

ENGINE

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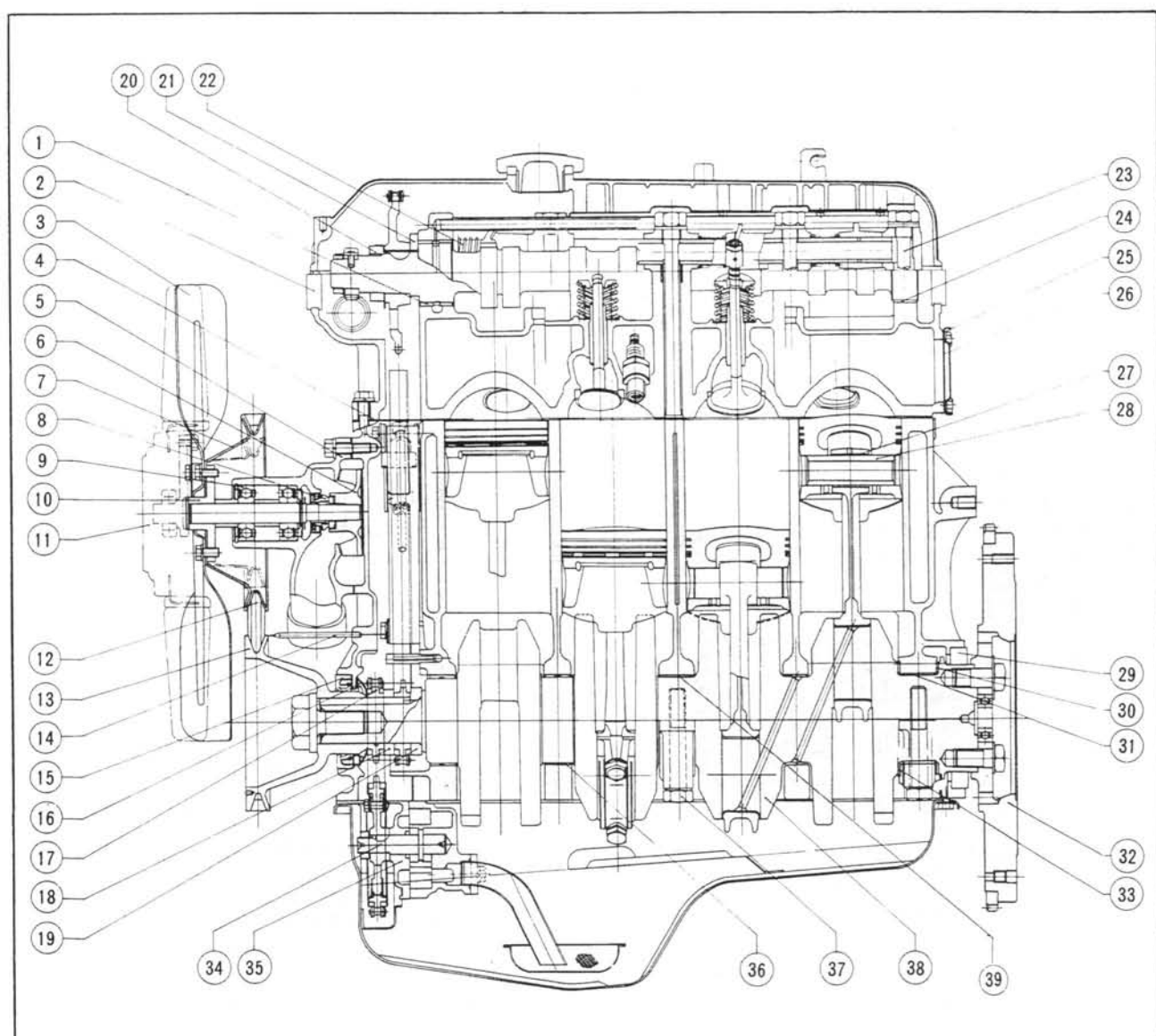


Fig. 1-1 Engine (1)

- | | |
|---------------------------|---------------------------|
| 1. Camshaft bearing front | 21. Thrust plate |
| 2. Oil seal | 22. Spring |
| 3. Cooling fan | 23. Cylinder head bolt |
| 4. Cylinder head gasket | 24. Camshaft bearing rear |
| 5. Water pump | 25. Blind cover |
| 6. Impeller | 26. Gasket |
| 7. Water pump pulley | 27. Small end bush |
| 8. Water seal | 28. Piston pin |
| 9. Bearing | 29. Oil seal |
| 10. Pulley boss | 30. Thrust bearing upper |
| 11. Fan drive | 31. Main bearing |
| 12. V belt | 32. Flywheel |
| 13. Crankshaft pulley | 33. Thrust bearing lower |
| 14. Top indicator pin | 34. Oil pump shaft |
| 15. Oil seal | 35. Oil pump cover |
| 16. Oil deflector | 36. Main bearing |
| 17. Crankshaft sprocket | 37. Main bearing cap bolt |
| 18. Spacer | 38. Crankshaft |
| 19. Spacer | 39. Main bearing |
| 20. Lock nut | |

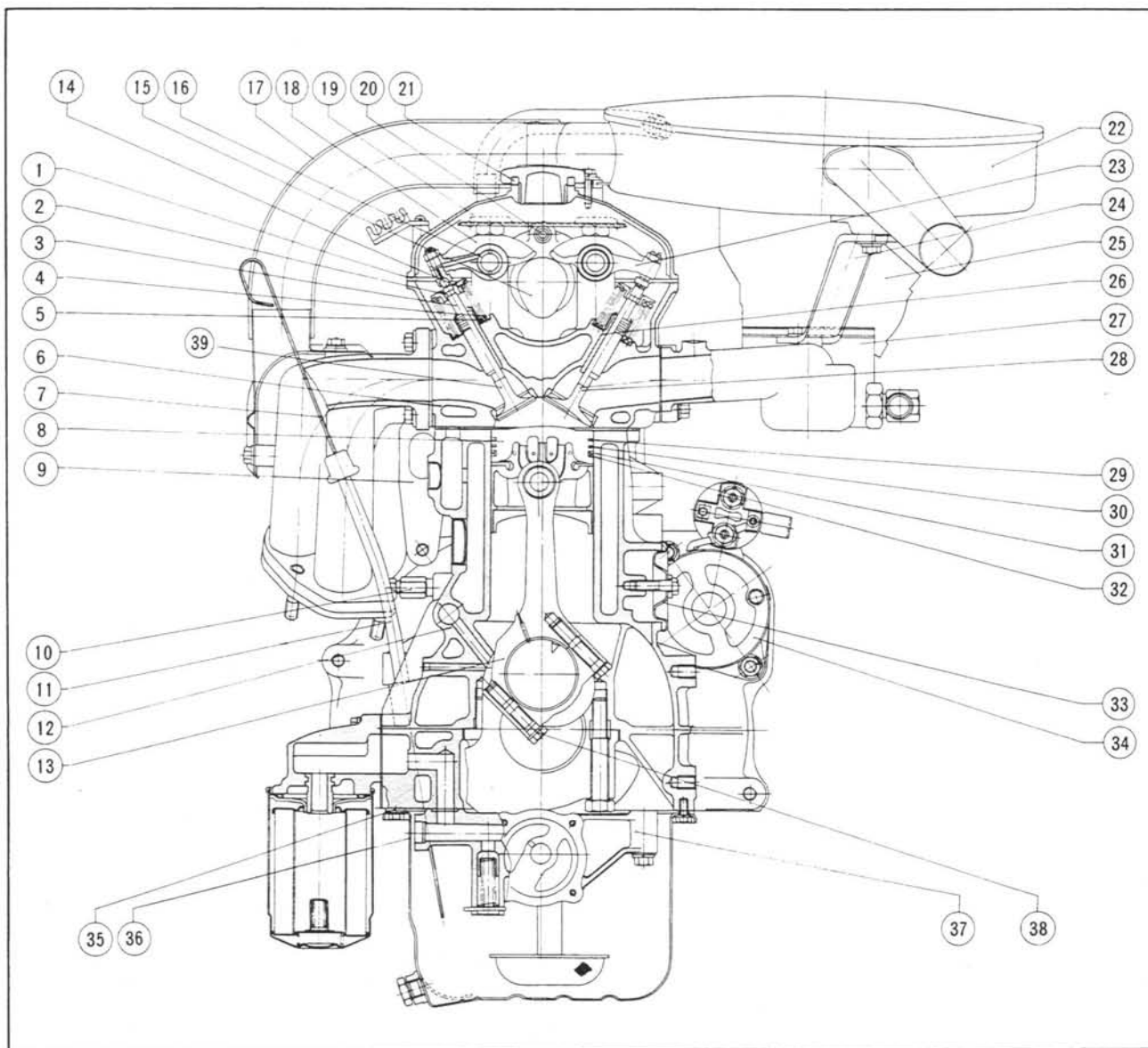


Fig. 1-2 Engine (2)

- | | |
|----------------------------|-----------------------------|
| 1. Rocker arm cover gasket | 21. Gasket |
| 2. Exhaust taper sleeve | 22. Air cleaner |
| 3. Exhaust valve | 23. Inlet taper sleeve |
| 4. Valve spring outer | 24. Air cleaner supporter |
| 5. Valve spring inner | 25. Carburetor |
| 6. Cylinder head | 26. Inlet valve guide |
| 7. Oil level gauge | 27. Inlet manifold |
| 8. Piston | 28. Inlet valve |
| 9. Engine hanger | 29. Piston ring top |
| 10. Water drain cock | 30. Piston ring second |
| 11. Level gauge guide pipe | 31. Piston ring oil |
| 12. Cylinder block | 32. Expander |
| 13. Connecting rod | 33. Crankcase cover |
| 14. Spring seat upper | 34. Starting motor |
| 15. Camshaft | 35. Gasket |
| 16. Exhaust rocker shaft | 36. Oil pan |
| 17. Hot air duct | 37. Oil pump body |
| 18. Rocker arm | 38. Connecting rod cap bolt |
| 19. Rocker arm cover | 39. Exhaust valve |
| 20. Oil distribution pipe | |

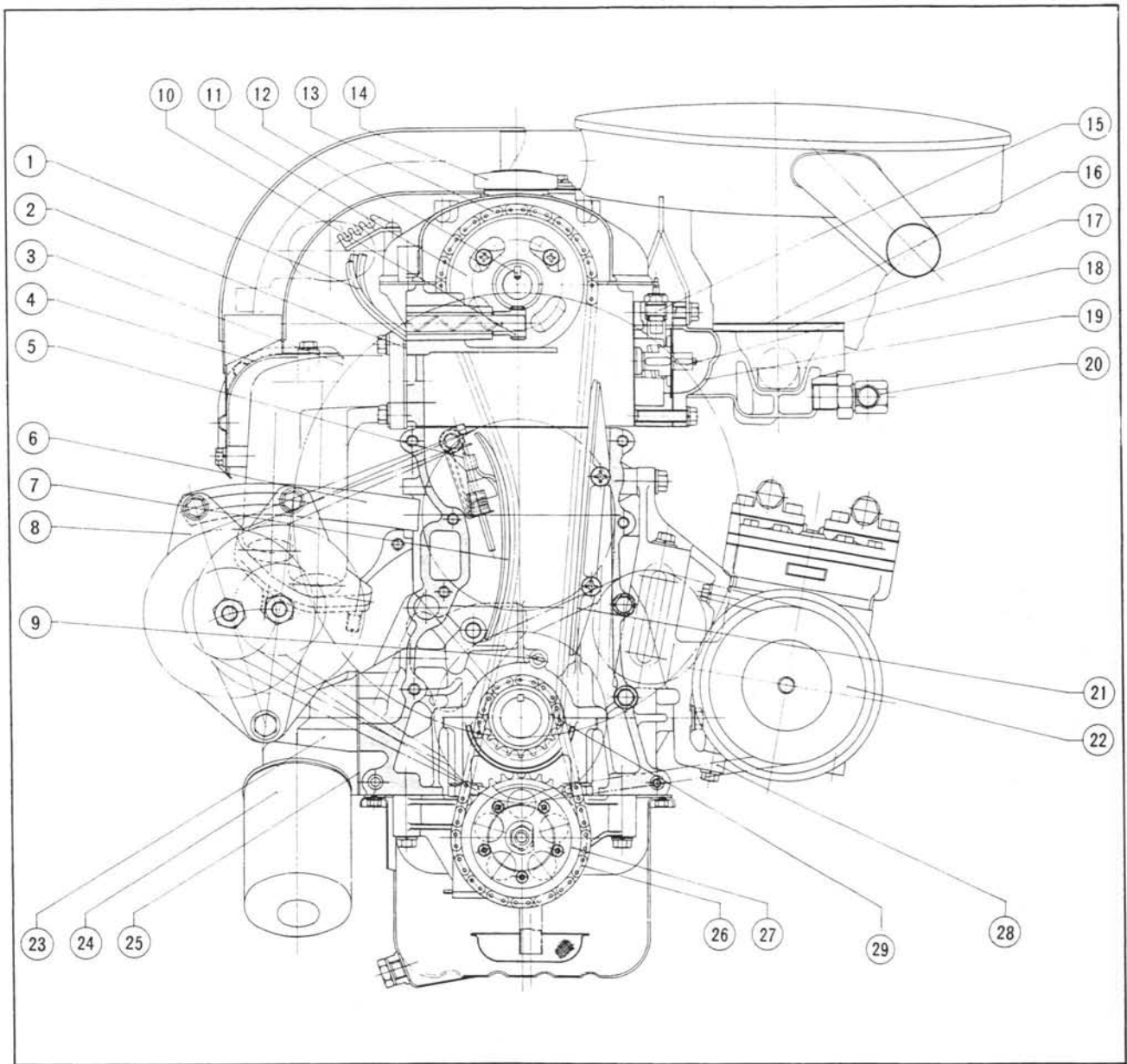


Fig. 1-3 Engine (3)

- | | |
|-----------------------------|-----------------------------|
| 1. Hightension cord | 16. Gasket |
| 2. Gasket | 17. Insulator |
| 3. Exhaust manifold | 18. Thermostat |
| 4. Insulator | 19. Thermostat casing cover |
| 5. Chain tensioner | 20. Hose connector |
| 6. Alternator strap | 21. Vibration damper |
| 7. Slipper blade | 22. Cooler compressor |
| 8. Alternator | 23. Alternator bracket |
| 9. Oil jet | 24. Oil filter |
| 10. Distributor driven gear | 25. Gasket |
| 11. Cam sprocket wheel | 26. Oil pump drive chain |
| 12. Distributor drive gear | 27. Oil pump sprocket |
| 13. Timing chain | 28. Bracket |
| 14. Oil filler cap | 29. Rubber ring |
| 15. Water temperature unit | |

ENGINE

MAZDA 616 is mounted with a 1,586 cc (96.8 cu-in) in-line water cooled, over head camshaft four cylinder engine. Its bore and stroke is 78 x 83 mm and the compression ratio is 8.6 : 1.

1-A. CHECKING COMPRESSION PRESSURE

To check the compression pressure, proceed as follows:

1. Warm up the engine to the normal operating temperature.
 2. Remove all spark plugs.
 3. Set the throttle valve to the wide open position.
 4. Place a compression gauge in the spark plug hole.
 5. Crank the engine with the starting motor until the pressure reaches a maximum value.
 6. Test the remaining cylinders in the same manner.
 7. The normal compression pressure is **11.9 kg/cm² (169.2 lb/in²)** at the engine speed of 310 rpm.
- If low or uneven values are obtained, test the compression pressure again after pouring a small quantity of oil into each cylinder. If the pressure is low, both with and without oil, this is a symptom of leaking valves. If the pressure is higher when the oil has been added, it is probable that the piston rings or cylinder bores are worn.

