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**(Ford 742)**

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## TROUBLESHOOTING

### Chart

The following troubleshooting chart is provided for assistance in locating and correcting problems which are most common. Many of the recommended procedures must be done by authorized Bobcat Service Personnel only.

PROBLEM	CAUSE
Engine will not turn over with the starter.	1, 2, 3, 4, 5, 6, 7
Engine will not start or is difficult to start.	8, 9, 10, 11, 12, 13, 14, 15, 16
Engine misses, runs irregularly or stops.	15, 17, 18, 19
Engine overheats.	20, 21, 22, 23, 24

### KEY TO CORRECT THE CAUSE

1. Battery has lost its charge.
2. Loose battery connections.
3. Loose starter connections.
4. Damaged starter switch.
5. Broken or damaged wire harness.
6. Damaged starter or solenoid.
7. Fuse has damage.
8. Wrong starting procedure.
9. No fuel in tank.
10. Air cleaner is dirty.
11. Fuel vent in cap has restricted.
12. Fuel line has air leak, dirt or water.
13. Hydraulic/Hydrostatic load on engine.
14. Fuel pump is damaged.
15. Ignition system is damaged or timing is wrong.
16. Incorrect crankcase oil.
17. Dirty fuel mixture.
18. Poor compression.
19. Water in the fuel line.
20. Engine is overloaded.
21. Radiator grill is dirty.
22. Dirty engine oil.
23. Restricted exhaust system.
24. Coolant level is low.
25. Oil cooler has restriction.

## CHECKS AND ADJUSTMENTS

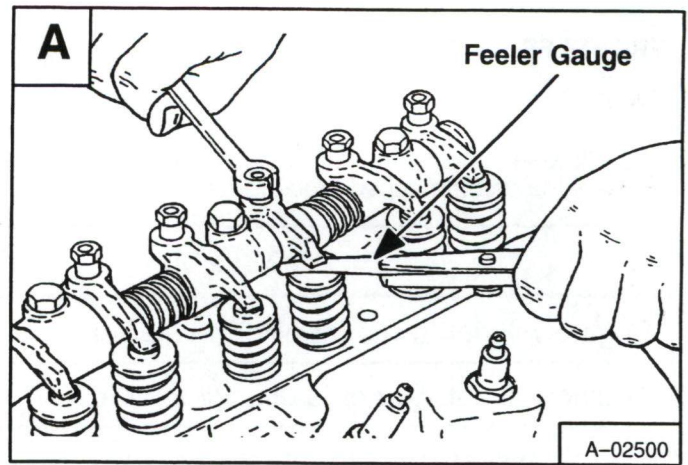
### Oil Pressure

Engine oil pressure can be checked by installing a gauge in the sender switch port. Normal pressure is 35–40 PSI at 2000 RPM.

### Valve Clearance

Make adjustment of valve clearance with the engine stopped

Put a feeler gauge between rocker arm and pushrod and turn adjustment screw in or out to get the correct clearance [A]. (See Section 8B *SPECIFICATIONS* for the correct clearance.)



### Compression

Make sure the crankcase oil level is correct, and the battery has a full charge.

Start the engine and operate for about 30 minutes at 1200 RPM or until the engine is at normal operating temperature.

Stop the engine and remove all the spark plugs.

Put the carburetor throttle plate and choke plate in the full open position.

Install a compression gauge in the No. 1 cylinder. (No. 1 cylinder is at the rear of the machine.)

Operate the starter until it turns the engine at least five compression strokes and record the highest reading. Count the number of compression strokes to get the highest reading.

Test each cylinder.

Make a comparison of the highest and the lowest compression readings. If the lowest is at least 75% of the highest compression pressure are normal [B].

If one or more of the cylinders show a low reading, put 1/2 oz. (14,75 ml) of oil in the low reading cylinders and make the compression test again.

If there is a lot of increase in the compression, the piston rings are worn.

B			
Maximum	Minimum	Maximum	Minimum
PSI	PSI	PSI	PSI
134	101	200	150
136	102	202	151
138	104	204	153
140	105	206	154
142	107	208	156
144	108	210	157
146	110	212	158
148	111	214	160
150	113	216	162
152	114	218	163
154	115	220	165
156	117	222	166
158	118	224	168
160	120	226	169
162	121	228	171
164	123	230	172
166	124	232	174
168	126	234	175
170	127	236	177
172	129	238	178
174	131	240	180
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## CHECKS AND ADJUSTMENTS (Cont'd)

### Compression (Cont'd)

If compression does not show increase, the valves are not operating correctly.

If two cylinders side by side each have a low compression and putting oil in the cylinders does not cause an increase in compression, the damage could be a cylinder head gasket leak between the cylinders.

Head gasket leakage can cause oil or coolant to enter the cylinders and cause damage to the engine.

### Carburetor, Throttle And Governor Adjustments

Put blocks under the frame of the bobcat so that there is no danger of the machine falling and causing personal injury.

Remove the belt shield [A].

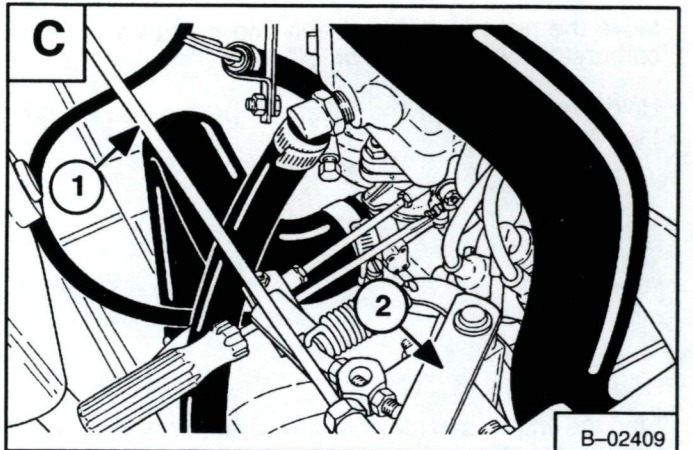
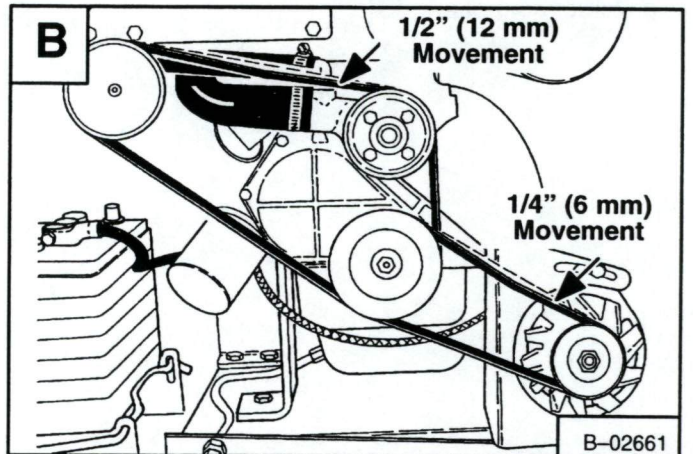
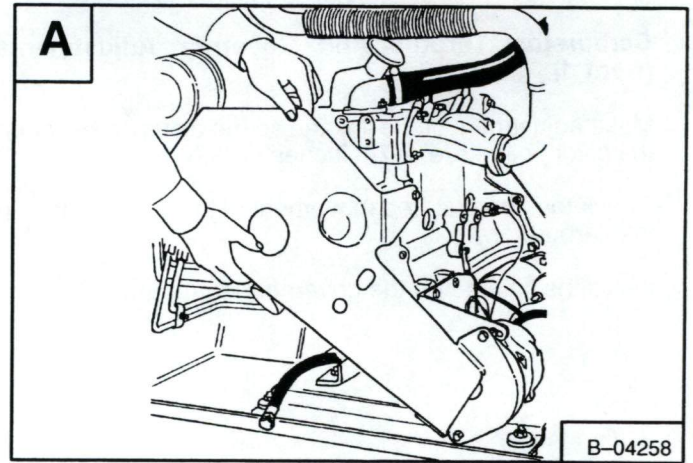
Loosen the governor fastening bolts and make adjustment of belt to give 1/4 inch (6,35 mm) freeplay [B]. Tighten the governor fastening bolts.

Install the belt shield.

**NOTE:** If only the belt needs adjustment, make adjustment to the linkage (Item 1) [C].

Disconnect the throttle rod and the governor linkage (Item 1) [C].

Remove the linkage from the governor control arms (Item 2) [C].



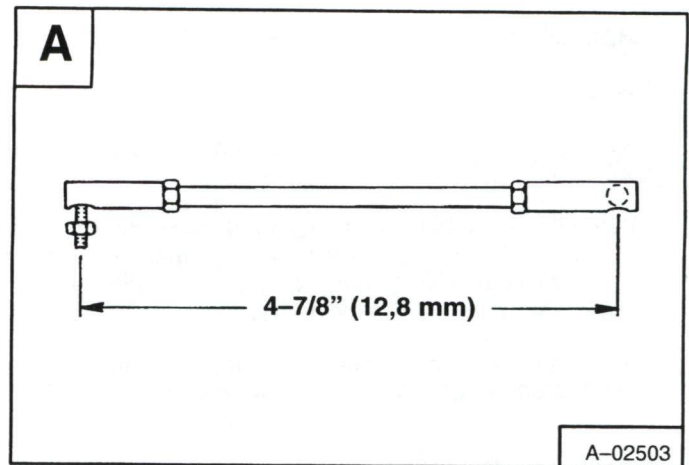
## CHECKS AND ADJUSTMENTS (Cont'd)

### Carburetor, Throttle And Governor Adjustments (Cont'd)

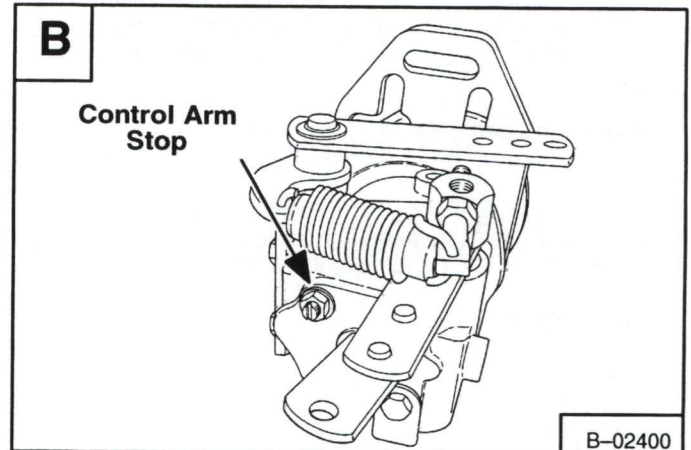
Make adjustment of the linkage so the distance between the pivot points are 4-7/8 inches (123,8 mm) [A].

Check that there is free movement of the throttle plate in the carburetor.

Install the linkage on the governor control arm.



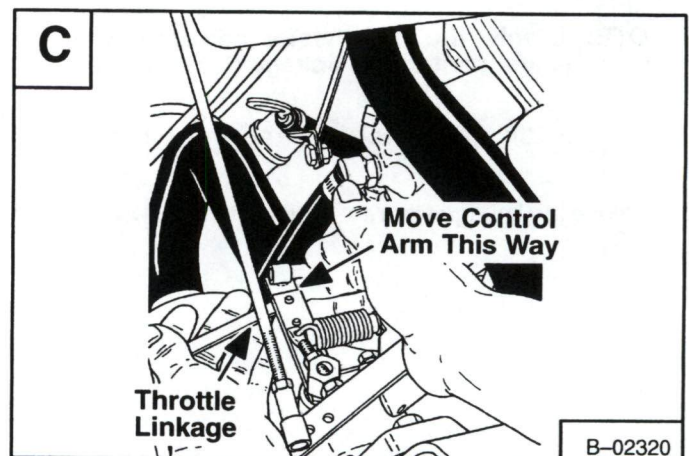
Loosen the control arm stop until it has no effect on the governor control arm [B].



Loosen the two screws on the governor control arm [C].

Move the governor control arm and control arm of the carburetor linkage as shown in [C].

Hold the control arm and linkage in position and tighten the two screws.



Start the engine and turn the idle adjustment screw on the carburetor to adjust the idle speed at 550-650 RPM [D].

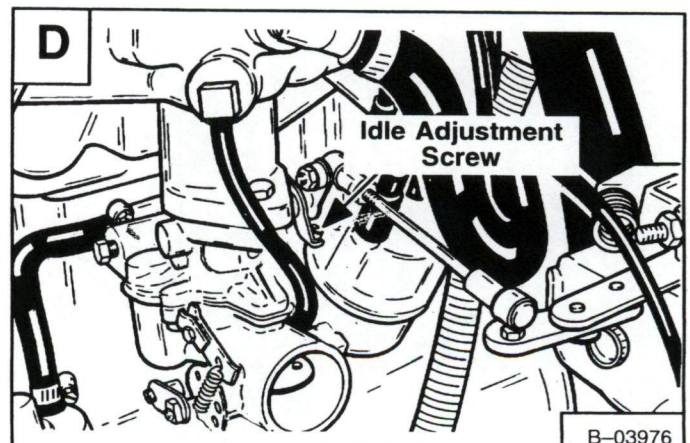
Adjust the ignition timing. (See Page 7B-5 *Ignition Timing* for the correct procedure.)

Put the throttle lever in idle position.

Hold the governor control arm all the way to the left as shown in [C]. then adjust the throttle rod until the pin goes into the hole in the throttle linkage.

Start the engine and put the throttle lever (inside the Operator Cab) at full RPM. Make adjustment to the top bolt until the engine runs at 2600-2675 RPM.

Turn the control arm stop until there is an increase of 25 RPM [B].





## CHECKS AND ADJUSTMENTS (Cont'd)

### Governor Oil Level

See the *SERVICE SCHEDULE* Section 1 for the service interval for checking the governor oil level. Use the following procedure:

Remove the check plug (Item 1) [A].

If oil flows out the hole, the level is adequate.

If no oil flows out the hole, remove the fill plug (Item 2) [A] at the top of the governor and add SAE 10W-30 or 10W-40 until oil flows from the check plug hole. Install the plug and tighten.

Grease the fittings at the shaft every 200-500 hours with a multi-purpose grease.

### Ignition System

#### Coil to Ground Voltmeter Test

Connect the voltmeter wires as shown in [B].

Operate the starter until the breaker points are fully closed.

Turn all the lights and accessories off.

Turn the ignition switch on.

If the voltmeter reading is 0.25 volt or less the primary circuit from the coil to the ground is good.

If the voltmeter reading is more than 0.25 volt test the voltage loss between each of the following:

- The connector marked DIST on the coil and the connection on the distributor.

- The moving breaker point and the stationary breaker point.

- The breaker point the distributor.

- The distributor housing the engine ground.

If the voltage loss of all the above has a total of more than 0.25 volts, it will cause bad engine performance.

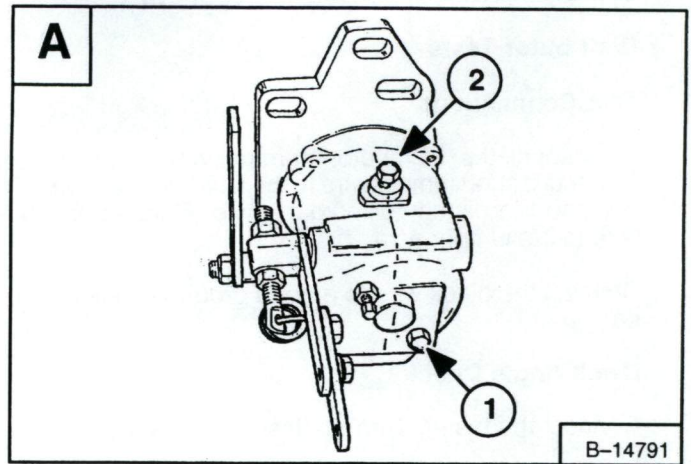
#### Spark Plug Wires Resistance Test

These wires include the wires connecting the distributor cap to the spark plug and the wire connecting the center connection of the distributor cap to the center connection of the ignition coil.

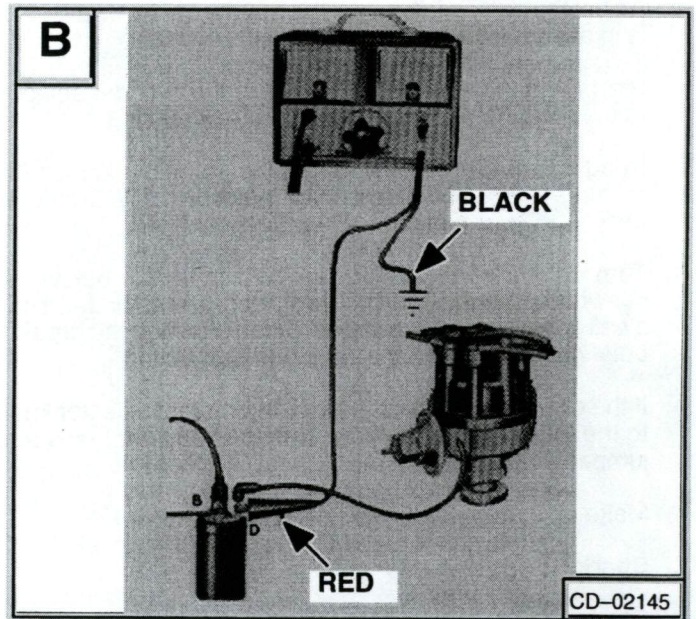
these wires are the radio resistance-type. The resistance of each wire must not be more than 5000 ohms per inch. When checking the resistance of the wires or adjusting ignition timing, do not damage the wires. This can cause separation in the conductor.

