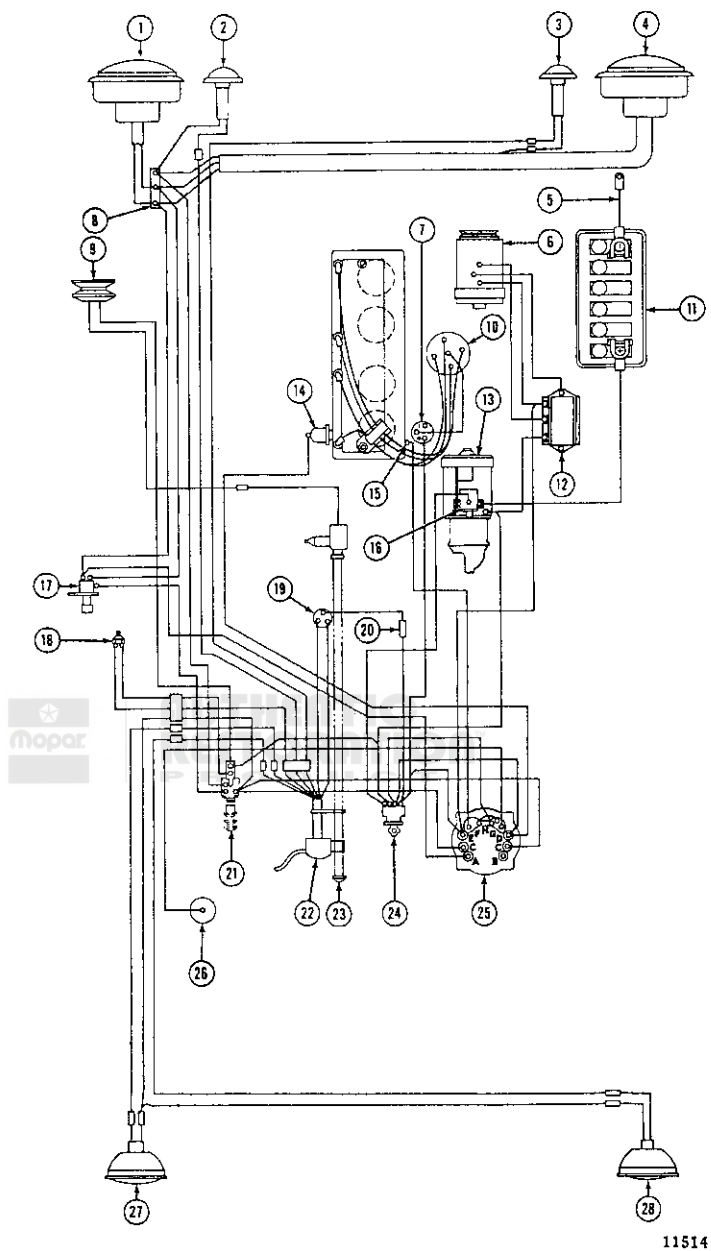


FIG. H-2—WIRING DIAGRAM—MODEL CJ-3B

(Serial No. 35522 and after)

- 1—Left Headlamp
- 2—Left Parking and Signal Lamp
- 3—Right Parking and Signal Lamp
- 4—Right Headlamp
- 5—Battery Ground Strap
- 6—Generator
- 7—Ignition Coil
- 8—Junction Block
- 9—Horn
- 10—Distributor
- 11—Battery
- 12—Voltage Regulator

- 13—Starting Motor
- 14—Oil Pressure Signal Switch
- 15—Temperature Sending Unit
- 16—Solenoid Switch
- 17—Foot Dimmer Switch
- 18—Stop Light Switch
- 19—Directional Signal Flasher
- 20—Fuse
- 21—Light Switch
- 22—Directional Signal Switch
- 23—Horn Button
- 24—Ignition and Starter Switch

- 25—Instrument Cluster
 - A—Upper Beam Indicator
 - B—Turn Signal Indicator
 - C—Instrument Lights
 - D—Oil Pressure Indicator
 - E—Charging Indicator
 - F—Temperature Gauge
 - G—Fuel Gauge
 - H—Instrument Voltage Regulator
- 26—Fuel Gauge Tank Unit
- 27—Left Tail end Stop Lamp
- 28—Right Tail and Stop Lamp

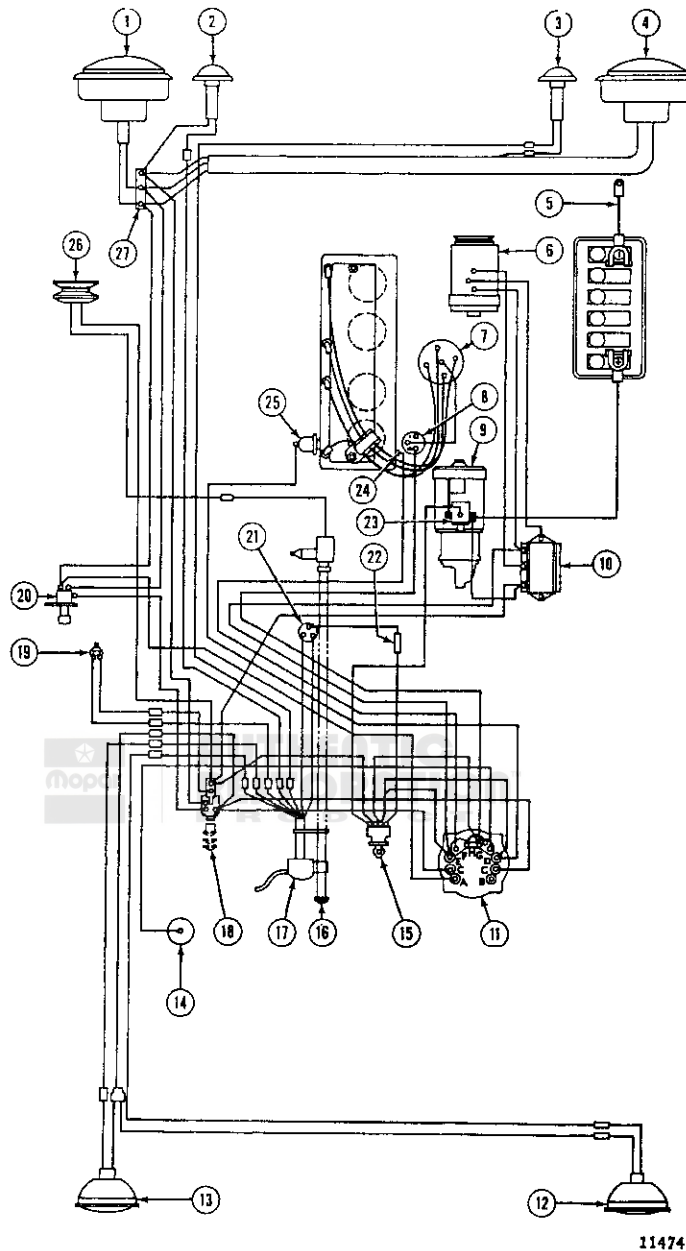


FIG. H-3—WIRING DIAGRAM—MODELS CJ-5, CJ-6, DJ-5 AND DJ-6—F4 ENGINE
(Model CJ-5 after Serial No. 49248, Model CJ-6 after Serial No. 12577)

- | | | |
|--------------------------------------|--------------------------------|-------------------------------|
| 1—Left Headlamp | B—Turn Signal Indicator | 17—Directional Signal Switch |
| 2—Left Parking and Directional Lamp | C—Instrument Lights | 18—Light Switch |
| 3—Right Parking and Directional Lamp | D—Oil Pressure Indicator | 19—Stop Light Switch |
| 4—Right Headlamp | E—Charging Indicator | 20—Foot Dimmer Switch |
| 5—Battery Ground Cable | F—Temperature Gauge | 21—Directional Signal Flasher |
| 6—Generator | G—Fuel Gauge | 22—Fuse |
| 7—Distributor | H—Instrument Voltage Regulator | 23—Solenoid Switch |
| 8—Ignition Coil | I—Instrument Voltage Regulator | 24—Temperature Sending Unit |
| 9—Starting Motor | 12—Right Tail and Stop Lamp | 25—Oil Pressure Signal Switch |
| 10—Voltage Regulator | 13—Left Tail and Stop Lamp | 26—Horn |
| 11—Instrument Cluster | 14—Fuel Gauge Tank Unit | 27—Junction Block |
| A—Upper Beam Indicator | 15—Ignition and Starter Switch | |
| | 16—Horn Button | |

whereas the Dauntless V-6 engine Delco starter drive is of the clutch type.

The starter circuit is opened when the ignition key is allowed to return to the "Ignition On" position. No repairs or adjustments can be made to the

ignition switch. If trouble develops in this switch, it must be replaced.

The ignition switch serves both to energize the ignition system and also to engage the starter solenoid switch. With the key in the vertical position, the electrical system is off. This is the only position

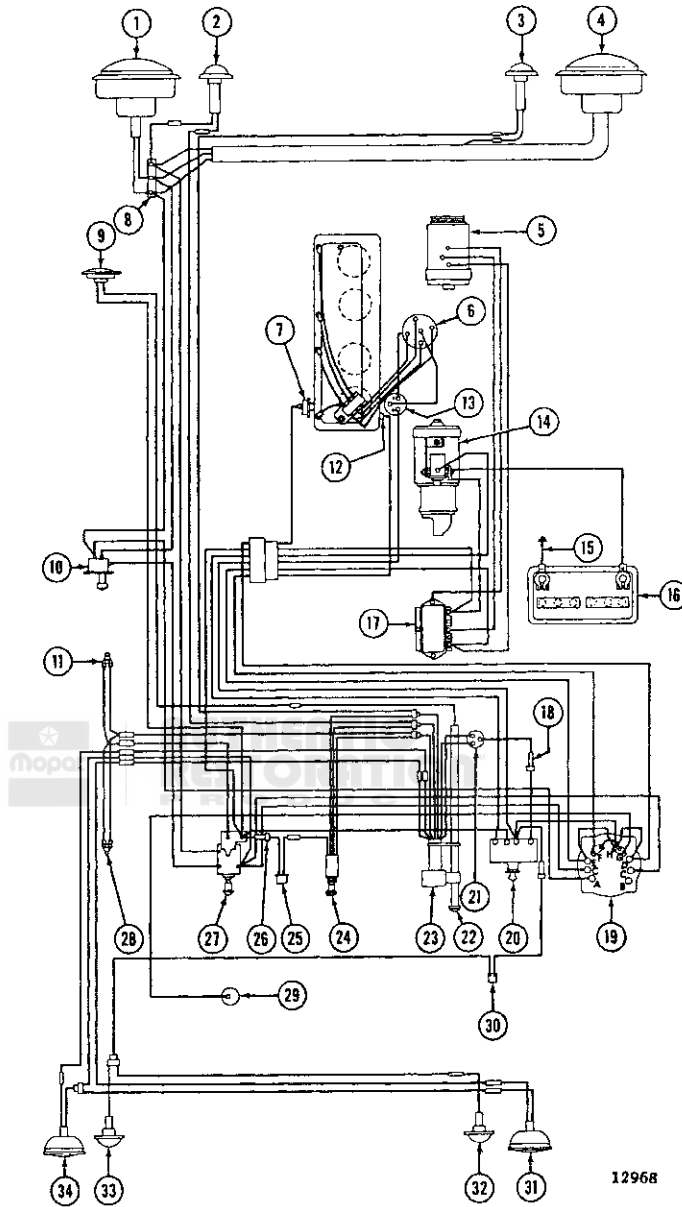


FIG. H-4—WIRING DIAGRAM—MODELS CJ-5, CJ-6, DJ-5, DJ-6 LATE F4 ENGINE

- | | | |
|---------------------------------|--------------------------------|---------------------------------|
| 1—Left Headlamp | 15—Battery Ground Cable | 21—Flasher (Directional Signal) |
| 2—Left Parking and Signal Lamp | 16—Battery | 22—Horn Button |
| 3—Right Parking and Signal Lamp | 17—Voltage Regulator | 23—Directional Signal Switch |
| 4—Right Headlamp | 18—Fuse | 24—4-Way Flasher Switch |
| 5—Generator | 19—Instrument Cluster | 25—Flasher (4-Way) |
| 6—Ignition Distributor | A—Hi-Beam Indicator | 26—Fuse |
| 7—Oil Pressure Sending Unit | B—Auxiliary | 27—Main Light Switch |
| 8—Junction Block | C—Instrument Lights | 28—Stop Light Switch — Rear |
| 9—Horn | D—Oil Pressure Indicator | 29—Fuel Gauge Tank Unit |
| 10—Foot Dimmer Switch | E—Charging Indicator | 30—Back-Up Light Switch |
| 11—Stop Light Switch — Front | F—Temperature Indicator | 31—Right Tail and Stop Lamp |
| 12—Temperature Sending Unit | G—Fuel Gauge | 32—Right Back-Up Lamp |
| 13—Ignition Coil | H—Instrument Voltage Regulator | 33—Left Back-Up Lamp |
| 14—Starting Motor | 20—Ignition and Starter Switch | 34—Left Tail and Stop Lamp |

in which the key can be removed. Turning the key to the left energizes auxiliary equipment such as windshield wipers, radio, and heater. The turn signal lights will operate with the ignition key in either the left or right position. The ignition switch is held in position by a tension spring on the back of the instrument panel and a notched bezel on the front of the instrument panel.

H-8. Lighting System

The wiring for the lighting system is shown in the wiring diagrams, Figs. H-2 thru H-7 of the manual, which indicate the various units in relation to their position in the vehicle. The lighting circuit is protected by an overload circuit breaker mounted on the rear of the light switch.

The main light switch controls the lighting system

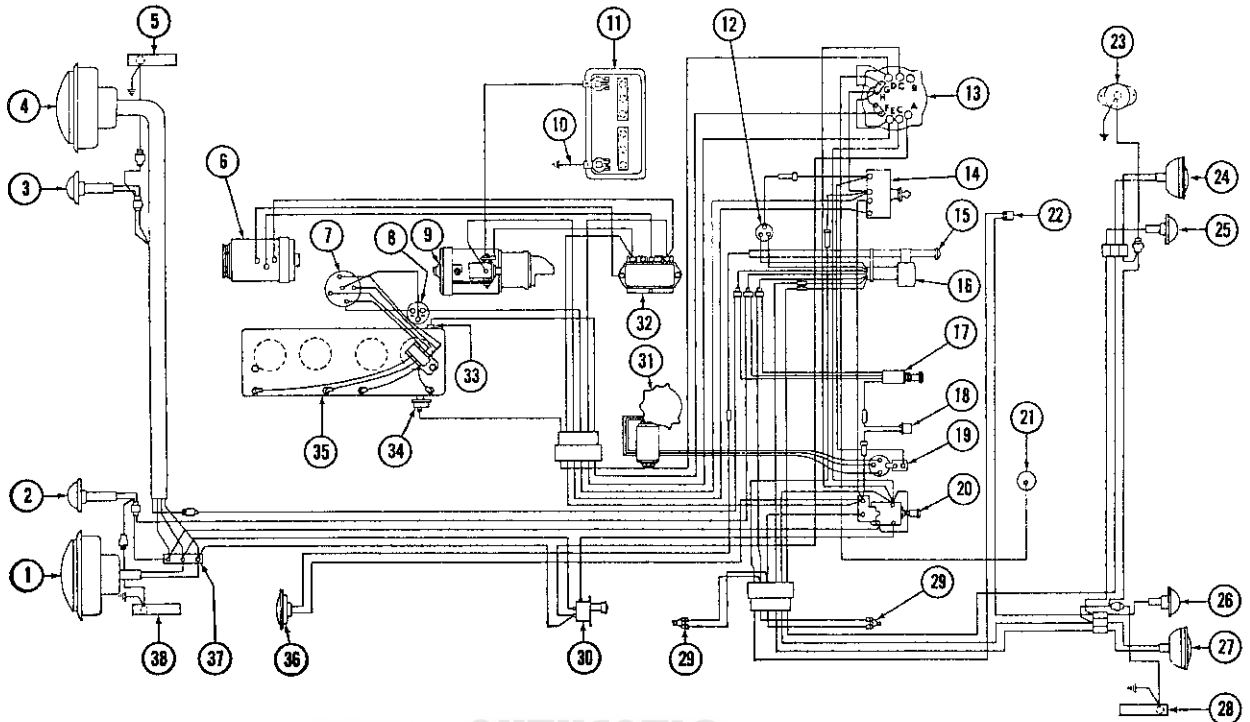


FIG. H-5—WIRING DIAGRAM—F4 ENGINE CURRENT MODEL

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- | | | |
|---------------------------------|----------------------------------|----------------------------------|
| 1—Left Headlamp | D—Oil Pressure Indicator | 24—Right Tail and Stop Lamp |
| 2—Left Parking and Signal Lamp | E—Charging Indicator | 25—Right Back-Up Lamp |
| 3—Right Parking and Signal Lamp | F—Temperature Indicator | 26—Left Back-Up Lamp |
| 4—Right Headlamp | G—Fuel Gauge Indicator | 27—Right Tail and Stop Lamp |
| 5—Marker Lamp — Amber | H—Instrument Voltage Regulator | 28—Marker Lamp — Red |
| 6—Generator | 14—Ignition and Starter Switch | 29—Stop Light Switch |
| 7—Distributor | 15—Horn Button | 30—Foot Dimmer Switch |
| 8—Ignition Coil | 16—Directional Signal Switch | 31—Windshield Wiper Motor Switch |
| 9—Starting Motor | 17—4-Way Flasher Switch | 32—Voltage Regulator |
| 10—Battery Ground Cable | 18—Flasher (4-Way) | 33—Temperature Sending Unit |
| 11—12 Volt Battery | 19—Windshield Wiper Motor Switch | 34—Oil Pressure Sending Unit |
| 12—Flasher (Directional Signal) | 20—Main Light Switch | 35—Spark Plugs & Cables |
| 13—Instrument Cluster | 21—Fuel Gauge Tank Unit | 36—Horn |
| A—Hi-Beam Indicator | 22—Back-Up Light Switch | 37—Junction Block |
| B—Auxiliary | 23—Marker Lamp — Red | 38—Marker Lamp — Amber |
| C—Instrument Lights | | |

through a two-position push-pull switch located on the left side of the control panel.

The foot-operated headlight dimmer switch is mounted on the floorboard to the left of the steering column.

H-9. PRESTOLITE DISTRIBUTOR — DAUNTLESS V-6 and HURRICANE F4 ENGINE

The Prestolite distributor on the F4 engine is mounted on the right side of the engine and is operated by a coupling on the oil pump shaft, see Fig. D-1, which is driven by a spiral gear on the camshaft. The spark advance is fully automatic, being controlled by built-in centrifugal weights. The Prestolite distributor on the V-6 engine (Fig. H-8) is mounted at the left front of the engine on the timing chain cover. It is driven by a spiral gear on the camshaft. The spark advance is fully automatic, being controlled by built-in centrifugal weights, and by a vacuum advance system. While some parts of the distributor may be checked or replaced with the unit mounted on the engine, it is best to periodically remove it for a thorough check. Infor-

mation covering the parts which can be serviced without removal is given below.

The Prestolite distributor installed on the V-6 engine is similar in construction to the distributor installed on the F4 engines except for the addition of a vacuum advance mechanism.

The same checking procedures outlined in Par. C-10a, are used for the Prestolite V-6 distributor with exception of specifications.

H-10. Distributor Cap

The distributor cap should be inspected for cracks, carbon runners and evidence of arcing. If any of these conditions exists, the cap should be replaced. Clean any corroded high tension terminals.

H-11. Rotor

Inspect the rotor for cracks or evidence of excessive burning at the end of the metal strip. After a distributor rotor has had normal use the end of the rotor will become burned. If burning is found on top of the rotor it indicates the rotor is too short and needs replacing. Usually when this condition is found the distributor cap segment will

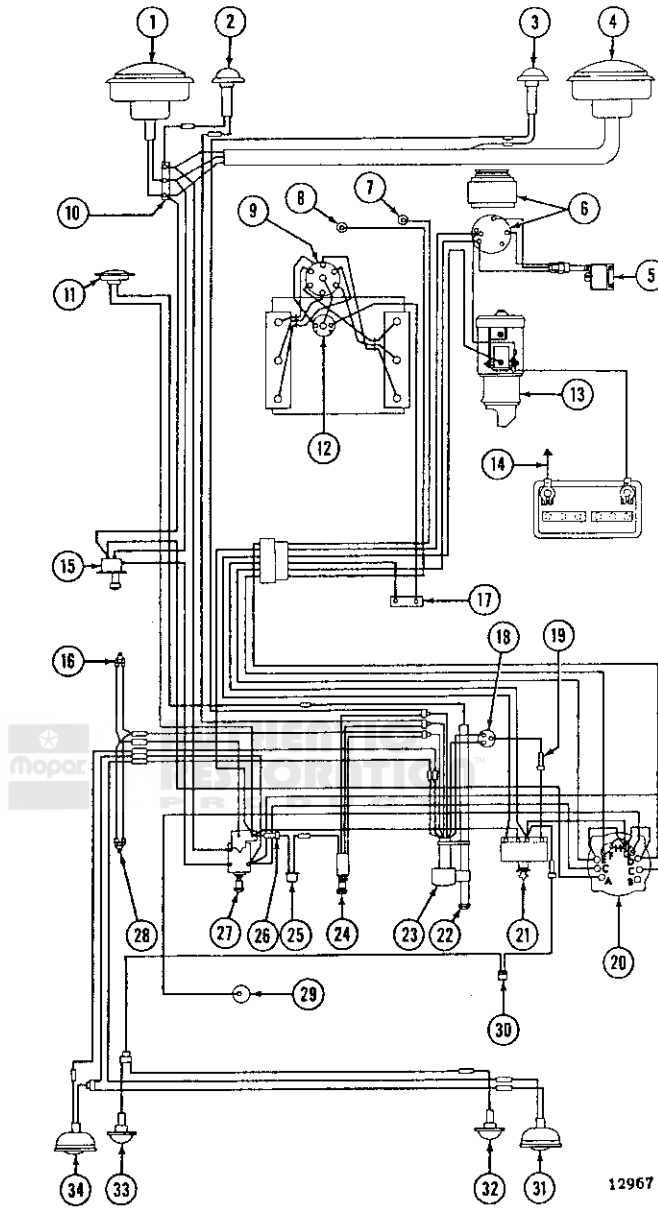


FIG. H-6—WIRING DIAGRAM—LATE V6 ENGINE

- | | | |
|---------------------------------|---------------------------------|--------------------------------|
| 1—Left Headlamp | 15—Foot Dimmer Switch | 21—Ignition and Starter Switch |
| 2—Left Parking and Signal Lamp | 16—Stop Light Switch -- Front | 22—Horn Button |
| 3—Right Parking and Signal Lamp | 17—Ballast | 23—Directional Signal Switch |
| 4—Right Headlamp | 18—Flasher (Directional Signal) | 24—4-Way Flasher Switch |
| 5—Voltage Regulator | 19—Fuse | 25—Flasher (4-Way) |
| 6—Alternator | 20—Instrument Cluster | 26—Fuse |
| 7—Oil Pressure Sender | A—Hi-Beam Indicator | 27—Main Light Switch |
| 8—Temperature Sender | B—Auxiliary | 28—Stop Light Switch -- Rear |
| 9—Ignition Distributor | C—Instrument Lights | 29—Fuel Gauge Tank Unit |
| 10—Junction Block | D—Oil Pressure Indicator | 30—Back-Up Light Switch |
| 11—Horn | E—Charging Indicator | 31—Right Tail and Stop Lamp |
| 12—Ignition Coil | F—Temperature Indicator | 32—Right Back-Up Lamp |
| 13—Starting Motor | G—Fuel Gauge | 33—Left Back-Up Lamp |
| 14—Battery Ground Cable | H—Instrument Voltage Regulator | 34—Left Tail and Stop Lamp |

be burned on the horizontal face and the cap will also need replacing.

H-12. Condenser

The condenser prolongs the life of the distributor points by preventing arcing at the contacts. It also

provides a hotter spark by creating a reverse surge of current which rapidly breaks down the magnetic field of the coil by demagnetizing the core. Should the condenser be leaky, a weak spark will result. Check the condenser lead for broken wires or frayed insulation. Clean and tighten the connec-

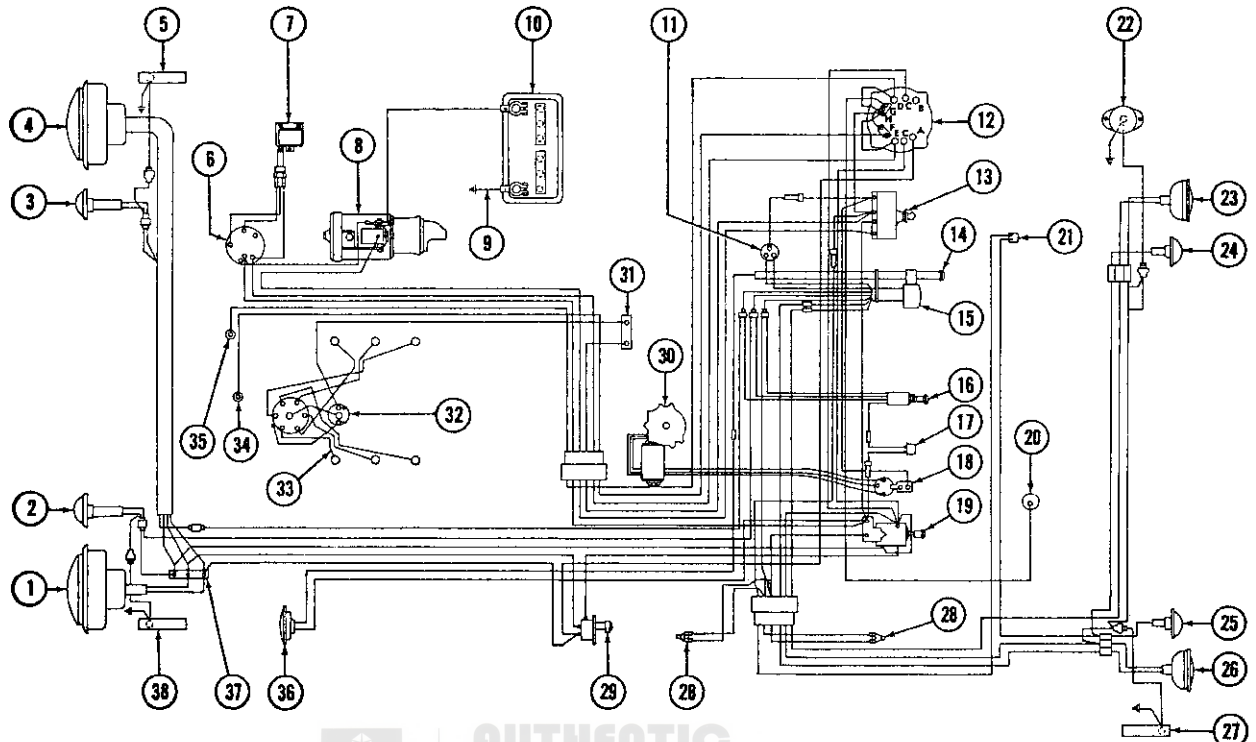


FIG. H-7—WIRING DIAGRAM—V6 ENGINE CURRENT MODEL

- | | | |
|---------------------------------|----------------------------------|------------------------------------|
| 1—Left Headlamp | E—Charging Indicator | 24—Right Back-Up Lamp |
| 2—Left Parking and Signal Lamp | F—Temperature Indicator | 25—Left Back-Up Lamp |
| 3—Right Parking and Signal Lamp | G—Fuel Gauge Indicator | 26—Left Tail and Stop Light |
| 4—Right Headlamp | H—Instrument Voltage Regulator | 27—Marker Lamp — Red |
| 5—Marker Lamp — Amber | 13—Ignition and Starter Switch | 28—Stop Light Switch |
| 6—Alternator | 14—Horn Button | 29—Foot Dimmer Switch |
| 7—Voltage Regulator | 15—Directional Signal Switch | 30—Windshield Wiper Motor Assembly |
| 8—Starting Motor | 16—4-Way Flasher Switch | 31—Ballast Resistor |
| 9—Battery Ground Cable | 17—Flasher (4-Way) | 32—Ignition Coil |
| 10—12 Volt Battery | 18—Windshield Wiper Motor Switch | 33—Spark Plugs and Cables |
| 11—Flasher (Directional Signal) | 19—Main Light Switch | 34—Temperature Sending Unit |
| 12—Instrument Cluster | 20—Fuel Gauge Tank Unit | 35—Oil Pressure Sending Unit |
| A—Hi-Beam Indicator | 21—Back-Up Light Switch | 36—Horn |
| B—Auxiliary | 22—Marker Lamp — Red | 37—Junction Block |
| C—Instrument Lights | 23—Right Tail and Stop Light | 38—Marker Lamp — Amber |
| D—Oil Pressure Indicator | | |

tions on the terminal posts. Be sure condenser is mounted firmly on the distributor for a good ground connection.

Should a condenser tester be available the capacity for both F4 and Prestolite V6 condenser should check from .25 to .28 microfarads. In the absence of tester, check by substituting a new condenser.

H-13. Distributor Points

- a. Examine the distributor points. If they show wear, poor mating, transferred metal, or pitting, then new ones should be installed. Clean the points with a suitable solvent and a stiff bristled brush.
- b. Check the alignment of the point for a full, square contact. If not correctly aligned, bend the stationary contact bracket slightly to provide alignment.
- c. The contact gap should be set at .020" [0,508 mm.], on the F4 and .016" [0,406 mm.] on the Prestolite V6. Adjustment of the gap is accomplished by loosening the lock screw and turning

adjusting eccentric screw until correct gap is secured. Be sure that the fiber block on the breaker arm is resting on the highest point on the cam while the adjustment is being made. Recheck the gap after locking the adjustment.

d. Apply a thin film of cam lubricant to the cam to lessen fiber block wear.

e. Using Tool C-4094, check point contact spring pressure, which should be between 17 and 20 ounces [0,487 a 0,567 kg.] on the F4 and 17 to 22 oz. [0,487 a 0,624 kg.] on the Prestolite V6. Check with a spring scale hooked on the breaker arm at the contact and pull at right angle to the breaker arm. Make the reading just as the points separate. Adjust the point pressure by loosening the stud holding the end of the contact arm spring and slide the end of the spring in or out as necessary. Retighten the stud and recheck the pressure. Too low a pressure will cause engine missing at high speeds. Too high a pressure will cause rapid wear of the cam, block, and points.

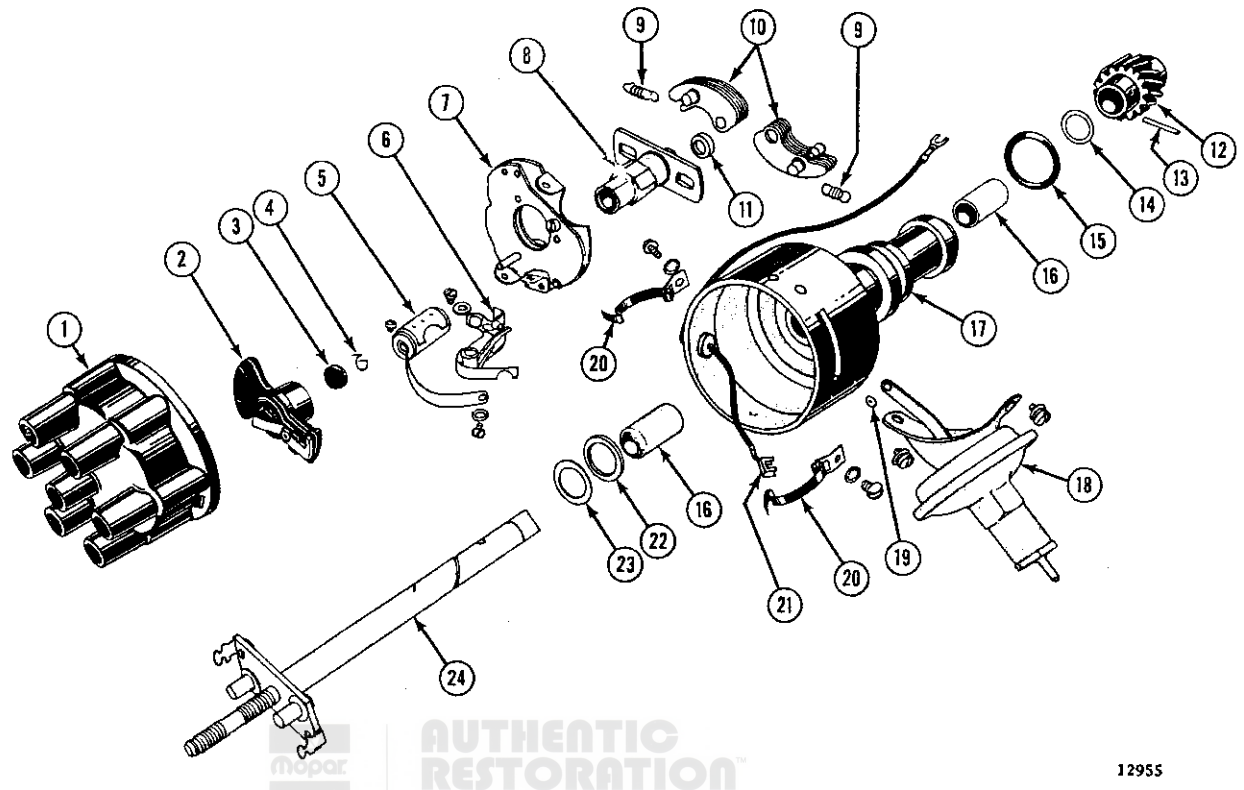


FIG. H-8—PRESTOLITE DISTRIBUTOR—DAUNTLESS V-6 ENGINE

- | | | | |
|--------------------|----------------------|------------------------|-------------------------|
| 1—Cap | 7—Breaker Plate | 13—Gear Pin | 19—Washer (Nylon) |
| 2—Rotor | 8—Cam and Stop Plate | 14—Washer | 20—Cap Clamp and Hinge |
| 3—Lubricating Wick | 9—Spring (2) | 15—O-Ring Seal | 21—Primary Lead |
| 4—Snap Ring | 10—Governor Weight | 16—Bushings | 22—Washer (outer upper) |
| 5—Condenser | 11—Cam Spacer | 17—Distributor Housing | 23—Washer (inner upper) |
| 6—Contact Set | 12—Gear | 18—Vacuum Chamber | 24—Drive Shaft |

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H-14. Governor Mechanism

The centrifugal advance mechanism consists of an automatic 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 contact points to open earlier and thus advancing the spark. The centrifugal type governor should be checked for free operation. Hold the governor shaft and turn the cam to the left as far as possible and release it. The cam should immediately return to the original position without drag.

Should a distributor test fixture be available it is best to make a check through the entire advance range, following the instructions of the fixture manufacturer.

The vacuum control unit is mounted separately on the outside of the distributor housing on the V6 Prestolite distributor.

The vacuum control unit consists of an enclosed spring-loaded diaphragm linked mechanically to the distributor. The air-tight side of the diaphragm is connected to the intake manifold side of the carburetor. Under part throttle operation, the intake manifold vacuum is sufficient to actuate the diaphragm and cause the distributor to rotate in its mount, thus advancing the spark and increasing fuel economy. During acceleration or when the

engine is pulling heavily, the vacuum is not sufficient to actuate the diaphragm and the distributor is held in the retarded position by a calibrated return spring which bears against the vacuum diaphragm.

H-15. Distributor Removal

- Remove high-tension wires from the distributor cap terminal towers, noting the order in which they are assembled to ensure correct reassembly.
- Remove the primary lead from the terminal post at the coil.
- Unlatch the two distributor cap springs and remove the cap.
- Note the position of the rotor in relation to the base. This should be remembered to facilitate re-installing and timing.
- Remove the screw holding the distributor to the crankcase and lift the assembly from the engine.

H-16. Prestolite Distributor Disassembly

Refer to Fig. H-8 and H-9.

- Remove the rotor.
- Remove the condenser.
- Remove the distributor points.
- Remove nylon washer attaching vacuum advance arm to breaker plate, V6 only. Remove two

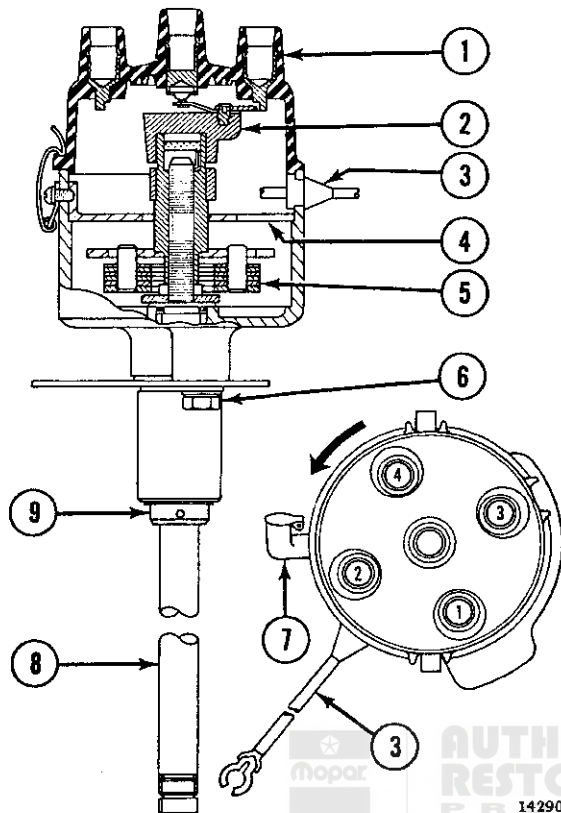


FIG. H-9—DISTRIBUTOR ASSEMBLY--
HURRICANE F4 ENGINE

- | | |
|--------------------|--|
| 1—Cap | 6—Advance Plate Lock Screw |
| 2—Rotor | 7—Oiler and Felt Wick |
| 3—Primary Wire | 8—Drive Shaft |
| 4—Breaker Plate | 9—Drive Shaft Collar and Thrust Washer |
| 5—Governor Weights | |

attaching screws; remove vacuum advance unit from housing.

e. Remove the two clamp hinge to breaker plate screws; remove breaker plate from housing.

f. Remove the shaft assembly. To do this, file off the upset end of the pin which is placed through the collar and shaft at the lower end of the housing and drive out the pin with a suitable punch. Remove the collar and washer. Pull the shaft from the housing.

g. Should it be necessary to remove the cam assembly, first remove the felt wick from the upper end. Use long-nose pliers to compress and remove the spring locking clip located at the bottom of the drilled center opening of the cam. Remove the cam.

H-17. Distributor Inspection

If the shaft and bearings are worn sufficiently to allow .005" or more looseness of the shaft, they must be replaced. Before installing new bearings, soak them in medium grade engine oil and allow them to drain. Wipe all oil from the upper part of the housing.

Important: After new bearing installation, drill a $\frac{1}{8}$ " [3,2 mm.] lubrication hole through the upper

bearing before installing the drive shaft. Refer to Fig. H-8 item 16.

At assembly, apply a film of grease to the upper drive shaft washer and put a small amount of grease in the bearing bore just above the bearings. Lubricate the governor mechanism sparingly with medium grade engine oil in the oiler mounted on the side of the housing and 5 drops on the left located in the center opening of the cam directly below the rotor. Place a very light smear of grease on the cam and 1 drop of oil on the breaker arm pivot.

Before installing the distributor, check the friction spring mounted on the lower end of the drive shaft and replace it if worn or damaged.

Inspect rod end of vacuum advance mechanism for excessive wear. Push rod into unit as far as possible, hold finger tightly over nipple, then release rod. After about 15 seconds, remove finger from nipple, and notice if air is drawn into unit. If not, diaphragm is leaking and unit must be replaced.

H-18. Installation and Ignition Timing

If the engine crankshaft has been rotated, with the distributor off, it will be necessary to place No. 1 piston in firing position to correctly install the distributor. Refer to Pars. C-10 and C-11.

Oil the distributor housing where it bears in the cylinder block and install the distributor on the cylinder block. Mount the rotor on distributor shaft and turn the shaft until the rotor points towards No. 1 spark terminal tower position (when cap is installed) with the contact points just breaking. Move the rotor back and forth slightly until the driving lug on the end of the shaft enters the slot cut in the oil pump gear and slide the distributor assembly down into place. Rotate the distributor body until the contact points are just breaking. Install the hold down screw.

H-19. Ignition Coil — F4 Engine

The sealed coil does not require any special service other than keeping the terminals and wire connection clean and tight.

The positive (+) terminal of the coil is connected to the ignition switch and is also connected directly to the starter solenoid to by-pass the resistance during cranking of engine.

The negative (—) terminal is connected to the distributor. The secondary (High tension) terminal is connected by a short cable to the center terminal in the distributor cap.

Note: Always make certain the coil wires are connected to the proper coil terminals to ensure correct coil polarity.

H-20. DELCO DISTRIBUTOR — DAUNTLESS V-6 ENGINE

The distributor (Fig. H-10) is mounted at the left front of the engine on the timing chain cover. It is driven by a spiral gear on the camshaft. The spark advance is fully automatic, being controlled

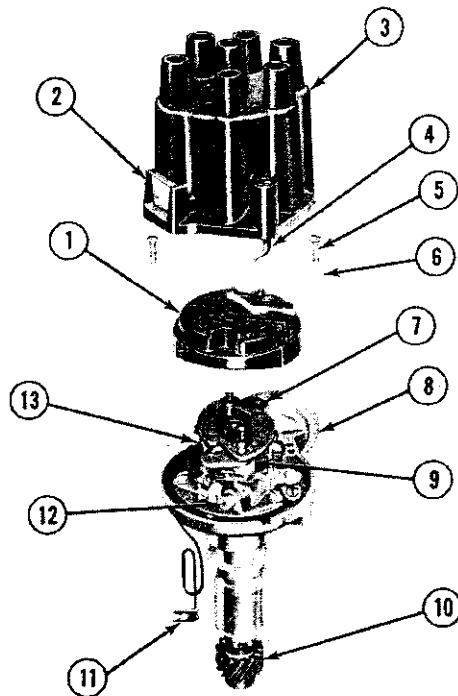


FIG. H-10—DELCO DISTRIBUTOR—
DAUNTLESS V-6 ENGINE

- | | |
|------------------------|-----------------|
| 1—Rotor | 8—Vacuum Unit |
| 2—Window | 9—Breaker Cam |
| 3—All Weather Cap | 10—Drive Gear |
| 4—Cap Latch | 11—Primary Lead |
| 5—Rotor Mounting Screw | 12—Contact Set |
| 6—Lock Washer | 13—Condenser |
| 7—Advance Mechanism | |

by built-in centrifugal weights, and by a vacuum advance system. Contact point opening is adjusted through a window in the distributor cap while the engine is idling. Some parts of the distributor may be checked or replaced with the distributor mounted on the engine, but it is best to remove it periodically for a thorough check. Information on parts which can be serviced without removal is given below.

Note: Prestolite and Delco distributors are interchangeable on V-6 engine equipped vehicles.

H-21. Distributor Cap

The distributor cap should be inspected for cracks, carbon runners and evidence of arcing. If any of these conditions exist, the cap should be replaced. Clean any corroded high tension terminals.

H-22. Rotor

Inspect the rotor for cracks or evidence of excessive burning at the end of the metal strip. After a distributor rotor has had normal use, the end of the rotor will become burned. If burning is found on top of the rotor it indicates the rotor is too short and needs replacing. Usually when this condition is found the distributor cap segment will be burned on the horizontal face and the cap will also need replacing.

H-23. Condenser

The condenser prolongs the life of the distributor points by preventing arcing at the contacts. It also provides a hotter spark by creating a reverse surge of current which rapidly breaks down the magnetic field of the coil by demagnetizing the core. Should the condenser be leaky a weak spark will result. Check the condenser lead for broken wires or frayed insulation. Clean and tighten the connections on the terminal posts. Be sure the condenser is mounted firmly on the distributor for a good ground connection.

Should a condenser tester be available the capacity should check from .18 to .23 microfarads. In the absence of a tester check by substituting new condenser.

H-24. Distributor Points

a. Examine distributor points. Using Tool C-4094, check point contact spring pressure, should be 19 to 23 oz. [0,538 a 0,652 kg.]. Install new points if they are worn, pitted, mate poorly, or show signs of metal transfer. Should premature ignition point failure occur because of dust entering the distributor cap and causing excessive wear to the ignition point fiber block, perform the following corrections after installing new distributor points.

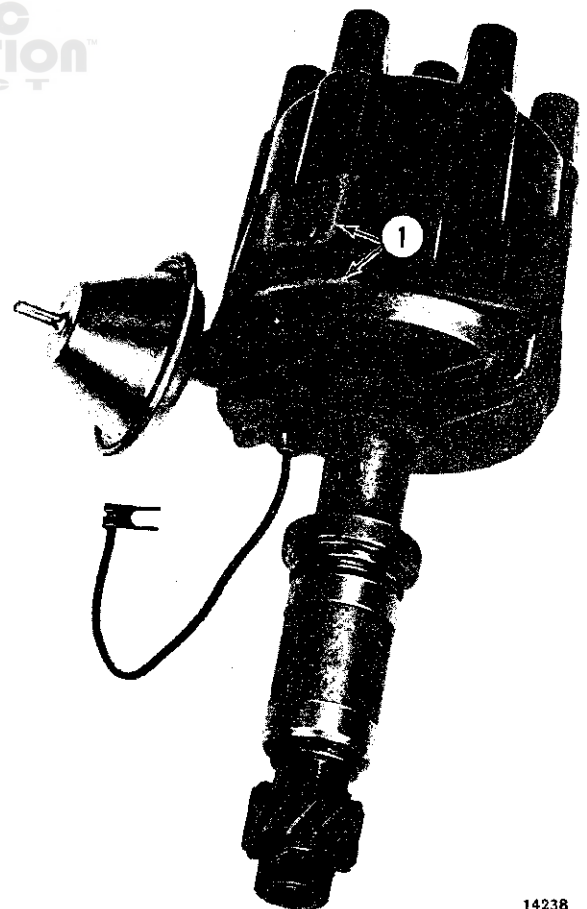


FIG. H-11—SEALING DISTRIBUTOR CAP

- 1—Caulking Compound

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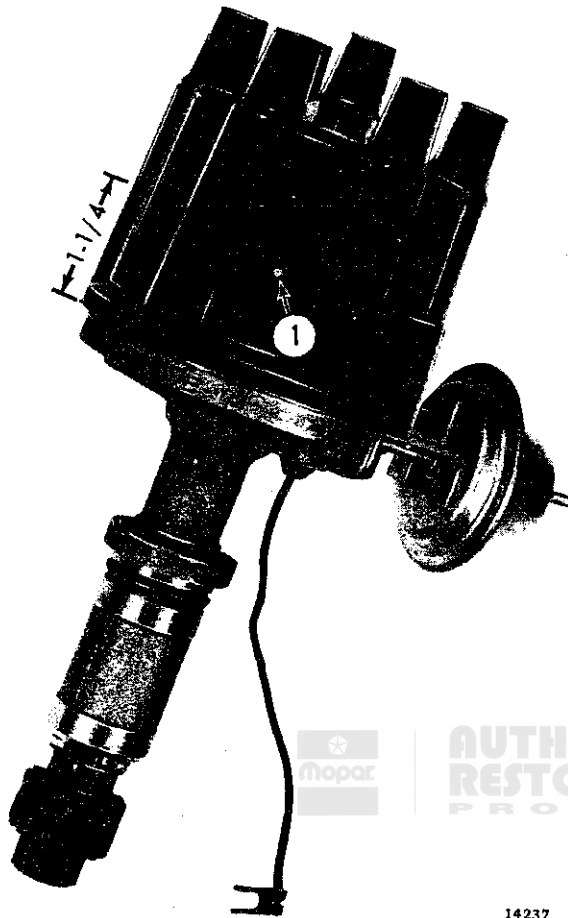


FIG. H-12—DRILLING DISTRIBUTOR CAP

1— $\frac{3}{32}$ " Vent Hole Location

Seal the distributor cap access window and the area beneath the distributor cap with caulking compound as shown in Fig. H-11. At approximately 180° from the distributor cap access window, drill a $\frac{3}{32}$ " [2,38 mm.] vent hole 1 $\frac{1}{4}$ " [31,75 mm.] from the bottom of the distributor cap as shown in Fig. H-12.

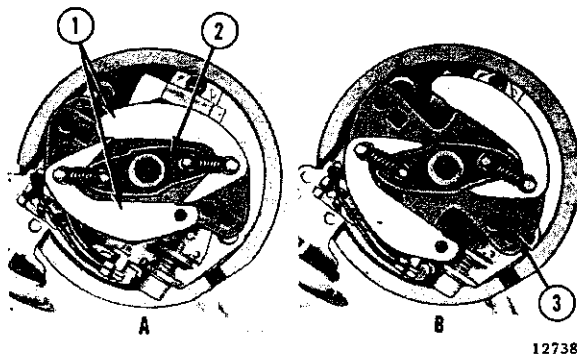


FIG. H-13—CENTRIFUGAL ADVANCE MECHANISM (DELCO)

A—No Advance
1—Advance Weights
2—Advance Cam
B—Full Advance
3—Full Advance

b. To adjust breaker point cam dwell, refer to Par. C-10.

H-25. Centrifugal Advance

Refer to Fig. H-13.

Inspect for excessive wear between centrifugal weights and advance cam, or pivot pins. Turn weight base plate in a clockwise direction until weights are fully extended, then release and allow springs to return to retard position. Repeat several times. Springs should return weights to stop without sticking and there should be no excess free movement in the retard position.

H-26. Distributor Removal

a. Disconnect the distributor primary wire from coil and disconnect hose from vacuum advance mechanism of distributor. Insert a screwdriver in upper slotted end of two distributor cap retainers. Press downward, and turn 90 degrees counterclockwise to release. Remove cap from distributor housing.

b. Make an index mark on distributor housing (Fig. H-14) in line with center of rotor. Carefully note the direction the vacuum unit points in relation to engine so that the distributor can be installed in the same position after it is serviced.

Caution: If engine is turned over while distributor is removed, complete ignition timing procedure must be followed upon distributor installation.

c. Remove attaching cap screw and distributor clamp from timing chain cover. Lift distributor upward and remove it from timing chain cover.

H-27. Distributor Disassembly (Delco)

Refer to Fig. H-15.

a. Remove rotor, breaker point assembly, and capacitor from distributor.

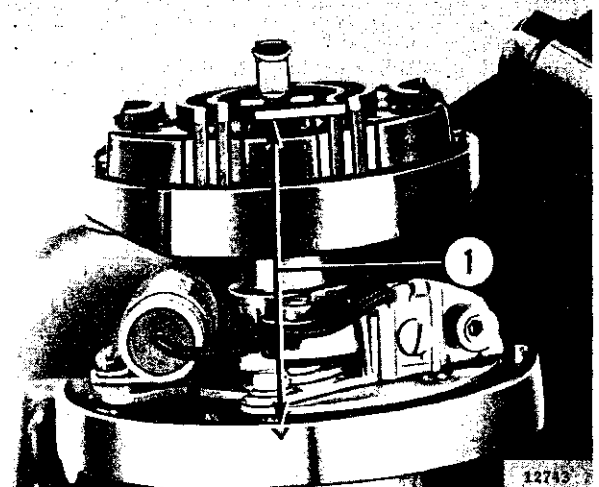


FIG. H-14—DELCO DISTRIBUTOR ROTOR POSITION

1—Rotor Tip Lined Up With Notch

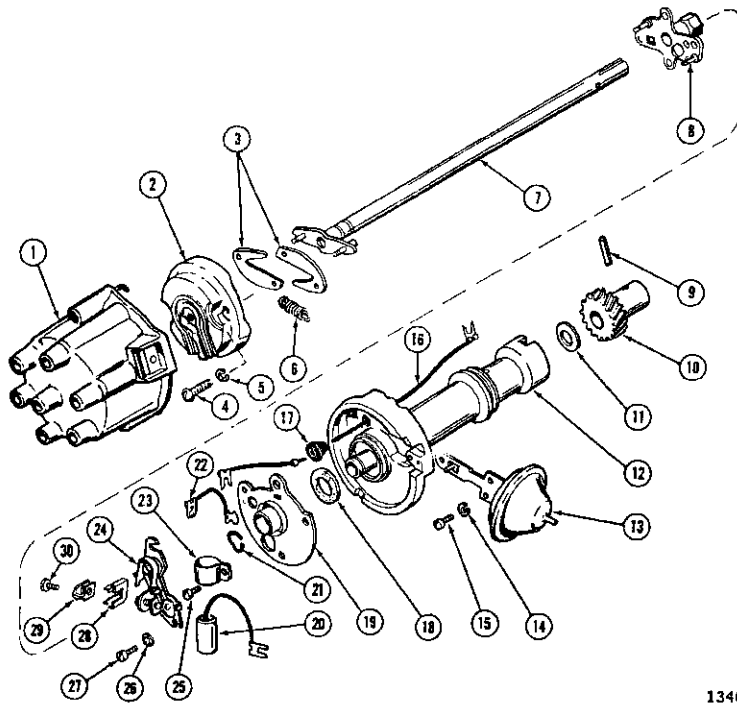


FIG. H-15—DELCO DISTRIBUTOR—DAUNTLESS V-6 ENGINE

- 1—Cap Assembly
- 2—Rotor
- 3—Governor Weight
- 4—Rotor Mounting Screw
- 5—Lock Washer
- 6—Weight Spring (Governor)
- 7—Shaft
- 8—Cam Assembly
- 9—Gear Fin
- 10—Drive Gear
- 11—Spacer Washer
- 12—Housing
- 13—Vacuum Control
- 14—Lock Washer
- 15—Control Mounting Screw
- 16—Primary Lead
- 17—Lead Grommet
- 18—Washer
- 19—Breaker Plate
- 20—Condenser
- 21—Retaining Spring
- 22—Ground Lead
- 23—Condenser Clamp
- 24—Contact Set
- 25—Clamp Screw
- 26—Lock Washer
- 27—Contact Screw
- 28—Insulator
- 29—Spring Clip
- 30—Screw

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b. Remove and discard O-ring seal from distributor housing.

c. Remove two attaching screws; remove vacuum advance from housing.

d. Drive pin from driven gear and shaft, using a 1/8" [3,2 mm.] straight punch. See Fig. H-16.

Caution: Be careful not to bend distributor shaft or damage gear when driving pin out.

e. Remove gear and thrust washer from shaft; pull the shaft, breaker cam, and centrifugal advance mechanism from the housing.

f. Remove two springs and centrifugal advance

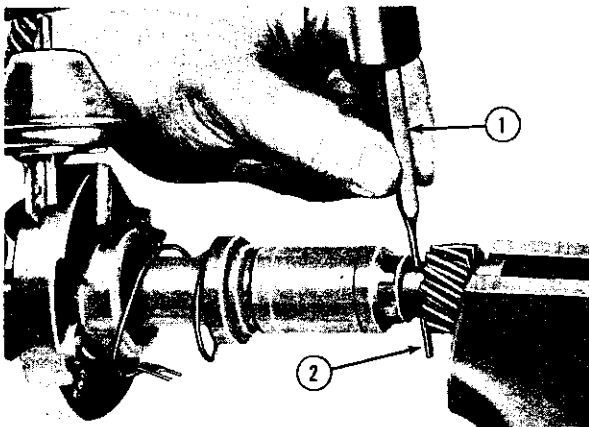
weights from the integral weight base plate and breaker cam. Remove plate from end of shaft.

g. Remove retainer breaker plate, and felt washer from upper bushing.

Note: Lubricant reservoir contains sufficient lubricant for the life of the distributor. Do not move plastic reservoir cover from housing. Do not degrease bore of housing.

h. Remove distributor primary lead and grommet from housing.

Caution: Do not attempt to replace the shaft bushings in the housing; the housing and bushings are serviced only as an assembly.



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FIG. H-16—DISTRIBUTOR GEAR AND SHAFT PIN REMOVAL (DELCO)

1—1/8" Punch

2—Spring Pin

H-28. Distributor Parts Cleaning and Inspection

a. Wash the distributor housing, shaft, gear, breaker plate, and weight base and cam in suitable cleaning solvent. Hold housing in horizontal position to avoid getting cleaning solvent into the lubricant reservoir. Dry parts thoroughly.

b. Wipe distributor cap with a clean cloth. Inspect it for chips, cracks, and carbonized paths which would allow high-voltage leakage. Such defects require replacement of cap. Clean loose corrosion from surfaces of terminal segments inside the cap. Do not use emery cloth or sandpaper. If segments are deeply grooved, the cap should be replaced. Pull cables from terminal sockets and inspect sockets for corrosion. Clean sockets, using a stiff wire brush to loosen corrosion.

c. Inspect rotor for wear and damage. If rotor is cracked, spring contact is badly worn, or rotor tip is badly burned, rotor must be replaced.

d. Inspect for excessive wear between centrifugal weights and advance cam and pivot pins. Turn weight base plate in a clockwise direction until weights are fully extended. Release and allow springs to return weights to retard position. Repeat several times. Springs should return weights to stop without sticking and there should be no excessive free movement in the retard position. Inspect springs for distortion and fatigue.

e. Inspect cam lobes for scoring or excessive wear. Check weight base plate for binding or excessive looseness on distributor shaft.

f. Check breaker plate for excessive looseness on outside diameter of upper distributor shaft bushing. Check breaker plate ground lead for poor spotweld at plate end and for loose or frayed terminal connections.

g. Check for excessive wear between distributor shaft and bushings in housing. Inspect shaft for distortion. Inspect gear for scoring of teeth or excessive wear.

h. Inspect rod end of vacuum advance mechanism for excessive wear. Push rod into unit as far as possible, hold finger tightly over nipple, then release rod. After about 15 seconds, remove finger from nipple, and notice if air is drawn into unit. If not, diaphragm is leaking and unit must be replaced.

H-29. Distributor Reassembly

Refer to Fig. H-15.

a. Install distributor primary lead and rubber grommet in distributor housing. Mount vacuum advance unit on housing with two slotted attaching screws; insert ground lead terminal of breaker plate under outer mounting screw.

b. Install felt washer over upper shaft bushing of distributor housing and apply a few drops of light oil. Secure breaker plate to upper bushing with retainer. See Fig. H-17.

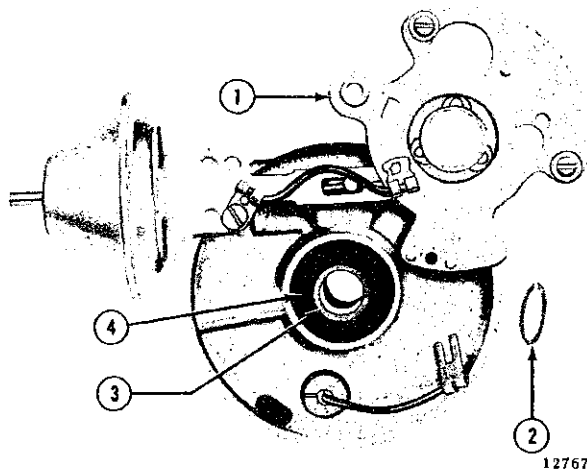


FIG. H-17—INSTALLING BREAKER PLATE ON DISTRIBUTOR HOUSING (DELCO)

- 1—Breaker Plate
- 2—Retainer
- 3—Retainer Groove
- 4—Lubricant Reservoir

c. Install distributor cam and weight base plate on distributor shaft.

d. Insert distributor shaft into distributor housing. Install centrifugal advance weights and springs on cam and weight base plate.

e. Fasten driven gear to shaft with pin. Be careful not to damage gear.

f. Secure condenser and bracket to breaker plate with slotted screw.

g. Install breaker point assembly over boss on breaker plate; secure with two slotted screws and lock washers. Apply one drop of light oil to breaker arm pivot. Connect condenser and coil primary leads to breaker point assembly.

h. Apply a small amount of high temperature cam and ball bearing lubricant to a clean cloth; hold cloth against distributor cam while turning distributor shaft.

Caution: Do not apply excessive grease. Petroleum jelly is not suitable as a distributor cam lubricant.

i. Make preliminary adjustment of breaker point gap, as described in Par. C-10.

j. Secure rotor to centrifugal timing advance mechanism with two screws, lock washers, and flat washers.

Note: The square and round lugs on the rotor must be positioned in the corresponding holes in the weight base plate.

k. If a reliable distributor tester is available, check the distributor to make certain that the centrifugal and vacuum advance mechanisms are operating according to specifications.

Note: Mount distributor in tester with all end play of the distributor shaft in upward position; this will eliminate any possible drag between the centrifugal advance cam and weight base plate.

l. Install new O-ring seal on distributor housing.

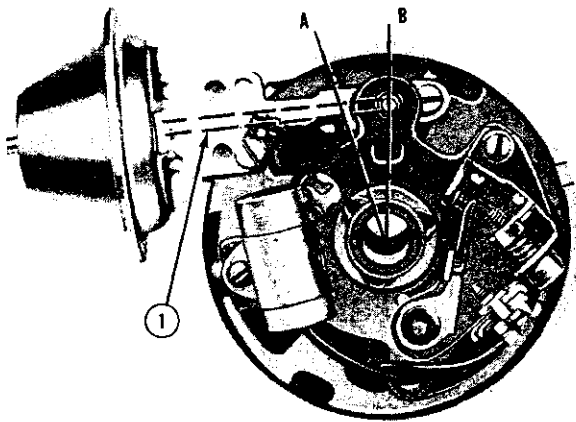
H-30. Distributor Installation and Timing

a. Insert distributor shaft into timing gear cover of engine so that rotor is pointing to mark made on distributor base (Fig. H-14), with vacuum advance unit pointing in exact, original direction (Fig. H-18).

b. Install distributor clamp and bolt with lock washer, leaving bolt just loose enough to permit movement of the distributor with heavy hand pressure.

c. Connect primary wire to distributor side of coil. Install distributor cap on distributor housing. Press screwdriver into upper slotted ends of two cap retainers. Turn retainers clockwise to secure cap to distributor.

d. If spark cables were disconnected from distributor cap, connect them. Wires must be pushed all the way down into the distributor cap terminals and onto the spark plugs. Nipples must be pushed firmly over the terminals; boots must be pushed firmly over the spark plugs.



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FIG. H-18—VACUUM ADVANCE MECHANISM (DELCO)

A—Full Advance
B—No Advance
1—Vacuum Pull Rod

e. To adjust breaker point cam dwell and set timing of engine, refer to Pars. C-10 and C-11.

H-31. Coil — V-6 Engine

The sealed coil does not require any special service other than keeping the terminals and wire connections clean and tight.

The positive (+) terminal of the coil is connected to the ignition switch through the ballast resistor, and is also connected directly to the starter solenoid to by-pass the resistance during cranking of engine.

The negative (—) terminal is connected to the distributor. The secondary (high tension) terminal is connected by a short cable to the center terminal in the distributor cap.

Always make certain the coil wires are connected to the proper coil terminals to ensure correct coil polarity.

Note: The ignition coil and ballast resistor must be of the same manufacturer. Ballast resistors and ignition coils of one manufacturer are interchangeable with both units of the other.

H-32. Ballast Resistor

● V-6 Engine.

An ignition ballast resistor is in series with the primary winding of the coil. The ballast resistor helps regulate the flow of primary current throughout the speed range. At low speeds when the contacts remain closed longer, the ballast heats and increases in resistance, thereby limiting the flow of primary current. At higher speeds when the contacts remain closed for shorter periods of time, the ballast cools and thereby decreases in resistance to allow more primary current and reduce the fall off in available voltage. During starting, the resistor compensates for the lowered battery voltage resulting from the starter load and permits an increase in primary current, resulting in a higher secondary voltage for starting.

The only test required of the ignition ballast resistor is a continuity check. Characteristics of the ballast produce wide variations in resistance with changes in ballast temperature. Therefore, checking voltage drop across the ballast would be misleading.

Caution: Never make a connection that connects the ballast across the battery as this will burn the ballast resistor winding.

H-33. Spark Plugs

Clean and gap spark plugs as described in Par. C-4. Inspect them for excessive burning and erosion of electrodes, blistering of porcelain at the firing tip, black deposits, or fouling. These conditions indicate that the plugs have not been operating at the correct temperature.

Note: Prolonged idling just before removing and checking the plugs should be avoided as it may produce false indications.

Spark plug operating temperatures may have been too hot, too cold, or normal as described.

a. At too hot a temperature, the tip of the insulator will show dark spots and blisters after fairly short service. As high-temperature operation is continued, the whole insulator nose will discolor, showing fused and blistered deposits near the electrode as well as considerable erosion and burning of the electrodes. After extreme service, the porcelain itself may be fused, cracked, and blistered at the tip. The electrodes will show extreme erosion and burning and possibly even surface cracking.

Note: If such cracking appears on certain plugs after fairly short service, it may be caused by water leaks in the associated cylinders.

b. At too cold a temperature plug operation, in the early stages, will result in a dull black sooting of the plug. This condition frequently is found in new vehicles during the break-in period and is no indication of trouble in this case. As the condition progresses, black deposits of oil and carbon build up on the base of the shell and on the insulator until, in extreme cases, the space between insulator and shell may be almost completely filled. Excessive electrode erosion will seldom be found in cases of cold plug operation. These indications can be produced by the use of an excessively rich air-fuel mixture and the carburetor should be checked if this condition is suspected. Fouling will also be caused by leaking rings or intake valve guides that permit excessive oil to reach the combustion chambers. The use of a hotter plug will help burn away some of this fouling but the mechanical condition of the engine should be corrected.

c. In normal temperature operation the plug will accumulate grayish-tan to reddish-brown deposits with fairly uniform discoloration of the insulator nose and slight, localized electrode erosion. If the insulator shows any blotches, blisters, irregular discoloration, etc., look for hot-plug symptoms. Too hot or too cold plug operation may be caused by the use of plugs of other than the specified heat rating but if the plugs are as specified a hotter or

colder plug may be desirable. However, under- or over-heating is usually caused by factors other than the type of spark plugs and the cause should be determined before changing plugs. The design of the engine calls for plugs equivalent to Champion J-8 for F4 engines and A.C. 44S or UJ12Y Champion for the V6 engines, (as installed in production) though any factor that consistently affects engine operating temperature may cause this requirement to change. Overheating may be caused by insufficient tightening of the plug in the head, which interferes with the flow of heat away from the firing tip. If this is the case, the plug gasket will show very little flattening. Over-tightening, in turn, will produce too easy a heat flow path and result in cold plug operation. This will be evident by excessive flattening and deformation of the gasket. Prevailing temperatures, condition of the cooling system, and air-fuel mixture can affect the engine operating temperature and should be taken into consideration.

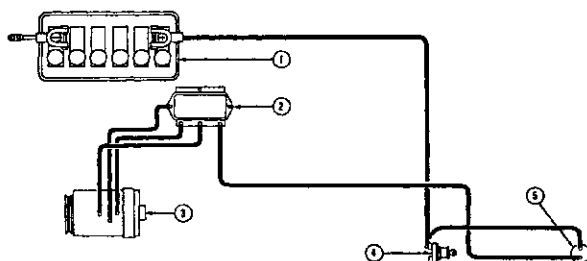
H-34. GENERATOR — F4 ENGINE

The generator is an air-cooled, two-brush unit which cannot be adjusted to increase or decrease output. 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. Par. H-1 explains the 12-volt system. Refer to the specifications at the end of this section for information on correct generator rating for a specific model series.

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. For service information covering current regulator see Par. H-41.

H-35. Generator Maintenance

A periodic inspection should be made of the charging circuit, Fig. H-19. The interval between these checks will vary depending upon type of service. Dust, dirt and high speed operation are factors



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FIG. H-19—CHARGING CIRCUIT

- | | |
|---------------------|--------------------|
| 1—Battery | 4—Starter Switch |
| 2—Voltage Regulator | 5—Charge Indicator |
| 3—Generator | |

which contribute to increased wear of bearings and brushes.

Under normal conditions a check should be made each 6000 miles [9.600 km.].

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.

Should the commutator be rough or worn the armature should be removed and the commutator turned and undercut. See Par. H-37.

The brushes should slide freely in their holders. Should they be oil soaked or if they are worn to less than 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.

Brush spring tension is important. High tension causes rapid brush and commutator wear while low tension causes arcing and reduced output. Test the tension with a spring scale. Check the specifications section at end of this section for correct spring tension for generator in question.

H-36. Generator Disassembly

- Refer to Fig. H-20;

Before beginning disassembly of the generator to correct electrical system malfunctions proceed with inspection and test procedures as detailed in Par. H-46 thru H-62. If it is definitely determined that trouble exists within the generator, which necessitates dismantling, proceed as follows.

Remove the two frame screws in the commutator end plate and remove the end plate assembly.

Next pull the armature and drive head complete from the generator housing. Remove the generator pulley from the armature by removing the nut and washer. Do not lose the Woodruff key when the pulley is removed. After this, remove the drive end head assembly which includes the oil seal and bearing. To remove the bearing, remove the three screws and lockwashers in the grease retainer and remove the retainer and felt washer, after which, remove the bearing, oil guard and felt washer.

H-37. Armature

If the commutator is rough or worn, turn it down in a lathe. After turning, the mica insulation between the segments should be undercut to a depth of $\frac{1}{32}$ " [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. H-21, 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. Should a coil be shorted the armature must be replaced.

If precision test equipment is available, the customary accurate tests can be made in accordance

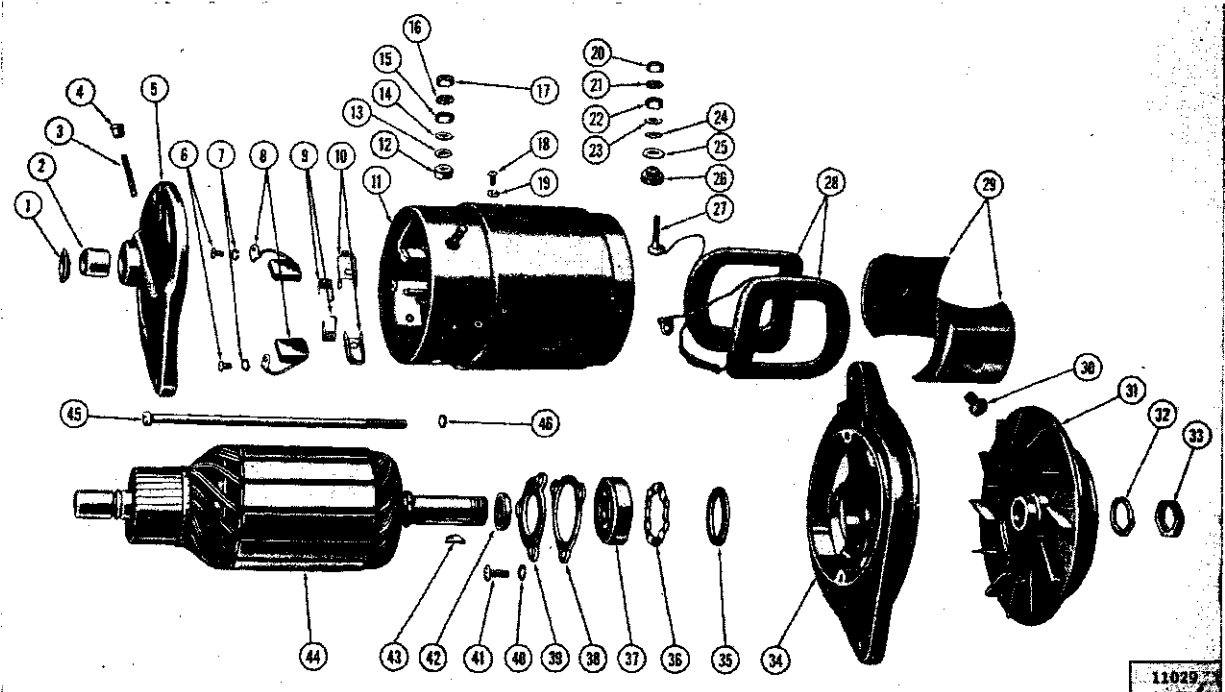


FIG. H-20—GENERATOR

- 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—Thru Bolt
- 46—Lockwasher

with instructions furnished with the testing equipment.

H-38. Field Coils

Inspect the field coils for chafed wires and using 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.

If accurate test equipment is available, check the field coils for current draw which should be within the limits of 1.2 to 1.3 amperes at 10 volts for both coils.

A shorted coil will of course 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.

H-39. 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.

H-40. Assembling Generator

Install the felt grease retainer and washer in the drive end head. See Fig. H-20. Check the bearing to be sure it is clean and fill it one-half full with a high melting point grease. Install the bearing and also install the inside felt washer and attach the bearing retainer with the lockwashers and screws. Place the drive end head over the front end of the armature shaft. Install the Woodruff key in the armature shaft and install the drive pulley, being sure the key is in position. Secure in position with the washer and nut. Place the assembly on

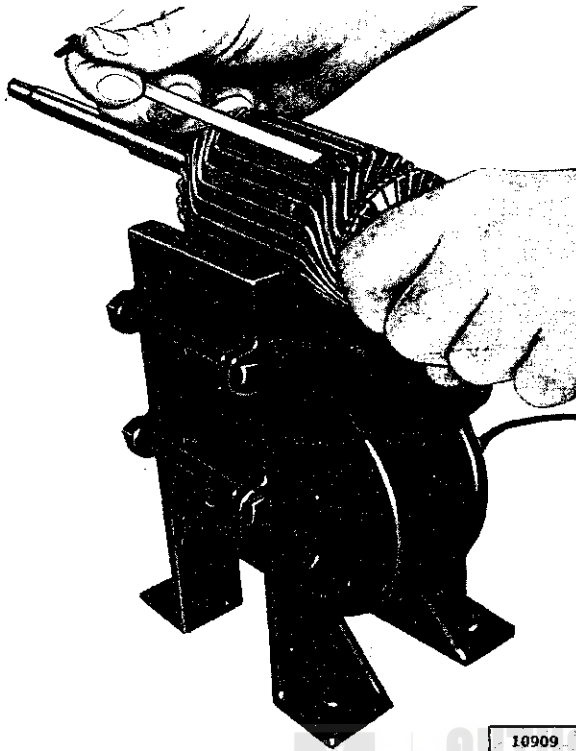


FIG. H-21—GROWLER

end so it rests on the pulley with the commutator end up.

While holding brushes clear of commutator with the thumbs, place generator housing and field coils assembly in position, turning front end bracket so the dowel pin in housing enters hole in end head. Place commutator end plate on shaft and install long frame screws.

When reinstalling the generator on the engine, the bracket bolt torque wrench reading is 25 to 35 lb.-ft. [3,4 a 4,8 kg.-m.].

H-41. CURRENT-VOLTAGE REGULATORS

- F4 Engine

H-42. Description and Operation

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.

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.

H-43. Circuit Breaker

It 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 two 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.

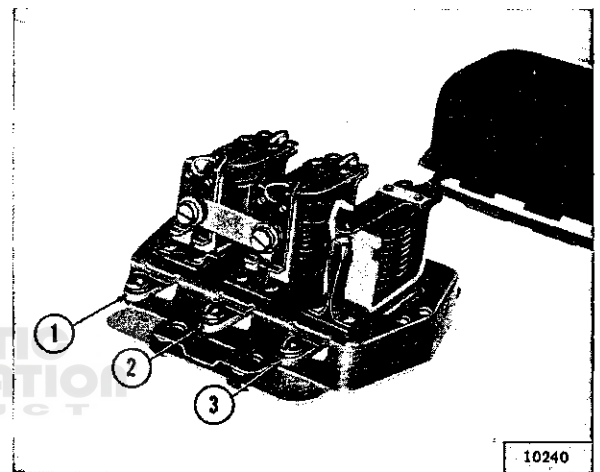


FIG. H-22—PRESTOLITE VOLTAGE REGULATOR

- 1—"ARM" Terminal
- 2—"FLD" Terminal
- 3—"BAT" Terminal

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 and 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 thus closed the current in the series coil is flowing 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, and as soon as the generator voltage drops below the battery terminal voltage, the current flows 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.

H-44. 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 and 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 so that 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 thus reducing the field current. The generated voltage immediately drops, which reduces 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 and 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 of the unit, the contacts will remain closed and the generator will maintain a charging rate as limited by its speed or 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 when the regulator is operating under varying temperature conditions. This is accomplished through the use of a nickel iron magnetic by-pass on the voltage regulator unit. This shunt by-passes some of the magnetic flux when the unit is cold and allows most of the flux to act on the armature when the unit is hot. Thus 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 compensation 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.

H-45. 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 of the current regulator unit consists of a winding of heavy wire that is connected in series with the generator output. When the generator output reaches a predetermined value, the current in the winding produces enough magnetism to overcome the spring tension and pull 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.

H-46. Preliminary Inspection

a. Wiring—Check the wiring to see that it is properly connected to the generator.

b. Generator Performance—Make sure the generator operates correctly 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, Fig. H-19, disconnect the armature cable at the regulator. Connect one lead of a 12v test lamp to the regulator terminal marked "armature" and with the engine running, ground the other lead. Should the test light fail to burn 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 to ground 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 definitely localized in the regulator.

c. Incorrect Regulator—Make sure the regulator is the correct type for use with the generator.

d. 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.

e. 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 a reliable ammeter with 1-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 accurate voltmeter graduated in .1-volt divisions. The voltmeter should not show a reading above the maximum noted.

Generator "A" terminal to regulator "A" terminal—.1-volt maximum.

Generator "F" terminal to regulator "F" terminal—.05-volt maximum.

Battery terminal to regulator "B" terminal—.1-volt maximum.

Regulator ground screw to generator frame—.03-volt maximum.

Regulator ground screw to battery ground post—.03-volt maximum.

Generator frame to battery ground post—.03-volt maximum.

H-47. Test Procedure

a. Circuit Breaker—Connect an ammeter in series between the regulator B-terminal and the lead wire removed from that terminal. Connect a voltmeter between the regulator A-terminal and the regulator mounting base. Disconnect the field lead from the regulator F-terminal and insert a variable resistance (3 amp., 50 ohm capacity) between the lead and the regulator terminal. Run the generator at about 1000 generator rpm. Insert all the resistance in the field circuit, then slowly reduce the resistance noting the voltage reading just before the change caused by the closing of the circuit breaker. Increase the charging rate to the figure specified for the regulator being tested then reduce the charging rate by inserting resistance in the field circuit. Note the voltmeter and ammeter reading just before the circuit breaker opens and the ammeter reading drops to zero. The closing voltage and the opening voltage or current should be within the limits specified. An accurate method for noting the exact instant of the opening or closing of the circuit breaker is to connect a headphone (2000 ohms or higher) to the battery and armature terminals of the regulator. When the contacts open or close a click will be heard in the headphones. To adjust the closing voltage change the armature spring tension by bending the hanger at the lower end of the spring. Increase the spring tension to raise the closing voltage or decrease the tension to lower the closing voltage. To adjust the opening voltage raise or lower the stationary contact keeping the contacts perfectly aligned. Increasing the contact gap lowers the opening voltage. Change the contact gap by expanding or contracting the stationary contact bracket, keeping the contacts aligned. Do not adjust the gap between the contacts to less than the specified minimum.

b. Voltage Regulator—Connect the ammeter as in step a. Connect the voltmeter between the regulator B-terminal and the regulator base. Remove the variable resistance from the field circuit. Run the generator at half output for 15 minutes to bring the regulator to normal operating temperature. Keep the cover on the regulator during the warm-up period and also when taking readings.

Stop the engine then bring it up to approximately 2500 generator rpm. Adjust the amperage to half maximum output by turning on lights or accessories and then note the voltmeter reading. This reading should be within the limits specified for the voltage regulator operation. To adjust the operating voltage change the armature spring tension by bending the hanger at the lower end of the armature spring. After each adjustment stop the engine then restart it. Bring it up to speed and adjust the current before taking a reading. In order to obtain an accurate indication of the operation of the voltage regulator unit connect a headphone (2000 ohm or higher) between the F-terminal and ground to pick up the sound of the opening and closing of the contacts. The clicks should be regular and clear

without irregularities or missing. If the tone is not clear and regular remove the regulator cover and inspect the contacts. The contacts should be flat and not burned excessively and should be aligned to make full face contact. If the contacts need cleaning refer to paragraph d for the method.

c. Current Regulator—Connect the regulator and the test equipment as in step b. Running the generator at approximately 3000 generator rpm., turn on lights and accessories so that the generator must charge at maximum rate. The ammeter should give a reading within the limits specified.

To adjust opening amperage, change the armature spring tension by bending the hanger at the lower end of the armature spring. After each adjustment, stop the engine, then restart it. Bring the engine up to speed and take an ammeter reading. Keep the cover on the regulator when taking these readings.

Connect a headphone (2000 ohms or higher) between the regulator F-terminal and ground to pick up the sound of opening and closing of the contacts. Clear, regular clicks should be heard over the headphones; they should not be irregular or missing. If the tone is not clear and regular remove the regulator cover and inspect the contacts. The contacts should be flat and not burned excessively and should be aligned to make full face contact. If the contacts need cleaning refer to paragraph d. below for the method.

d. Contacts—Inspect the contacts on all three units. In normal use the contacts will become grayed. If the contacts are burned or dirty or if they are not smooth, file the contacts with a #6 American, Swiss cut, equalling file. Move the file parallel and lengthwise to the armature. File just enough so that the contacts present a smooth surface toward each other. It is not necessary to remove every trace of pitting. After filing, dampen a piece of linen or lintless bond tape in refined carbon tetrachloride and draw the tape between the contacts. Repeat with a dry piece of tape. Use clean tape for each set of contacts.

e. Recheck—Operate the unit at half maximum output for five minutes with the cover on the regulator. Repeat the testing procedure for all units as described in a, b, c above. Be sure cover is on regulator when taking readings.

H-48. Quick Checks

H-49. Low Charging Rate with a Fully Charged Battery

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 ignition switch in the "off" position. Then 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.

H-50. High Charging Rate with a Fully Charged Battery

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 load.

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.

H-51. Test One

Disconnect the field lead at the generator.

- a. Output drops to zero—shorted field circuit in regulator or in wiring harness. See test 2.
- b. Output does not drop—shorted field circuit in generator. Inspect generator.

H-52. Test Two

Disconnect the field lead at the regulator.

- a. Output drops to zero—shorted field in regulator. See test 3.
- b. Output does not drop—shorted wiring harness. Repair or replace wiring harness.

H-53. Test Three

Remove the regulator cover and hold the voltage regulator contacts open.

- a. Output drops to zero—regulator contacts sticking, regulator out of adjustment, or regulator inoperative. Check operation (test 5), check for high resistance (test 4), and clean contacts per instructions in Par. H-56.
- b. Output does not drop—shorted field circuit in the regulator. Clean the regulator contacts and inspect the regulator visually for incorrect wiring between units and shorted leads.

H-54. Test Four

Operate the units at 10 amperes output and measure the voltage drop from the regulator base to the generator frame.

- a. Voltage reading below .03 volts—ground circuit is satisfactory. See test 5.
- b. Voltage reading above .03 volts—Inspect ground circuit for poor connections and eliminate the high resistance. See test 5.

H-55. Test Five

Connect a headphone from the regulator field terminal to the base and hold the current regulator contacts closed.

- a. A steady beat is heard—voltage regulator operating. Reset regulator as in the operation test, Par. H-47.
- b. An unsteady beat is heard—dirty or sticking contacts. Clean contacts per instructions in Par. H-56.
- c. No beat is heard—inoperative voltage regulator unit. Adjust regulator operation as in the operation test. If the regulator cannot be adjusted within limits, remove for overhaul.

H-56. Cleaning of Contacts

Clean the voltage regulator contacts with a #6 American Swiss cut equalling file. File lengthwise and parallel to the armature and then clean the contacts with clean linen tape. First draw a piece of tape that has been wet with carbon tetrachloride between the contacts then follow with dry tape. Reset the regulator operation as in the operation test, Par. H-47.

H-57. Low Battery and a Low or No Charging Rate

Check all wiring for loose connections, frayed insulation and high resistance connections and correct any fault.

Make sure the generator operates correctly without the regulator in the circuit. Remove the "A" and "B" 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. 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.

Connect an ammeter between the battery lead and the regulator "B" terminal. Connect the field lead to the regulator "F" terminal and connect the armature lead to the regulator "A" terminal. Connect a voltmeter from the regulator "A" terminal to the regulator base. Operate the generator at a medium speed and perform the following tests:

H-58. Test Six

Read the voltmeter.

- a. Voltage builds up—open series circuit. See test 7.
- b. Voltage does not build up—regulator out of adjustment, field circuit open, grounded series circuit. See test 8.

H-59. Test Seven

Remove the regulator cover and with the generator operating at a medium speed hold the 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 as in Par. H-47d. If the circuit breaker cannot be set, the shunt coil is open and the regulator should be removed for overhaul.
- b. No generator output—clean the circuit breaker contacts and try the test again. If there is still no charge the series windings are open and the regulator should be removed for overhaul.

H-60. Test Eight

Run the generator at idle speed and momentarily connect a jumper from the F-terminal to the regulator base.

- a. Voltage builds up—open field circuit or regulator out of adjustment. See test 9.
- b. Voltage does not build up—grounded series circuit. Remove regulator for overhaul.

H-61. Test Nine

Operate at a medium speed with the jumper removed. Remove the regulator cover and hold the voltage regulator contacts closed.

a. Voltage builds up—voltage regulator contacts burned or dirty or incorrect regulator setting. Clean the contacts and adjust the regulator as in Par. H-47d.

b. Voltage does not build up—clean contacts and repeat test. If the voltage still does not build up, see test 10.

H-62. Test Ten

Remove the regulator cover and hold the current regulator contacts closed.

a. Voltage builds up—current regulator contacts burned or dirty or incorrect regulator setting. Clean the contacts and adjust the regulator as in Par. H-47d.

b. Voltage does not build up—clean the contacts and repeat the test. If the voltage still does not build up remove the regulator for an overhaul.

H-63. ALTERNATOR CHARGING SYSTEM

Most vehicles have, as standard equipment, a 35-amp., 12-volt, negative ground alternator and a transistorized voltage regulator.

The alternator charging circuit consists of the battery, alternator, voltage regulator, ignition switch, and charge indicator light.

An alternator differs from a conventional DC shunt generator in that the armature is stationary, and is called the stator, while the field rotates, and is called the rotor. With the alternator construction, the higher current values involved in the stator may be conducted to the external circuit through fixed leads and connections, rather than through a rotating commutator and brushes, as in the DC generator.

The alternator employs a three-phase stator winding. The rotor consists of a field coil encased between six poled interleaved sections, producing a twelve pole magnetic field with alternator 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 of the alternator.

Six silicon diode rectifiers act as electrical one-way valves. Three of the diodes have negative polarity and are grounded. The other three diodes have positive polarity and connected to the output terminal. In all alternators discussed in this manual, the diodes are pressed into heat sinks. There are two heat sinks, one positive and the other negative.

Since the diodes have a high resistance to the flow of current in one direction and a low resistance in the opposite direction, they are connected in a manner which allows current to flow from the alternator to the battery in the low resistance direction. The high resistance in the opposite direction prevents the flow of current from the battery to the alternator. Because of this feature, no circuit breaker is required between the alternator and the battery.

Residual magnetism in the rotor field poles is negligible. Therefore the starting field current must be supplied by the battery. It is connected to the field winding through the ignition switch and charge indicator lamp.

As in the DC shunt generator, the alternator voltage is regulated by varying the field current. In these alternator systems, this is accomplished electronically in the transistorized voltage regulator. No current regulator is required since all alternators have self-limiting current characteristics.

The entire DC output of the alternator has to pass through the isolation diode. The isolation diode is not essential for rectification. Its purpose is threefold.

It provides automatic solid state switch for illuminating the alternator charge-discharge indicator light when the alternator is not charging properly. It automatically connects the voltage regulator to the alternator and battery when the alternator is operating.

It eliminates electrical leakage across the alternator diodes so that leakage is negligible when the vehicle is not in use.

The isolation diode is mounted in a separate aluminum heat sink. The 35-amp. alternator has a single silicon diode. The alternator is designed to supply the electrical demands of the battery and the accessory circuits through a wide range of engine speeds. The alternator is lighter and more compact than a conventional DC shunt generator of comparable electrical size.

The principal components of the alternator are the stator, the rotor, the slip ring end head, the drive end head, the diode rectifiers, and the isolation diode.

a. The stator consists of a laminated iron core on which the three-phase windings are wound in slots around the inside circumference. A pair of leads are connected to each of the three points of the winding. One of each pair of leads connects to a negative diode rectifier and one to a positive diode rectifier.

b. The rotor consists of a single field coil encased between two six-fingered, interleaved iron sections assembled to the shaft. The two ends of the field coil are connected to two slip rings which are insulated from each other and from the shaft.

c. The slip ring end head supports the rectifier heat sinks; a prelubricated sealed ball bearing, in which the rotor shaft rotates; and the brush holders and brushes.

d. The drive end head supports a prelubricated sealed ball bearing in which the drive end of the rotor shaft rotates.

e. The diode rectifiers are pressed in the rectifier brackets or heat sinks and are connected to the stator leads.

f. The isolation diode is pressed in the aluminum heat sink mounted to the rear of the alternator. The complete assembly is covered with a red insulating coating.

For repairing the alternator, many of its major components are furnished as complete assemblies including: complete brush assembly which requires

no soldering or unsoldering of leads; two complete rectifying diode assemblies which eliminate the need for removing and replacing individual diodes; a complete isolation diode assembly; and a rotor assembly complete with shaft, pole pieces, field coil, and slip rings.

The transistorized voltage regulator is an electronic switching device. It senses the voltage appearing at the auxiliary terminal of the alternator and supplies the necessary field current for maintaining the system voltage at the output terminal. The output current is determined by the battery electrical load; such as headlights, heater, etc.

The transistorized voltage regulator is a sealed unit, has no adjustments, and must be replaced as a complete unit.

H-64. ALTERNATOR PRECAUTIONS

The following precautions must be observed to prevent damage to the alternator and regulator.

- a. Never reverse battery connections. Always check the battery polarity with a voltmeter before any connections are made to be sure that all connections correspond to the battery ground polarity of the vehicle.
- b. Booster batteries for starting must be properly connected. Make sure that the negative cable of the booster battery is connected to the negative terminal of the battery in the vehicle. The positive cable of the booster battery should be connected to the positive terminal of the battery in the vehicle.
- c. Disconnect the battery cables before using a fast charger.
- d. Never use a fast charger as a booster for starting the vehicle.
- e. Never disconnect the voltage regulator while the engine is running.
- f. Do not ground the alternator output terminal.
- g. Do not operate the alternator on an open circuit with the field energized.
- h. Do not attempt to polarize an alternator.

These precautions are stated here as an aid to service personnel. They are also restated at appropriate places in the text of this section of the manual.

H-65. ALTERNATOR CHARGING SYSTEM SERVICE

Important: All alternator tests for the 35, 40 and 55 amp alternator are the same, however, there is a difference between the location of the various terminals and field current specifications. The field current of the 35 amp alternator should be 1.7 to 2.3 amps, 40 and 55 amp alternators should be 1.8 to 2.4 amps, with full battery voltage applied to the field coil. Disassembly and assembly procedures are the same for all three alternators. Terminal locations and wire harness color codes for the 35, 40 and 55 amp alternator are shown in Fig. H-38.

H-66. Service Diagnosis

In diagnosing a suspected malfunction of the alternator charging system, consideration must be given to the complete electrical power plant of

the vehicle; including the alternator, regulator, ignition switch, charge indicator lamp, battery, and all associated wiring. If it is suspected that the alternator is not fully charging the battery and fulfilling the electrical requirements of the electrical system, several checks should be made before checking the alternator itself:

Note: Whenever service is required in connection with an alternator problem, the first step should be to verify that the wiring harness hook-up is correct as indicated in Fig. H-38.

- a. Test the condition of the battery and state of charge (Par. H-2). If the battery is not fully charged and in good condition, use a replacement battery for making alternator system tests.

Caution: Make certain that the negative battery post is connected to ground when making the battery installation. Serious damage to the alternator can result if battery polarity is reversed.

- b. Check fan belt for proper tension (Par. C-27).

Caution: To increase belt tension, apply pressure to alternator front housing only as permanent damage can result if pressure is applied to rear housing.

H-67. Alternator In Vehicle Tests

The following tests are made with the alternator in the vehicle with output and regulator connections maintained to the alternator except as noted in Fig. H-27 and H-28. The field plug and voltage regulator are disconnected for these tests. The tests are given in proper order and detail in the following paragraphs.

- a. Isolation Diode Test: To determine if the isolation diode is open or shorted, refer to Par. H-69.
- b. Alternator Output Test: To isolate the trouble to the alternator or regulator, refer to Par. H-70.
- c. Alternator Field Circuit Test: To determine the condition of the field circuit (brushes and rotor), refer to Par. H-73.
- d. Brush Insulation and Continuity Test: To determine the condition of the brush, refer to Par. H-75.
- e. Rotor In-Vehicle Test: To determine whether the rotor coil is open or shorted, refer to Par. H-73.
- f. Any further tests must be conducted with the alternator removed and disassembled. When this is done, the condition of the rotor, the rectifying and isolation diodes, and the stator can be further tested.

A commercial alternator tester Sun Electric Model VAT-20 or equivalent can be used to make all necessary tests on the alternator system. If a commercial tester is used, follow the recommended testing procedure outlined by the tester manufacturer.

If a commercial tester is not available, follow the testing procedure as outlined in this manual.

H-68. Test Equipment

- a. Volt Ampere Tester such as Sun Electric Model VAT-20 or equivalent with meter ranges as shown in the following list can be used.

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ELECTRICAL SYSTEM

- DC ammeter — 0 to 60 ampere
- DC ammeter — 0 to 5 ampere
- DC voltmeter — 0 to 16 volt
- Rheostat — 40 ohm capable of handling 3 amps.
- Carbon Pile — 45 amperes

- b. Diode Rectifier Tester C-3829.
- c. 12-volt DC test lamp.
- d. Ohmmeter of any commercial type is not absolutely necessary but can be helpful.

H-69. Isolation Diode Check

With the ignition key in the off position the correct voltage at the auxiliary terminal is zero volts. If voltage measured at auxiliary terminal is the same as voltage at output terminal, the isolation diode is shorted. In most cases, the charge indicator lamp would be glowing with the ignition off if the isolation diode were shorted. Refer to Fig. H-23.

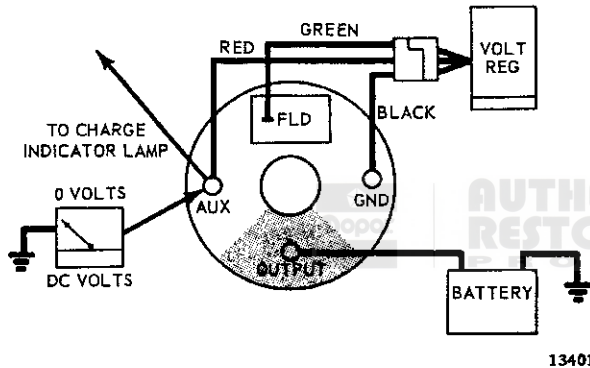


FIG. H-23—ISOLATION DIODE TEST—SHORTED DIODE

With the engine running the correct voltage at the auxiliary terminal is 15.4 volts and at output terminal is 14.4 volts. If voltage of auxiliary terminal is 15.4 volts, while at output terminal it is 12 volts or battery voltage, the isolation diode is open. In most cases, this would be indicated by the charge

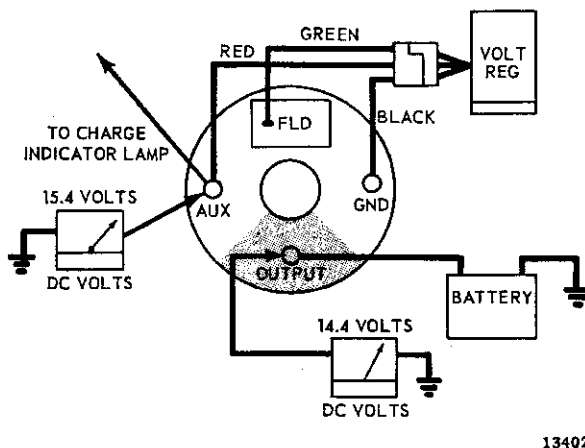


FIG. H-24—ISOLATION DIODE TEST—OPEN DIODE

indicator lamp glowing when the engine is running. Refer to Fig. H-24.

If the isolation diode is shorted or open, the heat sink and diode should be replaced as an assembly. At the time of manufacture, the diode is pressed into the heat sink and the complete assembly is insulated from the alternator housing.

H-70. Alternator Output Test

This test excludes the regulator from the alternator system, thereby isolating the problem to either the regulator or alternator.

Disconnect field and voltage regulator plug and connect jumper from auxiliary terminal to field terminal. Start engine and run at idle. Refer to Fig. H-25.

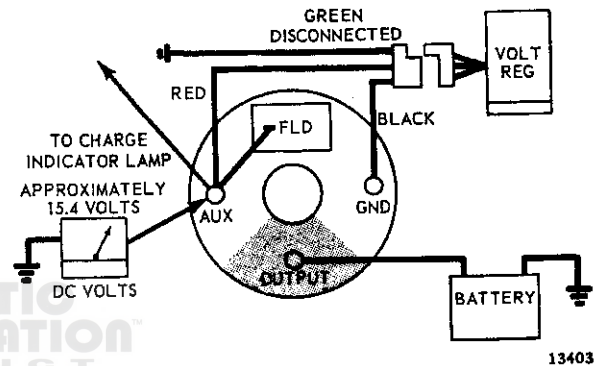


FIG. H-25—ALTERNATOR OUTPUT TEST

If voltage at auxiliary terminal rises to 15 or 16 volts now, when it did not with voltage regulator connected, then defect is in regulator and it should be replaced. If voltage does not rise at auxiliary terminal, defect is in alternator stator or rectifier diodes, if field circuit checked out properly. For defects in stator or diodes, remove alternator from vehicle.

If rated current output is obtained with at least 13 volts but less than 15 volts at the output terminal, the alternator is functioning properly.

Caution: Do not exceed rated current output of alternator by increasing load on alternator.

If rated current output cannot be obtained, proceed with the tests and checks given in the following paragraphs and isolate the cause.

Note: The system is designed to produce slightly more output at low operating temperatures and less at higher temperatures to accommodate the varying demands of electrical power normally consumed at these temperatures.

H-71. Regulator Test

The regulator should be checked with an alternator that is functioning properly. If the alternator is questionable, perform the Alternator Output Test (Par H-70) which excludes the regulator from the charging system and, therefore, tests the condition of the alternator alone.

H-72. Removal and Installation of Voltage Regulator

The transistorized voltage regulator is a sealed unit. It cannot be disassembled or adjusted. If found to be defective in any way, it must be replaced as a unit.

The transistorized voltage regulator is mounted on the fender dust shield by three mounting screws. Wiring connections to the charging circuit are made through a three-prong connector.

To remove the regulator, disconnect the three-prong connector and remove the three mounting screws. Installation of the regulator is the reverse of the removal. (Refer to Fig. H-26.)

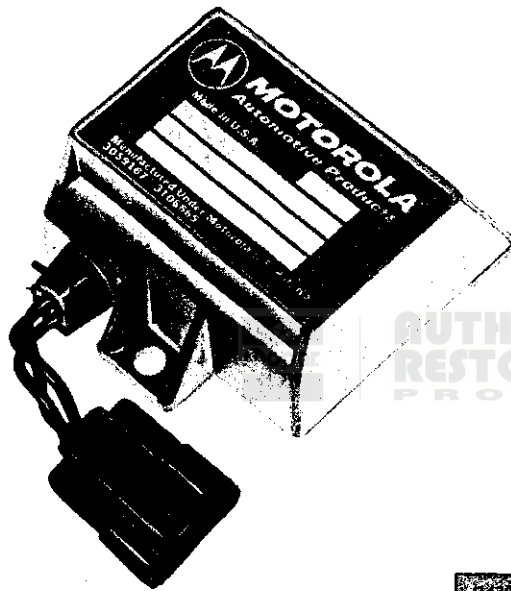


FIG. H-26—VOLTAGE REGULATOR

H-73. Alternator Field Circuit Test

Voltage Test — Refer to Fig. H-27.

a. With the ignition key on and engine **not** running, the correct voltage at the auxiliary terminal is approximately 1.5 volts. If the voltage at auxiliary terminal is higher than 2 volts, field circuit is defective — check brushes.

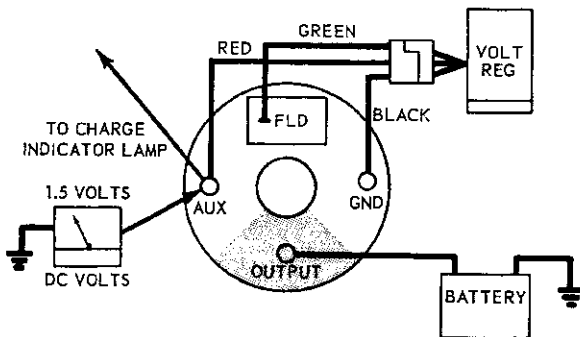


FIG. H-27—FIELD CIRCUIT TEST—VOLTAGE

If voltage reads zero volts at auxiliary terminal, check charge indicator lamp and associated circuit. If this voltage is not correct, continue with the following test described in paragraph b.

Amperage Test — Refer to Fig. H-28.

b. This test evaluates complete field circuit, independent of voltage regulator. Circuit is through brushes, slip rings, rotor to ground. With ignition switch off, current should be 2 to 2.5 amps. If less than this, check brushes and slip rings. It is desirable to use a field rheostat in series with meter for protection of the meter. If field is shorted, excessive current will flow through meter and damage may result.

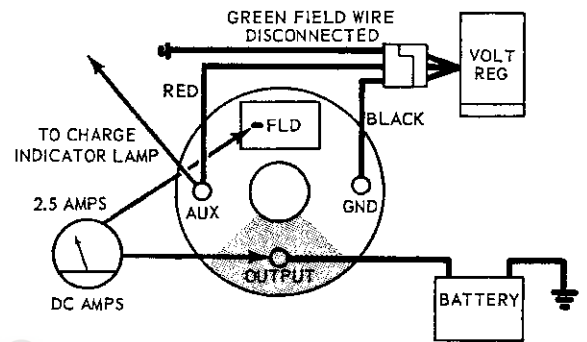


FIG. H-28—FIELD CIRCUIT TEST—AMPERAGE DRAW

H-74. Brush Removal and Inspection

Refer to Fig. H-29.

The brushes can be removed and inspected while the alternator is in the vehicle.

- a. Disconnect the plug to the field terminal.
- b. Remove the two screws and brush cover.
- c. Remove brushes.
- d. Inspect brushes for excessive wear and proper tension. The brushes can be installed by reversing the above procedure.

H-75. Brush Insulation and Continuity Test

Refer to Fig. H-30.

- a. Connect leads of a 12-volt test lamp to field

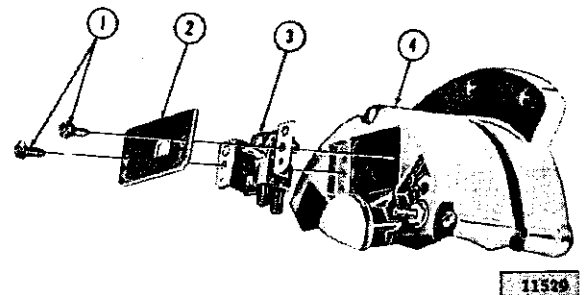


FIG. H-29—BRUSH REMOVAL

- 1—Screw
- 2—Cover
- 3—Brush and Holder Assembly
- 4—Alternator

terminal and bracket. Test lamp should not light. If it does, the brush is shorted and must be replaced.

b. Connect one lead of an ohmmeter to field terminal and the other lead to insulated brush. Resistance reading should be zero. 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.

c. Connect ohmmeter leads to bracket and grounded brush. Resistance reading should be zero. Repeat same test on brush lead wire as described in step b above.