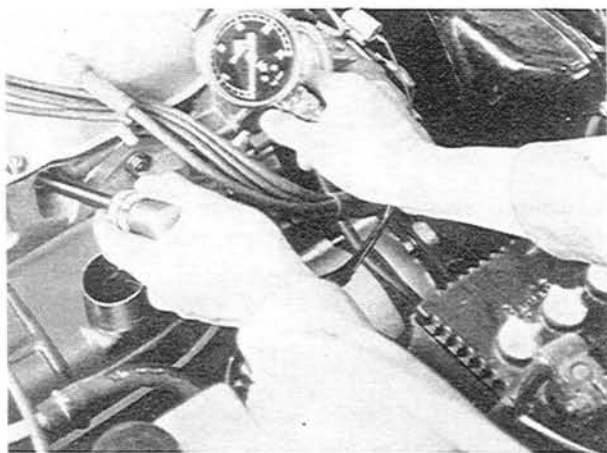


Fig. 1-4 Checking of compression pressure

1-B. ENGINE REMOVAL

The procedures for removing the engine from the vehicle for overhauling are as follows:

1. Remove the bonnet.
2. Loosen the under cover attaching bolts and remove the under cover.
3. Drain the cooling water by opening the drain cocks at the lower of the radiator and the right rear of the cylinder block.
4. Drain the engine oil.
5. Disconnect the earth wire at the battery to avoid the possibility of a short circuit.
6. Disconnect the wires to the engine. (Distributor, starting motor, alternator, oil pressure switch, water temperature gauge unit, carburetor solenoid and engine earth wire)
7. Remove the insulator at the exhaust manifold.

8. Loosen the nuts attaching the exhaust manifold to the cylinder head.
9. Remove the air cleaner.
10. Disconnect the choke control wire at the carburetor.
11. Disconnect the accelerator wire at the carburetor.
12. Disconnect the vacuum pipe for the power brake unit from the intake manifold.
13. Disconnect the fuel hose at the carburetor.
14. Remove the each water hose at the intake manifold.
15. Remove the water hose for the expansion tank at the radiator.
16. Remove the radiator hose at the upper and lower of the radiator.
17. Loosen the radiator cowling attaching bolts.
18. Loosen the radiator attaching bolts and then remove the radiator.

Note: The radiator cowling should be removed after the radiator has been removed.

19. Support the transmission with a suitable jack.
20. Remove the starting motor.
21. Remove the clutch cover plate and stays.
22. Remove the bolts and nuts supporting the transmission to the engine.
23. Install a suitable lifting sling on the engine hanger brackets. Attach the sling to a hoist or other lifting device and take up all slack.
24. Remove the bolts and nuts from each engine mount.
25. Pull the engine forward until it clears the clutch shaft. Then lift the engine from the vehicle.

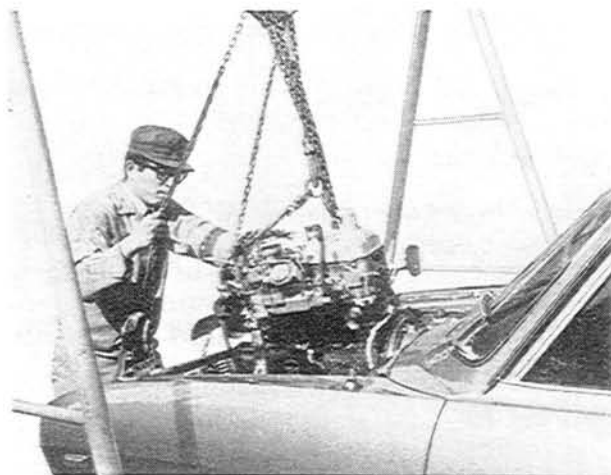


Fig. 1-5 Removing of engine

26. Remove the engine mounting brackets from the cylinder block and mount the engine on to the **engine stand** (49 0107 680A and 49 0305 005) or wood blocks.

1-C. ENGINE DISASSEMBLY

Engine overhaul should be done in the following order after removing the engine from the vehicle. If the engine repair stand is not available, take care so as to sufficiently protect the engine and its parts against damage.

1-C-1. Removing of Distributor

1. Disconnect the high-tension cords from each spark plug.
2. Pull off the vacuum control tube from the distributor.
3. Loosen the distributor locking nut and remove the distributor from the cylinder head.

1-C-2. Removing of Alternator and Bracket

1. Loosen the alternator strap attaching bolts.
2. Loosen the alternator mounting bolt and nut, and then remove the alternator and the "V" belt.
3. Loosen the nuts and bolt attaching the alternator bracket to the block.
4. Remove the alternator bracket.

1-C-3. Removing of Oil Filter

1. Remove the oil filter cartridge with a wrench, referring to Par. 2-F-1.
2. Loosen the bolts and remove the filter cover and gasket.

1-C-4. Removing of Cooling Fan and Pulley

1. Loosen the bolts that attach the cooling fan and pulley to the water pump boss.
2. Remove the fan and pulley.

1-C-5. Removing of Water Pump

1. Loosen the bolts and nuts attaching the water pump to the timing chain cover.
2. Remove the alternator strap.
3. Remove the water pump and gasket.

1-C-6. Removing of Thermostat

1. Loosen the bolts and nuts that attach the thermostat cover to the cylinder head.
2. Remove the thermostat cover, gasket and engine hanger bracket.
3. Remove the thermostat.

1-C-7. Removing of Intake Manifold and Carburetor

1. Loosen the bolts holding the inlet manifold to the cylinder head.
2. Remove the intake manifold and carburetor assembly and gasket.

1-C-8. Removing of Cylinder Head and Camshaft

1. Remove the attaching nuts and remove the rocker arm cover and gasket.
2. Remove two semicircular oil seals.
3. Remove the lock nut and washer and slide the distributor drive gear off the camshaft.
4. Install the **ring gear brake** (49 0221 030A) to the flywheel.
5. With the **spanner** (49 0164 631A) loosen the lock nut for the camshaft sprocket.
6. Remove the bolt that attach the cylinder head and the timing chain cover.
7. Loosen the cylinder head bolts in the reverse order of tightening.
8. Remove the rocker arm assembly.

9. Pull the camshaft rearward and remove the camshaft from the camshaft sprocket.
- Remove the camshaft sprocket.
10. Remove the camshaft bearing halves from the cylinder head.
11. Remove the cylinder head and gasket.

Note: When removing only the camshaft or the cylinder head, the timing chain should be lifted upward to prevent the slipper blade of the chain tensioner from flying out and causing a difficulty in adjusting the timing chain.

1-C-9. Removing of Valve and Valve Spring

1. Remove the carbon inside the combustion chamber.
2. Use the **valve spring lifter** (49 0636 100) as shown in Fig. 1-6 and compress the valve springs.

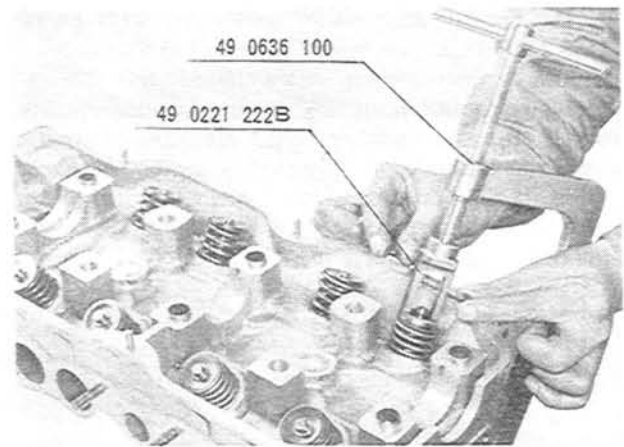


Fig. 1-6 Removing of valve

3. Remove the taper sleeve, upper spring seat, valve springs, lower spring seat and spacer.
4. Remove the valve.

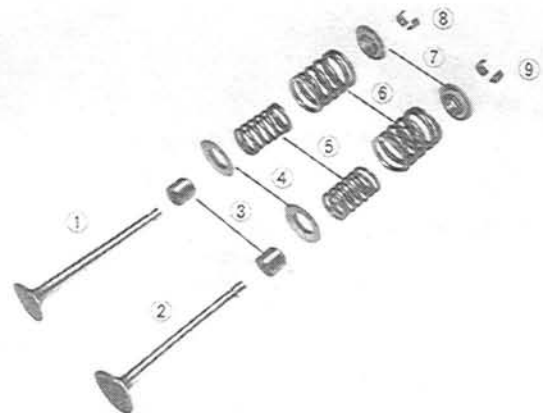


Fig. 1-7 Valve assembly

- | | |
|-----------------------|------------------------|
| 1. Exhaust valve | 6. Outer springs |
| 2. Intake valve | 7. Spring upper seats |
| 3. Valve seats | 8. Tapper sleeves (EX) |
| 4. Spring lower seats | 9. Tapper sleeves (IN) |
| 5. Inner springs | |

Note: Place the taper sleeves, upper spring seats, valve springs, lower spring seats and valves in order in a suitable case for reassembling.

1-C-10. Removing of Crankshaft Pulley

1. Install the **ring gear brake** (49 0221 030A) to the flywheel.
2. Loosen the pulley bolt and pull the pulley off the front end of the crankshaft.

1-C-11. Removing of Clutch Assembly

1. Install the **ring gear brake** (49 0221 030A).
2. Loosen the bolts holding the clutch cover to the flywheel and remove the clutch cover and pressure plate assembly and clutch disk.
3. Loosen the bolts attaching the flywheel to the rear end of the crankshaft.

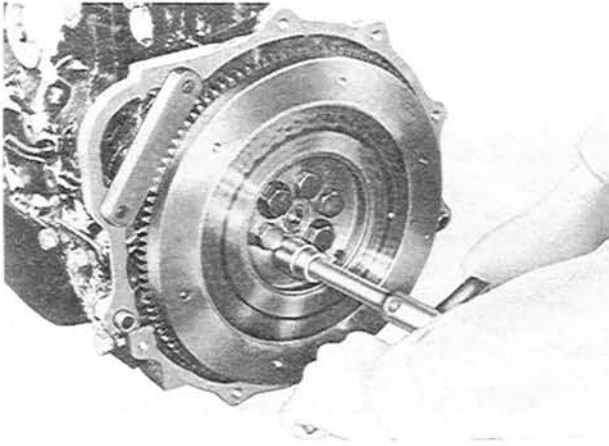


Fig. 1-8 Removing of flywheel

4. Remove the ring gear brake and flywheel.

1-C-12. Removing of Oil Pan

1. Rotate the cylinder block upside down position.
2. Loosen the nuts and bolts that attach the oil pan to the cylinder block.
3. Remove the oil pan and gasket.

1-C-13. Removing of Timing Chain Cover

1. Loosen the bolts and nuts that attach the timing chain cover to the cylinder block.
2. Remove the chain cover and gaskets.
3. Remove the oil deflector from the crankshaft.

1-C-14. Removing of Chain Tensioner and Chain Vibration Damper

1. Remove the bolt attaching the chain tensioner to the block and remove the tensioner.
2. Remove the slipper blade to the block and remove the slipper blade.
3. Remove the screws that attach the chain vibration damper to the block. Remove the chain vibration damper.

1-C-15. Removing of Chain and Sprockets

1. Remove the lock nut and washer for the oil pump sprocket.
2. Pull off the oil pump sprocket and crankshaft sprocket together with the oil pump drive chain.
3. Remove the spacer from the crankshaft.
4. Remove the crankshaft sprocket and timing chain.
5. Remove the key and spacer from the crankshaft.

1-C-16. Removing of Oil Pump and Strainer

1. Remove the nuts attaching the oil strainer to the oil pump and remove the oil strainer and "O" ring.
2. Loosen the bolts and remove the oil pump, "O" ring and adjusting washers from the cylinder block.

1-C-17. Removing of Piston and Connecting Rod

1. Remove the bolts from each connecting rod and remove the bearing caps.
2. Push the piston and connecting rod assembly out of the cylinder block with the handle end of a hammer until the piston rings are free from the cylinder bore. Remove the piston and connecting rod assembly from the top of the block.
3. To separate the piston and connecting rod, remove the clips and remove the piston pin with the **piston pin remover and installer** (49 0223 061). If tightly, heat the piston by a piston heater.

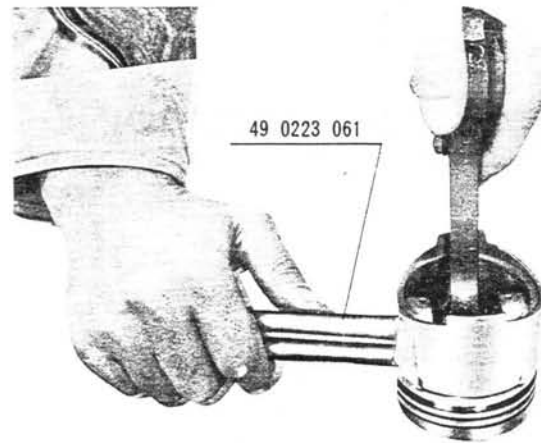


Fig. 1-9 Removing of piston pin

1-C-18. Removing of Crankshaft

1. Loosen the bolts that attach the main bearing cap to the cylinder block.
2. Use the **main bearing cap puller** (49 0221 270A) and remove the rear main bearing cap and thrust washers.

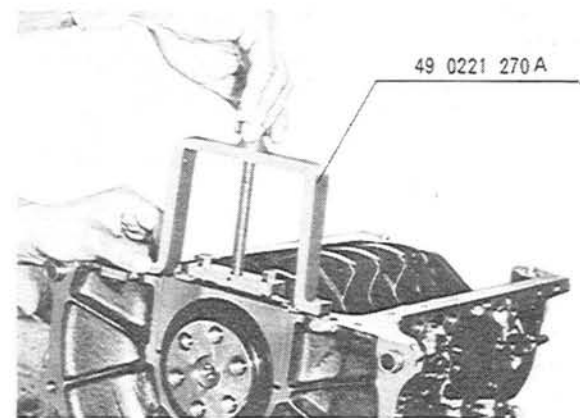


Fig. 1-10 Removing of rear main bearing

3. Remove the remaining bearing caps.
4. Take out the oil seal from the rear end of the crankshaft.
5. Remove the crankshaft from the cylinder block.

1-D. ENGINE INSPECTION AND REPAIR

1-D-1. Inspection of Cylinder Head

Remove all carbon in the combustion chamber and exhaust port. Be sure that the water passages are open. Inspect all tapped openings. Repair or replace any damaged threads or broken studs.

Check for cylinder head distortion by placing a straight edge on the cylinder head surface.

Measure the clearance between the straight edge and the cylinder head surface with a feeler gauge as shown in Fig. 1-11. If distortion exceeds **0.15 mm (0.006 in)**, grind with a surface grinder.

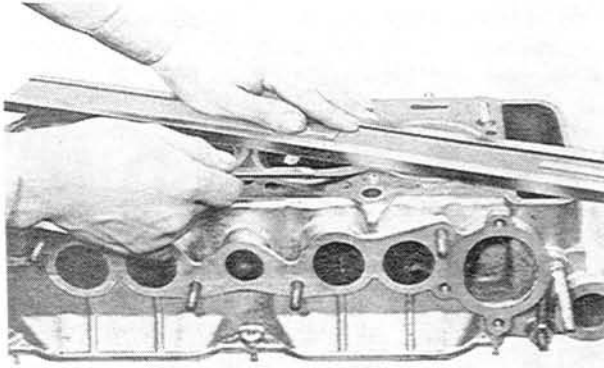


Fig. 1-11 Inspecting of cylinder head

1-D-2. Inspection of Valve Spring

Examine the springs for corrosion or acid etchings. If it is severe, replace with new ones.

