

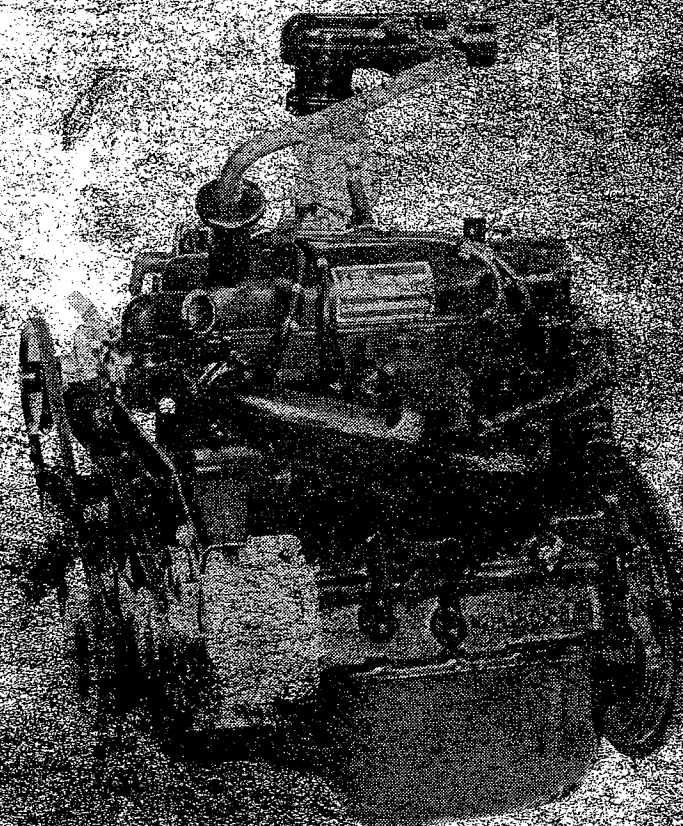


2274E

67 CID — 1100 C.C.

98 CID — 1600 C.C.

ENGINE SERVICE MANUAL



Introduction

This Shop Manual provides the Service Technician with information for the proper servicing of the Ford 67 and 98 CID Industrial Engines.

In general, this manual covers the servicing of the engine and associated standard equipment. In many cases, engines are supplied with accessories and equipment that are unique to the application. If service information is ever required on such unique accessories or equipment, it is suggested that the Industrial Engine Operations of Ford Motor Company be contacted. The proper information will either be forwarded or the Service Technician will be advised where it can be obtained.

The information in this manual is grouped in sections according to the type of work being performed. The various sections are indicated in the Index. In addition, each section is subdivided to include topics such as diagnosis and testing, cleaning and inspection, overhaul, removal and installation procedures, disassembly and assembly procedures, and service specifications.

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The descriptions and specifications contained in this manual were in effect at the time the book was released for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design, without notice and without incurring obligation.

67 AND 98 CID GASOLINE ENGINES

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PART 1 Basic Engine

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IDENTIFICATION

An Identification Decal (Fig. 1) is affixed to the left side of the rocker cover of the engine. The decal contains the engine serial number which identifies this unit from all others. Next is the engine displacement which determines the engine specifications, then the model number and S.O. or special options which determines the parts or components required on this unit. Use all the numbers when seeking information or ordering replacement parts for this engine.

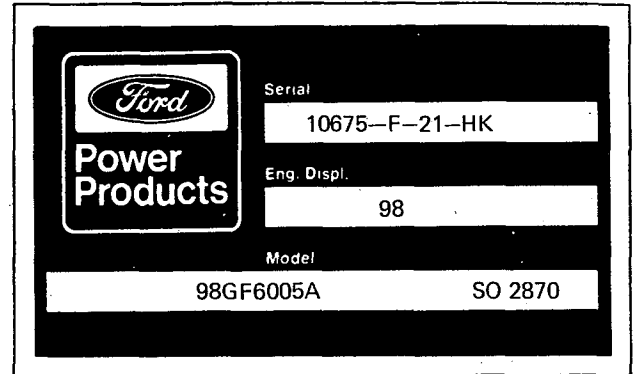


FIG. 1 Identification Decal

DESCRIPTION

The 67 and 98 CID engines (Fig. 2) are a four cylinder, in-line, overhead valve unit operating on the four stroke cycle with cross-flow cylinder head and bowl-in-piston combustion chambers.

The cylinder bores are machined directly in the cast iron cylinder block, which is cast integral with the upper half of the crankcase, and are provided with full length water jacketing.

The cast iron crankshaft runs in five large diameter main bearings fitted with steel-backed copper/lead or lead/bronze bearing liners.

End-play and thrust are controlled by half-thrust washers located in the cylinder block on either side of the center main bearing.

Seals pressed in the front cover and the rear oil seal carrier prevent oil leaks from the front and rear of the crankshaft. The front seal runs on the pulley hub while the rear seal runs on the crankshaft flange itself.

The connecting rods are H section forgings having separate rod caps attached by two bolts and located by hollow dowel pins. Connecting rod bearing liners are steel-backed copper/lead or aluminum/tin. The piston pin ends have steel-backed bronze bushings.

Solid skirt aluminum alloy pistons with two compression and one oil control ring situated above the piston pin bore are used. The combustion chamber is machined in the piston crown. The piston pins are fully floating and are retained in position by eyelet type snap rings installed in grooves at each end of the piston pin bore.

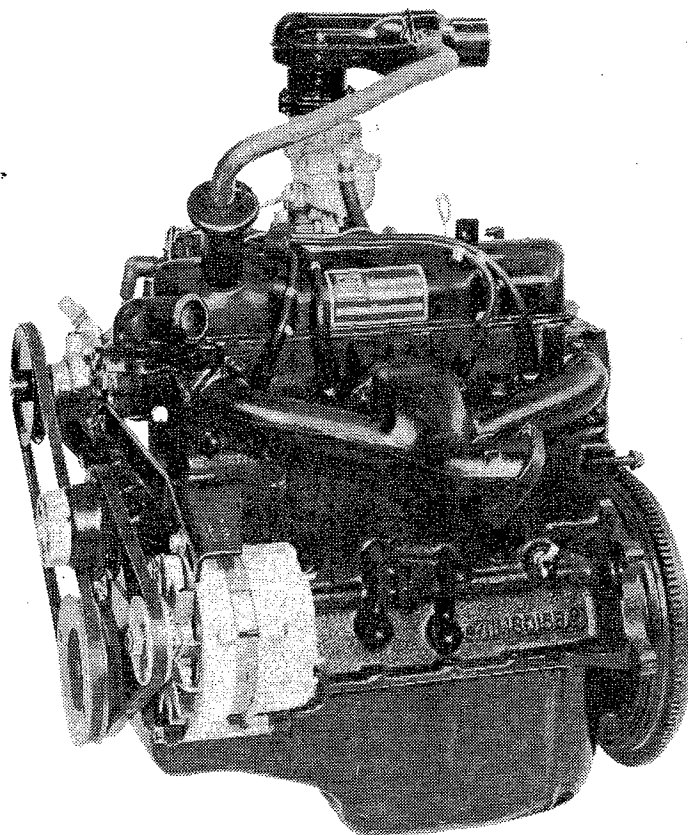
The camshaft is driven at half engine speed by a single row chain and sprockets from the crankshaft. This timing chain is automatically tensioned by a snail cam, bearing against a pivoted tensioner arm. A gear and an eccentric, machined integral with the camshaft, drive the distributor, oil pump and the fuel pump. A thrust plate is bolted to the cylinder block front face and located between the front bearing journal and the sprocket flange that retains the camshaft.

Overhead valves are mounted perpendicular to the cast iron cylinder head in integral valve guides and are operated by rocker arms, push rods and tappets from the camshaft. The rocker arms are mounted on a shaft supported by four mounting posts bolted to the cylinder head. Valve clearances are adjusted by means of self-locking screws provided in the rocker arms.

A cast iron flywheel is mounted on the crankshaft flange. The drive for the starter motor is provided by a steel ring gear shrunk onto the flywheel.

The oil pan is a steel stamping and has a sump for the lubricating oil. The engine lubrication system is the force feed type incorporating a full flow oil filter. The oil pump, which is mounted externally on the engine, is an eccentric bi-rotor type. The pump incorporates a non-adjustable plunger type relief valve.

An oil filler cap is located in the rocker cover. Crankcase ventilation is controlled by a positive-type closed system.



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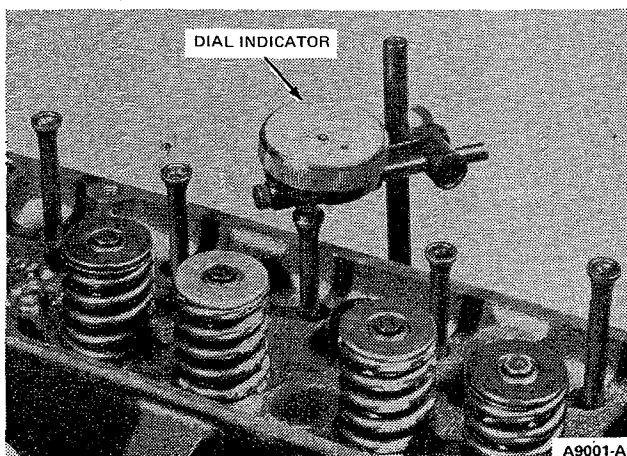
FIG. 2 98 CID (1600cc) Engine

DIAGNOSIS AND TESTING

CAMSHAFT LOBE LIFT

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

1. Remove the air cleaner and the valve rocker arm cover.
2. Remove the valve rocker arm shaft assembly as detailed in the pertinent section.
3. Make sure the push rod is in the valve lifter socket. Install a dial indicator in such a manner as to have the ball socket adapter of the indicator on the end of the push rod and in the same plane as the push rod movement (Figure 3).



A9001-A

FIG. 3 Testing Camshaft Lobe Lift

4. Connect an auxiliary starter switch in the starting circuit. Crank the engine with the ignition switch OFF. Bump 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 (highest indicator reading).
6. Compare the total lift recorded on the indicator with specifications.
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.
9. Install the rocker arm shaft assembly as detailed under Removal and Installation.
10. Install the valve rocker arm cover and the air cleaner.

COMPRESSION TEST

COMPRESSION GAUGE CHECK

1. Be sure the crankcase is at the proper level and the battery is properly charged. 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 and choke plate in the wide open position.
3. Install a compression gauge in No. 1 cylinder.

4. Install an auxiliary starter switch in the starting circuit. Using the auxiliary starter switch, crank the engine (with the ignition switch off) at least five compression strokes and record the highest reading.
Note the approximate number of compression strokes required to obtain the highest reading.
5. Repeat the test on each cylinder as was required to obtain the highest reading on the No. 1 cylinder.

TEST CONCLUSION

The indicated compression pressures are considered normal if the lowest reading cylinder is within 75% of the highest. Refer to the following example and (Figure 4).

Seventy-five percent of 140, the highest cylinder reading, is 105. Therefore, cylinder No. 7 being less than 75% of cylinder No. 3 indicates 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.

1. If compression improves considerably, the piston rings are at fault.
2. If compression does not improve, valves are sticking or seating poorly.
3. 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.

It is recommended the following quick reference chart be used when checking cylinder compression pressures. The chart has been calculated so that the lowest reading number is 75% of the highest reading.

EXAMPLE

After checking the compression pressures in all cylinders, it was found that the highest reading obtained was 196 psi. The lowest pressure reading was 155 psi. The engine is within specifications and the compression is considered satisfactory.

POSITIVE CLOSED-TYPE VENTILATION SYSTEM

A malfunctioning closed crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crankcase ventilation system and making carburetor adjustments. **The removal of the crankcase ventilation system from the engine will adversely affect the fuel economy and engine ventilation with resultant shortening of engine life.** To determine whether the loping or rough idle condition is caused by a malfunctioning crankcase ventilation system, perform either of the following tests.

AIR INTAKE TEST

This test is performed with the crankcase ventilation tester C8AZ-6B627-A (Figure 5) 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 that 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.
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.

Clean or replace the malfunctioning components as required. Repeat the test to ensure that the crankcase ventilation system is operating satisfactorily.

Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI
134	101	174	131	214	160
136	102	176	132	216	162
138	104	178	133	218	163
140	105	180	135	220	165
142	107	182	136	222	166
144	108	184	138	224	168
146	110	186	140	226	169
148	111	188	141	228	171
150	113	190	142	230	172
152	114	192	144	232	174
154	115	194	145	234	175
156	117	196	147	236	177
158	118	198	148	238	178
160	120	200	150	240	180
162	121	202	151	242	181
164	123	204	153	244	183
166	124	206	154	246	184
168	126	208	156	248	186
170	127	210	157	250	187
172	129	212	158		

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FIG. 4 Quick Reference Compression Pressure-Limit Chart

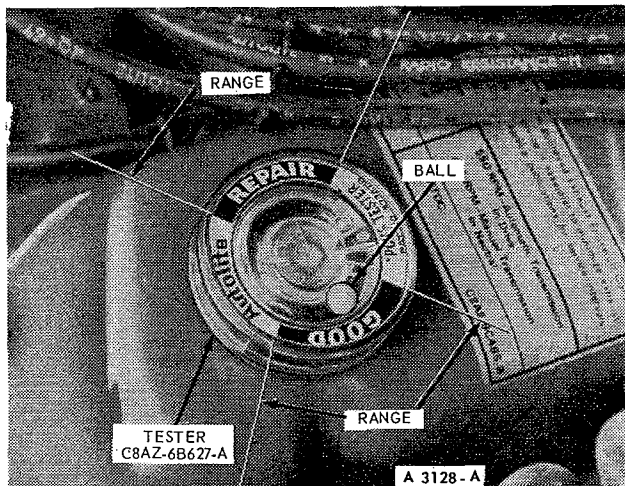


FIG. 5 Crankcase Ventilation System Tester

CRANKCASE VENTILATION REGULATOR VALVE TEST

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

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

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

If the loping or rough idle condition remains when the good regulator valve is installed, 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.

CRANKSHAFT END PLAY

1. Force the crankshaft toward the rear of the engine.
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 (Figure 6).
3. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.

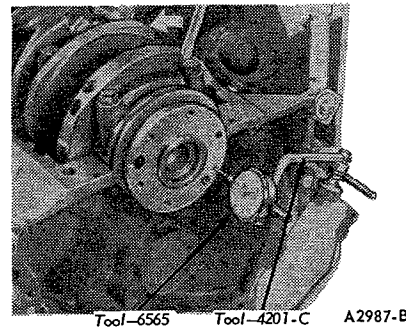


FIG. 6 Checking Crankshaft End Play

4. If the end play exceeds the wear limit, replace the thrust washers. If the end play is less than the minimum limit inspect the thrust bearing faces for scratches, burrs, nicks, or dirt.

FLYWHEEL FACE RUNOUT

Install a dial indicator so that the indicator point bears against the flywheel face. 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 sufficiently to true up the surface if the mounting flange runout exceeds specifications. Replace it or reinstall it on the flywheel.

CAMSHAFT END PLAY

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 or gear hub. Zero the dial indicator. Position a large screwdriver between the camshaft sprocket and the cylinder head. Pull the camshaft forward and release it. Compare the dial indicator reading with specifications. If the end play is excessive, replace the thrust plate retaining the camshaft. Remove the dial indicator.

OVERHAUL

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 (Figure 7) to install a valve with an oversize stem, a reaming kit is available 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 (Figure 8). Remove only enough stock to clean up pits and grooves 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 (Figure 9). 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.

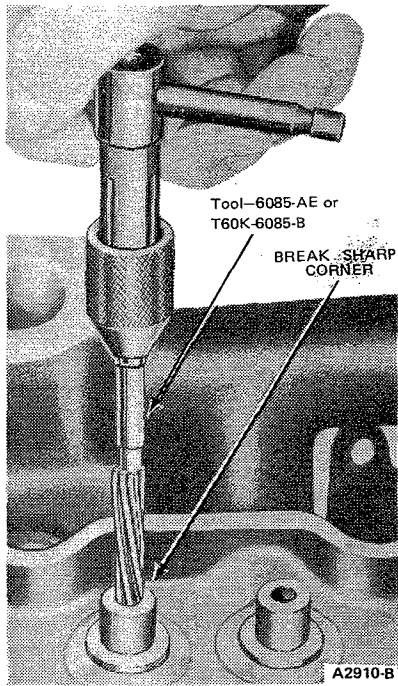


FIG. 7 Reaming Valve Guides

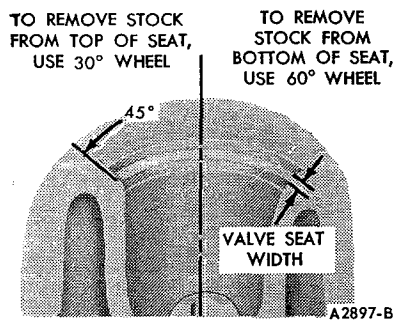


FIG. 8 Refacing Valve Seat

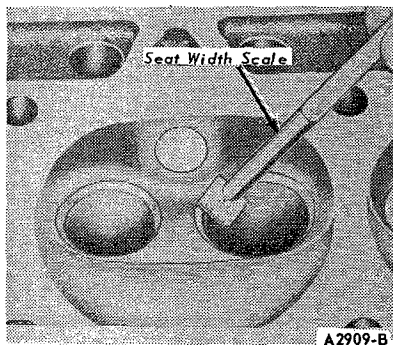


FIG. 9 Checking Valve Seat Width

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 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, if the face runout cannot be corrected by refinishing or stem clearance exceeds specifications. Discard any excessively 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.

Under no circumstances should the faces of aluminized intake valves be ground or the valves lapped in as this will remove the diffused aluminum coating and reduce the valves wear and heat resistant properties. If the valve faces are worn or pitted it will be necessary to install new valves and to resurface the valve seats or, alternatively, lap the seats using dummy valves. The exhaust valves may be lapped in or the faces ground if required.

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 (Figure 10), 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.**

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.

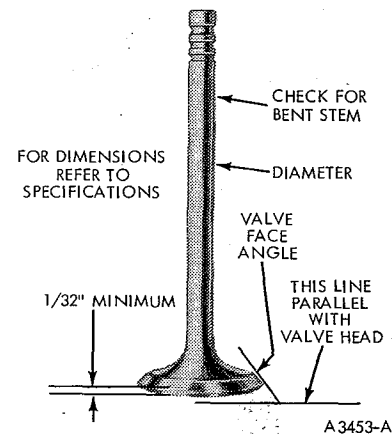


FIG. 10 Critical Valve Dimensions

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 and 0.015 inch are available for service. **Always reface the valve seat after the valve guide has been reamed. Refer 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 severely marred or exceed the wear limit, they should be refinished to size for the next undersize bearing.

REFINISHING JOURNALS

Refinish the journals 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.

FITTING MAIN OR CONNECTING ROD BEARINGS WITH PLASTIGAGE

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup 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 a 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance.
2. If fitting a main bearing in the chassis, 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 (Figure 11).

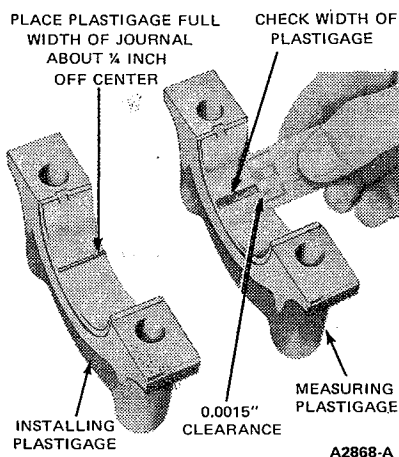


FIG. 11 Installing and Measuring Plastigage

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, on the connecting rod bearings, try a 0.002 inch undersize bearing 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, remove Plastigage, apply light coat of engine oil to journal and bearings. Install bearing cap. Torque cap bolts to specifications.
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 shown in the specifications.

