CHAPTER FOUR

ENGINE

Ski-Doo snowmobiles are equipped with single and twin cylinder 2-cycle engines. The high performance twin cylinder engines are equipped with rotary valves, all other engines use piston-porting.

All engines have ball or roller main crankshaft bearings and needle bearings on the lower and upper bearings of the connecting rods.

This chapter includes removal and repair procedures for most engine components. However, due to the special tools and expertise required, all crankshaft assembly inspection and alignment should be performed by an authorized dealer or competent machine shop. Some procedures in this chapter require the use of special tools. In all cases the special tools are illustrated and in many cases can be easily fabricated or substituted by a well-equipped home mechanic. However, each snowmobile owner must be honest with himself about his own supply of tools and expertise and avoid repair procedures that are not within his capabilities. It is often cheaper and easier in the long run to remove the engine and take it to an authorized dealer for required service and repair than to risk expensive damage if you do not have the proper tools and facilities for the necessary work.

TOP END AND COMPLETE OVERHAUL

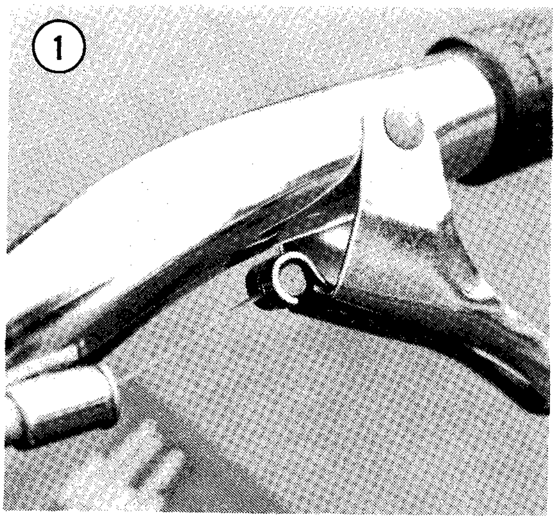
The following is an orderly sequence for removing and disassembling the engine to perform a top end overhaul or complete overhaul. Proceed to the applicable engine section and perform the procedures necessary in the order indicated to achieve desired level of disassembly for the necessary repairs. Tightening torques **(Table 1)**, single cylinder engine specifications **(Table 2)**, and twin cylinder engine specifications **(Table 3)** are found at the end of the chapter.

Top End Overhaul

a. Remove engine.
b. Remove fan housing and shrouds.
c. Remove flywheel and magneto assembly.
d. Remove cylinder head.
e. Remove cylinder, piston, and rings.
f. Perform component inspection.

Complete Overhaul

a. Perform top end overhaul.
b. Remove crankshaft assembly.
c. Perform component inspection.



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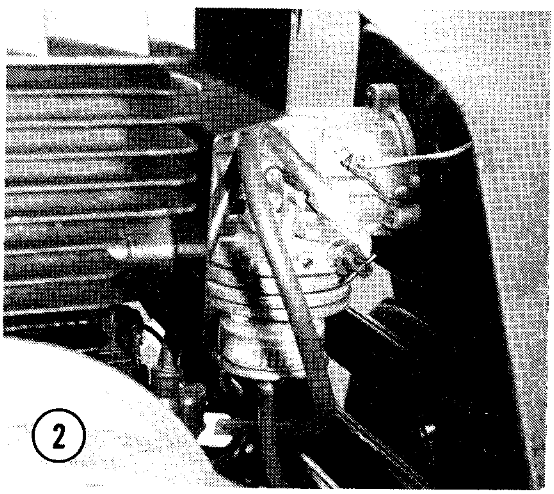

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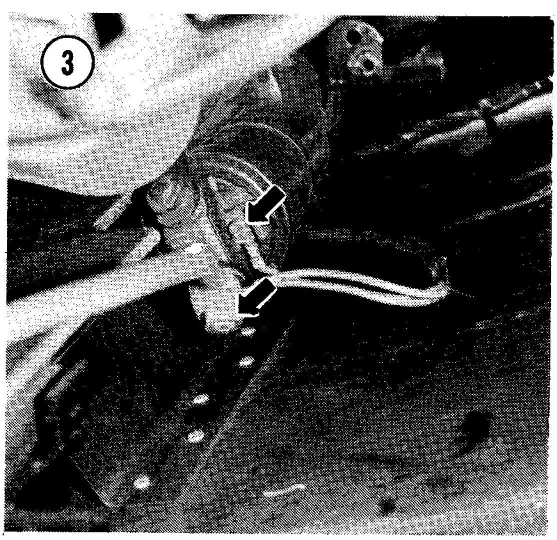

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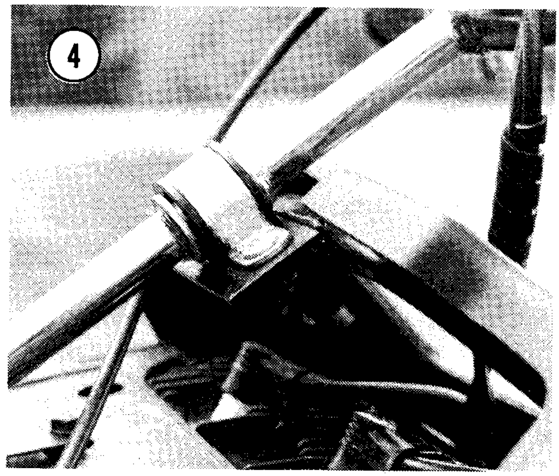

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SINGLE CYLINDER ENGINES

Engine Removal/Installation

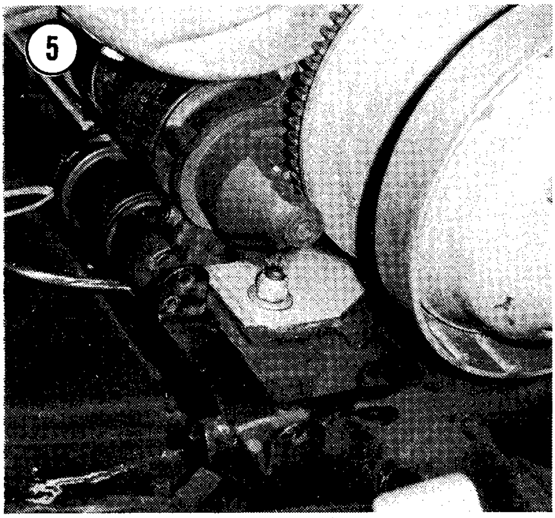
1. Disconnect brake and throttle cables and cable housings from handlebar and brake lever (**Figure 1**). On Elan models disconnect cable from handle plate and remove cable from engine bracket. Disconnect throttle cable from carburetor. Remove choke knob of necessary.
2. On all models except T'NT, remove console.
3. Remove pulley guard and drive belt as outlined in Chapter Seven.
4. Disconnect fuel lines from carburetor (**Figure 2**). Position lines up higher than level of tank to prevent tank from draining.
5. Disconnect all electrical connectors from engine. Tag wire locations to aid installation.
6. On electric start models, disconnect negative battery cable and disconnect solenoid and starter wires (**Figure 3**).
7. On applicable models, disconnect decompressor (compression release) knob from decompressor, and remove decompressor switch from holder.
8. Disconnect steering column from upper column as shown in **Figure 4**.
9. Remove engine mounting nuts and washers (**Figure 5**).
10. On Elan and T'NT models perform the following:
    a. Tilt upper column towards seat.
    b. Raise steering column and lift engine out from right side of machine.

11. On Olympique models, proceed as follows:
   a. Remove upper column.
   b. Remove engine from right side of machine.

12. Installation is the reverse of these steps. Keep the following points in mind:
   a. Torque nuts securing engine assembly as specified in **Table 1**.
   b. Adjust decompressor cable for 1/16 in. (1.6mm) free play between cable housing ferrule and valve lever (**Figure 6**).
   c. Adjust brakes as outlined in Chapter Two.
   d. Perform *Pulley Alignment* as outlined in Chapter Seven.

Exterior Component Removal/Installation

1. Remove air silencer, carburetor, and muffler.
2. Remove recoil starter and drive pulley.
3. Remove throttle cable bracket secured to engine. On models with 247cc engine, remove brake cable bracket from engine.
4. Remove electric starter on models so equipped.
5. Remove decompressor valve (compression release) from cylinder on models so equipped.
6. Remove engine mount from crankcase.
7. Installation is the reverse of these steps. Keep the following points in mind:
   a. Lower left screw in recoil starter on Olympique 335 E models also secures battery cable clamp.
   b. Torque decompressor valve to 10 ft.-lb. (1.4 mkg) and secure valve to cylinder by bending a section of locking and sealing sleeve over cylinder fin.
   c. Torque nuts securing engine mount to crankcase as specified in **Table 1**.
   d. When installing carburetor, assemble components in the following order: flange gasket, isolating flange, flange gasket, isolating sleeves, carburetor, isolating washers and nuts.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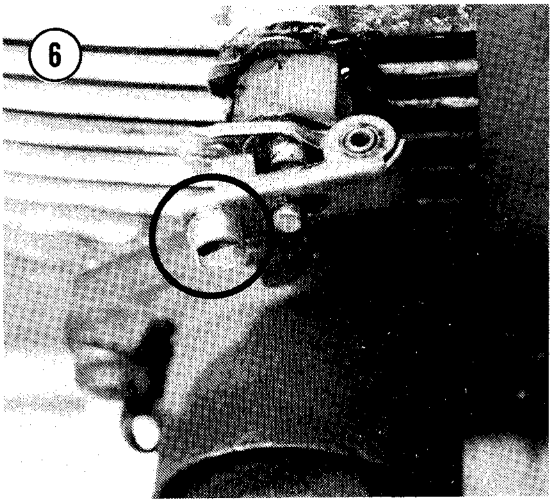
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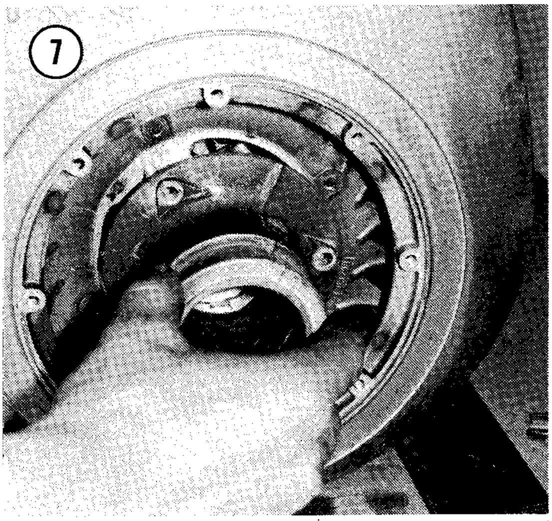
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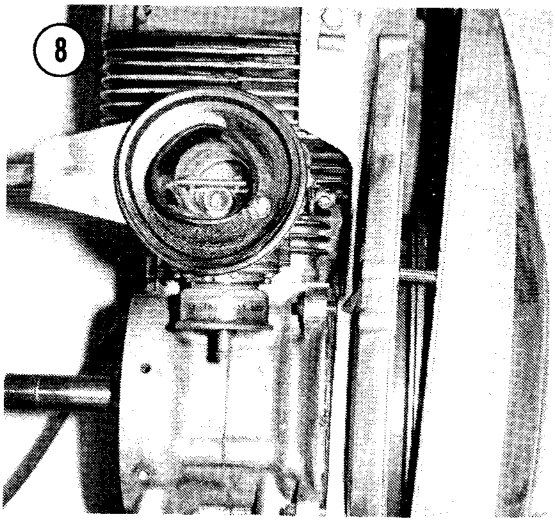

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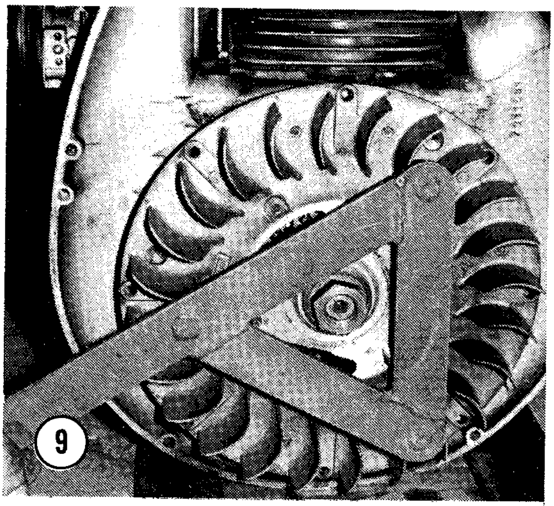

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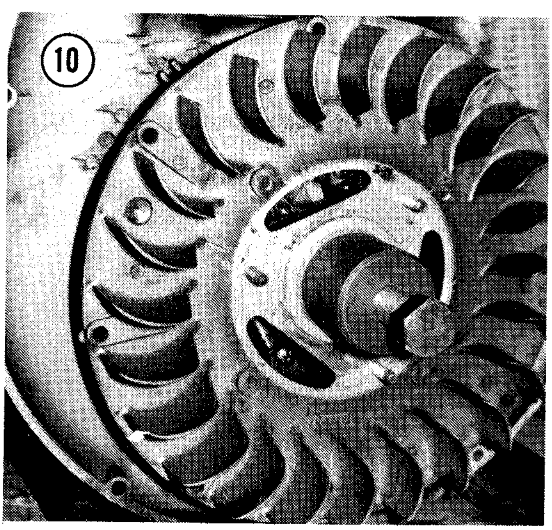

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NOTE: *Be sure that the hole in plastic flange aligns with vacuum port on engine flange.*

Fan Cowl, Fan, and Magneto Assembly Removal/Installation

The following procedure requires the use of special tools to remove magneto plate/fan assembly. If special tools or locally fabricated equivalents are not available, refer task to an authorized dealer.

1. Remove engine and recoil starter.
2. Remove electric starter on models so equipped.
3. Remove nuts securing starting pulley to magneto plate **(Figure 7)** and remove pulley.
4. Remove fan cowl assembly from engine **(Figure 8)**.
5. Using a hammer and small punch, bend back locking tab securing magneto nut.
6. Using special tool to hold fan, remove nut and washer securing magneto plate/fan housing assembly as shown in **Figure 9**.
7. Install special puller and tighten until magneto plate/fan assembly is removed from crankshaft **(Figure 10)**.

CAUTION

Always place magneto ring on a clean cloth or magneto may attract dirt and/or metal particles that can affect magneto efficiency.

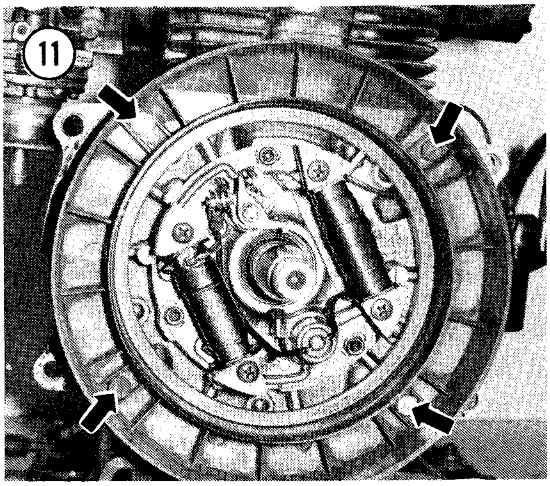
NOTE: *At this time electric starter gear or magneto plate can be removed from fan assembly if desired.*

8. Remove screws securing labyrinth ring to magneto assembly and remove ring **(Figure 11)**.
9. Using a hammer and small punch, gently remove Woodruff key from crankshaft.

CAUTION

Exercise care when key is removed or key and/or crankshaft may be damaged.

10. Remove cam spring and washer from end of crankshaft **(Figure 12)**.
11. Remove Allen screws securing magneto armature plate to engine **(Figure 13)**. Disconnect wiring and remove armature plate. Tag wires to aid connection during installation.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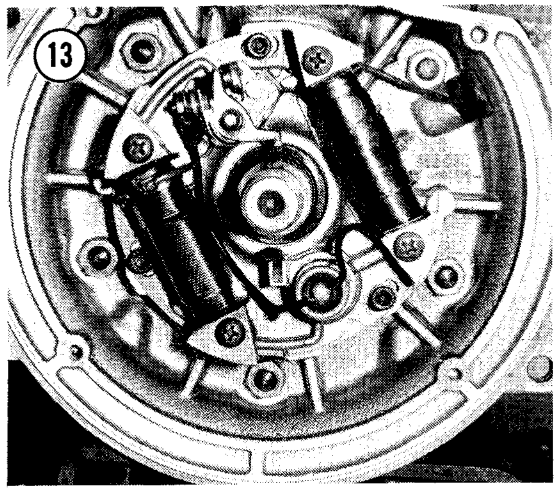
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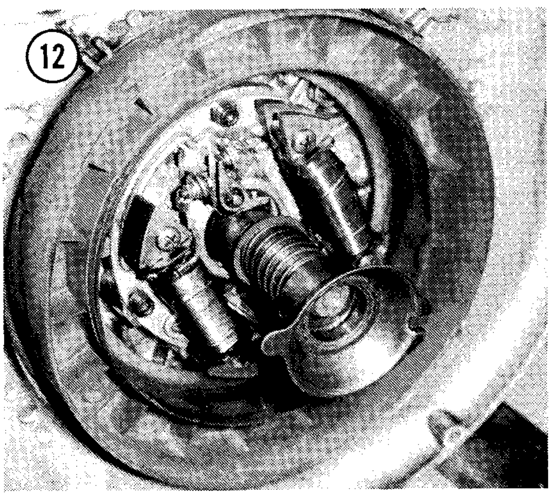
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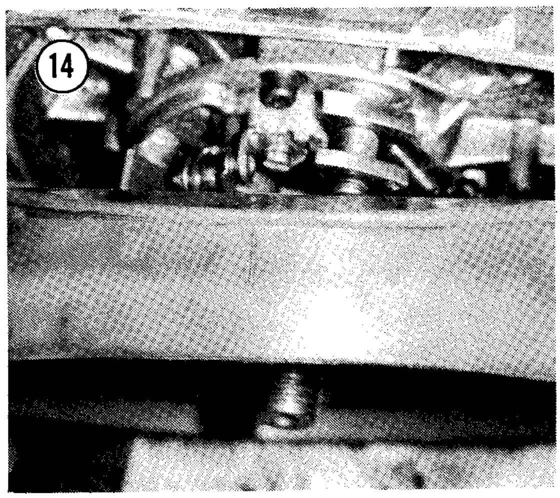
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12. On electric start and T'NT 292 models, remove screws securing ignition coil and bracket and remove coil and bracket from engine.

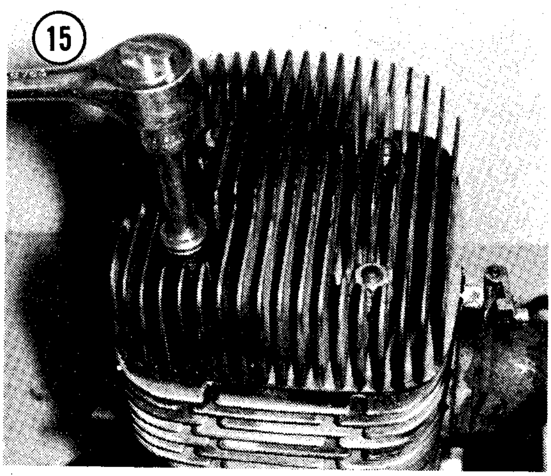
13. Installation is the reverse of these steps. Keep the following points in mind:

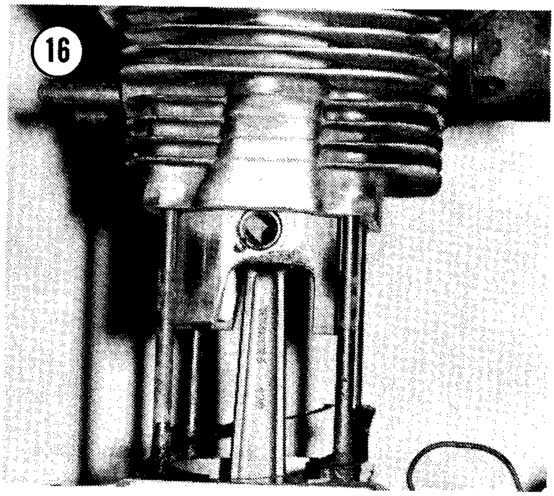
CAUTION
Ensure that magneto wires are correctly positioned to avoid their being squeezed behind armature plate.

