Engine - Block Assembly

GENERAL

The engine block assembly includes the pistons and connecting rods, crankshaft, camshaft, valves and lifters, cylinder heads, lubrication system, timing gears, governor mechanism, bearings, and cylinder block. Performing any major service on the block assembly will require that the generator set be removed from the coach (see Set Removal section). In addition, to gain complete access to the block assembly, the control, generator, and all primary engine systems must also be removed. Refer to the previous sections for the disassembly and removal procedures.

OIL FILTER AND ADAPTER

Open the oil drain valve and drain the crankcase oil. Remove the filter (see Figure 53) by turning counterclockwise with a filter wrench. The low oil pressure cut-off switch is installed in a threaded hole in the filter adapter and may be removed if required. Loosen the two capscrews that secure the adapter to the engine block and remove the adapter and gasket.

Assembly is the reverse of disassembly. Use a new adapter gasket and install so the two small oil holes are aligned with the oil holes in the block. Gasket should be installed dry. Coat the threads of each capscrew with non-hardening sealer and tighten to recommended torque.

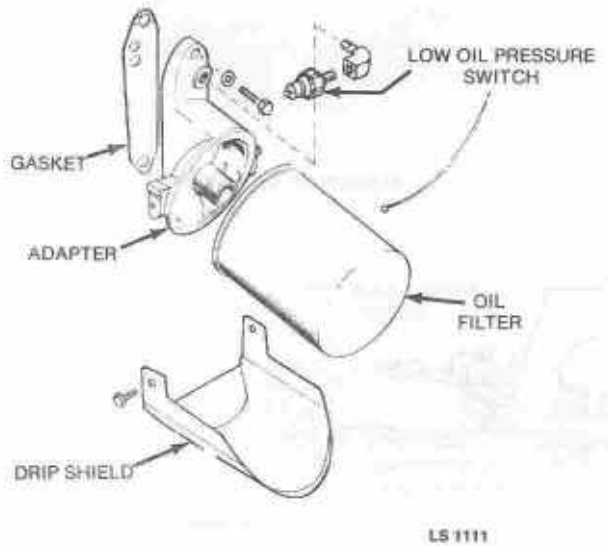


FIGURE 53. OIL FILTER AND ADAPTER

CYLINDER HEADS

Remove the cylinder heads for cleaning when poor engine performance is noticed. Use the following procedures to service.

1. Use a 1/2 inch socket wrench to remove the cylinder head bolts or stud nuts and lift off the head.

CAUTION ***Warpage might occur if the heads are removed while hot. Wait until engine has cooled before removing heads.***

2. After removing heads, clean out all carbon deposits. Be careful not to damage the outer sealing edges where gaskets fit. The heads are made of aluminum and can be damaged by careless handling.
3. Use new head gaskets and clean both the heads and the cylinder block thoroughly where the head gaskets rest.
4. Place heads in position and follow head torque tightening sequence shown in Figure 54. Start out tightening all bolts to 5 ft. lb (7 N•m), then 10 ft. lb (14 N•m), etc., until all bolts or stud nuts are tightened to the specified torque (see Specifications section).
5. Retorque before engine has run a total of 25 hours.

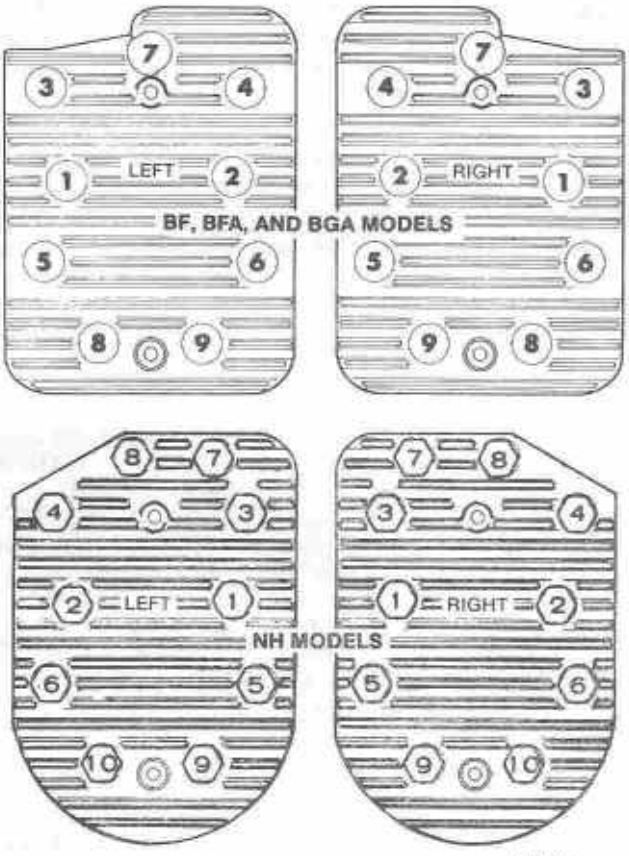


FIGURE 54. CYLINDER HEAD TIGHTENING SEQUENCE

VALVE SYSTEM

A properly functioning valve system is essential for good engine performance. All B and N series generator sets utilize an L-head type valve design as shown in Figure 55. Access to the valve system can be obtained by removing the cylinder heads and the valve covers on top of the engine. A valve spring compressor must be used to remove valves (see Figure 56) from the cylinder block. Use the following procedures to inspect and service the valve system.