The standard size pistons are color coded red or blue, or have .0025 O.S. stamped on the dome. Refer to the Specifications for standard size piston dimensions.

Measure the cylinder bore and select the piston to assure the proper clearance. When the bore diameter is in the lower one third of the specified range, a red piston should be used. When the bore diameter is in the middle one third a blue piston should be used. When the bore diameter is in the upper one third, the 0.0025 O.S. piston should be used.

Measure the piston diameter to ensure that the specified clearance is obtained. It may be necessary periodically to use another piston (red or blue) that is either slightly larger or smaller to achieve the specified clearance. **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.**

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). The piston should be measured 2-1/4 inches below the dome and at 90° to the piston pin bore.
3. Make sure the piston and cylinder block are at room temperature (70 degrees F.). **After any refinishing operation allow the cylinder bore to cool, and make sure the piston and bore are clean and dry before the piston fit is checked.**

FITTING PISTON RINGS

Three piston rings are fitted, two compression and one oil control ring. The lower compression ring is stepped externally to the bottom face and the upper ring is chrome plate and tapered on the O.D. Both rings are marked **top** and must be fitted correctly. The upper ring, when new, has a reddish brown compound on the outer edge. On no account must this compound be removed. The oil control rings have narrow ring lands and may be fitted either way.

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 (Figure 12). 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 (Figure 13). 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.

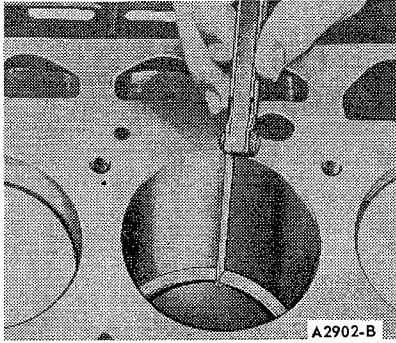


FIG. 12 Checking Piston Ring Gap

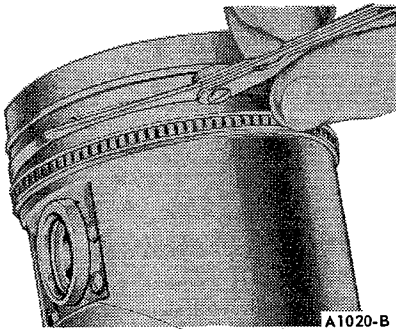


FIG. 13 Checking Piston Ring Side Clearance

FITTING PISTON PINS

The piston pins are selected to give the correct fit in the piston pin bore and bushing in the connecting rod. Pistons are only supplied in service complete with the piston pin, to ensure the correct fit. The piston pins should not be interchanged.

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.

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.

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. Refinish the cylinder to within approximately 0.0015 inch of the required oversize 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 SAND HOLES OR POROUS ENGINE CASTINGS

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 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 cylinder water jacket but not including machined areas.
2. Lower rear face of the cylinder block.
3. Intake manifold casting.
4. 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.

- a. 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 sur-

round 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 oily surface.

- b. Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.
- c. Apply the repair mixture with a suitable clean tool, (putty knife, wood spoon, etc.) forcing the epoxy into

the hole or porosity.

- d. 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.
- e. Sand or grind the repaired area to blend with the general contour of the surrounding surface.
- f. Paint the surface to match the rest of the block.

CLEANING AND INSPECTION

The cleaning and inspection procedures are for a complete 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, damaged gasket surfaces, or other defects 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.**

EXHAUST MANIFOLDS

Cleaning

Remove all gasket material from the manifolds.

Inspection

Inspect the cylinder head joining flanges of the exhaust manifold for evidence of exhaust gas leaks.

Inspect the manifolds for cracks, damaged gasket surfaces, or other defects that would make them unfit for further service.

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Cleaning

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

Make sure the oil passage in the push rod end of the rocker arm is open.

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 arm 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 adjusting nut(s) torque. If not within specifications, replace the nut(s). Check the rocker arm pad and

fulcrum seat for excessive wear, cracks, nicks or burrs.

PUSH RODS

Cleaning

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 (Figure 14).

If the push rod is visibly bent, it should be replaced.

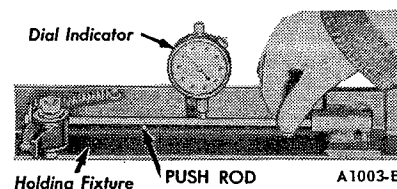


FIG. 14 Checking Push Rod Runout

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. Use cleaning solvent to remove dirt, grease and other deposits. Clean all bolt holes. Remove all deposits from the valves with a fine wire brush or buffing wheel.

Inspection

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

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.

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head gasket surface (Figure 15) for conformance to specifications. If necessary to refinish the cylinder head gasket surface, **do not plane or grind off more than 0.010 inch.**

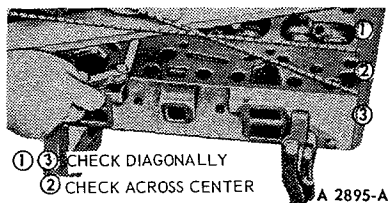


FIG. 15 Typical Cylinder Head Flatness

Check the valve seat runout with an accurate gauge (Figure 16). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat. Measure the valve seat width (Figure 9). Reface any valve seat whose width is **not within specifications**.

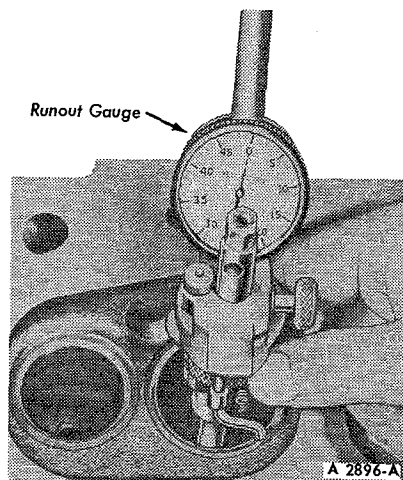
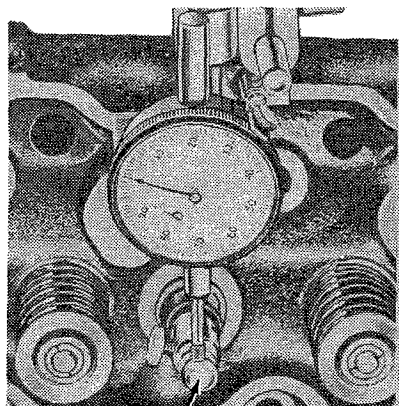


FIG. 16 Checking Valve Seat Runout

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

Inspect the valve spring, valve spring retainers, locks



TOOL 6505-E 302, 351M AND 400 CID
TOOL 6505-F 460 CID
TOOL 6505-G 200 AND 250 CID

A 3131-D

FIG. 17 Checking Valve Stem Clearance

and sleeves for wear or damage. Discard any visually damaged parts.

Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Figure 17 or its equivalent. Use a flat end indicator point.

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

Check the springs for proper pressure (Figure 18) at the specified spring lengths. (Tool 6513-DD.) **Manually rotating the valve spring assemblies while installed in the engine, must not be used to determine good and/or bad valve springs.** Weak valve springs cause poor engine performance. Replace any spring not within specifications.

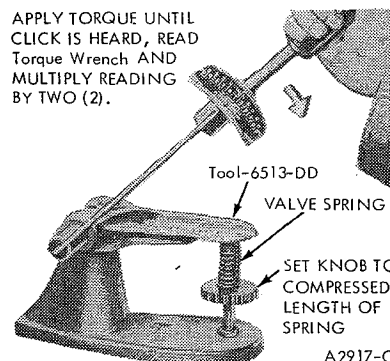


FIG. 18 Checking Valve Spring Pressure

Check each spring for squareness, using a steel square and a flat surface (Figure 19). Stand the spring and square on end on the flat surface. Slide the spring up to the square. Revolve the spring slowly and observe the space between the top coil of the spring and the square. The out-of-square limits are 5/64 inch.

Follow the same procedure to check new valve springs before installation. **Make certain the proper spring (color coded) is installed.**

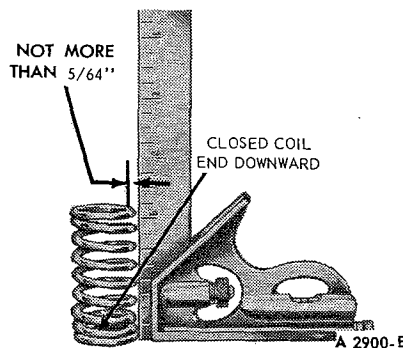


FIG. 19 Checking Valve Spring Squareness

TAPPETS Cleaning

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

Inspection

Check the tappets for wear or scores. Check the bottom end of tappet to make sure that it has a slight convex. Replace tappets that are scored, worn, or if the bottom is not smooth. If the bottom surface is worn flat, it may be used with the original camshaft only.

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 sprockets.

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.

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 unless the lobe lift loss has exceeded 0.005 inch.

The lift of the 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. Replace the camshaft if this condition exists.

CRANKSHAFT

Cleaning

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

Inspection

Inspect the main and connecting rod journals for cracks, scratches, grooves or scores. Inspect the crankshaft oil seal surface for nicks, sharp edges or burrs that might damage the oil seal during installation or cause premature seal wear.

Measure the diameter of each journal in at least four places to determine an out-of-round, taper or undersize condition (Figure 20).

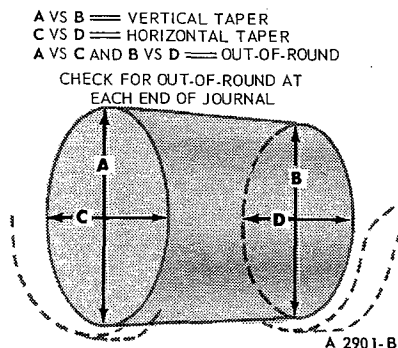


FIG. 20 Crankshaft Journal Measurement

On engines 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 (Figure 21). Replace the bushing if it is worn or damaged or the ID is not within specifications.

Inspect the pilot bearing (ball bearing) when so equipped, for roughness, evidence of overheating or loss of lubricant. Replace it if any of these conditions are found.

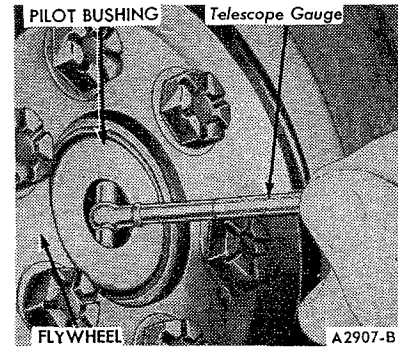


FIG. 21 Checking Clutch Pilot Bushing Wear

FLYWHEEL

Inspection

Inspect the flywheel for cracks, heat check, 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 under Diagnosis and Testing.

CONNECTING RODS

Cleaning

Remove the bearings from the rod and cap. Identify the bearings 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 either pin boss side of the piston usually indicates that a connecting rod is bent.

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, worn or damaged crankpin, or a tapered connecting rod bore.

Twisted connecting rods will not create an 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 recommended limits and/or if the connecting rod is fractured, it should be replaced. Check the ID of the connecting

rod piston pin bore. If the pin bore in the connecting rod is larger than specifications, install a 0.002 inch oversize piston pin. First, prefit the oversize piston pin to the piston pin bore by reaming or honing the piston. Then, assemble the piston, piston pin and connecting rod following the procedures for assembly. **It is not necessary to ream or hone the pin bore in the connecting rod. Replace damaged connecting rod nuts and bolts. Check the connecting 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 connecting rod must be straightened or replaced.**

PISTONS, PINS AND RINGS

Cleaning

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 (Figure 22). Make sure the oil ring slots (or holes) are clean.

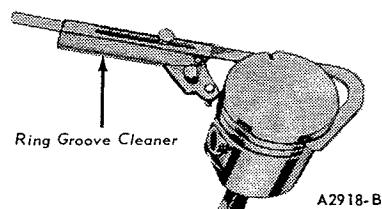


FIG. 22 Cleaning Piston Ring Grooves

Inspection

Carefully inspect the pistons for fractures at the ring lands, skirts and pin bosses, and for scuffed, rough or scored skirts. If the lower inner portion of the ring grooves has a high step, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the top of the piston are usually caused by detonation or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands or fractures or damage from detonation or pre-ignition.

Check the piston to cylinder bore clearance by measuring the piston and bore diameters. Refer to the specifications for the proper clearance. Refer to Cylinder Block Inspection for the bore measurement procedure. **Measure the OD of the piston with micrometers approximately 2-1/4 inches below the dome and at 90 degrees to the piston pin bore.** 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 Piston and Connecting Rod Assembly.

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, broken, chipped or cracked. Check the end gap and side clearance. **Rings should not be transferred from one piston to another regardless of mileage or hours.**

MAIN AND CONNECTING ROD BEARINGS

Cleaning

Clean the bearing inserts and caps thoroughly in solvent, and dry them with compressed air. **Do not scrape gum or varnish deposits from the bearing shells.**

Inspection

Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of unsatisfactory bearings and their causes are shown in Figure 23. 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 as detailed under Main and Connecting Rod Bearings.

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 with 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. 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. Thoroughly clean the grooves in the crankshaft bearings and bearing retainers.

Inspection

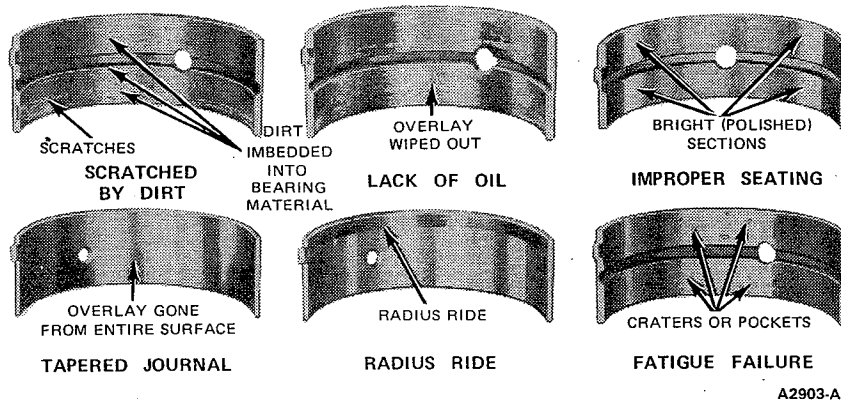
After the block has been thoroughly cleaned, check it for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25% kerosene and 75% light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol.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

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

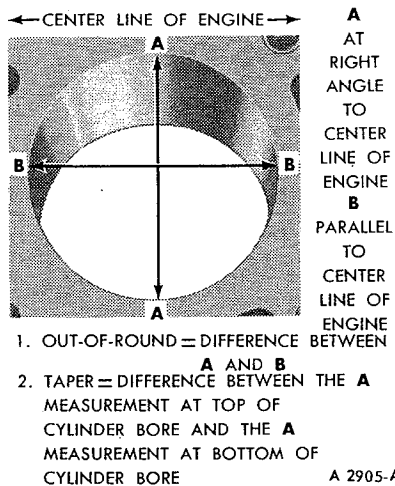
Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate bore gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle and bottom with the gauge placed at right angles and parallel to the centerline of the engine (Figure 24). **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 imperfections, but the out-of-round and taper are within limits, it may be possible to remove the imperfections by honing the cylinder walls and installing new service piston rings providing the piston clearance is within specified limits.



A2903-A

FIG. 23 Typical Bearing Failures

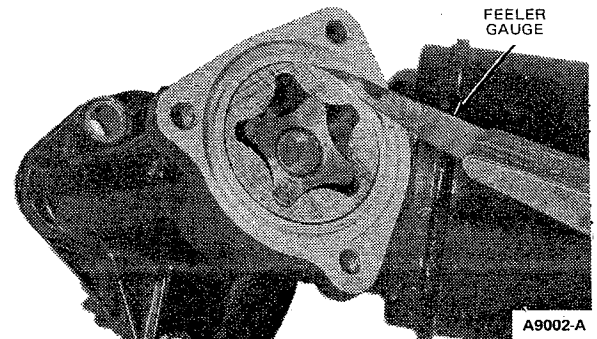


A 2905-A

FIG. 24 Cylinder Bore Out-of-Round and Taper

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 (Figure 25). Then check the clearance between the outer race and the rotor lobes (Figure 26).



A9002-A

FIG. 25 Checking Outer Race to Housing Clearance

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 or a damaged gasket surface.

Inspect for damage (uneven surface) at the bolt holes caused by over-torquing the bolts. Straighten surfaces as required. Repair any damage, or replace the pan if repairs cannot be made satisfactorily.

OIL PUMP

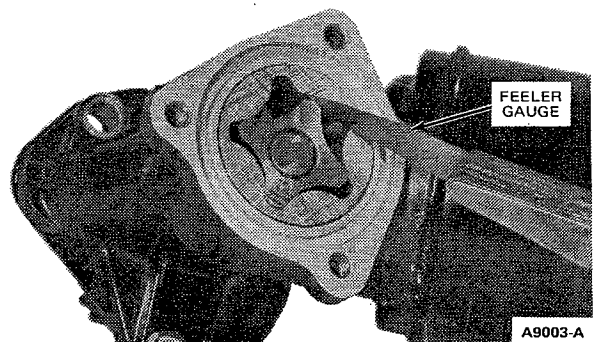
Cleaning

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.



A9003-A

FIG. 26 Checking Rotor Lobes to Outer Race Clearance

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 and the rotor and outer race (Figure 27). **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 collapsed or worn condition. Check 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.

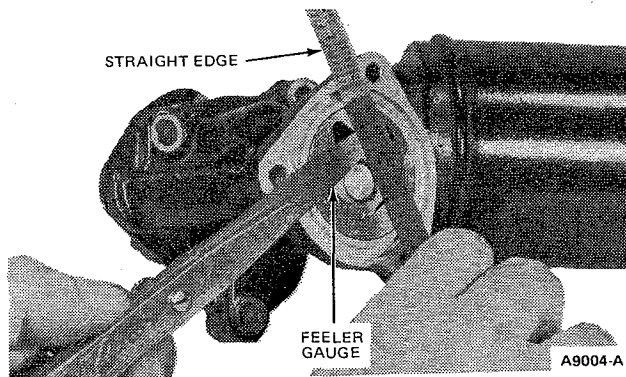


FIG. 27 Checking Rotor End Play

REMOVAL AND INSTALLATION

VALVE ROCKER ARM COVER, ROCKER ARM AND/OR SHAFT

Removal

1. Remove the air cleaner or air horn from the carburetor.
2. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position aside.
3. Remove the rocker cover attaching screws, remove the rocker cover and discard the gasket.
4. Remove the rocker arm shaft attaching bolts evenly and lift off the rocker arm shaft assembly (Figure 28).

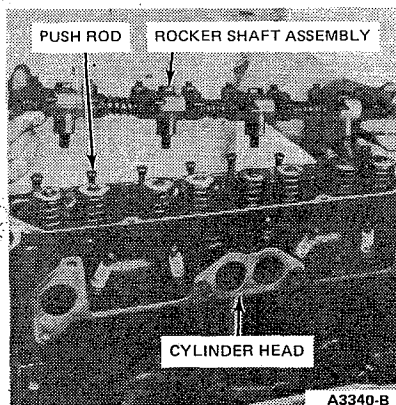


FIG. 28 Removing or Installing Rocker Arm Assembly

5. Remove the cotter pin from one end of the shaft and slip the flat washer, crimped washer and second flat washer off the shaft. The rocker arm shaft supports, rocker arms and springs can now be removed from the shaft.
6. Remove the plugs from the rocker shaft ends by drilling a hole in one plug. Insert a long rod through the drilled plug and knock the opposite plug out of the shaft. Remove the drilled plug in the same manner.
7. Clean the component parts of the shaft assembly in any suitable degreasing fluid.

