SECTION 5 - ENGINE MECHANICAL

MERCURY
SNOWMOBILES

PART E - 440 MAX, 440 M/X and 440 S/R

MERCURY
MARINE

INDEX

GENERAL

If major engine repairs are to be completed, remove engine from snowmobile. An engine repair bracket can be fabricated from angle iron with holes and dimensions as shown in Figure 1. Install repair bracket as shown in Figure 2. Metric tools are required. All nuts, bolts and allen screws are metric.

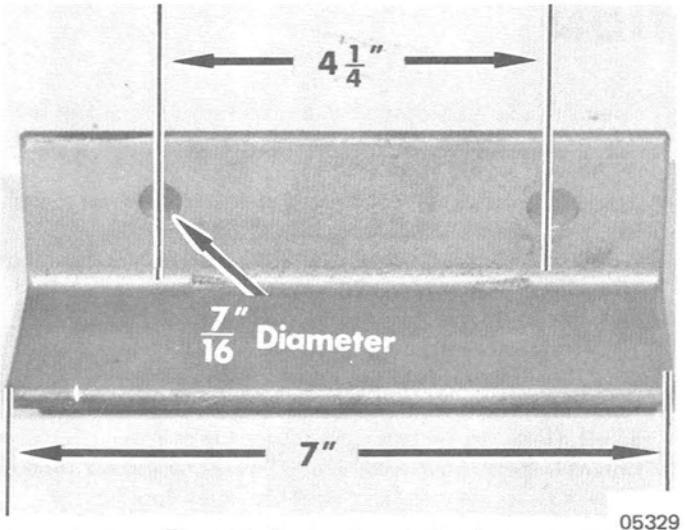

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Figure 1. Engine Repair Bracket

NOTE: Refer to "Specifications" Section 8 for all torque specifications.

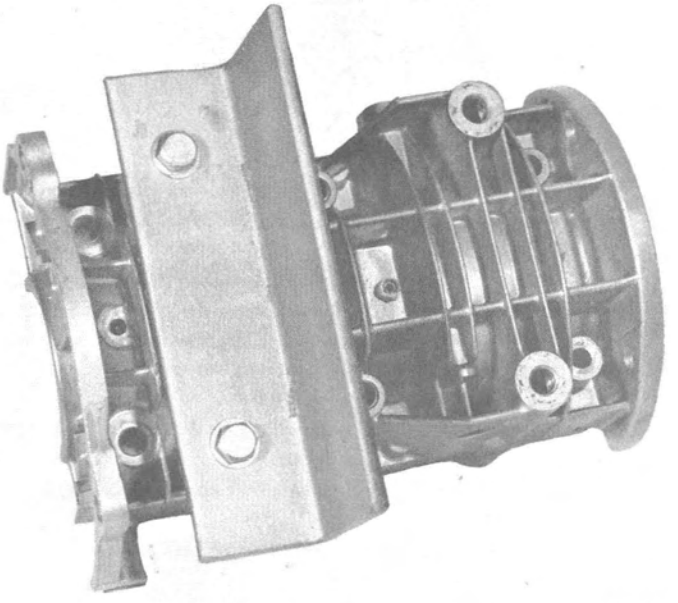

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Figure 2. Engine Mounting Bracket Installed

ENGINE COMPLETE - REMOVAL

1. Open top cowl.
2. Remove drive sheave shroud and drive belt.
3. Remove battery leads and disconnect harness from starter motor. Remove harness and clips from upper starter bracket cap screw and right, front mount plate nut (if so equipped).
4. Open door on dash. Remove carburetor intake silencer, if so equipped. Disconnect spark plug lead wires.
5. Disconnect throttle and choke core wires from carburetor.
6. Remove choke cable from mounting bracket.
7. Unhook throttle return spring from carburetor, if so equipped.
8. Remove dash and windshield assembly by removing attaching screws. Disconnect wiring harness from ignition switch and primer hose from primer.
9. Remove throttle and choke bracket from carburetor. (Figure 3)

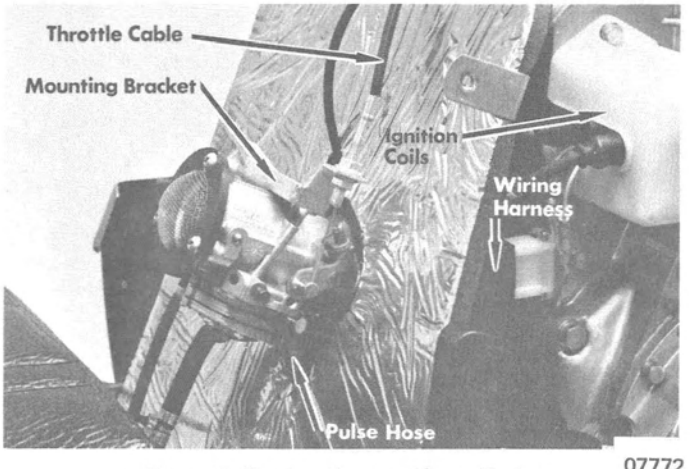

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Figure 3. Engine Removal/Installation

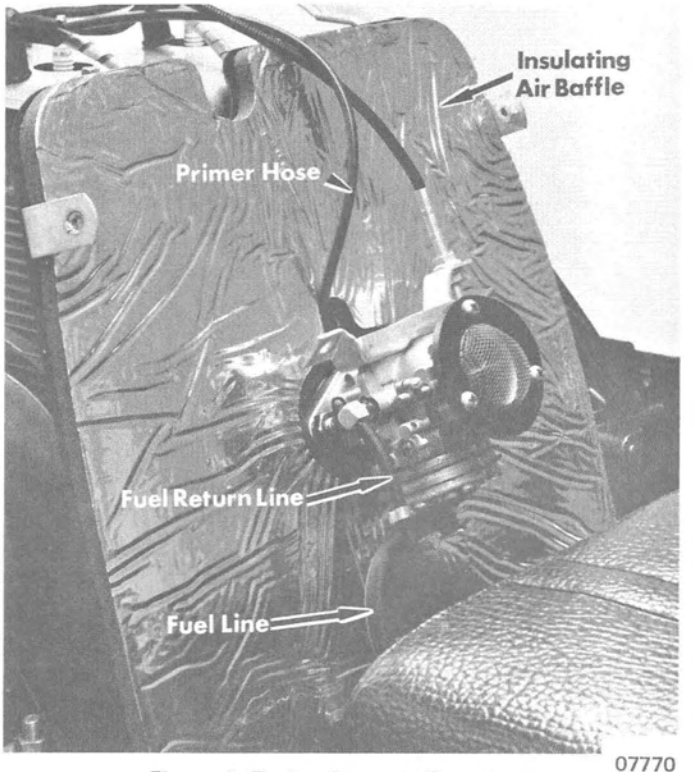

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Figure 4. Engine Removal/Installation

NOTE: To prevent fuel spillage, clamp, plug or elevate fuel line, if fuel tank contains fuel.