#### Spark Plug Test

Check and clean the electrodes and adjust the spark plug gap. After the gap is correct, check the plugs on a testing machine. Compare the operation of the old plug with a new plug.



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## CHECKS AND ADJUSTMENTS (Cont'd)

### Distributor Tests

#### Test Connections

Disconnect the distributor primary wire from the coil. Connect a short jumper wire to the DIST connection of the coil and the distributor primary wire. Connect the read wire to the jumper wire.

Connect the black wire to a good ground location on the engine

#### Dwell Angle Check

Connect the tester. Turn the test control knob to the set position.

Adjust the control knob until the needle on the dwell meter is in alignment with the set line.

Start the engine and let it idle. Turn the cylinder selector to the four.

Read the dwell angle on the dwell meter and compare the reading to specifications. (See Section 8 *TECHNICAL DATA*.)

Turn off the engine. If the dwell angle was below the specified amount, the breaker point gap is wide. If the dwell angle was above the specified amount, the breaker point gap is narrow.

If the dwell is at specifications, turn the test selector knob to the OFF position and disconnect the tester leads and jumper wire.

Make adjustment to the points as needed.

### Spark Strength Tests

Remove the coil high voltage wire from the distributor cap. Turn the ignition switch to ON position.

While holding the high tension lead about 3/16 inch from the cylinder head or any other good ground turn the engine over. If the spark is good, the problem is in the secondary circuit. Spark plugs or spark plug wires are damaged.

If there is no spark or a small amount of spark, the problem is in the primary circuit. The coil to the distributor wire, or the coil is damaged.

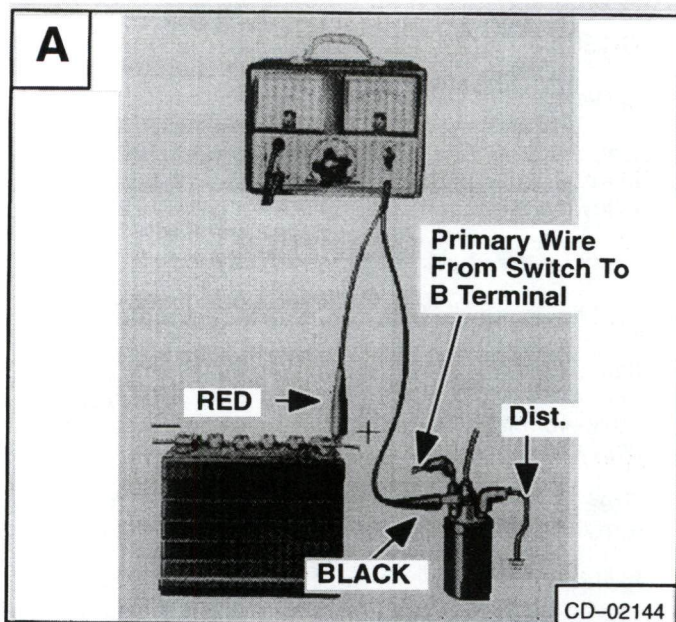
### Ignition System Tests

#### Battery To Coil Voltmeter Test

Connect the voltmeter wires as shown in [A]. Connect a jumper wire to the distributor connection of the coil and to a good ground location on the distributor housing.

Turn the lights and accessories off. Turn the ignition switch to ON position.

If the voltmeter reading is between 4.5 and 6.9 volts the primary circuit from the battery to the coil is good.



## CHECKS AND ADJUSTMENTS (Cont'd)

### Ignition System Tests (Cont'd)

#### Battery To Coil Voltmeter Test (Cont'd)

If the voltmeter reading is more than 6.9 volts, check the following:

The battery and cables for loose connections or corrosion.

The primary insulation, broken wires and loose or corroded connections.

If the voltmeter reading is less than 4.5 volts, the ignition resistor must be replaced.

Check the start relay to the ignition switch for damage.

#### Starting Ignition Circuit Voltmeter Test

Connect the voltmeter wires. (See Page 7B-3.)

Disconnect and ground the coil to distributor high voltage wire at the distributor.

With the ignition switch in the OFF position turn the engine with an auxiliary starter switch while reading the voltage loss.

If the voltage loss is 0.4 volt or less, the starting ignition circuit is good.

If the voltage loss is more than 0.4 volts clean and tighten the connections in the circuit or make replacement of the wiring as needed.

#### Breaker Point Gap Adjustment

Turn the engine over until the points are fully opened.

Put the correct thickness blade of a clean feeler gauge between the breaker points [A] & [B]. Make adjustment of the points to correct gap and tighten the screws.

Clean the cam area, then put a small amount of cam lubricant on the cam when new points are installed. Do not use engine oil as a lubricant.

#### Ignition Timing

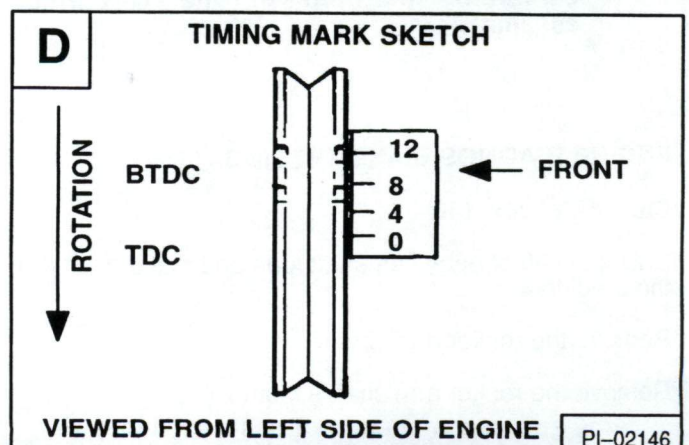
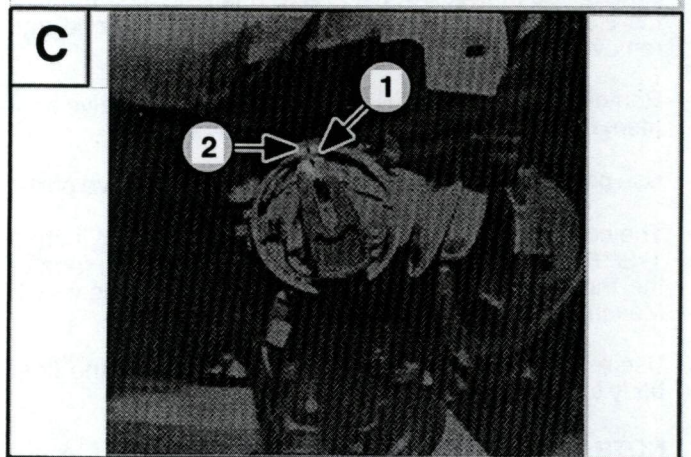
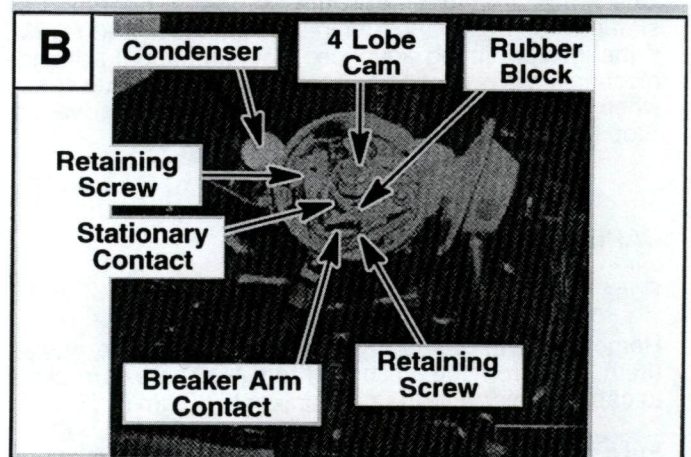
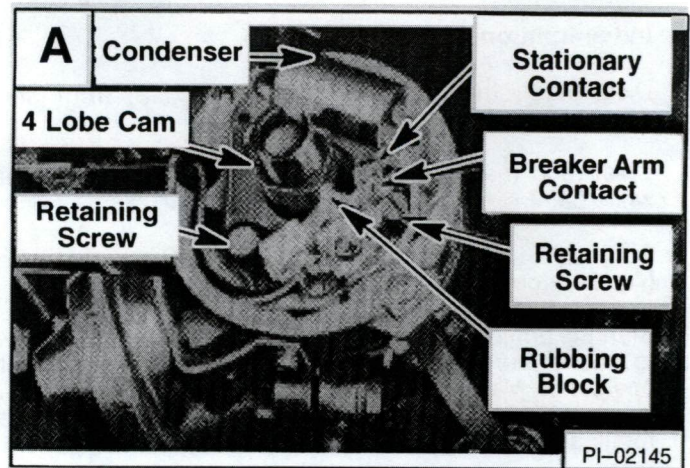
When installing distributor (Brown Cap) do the following:

Align the timing marks as shown [D].

Install the distributor and rotor marks (Item 1) [C] and housing marks (Item 2) [C] in alignment.

#### Timing Marks Location

The timing mark locations are shown in [D].



## CHECKS AND ADJUSTMENTS (Cont'd)

### Initial Ignition Timing

Disconnect the vacuum advance hose from the distributor and put a plug in the hose.

Clean and mark the correct timing mark with chalk or white paint.

Connect a timing light to No. 1 cylinder spark plug wire [A]. Connect a tachometer to the engine.

Start the engine and decrease the idle speed to 750 RPM to make sure that the centrifugal advance is not operating. Make the adjustment of the initial ignition timing to 12° BTDC by loosening the 7/16 inch bolt and rotating the distributor in the correct direction.

Check the centrifugal advance for correct operation by starting the engine and running the engine at 2000 RPM. If the ignition timing advances, the centrifugal advance mechanism is operating correctly. Note the engine speed when the advance starts and the amount of total advance. Stop the engine. Connect the vacuum hose.

### CARBURETOR REPAIR

Repair the four screws (Item 1) [B].

Remove the throttle body (Item 2) [B] and the gasket (Item 3) [B] from the fuel body (Item 4) [B]. Be careful not to cause damage to the float assembly (Item 5) [B].

Put a screwdriver against the float axle (Item 6) [B] at the slotted side of the float hinge and push the axle through the slotted side of the bracket. Remove the hinge and remove the float assembly (Item 5) [B].

Remove the fuel valve needle (Item 7) [B], the valve seat (Item 8) [B] and the fiber washer (Item 9) [B].

Use new parts in the repair kit to replace the above parts.

The correct float lever for the carburetor is 1-1/8 inch to 1-3/16 inch as measured from the machined surface of the throttle body (inverted) to the top of the float [C]. Measurement is made without the gasket.

Use a needle nose pliers to bend the lever on the float body to get the correct float adjustment.

**NOTE: If parts need replacement and are not in the carburetor kit, replace the carburetor assembly.**

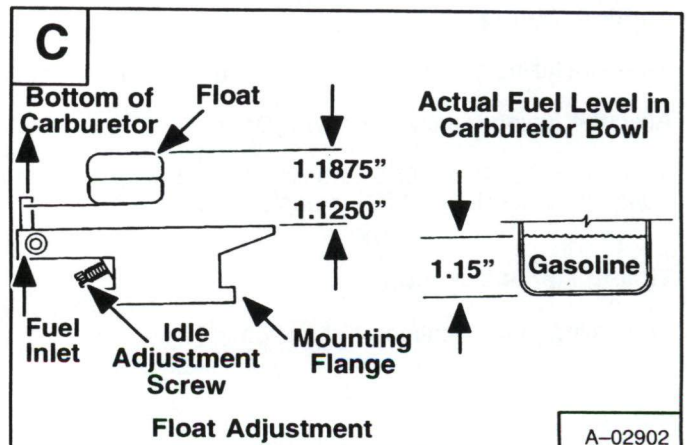
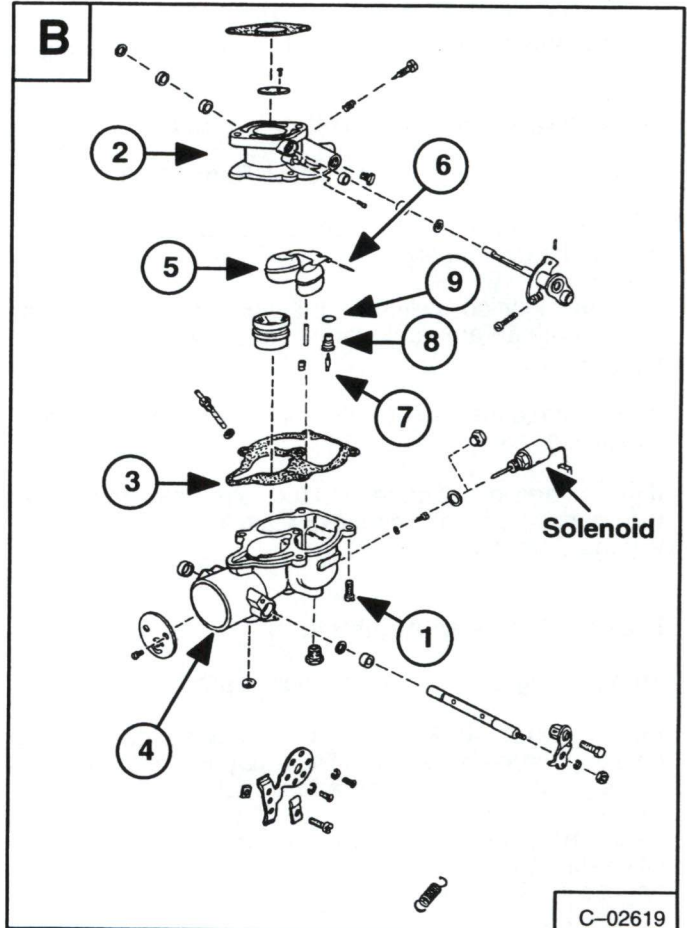
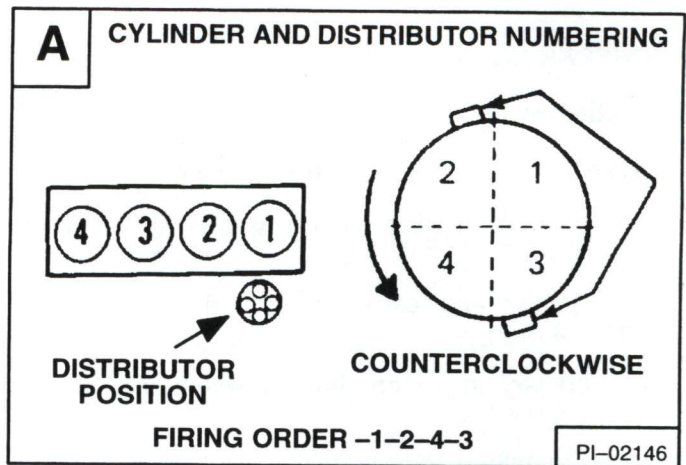
### ENGINE DIAGNOSIS AND TESTING

#### Camshaft Lobe Lift

Check the lift of each camshaft lobe and make a note of the readings.

Remove the rocker arm cover.

Remove the rocker arm shaft assembly.



## ENGINE DIAGNOSIS AND TESTING (Cont'd)

### Camshaft Lobe Lift (Cont'd)

Make sure the pushrod is in the valve lifter socket. Install a dial indicator so the ball socket adapter of the indicator is on the end of the pushrod and is vertical with the pushrod movement [A].

Turn the crankshaft over until the lifter is in its lowest position, highest indicator reading.

Position the dial indicator at zero. Continue to rotate the crankshaft at a slow rate until the pushrod is in the highest position, highest indicator reading.

Compare the total reading on the indicator with the specifications.

To check the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. If the reading on any lobe is below the specified wear limits, the camshaft and the valve lifters must be replaced.

Remove the dial indicator gauge. Install the rocker shaft assembly. Install the rocker cover.

### Crankshaft End Play

Move the crankshaft toward the rear, flywheel end, of the engine.

Install a dial indicator and position the contact point against the crankshaft flange at the front of the engine and the indicator is parallel to the crankshaft [B].

Position the dial indicator at zero. Push the crankshaft forward and note the reading on the dial.

If the end play is more than the wear limit, according to specifications, install new thrust washers. If the end play is less than the minimum limit, check the thrust bearing surfaces for scratches, rough areas or debris.

