Table 7 MAINTENANCE TIGHTENING TORQUES (continued)

	N•m	ft.-lb.
Magnum 4-stroke engines (continued)		
Spark plug		
New	12.0-15.2	8.7-11
Old	23.5-27.6	17-20
Starter motor	6.9-8.97	5-6.5
Stator plate	6.9-8.97	5-6.5
Oil pump case screws	2.76	2 (24 in.-lbs.)
Vehicle		
Clutch screw	54	40
Rear axle housing clamp bolts	65	48

Table 8 SPARK PLUGS

Model	NGK type	Champion type	Gap mm (in.)
1985-1987	BR8ES	RN4YC	0.51 (0.020)
1988	–	RN4YC	0.64 (0.025)
1989	BR8ES	RN4YC	0.70 (0.028)
1990-1995			
2-stroke models	BR8ES	–	0.70 (0.028)
4-stroke magnum	BKR6ES	–	0.64 (0.025)

Table 9 IGNITION TIMING (WITH DIAL INDICATOR)*

	Figure 74	Degrees	mm	in.
1985-1987				
All models except Cyclone				
At 3,000 rpm	"A"	23-27	3.482	0.137
At 6,000 rpm	"A"	17.5-21.5	2.145	0.084
Cyclone				
At 3,000 rpm	"A"	21-25	2.959	0.117
At 6,000 rpm	"A"	15.5-19.5	1.729	0.068
1988				
EC25PF-03 engine				
At 3,000 rpm	"A" or "B"	23-27	3.482	0.137
At 6,000 rpm	"A" or "B"	19.5	2.145	0.084
EC25PF-04 engine				
At 3,000 rpm	"C"	27-31	4.646	0.183
At 6,000 rpm	"C"	19.5	2.145	0.084
1989				
All models				
At 3,000 rpm	"B"	25	3.482	0.137
At 6,000 rpm	"B"	20	2.249	0.089
1990-1995				
250 models				
At 3,000 rpm	"B"	25	3.482	0.137
At 6,000 rpm	"B"	20	2.249	0.089
300 models				
At 3,000 rpm	"B"	25	3.482	0.137
At 6,000 rpm	"B"	17	1.632	0.064
350 & 400 models				
At 3,000 rpm	"D"	23.5	–3.504	–0.140
At 6,000 rpm	"D"	18	2.164	0.085
425 Magnum models				
At 3,000 rpm	"E"	30	–	–

* All specifications are before top dead center (BTDC).

Table 10 VALVE CLEARANCE

	mm	in.
4-stroke engines		
Exhaust valves	0.15	0.006
Inlet valves	0.15	0.006

Table 11 CARBURETOR TUNE-UP SPECIFICATIONS

	Carb. model	Pilot jet	Pilot air screw turns out	Idle rpm
1985				
Scrambler & Trail Boss	VM30SS	30	1 1/2	800
1986				
Scrambler & Trail Boss	VM30SS	50	1	800
1987				
Trail Boss	VM30SS	50	1	800
Cyclone	VM34SS	40	1	800
Trail Boss 4 × 4	VM30SS	50	1	800
1988				
Trail Boss 2 × 4 & 4 × 4	VM30SS	35	1	800
Trail Boss 250 R/ES	VM38SS	45	1 1/2	800
1989				
All models	VM30SS	40	1	800
1990				
Trail Blazer, Trail Boss 250, 2 × 4, 4 × 4 and Big Boss 4 × 6	VM30SS	40	1	700
Trail Boss 2 × 4-350L and 4 × 4-350L	VM34SS	30	1 1/2	700
1991				
Trail Blazer, Trail Boss 250, 2 × 4, 4 × 4, Big Boss 4 × 6 and 6 × 6	VM30SS	40	1	700
Trail Boss 2 × 4-350L and 4 × 4-350L	VM34SS	30	3/4	700
1992				
Trail Blazer, Trail Boss 250, 2 × 4, 4 × 4, Big Boss 4 × 6 and 6 × 6	VM30SS	40	1	700
Trail Boss 2 × 4-350L and 4 × 4-350L	VM34SS	30	3/4	700
1993				
Trail Blazer, Trail Boss, 250 2 × 4, 250 4 × 4 and 250 6 × 6	VM30SS	40	1	700
Sportsman, 350 2 × 4, 4 × 4 and 6 × 6	VM34SS	30	3/4	700
1994				
Trail Blazer and Trail Boss	VM30SS	40	1	700
Sport, Sportsman 4 × 4, 400 2 × 4, 4 × 4 and 6 × 6	VM34SS	30	1 1/2	700
300 2 × 4, 4 × 4 and 6 × 6	VM30SS	40	1 1/2	700
1995				
Trail Blazer and Trail Boss	VM30SS	40	1	700
300 2 × 4, 4 × 4	VM30SS	40	1 1/2	700
Scrambler	VM34SS	30	1 1/2	700
400 2 × 4, 6 × 6, Sport, Sportsman 4 × 4 and Xplorer	VM34SS	30	1 1/2	700
Magnum 2 × 4 and 4 × 4	CVBST34	42.5	1 3/8	1,200

CHAPTER FOUR

ENGINE (2-STROKE MODELS)

This chapter provides complete service and overhaul procedures, including disassembly, removal, inspection, service and reassembly for the 2-stroke engines used in all models except Magnum.

Refer to Chapter Five for service to the 4-stroke engine used in Magnum models.

Engines with 244 cc and 283 cc displacements are air cooled. The 244 cc engine is referred to as a "250" model and the 283 cc engine is referred to as a "300" model.

Engines with displacements of 352 cc and 378 cc are liquid cooled. The 352 cc engine is referred to as a "350L" model and the 378 cc engine is referred to as a "400L" model.

Before beginning any work, read the service hints in Chapter One. You will do a better job with this information fresh in your mind.

The text often refers to left and right sides of the engine as it sits in the ATV's frame, not as it happens to be sitting on your workbench. "Left" and "right" refers to the rider sitting on the seat of the ATV facing in the normal direction (forward).

Refer to **Table 1** for 2-stroke engine applications. **Tables 1-3** are at the end of this chapter.

ENGINE PRINCIPLES

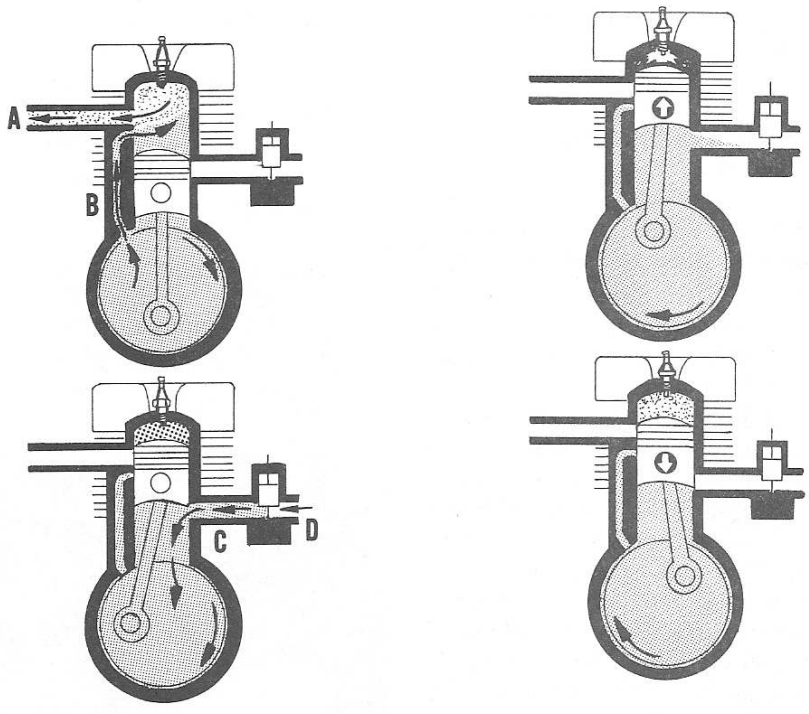
Figure 1 explains how a 2-stroke engine operates. Understanding the principles and knowing what must happen for the engine to run will help you troubleshoot problems when it doesn't start or run properly.

ENGINE LUBRICATION

Polaris 2-stroke engines are lubricated by the oil injection system. Oil is injected into the engine, circulates through the crankcase, and eventually enters the combustion chamber with the fuel. The oil is burned with the fuel and expelled through the exhaust. The various components of the engine are lubricated by oil, which clings to the various parts as it passes through the crankcase and cylinders. The

1

2-STROKE OPERATING PRINCIPLES



The crankshaft in this discussion is rotating in a clockwise direction.

As the piston travels downward, it uncovers the exhaust port (A) allowing the exhaust gases, which are under pressure, to leave the cylinder. A fresh fuel/air charge, which has been compressed slightly, travels from the crankcase into the cylinder through the transfer port (B). Since this charge enters under pressure, it also helps to push out the exhaust gases.

While the crankshaft continues to rotate, the piston moves upward, covering the transfer port (B) and exhaust port (A). The piston is now compressing the new fuel/air mixture and creating a low pressure area in the crankcase at the same time. As the piston continues to travel, it uncovers the intake port (C). A fresh fuel/air charge, from the carburetor (D), is drawn into the crankcase through the intake port, because of the low pressure within it.