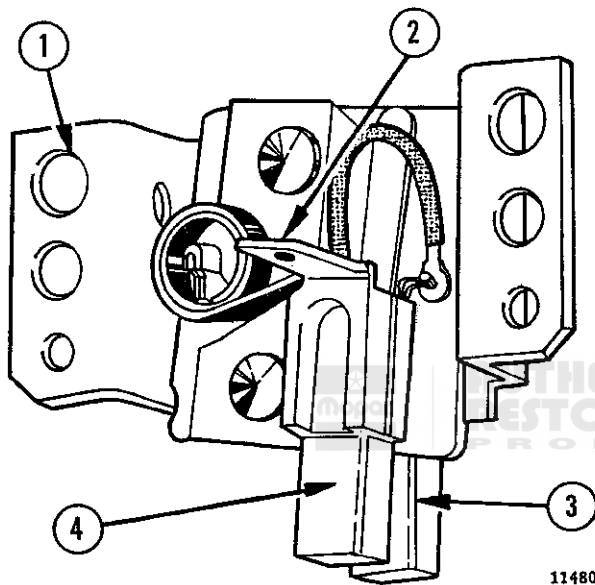


FIG. H-30—INSULATION AND CONTINUITY TEST POINTS

- 1—Bracket
2—Field Terminal
3—Grounded Brush
4—Insulated Brush

H-76. Rotor In-Vehicle Tests

- a.** Reference Par. H-73, Fig. H-28.
b. To check for a short circuit in the rotor windings, the alternator should be removed. Refer to Par. H-79 for rotor bench tests.

H-77. ALTERNATOR BENCH TESTS

When the various tests given in Par. H-69 through H-76 have determined a fault within the alternator itself, the alternator should be removed from the vehicle and the following tests given in sequence to isolate the trouble to a particular component of the alternator. Note that certain tests can be performed after the alternator is removed and before it is disassembled.

H-78. ALTERNATOR REMOVAL

Note: Brushes and isolation diode can be removed from alternator without removing unit from vehicle.

- a.** Disconnect all lead connections at alternator.

b. Remove nut and bolt at alternator support bracket. Remove nut, bolt, washer, and adjustment bracket. Remove belt from alternator pulley. The alternator is now free to be removed from the vehicle.

H-79. Rotor Tests — Bench

This test checks the condition of the rotor (field coil) for open or shorted field winding, excessively worn or sticky brushes, and open connections. It should be performed with the brush assembly installed in the alternator.

a. The field coil is checked for a short circuit by connecting a fully charged battery and an ammeter in series with the two slip rings.

A rheostat is placed in series in the circuit to protect the instruments and components of the alternator. Set rheostat to maximum resistance (40 ohms) before making connections.

b. Slowly reduce resistance of rheostat to zero. Then take reading on ammeter. With full battery voltage applied to the field coil, the field current of the 35-amp. alternator should be 1.7 to 2.3 amp.

Note: The field current of the 40 and 55 amp. alternator should be 1.8 to 2.4 amps with full battery voltage applied to the field coil.

c. Turn rotor by hand, noting reading. Rotating rotor will indicate if brushes are making good electrical contact. A slight fluctuation of reading (0.2 amp.) is to be expected.

If field current is not within limits, inspect brushes and slip rings for excessive dirt, sticky, or broken brushes, and bad connections. Check brush assembly for short and continuity (Par. H-75). Make same test to slip rings. Reinstall repaired or known good brush assembly and repeat test.

If the field current is above the maximum value specified, it indicates that the field coil is either shorted to rotor or field coil has shorted windings.

If the field current is zero, it indicates that the field coil or coil-to-slip ring connection is open. If the field current is considerably less than the value specified, it indicates a poor coil-to-slip ring connection or poor brush-to-slip ring connection.

d. To check continuity of the rotor, disconnect the battery and connect an ohmmeter directly across the field. Resistance between field terminal and ground terminal should be approximately 6 ohms. If resistance is high, field coil is shorted.

e. If rotor is found to be defective in above tests, repeat the above tests when the rotor is removed from the alternator by connecting the test circuit to rotor slip rings to ascertain findings. Field current will be approximately 0.2 amp. higher than the maximum value because of the normal brush-to-slip-ring contact resistance that reduces field current slightly. If the rotor is found to be defective, it should be replaced.

H-80. Alternator Disassembly

Refer to Fig. H-31.

- a.** Remove brush assembly by removing two tapping screws and cover. Then pull the brush as-

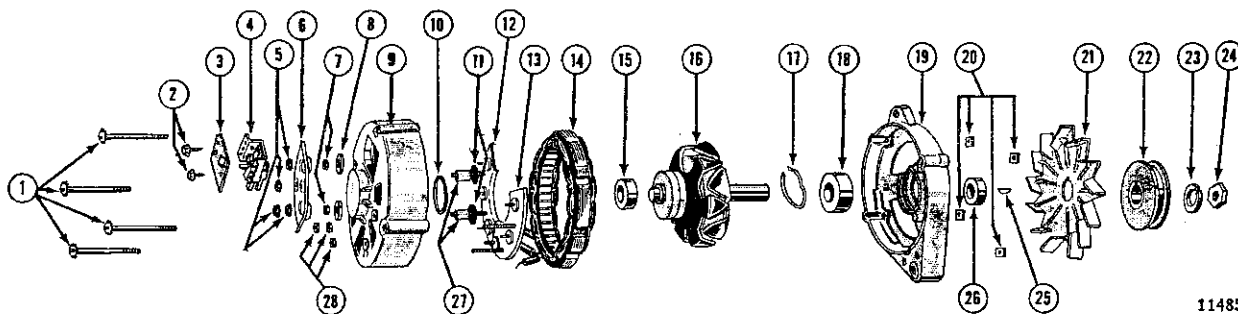


FIG. H-31—ALTERNATOR

- 1—Bolt
- 2—Cap Screw
- 3—Brush Assembly Cover
- 4—Brush Assembly
- 5—Locknut
- 6—Isolation Diode
- 7—Nut
- 8—Insulated Washer
- 9—Rear Housing
- 10—Slip Ring

- 11—Insulated Washer
- 12—Negative Diode Assembly
- 13—Positive Diode Assembly
- 14—Stator
- 15—Rear Bearing
- 16—Rotor
- 17—Retaining Clip
- 18—Front Bearing
- 19—Front Housing
- 20—Nut

- 21—Fan
- 22—Pulley
- 23—Lock Washer
- 24—Nut
- 25—Woodruff Key
- 26—Bushing
- 27—Insulated Sleeve
- 28—Nut

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sembly straight out until the brushes are clear of rotor assembly. Lift the brush assembly out of the housing.

b. Remove the isolation diode assembly by removing nuts.

c. Remove fan, pulley, lock washer, nut and spacer. With the nut removed, remove pulley using Puller, the other parts can then be removed easily from the rotor shaft. The spacer will not come off until the key is removed.

d. Separate front housing from rear housing by removing bolts and nuts. Then insert blade of a small screwdriver in the stator slots between the stator and the front housing. Wedge apart the halves of the alternator.

Caution: Take care not to insert the screwdriver blade deeper than $\frac{1}{16}$ " [0,16 cm.] below a stator. Otherwise damage to the stator windings may result. It may be necessary to apply pressure at several points around the stator to extract rotor and front housing as an assembly. Be careful not to burr the stator core as this would make reassembly difficult.

e. Remove the two rectifying diode heat sink assemblies and the stator as a complete unit from the rear housing by removing nuts and locknuts. Note that the positive diode assembly is insulated from the alternator housing by insulated washers and insulated sleeves.

f. The diode and stator assemblies may now be tested as outlined in Par. H-83. For additional testing (Pars. H-84 and H-85) or to replace a diode heat sink assembly, unsolder the three soldered connections at the diodes to separate heat sink from stator.

Caution: When unsoldering the stator wires from the rectifier diode assembly, provide a heat sink to the diode terminal using a pair of long-nosed pliers to dissipate the heat away from the diodes.

g. To remove the rotor assembly from the front housing remove the woodruff key and split spring washer (bearing retainer).

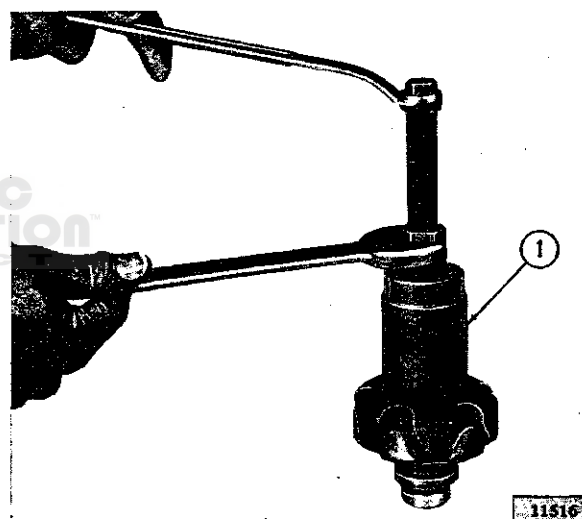


FIG. H-32—REMOVING FRONT BEARING

1—Front Bearing Remover C-4068

h. With the woodruff key removed and the split spring washer loose, the rotor may be removed from the front housing by tapping the rotor shaft on a soft wood surface.

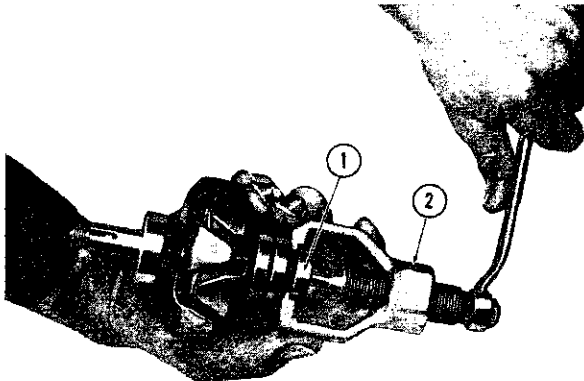
i. Remove the front and rear bearings from the rotor shaft by using Bearing Remover C-4068 for the front bearing, as shown in Fig. H-32, and Bearing Remover C-3936 for the rear bearing, as shown in Fig. H-33.

H-81. General Inspection

a. All parts should be wiped clean and visually inspected for wear, distortion, and signs of overheating or mechanical interference.

b. Check the bearings for roughness or excessive clearance. They should be replaced if found defective.

Note: New bearings are prelubricated. Additional lubrication is not required.



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FIG. H-33—REMOVING REAR BEARING

- 1—Rear Bearing
- 2—Rear Bearing Remover C-3936

The alternator end housing may be wiped clean with a cloth dampened in solvent if excessively dirty but should not be buffed as this will destroy special treatment given to inhibit corrosion.

H-82. Out-Of-Circuit Rotor Test

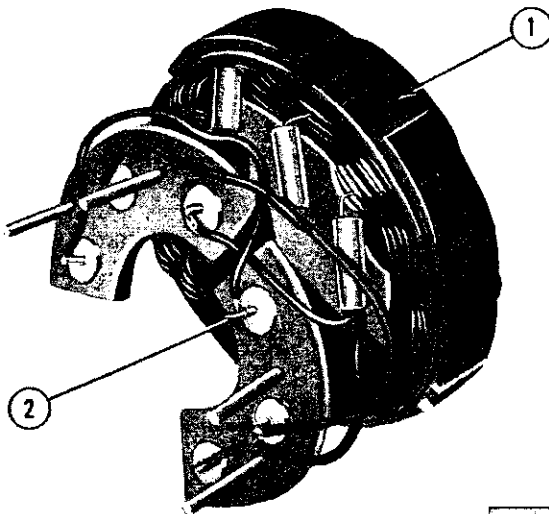
Refer to Pars. H-76 and H-79 for tests to be performed on the rotor. If these tests were not performed while the alternator was assembled, they can be performed with the alternator removed by following the procedure given in these paragraphs.

H-83. Out-Of-Circuit Stator Leakage Test

Disassemble alternator and remove the rectifier diode plates and stator as shown in Fig. H-34 as an assembly.

An ohmmeter or 12-volt test lamp may be used.

a. Connect one ohmmeter or test lamp probe to one of the rectifier diode terminals and the other to the stator as shown in Fig. H-34.



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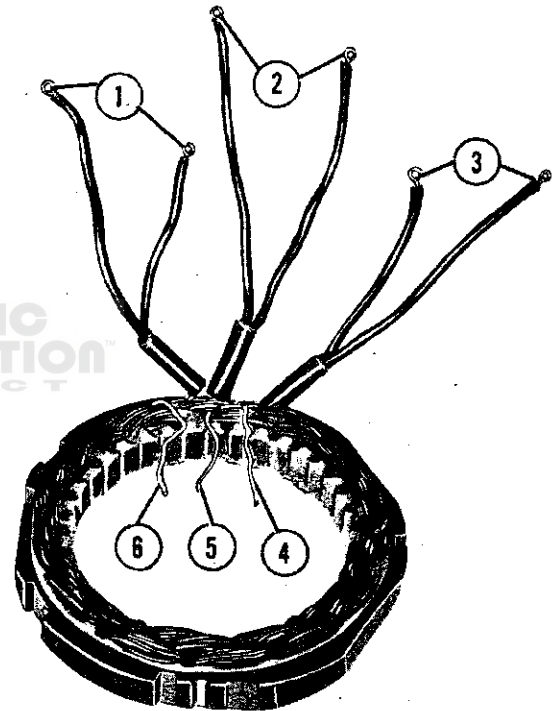
FIG. H-34—STATOR LEAKAGE TEST POINTS

- 1—Stator
- 2—Diode Terminal

Resistance reading should be infinite or test lamp should not light. If resistance reading is not infinite or test lamp lights, high leakage or a short exists between stator winding and stator. In either case, the diode heat sinks should be separated from the stator (Par. H-80) to ascertain whether the stator should be replaced (Par. H-84).

H-84. Stator Coil Leakage and Continuity Test

This test checks for shorts or leakage between stator coil windings. To conduct the test, the winding junctions must be separated as shown in Fig. H-35. An ohmmeter or 12-volt test lamp may be used.



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FIG. H-35—STATOR LEAKAGE AND CONTINUITY TEST POINTS

- 1—Test Point
- 2—Test Point
- 3—Test Point
- 4—Test Point
- 5—Test Point
- 6—Test Point

a. Connect one of the ohmmeter or test lamp probes to test point 4 as shown in Fig. H-35. Connect the other test probe to test point 5 and then to test point 6. Resistance should be infinite or test lamp should not light.

b. Connect one test probe to point 1 and the other to point 3 and then point 2. Resistance should be infinite or test lamp should not light.

In either test, if the resistance reading is not infinite or the test lamp lights, high leakage or a short exists between stator windings. Stator should be replaced.

c. Measure resistance of each winding in stator between test points 4 and 1, 5 and 3, and 6 and 2, in Fig. H-35.

Resistance should be approximately 0.1 ohm. An extremely accurate instrument would be necessary to ascertain shorted turns. Only an open condition can be detected with a commercial ohmmeter. If the alternator has been disassembled because of an electrical malfunction, replace stator only after all components have been checked and found to be satisfactory.

H-85. Out-Of-Circuit Rectifier Diode Test

With the rectifier diode heat sinks disconnected from the stator assembly (Par. H-80), the diodes can be individually checked with the Diode Tester C-3829.

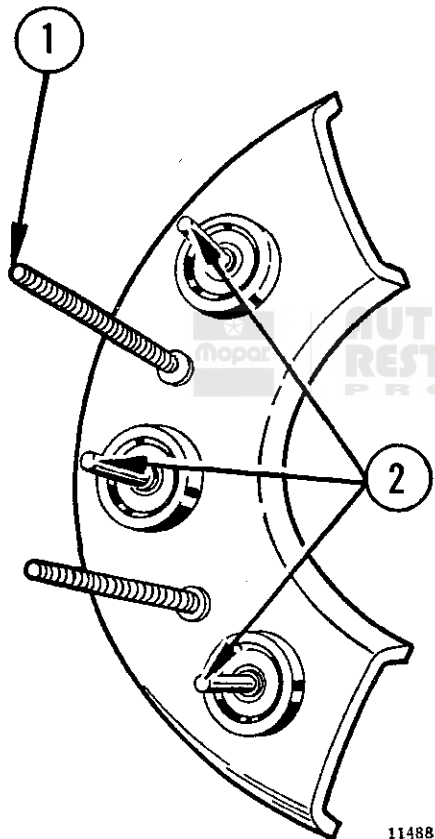


FIG. H-36—RECTIFIER DIODE TEST POINTS

1—Diode Plate Stud
2—Diode Terminals

Fig. H-36 shows the test point location for either positive or negative diode. Plug Tester C-3829 into a 110-volt AC outlet. Connect alligator clip to diode plate stud, and the probe of the tester to each of the three diode terminal's test points. Negative diodes will give a negative deflection of the needle and positive diodes will give a positive deflection. The meter reading should be the same for each of the diodes and should be 2 or over for a good diode. If a diode is faulty, replace the entire diode heat sink assembly.

H-86. Assembling Alternator

Refer to Fig. H-31.

- a. To install front bearing in front housing, press the bearing into place on an arbor press using Bearing Installer C-3858. Position the split spring washer in the front bearing housing on top of the bearing.
- b. Install the rear bearing on the rotor shaft front end using Bearing Installer C-3935 as shown in Fig. H-37.

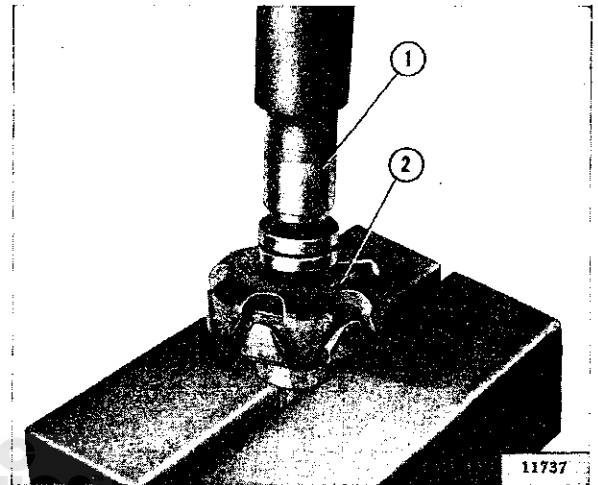


FIG. H-37—INSTALLING REAR ROTOR BEARING

1—Rear Bearing Installer C-3935
2—Rotor Shaft

- c. Place the rotor assembly into position in the front housing by tapping rotor shaft on a soft wood surface.
- d. Position diode assemblies and stator as a unit into the rear housing. Make certain that insulator washers and insulator sleeves are correctly positioned on the positive diode assembly.
- e. To assemble the subassembly halves of the alternator (front housing and rear housing). Slide the front housing over the stator. Install the bolts and nuts.
- f. Position first the spacer, then the woodruff key on the rotor shaft and slide on the fan. Carefully position the alternator in a vise with the clamps of the vise held to the pulley. Position the pulley so it is just starting to slide over the woodruff key. Press it into position by tightening nut with a wrench. When the pulley is properly positioned, remove the nut, place the lock washer on the rotor shaft, and again replace the nut.
- g. Install the isolation diode assembly and secure with locknuts.
- h. Install the brush housing in position in the rear housing. Install the brush housing cover and the tapping screws.
- i. Turn the rotor by hand listening carefully to make certain there is no interference between the rotor and the stator winding.

H-87. Alternator Installation

To install the alternator, reverse the procedure

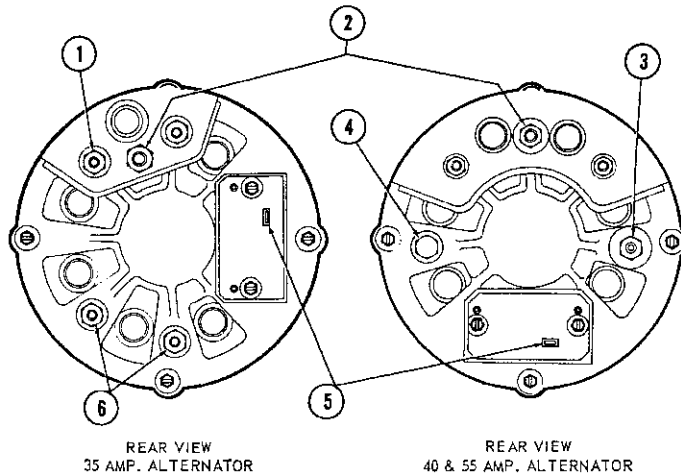


FIG. H-38—WIRE COLOR CODE AND LOCATIONS FOR ALTERNATOR HOOK-UP

- 1—Regulator (Auxiliary) Terminal (Cable — Grey)
- 2—Output Terminal (Red)
- 3—Regulator Terminal (Cable — Grey)
- 4—Ground Terminal (Cable — Black-White Tracer)
- 5—Field Terminal (Cable — Green-White Tracer)
- 6—Ground (Optional) Terminal (Cable — Black-White Tracer)

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given in Par. H-78, adjusting the fan belt to its proper tension after the alternator is mounted, as described in Par. C-27. Wires should be connected as shown in Fig. H-38.

When the vehicle is equipped with a radio, a .55 mfd. capacitor is required on the alternator. Mount the capacitor strap to a ground terminal and connect the lead to the output terminal.

H-88. STARTING SYSTEM SERVICE

H-89. Ignition Switch

The ignition switch serves both to energize the ignition system and engage the starter switch. The ignition switch has four positions: (1) ACCESSORY, (2) LOCK, (3) ON, and (4) START. The key must be in the switch to turn it to any position other than LOCK, and the key can be removed only in the LOCK position.

In "ACC.," a connection is made from the battery terminal to the accessory terminal of the switch to allow accessories such as the radio, blower and/or windshield wiper to be operated with the ignition, fuel gauge and indicator light circuits off.

In "LOCK," no accessory supplied through the ignition switch can be operated. Also, the ballast resistor (V-6 engine only) circuit to the ignition coil (IGN) is grounded.

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 ballast resistor (V-6 engine only) leading to the ignition coil (IGN). From this same terminal, a lead into the instrument cluster energizes the fuel gauge and indicator lights.

In "START," all ignition switch supplied accessories are temporarily disconnected. A connection is made to the starter solenoid lead. The charge and oil indicator lamps will light until the engine is started.

H-90. Ignition Switch Removal

a. Remove the bezel nut and pull back the main switch body. Lower the switch body from under the

instrument panel so that the wiring harness plug can be removed from the prong connection.

b. If the lock cylinder is to be removed, turn the ignition key to the right and insert a short piece of wire or end of a paper clip into the lock release hole in the switch body. Pressing on the lock cylinder retainer will allow the cylinder to be removed.

H-91. Ignition Switch Installation

Before installing the lock cylinder into the main switch body, note the position of the lock cylinder retainer.

a. Place the lock cylinder into the main switch body with the highest part of the lock cylinder retainer in line with the lock release hole in the main switch body.

b. Compress the lock cylinder retainer so that the lock cylinder can be installed all the way into the main switch body or until the retainer can be seen through the pin hole.

c. Install wiring harness plug onto switch body prong connection.

d. Install this main switch body into the instrument panel opening from the rear.

e. To make sure that the switch is in its correct position, install the ignition key in the off position. Then turn the switch body until the key is straight up and down. Remove the key, install the bezel nut and secure.

H-92. PRESTOLITE STARTING MOTOR DAUNTLESS V-6 and HURRICANE F4 ENGINE

The Prestolite starting motor on the V6 engine is similar in construction (with exception of pinion housings) to the starting motor installed on F4 engines.

The starter solenoid switch is bolted to the starter frame.

The starter is equipped with sealed-type absorbent bronze bearings and no lubricant is required. Service procedures for the Prestolite starter are given in Pars. H-93 to H-107.

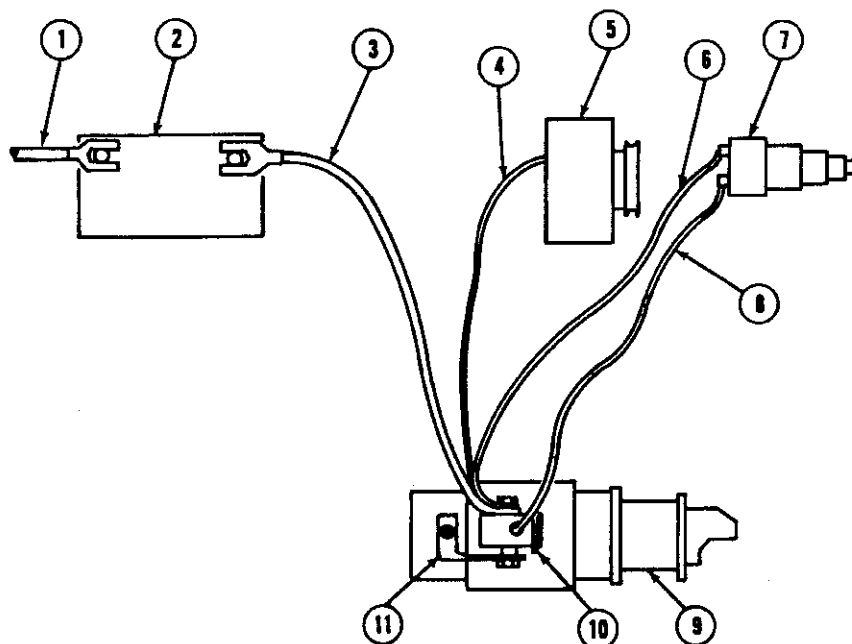


FIG. H-39—STARTING CIRCUIT

- | | |
|------------------------|--------------------|
| 1—Ground Cable | 7—Ignition Switch |
| 2—Battery | 8—Solenoid Wire |
| 3—Positive Cable | 9—Starter |
| 4—Alternator Wire | 10—Solenoid |
| 5—Alternator | 11—Connector Strap |
| 6—Ignition Switch Wire | |

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H-93. Maintenance Procedure

A periodic inspection should be made of the starting circuit. Since the interval between these checks will vary according to the type of service, it should, under normal conditions, be made every 500 hours of operation. Inspect all starting circuit wiring for damage. Check for loose or corroded terminals and for dependable operation of the starting motor.

H-94. Wiring

Refer to Fig. H-39.

Inspect the starting circuit to make sure that all connections are clean and tight. Check for worn or damaged insulation on the wires. Perform a voltage-loss test to make sure there is no loss of starting motor efficiency resulting from high resistance connections. Voltage loss from the battery terminal to the starting motor terminal should not exceed .30 volts for each 100 amperes. Voltage loss between the battery ground post and the starting motor frame should not exceed .10 volts for each 100 amperes. If the voltage loss is greater than these limits, measure the voltage loss over each part of the circuit until the resistance causing the voltage loss is located and corrected.

H-95. Commutator

Sluggish starting motor operation may be caused by a dirty commutator or worn brushes. The commutator cannot be cleaned while the starting motor is mounted on the engine and it will be necessary to remove it and proceed as for an overhaul. Should

the commutator be rough or worn, it should be removed for cleaning and reconditioning.

H-96. Overhaul Procedure

At periodic intervals the starting motor circuit should be thoroughly checked and the motor removed from the engine for cleaning and checking.

H-97. Removal and Disassembly

Refer to Fig. H-40 and H-41.

To remove the starting motor from the engine, disconnect the leads and cover the battery lead terminal with a piece of hose or tape to prevent short circuiting. Remove the flange bolts holding the starting motor to the flywheel housing. Remove the starting motor from the vehicle.

Each part of the starting motor should be removed, cleaned, and inspected for evidence of wear or damage. The Bendix Folo-Thru Drive should be cleaned and inspected for evidence of wear or a distorted spring. Bearings should be checked for proper clearance and fit. All insulation should be free of oil and in good condition. The armature, field coils, and brushes should be checked for good ground and lack of open circuits.

H-98. Brushes

a. The brushes should slide freely in their holders and make full contact on the commutator. Worn brushes should be replaced.

b. Check brush spring tension with a spring scale. Hook the scale under the brush spring near the

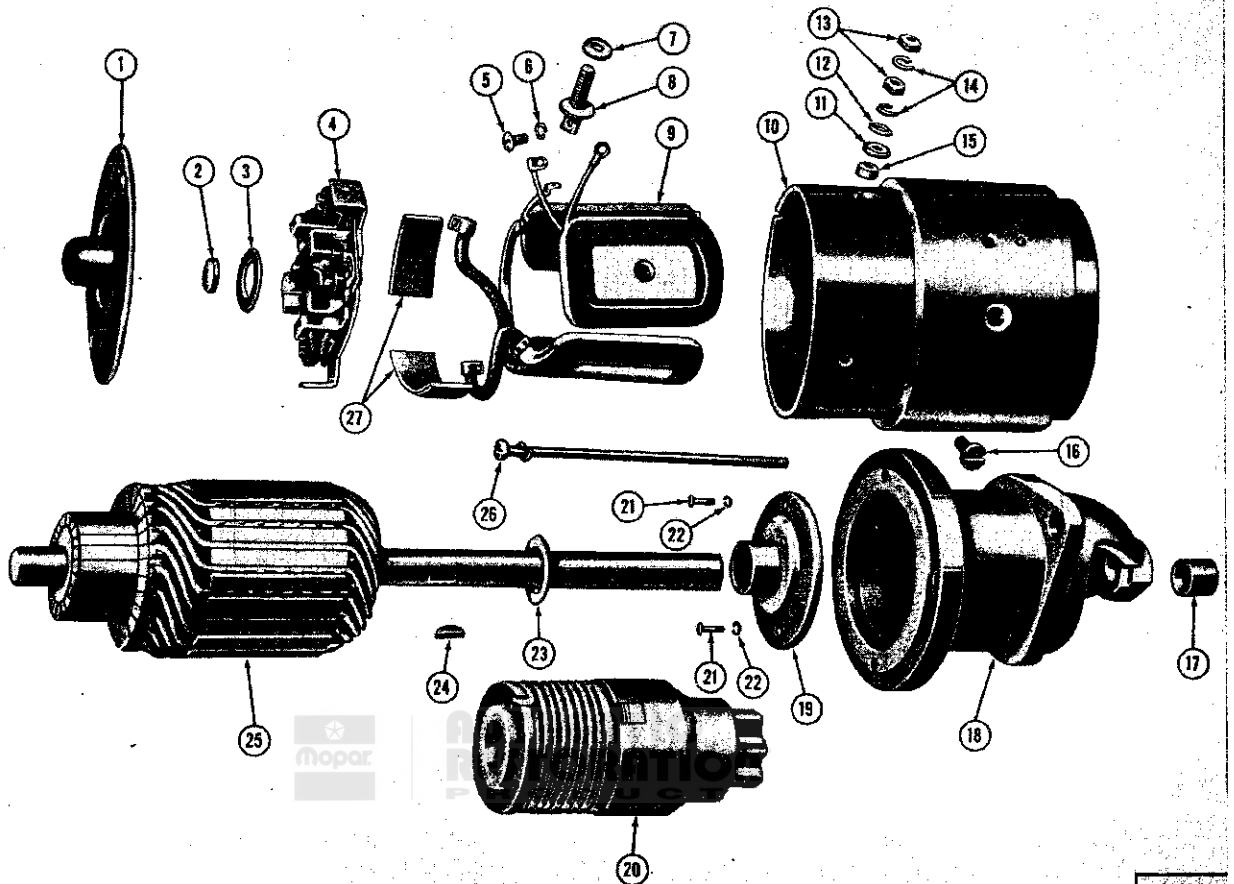


FIG. H-40—PRESTOLITE STARTING MOTOR—F4 ENGINE

- | | | |
|--------------------------------|-----------------------|-------------------------|
| 1—End Plate | 10—Frame | 19—Intermediate Bearing |
| 2—Plug | 11—Insulating Washer | 20—Bendix Drive |
| 3—Thrust Washer | 12—Washer | 21—Screw |
| 4—Brush Plate Assembly | 13—Nut | 22—Lock Washer |
| 5—Screw | 14—Lock Washer | 23—Thrust Washer |
| 6—Lock Washer | 15—Insulating Bushing | 24—Key |
| 7—Insulating Washer | 16—Pole Shoe Screw | 25—Armature |
| 8—Terminal | 17—Sleeve Bearing | 26—Thru Bolt |
| 9—Field Coil and Pole Shoe Set | 18—Drive End Frame | 27—Insulator |

brush and pull on a line parallel with the side of the brush. Take the reading just as the spring leaves the brush. It is important that the brush spring tension be kept within the limits specified at the end of this section. If the tension is too low, there will be a loss of efficiency from poor brush contact. Too great a tension will cause excessive brush and commutator wear. To change the tension, twist the spring at the holder with long-nosed pliers.

c. Worn brushes should be replaced. Brushes that are soldered to the field coil should be unsoldered and the loop in the field coil lead should be opened. Insert the new brush pigtail to its full depth in the loop. The new brush lead should be tightly clinched in the terminal and then soldered to make a strong, low-resistance connection.

H-99. Commutator

Check the commutator for wear and discoloration. If the commutator is rough or worn the armature

should be removed and the commutator turned down in a lathe. A discolored commutator should be cleaned with carbon tetrachloride. Never use emery cloth.

H-100. Armature

Visually inspect the armature for mechanical defects before checking for shorted or grounded coils. Use a set of test probes for testing armature circuits. To test the armatures for grounds, touch one point of the test probes to a commutator segment and touch the other point to the core or shaft. Do not touch the points to the bearing surface or to the brush surface as the arc formed will burn the smooth finish. If the lamp lights, the coil connected to the commutator segment is grounded. To test for shorted armature coils, a growler as shown in Fig. H-42 is necessary. The armature is placed against the core and a steel strip is held on the armature. The growler is then energized

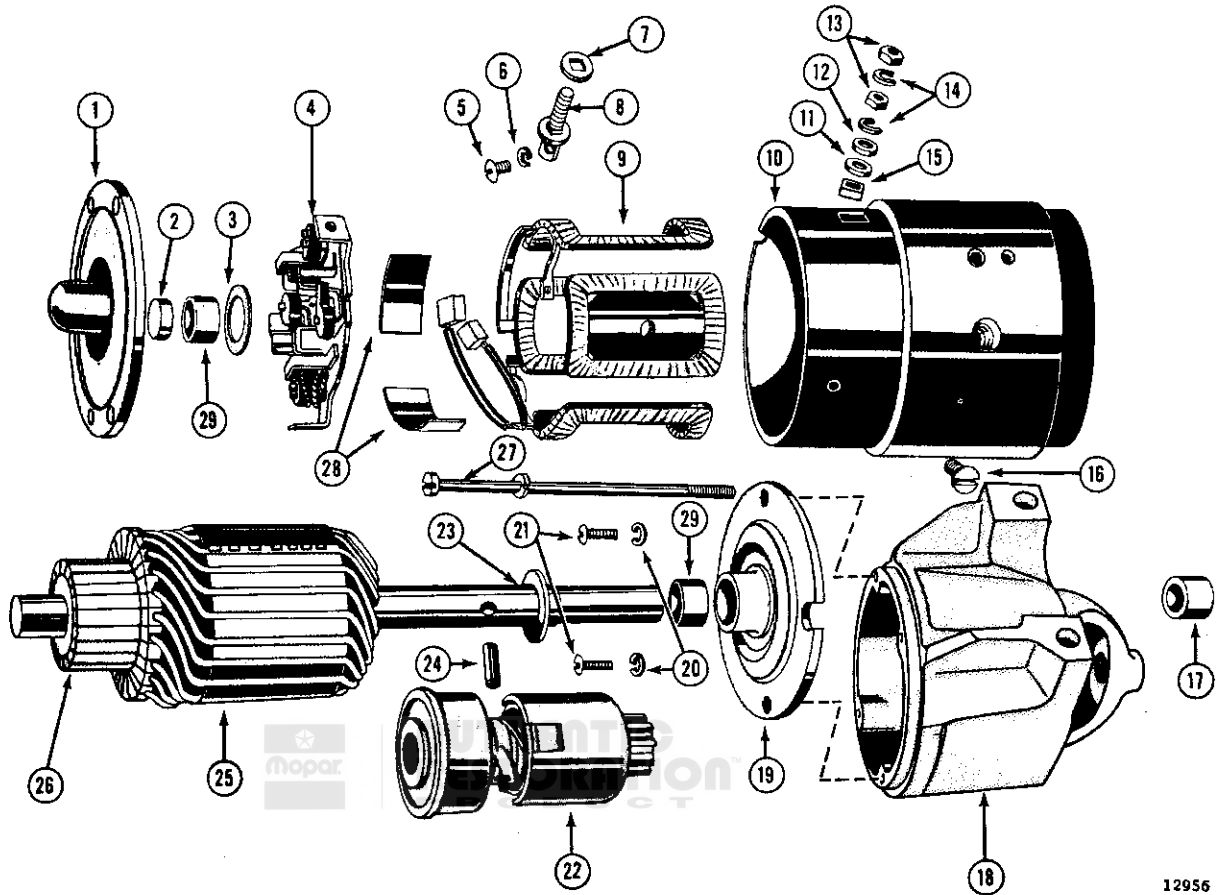


FIG. H-41—PRESTOLITE STARTING MOTOR—V-6 ENGINE

- | | | |
|----------------------------|-----------------------------------|--------------------------|
| 1—End Plate | 11—Insulating Washer | 21—Screw |
| 2—Oiling Pad | 12—Washer | 22—Bendix Drive |
| 3—Thrust Washer | 13—Nut | 23—Thrust Washer |
| 4—Brush Plate Assembly | 14—Lockwasher | 24—Pin |
| 5—Screw | 15—Insulating Bushing | 25—Armature |
| 6—Lock Washer | 16—Pole Shoe Screw | 26—Commutator |
| 7—Insulating Washer | 17—Bearing, Outer | 27—Thru Bolt |
| 8—Terminal | 18—Drive End Frame Pinion Housing | 28—Insulator |
| 9—Field Coil and Pole Shoe | 19—Intermediate Bearing Housing | 29—Bearing, Intermediate |
| 10—Frame | 20—Lock Washer | |

and the armature rotated slowly by hand. If a shorted coil is present, the steel strip will become magnetized and will then vibrate.

H-101. Field Coils

Using test probes, check the field coils for both ground and open circuits.

a. To test for ground, place one probe on the motor frame or pole piece and touch the other probe to the field coil terminals. If a ground is present, the lamp will light.

b. To test for open circuits, place the probes on the field coil terminal and on an insulated brush. If the light does not light, the coil is open circuited.

H-102. Brush Holder Inspection

Using test probes, touch the insulated brush holder with one probe and a convenient ground on the commutator end head with the other probe. If the lamp lights, it indicates a grounded brush holder.

H-103. Starting Motor Reassembly

Refer to Fig. H-40 and H-41.

a. When assembling absorbent bronze bearing found in the end plate and drive end frame, always use the proper arbor designed to give the proper bearing fit. Soak the bearings in oil before assembling in the bearing bore. Give the bearing seats a light coating of oil.

Note: At assembly, the outer pinion housing bearing must be flush with the bearing bore on the inside of the housing; the intermediate bearing must be flush with the bearing bore on the side toward the armature.

b. Brushes should be correctly installed and connected as outlined in Par. H-98 in order to be sure of proper starting motor efficiency.

c. Assemble the armature bearing plate and Bendix Folio-Thru Drive to the drive end frame. Install the two holding cap screws and lock washers. Tighten them securely.

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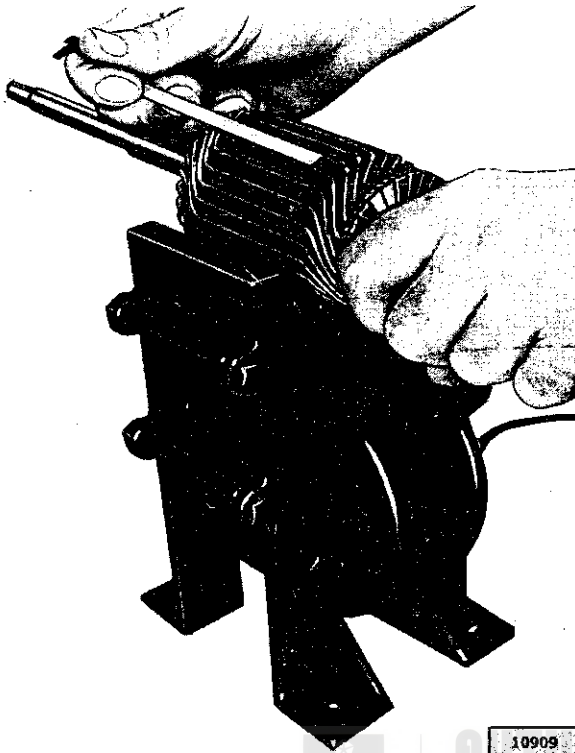


FIG. H-42—GROWLER

d. Install the armature in starter motor frame, using care to align the four brushes and brush springs on the commutator so that they are free to move and are square on the commutator.

e. Install the thrust washer on the shaft. Lubricate the plug and bearing in the end plate. Install the end plate. Install the two through bolts and tighten securely.

f. On Prestolite V6 starting motors, check pinion position by measuring from the centerline of the pinion housing mounting bolt holes to the outside edge of the pinion. Correct measurement with the Bendix drive retracted is $\frac{3}{4}$ " [19,05 mm.] to $\frac{7}{8}$ " [22,23 mm.]; with drive extended, $1\frac{3}{8}$ " [34,93 mm.] to $1\frac{1}{2}$ " [38,10]. Adjust by installing thrust washers just inside the commutator end head or intermediate bearing as required. The Bendix drive retaining pin must not project beyond the outside diameter of the pinion sleeve.

H-104. Bench Test

The motor should first be checked to see that the free running voltage and current are within specifications. To test, connect the motor to a battery, ammeter and voltmeter. If the current is too high check the bearing alignment and end play to make sure there is no binding or interference. Using a spring scale and torque arm check the stall torque to see that the motor is producing its rated cranking power. The stall torque will be product of the spring scale reading and the length of the arm in feet. If the torque is not up to specifications check the seating of the brushes on the commutator

and the internal connection of the motor for high resistance. The Bendix Folo-Thru-Drive should be checked for correct operation. The Bendix pinion should be checked to see that it shifts when the motor is operated under no load.

H-105. Bendix Folo-Thru Drive (Prestolite)

The Bendix Folo-Thru Drive is designed to overcome premature demeshing of the drive pinion from the flywheel ring gear until a predetermined engine speed is reached. See Fig. H-43.

No repairs or adjustments are possible on this drive and a complete new unit must be installed if trouble develops.

H-106. Lubrication of Folo-Thru Drive

A periodic cleaning and relubrication of the drive is advisable, the frequency of which will depend on the type of service to which the vehicle is subjected and the locale of operation.

a. Remove the starting motor from the engine and take off the outboard housing. The pinion and barrel assembly will be in the demeshed position on the screwshaft. **Do not** move it forward **until after** that portion of the armature shaft ahead of the pinion has been cleaned. If accidentally rotated to the outer end of the screwshaft it will lock in that position and cannot be forced back.

b. Do not disassemble the drive for any reason.

c. Do not dip or wash the drive in any cleaning solution.

d. Do not remove the drive from the armature shaft. Remove excess oil, grease or foreign matter from the armature shaft by wiping it with a clean cloth.

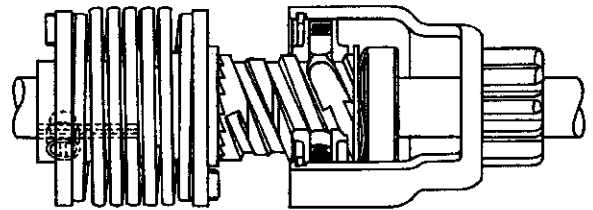


FIG. H-43—BENDIX FOLO-THRU DRIVE

Dampen the cloth with kerosene if necessary. A light film of SAE 10 oil may then be applied to the shaft.

e. Now rotate the pinion and barrel assembly to the fully extended position, thereby exposing the screwshaft triple threads. Use a cloth dampened with kerosene to wipe them clean. **Do not use gasoline or any commercial cleaner.** If the dirt is thick and gummy, apply the kerosene with a small brush. Tilt the starting motor so that a small amount will run under the control nut. Relubricate with a thin film of SAE 10 oil. Use SAE 5 at extremely low temperatures.

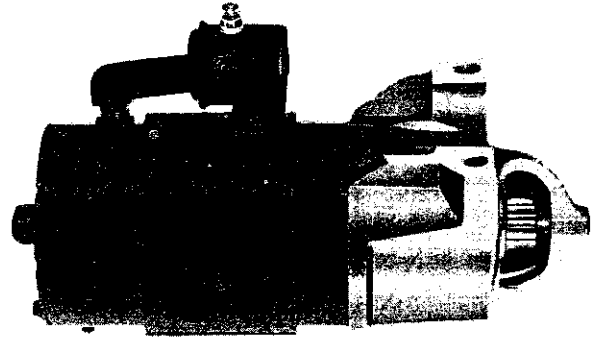
f. Reassemble the starting motor to the engine with the drive in the extended position. Carefully mesh the pinion with the flywheel ring gear before tightening the starter motor mounting bolts. It may

require a slight rotation of the pinion to index it into the ring gear. When the engine starts the drive pinion will automatically demesh from the ring gear and return to its normal position.

H-107. Starter Solenoid Switch (Prestolite)

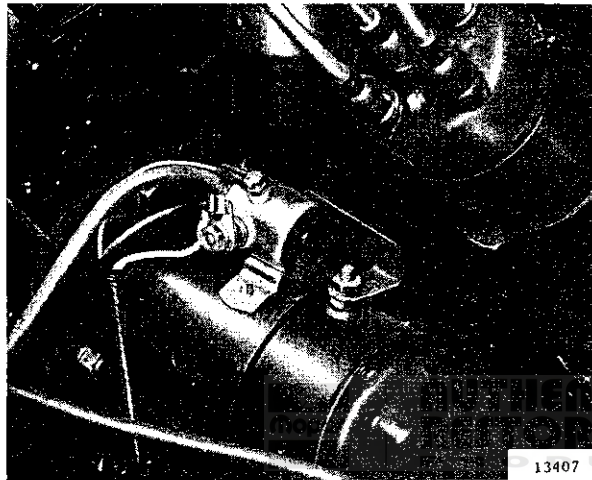
- Refer to Figs. H-44 and H-45.

Should a starting motor fail to deliver maximum power the fault may be due to voltage drop at the starting switch contacts due to corrosion or burning. Check the switch by comparing the voltage at the battery terminals and that at the starting



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FIG. H-46—PRESTOLITE STARTER AND SOLENOID—V-6 ENGINE



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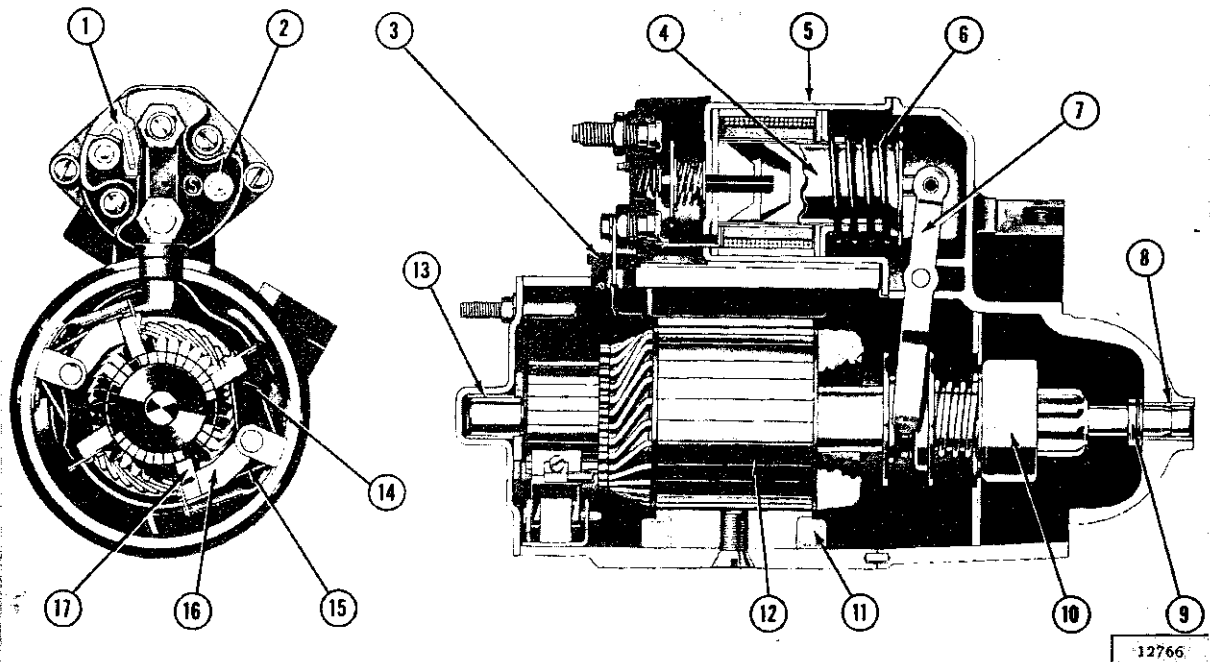
FIG. H-44—STARTER SOLENOID—HURRICANE F4

switch terminals. The voltage drop should not exceed .05 volts per 100 amperes.

Should it be impossible to file the switch contact plates to obtain a clean full surface contact the switch should be replaced.

Current model starting switches are of the solenoid type, mounted directly on the starting motors. This type switch is energized by turning the ignition key to the extreme right position. Should a solenoid switch fail in service it is necessary to install a new solenoid assembly.

a. To remove the solenoid switch first remove the nut and lock washer securing the solenoid strap to the starter post. Then remove nut and lock washer securing battery positive cable to solenoid post. Tape end of battery cable to eliminate the pos-



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FIG. H-45—DELCO STARTING MOTOR—V-6 ENGINE

- | | | |
|------------------------|-----------------------|---------------------------|
| 1—"R" Terminal Contact | 7—Shift Lever | 13—Bushing |
| 2—Switch Terminal | 8—Bushing | 14—Insulated Brush Holder |
| 3—Grommet | 9—Pinion Stop | 15—Brush Spring |
| 4—Plunger | 10—Overrunning Clutch | 16—Grounded Brush Holder |
| 5—Solenoid | 11—Field Coil | 17—Brush |
| 6—Return Spring | 12—Armature | |

sibility of the cable shorting at the engine or frame. Remove nut and lock washer securing the ignition wire to the solenoid post and remove the two screws and lock washers securing the solenoid to the starter frame. Remove the switch.

b. To install the solenoid switch reverse the removal procedure given above.

H-108. STARTING MOTOR — DELCO DAUNTLESS V-6 ENGINE

Refer to Fig. H-45.

The starting motor used on the Dauntless V-6 engine has an integral solenoid switch and enclosed shift lever which first shifts the overrunning clutch pinion into engagement with the ring gear on the flywheel of the engine and then closes the electrical circuit to cause engine cranking. When the engine starts, the overrunning clutch disengages to prevent transfer of engine speed to the starting motor.

Note: Should a service replacement starter motor be required the factory recommends replacement with original equipment parts; however, should the need arise an existing starter motor (Delco or Prestolite) could be replaced with the current Delco-Remy starter, model 1108375, with the following modifications to the wiring harness. If the existing starter motor wiring harness does not provide a 12 ga. purple conduit wire, (connects the ignition switch to the starter motor) then a 12 ga. purple conduit wire 70 inches long, must be installed. Should the existing starter motor wiring harness contain a 16 ga. light blue conduit wire, (connects the ignition switch and starter motor) bend this wire back and tape out of the way.

H-109. Starting Motor Disassembly

a. Before removing the starting motor from the engine, disconnect leads and cover battery lead terminal with piece of hose or tape to prevent short circuiting. Note locations of wiring connections to assure proper reconnection. Remove the cap screw that secures the starting motor to the angle bracket on the side of the engine. Remove the two cap screws that secure the drive end of the starting motor to the cylinder block; remove the starting motor.

b. Remove terminal nut and disconnect field lead, which passes through grommet at top of motor, from motor terminal of solenoid. Remove two thru bolts from motor. Remove commutator end frame and field frame assembly from solenoid and drive assembly.

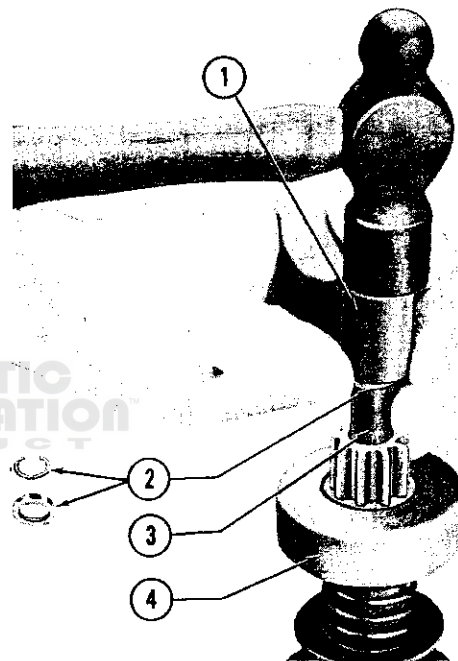
c. Pull out pivot pins of brush holders and remove each of two brush holder and spring assemblies from field housing. Remove screws which attach brushes and leads to holders.

d. Remove armature and drive assembly from drive housing. Remove thrust collar from pinion end of armature shaft. Remove leather thrust washer from opposite end of shaft.

e. To separate drive assembly from armature, place a metal cylinder of proper size ($\frac{1}{2}$ " [12,7 mm.] pipe coupling is satisfactory) over end of armature shaft to bear against the pinion stop retainer. Tap

retainer toward armature to expose snap ring as shown in Fig. H-47. Remove snap ring from groove in shaft; slide retainer and pinion drive assembly from shaft. Remove assist spring from shaft.

f. Remove two screws holding solenoid switch to drive housing remove switch. Remove small nut and insulating washer from the solenoid S terminal. Remove nut and insulating washer from the solenoid battery (large) terminal. Remove two screws that attach switch cover to solenoid and remove cover for inspection of switch parts. Remove shift lever fulcrum bolt and remove shift lever, plunger, and return spring.



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FIG. H-47—REMOVING PINION DRIVE ASSEMBLY FROM ARMATURE SHAFT

1— $\frac{1}{2}$ " Pipe Coupling
2—Snap Ring and Retainer
3—Armature Shaft
4—Drive Assembly

H-110. Starting Motor Cleaning and Inspection

a. Wipe all parts clean with clean cloths. The armature, field coils, and drive assembly must not be cleaned by any degreasing or high temperature method. This might damage insulation so that a short circuit or ground would subsequently develop. It would also remove lubricant originally packed in the overrunning clutch so that clutch would soon be ruined.

b. Carefully inspect all parts visually for wear or damage. Make necessary repairs or replace unserviceable parts. Any soldering must be done with rosin flux.

Note: Never use acid flux when soldering any electrical connections and never use emery cloth to clean armature commutator or other electrical units.

H-111. Brushes

Check brush length. If brushes are worn to one-half their original length, replace them. Also check for cracks, chips, damaged mounting holes, oil saturation, or other damage; replace brushes.

H-112. Commutator

Check the commutator for wear and discoloration. If the commutator is rough or worn the armature should be removed and the commutator turned down in a lathe. A discolored commutator should be cleaned with carbon tetrachloride and inspected. Scratches on the commutator may be removed with sand paper. Use compressed air to remove sand particles after cleaning.

H-113. Armature

Visually inspect the armature for mechanical defects before checking for shorted or grounded coils. Use a set of test probes for testing armature circuits. To test the armature for grounds, touch one point of the test probes to a commutator segment and touch the other point to the core or shaft. Do not touch the points to the bearing surface or to the brush surface as the arc formed will burn the smooth finish. If the lamp lights, the coil connected to the commutator segment is grounded.

H-114. Field Coils

Using test probes, check the field coils for both ground and open circuits. To test for ground, place one probe on the motor frame or pole piece and touch the other probe to the field coil terminals. If a ground is present, the lamp will light.

To test for open circuits, place the probes on the field coil terminal and on an insulated brush. If the light does not light, the coil is open circuited.

H-115. Brush Holder Inspection

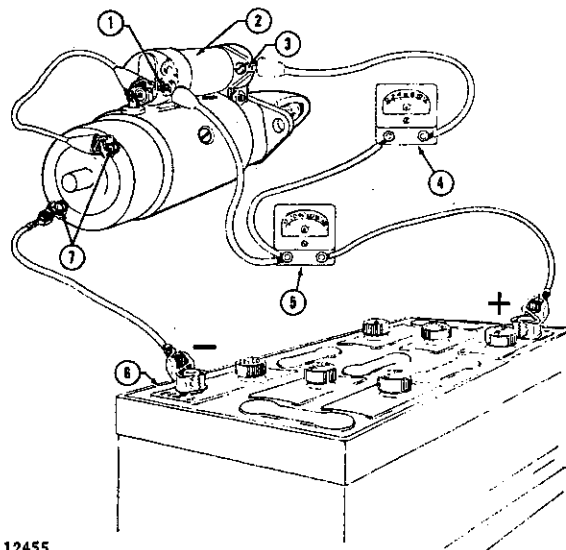
Inspect brush holders for distortion, wear, and other damage. Check that brush holders pivot freely on their pivot pins. Check brush spring tension with a spring scale. Hook the spring scale under the brush holder at the brush and pull on a line parallel to the side of the brush. Note scale reading just as brush leaves commutator. Tension must be 35 oz. [9,925 kg.] minimum. Replace brush springs if tension is insufficient.

H-116. Solenoid Coils

Check solenoid coil as follows:

a. Remove screw from motor terminal of solenoid and bend field coil leads away from terminal. Connect terminal to ground with a heavy jumper wire. See Fig. H-48.

b. Connect a 12-volt battery, a high-current variable resistance, and an ammeter of 100 amperes capacity in series between S terminal of solenoid and ground; battery negative is to be connected to ground. Connect a heavy jumper wire from solenoid base to ground terminal of battery. Connect a voltmeter between base of solenoid and small S terminal of solenoid. Refer to Fig. H-48.



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FIG. H-48—TEST CONNECTIONS, STARTER SOLENOID COIL

- | | |
|---------------------|----------------------|
| 1—S Terminal | 5—Ammeter |
| 2—Solenoid | 6—12-Volt Battery |
| 3—Ground Connection | 7—Ground Connections |
| 4—Voltmeter | |

c. Slowly decrease resistance until voltmeter reading increases to 10 volts. Note ammeter reading. This is current drawn by both windings in parallel; it should be 42 to 49 amperes at 10 volts, with solenoid at room temperature.

d. Disconnect jumper wire from motor terminal of solenoid. Increase resistance until voltmeter reads 10 volts; note ammeter reading. This is current drawn by hold-in winding only; it should be 10.5 to 12.5 amperes at 10 volts, with solenoid at room temperature.

e. If solenoid windings do not rest within specifications given, replace solenoid switch assembly.

H-117. Starting Motor Reassembly

a. Lubricate shift lever linkage and fasten in drive housing with lever stud.

Caution: Do not lubricate solenoid plunger or solenoid cylinder.

b. Install return spring on solenoid plunger and insert plunger into solenoid cylinder. Apply sealing compound on both sides of solenoid flange where it extends between drive housing and field frame. Attach plunger to shift lever with fulcrum pin. Fasten solenoid to drive housing with two mounting screws.

c. Lubricate armature shaft with silicone grease. Install assist spring and drive assembly on shaft with pinion outward.

d. Install pinion stop retainer on armature shaft with recessed side outward. Place a new snap ring on drive end of shaft and hold it in place with a hard wood block. Strike block with hammer to force snap ring over end of shaft; slide the ring down into groove in shaft. See Fig. H-49, left hand view.

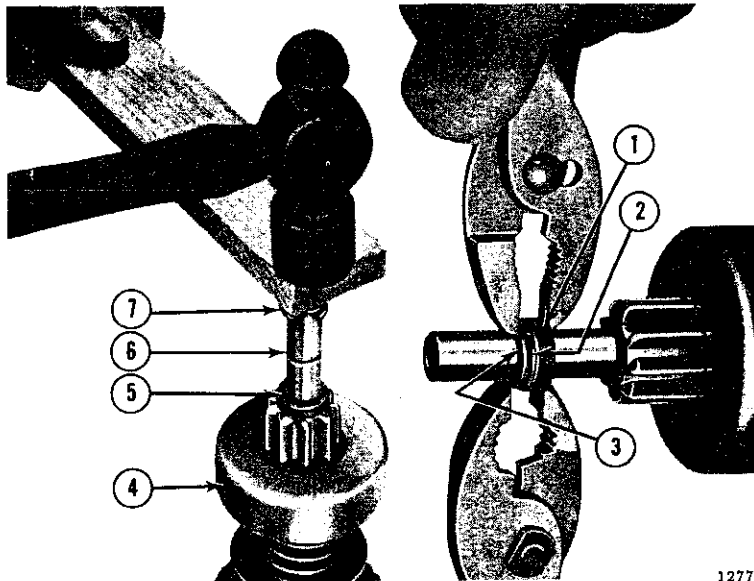


FIG. H-49—INSTALLING PINION STOP RETAINER AND THRUST COLLAR ON ARMATURE SHAFT

- 1—Retainer
- 2—Snap Ring
- 3—Thrust Collar
- 4—Drive Assembly
- 5—Retainer
- 6—Groove in Armature Shaft
- 7—Snap Ring

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e. Place thrust collar on armature shaft with shoulder next to snap ring. Move the retainer into contact with ring. Using pliers on opposite sides of shaft, squeeze retainer and thrust collar together until snap ring is forced into the retainer. See Fig. H-49, right hand view.

f. Lubricate bearing of drive housing with silicone grease and install armature and drive assembly in housing.

g. If field coils were removed from field frame, position coils of replacement field coil assembly on pole shoes and mount each pole shoe in field frame with a pole shoe screw. Use care in tightening screws to avoid distortion of parts. Be certain that screws are securely tightened. Insert ends of field coil leads through rubber bushing in field frame.

h. Position field frame assembly over armature assembly so that its dowel pin engages the hole in drive housing. Use care to prevent damage to brushes and brush holders. Make sure that brushes are properly sealed on commutator.

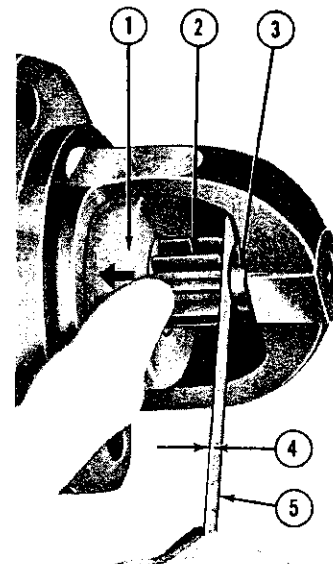
i. Install leather thrust washer on commutator end of armature assembly. Lubricate bearing in commutator end frame with silicone grease and position end frame to field frame so that armature shaft enters bearing. Secure field frame and end frame to drive housing with two thru bolts. Connect field leads to motor terminal of solenoid with connecting nut.

j. Whenever the starting motor is disassembled and reassembled, the pinion clearance should be checked. This is to make sure that proper clearance exists between the pinion and the pinion stop retainer when pinion is in cranking position. Lack of clearance would prevent solenoid starter switch from closing properly; too much clearance would cause improper pinion engagement in ring gear.

k. Supply 6 volts (3 battery cells or a 6-volt battery) between S terminal of the solenoid and ground (starter frame).

Caution: Do not supply more than 6 volts or the motor will operate. As a further precaution to prevent motor operation, connect a heavy jumper wire from the solenoid motor terminal to ground.

l. After energizing the solenoid, push the drive assembly away from the stop retainer as far as possible and use a feeler gauge to check clearance between pinion and retainer. See Fig. H-50. If pinion clearance is not .010" to .140" [0,25 a 3,55 mm.], there is either excessive wear or improper assembly of solenoid linkage or shift lever mechanism.



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FIG. H-50—MEASURING PINION CLEARANCE

- 1—Press Rearward
- 2—Pinion
- 3—Retainer
- 4—.010" to .140" Clearance
- 5—Feeler Gauge

Note: Pinion clearance cannot be adjusted. If clearance is not correct, motor must be disassembled and checked for the above mentioned defects. Any defective parts must be replaced.

H-118. Starting Motor Test — General

To obtain full performance data on a starting motor, or to determine the cause of abnormal operation, the motor should be submitted to no-load and locked armature tests, with equipment designed for such tests. A high-current variable resistance is required to obtain the specified voltage at the starting motor. This is necessary since a small variation in the voltage will produce a marked difference in the current drawn.

H-119. Starting Motor No-Load Test

This test requires a DC voltmeter capable of reading voltages in a 12-volt circuit, a DC ammeter with maximum range of several hundred amperes, a high-current variable resistance, an rpm. indicator, and a fully-charged, 12-volt battery.

a. Connect a jumper lead between S terminal and large battery terminal of starter solenoid. Connect voltmeter between either of these terminals (positive) and motor frame (negative, ground). Connect ammeter and variable resistance in series between positive terminal of battery and battery terminal of solenoid. Set up rpm. indicator to show starting motor speed.

b. Initially, adjust variable resistance to a value of approximately .25 ohm. To complete the circuit, connect negative terminal of battery to motor frame. Adjust variable resistance to obtain a voltmeter reading of 10.6 volts; note speed of starting motor and ammeter reading. Motor speed should be 6750 to 10,500 rpm.; ammeter reading should be 50 to 80 amperes.

c. Rated speed and current indicate normal condition of the starting motor. Low speed and high current may show friction; this could be caused by tight, dirty, or worn bearings, bent armature shaft, or a loose field pole shoe dragging against the armature. It could also be caused by a short-circuited armature, or by grounded armature or field coils.

d. Failure to operate and high current indicates a direct short circuit to ground at either the battery terminal or field coils.

e. Failure to operate and no current are usually caused by broken brush springs, worn brushes, high insulation between commutator bars, or some other condition preventing good contact between the brushes and commutator. It can also be caused by open circuit in either the field coils or armature coils.

f. Low speed and low current show high resistance due to poor connections, defective leads, dirty commutator, or one of the conditions mentioned in e, above.

g. High speed and high current indicates a short circuit in the field coils.

H-120. Locked Armature Test

This test requires a DC voltmeter with range appropriate to read voltages in a 12-volt circuit, a DC ammeter with maximum range of several hundred amperes, a high-current variable resistance, a clamping fixture to lock together the motor shaft and case, and a fully-charged 12-volt battery.

a. Connect a jumper lead between S terminal and large battery terminal of starter solenoid. Connect voltmeter between either of these terminals (positive) and motor frame (negative, ground). Connect ammeter and variable resistance in series between positive terminal of battery and battery terminal of solenoid. Install clamping fixture to lock motor shaft and case together securely.

b. Initially, adjust variable resistance to approximately .05 ohm. To complete the circuit, connect negative terminal of battery to motor frame. Adjust variable resistance to obtain a voltmeter reading of 4.0 volts. Ammeter reading should be 280 to 320 amperes.

H-121. Solenoid Starter Switch — Delco

The solenoid-type switch is mounted directly on the starting motor. This type of switch is energized by turning the ignition key to the extreme right position. Should the solenoid switch fail in service it is necessary to install a new assembly.

Should a starting motor fail to deliver maximum power the fault may be due to voltage drop at the starter switch contacts due to corrosion or burning. Check the switch by comparing the voltage at the battery across the terminals. The voltage drop should not exceed .05 volts per 100 amperes.

In order to remove the starter solenoid, it is necessary to remove the starter assembly.

H-122. ELECTRICAL INSTRUMENTS

H-123. Fuel Gauge — CJ-3B

The fuel gauge circuit is composed of the indicating unit, mounted on the instrument panel, and the fuel tank unit, connected by a single wire through the ignition switch.

Should the gauge fail to register, check all wire connections to be sure they are tight and clean; also be sure both units are well grounded. If, after this check, the gauge does not indicate properly, remove the wire from the tank unit and connect it to a new tank unit which must be grounded to the tank or frame for test. Turn the ignition switch "ON" and move the float arm through its range of travel, watching the dash unit to determine if it indicates correctly. If it fails to do so the trouble is probably in the dash unit and it should be replaced.

Should a new tank unit be unavailable for this test, disconnect tank unit wire at the instrument panel gauge. Connect one lead of a 12 V, 1 CP test light to the instrument panel unit terminal and with the ignition switch "ON" ground the other lead. If the unit is operating correctly the pointer will move approximately three-quarter across the dial.

Do not attempt to repair either unit; replacement is the only procedure.

H-124. Testing Indicators and Gauges

Two gauges (fuel and temperature) and two indicators (oil pressure and battery charge) that are located in the instrument cluster are electrically operated.

The fuel gauge is connected by a single wire to a float-and-slide-rheostat sending unit in the fuel tank.

The temperature gauge is connected by a single wire to a resistance-type sending unit mounted on the engine.

The battery charge indicator operates when there is a difference in potential between the generator and the battery. The battery charge indicator lights when the generator is not charging the battery. The indicator light goes out when the generator begins to charge the battery.

The oil pressure indicator is connected by a single wire to a diaphragm switch located on the engine. When engine oil pressure is low or zero and the ignition switch is on, the oil pressure indicator will light. When engine speed is increased slightly above idle speed, raising the oil pressure to approximately 6 psi. [0,2 kg-cm²], the diaphragm switch will open the circuit and the indicator light will go out.

A voltage regulator maintains a constant voltage to the gauges in normal operation. On early vehicles, this voltage regulator was mounted on the rear of the instrument cluster. On current vehicles, the voltage regulator is integral with the fuel gauge.

Should trouble develop in the gauges, first check the regulator (fuel gauge on current production vehicle). If the voltage to the regulator is below 10 volts system low gauge readings will result. Voltage in excess of 16 volts will not affect gauge readings but may result in premature wear of the regulator contacts. If the voltage to the regulator is within the above limits, check the electrical connections to the regulator (or fuel gauge), especially the ground connection. If the readings of all the gauges is too high, or they all read too low, replace the regulator (or fuel gauge).

If the temperature gauge or heat indicator in the instrument cluster have failed, the cause may originate from the jumper bar shorting out against the instrument case. Check the jumper bar between the temperature gauge and heat indicator at the rear of the instrument case. On later production vehicles, the jumper bar is covered with an insulating sleeve to protect it from shorting out against the instrument case. If the jumper bar does not have this sleeve, either install one or wrap the bar with plastic electrical tape to half an inch [12,7 mm.] from each end. When installing the jumper bar, be sure the curved segment is closest to the fuel gauge.

Should only one of the two gauges register incorrectly, check the lead wire from the gauge to the sending unit for shorts or open connections. Next disconnect the gauge from the sending unit, and connect the gauge to a new fuel tank sending unit which has been grounded to the vehicle. If the gauge registers incorrectly when operating the new unit, replace the gauge; if correctly, replace the sending unit.

Should a new fuel tank unit not be available for

testing, use a 12-volt test light in its place. When the gauge is operating correctly, the pointer will move approximately three-quarters across the dial.

On some vehicles, the temperature gauge may register on or close to the H (hot) mark when coolant temperature is 190°F. to 200°F. [88°C. a 93°C.]. In such cases, a 25-ohm, 1-watt resistor may be installed on the temperature gauge which will place the pointer just beyond the center mark at a coolant temperature of 190°F. to 200°F. Install the resistor between the two terminals on the back of the gauge. Insulate the exposed leads of the resistor with electrical tape.

If the oil pressure indicator does not indicate correctly, first check the light bulb. Next check all connections and lead wires. If, after all possible defects are corrected, the indicator light does not go on and off properly, then the diaphragm type switch in the cylinder block should be replaced.

H-125. 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 of different colors or are marked by tracers to aid when checking individual circuits.

The lighting circuits of all models are protected by an overload circuit breaker mounted on the back of the main light switch and no replaceable fuse is required.

The upper and lower headlight beams are controlled by a foot switch located on the toe board to the left of the clutch pedal.

H-126. Main Light Switch

This switch is a dual functioning unit having two push-pull positions and a rotary action. When pulled out to the first position, the front parking and tail lights are turned on. When pulled all the way out to the second position, the headlights and tail lights are turned on. Rotating the switch to the right dims the instrument cluster lighting. The switch may be removed from the instrument panel by first loosening the set screw in the control knob and removing the knob. The retaining nut may then be removed and the switch removed through the rear of the instrument panel.

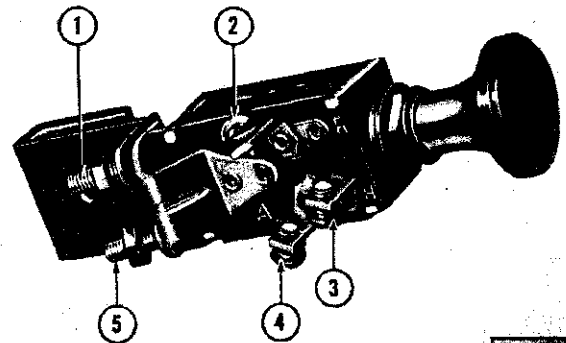


FIG. H-51—MAIN LIGHT SWITCH (EARLY)

- | | |
|---------------|------------------|
| 1—Battery | 4—Parking Lights |
| 2—Rear Lights | 5—Auxiliary |
| 3—Head Lights | |

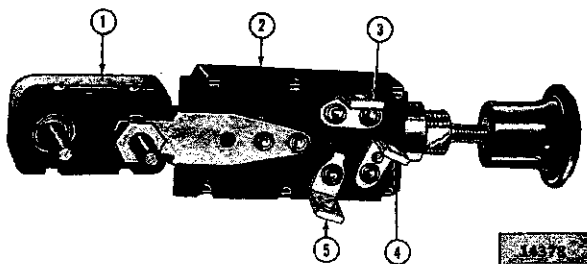


FIG. H-52—MAIN LIGHT SWITCH (LATE)

- 1—Circuit Breaker
- 2—Light Switch
- 3—Rear Lights
- 4—Head Lights
- 5—Parking Lights

The light switch shown in Fig. H-51 was superseded by the one shown in Fig. H-52.

H-127. Headlight Dimmer Switch

To remove the headlight dimmer switch, first raise the hood and disconnect the wires attached to the switch. Then remove the two screws that hold the dimmer switch to the floor board. Remove the switch. Check the operation of the 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 the test lamp when the switch is operated.

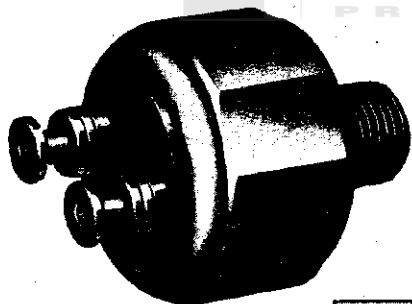


FIG. H-53—STOP LIGHT SWITCH

H-128. Stop Light Switch

The stop light switch is of the diaphragm type. Should the switch become inoperative, it is necessary to install a new one. Current production vehicles are equipped with two stop light switches that operate independently of each other. Both switches are located along the left side of frame, in the front and rear brake lines.

Caution: Do not apply the brakes while making this exchange as air may enter the hydraulic line. Bleed the brakes after replacing the switch.

Fig. H-54 shows the wiring of the stop light circuit.

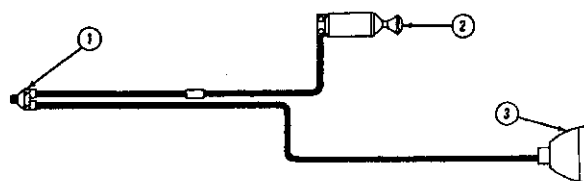


FIG. H-54—STOP LIGHT CIRCUIT

- 1—Stop Light Switch
- 2—Light Switch
- 3—Tail Light

H-129. Head Lamp Service

H-130. Head Lamp Replacement

Refer to Fig. H-59.

Each sealed beam head lamp can only be replaced as a complete unit.

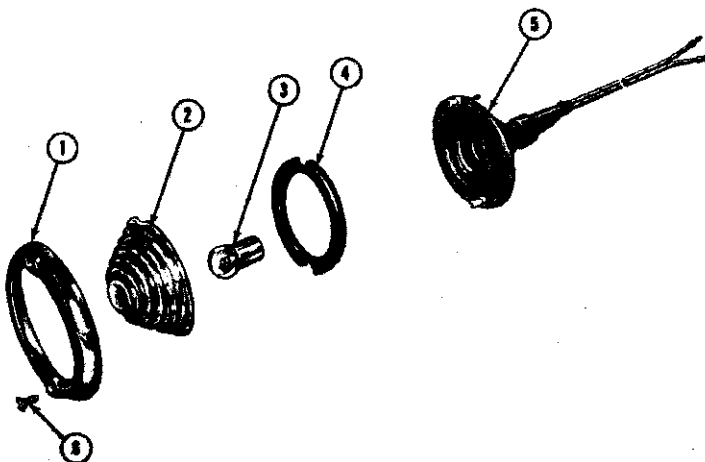
A sealed beam unit may be replaced by the following procedure:

- a. Remove door screw.
- b. Remove door.
- c. Remove retaining screws and retaining ring.
- d. Remove sealed beam unit.

Installation of sealed beam unit is the reverse of above procedure. When replacing head lamps, check lamp aim following procedures described in Par. H-132.

FIG. H-55—PARKING LIGHT (EARLY)

- 1—Bezel
- 2—Lens
- 3—Bulb
- 4—Gasket
- 5—Housing and Cable
- 6—Screw



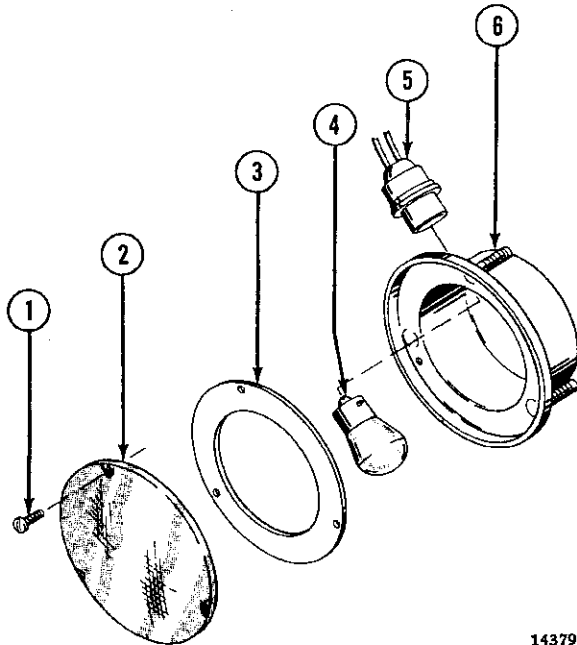


FIG. H-56—PARKING AND SIGNAL LIGHT (LATE)

- 1—Screw
- 2—Lens
- 3—Gasket
- 4—Bulb
- 5—Cable
- 6—Housing

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H-131. Head Lamp Aiming Preparation

All Jeep Universal-series lamps must be aimed on the low beam. Lamps may be aimed either with mechanical aimers or by using a screen. If mechanical aimers C-3674 are used, follow instruction supplied with the aiming equipment. If a screen is to be used, preparation for aiming is as follows:

- a. Locate the vehicle in a darkened area with a level floor area and with a screen (may be a wall) having a nonreflecting white surface. A reference line should be marked on the floor 25 feet [7,62 m.] away from and parallel to the screen. Position the vehicle perpendicular to the screen and with the front head lamps directly over the reference line.
- b. Locate the middle tape on the screen so that it is aligned with the center line of the vehicle.
- c. Equalize all tire pressures.
- d. Rock the vehicle from side to side to equalize springs and shock absorbers.
- e. Measure the distance between vehicle head lamp centers. Then, position marker tapes vertically on the screen to the right and left of the middle tape at half this distance.
- f. Measure the distance from the center of each lamp to the surface on which the vehicle rests. Position a marker tape horizontally on the screen

FIG. H-57—TAIL, STOP AND DIRECTIONAL LIGHT

- 1—Screw
- 2—Lens
- 3—Gasket
- 4—Bulb
- 5—Housing and Cable Assembly
- 6—Nut and Lockwasher

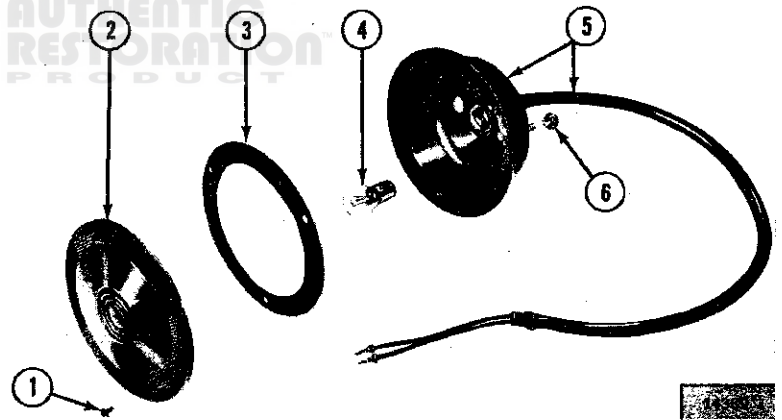


FIG. H-58—TAIL AND STOP LIGHT (EARLY)

- 1—Ring
- 2—Lens
- 3—Gasket
- 4—Retainer
- 5—Bulb
- 6—Gasket
- 7—Housing and Socket

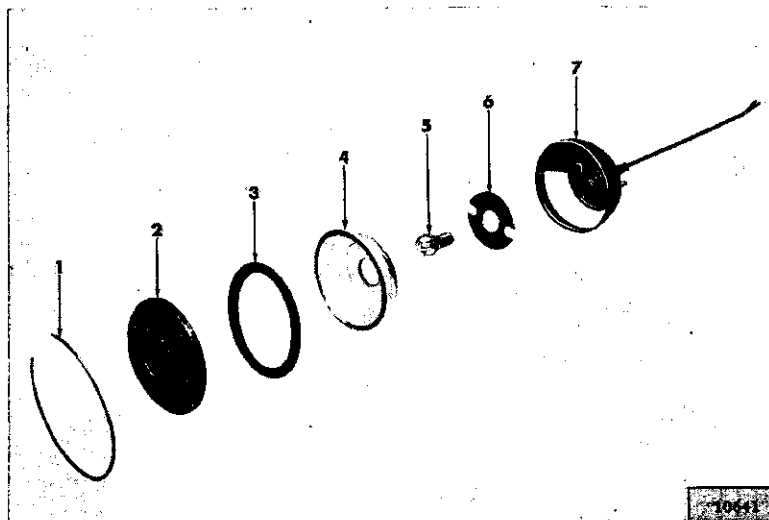
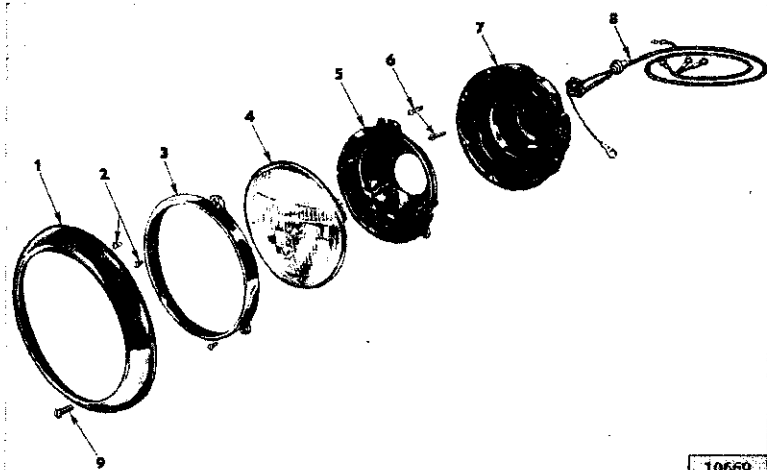


FIG. H-59—HEAD LAMP

- 1—Door
- 2—Retaining Screw
- 3—Retaining Ring
- 4—Sealed Beam Unit
- 5—Mounting Ring
- 6—Adjusting Screw
- 7—Housing
- 8—Wires
- 9—Door Screw



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to cross the vertical tapes at the measured height of each lamp center respectively.

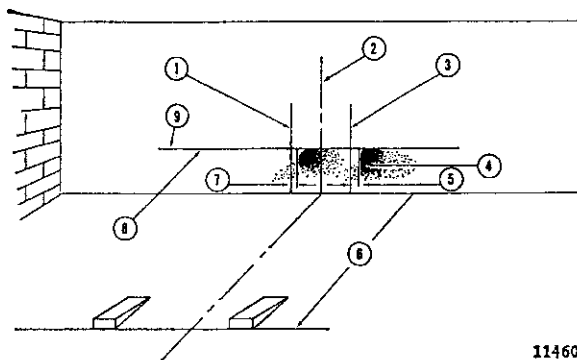
g. Remove the head lamp doors.

h. Clean the head lamps.

H-132. Aiming Head Lamps

a. Turn the headlights on low beam. 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.

b. Turn the vertical aiming screw counterclockwise until the lamp beam is considerably lower than the horizontal reference line on the screen. Then, turn the screw clockwise until the top edge of the high intensity area is even with the horizontal line. See Fig. H-60.



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FIG. H-60—HEADLIGHT AIMING CHART

- 1—Vertical Tape, Left Lamp Center
- 2—Vehicle Centerline
- 3—Vertical Tape, Right Lamp Center
- 4—Zone of Greatest Intensity
- 5—2' (Two Inches)
- 6—25'0"
- 7—2' (Two Inches)
- 8—Height of Lamp Centers
- 9—Horizontal Tape

Note: Always bring the beam into final position by turning both aiming screws clockwise so that the unit is held under proper tension when the operation is complete.

c. Turn the horizontal aiming screw counterclockwise until the beam is off. Then, turn the same

screw clockwise until the left edge of the high intensity area is 2" [5,08 cm.] to the right of the lamp center line. See Fig. H-60.

d. Cover the lamp that has been aimed and aim the other lamp using the same procedure.

e. Carefully reinstall the head lamp doors.

H-133. Parking and Turn Signal Light

The parking lights are mounted in the radiator guard panel just below the headlights. These lights are on only when the main switch control knob is pulled out to the first notch.

To replace a parking lamp, remove two screws allowing the lens and colored reflector to be removed. Replace the lamp, which is recessed back in the housing.

If the complete parking light assembly is to be removed for service or replacement, disconnect the wire plug at the back of the housing. Then remove the nuts and lock washers securing the parking light assembly and remove out the front of the panel.

H-134. Tail, Stop and Turn Signal Light

Refer to Fig. H-57 and H-58.

The tail lights are mounted in the rear corner posts of the body. They are on whenever the main switch control knob is pulled out to any position.

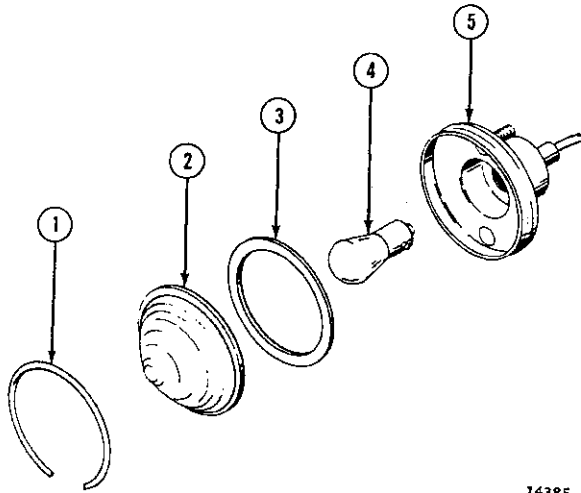
a. To replace a lamp, remove the snap ring on early models and remove the lens; on late models remove lens screws, lens and gasket. Clean lens and reflector before replacing.

b. To remove the parking and tail light housing, disconnect wiring, remove the two nuts and lock washers securing tail light assembly to body and remove from rear of body.

H-135. Backup Lights

● Refer to Fig. H-61.

The backup lights on late production vehicles are located on the rear of the vehicle directly below the tail light. The backup lights are actuated through a switch when the ignition is on and the transmission is in reverse.



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FIG. H-61—BACK-UP LIGHT

- 1—Snap Ring
- 2—Lens
- 3—Gasket
- 4—Bulb
- 5—Housing and Cable

On late production T14A transmissions the backup light switch is threaded into the right rear corner of the cover housing and is activated by the movement of the reverse shift rail. The backup light switch is not serviceable and must be replaced if defective. Bulbs can be replaced by removing the snap ring, lens and gasket from the assembly.

H-136. License Plate Light

On CJ-5A, CJ-6A and current production vehicles the license plate light is attached to the tailgate and is of the swing-type design to enable the license plate to be visible when the tailgate is in the down position. The bulb can be changed by removing the clear plastic lens. On early production vehicles the license plate light is integral with the tail light assembly.

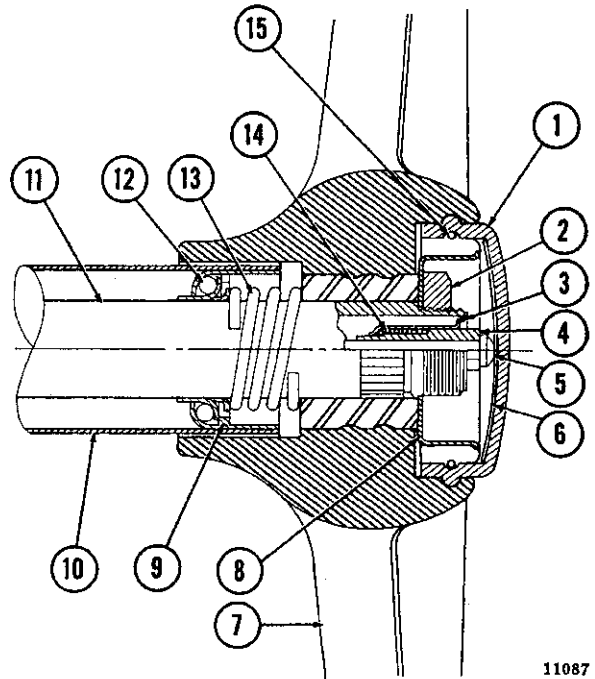
H-137. Horn

The horn is mounted under the hood on the left front fender. The horn is sounded by pressing the button located at the top center of the steering wheel.

To remove the horn wire, disconnect the wire at the snap connection at the base of the steering column. Pull off the rubber horn button cap and the brass contact cap from the steering wheel nut. This will expose the contact tip of the horn wire. Pull the wire out of the steering column from the top. Refer to Fig. H-62.

H-138. Directional Signals

Fig. H-63 shows the wiring of a composite directional signal circuit. 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 burned-out bulb in the circuit.

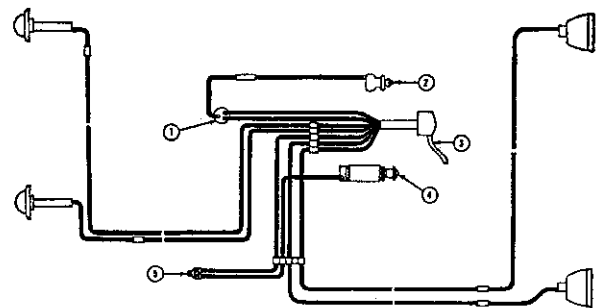


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FIG. H-62—HORN BUTTON

- 1—Cap
- 2—Nut
- 3—Horn Button Spring Cup
- 4—Ferrule
- 5—Horn Cable
- 6—Contact Disc
- 7—Steering Wheel
- 8—Cup
- 9—Bearing Spring Seat
- 10—Steering Column
- 11—Tube
- 12—Bearing
- 13—Bearing Spring
- 14—Horn Button Spring
- 15—Retainer Spring

When trouble in the signal switch is suspected it is advisable to make the following test to definitely locate the trouble before going to the effort of removing the signal switch. If, for example, the right rear stop light and right front parking light are inoperative and switch failure is indicated, first put the control lever in neutral position. Then disconnect the wire to the right side circuit and touch it to or bridge it to the "L" terminal, thus by-passing the signal switch. If the right side cir-



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FIG. H-63—DIRECTIONAL SIGNAL CIRCUIT

- 1—Flasher
- 2—Ignition Switch
- 3—Control
- 4—Light Switch
- 5—Stop Light Switch

cuit lights, the signal switch is inoperative and must be replaced.

H-139. Hazard Warning Lights

All current production vehicles are equipped with a four-way flasher warning system. The control switch is located on the instrument panel left of the steering column. With the switch pulled out, 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.

H-140. Marker Lights and Reflector Assembly

The marker lights and reflector assemblies on current production vehicles are mounted on the side of the front fender and on the side of the rear quarter panel. The spare wheel also mounts a marker light. Some earlier production vehicles have reflex reflectors mounted on the side of the hood and on the side of the rear quarter panel.

H-141. Windshield Wiper System

Early production vehicles equipped with the Dauntless V-6 engine have two single speed windshield wiper motors mounted above the windshield inside the vehicle. The wiper motors are operated and controlled by a switch located on the instrument panel.

Current production vehicles with stationary windshield have a two-speed electric windshield wiper motor mounted below the windshield outside the vehicle on the driver's side. The wiper motor switch is located on the instrument panel to the left of the steering column.

H-142. Two-Speed Wiper Motor

The two-speed electric wiper motor is operated and controlled by a turn type, three poled, dash switch, containing a 6 amp. circuit breaker. Current flow is directed from the battery through the ignition switch to the wiper dash switch assembly to the two-speed wiper motor, which passes current from the designated motor brush (high, low or park) to the armature circuit to ground.

H-143. Troubleshooting Procedure

Troubleshooting procedures are divided into two categories: wiper troubleshooting in vehicle; wiper troubleshooting on bench. Fig. H-65 and H-66 illustrates connecting leads of the two-speed wiper for either bench operation or to run wiper independently of dash switch and vehicle wiring when installed in the vehicle.

H-144. Wiper Troubleshooting in Vehicle

Typical wiper troubles and remedies are as follows:

a. Wiper is inoperative — Check wiper switch circuit breaker; wiring harness connection at wiper motor and wiper switch; wiper motor feed wire from ignition starter switch to wiper switch; and check wiper on switch to be securely mounted. With ignition switch on, check for 12 volts at harness terminal that connects to wiper terminal. To

determine if dash wiper switch or wiring is at fault, disconnect wiring harness from wiper motor and try operating wiper independently of dash switch. If still inoperative see procedure under Par. H-145.

b. 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. If wiper shuts off correctly with crank arm in park position and wiper has both speeds, check the lead between terminal 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 for an open circuit and check for defective dash switch. If still inoperative, see Par. H-145.

c. Wiper has only fast speed. Check for defective dash switch or open lead between terminal and dash switch.

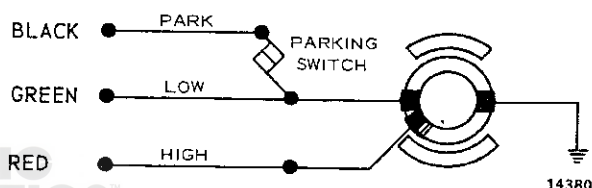


FIG. H-64—WIRING DIAGRAM

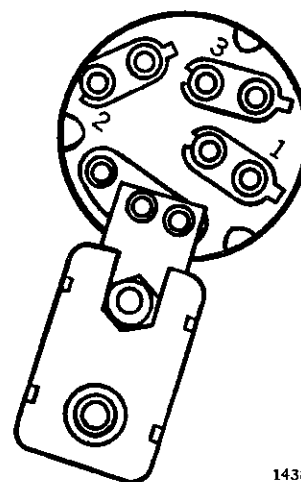


FIG. H-65—WINDSHIELD WIPER SWITCH ASSEMBLY (EARLY)

1. Park (black) 2. Low (green) 3. High (red)

d. Wiper has only slow speed and shuts off with dash switch in high speed position. Reverse harness leads that connect to wiper terminals.

e. If blades do not return to park position when wiper is turned off, check wiper ground connection to vehicle body. Remove wiper from vehicle and check for dirty, bent, or broken park switch contacts.

f. If wiper speed is normal in slow, but too excessive in fast speed, check for an open terminal.

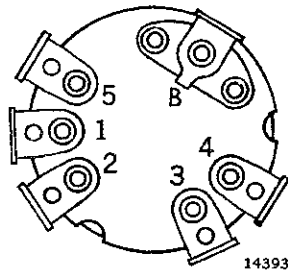


FIG. H-66—WINDSHIELD WIPER SWITCH ASSEMBLY (LATE)

- B—Battery
- 1—Wiper 1 Lo Speed
- 2—Wiper 1 Hi Speed
- 3—Wiper 2 Lo Speed
- 4—Wiper 2 Hi Speed
- 5—Park

g. If wiper operates erratically, check for loose wiper ground connection or loose dash switch mounting.

H-145. Wiper Troubleshooting on Bench

Using ammeter, capable of reading at least 30 amperes, check feed wire circuit for open circuit.

a. If wiper is inoperative, connect wiper to operate in low speed and observe current draw. If the reading is zero amp., check for loose solder connection at wiper terminal or loose splice joints. If reading is 1 to 1.5 amp., check for open armature, sticking brushes, or loose splice joint. If reading is 11 amp., check for broken gear seized shaft or some other condition that will stall the wiper.

b. 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 being grounded. If wiper has low speed only, check for internal wiper motor lead that connects to wiper terminal being grounded. If wiper has high speed only, check for internal wiper motor lead that connects to wiper terminal being open.

c. If wiper crank arm does not return to park position when wiper is turned off, check for dirty, bent to broken park switch contacts.

d. If wiper operates erratically, check for sticky brushes or loose splice joints.

e. If the wiper will not shut off, or wiper crank arm fails to stop in park position when jumper wire is removed from terminal, check that park switch contacts are opening. Also check for ground in internal motor lead that connects to terminal.

H-146. Disassembly of Two-Speed Wiper Motor

Refer to Fig. H-67.

- a. Remove windshield wiper motor cover.
- b. Disconnect drive arm from wiper linkage.
- c. Disconnect wiring from wiper dash switch.
- d. Remove wiper motor.
- e. Loosen drive arm hardware and pry drive off drive shaft.

f. Remove fastening screws, cover plate assembly and gasket.

g. Remove parking plate and gear assembly.

h. Remove parking brushes, spring and bowed washer from gear assembly.

i. Remove the two through bolts and mounting bracket.

j. Remove the magnet housing, armature and end cap as an assembly.

k. Tap end of armature shaft to loosen end cap assembly and remove cap from armature shaft. Be careful not to lose thrust disc, which is in end cap bearing bore.

l. Remove armature from magnet housing. Care should be taken to protect armature shaft bearing journals.

m. Remove brushes and brush spring from brush holders.

H-147. Cleaning of Two-Speed Wiper Motor

a. Clean magnet housing and armature with a cloth dampened in cleaning solvent.

b. The following bearing equipped parts should not be immersed in cleaning fluid:

- 1. Cover plate assembly.
- 2. Gear housing assembly.
- 3. End cap assembly.

The metal surfaces of these assemblies should be cleaned with a brush dipped in cleaning solvent, making certain that cleaning fluid does not contact bearings.

c. Clean remaining parts with a brush and cleaning solvent.

H-148. Reassembly of Two-Speed Wiper Motor

Refer to Fig. H-67.

To reassemble motor, reverse the steps given in Par. H-146.

When reassembling motor, fingers must be clean when handling brushes. Hold brushes in the holders by applying paper clips to brush shunts. Apply a light film of lubricant to armature shaft ends, armature worm gear and gear assembly shaft ends. Remove paper clips after assembling armature to gear housing. Align marks on magnet housing and gear housing. Armature end play should be .002 - .010".

Be sure to operate wiper to park position prior to installing drive arm.

H-149. No Load Testing

Test the motor to meet the following specifications:

LOW SPEED		HIGH SPEED	
R.P.M.	Ampere Draw (Max.)	R.P.M.	Ampere Draw (Max.)
42	2.75	62	3.75

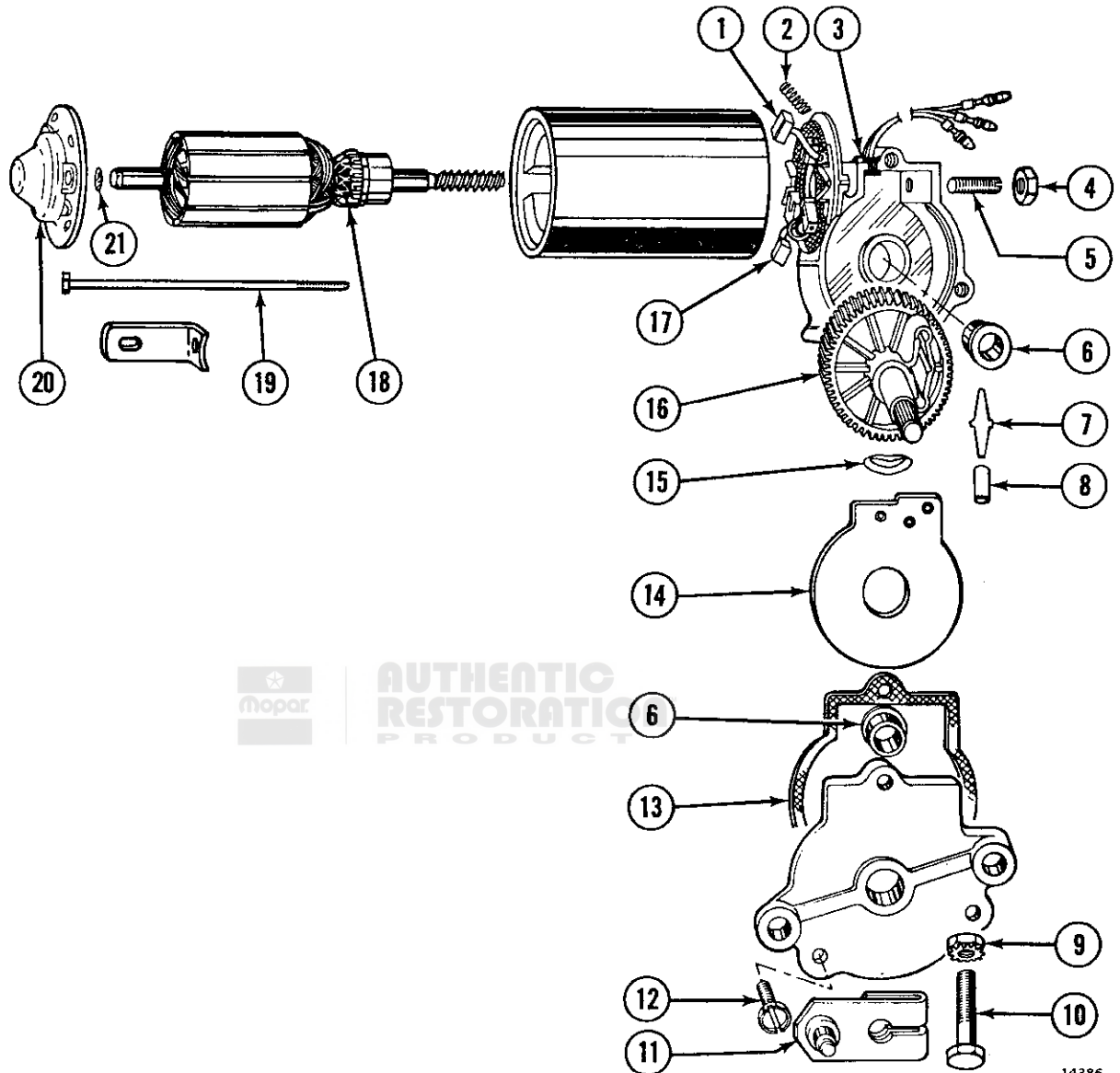


FIG. H-67--TWO-SPEED WIPER MOTOR

- | | | |
|--|--------------------------------------|--|
| 1—Brush, Commutator — Grounded — includes Terminal | 8—Brush, Parking | 16—Gear Assembly |
| 2—Spring, brush — Commutator | 9—Nut & Lockwasher, Drive Arm | 17—Brush, Commutator — Insulated |
| 3—Insulation Grommet, Cable | 10—Screw, Securing — Drive Arm | 18—Armature Assembly |
| 4—Nut, Locking — Set Screw | 11—Arm, Drive | 19—Thru Bolt, Fastening — Motor Assembly |
| 5—Screw, Set — armature End Play | 12—Screw, Fastening — Mounting Plate | 20—Cap Assembly, End — includes Bearing |
| 6—Bearing, Gear Shaft | 13—Gasket, Mounting Plate | 21—Disc, Thrust |
| 7—Spring, Parking Brush | 14—Plate Assembly, Parking | |
| | 15—Washer, Bowed | |

H-150. Major Electrical Component Replacement

● Prestolite and Delco-Remy Components

a. Some Prestolite and Delco-Remy electrical components may be intermixed on a vehicle as an approved production practice. No attempt should be made to convert to a complete Prestolite or Delco-Remy system. Prestolite components should be replaced by Prestolite components and Delco-Remy components should be replaced by Delco-Remy components insofar as availability of re-

placement components will allow. In those cases, however, where a component is being replaced with one produced by the other manufacturer, make certain factory approved service instructions are followed during these installations.

b. Distributor — No special instructions are required for interchanging Prestolite and Delco-Remy distributors on V6 models.

c. Starting Motor — Special instructions are required for interchanging Prestolite and Delco-Remy starting motors. See note following Par. H-108.