Installation

1. Refit new plugs to the rocker shaft ends.
2. Assemble the rocker arm shaft. **The bolt hole in the rocker arm shaft support must be on the same side as the adjusting screw in the rocker arm. The rocker arms are right and left handed, the rocker pads being inclined towards the support.** Install the cotter pins with the heads upwards and bend over the legs to secure.
3. Lubricate the valve stem tips, rocker arm pads and the

POSITIVE CLOSED-TYPE CRANKCASE VENTILATION SYSTEM

Cleaning

Do not attempt to clean the crankcase ventilation regulator valve; it should be replaced at the specified maintenance interval. The oil filler cap and oil separator should be cleaned at the proper mileage interval. Remove the cap and the oil separator and wash them in a low volatility, petroleum base solvent. Shake the cap dry and install them. Clean the crankcase ventilation system connection(s) on the intake manifold by probing with a flexible wire or bottle brush. Clean the hoses, fittings, tubes and associated hardware with a low volatility, petroleum base solvent and dry with compressed air.

- push rod ends with Lubriplate or equivalent. Position the rocker shaft assembly on the cylinder head (Figure 28) engaging the push rods with the adjusting screws. Install and tighten the bolts evenly to specifications.
4. Adjust the valve clearance to specifications.
5. Ensure that the mating surfaces on the cylinder head and rocker cover are free from all traces of the old gasket material.
6. Position the rocker cover and gasket on the cylinder head and secure with the attaching screws. Torque the screws to specifications.
7. Locate the spark plug leads in the rocker cover clip and re-connect them to their respective plugs.
8. Install the air cleaner.

VALVE PUSH ROD

Removal

1. Remove the rocker shaft bolts evenly and lift off the rocker arm shaft assembly.
2. Remove the push rods from their locations and keep them in their correct order.

Installation

1. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
2. Lubricate the valve stem tips and the rocker arm pads with Lubriplate or equivalent and position the rocker arm shaft assembly on the cylinder head, engaging the push rods with the adjusting screws. Tighten the bolts evenly to specifications.
3. Adjust the valve lifters to specifications.

INTAKE MANIFOLD

Removal

1. Partially drain the cooling system.
2. Remove the air cleaner.
3. Disconnect the throttle rod from the carburetor throttle lever.
4. Disconnect the fuel line and the distributor vacuum line from the carburetor.
5. Disconnect the water outlet hose and the crankcase ventilation hose from the intake manifold.
6. Disconnect external resistor wires. Remove mounting bolt and remove resistor.
7. Remove coil mounting bolt and position coil out of the way.
8. Remove the attaching nut and bolts and remove the intake manifold.

9. Remove the gasket.
10. If a new manifold is to be installed, transfer all necessary components to the new manifold.

Installation

1. Apply a water resistant sealer to both sides of the gasket around the water port and position it on the cylinder head.
2. Install the intake manifold and tighten the nuts and bolts evenly to specifications.
3. Connect the water hose and the crankcase ventilation hose to the intake manifold.
4. Connect the distributor vacuum line and the fuel supply line to the carburetor.
5. Connect the throttle rod.
6. Position coil to intake manifold and install mounting bolt.
7. Position external resistor, dipstick tube and fuel filter bracket to intake manifold and install retaining bolt.
8. Install the air cleaner.
9. Refill the cooling system with the recommended coolant.

EXHAUST MANIFOLD

Removal

1. Remove the two nuts attaching the manifold to the muffler pipe flange and separate the joint.
2. Remove the bolts and nuts attaching the exhaust manifold to the cylinder head and discard the gaskets.
3. Clean all mating surfaces of gasket material.

Installation

1. Position the center gasket on the studs, ensuring that it is the correct way up and locate the manifold on the studs.
2. Position the other gaskets between the manifold flanges and cylinder head, fit the nuts and bolts and tighten evenly to specifications.
3. Position the two manifold and muffler pipe flanges together and secure with two nuts.
4. Start engine and check for leaks.

CYLINDER HEAD

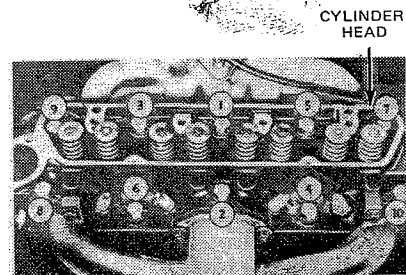
Removal

1. Remove the air cleaner or air horn from the carburetor.
2. Disconnect the fuel line at the fuel pump and carburetor.
3. Drain the coolant.
4. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position out of the way.
5. Disconnect the water outlet and crankcase ventilation hoses at the intake manifold.
6. Disconnect the wire from the temperature gauge sending unit (if so equipped).
7. Detach the exhaust pipe and move clear of the cylinder head.
8. Disconnect the throttle rod, choke cable and the distributor vacuum advance hose from the carburetor.
9. Disconnect the throttle linkage at the governor and position out of the way.
10. Remove the governor mounting bolts to cylinder head and remove governor.
11. Remove alternator adjusting bracket mounting bolt to cylinder head.
12. Disconnect resistor wires. Remove mounting bolt and remove resistor.
13. Remove coil mounting bolt and position coil out of the way.
14. Remove the thermostat housing, pull to one side and remove the thermostat.
15. Remove the rocker arm cover and gasket.

16. Remove the rocker arm shaft bolts evenly and lift off the rocker arm shaft assembly.
17. Lift out the push rods from their locations and keep them in their correct order.
18. Remove the cylinder head bolts and lift off the cylinder head and gasket. **Do not lay the cylinder head flat on its face as damage to the spark plugs or gasket surface can occur.**

Installation

1. Clean all gasket material from the mating surfaces and position the cylinder head gasket on the cylinder block using pilot studs.
2. Position the cylinder head, remove pilot studs and install the cylinder head bolts. Tighten the bolts down evenly in sequence (Figure 29) and in three steps to specifications.



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FIG. 29 Cylinder Head Bolt Tightening Sequence

3. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
4. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specifications.
5. Adjust the valve clearances.
6. Connect the exhaust pipe.
7. Connect the distributor vacuum advance line, the throttle rod, and choke cable to the carburetor.
8. Connect the wire to the temperature gauge sender unit.
9. Connect the water outlet and crankcase ventilation hoses to the intake manifold.
10. Locate the thermostat in its bore in the cylinder head and install the gasket and thermostat housing.
11. Refill the cooling system.
12. Position governor and mounting bracket to cylinder head and install bolts.
13. Loosen governor adjusting bolts and position drive belt to governor. Adjust belt to specification and tighten bolts.
14. Connect the throttle linkage to the governor.
15. Install the alternator bracket mounting bolt to cylinder head.
16. Position coil to intake manifold and install mounting bolt.
17. Position external resistor, dipstick tube and fuel filter bracket to intake manifold and install retaining bolt.
18. Connect the ignition wires to the spark plugs in the correct firing order.
19. Readjust the valve clearances to specification.
20. Install the rocker arm cover.
21. Install the air cleaner to the carburetor.
22. Adjust the carburetor idle speed and mixture settings.

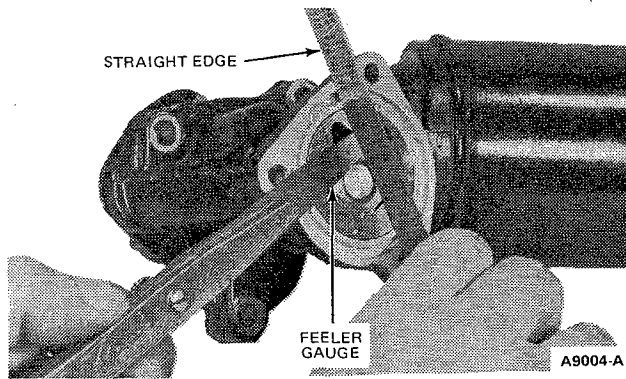


FIG. 27 Checking Rotor End Play

REMOVAL AND INSTALLATION

VALVE ROCKER ARM COVER, ROCKER ARM AND/OR SHAFT

Removal

1. Remove the air cleaner or air horn from the carburetor.
2. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position aside.
3. Remove the rocker cover attaching screws, remove the rocker cover and discard the gasket.
4. Remove the rocker arm shaft attaching bolts evenly and lift off the rocker arm shaft assembly (Figure 28).

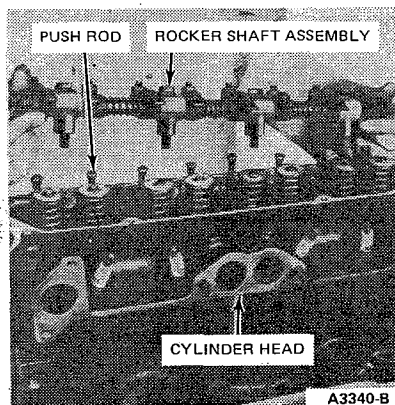


FIG. 28 Removing or Installing Rocker Arm Assembly

5. Remove the cotter pin from one end of the shaft and slip the flat washer, crimped washer and second flat washer off the shaft. The rocker arm shaft supports, rocker arms and springs can now be removed from the shaft.
6. Remove the plugs from the rocker shaft ends by drilling a hole in one plug. Insert a long rod through the drilled plug and knock the opposite plug out of the shaft. Remove the drilled plug in the same manner.
7. Clean the component parts of the shaft assembly in any suitable degreasing fluid.

Installation

1. Refit new plugs to the rocker shaft ends.
2. Assemble the rocker arm shaft. **The bolt hole in the rocker arm shaft support must be on the same side as the adjusting screw in the rocker arm. The rocker arms are right and left handed, the rocker pads being inclined towards the support.** Install the cotter pins with the heads upwards and bend over the legs to secure.
3. Lubricate the valve stem tips, rocker arm pads and the

POSITIVE CLOSED-TYPE CRANKCASE VENTILATION SYSTEM

Cleaning

Do not attempt to clean the crankcase ventilation regulator valve; it should be replaced at the specified maintenance interval. The oil filler cap and oil separator should be cleaned at the proper mileage interval. Remove the cap and the oil separator and wash them in a low volatility, petroleum base solvent. Shake the cap dry and install them. Clean the crankcase ventilation system connection(s) on the intake manifold by probing with a flexible wire or bottle brush. Clean the hoses, fittings, tubes and associated hardware with a low volatility, petroleum base solvent and dry with compressed air.

- push rod ends with Lubriplate or equivalent. Position the rocker shaft assembly on the cylinder head (Figure 28) engaging the push rods with the adjusting screws. Install and tighten the bolts evenly to specifications.
4. Adjust the valve clearance to specifications.
5. Ensure that the mating surfaces on the cylinder head and rocker cover are free from all traces of the old gasket material.
6. Position the rocker cover and gasket on the cylinder head and secure with the attaching screws. Torque the screws to specifications.
7. Locate the spark plug leads in the rocker cover clip and re-connect them to their respective plugs.
8. Install the air cleaner.

VALVE PUSH ROD

Removal

1. Remove the rocker shaft bolts evenly and lift off the rocker arm shaft assembly.
2. Remove the push rods from their locations and keep them in their correct order.

Installation

1. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
2. Lubricate the valve stem tips and the rocker arm pads with Lubriplate or equivalent and position the rocker arm shaft assembly on the cylinder head, engaging the push rods with the adjusting screws. Tighten the bolts evenly to specifications.
3. Adjust the valve lifters to specifications.

INTAKE MANIFOLD

Removal

1. Partially drain the cooling system.
2. Remove the air cleaner.
3. Disconnect the throttle rod from the carburetor throttle lever.
4. Disconnect the fuel line and the distributor vacuum line from the carburetor.
5. Disconnect the water outlet hose and the crankcase ventilation hose from the intake manifold.
6. Disconnect external resistor wires. Remove mounting bolt and remove resistor.
7. Remove coil mounting bolt and position coil out of the way.
8. Remove the attaching nut and bolts and remove the intake manifold.

9. Remove the gasket.
10. If a new manifold is to be installed, transfer all necessary components to the new manifold.

Installation

1. Apply a water resistant sealer to both sides of the gasket around the water port and position it on the cylinder head.
2. Install the intake manifold and tighten the nuts and bolts evenly to specifications.
3. Connect the water hose and the crankcase ventilation hose to the intake manifold.
4. Connect the distributor vacuum line and the fuel supply line to the carburetor.
5. Connect the throttle rod.
6. Position coil to intake manifold and install mounting bolt.
7. Position external resistor, dipstick tube and fuel filter bracket to intake manifold and install retaining bolt.
8. Install the air cleaner.
9. Refill the cooling system with the recommended coolant.

EXHAUST MANIFOLD

Removal

1. Remove the two nuts attaching the manifold to the muffler pipe flange and separate the joint.
2. Remove the bolts and nuts attaching the exhaust manifold to the cylinder head and discard the gaskets.
3. Clean all mating surfaces of gasket material.

Installation

1. Position the center gasket on the studs, ensuring that it is the correct way up and locate the manifold on the studs.
2. Position the other gaskets between the manifold flanges and cylinder head, fit the nuts and bolts and tighten evenly to specifications.
3. Position the two manifold and muffler pipe flanges together and secure with two nuts.
4. Start engine and check for leaks.

CYLINDER HEAD

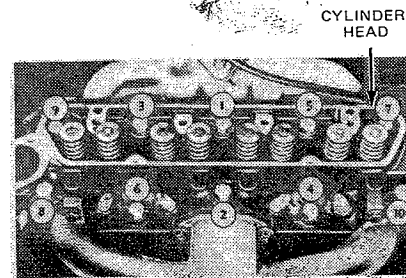
Removal

1. Remove the air cleaner or air horn from the carburetor.
2. Disconnect the fuel line at the fuel pump and carburetor.
3. Drain the coolant.
4. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position out of the way.
5. Disconnect the water outlet and crankcase ventilation hoses at the intake manifold.
6. Disconnect the wire from the temperature gauge sending unit (if so equipped).
7. Detach the exhaust pipe and move clear of the cylinder head.
8. Disconnect the throttle rod, choke cable and the distributor vacuum advance hose from the carburetor.
9. Disconnect the throttle linkage at the governor and position out of the way.
10. Remove the governor mounting bolts to cylinder head and remove governor.
11. Remove alternator adjusting bracket mounting bolt to cylinder head.
12. Disconnect resistor wires. Remove mounting bolt and remove resistor.
13. Remove coil mounting bolt and position coil out of the way.
14. Remove the thermostat housing, pull to one side and remove the thermostat.
15. Remove the rocker arm cover and gasket.

16. Remove the rocker arm shaft bolts evenly and lift off the rocker arm shaft assembly.
17. Lift out the push rods from their locations and keep them in their correct order.
18. Remove the cylinder head bolts and lift off the cylinder head and gasket. **Do not lay the cylinder head flat on its face as damage to the spark plugs or gasket surface can occur.**

Installation

1. Clean all gasket material from the mating surfaces and position the cylinder head gasket on the cylinder block using pilot studs.
2. Position the cylinder head, remove pilot studs and install the cylinder head bolts. Tighten the bolts down evenly in sequence (Figure 29) and in three steps to specifications.



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FIG. 29 Cylinder Head Bolt Tightening Sequence

3. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
4. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specifications.
5. Adjust the valve clearances.
6. Connect the exhaust pipe.
7. Connect the distributor vacuum advance line, the throttle rod, and choke cable to the carburetor.
8. Connect the wire to the temperature gauge sender unit.
9. Connect the water outlet and crankcase ventilation hoses to the intake manifold.
10. Locate the thermostat in its bore in the cylinder head and install the gasket and thermostat housing.
11. Refill the cooling system.
12. Position governor and mounting bracket to cylinder head and install bolts.
13. Loosen governor adjusting bolts and position drive belt to governor. Adjust belt to specification and tighten bolts.
14. Connect the throttle linkage to the governor.
15. Install the alternator bracket mounting bolt to cylinder head.
16. Position coil to intake manifold and install mounting bolt.
17. Position external resistor, dipstick tube and fuel filter bracket to intake manifold and install retaining bolt.
18. Connect the ignition wires to the spark plugs in the correct firing order.
19. Readjust the valve clearances to specification.
20. Install the rocker arm cover.
21. Install the air cleaner to the carburetor.
22. Adjust the carburetor idle speed and mixture settings.

VALVE SPRING, RETAINER AND STEM SEAL CYLINDER HEAD REMOVED

Removal

1. Remove the exhaust manifold and the spark plugs.
2. Compress the valve spring with a valve spring compressor. Remove the valve spring retainer locks, release the spring and remove the spring and retainer.
3. Remove the seal and withdraw the valve.

Installation

1. Install the valve and a new valve stem seal to the stem.
2. Position the valve spring and retainer over the valve stem.
3. Compress the valve spring. Locate the retainer locks in the valve stem grooves and slowly release the spring compressor to engage the collets in the retainer tappets.

CYLINDER HEAD INSTALLED

Removal

1. Remove the air cleaner or air horn from the carburetor.
2. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position out of the way.
3. Remove the rocker arm cover and gasket.
4. Remove the rocker arm shaft bolts evenly and lift off the rocker arm shaft assembly.
5. Lift the pushrods from their locations and keep them in their correct order.
6. Remove the spark plugs.
7. Suitably support the appropriate valve (Figure 30) with air pressure.
8. Compress the valve spring, using Tool No. T70P-6049-A. Remove the valve spring retainer locks. Release the spring compressor, remove the valve spring, retainer and the valve stem oil seal.

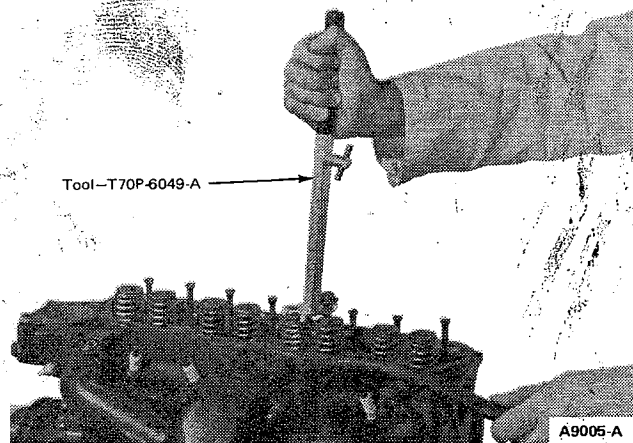


FIG. 30 Compressing Valve Spring — In-Chassis

Installation

1. Install a new valve stem seal over the valve stem.
2. Position the valve spring and retainer over the valve stem.
3. Compress the valve spring using Tool No. T70P-6049-A. Position the valve spring retainer locks in the valve stem grooves and slowly release the spring to engage the locks in the retainer. Remove the air hose and adaptor.
4. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specifications.

5. Adjust valve clearances to specification.
6. Install the rocker arm cover.
7. Install the spark plugs and connect the ignition wires to the spark plugs in the correct firing order.
8. Start the engine and run until engine reaches normal operating temperature.
9. Disconnect the ignition wires from spark plugs and remove the rocker arm cover.
10. Readjust the valve clearances (hot) to specifications.
11. Install the rocker cover with a new gasket and torque the attaching screws to specification.
12. Locate the spark plug leads in the rocker cover clip and reconnect them to their respective plugs.
13. Install the air cleaner assembly to the carburetor.

WATER PUMP

Removal

1. Drain the cooling system.
2. Loosen the governor adjusting bolts and remove drive belt.
3. Loosen the alternator adjusting and mounting bolts. Pivot the alternator towards the engine and remove the drive belt.
4. Remove the fan and pulley attaching bolts. Remove the fan and pulley.
5. Loosen the clamps and remove the lower hose from the water pump.
6. Disconnect the manifold water hose from the water pump.
7. Remove bolts securing water pump to cylinder block and remove the pump and gasket.