Now, as the piston almost reaches the top of its travel, the spark plug fires, thus igniting the compressed fuel/air mixture. The piston continues to top dead center (TDC) and is pushed downward by the expanding gases.

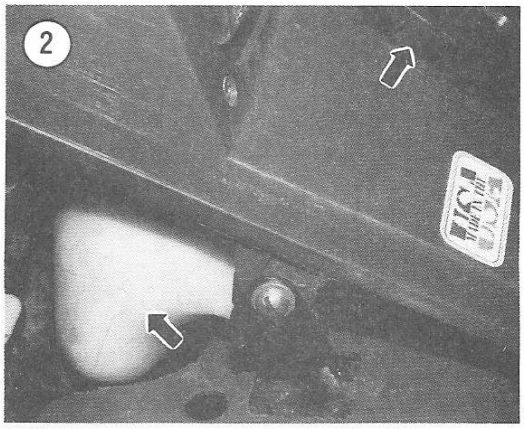
oil is not reused and the amount of oil in the reservoir will diminish as the oil is being used.

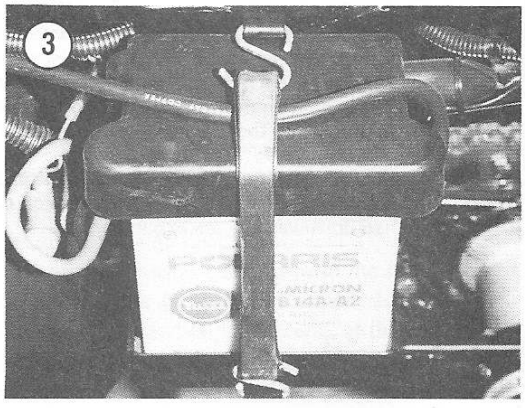
The oil injection system automatically injects oil into the engine during operation at a variable ratio depending on engine rpm. Check the oil level in the reservoir (**Figure 2**) daily and each time the vehicle is being filled with fuel. Refer to Chapter Three for *Oil Injection Pump Bleeding* and for *Oil Injection Pump Adjustment.*

SERVICE PRECAUTIONS

Whenever you work on your Polaris ATV, there are several precautions that should be followed to help with disassembly, inspection, and reassembly.

1. In the text there is frequent mention of the left and right side of the engine. This refers to the engine as it is mounted in the frame, not as it sits on your workbench.
2. Always replace a worn or damaged fastener with one of the same size, type and torque requirements. Make sure to identify each screw before replacing it with another. Screw threads should be lubricated with engine oil, unless otherwise specified, before torque is applied. If a tightening torque is not listed in **Table 2** at the end of this chapter, refer to the torque and fastener information in Chapter One.
3. Use special tools where noted. In some cases, it may be possible to perform the procedure with makeshift tools, but this procedure is not recommended. The use of makeshift tools can damage the components and may cause serious personal injury. Where special snowmobile tools are required, these may be purchased through any Polaris dealer. Other tools can be purchased through your dealer, or from a motorcycle or automotive accessory store. When purchasing tools from automotive accessory dealer or store, remember that all threaded parts that screw into the engine must have metric threads.
4. Before removing the first screw or nut and to prevent frustration during assembly, get a number of boxes, plastic bags and containers. Use these containers to separate and organize the parts as they are removed. Also have a roll of masking tape and a permanent, waterproof marking pen to label each part or assembly. If your ATV was purchased second hand and it appears that some of the wiring may have been changed or replaced, label each electrical connection before separating it.
5. Use a vise with protective jaws to hold parts. If protective jaws are not available, insert wooden blocks on each side of the part(s) before clamping it in the vise.
6. Remove and install pressed-on parts with an appropriate mandrel, support and press. *Do not* try to pry, hammer or otherwise force them on or off.
7. Refer to **Table 2** at the end of the chapter for torque specifications. Proper torque is essential to assure long life and satisfactory service from your engine's components.
8. Discard all O-rings and seals during disassembly. Apply a small amount of grease to the inner lips of new seals to prevent damage when the engine is first started.
9. Keep a record of all shims as they are removed. As soon as the shims are removed, inspect them for damage and write down their thickness and location.
10. Work in an area where there is sufficient lighting and room for component storage.





SERVICING THE ENGINE IN THE FRAME

The ATV's frame is a great holding fixture, especially when breaking loose stubborn bolts and nuts. The following components can be serviced while the engine is mounted in the frame.

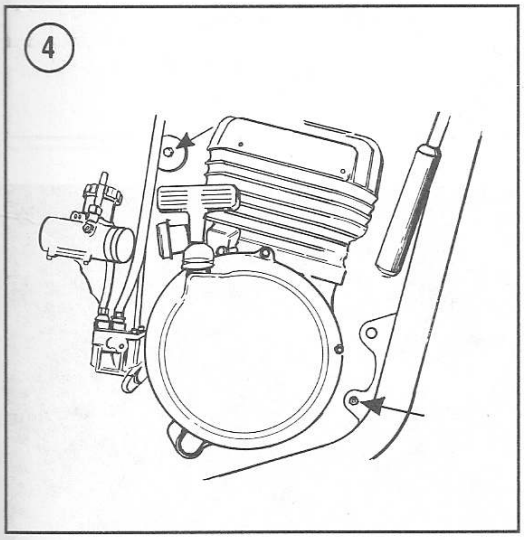
a. Alternator and stator.
b. Cylinder.
c. Cylinder head.
d. Flywheel.
e. Piston and rings.
f. Starter motor and drive.

LIQUID COOLING

Some engines (350L and 400L models) are cooled by a mixture of antifreeze and water that is circulated by a pump through passages inside the engine and to a radiator located in front of the engine. Refer to Chapter Three for cooling system maintenance (draining, filling, bleeding and checking the coolant level). Refer to Chapter Seven for service to other components of the engine cooling system.

ENGINE REMOVAL AND INSTALLATION

Before removing the engine, clean the engine, frame and work area thoroughly. If water is used, be sure blow or wipe the engine dry before beginning removal.



1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Refer to Chapter Fifteen to remove the seat, side covers, fuel tank cover, rear rack and rear cab.
3. Disconnect the ground wire from the negative terminal of the battery (**Figure 3**).
4. On liquid cooled models, refer to Chapter Three and drain the coolant.
5. Remove the exhaust system as described in Chapter Six.
6. Remove the air filter and air box.
7. On models with all wheel drive, refer to Chapter Ten and remove the center drive and driven sprockets, and chain.
8. Refer to Chapter Eight and remove the PVT (Polaris variable transmission) outer cover, drive belt, drive pulley, driven pulley and inner cover from the left side.
9. Unbolt the carburetor from the engine and move it out of the way. It is not necessary to detach the throttle control and the carburetor can remain attached to the control cable.
10. Detach the oil lines from the oil injection pump and immediately plug the oil lines.
11. Unbolt the oil injection pump from the engine and relocate it out of the way. It is not necessary to disconnect the control cable, if the pump can be moved out of the way.
12. Detach the spark plug wire from the spark plug. Relocate the high tension lead (wire) out of the way.
13. On liquid cooled models, proceed as follows:
    a. Detach the cooling hoses from the engine.
    b. Disconnect the wire from the temperature sending unit.
14. Detach the battery ground from the engine on models equipped with an electric starter.
15. Detach the battery positive lead from the starter solenoid on models so equipped.
16. Remove the nuts from the bolts attaching the engine to the frame. See **Figure 4**. Withdraw the bolts so the engine can be removed. It may be necessary to loosen the mount bolts so that the bracket can swing out of the way.
17. Carefully lift the engine from the ATV frame.
18. Reinstall the engine by reversing the removal procedure, and observe the following:
    a. Refer to Chapter Three for *Oil Injection Pump Bleeding*.
    b. Make sure that the overflow tube from the carburetor is routed over the frame as shown

in **Figure 5**. Be sure that the vent tube is not bent, kinked or clogged.

CAUTION

*The engine and drive system can be damaged severely if any covers, cooling ducts, boots or cowling are left off. Cooling for many models includes a cooling fan (**Figure 6**) and ducts for the variable drive belt and clutch pulleys. It is important that all of the cooling system components are in good condition, installed and properly sealed.*

c. Refer to Chapter Eight for installing and sealing the clutch inner cover.
d. Refer to Chapter Eight for installation and adjustment of the clutch pulleys and drive belt.
e. On models with liquid cooled engines, refer to Chapter Three for filling and bleeding the cooling system.
f. Refer to Chapter Fifteen for installing the side covers, fuel tank cover, rear rack and rear cab.

CYLINDER HEAD

Removal of only the cylinder head and the exhaust pipe will permit inspection of the cylinder and piston. The cylinder head, cylinder and piston may be removed with the engine mounted in the frame; however, depending upon the expected extent of service, mechanics sometimes prefer to first remove the engine.