H-151. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Battery Discharged:	
Shorted Cell in Battery.....	Replace Battery
Short in Wiring.....	Check Wiring Circuit
Generator Not Charging.....	Inspect Generator and Fan Belt
Loose or Dirty Terminals.....	Clean and Tighten
Excessive Use of Starter.....	Tune Engine
Excessive Use of Lights.....	Check Battery
Insufficient Driving.....	Recharge Battery
Low Regulator Setting.....	Correct Setting
Stuck Cut-out in Regulator.....	Correct
Low Electrolyte Level in Cells.....	Add Distilled Water
Alternator:	
FAILS TO CHARGE:	
Belt Loose.....	Tighten to Specifications
Open or High Resistance in Charging or Ground Return Circuit or Battery Connections.....	Test and Correct
Excessively Worn, Open, or Defective Brushes.....	Test Brushes and Replace if Necessary
Open Isolation Diode.....	Test and Replace if Necessary
Open Rotor (Field Coil).....	Test and Replace if Necessary
LOW OR UNSTEADY CHARGING RATE:	
Belt Loose.....	Tighten to Specifications
Intermittent or High Resistance Charging or Ground Return Circuit or Battery Connections.....	Test and Correct
Excessively Worn, Sticky, or Intermittent Brushes.....	Test and Replace if Necessary
Shorted or Open Rectifier Diode.....	Test and Replace if Necessary
Grounded or Shorted Turns in Rotor (Field Coil).....	Test and Replace if Necessary
Open, Grounded, or Shorted Turns in Stator.....	Test and Replace if Necessary
EXCESSIVE CHARGE RATE:	
Loose Connections on Alternator.....	Check and Correct
Faulty Regulator.....	Check and Correct
NOISY ALTERNATOR:	
Defective or Badly Worn Belt.....	Replace
Misaligned Belt or Pulley.....	Align, Replace Parts as Necessary
Loose Pulley.....	Tighten
Worn Bearings.....	Replace Bearings as Necessary
Shorted Rectifiers.....	Test and Replace as Necessary
Generator:	
Low Charging Rate—	
Dirty Commutator.....	Clean Commutator
Poor Brush Contact.....	Repair or Install New Brushes
Regulator Improperly Adjusted.....	Adjust
High Resistance in Charging Circuit.....	Clean and Tighten Terminals
Ground Strap Engine to Frame Broken.....	Replace
Loose or Dirty Terminals.....	Clean and Tighten
Slipping Generator Belt.....	Adjust Belt
Worn Out Brushes.....	Install New Brushes
Weak Brush Spring Tension.....	Replace
Out of Round Commutator.....	Repair

H-151. SERVICE DIAGNOSIS—Continued

SYMPTOMS	PROBABLE REMEDY
Generator: (continued)	
Fails To Charge—	
Open Charging Circuit.....	Correct
Sticking Brushes.....	Repair or Replace
Dirty or Burned Commutator.....	Clean Commutator
Grounded Commutator.....	Replace
Open Circuit in Field.....	Replace
Weak Soldering on Armature.....	Repair
Grounded Wiring.....	Repair
Defective Regulator.....	Replace Regulator
Too High Charging Rate—	
Regulator Improperly Adjusted.....	Adjust or Replace
Short in Armature.....	Replace
Grounded Field-to-regulator Wire.....	Correct
Shorted Cell in Battery.....	Replace Battery
Starting Motor:	
Slow Starter Speed—	
Discharged Battery or Shorted Cell.....	Recharge or Repair
Ground Strap Engine to Frame.....	Clean Terminals and Tighten
Loose or Dirty Terminals.....	Clean and Tighten
Dirty Commutator.....	Clean with No. 00 Sandpaper
Worn Out Brushes.....	Install New Brushes
Weak Brush Spring Tension.....	Replace
Worn Bearings.....	Replace
Burned Starter Switch Contacts.....	Replace Switch
Will Not Turn Engine—	
Open Circuit at Starter.....	Correct
Solenoid Open or Stuck.....	Replace Solenoid
Starter Switch Defective.....	Replace Switch
Starter Drive Broken or Stuck.....	Repair or Replace
Battery Discharged.....	Recharge Battery
Distributor:	
Hard Starting—	
Distributor Points Burned or Pitted.....	Clean Points or Replace (Adjust)
Breaker Arm Stuck on Pivot Pin.....	Clean and Lubricate
Breaker Arm Spring Weak.....	Replace
Points Improperly Adjusted.....	Adjust
Spark Plug Points Improperly Set.....	Adjust
Spark Plug Wire Terminals in Distributor	
Cap Corroded.....	Clean
Loose Terminals.....	Check Circuit
Loose or Dirty Terminals on Ground Strap—	
Engine to Frame.....	Clean and Tighten
Condenser Faulty.....	Replace
Improper Ignition Timing.....	Set Timing
Lights:	
Burn Dim—	
Loose or Dirty Terminals.....	Clean and Tighten
Leak in Wires.....	Check Entire Circuit for Broken Insulation
Poor Switch Contact.....	Install New Switch
Poor Ground Connection.....	Clean and Tighten
Aim Headlamp Beams.....	Use Aiming Chart

H-151. SERVICE DIAGNOSIS—Continued

SYMPTOMS	PROBABLE REMEDY
Horn Fails to Sound:	
Broken or Loose Electrical Connection.....	Check Wiring and Connections at Horn Button and Battery—Clean and Tighten
Battery Low or Dead.....	Check Battery
Contact Points Burned or Broken Off.....	Replace Parts Necessary
Horn Sounds Unsatisfactory Tone:	
Poor Electrical Connection.....	Check Connections at Horn, Horn Button, Battery
Battery Low.....	Check with Hydrometer
Loose Cover and Bracket Screws.....	Tighten Bracket Bolts at Horn
Voltage at Horn too High or too Low.....	Check with Voltmeter

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H-152. ELECTRICAL SPECIFICATIONS

MODEL	HURRICANE F4 ENGINE	DAUNTLESS V-6 ENGINE	
BATTERY:			
Make.....	Prestolite	Prestolite	Prestolite
Model.....	HS 11-50	HS 11-50	HS 11-50
Hour Rating.....	50 Ampere-hour	50 Ampere-hour	50 Ampere-hour
Voltage.....	12-volts	12-volts	12-volts
Terminal Ground.....	Negative	Negative	Negative
SPECIFIC GRAVITY:			
Fully Charged.....	1.260	1.260	1.260
Recharged At.....	1.225	1.225	1.225
Location.....	Engine Compartment- Right Rear	Engine Compartment- Right Rear	Engine Compartment- Right Rear
GENERATOR:			
Make.....	Prestolite	Prestolite	Prestolite
Model.....	GJP-7402A	GJP-7402A	GJP-7402A
Ground Polarity.....	Negative	Negative	Negative
Controlled Output.....	35 amp.	35 amp.	35 amp.
Control.....	CV Regulator	CV Regulator	CV Regulator
Armature End Play.....	.003" to .010" [0,076 a 0,25 mm.]	.003" to .010" [0,076 a 0,25 mm.]	.003" to .010" [0,076 a 0,25 mm.]
Brushes.....	2	2	2
Brush Spring Tension.....	18 to 36 oz. [510 a 1020 gr.]	18 to 36 oz. [510 a 1020 gr.]	18 to 36 oz. [510 a 1020 gr.]
REGULATOR:			
Make.....	Prestolite	Prestolite	Prestolite
Model.....	VBO-4201E-4A	VBO-4201E-4A	VBO-4201E-4A
For GJP 7202, GJP 7402A.	Vibrator	Vibrator	Vibrator
Type.....	Vibrator	Vibrator	Vibrator
Cutout Relay:			
Closing Voltage @	12.6 to 13.6 @ 1325	12.6 to 13.6 @ 1325	12.6 to 13.6 @ 1325
Generator rpm.....	3 to 5 amp.	3 to 5 amp.	3 to 5 amp.
Reverse Current to Open..	14.2 to 14.4	14.2 to 14.4	14.2 to 14.4
Regulated Voltage.....	36 amp. max.	36 amp. max.	36 amp. max.
Regulated Current.....			
ALTERNATOR:			
Make.....	Motorola	Motorola	Motorola
Model.....	A12 NW 526	A12 NW 528	A12 NW 528
Ground Polarity.....	Negative	Negative	Negative
Rated Output.....	35 amp.	35 amp.	35 amp.
Rated Field Coil Draw			
At 70°F. and 10-volt.....	1.7 to 2.3 amp.	1.7 to 2.3 amp.	1.7 to 2.3 amp.
Capacitor Capacity.....	.1 mfd.	.1 mfd.	.1 mfd.
REGULATOR:			
Make.....	Motorola	Motorola	Motorola
Model.....	R-2-K-1	R-2-K-1	R-2-K-1
Type.....	Transistor	Transistor	Transistor
STARTING MOTOR:			
Make.....	Prestolite	Delco-Remy	Prestolite
Model.....	MDU-7004	1107391, 1108366, 1108375	MHA-7008
Brush Spring Tension.....	32 to 40 oz. [907 a 1134 gr.]	32 to 40 oz. [907 a 1134 gr.]	32 to 40 oz. [907 a 1134 gr.]
LOCK TEST:			
Temperature.....	70°F. [21°C.]	Not Applicable	70°F. [21°C.]
Amp. (Max.).....	295	Not Applicable	200
Volt.....	4		4
Stall Torque (Min.).....	6 lb.-ft. [0,83 kg-m.]		3 lb.-ft. [0,41 kg-m.]
NO LOAD TEST:			
Temperature.....	70°F. [21°C.]	70°F. [21°C.]	70°F. [21°C.]
Amp. (Max.).....	50	75	43
Volt.....	10	10.6	10.0
Rpm. (Min.).....	5300	6200	9000
DRIVE:			
Type.....	Bendix Folo-Thru	Overrunning Clutch	Bendix Folo-Thru
COIL:			
Make.....	Prestolite	Delco-Remy	Prestolite
Model.....	200691	1115247	201700
Primary Resistance.....	3.9 to 4.2 ohms	1.28 to 1.42 ohms	4.25 to 4.60 ohms
Secondary Resistance.....	9400 to 11,700 ohms	7200 to 9500 ohms	5200 to 6100 ohms

H-152. ELECTRICAL SPECIFICATIONS—Continued

MODEL	HURRICANE F4 ENGINE	DAUNTLESS V-6 ENGINE EARLY MODELS	DAUNTLESS V-6 ENGINE LATE MODELS	
IGNITION COIL BALLAST:				
Make	None	Delco-Remy 1957154	Prestolite PU 5003	Prestolite PU 5003
Model	None	1.80 @ 80°F.	.495 - .605 @ 75°F.	.495 - .605 @ 75°F.
Ohms	None		.638 - .835 @ 212°F.	.638 - .835 @ 212°F.
DISTRIBUTOR:				
Make	Prestolite	Delco-Remy	Prestolite	Prestolite
Model	IAY 4012, 4401 IAY 4401A, 4401I	1110376	IAT 4501 or IAT 4502	IAT 4502A
Breaker Point Gap	.020" [0,508 mm.]	.016" [0,406 mm.]	.016" [0,406 mm.]	.016" [0,406 mm.]
Breaker Arm Tension	17 to 20 oz. [482 a 567 gr.]	19 to 23 oz. [538 a 652 gr.]	17 to 22 oz. [482 a 624 gr.]	17 to 22 oz. [482 a 624 gr.]
Cam Angle	42°	29° to 31°	29° ±3°	29° ±3°
Max. Auto Advance (Crankshaft Degrees)	11° @ 1,700 rpm. (a) 13.5° @ 1,700 rpm. (b)	13° to 15° at 1,950 rpm.	16° @ 1,800 rpm. 26° @ 4200 rpm.	21° @ 1,800 rpm. 32° @ 4200 rpm.
Max. Vac. Advance (Distributor Degrees)	None	8°	8°	8°
Condenser Capacity	.25 to .28 mfd.	.18 to .23 mfd.	.25 to .28 mfd.	.25 to .28 mfd.
TIMING:				
Crankshaft	See Note	See Note	See Note	See Note
Mark Location	Crankshaft Pulley	Crankshaft Pulley	Crankshaft Pulley	Crankshaft Pulley
Firing Order	1-3-4-2	1-6-5-4-3-2	1-6-5-4-3-2	1-6-5-4-3-2
SPARK PLUGS:				
Make	Champion	A.C.	A.C. or Champion	A.C. or Champion
Model	J8	44S	44S or UJ 12Y	44S or UJ 12Y
Thread	14 mm.	14 mm.	14 mm.	14 mm.
Thread Reach	3/8" [9,47 mm.]	3/8" [9,47 mm.]	3/8" [9,47 mm.]	3/8" [9,47 mm.]
Gap	.030" [0,762 mm.]	.035" [0,900 mm.]	.035" [0,900 mm.]	.035" [0,900 mm.]
LAMP BULB TRADE NUMBERS:				
Headlight	6012	6012	6012	6012
Parking and Directional Signals	1157NA	1157NA	1157NA	1157NA
License Plate Light	1155	1155	1155	1155
Marker and Reflector	194	194	194	194
INDICATOR LIGHTS:				
Headlight Beam	57	57	57	57
Directional Signals	57	57	57	57
Charge	57	57	57	57
Oil Pressure	57	57	57	57
Backup	1156	1156	1156	1156
Instrument Cluster	57	57	57	57
Warning — 4 Way Flasher	57	57	57	57
Brake Warning Light	57	57	57	57
FUSE DATA:				
Heater	9 amp.	9 amp.	9 amp.	9 amp.
Backup	14 amp.	14 amp.	14 amp.	14 amp.
WS/Wiper	14 amp.	14 amp.	14 amp.	14 amp.
Directional Signal	9 amp.	9 amp.	9 amp.	9 amp.
4-Way Flasher	14 amp.	14 amp.	14 amp.	14 amp.
Brake Warning Light	9 amp.	9 amp.	9 amp.	9 amp.
FLASHER DATA:				
Directional Signals	144	144	144	144
Hazzard Warning	170	170	170	170

NOTE: 0° T.D.C. on Distributor models IAY 4401A, IAY 4401B, IAT 4502A.

NOTE: 5° B.T.C. on Distributor models IAY 4012, IAY 4401, IAT 4501, IAT 4502, 1110376.

CLUTCH Contents

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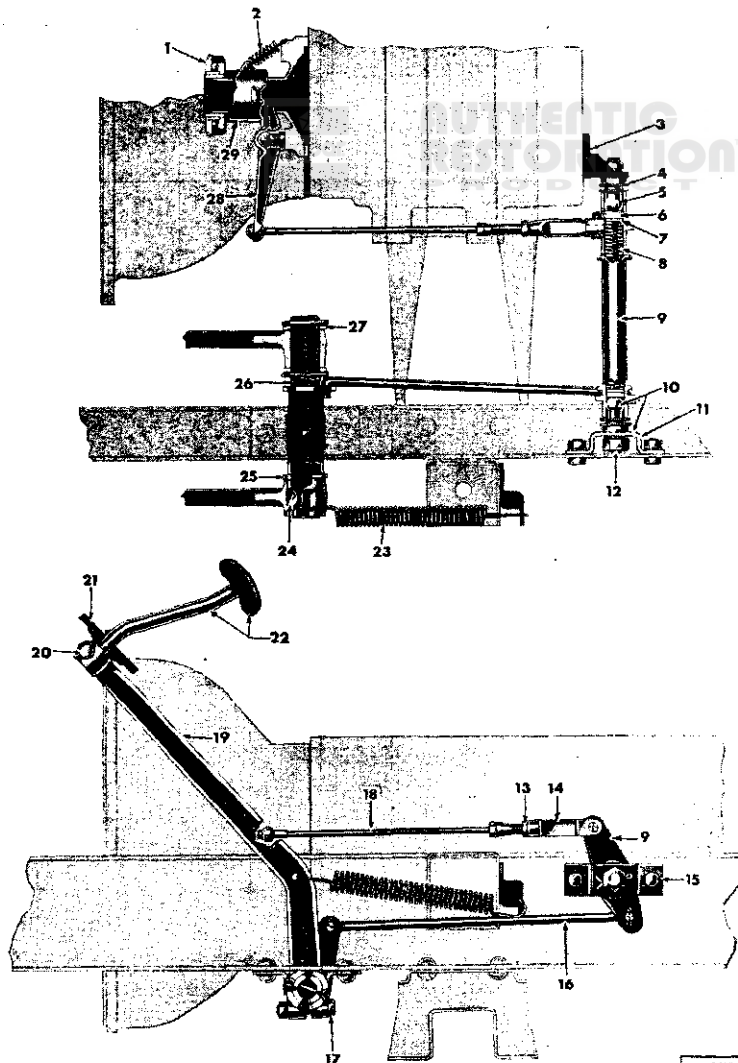


FIG. I-1—CLUTCH LINKAGE AND ADJUSTMENT, CROSS SHAFT TUBE AND LEVER TYPE

- 1—Clutch Release Bearing
- 2—Carrier Spring
- 3—Bracket
- 4—Dust Seal
- 5—Ball Stud
- 6—Pad
- 7—Retainer
- 8—Control Tube Spring
- 9—Control Lever and Tube
- 10—Ball Stud and Bracket
- 11—Frame Bracket
- 12—Ball Stud Nut
- 13—Yoke Lock Nut
- 14—Adjusting Yoke
- 15—Bolt
- 16—Pedal Release Rod
- 17—Pedal Clamp Bolt
- 18—Control Cable
- 19—Clutch Pedal
- 20—Screw and Lockwasher
- 21—Draft Pad
- 22—Pedal Pad and Shank
- 23—Retracting Spring
- 24—Pedal to Shaft Key
- 25—Washer
- 26—Pedal Shaft
- 27—Master Cylinder Tie Bar
- 28—Control Lever
- 29—Bearing Carrier

10734

I-1. GENERAL

The clutch on current 'Jeep' vehicles is either Auburn or Borg and Beck manufactured. Vehicles equipped with F4-134 engines have an Auburn 9.25" [23,4 cm.] single plate dry-disc clutch. The pressure plate has three coil pressure springs and three levers or fingers.

The V6-225 engine is equipped with a 10.4" [26,4 cm.] Borg and Beck single plate dry-disc clutch. The pressure plate utilizes either a finger-type diaphragm spring, or a coil type spring pressure plate for clutch release.

The driven plates of all models are built with vibration damper springs and have two flexible facings which provide smooth engagement of the engine power.

Early 'Jeep' vehicles equipped with a Dauntless V-6 engine use a 10.4" [26,4 cm.] single plate, dry-disc clutch, incorporating a diaphragm-type spring assembly.

The clutch is of the centrifugal single dry disc type and consists of the clutch disc, pressure plate and the clutch release bearing.

The clutch is actuated by a clutch pedal and a series of mechanical linkage.

When the clutch pedal is in the engaged position, the clutch disc facings are clamped between the friction surface of the engine flywheel and the face of the clutch pressure plate, thereby connecting engine power to the transmission. Depressing the clutch pedal actuates the clutch release shaft fork which moves the clutch release bearing against the clutch fingers. This, in turn, moves the pressure plate away from the clutch disc. Since the disc is splined to the transmission input shaft, the clutch disc and transmission input shaft will stop when the clutch is disengaged, thereby disconnecting engine power from the transmission.

I-2. Clutch Maintenance

To obtain normal life and satisfactory performance from any clutch it must be correctly operated and properly maintained. Two conditions which shorten clutch life are continuous operation of the clutch release bearing and clutch slippage.

The clutch release bearing is designed for intermittent use. If run continuously the bearing lubricant will become exhausted causing the bearing to become dry, noisy, or will seize, resulting in clutch finger or diaphragm wear. The clutch must be properly adjusted so that the release bearing is free of the clutch fingers or diaphragm at all times, except when the clutch pedal is depressed.

Excessive clutch slippage often occurs when the vehicle is overloaded, the vehicle load is applied too quickly, or when the pressure of the clutch fingers or diaphragm is only partially applied to the clutch plate. Friction between the clutch facing and flywheel produces excessive heat causing burned, glazed and worn linings, resulting in shortened clutch life. Avoid clutch slippage under heavy loads by using a lower gear or reducing the load.

I-3. Clutch Pedal Linkage and Adjustment

Adjust the clutch pedal free travel whenever the clutch does not disengage properly, or when new clutch parts are installed. Improper adjustment of the clutch pedal free travel is one of the most frequent causes of clutch failure and can be a contributing factor in some transmission failures.

As the clutch facings wear the free travel of the clutch pedal diminishes. When sufficient wear occurs the pedal clearance must be adjusted.

Two types of clutch linkage have been used on Jeep vehicles, a cross shaft tube and lever type shown in Fig. I-1, and a clutch control cable type shown in Fig. I-2. The clutch pedal adjustment procedures for both type linkages are as follows.

● Cross Shaft Lever and Tube Type

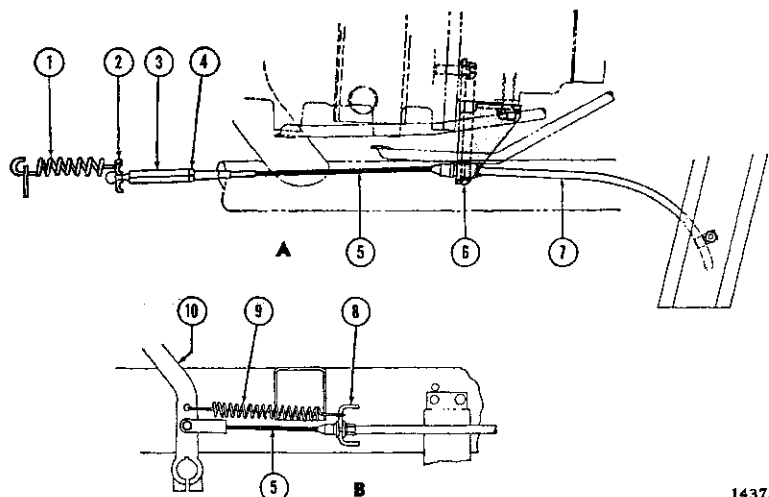
Refer to Fig. I-1.

Note: Two different Clutch Control Lever and Tube Assemblies have been installed on 'Jeep' Universal vehicles equipped with a V-6 engine and T14A transmission.

Should difficulty in shifting the transmission be noted, check the length of the clutch release pedal rod, item (16) in Fig. I-1. Measure the distance between the centerlines of the cotter key holes.

FIG. I-2—CLUTCH LINKAGE AND ADJUSTMENT, CONTROL CABLE TYPE

- A—Top View, Cable to Clutch Fork
- 1—Retracting Spring (Clutch Fork)
- 2—Clutch Fork
- 3—Ball Adjusting Nut
- 4—Lock Nut
- 5—Clutch Cable
- B—Side View, Cable to Clutch Pedal
- 6—Clutch Cable Support Bracket
- 7—Clutch Cable Housing
- 8—Anchor Bracket-to-Frame Side Rail
- 9—Retracting Spring (Clutch Pedal)
- 10—Clutch Pedal Assembly



The correct distance should be 10¼" [26,04 cm.]. If the length of the clutch release pedal rod is other than 10¼" [26,04 cm.], the vehicle is equipped with the early type Clutch Control Lever and Tube Assembly, which should be removed, and the latest designed parts should be installed. The free pedal clearance is adjusted by lengthening or shortening the clutch fork cable. To make this adjustment, loosen the jam nut on the cable clevis and lengthen or shorten the cable to obtain ¾" [19,05 mm.] free travel at the pedal pad, then tighten the jam unit.

● Clutch Control Cable Type

Refer to Fig. I-2.

- a. With the clutch pedal pad against the floor panel, (pedal up, clutch engaged) adjust ball adjusting nut until slack is removed from the cable and the clutch throwout bearing contacts the clutch pressure plate, release levers or diaphragm plate.
- b. Back-off ball adjusting nut 2½ turns to obtain approximately ¾" [19,05 mm.] free travel. Lock hex nut.

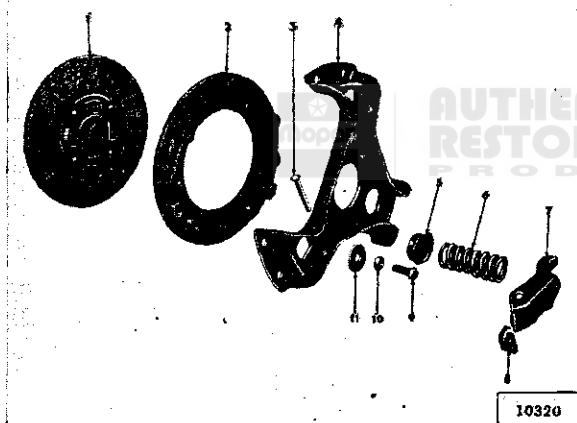


FIG. I-3—AUBURN CLUTCH ASSEMBLY—
HURRICANE F4 ENGINE

- | | |
|------------------------|-------------------|
| 1—Driven Plate and Hub | 7—Release Lever |
| 2—Pressure Plate | 8—Return Spring |
| 3—Pivot Pin | 9—Adjusting Screw |
| 4—Bracket | 10—Jam Nut |
| 5—Spring Cup | 11—Washer |
| 6—Pressure Spring | |

Note: Some older 'Jeep' vehicles may develop side movement of the clutch and brake pedals resulting from wear of the pedals, shafts, and bushings. One way to compensate for this wear is to install a pedal slack adjuster kit.

I-4. CLUTCH — HURRICANE F4 ENGINE

● Auburn

Vehicles equipped with the Hurricane F4 engine have a 9.25" [23,4 cm.] driven plate. The auburn clutch driving (pressure) plate assembly (Fig. I-3) has three pressure springs and three levers or fingers.

I-5. Clutch Removal

When necessary to remove the clutch, follow the

procedures outlined in Section J for the removal of the transmission and transfer case from the vehicle. Then remove the flywheel housing and use the following procedures for removing the clutch assembly.

Note: The F4 engine may be removed from the vehicle when inspecting or replacing the clutch. Refer to Section D for Hurricane F4 engine removal and then follow the instructions given below to remove the clutch assembly.

- a. Mark the clutch pressure plate and engine flywheel with a center punch so the clutch assembly may be installed in the same position after adjustments or replacement are completed.
- b. Remove the clutch pressure plate bracket bolts equally, a little at a time, to prevent distortion and to relieve the clutch springs evenly.
- c. Remove the pressure plate assembly and driven plate from the flywheel.

I-6. Clutch Pressure Plate and Disc Inspection

Inspect the pressure plate face for cracks, chips, and warpage. Check the pressure plate levers for excessive wear and the springs for breaks. If any of the above conditions exist, the complete pressure plate must be replaced. Check the clutch disc for excessive wear, loose or damaged facings, broken vibration damper springs and evidence of grease or oil. If any of the above conditions exist, replace the clutch disc.

I-7. Clutch Pressure Plate Adjustment — Auburn

The clutch pressure plate must be checked before installing a new or reconditioned clutch. The proper

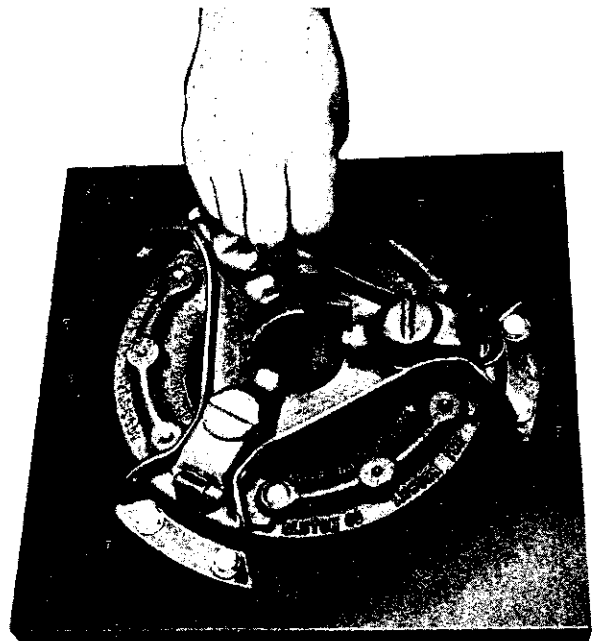
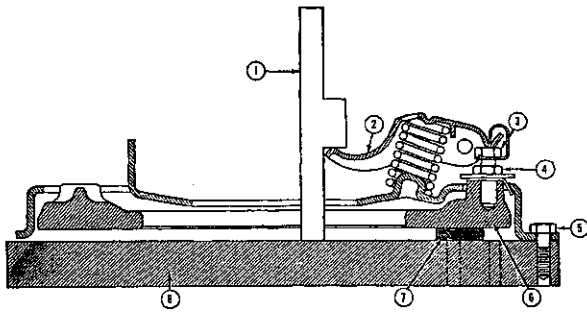


FIG. I-4—CHECKING AUBURN CLUTCH LEVER
ADJUSTMENT

- 1—Adjustment Gauge
- 2—Fixture Mounting Bolt
- 3—Clutch Fixture



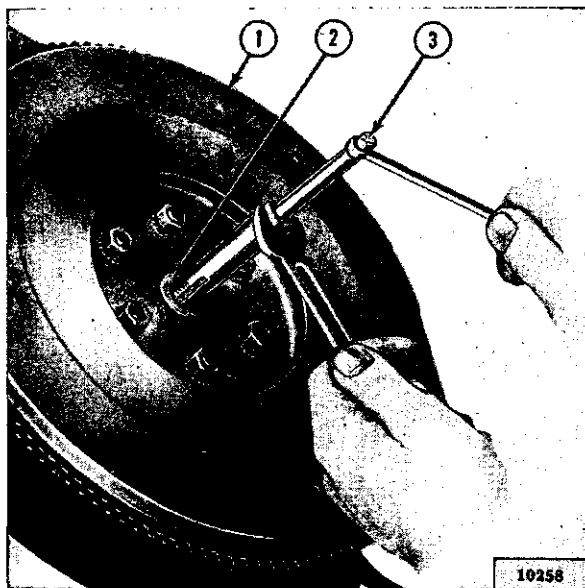
11378

FIG. I-5—ADJUSTING AUBURN CLUTCH LEVERS

- | | |
|-------------------|----------------------------|
| 1—Gauge | 5—Mounting Bolt |
| 2—Clutch Lever | 6—Clutch Pressure Plate |
| 3—Adjusting Screw | 7—Thickness Spacer |
| 4—Locknut | 8—Clutch Adjusting Fixture |

spacer thickness and gauge length is listed in Par. I-30. Use Clutch Adjusting Fixture W-296 and proceed as follows:

- a. Place the thickness spacers between the pressure plate face and clutch adjusting fixture. Locate the spacers under the pressure plate levers and at the center of the pressure plate face, see Fig. I-5.
- b. With the spacers properly installed, bolt the pressure plate to the adjusting fixture. Draw the bolts down evenly a little at a time until they are tight.
- c. Using the proper gauge length check the lever adjustment as shown in Fig. I-4.
- d. Lever adjustment can be altered by removing the lever clips, loosening the locknut and turning the adjusting screw (Fig. I-5) in or out as required.



10258

FIG. I-6—REMOVING PILOT BUSHING

- | |
|-------------------------|
| 1—Flywheel |
| 2—Pilot Bushing |
| 3—Pilot Bushing Remover |

I-8. Pilot Bushing Inspection and Replacement

● F4 and V-6 Engine.

Inspect the transmission main shaft pilot bushing which is pressed into the center of the flywheel on the Hurricane F4 engine and in the center of the crankshaft on the Dauntless V-6 engine. If the bushing is worn or damaged, it should be removed, using a pilot bushing remover. Screw the tapered end of the tool into the damaged bushing, allowing the tool to cut its own threads until a solid grip is obtained. Insert the puller screw and rotate it until bushing is forced out of flywheel, Fig. I-6 or crankshaft.

To install a new bushing, slide the bushing onto the end of a pilot bushing installing and burnishing tool and insert the bushing into flywheel or crankshaft. A soft hammer can be used against the tool to help drive the bushing in place. When the tool is removed (by tightening the cap and pressure nut as shown in Fig. I-7), the bushing will be burnished to correct size. Apply a small amount of lubricant to the bushing bore.



10260

FIG. I-7—INSTALLING PILOT BUSHING

- | |
|--|
| 1—Pilot Bushing Installing and Burnishing Tool |
| 2—Flywheel |

I-9. Clutch Installation

a. Inspect Clutch Disc

Before the clutch disc is installed, it should be carefully inspected for warpage. If grease or oil is evident on the friction facings, the facings should be replaced and the cause of oil accumulation corrected. Excessively worn facings should also be replaced with factory recommended parts.

b. Inspect Clutch Release Bearing and Sleeve

The clutch release bearing and sleeve are attached to the front facing of the transmission case by a spring. Check the bearing and sleeve for evidence of grease leaks from within the bearing or for wear and looseness. Replace parts as necessary.

Note: The clutch release bearing is lubricated at time of assembly and no attempt should be made to lubricate it. Refer to Fig. I-23 when lubricating the clutch throwout bearing collar.

c. Reassembly

To assemble the clutch to the flywheel, first put a small amount of light cup grease in the flywheel pilot bushing, install the driven plate, with short end of hub toward the flywheel, then place the pressure plate assembly in position. With a clutch plate aligning arbor or a spare transmission main shaft, align the driven plate splines leaving the arbor in position while tightening the pressure plate screws evenly.

Next, assemble the flywheel housing to the engine and reinstall the transmission and transfer case or install the engine in the vehicle, depending on the procedure of removal. Make sure that the clutch release bearing carrier return spring is hooked in place. For the remainder of the assembly reverse the operations that were used in removing the transmission and transfer case or the engine referring to the instructions given in Section J for the transmission and Section D and D1 for the engine.

d. Adjust the clutch control cable so there is $\frac{3}{4}$ " [19,05 mm.] free pedal travel. (Refer to Par. I-3)

I-10. CLUTCH — DAUNTLESS V-6 ENGINE

● Diaphragm Spring Type (Early Models)

'Jeep' vehicles equipped with a Dauntless V-6 engine use a 10.4" [26,4 cm.] single-plate, dry-disc clutch, incorporating a diaphragm-type spring assembly.

When the clutch pedal is depressed, it moves the clutch fork in the direction shown in Fig. I-8. The clutch fork, pivoting on a ball stud, acts upon the throwout bearing. The bearing then forces the prongs of the diaphragm spring in the direction shown in Fig. I-8. The diaphragm spring is mounted so that it pivots on its retaining rings. This reverses the direction of force. Force is applied directly to the three retracting springs which then move the pressure plate rearward, away from the driven plate.

The clutch driven plate assembly slides freely on the transmission main drive gear splined shaft. It is keyed to the gear shaft by ten splines. The front end of the main drive gear shaft is piloted by a bushing pressed into a recess in the rear end of the engine crankshaft. See Fig. I-8.

The outer area of the driven plate is divided into segments formed in low waves to provide springs between the plate facings and cushion engagement of the clutch. A molded facing is riveted to each side of every segment. When the clutch is fully released, the waved segments cause the facings to spread approximately .045" [1,14 mm.]. Pressure plate movement provides an additional clearance of approximately .030" [0.76 mm.] to assure full release of the driven plate. See Fig. I-8.

The driven plate assembly is designed to prevent torsional fluctuation of the engine from being transmitted to the transmission gears. Its hub is

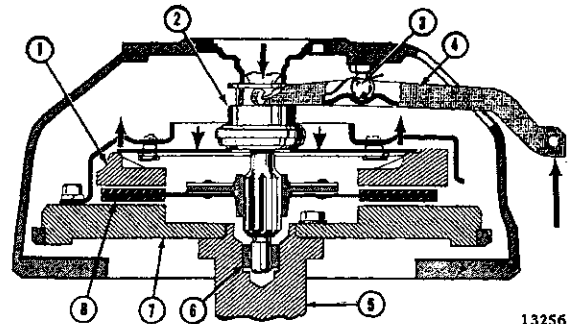


FIG. I-8—CLUTCH RELEASE ACTION

- | | |
|--------------------|---------------------|
| 1—Pressure Plate | 5—Engine Crankshaft |
| 2—Throwout Bearing | 6—Pilot Bearing |
| 3—Pivot Point | 7—Flywheel |
| 4—Clutch Fork | 8—Driven Plate |

driven through torsional coil springs; additional frictional dampening is supplied by molded frictional washers.

I-11. Clutch Removal

- Remove transmission as described in Section J.
- Remove clutch throwout bearing and pedal return spring from clutch fork.
- Remove flywheel housing from engine.
- Disconnect clutch fork from ball stud by forcing it toward the center of the vehicle.
- Mark clutch cover and flywheel with a center punch so that cover can later be installed in the same position on the flywheel. This is necessary to maintain engine balance.
- Loosen the clutch attaching bolts alternately, one turn at a time, to avoid distorting the clutch cover flange, until diaphragm spring is released.
- Support the pressure plate and cover assembly while removing last bolts; remove pressure plate and driven plate from flywheel.

Caution: Use extreme care to keep clutch driven plate clean.

h. If it is necessary to disassemble pressure plate, remove three drive strap-to-pressure plate bolts and retracting springs. Remove pressure plate from clutch cover.

Note: When disassembling, note position of grooves on edge of pressure plate and cover. These marks must be aligned in assembly to maintain balance.

i. The clutch diaphragm spring and two pivot rings are riveted to the clutch cover. Inspect spring, rings and cover for excessive wear or damage. If there is a defect, replace the complete cover assembly.

I-12. Clutch Inspection

Wash all metal parts of clutch, except release bearing and driven plate, in suitable cleaning solution to remove dirt and grease. If solvent seeps into bearing, lubricant may be dissolved. Cleaning solvent will also damage the facings of driven plate.

a. Inspect friction surfaces of flywheel and pressure plate for scoring or roughness. Slight roughness may be smoothed with fine emery cloth. If surface

is deeply scored or grooved, the part should be replaced.

b. Inspect driven plate for wear or damage to facings, loose rivets, broken or loose torsion springs, and flattened cushion springs. If facings are worn near rivets or are oily, replace the plate assembly. A slight amount of oil on clutch facings will cause clutch grab and chatter; excessive oil on facings will cause slippage. It is not practical to remove oil with solvents or by buffing since oil will continue to bleed from facing material when hot. If oil is found on driven plate facings, examine transmission drainback hole, pilot bushing, engine rear main bearing and other points of possible oil leakage. Test the fit of driven plate hub on transmission main drive gear for an easy sliding fit.

c. Inspect clutch release bearing for scoring or excessive wear on front contact face. Test for roughness of balls and races by pressing and turning front race slowly. Inspect main drive gear pilot bushing in crankshaft. Replace bushing if it is rough or worn. Regardless of whether the old plate or a new plate is to be installed, check the plate for runout. Slide the driven plate, front side first, over the transmission main drive gear shaft so that it is tight on the spline. Index a dial indicator to the plate facing as shown in Fig. I-9. While holding firmly against front end of main drive gear, to take up play in main drive gear bearing, slowly rotate driven plate and observe the amount of runout shown by indicator. If runout of front facing exceeds .025" [0,635 mm.], replace the plate. It is not practical to correct excessive runout by bending.

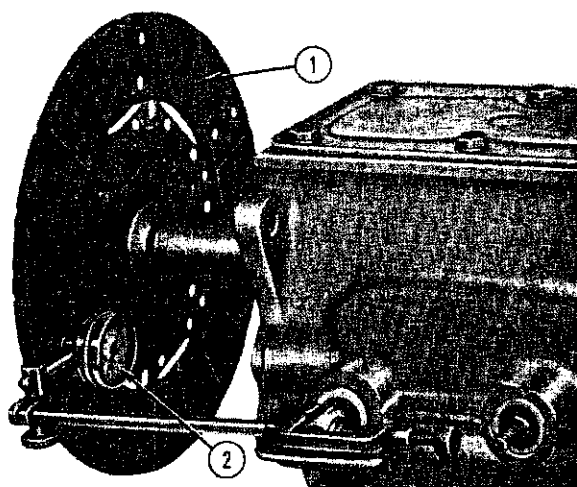


FIG. I-9—RUNOUT CHECK — CLUTCH PLATE

1—Front Facing (Flywheel Side)
2—Dial Indicator Set

d. Check clutch pilot bushing for excessive wear or damage. Replace pilot bushing, if necessary, with special removal and installation tools. (See Figs. I-6 and I-7).

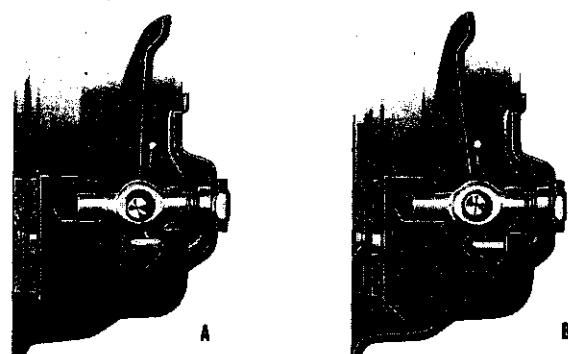
I-13. SERVICING CLUTCH PRESSURE PLATE AND DISC — BORG & BECK V6 (Late Models)

The Borg & Beck clutch is a single plate, dry disk type. It provides smooth engagement of engine power to the wheels. The clutch consists of a pressure plate assembly with pressure springs and release levers, and driven plate assembly. The driven plate assembly uses spring center vibration neutralizers and two flexible facings.

The clutch driven plate is spring cushioned with a facing riveted to both sides. The coil springs around the hub absorb the power shocks and cushion the driving mechanism. The clutch throw-out bearing is of the ball type, packed at time of manufacture, and requires no further lubrication.

No adjustment for wear is provided in the clutch itself. An individual adjustment is built into the clutch cover to adjust the height of the release levers. This adjusting nut is locked in position and should never be disturbed unless the clutch assembly has been disassembled for the replacement of worn parts or to correct the height of the release levers.

When the clutch pedal is depressed (disengaged), the release bearing is moved toward the flywheel and contacts the inner ends of the release levers. Each lever is pivoted on a floating pin which remains stationary in the lever and rolls across a short flat portion of the enlarged hole in the eyebolt. The outer ends of the eyebolts extend through holes in the stamped cover and are fitted with adjusting nuts to secure the levers in the correct position. The outer ends of the release levers engage the pressure plate lugs by means of fulcrums, which provide knife-edge contact between the outer ends of the levers and the lugs as shown in Fig. I-10.



12190

FIG. I-10—CLUTCH LEVER POSITIONS

A—Clutch Engaged
B—Clutch Disengaged

I-14. Clutch Pressure Plate Adjustment

The clutch pressure plate adjustment must be checked before installing a new or reconditioned clutch. The proper spacer thickness and gage length for a particular clutch is listed in Par. I-30. Use Clutch Adjusting Fixture W-296. If the W-296 fixture is not available one can be fabricated as described in Par. I-26.

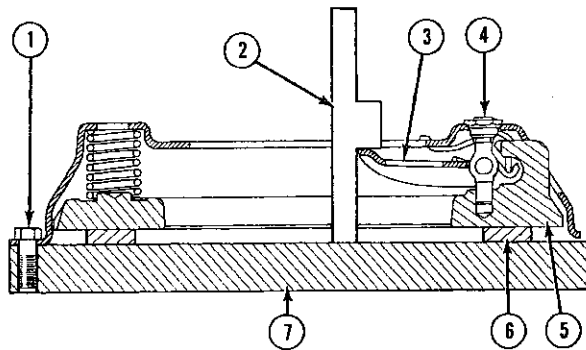


FIG. I-11—CLUTCH MOUNTED ON ADJUSTING FIXTURE

14172

- 1—Mounting Bolt
- 2—Gauge
- 3—Lever
- 4—Adjusting Nut
- 5—Pressure Plate
- 6—Spacer
- 7—Clutch Fixture W-296

a. Place the proper thickness spacers between the pressure plate face and the clutch adjusting fixture. Locate the spacers under the pressure plate fingers and at the center of the pressure plate face as shown in Fig. I-11.

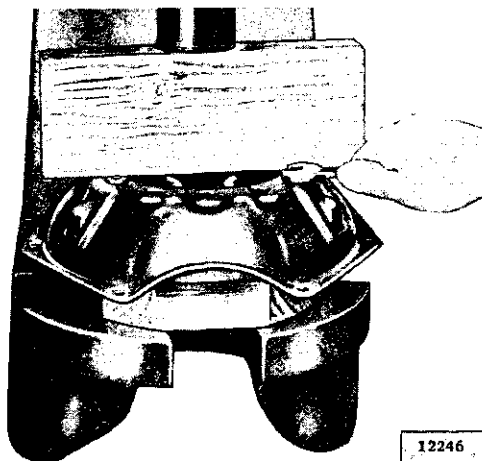
b. With the spacers properly installed, bolt the pressure plate to the adjusting fixture. Draw the bolts down evenly, a little at a time, until they are tight.

c. Using the proper gage length, check the lever adjustment.

d. Lever adjustment can be altered by removing the lever clips loosening the lock nut and turning the adjusting screw in or out as required.

I-15. Clutch Disassembly

The clutch cover and pressure plate are under spring tension at all times. Therefore, care must be exercised when a clutch cover assembly is disassembled. Place the clutch cover assembly in an arbor press with a hard wood block under the pres-



12246

FIG. I-12—COMPRESSING SPRING TO REMOVE NUTS

sure plate. Have the block of such a length that the cover can move down and not interfere with the block. Place a wood block across the top of the cover so that it rests on the spring bosses and does not interfere with the eyebolt adjusting nuts as shown in Fig. I-12.

Compress the clutch cover in the press until the clutch release levers are free. Remove the adjusting nuts. Release the press slowly to prevent the springs from flying out. Remove felt grease pads.

Caution: When relieving the spring pressure, be sure the cover does not stick on the pressure plate bosses.

I-16. INSPECTION OF CLUTCH PARTS

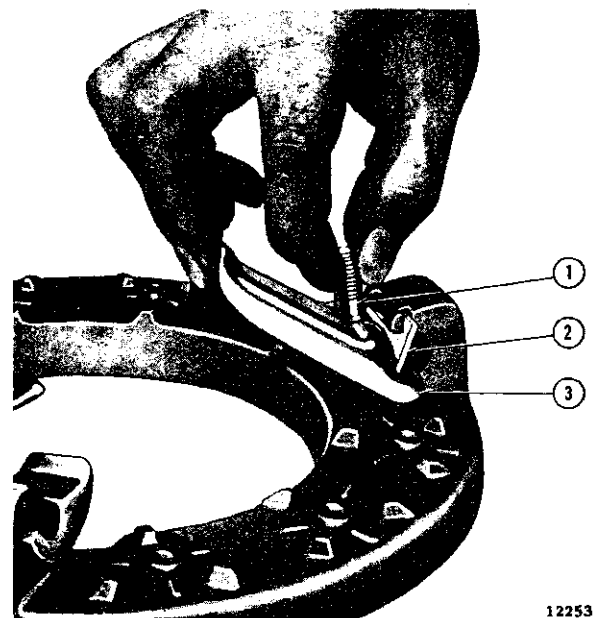
I-17. Inspect Clutch Pressure Springs

A thorough inspection of the clutch springs should always be made. They should be tested for spring tension when the spring is compressed to a given length.

On the clutch for the V6 engine, springs with black color markings, used adjacent to the clutch levers, must exert a force of 240 lb. ± 5 lb. [100,8 kg. ± 2,3 kg.] when compressed to 1 1/16" [3,7 cm.]. Springs with yellow markings, used between springs adjacent to the clutch levers, must exert a force of 145 lb. ± 5 lb. [65,6 kg. ± 2,3 kg.] when compressed to 1 1/16" [3,7 cm.].

I-18. Inspect Clutch Adjusting Levers

A thorough inspection should be given the levers, the eyebolt pin, and the fulcrum. If they show any wear, replace them. To remove the release levers, grasp a lever and eyebolt between the thumb and fingers so that the inner end of the



12253

FIG. I-13—REMOVING ADJUSTING LEVERS

- 1—Eyebolt
- 2—Fulcrum
- 3—Lever



12258

FIG. I-14—LIFTING LEVER AND EYEBOLT FROM PRESSURE PLATE

- 1—Lever
- 2—Eyebolt
- 3—Fulcrum
- 4—Pressure Plate

lever and the upper end of the eyebolt are as near together as possible. Keep the eyebolt pin seated in its socket in the lever as shown in Fig. I-13. Lift the fulcrum over the ridge on the end of the lever. Lift the lever and eyebolt off the pressure plate as shown in Fig. I-14.

I-19. Inspect Pressure Plate and Disc

Inspect the pressure plate to make sure that it is not cracked or scored. Check on a surface plate for a warped condition, as a pressure plate out of alignment will result in clutch chatter. Machining or grinding the face of a warped pressure plate is not recommended. If a warped condition exists, replace the pressure plate. A new plate should be installed if the plate or cushion springs appear to be defective. The cushion springs must not be bent out of shape or flattened.

The clutch discs for the nine or twelve spring clutches are designed for operation with their respective clutches. Difference in general appearance of the discs may be noted in the method of housing the six torque dampening springs and in the hub design.

After removal of the clutch assembly, the disc should be inspected. The presence of grease or oil on the friction facing can cause the clutch to chatter and grab during engagement and slip at higher speeds. If this condition is evident, the facings or disc should be replaced and the cause of oil accumulation corrected. Excessively worn facings should be replaced. The clutch disc must be installed with the long end of the hub toward the transmission.

I-20. Inspect 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 burred, remove the burrs with a fine file or stone. If the movement of the clutch driven plate is not free on the splines, the result will be clutch drag and hard shifting of transmission gears.

I-21. CLUTCH PRESSURE PLATE ASSEMBLY AND ADJUSTMENT

I-22. Assemble Clutch Levers

Prior to assembly, apply a small amount of petrolatum to each slide of the pressure plate lug.

a. Lay the pressure plate on the block in the press.

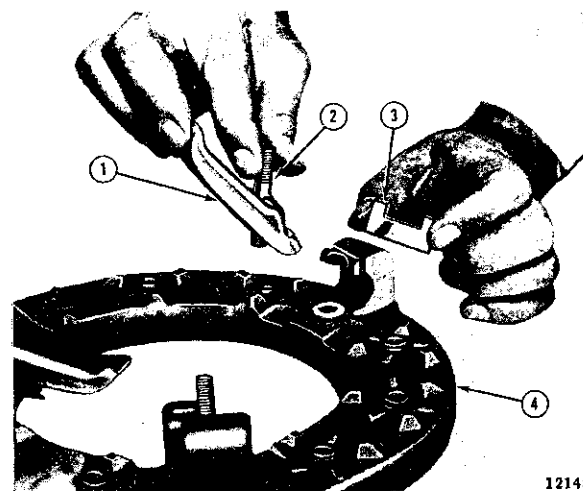
b. Assemble a lever, eyebolt, and pin holding the lever and eyebolt as close together as possible. With the other hand, grasp the fulcrum as shown in Fig. I-15.

c. Insert the fulcrum in the slots of the pressure plate lug. Lower slightly and tilt the lower edge until it touches the vertical milled surface of the lug. Insert the lower end of the eyebolt in the hole in the pressure plate. The short end of the lever will then be under the hook of the lug and near the fulcrum.

d. Slide the fulcrum upward in the slots of the lug. Lift it over the ridge on the short end of the lever and drop it into the groove in the lever (Fig. I-15).

I-23. Assemble Clutch Spring and Cover

a. After all levers are installed, place the felt grease pads over the eyebolts. Lubricate pads sparingly with light engine oil. Then place the clutch pressure springs in a vertical position on the spring bosses.



12145

FIG. I-15—INSTALLING CLUTCH LEVERS

- 1—Lever
- 2—Eyebolt
- 3—Fulcrum
- 4—Pressure Plate

- b. Check the anti-rattle springs in the clutch cover and place the cover on top of the pressure plate assembly. The top of each pressure spring must enter its spring seat in the cover. Line up punch marks on cover and pressure plate for balance.
- c. Slowly compress the cover making sure that the eyebolts and pressure plate lugs are guided through the proper holes in the cover.
- d. Hold the clutch under compression and screw down the adjusting nuts until they are flush with the tops of the eyebolts. Release the spindle of the press.

I-24. Clutch Lever Adjustment

Important: Always inspect release lever height adjustment when installing a new clutch drive plate.

Place a clutch gauge plate on the flywheel in the position normally occupied by the driven plate.

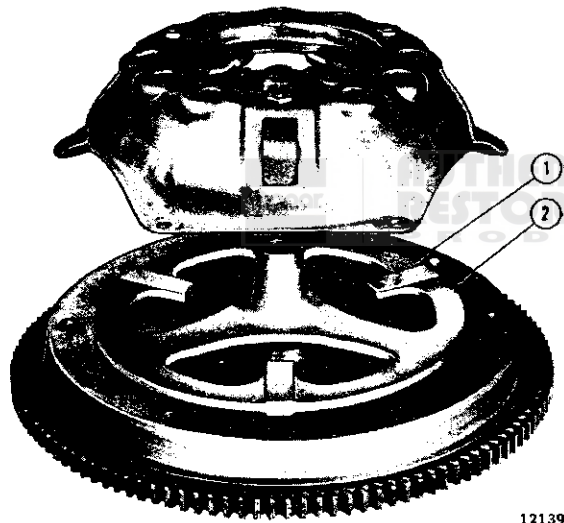


FIG. I-16—CLUTCH WITH GAUGE PLATE
1—Machined Land 2—Gauge Plate

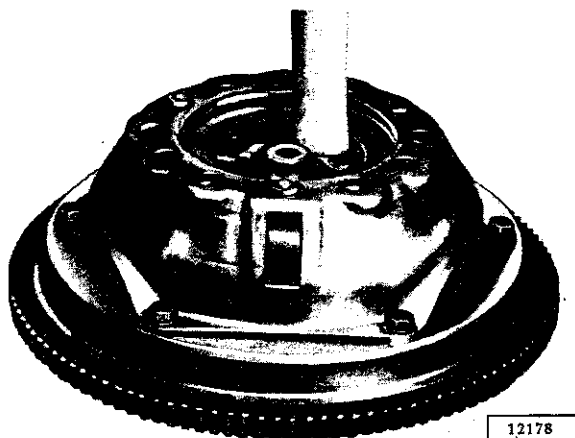


FIG. I-17—CHECKING LEVERS FOR FREE MOVEMENT

Mount the cover assembly, center the plate and line up the three machined lands on the gauge plate directly under the levers, as shown in Fig. I-16. Tighten the cover screws in rotation, one to two turns at a time, to avoid distortion of the cover.

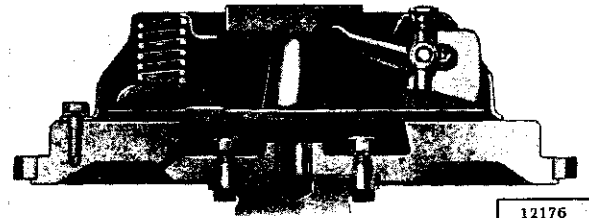


FIG. I-18—CLUTCH HEIGHT ADJUSTMENT

Each lever should be depressed several times before checking. This will seat the levers in their operating positions, as shown in Fig. I-17. Place the gauge on the hub as shown in Fig. I-18. To adjust the levers, turn the lever adjustment nut until the levers are $\frac{1}{32}$ " to $\frac{1}{16}$ " [0,93 a 1,59 mm.] above the hub. Before staking the adjusting nuts to lock them in place, work the lever up and down and recheck lever adjustment again. Stake the nut with a dull punch, as shown in Fig. I-19.

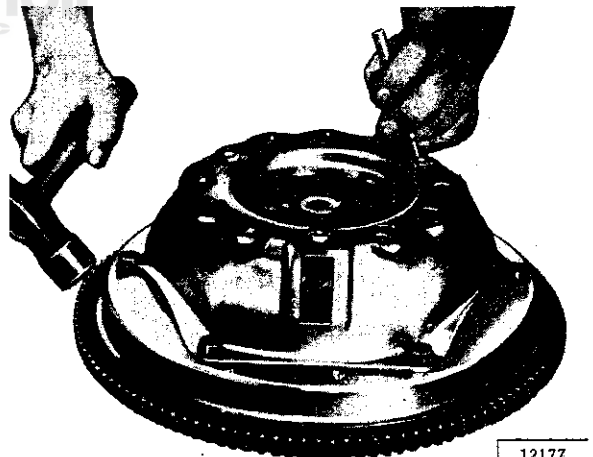
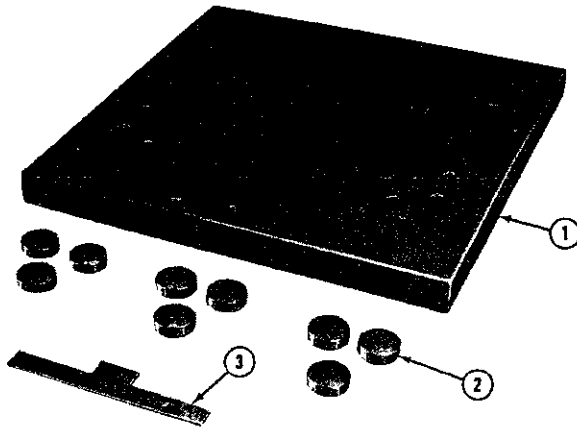


FIG. I-19—LOCKING ADJUSTING NUTS

I-25. Clutch 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 throwout lever return spring is anchored to a clip under the ball pivot and holds the lever in contact with the ball pivot. The clutch throwout bearing, which is a pre-lubricated unit, is attached to the forked end of the throwout lever.

Never wash the clutch throwout release bearing in gasoline or any solvent that will dissolve the lubricant. It is neither necessary nor possible to lubricate this bearing at any time. Connect linkage to the throwout release lever. Adjust free-play as directed in Par. I-3.



11641

FIG. I-20—CLUTCH REBUILDING AND ADJUSTING FIXTURE W-296 PIECES

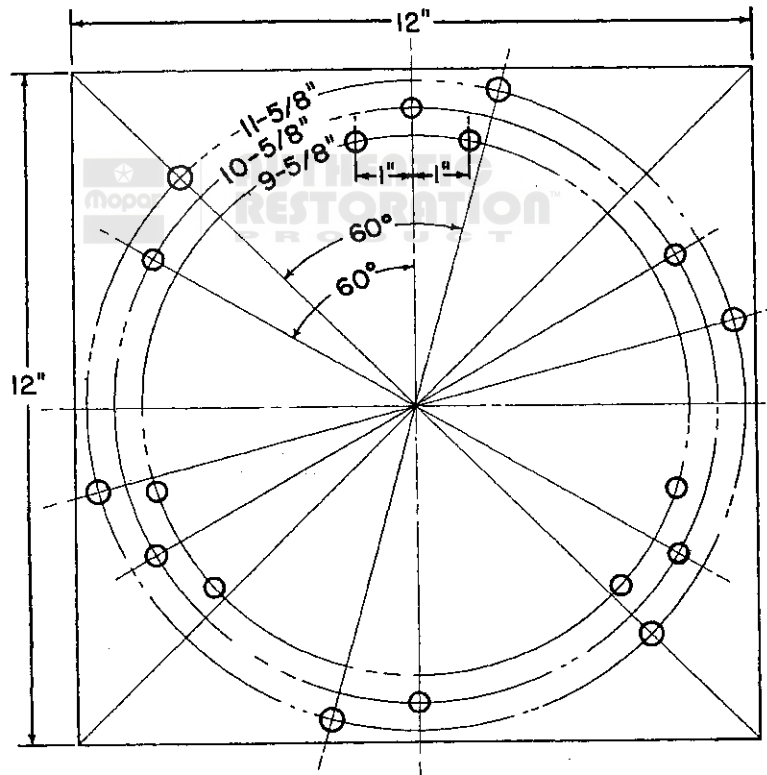
1—Mounting Fixture 2—Spacers 3—Gauge

I-26. FABRICATING CLUTCH FIXTURE

Where a Clutch Rebuilding and Adjusting Fixture W-296 is not available, one can be fabricated if desired. It is necessary to make a mounting fixture, nine spacers, and a gauge as shown in Fig. I-20. Proceed as follows:

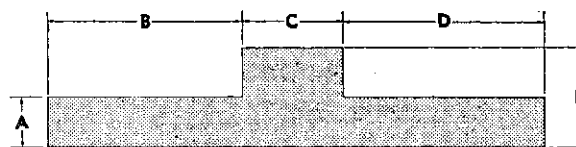
a. For the mounting fixture, select a flat steel plate 1" x 12" x 12" [2,54 x 3,05 x 3,05 cm.]. As shown in Fig. I-21, drill and tap six equally spaced holes $\frac{3}{8}$ "-16 thread on the 11- $\frac{5}{8}$ " [29,6 cm.] diameter bolt circle; and $\frac{5}{16}$ "-18 thread on the 10- $\frac{5}{8}$ " [27,1 cm.] diameter bolt circle. Drill and tap six $\frac{3}{16}$ "-18 thread holes as indicated on the 9- $\frac{5}{8}$ " [24,10 cm.] diameter bolt circle. Hole spacing and bolt circle tolerances should be held to plus or minus .002" [.050 mm.]. Countersink all holes to a depth of $\frac{3}{16}$ " [8 mm.]. Drill and tap the holes all the way through the plate.

b. From steel bar stock any size from $\frac{1}{2}$ " [12 mm.] to 1 $\frac{1}{2}$ " [2,86 cm.], make 3 spacers in each



11612

FIG. I-21—MOUNTING FIXTURE HOLE DIMENSIONS



10347

FIG. I-22—GAUGE FABRICATING DIMENSIONS

A— $\frac{1}{2}$ " [12,7 mm.] D—2" [5,08 cm.] ± 0.10 "
 B—1 $\frac{3}{8}$ " [4,92 cm.] ± 0.10 " E—1" [2,54 cm.]
 C—1" [2,54 cm.]

thickness: .285" [0,724 cm.], .305" [0,775 cm.]. Each spacer should be hardened and ground to size, and then have the dimensional thickness stamped thereon.

c. From flat bar stock at least 1/8" [3 mm.] thick, make a gauge as shown in Fig. I-22. Harden, grind to size, and stamp sizes on the gauge.

I-27. Clutch Installation

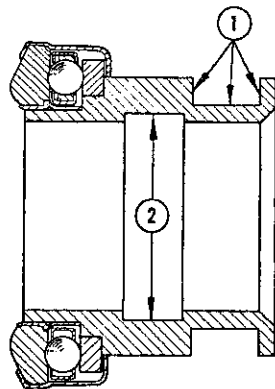
a. Very sparingly, apply wheel bearing lubricant to inner surface of pilot bushing in crankshaft.

Caution: If excessive lubricant is applied to pilot bushing, it will run out on face of flywheel when hot and ruin the driven plate facings.

b. Make sure that splines in the driven plate hub are clean; apply a light coat of lubricant to splines of hub and transmission drive gear shaft. Slide plate over gear shaft several times; remove plate from shaft and wipe off excess lubricant.

Caution: Driven plate facings must be kept clean and dry.

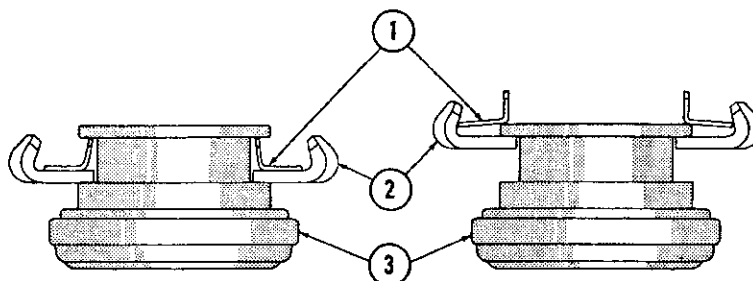
c. Fill groove in throwout bearing collar with wheel bearing lubricant. See Fig. I-23. Make sure that front bearing retainer of transmission is clean; apply a light coat of wheel bearing lubricant. Slide throwout bearing over bearing retainer several times. Remove bearing from retainer and wipe off excess lubricant.



12736

FIG. I-23—LUBRICATION POINTS—
CLUTCH THROWOUT BEARING COLLAR

1—Coat This Groove 2—Pack This Recess



CORRECT

INCORRECT

FIG. I-24—CLUTCH THROWOUT
BEARING INSTALLATION

1—Spring Retainer
2—Clutch Fork
3—Throwout Bearing

d. Clean and apply wheel bearing lubricant to ball stud in flywheel housing and to the seat in clutch fork.

e. If disassembled, install pressure plate in the cover assembly, lining up the groove on its edge with the groove on the edge of the cover. Install pressure plate retracting springs, and the three drive strap-to-pressure plate bolts and lock washers. Torque bolts 11 lb-ft. [1,51 kg-m.].

Note: The diaphragm type clutch assembly is factory calibrated and requires no adjustment before installation. Refer to Par. I-14 to adjust Borg and Beck coil spring type clutch assembly.

f. Install the pressure plate and driven plate on flywheel. Support both assemblies with a spare main drive gear.

Note: Be certain that mark on clutch cover is aligned with the mark made on the flywheel during clutch removal.

g. Install clutch attaching bolts and tighten alternately so that clutch is drawn squarely into position on flywheel. Each bolt must be tightened one turn at a time to avoid bending the clutch cover flange. Torque bolts 30 to 40 lb-ft. [4,1 a 5,5 kg-m.].

h. Lubricate the ball stud and clutch fork with wheel bearing lubricant and install clutch fork.

Note: Be certain that fork retaining spring is tight on pivot ball stud.

i. Install flywheel housing on engine cylinder block.

Caution: Be certain that dowel pins are installed in cylinder block.

j. Lubricate the recess on the inside of the throwout bearing collar. Be careful not to use too much lubricant. See Fig. I-23.

Caution: Make certain that the lips of the spring retainer (attached to the clutch fork) are in groove of the bearing. See Fig. I-24.

k. Install throwout bearing assembly and connect clutch linkage.

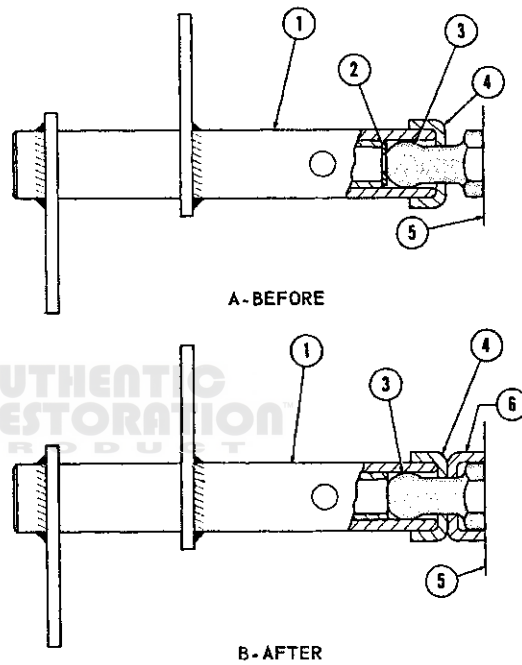
l. Install transmission as described in Section J.

m. Adjust clutch for 3/4" [19,05 mm.] free travel, see Par. I-3.

CLUTCH

Note: Should clutch chatter in reverse develop on a vehicle equipped with the V-6 engine, installation of Anti-Clutch Chatter Kit, Part No. 992824, will correct the difficulty. Make certain that the clutch linkage is tight and in proper adjustment.

Note: Should a noise occur at the clutch control lever and tube assembly when the clutch pedal is depressed, remove the existing washer, located inside the tube at the end of the ball stud mounted on the transfer case, and add a second dust shield on the transfer case, and add a second dust shield over the ball stud as shown in Fig. I-25.



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FIG. I-25—CONTROL LEVER AND TUBE

- | | |
|-----------------------|-----------------|
| A—Before | B—After |
| 1—Clutch Control Tube | 4—Dust Seal |
| 2—Washer | 5—Transfer Case |
| 3—Ball Stud | 6—New Dust Seal |

I-28. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Slipping:	
Improper Pedal Adjustment.....	Adjust Pedal Free Travel
Weak Pressure Springs.....	Replace
Lining Oil Soaked.....	Install New Driven Plate
Worn Linings or Torn Loose from Plate.....	Install New Driven Plate
Burned Clutch.....	Replace
Grabbing or Chattering:	
Gummy or Worn Linings.....	Install New Driven Plate
Loose Engine Mountings.....	Tighten
Scored or Broken Pressure Plate.....	Install New Pressure Plate
Improper Clutch Finger Adjustment.....	Readjust
Clutch Plate Crimp or Cushion Flattened Out....	Replace Driven Plate
Dragging:	
Too Much Pedal Play.....	Adjust
Improper Finger Adjustment.....	Readjust
Pressure Plate Binds in Bracket.....	Adjust
Warped Pressure or Driven Plate.....	Replace
Torn or Loose Clutch Facing.....	Replace
Rattling:	
Broken or Weak Return Springs in Driven Plate..	Replace
Worn Throwout Bearing.....	Replace
Fingers Improperly Adjusted.....	Readjust
Worn Driven Plate Hub of Transmission Main Gear Shaft.....	Replace
Pilot Bushings in Flywheel Worn.....	Replace
Pilot Bushing in Crankshaft Worn.....	Replace

I-29. CLUTCH SPECIFICATIONS

ENGINE	HURRICANE F4	DAUNTLESS V-6 EARLY MODELS	DAUNTLESS V-6 LATE MODELS
Pressure Plate:			
Make.....	Auburn	G.M.	Borg and Beck
Type.....	Single Dry Plate	Single Plate, Dry Disc.	Single Plate, Dry Disc.
No. of Springs.....	3	Diaphragm Type	Coil Spring Type (9)
Total Plate Pressure.....	1150 lb. [521,6 kg.]	1600 lb. [725 kg.]	1765 lb. [800 kg.]
Driven Plate			
Make.....	Auburn or Borg & Beck	G.M.	Borg and Beck
Facings.....	Woven Asbestos	Woven Asbestos	Woven Asbestos
Diameter.....	9.25" [23,4 cm.]	10.4" [26,4 cm.]	10.4" [26,4 cm.]
Thickness.....	.125" [3,17 mm.]	.135" [3,38 mm.]	.135" [3,38 mm.]
Torque Capacity.....	216 lb.-ft. [29,87 kg.-m.]	246 lb.-ft. [34,01 kg.-m.]	250 lb.-ft. [34,57 kg.-m.]
Clutch Release Bearing:			
Type.....	Sealed Ball Bearing Prelubricated	Sealed Ball Bearing Prelubricated	Sealed Ball Bearing Prelubricated
Clutch Pilot Bushing:			
Location.....	In Flywheel	In Crankshaft	In Crankshaft
Material.....	Bronze	Bronze	Bronze
Size.....	I.D. .628" [15,9 mm.]	I.D. .592" [18,05 mm.]	I.D. .592" [18,05 mm.]
Clutch Pedal Adjustment....	3/4" [19,05 mm.]	3/4" [19,05 mm.]	3/4" [19,05 mm.]

I-30. CLUTCH ADJUSTING FIXTURE DATA

Manufacturer	Disc Diameter	Spacer Thickness	Gauge Length
Auburn.....	9 1/4" [23,4 cm.]	.285" [0,723 cm.]	1 15/16" [4,9 cm.]
Borg and Beck.....	10.4" [26,4 cm.]	.305" [0,774 cm.]	2.0" [5,08 cm.]

THREE-SPEED TRANSMISSION

Contents

SUBJECT	PAR.	SUBJECT	PAR.
GENERAL.....	J-1	DISASSEMBLY OF CANE	
TRANSMISSION SHIFTING CONTROL..	J-2	SHIFT TRANSMISSION.....	J-8, J-12, J-16
TRANSMISSION REMOTE		Transmission Cleaning and	
CONTROL ADJUSTMENT.....	J-3	Inspection.....	J-10, J-18
REMOTE CONTROL DISASSEMBLY....	J-4	Transmission Interlocking	
REMOTE CONTROL REASSEMBLY.....	J-5	Sleeve Inspection.....	J-9
TRANSMISSION REMOVAL.....	J-6	REASSEMBLY OF CANE SHIFT	
SEPARATING TRANSMISSION		TRANSMISSION.....	J-11, J-14, J-19
AND TRANSFER CASE.....	J-7	SERVICE DIAGNOSIS.....	J-20
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J-1. GENERAL

A three speed synchromesh transmission is standard equipment on all 'Jeep' Universal vehicles.

The models T90 and T96 transmissions are used with the Hurricane F4 engine, and models T86AA and T14A transmissions are used with the Dauntless V-6 engine. All model transmissions are similar in design with exception of the T14A which is a fully synchronized (all forward gears) transmission with helical drive gears throughout.

The transmission assembly is attached to the rear face of the flywheel bell housing and is supported on a rubber insulator at the frame center cross member which forms the rear engine support.

All 4-wheel-drive vehicles are equipped with a transfer case attached to the rear of the transmission. Transfer case service and repair procedures are described in Section K.

Models CJ-5A, and CJ-6A are equipped with the same transmission, but with a remote control shift. Models DJ-5 and DJ-6 are equipped with a similar transmission, however, the construction is somewhat different because it is not designed to receive a transfer case for four-wheel drive.

For DJ-5 and DJ-6 2WD vehicles, the transmission repair procedures begin with Par. J-12.

J-2. TRANSMISSION SHIFTING CONTROL

The shift of the three-speed transmission is smooth and positive. The cane control lever shifts the transmission gears direct from the shift control housing mounted to the top side of the transmission housing. The remote control lever shifts the transmission gears through remote control rods attached to the adjusting levers of the shift shafts protruding from the left side of the transmission housing. Poppet balls and springs retain the transmission gears in mesh and an interlocking mechanism prevents shifting into two gears at the same time.

J-3. Transmission Remote Control Adjustment

- Early CJ-5A, CJ-6A

First disconnect the transmission shift rods from

the remote control levers. Check for binding of the remote control shaft on the steering column and make the necessary corrections to eliminate any binding condition.

If the shift is not smooth and positive, first make sure the gears are in neutral position then remove the shift rods at the transmission by removing clevis pins, Fig. J-1 No. 17, and slip a short piece of snug fitting $\frac{1}{4}$ " [6,35 mm.] aligning rod, through the gearshift levers and housing as shown in insert drawing.

This places the clutch and shift lever assemblies in the neutral position. Adjust the shift rod yokes at the transmission end, so clevis pins can be installed freely without moving the shift levers on the transmission after which remove alignment pin.

If shifting from first to second is difficult or transmission hangs in first gear, shorten the low and reverse shift rod one turn at a time until the condition is corrected. Usually three turns are required.

Should the fault continue after completing the above adjustment, check further as outlined below. First remove the lubricating fitting. Use a narrow feeler gauge which will enter the opening for the lubricator and check the clearance between the faces of the shifting clutches. This clearance should be .015" to .031", [$\frac{1}{64}$ " to $\frac{1}{32}$ "] [0,397-0,794 mm.]. If this clearance is greater the assembly must be removed for adjustment. The shift dog, which engages the clutch slots, should not have more than .009" [0,229 mm.] clearance in the slots. If the clearance between the clutch grooves and cross pins is too great, these parts must be replaced.

J-4. Removal of Remote Control

- Early CJ-5A, CJ-6A
- Refer to Fig. J-1

To remove the remote control the following procedure is suggested:

a. Remove shifting rods from the transmission and also from the steering remote control clutch levers.

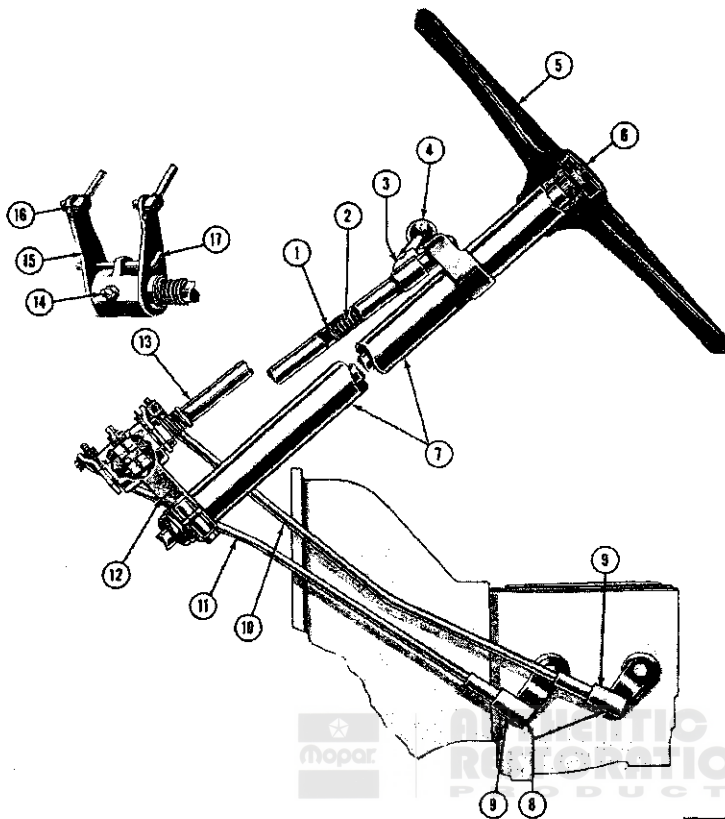


FIG. J-1—TRANSMISSION
REMOTE CONTROL CJ-5A, CJ-6A

- 1—Stop Screw
- 2—Bias Spring
- 3—Gearshift Lever
- 4—Lever Ball
- 5—Steering Wheel
- 6—Horn Button
- 7—Column and Bearing
- 8—End Nuts
- 9—Shift Rod Ends
- 10—Shift Rod
- 11—Shift Rod
- 12—Cross-Shift Bracket
- 13—Control Shaft
- 14—Lubrication Fitting
- 15—Lever and Clutch
- 16—Adjusting Yoke
- 17—Aligning Rod

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- b. Remove gearshift lever fulcrum pin and the gearshift lever.
- c. Remove plates on the toe board at the steering post.
- d. Remove two screws holding remote control housing to the steering post and lift the housing from the positioning pin.
- e. Remove the assembly down through the floor pan.
- f. Remove the lower clutch and shift lever from the housing by turning counterclockwise.
- g. Remove upper clutch and shift lever in the same manner.
- h. Wash all parts in a suitable cleaning solution.

J-5. Reassembly of Remote Control

- Refer to Fig. J-1

Check clearance of shift dog which engages in slot of clutches, and if found to be greater than .009" [0,229 mm.] clearance, replace the worn parts. Assemble upper clutch lever assembly in housing making sure that the alignment hole in the housing faces toward the engine. Turn the upper lever assembly in as far as it will go and then back off one full turn until the hole in the clutch lever aligns with hole in the housing.

Assemble the lower clutch lever assembly in housing until faces of clutches contact then back off not more than one-half turn which should bring the aligning hole in the lever in line with the hole

in the housing. If the one-half turn does not bring the alignment hole in proper position, it will be necessary to grind off (square with axis not to exceed .015") [0,397 mm.] the face of the lower clutch; in other words, backing off not more than one-half turn from face to face contact gives the proper clearance of .015" to .031" [0,397-0,794 mm.] between the two clutches.

Assemble the unit to the steering post in reverse order of dismantling and adjust remote control rods.

After assembly, if the shift dog catches on the edge of the slot in the clutch when moving the lever up and down, disconnect the shift rod at the transmission end and either lengthen or shorten it slightly to correct this condition.

J-6. TRANSMISSION REMOVAL

The following repair procedures given in Par. J-7 through J-11 for the standard 3-speed transmission apply in general to all models listed. Minor differences between models that affect the procedure are noted. Procedure for the optional 4-speed transmission begins with Section J-1.

Removal is as follows:

- a. Drain the transmission and transfer case. Replace the drain plugs.
- b. Remove the floor pan inspection plate.
- c. Remove the shift lever and shift housing assembly and its gasket from the transmission. On

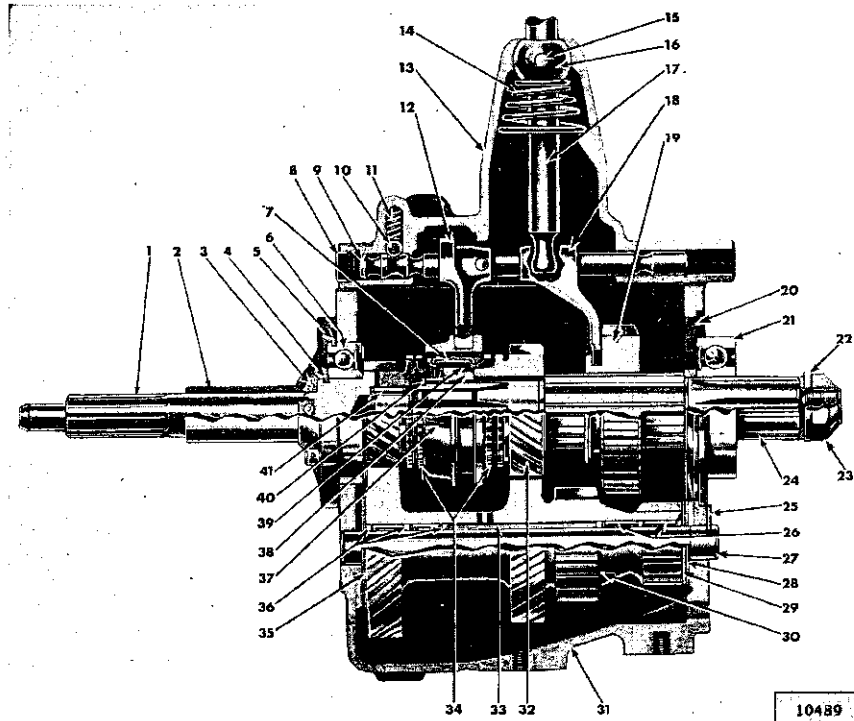


FIG. J-2—THREE-SPEED TRANSMISSION — T90

- | | |
|---|---|
| 1—Main Drive Gear | 22—Main Shaft Washer |
| 2—Main Drive Gear Bearing Retainer | 23—Main Shaft Nut |
| 3—Main Drive Gear Bearing Retainer Oil Seal | 24—Main Shaft |
| 4—Main Drive Gear Snap Ring | 25—Idler and Countershaft Lock Plate |
| 5—Main Drive Gear Bearing Snap Ring | 26—Countershaft Gear Bearing Rollers |
| 6—Main Drive Gear Bearing | 27—Countershaft |
| 7—Synchronizer Shifting Plate | 28—Countershaft Thrust Washer Rear—Steel |
| 8—Shift Rail Cap | 29—Countershaft Thrust Washer Rear—Bronze |
| 9—Shift Rail—High and Intermediate | 30—Countershaft Gears |
| 10—Shift Rail Poppet Ball | 31—Transmission Case |
| 11—Shift Rail Poppet Spring | 32—Main Shaft Second Speed Gear |
| 12—Shift Fork—High and Intermediate | 33—Countershaft Bearing Spacer |
| 13—Control Housing | 34—Synchronizer Blocking Ring |
| 14—Control Lever Support Spring | 35—Countershaft Thrust Washer Front—Bronze |
| 15—Control Lever Housing Pin | 36—Countershaft Bearing Washer |
| 16—Control Lever Fulcrum Ball | 37—Intermediate and High Speed Clutch Sleeve |
| 17—Gear Shift Lever | 38—Intermediate and High Clutch Hub |
| 18—Shift Fork—Low and Reverse | 39—Synchronizer Spring |
| 19—Sliding Gear—Low and Reverse | 40—Intermediate and High Clutch Hub Snap Ring |
| 20—Main Shaft Bearing Adapter | 41—Main Shaft Pilot Bearing Roller |
| 21—Main Shaft Bearing | |

CJ-5A, CJ-6A models, remove the remote control rods.

d. Remove the set screw from the transfer case shift lever pivot pin. Remove the pivot pin, shift levers, and shift lever springs. On models CJ-5A, and CJ-6A remove pivot pin cotter key and the adjusting rod attaching nut to remove shift lever. See Fig. J-1.

e. If the vehicle is equipped with power take-off, remove the shift lever plate screws and lift out the lever.

f. Disconnect the front and rear propeller shafts from the transfer case, following the procedure detailed in Section L. Should the vehicle be equipped with power take-off, disconnect the transfer case end of the power take-off drive shaft.

g. Disconnect the speedometer cable at the transfer case.

h. Disconnect the hand brake cable.

i. Disconnect the clutch release cable at bellcrank yoke end.

j. Place jacks under the transmission and engine, protecting the engine oil pan with a block of wood.

k. Remove the nuts holding rear mounting to frame cross member.

l. Remove the transfer case snubbing rubber bolt nut at cross member.

m. Remove bolts holding frame center cross member to frame side rail and remove cross member.

n. Remove bolts holding transmission to flywheel bellhousing.

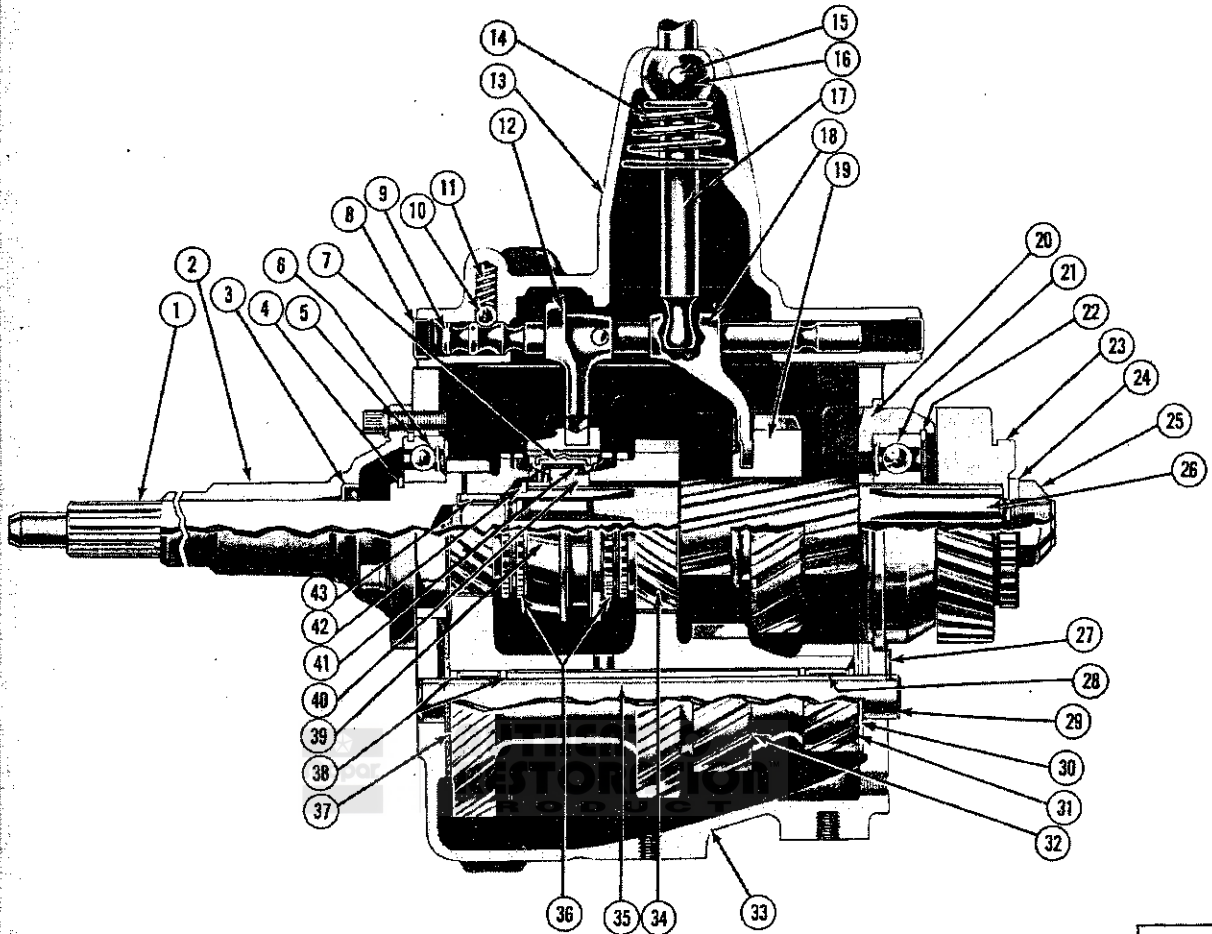
o. Force transmission to right to disengage clutch control lever tube ball joint.

p. Lower jacks under engine and transmission. Slide transmission and transfer case assemblies toward rear of vehicle until the clutch shaft clears the flywheel housing.

q. Lower jack under transmission. Remove transmission and transfer case as an assembly from under the vehicle.

r. For separation of the transmission and transfer case, refer to Par. J-7.

THREE-SPEED TRANSMISSION



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FIG. J-3—THREE-SPEED TRANSMISSION — T86AA

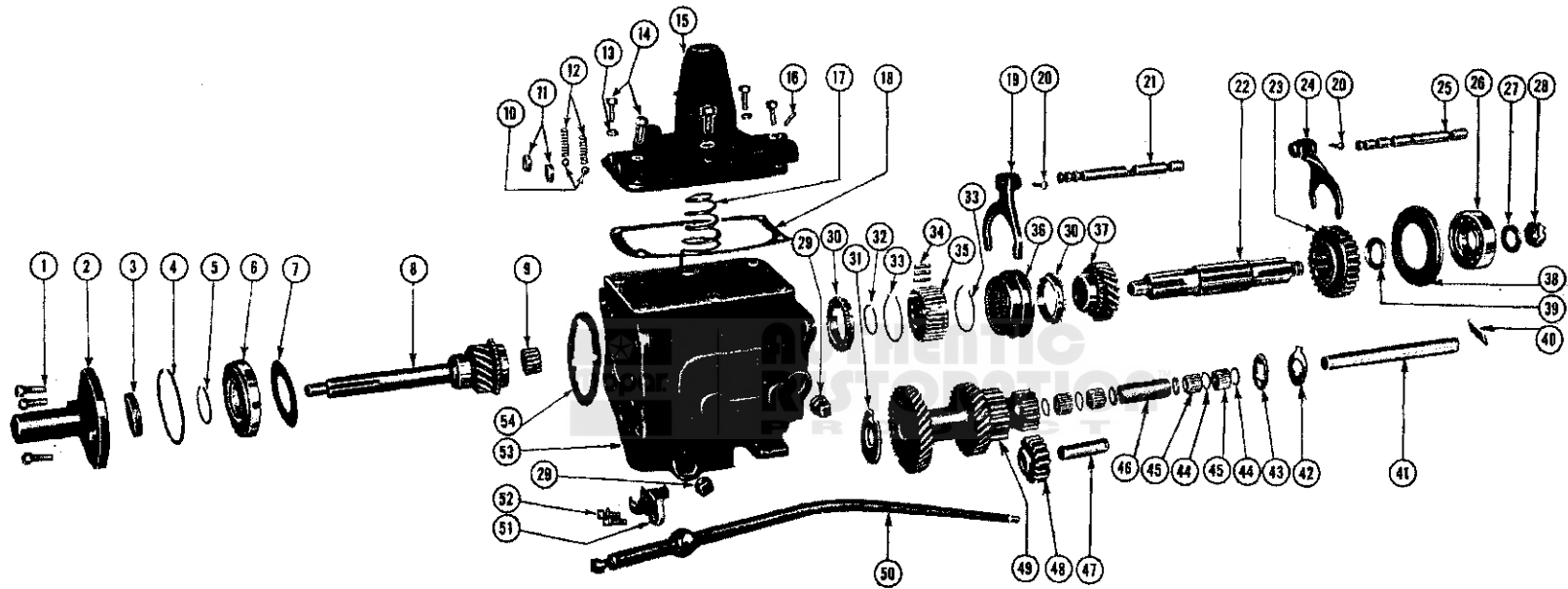
- | | | |
|---------------------------------------|--------------------------------------|--|
| 1—Main Drive Gear | 16—Control Lever Fulcrum Ball | 31—Countershaft Thrust Washer |
| 2—Main Drive Gear Bearing Retainer | 17—Gear Shift Lever | Rear — Bronze |
| 3—Main Drive Gear Bearing Retainer | 18—Shift Fork — Low and Reverse | 32—Countershaft Gears |
| Oil Seal | 19—Sliding Gear — Low and Reverse | 33—Transmission Case |
| 4—Main Drive Gear Snap Ring | 20—Main Shaft Bearing Adapter | 34—Main Shaft Second Speed Gear |
| 5—Main Drive Gear Bearing Snap Ring | 21—Main Shaft Bearing | 35—Countershaft Bearing Spacer |
| 6—Main Drive Gear Bearing | 22—Rear Bearing Snap Ring | 36—Synchronizer Blocking Ring |
| 7—Synchronizer Shifting Plate | 23—Transfer Case Driving Gear | 37—Countershaft Thrust Washer |
| 8—Shift Rail Cap | 24—Main Shaft Washer | Front — Bronze |
| 9—Shift Rail — High and Intermediate | 25—Main Shaft Nut | 38—Countershaft Bearing Washer |
| 10—Shift Rail Poppet Ball | 26—Main Shaft | 39—Intermediate and High Clutch Sleeve |
| 11—Shift Rail Poppet Spring | 27—Idler and Countershaft Lockplate | 40—Intermediate and High Clutch Hub |
| 12—Shift Fork — High and Intermediate | 28—Countershaft Gear Bearing Rollers | 41—Synchronizer Spring |
| 13—Control Housing | 29—Countershaft | 42—Intermediate and High Clutch Hub |
| 14—Control Lever Support Spring | 30—Countershaft Thrust Washer | 43—Main Shaft Pilot Bearing Roller |
| 15—Control Lever Housing Pin | Rear — Steel | |

J-7. Separating Transmission and Transfer Case

- a. Remove the six screws and lockwashers attaching the transfer case rear cover and remove the cover. Or, should the vehicle be equipped with a power take-off, remove the power take-off shift unit which replaces the cover.
- b. Remove cotter pin, nut, and washer which hold the transfer case main drive gear on the rear end of the transmission mainshaft. If possible at this point, remove the main drive gear. If not possible, see steps d and e below.
- c. Remove the transmission-to-transfer-case screws.
- d. Separate the transfer case from the transmission. When separating the two units, use care that the transmission mainshaft bearing, which bears in

both housings, remains in the transmission housing. To separate the two units if the transfer case main drive gear was not removed in step b above, follow the procedure in step e below.

- e. Install transmission mainshaft retaining plate, tool W-194, as shown in Fig. J-6 to prevent the mainshaft from pulling out of the transmission case. Should this tool be unavailable, loop a piece of wire around the mainshaft directly back of the mainshaft second-speed gear. Install the transmission shift housing right and left front attaching screws part way into the transmission case. Twist the wire and attach each end to one of the screws. Draw the wire tightly. With the mainshaft securely in place, support the transfer case and, with a rawhide mallet or brass drift and hammer, tap



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FIG. J-4—T90 THREE-SPEED TRANSMISSION — CANE SHIFT

- 1—Bearing Retainer Bolt
- 2—Bearing Retainer
- 3—Bearing Retainer Oil Seal
- 4—Bearing Snap Ring
- 5—Main Drive Gear Snap Ring
- 6—Main Drive Gear Bearing
- 7—Front Bearing Washer
- 8—Main Drive Gear
- 9—Pilot Roller Bearing
- 10—Poppet Ball
- 11—Shift Rail Cap
- 12—Poppet Spring
- 13—Lockwasher
- 14—Shift Housing Bolt
- 15—Control Housing
- 16—Interlock Plunger
- 17—Shift Lever Spring
- 18—Shift Tower Gasket

- 19—High and Intermediate Shift Fork
- 20—Shift Fork Pin
- 21—High and Intermediate Shift Rail
- 22—Main Shaft
- 23—Sliding Gear
- 24—Low and Reverse Shift Fork
- 25—Low and Reverse Shift Rail
- 26—Rear Bearing
- 27—Main Shaft Washer
- 28—Main Shaft Nut
- 29—Filler Plug
- 30—Blocking Ring
- 31—Front Countershaft Thrust Washer
- 32—Clutch Hub Snap Ring
- 33—Synchronizer Spring
- 34—Synchronizer Plate
- 35—Clutch Hub
- 36—Clutch Sleeve

- 37—Second Speed Gear
- 38—Rear Bearing Adapter
- 39—Bearing Spacer
- 40—Lock Plate
- 41—Countershaft
- 42—Rear Countershaft Thrust Washer
- 43—Rear Countershaft Thrust Washer
- 44—Countershaft Bearing Washer
- 45—Countershaft Bearing
- 46—Countershaft Bearing Spacer
- 47—Reverse Gear Shaft
- 48—Reverse Idler Gear
- 49—Countershaft Gear Set
- 50—Shift Lever
- 51—Oil Collector*
- 52—Oil Collector Screw*
- 53—Transmission Case
- 54—Bearing Retainer Gasket

*Removed on later models.

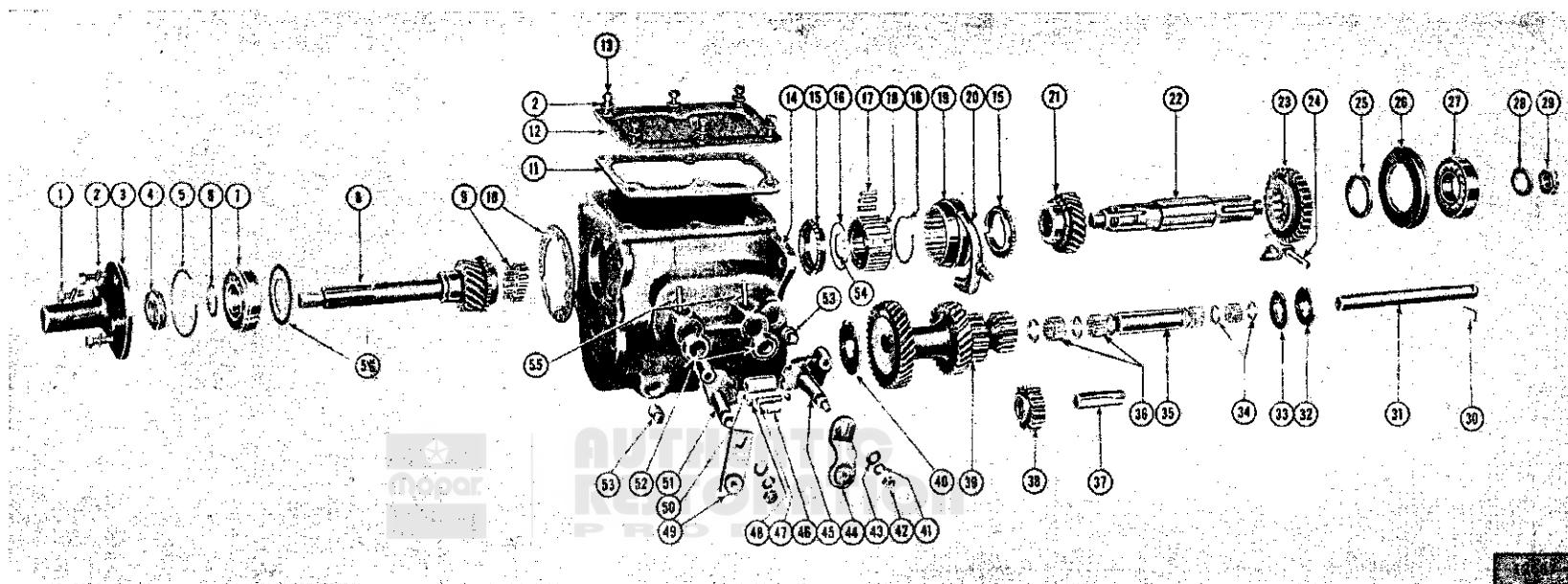


FIG. J-5—T90 THREE-SPEED TRANSMISSION — REMOTE SHIFT

- 1—Retainer Screw
- 2—Retainer Screw Gasket
- 3—Main Drive Gear Bearing Retainer
- 4—Oil Seal
- 5—Bearing Snap Ring
- 6—Main Drive Gear Snap Ring
- 7—Main Drive Gear Bearing
- 8—Main Drive Gear
- 9—Mainshaft Pilot Bearing Rollers
- 10—Retainer Gasket
- 11—Case Cover Gasket
- 12—Transmission Case Cover
- 13—Cover Screw
- 14—Transmission Case
- 15—Synchronizer Blocking Ring
- 16—Synchronizer Spring
- 17—Synchronizer Shifting Plate
- 18—Intermediate and High Clutch Hub
- 19—Intermediate and High Clutch Sleeve
- 20—Intermediate and High Shift Fork

- 21—Second Speed Gear
- 22—Mainshaft
- 23—Low and Reverse Sliding Gear
- 24—Low and Reverse Shifting Shoe
- 25—Mainshaft Bearing Spacer
- 26—Mainshaft Bearing Adapter
- 27—Mainshaft Bearing
- 28—Mainshaft Washer
- 29—Mainshaft Nut
- 30—Lock Plate
- 31—Countershaft
- 32—Steel Thrust Washer
- 33—Bronze Thrust Washer
- 34—Countershaft Bearing Spacer
- 35—Countershaft Bearing Center Spacer
- 36—Countershaft Bearing Rollers
- 37—Reverse Idler Gear Shaft
- 38—Reverse Idler Gear Assembly
- 39—Countershaft Gear

- 40—Countershaft Front Thrust Washer
- 41—Lockwasher
- 42—Nut
- 43—Control Lever Washer
- 44—Low and Reverse Control Lever
- 45—Low and Reverse Shift Lever
- 46—Shift Lever Interlock Pin
- 47—Shift Lever Poppet Spring
- 48—Shift Lever Poppet Ball
- 49—Intermediate and High Control Lever
- 50—Interlock Shift Lever Sleeve
- 51—High and Intermediate Shift Lever
- 52—Oil Seal
- 53—Plug
- 54—Clutch Hub Snap Ring
- 55—Taper Pin
- 56—Front Oil Retaining Washer

lightly on the end of the mainshaft to loosen the gear and separate the two units.

J-8. Disassembly — T90, T86AA

● Refer to Fig. J-5, J-7

a. If the transfer case is attached, separate it from the transmission as outlined in Par. J-7.

b. Remove the shift housing and gasket from the top of the transmission case. The shift housing can be disassembled, if necessary, at this point by removing the shift rails and forks from the shift housing. Use care not to lose the poppet balls and springs.

Note: On CJ-5A and CJ-6A models equipped with side-shift remote-control transmission it is necessary to remove the main drive gear before the shift forks can be removed.

c. Remove the three screws and washers attaching the front main drive gear bearing retainer to the transmission. Remove the retainer and gasket.

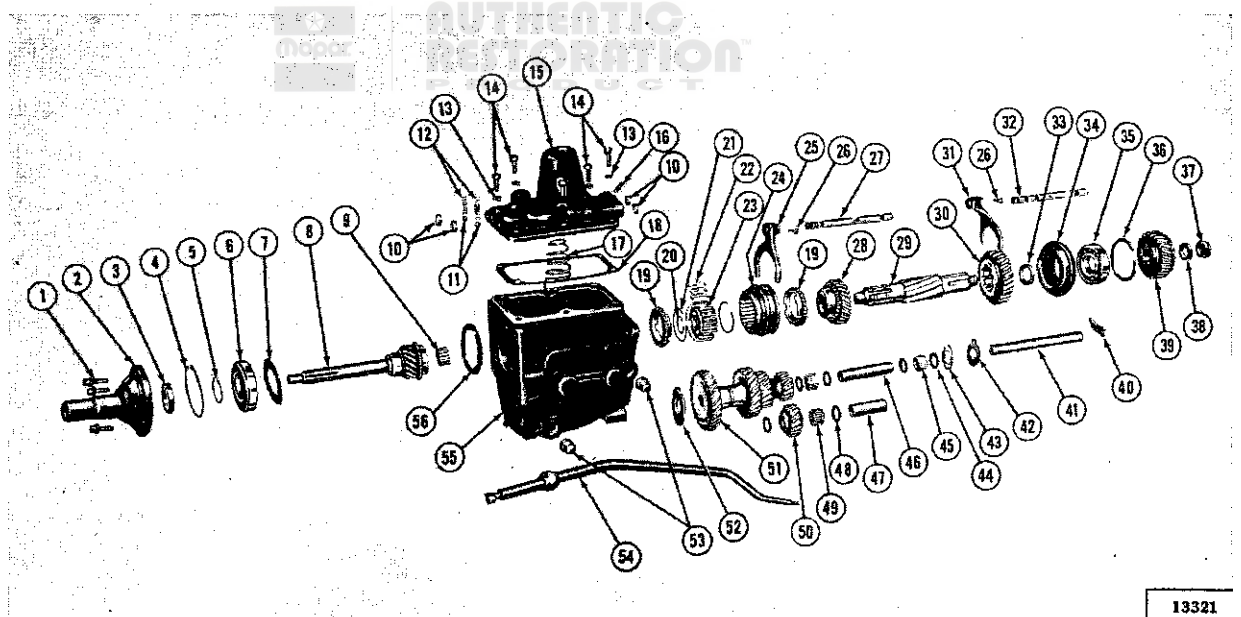
d. Remove the two socket-head screws from the front end of the transmission case. These screws support the oil collector inside the case.