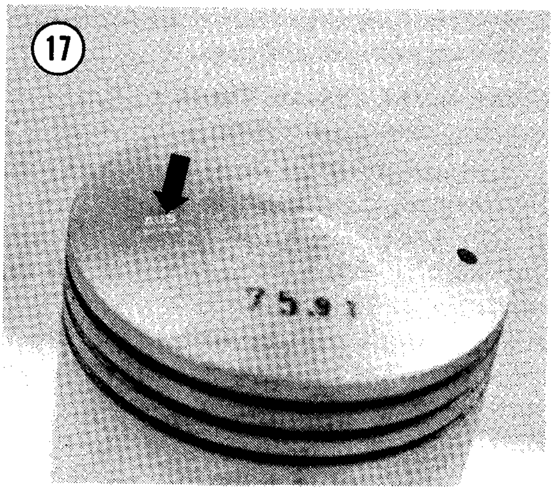
a. Lightly grease inner channel of cam with low temperature grease.
b. Be sure bevelled side of labyrinth ring is on top **(Figure 14)**.
c. Lightly grease spring seating of magneto ring plate with low temperature grease.
d. Turn crankshaft until Woodruff key is up and rotate cam until it is approximately 240° from key.
e. Torque magneto nut. See **Table 1**.
f. Perform engine timing as outlined in Chapter Two.

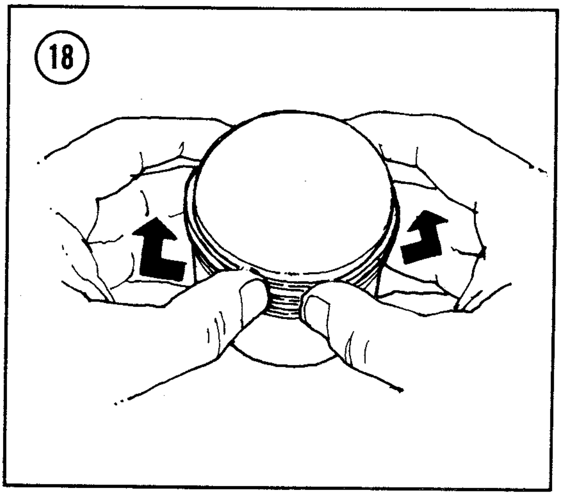
Cylinder Head, Cylinder, Piston, and Ring Removal

1. Remove engine and external components.
2. Remove fan and magneto assembly.
3. Remove nuts securing cylinder head (see **Figure 15**). To aid head removal, gently tap head with a rubber mallet. Remove head and discard old gasket.
4. Gently slide cylinder up over piston **(Figure 16)**.









5. Note mark on piston indicating exhaust side of engine **(Figure 17)**. If no marks are visible, inscribe piston accordingly.

> NOTE: *If rings are going to be changed, but not piston, rings may now be removed. However if piston is going to be removed, leave old rings on piston to protect ring grooves until new rings are to be installed.*

6. Using a ring expander tool or your thumbs on each end of piston ring, gently expand ring and slide up and off piston. **(Figure 18)**.
7. Be sure piston is appropriately marked. Remove circlips from each end of piston pin **(Figure 19)**.

> NOTE: *Stuff clean rags around connecting rod in crankcase to help prevent circlips from dropping into crankcase.*

Using a piston pin removal tool or an appropriately sized wooden dowel, gently remove pin from piston and connecting rod.

CAUTION

Exercise care when removing pin to avoid damaging connecting rod needle bearings. If a wooden dowel is used to drive out piston pin, ensure that piston is properly supported so that lateral shock is not transmitted to lower connecting rod bearing, otherwise rod and/or bearing damage may occur.

Remove needle bearing from connecting rod.

8. Refer to *Component Inspection* and inspect cylinder, piston, pin, and rings.

Cylinder Head, Cylinder, Piston, and Ring Installation

1. Lubricate piston pin needle bearings with oil and insert bearings into connecting rod.
2. Slide piston over connecting rod. Be sure that mark or letters AUS face exhaust side of engine (**Figure 17**).
3. Using piston pin installation tool or appropriately sized wooden dowel, install piston pin through piston and rod end.

CAUTION
Exercise care when installing pin to avoid damage to connecting rod needle bearing. If a wooden dowel is used to drive in piston pin, ensure that piston is properly supported so that lateral shock is not transmitted to lower connecting rod bearing, otherwise rod and/or bearing damage may occur.

4. Secure piston pin to piston with circlips. When circlip is properly installed in groove, rotate circlip so gap in clip is not directly on notch break of piston (**Figure 19**).

NOTE: *Stuff clean rags around connecting rod in crankcase to help prevent circlip from dropping into crankcase.*

CAUTION
If possible use new circlips to secure piston pin. If old circlips are used they must snap securely into grooves in piston. A weak circlip could become disengaged during engine operation and cause severe engine damage.

5. Using a ring expander tool or your thumbs on each end of piston ring, gently expand ring and slide over piston in ring groove (**Figure 18**). Install ring in bottom groove first. Be sure that ring groove clearance is within tolerance as outlined in *Component Inspection*.

NOTE: *Be sure that ring end "V" is properly positioned in ring groove.*

6. Install new cylinder base gasket.
7. Thoroughly lubricate piston, rings, and cylinder bore with engine oil.

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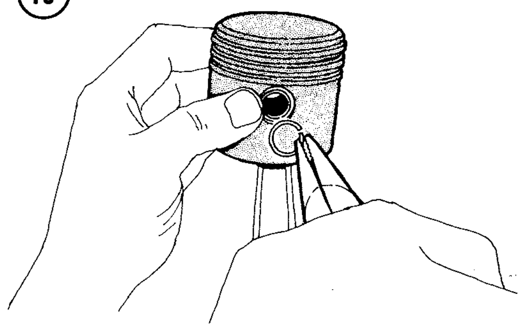

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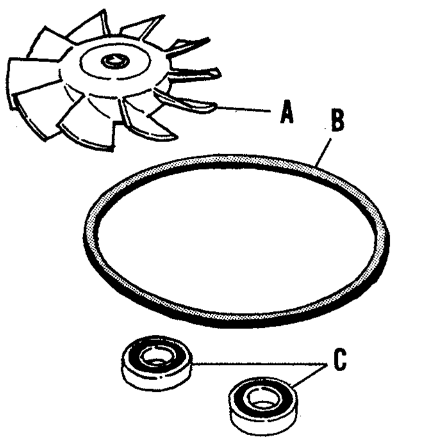

A. Cooling fan B. Fan belt C. Fan bearings

8. Position 2 thin, wooden supports such as tongue depressors under piston for piston support, and rotate crankshaft so that piston sits on wooden supports.
9. Compress rings with a suitable ring compressor or your fingers and carefully slide cylinder down over piston.

CAUTION
Crankshaft, connecting rod, and piston must rotate freely. Any "roughness," "tight spots," or "metallic noises" must be corrected before engine is run or serious damage may result.

10. Install cylinder head with a new head gasket. Torque head nuts in a crisscross pattern to 10 ft.-lb. (1.4 mkg) then torque as specified in **Table 1**.

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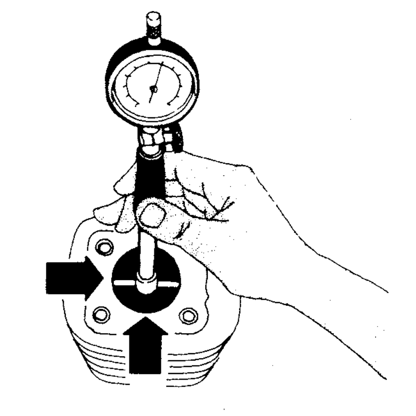

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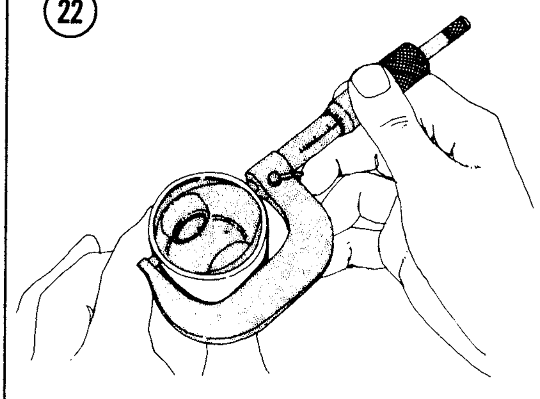


11. Install fan and magneto assembly.

12. Install external components on engine and install engine.

Crankshaft Assembly Removal/Installation

Crankshaft assembly, removal, inspection, service and repair, including crankcase bearing and seal replacement, should be referred to an authorized dealer or competent machine shop. They are equipped with the necessary special tools and expertise to perform the work.

COMPONENT INSPECTION

Some of the following inspection procedures require the use of micrometers and dial indicators for precise wear analysis. If such precision tools are not available, refer inspection procedures to an authorized dealer or competent machine shop. Refer to **Table 2 or 3** (end of chapter) for engine component dimensions and wear tolerances.

Cooling Fan and Belt

1. Inspect fan **(Figure 20)** for cracked, broken, or damaged fins. Dress nicks or dents with a file. If fins are cracked or broken, fan must be replaced.

2. Inspect fan bearings for wear or looseness. Replace if necessary.

3. Inspect fan belt and replace if frayed, stretched, or deteriorated.

Cylinder Taper and Out-of-Round

1. To check for cylinder taper perform the following:

   a. Refer to **Figure 21** and measure cylinder diameter ⅝ in. (16mm) from top of cylinder down to just below intake port.
   b. On rotary valve models, measure just below auxiliary transfer port, facing exhaust port.
   c. If cylinder taper exceeds 0.003 in. (0.08mm) rebore and hone or replace the cylinder.

2. To check cylinder for out-of-round measure cylinder ½-⅝ in. (13-16mm) from top of cylinder. If cylinder out-of-round exceeds 0.002 in. (0.05mm) rebore and hone or replace the cylinder.

Piston-to-Cylinder Clearance

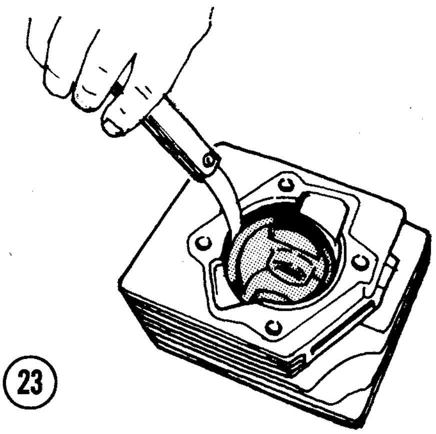
1. With a micrometer measure piston skirt at right angles to piston pin 5/16 in. (8mm) from bottom of piston **(Figure 22)**.

2. Measure cylinder bore ½-⅝ in. (13-16mm) below top of cylinder **(Figure 21)**.

3. Subtract the piston measurement from the cylinder measurement to obtain piston-to-cylinder clearance. If clearance exceeds wear limit specified in **Table 2 or 3** piston must be replaced. It may be necessary to bore cylinder to the next oversize.

Piston-to-Cylinder Clearance (Quick Method)

With the cylinder upside down on a workbench install the piston (without rings) into the cylinder bore. Refer to **Figure 23** and insert the thickest possible feeler gauge between the piston and cylinder wall on the intake side. If a feeler gauge larger than wear limit specified in **Table 3** can be inserted between piston and cylinder bore, a new piston or rebore is necessary.



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Honing Cylinder Bore

If cylinder is within wear tolerance, but lightly scored, hone by running a fine stone cylinder hone lightly in cylinder (**Figure 24**).

Clean cylinder thoroughly with detergent and water to remove all particles.

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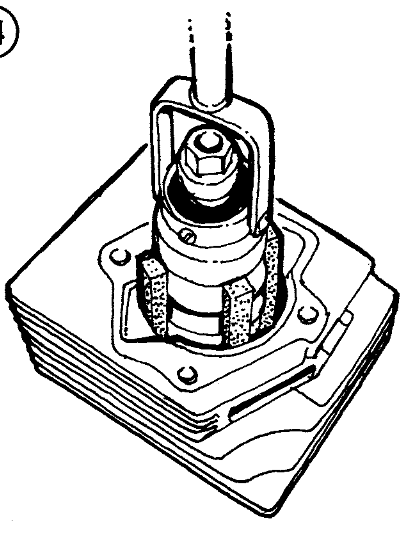

Cylinder Head

1. Carefully scrape carbon from cylinder head and exhaust ports of cylinders. Use a soft metal (nonferrous) scraper to avoid damage. A wooden spatula works well for cleaning exhaust ports.
2. Use a spark plug tap (14mm or 18mm) to clean carbon from spark plug threads in cylinder head, if required.

Crankcase

1. Inspect crankcase sealing surfaces (**Figure 25**) for deep scratches, scoring, or pitting.
2. Inspect bearing and oil seal retaining inserts for wear, scoring, or conditions that could cause leaks.
3. Replace crankcase halves if damaged. Crankcase halves are available only in a matched set — not individually.

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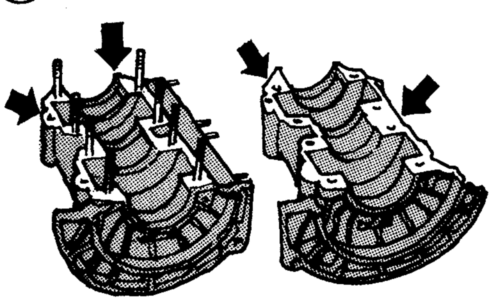

Piston Ring End Gap

Slide piston ring into cylinder between transfer port and intake port. On rotary valve engines, position ring just below the transfer ports. Use piston ring to slide ring into position to ensure that ring is perfectly square inside bore. Measure ring end gap with feeler gauge as shown in **Figure 26**. Refer to **Table 2 or 3** and replace ring if end gap is excessive.

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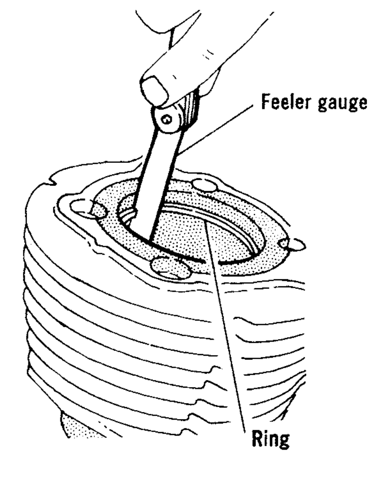

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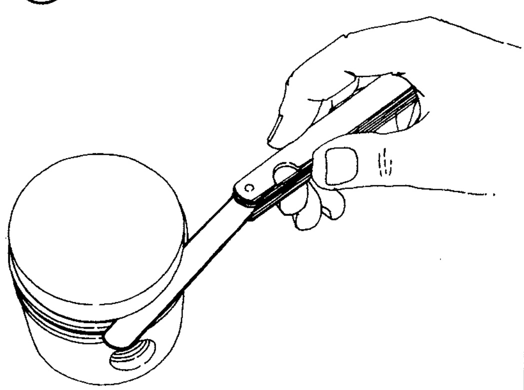

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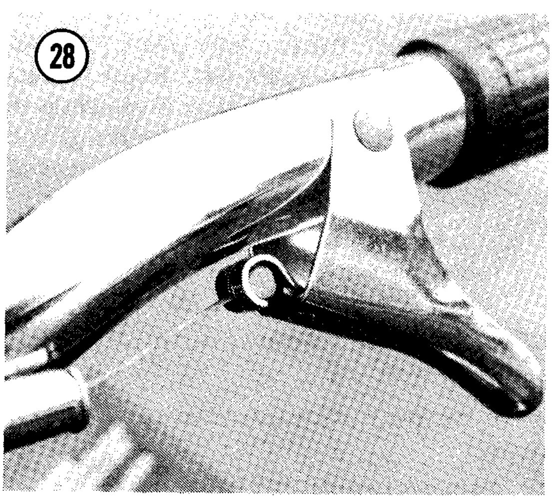


Piston Ring Groove Clearance

With a feeler gauge check side clearance of rings in grooves **(Figure 27)**. If clearance is greater than 0.008 in. (0.20mm), replace the piston and rings.

Crankshaft and Connecting Rod

Refer all clearance inspection, service, and repair work on crankshaft assembly to an authorized dealer or competent machine shop.

1. Inspect threads on each end of crankshaft. Inspect keyway on flywheel end and taper on each end of crankshaft for scoring or wear.
2. Inspect ball bearings for wear, free movement, and security.
3. Inspect seals for wear or damage.

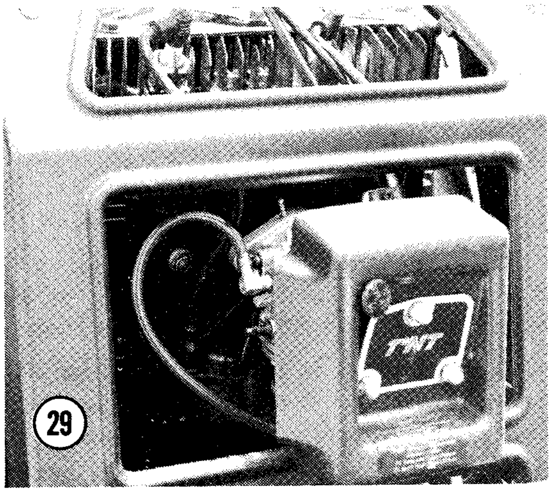
TWIN CYLINDER ENGINES

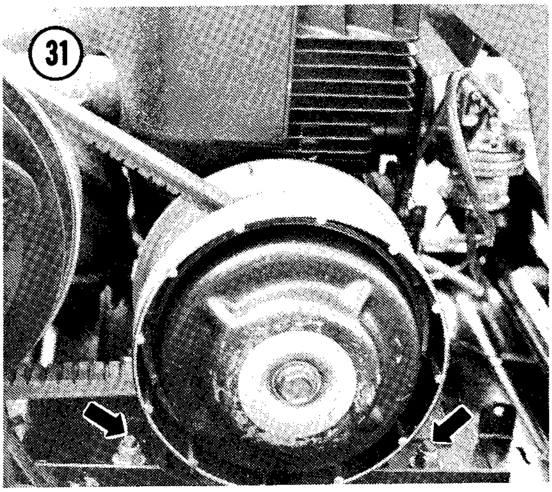
The basic procedures for removal, disassembly, and repair of twin cylinder engines are the same. Specific differences will be noted in the procedures where necessary.

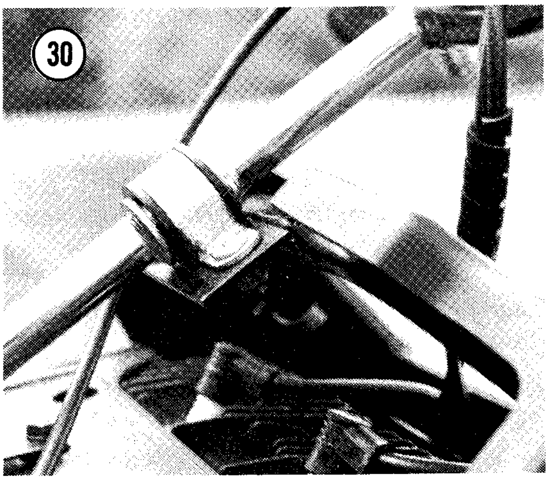
Engine Removal/Installation (Mid-Engine Models)

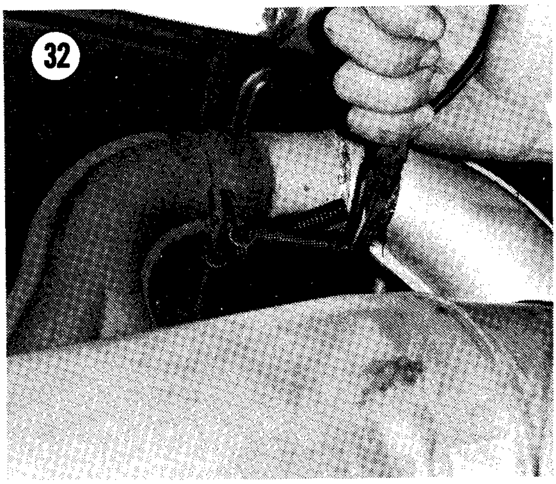
1. Remove pulley guard and drive belt. Remove console on Olympique models.
2. Disconnect brake and throttle cables and housings from handlebar and brake lever **(Figure 28)**.
3. Disconnect kill button from handlebar on models so equipped.
4. Disconnect all electrical connections from engine. Tag all wire locations to aid installation.
5. Remove air silencer on models so equipped **(Figure 29)** and disconnect fuel lines from carburetor. On T'NT models, disconnect springs securing muffler to engine.
6. Disconnect steering column retaining bracket from upper column **(Figure 30)**.
7. Remove nuts securing engine mount to frame **(Figure 31)**.
8. Lift engine from machine.