Check the free length, spring pressure and squareness of the spring. Replace with new spring if the length is decreased **more than 3 %** of the standard dimension, or if the spring fitting pressure is reduced **more than 15 %** of the standard dimension, or the out of squareness is more than 3 mm per 100 mm (0.03 in per 4.0 in).

The specifications of the valve springs are :

	Inner spring	Outer spring
Free length	36.8 mm (1.449 in)	37.3 mm (1.469 in)
Fitting length	32.5 mm (1.280 in)	34.0 mm (1.339 in)
Fitting pressure	9.5 kg (20.9 lb)	14.3 kg (31.5 lb)

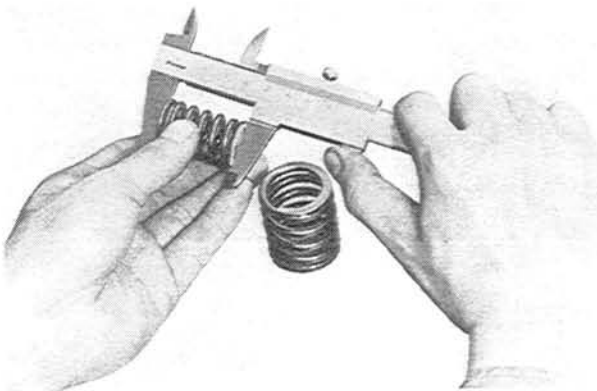


Fig. 1-12 Checking of free length

1-D-3. Inspection of Valve

Remove all carbon from the valves. Visually inspect all valves for warpage, cracks or excessive burning and replace if any of these conditions is found.

Replace any worn, pitted or corroded valves that can not be cleaned or refaced.

Measure the diameter of the valve stem at two or three places along the length of the stem with a micrometer. Replace if the wear of the valve stem is **more than 0.05 mm (0.0020 in)**.

The standard diameter is 8.0 mm (0.3150 in).

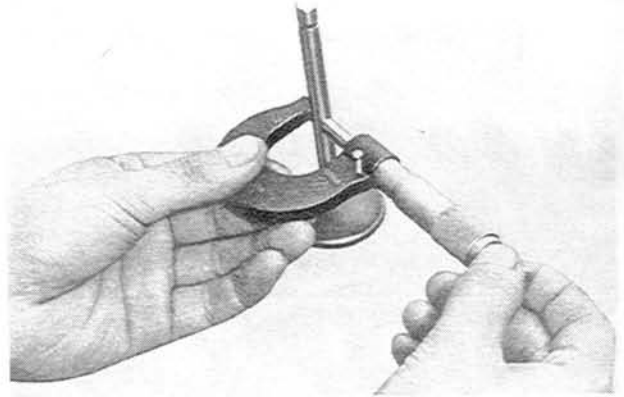


Fig. 1-13 Measuring of valve stem diameter

1-D-4. Checking of Valve Stem and Guide Clearance

The clearance between the valve stem and guide should be, under the condition of the guide being fitted with the cylinder head, **0.018 to 0.053 mm (0.0007 to 0.0021 in)** on the inlet side and **0.018 to 0.058 mm (0.0007 to 0.0023 in)** on the exhaust side. To check this clearance, place the valve in each guide. Check the clearance with a suitably mounted dial indicator, or feel the clearance by moving the valve stem back and forth. If this check shows excessive clearance, it will be necessary to replace the valve guide and valve.

1-D-5. Replacing of Valve Guide

1. Press out the old valve guide with the **valve guide remover (49 0221 251A)**.

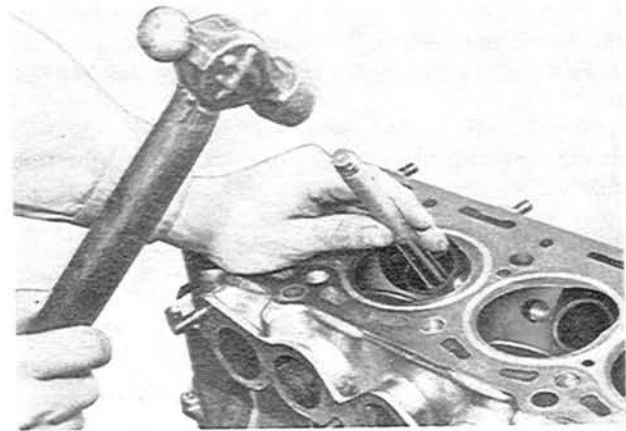


Fig. 1-14 Replacing of valve guide

2. Press in the new guide squarely with the same tool until the ring on the guide touches the cylinder head.

Note: Intake and exhaust valve guides are different as shown in Fig. 1-15.

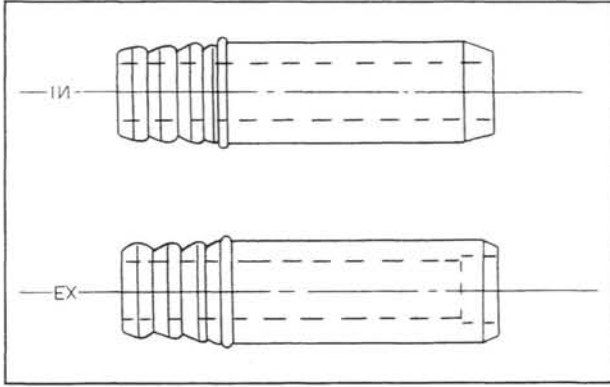


Fig. 1-15 Valve guides

3. Install the new valve seal onto the valve guide with the valve seal installer (49 0223 160A).

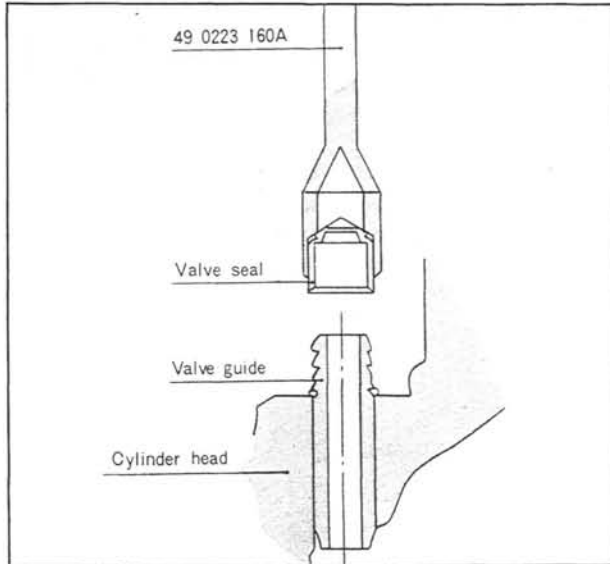


Fig. 1-16 Installing of valve seal

1-D-6. Refacing of Valve

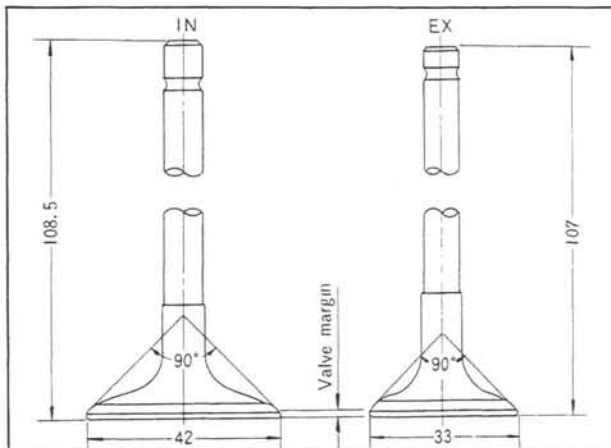


Fig. 1-17 Valves

Reface the valves with a valve refacer, following the instructions of the valve refacer manufacturer. The intake and exhaust valve face has a 90 degree angle. Take off only the minimum of metal required to clean the valve faces.

Note: If the outer edge of the valve (valve margin) becomes less than 1.0 mm (0.040 in) from excessive grinding, the valve must be replaced.

1-D-7. Inspection and Refacing of Valve Seat

Inspect the valve seats for cracks, burrs, ridges or improper angle and width. When necessary to reface the valve seat, use a valve seat grinder or a valve seat cutter and grind to a 90 degree angle. Do not grind any more than is necessary to clean up the valve seat. When using the seat cutter, refer to next paragraph.

Note:

- If the valve guides are to be replaced, this must be done before refacing the valve seat.
- The valve seat ring is shrinkage-fitted in the cylinder head. However, the seat ring cannot be replaced in view of maintaining strength.

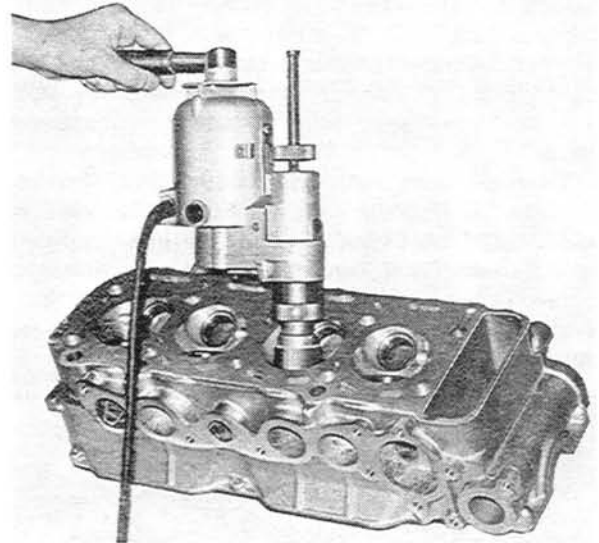


Fig. 1-18 Valve seat grinder

1-D-8. Valve Seat Cutter

The following cutters are available for refacing valve seats.

- | | |
|--|-------------|
| 1. Valve seat cutter pilot | 49 2765 034 |
| 2. Valve seat cutter pilot | 49 2728 033 |
| 3. 90° cutter (for inlet seat) | 49 2801 011 |
| 4. 30° cutter (for inlet port) | 49 2801 013 |
| 5. 150° cutter (for inlet spot facing) | 49 2821 012 |
| 6. 90° cutter (for exhaust seat) | 49 2952 011 |
| 7. 30° cutter (for exhaust port) | 49 2541 013 |
| 8. 150° cutter (for exhaust spot facing) | 49 2765 012 |

When refacing the valve seat with any one of these cutters, fit the cutter on the taper of the pilot and insert the pilot into the valve guide hole. Then, turn the handle and cut off to correct the valve seat.

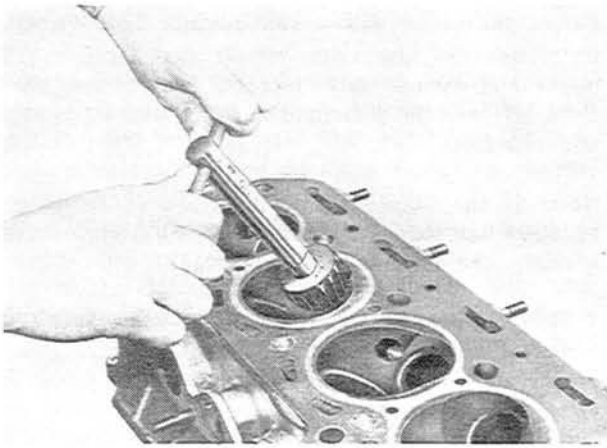


Fig. 1-19 Valve seat cutter

1-D-9. Checking of Contact between Valve and Valve Seat

After the valve or valve seat is ground, check the contact between the valve and valve seat as follows:

1. Apply a thin coat of "Prussian Blue" on the valve face and insert the valve into the valve seat.
2. Move the valve up and down with hand pressure, rotating the valve.
3. Remove the valve and observe the transfer of "Prussian Blue" to the valve seat.

An even transfer indicates accurate valve and valve seat refacing. If uneven, the valve must be lapped into the valve seat, using a suitable lapping compound.

4. Check the valve seat width with a steel scale placed across the face of the valve seat. The **valve seat width is 2.1 mm (0.083 in) for the intake valve seat and 1.4 mm (0.055 in) for the exhaust valve seat.** If the valve seat width is too wide, it can be reduced from inside with the 30° seat cutter and from outside with the 150° seat cutter.

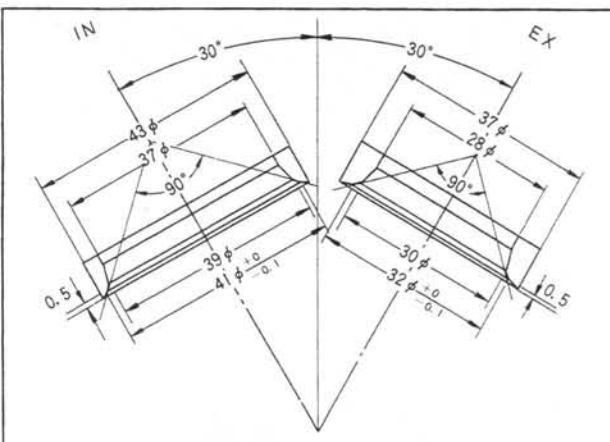


Fig. 1-20 Valve seat

1-D-10. Inspection of Valve Seat Sinking

When the valve and the valve seat have been refaced several times or they must be cut deeply for adequate reconditioning, the position of the valve sinks below the standard position. Accordingly, the spring pressure under the fitting condition falls. Check the sinking of the valve seat by using a vernier calipers

as shown in Fig. 1-21.

If the **sinking exceeds 0.5 mm (0.020 in)**, washers of sufficient thickness to compensate the sinking must be placed under the springs so as to maintain the specified spring pressure. If the sinking is **more than 1.5 mm (0.059 in)**, replace the valve or cylinder head.

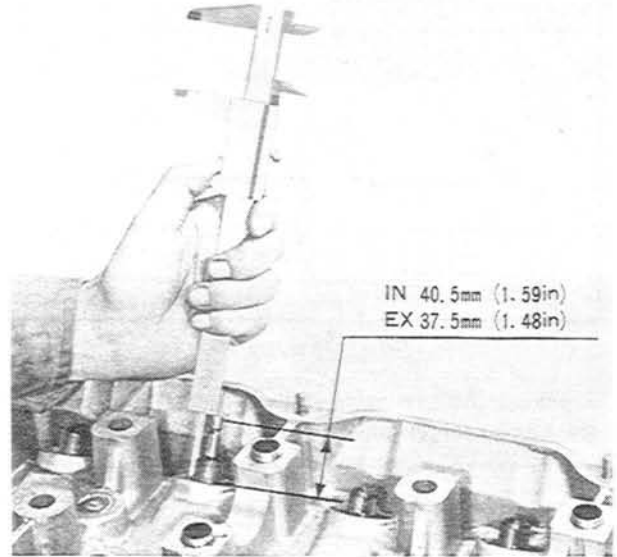


Fig. 1-21 Checking of valve seat sinking

1-D-11. Inspection of Rocker Arm and Shaft

The standard clearance between the rocker arm bush and shaft is 0.020 to 0.074 mm (0.0008 to 0.0029 in). Inspect the clearance and if it is **more than 0.10 mm (0.0039 in)**, replace the bush or shaft.