Removal/Installation

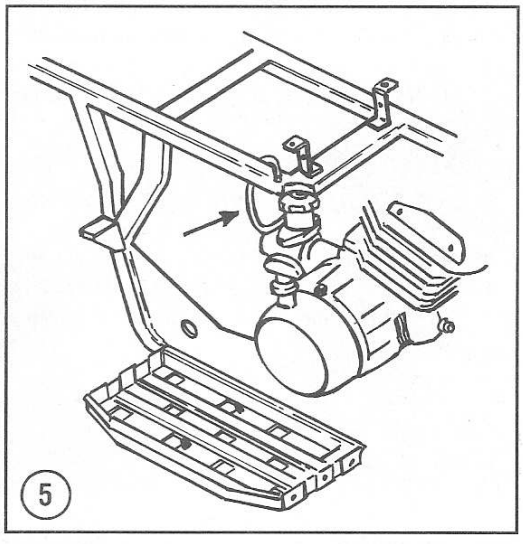
Allow the engine to cool to ambient temperature before removing the cylinder head.

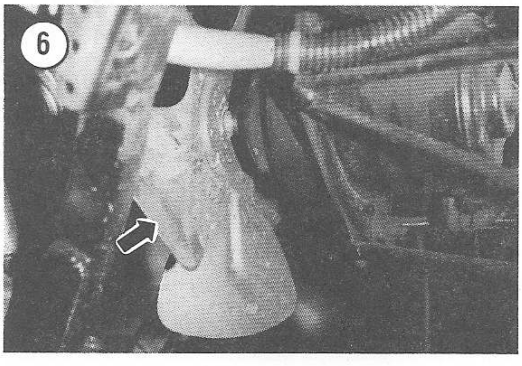
1. Place the ATV on a suitable level surface and block the wheels to hold the vehicle in place.
2. Disconnect the battery ground on models so equipped.
3. Remove the seat, the rear rack and rear fender as described in Chapter Fifteen.

NOTE

Removal of the front fender may not always be a required step, but it will often provide additional working room. It may also prevent components from getting dirty or being damaged.

4. Remove the exhaust system as described in Chapter Six.
5. Remove air filter and air box.
6. On liquid cooled models, disconnect the wire from the cooling temperature sending unit, drain the cooling system and detach the coolant hose from the cylinder head.
7. Disconnect the high tension lead from the spark plug. Move the wire out of the way.
8. Loosen all of the fasteners attaching the cylinder head to the cylinder in the reverse of the order shown in **Figure 7**. The cylinder head on models with the 250 engine is attached with five retaining nuts. The cylinder head on models with other air cooled engines is attached with six retaining nuts. The cylinder head on liquid cooled models is attached with six retaining screws. Remove the fasteners after all are loose.





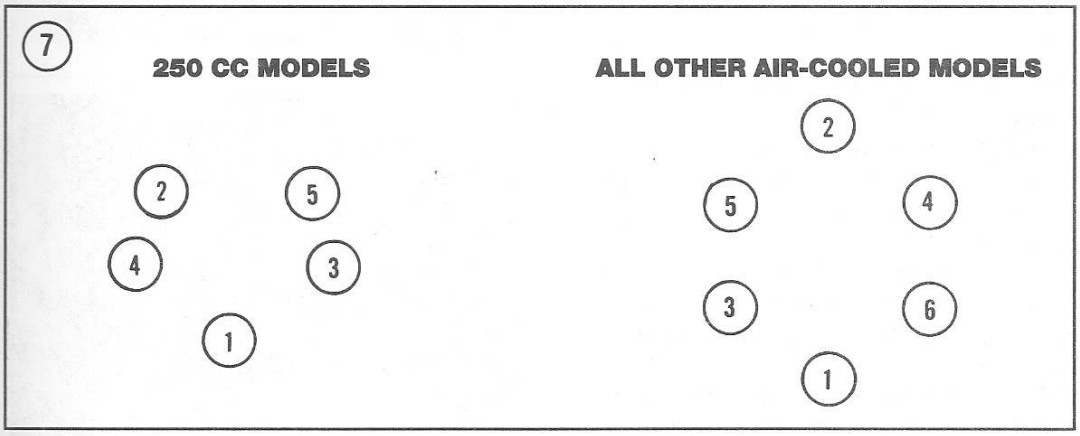
CAUTION

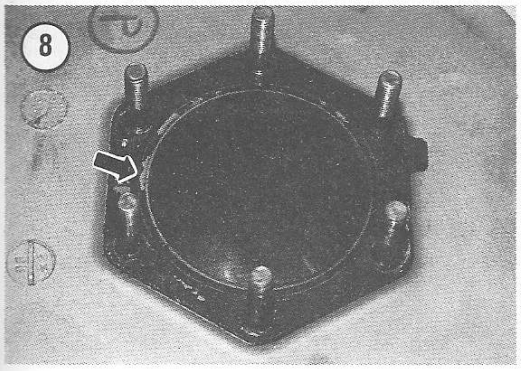
Use caution not to damage the cylinder, cylinder head or other parts by carelessly pounding on the cylinder head.

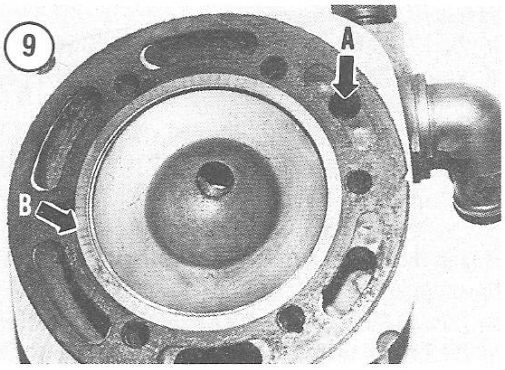
9. Loosen the cylinder head by bumping the perimeter of the head with a soft-faced mallet, then lift the cylinder head from the cylinder.
10. Remove and discard the cylinder head gasket.
11. Clean and inspect the gasket surfaces of the cylinder (**Figure 8**) and cylinder head before assembling. The seal between these two parts is important. The surfaces must not be nicked or gouged and all of the gasket must be removed before assembling.
12. Install the cylinder head gasket, observing the following.
    a. On liquid cooled models, the single round hole in the gasket (A, **Figure 9**) must be located directly below the coolant elbow cavity.
    b. If there is a difference, the wide side of the fire ring (B, **Figure 9**) should be down, against the cylinder.
    c. The gasket used on 400L models has a small hole above the exhaust port. This small hole is for the decompression aid for easier starting. Make sure that the correct gasket is installed.
13. Install the cylinder head and tighten retaining fasteners to the torque specified in **Table 2** in the order shown in **Figure 7**.
14. On liquid cooled models, refer to Chapter Three when filling and bleeding the cooling system.

Inspection

1. Inspect the cylinder head for warpage with a straightedge and flat feeler gauge. Replace the cylinder head if warped. If extent of warpage is slight, consult with a Polaris dealer about possible repair.
2. Check for cracks around the holes in the cylinder head. Also check for damaged threads in the spark plug hole. Cracked cylinder heads must be replaced, but usually threads for the spark plug can be repaired by a Polaris dealer or competent machine shop.







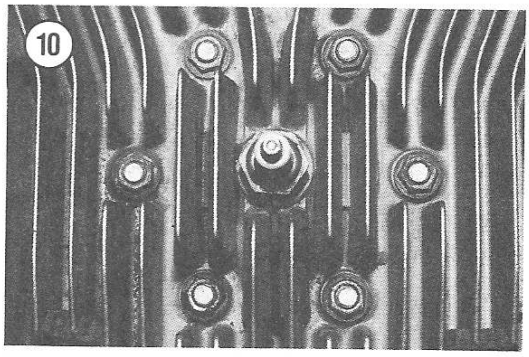
3A. On air cooled engines, check for broken or cracked cooling fins (**Figure 10**). Missing cooling fins can result in localized hot spots that affect engine operation. If any fins are cracked, have the cylinder head inspected by a Polaris dealer.

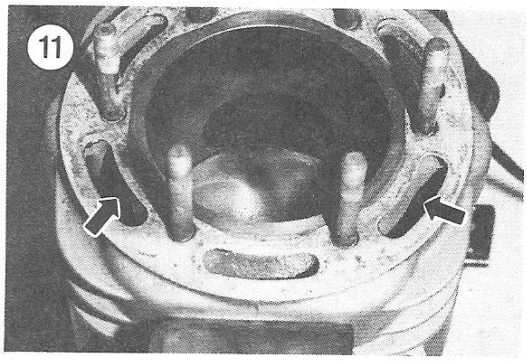
3B. On liquid cooled models, check the water passages for corrosion or other blockage. If cylinder head passages are corroded, those in the cylinder (**Figure 11**) should also be carefully checked.

CAUTION

Do not damage the cylinder head by cleaning with caustic solvents or hard scrapers. The soft material of the cylinder head is easily damaged by carelessness or harsh handling.

4. Clean all carbon deposits from the combustion chamber. Use a soft scraper that will not damage the cylinder head. To finish cleaning, wipe the cylinder head with a shop cloth and cleaning solvent.