NOTE: *On T'NT models, tilt upper column toward seat and lean engine to the*









rear to disengage exhaust manifold from muffler. Remove engine from left side.

9. Installation is the reverse of these steps. Keep the following points in mind:

   a. Torque engine mounting nuts to 22-25 ft.-lb. (3.0-3.5 mkg).
   b. Adjust brake as outlined in Chapter Two.
   c. Perform *Pulley Alignment* as outlined in Chapter Seven.

Engine Removal/Installation (Front Engine Models)

1. Remove pulley guard and drive belt.
2. Remove muffler and air silencer (**Figures 32 and 33**).
3. On liquid cooled models perform the following:

   a. Remove coolant tank pressure cap and disconnect bypass hose from cylinder head fitting (**Figure 34**). Route bypass hose into a clean container if coolant is to be retained. Block off bypass fitting and keep bypass hose as low as possible to drain the system.
   b. Cover filler neck with your hand and blow through tank vent tube to completely drain the system (**Figure 35**).
   c. Disconnect coolant hoses from the engine.

4. If necessary disconnect the cab retaining cable.
5. Disconnect primer and impulse lines.

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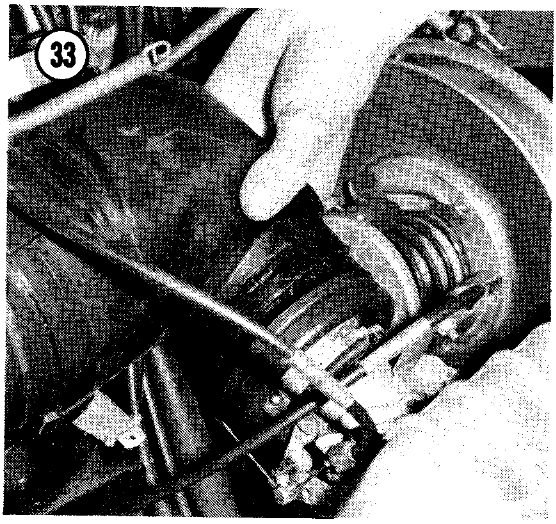

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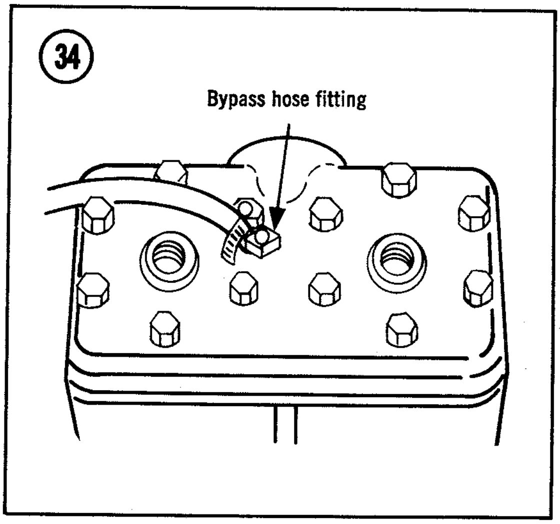

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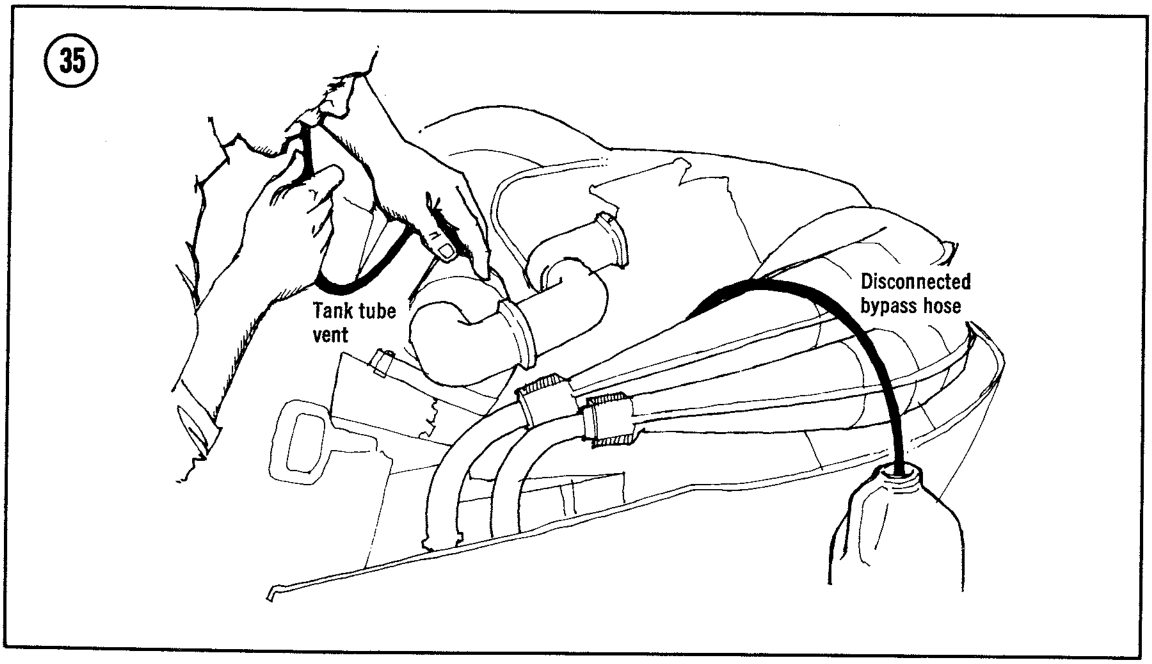


6. If carburetor is to be removed with the engine, disconnect the throttle cable and fuel lines.

7. If carburetor is to be removed, perform the following:

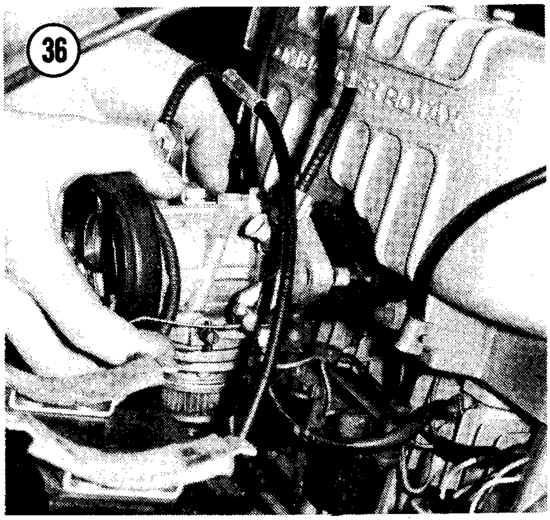
   a. Remove nuts securing carburetor and slide carburetor off mounting studs (**Figure 36**).

   b. With fuel lines and cables still attached, swing carburetor out of the way (**Figure 37**).

8. On rotary valve models, disconnect oil line from bottom of oil reservoir and drain oil from reservoir and crankcase. Disconnect upper oil vent line.

> NOTE: *On models equipped with 444 liquid cooled engines, it is not necessary to disconnect oil tank lines prior to engine removal. Tank can be drained and removed after engine removal.*

9. Remove recoil starter.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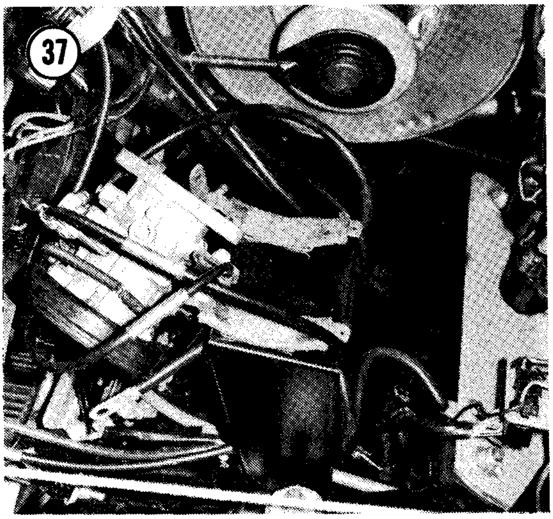
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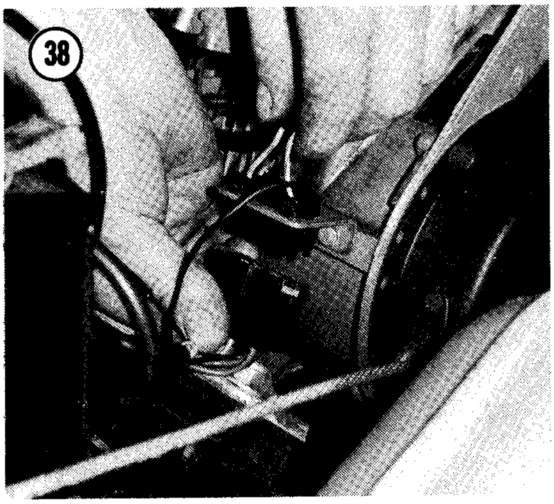
10. Disconnect all electrical connections (see **Figure 38**). Tag wire locations to aid installation. On models equipped with electric starter, disconnect ground cable (–) from battery before disconnecting other wires (**Figure 39**).

11. If necessary, remove drive pulley as outlined in Chapter Seven.

12. Remove nuts securing engine mount to machine (**Figure 40**) and lift out engine.

13. Installation is the reverse of these steps. Keep the following points in mind:

   a. Torque engine mounting nuts to 22-25 ft.-lb. (3.0-3.5 mkg).
   b. Perform *Pulley Alignment* as outlined in Chapter Seven.
   c. On rotary valve models top off oil reservoir as outlined in Chapter Two.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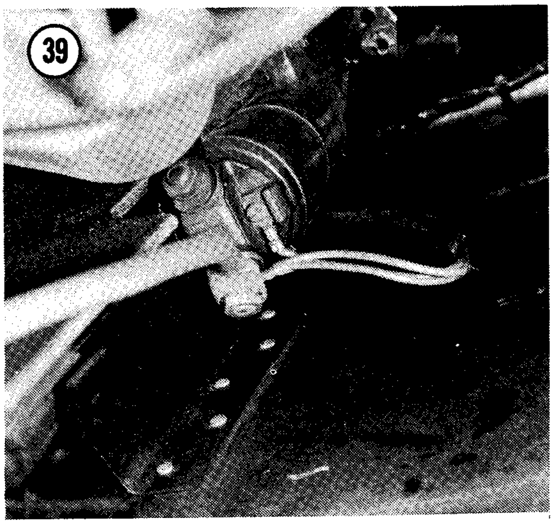
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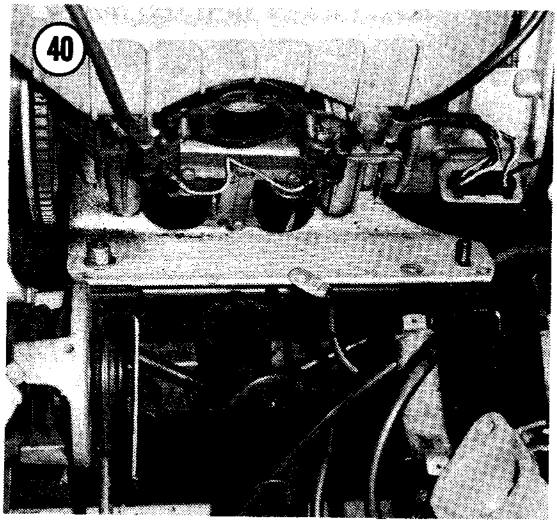
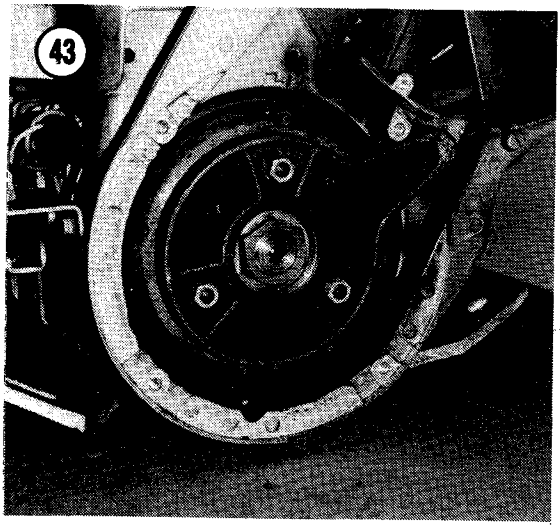
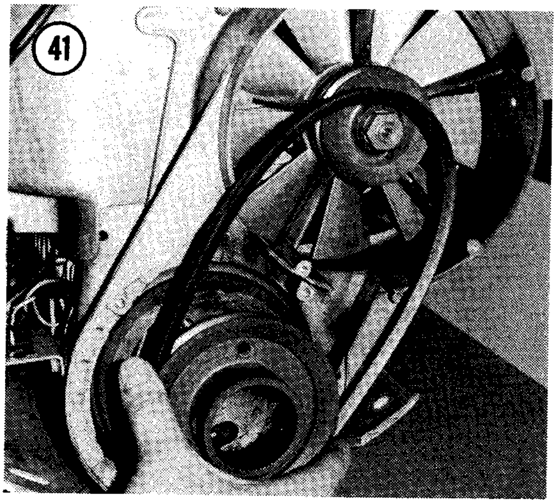
Flywheel and Magneto Removal/Installation

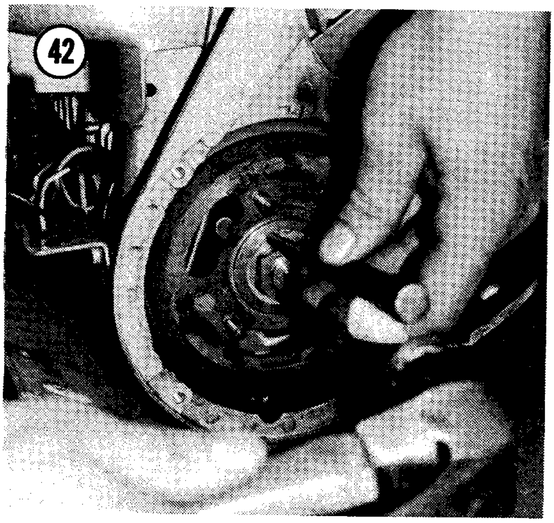
The following procedure requires the use of special tools to remove the flywheel and magneto assembly. If special tools or locally fabricated equivalents are not available, refer task to an authorized dealer.

1. Remove engine.
2. Remove muffler and recoil starter if not previously removed.
3. Remove nuts securing fan belt pulley/starter pulley to magneto ring plate. Remove belt and pulley (**Figure 41**).









4. Using a hammer and a small punch, straighten locking tab behind magneto unit (**Figure 42**).

5. Install special crankshaft holding tool to magneto ring plate using nuts and washers from fan belt/starter pulley (**Figure 43**).

If special crankshaft holding tool is not available, perform the following:

a. Insert a length of rope such as recoil starter rope into the spark plug hole.

b. Slowly rotate crankshaft counterclockwise until the piston bears against the rope.

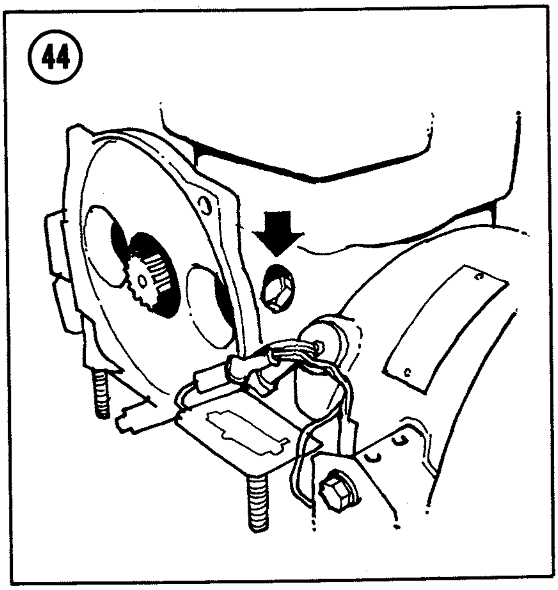
On 354 and 503 engines the crankshaft can be held by using the crankshaft locking bolt (**Figure 44**). Locate magneto side piston at TDC and install bolt into hole in crankshaft. On 503 models remove the aluminum spacer from under the bolt. *Do not* overtighten the bolt as it does not hold by pressure against the crankshaft.

NOTE: *On electric start engines that are being disassembled for major engine work, use special puller and remove starter gear complete with shims and spacers.*

Remove nuts securing starter motor and bracket to engine and remove starter and bracket.

6. Remove magneto nut.

7. Install flywheel puller (**Figure 45**) and



remove magneto housing (**Figure 46**). Remove puller and holding tool from magneto ring plate.

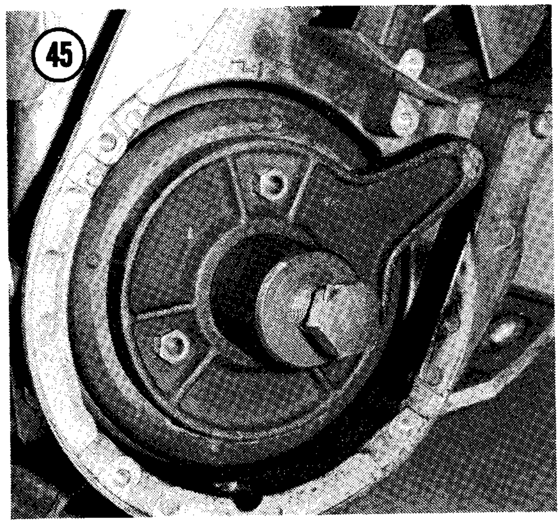
8. If desired, on models so equipped, remove flat end screw and remove centrifugal advance weight and spring from magneto ring plate (**Figure 47**).