Inspection

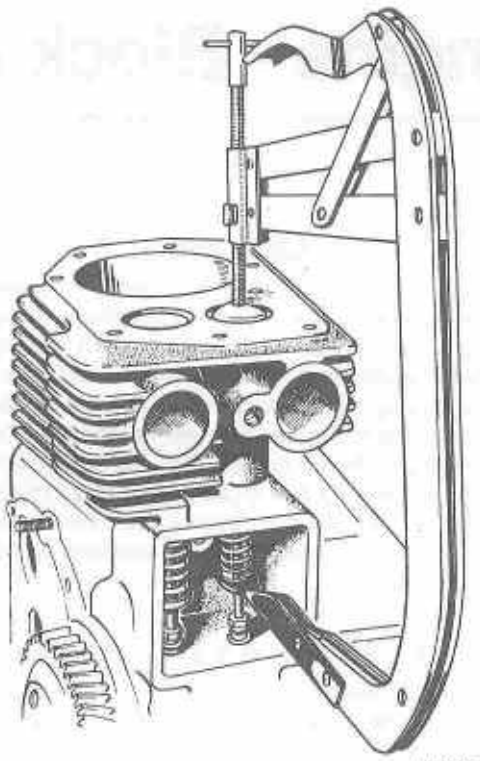
Valve Face: Check the valve face for evidence of burning, warpage, out-of-round, and carbon deposits (Figure 57).

Burning and pitting are caused by the valve failing to seat tightly. This condition is often caused by hard carbon particles on the seat. It may also be due to weak valve springs, insufficient tappet clearance, warpage, and misalignment.

Warpage occurs chiefly in the upper stem due to its exposure to intense heat. Out-of-round wear follows when the seat is pounded by a valve whose head is not in line with the stem and guide. If a valve face is burned or warped, or the stem worn, install a new one.

Too much clearance in the intake guide admits air and oil into the combustion chamber, upsetting carburetion, increasing oil consumption, and making heavy carbon deposits. Carbon prevents heat dissipation. Clean metal is a good heat conductor but carbon insulates and retains heat. This increases combustion chamber termperatures which causes warping and burning.

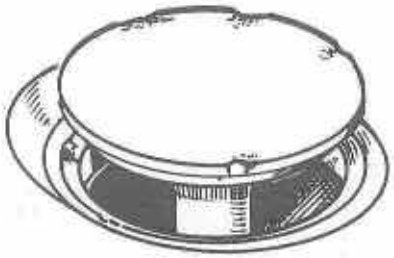
Unburned carbon residue gums valve stems and causes them to stick in the guide. Deposits of hard carbon with sharp points projecting become white hot and cause preignition and "pinging".



VT 1018

FIGURE 56. VALVE SPRING COMPRESSOR

Stems And Guides: Always check valve stems and guides for wear as shown in Figure 58. Use a hole gauge to measure the valve guide. When clearance with stem exceeds original clearance by 0.002 inch (0.05 mm), replace either valve or guide or both, as may be necessary. Always regrind seat to make concentric with the newly installed guide.



VT 1017

FIGURE 57. VALVE FACE

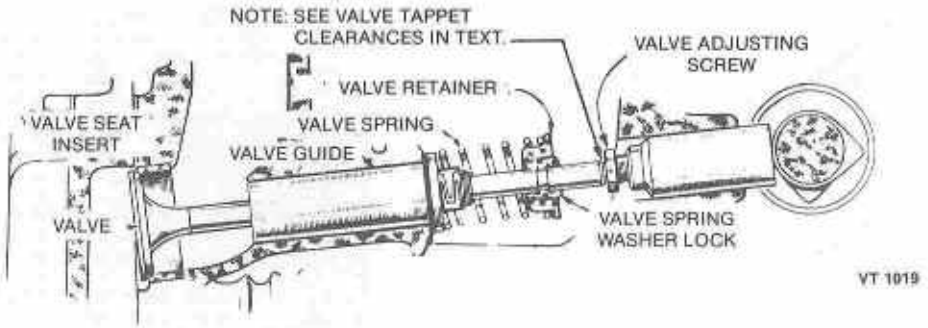
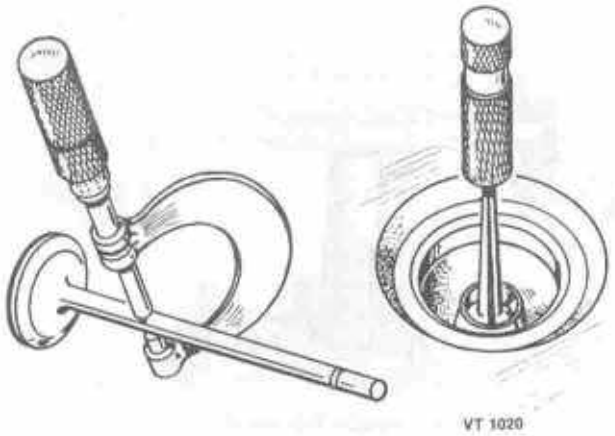