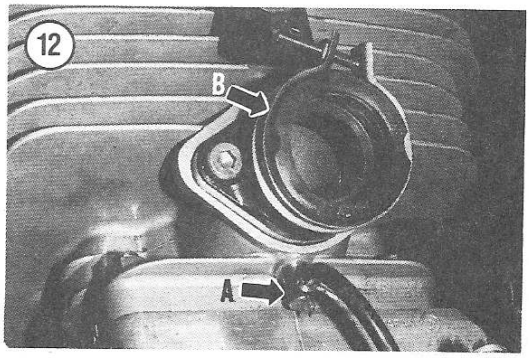


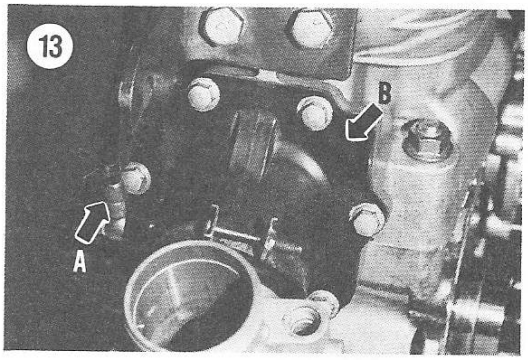


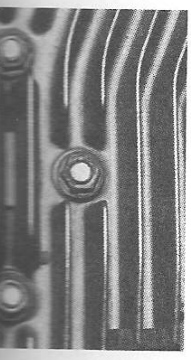
CYLINDER

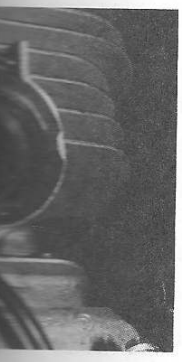
Removal

1. Remove the cylinder head as described in this chapter.
2. Remove air filter and air box.
3. On models with all wheel drive, refer to Chapter Ten and remove the center drive and driven sprockets, and chain.
4. Refer to Chapter Eight and remove the PVT (Polaris variable transmission) outer cover, drive belt, drive pulley, driven pulley and inner cover from the left side.
5. Unbolt the carburetor from the engine and move it out of the way. It is not necessary to detach the throttle control and the carburetor can remain attached to the control cable.
6. Disconnect the oil injection line (A, **Figure 12** or A, **Figure 13**) from the cylinder near the inlet port or from the carburetor adapter.
7. On 350L and 400L models remove the reed valve assembly (and carburetor adapter) as described in this chapter.
8. On liquid cooled models, loosen the clamps, then detach the coolant transfer hose (**Figure 14**) from the cylinder.
9. Loosen the four nuts that attach the cylinder base to the crankcase. Refer to **Figure 15**. A 14 mm









universal socket can be used on the two nuts at the front (exhaust) of engine, but an end wrench is required to loosen the nuts on the rear (inlet).

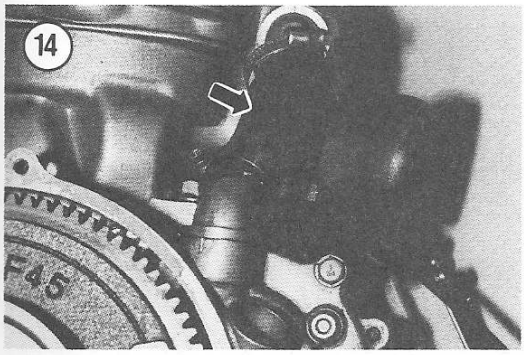
NOTE

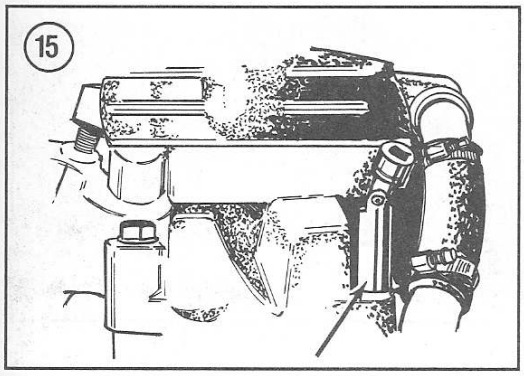
The piston should slide smoothly from the cylinder bore and only light taps should be required to release the cylinder.

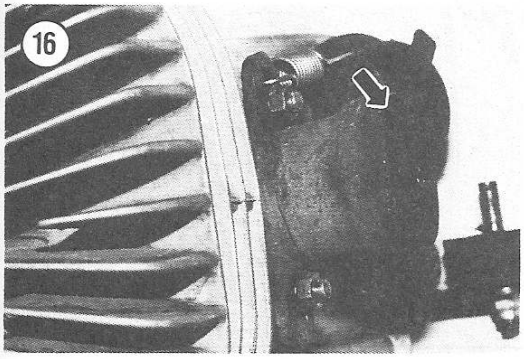
10. Tap the cylinder lightly with a soft hammer to separate the cylinder from the cylinder base gasket and the studs in the crankcase. Lift the cylinder from the piston and crankcase.

CAUTION

Stuff a shop towel around the connecting rod under the cylinder before the cylinder is completely removed to prevent dirt or any loose parts from falling into the crankcase. The shop towel will also keep the connecting rod and piston from falling when the cylinder is removed.







11A. On 250 and 300 engines, remove the carburetor adapter (B, **Figure 12**) from the cylinder to prevent it from becoming damaged while cleaning the cylinder.

11B. On 350L and 400L engines, unbolt and remove the carburetor adapter (B, **Figure 13**) and reed valve assembly from the rear of the cylinder. Be careful not to damage the reed valves. Inspect the reed valves as described in this chapter.

12. Remove the exhaust port spigot (**Figure 16**) to facilitate cleaning and to prevent it from being damaged while cleaning the port.

13. Remove the cylinder base gasket and discard it.

14. Soak any remaining gasket material with solvent, then scrape it from the cylinder base and crankcase. Be careful not to gouge the sealing surfaces.

Inspection

The following procedure requires the use of highly specialized and expensive measuring instruments. If such equipment is not readily available, have the measurements performed by a dealer or qualified machine shop.

1. Measure the cylinder bore with a cylinder bore gauge (**Figure 17**) or inside micrometer at the points shown in **Figure 18**. Measure both in line with the piston pin and at 90° to the pin. Measure the cylinder approximately 13 mm (1/2 in.) from the top of the cylinder, in the middle and approximately 13 mm (1/2 in.) from the bottom. If the taper or out-of-round exceeds the limits in **Table 3**, the cylinder must be rebored to the next oversize and fitted with a new piston, or a new standard size cylinder should be installed.

NOTE

Purchase the new piston before the cylinder is rebored so the piston can be measured by the machinist. Slight

manufacturing tolerances must be taken into account to determine the actual cylinder bore diameter and piston-to-cylinder clearance.

2. Check the cylinder bore for scratches or other obvious damage. Carefully inspect the cylinder around the exhaust and transfer ports.

NOTE

It may be possible to repair a damaged cylinder by reboring, but if you have any question, have the part inspected by your Polaris dealer or machine shop specializing in this type of repair.

3. Clean the cylinder and ports carefully. A broad-tipped, dull screwdriver or the end of a hacksaw blade can be used to scrape carbon from the ports, but be careful not to damage the cylinder.
4. Inspect the threaded holes and studs for damage and replace or repair as necessary.
5. Test the injection pump check valve located in the inlet passage as described in this chapter.

Installation

1. Check to be sure that all of the old gasket has been removed from the top surface of the crankcase and the bottom surface of the cylinder.
2. Make sure that the cylinder, piston, crankcase and work area are clean and undamaged.
3. Coat both sides of the cylinder base gasket with Loctite 515 Gasket Eliminator, be sure that all of the studs are in place in crankcase, then install a new cylinder base gasket over the studs.
4. Lubricate the cylinder bore, piston and rings with 2-stroke engine oil.

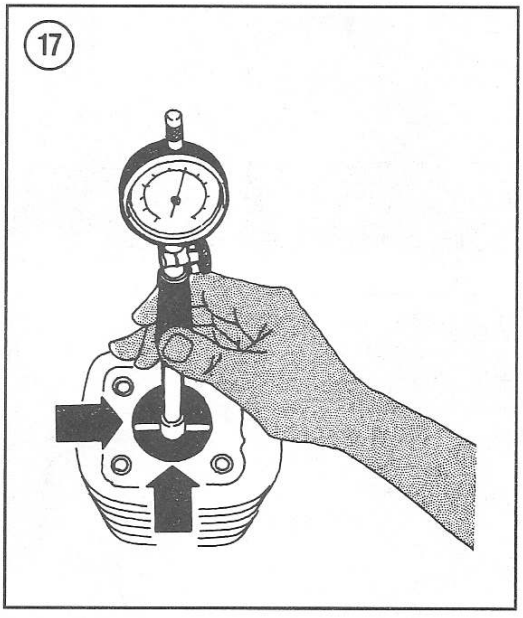
CAUTION

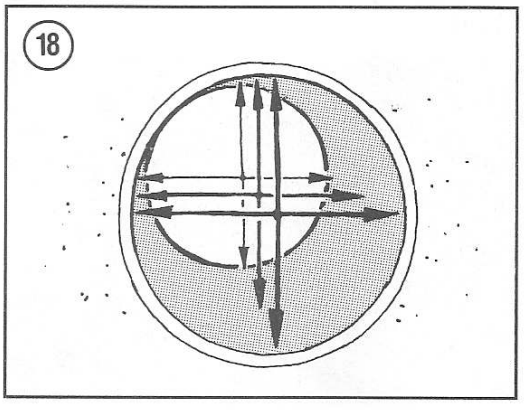
Be careful not to break the ends of the piston rings when installing the cylinder. The ends are small so they surround the alignment pins in the ring grooves and therefore, can be easily broken.

