SECTION 5 - ENGINE MECHANICAL

MERCURY
SNOWMOBILES

PART A - MODELS 220-250

MERCURY
MARINE

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ENGINE ASSEMBLY (COMPLETE)

REMOVAL

1. Remove dashboard as described in Section 2 "Chassis" - Part F.
2. Remove variable speed drive belt as outlined in Section 2 "Chassis" - Part B.
3. Remove ignition cover. (Figure 1)

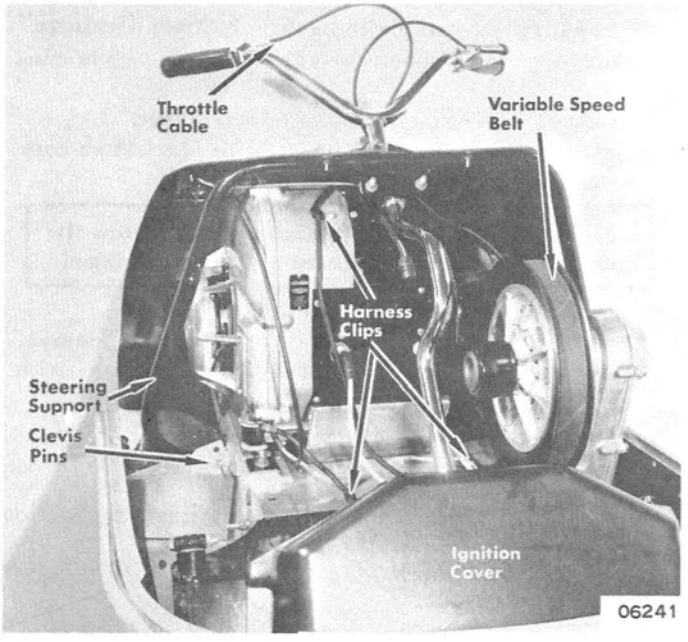


Figure 1.

Engine Removal

4. Disconnect the following electrical connections:
   a. Manual model
      (1) Trigger coil leads (brown, brown/white and braided ground wire) from switch box.
      (2) Stator leads (red, white and blue) from switch box.
      (3) Large, black ground wire from blower housing.
      (4) High tension leads from spark plugs.

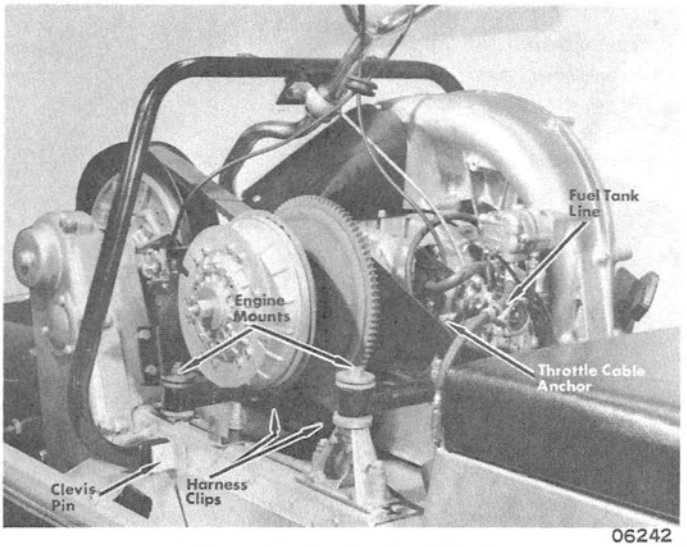


Figure 2. Engine Removal

   b. Electric start model
      (1) Remove battery.
      (2) Two (2) stator leads (yellow/red) from rectifier.
      (3) Large lead(s) (yellow) from starter motor(s).
5. Remove wiring harness from retaining clip on blower backplate and move harness and switches toward front of vehicle. (Figure 1)
6. Remove wiring harness from 2 retaining clips on forward edge of chassis. (Figure 1)
7. Remove taillight wiring harness from 2 retaining clips on air duct assembly. (Figure 2)
8. Disconnect fuel line from fuel pump inlet.
9. Disconnect throttle core wire from anchor on carburetor and remove core wire. (Figure 2)
10. Disconnect cable assembly from throttle lever on handlebar.
11. Remove 4 mounting screws and nuts from engine mounts.
12. Remove plastic retainers which hold wiring harness and control cables to steering support assembly.
13. Remove clevis pins/bolts from steering support (one on each side) and tip steering support as far forward as possible. (Figures 1 and 2)

NOTE: On 250 models, remove two (2) muffler couplings (muffler to exhaust pipes), loosen muffler hold-down strap and slide muffler toward rear of vehicle.

14. Lift engine from mounts and move as far forward as possible.
15. Shift engine at slight angle and disconnect exhaust pipes from muffler couplers.
16. Lift engine up and back to remove from vehicle.

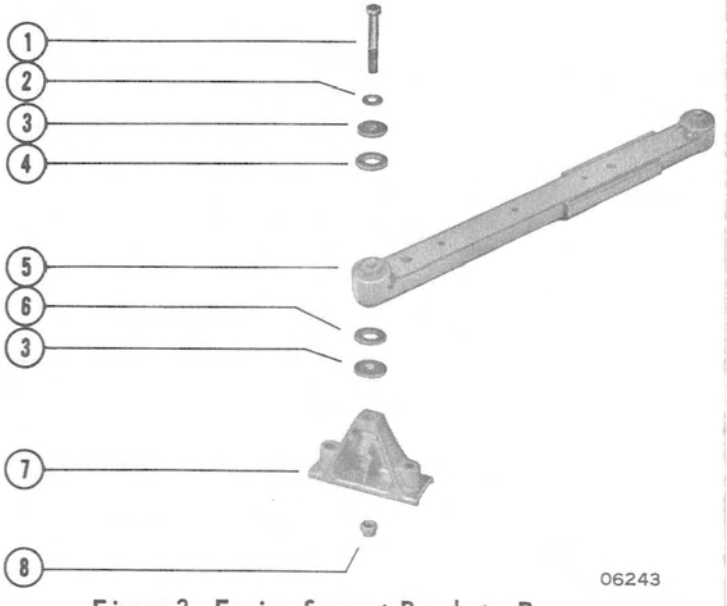


Figure 3. Engine Support Bracket - Rear

1 - Screw, Bracket to Extension
2 - Washer (Small OD)
3 - Washer (Large OD)
4 - Washer, Fiber (Thick)
5 - Bracket Assembly
6 - Washer, Fiber (Thin)
7 - Mount Extension
8 - Nut, Bracket to Extension

INSTALLATION

1. On 220 models, apply Exhaust Sealer (C-92-55004A1) to exhaust pipe extensions, connectors and muffler inlets, as outlined in Section 7 "Miscellaneous" - Part B.
2. Place engine assembly on vehicle, moving it as far forward as possible. Do not engage front support bracket on engine mount screws at this time. Shift engine at a slight angle and connect exhaust pipes to muffler couplers.
3. With exhaust system partially engaged and proper mounting hardware in place (items 3-6 in Figure 3 and and items 6-7 in Figure 4), lift and align rear engine support bracket with rear mount extensions and engage front support bracket on engine mount screws.
4. On 250 models, slide muffler forward, install 2 muffler clamps (exhaust seal and sealing ring in place) and tighten couplings and muffler hold-down strap.
5. Install hardware for mounting support brackets to chassis in the order shown in Figures 3 and 4. Refer to torque specifications in Section 8 "Specifications".
6. Secure steering support to chassis with clevis pins/bolts.
7. Connect throttle cable to lever on handlebar.
8. Install throttle core wire. Remove all slack from core wire and secure in anchor on carburetor.

> **CAUTION: DO NOT over-tighten set screw in core wire anchor, or core wire can be damaged.**

9. Connect fuel line to fuel pump inlet.
10. Connect large, black ground wire to blower housing.
11. Secure all electrical connections and insulate with Liquid Neoprene (C-92-25711-1).
12. Place wiring harnesses in their respective retaining clips. (Figures 1 and 2)
13. Reinstall ignition cover.
14. Reinstall variable speed belt as outlined in Section 2 "Chassis" - Part B.
15. Install dashboard as described in Section 2 "Chassis" - Part F.
16. Replace plastic retainers which secure wiring harness and control cables to steering support.
17. Connect high tension leads to their respective spark plugs (No. 1 toward blower).
18. Check timing and adjust and test as outlined in Section 3 "Ignition and Electrical Systems" - Part C.

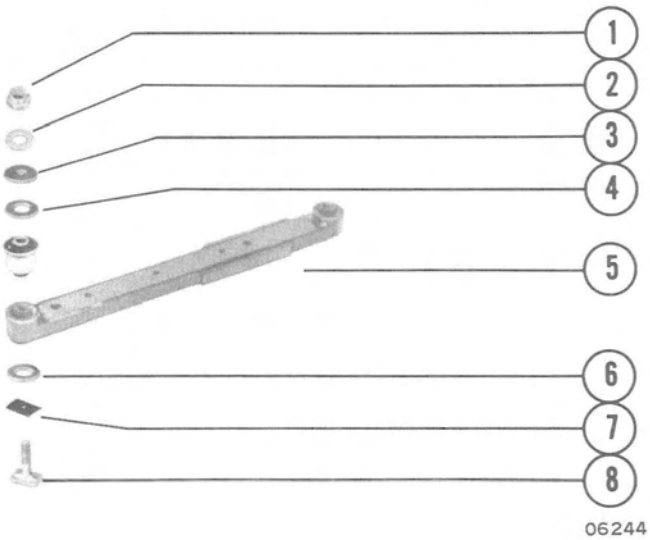


Figure 4. Engine Support Bracket - Front

1 - Nut, Bracket to Chassis
2 - Washer (Small OD)
3 - Washer (Large OD)
4 - Washer, Fiber (Thick)
5 - Bracket Assembly
6 - Washer, Fiber (Thin)
7 - Washer (Special)
8 - Screw, Bracket to Chassis

SHORT BLOCK REPLACEMENT

GENERAL

The section covers removal and installation of engine components for replacement of a complete short block. Refer to short block repair section for repair of any internal components.

CLUTCH BELL, FLYWHEEL and STATOR

REMOVAL

1. Remove grease fitting from flywheel stud. (Figure 1)
2. Hold flywheel with flywheel holder (C-91-45246) and remove flywheel nut and washer.