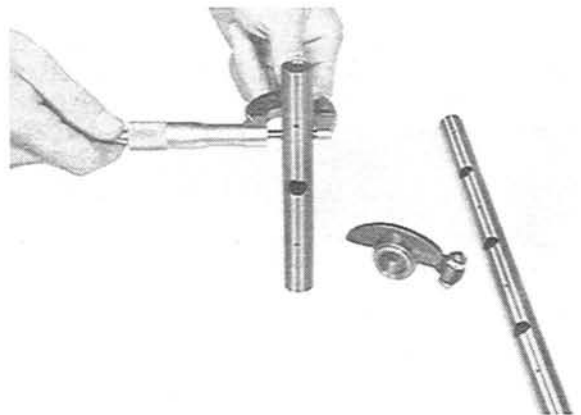


Fig. 1-22 Checking of rocker arm shaft

1-D-12. Replacing of Rocker Arm Bush

1. Using a suitable mandrel, press the bush out of the rocker arm.
2. Press fit the bush with the same tool used to remove, being sure to **align the oil holes** of the rocker arm and bush.
3. Ream up the bush to the correct fit.

1-D-13. Inspection of Cylinder Block

Clean the cylinder block with a suitable solvent. Special care must be taken when cleaning the oil passages, coolant passages and cylinder walls to remove

all sludge, dirt and carbon deposit. After cleaning, use compressed air to dry the block thoroughly. Examine the cylinder block for crack and any damage. Examine all machined surfaces of the block for burrs and scores. Check for the cylinder block distortion in the same way, as described in Par. 1-D-1.

1-D-14. Inspection of Cylinder Bore

Check the cylinder bores for wear, scratching and waviness. Measure the diameter of the cylinder bore by using a cylinder gauge as shown in Fig. 1-23.

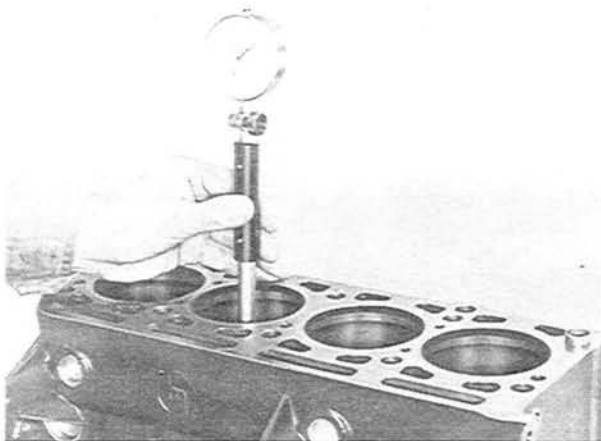


Fig. 1-23 Checking of cylinder bore (1)

This measurement should be taken in the X-X direction and the Y-Y direction at each of the 3 places,

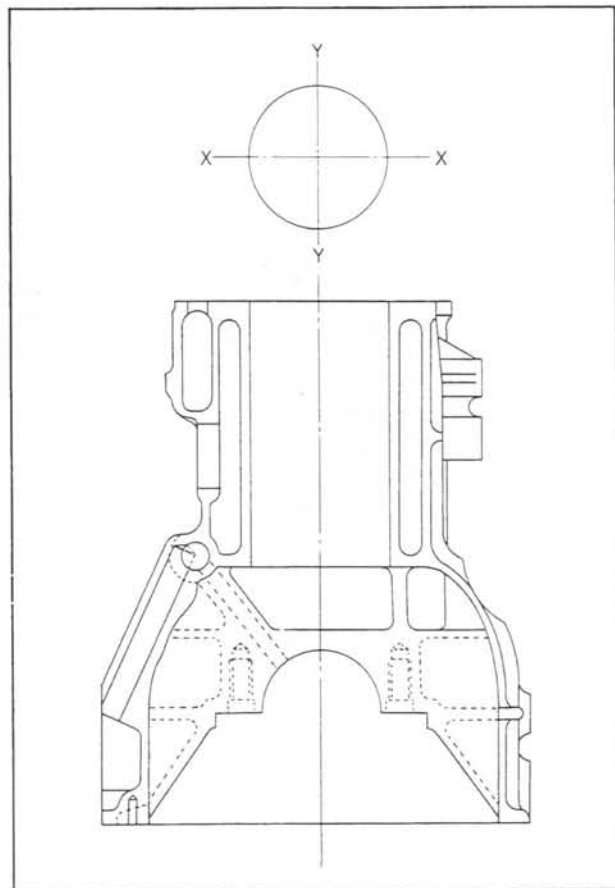


Fig. 1-24 Checking of cylinder bore (2)

upper, middle and lower, of one cylinder, as shown in Fig. 1-24. The difference between the minimum and maximum values out of the 6 measured values is regarded as the amount of wear. If the wear of cylinder bore is **0.15 mm (0.0059 in) or more**, it should be honed or rebored. Honing and reboring should be made to correspond to piston and rings oversize and to the recommended piston clearance of **0.057 to 0.072 mm (0.0022 to 0.0028 in)**.

Note:

- If any one of the cylinder bores requires reboring, the remaining ones also require reboring.
- Reboring must not go beyond 1.0 mm (0.0394 in).

The following oversizes of pistons and rings are available:

0.25 mm (0.0098 in)	0.75 mm (0.0295 in)
0.50 mm (0.0197 in)	1.00 mm (0.0394 in)

1-D-15. Inspection of Piston

Carefully inspect the piston and replace if it is severely scratched or burned.

Measure the diameter of the piston by means of a micrometer. The standard diameter is as shown in Fig. 1-25. If the wear is severe, replace the piston.

Note: This measurement should be carried out without the piston pin fitted.

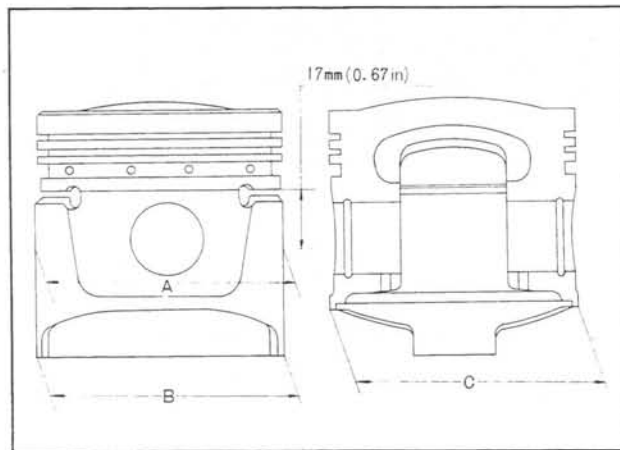


Fig. 1-25 Piston

- A: 77.945 ± 0.01 mm (3.0687 ± 0.0004 in)
 B: 78.0 ± 0.01 mm (3.0709 ± 0.0004 in)
 C: 77.69 ± 0.01 mm (3.0587 ± 0.0004 in)

1-D-16. Checking of Piston Clearance

Check the clearance between each piston and cylinder by measuring the diameter of the piston and cylinder bore. Refer to Par. 1-D-14 for the bore measurement procedure. Measure the piston diameter at **90 degrees to the pin bore axis and 17 mm (0.67 in) below the ring groove**.

The standard clearance is **0.057 to 0.072 mm (0.0022 to 0.0028 in)**.

If the clearance exceeds **0.15 mm (0.0059 in)**, rebore the cylinders and use the oversize piston referring to Par. 1-D-14.

Marked	Cylinder	Piston
A	78 $\begin{matrix} +0.019 \\ +0.013 \end{matrix}$ mm (3.0709 $\begin{matrix} +0.0007 \\ +0.0005 \end{matrix}$ in)	77.945 $\begin{matrix} +0.010 \\ +0.004 \end{matrix}$ mm (3.0687 $\begin{matrix} +0.0004 \\ +0.0002 \end{matrix}$ in)
Unmarked	78 $\begin{matrix} +0.013 \\ +0.006 \end{matrix}$ mm (3.0709 $\begin{matrix} +0.0005 \\ +0.0002 \end{matrix}$ in)	77.945 ± 0.004 mm (3.0687 ± 0.0002 in)
C	78 $\begin{matrix} +0.006 \\ -0 \end{matrix}$ mm (3.0709 $\begin{matrix} +0.0002 \\ -0 \end{matrix}$ in)	77.945 $\begin{matrix} -0.004 \\ -0.010 \end{matrix}$ mm (3.0687 $\begin{matrix} -0.0002 \\ -0.0004 \end{matrix}$ in)

The standard pistons and cylinders are graded into 3 classes respectively according to the diameter of the piston and cylinder bore, and each of them is stamped with A or C, or unmarked as shown in Fig. 1-26.

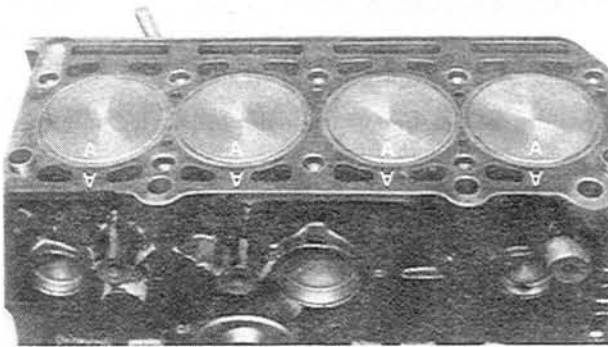


Fig. 1-26 Matching of piston and cylinder

The standard clearance is obtained by combining the piston and the cylinder which have the same marks.

1-D-17. Inspection of Piston Ring Groove

Remove the carbon from the piston ring grooves by using a ring groove cleaner or a shape square edge of broken ring piece. With a feeler gauge, check the side clearance of the piston rings as shown in Fig. 1-27. If it is improper, replace the piston rings.



Fig. 1-27 Piston ring groove inspection

The standard clearances are as follows:

	Side clearance
Top ring	0.035 ~ 0.070 mm (0.0014 ~ 0.0028 in)
Second ring	0.030 ~ 0.064 mm (0.0012 ~ 0.0025 in)
Oil ring	0.030 ~ 0.064 mm (0.0012 ~ 0.0025 in)

1-D-18. Checking of Piston Ring End Gap

Place the piston ring in the cylinder bore below the ring travel, using a piston head to push the ring in squarely. Check the piston ring end gap with a feeler gauge as shown in Fig. 1-28. The end gap should be **0.20 to 0.40 mm (0.008 to 0.016 in)**.

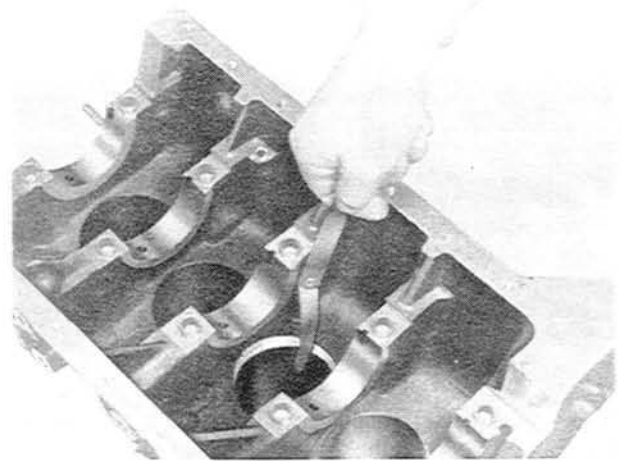


Fig. 1-28 Checking of end gap

1-D-19. Checking of Piston Pin Fit

Check the fit of the piston pin and the connecting rod small end bush to be **0.01 to 0.03 mm (0.0004 to 0.0012 in)**. Replace the piston pin and bush if they are worn heavily.

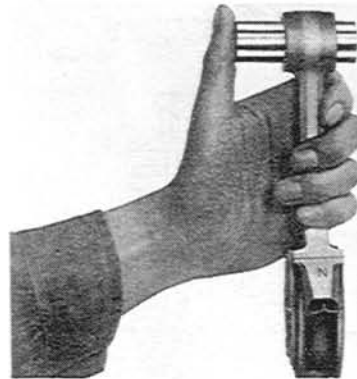


Fig. 1-29 Checking of piston pin fit

1-D-20. Replacing of Small End Bush

1. Press out the old bush with a suitable mandrel.
2. Press fit the new bush, being sure to **align the oil holes** of the bush and connecting rod.
3. Finish the inner surface of the bush with a reamer or a pin hole grinder.

Note: The fit is correct when the piston pin slides through the bush with some pressure but without any noticeable looseness.

1-D-21. Connecting Rod Bearing

The connecting rod bearings are of aluminum-lined and of the interchangeable type. When properly installed, the bearings provide proper clearance without filling, scraping or shimming.

Each bearing consists of two halves and should be replaced as a set.

The connecting rod bearing sets are available in the standard size and undersize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

Inspect the bearing carefully and replace if it is worn, scored or flaked.

1-D-22. Checking of Connecting Rod Bearing Clearance

The connecting rod bearing clearance should be **0.027 to 0.077 mm (0.0011 to 0.0030 in)**.

Check the bearing clearance by using a "Plastigage" as follows:

1. Clean the surfaces of the bearing and crankpin.
2. Place the "Plastigage" on the crankpin.
3. Install the bearing cap and tighten the bolts to the specified torque of **4.5 m·kg (30 ft·lb)**.
4. Remove the bearing cap and measure the width of the "Plastigage", using the scale printed on the envelope.

If the clearance is excessive, replace the connecting rod bearings by undersizes and grind the crankpins so as to obtain specified bearing clearance.

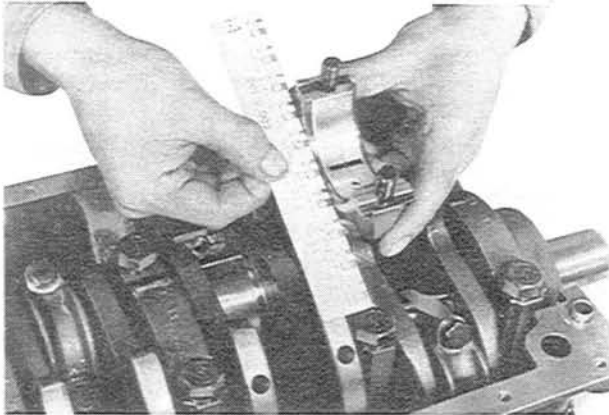


Fig. 1-30 Checking of bearing clearance

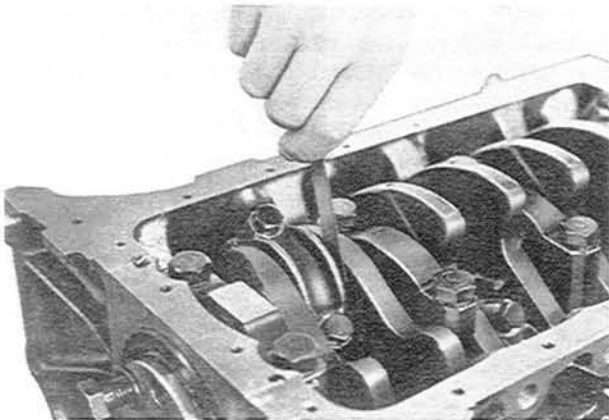
1-D-23. Checking of Connecting Rod Side Play

Fig. 1-31 Checking of side play

Check the connecting rod side play with a feeler gauge as shown in Fig. 1-31. The side play should be **0.11 to 0.21 mm (0.0043 to 0.0083 in)**.

1-D-24. Checking of Connecting Rod Alignment

Check the connecting rod for bend or twist by using a suitable alignment fixture. Follow the instructions of the fixture manufacturer. If the bend or twist exceeds specifications, the connecting rod must be straightened or replaced.