5. Make sure the piston ring gaps align with the pin in the piston grooves. Refer to **Figure 19**.
6. Compress the top ring and start the chamfered edge of the cylinder over the ring.
7. Compress the second ring and slide the cylinder down over the ring.
8. Continue to slide the cylinder down until it completely covers the rings. Slide the cylinder all the way down over the mounting studs, against the crankcase and base gasket.
9. Install the base nuts and tighten in a crossing pattern. Tighten the nuts to the torque listed in **Table 2**.

NOTE

*The two nuts on the front (exhaust side) of the engine can be tightened with a 14 mm universal socket as shown in **Figure 15**. A 14 mm crow's foot wrench must be used to torque the cylinder base nuts on the rear (inlet side) of the engine.*





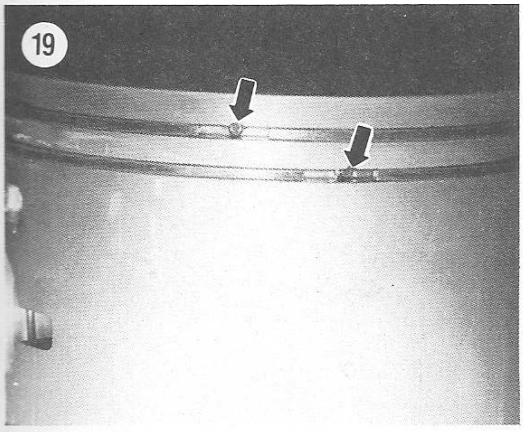
10. Complete reassembly of the engine by reversing the disassembly procedure and observe the following:

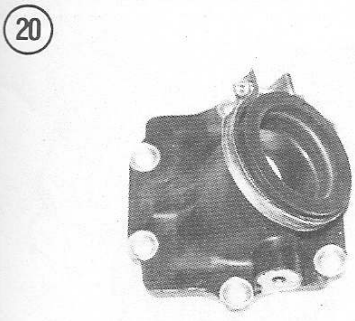
a. Make sure that overflow tube from the carburetor is routed over the frame as shown in **Figure 5**. Be sure that vent tube is not bent, kinked or clogged.

CAUTION

*The engine and drive system can be damaged severely if any covers, cooling ducts, boots or cowling are left off. Cooling for many models includes a cooling fan (**Figure 6**) and ducts for the variable drive belt and clutch pulleys. It is important that all of the cooling system components are in good condition, installed and properly sealed.*

b. Refer to Chapter Eight to install and seal the clutch inner cover.





c. Refer to Chapter Eight to install and adjust the clutch pulleys and drive belt.

d. On models with liquid cooled engines, refer to Chapter Three to fill and bleed the cooling system.

e. Refer to Chapter Fifteen to install the side covers, fuel tank cover, rear rack and rear cab.

REED VALVE ASSEMBLY

Engines with liquid cooling (350L and 400L) are equipped with a reed valve assembly installed in the intake port of the cylinder.

Special care must be taken when handling the reed valve assembly. The reeds are fragile and can be easily broken or bent by improper handling. A reed valve that doesn't open or close properly will cause severe performance loss and will lead to early engine failure.

Removal/Inspection/Installation

1. Place the ATV on a suitable level surface and block the wheels to hold the vehicle in place.
2. Disconnect the battery ground on models so equipped.
3. Remove the seat, the rear rack and rear fender as described in Chapter Fifteen.
4. Remove air filter and air box.
5. Unbolt the carburetor from the engine and move it out of the way. It is not necessary to detach the throttle control and the carburetor can remain attached to the control cable.
6. Disconnect the oil injection line (A, **Figure 12** or A, **Figure 13**) from the cylinder fitting or the carburetor adapter.

NOTE

The fitting on the oil injection line at the cylinder or carburetor adapter is also the check valve for the oil injection system. The check valve should allow oil to pass into the inlet passage, but should prevent crankcase pressure from entering the oil line.

7. Remove the 6 screws attaching the carburetor adapter (B, **Figure 13**) to the cylinder.
8. Carefully remove the carburetor adapter and check the adapter for cracks or other damage. Refer to **Figure 20**.

9. Remove the reed assembly (**Figure 21**). The reed housing on 400L models is equipped with a removable stuffer block, which is located nearest the carburetor. This reed stuffer block may also be installed in 350L models.

NOTE

*One early sign of reed failure is hard starting. Check the condition of the reeds whenever the reed assembly is removed. Be especially careful not to damage the reed petals when removing, checking, assembling or installing. The reed assembly (**Figure 22**) can be inspected without disassembly.*

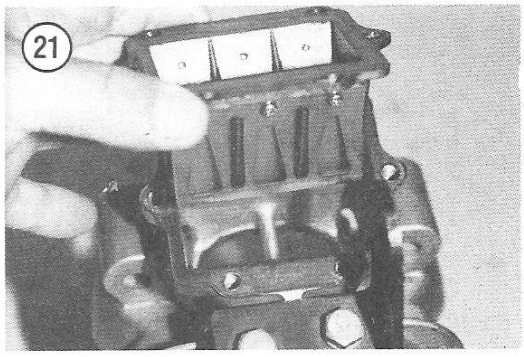
10. Measure the reed stop height. This is the distance between the reed valve stop and the reed housing. Refer to **Figure 23**. The recommended stop height is listed in **Table 3**. This height should not change during normal operation, but it may have been bumped. Make sure that the reed stop is smooth and straight so that it does not damage the reed petals.

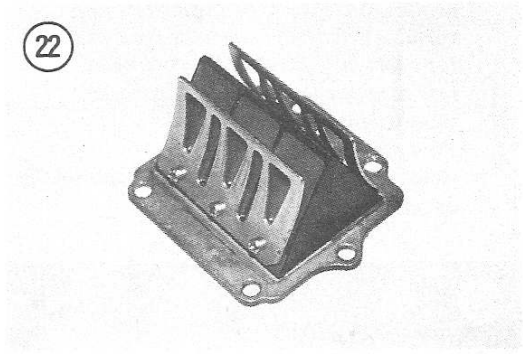
11. Measure the reed air gap. Refer to **Figure 24**. This is the distance the reed stands away from the reed housing when the reed is at rest. Install new reed petals if the gap exceeds the maximum limit listed in **Table 3**.

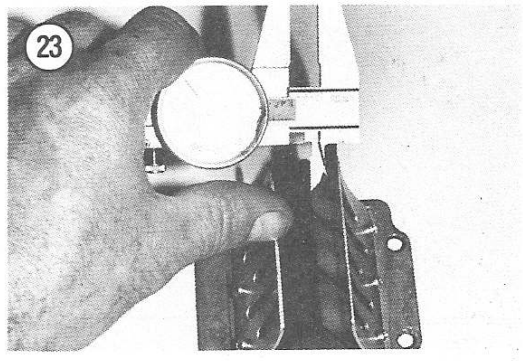
12. Inspect the reed petals for white stress marks, which are indications that the reed petal is about to fail. Install new reed petals if any stress marks are noticed.

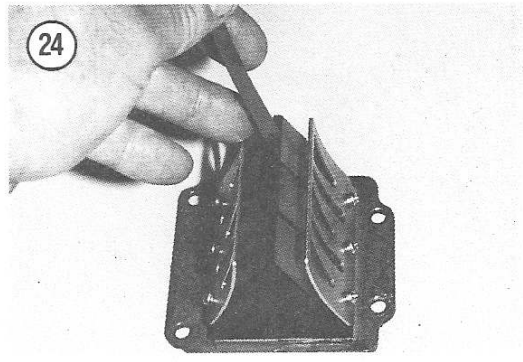
13. If the reed assembly (**Figure 22**) is disassembled, make sure that the petals are centered over the ports in the reed housing.