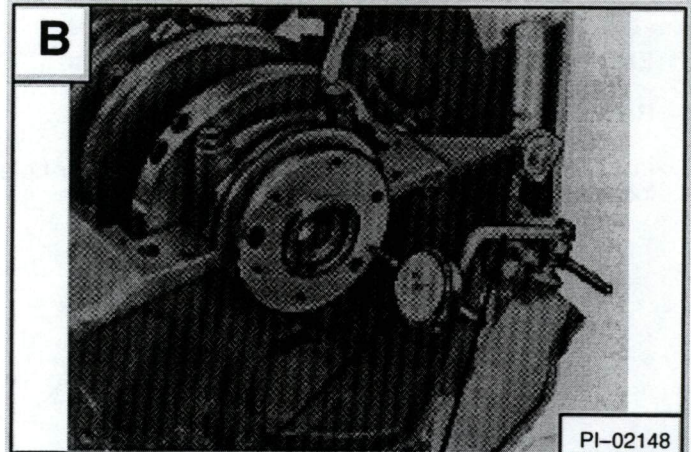
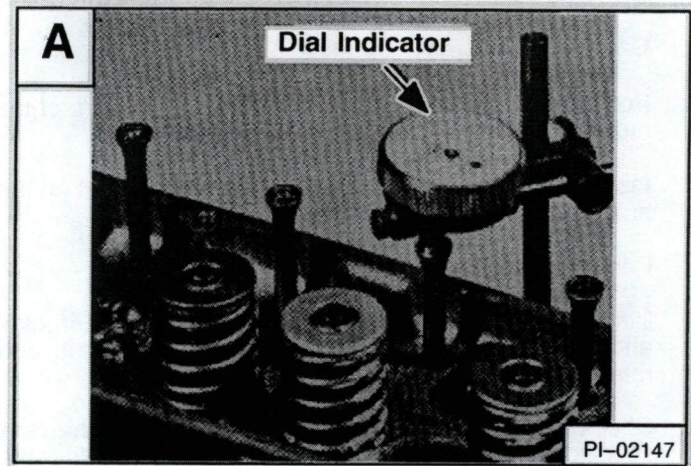
### Flywheel Surface Alignment Check

Move the crankshaft fully forward or to the rear.

Install a dial indicator so that the indicator point is against the flywheel surface.

Position the dial indicator at zero and turn the crankshaft. Check the indicator reading.

If alignment is not specification, remove the flywheel and check for dirt or other debris between the flywheel and crankshaft flange. If alignment is not to specifications, install a new flywheel or grind the crankshaft or flywheel as needed to correct the alignment.



## ENGINE DIAGNOSIS AND TESTING (Cont'd)

### Camshaft End Play

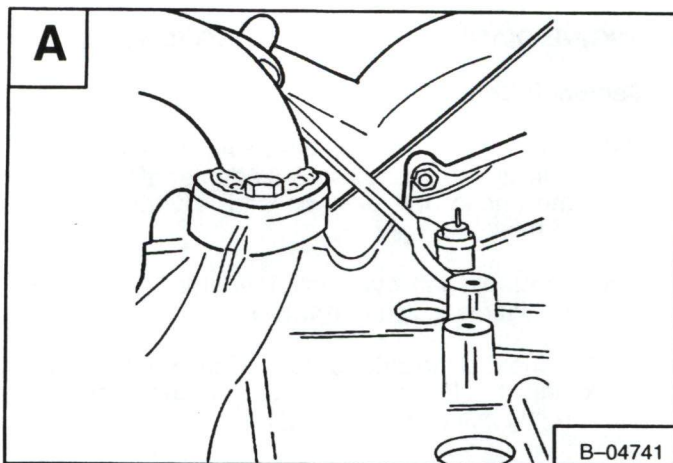
Push the camshaft toward the rear, flywheel end, of the engine.

Install a dial indicator. Position the indicator point on the hub of the camshaft sprocket.

Position the dial indicator at zero.

Put a large screwdriver between the camshaft sprocket and the cylinder head. Pull the camshaft forward and release it.

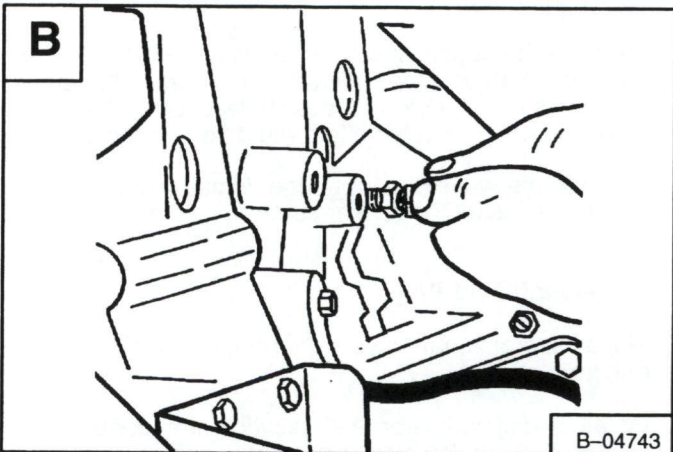
Check the indicator reading. If reading is more than the specification replace the thrust plate that holds the camshaft.



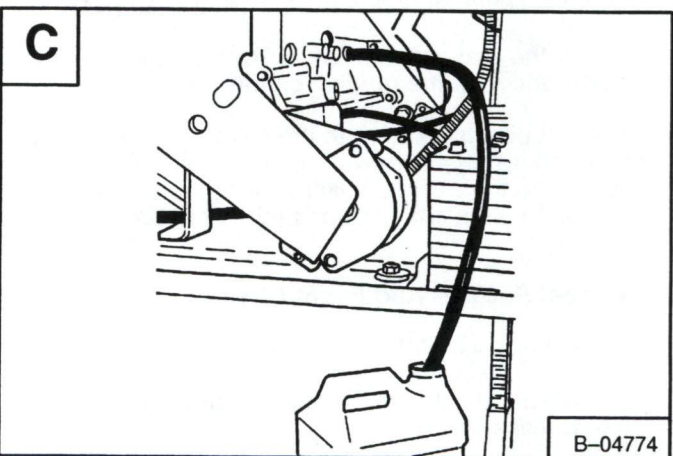
### ENGINE REMOVAL

Remove the temperature sender [A].

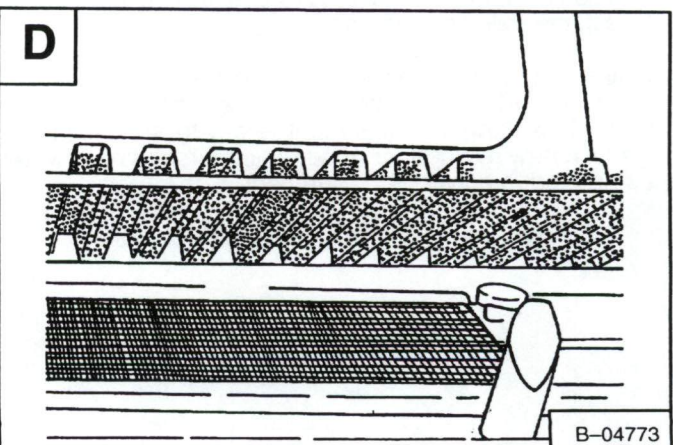
Install a fitting of the correct threads in the sender hole location [B].



Install a hose on the fitting and drain the coolant into a container [C].

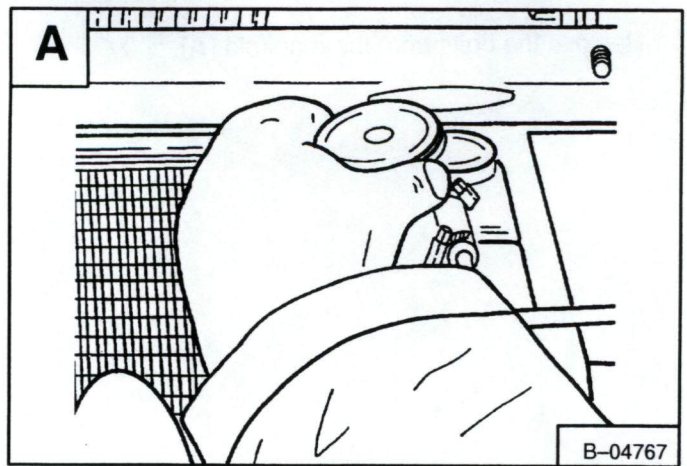


Remove the grill [D].



## ENGINE REMOVAL (Cont'd)

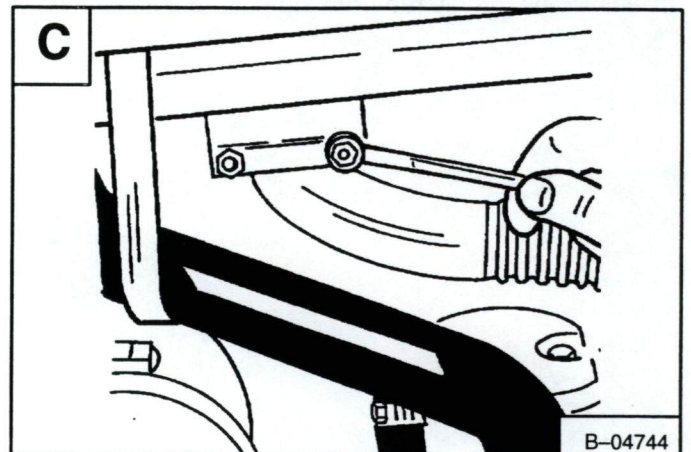
Remove the radiator cap [A].



Remove the line from the coolant recovery tank and remove the tank [B].

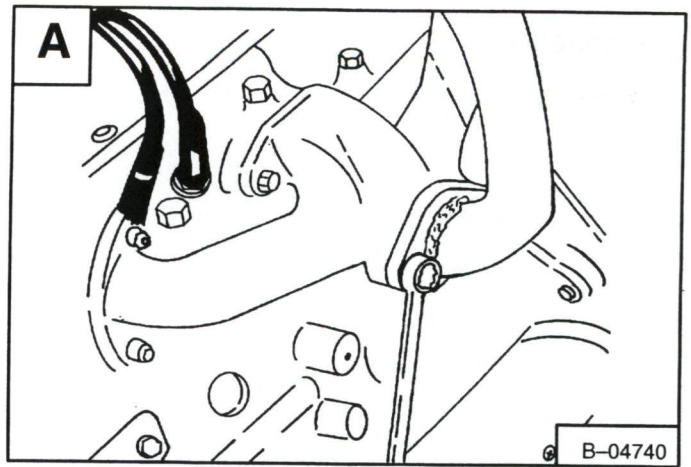


Loosen the exhaust pipe clamp [C].

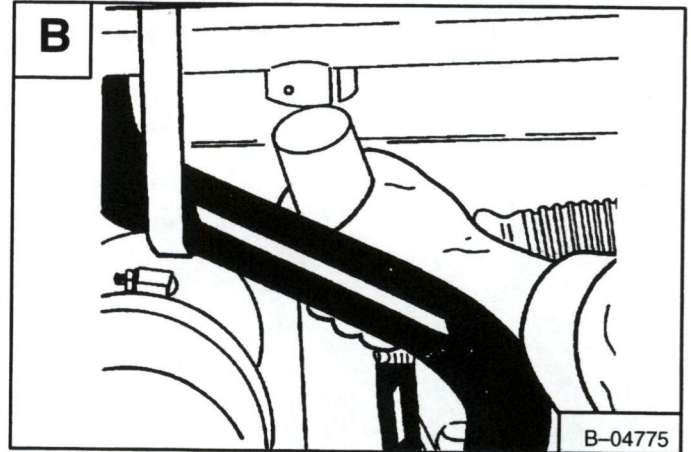


## ENGINE REMOVAL (Cont'd)

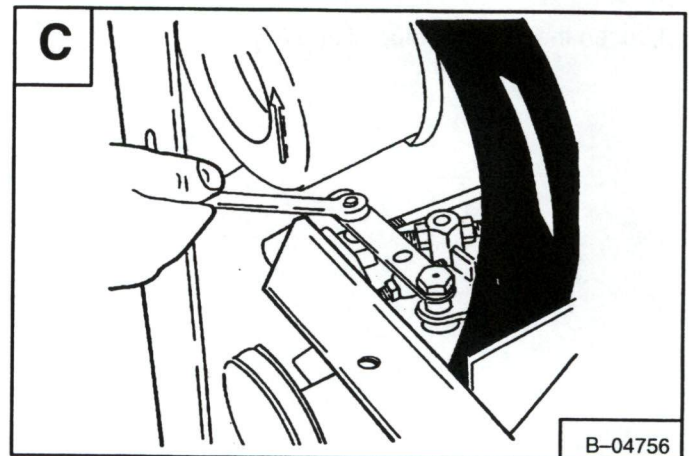
Remove the bolts from the manifold [A].



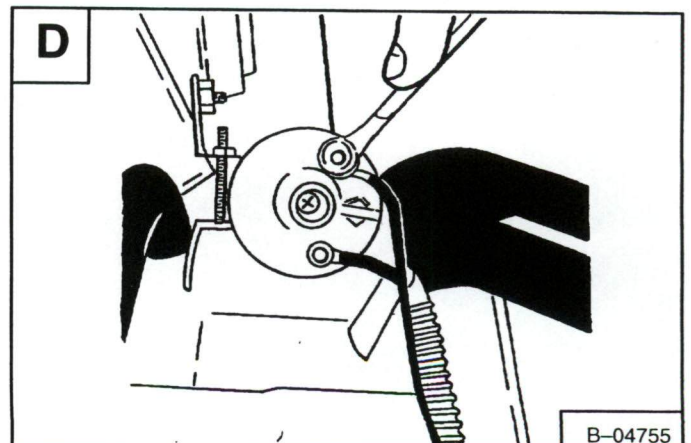
Remove the exhaust pipe from the muffler [B].



Remove the throttle rod from the governor linkage [C].



Remove the coil wire and remove the other wires from the coil [D].

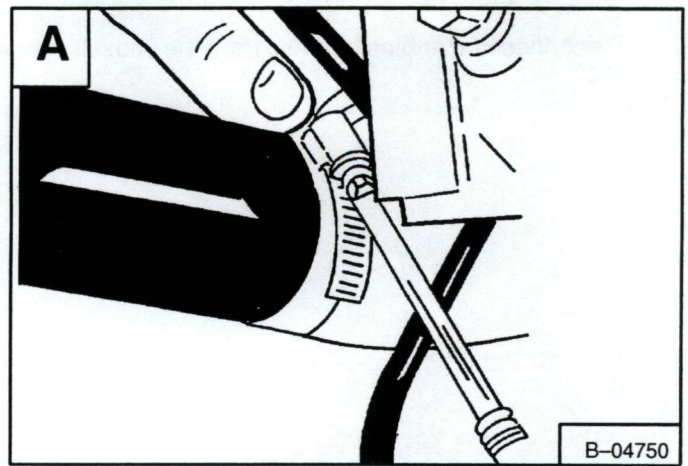




## ENGINE REMOVAL (Cont'd)

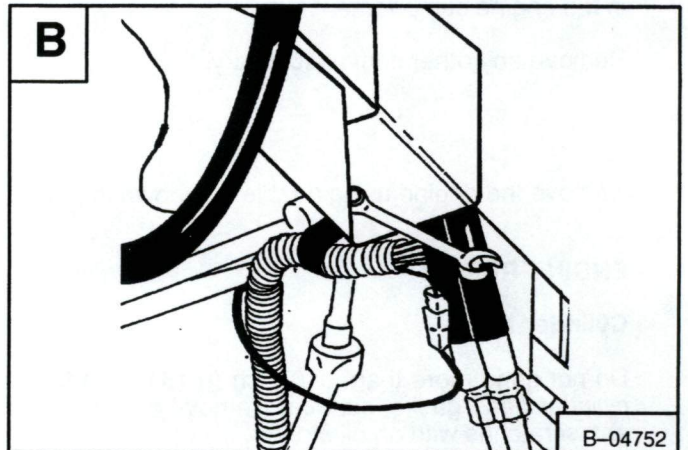
Remove air cleaner hose from the engine [A].

Remove the coolant hoses from the engine.

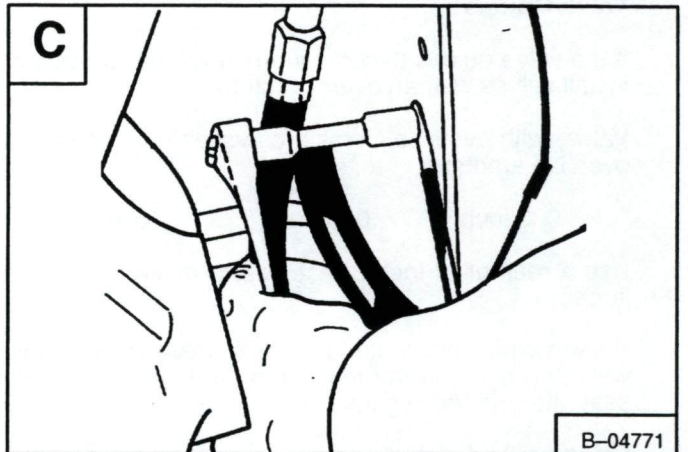


Remove the solenoid from the recovery tank bracket [B].

Disconnect the fuel line from the engine.

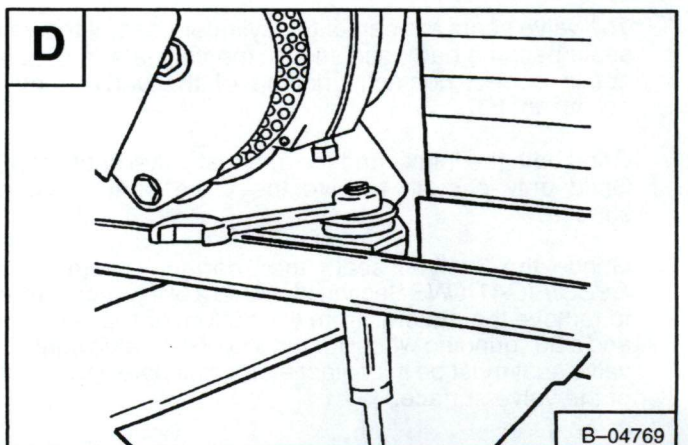


Remove the engine ground cable [C].