10. Disconnect fuel line, fuel return line, primer hose and pulse hose from carburetor. (Figure 4)
11. Remove carburetor from intake manifold.
12. Remove insulating air baffle which surrounds carburetor and insulator block.

    NOTE: If removal of drive sheave is necessary, remove at this time. Refer to Section 2C.

13. Unhook ball joint springs from exhaust ball joint.
14. Disconnect wiring harness (located below ignition coils).
15. Remove ground wire from rewind housing screw.
16. Remove locknuts and flat washers which secure engine mount plate to mounting rails.
17. Lift out engine.
18. Remove mount plate from engine. Note position of spacers (if so equipped) between mount plate and engine.

INSTALLATION

NOTE: "X" stamped on engine mount plate must be positioned up and below exhaust manifold when engine is installed in snowmobile.

1. Position spacers (if so equipped) between mount plate and engine and install mount plate. Torque to specifications.
2. Set engine on mounting rails and align exhaust ball joint.
3. Secure engine to front and rear engine rails with carriage bolts, flat washers and flex-loc nuts.

   NOTE: Electric models have a clip and harness attached below right front mount plate nut.

4. Attach ground wire from right cowl support assembly to rewind housing screw.
5. Connect engine harness plug to engine receptacle (located below ignition coils).
6. Secure exhaust ball joint with springs and install drive sheave if removed. Torque drive sheave to specifications.
7. Install insulating air baffle. Route pulse line thru baffle.
8. Secure insulator block and carburetor to intake manifold with new gaskets.
9. Connect pulse hose, primer hose, fuel return line and fuel line to carburetor. Remove clamp from fuel line, if used. (Figure 4)
10. Attach throttle and choke bracket to carburetor. (Figure 3)
11. Position dash on snowmobile. Connect primer hose to primer and wiring harness to ignition switch. Secure dash assembly with attaching screws.
12. Attach throttle return spring to carburetor, if removed.
13. Connect choke cable to mounting bracket.
14. Connect throttle and choke core wires to carburetor and adjust. (Refer to Section 7A for adjustment.)
15. Connect spark plug lead wires. Install carburetor intake silencer (if so equipped). Close dash access door.
16. Attach electric start harness to clip on upper starter bracket cap screw. Connect harness to starter motor. Connect battery leads (if so equipped).
17. Install drive belt and drive sheave shroud.
18. Close top cowl.

CYLINDER HEAD

REMOVAL

1. Remove spark plug lead wires, spark plugs and engine shrouds.
2. Remove cylinder head attaching nuts and flat washers. Lift head from cylinder studs.

NOTE: Mark location of cylinder head spacers which secure engine shroud.

CLEANING and INSPECTION

1. Thoroughly clean cylinder head and gasket surfaces.
2. Inspect head for deep grooves, cracks or distortion which could cause compression leakage.
3. Check spark plug hole for stripped or damaged threads.

INSTALLATION

1. Install a new head gasket on cylinder.
2. Set cylinder head on studs and secure with attaching nuts and washers.

NOTE: Cylinder head shroud spacers must be on proper studs.

3. Torque nuts to specifications.
4. Install engine shrouds, spark plugs and spark plug lead wires.

CYLINDER

REMOVAL

1. Remove spark plug lead clip from shroud, spark plugs and engine shrouds.
2. Remove exhaust manifold.
3. Remove cylinder head attaching nuts and flat washers. Lift head from cylinder studs.

NOTE: Mark location of cylinder head spacers which secure engine shroud.

4. Lift cylinder off studs.

CLEANING and INSPECTION

1. Thoroughly clean cylinder and gasket mating surfaces.
2. Inspect cylinder for cracks, distortion or pitting.
3. Inspect cylinder sleeve, refer to sleeve repairs following.

NOTE: Always deglaze or hone cylinder sleeve(s) before reassembly.

INSTALLATION

1. Lubricate cylinder and pistons with clean oil.
2. Place new cylinder base gaskets on crankcase.
3. Compress piston rings with Ring Compressor (C-91-54072). (Figure 1)
4. Make sure that cylinder being installed is on correct side. Place cylinder on studs and guide piston assembly into cylinder. (Figure 1)
5. Rotate crankshaft until piston rings can be viewed thru exhaust port. Depress ring with small punch or screwdriver (it will not "spring back" if broken).
6. Install exhaust manifold with new gaskets.
7. Install a new head gasket on cylinder.
8. Set cylinder head on studs and secure with attaching nuts and washers.

NOTE: Cylinder head shroud spacers must be on proper studs.

9. Torque nuts to specifications.
10. Install engine shrouds, spark plugs and spark plug lead wires.

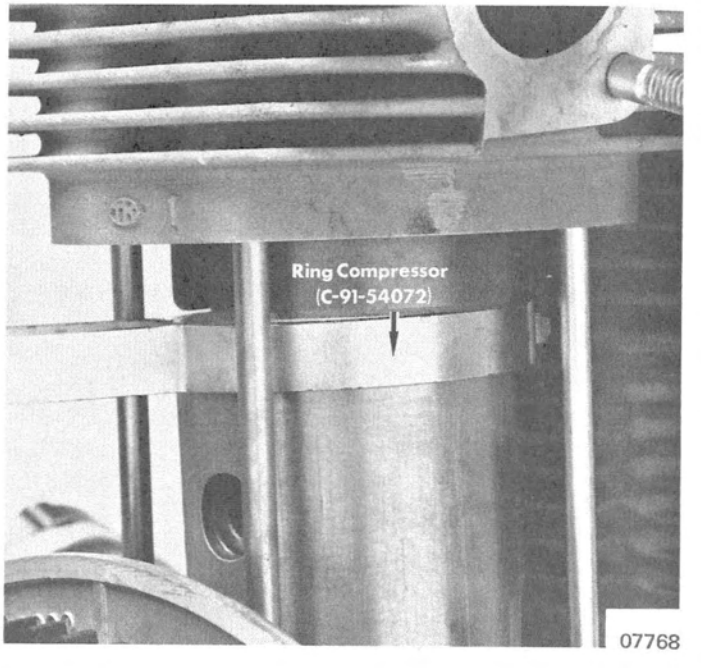

Figure 1. Piston Ring Compressor

CYLINDER SLEEVE REPAIRS

Repairs to cylinder sleeve depend upon amount of wear present. If inspection revealed that cylinder sleeve was slightly worn, honing may clean up the cylinder. If not, cylinder should be bored to next smallest oversize diameter that will resurface the sleeve. (Refer to Section 8 "Specifications".)

