PART 21-01 General Engine Service

This Information Applies to All Models

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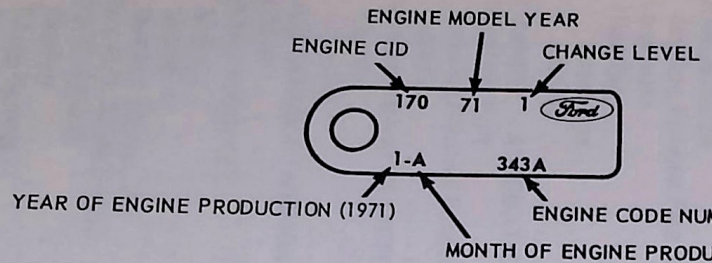
This part covers engine tests adjustment and repair procedures. In addition, the cleaning and inspection procedures are covered.

For engine removal, disassembly, assembly, installation and major repair procedures, refer to the part of this group which covers the applicable engine.

An engine identification tag is attached to the engine. The symbol code (Fig. 1) identifies each engine for determining parts usage; i.e., engine cubic inch displacement and model year. The change level and engine code number determine if parts are peculiar to specific engine. The engine plant code designates where and when the engine was built. **It is imperative that the codes on the engine identification tag be used when ordering parts or making inquiries about the engine. The pertinent codes are shown in the Master Parts Catalog to designate unique parts.**

ENGINE IDENTIFICATION TAG



Engine Codes																											
Conventional	Low Compression	Gasoline Engines CID	Bronco Econoline		Econoline Parcel—350-400-500 F-100-250-350-500 LN-500 B-500		Parcel—350-400-500 F-100-250-350-500 LN-500 B-500		C-500-550-600 F-B-LN-600		Bronco Econoline F-100		C-550 B-700 F-LN-B-C-500-600		F-LN-B-C-600-700 LT-LNT-800		F-100-250-350		F-LN-B-C-600-700-750 L-LN-C-LT-LNT-CT-800		F-LN-B-C-750 L-LN-C-LT-LNT-CT-800		L-LN-C-LT-LNT-CT-900	
F	6	170-1V	F	6																						
A	1	240-1V			A	1																				
B		300 MD-1V					B																			
B	2	300 HD-1V							B	2																
G	7	302-2V									G	7														
C	3	330-2V											C	3												
D	4	330 HD-2V													D	4										
Y	8	360-2V															Y	8								
E	5	361-2V																	E	5						
H		390-2V															H									
F		391-4V																			F					
H		401-4V																							H	
K		477-4V																							K	
L		534-4V																							L	

FIG. 1 Engine Identification

A 3488-A

1 GENERAL INFORMATION

ENGINE

The 1971 engines incorporate Imco exhaust emission control system or a nonexhaust emission control system.

The Imco system is designed to reduce the hydrocarbon and carbon monoxide content of the gasoline engine exhaust gases. By controlling the amount of contaminants emitted through the exhaust system to an acceptable minimum, air pollution is reduced.

When making carburetor idle fuel mixture and speed adjustments, follow the procedures in Part 23-01.

IMCO EXHAUST EMISSION CONTROL SYSTEM

The Imco exhaust emission control system uses a specially-calibrated carburetor and distributor in conjunction with retarded ignition timing at idle speeds. This reduces the exhaust contaminants by burning them within the cylinder combustion chamber before reaching the exhaust manifold.

2 DIAGNOSIS AND TESTING

Refer to the Truck Diagnosis Manual for all diagnosis procedures.

CAMSHAFT LOBE LIFT

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the air cleaner. Remove the heater hose and crankcase ventilation hose. Re move valve rocker arm cover(s).

2. On an engine with mechanical valve lifters: **if only one camshaft lobe is to be checked,** loosen the valve rocker arm adjusting screw. Slide the rocker arm assembly serving the camshaft lobe to be checked to one side. Secure it in this position. To move the rocker arm on either end of the shaft, remove the retaining pin and washers, and slide the rocker arm off the shaft. **If all of the cam lobes are to be checked, remove the rocker arm shaft assembly(ies) (except on Super Duty engines).**

On an engine with hydraulic valve lifters, remove the valve rocker arm shaft assembly(ies) and install a solid, tappet-type push rod in the push rod bore of the camshaft lobe to be checked or use the adapter for ballend push rods shown in Fig. 2.

On a 240 or 300 Six, remove the rocker arm stud nut, fulcrum seat and rocker arm. Use the adapter for ballend push rods.

3. Make sure the push rod is in the valve lifter socket. Install a dial indicator so that the actuating point of the indicator is in the push rod socket (or the indicator ball socket adapter is on the end of the push rod) and in the same plane as the push rod movement (Fig. 3 or 4).

4. Disconnect the brown lead (1 terminal) and the red and blue lead (S terminal) at the starter relay. Install an auxiliary starter switch between the battery and S terminals of the starter relay. **Crank the engine with the ignition switch OFF.**

Turn the crankshaft over until the tappet or lifter is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.

5. Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position.

6. Compare the total lift recorded on the indicator with specification.

7. To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. **If the lift on any lobe is below specified wear limits, the camshaft and the valve lifters operating on the worn lobe(s) must be replaced.**

8. Remove the dial indicator and auxiliary starter switch.

On an engine with mechanical valve lifters, position the valve rocker arm. If an end valve rocker arm was removed, slide it into position on the shaft, and install the washers and retaining pin. Tighten the valve clearance ad justing screw to hold the rocker arm and push rod in alignment. Adjust the valve clearance on all rocker arms that had been moved out of position. Install the valve rocker arm cover(s) and **partially tighten the attaching bolts.** Operate the engine until normal operating temperature has been reached. Remove the valve rocker arm cover(s). Check and adjust the valve clearance. (ld243.Adjust the valve clearance.

On a V-8 engine with hydraulic valve lifters, install the valve rocker arm shaft assembly(ies).

On a 240 or 300 Six, install the rocker arm, fulcrum seat and stud nut. Adjust the valve clearance (Section 2).

9. Install the valve rocker arm cover(s) and the air cleaner.

MANIFOLD VACUUM

A manifold vacuum test aids in determining the condition of an engine and in helping to locate the cause of poor engine performance. To check manifold vacuum:

1. Operate the engine for a minimum of 30 minutes at 1200 rpm or until the engine is at normal operating temperature.

2. Connect an accurate, sensitive vacuum gauge to the intake manifold vacuum line or on the fitting in the intake manifold.

3. Operate the engine at recommended idle rpm, with the transmission selector lever in neutral.

4. Check the vacuum reading on the gauge.

Test Conclusions

Manifold vacuum is affected by the carburetor adjustment, valve timing, valve clearance, ignition timing, condition of the valves, cylinder compression, condition of the crankcase ventilation system, and leakage of

the intake manifold, carburetor, carburetor spacer or cylinder head gaskets.

Because abnormal gauge readings may indicate that more than one of the above factors are at fault, exercise caution in analyzing an abnormal reading. For example, if the vacuum is low, the correction of one item may increase the vacuum enough to indicate that the trouble has been corrected. It is important therefore, that each cause of an abnormal reading be investigated and further tests conducted, where necessary, to arrive at the correct diagnosis of the trouble.

Fig. 5 lists various types of readings and their possible causes.

Allowance should be made for the effect of altitude on the gauge reading. The engine vacuum will decrease with an increase in altitude.

On engines equipped with dual diaphragm distributors the vacuum readings will average 1 inch less vacuum reading than when equipped with single diaphragm distributors.

COMPRESSION TEST

The following procedure is to be used on all engines when checking compression:

1. Be sure the crankcase oil is of the correct viscosity and make sure that the battery is properly charged.

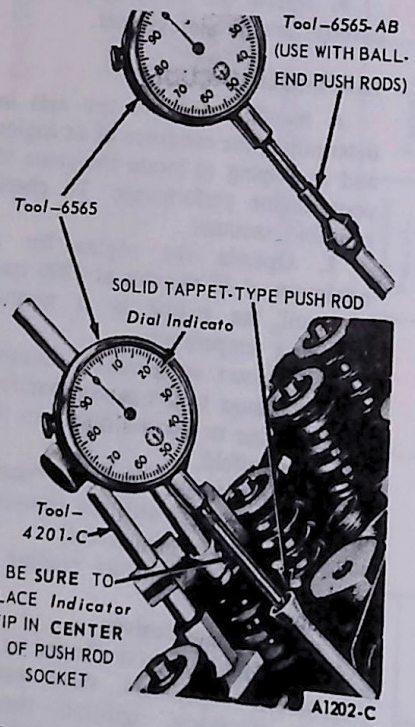


FIG. 2 Typical Camshaft Lobe Lift—Hydraulic Valve Lifters— V-8 Engines

Operate the engine for a minimum of 30 minutes at 1200 rpm, or until the engine is at normal operating temperature. Turn the ignition switch off; then remove all the spark plugs.

2. Set the carburetor throttle plates in the wide open position.

3. Install a compression gauge in No. 1 cylinder.

4. Disconnect the brown lead (No. 1 terminal) and the red and blue lead (S terminal) at the starter relay. Install an auxiliary starter switch between the battery and S terminals of the starter switch. Crank the engine (with the ignition switch off) at least five (5) pumping strokes and record the highest reading indicated. Note the approximate number of compression strokes required to obtain the highest reading.

5. Repeat the check on each cylinder cranking the engine approximately the same number of compression strokes.

The indicated compression pressures are considered Normal if the lowest reading cylinder is within 75 percent of the highest. Variations exceeding 75 percent in dicates an improperly seated valve or worn or broken piston rings. If one, or more, cylinders read low-squirt approximately one (1) tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on these cylinders.

a. If compression improves considerably, the piston rings are at fault.

b. If compression does not improve, valves are sticking or seating poorly.

c. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders. Engine oil and/or coolant in the cylinders could result from this problem.

HYDRAULIC VALVE LIFTER

Dirt, deposits of gum and varnish and air bubbles in the lubricating oil can cause hydraulic valve lifter failure or malfunction.

Dirt, gum and varnish can keep a check valve from seating and cause a loss of hydraulic pressure. An open valve disc will cause the plunger to force oil back into the valve lifter reservoir during the time the push rod is being lifted to force the valve from its seat.

Air bubbles in the lubricating system can be caused by too much oil in the system or too low an oil level.

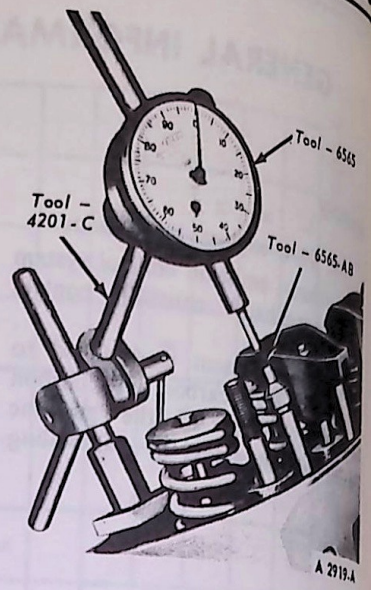


FIG. 3 Typical Camshaft Lobe Lift—240 and 300 Six Engines

Air may also be drawn into the lubricating system through an opening in a damaged oil pick-up tube. Air in the hydraulic system can cause a loss of hydraulic pressure.

Assembled valve lifters can be tested with tool 6500-E to check the leak down rate. The leak down rate specification is the time in seconds for the plunger to move the length of its travel while under a 50 lb load. Test the valve lifters as follows:

1. Disassemble and clean the lifter to remove all traces of engine oil. Lifters cannot be checked with engine oil in them. Only the testing fluid can be used.

2. Place the valve lifter in the tester, with the plunger facing upward. Pour hydraulic tester fluid into the cup to a level that will cover the valve lifter assembly. **The fluid can be purchased from the manufacturer of the tester. Do not use kerosene, for it will not provide an accurate test.**

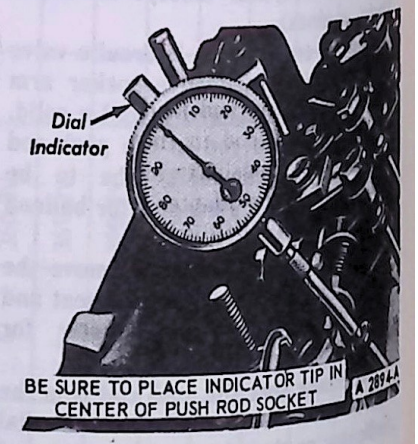


FIG. 4 Typical Camshaft Lobe Lift—Mechanical Tappets

3. Place a 5/16-inch steel ball in the plunger cup (Fig. 6).

4. Adjust the length of the ram so that the pointer is 1/16 inch below the starting mark when the ram contacts the valve lifter plunger (Fig. 7) to facilitate timing as the pointer passes the Start Timing mark.

Use the center mark on the pointer scale as the Stop Timing point instead of the original Stop Timing mark at the top of the scale.

5. Work the valve lifter plunger up and down until the lifter fills with fluid and all traces of air bubbles have disappeared.

6. Allow the ram and weight to force the valve lifter plunger downward. Measure the exact time it takes for the pointer to travel from the Start Timing to the Stop Timing marks on the tester.

7. A valve lifter that is satisfactory must have a leak-down rate (time in seconds) within the minimum and maximum limits specified.

8. If the valve lifter is not within specifications, replace it with a new lifter. **It is not necessary to test a new lifter before installing it in the engine.**

CRANKCASE VENTILATION SYSTEM OPERATION TEST

This test is performed with the crankcase ventilation tester, C8AZ6B627-A (Fig. 8) which is operated by the engine vacuum through the oil fill opening. Follow the procedures described below to install the tester and check the crankcase ventilation system for faulty operation.

1. With the engine at normal operating temperature, remove the oil filler cap.

2. Hold the tester C8AZ-6B627-A over the opening in the valve cover. Make sure the surface is flat to form a seal between the cover and tester. If the cover is distorted, shape it as required to make an air tight seal. An air leak between the cover and tester will render the tester inoperative or give an erroneous reading.

3. Start the engine and allow it to operate at the recommended idle speed.

4. Hold the tester over the oil filler cap opening making sure that there is a positive seal between the tester and cover.

5. If the ball settles in the **Good (green) area, the system is functioning properly. If the ball settles in the Repair** (red) area, clean or replace the malfunctioning components as required.

6. Repeat the test after repairs are made to make sure that the crankcase ventilation system is operating satisfactorily.

Gauge Reading	Engine Condition
15 inches or over 240 1-V Six 300 1-V Six 16 inches or over 302 2V V-8 17 inches or over 170 1-V Six 300 2V Six 330 2V V-8 330 2V HD V-8 360 2V V-8 361 2V V-8 390 2V V-8 391 2V V-8 401 4V V-8 477 4V V-8 534 4V V-8	Normal
Low and steady	Loss of power in all cylinders possibly caused by late ignition or valve timing, or loss of compression due to leakage around the piston rings.
Very low	Intake manifold, carburetor, spacer or cylinder head gasket leak.
Needle fluctuates steadily as speed increases	A partial or complete loss of power in one or more cylinders caused by a leaking valve, cylinder head or intake manifold gasket, a defect in the ignition system or a weak valve spring.
Gradual drop in reading at engine idle	Excessive back pressure in the exhaust system.
Intermittent fluctuation	An occasional loss of power possibly caused by a defect in the ignition system or a sticking valve.
Slow fluctuation or drifting of the needle	Improper idle mixture adjustment or carburetor spacer or intake manifold gasket leak or restricted crankcase ventilation system.
Engines equipped with dual diaphragm distributors, idle vacuum will be approx. 1 inch less.	

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FIG. 5 Manifold Vacuum Gauge Reading

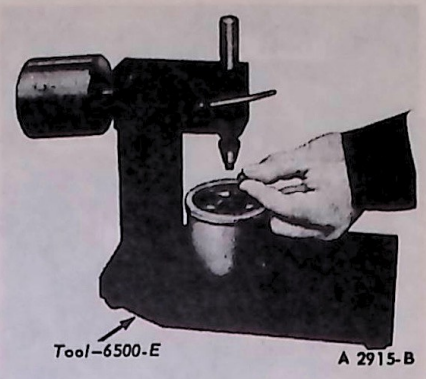

FIG. 6 Placing Steel Ball in Valve Lifter Plunger

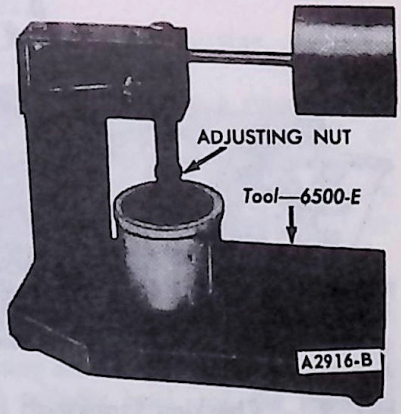

FIG. 7 Adjusting Ram Length

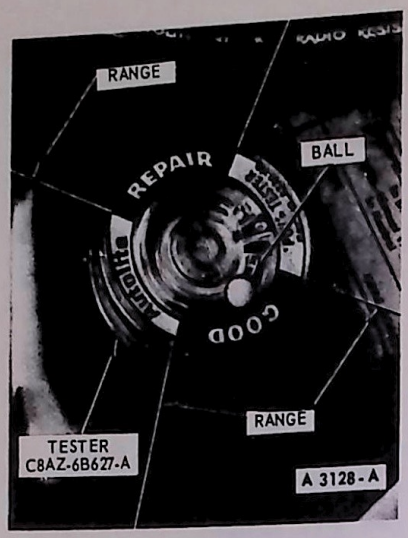

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FIG. 8 Crankcase Ventilation System Tester

Regulator Valve Test

Install a known good regulator valve in the crankcase ventilation system.

Start the engine and compare the engine idle condition to the prior idle condition.

If the loping or rough idle condition remains when the good regulator valve is installed, the crankcase ventilation regulator valve is not at fault. Check the crankcase ventilation system for restriction at the intake manifold or carburetor spacer. If the system is not restricted, further engine component diagnosis will have to be conducted to find the malfunction.

If the idle condition is found to be satisfactory, leave the new regulator valve installed and clean the hoses, fittings, etc.

CRANKSHAFT END PLAY

1. Force the crankshaft toward the rear of the engine.

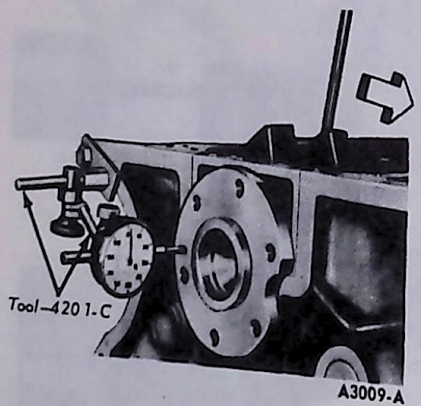

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FIG. 9 Checking Crankshaft End Play

2. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 9).

3. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

4. If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the procedure recommended under Main Bearing Replacement in the pertinent engine section. Check the crankshaft end play.

FLYWHEEL FACE RUNOUT—MANUAL-SHIFT TRANSMISSION

Install a dial indicator so that the indicator point bears against the flywheel face (Fig. 10). Turn the flywheel making sure that it is full forward or rearward so that crankshaft end play will not be indicated as flywheel runout.

If the clutch face runout exceeds specifications, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft-flywheel mounting face if the mounting face flange runout is excessive. If the ring gear runout exceeds specifications, replace it or reinstall it on the flywheel. Refer to Ring Gear Replacement for the proper procedure.

FLYWHEEL RUNOUT—AUTOMATIC TRANSMISSION

Remove the spark plugs.

Install a dial indicator so that the indicator point rests on the face of the ring gear adjacent to the gear teeth.

Push the flywheel and crankshaft forward or backward as far as possible to prevent crankshaft end play from being indicated as flywheel runout.

Set the indicator dial on the zero mark. Turn the flywheel one complete revolution while observing the total indicator reading (TIR). If the TIR exceeds specifications, the flywheel and ring gear assembly must be replaced.

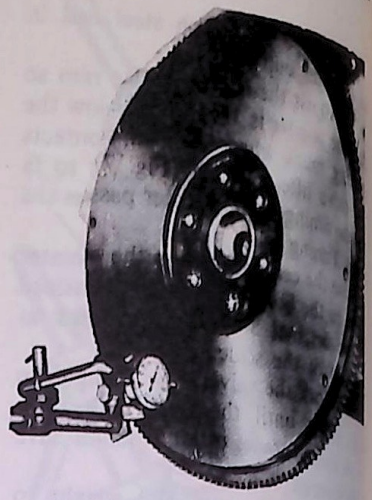

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FIG. 10 Checking Flywheel Face Runout

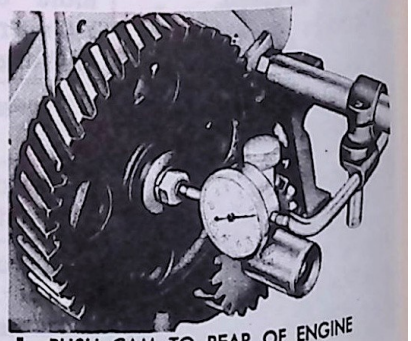
CAMSHAFT END PLAY

On all V-8 engines, prying against the aluminum-nylon camshaft sprocket, **with the valve train load on the camshaft,** can break or damage the sprocket. Therefore, the rocker arm adjusting nuts must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end play, adjust the valve clearance.

Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket attaching screw (Fig. 11). Zero the dial indicator. Position a large screwdriver between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with the specifications.

If the end play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate.

Remove the dial indicator.



1. PUSH CAM TO REAR OF ENGINE
2. SET *Dial* ON ZERO
3. PULL CAM FORWARD AND RELEASE

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FIG. 11 Checking Camshaft End Play

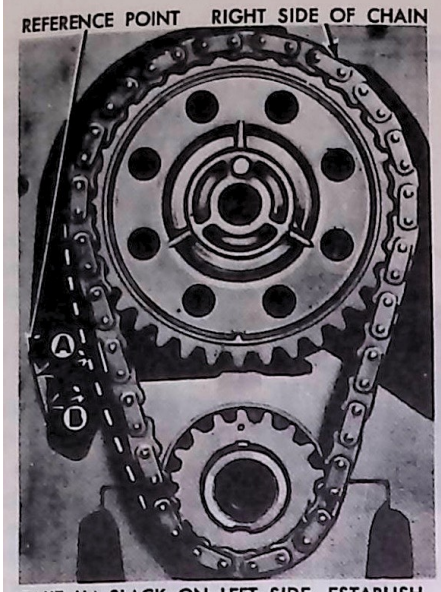


FIG. 12 Checking Timing Chain Deflection

TIMING CHAIN DEFLECTION

1. Rotate the crankshaft in a clockwise direction (as viewed from the front) to take up the slack on the left side of the chain.
2. Establish a reference point on the block and measure from this point to the chain (Fig. 12).
3. Rotate the crankshaft in the opposite direction to take up the slack on the right of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

If the deflection exceeds specifications, replace the timing chain and sprockets.

TIMING GEAR BACKLASH

Install a dial indicator on the cylinder block (Fig. 13). Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator. Hold the gear firmly against the block while making the check. Refer to specifications for the backlash limits.

TIMING GEAR RUNOUT

Install a dial indicator on the cylinder block as shown in Fig. 14. Hold the camshaft gear against the camshaft thrust plate, and zero the indicator. Rotate the crankshaft to turn the camshaft, while holding the camshaft gear against the thrust plate. Check the gear runout through one complete revolution of the camshaft. If the gear runout exceeds specifications, remove it and check for burrs or foreign particles on or between the camshaft and gear joining flanges. Check the runout. If it still exceeds specifications, replace both gears.

Follow the above procedure to check crankshaft gear runout.

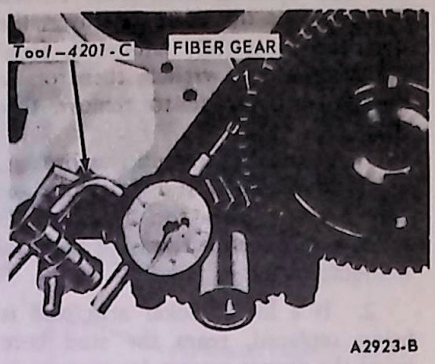


FIG. 13 Checking Timing Gear Backlash

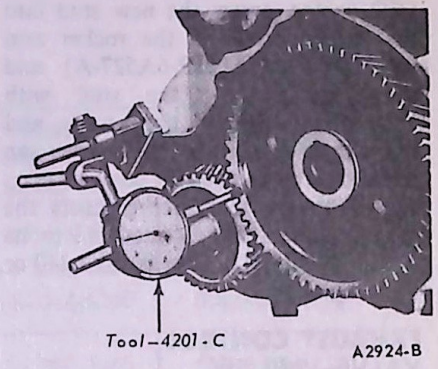


FIG. 14 Checking Timing Gear Runout

4 REMOVAL AND INSTALLATION

ROCKER ARM STUD NUT REPLACEMENT—240 SIX AND 302 V-8

If the rocker arm stud nut breakaway torque is less than specified, install a new standard stud nut and recheck the breaking torque. Refer to Valve Clearance Adjustment in Part 21-04 for the torque procedure.

ROCKER ARM STUD REPLACEMENT—240 SIX, AND 302 V-8

If it is necessary to remove a rocker arm stud, Tool Kit T62F-6A527-B is available which contains the following: a stud remover, a 0.006-inch oversize reamer and a 0.015-inch oversize reamer. For 0.010-inch oversize studs, use reamer T66P-6A527-B. To press in replacement studs, use stud replacer T64P-6A527-A on a 240 or 302 engine.

Rocker arm studs that are broken or have damaged threads may be replaced with standard studs. Loose studs in the head may be replaced with 0.006, 0.010 or 0.015-inch oversize studs which are available for service.

Standard and oversize studs can be identified by measuring the stud diameter within 1-1/8 inch from the pilot end of the stud. The stud diameters are:

Standard.....0.3714-0.3721
0.006 oversize...0.3774-0.7781
0.010 oversize...0.3814-0.3821
0.015 oversize...0.3864-0.3871

When going from a standard size rocker arm stud to a 0.010 or 0.015-inch oversize stud, always use the 0.006-inch oversize reamer before finish reaming with the 0.010 or 0.015-inch oversize reamer.

1. Position the sleeve of the rocker arm stud remover (Tool T62F-6A527-B) over the stud with the bearing end down. **When working on a 302 cylinder head, cut the threaded part of the stud off with a hack saw.**

This is necessary due to the puller being designed for 3/8-inch studs and will not grip the 5/16-inch thread on a 302 CID cylinder head stud. Thread the puller into the sleeve and over the stud until it is fully bottomed. Hold the sleeve with a wrench, then rotate the puller clockwise to remove the stud (Fig. 15).

If the rocker arm stud was broken off flush with the stud boss, use an easy-out to remove the broken stud following the instructions of the tool manufacturer.

2. If a loose rocker arm stud is being replaced, ream the stud bore using the proper reamer (or reamers in sequence) for the selected oversize stud (Fig. 16). **Make sure the metal particles do not enter the valve area.**

3. If working on a 240 or 302 CID engine, screw the new stud into the sliding driver of the rocker arm stud installer (T65P-6A527-A) and coat the end of the stud with Lubriplate. Align the stud and installer with the stud bore, then tap the sliding driver until it bottoms (Fig. 17). When the installer contacts the stud boss, the stud is installed to its correct height. This applies to a 240 or 302 engine only.

EXHAUST CONTROL VALVE—240 SIX

Removal

1. Separate the intake and exhaust manifolds.

2. Remove the valve tension spring and the thermostatic spring from the exhaust control valve shaft (Fig. 18).

3. Remove the stop pin spring from the manifold.

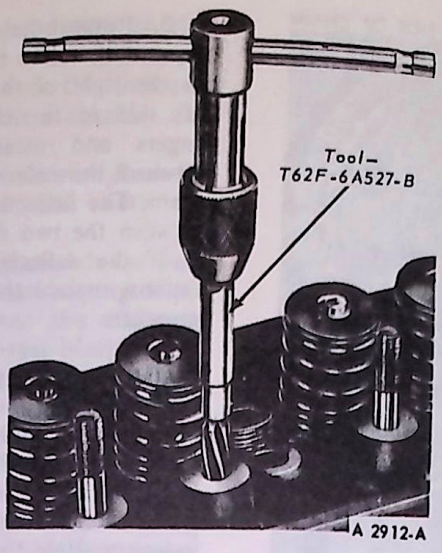


FIG. 16 Reaming Rocker Arm Stud Bore—240 Six and 302-W V-8

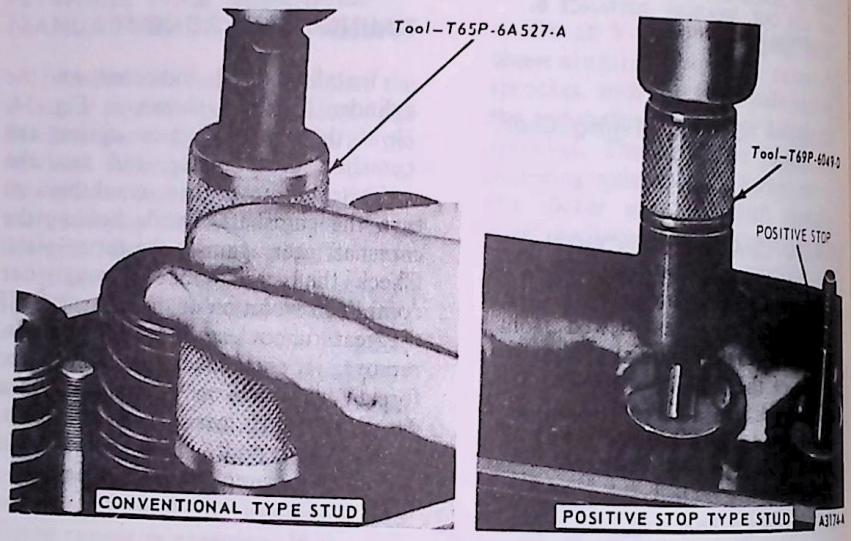


FIG. 17 Installing Rocker Arm Stud—240 Six and 302-W V-8

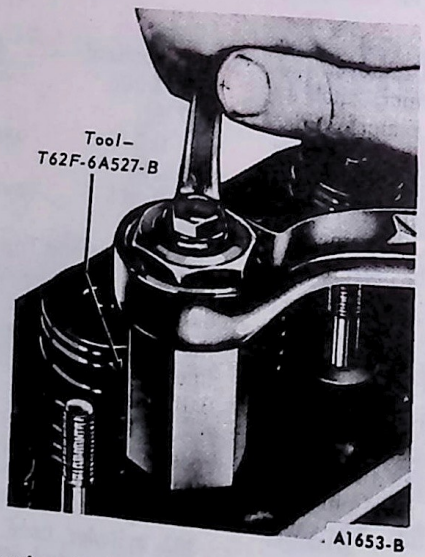


FIG. 15 Removing Rocker Arm Stud—240 Six and 302-W V-8

4. Using an actylene torch inside the manifold, cut the shaft on both sides of the valve plate.

5. Remove the valve plate, shaft and flat washer.

6. Remove the expansion plug from the control valve shaft bushing bore.

7. Remove the exhaust control valve bushings from the manifold. These bushings come in two sizes each, both front and rear. To determine which bushings should be used, measure the outside diameter of the removed bushings. Replace with the proper parts (Fig. 19).

Installation

1. Install the new control valve bushings. **The inner end of the smaller bushing should be 0.010-0.015 inch**

below the inner surface of the exhaust manifold. The inner end of the larger bushing should be 0.020 inch above the inner surface of the exhaust manifold.

2. Ream the bushings to 0.251-0.253 inch ID.

3. Slide the new shaft into the bushings, flat washer and valve plate. **The flat washer must be between the valve plate and the large bushing.**

4. Install a new stop pin spring on the stop pin.

5. Position the exhaust control valve at an 84 degree angle with the top surface of the manifold (Fig. 20).

6. Rotate the counterweight and shaft assembly clockwise until the counterweight contacts the stop pin spring. Place a 0.030 inch feeler gauge between the counterweight and manifold to maintain the specified clearance while welding.

7. With the plate and counterweight in position, **use stainless steel welding rod** to tack-weld the valve plate to the shaft.

8. Move the assembly back and forth to check for a binding condition. If there is no binding condition, securely weld the valve plate to the shaft.

9. Install the expansion plug in the manifold bushing bore.

10. Position the new thermostatic spring on the shaft and counterweight assembly so that it will be necessary to wind the spring approximately 1/2 turn in the clockwise direction to hook the open end over the stop pin. Use a 5/16 inch ID piece of tubing to slide the thermostatic spring on the shaft and counterweight assembly. Wind the spring clockwise and hook it over the stop pin.

11. Install a new valve tension spring on the exhaust control valve shaft and the stop pin.

CORE PLUGS

Removal

To remove a large core plug, drill a 1/2-inch hole in the center of the plug and remove with a clutch pilot bearing puller (Tool T59L-100-B and T58L-101-A) or pry it out with a large drift punch. On a small core plug, drill a 1/4-inch hole in the center of the plug and pry it out with a small pin punch. Clean and inspect the plug bore.

Prior to installing a core plug the plug bore should be inspected for any damage that would interfere with the proper sealing of the plug. If the bore is damaged it will be necessary to true the surface by boring for the next specified oversize plug.

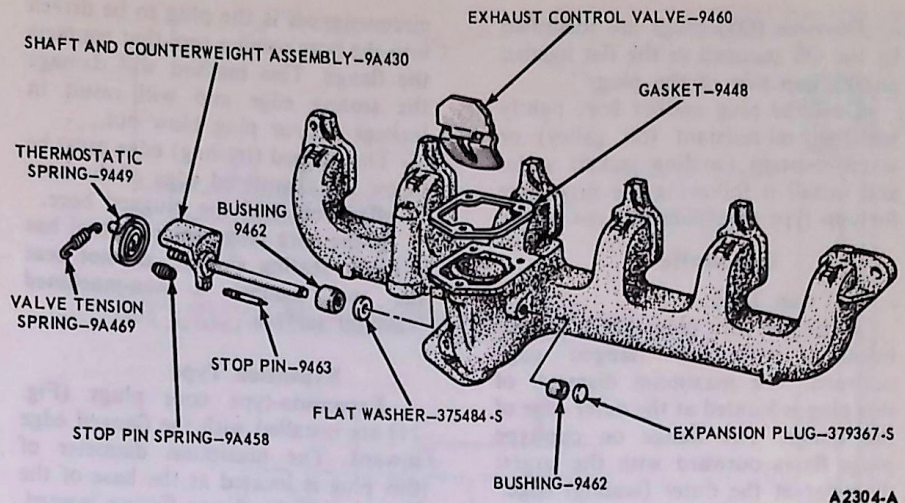


FIG. 18 Exhaust Control Valve Assembly—240 Six

Part Number	Bushing	Outside Diameter of Bushing	Inside Diameter of Bushing Bore in Manifold
(Front — Std.)	C5AZ-9462-A	0.3070-0.3065	0.3061-0.3051
(Rear — Std.)	C5AZ-9462-B	0.6255-0.6250	0.6246-0.6236
(Front — 0.010 O.S.)	C5AZ-9462-C	0.3170-0.3165	0.3161-0.3151
(Rear — 0.010 O.S.)	C5AZ-9462-D	0.6355-0.6350	0.6346-0.6336
Note: Dimensions are in inches.			

CA1026-A

FIG. 19 Exhaust Control Valve Bushing Sizes—240 Six

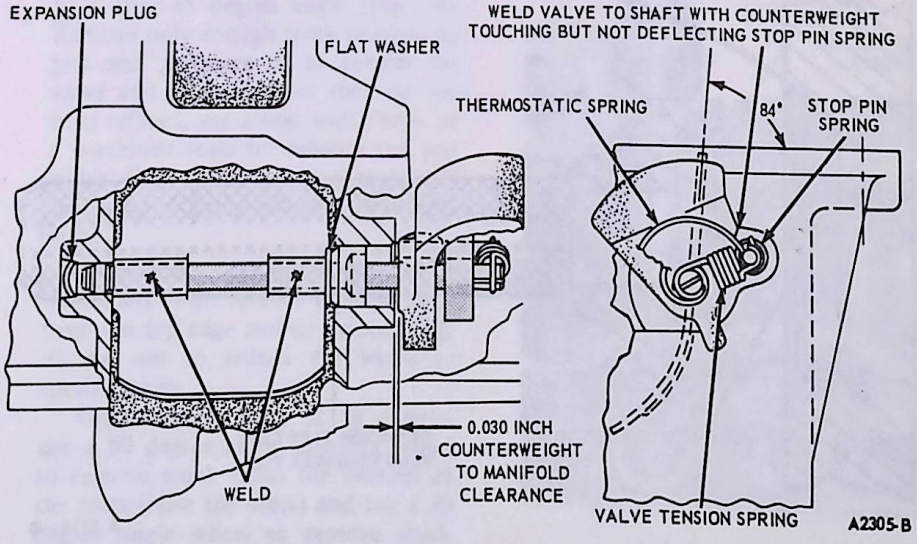


FIG. 20 Valve Plate Position and Counterweight Clearance

Oversize (OS) plugs are identified by the OS stamped in the flat located on the cup side of the plug.

Coat the plug and/or bore lightly with an oil-resistant (oil galley) or water-resistant (cooling jacket) sealer and install it following the procedure for cup type or expansion type below:

Installation

Cup Type

Cup-type core plugs (Fig. 21) are installed with the flanged edge outward. The maximum diameter of this plug is located at the outer edge of the flange. The flange on cup-type plugs flares outward with the largest diameter at the outer (sealing) edge.

It is imperative to pull the plug into the machined bore using a properly designed tool. Under no circumstances is the plug to be driven into the bore using a tool that contacts the flange. This method will damage the sealing edge and will result in leakage and/or plug blow out.

The flanged (trailing) edge must be below the chamfered edge of the bore to effectively seal the plugged bore.

If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

Expansion Type

Expansion-type core plugs (Fig. 21) are installed with the flanged edge inward. The maximum diameter of this plug is located at the base of the flange with the flange flaring inward.

It is imperative to push or drive the plug into the machined bore using a properly designed too. Under no circumstances is the plug to be driven using a tool that contacts the crowned portion of the plug. This method will expand the plug prior to installation and may damage the plug and/or plug bore.

When installed the trailing (rear-imum) diameter must be below the chamfered edge of the bore to effectively seal the plugged bore.

If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

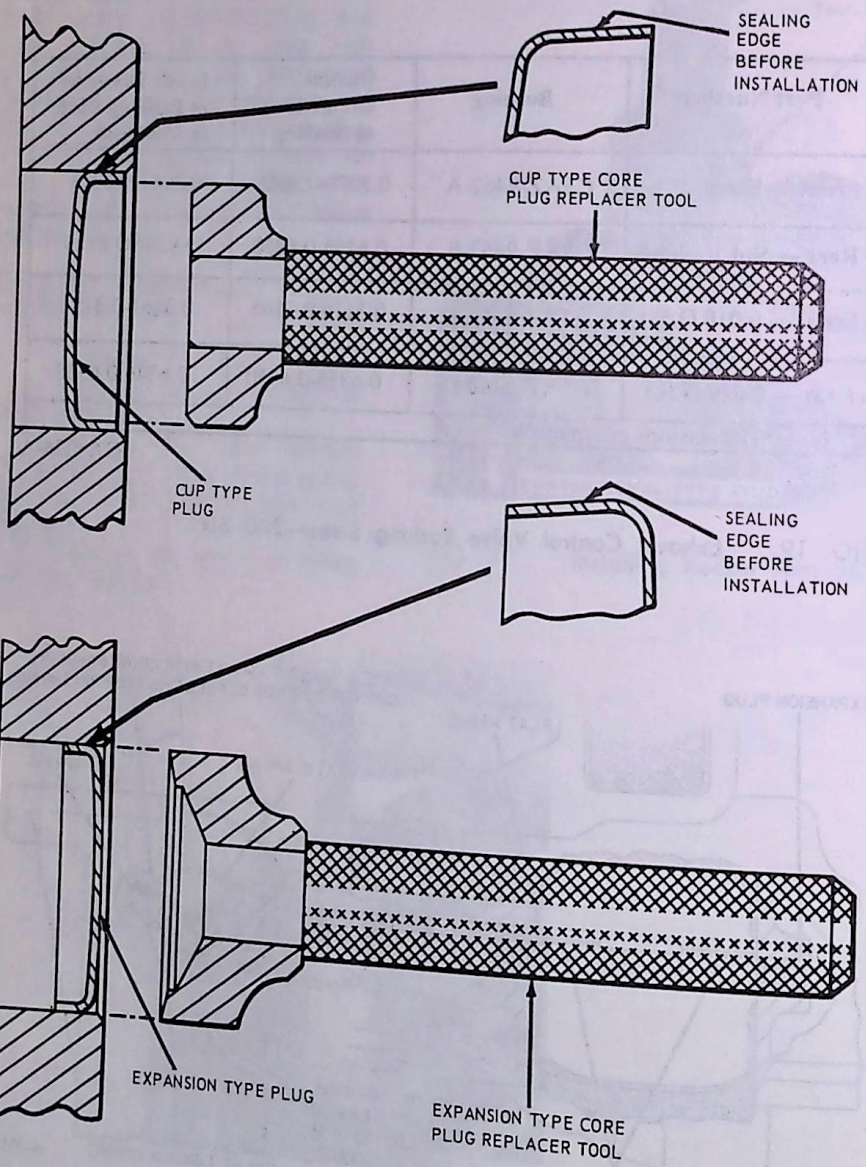


FIG. 21 Typical Core Plugs and Installation Tools A 2735 - B

FLYWHEEL RING GEAR—MANUAL-SHIFT TRANSMISSION

Removal

To replace a damaged or worn ring gear, heat the ring gear with a blow torch on the engine side of the gear, and knock it off the flywheel. **Do not hit the flywheel when removing the ring gear.**

Installation

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. **Do not heat any portion of the gear to a temperature higher than 500 degrees F. If this limit is exceeded, the temper will be removed from the ring gear teeth.**

CRANKSHAFT REAR OIL SEAL

A split-lip type crankshaft rear oil seal is provided for servicing all 1971 engines. The complete seal is replaced without removing the crankshaft.

Removal

1. Remove the oil pan and the oil pump (if required).
2. Loosen all the main bearing cap bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch.
3. Remove the rear main bearing cap, and remove the oil seal from the bearing cap and cylinder block. On the block half of the seal use a seal removal tool, or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Exercise caution to prevent scratching or damaging the crankshaft seal surfaces.**
4. Remove the oil seal retaining pin from the bearing cap if so equipped. **The pin is not used with the split-lip seal.**

Installation

1. Carefully clean the seal grooves in the cap and block with a brush and solvent.

2. Dip the split lip-type seal halves in clean engine oil.

3. Carefully install the upper seal (cylinder block) into its groove with undercut side of seal toward the FRONT of the engine (Fig. 22), by rotating it on the seal journal of the crankshaft until approximately 3/8-inch protrudes below the parting surface.

Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove.

4. Tighten the remaining bearing cap bolts and torque to specifications.

5. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine (Fig. 22), allow the seal to protrude approximately 3/8-inch above the parting surface to mate with the upper seal when the cap is installed.

6. Apply a thin coating of oil-resistant sealer to the rear main bearing cap at the rear of the top mating surface. **Do not apply sealer to the area forward of the side seal groove. Install the rear main bearing cap. Torque the cap bolts to specifications.**

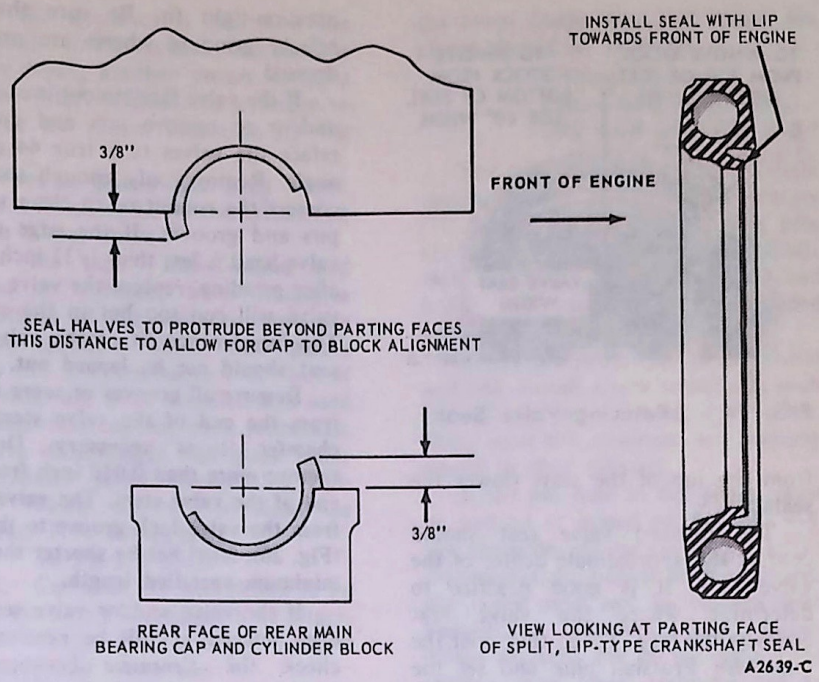


FIG. 22 Installing Crankshaft Rear Oil Seal

7. Install the oil pump and oil pan. Fill the crankcase with the proper amount and viscosity oil.

8. Operate the engine and check for oil leaks.

5 MAJOR REPAIR OPERATIONS

CYLINDER HEAD

Replace the head if it is cracked. **Do not plane or grind more than 0.010 inch from the cylinder head gasket surface.** Remove all burrs or scratches with an oil stone.

Reaming Valve Guides

If it becomes necessary to ream a valve guide (Fig. 23) to install a valve with an oversize stem, a reaming kit is avilable which contains the following reamer and pilot combinations: a 0.003-inch OS reamer with a standard diameter pilot, a 0.015-inch OS reamer with a 0.003-inch OS pilot, and a 0.030 inch reamer with a 0.015-inch OS pilot.

When going from a standard size valve to an oversize valve always use the reamer in sequence. **Always reface the valve seat after the valve guide has been reamed, and use a suitable scraper to break the sharp corner (ID) at the top of the valve guide.**

Refacing Valve Seats

Refacing of the valve seat should be closely coordinated with the refacing of the valve face so that the finished seat and valve face will be concentric and the specified interference fit will be maintained. This is important so that the valve and seat will have a compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

Grind the valve seats of all engines to a true 45 degree angle (Fig. 24). Remove only enough stock to clean up pits and groooves or to correct the valve seat runout. After the seat has been refaced, use a seat width scale or a machinist scale to measure the seat width (Fig. 25. Narrow the seat, if necessary to bring it within specifications.

If the valve seat width exceeds the maximum limit, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications.

On the valve seats of all engines use a 60 degree angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 30 degree angle wheel to remove stock

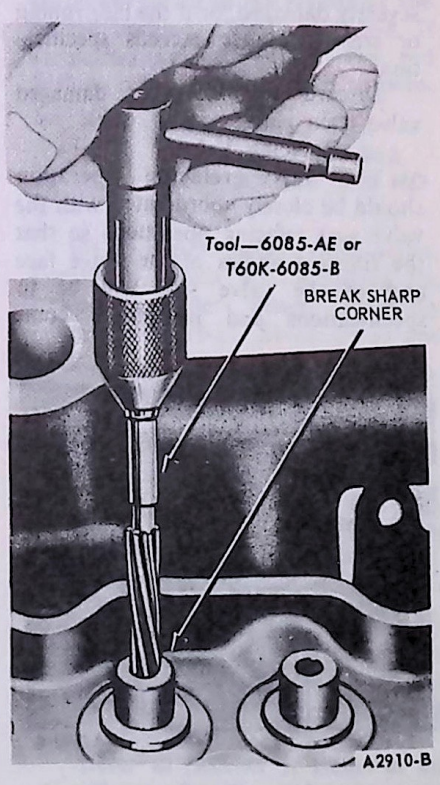


FIG. 23 Reaming Valve Guides

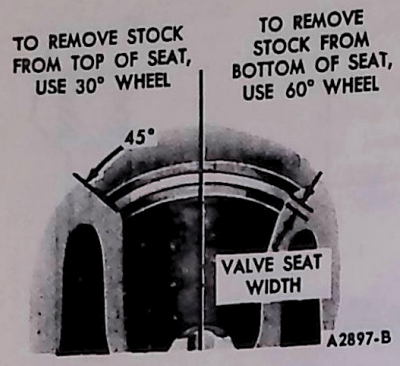


FIG. 24 Refacing Valve Seat

from the top of the seats (lower the seats).

The finished valve seat should contact the approximate center of the valve face. It is good practice to determine where the valve seat contacts the face. To do this, coat the seat with Prussian blue and set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

VALVES

Minor pits, grooves, etc., may be removed. Discard valves that are severely damaged, or if the face runout or stem clearance exceeds specifications.

Discard any worn or damaged valve train parts.

Refacing Valves

The valve refacing operation should be closely coordinated with the valve seat refacing operations so that the finished angles of the valve face and of the valve seat will be to specifications and provide a compression-tight fit. Be sure that the refacer grinding wheels are properly dressed.

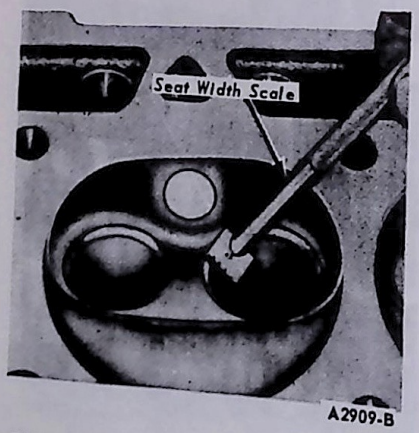


FIG. 25 Checking Valve Seat Width

If the valve face runout is excessive and/or to remove pits and grooves, reface the valves to a true 44 degree angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than 1/32 inch thick after grinding, replace the valve as the valve will run too hot in the engine. **The interference fit of the valve and seat should not be lapped out.**

Remove all grooves or score marks from the end of the valve stem, and chamfer it as necessary. Do not remove more than 0.010 inch from the end of the valve stem. The valve stem from the valve lock groove to the end (Fig. 26), must not be shorter than the minimum specified length.

If the valve and/or valve seat has been refaced, it will be necessary to check the clearance between the rocker arm pad and the valve stem with the valve train assembly installed in the engine.

Select Fitting Valves

If the valve stem to valve guide clearance exceeds the wear limit, ream the valve guide for the next oversize valve stem. Valves with oversize stem diameters of 0.003., 0.015 and 0.030 inch are available for service. **Always reface the valve seat after the valve guide has been reamed. Rfer to Reaming Valve Guides.**

CAMSHAFT REPAIR

Remove light scuffs, scores or nicks from the camshaft machined surfaces with a smooth oil stone.

CRANKSHAFT

Dress minor scores with an oil stone. If the journals are severly marred or exceed the wear limit, they should be refinished to size for the next undersize bearing.

Refinishing Journals

Refinish the jounrals to give the proper clearance with the next undersize bearing. If the journal will not clean up to maximum undersize bearing available, replace the crankshaft.

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

After refinishing the journals, chamfer the oil holes; then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may also be used as a polishing agent.

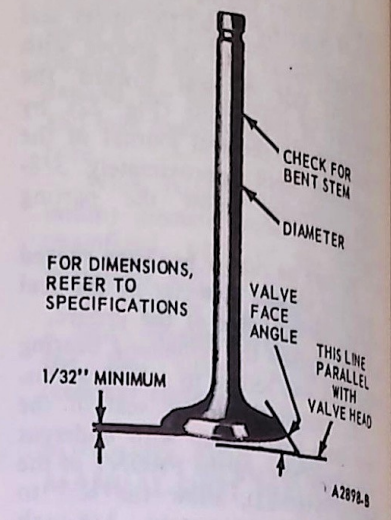


FIG. 26 Critical Valve Dimensions

FITTING MAIN OR CONNECTING ROD BEARINGS WITH PLASTIGAGE

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear. **When replacing standard bearings with new bearings, it is good practice to fit the bearing to minimum specified clearance.** If the desired clearance cannot be obtained with a standard bearing, try one half of a 0.001 or 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance.

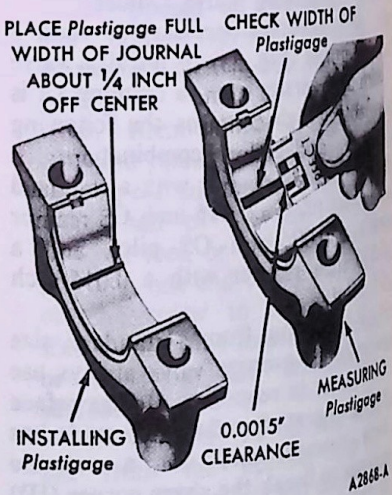


FIG. 27 Installing and Measuring Plastigage—Engine Installed

2. If fitting a main bearing, position a jack under counterweight adjoining bearing which is being checked. Support crankshaft with jack so its weight will not compress Plastigage and provide an erroneous reading.

3. Place a piece of Plastigage on bearing surface across full width of bearing cap and about 1/4-inch off center (Fig. 27).

4. Install cap and torque bolts to specifications. Do not turn crankshaft while Plastigage is in place.

5. Remove cap. Using Plastigage scale, check width of Plastigage at widest point to get minimum clearance. Check at narrowest point to get maximum clearance. Difference between readings is taper of journals.

6. If clearance exceeds specified limits, try 0.001 or 0.002 inch undersize bearings in combination with the standard bearings. Bearing clearance must be within specified limits. If 0.002 undersize main bearings are used on more than one journal, be sure they are all installed in cylinder block side of bearing. If standard and 0.002 inch undersize bearings do not bring clearance within desired limits, refinish crankshaft journal, then install undersize bearings.

7. After bearing has been fitted, apply light coat of engine oil to journal and bearings. Install bearing cap. Torque cap bolts to specificatons.

8. Repeat procedure for remaining bearings that require replacement.

PISTONS, PINS AND RINGS

Fitting Pistons

Pistons are available for service in standard sizes and the oversizes indicated in the Master Parts List.

The standard-size pistons are color coded **red** on the dome. Refer to the specifications for standard-size piston dimensions. Piston pins and retainers are provided with new pistons on the 390 V-8 engine. Retainers are not used on all other engines.

Measure the piston OD and cylinder bore. The dimensions should be within specifications, and the piston to bore clearance (bore ID minus piston OD) must be within the specified limits.

If the clearance is greater than the maximum limit, recheck calculations to be sure that the proper size piston has been selected, check for a damaged piston; then try a new piston.

If the clearance is less than the minimum limit, recheck calculations before trying another piston. If none can be fitted, refinish the cylinder to provide the proper clearance for the piston.

When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.

If the taper, out-of-round and piston to cylinder bore clearance conditions of the cylinder bore are within specified limits, new piston rings will give satisfactory service. If new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall glaze (refer to Cylinder Block, Refinishing Cylinder Walls). Be sure to clean the cylinder bore thoroughly.

To Fit a Piston:

1. Calculate the size piston to be used by taking a cylinder bore check. Follow the procedures outlined under Cleaning and Inspection.

2. Select the proper size piston to provide the desired clearance (refer to the specifications). Measure the piston diameter in line with the centerline of the piston pin and at 90 degrees to the piston pin axis.

3. Make sure the piston and cylinder block are at room temperature (70degrees F). After any refinishing operation allow the cyliner bore to cool, and make sure the piston and bore are clean and dry before the piston fit is checked.

Fitting Piston Rings

1. Select the proper ring set for the size cylinder bore.

2. Position the ring in the cylinder bore in which it is going to be used.

3. Push the ring down into the bore area where normal ring wear is not encountered.

4. Use the head of a piston to position the ring in the bore so that the ring is square with the cylinder wall. **Use caution to avoid damage to the ring or cylinder bore.**

5. Measure the gap between the ends of the ring with a feeler gauge (Fig. 28). If the ring gap is less or greater than the specified limits, try another ring set.

6. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 29). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**

Fitting Piston Pins—330, 360, 361, 390 and 391 HD V-8

The piston pin should be a light thumb press fit at normal temperature (70 degrees F). Standard piston pins are color coded green. Pins of 0.001 inch oversize (color coded blue) and 0.002 inch oversize (color coded yellow) are available.

Install the piston pin in the piston and rod. Install a new retainer at each end of the pin to hold it in place. Make sure the retainers are properly seated in their grooves.

If the pin hole in the piston must be reamed or honed on the 390 V-8, use precision honing equipment or an expansion-type, piloted reamer. **Piston pin bores must not be reamed with hand-driven reamers. Use motor-driven reamers, but do not exceed the cutting speed (rpm) recommended by the reamer manufacturer.**

If a reamer is used, set the reamer to the size of the pin bore; then expand the reamer slightly and trial ream the pin bore. Take a light cut. Use a pilot sleeve of the nearest size to maintain alignment of the bores.

Check the hole size, using the new piston pin. If the bore is small, expand the reamer slightly and make another cut. Repeat the procedure until the proper fit is obtained. Check the piston pin for fit in the respective rod or rod bushing. On the 390 V-8, if necessary, ream or hone the rod bushing to fit the pin to specifications.

Fitting Piston Pins—All Except 330, 360, 361, 390 and 391 HD V-8

On all engines except those above, install the piston pin, following the procedure under Piston Assembly (Parts 21-10, 21-21, 21-22, 21-23 and 21-24).

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Dress up minor surface defects on the rocker arm shaft and in the rocker arm bore with a hone (170, 200, 250 Six and 330, 360, 361, 390 and 391 V-8 only).

If the pad at the valve end of the rocker arm has a grooved radius, replace the rocker arm. **Do not attempt to true this surface by grinding.**

Refer to Section 4, Removal and Installation for the rocker arm stud replacement procedure.

PUSH RODS

Following the procedures under Push Rod Inspection, check the push rods for straightness.

If the runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**

CYLINDER BLOCK

Refinishing Cylinder Walls

Honing is recommended for refinishing cylinder walls only when the walls have minor scuffs or scratches, or for fitting pistons to the specified clearance. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. **Before any cylinder is refinished, all main bearing caps must be in place and tightened to the proper torque so that the crankshaft bearing bores will not become distorted from the refinishing operation.**

Refinish only the cylinder or cylinders that require it. All pistons are the same weight, both standard and oversize; therefore, various sizes of pistons can be used without upsetting engine balance.

Refinish the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when refinished for the maximum oversize piston recommended, replace the block.

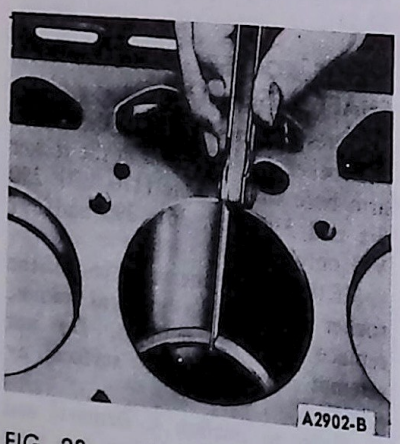


FIG. 28 Checking Piston Ring Gap

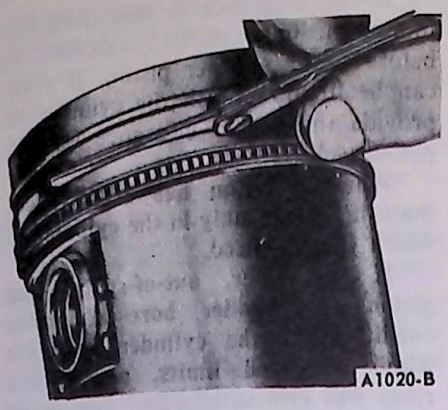


FIG. 29 Checking Piston Ring Side Clearance

Refinish the cylinder to within approximately 0.0015 inch of the required oversized diameter. This will allow enough stock for the final step of honing so that the correct surface finish and pattern are obtained.

For the proper use of the refinishing equipment, follow the instructions of the manufacturer. Only experienced personnel should be allowed to perform this work.

Use a motor-driven, spring pressure-type hone at a speed of 300-500 rpm. Hones of grit sizes 180-220 will normally provide the desired bore surface finish of 15/32 RMS. When honing the cylinder bores, use a lubricant mixture of equal parts of kerosene and SAE No. 20 MOTOR OIL. Operate the hone in such a way to produce a cross-hatch finish on the cylinder bore. The cross hatch pattern should be at an angle of approximately 30 degrees to the cylinder bore. After the final operation in either of the two refinishing methods described and prior to checking the piston fit, thoroughly clean and oil the cylinder walls. Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons are fitted, thoroughly clean the entire block and oil the cylinder walls.

Repairing Engine Castings Having Sand Holes or Being Porous

Porosity or sand hole(s) which will cause oil seepage or leakage can occur with modern casting processes. A complete inspection of engine and transmission should be made. If the leak is attributed to the porous condition of the cylinder block or sand hole(s), repairs can be made with metallic plastic (Part No. C6AZ-19554-A). **Do not repair cracks with this material. Repairs with this metallic plastic must be confined to those cast iron engine component surfaces (Fig. 30) where the inner wall surface is not exposed to engine coolant pressure or oil pressure, for example:**

1. Cylinder block surfaces extending along the length of the block, upward from the oil pan rail to the

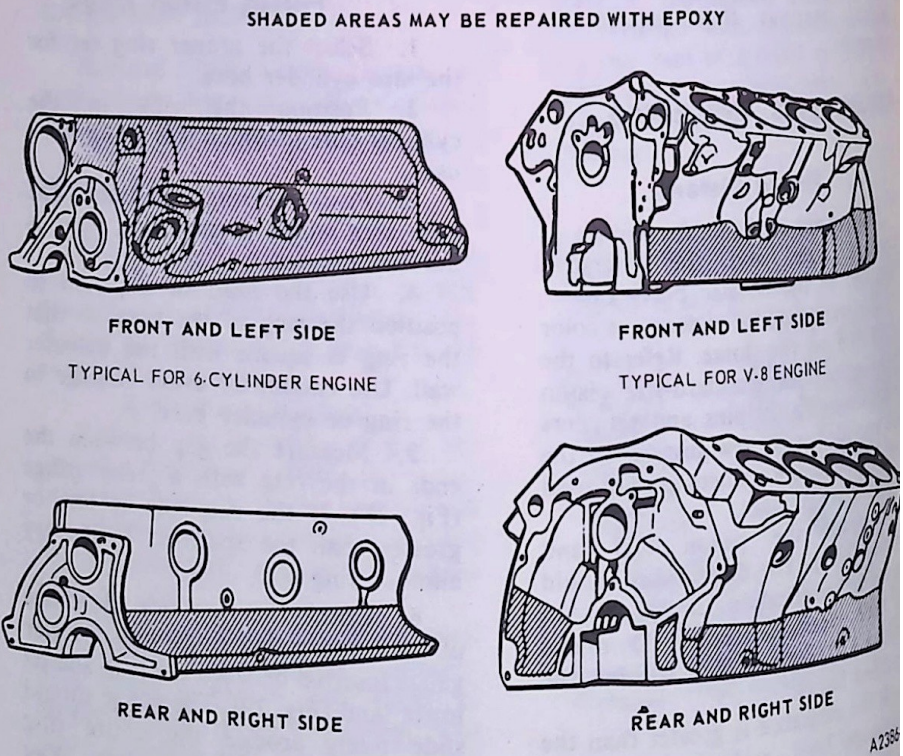


FIG. 30 Typical Cast Iron Cylinder Block Areas Repairable With Metal Plastic

cylinder water jacket but not including machined areas.

2. Lower rear face of the cylinder block.

3. Intake manifold casting. **Repairs are not recommended to the intake manifold exhaust crossover section since temperatures can exceed the recommended temperature limit of 500 degrees F.**

4. Cylinder front cover on engines using cast iron material.

5. Cylinder head, along the rocker arm cover gasket surface.

The following procedure should be used to repair porous areas or sand holes in cast iron:

1. Clean the surface to be repaired by grinding or rotary filing to a clean bright metal surface. Chamfer or undercut the hole or porosity to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole. Openings larger than 1/4-inch should not be repaired using metallic plastic. Openings in excess of 1/4-inch can be drilled, tapped and plugged using common tools. Clean the repair area thoroughly. Metallic plastic will not stick to a dirty or oil surface.

2. Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.

3. Apply the repair mixture with a suitable clean tool (putty knife, wood spoon, etc.) forcing the epoxy into the hole or porosity.

4. Allow the repair mixture to harden. This can be accomplished by two methods; heat cure with a 250 degree watt lamp placed 10 inches from the repaired surface, or air dry for 10-12 hours at temperatures above 50 degrees F.

5. Sand or grind the repaired area to blend with the general contour of the surrounding surface.

6. Paint the surface to match the rest of the block.

5 CLEANING AND INSPECTION

The cleaning and inspection procedures are for a com plete engine overhaul; therefore, for partial engine overhaul or parts replacement, follow the pertinent cleaning or inspection procedure.

INTAKE MANIFOLD

Cleaning

Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent and dry it with compressed air.

Inspection

Inspect the manifold for cracks, nicked gasket surfaces, or other damage that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. **Remove all filings and foreign matter that may have entered the manifold as a result of repairs.**

On a 330, 360, 361 and 391 V-8, check the baffle plate on the underside of the manifold; it should be securely fastened at all retaining points.

EXHAUST MANIFOLDS

Cleaning

Remove all gasket material from the manifold(s).

Inspection

On the 240 six and 300 LD six engines, check the exhaust control valve for freedom from binding throughout the valve travel. If necessary, free the shaft with exhaust control valve solvent. If the solvent does not eliminate the binding condition, replace the component parts (refer to Exhaust Control Valve Replacement - 240 and 300 Six).

Inspect the manifold(s) for cracks, damaged gasket surfaces, or other defects that would make them unfit for further service. Inspect the cylinder head joining flanges of the exhaust manifold(s) for evidence of exhaust gas leaks.

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Cleaning

Clean all the parts thoroughly. Make sure that all oil passages are open.

On ball stud rocker arms, make sure the oil passage in the push rod end of the rocker arm is open.

If necessary, remove the plugs from both ends of the rocker arm shaft to thoroughly clean the shaft passages.

Inspection

On rocker arm shaft assemblies, check the clearance between each rocker arm and the shaft by checking the ID of the rocker arm bore and the OD of the shaft. If the clearance between any rocker arm and the shaft exceeds the wear limit, replace the shaft and/or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs.

Inspect the pad at the valve end of the rocker arms for indications of scuffing or abnormal wear. If the pad is grooved, replace the rocker arm. **Do not attempt to true this surface by grinding.**

Check the rocker arm adjusting screws and the push rod end of the rocker arms for stripped or broken threads, and the ball end of the adjusting screw for nicks, scratches, or excessive wear.

On the ball stud rocker arms, check the rocker arm and fulcrum seat for excessive wear, cracks, nicks or burrs. Check the rocker arm stud and nut for stripped or broken threads.

VALVE ROCKER ARM COVERS

Check the gasket surfaces for damage caused by over-torqued bolts. Straighten the surface as required to restore original flatness.

PUSH RODS

Cleaning

On a 240 or 300 Six engine, clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air.

Inspection

Check the ends of the push rods for nicks, grooves, roughness or excessive wear.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator (Fig. 31).

CYLINDER HEADS

Cleaning

With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. **Be careful not to damage the cylinder head gasket surface.** After the valves are removed, clean the valve guide bores with a valve guide cleaning tool. Using cleaning solvent to remove dirt, grease and other deposits. Clean all bolt holes; be sure the oil transfer passage is clean (V-8 engines).

Remove all deposits from the valves with a fine wire brush or buffing wheel.

Inspection

Inspect the cylinder heads for cracks or excessively burned areas in the exhaust outlet ports.

Check the cylinder head for cracks and inspect the gasket surface for burrs and nicks. Replace the head if it is cracked.

On a 330, 361 and 391 HD V-8 and 401, 477 or 534 SD V-8 engine, check the valve seat inserts for excessive wear, cracks or looseness.

The following inspection procedures are for a cylinder head that is to be completely overhauled. For individual repair operations, use only the pertinent inspection procedure.

Cylinder Head Flatness

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head gasket surface (Fig. 32) for conformance to specifications. If necessary to refinish the cylinder head gasket surface, **do not plane or grind off more than 0.010 inch from the original gasket surface.**

Valve Seat Runout

Check the valve seat runout with an accurate gauge (Fig. 33). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat.

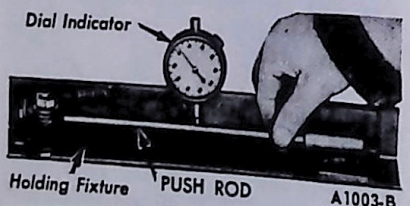


FIG. 31 Checking Push Rod Runout

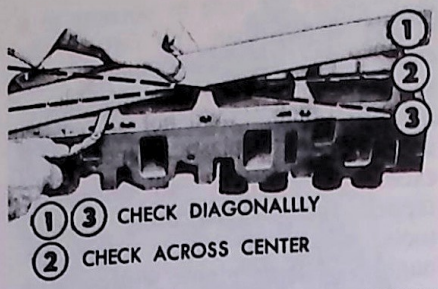


FIG. 32 Checking Cylinder Head Flatness

Valve Seat Width

Measure the valve seat width (Fig. 25). Reface the valve seat(s) if the width is not within specifications.

Valves

The critical inspection points and tolerances of the valve are illustrated in Fig. 34. Refer to specifications for the wear limits.

Inspect the valve face and the edge of the valve head for pits, grooves or scores. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for signs of burning or erosion, warpage and cracking. Minor pits, grooves, etc., may be removed. Discard severely damaged valves.

Do not discard sodium-cooled valves (330, 361 and 391 HD V-8 or 401, 477 or 534 SD V-8 exhaust valves) with other scrap metal in scrap bins. If a sodium-cooled valve is accidentally broken and the sodium exposed, it will react violently upon contact with water resulting in fire and explosion due to chemical action. Therefore, these valves should be handled with care and disposed of by being buried in the ground in an area not subjected to excavation, or dropped into deep natural water in a section not subjected to dredging.

Inspect the valve springs, valve spring retainers, locks and sleeves and discard any visually damaged parts.

Valve Face Runout

Check the valve face runout. It should not exceed the specified wear limit. If the runout exceeds the wear limit, the valve should be replaced or refaced as outlined under Refacing Valves in this section.

Valve Stem Clearance

Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 35 or its equivalent. Use a flat end indicator point.

Install the tool on the valve stem until it is fully seated, and tighten the

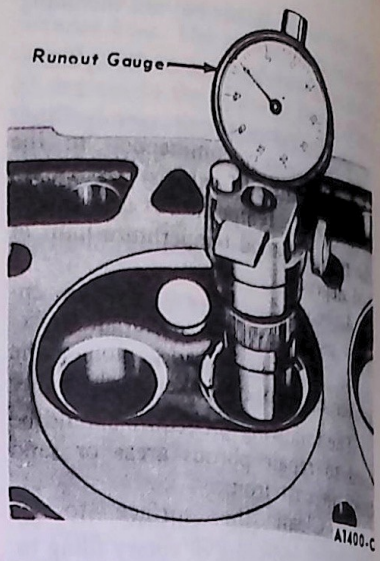


FIG. 33 Checking Valve Seat Runout

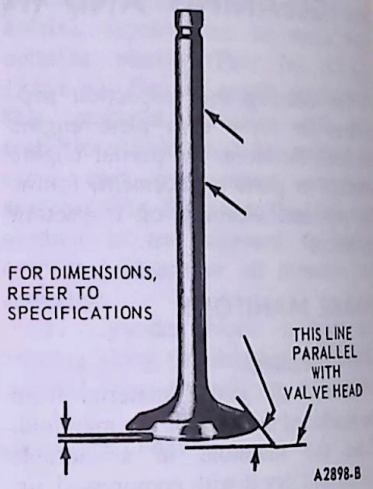


FIG. 34 Critical Valve Tolerances

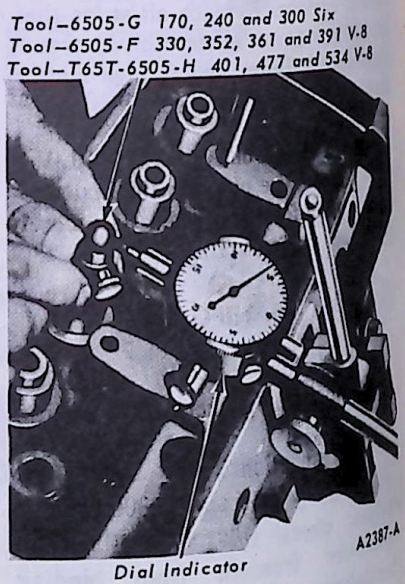


FIG. 35 Checking Valve Stem Clearance

knurled set screw firmly. Permit the valve to drop away from its seat until the tool contacts the upper surface of the valve guide.

Position the dial indicator with its flat tip against the center portion of the tool's spherical section at approximately 90 degrees to the valve stem axis. Move the tool back and forth in line with the indicator stem. Take a reading on the dial indicator without removing the tool from the valve guide upper surface. Divide the reading by two, the division factor for the tool.

Valve Spring Pressure

Check the valve spring for proper pressure (Fig. 36) at the specified spring lengths. Weak valve springs cause poor performance; therefore, if the pressure of any spring is lower than the wear limit, replace the spring.

Valve Spring Squareness

Check each spring for squareness using a steel square and a surface plate (Fig. 37). Stand the spring and square on end on the surface plate. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and square. If the spring is out of square more than 5/64 inch, replace it.