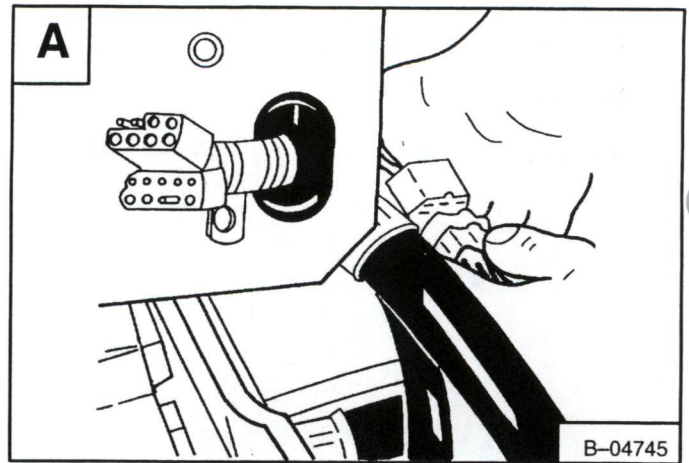
Remove the engine mounting bolts [D].

Raise the operator guard.



## ENGINE REMOVAL (Cont'd)

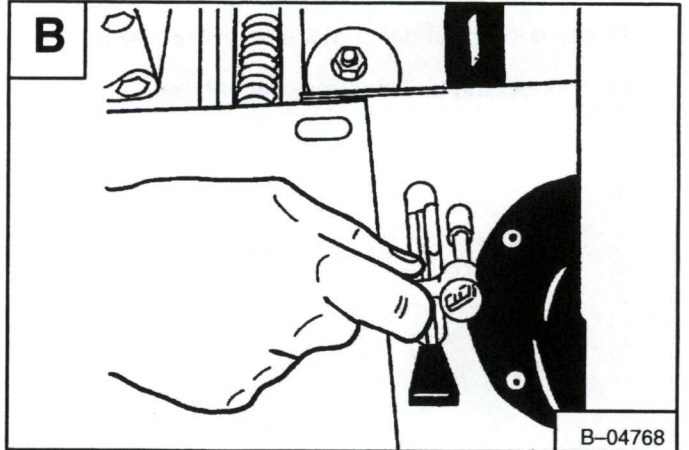
Disconnect the engine harness from the chassis harness [A].



Remove the choke control from the front panel and put it in the engine compartment [B].

Remove any other items necessary.

Remove the engine using a table as shown in [C].



## ENGINE REPAIR

### Cylinder Head

Do not grind more than .010 inch (0,154 mm) from the cylinder head gasket surface. Remove all rough edges and scratches with an oil stone.

### Valve Guides

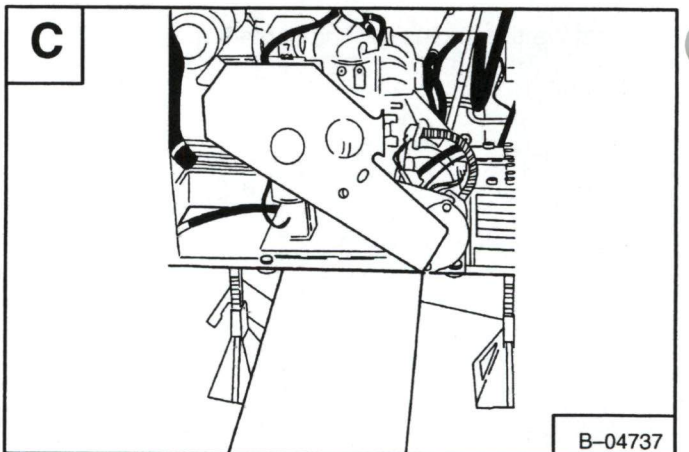
If the valve guides become worn, it will be necessary to install valves with an oversize stem.

Valves with oversize stems are available in the following oversize amounts:

.003 inch      .015 inch      .030 inch

Use a reamer of the correct size to make valve guides larger.

When going from a standard size valve to an oversize valve, always use the reamer in steps. Grind the valve seat after the valve guide.

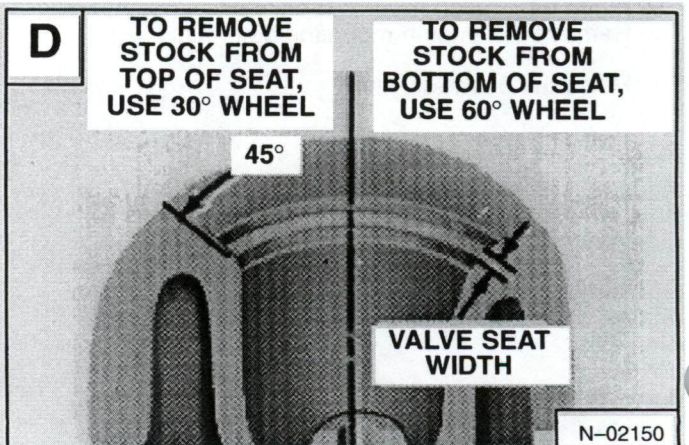


### Grinding The Valve Seats

The valve seats are part of the cylinder head. If the valve seats become damaged so that the valves and seat are not in correct contact, grinding of the valve seats is necessary [D].

Grind both the intake and the exhaust valve seats at 45°. Grind only enough to give the valve seat a smooth surface.

Grind the valve seat the correct width. (See *SPECIFICATIONS* Section 8B.) Use a 60° grinding wheel to remove the material from the bottom of the valve seat and a 30° grinding wheel for the top of the valve seat. The valve seat must be in contact at approximately the center of the valve surface.



## ENGINE REPAIR (Cont'd)

### Valves

Small burns, grooves, etc., can be removed. Remove valves that are damaged, if the surface alignment cannot be corrected by finishing or if the valve stem clearance is more than specifications allow.

### Grinding Valves

If the valve surface alignment is not within specifications grind the valve to a 45° angle. Remove only enough material to correct the alignment or to make the surfaces smooth. If the edge of the valve head is less than 1/32 inch thick after grinding [A], install new valve as the old valve will cause engine to run hot. Remove all grooves or scratches from the end of the valve stem, and make chamfer as needed. DO NOT remove more than 0.010 inch (0,245 mm) from the end of the valve stem.

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

### Selecting Fitting Of The Valves

If the valve stem to valve guide clearance is more than the wear limit, use a reamer to cut the valve guide to the next oversize valve stem. Valves with oversize stem diameters of 0.003 inch, 0.015 inch and 0.030 inch are available as service parts. Grind the valve seat after the valve guide has been cut.

### Camshaft Repair

Remove small marks from the camshaft machined surfaces with a smooth oil stone.

### Crankshaft

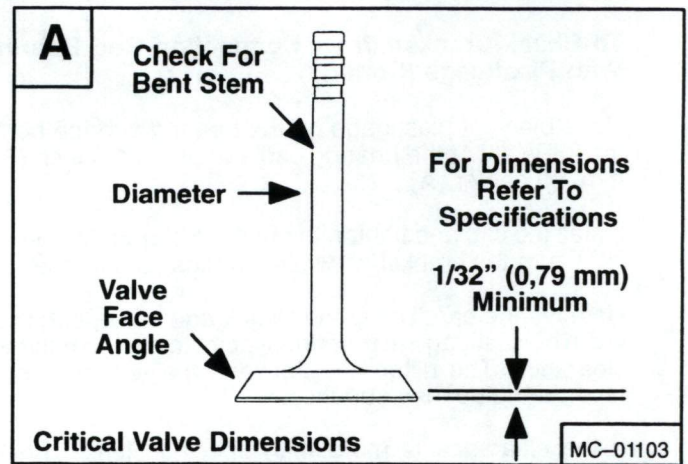
Remove small marks with an oil stone. If the journals are damaged or worn, they must be machined to the correct size for the next size smaller bearing.

### Repairing Journals

After machining the bearing surfaces, put a chamfer in the oil holes; then finish the bearing surfaces with a No. 320 grit cloth and engine oil. Crocus cloth may also be used for finishing.

### To Check Crankshaft Or Connection Rod Bearings With Plastigage

Clean crankshaft bearing surfaces. Check the surfaces and thrust bearings for damage. When making replacement of standard size bearings, install bearing of minimum specified clearance. If the needed clearance cannot be made with a standard bearing use a 0.002 inch size smaller in combination with a standard bearing to get the correct clearance. (See *SPECIFICATIONS* Section 8B-1.)



## ENGINE REPAIR (Cont'd)

### To Check Crankshaft Or Connection Rod Bearings With Plastigage (Cont'd)

Put a piece of plastigage on the bearing surface across the full width of the bearing cap and about 1/4 inch (6,35 mm) off center [A].

Install the cap and tighten the bolts to correct torque. DO NOT turn the crankshaft while Plastigage is in position.

Remove the cap. Using the Plastigage scale, check the width of plastigage at the widest point to get the minimum clearance. The difference between the readings is the taper of the bearing surfaces.

If the clearance is more than specified limits, on the connecting rod bearings, use a 0.002 inch size smaller bearing in combination with the standard bearings. Bearing clearance must be within specified limits. If 0.002 inch size smaller main bearings are used on more than one bearing surface, be sure they are installed in the cylinder block side of the bearing. If standard size and 0.002 inch smaller size bearings do not make clearance within the needed limits, machine the crankshaft bearing surface, and install the smaller size bearings.

After the bearing has been checked, remove Plastigage and put a small amount of oil on the bearing surface and the bearings. Install the bearing cap. Tighten the bearing caps bolts to the correct torque.

Do the above for all bearings that need replacement.

### Install Pistons

Pistons are available for service in standard sizes and over sizes.

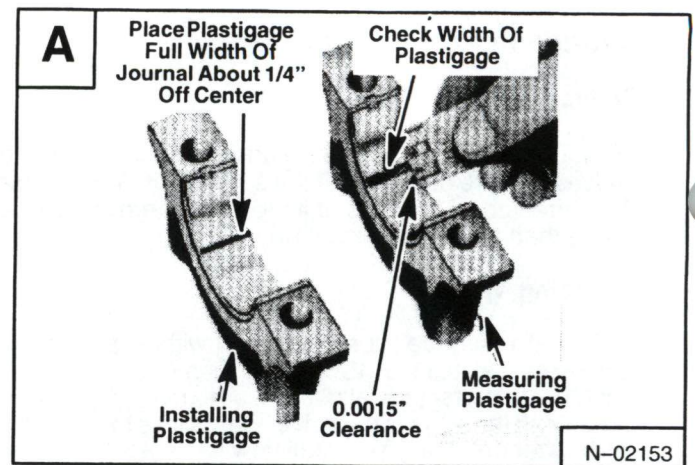
The standard size pistons are color coded red or blue or have .0025 O.S. marked on the top. Refer to *SPECIFICATIONS* Section 8B-1 for standard size piston dimensions.

Measure the piston diameter to be sure you have the specified clearance. When a new piston has been checked for clearance, mark the piston to the cylinder to which it was checked in. If the taper and piston to cylinder bore clearance conditions of the cylinder bore are within specified limits, new piston rings will give good service. If new rings are to be installed in a used cylinder that has not been finished, remove the cylinder wall glaze with a hone. Be sure to clean the cylinder bore after honing.

Find the correct size piston to be used by marking a cylinder bore check.

Find the correct size piston to give the correct clearance. (Refer to *SPECIFICATIONS* section 8B-1.) Measure the piston 2-1/4 inches (57,15 mm) below the top and a 90° to the piston pin bore.

Make sure the piston and cylinder block are at room temperature, 70°F (21,1°C). After any finishing option, let the cylinder bore cool and be sure the piston and the bore are clean and dry before the piston fit is checked.



## ENGINE REPAIR (Cont'd)

### Installing Piston Rings

The piston uses two compression rings and one oil control ring. The lower compression ring is stepped on the bottom outer edge and the upper ring is chrome plated and tapered on the outside diameter. Both rings are marked top and must be installed correctly. The upper ring, when new, has a red and brown compound on the outer edge. This compound must not be removed. The oil control rings have narrow ring cases and can be installed either way.

Use the correct size ring for the size of cylinder bore you have.

Put the ring in the cylinder bore it is going to be used in.

Use the head of a piston to push the ring in the bore about 1 inch (25,4 mm) so that the ring is square with the cylinder wall. Be careful not to damage the ring or the cylinder bore.

Measure the gap between the ends of the ring with a feeler gauge [A]. If the ring gap is not in the specified limits, use another ring set.

Check the side clearance of the compression rings with a feeler gauge installed between the ring and its lower edge [B]. The gauge must move easily around the ring circumference. If the grooves are worn, make replacement of the piston.

### Installing The Piston Pins

Pistons and piston pins are available as a unit only and cannot be purchased as individual parts. Keep the correct pins and pistons together.

### Valve Rocker Arm And Shaft Assembly

Use a hone to remove small surface damage to the rocker arm shaft and to the rocker arm bore.

If the valve end of the rocker arm has a grooved radius replace the rocker arm. You cannot grind this surface.

### Push Rods

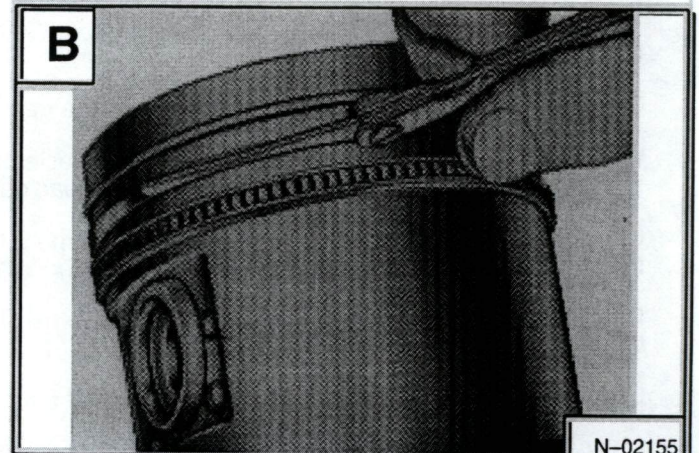
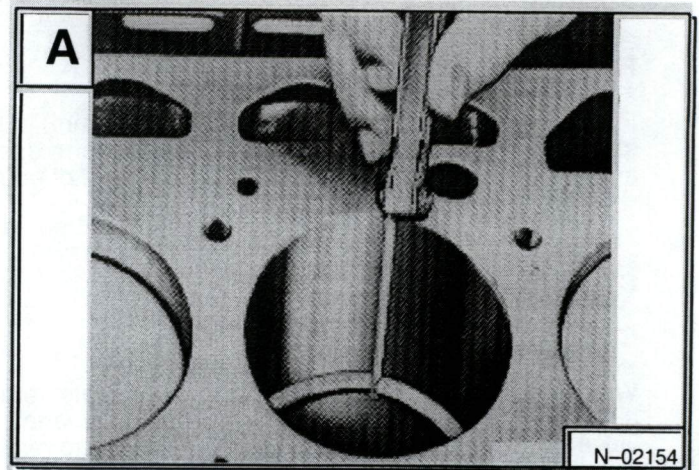
Make sure the push rods are straight.

If the push rod is not in specification replace the push rod.

## CYLINDER BLOCK

### Finishing The Cylinder Walls

Before any cylinder is machined all main bearing caps must be positioned and tightened to the correct torque. Finish only the cylinder or cylinders that need to be finished. All pistons are the same weight, both standard and oversize; and various sizes of pistons can be used without changing the engine balance. Finish the cylinder with the most wear first to find the maximum oversize.



## CYLINDER BLOCK (Cont'd)

### Finishing The Cylinder Walls (Cont'd)

Finish the cylinder to within 0.0015 inch (.038 mm) of the oversize diameter. This will leave enough material for the final step of honing for correct surface finish and pattern. Use a motor driven hone with spring pressure. Use an RPM of 300–500 and grit sizes 180–200. Use a lubricate mixture of equal parts of kerosene and SAE No. 20 motor oil

## CYLINDER HEADS

### Cleaning The Cylinder Heads

With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. Be careful not to damage the cylinder head gasket surface. Remove the valves and clean the valve guide cleaning tool. Use cleaning solvent to remove grease and other debris. Clean all the bolt holes. Remove the valves and clean the valve guide cleaning tool. Use cleaning solvent to remove grease and other debris. Clean all the bolt holes. Remove all the deposits from the valves with a fine wire brush or buffing wheel.

### Checking The Cylinder Heads

Check the cylinder head for cracks and check the gasket surface for debris and scratches.

When a cylinder head is removed because of gasket leaks, check the flat area of the cylinder head gasket surface for correct specifications. If necessary to finish the cylinder head gasket surface, do not machine off more than 0.010 inch (0,254 mm).

Check the valve seat with a gauge. If the wear is more than specifications allow, grind the valve and valve seat. Measure the valve seat width. Grind the valve seat when the width is not in specification.

Check the valve surface and the edge of the valve head for damage. Check the stem for damage and the end of the valve stem for wear.

Check the valve stem to valve guide clearance of each valve in its correct valve guide.

Check the springs for the correct pressure at the specified spring lengths. Use tool (P/N 6513-DD). Replace any springs not in specifications.