HONING

1. Follow recommendations of the hone manufacturer for correct usage of hone and proper cleaning and lubrication during honing. (Figure 2)
2. Occasionally, during honing operation, cylinder bore should be cleaned thoroughly and piston (selected for the individual cylinder) checked for correct fit per specified clearance.
3. When finish-honing a cylinder bore, hone should be moved up-and-down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch patern of approximately 45°-to-65° included angle. Finish marks should be clean but not sharp, free from inbedded particles and torn or folded metal.
4. Thoroughly clean cylinder bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is absolutely essential that a good cleaning operation be performed. If any abrasive material is allowed to remain in cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to bearings lubricated by the contaminated oil. The bores should be swabbed several times with light engine oil and a clean cloth, then wiped with a clean dry cloth. DO NOT clean cylinder with kerosene or gasoline.

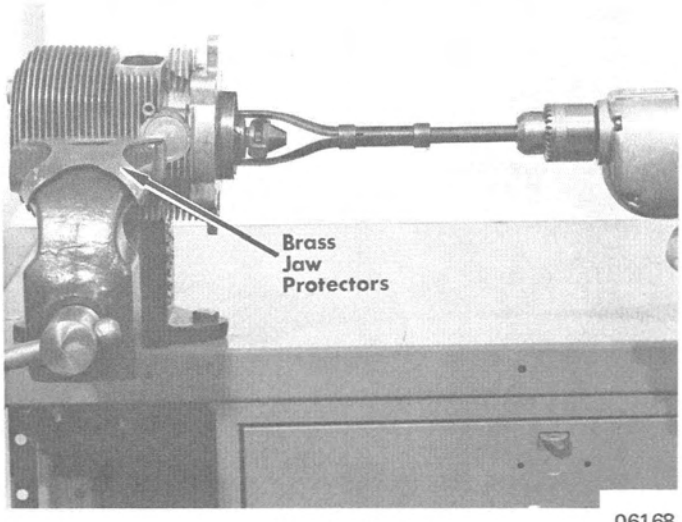

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Figure 2. Honing Cylinder

INSPECTION

1. Hone cylinder to clean up any score marks or scuffs in cylinder bore.
2. Measure piston diameter with a micrometer at center of piston skirt.
3. Measure cylinder sleeve diameter with any inside micrometer at approximate center of sleeve. (Figure 3)
4. Subtract piston diameter from cylinder bore diameter to determine "Piston Skirt Clearance".
5. If clearance exceeds specifications (Section 8) after honing, replace parts or bore cylinder oversize.

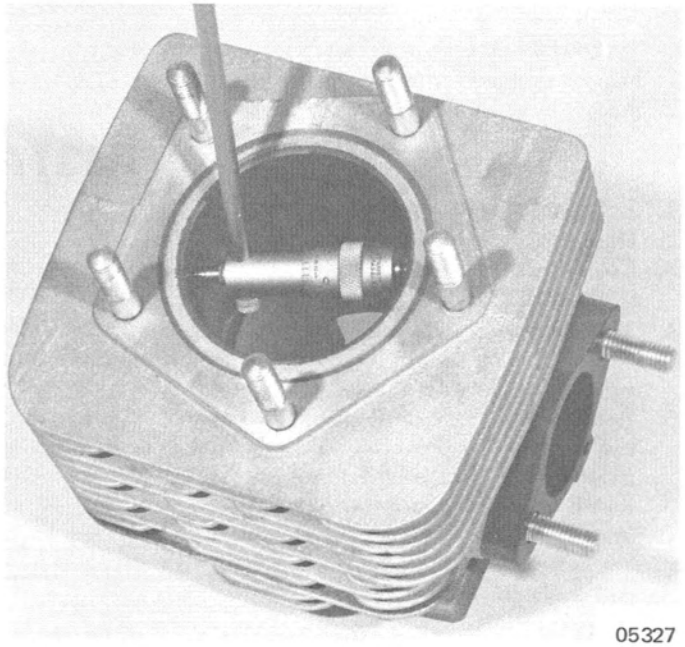

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Figure 3. Measuring Cylinder

PISTON and RING ASSEMBLY

REMOVAL

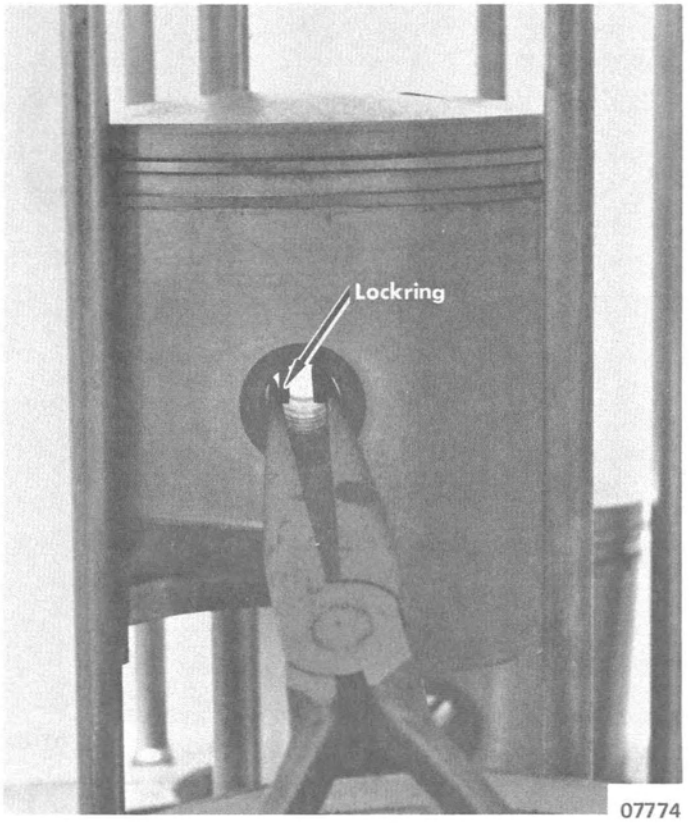

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Figure 4. Piston Lockrings

NOTE: It is necessary to remove the opposite cylinder prior to removal of either piston. When removing No. 1 piston (fan end), fan and rewind assembly must be removed.