Follow the same procedure to check new valve springs before installation.

Make certain the proper spring (color coded) is installed.

HYDRAULIC VALVE LIFTERS

The valve lifter assemblies should be kept in proper sequence so that they can be installed in their original position. Inspect and test each lifter separately so as not to intermix the internal parts. **If any part of the lifter assembly needs replacing, replace the entire assembly.**

FIG. 36 Checking Valve Spring Pressure

Cleaning

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint-free cloth.

Inspection

Inspect the parts and discard the entire lifter assembly if any part shows pitting, scoring, galling or evidence of non-rotation. Replace the entire assembly if the plunger is not free in the body. The plunger should drop to the bottom of the body by its own weight when assembled dry.

Assemble the lifter assembly and check for freeness of operation by pressing down on the push rod cup. The lifters can also be checked with a hydraulic tester to test the leak-down rate. Follow the instructions of the test unit manufacturer or the procedure in Section 1.

MECHANICAL TAPPETS

Cleaning

Thoroughly clean the tappets in clean solvent and wipe them with a clean, lint-free cloth.

Inspection

Inspect the tappets, and discard any that show signs of pitting, scoring or galling. Replace any tappets that show evidence of non-rotation.

CRANKSHAFT VIBRATION DAMPER AND SLEEVE

Cleaning

Clean the oil seal contact surface on the crankshaft damper or sleeve with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with crocus cloth. Use crocus cloth to remove any sharp edges, burrs or other imperfections which might damage the oil seal during installation or cause premature seal wear. **Do not use crocus cloth to the extent that the seal surface becomes polished. A finely polished surface may produce poor sealing or cause premature seal wear.**

Inspection

Inspect the crankshaft damper or sleeve oil seal surface for nicks, sharp edges or burrs that might damage the oil seal during installation or cause premature seal wear.

TIMING CHAIN AND SPROCKETS

Cleaning

Clean all parts in solvent and dry them with compressed air.

Lubricate the timing chain with engine oil before installing it on the engine.

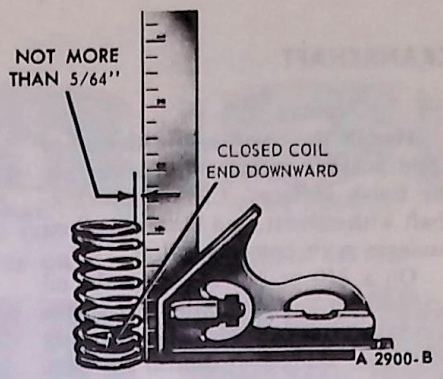


FIG. 37 Checking Valve Spring Squareness

Inspection

Inspect the chain for broken links. Inspect the sprockets for cracks and worn or damaged teeth. Replace all the components of the timing chain and sprocket assembly, if any one item needs replacement.

Inspect the fuel pump drive eccentric for scores, nicks and excessive wear. If the eccentric is scored, replace it.

TIMING GEARS

Cleaning

Clean the gears in solvent and dry them with compressed air.

Inspection

Inspect the gear teeth for scores, nicks, etc. Note the condition of the teeth contact pattern. If the teeth are scored, replace the gears.

On a 240 Six or 300 LD Six engine, it is not necessary to replace the gears in sets. Replace the camshaft gear and check the backlash, runout, etc., to determine if the crankshaft gear should be replaced.

CAMSHAFT

Cleaning and Inspection

Clean the camshaft in solvent and wipe it dry. Inspect the camshaft lobes for scoring and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general area of the lobe toe. This pitting is not detrimental to the operation of the camshaft; therefore, the camshaft should not be replaced until the camshaft lobe lift loss has exceeded 0.005 inch.

The lift of camshaft lobes can be checked with the camshaft installed in the engine or on centers. Refer to Camshaft Lobe Lift.

Check the distributor drive gear for broken or chipped teeth.

Check the fuel pump eccentric (if so equipped) for excessive wear.

C

CRANKSHAFT

Cleaning

Handle the crankshaft with care to avoid possible fractures or damage to the finish surfaces. Clean the crankshaft with solvent, and blow out all oil passages with compressed air.

On a 240 or 300 Six clean the oil seal contact surface at the rear of the crankshaft with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with crocus cloth. Use crocus cloth to remove any sharp edges, burrs or other imperfections which might damage the oil seal during installation or cause premature seal wear. **Do not use crocus cloth to the extent that the seal surfaces become polished. A finely polished surface may produce poor sealing or cause premature seal wear.**

Inspection

Inspect the main and connecting rod journals for cracks, scratches, grooves or scores.

Measure the diameter of each journal in at least four places to determine out-of-round, taper or undersize condition (Fig. 38).

On an engine used with a manual shift transmission, check the fit of the clutch pilot bushing in the bore of the crankshaft. The bushing is pressed into the crankshaft and should not be loose. Inspect the inner surface of the bushing for wear or a bell-mouth condition. Check the ID of the bushing (Fig. 39). Replace the bushing if it is damaged or the ID is not within specifications.

Inspect the pilot bearing, when used, for roughness, evidence of overheating or loss of lubricant. Replace if any of these conditions are found.

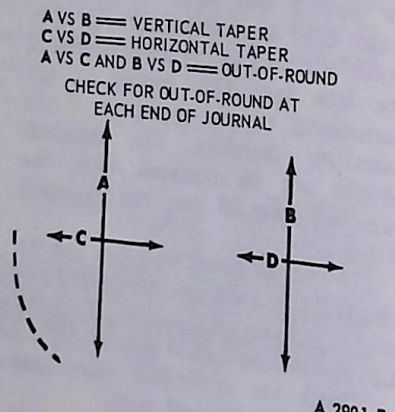


FIG. 38 Crankshaft Journal Measurement

On the 240 and 300 Six engines, inspect the rear oil seal surface of the crankshaft for excessively deep grooves, nicks, burrs, porosity, or scratches which could damage the oil seal lip during installation. Remove all nicks and burrs and polish the chamfered edge and oil seal contact surface with crocus cloth.

FLYWHEEL-MANUAL- SHIFT TRANSMISSIONS

Inspection

Inspect the flywheel for cracks, heat checks, or other damage that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout, following the procedure in Section 1.

FLYWHEEL-AUTOMATIC TRANSMISSION

Inspection

Inspect the flywheel for cracks or other damage that would make it unfit for further service. Inspect the starter ring gear for worn, chipped or cracked teeth. If the teeth are damaged, replace the starter ring gear and flywheel assembly.

With the flywheel installed on the crankshaft, check the gear face runout of the flywheel (refer to Section 1 for the proper procedure).

CONNECTING RODS

Cleaning

Remove the bearings from the rod and cap. Identify the bearing if they are to be used again. Clean the connecting rod in solvent, including the rod bore and the back of the inserts. **Do not use a caustic cleaning solution. Blow out all passages with compressed air.**

Inspection

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves.

FIG. 39 Measuring Clutch Pilot Bushing Wear

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined journal, or a tapered connecting rod bore.

Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the maximum limit and/or if the rod is fractured, it should be replaced.

On connecting rods that have a piston pin bushing, check the piston pin to connecting rod bushing clearance. Replace the connecting rod if the bushing is so worn that it cannot be reamed or honed for an oversize pin.

On the 240 and 300 Six engines, check the ID of the connecting rod piston pin bore. Replace the connecting rod if the pin bore is not within specifications. Replace defective connecting rod nuts and bolts.

After the connecting rods are assembled to the piston, check the rods for bend or twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend and/or twist exceeds specifications, the rod must be straightened or replaced.

PISTONS, PINS AND RINGS

Remove deposits from the piston surfaces. Clean gum or varnish from the piston skirt, piston pins and rings with solvent. **Do not use a caustic cleaning solution or a wire brush to clean pistons.** Clean the ring grooves with a ring groove cleaner (Fig. 40). Make sure the oil ring slots (or holes) are clean.

NSPECTION

Carefully inspect the pistons for ractures at the ring lands, skirts, and in bosses, and for scuffed, rough, or cored skirts. If the lower inner portion of the ring grooves have high teps, replace the piston. The step will nterfere with ring operation and cause xcessive ring side clearance.

Spongy, eroded areas near the edge f the piston top are usually caused by letonation or pre-ignition. A shiny urface on the thrust surface of the iston, offset from the centerline etween the piston pin holes, can be aused by a bent connecting rod. Replace pistons that show signs of xcessive wear, wavy ring lands or ractures, or damage from detonation r pre-ignition.

Check the piston to cylinder bore learance by measuring the piston and ore diameters. Refer to the specifiations for the proper clearance. Refer o Cylinder Block Inspection for the ore measurement procedure. **Measure the OD of the piston with micrometers at the centerline of the piston bore and at 90 degrees to the pin bore axis. Check the ring side clearance following the procedure under Fitting Piston Rings in this section.**

Replace piston pins showing signs of fracture, etching or wear. Check the piston pin fit in the piston and rod. Refer to Pistons and Connecting Rods Assembly, in the pertinent engine section.

Check the OD of the piston pin and the ID of the pin bore in the piston. Replace any piston pin or piston that is not within specifications.

Replace all rings that are scored, chipped or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling an engine. Rings should not be transferred from one piston to another regardless of mileage.

MAIN AND CONNECTING ROD BEARING

Cleaning

Clean the bearing inserts and caps thoroughly in solvent, and dry them

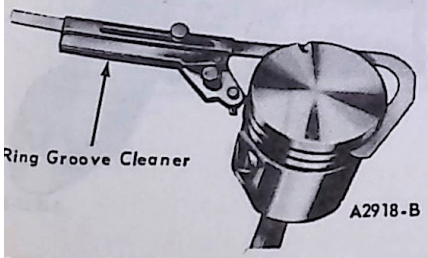


FIG. 40 Cleaning Ring Grooves—Typical

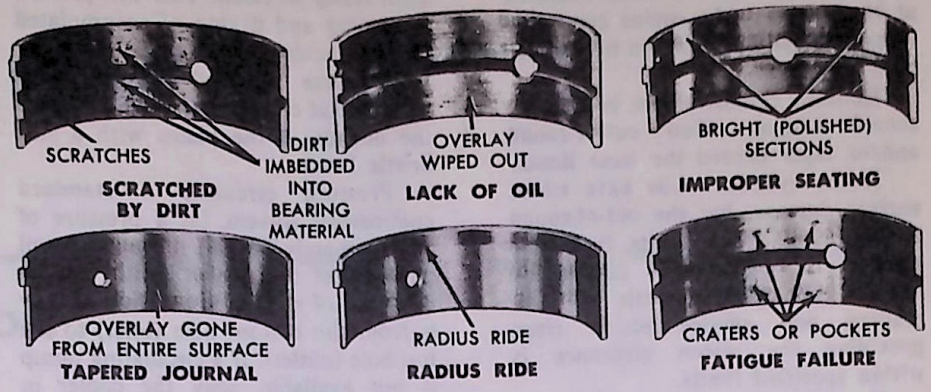


FIG. 41 Typical Bearing Failures

with compressed air. **Do not scrape gum or varnish deposits from bearing shells.**

Inspection

Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of bearings that should be replaced and the causes are shown in Fig. 41. The copper-lead bearing base may be visible through the bearing overlay. This does not mean that the bearing is worn. **It is not necessary to replace the bearing if the bearing clearance is within recommended limits.** Check the clearance of bearings that appear to be satisfactory with Plastigage. Fit new bearings following the recommended procedure in Section 4.

CYLINDER BLOCK

Cleaning

After any cylinder bore repair operation, such as honing or deglazing, clean the bore(s) with soap or detergent and water. **Then, thoroughly rinse the bore(s) with clean water to remove the soap or detergent, and wipe the bore(s) dry with a clean, lint-free cloth. Finally, wipe the bore(s) with a clean cloth dipped in engine oil. If these procedures are not followed, rusting of the cylinder bore(s) may occur.**

If the engine is disassembled, thoroughly clean the block in solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs that seal oil passages; then clean out all the passages. Blow out all passages, bolt holes, etc., with compressed air.

On the 330, 360, 361 and 391 V-8 engines, be sure the jiggle pin in the main oil gallery front plug operates freely.

Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

Inspection

After the block has been thoroughly cleaned, check it for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the cracked area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone. Check the cylinder block for flatness of the cylinder head gasket surface following the procedure and specifications recommended for the cylinder head. The cylinder block can be machined to bring the cylinder head gasket surface within the flatness specifications, **but not to exceed 0.010 inch stock removal from the original gasket surface.**

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for outof-round and taper. Measure the bore with an accurate bore gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle and bottom with the gauge placed at right angles and parallel to

the centerline of the engine (Fig. 42). Use only the measurements obtained at 90 degrees to the engine centerline when calculating the piston to cylinder bore clearance.

Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the wear limits.

If the cylinder walls have minor surface damage, but the out-of-round and taper are within limits, it may be possible to remove such damage by honing the cylinder walls and installing new service piston rings providing the piston clearance is within specified limits.

To remove the cylinder wall glaze or to refinish a cylinder bore, follow the honing procedure described under Cylinder Block-Refinishing Cylinder Walls (Section 5).

OIL PAN

Cleaning

Scrape any dirt or metal particles from the inside of the pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign particles are removed from below the baffle plate.

Inspection

Check the pan for cracks, holes, damaged drain plug threads, and a loose baffle. Check the gasket surface for damage caused by over-torqued bolts. Straighten the surface as required to restore original flatness.

Replace the pan if repairs cannot be made.

OIL COOLER-401, 477 AND 534 V-8

Cleaning

Clean the oil cooler as soon as possible after removing it from the engine, or soak it in cleaning solvent until ready to clean. This will prevent hardening and drying of accumulated foreign material.

Immerse the oil cooler in a commercial cleaning solvent and clean the outside of the plates with a stiff bristle brush.

Pressure circulate a standard commercial solvent (at a pressure of approximately 20 psi) through the oil passages of the cooler in the reverse direction of normal flow. Normal flow is from the bottom hole (inlet) to the top hole (outlet). If a circulating pump is not available, soak the cooler in solvent for a few minutes and force the solvent through the oil passages with a plunger or piston-type hand pump. If the oil passages are severely clogged, use an Oakite or alkaline solution. After cleaning, pressure flush the cooler with clean hot water.

Thoroughly clean the passages in the cover and clean the relief valve assembly. Remove gasket sealer from the cover, oil cooler, and block.

Inspection

The cooler should be checked for leaks under a pressure equivalent to the maximum engine oil pressure.

OIL PUMP

Cleaning

Wash all parts in a solvent and dry them thoroughly with compressed air. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and metal particles are removed.

Inspection

Refer to the specifications for clearances and wear limits.

Check the inside of the pump housing and the outer race and rotor for damage or excessive wear or scoring.

Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored or grooved, replace the cover.

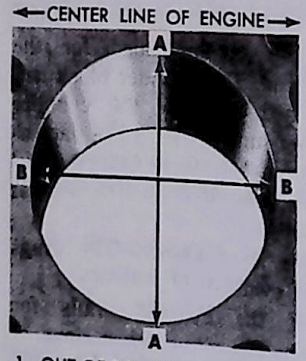
Measure the outer race to housing clearance (Fig. 43).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance (rotor end play) between the straight edge andtthe rotor and outer race (Fig. 44).

The outer race, shaft and rotor are replaceable only as an assembly.

Check the drive shaft to housing bearing clearance by measuring the OD of the shaft and the ID of the housing bearing.

Inspect the relief valve spring for a



A AT RIGHT ANGLE TO CENTER LINE OF ENGINE
B PARALLEL TO CENTER LINE OF ENGINE

1. OUT-OF-ROUND = DIFFERENCE BETWEEN A AND B
2. TAPER = DIFFERENCE BETWEEN THE A MEASUREMENT AT TOP OF CYLINDER BORE AND THE A MEASUREMENT AT BOTTOM OF CYLINDER BORE

A 2905-A

FIG. 42 Cylinder Bore Out-of-Round and Taper

the relief valve spring tension. If the spring tension is not within specifications and/or the spring is worn or damaged, replace the spring.

Check the relief valve piston for scores and free operation in the bore.

CRANKCASE VENTILATION SYSTEM

Refer to the 1971 Truck Maintenance and Lubrication Manual for the correct mileage interval for maintenance.

Do not attempt to clean the crankcase ventilation regulator valve; replace it at the recommended maintenance interval.

The oil filler tube breather cap, located on the valve rocker arm cover should be cleaned at the proper mileage interval. Remove the cap and wash it in a low-volatility, petroleumbase solvent. Shake the cap dry and install it. Do not dry with compressed air as air pressure may damage the filter element.

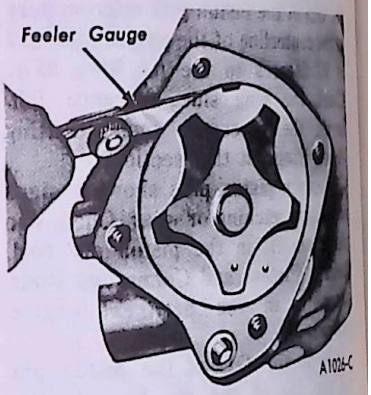


FIG. 43 Checking Outer Race-to-Housing Clearance

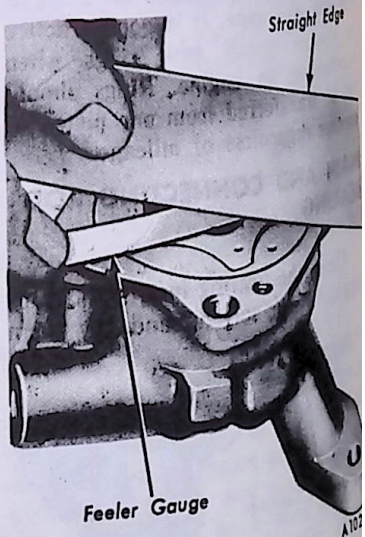


FIG. 44 Checking Rotor End

Clean the crankcase ventilation system connection(s) on the carburetor spacer or intake manifold by probing the inlet nipple with a flexible wire or bottle brush.

Clean the rubber hoses with a lowvolatility, petroleum-base solvent and dry with compressed air.

9 SPECIAL SERVICE TOOLS

SPECIAL SERVICE TOOLS

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			170, 240, 300	360, 390	330MD, 330 361, 391 H.D.	401, 477, and 534
Engine Lifting Bracket — Use with T53L-300-A	T58P-6000-A	6000-BD		X	X	
Engine Lifting Hook	T65L-6000-A		X			
Engine Lifting Cradle	T65E-6000-B		X			
Engine Support Bar	T65E-6000-J		X			
Engine Lifting Sling	TOOL-6000-BE					X
Adapter Mount — To fit K. R. Wilson 1009 or Manzel 6001-TES	T64L-6001-B or T64L-6001-C	T52T-6005-CJD T52T-6005-KJD TOOL-6001-FBA	X	X		
Ridge Reamer	T64L-6011-EA					X
Cylinder Front Cover Pilot	T61K-6019-A	4222-M, 6059-D				
	T64T-6019-A				X	
	T61P-6019-B	6059-F	X	X	X②	
Cylinder Head Holding Fixture	T58P-6085-A	6085-M			X	
Valve Guide Reamer Kit	T58P-6085-B	6085-H		X		
	T60K-6085-B	6085-AE	X			
Piston Pin Remover and Replacer Press	T65L-6135-C	T60K-6135-B	X			
Piston Pin Remover	T52P-6135-DAD			X	X	
Piston Ring Compressor	TOOL-6149-E					X
Camshaft Bearing Remover or Replacer	T56T-6250-A					X
Camshaft Bearing Remover and Replacer Adapters	T65L-6250-A	T52L-6261-CEE	X	X	X X	
Camshaft Rear Bearing Bore Plug Installer	T58P-6266-A					
Cylinder Head Core Plug, Cylinder Block Core Plug and Camshaft Bearing Bore Plug Replacer	T52L-6266-BGD	6266-B	X			
Camshaft Rear Bearing Bore Plug Installer	T52T-6266-CJD					X
Crankshaft Sprocket and Crankshaft Damper Replacer	T52L-6306-AEE	3355-D 6306-AC				X
Crankshaft Gear Remover	T58T-6306-A					X
Crankshaft Damper Replacer	T64T-6306-A		X	X	X	
Crankshaft Damper Replacer — Use with T64T-6306-A	T65L-6306-A		X			
Crankshaft Gear Installer	T52L-6306-AEE					X
Crankshaft Damper Remover Adapter Screw Use with T58P-6316-B	T64T-6316-A		X		X	
Crankshaft Damper Remover	T58P-6316-B		X	X	X	
Upper Main Bearing Insert Remover and Replacer	TOOL-6331	6331	X			
Upper Main Bearing Insert Remover and Replacer	TOOL-6331-E	6331-E		X		
Crankshaft Pulley Spacer Remover	T56P-6362-A				X	
Hydraulic Tappet Clip Replacer	TOOL-6500-C	6500-C	X	X		

CA1092-A

SPECIAL SERVICE TOOLS

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			170,240, 300	360, 390	330MD,330 361,391 H.D.	401,477, and 534
Impact Hammer	T50T-100-A		X	X		
Impact Slide Hammer (Replaces OTC-927)	T59L-100-B		X	X		X
Puller Attachment – Use with T50T-100-A or T59L-100-B	T58L-101-A	OTC-927	X	X		
Handle Adapter	T53L-200-A		X	X		X
Engine Lifting Sling	T53L-300-A	6000-BA	X	X	X	
In Chassis – Valve Spring Compressor	K-D915				X	
Gear Puller ①	TOOL-OTC-943		X			
Differential Backlash and Runout Gauge, with Universal Bracket Dial Indicator and Bracket – Includes Indicator TOOL-6565	TOOL-4201-C	4201-C	X	X		
① Used on 300 CID engines only						

SPECIAL SERVICE TOOLS (Continued)

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			170,240, 300	360, 390	330 MD 330, 361 391 MD	401, 477 534
Hydraulic Tappet Leakdown Tester	TOOL-6500-E	6500-E	X	X		
Hydraulic Tappet Plunger Remover and Replacer	TOOL-6500-F	6500-F	X	X		
Solid Tappet Remover	T52T-6500-DJD	6500-D				X
Valve Stem Clearance Checking Tool	TOOL-6505-E	6505-E	X			
Valve Stem Clearance Checking Tool	TOOL-6505-F	6505-F		X		
Valve Stem Clearance Checking Tool	TOOL-6505-G	6505-G				
Crankshaft Damper Remover	T64T-6512-A					X
Valve Spring and Rocker Arm Compressor	TOOL-6513-J	6513-J		X		
Valve and Clutch Spring Tester	TOOL-6513-DD	6513-DD	X	X		
Air Adapter and Hose-Valve Holdup	TOOL-6513-ABA	6513-AB	X	X		
Rocker Arm Stud Kit	T62F-6A527-B	6527-A,B	X			
Cam Lift and Push Rod Stroke Dial Indicator – 1 inch range (Part of TOOL-4201-C)	TOOL-6565	6565	X	X		
Valve Spring Compressor	T62F-6565-A	6513-HH	X			
Cup Shaped Adapter to TOOL-6565	TOOL 6565-AB	6565-AB	X	X		
Cylinder Front Cover Oil Seal Installer	T58T-6700-A					X
Cylinder Block Front Cover Oil Seal Replacer Adapter – Use With T53L-200-A	T58P-6700-B	6700-B	X	X	X②	
Cylinder Front Cover Oil Seal Installer	T64T-6700-B				X	
Crankshaft Rear Oil Seal Forming Tool	T58P-6701-A	6701-C		X	X	
Crankshaft Rear Oil Seal Forming Tool	T60K-6701-A	6701-E				
Crankshaft Rear Oil Seal Forming Tool	T65L-6701-A		X			
Clutch Pilot Bearing Replacer	T65L-7600-A		X			
Clutch Pilot Bearing Replacer	TOOL-7600-H	7600-H				
Clutch Disc Alignment Pilot	TOOL-7563-E	7563				X
① Used on 300 CID engines only			② 330 MD only			

LUBRICANTS

Item	Ford Part No.
Exhaust Control Valve Lubricant	COAZ-19A501-A, R-149-A

SEALERS

Item	Ford Part No.
Loctite (thread locking compound)	C3AZ-19554-A

CA1092-A1

PART 21-26 Super Duty Engines

This Information Applies To: 900 C, L, LN, LT, LNT, CT and LTS - Series

This Information Applies To: 900 C, L, LN, LT, LNT, CT and LTS-Series

1 DESCRIPTION

The differences between the engine models and the vehicle model applications are listed in Fig. 1. The 401, 477 and 534 SD (Super Duty) V-8 engines (Figs. 2 and 3) have the same basic design.

Rating Plate Identification	Engines	Piston Displacement (cu-in)	Bore (Inches)	Stroke (Inches)	Compression Ratio	Carburetor	Governor	Distributor	Vehicle Model Application
H	401 SD V-8	401	4.125	3.75	7.5:1	4-V	Mechanical-Centrifugal	Centrifugal and Vacuum	L-900,LN-900,C-900 LT-900,LNT-900,CT-900, LTS-900
K	477 SD V-8	477	4.500	3.75	7.5:1	4-V	Mechanical-Centrifugal	Centrifugal and Vacuum	L-900,LN-900,C-900 LT-900,LNT-900,CT-900, LTS-900
L	534 SD V-8	534	4.500	4.20	7.5:1	4-V	Mechanical-Centrifugal	Centrifugal and Vacuum	L-900,LN-900,C-900 LT-900,LNT-900,CT-900, LTS-900

6 7/8 x 3 1/2

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FIG. 1 Engine Applications

The engines are equipped with a positive crankcase ventilation system.

On a closed-type crankcase ventilation system, the oil filler caps are sealed and connected to the air cleaner (L-FT-C- and CT-Series) (Fig. 4). Thus, the crankcase receives air from the air cleaner. If the system becomes restricted, a backflow condition will occur, thereby venting the crankcase gases into the air cleaner.

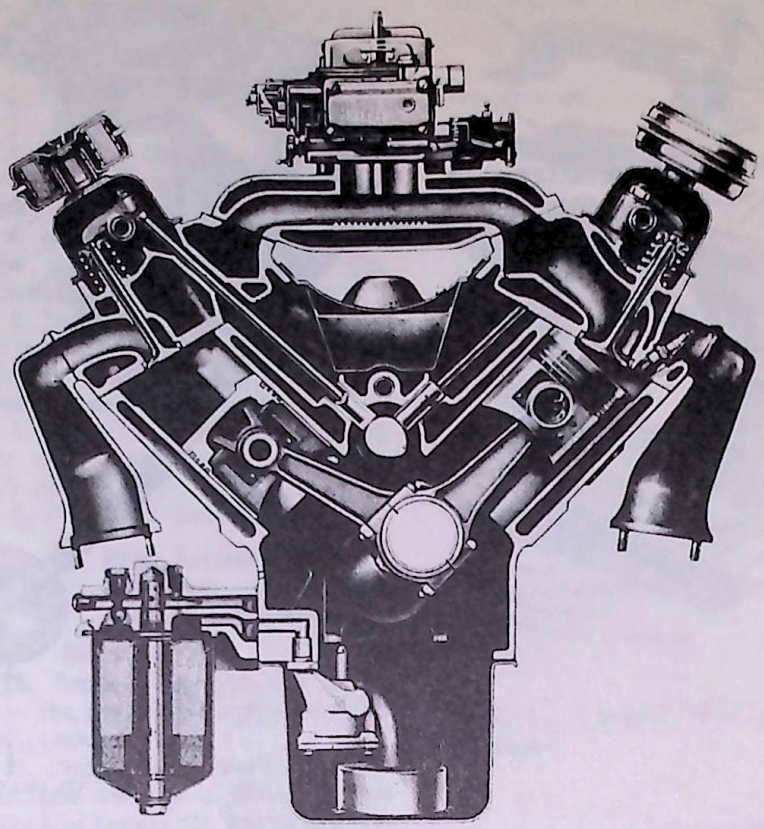

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FIG. 3 SD V-8 Engine Sectional View— Typical

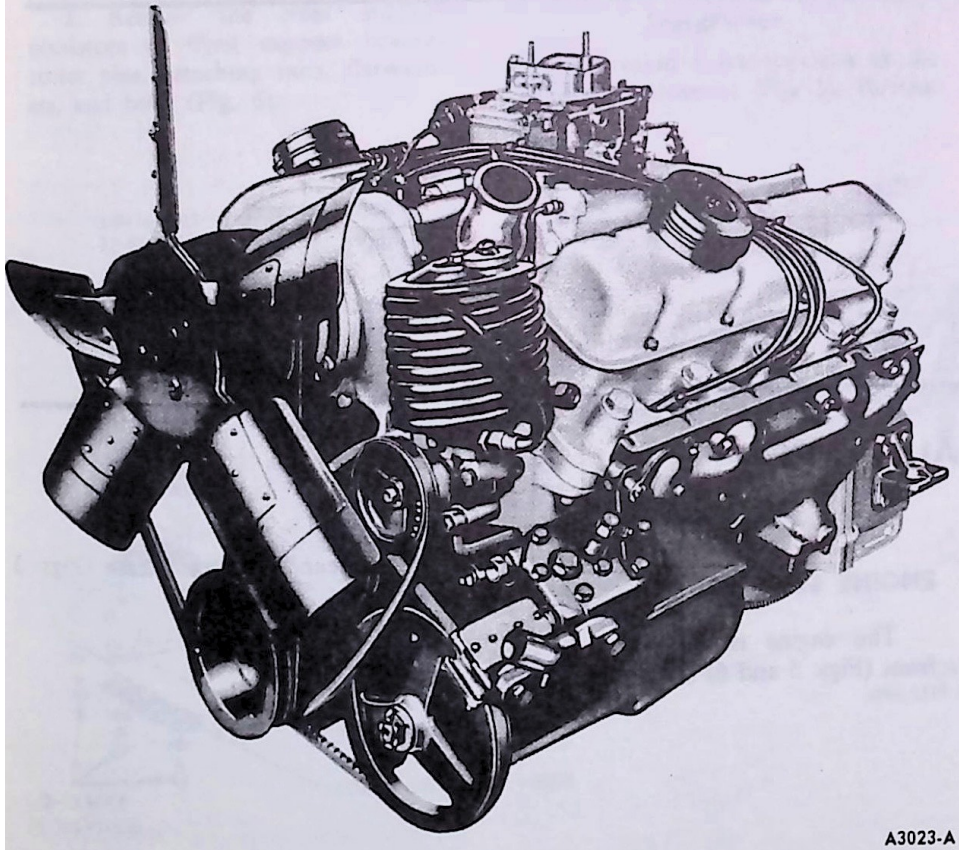

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FIG. 2 SD V-8 Engine—Typical

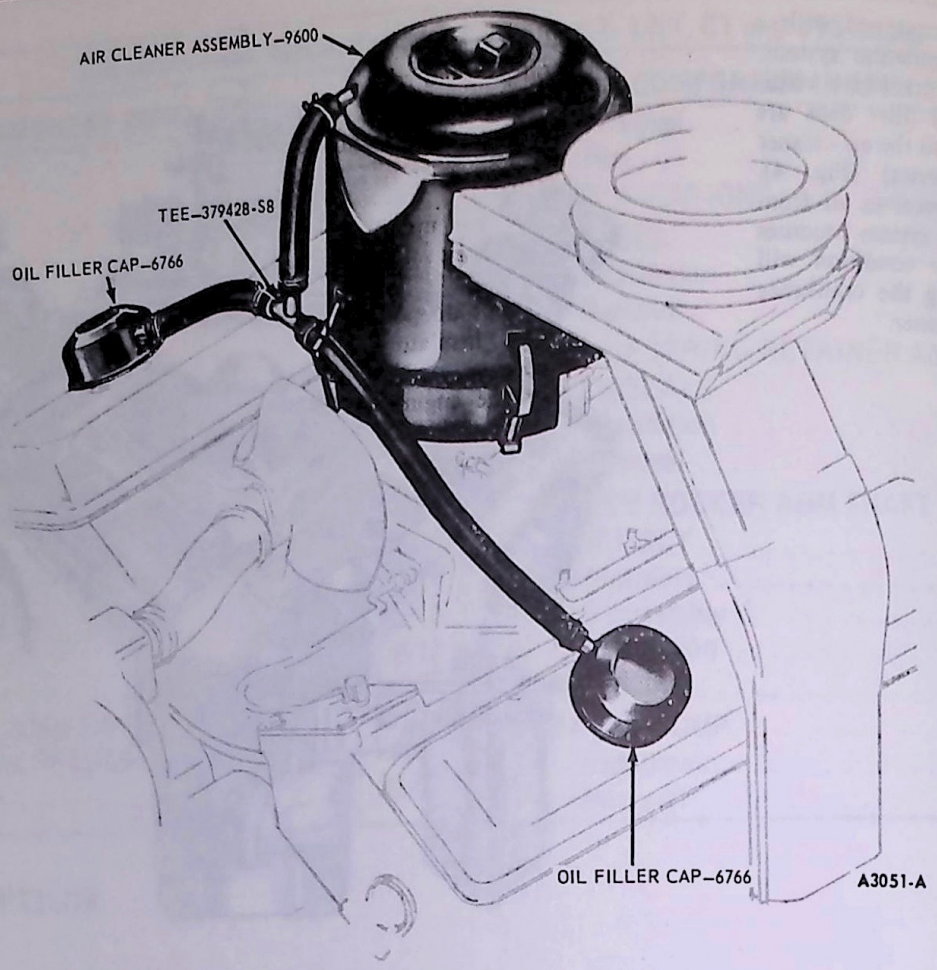


FIG. 4 Crankcase Ventilation System—L-, LT-, C- and CT-Series—Typical

2 TESTING

CRANKCASE VENTILATION REGULATOR VALVE

Refer to Part 21-01 for the test procedure.

4 REMOVAL AND INSTALLATION

When installing nuts or bolts (refer to the end of this Part for torque specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

ENGINE SUPPORTS

The engine is supported at the front (Figs. 5 and 6) and on each side at the rear of the crankcase (Figs. 5 and 7).

Front Support Insulators—L, LT, LTS, LN and LNT-Series

Removal

1. Remove the two upper insulator attaching bolts (Fig. 5).
2. Remove the two lower insulator attaching bolts and remove the lower insulator and spacers.
3. Place a wood block on a jack, then raise the engine high enough to remove the upper insulator.

Installation

1. Torque the engine support bracket-tocrossmember attaching bolts to specification.
2. Position a new upper insulator on the support bracket (Fig. 5).
3. Lower the engine enough to start the attaching bolts and washers in the spacers, then remove the jack.
4. Secure the lower insulator to the support bracket with the attaching bolts and washers. Torque the four insulator attaching bolts to specification.

Front Support Insulators— C-Series

Removal

1. Disconnect the alternator adjusting arm at the engine front support insulator and remove the air compressor idler pulley.
2. Remove the front support insulators to front support bracket cotter pins, attaching nuts, flatwashers, and bolts (Fig. 6).
3. Position a jack and wood block under the oil pan and raise the engine slightly.
4. Remove the upper and lower insulators.

Installation

1. Position the upper and lower insulators on the front support bracket.
2. Install, but do not tighten, the front support insulator bolts, flat washers, and nuts.
3. Lower the engine and remove the jack and wood block. Tighten the nuts and attaching bolts to specifications and insert new cotter pins.
4. Connect the alternator adjusting arm and install the air compressor idler pulley.
5. Adjust the drive belts.

Rear Support Insulators— L, LT, LTS, LN and LNT-Series

Removal

1. Remove the two cap screws from the engine rear support bracket and remove the cap.
2. Place a wood block on a jack and raise the rear of the engine just enough to remove the weight from the rear supports.
3. Remove the four bolts that attach the engine rear support to the frame side rail and remove the support and insulator.

Installation

1. Position a new insulator on the engine rear support (Fig. 5). Position the support and insulator to the frame side rail. Install and torque the attaching bolts to specification.
2. Lower the engine and remove the jack.
3. Install and torque the cap screws in each engine rear support bracket and cap.

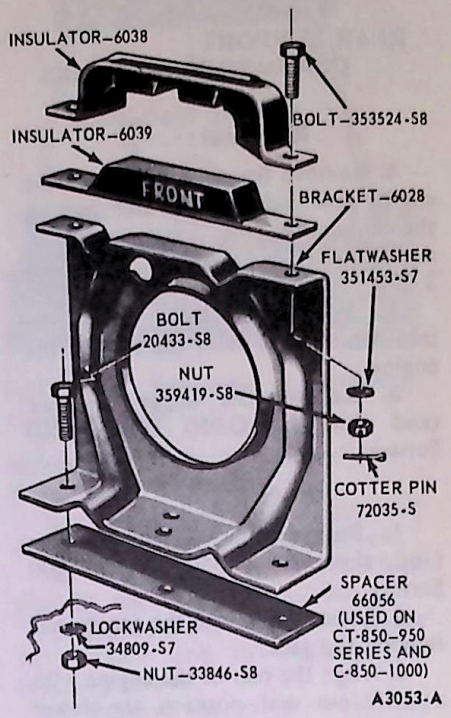


FIG. 6 Engine Front Support—C-Series

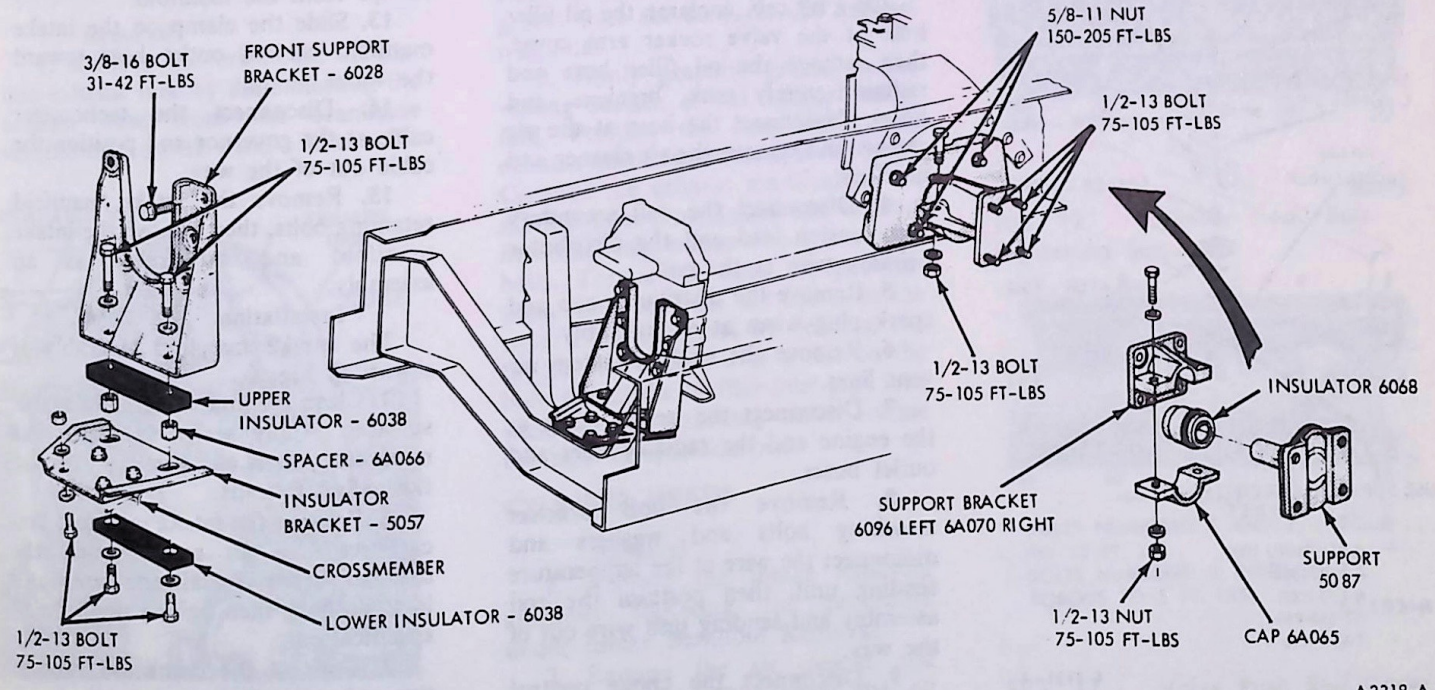


FIG. 5 Engine Front and Rear Supports—L, LT, LTS, LN and LNT-Series

REAR SUPPORT INSULATORS—C-SERIES

Removal

1. Remove the cotter pin from the engine rear mount bolt, then remove the mounting bolt, lower insulator, and spacer (Fig. 7). A3121-A 2 1/16 x 3 1/2
2. Position a jack under the transmission and raise the rear of the engine.
3. Remove the upper insulator (and shim on C-950 and C-1000 Series).

Installation

1. Position the upper insulator (and shim on C-950 and C-1000 Series).
2. Lower the rear of the engine and remove the jack.
3. Align the rear of the engine with a drift pin and position the lower insulator and spacer.
4. Install the engine mounting bolt and nut and tighten them to specifications.
5. Install a new cotter pin in the mounting bolt. Be sure the cotter pin is in the correct hole in the bolt according to the vehicle model. The hole nearest the end of the mounting bolt is used for C-950 and C-1000 Series. The other hole is used for the remainder of the vehicle series.

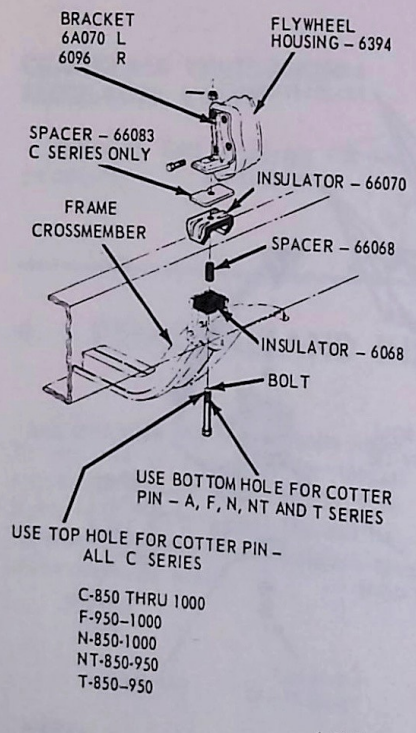


FIG. 7 Engine Rear Support-C-Series

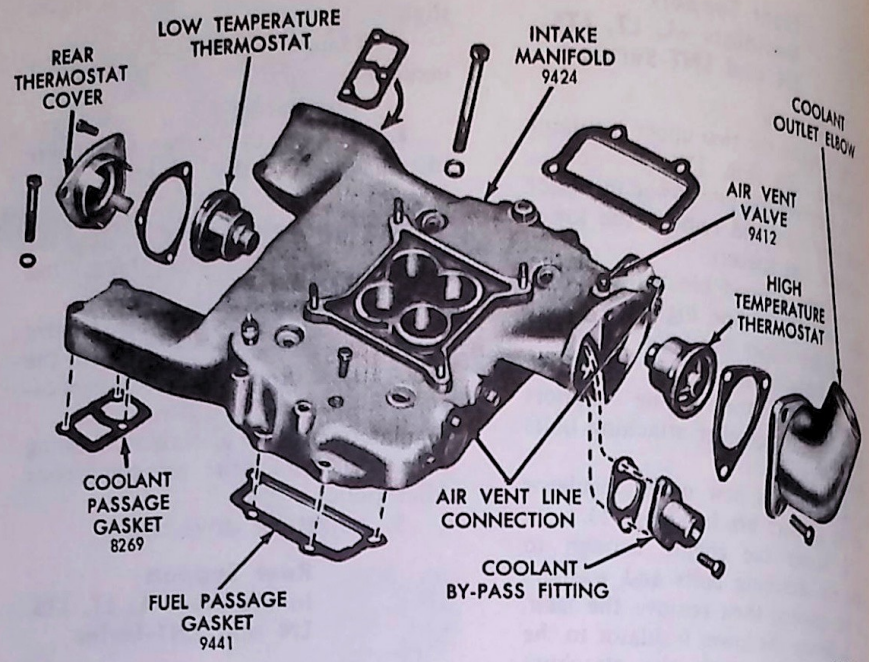


FIG. 8 Intake Manifold Assembly

INTAKE MANIFOLD

Removal

1. Drain the cooling system. Disconnect the radiator upper hose at the water pump.
2. Remove the clamp retaining the radiator shutter air lines to the cross braces. Remove the cross braces.
3. Disconnect the air tubes at the carburetor air duct, then remove the air duct assembly.

On a tilt cab, unclamp the oil filler hose at the valve rocker arm cover, then remove the oil filler hose and radiator supply tank, brackets, and hoses. Disconnect the hose at the air cleaner and remove the air cleaner and brackets.

4. Disconnect the coil secondary high tension lead and the distributor primary wire at the coil.
5. Remove the distributor cap and spark plug wires as an assembly.
6. Remove the cooling system air vent lines.
7. Disconnect the heater hoses at the engine and the radiator inlet and outlet hoses.
8. Remove the coil bracket attaching bolts and washers and disconnect the wire at the temperature sending unit, then position the coil assembly and sending unit wire out of the way.
9. Disconnect the choke control cable at the carburetor and the

Disconnect the vacuum assist brake line and the positive crankcase ventilation exhaust tube at the intake manifold.

10. Disconnect the accelerator linkage at the accelerator assembly and the hand throttle control cable at the carburetor. Remove the accelerator retracting spring.
11. Disconnect the oil pressure safety switch wires.
12. Disconnect the carburetor fuel inlet line and remove the retaining clamps from the manifold.
13. Slide the clamp on the intake manifold coolant outlet hose toward the water pump.
14. Disconnect the tachometer cable at the governor and position the cable out of the way.
15. Remove the intake manifold retaining bolts, then remove the intake manifold and carburetor as an assembly.

Installation

The intake manifold assembly is shown in Fig. 8.

1. Clean the intake manifold gasket surfaces. Apply sealer to the intake manifold gaskets and position them on the cylinder heads.
2. Position the intake manifold and carburetor as an assembly on the cylinder heads. Install the bolts and lock washers, then tighten the bolts to specifications.
3. Connect the crankcase ventilation exhaust tube.

4. Connect the carburetor inlet line and retaining clamps. Connect the oil pressure safety switch wires.

5. Install the accelerator retracting spring. Connect the hand throttle control cable, the accelerator linkage and the tachometer cable.

6. Connect the choke control cable, the governor and control rod, the heater hoses, and the radiator hoses.

7. Install the coil and connect the temperature sending unit wire. Connect the distributor primary wire and coil high tension lead at the coil. Connect the vacuum assist brake line.

8. Install the cooling system air vent lines, and the distributor cap and spark plug wire assembly. Connect the radiator upper hose.

9. Install the cross braces and the clamp retaining the radiator shutter air lines.

On a tilt cab, install the air cleaner and brackets. Install the radiator support tank, bracket, and hoses. Connect the oil filler hose to the valve rocker arm cover.

10. Open the air bleed valve at the front of the intake manifold. Fill the cooling system. When coolant is discharged at the bleed valve, close it finger tight. Operate the engine at fast idle and check for coolant leaks.

11. Install the carburetor air duct assembly and connect the air tubes.

Connect the hose to the air cleaner.

POSITIVE CLOSED-TYPE CRANKCASE VENTILATION—REGULATOR VALVE

Removal

1. Remove the crankcase ventilation exhaust tube by disconnecting the exhaust tube from the crankcase ventilation outlet and from the

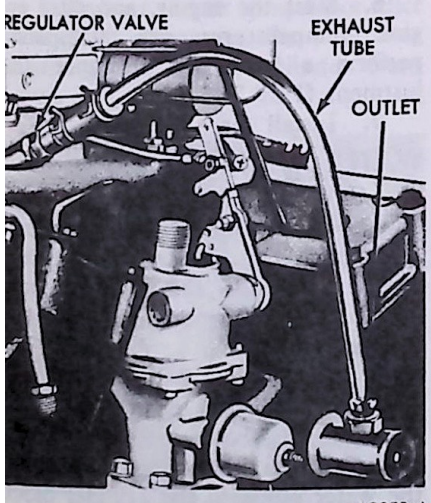


FIG. 9 Crankcase Ventilation System Regulator Valve Installed

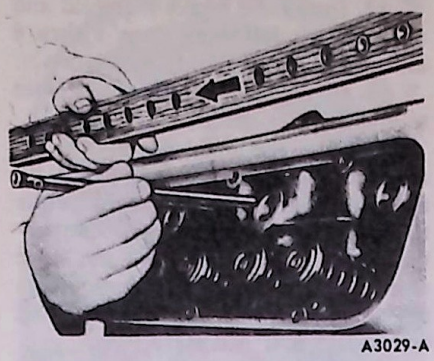


FIG. 10 Removing Push Rod

regulator valve in the intake manifold (Fig. 9).

2. Remove the regulator valve assembly and the rubber connection.

Installation

1. Install the regulator valve in the intake manifold.

2. Position and install the rubber connection and exhaust tube on the engine.

EXHAUST MANIFOLDS

Removal

1. Disconnect the exhaust manifold(s) at the muffler inlet pipe(s).

2. Straighten the lock tab on the washers. Remove the exhaust manifold retaining bolts and remove the exhaust manifold and heat shield.

Installation

1. Clean the mating surfaces of the exhaust manifold and cylinder head. Scrape the gasket material from the mounting flange of the exhaust manifold and muffler inlet pipe. Position a new muffler inlet pipe gasket over the studs of the exhaust manifolds.

2. Apply graphite grease to the mating surface of the exhaust manifold. Position the heat shield and exhaust manifold on the cylinder head. Connect the exhaust manifold to the muffler inlet pipe. Install the exhaust manifold tab washers and attaching bolts. Torque the bolts to specifications, working from the center to the ends. Lock the bolts by bending one tab on the washer over a flat on the bolt. Install the muffler inlet pipe lock washers and attaching nuts. Torque the nuts to specifications.

CYLINDER HEADS

Removal

1. Remove the intake manifold assembly following the procedure under Intake Manifold Removal.

2. Remove the air cleaner and support bracket. Disconnect the oil pressure sending unit wire and

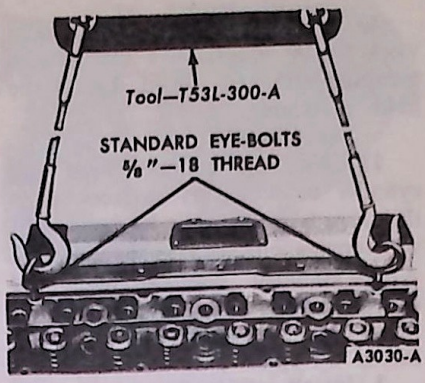


FIG. 11 Removing or Installing Cylinder Head

tachometer cable at the governor. Remove the governor.

3. Remove the valve push rod cover and valve rocker arm covers.

4. Disconnect the muffler inlet pipes at the exhaust manifolds.

5. Release the spring tension on the valve rocker arm by loosening the adjusting screws.

6. Remove the valve rocker arm shaft assembly and the oil baffle plate.

7. Remove the valve push rods in sequence (Fig. 10).

8. Install standard eye bolts with 5/8-18 threads in the cylinder head and attach the engine lifting sling (Fig. 11).

9. Remove the remaining cylinder head bolts. Raise the cylinder head and remove it from the engine. Remove and discard the the cylinder head gasket.

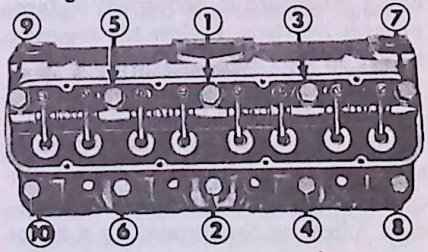


FIG. 12 Cylinder Head Bolt Tightening Sequence

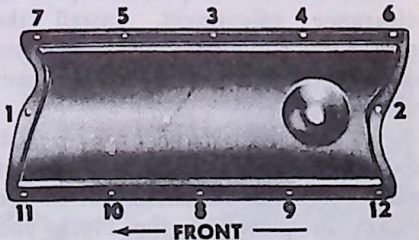


FIG. 13 Valve Push Rod Cover Bolt Tightening Sequence

10. Place the cylinder head on a work bench and remove the exhaust manifold and heat shield. Install the holding fixtures.

Installation

1. Clean the cylinder head and cylinder block gasket surfaces. Coat the threads of the cylinder head bolts with engine oil.

2. Remove the cylinder head holding fixtures and install the heat shield and the exhaust manifold. Install the spark plugs.

3. Install standard eye bolts with 5/8-18 threads in the cylinder head and attach the engine lifting sling.

4. Guided by the word TOP on the gasket, install the gasket over the cylinder head dowels. **Gasket sealer must not be used on the cylinder head gasket.**

5. Position the cylinder head on the engine (Fig. 11).**Slide the flat washers on the cylinder head bolts.**

6. Install the five outside bolts with the flat washers but do not tighten. Remove the lifting sling and eye bolts.

7. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods in their proper sequence making sure the lower ends are positioned in the tappet socket.

8. Position the oil baffle plate and the valve rocker arm shaft assembly on the cylinder head. Install the remaining five cylinder head bolts with flat washers but do not tighten.

9. The cylinder head bolt tightening procedure is performed in three progressive steps. Follow the sequence shown in Fig. 12. Tighten the bolts to 130-140 ft-lbs torque; then tighten them to 150-160 ft-lbs torque. Finally tighten them to specification section at the end of this Part. When the cylinder head bolts have been tightened following this procedure it is not necessary to retorque them after extended operation. They may, however, be checked and retorqued if desired.

10. Perform a preliminary valve clearance adjustment. Install the governor. Connect the tachometer cable and oil pressure sending unit wire.

11. Coat one side of the valve push rod cover gasket with oil resistant sealer. Lay the cemented side of the gasket in place on the block and cylinder head. Position the cover making sure that the gasket seats evenly all around the block. Install the bolts with new washers. Be sure the washers are installed with the rubber side toward the cover. Tighten the bolts following the sequence in Fig. 13.

12. Install the intake manifold and related parts following steps 1 thru 8 under Intake Manifold Installation.

13. Connect the muffler inlet pipes to the exhaust manifolds.

14. Open the air bleed valve at the front of the intake manifold and fill and bleed the cooling system. Operate the engine until the engine temperatures have stabilized. Check the valve clearance when engine temperatures are stabilized with the engine idling and adjust it if necessary.

15. Check all hose connections and gaskets for leaks. Coat one side of the valve rocker arm cover gaskets with oil resistant sealer, and lay the cemented side of the gaskets in place in the covers.

16. Install the valve rocker arm covers, making sure that the gaskets seat evenly all around the head. Install the attaching screws and tighten them to specifications. Install the air cleaner and support brackets.

17. Adjust the engine idle speed and fuel mixture.

VALVE ROCKER ARM SHAFT ASSEMBLY

Removal

Because five cylinder head bolts also serve to retain the pedestals for the valve rocker arm shaft assembly, each time the valve rocker arm shaft assembly is removed, the cylinder head gasket must be replaced.

1. Follow steps 1 thru 4 under Cylinder Head Removal.

2. Release the spring tension on the valve rocker arms by loosening the adjusting screws.

3. Remove the valve rocker arm shaft assembly and the oil baffle plate.

4. Follow steps 7 thru 10 under Cylinder Head Removal.

Installation

1. Follow steps 1 thru 7 under cylinder Head Installation.

2. Position the oil baffle plate and the valve rocker arm shaft assembly on the cylinder head. Install the bolts and flat washers but do not tighten.

3. Follow steps 9 thru 17 under Cylinder Head Installation.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or leaking or damaged valve stem seals and retainers may be replaced without removing the cylinder head, provided damage to the valve or valve seat has not occurred.

Removal

1. Operate the engine until normal operating temperatures have been reached.

2. Remove the air cleaner and the valve rocker arm cover.

3. Remove the applicable spark plug. **Disconnect the brown lead (I terminal) and the red and blue lead (S terminal) at the starter relay.** Install an auxiliary starter switch between the S and battery terminals of the starter relay. **Crank the engine with the ignition switch off.** Crank the engine until the applicable piston is on TDC after the compression stroke. Be sure that both valves are closed. **Be sure that the piston is on TDC to prevent the crankshaft from turning when the air is applied.**

4. Backout the adjustment screw and remove the push rod. Install an air line with an adapter in the spark plug hole.

5. Push the rocker arm to one side and secure it in this position.

6. Turn on the air supply. Using the valve spring compression tool (tool K-D915), compress the valve and remove the valve spring retainer locks, the sleeve, spring retainer, and the valve spring.

7. Remove the valve stem seal.

Installation

1. Install a new valve stem seal. Place the spring in position over the valve. Install the spring retainer and sleeve. Compress the valve spring and install the valve spring retainer lock.

2. Apply Lubriplate to both ends of the push rod. Install the push rod, making sure the lower end of the rod is positioned in the tappet push rod cup.

3. Remove the wire securing the valve rocker arm and slide the rocker arm into position. Turn off the air and remove the air line and adapter. Install the spark plug and spark plug wire.

4. Perform a preliminary valve clearance adjustment (Part 21-01).

5. Temporarily install the valve rocker arm cover and connect the spark plug wires.

6. Start the engine, and after engine temperatures are stabilized, perform a hot valve clearance adjustment (Part 21-01).

7. Install the air cleaner.

WATER PUMP

Removal

1. Drain the cooling system. Disconnect the radiator lower hose, heater hose, and the water by-pass hose at the water pump. Remove the fan belt(s).

On L- and LT-Series vehicles, remove the fan and pulley and lower them into the bottom of the radiator shroud. Remove the bolts attaching the water pump to the cylinder block and remove the water pump and gaskets.

On C-Series vehicles, remove the water pump attaching bolts and remove the water pump, pulley, and gaskets as an assembly.

Installation

Before a water pump is re-installed, check it for damage. If it is damaged and requires repair, replace it with a new pump or install a rebuilt pump obtained from a Ford-Authorized Reconditioner.

1. Position new gaskets coated on both sides with water-resistant sealer, on the cylinder block, then install the water pump assembly. Install the attaching bolts and torque them to specifications. Install the fan and pulley on the hub, then install the fan belt(s). Adjust the belt tension.

On C-Series vehicles, install the water pump, pulley, and gaskets as an assembly.

2. Connect the radiator lower hose, heater hose, and water by-pass hose to the water pump. Open the air bleed valve at the front of the intake manifold and fill and bleed the cooling system, warm up the engine, and check for leaks.

CYLINDER FRONT COVER AND TIMING GEARS

Removal

1. Drain the cooling system and the crankcase.

2. Remove the fan, shroud, radiator and radiator shutter.

3. Remove the alternator, power steering pump, and air compressor drive belts.

On the L- or LT-Series vehicles, remove the upper front support insulator attaching bolts. Lift the front of the engine approximately one inch with a floor jack to allow removal of the damper.

4. Remove the damper cap screw and washer. Install the removal tool and remove the damper (Fig. 14).

5. Remove the air compressor idler pulley and disconnect the alternator adjusting arm at the cylinder front cover.

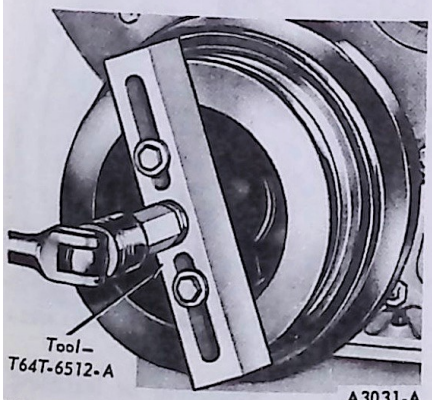


FIG. 14 Removing Damper

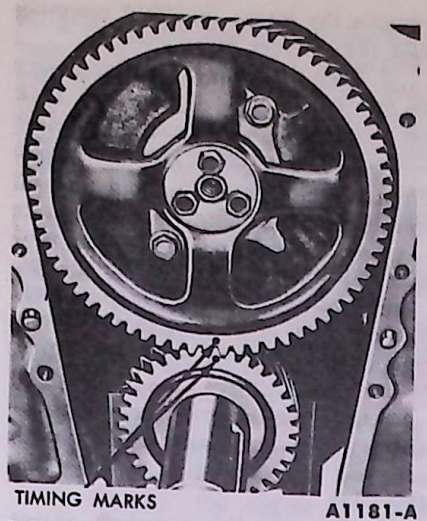


FIG. 15 Timing Mark Alignment

6. Remove the water pump assembly.

7. Remove the engine front support bracket, and the oil level dipstick.

8. Remove the bolts fastening the cylinder front cover to the block and to the oil pan. Using a thin blade knife cut the oil pan gasket flush with cylinder block face prior to separating the cover from the cylinder block. Remove the cylinder front cover.

9. Discard the cylinder front cover gasket.

10. Remove the crankshaft front oil slinger.

11. Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator. Hold the gear firmly against the block while making the check. Refer to the specifications for the backlash limits.

12. Check the camshaft and crankshaft gear runout with a dial indicator. If the gear runout is excessive, remove the gear and clean any burrs from the shaft, or replace the gear and/or gears.

13. Align the timing marks on the timing gears (Fig. 15). Remove the camshaft gear attaching bolts, then remove the camshaft gear.

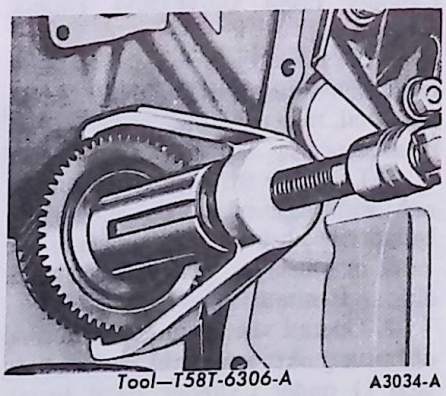


FIG. 16 Removing Crankcase Gear

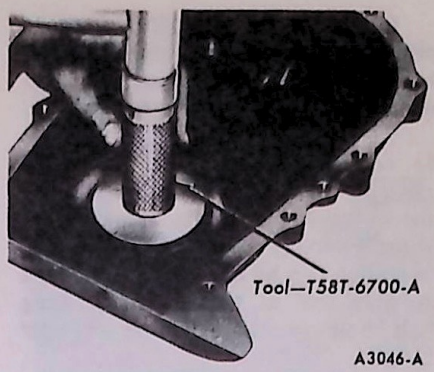


FIG. 17 Installing Oil Seal

14. To remove the crankshaft gear, install the tool shown in Fig. 16 and pull the gear off the shaft.

FRONT OIL SEAL REPLACEMENT

It is good practice to replace the oil seal each time the cylinder front cover is removed.

1. Drive out the old seal with a pin punch.

2. Clean out the recess in the cover.

3. Coat a new seal (Fig. 17). Drive the seal in until it is fully seated in the recess. Check the seal after installation to be sure the spring is properly positioned in the seal.

Installation

1. Install the crankshaft gear (Fig. 18) and the camshaft gear with the timing marks aligned (Fig. 15), then install the camshaft gear attaching bolts. **The bolts are unequally spaced. Tighten the bolts to specifications.**

2. Install the crankshaft front oil slinger.

3. Clean all oil pan and cylinder block-to-front cover gasket surfaces.

4. Coat the gasket surface of the oil pan with sealer, cut and position the required section of a new gasket on the oil pan, apply sealer at the corners.

5. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the block.

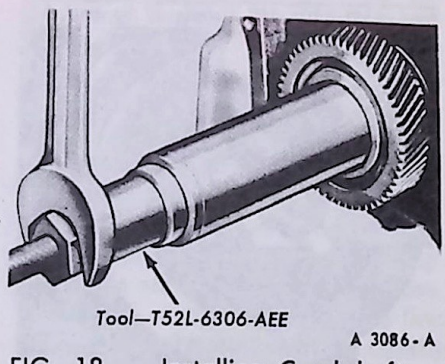


FIG. 18 Installing Crankshaft Gear

6. Position the cylinder front cover on the cylinder block. **Use care when installing the cover to avoid seal damage or possible gasket mislocation.**

7. Install the cylinder front cover to seal alignment tool into proper position. It may be necessary to force the cover downward in a manner to slightly compress the pan gasket. This operation can be facilitated by using a suitable tool at the cover attaching bolt hole locations in the cylinder block.

8. Coat the threads of the attaching bolts with oil-resistant sealer. While pushing in on the pilot, install and torque the oil pan-to-cover attaching screws to specifications. Install and torque the cover attaching bolts to specification. Remove the pilot.

9. Install the engine front support bracket.

10. Apply sealer to the water pump gasket and position it on the block; then install the water pump assembly.

11. Install the air compressor idler pulley and the alternator adjusting arm on the cylinder front cover.

12. Lubricate the crankshaft with a white lead and oil mixture and lubricate the oil seal rubbing surface with grease.

13. Clean and inspect the oil sealing surface on the crankshaft damper hub, following the procedures in Part 21-01. Apply Lubriplate to this surface. Align the damper keyway with the key on the crankshaft, then install the damper (Fig. 19).

14. Install and adjust the drive belts.

15. Install the fan, shroud, radiator and radiator shutter.

16. Fill and bleed the cooling system.

17. Fill the crankcase with the proper grade and quantity of engine oil.

CAMSHAFT

Removal

1. Following the procedures outlined in their respective sections, remove the intake manifold assembly and the cylinder front cover.

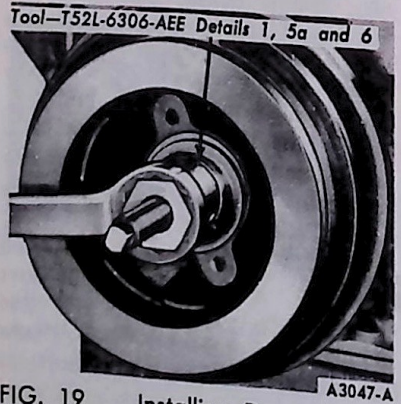


FIG. 19 Installing Damper

2. Turn the crankshaft as necessary to follow the firing order, then back off the valve clearance adjustment screw. Slide the rocker arm to one side and remove the valve push rods in sequence.

3. Remove the distributor and governor. Remove the push rod cover.

4. Remove the valve tappets keeping them in order so that they can be replaced in their original position (Fig. 20).

5. Remove the crankshaft front oil slinger. Align the timing marks on the camshaft and crankshaft timing gears (Fig. 15).

6. Remove the camshaft thrust plate attaching bolts. Remove the camshaft gear, spacer, thrust plate and camshaft as an assembly (Fig. 21).

Installation

The camshaft and related parts are shown in Fig. 22.

If a new camshaft is to be installed, remove the gear, spacer, and thrust plate from the old camshaft and install them on the new camshaft. Apply a coating of Lubriplate or equivalent to each camshaft lobe. Apply heavy engine oil MS to each camshaft bearing journal and to each bearing in the cylinder block, then install the camshaft.

1. Oil the camshaft bearing journals and apply Lubriplate to all the lobes as detailed above then carefully slide it through the bearings. Be sure the camshaft is installed so that the timing mark on the camshaft gear is aligned with the timing mark on the crankshaft gear (Fig. 15).

2. Install the thrust plate attaching bolts and torque them to specifications. Check the camshaft end play and gear backlash.

3. Install the crankshaft front oil slinger. Install the cylinder front cover and related parts and the crankshaft damper following the procedure under Cylinder Front Cover and Timing Gears Installation.

4. Immerse each tappet in heavy oil and lubricate each tappet bore in heavy oil, then install the valve tappets in sequence.

5. Lubricate the ends of each push rod with Lubriplate or equivalent. Install the push rods in sequence.

6. Perform a preliminary valve clearance adjustment.

7. Install the valve push rod chamber gasket and cover by following step 11 under Cylinder Head Installation. Install the governor.

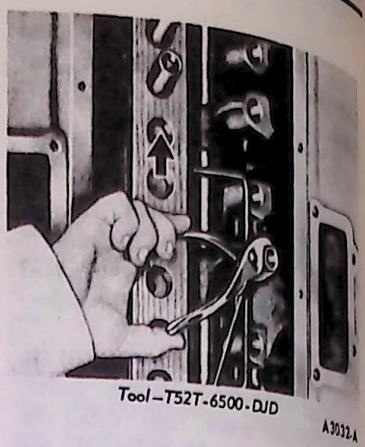


FIG. 20 Removing Tappet

8. Install the water pump, and the oil level dipstick.

9. Crank the engine until No. 1 piston is on TDC.

10. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points open, and install the hold down clamp.

11. Install the intake manifold assembly and related parts following the procedure under Intake Manifold Installation.

12. Install the distributor cap and connect the spark plug wires and the coil secondary high tension lead.

13. Install the radiator shutter, fan, shroud, and radiator.

14. Open the air bleed valve at the front of the intake manifold. Fill the cooling system. When coolant is discharged at the bleed valve, close it finger tight.

15. Start the engine. Adjust the ignition timing. Check all hose connections and gaskets for leaks.

16. Operate the engine until the engine temperatures have stabilized, then check and adjust the valve clearance.

17. Install the valve rocker arm covers and the air cleaner.

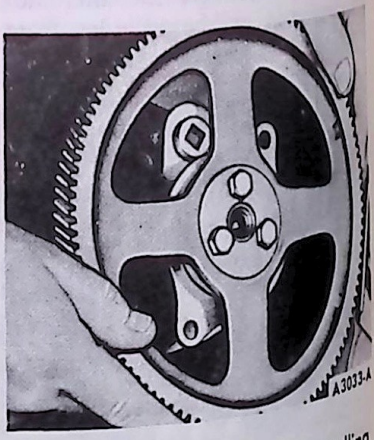


FIG. 21 Removing or Installing Camshaft

AMSHAFT BEARING BORE LUG

Removal

1. Slide the transmission to the ear and remove the clutch pressure late and disc.
2. Remove the flywheel attaching olts and remove the flywheel.
3. Follow the instructions in Part 1-01, Core Plug Replace ment to nstall the plug.

Installation

1. Install the flywheel.
2. Install the clutch pressure late and disc, and install the ransmission.

APPETS

Removal

1. Drain the cooling system.
2. Remove the intake manifold ssembly and valve push rod cover ollowing the procedure outlined in his section.
3. Remove the valve rocker arm covers.
4. Back off the valve clearance adjusting screws, turning the crankshaft damper as necessary to follow the firing order and remove the valve push rods keeping them in order so that they can be installed in their original locations.
5. Remove and replace one tappet at a time. If the tappets are difficult to remove, use the tool shown in Fig. 20. Apply Lubriplate to each tappet foot; then coat the remainder of each tappet and tappet bore with heavy engine oil before installation.

Installation

1. Install the valve push rod cover by following step 11 under Cylinder Head Installation.
2. Lubricate each end of the push rods with Lubriplate or equivalent. Install the valve push rods (in se quence) and the intake manifold assembly following the procedure under Intake Manifold Installation.
3. Perform a preliminary valve clearance adjustment (Part 21-01). In stall the distributor cap and connect the spark plug wires and the coil secondary high tension lead.
4. Open the air bleed valve at the front of the intake manifold and fill and bleed the cooling system. Start the engine. Ad just the ignition timing. Check the hose connections and gaskets for leaks.
5. Operate the engine until the engine temperatures have stabilized. Check and adjust the valve clearance. In stall the air cleaner. Adjust the engine idle speed and fuel mixture.

MAIN AND CONNECTING ROD BEARING

The main and connecting rod bearing inserts are selective fit. **Do not file or lap bearing caps or use shims to obtain the proper bearing clearance. Bearings are available for service in standard sizes, 0.001 and 0.002 inch undersize. Refer to the Parts Catalog for other available undersize bearings. Undersized bearings, are available for use on journals that have been refinished. Bearings should be checked and fitted to the crankshaft with Plastigage as detailed in Part 21-01 prior to final installation in the engine.**

Main Bearing

Removal

1. Drain the crankcase, Remove the oil pan following the procedures under Oil Pan and Oil Pump Removal.

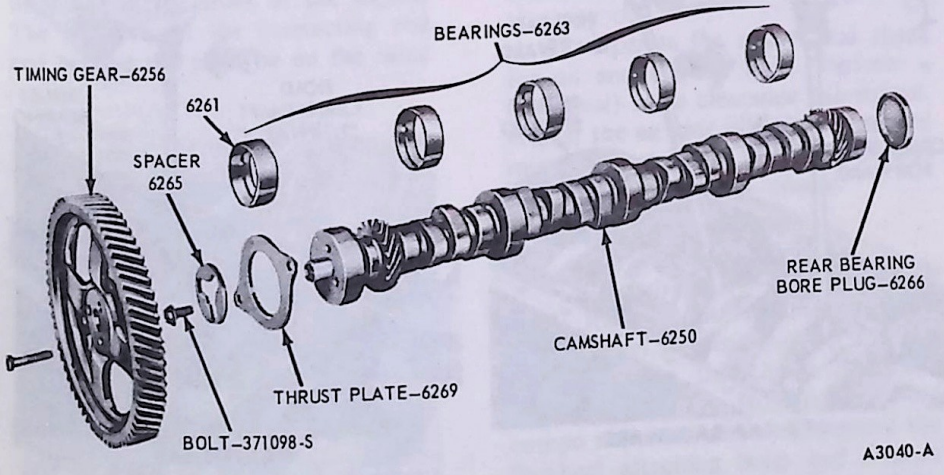


FIG. 22 Camshaft Assembly

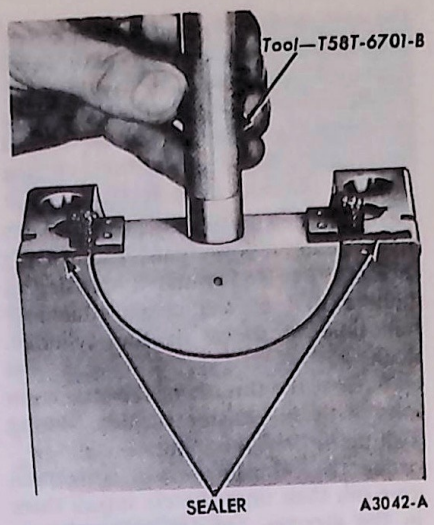


FIG. 23 Installing Seal in Rear Bearing Cap

2. **Replace one bearing at a time, leaving the other bearing securely fastened.** Remove the main bearing cap to which new bearings are to be installed.
3. Insert the upper bearing removal tool (TOOL 6331E) in the oil hole in the crankshaft journal.
4. Rotate the crankshaft slowly in the direction of engine rotation to force the bearing out of the block.
5. Clean the crankshaft journal and bearing inserts.