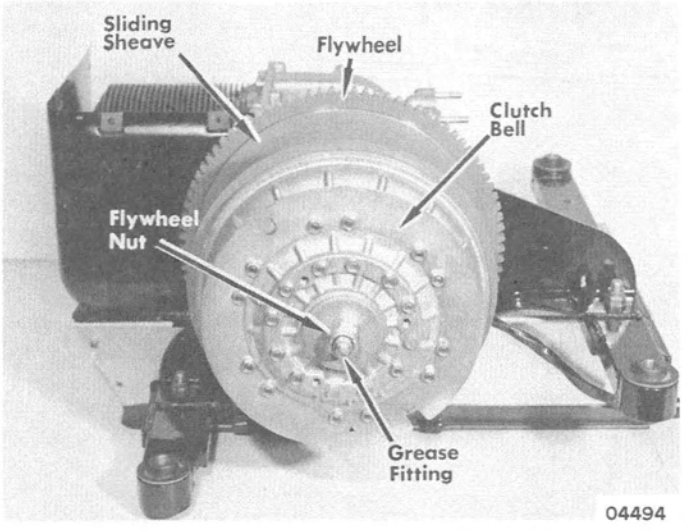


Figure 1. Removing Grease Fitting from Flywheel Stud

3. Place Thread Protector (C-91-54360) over flywheel stud. Install Universal Puller (C-91-25733A2) on clutch bell. Hold flywheel with flywheel holder and tighten center screw of puller until clutch bell snaps loose from flywheel shaft. (Figure 2)

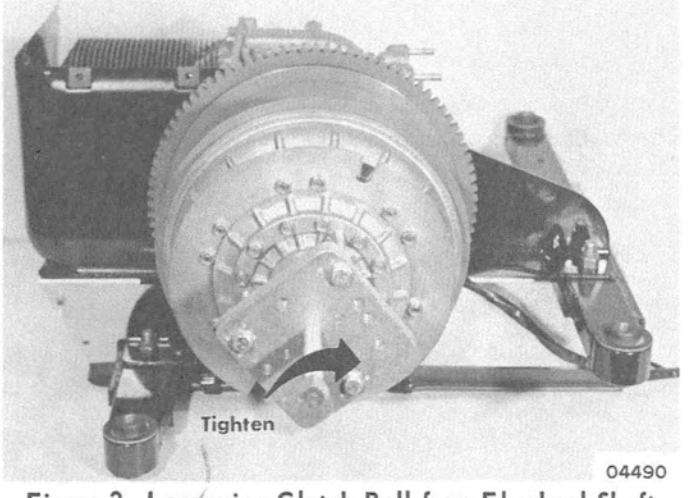


Figure 2. Loosening Clutch Bell from Flywheel Shaft

4. Push sliding sheave in slightly and remove clutch bell key from flywheel shaft. Remove thrust washer (on sliding sheave), sliding sheave, return spring, spring retainer cup and idler bearing from flywheel.
5. Remove flywheel stud with a suitable stud remover or. .
   a. Thread one nut (½ x 20) onto stud until it is against the flywheel shaft. (Figure 3)

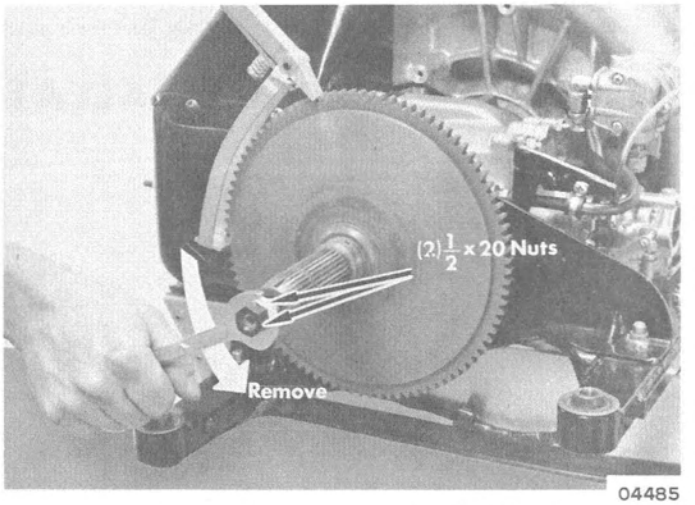


Figure 3. Removing Flywheel Stud

   b. Thread second nut onto stud until it jams against the first nut.
   c. Use 2 wrenches to tighten the second nut against the first.
   d. Hold flywheel with Flywheel Holder (C-91-45246), place wrench on inner nut and turn stud counter-clockwise to remove.

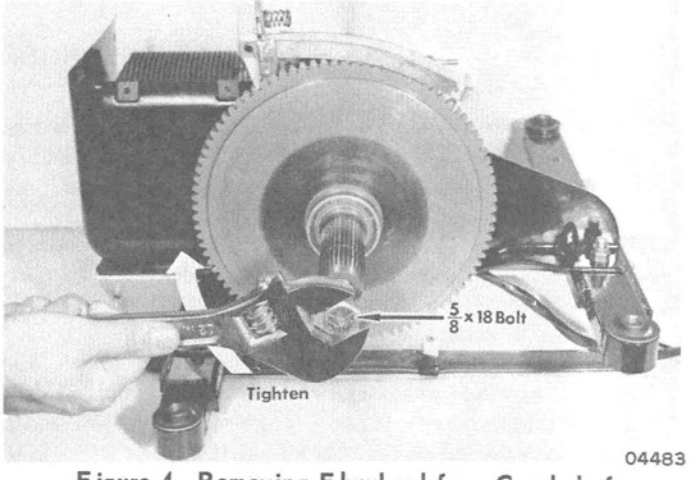


Figure 4. Removing Flywheel from Crankshaft

6. Place Flywheel Plug (C-91-54071) into center of flywheel shaft. Thread 5/8 x 18 screw (C-10-53970 part of Clip Former Tool C-91-53971A1) into flywheel shaft.
7. Hold flywheel with flywheel holder and tighten screw until flywheel snaps loose from crankshaft. Remove flywheel and screw. (Figure 4)
8. Remove ignition stator by taking out 4 mounting screws.
9. Further disassembly of clutch bell is outlined in Section 2 "Chassis" - Part C.

INSPECTION

1. Check ring gear of flywheel for chipped or broken teeth.
2. Check clutch bell as outlined in Section 2 "Chassis" - Part C.
3. Check idler bearing for rough operation and/or excess play between inner and outer races.
4. Check stator as outlined in Section 3 "Ignition and Electrical Systems".
5. Replace all damaged parts.

INSTALLATION (Figure 5)

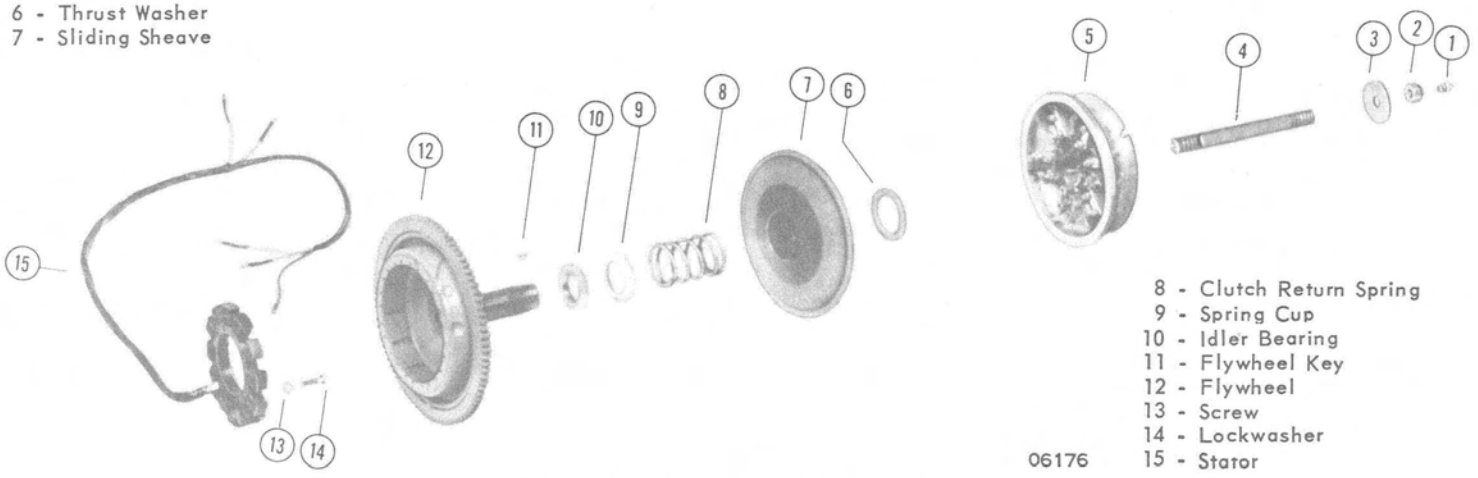


Figure 5. Clutch Bell, Flywheel and Stator

1. Reinstall stator. Pass stator leads behind engine mounting place, then down along air duct assembly. Place stator leads in harness retaining clips, as shown in Figure 3.
2. Apply Loctite Type "A" (C-92-32609) to threads of flywheel stud. Install stud in crankshaft.
3. Place flywheel on crankshaft. Be certain that crankshaft key engages keyway in flywheel.
4. Place idler bearing, spring retainer cup (cup toward sliding sheave), return spring and sliding sheave on flywheel shaft. (Figure 5, items 7-8-9-10)
5. Push in sliding sheave and install Clutch Clamp (C-92-54702)
6. Place thrust washer on sliding sheave. Install key in flywheel shaft. (Figure 5, items 6-11)
7. Place clutch bell on flywheel shaft. Be sure that flywheel key engages keyway in clutch bell.
8. Thread nut on flywheel stud. Hold flywheel with flywheel holder and torque nut to "Specifications", Sec. 8.
9. Remove clutch clamp by pulling straight up.
   wheel holder and torque nut. Refer to Section 8 "Specifications".
9. READ WARNING, following! Remove clutch clamp by pulling straignt up.
10. Reinstall grease fitting into end of flywheel stud.

WARNING: KEEP HANDS from between sliding sheave and clutch bell when removing clutch clamp.