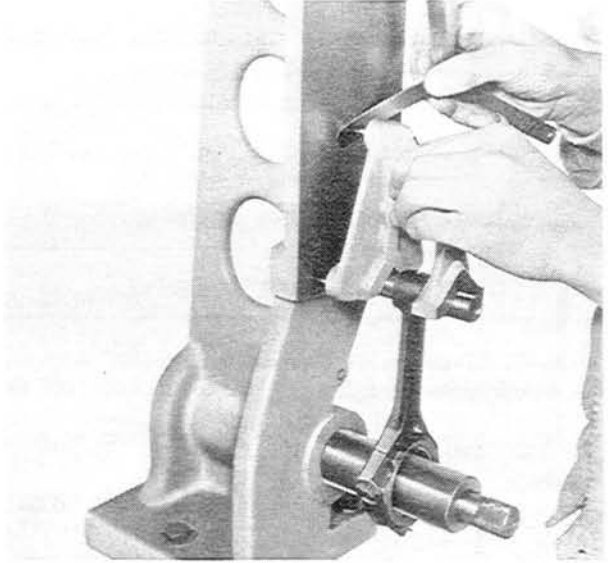


Fig. 1-32 Checking of connecting rod alignment

1-D-25. Weight of Connecting Rod

The weight of four connecting rods in the engine should balance within 5 gr (0.18 oz).

In order to effect this, the connecting rods are classified into following groups and inscribed the mark on each connecting rod.

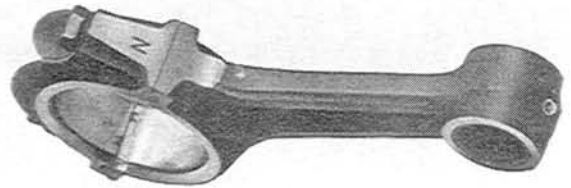


Fig. 1-33 Mark of connecting rod weight

Code No.	Minimum weight	Maximum weight
C	675 gr (23.81 oz)	680 gr (23.98 oz)
D	680 gr (23.98 oz)	685 gr (24.16 oz)
E	685 gr (24.16 oz)	690 gr (24.34 oz)
F	690 gr (24.34 oz)	695 gr (24.51 oz)
G	695 gr (24.51 oz)	700 gr (24.69 oz)
H	700 gr (24.69 oz)	705 gr (24.87 oz)
I	705 gr (24.87 oz)	710 gr (25.04 oz)
J	710 gr (25.04 oz)	715 gr (25.22 oz)
K	715 gr (25.22 oz)	720 gr (25.39 oz)
L	720 gr (25.39 oz)	725 gr (25.57 oz)
M	725 gr (25.57 oz)	730 gr (25.75 oz)
N	730 gr (25.75 oz)	735 gr (25.92 oz)
O	735 gr (25.92 oz)	740 gr (26.10 oz)

1-D-26. Checking of Main Journal and Crankpin

Clean the crankshaft thoroughly with a suitable solvent and blow out the oil passages with compressed air.

Inspect the crankshaft for cracks, scratches and the oil passages for clog.

Measure the diameter of each main journal and crankpin with a micrometer. If the wear is **more than 0.05 mm (0.0020 in)**, the crankshaft should be ground to the undersize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

The standard diameter of the crankpins and main journals is shown in the following table.

Crankpin		53	- 0.045	mm (2.0866	- 0.0018
			- 0.060		- 0.0024 in)
Main journal	Green	63	- 0.052	mm (2.4804	- 0.0020
			- 0.060		- 0.0024 in)
journal	Brown	63	- 0.045	mm (2.4804	- 0.0018
			- 0.052		- 0.0020 in)

1-D-27. Checking of Crankshaft Run-Out

To check alignment, mount the crankshaft on the V blocks and apply a dial indicator. Slowly rotate the crankshaft and note the reading on the dial indicator.

The maximum allowable run-out is **0.03 mm (0.0012 in)**. If the run-out exceeds 0.03 mm (0.0012 in), correct with a press.

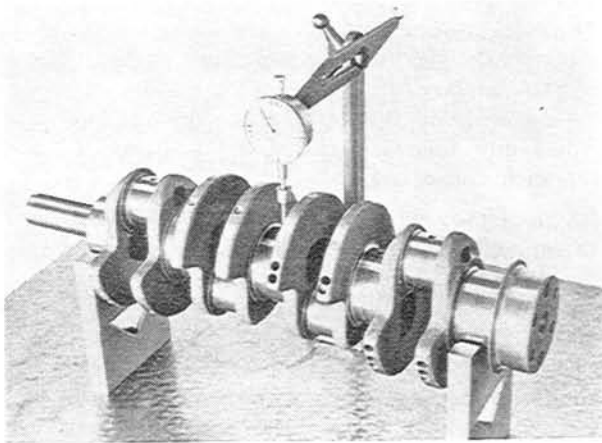


Fig. 1-34 Checking of crankshaft run-out

1-D-28. Main Bearing

The main bearings are of aluminum-lined and interchangeable type. They are classified 3 types according to the shape as shown in Fig. 1-35.

When correctly installed, it is provided proper clearance without filing, scraping or shimming.

Each bearing consists of two halves and should be replaced as a set.

The main bearings are available in the standard size and undersize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

The standard main bearings are graded into three classes according to the thickness and each of them is painted with green, brown and yellow. Refer to Par. 1-D-29 when replacing the main bearings.

Inspect the bearings carefully for wear, scoring, flaking or any damage. If any of these conditions exists, replace with new bearings.

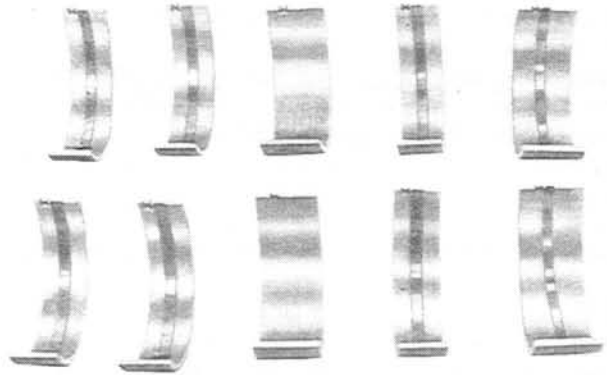


Fig. 1-35 Main bearings

1-D-29. Checking of Main Bearing Clearance

Check the main bearing clearance by using "Plastigage" in the same manner for the connecting rod bearing clearance.

Note the following differences.

1. The standard main bearing clearance is **0.031 to 0.061 mm (0.0012 to 0.0024 in)**.
2. The tightening torque of the bearing cap nuts is **8.5 m·kg (60 ft·lb)**.

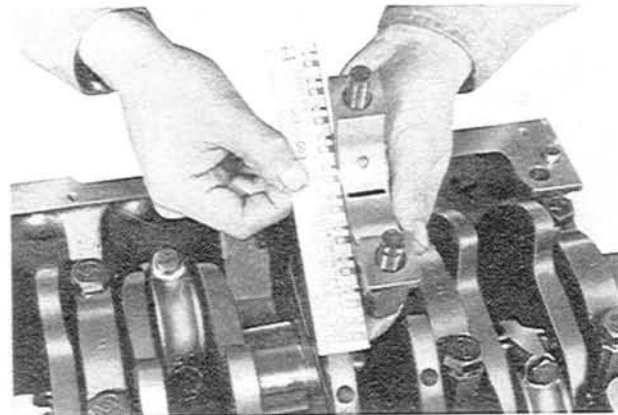


Fig. 1-36 Checking of bearing clearance

Note: The standard main bearing, main journal and bearing housing are classified into two or three grades respectively by the sizes of the diameter and the standard bearing clearance is obtained by combining the main bearing, main journal and bearing housing in accordance with the following chart.

Bearing housing (Cylinder block)	Main journal (Crankshaft)	Main bearing	Clearance
Brown	Green	Green	0.032 ~ 0.059 mm (0.0013 ~ 0.0023 in)
	Brown	Yellow	0.035 ~ 0.061 mm (0.0014 ~ 0.0024 in)
Green	Green	Brown	0.031 ~ 0.059 mm (0.0012 ~ 0.0023 in)
	Brown	Green	0.034 ~ 0.061 mm (0.0013 ~ 0.0024 in)

1-D-30. Checking of Crankshaft End Play

The end thrust of the crankshaft is taken by the thrust washers at the rear of the crankshaft.

The standard end play of the crankshaft is **0.08 to 0.242 mm (0.0031 to 0.0095 in)**.

Check the end play with a dial indicator or a feeler gauge as shown in Fig. 1-37.

Correct, if the end play exceeds **0.3 mm (0.012 in)**. The end play can be adjusted by the thrust washers. The thrust washers are available in the oversize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

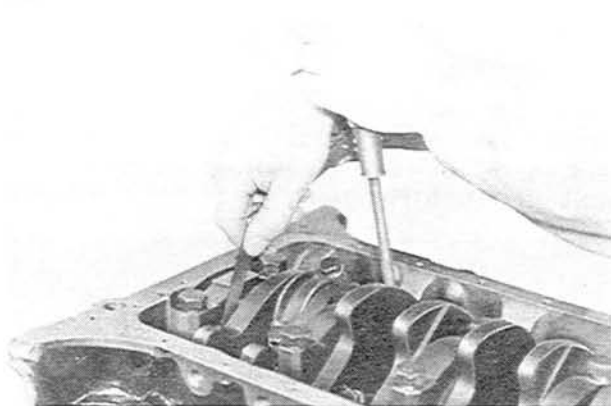


Fig. 1-37 Checking of end play

1-D-31. Camshaft Inspection

Check to see that the cam faces and journals are smooth and are not scored or worn.

Measure the cam height with a micrometer and if a wear exceeding **0.2 mm (0.0079 in)** is found, replace the camshaft.

The standard cam height is **44.715 mm (1.7605 in)** on inlet and **44.682 mm (1.7592 in)** on exhaust. Measure the diameter of the camshaft journals. If a wear of **more than 0.05 mm (0.0020 in)** is found, grind the journals to an undersize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

The standard diameters of the camshaft journals are in the following table.

Front	45	-0.040 -0.055	mm	(1.7717	-0.0016 -0.0022	in)
Center	45	-0.050 -0.065	mm	(1.7717	-0.0020 -0.0026	in)
Rear	45	-0.040 -0.055	mm	(1.7717	-0.0016 -0.0022	in)

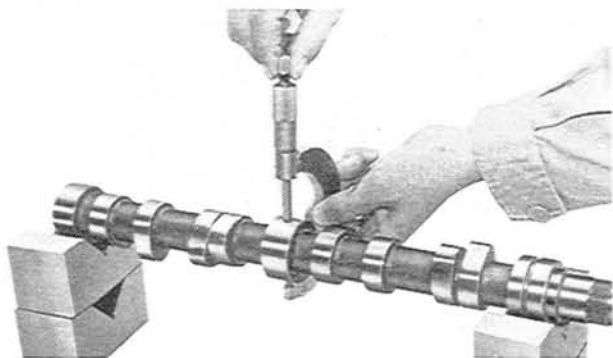


Fig. 1-38 Checking of camshaft journal

1-D-32. Checking of Camshaft Run-Out

To check the run-out, mount the camshaft on the V blocks or center holding device and use a dial indicator, as shown in Fig. 1-39.

Rotate the camshaft with hand and determine the reading on the indicator.

If run-out exceeds **0.03 mm (0.0012 in)**, straighten the camshaft with a press or replace with a new one.

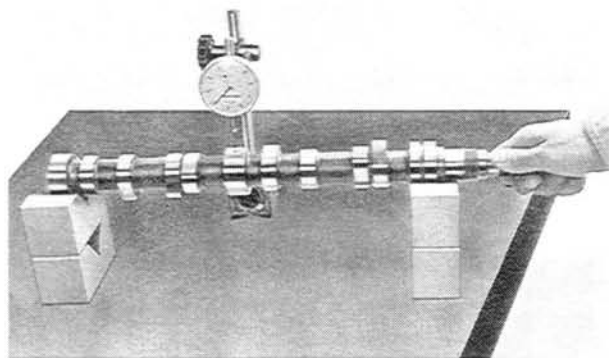


Fig. 1-39 Checking of camshaft run-out

1-D-33. Camshaft Bearing

The camshaft bearings are of babbitt-lined and interchangeable types. They are classified into 2 types as shown in Fig. 1-40.

When correctly installed, it is provided proper clearance without filing, scraping or shimming. Each bearing consists of two halves and should be replaced as a set.

The camshaft bearings are available in the standard size and undersize of **0.25, 0.50 and 0.75 mm (0.0098, 0.0197 and 0.0295 in)**.

Inspect the bearings carefully for wear, scoring, flaking or any damage. If any of these conditions exists, replace with new bearings.

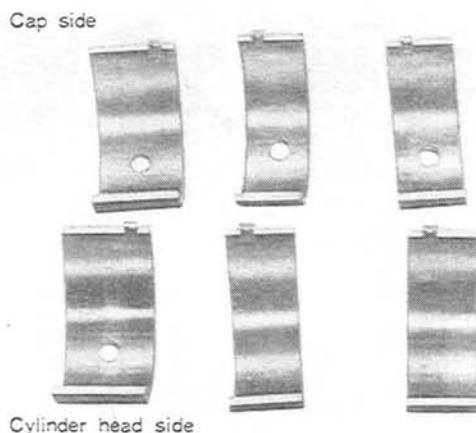


Fig. 1-40 Camshaft bearings

1-D-34. Checking of Camshaft Bearing Clearance

Check the camshaft bearing clearance by using a "Plastigage" in the same manner for the connecting rod bearing clearance.

Note the following differences:

1. The standard camshaft bearing clearances are as follows.

Front	0.019 ~ 0.069 mm (0.0007 ~ 0.0027 in)
Center	0.029 ~ 0.079 mm (0.0011 ~ 0.0031 in)
Rear	0.019 ~ 0.069 mm (0.0007 ~ 0.0027 in)

2. The tightening torque of the bolts is **8 m·kg (60 ft·lb)**.

1-D-35. Checking of Camshaft End Play

The end play of the camshaft is determined by the clearance between the sprocket surface and the thrust plate surface.

Measure this clearance with a feeler gauge as shown in Fig. 1-41.

The end play of the camshaft should be **0.02 to 0.18 mm (0.0008 to 0.0071 in)**. If the end play is excessive, replace with a new thrust plate.

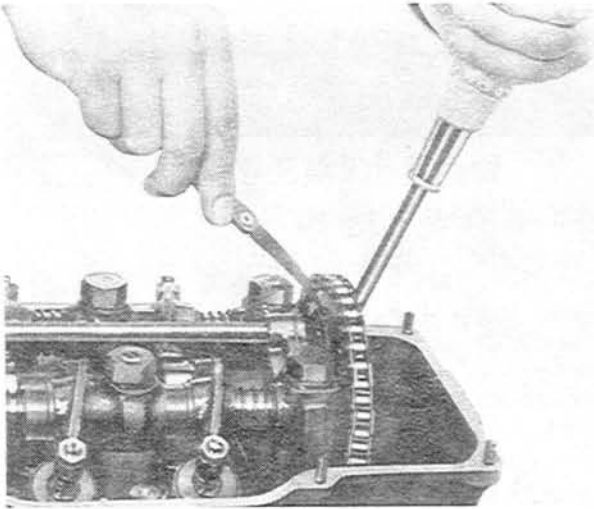


Fig. 1-41 Checking of camshaft end play

1-D-36. Checking of Timing Chain, Oil Pump Drive Chain and Sprockets

Check each chain for broken links. Check the sprockets for cracks and worn or damaged teeth. If any defects are found, replace with new parts.