Installation

1. To install the upper main bear ing, place the plain end of the bearing over the shaft on the locking tang side of the block. Using TOOL 6331E in the oil hole in the crankshaft journal, rotate the crankshaft slowly in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
2. After the bearing has been checked with Plastigage and found to be satisfactory, apply a light coat of heavy engine oil to the journal and bearings, then install the bearing cap. Torque the cap bolts to specifications.
3. Repeat the procedure for the remaining bearings that require re-placement.
4. If the rear main bearing is re placed, replace the lower seal and side seals in the rear main bearing cap. Remove and discard the rear seal and side seals.
5. Preform the new seal by hand to the approximate radius of the cap. Insert the seal in the oil seal groove, seating the center of the oil seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of

the seal, and then press both ends of the seal into the groove, working from the ends to the center.

Position the seal forming tool as shown in Fig. 23 and complete the seal installation. After installation, cut the ends of the seal flush.

6. Apply a thin coating of oil resistant sealer to the rear main bearing cap at the rear of the top mating surface. **Do not apply sealer to the area forward of the side seal groove. Sealer should be applied up to but not past the side seal.** Install the rear main bearing cap. Torque the main bearing cap bolts to specifications.

7. Dip the side seals in light engine oil, then immediately install them in the grooves. **Do not use sealer on the side seals. The seals are designed to expand when dipped in oil Using sealer may retard this expansion.** It may be necessary to tap the seals into place for the last 1/2 inch of travel. Do not cut the seal projecting ends.

8. Check the side seals for leaks by squirting a few drops of oil into the parting lines between the retainer and the cylinder block from the outside. Blow compressed air against the seals from the inside of the block. If air bubbles appear in the oil, it indicates possible oil leakage. **This test should not be performed on newly installed seals until sufficient time has been allowed for the seals to expand into the grooves.**

9. If the thrust bearing (No. 3) is replaced, install the thrust bearing cap with the bolts finger tight.

10. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 24).

11. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.

12. Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications.

13. Force the crankshaft toward the rear of the engine.

14. Install a dial indicator so the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 38).

15. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, they probably require alignment. Install the thrust bearing and align the faces following the recommended procedure (steps 19 thru 22) then check the end play.

16. Install the oil pan following the procedures under Oil Pan and Oil Pump Installation.

17. Fill the crankcase with the proper amount and viscosity oil.

18. Operate the engine and check for oil leaks.

Connecting Rod Bearings

Removal

1. Follow step 1 under Main Bearing Replacement.

2. Remove the cap from the connecting rod to which a new bearing is to be fitted.

3. Follow step 5 under Main Bearing Replacement.

Installation

1. Install the new bearings in the connecting rod and cap.

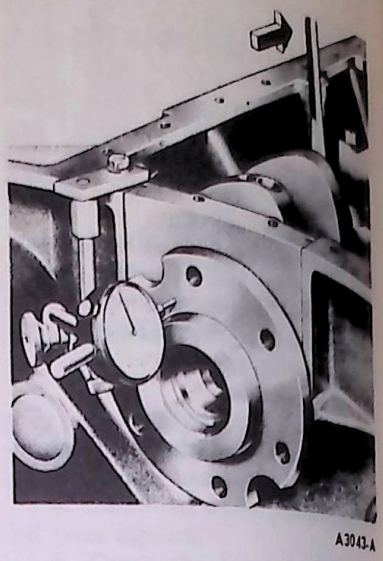


FIG. 25 Checking Crankshaft End Play

2. Pull the connecting rod assembly down firmly on the crankshaft journal.

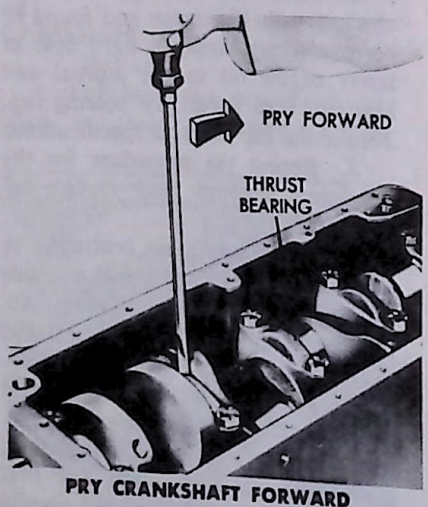
3. After the bearings have been fitted as detailed in Part 21-01, apply a light coat of heavy engine oil to the journal and bearings, then install the connecting rod cap. Torque the nuts to specifications.

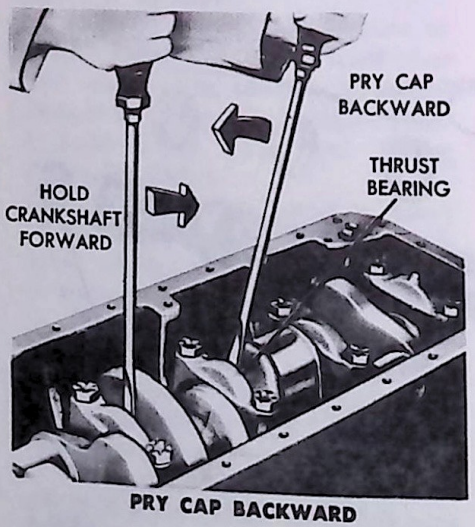
4. Repeat the procedure for the remaining connecting rods that require new bearings.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the valve rocker arm shaft assemblies, intake manifold, cylinder heads, oil pan, and oil pump following the procedures in this section.





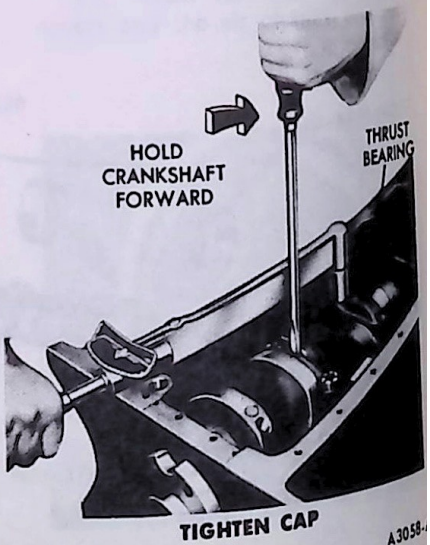


FIG. 24 Aligning Thrust

2. Turn the crankshaft until the piston to be removed is at the bottom of its travel. Place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore with Tool T64L-6011-EA or its equivalent. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

3. Make sure all connecting rod caps are marked so that they can be installed in their original locations.

4. Turn the crankshaft until the connecting rod being removed is down.

5. Remove the connecting rod cap.

6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damaging the crankshaft journal or the cylinder wall with the connecting rod studs when removing the piston and connecting rod.**

7. Remove the bearing inserts from the connecting rod and cap.

8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze (Part 21-01, Cylinder Block). Follow the instructions of the tool manufacturer. After performing cylinder bore repairs clean the bore(s), following the procedure in Part 21-01.

2. Oil the piston rings, pistons, and cylinder walls with heavy engine oil before installation.

Be sure to install the pistons in the same cylinders from which they were removed, or to which they were fitted. The connecting rod and bearing cap are numbered from 1 to 4 in the right bank, and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted, and the connecting rod should be numbered to correspond with the new cylinder number.

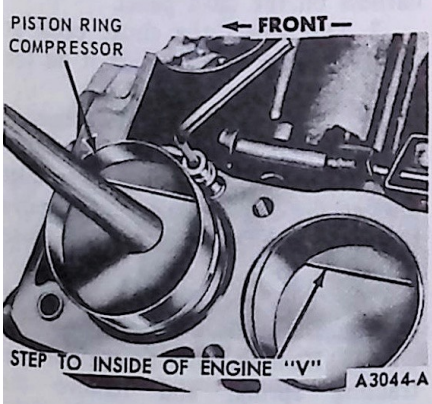


FIG. 26 Installing Piston

3. Make sure the ring gaps are properly spaced around the circumference on the piston.

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 26). Be sure to guide the con necting rods to avoid damaging the crankshaft journals. **Install the piston with the step toward the inside of the engine V.**

5. Check the clearance of each bearing following the procedure in Part 21-01, Fitting Bearings with Plastigage.

6. After the bearings have been fitted, apply a light coat of engine oil to the journal and bearings.

7. Turn the crankshaft throw to the bottom of its stroke; then push the piston all the way down until the rod bearing seats on the crankshaft journal.

8. Install the connecting rod cap. Torque the nuts to specifications.

9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 27).

10. Clean the oil pump inlet tube screen and the oil pan and block gasket surface. Prime the oil pump and install the pump, oil pan, cylinder heads, valve rocker arm shaft assemblies, and intake manifold following **the procedures in this section.**

11. Open the air bleed valve at the front of the intake manifold and fill and bleed the cooling system. Fill the crankcase with the proper amount and viscosity oil.

12. Operate the engine and check for oil and coolant leaks. Perform a final (hot) valve clearance adjustment. Adjust the en gine idle speed and fuel mixture. Install the valve rocker arm covers. Install the air cleaner.

FLYWHEEL

Removal

1. Remove the transmission from the flywheel housing (Group 16).

2. Remove the clutch from the flywheel (Group 16). After these compo nents are removed, remove the flywheel attaching bolts and remove the flywheel through the bottom of the housing.

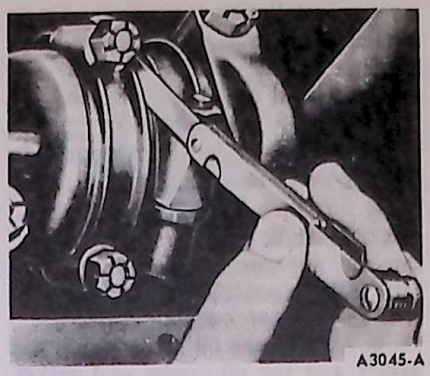


FIG. 27 Checking Connecting Rod Side Clearance

Installation

1. Install the flywheel on the crankshaft flange, then tighten the attaching bolts to specifications.

2. To check flyweel face runout or replace flywheel ring gear for manual-shift transmissions, refer to Part 21-01.

3. Install the clutch (Group 16) and the transmission (Group 16). Install the flywheel housing dust cover.

CLUTCH PILOT BUSHING

Removal

1. Disconnect the transmission from the engine and slide it to the rear as outlined in Group 16.

2. Remove the pressure plate and the clutch disc.

3. Remove the pilot bushing.

4. Coat the pilot bushing bore in the crankshaft with a small quantity of wheel bearing lubricant. Avoid using too much lubricant because it may be thrown onto the clutch disc when the clutch revolves.

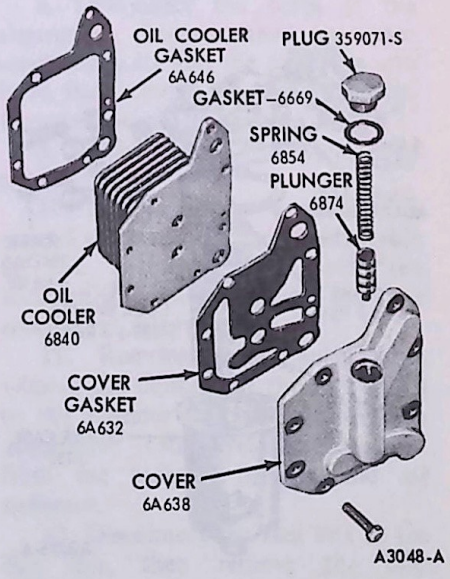


FIG. 28 Oil Cooler Assembly

Installation

1. Install the replacement bushing.
2. Install the clutch disc and the pressure plate assembly.
3. Connect the transmission to the engine (Group 16).

OIL COOLER

Removal

1. Drain the cooling system.
2. Remove the oil cooler cover and gasket and the oil cooler and gasket.
3. Remove the relief valve plug and gasket; then remove the spring and plunger. The oil cooler assembly is shown in Fig. 28.

Installation

1. Install the relief valve plunger (with the open chamber up), spring, gasket and plug in the cover.
2. Place a new cooler gasket, with sealer on both sides, on the block. Position the oil cooler in the block.
3. Place a new cover gasket on the cover with sealer on both sides and install the cover, then tighten the cover bolts to specifications.
4. Open the air bleed valve at the front of the intake manifold and fill and bleed the cooling system.

OIL FILTER

The oil filter assembly is shown in Fig. 29.

Removal

1. Place a drip pan under the filter. Remove the filter center bolt, then remove the filter assembly and gasket.
2. Remove the filter element, neoprene gasket, spring and retainer.
3. Remove the center bolt from the container and the fiber gasket from the bolt. Discard the filter element

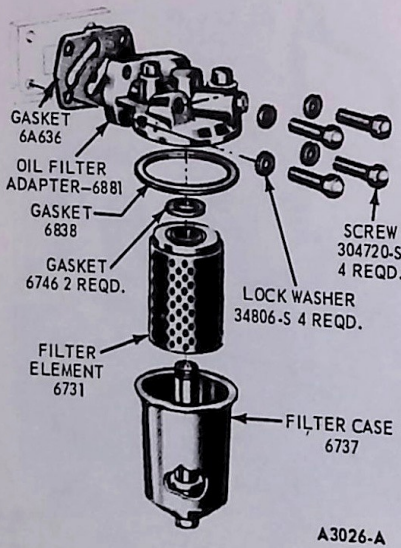


FIG. 29 Oil Filter Assembly

4. Wash all parts in solvent. Make sure all the openings in the center bolt are clean.

Installation

1. Install the new filter element in the housing following the instructions furnished with the new element.
2. Clean the filter adapter recess, then install a new gasket. Place the filter assembly in position, and thread the center bolt into the adapter finger tight.
3. Rotate the filter assembly slightly, in each direction to make sure the gasket is seated evenly. Tighten the center bolt to specifications. **Do not overtighten the center bolt.**
4. Add oil to the crankcase as necessary; then operate the engine at fast idle, and check for leaks.

OIL PAN AND OIL PUMP

Removal

1. Drain the oil from the crankcase and remove the oil level dipstick. Remove the oil pan and discard the gasket.
2. If the oil pump is to be removed, remove the oil pump and pick-up tube assembly. Discard the oil pump gasket. Remove the intermediate drive shaft from the engine.

Installation

1. Insert the oil pump drive shaft into the oil pump.
2. Position a new gasket on the pump housing, prime the pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump, shaft, and pick up tube as an assembly (Fig. 30). **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate shaft into a new position.**
3. Tighten the oil pump attaching bolts to specifications. Remove the old gasket from the oil pan and block gasket surfaces. Position a new gasket on the oil pan.
4. Hold the oil pan in place against the cylinder block and install two of the attaching bolts on each side of the pan. Install the remaining bolts and tighten them from the center outward to specifications.
5. Fill the crankcase and install the oil level dipstick. Operate the engine and check for oil leaks.

ENGINE

The engine removal and installation procedures are for the engine only without the transmission attached.

FIG. 30 Oil Pump and Pick-Up Tube Installed

L- and T-Series

Removal

1. Support the hood and fenders in a vertical position.
2. Drain the cooling system and the crankcase.
3. Disconnect the battery ground strap. Disconnect the crankcase ventilation system hose. Remove the carburetor air cleaner.
4. Remove the fan, radiator shutter, and the fan shroud.

Disconnect the vacuum assist brake line at the intake manifold.

On a vehicle with power steering, disconnect the power steering return line and the pump pressure line at the bracket on the frame left side member. Drain the oil into a suitable container. Disconnect the power steering return line at the pump steering return line at the pump reservoir and the pressure line at the pump housing.

On a vehicle with an air compressor, loosen the outlet line at the air compressor and allow the air to escape, then disconnect the line. Disconnect the air compressor governor line at the air compressor.

5. Disconnect the heater hose at the water pump and at the intake manifold.
6. Disconnect the wires at the coil, and the oil pressure and temperature sending unit wires at the sending units. Remove the wiring harness from the clip at the coil and on the intake manifold, then position the wiring harness on the dash panel.
7. Disconnect the choke cable at the carburetor and position it on the dash panel.
8. Disconnect the oil pressure safety switch wires at the switch.
9. Disconnect the fuel filter inlet line at the flexible hose and remove the retaining clamp at the intake manifold.
10. Disconnect the tachometer drive cable at the governor.
11. Remove the accelerator retracting spring, and remove the accelerator linkage retaining clip at the carburetor.

12. Remove the hand throttle cable from the carburetor and position it on the dash panel. Disconnect the engine ground strap at the dash panel.

13. Disconnect the wiring harness at the alternator.

14. Remove the oil filter.

15. Disconnect the right and left muffler inlet pipes at the exhaust manifolds.

16. Place a jack under the front bumper at the right side and raise the right front of the vehicle. Remove the starter shield and starter, then lower the vehicle and remove the jack.

17. Install the engine lifting eye bolts and sling (Fig. 31).

18. Remove the engine front support to frame attaching bolts, nuts, and washers. Remove the flywheel housing dust cover.

19. Position a jack under the transmission and remove the flywheel housing to engine attaching bolts.

20. Remove the engine from the chassis and install it on a work stand (Fig. 32).

Installation

1. Install guide pins in the two flywheel housing lower bolt holes in the engine.

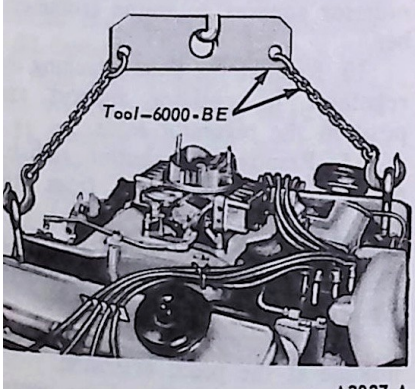
2. Place new muffler inlet pipe gaskets over the exhaust manifold studs.

3. Attach the engine lifting eye bolts and sling (Fig. 38) and remove the engine from the work stand.

4. Carefully lower the engine into the chassis. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and that the guide pins in the cylinder block engage the holes in the flywheel housing.

5. Install two flywheel housing bolts and remove the guide pins. Install the remaining bolts, then tighten all the bolts to specifications.

6. Remove the jack from transmission. Install the flywheel housing dust cover.



A3027-A

G. 31 Engine Lifting ling—Typical

7. Install the engine front support bolts, washers, and nuts; then tighten them to specifications. Install the oil filter. Connect the muffler inlet pipes.

8. Place a jack under the front bumper at the right side and raise the right front of the vehicle. Install the starter and starter shield; then lower the vehicle and remove the jack.

9. Remove the engine lifting eyes and sling. Connect the ignition wires.

Connect the vacuum assist brake line at the intake manifold.

On a vehicle with an air compressor, connect the governor line and the outlet at the air compressor.

On a vehicle with power steering, connect the power steering return line to the pump reservoir and the pressure line at the pump housing. Connect the return line and pressure line to the bracket on the frame left side member.

10. Connect the hand throttle cable, accelerator linkage and retaining clip, and the accelerator return spring.

11. Connect the fuel inlet line and connect the retaining clamp to the intake manifold. Position the wiring harness in the retaining clip at the left rear corner of the intake manifold.

12. Connect the ignition coil wires, the alternator wires, the choke control cable, the tachometer drive cable, the oil pressure and engine temperature sending unit wires, and the oil pressure safety switch wires.

13. Connect the heater return hose to the water pump and the heater inlet hose at the engine.

14. Position the fan shroud in the engine compartment; then install the radiator and radiator shutter. Install the fan blade assembly, then install the fan shroud. Connect the radiator inlet and outlet hoses.

15. Connect the battery ground strap.

16. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.

On a vehicle with power steering, fill the power steering pump following the recommended procedure.

17. Operate the engine at fast idle and check all gaskets and hose connections for leaks.

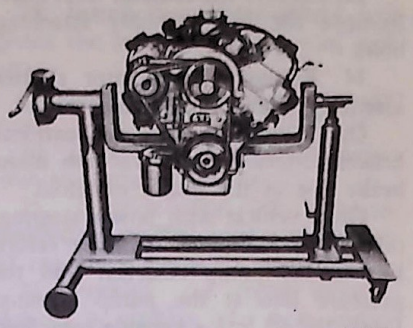
18. Install the air cleaner and connect the closed crankcase ventilation system hose. Secure the hood and fenders in the locked position.

C- and CT-Series

Removal

1. Release the cab lock and tilt the cab forward.

2. Drain the cooling system and the crankcase.



A3028-A

FIG. 32 Engine Work Stand—Typical

3. Disconnect the battery ground cable at the battery. Disconnect the crankcase ventilation hose, and remove the carburetor air cleaner. Remove the oil level dipstick.

4. Disconnect the oil filler hose at the valve rocker arm cover. Disconnect the radiator supply tank tube at the front thermostat housing. Disconnect the cab latch anti-rattle springs, then remove the bracket and tank assembly.

5. Disconnect the resistor, tachometer and distributor wires from the coil. Disconnect the oil pressure and engine temperature wires at the sending units. Disconnect the choke control cable at the carburetor.

6. Disconnect the oil pressure safety switch wires at the switch. Disconnect the heater hoses at the engine and remove the hose retaining bracket from the intake manifold. Remove the heater return hose adapter from the water pump.

7. Disconnect the radiator outlet hose at the water pump and slide the hose downward.

8. Disconnect the wires at the alternator. Loosen the alternator mounting bolts and the adjusting arm bolts, then remove the two drive belts. Remove the oil filter.

9. Remove the starter shield and starter.

10. Disconnect the hand throttle control cable and the accelerator cable at the carburetor. Remove the accelerator cable bracket and the accelerator return spring.

11. Remove the bracket that secures the choke and throttle cables to the radiator bracket. Remove the accelerator cable retaining bracket from the radiator bracket and air deflector.

12. Disconnect the fuel line at the flex line, then remove the line. Disconnect the tachometer drive cable at the governor.

13. Remove the radiator inlet hose. Remove the fan assembly attaching bolts.

14. Remove the radiator shutter assembly, radiator, fan, and shroud.

On a vehicle with conventional brakes, disconnect the vacuum assist brake line at the intake manifold.

On a vehicle with power steering, disconnect the power steering return line at the pump reservoir and the pressure line at the pump housing. Drain the oil into a suitable container. Loosen the pump assembly and remove the drive belt.

On a vehicle with an air compressor, loosen the outlet line at the air compressor and allow the air to escape; then disconnect the line. Disconnect the air compressor governor line at the air compressor. Loosen the air compressor idler pulley and remove the drive belt. Remove the air compressor pulley.

15. Install the engine lifting eye bolts and sling (Fig. 31).

16. Disconnect the muffler inlet pipes at the exhaust manifold.

17. Remove the oil pan. Position a floor jack under the transmission with no pressure applied. Remove the flywheel housing dust cover and the flywheel housing to engine bolts.

18. Disconnect the parking brake clevis pin. Disconnect the engine front support at the frame cross member.

19. Raise the engine approximately one inch and support the transmission with the jack.

20. Remove the engine from the chassis and install it on a work stand (Fig. 39).

Installation

1. Install guide pins in the two lower bolt holes in the cylinder block.

2. Place a new gasket over the exhaust manifold studs.

3. Attach the engine lifting eye bolts and sling (Fig. 31) and remove the engine from the work stand.

4. Carefully lower the engine into the chassis. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes and the guide pins in the cylinder block engage the holes in the flywheel housing.

5. Install two flywheel housing-toengine bolts and remove the guide pins. Install the remaining bolts, then tighten all the bolts to specifications.

6. Install the engine front support bolts, washers, and nuts, then tighten them to specifications.

7. Remove the jack from the transmission. Install the flywheel housing dust cover and the parking brake clevis pin.

8. Install the starter. The engine ground strap is retained by the starter mounting at the starter shield bolt.

9. Connect the muffler inlet pipes to exhaust manifold. Install oil pan and the oil filter.

10. Remove the engine lifting eye bolts and sling.

11. Connect the fuel line to the flex line.

Connect the vacuum assist brake line at the intake manifold.

On a vehicle with an air compressor, install the air compressor pulley and the drive belt. Adjust the belt tension, then tighten the idler pulley. Connect the air compressor governor line and outlet at the air compressor.

On a vehicle with power steering, install the drive belt. Adjust the belt tension, then tighten the pump assembly. Disconnect the power steering return line at the pump housing, and connect the lines at the bracket on the frame left side member.

12. Install the alternator drive belts. Adjust the tension of the belts, then tighten the alternator mounting bolts and the adjusting arm bolts. Connect the alternator wires.

13. Install the oil pressure safety switch. Connect the oil pressure safety switch wires, the choke control cable, and the oil pressure and engine temperature sending unit wires.

14. Install the radiator and shroud assembly in the chassis with the fan positioned in the shroud.

15. Install the fan on the crankshaft damper. Install the radiator shutter assembly.

16. Connect the radiator outlet hose at the water pump and the radiator inlet hose at the intake manifold. Install the radiator drain cock.

17. Apply sealer to the heater return hose adapter and install the adapter in the water pump.

18. Connect the heater hose and install the retaining bracket on the intake manifold.

19. Install the radiator supply tank and bracket (with the coil). The cab lock release spring bracket is retained by the radiator supply tank upper bolt. Connect the radiator supply tank tube to the front thermostat housing. Connect the oil filter hose at the valve rocker arm cover. Connect the cab latch anti-rattle springs.

20. Connect the resistor, tachometer and distributor wires to the coil. Install the oil level dipstick.

21. Install the accelerator cable retaining bracket on the radiator bracket and air deflector. Install the bracket for the choke and throttle cable and tachometer wire on the radiator bracket. Install the accelerator retracting spring.

22. Connect the hand throttle control cable and the accelerator cable at the carburetor. Connect the tachometer drive cable.

23. Connect the battery ground strap.

24. Fill and bleed the cooling system. Fill the crankcase with proper grade and quantity of engine oil.

On a vehicle with power steering, fill the power steering pump following the recommended procedure.

25. Operate the engine at fast idle and check all gaskets and hose connections for leaks.

26. Install the air cleaner. Connect the closed positive crankcase ventilation hose, if so equipped. Lower and lock the cab.

LN-Series

Removal

1. Support the hood and fender in a vertical position.

2. Disconnect the battery ground strap at the battery.

3. Drain the cooling system and the crankcase.

4. Disconnect the radiator upper hose at the intake manifold and the radiator lower hose at the water pump.

5. Disconnect the crankcase ventilation system hose at the air cleaner, and remove the air cleaner assembly.

6. Remove two nuts attaching the radiator support rods to the radiator.

7. Bleed the air system and dis connect the lines from the shutterstat. Disconnect the power steering lines, if so equipped. Drain the oil into a suitable container.

8. Remove the bolts attaching the fan blade to the water pump hub. Remove the fan blade, pulley and belts.

9. Remove the nuts attaching the radiator support to frame crossmember.

10. Remove the bolts attaching the regulator to radiator support and position the regulator aside.

11. Remove the shutter, radiator and support assembly from th vehicle.

12. Disconnect the heater hoses at the water pump and at the intak manifold.

13. Disconnect the accelerat linkage at the pedal extension.

14. Disconnect the choke cont and throttle control cables at carburetor.

15. Disconnect the tachometer cable at the governor.
16. Disconnect the flex fuel line at the tank line.
17. Disconnect the fuel cut-off switch and the oil pressure sending unit wires.
18. Disconnect the temperature and safety switch wires from the sending units.
19. Disconnect the coil secondary high tension wire from the coil and remove the bolt attaching the wiring harness to the intake manifold. Disconnect the coil primary wire from the coil. Position the harness out of the way.
20. Remove the nut attaching the alternator-ground wire to the alternator. Disconnect alternator lead wires.
21. Remove the nuts attaching the right-hand exhaust inlet pipe to the exhaust manifold. Remove the pipe.
22. Remove the nuts attaching the left exhaust inlet pipe to the exhaust manifold. Remove the pipe.
23. Disconnect the starter cable at the starter and remove the starter shield and starter.
24. Remove the bolts attaching the flywheel housing cover to the engine and flywheel housing.
25. On a vehicle equipped with an air compressor, loosen the outlet line at the air compressor and allow the air to escape, then disconnect the line. Disconnect the air compressor governor line at the air compressor.
26. Remove the engine front support attaching bolts, nuts and washers.
27. Remove the accelerator retract ing spring and the fuel inlet line from the carburetor.
28. Disconnect the distributor vacu um line at the carburetor and the governor control rod from the carburetor.
29. Remove the nuts and washers retaining the carburetor to the intake manifold and remove the carburetor.
30. Install eye bolts in the left front and right rear cylinder head tapped holes. Attach lifting tool 6000-BE.
31. Position the floor crane to the engine and attach the chain to the lifting tool.
32. Position a floor jack under the transmission and raise it approximately 1/2-inch.
33. Remove the bolts attaching the engine to the flywheel housing.
34. Remove the engine from the ve hicle.

Installation

1. Attach the engine lifting eye bolts and sling and remove the engine from the work stand.
2. Carefully lower the engine into the chassis. Make sure the exhaust manifolds are properly aligned with the muffler inlet pipes, and that the clutch disc is properly centered (Group 16).
3. Install the bolts that attach the engine to the flywheel housing and tighten to specifications.
4. Remove the lifting sling and eye bolts from the engine.
5. Remove the jack from under the transmission.
6. Install the engine front support bolts, washers, and nuts, then tighten them to specifications.
7. Position the carburetor to intake manifold gasket on the manifold, and install the carburetor with the washers and nuts.
8. Connect the governor control rod to the carburetor.
9. Connect the distributor vacuum line and fuel inlet line to the carburetor.
10. Connect the tachometer cable to the governor.
11. Connect the throttle cable and choke to the carburetor. Connect the accelerator retracting spring.
12. Connect the accelerator linkage to pedal extension.
13. Connect the lead wires and ground wire to the alternator.
14. Position the wiring harness to the engine and connect the temperature sending unit, safety switch, and coil. Install a ground bolt to the intake manifold. Connect the coil secondary high tension wire to the coil.
15. On a vehicle equipped with an air compressor, connect the outlet line and governor line to the compressor. On a vehicle equipped with power steering, connect the power steering lines.
16. Connect the fuel line to the tank line.
17. Position the starter gasket and install the starter to the engine with one bolt, washer, and nut. Do not tighten.
18. Install the starter shield and tighten the starter attaching nuts and bolts.
19. Connect the starter cable to the starter.
20. Install the flywheel housing cover and attaching bolts.
21. Position the left exhaust manifold to muffler inlet pipe gasket and connect the pipe to the manifold.
22. Position the right exhaust manifold to muffler inlet pipe gasket and connect the pipe to the manifold.
23. Position the radiator shutter, radiator, and support assembly in the vehicle.
24. Install the washers and nuts attaching the radiator support to the crossmember.
25. Install the water pump pulley, drive belts and fan.
26. Connect the radiator lower hose to the water pump and the upper hose to the intake manifold.
27. Connect the heater hose to the water pump and the intake manifold.
28. Adjust the belt tension.
29. Connect the radiator support rods to the radiator support.
30. Connect the lines to the shutterstat.
31. Install the air cleaner assembly. Connect the crankcase ventilation system hose to the air cleaner.
32. Install the regulator on the radiator support.
33. Fill and bleed the cooling system.
34. Fill the crankcase with the proper grade and quantity of engine oil.

On a vehicle with power steering, fill the power steering pump following the recommended procedure.

35. Connect the battery ground strap to the battery.
36. Operate the engine at fast idle and check all gaskets and hose connections for leaks. Make necessary adjustments.
37. Close the hood and fenders and lock in place.

5 MAJOR REPAIR OPERATIONS

To perform the operations in this section with the exception of those on the cylinder head, valve rocker arm shaft, oil pump and piston and connecting rod, it will be necessary to remove the engine from the vehicle and install it on a work stand. For engine removal and installation procedures, refer to Section 4.

When installing nuts or bolts (refer to the torque specitications at end of this Part), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 33.

Removal

1. Remove the alternator adjusting arm attaching bolt and spacer from the cylinder front cover. Loosen the alternator mounting bolts and pivot the alternator toward the engine and remove the drive belts.
2. Remove the power steering pump and drive belts.
3. Remove the air compressor idler pulley and drive belt.
4. Remove the crankshaft damper retaining nut, then remove the crankshaft damper (Fig. 14).
5. Remove the key from the crankshaft. Remove the cylinder front cover.
6. Remove the oil slinger. If it is necessary to remove the crankshaft gear, remove the gear at this time with the tool shown in Fig. 16.
7. Invert the engine on the workstand. Remove the clutch pressure plate and disc. Remove the flywheel. Remove the oil pan and gasket. Remove the oil pump.
8. **Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in the original locations.** Remove the connecting rod bearing caps. Turn the crankshaft until the connecting rod from which the cap is being removed is at the bottom of its stroke. After the cap is removed, push the connecting rod and piston assembly up in the cylinder.
9. Remove the main bearing caps.
10. Carefully lift the crankshaft (and gear if it was not removed) out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid damage to the finish surfaces.**

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap. Remove the side seals.
2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.

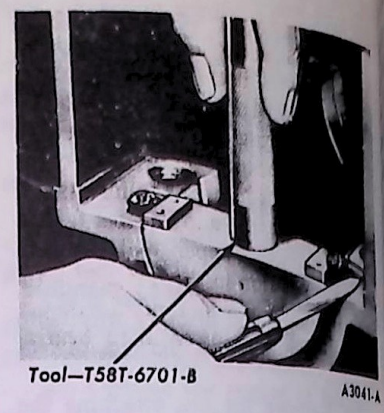
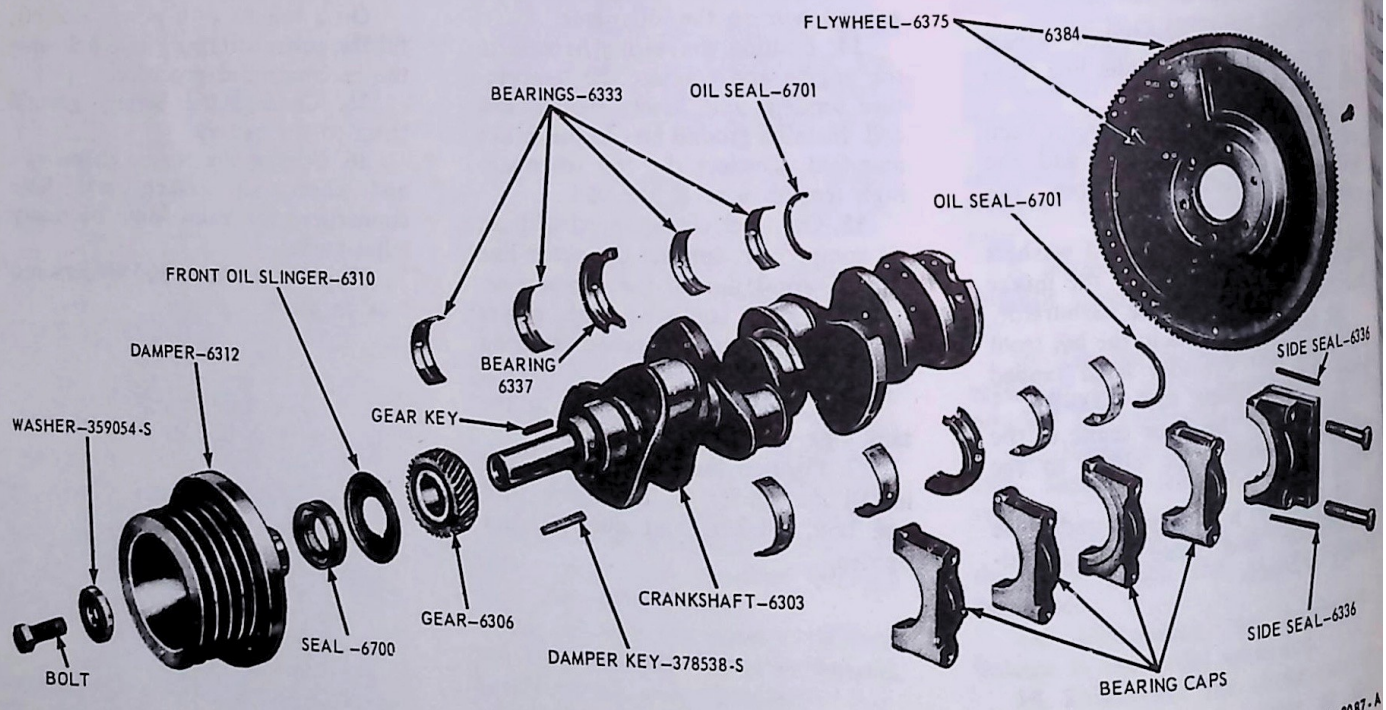


FIG. 34 Installing Oil Seal

4. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap. Preform the new seal by hand to the ap proximate radius of the cap.

Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, and then press both ends of the seal into the groove, working from the ends to the center. Position the seal forming tool as shown in Fig. 41 and complete the seal installation. After installation, cut the ends of the seals flush.

It is very important that the seal be cut flush with the surface of the



cylinder block. This prevents rough edges which may project from the groove and lodge between the bearing cap and cylinder block.

5. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.

6. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.

7. Install the lower main bearing inserts in the bearing caps.

8. Carefully lower the crankshaft (and gear if not removed) into place. **Be careful not to damage the bearing surfaces.** Align the timing mark on the crankshaft gear with the mark on the camshaft gear as the gears are meshed.

9. Check the clearances of each main bearing as detailed in Part 21-01.

10. After the bearings have been fitted, apply a coat of heavy engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No.3 bearing). **Be sure that the main bearing caps are installed in the original locations. Torque the bearing cap bolts to specifications.**

11. Install the thrust bearing cap with the bolts finger tight.

12. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 24).

13. Hold the crankshaft forward and pry the thrust bearing cap to the rear . This will align the thrust surfaces of both halves of the bearing.

14. Retain the forward pressure on the crankshaft. Torque the cap bolts to specifications.

15. Force the crankshaft toward the rear of the engine.

16. Install a dial indicator so the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 31).

17. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, they probably need alignment. Install the thrust bearing and align the faces following the recommended procedure (steps 11 thru 14), then check the end play.

18. Install the rear main bearing cap oil seal and side seals; then check the seals for leaks by following steps 16 thru 19 under Main Bearing Replacement.

19. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.

20. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under Connecting Rod Bearing Replacement.

21. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

22. Install the connecting rod cap. Torque the nuts to specifications.

23. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 27).

24. Clean the oil pan, oil pump, and oil pump screen.

25. Position the flywheel on the crankshaft. Install the attaching bolts. Torque the bolts to specifications.

Use tool 7653 to center the clutch disc. Install the pressure plate.

If the crankshaft gear was removed, install it on the crankshaft with the tool shown in Fig. 20 with timing marks on the camshaft gear and crankshaft gear in alignment (Fig. 15).

26. Install the oil slinger. Install the cylinder front cover and related parts and the crankshaft damper following the procedure under Cylinder Front Cover and Timing Gears Installation.

27. Prime the oil pump and install the oil pump and the oil pan.

28. Install the air compressor idler pulley and drive belt. Adjust the drive belt tension. Position the alternator adjusting arm and spacer on the cylinder front cover. Install the drive belt and adjust the tension. Tighten the alternator attaching bolts.

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and 0.015-inch undersize journal diameters. The No. 1 camshaft bearing is not interchangeable with the other bearings.

Removal

1. Remove the flywheel, crankshaft and camshaft.

2. Push the pistons to the top of the cylinders to move the connecting rods out of the way.

3. Remove the camshaft rear bearing bore plug.

4. Remove the camshaft bearings.

If the camshaft bearings are being removed with the tool shown in Fig. 35 the following procedure will apply. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearing at the bearing bores, and press them in place with the tool shown in Fig. 35. Be sure to center the pulling plate and the puller screw to avoid damage to the bearing. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the bearings with the oil holes in the cylinder block when the bearings are installed. Particular care should be taken with the No. 2 and 4 bearings because they supply oil to the valve rocker arms. Be sure the front bearing is installed below the front face of the cylinder block to specifications.

2. Install the camshaft rear bearing bore plug as detailed in Part 21-01.

3. Clean and install the camshaft, crankshaft, flywheel, and related parts. Install the engine in the vehicle.

ENGINE DISASSEMBLY

1. Remove the distributor cap and spark plug wires as an assembly.

2. Remove the cooling system air vent lines.

3. Remove the coil.

4. Disconnect the governor control rod at the governor.

5. Remove the carburetor fuel inlet line. Remove the crankcase ventilation regulator valve and exhaust tube.

6. Slide the clamp on the intake manifold coolant outlet hose toward the water pump.

7. Remove the intake manifold retaining bolts; then remove the intake manifold assembly.

8. Remove the intake manifold coolant outlet hose elbow and gasket from the intake manifold and remove the front thermostat.

9. Remove the rear thermostat housing cover and gasket; then remove the rear thermostat.

10. Remove the distributor.

11. Remove the governor.

12. Remove the valve push rod cover attaching screws, then remove the cover. Discard the cover gasket.

13. Remove the spring tension on the valve rocker arms by loosening the adjusting screws.

14. Remove the valve rocker arm shaft assembly and the oil baffle plate.

15. Remove the valve push rods in sequence (Fig. 10).

16. Install standard eye bolts with 5/8-18 threads in the cylinder head and attach the engine lifting sling (Fig. 11).

17. Remove the remaining cylinder head bolts. Raise the cylinder head and carefully remove it from the engine.

18. Place the cylinder head on a work bench and remove the exhaust manifold and heat shield, then install the holding fixtures. The flat washers can be reused.

19. Loosen the oil filter center bolt; then remove the filter assembly and gasket.

20. Remove the oil filter adapter and discard the gasket.

21. Remove the oil cooler cover, gasket, oil cooler, and gasket.

22. Remove the relief valve plug and gasket; then remove the spring and plunger.

23. Invert the engine on the work stand.

24. Remove the oil pan. Discard the gasket.

25. Remove the oil pump. Discard the gasket. Remove the intermediate drive shaft from the engine.

26. Remove the clutch from the flywheel.

27. Remove the flywheel.

28. Remove the drive belts.

29. Remove the damper cap screw and washer. Install the removal tool and remove the damper (Fig. 14).

30. Remove the alternator and adjusting arm as an assembly.

31. Remove the air compressor.

32. Remove the water pump assembly and the engine front support bracket.

33. Remove the cylinder front cover. Discard the gasket.

34. Remove the valve tappets keeping them in order so that they can be installed in their original position (Fig. 20).

35. Remove the camshaft gear, spacer, thrust plate and camshaft as an assembly (Fig. 21).

36. Remove the crankshaft front oil slinger.

37. Remove the crankshaft gear (Fig. 16).

38. Turn the engine on the workstand so that the front is up.

39. Remove any ridge and/or deposits from the upper end of the cylinder bores with Tool T64L-6011-EA, or equivalent. Turn the crankshaft until the piston to be removed is at the bottom of its travel. Place a cloth on the piston heads to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

40. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in the original locations.

41. Turn the crankshaft until the connecting rod being removed is down.

42. Remove the nuts from the connecting rod bolts, then pull the cap off the rod.

43. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the pistons and rod.**

44. Remove the bearing inserts from the connecting rod and caps.

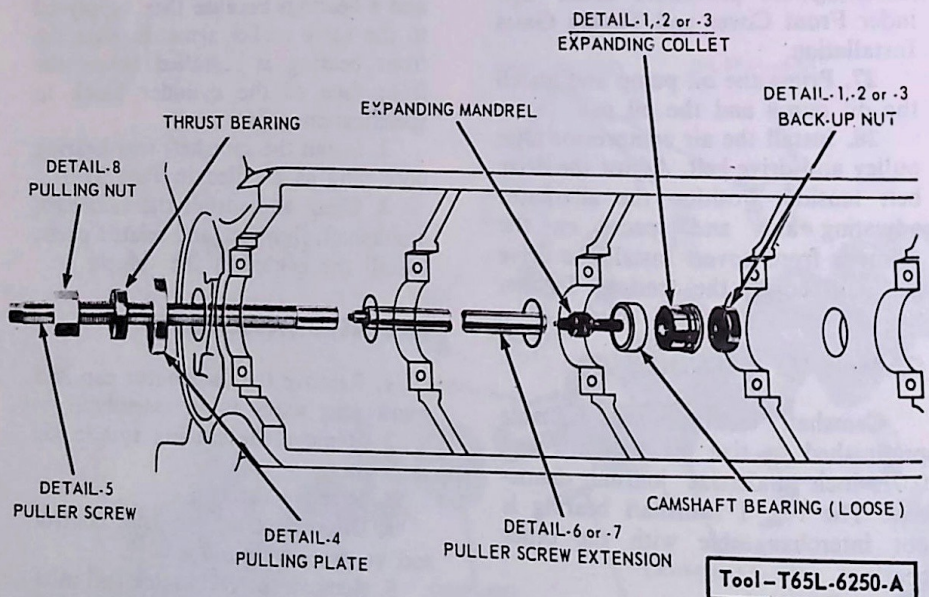
45. Remove the main bearing caps.

46. Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible damage to the finished surfaces.**

47. Remove the rear journal oil seal from the block and rear main bearing cap. Remove the rear bearing cap to block side seals.

48. Drill a 1/2-inch hole in the camshaft rear bearing bore plug and use tools T-59L-100-B and T58L-101-A to remove the plug.

49. Remove the camshaft bearings (Fig. 35).



C44 FIG. 35 Replacing Camshaft Bearing

ENGINE ASSEMBLY

Many of the procedures given here are condensed from other sections of this group. For more detailed steps, refer to the index at the beginning of this part or Part 21-01. These indexes will show the pages on which more detailed instructions can be found.

1. Position the new camshaft bearing at the bearing bore, and align the oil holes in the bearings with the

oil holes in the cylinder block. Press each bearing into place as shown in Fig. 35. **Be sure the camshaft front bearing is installed below the front face of the cylinder block to specifications.**

2. Check the oil passage that feeds the rocker arm shafts for obstructions by squirting oil into the opening on each cylinder bank and observing the flow through the oil holes at No. 4 camshaft bearing for the left bank and No. 2 camshaft bearing for the right bank.

3. Install a new camshaft rear bearing bore plug as detailed in Part 21-01.

4. If a new camshaft is to be installed, remove the gear, spacer, and thrust plate from the old camshaft and install them on the new camshaft, then install the camshaft.

5. Apply heavy oil on the camshaft bearing journals, camshaft gear and bearings. Apply Lubriplate or equivalent to all camshaft lobes. Carefully slide it through the bearings with the gear, spacer, and thrust place attached (Fig. 21). Be sure the camshaft is in stalled so that the timing mark on the camshaft gear is aligned with the center of the crankshaft front bearing bore.

6. Install the thrust plate attaching bolts and tighten them to specifications. Check camshaft end play.

7. Be sure that the rear journal oil seal grooves are clean. Install a new rear journal oil seal in the block. Preform the new seal by hand to the approximate radius of the cap.

Insert the seal in the oil seal groove, seating the center of the seal first and allowing the seal to extend equally on both ends. Press the seal down firmly with the thumb at the center of the seal, and then press both ends of the seal into the groove, working from the ends to the center. Position the seal forming tool as shown in Fig. 34 and complete the seal installation. After installation, cut the ends of the seal flush.

8. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean.

Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.

10. Carefully lower the crankshaft into place so that the timing mark on the gear is aligned with the timing mark on the camshaft gear (Fig. 15). **Be careful not to damage the bearing surfaces.**

11. Check the clearance of each main bearing following the procedure in Part 21-01 Fitting Bearings with Plastigage.

12. After the bearings have been fitted, apply a light coat of heavy engine oil to the journals and bearings, then install all the bearing caps except the thrust bearing cap (No. 3 bearing). Install the rear main bearing cap oil seal and side seals, then check the side seals for leaks by following steps 16 thru 19 under Main Bearing Replacement. Torque the bearing cap bolts to specifications.

13. Install the thrust bearing cap and check crankshaft end play by following steps 11 thru 17 under Crankshaft Installation. Check the camshaft gear backlash (Part 21-01).

14. Turn the engine on the workstand so that the front end is up.

15. Install the pistons and connecting rods by following steps 1 thru 8 under Piston and Connecting Rod Installation.

16. Clean the cylinder front cover, water pump, and the cylinder block gasket surfaces. Install a new front oil seal.

17. Coat the gasket surface of the cover and block and the cover bolt threads with sealer.

18. Position a new gasket on the block; then install the cylinder front cover.

19. Install the engine front support bracket. Clean, inspect and polish the oil seal rubbing surface on the crankshaft damper hub (Part 21-01). Install the crankshaft damper (Fig. 19).

20. Refer to Fig. 28 for the oil cooler assembly. Install the relief valve plunger (with the open end up), spring, gasket and plug in the cover. Place a new oil cooler gasket with sealer on both sides on the block. Position the oil cooler in the block. Place a new gasket on the cover with sealer on both sides of the gasket. Install the cover. Tighten the cover bolts to specifications.

21. Apply water-resistant sealer to the water pump gaskets and position them on the block. Install the water pump assembly.

22. Install the alternator.

23. Install the air compressor. Install the air compressor idler arm pulley on the cylinder front cover.

24. Install and adjust the drive belts. Install the fan.

25. Invert the engine on the work stand.

26. Insert the oil pump drive shaft into the oil pump.

27. Position a new gasket on the oil pump housing, prime the pump, and install the oil pump, shaft, and pickup tube as an assembly (Fig. 30). Tighten the oil pump attaching screws to specifications at the end of this Part.

28. Remove old gasket sealer from the oil pan and block gasket surfaces.

29. Position a new gasket on the oil pan. Hold the oil pan in place against the cylinder block and install two of the attaching screws on each side of the pan. Install the remaining screws and tighten them from the center outward to specifications at the end of this Part.

30. Position the flywheel on the crankshaft and install the attaching bolts. Tighten the bolts to specifications.

31. Install the clutch on the flywheel.

32. Clean the oil filter adapter gasket surfaces. Apply oil-resistant sealer to a new adapter gasket, and install the adapter assembly and gasket. Install the oil filter assembly following the procedure under Oil Filter Replacement.

33. Clean the old gasket from the cylinder head and block gasket surfaces. Coat the threads of the cylinder head bolts with engine oil.

34. Remove the cylinder head holding fixtures.

35. Install the gaskets and the exhaust manifolds and the spark plugs.

36. Install standard eye bolts with 5/8-18 threads in the cylinder head and attach the engine lifting sling.

37. Guided by the word TOP on the gasket, install the gasket over the cylinder head dowels. **Gasket sealer must not be used on the cylinder head gasket.**

38. Position the cylinder head on the engine (Fig. 13). Slide the flat washers on the cylinder head bolts. Install the five outside bolts with the flat washers but do not tighten. Remove the lifting sling and eye bolts.

39. Dip the tappet foot in Lubriplate or equivalent. Coat the remainder of each tappet and tappet bore with heavy engine oil. Install the tappets in their original bore.

40. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods in their proper sequence, making sure the lower ends are positioned in the tappet socket.

41. Position the oil baffle plate and the valve rocker arm shaft assembly on the cylinder head.

42. Install the remaining five cylinder head bolts and flat washers but do not tighten.

43. The cylinder head bolt tightening procedure is performed in three progressive steps. Follow the sequence shown in Fig. 12. Tighten the bolts to 130-140 ft-lbs torque, then to 150-160 ft-lbs torque. Finally tighten them to specifications. When the cylinder head bolts have been tightened as detailed in this procedure, it is not necessary to retorque them after extended operation.

44. Perform a preliminary valve clearance adjustment (Part 21-01). The final valve clearance adjustment is made with the engine installed in the vehicle.

45. Coat one side of the valve push rod cover gasket with oil-resistant sealer. Lay the cemented side of the gasket in place on the block and cylinder head. Install the cover by following step 11 under Cylinder Head Installation.

46. Using a new gasket, position the governor assembly on the cylinder block and install the washers and attaching nuts.

47. Crank the engine until No. 1 piston is on TDC at the end of the compression stroke.

48. Inspect the distributor O-ring seal and replace it if it is damaged. Position the distributor in the block with the rotor at the No. 1 firing position and the breaker points just start to open. Install the hold down clamp.

49. Clean the intake manifold gasket surfaces (including the front and rear thermostat housing gasket surface if the thermostats were removed).

50. If the thermostats were removed, position them in their respective housing. **Be sure the lower temperature thermostat is installed in the rear of the manifold and the higher temperature thermostat is installed in the front of the manifold.** Apply water-resistant sealer to the thermostat housing gaskets and position them on the intake manifold. Install the intake manifold coolant outlet elbow and the rear thermostat housing cover.

51. Apply oil-resistant sealer to the intake manifold gaskets and position them on the cylinder heads.

52. Position the intake manifold assembly on the cylinder heads. Install the intake manifold bolts and lock washers; then tighten the bolts to specifications.

Install the crankcase ventilation valve and exhaust tube.

53. Install the cooling system air vent lines, the distributor cap and spark plug wire assembly. Install the coil. Connect and adjust the governor linkage.

54. Clean the valve rocker arm cover(s). Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s) in place in the cover(s).

55. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts (and the wire harness clamps on the left cover). The cover is tightened in two steps. Torque the bolts to specifications. Two minutes later, torque the bolts to the same specifications.

CYLINDER HEAD

Disassembly

The cylinder head assemblies are interchangeable from one side of the block to the other, provided the coolant air vent line plate is installed at the front of each cylinder head.

1. Install the cylinder head holding fixtures. Remove the deposits from the cylinder head and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surface.**

2. Compress the valve springs (Fig. 36), then remove the spring retainer lock, and release the spring.

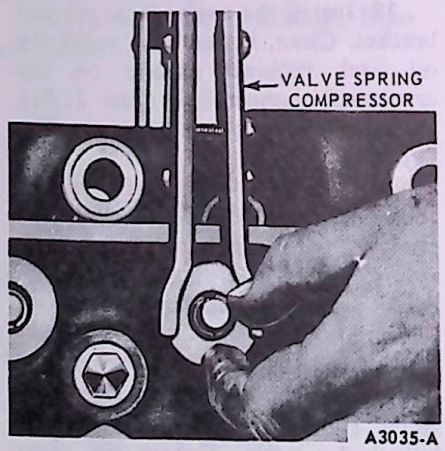


FIG. 36 Compressing Valve Spring

3. Remove the spring retainer, pring, stem seal, and valve. Discard the valve stem seals. Identify all valve parts.

Assembly

1. Lubricate the valve guides and valve stems with heavy engine oil MS. Apply Lubriplate to the tip of the valve stems.

2. Install each valve (Fig. 37) in the valve guide from which it was removed or to which it was fitted.

3. Install a new stem seal on the valve.

4. Position the valve spring over the valve, then install the spring retainer.

5. Compress the spring and install the retainer lock (Fig. 36).

6. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with a scale (Fig. 38).

7. If the assembled height is greater than the specified height, install the necessary 0.030-inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to within specified length. **Do not install spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.**

VALVE ROCKER ARM SHAFT

Disassembly

1. Remove the cotter pins from each end of the valve rocker arm shaft.

2. Slide the rocker arms, springs and the supports off the shaft. Be sure to identify all parts.

3. If it is necessary to remove the plugs from each end of the shaft, drill or pierce one plug; then insert a steel rod through the drilled plug and knock out the plug on the opposite end. Working from the open end, knock out the remaining plug.

Assembly

1. Lubricate all valve parts with heavy engine oil. Apply Lubriplate to the pad of the valve rocker arms.

2. If the plugs were removed from the ends of the shaft, use a blunt tool, or large diameter pin punch and install a plug, cup side out, in each end of the valve rocker arm shaft.

3. Install a cotter pin in one end of the shaft; then install the rocker arms, supports, and springs in the order shown in Fig. 39. Complete the assembly by installing a cotter pin in the end of the shaft.

OIL PUMP

Disassembly

The oil pump assembly is shown in Fig. 40.

1. Remove the oil pick-up tube and screen assembly from the oil

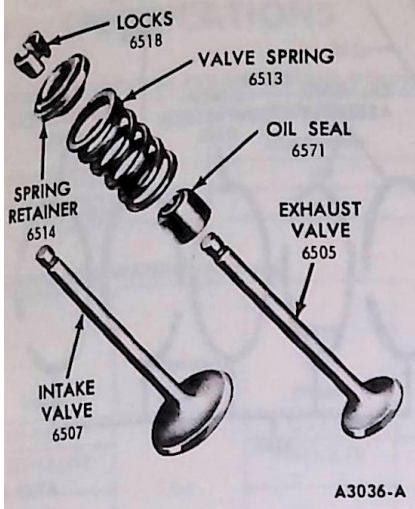


FIG. 37 Valve Assembly

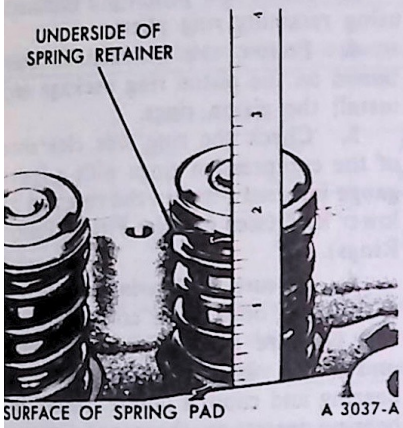


FIG. 38 Valve Spring Assembled Height

pump and discard the gasket.

2. Remove the oil screen retaining wire and remove the screen.

3. Remove the cover attaching bolts, then remove the cover.

4. Remove the inner rotor and shaft assembly, then remove the outer race.

5. Insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

Assembly

1. Clean and oil all parts thoroughly.

2. Install the oil pressure relief valve plunger, spring, gasket, and new cap.

3. Install the outer race, and the inner rotor and shaft assembly (Fig. 40). **Be sure to assemble the outer race so the dimple identification on the race is on the same side as the dimple on the rotor. The inner rotor and shaft, and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.**

4. Install the cover and tighten the cover attaching bolts to specifications.

5. Install the screen and retaining wire in the pick-up tube.

6. Position a new gasket and the oil pick-up tube on the oil pump and install the attaching bolts.

7. Prime the pump installing it on the engine by filling either the inlet

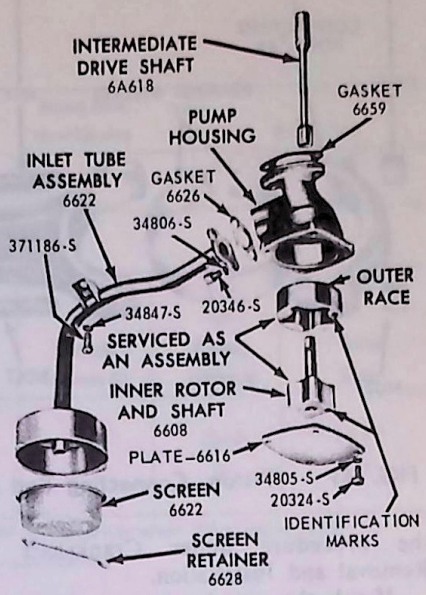


FIG. 40 Oil Pump Assembly

or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

CRANKSHAFT REAR OIL SEAL

To correct an oil leakage condition both the upper and lower crankshaft rear seals must be replaced. Remove the engine; then, remove the crankshaft and replace the seals, following

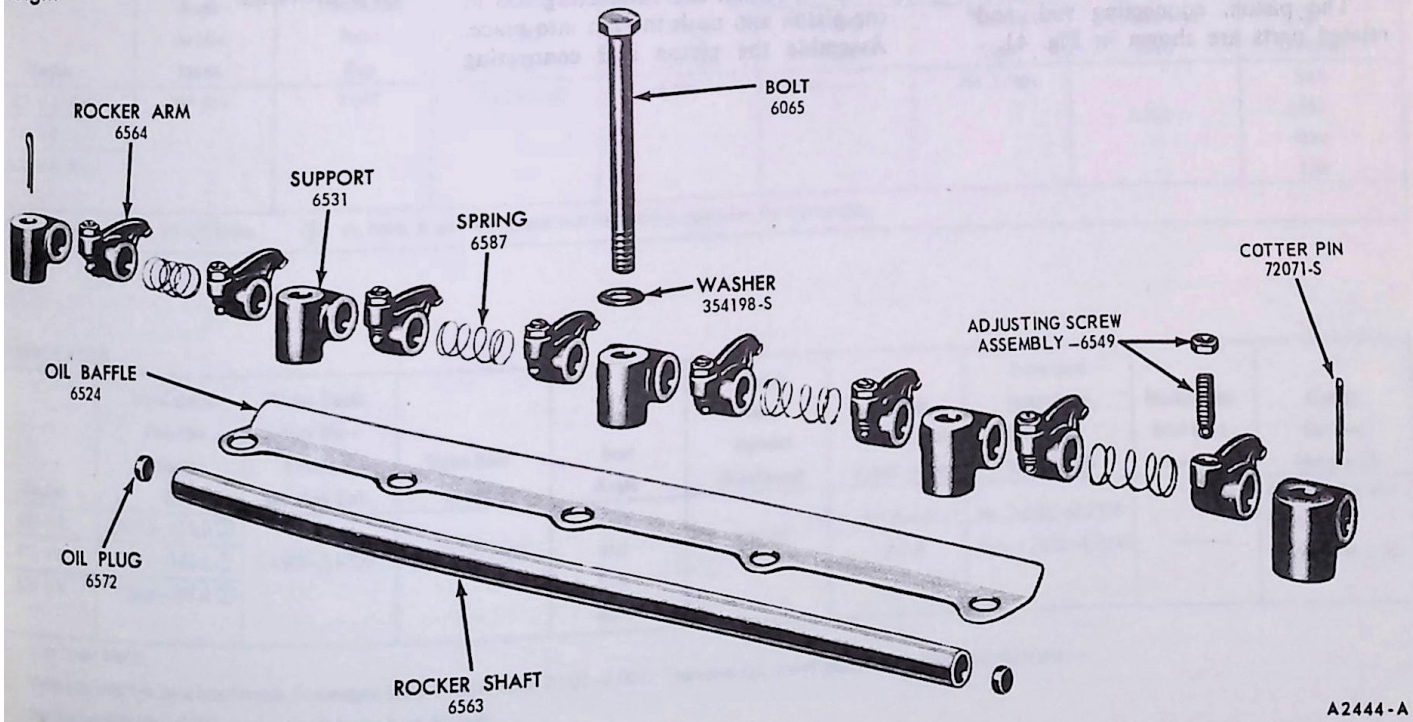


FIG. 39 Valve Rocker Arm Shaft Assembly

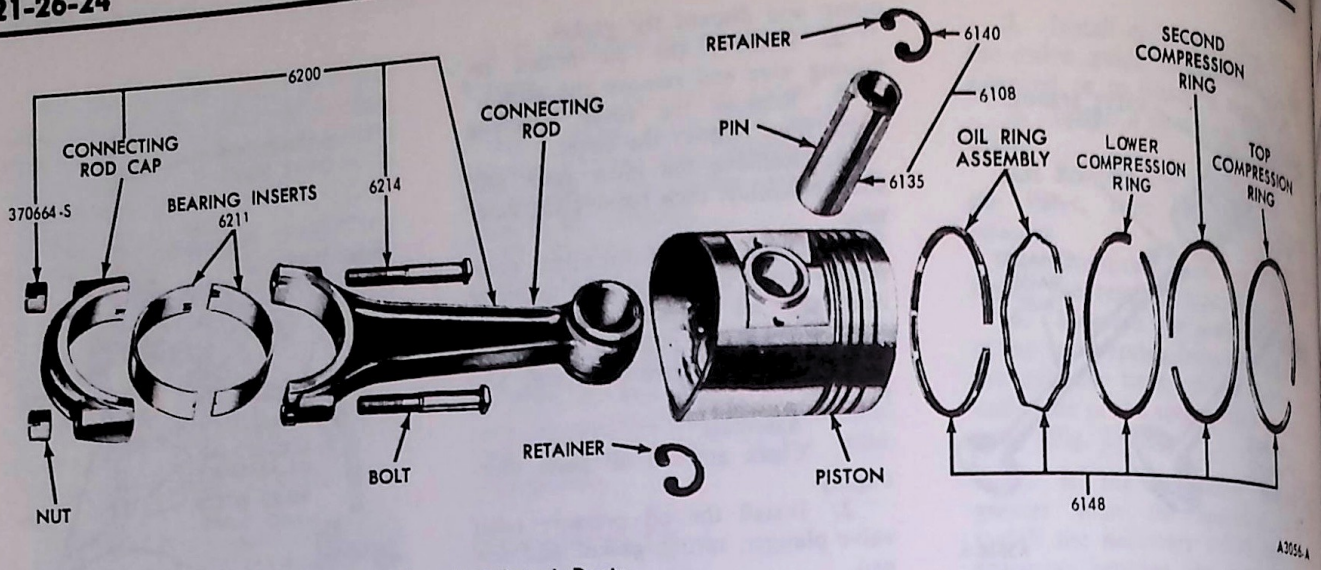


FIG. 41 Piston, Connecting Rod and Related Parts

the procedure under Crankshaft Removal and Installation.

If only the main bearings are being replaced while the engine is in the vehicle, it is generally only necessary to replace the lower seal.

PISTON AND CONNECTING ROD

Disassembly

1. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed.
2. Remove the piston rings. Remove the piston pin retainers using retaining ring pliers. Drive the pin out of the piston and rod. Discard the retainers.

Assembly

The piston, connecting rod, and related parts are shown in Fig. 41.

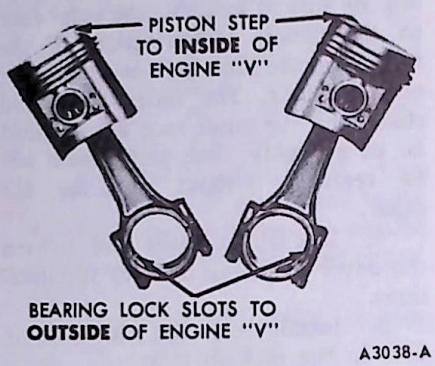


FIG. 42 Connecting Rod and Piston Assembly

1. Lubricate all parts with heavy engine oil prior to installation.
2. Position the connecting rod in the piston and push the pin into place. **Assemble the piston and connecting rod as shown in Fig. 42.**
3. Insert new piston pin retainers using retaining ring pliers.
4. Follow the instructions contained on the piston ring package and install the piston rings.
5. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (step 6 under Fitting Piston Rings).
6. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

9 SPECIFICATIONS

ENGINE IDENTIFICATION AND APPLICATION–HEAVY DUTY TRUCK–GASOLINE

Engines	Rating Plate Identification	Application		Engines	Rating Plate Identification	Application
401 V-8 (4V)	H	L,LT,LN,LNT,C,CT-900		534 V-8	L	L,LT,LN,LNT,C,CT-900
477 V-8 (4V)	K	L,LT,LN,LNT,C,CT-9000				

GENERAL SPECIFICATIONS (Continued)

Engine	Compression Ratio	Bore And Stroke	Taxable Horsepower	Brake Horsepower @ Specified rpm (Gross)	Torque-Ft-Lbs @ Specified rpm (Gross)	Compression Pressure ③	Engine Idle Manifold Vacuum ②	Oil Pressure 2000 rpm	Firing Order
401 V-8 (4V)	7.5:1	4.125 x 3.75	65.00	226 @ 3600	343 @ 20-2600		17	35-60 psi	1-5-4-8-6-3-7-2
477 V-8 (4V)		4.50 x 3.75		253 @ 3400	415 @ 20-2600				
534 V-8 (4V)		4.50 x 4.20		266 @ 3200	481 @ 16-1800				

① Engine No. Shown is the Piston Displacement in Cubic Inches.

② Minimum inches of Mercury @ specified engine rpm (sea level). This includes automatic transmission in neutral. Subtract 1 inch of mercury for engines equipped with daul diaphragm distributors.

③ Lowest reading must be within 75% of highest to be within specifications.

ENGINE PERFORMANCE SPECIFICATIONS–MEDIUM AND HEAVY DUTY TRUCK

Engine ①	Curb Idle RPM ①		Fast (Cold) Idle RPM		Initial② Ignition Timing		Engine Governed Speed-RPM			
							Manual Transmission		Automatic Transmission	
	Auto. Trans.	Std. Trans.	Auto. Trans.	Std. Trans.	Auto. Trans.	Std. Trans.	Full Load	No Load	Full Load	No Load
401 V-8 (4V)	500	550	2300	2300	8° BTC	8° BTC	3400	2500-3600	3600	3800
477 V-8 (4V)							3200	2500-3400	3400	3600
534 V-8 (4V)							3000	2500-3200	3200	3400

① Adjusted with headlights on, automatic transmission drive, and A/C operating at maximum cooling.

② If the individual requirements of the vehicle and/or the use of sub-standard fuels dictate, the initial timing may have to be retarded from the recommended setting to eliminate detonation (spark knock). If retarding is necessary, it should be done progressively and not to exceed 2° BTDC.

ENGINE PERFORMANCE SPECIFICATIONS (Continued)–MEDIUM AND HEAVY DUTY TRUCK

Engine	Dwell Angle At Idle Speed	Distributor Point Gap	Spark Plug Gap	Spark Plug No. ①	Accelerator Pump Setting		Valve Lash (Cold Or Hot) or Clearance (Hot)	Belt Tension ② (Ft-Lbs)
					Pump Link	Throttle Lever		
401 V-8 (4V)	26°-31°	0.017	0.028-0.032	BTF-31	———	No. 2 Hole	0.020	New 140 Used 110
477 V-8 (4V)								
534 V-8 (4V)								

① Installation torque 15–20 ft-lbs. ② All belts. A used belt is one that has been in operation for 10 minutes.

CYLINDER HEAD

Engine	Combustion Chamber Volume–CC	Valve Guide Bore Dia–Standard Int. And Exh.	Valve Seat Width	Valve Seat Angle	Valve Seat Runout (Maximum)	Valve Arrangement Front to Rear	Valve Seat Insert Bore Diameter–Standard ②	Rocker Arm Stud Bore Dia–Std	Gasket Surface Flatness ③
401 V-8	109.5–114.0 ①	0.4368–0.4375	0.090–0.110	Int. and Exh. 45°	0.0015	E-1-E-1-1–E-1-E	Int. 2.2165–2.2175 Exh. 1.7405–1.7415	———	0.003 inch in any 6 inches or an overall of 0.007
477 V-8	138.0–143.5 ①								
534 V-8	155.5–161.0 ①								

1 In cylinder block.

2 Valve seat insert to bore interference fit-standard (intake and exhaust 0.002–0.004). The valve seat insert diameter-standard minimum and standard maximum is 0.003 larger than the insert bore diameter.

3 Head gasket surface finish RMS 90–150

CA1218-A

VALVE ROCKER ARMS, ROCKER ARM SHAFT, PUSHRODS AND TAPPETS

Engine	Rocker Arm Shaft O D	Rocker Arm To Rocker Shaft Clearance	Rocker Arm Bore Diameter	Rocker Arm Lift Ratio	Valve Push Rod (Maximum Runout)	Valve Tappet or Lifter		
						Standard Diameter	Clearance To Bore ②	Hydraulic Lifter Leakdown Rate
401,477,534	0.781–0.782	0.0010–0.0030 ①	0.7830–0.7840	1;58:1	0.025	0.8740–0.8745 –	0.0005–0.0020	–

① Wear Limit – 0.0070 ② Wear Limit– 0.005

VALVE SPRINGS

Engine	Valve Spring Pressure– Lbs @ Specified Length		Valve Spring Free Length (Approx)	Valve Spring Assembled Height (Pad to Retainer)	Valve Spring Out of Square (Max)
	Pressure	Wear Limit			
401,477,534	73–81 @ 1.70 171–189 @ 1.28	65 @ 1.70	2.02	1-11/16–1-23/32	5/64 (0.078)

VALVES

Engine	Valve Stem to Valve Guide Clearance		Valve Head Diameter		Valve Face Angle	Valve Face Runout (Maximum)
	Intake	Exhaust	Intake	Exhaust		
401,477,534	0.0010–0.0027 ①	0.0024–0.0040 ①	2.015–2.025	1.630–1.640	44°	0.0020

① Wear Limit 0.0055

Engine	Valve Stem Diameter							
	Standard		0.003 Oversize		0.015 Oversize		0.030 Oversize	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
401,477,534	0.4349–0.4358	0.4335–0.4344	0.4379–0.4388	0.4365–0.4374	0.4499–0.4508	0.4485–0.4494	0.4649–0.4685	0.4635–0.4644

CAMSHAFT

Engine	Lobe Lift		Theorectical Valve Lift		Camshaft		Camshaft Journal to Bearing Clearance ②
	Intake	Exhaust	Intake	Exhaust	End Play	Wear Limit	
401,477,534	0.2780	0.2780	0.439	0.439	0.003–0.007	0.012	0.001–0.003

① Maximum allowable lobe lift loss (All Engines) 0.005 ② Wear Limit – 0.006

CAMSHAFT (Continued)

Item	Bearing	Engine 401,477,534
Camshaft Journal Diameter–Standard ①	(No. 1)	2.4740–2.4750
	(No. 2)	2.37–2.3710
	(No. 3)	
	(No. 4)	
	(No. 5)	
Camshaft Bearings Location ②	(No. 1)	0.310–0.330

Item	Bearing	Engine 401,477,534
Camshaft Bearings Inside Diameter	(No. 1)	2.4760–2.4770
	(No. 2)	2.3720–2.3730
	(No. 3)	
	(No. 4)	
	(No. 5)	

① Camshaft Journal maximum runout..... 0.008
Camshaft Journal maximum out-of-round..... 0.0010

② Distance in inches that the front edge of the bearing is installed towards the rear from the front face of the cylinder block.