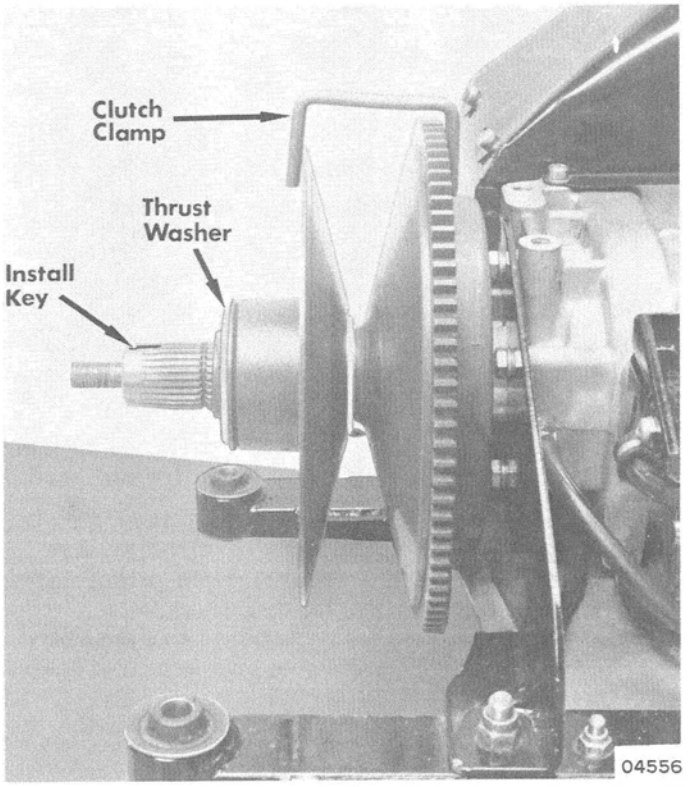


Figure 6. Installing Clutch Clamp

MOUNTING BRACKETS, EXHAUST PIPES and AIR DUCT ASSEMBLY

REMOVAL

1. Remove spark plug.
2. Remove screws and lockwashers which fasten engine mount plate to crankcase. (Figure 1)
3. Remove engine mount plate and front and rear support brackets as an assembly.
4. Remove lower engine shroud. (Figure 1)
5. Place engine upside-down on bench for further disassembly.
6. Loosen exhaust pipe clamps and slide clamps from hangers.
7. Remove exhaust pipes and gaskets from cylinders.
8. Remove air duct and exhaust pipe hanger screws from crankcase. Lift air duct from powerhead assembly.

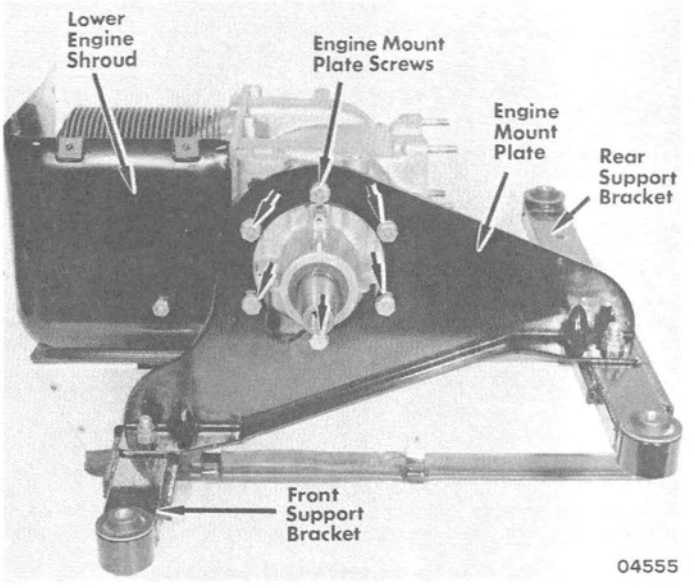


Figure 1. Mounting Plate and Brackets

INSPECTION

1. Clean and inspect all parts for damage.
2. Replace air duct sealing strip and gasket, if cut or damaged.
3. Inspect rubber engine mounts (in front and/or rear support bracket) and replace if necessary. Rubber mounts are a press fit in support brackets.
4. Use new exhaust pipe gaskets.

INSTALLATION

1. Place air duct assembly on crankcase. Position exhaust pipe hanger on air duct assembly. Secure both assemblies to crankcase with lockwashers and screws.
2. Install new exhaust port gaskets and position exhaust pipes on cylinders.
3. Secure exhaust pipes to cylinders.
4. Slide exhaust pipe clamps over hangers and tighten screws.

   NOTE: (220 Only) Before installing exhaust pipe extensions, clean all joints with lacquer thinner, carbon tetrachloride or another greaseless solvent. Use sandpaper to roughen surfaces at joints. Apply Exhaust Sealer (C-92-55004-1) to OD of both exhaust pipes. Slide extension pipes on exhaust pipes. For best results, Exhaust Sealer should be allowed to set for 24 hours before engine is run.

5. Turn engine over and set on air duct assembly.
6. Install lower engine shroud. (Figure 1)
7. Install engine mount plate and front and rear support brackets on air duct and crankcase. Secure with lockwashers and screws and torque to specifications.

FAN HOUSING and FAN REMOVAL

1. Remove fan housing cover. Disassembly of rewind starter is covered in Section 6 "Starters" - Part A.

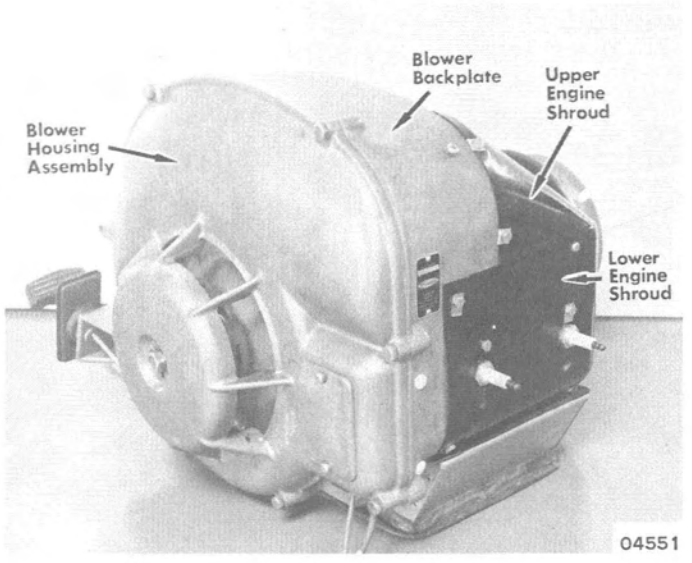


Figure 1. Fan Component Location

2. Remove fan assembly as follows: (Figure 2)
   a. Hold flywheel with Flywheel Holder (C-91-45246) and loosen screw (5 or 6 turns) that holds fan assembly to crankshaft.

   NOTE: Fan retaining screw must be left in to serve as a crankshaft plug for the puller.

   b. Remove 2 starter ratchet screws and install Flywheel Puller (C-91-24695A2).

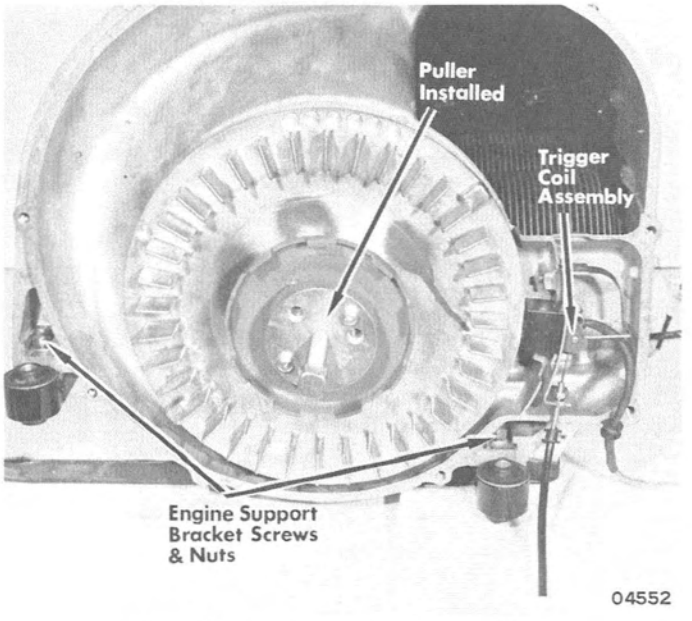


Figure 2. Removing Fan Assembly

   c. Hold flywheel with flywheel holder and operate puller until fan assembly loosens from crankshaft.
   d. Remove puller from fan assembly.
   e. Remove screw and washer from crankshaft and remove fan assembly.
3. Remove upper and lower engine shroud. (Figure 1)
4. Remove fasteners, engine support to fan housing. (Figure 2)
5. Remove fasteners which hold rear engine support to air duct.
6. Remove fuel pump from fan housing.
7. On "E" or "ER" models, it will be necessary to remove starter motor(s) as follows:
   a. Remove 2 screws that hold front starter motor mounting bracket to crankcase.
   b. Remove screws which fasten front mounting bracket to starter motor(s).
   c. Remove front mounting bracket from starter motor(s).
   d. Remove screws which fasten rear starter motor mounting bracket to fan housing.
   e. Remove starter motor(s) and rear mounting plate from engine.
8. Remove choke cable from bracket on manifold and disconnect inner wire from choke lever.
9. Remove nuts and washers which fasten fan housing to end cap studs. (Figure 3)

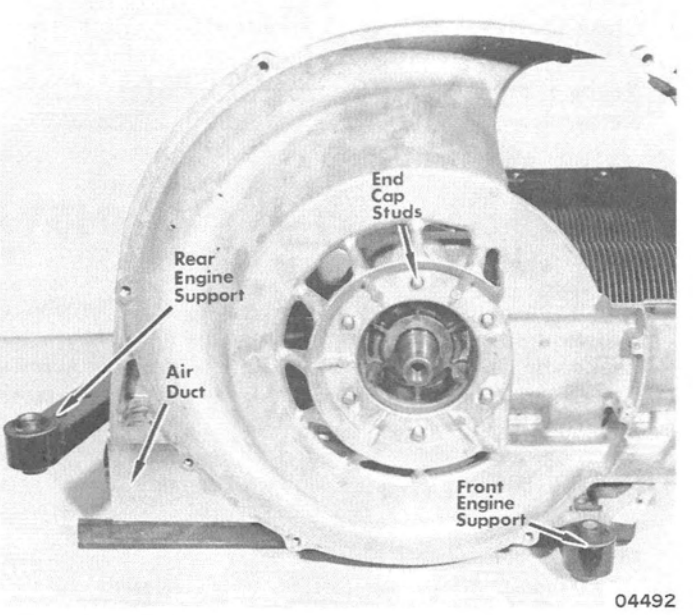


Figure 3. Engine Supports

10. Pull rear engine support away from fan housing, as shown in Figure 3, and remove fan housing.
11. Remove trigger coil assembly by removing 2 screws that fasten assembly to fan housing.

INSPECTION

1. Clean all parts and inspect for cracks or other damage.
2. Replace all damaged parts.

INSTALLATION

1. Place shim and trigger coil assembly in fan housing and secure with 2 screws, (Figure 2)
2. Place fan housing on end cap studs and secure with lockwashers and nuts. Do not tighten nuts at this time.
3. Secure front and rear engine support brackets to fan housing with screws and nuts. Torque screws to specifications.
4. Secure rear engine support bracket to air duct with screws and nuts.
5. Torque fan housing mounting nuts (to end cap studs) to specifications.
6. Install upper and lower engine shroud.

