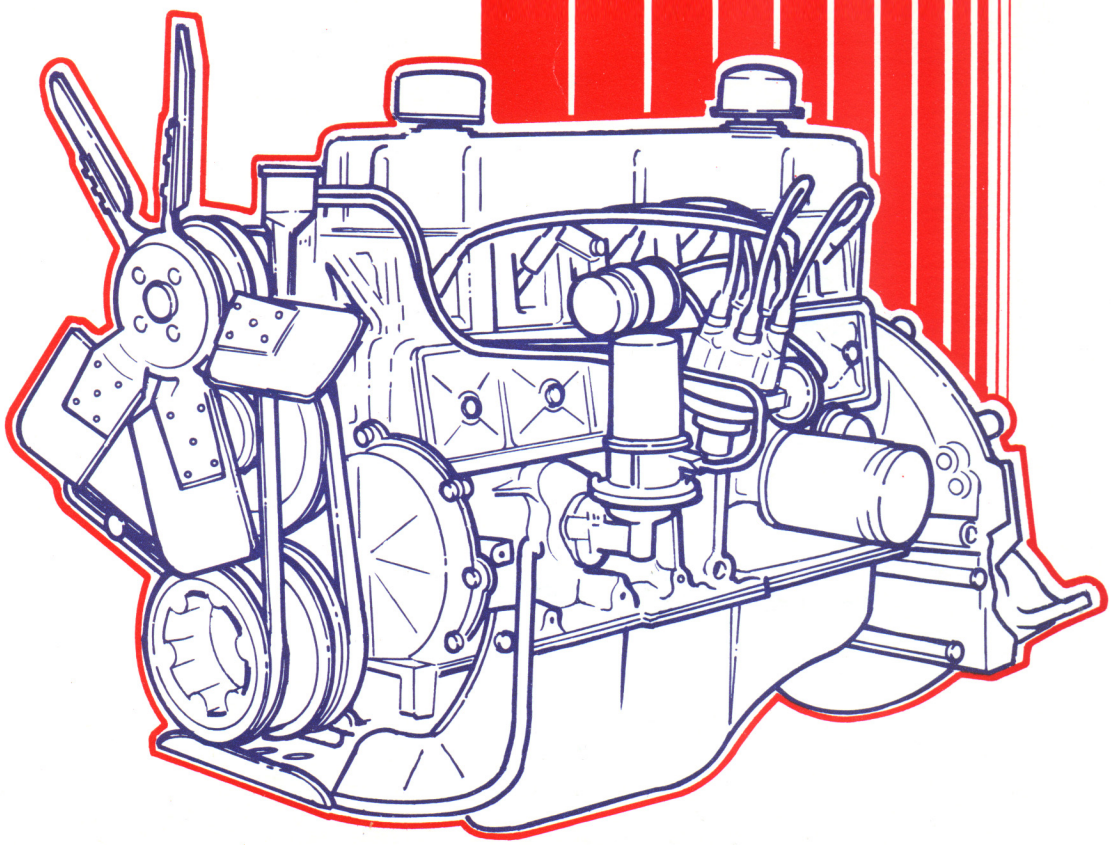
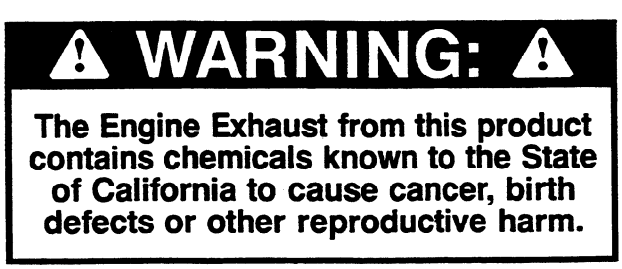
Ford

Power Products

CSG-649 INDUSTRIAL SERVICE MANUAL




WARNING:
The Engine Exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

Introduction

This Service Manual provides the Service technician with information for the proper servicing of the Ford 300 CID Industrial Engine.