CAMSHAFT DRIVE MECHANISM

Engine	Camshaft Gear To Crankshaft Gear Backlash	Camshaft Gear or Sprocket		Crankshaft Gear or Sprocket		Timing Chain Deflection (Maximum)
		Face Runout T I R Max	Assembled Face Runout T I R Max	Face Runout T I R Max	Assembled Face Runout T I R Max	
401,477,534	0.002–0.004	–	0.006	–	0.006	–

CA1218-A1

CYLINDER BLOCK

Engine	Cylinder Bore Diameter ①	Cylinder Bore Diameter 0.003 OS	Tappet Bore Diameter	Main Bearing Bore Diameter	Distributor Shaft Bearing Bore Diameter	Head Gasket Surface Flatness ②
401	4.1250–4.1274	4.1274–4.1286	0.875–0.876	3.3176–3.3184	0.4525–0.4535	0.003 inch in any 6 inches or an overall of 0.006 inch
477, 534	4.5000–4.5024	4.5024–4.5036				

① Maximum out-of-round 0.001
Wear Limit 0.005
Maximum taper 0.001

Wear Limit 0.010
Cylinder bore surface finish RMS 15–35
② Head gasket surface finish RMS 401, 477 and 534 60–150

CRANKSHAFT AND FLYWHEEL

Engine	Main Bearing Journal Diameter ①	Main Bearing Journal Runout–Maximum ②	Main Bearing Journal Thrust Face Runout	Main Bearing Journal Max. Taper	Thrust Bearing Journal Length	Main and Rod Bearing Journal Finish R M S Max.	Main and Rod Bearing Journal Thrust Face Finish R M S
401, 477, 534	3.1246–3.1254	0.0025	0.001	0.0003 Per Inch	1.279–1.281	12	20

① Maximum Out-of-round 0.0004 ② Wear Limit 0.004

Engine	Connecting Rod Journal Diameter ①	Connecting Rod Bearing Journal Maximum Taper	Crankshaft Free End Play	Crankshaft To Rear Face of Block Runout T I R Max.	Flywheel Clutch Face Runout	Flywheel O D Runout	
						Standard Transmission	Automatic Transmission
401, 477, 534	2.7092–2.7100	0.0004 Per Inch	0.004–0.008 ②	0.010	0.010	0.018	0.020

① Maximum Out-of-round 0.0004 ② Wear Limit 0.012

CRANKSHAFT BEARINGS

Engine	Connecting Rod Bearings			Main Bearings		
	To Crankshaft Clearance		Wall Thickness –Standard ①	To Crankshaft Clearance		Wall Thickness –Standard ②
	Desired	Allowable		Desired	Allowable	
401, 477, 534	0.0015–0.0025	0.0015–0.0035	0.0957–0.0962	0.0015–0.0025	0.0015–0.0035	0.0951–0.0955 ③

① 0.002 U. S. thickness ..... Add 0.0010 to standard thickness
② 0.002 U. S. thickness ..... Add 0.0010 to standard thickness
③ Thrust Bearing Wall Thickness 0.0949–0.0954

CONNECTING ROD

Engine	Piston Pin Bore or Bushing I D ①	Connecting Rod Bearing Bore Diameter ②	Connecting Rod Length Center to Center	Connecting Rod Alignment Max. Tot. Difference ③		Connecting Rod Assembly (Assembled to Crankshaft)	
				Twist	Bend	Side Clearance	Wear Limit
401, 477, 534	1.2201–1.2204	2.9032–2.9040	7.7390–7.7410	0.012	0.004	0.0060–0.0140	0.0170

① Piston pin bushing or bore
Maximum out-of-round 0.0002
Maximum taper 0.0002

② Connecting rod bearing bore maximum out-of-round and taper 0.0004
③ Pin bushing and crankshaft bearing bore must be parallel and in the same vertical plane within the specified total difference at ends of 8-inch long bar measured 4 inches on each side of rod.

PISTON

Engine	Diameter ①			Piston To Cylinder Bore Clearance ②	Piston Pin Bore Diameter	Ring Groove Width			
						Compression			Oil
	Coded Red	Coded Blue	0.003 Oversize			Top	Intermed.	Bottom	
401	4.1233–4.1239	4.1245–4.1251	4.1257–4.1263	0.0028–0.0034	1.2202–1.2205	0.0965–0.0975	0.0965–0.0975	0.0965–0.0975	0.1880–0.1890
477, 534	4.4983–4.4989	4.4995–4.5001	4.5007–4.5013						

① Measured 90 to pin centerline and at pin centering height.
② Refer to Part 21–01 in Shop Manual for the proper procedures for measuring piston to bore clearance. Wear limit 0.008

CA 1218-A2

PISTON PIN

Engine	Length	Diameter Standard	Diameter 0.001 Oversize	Diameter 0.002 Oversize	To Piston Clearance	To Connecting Rod Bushing Clearance
401	3.335–3.350	1.2198–1.2201	1.2208–1.2211	1.2218–1.2221	0.0003–0.0005	0.0001–0.0006 ①
477, 534	3.840–3.855					

① Wear Limit 0.0010

PISTON RINGS

Engine	Ring Width: Compression Ring ① Top	Ring Width: Compression Ring ① Bottom	Ring Width: Oil Ring	Side Clearance: Compression Ring ① Top	Side Clearance: Compression Ring ① Bottom	Side Clearance: Oil Ring	Ring Gap: Compression Ring Top	Ring Gap: Compression Ring Bottom	Ring Gap: Oil Ring
401,477 534	0.0929–0.0936	0.0930–0.0940	0.1859–0.1866	0.0029–0.0046 ①	0.0025–0.0045 ②	0.0014–0.0045 ③	0.018–0.039	0.015–0.036 ②	0.013–0.039

① Intermediate ring width and clearance is same as top compression ring
② Intermediate ring gap is the same as bottom compression ring
③ Wear limit 0.0600
④ Wear limit 0.0070

WATER PUMP

Engine and Model	Water Pump Pulley to Engine Ratio: Low Fan	Water Pump Pulley to Engine Ratio: Crankshaft Mounted	Water Pump Assembly Dimensions: Front Face of Pulley Hub Pump Housing Face	Water Pump Assembly Dimensions: Impeller to Housing Cover Mounting Surface Clearance
401,477,534 Conventional Cab	0.90:1	1.00:1	5.48	0.0005–0.025
401,477,534 Tilt Cab	0.95:1	–	–	–

FRONT FACE OF SHAFT TO FRONT FACE OF HUB OR PULLEY

401, 477, 534	0.732–0.738	Pulley 0.812–0.818

OIL PUMP

Engine	Relief Valve Spring Tension-Lbs @ Specified Length	Drive Shaft To Housing Bearing Clearance	Relief Valve Clearance	Rotor Assembly End Clearance– (Pump Assembled)	Outer Race To Housing (Radial Clearance)
401	10.7–11.9 @ 1.07	0.0015–0.002	0.0015–0.0029	0.0010–0.0035	0.006–0.011
477,534					

APPROXIMATE OIL PAN CAPACITIES

Crankcase Capacity (Quarts)	ENGINE			
	401, 477 and 534 V-8			
	U.S. Measure	9.00 ①	Imperial Measure	7.20 ①

① Add two quarts extra when changing oil filter

TORQUE LIMITS

NOTE: All values given are in Ft-Lbs unless otherwise stated. Oil threads with lightweight engine oil unless the threads require oil resistant or water-resistant sealer.

Item	Engines Applicable	Torque	Item	Engines Applicable	Torque
Cylinder Head Bolts Step 1	401, 477, 534	130–140	Oil Pan to Cylinder Block	401, 477, 534	10–13
Cylinder Head Bolts Step 2	401, 477, 534	150–160	Oil Pan Drain Plug	401, 477, 534	25–35
Cylinder Head Bolts Step 3	401, 477, 534	170–180	Intake Manifold to	401, 477, 534	23–28
Main Bearing Cap Bolts	401, 477, 534	130–150	Cylinder Head		

CA1216-A

TORQUE LIMITS (Continued)

NOTE: All values given are in Ft-Lbs unless otherwise stated. Oil threads with lightweight engine oil unless the threads require oil resistant or water resistant sealer.

Item	Engines Applicable	Torque
Exhaust Manifold to Cylinder Head	401, 477, 534	23–28
Intake to Exhaust Manifold	–	–
Oil Pump to Cylinder Block	401, 477, 534	23–28
Oil Pump Cover Plate	401, 477, 534	6–9
Oil Filter Center Bolt	401, 477, 534	45–50
Flywheel to Crankshaft	401, 477, 534	100–110
Exhaust Manifold to Muffler Inlet Pipe	Light Trucks	25–35
	Medium and Heavy Duty Trucks	25–30
Engine Governor to Cylinder Block	401, 477, 534	23–28
Valve Rocker Arm Adjustment Screw-Locknut	401, 477, 534	30-35
Oil Filter Adapter to Cylinder Block	401, 477, 534	14–19
Damper or Pulley to Crankshaft	401, 477, 534	130–145
Water Pump To Cylinder Block to Front Cover	401, 477, 534	23–28
Oil Pick-Up Tube To Oil Pump	401, 477, 534	12–15
Valve Rocker Arm Cover	401, 477, 534	5–7
Valve Push Rod Chamber Cover	401, 477, 534 Center End Bolts	10
	Side Bolts	7
Fuel Pump to Cylinder Block Or Cylinder Front Cover	–	–
Oil Cooler to Cylinder Block	401, 477, 534	20–25
Connecting Rod Nuts	401, 477, 534	60–65
Fuel Filter Center Bolt	401, 477, 534	18–22
Cylinder Front Cover	401, 477, 534	35–40
Water Outlet Housing	401, 477, 534	23–28
Camshaft Sprocket or Gear to Camshaft	401, 477, 534	20–24
Camshaft Thrust Plate to Block	401, 477, 534	12–15

MEDIUM AND HEAVY TRUCK ENGINE SUPPORT TORQUE LIMITS

Supports	Engine	Application	Thread Size	Torque Ft-Lbs
Front	401–477 and 534 V 8	Engine Front bracket to crossmember	5/8–18	145–165
		Engine Front Mounting Bracket To Engine Cover	3/8–16	31–42
		Insulator to Spacers	1/2–13	75–105
		Engine Front Support Bracket to Front Support	1/2–13	75–105
Rear	401–477 and 534 V 8	Engine Rear Support to Clutch Housing Bracket	5/8–18	145–165
		Engine Rear Mounting Bracket to Clutch Housing	1/2–13	75–105
		Cap to Support	5/8–18	75–105
		Engine Rear Support Bracket to Frame	1/2–13	75–105
			5/8–11	150–205

GENERAL TORQUE LIMITS

TORQUE LIMITS FOR VARIOUS SIZE BOLTS.

NOTE: The torque values in this table are to be used ONLY for standard bolts and nuts where a specific torque value has not been listed in the preceding tables.

Size (Inches)	1/4–20	1/4–28	5/16–18	5/16–24	3/8–16	3/8–24
Torque (Ft-Lbs)	6–9	6–9	12–15	15–18	23–28	30–35
Size (Inches)	7/16–14	7/16–20	1/2–13	1/2–20	9/16–18	5/8–18
Torque (FT-Lbs)	45–50	50–60	60–70	70–80	85–95	130–145

SEALERS

Item	Ford Part No.
Loctite (thread locking compound)	C3AZ 19554-A

CA1218-A4

PART 23-01 General Ignition Service

Model Application – All Gas Engines

Model Application – All Gas Engines

All 1971 truck gasoline engines are equipped with the Imco Exhaust Emission Control System. Positive crankcase ventilation is continued on all gasoline-powered trucks.

E-Series and F-100 trucks using the 240-6 or 302 V-8 engine and automatic transmission are equipped with an electronic distributor modulator for closer control of the spark advance during low-speed and idle operation. Additionally, E-Series and F-100 trucks equipped with 240-6 engines and manual transmission offered for sale in California have this device installed. This control is designed to further reduce engine exhaust emission. Service information on this and other distributor control devices is given in Part 23-15.

Distributor specifications (Parts 23-10 and 23-16) have been, in some cases, changed. New distributor part numbers reflect these changes.

Other than the above, the 1971 ignition systems are basically the same as the 1970 systems.

To maintain the required exhaust emission levels, the carburetor must be kept in good operating condition and be adjusted to specifications, and the engine should be in good operating condition.

Additional engine performance checks are required to keep the exhaust emissions at the specified minimum pollutant level. Refer to the applicable owners manual for these performance checks and the recommended intervals.

When performing tests, adjustments or repairs to the engine, ignition system or fuel system, it is essential to follow the procedures and specifications in Groups 21, 23 and 24 of this manual.

This part covers conventional ignition system description, test, adjustments and repair operations.

Distributor control systems, such as electronic modulators, vacuum control valves and related mechanisms are covered in Part 23-15.

Complete engine performance specifications, including engine, ignition and fuel system components, are covered in Group 12. All other specifications for ignition system components are coverd in Parts 23-10 and 23-16.

For distributor removal, disassembly, assembly, installation, major repair procedures and specification, refer to the pertinent part of this group.

DISTRIBUTOR IDENTIFICATION

The distributor identification number is stamped on the distributor housing. The basic part number for ungoverned distributors is 12127. To procure replacement parts, it is necessary to know the part number prefix and suffix and, in some cases, the design code change (Fig. 1).

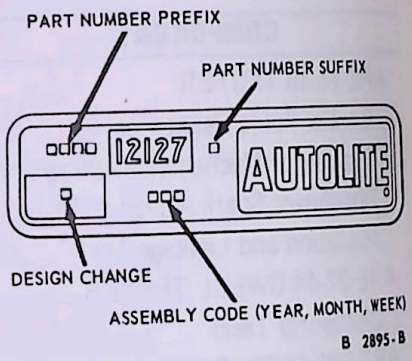


FIG. 1 Distributor Identification

Always refer to the Master Parts Catalog for parts usage and interchangeability before replacing a distributor or a component part for a

2 TESTING

GENERAL INFORMATION

Conventional Ignition System

The conventional ignition system consists of a primary (low voltage) and a secondary (high voltage) circuit (Fig. 2).

The primary circuit consists of the:

1. Battery.
2. Ignition switch.
3. Primary circuit resistance wire.
4. Primary windings of the ignition coil.
5. Breaker points.
6. Condenser.

The secondary circuit consists of the:

1. Secondary windings of the ignition coil.
2. Distributor rotor.
3. Distributor cap.
4. High tension wires.
5. Spark plugs.

When the breaker points are closed, current flows from the battery through the ignition switch to the primary windings in the coil, then to ground through the closed breaker points. When the breaker points open, the magnetic field built up in the primary windings of the coil moves through the secondary windings of the coil producing high voltage. **High voltage is produced each time the breaker points open.** The high voltage flows through the coil high tension lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the distributor cap. This process is repeated for every power stroke of the engine.

Transistor Ignition System

The permatuned transistor ignition system is available on the 361, 391, 401, 477 and 534 V-8 engines. Figure 3 shows a schematic of the transistor ignition system.

The ignition coil primary in the transistor system is designed to draw 12 amperes peak current, or approximately 5.5 amperes average current as indicated on an ammeter, in order to provide high spark plug voltage at the higher engine speeds.

The transistor in the system acts as a heavy duty switch or relay. It is similar in action to a horn relay, except that it has no moving parts, and thus acts with very little time lag. The transistor is connected between the battery and the coil, and is used to make and break the coil primary circuit.

The distributor controls the transistor. The 7.1-7.9-ohm resistor, connected between the distributor and the transistor (in the wiring harness), limits the transistor control current (and distributor point current) to 0.5 ampere. The low distributor point current eliminates pitting and gives long distributor point life.

The amplifier assembly (Fig. 4) is mounted away from the engine to protect the parts from engine heat.

A ceramic ballast resistor block and a tachometer connector block are mounted in the engine compartment.

The tachometer block is used to connect a tachometer or other test equipment into the circuit. **Do not connect test equipment into the circuit in any other manner, or readings will be inaccurate and damage may occur to the transistor, or change its operating characteristics.**

Connect the tachometer red lead to the tachometer block small terminal and black lead to the large terminal, when making tests.

DIAGNOSIS

Refer to the appropriate Section of the Truck Diagnosis Manual for diagnosis procedures.

Transistor Ignition System

Do not use any testing procedures or conventional shortcuts other than those listed below, or extensive damage can result to the system.

TESTS

Spark Intensity Test

Trouble Isolation

1. Disconnect the brown wire from the starter relay I terminal and the red and blue wire from the starter relay S terminal.
2. Remove the coil high tension lead from the distributor cap.
3. Turn on the ignition switch.
4. While holding the high tension lead approximately 3/16 inch from the cylinder head or any other good ground, crank the engine by using an auxiliary starter switch between the starter relay battery and S terminals.

If the spark is good, the trouble lies in the secondary circuit.

If there is no spark or a weak spark, the trouble is in the primary circuit, coil to distributor high tension lead, or the coil.

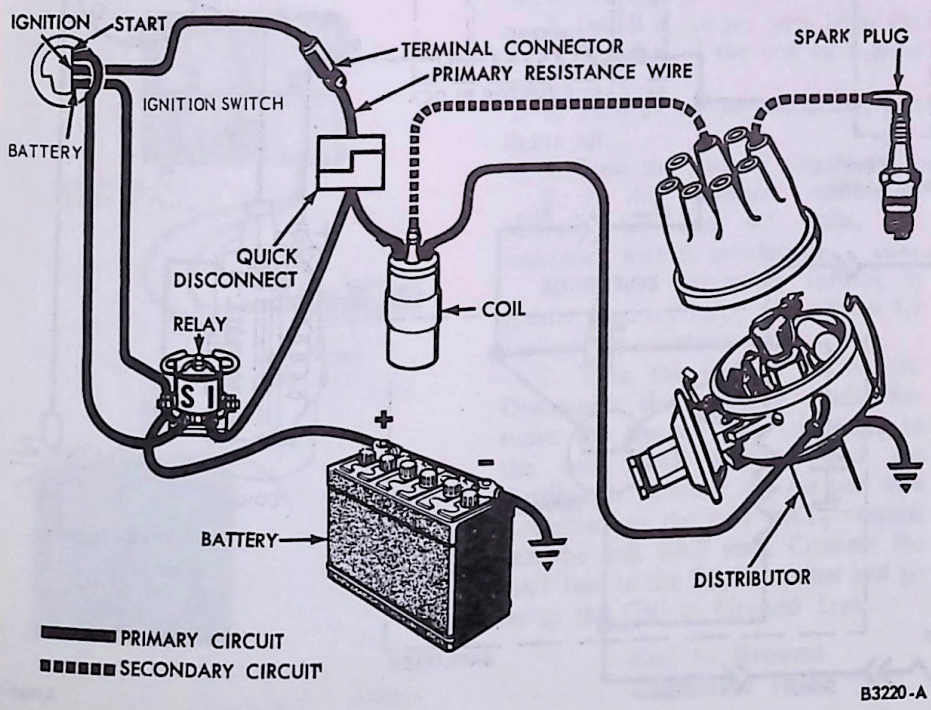


FIG. 2 Typical Conventional Ignition System Circuit

Primary Circuit

A breakdown or energy loss in the primary circuit can be caused by: defective primary wiring, or loose or corroded terminals; burned, shorted, sticking or improperly adjusted breaker points: a defective coil; or defective condenser.

A complete test of the primary circuit consists of checking the circuit from the battery to the coil, the circuit from the coil to ground, and the starting ignition circuit.

Excessive voltage drop in the primary circuit will reduce the secondary output of the ignition coil, resulting in hard starting and poor performance.

To isolate a trouble in the primary circuit, use a voltmeter and perform the following tests: Battery to Coil; Starting Ignition Circuit; Resistance Wire; Coil to Ground; or Breaker Points.

Secondary Circuit

A breakdown or energy loss in the secondary circuit can be caused by: fouled or improperly adjusted spark plugs; defective high tension wiring; or high tension leakage across the coil, distributor cap or rotor resulting from an accumulation of dirt.

To check the spark intensity at the spark plugs, thereby isolating an ignition problem to a particular cylinder, proceed as follows:

1. Disconnect a spark plug wire. **Check the spark intensity of one wire at a time.**
2. Install a terminal adapter in the terminal of the wire to be checked. Using insulated pliers hold the adapter approximately 3/16-inch from the exhaust manifold and crank the engine, using a remote starter switch. The spark should jump the gap regularly.
3. If the spark intensity of all the wires is satisfactory, the coil, condenser, rotor, distributor cap and the secondary wires are probably satisfactory.

If the spark is good at only some wires, check the resistance of the faulty leads.

If the spark is equal at all wires, but weak or intermittent, check the coil, distributor cap and the coil to distributor high tension wire. The wire should be clean and bright on the conducting ends, and on the coil tower and distributor sockets. The wire should fit snugly and be bottomed in the sockets.

Battery to Coil Voltmeter Test

1. Connect the voltmeter leads as shown in Fig. 5.

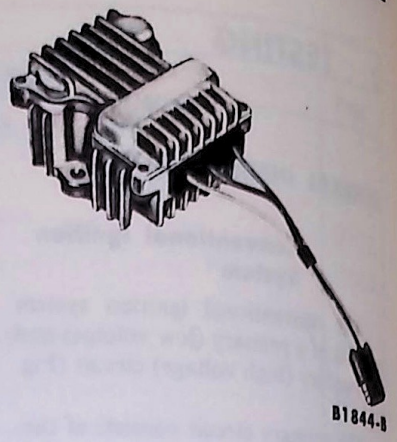


FIG. 4 Amplifier Assembly

2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor housing.
3. Turn the lights and accessories off.
4. Turn the ignition switch on.
5. If the voltmeter reading is between 4.5 and 6.9 volts, the primary circuit from the battery to the coil is satisfactory.
6. If the voltmeter reading is greater than 6.9 volts, check the following:

The battery and cables for loose connections or corrosion.

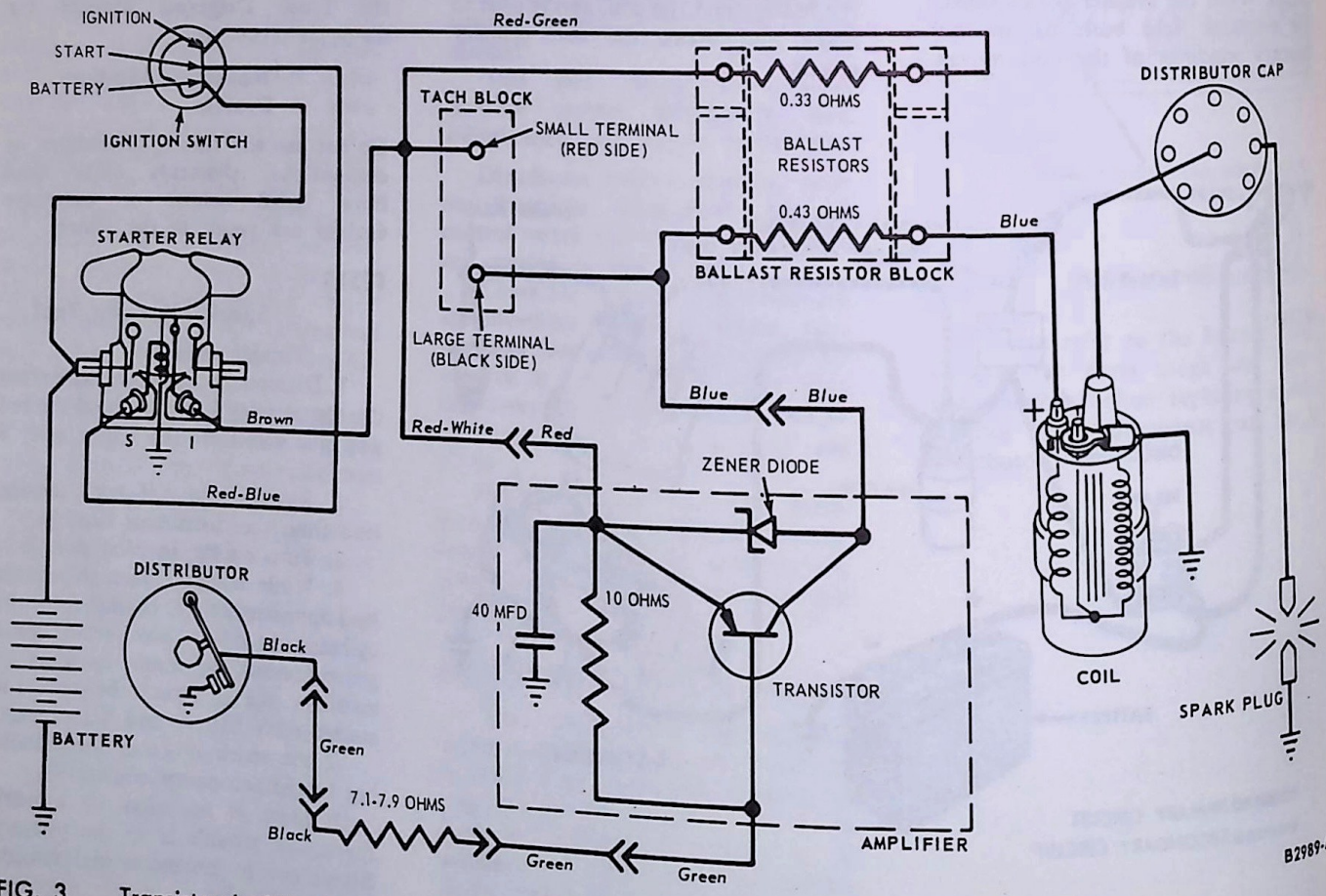


FIG. 3 Transistor Ignition System

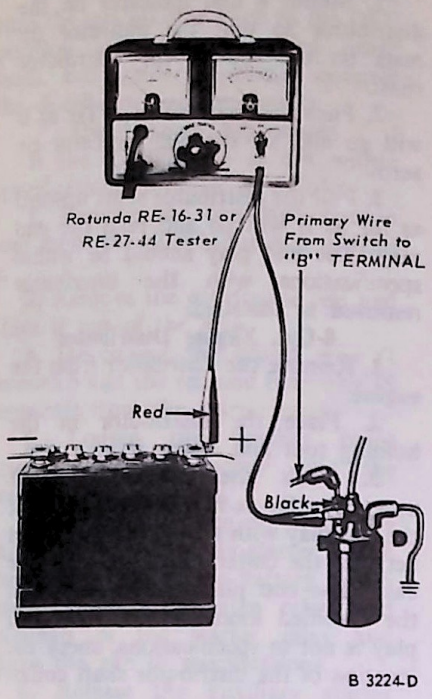


FIG. 5 Battery-to-Coil and Starting Ignition Circuit Test

The primary wiring for worn insulation, broken strands, and loose or corroded terminals.

The resistance wire for damage.

The starter relay to ignition switch for malfunctions.

If the voltmeter reading is less than 4.5 volts the resistance wire should be replaced.

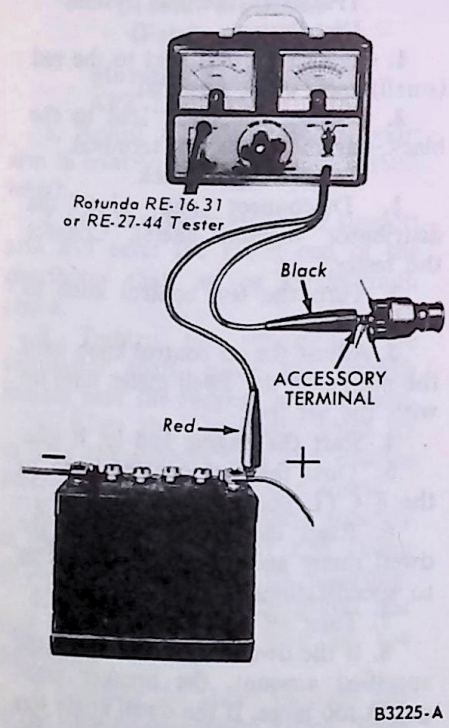


FIG. 6 Ignition Switch Test

Starting Ignition Circuit Voltmeter Test

1. Connect the voltmeter leads as shown in Fig. 5.
2. Disconnect and ground the coil to distributor high tension lead at the distributor.
3. With the ignition switch off, crank the engine by installing a jumper wire between the battery and the S terminal of the starter relay while observing the voltage drop.
4. If the voltage drop is 0.1 volt or less, the starting ignition circuit is satisfactory.
5. If the voltage drop is greater than 0.1 volt, clean and tighten the terminals in the circuit or replace the wiring as necessary.

Ignition Switch Voltmeter Test

1. Connect the voltmeter leads as shown in Fig. 6.
2. Install a jumper wire from the distributor terminal of the coil to a good ground on the distributor body.
3. Turn all of the accessories and lights off.
4. Turn the ignition switch on.
5. If the voltmeter reading is 0.3 volt or less, the ignition switch and the relay to switch wire are satisfactory.
6. If the voltmeter reading is greater than 0.3 volt, the ignition switch and/or the wire are defective.

Resistance Wire Voltmeter Test

1. Connect the voltmeter leads as shown in Fig. 7.
2. Install a jumper wire from the DIST terminal of the coil to a good ground.
3. Turn all of the accessories and lights off.
4. Turn the ignition switch on.
5. If the voltmeter reading is between 6.6 and 4.5 volts, the resistance wire is satisfactory.
6. If the voltmeter reading is greater than 6.6 volts, or less than 4.5 replace the resistance wire.
7. Turn the ignition switch off. Disconnect the voltmeter leads. Remove the jumper wire connected to the coil DIST terminal and the distributor. Remove the jumper wire connected to the coil BAT terminal and the coil BAT lead. Connect the BAT lead to the BAT terminal and go on to the Coil to Ground Test.

Coil to Ground Voltmeter Test

1. Connect the voltmeter leads as shown in Fig. 8.

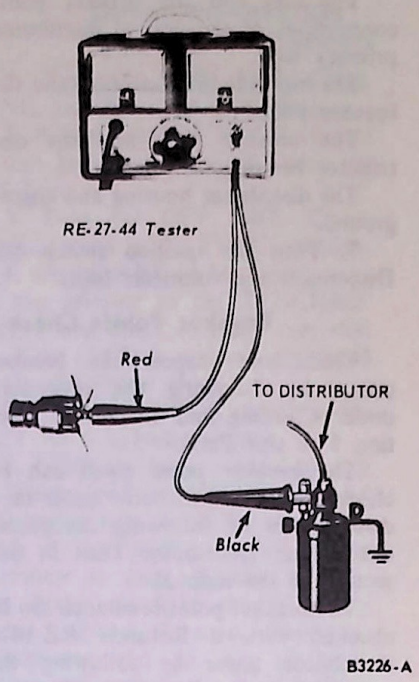


FIG. 7 Resistance Wire Test

2. Close the breaker points.
3. Turn all lights and accessories off.
4. Turn the ignition switch on.
5. If the voltmeter reading is 0.25 volt or less, the primary circuit from coil to ground is satisfactory.
6. If the voltmeter reading is greater than 0.25 volt, test the voltage drop between each of the following:

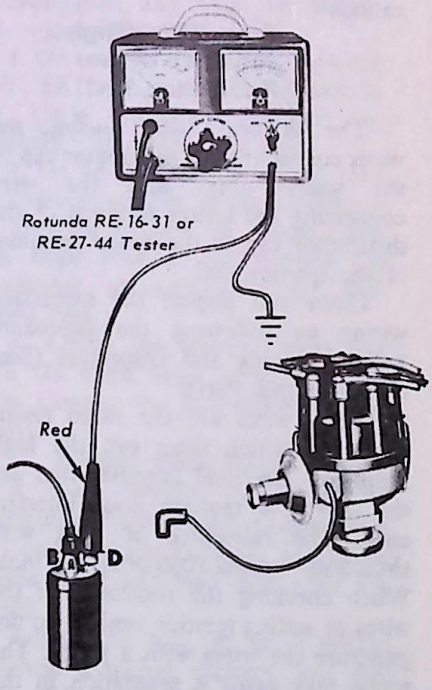


FIG. 8 Coil to Ground Test

The coil and the breaker point connections of the coil to distributor primary wire.

The movable breaker point and the breaker plate.

The breaker plate and the distributor housing.

The distributor housing and engine ground.

7. Turn the ignition switch off. Disconnect the voltmeter leads.

Breaker Points Check

Clean and inspect the breaker points by following the procedure under Cleaning and Inspection (Section 5 of this Part).

The breaker point dwell can be checked with a distributor tester or a dwell meter by following the procedure under Distributor Tests in this section of the manual.

The breaker point resistance can be checked with a Rotunda RE-1416 distributor tester by following the procedure under Distributor Tests in this section of the manual.

Coil Test

Clean and inspect the coil by following the procedure under Cleaning and Inspection (Section 5 of this Part).

Check the coil on a coil tester by following the manufacturers instructions. Check for ohms resistance both primary and secondary. Also check the amperage draw both with the engine idling and stopped. These checks should all fall within specifications.

Secondary (High Tension) Wires Resistance Test

The secondary wires include the wires connecting the distributor cap to the spark plugs and the wire connecting the center terminal of the distributor cap to the center terminal of the ignition coil.

Clean and inspect the secondary wiring by following the procedure under Cleaning and Inspection (Section 5 of this Part).

These wires are the radio resistance-type which filter out the high frequency electrical impulses that are the source of ignition noise interference. The resistance of each wire should not exceed 1000 ohms per inch. When checking the resistance of the wires or setting ignition timing, do not puncture the wires with a probe. The probe may cause a separation in the conductor.

When removing the wires from the spark plug grasp and twist the moulded cap, then pull the cap off the spark plug. Do not pull on the wire because the wire connection inside the cap may become separated or the insulator may be damaged.

To check the spark intensity at the spark plugs, proceed as follows:

1. Disconnect a spark plug wire. Check the spark intensity of one wire at a time.

2. Install a terminal adapter in the terminal of the wire to be checked . Hold the adapter approximately 3/16-inch from the exhaust manifold and crank the engine, using a remote starter switch. The spark should jump the gap regularly.

3. If the spark intensity of all the wires is satisfactory, the coil, condenser, rotor, distributor cap and the secondary wires are probably satisfactory.

If the spark is good at only some wires, check the resistance of the faulty leads.

If the spark is equal at all wires, but weak or intermittent, check the coil, distributor cap and the coil to distributor high tension wire.

Spark Plug Test

Inspect, clean and gap the plugs following the instructions in Sections 4 and 5. After the proper gap is ob tained, check the plugs on a testing machine. Compare the sparking efficiency of the cleaned and gapped plug with a new plug. Replace the plug if it fails to meet 70 percent of the new plug performance.

Test the plugs for compression leakage at the insulator seal. Apply a coating of oil to the shoulder of the plug where the insulator projects through the shell, and to the top of the plug, where the center electrode and terminal project from the insulator. Place the spark plug under pressure with the tester's high tension wire removed from the spark plug. Leakage is indicated by air bubbling through the oil. If the test indicates compression leakage, replace the plug. If the plug is satisfactory, wipe it clean.

Distributor Checks

Distributor Shaft End Play

If the shaft end play is not to specifications, check the location of the gear on the shaft (6-cyl. engine distributor), or the distributor shaft collar, (dual advance 8-cyl. engine distributor).

6-Cyl. Engine Distributor

The shaft end play can be checked with the distributor installed on the engine.

1. Mount a dial indicator on the distributor so that the indicator tip rests on the top of the distributor shaft.

2. Push the shaft down as far as it will go and set the dial indicator on zero.

3. Pull the distributor shaft upward as far as it will go and read the end play. The end play should be within specifications with the distributor removed or installed.

8-Cyl. Engine Distributor

1. Remove the distributor from the engine.

2. Place the distributor in the holding tool and clamp it in a vise.

3. Push the distributor shaft upward as far as it will go, and check the end play with a feeler gauge placed between the collar and the distributor base. The end play should be within the specified limits. If the shaft end play is not to specifications, check the location of the distributor shaft collar.

Distributor Tests—Rotunda ARE-27-44 Dwell Tester

Test Connections Conventional Ignition System Distributor

1. Disconnect the distributor primary wire at the coil. Connect a short jumper wire to the DIST terminal of the coil and the distributor primary wire. Connect the red lead to the jumper wire.

2. Connect the black lead to a good ground on the engine.

Transister Ignition System Distributor

1. Connect the red lead to the red (small) tach block terminal.

2. Connect the black lead to the black (large) tach block terminal.

Dwell Angle Check

1. Disconnect and plug the distributor vacuum line(s). Connect the tester.

2. Turn the test control knob to the set position.

3. Adjust the set control knob until the needle on the dwell meter lines up with the set line.

4. Start the engine and let it idle.

5. Turn the test control knob to the 8 CYL position.

6. Read the dwell angle on the dwell meter and compare the reading to specifications.

7. Turn off the engine.

8. If the dwell angle was below the specified amount, the breaker point gap is too large. If the dwell angle was above the specified amount, the is too small.

If the dwell is to specifications, turn the test selector knob to the OFF position and disconnect the tester leads, and jumper wire; then connect the distributor vacuum line(s).

Dwell Angle Adjustment

If the dwell angle is not within specifications, proceed as follows:

1. Remove the coil high tension lead from the distributor and ground it.
2. Remove the distributor cap and place it out of the way.
3. Disconnect the brown wire (I terminal) and the red and blue wire (S terminal) from the starter relay.
4. Loosen the breaker point assembly retaining screw near the breaker point contacts.
5. With the ignition on, crank the engine with an auxiliary starter switch connected between the battery and S terminals of the starter relay and terminals of the starter relay and adjust the gap to specifications.
6. Release the auxiliary starter switch and tighten the breaker point assembly retaining screw.
7. Since the adjustment may have changed when the retaining screw was tightened, crank the engine again with the auxiliary starter switch and check the dwell. When the dwell is properly adjusted, remove the jumper wire, auxiliary starter switch and tester leads and install the distributor cap, coil high tension lead and starter relay wires. Connect the distributor vacuum line(s).

Distributor Tests—Rotunda Distributor Tester

Mounting Distributor ARE-236 Tester

1. Adjust the distributor support arm in relation to the distributor shaft length.
2. Set the distributor in the support arm and enter the lower end of the distributor shaft in the Syncrograph chuck.
3. Tighten the chuck on the distributor shaft, using the wrench located near the support arm column.
4. Align the distributor shaft by shifting the support arm and distributor, and tighten the clamp screw.
5. Clamp the distributor securely in the distributor support arm clamp so that it will not turn in its mounting.
6. Connect the Synchrograph test lead to the primary wire of the distributor.
7. Connect the tester vacuum line to the vacuum diaphragm fitting. Since the transistor ignition distributor does not have a condenser, (the wire has been cut) it will be necessary to install one in the circuit of the tester (Fig. 9).

Mounting Distributor ARE-14-16 Tester

1. Clamp the distributor securely in the distributor support arm clamp so that it will not turn in its mounting.
2. Loosen the hand-operated locking screw on the side of distributor support arm, and adjust the support arm column up or down by turning the crank on the knob at the top of the column until the distributor shaft or adapter shaft can be securely fastened in the driving chuck.
3. Securely tighten the drive chuck to the distributor drive shaft by means of the chuck key, attached by a chain to the Synchrograph.
4. Rotate the drive chuck by hand to make sure the distributor shaft turns freely and then tighten the locking screw on the distributor support arm.
5. Connect the Synchrograph test lead to the primary or distributor-transistor lead wire of the distributor.

Breaker Point Resistance

ARE-14-16 Tester

1. Turn the test selector to the POINT RES. position.
2. Revolve the chuck by hand until the distributor breaker points are closed.
3. The meter pointer on the cam angle meter should read in the OK zone at the left side of the meter scale to specifications. If the meter pointer does not fall in the OK zone, there is excessive resistance caused by a faulty contact across the distributor points, a faulty primary lead, or a poorly grounded base plate. A faulty contact across the distributor points indicates improper spring tension or burned or pitted points.

Insulation and Leakage ARE-236 and ARE-14-16 Testers

1. Turn the test selector to the cam angle position and revolve the chuck by hand until the distributor breaker contacts are open.
2. The cam angle meter should show a zero reading. If a zero reading is not obtained, a short circuit to ground exists.

A short could be caused by poor primary wire insulation, a shorted condenser or a short between the breaker arm and breaker plate.

Mechanical Operation—ARE-236 and ARE-14-16 Testers

1. Turn the OFF, SET, CAM, SYNC. switch to the SET position.
2. Adjust the SET TACH control so that tachometer pointer is on the SET line.
3. Turn the OFF, SET, CAM, SYNC. switch to the SYNC. position.
4. On an ARE-14-16 Tester, turn the test selector to the SYNCHRO. position and check to make sure that the drive chuck is securely tightened on the distributor shaft.
5. Turn the MOTOR switch to the LEFT for 8 cylinder setting.
6. Adjust the speed control to vary the distributor speed between 400 and 4000 engine rpm, or at the maximum speed of the engine on which the distributor is used. Erratic or thin faint flashes of light preceding the regular flashes as the speed of rotation is increased can be due to weak breaker arm spring tension or binding of the breaker arm on the pivot pin.
7. Operate the distributor at approximately 2500 engine rpm and move the protractor scale so that the zero degree mark on the scale is opposite one of the neon flashes. The balance of all the flashes should come within 1 degree, plus or minus, evenly around the protractor scale. A variation larger than 1 degree or erratic or wandering flashes may be caused by a worn cam or distributor shaft or a bent distributor shaft.

Dwell ANGLE

Disconnect and plug the distributor vacuum line(s).

1. On an ARE-236 Tester turn the OFF, SET, CAM, SYNC. switch to the CAM position. Operate the distributor at about 1000 rpm.
2. On an ARE-14-16 Tester, turn the cylinder selector to the 8 position.

Turn the test selector switch to the cam angle position and operate the distributor at approximately 1000 engine rpm.

3. Adjust the breaker point gap until the dwell angle is to specifications. Connect the distributor vacuum line(s).

Breaker Plate Wear

A worn breaker plate on the distributor will cause the breaker point gap and contact dwell to change as engine speed and load conditions are varied.

Adjust the test set to 0 degree advance, 0 inches vacuum, and 100 rpm. Adjust the dwell angle to 26 degrees. Apply vacuum to the distributor diaphragm and increase it

very slowly while observing the indicated dwell angle. The maximum dwell angle variation should not exceed 6 degrees when going from zero to maximum vacuum at constant rpm. If the dwell angle variation exceeds this limit, there is excessive wear at the stationary subplate pin or the diaphragm rod is bent or distorted.

Distributor Advance and Retard Check—On Engine

Check the initial ignition timing, centrifugal advance, vacuum advance, and vacuum retard (dual-diaphragm distributor), following the procedure under Initial Ignition Timing Adjustment in Section 3 of this Part.

Distributor Spark Advance Test—ARE-236 and ARE-14-16 Testers

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

Dual Advance Distributor

1. Check the contact dwell. If the contact dwell or the breaker point gap is not within specifications, adjust the breaker points.

2. Check the breaker arm spring tension and adjust it, if necessary.

The dual advance distributor has two independently operated spark advance systems. Each system is adjusted separately. **Adjust the centrifugal advance before adjusting the vacuum advance.**

Centrifugal Advance

1. Do not connect the test set vacuum line to the diaphragm. Set the test set to 0 degree advance and the initial rpm setting listed in the specifications.

2. Operate the distributor in the direction of rotating (counterclockwise) and slowly increase the rpm to the setting specified for the first advance reading listed in the specifications.

If the correct advance is not indicated at this rpm, stop the distributor and bend one spring adjustment bracket to change its tension (Figs. 10 and 11). Bend the adjustment bracket away from the distributor shaft to decrease advance (increase spring tension) and toward the shaft to increase advance (decrease spring tension). After the adjustment is made, identify the bracket.

3. After an adjustment has been made to one spring, check the minimum advance point again.

4. Operate the distributor at the specified rpm to give an advance just below the maximum. If this advance is not to specifications, stop the distributor and bend the other spring bracket to give the correct advance.

5. Check the advance at all rpm settings listed in the specifications. Operate the distributor both up and down the rpm range.

Vacuum Advance (Single or Dual Diaphragm)

1. Connect the test set vacuum line to the fitting on the diaphragm.

2. Set the test set to 0 degree advance, 0 vacuum, and at 1000 rpm.

3. Check the advance at the first vacuum setting given in the specifications.

4. If the advance is incorrect, change the calibration washers between the vacuum chamber spring and nut (Fig. 12). After installing or removing the washers, position the gasket in place and tighten the nut. **The addition of a washer will decrease advance and the removal of a washer will increase advance.**

5. After one vacuum setting has been adjusted, the others should be checked. **Do not change the original rpm setting when going to a different vacuum setting.** If the other settings are not within limits, there is incorrect spring tension, leakage in the vacuum chamber and/or line, or the wrong fibre stop has been installed in the vacuum chamber of the diaphragm housing.

To check the diaphragm for leakage (either, or both on dual diaphragm distributors):

Remove the vacuum line from the distributor. Adjust the vacuum pressure of a distributor tester to its

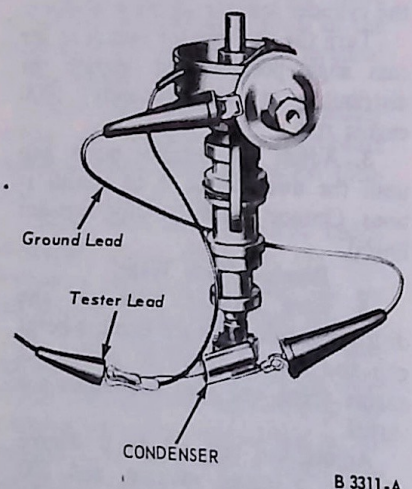


FIG. 9 Testing Transistor Ignition Distributor

FIG. 10 Centrifugal Advance Adjustment

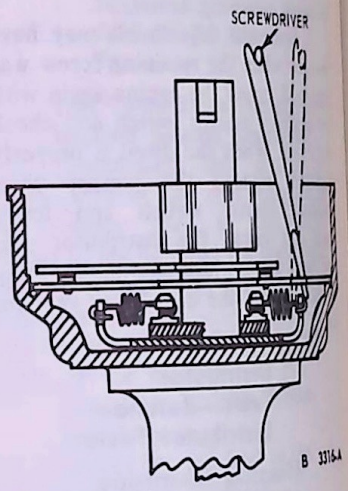


FIG. 11 Centrifugal Advance Adjustment

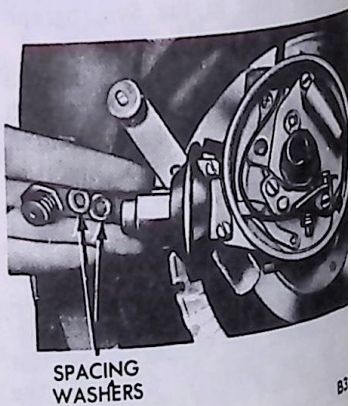


FIG. 12 Vacuum Advance Adjustment

maximum position. Hold your hand over the end of the tester's vacuum hose and note the maximum reading obtained. **Do not exceed 25 inches Hg.**

If the maximum reading is 25 inches Hg or less, connect the tester's vacuum line to the vacuum fitting on the diaphragm to be tested without changing any of the adjustments. The maximum gauge reading should not be less than it was above. If it is less, the diaphragm is leaking and should be replaced.

Distributor Dual Diaphragm Test

Vacuum Advance

1. Disconnect the vacuum lines from both the outer and inner diaphragms. Plug the line removed from the inner diaphragm.
2. Connect a tachometer and increase the idle speed by setting the throttle on the first step of the fast idle cam.
3. Using a timing light observe ignition timing setting.
4. Connect the carburetor vacuum line to the outer diaphragm. The timing should advance immediately. Adjust if necessary.

Vacuum Retard

1. Readjust the engine idle speed to 550-600 rpm.
2. Using a timing light, observe the spark timing.
3. Remove the plug from the manifold vacuum line and connect the line to the inner diaphragm.
4. The timing should retard immediately. Replace the dual diaphragm unit if the retard portion is out of calibration, the advance portion cannot be calibrated to specifications, if ei ther of the diaphragms are leaking.

Governor Tests

Velocity Governor

The governor is calibrated for sensitivity and adjusted at the factory. There are no provisions made for remedying malfunctions of this governor in service except to increase or decrease the governed speed (refer to Velocity Governor Adjustment in Part 23-20. If the governor is ino perative, too sensitive, or not sensitive enough, replace the unit.

The 330 MD engine governor can be adjusted for altitude operation. Refer to Part 23-20 for the procedure.

Vacuum Governor

To determine if the governor is at fault when loss of power and performance are encountered, make the following test:

1. Disconnect the governor vacuum line at the carburetor.
2. Operate the engine under load to determine if the engine reaches governed rpm. **Disconnecting the governor line makes the governor control inoperative. Do not exceed recommended governor engine rpm.**
3. If the engine performs satisfactorily the trouble is the governor control. If the engine does not operate satisfactorily, the trouble is not in the governor system. Connect the governor vacuum line.

If the trouble is in the governor, it can be further localized to the controlling unit, vacuum lines, or the throttle actuating unit as follows:

Connect the governor vacuum line to the carburetor. Disconnect the governor vacuum line at the distributor. Operate the engine at governed speed. **Disconnecting the governor line makes the governor control inoperative. Do not exceed recommended governor engine rpm.** Place a finger over the end of the line.

If there is no change in engine rpm, the trouble is in the throttle actuating unit (on the carburetor).

If the engine speed changed, the trouble is in the controlling unit (on the distributor).

Diagnosis Procedure

Loss of Speed Control. Check for vacuum leaks and the operation of the governor valve in the distributor.

Check for proper sealing of the diaphragm cover.

Check the diaphragm for leaks by removing the vacuum line at the carburetor and attaching a vacuum pump to the fitting at the carburetor. Apply 25 inches Hg following the instructions of the test unit manufacturer. The vacuum reading should not drop off when the vacuum is applied to the diaphragm assembly. If a leak is indicated by the test, replace the diaphragm.

Erratic Operation Under Load. Check for binding of the throttle shaft and throttle lever.

No Governing Action. Vacuum leak in the controlling unit, throttle actuating unit, or in the fittings or lines.

Governor valve in the controlling unit stuck.

Passages in the carburetor blocked.

Over Governing. Passages in the carburetor and/or distributor restricted.

Improper governor adjustment.

Governor spring pin in throttle actuating unit installed in the wrong hole.

Mechanical Governor

If under certain conditions of loading, the engine will not approach the no load governed engine speed within 200-300 rpm, the load limitation of the engine has been exceeded, or the governor throttles the engine too soon, make the following test:

Governor Throttle Linkage Preliminary Adjustment

1. Disconnect, at the governor, the governor-to-carburetor throttle control rod.
2. Make sure the throttle control rod is free to operate in all operating positions.
3. Check the primary spring location on the governor control lever arm. The spring should be in the inner hole on the 2 venturi carburetor, and in the outer hole on the 4 venturi carburetor. Change the spring location if it is not correct.
4. Check the auxiliary secondary spring. Replace the spring if it has been overstretched.
5. To adjust the primary spring tension, loosen the top nut on the eye bolt. Tighten the bottom nut finger tight, then tighten the nut two additional full turns. After adjusting, lock eye bolt in place by tightening bottom nut.
6. With accelerator in wide open throttle position and auxiliary lever fully forward, adjust the governorto-carburetor throttle control rod to fit in the auxiliary control rod hole. Next shorten the control rod one more full turn. This will help to avoid compression of the control rod linkage.
7. Attach control rod to the auxiliary lever and depress accelerator pedal to be sure that wide open throttle is achieved.

Engine Speed Final Adjustment

1. Bring engine up to normal operating temperature.
2. Adjust governor to obtain the recommended engine no-load rpm by depressing the accelerator to the full wide-open throttle position. Adjust speed as follows: To increase rpm, loosen the top nut on the primary spring eye bolt and tighten the bottom, (increasing the spring tension). To decrease rpm, loosen the bottom nut and tighten the top nut, (decreasing the spring tension).

3 ADJUSTMENTS

GENERAL PROCEDURES

Accurate ignition system adjustments are of great importance in the control of hydro-carbon and carbon monoxide emissions for reducing air pollution.

After any adjustment of ignition timing and distributor point dwell, check the distributor automatic advance for proper operation.

To keep engine emissions controlled within the limits of government regulations, the carburetor fuel mixture and idle speed adjustments should be checked after making ignition system adjustments. Also the exhaust control valve (if so equipped), crankcase ventilation system, and vacuum systems must be in good operating condition. Refer to the applicable Group in this manual for maintenance and repair procedures.

Initial Ignition Timing

Because of the high engine idle speeds required on exhaust emission control engines, precautions must be taken when setting the initial ignition timing to be sure that the distributor is not partially advanced. To be sure that no distributor advance is taking place, idle speed should be reduced to 600 rpm **after the vacuum hoses have been disconnected from the diaphragm unit and plugged.** Reset the idle to the specified rpm after adjusting the initial timing. Initial ignition timing and idle specifications for 1971 trucks are given in Specifications, Part 23-10, Section 9, and in Specifications, Group 24.

Breaker Point Alignment

The vented-type **pivoted** breaker points must be accurately aligned and strike squarely to assure normal breaker point life. Misalignment of these breaker point surfaces can cause premature wear, overheating and pitting. However, misalignment of pivotless points is not so critical, and as Fig. 16 indicates, alignment tends to improve with use.

1. Turn the cam so that the breaker points are closed and check the alignment of the points (Fig. 15).

If the distributor is in the engine, close the points by proceeding as follows:

Disconnect the brown wire and the red and blue wire from the starter relay and, with the ignition switch off, crank the engine by using an auxiliary starter switch between the S and the battery terminals of the starter relay.

2. Using the tool shown and **exerting very light pressure,** align the breaker points to make full face contact by bending the stationary breaker point bracket (Figs. 17 and **18). Do not bend the breaker arm.**

3. After the breaker points have been properly aligned, adjust the breaker point gap or dwell.

Breaker Point Gap Adjustment

A scope, a dwell meter, or a feeler gauge can be used to check the gap of new breaker points.

A scope or a dwell meter should be used to check the gap of used breaker points. Due to the roughness of used points, it is not advisable to use a feeler gauge to check the gap.

To check and adjust the breaker points with a feeler gauge:

1. Check and adjust the breaker point alignment.

2. Rotate the distributor until the rubbing block rests on the peak of a cam lobe.

If the distributor is in the engine, place the rubbing block on the peak of the cam by proceeding as follows:

Disconnect the brown wire and the red and blue wire from the starter relay and, with the ignition switch off, crank the engine by using an auxiliary starter switch between the S and battery terminals of the starter relay.

Insert the correct blade of a clean feeler gauge between the breaker points (Fig. 17). Adjust the points to the correct gap and tighten the screws.

Apply a light film of distributor cam lubricant (C4AZ-19D530-A) to the cam when new points are installed. **Do not use engine oil to lubricate the distributor cam.**

Set the ignition timing.

If a scope or a dwell meter is used to adjust new points, be sure the points are in proper alignment. Also, set the contact dwell to the low setting.

To check and adjust the breaker points with a scope, refer to the scope manufacturer's instructions.

To check and adjust the breaker points with a dwell meter, refer to Distributor Tests - Rotunda ARE27-55 Dwell Tester.

Breaker Point Spring Tension Adjustment (Pivot Type Only)

Correct breaker point spring tension is essential to proper engine operation and normal breaker point life. If the spring tension is too great, rapid wear of the breaker arm rubbing block will result, causing the breaker point gap to close up and retard the spark timing. If the spring tension is too weak, the breaker arm will flutter at high engine rpm resulting in an engine miss.

To check the spring tension on the breaker points (pivot type only), place the hooked end of the spring tension gauge over the movable breaker point. Pull the gauge at a right angle (90 degrees) to the movable arm until the breaker points just start to open (Fig. 18. If the tension is not within specifications, adjust the spring tension.

To adjust the spring tension (Fig. 16):

1. Disconnect the primary lead wire and the condenser lead.

2. Loosen the nut holding the spring in position. **Move the spring toward the breaker arm pivot to decrease tension and in the opposite direction to increase tension.**

3. Tighten the lock nut; then check spring tension. Repeat the adjustment until the specified spring tension is obtained.

4. Install the primary lead wire and the condenser lead.

IGNITION TIMING

Timing Mark Locations

The timing marks and their locations are illustrated in Figs. 20, 21 and 22.

The timing mark on the 240 engine in the Econoline and the 240 and 300 engines in P-Series trucks is a machined groove on the flywheel (Standard Transmission) or a stamped line on the flexplate (Automatic Transmission). It is viewed through an opening in the engine rear cover plate (Fig. 22) on the lower left side of the engine. A rubber plug covers the opening to prevent the entrance of dust and dirt. Steel stamped degree marks ranging from 0 degree or top dead center (TDC) to 14 degrees before top dead center (BTDC) are located at the edge of the opening.

When checking the timing, the flywheel (or

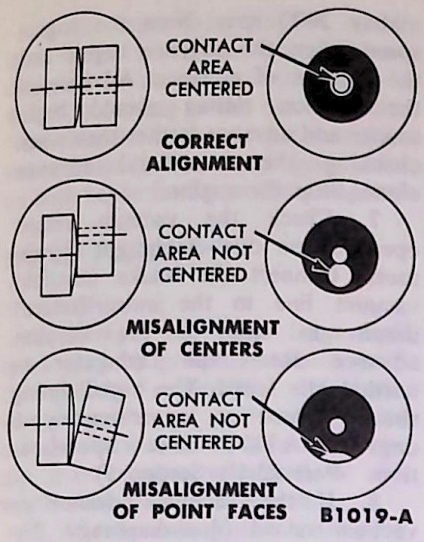


FIG. 13 Checking Pivoted Breaker Point Alignment

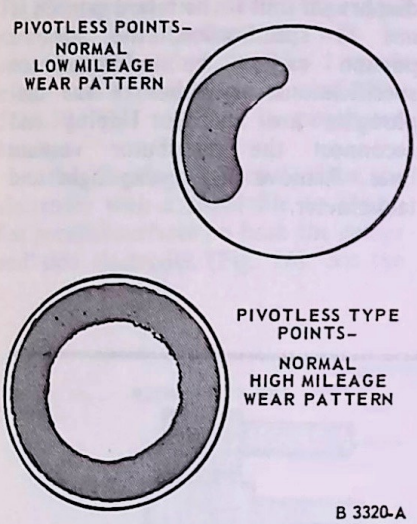


FIG. 14 Pivotless Point Wear Pattern

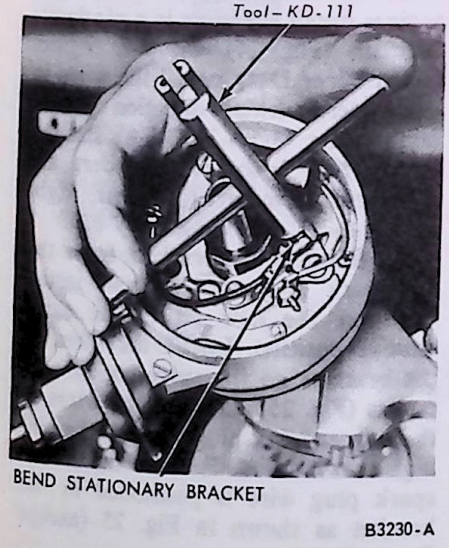


FIG. 15 Aligning Breaker Points

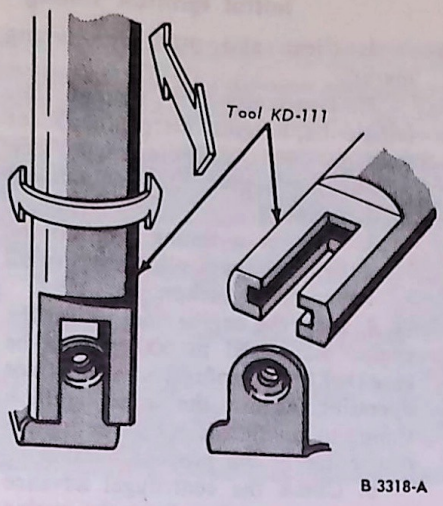


FIG. 16 Using Alignment Tool

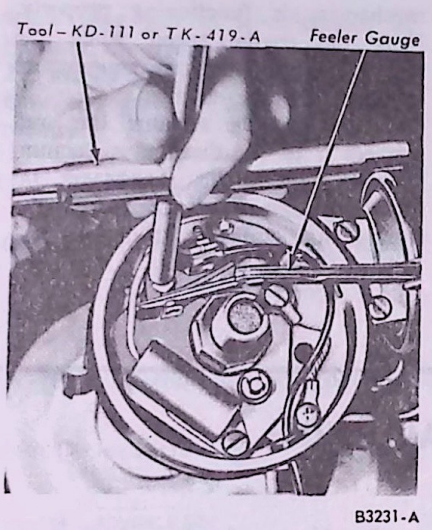


FIG. 17 Adjusting New Breaker Point Gap

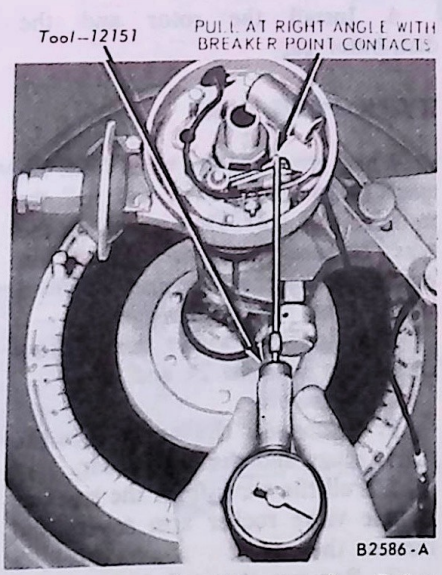


FIG. 18 Checking Breaker Point Spring Tension

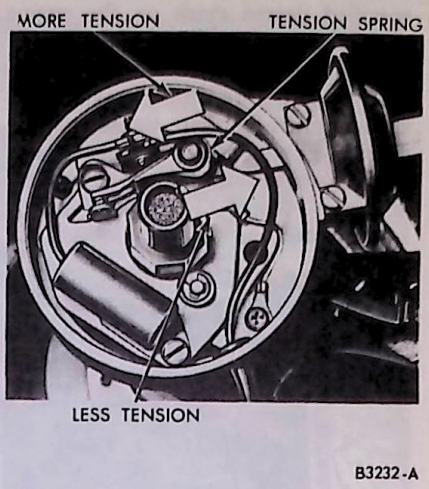


FIG. 19 Adjusting Breaker Point Spring Tension

FIG. 20 Typical Engine Timing Marks—Pointer Mounted

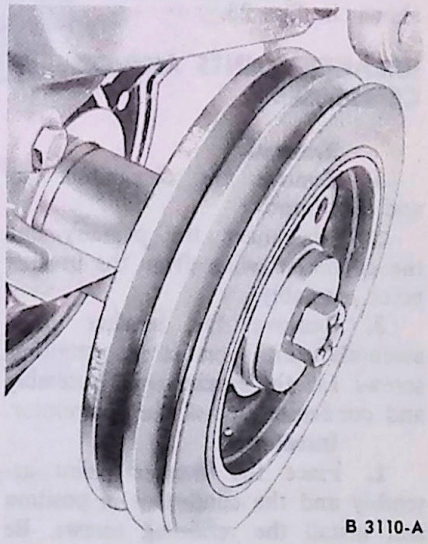


FIG. 21 Typical Engine Timing Marks—Pulley Mounted

flexplate) should be in line with the specified degree mark on the engine rear cover plate opening when the timing light flashes.

The procedure for checking and adjusting the ignition timing with a scope is given in section one of this part. To check and adjust the timing with a Rotunda 13-07 power timing light proceed as follows:

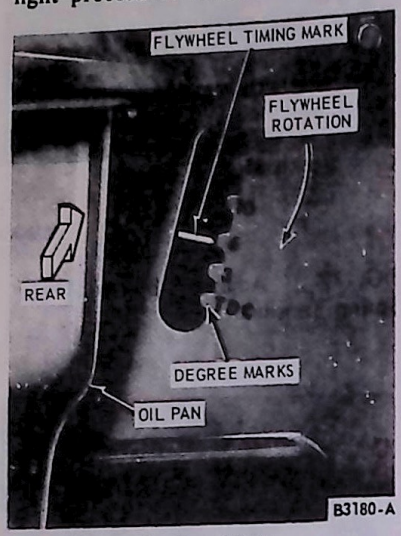


FIG. 22 Engine Timing Marks—240 Engine—Econoline and 240, and 300 Engines—P-Series Trucks

Initial Ignition Timing

1. Clean and mark the timing marks..
2. Disconnect the vacuum line (single-diaphragm distributors) or vacuum lines (dual-diaphragm distributor), and plug the disconnected vacuum line(s).
3. Connect a timing light to the No. 1 cylinder spark plug wire. Install an engine speed tachometer.
4. Start the engine and reduce the engine idle speed to 600 rpm to be sure that the centrifugal advance is not operating. Adjust the initial ignition timing to specifications by rotating the distributor in the proper direction.
5. Check the centrifugal advance for proper operation. Start the engine and accelerate it to approximately 2000 rpm. If the ignition timing advances, the centrifugal advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of advance. Stop the engine.
6. Unplug the vacuum line and connect it to the distributor vacuum advance unit (outer diaphragm on dual diaphragm distributors). Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the amount of advance. Advance of the ignition timing should begin sooner and advance farther than when checking the centrifugal advance alone. Stop the engine.
7. Check the vacuum retard operation on dual-diaphragm distributors. Connect the intake manifold vacuum line to the inner (retard) diaphragm side of the vacuum advance. Reset the carburetor to normal idle speed. The initial timing should retard to approximately 6 degrees ATDC (See Specifications -Part 23-10, Section 9).
8. If the vacuum advance or vacuum retard (dual-diaphragm distributors) is not functioning properly (refer to steps 6 and 7 above), remove the distributor and check it on a distributor tester. Replace the dual diaphragm unit if the retard portion is not to specification, the advance portion cannot be calibrated to specifications, or either of the diaphragms are leaking. Unplug and reconnect the distributor vacuum lines. Remove the timing light and tachometer.

4 REMOVAL AND INSTALLATION

VACUUM HOSES

The basic vacuum hose connections for all distributor systems are shown in Fig. 23.

BREAKER POINTS AND/OR CONDENSER

Removal

1. Remove the distributor cap and the rotor.
2. Disconnect the primary and the condenser wires from the breaker point assembly.
3. Remove the breaker point assembly and condenser retaining screws. Lift the breaker point assembly and condenser out of the distributor.

Installation

1. Place the breaker point assembly and the condenser in position and install the retaining screws. Be sure to place the ground wire in the same location as the original installation.
2. Align and adjust the breaker point assembly.
3. Connect the primary and condenser wires to the breaker point assembly.
4. Install the rotor and the distributor cap.

SPARK PLUG WIRE

When removing the wires from the spark plugs, grasp, twist and pull the moulded cap only. Do not pull on the wire because the wire connection inside the cap may become separated or the boot may be damaged.

The ignition wiring installations are shown in Figs. 24 and 25.

Removal

1. Disconnect the wires from the spark plugs and distributor cap.
2. Pull the wires from the brackets on the valve rocker arm covers and remove the wires.
3. Remove the coil high tension lead. Be sure the No. 7 spark plug wire is positioned in the bracket as shown in Fig. 25 (except Super Duty).

Installation

1. Insert each wire in the proper socket of the distributor cap. Be sure the wires are forced all the way down into their sockets. The No. 1 socket is identified on the cap. On six cylinder engines install the wires in a clockwise direction (Fig. 24). On V-8 engines except Super Duty install the wires in a counterclockwise direction in the firing order (1-5-4-2-6-3-7-8) starting at the No. 1 socket. Cylinders are numbered from front to rear; right bank 1-2-3-4, left bank 5-6-7-8.
2. Remove the brackets from the old spark plug wire set and install them on the new set in the same relative position. Install the wires in the brackets on the valve rocker arm covers (Fig. 25). Connect the wires to the proper spark plugs. Install the coil high tension lead. Be sure the No. 7 spark plug wire is positioned in the bracket as shown in Fig. 25 (except

3. On Super Duty engines install the wires in a counterclockwise direction in the firing order (1-5-4-86-3-7-2) starting at the No. 1 socket. Note that the wires are positioned in the brackets in exact spark plug order on both banks for Super Duty engines.

SPARK PLUGS

Removal

1. Remove the wires from each spark plug by grasping, twisting and then pulling the moulded cap of the wire only. Do not pull on the wire because the wire connection inside the cap may become separated or the weatherseal may be damaged.

2. After loosening each spark plug one or two turns, clean the area around each spark plug port with compressed air, then remove the spark plugs. If working on an Econoline or F-100 equipped with a 240 CID engine and air conditioning, it will be necessary to remove the No. 1 spark plug with special Proto tool No. 5026-50. This tool can be purchased locally.