1. Remove cylinder assemblies.

   NOTE: Place a clean rag around crankcase opening to prevent entrance of foreign objects.

2. Disconnect ignition coil leads and connector from below coils.
3. Remove cap screws which hold flywheel housing.
4. Remove flywheel housing, rewind, fan assembly, ignition coils and fan belt as one complete assembly.
5. Remove piston pin lockrings from piston. (Figure 4)
6. Remove piston pin with Piston Pin Tool (C-91-65099). (Figure 5)

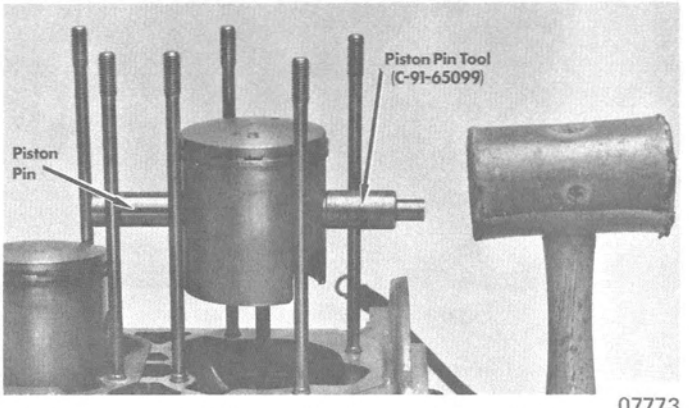

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Figure 5. Piston Pin Removal - Installation

7. Remove bearing from connecting rod.
8. Use Piston Ring Expander (C-91-24697) to remove piston rings. (Figure 6)

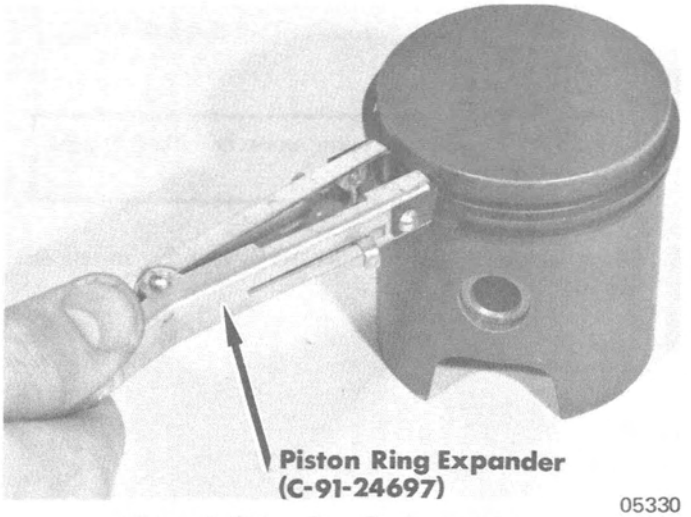

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Figure 6. Piston Ring Replacement

CLEANING and INSPECTION

1. Replace pistons if scoring or metal damage is present.
2. Inspect piston ring grooves for wear, burn and distortion. Pins (located in ring grooves) prevent rings from rotating.
3. Before installing rings, clean grooves with recessed end of a broken ring. Clean carbon and varnish deposits from top sides of piston with soft wire brush or carbon remover solution. Do not burn or round machined edges.

   NOTE: Piston pins are not sold separately. Each piston pin is mated to only one piston. The piston and pin must be replaced as an assembly if pin is loose.

4. Inspect piston pin end of connecting rod for pitting or rust. Clean (if necessary), using 320 grit carborundum cloth.

INSTALLATION

1. Insert piston pin bearing in connecting rod.

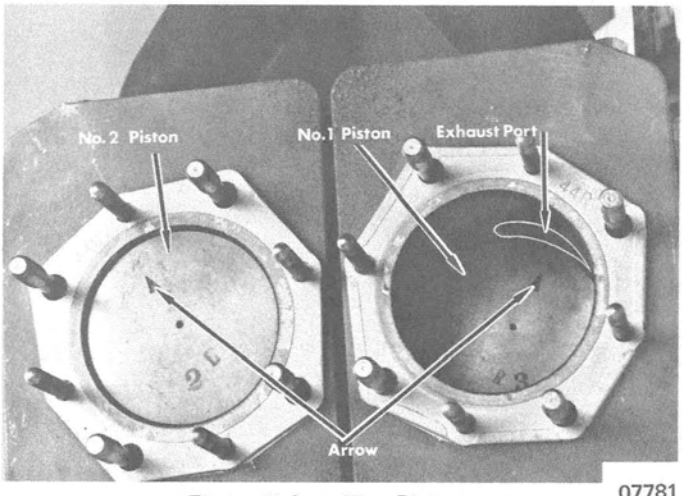

Figure 7. Installing Pistons

2. Position piston on connecting rod with arrow on dome of piston toward exhaust port of cylinder. (Figure 7)

NOTE: Pistons are not interchangeable. No. 1 piston must be on No. 1 rod (fan end) and No. 2 piston must be on No. 2 rod (PTO end).

3. Install piston pin with Piston Pin Tool (C-91-65099).
4. Install new lockrings.

CAUTION: Lockring opening must be either straight up or straight down.