Note: The oil collector has been discontinued in late production transmission assemblies.



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FIG. J-6—MAIN SHAFT RETAINING PLATE



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FIG. J-7—T86AA THREE-SPEED TRANSMISSION — CANE SHIFT

- | | | |
|--------------------------------------|--------------------------------------|---|
| 1—Bearing Retainer Screws | 20—Clutch Hub Snap Ring | 40—Lock Plate |
| 2—Main Drive Gear Bearing Retainer | 21—Synchronizer Spring | 41—Countershaft |
| 3—Bearing Retainer Oil Seal | 22—Synchronizer Plate | 42—Rear Countershaft Thrust Washer (steel) |
| 4—Bearing Snap Ring | 23—Clutch Hub | 43—Rear Countershaft Thrust Washer (bronze) |
| 5—Main Drive Gear Snap Ring | 24—Clutch Sleeve | 44—Countershaft Bearing Washer |
| 6—Main Drive Gear Bearing | 25—High and Intermediate Clutch Fork | 45—Countershaft Bearing |
| 7—Front Bearing Oil Retaining Washer | 26—Shift Fork Pin | 46—Countershaft Center Bearing Spacer |
| 8—Main Drive Gear | 27—High and Intermediate Shift Rail | 47—Reverse Idler Gear Shaft |
| 9—Pilot Roller Bearing | 28—Second Speed Gear | 48—Reverse Idler Gear Bearing Washer |
| 10—Shift Rail Cap | 29—Main Shaft | 49—Reverse Idler Gear Roller Bearings |
| 11—Poppet Ball | 30—Low and Reverse Sliding Gear | 50—Reverse Idler Gear |
| 12—Poppet Spring | 31—Low and Reverse Shift Fork | 51—Countershaft Front |
| 13—Lock Washer | 32—Low and Reverse Shift Rail | 52—Countershaft Front Thrust Washer |
| 14—Shift Housing Bolt | 33—Bearing Spacer | 53—Plug |
| 15—Control Housing | 34—Rear Bearing Adapter | 54—Shift Lever |
| 16—Interlock Plunger | 35—Rear Bearing | 55—Transmission Case |
| 17—Shift Lever Spring | 36—Rear Bearing Snap Ring | 56—Retainer Gasket |
| 18—Shift Tower Gasket | 37—Nut | |
| 19—Blocking Ring | 38—Washer | |
| | 39—Transfer Case Drive Gear | |

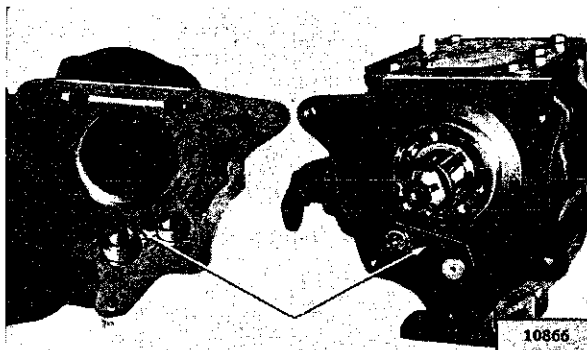


FIG. J-8—SHAFT LOCK PLATE

e. Tap lightly on the front end of the countershaft to loosen the lock plate. Remove the lock plate from slots cut in the rear ends of the countershaft and reverse idler shaft. Refer to Fig. J-8.

f. Using special tool No. W-166 or a brass drift, drive the countershaft toward the rear of the case and remove it. The countershaft gear set will drop to the bottom of the transmission case. If the special tool is used, the needle bearing rollers will remain in the countershaft gear hub and the gears and bearings may later be removed as an assembly.

g. Remove the mainshaft rear bearing adapter.

h. Remove the mainshaft and gears from the case. The mainshaft assembly with the gears still in place may be removed through the rear bearing adapter opening. Do not lose pilot roller bearing when separating shafts.

i. On early production transmissions drive the main drive gear into the case enough to remove the oil collector. Remove the oil collector from the transmission case.

j. Remove the main drive gear.

k. Remove the countershaft gear set and the three thrust washers. Remove the washers, needle bearing rollers, and spacer from the assembly.

l. Remove the reverse idler shaft and gear by driving the shaft into the case using a brass drift.

m. This completes the disassembly of the transmission on those models with a cane shift.

n. On CJ-5A and CJ-6A models equipped with a remote shift transmission, inspect the poppet and interlock assembly which floats between the shift lever assemblies described in Par. J-9.

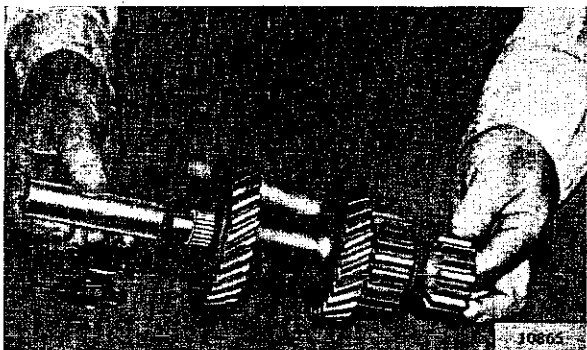


FIG. J-9—COUNTERSHAFT GEAR BEARING ARBOR

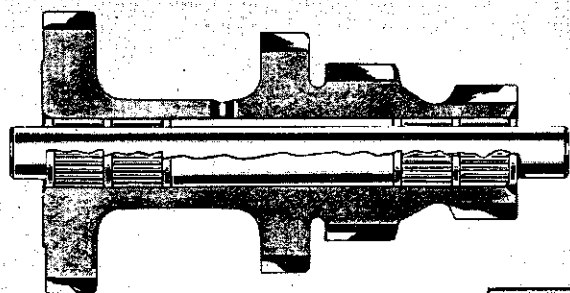


FIG. J-10—COUNTERSHAFT BEARING SPACERS

J-9. Transmission Interlocking Sleeve Inspection

a. The interlock sleeve and poppet assembly should be carefully checked. Should the assembly be too long, it will be impossible to shift gears and if it is too short, it will fail to function as an interlock to prevent shifting into two gears at one time. Locate the intermediate-and-high control arm for second gear position. Use a feeler gauge to measure the clearance between the ends of the interlock sleeve and the notched surface of each shift lever as shown in Fig. J-11.

Clearance must be from .001" to .007" [0,025 a 0,178 mm.] on each side of the interlock sleeve. To obtain correct clearance, interlock sleeves are available for selective fit.

The different lengths can be identified by a letter at the end.

1.287" [3,269 cm.] — etched C

1.291" [3,279 cm.] — etched B

1.295" [3,289 cm.] — etched A

1.299" [3,299 cm.] — no mark

1.303" [3,309 cm.] — etched D

Should an interlock sleeve need replacing, proceed as follows:

Where necessary drive out the taper retaining pins from the bottom of the shift lever bosses. Remove the nuts, lock washers, and flat washers from the

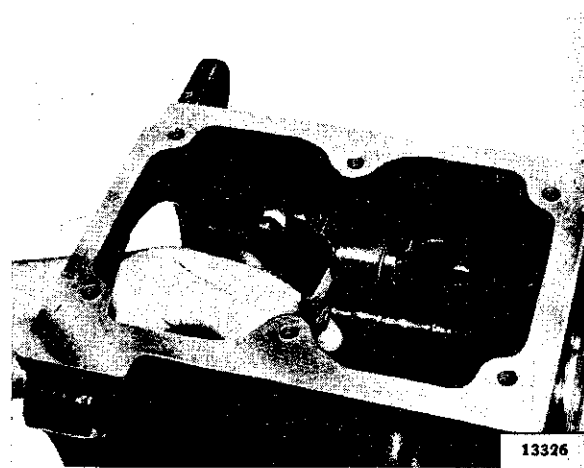


FIG. J-11—INTERLOCK SLEEVE CLEARANCE

control levers and remove arms. Remove the shift levers and then remove the sleeve, poppet balls, spring, and interlock pin. Check the oil seal carefully for oil leakage and replace if necessary.

b. If it is evident that a minimum clearance of .001" to .007" [0,025 a 0,178 mm.] cannot be obtained between the end of the interlock sleeve and the shift levers, even though the longest sleeve has been installed, replace the existing sleeve with an Interlock Sleeve Service Kit.

When assembling the interlock sleeve be sure that the shift lever poppet spring works freely inside the interlock sleeve and that the interlock pin is not omitted from inside the spring.

If the notched surfaces of the shifting lever are dirty or rough, they should be cleaned and smoothed. If notched surfaces are scored or damaged, the lever should be replaced.

Each time an interlock sleeve or shift lever is replaced, check the clearance between the interlock sleeve and the shift lever.

J-10. Transmission Inspection

a. Wash the transmission case thoroughly inside and outside with cleaning solvent.

b. 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 or the bores are not true, replace the case.

c. Clean and inspect all gears and bronze blocking rings for cracks, chipped or cracked teeth, or excessive wear of the teeth.

d. Inspect all bushings and bearings for wear or damage.

e. Check first and reverse sliding gear for freedom of movement on the mainshaft.

f. Check the clutch sleeve to see that it slides freely on the hub.

g. Check the condition of the bearing retainer oil seal.

J-11. Transmission Reassembly — T90, T86AA

● Refer to Fig. J-5, J-7

Assemble the unit in the reverse order of disassembly, noting the following points:

a. Oil circulation is provided between the transmission and transfer case by the addition of drilled passages between the two units. The rear face of the transmission case is drilled with two $\frac{1}{16}$ " [1,11 mm.] holes and two $\frac{1}{4}$ " [6,35 mm.] holes. The front face of the transfer case is drilled with two $\frac{1}{16}$ " [1,11 mm.] holes to register with those drilled in the transmission case. When making replacement of either unit or case, it is important that mating parts be installed, that is, if a transmission case is drilled use a drilled transfer case. It is important that the correct gasket, having openings for oil passage, be used with the drilled cases.

b. Position the reverse idler gear in the case and install the shaft using care that the slot at the shaft end is correctly aligned to receive the lock plate.

c. Assemble the spacer, six washers, and four

countershaft needle bearings in the countershaft gear hub, using special tool W-166 with loading sleeve, as shown in Fig. J-9 and J-10. Place the spacer inside the hub and insert the special tool in the spacer. Place a washer at each end of the spacer and load a set of bearing rollers at each end. Then add a washer, a set of bearing rollers, and finally another washer at each end to complete the assembly. Place the countershaft gear assembly in the case but do not install the countershaft until the mainshaft and main drive gear are installed.

d. When assembling the mainshaft gears, the low and reverse sliding gear is installed with the shift shoe groove toward the front of the transmission.

e. The sequence of assembly of the synchronizer unit is shown in Fig. J-4. First install the two springs in the high and intermediate clutch hub with the spring tension opposed. Place the right lipped end of one spring in a slot of the hub and place the spring in the hub. Turn the hub around and make exactly the same installation with the other spring, starting with the same slot. Install the three synchronizer shifting plates in the three slots in the hub with the smooth side of the plates out. Hold the plates in position and slip the second and direct speed clutch sleeve over the hub with the long beveled edge toward the long part of the clutch hub. Install the two blocking rings one on each side of the hub. Install the completed assembly on the mainshaft with the beveled edge of the clutch sleeve toward the front end of the shaft.

f. Install main drive gear bearing onto the main drive gear shaft, using tool KF-128A.

g. When installing the mainshaft, use care that the needle bearing rollers in the main drive gear are correctly positioned. Use heavy grease to hold them in position for assembly.

h. The countershaft gear set, when assembled in the case, should have .012" to .018" [0,305 a 0,457 mm.] end play. This clearance is obtained by selective thickness of the rear steel thrust washer which is available in .0555" and .0625" [1,410 a 1,587 mm.] thickness.

After installation of the front and rear bearing retainers on the mainshaft, turn the transmission over to allow the gears to mesh and also to permit alignment and installation of the countershaft.

i. To install the countershaft gear set in the case, first install the large bronze thrust washer at the front of the case with the lip of the washer entered in the slot of the case. Use heavy grease to hold this washer in position. Next, install the steel thrust washer at the rear of the case. Start the countershaft into the case just enough to hold this washer in place. Align the slot in the countershaft with the slot in the reverse idler gear shaft to permit installation of the lock plate. Be sure the thrust washers are correctly positioned. Then position the bronze-faced washer against the rear end of the gear and place the gear in its running position. Tap the countershaft through the countershaft gear set and the case, forcing out the special tool W-166.

j. Attach the transfer case to the transmission

before the unit is installed in the vehicle. When doing this, use care that the countershaft and reverse idler shaft lock plate shown in Fig. J-8 is correctly positioned in the recess in the transfer case housing. Three $1\frac{1}{8}$ " long [2,86 cm.] screws and two 1" long [2,54 cm.] screws are used to attach the transfer case housing to the transmission housing. Install the 1" long [2,54 cm.] screws in the lower left and lower right mounting holes.

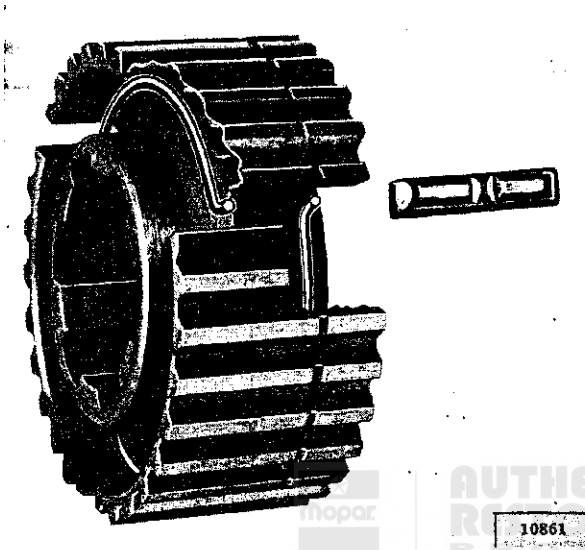


FIG. J-12—SYNCHRONIZER SPRINGS

J-12. Transmission — T96

- Model DJ-5, DJ-6
- a. Remove the shift housing and gasket from the top of the transmission case if it has not been previously removed. The shift housing can be disassembled, if necessary, at this point by removing the shift rails and forks from the shift housing. Use care and do not lose the poppet balls and springs.
- b. Drain the lubricant from housing and wash the assembly with a suitable solvent.
- c. Remove the screws from the front main bearing retainer and remove retainer.
- d. Remove nut which attaches the companion flange to the main shaft; also the flat washer and lock washer.
- e. Remove the companion flange with special puller tool W-172.
- f. Remove the screws attaching the rear bearing retainer to case and remove retainer and gasket.
- g. Remove oil seal speedometer drive gear and main shaft rear bearing from the bearing retainer.
- h. Remove the reverse idler and countershaft lock plate.
- i. Using tool W-193 or a soft drift, drive the countershaft out through the rear of the case allowing the countershaft gears to drop to the bottom of the case.
- j. Remove the main drive gear with bearing through the front of the case. Note that this gear cannot be removed when the countershaft gears are

in position. Take care when removing this gear not to misplace the thirteen needle type rollers in the gear end of the shaft which make up the main shaft pilot bearing.

- k. Remove the main shaft snap ring, the main shaft bearing snap ring and the mainshaft bearing which is grooved, from the main shaft.
- l. Remove the bronze blocking ring then remove the clutch hub and synchronizer assembly through the top.
- m. Remove the low and reverse sliding gears and the constant mesh gear and main shaft in one unit, through the top.
- n. Remove the countershaft gears through the top. Take care not to misplace the twenty rollers at each end of the long spacer as well as the two thrust washers and the two roller spacer bearings.
- o. Using a soft drift, drive the reverse idler shaft out toward the rear and remove the gear.

J-13. Transmission Cleaning and Inspection

Refer to Fig. J-7.

- a. Wash the transmission case inside and outside with cleaning solvent.
- b. 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 or the bores are not true, replace the case.
- c. Clean and inspect all gears and bronze blocking rings for cracks, chipped or cracked teeth, or excessive wear of the teeth.

Note: Whenever any transmission gear requires replacement, the gear with which it meshes should also be replaced.

- d. Inspect all bushings and bearings for wear or damage.
- e. Check low-and-reverse sliding gear for freedom of movement on the main shaft.
- f. Check the intermediate-and-high clutch sleeve to see that it slides freely on the intermediate-and-high clutch hub.

J-14. Transmission Reassembly — T96

- a. Position the reverse idler gear in the case and install the shaft using care that the slot at the shaft end is correctly aligned to receive the lock plate.
- b. To assemble the countershaft gear, it is necessary to use Tool W-193 or equivalent Fig. J-9. Place the special tool through the gear set and insert the long spacer positioning it at the center of the gear set. Place a set of twenty rollers at each end of the spacer followed by a spacing washer at each end. A small amount of grease will hold the spacing washer in position. Place the assembled countershaft gear set in the bottom of the case with the large gear toward the front.
- c. Install the rear main shaft bearing on the main shaft with the closed side of the bearing toward the front or low end of the shaft. Replace the bearing snap ring and main shaft snap ring.
- d. Pass the front end of the main shaft through the rear bearing opening and assemble the low and

reverse sliding gear on the shaft with the shifting fork groove toward the rear.

e. Assemble the second speed gear on the shaft with the teeth which engage in the clutch sleeve toward the front of the case.

f. Next, assemble the synchronizer unit. The assembly sequence of the synchronizer is shown in Fig. J-12. First install the two springs in the high and intermediate clutch hub. These springs must be installed with the spring tension opposed. Place the right lipped end of a spring in a slot of the hub and place the spring in the hub. Turn the hub around and make exactly the same installation with the other spring starting with the same slot. Fig. J-5. Install the three synchronized shifting plates in the three slots in the hub with the smooth side of the plates out. Hold the plates in position and slip the second and direct speed clutch sleeve

over the hub. Install the two blocking rings one on each side of the hub.

g. Place some heavy grease in the main shaft pilot and position the thirteen needle type roller bearings.

h. Install the main drive gear. If the bearing has been removed, note that the closed side is assembled toward the inside of the case.

i. Enter the main shaft bearing in the case and assemble the shaft in position.

j. Install the front bearing retainer.

k. For ease in installing the countershaft, turn the transmission case over to allow the gears to mesh. With the countershaft thrust washers correctly positioned, start the countershaft through the rear of the case with the lock plate slot toward the rear and the slot in alignment with the slot in the

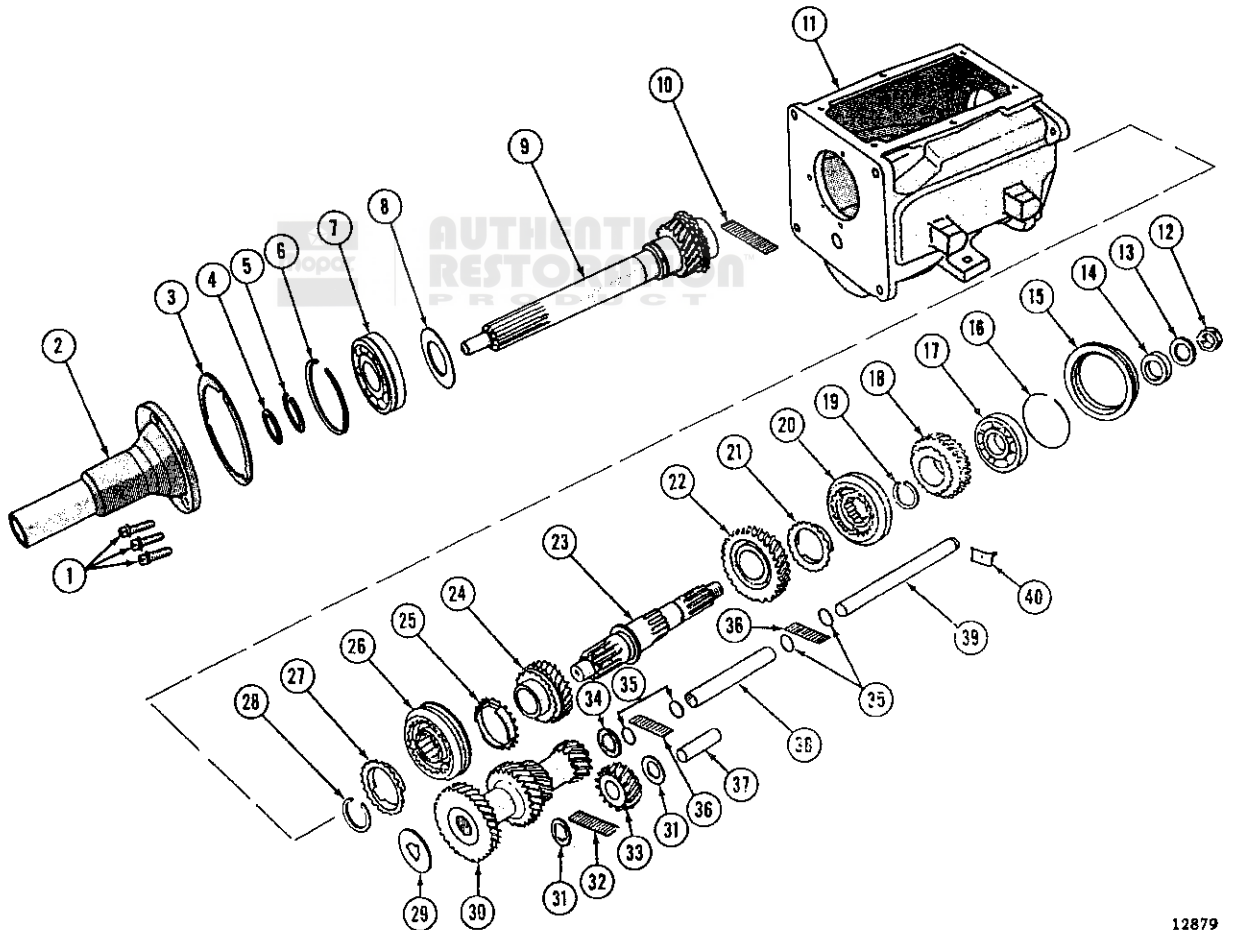


FIG. J-13—T14A THREE-SPEED TRANSMISSION

- | | | |
|------------------------------------|---------------------------------------|---|
| 1—Retainer Screws | 15—Bearing Adapter | 29—Countershaft Front Thrust Washer (large) |
| 2—Main Drive Gear Bearing Retainer | 16—Snap Ring | 30—Countershaft Gear |
| 3—Retainer Gasket | 17—Mainshaft Bearing | 31—Reverse Idler Gear Bearing Washer |
| 4—Oil Seal | 18—Reverse Gear | 32—Reverse Idler Gear Roller Bearings |
| 5—Snap Ring (small) | 19—Snap Ring | 33—Reverse Idler Gear |
| 6—Snap Ring (large) | 20—Low Synchronizer Assembly | 34—Countershaft Rear Thrust Washer (small) |
| 7—Main Drive Gear Bearing | 21—Synchronizer Blocking Ring | 35—Countershaft Bearing Spacer Washer |
| 8—Oil Retaining Washer (slinger) | 22—Low Gear | 36—Reverse Idler Shaft |
| 9—Main Drive Gear | 23—Mainshaft | 37—Countershaft Roller Bearings |
| 10—Mainshaft Pilot Bearing Rollers | 24—Second Gear | 38—Spacer Washer |
| 11—Case | 25—Synchronizer Blocking Ring | 39—Countershaft |
| 12—Nut | 26—Second-Third Synchronizer Assembly | 40—Lockplate |
| 13—Flatwasher | 27—Synchronizer Blocking Ring | |
| 14—Spacer | 28—Snap Ring | |

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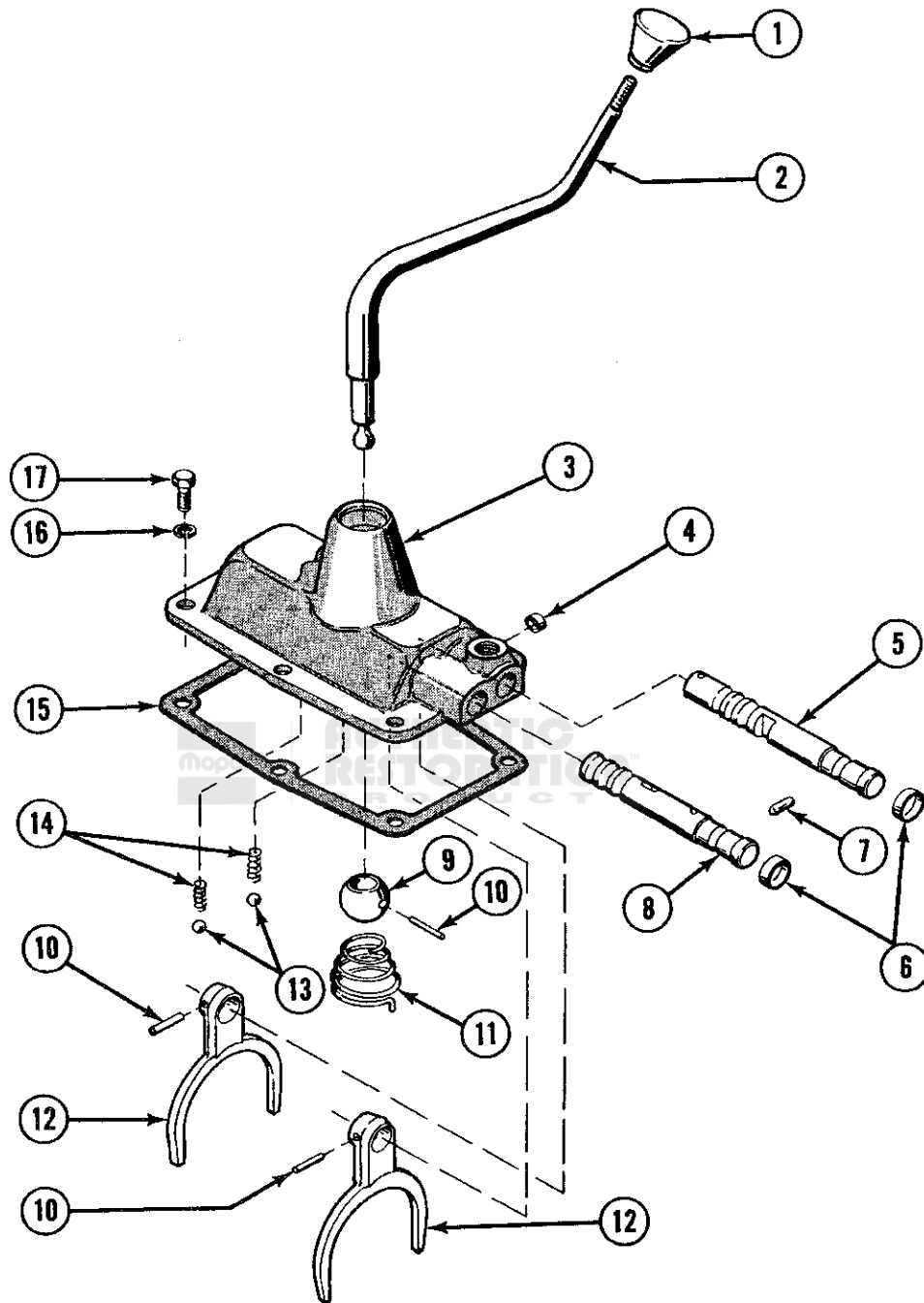


FIG. J-14—CANE SHIFT CONTROL HOUSING ASSEMBLY

- | | | |
|-----------------------------|-------------------------------|------------------|
| 1—Shift Lever Knob | 7—Interlock Plunger | 13—Poppet Ball |
| 2—Shift Lever | 8—Shift Rail (Low-Reverse) | 14—Poppet Spring |
| 3—Control Housing | 9—Shift Lever Fulcrum Ball | 15—Gasket |
| 4—Plug | 10—Pin | 16—Lockwasher |
| 5—Shift Rail (Second-Third) | 11—Shift Lever Support Spring | 17—Bolt |
| 6—Shift Rail Cap | 12—Shift Fork | |

reverse idler gear shaft. Press the shaft through the gears and into the front of the case, forcing out Tool W-193.

l. Locate the lock plate in the slots of the reverse idler gear shaft and countershaft. Tap the two shafts until lock plate is tight against case.

m. Install rear bearing snap ring and rear mainshaft bearing on shaft.

n. Attach rear bearing retainer and gasket to the transmission case. Tighten cap screws evenly and securely.

o. Install speedometer drive gear on shaft with the shoulder of gear toward the front. Check the oil seal which is installed next and replace with new one if necessary.

p. Install the companion coupling flange with the

- flat washer, lock washer and nut.
- q. Check the complete transmission for operation.
- r. Install transmission case cover.

J-15. T14A TRANSMISSION

The T14A is a three speed fully synchronized (all forward gears) transmission with helical drive gears throughout.

The main drive gear is supported by a ball bearing at the front end of the transmission case and is piloted at its front end in an oil impregnated bushing mounted in the crankshaft.

The front end of the mainshaft is piloted in a row of roller bearings set into the hollow end of the main drive gear and the rear end is carried by a ball bearing mounted in the rear transmission case.

The counter gear is carried on a single row of rollers at both ends. The reverse idler gear is carried on a single row of rollers in the center. Thrust is taken on thrust washers located between the ends of the counter and reverse idler gear and the thrust bosses in the case.

The three forward gears (low, second, third) are fully synchronized. The synchronizer assemblies consist of clutch hubs, clutch sleeves, clutch springs, and three synchronizer plates and are retained on the mainshaft by a select fit snap ring.

The shift is manual through a cane shift lever and interlock assembly to the rearward shift fork operating low and reverse gear and to the forward shift fork operating second and third gear.

J-16. TRANSMISSION DISASSEMBLY — T14A

Refer to Fig. J-13.

- a. If the transfer case is attached, separate it from the transmission by removing the five capscrews and lockwashers.
- b. Remove cane shift housing cover and gasket from top of transmission case. The shift housing cover can be disassembled if necessary, at this point, by removing the shift rails, poppet balls, springs, and shift forks. Refer to Fig. J-14.
- c. Remove nut and flat washer securing transfer case drive gear on the mainshaft. Remove transfer case drive gear, adapter, and spacer. Refer to Fig. J-15.

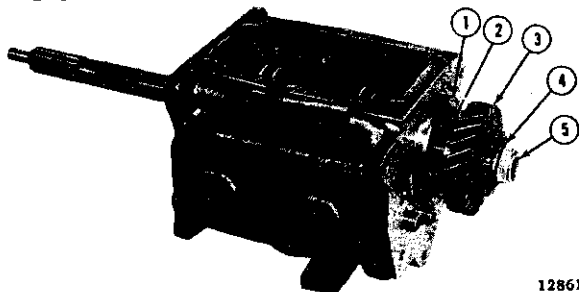


FIG. J-15—TRANSFER CASE DRIVE GEAR ASSEMBLY

- 1—Bearing Adapter
- 2—Bearing Spacer
- 3—Transfer Case Drive Gear
- 4—Flat Washer
- 5—Nut

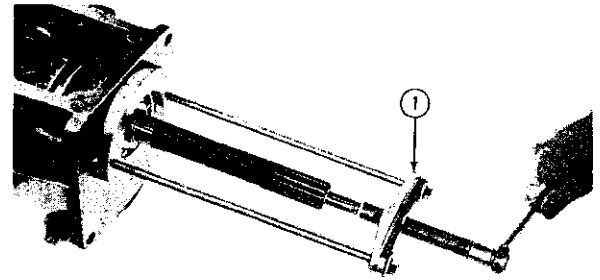


FIG. J-16—REMOVING MAIN DRIVE GEAR BEARING

1—W-329 Puller

- d. Remove main drive gear bearing retainer and gasket.
- e. Remove main drive gear and mainshaft bearing snap rings.
- f. Remove the main drive gear and mainshaft bearings using bearing puller set W-329. Refer to Figs. J-16 and J-17.

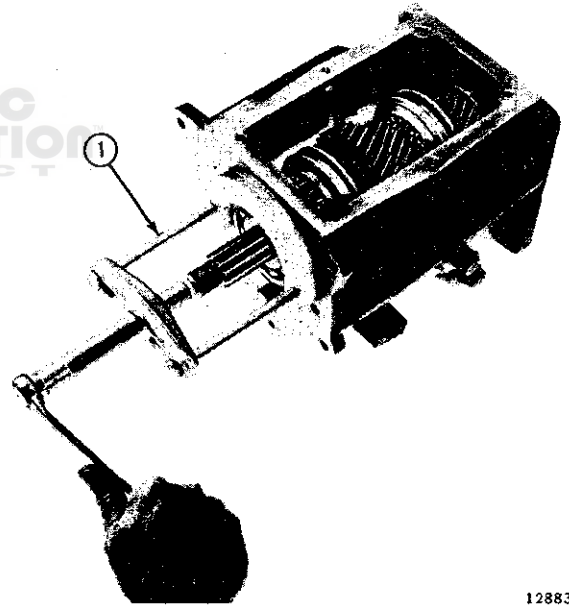


FIG. J-17—REMOVING MAINSHAFT BEARING

1—W-329 Puller

- g. Remove main drive gear from transmission case.
- h. Remove mainshaft and gears as an assembly, through the case cover opening as shown in Fig. J-18.
- i. Remove the lockplate by tapping lightly on the front end of the countershaft and reverse idler shaft. Remove lockplate from slots in shafts. Refer to Fig. J-19.
- j. Using Tool W-335, drive the countershaft rearward, out of the case, as shown in Fig. J-20. The countershaft gear assembly will drop to the bottom of the case. Using Tool W-335 will ensure that the roller bearings will remain in the countershaft gear hub and may be removed as an assembly.

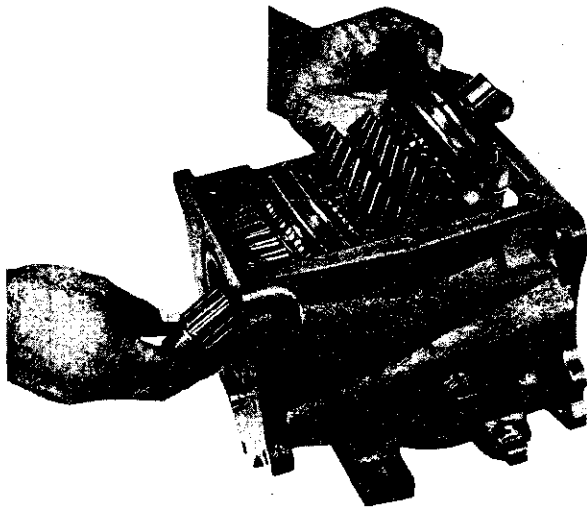


FIG. J-18—REMOVING-INSTALLING MAINSHAFT GEAR ASSEMBLY

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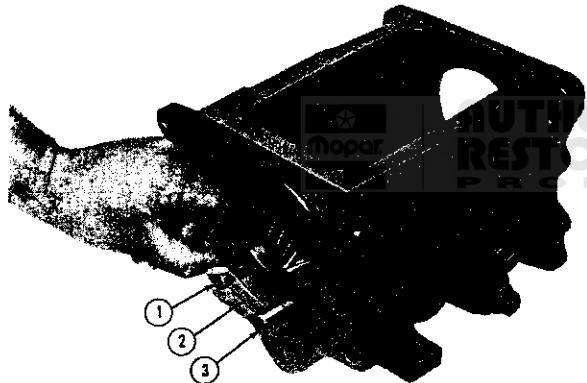


FIG. J-19--REMOVING-INSTALLING LOCKPLATE

- 1—Reverse Idler Shaft
- 2—Lockplate
- 3—Countershaft

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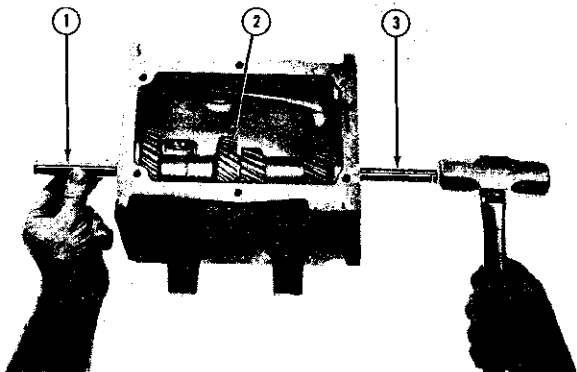


FIG. J-20—REMOVING-INSTALLING COUNTERSHAFT

- 1—Arbor Tool W-335
- 2—Countergear
- 3—Countershaft

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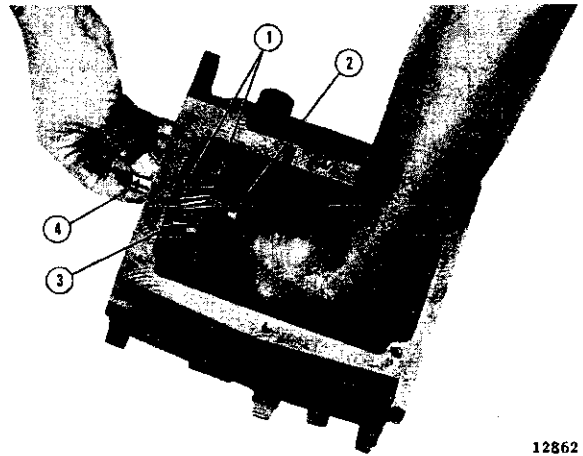


FIG. J-21—REMOVING-INSTALLING REVERSE IDLER GEAR

- 1—Washer
- 2—Arbor Tool W-336
- 3—Reverse Idler Gear
- 4—Reverse Idler Shaft

12862

k. Remove the countershaft gear assembly and the two thrust washers. Remove spacer washers, bearing rollers, and spacer from the countergear hub assembly for inspection.

l. Using Tool W-336 drive the reverse idler shaft rearward, out of the case. Remove reverse idler gear, washers, and roller bearings as an assembly. Refer to Fig. J-21.

m. Remove the clutch hub snap ring and the second-third synchronizer assembly from the mainshaft. Refer to Fig. J-22.

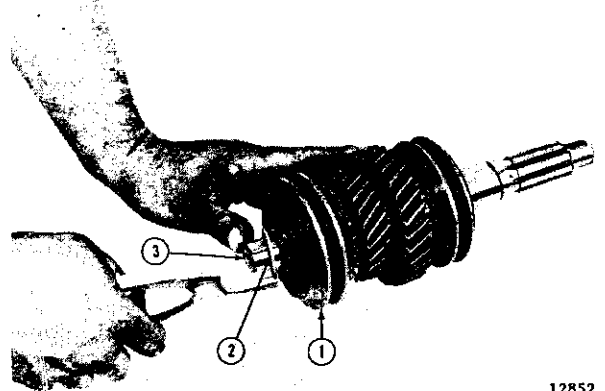


FIG. J-22—REMOVING-INSTALLING SECOND-THIRD CLUTCH HUB SNAP RING

- 1—Second-Third Synchronizer Assembly
- 2—Snap Ring
- 3—Mainshaft

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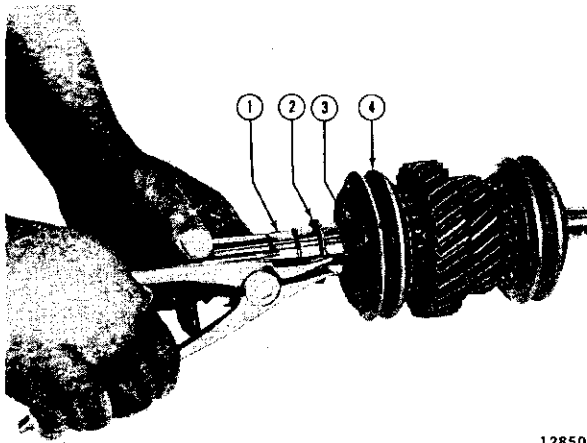
n. Remove second speed gear from mainshaft.

o. Remove reverse gear from mainshaft.

p. Remove the clutch hub snap ring, and the low synchronizer assembly from the mainshaft. Refer to Fig. J-23.

q. Remove low speed gear from mainshaft.

r. This completes the transmission disassembly.



12850

FIG. J-23—REMOVING-INSTALLING LOW CLUTCH HUB SNAP RING

- 1—Mainshaft
- 2—Snap Ring
- 3—Snap Ring Groove
- 4—Low Synchronizer Assembly

J-17. DISASSEMBLY SYNCHRONIZER ASSEMBLIES

Important: Should a synchronizer assembly (either low-and-reverse or second-and-high) be replaced for any reason on a cane 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 fork that has a letter "A" appearing thereon.

Refer to Fig. J-24.

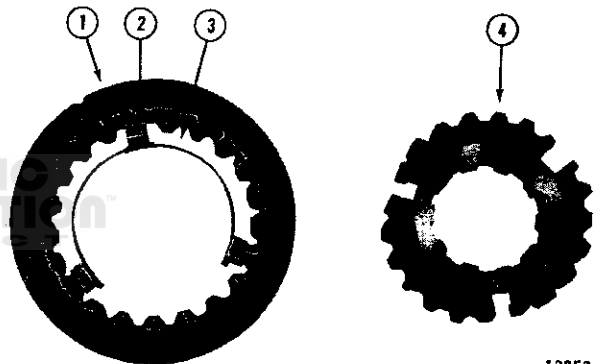
Second-Third Synchronizer Unit.

- a. Remove springs (one on each side of unit).
- b. Mark sleeve and hub before separating to ensure proper installation at time of assembly.
- c. Remove hub from sleeve.
- d. Remove the three synchronizer plates from third speed side of the hub.
- e. Clean and inspect synchronizer assembly parts.
- f. Assemble synchronizer in reverse order of disassembly, making certain the two synchronizer spring openings are installed 120° of each other, with spring tension opposed.

Low Synchronizer Unit.

Refer to Fig. J-25.

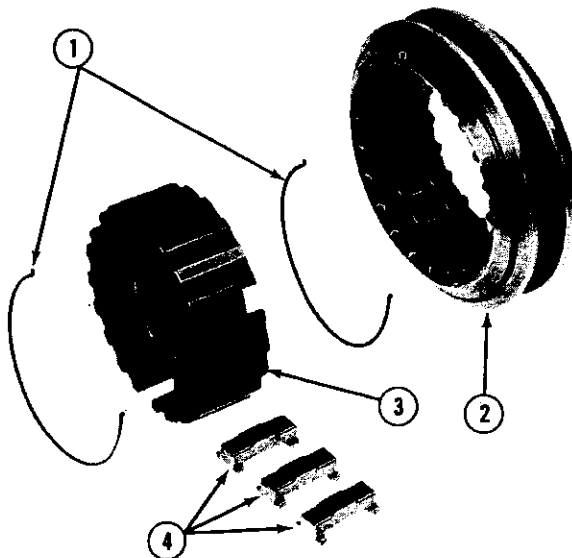
The low synchronizer assembly is serviced in the same manner as second-third with exception of one synchronizer spring.



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FIG. J-25—LOW SYNCHRONIZER ASSEMBLY

- 1—Clutch Hub
- 2—Shifter Plate
- 3—Synchronizer Spring (1)
- 4—Clutch Sleeve



12878

FIG. J-24—SECOND-THIRD SYNCHRONIZER ASSEMBLY

- 1—Synchronizer Spring (2)
- 2—Clutch Hub
- 3—Clutch Sleeve
- 4—Shifter Plate

J-18. TRANSMISSION CLEANING AND INSPECTION

Refer to Fig. J-13.

- a. Wash transmission case inside and outside with cleaning solvent.
- b. 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.
- c. Clean and inspect all gears and bronze blocking rings for cracks, chipped or cracked teeth, or excessive wear of the teeth.

Note: Whenever any transmission gear requires replacement, the gear with which it meshes should also be replaced.

- d. Inspect all bearings or bushings for wear or damage.
- e. Check the second-third, and low synchronizer clutch sleeves making certain they slide freely on the clutch hub.

J-19. TRANSMISSION REASSEMBLY — T14A

Note: Lubricate all internal transmission parts before assembly using the proper lubricant.

a. Position reverse idler gear with Arbor Tool W-336, roller bearings, and thrust washers in the case. Install reverse idler shaft forcing out Tool W-336. Make certain the slot end of the idler shaft is correctly aligned to receive the lockplate. Refer to Fig. J-19.

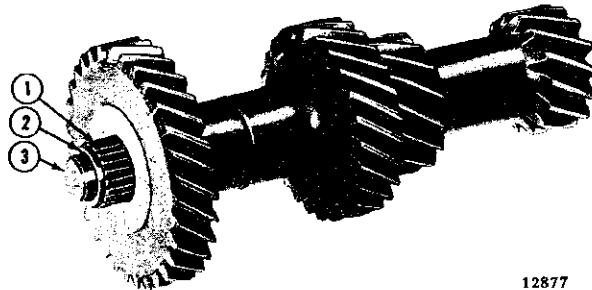


FIG. J-26—COUNTERSHAFT GEAR BEARING ARBOR

- 1—Roller Bearings
- 2—Spacer
- 3—Arbor Tool W-335

b. Assemble the countergear center spacer, four bearing spacers, and countershaft bearing rollers in the countershaft gear hub assembly as follows, using Arbor Tool W-335. Place the center spacer inside the hub and insert Arbor Tool in the spacer. Place a bearing spacer at each end of the center spacer and load a set of bearing rollers, and place a bearing spacer at each end to complete the assembly. Refer to Fig. J-26 and J-27.

c. Install large countergear thrust washer in the front of the case. Position small thrust washer on the countershaft gear hub with lip facing groove in the case. Holding the countershaft gear assembly in position, start the countershaft in the rear of the case with the lockplate slot toward the rear and the slot in alignment with the slot in the reverse idler

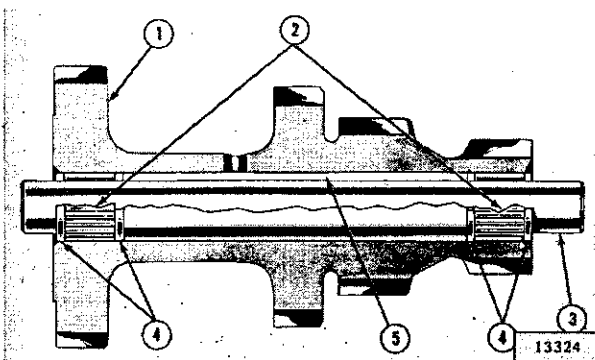


FIG. J-27—COUNTERSHAFT BEARINGS AND SPACERS INSTALLED

- 1—Countershaft Gear
- 2—Countershaft Bearing Rollers
- 3—Countershaft
- 4—Spacers
- 5—Center Spacer

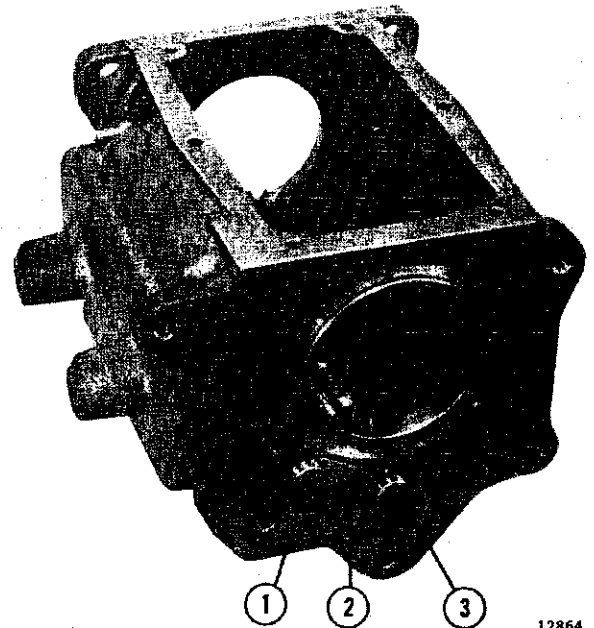


FIG. J-28—LOCKPLATE INSTALLATION

- 1—Reverse Idler Shaft
- 2—Lockplate
- 3—Countershaft

gear shaft. Press shaft through the gear hub assembly and into the front of the case forcing out Tool W-335.

d. Locate the lockplate in the slots of the reverse idler shaft and countershaft. Tap the two shafts alternately until lockplate is tight against case. Refer to Fig. J-28.

e. When assembling the mainshaft, first install mainshaft low gear and bronze blocking ring. Install the low synchronizer assembly, then install the select fit snap ring. Refer to Fig. J-23.

Note: Mainshaft 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.

f. Install the mainshaft second gear and bronze blocking ring. Install the second-third synchronizer assembly, then install select fit snap ring. See Fig. J-22.

g. Install reverse gear on mainshaft.

h. Install the mainshaft and gear assembly as a unit, through the top cover opening of the transmission case. Refer to Fig. J-18.

i. Install bronze blocking ring onto the second-third synchronizer assembly.

j. Install main drive gear roller bearings using low melting point grease to hold them in place. Refer to Fig. J-29.

k. Install the main drive gear and oil retainer washer (slinger) into the case with the cutaway portion of the gear positioned downward toward the countergear assembly. Guide main drive gear onto the mainshaft using care not to drop the roller bearings, as shown in Fig. J-30.

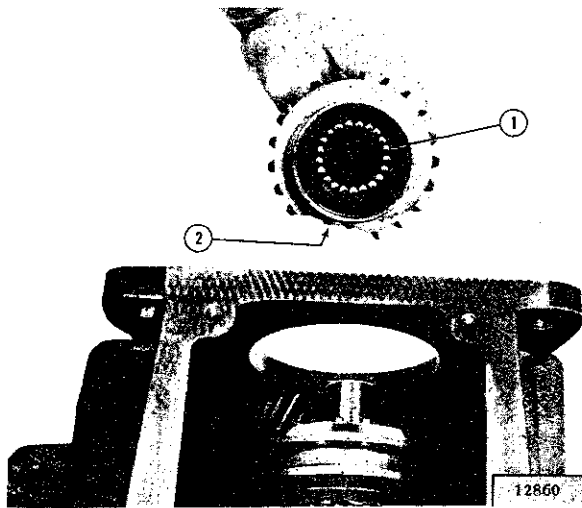


FIG. J-29—MAIN DRIVE GEAR ROLLER BEARINGS INSTALLED

- 1—Roller Bearings
- 2—Cutaway Main Drive Gear

l. Install main drive gear and mainshaft bearings using bearing installer set W-331 together with a thrust yoke Tool W-334 to prevent damage to the synchronizer clutch. Install thrust yoke Tool W-334 into the second speed gear groove and between the main drive gear (steel) clutch teeth and bronze synchronizer ring. Use both bearing drivers (W-331, SP-5364) and a backup block when driving bearings into position, as shown in Figs. J-31 and J-32.

m. Install main drive gear and mainshaft bearing snap rings.

Note: The mainshaft bearing snap ring is .010" [0,254 mm.] thicker than the main drive gear bear-

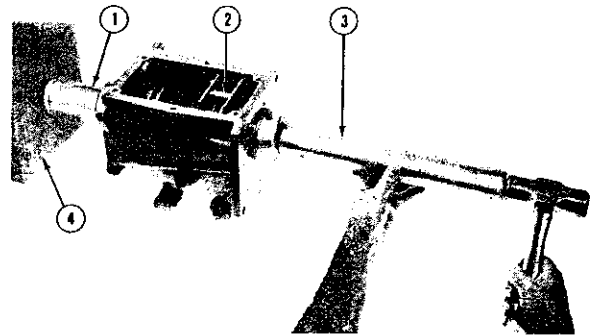


FIG. J-31—INSTALLING MAIN DRIVE GEAR BEARING

- 1—Tool SP-5364 Short Driver
- 2—Tool W-334 Thrust Yoke
- 3—Tool W-331 Long Driver
- 4—Wood Block

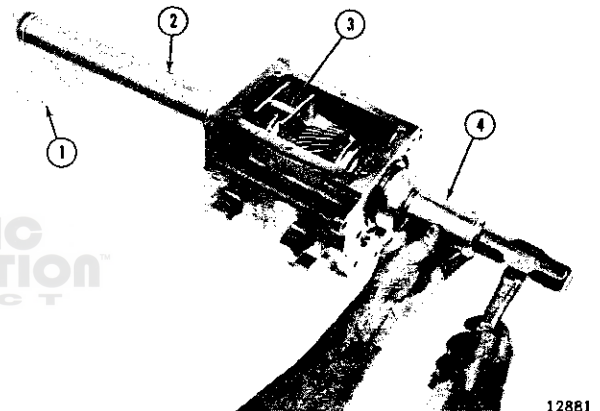


FIG. J-32—INSTALLING MAINSHAF BEARING

- 1—Wood Block
- 2—Tool W-331 Long Driver
- 3—Tool W-334 Thrust Yoke
- 4—Tool SP-5364 Short Driver

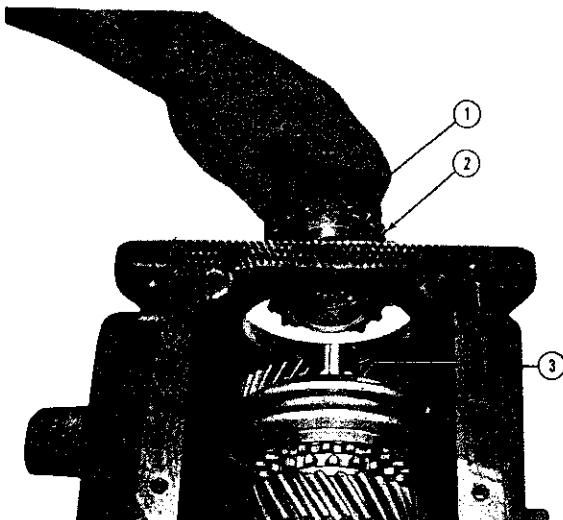


FIG. J-30—INSTALLING MAIN DRIVE GEAR ASSEMBLY

- 1—Oil Retainer Washer (Slinger)
- 2—Main Drive Gear
- 3—Mainshaft

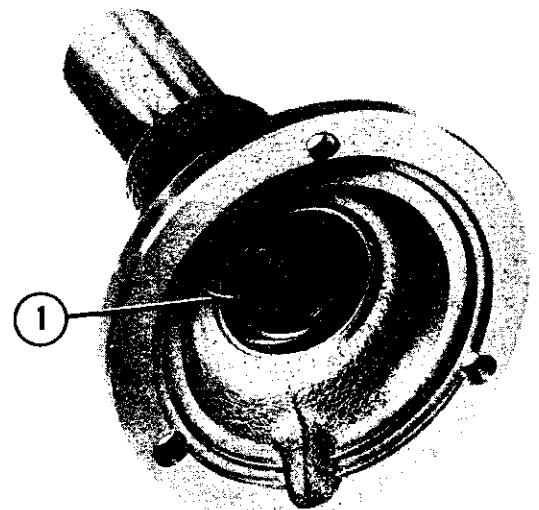


FIG. J-33—MAIN DRIVE GEAR BEARING RETAINER OIL SEAL

- 1—Oil Seal

ing snap ring. Care should be taken to install the proper snap ring at these locations.

n. Install the mainshaft rear bearing adapter, spacer, transfer case drive gear, flat washer, and nut. Torque nut 130 to 170 lb-ft. [17,9 a 23,5 kg-m.]. Refer to Fig. J-15.

o. Check the main drive bearing retainer oil seal. If seal is worn or damaged it must be replaced. Refer to Fig. J-33.

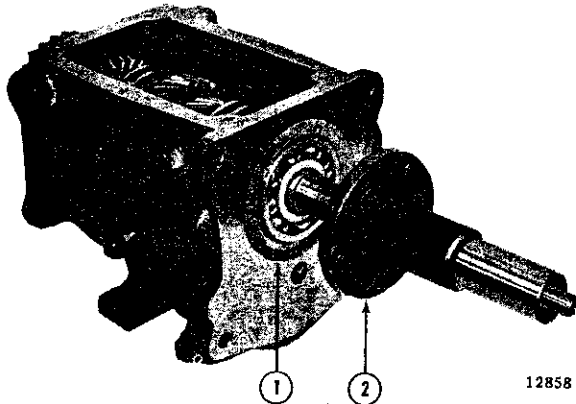


FIG. J-34—INSTALLING MAIN DRIVE GEAR BEARING RETAINER

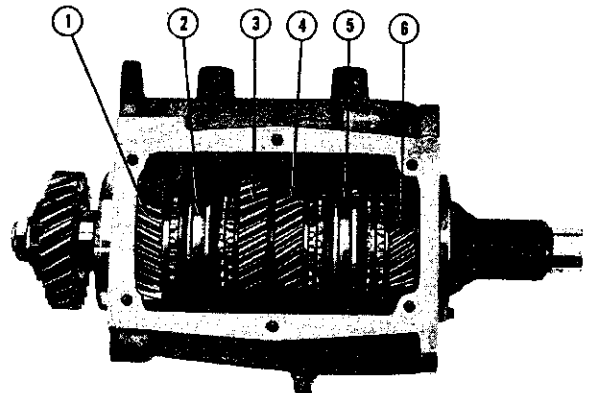
- 1—Gasket
- 2—Bearing Retainer

p. Install main drive gear bearing retainer gasket, and retainer assembly. Make certain the oil drain hole slot in the retainer housing and gasket are aligned. Install the three ferry type screws and washers. Refer to Fig. J-34.

q. Install the transmission case cover gasket.

r. Position the transmission gear train and shift cover housing assembly in neutral. Enter the shifter forks into the clutch sleeves and align cover, case and gasket holes. Install capscrews and lock-washers and torque 8 to 15 lb-ft. [1,1 a 2,1 kg-m.]. Refer to Figs. J-35 and J-36.

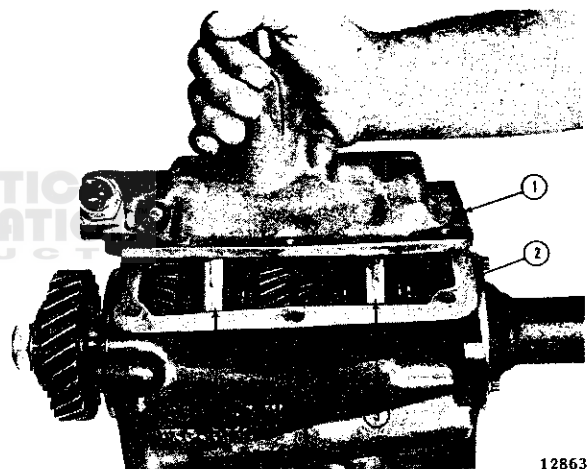
s. This completes the transmission reassembly.



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FIG. J-35—MAINSHAFT GEAR TRAIN — NEUTRAL

- 1—Reverse Gear
- 2—Low Synchronizer Assembly
- 3—Low Gear
- 4—Second Gear
- 5—Second-Third Synchronizer Assembly
- 6—Main Drive Gear



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FIG. J-36—INSTALLING CANE SHIFT COVER ASSEMBLY

- 1—Control Housing Cover
- 2—Gasket
- 3—Second-Third Shift Fork
- 4—Low-Reverse Shift Fork



J-20 TRANSMISSION SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Lock in Two Gears	Replace Poppet or Shift Levers
Slips Out of High Gear	
Transmission Misaligned with Bellhousing.....	Align Transmission Case to Bellhousing and Bellhousing to Engine
End Play in Main Drive Gear	Tighten Front Retainer
Damaged Pilot Bearing or Front Bearing	Replace
Slips Out of Second	
Worn Gear	Replace
Weak Poppet Spring	Replace
Noise in Low Gear	
Gear Teeth Worn	Replace Gears
Shifting Shoe Bent	Replace Shoe
Lack of Lubrication	Drain and Refill
Grease Leak into Bellhousing	
Gasket Broken Front Bearing Retainer	Replace
Transmission Main Drive Gear Oil Seal.....	Replace

J-21. TRANSMISSION SPECIFICATIONS

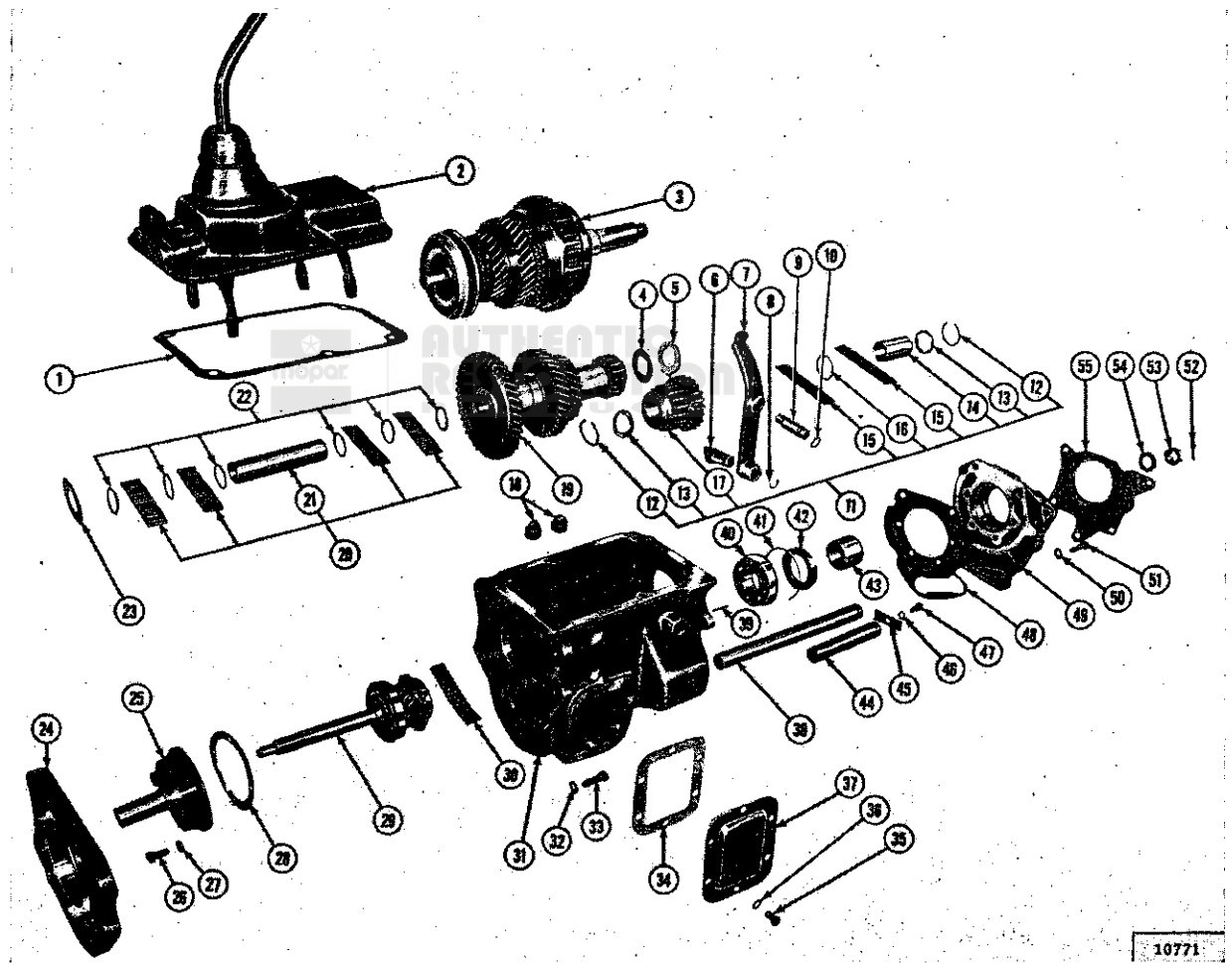
HURRICANE F4 ENGINE	3-SPEED	
Vehicle:	CJ-3B, CJ-5, CJ-5A, CJ-6, CJ-6A	DJ-5, DJ-6
Make	Warner T90C	Warner T96
Model	Synchronous Mesh	Synchronous Mesh
Type	3 Forward — 1 Reverse	3 Forward — 1 Reverse
Speeds	3.339 to 1	2.605 to 1
Ratios: — First	1.551 to 1	1.630 to 1
Second	1.000 to 1	1.000 to 1
Third .....	.....	.....
Fourth	3.798 to 1	3.536 to 1
Reverse .....	.....	.001" to .007"
Interlock Poppet Clearance .....	.....	[0,025 a 0,178 mm.]

DAUNTLESS V-6 ENGINE	3-SPEED		
Vehicle:	CJ-5, CJ-6, CJ-5A, CJ-6A	DJ-5, DJ-6	Late CJ-5, CJ-6
Make	Warner AS7 T86AA	Warner AS9 T86AA	Warner T14A
Model	Synchronmesh	Synchronmesh	Synchronmesh
Type	3 Forward — 1 Reverse	3 Forward — 1 Reverse	3 Forward — 1 Reverse
Speeds	2.798 to 1	2.798 to 1	3.100 to 1
Ratios: — First	1.687 to 1	1.687 to 1	1.612 to 1
Second	1.000 to 1	1.000 to 1	1.000 to 1
Third	3.798 to 1	3.798 to 1	3.100 to 1
Reverse

FOUR-SPEED TRANSMISSION

Contents

SUBJECT	PAF.	SUBJECT	PAR.
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FOUR-SPEED TRANSMISSION REMOVAL.....	J1-2	Transfer Case Adapter Plate Oil Seal.....	J1-8
Four-Speed Transmission Disassembly.....	J1-3	Four-Speed Transmission Installation.....	J1-7
Four-Speed Transmission Control Housing Disassembly.....	J1-4	FOUR-SPEED TRANSMISSION SPECIFICATIONS.....	J1-10
Four-Speed Transmission Reassembly.....	J1-5	SERVICE DIAGNOSIS.....	J1-9



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FIG. J1-1—FOUR-SPEED TRANSMISSION

- | | | |
|--------------------------------|--|---------------------------------|
| 1—Control Housing Gasket | 20—Bearing Rollers | 38—Countershaft |
| 2—Control Housing Assembly | 21—Spacer | 39—Shifting Arm Pivot Taper Pin |
| 3—Mainshaft Assembly | 22—Spacer | 40—Bearing |
| 4—Thrust Washer | 23—Thrust Washer | 41—Snap Ring |
| 5—Thrust Washer | 24—Bellhousing-to-Transmission Adapter Plate | 42—Oil Seal |
| 6—Reverse Shifting Shoe | 25—Bearing Retainer | 43—Spacer |
| 7—Reverse Shifting Arm | 26—Bearing Retainer Bolt | 44—Reverse-Idler Gear Shaft |
| 8—C-Washer | 27—Bearing Retainer Lockwasher | 45—Lock Plate |
| 9—Reverse Shifting Arm Pivot | 28—Bearing Retainer Gasket | 46—Lock Plate Lockwasher |
| 10—O-Ring | 29—Main Drive Gear | 47—Lock Plate Bolt |
| 11—Reverse Idler Gear Assembly | 30—Bearing Rollers | 48—Gasket |
| 12—Snap Ring | 31—Transmission Case | 49—Adapter Plate |
| 13—Thrust Washer | 32—Adapter Plate Lockwasher | 50—Adapter Plate Lockwasher |
| 14—Sleeve | 33—Adapter Plate Capscrew | 51—Adapter Plate Bolt |
| 15—Bearing Rollers | 34—Side Opening Cover Gasket | 52—Cotter Key |
| 16—Spacer | 35—Side Opening Cover Bolt | 53—Nut |
| 17—Reverse Idler Gear | 36—Side Opening Cover Lockwasher | 54—Washer |
| 18—Pipe Plug | 37—Side Opening Cover | 55—Gasket |
| 19—Countershaft Gears | | |

J1-1. GENERAL

A model T-98 four-speed transmission with a cane-type shift is optional on 'Jeep' Models CJ-5 and CJ-6 equipped with the Hurricane F4 engine. A model T-18 four-speed transmission is optional on the 'Jeep' Model CJ-5 equipped with the Dauntless V6 engine. These transmissions provide four speeds forward and one reverse with synchromesh engagement in second, third, and fourth speed. For quick identification, the optional 4-speed

transmission is 11 $\frac{7}{8}$ " [30,16 cm.] long whereas the standard 3-speed transmission is 8" [20,32 cm.] long. However the instructions for removal and installation of the two transmissions are the same.

J1-2. Four-Speed Transmission Removal

Use the procedure outlined under the heading, "TRANSMISSION REMOVAL" Section J Par. J-6.

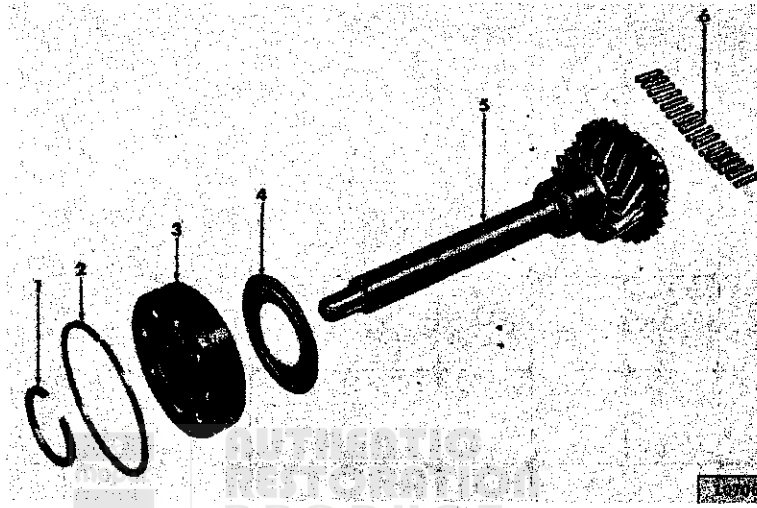


FIG. J1-2—FOUR-SPEED TRANSMISSION MAIN DRIVE GEAR

- | | | |
|-------------|-----------|-------------------|
| 1—Snap Ring | 3—Bearing | 5—Main Drive Gear |
| 2—Snap Ring | 4—Washer | 6—Bearing Rollers |

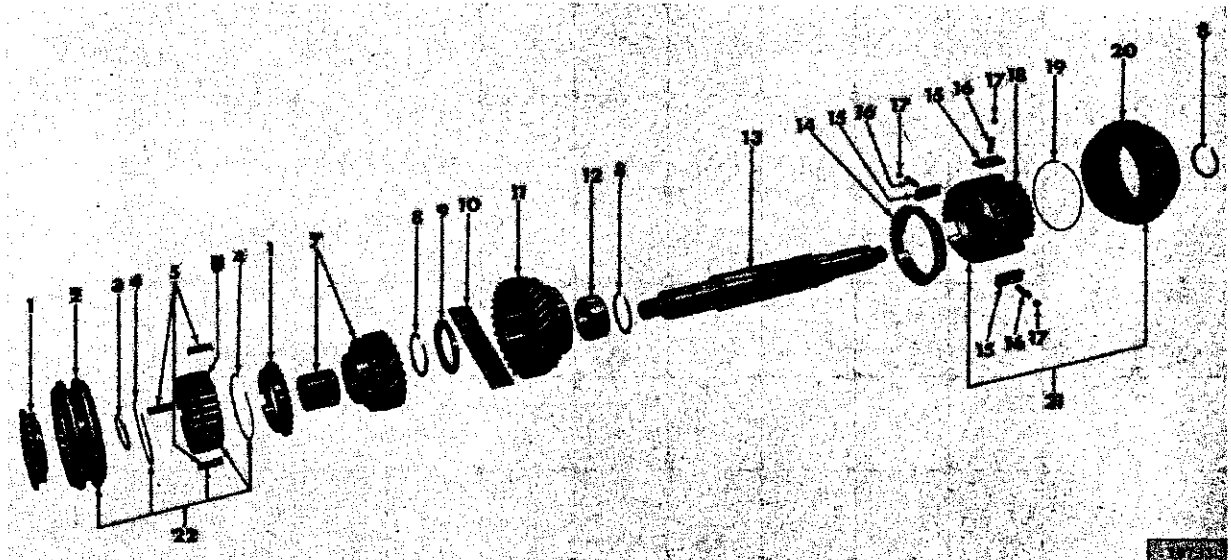


FIG. J1-3—T-98 FOUR-SPEED TRANSMISSION MAIN SHAFT

- | | | |
|----------------------------------|----------------------|---|
| 1—Blocking Ring | 9—Thrust Washer | 17—Ball |
| 2—Direct and Third Clutch Sleeve | 10—Bearing Rollers | 18—Low and Second Clutch Hub |
| 3—Snap Ring | 11—Second Speed Gear | 19—Retaining Ring |
| 4—Spring | 12—Spacer | 20—Low and Second Speed Gear |
| 5—Shifting Plate | 13—Mainshaft | 21—Second Speed Synchronizer Assembly |
| 6—Direct and Third Clutch Hub | 14—Blocking Ring | 22—Direct and Third Synchronizer Assembly |
| 7—Third Speed Gear Assembly | 15—Shifting Plate | |
| 8—Snap Ring | 16—Poppet Spring | |

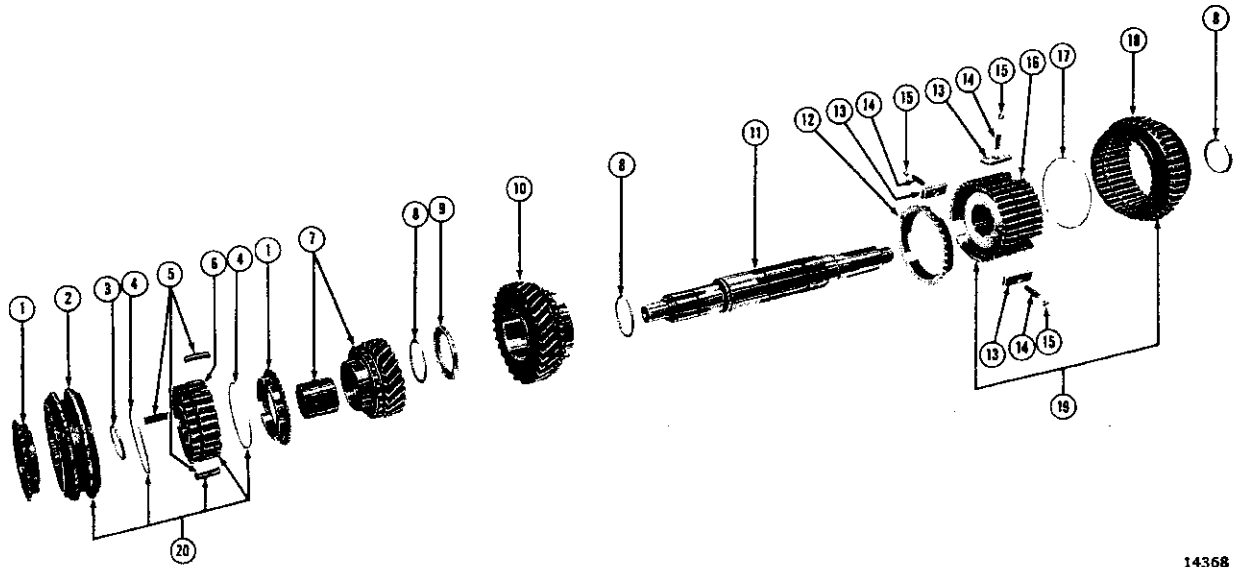


FIG. J1-4—T-18 FOUR-SPEED TRANSMISSION MAINSHAFT ASSEMBLY

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- | | | |
|----------------------------------|----------------------|---|
| 1—Blocking Ring | 8—Snap Ring | 15—Ball |
| 2—Direct and Third Clutch Sleeve | 9—Thrust Washer | 16—Low and Second Clutch Hub |
| 3—Snap Ring | 10—Second Speed Gear | 17—Retaining Ring |
| 4—Spring | 11—Mainshaft | 18—Low and Second Speed Gear |
| 5—Shifting Plate | 12—Blocking Ring | 19—Second Speed Synchronizer Assembly |
| 6—Direct and Third Clutch Hub | 13—Shifting Plate | 20—Direct and Third Synchronizer Assembly |
| 7—Third Speed Gear Assembly | 14—Poppet Spring | |

J1-3 4-Speed Transmission Disassembly

• Refer to Fig. J1-1.

Note: The models T-98 and T-18 four-speed transmission are similar in design with exception of the second speed gear-to-mainshaft arrangement. In the model T-18 transmission, the second speed gear is a slide fit on the mainshaft, whereas in the model T-98 transmission roller bearings and a spacer are required in this area. Refer to Figs. J1-3 and J1-4.

- a. Remove the transmission to transfer case adapter plate and gasket. Remove the oil seal from the plate and, if damaged, discard the seal.
- b. Remove the transmission control housing assembly. Refer to paragraph J1-4 for its disassembly.
- c. To make certain the two blocking rings, direct-and-third clutch hub, and direct-and-third clutch sleeve will be assembled in their original relationship, mark them with a quick drying lacquer or an electric pencil. Also mark the blocking ring, low-and-second clutch hub, and the low-and-second speed gear.
- d. Slide the low-and-second speed gear toward the rear of the transmission case.
- e. Disengage the reverse shifting arm and reverse shifting shoe from the reverse idler gear. Remove the arm from the reverse shifting arm pivot.
- f. Move the low-and-second speed gear into neutral position.
- g. Remove the bearing retainer and gasket. Remove the snap rings from the main drive gear and the outer race of the ball bearing.
- h. With a bearing puller, remove the main drive gear ball bearing.

i. Remove the oil slinger.

j. Remove the snap ring from the outer bearing race of the transmission mainshaft ball bearing.

k. With a bearing puller, remove the mainshaft ball bearing.

Note: It may be necessary to drive the mainshaft rearward by striking the end of the main drive gear with a lead hammer to get sufficient clearance to install the bearing puller plates.

- l. Slide the direct-and-third clutch sleeve to the rear (third speed) position. Separate the mainshaft assembly from the main drive gear. Be careful not to lose any of the mainshaft pilot bearing rollers.
- m. Lift the mainshaft assembly out of the top of the transmission case.
- n. Remove the main drive gear from the transmission case.
- o. Remove the mainshaft bearing rollers from the gear.
- p. Mark relationship between synchronizer hubs and the splines on the mainshaft.
- q. Begin disassembly of the main shaft assembly by removing the snap ring which holds the direct and third synchronizer assembly on the mainshaft.
- r. Remove the front blocking ring from the front of the shaft.
- s. Slide the direct-and-third-synchronizer assembly and the third-speed-gear assembly off the mainshaft.
- t. Remove the snap ring at the rear of the mainshaft. Slide the second synchronizer assembly and the blocking ring off the mainshaft.

u. On the T-98 transmission remove the snap rings holding the thrust washer, bearing rollers, second-speed gear, and spacer on the mainshaft. Slide these components off the shaft. Refer to Fig. J1-3.

Note: The second speed gear in the T-18 transmission is a slide fit onto the mainshaft and does not contain roller bearings or a spacer.

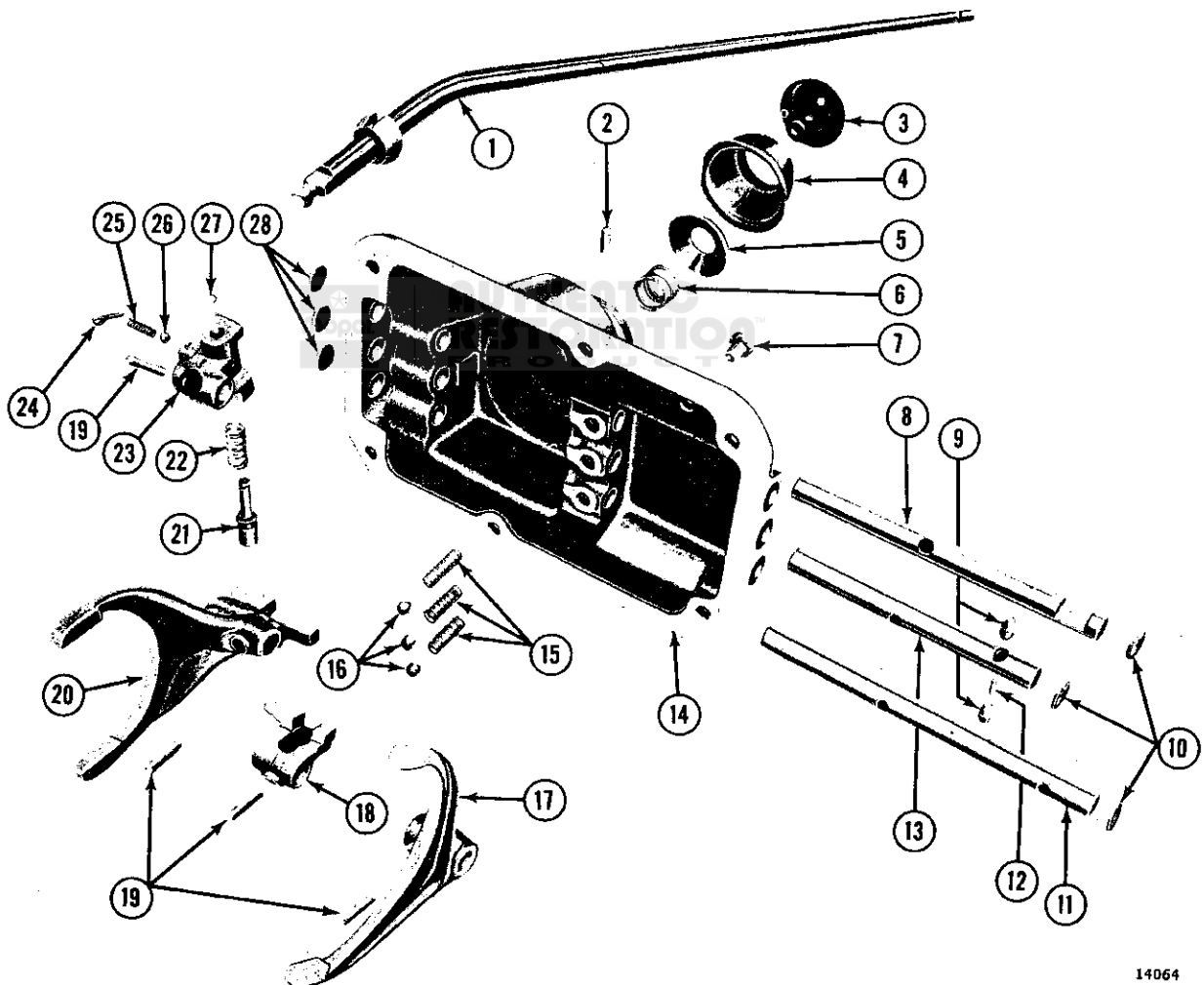
v. If the synchronizer assemblies are to be disassembled and serviced proceed as follows: Wrap the second-speed synchronizer assembly in a cloth to prevent losing the lock balls and springs. Push the clutch hub out of the low-and-second-speed gear in a direction opposite the shift fork groove.

Remove the cloth. Lift the balls, springs, and plates out of the hub.

w. Remove the lockplate for the countershaft and reverse idler gear shaft.

x. Use a pry bar in the slot of the reverse idler gear shaft to loosen the shaft. Then, slip the reverse idler gear shaft out of the housing and gear. Lift the reverse idler gear assembly from the transmission case.

y. To remove the countershaft, use a heavy brass drift and drive the countershaft toward the rear of the transmission case. When the countershaft end is just about even with the inside of the transmission case, use a dummy shaft to force it the remainder of the way. (Since a dummy shaft is a



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FIG. J1-5—FOUR-SPEED TRANSMISSION CONTROL PARTS

- 1—Shift Lever
- 2—Control Housing Pin
- 3—Shift Handle
- 4—Control Housing Cap
- 5—Washer
- 6—Control Lever Spring
- 7—Breather Assembly
- 8—Reverse Shift Rail
- 9—Shift Rail Interlock Plunger
- 10—Expansion Plug

- 11—Low and Second Shift Rail
- 12—Shift Rail Interlock Pin
- 13—Direct and Third Shift Rail
- 14—Control Housing
- 15—Shift Rail Poppet Spring
- 16—Shift Rail Poppet Ball
- 17—Lockwire
- 18—Low and Second Shift Fork
- 19—Lock Pin
- 20—Shift Rail End

- 21—Direct and Third Shift Fork
- 22—Reverse Plunger
- 23—Reverse Plunger Spring
- 24—Reverse Rail End
- 25—Cotter Pin
- 26—Reverse Plunger Poppet Spring
- 27—Reverse Plunger Poppet Ball
- 28—C-Washer

necessity for assembly, one should be made at this time to assist on disassembly. One can be made by using a 1 1/8" [2,86 cm.] diameter steel rod cut to 9.850" [25,02 cm.] long. Break sharp edges with a mill file.) Keep the dummy shaft in contact with the countershaft at all times to prevent dropping the bearing rollers or thrust washers.

z. With the dummy shaft in position, place the transmission case on its side and carefully roll the countershaft gear cluster out of the case.

aa. Complete the disassembly by removing the dummy shaft, thrust washers, four sets of bearing rollers, and spacers.

bb. To disassemble the reverse idler gear assembly, remove one of the snap rings and tap out the washers, both sets of bearing rollers, center spacer, and sleeve. Remove the remaining snap ring.

J1-4. 4-Speed Transmission Control Housing Disassembly

● Refer to Fig. J1-5.

The gearshift lever, spring, and spring seat were previously removed for removal of the transmission from the vehicle.

a. Remove the lock pins from the gearshift forks and gearshift rod ends. Remove the expansion plugs from the front and rear of the gearshift lever base. Remove back-up light switch.

b. Remove the center (third and high) gearshift rod first. Drive this gearshift rod out the rear of the gearshift lever base. As the gearshift rod is withdrawn from the center section of the gearshift base, remove the interlock pin from the cross-over hole in the gearshift rod. Before the gearshift rod is removed from the center section of the gearshift base, place a finger over the hole to prevent loss of the ball and spring. Then remove the rod.

c. Remove the low- and second-speed gearshift rod in the same manner.

d. Remove the gearshift rod lock balls and springs and, with a piece of wire, push the two gearshift rod interlock plungers out of the pockets in the center section of the gearshift base.

In the reverse gearshift rod end is a spring-loaded plunger which prevents the driver from accidentally shifting into reverse gear. Should this part require servicing, proceed as follows:

Remove the cotter key from the rod end assembly and at the same time hold a finger over the hole to prevent loss of the spring. Then shake out the spring and ball. Compress the plunger and spring until the C-washer groove just clears the end of the casting. Remove the C-washer.

J1-5. 4-speed Transmission Reassembly

● Refer to Fig. J1-1.

Assemble the unit in the reverse order of disassembly noting the following points:

a. Assemble the countershaft assembly with the fabricated dummy shaft. The bronze front thrust washer and the steel backed bronze rear thrust washer should be coated with stiff lubricant and installed with the lugs engaged in the notches in the end of the gear cluster. Place the assembly

in the transmission case and install the countershaft from the rear, keeping the countershaft and dummy shaft in contact to prevent dropping bearing rollers or washers. Tap the countershaft lightly into position in the front of the case but do not seat it until the reverse idler gear assembly and shaft have been installed in the case.

b. Install the reverse idler gear shaft in the case until the lock plate slot is adjacent to the slot in the countershaft. Insert the lock plate in the slots of the shafts making sure the plate ends are square with the slots. Install the lock plate screw and lockwasher to act as a pilot while tapping the shafts alternately into position in the case. Tighten the lock plate screw securely.

c. Begin assembly of the second speed synchronizer assembly (see Fig. J1-6) by installing the low-and-second-speed clutch hub in the low-and-second-speed gear. Install the retaining ring in the speed gear. Install the retaining ring in the low and

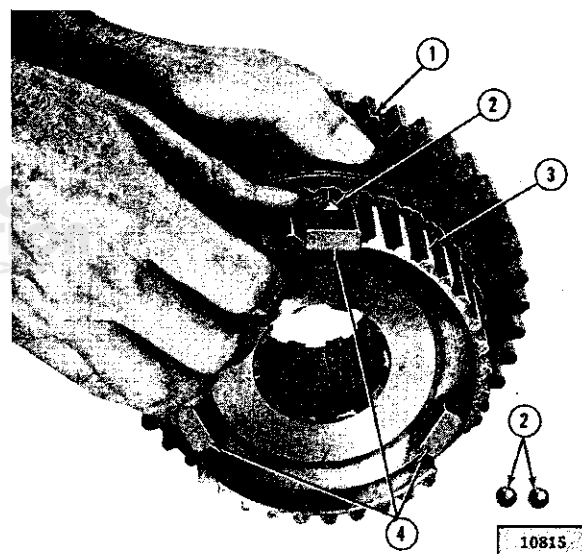


FIG. J1-6—ASSEMBLING SECOND-SPEED SYNCHRONIZER

- 1—Low and Second Clutch Gear
- 2—Ball
- 3—Low and Second Clutch Hub
- 4—Shifting Plate

second speed gear. Slide the hub out of the gear in the direction opposite the shift fork groove until the holes in the hub are clear of the gear.

Install the shifter plates and springs. Push the hub back into the gear until the springs touch the internal teeth of the gear. Push one of the shifter plates toward the center of the gear while installing ball. See Fig. J1-6. This will hold the ball in position. Install the other two balls in the same manner. Be careful when rotating the assembly to prevent the hub from slipping out of the gear. When the balls are installed, push the hub into the gear until the balls snap into the neutral position.

d. Assemble the direct-and-third synchronizer assembly in accordance with the instructions given in Section J, Par. J-11e.

e. Start assembly of the mainshaft assembly by

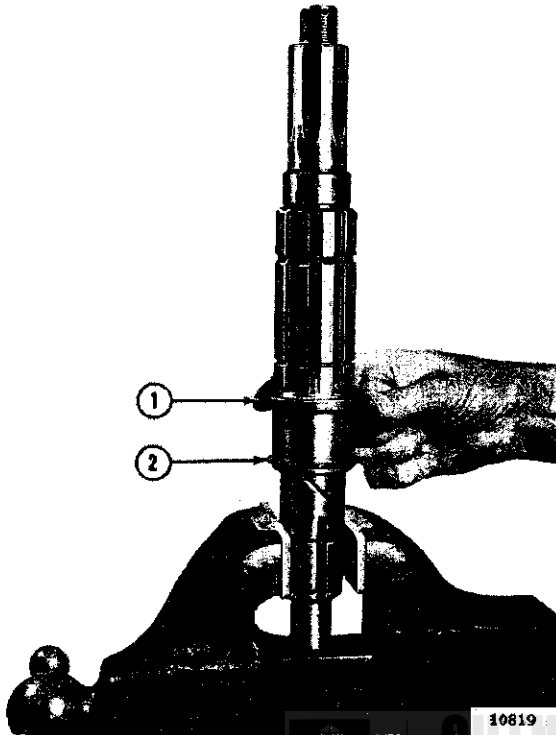


FIG. J1-7—SNAP RING AND THRUST WASHER INSTALLATION—T-98 ONLY

- 1—Thrust Washer
- 2—Snap Ring

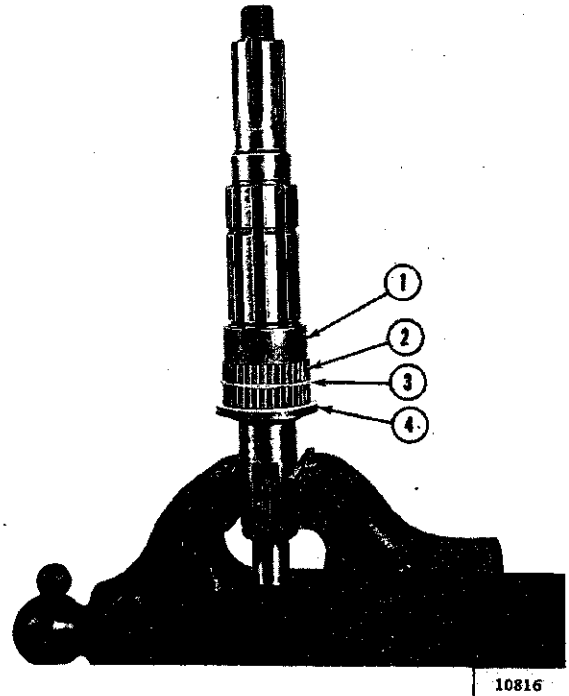


FIG. J1-8—SECOND-SPEED GEAR ASSEMBLY—T-98 ONLY

- 1—Spacer
- 2—Bearing Rollers
- 3—Rubber Band
- 4—Thrust Washer

placing the shaft in a vise (with soft metal covering the jaws) so that the threaded end of the shaft is up. Install snap ring and thrust washer at the forward end of the second-speed gear position. See Fig. J1-7. Install thrust washer with the recessed side covering the snap ring.

Note: The second speed gear in the T-18 transmission is a slide fit onto the mainshaft and does not contain roller bearings or a spacer.

On model T-98 transmission, place a rubber band around the second-speed gear bearing surface on the shaft. Install the thirty-four bearing rollers Fig. J1-3 around the shaft. See Fig. J1-8. Install spacer on the shaft. With the tapered shoulder of the second-speed gear up, slide gear on the shaft far enough to hold the bearing rollers in place. Remove the rubber band and slide the gear down onto the thrust washer. Install the rear snap ring and the blocking ring onto the tapered shoulder of the gear.

f. Install the second-speed synchronizer assembly on the mainshaft. Line up the marks made at the time of disassembly. Install the snap ring.

g. Install the third-speed gear assembly on the shaft with the tapered shoulder to the front. Slide the direct-and-third synchronizer assembly onto the mainshaft, lining up the marks made at the time of disassembly. Install snap ring.

h. Install main drive gear assembly with roller bearings in place in front of case. Install mainshaft

assembly through top of case, making sure roller bearings are not knocked out of place.

i. Temporarily install main drive gear bearing retainer to support drive gear. Install snap ring on mainshaft bearing and press bearing on shaft and into case until snap ring is seated against case.

j. Remove the main drive gear bearing retainer, install the oil slinger on the drive gear. Install the snap ring on the main drive gear bearing. Then press the bearing on the shaft and into the case. Install the thickest of the four available snap rings that will fit into the groove on the main drive gear shaft.

k. Slide main drive gear bearing retainer on the shaft and hold tightly against transmission. With a feeler gauge, measure the distance between the retainer and the case. Select gaskets that will be .003" to .005" [0,076 a 0,127 mm.] thicker than space between retainer and case. Install gaskets and retainer.

l. Complete assembly of transmission. Check condition of rear oil seal and gaskets.

J1-6. Four-Speed Transmission Control Housing Reassembly

Reassembly of the control housing is the reverse of disassembly. Make sure lock pins are installed in both shift forks. Install new expansion plugs in base of the housing. Inspect the transmission breather for damage and replace if necessary.

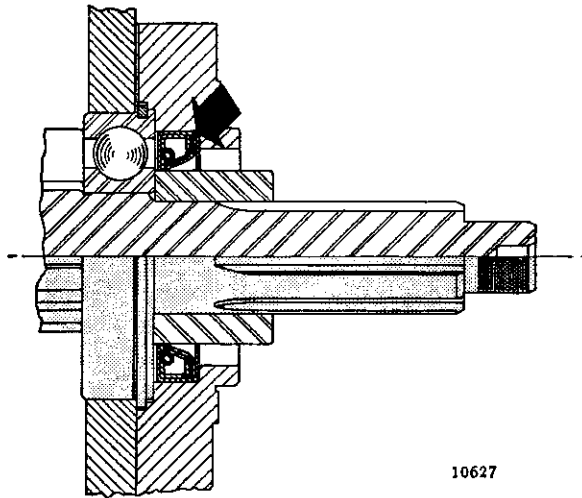


FIG. J1-9—INCORRECT OIL SEAL POSITION

J1-7. Installing 4-Speed Transmission

Install the four-speed transmission in the reverse order of the removal, noting the following points: When installing the front adapter plate (Fig. J1-1, insert the bearing retainer in the adapter plate and position the adapter plate against the flywheel housing. With the adapter plate cap screws tight, make sure the bearing retainer can be removed freely. If not, relocate the adapter plate and tighten again to test proper location of adapter plate.

When installing rear adapter plate, be sure cap screw heads do not protrude beyond the adapter plate face or interfere with transfer case fitting tightly against rear adapter plate.

When installing transfer case gear on the trans-

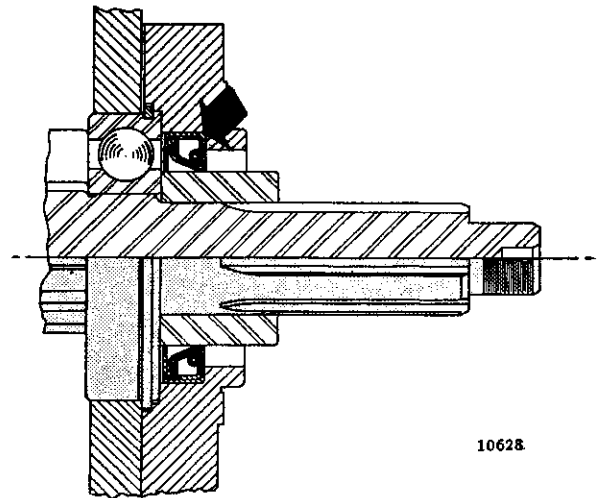


FIG. J1-10—CORRECT OIL SEAL POSITION

mission rear splined drive shaft tighten the large gear nut securely and insert cotter pin. Sink cotter pin well into nut slots so it will clear P.T.O. drive.

J1-8. Adapter Plate Oil Seal

It is important that the four-speed transmission adapter plate oil seal be correctly installed to prevent flow of lubricant from the transfer case to the transmission. Should the lubricant level be low in the transfer case and high in the transmission, check the position of the oil seal. See Fig. J1-9 and J1-10. Correctly positioned, the lip of the oil seal is toward the transfer case. Always replace the oil seal whenever it has been removed.

J1-9. TRANSMISSION SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Lock in Two Gears	Replace Poppet or Shift Levers
Slips Out of High Gear	
Transmission Misaligned with Bellhousing	Align Transmission Case to Bellhousing and Bellhousing to Engine
End Play in Main Drive Gear	Tighten Front Retainer
Damaged Pilot Bearing or Front Bearing	Replace
Slips Out of Second	
Worn Gear	Replace
Weak Poppet Spring	Replace
Noise in Low Gear	
Gear Teeth Worn	Replace Gears
Shifting Shoe Bent	Replace Shoe
Lack of Lubrication	Drain and Refill
Grease Leak into Bellhousing	
Gasket Broken Front Bearing Retainer	Replace
Transmission Main Drive Gear Oil Seal	Replace



J1-10. TRANSMISSION SPECIFICATIONS

HURRICANE F4 ENGINE	4-SPEED
Vehicle:	CJ-5, CJ-6
Make	Warner
Model	T98A
Type	Synchronous Mesh
Speeds	4 Forward — 1 Reverse
Ratios: — First	6.398 to 1
Second	3.092 to 1
Third	1.686 to 1
Fourth	1.000 to 1
Reverse	7.820 to 1
DAUNTLESS V-6 ENGINE	4-SPEED
Vehicle:	Late CJ-5 Only
Make	Warner
Model	T-18
Type	Synchronesh
Speeds	4 Forward — 1 Reverse
Ratios: — First	4.02 to 1
Second	2.41 to 1
Third	1.41 to 1
Fourth	1.00 to 1
Reverse	4.73 to 1

TRANSFER CASE

Contents

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K-1. GENERAL

All 4-wheel-drive models are equipped with a transfer case to connect the power to the front axle. It is essentially a two-speed transmission located at the rear of the standard transmission and provides a low and direct gear.

The transfer case gears are controlled by the driver through one shift lever. Early 'Jeep' Universal Models with the F4-134 Hurricane engine are equipped with two transfer case shift control levers.

a. On vehicles equipped with one transfer case shift lever, the transfer case shift lever has four positions: 2WD High, 4WD High, Neutral, and 4WD low. The forward position of the lever 2WD High allows the rear wheels only to drive. The first rear position (4WD High) engages the 4-wheel drive and provides high range 4-wheel drive. The second rear position (Neutral) disengages all power to the wheels and is used for stationary power take-off operations. The last rear position (4WD Low) provides low range 4-wheel drive.

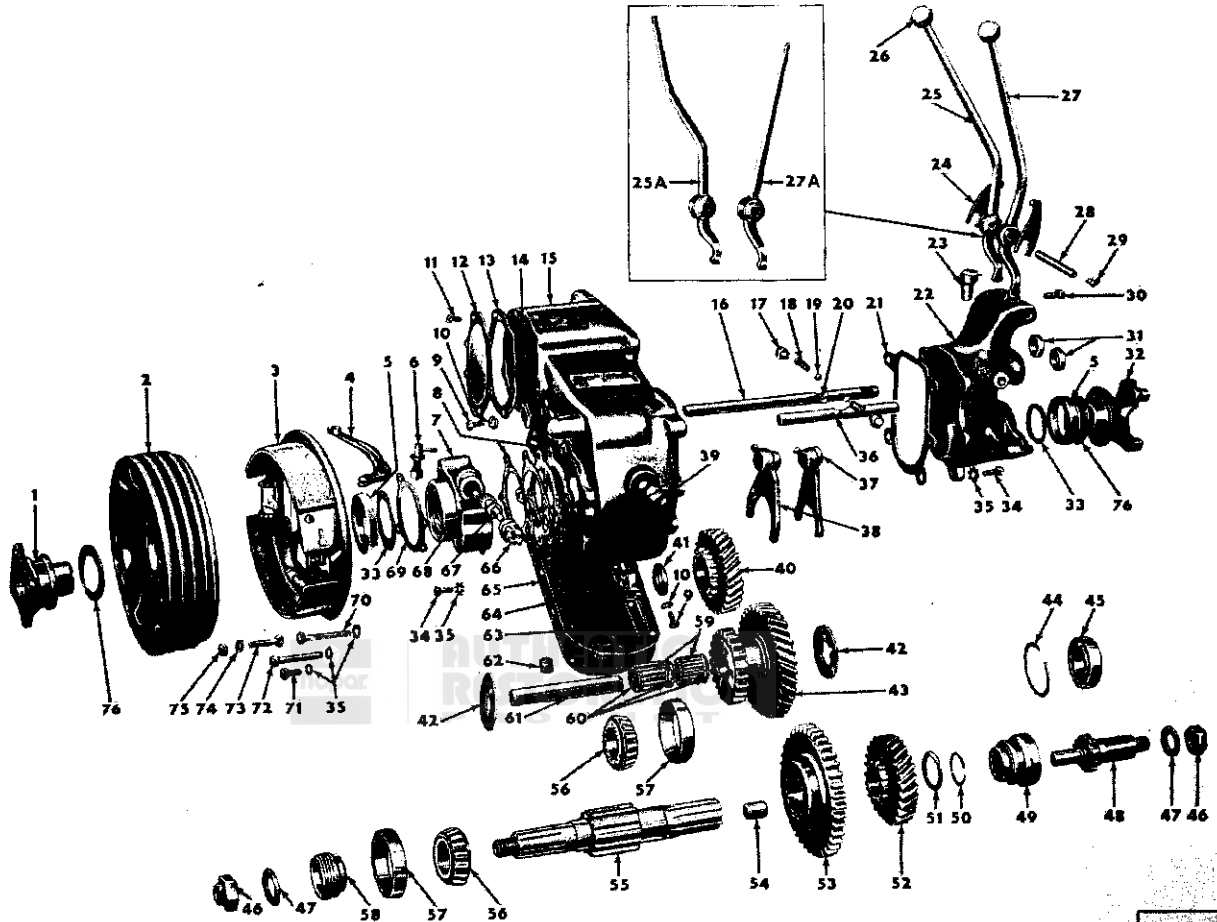
b. On vehicles equipped with two transfer case shift levers, the transfer case front axle drive lever (left hand lever) gives a choice of 2-wheel or 4-wheel drive. In the forward (out) position the vehicle is in 2-wheel drive. Move the lever to the rear (in) position for 4-wheel drive operation.