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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NOTE: *The recommendations and suggestions contained in this publication are made to assist the distributor in improving his distributorship parts and/or service department operations. These recommendations and suggestions do not supersede or override the provisions of the Warranty and Policy Manual and in any cases where there may be a conflict, the provisions of the Warranty and Policy Manual shall govern.*

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK. If you have a manual transmission, it should be in REVERSE.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts, especially the fan and belts, whenever the engine is running.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle.

CSG-649 GASOLINE ENGINE

Part 1 Basic Engine

IDENTIFICATION

An Identification Decal (Figure 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.

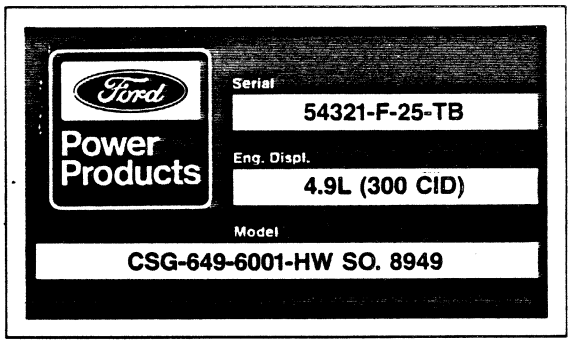

FIG. 1 Engine I.D. Decal

DESCRIPTION

The Ford 300 cubic inch six-cylinder engine is available as an engine assembly or a complete ready-to-run power unit. In addition, a full range of optional equipment is available to custom tailor the engine or power unit to individual requirements.

The cylinder block is manufactured from cast iron using the Ford-pioneered precision casting process. This process provides ultra-lightweight design with a maximum of strength and rigidity. Special design features of the cylinder block include seven main bearings and full-length, full-circle water jackets. The seven main bearings provide a rugged "foundation" for extra durability and a smoothness of operation comparable to many V-8s. The full-length, full-circle water jackets help eliminate hot-spots and provide more uniform cylinder wall expansion under heavy-duty operation.

The precision molded, cast-alloy iron crankshaft is carried in seven replaceable copper-lead alloy main bearings. Crankshaft end thrust is controlled by the flanges of the No. 5 main bearing.

The aluminum alloy piston has three rings; two compression and one oil control. The autothermic, semi-dish type cam ground pistons give longer life with a minimum of maintenance. The connecting rods are forged steel and use replaceable copper-lead bearings.

The camshaft is supported by four bearings pressed into the block. It is driven by gears from the crankshaft. Camshaft end play is controlled by a plate bolted to the front of the block. The distributor, located on the left side of the engine, is driven by a gear on the camshaft. The distributor drives the rotor-type oil pump through an intermediate driveshaft.

The cylinder head assembly contains the fuel intake passages, the valves, and the individual valve rocker arm assemblies. Valve guides are an integral part of the head. Optional hard-faced intake and exhaust valve seat inserts are pressed into the heads. The intake and exhaust valves are actuated through hydraulic valve lifters and rocker arms. Rocker arms are individually pedestal-mounted with a provision for adjustment.

A chamber (heat riser), cast into the intake manifold between the carburetor and exhaust manifold provide the heat to vaporize the incoming fuel charge until the engine reaches operating temperature.

The engine is equipped with a crankcase ventilation system that vents crankcase fumes through two vented oil fill caps on the rocker arm cover.

The 300 power unit is a complete ready-to-run engine mounted on a foot-type frame. Included are radiator, pusher or puller-type fan, power take-off instruments, throttle, choke, air cleaner, fuel tank, exhaust pipe, and a sheet metal shroud enclosing the front, rear and top of unit.