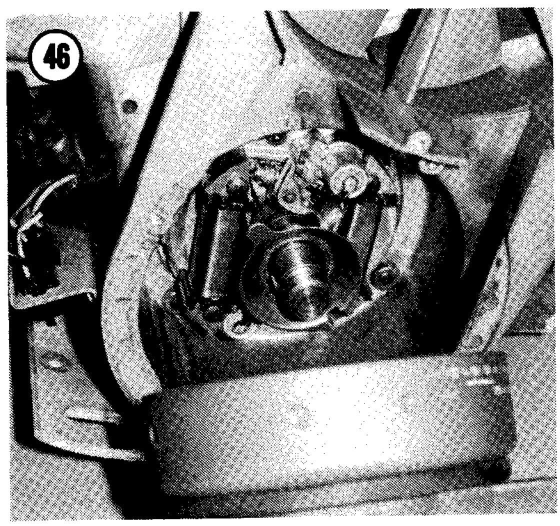
> NOTE: *If further disassembly is desired, remove 4 Allen screws and remove ring plate from magneto ring.*

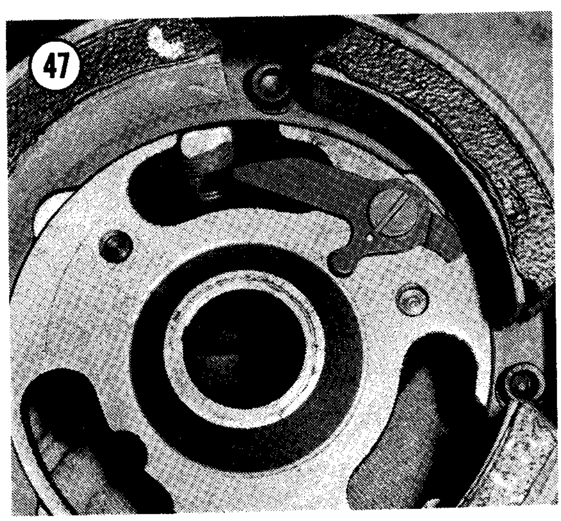
> CAUTION
> *Always place magneto ring on a clean cloth or magneto may attract dirt and/or metal particles that can affect magneto efficiency.*

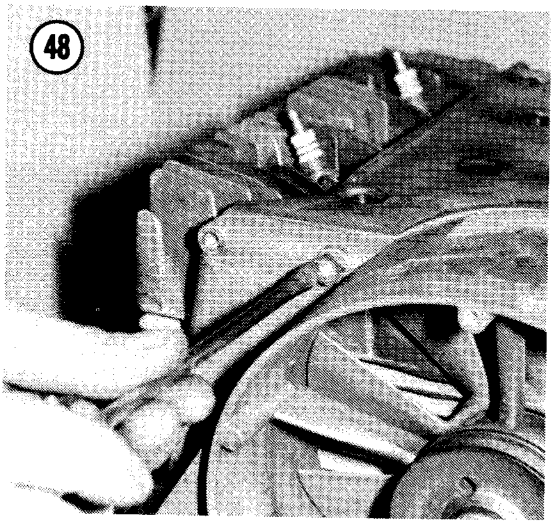
9. On models equipped with one-piece cooling shroud, perform the following:
   a. Remove bolts and washers securing shroud to cylinder head spacer nut.
   b. Remove 3 screws securing fan housing to shroud and remove shroud.

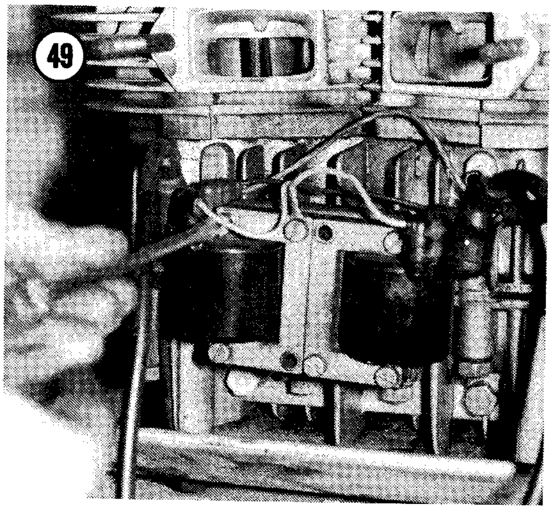
10. On models equipped with 2-piece cooling shroud, perform the following:
    a. Remove bolts securing exhaust side shroud.
    b. Remove 2 screws securing fan housing to exhaust side shroud (**Figure 48**).

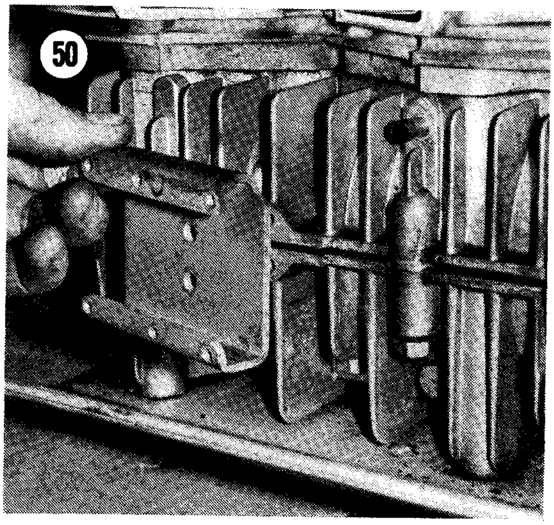


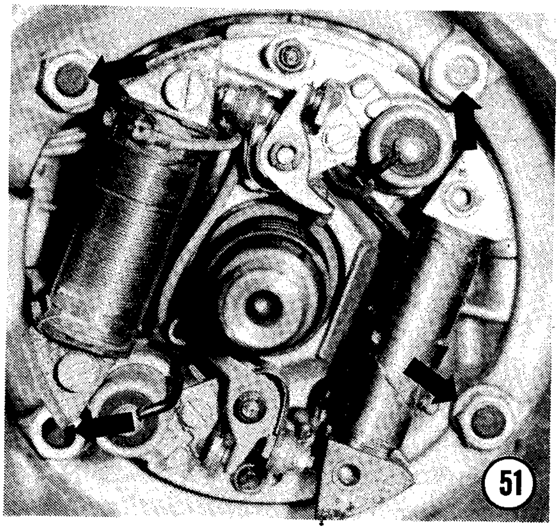












c. Remove nut securing shroud stud and remove stud and shroud.

11. On models equipped with engine console, remove Allen screws securing console to cooling shroud and remove console.

12. Remove throttle cable bracket from shroud on models so equipped.

13. Disconnect wiring from ignition coils and remove coils (**Figure 49**). Tag wires to aid installation.

14. Remove coil bracket from crankcase on models equipped with one-piece cooling shroud (**Figure 50**).

15. On models equipped with 2-piece shroud, remove screws securing fan housing to intake side shroud and complete shroud removal.

16. Remove 4 nuts and washers securing fan housing (**Figure 51**) to engine and remove housing. If repair of fan housing is necessary, refer to *Cooling Fan Disassembly*.

17. Press in and hold magneto cam toward armature plate and tap out crankshaft Woodruff key with a hammer and small punch. Remove cam with spring and washer from crankshaft (**Figure 52**).

18. Remove 2 nuts or Allen screws securing armature plate and remove plate (**Figure 53**).

19. Installation is the reverse of these steps. Keep the following points in mind:

a. Be sure armature plate wiring is routed through notch in fan housing and shroud

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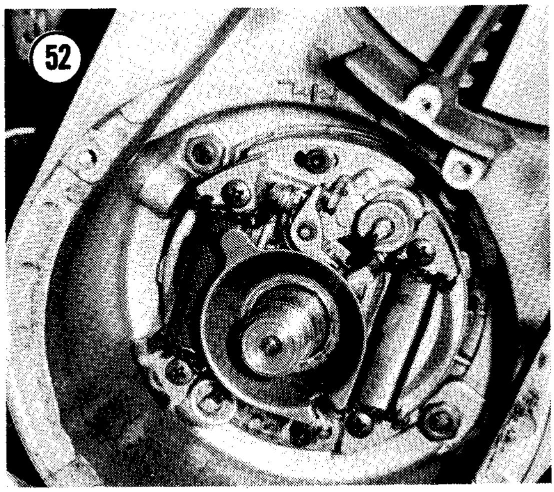

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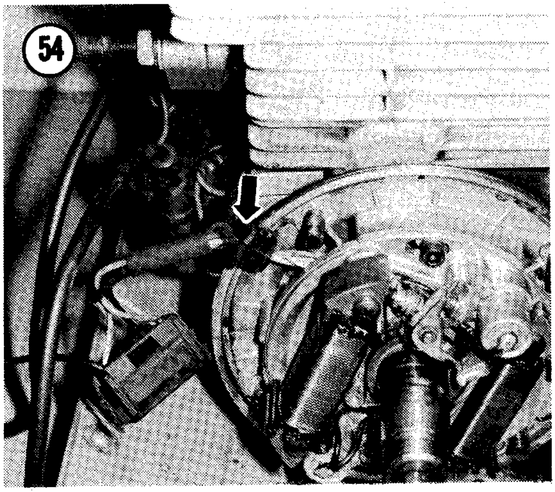

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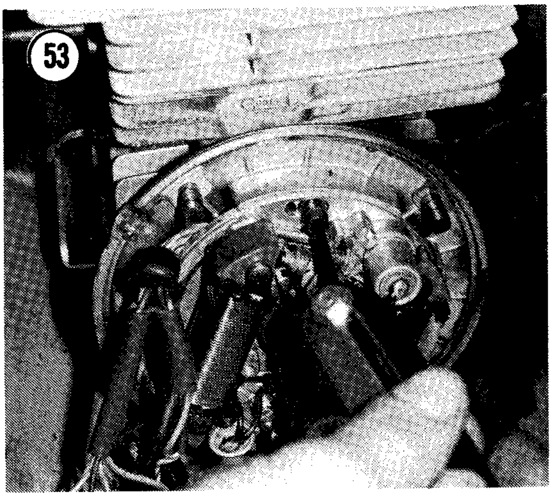

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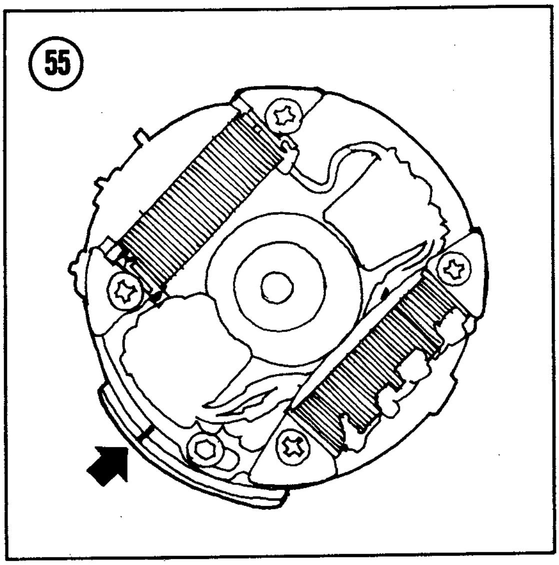


and rubber grommet is in proper position (**Figure 54**).

b. Lightly grease inner channel of cam with low temperature grease.

c. Lightly grease spring seating of magneto ring plate with low temperature grease.

d. Rotate crankshaft until Woodruff key is up and rotate cam clockwise until notch is 45° from key.

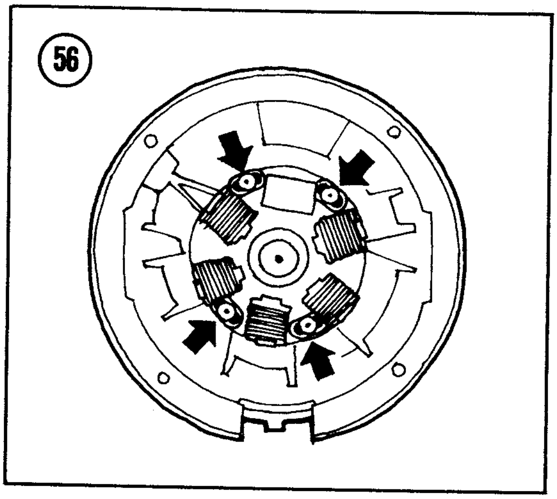
e. When installing magneto plate, align crankcase and armature plate marks (**Figure 55**) for preliminary timing adjustment. For 354 engines, position armature plate on crankcase with retaining screws in the middle of plate slots as shown in **Figure 56**.

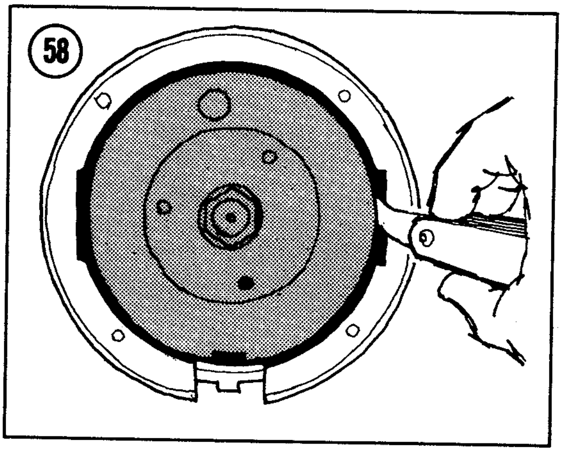
f. Check magneto coil air gap (distance between end of coil and magnet) with a feeler gauge as shown in **Figure 57**. For 354 engines, check gap as shown in **Figure 58**. Refer to **Table 4** for air gap specifications.

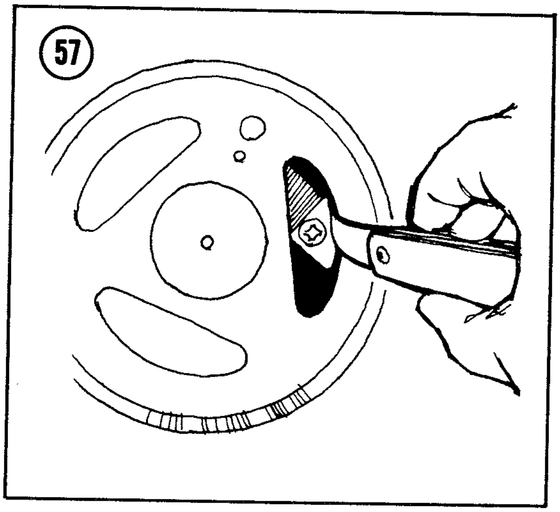
g. Torque the magneto nut as specified in **Table 1**.

h. On models equipped with one-piece cooling shroud, install ignition coil bracket before mounting coils.

i. On 1978 and later models equipped with 440 engines, install fan shroud bolts as shown in **Figure 59**.







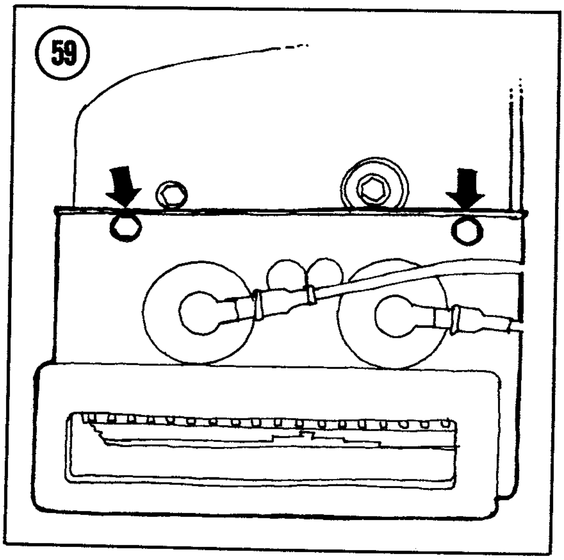


Table 4 MAGNETO AIR GAP SPECIFICATIONS

Engine	Air Gap
247; 302 singles	0.010-0.015 in. (0.25-0.38mm)
354 twin	0.040-0.063 in. (1.0-1.6mm)
All other twins	0.012-0.018 in. (0.30-0.45mm)

j. Perform *Fan Belt Adjustment*.

k. Perform ignition timing as outlined in Chapter Two.

Cylinder Head, Cylinder, Piston, and Ring Removal

Refer to **Figures 60 and 61** for typical examples of air and liquid cooled top end components.

1. Remove engine.
2. Remove flywheel, magneto assembly, and fan housing with cooling shrouds.
3. Remove intake manifold, gaskets, and flanges **(Figure 62)**. Remove air deflector if so equipped **(Figure 63)**.
4. Remove exhaust manifolds **(Figure 64)**. Unscrew exhaust sockets from cylinders on engines so equipped **(Figure 65)**.

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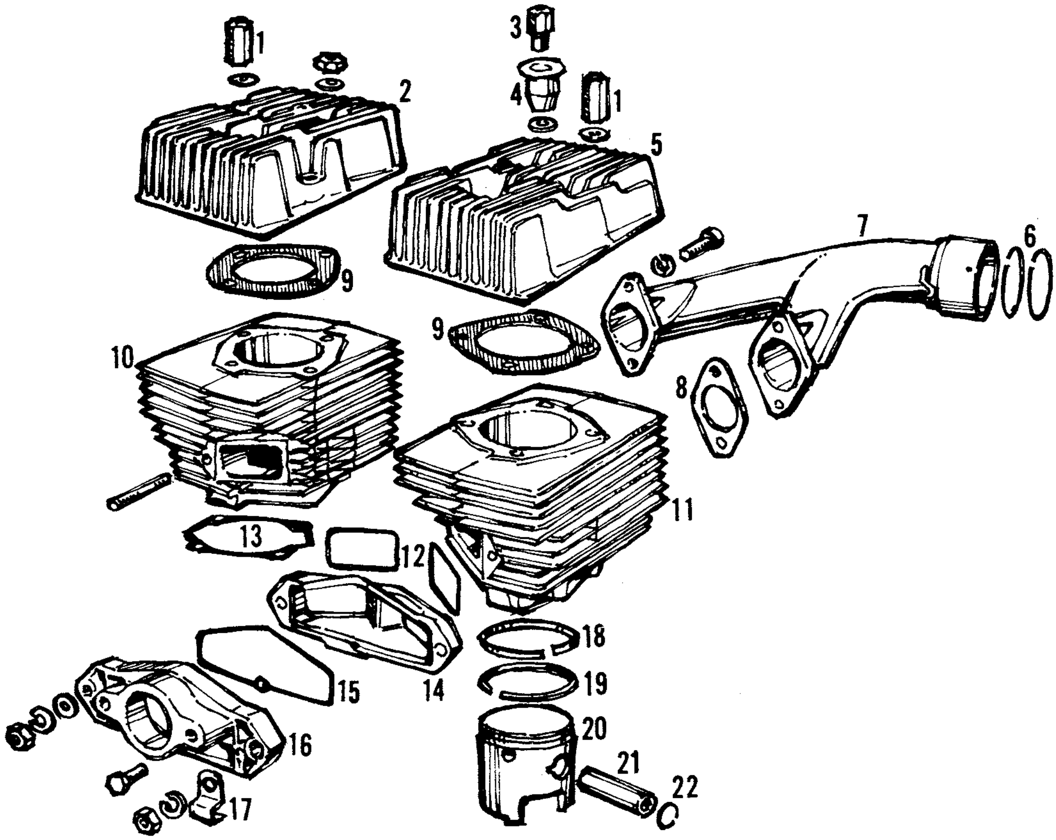
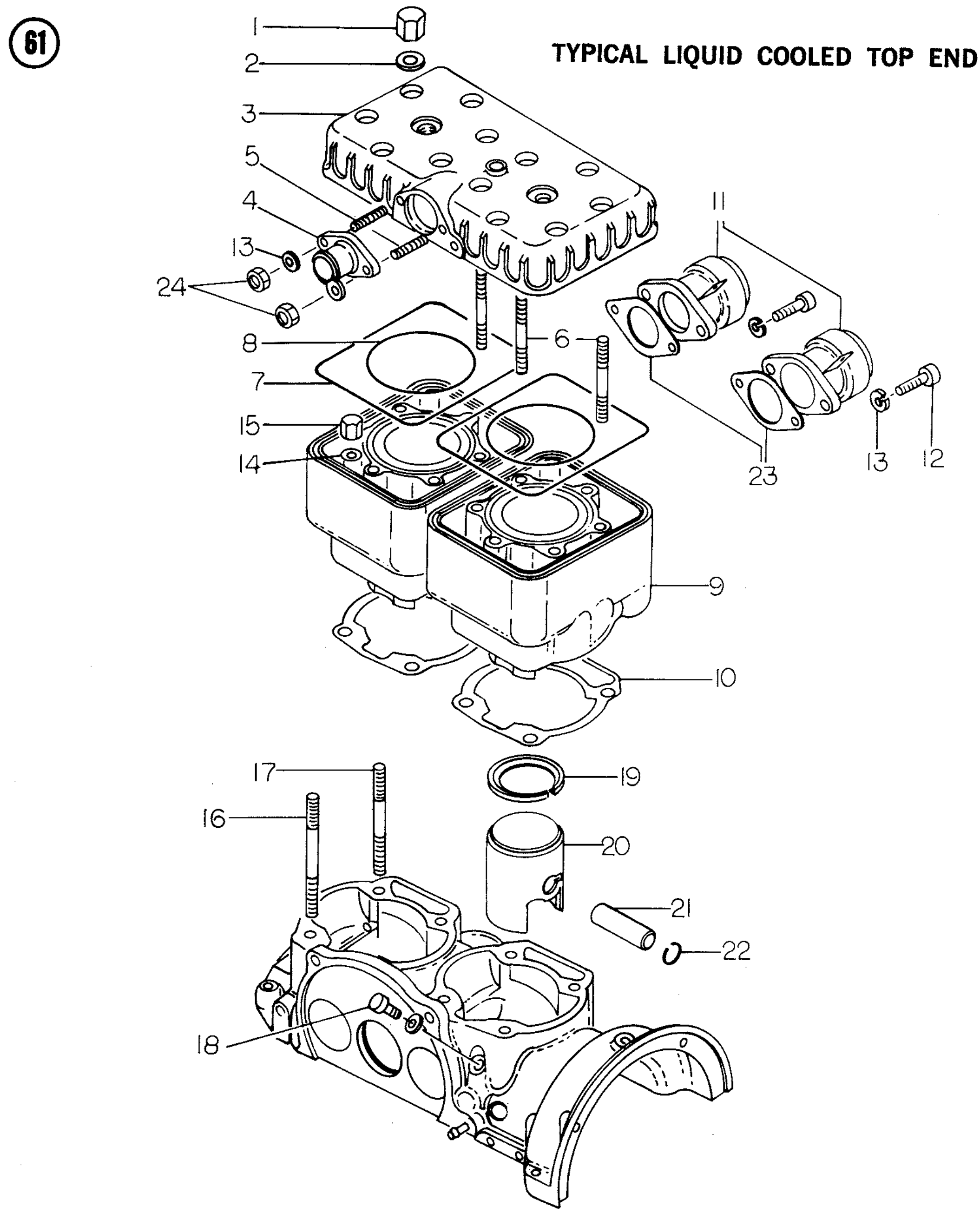
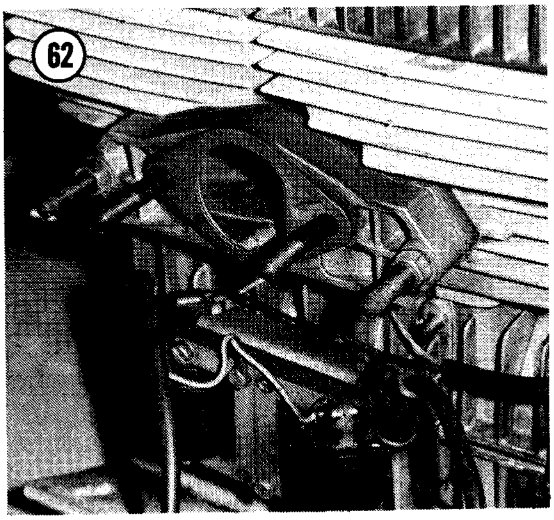