After cleaning (Section 5) dress the electrodes with a small file to obtain flat parallel surfaces on both the center and side electrodes (Fig. 26). Set the spark plug gap to specifications by bending the ground electrode), (Fig. 27): **all spark plugs new or used should have the gap checked and reset as required.**

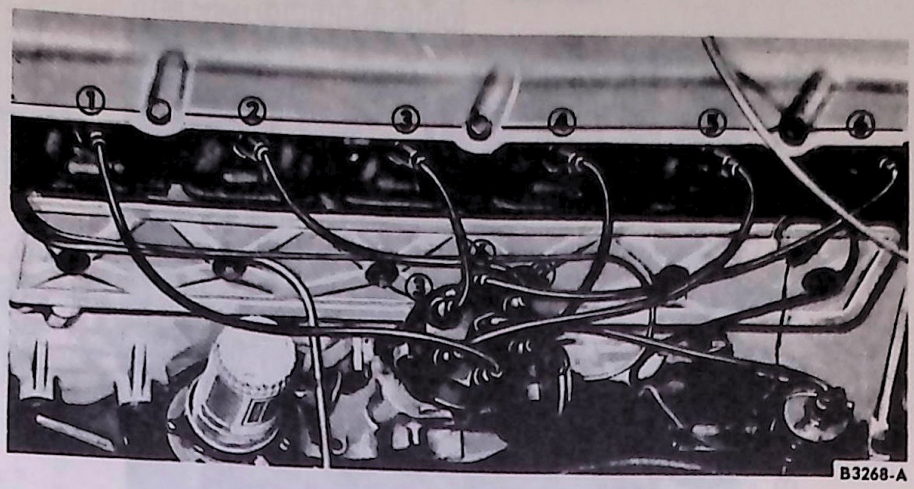


FIG. 24 Typical Ignition Wiring—Six-Cylinder Engine

Installation

1. Install the spark plugs and torque each plug to specifications.
2. Connect the spark plug wires.

RESISTANCE WIRE REPLACEMENT

The special resistance wire must be of a specified length in order to exactly reduce the operating voltage of the ignition system. It cannot, therefore, be repaired by splicing. It is also inaccessible because it is part of a

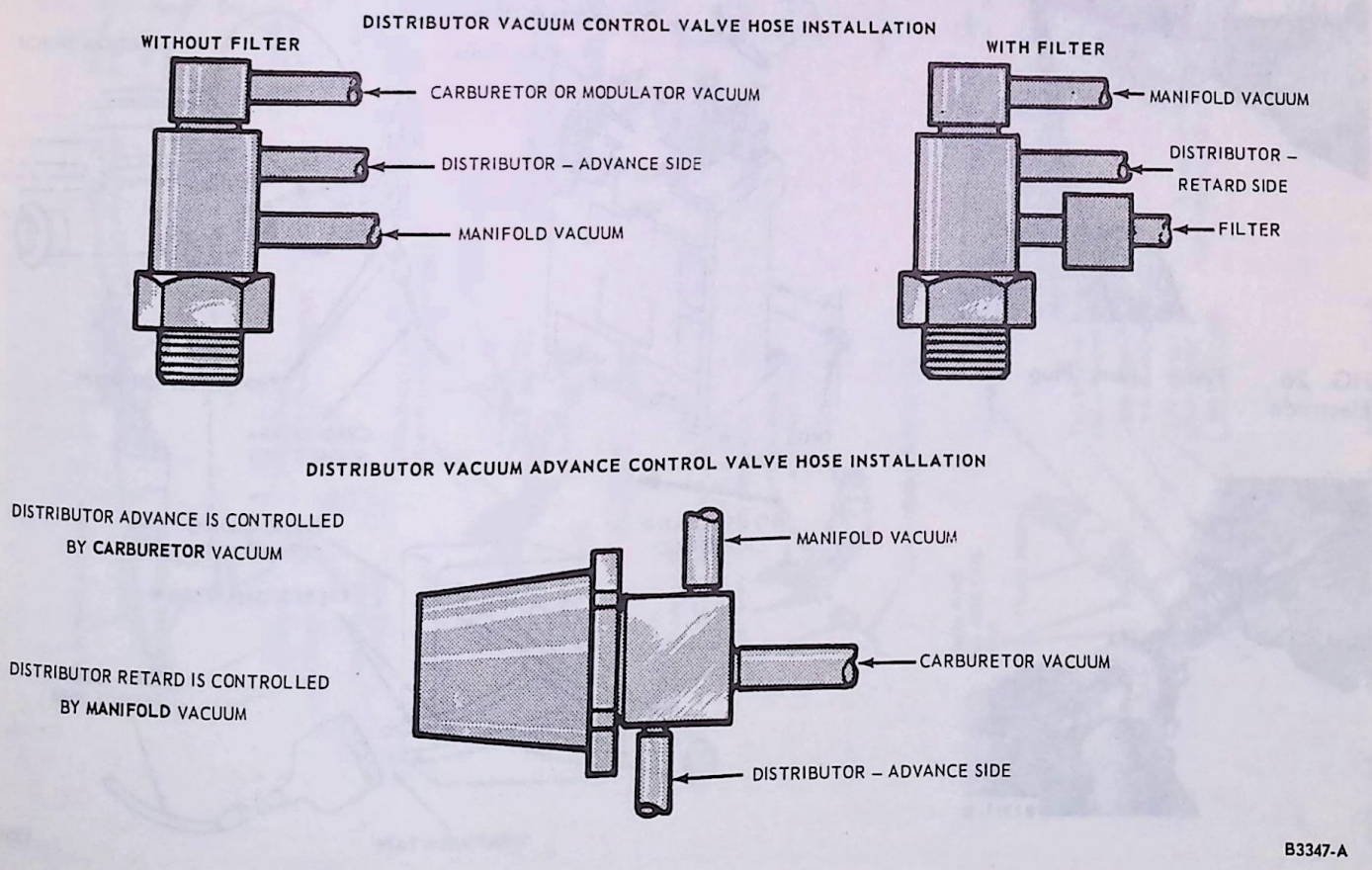


FIG. 23 Distributor Vacuum Hose Connections

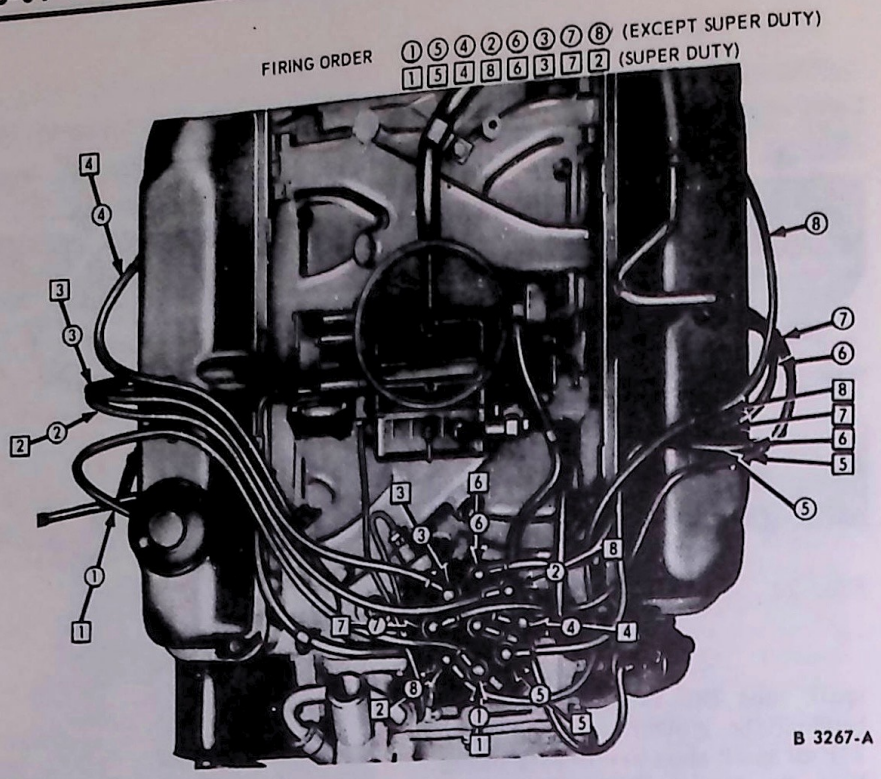


FIG. 25 Typical Ignition Wiring—V-8 Engines

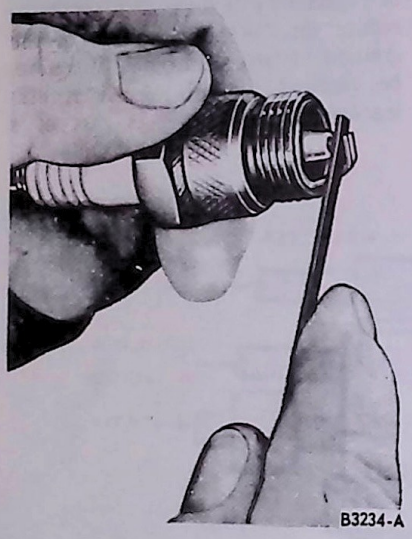


FIG. 26 Filing Spark Plug Electrode

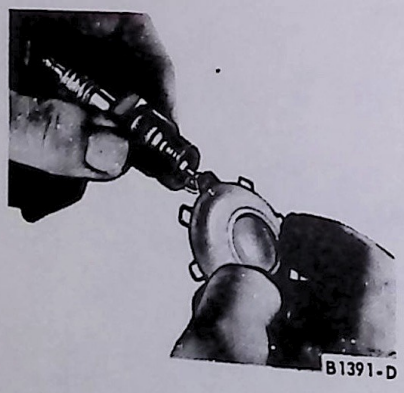


FIG. 27 Checking Spark Plug Gap

wiring harness. The repair procedure therefore consists of connecting the replacement resistance wire into another wire which will always be carrying current when the ignition switch is in the running position. In effect, the replacement resistance wire is installed as a jumper wire, outside of the main ignition harness.

Due to its special resistance, under no circumstances should the resistor wire be spliced or replaced by any wire other than the service resistor wire. Do not coil or loop the surplus wire so that the coils or loops contact each other or excessive heat is generated which can cause the main harness to overheat.

On Econoline, F-100 through F-350 and F-700 and B-Series (Fig. 29), installation of the replacement resistance wire is made behind the instrument panel, without drilling the dash panel. Refer to the instructions in the illustration (Fig. 29) for procedure.

On Bronco (Fig. 28), C- CT Series, L-Series and P-Series (Fig. 29), one connection is made behind the instrument panel and one forward of the dash panel in the engine compartment. On all these vehicles, except P-Series, a hole must be drilled in the dash panel to accommodate the new resistance wire and grommet. Follow the instructions given in the illustration for the procedure.

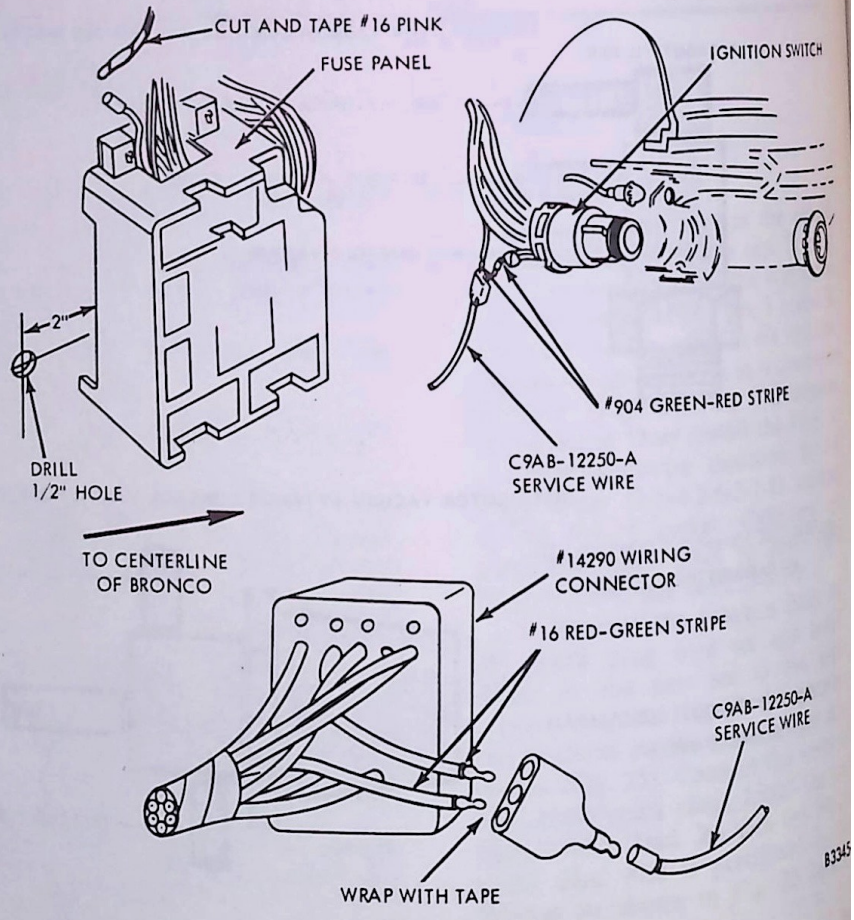


FIG. 28 Replacing Resistance Wire

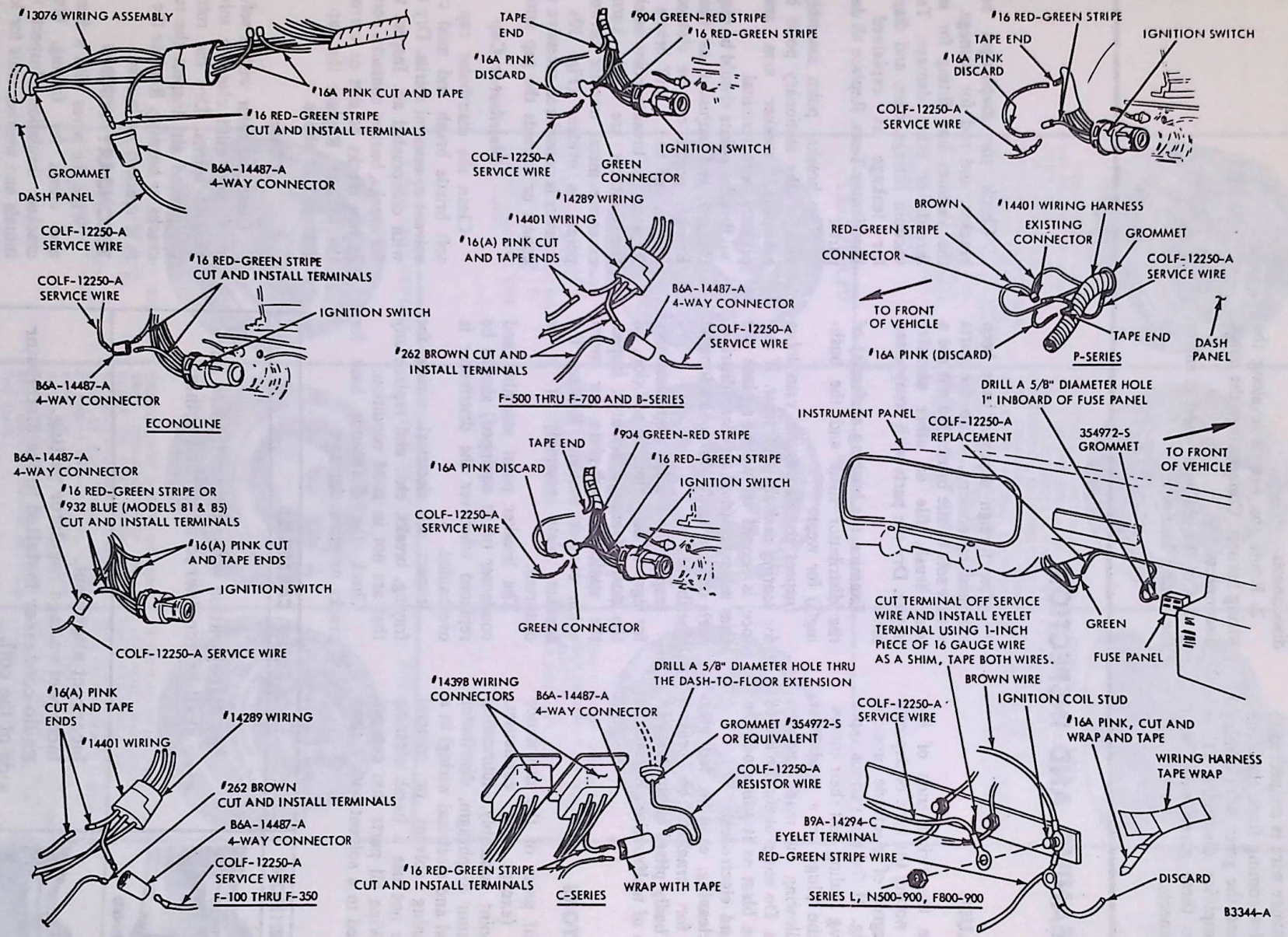


FIG. 29 Replacing Resistance Wire—Truck

All Series—Transistor Ignition

The resistance wire is connected to the green wire coming from the main disconnect and the green wire coming from the amplifier disconnect. It is connected to these green wires with quick disconnects.

1. Remove the malfunctioning resistance wire (black) from the quick disconnects.
2. Route the new wire along the wiring harness. Connect it to the quick disconnects.
3. Cut the old wire where it enters the wiring harness.

5 CLEANING AND INSPECTION

SPARK PLUGS

Examine the firing ends of the spark plug, noting the type of deposits and the degree of electrode erosion. Refer to Fig. 31 for the various types of spark plug fouling and their causes.

Clean the plugs on a sand blast cleaner, following the manufacturer's instructions. **Do not prolong the use of the abrasive blast as it will erode the insulator and electrodes.**

After cleaning, examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of malfunction. Replace as required.

DISTRIBUTORS

Soak all parts of the distributor assembly (except the condenser, breaker point assembly, lubricating wick, vacuum diaphragm, distributor base oil seal and electrical wiring) in a mild cleaning solvent or mineral spirits. Do not use a harsh cleaning solution. Wipe all parts that can not be immersed in a solvent with a clean dry cloth.

After foreign deposits have been loosened by soaking, scrub the parts with a soft bristle brush. **Do not use a wire brush, file or other abrasive object.** Dry the parts with compressed air.

Examine the bushing surface(s) of the distributor shaft and the bushing(s) for wear.

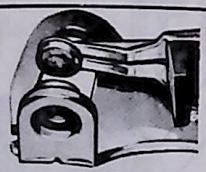
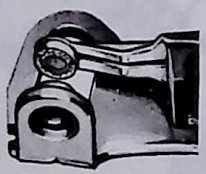
Inspect the distributor cam lobes for scoring and signs of wear. If any lobe is scored or worn, replace the cam assembly (dual advance distributor) or the shaft on a loadomatic distributor.

Inspect the breaker plate assembly for signs of distortion. In addition, on the dual advance distributor, inspect the stationary sub-plate for worn nylon contact buttons. Replace the breaker plate assembly if it is distorted.

The breaker point assembly and condenser (if so equipped) should be replaced whenever the distributor is overhauled.

Inspect all electrical wiring for fraying, breaks, etc., and replace any that are not in good condition.

Check the distributor base for cracks or other damage.

CONDITION	CAUSED BY
 BURNED	Any discoloration other than a frosted slate grey shall be considered as burned points.
 EXCESSIVE METAL TRANSFER OR PITTING	Incorrect alignment. Incorrect voltage regulator setting. Radio condenser installed to the distributor side of the coil. Ignition condenser of improper capacity. Extended operation of the engine at speeds other than normal.

B1443-B

FIG. 30 Breaker Point Inspection

Check the diaphragm housing, bracket, and rod for damage. Check the vacuum line fitting for stripped threads or other damage. Test the vacuum fittings, case, and diaphragm for leakage as explained under Distributor Tests. Replace all damaged parts.

The breaker point assembly consists of the stationary point bracket assembly, breaker arm and the primary wire terminal.

Breaker points should be inspected, cleaned and adjusted as necessary. Breaker points can be cleaned with chloroform and a stiff bristle brush. Replace the breaker point assembly if the contacts are badly burned or excessive metal transfer between the points is evident (Fig. 30). Metal transfer is considered excessive when it equals or exceeds the gap setting.

Distributor Cap

Clean the distributor cap with a soft bristle brush and mild cleaning solvent or mineral spirits. Dry the cap with compressed air. Inspect the cap for cracks, burned contacts, permanent carbon tracks or dirt or corrosion in the sockets. Replace the cap if it is damaged as above.

Rotor

Clean the rotor with a soft bristle brush and mild cleaning solvent or mineral spirits. Dry the rotor with compressed air. Inspect the rotor for cracks or burning. Replace the rotor if it is cracked or burned.

SECONDARY WIRING

Wipe the wires with a damp cloth and check for fraying, breaks or cracked insulation. Inspect the terminals and weather seals for looseness or corrosion. Replace any wires that are not in good condition.

COIL

Wipe the coil with a damp cloth and check for any cracks or other damage.

CARBON FOULED

IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES.

CAUSED BY TOO COLD A PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.

OIL FOULED

IDENTIFIED BY WET BLACK DEPOSITS ON THE INSULATOR SHELL BORE ELECTRODES CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBER THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. CAN BE CLEANED IF ENGINE IS NOT REPAIRED, USE A HOTTER PLUG.

GAP BRIDGED

IDENTIFIED BY DEPOSIT BUILD-UP CLOSING GAP BETWEEN ELECTRODES.

CAUSED BY OIL OR CARBON FOULING. IF DEPOSITS ARE NOT EXCESSIVE, THE PLUG CAN BE CLEANED.

LEAD FOULED

NORMAL

WORN

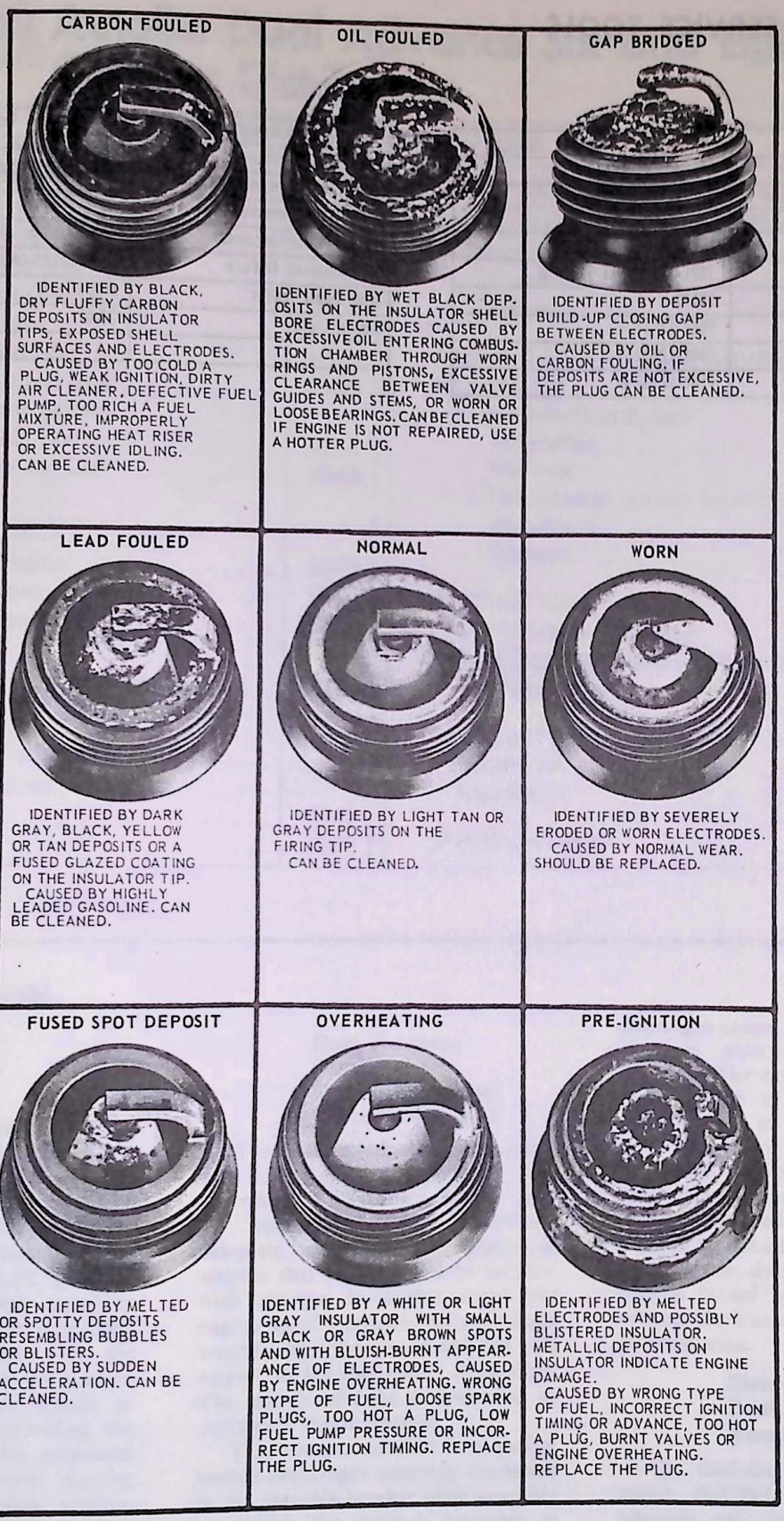


FIG. 31 Spark Plug Inspection

9 SPECIAL SERVICE TOOLS

SPECIAL TOOLS

Tool Description	Tool No.
Breaker Point Aligning Tool	KD-111 or TK-419-A
Breaker Point Spring Tension Scale	12151
Bushing Burnisher	12132
Bushing Installer	T57L-12120-A or 12132-A
Bushing Remover	12132-H
Distributor Puller	T66L-12132-A
Distributor Puller Adapter	T66L-12132-B
Distributor Holding Clamp	T58L-12132-B

Tool Description	Tool No.
Distributor Testers	ARE-236 or ARE-1416
Drive Gear Installing Fixture	T52L-12390-DED and T65L-12390-B
Drive Gear Remover Kit	T52L-1290-C
Ignition Oscilloscopes	ARE-27-55 or ARE-881
Pin Removing Fixture	T52L-12131-CAD
Tach-Dwell Tester	ARE-27-44
Timing Light	13-07

CB1016-A

PART 23-10 Autolite Dual Advance Six and Eight Cylinder Distributors

Applies To All Gasoline Engines

1 DESCRIPTION

IGNITION SYSTEM

The 1971 engine ignition systems include all components required for the exhaust emissions control.

All distributors are equipped with both vacuum and centrifugal advance units. The vacuum advance governs the ignition timing (spark advance) during low engine speeds (rpm) or light engine loadings. The centrifugal advance, in combination with the vacuum advance, controls the ignition timing at higher engine speeds or heavy engine loadings providing the correct ignition timing for maximum engine performance while meeting U.S. Government emission requirements. A dual-diaphragm vacuum advance is used on some engines to provide additional ignition timing retard during engine idle and deceleration operation.

Dual Advance Distributor Single-Diaphragm Vacuum Advance

The distributor advance systems are independently operated. The centrifugal advance mechanism (Fig. 1), located below the stationary sub-plate assembly, has centrifugal weights that move inward or outward with changes in engine speed. As engine speed increases, the centrifugal weights cause the cam to advance with respect to the distributor drive shaft. The rate of advance is controlled by calibrated weight springs.

The vacuum advance is a spring-loaded diaphragm assembly connected to the movable breaker plate assembly on which the contact assembly is fastened to a pivot pin. The diaphragm is actuated against the spring force by vacuum pressures. When the vacuum increases, resultant forces on the diaphragm causes the movable breaker plate to pivot on the stationary sub-plate. The breaker point rubbing block, which is positioned on the opposite side of the cam from the pivot pin, then moves opposite to distributor rotation and advances the spark timing. As the movable breaker plate is rotated from no-advance posltion to full-advance posi tion, the breaker point dwell decreases slightly. This is caused by the breaker point rubbing block and the cam rotating on different axes.

Distributor Dual-Diaphragm Vacuum Advance

On dual-diaphragm vacuum advance distributors, the centrifugal advance unit is the same as on single-diaphragm vacuum advance dis tributors. The dual-diaphragm unit consists of two independently operating diaphragms (Fig. 2). The outer

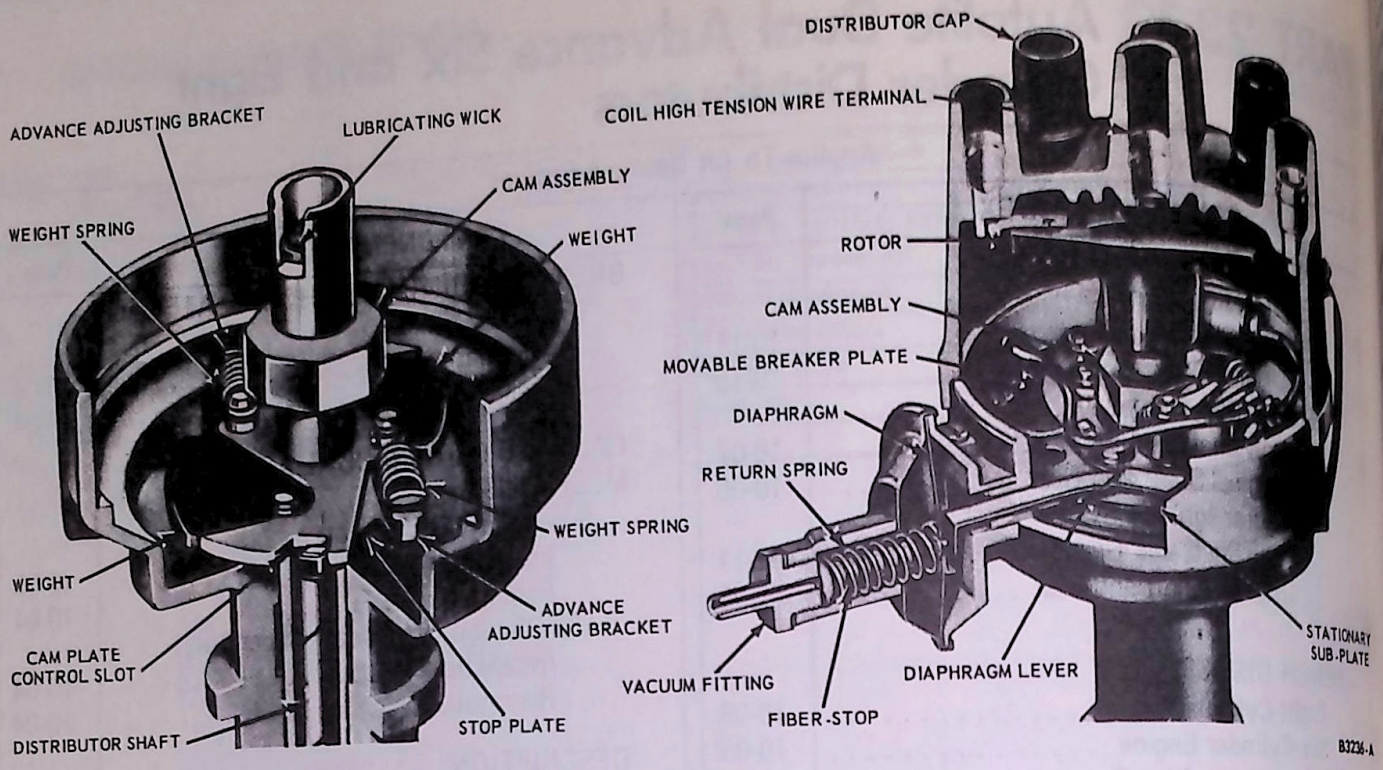


FIG. 1 Advance Mechanisms—Dual Advance Distributor With Single Vacuum Diaphragm

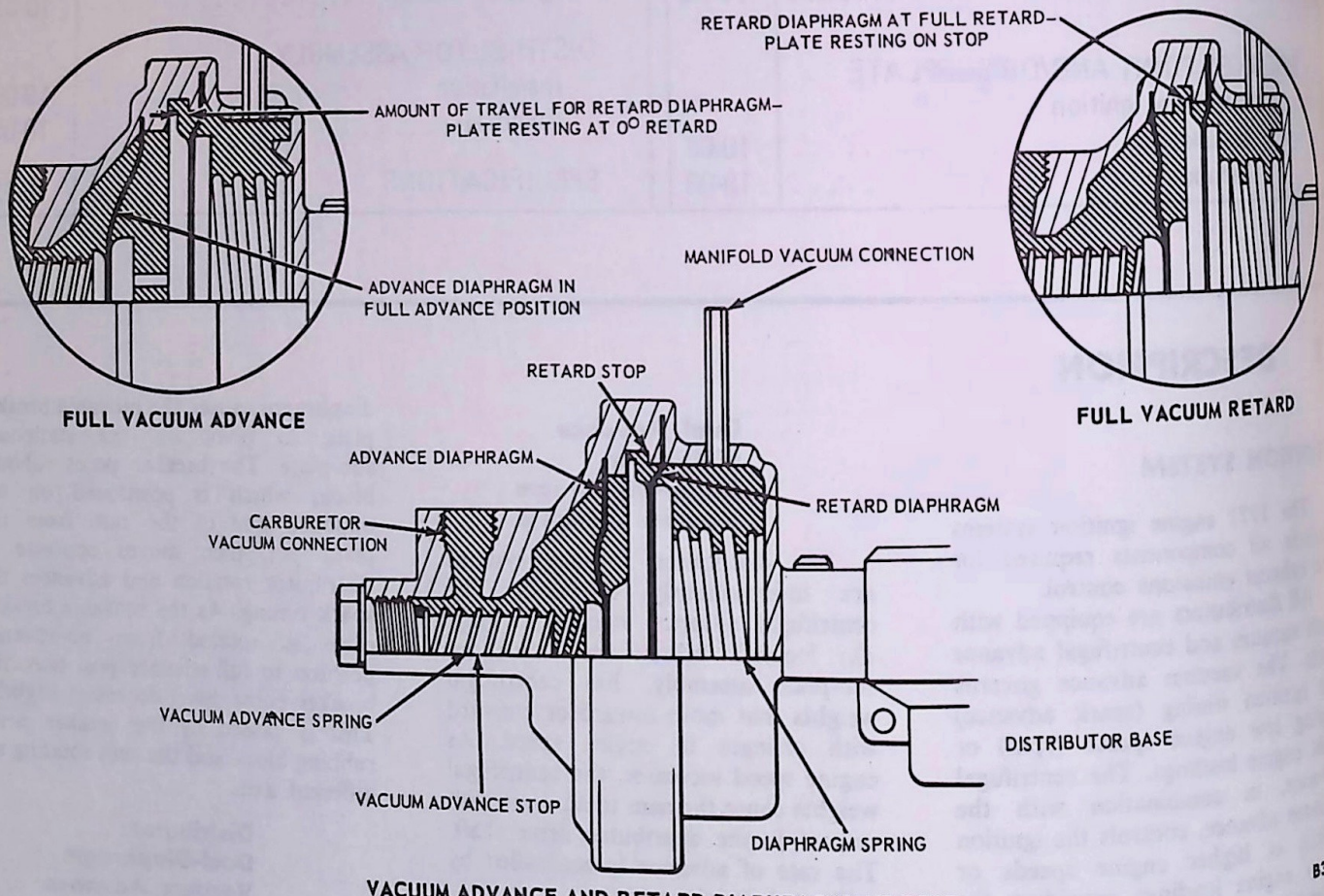


FIG. 2 Dual-Diaphragm Vacuum Advance Mechanism

(primary) diaphragm utilizes carburetor vacuum to advance ignition timing. The inner (secondary) diaphragm is actuated by intake manifold vacuum to provide ignition timing retard during periods of closed throttle deceleration and idle, thereby assisting in the reduction of exhaust system hydrocarbons.

The outer diaphragm is coupled to the movable breaker plate the same as single-diaphragm distributors. An increase in vacuum pressure moves the diaphragm against the advance diaphragm spring force, causing the movable breaker plate to pivot opposite to distributor rotation, advancing ignition timing. This is calibrated to occur during normal road-load operation, but not during deceleration or idle.

When intake manifold vacuum is applied to the inner diaphragm (retard), it moves inward toward the center of the distributor. This allows the advance diaphragm spring to move the breaker plate in the same direction as distributor rotation. This retard of the ignition timing occurs during engine idle or deceleration.

4 REMOVAL AND INSTALLATION

BREAKER POINT AND/OR CONDENSER

The replacement procedures are covered in Part 23-01.

VACUUM ADVANCE UNIT (SINGLE AND DUAL DIAPHRAGM)

Removal

1. Remove the distributor cap and the rotor.
2. Disconnect the vacuum line(s).
3. Remove the spring clip that secures the diaphragm arm to the movable breaker plate.
4. Remove the advance unit retaining screws, and carefully remove the advance unit.

Installation

1. Install the advance unit on the distributor and place the diaphragm arm in position.
2. Install the spring clip that secures the diaphragm arm to the movable breaker plate. Install the advance unit retaining screws.
3. Install the vacuum line(s).
4. Install the rotor and the distributor cap.

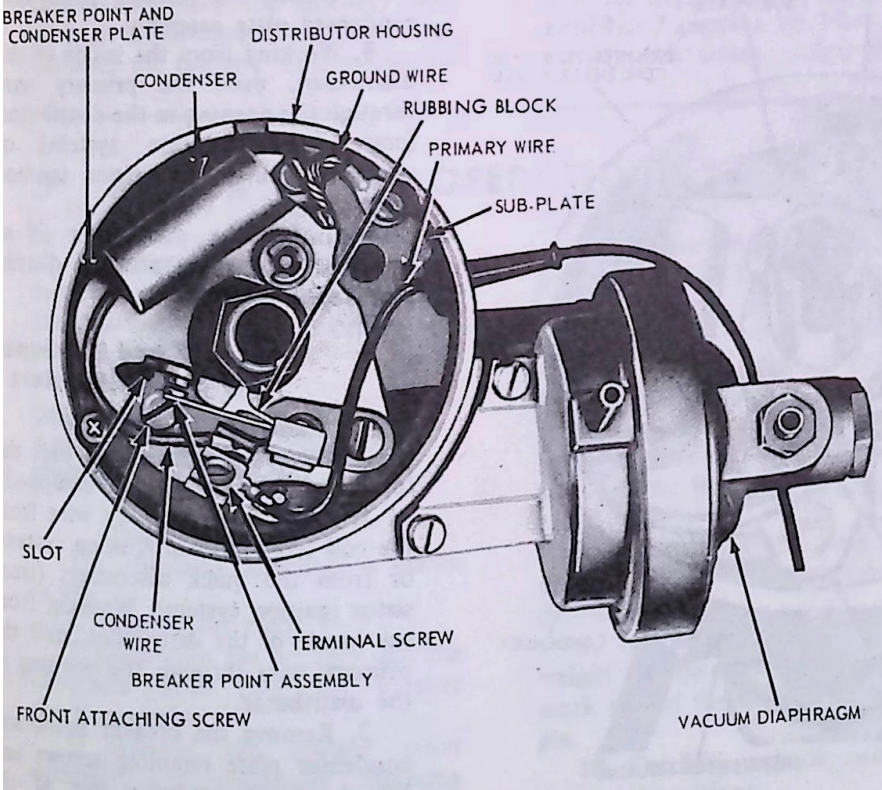


FIG. 3 Breaker Plate Installed—6-Cylinder Engine Dual Diaphragm Distributor

BREAKER PLATE AND/OR SUB-PLATE

Conventional Ignition System Distributor

Refer to Figs. 3 and 4 for the correct location of parts.

Removal

1. Remove the distributor cap and the rotor.
2. Remove the breaker point assembly, the condenser and the vacuum diaphragm.
3. Working from the inside of the distributor, pull the primary wire through the opening in the distributor.
4. Remove the spring clip, the flat washer and the spring washer securing the breaker plate to the sub-plate.
5. Remove the sub-plate retaining screws and lift both plates out of the distributor.

Installation

1. Place the breaker plate in position on the sub-plate.
2. Install the spring washer, the flat washer and the spring clip that secures the breaker plate to the sub-plate.
3. Install the sub-plate hold down screws (the ground wire should be under the sub-plate hold down screw near the primary wire opening in the distributor).
4. Working from the inside of the distributor, push the primary wire through the opening in the distributor.
5. Install the breaker point assembly, the condenser and the vacuum diaphragm.
6. Install the rotor and the distributor cap.

Transistor Ignition System Distributor

The transistor ignition system distributor does not have a condenser. It does have a lubricating wick on the breaker point assembly rubbing block. With the exception of these two items, Fig. 3 shows the correct location of parts.

Removal

1. Remove the distributor cap, the rotor and the dust cover.
2. Remove the breaker point assembly and the vacuum diaphragm.
3. Working from the inside of the distributor, pull the primary wire through the opening in the distributor.
4. Remove the spring clip, the flat washer and the spring washer se curing the breaker plate to the sub-plate.
5. Remove the sub-plate retaining screws and lift both plates out of the distributor.

Installation

1. Place the breaker plate in position on the sub-plate.
2. Install the spring washer, the flat washer and the spring clip that secures the breaker plate to the sub-plate.
3. Install the sub-plate hold down screws (the ground wire should be under the sub-plate hold down screw near the primary wire opening in the distributor).
4. Working from the inside of the distributor, push the primary wire through the opening in the distributor.
5. Install the breaker point assembly and the vacuum diaphragm.
6. Install the dust cover, the rotor and the distributor cap.

CAM AND CENTRIFUGAL ADVANCE MECHANISM

V-8 Distributors (Except Super Duty)

Removal

1. Remove the distributor cap and the rotor.
2. Remove the primary wire from the coil (conventional ignition system) or from the quick disconnect (transistor ignition system). Working from the inside of the distributor, pull the primary wire through the opening in the distributor.
3. Remove the breaker point and condenser plate retaining screws and lift the plate assembly out of the distributor.
4. **Mark one of the distributor weight springs and its brackets. Also mark one of the weights and its pivot pin.**
5. Carefully unhook and remove the weight springs.
6. Lift the lubricating wick from the cam assembly. Remove the cam assembly retainer and lift the cam assembly off the distributor shaft. Remove the thrust washer.
7. If replacing the weights, remove the weight retainers and lift the weights out of the distributor.

Installation

1. If the weights were removed, lubricate the weight pivot pins with distributor cam lubricant.
2. Position the weight in the distributor (the marked weight is placed on the marked pivot pin) and install the weight retainers.
3. Place the thrust washer on the shaft.
4. Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant (C4AZ-19D530-A).
5. Install the cam assembly. Be sure that the marked spring bracket on the cam assembly is near the marked spring bracket on the stop plate. Place a light film of distributor cam lubricant on the distributor cam lobes. Install the retainer and the wick. Oil the wick with SAE 10W engine oil.
6. Install the weight springs. Be sure that the marked spring is attached to the marked spring brackets.
7. Install the breaker point and condenser plate assembly.
8. Working from the inside of the distributor, push the primary wire through the opening in the distributor. (conventional ignition system) or quick disconnect (transistor ignition system).
9. Install the dust cover (if so equipped), the rotor and the distributor cap.

401, 477 and 534 Super Duty V-8 Distributors

Removal

1. Remove the distributor cap, the rotor and dust cover (if so equipped).
2. Remove the primary wire from the coil (conventional ignition system) or from the quick disconnect (transistor ignition system). Working from the inside of the distributor, pull the primary wire through the opening in the distributor.
3. Remove the breaker point and condenser plate retaining screws and lift the plate assembly out of the distributor.
4. Lift the lubricating wick from the cam assembly. Remove the cam assembly retainer and lift the cam

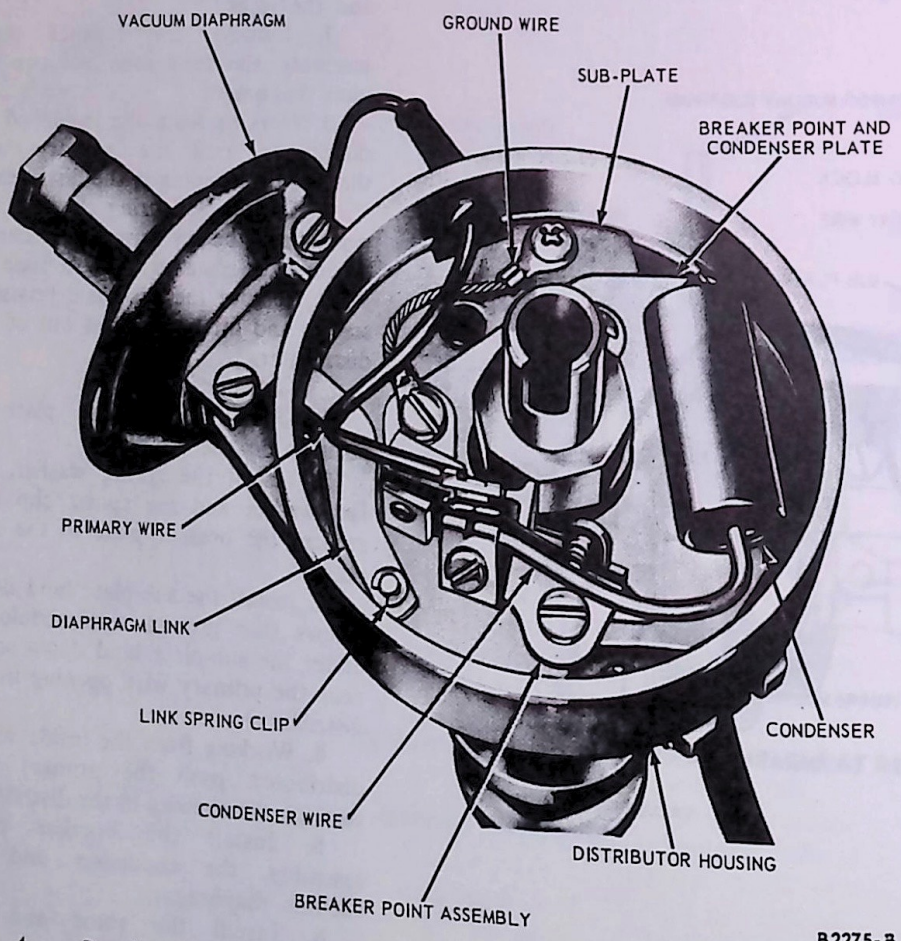


FIG. 4 Breaker Plate Installed—V-8 Engine Single Diaphragm Distributor

assembly and thrust washer off the distributor shaft.

5. Mark one of the distributor weight springs. Place a mark on the bracket, weight and weight pivot that are assembled to the marked spring.

6. Carefully unhook and remove the weight springs.

7. Lift the weights out of the distributor.

Installation

1. Lubricate the weight pivot pin with distributor cam lubricant.

2. Position the weights in the distributor (the marked weight is placed on the marked pivot pin).

3. Install the weight springs (the marked spring is connected to the marked weight and bracket).

4. Place the thrust washer on the shaft.

5. Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant (C4AZ-19D530-A).

6. Install the cam assembly. Be sure that the slots in the cam engage the pins on the weights.

7. Install the cam retainer. Place a light film of distributor cam lubricant on the cam lobes. Install the wick in the cam assembly and oil the wick with SAE 10W engine oil.

8. Install the breaker plate and sub-plate assembly.

9. Working from the inside of the distributor, push the primary wire through the opening in the distributor. Connect the primary wire to the coil (conventional ignition system) or the quick disconnect (transistor ignition system).

10. Install the dust cover (if so equipped), the rotor and the distributor cap.

DISTRIBUTOR ASSEMBLY

Removal

1. On a conventional ignition system, disconnect the primary wire at the coil. On a transistor ignition system, disconnect the primary wire from the quick disconnect. Disconnect the vacuum advance rubber line at the distributor. Remove the distributor cap.

2. Scribe a mark on the distributor body and engine block indicating the position of the body in the block, and scribe another mark on the distributor body indicating the position of the rotor. These marks can be used as guides when installing the distributor in a correctly timed engine.

3. Remove the distributor hold down cap screw and clamp. Lift the distributor slowly out of the block.

Do not rotate the crankshaft while the distributor is removed, or it will be necessary to time the engine.

Installation

1. If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine. Rotate the crankshaft until No. 1 piston is on TDC after the compression stroke. Align the TDC mark on the timing pointer with the timing pin on the crankshaft damper. Position the distributor in the block with the rotor at the No. 1 firing position.

Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, while applying light pressure to the top of the distributor, after the distributor drive gear is partially engaged in order to engage the oil pump intermediate shaft.

Install, but do not tighten, the retaining clamp and screw. Rotate the distributor body counterclockwise for 6 cylinder (clockwise for 8 cylinder engines) until the breaker points are just starting to open. Tighten the clamp.

2. If the crankshaft has not been rotated, position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body and the marks on the distributor body and engine block in alignment. Install the retaining clamp.

3. Install the distributor cap.

4. On a conventional ignition system, connect the primary wire to the coil. On a transistor ignition system, connect the primary wire to the quick disconnect.

5. Check the ignition timing with a timing light and adjust if necessary. Connect the vacuum line and check the advance with the timing light when the engine is accelerated.

5 MAJOR REPAIR OPERATIONS

To perform the operations in this section, it will be necessary to remove the distributor from the engine and place it in a vise.

DISTRIBUTOR ASSEMBLY—SIX-CYLINDER ENGINE

Disassembly

The distributor assembly is shown in Fig. 5.

1. Remove the rotor.

2. Disconnect the primary and the condenser wires from the breaker point assembly.

3. Remove the breaker point assembly and condenser retaining screws. Lift the breaker point assembly and condenser out of the distributor.

4. Remove the spring clip that secures the diaphragm link to the movable breaker plate.

5. Remove the diaphragm retaining screws and slide the diaphragm out of the distributor.

6. Working from the inside of the distributor, pull the primary wire through the opening in the distributor.

7. Remove the spring clip, the flat washer, and the spring washer securing the breaker plate to the sub-plate.

8. Remove the sub-plate retaining screws and lift both plates out of the distributor.

9. Mark one of the distributor weight springs and its brackets. Also mark one of the weights and its pivot pin.

10. Carefully unhook and remove the weight springs.

11. Lift the lubricating wick from the cam assembly. Remove the cam assembly retainer and lift the cam assembly retainer and lift the cam assembly off the distributor shaft. Remove the thrust washer.

12. Remove the weight retainers and lift the weights out of the distributor.

13. Remove the distributor cap clamps.

14. If the gear and shaft are to be used again, mark the gear and the shaft so that the pin holes can be easily aligned for assembly. Remove the gear roll pin (Fig. 6).

15. Invert the distributor and place it on a support plate in a position that will allow the distributor shaft to clear the support plate and press the shaft out of the gear and the distributor housing (Fig.7).

16. Refer to Fig. 8 and remove the distributor shaft bushing.

17. Remove the oil filler cap and wick.

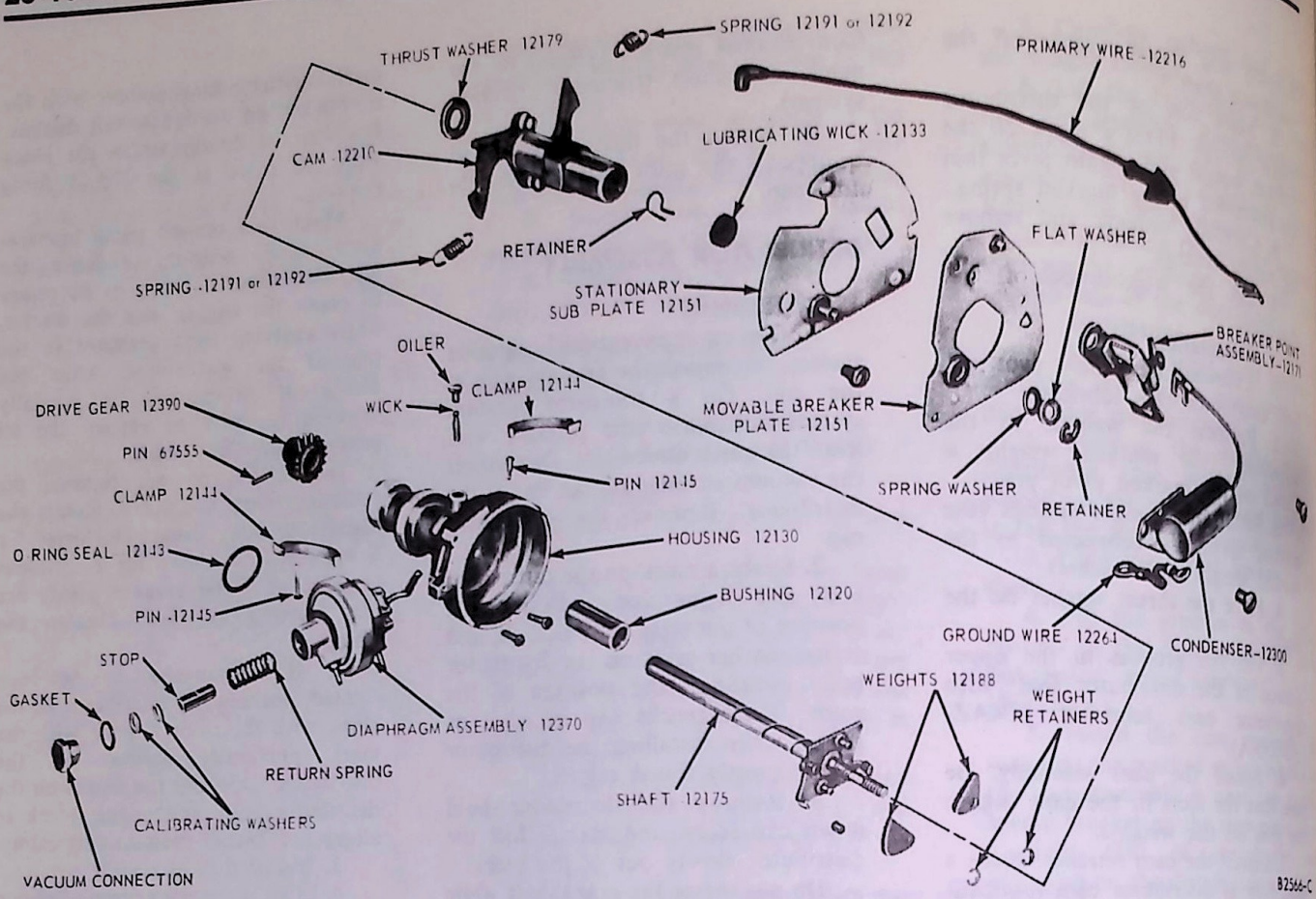


FIG. 5 Distributor Assembly—6-Cylinder Engine

Original Shaft and Gear

Assembly

1. Oil the new bushing and position it on the bushing replacer tool. Install the bushing (Fig. 9). When the tool bottoms against the distributor base, the bushing will be installed to the correct depth.

2. Burnish the bushing to the proper size (Fig. 10).

3. Clean out the bushing; then oil the shaft and slide it into the distributor body.

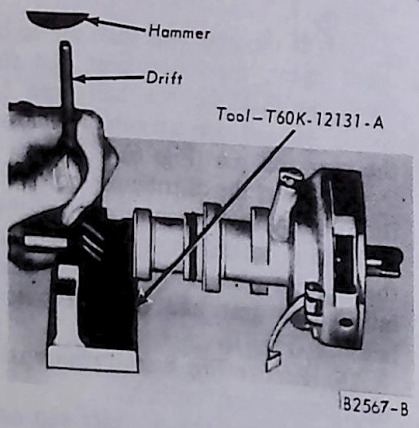


FIG. 6 Removing or Installing Typical Gear Pin

4. Attach the distributor shaft supporting tool to the distributor. Tighten the backing screw in the tool enough to remove all shaft end play.

5. Install the assembly in a press. Press the gear on the shaft (Fig. 11).

6. Check the shaft end play with a feeler gauge placed between the collar and the base of the distributor. If the end play is not within specifications, replace the shaft and gear.

7. Remove the distributor from the press. Install the gear retaining pin (Fig. 6).

8. Position the distributor in a vise. Lubricate the weight pivot pins with a distributor cam lubricant (C4AZ-19D530-A).

9. Position the weights in the distributor **(the marked weight is placed on the marked pivot pin)** and install the weight retainers.

10. Place the thrust washer on the shaft.

11. Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant (C4AZ-19D530-A).

12. Install the cam assembly. **Be sure that the marked spring bracket on the cam assembly is near the marked spring bracket on the stop plate.**

If a new cam assembly is being installed, make sure that the cam is installed with the hypalon covered stop in the correct cam plate control slot. This can be done by measuring the length of the slot used on the old cam and by using the corresponding slot on the new cam. Some of the cams will have the size of the slot in degrees stamped near the slot. If the wrong slot is used, an incorrect maximum advance will be obtained.

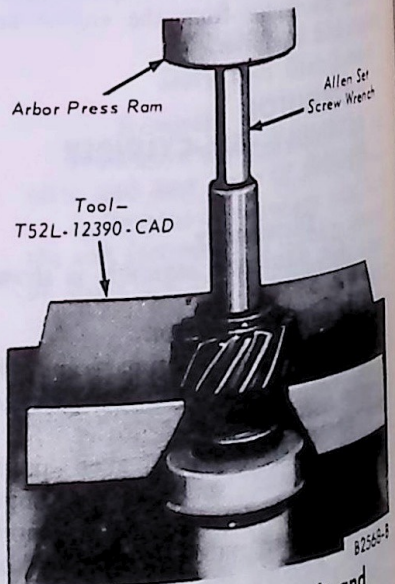


FIG. 7 Removing Shaft and [illegible]

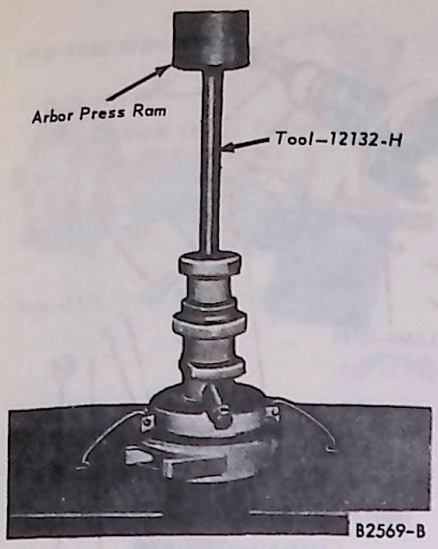


FIG. 8 Removing Bushing—6-Cylinder Engine

Place a light film of distributor cam lubricant on the distributor cam lobes. Install the retainer and the wick. Oil the wick with SAE 10W engine oil.

13. Install the weight spring. **Be sure that the marked spring is attached to the marked spring brackets.**

14. Place the breaker plate in position on the sub-plate.

15. Install the spring washer, the flat washer, and the spring clip that secures the breaker to the sub-plate.

16. Install the sub-plate hold down screws (the ground wire should be under the sub-plate hold down screw near the primary wire opening in the distributor).

17. Working from the inside of the distributor, push the primary wire through the opening in the distributor.

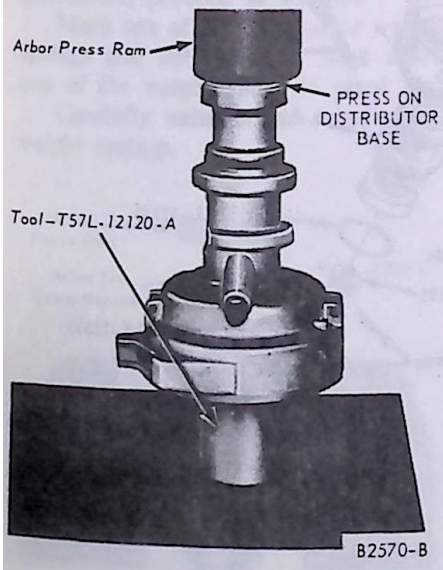


FIG. 9 Installing Bushing—6-Cylinder Engine

18. Slide the diaphragm into the opening in the distributor and place the link in its position.

19. Install the spring clip that secures the diaphragm link to the moveable breaker plate and install the retaining screws.

20. Place the breaker point assembly and the condenser in position and install the retaining screws. Be sure to place the ground wire under the breaker point assembly screw farthest from the breaker point contacts on an eight cylinder engine distributor or under the condenser retaining screw on a six cylinder engine distributor. Align and adjust the breaker point assembly by following the procedure in Part 23-01.

21. Connect the primary and condenser leads to the breaker point assembly.

22. Install the rotor and the distributor cap.

23. Check and adjust (if necessary) the centrifugal and vacuum advance (Refer to Part 23-01).

New Shaft and Gear Assembly

The shaft and gear are replaced as an assembly. One part should not be replaced without replacing the other. Refer to Fig. 5 for the correct location of parts.

1. Follow steps 1, 2 and 3 under Installing Original Shaft And Gear-Six Cylinder Engine.

2. Attach the distributor shaft supporting tool to the distributor and install the assembly in a vise. Insert a 0.003 inch feeler gauge between the backing screw and the shaft. Tighten the backing screw on the tool enough to remove all shaft end play. Remove the feeler gauge and allow the shaft to rest on the backing screw. Place the gear thrust washer in position. Press the gear on the shaft until it bottoms on the gear thrust washer (Fig. 12). Drill a 1/8-inch hole through the shaft using the access opening in the gear as a pilot.

3. Remove the distributor from the press and remove the support tool. Install the gear retaining pin (Fig. 6).

4. Complete the assembly by following steps 8-23 under Installing Original Shaft and Gear - Six Cylinder Engine.

DISTRIBUTOR ASSEMBLY—EIGHT-CYLINDER ENGINE

The distributor assemblies are shown in Figs. 13 and 14.

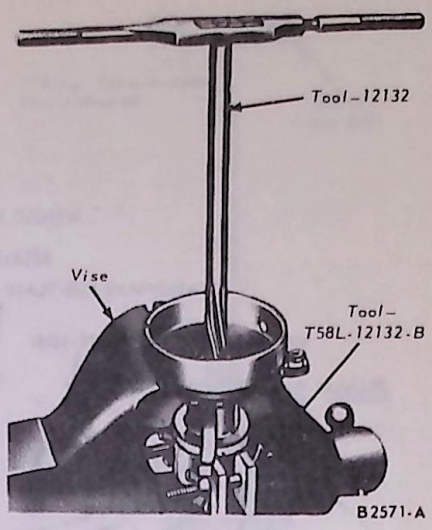


FIG. 10 Burnishing Bushing—Typical

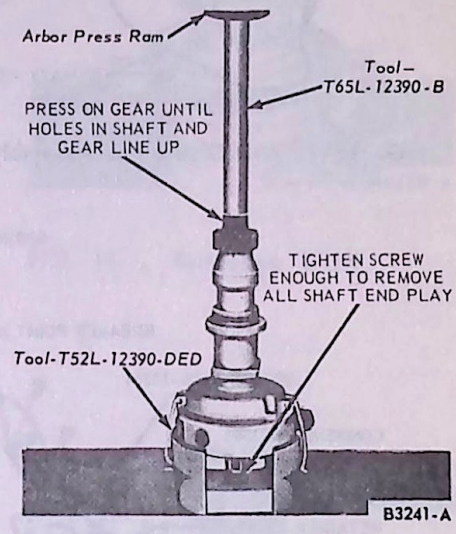


FIG. 11 Installing Original Shaft and Gear—6-Cylinder Engine

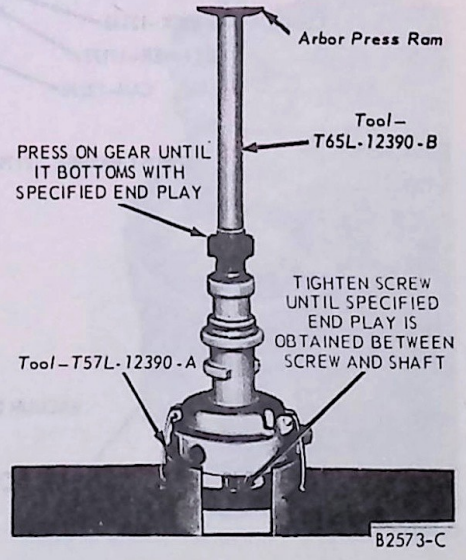


FIG. 12 Installing New Shaft and Gear—6-Cylinder Engine

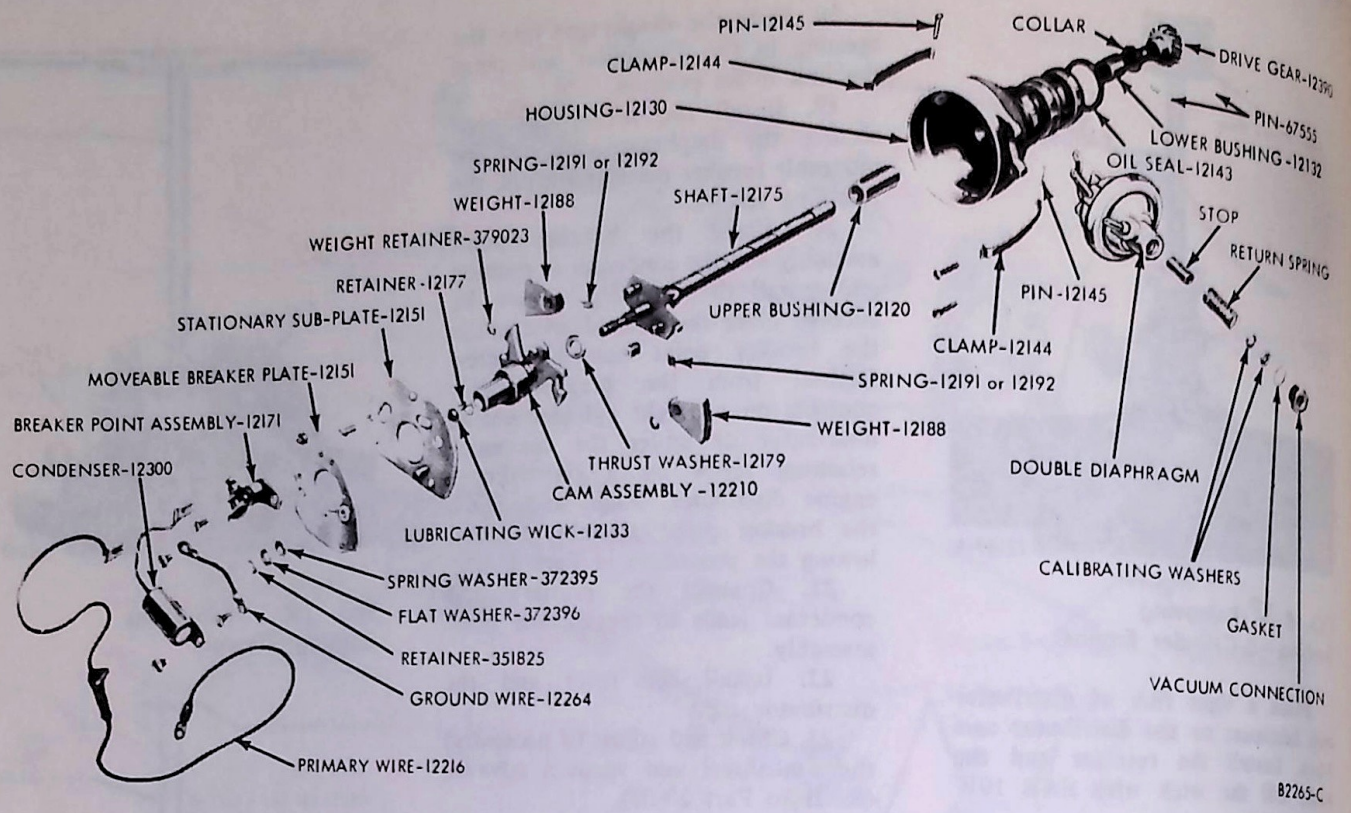


FIG. 13 V-8 Distributor Assembly

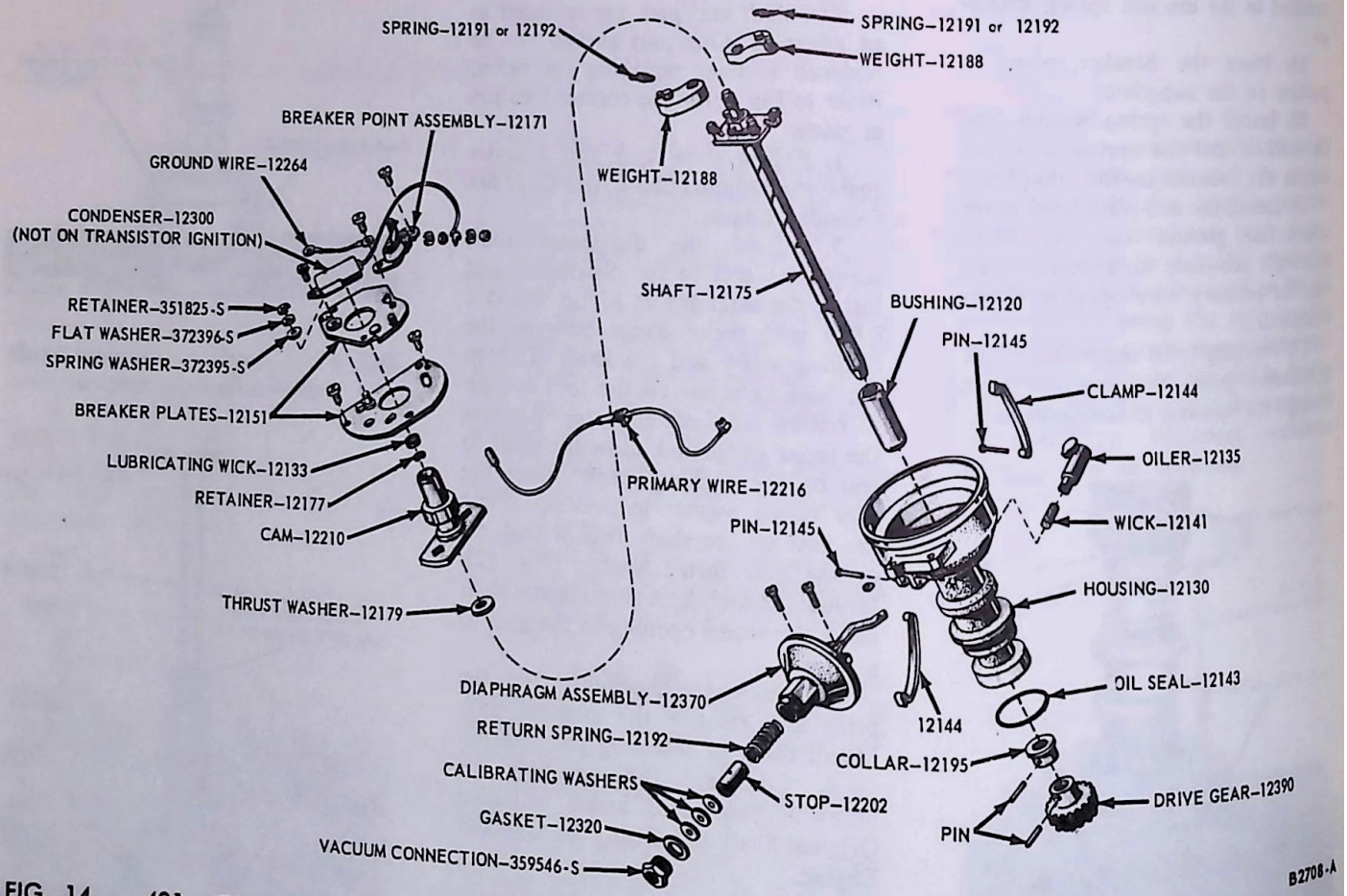


FIG. 14 401, 477 and 534 SD V-8 Distributor Assembly

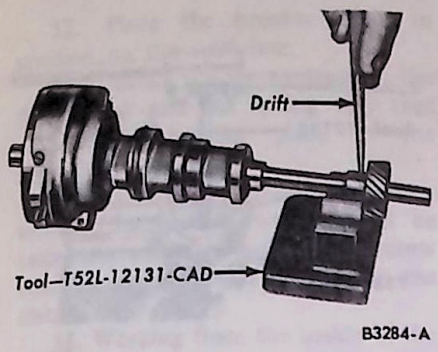


FIG. 15 Removing or Installing Gear Pin

Conventional Ignition System

Disassembly

1. Remove the rotor.
2. Disconnect the primary and the condenser wires from the breaker point assembly.
3. Remove the breaker point assembly and condenser retaining screws. Lift the breaker point assembly and condenser out of the distributor.
4. Remove the spring clip that secures the diaphragm link to the moveable breaker plate.
5. Remove the diaphragm retaining screws and slide the diaphragm out of the distributor.
6. Working from the inside of the distributor, pull the primary wire through the opening in the distributor.
7. Remove the spring clip, the flat washer, and the spring washer securing the breaker plate to the sub-plate.
8. Remove the sub-plate retaining screws and lift both plates out of the distributor.
9. On a 330 MD, a 360 or 390 V-8 distributor, proceed as follows:

Mark one of the distributor weight springs and its brackets. Also mark one of the weights and its pivot pin.

Carefully unhook and remove the weight springs.

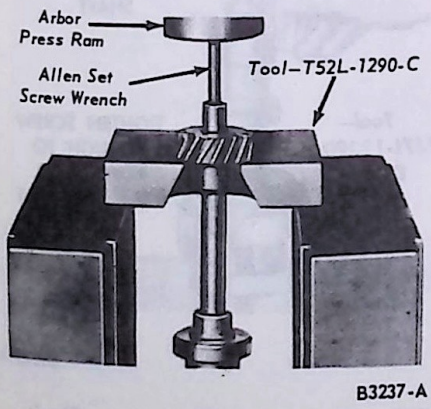


FIG. 16 Removing Gear

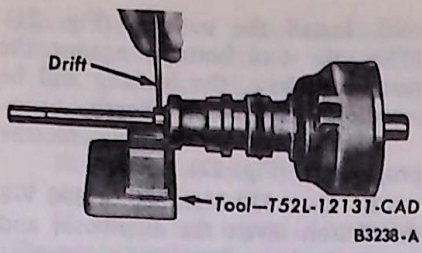


FIG. 17 Removing or Installing Collar Retaining Pin

Lift the lubricating wick from the cam assembly. Remove the cam assembly retainer and lift the cam assembly off the distributor shaft. Remove the thrust washer.

Remove the weight retainers and lift the weights out of the distributor.

10. On a 401, 477 or 534 SD V-8 distributor, proceed as follows:

Remove the lubricating wick and the cam retainer. Lift the cam out of the distributor. Remove the thrust washer.

Mark one of the weight springs and the brackets that it is attached to.

Carefully unhook and remove the weight springs. Remove the weights.

11. Remove the distributor cap clamps.
12. **If the gear and shaft are to be used again, mark the gear and the shaft so that the pin holes can be easily aligned for assembly.** Remove the gear roll pin (Fig. 15), and then remove the gear (Fig. 16).
13. Remove the shaft collar roll pin (Fig. 17).
14. Invert the distributor and place it on a support plate in a position that will allow the distributor shaft to clear the support plate and press the shaft out of the collar and the distributor housing (Fig. 18).

The 401, 477 and 534 SD V-8 distributor does not require the Allen Set Screw Wrench (Fig. 18) for shaft removal. Just press on the end of the shaft with the arbor press ram.

15. Refer to Figs. 19 and 20 and remove the distributor shaft upper and lower bushings. (The 401, 477 and 534 SD V-8 distributors do not have lower bushings).

Transistor Ignition System

Disassembly

1. Remove the rotor and the dust cover.
2. Disconnect the primary wire from the breaker point assembly.
3. Remove the retaining screws from the breaker point assembly and lift the breaker point assembly out of the distributor.

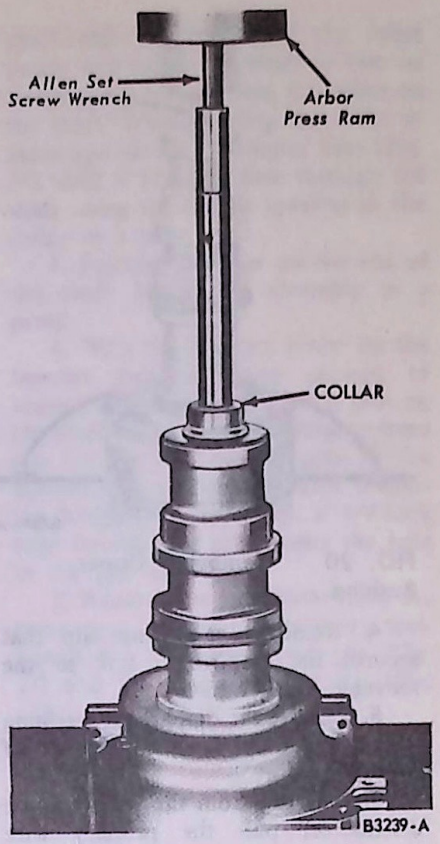


FIG. 18 Removing Shaft

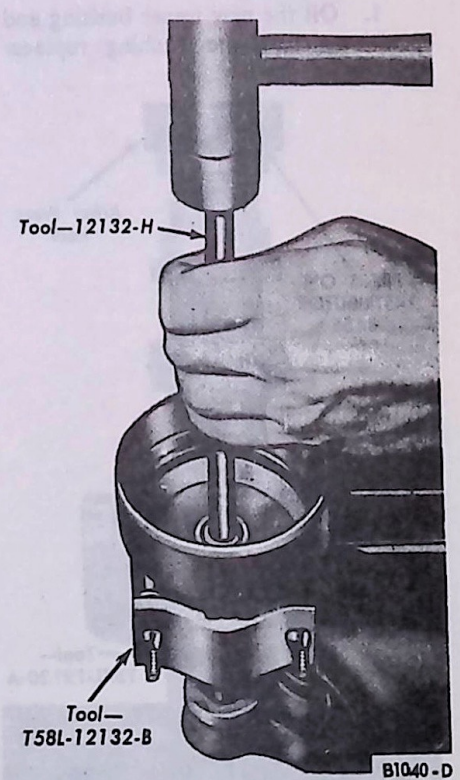


FIG. 19 Removing Lower Bushing

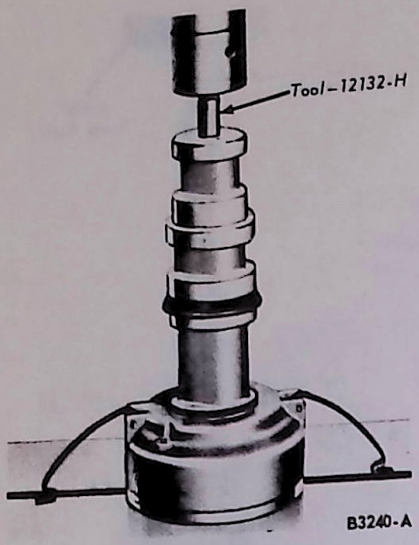


FIG. 20 Removing Upper Bushing

4. Remove the spring clip that secures the diaphragm link to the movable breaker plate.

5. Remove the diaphragm retaining screws and slide the diaphragm out of the distributor.

6. Working from the inside of the distributor, pull the primary wire through the opening in the distributor.

7. Follow steps 7-15 under Conventional Ignition System Distributor.

Original Shaft and Gear

Assembly

1. Oil the new upper bushing and position it on the bushing replacer tool. Install the bushing (Fig. 21). When the tool bottoms against the distributor base, the bushing will be installed to the correct depth.