FIGURE 55. VALVE SYSTEM



VT 1020

FIGURE 58. VALVE STEM AND VALVE GUIDE INSPECTION

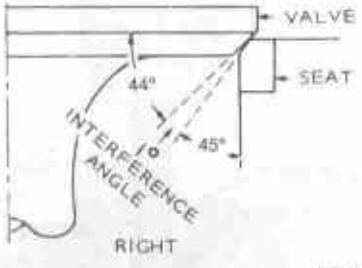
Valve Springs: Test the valve springs for uniform strength (see Specifications). Use a valve spring tester for accurate check — or place springs on end on a level surface (see that spring ends are flat) and use a straight edge to determine irregularity in height. Unequal or cocked valve springs will undo in the assembled job all the precision that has been put into it. Spring tension too weak allows valves to flutter. Spring tension too heavy causes "stretched" valves. Either condition aggravates wear on valve and seat with possible valve breakage.

Replace valve springs not within specifications.

Reconditioning Valves And Valve Seats

The interference angle method of valve seating is used on all B and N series generator set engines. With this method, different seat and face angles are used and line contact between the valve face and seat occurs.

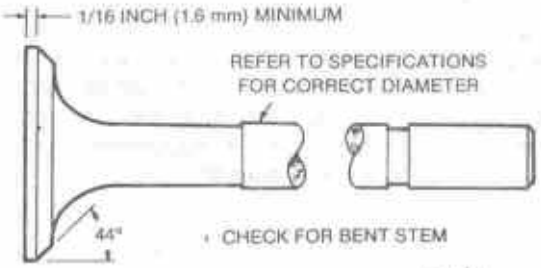
The valve *face* angle is 44 degrees. The valve *seat* angle is 45 degrees. This 1-degree interference angle results in a sharp seating surface between the valve and the top of the valve seat (see Figure 59).



VT 1021

FIGURE 59. VALVE INTERFERENCE ANGLE

The valves should not be hand lapped because the sharp contact will be destroyed. This is especially important where chrome cobalt faced valves and seats are used. Valve faces must be finished in a machine to 44 degrees.



VT 1022

FIGURE 60. VALVE MARGIN

Every valve must have a minimum of 1/16 inch (1.6 mm) margin, Figure 60. If the valve has less margin than this, it will heat up excessively. It will retain that heat during the compression stroke and preignite the mixture, causing loss of power and economy. This valve is also susceptible to warping and breakage.

Not all valves can be reconditioned. A badly warped valve must be replaced because the excessive grinding required to make it seat correctly removes the margin. To make a valve gas tight, every trace of pitting must be removed from the valve face and seat. Deeply pitted or cut valves must be replaced because the grinding removes the margin.

Valve seats should be ground with a 45-degree stone and the width of the seat band should be 1/32-inch to 3/64-inch (0.79 to 1.2 mm) wide. Grind only enough to assure proper seating.

Place each valve in its proper location. Check each valve for a tight seat. Make several marks at regular intervals across the valve face using machinists bluing. Observe if the marks rub off uniformly when the valve is rotated part of a turn against the seat. The valve seat should contact the valve face evenly at all points. The line of contact should be at the center of the valve face.

Valve Guide Replacement

Worn valve stem guides can be replaced from inside the valve chamber (a seal is provided behind the intake valve guides only). The smaller diameter of the tapered valve guides must face toward the valve head. Tappets are also replaceable from the valve chamber after first removing the valve assemblies.

Removal: Before removing valve guides, use an electric drill with a wire brush to remove carbon and other foreign material from top surface of guides. Failure to perform this operation may result in damage to the guide bores. Drive the guides out with a hammer and valve guide driver.

CAUTION ***Driving out old guides can damage the tapped bores. Be careful not to strike bores with driver.***

Installation: Run a small polishing rod with crocus cloth through valve guide holes to clean out carbon and other foreign materials. Place a new gasket on the intake valve guide and coat the outer edge of each new guide with oil. Place guide, notch up, in cylinder block and press in until guide protrudes 11/32-inch (8.7 mm) from rocker box side of block. A suggested method of installation is shown in Figure 61.