5. Using Piston Ring Expander (C-91-24697), install new piston rings.

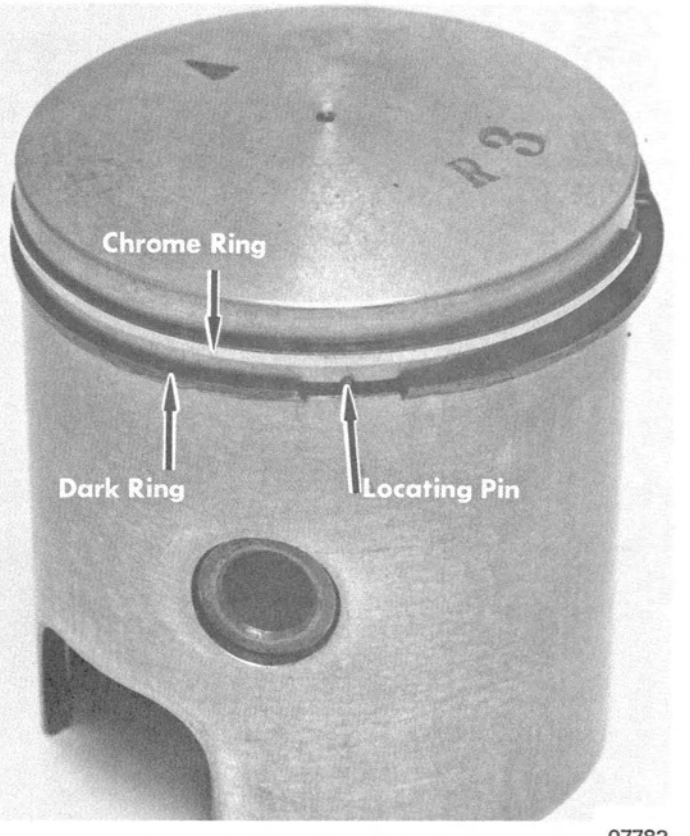

Figure 8. Piston Ring Installation

CAUTION: Chrome ring must be installed in top ring groove and dark colored ring in bottom ring groove. Piston rings must be properly installed to locate below locating pins in ring grooves. Rings fit only one way and must not be forced during installation in cylinder. (Figure 8)

6. Install cylinder assembly.

FAN BELT and FLYWHEEL HOUSING

REMOVAL

1. Remove rewind starter, plastic fan guard and fan belt shield (if so equipped).
2. Remove rewind starter pulley, lower fan belt pulley and dust cover (if so equipped).
3. Remove fan belt by placing belt between any 2 blades of fan and rotate fan until belt is off top fan pulley. (Figure 1.)
4. Disconnect ignition coil leads and remove harness connector from flywheel housing.
5. Remove spark plug lead wires from engine shroud.
6. Remove attaching cap screws and pull off flywheel housing.

NOTE: If engine shrouds are still on engine, cap screw, which holds shrouds to flywheel housing, must be removed.

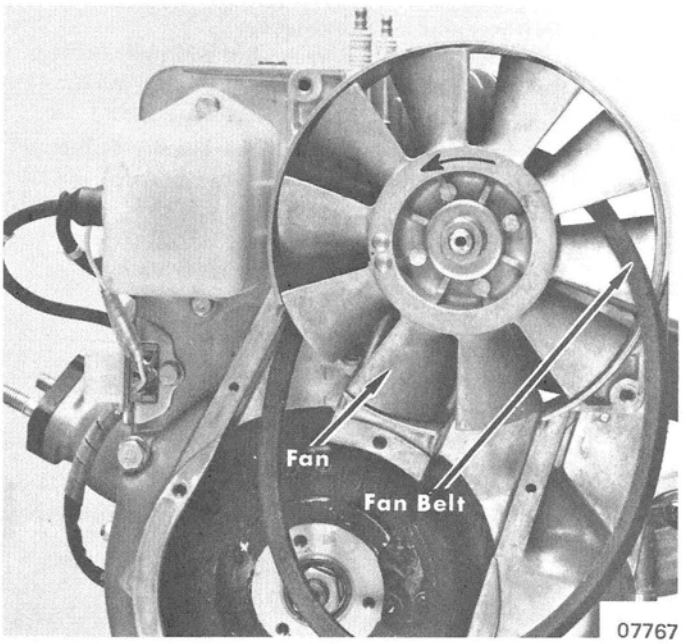

Figure 1. Removing Fan Belt

CLEANING and INSPECTION

1. Check fan belt for wear, cracks or deterioration.
2. Check flywheel housing for cracks.

INSTALLATION

1. If replacing flywheel housing, remove ignition coils, shroud bracket and fan assembly from old housing and install on new housing.
2. Position flywheel housing on backing plate and secure with attaching cap screws.
3. Attach spark plug lead wires to engine shroud.
4. Install harness connector on flywheel housing and connect ignition coil leads.
5. Install fan belt by placing belt between any 2 blades of fan and rotate fan until belt is on top fan pulley.
6. Position fan belt on lower fan belt pulley. Fasten dust cover (if so equipped), fan belt pulley and rewind starter pulley to flywheel with 3 cap screws.
7. Check fan belt tension. When properly adjusted, fan belt will have a total deflection of about ¼" at center of belt between pulleys. Tension is adjusted by removing or installing spacer(s), as required, from between top pulley halves.

   NOTE: Retain spacers to use when new belt is installed.
8. Install fan belt shield (if so equipped), plastic fan guard and rewind starter. Be sure that spacers are installed below flat washers on cap screws which secure plastic fan guard.

FAN ASSEMBLY

REMOVAL

1. Remove flywheel housing from engine.
2. Remove fan attaching nut. Remove fan and pulley halves. Note position of spacers and washers for reinstallation.
3. Drive out fan shaft with soft hammer. (Figure 2)
4. DO NOT remove fan bearings unless bearing failure is evident. If replacement is necessary, drive bearings out of housing with a punch and hammer.

NOTE: Bearings bottom against snap rings with a spacer between bearings.