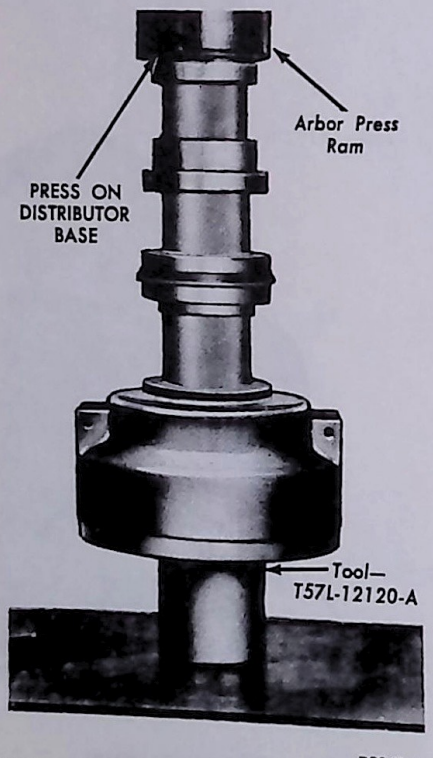


FIG. 21 Installing Upper Bushing

2. Burnish the bushing to the proper size (Fig. 22).

3. On a 330 MD, 360 or 390 V-8 distributor, invert the distributor and install the lower bushing in a similar manner.

4. Oil the shaft and slide it into the distributor body.

5. Place the collar in position on the shaft and align the holes in the collar and the shaft, then install a new pin. Install the distributor cap clamps.

6. Check the shaft end play with a feeler gauge placed between the collar and the base of the distributor. If the end play is not within specifications, replace the shaft and gear.

7. Attach the distributor shaft supporting tool to the distributor. Tighten the backing screw in the tool enough to remove all shaft end play.

8. Install the assembly in a press. Press the gear on the shaft (Fig. 23), using the marks made on the gear and shaft as guides to align the pin holes.

9. Remove the distributor from the press. Install the gear retaining pin (Fig. 14).

10. On a 330 MD, a 360 or 390 V-8 distributor, proceed as follows:

Position the distributor in a vise. Fill the grooves in the weight pivot pins with a distributor cam lubricant (C4AZ-19D530-A).

Position the weights in the distributor (the marked weight is placed on the marked pivot pin) and install the weight retainers.

Place the thrust washer on the shaft.

Fill the grooves in the upper portion of the distributor shaft with distributor cam lubricant (C4AZ-19D530-A).

Install the cam assembly. Be sure that the marked spring bracket on the cam assembly is near the marked spring bracket on the stop plate. Place a light film of distributor cam lubricant on the distributor cam lobes. Install the retainer and the wick. Oil the wick with SAE 10W engine oil.

Install the weight springs. Be sure that the marked spring is attached to the marked spring brackets.

11. On a 401, 477 or 534 SD V-8 distributor, proceed as follows:

Position the weights in the distributor and install the weight springs. **Be sure that the marked spring is connected to the marked spring brackets.** Install the shaft upper thrust washer. Fill the grooves in the

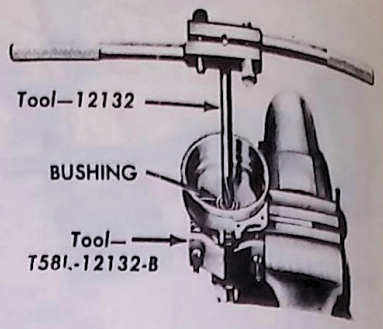


FIG. 22 Burnishing Bushing

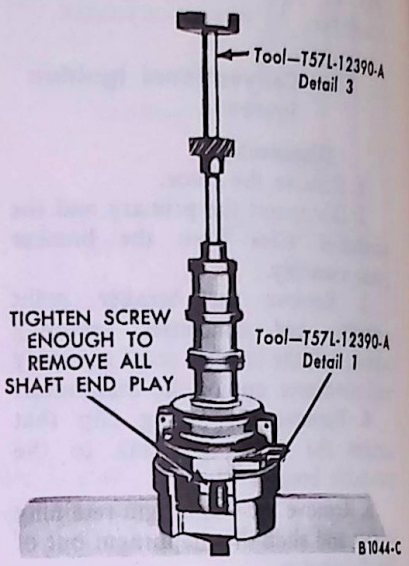


FIG. 23 Installing Original Shaft and Gear

upper portion of the distributor shaft with distributor cam lubricant (C4AZ-19D530-A). Install the cam assembly. Be sure that the slots in the cam engage the pins in the weights. Install the cam retainer and wick. Oil the wick with SAE 10W engine oil.

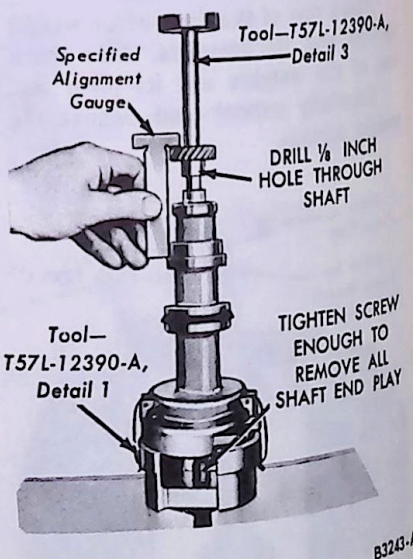


FIG. 24 Installing New Shaft and Gear

12. Place the breaker plate in position on the sub-plate.

13. Install the spring washer, the flat washer and the spring clip that secures the breaker plate to the sub-plate.

14. Install the sub-plate hold down screws (the ground wire should be under the sub-plate hold down screw near the primary wire opening in the distributor).

15. Working from the inside of the distributor, push the primary wire through the opening in the distributor.

16. Slide the diaphragm into the opening in the distributor and place the link in its position.

17. Install the spring clip that secures the diaphragm link to the moveable breaker plate and install the retaining screws.

18. Place the breaker point assembly and the condenser (if so equipped) in position and install the retaining screws. Be sure to place the ground wire under the breaker point assembly screw farthest from the breaker point contacts. Align and adjust the breaker point assembly by following the procedure in Part 23-01.

19. Connect the primary and condenser (if so equipped) leads to the breaker point assembly.

20. Install the rotor and dust cover (if so equipped).

21. Check and adjust (if necessary) the centrifugal and vacuum advance (Refer to Part 23-01).

New Shaft and Gear

Assembly

The shaft and gear are serviced as an assembly. One part should not be replaced without replacing the other. Refer to Fig. 5 for the correct location of the parts.

1. Follow steps 1 thru 4 under Installing Original Shaft and Gear.

2. Attach the distributor shaft supporting tool to the distributor and install the assembly in a vise. Insert a feeler gauge equal to the minimum specified end play for the particular distributor between the backing screw and the shaft. Tighten the backing screw on the tool enough to remove all shaft end play. Remove the feeler gauge and allow the shaft to rest on the backing screw. Slide the collar on the shaft. While holding the collar in place against the distributor base (Fig. 24), drill a 1/8-inch hole through the shaft using the access opening in the collar as a pilot.

3. Position the gear on the end of the shaft. Install the assembly in a press.

4. With the backing screw on the support tool tightened enough to remove all end play, press the gear on the shaft to the specified distance from the bottom face of the gear to the bottom face of the distributor mounting flange (Fig. 15). Drill a 1/8-inch hole through the shaft using the hole in the gear as a pilot.

5. Remove the distributor from the press and remove the support tool. Install the collar retaining pin (Fig. 17) and the gear retaining pin (Fig. 15).

Complete the assembly by following steps 9 through 21 under Installing Original Shaft and Gear.

9 SPECIFICATIONS

DISTRIBUTOR ADVANCE SPECIFICATIONS

VACUUM ADVANCE				CENTRIFUGAL ADVANCE			VACUUM RETARD		
SET TEST STAND TO 0° AT 1000 DISTRIBUTOR RPM AND 0 INCHES OF MERCURY				SET TEST STAND TO 0° AT 250 DISTRIBUTOR RPM AND 0 INCHES OF MERCURY			SET TEST STAND TO 0° AT 1000 DISTRIBUTOR RPM AND 0 INCHES OF MERCURY		
Distributor	Vacuum (Inches of Mercury)	Advance (Distributor or Camshaft Degrees)	Max. Adv. (Camshaft Degrees) @ 25" Hg.	Distributor rpm	Advance (Distributor or Camshaft Degrees)	Max. Adv. (Camshaft Degrees)	Vacuum (Inches of Mercury)	Retard (Distributor or Camshaft Degrees)	Max. Ret. (Camshaft Degrees) @ 20" Hg.
C9UF-F	5 10 15 20 25	0-3/4 0-2 2 3/4-6 ② 3 1/2-6 3 1/2-6	6°	350 500 750 1000 1500 2000	0-1/2 0-1/2 0-2 3 1/2–5 1/2 ① 7 3/4-10 9 1/2-12	14° @ 2500 rpm	5 10 15 20	0-1/4 1 1/4-8 1/4 5-7 5-7	7°
D1TF-CA	5 10 15 20 25	0-1 1-4 5 1/2-8 ② 5 1/2-8 5 1/2-8	8°	350 500 750 1000 1500 2000	0-1/2 0-1/2 0-1/2 1/2–2 1/2 ① 5 3/4-8 7 3/4–10 1/4	14° @ 2800 rpm	5 10 15 20	0-1 1/4 2 1/2-7 5-7 5-7	7°
C8AF-A	5 10 15 20 25	0-3/4 3/4-3 3/4 5 1/2-8 ② 5 1/2-8 5 1/2-8	8°	350 500 750 1000 1500 2000	0-1/2 0-1/2 0-1 1/2 2 1/4-4 1/2 ① 6-8 7 1/2-10	14° @ 2600 rpm	5 10 15 20	0-1 1/2 2 1/2-6 5-7 5-7	7°
C9UF-A	5 10 15 20 25	0-3/4 3/4-3 3/4 5 1/2-8 ② 5 1/2-8 5 1/2-8	8°	350 500 750 1000 1500 2000	0-1/2 0-1/2 0-1 1/2 2 1/4-4 1/2 ① 6-8 7 1/2-10	14° @ 2600 rpm			
C8TF-D	5 10 15 20 25	0-1 6 3/4-9 3/4 10-12 1/2 ② 10-12 1/2 10-12 1/2	12 1/2°	350 500 750 1000 1500 2000	0-1/2 0-1 3/4-2 3/4 1 3/4-4 ① 4 1/4-6 1/2 6 1/2-9	11° @ 2400 rpm	5 10 15 20	0-1 1/4 2 3/4-6 5-7 5-7	7°
C8TF-U	5 10 15 20 25	0-1 1/2 5 3/4-8 3/4 8 3/4-11 3/4 ② 10-12 1/2	12 1/2°	350 500 750 1000 1500 2000	0-1/2 0-1/2 3/4-3 4 1/2-6 1/2 ① 6-8 1/4 7 1/2-10	11° @ 2275 rpm			
D0TF-M	5 10 15 20 25	0-3/4 0-2 1/4 5-8 ② 8-10 1/2 8-10 1/2	10 1/2°	350 500 750 1000 1500 2000	0-1/2 0-1/2 1/2-2 1/2 6-8 ① 8 1/2-10 3/4 9 3/4-12 1/4	14° @ 2600 rpm	5 10 15 20	0-3 4 1/2-7 5-7 5-7	7°
D1UF-AA	5 10 15 20 25	0-1 0-2 1/4 5-8 ② 8-10 1/2 8-10 1/2	10 1/2°	350 500 750 1000 1500 2000	0-1/2 0-1/2 1/2-2 1/2 6-8 ① 8 1/2-10 3/4 9 3/4-12 1/4	14° @ 2500 rpm			
D1TF-DA	5 10 15 20 25	0-1 0-3 5 1/2-9 ② 6 1/2-9 6 1/2-9	9°	350 500 750 1000 1500 2000	0-1/2 0-1/2 2 1/2-5 1/2 9-11 ① 11 1/4-13 1/2 13 1/2-16	19° @ 2600 rpm	5 10 15 20	0 0-4 1/2 5-7 5-7	7°

① Double for Crankshaft Advance @ 2,000 rpm with Distributor Vacuum Line Disconnected

② Double and Add to Computation for Distributor Vacuum Line Disconnected (See Footnote ①) for Crankshaft Advance @ 2000 rpm with Distributor Vacuum Line Connected.

C81010-D

DISTRIBUTOR ADVANCE SPECIFICATIONS (Continued)

Vacuum Advance (Set Test Stand to 0° at 1000 Distributor rpm and 0 inches of Mercury.)				Centrifugal Advance (Set Test Stand at 0° at 250 Distributor rpm and 0 inches of Mercury.)			Vacuum Retard (Set Test Stand at 0° at 250 Distributor rpm and 0 inches of Mercury.)		
Distributor	Vacuum (Inches of Mercury)	Advance (Distributor or Camshaft Degrees)	Max. Adv. (Camshaft Degrees) @ 25" Hg.	Distributor rpm	Advance (Distributor or Camshaft Degrees)	Max. Adv. (Camshaft Degrees)	(Inches of Mercury)	Retard (Distributor or Camshaft Degrees)	Max. Ret. (Camshaft Degrees) @ 20" Hg.
D0TF-J	5 10 15 20 25	0-1 1/4 6 1/2-9 6 1/2-9 6 1/2-9 6 1/2-9 ②	9°	350 500 750 1000 1500 2000	0-1/2 2 1/2-4 1/2 7 3/4-9 3/4 9-11 ① 11 1/4-13 1/2 13 3/4-16 1/4	19° @ 2550 rpm	5 10 15 20	0-1/4 2-7 5-7 5-7	7°
D1TF-EA	5 10 15 20 25	0-1 1/4 6-9 6 1/2-9 6 1/2-9 6 1/2-9 ②	9°	350 500 750 1000 1500 2000	0-1/2 0-3/4 2 1/2-5-3/4 9-11 ① 11 1/4-13 1/2 13 1/2-16	19° 2600 rpm			
D1HF-AA	5 10 15 20 25	0-1 5 1/2-8 1/2 5 1/2-8 1/2 5 1/2-8 1/2 ②	8 1/2°	350 500 750 1000 1500 2000	0-1/2 2-3 1/4 7-8 1/4 9-11 ① 9-11 9-11	11° @ 900 rpm			
C7TF-D	5 10 15 20 25	0-1 1/2 5 1/2-8 1/2 6 1/2-9 6 1/2-9 ②	9°	350 500 750 1000 1500 2000	0-1/2 0-1 1 1/2-3 1/2 2 3/4-5 ① 5-7 1/4 7-9 1/2	11° @ 2350 rpm			

① Double for Crankshaft Advance @ 2000 rpm with Distributor Vacuum Line Disconnected.
② Double and Add to Computation for Distributor Vacuum Line Disconnected (See Footnote 1) for Crankshaft Advance @ 2000 rpm with Distributor Vacuum Line Connected.

ENGINE PERFORMANCE SPECIFICATIONS

Engine	Dwell Angle At Idle Speed	Distributor Point Gap	Spark Plug Gap	Spark Plug No. ①
170 1-V	35-40	0.027	0.032-0.036	BF-82
240 1-V Econoline except E300 Van, F-100				BF-42
240 1-V F250-350, F, B and N-500, P350-500, E-300 Van	37-42	0.025	0.028-0.032	BTF-31
300 1-V,F-100	35-40	0.027	0.032-0.036	BF-42
300 1-V, all except F-100	37-42	0.025	0.032-0.036	BTF-31
302-2V Bronco Econoline Bus-E-100-200-300, F-100	24-29	0.021	0.028-0.032	BTF-31
330 2-V MD & HD	26-31	0.017	0.028-0.032	BTF-31
360 2-V F-100	24-29	0.017	0.032-0.036	BF-32
360 2-V F-250-350	26-31	0.017	0.032-0.036	BF-32
361 2-V	26-31	0.017 ②	0.028-0.032	BTF-31
390 2-V F-100	24-29	0.021	0.032-0.036	BF-32
390 2-V F-250-350	26-31	0.017 ②	0.032-0.036	BF-32
391 4-V	26-31	0.017 ②	0.028-0.032	BTF-31
401 477 534	26-31	0.017 ②	0.028-0.032	BTF-31

Initial Ignition Timing
All Truck Enginex except 401, 477, 534 6°BTC
401, 477, 534 10°BTC

① Installation torque 15-20 Ft-lbs.

② If equipped with transistorized ignition, set point gap at 0.020 and dwell angle at 22-24°.

CONVENTIONAL IGNITION SYSTEM – COIL CONDENSER AND PRIMARY CIRCUIT RESISTOR SPECIFICATIONS

Coil		Primary Circuit Resistor	CONDENSER		
			Capacity (Micro-farads)	Minimum Leakage (Megohms)	Maximum Series Resistance (Ohms)
Primary Resistance (Ohms)	1.40–1.54 (75°F)	Resistance (Ohms)	0.21–0.25	10	1
Secondary Resistance (Ohms)	7600–8800 (75°F)				
Amperage Draw (Engine Stopped)	4.5	1.30–1.40 (75°F)			
Amperage Draw (Engine Idling)	2.5				

DISTRIBUTOR GENERAL INFORMATION

Engine	Point Voltage Drop (Max)	Rotor Air Gap Voltage Drop (Max)	Breaker Arm Spring Tension (Oz)	Distributor Shaft End Play ①	Gear Location ②
170	0.25	7.5 KV	17-21	0.022-0.033	2.510-2.515
240				0.003-0.010	N.A.
300				0.024-0.035	4.031-4.038
302				0.022-0.032	3.071-3.080
330 (MD)				0.025-0.035	
330 (HD)				0.022-0.032	3.071-3.078
360				0.025-0.035	3.071-3.080
361				0.022-0.032	3.071-3.078
390				0.025-0.035	3.071-3.080
391				0.022-0.030	5.111-5.116
401					
477					
534					

① Measured with distributor removed
② Distance from bottom of mounting flange to bottom of gear.

TRANSISTOR IGNITION SYSTEM

COIL			
Primary Resistance (Ohms)	0.226–0.251 (75°F)	Emitter (Ohms)	0.31–0.35 (75°F)
Secondary Resistance (Ohms)	4900–5680 (75°F)	Collector (Ohms)	0.41–0.45 (75°F)
Amperage Draw (Engine Cranking)	4.0	Base (Ohms)	7.1–7.9 (75°F)
Amperage Draw (Engine Idling)	5.0		

CB 1010-D2

PART 23-20 Governors

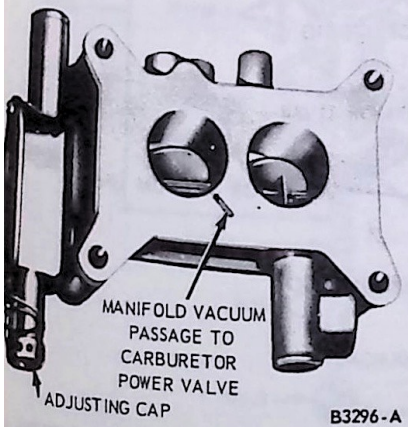
1 DESCRIPTION AND OPERATION

VELOCITY GOVERNORS

Conventional Velocity Governor

The velocity governor (Fig. 1) is a single unit mounted between the carburetor and the intake manifold. There is no provision for repair of this governor. It should be replaced when damaged.

The governor is operated by a combination of manifold vacuum and the air flow past the governor valves. The governor throttle valves are offset in the throttle bore so that the combined force of manifold vacuum and the fuel air flow through the bores has greater effect on the larger, upstream area of the valves. This forces the throttle valves to move toward the closed position restricting the fuel-air flow. The closing action of the throttle valves is opposed by the control spring. The control spring is attached to the throttle valve shaft cam. The cam provides a balance



IG. 1 Typical Velocity
overnor

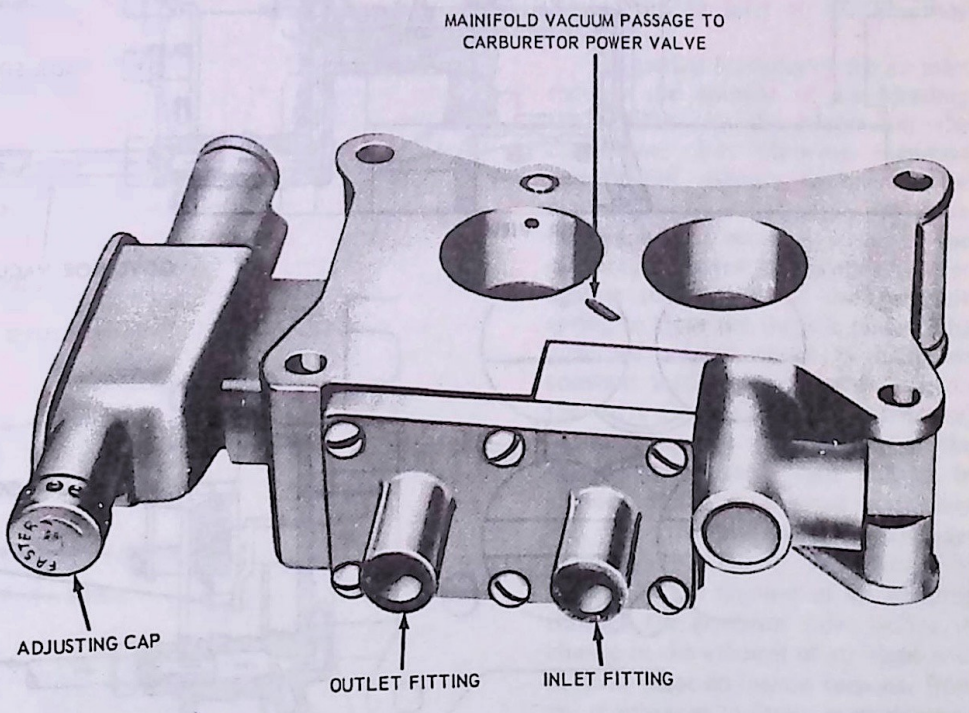


FIG. 2 Coolant Heated Velocity Governor

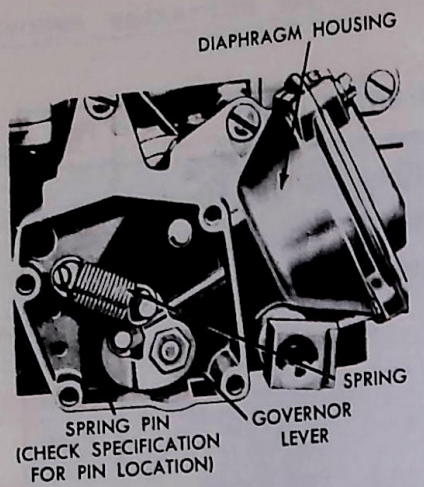


FIG. 3 Throttle Actuating Mechanism—Vacuum Governor

between the closing action of the throttle valves and the action of the control spring at all engine speeds.

Under operating conditions, the governor throttle valves do not close, but remain open enough to allow the required quantity of the fuel-air mixture to flow into the manifold to maintain the governed engine speed.

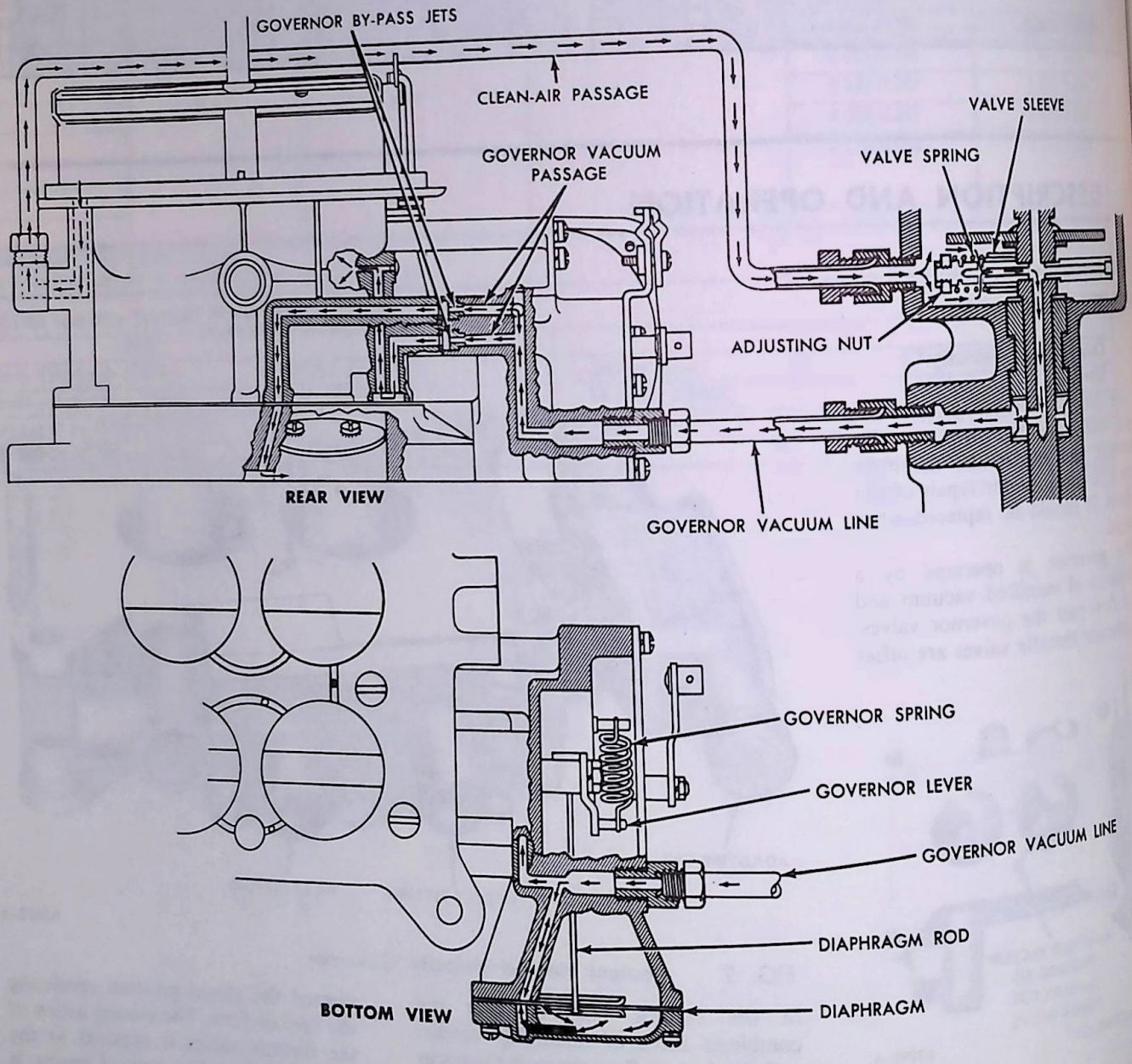
To maintain the proper vacuum to the distributor, the governor has two interconnected vacuum transfer ports and a vacuum transfer plunger. When the governor throttle valves are forced toward the closed position, vacuum from the lower port is supplied to the distributor to maintain sufficient spark advance. When the governor throttle valves are open wide enough, the plunger shuts off the bottom port and the top port supplies vacuum to the carburetor distributor vacuum passage for sufficient vacuum to the distributor.

Coolant Heated Velocity Governor

The coolant heated velocity governor (Fig. 2) is used on the 360 and 390 truck engines with manual transmissions. This governor has a coolant passage so that the governor can also be used as a coolant heated carburetor spacer. Otherwise, the description and operation of this governor is the same as the conventional velocity governor.

Compensating Governor 300 MD Engine

A characteristic of velocity-type governors is that the regulated engine speed increases in direct proportion to any increase in the altitude in which



C87 FIG. 4 Governor System

the engine is operated. This also causes a proportionate increase in the variance between regulated load and noload settings. A normal sea level load setting of 3600 engine rpm becomes 4000 engine rpm at 5000 feet above sea level. A normal sea level no-load setting of 3900 engine rpm becomes 4500 engine rpm at 5000 feet above sea level. The 300 engine rpm variation at sea level become a 500 engine rpm variation at 5000 feet above sea level.

The velocity governor used on a 330 MD V-8 can be adjusted to compensate for variations due to altitude. **Any 330 MD V-8 engine equipped with a velocity governor and operated consistently at or above 2000 feet above sea level must have the velocity governor adjusted for specific altitude.**

With the exception of the altitude compensating adjustment, the description and operation of this governor is the same as the conventional velocity governor.

VACUUM GOVERNOR

The throttle actuating mechanism on the carburetor (Fig. 3) has a diaphragm assembly, governor spring, and governor lever assembly. The spring and diaphragm are linked together by the governor lever which is attached to the carburetor primary throttle shaft. The controlling unit contains a centrifugally operated governor valve. The valve is driven by the distributor drive mechanism.

The operator controls the throttle plates in the usual manner below governing speeds through a clutch arrangement on the carburetor throttle body. When governing speed is reached, a combination of venturi and manifold vacuum acts on the governor diaphragm to close the throttle plates (Fig. 4). Two calibrated by-pass jets in the vacuum passages meter the vacuum from the venturi and the manifold to provide the correct balance for proper operation of the governor. At speeds below governing rpm, this vacuum is weakened by air from the governor valve so that premature governing action will not occur. Filtered air from the carburetor air cleaner enters the governor system through a passage in the carburetor to the controlling unit. A combination of vacuum from the venturi and manifold transmitted through the governor system passages on the carburetor, draws the air through the governor valve and back to the governor diaphragm on the carburetor.

In the controlling unit, centrifugal force acting on the governor valve, which has kept pace with engine speed, overcomes the tension of the valve spring and partially retards the flow of air to the throttle actuating mechanism when governing speed is reached.

The air flow is retarded by the valve sleeve being thrown outward by centrifugal force and thus partially closing the air inlet on the governor valve shaft.

The partial blocking of the air inlet reduces the amount of air bleeding through to the diaphragm on the carburetor, thus allowing manifold and venturi vacuum to operate the diaphragm. As the vacuum acting on the diaphragm becomes stronger, the diaphragm moves the governor lever against the tension of the governor spring to close the throttle plates. The governed engine speed is held for constant load by centrifugal force on the valve (in the ignition distributor) balanced against the tension of the valve spring. Any slight change in engine speed due to load restriction will cause the governor valve to react immediately, either increasing or decreasing the amount of air bleeding through the governor valve orifice. A change in the amount of air bleed will, in turn, cause an instant response from the diaphragm to increase or decrease the throttle plate opening. When the accelerator is released, control is taken from the governor by the external throttle lever, and the return spring in the accelerator pedal linkage closes the throttle pedal to bring the engine to any desired lower speed.

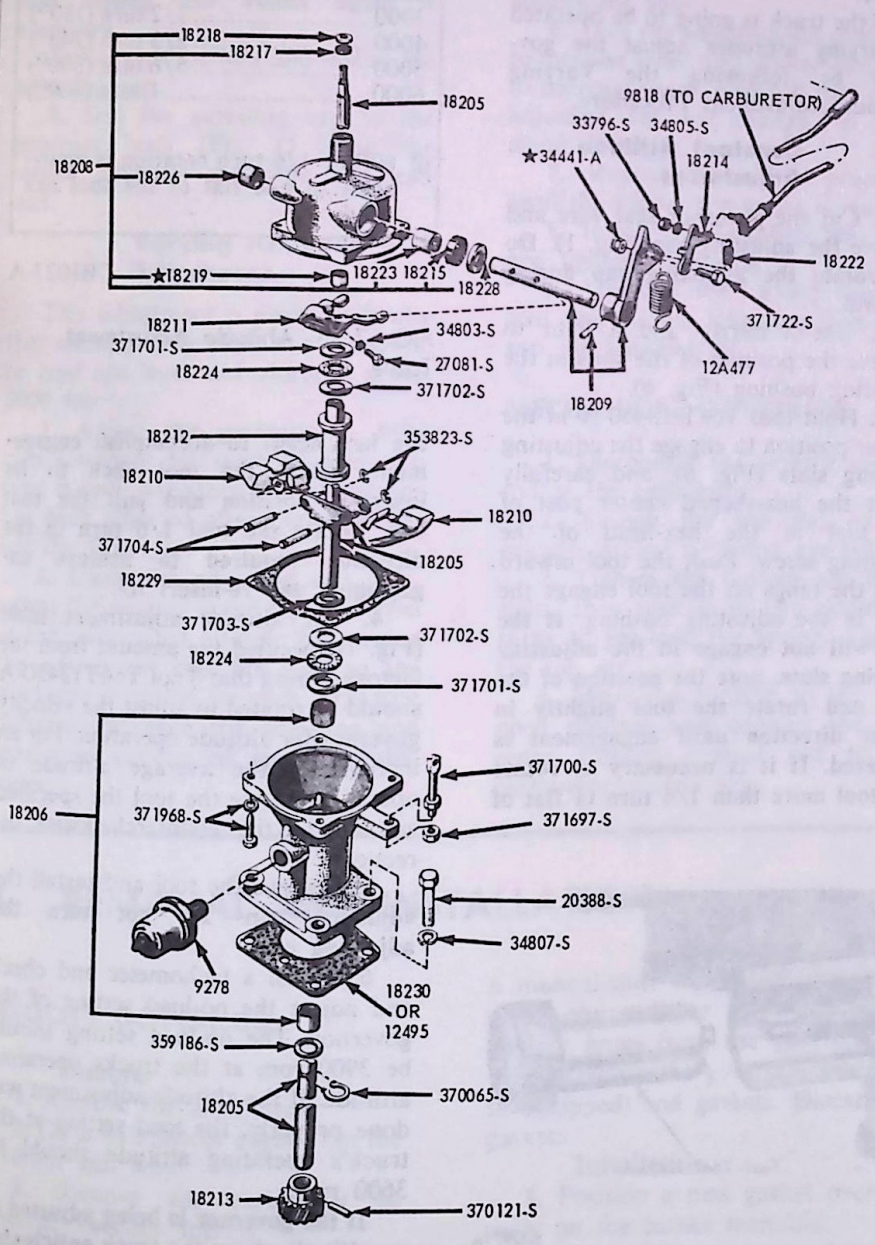


FIG. 5 Mechanical Governor

MECHANICAL GOVERNOR

The governor is the mechanical flyweight type (Fig. 5). The flyweights are pivoted on the governor shaft. A direct mechanical linkage from the governor throttle control arm to the carburetor throttle control arm limits carburetor action to the governor setting. As the engine speed increases, the rotation of the governor shaft increases. Centrifugal force causes the weights to move outward as the rotation of the governor shaft increases. However, a spring retards or limits the movement of the weights until the centrifugal force overcomes the spring tension. At this time, the weights are forced outward closing the throttle plates through the linkage to the throttle shaft.

A clutch assembly, located on the side of the carburetor, connects the carburetor throttle shaft to the accelerator pedal linkage. When engine speed is below the governor full-load setting, the clutch is engaged. Once the full-load speed is attained, the main actuating lever on the governor and its linkage become the controlling factors and tend to close the throttle plates and disengage the clutch. At this point the maximum engine rpm is determined by the governor. When engine speed falls below the governor setting, the clutch re-engages, and the pedal accelerator linkage once again controls the rpm of the engine.

3 ADJUSTMENTS

VELOCITY GOVERNOR

Conventional and Coolant Heated Velocity Governors

Connect a tachometer to the engine. With the engine at normal operating temperature, operate the engine at wide open throttle and compare the rpm with the operating range of the governor. The operating range is stamped on the governor plate.

If governed speed is within range, stop the engine and remove the tachometer.

If adjustment is required or desired, remove the governor seal (Fig. 1). To increase rpm, turn the cap counterclockwise. To decrease rpm, turn the cap clockwise. When adjustment is complete, stop the engine, seal the cap, and remove the tachometer.

Compensating Governor

If the truck is going to be operated at a consistent altitude, adjust the governor by following the Constant Altitude Adjustment Procedure.

If the truck is going to be operated at varying altitudes above 2000 feet, adjust the governor by following the Constant Altitude Adjustment procedure.

If the truck is going to be operated at varying altitudes adjust the governor by following the Varying Altitude Adjustment Procedure.

Constant Altitude Adjustment

1. Cut the governor seal wire and remove the adjusting cap (Fig. 1). **Do not rotate the adjusting cap during removal.**

2. Use a mirror and a light to observe the position of the slots in the adjusting bushing (Fig. 6).

3. Hold tool T64T-12450-A in the proper position to engage the adjusting bushing slots (Fig. 6), and carefully insert the hex-shaped center post of the tool in the hex-head of the adjusting screw. Push the tool inward until the tangs on the tool engage the slots in the adjusting bushing. **If the tool will not engage in the adjusting bushing slots, note the position of the tool and rotate the tool slightly in either direction until engagement is achieved. If it is necessary to rotate the tool more than 1/6 turn (1 flat of the hex head) to accomplish engagement, rotate the tool back to its insertion position and pull the tool out. Rotate the tool 1/6 turn in the direction required to achieve engagement and re-insert it.**

Average Operating Altitude—Feet	Amount of ① Tool Rotation
2000	1/3 turn (120°)
3000	1/2 turn (180°)
4000	2/3 turn (240°)
5000	5/6 turn (300°)
6000	1 turn (360°)

① 60° or 1/6 turn rotation is equivalent to one flat of the tool hex head.

CB1023-A

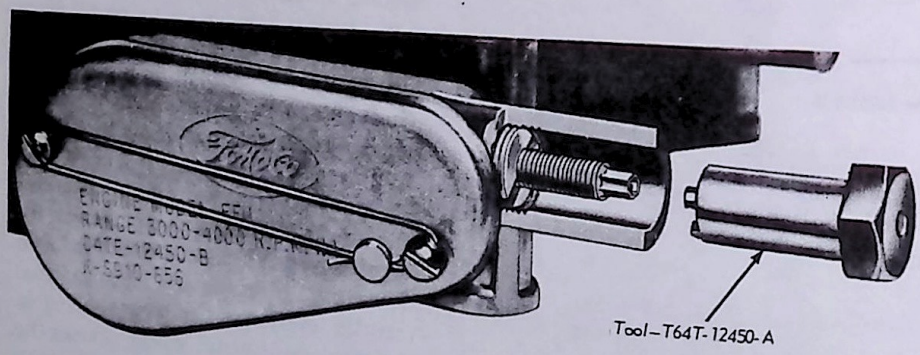
FIG. 7 Altitude Adjustment Table

4. The altitude adjustment table (Fig. 7) specified the amount from the factory setting that Tool T64T12450-A should be rotated to adjust the velocity governor for altitude operation. For an increase in the average altitude of operation, rotate the tool the specified amount in the counterclockwise direction.

5. Remove the tool and install the adjusting cap. **Do not turn the adjusting cap.**

6. Install a tachometer and check and adjust the no-load setting of the governor. The no-load setting should be 3900 rpm at the trucks operating altitude. If the altitude adjustment was done properly, the load setting at the truck's operating altitude should be 3600 rpm.

If the governor is being adjusted at an altitude above the truck anticipated operating altitude, the load and noload speeds should be slightly above 3600



B3297-A

FIG. 6 Altitude Compensation Adjustment

and 3900 rpm respectively. If the governor is being adjusted at an altitude below the truck anticipated operating altitude, the load and no-load should be slightly below 3600 and 3900 rpm respectively.

If the load rpm is below the specified rpm (3500 at sea level and 3600 at operating altitudes above 2000 feet), insert the tool by following step 3 and turn it counterclockwise. Remove the tool, insert the adjusting cap and adjust the no-load setting. Check the load setting and adjust again if necessary.

If the load rpm is above the specified rpm (3500 at sea level and 3600 at operating altitudes above 2000 feet), insert the tool by following step 3 and turn it clockwise. Remove the tool, insert the adjusting cap and adjust the no-load setting. Check the load setting and adjust again if necessary.

7. Remove the tool and install the adjusting cap.

8. Seal the adjusting cap to the governor body (Fig. 1) using the service governor seal wire and lead seal.

Varying Altitude Adjustment

This adjustment is made on trucks that are operating between altitudes at or near sea level and altitudes above 2000 feet.

1. Adjust the governor to 3800 rpm (no-load) for sea-level operation (this is only necessary if the governor has been adjusted after the truck has left the factory).

2. Using the adjusting cap only, adjust the no-load speed for 4100 rpm at the anticipated altitude by turning the adjustment cap 1/4 turn in the clockwise direction for each 1000 foot difference between the adjusting and maximum anticipated operating altitudes.

If the maximum operating altitude of the truck is lower than the altitude at which the adjustment is being made, adjust the no-load speed to 4100 rpm with the adjustment cap.

VACUUM GOVERNOR

1. Connect a tachometer to the engine.

2. Operate the engine until normal operating temperature has been reached.

3. Operate the engine at wide open throttle and note the engine speed registered.

4. Stop the engine and remove the adjusting hole plug from the controlling unit housing.

5. With the ignition switch off, crank the engine until the governor adjusting nut is aligned with the adjustment hole.

6. Turn the adjusting nut clockwise to increase speed and counterclockwise to decrease speed. One full turn of the adjusting nut will change top speed about 150 rpm.

7. Repeat the above procedure until the proper top speed is reached.

8. Install the adjusting hole plug and tighten it securely.

9. Attach a new locking wire and lead seal to the adjusting hole plug and the adjacent fin.

MECHANICAL GOVERNOR

1. Disconnect the throttle control rod at the carburetor.

2. Loosen the top nut on the primary spring adjusting eye bolt.

3. Tighten the bottom nut finger tight, then turn it in two additional turns to pre-load the spring. Tighten the top nut.

4. Move the throttle to the wide open position and connect the governor throttle control rod to the carburetor control arm.

5. Adjust the governor throttle control rod so that the governor throttle control auxiliary lever is full forward. This is the wide open throttle position. Next, shorten the rod one full turn. This will position the throttle plates slightly off wide open position and will avoid compression of the control rod linkage.

6. Check the accelerator linkage to be sure that wide open throttle position is achieved when the accelerator pedal is depressed to the floor. Be sure that the accelerator rod or cable is attached to the proper hole in the throttle lever.

7. Check the operation of the choke plate from the full open to the full closed position for proper adjustment and freedom of operation. **On a C- or W-Series truck, the choke plate will not close completely when the choke knob is pulled all the way out.**

If there is any bind in the choke cable on a C- or W-Series truck, examine the cable for sharp or reverse bends. Be sure the end of the cable is bent downward to prevent interference with the bottom of the air cleaner, as interference will restrict opening of the choke plate.

8. To adjust the speed, operate the engine (with the parking brake applied) until normal operating temperature has been reached. Depress the throttle to the full wide open position and adjust the speed by increasing the tension of the governor main spring to increase the rpm, and by decreasing the tension to decrease the rpm.

Sensitivity of the governor can be sharpened by installing the governor spring in the hole closest to the governor lever arm pivot. Adjust the governed speed after changing the spring position.

4 REMOVAL AND INSTALLATION

VELOCITY GOVERNOR

Removal

1. Remove the air cleaner.

2. On a six cylinder engine, cut the governor seal wire.

3. Remove the carburetor to governor vacuum line.

4. Remove the carburetor and gasket.

5. On a 360 or 390 V-8 engine with a manual-shift transmission, partially drain the radiator and remove the coolant hoses from the governor.

6. Remove the governor, spacer (if so equipped) and gaskets. Discard the gaskets.

Installation

1. Position a new gasket over the studs on the intake manifold.

2. Install the governor and gasket.

3. Install the spacer and gasket (if so equipped).

4. Install the carburetor.

5. On a 360 or 390 V-8 with a manual-shift transmission, connect the coolant hoses to the radiator and fill the radiator.

6. Install the governor to carburetor vacuum line.

7. On a six cylinder engine, install a new governor wire and seal.

8. Install the air cleaner.

VACUUM GOVERNOR

Throttle Actuating Mechanism

Removal

1. Disconnect the lines at the governor unit on the carburetor.
2. Remove the choke control lever and the governor housing cover, the governor spring and spring pin, the governor lever nut and lockwasher, and the governor housing to main body screws and lockwashers. Mark the position of the spring pin for correct assembly.
3. Lift the governor housing off the throttle shaft and remove and discard the governor housing seal.

Installation

1. Position a new governor housing gasket on the main body. Install a new governor body seal on the governor housing, then slide the housing on the throttle shaft.
2. Insert the end of the throttle shaft into the governor lever and install the governor lever lockwasher and nut.
3. Install the governor housing to main body lockwashers and screws.
4. Install the governor housing cover and choke control lever.
5. Connect the governor lines.

Controlling Unit

Because the governor controlling unit is integral with the distributor, the removal, disassembly, assembly, and installation procedures are covered with the distributor.

MECHANICAL GOVERNOR

Removal

1. Disconnect the tachometer drive, the oil pressure sending unit wires, and the throttle control linkage at the governor.
2. Remove the governor assembly and gasket.

Installation

1. Using a new gasket, position the governor assembly in the engine block and install the washers and retaining nuts.
2. Connect the throttle control linkage, the tachometer drive, and the oil pressure sending unit wires. Adjust the governor.

5 DISASSEMBLY AND ASSEMBLY

VACUUM GOVERNOR

Throttle Actuating Mechanism

Disassembly

1. Remove the diaphragm rod retainer and the governor lever.
2. Remove the governor line fitting, the by-pass jets, the diaphragm cover, and the diaphragm.
3. Remove the fast idle cam shaft retainer and slide the fast idle cam and shaft out of the housing.
4. Remove the cam plunger, plunger spring, and the fast idle pin.

Cleaning and Inspection. Clean all the metal parts in carburetor cleaner. Check the housing for cracks or stripped threads.

Assembly

Refer to Fig. 8 for the correct location of the parts.

1. Place the fast idle pin in position in the governor housing with the small end toward the throttle shaft.
2. Insert the fast idle cam plunger spring in the plunger and install the assembly in the governor housing.
3. Slide the fast idle cam and shaft in position and install the retainer.
4. Install the governor by-pass jets and the governor line fitting.
5. Install the governor spring pin in the same hole from which it was removed.
6. Position the governor diaphragm in the governor housing.
7. Install the cover, then install a new safety wire and seal.
8. Place the governor lever in the housing and insert the diaphragm rod on the smallest stud of the lever.
9. Install the rod retainer.

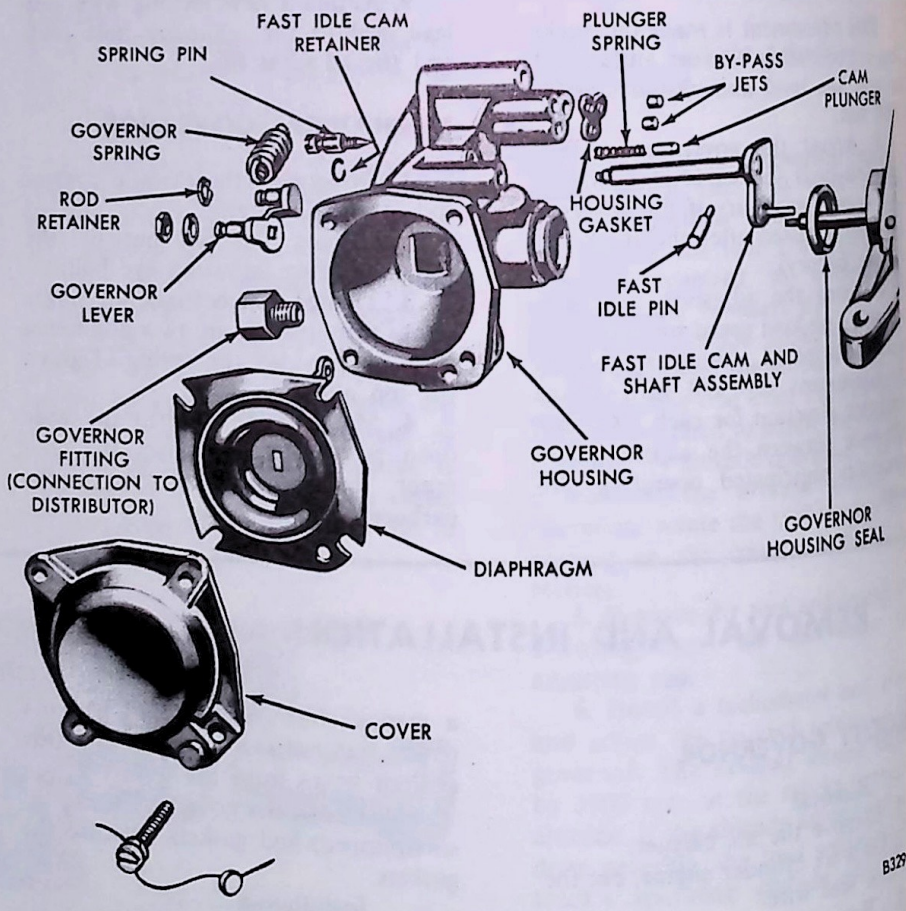
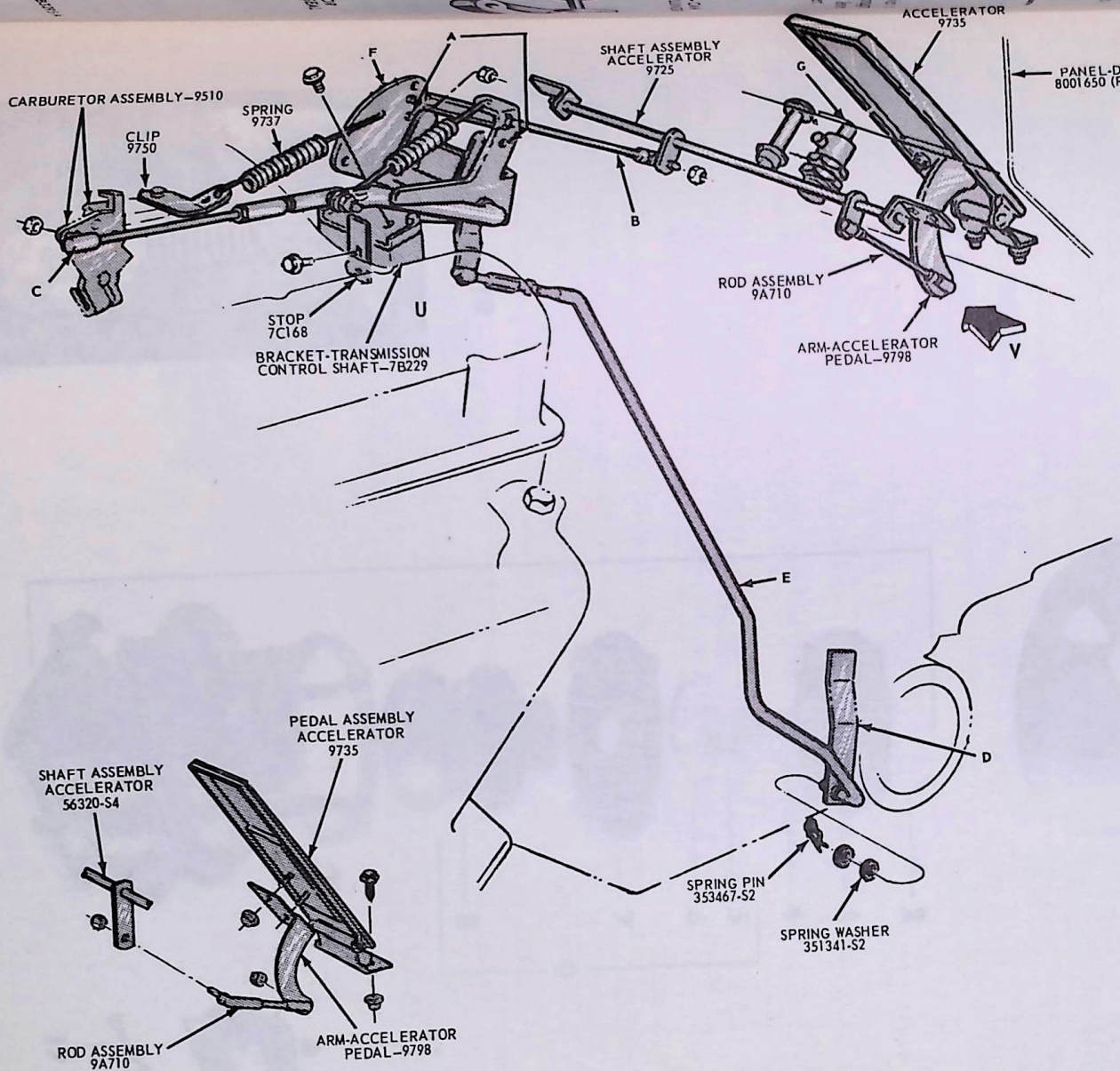
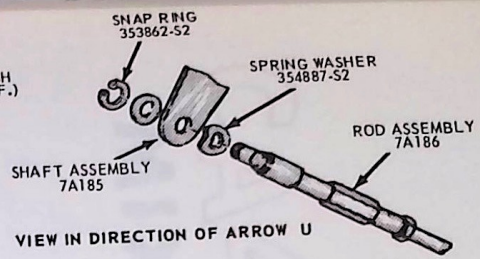


FIG. 8 Throttle Actuating Mechanism



VIEW IN DIRECTION OF ARROW V



VIEW IN DIRECTION OF ARROW U

INSTALLATION & ADJUSTMENT PROCEDURE

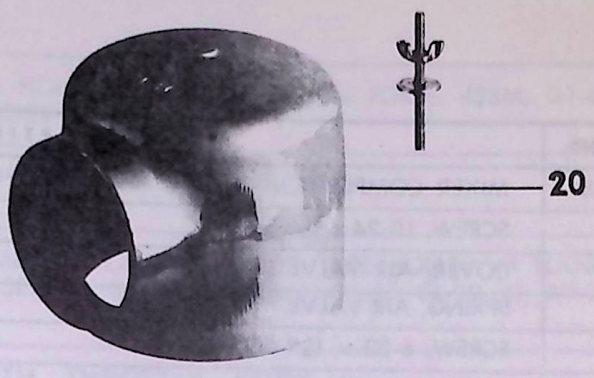
1. WITH THE TRANSMISSION IN DRIVE AND THE ENGINE AT NORMAL OPERATING TEMPERATURE, ADJUST CARBURETOR SETTING TO OBTAIN ENGINE IDLE SPECIFIED.
   NOTE: ENGINE MUST NOT BE RUNNING WHILE ADJUSTING STEPS 2, 3, & 4 ARE MADE.
2. INSERT A .245-.250 DIA. PIN THRU LOCKING HOLES "A".
3. ADJUST STOP 'H' TO CONTACT ROD 'C'.
4. ADJUST ROD 'C' TO LENGTH WITH CARBURETOR LEVER AT IDLE POSITION.
5. PLACE LEVER "D" IN EXTREME REARWARD POSITION AND INSTALL ROD "E". SHORTEN ROD "E" BY THREE (3) TURNS.
6. REMOVE LOCKING PIN. HOLD ACCELERATOR PEDAL AGAINST STOP AND ADJUST ROD 'B' UNTIL LEVER 'D' IS ROTATED BACK AGAINST THE FULL KICK DOWN STOP.
7. ADJUST DETENT STOP 'G' TO JUST CONTACT THE ACCELERATOR PEDAL WHEN CARBURETOR THROTTLE LEVER IS IN WIDE-OPEN POSITION.
8. CHECK SHIFT POINTS AND DOWNSHIFT. IF FULL THROTTLE (AT DETENT) UPSHIFT DOES NOT OCCUR BETWEEN THE FOLLOWING ENGINE R.P.M.
   3525 TO 3575 FOR 401 CU. IN. ENG.
   3325 TO 3375 FOR 477 CU. IN. ENG.
   3125 TO 3175 FOR 534 CU. IN. ENG.
   IT WILL BE NECESSARY TO RE-ADJUST THE ROD ASSEMBLY E AS FOLLOWS:
   TO RAISE SHIFT POINT R.P.M. SHORTEN ROD ASSEMBLY
   TO LOWER SHIFT POINT R.P.M. LENGTHEN ROD ASSEMBLY

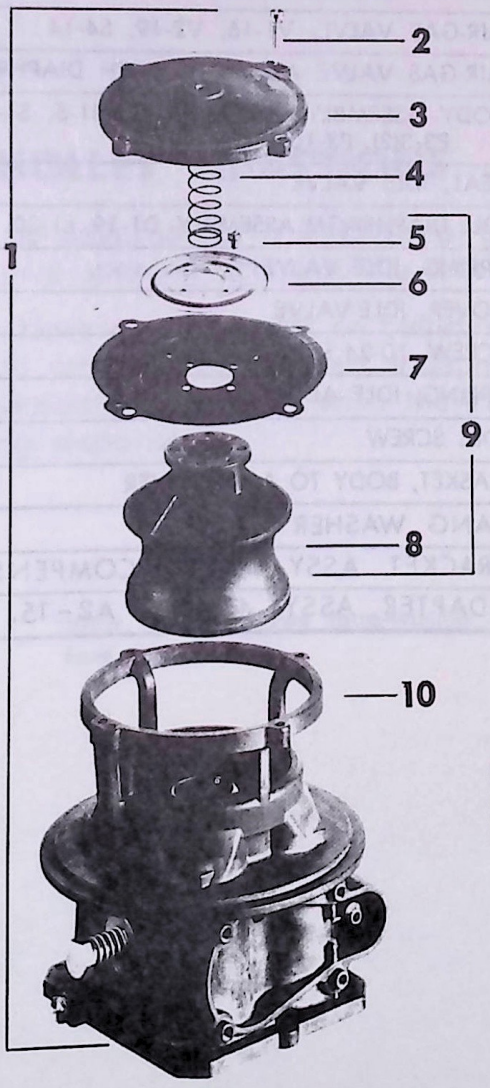
V 1327-B

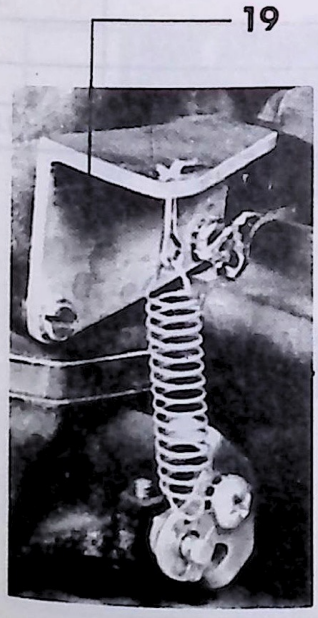
FIG. 14 Accelerator Linkage—L-, LT-, LTS-900 with 401, 477, 534 SD V-8 and Transmatic

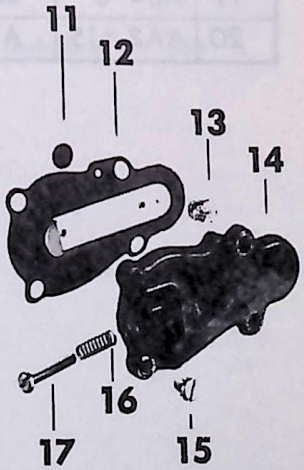
Impco CARBURETION

CA425
MIXER



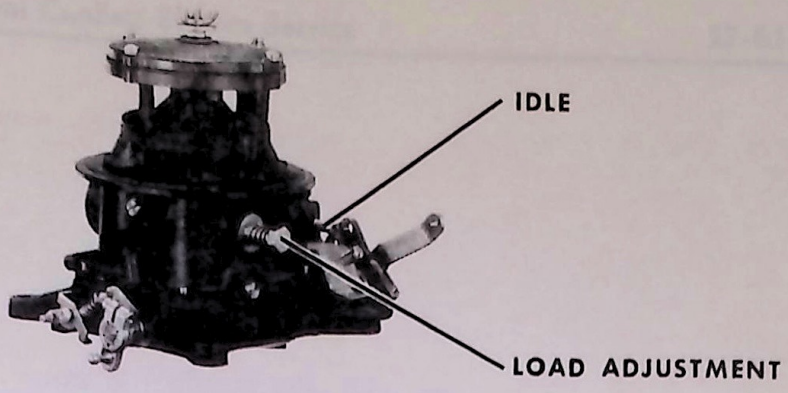






REPAIR PARTS LIST

INDEX	PART NO.	DESCRIPTION	LIST PRICE EA.
1	CA425M	MIXER COMPLETE	$70.00
2	S1-3	SCREW, 10-24 x 5/8" SEMS (4)	.08
3	C1-30	COVER, AIR VALVE DIAPHRAGM	4.80
4	S2-30	SPRING, AIR VALVE	.80
5	S1-22	SCREW, 6-32 x 1/4" SEMS (4)	.12
6	P2-22	BACKUP PLATE	.65
7	D1-18	DIAPHRAGM, AIR VALVE	2.50
8	BV1-16	AIR-GAS VALVE: V1-16, V2-19, S4-14	12.00
9	AV1-16	AIR-GAS VALVE ASSEMBLY, WITH DIAPHRAGM	15.25
10	AB1-27	BODY ASSEMBLY: B1-27, C1-29, J1-5, S1-50, S2-16, W1-33, S3-27, V2-18, P3-3(2), P3-10	52.00
11	S4-13	SEAT, IDLE VALVE	.40
12	AD1-19	IDLE DIAPHRAGM ASSEMBLY: D1-19, L1-30, P2-23, R2-4(2), S4-13	2.50
13	S2-24	SPRING, IDLE VALVE	.40
14	C1-31	COVER, IDLE VALVE	4.20
15	S1-40	SCREW, 10-24 x 3/8" SEMS (4)	.08
16	S2-3	SPRING, IDLE ADJUST.	.36
17	S1-51	IDLE SCREW	.20
NS	G1-66	GASKET, BODY TO AIR CLEANER	.50
18	W1-37	TANG WASHER	
19	AB4-6	BRACKET ASSY – DRAG COMPENSATOR	
20	AA2-15	ADAPTER ASSY, 4" HOSE: A2-15, AS3-29	30.00



CAG425-6	ADAPTION TO LOW BOWL HOLLEY TB x 5½" CS (534 FORD): 425M, G1-65, W1-37, S1-39 (4), AS3-29	73.00

WITHOUT THROTTLE BODY

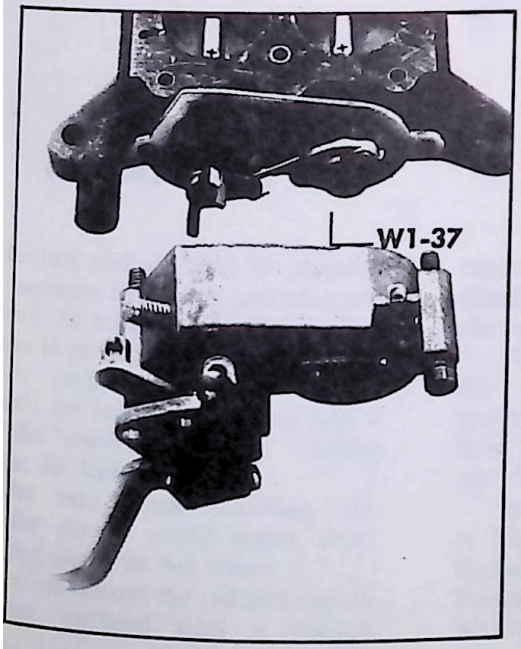
CAG425-14	CARBURETOR COMPLETE, MECHANICAL GOVERNOR, LATE HOLLEY 4B FLANGE x 5½" CS (534 FORD SEE FIG. 2 ABOVE): 425M, G1-65, S1-39 (4), W1-37, 12R-2863A, AS3-29	150.00

WITH THROTTLE BODY

IMPCO-HOLLEY ADAPTIONS

Holley models that have no governor, or a mechanical governor (534 Ford) use the tang-washer to give a positive opening action to the secondary throttles.

IMPCO carburetors inherently have no flat spots or blending problems, so the use of the tang-washer is preferred when it can be used. Independent action of primary and secondary throttles is necessary however, with the Holley vacuum type governor, to insure good governing response.



View at left shows tang-washer installed on 534 Ford throttle body.

PART 27-01 General Cooling System Service

This Information Applies To: All Models

1 DESCRIPTION

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes keeping the radiator fins clean and a periodic inspection of the cooling system for leakage.

Use care when removing the radiator cap to avoid injury from escaping steam or hot water.

Do not remove the radiator cap on vehicles equipped with a coolant recovery system. Add coolant to the plastic bottle only. Maintain level at the specified cold or hot fill mark.

When cooling system is drained, fill radiator with coolant, vent the system by disconnecting heater upper hose and add fluid to specified mark on plastic bottle.

In production, the cooling system is filled with a 45-55 (50-50 for Canada and export) solution of Ford Permanent Anti-freeze and water which prevents corrosion, keeps the cooling system clean, provides anti-freeze protection to -20 (-35 for Canada and export) degrees F in winter and provides for higher summer operation temperatures.

For the most effective cooling system operation, this mixture strength should be maintained all year round and in all climates.

All coolant added should be the specified mixture of Ford permanent anti-freeze and water. If Ford Permanent Anti-freeze is not available,

another reputable permanent anti-freeze may be used and diluted with an equal quantity of water.

Ordinary tap water may be used in an emergency except in areas where the water is known to be exceptionally hard or to have a high alkali content. The cooling system should be drained and flushed and the proper mixture of anti-freeze added as soon as possible, however.

To avoid possible overheating in very hot weather, do not use mixtures with more than 50 percent anti-freeze except in areas where anti-freeze protection below -35 degrees F is required. In this case, refer to the coolant mixture chart on the Ford permanent anti-freeze container.

On diesel engines using water only in the cooling system, add a can of Radiator Rust Inhibitor whenever the system is completely refilled.

Do not add any radiator sealers containing water soluble oil to the cooling system as it will make the corrosion resistor inoperative.

A standard ethylene glycol hydrometer can be used to check the protection level of the long-life coolant.

Do not backflush cooling systems that have a water shut-off valve in the heater system, or damage to the valve can result.

DRAINING AND FILLING THE COOLING SYSTEM

100-900 Series Trucks

To prevent loss of anti-freeze when draining the radiator, attach a hose on the radiator drain cock and drain the coolant from the radiator into a clean container.

To drain the radiator, open the drain cock located at the bottom of the radiator and remove the radiator or supply tank cap. The cylinder block of the V-8 engine is drained by removing the drain plugs located on both sides of the block. The 6-cylinder engines have one drain plug located at the left rear of the cylinder block.

To fill the cooling system, install the cylinder block drain plug(s) and close the radiator drain cock. On 100-750 Series trucks, disconnect the heater outlet hose at the water pump to bleed or release trapped air in the system. When the coolant begins to escape, connect the heater outlet hose.

On C-800-900 Series trucks with super duty engines, open the air vent valve located at the front of the intake manifold to bleed the system. When coolant begins to escape at the opening, close the valve finger-tight. Do not overtighten, as the air vent valve is designed to be closed finger-tight only.

C-Series trucks equipped with Ford Diesels have an auxiliary air bleed connecting the supply tank to the top of the radiator tank. L-Series trucks have an automatic air bleed.

On downflow radiators, operate the engine and add more coolant, if necessary, to fill the radiator to the proper level. On trucks without a supply tank, fill the radiator one inch above the baffles (or core). On trucks equipped with a supply tank, fill the supply tank 2/3 full.

On L-Series-gasoline and Ford V-8 Diesel engines, with crossflow radiators, fill until the coolant is 1 inch from the top of the tank with engine cold. (Caution—Do not operate engine if coolant level is below sightglass.) (Refer to Fig. 1).

On L-Series—Cummins and Detroit Diesel engines, fill until the coolant is visible through the upper sightglass with engine cold. (Caution—Do not operate engine if coolant level is below the lower sightglass.) (Refer to Fig. 2).

After the initial fill, the coolant level will drop approximately 1 quart after the engine has been operated about 20 minutes at 2000 rpm. This is due to the displacement of entrapped air. Refill radiator as required.

TRUCKS WITH CUMMINS DIESEL ENGINES

NH-Series Engine

To prevent loss of anti-freeze when draining the radiator, attach a hose to the radiator drain cock and drain the coolant from the radiator into a clean container.

To drain the radiator, open the drain cock located at the bottom of the radiator. The cylinder block is drained by opening one drain plug located at the right rear of the block. Also, drain the oil cooler and heat exchanger (if so equipped).

To fill the cooling system, close the drain cocks, venting is automatic.

Operate the engine and add more coolant, if necessary, to fill the radiator to the proper level. On trucks without a supply tank, fill the radiator one inch above the baffle on downflow radiators. On crossflow radiators, fill to the sight glass. On trucks equipped with a supply tank, fill the supply tank 2/3 full. After the initial fill, the coolant level will drop approximately 1 quart when the engine has been operated about 20 minutes at 2000 rpm. This is due to the displacement of entrapped air.

TRUCKS WITH DETROIT DIESEL ENGINES

To drain the radiator, open the drain petcock at the bottom of the radiator and drain the coolant into a container to prevent loss of anti-freeze. The radiator will drain faster if the filler cap is removed.

To drain the cylinder block, open the two drain petcocks on each side of the engine block and on the bottom of the oil cooler.

To fill the cooling system, close the drain petcocks and pour the coolant into the radiator. Operate the engine until operating temperature is obtained and check the coolant level.

FORD V-8 DIESEL ENGINES

To drain the radiator, open the drain petcock at the bottom of the radiator and drain the coolant into a container to prevent loss of anti-freeze. The radiator will drain faster if the filler cap is removed.

To drain the cylinder block, open the drain cocks at the thermostat housing and oil cooler, and remove the drain plugs from the rear of the cylinder block (one on each side).

To fill the cooling system, install the cylinder block plugs and close the drain cocks at the radiator, thermostat housing and oil cooler. Pour the coolant into the radiator. Operate the engine until operating temperature is reached and check the coolant level.

FAN DRIVE BELT

If the fan drive belt(s) are noisy, check the tension of the belt(s) to make certain it is within specifications. Also, check for misaligned pulleys. If the drive belt(s) are worn or frayed, replace, following the procedure in Part 27-02.

RADIATOR COOLANT MIXTURE

To prevent damage to the cooling system during periods of below freezing ambient temperature, when water or anti-freeze is added to the supply tank, always operate the engine at fast idle for 30 minutes before letting the truck stand with the engine off for prolonged periods. This will allow a uniform mixture throughout the cooling system and prevent damage by freezing, when sufficient

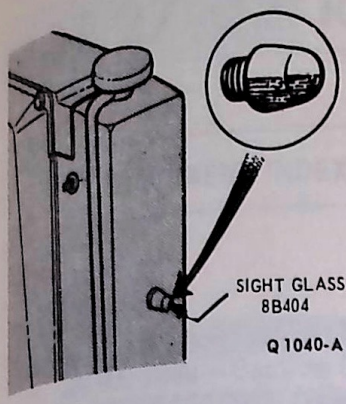


FIG. 1 Sightglass L-Series—Gasoline and Ford V-8 Diesel Engines With Crossflow Radiator

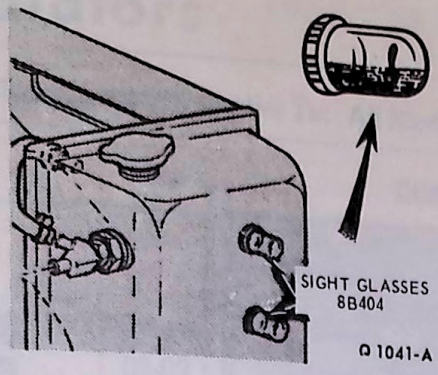


FIG. 2 L-Series Sightglass—Cummins and Detroit Diesel Engines

CORROSION RESISTOR—CUMMINS DIESEL ENGINES

Check the coolant chromate concentration as described under Check Engine Coolant in the Cummins Engine Operation and Maintenance Manual.

To change the filter element:

1. Close the shut-off valves on the inlet and drain lines of the Filter assembly. Unscrew the drain plug at the bottom of the housing (Fig. 3).

2. Remove the cover retaining bolts. Remove the cover (with hose attached) and gasket. Discard the gasket. Remove the upper plate, element, lower plate and the spring from the housing. Discard the element.