   NOTE: Make sure that crankshaft key engages keyway in fan assembly.

7. Install fan assembly on crankshaft.
8. Place washer on screw (step toward crankshaft) and thread into crankshaft. Hold flywheel with Flywheel Holder (C-91-45246) and torque to specifications.
9. Reinstall starter ratchet screws.
10. Check air gap between magnet in fan assembly and pole shoe in trigger assembly. Refer to Section 3 "Ignition and Electrical Systems" - Part C, for trigger coil adjustments and timing procedure.
11. Place fan housing cover on fan housing and secure with screws and lockwashers. Torque screws to specifications.
12. On "E" and "ER" models, install starter motor(s) and mounting brackets as follows:
    a. Place starter motor(s) and rear mounting bracket on engine and secure to fan housing.
    b. Slide front mounting bracket on starter motor(s) (drive end) and fasten to crankcase.
    c. Install front mounting bracket on starter motor(s).
13. Reinstall fuel pump to fan housing.

SHORT BLOCK REPAIRS

This section covers repairs which can be completed on the basic short block. To remove engine components prior to short block repairs, refer to preceding section.

MANIFOLD and REED BOX

REMOVAL

NOTE: To remove manifold and reed box assembly, engine need not be removed from the vehicle.

1. Remove fuel pump from fan housing. plate.
2. Disconnect fuel line from carburetor elbow (inlet).
3. Separate fuel pump, gaskets and diaphragm from mounting block.
4. Remove impulse hose from 90° elbow in mounting block.
5. Remove throttle return spring.
6. Disconnect throttle and choke control cables from carburetor.
7. Remove nuts and lockwashers from crankcase studs.
8. Remove control cable bracket and manifold/carburetor assembly from crankcase.
9. Remove carburetor from manifold.
10. Remove reed box and plate from crankcase.
11. Separate reed box from reed box plate. (Figure 1)
12. Separate reed clusters and reed stops from reed box.

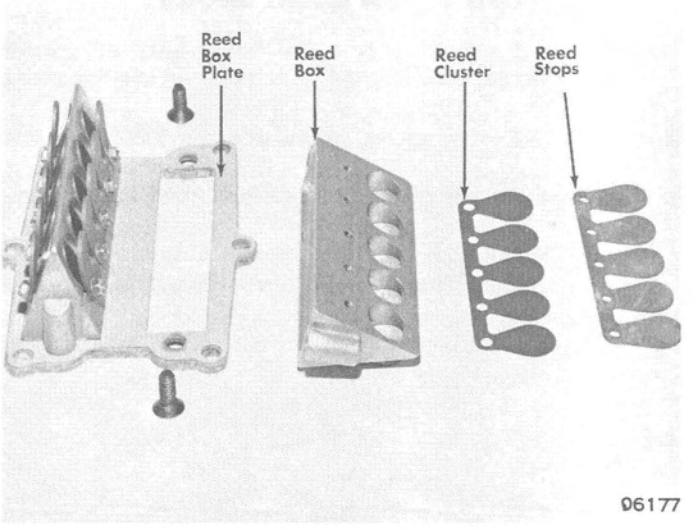


Figure 1. Reed Box and Reed Box Plate

INSPECTION

1. Repair procedure for carburetor and fuel pump are found in Section 4, "Fuel System".
2. Check for chipped, bent or damaged reed clusters. DO NOT bend reeds to obtain proper setting. Bending may cause leakage or eventual breakage.
3. Check for wear on face of reed box (indentations). Replace box if indentations from reed clusters are present.
4. Replace all gaskets during reassembly.

INSTALLATION

1. Coat reed cluster with oil. One side has a slight burr at the edges of reed cluster. Burr MUST face up (away from reed box).
2. Place reed cluster and reed stops on reed box.
3. Apply Loctite Type "A" (C-92-32609) to threads of reed stop screws and thread into reed box. Torque screws to specifications.

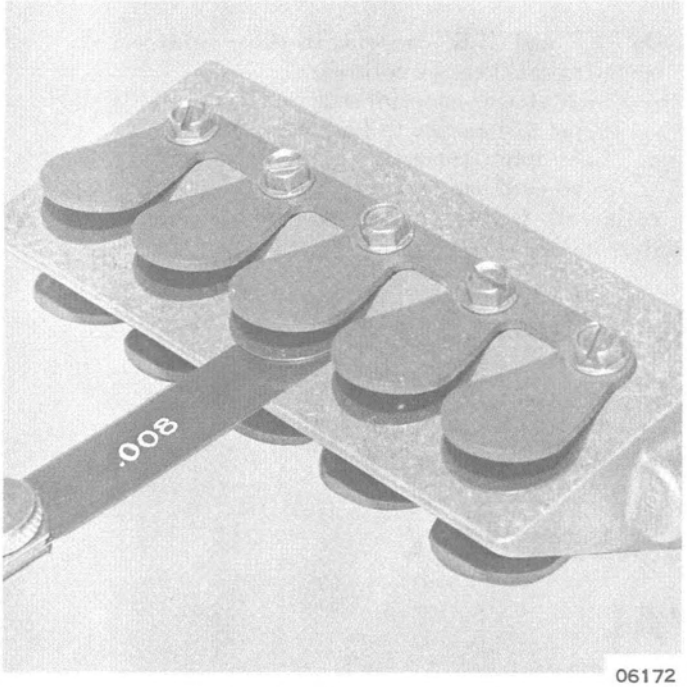


Figure 2. Reed Cluster Opening

4. Check reed cluster opening. If reeds have an opening in excess of .008", reed cluster must be replaced. (Figure 2)
5. Check reed stop setting which must be 7/32", (Figure 3)
6. Place gasket on reed box plate and reed box on top of gasket.
7. Apply Loctite Type "A" to threads of reed box screws and secure reed box to reed box plate. Torque screws to specifications.
8. Install reed box and plate in crankcase.
9. Place gasket and carburetor on studs in manifold and secure with lockwasher and nuts.
10. Place manifold/carburetor assembly and gasket on crankcase studs. Place control cable bracket on upper 2 (flywheel side) crankcase studs.
11. Secure with lockwashers and nuts and torque nuts to specifications.
12. Connect throttle and choke control cables to carburetor.
13. Connect throttle return spring.
14. Connect impulse hose to the 90° elbow on the fuel pump mounting block.
15. Assemble fuel pump, gaskets, diaphragm and mounting block. Secure assembly to fan housing.
16. Connect fuel line to carburetor elbow (inlet).

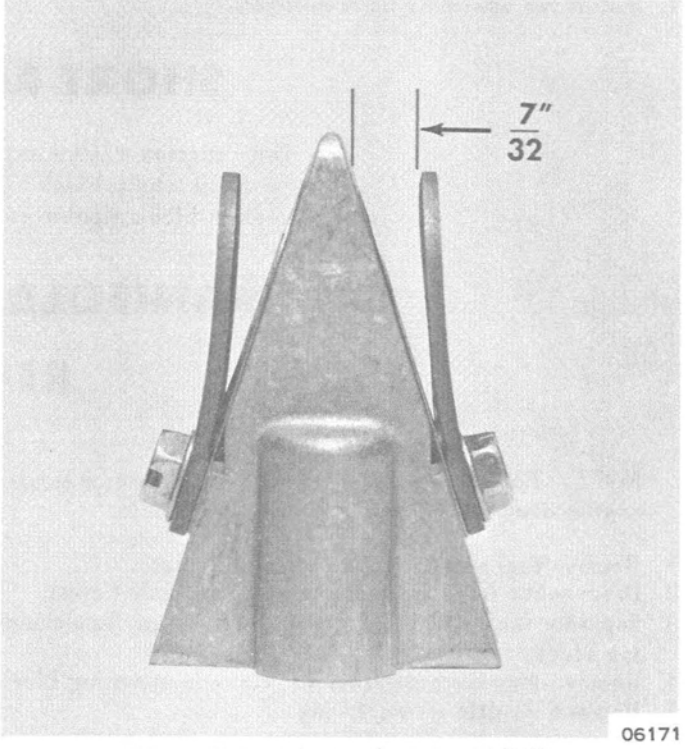


Figure 3. Reed Stop Opening 7/32"

CYLINDER ASSEMBLY
REMOVAL

1. Remove cylinder retaining nuts.
2. Lift cylinders from crankcase assembly. Care should be taken so that cooling fins on cylinder are not damaged.

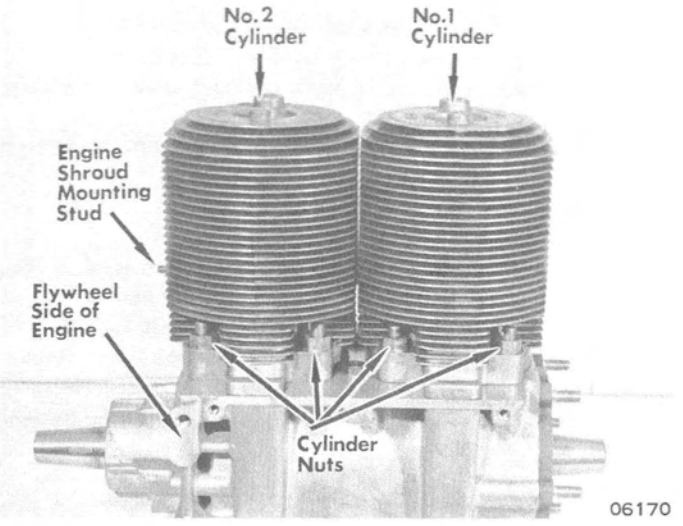


Figure 1. Cylinder Assembly - Intake Side

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.