Check each spring for being round, using a steel square and a flat surface. Put the spring and square on end on the flat surface. Move the spring up to the square. Turn the spring and check the space between the top coil of the spring and the square. The out of round limits are 0.078 inch (1,98 mm).

Follow the same procedure to check new valve springs before installation. Be sure the correct spring is installed. The springs are color coded.

## TAPPETS

### Cleaning The Tappets

Clean the tappets in cleaning solvent and wipe the tappets with a clean lint free cloth

### Checking The Tappets

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

## **CAMSHAFT**

### **Cleaning And Checking The Camshaft**

Clean the camshaft in solvent and wipe it dry. Check the camshaft lobes for damage and war. The camshaft does not need replacement unless the lobe lift is worn more than 0.005 inch (0,127 mm).

The lift of the camshaft lobes can get check with the camshaft installed in the engine or on the centers. Make reference to Page 7B-10 *Camshaft Lobe Lift*.

## **CRANKSHAFT**

### **Checking The Crankshaft**

Measure the diameter of each journal in at least four locations to look for out of round taper or smaller size conditions.

## **FLYWHEEL**

### **Checking The Flywheel**

Check the flywheel for cracks, or other damage.

Check the ring gear of r wear and damage to the teeth. If the teeth have damage, install a new ring gear.

With the flywheel installed on the crankshaft, check the flywheel surface alignment.

## **CONNECTING RODS**

### **Cleaning The Connecting Rods**

Remove the bearings from the rod and cap. Mark the bearings for identification if you are to use them again. Clean the connecting rods in solvent, including the rod bore and under the bearings. Clean all passages with compressed air using a low air pressure.

### **Checking The Connecting Rods**

Check the connecting rod bearing bores for out of round and taper. Check the inside diameter of the connecting rod piston pin bore. If the pin bore in the connecting rod is larger than the specification, install a 0.002 inch oversize piston pin. First fit the oversize piston pin to the piston pin bore by using a reamer tool Then assemble the piston, the piston pin and the connecting rod.

## PISTONS, PINS AND RINGS

### Cleaning The Pistons, Pins And Rings

Remove debris from the piston surfaces. Clean debris from the piston skirt, piston pins and rings with solvent.

Clean the ring grooves with a ring groove cleaner. Make sure the oil ring slots are clean.

### Checking The Pistons, Pins And Rings

Replace the pistons that show signs of over maximum wear or damage.

Check the piston to cylinder bore clearance by measuring the piston and bore diameters. Refer to Page 7B-19 *Cylinder Block* for the bore measurement procedure. Measure the outside diameter of the piston with micrometers about 2-14 inches (57,15 mm) below the dome and at 90° to the piston pin bore. Check the ring side clearance. (See Page 7B-14 *Installing Piston Rings*.)

Check the outside diameter of the piston pin and the inside diameter of the pin bore in the piston. Make replacement of any piston pin or piston that is not in specifications.

Replace all rings that have damage. Check the end gap and the side clearance. Rings must not be moved from one piston and installed on another.

## MAIN BEARINGS AND CONNECTING ROD BEARINGS

**NOTE:** Main bearings have color codes to identify size. See *SPECIFICATIONS* Section 8B-1.

### Cleaning Bearings

Clean the bearing inserts and caps in solvent and dry them with compressed air. Do not remove deposits from the bearing shells.

### Checking Bearings

Check each bearing carefully. Bearings that have damage or excessive wear need replacement. Check the clearance of bearings that look good with Plastigage. (See Page 7B-15 *To Check Or Connection Rod Bearings With Plastigage*.)

## CYLINDER BLOCK

### Cleaning The Cylinder Block

After any cylinder bore repair operation clean the bore with soap and water. The rinse the bore with clean water to remove the soap and wipe the bore with a clean cloth with engine oil on it.

If the engine is disassembled clean the block with solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs that seal oil passages and clean all the passages. Clean all passages, bolt holes, etc., with compressed air. Make sure the threads in the cylinder head bolt holes are clean.

Use a tap to clean the threads and to remove any debris. Clean the groove in the crankshaft bearing and bearing retainers.



## CYLINDER BLOCK (Cont'd)

### Checking The Cylinder

Check the cylinder walls for damage and wear. Check the cylinder bore for out of round and taper. Measure the diameter of each cylinder bore at the top, center and bottom with the gauge positioned at the right angles and parallel to the centerline of the engine. Use only the measurement at 90° to the engine centerline when calculating the piston to cylinder bore clearance.

Machine the cylinders that are damaged or when out of round or taper is more than the wear limits allow.

## OIL PUMP

### Cleaning The Oil Pump

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

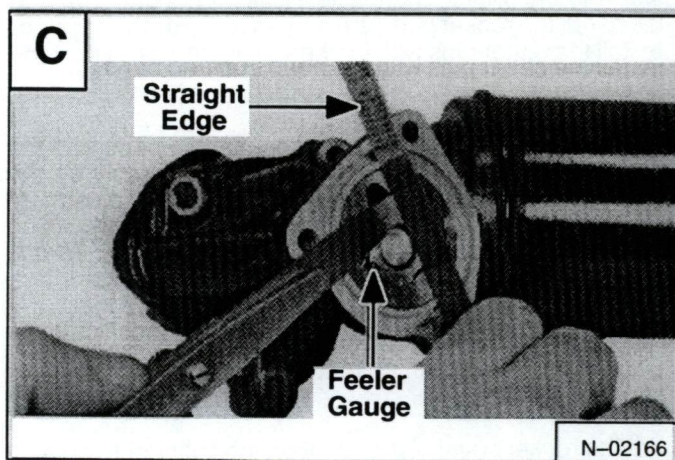
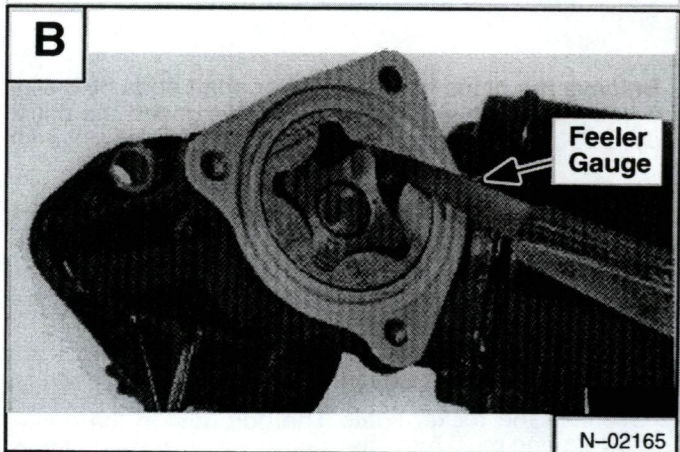
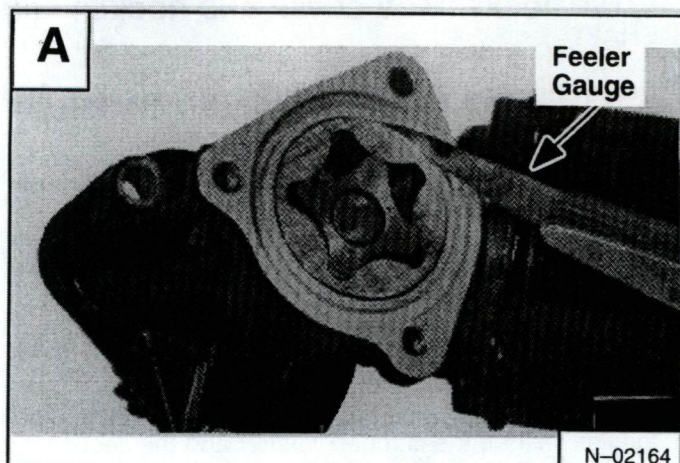
### Checking The Oil Pump

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

Measure the outer race to housing clearance [A]. check the clearance between the outer race and the rotor lobes [B].

With the rotor assembly installed in the housing. Put a straight edge over the rotor assembly and the housing. Measure the clearance (rotor end play) between the straight edge and the rotor [C]. The outer race, shaft and rotor can be replaced only as an assembly. Check the drive shaft to housing bearing clearance by measuring the outside diameter of the shaft and the inside diameter of the housing bearing. Check the relief valve spring tension.

If the spring tension is not within specifications and the spring is worn or has damage, install a new spring. Check the relief valve piston for damage and free movement in the bore.



## VALVE ROCKER ARM COVER AND ROCKER ARM SHAFT

### Removing And Disassembly Of The Rocker Arm Shaft

Disconnect the spark plug wires and remove them from the fastener on top of the rocker cover.

Remove the rocker cover fastening screws. Remove the rocker cover and the gaskets.

Remove the rocker arm shaft attaching bolts evenly and lift off the rocker arm shaft assembly **[A]**.

Remove the cotter pin from one end of the shaft and pull the flat washer, the crimped washer and the second flat washer from the shaft. The rocker arm shaft supports the rocker arms and the springs can be removed from the shaft.

Remove the plugs from the rocker shaft ends by drilling a hole in one plug. Install a long rod through the drilled plug and hit the other plug out of the shaft. Remove the drilled plug using the same method.

Clean the component parts of the shaft assembly in cleaning solvent.

### Installing Rocker Arm Shaft

Put new plugs in the ends of the rocker shaft.

Assemble the rocker shaft. The bolt hole in the rocker shaft support must be so the same side as the adjustment screw in the rocker shaft. The rocker arms are right and left hand, the rocker pads are angled towards the support. Install the cotter pins with the heads up and bend the legs apart.

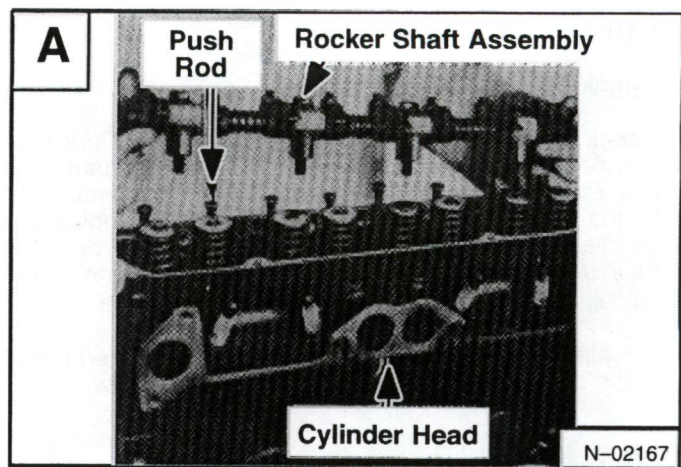
Put oil on the valve stem tops, rocker arm pads and the pushrod ends. Install the rocker shaft assembly on the cylinder head and put the pushrods on the adjustment screws. Install and tighten the bolts evenly. (See *SPECIFICATIONS* Section 8B for *Torque Specifications*.)

Make adjustment of the valve clearance to specifications.

Remove the old gasket material from the contacting surfaces.

Put the rocker cover and gasket on the cylinder head and fasten with the screws. Tighten the screws to the correct torque specifications. (See *SPECIFICATIONS* Section 8B.)

Put the spark plug wires in the rocker cover fasten fastener and connect them to the correct spark plug.



## **VALVE PUSHRODS**

### **Removal**

Remove the rocker shaft bolts evenly and lift off the rocker arm shaft assembly.

Remove the pushrods and keep them in the correct order.

### **Installation**

Put oil on both ends of the pushrods and install them in the correct bores.

Put oil on the valve stem and the rocker arm pads, and install the rocker arm shaft assembly on the cylinder head. Put the pushrods on the adjustment screws. Tighten the bolts to 25–30 ft.-lbs. (34–41 Nm) torque.

Make adjustment of the valve lifters according to the specifications.

## **INTAKE MANIFOLD**

### **Removal**

Remove the coolant from the cooling system.

Disconnect the throttle linkage from the throttle lever on the carburetor.

Disconnect the fuel line from the carburetor.

Disconnect the water hose from the intake manifold.

Remove the intake manifold.

### **Installation**

Put a water resistance sealer on both sides of the new gasket and around the water port. Install it on the cylinder head.

Install the intake manifold and tighten the nuts and bolts evenly 15–18 ft.-lbs. (20–24 Nm) torque.

Connect the water hose to the intake manifold.

Connect the fuel line to the carburetor.

Connect the throttle linkage.

Install the dipstick tube bracket to the intake manifold and install the fastening bolt.

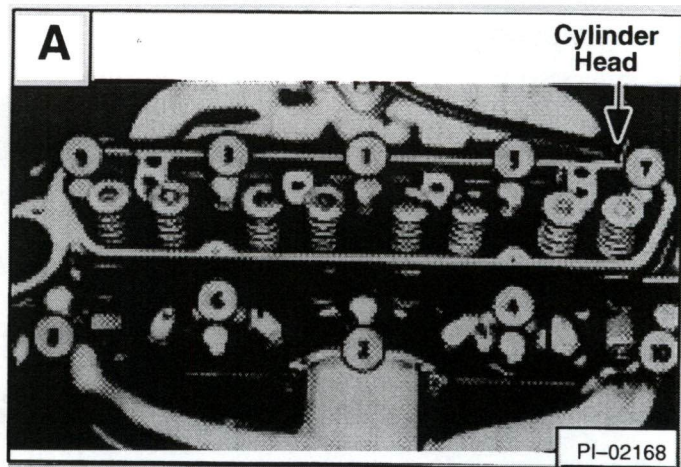
Fill the cooling system with the correct coolant.

If a new manifold is to be installed put all the needed parts on the new manifold.

## CYLINDER HEAD

### Removal

- Remove the air cleaner hose from the carburetor.
- Disconnect the fuel line from the carburetor.
- Remove the coolant from the cooling system.
- Disconnect the spark plug wires, remove them from the fastener on the rocker cover.
- Disconnect the water outlet hose at the intake manifold.
- Remove the muffler from the manifold.
- Disconnect the throttle linkage, the choke cable and the distributor vacuum advance hose from the carburetor.
- Disconnect the throttle linkage at the governor.
- Remove the governor mounting bracket.
- Remove the thermostat housing and remove the thermostat.
- Remove the rocker cover and the gasket.
- Remove the rocker shaft bolts evenly and lift off the rocker shaft assembly.
- Lift out the pushrods and keep them in the correct order.
- Remove the cylinder head bolts and lift off the cylinder head and gasket. Do not put the cylinder head flat on its contact surface. Damage to the spark plugs or gasket surface can result.



### Installation

- Clean all the gasket material from the contact surfaces and put the cylinder head gasket on the cylinder block using the pilot studs.
- Install the cylinder head, remove the pilot studs and install the cylinder head bolts. Tighten the bolts evenly and in three steps, to the correct torque specifications [A].
- Put oil on both ends of the pushrods and install the pushrods in the correct bores.
- Install the rocker arm shaft assembly on the cylinder head. Put the pushrods on the adjustment screws. Tighten the bolts 25–30 ft.-lbs. (34–41 Nm) torque.
- Make adjustment of the valve clearance.
- Install the muffler onto the manifold.

## **CYLINDER HEAD (Cont'd)**

### **Installation (Cont'd)**

Connect the distributor vacuum advance hose, the throttle linkage and choke cable to the carburetor.

Connect the water outlet hose to the intake manifold.

Install the thermostat in the cylinder head and install the gasket and thermostat housing.

Fill the cooling system with coolant.

Install governor and mounting bracket to cylinder head and install the bolts.

Loosen the governor adjustment bolts and install the belt on the governor sheave. Make adjustment of the belt to the specification and tighten the bolts.

Connect the throttle linkage to the governor.

Connect the ignition wires to the spark plugs in the correct firing order.

Make a second adjustment of the valve clearances to specification.

Install the rocker arm cover.

Install the air cleaner hose to the carburetor.

Make adjustment to the carburetor idle speed and mixture setting.

Adjust the governor.

## **VALVE SPRING, RETAINER AND STEM SEAL (With The Cylinder Head Removed)**

### **Removing The Valve Spring**

Remove the muffler from the manifold and remove the spark plugs.

Compress the valve spring with a valve spring compressor and remove the keepers, rotators, spring and retainer.

Remove the seal and remove the valve.

### **Installing The Valve Spring**

Install the valve and a new valve stem seal.

Install the valve spring and the retainer over the valve stem.

Compress the valve spring. Install the rotator on the exhaust valve. Put the retainer locks in the valve stem grooves and release the spring compressor to engage the locks in the retainer tappets.

## **VALVE SPRING, RETAINER AND STEM SEAL (With The Cylinder Head Installed)**

Disconnect the spark plug wires and remove them from the fastener on the rocker cover.

Remove the rocker cover and the gasket

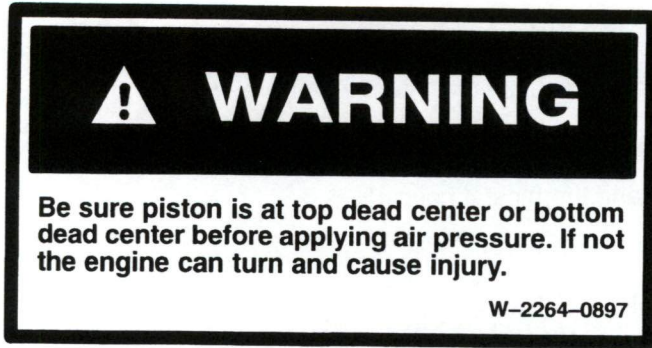
Remove the rocker shaft bolts evenly and remove the rocker shaft assembly.