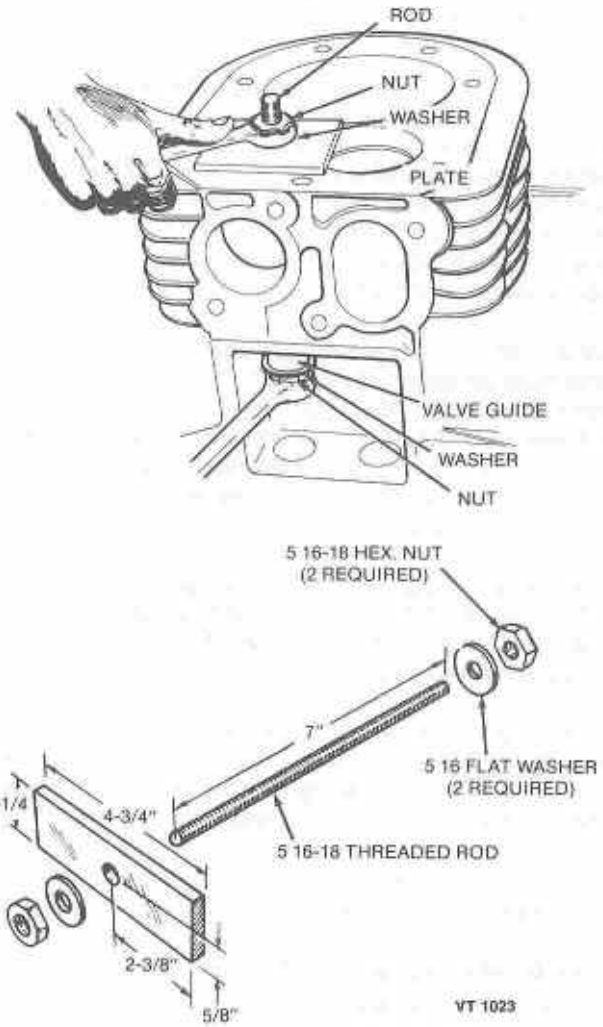


FIGURE 61. VALVE GUIDE INSTALLATION

Valve Seat Replacement

Worn valve seats can be replaced with new valve seat inserts.

Removal: Use a standard 3/4-inch or 1 inch pipe tap (depending on the seat diameter) to remove the valve seat (see Figure 62). Place a small piece of flat steel or a flat washer on the top of the valve guide for the tap to bottom against. Turn the pipe tap in until the seat starts to turn in the seat recess. Continue to turn the tap and pull outward to remove the seat. If the valve guide is pushed downward by the tap, be sure to push it back into the proper position. Because a slight amount of recess metal will be removed by this operation, an oversize replacement seat must be used.

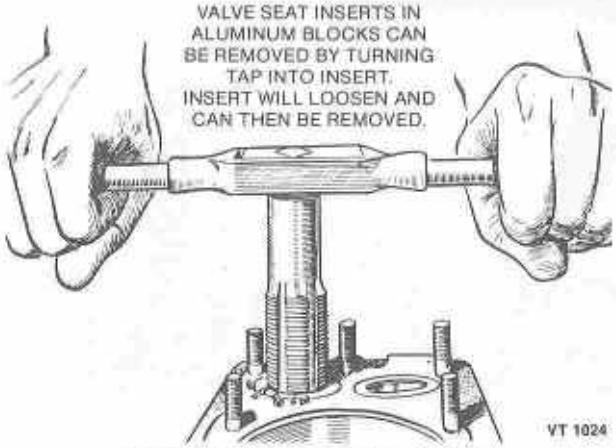


FIGURE 62. REMOVING VALVE SEAT

Replacement: After the old seat has been removed, clean out any carbon or metal burrs from the seat insert recess. The easiest and most accurate method of installation involves slowly heating the cylinder block to 325° F (163° C) and chilling the valve seat insert in dry ice for one-half hour. Use a valve seat insert driver and hammer to install the insert.

CAUTION ***Contact with dry ice might cause personal injury. Do not handle or touch dry ice.***

Insert the pilot of the tool into the valve guide hole in the cylinder block and quickly drive the valve seat insert in so that the insert goes evenly to the bottom of the recess in the cylinder block. Make certain that the valve seat insert rests solidly on the bottom of the recess all the way around its circumference (Figure 63).

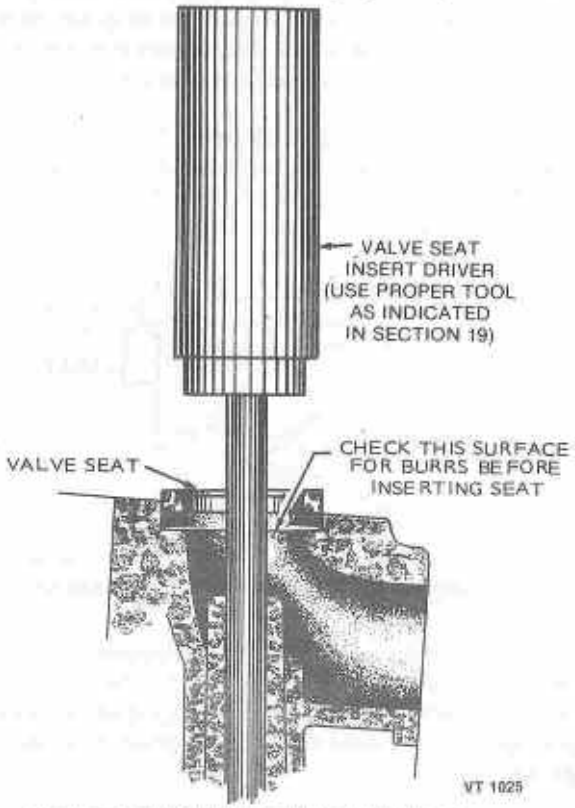
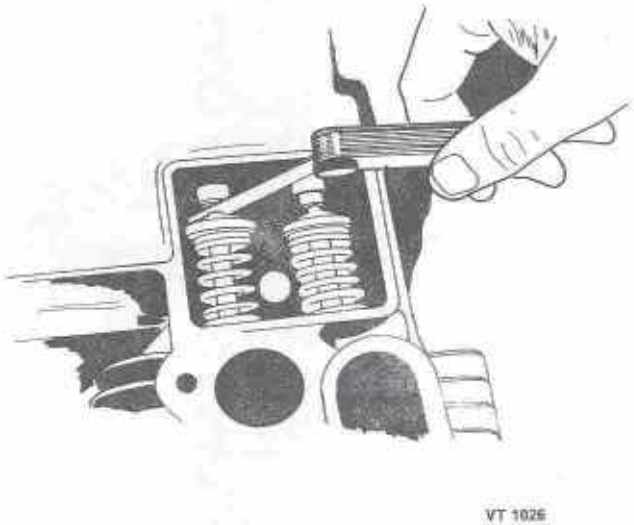