3. Polish the surface of the lower plate. If less than one-half of the upper and lower surfaces of the plate can be exposed by polishing, replace the plate.

4. Install the spring and lower plate. Remove the transparent bag from the new resistor element, and install the element in the housing.

5. Install the upper plate, gasket and cover. Install the drain plug, and open the shut-off valves in the corrosion resistor inlet and drain lines. **Do not add any radiator sealers containing water soluble oil to the cooling system as it will make the corrosion resistor and lower plate inoperative.**

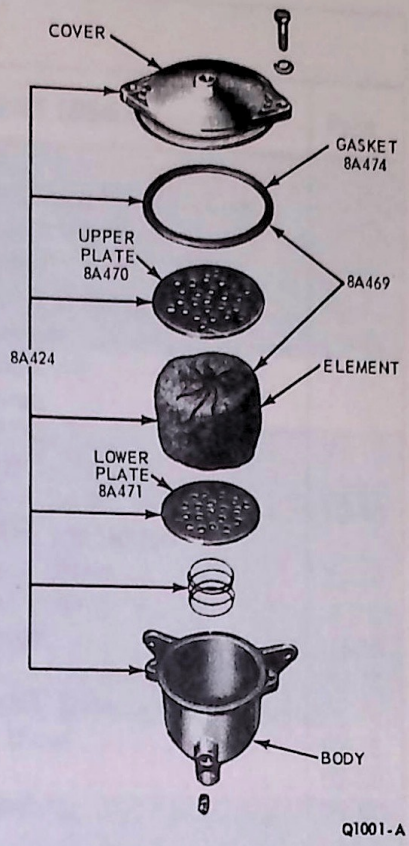


FIG. 3 Corrosion Resistor

WATER FILTER AND CONDITIONER—DETROIT DIESEL ENGINES

For maintenance of the engine coolant and water filter, refer to the Detroit Diesel Engine Maintenance Manual.

PART 27-02 Radiators

This Information Applies To: All Models

1 DESCRIPTION AND OPERATION

RADIATOR

All radiators except 8-cylinder Bronco and L-Series trucks are of the tube and corrugated-fin-core type with the tubes arranged for vertical flow of the coolant. Two header tanks, one on the top and one on the bottom of the radiator provide uniform distribution of the coolant to the tubes. The radiator outlet port (lower header tank) is connected to the water pump inlet port. The radiator inlet port(s) (upper header tank) is connected to the coolant outlet elbow of the engine, thereby permitting coolant circulation through the radiator when the thermostat is open.

The Bronco V-8 and L-Series radiator is of the cross-flow type, with the tubes and fins arranged for horizontal flow. The header tanks are therefore located at the sides of the radiator.

An expansion tank is provided as a means of filling and checking the system.

SUPPLY TANK

C-Series trucks and 8-cylinder Bronco have a separate coolant supply or expansion tank, with the radiator cap on this tank.

On all other trucks the radiator upper header tank serves as the supply and expansion tank.

COOLANT RECOVERY SYSTEM

Some F-100, F-250 6-cylinder models are equipped with a coolant recovery system. Do not remove the radiator cap on these vehicles—add coolant to the plastic bottle only. Maintain level at the specified cold or hot fill mark.

When cooling system is drained, fill radiator with coolant according to the instructions in Section 4.

2 TESTING

COOLING SYSTEM PRESSURE TEST

It is recommended that a cooling system pressure test gauge be used to properly test the system for:

1. Blown or leaking cooling system sealing gaskets.
2. Internal or external cooling leakage.
3. Pressure cap malfunction.

Test Procedure

Some modification of existing pressure testers may be required in order to use this procedure.

1. Shut the engine off. **To prevent loss of coolant and to avoid the danger of being burned, place a cloth over the cap and rotate the cap slowly counterclockwise to first stop and allow pressure to escape completely. Then turn cap again slowly counterclockwise to remove.**
2. After the cooling system pressure has been released, remove the radiator cap, wet the rubber sealing surface and reinstall cap tightly on the radiator.
3. Disconnect the electrical connector from the engine temperature sending unit and remove the temperature sending unit from the manifold.

With the radiator cap installed, only a small amount of coolant will be lost when the sending unit is removed.

4. Install an adaptor fitting (3/8 N.P.T. male thread on one end, and a hose connection on the other end to accommodate the tester hose) tightly into the intake manifold or cylinder head in place of the sending unit.
5. Remove the radiator overflow hose from the retainer clips. Make sure the hose is firmly installed on the radiator overflow tube and is in good condition. Insert the free end of the overflow hose into a container of water.
6. Attach the pressure pump and gauge to the adapter fitting and pressurize the cooling system until bubles are observed in the water container. Discontinue pumping when bubbles appear.

When the bubbles cease, read the pressure gauge. The gauge reading is the pressure relief of the cap and should be within specifications. If the pressure reading exceeds the specified limit, replace the radiator cap.

7. If bubbles continue and the pressure drops below 10 psi, the radiator cap is not holding pressure. Release pressure and wash cap in clean water to dislodge any foreign matter from the valves. Check the rubber sealing surface of the cap and also the cap sealing surface in the radiator neck. Inspect the cam lock flanges on both sides of the filler neck for maximum cap engagement.
8. Recheck the cooling system as outlined in step 6. If the cap still does not hold pressure, the cap is damaged and must be replaced. Recheck system after a new cap is installed to assure that the system will now hold pressure.
9. If the bubbles in the water container cease and the radiator cap is within pressure specifications, observe gauge reading for approximately two minutes. Pressure should not drop during this time.
10. If pressure drops, check for leaks at the engine to heater core hoses, engine to radiator hoses, bypass hose, water valve hose (A/C equipped), thermostat housing gasket, etc. Any leaks which are found must be corrected and the system rechecked.
11. If the system holds pressure, remove the radiator cap to release the pressure, then reinstall the cap.
12. Remove the adapter from the manifold or cylinder head and reinstall the temperature sending unit. Check coolant level and replenish if necessary with the correct coolant solution.

THERMOSTAT TEST

Trucks Equipped With Gasoline Engines

It is good practice to test new thermostats before installing them in the engine.

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open more than 1/4 inch.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to a lighted background. Light leakage around the thermostat valve (thermostat at room temperature) is unacceptable and the ther-

mostat should be replaced. It is possible, on some thermostats, that a slight leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

Trucks Equipped With Cummins Diesel Engines

Suspend a thermometer and the thermostat to be tested in a container of water so that neither one touches the container. Heat the water container until the thermostat begins to open and note the temperature. Continue heating the water until the thermostat is fully open. The temperature stamped on the thermostat is that at which the thermostat should begin to open. The fully open temperatures for the thermostats are listed in Section 9.

Trucks Equipped With Detroit Diesel Engines

Refer to the Detroit Diesel Maintenance Manuals for the test procedures.

Trucks Equipped With Ford V-8 Diesel Engines

Refer to the appropriate Caterpillar Diesel engine service manual.

CORROSION RESISTOR TEST—CUMMINS DIESEL

Check the coolant chromate concentration to determine if the corrosion resistor element should be changed.

WATER FILTER AND CONDITIONER—DETROIT DIESEL ENGINES

For coolant system checks, refer to the Detroit Diesel Engine Maintenance Manual.

3 ADJUSTMENTS

BELT TENSION—GASOLINE ENGINES

100-350 Series Trucks

1. Install the belt tension tool on the drive belt(s) (Fig. 1) and check the tension following the instructions of the tool manufacturer.

2. If adjustment is necessary, loosen the alternator mounting bolts and move the alternator adjusting arm bolt. Move the alternator toward or away from the engine until the correct tension is obtained (Section 9). Remove the gauge. Tighten the alternator adjusting arm bolt and the mounting bolts. Install the tension gauge and check the belt tension.

FIG. 1 Checking Drive Belt Tension

500-900 Series Trucks

1. Install the belt tension tool on the drive belt(s) (Fig. 1) and check the tension following the instructions of the tool manufacturer.

The tension is checked between the water pump pulley and the alternator pulley on single or double fan drive belts and all alternator and water pump fan drive belts. The tension on separate fan drive belts is checked between the fan pulley and the crankshaft pulley. The tension of the air compressor drive belt is checked between the compressor pulley and the fan pulley or the crankshaft (C-Series). The belt tensions are given in Section 9.

2. If adjustment is necessary, follow the applicable procedure.

Ford V-8 Diesel Engines

To check belt tension, exert 25 lb. force on the belt midway between the pulleys. Correctly adjusted belts will deflect 1/2 to 3/4 inch.

Single or Double Fan Belts

Loosen the alternator mounting bolts and the alternator adjusting bracket bolt. Move the alternator generator toward or away from the engine until the correct belt tension (Section 9) is obtained. Tighten the alternator mounting bolts and the adjusting bracket bolt before checking the tension.

Separate Fan Belt

Loosen the fan bracket mounting bolts. Slide the bracket up or down until the correct belt tension (Section 9) is obtained. Tighten the bracket bolts before checking the tension.

On a truck equipped with an air compressor, it may be necessary to loosen the compressor drive belt in order to obtain proper fan drive belt adjustment. Adjust the compressor drive belt after the fan drive belt adjustment is complete.

Air Compressor Belt

Loosen the air compressor mounting bolts and slide the compressor in its bracket until the correct tension (Section 9) is obtained. Tighten the compressor mounting bolts before checking the deflection. **Adjust the air compressor drive belt whenever the fan drive belt is adjusted or replaced. Adjust the air compressor drive belt last.**

Cummins NH-Series Diesel Engines Fan Belts

Loosen the adjusting screw locknut on the fan hub. Adjust the fan hub adjusting screw to obtain the specified fan belt tension (Section 9) and tighten the locknut.

Water Pump Belts

1. Loosen the alternator adjusting bracket and the alternator to mounting bracket bolts. Loosen the water pump retainer mounting bolts.

2. Pivot the water pump assembly to obtain the specified drive belt tension (Section 9) and tighten the water pump retainer bolts to specifications.

3. Adjust the alternator to obtain the specified drive belt tension (Section 9) and tighten the adjusting bracket bolt and alternator to mounting bracket bolts.

Detroit Diesel Engines

If the belt needs adjustment, loosen the support bracket mounting bolts and the adjusting bolt. Move the bracket up or down, as required, to obtain the specified belt tension (Section 9) and tighten the adjusting bolt. Check the belt tension again. When the belt is properly adjusted, tighten the bracket mounting bolts.

4 REMOVAL AND INSTALLATION

FAN—EXCEPT ECONOLINE SIX CYLINDER

1. Examine the fan mounting system to determine whether or not the drive belt tension should be relieved. Loosen fan drive belt(s) tension, if necessary.
2. Remove the fan blade retaining bolts and remove the fan and spacer (if so equipped).
3. Position the spacer (if so equipped) and fan blade on the water pump hub or the crankshaft damper (low-mount fan). Tighten the retaining bolts.
4. Adjust fan belt(s) tension.

FAN—ECONOLINE

170 Six Engine

This fan is removed from under the vehicle.

1. Relieve fan belt tension.
2. Raise the vehicle.
3. Remove the bolts retaining the fan and spacer to the water pump pulley and remove fan, spacer and bolts as a unit.
4. Position the fan, spacer and bolts to the drive pulley and install and torque the bolts.
5. Lower the vehicle and adjust the fan belt tension to specification, Section 9.

240 Six Engine

The radiator must be removed in order to remove the fan. Refer to the instructions in this Section for procedures.

1. With the radiator removed, release the fan belt tension and remove the bolts retaining the fan and spacer to the water pump pulley and remove the fan, spacer and retaining bolts.
2. Position the fan, spacer and bolts to the water pump pulley and install the retaining bolts, torquing to the proper value.
3. Adjust fan belt tension to specification, Section 9.
4. Install the radiator per instructions.

FAN BELT—GASOLINE ENGINES

1. Loosen the alternator mounting bolts and the alternator adjusting arm bolt. Move the alternator toward the engine. Remove the belt from the alternator, crankshaft pulley, and water pump pulley. Lift the belt(s) over the fan.
2. Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley, and alternator pulley grooves. Adjust the belt tension to specifications, Section 9.

DRIVE BELTS—CUMMINS DIESEL ENGINE

NH-Series Engines

Fan Belts

1. Loosen the cooling fan hub locknut and back-off the adjusting screw.
2. Remove the drive belts from the compressor pulley and the fan hub.
3. Position the new drive belts on the cooling fan hub and the compressor pulley. Adjust the tension of the drive belts to specifications, Section 9, and tighten the fan hub locknut.

Water Pump Belt

1. Remove the cooling fan drive belts and the power steering pump drive belts from the compressor pulley.
2. Loosen the water pump retaining ring mounting bolts. Loosen the alternator to mounting bracket bolts and the adjusting bracket bolt.
3. Rotate the water pump and remove the drive belt from the compressor pulley and the water pump pulley.
4. Position a new water pump drive belt on the compressor pulley and the water pump pulley. Rotate the water pump to obtain the specified drive belt tension, Section 9, and tighten the retaining ring bolts.
5. Adjust the alternator to obtain the specified belt tension, Section 9, and tighten the adjusting bracket and alternator mounting bolts.
6. Install the power steering pump drive belts and adjust the belt tension to specifications, Section 9. Install the cooling fan drive belts and adjust the belt tension to specifications, Section 9.

FAN BELT—DETROIT DIESEL ENGINES

1. Loosen the adjusting bolt on the top of the fan pulley support bracket.
2. Loosen the adjusting bracket assembly bolts and let the bracket slide down.
3. Slip the belts off the pulleys and over the fan.
4. Position the new belts on the pulleys and adjust the belts by following the procedure under Belt Tension—Detroit Diesel Engines in this section of the book.

DRIVE BELT—FORD V-8 DIESEL ENGINES

C-Series Truck

The fan on the C-Series truck is mounted on the crankshaft. A belt from the fan pulley drives the air compressor. The next pulley rearward on the crankshaft drives the power steering pump. A double-grooved pulley at the rear drives the water pump and alternator by means of two belts.

To replace the water pump alternator belts, first loosen the air compressor drive belt idler pulley and remove the air compressor drive belt.

Next, loosen the power steering pump mounting, move the pump inward and remove the power steering pump drive belt.

Loosen the alternator mounting and adjusting bolts, move the alternator inward and remove the drive belts.

Belts mounted in pairs must be replaced in pairs.

Install the new alternator-water pump belts on the pulleys. Adjust the belts to the specified tension, Section 9, and tighten the alternator mounting and adjusting bolts.

Position the power steering pump drive belt on the pulleys and adjust the

belt tension, Section 9. Tighten the power steering pump mounting bolts.

Position the air compressor drive belt on the drive and idler pulleys. Adjust the idler pulley until the drive belt has the specified tension, Section 9. Tighten the idler pulley adjusting bolt.

F- and B-Series Truck

A four-groove pulley is used on the crankshaft. The two grooves nearest the engine are used for the fan, water pump and alternator drive belts. The next groove forward is used for the air compressor drive belt. If a power steering pump is used, it is belt driven from the front pulley groove.

To replace the fan, water pump and alternator belts, first loosen the power steering pump bracket (if so equipped), move the pump inward and remove the power steering pump drive belt. Next loosen the air compressor drive belt idler pulley and remove the air compressor drive belt. Loosen the alternator mounting bolt and the adjusting bolt and remove the two fan belts. **Always replace double belts in pairs.**

Position the fan belts on the pulleys and adjust the tension, Section 9, of the belts by moving the alternator outward. Tighten the alternator mounting and adjusting bolts.

Position the air compressor drive belt on the pulleys and adjust the idler pulley until the drive belt has the specified belt tension, Section 9.

Position the power steering pump drive belt (if so equipped) on the pulleys and move the power steering pump outward until the belt has the specified belt tension, Section 9.

RADIATOR HOSE REPLACEMENT

The cooling system hoses should be replaced whenever they become cracked or deteriorated, or have a tendency to collapse.

Partially drain the cooling system to replace a cooling system upper hose(s). Drain the cooling system to replace the radiator outlet hose.

1. Drain or partially drain the radiator, then loosen the clamps on each end of the hose(s) to be removed. Slide the hose(s) off the connections.
2. Position the clamps on each end of the new hose. Slide the hose onto the connections, then tighten the clamps. **If the connections have a bead around the edges, make sure the clamps are located beyond the beads.**
3. Fill the cooling system with coolant and bleed the system.
4. Operate the engine for several minutes, then check the hose(s) and connections for leaks.

THERMOSTAT REPLACEMENT

Whenever changing the thermostat to a higher or lower temperature range on trucks equipped with automatic shutters, change the shutterstat accordingly to a higher or lower range.

A poppet-type thermostat is used with all engines.

When the thermostat is closed, coolant flows to the water pump through a by-pass passage at the front of the engine. When the thermostat is open, coolant flows through the coolant outlet elbow (thermostat housing) to the radiator.

Super Duty V-8 engines are equipped with a front and a rear thermostat. The front thermostat is mounted inside the water outlet elbow. The rear thermostat is mounted inside the intake manifold at the rear.

The thermostat used in production is a high temperature thermostat for use with a 45-55 mixture of water and permanent-type anti-freeze. A low temperature thermostat should be installed if a non-permanent type anti-freeze and water coolant solution is used (except on trucks with automatic radiator shutters).

Do not attempt to repair the thermostat. It should be replaced if it is not operating properly.

Check the thermostat before installing it, following the procedure under Thermostat Test, Section 2.

6-Cylinder Engines—Gasoline

Replacement of the thermostat in 6-cylinder Econoline vehicles requires removal and installation of the radiator. Refer to the radiator part of this Section for instructions on removal and installation. Otherwise, the instructions given below also apply to the 6-cylinder Econoline thermostat installation.

Removal

1. Drain the radiator so that the coolant level is below the thermostat.

On C-Series trucks remove the supply tank hose at the coolant outlet elbow.

2. Remove the coolant outlet elbow retaining bolts. Pull the elbow away from the cylinder head sufficiently to provide access to the thermostat. Remove the thermostat and gasket.

Installation

1. Clean the coolant outlet elbow and cylinder head gasket surfaces. Coat a new gasket with water-resistant sealer. Position the gasket on the cylinder head opening. The gasket must be positioned on the cylinder head before the thermostat is installed.
2. The coolant outlet elbow contains a locking recess into which the thermostat is turned and locked. Install the thermostat with the bridge section in the outlet elbow. Turn the thermostat clockwise to lock it in position on the flats cast into the outlet elbow.
3. Position the coolant outlet elbow against the cylinder head. Install and torque the retaining bolts to specifications.

On C-Series trucks connect the supply tank hose.

4. Fill and bleed the cooling system. Check for leaks and proper coolant level after the engine has reached normal operating temperatures.

V-8 Engines—Gasoline

On 8-cylinder Econoline vehicles, the engine cover and air cleaner must be removed for access to the thermostat. Otherwise, instructions given below also apply to thermostat replacement on this vehicle.

Removal

1. Drain the radiator so that the coolant level is below the thermostat.

On C-Series trucks remove the supply tank hose at the water outlet housing.

2. Disconnect the by-pass hoses at the water pump and intake manifold. Remove the by-pass tube. Remove the water outlet housing retaining bolts. Bend the radiator upper hose upward and remove the thermostat and gasket.

Installation

1. Clean the water outlet housing gasket surfaces. Coat a new water outlet housing gasket with water-resistant sealer. Position the water outlet housing gasket on the intake manifold opening.
2. Install the thermostat in the intake manifold opening with the copper pellet or element toward the engine and the thermostat flange positioned in the recess. If the thermostat is improperly installed, it will cause a retarded flow of coolant.
3. Position the water outlet housing against the intake manifold. Install and torque the retaining bolts to specifications. Install the water by-pass line and tighten hose connections.

On C-Series trucks connect the supply tank hose.

4. Fill and bleed the cooling system. Operate the engine until normal operating temperature is reached; then check the coolant level and check for leaks.

Cummins NH-Series Diesel Engines—L-, LN-, LT-, LNT- and W-Series Trucks

Removal

1. Drain the cooling system to below the thermostat level.
2. Disconnect the oil cooler coolant hose, radiator supply tank vent line, and air compressor coolant line from the thermostat housing.
3. Close the air control valve and disconnect the air hoses from the shutterstat, if so equipped.
4. Remove the thermostat housing retaining bolts. Move the thermostat housing forward and to one side, then remove the thermostat. Discard the gasket.

Installation

1. Clean and apply water-resistant sealer to the gasket surfaces at the coolant manifold and thermostat housing.
2. Position the thermostat in the housing with the V notch at the top to vent as much air as possible. **If the thermostat is not properly installed, an air lock and incomplete coolant circulation may result.**
3. Install a new gasket on the thermostat housing and position the housing to the water manifold. Install and tighten the retaining bolts.
4. Connect the oil cooler coolant hose, radiator supply tank vent line, and air compressor water line to the thermostat housing. Connect the air hoses to the shutterstat and open the air control valve.
5. Fill the cooling system. Operate the engine and check for coolant leaks.

Detroit Diesel Engines

For thermostat replacement procedures, refer to the appropriate Detroit Diesel Highway Maintenance Manual.

Ford V-8 Deisel Engines

For Thermostat replacement procedures, refer to the appropriate Caterpillar Service Manual.

RADIATOR

RADIATOR SHROUD NOTE: Fiberglass shrouds are retained to the radiator support with bolts having a flat washer between the bolt head and the fiberglass. Always assemble in this manner.

Six and V-8 Engines—Econoline

Removal

1. Refer to Figs. 2 and 3.
2. Drain the cooling system.
3. Open the hood and raise the support rod to hold the hood open.
4. Disconnect the upper radiator hose at the radiator.
5. Disconnect the lower radiator hose at the radiator.
6. Disconnect the transmission oil cooler lines from the radiator (if so equipped).
7. On a 240-6 only, remove the right hood lock bracket and bolts from the radiator grille.
8. Remove the 4 bolts retaining the radiator to the radiator support and remove the radiator.

Installation

1. If a new radiator is to be installed, remove the drain cock from the old radiator and install it in the new radiator. On a vehicle with automatic transmission, remove the oil cooler line fittings from the old radiator and install them in the new radiator, using oil-resistant sealer M-46-11.

On a vehicle with a coolant recovery system, remove the reservoir from the old radiator and install it on the new radiator.

2. Position the radiator assembly and install the support bolts.
3. Connect the radiator upper and lower hoses.

On a vehicle with automatic transmission connect the oil cooler lines.

4. Install the hood lock bracket and bolts.
5. Close the drain cock. Fill and bleed the cooling system.
6. On 6-cylinder engines equipped with a coolant recovery system (Fig. 4) fill the radiator, through the filler cap opening of the radiator upper tank, completely full. The cap may be removed by turning to the stop and, pressing down on the cap, force the cap past the **stop** tangs on the filler neck. Engine should be running at idle speed to circulate the coolant and eliminate any trapped air in the system. Install the radiator cap. Fill coolant reservoir with one quart of coolant. Operate vehicle until normal engine temperature is evident. Check coolant reservoir to see if coolant level is noted at the **Engine Hot** level. If necessary, add coolant to bring to this level.
7. Operate the engine and check for leaks at the hose connections and the automatic transmission oil cooler lines. Check the automatic transmission fluid level.

170 Six Engine—Bronco

Removal

Refer to Figure 5.

1. Drain the cooling system.
2. Disconnect the upper hose at the radiator.
3. Disconnect the lower hose at the radiator.
4. Remove the radiator retaining screws, and remove the radiator.

Installation

If a new radiator is to be installed, remove the drain cock from the old radiator and, using water-resistant sealer, install it on the new radiator.

1. Position the radiator, and install the retaining screws.
2. Connect the lower hose at the radiator.
3. Connect the upper hose at the radiator.
4. Fill and bleed the cooling system.
5. Operate the engine and check for leaks.

302 V-8 Engine—Bronco

Removal

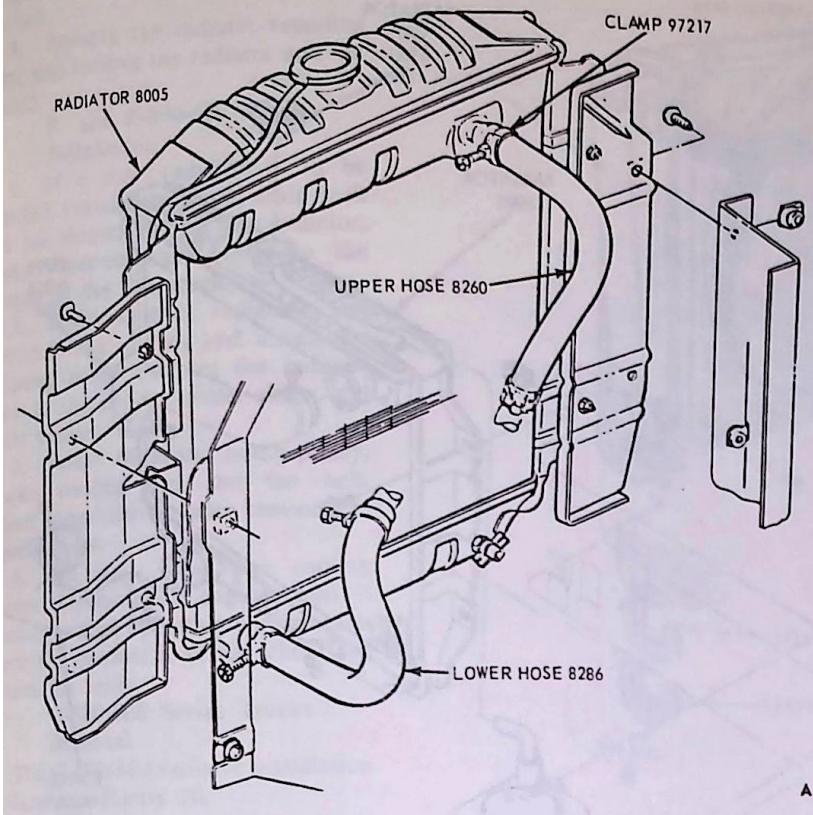
Refer to Figure 6.

1. Drain the cooling system.
2. Disconnect the upper hose at the radiator.
3. Loosen the two shroud lower retaining bolts.
4. Remove the two shroud upper retaining bolts.
5. Position the radiator shroud over the fan, clear of the radiator.
6. Disconnect the lower hose at the radiator.
7. Remove the two radiator upper supports (1 bolt each, Fig. 6 and remove the radiator.

Installation

If a new radiator is to be installed, remove the drain cock from the old radiator and, using water-resistant sealer, install it in the new radiator.

1. Slide the radiator into the lower supports (Fig. 6) and install the upper supports.
2. Connect the lower hose to the radiator.
3. Position the shroud to the radiator and install the retaining bolts.
4. Connect the upper hose to the radiator.
5. Fill the cooling system, bleeding air as necessary.



IG. 2 Radiator and Related Parts—170 6-Cylinder Econoline

6. Operate the engine and check for leaks.

240 and 300 Six Engines

P-Series Trucks Removal

The 6-cylinder P-Series radiator installations are shown in Fig. 7.

1. Remove the hood. Disconnect the headlights and parking lights at the bullet connectors. Remove the grille, headlights, parking lights, wind deflector and hood lower weatherstrip as an assembly. Drain the cooling system.

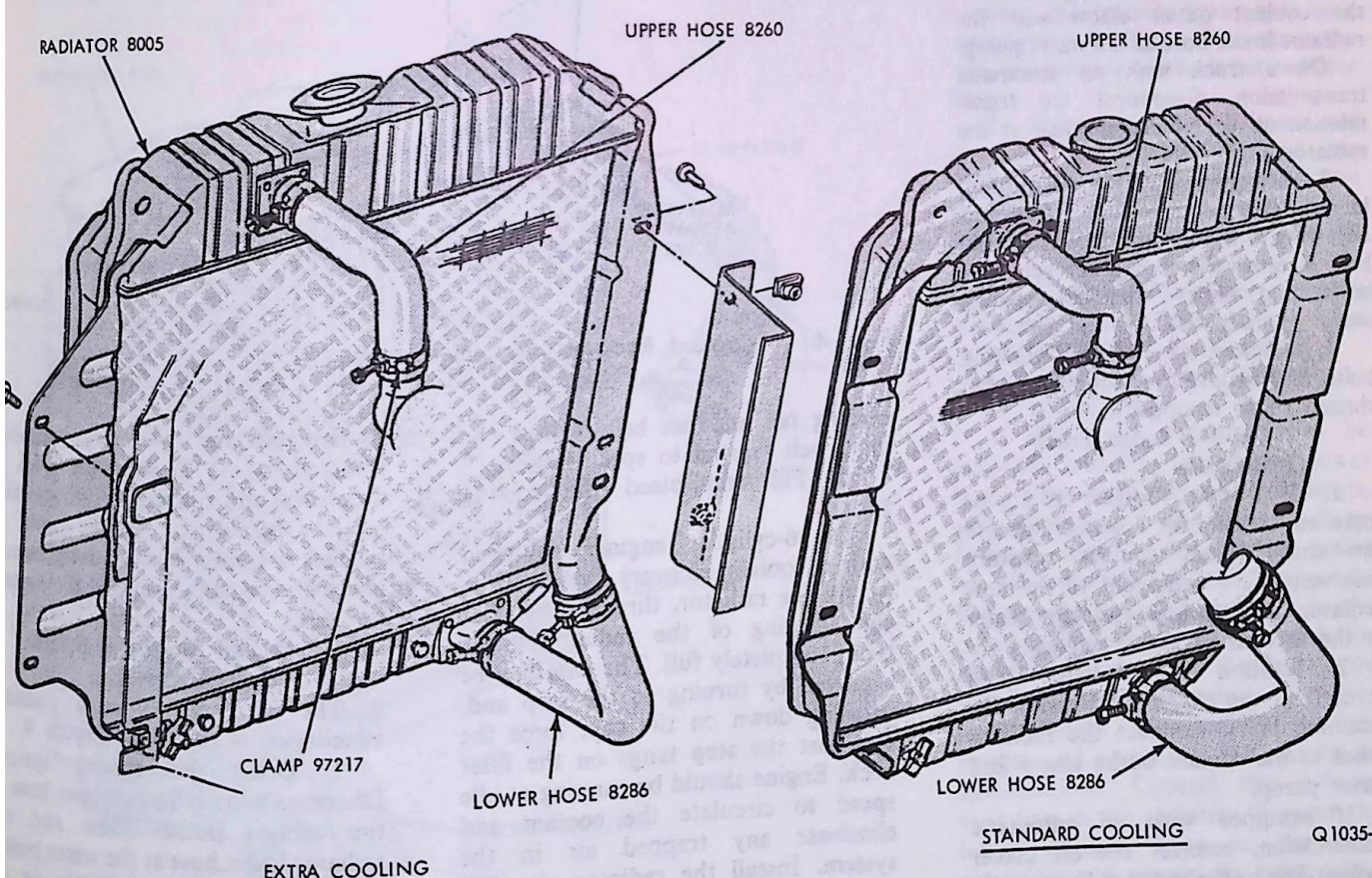
2. If equipped with a fan shroud, remove the fan, spacer, water pump pulley and drive belt.

Disconnect the radiator upper hose at the radiator and the thermostat housing.

3. Disconnect the radiator lower hose at the water pump.

If equipped with an automatic transmission, disconnect the transmission oil cooler line at the radiator lower hose tee.

Remove the radiator retaining bolts and radiator support tie-bar; then remove the radiator and shroud (if so equipped).



G. 3 Radiator and Related Parts—240 6-Cylinder and 302 V8 Engine

P-Series Trucks Installation

1. If a new radiator is to be installed, transfer the hoses, draincock and fan shroud (if so equipped) to the new radiator. **Apply water-resistant sealer to the threads of the drain cock.**

2. Position the radiator in the chassis and install the retaining bolts and radiator support tie-bar. Connect the radiator upper hose. Connect the transmission oil cooler coolant line (if so equipped) to the radiator lower hose tee. Connect the radiator lower hose.

If equipped with a fan shroud, install the fan, spacer and drive belt. Adjust the belt tension to specifications.

3. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature and check the coolant level. Check for leaks.

4. Install the grille, headlights, parking lights, wind deflector and hood lower weatherstrip. Install the hood and retaining bolts; then adjust the hood at the hinge retaining bolts.

F-100-350 Series Trucks Removal

The F-100-350 radiator installations are shown in Figure 8.

1. Drain the cooling system. Disconnect the radiator upper hose at the coolant outlet elbow and the radiator lower hose at the water pump.

On a truck with an automatic transmission, disconnect the transmission oil cooler coolant line at the radiator.

2. If equipped with a fan shroud, loosen the generator or alternator adjusting arm bolts and loosen the fan belt. Remove the cooling fan retaining bolts, and remove the fan, spacer, water pump pulley and fan belt.

3. Remove the radiator retaining bolts, and remove the radiator and fan shroud (if so equipped).

F-100-350 Series Truck Installation

1. If a new radiator is to be installed, transfer the hoses, draincock, fan shroud, and coolant recovery reservoir (if so equipped) to the new radiator. **Apply water resistant sealer to the threads of the draincock.**

2. Position the radiator (and shroud) in the chassis and install the retaining bolts. Connect the radiator hoses to the coolant outlet elbow and water pump.

If equipped with an automatic transmission, connect the oil cooler coolant-line to the radiator lower tank.

3. If equipped with a fan shroud, install the water pump pulley, spacer, cooling fan and fan belt. Adjust the drive belt tension to specifications.

4. Fill and bleed the cooling system.

On 6-cylinder engines equipped with a coolant recovery system (Fig. 4), fill the radiator, through the filler cap opening of the radiator upper tank, completely full. The cap may be removed by turning to the stop and, pressing down on the cap, force the cap past the **stop** tangs on the filler neck. Engine should be running at idle speed to circulate the coolant and eliminate any trapped air in the system. Install the radiator cap. Fill coolant reservoir with one quart of coolant. Operate vehicle until normal engine temperature is evident. Check coolant reservoir to see if coolant level is noted at the **Engine Hot** level. If necessary, add coolant to bring to this level. Operate the engine until it reaches normal operating temperature; check the coolant level and the system for leaks.

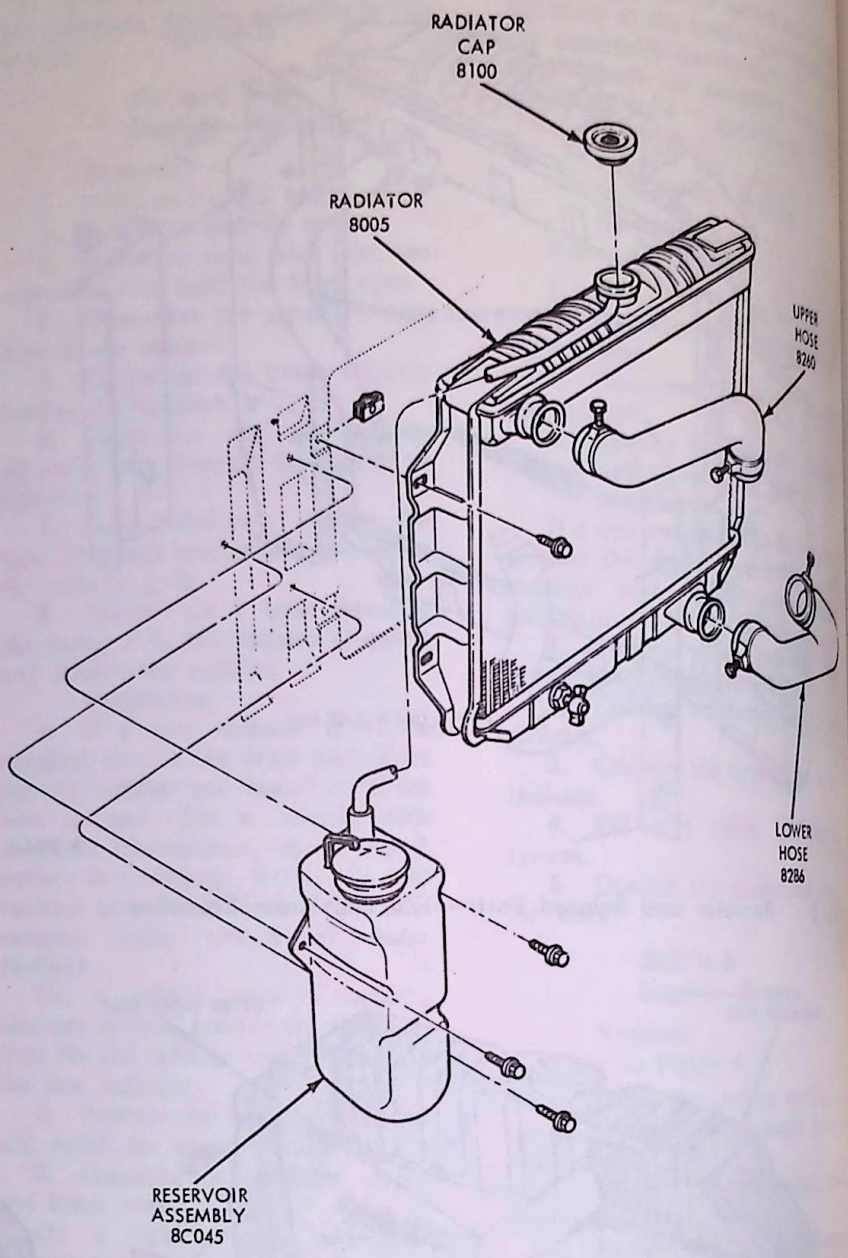


FIG. 4 Coolant Recovery System—Typical

B- and F-500-600 Series Trucks Removal

The B- and F-Series radiator installation is shown in Figure 9.

1. Drain the cooling system. Disconnect the radiator upper hose at the coolant outlet elbow and the radiator lower hose at the water pump.

2. Loosen the generator or alternator adjusting arm bolts and loosen the fan belt. Remove the cooling fan retaining bolts, and remove

the fan, spacer, water pump pulley and fan belt.

3. Remove the radiator retaining bolts, and remove the radiator and fan shroud.

B- and F-500-600 Series Installation

1. If a new radiator is to be installed, transfer the hoses, drain cock and fan shroud to the new radiator. **Apply water-resistant sealer to the threads of the draincock.**

2. Position the radiator and shroud in the chassis and install the retaining bolts. Connect the radiator hoses to the coolant outlet elbow and water pump.

3. Install the water pump pulley, spacer, cooling fan and fan belt. Adjust the drive belt tension to specifications.

4. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature; check the coolant level and check the system for leaks.

C-500-600 Series Trucks Removal

The C-500-600 radiator installation is shown in Figure 10.

1. Drain the cooling system. Disconnect the upper radiator hose from the radiator. Remove the bolt

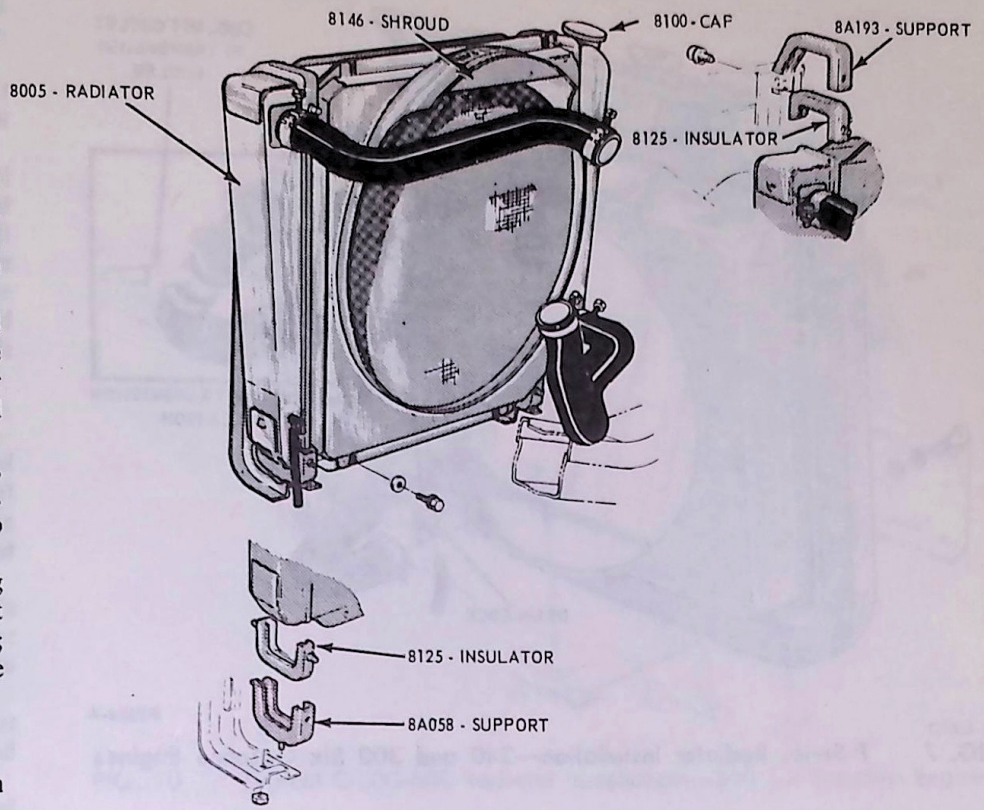
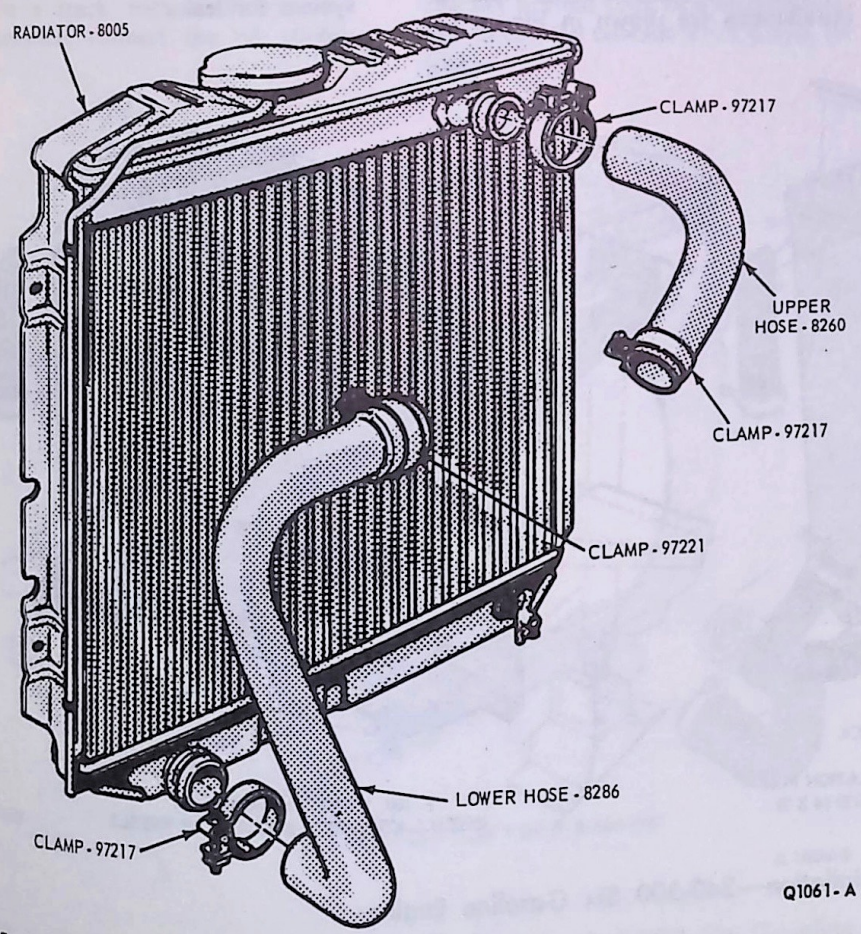


FIG. 6 Radiator and Related Parts—8-Cylinder Bronco



securing the radiator lower hose tube extension to the frame. Disconnect the tube extension from the lower radiator hose.

2. Disconnect the radiator vent line at the radiator. Remove the cooling fan retaining bolts and remove the fan assembly. Remove the bolts securing the radiator brace to the frame.

3. Remove the radiator retaining bolts and remove the radiator, fan shroud and hose as an assembly.

C-500-600 Series Trucks Installation

1. If a new radiator is to be installed, transfer the radiator lower hose, draincock, fan shroud, struts, and vent line fittings to the new radiator. **Apply water-resistant sealer to the threads of the draincock.** Position the radiator assembly in the chassis and install the retaining bolts. Position the struts to the frame and install the retaining bolts.

2. Install the cooling fan assembly and adjust the belt tension to specifications. Connect the radiator vent line to the radiator. Connect the lower radiator hose to the tube extension and secure the tube extension to the frame. Connect the upper radiator hose to the radiator.

IG. 5 Radiator and Related Parts—6-Cylinder Bronco

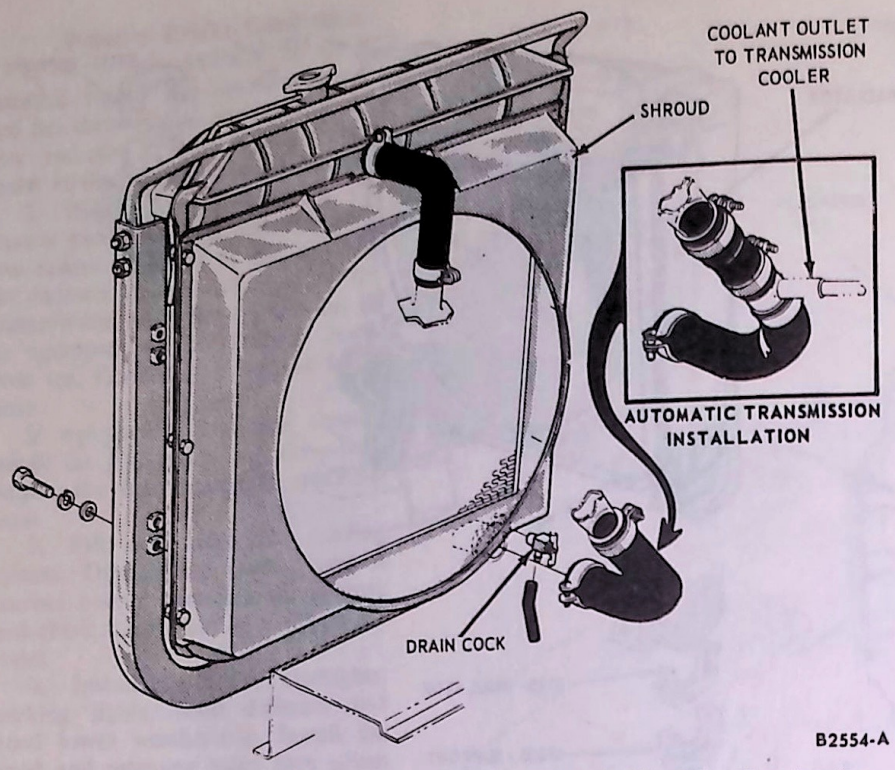


FIG. 7 P-Series Radiator Installation—240 and 300 Six Gasoline Engines

3. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature; check the coolant level and check the system for leaks.

302, 360, and 390 V-8 Gas Engine

F-100-350 Series Trucks

Removal

The V-8 F-100-350 Series Radiator installations are shown in Figure 11.

1. Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator.

On a truck with an automatic transmission, disconnect the transmission oil cooler line at the radiator.

2. If equipped with a fan shroud, loosen the alternator adjusting arm bolts and loosen the fan belt. Remove the cooling fan retaining bolts and remove the fan assembly.

3. Remove the radiator retaining bolts and remove the radiator and fan shroud, if so equipped.

F-100-350 Series Trucks

Installation

1. If a new radiator is to be installed, transfer all the fittings and fan shroud (if so equipped) to the new radiator. **Apply water-resistant sealer to the threads of the draincock.**

2. Position the radiator (and shroud) in the chassis and install the retaining bolts. Connect the radiator upper and lower hoses to the radiator.

If equipped with an automatic transmission, connect the oil cooler line to the radiator.

3. If equipped with a fan shroud, install the cooling fan assembly and adjust the fan belt to specifications.

4. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature; check the coolant level and check the system for leaks.

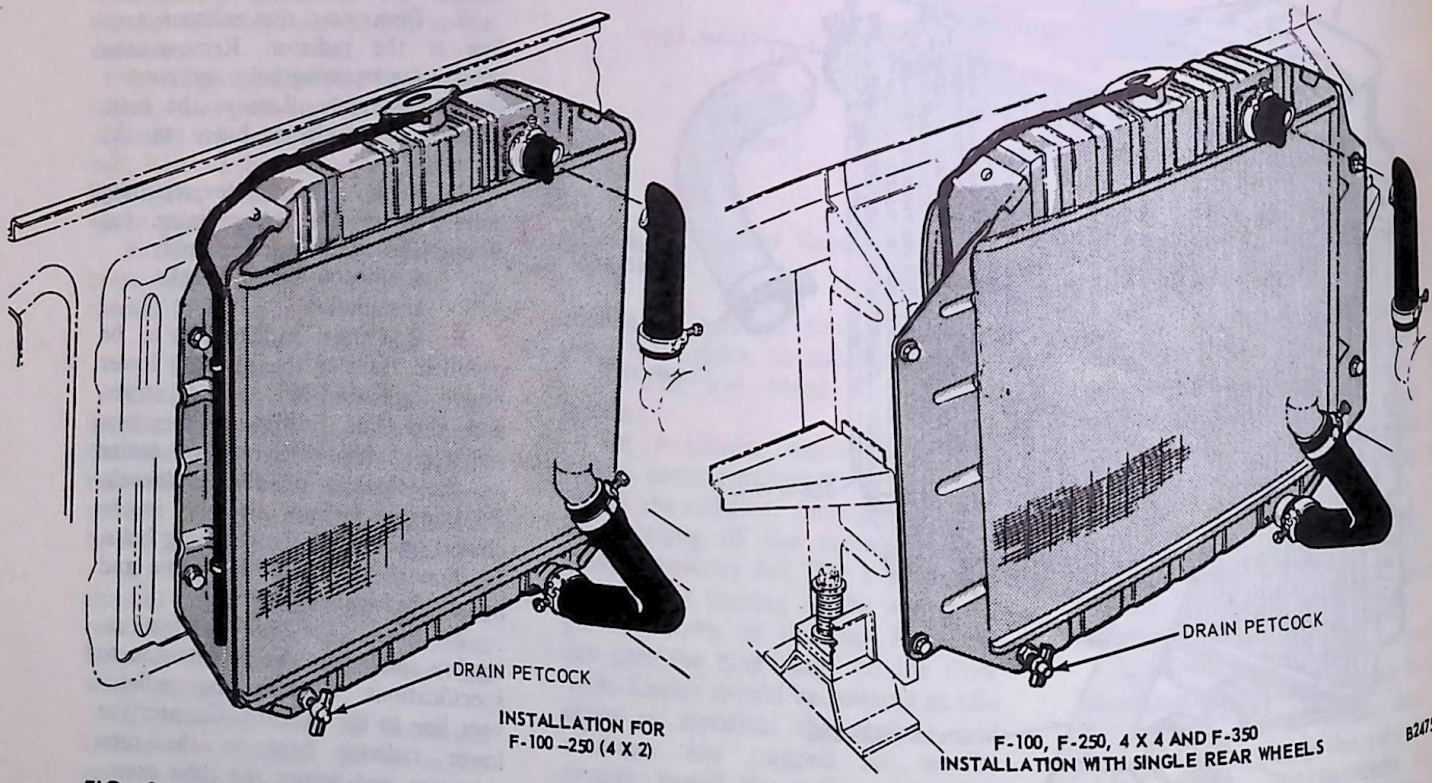


FIG. 8 Typical F-100-350 Radiator Installation—240-300 Six Gasoline Engines

330, 361 and 391 V-8 Gas Engines

B- and F-500-750 Series Trucks Removal

The B- and F-Series radiator installation is shown in Figure 12.

1. Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator.

On a truck with a Transmatic transmission, disconnect the oil cooler lines at the radiator.

On a truck with an air compressor, remove the compressor belt.

2. Loosen the alternator adjusting bracket bolts. Remove the fan assembly retaining bolts and remove the fan, spacer, pulley, and fan belt.

3. Remove the radiator retaining bolts and remove the radiator and shroud.

B- and F-500-750 Series Installation

1. If a new radiator is to be installed, transfer the drain cock and fan shroud to the new radiator. **Apply water-resistant sealer to the threads of the draincock.**

2. Position the radiator and shroud in the chassis and install the retaining bolts. Connect the radiator hoses. Install the fan, spacer, pulley and fan belt. Adjust the drive belt tension to specifications.

On a truck with a Transmatic transmission, connect the oil cooler lines.

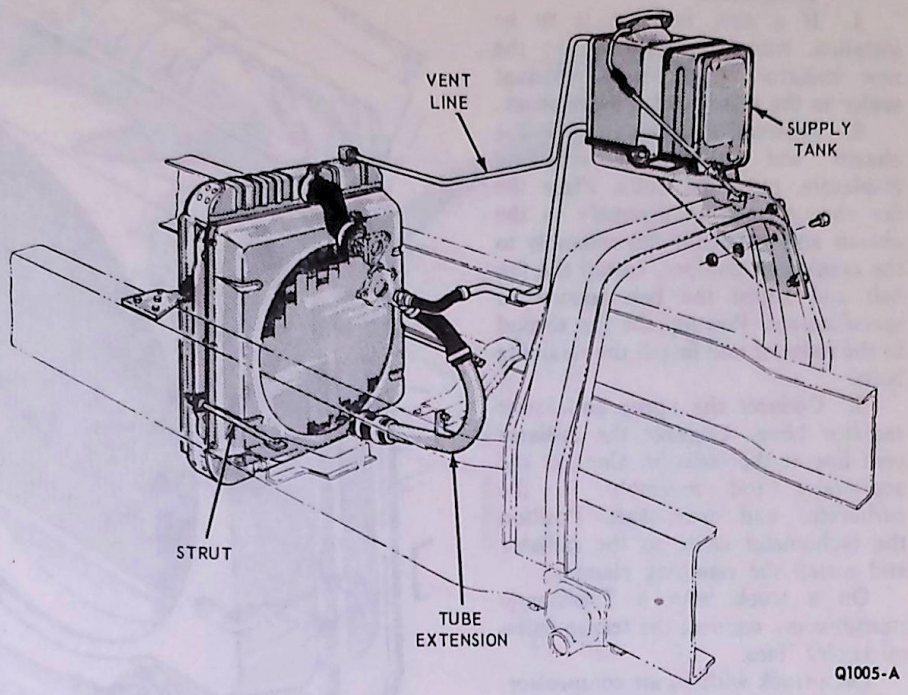


FIG. 10 Typical C-500-600 Radiator Installation—300 Six Gasoline Engines

On a truck with an air compressor, install the air compressor belt and adjust the belt tension to specification.

3. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperatures and check the coolant level. Check for leaks.

On a truck with a Transmatic transmission, check the Transmatic transmission oil cooler lines for leakage. Check the fluid level.

C-500-800 Series Trucks Removal

The C-500-800 Series radiator installation is shown in Figure 13.

1. Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator. Disconnect the radiator vent line at the radiator.

On a truck with a Transmatic transmission, disconnect the transmission oil cooler inlet and outlet lines and clamps from the radiator.

On a truck with an air compressor, remove the compressor belt.

2. Remove the tachometer cable clamps from the left side of the radiator. Disconnect the accelerator rod assembly at the cross-shaft and carburetor and remove the rod.

3. Disconnect the supply tank hose clamps from the fan shroud, if so equipped.

4. Remove the bolts securing the fan shroud to the radiator and lay the shroud over the fan. Remove the fan assembly from the crankshaft damper and remove the fan and shroud. Remove the radiator retaining bolts and insulators from top brackets and nuts and insulators from bottom support rods. Remove the radiator.

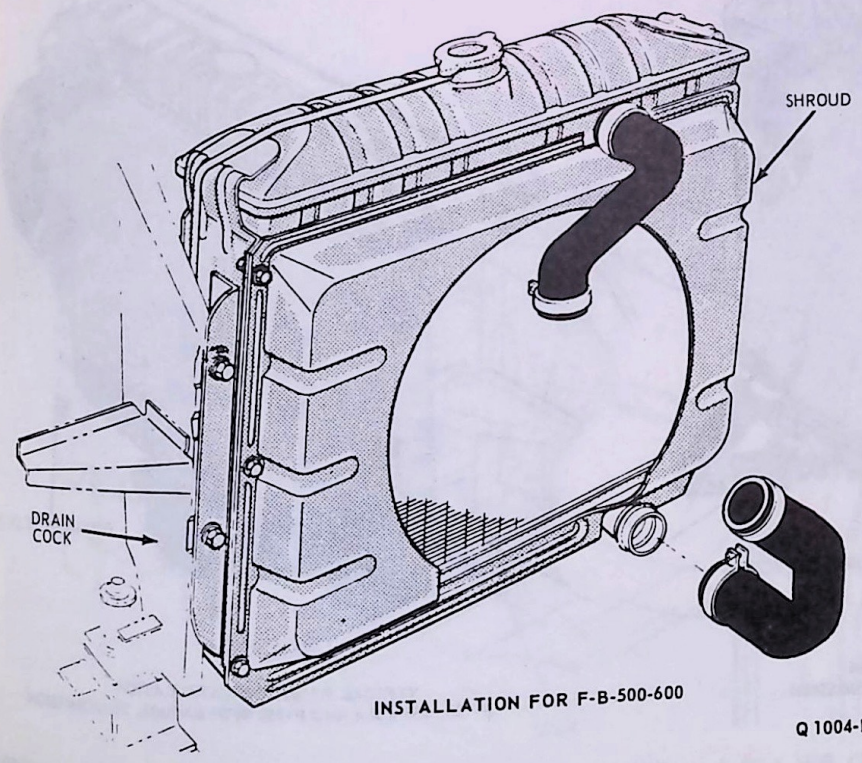


FIG. 9 Typical F-B-500-600 Radiator Installation—240-300 Six Gasoline Engines

C-500-800 Series Trucks

Installation

1. If a new radiator is to be installed, transfer all fittings to the new radiator. **Apply water-resistant sealer to the threads of the draincock.**

2. Position the radiator in the chassis and install the retaining insulators, nuts and bolts. Place the fan shroud and fan assembly in the chassis and install the fan assembly to the crankshaft damper. Install the fan belt and adjust the belt tension to specifications. Position the fan shroud to the radiator and install the retaining bolts.

3. Connect the upper and lower radiator hoses. Connect the radiator vent line at the radiator. Connect the accelerator rod assembly to the carburetor and cross-shaft. Position the tachometer cable to the radiator and install the retaining clamps.

On a truck with a Transmatic transmission, connect the transmission oil cooler lines.

On a truck with an air compressor, install the compressor belt and adjust the belt tension to specifications.

4. Position the supply tank hose to the shroud and install the hose clamps, if so equipped.

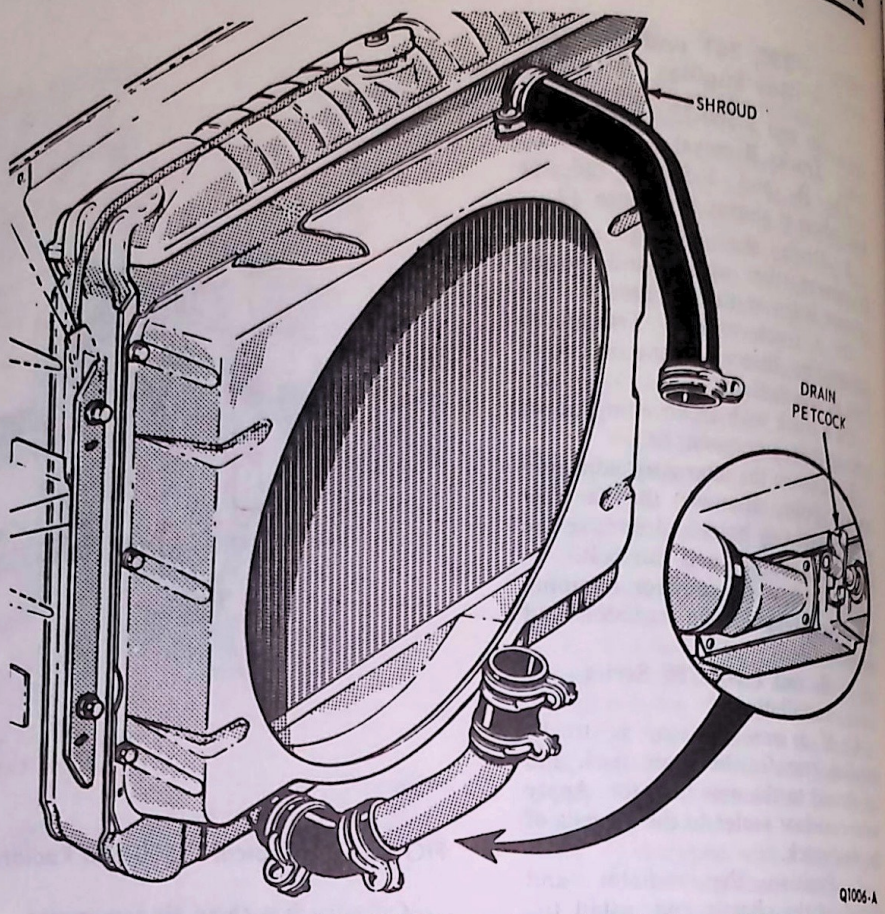


FIG. 12 Typical B and F 500-750 Radiator Installation—330-361 and 391 Gasoline Engines

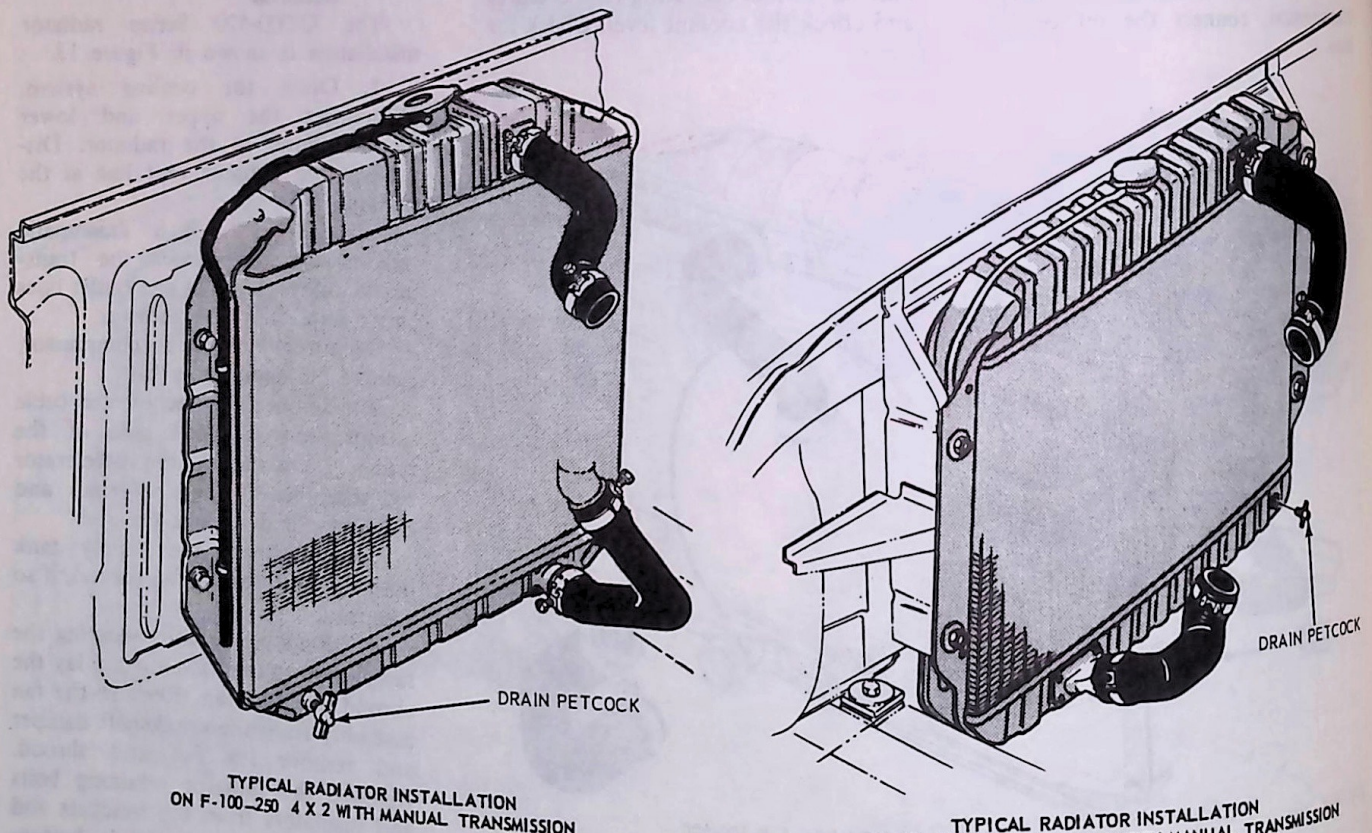


FIG. 11 Typical F-100-350 Radiator Installation—V-8 Gasoline Engines

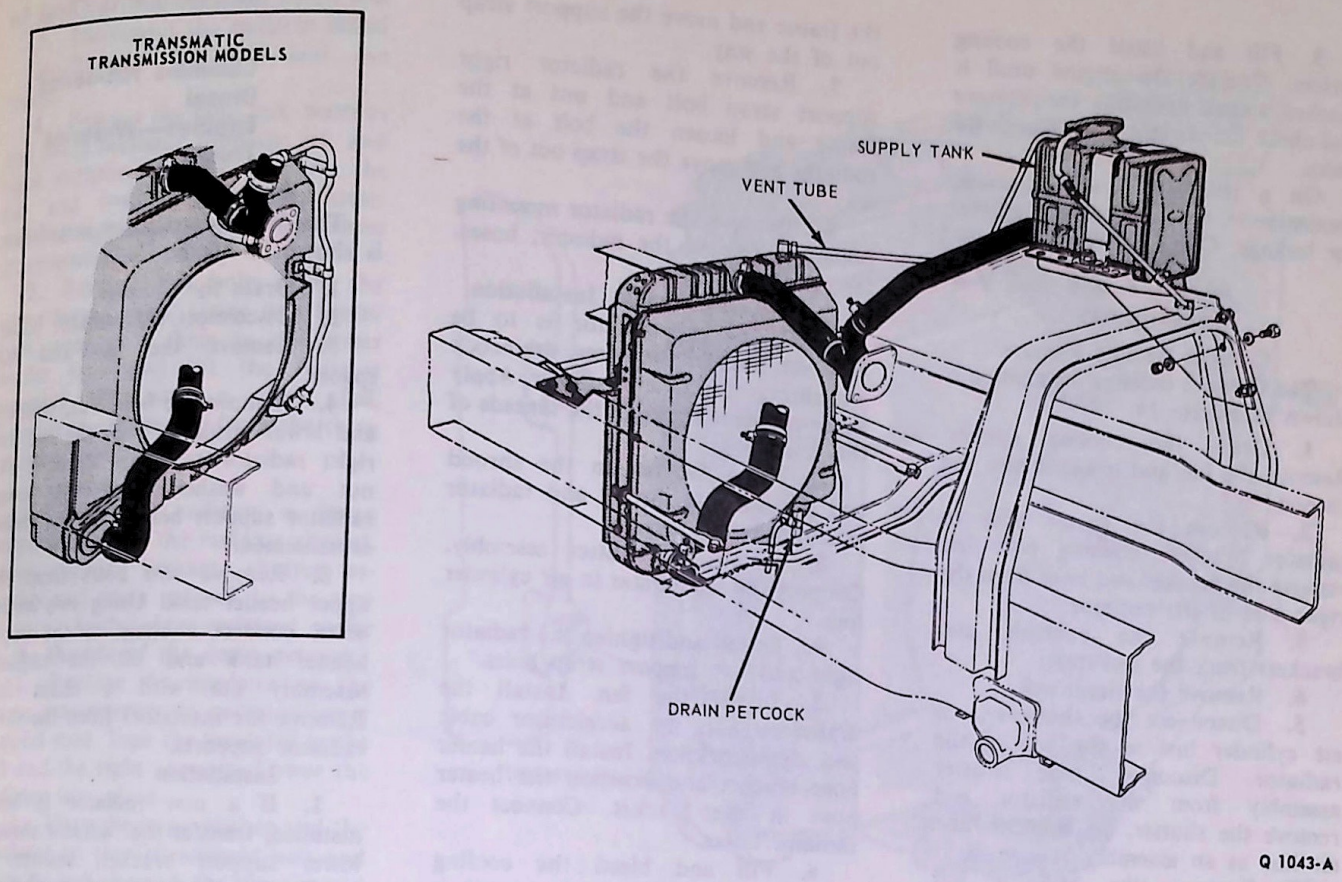


FIG. 13 Typical C-500-800 CT-750-800 Radiator Installation—330-361 and 391 V-8 Gasoline Engines

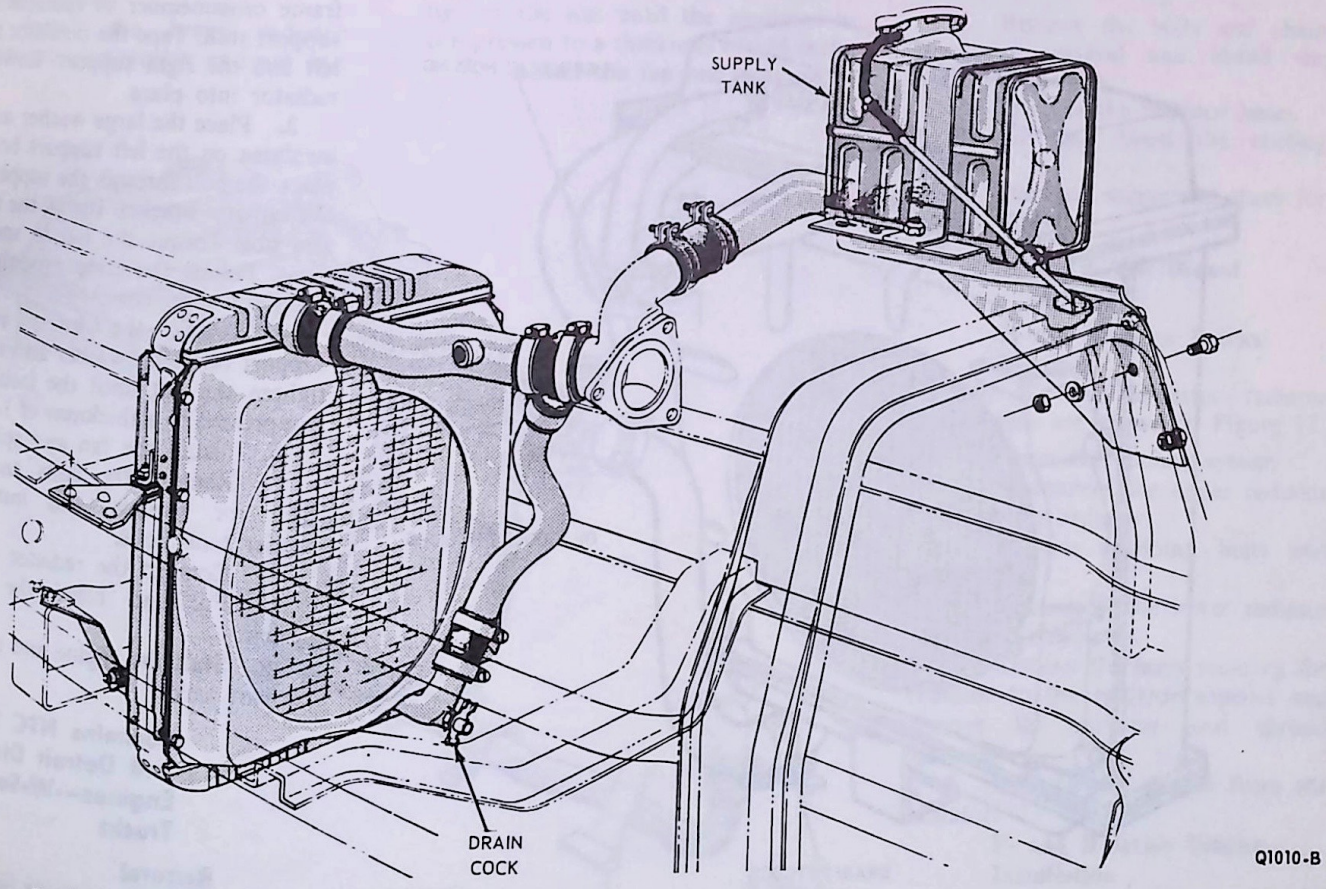


FIG. 14 Typical C-Series Radiator Installation—401, 477 and 534 V-8 Gasoline Engines

5. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature and check the coolant level. Check for leaks.

On a truck with a Transmatic transmission, check the oil cooler lines for leakage. Check the fluid level.

401, 477 and 534 V-8 Gas Engines

C-Series Trucks Removal

The C-Series radiator installation is shown in Figure 14.

1. Drain the cooling system. Remove the fan and lower it into the shroud.
2. Remove the heater hose to radiator bracket retaining bolt and remove the bracket and hose from the right side of the radiator.
3. Remove the controls and brackets from the radiator.
4. Remove the draincock.
5. Disconnect the shutterstat to air cylinder line at the top of the radiator. Disconnect the shutter assembly from the radiator and remove the shutter, air cylinder, and air line as an assembly.
6. Remove the radiator left support strap bolt and nut at the radiator and loosen the nut and bolt at the frame and move the support strap out of the way.
7. Remove the radiator right support strap bolt and nut at the frame and loosen the bolt at the radiator and move the strap out of the way.
8. Remove the radiator mounting bolts and remove the radiator, hoses, fan, and shroud.