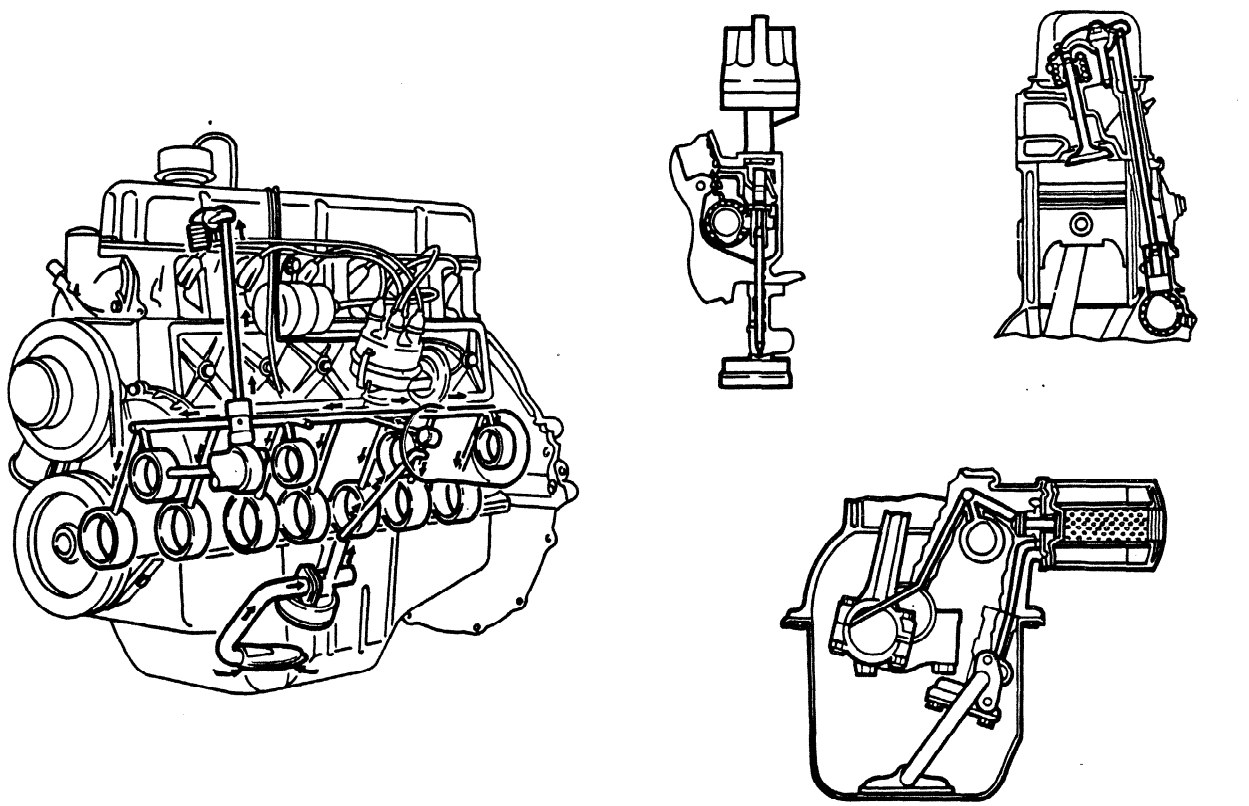

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FIG. 2 300 CID Engine

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. Remove the heater hose and crankcase ventilation hose, if so equipped. Remove valve rocker arm cover.
2. Remove the rocker arm stud nut, fulcrum seat and rocker arm. Use the adapter for ball end push rods.
3. Make sure the push rod is in the valve lifter socket. Install a dial indicator so that the actuating point of the indicator is in the push rod socket and in the same plane as the push rod movement (Figure 3).
4. Connect an auxiliary starter switch in the starting circuit. Crank the engine with the ignition switch OFF.
5. Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position.
6. Compare the total lift recorded on the indicator with specification.
7. To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. **If the lift on any lobe is below specified wear limits, the camshaft and the valve lifters operating on the worn lobe(s) must be replaced.**
8. Remove the dial indicator and auxiliary starter switch.
9. Install the rocker fulcrum seat and stud nut. Adjust the valve clearance.
10. Install the valve rocker arm cover and the air cleaner.