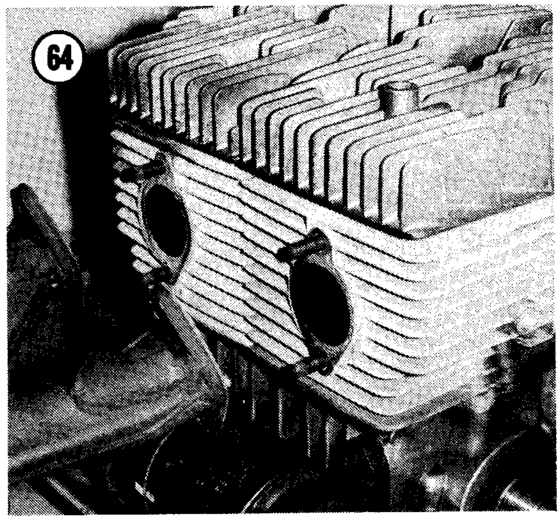
TYPICAL AIR COOLED TOP END

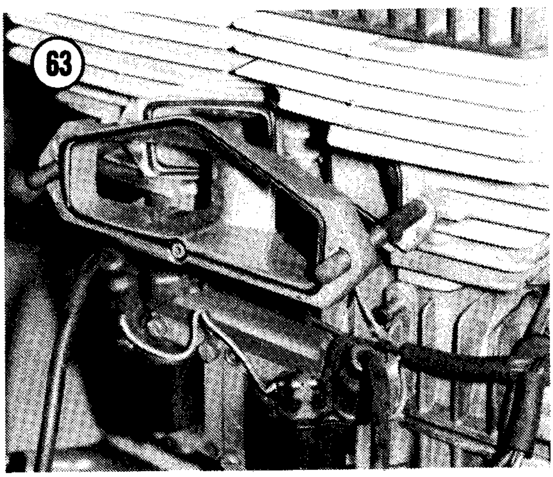
1. Distance nut
2. Cylinder head (P.T.O.)
3. Distance nut (short)
4. Support sleeve
5. Cylinder head (mag.)
6. Sealing ring
7. Exhaust manifold
8. Exhaust gasket
9. Cylinder head gasket
10. Cylinder (P.T.O.)
11. Cylinder (mag.)
12. Gasket
13. Gasket (cylinder/crankcase)
14. Intake manifold
15. Gasket
16. Intake cover
17. H.T. cable bracket
18. L-trapez ring
19. Rectangular ring
20. Piston
21. Gudgeon pin
22. Circlip

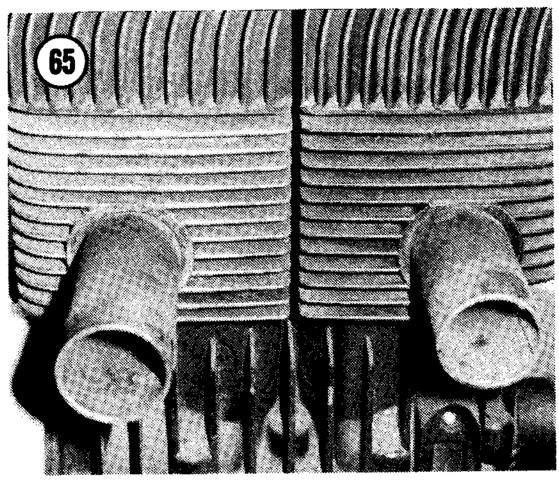


1. Capnut
2. Flat washer
3. Cylinder head
4. Coolant outlet collar
5. Stud
6. Stud (head)
7. Gasket
8. Gasket (O-ring)
9. Cylinder
10. Cylinder/crankcase gasket
11. Exhaust socket
12. Capscrew
13. Lockwasher
14. Flat washer
15. Capnut
16. Cylinder stud (79mm)
17. Cylinder stud (104mm)
18. Bolt
19. L-ring
20. Piston
21. Gudgeon pin
22. Circlip
23. Exhaust gasket
24. Nut



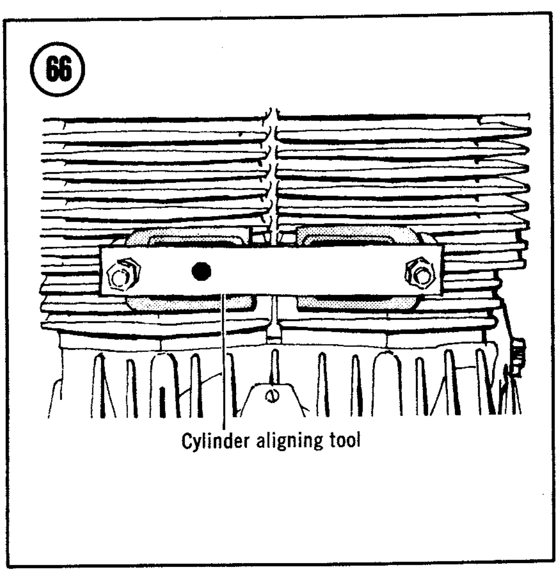


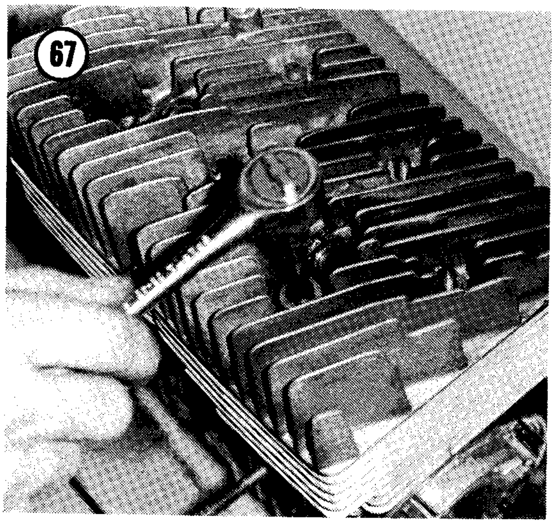


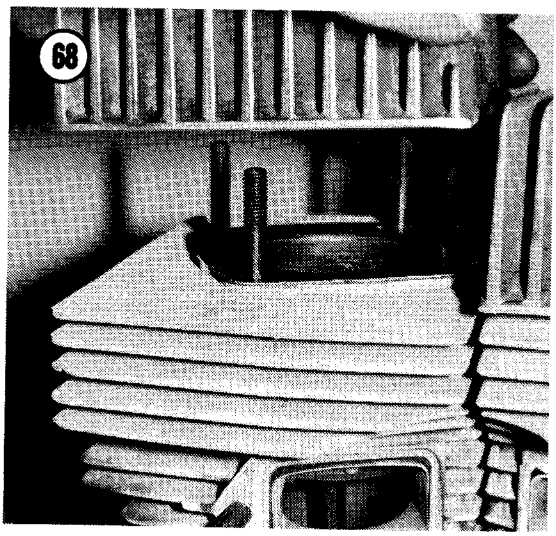


NOTE: *Cylinder installation requires that cylinders be properly aligned before head bolts are tightened. This is accomplished by first installing the intake and/or exhaust manifolds. On models with exhaust sockets and/or twin carburetors, proper alignment cannot be achieved without the use of an alignment tool. Such a tool can easily be locally fabricated from strap or angle iron and drilled to exactly match the manifold studs (**Figure 66**). If it is necessary to locally fabricate such a tool, do so before head bolts are loosened in order for the tool to exactly represent correct cylinder alignment.*

5. Gradually loosen, in a crisscross pattern, then remove nuts securing cylinder heads





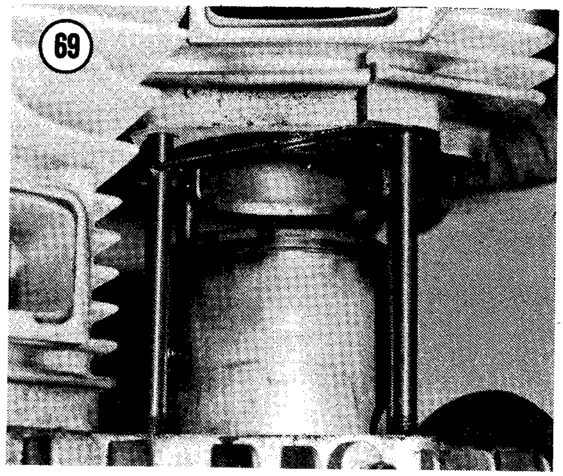


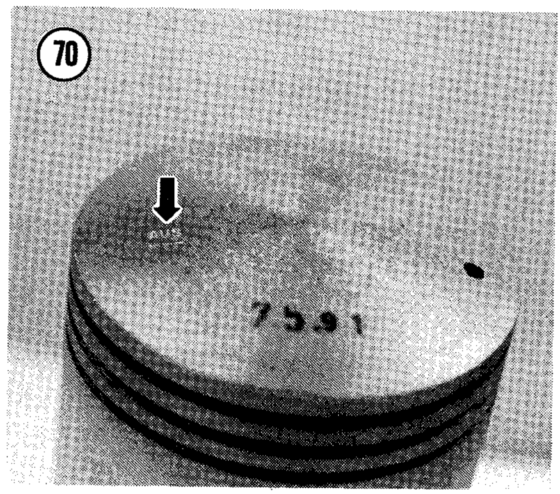
(Figure 67). Note location of long nuts to aid installation. To aid head removal, gently tap head with a rubber mallet. Remove heads and discard old gaskets **(Figure 68)**.

6. Gently slide cylinders up over pistons **(Figure 69)**.

7. Note mark on each piston indicating exhaust side of engine **(Figure 70)**. If no marks are visible, inscribe them accordingly. Also ensure that pistons are marked "1" and "2" since they are not interchangeable, if they are not to be replaced with new ones.

> NOTE: *If rings are going to be changed, but not pistons, rings may now be removed. However, if pistons are going to be removed, leave old rings on pistons to protect ring grooves until new rings are to be installed.*



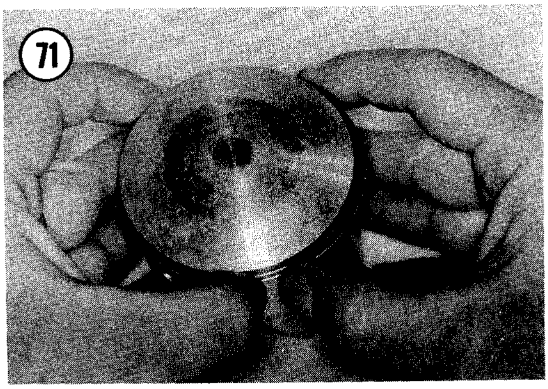


8. Using a ring expander tool or your thumbs on each end of piston ring, gently expand ring and slide up and off piston **(Figure 71)**.

9. Be sure pistons are appropriately marked. Remove circlips from each end of piston pins **(Figure 72)**.

> NOTE: *Stuff clean rags around connecting rods in crankcase to help prevent circlips from dropping into crankcase.*

Using a piston pin removal tool or an appropriately sized wooden dowel, gently remove pins from piston and connecting rod **(Figure 73)**.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CAUTION
Exercise care when removing pins to avoid damaging connecting rod needle bearings. If a wooden dowel is used to drive out piston pins, ensure that piston is properly supported so lateral shock is not transmitted to lower connecting rod bearing, otherwise rod and/or bearing damage may occur.

Remove needle bearings from connecting rods **(Figure 74)**.

10. Refer to *Component Inspection* and inspect cylinders, pistons, pins, and rings.

Cylinder Head, Cylinder, Piston and Ring Installation

1. Lubricate piston pin needle bearings with oil and insert bearings into connecting rods.
2. Slide piston over connecting rod. Be sure that the mark or letters AUS face exhaust side of engine **(Figure 70)**.
3. Using piston pin installation tool or appropriately sized wooden dowel, install piston pins through piston and rod ends **(Figure 73)**.

CAUTION
Exercise care when installing pins to avoid damage to connecting rod needle bearings. If a wooden dowel is used to drive in piston pins, ensure that piston is properly supported so lateral shock is not transmitted to lower connecting rod bearing; otherwise rod and/or bearing damage may occur.

4. Secure piston pins to pistons with circlips. When circlip is properly installed in groove,


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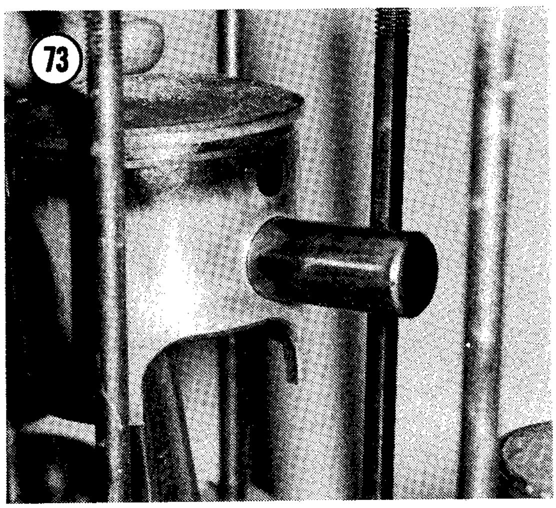
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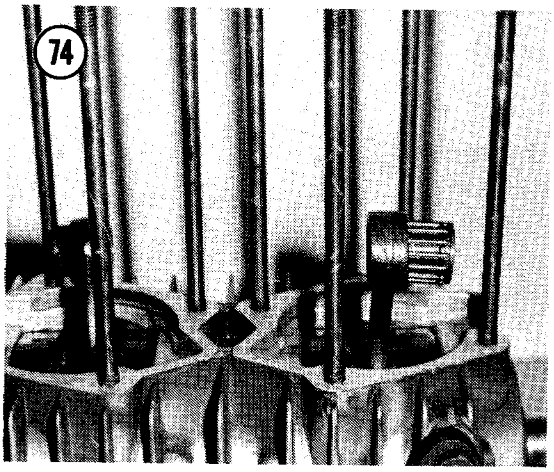
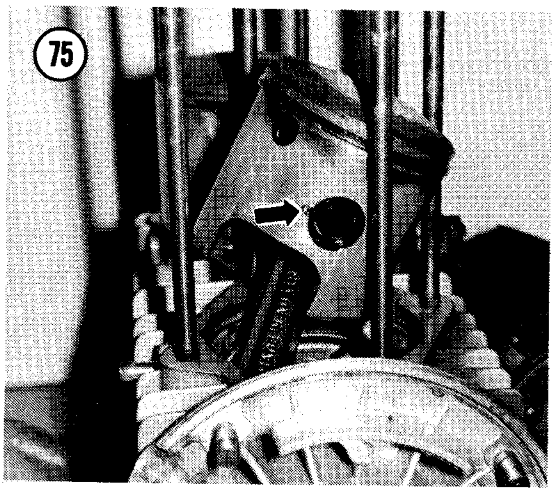
rotate circlip so gap in clip is not directly on notch break of piston **(Figure 75)**.

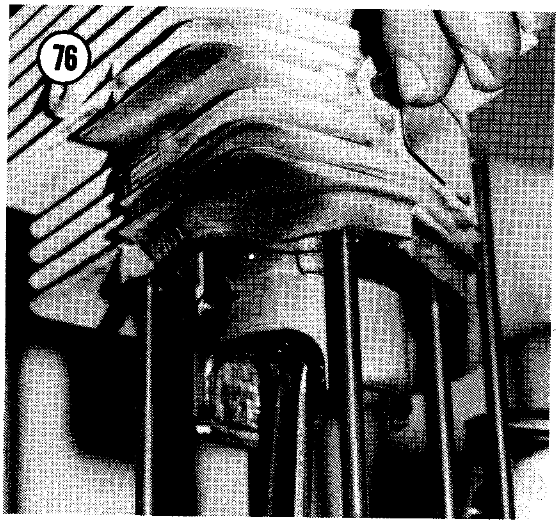
NOTE: *Stuff clean rags around connecting rods in crankcase to help prevent circlip from dropping into crankcase.*

CAUTION
If possible, use new circlips to secure piston pins. If old circlips are used, they must snap securely into grooves in pistons. A weak circlip could become disengaged during engine operation and cause severe engine damage.

5. Using a ring expander tool, or your thumbs on each end of piston ring, gently expand ring







and slide over piston into ring groove (**Figure 71**). Install ring in bottom groove first. Be sure that ring groove clearance is within tolerance as outlined in *Component Inspection*.

> NOTE: *Be sure ring end "V" is properly positioned in ring groove.*

6. Install new cylinder base gaskets.

7. Thoroughly lubricate pistons, rings, and cylinder bores with engine oil.

8. Install cylinder over studs. Ensure that exhaust ports face exhaust side of engine. Compress rings with your fingers and slide cylinders down over piston (**Figure 76**).

CAUTION

Cylinders must be properly aligned before head nuts are tightened or serious engine damage may result.

9. On liquid-cooled models, keep the following points in mind:

   a. Cylinder stud length must be correct or the cap nuts will not tighten completely. Refer to **Figure 77** for 354 engines and **Figure 78** for 444 engines. If stud length is excessive, washers must be added under cap nuts to prevent nuts from bottoming on studs.

   b. Longer threaded portion of studs should be screwed into crankcase.

   c. On 354 engines, temporarily install cylinder head to align both cylinders. Torque cylinder nuts in a crisscross pattern to 12 ft.-lb. (1.6 mkg).

10. Install intake and exhaust manifolds with new gaskets on cylinders. On models with twin carburetors or exhaust sockets, install alignment tool as described in removal procedure (**Figure 66**). Tighten nuts securing manifolds and/or alignment tool.