C-Series Trucks Installation

1. If a new radiator is to be installed, transfer the hoses, draincock and shroud to the new radiator, **Apply water-resistant sealer to the threads of the draincock.**
2. Place the fan in the shroud and position the shroud and radiator assembly in the chassis.
3. Install the shutter assembly. Connect the shutterstat to air cylinder line.
4. Install and tighten the radiator right and left support strap bolts.
5. Install the fan. Install the draincock and the accelerator cable and clamp bracket. Install the heater hose bracket and position the heater hose in the bracket. Connect the radiator hoses.
6. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature and check the coolant level. Check for leaks.

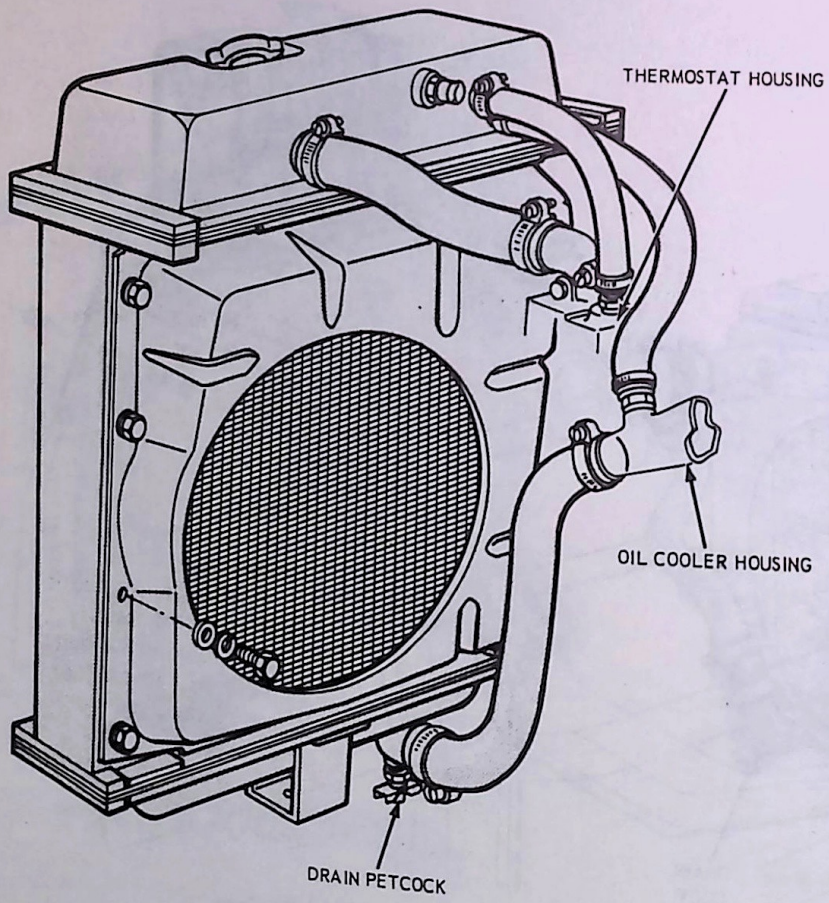


FIG. 15 W-Series Radiator Installation— Cummins NH-Series Diesel

Cummins NH-Series Diesel Engines—W-Series Trucks

Removal

The W-Series radiator installation is shown in Figure 15.

1. Drain the radiator.
2. Disconnect the radiator hoses.
3. Remove the fan and fan spacer.
4. Remove the bolt, nut, washers and lower insulator from the left and right radiator supports. Remove the nut and washer from the lower radiator support bracket at the frame crossmember.
5. Remove two bolts from the upper header tank. Using two longer bolts, connect a chain to the upper header tank and lift the radiator assembly out with a chain fall. Remove the insulators from the three radiator supports.

Installation

1. If a new radiator is being installed, transfer the radiator shroud, lower support bracket, shutter assembly and drain petcock to the new radiator. Apply water-resistant sealer to the threads of the drain petcock.
2. Position the insulator on the frame crossmember to radiator lower support stud. Tape the insulator to the left and the right support. Lower the radiator into place.
3. Place the large washer and the insulator on the left support bolt and place the bolt through the support and the radiator bracket. Install the washer and nut. Torque the nut to specifications. Follow the same procedure for the right support.
4. Install the lower radiator support retaining washer and nut and tighten the nut until the insulator is compressed to a thickness of 1/4 inch.
5. Install the fan and spacer.
6. Remove the bolts and chain used for removal and install the header tank bolts.
7. Connect the radiator hoses.
8. Fill and bleed the cooling system.
9. Start the engine and check for coolant leaks.

Cummins NTC Diesel and Detroit Diesel Engines—W-Series Trucks

Removal

The W-Series radiator installations are shown in Figs. 16, 19 and 20.

1. Drain the radiator.
2. Disconnect the radiator hoses.
3. Remove the fan and fan spacer.
4. Remove the bolt, nut, washers and lower insulator from the left and right radiator supports. Remove the nut and washer from the lower radiator support bracket at the frame crossmember.
5. Remove two bolts from the upper header tank. Using two longer bolts, connect a chain to the upper header tank and lift the radiator assembly out with a chain fall. Remove the insulators from the three radiator supports.

Installation

1. If a new radiator is being installed, transfer the radiator shroud, lower support bracket, shutter assembly and drain petcock to the new radiator. **Apply water-resistant sealer to the threads of the drain petcock.**
2. Position the insulator on the frame crossmember to radiator lower support stud. Tape the insulator to the left and the right support. Lower the radiator into place.
3. Place the large washer and the insulator on the left support bolt and place the bolt through the support and the radiator bracket. Install the washer and nut. Torque the nut to specifications. Follow the same procedure for the right support.
4. Install the lower radiator support retaining washer and nut and tighten the nut until the insulator is compressed to a thickness of 1/4 inch.
5. Install the fan and spacer.
6. Remove the bolts and chain used for removal and install the header tank bolts.
7. Connect the radiator hoses.
8. Fill and bleed the cooling system.
9. Start the engine and check for coolant leaks.

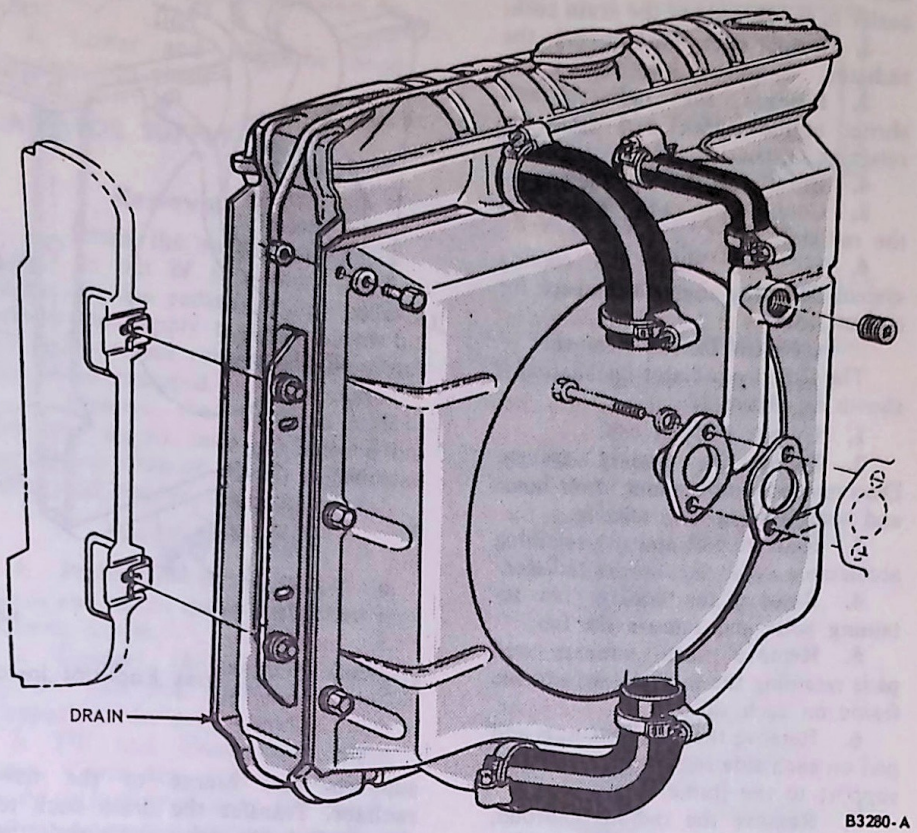


FIG. 17 Typical F- and B-6000-7000 Series Radiator Installation—Ford V-8 Diesel Engine

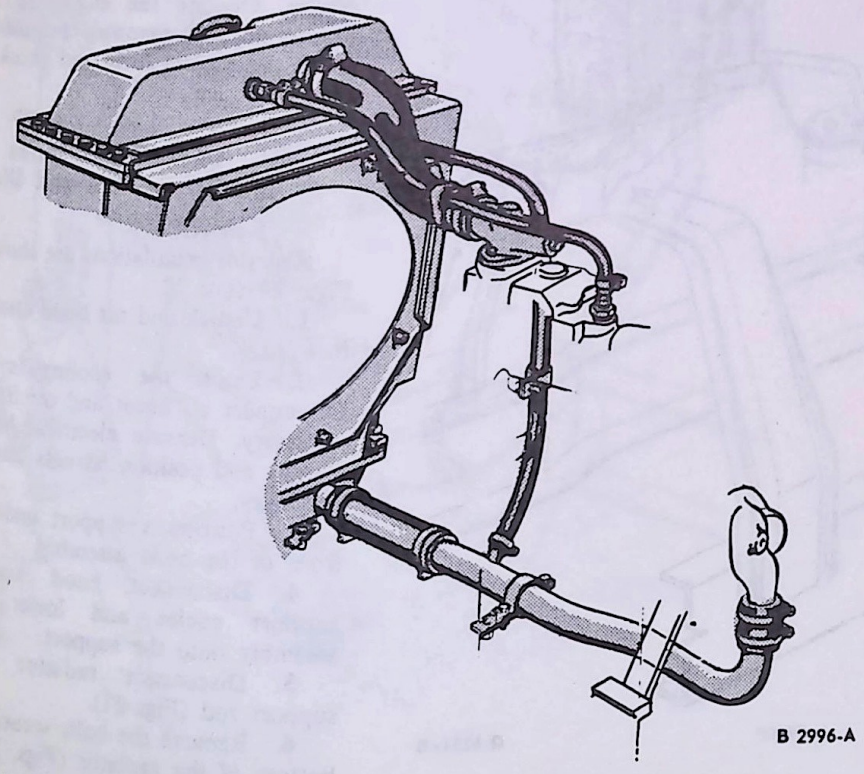


FIG. 16 W-Series Radiator Installation— Cummins NTC Engine

Ford V-8 Diesel Engines

F- and B-Series Trucks

Removal

The F- and B-Series radiator installations are shown in Figure 17.

1. Drain the cooling system.
2. Disconnect the upper radiator hoses at the radiator.
3. Remove retaining bolts and remove fan.
4. Disconnect the lower radiator hose at the radiator.
5. Remove the bolts securing the radiator to the radiator support and remove the radiator and shroud assembly.
6. Remove the shroud from the radiator.

F- and B-Series Trucks

Installation

1. If a new radiator is to be installed, transfer the drain cock to the

new radiator. **Apply water-resistant sealer to the threads of the drain cock.**

2. Install the shroud to the radiator.

3. Position the radiator and shroud to the support and install the retaining bolts.

4. Install the fan.

5. Connect the radiator hoses to the radiator.

6. Fill and bleed the cooling system. Start the engine and check for coolant leaks.

C-Series Trucks Removal

The C-Series radiator installation is shown in Figure 18.

1. Unlock and tilt cab.

2. Drain the cooling system. Disconnect the upper and lower hoses and vent hose at the radiator.

3. Remove bolt and nut retaining accelerator cable bracket to radiator.

4. Remove the cooling fan retaining bolts and remove the fan.

5. Remove nuts, washers and pads retaining the radiator strut to the frame on each side.

6. Remove the two bolts nuts and pad on each side retaining the radiator support to the frame.

7. Remove the radiator, shroud, supports and braces as an assembly.

C-Series Trucks Installation

1. If a new radiator is to be installed, transfer the radiator shroud, supports and braces to the new radiator. Transfer the drain cock to the new radiator, **using water-resistant sealer on the threads.**

2. Position the radiator and related parts in the vehicle.

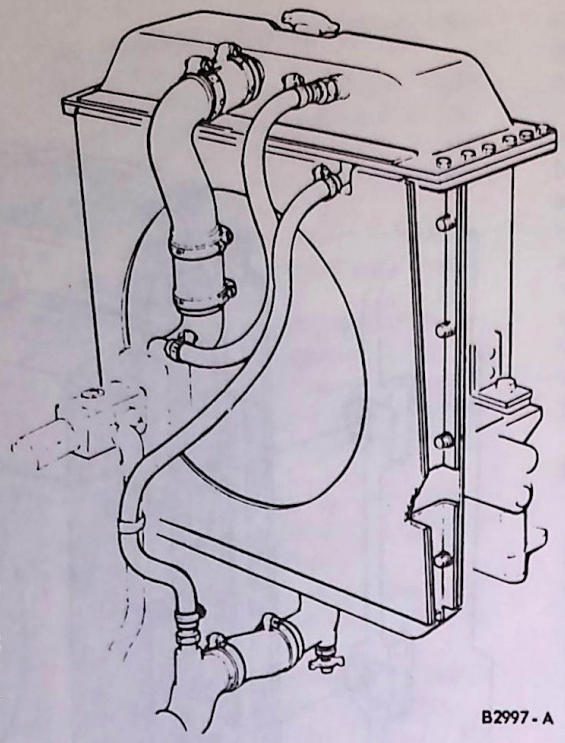


FIG. 19 W-Series Radiator Installation— Detroit Diesel

3. Install the radiator support retaining bolts, nuts and pads.

4. Install the radiator strut retaining nuts, washers and pads.

5. Connect the radiator hoses and vent hose.

6. Install the cooling fan and retaining bolts.

7. Install accelerator cable bracket.

8. Fill and bleed the cooling system. Operate the engine until it reaches normal operating temperature; check the coolant level and check the system for leaks.

9. Lower and lock the cab.

L-LN-LT-LNT-Series Trucks Gas and Diesel

Removal

Radiator installations are shown in Figs. 24 thru 32.

1. Unlock and tilt hood assembly forward.

2. Drain the cooling system. Disconnect all hoses and air lines as necessary. Remove electrical harness clamps and position harness aside, as necessary.

3. Position a support under the front of the hood assembly.

4. Disconnect hood assembly support cables and lower hood assembly onto the support.

5. Disconnect radiator upper support rod (Fig. 21).

6. Remove the bolts securing the bottom of the radiator (Figs. 22 and 23).

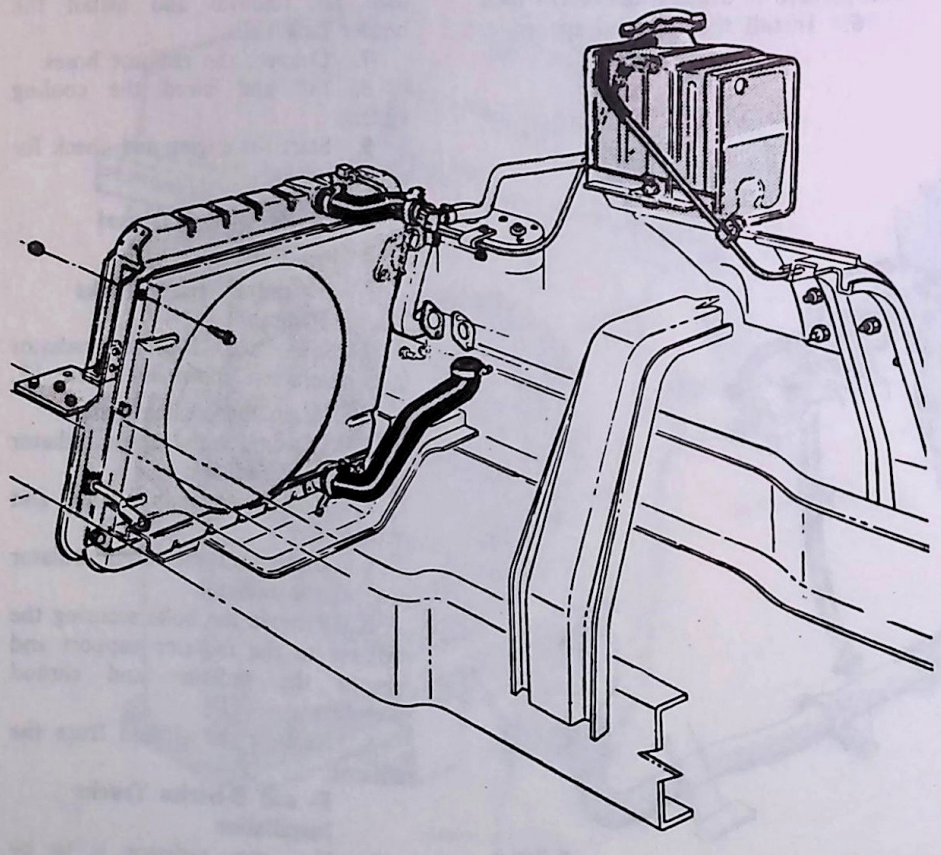


FIG. 18 C-Series Radiator Installation— Ford V-8 Diesel Engine

7. Using a rope sling and chain fall, lift the radiator assembly from the truck. Move the radiator forward enough so the shroud clears the fan assembly as the radiator assembly is being removed.

8. Remove the shroud from the radiator.

9. Remove the shutter assembly if so equipped.

Installation

1. If a new radiator is to be installed, transfer the drain cock and all necessary fittings to the new radiator.

2. Install the shroud to the radiator.

3. Install the shutter assembly if so equipped.

4. Using the proper rope, sling and a chain fall, position the radiator assembly in the truck.

5. Install the lower radiator retaining bolts and upper radiator support rod. Disconnect the rope sling and chainfall. Be sure to use the correct shoulder bolt for thickness of truck frame (Fig. 23).

6. Connect all radiator hoses and air lines as necessary to the radiator. Install electrical harness as necessary.

7. Fill and bleed the cooling system. (Refer to Part 27-01). Operate the engine until it reaches normal operating temperatures; check the coolant level and check the system for leaks.

8. Lower and lock the hood assembly into place.

RADIATOR SUPPLY TANK

Removal

1. Drain the radiator until the coolant is out of the supply tank. Disconnect the radiator supply tank hose at the supply tank. Disconnect the radiator vent tube at the supply tank, if so equipped.

2. Remove the overflow tube from the supply tank. Remove the supply tank strap or bracket retaining bolt(s) and remove the supply tank.

Installation

1. Position the supply tank in the chassis and install the strap or bracket retaining bolt(s).

2. Connect the radiator hose, overflow tube and vent tube (if so equipped) to the supply tank.

3. Fill and bleed the cooling system. Check for coolant leaks and proper coolant level after the engine reaches normal operating temperatures.

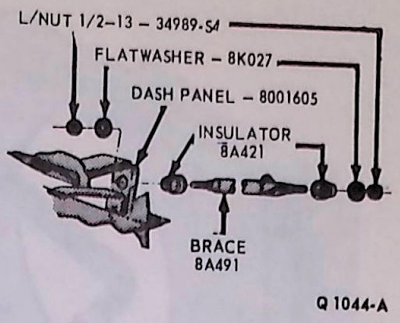


FIG. 21 Typical L-Series Upper Radiator Brace

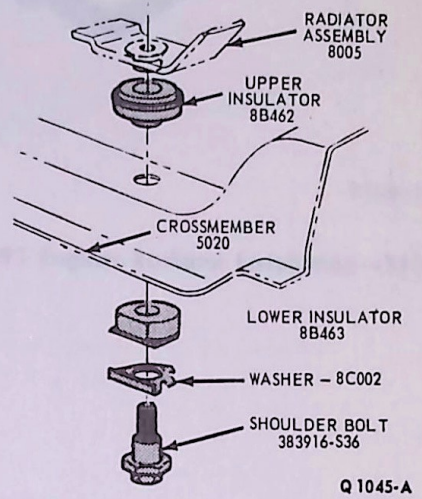


FIG. 22 Typical LN-500-750 Lower Radiator Mount, 330, 361, 391 and LN-6000-7000 Ford V-8 Diesel

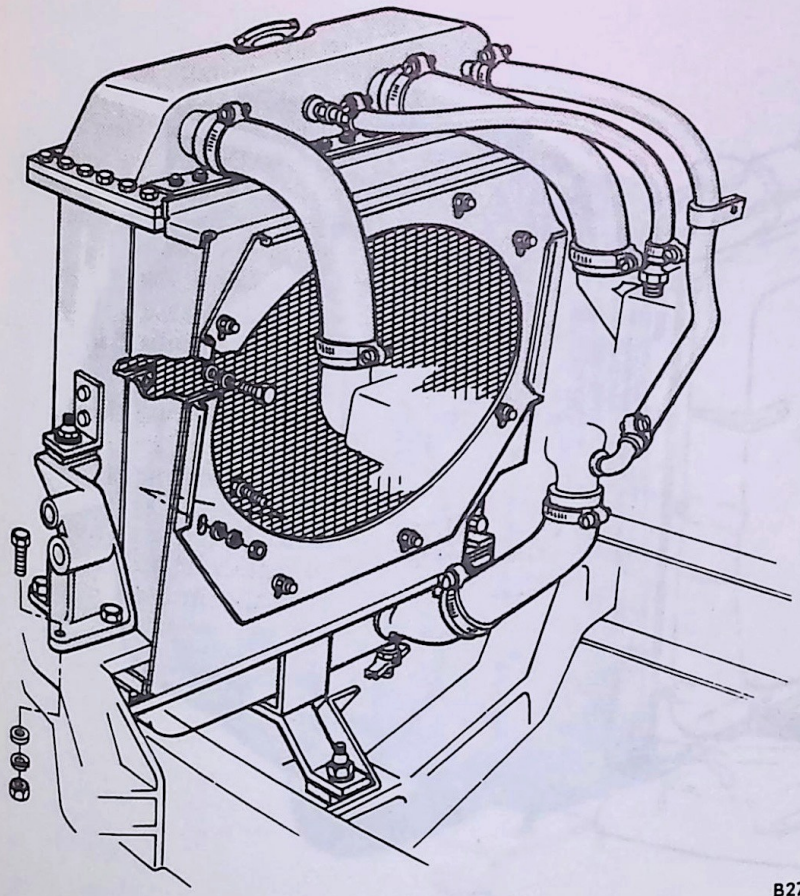


FIG. 20 W-Series Radiator Installation— Detroit Diesel 8V-71

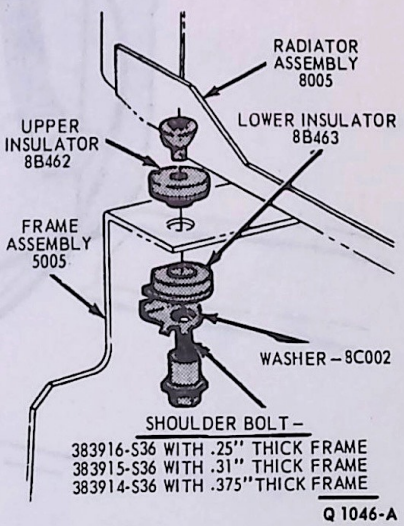
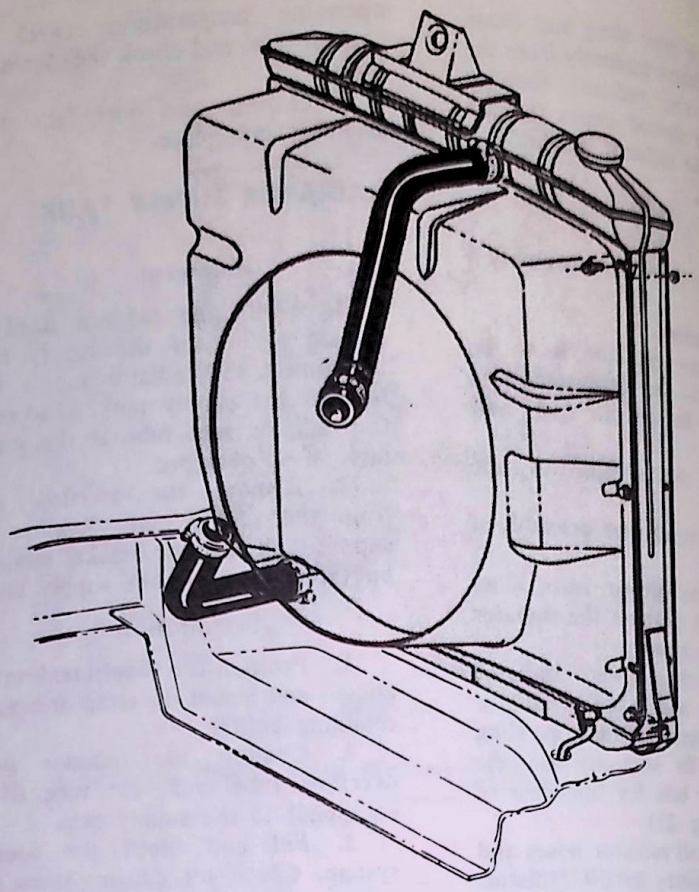
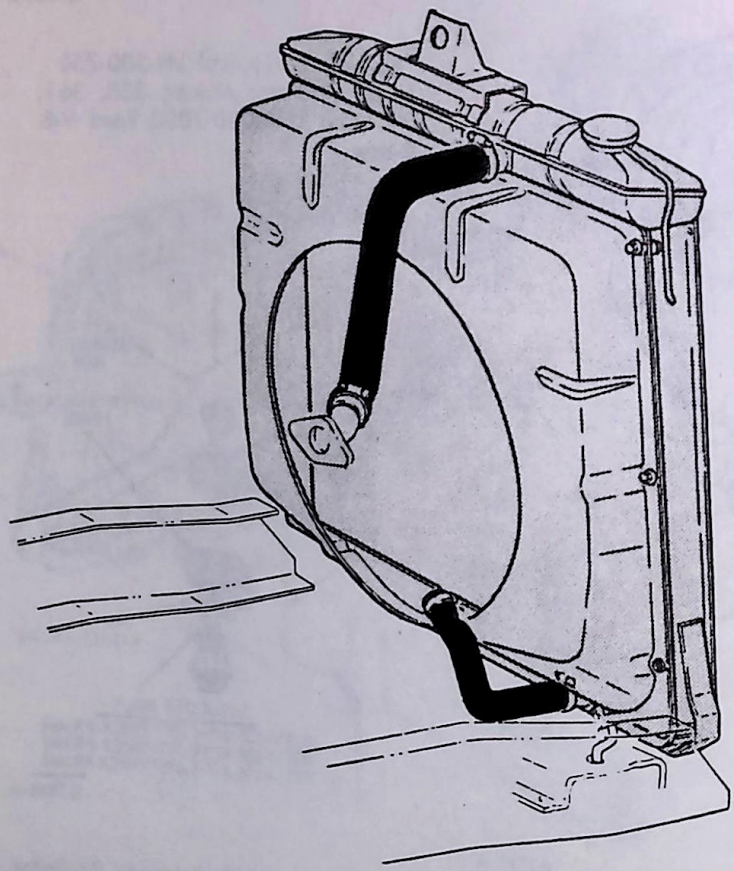


FIG. 23 Typical Lower Radiator Mount



Q 1048-A

FIG. 25 LN-500-750 Radiator Installation—330, 361 and 391



Q 1047 - A

FIG. 24 LN-500-600 Radiator Installation—240 and 300 Engines

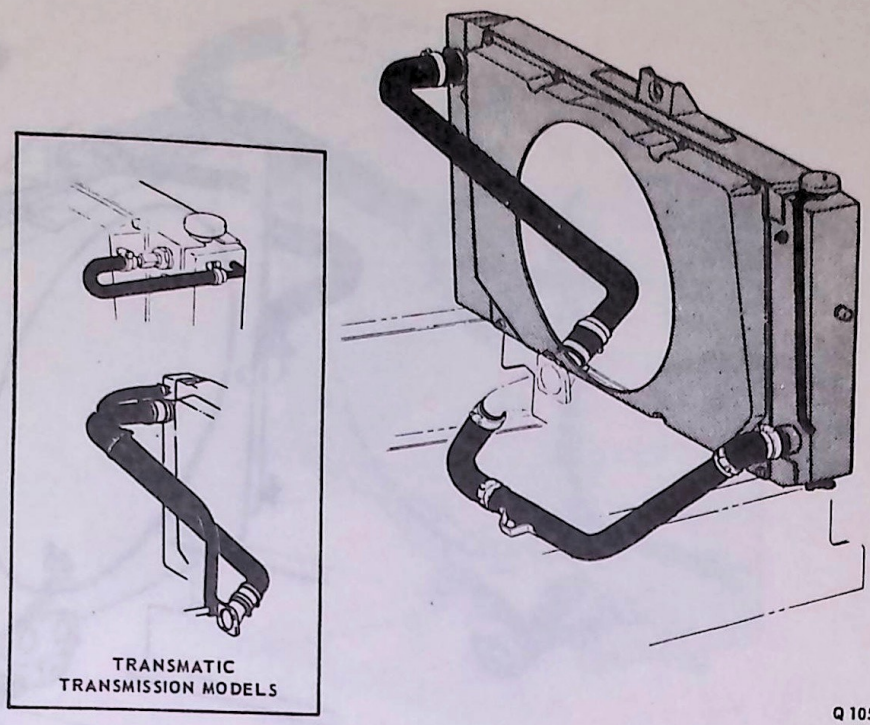


FIG. 27 L-, LN-, LT-, LNT-800 and 391 Engines Radiator Installation—330, 361

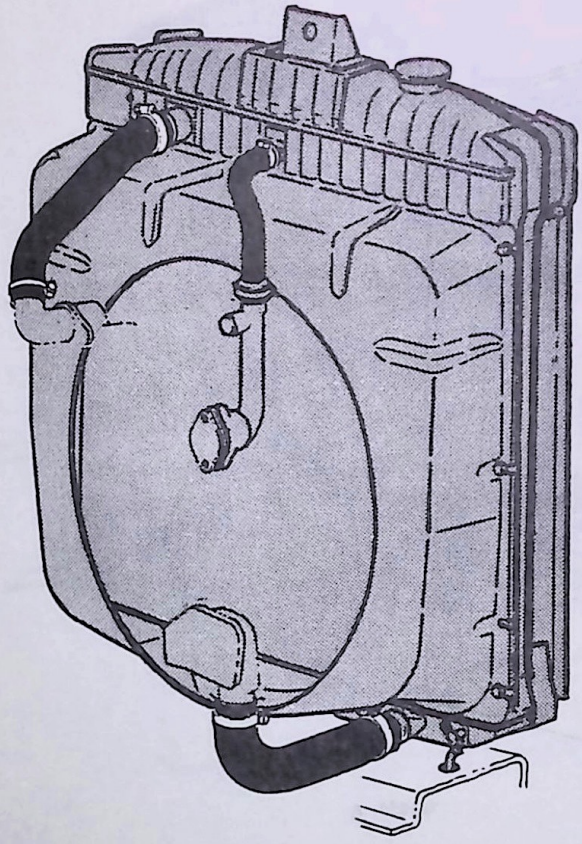


FIG. 26 LN-6000-7000 Radiator Installation— Ford V-8 Engines

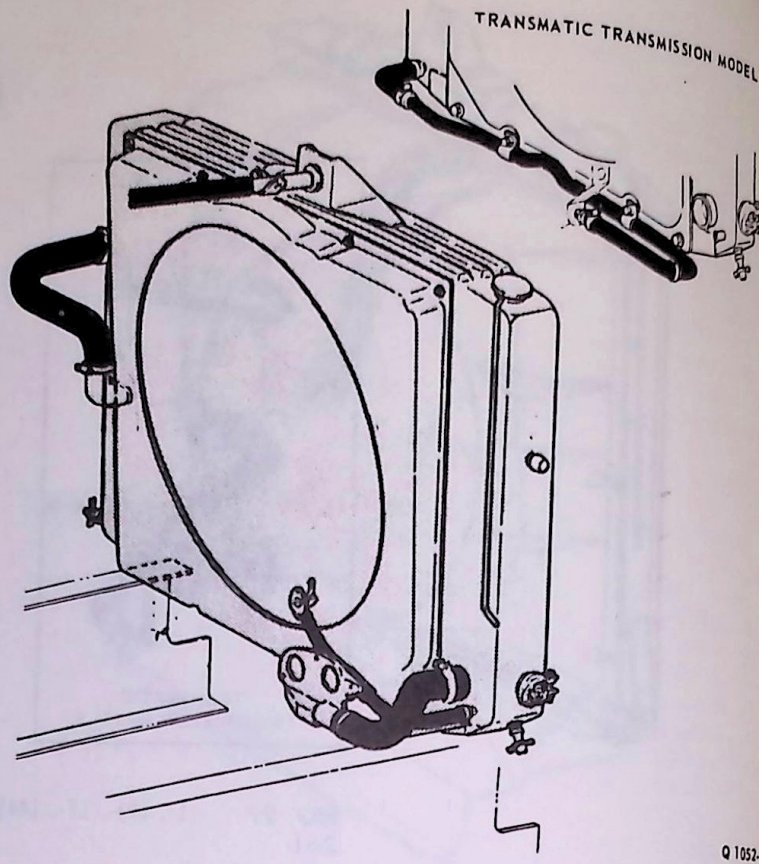


FIG. 29 L-, LN-, LT-, LNT-8000 Radiator Installation—Ford V-8 Diesel Engines

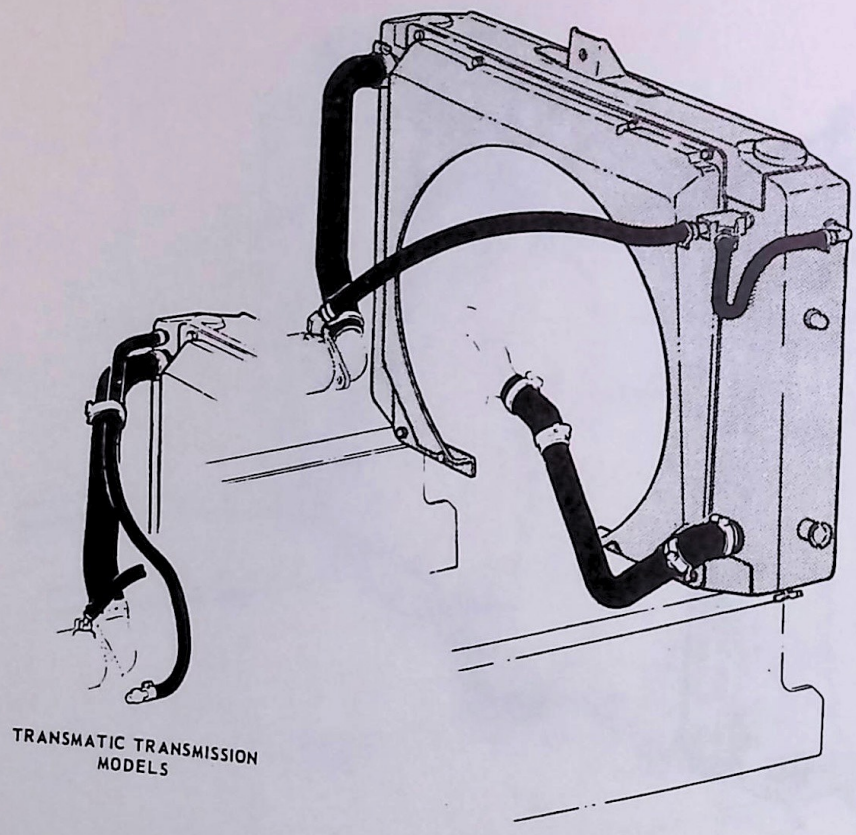
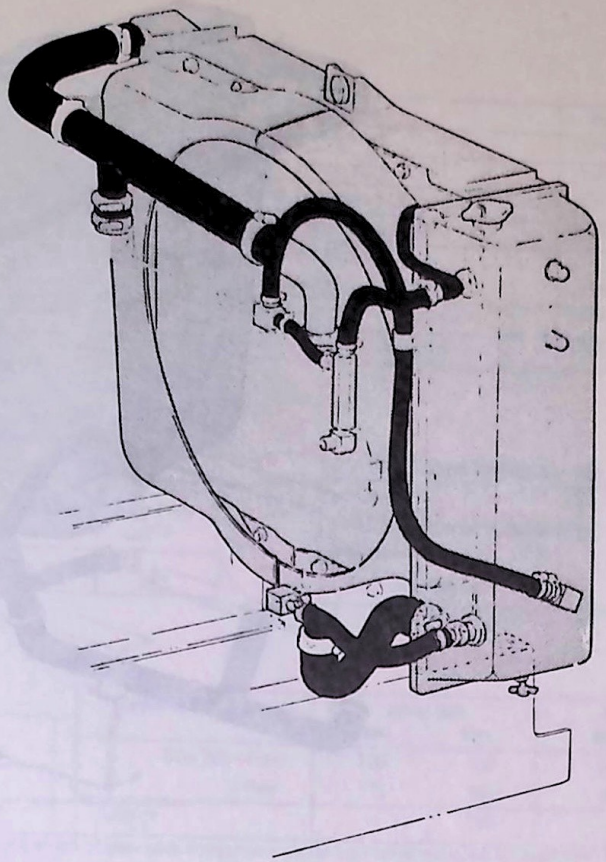
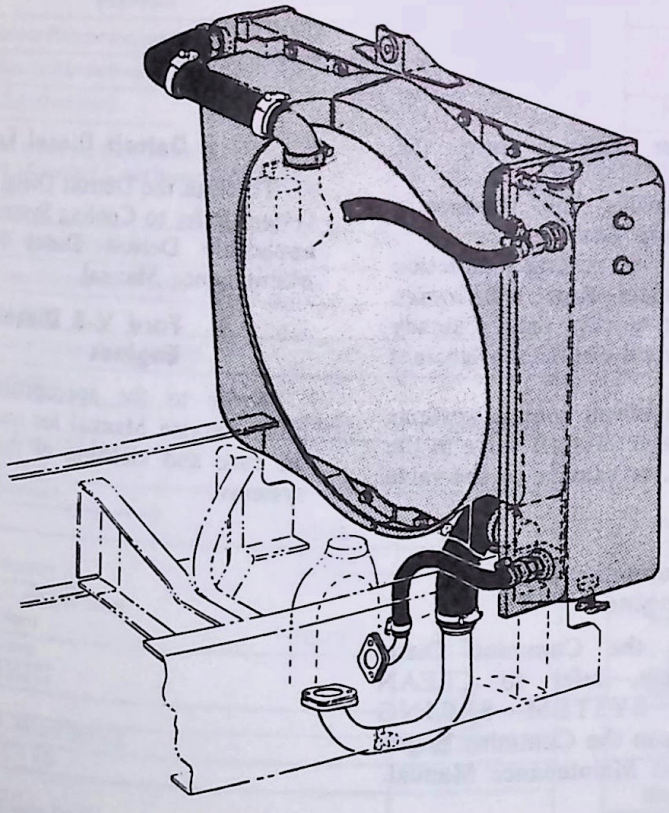


FIG. 28 L-, LN-, LT-, LNT-900 and 534 Engines Radiator Installation—401, 477



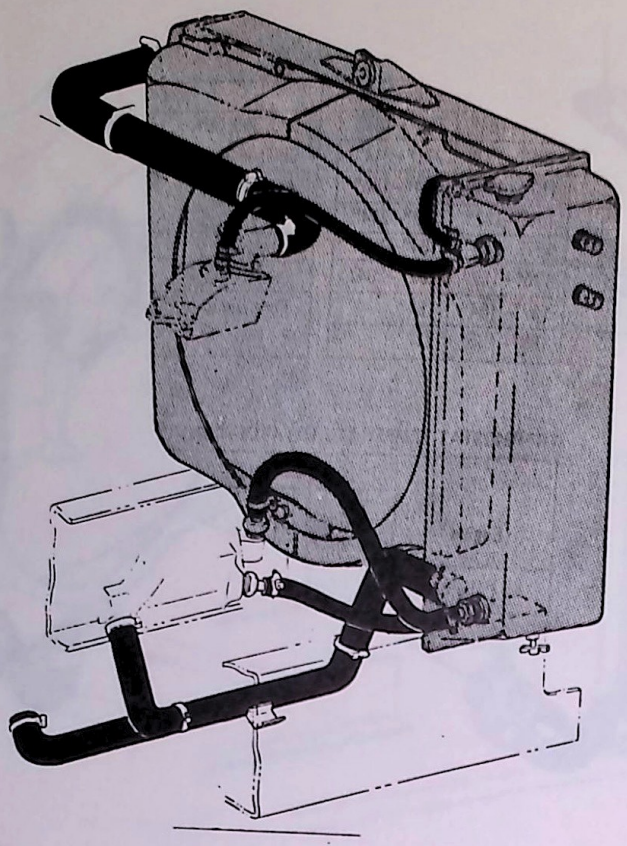
Q 1054-A

FIG. 31 L-, LN-, LT-, LNT-9000 Detroit Diesel Engines Radiator Installation—8V-71



Q 1053-A

FIG. 30 L-, LN-, LT-, LNT-9000 Detroit Diesel Engines Radiator Installation—6-71



Q 1055-A

FIG. 32 L-, LN-, LT-, LNT-9000 Radiator Installation—NH-Series Cummins Diesel Engines

5 CLEANING AND INSPECTION

CLEANING COOLING SYSTEM

Ford Gasoline Engines

To remove rust, sludge and other foreign material from the cooling system, use either FoMoCo Regular Cooling System Cleanser or in severe cases use Heavy Duty Cleanser. Removal of such material restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head bolts are properly tightened to prevent possible water leakage into the cylinders.

Always remove the thermostat prior to pressure flushing.

A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

Do not backflush cooling systems that have a water shut-off valve in the heater system, or damage to the valve can result.

Cummins Diesel Engines

To clean the Cummins Diesel cooling system, refer to CLEAN COOLING SYSTEM—SPRING AND FALL, in the Cummins Engine Operation and Maintenance Manual.

Detroit Diesel Engines

To clean the Detroit Diesel cooling system, refer to Cooling System in the applicable Detroit Diesel Highway Maintenance Manual.

Ford V-8 Diesel Engines

Refer to the appropriate Caterpillar Service Manual for instructions on care and cleaning of the cooling systems.

9 SPECIFICATIONS

THERMOSTATS

Gasoline Engine		Opens	Fully Open
170 C.I.D.	Low Temperature	157°–164°	184°–186°
	High Temperature	185°–192°	211°–214°
240 and 300 LD Six	Low Temperature	157°–164°	184°–186°
	High Temperature	185°–192°	212°–214°
300 HD Six	Low Temperature	157°–164°	184°–186°
	High Temperature	175°–182°	202°–204°
302 V-8	Low Temperature	157°–164°	184°
	High Temperature	188°–195°	212°

Gasoline Engine		Opens	Fully Open
330, 360, 361, 390 and 391 V-8	Low Temperature	157°–162°	182°
	High Temperature	175°–182°	200°
401, 477 and 534 V-8	Low Temperature (Main)	157°–162°	182°
	High Temperature (Main)	177°–182°	202°
	Manifold or Block – Thermostat	147°–152°	160°
Ford Diesel	242 C.I.D.	175°	180°
	363 C.I.D.	175°	180°

VERNATHERM POWER ELEMENT TEMPERATURE TABLE – W-SERIES

Stamped Number	Temperature
383	170°
137	175°
380	180°

THERMOSTAT TEMPERATURE TABLE–CUMMINS

Engine	Thermostat	
	Opens at °F	Open Fully at °F
All Cummins	170	185

COOLING SYSTEM PRESSURE–PSI

P-Series	7
F-100-350, Econoline and Bronco	13
All Others	12-15
Super Duty Engines	7

Engine Drive Belt Tension (Lbs) – Using Belt Tension Gauge Tool T63L-8620-A

Application	Initial Belt		Reset ① Tension	
	Min.	Max.	Min.	Max.
Diesel Single Belt	120	150	90	120
Dual Belt–Front	120	150	90	120
–Rear	115	165	85	130
Gasoline	–	140	–	110

① Reset tensions apply to any belt which requires retensioning because of repair or replacement of associated components and/or has been in operation for more than 10 minutes.

CQ 1083-A

TORQUE VALUES

Description		Ft-Lbs
Radiator Clamp to Radiator Support Bronco		5-8
Shutter to Radiator P-Series Diesel		5-8
Radiator to Body Sheet Metal		
All F-Series, Bronco and Econoline except F-350 with A/C and/or E.C. and Bronco W/302 C.I.D. Engines		10-15
F-350 with A/C and/or DR with EC		20-25
Radiator to Frame Crossmember P-Series		20-24
Radiator Hose Clamp		16-24 in-lb
Tie-Bar to Radiator Support P-350-400-500		20-24
Fan Shroud to Radiator		
W-Series	1/4-20	30-45 in-lb
F-, L-, LN-, LT- and LNT-Series Medium and Heavy	1/4-20	50-68 in-lb
Radiator-to-Sidemember-		
C-Series	3/8-16	20-24
	7/16-14	33-45
Radiator-to-top-Support		
F-, L-, LN-, LT- and LNT-Series Medium and Heavy	1/2-13	31-42
Water Outlet Housing		
170, 240 and 300 Six		12-15
302 V-8		12-15
330, 360, 361, 390 and 391 V-8		23-28
401, 477 and 534 V-8		23-28
Fan to Fan Hub		
NH-Engines, W-Series Truck		45-50
Radiator Brace Rods		
L-, LN-, LT- and LNT-Series Trucks		30-35

Description		Ft-Lbs
Radiator Support to Frame Insulator Bolts		30-35
Fan to Water Pump-All F-Series (Except F-350 DR)		12-18
Econoline, Bronco and Parcel Delivery (Gas Only)		10-14
Fan to Fan Spacer - P-Series Diesel and F-350 (DR)		8-12
Radiator to Radiator Support - P-Series (Gas)		20-30
Shroud to Radiator - F-100 through 350 and P-Series		5-8
Shroud to Radiator - Bronco		1-2
Radiator-to-Body Side Supports -		
F, B and LN-Series Medium	3/8-16	20-24
Radiator Hose Clamp		16-22 in-lb
Water By-Pass Connector to Engine Front Cover		
	F and B-6000-7000 C-6000-8000 F and T-8000	13-23
Shutter to Radiator		
W-Series	1/4-20	30-45 in-lb
F-, L-, LN-, LT-, LNT-Series Medium and Heavy	5/16-18 and 5/16-24	8-12
C-Series	1/4-20	50-68 in-lb
Water Filter Hose Clip-to-Air Inlet Housing	3/8-16	20-25
Water Filter Hose Clip-to-Engine Idler Gear Cover	3/8-16	29-36
Water Filter Ground Wire to Engine	3/8-16	29-36
EC-EXTRA COOLING	DR-DUAL WHEELS	

CQ 1084-A

COOLING SYSTEM REFILL CAPACITIES (QUARTS) AND RADIATOR AND FAN APPLICATIONS—LIGHT TRUCKS, BRONCO AND ECONOLINE

Model	Engine	Cooling	Usage	Radiator						Fan	
				Core Size			Fins/ In.	Approx. Capacity (Qts)*		No. of Blades	Dia.
				Height	Width	Thick		U.S.	Imperial		
Bronco	170	Std.	W/Manual Trans.	17.38	17.24	1.27	11.0	9 1/8	7 5/8	6	
U-100	302	Std.	W/Manual Trans.	19.04	19.74	1.95	9.0	14 5/8	12 1/8	5	
(4 x 4)		E.C.	W/Manual Trans.	19.04	19.74	1.95	10.0	14 5/8	12 1/8	5	
E-100	240	Std.	W/Manual Trans.	17.38	20.24	1.27	8.5	14.1	11 5/8	4	
E-200		E.C.	W/Manual Trans.	18.26	23.75	1.25	9.5	14.4	12	4	
E-300		Std.	W/Automatic Trans.	18.26	23.75	1.25	8.5	14.4	12	4	
		E.C.	W/Automatic Trans.	19.73	26.25	1.95	8.0	14.4	12	4	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	8.0	16.7	13 7/8	4	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	7.0	16.7	13 7/8	5	
		E.C.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	10.0	16.7	13 7/8	5	
		E.C.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	9.0	16.7	13 7/8	7	
	302	Std.	W/Manual Trans.	18.26	23.75	1.25	9.5	15.2	12 3/4	7	
		E.C.	W/Manual Trans.	19.73	26.25	1.95	7.0	17.5	14 5/8	4	
		Std.	W/Automatic Trans.	18.26	23.75	1.25	10.5	15.2	12 3/4	4	
		E.C.	W/Automatic Trans.	19.73	26.25	1.95	8.0	17.5	14 5/8	4	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	8.0	17.5	14 5/8	4	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	7.0	17.5	14 5/8	5	
		E.C.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	10.0	17.5	14 5/8	5	
		E.C.	A.C. - W/Man. Trans.	19.73	26.25	1.95	9.0	17.5	14 5/8	7	
F-100-250	240	Std.	W/Man. Trans.	17.38	20.24	1.27	8.0	14.1	11 5/8	7	
(4 x 2)		E.C.	W/Man. Trans.	18.38	18.45	1.27	10.0	14.4	12 1/8	4	
		Std.	W/Auto. Trans.	18.26	23.25	1.25	9.5	14.4	12	4	
		E.C.	W/Auto. Trans.	19.73	26.25	1.95	9.0	16.7	13 7/8	4	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	9.0	16.7	13 7/8	4	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	8.5	16.7	13 7/8	5	
	300	Std.	W/Manual Trans.	18.38	18.45	1.27	10.0	14.4	12	5	
		E.C.	W/Manual Trans.	19.73	26.25	1.95	8.5	16.7	13 7/8	4	
		Std.	W/Automatic Trans.	18.26	23.25	1.25	9.5	14.4	12	4	
		E.C.	W/Automatic Trans.	19.73	26.25	1.95	9.0	16.7	13 7/8	4	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	9.0	16.7	13 7/8	5	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	8.5	16.7	13 7/8	5	
	302	Std.	W/Manual Trans.	19.73	26.25	1.27	7.0	17.1	14 1/8	4	
		E.C.	W/Manual Trans.	19.73	26.25	1.95	9.0	17.5	14 5/8	4	
		Std.	W/Automatic Trans.	19.73	26.25	1.27	8.0	17.1	14 1/8	4	
		E.C.	W/Automatic Trans.	19.73	26.25	1.95	10.0	17.5	14 5/8	4	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	10.0	17.5	14 5/8	5	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	9.0	17.5	14 5/8	5	
	360	Std.	W/Man. Trans.	19.73	26.25	1.27	8.5	21 7/8	18 1/4	5	
		E.C.	W/Man. Trans.	19.73	26.25	1.95	7.0	22 1/4	18 1/2	5	
		Std.	W/Auto. Trans.	19.73	26.25	1.27	9.5	21 7/8	18 1/4	5	
		E.C.	W/Auto. Trans.	19.73	26.25	1.95	8.0	22 1/4	18 1/2	5	
		Std.	A.C. W/Auto. Trans.	19.73	26.25	1.95	11.0	22 1/4	18 1/2	5	
		Std.	A.C. W/Manual Trans.	19.73	26.25	1.95	10.0	22 1/4	18 1/2	5	
	390	Std.	W/Manual Trans.	19.73	26.25	1.27	8.5	21 7/8	18 1/4	5	
		E.C.	W/Manual Trans.	19.73	26.25	1.95	10.0	22 1/4	18 1/2	5	
		Std.	W/Automatic Trans.	19.73	26.25	1.27	9.5	21 7/8	18 1/4	5	
		E.C.	W/Automatic Trans.	19.73	26.25	1.95	11.0	22 1/4	18 1/2	5	
		Std.	A.C. - W/Auto. Trans.	19.73	26.25	1.95	11.0	22 1/4	18 1/2	5	
		Std.	A.C. - W/Man. Trans.	19.73	26.25	1.95	10.0	22 1/4	18 1/2	5	
F-350 SR	240	Std.	W/Man. Trans.	18.26	23.25	1.25	10.5	14 3/8	12	4	
		E.C.	W/Man. Trans.	19.73	26.25	1.27	11.0	16 5/8	13 7/8	4	
		Std.	W/Auto. Trans.	19.73	26.25	1.27	12.0	16 5/8	13 7/8	4	
		E.C.	W/Auto Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	
	300	Std.	W/Man. Trans.	18.26	23.75	1.25	11.0	14 3/8	12	4	
		E.C.	W/Man. Trans.	19.73	26.25	1.27	11.0	16 5/8	13 7/8	4	
		Std.	W/Auto. Trans.	19.73	26.25	1.27	12.0	16 5/8	13 7/8	4	
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	

*Includes Allowance for Standard Heater Std. – Standard Cooling E.C. - Extra Cooling

C0106743

COOLING SYSTEM REFILL CAPACITIES (QUARTS) AND RADIATOR AND FAN APPLICATIONS—LIGHT TRUCKS, BRONCO AND ECONOLINE (Cont'd.)

Model	Engine	Cooling	Usage	Radiator						Fan	
				Core Size			Fins/ In.	Approximate System Capacity (Qts)*		No. of Blades	Dia.
				Height	Width	Thick		U.S.	Imperial		
F-350 SR (Cont'd.)	360	Std.	W/Man. Trans.	19.73	26.25	1.95	8.0	22 1/4	18 1/2	5	18.5
		E.C.	W/Man.Trans.	24.19	26.25	1.78	11.0	12 7/8	19 7/8	5	18.5
		Std.	W/Auto. Trans.	19.73	26.25	1.95	10.5	22 1/4	18 1/2	5	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	18.5
		Std.	A.C.-W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
		Std.	A.C.-W/Man. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
	390	Std.	W/Man. Trans.	19.73	26.25	1.95	12.0	22.3	18 1/2	5	18.5
		E.C.	W/Man. Trans.	24.19	26.25	1.78	11.0	23.9	19 7/8	5	18.5
		Std.	W/Auto. Trans.	19.73	26.25	1.95	10.5	22.3	18 1/2	5	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	11.0	23.9	19 7/8	5	18.5
		Std.	A.C.-W/Auto. Trans.	24.19	26.25	1.78	11.0	23.9	19 7/8	5	19.5
		Std.	A.C.-W/Man. Trans.	24.19	26.25	1.78	11.0	23.9	19 7/8	5	19.5
F-350 DR	240	Std.	W/Man. Trans.	19.73	26.25	1.27	11.0	16 5/8	13 7/8	4	18.5
		E.C.	W/Man. Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	18.5
		Std.	W/Auto. Trans.	19.73	26.25	1.27	12.0	16 5/8	13 7/8	4	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	18.5
	300	Std.	W/Man. Trans.	19.73	26.25	1.27	11.0	16 5/8	13 7/8	4	18.5
		E.C.	W/Man. Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	19.5
		Std.	W/Auto. Trans.	19.73	26.25	1.27	12.0	16 5/8	13 7/8	4	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	9.0	18 1/4	15 1/4	4	19.5
	360	Std.	W/Man. Trans.	19.73	26.25	1.95	10.0	22 1/4	18 1/2	5	18.5
		E.C.	W/Man. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	4	20.0
		Std.	W/Auto. Trans.	19.73	26.25	1.95	10.5	22 1/4	18 1/2	5	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	4	20.0
		Std.	A.C.-W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
		Std.	A.C.-W/Man. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
F-350 DR	390	Std.	W/Man. Trans.	19.73	26.25	1.95	10.0	22 1/4	18 1/2	5	18.5
		E.C.	W/Man. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	4	20.0
		Std.	W/Auto. Trans.	19.73	26.25	1.95	10.5	22 1/4	18 1/2	5	18.5
		E.C.	W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	4	20.0
		Std.	A.C.-W/Auto. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
		Std.	A.C.-W/Man. Trans.	24.19	26.25	1.78	11.0	23 7/8	19 7/8	5	19.5
F-100-250 (4 x 4)	240	Std.	W/Man. Trans.	18.26	23.75	1.25	10.5	14 3/8	12	4	18.5
		E.C.	W/Man. Trans.	19.73	26.25	1.78	10.0	16 3/4	14	4	18.5
		Std.	A.C.-W/Man. Trans.	19.73	26.25	1.78	10.0	16 3/4	14	5	17.5
F-100-250 (4 x 4)	300	Std.	W/Man. Trans.	18.26	23.75	1.25	11.0	14 3/8	12	4	18.5
		E.C.	W/Man. Trans.	19.73	23.75	1.78	10.0	16 3/4	14	4	18.5
		Std.	A.C.-W/Man. Trans.	19.73	23.75	1.78	10.0	16 3/4	14	5	17.5
F-100-250 (4 x 4)	360	Std.	W/Man. Trans.	19.73	26.25	1.78	9.0	22 1/4	18 1/2	5	18.5
		E.C.	W/Man. Trans.	19.73	26.25	1.78	11.5	22 1/4	18 1/2	5	18.5
		Std.	A.C.-W/Man. Trans.	19.73	26.25	1.78	11.5	22 1/4	18 1/2	5	19.5
P-350 SR	240	Std.	W/Man. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	4	18.0
		Std.	W/Auto. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	4	18.0
		E.C.	W/Man. & Auto. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	5	18.0
	300	Std.	W/Man. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	4	18.0
		Std.	W/Auto. Trans.	20.45	21.88	1.78	12.0	18 1/8	15 1/8	4	18.0
		E.C.	W/Man. & Auto. Trans.	20.45	21.88	1.78	12.0	18 1/8	15 1/8	5	18.0
P-350 DR P-400 P-500	240	Std.	W/Man. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	4	18.0
		Std.	W/Auto. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	4	18.0
		E.C.	W/Man. & Auto. Trans.	20.45	21.88	1.78	9.5	18 1/8	15 1/8	5	18.0
	300	Std.	W/Man. Trans.	20.45	21.88	1.78	12.0	18 1/8	15 1/8	4	18.0
		Std.	W/Auto. Trans.	20.45	21.88	1.78	12.0	18 1/8	15 1/8	4	18.0
		E.C.	W/Man. & Auto. Trans.	20.45	21.88	1.78	12.0	18 1/8	15 1/8	5	18.0
P-3500 P-4000 P-5000	254 Diesel	Std.	W/Man. Trans.	20.45	21.88	1.78	6.0	18 1/8	15 1/8	4	15.0

* — Includes Allowance for Standard Heater

E.C. - Extra Cooling Std. - Standard Cooling S.R. - Single Rim D.R. - Dual Rim

CQ1057-B2

COOLING SYSTEM REFILL CAPACITIES AND RADIATOR APPLICATIONS—MEDIUM, HEAVY AND EXTRA-HEAVY TRUCKS

Model	Engine	Cooling	Usage	Radiator Core Size Height	Core Size Width	Core Size Thick	Fins/ In.	Approx. System Capacity (Qts) ① U.S.	Approx. System Capacity (Qts) ① Imperial
F and B-500, LN-500	240	Std.		23	26.5	1.75	11	18	15
F and B-500-600	300	Std.		23	26.5	1.75	11	18	15
	330 M.D.	Std.		24.3	26.3	1.78	12	24	20
F and B-600-700	330	Std.		24.3	26.3	1.78	12	24	20
	361	Std.		24.3	26.3	1.78	9.5	24	20
F and B-750	361& 391	Std.		24.3	26.3	2.32	9.5	24	20
L, LN, LT-LNT-800	330	Std.	W/Transmatic Trans.	26.25	30.73	1.25	11	24.5	20-3/8
	361,391	RPO		26.25	30.76	2.33	11	28	23-1/2
LN-500-600	240	Std.	LN-500 Only	24.60	26.25	1.75	11	18	15
	300	Std.		24.60	26.25	1.75	11	18	15
LN-500,600 & 700	330	Std.		24.60	26.25	1.75	11	24	20
LN-600-750	361	Std.		24.60	26.3	2.33	11	24	20
LN-750	391	Std.		24.60	26.3	2.33	11	24	20
L,LT,LN & LNT-900	401,477, 534	Std.		26.25	30.76	1.75	11	46	38-3/8
		RPO	Transmatic	26.25	30.76	2.33	11	43	40
C-500-600	300	Std.		24.3	26.3	1.75	11	22	18-1/2
	330 M.D.	Std.		24.3	26.3	1.78	11	28	23-3/8
C-600-700	330 M.D.	Std.		24.3	26.3	1.78	11	28	23-3/8
		RPO	W/Transmatic Trans.	24.3	26.3	2.32	9.5	30	25
C-600-750	361	Std.		24.3	26.3	2.32	9.5	28	23-3/8
		RPO	W/Transmatic Trans.	24.3	26.3	2.32	9.5	30	25
C-750-800 CT-800	391	Std.		24.3	26.3	2.32	9.5	28	23-3/8
		RPO	W/Transmatic Trans.	24.3	26.3	2.32	9.5	30	25
C & CT-900	401	Std.		24	25.6	2.33	9.5	51	42-1/2
		RPO		24	25.6	2.33	9.5	58	48-3/8
	477	Std.	5.5 qt. Surge Tank	24	25.6	2.33	9.5	51	42-1/2
		RPO	C-850-950 Only	24	25.6	2.33	9.5	58	48-3/8
	534	Std.		24	25.6	2.87	10.5	52	43-3/8
		RPO		24	25.6	2.87	10.5	59	49-1/8
F and B-6000-7000,LN-6000-	150 H.P.	Std.		24.5	26.2	1.78		41	34-1/8
	175 H.P.	Std.	Ford V-8 Diesel Mid-Range	24.5	26.2	2.33	11	41	34-1/8
	200 H.P.	Std.	Ford V-8 Diesel Mid-Range	24.5	26.2	2.33	11	42	35

① Add 1 U.S. Quart for trucks equipped with heater.

CQ1055-B

COOLING SYSTEM REFILL CAPACITIES AND RADIATOR APPLICATIONS—MEDIUM, HEAVY AND EXTRA-HEAVY TRUCKS

Model	Engine	Cooling	Usage	Radiator					
				Core Size			Fins/ In.	Approx. System Capacity (Qts) ①	
				Height	Width	Thick		U.S.	Imperial
L,LT, LN and LNT-8000	175 H.P.	Std.	Ford V-8 Diesel Mid-Range	26.25	30.76	1.25	11	39	32-1/2
	200 H.P.								
	225 H.P.		Transmatic	26.25	30.76	2.33	11	41	34
	6V-53N	Std.	Detroit Diesel	26.25	30.76	1.75	11	27	22-1/2
LN-6000-7000	150 H.P.	Std	LN-6000 Only	24.60	26.3	2.33	11	41	34-1/8
	175 H.P.								
	200 H.P.		LN-7000 Only						
L,LT,LN & LNT-9000	NTC-335			27.50	37.84	2.88	11	44	36-3/4
	NH-230					1.78		42	35
	NHC-250	Std.				2.33		43	36
	6-71N	Std.		27.50	37.84	1.78	11	43	35-7/8
	8-71N-NE	Std.	L & LT 9000 Only	27.50	37.84	2.88	11	64	53 3/8
	NHCT-CT	Std.	LN & LNT 9000 Only	27.50	37.84	2.33	11	43	35-7/8
C-6000-7000	150 H.P.	Std.	(C-6000 Only)	24.7	26.2	1.78	11	43	35-7/8
		E.C.	Ford V-8 Diesel Mid-Range	24.7	26.2	1.78	11	43	35-7/8
	175 H.P.	Std.	Ford V-8 Diesel Mid-Range	24.7	26.2	2.33	10	43	35-7/8
C-7000 8000	200 H.P.	Std.	Ford V-8 Diesel Mid-Range	24.7	26.2	2.33	10	43	35-7/8
	225 H.P.	Std.	(C-8000 Only) Ford V-8 Diesel Mid-Range	24.7	26.2	2.33	10	43	35-7/8
W-9000-D WT-9000-D	8V-71N	Std.		38.4	31.2	2.33	10	65	54-1/8
	6-71	Std.		32.8	29.3	2.87	9	45	37-1/2
	NTC-335	Std.		38.4	31.2	2.88	11	53	48-1/2
	NHC-250	Std.		32.8	29.3	2.33	11	47	39-1/8
	NH-230	Std.		32.8	29.3	2.33	11	47	39-1/8

5 Quart Surge Tank 9 Quart Surge Tank 6-1/2 Quart Surge Tank 8 Quart Surge Tank *Includes Heater

① Add 1 U.S. Quart for trucks equipped with heater.

CQ1058-B2

FAN APPLICATIONS–MEDIUM, HEAVY, AND EXTRA–HEAVY TRUCKS

Model	Engine	Usage	Fan No. of Blades	Fan Dia.
F,B,LN-500	240	Std.	4	19-1/2
	300	Std.	4	19-1/2
		RPO	7	19-1/2
	330	Std.	4	20
		RPO	5	20
F,N,LN-600	300	Std.	4	19-1/2
		RPO	7	19-1/2
	330	Std.	4	20
		RPO	5	20
	361	Std.	4	20
		RPO	5	20
F,B,LN-700	330	Std.	4	20
		RPO	5	20
	361	Std.	4	20
		RPO	5	20
F,B,LN-750	361	Std.	4	20
		RPO	5	20
	391	Std.	5	20
LT and LNT-800	330	Std.	4	20
		Std.		
L,LT-800	361	Std.	4	20
LT-800	391	Std.	5	20
L-,LT-,LN-, LNT-900	401	Std.	5	22
	477	Std.	5	22
	534	Std.	5	22
L-,LT-,LN-LNT-9000	8-71N-NE	Std.	6	28
	6-71N	Std.	5	26
	NTC-335,NHC-250	Std.	6	30
	NH-230	Std.	5	22
	NCT-CT	Std.	6	28
F,B-6000-7000	150 H.P. Ford V-8 Diesel	Std.	4	20
F,LN and B-6000	175 H.P. Ford V-8 Diesel	Std.	4	20
		RPO	5	21
F,LN and B-7000	175 H.P. Ford V-8 Diesel F&B Only	Std.	4	20
		RPO	5	21
	(F-7000 Only 200 H.P. Ford V-8 Diesel	Std.	5	21
	(LN-7000 Only)	Std.	4	20
L and LT-8000	175 H.P.	Std.	4	20
	200 H.P. Ford V-8 Diesel	Std.	5	20
	225 H.P. Ford V-8 Diesel	Std.	5	20
LN and LT-8000	6V53N	Std.	5	22
C-500-600	300	Std.	4	20
		RPO	5	20
	330 M.D.	Std.	4	20
C-600-700	330 H.D.	Std.	4	20
	361	Std.	4	20
		RPO	5	20
C-750-800	361	Std.	4	20
		RPO	5	20
CT-800	391	Std.	5	20
C-,CT-900	401	Std.	5	20
	477	Std.	5	21
	534 (CT-Only)	Std.	5	23
C-6000-7000	(C-6000) 150 H.P. Ford V-8 Diesel	Std.	5	23
		RPO	4	20
	175 H.P. Ford V-8 Diesel	Std.	5	21
		RPO	4	20
	(C-7000) 200 H.P. Ford V-8 Diesel	Std.	5	21
		RPO	5	21
C-8000	200 H.P. Ford V-8 Diesel	Std.	5	23
		RPO	5	21
	225 H.P. Ford V-8 Diesel	Std.	5	23
		RPO	6	23
W-9000-WT-9000	6-71N	Std.	4	26
	NTC-335	Std.	6	28
	NH-230	Std.	5	22
	NHC-250	Std.	5	22
	8V-71N 8V-71NE	Std.	5	28

CQ1059-91

PART 28-11 Prestolite Starter

This Information Applies To All Trucks with 401, 477 and 534 C.I.D. Gasoline Engines

1 DESCRIPTION AND OPERATION

PRESTOLITE STARTER

The Prestolite starter is a heavy duty unit. An armature shaft center bearing is used (Fig. 1). The starter drive shaft is thus supported at two places. An overrunning clutch in the drive protects the starter from excessive speed when the engine starts.

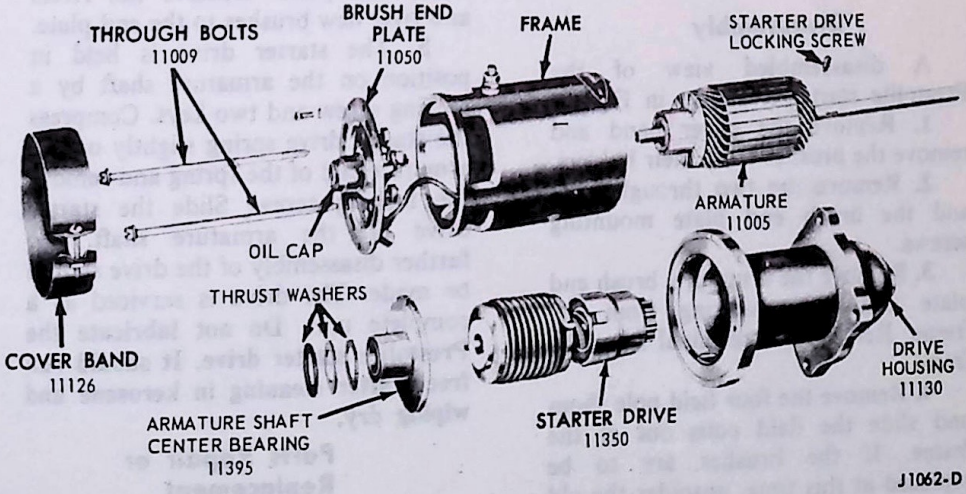


FIG. 1 Disassembled Prestolite Starter

2 TESTING

ROAD SERVICE

On road service calls, connect a booster battery to the system for cases of a starter that will not crank the engine or a starter that cranks the engine very slowly. If the starter turns the engine over, but the engine still will not start, even with the booster battery attached, refer to the following tests. **Be certain that correct battery polarity is observed when using a booster battery; positive to positive, and negative to negative connection of the auxiliary cables.**

STARTER CRANKING CIRCUIT TEST

Follow the procedure given in Part 28-02, Section 2, Starter Cranking Circuit Test

STARTER LOAD AND NO LOAD TESTS

Follow the procedures under these headings given in Part 28-02, Section 2.

4 REMOVAL AND INSTALLATION

PRESTOLITE STARTER

1. Disconnect the starter cable at the starter terminal.
2. Remove the starter mounting bolts, then remove the starter assembly. **It may be necessary to tilt the starter slightly to clear the starter drive around the flywheel.**
3. Position the starter assembly to the flywheel housing, and start the mounting bolts. On a vehicle with an automatic transmission, the transmission dipstick tube bracket is mounted under the starter side mounting bolt.
4. Snug all bolts and then tighten them to specification (Section 9 of this Part).
5. Connect the starter cable and check the starter operation.

5 OVERHAUL

PRESTOLITE STARTER

Disassembly

A disassembled view of the Prestolite starter is shown in Fig. 1.

1. Remove the cover band and remove the brushes from their holders.
2. Remove the two through bolts and the brush end plate mounting screws.
3. Remove the armature, brush end plate and drive housing from the frame. Remove the terminal from the frame.
4. Remove the four field pole shoes and slide the field coils out of the frame. If the brushes are to be replaced at this time, unsolder the old brushes from the field coils and solder new brushes in their place. The ground brushes are riveted to the brush end plate. Remove the rivets and rivet new brushes to the end plate.
5. The starter drive is held in position on the armature shaft by a locking screw and two keys. Compress the starter drive spring slightly on the armature end of the spring and remove the locking screw. Slide the starter drive off the armature shaft. No further disassembly of the drive should be made. The drive is serviced as a complete unit. **Do not lubricate the Prestolite starter drive. It should run freely after cleaning in kerosene and wiping dry.**

Parts Repair or Replacement

Nicks and scratches may be removed from the commutator by turning it down. All other serviced parts are to be replaced rather than repaired.

Assembly

1. Position the thrust washers and armature shaft center bearing on the armature shaft in the order shown in Fig. 1.
2. Slide the drive on the shaft, and install the drive locking screw.
3. Position the armature and drive in the drive housing so that the slot in the armature shaft center bearing support plate engages the pin in the drive housing, and the bearing is seated firmly in the housing.
4. Slide the field coils into the frame with the brush leads opposite the terminal hole, and install the field pole shoes. **As the pole shoe screws are tightened, strike the frame several**

sharp blows with a soft-faced hammer to seat and align the pole shoes. Install the terminal.

5. Attach the brush end plate to the frame with the six screws. Position the armature and drive housing into the frame with the frame dowel engaging the hole in the drive housing, and install the through bolts.

6. Install the brushes in their holders making certain that the brush springs are centered on the brushes and that the insulated brush leads are clear of the armature.

7. Install the cover band, oil felt and oil cap. Put a few drops of engine oil in the oil cap opening.

9 SPECIFICATIONS

PRESTOLITE STARTER

Vendor	Current Draw Under Normal Load (Amperes)	Minimum Stall Torque		Maximum Load (Amperes)	No-Load (Amperes)	Brushes			Through Bolt Torque (In-Lbs)	Mounting Bolt Torque (Ft-Lbs)
		(Ft-Lbs)	Volts			Mfg. Length (Inches)	Wear Limit (Inches)	Brush Spring Tension (Ounces)		
Prestolite	200	17.2	5	525	60	0.46–0.48	0.25	45–53	72–96	23–28

Maximum commutator runout in inches is 0.005. Maximum starting circuit voltage drop (battery + terminal to starter terminal) at normal engine temperature 0.5 volt.

CJ1466-A