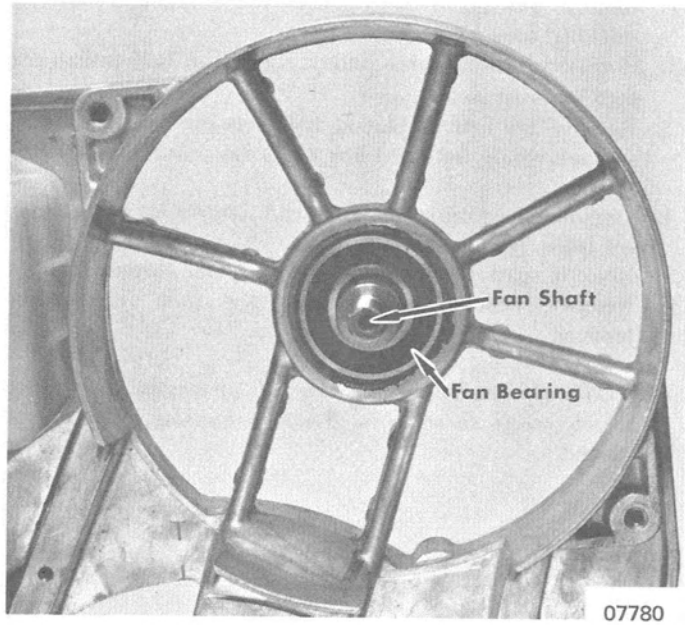

Figure 2. Fan Shaft Removal

CLEANING and INSPECTION

1. Clean and inspect fan and fanshaft. If blades on fan are cracked or chipped, replace fan.
2. Check fan bearings for roughness.

INSTALLATION

1. If removed, install snap rings in flywheel housing between fan bearings.
2. Press bearings into housing until they bottom against snap ring. Be sure that spacer is installed between bearings.
3. Install fan shaft, spacers and pulley halves as removed. (Figure 3)
4. Install fan and secure with washers and retaining nut. Torque retaining nut to specifications.
5. Install flyhweel housing on engine.

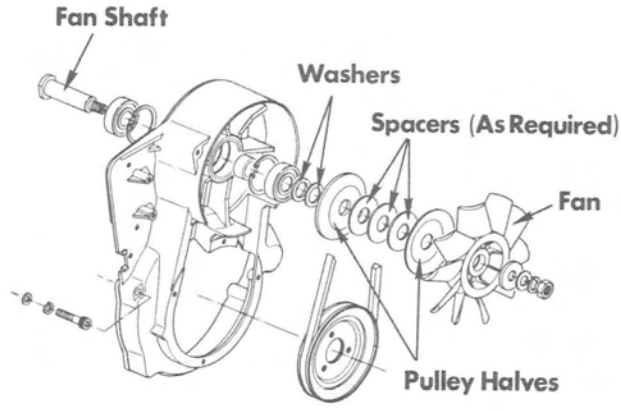

Figure 3. Fan Assembly

FLYWHEEL

REMOVAL

1. Remove flywheel housing.

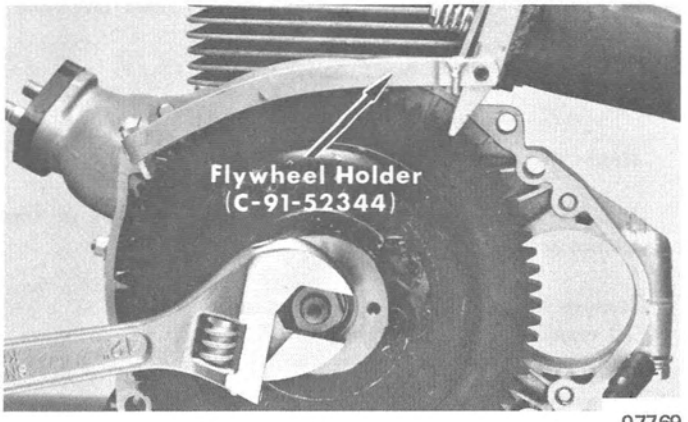

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Figure 4. Flywheel Nut Removal

2. Hold flywheel with Flywheel Holder (C-91-52344) and remove flywheel retaining nut. (Figure 4)
3. Install Flywheel Puller (C-91-24695A3) on flywheel with three 2½" x 6mm cap screws (C-10-58174). (Figure 5)

CAUTION: Crankshaft damage may result if a protector cap is not used between crankshaft and flywheel puller.

4. Hold flywheel with Flywheel Holder (C-91-52344) and tighten center bolt of puller to 40 ft. lbs. maximum.
5. Using a hardwood block and hammer, tap each side of flywheel alternately (while maintaining torque on center bolt) until flywheel is free.

CAUTION: DO NOT hammer on end of puller center bolt to remove flywheel, or damage may result to crankshaft or bearings. DO NOT use heat to aid flywheel removal, as excessive heat may seize flywheel to crankshaft.

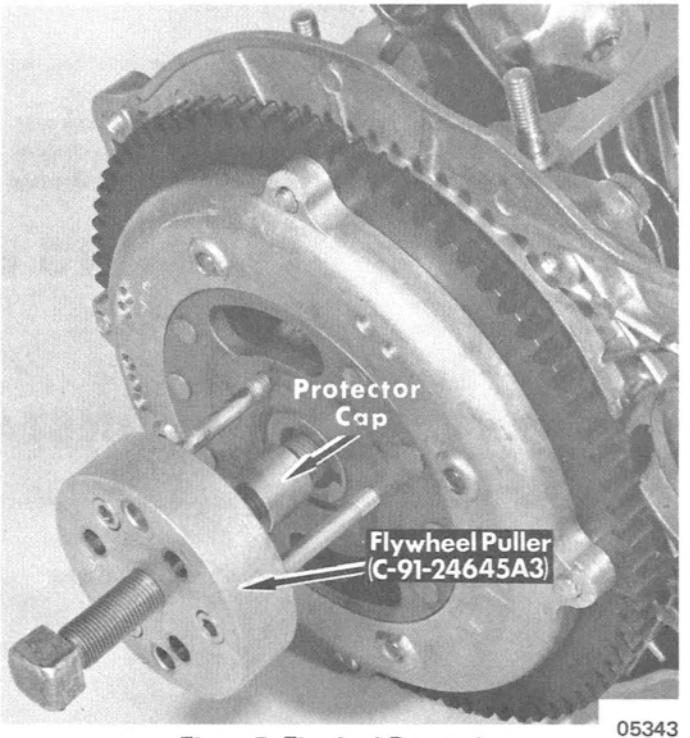

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Figure 5. Flywheel Removal

CLEANING and INSPECTION

1. Check ring gear of flywheel for chipped or broken teeth.
2. Inspect automatic spark advance inside flywheel. Refer to "Centrifugal Advance" in Section 3A.
3. Replace all worn or broken parts.

INSTALLATION

1. Place key in crankshaft keyway, if removed.
2. Align flywheel keyway and crankshaft key and install flywheel. Secure with attaching nut and lockwasher.
3. Torque nut to specifications.
4. Install flywheel housing.