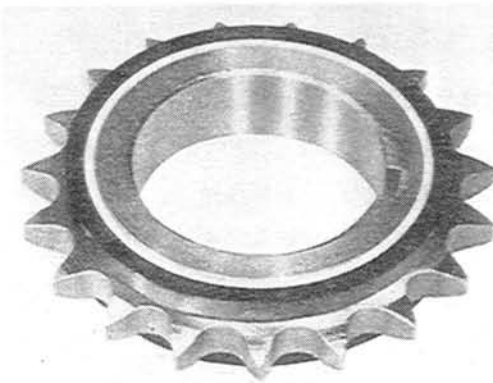


Fig. 1-42. Sprocket

1-D-37. Checking of Chain Tensioner and Chain Vibration Damper

Check the chain tensioner and chain vibration damper for wear or any damage. Replace with new parts if necessary.

1-E. ENGINE ASSEMBLY

The procedures for assembling the engine when the engine is to be completely overhauled are as follows:

1-E-1. Assembling of Piston and Connecting Rod

1. Install the piston pin clip in the groove on one side of the piston.
2. Place the connecting rod in the piston and align the hole of the connecting rod with the hole of the piston.
3. Insert the piston pin with the **piston pin installer (49 0223 061)** until the piston pin clip can be fitted. Preheat the piston if tightly.
4. Fit the piston pin clip in the groove.

Note: Care must be taken during the installation that relative positions of the oil hole on the connecting rod big end and the "F" mark on the piston are in accordance with Fig. 1-43.

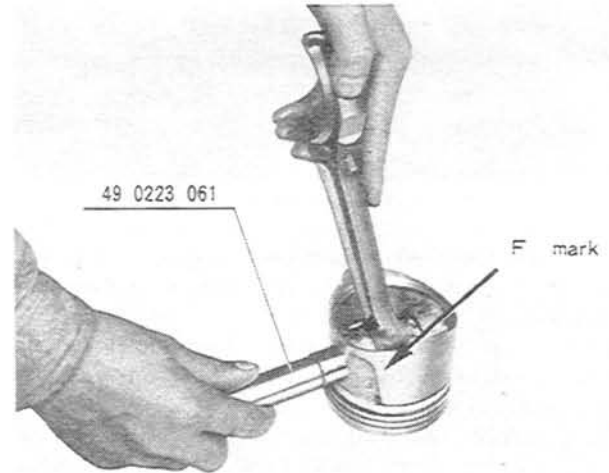


Fig. 1-43 Inserting of piston pin

1-E-2. Installing of Piston Ring

1. Fit the expander in the bottom ring groove and install the oil ring on it with a installer as shown in Fig. 1-44.
2. Install the second ring and then the top ring.



Fig 1-44 Installing of piston ring

Note:

(a) Be sure to install the rings with the inscription mark "R" upward as the faces of the top and second

rings are tapered as shown in Fig. 1-45. (b) Do not expand the rings more than necessary to install, also be careful not to burr the piston with the end of the rings.

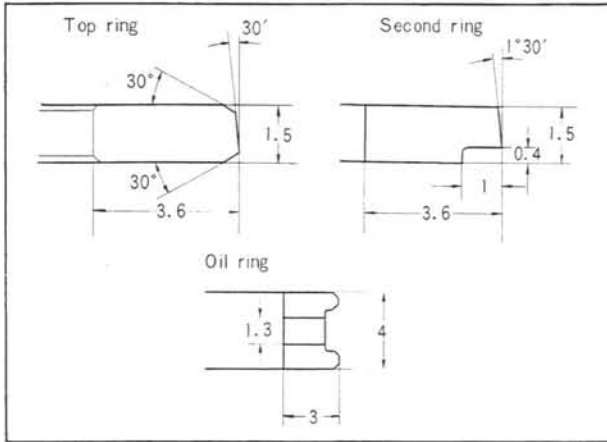


Fig. 1-45 Piston rings

1-E-3. Installing of Piston and Connecting Rod Assembly

1. Place the piston rings at about 120 apart so that the gap is not located on the thrust side and the piston pin side.
2. Lubricate the entire assembly with engine oil.
3. Using the suitable piston installer, insert the piston and connecting rod assembly from the top of the cylinder block by tapping the piston lightly with a plastic hammer.

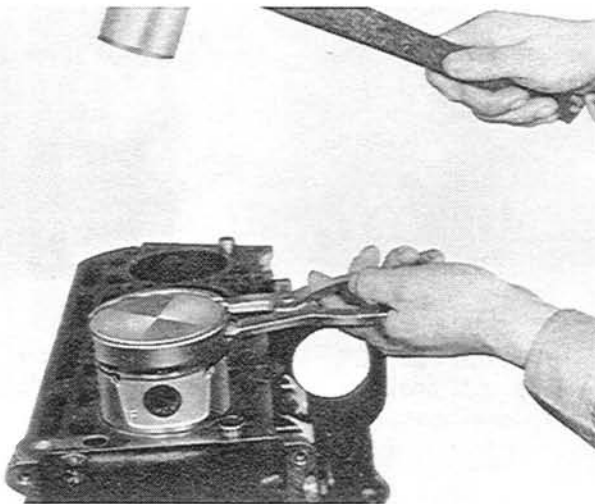


Fig. 1-46 Installing of piston assembly

Note: Insert the piston to the cylinder so that "F" mark on the piston is directed to the front of the engine.

4. Rotate the cylinder block upside down.
5. Fit the connecting rod bearing halves into their respective locations.

1-E-4. Installing of Crankshaft

1. Clean the contact surfaces of the cylinder block, main bearings and crankshaft.

2. Fit the five sets of main bearings properly to the cylinder block and the bearing caps respectively.

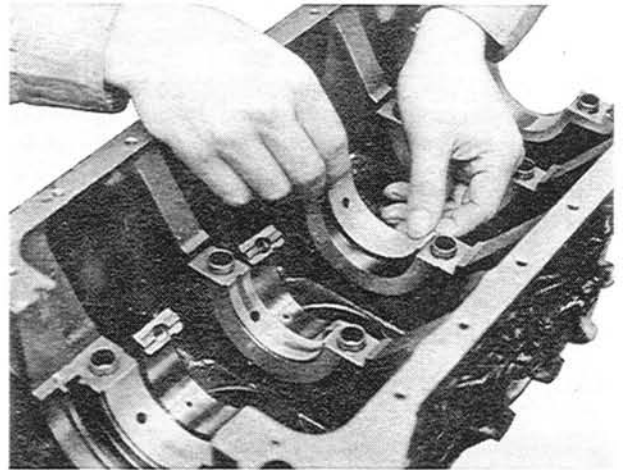


Fig. 1-47 Installing of main bearing

Note: When it is necessary to replace the main bearings with new ones, refer to Par. 1-D-29.

3. Fit the half of the thrust washers to the cylinder block with oil grooved surface facing the crankshaft thrust side.

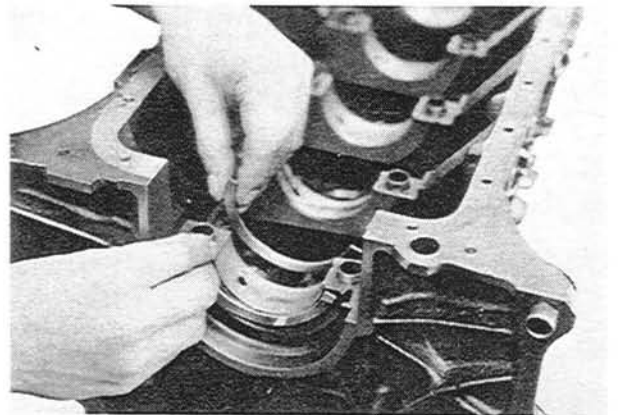


Fig. 1-48 Fitting of thrust washers

4. Lubricate the main bearing surfaces with engine oil.
5. Place the crankshaft in the cylinder block, being careful not to drop the thrust washers.

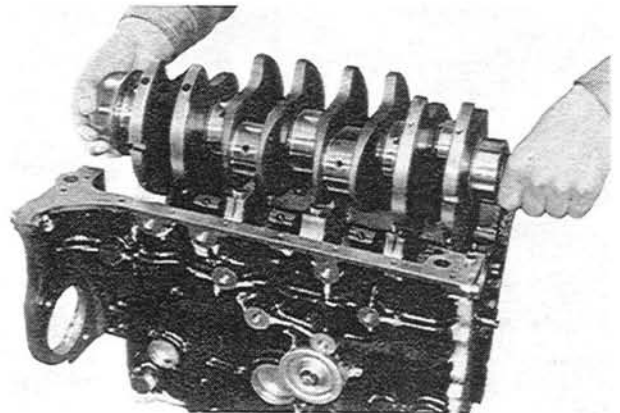


Fig. 1-49 Installing of crankshaft

6. Fit the oil seal to the rear end of the crankshaft after applying grease to the seal lip.

7. Fit the rod-shaped oil seals (side seals) into the grooves on both sides of the rear main bearing cap.

Note: The side seals should be placed as shown in Fig. 1-50.

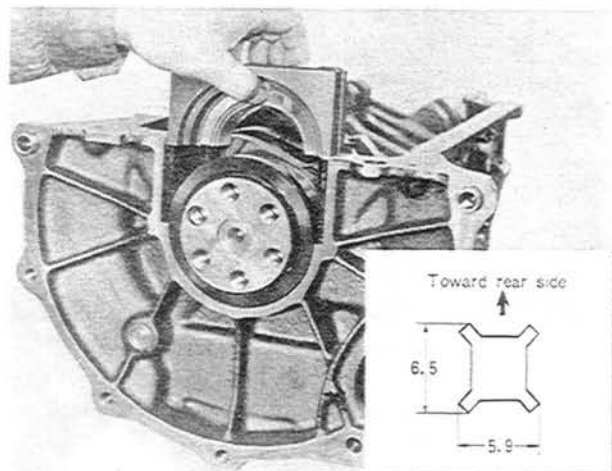


Fig. 1-50 Installing of main bearing cap

Fit the half of the thrust washers to the rear main bearing cap with the grooves toward the crankshaft thrust side.

9. Install the main bearing caps.

10. Tighten the bolts to 8.5 m·kg (60 ft·lb).

Note: The main bearing caps are marked with a number which shows the order of their arrangement.

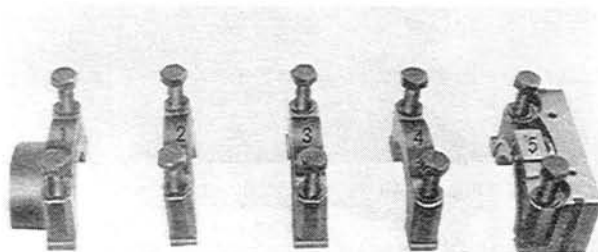


Fig. 1-51 Main bearing caps

1-E-5. Checking of Main Bearing Clearance and End Play

Refer to Par. 1-D-29 and 1-D-30.

1-E-6. Installing of Connecting Rod Bearing Cap

1. Install the connecting rod bearing halves into their respective caps with the tang fitting in the slot provided.

2. Lubricate the connecting rod bearing surfaces with engine oil.

3. Install the caps to the connecting rods, ensuring that the identification numbers are matched.

4. Tighten the bolts to 4.5 m·kg (30 ft·lb).

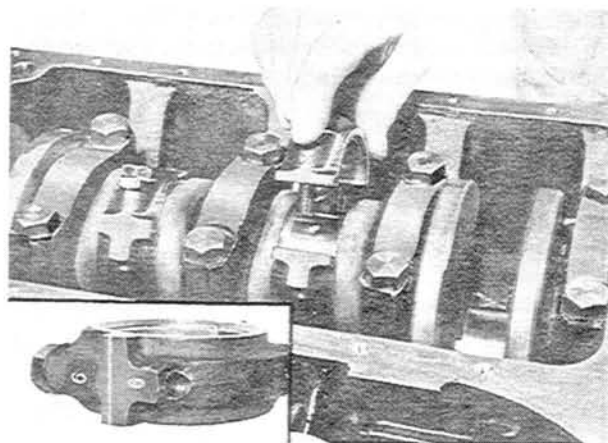


Fig. 1-52 Installing of connecting rod cap

5. After tightening, turn the crankshaft and make sure that the rotation is light and smooth.

1-E-7. Checking of Connecting Rod Bearing Clearance and Side Play

Refer to Par. 1-D-22 and 1-D-23.

1-E-8. Installing of Oil Pump and Strainer

1. Place the adjusting shims on the cylinder block.

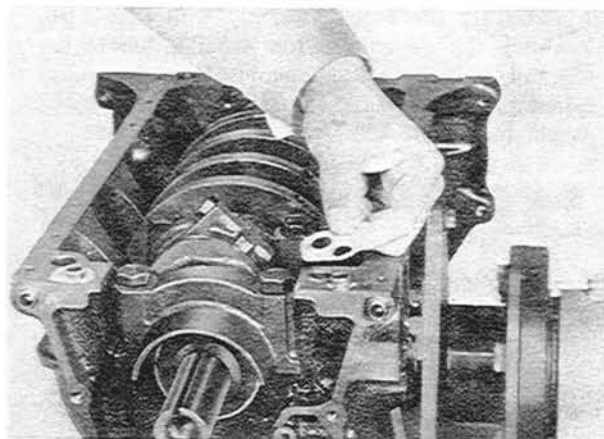


Fig. 1-53 Placing of adjusting shim

2. Fit the "O" ring to the outlet hole on the oil pump and install the oil pump to the block, aligning the dowel pins.

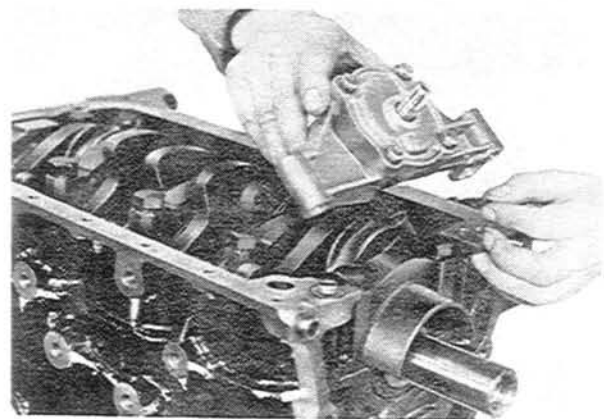


Fig. 1-54 Fitting of "O" ring

3. Tighten the attaching bolts.
4. Place the "O" ring on the oil pump and install the oil strainer to the oil pump. Tighten the nuts.

1-E-9. Installing of Timing Chain and Sprockets

1. Fit the spacer onto the crankshaft.
2. Place the timing chain on the crankshaft sprocket and camshaft sprocket with the tally marks aligned as shown in Fig. 1-55.

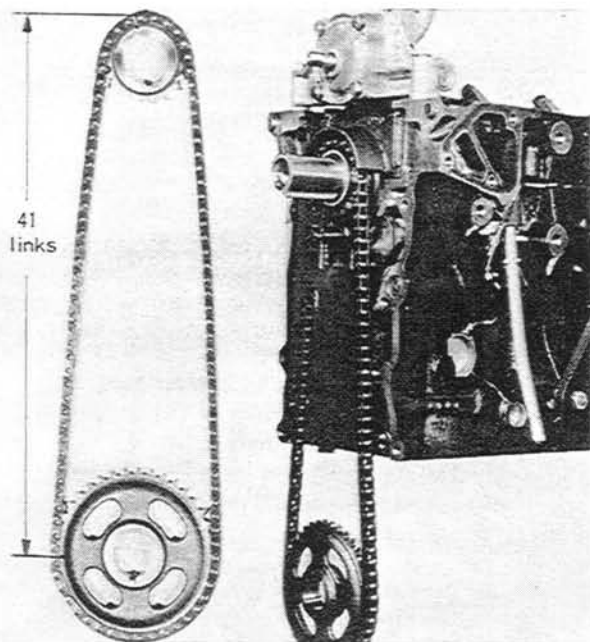


Fig. 1-55 Installing of timing chain

3. Being careful not to change the relation of timing chain, camshaft sprocket and crankshaft sprocket, fit the crankshaft sprocket onto the crankshaft.
4. Align the keyways of the crankshaft and sprocket and install the key.
5. Fit the spacer onto the crankshaft.