FIGURE 63. INSERTING NEW VALVE SEAT

Tappet Adjustment

The engine is equipped with adjustable valve tappets. Adjust the valve clearance only when engine is at ambient temperature. Proceed as follows.

1. Remove all parts necessary to gain access to valve tappets.
2. Remove spark plugs to make turning the engine easier.
3. Place a socket wrench on the flywheel capscrew and rotate the crankshaft in a clockwise direction until the left intake valve (viewed from flywheel end) opens and closes. Continue turning the crankshaft until the TC mark on the flywheel is lined up with the TC mark on the gear cover. This should place the left piston (#1) at the top of its compression stroke. Verify that the left intake and exhaust valves are closed and there is no pressure on the valve lifters.
4. Clearances are shown in the Specifications section. For each valve, the gauge should just pass between the valve stem and valve tappet (see Figure 64).
5. To correct the valve clearance, turn the adjusting screw as needed to obtain the right clearance. The screw is self-locking.
6. To adjust valves on the right cylinder, turn engine one complete revolution and again line up mark on the flywheel and the TC mark on the gear cover. Then follow adjustment procedure given for left cylinder.
7. Replace all parts removed. Tighten all screws securely. Torque manifold bolts.



VT 1026

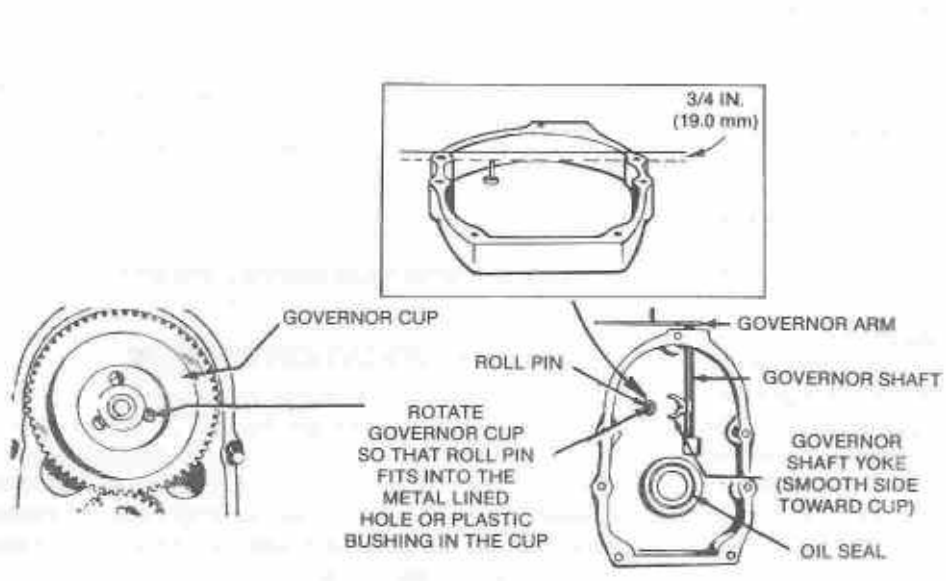
FIGURE 64. VALVE CLEARANCE ADJUSTMENT

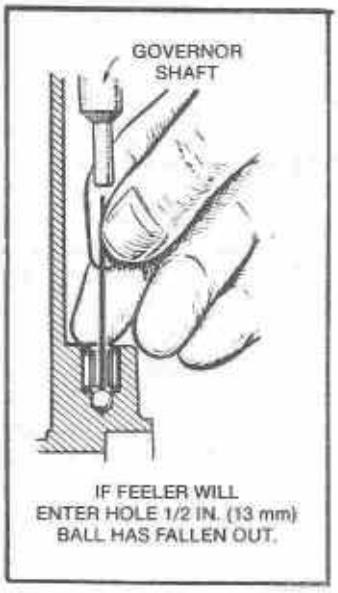
GEAR COVER

Remove the flywheel key and gear cover mounting screws. Gently tap the gear cover with a plastic-faced hammer to loosen it (see Figure 65).