CRANKSHAFT

GENERAL

The crankshaft is sold as a complete assembly with connecting rods, centermain seals and bearings. Components included in the crankshaft assembly cannot be purchased separately. If a crankshaft component fails, the entire crankshaft assembly must be replaced.

REMOVAL

1. Remove cylinders, pistons and drive sheave.
2. Remove flywheel.
3. Remove cover plate (remove starter motor and ground strap, if so equipped) and ground attaching cap screw.
4. Remove screws which secure stator assembly to crankcase.
5. Remove nuts and washers which secure crankcase halves.
6. Separate crankcase halves. Be careful not to damage crankcase sealing surfaces.

   NOTE: Observe location of 4 oil seal retainers in top crankcase half.

7. Remove stator assembly and wiring harness.
8. Lift crankshaft assembly from crankcase half.

CLEANING and INSPECTION

1. Clean mating surfaces of crankcase halves.
2. Inspect crankcase mating surfaces for cracks, scratches or grooves.

INSTALLATION

1. Be sure that mating surfaces of crankcase halves are clean and free of foreign material.

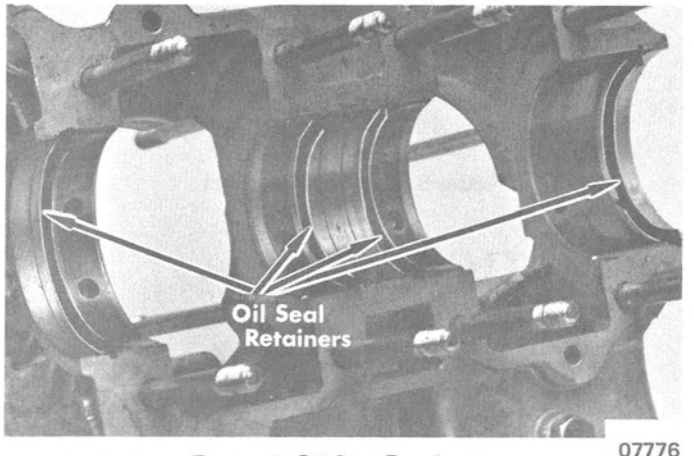

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Figure 6. Oil Seal Retainers

2. Place oil seal retainers in grooves of upper crankcase half. (Figure 6)
3. Place crankshaft assembly in upper crankcase half. Be sure that retainers are properly positioned between seals and bearings. (Figure 7)

   NOTE: Crankshaft end with 2 bearings (PTO end) must be installed on PTO side of crankcase.

4. Apply Gasket Sealer (C-91-28804-1) to crankcase halves.
5. Place stator assembly and wiring harness in position. Grommet on wiring harness must be in notch in lower crankcase half.
6. Place crankcase halves together and secure with attaching nuts and washers. Be sure that crankshaft seals are properly positioned.
7. Torque crankcase nuts to specifications.
8. Secure stator assembly to crankcase.
9. Install cover plate (install starter motor and ground strap, if so equipped) and ground attaching cap screw.
10. Install pistons, cylinders and drive sheave.
11. Install flywheel.

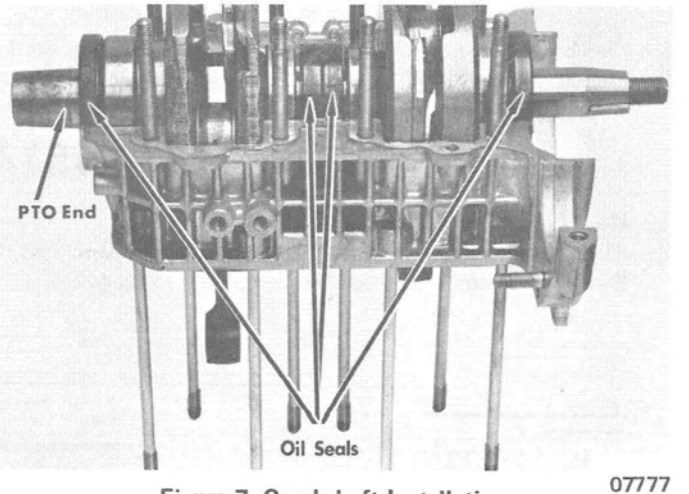

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Figure 7. Crankshaft Installation

CRANKSHAFT END BEARINGS and SEALS

REMOVAL

NOTE: Flywheel key must be removed before removing (fan end) seal.

1. Pull off seal.
2. Install Puller Plate (C-91-37241) behind end bearing. (Figure 8)
3. Place crankshaft in press and support under Puller Plate.
4. Press crankshaft out of bearing.

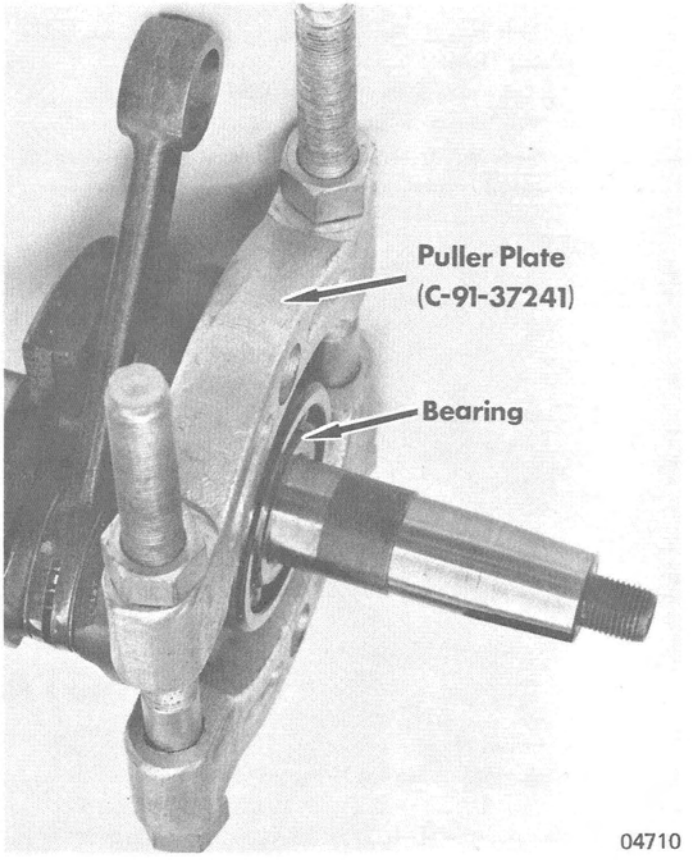

Figure 8. Bearing Removal

CLEANING and INSPECTION

1. Clean and dry ball bearings before checking.
2. Move inner race in-and-out of outer race (there should not be excessive play).
3. Lubricate bearings with light oil. Replace, if bearing sounds or feels "rough".
4. Check lip of seals for wear or cuts. Replace if necessary.