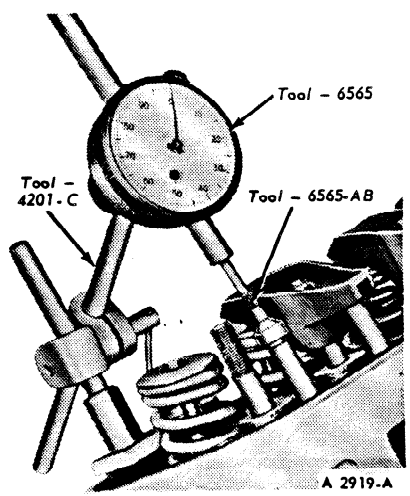

FIG. 3 Typical Camshaft Lobe Lift

COMPRESSION TEST

COMPRESSION GAUGE CHECK

The following procedure is to be used when checking compression:

1. Be sure the crankcase oil is of the correct viscosity and make sure that 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 in the wide open position.
3. Install a compression gauge in No. 1 cylinder.
4. Install an auxiliary starter switch in the starting circuit. Crank the engine (with the ignition switch OFF) at least five (5) pumping strokes and record the highest reading indicated. Note the approximate number of compression strokes required to obtain the highest reading.
5. Repeat the check on each cylinder cranking the engine approximately the same number of compression strokes.

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.

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.

HYDRAULIC VALVE LIFTER

Dirt, deposits of gum and varnish and air bubbles in the lubricating oil can cause hydraulic valve lifter failure or malfunction by preventing a check valve from seating and causing a loss of hydraulic pressure. An open valve disc will cause the plunger to force oil back into the valve lifter reservoir during the time the push rod is being lifted to force the valve from its seat.

Air bubbles in the lubricating system can be caused by too much oil in the system or too low an oil level. Air may also be drawn into the lubricating system through an opening in a damaged oil pick-up tube. Air in the hydraulic system can cause a loss of hydraulic pressure.

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

1. Disassemble and clean the lifter to remove all traces of engine oil. Lifters cannot be checked with engine oil in them. Only the testing fluid can be used.
2. Place the valve lifter in the tester with the plunger facing upward. Pour hydraulic tester fluid into the cup to a level that will cover the valve lifter assembly. The fluid can be purchased from the manufacturer of the tester. Do not use kerosene, for it will not provide an accurate test.
3. Place a 5/16 inch steel ball in the plunger cup.
4. Adjust the length of the ram so that the pointer is 1/16 inch below the starting mark when the ram contacts the valve lifter plunger to facilitate timing as the pointer passes the start timing mark.

   Use the center mark on the pointer scale as the stop timing point instead of the original stop timing mark at the top of the scale.
5. Work the valve lifter plunger up and down until the lifter fills with fluid and all traces of air bubbles have disappeared.
6. Allow the ram and weight to force the valve lifter plunger downward. Measure the exact time it takes for the pointer to travel from the start timing to the stop timing marks on the tester.
7. A valve lifter that is satisfactory must have a leak-down rate (time in seconds) within the minimum and maximum limits specified.
8. If the valve lifter is not within specifications, replace it with a new lifter. It is not necessary to test a new lifter before installing it in the engine.

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		

CA1005-A

FIG. 4 Quick Reference Compression Pressure Limit Chart

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 the surface is flat to form a seal between the cover and tester. If the cover is distorted, shape it as required to make an air tight seal. An air leak between the cover and tester will render the tester inoperative or give an erroneous reading.
3. Start the engine and allow it to operate at the recommended idle speed.
4. Hold the tester over the oil filler cap opening making sure that there is a positive seal between the tester and cover.
5. If the ball settles in the **GOOD** (green) area, the system is functioning properly. If the ball settles in the **REPAIR** (red) area, clean or replace the malfunctioning components as required.
6. Repeat the test **AFTER** repairs are made to make sure that the crankcase ventilation system is operating satisfactorily.