Installation

1. Make sure that the mating faces of cylinder block and pump are clean.
2. If new pump is being installed, transfer water hose connection to new pump.
3. Position the pump and gasket on the cylinder block and secure with the attaching bolts.
4. Connect the manifold water hose to the water pump and tighten clamp.
5. Position lower hose on water pump and tighten the clamp.
6. Position the pulley and fan and secure with bolts. Torque the bolts to specification.
7. Position drive belt over crankshaft, fan and alternator pulley and adjust the belt tension to specifications using Tool No. T63L-8620-A. Tighten the alternator mounting and adjusting bolt to specifications.
8. Position the governor drive belt to governor and fan pulley. Adjust the belt to specification. Tighten adjusting bolts.
9. Refill radiator and install cap. Start the engine and check for leaks.

CYLINDER FRONT COVER AND TIMING CHAIN, OR CRANKSHAFT SPROCKETS

Removal

1. Drain the engine coolant by opening the drain cock on the radiator and removing the drain plug in the cylinder block.
2. Disconnect the radiator hoses at the engine.
3. Remove the radiator.
4. Remove the governor and fan belts and then remove the fan and the water pump pulley.
5. Remove the water pump.
6. Remove the crankshaft pulley, using a suitable puller.

7. Remove the oil pan to cylinder front cover attaching bolts. Use a thin knife to cut the oil pan gasket flush with cylinder block face prior to separating the cover from the cylinder block. Remove the front cover.
8. Remove the crankshaft oil slinger. Remove the camshaft sprocket retainer and bolts.
9. Remove the timing chain tensioner arm. Remove the camshaft sprocket, and disconnect the timing chain.
10. If crankshaft sprocket is to be removed, use tool No. T64P-3590-F (Figure 31).

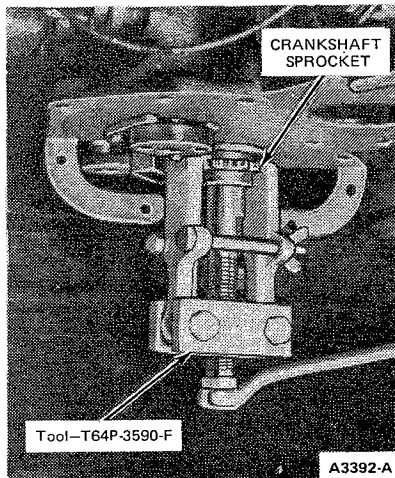


FIG. 31 Removing Crankshaft Sprocket

Installation

1. If crankshaft sprocket was removed, install using replacer tool No. T70P-6150 (Figure 32).
2. Position the timing chain over the camshaft and crankshaft sprockets so that the timing marks are aligned when the sprocket is installed (Figure 33). Tighten the bolts to specification, then bend up the locking tabs.

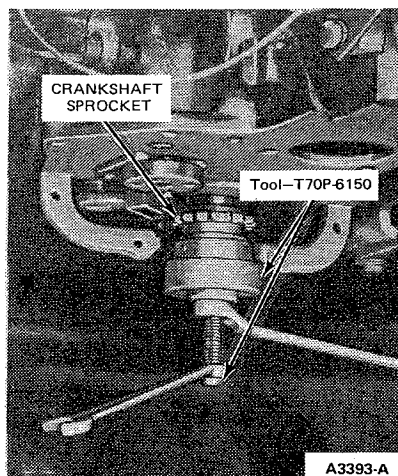


FIG. 32 Installing Crankshaft Sprocket

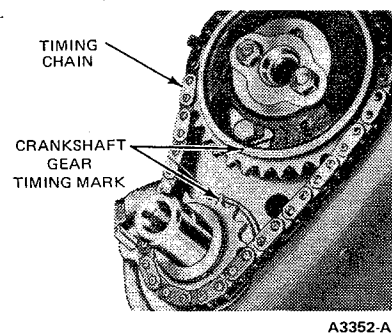


FIG. 33 Valve Timing Marks

3. Locate the tensioner arm on the pivot pin while holding the tensioner cam in the released position.
4. Install the oil slinger on the crankshaft. Install the camshaft sprocket retainer and bolts. Torque the bolts to specifications. Install the timing chain tensioner.
5. Position the gasket, portions of oil pan gasket, if necessary, and the end seal on the front cover with an oil resistant sealer at the ends. Align the cover in position with Tool No. T70P-6150 (Figure 34). Tighten the attaching bolts evenly to specification and remove the aligner tool. Tighten the oil pan bolts to specification.
6. Position the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the attaching bolt to specifications.
7. Install the water pump and torque the attaching bolts to specification.
8. Install the water pump pulley and fan. Install the governor and fan belts and adjust the tension of the belts to specifications using Tool T63L-8620-A.
9. Install the radiator.
10. Install the radiator upper and lower hoses and tighten the clips.
11. Refill the radiator.
12. Start engine and check for oil and water leaks.

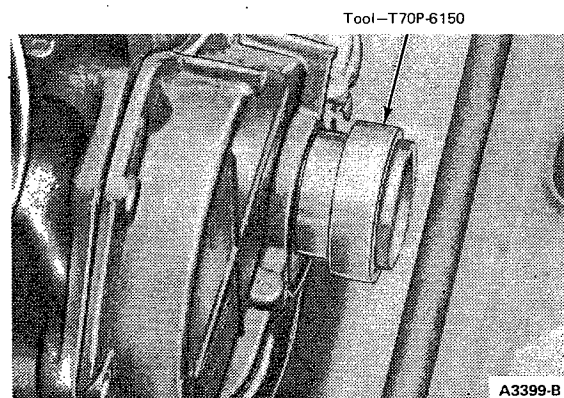


FIG. 34 Aligning Front Cover Oil Seal

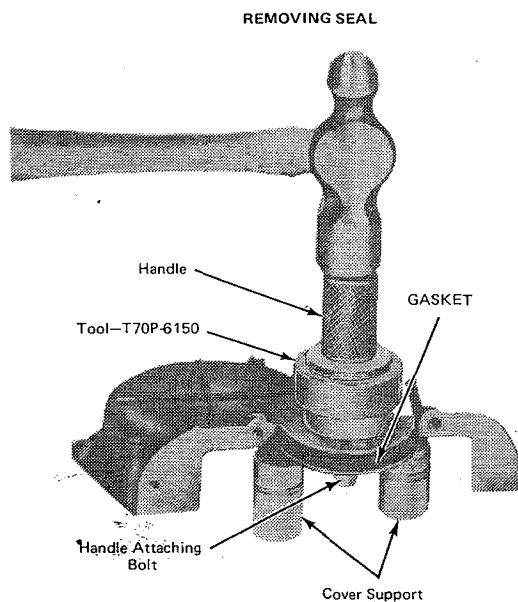
FRONT OIL SEAL

Removal

The oil seal can be removed, after first removing the front cover and driving the seal out from the rear.

Installation

1. Drive a new seal into the housing with Tool T70P-6150 (Figure 35), while supporting the cover around the seal.
2. When fitting the cover it is important that the oil seal is aligned concentrically with the crankshaft and pulley boss with Tool No. T70P-6150 (Figure 34).



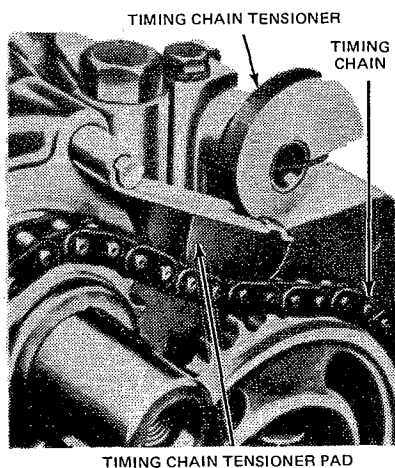
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FIG. 35 Installing Front Cover Oil Seal

TIMING CHAIN TENSIONER

Removal

1. Remove the cylinder front cover and oil pan.
2. Remove the timing chain tensioner and tensioner arm by removing the two attaching bolts (Figure 36).



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FIG. 36 Timing Chain Tensioner

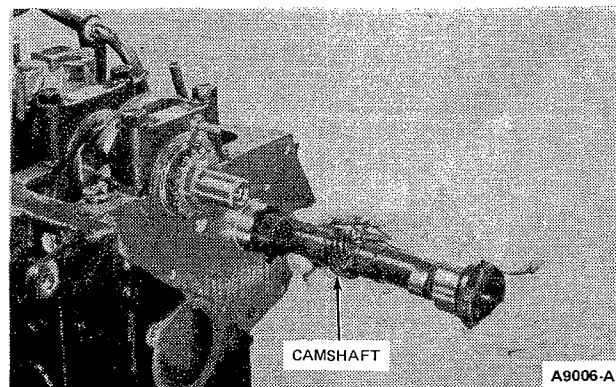
Installation

1. Locate the tensioner arm on the pivot pin.
2. Position the tensioner and replace the two bolts.
3. Replace the cylinder front cover and oil pan.

CAMSHAFT AND/OR VALVE LIFTERS

Removal

1. Remove the engine assembly and mount the engine on a stand. Drain the crankcase.
2. Disconnect the fuel line at the fuel pump.
3. Loosen the alternator and governor adjustment bolts and remove the belts.
4. Remove the fan and water pump pulley.
5. Remove the oil and fuel pumps from the cylinder block.
6. Disconnect the spark plug wires from the plugs and remove the cover. Clean all gasket material from rocker arm cover and cylinder head.
7. Remove the rocker arm cover attaching screws and rocker cover. Remove the distributor from the cylinder block.
8. Remove the rocker arm shaft support bolts evenly and lift off the rocker arm shaft.
9. Lift the push rods from their locations in the cylinder block, taking care to keep them in their correct order.
10. Invert the engine on the stand and remove the oil pan and gaskets.
11. Remove the crankshaft pulley, the front cover and oil slinger.
12. Remove the timing chain tensioner assembly.
13. Remove the camshaft sprocket and timing chain.
14. With the engine inverted, remove the camshaft thrust plate and remove the camshaft (Figure 37).



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FIG. 37 Removing Camshaft

15. If necessary, remove the tappets from their locations in the cylinder block and keep them in the correct order.

Installation

1. Install a new front cover oil seal, using Tool No. T70P-6150 (Figure 35).
2. Install the tappets, if removed.
3. Install the camshaft and fit the thrust plate in the camshaft groove. Tighten the attaching bolts to specification and bend up the locking tabs.
4. Check the camshaft end play.
5. Locate the timing chain on the camshaft sprocket and fit the camshaft sprocket with the timing mark aligned with the one on the crankshaft sprocket. Tighten the attaching bolts to specification and bend up the locking tabs.

6. Locate the tensioner arm on the pivot pin and install the timing chain tensioner.
7. Install the oil slinger on the crankshaft.
8. Position the gasket on the front cover with an oil resistant sealer at the ends, align the front cover with Tool No. T70P-6150 and tighten the bolts evenly to specification before removing the aligner.
9. Position a new gasket on the block flange using an oil resistant sealer compound at each end. Position the end seals chamfered ends into the groove, again using an oil resistant sealer at the ends and refit the oil pan. Tighten the oil pan bolts to the correct torque, **FOLLOWING FIRST THE ALPHABETICAL, THEN THE NUMERICAL SEQUENCES SHOWN IN Figure 38.**
10. Install the dipstick.
11. Install the crankshaft pulley aligning the pulley slot with the crankshaft key. Tighten the pulley attaching bolt to specification.
12. Right the engine on stand. Install and time the distributor.
13. Position a new gasket on the oil pump mounting flange and install the oil pump and filter assembly. Tighten the attaching bolts to specification.
14. Position a new gasket to the fuel pump flange and insert the rocker arm through the slot in the block wall so that the arm lies on the camshaft eccentric. Secure the fuel pump to the cylinder block with two washers and bolts, tightening the bolts evenly to specifications.
15. Lubricate push rod ends, valve stem tips and rocker pads with Lubriplate or equivalent. Install the push rods in their respective bores and install the rocker arm shaft assembly, making sure that the cupped ends of the push rods engage the adjusting screws. Tighten the rocker arm shaft attaching bolts evenly to specification.
16. Adjust the valve clearances to specification.
17. Connect the distributor vacuum advance line to the carburetor.
18. Install the water pump pulley and fan. Position the alternator and drive belts on the pulley and adjust the belt governor tension to specifications. Connect the fuel line from the carburetor to the fuel pump.
19. Install distributor cap and connect wires to spark plugs.
20. Remove engine from stand.
21. Install the engine assembly in the vehicle.
22. Start the engine and check for oil and water leaks.
23. Readjust the valve clearances (hot) to specification.
24. Install the rocker arm cover and a new gasket and secure with attaching screws and torque to specifications.
25. Install the air cleaner assembly.
26. Start engine, adjust the ignition timing, if necessary.
27. Adjust the carburetor idle speed and fuel-air mixture to specifications.

FLYWHEEL RING GEAR

The flywheel ring gear is located in a retention groove and can be removed by cutting between two adjacent teeth with a hack saw and splitting the gear with a chisel. In no circumstances should pressure be applied in an attempt to remove the ring gear for repositioning on the flywheel.

When installing the ring gear it must be heated evenly to a temperature not to exceed 600 degrees F. or the ring gear wear resistant properties will be destroyed. If the ring gear is heated by a direct flame place the ring gear on a bed of fire bricks and then play the flame in a circular motion onto the bricks about 1-1/2 inches from the inside of the gear until it reaches the required temperature. The correct temperature can be detected by using a special type of temperature sensitive crayon, or alternatively by polishing a section of

the ring gear and heating until it turns dark blue. Fit the ring gear with the chamfers on the leading faces of the gear teeth relative to the direction of rotation. Allow the ring gear to cool naturally in air. **Do not quench.**

OIL PAN

Removal

1. Drain the crankcase.
2. Remove the oil level dipstick.
3. Remove the three bolts and remove the starter motor.
4. Remove the oil pan attaching bolts and remove the pan and gasket.

Installation

1. Clean the oil pump inlet tube and screen assembly.
2. Clean the gasket surfaces of the block and oil pan. Be sure to clean the seal retainer grooves in the cylinder front cover and the rear seal retainer. The oil pan has a two-piece gasket. Coat the block surface and the oil pan gasket surface with oil-resistant sealer. Position the oil pan gaskets on the cylinder block.
3. Position the end seals with the chamfered ends into the grooves, again using an oil resistant sealer. Position the oil pan and tighten the bolts evenly to specifications following first the alphabetical, then the numerical sequences shown in Figure 38.



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FIG. 38 Oil Pan Bolts Tightening Sequence

4. Clean and install the starter motor, securing it with the three bolts.
5. Refill the oil pan with the correct grade of engine oil and install the dipstick.
6. Start the engine and check for oil leaks.

OIL PUMP

The oil pump and filter assembly is bolted to the right side of the cylinder block and can be removed with the engine in place.

Removal

1. Place a drain pan under the oil pump.
2. Remove the three bolts attaching the oil pump and filter assembly and withdraw the assembly (Figure 39).
3. Separate the oil filter from the oil pump.

Installation

1. Position the oil filter to the oil pump assembly.
2. Ensure the mating surfaces are clean of old gasket material, then install the oil pump and filter assembly on the cylinder block, using a new gasket together with an oil resistant sealer and secure with the three bolts. Tighten the bolts to specifications.
3. Check the oil level and add oil if necessary.
4. Start the engine and check for oil leaks.

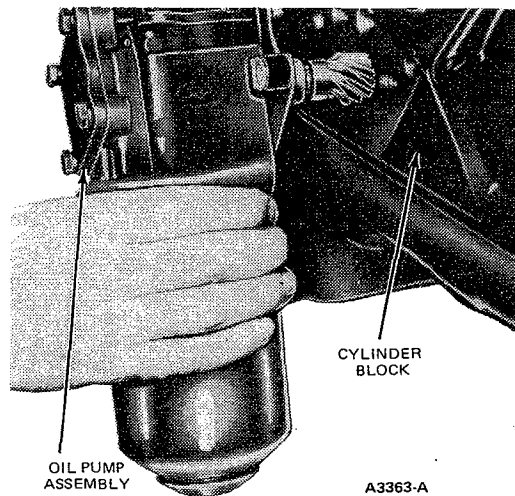


FIG. 39 Removing Oil Pump

CRANKSHAFT REAR OIL SEAL

1. Remove the pressure plate bolts evenly and remove the pressure plate and clutch disc.
2. Remove the flywheel.
3. Remove the oil pan and gaskets.
4. Remove the rear oil seal carrier and remove the seal.

Installation

1. Install a new crankshaft rear oil seal using Tool No. T70P-6165 (Figure 40).

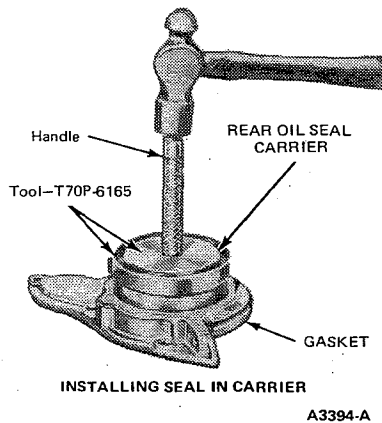


FIG. 40 Installing Crankshaft Rear Oil Seal

2. Position a new gasket on the rear oil seal carrier, using an oil resistant sealer compound at the ends, and fit the carrier to the block rear face using aligner Tool No. T70P-6165. Tighten the bolts evenly to specifications and remove the aligner.
3. Position new gaskets on the block flange using oil resistant sealer at each end. Position the end seals with the chamfered ends into the grooves, again using an oil resistant sealer and refit the oil pan. Tighten the bolts to the correct torque and in sequence.
4. Locate the flywheel squarely upon the crankshaft flange. Tighten the bolts evenly to specifications.
5. Install the clutch disc and pressure plate.

MAIN BEARINGS

Removal

1. Remove main bearing caps and thrust washers. Keep the caps in order so they can be installed in their original positions.
2. Remove upper bearing liners from the cylinder block and the lower bearing liners from the caps.
3. Check caps and journals for damage.
4. Install new upper bearing liners in the cylinder block, and new lower bearing liners in the bearing caps.
5. Make sure that the journals and bearings are free from dirt and abrasive particles.
6. Fit the bearings using Plastigage as detailed in General Engine Service.

Installation

1. Clean off the journals and liners.
2. Install the crankshaft thrust washers.
3. Oil the bearing surfaces and install the bearing caps in their original positions, tightening the bolts to specification.

CONNECTING ROD BEARINGS

Removal

1. Turn the crankshaft to allow removal of number one connecting rod cap. Partially remove the connecting rod bolts two or three turns and tap them to release the cap. Completely remove the bolts and remove the cap. Keep them in order so they can be installed in their original positions.
2. Remove the upper connecting rod bearing from the connecting rod and the lower bearing from the connecting rod cap.

Installation

1. Install the upper and lower bearing liners in their appropriate locations.
2. Measure the bearing clearances using Plastigage as detailed in General Engine Service.
3. Install the connecting rod caps on the connecting rods in their original positions and tighten the bolts to specifications.

PISTONS AND CONNECTING RODS

Removal

1. Drain the engine oil.
2. Drain the cooling system.
3. Disconnect the battery.
4. Disconnect the spark plug leads and position out of the way.
5. Disconnect the water outlet and crankcase ventilation hoses at the intake manifold.
6. Disconnect the wire from the temperature gauge sending unit (if so equipped).
7. Detach the exhaust pipe and move clear of the cylinder head.
8. Disconnect the throttle rod, choke cable and the distributor vacuum advance hose from the carburetor.
9. Disconnect the throttle linkage at the governor and position out of the way.
10. Remove the governor mounting bolts to cylinder head and remove governor.
11. Remove alternator adjusting bracket mounting bolt to cylinder head.
12. Disconnect resistor wires. Remove mounting bolt and remove resistor.
13. Remove coil mounting bolt and position coil out of the way.