11. Install cylinder heads with new head gaskets. On liquid-cooled models, apply silicone sealant around studs and washer seats before installing head cap nuts. Install head nuts making sure long and short nuts are properly positioned (**Figure 79**).

12. On air-cooled models, tighten head nuts in a crisscross pattern, each head separately. Refer to **Figure 80** for liquid-cooled models. Torque all nuts to 10 ft.-lb. (1.4 mkg) then to value specified in **Table 1**.

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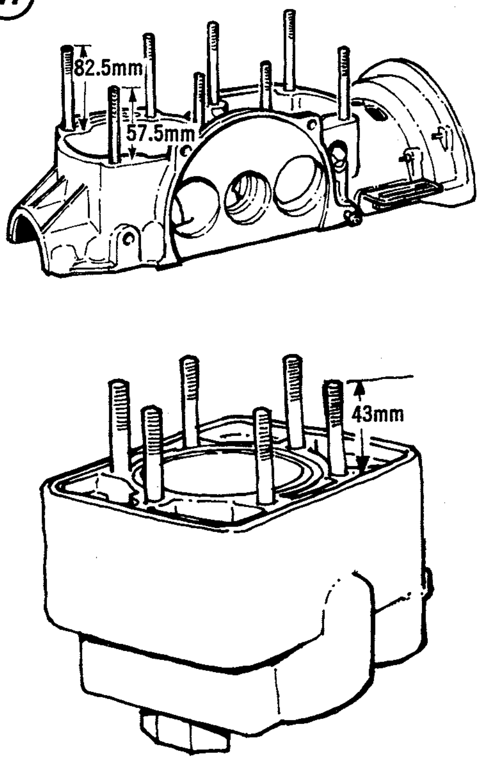

354 ENGINES

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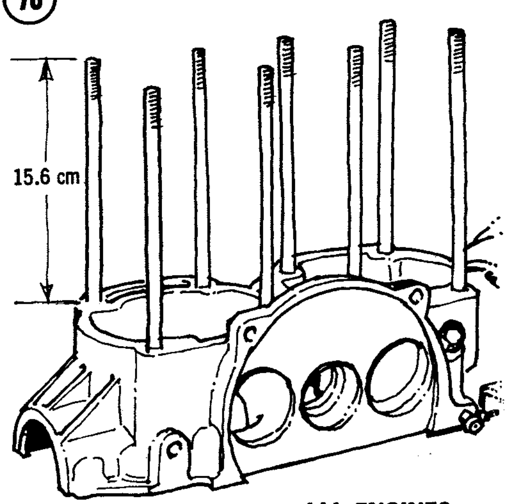

444 ENGINES

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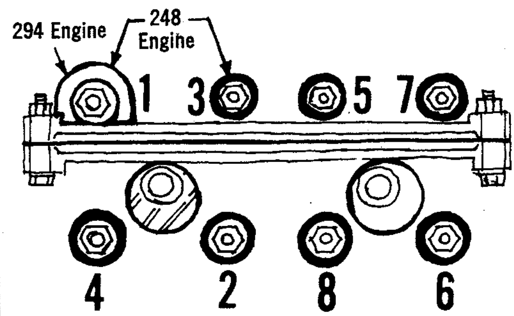
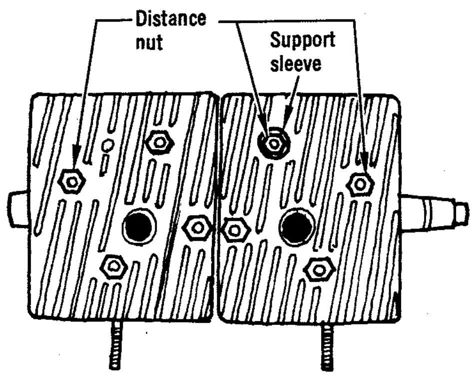
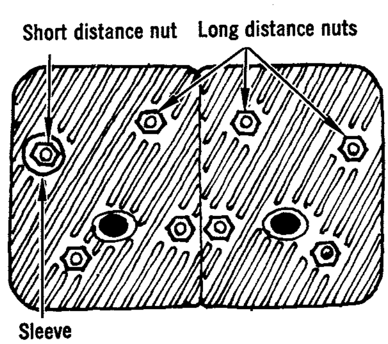


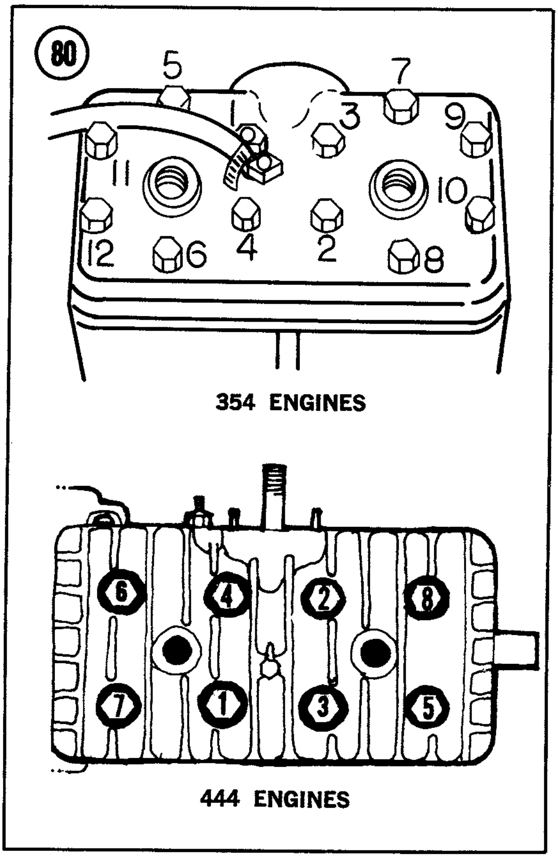
248, 294 ENGINES

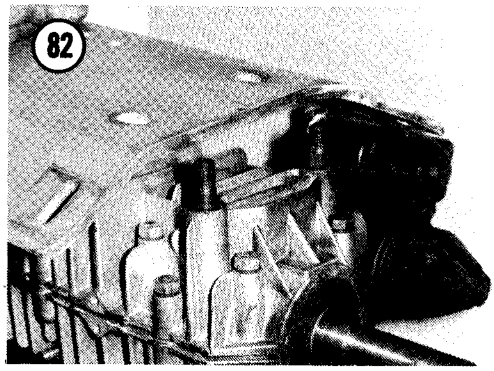


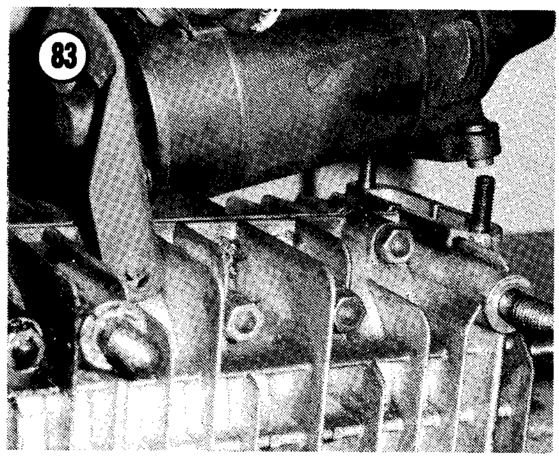
440 ENGINES (1978 AND LATER)

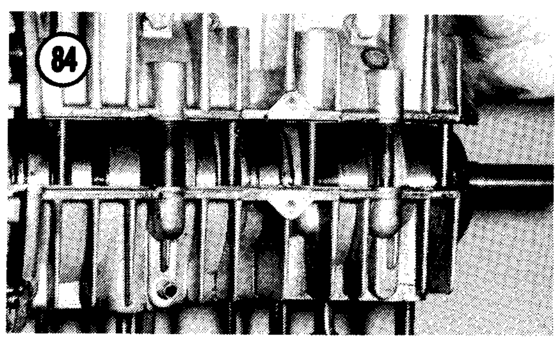


305, 343 AND 402 ENGINES









13. Install exhaust sockets or exhaust manifold. Shorter socket is installed on the PTO (power take off) side of the engine.

14. Install intake manifold, flywheel, magneto assembly, and fan housing with cooling shrouds.

15. Install engine.

Crankshaft Assembly Removal

Refer to **Figure 81** for a typical crankshaft assembly.

1. Remove cylinder heads, cylinders and pistons.

2. On rotary valve models perform *Rotary Valve Removal*.

3. Remove engine mount from crankcase if not previously performed (**Figure 82**).

4. Remove electric starter on models so equipped (**Figure 83**).

5. Remove nuts securing crankcase halves together.

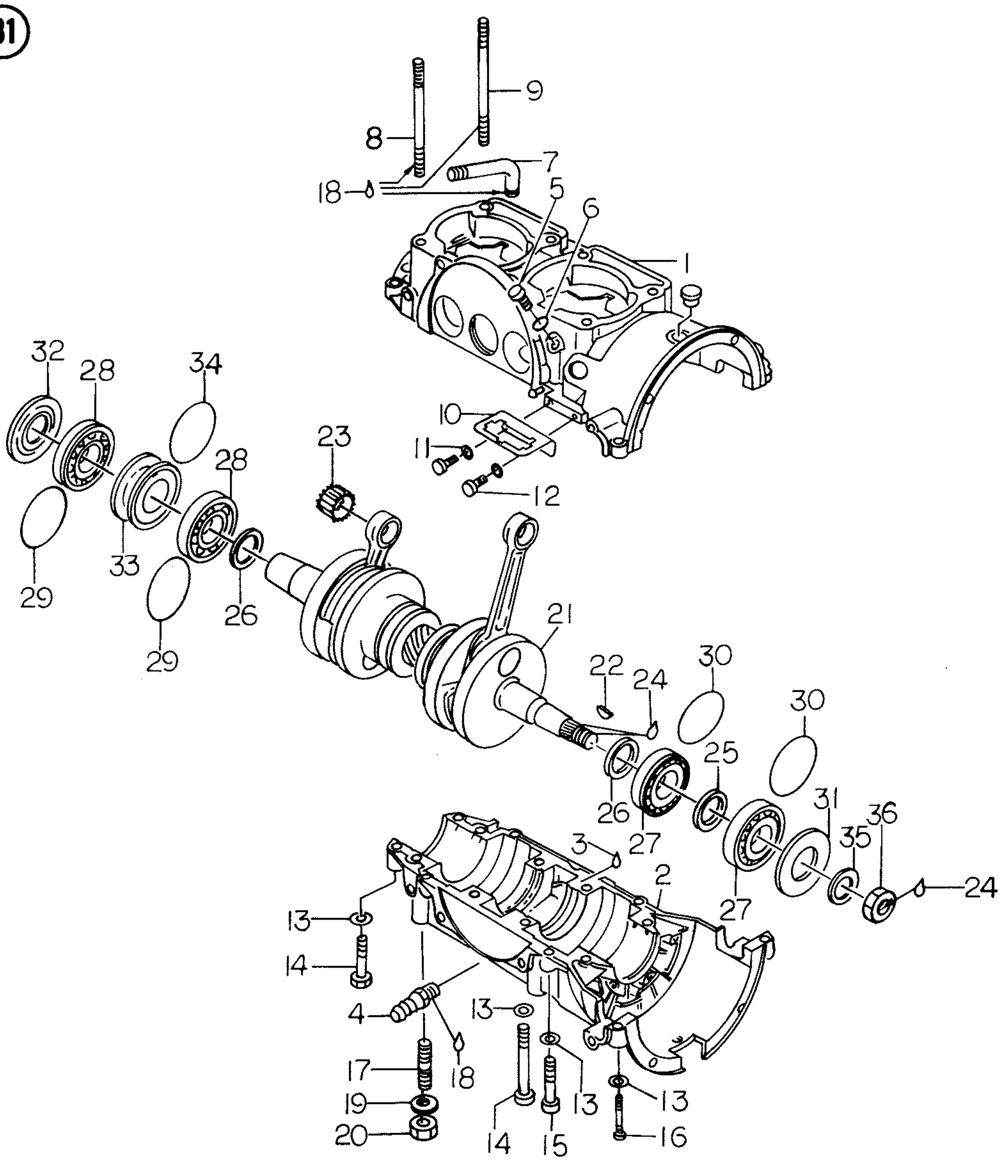
6. Tap upper crankcase half lightly with a soft mallet and separate crankcase halves (**Figure 84**).

CAUTION

Never attempt to pry crankcase halves apart with screwdriver or similar object or crankcase sealing surface will be damaged.

7. Gently lift up and remove crankcase assembly (**Figure 85**).

81



TYPICAL CRANKSHAFT ASSEMBLY

1. Crankcase (upper half)
2. Crankcase (lower half)
3. Crankcase sealant
4. Oil fitting
5. Bolt (M8 x 16)
6. Sealing ring
7. Angular tube (oil)
8. Cylinder stud (79mm)
9. Cylinder stud (104mm)
10. Junction block support
11. Lockwasher
12. Screw
13. Lockwasher
14. Bolt
15. Capscrew
16. Bolt
17. Stud
18. Loctite 242
19. Lockwasher
20. Nut
21. Crankshaft
22. Woodruff key
23. Needle cage bearing
24. Loctite 242
25. Distance ring (2mm)
26. Distance ring
27. Bearing
28. Bearing
29. O-ring
30. O-ring
31. Oil seal (mag.)
32. Oil seal (P.T.O.)
33. Labyrinth sleeve
34. O-ring
35. Lockwasher
36. Nut

8. Perform crankshaft assembly and crankcase inspection as outlined in *Component Inspection*. Refer all crankcase assembly repair and service work to an authorized dealer or competent machine shop. They are equipped with the necessary special tools and expertise for the task.

Crankshaft Assembly Installation

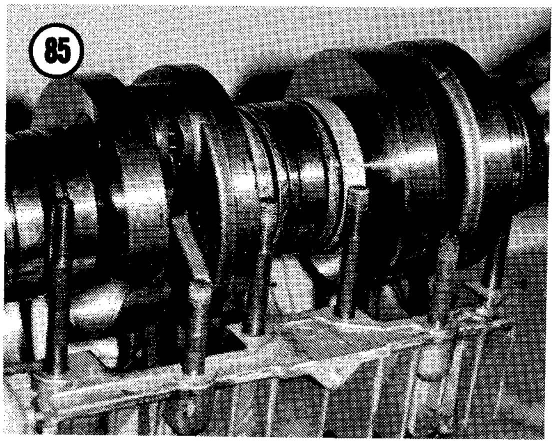
1. Check the condition of O-rings on outer bearing races. The O-rings are necessary to keep the outer bearing races from turning in the crankcase. Replace O-rings if necessary.

NOTE: *On 503 engines the O-rings are replaced by rubber buttons.*

2. Install crankshaft assembly into lower crankcase half. Thoroughly lubricate crankshaft and bearings with engine oil.

CAUTION
If crankshaft and/or crankcase has been repaired or replaced, ensure that end play is properly set by an authorized dealer or machine shop. See Table 3.

3. Check that crankcase sealing surfaces are clean and not damaged. Apply an even coat of silicone rubber adhesive to sealing surfaces on both crankcase halves. Make sure no rubber adhesive runs into crankcase.
4. Install upper crankcase half. Check that the seals are correctly positioned and are not cocked down.
5. Install nuts, flat washers, and lockwashers and tighten evenly in sequence (**Figure 86**).

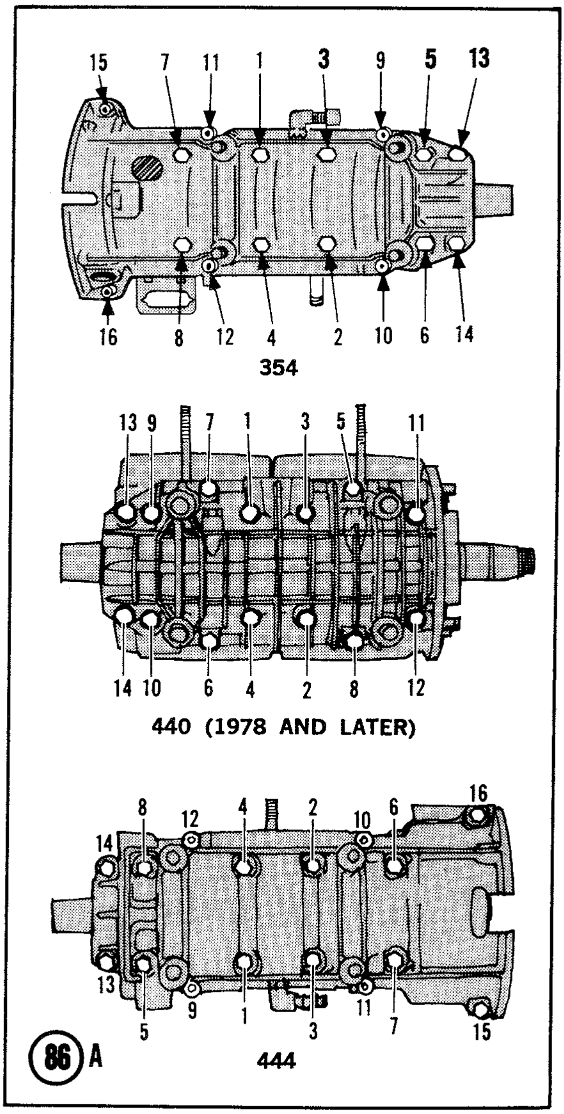


Torque nuts as specified in **Table 1**. Keep the following points in mind:

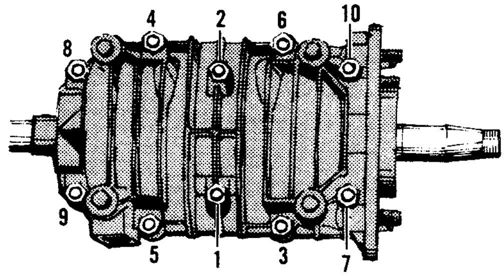
a. On 245, 345, 346, 396, and 436 engines, spring washers are *not* installed on last 2 magneto side studs.
b. On 248cc and 294cc engines, torque 2 smaller nuts on magneto side to 9 ft.-lb. (1.2 mkg).
c. On 354 engines, torque 2 smaller bolts on magneto side to 10 ft.-lb. (1.3 mkg).

Rotary Valve Removal/Installation

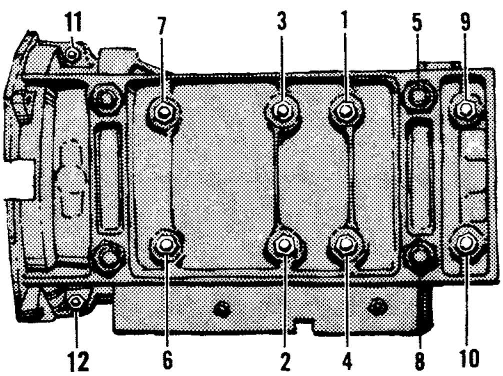
Refer to **Figure 87** for a typical rotary valve assembly.