Remove the pushrods and keep them in the correct order.

Remove the spark plugs.

Use an adapter to connect air pressure hose to the cylinder to keep the valve closed.

VALVE SPRING, RETAINER AND STEM SEAL (With The Cylinder Head Installed) (Cont'd)



Compress the valve spring, and remove the valve spring, retainer locks. Release the spring compressor remove the valve spring, rotator, retainer and the valve stem to seal.

### Install The Valve Spring

Install a new seal over the valve stem. Two types are used. Early engines use an umbrella type (Item 1) [A]. Later production engines use pedestal type which fasten the valve stem guide (Item 2) [A].

Install the valve spring and retainer on the valve stem.

Compress the valve spring Put the valve spring retainer locks in the valve stem grooves and release the spring at a slow rate to engage the locks in the retainer. Remove the air hose and adapter.

Put oil on both ends of the pushrods and install the pushrods in the correct bores. Install the rocker shaft assembly to the cylinder head, put the pushrods on the adjustment screws. Tighten the bolts evenly to specifications.

Adjust the valve clearances to specifications.

Install the rocker cover.

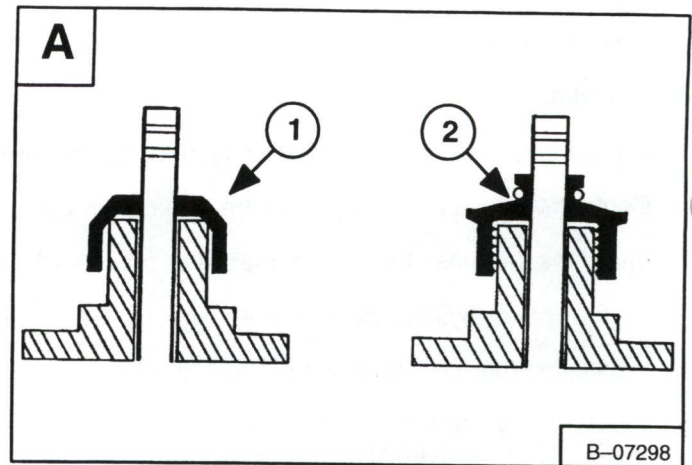
Install the spark plugs and connect the wires to the spark plugs in the correct firing order.

Disconnect the wires from the spark plugs and remove the rocker cover.

Make a second adjustment of the valve clearances (hot) to specifications.

Install the rocker cover with a new gasket and tighten the fastening screws to specification.

Put the spark plug wires in the rocker cover fastener and connect them to the correct spark plugs.



## **WATER PUMP**

### **Removal**

Remove the coolant from the cooling system.

If a new water pump is being installed, move the water hose connection to the new water pump.

Put the water pump and the gasket on the cylinder block and fasten with the bolts.

Connect the manifold water hose the water pump and tighten the clamp.

Connect the lower hose on the water pump and tighten the clamp.

Install the sheave and the fan. Install the bolts and tighten to the correct torque specifications.

Install the drive belt over the crankshaft, fan and governor sheave and make adjustment of the belt tension to specifications. Tighten the governor fastening and adjusting bolt to specifications.

Adjust the governor.

Fill the radiator and install the radiator cap. Start the engine and check for leaks

## **CYLINDER FRONT COVER, TIMING CHAIN AND CRANKSHAFT SPROCKETS**

### **Removal**

Remove the engine coolant by opening the drain valve on the radiator and removing the drain plug in the cylinder block.

Disconnect the radiator hoses from the engine.

Remove the governor belt and remove the water pump sheave.

Remove the water pump.

Remove the crankshaft sheave, using a puller.

Remove the four bolts that hold the oil pan to the timing chain cover. Remove the six bolts that hold the timing cover to the cylinder block.

**NOTE: Be careful not to cause damage to the oil pan gasket. If the gasket becomes damaged it will be necessary to remove the oil pan and replace the gasket. A damaged gasket will cause an oil leak.**

## WATER PUMP (Cont'd)

### Removing the Timing Cover

Remove the crankshaft oil thrower. Remove the crankshaft sprocket retainer and the bolts.

Remove the timing chain tightening arm. Remove the camshaft sprocket and disconnect the timing chain.

Use a puller to remove the crankshaft sheave [A].

### Installation Of The Timing Cover

Install the crankshaft if removed [B].

Install the camshaft sprocket.

Install the timing chain over the camshaft and crankshaft sprockets so the timing marks are in alignment [C].

Install the camshaft sprocket retainer and the bolts, then tighten the bolts to specification. Bend the locking tabs.

Install the tightening arm on the pivot pin while holding and tightening the cam in the released position.

Install the oil thrower on the crankshaft. Install the timing chain tightener.

Install the timing cover gasket, the oil pan gasket (if needed) and the end seal on the front cover with an oil resistant sealer at the ends. Make alignment of the cover with the tool [D]. Tighten the fastening bolts evenly to specification and remove the alignment tool. Tighten the oil pan bolts to specification.

Install the crankshaft sheave, making alignment of the slot with the crankshaft key. Tighten the fastening bolts to specification.

Install the water pump sheave. Install the governor belt and make adjustment of the tension of the belt to specifications.

Install the radiator hoses and tighten the clamps.

Fill the radiator with coolant.

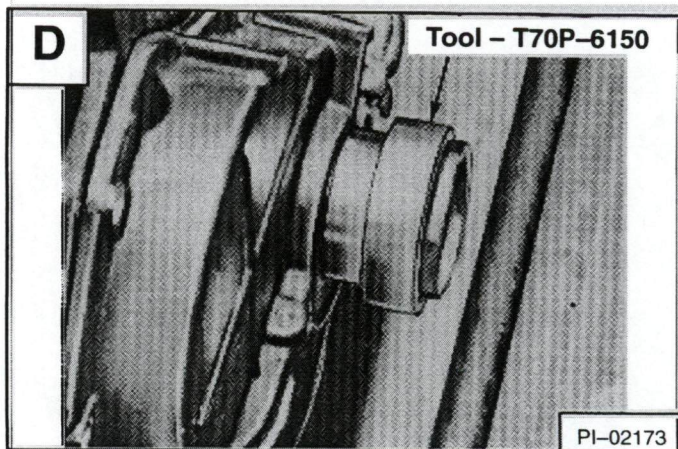
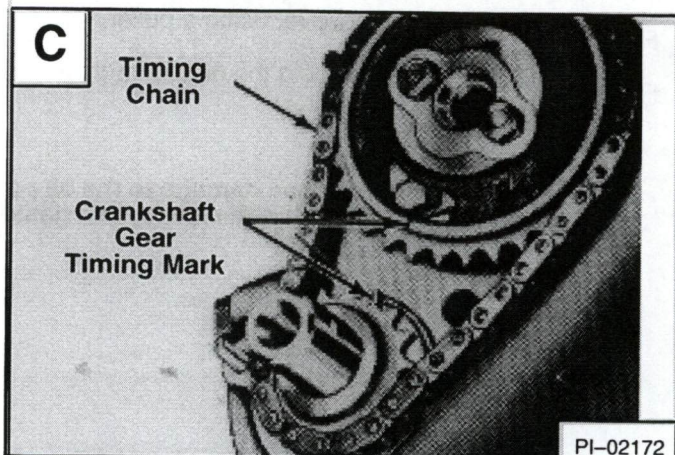
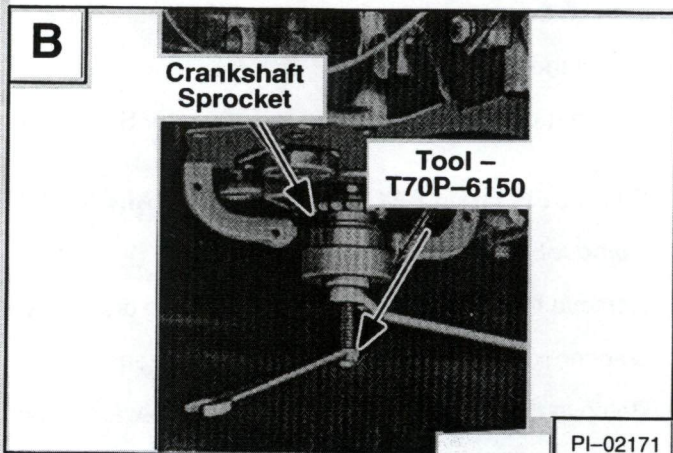
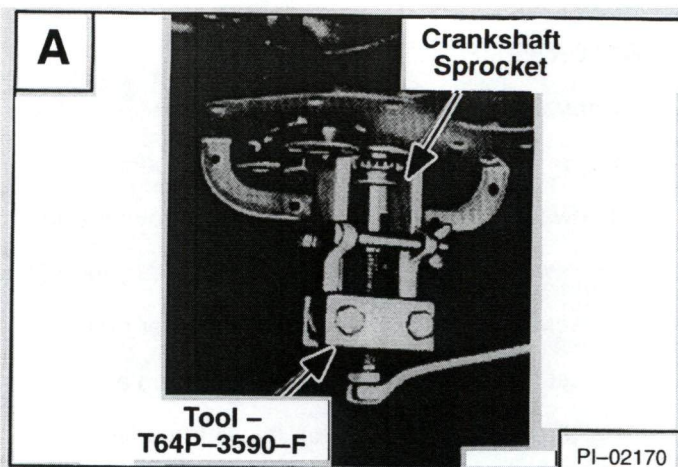
Start the engine and check for oil and water leaks.

### FRONT OIL SEAL

#### Removal

Remove the timing cover.

Push the seal out from the inside of the cover.





## FRONT OIL SEAL

### Removal

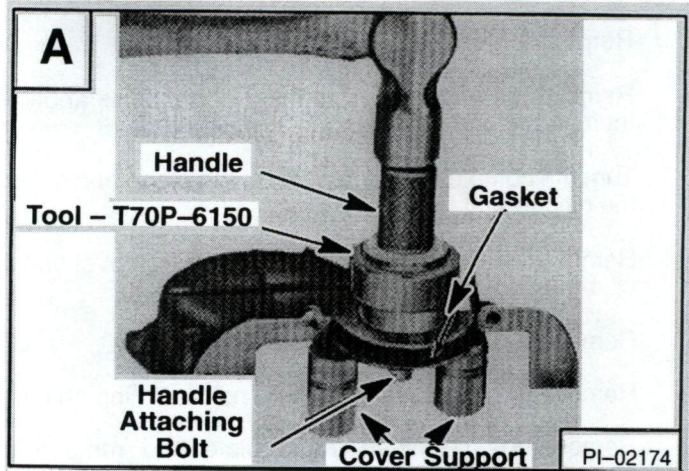
Remove the timing cover.

Push the seal out from the inside of the cover.

### Installation

Push the new seal into the housing [A]. Put a support under the housing near the seal to keep housing from breaking.

When installing the cover it is important that the oil seal is in alignment with the crankshaft and sheave boss.



## TIMING CHAIN TIGHTENING

### Removal

Remove the timing chain cover (and oil pan if necessary).

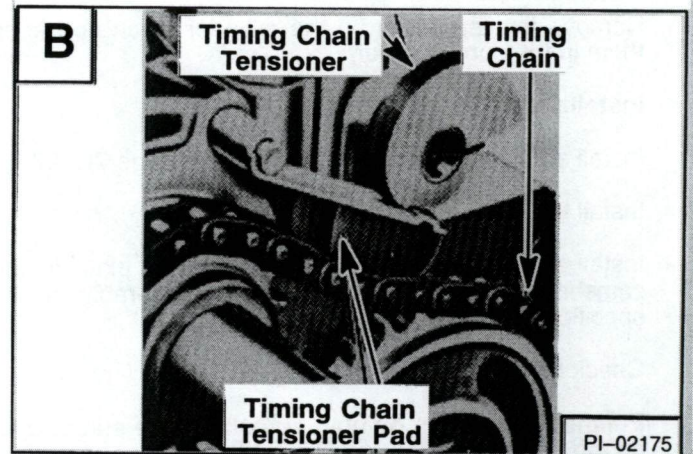
Remove the timing chain tightener and arm by removing the two fastening bolts [B].

### Installation

Install the tightener arm on the pivot pin.

Install the tightener and install the two bolts.

Install the timing chain cover (and oil pan if necessary).



## CAMSHAFT AND VALVE LIFTERS

### Removal

Remove the engine assembly and put the engine on a stand. Remove the crankcase oil.

Disconnect the fuel line at the fuel pump.

Loosen the governor adjustment bolts and remove the belt.

Remove the water pump sheave.

Remove the oil and fuel pumps from the cylinder block.

Disconnect the spark plug wires from the spark plugs and remove the rocker cover. Clean all gasket material from the rocker arm cover and cylinder head.

Remove the distributor from the cylinder block.

Remove the rocker shaft bolts evenly and lift off the rocker shaft.

## CAMSHAFT AND VALVE LIFTERS (Cont'd)

### Removal (Cont'd)

Remove the pushrods from the cylinder block and keep them in the correct order.

Turn the complete engine over on the stand and remove the oil pan and the gaskets.

Remove the crankshaft sheave. The timing cover and the oil thrower.

Remove the timing chain tightener assembly.

Remove the camshaft sprocket and the timing chain.

Remove the camshaft thrust plate and remove the camshaft **[A]**.

Remove the tappets from the cylinder block and keep them in the correct order.

### Installation

Install a new timing cover oil seal. (See Page 7B-27.)

Install the tappets.

Install the camshaft and install the thrust plate in the camshaft groove. Tighten the fastening assembly bolts to specification and bend the locking tabs.

Check the camshaft end play.

Put the timing chain on both sprockets. (Be sure marks on the sprockets are in alignment.) Install the sprockets on the crankshaft and the camshaft then tighten the bolts to specification and bend the locking tabs.

Find the tightener arm on the pivot pin and install the timing chain tightener.

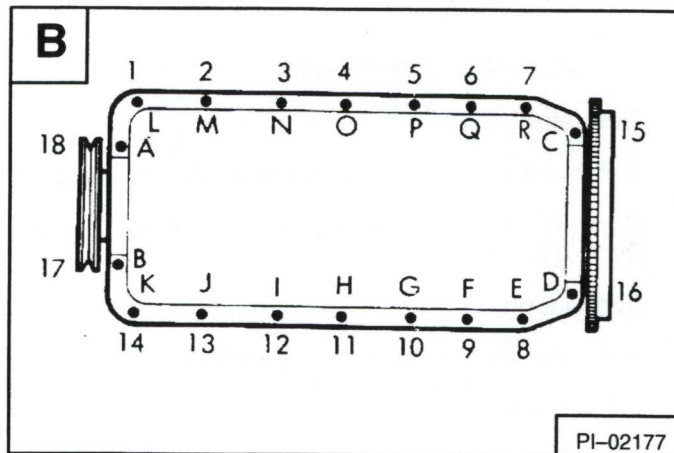
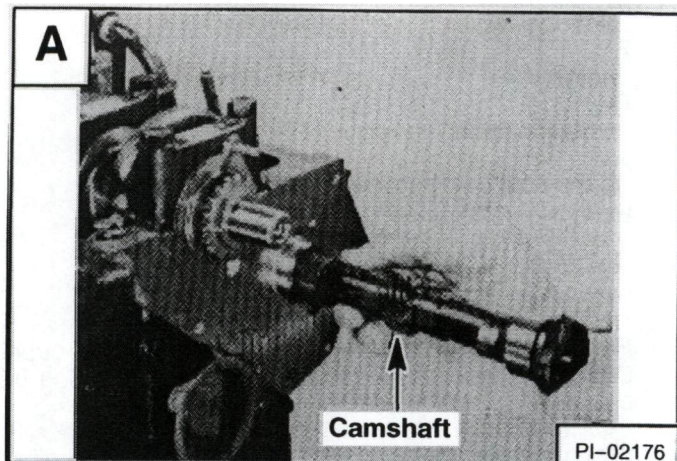
Install the oil thrower on the crankshaft.

Put the gasket on the timing cover with an oil sealer at the end. Make alignment of the front cover and tighten the bolts evenly to specification.

Put a new gasket on the block flange using an oil resistant sealer compound at each end. Put the end seals (chamfered ends) into the groove, again using an oil resistant sealer at the ends and install the oil pan. Tighten the oil pan bolts 6-8 ft.-lbs. (8-10 Nm) torque **[B]**. First tighten according to alphabetical order (A-B-C etc.) then tighten according to numerical order (1-2-3).

Install the dipstick.

Install the crankshaft sheave, making alignment of the slot with the crankshaft key. Tighten the sheave fastening bolt to specification.



## **CAMSHAFT AND VALVE LIFTERS (Cont'd)**

### **Installation (Cont'd)**

Turn the engine over on the stand. Install the distributor and adjust the timing.

Install a new gasket on the oil pump mounting flange and install the oil pump and the filter assembly. Tighten the fastening bolt to specification.

Install a new gasket on the fuel pump flange and install the pump lever through the slot in the block so that the lever is on the lobe of the camshaft. Fasten the fuel pump to cylinder block with the two washers and bolts. Tighten the bolts evenly to specifications.

Put oil on the contact surfaces of the pushrods, valve stems and rocker arms. Install the pushrods in the correct bores and install the rocker shaft assembly. Be sure to put the end of the pushrods on the adjustment screws. Tighten the rocker shaft fastening bolts evenly to specification.

Adjust the valve clearance. (See *SPECIFICATIONS* Section 8B-1.)