14. Remove the thermostat housing, pull to one side and remove the thermostat.
15. Remove the rocker arm cover and gasket.
16. Remove the rocker arm shaft bolts evenly and lift off the rocker arm shaft assembly.
17. Lift out the push rods from their locations and keep them in their correct order.
18. Remove the cylinder head bolts and lift off the cylinder head and gasket. **Do not lay the cylinder head flat on its face as damage to the spark plugs or gasket surface can occur.**
19. Remove the starter motor and oil pan.
20. Clean the oil pan and cylinder block faces and remove the end seals.
21. Partially remove the bearing cap bolts several turns and tap them to release the cap. Completely remove the bolts and remove the bearing cap. Keep them in order so they can be installed in their original positions. Push the piston and connecting rod out of the bore and remove the assembly.

Piston Selection

Installation

1. Position the bearing liners in the connecting rods and end caps. Turn the crankshaft as necessary to fit each connecting rod to the crank, but do not fit the end cap.
2. Measure the bearing clearances using the Plastigage method as detailed in the Overhaul Section.
3. Clean all bearing surfaces of Plastigage material. If necessary, select new bearing liners to give the correct clearances.
4. Install the connecting rods on the crank and tighten the connecting rod bolts to specifications.
5. Position a new gasket on the block flange, using oil resistant sealer at each end. Install the end seals, with the chamfered ends into the grooves, again using an oil resistant sealer.
6. Install the oil pan and tighten the bolts evenly to the correct torque following first the alphabetical, then the numerical sequences shown in Figure 38.
7. Clean and install the starter motor, securing it with the two bolts.
8. Clean all gasket material from the mating surfaces and position the cylinder head gasket on the cylinder block using pilot studs.
9. Position the cylinder head, remove pilot studs and install the cylinder head bolts. Tighten the bolts down evenly in sequence (Figure 29) and in three steps to specifications.
10. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
11. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specifications.
12. Adjust the valve clearances.
13. Connect the exhaust pipe.
14. Connect the distributor vacuum advance line, the throttle rod, and choke cable to the carburetor.
15. Connect the wire to the temperature gauge sender unit.
16. Connect the water outlet hoses and crankcase ventilation hose to the intake manifold.
17. Locate the thermostat in its bore in the cylinder head and install the gasket and thermostat housing.
18. Refill the cooling system.
19. Connect the ignition wires to the spark plugs in the correct firing order.
20. Readjust the valve clearances to specification.
21. Install the rocker arm cover.
22. Refill the oil pan with the correct grade of oil.

23. Install the air cleaner to the carburetor.
24. Adjust the carburetor idle speed and mixture settings.

CRANKSHAFT

Removal

1. Remove the engine from the vehicle and mount it in an engine stand.
2. Remove the clutch disc and pressure plate.
3. Remove the flywheel from the crankshaft.
4. Loosen the alternator and governor belt adjusting bolts and remove the drive belts.
5. Remove the pulley from the front of the crankshaft.
6. Remove the cylinder front cover.
7. Slide the oil slinger off the shaft (Figure 41). Remove the timing chain tensioner and timing chain, then remove the crankshaft sprocket from the crankshaft with Tool No. T64P-3590-F.
8. Invert engine, remove oil pan and oil inlet tube and screen.
9. Remove the four connecting rod bearing caps and keep them in order so that they will be installed on the rods from which they were removed.
10. Remove the five main bearing caps and keep them in order so that they may be installed in their original positions.
11. Carefully lift the crankshaft from the cylinder block.

Installation

1. Place the lubricated main bearing liners in the cylinder block. Install the crankshaft and check the bearing clearance using the Plastigage method as detailed in the Overhaul Section and torque the main bearing caps on their respective journals to specification.
2. Check the crankshaft end play (Figure 6).
3. Install the correct thickness of thrust washers to establish the specified end play (Figure 41A).
4. Fit the connecting rod bearing using the Plastigage method.
5. Install the correct connecting rod caps in their original positions and torque the cap bolts to specification.
6. Install the oil inlet tube and screen.
7. Install the crankshaft sprocket and timing chain making sure that the timing marks are in alignment.
8. Install the oil slinger, timing chain tensioner and cylinder front cover. Install the crankshaft pulley (Figure 43).
9. Install the oil pan and new gaskets. Tighten the oil pan attaching bolts to specification following first the alphabetical, then the numerical sequence shown in Figure 38.

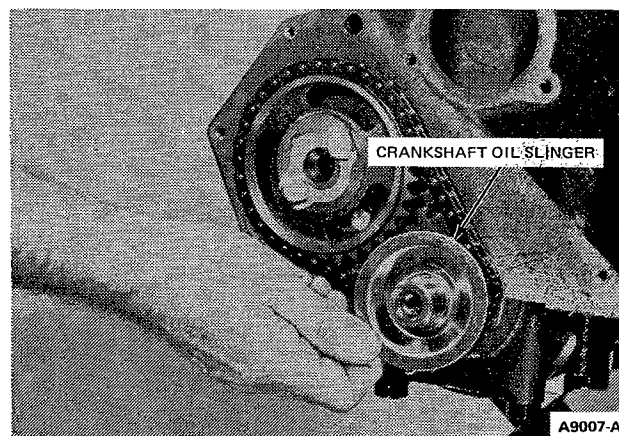


FIG. 41 Crankshaft Oil Slinger

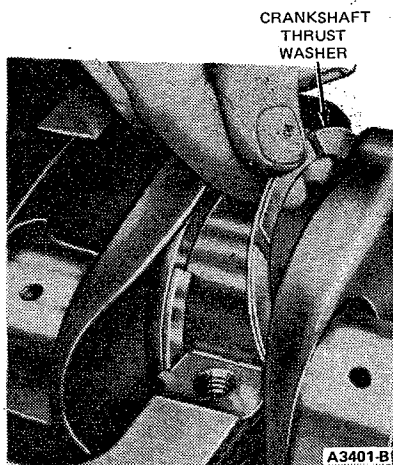


Fig. 41A Crankshaft End Play

10. Right engine and install alternator and governor drive belts. Adjust belts to specified tension. Tighten adjusting bolts.
11. Install the flywheel, clutch disc and pressure plate.
12. Remove engine from stand.
13. Install the engine in vehicle.
14. Fill the crankcase and the cooling systems to the correct level with the specified oil and coolant. Start the engine and check for oil and water leaks.

CAMSHAFT BEARINGS

The service bearings for the camshaft are pre-sized and require no machining after installation. When one bearing requires replacement it is advisable to replace all three, as camshaft alignment may be affected if only one bearing is changed.

The camshaft front and rear bearings are both approximately 3/4 inch wide, the front one having an additional oil hole for the rocker arm shaft oil feed, and the center bearing approximately 5/8 inch wide. Install the bearings using a replacer in addition to the adapters previously used. Make sure that the oil holes in the bearings and cylinder block are correctly aligned before installation and that the splits in the bearings are upwards and outwards at 45 degrees to the vertical.

Removal

Remove camshaft following the appropriate procedures in this section.

1. Remove the flywheel.
2. Remove the crankshaft rear oil seal carrier.
3. Remove the camshaft bearings.

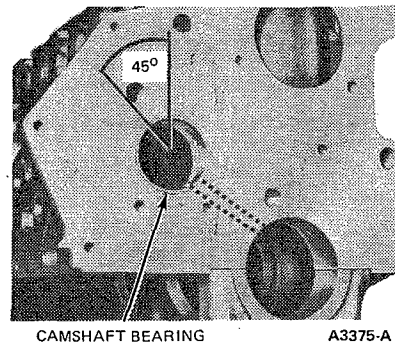


FIG. 42 Camshaft Bearing Position

4. Check all the oil passages to make sure that they are clear. Apply an oil resistant sealer to the oil gallery plugs prior to installation.

Installation

1. Install new camshaft bearings. Make sure that the oil holes in the bearings and cylinder block are aligned. The splits in the bearings should be upwards and outwards at 45 degrees to the vertical (Figure 42).
2. Install a new crankshaft rear oil seal using Tool No. T70P-6165 (Figure 40).
3. Position a new gasket to the rear oil seal carrier using an oil resistant sealer at the ends. Install the carrier on the cylinder block and tighten the bolts evenly to specification.
4. Locate the flywheel squarely on the crankshaft flange. Tighten the attaching bolts to specification.
5. Install the camshaft and related parts following the appropriate procedures in this section.

OIL FILTER

Removal

Place a drip pan under the filter. Unscrew the filter from the adapter fitting. Clean the adapter filter recess.

Installation

1. Coat the gasket on the replacement filter with oil. Position the filter on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, then advance it 1/2 turn.
2. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase as required.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be torqued (refer to the torque specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

ENGINE ASSEMBLY

Disassembly

1. Mount the engine on a stand and drain crankcase.
2. Disconnect the fuel line at the fuel pump and carburetor.
3. Disconnect the spark plug leads, remove them from the clip on the rocker cover and position out of the way.
4. Disconnect the water outlet and crankcase ventilation hoses at the intake manifold.
5. Disconnect the wire from the temperature gauge-sending unit (if so equipped).
6. Disconnect the throttle rod, and the distributor vacuum advance hose from the carburetor.
7. Remove the governor mounting bolts to cylinder head. Remove governor and drive belts.
8. Remove alternator adjusting bracket mounting bolt to cylinder head.
9. Disconnect resistor wires. Remove mounting bolt and remove resistor, fuel filter and bracket, dipstick and tube.
10. Disconnect coil wires, remove mounting bolt and remove coil.
11. Remove the thermostat housing and thermostat.
12. Remove the rocker arm cover and gasket.
13. Remove the rocker arm shaft bolts evenly and lift off the rocker arm shaft assembly.
14. Lift out the push rods from their locations and keep them in their correct order.
15. Remove the cylinder head bolts and lift off the cylinder head and gasket. Do not lay the cylinder head flat on its face as damage to the spark plugs or gasket surface can occur.
16. Remove the fuel pump and oil pump.
17. Remove the bolt securing the oil separator to the cylinder block and remove the separator.
18. Remove the distributor and secondary wiring.
19. Remove fan, spacer, pulley and alternator belt.
20. Remove the alternator mounting and adjusting bracket bolts. Remove alternator.
21. Remove crankshaft pulley.
22. Remove the water pump, front cover and crankshaft oil slinger.
23. Remove any ridge and/or carbon deposits from the upper end of the cylinder bores. Move the piston to the bottom of its travel and place a cloth on the piston head to collect the cuttings. 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 ridge.**
24. Invert the engine on the stand and remove the oil pan and gaskets.
25. Remove the oil pick up tube retaining bolt and remove the assembly. Remove the oil return tube.
26. Remove the flywheel and rear engine plate.
27. Remove the rear bearing retainer.
28. Remove the timing chain tensioner.
29. Remove the camshaft sprocket and timing chain.
30. Remove the camshaft thrust plate and the camshaft. Remove the tappets keeping them in their correct order.
31. Make sure all connecting rods and caps are marked so that they can be installed in their original locations. Partially loosen the connecting rod bolts several turns

- and tap them to release the bearing caps. Remove the bolts completely and remove the caps. Push the pistons out of the bores and remove the assemblies (Figure 43).
32. Remove the main bearing caps bolts evenly and lift off each cap. Lift out the crankshaft and handle with care to avoid possible fracture or damage to finished surfaces.
33. Remove the main bearings from block and cap. Remove the thrust washers.
34. Disassemble the piston and connecting rod assemblies. Remove the piston rings and the two piston pin snap rings. Push the piston pin out of each piston.
35. Remove the coolant drain plug and oil pressure sending unit from the block.
36. Remove the block from the stand.

Assembly

1. Mount the block in the stand inverted.
2. Install the coolant drain plug and oil pressure sending unit.
3. Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided.
4. Install the lower main bearing inserts in the bearing caps.
5. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.** Check the clearance of each main bearing following the procedures in the Overhaul Section.
6. Install the thrust washers to the center main. Apply a light coat of oil to the journals and bearings. Install the main bearing caps. Tighten the main bearing cap bolts evenly to specifications and check crankshaft rotation.
7. Check the crankshaft end-play.
8. Install the tappets into their respective bores.
9. Oil the camshaft journals with heavy SE engine oil and apply Lubriplate or equivalent to all lobes and then carefully slide it through the bearings.
10. Position the camshaft thrust plate and tighten the attaching bolts to specifications. Check the camshaft end play. Bend the locking tabs to secure the bolts.
11. Install the camshaft sprocket and timing chain aligning the timing marks on the camshaft and crankshaft sprockets (Figure 45). Tighten the attaching bolts to specification and bend up the locking plate tabs.
12. Position the timing chain tensioner arm on the pivot pin and install the tensioner (Figure 46).
13. Install a new oil seal to the front cover using Tool No. T70P-6150 (Figure 47).
14. Install the oil slinger on the crankshaft and position the front cover gasket in place using oil resistant sealer. Locate the front cover, aligning the seal to the crankshaft with Tool No. T70P-6150. Tighten the bolts evenly to specification and remove the aligner tool.
15. Install a new oil seal in the rear oil seal carrier using Tool No. T70P-6165 (Figure 48).
16. Position a new gasket on the rear oil seal carrier using oil resistant sealer. Secure the carrier to the cylinder block. Tighten the bolts evenly to specification.
17. Assemble the respective pistons to their connecting rods. Be sure the word "front" on the rod on the arrow on the top of the piston face the same side (Figure 49). Push the piston pin into the piston and rod and install the two piston pin snap rings.
18. Install the rings on the piston starting with the oil ring, then the second compression ring and the top compression ring. Position the gaps as shown in Figure 50.

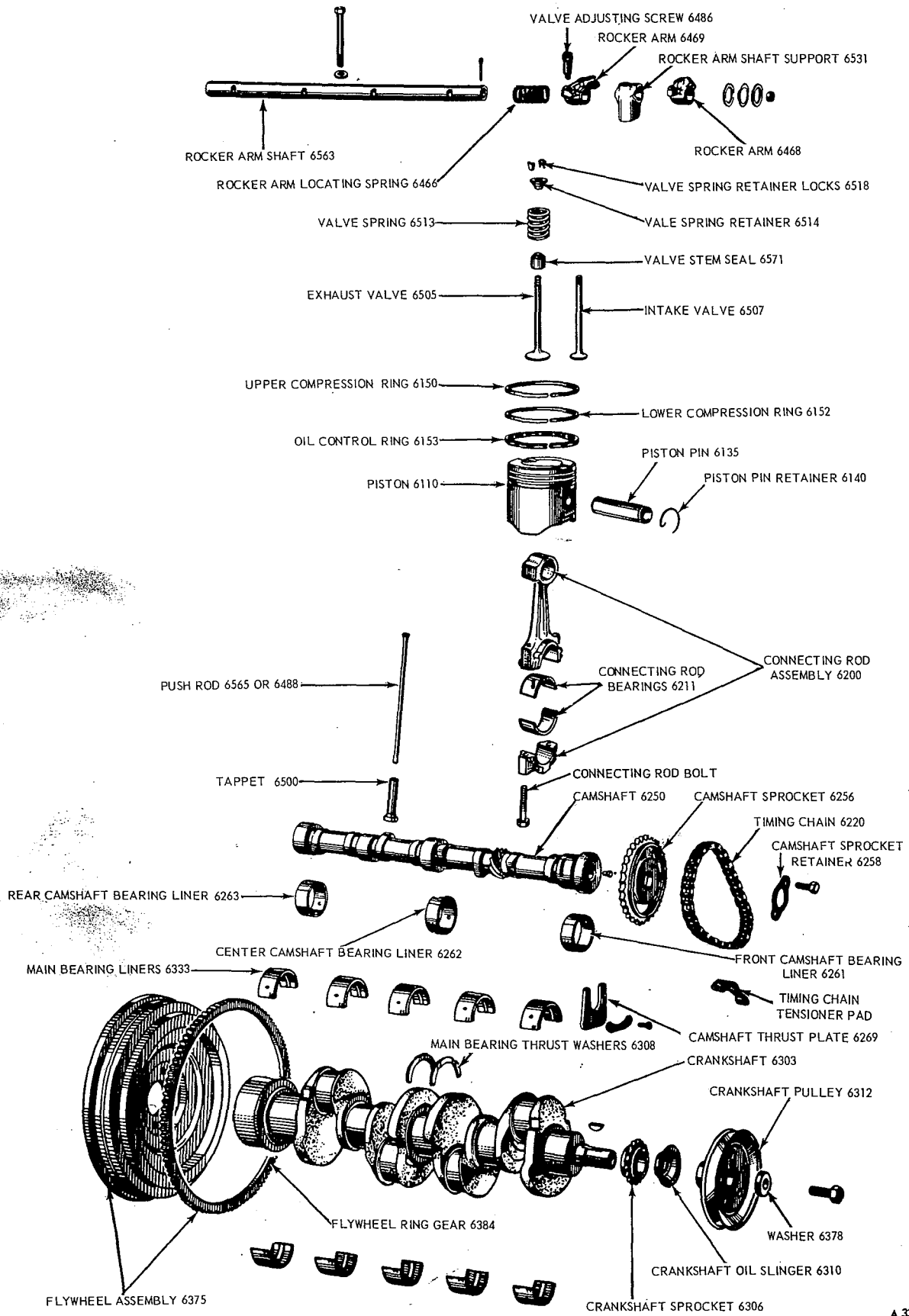
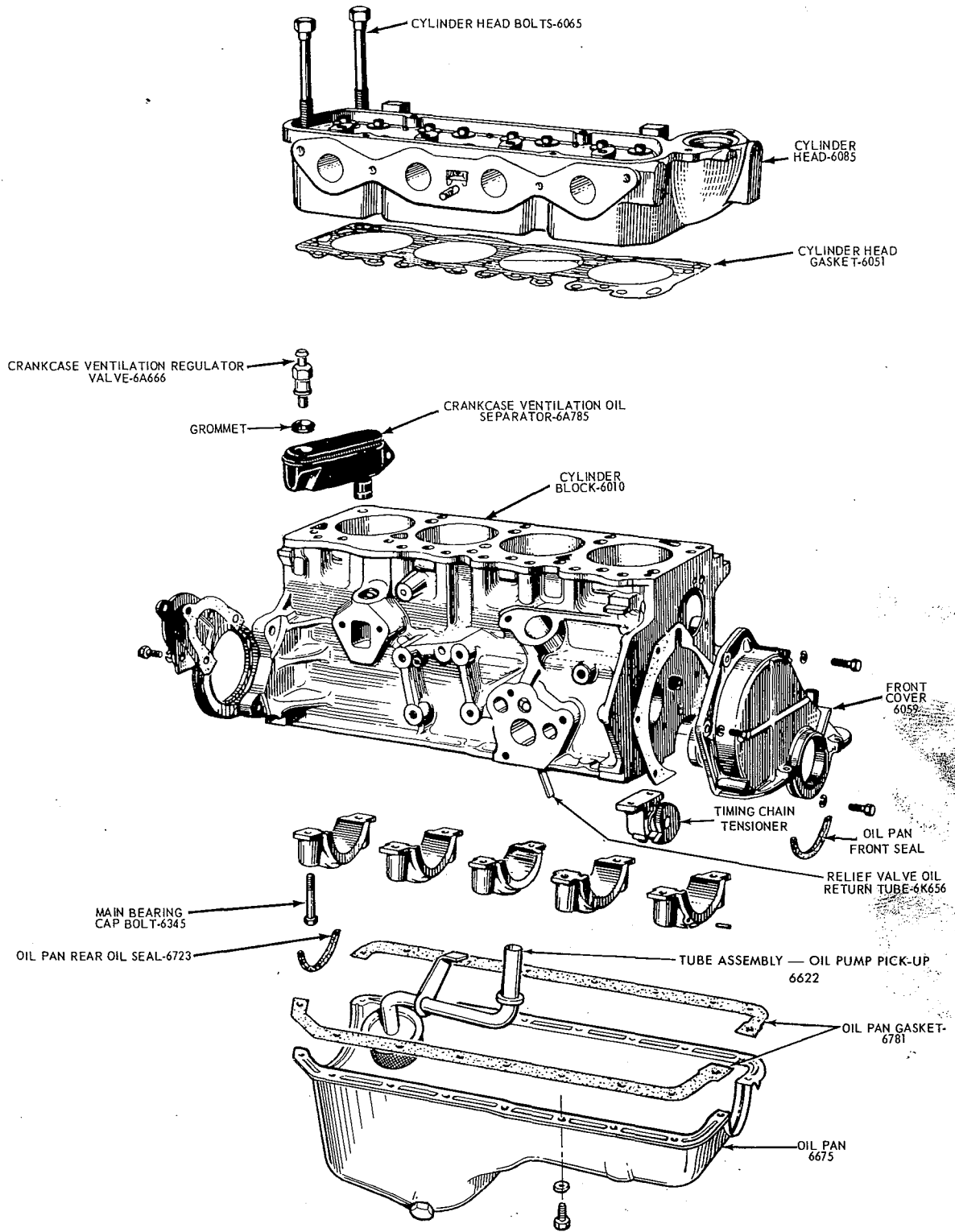