HONING

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

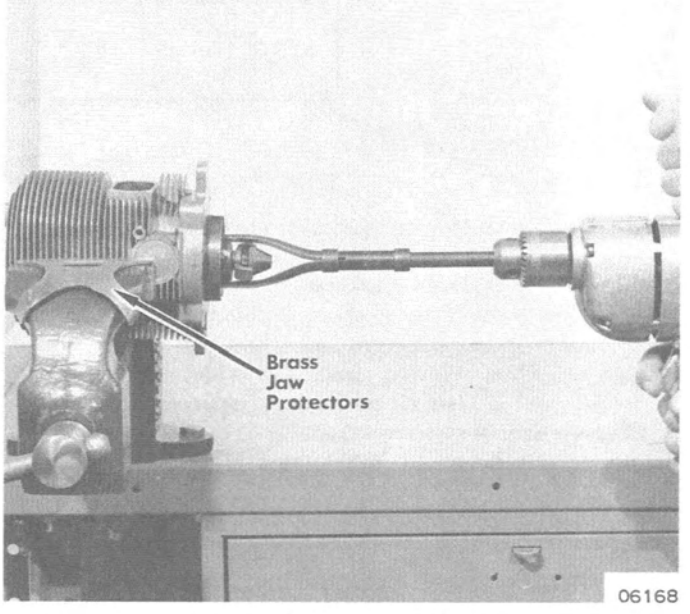


Figure 2. Honing Cylinder

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 an inside micrometer at approximate center of sleeve. (Figure 3)
4. Subtract piston diameter from cylinder bore diameter to determine "piston to bore clearance".
5. If clearance exceeds .010" after honing, replace parts or bore cylinder oversize.
6. Inspect welch plug. (Figure 3)

NOTE: If a blown cylinder gasket is encountered, it may be the result of crankcase distortion around cylinder studs. If distortion is found, countersink a relief area (1/16" oversize, 1/16" deep) on cylinder mounting holes. (Figure 3)

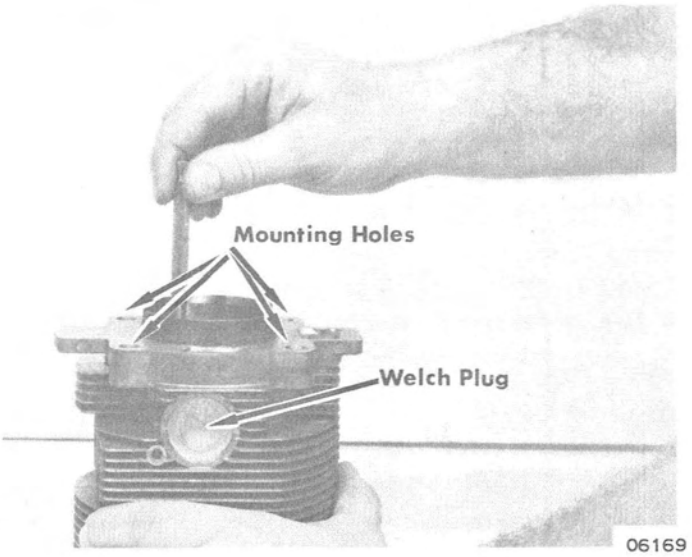


Figure 3. Checking Cylinder

CYLINDER BORING

1. Carefully follow instructions furnished by manufacturer of the boring equipment.
2. Replacement pistons are available in .015" oversize. Bore and finish hone cylinder to dimensions shown in following chart.

.015 OVERSIZE CYLINDER/PISTON DIMENSIONS

Model	Piston Skirt Diameter	Cylinder Bore Diameter	Skirt Clearance
220	2.508-2.506	2.515-2.514	.006"-.009"
250	2.631-2.633	2.639-2.640	.0045"-.0075"

INSTALLATION

1. Coat cylinder sleeves and piston rings with oil before installing.
2. Place new cylinder gaskets on crankcase as shown in Figure 4. Install cylinder exhaust ports to right of engine when viewed from fan side.
3. Insert piston and rings into cylinder. (Figure 5)
4. Secure cylinder to crankcase studs with 4 nuts. Torque nuts to 350 in. lbs. with Torque Wrench (C-91-25666) and Torque Wrench Adaptor (C-91-54751).
5. Rotate crankshaft until piston rings can be viewed thru exhaust port.

NOTE: Check for broken rings. Depress ring. If ring is broken, it will not "spring" back when depressed.

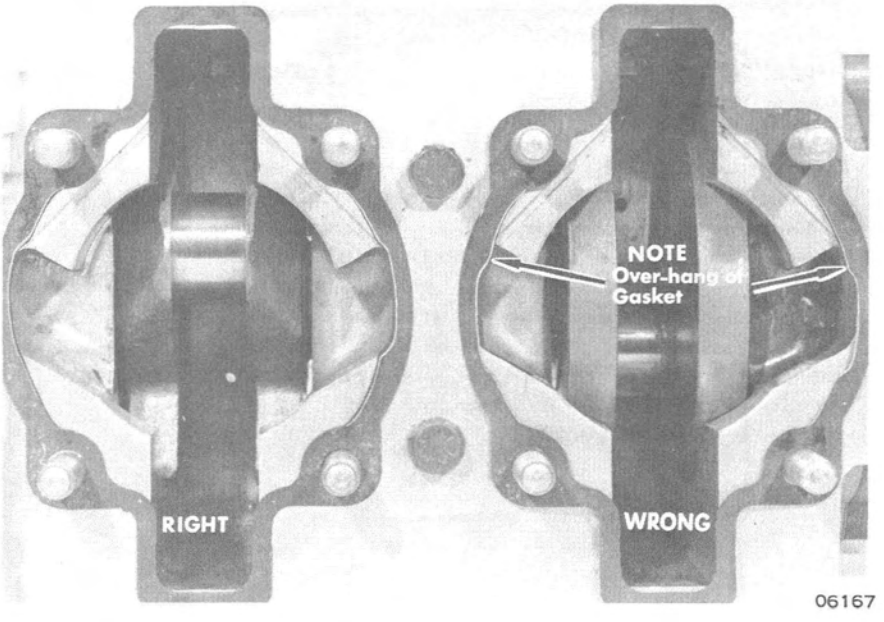


Figure 4. New Cylinder Gasket on Crankcase

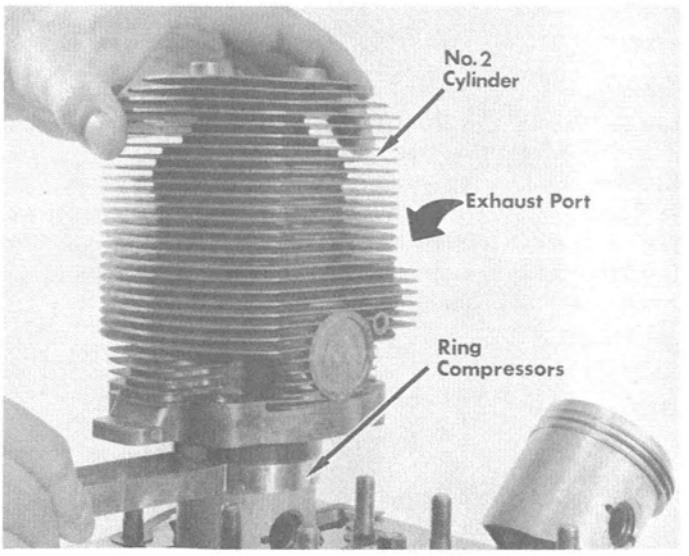


Figure 5. Installing Cylinder

PISTON and RING ASSEMBLY

REMOVAL

1. Remove cylinder as outlined and remove piston rings with Piston Ring Expander (C-91-24697). (Figure 1)

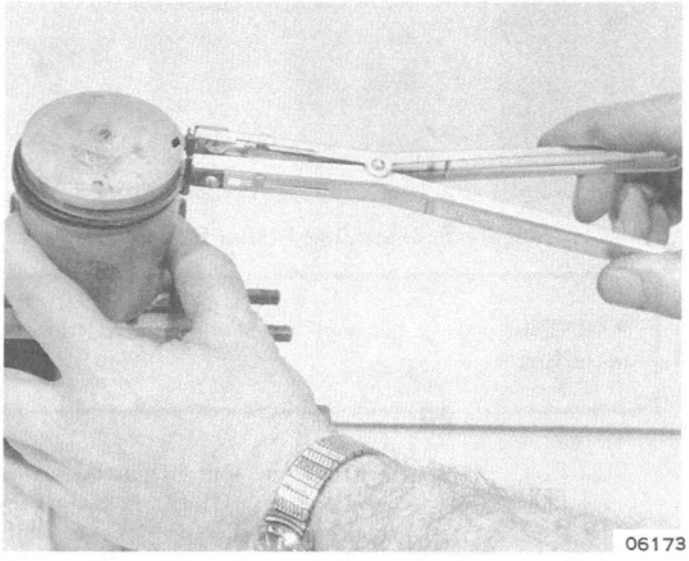


Figure 1. Removing/Installing Piston Ring

2. READ WARNING, following! Remove piston pin lock rings with Lock Ring Tool (C-91-52952A1).

> **WARNING: Safety glasses are recommended when removing lock rings.**

3. Rotate crankshaft until piston is at TDC. Remove piston with Tool C-91-54453A1. (Figure 2)

NOTE: Be careful (when pin emerges from piston) that 29 needle bearings and two washers are caught in hand. Place a rag around connecting rod to keep foreign objects from entering crankcase.

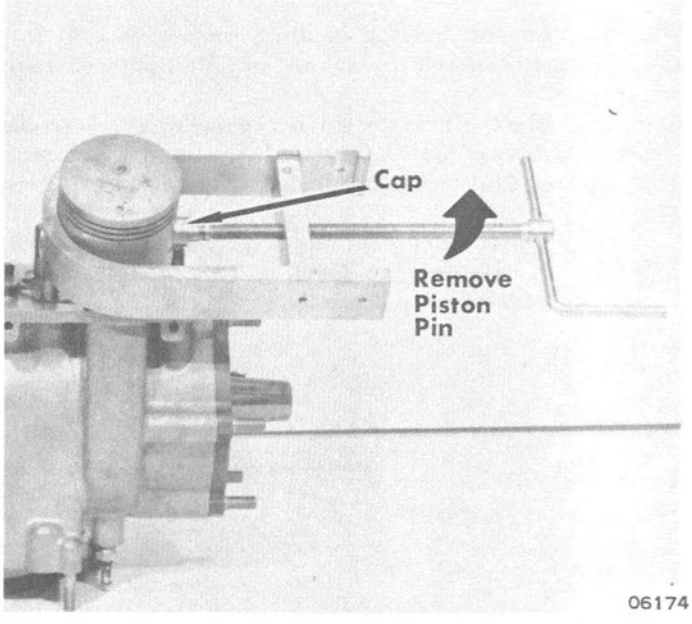


Figure 2. Positioning Piston Pin Tool

CLEANING and INSPECTION

1. Replace scored or damaged pistons.
2. Inspect piston ring grooves for wear, burn and distortion. Install new piston rings, unless old rings are free from cracks, burns, carbon or other abnormal wear. Locating pins prevent rings from rotating.
3. Clean out piston ring grooves thoroughly, using recessed end of broken ring.
4. Clean carbon and varnish deposits from top sides of piston with soft wire brush or carbon remover solution. When wire brushing top of piston, do not burr or round machined edges.
5. Gum, varnish and softer carbon deposits can be removed by soaking in a carbon remover solution.
6. Piston skirt can be polished with crocus cloth to remove burrs.
7. Piston pins are not sold separately because of slight variation in sizes and correct "fit" to piston.
8. Inspect piston pin needle bearings as outlined in "Inspection, Connecting Rod", following.