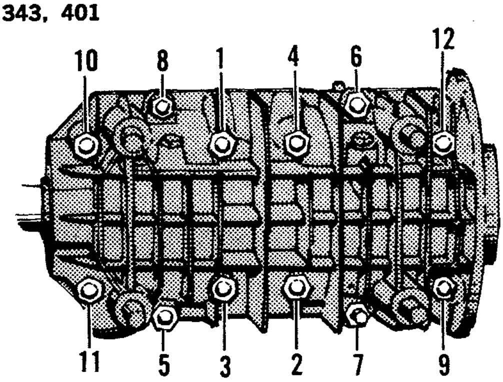
86 B



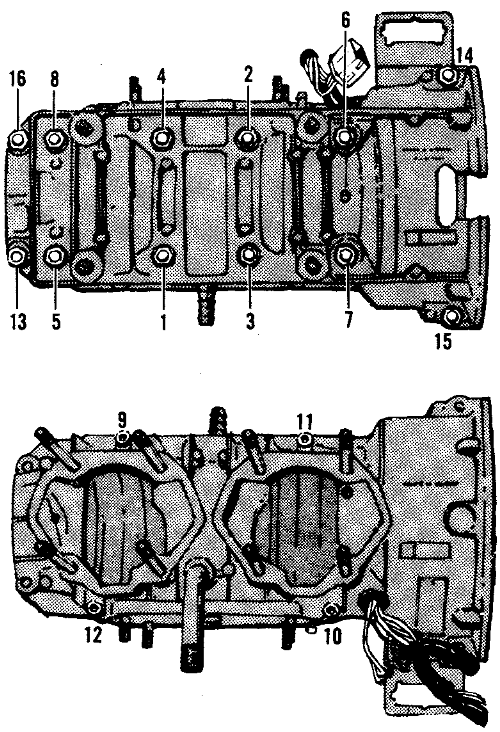
305, 338, 343, 401



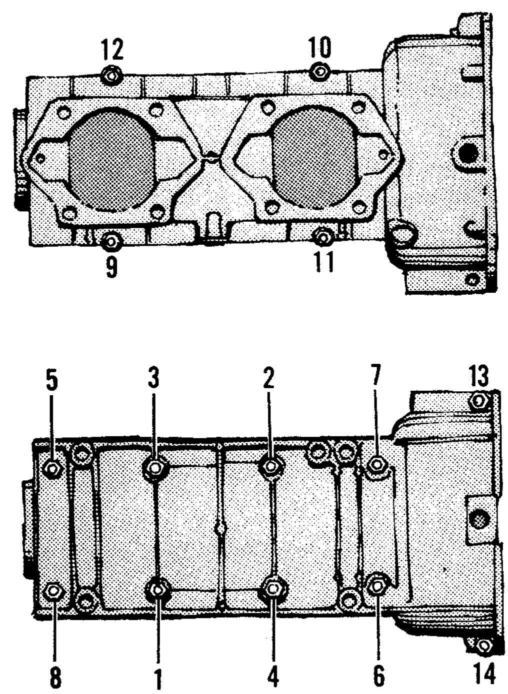
248, 294



434, 440 (TO 1977)

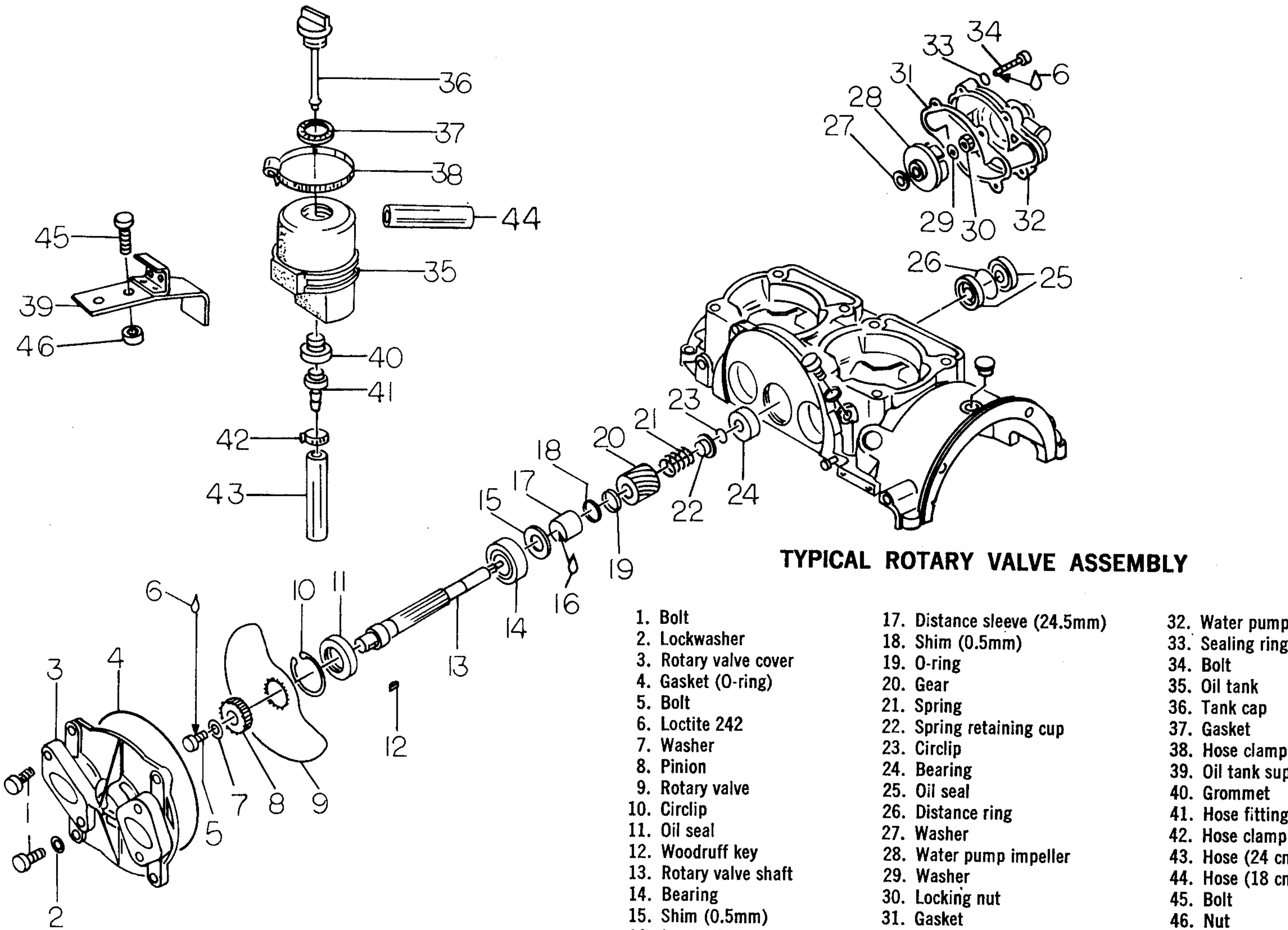


245, 345



346, 396, 436

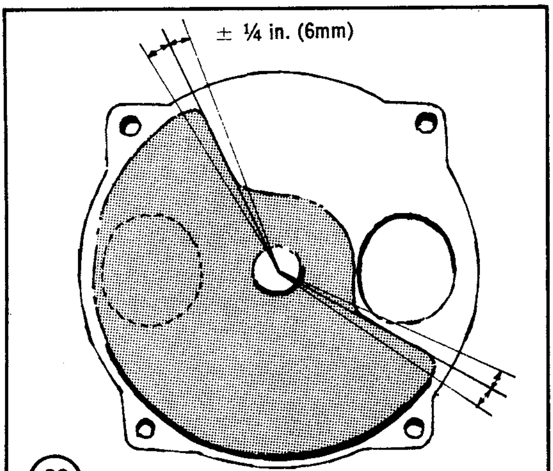
87



TYPICAL ROTARY VALVE ASSEMBLY

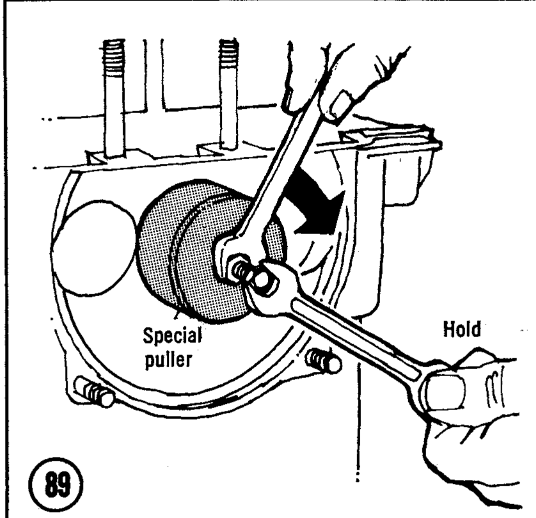
1. Bolt
2. Lockwasher
3. Rotary valve cover
4. Gasket (O-ring)
5. Bolt
6. Loctite 242
7. Washer
8. Pinion
9. Rotary valve
10. Circlip
11. Oil seal
12. Woodruff key
13. Rotary valve shaft
14. Bearing
15. Shim (0.5mm)
16. Loctite 271
17. Distance sleeve (24.5mm)
18. Shim (0.5mm)
19. O-ring
20. Gear
21. Spring
22. Spring retaining cup
23. Circlip
24. Bearing
25. Oil seal
26. Distance ring
27. Washer
28. Water pump impeller
29. Washer
30. Locking nut
31. Gasket
32. Water pump housing
33. Sealing ring
34. Bolt
35. Oil tank
36. Tank cap
37. Gasket
38. Hose clamp
39. Oil tank support
40. Grommet
41. Hose fitting
42. Hose clamp
43. Hose (24 cm)
44. Hose (18 cm)
45. Bolt
46. Nut

4



88

Magneto side piston must be at TDC



89

1. Remove carburetors and rotary valve cover. Note location of large O-ring gasket behind rotary valve cover.

2. Mark outside of valve disc with a felt tip pen to assist valve installation. Remove screw and washer retaining valve disc and remove disc.

3. To install valve disc, perform the following:

   a. Rotate magneto side piston to TDC (top dead center). Use dial indicator-type timing gauge as described in Chapter One.
   b. Position rotary valve on gear so edges align within ¼ in. (6mm) of timing marks on each side **(Figure 88)**.

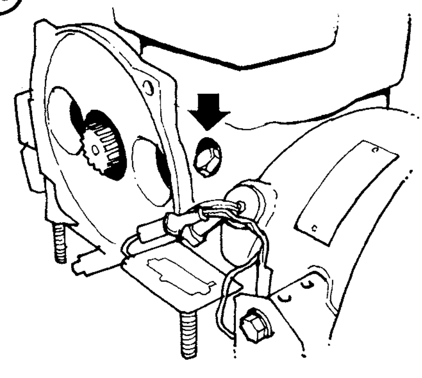
   NOTE: *If timing marks are not visible, perform **Rotary Valve Timing.***

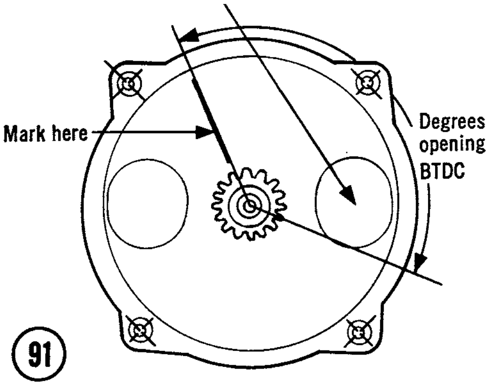
   c. Rotary valve disc is asymmetrical. Position each side of valve disc on gear to determine position in which greater alignment accuracy can be achieved.

4. If rotary valve shaft assembly removal is desired, perform the following:

   a. Remove circlip securing shaft assembly (10, **Figure 87**).
   b. On liquid-cooled models remove water pump housing and water pump impeller.
   c. Install special puller **(Figure 89)** and remove shaft assembly. If puller is not available, refer task to an authorized dealer. Refer shaft component inspection and repair to a dealer.

90





91

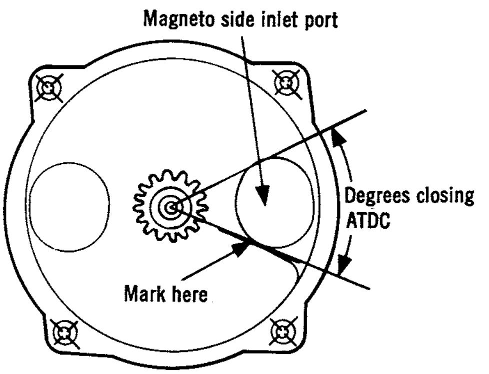
5. Secure valve disc with washer and screw. Install rotary valve cover. Ensure that O-ring is properly positioned. Install carburetors.

Rotary Valve Timing

Refer to **Table 5** for timing specifications.

1. Perform *Rotary Valve Removal.*
2. Rotate magneto side piston to TDC (top dead center). Use a dial indicator-type timing gauge as described in Chapter One. On 354 engines, install special locking bolt to hold magneto side piston at TDC **(Figure 90)**.
3. Use a protractor or degree wheel and mark BTDC opening point from *bottom* edge of magneto side inlet port as shown in **Figure 91**.

92



4. With protractor or degree wheel mark ATDC closing point from *top* edge of inlet port as shown in **Figure 92**.
5. Proceed to Step 3b of *Rotary Valve Installation.*

Cooling Fan Disassembly/Assembly

This procedure requires a special tool to remove fan from fan housing. If special tool or locally fabricated equivalent is not available, refer task to an authorized dealer.

Refer to **Figure 93** for a typical cooling fan assembly.

1. Remove fan housing.
2. Install fan holder tool to hold fan and remove fan nut **(Figure 94)**.
3. Remove lockwasher with outer half of pulley, shims, inner pulley, shim, Woodruff key and fan **(Figure 95)**.

NOTE: *Newer type pulley half is constructed without a shoulder on the inner face (Figure 96). A 0.230 in. (6mm) spacer must be installed with a new style pulley half.*

4. Remove bearings from fan housing.

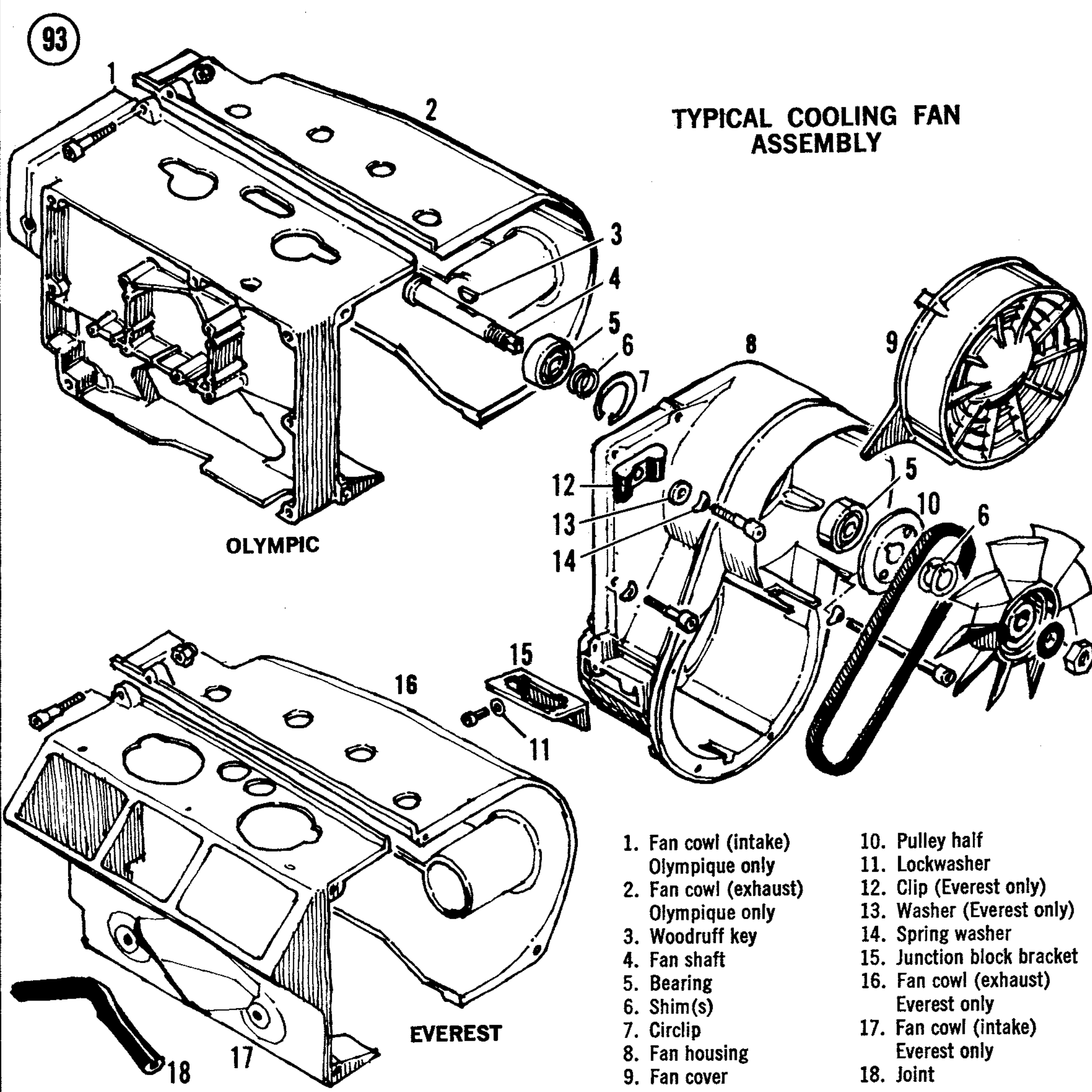
NOTE: *It may be necessary to heat fan housing in an oven to 140°-160°F (60°-71°C) to aid bearing removal. Use a hammer and a block of wood to gently tap bearings from housing.*

5. Remove 2 shims from between bearings when bearings are removed. Remove circlip from fan housing if desired.

Table 5 ROTARY VALVE TIMING SPECIFICATIONS

Engine	Degrees Opening B.T.D.C.	Degrees Closing A.T.D.C.
245, 345	127	48
354 (1978)	131	52
(1979)	132	50
444 (1978)	140	51
(1979)	139	49
454	137	65

93



1. Fan cowl (intake) Olympique only
2. Fan cowl (exhaust) Olympique only
3. Woodruff key
4. Fan shaft
5. Bearing
6. Shim(s)
7. Circlip
8. Fan housing
9. Fan cover
10. Pulley half
11. Lockwasher
12. Clip (Everest only)
13. Washer (Everest only)
14. Spring washer
15. Junction block bracket
16. Fan cowl (exhaust) Everest only
17. Fan cowl (intake) Everest only
18. Joint

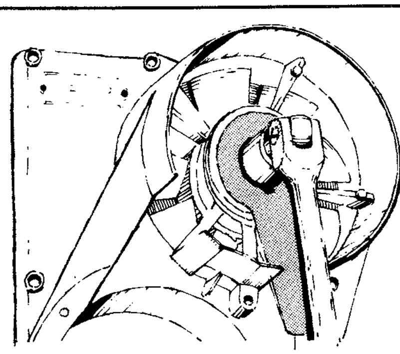
6. Carefully inspect bearings for evidences of roughness or excessive wear and replace if necessary. Refer to *Component Inspection*.

7. Assembly is the reverse of these steps. Keep the following points in mind:

   a. Lubricate bearings with light oil and insert one bearing into housing. Heat fan housing if necessary to aid bearing installation.

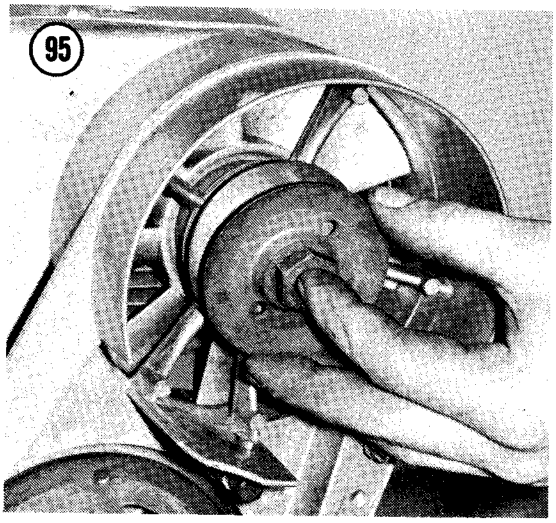
   b. Install 2 washers against face of installed bearing and install second bearing. Bearing shields must face outward.