FIG. 43 Engine Internal Parts Disassembled



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FIG. 44 Engine Exterior Parts Disassembled

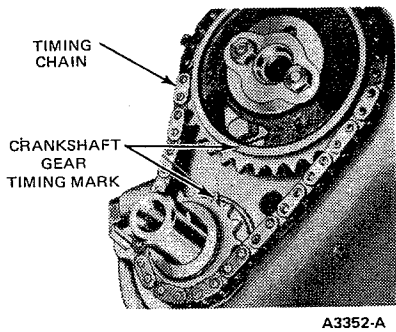


FIG. 45 Camshaft Sprocket and Timing Chain Aligning Marks

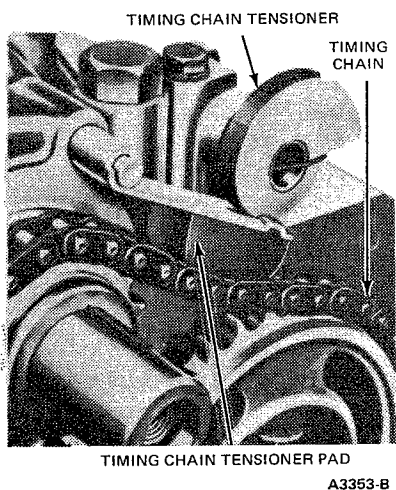


FIG. 46 Timing Chain Tensioner

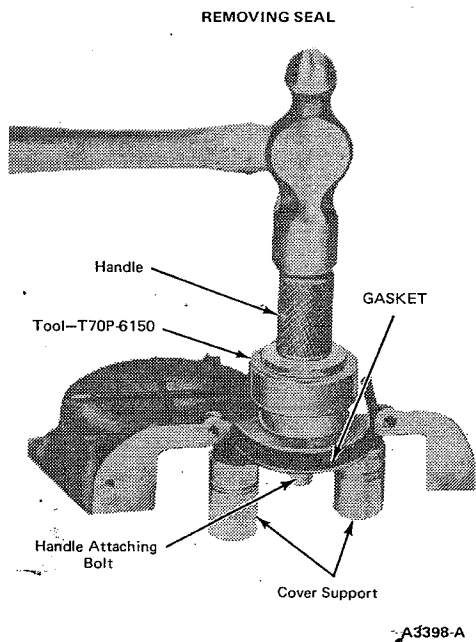


FIG. 47 Installing Front Cover Oil Seal

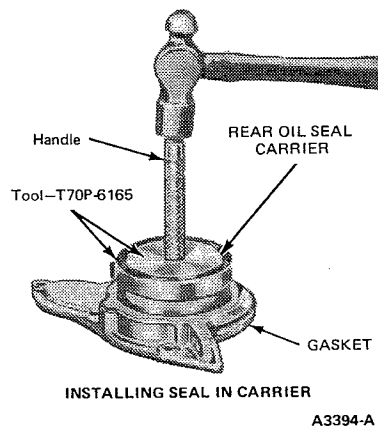


FIG. 48 Installing Crankshaft Rear Oil Seal

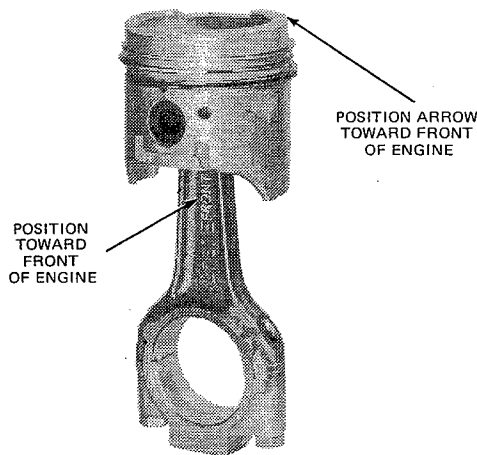


FIG. 49 Connecting Rod and Piston Assembly

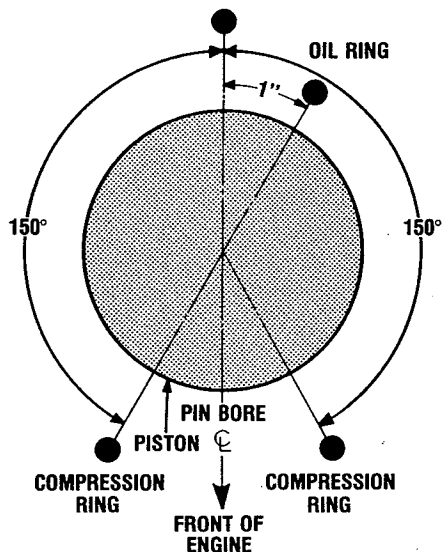
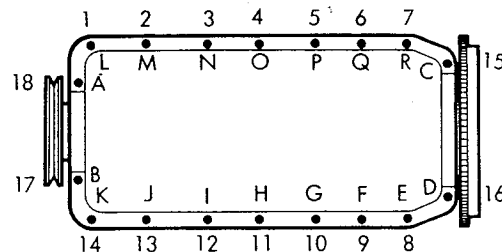


FIG. 50 Piston Ring Cap Spacing

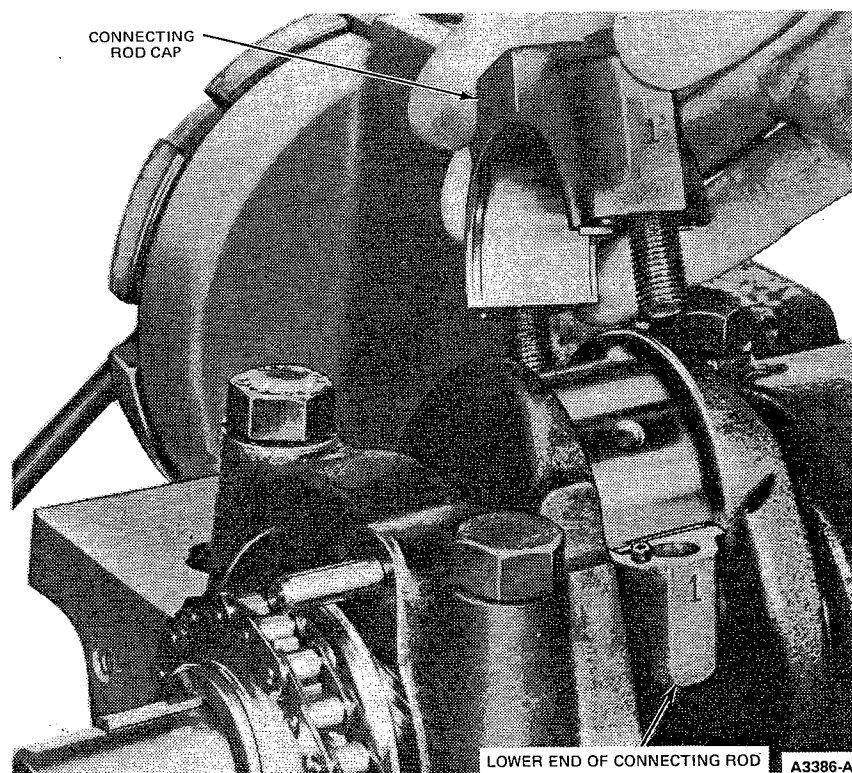
19. Rotate the engine in the stand so that the front end is up. Oil the piston rings and cylinder bores with engine oil. Compress the rings using a universal piston ring compressor. Install the piston and connecting rod assemblies into their respective bores with the arrow on top of the piston pointing toward the front of the block.
20. Install the connecting rod bearings and check the clearances as detailed in the Overhaul Section.
21. Oil the bearings and journals with engine oil and install the connecting rod bearing caps (Figure 51). Tighten the bolts to specification. Check the connecting rod side clearance.
22. Rotate the engine to the inverted position. Replace the oil pump inlet tube and screen and the oil return tube. Press the tubes to the full depth of the counterbored holes. Install the inlet tube retaining bolt.
23. Position the flywheel squarely on the crankshaft flange. Tighten the attaching bolts evenly to specification.
24. Install the crankshaft pulley and torque the bolt to specification.
25. Coat the block surface and the oil pan gasket surface with oil resistant sealer. Position the oil pan gaskets on the cylinder block. Position the end seals with the chamfered ends into the grooves, again using an oil resistant sealer at the mating areas. Position the oil pan and tighten the bolts evenly to specification following first the alphabetical, then the numerical sequences shown in Figure 52.
26. Right the engine in the stand. Position a new gasket on the water pump and install the pump on the block.



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FIG. 52 Oil Pan Bolts Tightening Sequence

27. Position the alternator and brackets to the block and install mounting bolts.
28. Install and time the distributor.
29. Position the oil separator to the block and install the retaining bolt.
30. Position a new oil pump mounting gasket to the block using oil resistant sealer. Position the pump to the block, install the mounting bolts and torque to specifications.
31. Position a new gasket to the fuel pump flange and insert the rocker arm through the slot in the block so that the arm lies on the camshaft lobe. Install the mounting bolts and tighten evenly to specification.
32. Position the cylinder head gasket on the cylinder block using pilot studs.



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FIG. 51 Installing Connecting Rod Caps

33. Position the cylinder head, remove the pilot studs and install the cylinder bolts. Tighten the bolts down evenly in sequence (Figure 53) and in three steps to specification.

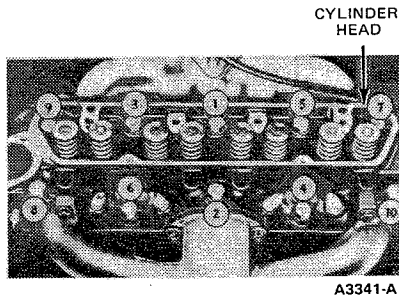


FIG. 53 Cylinder Head Bolt Tightening Sequence

34. Lubricate both ends of the push rods with Lubriplate or equivalent and install them in their respective bores.
35. Install the rocker arm shaft assembly to the cylinder head, locating the push rods on the adjusting screws. Tighten the bolts evenly to specification. Adjust the valve clearances. Install the rocker cover.
36. Locate the thermostat in its bore in the cylinder head and install the gasket and thermostat housing. Connect the wire to the temperature gauge sending unit.
37. Position the coil to the intake manifold and install mounting bolt. Connect primary wires to coil.
38. Install dipstick and tube. Position dipstick tube bracket, fuel filter and bracket and resistor to intake manifold and install mounting bolt. Connect coil wire to resistor.
39. Position governor to cylinder head and install mounting bolts.
40. Connect the throttle rod, and distributor vacuum advance hose to the carburetor.
41. Connect the water outlet and crankcase ventilation hoses at the intake manifold.
42. Install the distributor cap, position leads into clip on rocker cover and connect the leads to the spark plugs.
43. Connect the fuel line at the fuel pump and carburetor.
44. Install remaining alternator adjusting arm mounting bolts to cylinder head. Loosen alternator and governor adjusting bolts.
45. Install water pump pulley, spacer and fan. Install alternator and governor drive belts. Adjust both belts to specifications.
46. Remove engine from stand.

CYLINDER HEAD

Disassembly

1. Remove the exhaust manifold and the spark plugs.
2. Remove the intake manifold.
3. Remove deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the gasket surfaces.**
4. Compress the valve springs. Remove the valve spring retainer locks and release the spring. Remove the spring

retainer, spring, valve stem seal and valve. Discard the valve stem seals. Identify all valve parts. Refer to the Overhaul Section for repair procedures.

Assembly

1. Lubricate the valve guides and valve stems with engine oil. Apply Lubriplate or equivalent to the tips of the valve stems.
2. Install each valve in the valve guide from which it was removed or to which it was fitted. Install a new stem seal on the valve. Install the valve spring, valve spring retainer, compress the spring and install the retainer locks.
3. Measure the assembled height of the assembled valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer. If the assembled height is greater than specification, install the necessary spacer between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **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 would lead to spring breakage and/or worn camshaft lobes.**

OIL PUMP

Disassembly

1. Remove the filter.
2. Remove the end plate and withdraw the rubber O-ring from the groove in the pump body.
3. If it is necessary to replace the rotor assembly, remove the outer rotor, then drive out the retaining pin securing the gear to the shaft and pull off the gear.
4. Remove the inner rotor and shaft.
5. Drill a small hole and 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. Oil all parts thoroughly.
2. Install the oil pressure relief valve plunger, spring and new cap.
3. Install the inner rotor and shaft assembly in the pump body. Press the gear onto the shaft supporting the shaft at the rotor end on a suitable spacer, until the far end of the gear teeth are 2-1/4 inches (57.15mm) from the mounting flange. If a new shaft and/or gear are used, drill a 1/8 inch (3.175mm) hole at right angles to the shaft through the gear shoulder 1-5/16 inches (33.338mm) from the mounting flange. Replace the gear retaining pin and peen over the ends securely.
4. Install the outer rotor with its chamfered side facing inward toward the pump body.
5. Place a new rubber O-ring in the groove in the pump body. Position the end plate with the machined face toward the rotors and install the retaining bolts.
6. Coat the gasket on the oil filter with engine oil. Position the filter to the pump housing. Hand tighten the filter until the gasket contacts the face, then advance it 1/2 turn.

PART 2 Ignition System

COMPONENT INDEX	Page	COMPONENT INDEX	Page
IDENTIFICATION	2-01	REMOVAL AND INSTALLATION	
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DIAGNOSIS AND TESTING		Spark Plug Wire	2-07
Spark Intensity Tests	2-02	Spark Plugs	2-07
Ignition System Tests	2-02	Distributor	2-08
Distributor Tests — On Vehicle	2-03	Breaker Plate and/or	
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ADJUSTMENTS		CLEANING AND INSPECTION	
Breaker Points and/or Condenser	2-05	Spark Plugs	2-10
Ignition Timing	2-06	Distributor	2-10

IDENTIFICATION

The distributor identification number is stamped on the distributor housing. The basic part number for distributors is 12100. To procure replacement parts, it is necessary to know the part number prefix and suffix (Figure 1).

Always refer to the Parts Catalog for parts usage and interchangeability before replacing a distributor or a component part for a distributor.

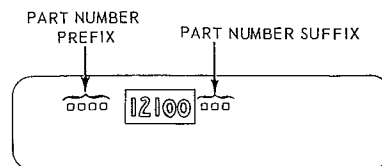


FIG. 1 Distributor Identification

DESCRIPTION

The distributor is located on the right side of the engine. It is equipped with a vacuum and a centrifugal advance unit to control ignition timing. The vacuum advance governs the ignition timing (spark advance) during low engine speeds, or low engine loadings. The centrifugal advance, in combination with the vacuum advance, controls the ignition timing at higher engine speeds or heavy engine loadings to provide the correct ignition timing for maximum engine performance.

The diaphragm is connected to the movable breaker plate by a link. An increase in vacuum will move the diaphragm against the advance diaphragm spring tension, causing the movable breaker plate to pivot opposite the distributor rotation. Thus, ignition timing is advanced, and this is calculated to occur during normal roadload operation, but not during deceleration or idle.

The ignition system consists of a primary (low voltage) and a secondary (high voltage) circuit (Figure 2).

The primary circuit consists of the:

1. Battery.
2. Ignition switch.
3. Primary circuit resistor.
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 (spark plug) wires.
5. Spark plugs.

When the breaker points are closed, current flows from the battery through the ignition switch to the primary wind-

ings 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.

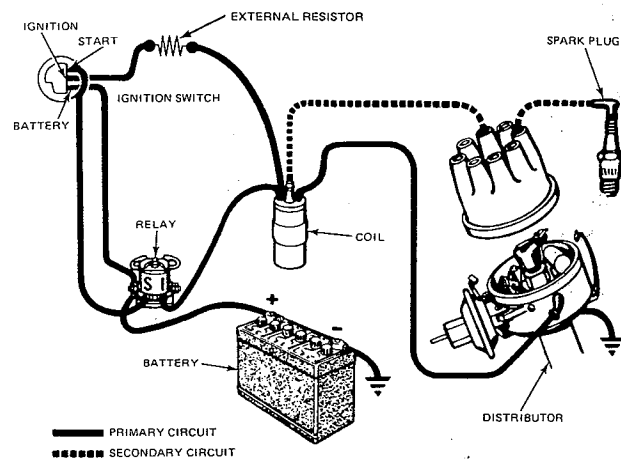


FIG. 2 Typical Conventional Ignition System Circuits

DIAGNOSIS AND TESTING

Ignition systems troubles are caused by a failure in the primary and/or the secondary circuit; incorrect ignition timing; or incorrect distributor advance. Circuit failures may be caused by shorts, corroded or dirty terminals, loose connections, defective wire insulation, cracked distributor cap or rotor, defective distributor points, fouled spark plugs, or by improper dwell angle.

If engine starting or operating trouble is attributed to the ignition system, start the engine and verify the complaint. On engines that will not start, be sure there is gasoline in the fuel tank and that fuel is reaching the carburetor. Then locate the ignition system problem by an oscilloscope test or by a spark intensity test.

SPARK INTENSITY TESTS

Trouble Isolation

1. Connect auxiliary starter switch in the starting circuit.
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 with an auxiliary starter switch.

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.

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; an open or shorted coil; or condenser.

A complete test of the primary circuit consists of checking 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; 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. Hold the adapter approximately 3/16 inch from the exhaust manifold and crank the engine, using an auxiliary 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 those particular 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.