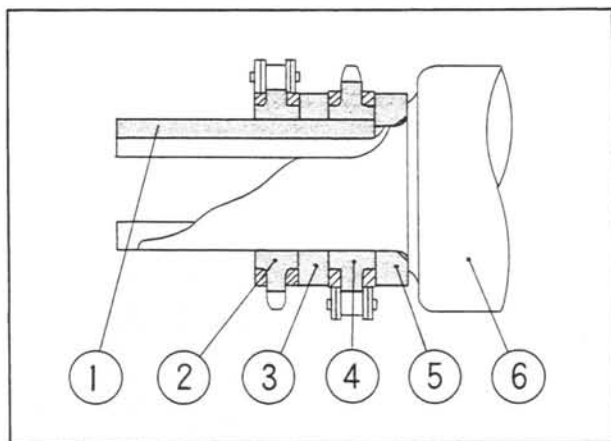


Fig. 1-56 Crankshaft sprockets

- | | |
|----------------------|--------------------|
| 1. Key | 4. Timing sprocket |
| 2. Oil pump sprocket | 5. Spacer |
| 3. Spacer | 6. Crankshaft |

6. Install the chain tensioner, slipper blade and chain vibration damper in positions.

1-E-10. Installing of Oil Pump Drive Chain and Sprockets

1. Fit the key on the oil pump shaft.
2. Fit the oil pump drive chain to the crankshaft sprocket and oil pump sprocket and install them to the crankshaft and oil pump shaft, aligning the key.
3. Tighten the oil pump nut and check the slack of the oil pump chain by pressing with a finger as shown in Fig. 1-57.

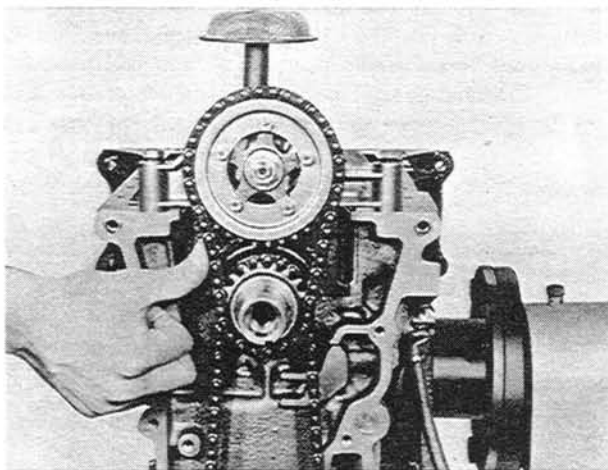


Fig. 1-57 Checking of oil pump drive chain

- The slack should be within 4.0 mm (0.16 in). If it exceeds 4.0 mm (0.16 in), remove the oil pump and add the shims between the cylinder block and oil pump. The thickness of the shim is 0.15 mm (0.006 in).
4. After adjusting, torque the oil pump nut 3.5 m·kg (25 ft·lb) and bend the tab of the lockwasher.

1-E-11. Installing of Timing Chain Cover

1. Install the oil baffle plate to the crankshaft with the edge turned outward.

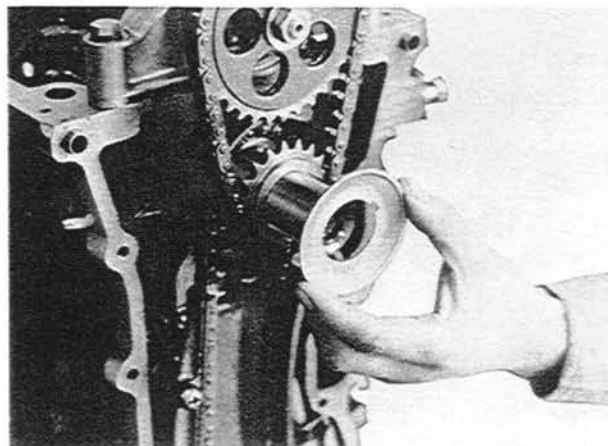


Fig. 1-58 Installing of Timing Chain Cover

2. Fit the oil deflector and the oil seal into the timing chain cover. Then, apply grease to the oil seal lip.
3. Place the gaskets on the cylinder block and install the chain cover, aligning the dowel pins. Tighten the bolts and nuts.

Note: Cut off the excess gaskets along the mounting surfaces of the oil pan and cylinder head.

1-E-12. Installing of Oil Pan

1. Before installing the oil pan, make a final internal inspection.
2. Apply a thin coat of gasket paste on the cylinder block.
3. Place a new gasket on the cylinder block.
4. Install the oil pan and tighten the bolts and nuts little by little in turn until the torque becomes **0.7 m-k_g (5.0 ft-lb) evenly**.

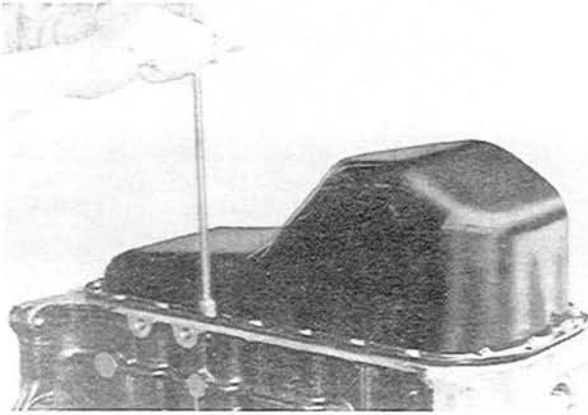


Fig. 1-59 Installing of oil pan

1-E-13. Installing of Clutch Assembly

Install the clutch assembly, as described in Par. 6-E.

1-E-14. Installing of Crankshaft Pulley

1. Lock the flywheel with the **ring gear brake (49 0221 030A)**.
2. Install the crankshaft pulley to the crankshaft so that the key groove of the pulley aligns with the key on the crankshaft.

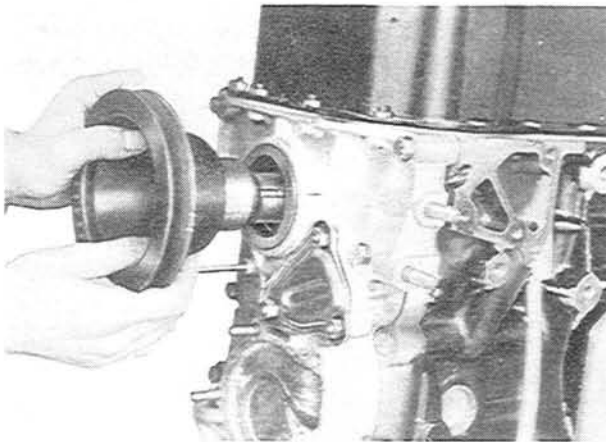


Fig. 1-60 Installing of crankshaft pulley

3. Tighten the pulley bolts to **14.5 m-k_g (105 ft-lb)**.

1-E-15. Installing of Cylinder Head

1. Hold the camshaft sprocket and chain securely with a hand and rotate the cylinder block upside down.
2. Place the sprocket and the chain on the tops of the slipper blade and the vibration damper.

Note: Ensure that the tally marks of both the camshaft sprocket and the chain are engaged properly.

3. Place a new gasket on the cylinder block.
4. Position the cylinder head on the cylinder block, aligning the dowels.

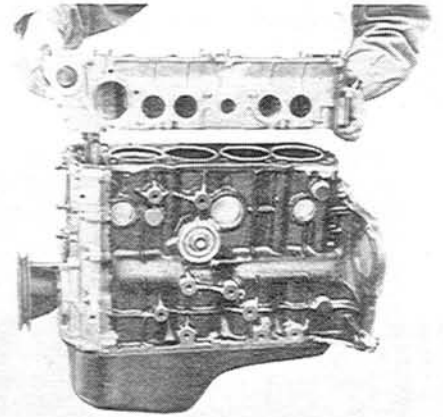


Fig. 1-61 Installing of cylinder head

1-E-16. Installing of Camshaft

1. Fit the three sets of the camshaft bearings properly to the cylinder head and the bearing caps respectively.

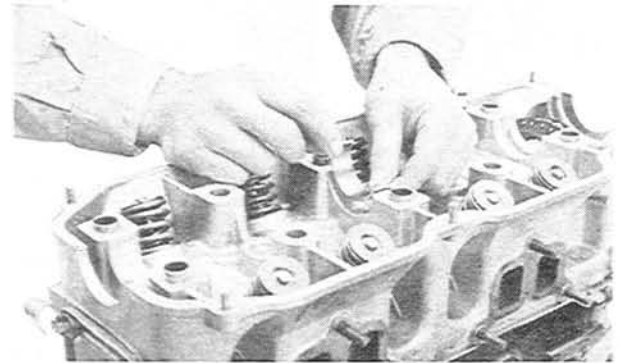


Fig. 1-62 Installing of camshaft bearing

2. Lubricate the bearing surfaces with engine oil.
3. Install the camshaft to the sprocket, aligning the key and fit the camshaft journals onto the respective bearings.

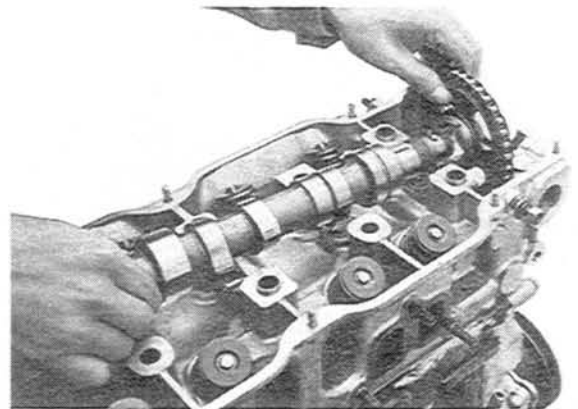


Fig. 1-63 Installing of camshaft

Note: The valve timing is as shown in Fig. 1-64.

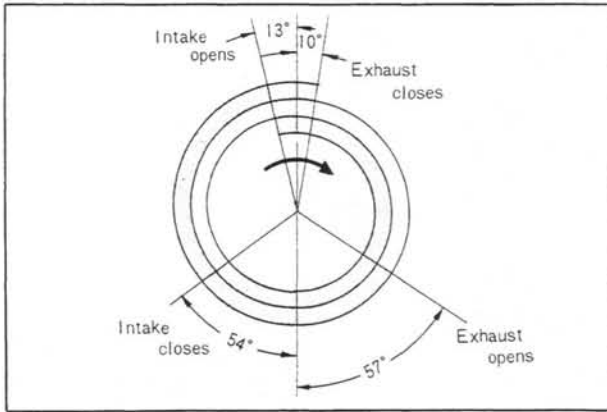


Fig. 1-64 Valve timing

1-E-17. Assembling of Rocker Arm

Assemble the rocker arms in the formation shown in Fig. 1-65.

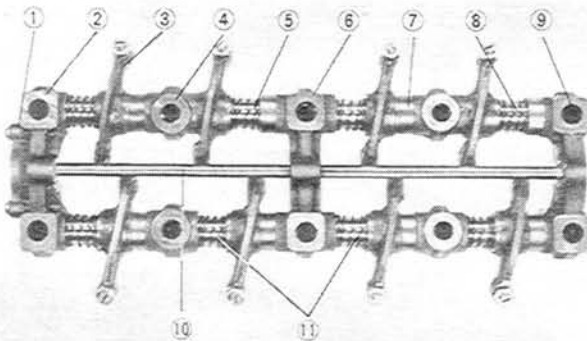


Fig. 1-65 Rocker arm assembly

- 1. Thrust plate
- 2. Front bearing cap
- 3. Rocker arm
- 4. Supporter
- 5. Rocker arm shaft (EX)
- 6. Center bearing cap
- 7. Spacer
- 8. Spring
- 9. Rear bearing cap
- 10. Oil pipe
- 11. Rocker arm shaft (IN)

Care must be taken on the following points:

1. The rocker arms, spacers and rocker arm shaft supporters are respectively interchangeable for the intake and the exhaust.
2. The rocker arm shafts for the intake and the exhaust are not interchangeable. Two shafts are installed on the intake side and one on the exhaust side. The two shafts for the intake side are interchangeable.

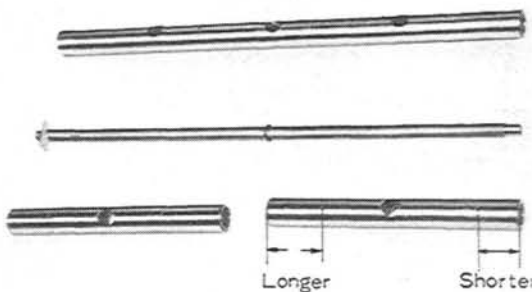


Fig. 1-66 Rocker arm shafts and oil pipe

3. When installing the rocker arm shafts on the intake side, the ends with the longer distance between the oil hole and the tip are turned towards inside each other.

4. The center bearing cap is installed with the oil hole facing toward the intake side.

5. The oil pipe is installed with the oil ejection hole facing the camshaft. In order to avoid vibration of the pipe after it has installed, the "O" ring fitted on the pipe is pressed into the hole for the pipe on the center bearing cap.

1-E-18. Installing of Rocker Arm Assembly

1. Face the flat surface on the ball on each of the rocker arms downward.

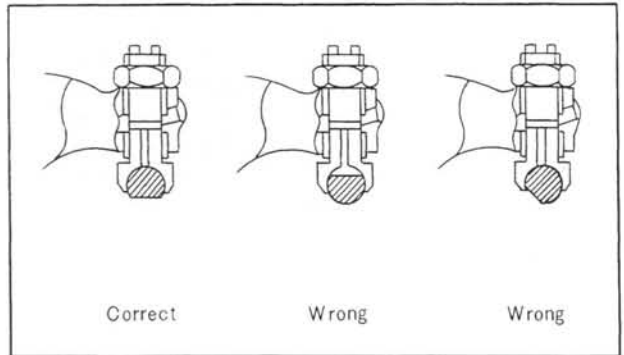


Fig. 1-67 Tappet ball

2. Aligning the dowels, position the rocker arm assembly on the cylinder head.

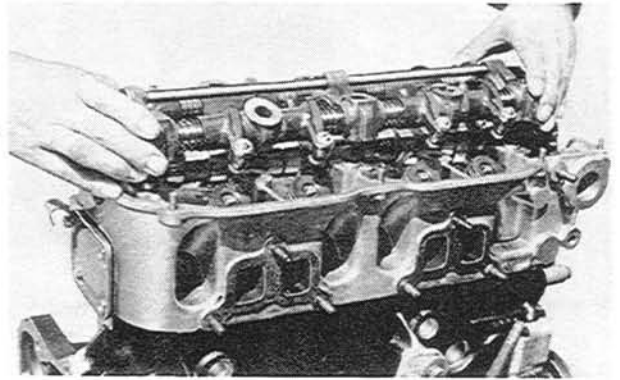


Fig. 1-68 Installing of rocker arm assembly

3. Tighten the cylinder bolts temporarily.

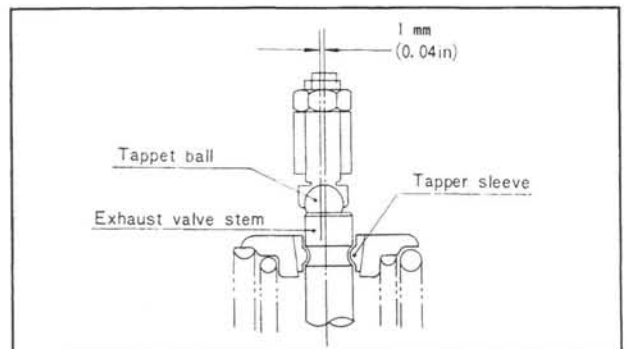


Fig. 1-69 Rocker arm offset

4. Move the rocker arm supporters and **offset** each of the **exhaust side rocker arms 1 mm (0.04 in)** from the valve stem center.