INSTALLATION

1. Use Piston Pin Tool (C-91-46739A2) to assemble piston to connecting rod.
2. Slide one bearing retaining washer on tool sleeve.
3. Coat sleeve with small amount of New Multipurpose Lubricant (C-92-49588) to hold needle bearings (29).
4. Place bearings around sleeve, then insert assembly into race of connecting rod. (Figure 3)

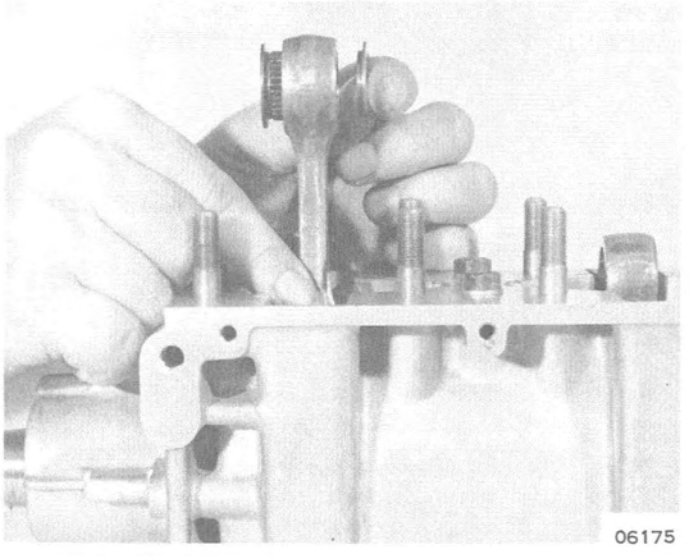


Figure 3. Placing Bearing Assembly in Connecting Rod

5. Place opposite bearing locating washer on rod. Hold in place with small amount of New Multipurpose Lubricant.
6. Piston MUST BE installed on connecting rod so that "E" (Exhaust side), stamped in top of piston, is toward exhaust ports of cylinder. (Figure 4)

NOTE: If piston does not have "E" stamping, refer to Figure 4. Piston ring locating pins are located on exhaust side of piston.

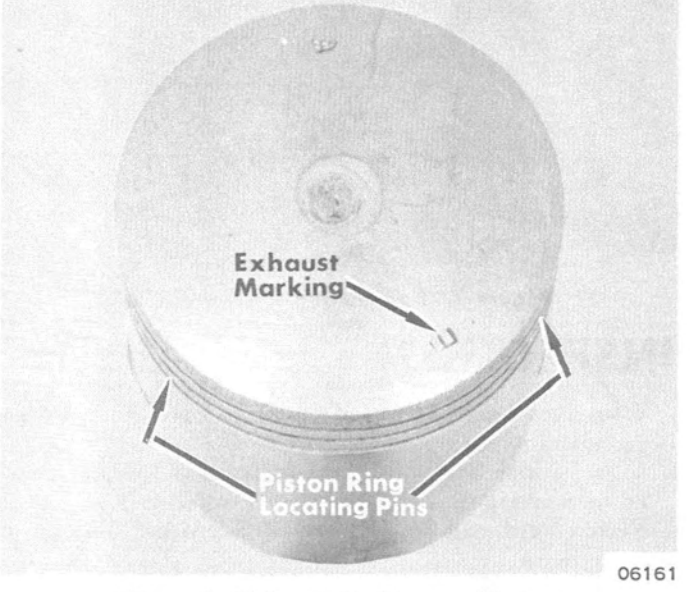


Figure 4. Exhaust Marking on Piston

7. Place piston over connecting rod. Push out sleeve with Piston Pin Tool (C-91-54453A1). Set piston pin on small end of piston pin tool. (Figure 5)
8. Press in piston pin with hand pressure. If tight, tap with mallet; support piston and rod assembly so that rod is not bent. Check assemblies for binding after installing piston pin.
9. Install piston pin lock ring with Lock Ring Tool (C-91-52952A1) as follows:

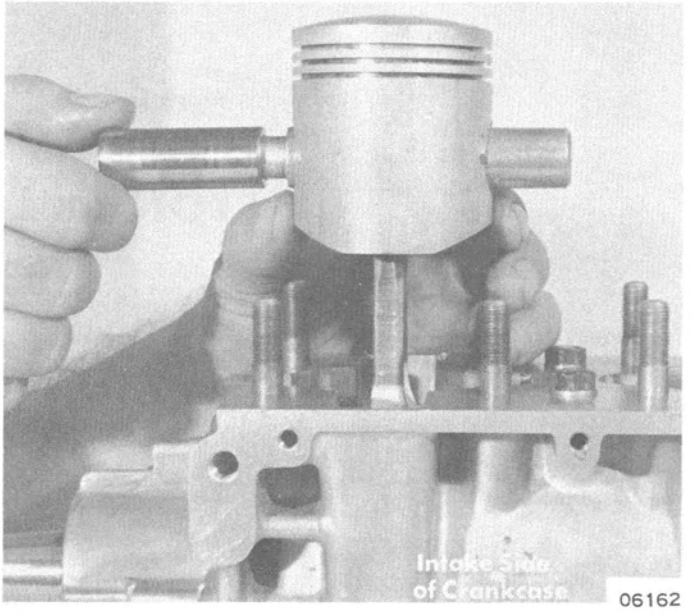


Figure 5. Installing Piston Pin

WARNING: Safety glasses are recommended when installing lock rings.

a. Do not re-use lock rings.
b. Position lock ring so that one end is partially secured in groove located at one o'clock on imaginary clock face. Approximately 1/16" of loose end of lock ring should extend beyond the installation slot on piston. Be sure that the secured end is well-seated in groove.
c. Position lock ring tool in slot and apply leverage to loose end of lock ring toward center of pin hole. Apply light pressure downward with thumb of other hand until lock ring has been sufficiently compressed, then press down on lock ring with thumb, thus forcing ring to slide down ramp provided by lock ring tool. Be careful that lock ring does not snap free before ring is properly lodged in groove.
d. Double check that ring is seated in groove by installing piston pin installation portion of tool in lock ring and pushing down with pressure.

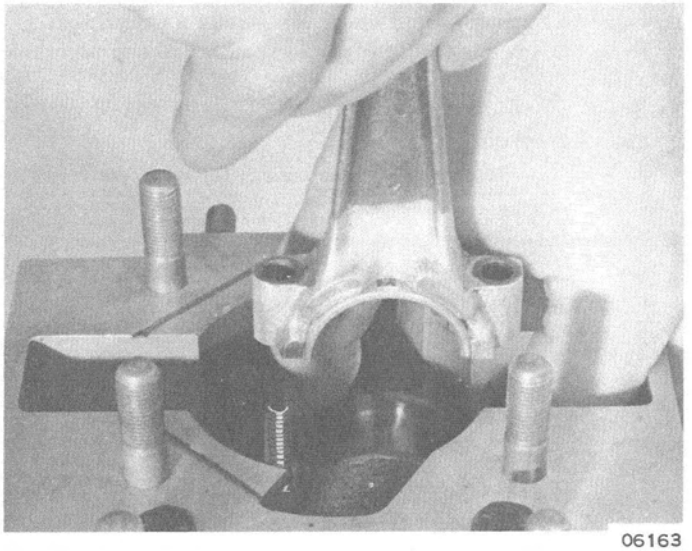
10. Install piston rings with Piston Ring Expander (C-91-24697). (Figure 1)
11. Check that rings float freely in piston grooves after lubricating with oil. Align ring openings over locating pins in piston ring grooves.

CONNECTING ROD

REMOVAL

1. Remove cylinder as outlined.
2. Remove elastic stop nuts from connecting rod bolts.
3. Hold rod cap and pull upper half of connecting rod free. (Figure 1)
4. Rematch connecting rod and cap with mating dots (or etched line) on same side.

NOTE: When repairs are made, it will be necessary that each bearing assembly for each individual rod be kept separate. DO NOT intermix bearings and bearing carriers from different rods.



06163

Figure 1. Removing/Installing Connecting Rod

INSPECTION

CONNECTING ROD

1. Check all bearing surfaces for pit marks.
2. Replace parts, if bearing surfaces are pitted.
3. Place rods flat on surface plate. If light can be seen under portion of machined surfaces, or if it shows a slight wobble on plate, rod is bent and must be replaced.
4. Clean connecting rods before reassembly.

BEARINGS

1. Roller bearing assembly (crankpin) is sold only as an assembly. Individual roller bearings are not available.
2. Bearings should be replaced during overhaul and when pitting is present.
3. During reassembly, keep roller bearings and respective bearing carrier together.

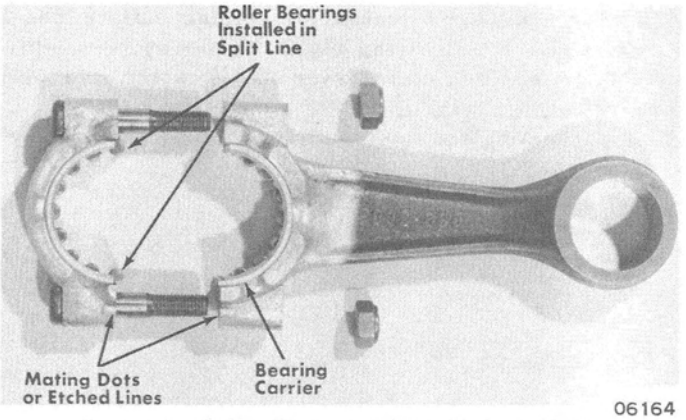
NOTE: Count bearings when removing pistons and/or rods, to be sure that all bearings have been removed. Also count bearings when assembling, so that all are installed. Rotate after installation and check that binding does not exist.

4. Clean bearings before reassembling connecting rod.
5. Clean crankshaft journals as outlined under "Inspection, Crankshaft", following.

INSTALLATION

1. Remove elastic stop nuts which hold bottom cap to rod.
2. Coat each half of connecting rod bearing race with Multipurpose Lubricant (C-92-49588) to hold roller bearing assembly halves in place.
3. Place one half of bearing carrier on race of rod cap. Place roller bearing in each slot of bearing carrier. One roller bearing is placed in split line of bearing carrier at each end. (Figure 2)
4. Place other half of bearing carrier on race of upper part of rod. Place roller bearing in each slot of bearing carrier. (Figure 2)
5. Place rod cap around crankshaft journal and hold in place with index finger. (Figure 1)

   NOTE: Make sure that mating dots (or etched markings) are aligned with each other before proceeding with Step 6.
6. Insert upper half of connecting rod over rod cap and bolts. (Figure 1)
7. Secure with elastic stop nuts. Use Torque Wrench (C-91-25666) and 6-point socket to torque nuts to specifications.