Connect the distributor vacuum advance line to the carburetor.

Install the water pump sheave. Install the drive belt on the sheave and make adjustment of the belt tension to specifications. Connect the fuel line from the carburetor to the fuel pump.

Install distributor cap and connect the wires to the spark plugs.

Remove the engine from the stand.

Install the engine assembly in the Bobcat loader.

Start the engine assembly in the Bobcat loader.

Start the engine and check for oil water leaks.

Make a second adjustment of the valve clearances (cold) to specifications.

Install the rocker cover and install a new gasket and fasten with screws. Tighten to specifications.

Start the engine and make adjustment of the ignition timing if needed.

Make adjustment of the carburetor idle speed and fuel air mixture to specifications.

## **OIL PAN**

### **Removal**

Remove the crankcase oil.

Remove the dipstick.

Remove the three bolts and remove the starter. (See Page 7B-41.)

Remove the oil pan fastening bolts and remove the pan and the gasket.

## OIL PAN (Cont'd)

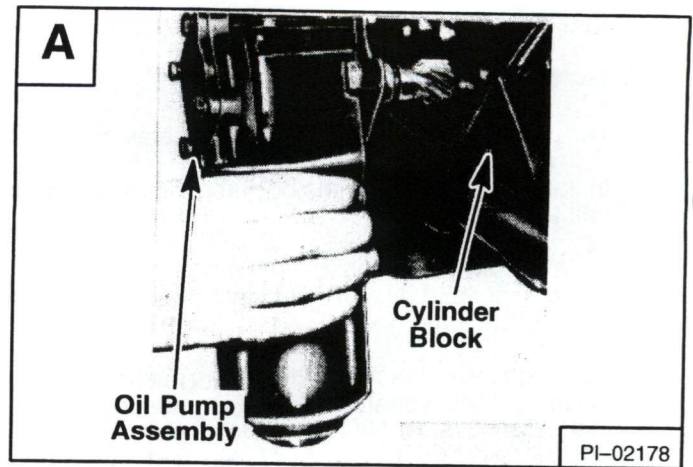
### Installation

Clean the oil pump inlet tube and the screen assembly.

clean the gasket surfaces of the block and the oil pan. Be sure to clean the seal grooves in the timing chain cover and the rear seal retainer. The oil pan has a two piece gasket. Put sealing compound on the block surface and the oil pan gasket surface. Install the oil pan and tighten the bolts evenly to specifications following first the alphabetical, then the numerical steps. (See Page 7B-29.)

Clean and install the starter and fasten it with three bolts.

Fill the oil pan with the correct engine oil and install the dipstick.



### OIL PUMP

The oil pump and filter assembly is installed on the left side of the cylinder block and can be removed with the engine in the machine.

### Removal

Put a pan under the oil pump.

Remove the three bolts that hold the oil pump and filter assembly and remove the assembly [A].

Remove the oil filter from the oil pump.

### Installation

Install the new oil filter on the oil pump assembly.

Make sure the contact surfaces are clean of the old gasket material, then install the oil pump and the filter assembly on the cylinder block, using a new gasket with sealing compound and fasten with the three bolts. Tighten the bolts to specifications.

Check the oil level and add oil if needed.

### CRANKSHAFT REAR OIL SEAL

#### Removal

Remove the flywheel

Remove the oil pan and the gasket.

Remove the rear oil seal carrier and remove the seal.

## CRANKSHAFT REAR OIL SEAL (Cont'd)

### Installation

Install a new crankshaft rear oil seal [A].

Put a new gasket on the rear oil seal carrier using a sealing compound at the end, and the carrier on the block rear surface. Tighten the bolts evenly to specifications.

Put new gaskets on the block flange using sealing compound at each end. Install the end seals with the chamfered end into the grooves, again using a sealing compound and install the oil pan. Tighten the bolts to the correct torque using the steps in [B].

Install the flywheel on the crankshaft flange. Be sure to contact surfaces of flywheel and crankshaft are clean. Tighten the bolts evenly to specifications.

### MAIN BEARINGS

The cast iron crankshaft is supported by five bearings.

The main bearing caps must be kept in original position. An arrow in the cap points to the front of the engine location marks are on the caps.

The front bearing cap has the letter F. The second cap has the number 2. The center cap has the letter C. The fourth cap has the number 4. The rear cap does not have a marking.

### Removal

Remove the main bearing caps and the thrustwashers. Keep the caps in order so each cap will be installed in its original position.

Remove the bearing halves from the cylinder block and from the caps.

Check the caps and crankshaft for damage.

Install new bearing halves in the cylinder block and from the bearing caps.

Make sure that the crankshaft and the bearings are free from dirt and other debris.

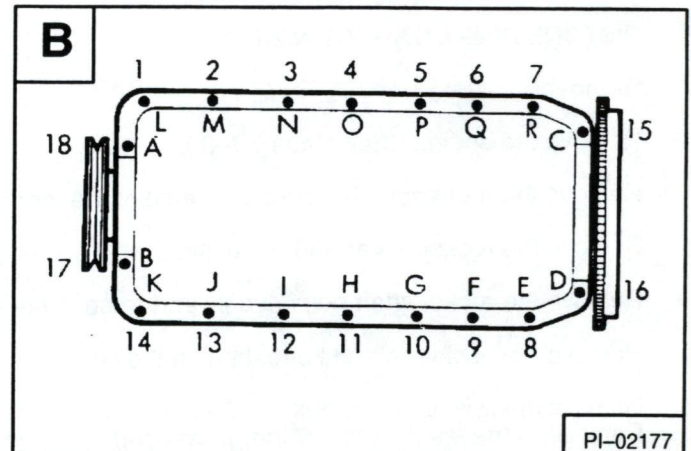
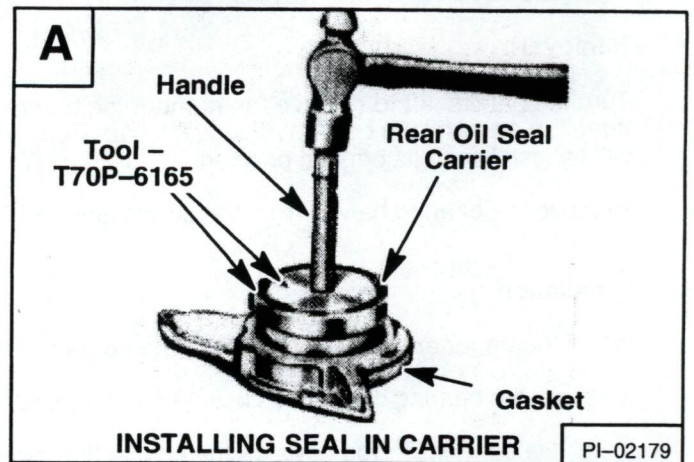
Measure the bearing clearances using Plastigage. (See Page 7B-13.)

### Installation

Clean the crankshaft and the bearings.

Install the crankshaft thrustwashers.

Put oil on the bearing surfaces and install the bearing caps in their original positions and tighten the bolts to specifications.



## CONNECTING ROD BEARINGS

### Removal

Turn the crankshaft to remove the number one connecting rod cap. Loosen the connecting rod bolts two or three turns and hit the bolts to release the cap. Remove the bolts and remove the cap. Keep the caps in order so each cap will be installed in its original position.

Remove the bearing halves from the connecting rod caps.

### Installation

Install the upper and lower bearings in the correct locations.

Measure the bearing clearances using Plastigage. (See Page 7B-13 *To Check Crankshaft Or Connecting Rod Bearing.*)

Install the connecting rod caps on the connecting rods in their original positions and tighten the bolts to specifications.

## PISTONS AND CONNECTING RODS

### Removal

Remove the engine. (See Page 7B-8.)

Remove the thermostat housing and remove the thermostat.

Remove the rocker cover and the gasket.

Remove the rocker shaft bolts evenly and remove the rocker arm shaft assembly.

Remove the pushrods and keep them in the correct order.

Remove the cylinder head bolts and remove the cylinder head and gasket. Do not put the cylinder head flat on its surface. Damage to the spark plugs or the gasket surface can result.

Remove the starter and the oil pan.

Clean the oil pan and the cylinder block surfaces and remove the end seals.

Loosen the bearing cap bolts several turns and hit the bolts to release the bearing cap. Remove the bolts and remove the bearing cap. Keep the bearing caps in order so each can be installed in its original positions. Push the piston and the connecting rod out of the bore.

## PISTONS AND CONNECTING RODS (Cont'd)

### Installation

Install the bearing halves in the connecting rods and the end caps. Turn the crankshaft as needed to fit each connecting to the crankshaft, but do not install the end cap.

Measure the bearing clearances using Plastigage. (See Page 7B-13 *To Check Crankshaft Or Connecting Rod Bearing.*)

Clean all the bearing surfaces of the Plastigage material. If needed use new rod bearings to correct clearances.

Install the connecting rods on the crankshaft and tighten the connecting rod bolts to specifications.

Install a new gasket on the block flange using sealing compound at each end. Install the end seals with the chamfered ends into the grooves again using sealing compound.

Install the oil pan and tighten the bolts to the correct torque, following the tightening sequence. (See Page 7B-31.)

Clean and install the starter. Fasten the starter with the two bolts.

Clean all the gasket material from the contact surfaces and install the cylinder gasket on the cylinder block using alignment studs.

Install the cylinder head. Remove the alignment studs and install the cylinder head bolts. Tighten the bolts. (See Page 7B-22 *Installing The Cylinder Head.*)

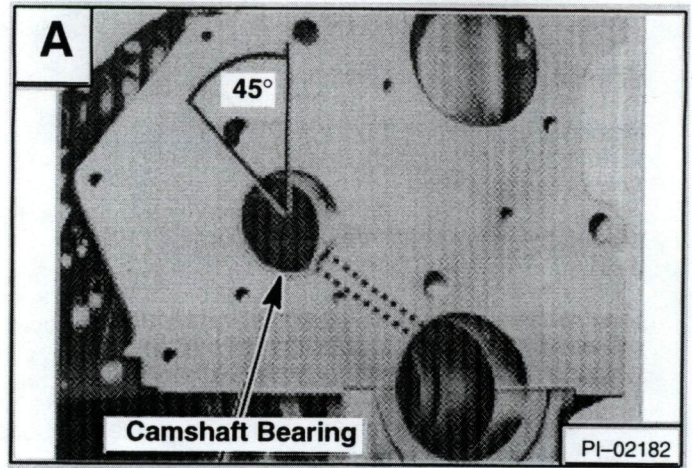
Put oil on both ends of the pushrods and install the pushrods in the correct bores.

Install the rocker shaft assembly on the cylinder head put the pushrods on the adjustment screws. Tighten the bolts to the correct specifications.

## CAMSHAFT BEARINGS

The service bearings for the camshaft are machines to fit and need no machining after installation. When one bearing needs replacement replace all three bearings to be sure of the correct camshaft alignment.

Make sure that the oil holes in the bearings and the cylinder block are in correct alignment before installation and that the bearing openings are at 45° to the vertical [A].



## CAMSHAFT BEARINGS (Cont'd)

### Removal

Remove the engine. (See Page 7B-8.)

Remove the flywheel.

Remove the crankshaft rear oil seal bracket. (See Page 7B-31.)

Put a new gasket on the rear oil seal bracket using sealing compound at the ends. Install the bracket on the cylinder block and tighten the bolts to specifications.

Install the flywheel on the crankshaft flange. Be sure contact surfaces are clean. Tighten the fastening bolts to specifications.

Install the camshaft.

## CRANKSHAFT

### Removal

Remove the engine from the Bobcat and put it in an engine stand. (See Page 7B-8.)

Remove the flywheel from the crankshaft.

Loosen the governor fastening bolts and remove the drive belt.

Remove the sheave from the front of the crankshaft.

Remove the front cover.

Remove the oil thrower from the shaft [A]. Remove the timing chain tightener and timing chain. Remove the crankshaft sprocket from the crankshaft.

Turn the engine over, remove the oil pan. Remove the oil inlet tube and the screen.

Remove the four connecting rod bearing caps and keep them in order so that each cap will be installed on the correct rods.

Remove the five main bearing caps and keep them in order so that each will be installed in the correct location.

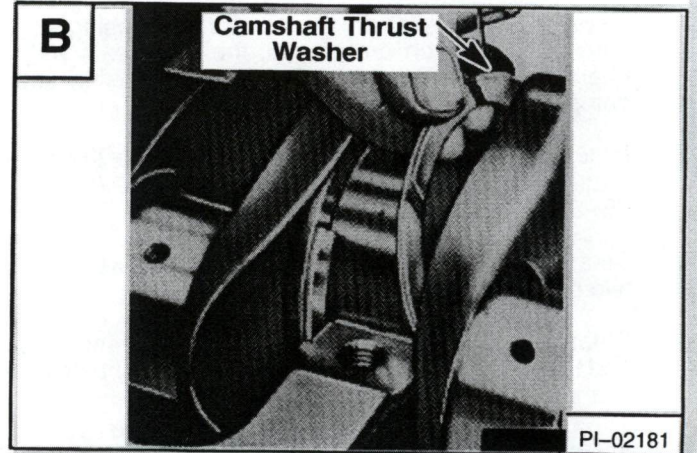
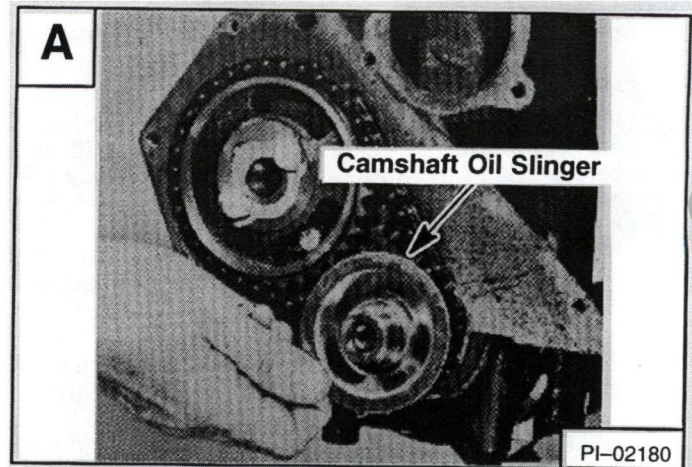
Carefully remove the crankshaft from the cylinder block.

### Installation

Install the main bearings in the cylinder block. Install the crankshaft and check the bearing clearance using the Plastigage method. (See Page 7B-13.) Install the correct main bearing caps and tighten to specifications.

Check the crankshaft end play. (See Page 7B-7.)

Install the correct thickness of thrustwashers to give the correct endplay [B].





## CRANKSHAFT (Cont'd)

### Installation (Cont'd)

Check the connecting rod bearings using the Plastigage method. (See Page 7B-13.)

Install the rod bearings and the correct connecting rod caps in the correct locations and tighten the cap bolts to specifications.

Install the oil inlet tube and the screen.

Install the crankshaft sprocket and timing chain making sure that the timing marks are in alignment.

Install the oil thrower timing chain tightener and timing chain tightener and timing chain cover. Install the crankshaft sheave.

Install the oil pan and new gaskets. Tighten the oil pan fastening bolts to specifications. (See Page 7B-31.)

Turn the engine over again and install the governor drive belt. Make belt adjustment to specified tension. Install the flywheel.

Install the engine in the Bobcat loader.

Fill the crankcase and the cooling system to the correct level with the specified oil and coolant. Start the engine and check for oil and water leaks.

### UNIVERSAL JOINT

The tool listed will be needed to do the following procedure:

MEL1187 – Socket

#### Removal

Remove the engine. (See Page 7B-8.)

Remove the bolts (Item 1) [A], holding the u-joint on the flywheel. Remove the u-joint assembly.

#### Installation

Put LOCTITE on the four bolts. Install the u-joint.

Install the bolts and tighten to 270-300 in.-lbs. (31-34 Nm) torque. Put spline lube (MEL1121) on the splines before installation.

### FLYWHEEL

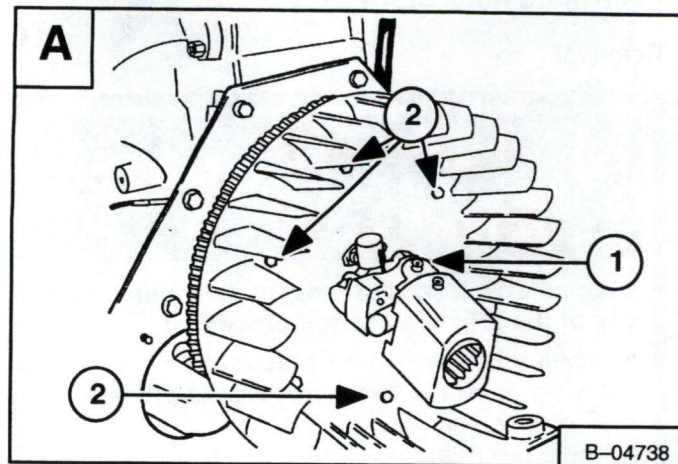
#### Removal

Remove the bolts that attach the blower fan to the flywheel (Item 2) [A]. Remove the blower fan.

Remove the bolts holding the flywheel onto the crankshaft.

**Installation:** Tighten the bolts to 45-50 ft.-lbs. (61-68 Nm) torque.

Remove the flywheel. Installation is the reverse of removal.