This offsetting will rotate the exhaust valves and thus prevent carbon deposits and uneven wear on the valve seats.

5. Tighten the cylinder head bolts evenly to **8.0 m-kg (60 ft-lb)** in the sequence shown in Fig. 1-70.

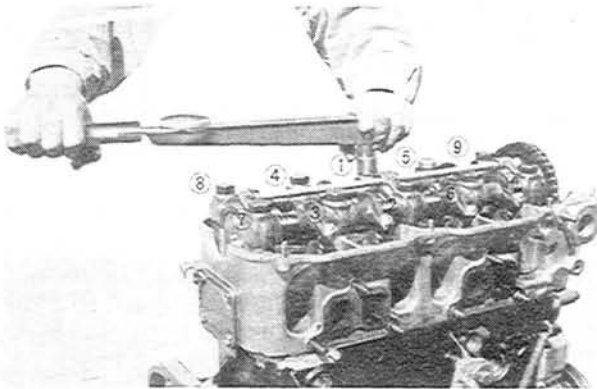


Fig. 1-70 Tightening order

6. Tighten the bolt attaching the cylinder head and the timing chain cover.

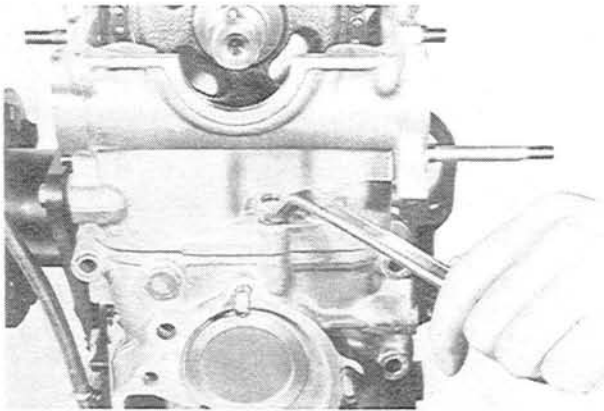


Fig. 1-71 Tightening of attaching bolt

7. Lock the flywheel with the **ring gear brake (49 0221 030A)** and tighten the camshaft sprocket lock nuts to **8.0 m-kg (60 ft-lb)** with the **spanner (49 0164 631A)**. Bend the tab of the lock washer.

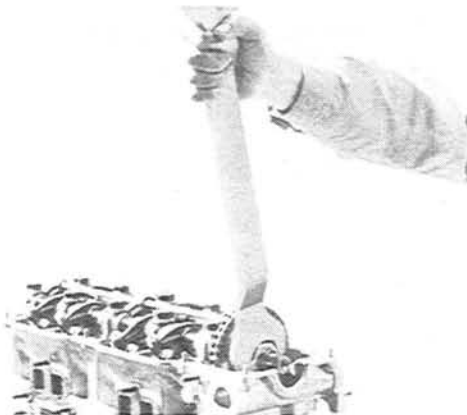


Fig. 1-72 Tightening of camshaft sprocket nut

8. Align the key groove with the pin and install the distributor drive gear to the camshaft.

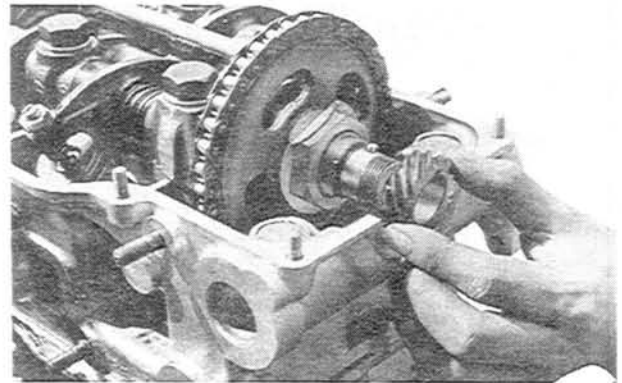


Fig. 1-73 Installing of distributor drive gear

9. Tighten the lock nut to **8.0 m-kg (60 ft-lb)** and bend the tab of the lock washer.

1-E-19. Checking of Camshaft Bearing Clearance and End Play

Refer to Par. 1-D-34 and 1-D-35.

1-E-20. Adjusting of Timing Chain

Using a screw driver through the opening of the cylinder head, turn the slide pin of the chain tensioner counter-clockwise and release the adjusting arm. The timing chain now has the proper tension and no further manual adjustment is required.

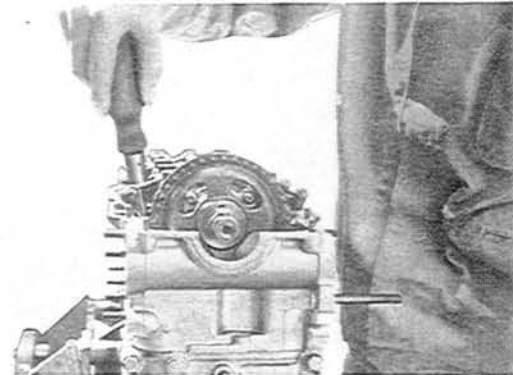


Fig. 1-74 Adjusting of timing of chain

1-E-21. Installing of Water Pump

1. Position the gasket on the timing chain cover and install the water pump.



Fig. 1-75 Installing of water pump

2. Install the alternator strap.
3. Tighten the attaching bolts and nuts.

1-E-22. Installing of Thermostat

1. Install the thermostat casing and gasket to the cylinder head.
2. Insert the thermostat into thermostat casing.

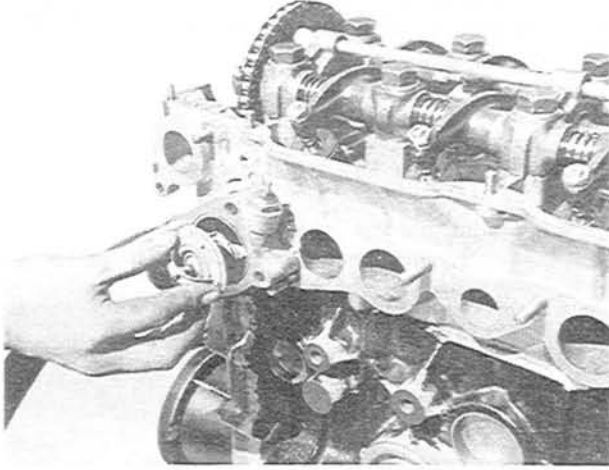


Fig. 1-76 Inserting of thermostat

3. Install the thermostat cover and gasket.
4. Install the engine hanger.
5. Tighten the attaching bolts and nuts.

1-E-23. Installing of Intake Manifold and Carburetor

1. Place the gasket on the cylinder head.
2. Install the intake manifold and carburetor assembly to the cylinder head and tighten the attaching nuts.

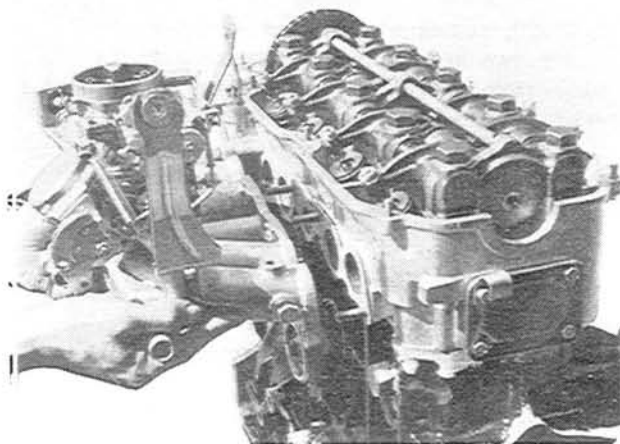


Fig. 1-77 Installing of intake manifold

1-E-24. Installing of Distributor

1. Rotate the crankshaft in the direction of revolution until the No. 1 piston is at 8 degrees before top of the compression stroke. The first mark on the edge of the crankshaft pulley should be in line with the needle on the timing chain cover, as shown in Fig. 1-78.
2. Align the tally marks on the distributor housing and the drive gear as shown in Fig. 1-79.



Fig. 1-78 Aligning of crankshaft pulley

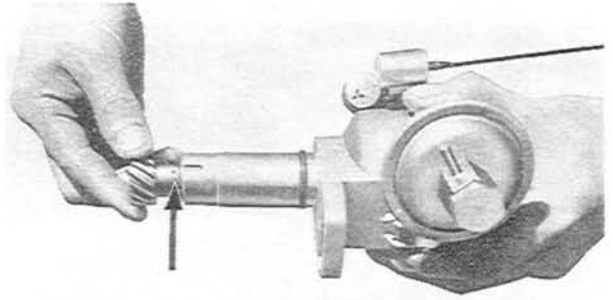


Fig. 1-79 Aligning of tally marks

3. Insert the distributor to the cylinder head and engage the gears.

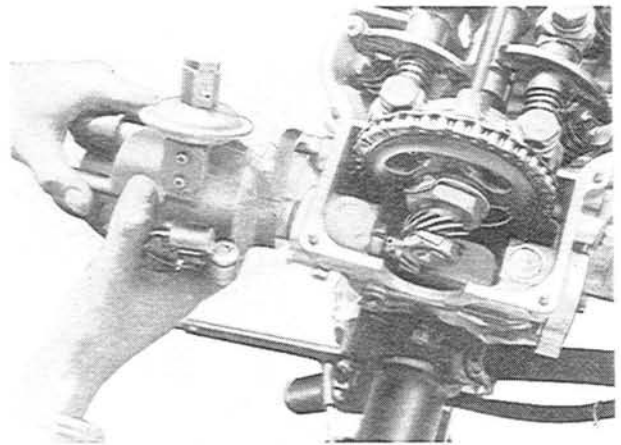


Fig. 1-80 Inserting of distributor

4. Tighten the distributor locking nut.

1-E-25. Installing of Oil Filter

1. Place the gasket on the block and install the oil filter cover. Tighten the bolts.
2. Apply oil onto the oil seal on the new filter cartridge.
3. Install the cartridge onto the cover and screw in until it just touches the cover.
4. Tighten the cartridge a further 2/3 of a turn but absolutely no more.

1-E-26. Installing of Cooling Fan

Install the pulley and fan onto the pulley boss of the water pump and tighten the attaching bolts.

1-E-27. Installing of Alternator Bracket and Alternator

1. Install the alternator bracket to the cylinder block.
2. Install the alternator to the bracket with bolts.

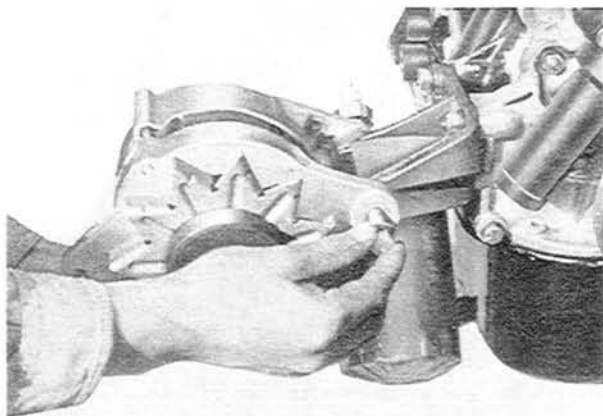


Fig. 1-81 Installing of alternator

3. Attach the upper end of the alternator flange to the strap.
4. Fit the "V" belt.
5. Using a lever, pull the alternator away from the engine until the proper tension is obtained. Correct adjustment will permit the belt to flex 12 to 14 mm (0.47 to 0.55 in) by pressing with a finger in the middle between the pulleys. For a new belt, it should be 9 to 11 mm (0.35 to 0.43 in).
6. Tighten the bolts.

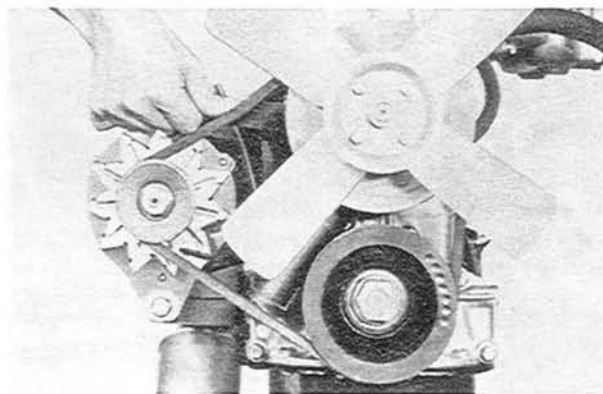


Fig. 1-82 Adjusting of tension

1-E-28. Adjusting of Valve Clearance

Adjust the valve clearance to be 0.3 mm (0.012 in) for both the intake and exhaust when the piston is at top dead center of the compression stroke.

To adjust valve clearance, loosen the lock nut and insert a feeler gauge between the rocker arm and valve stem, and then, turn the adjusting screw until the proper clearance is obtained.

After adjustment, tighten the lock nut securely and recheck clearance.

Note:

- (a) Before inserting the feeler gauge, engine that the flat surface of the ball on the rocker arm is facing downward.
- (b) When adjusting the valve clearance at the camshaft side, the clearance should be 0.25 mm (0.010 in)

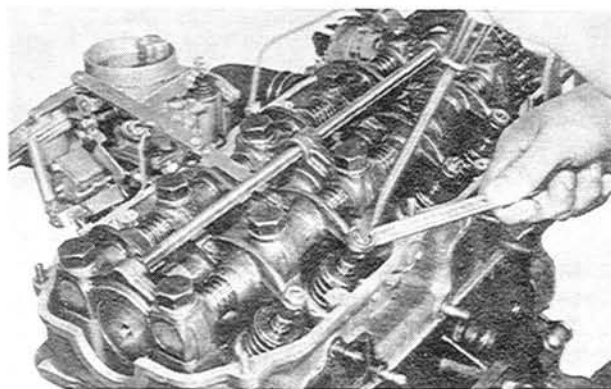


Fig. 1-83 Adjusting of valve clearance

- (c) Whenever the engine is overhauled, the valve clearance must be readjusted after warming up the engine and retightening the cylinder head bolts to the specified torque.

1-E-29. Installing of Rocker Arm Cover

1. Fit two semicircular oil seals, with the "OUT" mark facing outwards, to the front and rear of the cylinder head.
2. Place a new gasket on the cylinder head.
3. Install the rocker arm cover and tighten the attaching nuts.

1-F. ENGINE INSTALLATION

Carry out the removing operations in the reverse order.

SPECIAL TOOLS

49 0107 680A	Engine stand	49 0223 160A	Valve seal installer
49 0305 005	Hanger (for engine stand)	49 2765 034	Valve seat cutter pilot
49 0164 631A	Spanner	49 2728 033	Valve seat cutter pilot
49 0636 100	Valve spring lifter	49 2801 011	90° Cutter (for IN seat)
49 0221 222A	Pivot (for valve spring lifter)	49 2801 013	30° Cutter (for IN port)
49 0221 030A	Ring gear brake	49 2821 012	150° Cutter (for IN spot facing)
49 0223 061	Piston pin remover and installer	49 2952 011	90° Cutter (for EX seat)
49 0221 270A	Main bearing cap puller	49 2541 013	30° Cutter (for EX port)
49 0221 251A	Valve guide remover	49 2765 012	150° Cutter (for EX spot facing)