The 4-wheel-drive auxiliary-range shift lever (right hand lever) has three positions; low, neutral, and high. The forward position (low) gives low-range 4-wheel drive. The center position (neutral) disengages all power to the wheels and is used for stationary power take-off operations. A built-in interlock prevents shifting into low range, 2-wheel drive. This feature protects the rear axle from overload.

K-2. Removal of Transfer Case

The transfer case may be removed from the vehicle without removing the transmission. Where both transmission and transfer case are to be removed together, refer to Section J. To remove only the transfer case from the vehicle, proceed as follows:

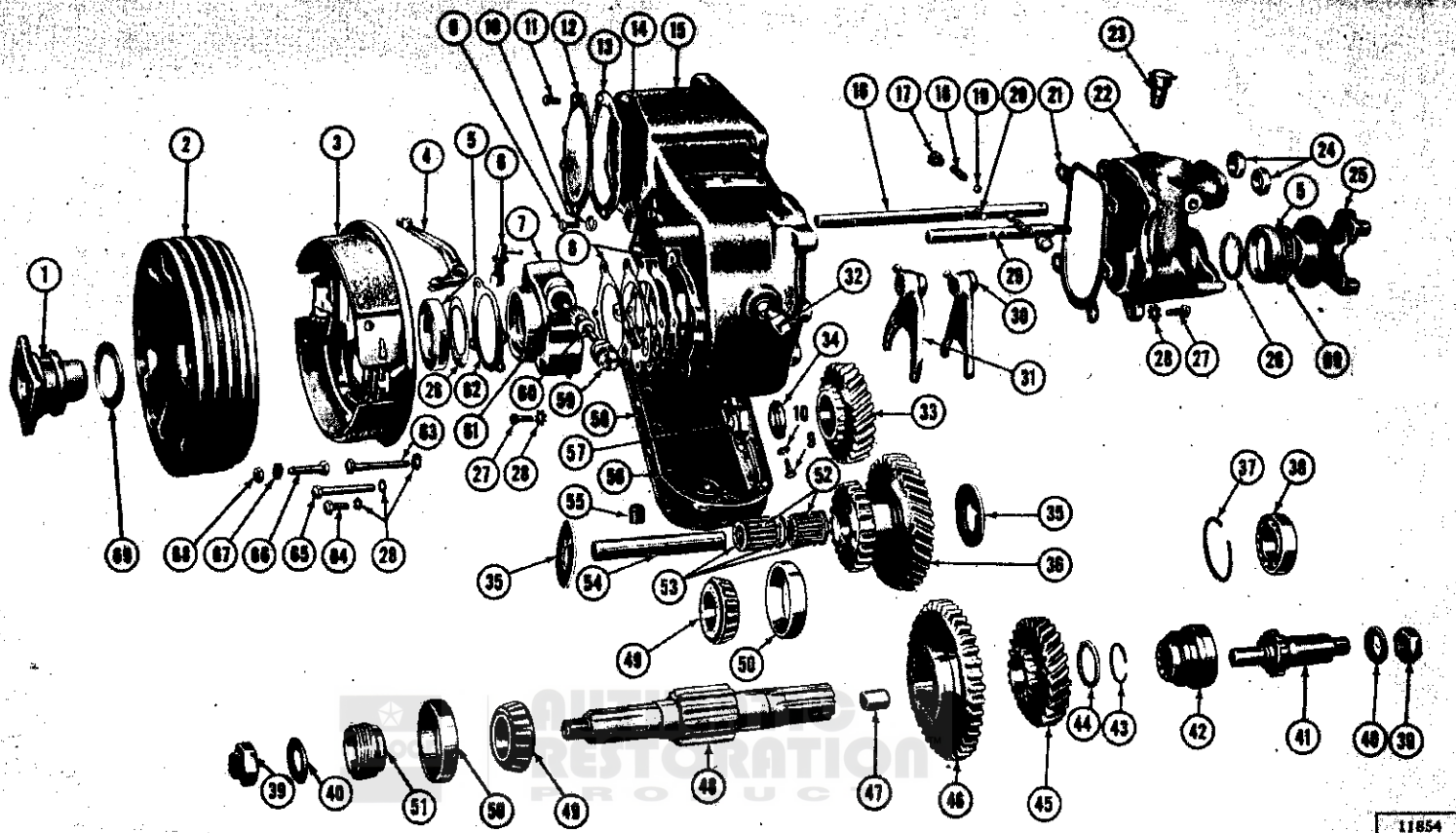
- a. Drain transmission and transfer case and replace drain plugs.
- b. Disconnect the brake cable.
- c. Disconnect front and rear propeller shafts at the transfer case. See "Propeller Shafts and Universal Joints."
- d. Disconnect speedometer cable at transfer case.
- e. Disconnect the transfer case shift levers. On vehicles equipped with two shift levers loosen set screw and remove pivot pin. Use a screw driver to pry shift lever springs away from shift levers. Lift levers from transfer case. On models equipped with a single shift lever remove pivot pin cotter key, and the adjusting rod attaching nut to remove shift lever. See Fig. K-4.
- f. Remove cover plate on rear face of transfer case. Remove cotter key, nut and washer from transmission main shaft.
- g. If possible, at this point remove the transfer case main drive gear from the transmission main shaft. If not possible, see step j below.
- h. Remove transfer case torque reaction support bracket bolt and nut.
- i. Remove transmission to transfer case bolts.
- j. Remove transfer case. If the transfer case main drive gear has not been removed in step g above, proceed as follows: Brace the end of the transmission main shaft so that it cannot move in the transmission, pull the transfer case to the rear to



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FIG. K-1—TRANSFER CASE—TWO SHIFT LEVERS

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> 1—Companion Flange 2—Brake Drum 3—Emergency Brake 4—Operating Lever 5—Oil Seal 6—Lever Stud 7—Rear Cap 8—Shims 9—Screw 10—Lockwasher 11—Bolt 12—Rear Cover 13—Gasket 14—Lock Plate 15—Transfer Case 16—Shift Rod 17—Poppet Plug 18—Poppet Spring 19—Poppet Ball 20—Interlock 21—Gasket 22—Front Cap 23—Breather 24—Shift Lever Spring 25—Shift Lever 25A—Shift Lever (used with 4-speed transmission) | <ul style="list-style-type: none"> 26—Shift Lever Knob 27—Shift Lever 27A—Shift Lever (used with 4-speed transmission) 28—Pivot Pin 29—Lubrication Fitting 30—Set Screw 31—Oil Seal 32—Front Yoke 33—Gasket 34—Bolt 35—Lockwasher 36—Shift Rod 37—Shift Fork 38—Shift Fork 39—Filler Pipe Plug 40—Mainshaft Gear 41—Plain Washer 42—Thrust Washer 43—Intermediate Gear 44—Snap Ring 45—Bearing 46—Nut 47—Washer 48—Output Clutch Shaft 49—Output Clutch Gear 50—Snap Ring | <ul style="list-style-type: none"> 51—Thrust Washer 52—Output Shaft Gear 53—Sliding Gear 54—Bushing 55—Output Shaft 56—Cone and Rollers 57—Bearing Cup 58—Speedometer Gear 59—Needle Bearings 60—Bearing Spacers 61—Intermediate Shaft 62—Drain Plug 63—Gasket 64—Nut 65—Bottom Cover 66—Sleeve 67—Speedometer Gear 68—Bushing 69—Gasket 70—Bolt 71—Bolt 72—Hex Nut 73—Bolt 74—Lockwasher 75—Nut 76—Output Shaft Seal |
|--|---|---|



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FIG. K-2—TRANSFER CASE—ONE SHIFT LEVER

- | | | | |
|---------------------------------------|-------------------------------------|---------------------------------|------------------------------------|
| 1—Companion Flange and Oil Seal Guard | 19—Poppet Ball | 37—Bearing Shaft Snap Ring | 55—Drain Plug |
| 2—Emergency Brake Drum | 20—Shift Rod Interlock | 38—Output Clutch Shaft Bearing | 56—Bottom Cover Gasket |
| 3—Emergency Brake | 21—Bearing Cap Gasket | 39—Companion Flange Nut | 57—Mainshaft Nut |
| 4—Brake Operating Lever | 22—Front Bearing Shaft Cap | 40—Plain Washer | 58—Transfer Case Bottom Cover |
| 5—Bearing Cap Oil Seal | 23—Breather | 41—Output Clutch Shaft | 59—Speedometer Driven Gear Sleeve |
| 6—Brake Operating Lever Stud | 24—Shift Rod Oil Seal | 42—Output Clutch Shaft Gear | 60—Speedometer Driven Gear (15-T) |
| 7—Rear Bearing Cap | 25—End Yoke | 43—Output Shaft Gear Snap Ring | 61—Speedometer Driven Gear Bushing |
| 8—Rear Bearing Cap Shim Set | 26—Oil Seal Gasket | 44—Thrust Washer | 62—Backing Plate Gasket |
| 9—Bolt | 27—Bolt | 45—Output Shaft Gear | 63—Bolt |
| 10—Lockwasher | 28—Lockwasher | 46—Output Shaft Sliding Gear | 64—Bolt |
| 11—Bolt | 29—Shift Rod | 47—Pilot Bushing | 65—Bolt |
| 12—Transfer Case Rear Cover | 30—Front Wheel Drive Shift Fork | 48—Output Shaft | 66—Bolt |
| 13—Rear Gasket Cover | 31—Underdrive and Direct Shift Fork | 49—Cone and Rollers | 67—Lockwasher |
| 14—Intermediate Shaft Lock Plate | 32—Filler Plug | 50—Output Shaft Bearing Cup | 68—Nut |
| 15—Transfer Case | 33—Mainshaft Gear | 51—Speedometer Drive Gear (6-T) | 69—Output Shaft Felt Seal |
| 16—Shift Rod | 34—Mainshaft Washer | 52—Needle Bearing | |
| 17—Poppet Plug | 35—Thrust Washer | 53—Bearing Spacer | |
| 18—Poppet Spring | 36—Intermediate Gear | 54—Intermediate Shaft | |



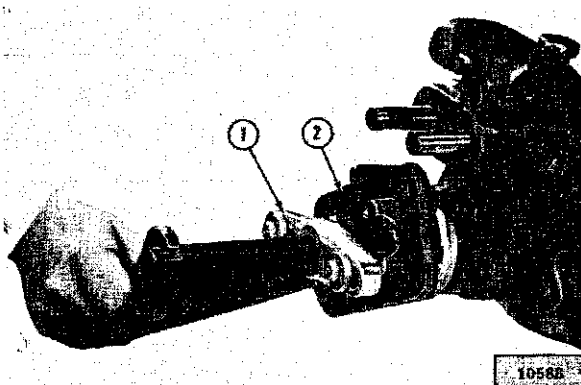


FIG. K-3—UNIVERSAL JOINT FLANGE PULLER

- 1—U-joint Flange Puller W-172
2—U-joint Flange Holding Wrench C-3281

FIG. K-4—TRANSFER CASE SHIFT LINKAGE
CJ-5A, CJ-6A

- 1—Linkage Adjustment

loosen the gear and remove the gear. When separating the two housings, use care that the transmission main shaft bearing, which bears in both housings, remains in the transmission case.

K-3. Transfer Case Disassembly

- Refer to Fig. K-1, K-2.

To remove the gears and bearings from the transfer case on the bench, the following procedure is recommended.

a. Remove output shaft nuts and washers using Yoke Holding Wrench, C-3281. Remove rear output shaft companion flange with brake drum (if

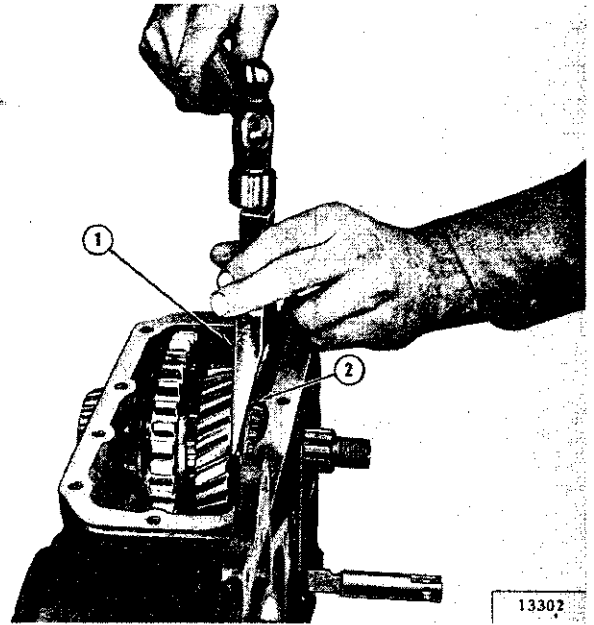


FIG. K-5—BEARING CONE REMOVING WEDGE

- 1—Wedge W-139
2—Cone and Roller

so equipped) and front output shaft yoke, using Tool W-172.

b. Remove cover bolts, lockwashers, and bottom cover.

c. Remove the lockplate screw, lockwasher, and lock plate.

d. Use a brass punch to drive out intermediate shaft to the rear of the case. Do not lose the thrust washers located at each end of the gear shaft.

e. Remove the intermediate gear, two thrust washers, needle bearings, and spacers, thru the bottom of the case.

f. Remove the poppet plugs, springs, and balls on both sides of front bearing cap. Shift front wheel shift lever to engaged position (shaft forward).

g. Remove the screws, lockwashers, holding the front bearing cap. Remove the cap as an assembly including the clutch shaft, bearing, clutch gear, fork, and shift rod. Use care not to lose the interlock which floats between the shift rods.

h. Remove the screws, lockwashers holding the brake backing plate assembly (if so equipped) and rear output cap with speedometer gear assembly. Remove entire unit as an assembly.

i. Use a rawhide hammer to drive against the front end of output shaft to drive the rear bearing cup from the case. Use Tool W-139, as shown in Fig. K-5, to wedge front bearing cone and roller assembly from its seat on the shaft. Place Tool W-141, Fig. K-6, on the output shaft between the front bearing and output shaft gear. Use a rawhide hammer to drive against the rear end of the output shaft to remove front bearing cup from the case. Loosen snap ring and slide it forward on the shaft. Drive the shaft thru the rear of the case. As the shaft is removed, gears, snap ring, and thrust washer will remain in the case and can be removed from

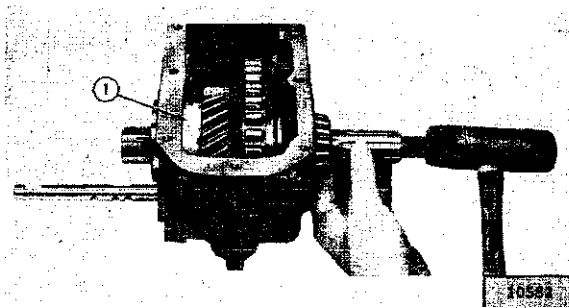


FIG. K-6—BEARING CUP REMOVING RING
1—Removing Ring

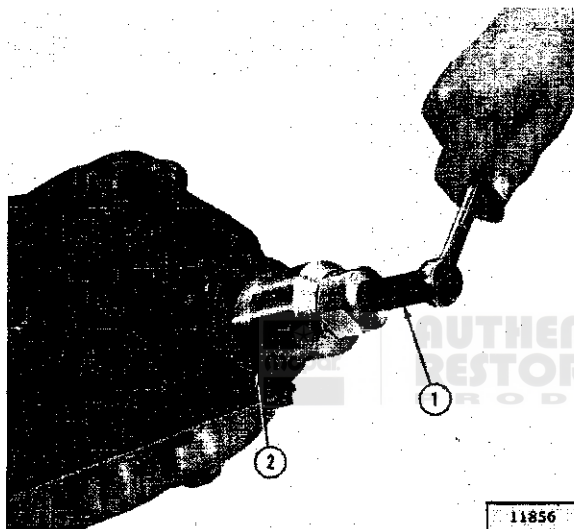


FIG. K-7—PULLING OUTPUT SHAFT OIL SEAL
1—Tool W-251
2—Oil Seal

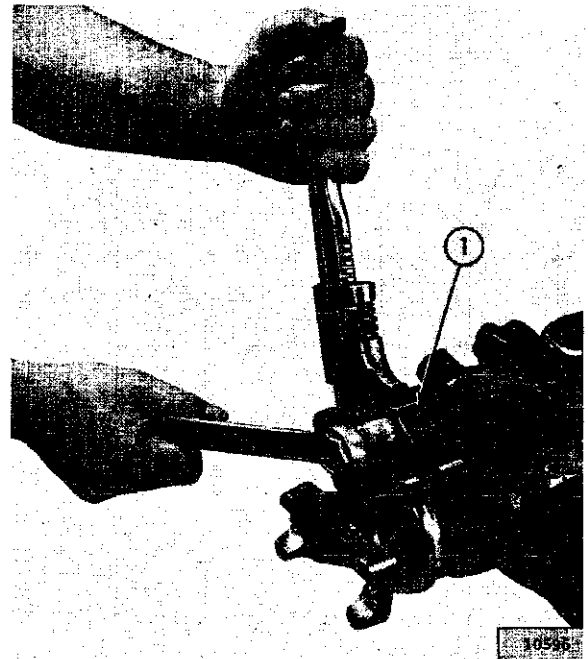


FIG. K-8—SHIFT ROD OIL SEAL PULLER
1—Seal Puller

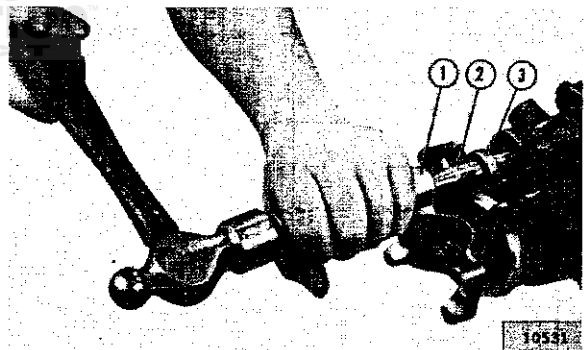


FIG. K-9—SHIFT ROD OIL SEAL INSTALLER
1—Driver
2—Thimble
3—Oil Seal

the bottom. Remove rear bearing cone and roller assembly from the shaft by striking the end of the shaft lightly against a wooden block.

j. Remove the set screw in sliding gear shift fork. Remove shift rod. See the following paragraphs for disassembly of the front and rear bearing caps.

K-4. Front Bearing Cap Disassembly

● Refer to Fig. K-1, K-2.

The front bearing cap is a separate assembly which may be removed for service. Should difficulty be experienced in this section of the transfer case, follow the sequence below for removal and disassembly.

a. Remove the output shaft yoke as outlined in Par. K-3. Remove the poppet balls and move the front wheel drive shift rod forward as outlined in Par. K-3f.

b. Remove yoke oil seal with Tool W-251, as shown in Fig. K-7. Remove shift rod oil seals with Tool W-176, as shown in Fig. K-8.

c. Remove the front bearing cap assembly as outlined in Par. K-3g.

d. Remove the set screw from shifting fork and shifting rod. The clutch gear and shifting fork can be removed together.

e. Remove output clutch shaft assembly by carefully pressing it thru the bearing.

f. Remove bearing retainer snap ring and the bearing.

K-5. Rear Cap Disassembly

● Refer to Fig. K-1, K-2.

The rear bearing cap is partially disassembled during the dismantling of the transfer case. The cap is, however, a separate assembly which may be removed for service. Follow the sequence below for removal and disassembly.

a. Remove the output shaft rear end yoke or companion flange as outlined in Par. K-3a. Separate

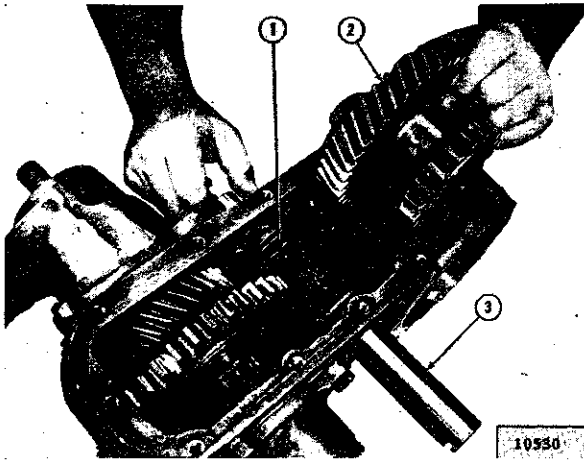


FIG. K-10—THRUST WASHER PILOT

1—Pilot 2—Gear 3—Shaft

the brake drum and companion flange by removing bolts, lockwashers, and nuts.

b. Remove the oil seal with Tool W-251, as shown in Fig. K-7.

c. Remove speedometer driven gear assembly.

d. Remove the cap screws attaching the cap and brake backing plate to the case. Take precautions not to lose or damage bearing adjusting shims placed between the cap and the transfer case housing.

e. Separate the rear cap and brake backing plate assembly. See Section P for brake service procedures.

f. Remove speedometer driving gear.

K-6. Transfer Case Reassembly

● Refer to Fig. K-1, K-2.

Reassembly of the transfer case is reversal of the foregoing procedure of disassembly. The output shaft snap ring may best be installed with Tool

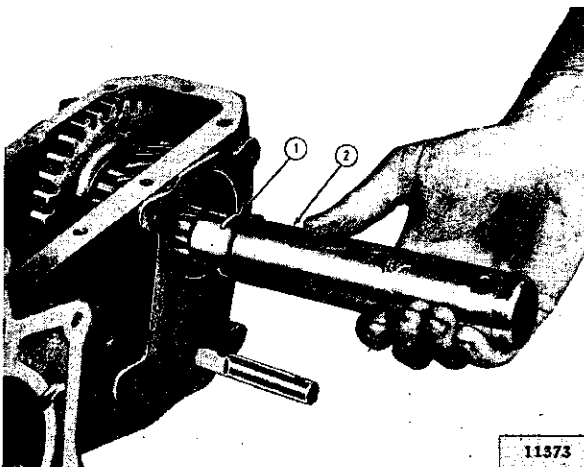


FIG. K-11—OUTPUT SHAFT SNAP RING INSTALLER

1—Snap Ring
2—Snap Ring Installer Tool W-131

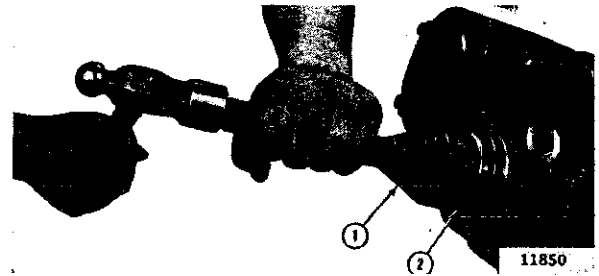


FIG. K-12—OUTPUT SHAFT OIL SEAL DRIVER

1—Driver Tool W-143
2—Seal

W-131, output shaft snap ring installing thimble and driver, shown in Fig. K-11. Use a piece of tubing for installing the bearing cone and roller assemblies on the output shaft to prevent damage to the assemblies.

Early production transfer cases were equipped with a 1 1/8" [2,86 cm.] diameter intermediate shaft and caged needle bearings. When installing the intermediate gear in early production transfer cases, insert the bearings in the gear, support the front thrust washer with Pilot Pin Tool W-192, Fig. K-10, position the gears and rear thrust washer, and insert the shaft from the rear of the case.

Late production transfer cases were equipped with a 1 1/4" [3,18 cm.] diameter intermediate shaft, and bearings consisting of individual rollers and spacers. A dummy shaft is required to install the intermediate gear. The dummy shaft should be slightly smaller in diameter than the intermediate shaft and a little shorter than the width of the intermediate gear. To install the intermediate gear, first load the bearing rollers and spacers in the gear using the dummy shaft. Then supporting the front thrust washer with the fingers, position the gears and rear thrust washer and insert the shaft from the rear of the case, driving out the dummy shaft.

Should it be necessary to replace the speedometer driven pinion bushing installation may be best made with bushing installer Tool W-133, shown in Fig. K-13. When the rear bearing cap assembly is installed, check the end movement of the mainshaft which determines the adjustment of the tapered roller bearings. For correct bearing adjust-

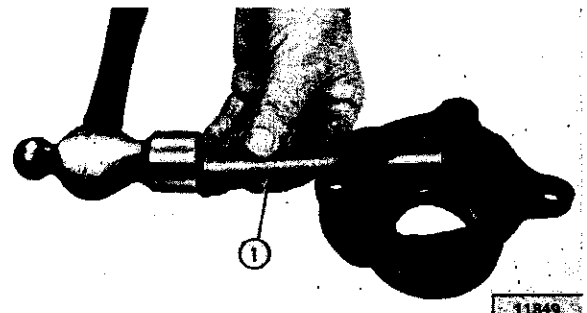


FIG. K-13—SPEEDOMETER PINION BUSHING DRIVER

1—Tool W-133

ment, the shaft should have .004" to .008" [0,102 a 0,203 mm.] end play. Adjustment is made by selective shim installation between the cap and the case. Shims .003", .010" and .031" [0,076, 0,254, 0,787 mm.] in thickness are available for this adjustment. Do not install the rear cap oil seal until the bearings are correctly adjusted. Both the front and rear oil seals may be installed with oil seal driver Tool W-143, shown in Fig. K-12.

When installing the end yokes on the output shafts, inspect for the presence of felt seals in each oil seal guard. (The oil seal guard is a part of each yoke assembly.) Felt seals should be installed in the oil seal guards if they are not present. When installing the shift rail oil seals in the front bearing cap, it is necessary to protect the seals against damage when passing over the shift rail notches. Protect them with the thimble, and install them

with the driver, Tool W-130, shown in Fig. K-9.

K-7. Transfer Case Installation

The installation of the assembly in the vehicle is the reverse of the removal operation covered in Par. K-2.

If the transmission was removed from the vehicle, lubricate the pilot bearing and also lubricate the transmission and transfer case as outlined in the "Lubrication Section". Be sure that the clutch pedal has 3/4" [19,05 mm.] free travel as outlined in the "Clutch Section".

K-8. Transfer Case Linkage Adjustment

Adjust the link to provide 1/2" [12,7 mm.] clearance between the floor pan and the shift lever bend when operating in four wheel drive low position. Refer to Fig. K-4.

K-9. TRANSFER CASE SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Slips Out of Gear (High-Low)	
Shifting Lock Spring Weak.....	Replace Spring
Bearing Broken or Worn.....	Replace
Shifting Fork Bent.....	Replace
Slips Out of Front Wheel Drive	
Shifting Lock Spring Weak.....	Replace
Bearing Worn or Broken.....	Replace
End Play in Shaft.....	Adjust
Shifting Fork Bent.....	Replace
Hard Shifting	
Lack of Lubricant.....	Drain and Refill
Shift Lever Stuck on Shaft.....	Remove, Clean and Lubricate
Shifting Lock Ball Scored.....	Replace Ball
Shifting Fork Bent.....	Replace Fork
Low Tire Pressure.....	Inflate
Grease Leak at Front or Rear Drive	
Grease Leak at Covers.....	Install New Gaskets
Grease Leak between Transmission and Transfer Cases.....	Install New Gaskets
Grease Leak at Output Shaft.....	Install New Oil Seal

K-10. TRANSFER CASE SPECIFICATIONS

Transfer Case:	All Models
Make.....	Spicer
Model.....	18
Shift Lever.....	On Floor
Gear Ratio:	
High.....	1.00 to 1
Low.....	2.46 to 1

PROPELLER SHAFTS AND UNIVERSAL JOINTS

Contents

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Snap Ring Type Disassembly.....	L-3
U-Bolt Type Assembly.....	L-6
U-Bolt Type Disassembly.....	L-5
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L-1. GENERAL

The drive of 'Jeep' 4-wheel-drive Universal models from the transfer case to the front and rear axles is through two tubular propeller shafts, each shaft having two cardan cross universal joints. The drive of 'Jeep' 2-wheel-drive models from the transmission to the rear axle is through a tubular propeller shaft having two cardan cross universal joints. Propeller shafts and universal joints should be

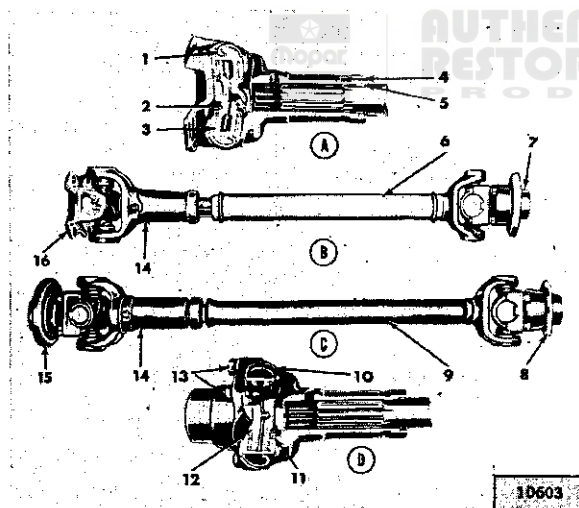


FIG. L-1—UNIVERSAL JOINTS

- | | |
|-------------|-------------------|
| 1—Snap Ring | 9—Front Tube |
| 2—Journal | 10—"U" Bolt |
| 3—Bearing | 11—Retainer |
| 4—Dust Cap | 12—Gasket |
| 5—Washer | 13—"U" Bolt Nut |
| 6—Rear Tube | 14—Sleeve |
| 7—Yoke End | 15—Front Yoke End |
| 8—Yoke End | 16—Flange Yoke |

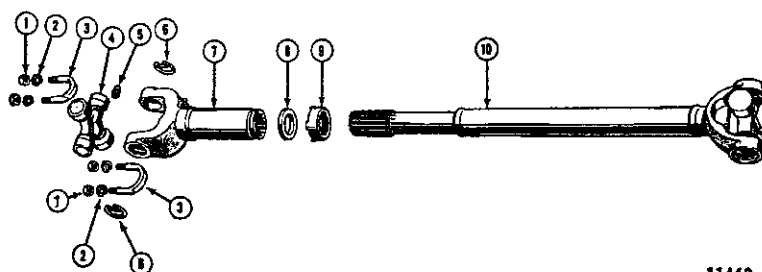


FIG. L-3—PROPELLER SHAFT AND UNIVERSAL JOINT

- | |
|-------------------------------|
| 1—U-Bolt Nut |
| 2—U-Bolt Washer |
| 3—U-Bolt |
| 4—Universal Joint Journal |
| 5—Lubrication Fitting |
| 6—Snap Ring |
| 7—Universal Joint Sleeve Yoke |
| 8—Rubber Washer |
| 9—Dust Cap |
| 10—Propeller Shaft Tube |

checked for foreign matter around the shafts, dented or bent shafts, and loose attaching bolts.

L-2. Needle Bearing and Trunnion Universal Joint

Each shaft is equipped with a splined slip joint at one end to allow for variations in length caused by vehicle spring action. Some slip joints are marked with arrows at the spline and sleeve yoke, Fig. L-3. When installing, align the arrows in the same plane. If unmarked with arrows, align the yokes at the front and rear of the shaft in the same parallel plane. This is necessary to avoid vibration. All the universal joints used are similar in construction except that some are of the "U"-bolt type and

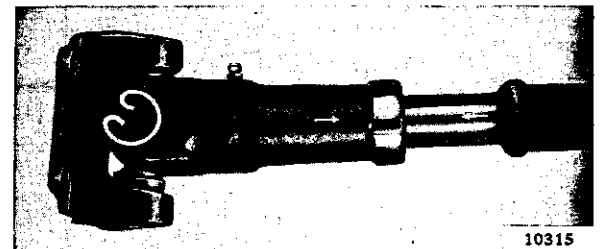


FIG. L-2—ARROW MARKINGS

others of the "Snap Ring" type. This difference is in the attachment of the joints only. These universal joints have needle bearings and are so designed that correct assembly is a very simple matter. No hand fitting or special tools are required.

L-3. Snap Ring Type Disassembly

This type joint is illustrated in Fig. L-1. To re-

L

PROPELLER SHAFTS AND UNIVERSAL JOINTS

move the snap rings, pinch the ends together with a pair of pliers. If the rings do not readily snap out of the groove, tap the end of the bearing lightly which will relieve pressure against the rings. After removing the snap rings, press on the end of one bearing until the opposite bearing is pushed from the yoke arm. Turn the joint over and press the first bearing back out of that arm by pressing on the exposed end of the journal shaft. Use a soft ground drift with a flat face about $\frac{1}{32}$ " [0,8 mm.] smaller in diameter than the hole in the yoke arm and drive it out, otherwise there is danger of damaging the bearing.

Repeat this operation for the other two bearings, then lift out journal assembly by sliding it to one side.

L-4. Snap Ring Type Assembly

Wash all parts in cleaning solvent and inspect the parts after cleaning. Replace any parts that indicate extensive wear. It is advisable to install new gaskets on the journal assembly regardless of the condition of the old gaskets. Make certain that the grease channel in each journal trunnion is open.

Pack the bearing cones one-third full of lubricant and install the rollers.

Draw the bearings into the end yoke arm and seat them firmly against the bearing shoulders. Hold the bearings in a vertical position to prevent the needles from dropping out until the joint is assembled. If the joint binds when assembled, tap the arms lightly to relieve any pressure on the bearings at the end of the journal.

L-5. U-Bolt Type Disassembly

Removal of the attaching "U"-bolt releases one set of bearing races. Slide the propeller shaft into the yoke flange to remove them using care not to lose the rollers.

After the removal of the one set of bearing races, release the other set by removing the snap rings in the sleeve yoke by pinching the ends together with a pair of pliers. Should the rings fail to snap readily from the groove, tap the end of the bearing lightly, which will relieve the pressure against them. Press on the end of one bearing, until the opposite bearing is pushed out of the yoke arm. Turn the universal joint over and press the first bearing out by pressing on the exposed end of the journal assembly. Use a soft ground drift with a flat face about $\frac{1}{32}$ " [0,8 mm.] smaller in diameter than the hole in the yoke arm and drive out the bearing. Lift the journal out by sliding to one side. Clean all parts and check for wear.

L-6. U-Bolt Type Assembly

Wash all parts in cleaning solvent and inspect the parts after cleaning. Replace any parts that indicate extensive wear. It is advisable to install new gaskets on the journal assembly regardless of the condition of the old gaskets. Make certain that the grease channel in each journal trunnion is open.

Pack the bearing cones one-third full of lubricant and install the rollers.

Draw the bearings into the end yoke arm and seat them firmly against the bearing shoulders. Hold the bearings in a vertical position to prevent the needles from dropping out until the joint is assembled. If the joint binds when assembled, tap the arms lightly to relieve any pressure on the bearings at the end of the journal. Tighten the U-bolts equally. U-bolt torque wrench reading is 15 to 20 lb-ft. [2,07 a 2,76 kg-m.].

When installing the assembly in the vehicle be sure that the arrows on the propeller shaft and yoke sleeve are in alignment as shown in Fig. L-2, or that the unmarked joints are aligned with the yokes in the same parallel plane.

SPECIFICATIONS

L-7. PROPELLER SHAFTS AND UNIVERSAL JOINTS

PROPELLER SHAFTS:

Make	SPICER			
	Front		Rear	
	O.D.	Length	O.D.	Length
F4 Engine Vehicles:				
CJ-5, CJ-5A — 3 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$22\frac{3}{4}$ " [57,78 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$18\frac{3}{4}$ " [45,95 cm.]
4 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$28\frac{1}{2}$ " [72,39 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$13\frac{1}{16}$ " [34,131 cm.]
CJ-6, CJ-6A — 3 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$22\frac{3}{4}$ " [57,78 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$38\frac{1}{2}$ " [97,79 cm.]
4 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$28\frac{1}{2}$ " [72,39 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$33\frac{1}{16}$ " [84,69 cm.]
CJ-3B.....	$1\frac{1}{4}$ " [3,175 cm.]	$33\frac{1}{16}$ " [85,57 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$19\frac{5}{16}$ " [50,64 cm.]
DJ-5.....	.....	.....	$1\frac{3}{4}$ " [4,45 cm.]	$24\frac{1}{2}$ " [61,60 cm.]
DJ-6.....	.....	.....	3" [7,62 cm.]	$44\frac{1}{4}$ " [112,40 cm.]
V-6 Engine Vehicles:				
CJ-5, CJ-5A — 3 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$21\frac{3}{4}$ " [55,25 cm.]	2" [5,08 cm.]	$19\frac{5}{16}$ " [50,64 cm.]
CJ-6, CJ-6A — 3 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$21\frac{3}{4}$ " [55,25 cm.]	2" [5,08 cm.]	39" [99,06 cm.]
CJ-5 — 4 Speed.....	$1\frac{1}{4}$ " [3,175 cm.]	$26\frac{13}{16}$ " [68,10 cm.]	$1\frac{3}{4}$ " [4,45 cm.]	$14\frac{3}{4}$ " [37,47 cm.]

UNIVERSAL JOINTS:

Make.....	Spicer
Type.....	Cardan Cross
Bearing.....	Antifricion

FRONT AXLE

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M-1. GENERAL

The front axle for all 'Jeep' Universal models, which have 4-wheel drive, is described in Par. M-2. The front axle for all DJ-5, DJ-6 models, which have 2-wheel drive, is described in Par. M-15.

M-2. 4-WHEEL-DRIVE FRONT AXLE

The front axle is a live driving unit with hypoid type driving gears and spherical steering knuckles mounted on pivot pins which ride on tapered roller bearings for ease of steering. The drive is of the full floating type through axle shafts built integrally with cardan cross universal joints which revolve in the steering knuckles. The steering knuckle tie rod arm is made integrally with the knuckle. The knuckles are connected by a divided tie rod to a steering bell crank. A steering connecting rod connects the bell crank to the steering gear arm. The divided tie rod is adjustable and the toe-in of each front wheel is adjusted independently. Camber and

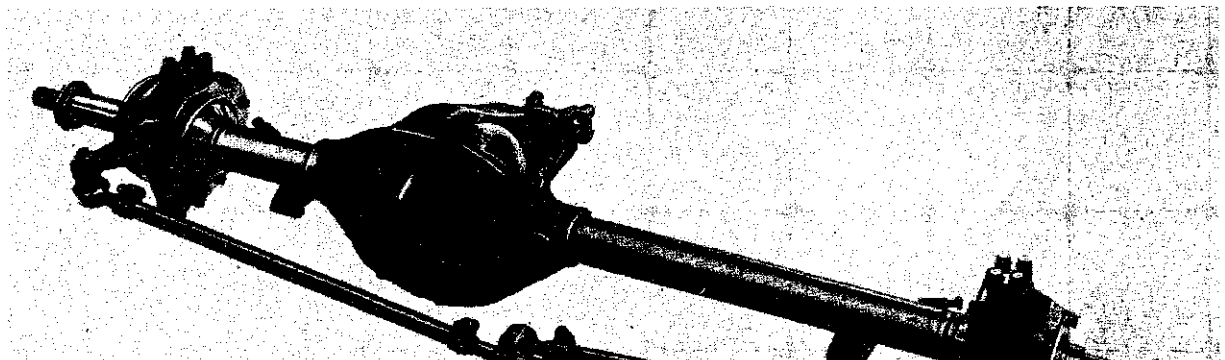
caster of the front wheels is preset. Camber cannot be altered but caster can be adjusted by installing caster shims between the axle pad and the springs. For information on the steering geometry see "Steering Section."

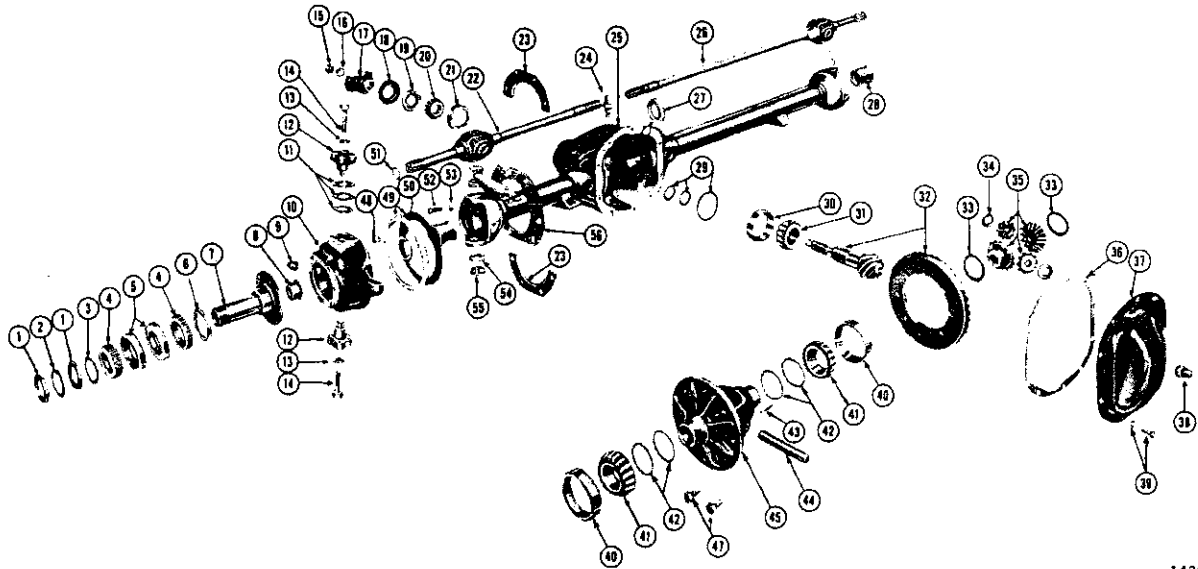
Service procedures given in this section include the removal, installation, disassembly and assembly of the Model 27AF front axle assembly, the axle shafts, steering knuckles, and universal joints.

Note: All service replacement axle assemblies are shipped from the factory without lubricant in the differential. Lubricant must be added; use grade and quantity as specified in the lubrication chart (Section B).

M-3. Maintenance Requirements

A spring-loaded breather is located on the top of the differential housing. Each time the differential lubricant is checked, the breather should be





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FIG. M-2—FRONT AXLE

- | | | |
|--------------------------|--|------------------------------|
| 1—Nut | 20—Cone and Rollers | 39—Screw and Lock Washer |
| 2—Lock Washer | 21—Bearing Cup | 40—Bearing Cup |
| 3—Bearing Lock Washer | 22—Right Axle Shaft with Universal Joint | 41—Cone and Rollers |
| 4—Wheel Bearing Cup | 23—Knuckle Oil Seal Retainer | 42—Shims |
| 5—Cone and Rollers | 24—Housing Breather | 43—Lock Pin |
| 6—Oil Seal | 25—Front Axle Housing | 44—Pinion Shaft |
| 7—Spindle | 26—Axle Shaft with Universal Joint | 45—Differential Case |
| 8—Spindle Bushing | 27—Oil Seal | 47—Bolts |
| 9—Filler Plug | 28—Axle Shaft Guide | 48—Nut |
| 10—Right Knuckle and Arm | 29—Shim Pack | 49—Oil Seal and Backing Ring |
| 11—Shims | 30—Bearing Cup | 50—Thrust Washer |
| 12—Pivot Pin | 31—Cone and Rollers | 51—Snap Ring |
| 13—Lock Washer | 32—Ring Gear and Pinion | 52—Stop Bolt |
| 14—Cap Screw | 33—Thrust Washer | 53—Nut |
| 15—Nut | 34—Thrust Washer | 54—Bearing Cup |
| 16—Washer | 35—Differential Gears | 55—Cone and Rollers |
| 17—Universal Joint Yoke | 36—Housing Cover Gasket | 56—Gasket |
| 18—Oil Seal | 37—Housing Cover | |
| 19—Oil Slinger | 38—Fill Plug | |

checked, making sure it is clean and open.

The front wheel bearings should be checked every 12,000 miles. Refer to Section Q. Front wheel toe-in is adjustable by lengthening or shortening the tie rod. However, standard caster and camber of the front wheels are built into the axle. Wheel caster can be adjusted by placing tapered shim plates or wedges between the springs and spring seats welded to the axle housing. Steering geometry and front wheel adjustments are discussed in Section O.

The axle housing should be checked periodically for weld cracks and/or other damage that may cause misalignment of the front wheels or loss of lubricant. The spring clips (U-bolts) should be inspected and torqued every 12,000 miles. Torque (spring clip) nuts 45 to 50 lb-ft. [6,2 a 6,9 kg-m.].

M-4. FRONT AXLE REMOVAL

- Raise front end of vehicle and safely support the frame by placing stands under the frame at the rear of the front spring rear hangers.
- Place jack under front axle housing and relieve axle weight from the springs.
- Disconnect shock absorbers from spring clip plates.

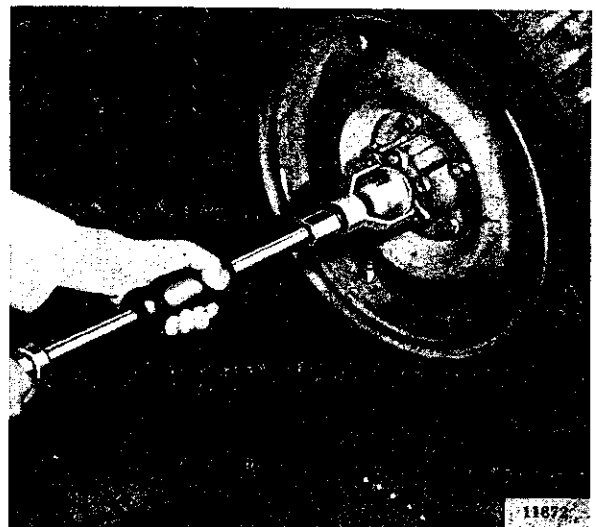


FIG. M-3—HUB CAP PULLER

- Disconnect steering link from tie rod socket-joint assembly.
- Disconnect hydraulic brake hoses from front brake lines. Disconnect hoses from frame brackets.

- f. Disconnect propeller shaft from the differential companion flange.
- g. Disconnect both front springs from front spring hangers.
- h. Remove spring clip and spring clip plates securing axle to front springs.
- i. Remove front wheels from axle assembly.
- j. Lower jack slightly and pull axle forward from under vehicle.

M-5. FRONT AXLE SHAFT REMOVAL

Refer to Fig. M-2.

The following procedure applies to either right or left front axle shaft.

Note: Axle shafts can be removed without removing the axle housing from the vehicle. Use the following procedure. First raise and support front end of vehicle, and remove front wheels.

- a. Remove drive flange snap ring.
- b. Remove the hub cap with a puller as shown in Fig. M-3.
- c. Remove the axle shaft driving flange bolts.
- d. Apply the foot brakes and remove the axle shaft flange with puller W-163 as illustrated in Fig. M-4.

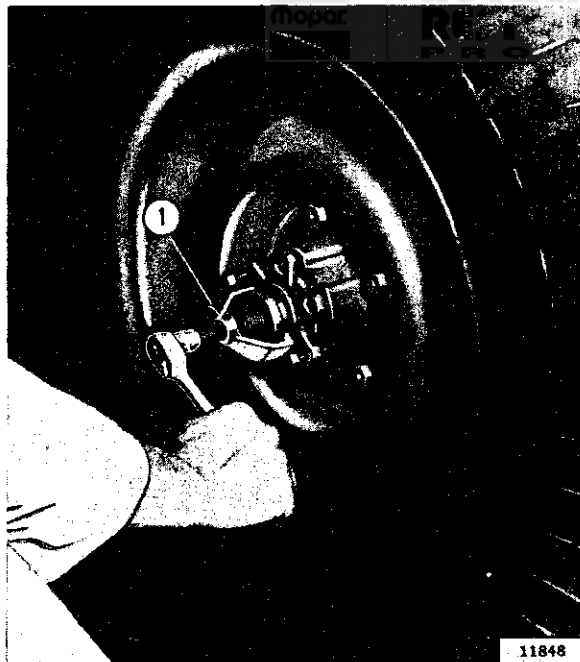


FIG. M-4—AXLE SHAFT DRIVE FLANGE PULLER

1—Tool W-163

- e. Release the locking lip on the lockwasher and remove the outer nut, lockwasher, adjusting nut and bearing lockwasher. Use wrench W-144, Fig. M-5, for removal of the nut.
- f. Remove the wheel hub and drum assembly with the bearings. Be careful not to damage the oil seal.

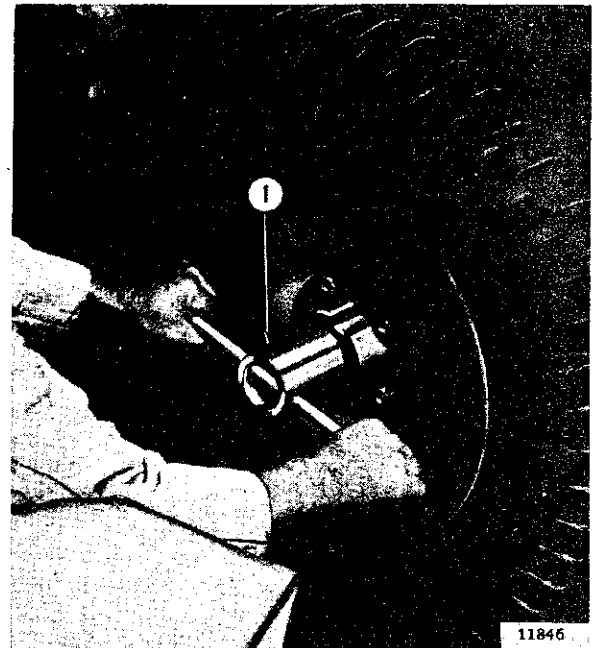


FIG. M-5—WHEEL BEARING NUT WRENCH

1—Tool W-144

- g. Remove the hydraulic brake tube and the brake backing plate screws.
- h. Remove the spindle.
- i. Remove the axle shaft and universal joint assembly.

M-6. Removing and Overhauling Differential

Adjustment and overhaul of the front axle differential assembly is the same as that of a full floating type rear axle. Information covering dismantling and assembling of this type differential is contained in Section N.

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 the grade and quantity of lubricant specified in the lubrication section.

After the axle has been installed in the vehicle, check to be sure the lubricant level in the differential is level with the fill plug opening.

M-7. AXLE SHAFT UNIVERSAL JOINT SERVICE

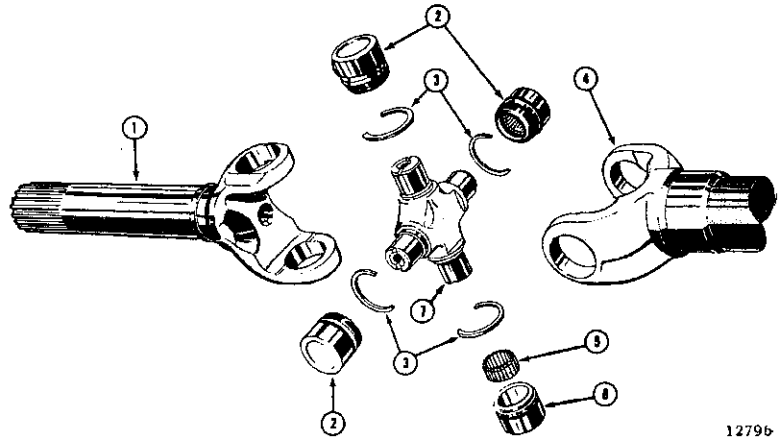
Refer to Fig. M-6 and M-7.

After the axle shaft and universal joint assembly have been removed, the Cardan cross universal joint can be disassembled and inspected as follows:

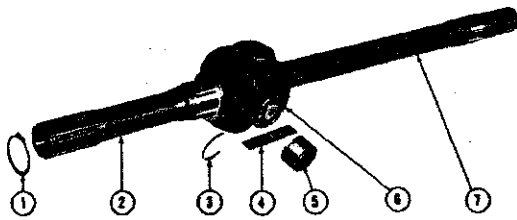
- a. Remove the snap rings from the bearing cup assemblies.
- b. Press on the end of one bearing cup assembly until the opposite bearing is pushed from the yoke arm. Turn the yoke over and press the first bearing back out of that arm by pressing on the exposed end of the journal shaft. To avoid damaging the

FIG. M-6—CARDAN CROSS UNIVERSAL JOINT

- 1—Axle Shaft Yoke Half
- 2—Bearing Cup
- 3—Snap Ring
- 4—Axle Shaft Yoke Half
- 5—Roller Bearing
- 6—Bearing Cup
- 7—Bearing Cross Journal



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FIG. M-7—CARDAN CROSS UNIVERSAL JOINT

- 1—Outer Axle Shaft Snap Ring
- 2—Outer Shaft
- 3—Bearing Retainer Snap Ring
- 4—Bearing Rollers
- 5—Bearing Retainers
- 6—Universal Joint Journal Assembly
- 7—Inner Shaft

bearing, use a soft drift with a flat about $\frac{1}{32}$ " [0,8 mm.] smaller in diameter than the hole in the yoke arm to drive out the bearing.

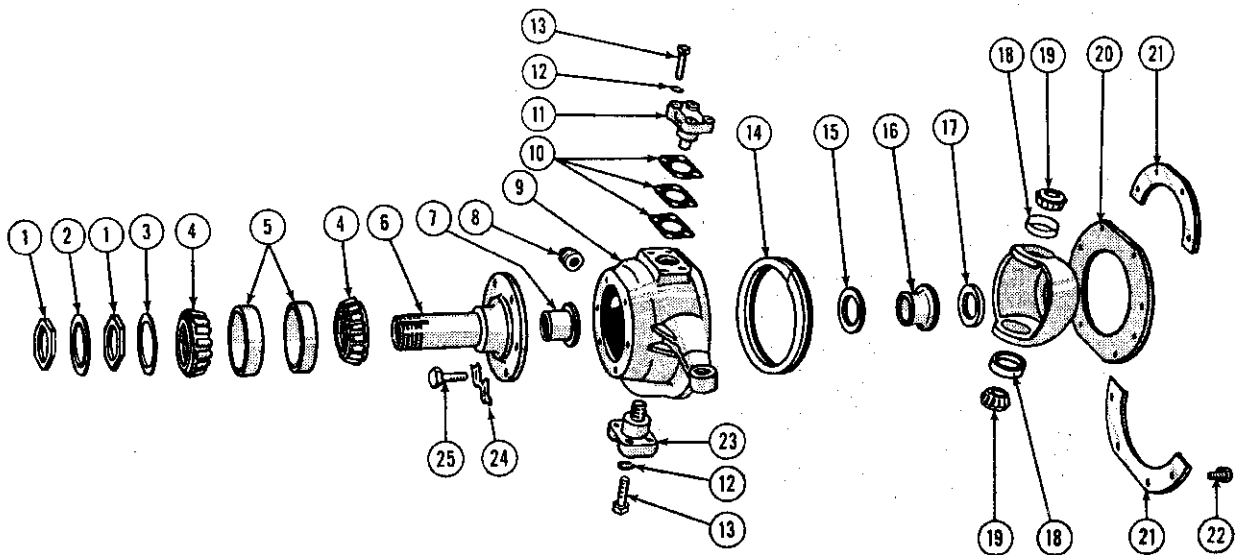
c. Repeat the above step for the other two bearings. Then lift out the bearing cross journal by sliding it to one side.

d. Wash all parts in cleaning solvent and inspect the parts after cleaning. Replace any parts that indicate extensive wear.

e. Pack the bearing cones one-third full of lubricant and install the rollers.

f. Insert the bearings into the end yoke arm and seat them firmly against the bearing shoulders.

g. Holding the bearings in a vertical position to prevent the needles from dropping out, reassemble the joint in the reverse order of the disassembly.



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FIG. M-8—STEERING KNUCKLE AND WHEEL BEARINGS

- 1—Bearing Adjusting Nut
- 2—Lockwasher
- 3—Lockwasher
- 4—Bearing Cone and Rollers
- 5—Bearing Cup
- 6—Spindle
- 7—Bushing
- 8—Filler Plug

- 9—Left Knuckle and Arm
- 10—Shims
- 11—Upper Bearing Cap
- 12—Lockwasher
- 13—Bolt
- 14—Oil Seal and Backing Ring
- 15—Thrust Washer
- 16—Axle Pilot

- 17—Oil Seal
- 18—Bearing Cup
- 19—Bearing Cone and Rollers
- 20—Oil Seal
- 21—Retainer
- 22—Bolt
- 23—Lower Bearing Cap
- 24—Lock Strap
- 25—Bolt

If the joint binds when assembled, tap the yoke lightly to relieve any pressure on the bearings at the end of the journal.

M-8. Steering Knuckle Service

The steering knuckle pins pivot on tapered roller bearings. Replacement of these bearings requires removal of the hub and brake drum assembly, wheel bearings, axle shaft, spindle, steering tie rod, and steering knuckle. Disassemble the steering knuckle as follows:

Remove the eight screws which hold the oil seal retainer in place. Remove the four screws holding the lower pivot pin bearing cap. Remove the four screws holding the upper bearing cap in place. Remove the bearing cap. The steering knuckle can now be removed from the axle. Wash all parts in cleaning solvent. Replace any damaged or worn parts. Inspect the bearing and races for scores, cracks, or chips. Should the bearing cups be damaged, they may be removed and installed with Special Driver W-138, as shown in Fig. M-9.

M-9. Reassemble and Bearing Preload

Reverse the procedure of Par. M-8 to reassemble the unit. When reinstalling the steering knuckle, sufficient shims must be installed under the top bearing cap to obtain correct preload on the bearing. Shims are available in these thicknesses:

- .003" [0,076 mm.] .010" [0,254 mm.]
- .005" [0,127 mm.] .030" [0,762 mm.]

Install one each of the above shims at the top only. Install the bearing caps, lockwashers, and screws, and tighten securely.

Check the preload on the bearings by hooking a spring scale, Tool C-690, in the hole in the knuckle arm for the tie rod socket. Take the scale reading when the knuckle has just started its sweep.

The kingpin bearing preload should be 12 to 16 lb. [5,43 a 7,24 kg.] with the oil seal removed. Remove or add shims to obtain a preload within these limits.

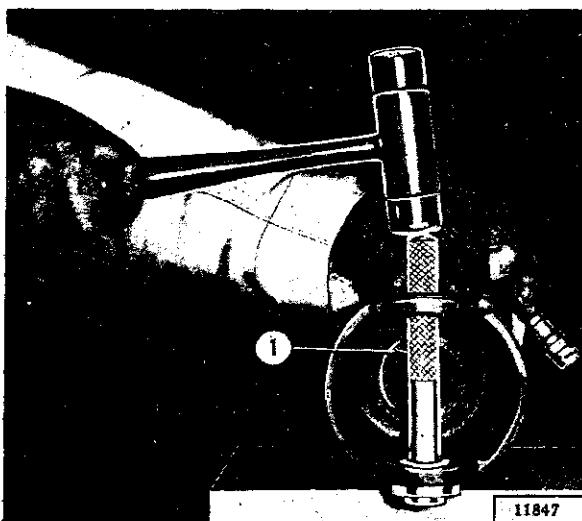


FIG. M-9—SPINDLE PIN BEARING CUP DRIVER
1—Tool W-138

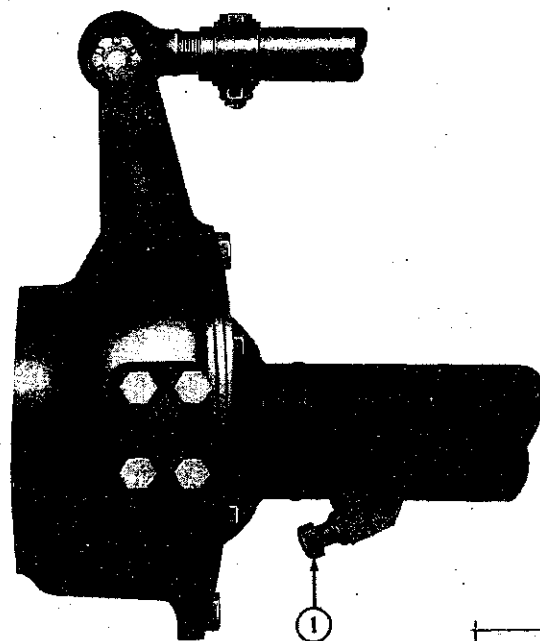


FIG. M-10—TURNING ANGLE STOP SCREW
1—Stop Screw

M-10. Replacing Steering Knuckle Oil Seal

Remove the old steering knuckle oil seal by removing the eight screws which hold it in place. Earlier production vehicles are equipped with seals consisting of two oil seal halves. Later production vehicles are equipped with oil seal assemblies consisting of a split oil seal and backing ring assembly, an oil seal felt, and two seal retainer plate halves. Examine the spherical surface of the axle for scores or scratches which could damage the seal. Smooth any roughness with emery cloth.

Before installing the oil seal felt, make a diagonal cut across the top side of the felt so that it may be slipped over the axle. Install the oil seal assembly in the sequence given above, making sure the backing ring (of the oil seal and backing ring assembly) is toward the wheel.

After driving in wet, freezing weather swing the front wheels from right to left to remove moisture adhering to the oil seal and the spherical surface of the axle housing. This will prevent freezing with resulting damage to the seals. Should the vehicle be stored for any period of time, coat these surfaces with light grease to prevent rusting.

M-11. AXLE SHAFT INSTALLATION

Refer to Fig. M-2.

Installation of the front right and left axle shaft is the same and is given in the following paragraphs.

- a. Clean all parts of dirt and foreign matter.
- b. Enter universal joint and axle shaft assembly in the axle housing, taking care not to knock out the inner oil seal. Enter the splined end of the axle shaft into the differential and push into place.

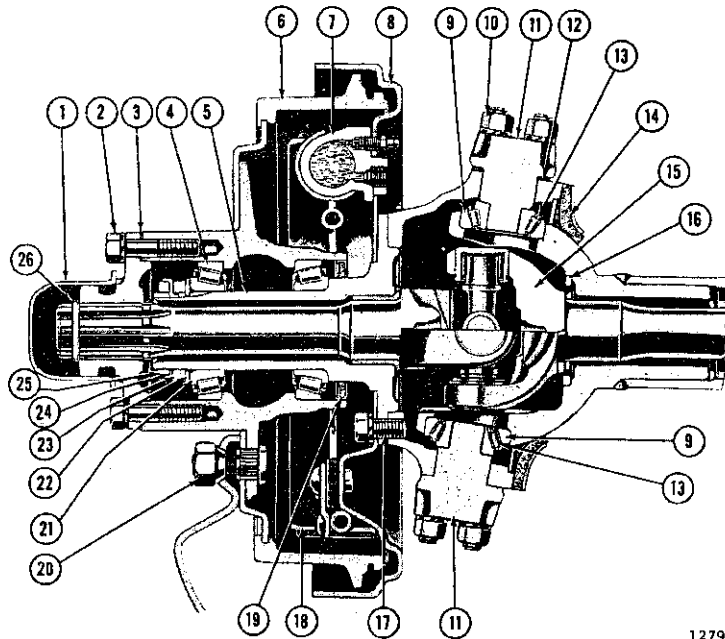


FIG. M-11—FRONT STEERING
KNUCKLE
(With Spicer Universal Joint)

- 1—Wheel Hub Cap
- 2—Driving Flange Cap Screw
- 3—Axle Shaft Drive Flange Gasket
- 4—Wheel Bearing Cup
- 5—Front Wheel Spindle
- 6—Brake Drum
- 7—Front Brake Cylinder
- 8—Brake Backing Plate
- 9—Pivot Pin Bearing Cap
- 10—Pivot Pin Bearing Cap Nut
- 11—Pivot Pin
- 12—Pivot Bearing Adjusting Shims
- 13—Pivot Pin Cone and Rollers
- 14—Steering Knuckle Oil Seal
- 15—Front Axle Universal Joint
- 16—Thrust Washer
- 17—Brake Backing Plate Screw
- 18—Brake Shoe and Lining
- 19—Hub Oil Seal
- 20—Wheel Hub Bolt Nut
- 21—Wheel Bearing Cone and Rollers
- 22—Wheel Bearing Washer
- 23—Wheel Bearing Retaining Nut
- 24—Wheel Adjusting Nut Lock Washer
- 25—Wheel Bearing Retaining Nut
- 26—Snap Ring

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- c. Install the wheel bearing spindle and bushing.
- d. Install brake backing plate.
- e. Grease and assemble wheel bearings and oil seal. 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 as shown in Fig. M-5, until there is a slight drag on the bearings when the hub is turned. Then back off approximately one-sixth of a turn. Install lock washer and nut, tightening nut into place, and then bend lip of lock washer over on the locknut.
- f. Install drive flange and gasket on hub and attach with six cap screws and lock washers. Install snap ring on outer end of axle shaft.
- g. Install hub cap.
- h. Install the wheel, lug nuts, and wheel disc.
- i. If tube was installed with axle assembly on vehicle, check front wheel alignment (Section O), bleed brakes (Section P), and lubricate front axle universal joints (Section B).

M-12. FRONT AXLE INSTALLATION

To install the front axle, reverse the procedures described in Par. M-4 and then perform the following operations:

- a. Torque spring clip plate (U-bolt) nuts securing the axle to the front springs, (see Par. M-4).
- b. Adjust and bleed the brakes (see Section P).
- c. Check axle lubricant level and fill as necessary, (see Section B).
- d. Check front end wheel alignment (see Section O).
- e. Check wheel turning angle. Refer to Par. M-14.

M-13. Steering Tie Rod and Bell Crank

These parts of the front axle are covered in Section O.

M-14. 4-Wheel Drive Turning Angle

Adjustment and service information regarding turning angles is covered in Section O.

M-15. 2-WHEEL-DRIVE FRONT AXLE

The front axle is of the reverse Elliot type. It is a steel forging, heat treated for strength and machined to close limits. The steering knuckles are mounted on pins which pass through openings at each end of the "I" beam and are locked securely in position with tapered pins and nuts. The knuckles ride on ball thrust bearings for ease of steering. See Figs. M-12, M-13.

The knuckles are connected by a tie rod which is mounted on ball and socket connections. The tie rod is adjustable to secure correct toe-in of the front wheels. A steering connecting rod connects the left knuckle arm with the steering gear arm. Standard caster and camber of the front wheels are built into the front axle. Wheel camber cannot be changed however, caster can be adjusted by placing tapered shims or wedges between the springs and spring seats. For complete information regarding the steering geometry refer to the Section O.

M-16. Removal of Solid Front Axle

Note: The procedure for removing the solid front axle varies slightly, depending on whether the springs are slung under or over the axle. These variations are noted in the following procedure.

- a. Raise the front end of the vehicle and safely support the frame behind the springs.
- b. Remove the wheels by removing the wheel discs and lug nuts.
- c. Disconnect the steering connecting rod at the ball and socket connection on the steering knuckle.

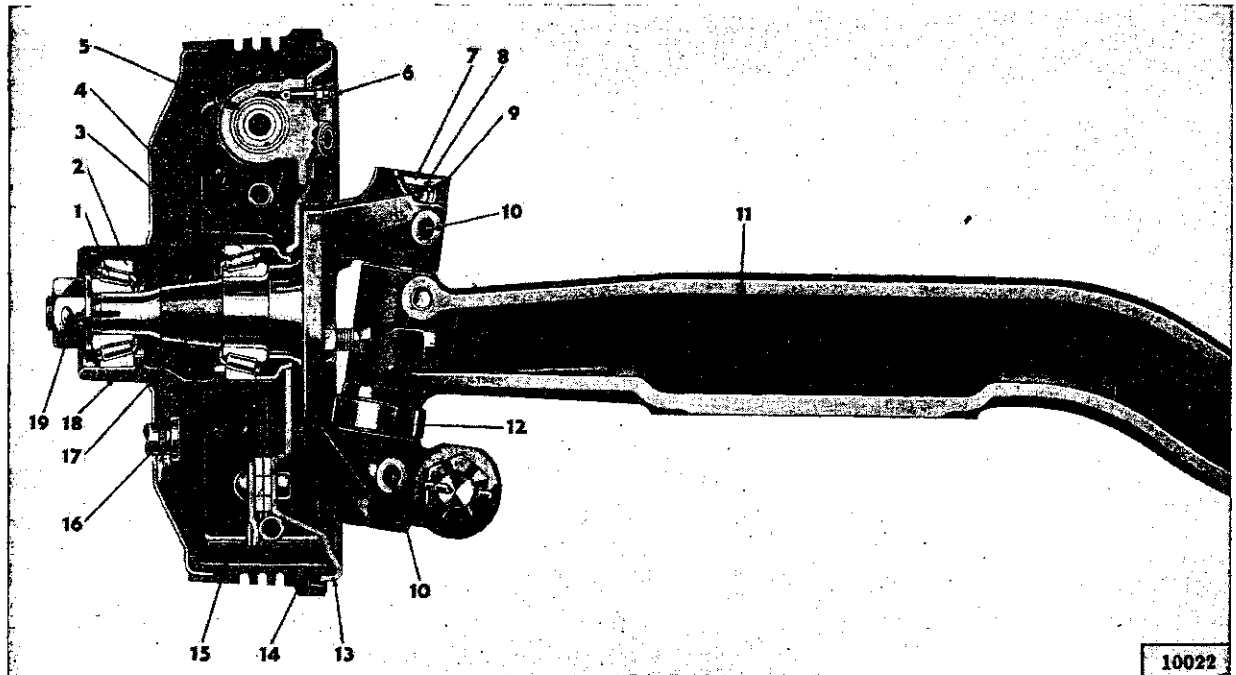


FIG. M-12—FRONT AXLE—EARLY MODEL DJ-5, DJ-6

- | | | |
|----------------------------------|---------------------------------|------------------------|
| 1—Outer Bearing Cone and Rollers | 7—Upper Expansion Plug | 13—Brake Backing Plate |
| 2—Outer Bearing Race | 8—Steering Knuckle Pin | 14—Brake Drum |
| 3—Inner Bearing Cone and Rollers | 9—Steering Knuckle Bushing | 15—Brake Shoe |
| 4—Inner Bearing Race | 10—Lubrication Fitting Opening | 16—Wheel Hub Bolt |
| 5—Wheel Brake Cylinder | 11—Front Axle I-Beam | 17—Spindle |
| 6—Bleeder Screw | 12—Steering Knuckle Pin Bearing | 18—Front Wheel Hub |
| | | 19—Spindle Nut |

- d. Disconnect the shock absorbers at the axle mounting pads.
- e. Disconnect the brake hydraulic hoses at the connections between front brake lines and flexible hoses.
- f. Support the axle assembly on a jack, ready for removal.

- g. On vehicles with the springs slung over the axle, remove the nuts from the spring to axle U-bolt clips, remove the spring clip plates, and slide the axle assembly from underneath the vehicle.
- On vehicles with the springs slung under the axle, remove the nuts from the spring clips and remove the spring clip plates. Then disconnect the spring

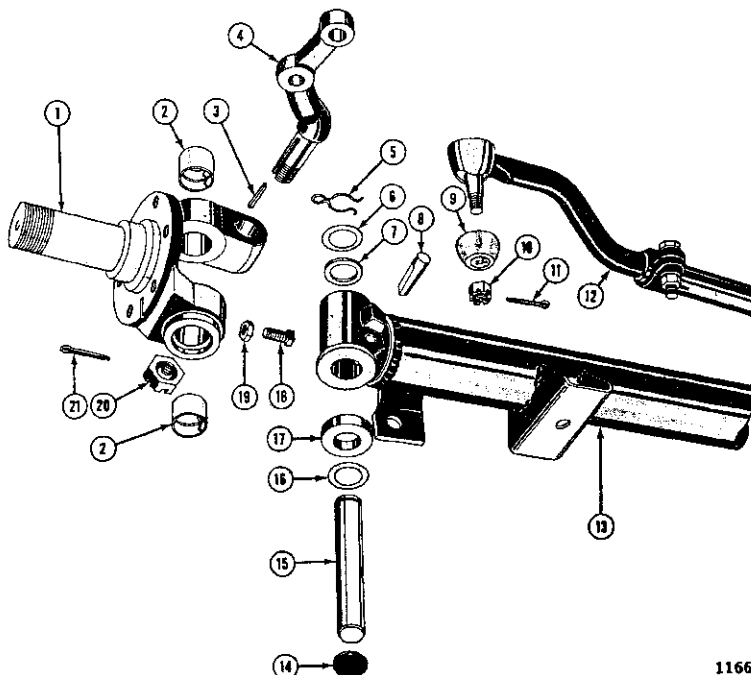


FIG. M-13—FRONT AXLE, LATE MODEL DJ-5, DJ-6

- 1—Steering Knuckle
- 2—Steering Knuckle Bushing
- 3—Key
- 4—Steering Arm
- 5—Lock Spring
- 6—Oil Seal Retainer
- 7—Oil Seal
- 8—Tapered Pin
- 9—Dust Cover
- 10—Nut
- 11—Cotter Pin
- 12—Tie Rod
- 13—Axle Tube
- 14—Plug
- 15—Steering Knuckle Pin
- 16—Shim
- 17—Thrust Bearing
- 18—Bolt
- 19—Nut
- 20—Nut
- 21—Cotter Pin

from the spring shackles by removing the lower spring shackle bolts. Lower the front springs to the floor and slide the axle assembly from underneath the vehicle.

M-17. STEERING KNUCKLE SERVICE

The following procedures are given for steering knuckle service when the axle is installed on the vehicle. With the axle removed, eliminate the appropriate steps.

M-18. Steering Knuckle Pin Replacement

Refer to Figs. M-12, M-13.

The only parts of the front axle, subjected to wear which may require replacement are the steering knuckle pins and bushings. To accomplish this replacement follow the procedure outlined below.

- a. Jack up the front of the vehicle to free the wheels. Install axle stands under the front axle for safety.
- b. Remove the hub cap and dust cap.
- c. Remove the wheel retaining cotter pin, nut, and washer.
- d. Remove the wheel with hub, bearings, and oil retainer.
- e. Disconnect the hydraulic brake tube.
- f. Remove the brake backing plate.

- g. Remove the tapered steering knuckle pin lock.
- h. Remove the upper steering knuckle expansion plug on early models, or the lock spring on late models.

- i. Drive the Steering Knuckle Pin and lower expansion plug out through the bottom. When the spindle is disassembled, do not lose the spacing shim between the upper face of the axle and the spindle.

- j. Remove the thrust bearing and bushings.

- k. Assemble in reverse order. Be sure the oil holes in the bushings are aligned with the lubrication fittings. Ream the bushings for running clearance with the steering knuckle pin. Check the thrust bearing to be sure it is not worn or damaged. When installing the steering knuckle pin, align the notch for the tapered retaining pin with the pin hole. When assembling the knuckle, guard against lost motion between the axle and inner face of the knuckle. Adjustment is made by selective fitting of the spacing shim between the upper face of the axle and the inner face of the knuckle. Shims are available in the following thicknesses:

.011" [0,279 mm.]	.035" [0,889 mm.]
.033" [0,838 mm.]	

Do not overlook bleeding the brakes after the axle end has been reassembled.



**AUTHENTIC
RESTORATION
PRODUCT**

M-19. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Hard Steering	
Lack of Lubrication.....	Lubricate
Tires Soft.....	Inflate
Tight Steering.....	Adjust. See "Steering" Section
Low Speed Shimmy or Wheel Fight	
Spring Clips and Shackles Loose.....	Readjust or Replace
Front Axle Shifted.....	Broken Spring Center Bolt
Insufficient Toe-In.....	Adjust
Improper Caster.....	Reset
Steering System Loose or Worn.....	Adjust or Overhaul Steering Gear, Front Axle or Steering Parts
Twisted Axle.....	Straighten or Adjust
High Speed Shimmy or Wheel Fight	
Check Conditions Under "Low Speed Shimmy"	
Tire Pressures Low or not Equal.....	Inflate
Wheel Out of Balance.....	Balance
Wheel Runout.....	Straighten
Radial Runout of Tires.....	Mount Properly
Wheel Camber.....	Same on Both Wheels
Front Springs Settled or Broken.....	Repair or Replace
Bent Steering Knuckle Arm.....	Straighten or Replace
Shock Absorbers not Effective.....	Replace or Repair
Steering Gear Loose on Frame.....	Tighten
Front Springs too Flexible.....	Over Lubricated
Tramp	
Wheels Unbalanced.....	Check and Balance
Wandering	
Improper Toe-in.....	Adjust—Check for Bent Steering Knuckle Arm
Broken Front Spring Main Leaf.....	Replace
Axle Shifted.....	Spring Center Bolt Broken
Loose Spring Shackles or Clips.....	Adjust or Replace
Improper Caster.....	Reset
Tire Pressure Uneven.....	Inflate
Tightness in Steering System.....	Adjust
Loose Wheel Bearings.....	Adjust
Front Spring Settled or Broken.....	Repair or Replace
Axle Noisy on Pull	
Pinion and Ring Gear Adjusted too Tight.....	Readjust
Pinion Bearings Rough.....	Replace
Axle Noisy on Coast	
Excessive Back Lash at Ring and Pinion Gears.....	Readjust
End Play in Pinion Shaft.....	Readjust
Rough Bearing.....	Replace
Axle Noisy on Coast and Pull	
Ring and Pinion Adjusted too Tight.....	Readjust
Pinion Set too Deep in Ring Gear.....	Readjust
Pinion Bearing Loose or Worn.....	Readjust or Replace
Back Lash	
Axle Shaft Universal Joint Worn.....	Replace
Axle Shaft Improperly Adjusted.....	Readjust
Worn Differential Pinion Washers.....	Replace
Worn Propeller Shaft Universal Joints.....	Repair

Emergency

Where difficulty is experienced with front axle differential making the vehicle inoperative, remove axle driving flanges. This will allow bringing vehicle in under its own power. Be sure the transfer case shift lever is in the neutral (disengaged) position.

M-20. FRONT AXLE SPECIFICATIONS

MODEL:	Four Wheel Drive Models	Two Wheel Drive Models
Front Axle: Make..... Model..... Capacity..... Description.....	Dana 27AF 2000 lb. [907 kg.] Full-floating Hypoid Gears	Clark 130097 2000 lb. [907 kg.] Reverse Elliot
Universal Joints: Make..... Type..... King Pin Bearing Preload.....	Spicer Cardan Cross 12 to 16 lb. [5,44 a 7,25 kg.]	
Differential: Drive Pinion Offset..... Number of Differential Pinions..... Gear Ratio: F4 Engine Standard..... Optional..... V-6 Engine Standard..... Optional..... Ring Gear Pitch Diameter..... Pinion Adjustment..... Pinion Bearing Adjustment.....	1.38" [35,05 mm.] 2 4.27:1 5.38:1 3.73:1 4.88:1 7.12" [19,05 cm.] Shim Shim	


AUTHENTIC
RESTORATION
PRODUCT

REAR AXLE

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N-1. GENERAL

A semifloating rear axle assembly is standard on all Jeep Universal Series vehicles. Two models of similar design rear axles are used. See Specifications Chart, Par. N-38, for description and ratio. The axle model number is cast into the housing as



FIG. N-1—AXLE MODEL IDENTIFICATION

illustrated in Fig. N-1. A metal tag under two adjacent differential housing cover cap screws is stamped to identify the number of teeth in the drive gear and pinion and notes the axle ratio. A

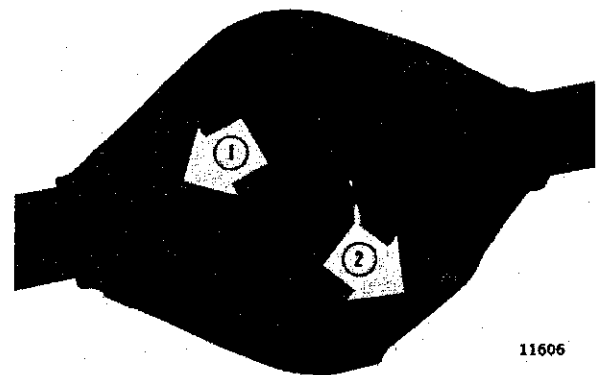


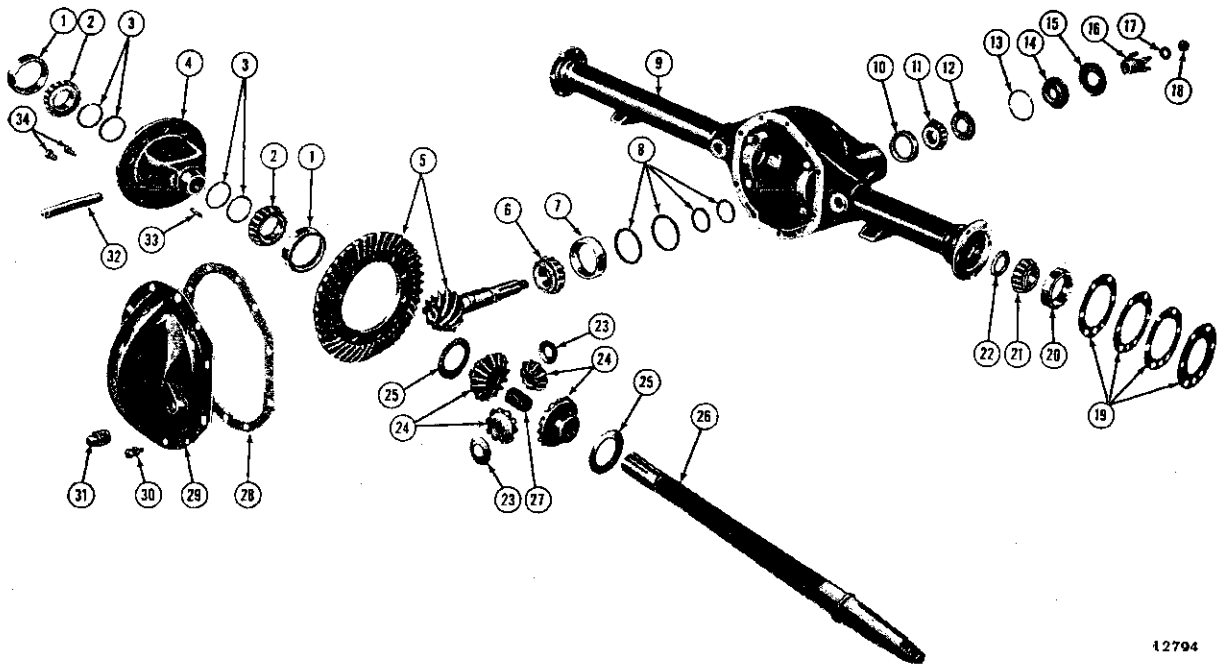
FIG. N-2—RATIO, POWR-LOK AND TRAC-LOK DIFFERENTIAL IDENTIFICATION

1—Ratio Tag 2—Powr-Lok or Trac-Lok Tag

N-2. REAR AXLE SHAFT REMOVAL AND INSTALLATION (Semi-Float Tapered Shaft)

Procedure for removing the rear axle shafts is as follows:

- a. Jack up the wheel and remove the hub cap.
- b. Remove wheel.



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FIG. N-3—SEMI-FLOATING REAR AXLE -- TAPERED SHAFT

- | | | |
|--|-----------------------------|------------------------------|
| 1—Differential Bearing Cup | 12—Oil Slinger | 23—Thrust Washer |
| 2—Differential Bearing Cone and Rollers | 13—Gasket | 24—Differential Pinion Gears |
| 3—Shims | 14—Pinion Oil Seal | 25—Thrust Washer |
| 4—Differential Case | 15—Dust Shield | 26—Axle Shaft |
| 5—Ring Gear and Pinion | 16—Yoke | 27—Thrust Block |
| 6—Pinion Inner Bearing Cone and Rollers | 17—Flat Washer | 28—Gasket |
| 7—Pinion Inner Bearing Cup | 18—Pinion Nut | 29—Housing Cover |
| 8—Pinion Shims | 19—Wheel Bearing Shims | 30—Screw and Lock Washer |
| 9—Axle Housing | 20—Bearing Cup | 31—Filler Plug |
| 10—Pinion Outer Bearing Cup | 21—Bearing Cone and Rollers | 32—Differential Shaft |
| 11—Pinion Outer Bearing Cone and Rollers | 22—Oil Seal | 33—Lock Pin |
| | | 34—Ring Gear Screw |

- c. Remove the axle shaft cotter pin, castle nut, and flat washer.
- d. Back off on brake adjustment eccentric.

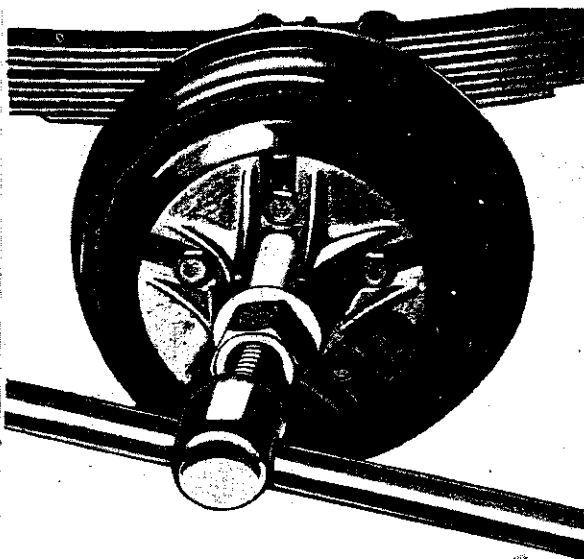


FIG. N-4—WHEEL HUB PULLER

- e. Use Wheel Hub Puller C-319 to remove the wheel hub as shown in Fig. N-4.
 - f. Remove the screws attaching the brake dust protector, grease and bearing retainers, brake assembly, and shim to the housing.
 - g. Remove the hydraulic line from the brake assembly.
 - h. Remove the dust shield and oil seal.
 - i. Using Tool C-637 and Adapter Tool SP-342, remove the axle shaft bearing cone, roller, and cup as shown in Fig. N-5.
 - j. Should an axle shaft be broken, the inner end can usually be drawn out of the housing with a wire loop after the outer oil seal is removed. However, if the broken end is less than 8" [20,3 cm.] long it will usually be necessary to remove the differential assembly.
- To remove the bearing from an axle shaft, use Combination Bearing Puller W-104-B shown in Fig. N-6.
- Installation is the reverse of removal.

Note: Place the hub and drum on the axle shaft taper and then insert the axle shaft key in the keyway. Never install the key in the keyway before placing the hub and drum assembly on the axle shaft. Further, be sure that the axle shaft nut is torqued to a minimum of 150 lb-ft. [21 kg-m.].

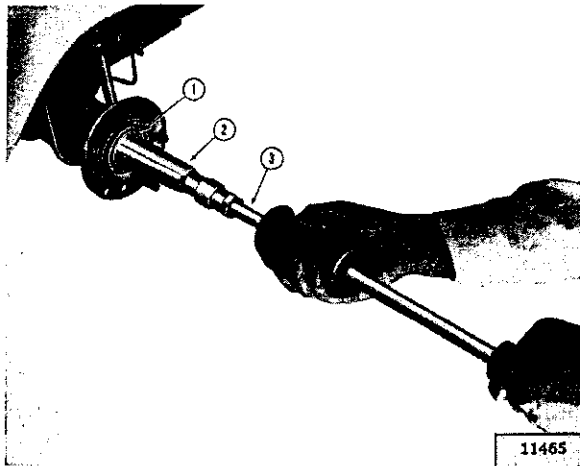


FIG. N-5—REMOVING TAPERED AXLE SHAFT
1—Cone and Roller 2—Axle 3—Tool C-637

Check the shaft oil seal before installing the rear axle. If replacement is necessary, use Axle Shaft Oil Seal Driver W-186, Fig. N-17. Before installing the axle shaft nut cotter pin, adjust the wheel bearings as outlined in Section Q.

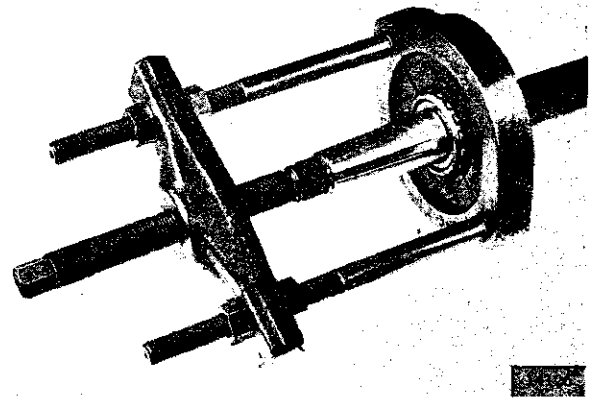


FIG. N-6—REMOVING AXLE SHAFT BEARING — TAPERED SHAFT

**N-3. Rear Axle Shaft Removal
(Semi-Float-Flanged Shaft)**

- a. Jack up vehicle and remove wheels.
- b. Remove brake drum.
- c. Remove axle shaft flange cup plug by piercing the center with a sharp tool and prying it out.
- d. Using access hole in axle shaft flange remove

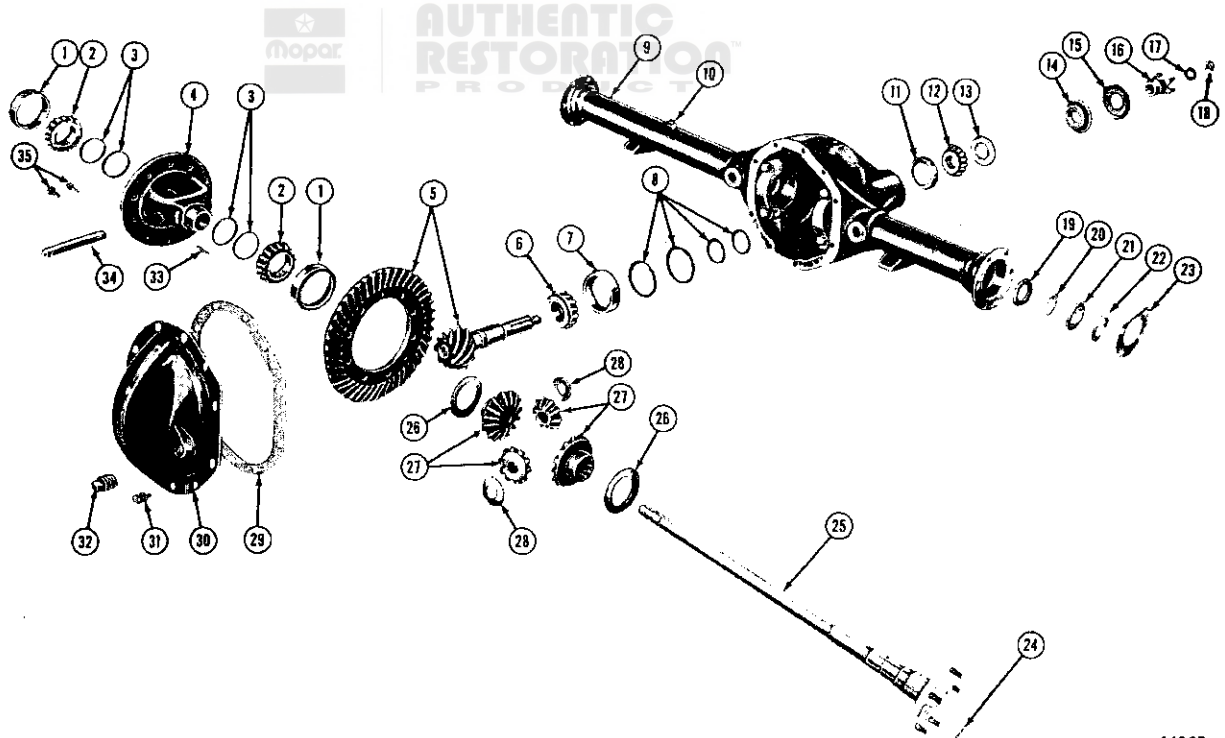
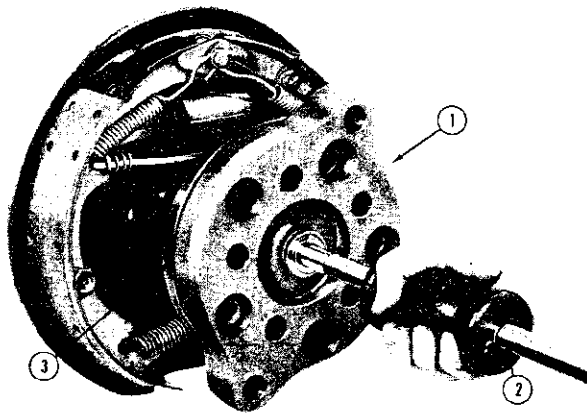


FIG. N-7—SEMI-FLOAT REAR AXLE ASSEMBLY — FLANGED SHAFT

- | | | |
|-----------------------------|------------------------------|------------------------------|
| 1—Differential Bearing Cup | 13—Oil Slinger | 25—Axle Shaft |
| 2—Differential Bearing | 14—Pinion Oil Seal | 26—Thrust Washer |
| 3—Shims | 15—Dust Shield | 27—Differential Pinion Gears |
| 4—Differential | 16—Yoke | 28—Thrust Washer |
| 5—Ring Gear and Pinion | 17—Flat Washer | 29—Gasket |
| 6—Pinion Inner Bearing | 18—Pinion Nut | 30—Housing Cover |
| 7—Pinion Inner Bearing Cup | 19—Axle Housing Oil Seal | 31—Screw and Lockwasher |
| 8—Pinion Shims | 20—Axle Shaft Retainer Ring | 32—Filler Plug |
| 9—Axle Housing | 21—Axle Shaft Bearing | 33—Lock Pin |
| 10—Breather | 22—Axle Shaft Oil Seal | 34—Differential Shaft |
| 11—Pinion Outer Bearing Cup | 23—Axle Shaft Retainer Plate | 35—Ring Gear Screw |
| 12—Pinion Outer Bearing | 24—Axle Shaft Cup Plug | |

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FIG. N-8—REMOVING FLANGED AXLE SHAFT

- 1—Flange Adapter Tool W-343
 2—Tool C-637
 3—Axle Flange

nuts attaching backing plate and retainer to axle tube flange.

e. Attach axle shaft adapter tool W-343 and slide hammer handle C-637 to axle shaft flange and remove axle shaft, as shown in Fig. N-8.

Caution: Should a bearing disintegrate on the axle shaft because of inadequate lubrication, the axle shaft and housing assembly must be carefully inspected for possible damage before new parts are installed.

If the bearing cone (inner race) is seized (cold welded) onto the axle shaft due to excessive overheating, the axle shaft must be discarded and a new axle shaft and bearing assembly installed.

Note: Make certain the bearing cup has been removed from the axle housing.

f. Remove axle shaft oil seal from axle housing tube using tool C-637.

g. Wipe axle housing tube seal bore clean and install a new oil seal using driver tool W-186, as shown in Fig. N-17.

N-4. UNIT BEARING

Basically, there are five parts to a Unit Bearing assembly: the cup, or outer race, the cone, or inner race, the tapered rollers which roll freely between the cup and cone, and the cage which serves as a retainer to maintain the proper spacing between the tapered rollers grouped around the cone.

When the bearing is manufactured, the cup and rib ring are bonded together with an adhesive to facilitate bearing handling and installation. Since the cup and rib ring are clamped together in the axle housing, there is no need for a permanent bond. When the bearing is serviced the cup will usually be separated from the rib ring.

The bearing is held on the shaft by the press fit of the cone plus the press fit of the retainer ring. The cup and rib ring are clamped together in the axle housing through the outboard seal by the retainer plate. The outboard seal wipes on the rotat-

ing axle shaft and at the same time functions as a static seal to prevent lubricant from escaping between the housing and the seal outside diameter. It's important to note that the seal serves also as a "spacer" or "filler" in the clamp-up of the bearing in the axle housing.

Note: All Unit Bearings are manufactured with built-in adjustment for axle shaft end play. No adjustment shims are necessary when installing a flange type axle shaft.

N-5. Servicing Unit Bearing

The Unit Bearing assembly should be serviced each 12,000 miles [19,200 km.] with bearing cleaning, inspection and relubrication. The Unit Bearing requires little attention while in service if the bearings have been properly installed and are adequately lubricated.

● Cleaning and Inspection

a. The Unit Bearing assembly should not be removed from the axle shaft unless the outer seal is defective, the retainer plate is distorted or damaged, or the Unit Bearing is defective.

Should it be necessary to remove the Unit Bearing from the axle shaft for any of these reasons, refer to Par. N-7 for proper Unit Bearing removal.

b. Clean bearing cup with solvent and inspect cup for any possible wear, nicks or damage.

c. The bearing assembly can be cleaned in place on the axle shaft. Use cleaning solvent and a stiff bristle brush to loosen the old grease. To assure removal of old grease and any contamination that might be present, use compressed air. Air should be directed at the bearing assembly so that it goes through the bearing from one end of the rollers to the other. It is important not to "spin dry" the bearing with compressed air. Spinning the dry bearing may score the raceways and rollers due to lack of lubricant.

d. Use cleaning solvent to clean out the bearing and oil seal bore in the housing. Wipe the area clean making sure it is free from old grease or other contamination that might be present.

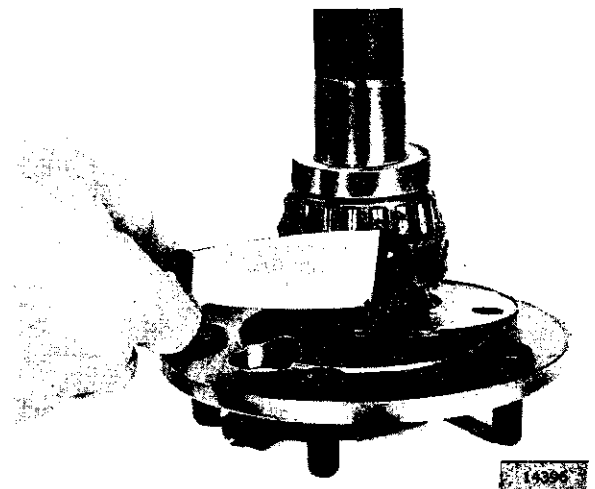


FIG. N-9—LUBRICATING BEARING

N-6. Lubricating Unit Bearing

- a. After the bearing has been inspected and approved for continued service, it must be relubricated prior to re-installation into the axle housing. The Unit Bearing assembly can be hand packed with grease on the axle shaft by the method outlined below. Lithium soap wheel bearing grease Part No. 998386 should be used to relubricate Unit Bearing assembly.
- b. Push seal away from bearing and fill the area or cavity between the seal and bearing with the recommended grease. Refer to Fig. N-9.
- c. After the cavity is full of grease, wrap tape completely around the rib ring and seal to enclose the cavity as shown in Fig. N-10.

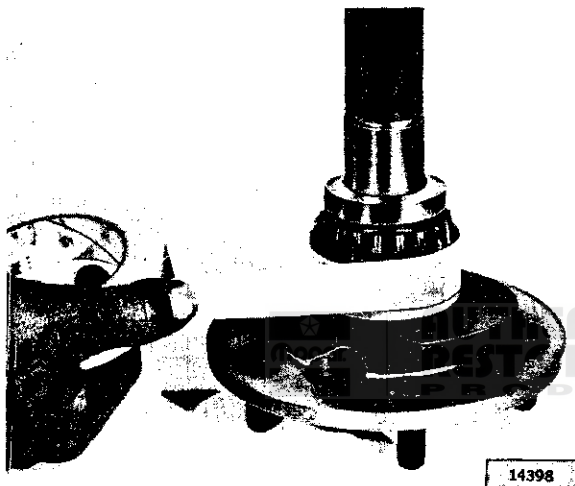


FIG. N-10—APPLYING TAPE TO BEARING AND SEAL

- d. With the tape in place, push the seal upward toward the bearing assembly forcing the grease between the rollers and through the bearing assembly, make certain the bearing assembly is packed completely full of grease. Refer to Fig. N-11.

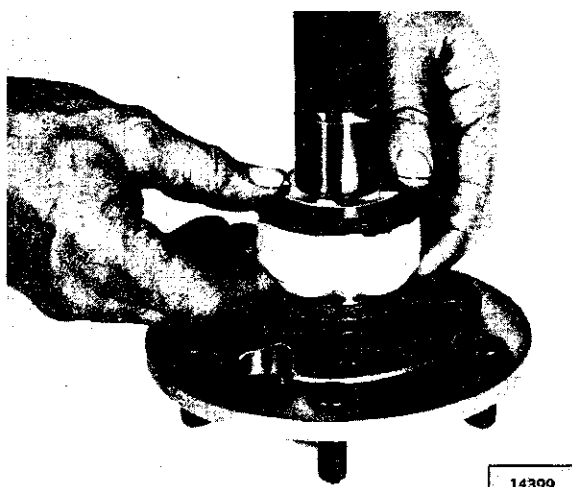


FIG. N-11—FORCING GREASE INTO BEARING

- e. Remove tape and apply additional grease to the outside surfaces of the rollers and cage as shown in Fig. N-12.

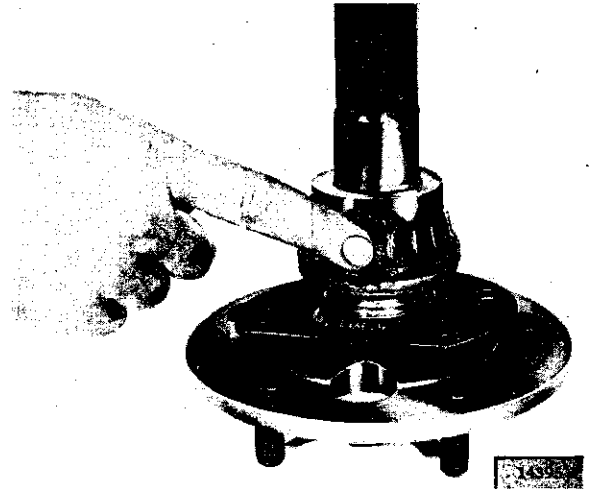


FIG. N-12—APPLYING GREASE TO ROLLERS

- f. Grease should also be applied to the inboard grease seal in the axle housing and in the cavity between the inboard grease seal and the bearing. The bottom one-third of this cavity should be filled with grease.
- g. Install the axle shaft and bearing assembly into axle housing as described in Par. N-8. This completes the servicing of the axle shaft Unit Bearing.

N-7. Unit Bearing Removal

If it is necessary to remove the Unit Bearing assembly from the axle shaft, the procedure outlined below should be followed.

Caution: Under no circumstances should axle shaft retaining rings or bearings be removed using a torch, because heat fed into the axle shaft bearing journal weakens this area.

- a. Place the axle shaft assembly in a heavy vise. Drill a 1/4 inch [6,35 mm.] hole in the outside diameter of the retainer ring to a depth approximately 3/4 the thickness of the retainer ring. DO NOT drill all the way through the retainer ring because the drill could damage the axle shaft. After drilling the retainer ring, use a chisel positioned across the drilled hole and cut a deep groove into the retainer ring. This will enlarge bore of retainer ring or split the ring and permit it to be driven off of the axle shaft. Refer to Fig. N-13.
- b. Using a hacksaw, cut through the oil seal, being careful not to damage the seal contact surface. Remove oil seal from axle shaft.

Important: 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.

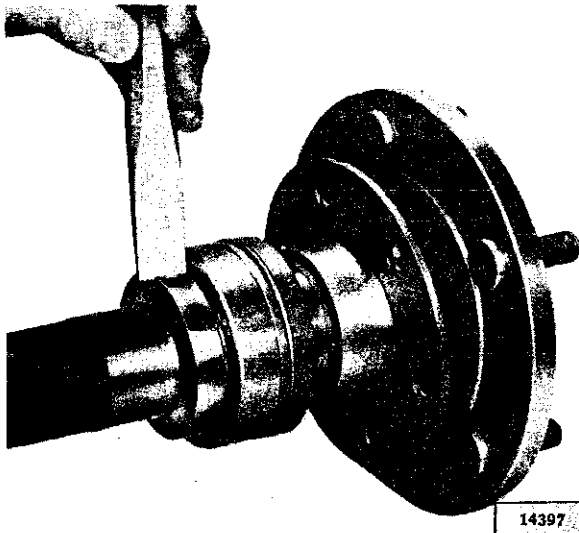


FIG. N-13—NOTCHING BEARING RETAINING RING

c. Attach puller tool W-343 to axle shaft flanged end using the wheel lug nuts. Position puller bolts against dimples of holding ring and alternately tighten until bearing is pressed from shaft, as shown in Fig. N-14.