06164

Figure 2. Roller Bearings Installed on Rod

CRANKSHAFT ASSEMBLY

REMOVAL

1. Remove cylinders and connecting rods as outlined.
2. Remove flywheel and blower assembly keys from crankshaft.
3. Remove end cap assembly by tapping on OD of end cap and pulling outward.

   NOTE: Scribe crossed lines on center main for reinstallation in exact location.
4. Scribe crossed lines on center main assembly with awl before pressing crankshaft assembly out of crankcase. (Figure 1)

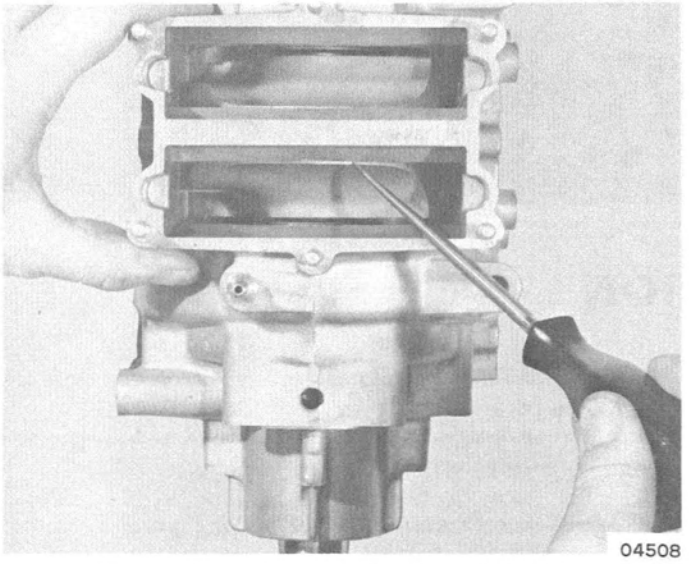


Figure 1. Scribing Center Main Assembly

5. Remove 2 center main retaining screws.
6. Press crankshaft assembly out of crankcase assembly with press. (Figure 2)

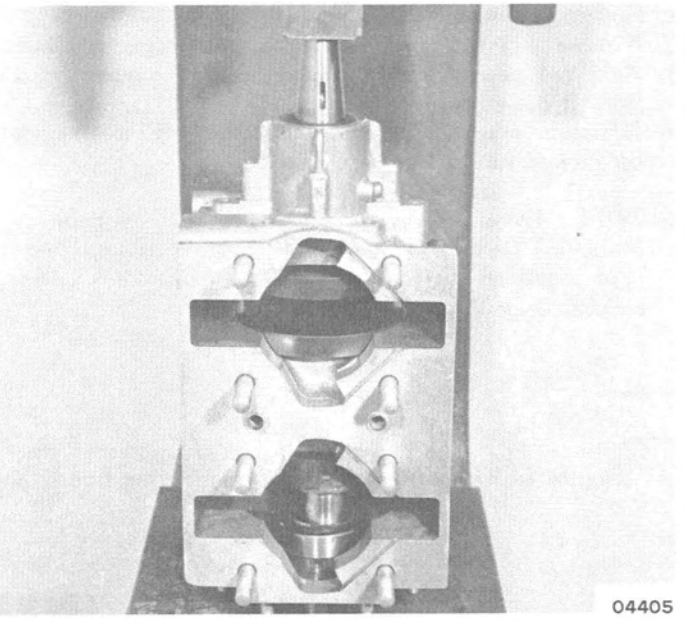


Figure 2. Pressing Crankshaft Assembly from Crankcase

7. Separate center main bearing halves by removing 2 allen screws.

> **CAUTION: When main bearing halves are separated, roller bearing and bearing carriers will drop out of the half that is being removed first. Care should be exercised so that bearings and carriers are not intermixed with each other.**

8. Use Bearing Puller Plate (C-91-22115) to press ball bearing off crankshaft.
9. Remove oil seal from end cap assembly

CLEANING and INSPECTION

CRANKSHAFT

1. Clean by using a 320 grit carborundum cloth. DO NOT polish crankshaft journals, or the bearing may skid.
2. Crankshaft with pitted bearing surfaces must be replaced.
3. Chatter marks on crankshaft bearing surface can be seen with a magnifying glass. This surface condition can be repaired if not over .001" is removed while eliminating marks.
4. If connecting rod has chatter marks, it should be replaced.

BEARINGS

Check ball bearing, as explained in "Inspection, Crankcase Assembly", following.

SEALS

1. Replace oil seals and "O" rings when repairing. This can eliminate trouble at a later date.
2. Lubricate oil seal inner lip before placing over crankshaft to prevent seal lips from wearing on dry surface.
3. Be sure that seals are pressed in straight.

INSTALLATION

1. Press new seal in end cap with lips of seal facing inward. (Figure 3)

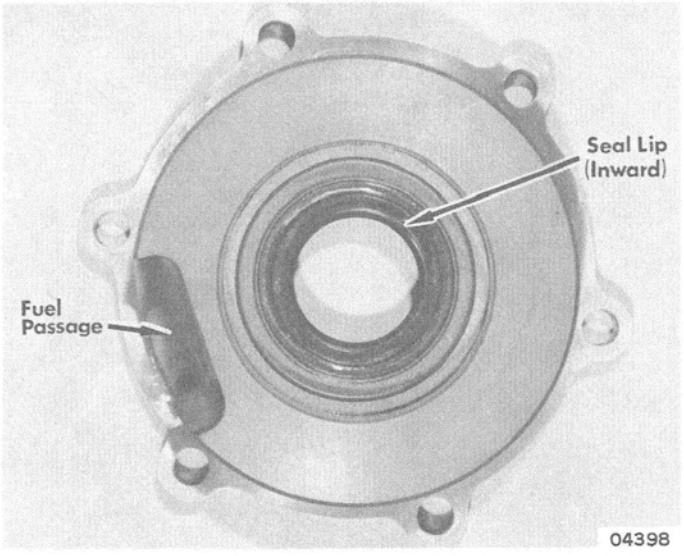


Figure 3. Seal Pressed in End Cap

2. Place original shims and new "O" ring on end cap assembly.
3. Press ball bearing on crankshaft from fan assembly end (short end) of shaft. (Figure 4)

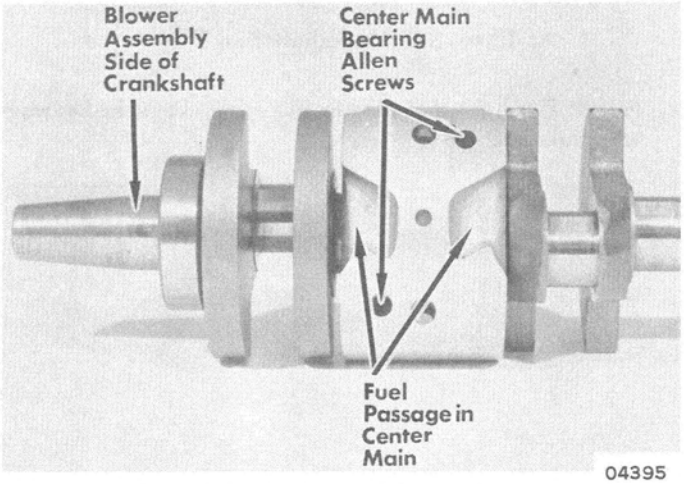


Figure 4. Bearing on Crankshaft

4. Reassemble center main bearing to crankshaft as follows:

> **CAUTION: DO NOT intermix roller bearings, bearing carriers or outer races, because they are matched sets.**

   a. Coat crankshaft center main bearing journal with a small amount of New Multipurpose Lubricant (C-92-49588). (Figure 5)
   b. Place roller bearings in bearing carrier halves.
   c. Place both halves of bearing carrier on journal.

NOTE: Roller bearings must be placed in bearing carrier halves after halves are assembled to crankshaft journal. Roller bearings will not pass thru bearing carriers as they do on connecting rod roller bearing assembly. (Figure 5)

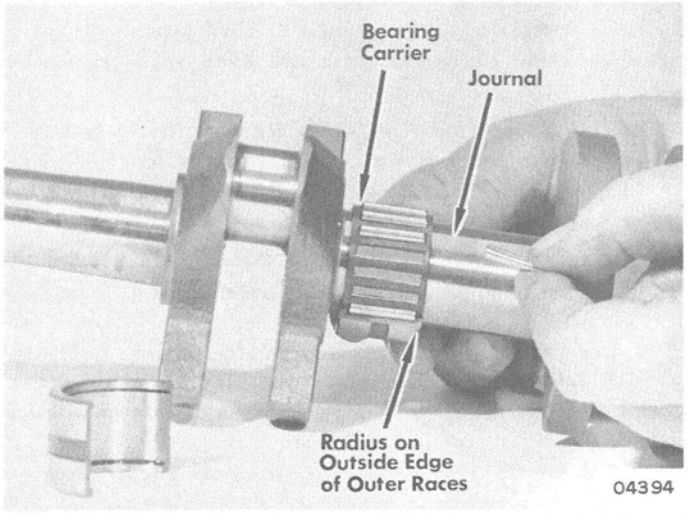


Figure 5. Installing Bearings in Carrier on Journal

   d. Repeat Steps "a" thru "c", immediately preceding, for second center main bearing.
   e. Place outer race halves around their respective roller bearings and carriers.

NOTE: Outer race halves have a greater radius on one outer edge. This radius MUST FACE each other when outer races are around roller bearing. (Figure 5)

   f. Before assembling center main halves to outer races of roller bearing, position halves so that fuel passage in center main will be positioned as shown in Figure 4 when halves are placed around outer races.
   g. One half of center main contains dowel pins to properly locate roller bearing outer races. Place this half around outer races and locate races with dowel pins.
   h. Place second half of center main around outer races and secure center main halves together with 2 allen screws.