When installing the gear cover, make sure that the pin in the gear cover engages the nylon lined (smooth) hole in the governor cup. Turn the governor cup so that the nylon lined hole is at the three o'clock position. Use a small amount of grease to assist in holding governor cup in position. The rounded side of the governor yoke must ride against the governor cup. Turn the governor arm and shaft clockwise as far as possible and hold in this position until the gear cover is installed flush against the crankcase. Be careful not to damage the gear cover oil seal.

Refer to Oil Seals section if replacing the gear cover oil seal.





VT 1027

FIGURE 65. GEAR COVER ASSEMBLY

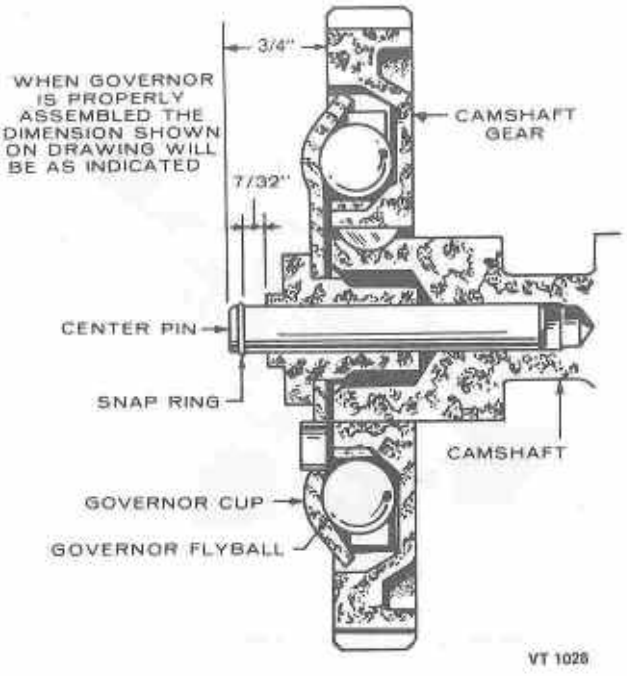


FIGURE 66. GOVERNOR CUP

GOVERNOR CUP

With the gear cover removed, the governor cup can be taken off after removing the snap ring from the camshaft center pin, Figure 66. Catch the flyballs while sliding the cup off.

Replace any flyball that is grooved or has a flat spot. If the arms of the ball spacer are worn or otherwise damaged, remove the spacer by splitting with a chisel. Use a press to install a new spacer on the camshaft gear. The governor cup must spin freely on the camshaft center pin without excessive looseness or wobble. If the race surface of the cup is grooved or rough, replace it with a new one.

The governor cup and flyballs are easily installed when the camshaft assembly is removed from the engine. If necessary, the engine may be tilted up to install the cup and flyballs. Put the flyballs between the spacer arms and install the cup on the center pin. Lock the cup in place with the snap ring.

The camshaft center pin extends out 3/4-inch (19 mm) from the end of the camshaft. This distance provides an in and out travel distance of 7/32-inch (5.6 mm) for the governor cup, as illustrated. Hold the cup against the flyballs when measuring. If the distance is less, the engine may race, especially at no load. Remove the center pin and press in a new pin the specified amount. Do not hammer the new pin into place or it will be damaged. The camshaft center pin cannot be pulled outward nor removed without damage. If the center pin extends out too far, the cup will not hold the flyballs properly.

TIMING GEARS AND CAMSHAFT

If replacement of either the crankshaft gear or the camshaft gear becomes necessary, it is recommended that both gears be replaced.

To remove the crankshaft gear, first remove the snap ring and retainer washer; then attach the gear pulling ring using two No. 10-32 screws (Figure 67). Tighten the screws alternately until both are tight. Attach a gear puller to the puller ring and remove the gear.

The camshaft and gear are removed as an asembly. Before removing the camshaft and gear assembly, remove the cylinder head and valve assemblies. Then remove the operating plunger for the breaker points and tappets.

Each timing gear is stamped with "O" near the edge. The gear teeth must mesh so that these marks exactly coincide when the gears are installed in the engine. When installing the camshaft gear and shaft assembly, be sure that the thrust washer is properly in place behind the camshaft gear. Then install the crankshaft retaining washer and lock ring.