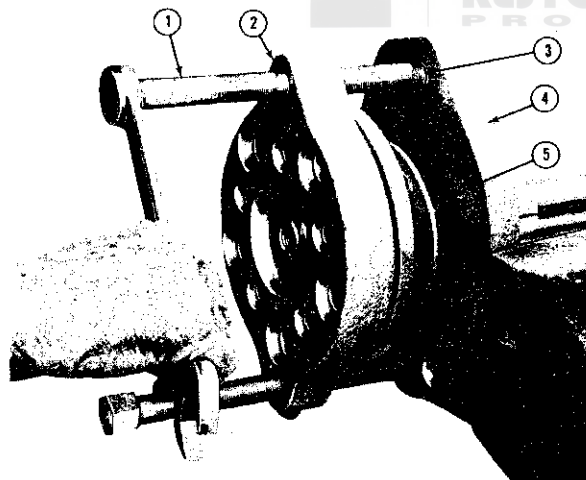


FIG. N-14—REMOVING AXLE SHAFT BEARING

- 1—Bolt
- 2—Flange Adapter
- 3—Dimple in Holding Ring
- 4—Holding Ring
- 5—Adapter Plates

N-8. Rear Axle Shaft and Bearing Installation (Semi-Float-Flanged Shaft)

- a. Inspect the axle shaft oil seal journal for scratches and polish with fine crocus cloth if necessary.
- b. Install retainer plate on the axle shaft.
- c. Apply grease to the new oil seal cavity between the seal lips and carefully slide seal, on the axle

shaft seal seat. The outer face of the seal must be toward the axle flange.

- d. Pack the new bearing full of grease prior to installation, using the proper lubricant.
- e. Install the unit bearing on the axle shaft making certain the cup rib ring is facing the axle flange.
- f. Install the new bearing retainer ring on the axle shaft.
- g. Using puller tool W-343, press the new axle shaft bearing and retainer ring on the axle shaft simultaneously. Tighten puller bolts alternately until the bearing and retainer ring are properly seated against the shaft shoulder. Refer to Fig. N-15 and N-16.

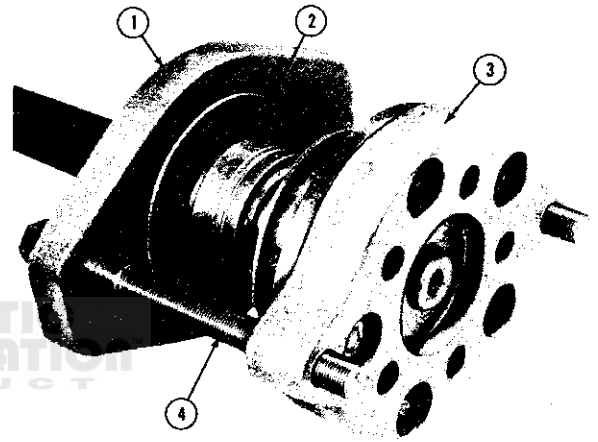


FIG. N-15—INSTALLING AXLE SHAFT BEARING

- 1—Holding Ring
- 2—Adapter
- 3—Flange Adapter
- 4—Bolt

Note: Make certain the old bearing cup has been removed from the axle housing before the axle shaft and new unit bearing is installed into the axle housing.

- h. Install axle shaft through the backing plate using care not to damage the axle housing tube inner oil seal.
- i. Apply a thin coating of lubricant to the outside diameter of the bearing cup prior to installing in the bearing bore.
- j. Tap end of flanged shaft lightly with a rawhide mallet to position the axle shaft bearing in the housing bearing bore.
- k. Attach the axle shaft retainer and brake backing plate to the axle tube flange. Secure with nuts and lockwashers. Torque 25 to 35 lb. ft. [3,4,4,8 kg-m.].
- l. Install a new cup plug into the axle shaft flange hole.
- m. Install the brake drum, and rear wheel assembly.

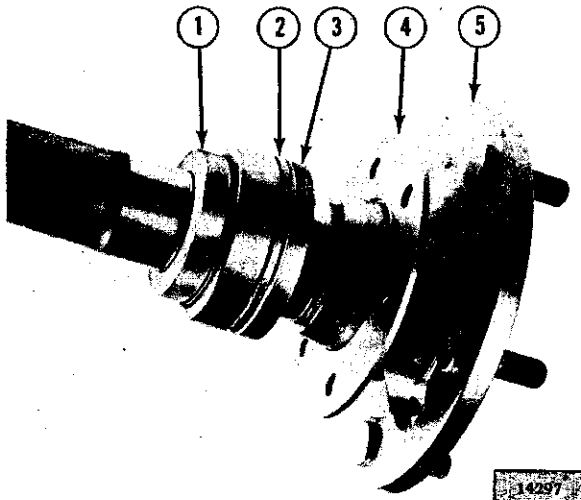


FIG. N-16—AXLE SHAFT BEARING INSTALLED

- 1—Retainer Ring
- 2—Unit Bearing
- 3—Seal
- 4—Retainer Plate
- 5—Axle Shaft Flange

N-9. REAR AXLE ASSEMBLY

The following paragraphs (Pars. N-9 through N-19) describe the removal, disassembly, assembly and services performed on rear axle assemblies having conventional differentials. Pars. N-20 through N-32 describe the services to be performed on rear axle assemblies having Powr-Lok and Trac-Lok differentials.

Note: The full floating front axle differential assembly is similar to the rear axle differential and is removed, inspected, disassembled, and assembled in the same manner as the rear axle differential covered in this section.

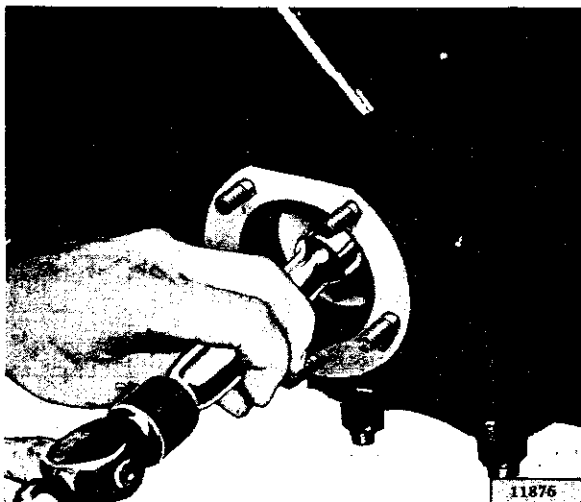


FIG. N-17—OIL SEAL DRIVER

Note: The pinion shaft oil seal is serviced in the vehicle when replacement is necessary. Refer to Fig. N-18.

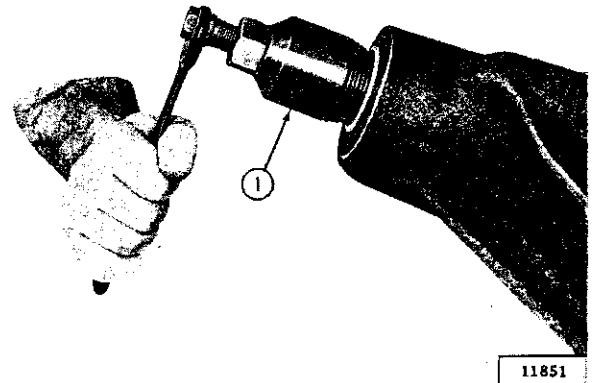


FIG. N-18—REMOVING PINION SHAFT OIL SEAL

1—Tool W-251

N-10. Inspection

Refer to Fig. N-3 and N-7.

Before disassembling the differential, it is advisable to determine through inspection the cause of the failure. Inspection procedure is as follows:

- a. Drain lubricant and remove housing cover and gasket.
- b. Clean the differential parts thoroughly with solvent.
- c. Carefully inspect all parts.

Should it be determined by inspection that the differential requires overhauling, the axle must first be removed from the vehicle.

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 the grade and quantity of lubricant specified in the Lubrication Chart.

After the axle has been installed in the vehicle, check to be sure the lubricant level in the differential is up to the filler plug opening.

N-11. Rear Axle Removal

To remove the rear axle, proceed as follows:

- a. Raise the rear of the vehicle with a hoist. Safely support the frame ahead of the rear springs.
- b. Remove the wheels.
- c. Disconnect the propeller shaft at the rear yoke.
- d. Disconnect the shock absorbers at the axle mounting.
- e. Disconnect the brake hydraulic hose at the tee fitting on the axle just below the left frame side rail. Tape ends of hose to keep out dirt.
- f. Disconnect the parking brake cable at the frame mounting. DJ models only.
- g. Support the axle housing on a jack.
- h. Remove the axle U-bolts.
- i. Slide the axle from under the vehicle.

N-12. Differential Case Disassembly

Refer to Fig. N-3 and N-7.

- a. Remove the axle shafts. Refer to Par. N-11 for rear axle removal and Par. M-4 for front axle removal.
- b. Remove the housing cover and four cap screws holding the two differential side bearing caps in position. Make sure there are matching letters or some type of identification marks on the caps and housing so that each cap can be reinstalled in the same position and location from which it is removed.
- c. Use Spreader W-129, as shown in Fig. N-19, to spread the housing. Install Hold-Down Clamps W-129-18, if available, to keep the spreader in position. Clamp on a dial indicator. From the side, measure the carrier spread. Do not spread the carrier more than .020" [0,508 mm.].
- d. Remove the dial indicator.

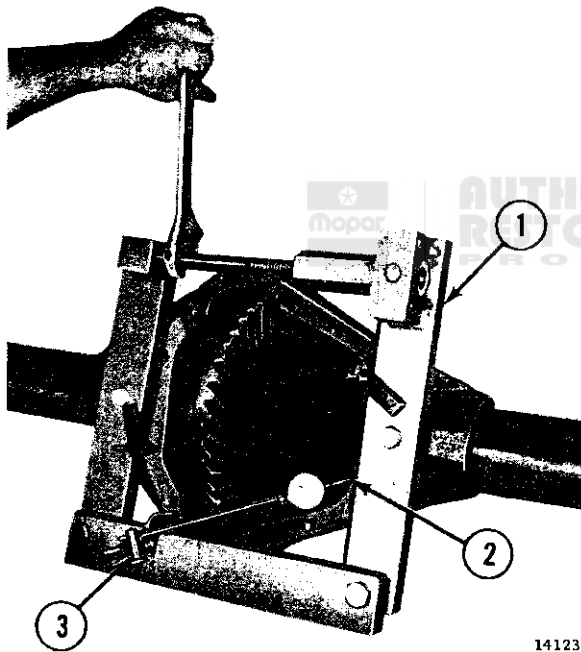


FIG. N-19—DIFFERENTIAL CARRIER SPREADER TOOL W-129

- 1—Spreader W-129
- 2—Dial Indicator and Pointer
- 3—Dial Indicator Clamp

Note: When removing the axle differential from the rear axle housing, use Spreader Tool No. W-129.

- e. Carefully pry the differential case loose, using pry bars at the heads of the ring gear bolts and carrier casting.
- f. Remove spreader immediately to prevent the possibility of the carrier taking a set.
- g. Remove the screws holding the ring gear to the differential case.
- h. With a small punch, as shown in Fig. N-20, drive out the lock pin.



FIG. N-20—REMOVING LOCK PIN

- i. Remove the differential shaft and thrust block.
- Note:** Thrust block used with semi-float tapered axle shaft only. Refer to Fig. N-3.
- j. Carefully so as not to lose the thrust washers, remove the differential pinion gears.
 - k. With Tool C-3281 to hold the shaft as shown in Fig. N-21, remove the nut. With Puller W-172 remove the yoke as shown in Fig. N-22.
 - l. Using a rawhide hammer, drive on the end of the pinion shaft to force the pinion out of the differential housing.

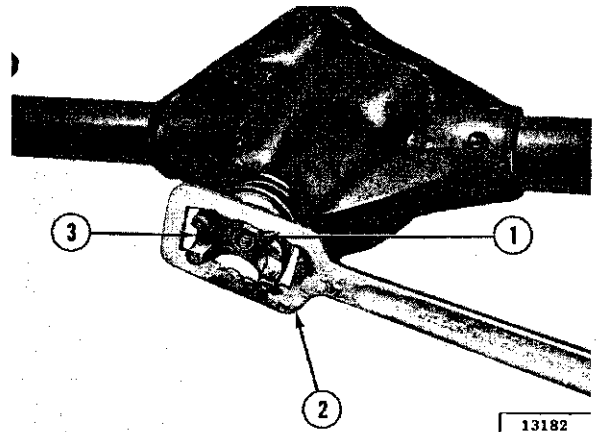


FIG. N-21—END YOKE HOLDING WRENCH

- 1—Nut
- 2—Wrench C-3281
- 3—Yoke

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 reassembly.

- m. Remove outer pinion bearing cone, baffle and oil seal by using a 2" x 2" piece of hardwood or a length of pipe and drive out through the neck of the carrier housing. Discard seal.

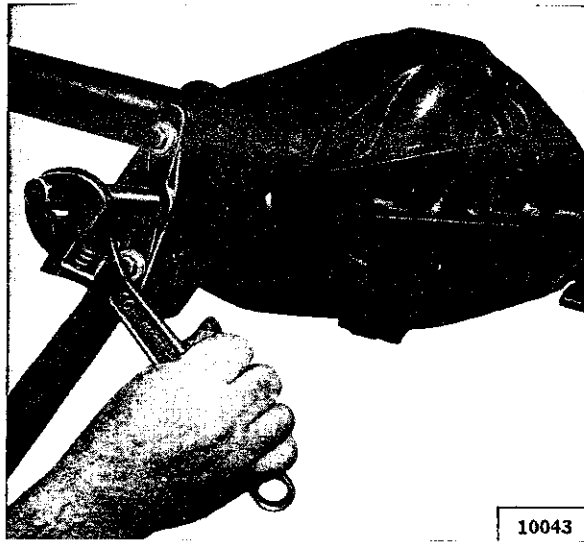


FIG. N-22—END YOKE PULLER

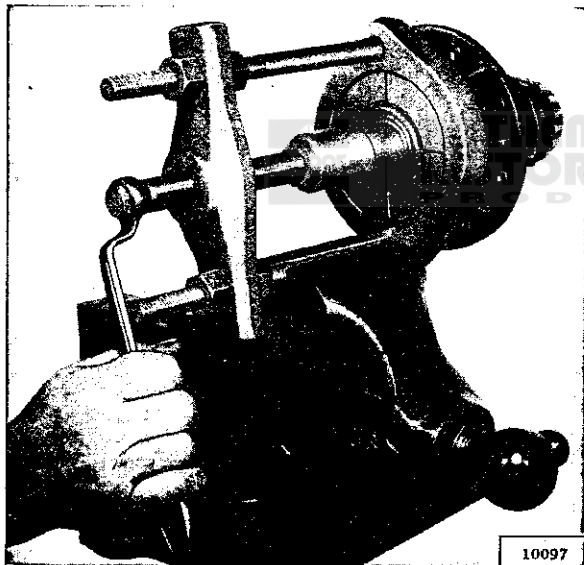


FIG. N-23—REMOVING CONE AND ROLLER WITH PULLER

N-13. Pinion and Differential Case Bearing Removal

To remove the differential bearing cones and rollers and pinion inner bearing cone and roller, use Bearing Puller W-104-B with proper adapters as shown in Fig. N-23 and N-24. Use of the puller and adapters assures easy removal of bearings without damage to cone rollers as pulling pressure is applied directly to the bearing cone. The information outlined below references the axle model and adapter plate number used with Puller W-104-B when removing tapered roller bearings from the axle assembly components.

Axle Model	Axle Shaft Bearing (Tapered Shaft)	Pinion Bearing	Differential Side Carrier Bearing
27	# 41 Adapter	# 40 Adapter	# 39 Adapter with SP-1100
44	# 13 Adapter	# 21 Adapter	# 18 Adapter with SP-1100

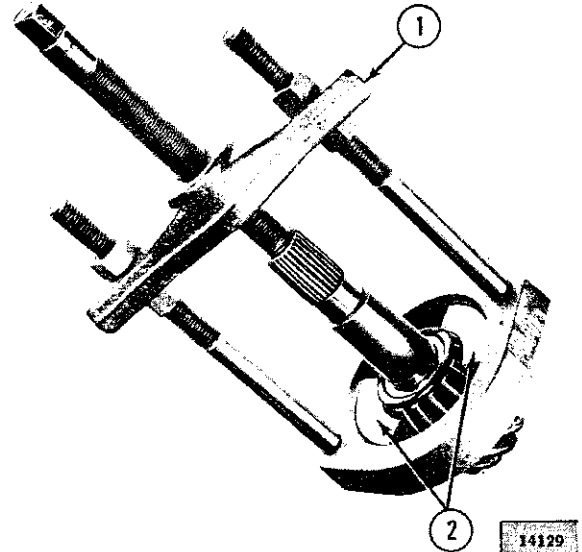


FIG. N-24—PULLING PINION INNER BEARING

1—Puller Tool W-104-B
2—Adapters

N-14. 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 bearing cups from the housing.

- a. Using a brass drift, drive the pinion inner bearing cup and shims from the housing. Even if mutilated, these shims should be kept for proper assembly of differential.
- b. Using a brass drift, drive the outer pinion cup from the housing.

N-15. Cleaning and Inspection

- a. Clean all parts in fast evaporating mineral spirits or a dry cleaning solvent and with the exception of bearings, dry with compressed air.
- b. Inspect differential bearing cones, cups and rollers for pitting, galling or other visible damage.
- c. 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.
- d. 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
- e. 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.

f. Inspect axle shaft thrust block for excessive wear or visible damage. The wear surface on the opposite ends of the blocks, must be smooth.

Note: Thrust block used with semi-float tapered axles only.

g. Inspect differential pinion shaft lock pin for damage or looseness in case. Replace pin or case as necessary.

h. 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.

i. 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.

j. 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.

k. 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.

l. Inspect companion flange for cracks, worn splines, pitted, rough or corroded oil seal contacting surface. Repair or replace companion flange as necessary.

m. Inspect drive pinion bearing shim pack for broken, damaged or distorted shims. Replace if necessary during establishment of pinion bearing preload.

N-16. Pinion Installation and Adjustment

Refer to Fig. N-3 and N-7.

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 shoulder and the outer bearing. The shims behind

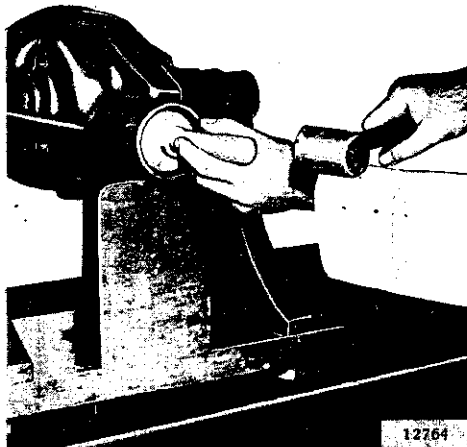


FIG. N-25—INSTALLING OUTER BEARING CUP

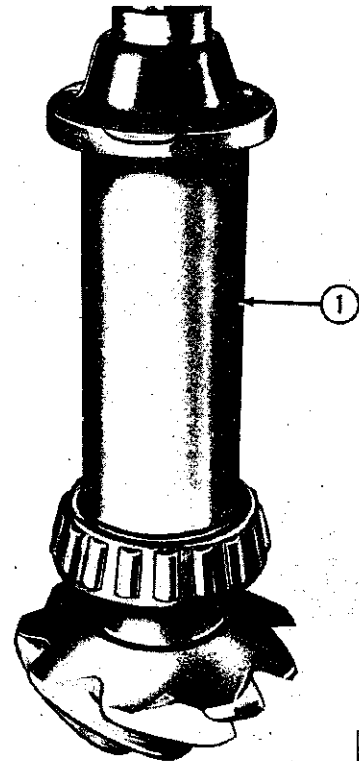


FIG. N-26—PINION BEARING INSTALLING SLEEVE

1—Sleeve

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. Install the pinion as follows:

a. Install outer bearing cup using Tool W-264 on model 27 and W-126 on model 44 axles, as shown in Fig. N-25.

b. Install the inner bearing cup using Tool W-126 on model 27 axles, and Tool W-344 on model 44 axles to drive the cup into the housing.

c. Use Tool C-3095 to press the inner bearing cone and roller onto the pinion shaft on axle Model 44. Other models use Tool W-262 as shown in Fig. N-26.

d. Place the pinion in the housing and install a .065" [1,651 mm.] shim, the inner cone and roller, sleeve SP-1997 from Tool W-162, and the pinion nut.

e. Select the proper pinion adjusting gauge to obtain the correct reading for the differential model. 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 W-101-A-24 or SP5433 is stamped with the letter H which indicates it is used to set the adjusting fixture on Model 27AF axle differentials. Gauge block W-101-A-22 or SP5453 is stamped with the letters D, G, F, A, C, E and B. Use the letter E for Model 44 axle differentials. Tool SP-5264 is used with the dial indicator in W-99 Tool Set for setting pinion.

After selecting the proper gauge, the adjusting fixture can be set as follows:

- f. Place the gauge block against the machined surface of the dial indicator mount, as shown in Fig. N-28.
- g. Set the dial indicator on zero by rotating the face.
- h. Install the pinion adjusting fixture on the pinion with the stationary guide pin and the adjustable guide pin seated in pinion shaft lathe centers, as shown in Fig. N-27.

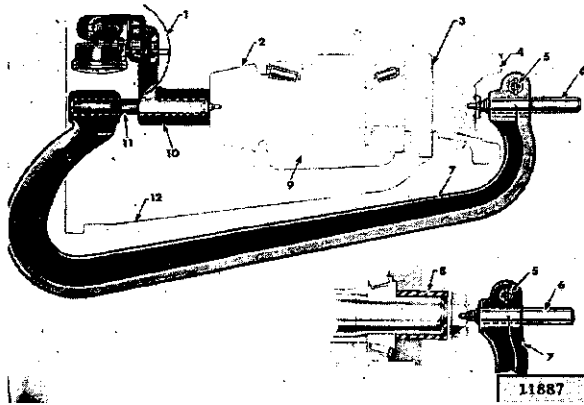


FIG. N-27—PINION ADJUSTING FIXTURE

- | | |
|------------------------|-------------------------|
| 1—Dial Gauge Swing Arc | 7—C-Clamp |
| 2—Pinion | 8—Sleeve Bearing |
| 3—Flange | 9—Inner Bearing |
| 4—Yoke | 10—Housing |
| 5—Thumb Screw | 11—Stationary Guide Pin |
| 6—Guide Pin | 12—Pinion Housing |

Note: Use the "C" type alignment fixture vertically as shown in Fig. N-29, 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

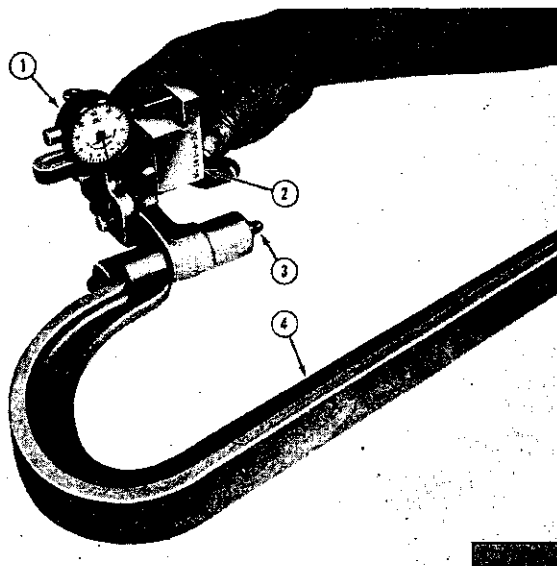


FIG. N-28—SETTING PINION GAUGE FOR MODEL 27AF AXLE DIFFERENTIAL

- | | |
|------------------|------------------|
| 1—Dial Indicator | 3—Stationary Pin |
| 2—Gauge Block | 4—C-Clamp |

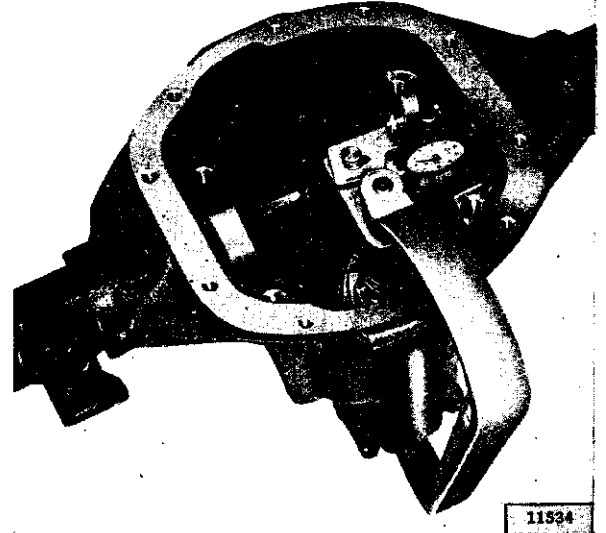


FIG. N-29—CHECKING PINION ADJUSTMENT

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 jig. Keep jig flat in metal case when not in use. Do not allow other tools to rest on it. Treat the C-type fixture tool carefully as a precision instrument.

- i. Seat the gauge mount firmly on the pinion head and swing the dial indicator through the differential bearing bore as shown in Fig. N-29.
- j. 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 the shims behind the bearing cup until the readings agree.
- k. 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 .002" 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 .002" more shims than would be required if the pinion were etched "0". By adding .002" 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 shims. Example: With a dial reading of minus .001" and a pinion marking of plus .002" remove .003" shims to obtain a higher dial reading of plus .002"

- l. If the original ring and pinion set is to be re-used, 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 adjust the thickness of new shim pack to compensate for the difference between these two figures. Refer to chart for example. If the old pinion reads (+2) and the new pinion is (-2), add .004" shims to the original pack dimension. Now build a new shim pack to this resulting dimension.

m. When the correct adjustment is reached, remove the pinion adjusting fixture and sleeve SP-1997. Install outer bearing.

n. Install only the oil slinger, the yoke, the flat washer, and the pinion nut. Holding the yoke with Flange Holder C-3281, torque the nut 200 to 220 lb-ft. [27,65 a 30,42 kg-m.].

o. Using Inch-Pound Torque Wrench W-297 on the nut check the rotating torque. The rotating torque should be 10 to 25 lb-in. [0,115 a 0,288 kg-m.].

p. Add or remove shims between the pinion outer bearing and the pinion shaft to obtain correct torque reading.

N-17. Differential Case Reassembly

Procedure for assembling the differential case on semifloating rear axles is as follows:

a. Reassemble the differential pinions, side gears, thrust washers, and shaft in relative position shown in Fig. N-3 and N-7. Make sure the spacers are installed.

b. Install differential shaft lock pin.

Note: Disregard starting torque.

Old Pinion Marking	NEW PINION MARKING				
	-4	-3	-2	-1	0
+4	+0.008	+0.007	+0.006	+0.005	+0.004
+3	+0.007	+0.006	+0.005	+0.004	+0.003
+2	+0.006	+0.005	+0.004	+0.003	+0.002
+1	+0.005	+0.004	+0.003	+0.002	+0.001
0	+0.004	+0.003	+0.002	+0.001	0
-1	+0.003	+0.002	+0.001	0	-0.001
-2	+0.002	+0.001	0	-0.001	-0.002
-3	+0.001	0	-0.001	-0.002	-0.003
-4	0	-0.001	-0.002	-0.003	-0.004

Old Pinion Marking	NEW PINION MARKING				
	+1	+2	+3	+4	
+4	+0.003	+0.002	+0.001	0	
+3	+0.002	+0.001	0	-0.001	
+2	+0.001	0	-0.001	-0.002	
+1	0	-0.001	-0.002	-0.003	
0	-0.001	-0.002	-0.003	-0.004	
-1	-0.002	-0.003	-0.004	-0.005	
-2	-0.003	-0.004	-0.005	-0.006	
-3	-0.004	-0.005	-0.006	-0.007	
-4	-0.005	-0.006	-0.007	-0.008	

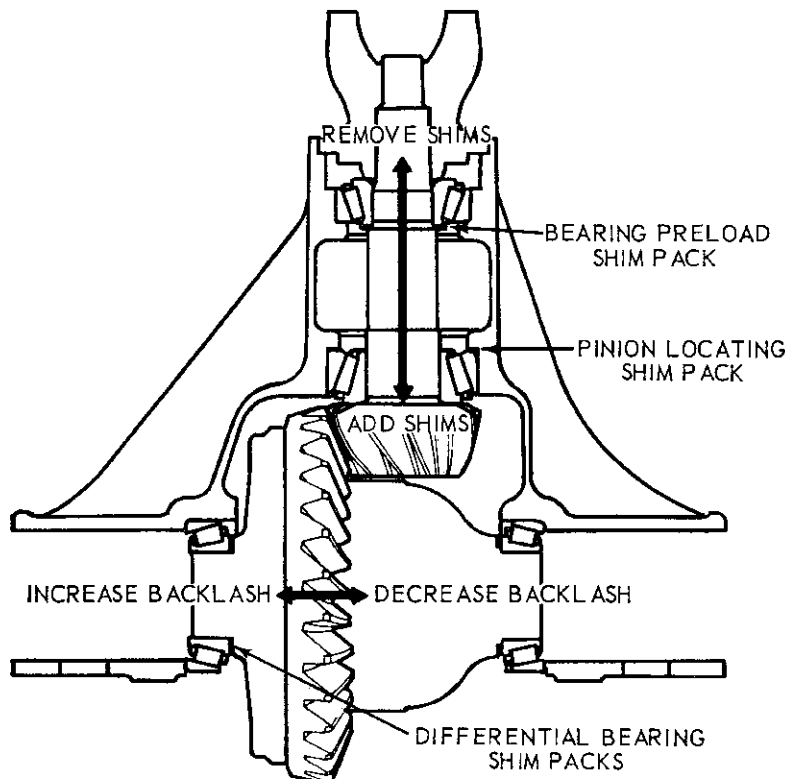


FIG. N-30—DIFFERENTIAL SHIM PACK LOCATIONS

- c. Check side gear clearance as described in Par. N-18.
- d. Examine contacting surfaces of ring gear and differential case for burrs or foreign matter.
- e. Assemble ring gear on differential case with assembly hole on each lined up.
- f. Tap ring gear into place with mallet.
- g. Install ring gear screws. Torque 35 to 55 lb-ft. [4,84 a 7,60 kg-m.].

N-18. Adjustment of Differential Side Gears

Clearance between the differential side gears and differential case should be .000" to .006" [0,000 a 0,192 mm.]. Procedure for checking clearance is as follows:

- a. With the differential positioned as shown in Fig. N-31, tap the differential lightly on a flat surface so the differential gears settle into proper position.
- b. Measure the clearance between side gears and the case with leaf feeler gauge as illustrated.
- c. If the clearance exceeds .006" add shims between the side gears and the case. To bring the clearance within specified tolerance, shims in these thicknesses are available. .004" [0,102 mm.], .006" [0,152 mm.], .008" [0,203 mm.]. 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.

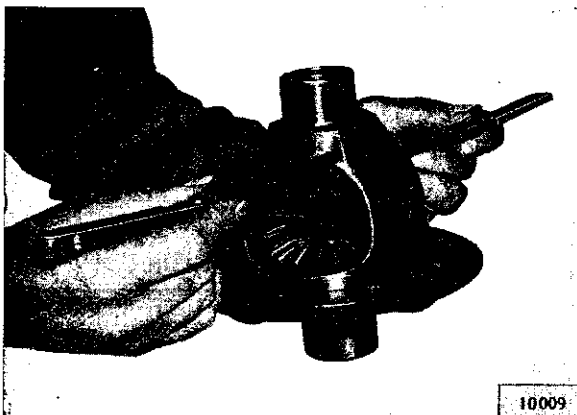


FIG. N-31—CHECKING SIDE GEAR CLEARANCE

N-19. Adjustment of Differential Bearing Preload and Ring Gear Backlash

Refer to Fig. N-30.

The adjustment of the differential bearings is maintained by the use of shims placed between the differential case and the differential bearing. Procedure for adjusting bearing preload is as follows:

- a. Install the differential case and bearings in the axle housing without shims and with the bearing cups snug.
- b. Holding the ring gear in contact with the pinion and using a screwdriver blade to move the differential bearing cups toward the center, insert feeler gauge on each side between differential bearing

cup and the axle housing. There should be only .001" to .002" [0,025 a 0,051 mm.]. Backlash remaining with the feeler gauge inserted.

c. After the shim pack requirement for each bearing has been established remove the differential assembly. Make up shim packs and keep them separated.

d. Add an additional .015" [0,381 mm.]. thickness of shims to the pack on the tooth side of the ring gear.

e. Place the differential bearing shim packs on the differential case under each bearing. Install bearings with Driver C-3716 for Model 27AF axles and Driver W-188 for Model 44 axles. See Fig. N-32.

Note: When overhauling the Model 27AF front axle differential, check the axle inner oil seals. Should new seals be required, install them using Tool W-128 as shown in Fig. N-33. When installing the axle differential in the axle housing, use Spreader Tool W-129.

f. Attach the Carrier Spreader W-129, (see note Par. N-12) install a dial indicator, (Fig. N-19) and spread the carrier a maximum of .020" [0,508 mm.].



FIG. N-32—DIFFERENTIAL BEARING DRIVER

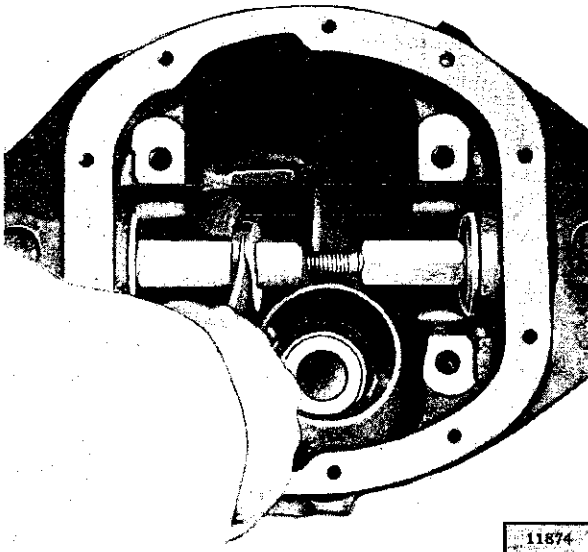


FIG. N-33—INSTALLING INNER OIL SEALS—
MODEL 27 FRONT AXLE DIFFERENTIAL

- g. Remove the indicator.
- h. Lubricate bearings and place the differential in the carrier.
- i. Tap the unit carefully into place with soft mallet, making sure the ring gear teeth mesh with the pinion teeth.
- j. Install bearing caps, matching their markings with those on the carrier.
- k. Apply sealing compound to the screw threads. Torque the screws 70 to 90 lb-ft. [9,68 a 12,44 kg-m.].
- l. Install dial indicator to check ring gear backlash (Fig. N-34). Check backlash at two points. Backlash must be held between .005" to .010" [0,127 a 0,254 mm.]. If backlash does not fall within specifications, shims should be interchanged be-

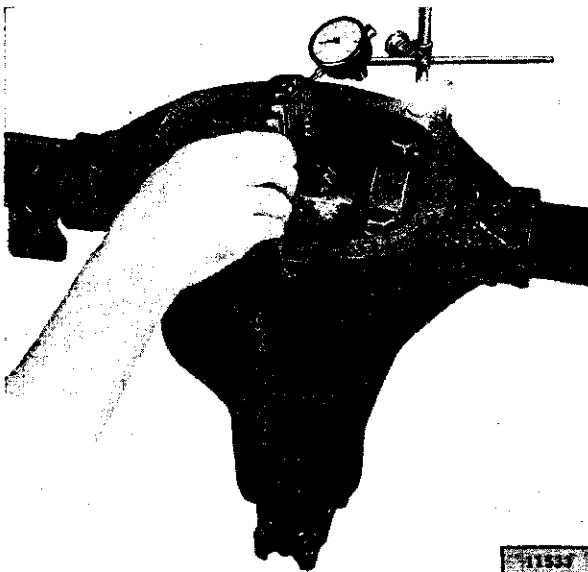


FIG. N-34—CHECKING RING GEAR BACKLASH

tween the two differential bearing shim packs until correct backlash is obtained.

Note: Changing the position of a .005" [0,127 mm.] shim from one side to the other will change the amount of backlash approximately .003" [0,076 mm.].

m. Check ring gear for runout. A reading in excess of .006" [0,152 mm.] indicates a sprung differential case, dirt between the case and the gear, or loose ring gear screws.

n. In order to assist in determining whether the gears are properly adjusted, paint the bevel gear teeth with red lead or prussion blue and turn the bevel gear so the pinion will make an impression on the teeth. The correct procedure to follow in the event of an unsatisfactory tooth contact is shown in Fig. N-35.

o. After the differential has been assembled and adjusted, the pinion shaft oil seal should be installed.

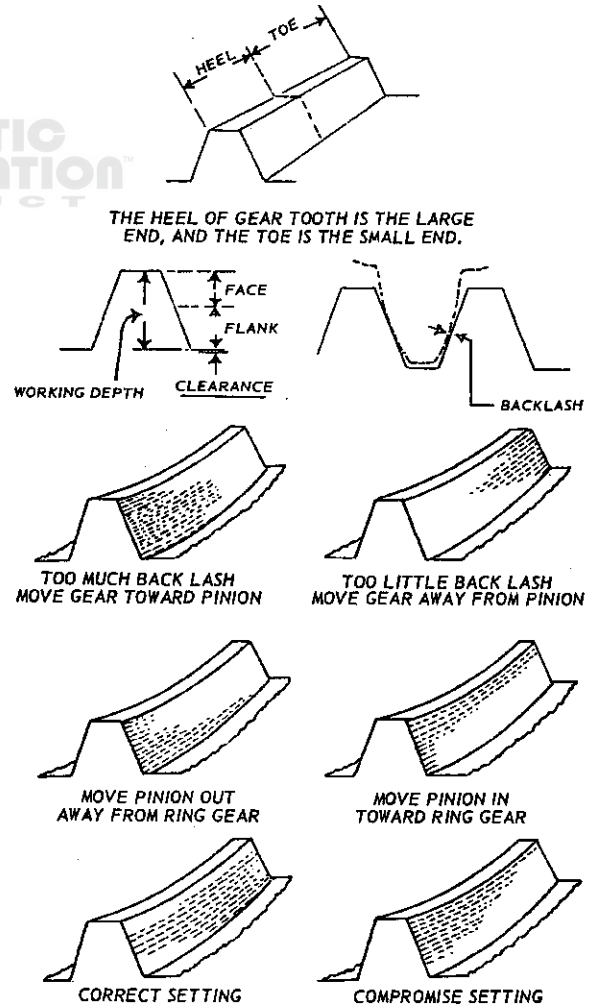


FIG. N-35—GEAR TOOTH CONTACT

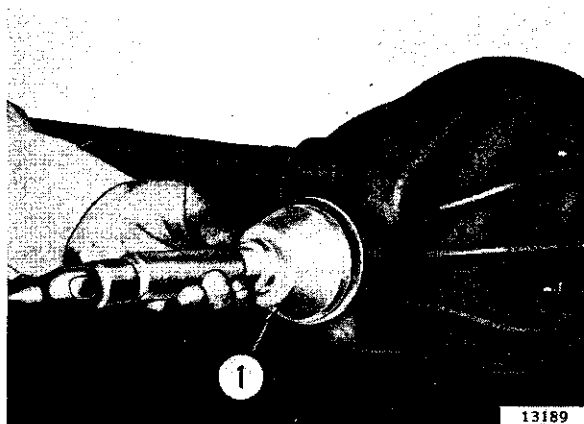


FIG. N-36—PINION SHAFT OIL SEAL INSTALLER
1—Tool W-147

- p. Remove the sleeve previously installed in place of the yoke. Install the oil seal with Tool W-147 shown in Fig. N-36.
- q. Install the yoke with Flange Installer W-162, as shown in Fig. N-37.
- r. Install pinion nut and cotter pin.
- s. Install axle shafts and housing cover.

N-20. POWR-LOK DIFFERENTIAL

As optional equipment, Powr-Lok was previously available on all Jeep Universal models equipped with semi-float tapered axle shafts. The Powr-Lok differential may be identified by a tag located on the opposite side of the differential housing from the ratio tag (Fig. N-2) and stamped with either a "T" or with the words, "USE LIMITED SLIP

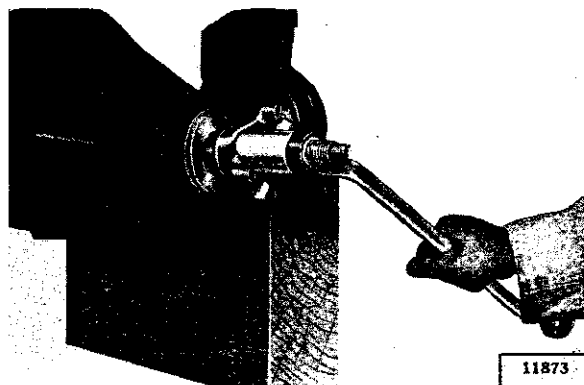


FIG. N-37—YOKE INSTALLING TOOL

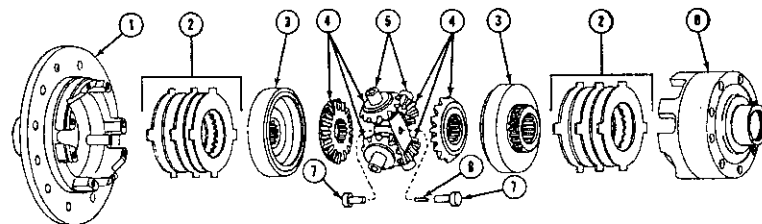


FIG. N-38—POWR-LOK DIFFERENTIAL

- 1—Differential Case Flange Half
- 2—Disc and Plate Set
- 3—Side Gear Ring
- 4—Side Gear and Pinion Mate Gear Set
- 5—Pinion Mate Cross Shaft
- 6—Differential Case Button Half
- 7—Axle Shaft Spacer
- 8—Axle Shaft Spacer Roll Pin

DIFF. LUBE ONLY." This differential is available for rear axles only.

Whenever a replacement or conversion Powr-Lok differential is to be installed in an axle which has been previously in service and acquired mileage, be sure to record the amount of backlash between the ring gear and pinion at the time of disassembly. When the axle is again assembled the ring gear and pinion must be set to this same amount of backlash.

Axle ratios and speedometer gear application is very important. In like model axles, the ratio may be changed by simply changing to the desired ring gear and pinion; except in the case of the 3.73:1 or higher ratios. When changing from a 3.73:1 or higher to 3.54 or lower ratio, or vice versa, the differential case must also be changed on a standard differential assembly, and the differential assembly, less ring gear and pinion, when a Powr-Lok differential assembly is involved. When changing from any ratio to another, it will also be necessary to change speedometer gears. Speedometer gears for Powr-Lok and standard differentials of the same ratio, are interchangeable. A complete rear axle assembly replacement is necessary, if a conversion from one type of differential assembly to another is desired.

Note: Powr-Lok differentials use a special lubricant. Refer to the Lubrication Chart.

N-21. Trouble Symptoms and Possible Causes

If noises such as chatter are detected, when turning a corner, the probable reason for this is that incorrect gear lubricant has been installed in the axle. Axles equipped with a limited slip differential require special lubricant. Refer to Lubrication Section, Par. B-52.

Note: It may be necessary to use an additive to attempt to eliminate chatter. If this is not successful then disassembly and inspection of the differential becomes necessary.

Warning: Extreme care must be exercised on a Powr-Lok equipped vehicle to be sure the transmission is in the neutral position whenever the engine is started with one wheel jacked up. Otherwise the vehicle may lurch unexpectedly and fall off the jack.

N-22. Torque Test

Procedure for testing torque Powr-Lok differentials on Jeep Universal Series vehicles is as follows:

- a. Place the transmission in neutral.
- b. Raise one wheel off the floor and place a block in front and at the rear of the opposite wheel.
- c. Apply a torque wrench to the axle shaft nut of the elevated wheel.
- d. Turn wheel with torque wrench. Disregard breakaway torque and observe torque required to continuously turn wheel smoothly. Torque should read 40 lb-ft. [5,53 kg-m.] or more.

N-23. Powr-Lok Differential Disassembly and Reassembly

Refer to Figs. N-38 and N-39.

The procedure for overhauling disc type Powr-Lok differentials is as follows:

- a. Remove axle shafts following procedure described in Par. N-2.
- b. Remove housing cover and gasket.
- c. Remove the Powr-Lok differential from the axle. Do not remove the ring gear or bearing cone and rollers unless replacement is to be made. Mark the bearing cups so they may later be reassembled with the same bearing cones. Mark the differential case halves for correct alignment at reassembly. Each pinion mate cross shaft should also be marked so that each pin cam surface will match with the same V-ramp in the case when reassembled.
- d. Separate the case halves.
- e. Remove the disc and plate sets. The illustration (Fig. N-39) shows the arrangement of plates and discs. When reassembling unit, discs and plates must be reinstalled in this arrangement. Be sure to keep in mind which way the set will face toward the case.

- f. Remove the pinion mate cross shafts, bevel pinion mate gears, bevel side gears, and side gear rings.
- g. Clean all parts thoroughly in kerosene and dry with compressed air.
- h. Inspect all parts. Replace any items which appear to be worn or damaged.
- i. Inspect the plate surfaces of the case halves, the side gear rings, and the clutch friction plates and discs for excessive wear or scoring.
- j. Inspect the pinion mate shaft and ramp surfaces on the case for excessive wear and pitting.
- k. Inspect the pinion gear races that bear on the side gear rings.
- l. Inspect the corresponding surfaces on the side gear rings.
- m. Inspect the clutch plates and discs for cracks and distortion. In the event one or more of the clutch plates or discs needs replacing, replace the entire stack of plates and discs on each side of the pinions. These stacks are supplied in sets. The differential case halves are not serviced. Should replacement be required, it is necessary to replace the complete differential.
- n. Assemble the clutch friction plates, clutch friction discs, and dished plates on the splined hub of each bevel side gear. Make sure the plates and discs are installed in the proper relationship as shown in Fig. N-39. The dished plates in the plate and disc set are always assembled with the convex side toward the case. As each part is reassembled in its proper position, it is necessary that it be lightly coated with Powr-Lok lubricant.
- o. Place each differential case half on its side and install the side gear rings with the plates and discs assembled. The side gear ring will rotate with a slight drag when properly located in the case.
- p. With the ring gear flange half of the differential case in an upright position, assemble the bevel side gears, pinion mate cross shafts, and bevel pinion mate gears. Install the remaining case half on the ring gear flange half. Make sure that all markings coincide.

- q. Install the differential case bolts and turn them in a few threads.
- r. Using axle shafts from the vehicle, align the splines of the side gear, and the side gear ring.
- s. With these axle shafts in position, tighten the differential case bolts evenly. Torque 35 to 45 lb-ft. [4,84 a 6,22 kg-m.].
- t. Remove the axle shafts.

- u. Check for proper assembly. Each pinion mate cross shaft should be tight on its ramp. If there is clearance between the cross shaft and the ramp, the clearance should be no more than .005" [0,127 mm.]. This clearance should be equal on all four cross shaft ends.
- v. Reinstall the unit in the axle.

- w. Install axle shafts as described in Par. N-2. Other service operations such as ring gear and pinion replacement, or pinion and bearing adjustments, are performed in the same manner as de-

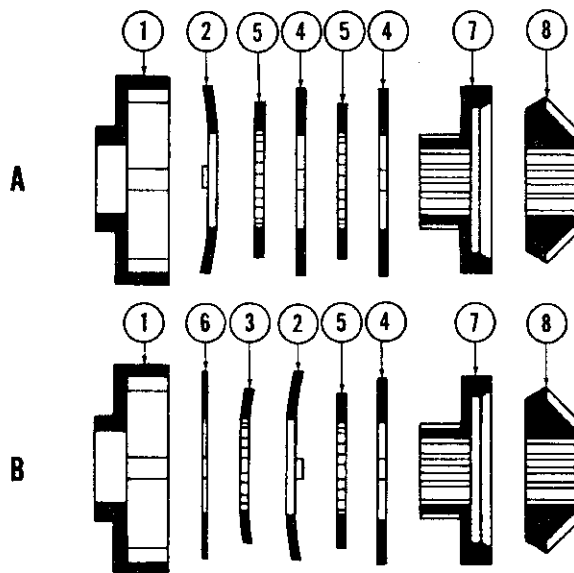


FIG. N-39—PLATE ASSEMBLY ORDER 12876

- | | |
|--------------------|-----------------|
| A—Model 44 | B—Model 27 |
| 1—Case | 5—Disc |
| 2—Belleville Plate | 6—Thin Plate |
| 3—Belleville Disc | 7—Sidegear Ring |
| 4—Plate | 8—Side Gear |

scribed in Pars. N-11 through N-19 for standard axles, with the exception of the following torque recommendations. Torque the differential case bearing cap screws 70 to 90 lb-ft. [9,7 a 12,4 kg-m.] and the cover screws 15 to 25 lb-ft. [2,1 a 3,4 kg-m.]. The ring gear screws on axles with Powr-Lok differentials should be torqued as follows: Model 30 and 44 axles 35 to 55 lb-ft. [4,84 a 7,60 kg-m.].

N-24. TRAC-LOK DIFFERENTIAL

As optional equipment Trac-Lok Model 44 differential is available on all Jeep Universal vehicles equipped with semi-float flanged axle shafts. 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, 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 tries to spin due to leaving the ground, a patch of ice, etc., the clutch packs automatically provide more torque to the wheel which is not trying to spin.

It can be seen then that the Trac-Lok differential resists wheel spin on bumpy roads and provides more pulling power when one wheel tries to slip. In many cases of differences in traction, pulling power will be automatically provided until both wheels start to slip.

In diagnosis of vehicle operators' complaints, it is important to recognize two things:

- a. If, with unequal traction, both wheels slip, the Trac-Lok has done all it can possibly do.
- b. 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 non-slipping wheel.

N-25. Lubrication

The Trac-Lok differential requires a special lubricant and ordinary multipurpose gear lubricants **MUST NOT** be used. Use only 'Jeep' Differential Oil, Part No. 94557.

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

Note: The Trac-Lok differential is serviced at the same time intervals as the standard differential.

N-26. 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, the correctness of lubricant can and should be determined.

A complete lubricant drain, and refill with specified Limited Slip Differential lubricant will usually correct chatter.

The following procedure is recommended to ensure complete removal of old lubricant.

- a. Warm the lubricant by vehicle road operation, or 5 minutes of operation in gear at 30 mph with both wheels off the ground on a hoist.

Caution: Never place the transmission in gear with the engine running when only one wheel of a Limited Slip Differential equipped vehicle is raised. The vehicle might drive itself off the jack and produce damage or injury.

- b. 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.

- c. Refill axle with specified Limited Slip Differential lubricant.

- d. Operate the vehicle for approximately ten miles [16,09 km.], making at least ten figure 8 turns to flush the old lubricant out of the clutch packs.

- e. Repeat steps b, c, and d, making sure to replace the cover gasket if required in step c.

- f. It is possible that slight chatter, requiring additional vehicle operation, may remain after step e. If chatter persists after 100 miles [160,9 km.] of vehicle operation, or remains severe after step e above, disassembly and repair will be necessary.

N-27. Unit Inoperative

Proper performance and capabilities of Limited Slip Differentials are often misunderstood. No precise methods of measuring Limited Slip Differential performance are generally available in the field. A functioning unit can be determined by relatively simple vehicle operational tests, as follows:

- a. Place one wheel on good dry pavement, and the other on ice, mud, grease, etc.

- b. Gradually increase engine rpm to obtain maximum traction prior to "break-a-way." The ability to move the vehicle effectively will demonstrate proper performance.

- c. If extremely slick surfaces, such as ice or grease, are used some question may exist as to proper performance at step b. In these extreme cases a properly performing Limited Slip Differential will provide greater "pulling" power by lightly applying the parking brake.

N-28. Trac-Lok Differential Disassembly and Reassembly

It is recommended that the complete axle assembly be removed from the vehicle, when it becomes necessary to remove the Trac-Lok from the housing. Refer to Par. N-3 and N-12 for removal of axle shafts and differential case from axle housing.

With the Trac-Lok unit removed from the axle housing, proceed as follows:

N-29. Disassembly

a. Place the axle shaft, which was removed from the assembly, into a vise. Tighten shaft in vise firmly. The spline end of the shaft is not to extend beyond $2\frac{3}{4}$ " [7 cm.] 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, etc. Refer to Fig. N-40.

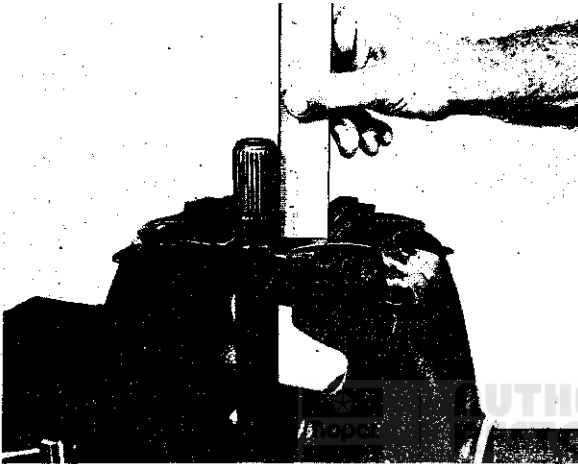


FIG. N-40—AXLE SHAFT POSITIONED IN VISE

b. Assemble the differential case to the axle shaft with the ring gear screw heads up. Assembling the differential case onto the shaft will serve as a holding device to remove the ring gear and to disassemble the internal parts of the case.



FIG. N-41—DIFFERENTIAL POSITIONED ON AXLE SHAFT

c. Remove the ring gear screws and ring gear. It is necessary to remove the ring gear to allow clearance for the removal of the cross pin. Place a few shop towels over the top of the vise to protect

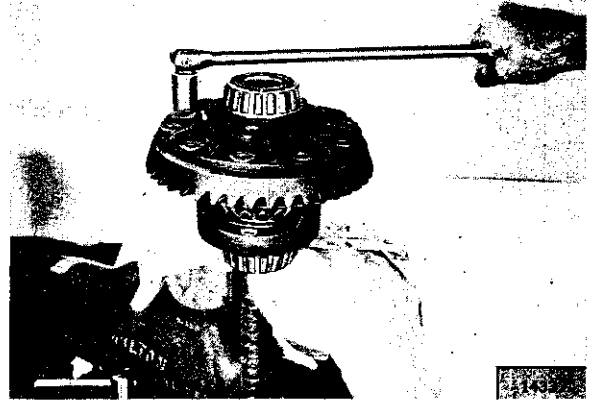


FIG. N-42—REMOVING RING GEAR

the gear teeth from becoming nicked after it is free from the case. Tap ring gear with a rawhide hammer to free it from the case.

Note: It is recommended that whenever the ring gear screws are removed they are to be replaced with new screws.

d. Remove differential case from axle shaft and remove ring gear.

e. All Trac-Loks are identified with a manufacturing date, and the complete part number stamped on the barrel of the case. If the axle is equipped with Trac-Lok Limited Slip Differential, it will contain a tag requesting the use of Limited Slip Lubricant.



FIG. N-43—TRAC-LOK IDENTIFICATION

f. The Trac-Lok is identified with $\frac{1}{8}$ " [3,18 mm.] high numbers stamped in the case. For example: The numbers 8-5-69A is the manufacturing or build date of the Trac-Lok and is interpreted as follows. The first number is the month, second number is the day of the month, third number is the year, the letter is the shift. For example: August 5, 1969 first shift. The number stamped above the

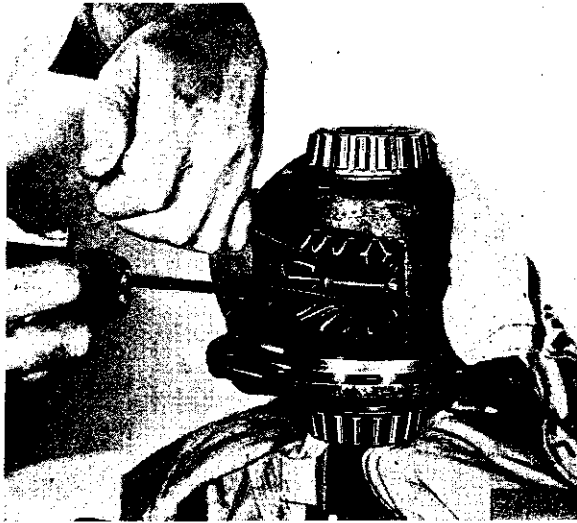


FIG. N-44—REMOVING SNAP RINGS FROM CROSS PIN

manufacturing date is the complete Trac-Lok assembly part number.

g. 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 off the lubricant from the case. See Fig. N-43.

h. Reposition differential case onto axle shaft as shown. Remove the two snap rings from the cross pin. Use two screw drivers and push the rings free from the cross pin. Place a shop towel behind the case to prevent the snap rings from flying out of the case. Refer to Fig. N-44.

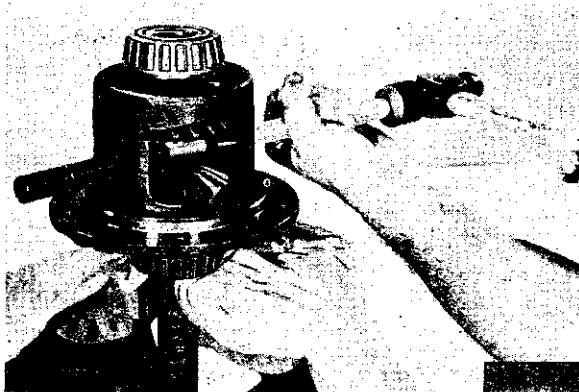


FIG. N-45—REMOVING CROSS PIN

i. Remove the cross pin. Use a hammer and punch as shown to remove the cross pin from the case.

Note: A gear rotating tool C-4142 is required to service the Trac-Lok differential. The Tool consists of four parts: a Handle, Pawl, Forcing Screw and Step Plate.

j. Assemble the step plate tool into the bottom side gear, as shown in Fig. N-46.

k. Position the gear rotating tool into the top side gear, as shown in Fig. N-47.

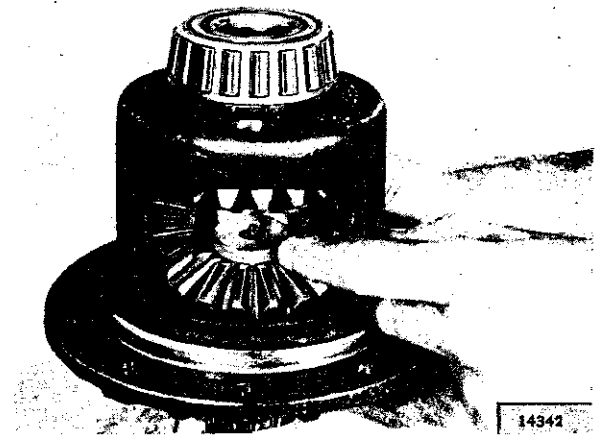


FIG. N-46—INSTALLING STEP PLATE TOOL

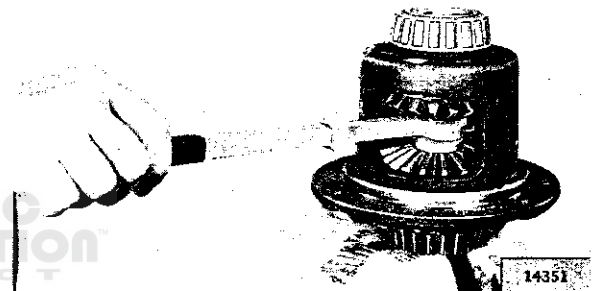


FIG. N-47—INSTALLING GEAR ROTATING TOOL

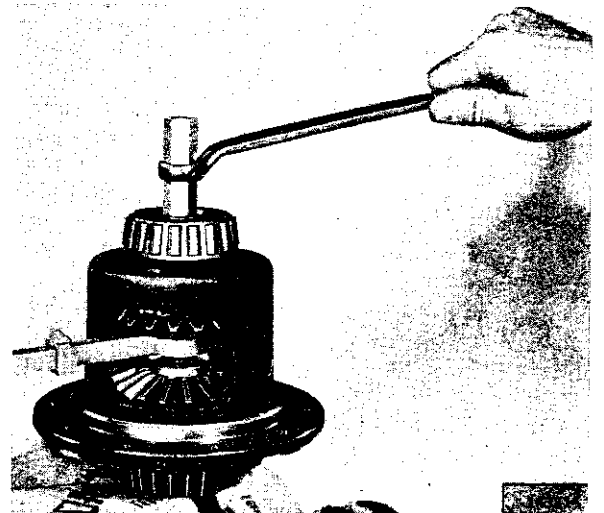


FIG. N-48—THREADING FORCING SCREW INTO ROTATING TOOL

l. Insert the forcing screw down through the top of the case and thread into the 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.

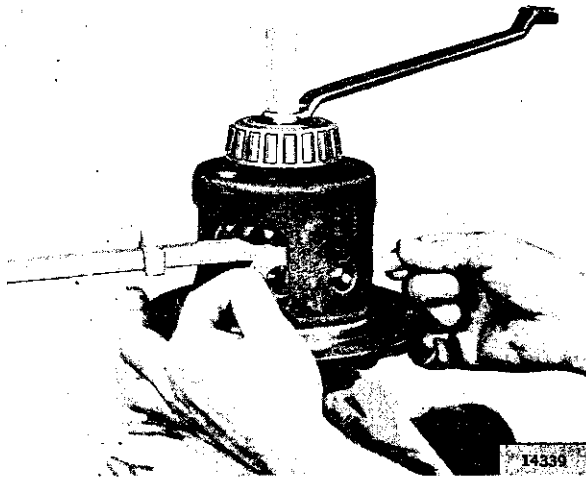


FIG. N-49—REMOVING PINION MATE WASHERS

m. Thread forcing screw so that it becomes centered into the step plate. Torque forcing screw tight. This will move the side gears away from the pinion mate gears, and relieve the load between the gears, allowing only the pinion mate gears to be loose.

n. Remove both pinion mate spherical washers. Use a shim stock of .030" [0,762 mm.] thickness or an equivalent tool to push out the spherical washers. Relieve the tension of the Belleville spring by loosening the forcing screw. Refer to Fig. N-49.

o. Retighten forcing screw until a very slight movement of the pinion mate gears is detected.

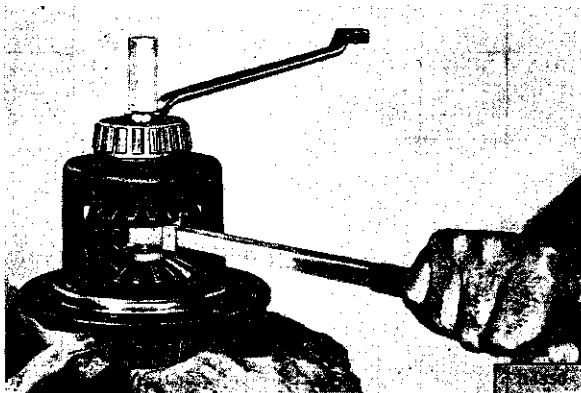


FIG. N-50—REMOVING PINION MATE GEARS

p. Insert the pawl rotating tool between one of the side gear teeth as shown. Pull on handle so the top side gear will rotate and also allow the pinion mate gears to rotate. Also continue pulling on tool until the gear hits the handle.

q. Remove pawl from between the gear teeth and repeat the above until the pinion mate gears can be removed through the large opening of the 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. Refer to Fig. N-50.

r. Retain the top side gear and clutch pack in the case by holding hand on the bottom of the rotating tool while removing forcing screw. Remove rotating tool, top side gear, and clutch pack.

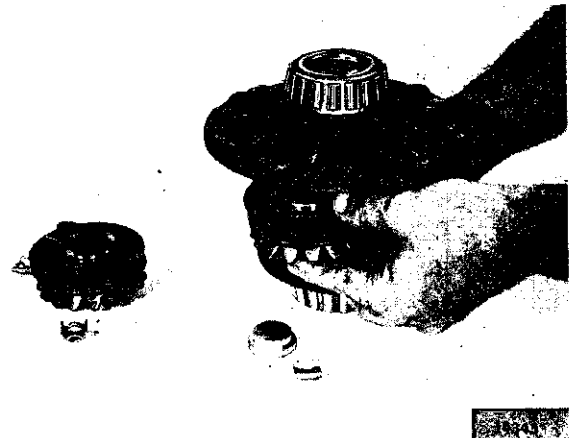


FIG. N-51—TRAC-LOK UNIT DISASSEMBLY

s. Remove the differential case from the axle shaft. Turn case with the flange or ring gear side up and allow the step plate tool side gear and clutch pack to be removed from the case. Remove the retainer clips from both clutch packs to allow separation of the plates and discs. Refer to Fig. N-51.

N-30. Inspection

a. 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.

b. 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.

c. Cross pin—If excessive wear is evident, then the cross pin should be replaced.

d. Clutch retainer clips—If wear is evident on any one of the retainer clips, it is suggested that all four clips be replaced.

e. Differential case—If scoring, wear, or metal pick-up is evident on the machined surfaces, then replacement of the case is necessary.

f. Example of radial groove plate (A) and the concentric groove disc (B) shown in Fig. N-52.

N-31. Reassembly

a. Assemble plates and discs in exactly the same position as they were removed, regardless of whether they are new parts or the original parts.

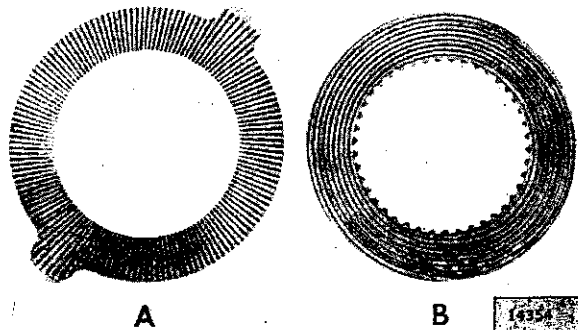


FIG. N-52—PLATE AND DISC IDENTIFICATION

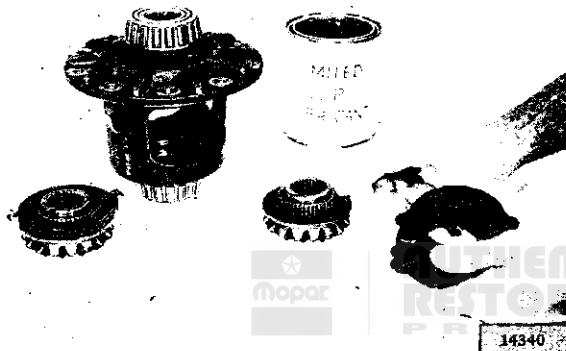


FIG. N-53—LUBRICATING TRAC-LOK COMPONENTS

b. Prelubricate the thrust face of the side gear, assemble the plates and discs to the side gear splines, prelubing each part as shown with the specified lubricant. Both stacks. See Fig. N-53.

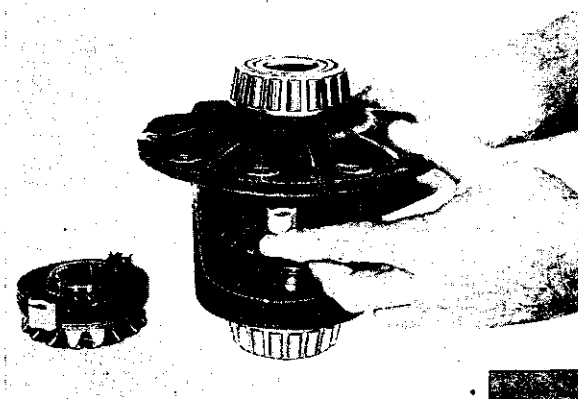


FIG. N-54—INSTALLING PLATE RETAINER CLIPS

c. Assemble the retainer clips to the ears of the plates. Make sure both stacks are completely assembled or seated onto the ears of the plates.

d. With the differential case positioned as shown, assemble the clutch pack and side gear into the case. 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.

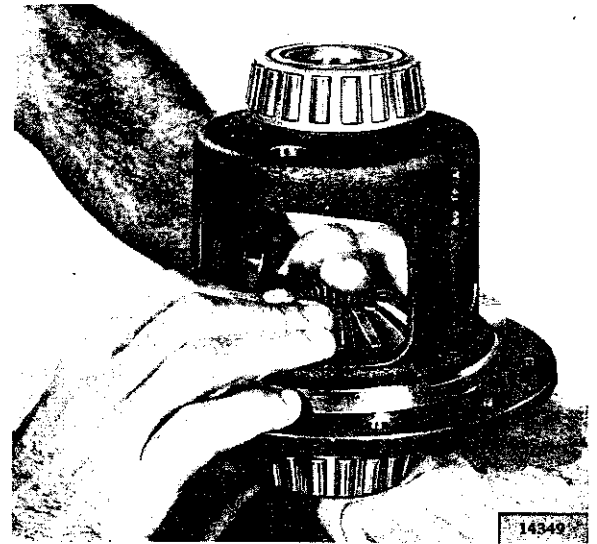


FIG. N-55—INSTALL DIFFERENTIAL CASE ON AXLE SHAFT

e. Assemble differential case onto the axle shaft in the position as shown in Fig. N-55.

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.

f. Assemble the step plate tool into the side gear as shown in Fig. N-46. Apply a small dab of grease into the centering hole of the step plate tool.

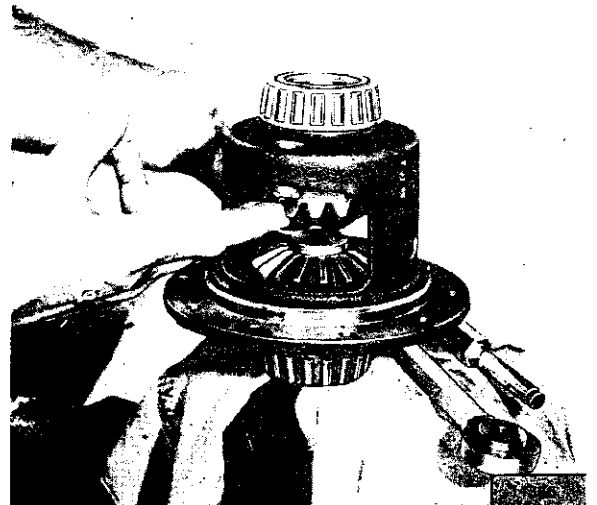


FIG. N-56—INSTALLING CLUTCH PACK AND SIDE GEAR

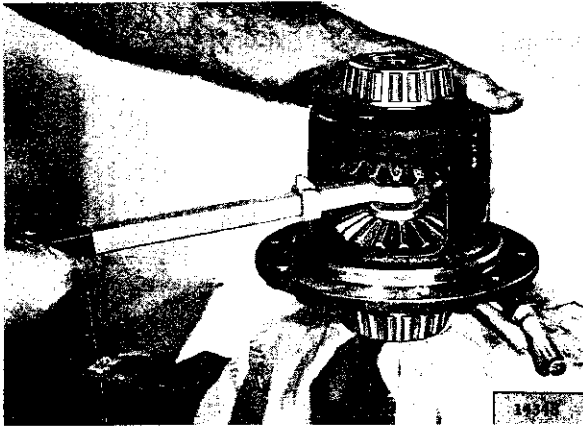


FIG. N-57—POSITIONING GEAR ROTATING TOOL

g. Assemble the other clutch pack and side gear exactly as shown. Be sure the clutch pack stays assembled onto the side gear splines and that the retainer clips are completely seated into the pockets of the case. Refer to Fig. N-56.

h. Position the gear rotating tool into the top side gear.

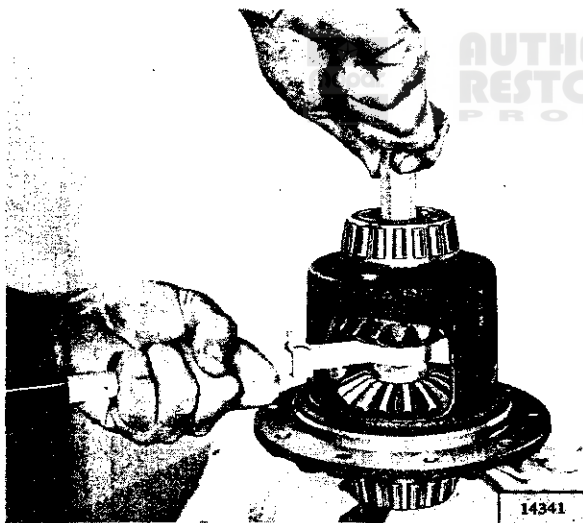


FIG. N-58—THREADING FORCING SCREW INTO ROTATING TOOL

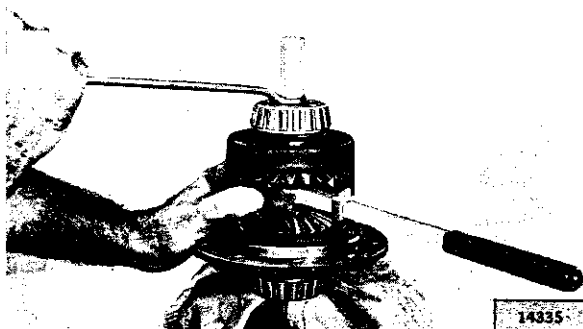


FIG. N-59—STARTING PINION MATE GEARS INTO CASE

i. Keep side gear and rotating tool in position by holding with hand. Insert the forcing screw down through the top of the case, and thread into the rotating tool. Refer to Fig. N-58.

j. Position both pinion mate gears exactly as shown. Be sure the holes of the gears are lined up with each other. Hold gears in place by hand. See Fig. N-59.

k. Tighten forcing screw so that the Belleville springs will compress and allow clearance between the teeth of the pinion mate gears and side gears.

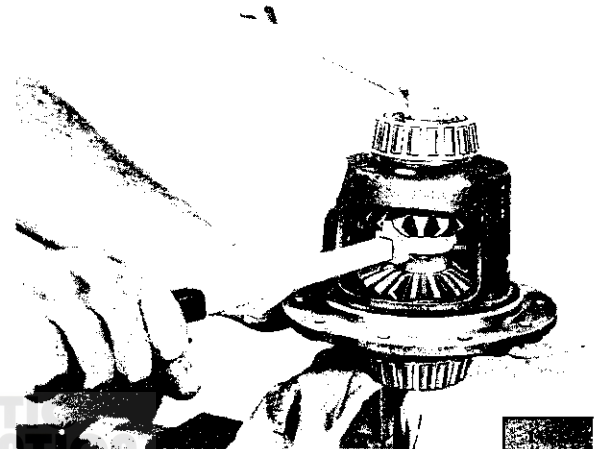


FIG. N-60—ROTATING PINION MATE GEARS INTO POSITION

l. While holding the pinion mate gears in place, insert the pawl of the rotating tool between one of the side gear teeth as shown. Pull on handle so that the top side gear will rotate and allow the pinion mate gears to rotate and enter into the 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.

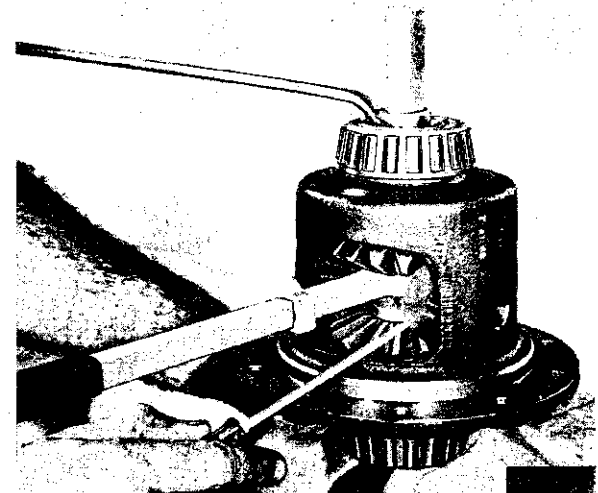


FIG. N-61—INSTALLING PINION MATE WASHERS

- m. Pull on tool until the handle hits the gear. Remove pawl from between the gear teeth, reposition handle and pawl. Repeat the same operation until the holes of both pinion mate gears are lined up exactly with those of the case.
- n. Prelubricate both sides of the pinion mate spherical washers with the specified lubricant.
- o. Apply torque to the forcing screw to allow clearance to assemble the spherical washers.
- p. Assemble washers into case. Use a very small screw driver to push washers into place, as shown in Fig. N-61.

Caution: Be sure the holes of the washers and gears are lined up exactly with those of the case.

- q. Remove forcing screw, rotating tool, and step plate.

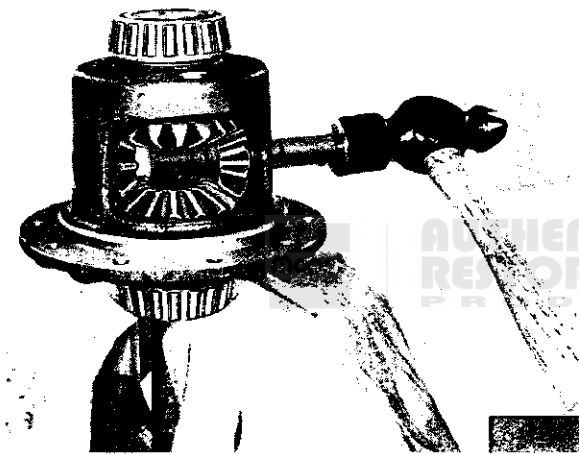


FIG. N-62—INSTALLING CROSS PIN

- r. Prelubricate the cross pin with the specified lubricant. Assemble cross pin into case. Use a hammer as shown. Be sure the snap ring grooves of the cross pin are exposed to allow assembly of the snap rings. Refer to Fig. N-62.
- s. Assemble snap rings.

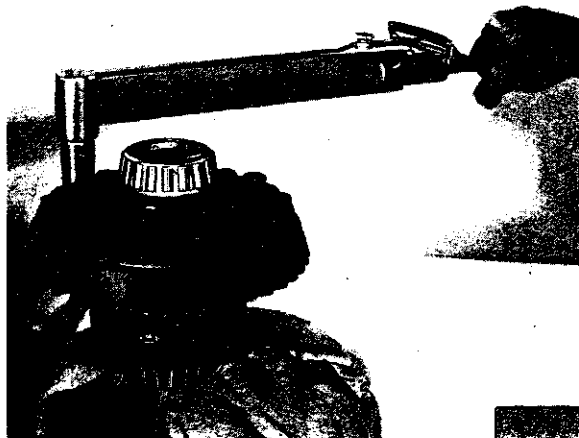


FIG. N-63—TORQUING RING GEAR SCREWS

- t. Remove case from axle shaft. Assemble ring gear to case.
- u. Line up the ring gear screw holes with those of the case. Assemble ring gear screws finger tight.
- v. Reposition differential case onto axle shaft as shown. Draw screws up evenly.

Note: Use new ring gear screws and torque to 45-50 ft. lbs.

w. This completes the service procedure for the Trac-Lok assembly. Install Trac-Lok differential case assembly into axle housing. Follow the service procedure given in Par. N-8 and N-17 through N-19, to complete the differential and axle assembly servicing.

N-32. Complete Trac-Lok Assembly Replacement

- a. If inspection reveals that the replacement of the Trac-Lok as a unit is required, the following steps should be followed.
- b. 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.
- c. To remove ring gear from case, follow the same steps as illustrated in Fig. N-42.
- d. Assemble ring gear to new Trac-Lok case. Follow the same steps as illustrated in Fig. N-63. Make sure the gear flange on the differential case is free of nicks, burrs, etc.
- e. Inspect shims and bearings which were removed from the old case. If shims on 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 they were removed from the old case. Assemble shims and differential bearing cones. Use step plate on bottom bearing to protect the bearing from becoming damaged during assembly of the top bearing. To completely seat the bearings use the proper bearing driver tool.
- f. Prelubricate differential bearing cones with the specified lubricant, and assemble case into axle housing. Follow the service procedure given in Par. N-8 and N-17 through N-19 to complete the differential and axle assembly servicing.

N-33. INSTALLING REAR AXLE

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 the grade and quantity of lubricant specified in the Lubrication Chart.

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.

Procedure for installing the rear axle on Jeep Universal Series vehicles is as follows:

- a. Position the axle assembly under the vehicle.
- b. Position springs to axle pads, and install spring clips and nuts.

- c. Attach the brake line hose at tee fitting on top of housing.
- d. Attach parking brake cables at rear of brake backing plate. DJ models only.
- e. Connect the shock absorbers at the axle mounting pads.
- f. Connect the propeller shaft at the rear universal joint.
- g. Adjust and bleed brakes. (See Section P).
- h. Install wheels and lower vehicle to floor.
- i. Check parking brake as described in Section P.
- j. Fill the axle housing with the proper lubricant. For correct lubricant refer to the Lubrication Chart.

Excessive backlash in the differential may be measured as follows:

- a. Jack up one rear wheel.
- b. Put the transmission in gear.
- c. Measure the travel of the jacked-up wheel on a 10" [25,40 cm.] radius from the wheel center. This total movement should not exceed 1 1/4" [3,17 cm.] in a new unit. In order to restrict the backlash to the axles only, make sure that the yoke of the propeller shaft does not move during the check.
- d. 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.

N-34. TROUBLE SHOOTING

The following problems can be present with either the conventional differential, Powr-Lok or Trac-Lok differential.

N-35. Backlash

Excessive backlash in the vehicle drive line may be the results of excessive backlash in the transmission, propeller shaft spline, universal joint, ring gear and pinion, the axle shaft spline, or the differential.

N-36. Rear Wheel Noise

Looseness of the rear axle shaft nut on semifloating tapered rear axles may produce a clicking or creaking noise. This noise can usually be stopped by torquing the wheel hub nut 150 to 175 lb-ft. [20,7 a 24,2 kg-m.]. If the condition has continued for some time, slight wear may have resulted allowing the noise to persist. In this case, coat the hub, key, and keyway on tapered axle shafts with white lead and torque the nut as specified. If the noise persists after this treatment, replace the worn parts.

 **AUTHENTIC RESTORATION**
N-37. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Axle Noisy on Pull and Coast	
Excessive Back Lash Bevel Gear and Pinion.....	Adjust
End Play Pinion Shaft.....	Adjust
Worn Pinion Shaft Bearing.....	Adjust
Pinion Set too Deep in Bevel Gear too Tight.....	Adjust
Wrong Lubricant Being Used (Powr-Lok or Trac-Lok Differential).....	Replace
Axle Noisy on Pull	
Pinion and Bevel Gear Improperly Adjusted.....	Adjust
Pinion Bearings Rough.....	Adjust
Pinion Bearings Loose.....	Adjust
Axle Noisy on Coast	
Excessive Back Lash in Bevel Gear and Pinion...	Adjust
End Play in Pinion Shaft.....	Adjust
Improper Tooth Contact.....	Adjust
Rough Bearings.....	Replace
Back Lash	
Worn Differential Pinion Gear Washers.....	Adjust
Excessive Back Lash in Bevel Gear and Pinion...	Adjust
Worn Universal Joints.....	Replace

N-38. REAR AXLE SPECIFICATIONS

	DJ MODELS TAPERED AXLE SHAFT	CJ MODELS TAPERED AXLE SHAFT	DJ and CJ MODELS FLANGED AXLE SHAFT
Make	Dana	Dana	Dana
Model	27	44	44
Description	Semifloating Hypoid Gears	Semifloating Hypoid Gears	Semifloating Hypoid Gears
Drive Pinion Offset (Vertical)	1.38" [35 mm.]	1.50" [38,0 mm.]	1.50" [38,0 mm.]
Number of Differential Pinions	2	2	2
Gear Ratio:			
V6 Engine:			
Standard	3.73:1	3.73:1	3.73:1
Optional	4.88:1	4.88:1	4.88:1
F4 Engine:			
Standard	4.56:1	4.27:1	4.56:1
Optional .....	.....	5.38:1	5.38:1
Ring Gear Pitch Diameter	7.75" [19,68 cm.]	8.50" [21,6 cm.]	8.50" [21,6 cm.]
Pinion Adjustment	Shim	Shim	Shim
Pinion Bearing Adjustment	Shim	Shim	Shim



STEERING SYSTEM

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Caster Adjustment.....	O-10	Disassembly of Steering Gear.....	O-24
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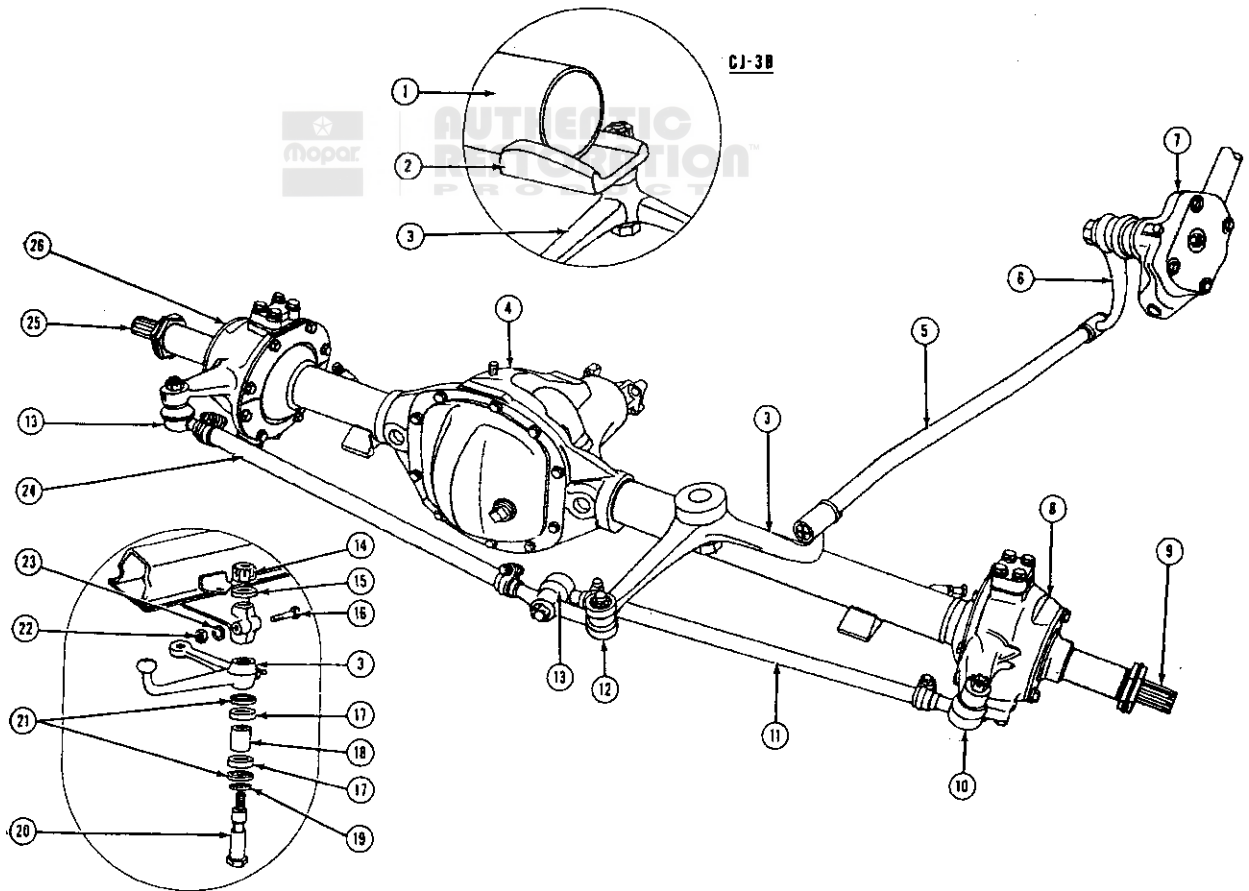


FIG. O-1—STEERING LINKAGE

- | | | |
|---------------------------------------|---------------------------------|------------------------------------|
| 1—Frame Cross Tube (CJ-3B) | 10—Left Tie Rod Socket | 19—Washer |
| 2—Steering Bellcrank Bracket (CJ-3B) | 11—Left Steering Tie Rod | 20—Bellcrank Shaft |
| 3—Steering Bellcrank | 12—Left Tie Rod Socket | 21—Bearing Seal |
| 4—Front Axle Assembly | 13—Right Tie Rod Socket | 22—Nut |
| 5—Steering Connecting Rod (Drag Link) | 14—Bellcrank Nut | 23—Lockwasher |
| 6—Steering Arm | 15—Washer | 24—Right Steering Tie Rod |
| 7—Steering Gear | 16—Bolt | 25—Right Shaft and Universal Joint |
| 8—Left Steering Knuckle and Arm | 17—Bellcrank Bearing | 26—Right Steering Knuckle and Arm |
| 9—Left Shaft and Universal Joint | 18—Bearing Spacer (Early Model) | |

14441

O-1. GENERAL

The steering system on all Jeep Universal vehicles consists of the steering gear, steering wheel, steering column and shaft, and steering linkage. This section covers wheel alignment, steering linkage, steering gear, steering column and steering wheel.

O-2. Steering Gear Function

The steering gear is a reducing gear. It exchanges a relatively large amount of movement with a small force (applied by the driver at the steering wheel), for a much smaller amount of movement with a greatly increased force through a cam and lever action type steering gear. The steering gear ratio is 17.9 to 1 on vehicles equipped with the F4 engine and 19 to 1 with the V6 engine.

O-3. Steering Linkage

Refer to Fig. O-1.

The steering linkage consists of a steering arm attached to the steering gear, a steering connecting rod, (drag link), connecting the steering arm to the bellcrank, and a steering tie rod connecting the bellcrank to the axle tie rod. The bellcrank pivots on a pin mounted just to the left of the frame front crossmember. The steering tie rod is connected to the bellcrank and extends to the right ball joint as-

sembly of tie rod. The tie rod extends to the wheels, being connected to their respective steering knuckle arms at the wheels. With this linkage arrangement, as the steering arm moves rearward, the front wheels turn to the left. As the steering arm moves forward, the wheels turn to the right.

Ball joints are used to secure the drag link, steering connecting rod and tie rod ends. The ball joints assist in maintaining good steering control and constant toe-in of the front wheels under all driving conditions. If the ball joints become worn enough to allow free motion in the linkage, they should be replaced.

Note: Ball joint replacement of the tie rod requires resetting of the wheel toe-in adjustment.

O-4. Steering Column and Gear Alignment

When adjusting a steering gear remove all loads from the unit by disconnecting the steering connecting rod (drag link) from the steering arm and also loosen the instrument panel bracket and the steering gear to frame bolts to allow the steering post to correctly align itself. When retightening the steering gear to frame bolts use a torque wrench pull of 45 to 55 lb-ft. [6,2 a 7,6 kg-m.] on the 1/16" bolts and 30 to 40 lb-ft. [4,15 a 5,5 kg-m.] on the 3/8" bolts.

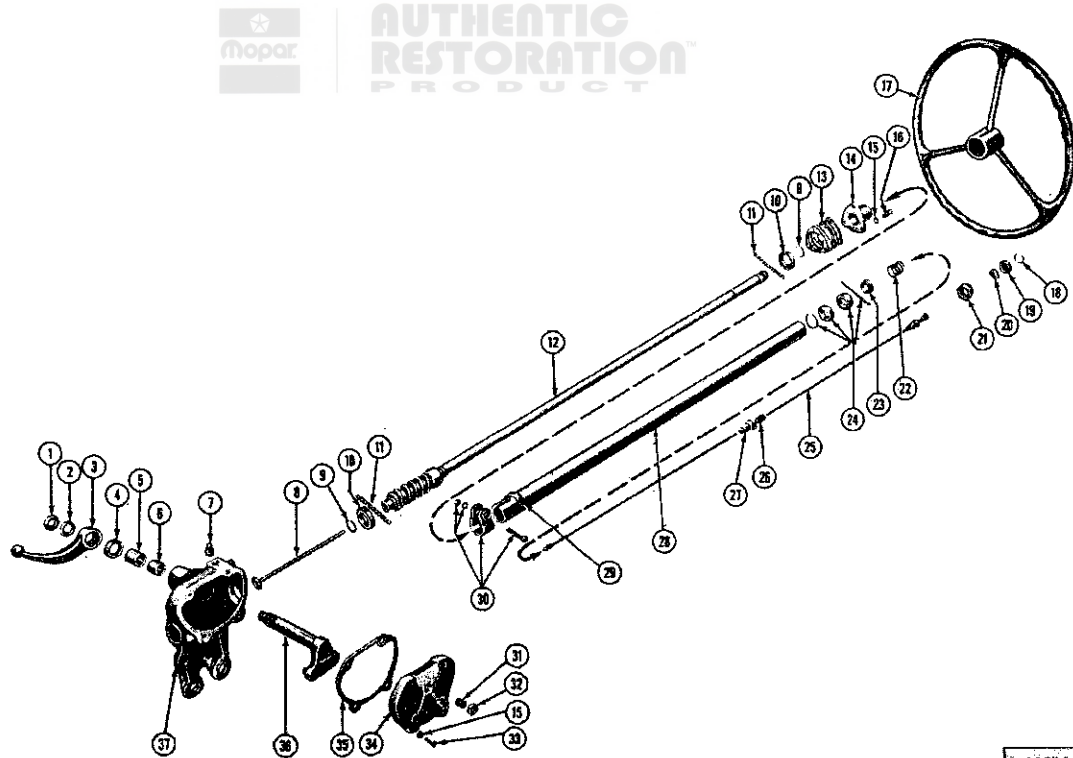


FIG. O-2--STEERING GEAR

- | | | | |
|-------------------------|-------------------------|-----------------------|--------------------|
| 1—Nut | 11—Ball (Steel) | 21—Nut | 31—Adjusting Screw |
| 2—Lockwasher | 12—Tube and Cam | 22—Spring | 32—Nut |
| 3—Steering Gear Arm | 13—Shims | 23—Spring Seat | 33—Bolt |
| 4—Lever Shaft Oil Seal | 14—Upper Cover | 24—Bearing | 34—Side Cover |
| 5—Outer Housing Bushing | 15—Lockwasher | 25—Horn Cable | 35—Gasket |
| 6—Inner Housing Bushing | 16—Bolt | 26—Horn Button Spring | 36—Shaft and Lever |
| 7—Filler Plug | 17—Steering Wheel | 27—Spring Cup | 37—Housing |
| 8—Cover and Tube | 18—Horn Button Retainer | 28—Steering Column | |
| 9—Ball Retaining Ring | 19—Horn Button | 29—Oil Hole Cover | |
| 10—Cup | 20—Horn Button Cap | 30—Clamp | |

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Note: If the steering-gear-to-frame bolts are not properly torqued, they will eventually loosen during operation of the vehicle. Loose bolts will result in elongated bolt holes making maintenance of bolt torque difficult, and may allow position of the steering columns to be misaligned. Therefore, proper torquing is extremely important.

Do not tighten the steering gear to dampen out steering trouble. Adjust the steering gear only to remove lost motion or play within the unit.

O-5. Steering Gear Adjustment

The cam and lever steering gear is illustrated in Fig. O-2. It consists of a spiral cam, and a cross shaft and lever assembly with two lever studs. When the steering wheel is turned, the cam moves the studs, causing rotary movement of the cross shaft, which in turn causes angular movement of the steering arm.

Two adjustments of the steering gear are necessary: up and down play of the steering shaft, and adjustment of the lever studs (tapered pins) in the cam groove.

Adjustment of the ball thrust bearings to eliminate up and down play of the steering shaft is accomplished by removing shims which are installed between the steering gear housing and the upper cover. Before making this adjustment loosen the housing side cover adjusting screw to free the pins in the cam groove. Loosen the housing cover to cut and remove a shim or more as required. Install the screws and tighten. Adjustment should be made to have a slight drag but allow the steering wheel to turn freely with thumb and forefinger lightly gripping the rim.

Shims installed for adjustment are .002", .003", and .010" [.0508, .0762 and .254 mm.] in thickness.

Adjustment of the tapered pins in the cam groove is accomplished by adjusting screw. Unlock the adjusting screw and turn it in until a very slight drag is felt through the mid-position when turning the steering wheel slowly from one extreme position to the other.

Backlash of the pins in the groove shows up as end play of lever shaft, also as backlash of steering arm.

The cam groove is purposely cut shallow in the straight ahead driving position for each pin. This feature permits a close adjustment for normal straight ahead driving and provides precision steering and permits take up of backlash at this point after the wear occurs without causing a bind elsewhere. Always adjust within the high range through the mid-position of pin travel. Do not adjust off "straight ahead" position. Backlash in turned positions is not objectionable.

O-6. Front Wheel Alignment Adjustments

To ensure correct alignment, a definite procedure for inspection of the steering system is recommended. It is suggested that the following sequence be used:

a. Equalize tire pressures and level vehicle.

b. Check steering gear to steering column alignment.

c. Inspect steering knuckle pivots, spindle, and wheel bearing looseness.

d. Check wheel runout.

e. Test wheel balance and bearing adjustment.

f. Check for spring sag.

g. Inspect brakes and shock absorbers.

h. Check steering gear assembly adjustment and steering connecting rod.

i. Check caster.

j. Check toe-in.

k. Check toe-out on turns.

l. Check camber.

m. Check tracking of front and rear wheels.

n. Check frame alignment.

The factors of alignment, caster, camber, and toe-in, are all interrelated and if one adjustment is made, another adjustment may be affected. Therefore, 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.

Proper alignment of front wheels must be maintained in order to ensure ease of steering and satisfactory tire life.

The most important factors of front wheel alignment are wheel camber, axle caster and wheel toe-in.

Wheel toe-in is the distance the wheels are closer together at the front than at the rear.

Wheel camber is the amount the wheels incline outward at the top from a vertical position.

Front axle caster is the amount in degrees that the steering pivot pins are tilted towards the front or rear of the vehicle. Positive caster is inclination of the top of the pivot pin towards the rear of the vehicle. Zero caster is the vertical position of the pivot pin. Negative or reverse caster is the inclination of the top of the pin towards the front of the vehicle.

These points should be checked at regular intervals, particularly when the front axle has been subjected to a heavy impact. When checking wheel alignment, it is important that wheel bearings and knuckle bearings be in proper adjustment. Loose bearings will affect instrument readings when checking the camber, pivot pin inclination and toe-in.

To accurately check camber and caster, use a wheel aligning fixture. Camber and caster of the front wheels are both preset. Camber cannot be altered but caster can be adjusted by installing caster shims between the axle pad and the springs. Wheel toe-in may be adjusted. To measure wheel toe-in, use a wheel aligning fixture or follow the procedure given in Par. O-8.

O-7. Front Wheel Toe-In

Toe-in as illustrated in Fig. O-3, is necessary to offset the effect of camber as shown in Fig. O-4.

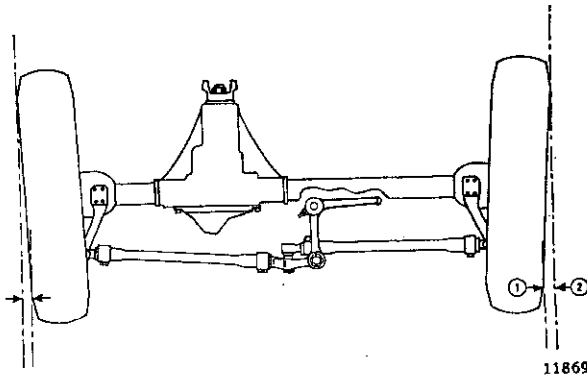


FIG. O-3—FRONT WHEEL TOE-IN

1—Toe-In Angle
2—Vertical Line

In the absence of a wheel aligning fixture, toe-in may be set by measuring between the front wheels at the edge of the rim, at the flange or at the tire tread center. When making this adjustment the wheels must be in a straight ahead position. It is highly important that toe-in be checked regularly and if found to be out of adjustment, correction should be made immediately. The correct toe-in of these models is found in the specifications at the end of this section.

O-8. Toe-In Adjustment

The toe-in may be adjusted with a line or straight edge as the vehicle tread is the same in front and rear. To set the adjustment both tie rods must be adjusted as outlined below:

Set the tie rod end of the steering bell-crank at right angles with the front axle. Place a straight edge or line against the left rear wheel and left front wheel to determine if the wheel is in a straight ahead position. If the front wheel tire does not touch the straight edge at both the front and rear, it will be necessary to adjust the left tie rod by loosening the clamps on each end and turning the rod until the tire touches the straight edge.

Check the right hand side in the same manner, adjusting the tie rod if necessary, making sure that the bell-crank remains at right angles to the axle. When it is determined that the front wheels are in the straight ahead position, set the toe-in by shortening each tie rod approximately one-half turn.

O-9. Front Wheel Camber

The purpose of camber Fig. O-4, is to more nearly place the weight of the vehicle over the tire contact on the road to facilitate ease of steering.

The result of excessive camber is irregular wear of tires on outside shoulders and is usually caused by bent axle parts.

The result of negative or reverse camber, if excessive, will be hard steering and possibly a wandering condition. Tires will also wear on inside shoulders. Negative camber is usually caused by excessive wear or looseness of front wheel bearings, axle parts or the result of a sagging axle.

Unequal camber may cause any or a combination of the following conditions: unstable steering, wan-

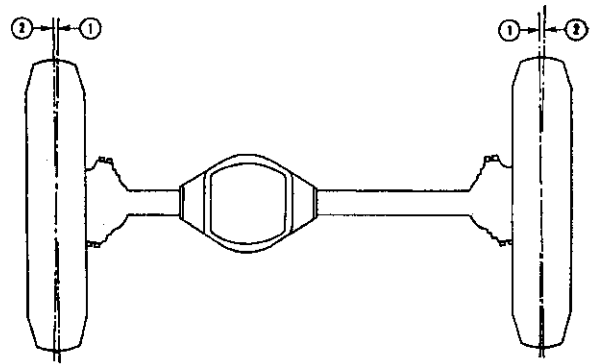


FIG. O-4—WHEEL CAMBER

1—Vertical Line
2—Camber Angle

dering, kick-back or road shock, shimmy or excessive tire wear. The cause of unequal camber is usually a bent steering knuckle or axle end.

Correct wheel camber is set in the axle at the time of manufacture and cannot be altered by any adjustment. It is important that the camber be the same on both front wheels. Heating of any of these parts to facilitate straightening usually destroys the heat treatment given them at the factory. Cold bending may cause a fracture of the steel and is also unsafe. Replacement with new parts is recommended rather than any straightening of damaged parts.

O-10. Axle Caster

Caster angle is established in the axle design by tilting the top of the kingpin toward the rear and the bottom of the kingpin forward so that an imaginary line through the center of the kingpin would strike the ground at a point ahead of the point of tire contact.

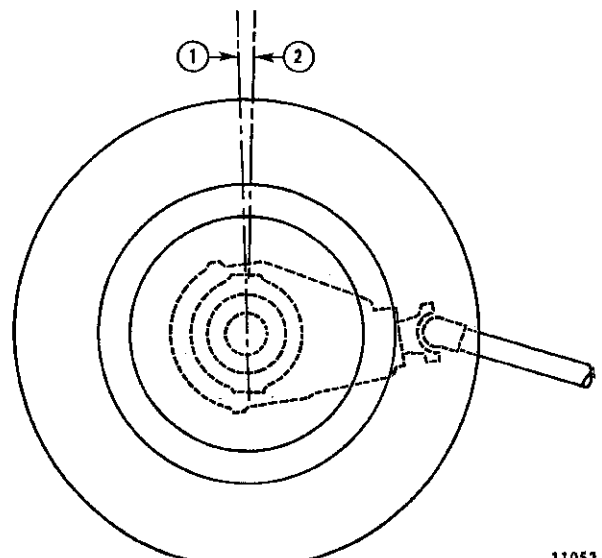


FIG. O-5—AXLE CASTER

1—Vertical Line
2—Caster Angle

The purpose of caster Fig. O-5, is to provide steering stability which will keep the front wheels in the straight ahead position and also assist in straightening up the wheels when coming out of a turn.

Caster of the front wheels is preset. If the angle of caster, when accurately measured, is found to be incorrect, correct it to the specification given at the end of this section 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 the 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 is hard to straighten out, insufficient caster for easy handling of vehicle 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.

O-11. Front Wheel Turning Angle

When the front wheels are turned, the inside wheel on the turn travels in a smaller circle than the outside wheel, therefore, it is necessary for the wheels to toe out to prevent the tire on the inside wheel from being scuffed sideways. This angle for toe out on turns is designed to permit both front wheels to turn on a common center by having the ends of the steering knuckle arms closer together than the king-pins.

To avoid possible damage to the universal joints on the front axles of 4-wheel drive vehicles, it is advisable to check the turning angle. Wearing away of the upset edge on the spindle housing bolt which

contacts the stop screw will increase the turning angle to the point where the universal joints may be damaged.

The Jeep Universal Series vehicles should have a turning angle of not more than $27\frac{1}{2}^{\circ}$ both left and right. To adjust the stop screw, it is necessary to loosen the locknut holding the stop screw. When the adjustment has been made, tighten the locknut on the screw to prevent any movement. Refer to Fig. O-6.