5. Press crankshaft assembly into crankcase assembly. (Figure 6)

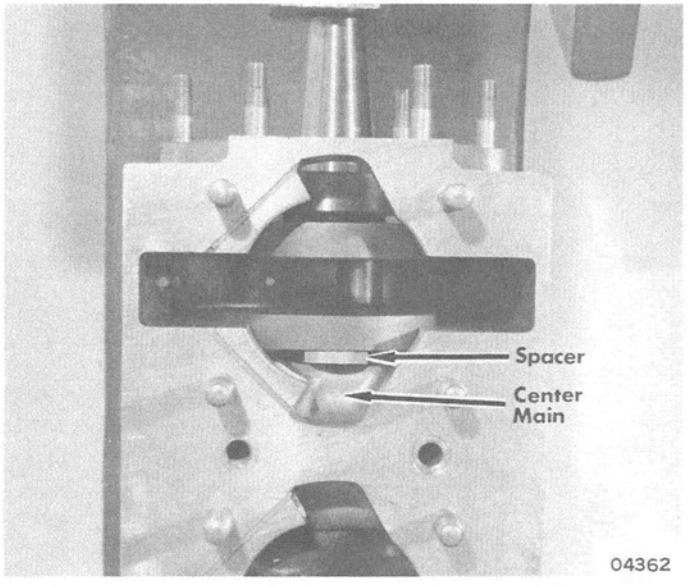


Figure 6. Crankshaft Pressed into Crankcase

6. To press center main bearing assembly into position, place a spacer between crankshaft throw and center main. (Figure 6)
7. Press center main down until scribed crossed lines on intake side of center main are even with crankcase. (Figure 1)

   NOTE: Fork Tool (C-91-45070) is available for easier location of center main. Insert fork at location shown in Figure 7 and adjust center main to align scribed crossed lines.

8. Lock center main in place by threading 2 screws thru crankcase and center main. Torque screw to specifications.
9. Apply small amount of New Multipurpose Lubricant (C-92-49588) to lip of seal and install end cap assembly. End cap assembly has a fuel passage that must mate with fuel passage in crankcase.
10. Check crankshaft end play as follows: (Figure 7)
    a. Secure end cap to crankcase by placing spacer over end cap studs, then threading nuts on studs. Tighten nuts evenly.
    b. To ensure a true seat, tap crankshaft either direction with a mallet.
    c. Use feeler gauge to check measurement between inner face of end cap and first counterweight of crankshaft (approximately .030" starting point).
    d. After reading is obtained, tap crankshaft in opposite direction, again acquiring a true seat, and recheck this measurement.
    e. Difference between 2 readings is amount of crankshaft end play. Tolerance of end play should be .008" to .012". If reading does not meet this specification, add shims to increase end play or remove shims to decrease end play.
    f. Remove spacers and nuts from end cap studs.

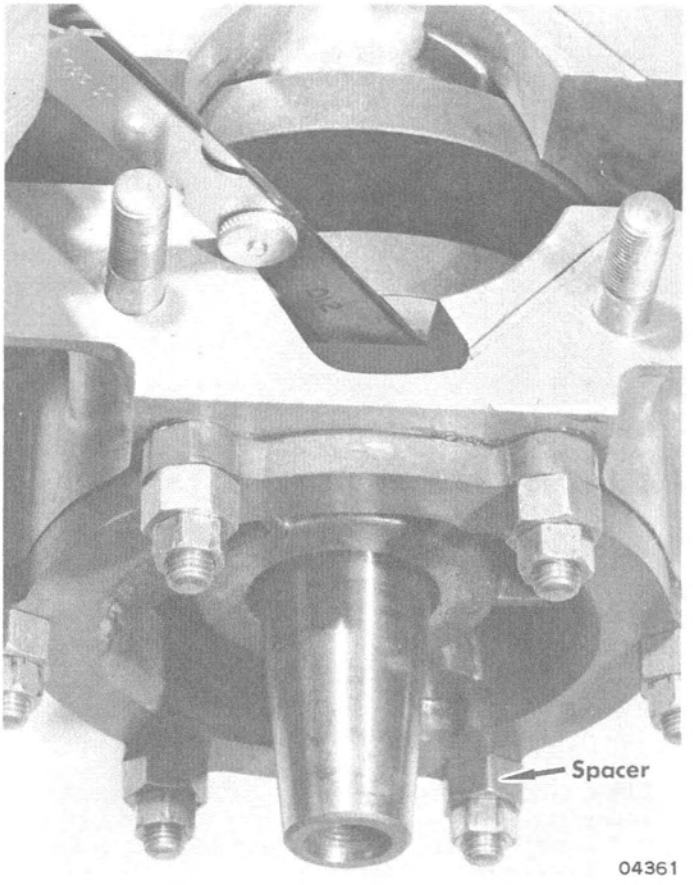


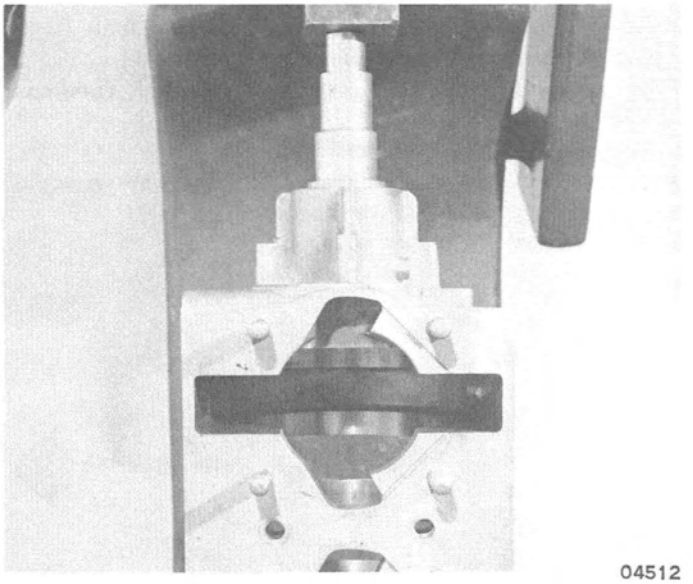
Figure 7.
Checking Crankshaft End Play

11. Install flywheel and blower assembly keys in keyways on crankshaft.

CRANKCASE ASSEMBLY

DISASSEMBLY

1. Remove bearing locking screw from crankcase.
2. Remove oil seal from crankcase.
3. Press roller bearing and ball bearing out of crankcase. (Figure 1)
4. Crankcase drain hoses may be removed, if required. Bayonet fittings (containing check valves) are placed in 2 lower tapped holes in crankcase.



04512

Figure 1. Pressing Roller and Ball Bearings from Crankcase

INSPECTION

CRANKCASE

1. Inspect crankcase thoroughly for cracks.
2. Check plugged holes in crankcase for leaks around lead shot. If a leak is observed, insert new lead shot and "stake" in place with a small punch. (Figure 2)

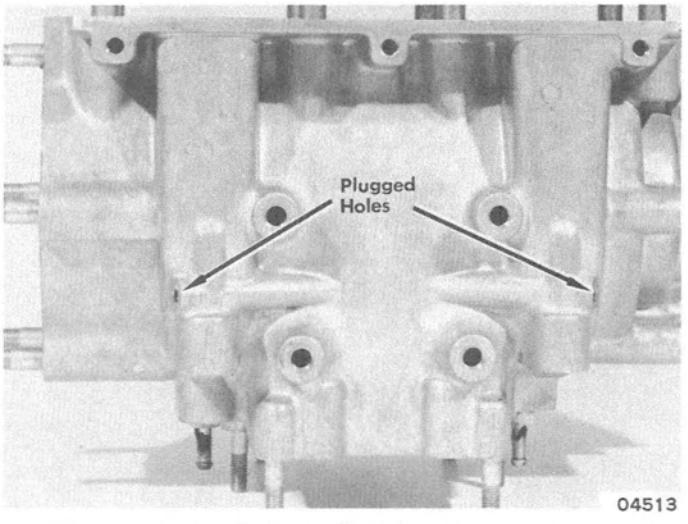


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Figure 2. Lead Shot Locations

BEARINGS

1. Ball bearings should be cleaned and dried before checking.
2. With one hand, grasp outer race firmly and, with other hand, attempt to work inner race in-and-out. There should be no excessive play.
3. Spin outer race after lubricating with oil. Discard, if bearing sounds or feels rough. Bearing should have smooth action, no rust stains.

IMPORTANT: DO NOT spin bearing with compressed air.

4. Check roller bearings for wear. When repairing an engine, it is recommended that roller bearings be replaced.

IMPORTANT: Press cartridge-type roller bearing into housing with "lettered" side up (opposite side has a greater radius for easier installation). After installation, check that bearings are free and not frozen or sticking caused by improper installation or tight fit.

SEALS

1. Check seals as explained in "Inspection, End Cap Assembly and Crankshaft Assembly", preceding.
2. Lip of seal faces inward. Lubricate lip of seal with New Multipurpose Lubricant (C-92-49588) before installing crankshaft.

REASSEMBLY

1. Thread Bearing Adaptor (C-91-54069) on Shaft (C-91-37323, a part of Bearing Removing and Installing Kit C-91-31229A1) and press in roller bearing. (Figure 3)
2. Thread Bearing Adaptor (C-91-54701) on Shaft (C-91-37323) and press in ball bearing. (Figure 3)
3. Press in oil seal until seal is flush with crankcase (lips of seal inward).
4. Secure roller bearing with locking screw.
5. If any drain hoses or bayonet fittings were removed, reinstall and secure with clamps.
6. Install crankshaft assembly.

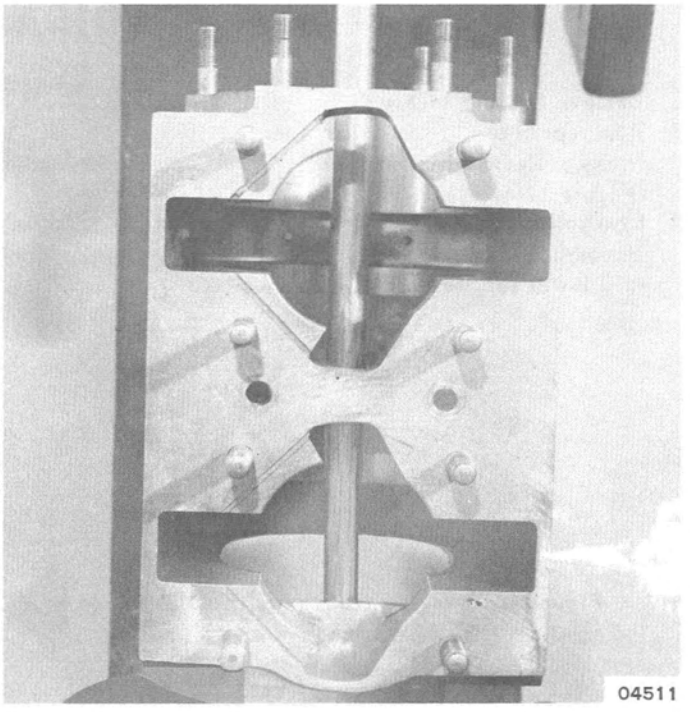

Figure 3. Pressing In Roller Bearing