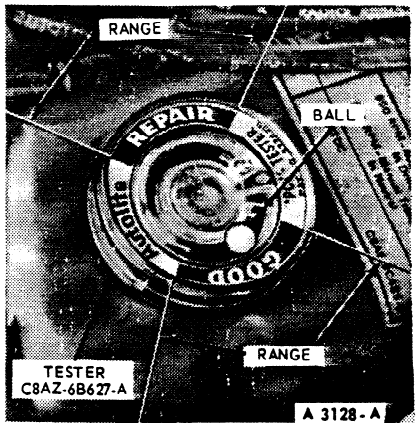

FIG. 5 Crankcase Ventilation System Tester

CRANKCASE VENTILATION REGULATOR VALVE TEST

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

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

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

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.
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 if the mounting flange runout exceeds specifications. Replace it or reinstall it on the flywheel.

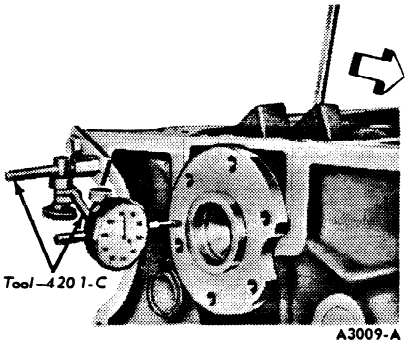

FIG. 6 Checking Crankshaft End Play

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 (Figure 7). Zero the dial indicator. Position a large screwdriver between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with the specifications.

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

Remove the dial indicator.

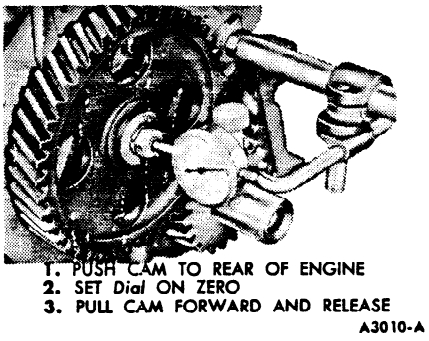

FIG. 7 Checking Camshaft End Play — Typical

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

EXHAUST MANIFOLDS

Cleaning

Remove all gasket material from the manifolds.

Inspection

Check the exhaust control valve for freedom from binding throughout the valve travel. If necessary, free the shaft with exhaust control valve solvent. If the solvent does not eliminate the binding condition, replace the component parts.

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

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Cleaning

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

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

Inspection

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

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

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

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 8).

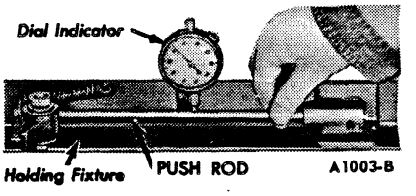

FIG. 8 Checking Push Rod Runout

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. Using 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

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

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

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

CYLINDER HEAD FLATNESS

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head gasket surface (Figure 9) for conformance to specifications. If necessary to refinish the cylinder head gasket surface, **do not plane or grind off more than 0.010 inch from the original gasket surface.**

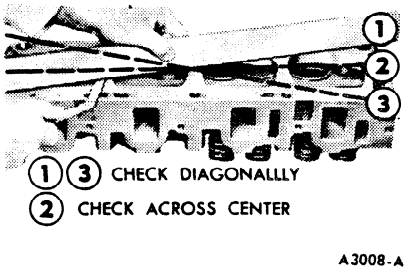

FIG. 9 Checking Cylinder Head Flatness

VALVE SEAT RUNOUT

Check the valve seat runout with an accurate gauge (Figure 10). Follow the instructions of the gauge manufacturer. If the runout exceeds the wear limit, reface the valve and valve seat.