The left steering knuckle arm controls the relationship of the front wheels on a left turn and the right arm controls the relation on a right turn.

O-12. Steering Knuckle Arm

Should a steering knuckle arm become bent, the knuckle housing must be replaced. It is not safe to straighten the knuckle arm.

O-13. 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:

- a. Equalize tire pressures and see that they are according to specifications.
- b. Check the wheel bearings for looseness. Be sure that the inner wheel bearing race is not too loose on the spindle.
- c. Remove both steering knuckles and carefully inspect the upper and lower king pin bearings. Inspect the bearing cups for evidence of brinelling, pitting, or fretting. Any bearings that show the slightest imperfection must be replaced. Reassemble and lubricate the front axle and steering linkage, installing new steering knuckle oil seals if present seals show any wear.
- d. With full weight on the front wheels and one man working the steering play with the steering wheel, a second man should closely observe the steering bell crank for any rocking motion and the double tie rod socket for any rocking motion or looseness at both points. Replace the complete bell crank assembly if it has even the slightest rocking motion. The same applies to the double tie rod socket.
- e. Check wheel run-out. This check should include radial run-out and wheel looseness on the hub.
- f. Test wheel balance—check for blowout patches, uniform tire tread, vulcanized tires, mud on inside of wheels, and tires creeping on the rims.
- g. Try switching front wheels and tires to the rear, criss-crossing them in this operation.
- h. Check for front spring sag. Also check for broken spring leaves, broken center spring bolt, loose spring clips (or tight clips), over-lubrication 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.
- i. Check brakes to make sure that one does not drag.
- j. Check the steering assembly and steering connecting rod. This includes the up-and-down-play of the steering worm shaft, end play of the cross

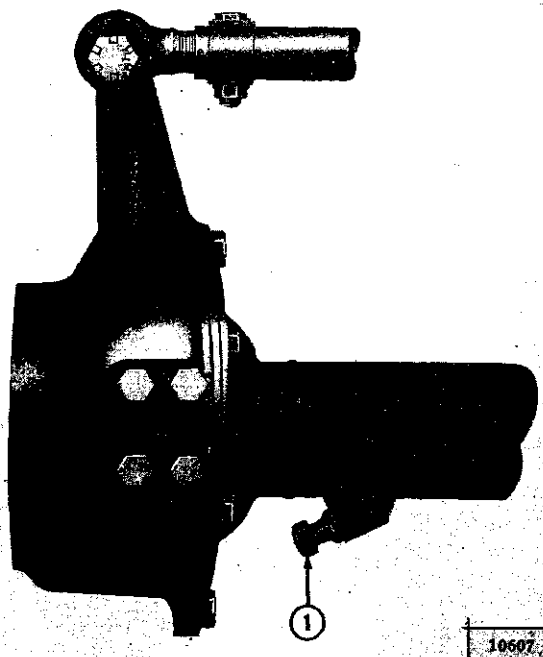


FIG. O-6—TURNING ANGLE STOP SCREW

1—Stop Screw

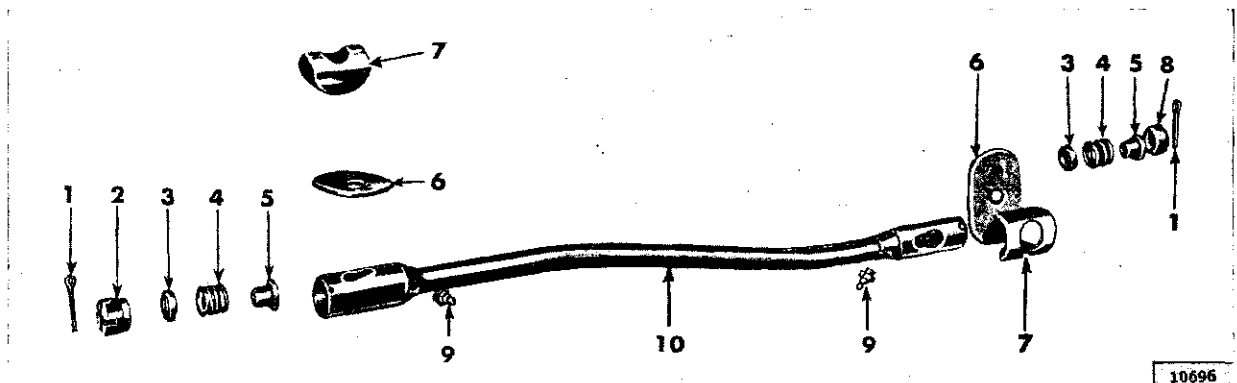


FIG. O-7—STEERING CONNECTING ROD (DRAG LINK)

- | | |
|--------------------|------------------------|
| 1—Cotter Pin | 6—Dust Cover |
| 2—Large Plug | 7—Dust Shield |
| 3—Ball Seat | 8—Small Adjusting Plug |
| 4—Ball Seat Spring | 9—Lubrication Fitting |
| 5—Spring Plug | 10—Connecting Rod |

shaft, tightness of the steering gear in the frame, tightness of steering gear arm, adjustment of the steering connecting rod and condition of the steering tie rod ball joint ends. Adjust the steering connecting rod (drag link) to maximum safe tightness at both ends. Examine the steering bellcrank bearings, the shaft in the mounting bracket, and the mounting bracket on the frame cross member.

k. 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. Correct caster is shown in specifications at the end of this section.

l. Check the front wheel toe-in. See Specifications.

m. Check wheel toe-out on turns. This gives you 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.

n. Check wheel camber. This should be the same on both wheels as shown on the Specifications.

o. Check the king pin inclination. See Specifications.

p. Check the tracking of the front axle and frame alignment, which may be incorrect due to an accident.

O-14. STEERING LINKAGE SERVICE

The steering linkage must maintain constant toe-in and good steering control under all driving conditions. This requires ball joints at each end of the tie rods and steering connecting rod. All joints in the steering linkage must be kept well lubricated for easy operation and long life. Should the joints be worn, allowing excessive free motion in the linkage, the joints must be replaced. Whenever ball joints are replaced, toe-in must be reset. Because some members of the steering system may have become bent or distorted, a periodic inspection should be made.

O-15. Steering Connecting Rod (Drag Link)

The steering connecting rod is of the ball and socket type. All ball seat springs and adjusting plugs are

identical, the only difference between front and rear end being the relative location of the springs. The correct assembly of the steering connecting rod is shown in Fig. O-7. At the front or axle end, the spring and spacer are assembled between the rod and ball seat, while at the steering gear end, spring and spacer are between the ball seat and the end plug. In the illustration the front end is to the left.

When removing springs and seats for any reason, make sure they are reassembled as shown in the illustration because this method of assembly relieves road shock from the steering gear in both directions. To adjust the ball joint, screw in the plug firmly against the ball, approximately 20 ft. lb. [2,8 kg-m.] then back off one quarter turn and lock with a new cotter pin inserted through holes in the tube and the slot in the adjusting plug. To adjust the ball joint at the steering gear arm, screw in the end plug firmly against the ball, then back off one full turn and lock with a new cotter pin inserted through holes in the tube and the slot in the adjusting plug.

The above adjustments will give the proper spring tension and avoid any tightness when swinging the wheel from maximum left to right turn.

The ball joints must be tight enough to prevent end play and yet loose enough to allow free movement.

O-16. Tie Rod

The tie rods are of three piece construction consisting of the rod and two ball and socket end assemblies. Ball and socket end assemblies are threaded into each rod and locked with clamps around each end of the rod. Right and left hand threads on tie rod end assemblies provide toe-in adjustments without removing the tie rod ends from the steering arm.

'Jeep' Universal models are equipped with a divided tie rod connected to a bell-crank mounted on the frame cross member. With this type construction the toe-in of each wheel is adjusted independently. See heading "Toe-in adjustment".

When wear takes place in the tie rod end ball and socket, it will be necessary to replace the ball and socket assembly and also the rubber seal.

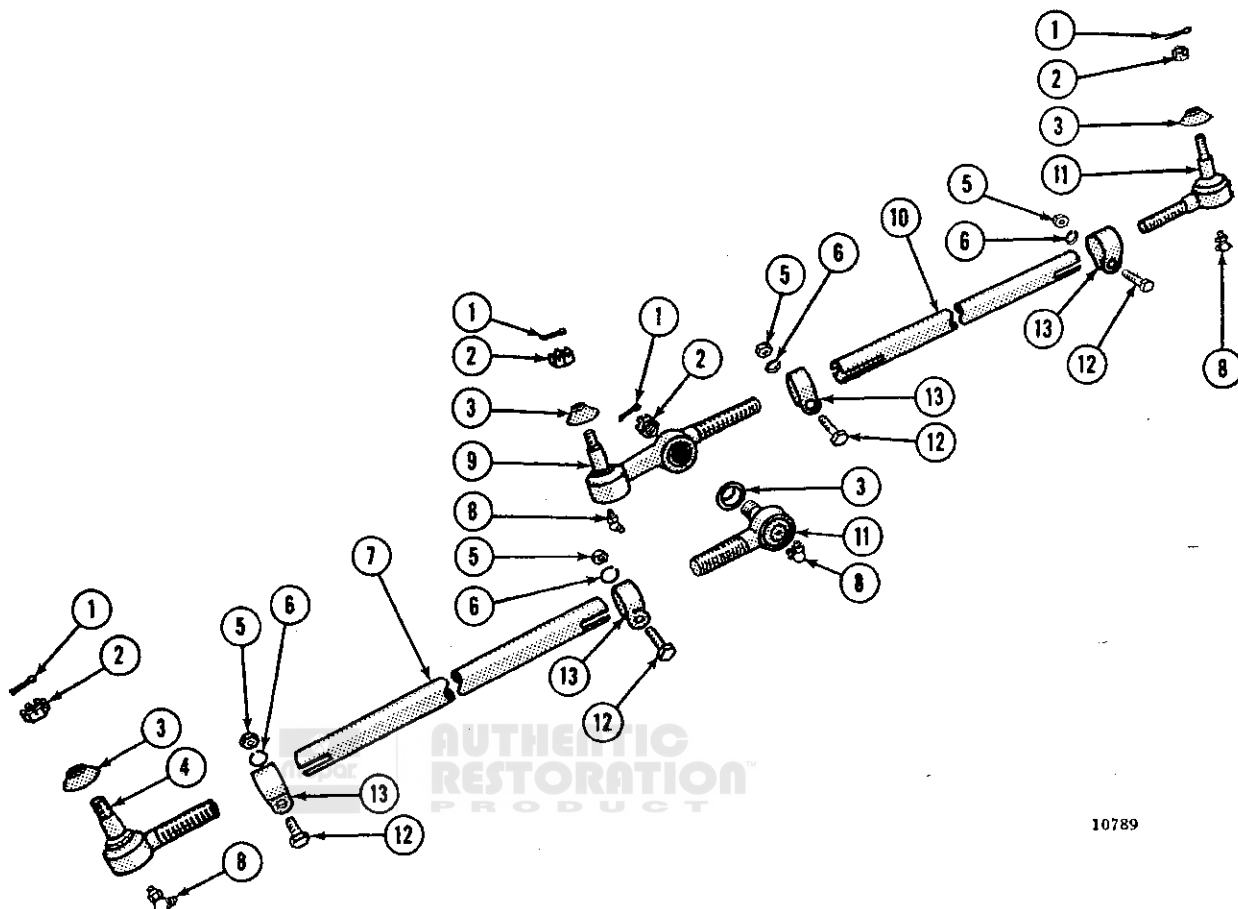


FIG. O-8—STEERING TIE ROD

- | | | |
|---------------|-----------------------------------|------------------|
| 1—Cotter Pin | 6—Lockwasher | 11—Right Socket |
| 2—Nut | 7—Left Tie Rod | 12—Bolt |
| 3—Dust Cover | 8—Lubrication Fitting | 13—Tie Rod Clamp |
| 4—Left Socket | 9—Left Socket (For Right Tie Rod) | |
| 5—Nut | 10—Right Tie Rod | |

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O-17. Tie Rod Removal

First disconnect and remove the steering tie rod from the bellcrank. Refer to Fig. O-1. The tie rod can then be removed by removing the cotter pins and nuts at the ends. To remove the tie rod from the steering knuckle arms, use a puller or expansion fork. Then separate the joint seals and fittings, if necessary. The tie rod sockets can be removed by loosening the nuts on the clamp bolts and unscrewing the sockets from the tie rod tubes. Refer to Fig. O-8. When installing the components of the steering linkage, new seals should be installed as necessary. All nuts should be torqued 38 to 42 lb-ft. [5,2 a 5,8 kg-m.], and new cotter pins installed. If the bellcrank was removed, the steering bellcrank nut should be torqued 70 to 90 lb-ft. [9,7 a 12,4 kg-m.].

O-18. Steering Bellcrank Service

Refer to Fig. O-9.

The assembly and adjustment of this unit is extremely important; the information outlined below must be followed carefully whenever servicing the bellcrank assembly on late model vehicles.

A service kit Part No. 991381 containing the bellcrank shaft, bearings, seals, bolt, nuts, and washer is available for servicing this assembly. Be certain that all parts are installed in their proper position. When assembling the parts, be sure the new bearings in the bellcrank are positioned $\frac{1}{8}$ " [3,175 mm.] below the surface of the bellcrank face as shown. The bearings have a light press fit that will hold them in place after locating them in the proper position. Finally, when installing washers, the chamfer on the washer must be installed toward the bellcrank.

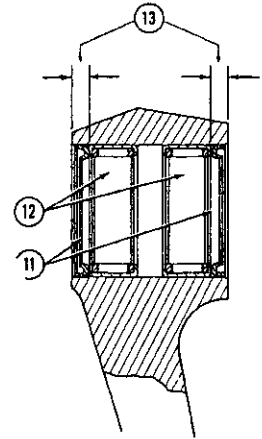
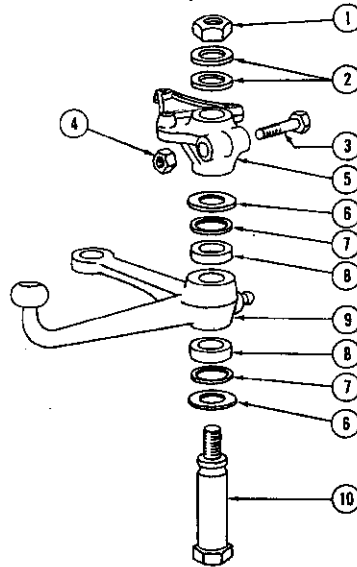
After completing the assembly, and before attaching the connecting rods to the bellcrank levers, make your final adjustment to the assembly as follows:

- a. With the $\frac{1}{8}$ " [11,113 mm.] diameter clamp bolt loosened, adjust the locknut on the end of the bellcrank shaft until the bellcrank just rotates freely without a bind.

Note: On early model vehicles using bellcrank kit Part No. 920556, torque the bellcrank shaft nut (Fig. O-1 #14) 70 - 90 lb-ft. [9,7 a 12,4 kg-m.].

FIG. O-9—STEERING
BELLCRANK ASSEMBLY

- 1— $\frac{3}{8}$ "-18 Stollock Locknut
- 2—Plain Washer
- 3— $\frac{1}{16}$ "-20 x 2 $\frac{1}{2}$ " Bolt
- 4— $\frac{7}{16}$ "-20 Stollock Locknut
- 5—Bellcrank Support
- 6—Special Ground Washer
- 7—Seal
- 8—Bearing
- 9—Bellcrank
- 10—Bellcrank Shaft
- 11—Seals
- 12—Bearings
- 13— $\frac{1}{4}$ "



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b. Torque the $\frac{1}{16}$ " [11,113 mm.] diameter clamp bolt to 50-70 lb-ft. [6,9 a 9,7 kg-m.].

c. Assemble the tie rod to the bellcrank lever, making sure to tighten the nut to the proper torque value of 38 to 45 lb-ft. [5,2 a 6,2 kg-m.].

d. Connect the drag link to the bellcrank arm, adjust the ball joint by screwing in the plug firmly against the ball, approximately 20 lb-ft. [2,8 kg-m.], then back off one quarter turn and lock with a new cotter pin.

O-19. Bellcrank Support Bracket Rivet Replacement

The procedure for replacing a rivet with a bolt is as follows:

- a. Drill a $\frac{3}{16}$ " [4,76 mm.] pilot hole up through the front rivet.
- b. Enlarge the $\frac{3}{16}$ " [4,76 mm.] hole with a $\frac{11}{32}$ " [8,73 mm.] drill.
- c. Chisel off the bottom rivet head and drive the remainder of the rivet upward and out, using a punch and hammer.
- d. Install a $\frac{3}{8}$ " [9,53 mm.] bolt and lock nut, torque to 30-45 lb-ft. [4,1 a 6,2 kg-m] and stake the nut.
- e. Clamp a metal plate to the frame to protect the radiator, then drill and remove the remaining two rivets, install bolts, lock nuts and torque as specified.

O-20. STEERING COLUMN AND WHEEL SERVICE

Jeep Universal Series vehicles use a one-piece steering shaft that is integral with the steering gear assembly, as shown in Fig. O-2. Alignment instructions in paragraph O-4 apply.

O-21. Steering Wheel Removal

- Refer to Fig. O-2.
- a. Carefully pry the rubber horn cap from the housing slot.

b. Remove steering shaft nut.

c. Remove steering wheel and spring.

O-22. STEERING GEAR SERVICE

Note: The steering gear can be adjusted when the gear is mounted in the vehicle by first disconnecting the drag link from the steering arm. Refer to Par. O-5.

O-23. Removal of Steering Gear

- F4-Engine.
 - a. Remove the directional signal unit from the steering column.
 - b. Remove the steering column bracket attached at the instrument panel.
 - c. Remove upper section of the floor pan.
 - d. Disconnect shift rods from the shift levers at lower end of the steering column if applicable.
 - e. Disconnect the horn wire at lower end of steering gear assembly.
 - f. Remove steering gear arm from the steering gear assembly.
 - g. Remove bolts attaching the steering gear housing to the frame.
 - h. Remove the steering gear assembly by bringing it up through the floor pan opening.
- V6 Engine.
 - a. Remove oil pan skid plate.
 - b. Remove left exhaust pipe.
 - c. Disconnect connecting rod (drag link) from steering gear arm.
 - d. Disconnect steering gear assembly from frame.
 - e. Remove steering wheel from steering column.
 - f. Disconnect accelerator linkage.
 - g. Remove upper floor pan assembly.
 - h. Disconnect directional signal switch.
 - i. Jack-up vehicle, and remove steering gear and

column assembly down through the floor pan opening and out from under vehicle.

O-24. Disassembly of Steering Gear

Refer to Fig. O-2.

When the steering gear arm is installed on early production vehicles, the line across the face of the arm and the end of the shaft should be in alignment. On later production vehicles, blind splines on the lever shaft and in the steering gear arm ensure correct positioning of the arm.

a. Remove the steering gear arm with a puller C-3646.

Caution: Do not use a hammer or wedge to remove the steering arm from the shaft and lever. This can cause damage to the shaft assembly.

b. Loosen the lock nut and unscrew the adjusting screw two turns.

c. Remove the side cover screws and washers. Remove the side cover and gasket.

d. Remove lever shaft.

e. Remove upper cover plate screws. Remove cam, wheel tube, and bearing assembly from the housing.

f. Clean all parts with suitable cleaning solvent and wipe dry.

g. After dismantling as outlined above is completed, inspect cam grooves for wear, chipping and scoring, also the ball races on the cam ends and the separate ball cups. Existence of any of these conditions indicates the necessity for parts replacement.

h. Inspect the tapered stud mounted on the lever shaft for flat spots and chipping. In the case of either, replacement is usually advisable. Inspect the lever shaft for wear and test the fit of the shaft in the bushings.

i. Inspect condition of the oil seal at outer end of lever shaft and the bearing at top end of steering column.

O-25. Reassembly of Steering Gear

● Refer to Fig. O-2.

Reassemble all parts to wheel tube in reverse order of dismantling. Assemble cam, wheel tube and bearing assembly in housing, seating the lower bearing ball cup in the housing.

Note: New plastic retainer type cam bearings are now available for the Ross steering gears. The new bearings replace, and are interchangeable with, the lock ring type cam bearings on gears equipped with early type cams.

With adjusting shims in place, assemble upper cover and adjust the cam bearings.

Assemble lever shaft in housing and with gasket in place assemble the side cover and set adjusting screw for a minimum backlash of the studs in the cam groove, with the steering gear at the center point of travel.

When assembling upper bearing spring and spring seat in jacket tube make sure that the spring seat is positioned correctly. It must be installed with the lengthwise flange down against the bearing and not up inside of spring coil.

O-26. Installation of Steering Gear

a. After the gear has been properly adjusted, as outlined in Par. O-5, install steering gear assembly in chassis in the reverse order in which it was removed.

b. After installing the assembly in the vehicle, jack up front of vehicle and place the front wheels in the straight ahead position.

c. Temporarily install the steering wheel to locate the mid-position of the steering gear. To locate the mid-position, turn the steering wheel as far to the right as possible and then turn in the opposite direction as far as possible, noting the total number of turns. Turn the wheel back just $\frac{1}{2}$ of the total movement to place the gear in mid-position.

d. With the steering gear in mid-position and the wheels in the straight ahead position install steering gear arm on lever shaft with the ball end down. When installed the line across the face of the arm and end of shaft should be in alignment.

O-27. Steering Wheel Installation

● Refer to Fig. O-2.

a. Install steering wheel and spring on shaft. Align scribe marks on shaft and hub of wheel.

b. Install steering shaft nut and torque 20 to 25 lb-ft. [2,8 a 3,4 kg-m.].

c. Install horn cap. Test horn.

O-28. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Hard Steering	
Lack of Lubrication.....	Lubricate all Connections
Tie Rod Ends Worn.....	Replace
Connecting Rod Ball Joints Tight.....	Adjust
Cross Shaft Improperly Adjusted.....	Adjust
Steering Gear Parts Worn.....	Replace
Steering Loose	
Tie Rod Ends Worn.....	Replace
Connecting Rod Ball Sockets Worn.....	Replace
Steering Gear Parts Worn.....	Replace
Steering Gear Improperly Adjusted.....	Adjust
Road Shock:	Steering Connecting Rod too Tight; Axle Spring Clip Loose; Wheel Bearings Loose; Poor Shock Absorber Control.
Turning Radius	
Short One Side.....	Center Bolt in Spring Sheered Off, Axle Shifted, Steering Arm Bent, Steering Arm not Properly Located on Steering Gear.



O-29. STEERING SPECIFICATIONS

	F4 ENGINE	V6 ENGINE
STEERING GEAR:		
Make.....	Ross	Ross
Type.....	Cam and Lever	Cam and Lever
Ratio.....	17.9 to 1	19 to 1
Bearings:		
Cam-Upper.....	Ball	Ball
Cam-Lower.....	Ball	Ball
Lever Shaft.....	Bushing	Bushing
Steering Column-Upper.....	Ball	Ball
Lever Shaft:		
Clearance to Bushing.....	.0005" to .0025" [0,0127 a 0,0635 mm.]	.0005" to .0025" [0,0127 a 0,0635 mm.]
End Play.....	.000"	.000"
Lash at Cam (Straight Ahead).....	Slight Drag	Slight Drag
Wheel Diameter.....	17 1/4" [438 mm.]	17 1/4" [438 mm.]
Wheel Turns.....	2.58	2.58
STEERING GEOMETRY:		
King Pin Inclination.....	7 1/2°	7 1/2°
Toe-In.....	3/4" to 3/8" [1,2 a 2,3 mm.]	3/4" to 3/8" [1,2 a 2,3 mm.]
Camber.....	1° 30'	1° 30'
Caster.....	3°	3°
Turning Angle:		
DJ, CJ Models.....	27 1/2°	27 1/2°
Turning Radius with 27 1/2° Angle:		
CJ-3B, CJ-5, CJ-5A.....	17' 6" [5,3 mm.]	17' 6" [5,3 mm.]
CJ-6, CJ-6A.....	22' 10" [7,0 mm.]	22' 10" [7,0 mm.]
Outside Wheel Angle with Inside Wheel at 20°:		
'Jeep' Universal.....	20°	20°

BRAKES

Contents

SUBJECT	PAR.	SUBJECT	PAR.
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P-1. GENERAL

A double-safety hydraulic brake system in conjunction with self-adjusting wheel brake units are standard equipment on all current production 'Jeep' vehicles. The double-safety brake system is equipped with dual stop light switches that operate independently of each other, thus eliminating possible stop light failure. Service information for self adjusting brakes starts with Par. P-14. All four-wheel-drive vehicles are equipped with a transmission brake that operates in the drive line and is mounted to the rear of the transfer case.

Two-wheel-drive vehicles (DJ-5, DJ-6) are equipped with a hand-operated parking brake that operates at the rear wheels.

**P-2. Master Cylinder —
Double Safety-Brake System**

The master cylinder (cast integrally with the reservoir) is the compensating type. Refer to Fig. P-2 and P-13.

Action by the brake pedal moves the master cylinder piston which exerts pressure on the fluid in the cylinder and lines.

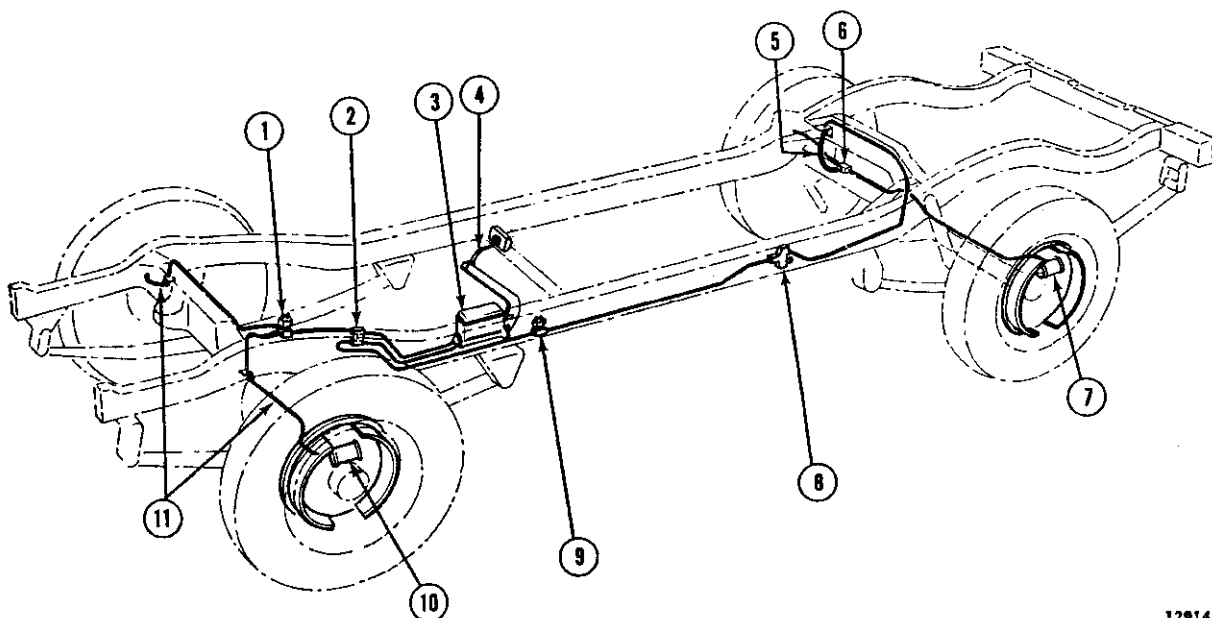


FIG. P-1—DOUBLE SAFETY BRAKE SYSTEM — LATE MODELS

- | | |
|-------------------------------------|--------------------------------------|
| 1—Stop Light Switch and Tee (Front) | 7—Wheel Cylinder (Left Rear) |
| 2—Line Tee (Front) | 8—Proportioning Valve (Early Models) |
| 3—Master Cylinder (Dual System) | 9—Stop Light Switch and Tee (Rear) |
| 4—Brake Pedal Assembly | 10—Wheel Cylinder (Left Front) |
| 5—Brake Hose | 11—Front Brake Hoses |
| 6—Line Tee (Rear) | |

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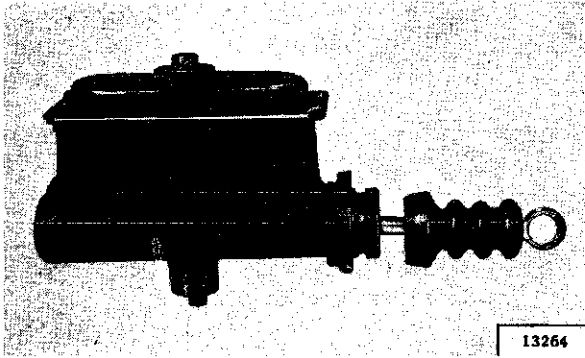


FIG. P-2--DOUBLE SAFETY BRAKE MASTER CYLINDER

With the Double-Safety brake system type master cylinder, failure in one part of the brake system does not result in failure of the entire hydraulic brake system. Failure in the front brake system will leave the rear brake system still operative or failure in the rear system will leave the front brake system operative.

A double hydraulic cylinder with two outlets, two residual check valves, two fluid reservoirs, and two hydraulic pistons (a primary and secondary) are operated in tandem by a single hydraulic push

rod. The primary outlet is connected to the front brakes with the secondary outlet connected to the rear brakes.

With the master cylinder fluid reservoirs filled and the front and rear brake system 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, through movement of the brake pedal, 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 rear wheel cylinders through the secondary residual check valve to the secondary portion of the master cylinder bore. Fluid also returns from the front wheel cylinders through the primary residual check valve to the primary portion of the master cylinder bore.

P-3. Parking Brakes — DJ-5, DJ-6

a. The parking brake is operated by a T-handle parking lever mounted to the left of the steering column and suspended from the instrument panel. When the brake lever is pulled outward, tension is exerted on the parking brake cable leading to the brake. The amount of brake grip depends on the number of notches the lever is pulled out. To set the parking brake, pull out on the parking brake control T-handle. To release the brake, turn the handle slightly and push it forward.

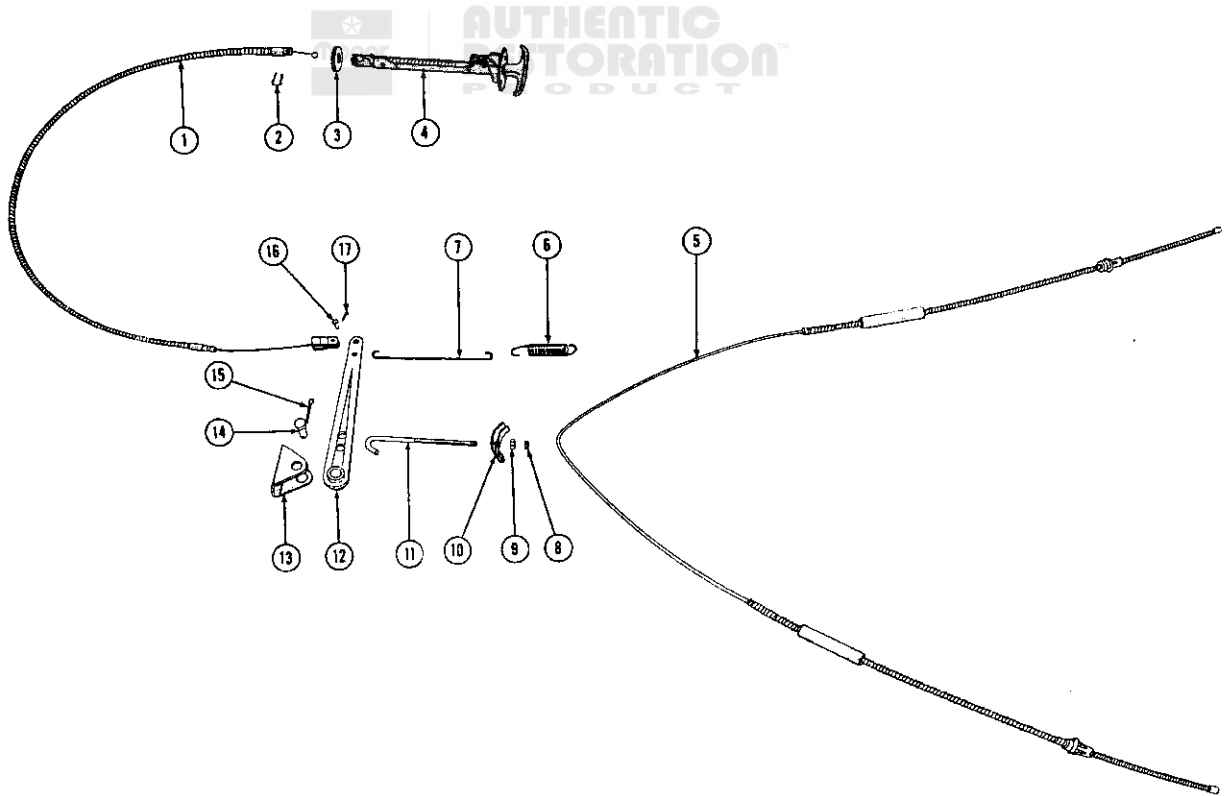


FIG. P-3--PARKING BRAKE LINKAGE — DJ-5, DJ-6

- | | | |
|-------------------------------|---------------------------|-------------------------|
| 1--Cable and Conduit (Front) | 7--Retracting Spring Link | 13--Brake Lever Bracket |
| 2--Clip | 8--Nut | 14--Clevis Pin |
| 3--Grommet | 9--Nut | 15--Cotter Pin |
| 4--Hand Brake Handle Assembly | 10--Equalizer | 16--Clevis Pin |
| 5--Cable and Conduit (Rear) | 11--Adjusting Rod | 17--Cotter Pin |
| 6--Retracting Spring | 12--Hand Brake Lever | |

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The standard parking brakes (Fig. P-3) consist of cable-controlled linkage for applying the rear wheel brake shoes mechanically. A single cable from the parking brake control lever is connected, by means of an equalizer, to cables leading to individual rear brakes. A lever attached to the secondary shoe, with a link acting against the primary shoe, expands the shoes into contact with the drums.

P-4. Transmission Brake

The transmission brake is mechanically operated by a hand lever through a cable and conduit and is mounted at the rear output bearing housing on the transfer case. The transmission brake and its linkage are shown in Fig. P-4.

P-5. Brake Maintenance

No brake can be expected to work well when grease or oil is allowed to leak into the drum from the rear axle. Little braking friction can be obtained between brakes and drums when the surface is covered with grease and oil. For this reason, take care not to over-lubricate wheel bearings, forcing lubricant past seals. Also, check condition of seals if leak is suspected or whenever brake drums are pulled.

Whenever wheels are removed, it is advisable to wash the drums with a suitable solvent so that all grease and dirt are removed. Linings with any evidence of grease or oil on them should be replaced. The hydraulic system should be kept free of dirt and moisture.

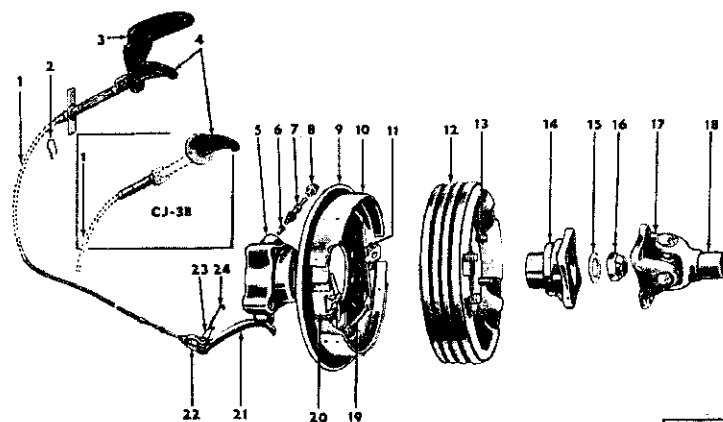
Use only SAE standard J-1703 Hydraulic Brake Fluid.

Caution: Keep mineral oils, gasoline, or kerosene out of the system as they cause rubber cups to soften, swell, and distort, resulting in failure.

P-6. Brake Service

To service the brakes, follow the procedure below:

- a. Check the fluid level in the brake master cylinder. See Lubrication Section, Par. B-40.
- b. Check brake pedal adjustment. See Par. P-9.
- c. Check brake pedal travel. If the pedal travels more than halfway to the floor, the brake system must be checked and the self adjusting star wheel mechanisms checked for binding, also the brake linings should be inspected as they may be badly worn. How much lining is left can only be determined by visually inspecting the linings. See Par. P-16 for relining brakes.
- d. If the brakes pull to one side after adjustment, check tire pressures. All tires must be inflated to recommended pressures to ensure even braking. If the condition persists, examine the brake linings for foreign material and clean as necessary. If cleaning does not correct the condition the linings should be replaced. If the side pull persists, check front wheel alignment and balance.
- e. Check the brake system for leaks by applying a steady pressure on the brake pedal. A leak in the system will allow the pedal to "fall away". If the pedal "falls away" check for a leaking wheel cylinder. Remove wheels and drums and carefully check each cylinder. Also examine all lines and fittings. Rebuild or replace all wheel cylinders (Par. P-21) if one is defective as they are all probably in poor condition. If the leak has allowed brake fluid to get on the linings, the linings will have to be replaced.
- f. A "spongy" brake pedal indicates the pressure of air in the hydraulic system. This condition must be corrected by bleeding the brakes. See Par. P-7.
- g. Should the brakes become locked so that the vehicle cannot be moved, the brakes may be released by opening the bleeder screw on any one of the wheel cylinders. Before the vehicle is driven, correct the cause of the condition. The cause may



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FIG. P-4—TRANSMISSION BRAKE

- | | | |
|------------------------------|----------------------------|--------------------------------|
| 1—Cable and Conduit | 9—Backing Plate | 17—Propeller Shaft Flange Yoke |
| 2—Hand Brake Clip | 10—Shoe and Lining | 18—Rear Propeller Shaft |
| 3—Hand Brake Bracket | 11—Lever End Return Spring | 19—Adjusting End Spring |
| 4—Hand Brake Handle Assembly | 12—Brake Drum | 20—Adjusting Screw Bracket |
| 5—Rear Cap | 13—Bolt | 21—Operating Lever |
| 6—Drive Gear Bushing | 14—Rear Companion Flange | 22—Clevis |
| 7—Driven Gear | 15—Washer | 23—Retracting Spring Clip |
| 8—Driven Gear Sleeve | 16—Nut | 24—Retracting Spring Link |

be either a defective master cylinder or the use of low grade brake fluid which has expanded because of heat. Use standard duty brake fluid conforming to SAE-J1703 specification.

P-7. Bleeding Brakes

The hydraulic brake system must be bled whenever a fluid line has been disconnected or air gets into the system. A leak in the system may sometimes be indicated by the presence of a spongy brake pedal. Air trapped in the system is compressible and does not permit the pressure, applied to the brake pedal, to be transmitted solidly through to the brakes. The system must be absolutely free from air at all times. When bleeding brakes, bleed at that wheel with the longest line from the master

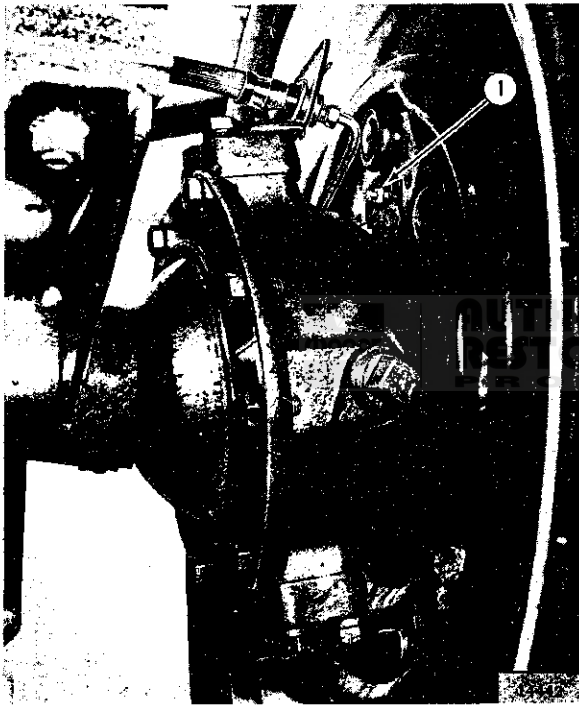


FIG. P-5—BLEEDING BRAKES

1—Bleeder Screw

cylinder first, the next longest second, etc. During the bleeding operation the master cylinder must be kept at least $\frac{3}{4}$ full of hydraulic brake fluid. To bleed the brakes, first carefully clean all dirt from around the master cylinder filler plug. If bleeder tank is used follow the manufacturers instructions. Remove the filler plug and fill the master cylinder to the lower edge of filler neck. Clean off all bleeder connections at all four wheel cylinders. Attach bleeder hose and fixture to right rear wheel cylinder bleeder screw and place end of tube in a glass jar, and submerged in brake fluid. Open the bleeder valve one-half to three-quarters of a turn. See Fig. P-5.

Depress the foot pedal, allowing it to return very slowly. Continue this pumping action to force the fluid through the line and out of the bleeder hose which carries with it any air in the system. When

bubbles cease to appear at the end of the bleeder hose, close the bleeder valve and remove the hose. After the bleeding operation at each wheel cylinder has been completed, fill the master cylinder reservoir and replace the filler plug.

Do not re-use the liquid which has been removed from the lines through the bleeding process because of air bubbles and dirt.

P-8. Brake Hoses

a. Hydraulic lines (tubing and hose) are the means of transmitting fluid under pressure between the master cylinder and the wheel cylinders.

Note: On some vehicles a proportioning valve is located in the rear brake line along the inside left frame side rail. The valve is not serviceable and must be replaced as an assembly.

Should replacement be necessary make certain the valve is properly positioned with the centerline of the hex plug (in the bottom of the valve) in the vertical position. Refer to Fig. P-1.

The hoses are the flexible links between the wheels or axles and the frame or body. The hoses must withstand the fluid pressures without expansion and must be free to flex during spring deflection and wheel turns without causing damage to the hose.

b. Hydraulic lines are subject to damage and deterioration. Hoses should be inspected for cuts, chafing, cracks, twists and loose frame supports. Hydraulic tubing should be inspected for signs of leakage (due to faulty flares or loose connections); restrictions (due to dents or corrosion); and wear (due to friction against other metal parts). Always use correct type and size of wrench on fittings. Avoid damage to female fittings by supporting fitting with tube nut during removal of assembly.

c. On fittings where gaskets are used, always use a new gasket. Copper gaskets take a set and may not form a good seal if reused.

d. When replacing hydraulic brake hose, attach hose to wheel cylinder and securely tighten hose, then attach opposite end to frame fitting or tubing. Avoid twists in hose when assembling to frame fitting or tubing. Hold hose end securely with wrench while attaching tubing to hose. If hose end clip is used, make certain clip is assembled properly. Check for interference during spring deflection or rebound and during front wheel turns.

e. Check for any possible contact between front brake hose and inner sidewall of tire when the front wheels are in maximum turn position. Check for sufficient but not excessive length of hose between the clamp and the wheels by turning the wheels from one extreme turn position to the other.

f. Check that there is no possibility of any contact between the tail pipe and rear brake hose under all operating conditions.

P-9. Brake Pedal Adjustment

There should always be at least $\frac{1}{2}$ " [12,7 mm.] free pedal travel before the push rod engages the master cylinder piston.

This adjustment is accomplished by shortening or

lengthening of the brake master cylinder eye bolt. This is done so the primary cup will clear the bypass port when the piston is in the off position, otherwise the compensating action of the master cylinder for expansion and contraction of the fluid in the system, due to temperature changes, will be destroyed and cause the brakes to drag.

Note: Some older 'Jeep' vehicles may develop side movement of the clutch and brake pedals resulting from wear of the pedals, shafts, and bushings. One way to compensate for this wear is to install a pedal slack adjuster kit, Part No. 921936.

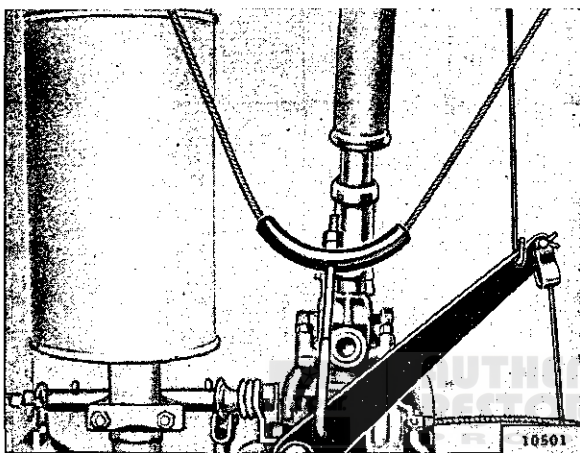


FIG. P-6—HAND BRAKE ADJUSTMENT

P-10. Hand Brake

On Model DJ-5 and DJ-6 vehicles the rear brake shoes are operated through cables and conduits to form the hand or parking brake. A brake cable equalizer and adjusting rod, Fig. P-6, is located directly back of the frame center cross member.

P-11. Parking Brake Adjustment

• Model DJ-5, DJ-6.

The foot brakes must be satisfactorily adjusted before attempting adjustment of the hand brake. To adjust the hand brake raise both rear wheels free of the floor. Pull up three notches on the hand brake lever and tighten the adjustment until the rear brakes drag slightly. Release the hand brake lever and check the rear wheels for drag. The wheels must turn freely with the lever released.

P-12. Transmission Brake Adjustment

The transmission brake is located on the propeller shaft at the rear of the transfer case, see Fig. P-4. The brake is operated by a cable connection from the brake handle mounted on the instrument panel. To adjust the transmission brake, the following sequence should be followed:

Make sure that the brake handle on the instrument panel is fully released. Give due attention to the cable and operating linkage to see that they do not bind. If necessary free up the cable and lubri-

cate it. Rotate the brake drum until one pair of the three sets of holes are over the shoe adjusting screw wheels in the brake. Use the edge of the holes in the brake drum as a fulcrum for suitable adjusting tool or a screwdriver, rotate each notched adjusting screw by moving the handle of the tool away from the center of the drive shaft until the shoes are snug in the drum. Back off seven notches on the adjusting screw wheels to secure proper running clearance between the shoes and the drum. Refer to Fig. P-8.

P-13. Relining Transmission Brake

Note: The condition of the brake lining on the transmission brake can be visually checked through the adjusting holes in the brake drum.

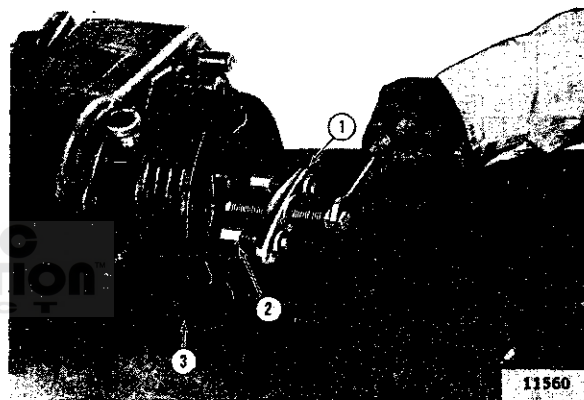


FIG. P-7—REMOVING TRANSMISSION BRAKE DRUM

1—Tool W-172
2—Adapter
3—Brake Drum

a. To reline the brake shoes and make a major adjustment, first remove the four universal joint attaching nuts and lower the propeller shaft. Remove the retracting spring clevis pin and the spring clip. Remove the hug lock nut, the nut and washer from the transfer case output shaft. Both the universal joint companion flange and the brake drum may be readily removed by using puller Tool No. W-172 which is illustrated in Fig. P-7. Remove the two brake shoe retracting springs and the shoes.

b. Clean all parts with a suitable cleaning solution and examine them for damage or wear. Brake shoes may be distorted by improper lining installation and the lining should be ground true after installation on the shoes. For this reason it is recommended that new or replacement shoe and lining assemblies be installed.

c. To reassemble, first turn both adjusting screw wheels away from the center to "all off" position. Place a light film of grease on the brake actuating cam and install the shoes. Install the black shoe return spring next to the cam and the yellow spring next to the notch adjusting wheel screw. Place the brake drum and universal joint flange in position and install the transfer case output shaft washer, nut and hug lock nut.

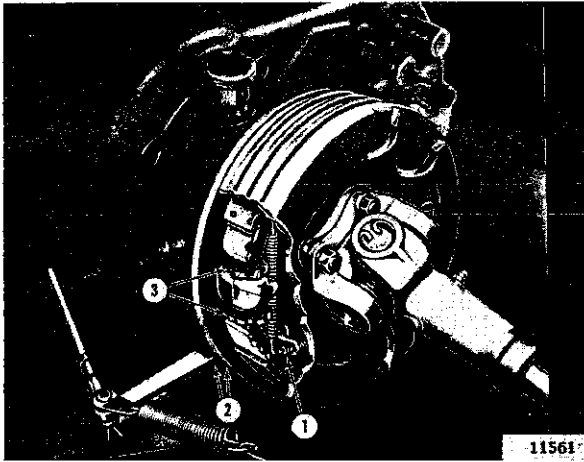


FIG. P-8—TRANSMISSION BRAKE ADJUSTMENT

- 1—Ball Nut
2— $\frac{1}{16}$ " [2,38 mm.] Clearance
3—Adjusting Screw

d. Rotate the drum until one pair of holes in the drum are opposite the two adjusting screw wheels in the brakes. Use the edge of the holes as a fulcrum and with a suitable tool or screwdriver for adjusting, rotate the adjusting screw wheels, moving the handle of the tool away from the drum until the shoes are snug in the drum.

e. Examine the brake operating cable to be sure that it is not worn or damaged. Free it up thoroughly and lubricate it. Make sure the operating handle on the instrument panel is fully released. Adjust the clevis on the brake end of the operating cable until the clevis pin will just go through the hole in the clevis and brake operating lever without slack in the cable. Tighten the clevis lock nut.

f. After the cable is connected back off seven notches on each adjusting screw wheel which will give the proper running clearance between the lining and the drum.

g. Reconnect the propeller shaft. Install retracting spring clip, clevis pin and the cotter pin, also, install the retracting spring link and spring.

h. The position of the brake operating lever, Fig. P-8, must be correctly set. The position of this lever is determined by the adjustment of the cam or brake operating link, which spreads the two shoes. The operating link is adjusted by means of the special ball nut to set the operating lever with $\frac{3}{32}$ " [2,38 mm.] clearance between the closest point of the lever and the brake backing plate.

i. The position of this lever should be checked when making a major adjustment or when relining the brakes and if found incorrect readjust it to give this clearance before adjusting the brake cable clevis.

P-14. Self-Adjusting Wheel Brake Units

Self-adjusting brakes are standard equipment on all late production 'Jeep' vehicles.

The wheel brake units consist of a support plate, two brake shoes, brake shoe return springs, self-adjusting operating parts, and a wheel cylinder. The automatic adjuster continuously maintains correct operating clearance between the brake lin-

ings 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, therefore, 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 or link will lift the lever into engagement with the next tooth of the star wheel when the brake is applied. When the brake is released, the shoes return to the anchor. The self-adjuster utilizes the movement of the brake shoes in a brake application to actuate the adjuster lever.

This action will repeat on subsequent brake applications, if necessary, until the shoe to lining clearance is reduced to a point where the shoe movement is not enough to cause the cable to lift the lever to the next tooth.

The adjusting lever, adjusting screw assembly, linkage rods and lever crank parts are left hand or right hand parts, NOT interchangeable, and MUST be kept separated.

The automatic adjuster on the brake system consists of an adjusting screw assembly, adjusting lever, two adjusting links, and a lever crank, (Fig. P-10).

Note: It is not necessary to remove the rear axle shaft hubs to perform minor brake service.

When replacement of oil seals is also required, hubs must be removed.

On vehicles equipped with self-adjusting brake assemblies, self-adjustment of the front wheel brakes takes place during reverse wheel brake application and the rear wheel brake adjustment takes place during forward vehicle brake application.

P-15. Relining Wheel Brakes

a. When necessary to reline the brakes, the vehicle should be raised so that all four wheels are free.

b. Turn the brake shoe star adjustment all the way in. Refer to Fig. P-12.

c. Remove the wheels, hubs and drums, which will give access to the brake shoes (Fig. P-10, P-11).

d. Install Wheel Cylinder Clamps C-416 to retain the wheel cylinder pistons in place and prevent leakage of brake fluid while replacing the shoes.

P-16. Brake Shoe Removal

● Removing the Front Brake Shoes.

● Refer to Fig. P-10.

a. Using Tool C-3785 or equivalent remove the upper linkage rod and brake shoe return springs.

b. Remove the brake shoe retainer, spring and pins.

c. Remove the anchor pin plate.

d. Remove the primary and secondary brake shoe assembly from the support.

e. Overlap the anchor ends of the primary and secondary brake shoes and remove the adjusting screw, adjuster lever, lower return spring, and linkage rods.

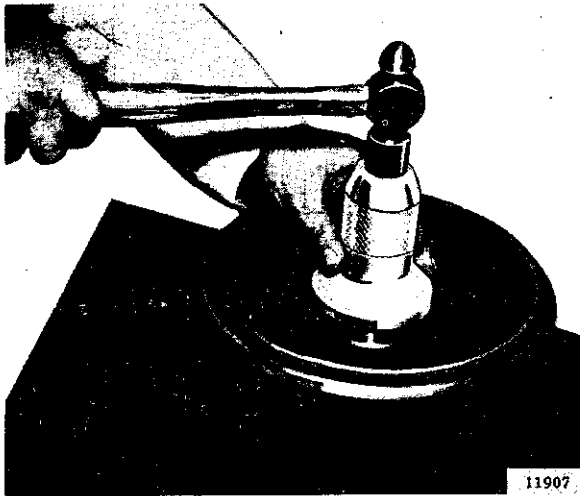


FIG. P-9—WHEEL HUB OIL SEAL DRIVER

- Removing the Rear Brake Shoes.
- Refer to Fig. P-11.
- a. Using Tool C-3785 or equivalent remove the upper linkage rod and brake shoe return springs.
- b. Remove the brake shoe retainer, spring and pins.
- c. Remove the anchor pin plate and tilt the brake shoe assembly out from the backing plate.
- d. On vehicles without a transmission brake, spread the anchor ends of the primary and secondary shoes and remove the parking brake strut and spring.
- e. On vehicles without a transmission brake, disengage the parking brake cable from the parking brake lever and remove the brake assembly.
- f. Overlap the anchor ends of the primary and secondary shoes and remove the adjusting screw, adjusting lever, lower return spring, and linkage rods.

P-17. Inspection

Inspect the oil seals in the wheel hubs. If the condition of any oil seal is doubtful, replace it. Install the oil seal with an oil seal driver as shown in Fig. P-9.

Brake shoes may be distorted by improper lining installation and linings should be ground true. For this reason it is recommended that new or replacement shoe and lining assemblies be installed. Using brake drum micrometer C-3920 or equivalent, check all drums. Should a brake drum be rough and scored, it may be reconditioned by grinding or turning in a lathe. Do not remove more than .030" [0,762 mm.] thickness of metal .060" [1,52 mm.] overall diameter. If a drum is reconditioned in this manner, either the correct factory-supplied, oversize lining .030" [0,762 mm.] must be installed or a shim equal in thickness to the metal removed must be placed between the lining and shoe so that the arc of the lining will be the same as that of the drum.

If it is found when wheels are removed that there is brake fluid leakage at any of the wheel cylinders,

it will be necessary to replace or recondition the wheel cylinder (Par. P-21) and bleed the brake lines (Par. P-7).

Whenever the brake lining is replaced in one front or one rear wheel, be sure to perform the same operation in the opposite front or rear wheel, using the same brake lining part number. Otherwise, unequal brake action will result.

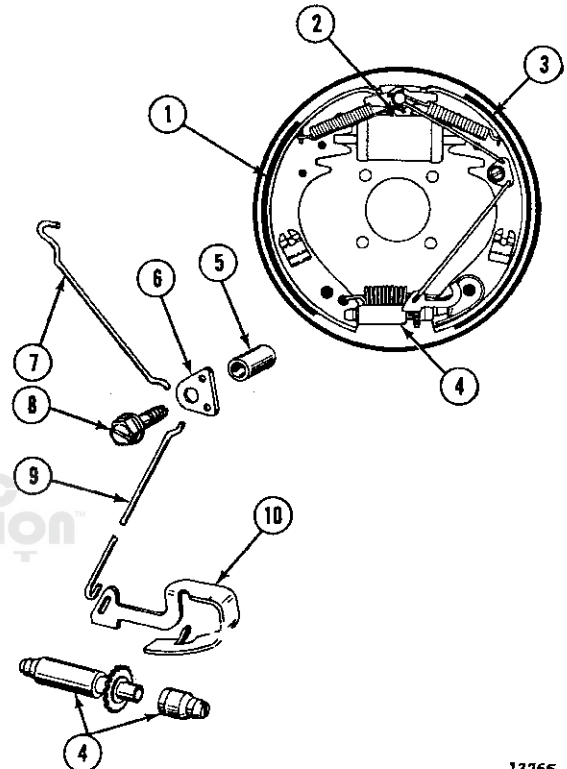


FIG. P-10—STANDARD FRONT WHEEL BRAKE ASSEMBLY WITH LINK TYPE ADJUSTER

- | | |
|---------------------------|-----------------------|
| 1—Primary Shoe | 6—Lever Plate |
| 2—Wheel Cylinder | 7—Linkage Rod (Upper) |
| 3—Secondary Shoe | 8—Screw |
| 4—Adjuster Screw Assembly | 9—Linkage Rod (Lower) |
| 5—Sleeve | 10—Adjuster Lever |

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P-18. Brake Shoe Installation

Refer to Fig. P-10.

INSTALLING THE FRONT BRAKE SHOES

To install the front brake shoes proceed as follows:
a. Match a primary with a secondary brake shoe and place them in their relative position on a work bench.

Note: Primary brake linings are color coded red and green. Secondary brake linings are color coded white and green.

b. Lubricate the threads of the adjusting screw and install it between the primary and secondary shoes. The star adjusting wheels are stamped "R" and "L" indicating thread rotation. The left front brake adjusting screw has right hand thread rotation and the right front brake adjusting screw has left hand thread rotation.

c. To assemble the brake unit, place the shoes on the backing plates and secure with the shoe hold down pin and clip. Place the adjusting lever on the secondary shoe web making sure the slot in the lever engages to full depth with the slot in the shoe web. The adjuster levers are painted RED for right hand brakes and BLUE for left hand brakes.

d. Install the adjusting screw assemblies. The star wheel must be installed over the adjusting hole in the backing plate.

Note: Interchanging adjusting screw assemblies will cause shoe to retract rather than expand.

e. Assemble the lower spring that fastens to the two shoe webs. THE LONG HOOK END should be secured in the small hole in the secondary shoe and should be UNDER the shoe web. The short hook end should be secured in the small hole in the primary shoe. If the spring is installed correctly, the long hook end will not interfere with either the lever or the star wheel teeth.

f. Install the anchor block with arrow pointing in the forward direction of the drum rotation. Place the guide plate over the anchor pin and using Tool C-3785 install the shoe return springs (secondary spring first) with the long hook end flat against the guide plate.

g. Install the lever crank in the small hole on the secondary shoe web, the left lever crank on the left, and right lever crank on the right. A "L" or "R" is located on the hexagon side of the crank for identification. Make certain the lever rotates freely on the hexagon head screw.

h. Assemble the short wire link with large hook by first inserting the "S" shape offset end into the lever crank hole which is closest to the hexagon head and then snap the hook end of the link in the top groove of the anchor pin.

i. Insert the long link with "S" shaped end in the crank lever. Lift the adjuster lever up enough to hook the link in the slot of the adjusting lever. The adjusting lever will then engage the star wheel teeth between $\frac{1}{16}$ " [1,59 mm.] above or below the centerline of adjusting screw assembly.

j. Lubricate the wheel bearings and install the brake drum and adjust the wheel bearing to the proper preload.

k. Adjust the brakes as described in Par. P-19.

INSTALLING THE REAR BRAKE SHOES

Refer to Fig. P-11.

a. Inspect the platforms of the backing plates for nicks or burrs. Apply a thin coat of lubricant to the backing plates platforms.

b. On vehicles without a transmission brake, attach the parking brake lever to the back side of the secondary shoe.

c. Place the secondary and a primary shoe in their relative position on a work bench.

Note: Primary brake linings are color coded red and green. Secondary brake linings are color coded white and green.

d. Lubricate the threads of the adjusting screw and install it between the primary and secondary shoes with the star wheel installed over the adjusting hole in the backing plate. The threaded ends of the star adjusting wheels are stamped "R" and "L" indicating thread rotation.

The left rear brake adjusting screw has left hand thread rotation and the right rear brake adjusting screw has right hand thread rotation.

e. Overlap the anchor ends of the primary and the secondary brake shoes and install the lower return spring.

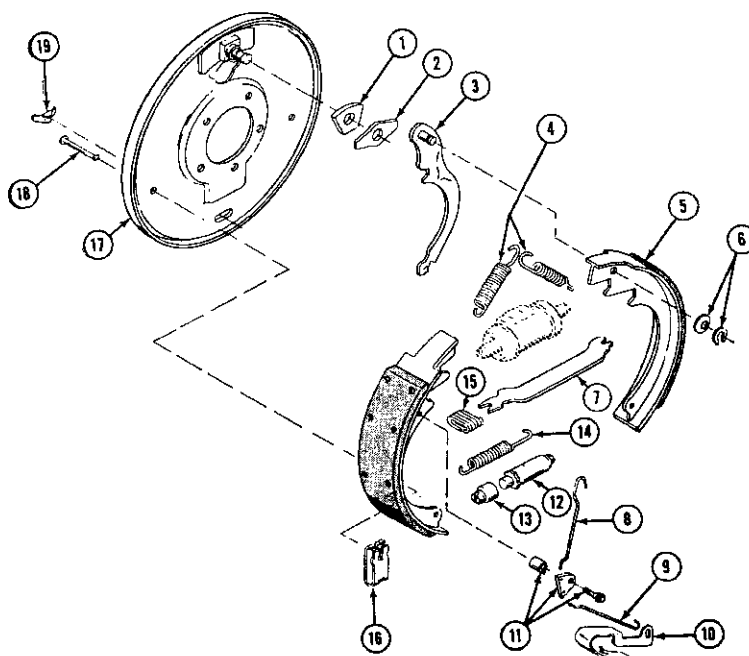


FIG. P-11—REAR WHEEL BRAKE WITH HAND BRAKE

- 1—Anchor Block
- 2—Anchor Plate
- 3—Parking Brake Lever and Pin
- 4—Shoe Return Spring
- 5—Shoe Set
- 6—"C" Washer
- 7—Strut
- 8—Anchor End Link
- 9—Actuator Link
- 10—Lever Shoe Adjusting Spring
- 11—Lever and Sleeve Screw
- 12—Brake Adjusting Screw (LH Thd.)
- 13—Brake Adjusting Screw (RH Thd.)
- 14—Adjusting Screw Spring
- 15—Strut Spring
- 16—Shoe Guide Clip
- 17—Backing Plate Assembly
- 18—Shoe Guide Pin
- 19—Adjusting Hole Plug

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- f. On vehicles without a transmission brake hold the brake shoes in their relative position and engage the parking brake cable into the parking brake lever.
- g. On vehicles without a transmission brake install the parking brake strut and spring between the parking brake lever and the primary shoe.
- h. Place the brake shoes on the backing plate and install the retainer pins, springs and retainers.
- i. Install the anchor pin plate.
- j. Install the lever and sleeve on the primary shoe then install the secondary return spring, then the primary return spring.

Important: A "L" or "R" is located on the hexagon side of the lever crank for identification. The lever crank marked "R" applies to the primary shoe on the left rear brake assembly. The lever crank marked "L" applies to the primary shoe on the right rear brake assembly.

- k. Place the upper linkage rod in the groove of the anchor pin and engage the hook of the link rod into the adjusting lever.
- l. Install the brake drum. Install the wheel and tire assembly.
- m. Adjust the brakes as described below.

P-19. Brake Shoe Initial Adjustment —

- a. Should wheel brake units have been disassembled for any reason, an initial adjustment **MUST** be made before drum installation.
- b. When the brake parts have been installed in their correct position, initially adjust the adjusting screw assemblies to a point where approximately $\frac{3}{8}$ " [9,53 mm.] of threads are exposed between the star wheel and star wheel nut.

Note: Following the initial adjustment and final assembly, check brake pedal height to ensure brake operation. Then drive the 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.

- c. Adjustment may be made manually by removing the access slot cover and using a brake adjusting tool or screw driver to rotate the star wheel until the wheel is in the locked position. To tighten, rotate the star wheel in the clockwise direction. Then back off the star wheel at least 15 to 20 notches (clicks).
- d. To back off the star wheel on the 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.

P-20. Master Cylinder Reconditioning — Dual System

Refer to Fig. P-13.

DISASSEMBLY

- a. Remove the filler cap and empty all fluid.
- b. Remove the snap ring, push rod assembly, and the primary and secondary piston assemblies. Air pressure applied in the piston stop hole will help facilitate the removal of the secondary piston assembly.
- c. The residual check valves are located under the front and rear fluid outlet tube seats.
- d. The tube seats must be removed with the self-tapping screws supplied in the repair kit to permit removal of the check valves. Screw the self-tapping screws into the tube seats and place two screw driver tips under the screw head and force the screw upward as shown in Fig. P-14.
- e. Remove the expander in the rear secondary cup, secondary cups, return spring, cup protector, primary cup, and washer from the secondary piston.
- f. The primary piston, with the rubber cups installed, is supplied in the repair kit.

CLEANING

- a. After disassembly, immersion of all metal parts in clean brake fluid or a brake system cleaner is recommended. Use air hose to blow out dirt and cleaning solvent from recesses and internal passages. When overhauling a hydraulic brake unit, use all parts furnished in the repair kit. Discard all old rubber parts.
- b. After cleaning, place all hydraulic system parts on clean paper or in a clean pan.

INSPECTION

Inspect all other parts for damage or excessive wear. Replace any damaged, worn, or chipped parts. Inspect hydraulic cylinder bore for signs of scoring, rust, pitting, or etching. Any of these will require replacement of the hydraulic cylinder.

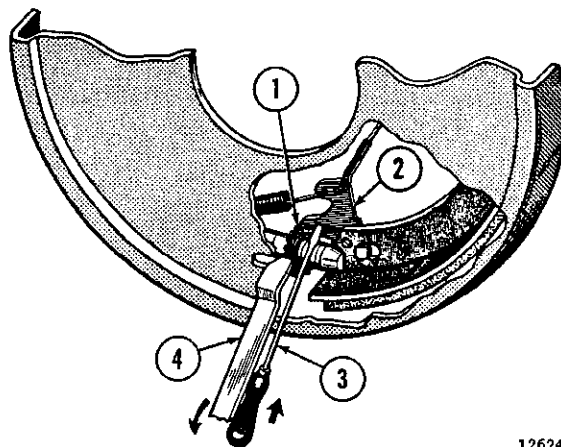


FIG. P-12—BRAKE SHOE ADJUSTMENT

- 1—Star Wheel
- 2—Lever
- 3—Screwdriver
- 4—Brake Adjusting Tool

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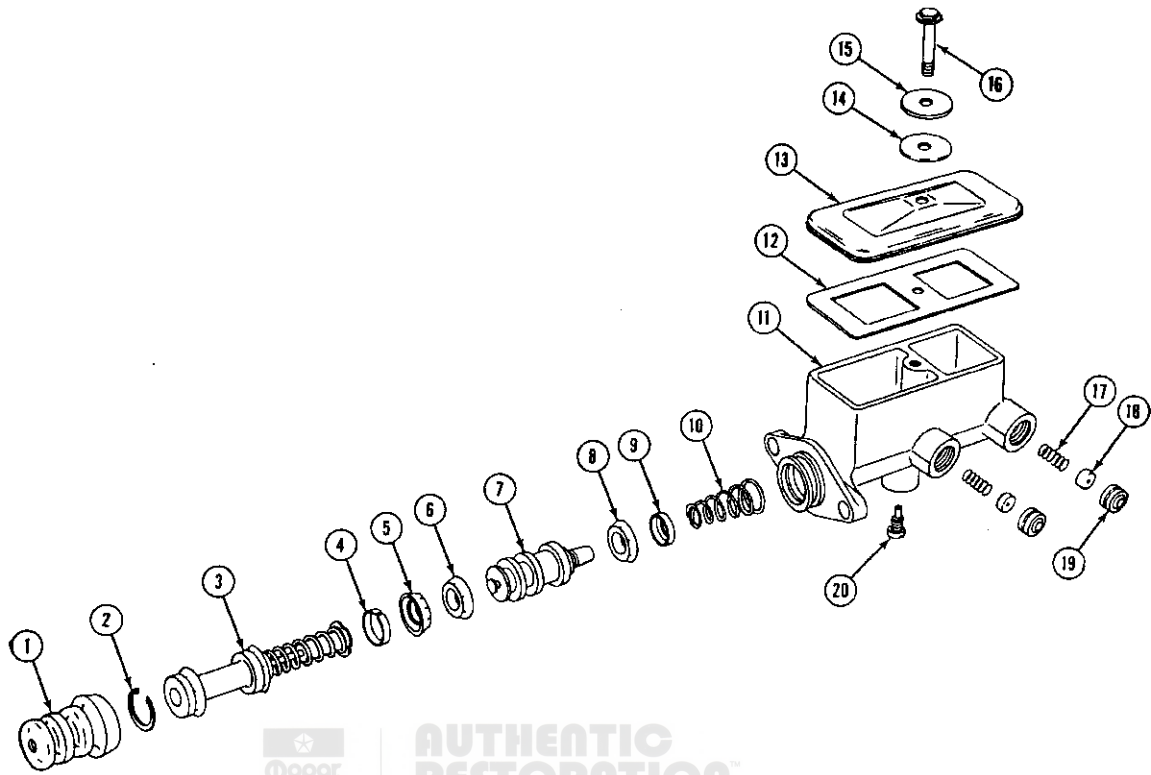


FIG. P-13—DOUBLE SAFETY MASTER CYLINDER

- | | | | |
|-----------------------|-----------------------|---------------------|-----------------------|
| 1—Boot | 6—Master Cylinder Cup | 11—Cylinder Housing | 16—Cover Bolt |
| 2—Snap Ring | 7—Piston | 12—Cover Gasket | 17—Check Valve Spring |
| 3—Piston Assembly | 8—Master Cylinder Cup | 13—Cover | 18—Check Valve |
| 4—Backing Ring | 9—Cup Protector | 14—Washer Gasket | 19—Tube Seat |
| 5—Master Cylinder Cup | 10—Spring | 15—Washer | 20—Piston Stop |

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REASSEMBLY

- a. Prior to reassembly of the master cylinder, dip all components in clean brake fluid and place on clean paper or in a clean pan.
- b. Install the primary cup washer, primary cup, cup protector, and return spring on the secondary piston.
- c. Install the piston cups in the double groove end of the secondary piston, so the flat ends of the cups face each other (lip of cups away from each other). Install the cup expander in the lip groove of the end cup.
- d. Coat the cylinder bore and piston assemblies with clean brake fluid before installing any parts in the cylinder.
- e. Install the secondary piston assembly first and then the primary piston which is supplied in the repair kit.
- f. Install the push rod assembly, which includes the push rod, boot, and rod retainer, and secure with the snap ring. Install the primary piston stop.
- g. Place new rubber check valves over the check valve springs and install in the outlet holes, spring first.

Note: When replacing a complete master cylinder with a service unit, the original push rod must be used. The push rod retainer and snap ring retainer

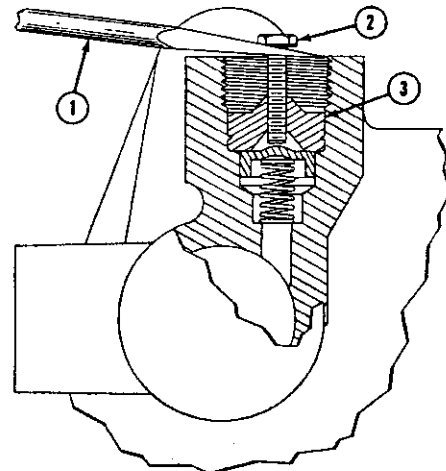


FIG. P-14—REMOVING TUBE SEATS

- 1—Screwdriver
- 2—No. 6-32 Self-Tapping Screw
- 3—Tube Seat

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must be removed and discarded. As the new unit has the retainers installed it is only necessary to install the push rod until a "snap" is heard and the push rod is retained.

h. Install the tube seats, flat side toward the check valve, and press in with tube nuts or the master cylinder brake pipe tube nuts.

BLEEDING

a. Before the master cylinder is installed on the car, the unit must be bled.

b. Support the cylinder assembly in a vise and fill both fluid reservoirs with approved brake fluid.

c. Loosely install a plug in each outlet of the cylinder. Depress the push rod several times until air bubbles cease to appear in the brake fluid.

d. Tighten the plugs and attempt to depress the piston. The piston travel should be restricted after all air is expelled.

e. Install the master cylinder on the car and bleed the hydraulic lines at the wheel cylinder. Refer to Par. P-7.

b. Remove the rubber dust covers on ends of cylinder. Remove the pistons and piston cups and the spring.

c. Wash the parts in clean alcohol.

d. Examine the cylinder bore for roughness or scoring. Check fit of pistons to cylinder bore.

e. When reassembling the cylinder, dip springs, pistons and piston cups in brake fluid. Install spring in center of the wheel cylinder. Install piston cups with the cupped surface towards the spring so that the flat surface will be against the piston. Install pistons and dust covers.

f. Install wheel cylinder to the backing plate and connect brake line and install brake shoe return spring.

g. Replace wheel, hub, and drum.

h. Bleed the brake lines (Par. P-7).

P-21. Wheel Cylinder Reconditioning

• Refer to Fig. P-15.

Note: Make sure a replacement brake cylinder has the same part number as the original cylinder.

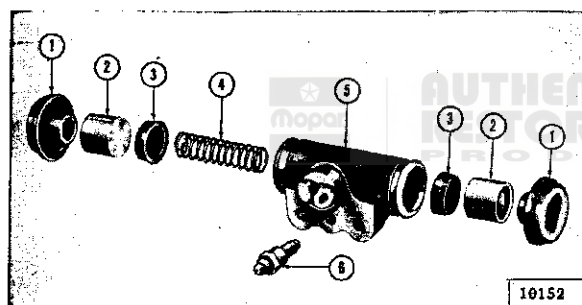


FIG. P-15—WHEEL BRAKE CYLINDER

- 1—Boot
- 2—Piston
- 3—Cylinder Cup
- 4—Cup Spring
- 5—Cylinder
- 6—Bleeder Screw

a. To remove a wheel cylinder, jack up the vehicle and remove the wheel, hub, and drum. Disconnect the brake line at the fitting on the brake backing plate. Remove the brake shoe return spring which will allow the brake shoes at the toe to fall clear of the brake cylinder. Remove two screws holding the wheel cylinder to the backing plate.

P-22. TROUBLE SHOOTING

P-23. Squeaky Brakes

In most cases, squeaks are entirely eliminated by correct adjustment of the brakes. Squeaks may be caused however, by glazed linings, lining wore thin to the point of exposed rivets or by vibration. A drum will not vibrate when the brake is securing uniform contact over the entire lining surface, except when due to improper conditions such as the linings becoming glazed. Glazed surface of the brake linings may be removed by a stiff wire brush.

Occasionally squeaks are caused by roughened surface of the drum, which can usually be remedied by rubbing down with emery cloth and by wiping the brakings surface clean. In extreme cases it may be necessary to reface the drum in a lathe. Should this be done, do not remove a metal thickness greater than .030" [0,762 mm.] - .060" [1,52 mm.] overall diameter.

P-24. Rattles in Brakes

See that the tension of the springs in the brakes and attached to the control system are sufficient to return brakes and brake mechanism to their normal position. Return springs are so placed that they keep all slack out of the control system by tension on all joints.

Brakes will not rattle inside the drum if the springs holding the shoes are kept at the proper tension.

P-25. SERVICE DIAGNOSIS

SYMPTOMS	PROBABLE REMEDY
Brakes Drag	
Brake Shoes Improperly Adjusted.....	Adjust
Piston Cups Enlarged.....	Flush all lines with Alcohol. Install new cups in wheel and Master Cylinders
Mineral Oil or Improper Brake Fluid in System...	
Improper Pedal Adjustment.....	Adjust Master Cylinder Eye Bolt
Clogged Master Cylinder By-Pass Port.....	Clean Master Cylinder
One Brake Drags	
Brake Shoe Adjustment Incorrect.....	Adjust
Brake Hose Clogged.....	Replace
Return Spring Broken.....	Replace
Wheel Cylinder Piston or Cups Defective.....	Replace
Loose or Damaged Wheel Bearings.....	Adjust or Replace
Brake Grabs — Vehicle Pulls to One Side	
Grease or Brake Fluid on Lining.....	Replace Lining
Dirt Between Lining and Drum.....	Clean with Wire Brush
Drum Scored or Rough.....	Turn Drum and Replace Lining
Loose Wheel Bearings.....	Adjust
Axle Spring Clips Loose.....	Tighten
Brake Backing Plate Loose.....	Tighten
Brake Lining.....	Different Kinds on Opposite Wheels
Brake Shoe Reversed.....	Forward and Rear Shoes misinstalled
Tires Under-Inflated.....	Inflate
Tires Worn Unequally.....	Replace or Rotate
Glazed or Worn Lining.....	Replace Linings
Restricted Brake Line.....	Locate and Repair
Excessive Pedal Travel	
Normal Lining Wear.....	Adjust
Lining Worn Out.....	Replace
Leak in Brake Line.....	Locate and Repair
Scored Brake Drums.....	Replace or Re grind
Incorrect Brake Lining.....	Replace
Air in Hydraulic System.....	Fill Master Cylinder — Bleed Lines
Spongy Brake Pedal	
Air in Lines.....	Bleed Lines
Brake Shoe Adjustment Incorrect.....	Adjust
Insufficient Brake Fluid.....	Fill Master Cylinder
Excessive Pedal Pressure	
Grease or Brake Fluid in Lining.....	Replace Lining
Shoes Improperly Adjusted.....	Major Adjustment
Warped Brake Shoes.....	Replace
Distorted Brake Drums.....	Replace or Re grind
Glazed or Worn Lining.....	Replace Linings
Restricted Brake Line.....	Locate and Repair
Faulty Brake Cylinder.....	Repair or Replace
Insufficient Brake Fluid.....	Fill Master Cylinder
Squeaky Brakes	
Shoes Warped or Drums Distorted.....	Replace
Lining Loose.....	Replace
Dirt Imbedded in Lining.....	Wire Brush or Replace
Improper Adjustment.....	Adjust
Oil or Grease on Lining.....	Replace Linings
Glazed or Worn Lining.....	Replace Linings
Drum Scored.....	Turn Drum and Replace Linings

WHEELS

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Q-1. GENERAL

Each front wheel of a Jeep vehicle is carried on two opposed tapered roller bearings as shown in Fig. Q-1 and Q-2. Rear wheels are carried on a single tapered roller bearing mounted on each axle shaft as shown in Fig. Q-3, Q-4 and Q-5. These

bearings are adjustable for wear and their satisfactory operation depends upon periodic attention and correct lubrication.

Q-2. Wheel Balancing

Wheel balancing with the wheel on the vehicle is

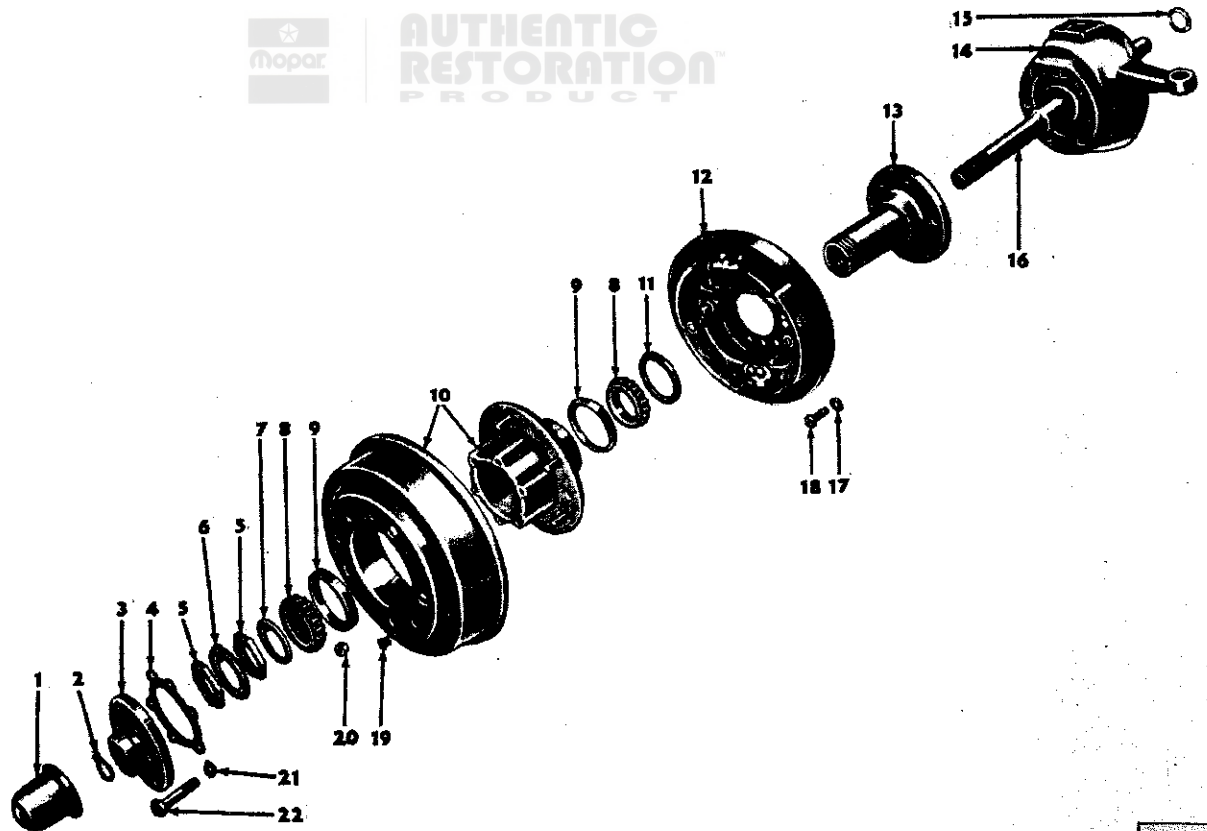


FIG. Q-1—FRONT WHEEL ATTACHING PARTS — 4-WHEEL-DRIVE

- | | | | |
|----------------|---------------------|--------------------------|---------------|
| 1—Hub Cap | 7—Lockwasher | 13—Spindle and Bushing | 19—Screw |
| 2—Snap Ring | 8—Cone and Rollers | 14—Left Knuckle and Arm | 20—Nut |
| 3—Drive Flange | 9—Cup | 15—Thrust Washer | 21—Lockwasher |
| 4—Gasket | 10—Hub and Drum | 16—Universal Joint Shaft | 22—Bolt |
| 5—Nut | 11—Oil Seal | 17—Lockwasher | |
| 6—Lockwasher | 12—Left Front Brake | 18—Bolt | |

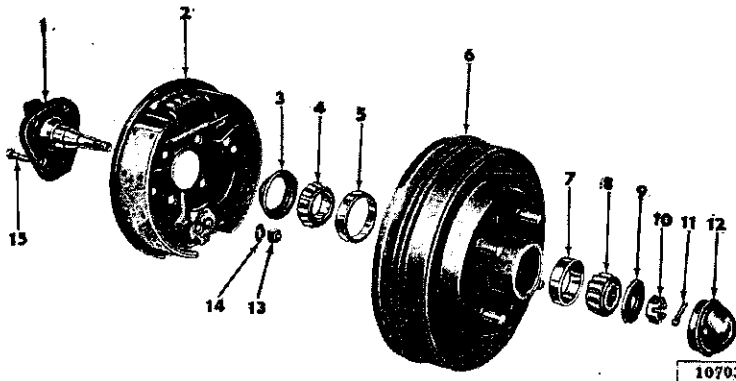


FIG. Q-2—FRONT WHEEL ATTACHING PARTS—2-WHEEL-DRIVE

- 1—Steering Knuckle
- 2—Brake
- 3—Hub Grease Seal
- 4—Inner Bearing Cone
- 5—Inner Bearing Cup
- 6—Hub and Drum
- 7—Outer Bearing Cup
- 8—Outer Bearing Cone
- 9—Tongued Washer
- 10—Nut
- 11—Cotter Pin
- 12—Grease Cap
- 13—Nut
- 14—Lockwasher
- 15—Bolt

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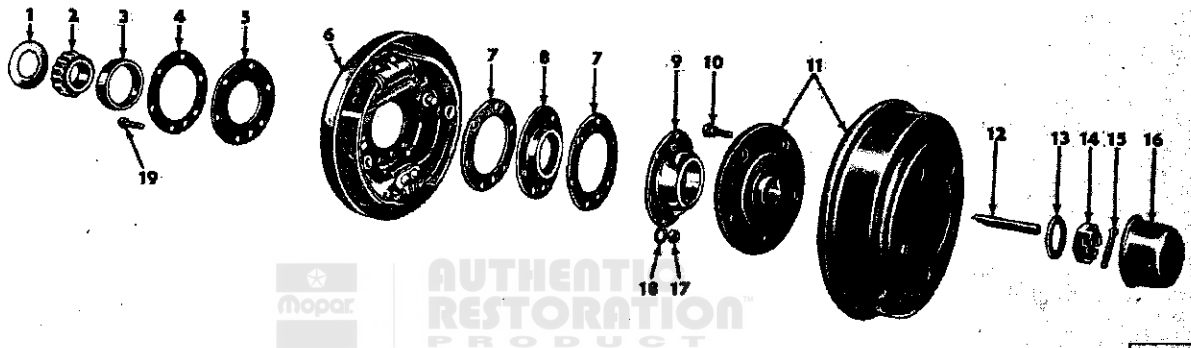


FIG. Q-3—REAR WHEEL ATTACHING PARTS—4-WHEEL-DRIVE TAPERED AXLE

- | | | | |
|--------------------|-----------------------|-----------------|----------------|
| 1—Oil Seal | 6—Brake Backing Plate | 11—Hub and Drum | 16—Hub Cap |
| 2—Cone and Rollers | 7—Gasket | 12—Shaft Key | 17—Nut |
| 3—Cup | 8—Grease Retainer | 13—Washer | 18—Lock Washer |
| 4—Shims | 9—Grease Protector | 14—Nut | 19—Bolt |
| 5—Bearing Retainer | 10—Bolt | 15—Cotter Pin | |

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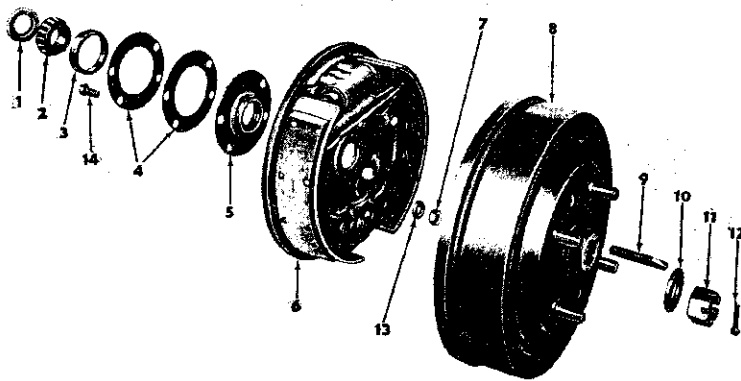


FIG. Q-4—REAR WHEEL ATTACHING PARTS—2-WHEEL-DRIVE-TAPERED AXLE

- 1—Oil Seal
- 2—Bearing Cone
- 3—Bearing Cup
- 4—Shim Set
- 5—Retainer and Seal
- 6—Brake
- 7—Nut
- 8—Hub and Drum
- 9—Axle Shaft Key
- 10—Washer
- 11—Nut
- 12—Cotter Pin
- 13—Lockwasher
- 14—Bolt

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recommended with the exception that rear wheels on vehicles having Trac-Lok or Powr-Lok axles should always be removed for balancing.

Q-3. WHEEL BEARING SERVICE

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.

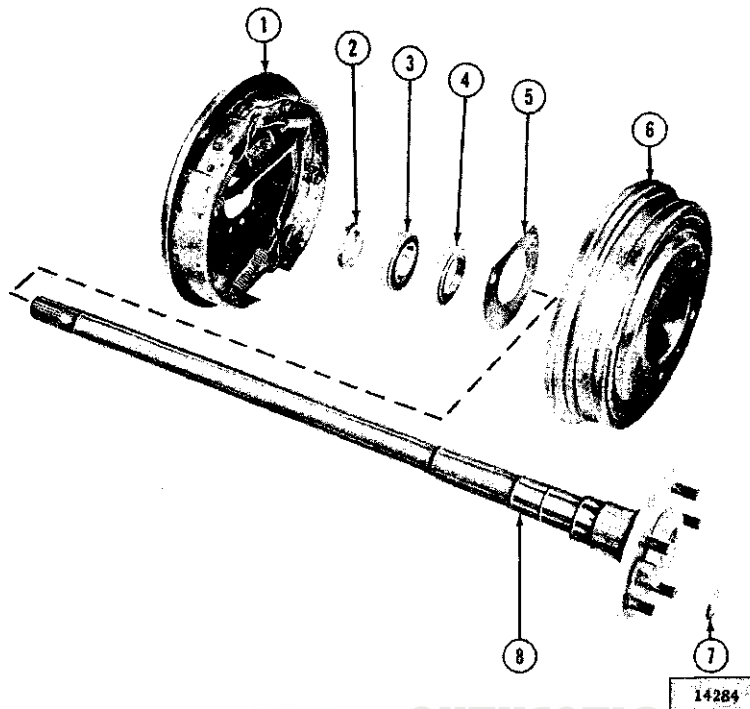


FIG. Q-5—REAR WHEEL ATTACHING PARTS — FLANGED AXLE

- 1—Brake Backing Plate
- 2—Retainer Ring
- 3—Unit-Bearing
- 4—Oil Seal
- 5—Retainer Plate
- 6—Brake Drum
- 7—Cup Plug
- 8—Flanged Axle Shaft

Q-4. Checking Front Wheel Bearings

Raise the front end of the vehicle with a jack so that the tires clear the floor.

Grip the tire and test sidewise shake of the wheel. If bearings are correctly adjusted, shake of the wheel will be just perceptible and wheel will turn freely with no drag.

If bearing adjustment is too tight, the rollers may break or become overheated. Loose bearings may cause excessive wear and noise.

If this test indicates bearing adjustment is necessary, follow the procedure given in Par. Q-5. Loose bearings will cause sidewise shake that is evident around the entire circumference of the wheel. A shake that is evident only when gripping the wheels in a plane parallel to the ground, but not evident around the entire circumference, probably indicates looseness in the steering linkage.

Q-5. Front Wheel Bearing Adjustment

With the vehicle on the jack, the following procedure should be followed to adjust the front wheel bearings on four wheel-drive vehicles.

- a. Remove the hub cap, snap ring, capscrews, and washers that attach the driving flange to the hub.
- b. Using the Front Axle Shaft Drive Flange Puller W-163, pull the driving flange.
- c. Bend the lip of the nut lock washer so that the locknut and lock washer may be removed.
- d. Rotate the wheel and tighten the adjustment nut until the 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. Then back off the adjusting nut about one-sixth

turn making sure that wheel rotates freely without sidewise shake.

e. Replace the lock washers and locknut. Bend over the lock washer lip.

f. Check the adjustment (Par. Q-4). Reassemble the driving flange and hub cap. Make certain the gasket is properly installed between the hub and the flange.

• Model DJ-5, DJ-6

On two-wheel drive vehicles, remove the hub cap and the wheel retaining nut cotter pin. Rotate the wheel and tighten the wheel retaining nut until the wheel binds. Then back off nut about one-sixth turn or more if necessary making sure wheel rotates freely without sidewise shake. Replace the cotter pin and hub cap.

Q-6. Rear Wheel Bearing Adjustment — Flanged Axle Shaft

Vehicles equipped with the flange type rear axle 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. Q-6.

Q-7. Checking Rear Wheel Bearings — Tapered Axle

Raise wheel on which adjustment is to be made by placing a jack under the axle housing. With hands, test sidewise shake and in and out play of the wheel. If bearings are correctly adjusted, shake of wheel will be just perceptible and the

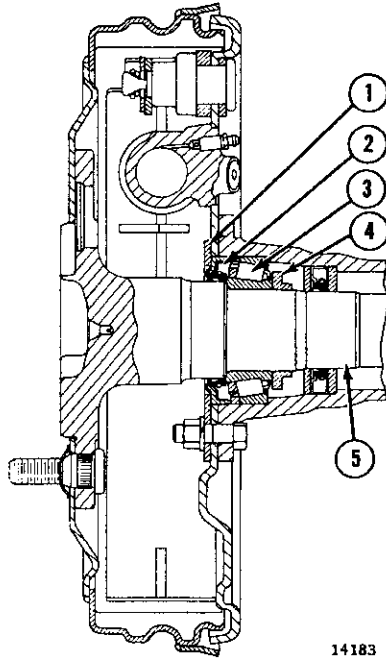


FIG. Q-6—REAR WHEEL, FLANGED AXLE AND BEARING ASSY.

- 1—Retainer Plate
2—Oil Seal
3—Unit Bearing
4—Retaining Ring
5—Axle Shaft

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wheel will turn freely with no drag. If adjustment is necessary, follow the procedure given in Par. Q-8.

Q-8. Rear Wheel Bearing Adjustment — Tapered Axle

The bearing adjusting shims are placed between the brake backing plate and axle flange as shown in Fig. Q-7.

With wheel raised on jack, the following procedure should be used to make the rear wheel bearing adjustment.

- Remove the hub cap with hub cap puller, the cotter pin, axle shaft nut, and washer. Remove the wheel hub and drum with a wheel puller.
- Disconnect hydraulic brake line at wheel cylinder.
- Remove the bolts holding the brake dust shield, grease and bearing retainer, and the brake backing plate.
- Remove or install shims to adjust the bearings to provide .001" to .006" [0,025 a 0,152 mm.] end float of the axle shaft.

Note: Before reassembly of the wheel make certain the backing plate nuts are tight and torqued at 25 to 35 lb-ft. [3,4 a 4,8 kg-m.].

- Reassemble the wheel, adjust brakes, and check the bearing adjustment (Par. Q-7).

Q-9. REAR WHEEL MOUNTING — TAPERED AXLE

Proper axle shaft key installation is accomplished by placing the hub and drum on the axle shaft taper and then inserting the axle shaft key in the

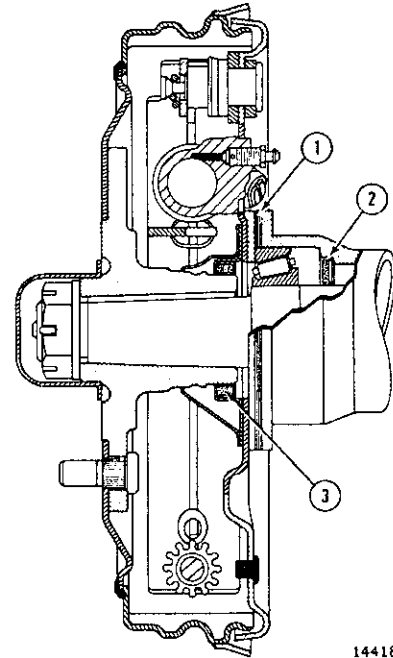


FIG. Q-7—REAR WHEEL AND HUB BEARING — TAPERED AXLE SHAFT

- 1—Adjusting Shims 2—Inner Seal 3—Outer Seal

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keyway. Never install the key in the keyway before placing the hub and drum assembly on the axle shaft. Be sure that the axle shaft nut is torqued to a minimum of 150 lb-ft. [20,7 kg-m.].

Q-10. BRAKE DRUM SERVICE

On rear wheels, the hub fits inside the brake drum (Fig. Q-3). On front wheels, the hub is attached to the outside of the brake drum (Fig. Q-1). The brake drums are attached to the wheel hubs by five serrated bolts. These bolts are also used for mounting the wheels on the hub. To remove a brake drum, press or drive out the serrated bolts and remove the drum from the hub. When placing the drum on the hub, make sure that the contacting surfaces are clean and flat. Line up the holes in the drum with those in the hub and put the drum over the shoulder on the hub. Insert five new serrated bolts through the drum and hub and drive the bolts into place solidly. Place a round head of the bolt in a vise. Next, place the hub and drum assembly over it so that the bolt head rests on it. Then swage the bolt into the countersunk section of the hub or drum with a punch. The runout of the drum face should be within .030" [0,76 mm.] total indicator reading. If the runout is found to be greater than .030" it will be necessary to reset the bolts to correct the condition.

Q-11. TIRE SERVICE

Refer to Fig. Q-8.

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 serv-

ice, 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 under-inflated tire is dangerous as too much flexing can cause breakage of the casing. Overinflation in time may 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.

a. 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.

b. 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.

c. MISALIGNMENT WEAR

Excessive wheel camber causes the tires to run at an angle to the road when camber is incorrect it will cause excessive wear on one side of the tire tread.

Front wheels should be straight ahead or toe-in

slightly. When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber 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.

d. BALANCE

Cupping and bald spotting of tires is associated with wear on a vehicle driven mostly at high-way speeds without the recommended tire rotation and with unbalance conditions.

Q-12. Tire Care

Note: For satisfactory 4-wheel drive operation, a 4-wheel drive vehicle **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.

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:

- a. Excessive wear around the outer edges resulting from underinflation.
- b. Excessive wear in the center of the tread resulting from overinflation.
- c. Tire tread worn on one side indicating wheels need realigning.
- d. Cuplike depressions on one side of the tread indicating wheels need balancing.

If the vehicle normally carries a full load, two to four psi. [0,14 a 0,28 kg-m²] can be added to the recommended air pressures. But, remember that adding air with a light load means a harsher ride, doesn't help tires, and wears out shock absorbers. Rotate the tires as shown in Fig. Q-9 for correct rotation system.

Q-13. Tire Removal and Installation

To remove a tire from a drop center rim, first

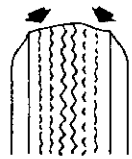
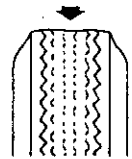
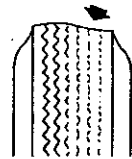
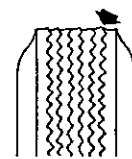
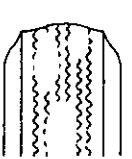


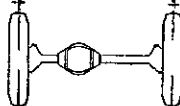
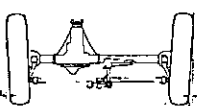

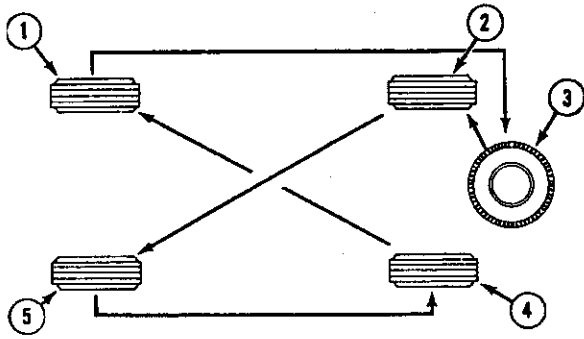
	WEAR AT SHOULDERS	WEAR AT CENTER	WEAR ON ONE SIDE	FEATHERED EDGE	BALD SPOTS
CONDITION					
CAUSE					
CORRECTION	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL	ADJUST PRESSURE TO SPECIFICATIONS WHEN TIRES ARE COOL	ADJUST CAMBER TO SPECIFICATIONS	ADJUST FOR TOE-IN	DYNAMIC OR STATIC BALANCE WHEELS

FIG. Q-8—TIRE WEAR PATTERN



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FIG. Q-9--TIRE ROTATION

- 1—Right Front Tire
- 2—Right Rear Tire
- 3—Spare Tire
- 4—Left Rear Tire
- 5—Left Front Tire

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 by 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. Torque nuts to 60-75 lb.-ft. [8,3 a 10,4 kg-m.].

Note: New "wide" tires have been given new sizes by tire manufacturers. They use a letter as a key unit in the name size for the new wide treads. The single letter in front of the "70" indicates load rating, or the weight a tire can support safely when inflated to 32 psi. The number 70 is used to show the 7-to-10 (70 percent) ratio of tire section height to width. The last two-digit number of the new sizes — 15 — is the rim diameter. Radial ply tire sizes all contain the letter "R" to designate radial ply construction.

15-inch Diameter

New	Old
E70-15.....	7.35-15
F70-15.....	7.75-15
G70-15.....	8.15-15
H70-15.....	8.45-15
J70-15.....	8.85-15
K70-15.....	9.00-15
L70-15.....	9.15-15

You should explain to customers these new tire designations. Such knowledge will act as a reminder never to mix radial ply, wide treads or conventional tires on one axle.

Q-14. WHEEL AND TIRE SPECIFICATIONS

	'Jeep' Universal V6 Engine CJ-5, CJ-6, CJ-5A, CJ-6A	'Jeep' Universal F4 Engine CJ-3B, CJ-5, CJ-6	DJ-5, DJ-6
WHEELS:			
Rim Size.....	15 x 6.00	16 x 4.50	15 x 5.50
Flange Type.....	K	E	K
Attachment Type.....	Stud	Stud	Stud
Circle Dia.....	5.50	5.50	5.50
Number.....	5	5	4
Size.....	1½-20	1½-20	1½-20
Rear Axle Shaft End Float.....	.001"-.006" [0,025 a 0,152 mm.]	.001"-.006" [0,025 a 0,152 mm.]	.001"-.006" [0,025 a 0,152 mm.]
TIRES:			
Size.....	7.35-15	6.00-16	6.85-15
Ply Rating.....	4	4	2
Revolutions per Mile @ 30 mph.....	781	730	803
Inflation Pressure.....			
Front.....	20 psi [1,406 kg-cm ²]	20 psi [1,406 kg-cm ²]	24 [1,687 kg-cm ²]
Rear.....	24 psi [1,687 kg-cm ²]	20 psi [1,406 kg-cm ²]	24 [1,687 kg-cm ²]

FRAME

Contents

SUBJECT	PAR.
Draw Bar	R-6
Frame Alignment	R-2
Frame Dimensions	R-3
Front Axle Alignment	R-5
Straightening Frame	R-4

R-1. GENERAL

The frame is the structural center of the vehicle, for in addition to carrying the load, it provides and maintains correct relationship between other units to assure their normal functioning.

Of rugged design, the frame is constructed of heavy channel steel side rails and cross-members. Brackets and diagonal braces are used to maintain the proper longitudinal position of the side rails relative to each other, and at the same time provide additional resistance to torsional strains. Fig. R-1, R-2, and R-3 illustrate the subject models.

Vehicles that have been in an accident of any nature, which may result in a swayed or sprung frame, should always be carefully checked for proper frame alignment, steering geometry, and axle alignment.

equipped with V6 engines, refer to measurements shown in Fig. R-3.

The most convenient method of making this check, particularly when the body is on the chassis, is by marking on the floor all dimensional points from which measurements should be taken. This is known as "plumb-bobbing" the frame. Select a space on the floor which is extremely level. If working on a cement floor, clean it so that the chalk marks will be visible underneath the frame to be checked. If working on a wooden floor, it is advisable to lay sheets of paper underneath the vehicle and carefully tack them in place. Drop a plumb-bob from each point indicated in Figures R-1 and R-2, marking the floor directly underneath the point. Satisfactory checking depends entirely on the accuracy of the marks in relation to the frame.