14. Reinstall the reed assembly by reversing the removal procedure.









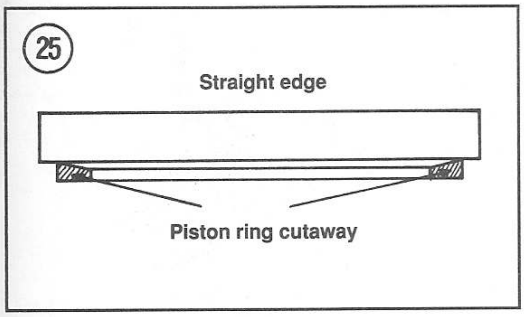
PISTON, PISTON PIN AND RINGS

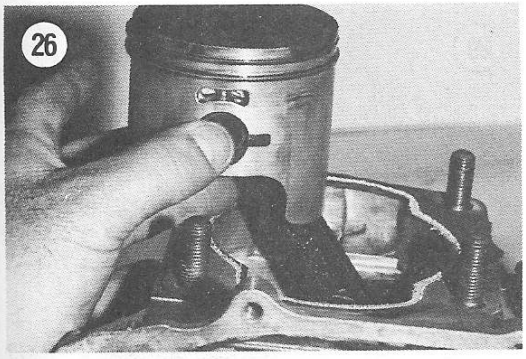
The piston is made of aluminum alloy and is fitted with Keystone type rings. The Keystone cross section is easily seen by positioning a straightedge across the ring as shown in **Figure 25**. The Keystone cross section is designed to move in and out in the groove to prevent carbon buildup. When installing the ring, make sure that the identification mark is toward the top of the piston.

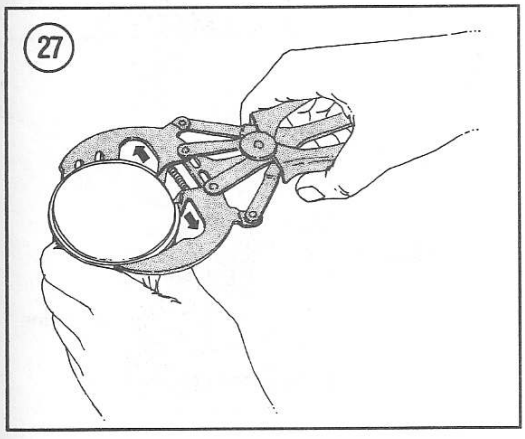
The piston pin is made of steel and is a precision fit in the piston. The piston pin is held in place by a clip at each end of the bore in the piston.

Piston Removal

1. Remove the cylinder head and the cylinder as outlined in this chapter.
2. Before removing the piston, hold the rod tightly and rock the piston to detect excessive clearance between the piston, piston pin and connecting rod. Refer to **Figure 26**. Do not confuse the normal sliding motion of the piston on the pin with rocking motion. Any perceptible rocking motion indicates wear on the piston pin, piston, connecting rod small end bearing or the connecting rod small end. Any excessive wear is probably a combination of the wear of all of these parts.







NOTE

Do not reuse the piston pin retaining clips. The clips are damaged during removal. Severe engine damage will result if a clip becomes loose while the engine is running.

3. Remove the clips from each side of the piston pin bore. The slot in the pin bore permits a small screwdriver to be used to remove the spring clip. Be careful to prevent the clips from springing out.
4. Use a suitable tool (part No. 2870386) to pull the piston pin from the bore in the piston.

CAUTION

Be careful when removing the piston pin to avoid damaging the connecting rod. The piston should be supported to either push or pull the pin from the pin bore. Be sure that lateral loads are not transmitted to the lower connecting rod bearing.

5. Lift the piston from the connecting rod.

NOTE

If the piston is to be left off for some time, protect the connecting rod by placing a piece of foam insulation tube over its end to protect it. Stuff a clean, lint free shop towel around the connecting rod to keep dirt from entering the crankcase.

WARNING

The edges of all piston rings are very sharp. Be very careful when handling them to avoid cutting your fingers.

6. Remove the top ring with a ring expander tool (**Figure 27**) or by spreading the ends with your thumbs (**Figure 28**) just enough to slide the ring up over the top of the piston. Repeat the procedure for the second ring.

Inspection

1. Carefully clean the carbon from the piston crown with a scraper. Do not damage the piston. Also notice the "F" mark or arrow cast into the piston crown. Refer to **Figure 29**.

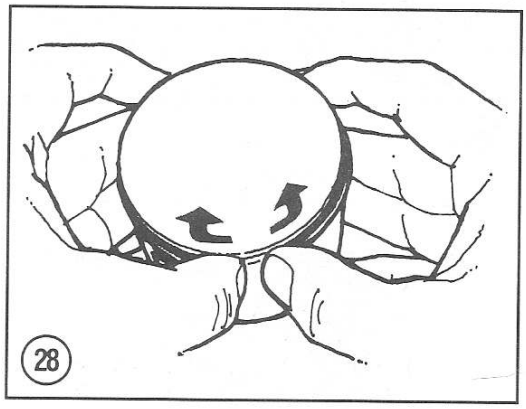
CAUTION

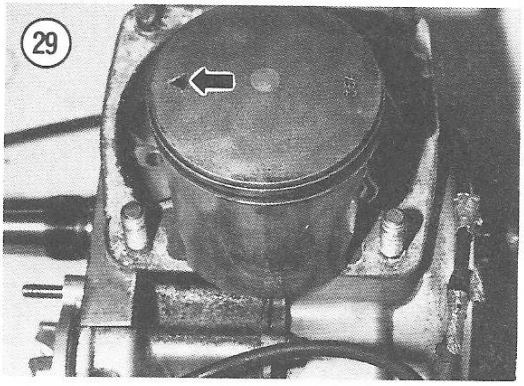
*Do not use a wire brush to clean the piston skirt and do not gouge the piston while attempting to clean it. The soft aluminum of the piston is easily damaged by improper cleaning techniques. Notice that the ring grooves are Keystone shaped (**Figure 30**) and should not be cleaned with a tool that has straight sides.*

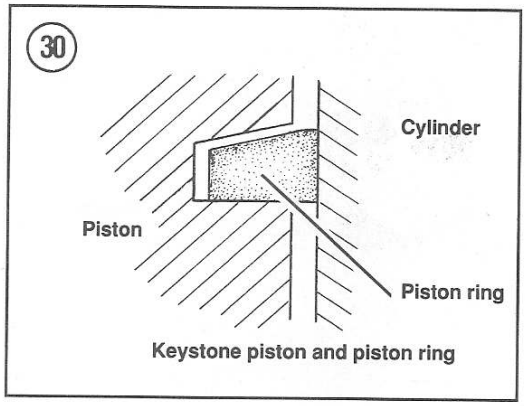
2. Examine each ring groove in the piston for carbon deposits or other conditions that reduce the width of the groove.
3. Examine each ring groove for gouges, bent lands or other conditions that increase the width of the groove.
4. Measure the *Piston Clearance* as described in this chapter.
5. Measure the diameter of the pin bore in the piston (**Figure 31**), then measure the piston pin diameter (**Figure 32**).
6. Subtract the diameter of the piston pin from the diameter of the pin hole in the piston to determine the pin-to-pin bore clearance.
7. Refer to the specifications listed in **Table 3** and replace parts as required.
8. If damage or wear indicates that the piston should be replaced, select a new piston as described in *Piston Clearance* in this chapter.
9. Inspect and install new piston rings as described in *Piston Ring Removal/Inspection/Installation* in this chapter.

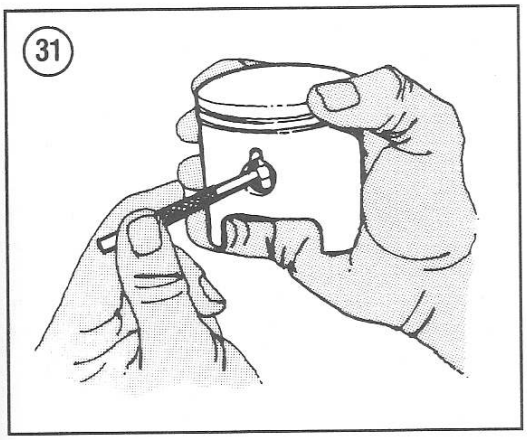
Piston Clearance

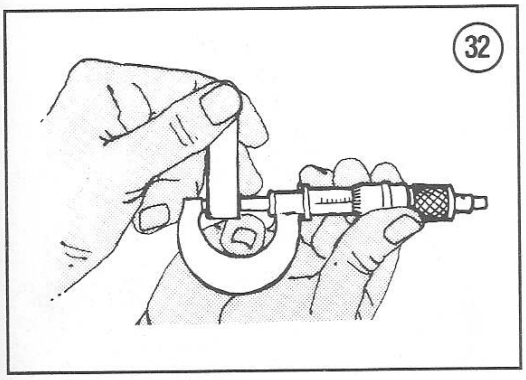
1. Measure the piston diameter at a point 10 mm (0.40 in.) from the bottom of the piston skirt.
2. Measure the cylinder bore diameter with a cylinder bore gauge (**Figure 33**) or inside micrometer at the points shown in **Figure 34**. Measure in line with the piston pin and at 90° to the pin. If the taper or out-of-round exceeds the limits in **Table 3**, the cylinder must be rebored to the next oversize and fitted with a new piston, or a new standard size cylinder should be installed.
3. Subtract the diameter of the piston skirt from the maximum diameter of the cylinder bore to determine the piston skirt-to-cylinder clearance.
4. The piston skirt-to-cylinder clearance should not exceed the limit listed in **Table 3**. It may be possible

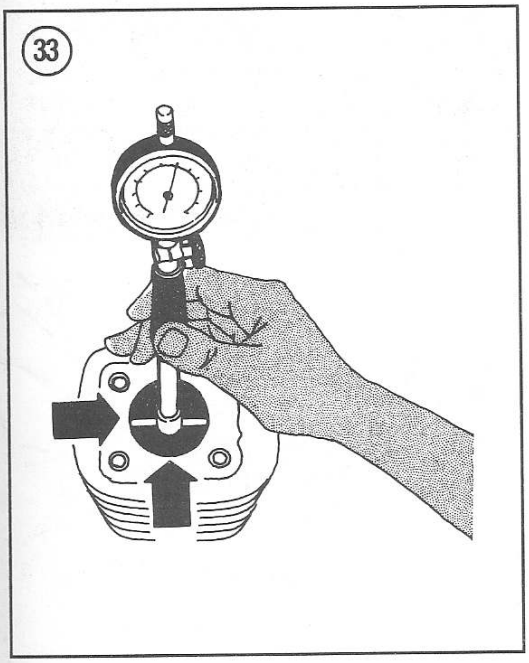

28


29









to repair a damaged cylinder by reboring, but if you have any question, have the parts inspected by your Polaris dealer or machine shop specializing in this type of repair.