## FLYWHEEL RING GEAR

### Removal

# ⚠ WARNING

Wear safety glasses to prevent eye injury when any of the following conditions exist:

- When fluids are under pressure.
- Flying debris or loose material is present.
- Engine is running.
- Tools are being used.

W-2019-1285

Cut between the teeth with a hacksaw.

Use a chisel to break the ring gear.

### Installation

Heat the ring gear to a temperature of not more than 600°F (315°C). Temperature of more than 600° will cause damage to hardness of the ring gear.

Install the hot ring gear on the flywheel.

## MUFFLER

### Removal

Remove the rear grill.

Remove the exhaust pipe from the muffler [A].

Remove the bolts holding the muffler on [B].

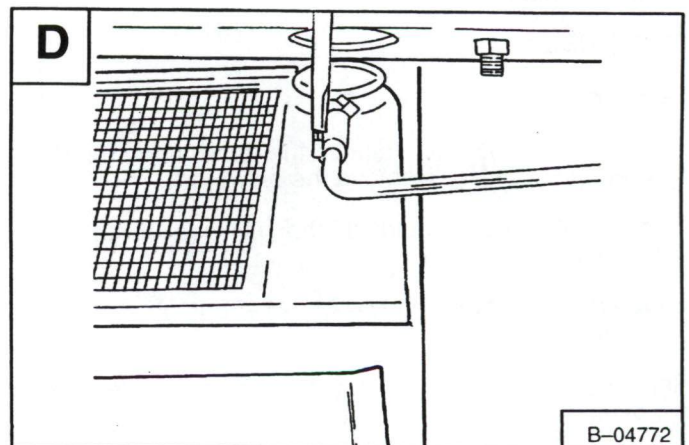
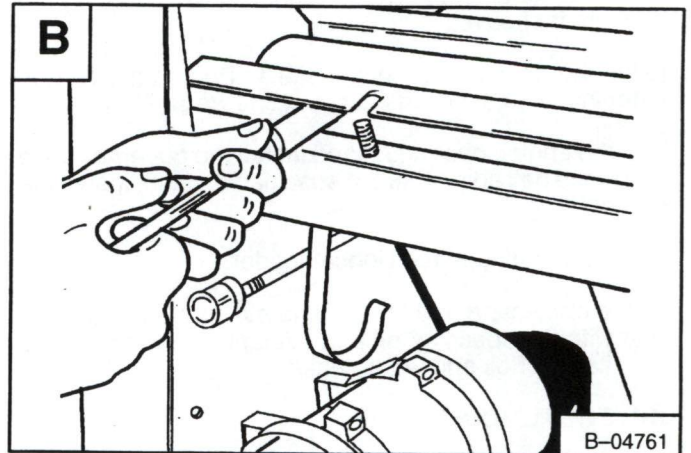
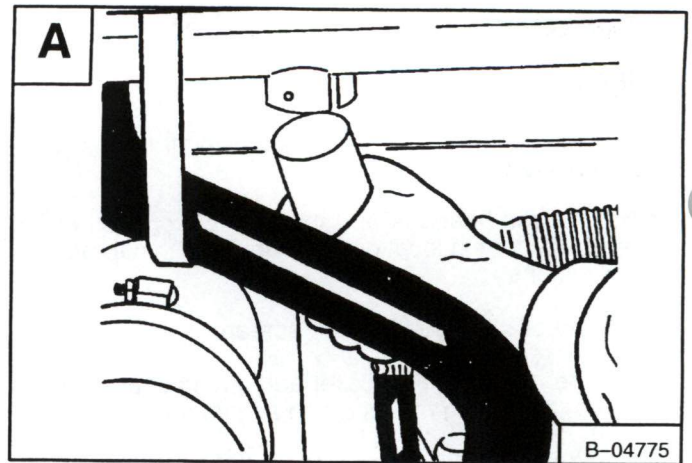
Installation is the reverse of removal.

## RADIATOR

### Removal

Remove the panel from the blower housing [C].

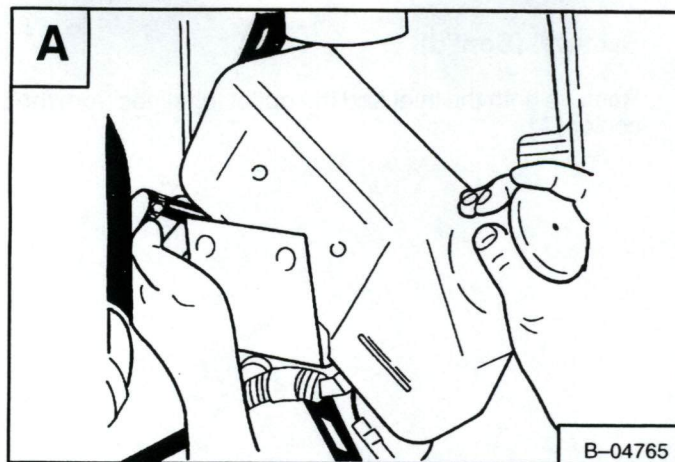
Loosen the hose clamp on the overflow tube [D].



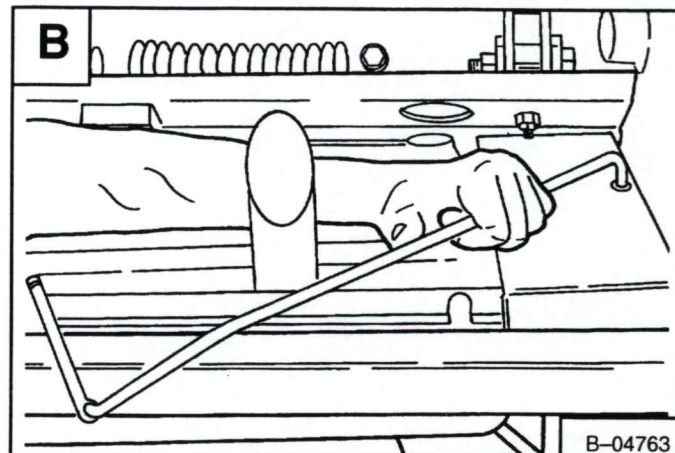
## RADIATOR (Cont'd)

### Removal (Cont'd)

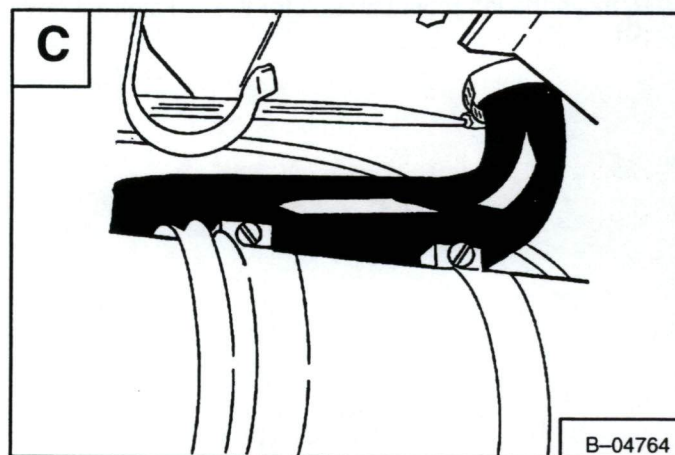
Loosen the clamp on the overflow tube by the recovery tank and remove the tank [A].



Remove the overflow tube [B].



Remove the muffler exhaust pipe.  
Remove the inlet radiator hose [C].



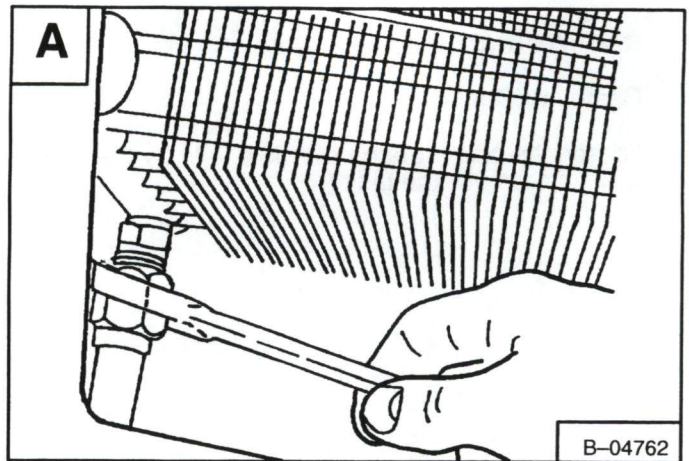
Remove the outlet radiator hose [D].



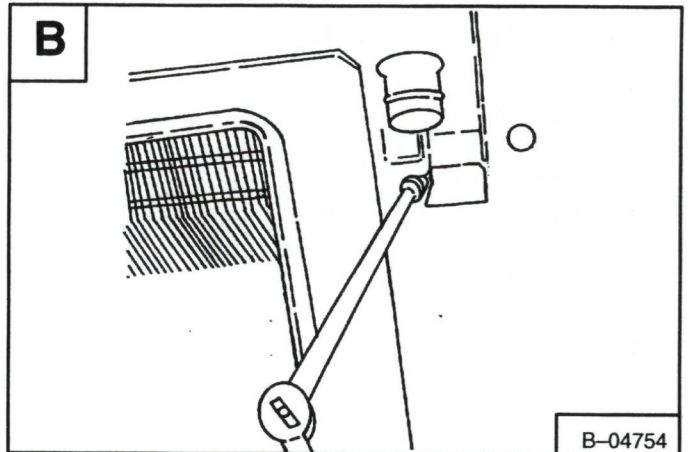
## RADIATOR (Cont'd)

### Removal (Cont'd)

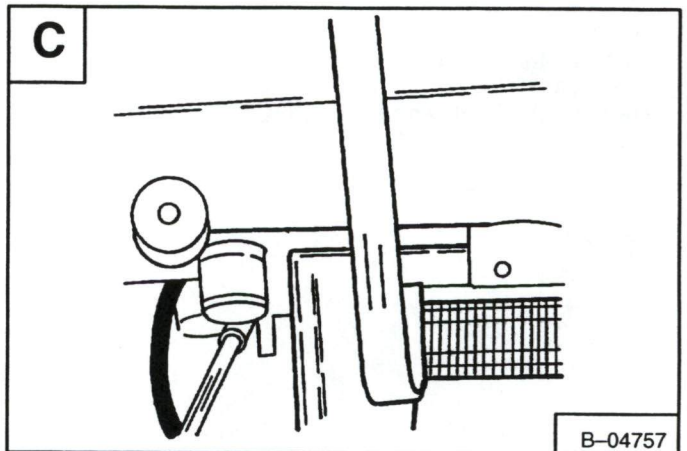
Remove both the inlet and the outlet tubelines from the oil cooler [A].



Remove the right mounting bolt for the radiator assembly [B].



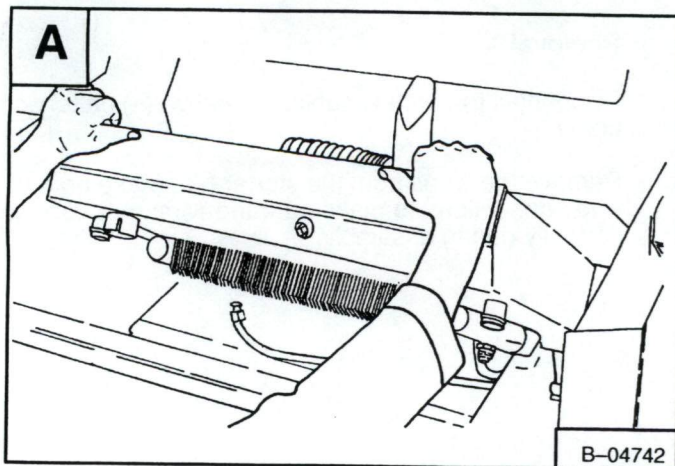
Remove the left mounting bolt for the radiator assembly [C].



## RADIATOR (Cont'd)

### Removal (Cont'd)

Remove the radiator assembly [A].



Remove the radiator mounting bolts [B].

Remove the radiator from the assembly.

### Installation

Install the mounting bolts [B].

Tighten the mounting bolts 180–200 in.-lbs. (21–23 Nm) torque.

Install the radiator assembly [A].

Install the assembly mounting bolts (See Page 7B–38.)

Tighten the bolts 180–200 in.-lbs. (21–23 Nm) torque.

Install the tubelines to the oil cooler.

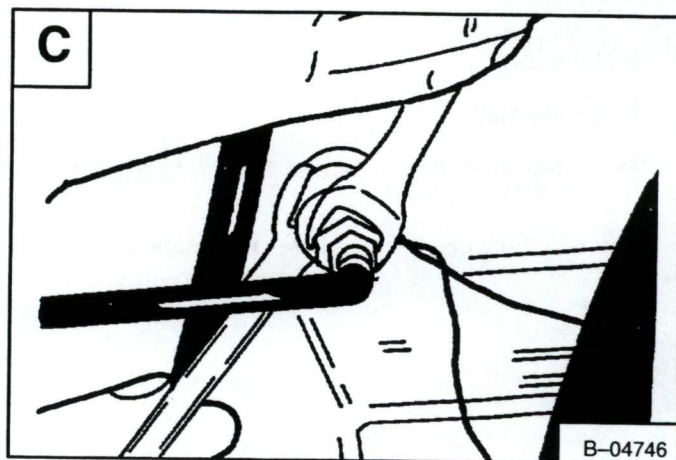
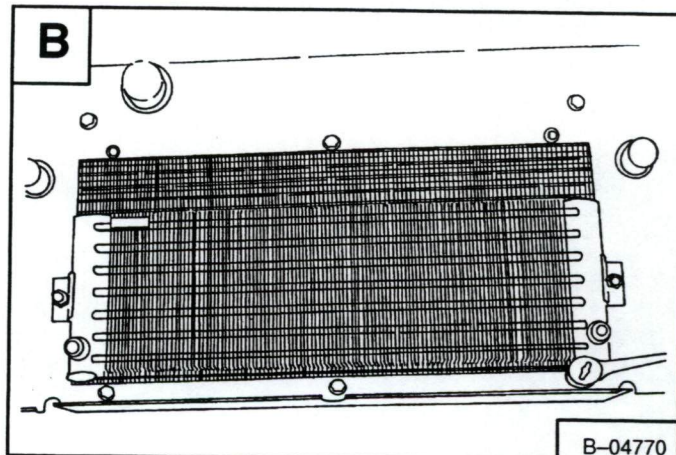
Install the two radiator hoses.

Install the muffler exhaust pipe.

Install the overflow tube and the coolant recovery tank.

Connect the overflow tube at both ends and tighten the hose clamps.

Install the panel on the blower housing. Tighten the bolts to 180–200 in.-lbs. (21–23 Nm) torque.



## BLOWER HOUSING

### Removal

Remove the engine. (See Page 7B–8.)

Remove the radiator, oil cooler assembly. (See Page 7B–36.)

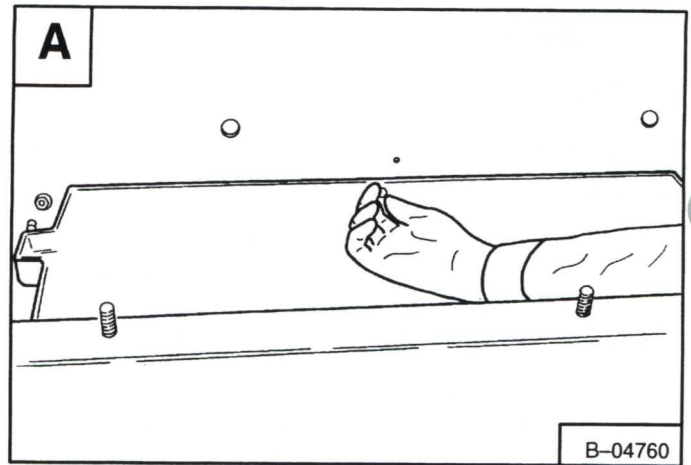
Disconnect the fuel lines from the fuel filter [C].

## STARTER

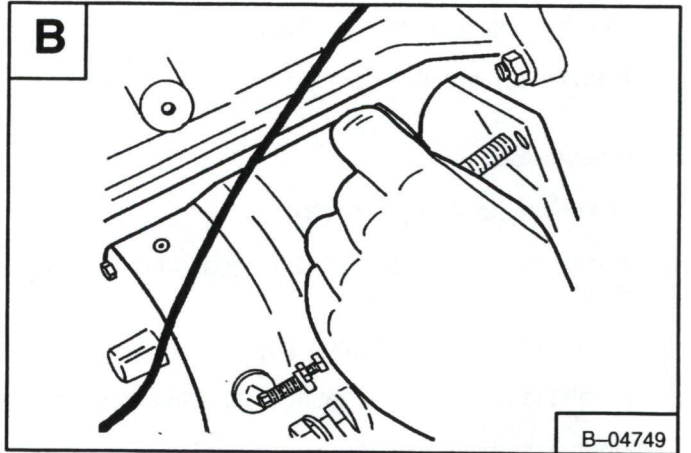
### Removal

Disconnect the battery cables (negative (-) battery cable first).

Remove the wires from the starter **[A]**. Make note of the wire connections to make sure the wires are connected correctly during assembly.



Remove the starter mounting bolts **[B]**.



Remove the starter **[C]**.

### Installation

Install the starter.

Install the mounting bolts and tighten to 25–28 ft.-lbs. (34–38 Nm) torque.

Connect the wires to the correct terminals **[A]**.