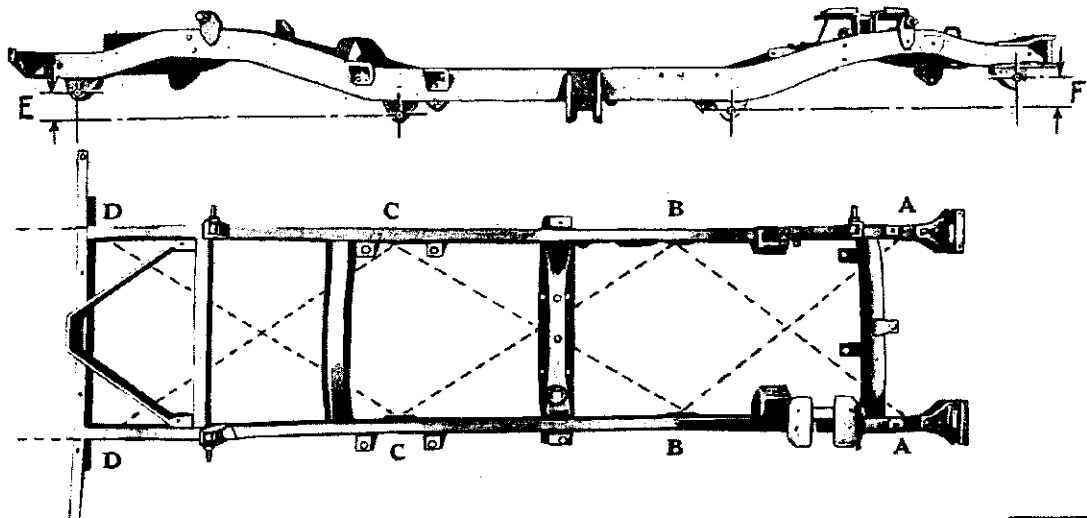
To check points that have been marked, carefully move the vehicle away from the layout on the floor, and proceed as follows:

R-2. Checking Frame Alignment

The most efficient and satisfactory method of checking frame alignment is with a frame aligning fixture which is equipped with bending tools for straightening frame parts. In the absence of such a fixture, frame alignment may be determined by using the "X" or diagonal method of checking from given points on each side rail. Figs. R-1 and R-2 illustrate this method of checking the frame.

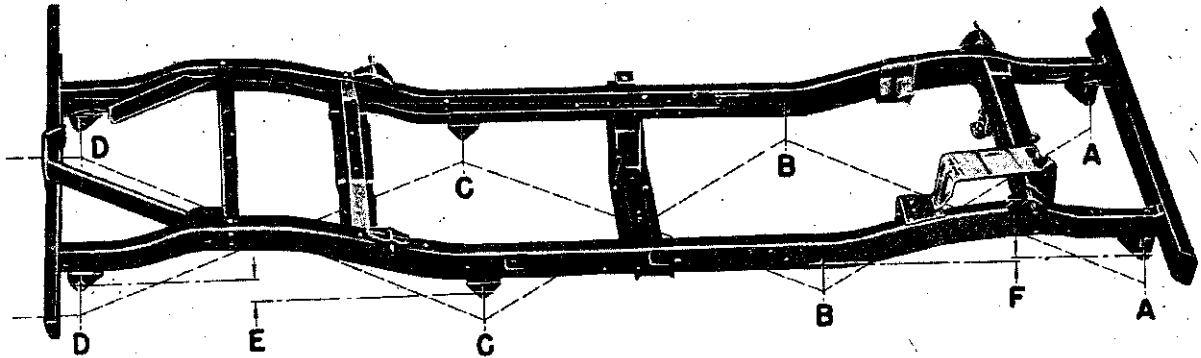
When checking frame alignment on vehicles

a. Check the frame at front and rear end using corresponding marks on the floor. If widths correspond to frame specifications, draw a center line the full length of the vehicle, halfway between the marks indicating front and rear widths. If frame width is not correct and the center line 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.



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FIG. R-1—FRAME ASSEMBLY — MODEL CJ-3B



11900

FIG. R-2—FRAME ASSEMBLY — MODEL CJ-5, CJ-5A, CJ-6, CJ-6A (F4 ENGINE)

b. With the center line correctly laid out, measure the distance from it to several opposite points over the entire length of the frame. If the frame is in proper alignment, opposite measurement should be the same.

c. To locate the point at which the frame is sprung, measure the diagonals marked A-B, B-C, C-D. If the diagonals in each pair are within $\frac{1}{8}$ " [3,175 mm.], that part of the frame included between

points of measurements may be considered as satisfactory alignment. These diagonals should also intersect at the center line. If the measurements do not agree within the above limits, it means that correction 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

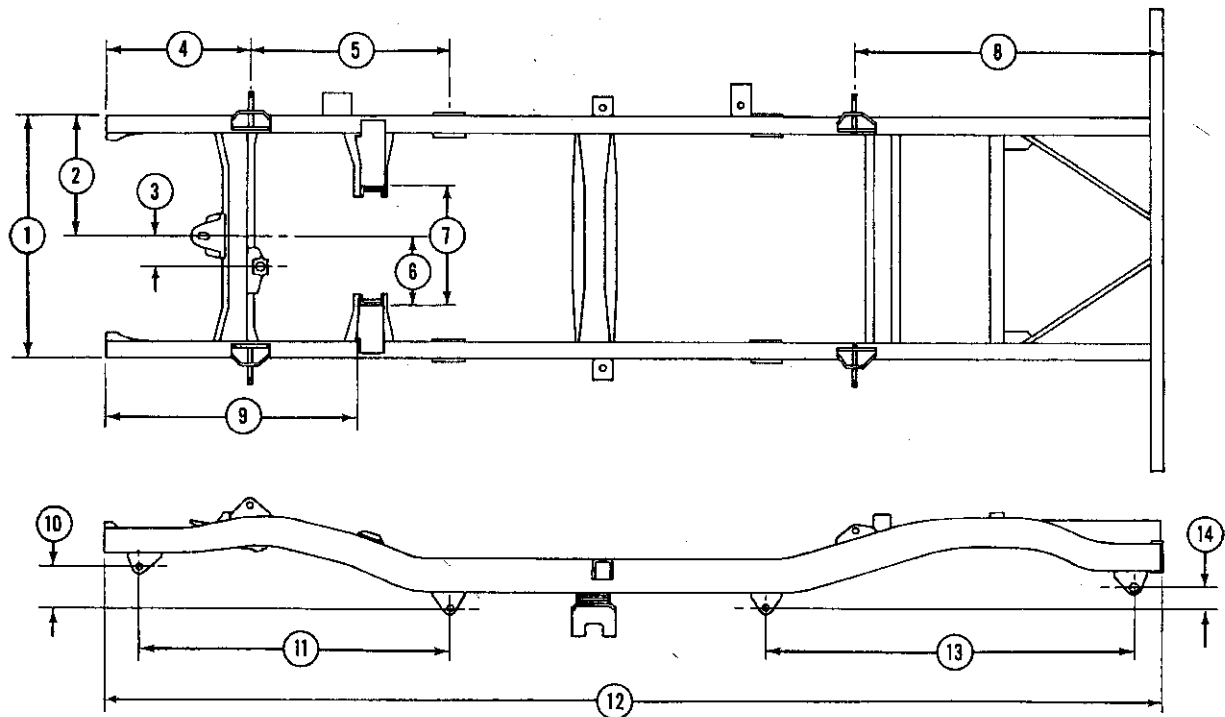


FIG. R-3—FRAME ASSEMBLY MEASUREMENTS — V6 ENGINE

1—29 $\frac{1}{4}$ " [74,3 cm.]	6—8 $\frac{1}{8}$ " [20,40 cm.]	11—38 $\frac{1}{4}$ " [97,55 cm.]
2—14 $\frac{3}{8}$ " [37,15 cm.]	7—14 $\frac{1}{4}$ " [36,99 cm.]	12—128 $\frac{1}{4}$ " [326,23 cm.]
3—3 $\frac{1}{4}$ " [10,0 cm.]	8—37 $\frac{1}{4}$ " [94,62 cm.]	13—44 $\frac{25}{16}$ " [113,74 cm.]
4—18 $\frac{1}{4}$ " [46,20 cm.]	9—27 $\frac{1}{2}$ " [70,49 cm.]	14—3 $\frac{1}{2}$ " [8,18 cm.]
5—24 $\frac{1}{8}$ " [61,83 cm.]	10—4 $\frac{1}{8}$ " [10,56 cm.]	

12875

frame. This could cause the already aligned sections of the frame to become misaligned or weakened.

R-3. Frame Dimensions

Points for measuring frame alignment on vehicles equipped with the F4 engine are shown in Fig. R-1 and R-2. The correct measurements for each model are given in the table. Point A is at the front of the frame.

A-B and C-D are the distances between spring shackle bolt and spring pivot bolt frame centers measured on a line parallel with the frame centerline. E and F show the shackle bolt centers in relation (above or below) to the pivot bolt centers.

On vehicles equipped with V6 engines the frame dimensions are shown in Fig. R-3.

CJ-3B

A-B.....	44.31" [112,55 cm.]
C-D.....	48.48" [123,14 cm.]
Width Front.....	29 1/4" [74,3 cm.]
Width Rear.....	29 1/4" [74,3 cm.]
"E" above.....	3 7/32" [8,18 cm.]
"F" above.....	4 5/32" [10,56 cm.]

CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6

A-B.....	47.08" [119,58 cm.]
C-D.....	52.37" [133,02 cm.]
Width Front.....	29 1/4" [74,3 cm.]
Width Rear.....	29 1/4" [74,3 cm.]
"E" above.....	3 7/32" [8,18 cm.]
"F" above.....	5 29/32" [15,0 cm.]

R-4. Straightening Frame

In case the bending or twisting of the frame is not excessive, it may be straightened. This should be done cold, as excessive heat applied to the frame will weaken it. For this reason it is recommended that badly damaged frame parts be replaced.

Note: A technique known as "controlled heat" can be utilized where a frame section is "squashed" and must be brought out without "tearing" or excessive stretch to the metal.

R-5. Front Axle Alignment

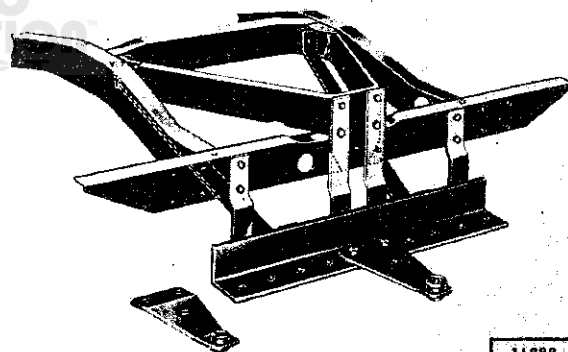
After it has been determined that the frame is properly aligned, the front axle alignment with the frame can be checked. The front axle is square with the frame if the distance between the front and rear axle is the same on both sides. The distance from the spring upper bushings to the front axle on both sides should be equal.

Note: Always inspect the springs for broken spring center bolts when checking the frame and axle alignment.

R-6. Draw Bar

Fig. R-4, shows method of attachment and bracing of the Jeep draw bar. The braces and the reinforcement installed in the frame rear cross-member channel provide even distribution of the stresses when moving a heavy load.

The draw bar plate may be shifted to any one of nine positions for alignment on the draw bar and may be used with the offset up or down to change the height of attachment. Check the attaching bolts periodically to be sure they are tight at all times.



11888

FIG. R-4—DRAW BAR MOUNTING

R-7. FRAME SPECIFICATIONS

Type — All Models	Vehicle	Number of Cross Members	Ladder with Steel Channel Side Members			Section Modulus
			Overall Length	Width		
				Front	Rear	
	CJ-3B.....	4 Intermediate Front Bumper Bar Rear K-member	122 21/32" [311,55 cm.]	29 1/4" [74,3 cm.]	29 1/4" [74,3 cm.]	1.493 in. cu.
	CJ-5, CJ-5A, DJ-5.....		128 7/16" [326,23 cm.]	29 1/4" [74,3 cm.]	29 1/4" [74,3 cm.]	1.493 in. cu.
	CJ-6, CJ-6A, DJ-6.....		148 1/16" [377,03 cm.]	29 1/4" [74,3 cm.]	29 1/4" [74,3 cm.]	1.493 in. cu.

SPRINGS AND SHOCK ABSORBERS

Contents

SUBJECT	PAR.	SUBJECT	PAR.
Pivot Bolts.....	S-3	Spring Removal.....	S-4
Shock Absorbers.....	S-7	Spring Shackles.....	S-2
Spring Installation.....	S-5	U-Shackles.....	S-6

S-1. GENERAL

Semielliptical leaf springs are used for all models. The springs are hung longitudinally from the frame side rails by means of brackets welded to the rails. All axles are firmly attached to the springs by U-bolts (spring clips), spring saddles welded to the underside of the axles, and spring plates under the springs. Early model DJ-5 and DJ-6 front axles (I beam) are attached to the springs with conventional bolts and spring plates. Spring center bolts are inserted in the axle spring saddles to prevent shifting of the axle.

All front springs, except as noted below, are provided with shackles at the front ends of the springs and pivot bolts at the rear ends of the springs. Model CJ-5 up to Serial No. 44437 and Model CJ-6 up to Serial No. 11981 are provided with shackles at the rear ends of the front springs, and pivot bolts at the front ends.

Note: Models CJ-5A and CJ-6A are equipped with the two stage type front and rear spring.

All rear springs are provided with shackles at the rear end and pivot bolts at the front end.

Springs should be examined periodically for broken or shifted leaves, loose or missing rebound clips, angle of spring shackles, and position of springs on the saddles. Springs with shifted leaves do not have their normal strength. Missing rebound clips may permit the spring leaves to fan out or break on rebound. Broken leaves may make the vehicle hard to handle or permit the axle to shift out of line. Weakened springs may break causing difficulty in steering. Spring attaching clips or bolts must be tight. It is suggested that they be checked at each vehicle inspection and torqued 45 to 55 lb-ft. [6,2 a 7,6 kg-m.].

S-2. Spring Shackles

Rubber-bushed shackles are provided on all current production vehicles. The steel-backed rubber (silent bloc) bushings are pressed into the spring eyes and mounting brackets. The shackle bolts tighten the side plates against the inner steel backing of the bushings. Oscillation of the springs is taken in the rubber bushings.

All vehicles produced before early 1957 were equipped with U-shackles and threaded core bush-

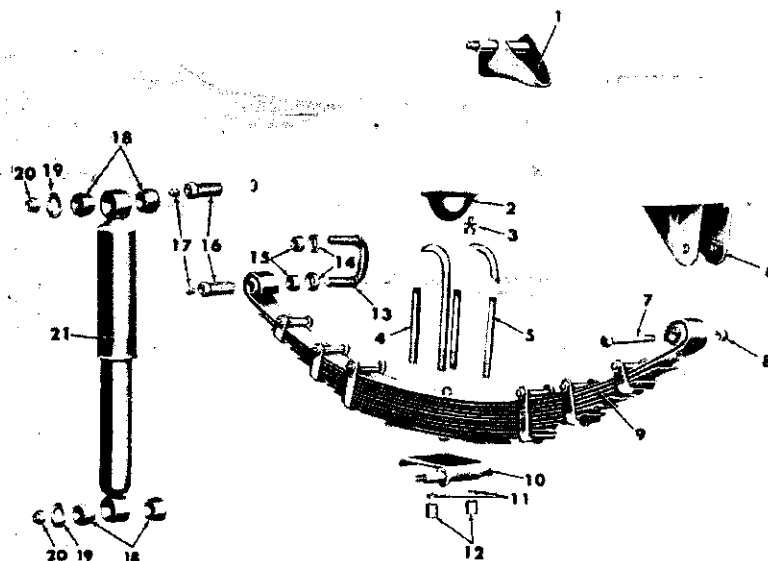


FIG. S-1—FRONT SPRING AND SHOCK ABSORBER EARLY CJ-5 and CJ-6

- 1—Front Shock Absorber Bracket
- 2—Front Axle Bumper
- 3—Bolt
- 4—"U" Bolt
- 5—"U" Bolt
- 6—Spring Pivot Bracket
- 7—Pivot Bolt
- 8—Nut
- 9—Front Spring Assembly
- 10—Front Spring Clip Plate
- 11—Lockwasher
- 12—"U" Bolt Nut
- 13—Shackle
- 14—Retainer
- 15—Grease Seal
- 16—Threaded Shackle Bushing
- 17—Lube Fitting
- 18—Mounting Pin Bushing
- 19—Washer
- 20—Lock Nut
- 21—Shock Absorber Assembly

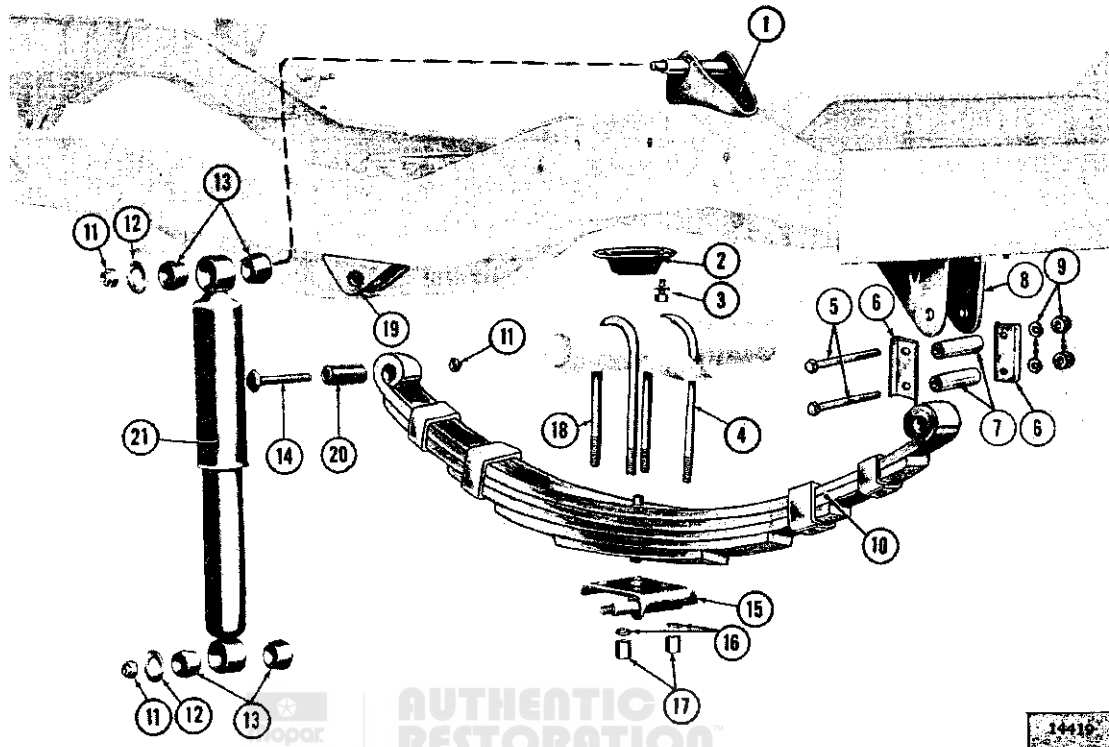


FIG. S-2—FRONT SPRING AND SHOCK ABSORBER — LATE CJ-3B, CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6

1—Bracket and Shaft	7—Bearing	13—Bushing	19—Bracket
2—Axle Bumper	8—Bracket	14—Bolt	20—Bushing (Spring)
3—Bolt and Lockwasher	9—Nut and Lockwasher	15—Plate and Shaft	21—Shock Absorber
4—Spring Clip	10—Spring	16—Lockwasher	
5—Bolt	11—Nut	17—Nut	
6—Plate	12—Washer	18—Spring Clip	

ings. See Par. S-6 for service information on U-shackles.

S-3. Pivot Bolts

Early model CJ-3B is equipped with bronze bushings, pivot bolts, and lubrication fittings. The bolts are secured with castellated nuts and cotter pins. Late model CJ and DJ models are equipped with rubber (silent bloc) bushings, bolts, and locknuts or lockwashers and nuts. See Fig. S-2. See Par. S-2 for additional description.

S-4. Remove Spring

To remove a spring, proceed as follows:

- a. Raise the vehicle with a jack under the axle. Place a stand jack under the frame side rail. Then power the axle jack so that the load is relieved from the spring with the wheels resting on the floor.
- b. Remove nuts securing spring clip bolts. Remove the spring plate and clip bolts. Free the spring from the axle by raising the axle jack.
- c. Remove the pivot bolt nut and drive out the pivot bolt. Disconnect the shackle either by removing the lower nuts and bolts on rubber-bushed shackles, or by removing the threaded bushings on U-shackles (see Par. S-6).

S-5. Install Spring

To install a spring, first install the pivot bolt. Then, connect the shackle using the following procedure:

- a. On bronze-bushed pivot bolts, install the bolt and nut and tighten the nut. Then back it off two cotter pin slots and install the cotter pin. The nut must be drawn up tightly but must be sufficiently loose to allow the spring to pivot freely. Otherwise spring breakage may result.
- b. On rubber-bushed pivot bolts, install the pivot bolt and locknut (or lockwasher and nut) only tightly enough to hold the bushings in position until the vehicle is lowered from the jack.
- c. Connect the shackle. On rubber-bushed shackles install the bolts as in subparagraph b above. For U-shackles see Par. S-6 installation instructions.
- d. Move the axle into position on the spring by lowering (or raising) the axle jack. Place the spring center bolt in the axle saddle. Install the spring clip bolts, spring plate, lockwashers, and nuts. Torque the nuts 50 to 55 lb-ft. [6,9 a 7,6 kg-m.]. Avoid over-tightening. Be sure the spring is free to oscillate at both ends.
- e. Remove both jacks. On rubber-bushed shackles and pivot bolts, allow the weight of the vehicle to seat the bushings in their operating positions. Then torque the nuts to 21 to 30 lb-ft. [2,90 a 4,15 kg-m.].

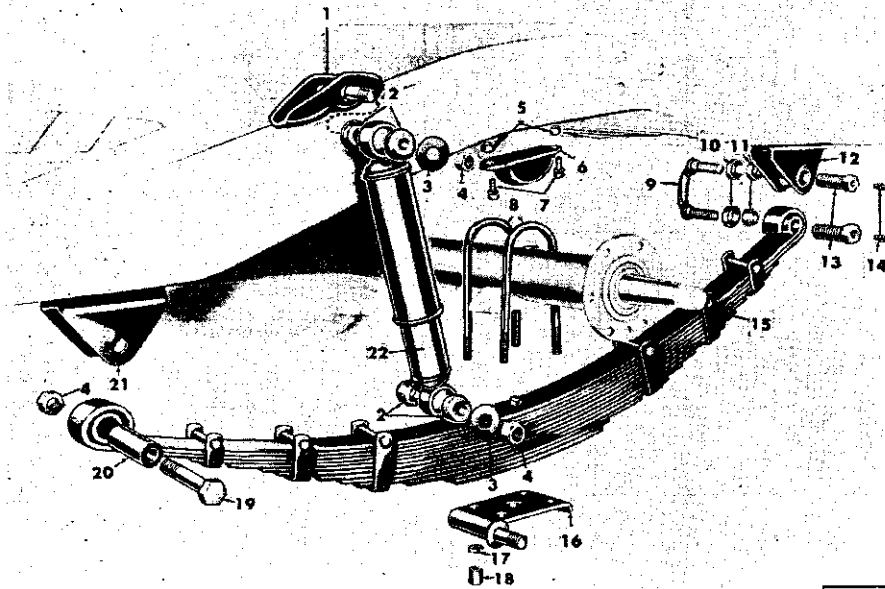


FIG. S-3—REAR SPRING AND SHOCK ABSORBER—EARLY CJ-3B, CJ-5 AND CJ-6

- 1—Shock Absorber Bracket
- 2—Mounting Pin Bushing
- 3—Washer
- 4—Lock Nut
- 5—Nut
- 6—Rear Axle Bumper
- 7—Bolt
- 8—“U” Bolt
- 9—Shackle
- 10—Retainer
- 11—Grease Seal
- 12—Bracket
- 13—Threaded Shackle Bushing
- 14—Lube Fitting
- 15—Rear Spring Assembly
- 16—Rear Spring Clip Plate
- 17—Lockwasher
- 18—“U” Bolt Nut
- 19—Pivot Bolt
- 20—Rubber Bushing
- 21—Spring Pivot Bracket
- 22—Shock Absorber Assembly

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S-6. U-Shackles

The threaded bushings of the U-shackles, used to early 1957 production, are anchored solidly in the frame brackets and spring eyes, and the oscillation is taken between the threads of the U-shackle and the inner threads of the bushings.

On early production of Models CJ-3B, CJ-5, and CJ-6, six bushings are used with right-hand threads and two with left-hand threads. The right-hand threaded bushings have plain hexagon heads. The left-hand bushings have a groove around the heads. The two left-hand threaded U-shackles are identified by a small forged boss on the lower shank of the shackle. They are used at the left front spring and the right rear spring with the left-hand threaded end DOWN at the spring eye. The left-hand

threaded parts have been cancelled in the production of Models CJ-3B, CJ-5 and CJ-6. All later production vehicles, up to early 1957, use all right-hand threaded parts.

When replacing shackles and bushings on these vehicles, examine the parts carefully for parts of the same type removed must be reinstalled. A right-hand threaded bushing cannot be installed satisfactorily after one having left-hand threads has once been installed.

U-shackles are installed with the bushing hexagon heads at the outside of the frame.

When installing a new U-shackle or a shackle bushing, follow the procedure outlined below:

Install the shackle grease seal and retainer over the threaded end of the shackle up to the shoulder. In-

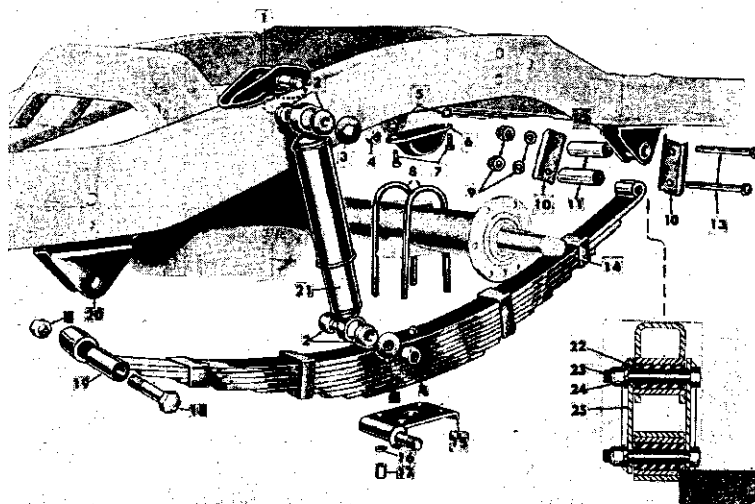


FIG. S-4—REAR SPRING AND SHOCK ABSORBER—LATE CJ-3B, CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6

- 1—Bracket
- 2—Bushing
- 3—Washer
- 4—Lock Nut
- 5—Nut and Lockwasher
- 6—Axle Bumper
- 7—Bolt
- 8—Spring Clip
- 9—Nut and Lockwasher
- 10—Plate
- 11—Bearing
- 12—Bracket
- 13—Bolt
- 14—Spring
- 15—Plate and Shaft
- 16—Lockwasher
- 17—Nut
- 18—Bolt
- 19—Bearing
- 20—Bracket
- 21—Shock Absorber
- 22—Silent Block Bearing
- 23—Bolt
- 24—Nut
- 25—Side Plate

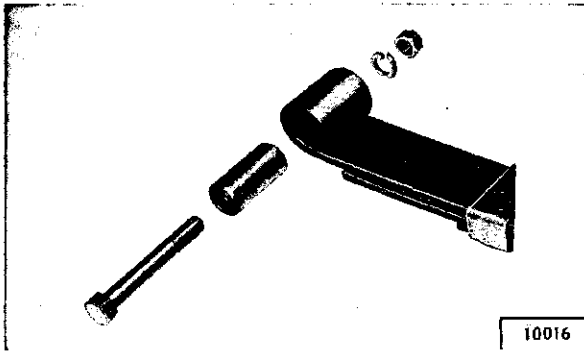


FIG. S-5—SPRING PIVOT BOLT

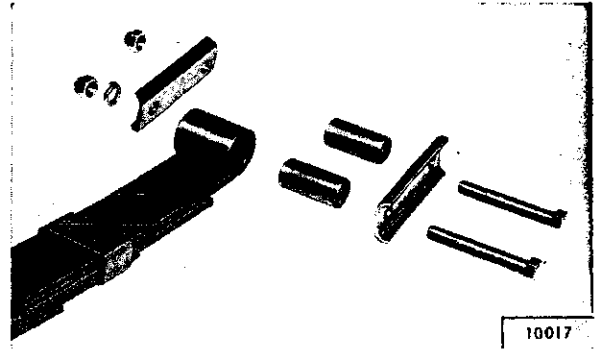


FIG. S-6—FRONT SPRING SHACKLE

sert the shackle through the frame bracket and eye of the spring. Holding the U-shackle tightly against the frame, start the upper bushing on the shackle, taking care that when it enters the thread in the frame it does not cross-thread. Screw the bushing on the shackle about half way. Start the lower bushing, holding the shackle tightly against the spring eye, and thread the bushing in approximately half way. Then, alternating from top bushing to lower bushing, turn them in until the head of the bushing is snug against the frame bracket and the bushing in the spring eye is $\frac{1}{32}$ " [0,794 mm.] away from the spring as measured from the inside of hexagon head to the spring.

Lubricate the bushing and then try the flex of the shackle, which must be free. If a shackle is tight it may cause spring breakage and it will be necessary to rethread the bushings on the shackle.

where cotter pins are used or 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 absorber must be discarded and replaced with a new one. If a shock absorber 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 the full travel four or five times to determine whether action is positive or faulty.

Note: The shock absorber 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 removal or installation as this will destroy the effectiveness of the seal.

S-7. Shock Absorbers

The hydraulic, direct-action shock absorbers used on these vehicles are designed to absorb both upward and downward motion. The upper ends of the shock absorbers are secured to the vehicle frame side rails with mounting brackets and pins. The lower ends are secured to the springs with pins which are an integral part of the spring plates.

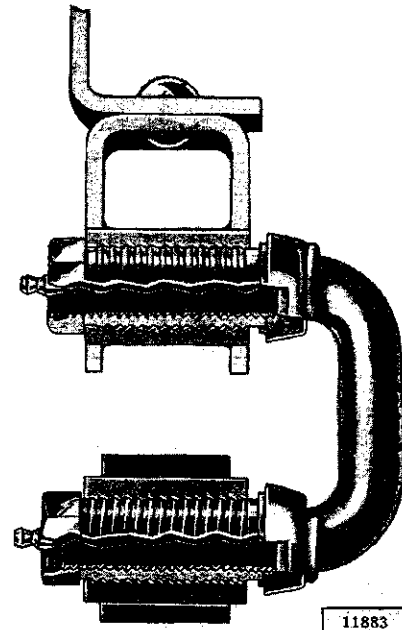
Rubber bushings are installed between the mounting pins and shock absorber eyes. Movement at the bushings is taken by flexing of the rubber.

The rubber bushings and shock absorber eyes are held in place on the mounting pins either by a flat washer and a cotter pin on Model CJ-3B, or by a flat washer and a locknut on Models CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, and DJ-6.

To remove a shock absorber, first remove the cotter pins (or locknuts) and washers. Then pull the shock absorber eyes and rubber bushings from the mounting pins.

To install a shock absorber, first install the rubber bushings and shock absorber eyes on the mounting shafts. Then install the cotter pins or lock nuts. Tighten the lock nuts securely.

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 either by adding additional washers

FIG. S-7—FRONT SPRING SHACKLE
(Up to early 1957)

S-8. SPRING SPECIFICATIONS

TYPE	Longitudinal Leaf		
DRIVE THROUGH	Springs		
SPRING TYPE	Semielliptical		
MODEL: F4 ENGINE	CJ-3B	CJ-5	CJ-6
FRONT SPRINGS:			
Number of Leaves.....	10	7	7
Length.....	36 $\frac{1}{4}$ " [92,08 cm.]	39 $\frac{5}{8}$ " [100,65 cm.]	39 $\frac{5}{8}$ " [100,65 cm.]
Width.....	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]
Spring Rate.....	260 lbs. per in.	240 lbs. per in.	240 lbs. per in.
REAR SPRINGS:			
Number of Leaves.....	9	9	9
Length.....	42" [106,68 cm.]	46 $\frac{1}{8}$ " [117,16 cm.]	46 $\frac{1}{8}$ " [117,16 cm.]
Width.....	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]
Spring Rate.....	190 lbs. per in.	200 lbs. per in.	270 lbs. per in.
MODEL: V-6 ENGINE	CJ-5A, CJ-6A	CJ-5, CJ-6	DJ-5, DJ-6
FRONT SPRINGS:			
Number of Leaves.....	6	10	5
Length.....	39 $\frac{5}{8}$ " [100,65 cm.]	39 $\frac{5}{8}$ " [100,65 cm.]	39 $\frac{5}{8}$ " [100,65 cm.]
Width.....	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]
Spring Rate.....	260 lbs. per in.	176 lbs. per in.	188 lbs. per in.
REAR SPRINGS:			
Number of Leaves.....	5	5	5
Length.....	46 $\frac{1}{8}$ " [117,16 cm.]	46 $\frac{1}{8}$ " [117,16 cm.]	46 $\frac{1}{8}$ " [117,16 cm.]
Width.....	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]	1 $\frac{3}{4}$ " [4,45 cm.]
Spring Rate.....	230 lbs. per in.	230 lbs. per in.	230 lbs. per in.

S-9. SHOCK ABSORBER SPECIFICATIONS

TYPE	Hydraulic	
ACTION	Double	
MODEL:	CJ-3B	CJ-5, CJ-5A, CJ-6, CJ-6A DJ-5, DJ-6
FRONT SHOCK ABSORBERS:		
Length:		
Compressed.....	10 $\frac{3}{4}$ " [27,31 cm.]	11 $\frac{1}{16}$ " [29,05 cm.]
Extended.....	17 $\frac{1}{2}$ " [44,45 cm.]	18 $\frac{1}{16}$ " [46,83 cm.]
Piston Diameter.....	1" [2,54 cm.]	1" [2,54 cm.]
REAR SHOCK ABSORBERS:		
Length:		
Compressed.....	10 $\frac{3}{4}$ " [27,31 cm.]	11 $\frac{1}{16}$ " [30,32 cm.]
Extended.....	17 $\frac{1}{2}$ " [44,45 cm.]	19 $\frac{1}{16}$ " [48,37 cm.]
Piston Diameter.....	1" [2,54 cm.]	1" [2,54 cm.]

BODY

Contents

SUBJECT	PAR.
Brake and Clutch Pedal Pads	T-7
Canvas Tops	T-5
Care of Fabric Tops	T-6
Front Seat Adjustment	T-8
Passenger Seat Safety Catch	T-9
Windshield	T-2, T-3
Windshield Glass and Weatherstrip	T-4

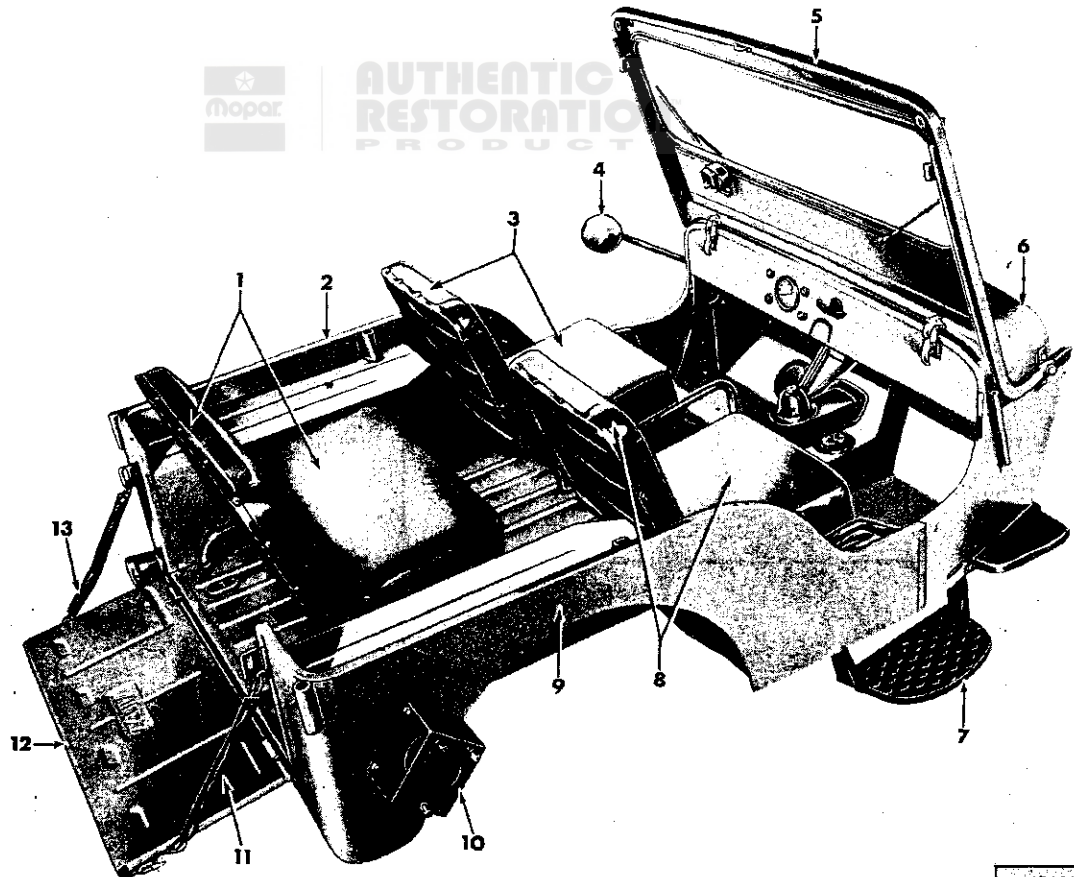
T-1. GENERAL

The body is of all steel construction with mountings that provide a secure attachment to the frame. All major panels are of No. 18 gauge steel. All open edges of the panels are turned under, reinforced and flanged to provide strength. These panels are reinforced with "U" sections and welded. All component panels are seamed and welded together. The body is insulated from the frame with insulator

shims placed between the body and frame and held in position by the body bolts.

The instruments and controls, mounted on the instrument panel are within clear view and easy to reach.

Note: A new floor pan cover plate has been released on late CJ-5 and CJ-6 models, that is identified by a stamped oval-shaped bubble or relief, located to the right of the accelerator treadle.



10803

FIG. T-1—MODEL CJ-3B BODY

- | | |
|-----------------------|--------------------------|
| 1—Rear Passenger Seat | 8—Front Passenger Seat |
| 2—Left Side Panel | 9—Right Side Panel |
| 3—Driver's Seat | 10—Spare Wheel Bracket |
| 4—Rear View Mirror | 11—Right Tail Gate Chain |
| 5—Windshield | 12—Tail Gate |
| 6—Cowl | 13—Left Tail Gate Chain |
| 7—Step | |

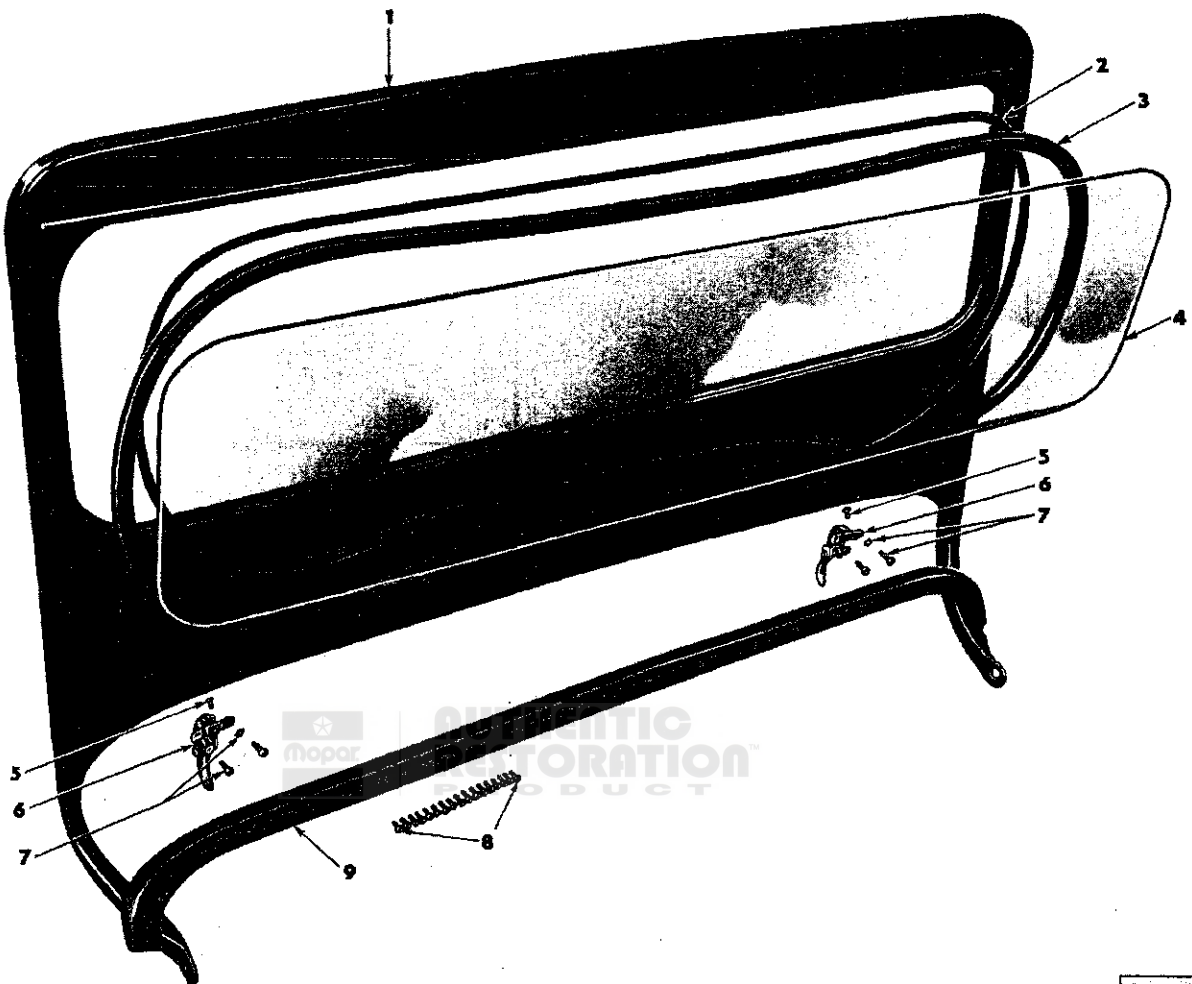


FIG. T-2—WINDSHIELD — CJ-3B

1—Windshield Assembly
2—Filler Strip
3—Weatherstrip

4—Windshield Glass
5—Screw
6—Clamp

7—Screw and Lockwasher
8—Screw
9—Weatherstrip

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Floor pan noise on early CJ-5 and CJ-6 models may be corrected by installing the new floor pans.

T-2. Windshield

• Model CJ-3B

The entire windshield and frame assembly may be lowered down on top of the hood. This is accomplished by unlatching the retaining catches mounted on the cowl above the instrument panel. When lowered do not fail to strap it down with the strap provided which is mounted at the top of the radiator guard.

A stationary type windshield is used on all vehicles equipped with soft or canvas tops. A hinged ventilator mounted in the center of the panel directly under the glass is provided for ventilation. The glass is installed in the same manner as on Models

CJ-5, and CJ-6.

Vehicles equipped with metal enclosure employ a stationary windshield which is the same as that used with the canvas top except that it has a higher silhouette and is wider. Glass installation is the same as CJ-5, CJ-5A, CJ-6, and CJ-6A.

T-3. Windshield

• Model CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5, DJ-6

The windshield and frame 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.

To remove the windshield from the body on early models, first, pull the windshield wiper vacuum hose

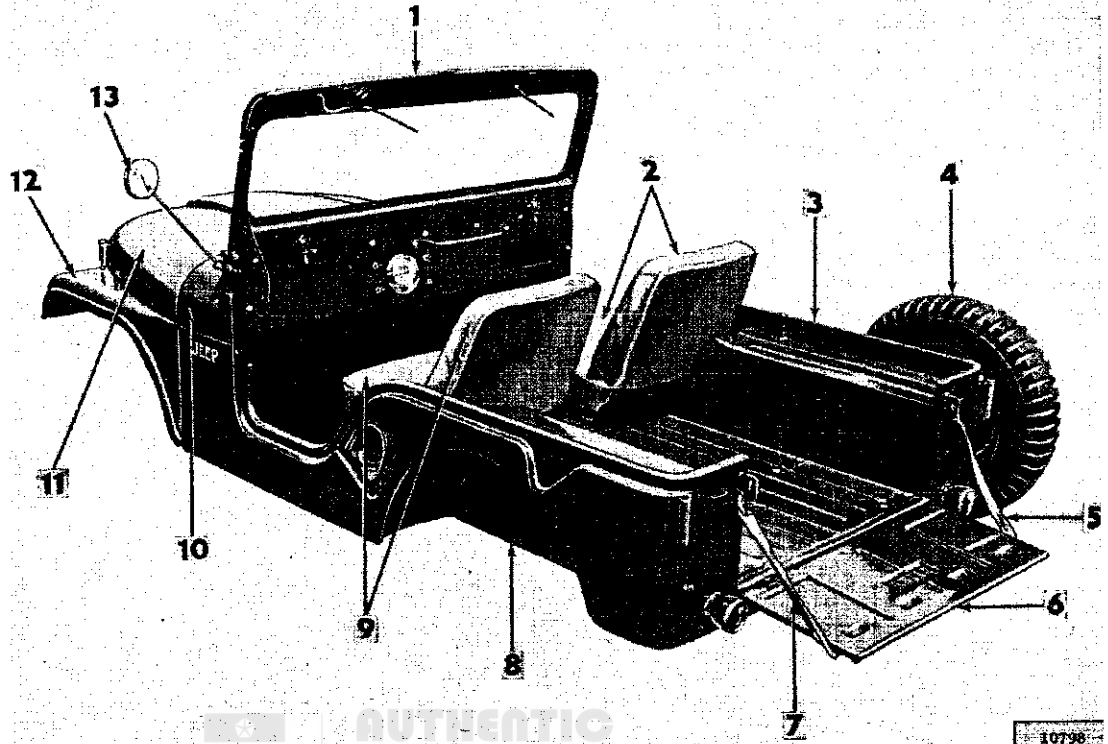


FIG. T-3--MODEL CJ-5 BODY

- | | | |
|------------------------|-------------------------|----------------------|
| 1—Windshield | 5—Right Tail Gate Chain | 9—Driver Seat |
| 2—Front Passenger Seat | 6—Tail Gate | 10—Cowl |
| 3—Right Side Panel | 7—Left Tail Gate Chain | 11—Hood |
| 4—Spare Wheel and Tire | 8—Left Side Panel | 12—Left Front Fender |
| | | 13—Rear View Mirror |

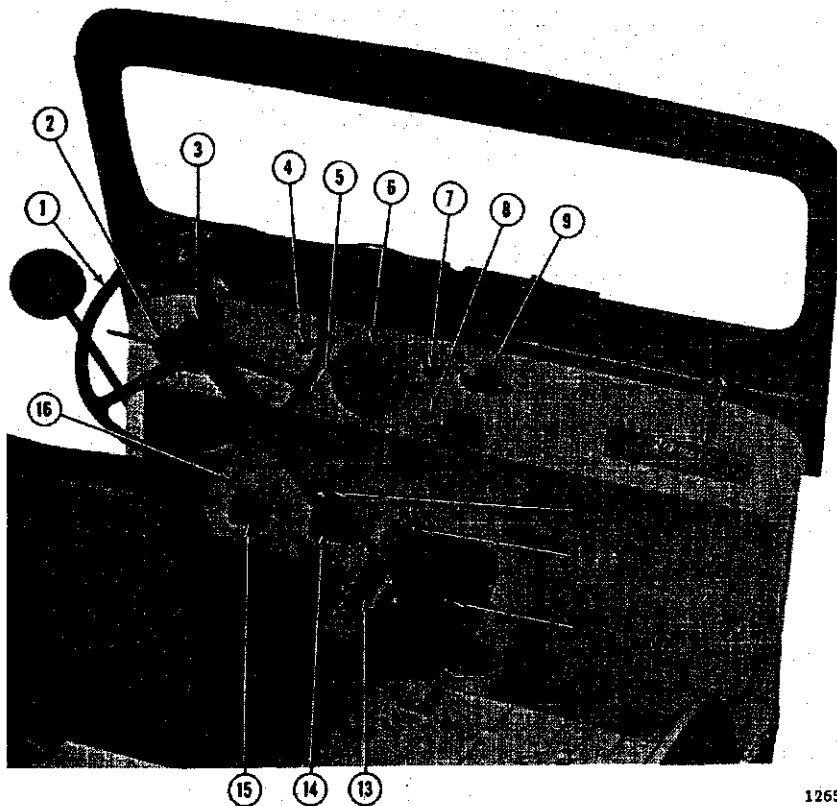


FIG. T-4—VEHICLE CONTROLS — CJ-3B

- | |
|----------------------------------|
| 1—Steering Wheel |
| 2—Turn Signal Switch |
| 3—Horn Button |
| 4—Light Switch |
| 5—Ignition — Starter Switch |
| 6—Instrument Cluster |
| 7—Carburetor Choke |
| 8—Hand Throttle |
| 9—Hand Brake |
| 10—Transmission Shift Lever |
| 11—Front Axle Drive Shift Lever |
| 12—Aux. Range Shift Lever |
| 13—Accelerator Pedal |
| 14—Brake Pedal |
| 15—Clutch Pedal |
| 16—Headlight Beam Control Switch |

from the windshield wiper vacuum fitting. On late models disconnect electrical wires from wiper motor. Unlatch the two windshield clamps on each side of the windshield. Fold the windshield forward until the slot in the windshield hinges aligns with the flat side of the pin in the body hinges. Slip windshield off the pins and remove from body.

T-4. Windshield Glass

The windshield glass is mounted in a rubber weatherstrip which in turn mounts in the frame. A

rubber locking strip, which holds the glass firmly in the frame, is inserted in a moulded groove around the rear face of the weatherstrip as shown in Fig. T-2. To remove the glass it is necessary to first remove the locking strip which may be pried out with a screwdriver or similar tool. Installation is obvious.

T-5. Canvas Tops

Canvas tops are available in Half Tops and Full Tops. Installation instructions are provided with each canvas top kit for each model vehicle.

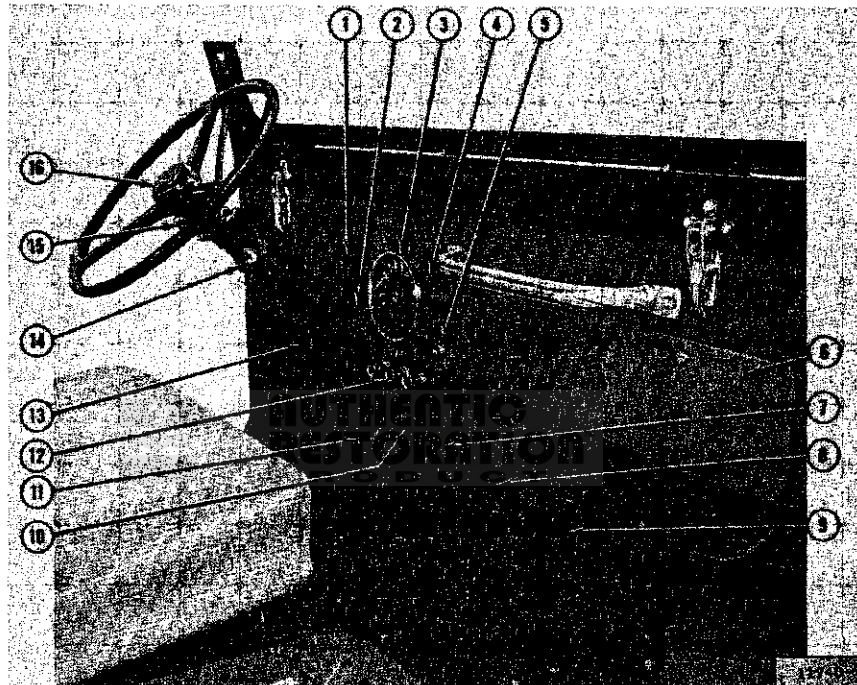


FIG. T-5—VEHICLE CONTROLS — MODEL CJ-5A, CJ-6A SINGLE LEVER TRANSFER CASE

- | | |
|-----------------------------|------------------------------|
| 1—Hand Throttle | 9—Transfer Case Shift Lever |
| 2—Choke Control | 10—Headlight Dimmer Switch |
| 3—Instrument Cluster | 11—Clutch Pedal |
| 4—Light Switch | 12—Heater Controls |
| 5—Ignition — Starter Switch | 13—Hand Brake Handle |
| 6—Glove Compartment | 14—Transmission Shift Lever |
| 7—Brake Pedal | 15—Directional Signal Switch |
| 8—Accelerator Pedal | 16—Horn Button |



FIG. T-6—TAIL GATE ASSEMBLY — EARLY MODEL CJ-5A, CJ-6A

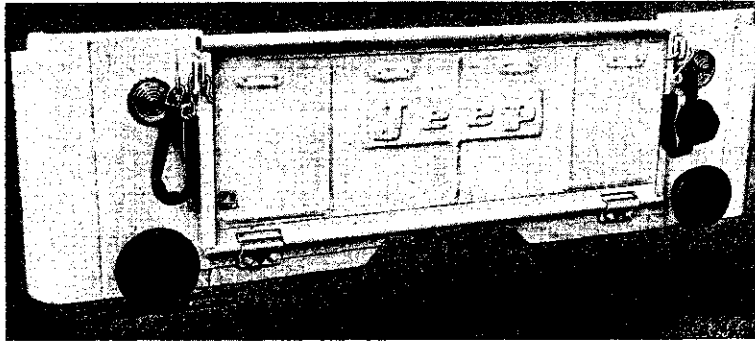


FIG. T-7—TAIL GATE ASSEMBLY
— LATE MODEL CJ-5, CJ-6

T-6. Care of Fabric Tops

Remove fabric tops from their protective covering immediately after they are received. Store in a dry, clean, airy place. If the material is damp, the top should be installed on the vehicle immediately and washed with a mild soap; then give the top a quick and thorough rinsing.

T-7. Brake and Clutch Pedal Pads

A clutch and brake pedal pad cover has been released which has a .44" [11,18 mm.] groove molded into the back side of the pad cover. When installing, the grooved opening is located down and to the bottom of the pedal. See Fig. T-11. The purpose of the groove concerns models not listed in this manual. The pedal pad cover formerly used is

solid in construction without groove. Either grooved and solid pad covers can be installed on CJ-3B, CJ-5, CJ-5A, CJ-6, CJ-6A, DJ-5 and DJ-6 models.

T-8. Front Seat Adjustment

The Bostrom bucket type driver's seat installed on early Models CJ-5, CJ-6, DJ-5 and DJ-6, are equipped with a 3-position manual adjustment. Three attaching holes are provided in the seat support at the four seat mounting locations. To adjust the seat, remove the four attaching bolts, move the seat and four mounting spacers to the desired location, and reinstall the bolts at the new location. Refer to Fig. T-12.

On late models the driver's seat may be quickly adjusted to the most comfortable driving position by releasing the lever located at the lower left front edge of the seat. Pushing the lever to the right al-

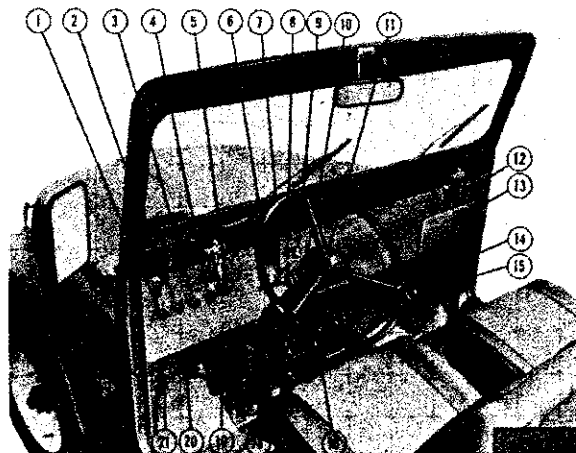


FIG. T-8—VEHICLE CONTROLS — LATE CJ-5 AND CJ-6 SINGLE LEVER TRANSFER CASE

- 1—Light Switch
 - 2—Windshield Wiper Switch
 - 3—Hazard Warning Light Switch
 - 4—Hand Throttle*
 - 5—Choke Control
 - 6—Brake Warning Light*
 - 7—Windshield Washer Control
 - 8—Ignition Starter Switch
 - 9—Cigarette Lighter*
 - 10—Turn Signal Lever
 - 11—Instrument Cluster
 - 12—Horn Button
 - 13—Glove Compartment
 - 14—Transfer Case Shift Lever
 - 15—Transmission Shift Lever
 - 16—Heater Controls*
 - 17—Accelerator Pedal
 - 18—Brake Pedal
 - 19—Clutch Pedal
 - 20—Hand Brake Control
 - 21—Headlight Dimmer Switch
- *On applicable models only.

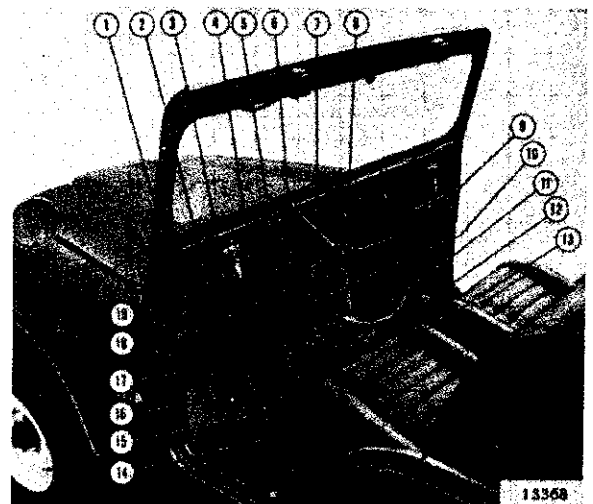


FIG. T-9—VEHICLE CONTROLS — CJ-5, CJ-6 DUAL LEVER TRANSFER CASE

- 1—Light Switch
- 2—4-Way Flasher Switch*
- 3—Hand Throttle
- 4—Choke Control
- 5—Brake Warning Light*
- 6—Ignition-Starter Switch
- 7—Instrument Cluster
- 8—Horn Button
- 9—Glove Compartment
- 10—Heater Controls*
- 11—Front Axle Drive Shift Lever
- 12—Transmission Shift Lever
- 13—Aux. Range Shift Lever
- 14—Accelerator Pedal
- 15—Brake Pedal
- 16—Clutch Pedal
- 17—Headlight Dimmer Switch
- 18—Hand Brake Control
- 19—Turn Signal Lever

*On applicable models only.

lows the seat to be moved forward or rearward. Repositioning the lever to the left will lock the seat in the desired position.

T-9. Passenger Seat Safety Catch

The front passenger seat on late model vehicles is provided with a safety catch, located at the left rear base of the seat. To tilt the seat forward, first release the catch by pulling upwards on the catch lever.

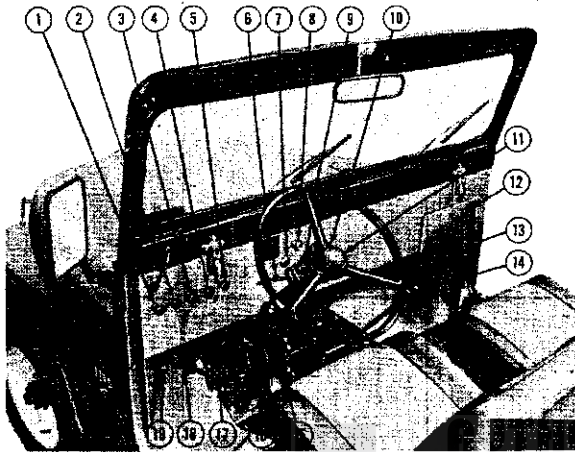


FIG. T-10—VEHICLE CONTROLS—MODELS DJ-5 AND DJ-6

- 1—Light Switch
- 2—Windshield Wiper Switch
- 3—Hazard Warning Light Switch
- 4—Hand Throttle*
- 5—Choke Control
- 6—Windshield Washer Control
- 7—Ignition Starter Switch
- 8—Cigarette Lighter*
- 9—Turn Signal Lever
- 10—Instrument Cluster
- 11—Horn Button
- 12—Glove Compartment
- 13—Heater Controls*
- 14—Transmission Shift Lever
- 15—Accelerator Pedal
- 16—Brake Pedal
- 17—Clutch Pedal
- 18—Hand Brake Control
- 19—Headlight Dimmer Switch

*On applicable models only.

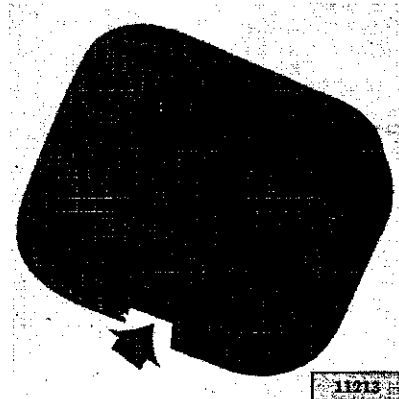


FIG. T-11—CLUTCH AND BRAKE PEDAL PAD

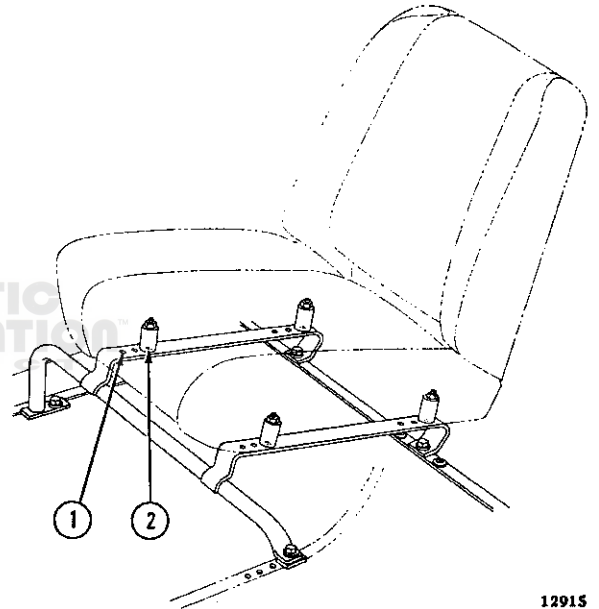


FIG. T-12—EARLY MODELS FRONT SEAT ADJUSTMENT

- 1—Location Holes
- 2—Spacer

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MISCELLANEOUS

Contents

SUBJECT	PAR.	SUBJECT	PAR.
Abbreviations	U-15	Heater	U-10
Extra Equipment	U-2	Miscellaneous Data	U-16
Front Bumper Weight	U-9	Pintle Hook	U-7
Governor	U-3	Special Tools	U-11
Governor Adjustment	U-4	Torque Specifications	U-13, 14, 15
Governor Maintenance	U-6	Standard and Recommended Tools	U-12

U-1. GENERAL

Miscellaneous information included in this section includes coverage of extra equipment, special tools, torque specifications, and charts and tables.

U-2. EXTRA EQUIPMENT

Much of the utility of the 'Jeep' Universal is due to the extra equipment which has been designed to adapt it for farming and industry. The maintenance and use of some of this equipment is outlined in this section.

U-3. Governor Assembly

The Novi governor is supplied for models equipped with the F4 engine. This is a centrifugal type governor and is illustrated in Fig. U-2. Complete installation instructions are supplied with each assembly. Adjustment and operating procedures are given below.

U-4. Governor Adjustment

- a. Adjust the carburetor to obtain smooth engine idle at 600 rpm., then stop the engine.
 - b. Check throttle linkage to ensure maximum throttle opening. Be certain that throttle and governor linkage is free.
 - c. Place the carburetor throttle in wide-open position and pull the governor control handle out to the last notch. Adjust the governor to bellcrank rod so that the linkage will hold the carburetor throttle in wide-open position.
 - d. Close the governor control and start the engine. Again pull the control out to the last notch and adjust the length of the cable at adjusting yoke so that the engine will run at 2600 rpm. Close the control to recheck the linkage for free action and to make sure the engine will return to 600 rpm. idle speed.
- If the engine runs faster than this speed, loosen the lock nut which locks the governor hand control handle on the dash to the rod and back off the handle until the carburetor idle speed adjusting screw bears on the stop. Tighten the lock nut.
- In the absence of electrical tachometer equipment, engine speed may be determined by the speedometer. Safely jack up the rear wheels and be sure the front wheel drive is not engaged. When driving the rear wheels in high or direct transmission gear, the speedometer will read from 13½ to 15 mph. [21.6 to 24.0 kph.] at an engine speed of from 900 to 1000 rpm.

U-5. Novi Governor Operation

The Novi governor is directly belted to the F4 engine as no clutch is provided to disconnect the drive.

To operate the vehicle **WITHOUT** governor control, push the governor hand control all the way **IN** against the instrument panel.

To operate the vehicle **WITH** governor control, pull the governor hand control handle out. The hand control has nine notched positions. Pulling the control out to the first notch sets the controlled engine speed at approximately 1000 rpm. and each successive notch increases the speed 200 rpm. until 2600 rpm. is reached in the ninth notch. The hand control may be released by turning the handle one-quarter turn in either direction.

When the engine is being operated under governor control (hand control out) the controlled engine speed may be exceeded at any time by depressing the foot accelerator in the conventional manner to secure a greater carburetor throttle opening than that determined by the governor hand control setting.

U-6. Governor Maintenance

The belt tension may be adjusted by raising or lowering the governor in the slotted holes in the mounting bracket. Keep the pulleys and belt free of dirt and oil. Belt slippage will affect governor operation and a tight belt may cause rapid wear of the governor shaft and bearings. Adjust it to allow ½" [12,7 mm.] depression midway between the pulleys with thumb pressure.

There is little wear of the internal parts for they operate in oil. The governor housings are equipped with both fill and drain plugs and also with level indicating plugs. Check the oil level at each vehicle lubrication and change the oil each time the engine oil is changed using the same grade oil used in the engine.

Caution: Do not fill the governor housing above the level plug. Overfilling will prevent governor control and possibly cause damage to governor internal parts. The capacity of these governors is two fluid ounces [59,15 cm³]. The filler plug is also a vent which should be cleaned thoroughly at each oil change to be sure that the vent operates.

U-7. Pintle Hook

The standard type pintle hook, Fig. U-1, affords a safe, easy hitch for towing a trailer or other vehicle.

Designed primarily for use on the road, a safety latch locks the hook in the closed position and two eye bolts are provided for attachment of safety chains which should be crossed when installed, to prevent the hooks from jumping out of the eyes. Keep the attaching bolts tight at all times. When lubricating the vehicle, place a few drops of oil on the hook and safety latch pivot pins.

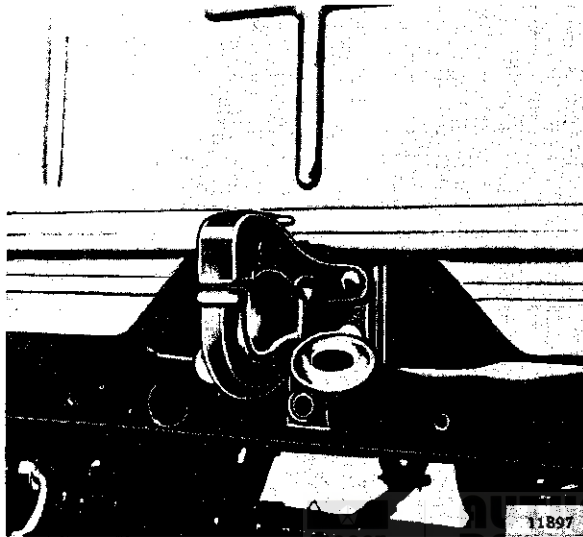


FIG. U-1—PINTLE HOOK

U-8. Pintle Hook Installation

Six holes are provided in the frame rear cross members of 'Jeep' Universals for the installation of pintle hooks and safety chain eye bolts. On most vehicles, the pintle hook is attached using the top four holes and the eye bolts are attached using the lower two holes. On 'Jeep' Universals equipped with tail gates, the position of the hook and the eye must be changed to provide proper clearance. On these vehicles, use the lower four holes for attaching the pintle hook and the upper two holes for attaching the safety chain eye bolts.

U-9. Front Bumper Weight

The best performance of a four-wheel drive vehicle is obtained when the load is equally distributed for traction on the front and rear wheels. This weight distribution is disturbed when the vehicle is used for drawbar work as the load on the rear wheels is increased and that on the front wheels decreased. The addition of a 265 pound front bumper weight equalizes the load.

When the load is equalized the front and rear axles do approximately the same work which results in prolonged life of these parts and considerably more satisfactory performance.

The bumper weight, Fig. U-3, is held in place by four bolts and is provided with hand holes for lifting. Do not add sand bags or other weights in the vehicle. When driving over rough terrain, with the weight in place, the driver should exercise due care.

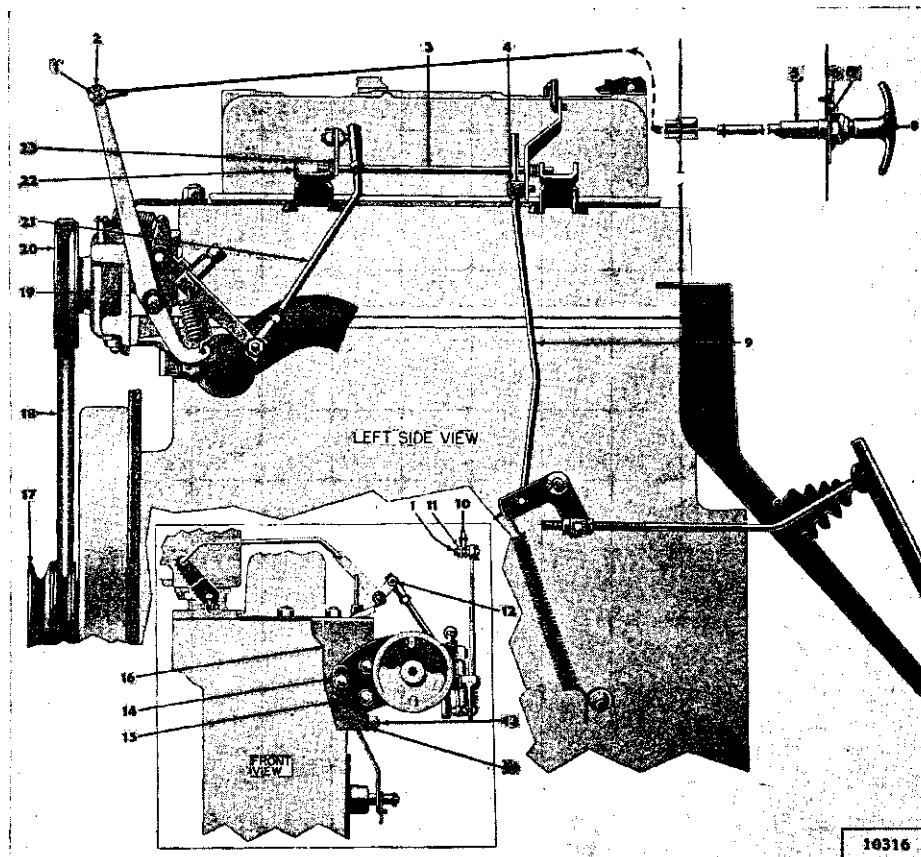


FIG. U-2—NOVI GOVERNOR — F4 ENGINE

- 1—Pivot Bolt
- 2—Cotter Pin
- 3—Governor Bellcrank
- 4—Adjusting Block
- 5—Governor Control
- 6—Screw
- 7—Control Bezel
- 8—Handle
- 9—Vertical Rod
- 10—Washer
- 11—Nut
- 12—Nut and Lockwasher
- 13—Stud
- 14—Washer
- 15—Screw
- 16—Support Bracket
- 17—Fan Drive Pulley
- 18—Governor Drive Belt
- 19—Governor (Novil)
- 20—Governor Drive Pulley
- 21—Horizontal Rod
- 22—Bellcrank Bracket
- 23—Washer

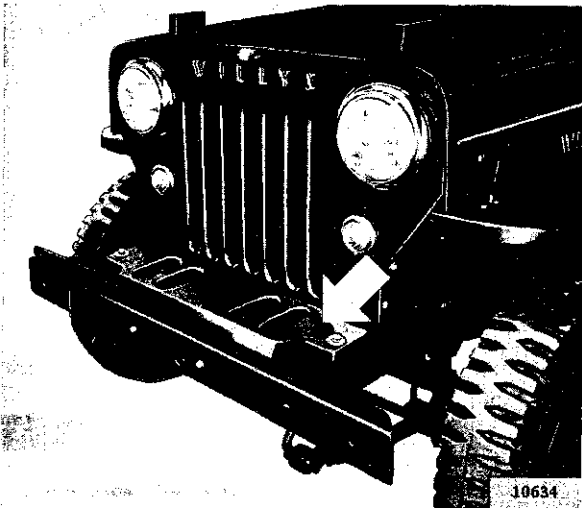


FIG. U-3—FRONT BUMPER WEIGHT

U-10. FRESH AIR HEATER AND DEFROSTER

Refer to Fig. U-4.

Air circulation of the heater and defroster unit is accomplished by the use of a 12-volt, two-speed fan motor.

Outside air may be drawn through the vehicle fresh air intake shroud into the fan and blown out across the heater core where it is heated by the hot circulating coolant from the engine. The heated air then enters the transition duct. From the transition duct the heated air passes into the heat distributor where it is distributed to the defroster nozzle and/or floor diffuser. The heater and defroster controls are mounted in the control panel on the instrument panel. A three-position switch mounted in the control panel operates the heater fan.

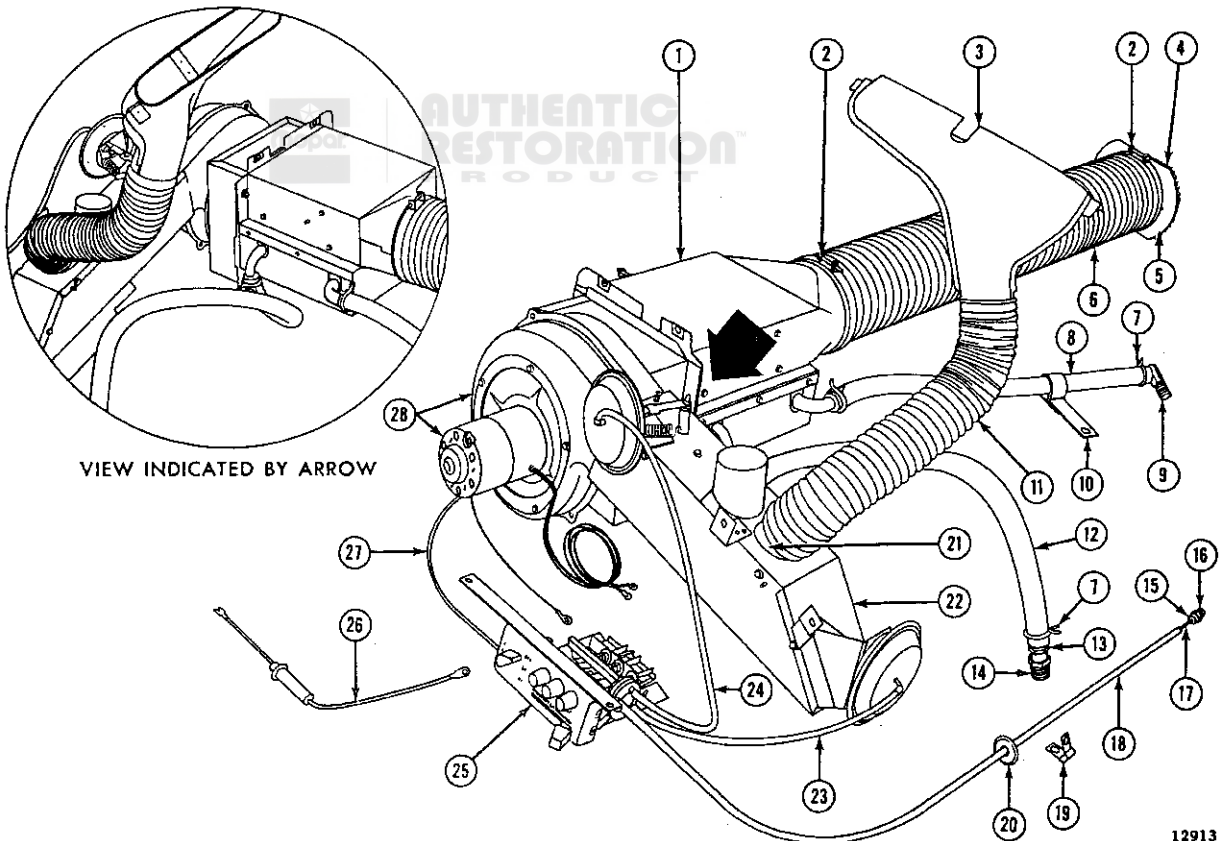


FIG. U-4—FRESH AIR HEATER AND DEFROSTER
CJ-5 AND CJ-6

- | | | |
|--------------------------------|-----------------------------------|--|
| 1—Heater Assembly | 11—Defroster Hose | 20—Grommet |
| 2—Hose Clamp | 12—Hot Water Hose | 21—Defroster Bushing |
| 3—Defroster Nozzle | 13—Heater Nipple | 22—Heat Distributor Assembly |
| 4—Air Duct Screen | 14—Reducing Bushing | 23—Heater Control Tube |
| 5—Air Duct and Heater Collar | 15—Inverted Flared Tube Nut | 24—Heater Control Tube |
| 6—Air Duct Intake Tube | 16—Inverted Flared Tube Connector | 25—Heater Control Assembly |
| 7—Hose Clamp | 17—Heater Vacuum to Engine Tube | 26—Fuse Holder Assembly |
| 8—Straight Hot Water Hose | 18—Heater Control Tube | 27—Bowden Wire (Control Panel to Heater) |
| 9—Heater Tube Elbow | 19—Clip | 28—Blower and Air Inlet Assembly |
| 10—Heater Hose Support Bracket | | |

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U-11. SPECIAL TOOLS

Below are listed the tools applicable to models covered in this manual. These special tools are essential not only for the time they will save but also because many operations described cannot be

performed without them.

Note: Tools W-274, W-283, and W-285 are universal and can be used on all engines.

Tool	Description
HURRICANE F4 ENGINE	
W-172	Puller, Timing Gear, U-Joint Flange, Vibration Damper
W-231	Kit, Flywheel Dowel Installing
W-238	Driver, Intake and Exhaust Valve Guide
W-274	Pliers, Spark Plug Terminal Removal and Installing
W-283	Gauge, Fan Belt Tension
W-285	Studs, Oil Pan Gasket Aligning
C-690	Scale and Gauge, Piston Fitting
DAUNTLESS V-6 ENGINE	
W-274	Pliers, Spark Plug Terminal Removal and Installing
W-283	Gauge, Fan Belt Tension
W-285	Studs, Oil Pan Gasket Aligning
W-323	Rear Main Bearing Cap Remover Bolt
W-338	Piston Pin Remover and Installer Set
	J-6047-1 Support, J-6047-3 Spring,
	J-6047-4 Driver, J-6047-5 Collar, J-6047-20 Pilot
C-690	Scale & Gauge, Piston Fitting
J-5127-2	Carburetor Float Gauge
J-5830-1	Reamer, .004" [0,102 mm.] Oversize
Electrical Group	
C-3858	Installer, Rotor, Housing and Shaft Bearing Assembly
C-3935	Driver, Alternator Rotor Bearing (Small)
C-3936	Puller, Alternator Rotor Bearing (Small)
C-4068	Puller, Alternator Rotor Bearing (Large)
Transmission Group	
KF-128-A	Driver, Main Drive Shaft Bearing
W-166	Arbor & Sleeve, Countershaft Needle Bearing Aligning
W-193	Arbor, Countershaft Needle Bearing Aligning
W-194	Plate, Transmission Main Shaft Retaining
W-329	Puller — Main Drive Gear and Mainshaft Bearing (used with SP-5350 Adapters)
W-331	Driver Set — Main Drive Gear and Mainshaft Bearing (used with SP-5361 Driver Heads)
W-334	Thrust Yoke Tool — Second-Third Synchronizer Clutch Protecting
W-335	Arbor — Countershaft Needle Bearing Aligning
W-336	Arbor — Reverse Idler Shaft Needle Bearing Aligning
C-3105	Driver, Mainshaft Rear Oil Seal (2WD)
Transfer Case Group	
W-130	Thimble & Driver, Shifter Rod Oil Seal
W-131	Thimble & Driver, Pinion Shaft Rear Bearing Cone
W-133	Driver, Speedometer Drive Pinion Bushing
W-139	Driver, Output Shaft Front Bearing Cone Removing
W-141	Ring, Output Shaft Front Bearing Cone Removing
W-143	Driver, Output Shaft Front & Rear Oil Seal Installer
W-176	Puller, Shift Rod Oil Seal
W-192	Pilot Pin, Transfer Case Intermediate Gear Thrust Washer
W-251	Puller, Pinion Shaft Oil Seal, Transfer Case Front and Rear Oil Seal Removing
Universal Joint Group	
W-162	Tool, U-Joint Flange Installer
W-220	Jig & Bushing, Power-Take-Off U-Joint Pin Remover & Installer
C-3281	Wrench, U-Joint Holding

DESCRIPTION — Continued

AXLES

W-99*	Gauge — Pinion & Ring Gear Setting
W-104-B*	Puller — Tapered Roller Bearing Removing
W-126*	Driver — Pinion Bearing Cup
W-128*	Installer — Differential Inner Oil Seal
W-129	Spreader — Differential Carrier Housing
W-138*	Driver & Adapter — King Pin Bearing
W-144*	Wrench — Wheel Bearing Adjusting Nut
W-147*	Driver — Pinion Oil Seal
W-163*	Puller — Axle Shaft Drive Flange
W-186*	Driver — Axle Shaft Oil Seal
W-188*	Driver — Differential Case Bearing
W-251*	Puller — Pinion Oil Seal
W-262*	Sleeve — Pinion Bearing Installing
W-263	Semi-Floating Rear Axle Shaft Oil Seal
W-264*	Driver — Pinion Outer Bearing Cup
W-297*	Torque Wrench — Pinion Bearing Adjusting
W-343*	Remover & Installer — Rear Axle Bearing (Flanged Axle)
W-344*	Installer — Pinion Inner Bearing Cups
C-319-A	Puller — Rear Wheel Hub (Tapered Axle Shaft)
C-690	Checking Scale — King Pin Bearing Preload
DD-914-P	Press — Tapered Roller Bearing Removing
DD-914-9	Reducer Ring — Differential & Pinion Bearings (Use with DD-914-P)
C-3716	Driver — Differential Carrier Bearing
C-4142	Gear Rotating Tool — Trac-Lok Differential

*Jeep' exclusive tool

Steering Group

C-3646	Puller, Steering Shaft Arm
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Brake Group

W-172	Puller, Parking Brake Drum
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U-12. STANDARD AND RECOMMENDED TOOLS

Tool	Description
ENGINE	
W-292	Tester — Cooling System Thermostat
C-119	Indicator — Cylinder Bore
C-385	Compressor — Piston Ring
C-647	Fixture — Spring Testing
C-823	Hone — Cylinder Bore Refinishing
C-3012	Reamer — Cylinder Ridge
C-3250	Pliers — Radiator & Heater Hose Wire Clamp
C-3411	Gauge — Pressure & Vacuum
C-3422-A	Compressor — E-type Valve Spring
C-3501	Hone — Cylinder Deglazing
C-3514	Flusher — Cooling System
C-3886	Fixture — Carburetor Holding
C-3896-A	Tachometer — Portable
C-3943	Gauge — Compression Checking
C-3952	Torque Wrench, 150 lb-ft. Swivel Head
C-3953	Stand, Engine Repair
C-3959	Light — Ignition Timing
C-4065	Wrench — Oil Filter Removing
C-4080	Tester — Cooling System & Pressure Cap
ELECTRICAL	
40B	Hydrometer — Battery Service
W-291	Tester — Instrument
C-3674	Aimers — Headlight (Pair)
C-3829	Tester — Diode Polarity
C-3888	Tester — Volt-Ampere
C-3950	Tester — 12V 60 Amp. Carbon Pile Resistor

U

MISCELLANEOUS

U-12. STANDARD AND RECOMMENDED TOOLS (Continued)

Tool	Description
CLUTCH	
W-296	Fixture — Adjusting
TRANSMISSION	
C-3201-A	Lo-Jack — Floor Type
AXLE	
C-637	Puller — Axle Shaft & Oil Seal
STEERING	
DD-428	Gauge — Camber & Caster
DD-435	Turntables — Wheel Alignment
C-3479	Gauge & Scribe — Toe-in Checking
BRAKES	
C-416	Clamps — Brake Cylinder Retaining
C-3080	Hone — Brake Cylinder
C-3496-B	Bleeder — Hydraulic Pressure Type
C-3785	Remover & Installer — Brake Return Spring
C-3920	Micrometer — Brake Drum Checking



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U-13. ENGINE TORQUE SPECIFICATIONS

HURRICANE F4 ENGINE	Pounds - Feet	kg-m.
Camshaft Gear to Camshaft.....	30-40	4,1 a 5,5
Camshaft Thrust Plate Bolt.....	20-26	2,8 a 3,6
Clutch Control Ball Stud — 5/16" [7,93 mm.].....	35-45	4,8 a 6,2
Connecting Rod Cap Bolt Nut — 3/8" [9,53 mm.].....	35-45	4,8 a 6,2
Crankshaft Counterweight Bolt.....	60-70	8,3 a 9,7
Cylinder Head to Block Bolts.....	60-70	8,3 a 9,7
Engine Mounting (Center Bolt).....	45-55	6,2 a 7,6
Exhaust Manifold to Cylinder Block.....	29-35	4,0 a 4,8
Flywheel to Crankshaft Bolt.....	35-41	4,8 a 5,7
Fuel Pump Mounting Bolts.....	13-17	1,8 a 2,4
Alternator Bracket to Cylinder Block.....	25-35	3,5 a 4,8
Intake Manifold to Cylinder Block.....	29-35	4,0 a 4,8
Main Bearing Caps.....	65-75	9,0 a 10,4
Oil Pan Drain Plug.....	25-35	3,5 a 4,8
Oil Fan Screws to Cylinder Block.....	9-14	1,2 a 1,9
Piston Pin Lock Bolt.....	35-41	4,8 a 5,7
Rocker Arm Bracket to Head Nut.....	30-36	4,1 a 5,0
Spark Plugs to Cylinder Head.....	25-33	3,5 a 4,6
Starting Motor Mounting Bolt.....	20-25	2,8 a 3,5
Valve Chamber Cover Nuts.....	7-10	0,9 a 1,4
Water Outlet Elbow to Cylinder Head.....	20-25	2,8 a 3,5
Water Pump to Cylinder Block.....	12-17	1,7 a 2,4

NOTE: Turn the connecting rod cap nut locks (inverted type, pressed steel) finger tight and then tighten 1/3 turn more with wrench

ENGINE TORQUE SPECIFICATIONS

DAUNTLESS V-6 ENGINE	Pounds - Feet	kg-m.
Crankshaft Bearing Caps to Cylinder Block	80-110	11,1 a 15,2
Connecting Rods	30-40	4,2 a 5,5
Cylinder Head to Cylinder Block	65-85	9,0 a 11,8
Vibration Damper to Crankshaft	140 Minimum	19,4
Fan Driving Pulley to Vibration Damper	18-25	2,5 a 3,4
Flywheel to Crankshaft	50-65	6,9 a 9,0
Oil Pan to Cylinder Block	10-16	1,4 a 2,2
Oil Pan Drain Plug	14-18	1,9 a 2,5
Oil Pump Cover to Timing Chain Cover	8-12	1,1 a 1,7
Oil Pump Pressure Valve Cap	30-40	4,2 a 5,5
Oil Screen Housing to Cylinder Block	6-9	0,8 a 1,2
Oil Pan Baffle to Cylinder Block	6-9	0,8 a 1,2
Oil Gallery Plugs	20-30	2,8 a 4,2
Filter Assembly to Pump Cover	10-15	1,4 a 2,1
Timing Chain Cover to Block	25-33	3,5 a 4,6
Water Pump Cover to Timing Chain Cover	6-9	0,8 a 1,2
Fan Driven Pulley	17-23	2,4 a 3,2
Thermostat Housing to Intake Manifold	17-23	2,4 a 3,2
Intake Manifold to Cylinder Head	45-55	6,2 a 7,6
Exhaust Manifold to Cylinder Head	15-20	2,1 a 2,8
Carburetor to Intake Manifold	10-15	1,4 a 2,1
Air Cleaner Stud	17-23 Lb. In.	0,195 a 0,265 kg-cm.
Air Cleaner Wing Nut	17-23 Lb. In.	0,195 a 0,265 kg-cm.
Fuel Pump to Cylinder Block	17-23	2,4 a 3,2
Engine Mounting Bracket to Cylinder Block	50-75	6,9 a 10,4
Fuel Pump Eccentric and Timing Chain Sprocket to Camshaft	40-55	5,5 a 7,6
Rocker Arm Cover to Cylinder Head	3-5	0,4 a 0,7
Rocker Arm Shaft Bracket to Cylinder Head	25-35	3,5 a 4,8
Alternator Bracket to Cylinder Head	30-40	4,1 a 5,5
Alternator Bracket to Water Pump Timing Chain Cover	18-25	2,5 a 3,5
Alternator Mounting Bracket S.O. Alternator to Cylinder Head at Pivot Location	30-40	4,2 a 5,5
Starting Motor to Block	30-40	4,2 a 5,5
Starting Motor Bracket to Block	10-12	1,4 a 1,7
Starting Motor Brace to Starting Motor	10-12	1,4 a 1,7
Distributor Hold-down Clamp	18-20	2,5 a 2,8
Spark Plugs	26-30	3,6 a 4,2
Flywheel Housing to Cylinder Block	30-40	4,2 a 5,5
Timing Chain Damper to Cylinder Block Bolt	6-9	0,8 a 1,2
Bolt — Special Moveable Timing Chain Damper	10-15	1,4 a 2,1
Clutch to Flywheel	30-40	4,2 a 5,5
Oil Filter Element	10-15	1,4 a 2,1

U-14. SPECIAL CHASSIS TORQUE SPECIFICATIONS

CHASSIS:	Pounds - Feet	kg-m.
Brake Backing Plate Bolts	25-35	3,4 a 4,8
Clutch and Brake Pedal Shaft Hugnut	25-40	3,4 a 5,5
Differential Carrier	38-42	5,2 a 5,8
Engine Front Insulator to Frame	10-15	1,4 a 2,1
Engine Rear Insulator to Crossmember Bolt	20-30	2,8 a 4,1
Engine Rear Mounting Bracket to Transmission Bolt	20-30	2,8 a 4,1
Pressure Plate to Flywheel Bolts	12-17	1,7 a 2,3
Propeller Shaft and Universal Joint Flange Bolt	25-45	3,4 a 6,2
Propeller Shaft and Universal Joint U-Bolt	13-18	1,8 a 2,4
Rear Axle Shaft Nut	150 Minimum	20,8
Spring Mounting — Front and Rear U-Bolt $\frac{1}{16}$ " [11,11 mm.]	32-46	4,5 a 6,3
Spring Mounting — Rear U-Bolt — $\frac{1}{2}$ " [12,7 mm.]	45-65	6,2 a 9,0
Spring Pivot Bolts	25-40	3,4 a 5,5
Steering Arm to Gear Nut (Ross)	70-90	9,7 a 12,4
Steering Arm to Gear Nut (Saginaw)	120-160	16,6 a 22,1
Steering Knuckle and Arm Nut	55-65	7,6 a 9,0
Steering Bellcrank Bolt Nut	14-19	1,9 a 2,6
Steering Knuckle Seal Retainer Bolts	10-15	1,4 a 2,1
Steering Knuckle Support to Knuckle Arm to Wheel Spindle Bolt	45-55	6,2 a 7,6
Steering Mounting to Frame — $\frac{3}{8}$ " [9,53 mm.]	30-40	4,1 a 5,5
Steering Mounting to Frame — $\frac{1}{16}$ " [11,11 mm.]	45-55	6,2 a 7,6
Steering Tie Rod Clamp Bolts — $\frac{5}{16}$ " [7,94 mm.]	10-15	1,4 a 2,1
Steering Tie Rod Clamp Bolts — $\frac{7}{16}$ " [11,11 mm.]	35-45	4,8 a 6,2
Steering Wheel Nut	32-38	2,7 a 5,2
Transmission Mainshaft Nut	130-170	18,0 a 23,5
Wheel to Hub Bolts	65-90	9,0 a 12,4
Spring Mounting — Suspension Bolts (All)	65-80	9,0 a 11,0
Body Hold-Down Bolts — $\frac{1}{16}$ " [11,11 mm.]	25-30	3,4 a 4,1
— $\frac{1}{2}$ " [12,7 mm.]	45-50	6,2 a 6,9

U-15. CHASSIS AND BODY BOLT TORQUE CHART

Note: Applies to all applications not listed.

Bolt Size	Pounds - Feet	kg-m.
$\frac{1}{4}$ [6,35 mm.]	4-8	0,6-1,1
$\frac{5}{16}$ [7,94 mm.]	8-15	1,1-2,1
$\frac{3}{8}$ [9,53 mm.]	18-30	2,5-4,1
$\frac{7}{16}$ -14..... [11,11 mm.]	27-45	3,8-6,2
$\frac{1}{2}$ -20..... [11,11 mm.]	32-46	2,7-6,3
$\frac{1}{2}$ -13..... [12,7 mm.]	40-60	5,5-8,3
$\frac{1}{2}$ -20..... [12,7 mm.]	48-62	6,7-8,5
$\frac{9}{16}$ -12..... [14,29 mm.]	48-80	6,7-11,0
$\frac{9}{16}$ -18..... [14,29 mm.]	57-86	7,9-11,9
$\frac{5}{8}$ -11..... [15,88 mm.]	75-140	10,4-19,4
$\frac{5}{8}$ -18..... [15,88 mm.]	87-152	12,0-20,9
$\frac{3}{4}$ -10..... [19,05 mm.]	126-192	17,4-25,5
$\frac{3}{4}$ -16..... [19,05 mm.]	150-184	20,7-26,5
$\frac{7}{8}$ -9..... [22,23 mm.]	215-290	29,7-40,1
$\frac{7}{8}$ -14..... [22,23 mm.]	255-290	35,3-40,1
1-8..... [25,4 mm.]	300-430	41,5-59,5
1-14..... [25,4 mm.]	300-390	41,5-54,0

U-16. MISCELLANEOUS DATA

DRAW BAR PULL

The power plant of the 'Jeep' Universal is particularly well adapted to the great variety of applications. For higher speed highway use, and draw bar pull requirements for towing loads, the full engine power is available; for power take-off shaft and pulley drive, the full engine torque (turning effort) is available.

Draw bar pull is the force exerted by a vehicle to tow a trailed load and is expressed in pounds.

For continuous agricultural work, the maximum draw bar pull should be limited to 1200 pounds [544 kg.]. The 'Jeep' Universal is capable of much higher draw bar pulls than the 1200 pounds approved for continuous service, which may be used for starting loads or towing loads for short periods on good ground in which case a draw bar pull as high as 1800 pounds [817 kg.] may be safely used.

Maximum continuous draw bar pulls are most often encountered in plowing, disking and harrowing and it is in these applications that the owner should guard against continuously exceeding the recommended limit.

The approved limit of 1200 pounds [544 kg.] may be judged by the following operations which nearly approach this limit:

Operating two 12 inch [30,5 cm.] plows at a depth of 6½ inches [16,5 cm.] in dry clay loam.

Operating a 7 foot [2,13 meter] tandem disk at a depth of 4½ inches [11,4 cm.] in hard winter packed soil.

Operating a 3-section spring tooth harrow at a depth of 5 inches [12,7 cm.] in soil which has been previously disked.

It is expected that, either on account of soil conditions or implement adjustments, these draw bar pulls will be exceeded. In these instances, tire slippage provides an inherent safeguard against overloading. Do not add weight, other than the standard bumper weight, to increase draw bar pull.

**POWER TAKE-OFF SHAFT AND VEHICLE GROUND SPEEDS
ALL GEAR SHIFT POSITIONS
MILES PER HOUR**

Governor Control Position	Transfer In	POWER TAKE-OFF 1 TO 1 GEAR RATIO						Engine Speed
		Transmission Gear In						
		Low		Intermediate		High		
		Take-Off Shaft R.P.M.	Vehicle Speed M.P.H.	Take-Off Shaft R.P.M.	Vehicle Speed M.P.H.	Take-Off Shaft R.P.M.	Vehicle Speed M.P.H.	
1	Low	358	2.22	644	4.01	1000	6.22	1000
	High	358	5.40	644	9.75	1000	15.13	
2	Low	428	2.67	773	4.81	1200	7.47	1200
	High	428	6.48	773	11.71	1200	18.15	
3	Low	500	3.11	902	5.82	1400	8.72	1400
	High	500	7.56	902	13.85	1400	21.17	
4	Low	571	3.56	1031	6.42	1600	9.86	1600
	High	571	8.65	1031	15.61	1600	24.20	
5	Low	643	4.00	1160	7.22	1800	12.08	1800
	High	643	9.73	1160	17.56	1800	27.22	
6	Low	714	4.44	1289	8.02	2000	12.45	2000
	High	714	10.81	1289	19.51	2000	30.25	
7	Low	786	4.89	1418	8.83	2200	13.70	2200
	High	786	11.89	1418	21.48	2200	33.27	
8	Low	857	5.34	1547	9.63	2400	14.84	2400
	High	857	12.97	1547	23.41	2400	36.31	
9	Low	929	5.78	1675	10.43	2600	16.19	2600
	High	929	14.05	1675	25.36	2600	39.33	

**POWER TAKE-OFF SHAFT AND VEHICLE GROUND SPEEDS
ALL GEAR SHIFT POSITIONS
KILOMETERS PER HOUR**

Governor Control Position	Transfer In	POWER TAKE-OFF 1 TO 1 GEAR RATIO						Engine Speed
		Transmission Gear In						
		Low		Intermediate		High		
		Take-Off Shaft R.P.M.	Vehicle Speed K.P.M.	Take-Off Shaft R.P.M.	Vehicle Speed K.P.M.	Take-Off Shaft R.P.M.	Vehicle Speed K.P.M.	
1	Low	358	3.57	644	6.45	1000	16.00	1000
	High	358	8.68	644	15.68	1000	24.35	
2	Low	428	4.29	773	7.73	1200	12.02	1200
	High	428	10.43	773	18.84	1200	28.20	
3	Low	500	5.00	902	9.04	1400	14.02	1400
	High	500	12.16	902	21.88	1400	34.05	
4	Low	571	5.72	1031	10.33	1600	16.03	1600
	High	571	13.91	1031	25.12	1600	38.93	
5	Low	643	6.44	1160	11.61	1800	19.43	1800
	High	643	15.65	1160	28.25	1800	43.80	
6	Low	714	7.15	1289	12.90	2000	20.00	2000
	High	714	17.39	1289	31.40	2000	48.65	
7	Low	786	7.86	1418	14.20	2200	22.02	2200
	High	786	19.11	1418	34.53	2200	53.53	
8	Low	857	8.59	1547	15.48	2400	24.03	2400
	High	857	20.87	1547	37.66	2400	58.40	
9	Low	929	9.30	1675	16.78	2600	26.04	2600
	High	929	22.60	1675	40.80	2600	63.23	

PULLEY SPEEDS (R.P.M.) - 8" (20.3CM.) PULLEY

Governor Control Positions	I-1 RATIO			Engine Speeds
	TRANSMISSION			
	Low	Inter.	High	
1	306	662	867	1000
2	367	662	1028	1200
3	428	774	1200	1400
4	490	884	1372	1800
5	551	995	1542	1800
6	612	1105	1714	2000
7	673	1237	1888	2200
8	734	1326	2057	2400
9	796	1436	2228	2600

SPLINE SHAFT HORSEPOWER

The chart below shows the draw bar horsepower at the governor controlled engine speeds and the horsepower at the spline shaft with the vehicle stationary. Also is shown the horsepower available at the spline shaft with the vehicle

at the maximum approved weight (3500 lbs.) (1590 kg.) moving at the speed shown and exerting a draw bar pull of zero pounds through 1200 pounds (544 kg.) (maximum recommended) in steps of 300 pounds (136 kg.).

Governed Engine R.P.M.	Vehicle Speed M.P.H.*	Draw Bar H.P.**	Vehicle Stationary	H.P. AT P.T.O. SPLINE SHAFT				
				3500 Lb. Vehicle Moving with				
				No Lbs. Draw Bar Pull	300 Lbs. Draw Bar Pull	600 Lbs. Draw Bar Pull	700 Lbs. Draw Bar Pull	1200 Lbs. Draw Bar Pull
1000	2.2	7.18	16.3	13.7	11.9	10.2	8.4	6.6
1200	2.7	8.62	20.3	17.2	15.0	13.0	10.8	8.6
1400	3.1	10.06	24.5	20.8	18.3	15.9	13.3	10.8
1600	3.6	11.49	28.5	24.3	21.5	18.8	15.8	12.9
1800	4.0	12.93	33.0	28.6	25.3	22.2	19.0	15.8
2000	4.5	14.36	33.0	33.0	30.0	26.4	22.9	19.3
2200	4.9	15.80	33.0	33.0	32.5	28.5	24.7	20.7
2400	5.4	17.24	33.0	33.8	33.0	29.8	25.4	21.2
2600	5.8	18.68	33.0	33.0	33.0	31.2	26.6	22.0

*Vehicle speed in low transmission and transfer case ratios.

**Based on maximum recommended draw bar pull for continuous service — 1200 Lbs.

METRIC

Governed Engine R.P.M.	Vehicle Speed K.P.H.*	Draw Bar H.P.** (Metric)	METRIC H.P. AT P.T.O. SPLINE SHAFT					
			Vehicle Stationary	1580 Kg. Vehicle Moving with				
				No Kg. Draw Bar Pull	135 Kg. Draw Bar Pull	270 Kg. Draw Bar Pull	405 Kg. Draw Bar Pull	540 Kg. Draw Bar Pull
1000	3.5	7.28	16.5	13.9	12.1	10.3	8.5	6.7
1200	4.4	8.74	20.6	17.4	15.2	13.2	10.9	8.7
1400	5.0	10.20	24.8	21.1	18.6	16.1	13.5	10.9
1600	5.8	11.65	28.9	24.6	21.8	19.1	16.0	13.1
1800	6.4	13.11	33.5	27.2	25.7	22.5	19.3	16.0
2000	7.2	14.58	33.5	33.5	30.4	26.8	23.2	19.8
2200	8.9	16.02	33.5	33.5	33.0	28.9	25.0	21.0
2400	8.7	17.48	33.5	33.5	33.5	30.2	25.8	21.5
2800	9.3	18.94	33.5	33.5	33.5	31.6	27.0	22.3

*Vehicle speed in low transmission and transfer case ratios.

**Based on maximum recommended draw bar pull for continuous service — 540 Kg.



U-17. LIST OF ABBREVIATIONS

a	to (metric conversions)	kph.	kilometers per hour
ABC	after bottom center	lb.	pounds
amp.	ampere	lb-ft.	pounds-feet of torque
API	American Petroleum Institute	lg.	long
appx	approximately	l.h.	left hand
assy	assembly	ltr.	liters
ATC	after top center	m.	meters
BBC	before bottom center	max.	maximum
BTC	before top center	mfd.	microfarads
C.	centigrade	min.	minimum
cm	centimeter	mm.	millimeters
cm ²	square centimeter	mph.	miles per hour
cm ³	cubic centimeter	No.	number(s)
cp.	candle power	O.D.	outside diameter
cu. in.	cubic inches	O.S.	over size
cw.	clockwise	oz.	ounces
ccw.	counter clockwise	P.T.O.	Power Take-Off
dia.	diameter	Par.	paragraph
F.	fahrenheit	psi.	pounds per square inch
Fig.	figure(s)	r.h.	right hand
gal.	gallons	rpm.	revolutions per minute
gm.	grams	SAE	Society of Automotive Engineers
gpm.	gallons per minute	S/N	serial number
H.P.	horsepower	sq. in.	square inches
I.D.	inside diameter	U.S.	under size
kg.	kilograms	v.	volts
kg-cm ²	kilograms per square centimeter	x	times or by
kg-m.	kilograms per meter	'	inches
km.	kilometers	:	to (ratio)
		°	degrees

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PRODUCTIONS

ALPHABETICAL INDEX

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