NOTE

Purchase the new piston before the cylinder is rebored so that the piston can be measured by the machinist before any changes are made. Slight manufacturing tolerances must be taken into account to determine the bore diameter and piston-to-bore clearance.

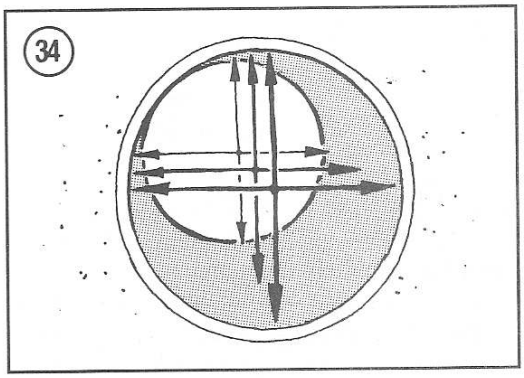
Piston Installation

1. Coat the piston pin, pin bore, needle bearing and connecting rod small end bore in with clean engine oil.

CAUTION

Do not reuse old clips to retain the piston pin in the piston. The clips are deformed during removal and severe engine damage can result if the clips become loose while the engine is running. Always install new clips if the piston is removed. Use a special piston pin clip installer tool part No. 2870773 (or equivalent) to prevent damage to the pin retaining clips while installing. Be certain the clip properly engages the groove in the piston.

2. Install a new retaining clip in one end of the piston pin bore. The opening of the retaining ring should face down, toward the crankshaft (bottom of the piston).



3. Insert the piston pin through the bore in the piston, until it extends slightly beyond the inside of the pin boss. Refer to **Figure 35**.
4. Place the piston over the connecting rod with the "F" mark or arrow (**Figure 29**) on the piston crown pointing toward the magneto (right) side of the engine.
5. Align the piston pin with the hole in the connecting rod and needle bearing, then push the pin through the connecting rod. Continue pushing the pin until it just contacts the previously installed retaining clip.

NOTE

The pin should be a smooth fit in the bore when the pin and the bores are lubricated. If the piston pin is tight, cool the pin and warm the piston slightly. Be careful not to transmit lateral shock to the connecting rod or otherwise damage parts by carelessly pounding on the side of the piston.

6. Install a new retaining clip in the piston pin bore, with the opening facing down, toward the bottom of the piston. Use a special piston pin clip installer tool part No. 2870773 (or equivalent) to prevent damage to the clips. Be sure that the clip properly engages the groove in the piston.
7. Check installation by rocking the piston back and forth around the pin axis, then sliding the piston from side to side. It should rotate freely without perceptible play.
8. Install the piston rings as described in this chapter.
9. Install the cylinder and cylinder head as described in this chapter.

Piston Ring Removal/Inspection/Installation

WARNING

The edges of all piston rings are very sharp. Be very careful when handling them to avoid cutting your fingers.

1. Remove the top ring with a ring expander or spread the ring with your thumbs just enough to slide the ring up over the top of the piston. Repeat the procedure for the remaining ring.
2. Clean the carbon from the ring grooves with a section of a broken ring as shown in **Figure 36**. Be careful not to cut your hand on the ring used as a cleaning tool, or damage the piston. Do not gouge the aluminum piston; remove only the carbon.

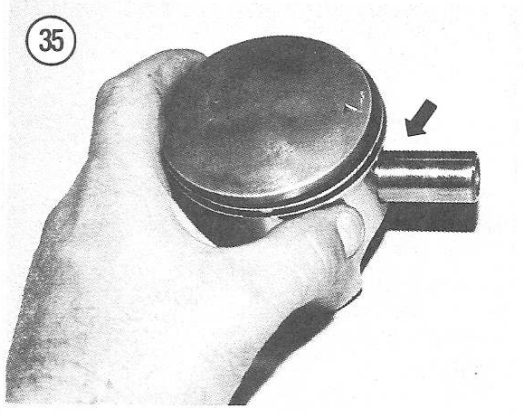
CAUTION

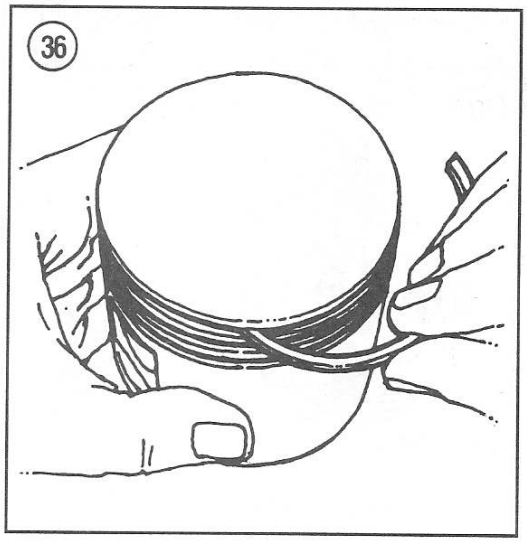
Do not use a wire brush to clean the piston skirt. Do not gouge the piston while attempting to clean it. The soft aluminum of the piston is easily damaged by improper cleaning techniques.

3. Examine each ring groove in the piston for carbon deposits or other conditions that reduce the width of the groove.

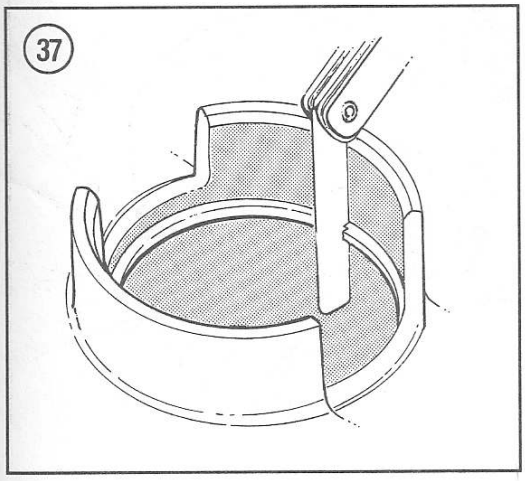
NOTE

The groove for the top compression ring usually wears more than the other groove, but both should be carefully inspected.





4. Examine each ring groove for gouges, bent lands or other conditions that increase the width of the groove.
5. Check each ring for binding in its groove. Clean or replace the piston as necessary.
6. Measure the end gap of each ring in the cylinder bore, before installing the ring on the piston as follows.
   a. Insert one ring into the cylinder. Make sure the ring is square in the cylinder by using the top of the piston to slide the ring up or down in the cylinder.
   b. Use a feeler gauge to measure the gap between the ends of the ring as shown in **Figure 37**.
   c. Check the end gap at several locations in the cylinder and always make sure that the ring is positioned squarely in the cylinder. Compare the measured end gap with the specifications listed in **Table 3**.
   d. If the gap is too wide, the rings will not seal properly. Some causes for the gap to be too wide are: the cylinder bore may be worn, the rings may be worn or the ring is not correct for the application.
   e. If the gap is less than the minimum specified in **Table 3**, make sure that the correct ring is being used. The rings may bind and break if the gap is not wide enough. Do not attempt to file the ends of the ring to enlarge the gap, because the ends of the rings must fit around the pins located in the grooves.
7. Make sure the piston ring grooves are absolutely clean. Identify the top of the piston ring. The top has the manufacturer's mark and is angled. The angle can be checked with a straight edge as shown in **Figure 25**.



CAUTION

If the ends of the ring are spread too far, the ring will probably break. Use care when installing the rings and spread the ends of the rings only enough to install without scratching the sides of the piston.

8. Install the bottom ring in the piston's lower groove, then install the top ring. Refer to **Figure 27** or **Figure 28** for the correct method of spreading the rings.

CAUTION

Be extremely careful not to damage the assembled piston or rings. It is suggested that the cylinder be installed as soon as possible after installing the rings in the piston grooves. Also, be careful not to break the ends of the piston rings when installing the cylinder. The ends of the rings are small so they surround the alignment pins in the ring grooves and therefore, can be easily broken by improper handling.