IGNITION SYSTEM TESTS

Battery to Coil Voltmeter Test

1. Connect the voltmeter leads as shown in Figure 3.

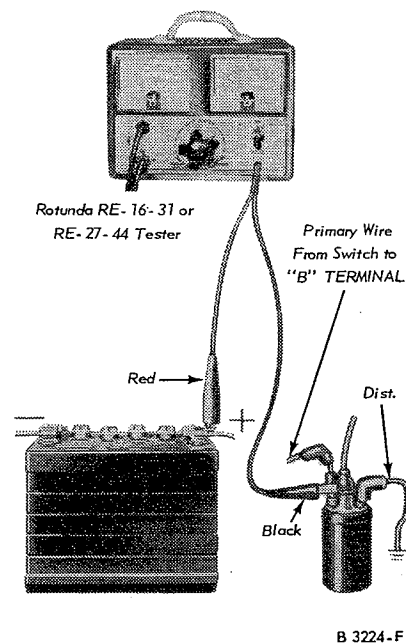


FIG. 3 Battery-to-Coil and Starting Ignition Circuit Test

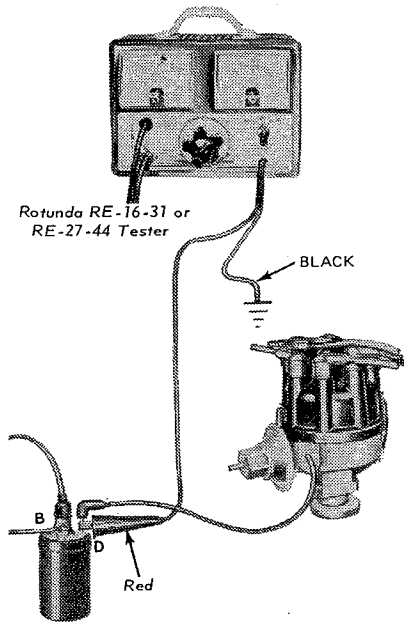
2. Connect a jumper wire to the distributor terminal of the coil to a good ground on the distributor housing.
3. Turn the lights and accessories off.
4. Turn the ignition switch on.
5. If the voltmeter reading is between 4.5 and 6.9 volts, the primary circuit from the battery to the coil is satisfactory.
6. If the voltmeter reading is greater than 6.9 volts, check the following:
 - The battery and cables for loose connections or corrosion
 - The primary insulation, broken strands, and loose or corroded terminals
 - If the voltmeter reading is less than 4.5 volts the ignition resistor should be replaced
 - Check the starter-relay-to-ignition switch for damage.

Starting Ignition Circuit Voltmeter Test

1. Connect the voltmeter leads as shown in Figure 3.
2. Disconnect and ground the coil to distributor high tension lead at the distributor.
3. With the ignition switch off, crank the engine with an auxiliary starter switch while observing the voltage drop.
4. If the voltage drop is 0.4 volt or less, the starting ignition circuit is satisfactory.
5. If the voltage drop is greater than 0.4 volt, clean and tighten the terminals in the circuit or replace the wiring as necessary.

Coil to Ground Voltmeter Test

1. Connect the voltmeter leads as shown in Figure 4.



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FIG. 4 Coil to Ground 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:
 - 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.

Coil Test

Check the coil on a coil tester following the manufacturer's 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.

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 5000 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 plugs, grasp and twist the moulded cap, then pull the cap off the spark plug by hand only. 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 an auxiliary 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 those particular leads.
 - If the spark is equal at all wires, but weak or intermittent, check the coil, distributor cap and the coil to distributor secondary (high tension) wires.

Spark Plug Test

Inspect, clean, file the electrodes and gap the plugs. After the proper gap is obtained, 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.

DISTRIBUTOR TESTS — ON VEHICLE

Test Connections

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.

Dwell Angle Check

1. Disconnect the distributor vacuum line. 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 cylinder selector to the figure corresponding to the number of lobes on the cam of the distributor.
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 wide. If the dwell angle was above the specified amount, the breaker point gap is too close.

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.

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. Remove the rotor.
3. Connect an auxiliary starter switch in the circuit.
4. Loosen the breaker point attaching screw near the breaker point contacts.
5. With the ignition on, crank the engine with an auxiliary

starter switch and adjust the gap to specifications.

6. Release the auxiliary starter switch and tighten the breaker point attaching screw.
7. Since the adjustment may have changed when the attaching 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 rotor, distributor cap, coil high tension lead and starter relay wires. Connect the distributor vacuum line.

DISTRIBUTOR TESTS — OFF VEHICLE

The following instructions indicate the general principles to be followed for testing the distributor on a tester. The method of testing, however, may vary for machines of different manufacture. For specific instructions refer to the equipment manufacturer's handbook.

1. Mount the distributor on the tester. Check that the distributor is free to rotate.
2. Make the necessary electrical connections and zero the instrument if required.
3. Tighten the drive chuck to the distributor drive shaft securely.
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 Synchronograph test lead to the primary lead wire of the distributor.

Breaker Point Resistance

1. Turn the test selector to the position for checking resistance.
2. Rotate the chuck by hand until the distributor breaker contacts are closed.
3. The pointer on the cam angle meter should read in the OK zone of the meter scale. 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 damaged 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

1. Turn the test selector to the cam angle position and rotate 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

1. Manually check the advance mechanism by turning the rotor in the direction of distributor rotation and then

releasing it. The rotor will return to its original position if the mechanism has freedom of movement and the springs are in good condition.

2. Make the necessary connections for the stroboscopic timing light or sparking protractor. (Refer to equipment manufacturer's handbook).
3. 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 then 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.
4. 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

1. Disconnect and plug the distributor vacuum line.
2. Turn the test selector switch to the correct 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. Unplug and connect the distributor vacuum line.

Breaker Plate Wear

A worn breaker plate on the distributor will usually cause the breaker point gap and contact dwell to be erratic 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 4 degrees when going from zero to maximum vacuum at constant rpm. If the dwell angle variation exceeds this limit, there is excessive wear.

Distributor Spark Advance Test

The spark advance is checked to determine if the ignition timing advances in proper relation to engine speed and load.

Check the contact dwell. If the contact dwell is not within specifications, adjust the breaker points.

Check the breaker arm spring tension and adjust it or replace the points as 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.**

ADJUSTMENTS

Accurate ignition system adjustments are of great importance in the proper operation and performance of the engine.

After any adjustment of ignition timing and distributor point dwell, check the distributor automatic advance for proper operation.

Centrifugal Advance

1. Operate the distributor in the direction of rotation and adjust the speed to the initial rpm setting listed in the specifications. Move the protractor scale so that one of the flashes lines up with the zero degree mark.
2. 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 (Figure 5). 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 so as not to repeat the adjustment on the same spring.

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 obtain the correct advance.
5. Check the advance at all rpm settings listed in the specification booklet. Operate the distributor both up and down the rpm range.

Vacuum Advance

1. Connect the test set vacuum line to the fitting on the diaphragm.
2. Set the test set at 0 degree advance, 0 vacuum, and at 1000 rpm.
3. Check the advance at the vacuum settings given in the specifications.

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.

To check the diaphragm for leakage:

Install the distributor tester. Do not connect the vacuum line to the distributor.

Adjust the vacuum pressure of distributor tester to obtain 25 inches of Hg or slightly less. Hold your hand over the end of the tester's vacuum hose and note the reading obtained. **Do not exceed 25 inches Hg.**

If the 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 gauge reading should not be less than it was above. If it is less, the diaphragm is leaking and should be replaced.

BREAKER POINTS AND/OR CONDENSER

Breaker Point Alignment

The breaker points must be accurately aligned and stroke squarely to assure normal breaker point life. Misalignment of these breaker point surfaces can cause premature wear, overheating and pitting.

1. Turn the cam so that the breaker points are closed, then check the alignment of the points (Figure 6).

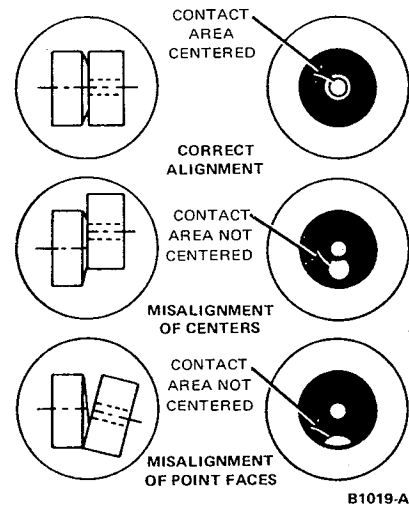


FIG. 6 Checking Breaker Point Alignment

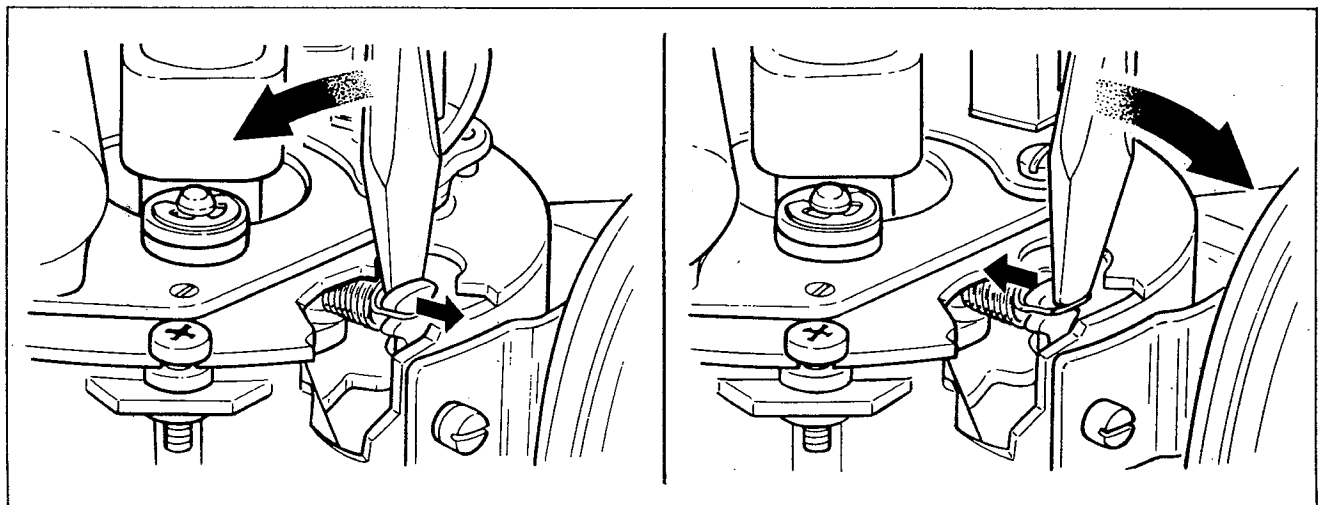
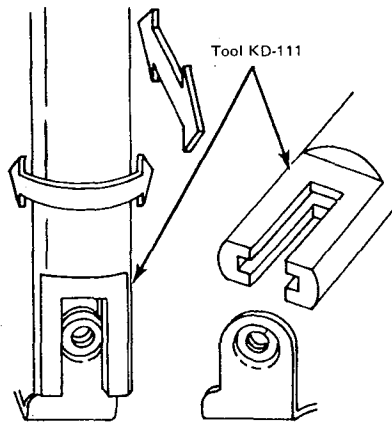


FIG. 5 Centrifugal Advance Adjustment

If the distributor is on the engine, close the points by proceeding as follows:

1. With the ignition switch off, crank the engine by using an auxiliary starter switch.
2. Using the tool shown (Figure 7) and exerting **very light pressure**, align the breaker point bracket. **Do not bend the breaker arm.**
3. After the breaker points have been properly aligned, adjust the breaker point gap.



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FIG. 7 Using Alignment Tool

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 on the engine, place the rubbing block on the peak of the cam by proceeding as follows:

Crank the engine with an auxiliary starter switch.

Insert the correct thickness blade of a clean feeler gauge between the breaker points (Figure 8). Adjust the points to the correct gap and tighten the screws.

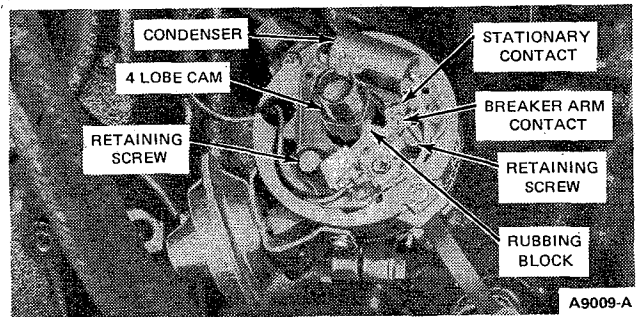


FIG. 8 Adjusting New Breaker Point Gap

Clean the cam, then 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.

Also, set the contact dwell to the low setting.

To check and adjust the breaker points with a scope or a dwell meter, refer to the manufacturer's instructions.

IGNITION TIMING

Timing Mark Locations

The timing marks and their locations are illustrated in Figure 9.

For checking and adjusting the ignition timing with a scope refer to the scope manufacturer's instructions. To check and adjust the timing with a timing light, proceed as follows:

Initial Ignition Timing

1. Clean and mark the specified timing mark with chalk or white paint.
2. Disconnect the vacuum line and plug the disconnected vacuum line.
3. Connect a timing light to the No. 1 cylinder spark plug wire. Connect a tachometer to the engine.
4. Start the engine and reduce the 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 by starting the engine and accelerating it to approximately 2000 rpm. If the ignition timing advances, the centrifugal

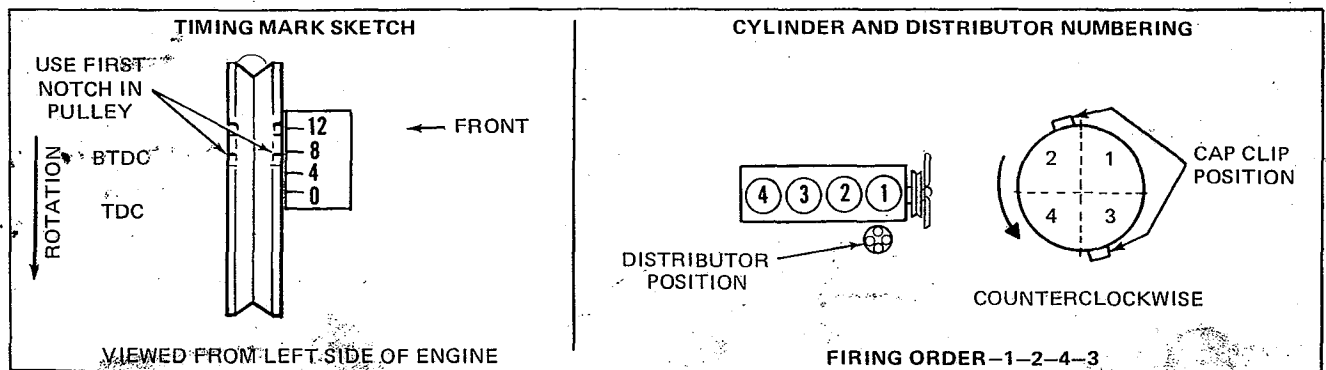


FIG. 9 Engine Timing and Cylinder Firing Order

advance mechanism is functioning properly. Note the engine speed when the advance begins and the amount of total advance. Stop the engine.

- Unplug the vacuum line and connect it to the distributor vacuum advance unit. Start the engine and accelerate it to approximately 2000 rpm. Note the engine speed when the advance begins and the total amount of advance.

Advance of the ignition timing should begin sooner and advance farther than when checking the centrifugal advance alone. Stop the engine.

- If the vacuum advance is not functioning properly, remove the distributor and check it on a distributor tester. Replace the diaphragm unit if the vacuum portion is out of calibration.

REMOVAL AND INSTALLATION

BREAKER POINTS AND/OR CONDENSER

Removal

- Remove the distributor cap and rotor.
- Disconnect the primary and the condenser wires from the breaker point terminal.
- Remove the breaker point assembly and condenser attaching screws. Lift the breaker point assembly and condenser out of the distributor.

Installation

- Clean the distributor cam thoroughly.
- Apply a light film of distributor cam lubricant C4AZ-19D500-A on the cam. **Do not use any type of oil.**
- Place the breaker point assembly and the condenser in position and install the attaching screws.
- Align and adjust the breaker points.
- Connect the primary and condenser wires to the breaker point terminal.
- 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 by hand only. Do not pull on the wires because the wire connection inside the cap may become separated or the boot may be damaged.

Removal

- Disconnect the wires from the spark plugs and distributor cap.
- Lift the wires from the clip on the valve rocker arm cover and remove the wires.
- Remove the coil high tension lead.

Installation

- Insert each wire in the proper socket of the distributor cap (Figure 10). Be sure the wires are forced all the way down into their sockets.
- Remove the wire retaining bracket from the old spark plug wire set and install it on the new set in the same relative position. Install the wires in the clip on the valve rocker arm cover. Connect the wires to the proper spark plugs. Install the coil high tension lead.

SPARK PLUGS

Removal

- Disconnect the wire 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.**
- 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.

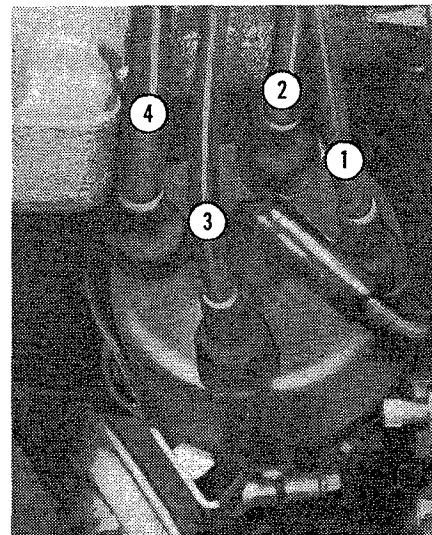


FIG. 10 Distributor Cap

After cleaning, the electrodes must be dressed with a small file to obtain flat parallel surfaces on both the center and side electrodes (Figure 11). Set the spark plug gap to specifications by bending the ground electrode (Figure 12); all spark plugs new or used should have the gap checked and reset as required.

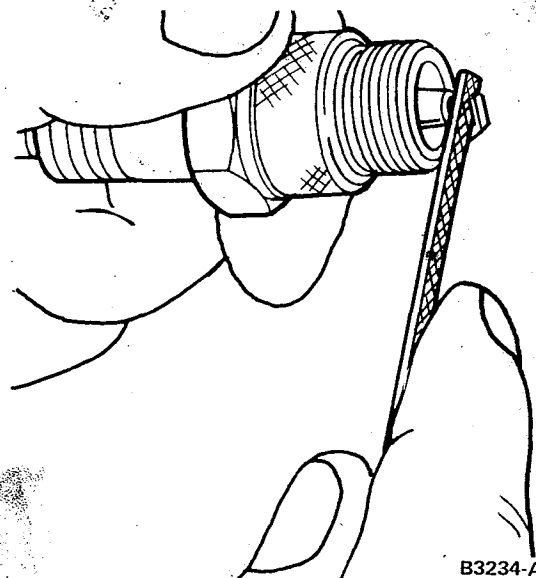


FIG. 11 Filing Spark Plug Electrode

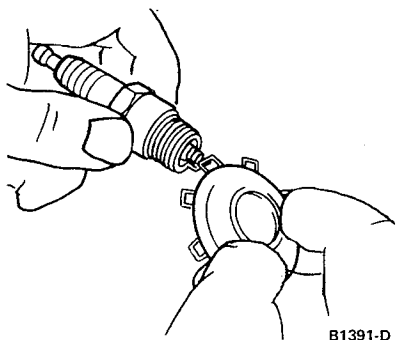


FIG. 12 Checking and Setting Spark Plug Gap

Installation

1. Install the spark plugs and torque each plug to specification.
2. Connect the spark plug wires.

DISTRIBUTOR

Removal

1. Remove the distributor cap.
2. Disconnect the vacuum line from the distributor.
3. Scribe a mark on the distributor body and the cylinder 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 providing the crankshaft has not been turned while the distributor is removed.
4. Remove the bolt attaching the distributor to the engine and carefully remove the distributor.

Installation

1. Align the scribe marks previously made on the distributor body, cylinder block and rotor. Install the distributor.
2. If the crankshaft was rotated while the distributor was removed, the engine must be timed as follows:
3. Turn the engine crankshaft until the appropriate timing mark on the timing cover is in line with the notch on the crankshaft pulley as the No. 1 piston comes up on the compression stroke.
4. With the vacuum advance unit pointing to the rear of the engine position the rotor to point to No. 2 spark plug (Figure 13).