INSTALLATION

1. Support crankshaft directly under crankshaft counterweight of end bearing being replaced.
2. Install bearing with "lettered side" up, using tubing as a mandrel to press bearing onto crankshaft. Press on inner race of bearing only.
3. Install seal on crankshaft with lip facing toward counterweights of crankshaft.

INTAKE MANIFOLD and REED BLOCK

REMOVAL

1. Remove dash assembly, carburetor, insulating air baffle and insulator block.
2. Remove intake manifold and reed blocks from engine.
3. Separate reed blocks from manifold.
4. Remove reed stops, reeds and shims from below reeds. Note position of rounded edge of shim. (Figure 1)

NOTE: Reeds may be in 2 pieces rather than one, as shown in Figure 1.

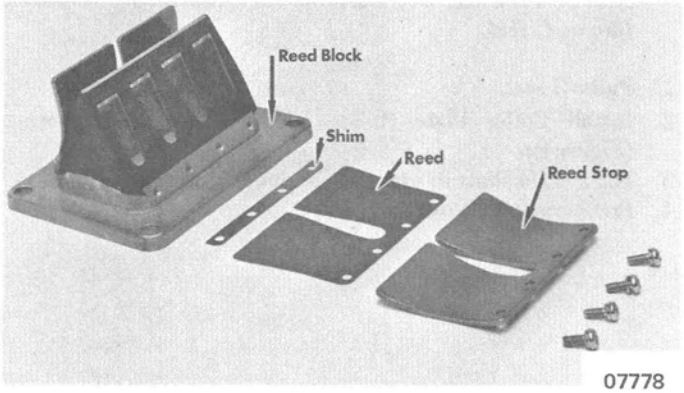

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Figure 1. Reed Block

CLEANING and INSPECTION

1. Remove gaskets and clean surfaces of intake manifold and reed blocks.
2. Check for chipped, bent or damaged reeds.
3. Check for wear on face of reed block (indentations). Replace block if indentations are present.
4. Inspect intake manifold for cracks. Check sealing surfaces for scratches or grooves.

INSTALLATION

1. Apply a film of oil to reeds.
2. Place shims, reeds and reed stops on reed block.

NOTE: Rounded edge of shim must be toward rear of reed block.

3. Thread reed stop screws into reed block. Torque screws to specifications.

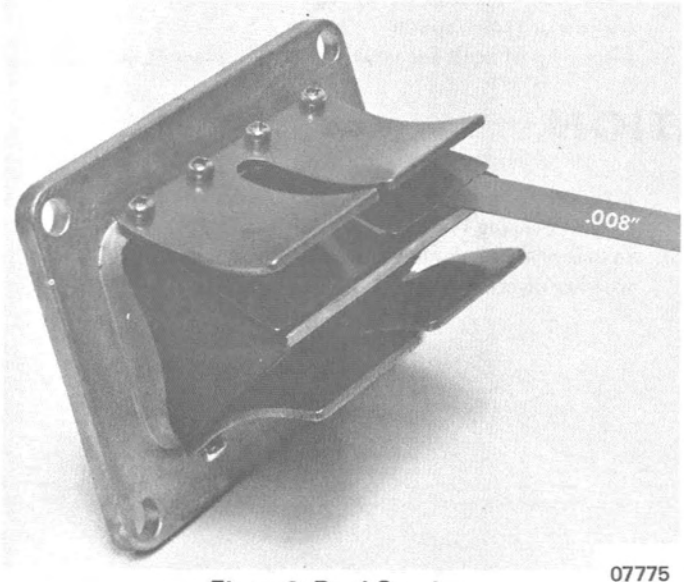

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Figure 2. Reed Opening

4. Check reed opening. If reed opening is in excess of .008", replace reed. (Figure 2)
5. Check that reed stop setting is 7/16". (Figure 3)

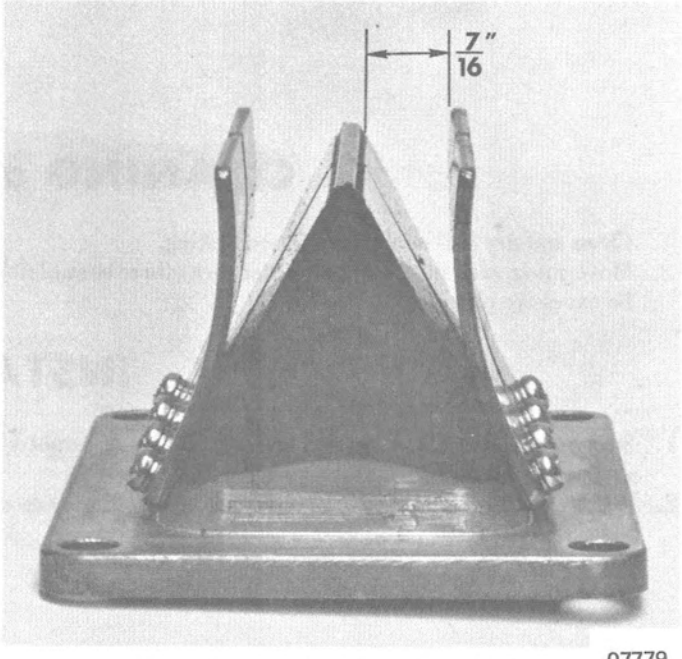

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Figure 3. Reed Stop Opening 7/16"

6. Using new gaskets, install reed blocks and intake manifold on crankcase studs.

NOTE: Carburetor opening of manifold will be positioned on an upward incline when manifold is correctly installed.

7. Secure intake manifold with lockwashers and nuts. Torque to specifications.
8. Install insulator block, insulating air baffle, carburetor and dash assembly.