94



Special wrench holder

95



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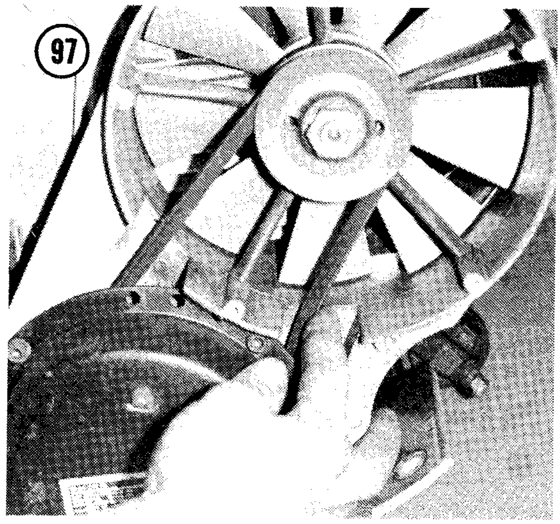

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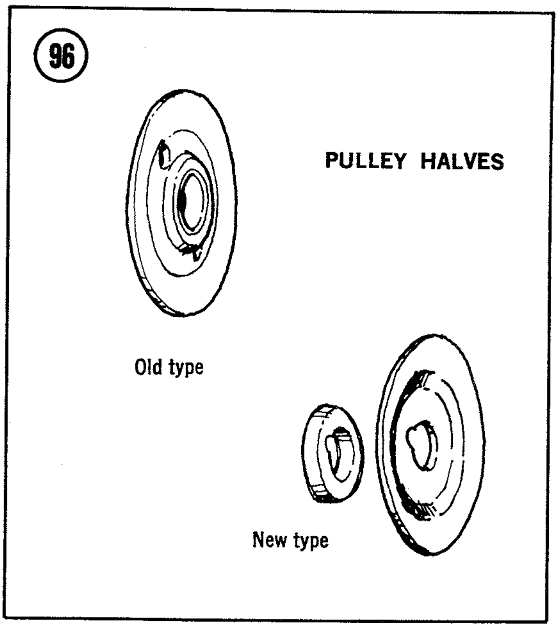

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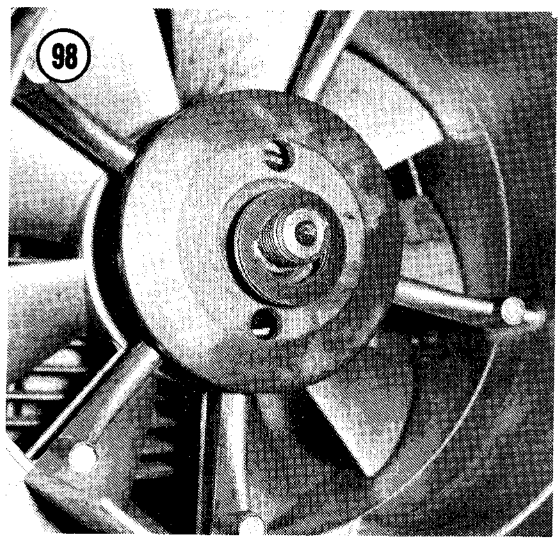


c. Do not tighten fan nut at this time. Install fan housing and perform *Fan Belt Adjustment*.

Fan Belt Adjustment

1. Check fan belt for approximately ¼ in. (6mm) deflection as shown in **Figure 97**.

2. If belt tension is incorrect, remove fan protector. Use special holding tool to hold fan and remove fan nut **(Figure 94)**.

3. Remove or install shims between inner and outer pulley halves until specified tension is achieved. Extra shims can be stored under the fan nut (**Figure 98**).

4. Torque fan nut as specified in **Table 1**. Recheck fan belt tension and readjust if necessary.

5. Install fan protector onto fan housing.

RECOIL STARTER

Removal/Installation

Remove 4 bolts securing recoil starter assembly to engine and lift off starter **(Figure 99)**. Installation is the reverse of removal.

Disassembly

Refer to **Figure 100** for this procedure.

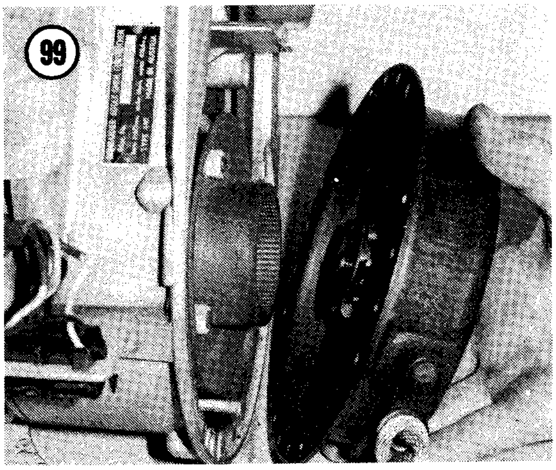
1. Pull out rope and hold. Use an ice pick or similar sharp tool and disengage key clamp from rope **(Figure 101)**. Remove rope from sheave and hand grip.

> NOTE: *On some early models, starter rope was secured by a jam pin through the center of the sheave hub. On these models, remove circlip, cover washer, and pivoting arm assembly to expose rope end loop and jam pin on back of sheave. Remove rope from sheave, taking care not to lose jam pin.*

2. Remove circlip, cover washer, and pivot arm assembly complete with friction washers. Do not disassemble pivot arm assembly unless worn and replacement parts are necessary.
3. Remove "D" washer and rope sheave.
4. Gently tap on outside starter housing to remove spring cartridge.
5. Pry spring cartridge open with a small screwdriver and remove spring.

WARNING
Exercise great care when opening spring cartridge. Spring is tightly wound and may fly out causing injury.

99



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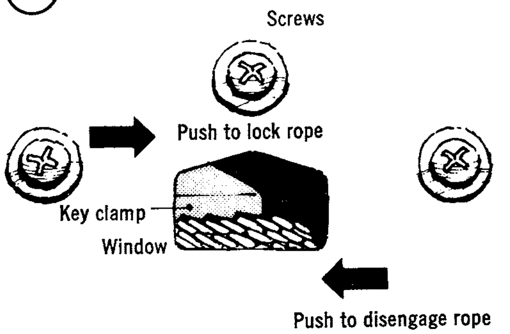

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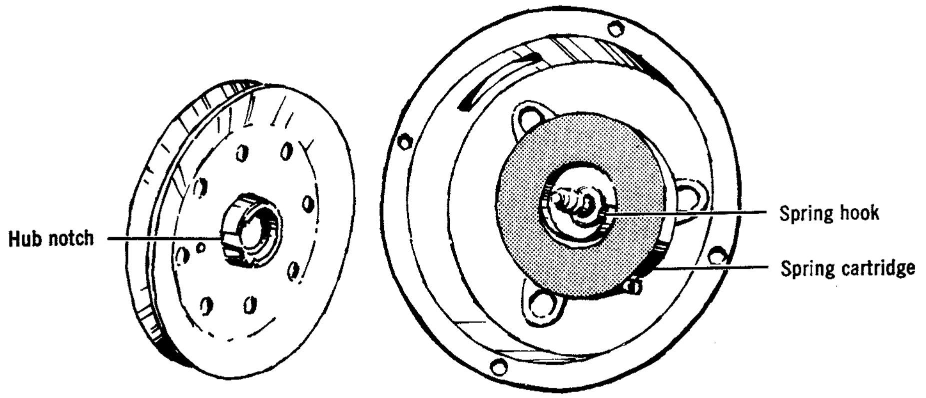


Assembly

1. Wind spring into smaller half of cartridge case. Lightly grease spring as it is wound into case. Install case cover.

2. Install spring cartridge in starter housing with large opening of cartridge facing up. Gently tap cartridge into place.

3. Install rope sheave in housing and align notch in sheave with spring hook **(Figure 102)**.

> NOTE: *On early model jam pin starters, secure rope end in sheave with jam pin and tap rope end until it is flush with back of sheave.*

4. Install "D" washer and complete pivot arm assembly with friction washers.

5. Secure pivot arm assembly with circlip. Ensure that pivot arm is positioned so that arm can turn clockwise.

6. Fuse rope ends with a match.

7. Install rope end in hand grip and secure with knot.

8. Rotate sheave counterclockwise 6 turns to wind up rewind spring and hold.

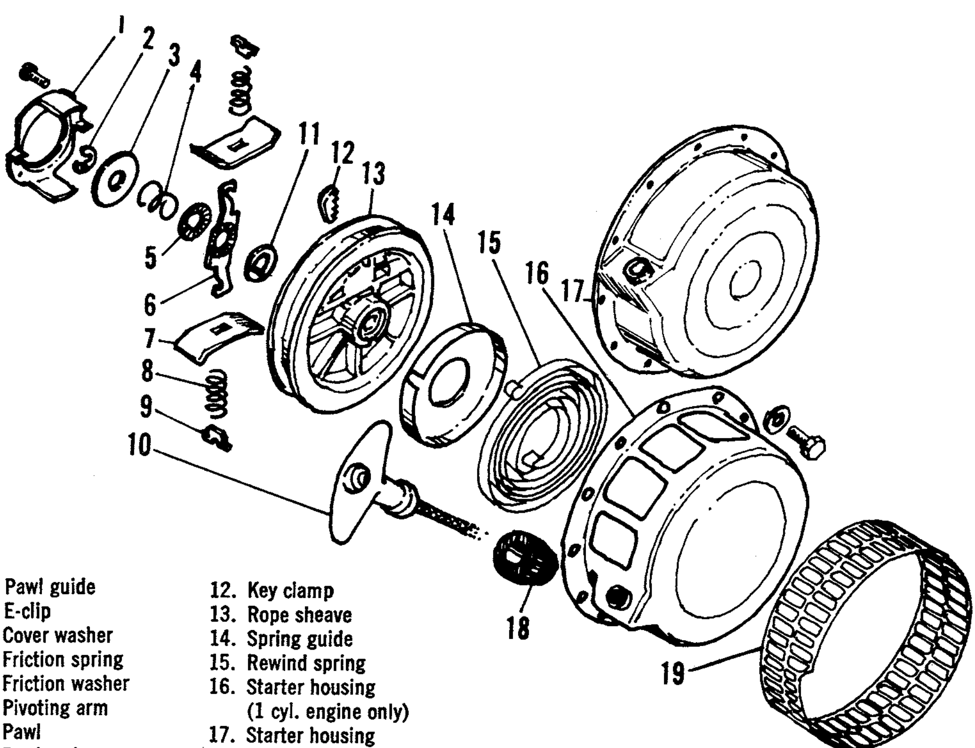
9. Look through rope hole in starter housing and turn sheave until hole in sheave aligns with hole in housing.

10. Route rope through housing and into sheave hole until approximately ¾ in. (19mm) of rope is visible in housing.

11. Install key in housing and push key to lock rope **(Figure 101)**.

(100)

STARTER ASSEMBLY



1. Pawl guide
2. E-clip
3. Cover washer
4. Friction spring
5. Friction washer
6. Pivoting arm
7. Pawl
8. Pawl spring
9. Pawl spring stop
10. Starter grip
11. D-washer
12. Key clamp
13. Rope sheave
14. Spring guide
15. Rewind spring
16. Starter housing (1 cyl. engine only)
17. Starter housing
18. Rubber buffer
19. Protection sleeve (1 cyl. engine only)

Table 1 TORQUE SPECIFICATIONS

Engine	Engine Assembly to Frame	Engine Mount to Crankcase	Crankcase Bolts/Nuts	Cylinder Head Nut	Magneto Nut	Fan Nut	Intake/Exhaust Manifold Bolt/Nut
247* and 302	22-25 ft.-lb. (3.0-3.5 mkg)	to 1973 50 ft.-lb. (6.9 mkg) 1974 and later 23-29 ft.-lb. (3.2-4.0 mkg)	16 ft.-lb. (2.2 mkg)	to 1973 16-18 ft.-lb. (0.8-2.5 mkg) 14-16 1974 and later 14-16 (1.9-2.2)	50-56 ft.-lb. (6.9-7.7 mkg)	N/A	16 ft.-lb. (2.2 mkg)
245 and 345	22-25 ft.-lb. (3.0-3.5 mkg)	to 1977 23-29 ft.-lb. (3.2-4.0 mkg) 1978 and later 26 ft.-lb. (3.6 mkg)	16 ft.-lb. (2.2 mkg) Allen cap screws to 7 ft.-lb. (1.0 mkg)	to 1977 16-18 ft.-lb. (2.2-2.5 mkg) 1978 and later 12 ft.-lb. (1.5 mkg)	58-62 ft.-lb. (8.0-8.6 mkg)	N/A	16 ft.-lb. (2.2 mkg)
248 and 294	22-25 ft.-lb. (3.0-3.5 mkg)	23-29 ft.-lb. (3.2-4.0 mkg)	16 ft.-lb. (2.2 mkg) Bolts 11, 12 9 ft.-lb. (1.2 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	to 1977 42-50 ft.-lb. (5.8-6.9 mkg) 1978 and later 46 ft.-lb. (6.4 mkg)	to 1973 12-17 ft.-lb. (1.7-2.3 mkg) 1974 and later 42-50 ft.-lb. (5.8-6.9 mkg)	15 ft.-lb. (2.1 mkg)
305, 338, 343, 401, and 402	22-25 ft.-lb. (3.0-3.5 mkg)	23-29 ft.-lb. (3.2-4.0 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	to 1977 42-50 ft.-lb. (5.8-6.9 mkg) 1978 and later 60 ft.-lb. (8.3 mkg)	to 1973 12-17 ft.-lb. (1.7-2.3 mkg) 1974 and later 42-50 ft.-lb. (5.8-6.9 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)
346, 396, and 436	22-25 ft.-lb. (3.0-3.5 mkg)	30-35 ft.-lb. (4.1-4.8 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	58-62 ft.-lb. (8.0-8.6 mkg)	N/A	14-16 ft.-lb. (1.9-2.2 mkg)
354	22-25 ft.-lb. (3.0-3.5 mkg)	26 ft.-lb. (3.6 mkg)	16 ft.-lb. (2.2 mkg) Bolts 15, 16 10 ft.-lb. (1.4 mkg)	1978 12 ft.-lb. (1.7 mkg) 1979 16 ft.-lb. (2.2 mkg)	70-72 ft.-lb. (9.7-10.0 mkg)	N/A	15 ft.-lb. (2.1 mkg)
434 and 440	22-25 ft.-lb. (3.0-3.5 mkg)	29-35 ft.-lb. (4.0-4.8 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)	434— 50-58 ft.-lb. (6.9-8.0 mkg) 440— 58-63 ft.-lb. (8.0-8.7 mkg)	to 1973 12-17 ft.-lb. (1.7-2.3 mkg) 1974 and later 42-50 ft.-lb. (5.8-6.9 mkg)	14-16 ft.-lb. (1.9-2.2 mkg)
444 and 454	22-25 ft.-lb. (3.0-3.5 mkg)	26 ft.-lb. (3.6 mkg)	16 ft.-lb. (2.2 mkg)	1978—12 ft.-lb. (1.7 mkg) 1979—28 ft.-lb. (3.9 mkg)	60 ft.-lb. (8.3 mkg)	N/A	15 ft.-lb. (2.1 mkg)
503	22-25 ft.-lb. (3.0-3.5 mkg)	26 ft.-lb. (3.6 mkg)	16 ft.-lb. (2.2 mkg)	16 ft.-lb. (2.2 mkg)	60 ft.-lb. (8.3 mkg)	46 ft.-lb. (6.4 mkg)	15 ft.-lb. (2.1 mkg)

Table 2 SINGLE CYLINDER ENGINE SPECIFICATIONS

Engine	Cylinder Bore (Standard)	Wear Limit	Ring End Gap	Crankshaft End Play
247	2.7165 in. (69.0mm)	0.0065 in. (0.165mm)	0.010-0.063 in. (0.25-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
292	2.9528 in. (75.0mm)	0.0076 in. (0.195mm)	0.012-0.063 in. (0.30-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
300, 302	2.9921 in. (76.0mm)	0.0076 in. (0.195mm)	0.012-0.063 in. (0.30-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
335, 337	3.0708 in. (78.0mm)	0.0076 in. (0.195mm)	0.012-0.063 in. (0.30-1.60mm)	0.004-0.016 in. (0.10-0.40mm)

Table 3 TWIN CYLINDER ENGINE SPECIFICATIONS

Engine Type	Cylinder Bore (Standard)	Wear Limit	Ring End Gap	Crankshaft End Play
245	2.1260 in. (54.0mm)	0.0069 in. (0.175mm)	0.008-0.020 in. (0.020-0.50mm)	0.04-0.016 in.* (0.10-0.40mm)
248	2.1260 in. (54.0mm)	0.0053 in. (0.135mm)	0.008-0.063 in. (0.20-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
248 (1978-1979)	2.1260 in. (54.0mm)	0.0053 in. (0.135mm)	0.006-0.014 in. (0.15-0.35mm)	0.004 in. (0.10mm)
294	2.2441 in. (57.0mm)	0.0053 in. (0.135mm)	0.008-0.063 in. (0.20-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
305	2.1850 in. (55.5mm)	0.0053 in. (0.135mm)	0.008-0.063 in. (0.20-1.60mm)	0.004-0.106 in. (0.10-0.40mm)
305 (1978)	2.1850 in. (55.5mm)	0.0068 in. (0.172mm)	0.006-0.014 in. (0.15-0.35mm)	0.009 in. (0.10mm)
338	2.3425 in. (59.5mm)	0.0076 in. (0.195mm)	0.008-0.063 in. (0.20-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
343	2.3425 in. (59.5mm)	0.0076 in. (0.195mm)	0.008-0.063 in. (0.20-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
343 (1978)	2.3425 in. (59.5mm)	0.0076 in. (0.195mm)	0.006-0.014 in. (0.15-0.35mm)	0.004 in. (0.10mm)
343 (1979)	2.3425 in. (59.5mm)	0.008 in. (0.20mm)	0.006-0.014 in. (0.15-0.35mm)	0.004 in. (0.10mm)
345	2.4803 in. (63.0mm)	0.0053 in. (0.135mm)	0.008-0.020 in. (0.20-0.50mm)	N/A
345 (1978)	2.4803 in. (63.0mm)	0.0053 in. (0.135mm)	0.008-0.015 in. (0.20-0.40mm)	N/A
346	2.3425 in. (59.5mm)	0.0092 in. (0.235mm)	0.008-0.063 in. (0.20-1.60mm)	N/A

(continued)

Table 3 **TWIN CYLINDER ENGINE SPECIFICATIONS** (continued)

Engine Type	Cylinder Bore (Standard)	Wear Limit	Ring End Gap	Crankshaft End Play
346 (1978)	2.3425 in. (59.5mm)	0.0092 in. (0.235mm)	0.006-0.014 in. (0.15-0.35mm)	N/A
354 (1978)	2.3425 in. (59.5mm)	0.0076 in. (0.195mm)	0.006-0.014 in. (0.15-0.35mm)	N/A
354 (1979)	2.3425 in. (59.5mm)	0.008 in. (0.20mm)	0.006-0.014 in. (0.15-0.35mm)	0.004 in. (0.10mm)
396	2.5394 in. (64.5mm)	0.0084 in. (0.215mm)	0.010-0.063 in. (0.25-1.60mm)	N/A
401	2.5394 in. (64.5mm)	0.0076 in. (0.195mm)	0.010-0.063 in. (0.25-1.60mm)	0.004-0.016 in. (0.10-0.40mm)
434	2.6575 in. (67.5mm)	0.0076 in. (0.195mm)	0.010-0.063 in. (0.25-1.60mm)	N/A
436	2.6575 in. (67.5mm)	0.010 in. (0.255mm)	0.010-0.063 in. (0.25-1.60mm)	N/A
440	2.6575 in. (67.5mm)	0.0086 in. (0.216mm)	0.010-0.063 in. (0.25-1.60mm)	N/A
440 (1978)	2.6575 in. (67.5mm)	0.0069 in. (0.175mm)	0.008-0.016 in. (0.20-0.40mm)	N/A
440 (1979)	2.6575 in. (67.5mm)	0.007 in. (0.18mm)	0.008-0.016 in. (0.20-0.40mm)	0.004 in. (0.10mm)
444 (1978-1979)	2.7362 in. (69.5mm)	0.007 in. (0.18mm)	0.008-0.016 in. (0.20-0.40mm)	0.004 in. (0.10mm)
454	2.6575 in. (67.5mm)	0.009 in. (0.22mm)	0.008-0.016 in. (0.20-0.40mm)	0.004 in. (0.10mm)
503	2.8346 in. (72mm)	0.006 in. (0.16mm)	0.008-0.016 in. (0.20-0.40mm)	0.004 in. (0.10mm)

*Not applicable on 1976 models.