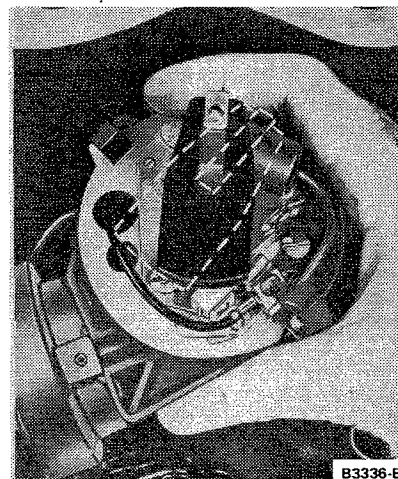


FIG. 13 Installing Distributor

5. Insert the distributor and, as the gears mesh, the rotor should rotate slightly. If necessary re-position the clamp, without turning the distributor, so that the hole is in line with the one in the cylinder block. Install the attaching bolt and tighten.

BREAKER PLATE AND/OR SUB-PLATE REMOVAL

Removal

1. Remove the distributor cap and the rotor.
2. Remove the breaker points from the plate (Figure 14).
3. Remove the C-clip that secures the vacuum advance arm to the plate.
4. Remove the two sub-plate attaching screws and lift the plate and wire from the housing.

Installation

1. Position the plate and wire in the housing and secure it with the two attaching screws.
2. Secure the vacuum advance arm to the plate with the C-clip.
3. Install the breaker points and rotor. Adjust the breaker point spacing to specification.
4. Install the rotor and the distributor cap.

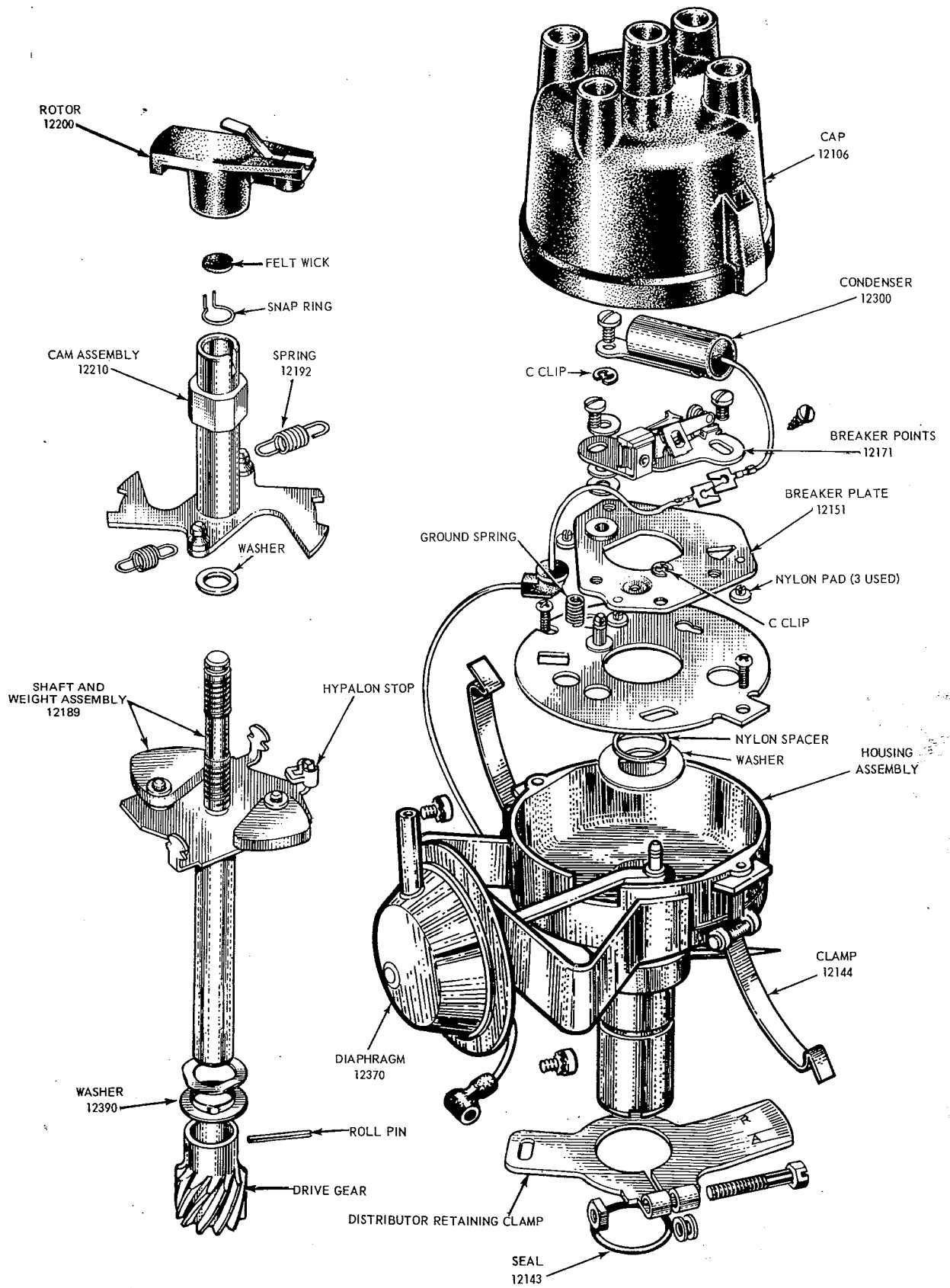


FIG. 14 Distributor — Disassembled

CLEANING AND INSPECTION

SPARK PLUGS

Examine the firing of the spark plugs, noting the type of deposits and the degree of electrode erosion. Refer to Figure 15 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 electrode.**

Examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of failure. Replace as required.

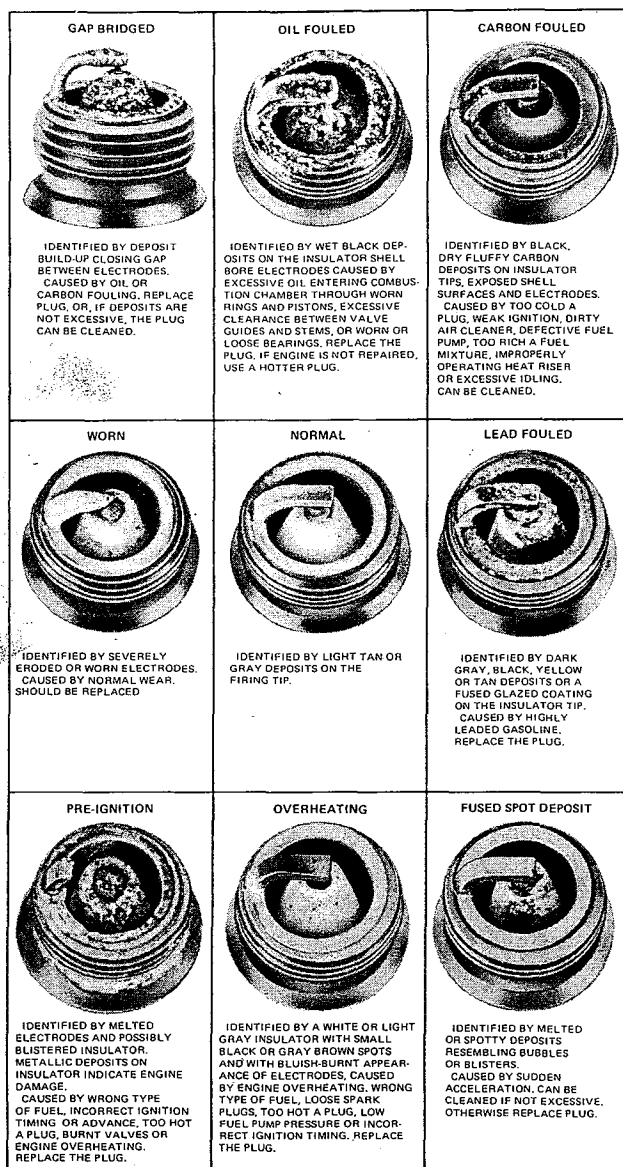


FIG. 15 Spark Plug Inspection

DISTRIBUTOR

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 cannot 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.

Inspect the distributor cam lobes for scoring and signs of wear. If any lobe is scored or worn, replace the distributor.

Inspect the breaker plate assembly for signs of distortion, wear or damage. Replace the breaker plate assembly if it is damaged.

Inspect all electrical wiring for fraying, breaks, etc. and replace any that is not in good condition.

Check the distributor base for cracks or other damage.

Check the diaphragm housing, bracket, and rod for damage. Check the vacuum line damage. Test the diaphragm for leakage as explained under Distributor Test. Replace all defective 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 (Figure 16). Metal transfer is considered excessive when it equals or exceeds the gap setting specifications.

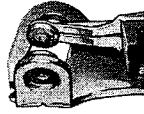

CONDITION	CAUSED BY
 <p>BURNED</p>	<p>Incorrect voltage regulator setting. Radio condenser installed to the distributor side of the coil.</p>
 <p>EXCESSIVE METAL TRANSFER OR PITTING</p>	<p>Incorrect alignment. Incorrect voltage regulator setting. Radio condenser installed to the distributor side of the coil. Ignition condenser of improper capacity. Extended operation of the engine at speeds other than normal.</p>

FIG. 16 Breaker Point Inspection

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, broken carbon button, carbon tracks or dirt or corrosion in the sockets. Replace the cap if it is damaged.

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 being broke, cracked, having carbon tracks, or burning. Replace the rotor if it is corroded or damaged.

Secondary Wiring

Wipe the wires with a damp cloth and check for breaks or cracked insulation. Inspect the terminals and boots 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 defects.

PART 3 Fuel System

COMPONENT INDEX	Page	COMPONENT INDEX	Page
IDENTIFICATION	3-01	Idle Speed	3-03
DESCRIPTION	3-01	Fuel Level (Float Level)	3-03
DIAGNOSIS AND TESTING		REMOVAL AND INSTALLATION	
Pressure Test	3-02	Carburetor	3-03
Capacity (Volume) Test	3-02	Fuel Pump	3-03
ADJUSTMENTS		DISASSEMBLY AND ASSEMBLY	
Idle Fuel Mixture and		Carburetor	3-04

IDENTIFICATION

The carburetor identification tag is attached to the upper body of the carburetor. The basic part number for all carburetors is 9510. To procure replacement parts, it is necessary to know the part number prefix and suffix.

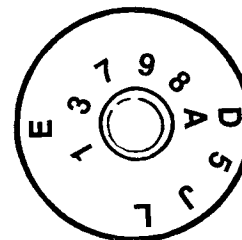


FIG. 1 Carburetor Identification

DESCRIPTION

The fuel system includes a single action fuel pump operated by a lobe on the camshaft. It is a permanently sealed unit and is not repairable.

The fuel filter is the disposable in-line type located in the line between the fuel pump and carburetor.

The carburetor is a Bendix single venturi, downdraft design.

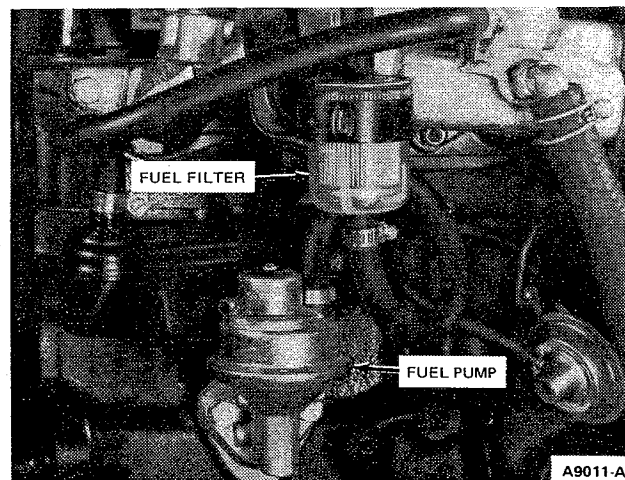


FIG. 2 Fuel Pump and Filter

DIAGNOSIS AND TESTING

To determine that the fuel pump is in satisfactory operating condition, tests for both fuel pump pressure and fuel pump capacity (volume) should be performed.

The tests are performed with the fuel pump installed on the engine and the engine at normal operating temperature at idle speed.

Before the tests, make sure the replaceable fuel filter has been changed within the recommended maintenance mileage interval. When in doubt, install a new filter.

PRESSURE TEST

Refer to the fuel pump specification in this Part, and note the fuel pump pressure and capacity (volume) design tolerances.

1. Remove the air cleaner assembly. Disconnect the fuel inlet line or the fuel filter at the carburetor. Use care to prevent combustion due to fuel spillage.
2. Connect a pressure gauge, a restrictor and a flexible hose (Figure 3) between the fuel filter and the carburetor.

NOTE: Inside diameter of smallest passage in test flow circuit must not be smaller than .220.

3. Position the flexible fuel outlet hose and the restrictor so the fuel can be discharged into a suitable, graduated container (Figure 3).
4. Before taking a pressure reading operate the engine at

the specified idle rpm and vent the system into the container by opening the hose restrictor momentarily.

5. Close the hose restrictor, allow the pressure to stabilize, and note the reading. Refer to the Specifications Section in this Part.

If the pump pressure is not within specifications, and the fuel lines and filter are in satisfactory condition, the pump is defective and should be replaced.

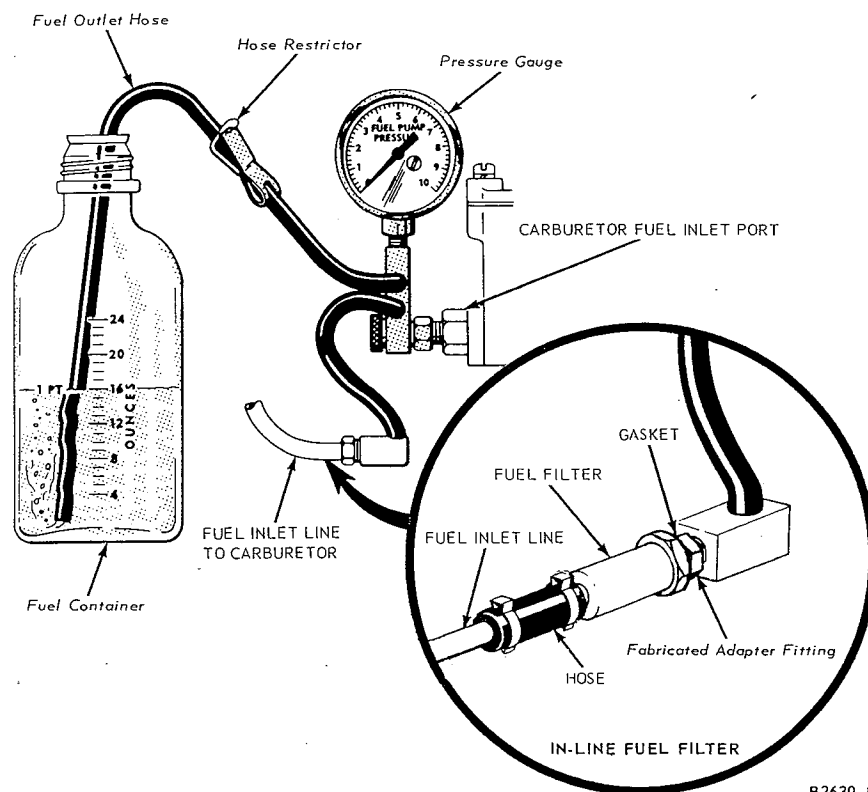
If the pump pressure is within specifications, perform the tests for fuel capacity (volume).

CAPACITY (VOLUME) TEST

With the fuel pump pressure within specifications, test the capacity (volume) as follows:

1. Operate the engine at the specified idle rpm.
2. Open the hose restrictor and expel the fuel into the container (Figure 3), while observing the time required to expel one pint. Close the restrictor. One pint or more of fuel should be expelled within the specified time limit.

If the pump volume is below specifications, repeat the test using an auxiliary fuel supply and a new fuel filter. If the pump volume meets specifications while using the auxiliary fuel supply, check for a restriction in the fuel supply from the tank and for the tank not venting properly.



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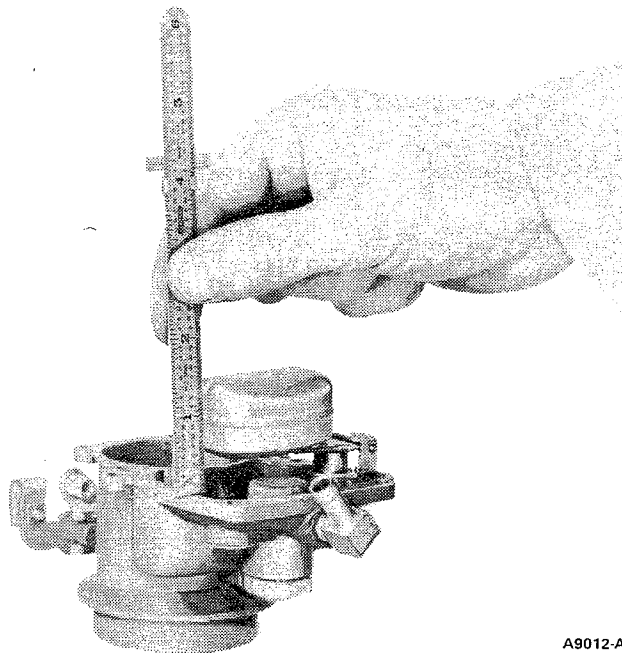
FIG. 3 Typical Fuel Pump Pressure and Capacity Test Equipment

ADJUSTMENTS

IDLE FUEL MIXTURE AND IDLE SPEED

The idle fuel mixture and idle speed adjustment screws are the only external adjusting items on this carburetor. To adjust the idle fuel mixture and idle speed, proceed as follows:

1. Remove the air cleaner. Operate the engine at a fast idle speed until normal operating temperature is reached.



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FIG. 4 Float Level

2. Disengage any load on the engine.
3. Set the throttle at minimum speed. Be sure the throttle linkage does not control the idle speed. The idle speed adjustment screw must contact the throttle lever.
4. Turn the idle speed adjusting screw either in or out to obtain 700 rpm.
5. Turn the idle mixture adjustment screw inward until the engine speed begins to drop due to a lean mixture. Next turn the screw outward until the engine speed begins to drop due to a too rich mixture. Then turn the screw inward to a point between these two extremes to obtain maximum engine smoothness and rpm.
6. Set the idle speed to the smoothest point within the range of 700-850 rpm.
7. Recheck idle mixture adjustment and reset if needed.

FUEL LEVEL (FLOAT LEVEL)

1. Disconnect the choke cable.
2. Remove the screws attaching the air intake body to the fuel bowl assembly.
3. Raise the air intake body slightly and loosen the gasket from the fuel bowl, then lift the air intake and gasket clear of the fuel bowl.
4. Invert the air intake body and remove the gasket.
5. With the air intake body inverted, and only the weight of the float assembly pressing against the inlet needle and seat, measure the vertical distance from the air intake body gasket surface to the top of the float (Figure 4).
6. Bend the float arm as necessary to adjust the float to the proper dimension.
7. Place the gasket on the fuel bowl and position the air intake body. Install the retaining screws. Tighten the screws evenly and securely.
8. Connect the choke cable.

REMOVAL AND INSTALLATION

CARBURETOR

Removal

1. Remove the air cleaner.
2. Disconnect the fuel inlet line and distributor vacuum hose.
3. Disconnect the carburetor throttle linkage. Disconnect choke cable.
4. Remove carburetor retaining nuts and lift off carburetor.
5. Remove and discard carburetor gasket.

Installation

1. Install new carburetor gasket and mount carburetor. Secure with retaining nuts.
2. Connect throttle linkage and the choke cable. Check operation of throttle and choke for full travel.

3. Connect fuel line and distributor vacuum line.
4. Start engine and adjust idle speed and idle fuel mixture.
5. Install the air cleaner.

FUEL PUMP

Removal

1. Disconnect the fuel inlet and outlet lines at the fuel pump.
2. Remove fuel pump retaining screws. Lift off pump and gasket.

Installation

1. Place new gasket on pump and position pump on cylinder block. Install retaining screws.
2. Connect fuel inlet and outlet lines.