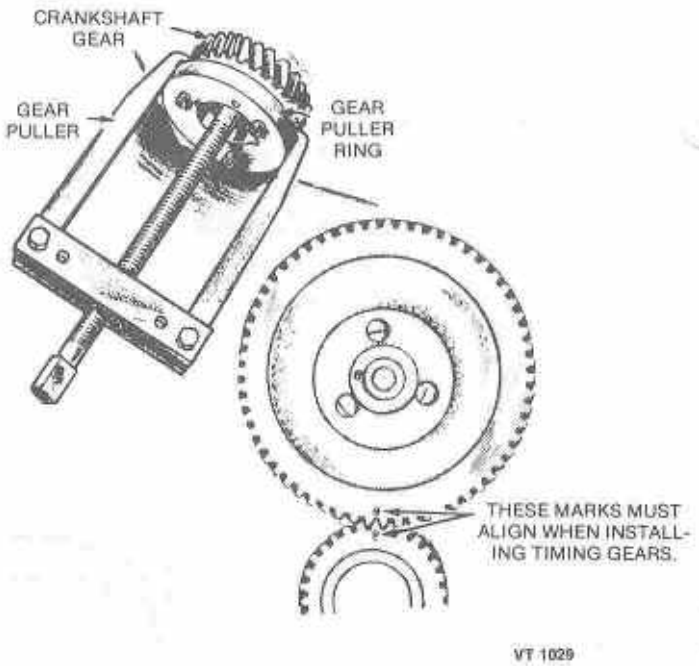


FIGURE 67. TIMING GEAR REMOVAL AND INSTALLATION

LUBRICATION SYSTEM

All B and N series generator set engines use an oil pump to provide a constant flow of oil to the engine parts. The oil supply collects in the oil base where it is picked up by the oil pump pick-up cup. A by-pass valve is used to control oil pressure. Drain the oil before removing the oil base and always use a new gasket when replacing the oil base.

Oil Pump

The oil pump (Figure 68) is mounted on the front of the crankcase behind the gear cover and is driven by the crankshaft gear. The inlet pipe and screen assembly is attached directly to the pump body. A discharge passage in the cover of the pump registers with a drilled passage in the crankcase. Parallel passages distribute oil to the front main bearing, rear main bearing and pressure control bypass valve.

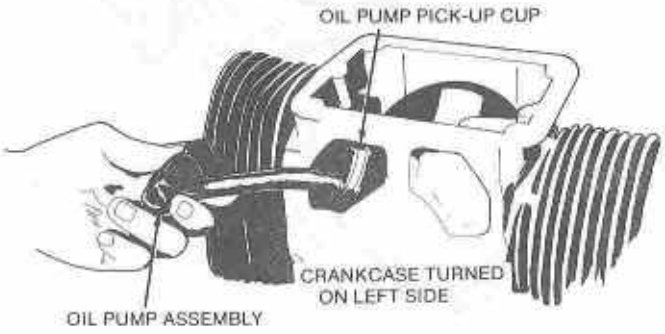


FIGURE 68. OIL PUMP ASSEMBLY

Circumferential grooves in the main bearings supply oil to the connecting rod bearings through drilled passages from each main journal. A drilled passage connects the front main bearing oil supply to the front camshaft bearing. The oil overflow from the bypass valve furnishes lubrication to the camshaft drive gears.

Normal oil pressure should be 30 psi (207 kPa) or higher when the engine is at normal operating temperature. If pressure drops below this value at governed speed, inspect the oil system for faulty components.

Check the oil pump thoroughly for worn parts. Oil the pump to prime it before reinstalling. Except for gaskets and pick-up cup, the component parts of the pump are not available individually. Install a new pump assembly if any parts are worn.

Oil By-Pass Valve

The by-pass valve (located to the right and behind gear cover, Figure 69) controls oil pressure by allowing excess oil to flow directly back to the crankcase. Normally the valve begins to open about 30 psi (207 kPa).

The valve is non-adjustable and normally needs no maintenance. To determine if abnormal (high or low) oil pressure is caused by improper valve operation inspect as follows:

1. Remove 3/8 in. -24 x 1 in. cap screw located behind gear cover and under governor arm.
2. Remove spring and plunger with a magnet tool.

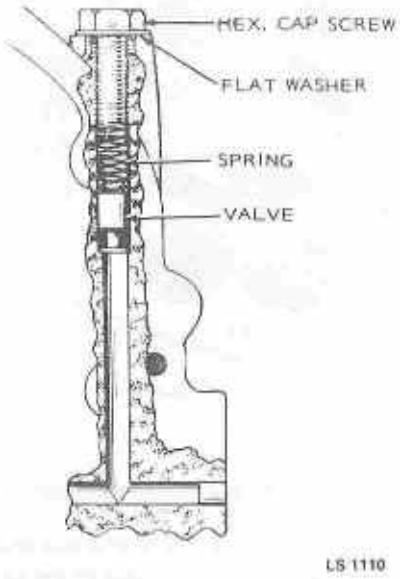


FIGURE 69. OIL BY-PASS VALVE

3. Determine proper valve operation by checking the spring and plunger according to the following measurements.

   Plunger Diameter ..... 0.3365 to 0.3380 in. (8.55 to 8.59 mm)

   Spring
   Free Length ..... 1.00 inch (25.4 mm)
   Load ..... 2.6 ± 0.2 lbs (11.6 ± 0.9N) when compressed to 0.500 inch (12.7 mm)
4. Check the valve seat and clean away any accumulation of metal particles which could cause erratic valve action. Verify that the valve seat is concentric with the larger diameter valve bore.
5. Clean plunger and spring in parts cleaning solvent and install.

PISTON ASSEMBLY

The piston assembly consists of the piston, piston rings, piston pin, connecting rod assembly, and bearing. After removal from the engine, all parts must be carefully inspected for damage and wear before replacing.

Removal And Disassembly

Whenever there is a noticeable wear ridge at the top of each cylinder, remove the ridge before removing the pistons. If not, the rings can catch the ridge when pushing out the pistons and cause a ring land fracture. See Figure 70.

CAUTION ***Forcing the piston from the cylinder before reaming might cause damage to the piston lands and break rings. Remove the wear ridge before removing the piston.***

To remove the piston and connecting rod assemblies, turn the crankshaft until a piston is at the bottom of the stroke. Remove the nuts from the connecting rod bolts.

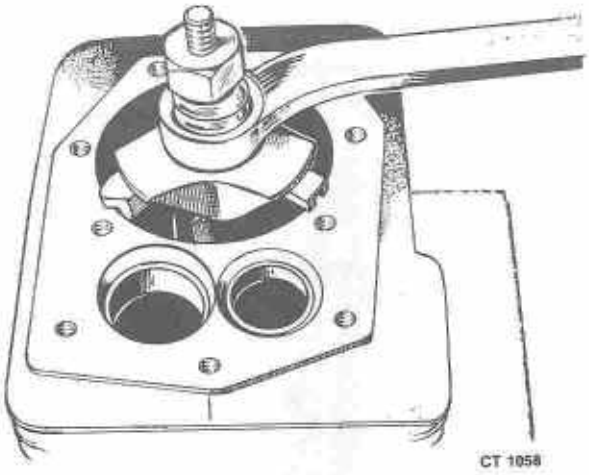


FIGURE 70. REMOVING WEAR RIDGE

Lift the rod bearing cap from the rod and push the rod and piston assembly out the top of the cylinder with the handle end of a hammer. Be careful not to scratch the crankpin or the cylinder wall when removing these parts.

Mark each piston and rod assembly so they can be returned to their respective cylinders after overhaul. Keep connecting rod bearing caps with their respective rods.

The pistons are fitted with two compression rings and one oil control ring. Remove these rings from the piston using a piston ring spreader as shown in Figure 71.

FIGURE 71. REMOVING PISTON RINGS

Mark each piston to make sure the rod will be assembled on the piston from which it was removed. Remove the piston pin retainer from each side and push the pin out.

Remove dirt and deposits from the piston surfaces with an approved cleaning solvent. Clean the piston ring grooves with a groove cleaner or the end of a piston ring filed to a sharp point (Figure 72). Care must be taken not to remove metal from the groove sides.

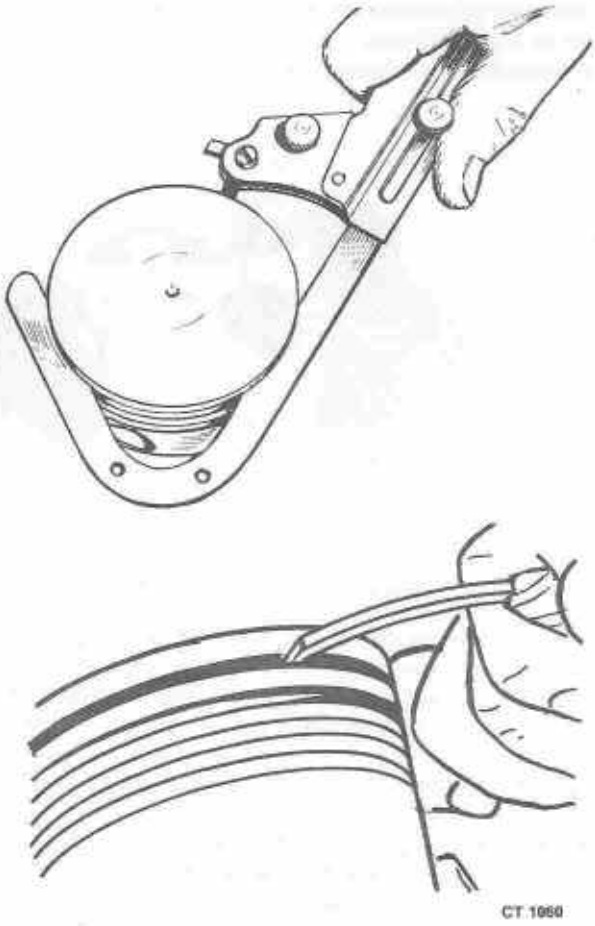


FIGURE 72. CLEANING RING GROOVES

CAUTION ***Using a caustic cleaning solvent or wire brush for cleaning pistons will cause piston damage. Use only parts cleaning solvent.***

When cleaning the connecting rods in solvent, include the rod bore. Blow out all passages with low pressure compressed air.

Inspection

The following covers inspection procedures for pistons and connecting rods.

Piston Inspection: Inspect the pistons for fractures at the ring lands, skirts and pin bosses. Check for wear at the ring lands using a new ring and feeler gauge as shown in Figure 73. Replace the piston when the side clearance of the top compression ring reaches 0.008 inch (0.20 mm).