9. Follow the *Break-in Procedure* in this chapter if the cylinder was rebored, a new piston was installed or if new piston rings were fitted.

RECOIL STARTER (EARLY 250 MODELS)

Refer to the following for service to the recoil starter used on early 250 models. Refer to **Figure 38**.

Removal/Installation

1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Remove the screws attaching the recoil starter, then remove the starter and gasket.
3. Install the recoil starter assembly and tighten the retaining screws.

Disassembly and Starter Rope Removal

1. Pull the starter rope from the housing and tie a loose knot to keep the rope from recoiling, if the rope is not broken.
2. Remove the anchor from the starter handle and remove the handle from the end of the rope.
3. Hold the rope, untie the previously tied knot, then allow the rope to unwind slowly into the housing.
4. Remove the nut from the center post.
5. Remove the friction plate, ratchet pawl (**Figure 39**) and spring (A, **Figure 40**).

CAUTION

The recoil spring is under pressure and may jump from the housing during disassembly. Its edges are sharp and may cut or cause eye injury. Wear safety glasses or a face shield and gloves when disassembling and assembling.

6. Carefully lift the starter pulley and rope from the housing. Make sure that the recoil spring (**Figure 41**) remains in the starter housing.
7. Unwind and remove the rope from the starter pulley if replacement is required.

Inspection and Assembly

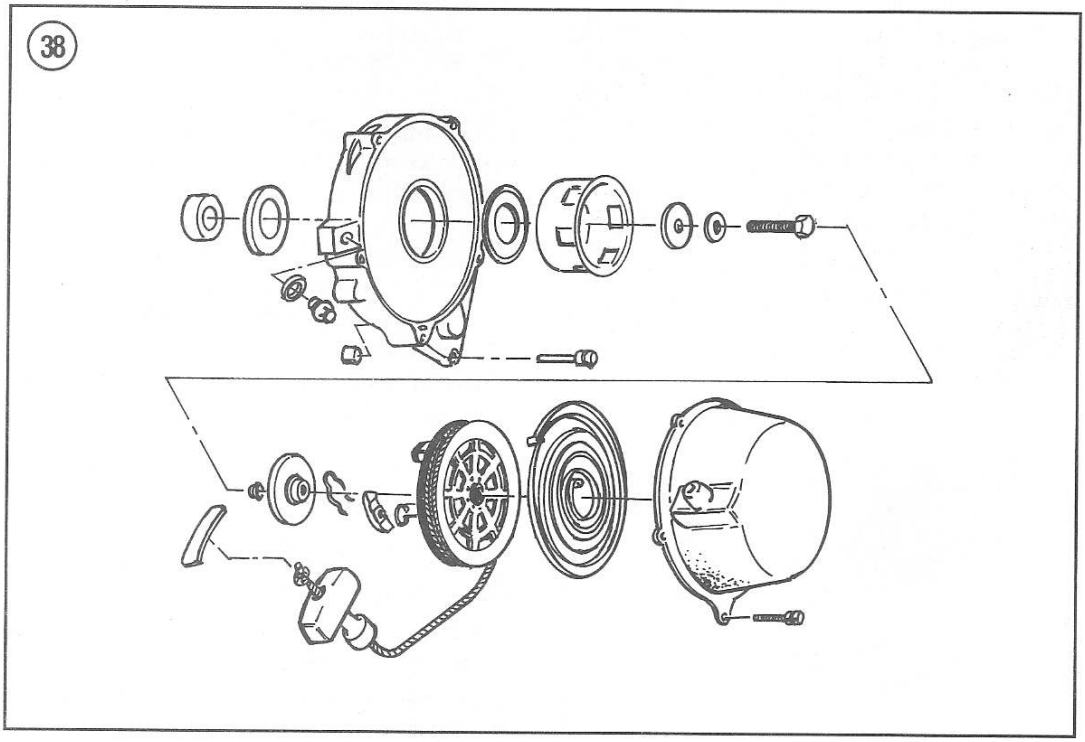
1. Clean all parts and dry thoroughly.
2. Inspect the friction plate, friction spring, ratchet pawl and pawl spring (**Figure 42**) for damage. Friction spring should grip the friction plate securely.
3. Check the rope for fraying or other damage. It is usually a good practice to replace a rope that has even slight damage, before it breaks.
4. Inspect the tabs at the ends of the recoil spring. To remove the spring, invert the starter housing and tap it on a solid surface. Allow the recoil spring to unwind inside the starter housing.

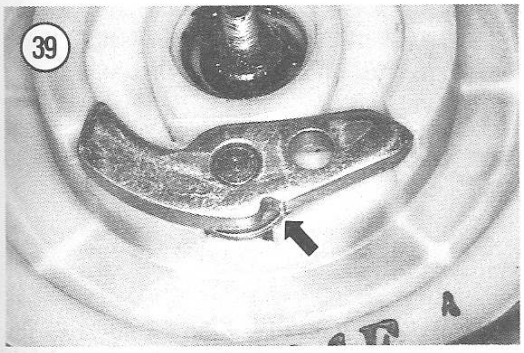
5A. If removed, reinstall the old recoil spring as follows:

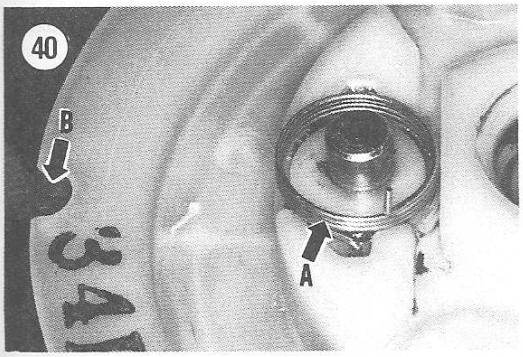
a. Hook the outer end of the recoil spring in the housing.

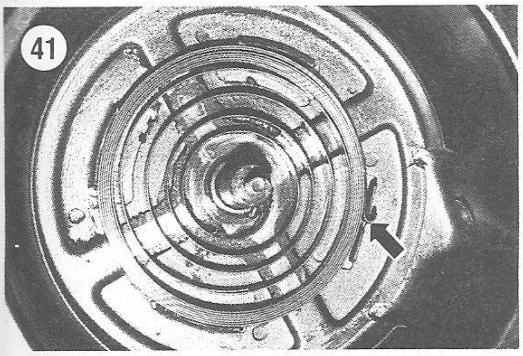
b. Wind the spring into the housing in a counterclockwise direction until the spring is completely in the housing. Hold the coils in place while winding the spring in place.

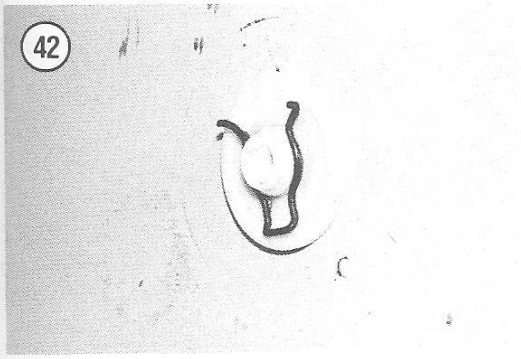
c. The installed spring should be positioned as shown in **Figure 41**.











5B. New recoil springs are held compressed by a wire. Use the following instructions to install the new spring.

a. Position the new spring in the housing so that it spirals inward in a counterclockwise direction and attach the outer end of the spring to the housing.
b. Hold the spring in place and cut the retaining wire. The installed spring should be positioned as shown in **Figure 41**.

6. Lubricate the spring with a light, low temperature lubricant.
7. If the rope is detached from the pulley, attach the rope as follows:
   a. Tie a secure knot at one end of the rope and insert the other end through the hole in the pulley.
   b. Pull the rope through the pulley until the knot is firmly seated in the pocket of the pulley.
   c. Wind the rope into the pulley groove counterclockwise (as viewed from the side shown in **Figure 40**). The rope should be wound fairly tightly into the groove.
   d. When the rope is almost completely wound into the pulley, pull the end up through the notch (B, **Figure 40**). The end of the rope should lock into the notch.
8. Apply a small amount of low temperature grease to the center post in the starter housing and to the bushing in the center of the starter pulley.
9. Install the starter pulley over the center post making sure the inner end of the recoil spring engages the tab at the center of the pulley. Refer to **Figure 41**. Make sure that the pulley is fully seated (down) in the housing.
10. Preload the recoil spring as follows:
    a. Hold the pulley down in the housing.
    b. Grasp the end of the rope that extends from the notch in the pulley and wind the pulley counterclockwise four (4) turns.
    c. Hold the pulley to prevent the spring from pulling the rope back into the housing.
    d. Route the end of the rope out through the housing, while continuing to hold the pulley.
    e. When the rope exits the housing, pull enough rope out to tie a large knot in the rope to keep it from winding into the housing.
11. Install the pawl spring (A, **Figure 40**).
12. Install the pawl as shown in **Figure 39**. The pawl spring is located at the arrow.

13. Install the friction plate and spring (**Figure 42**) with each end of the spring located on the drive side of the ratchet.

14. Install the spring washer and nut on the center post. Tighten the nut securely.

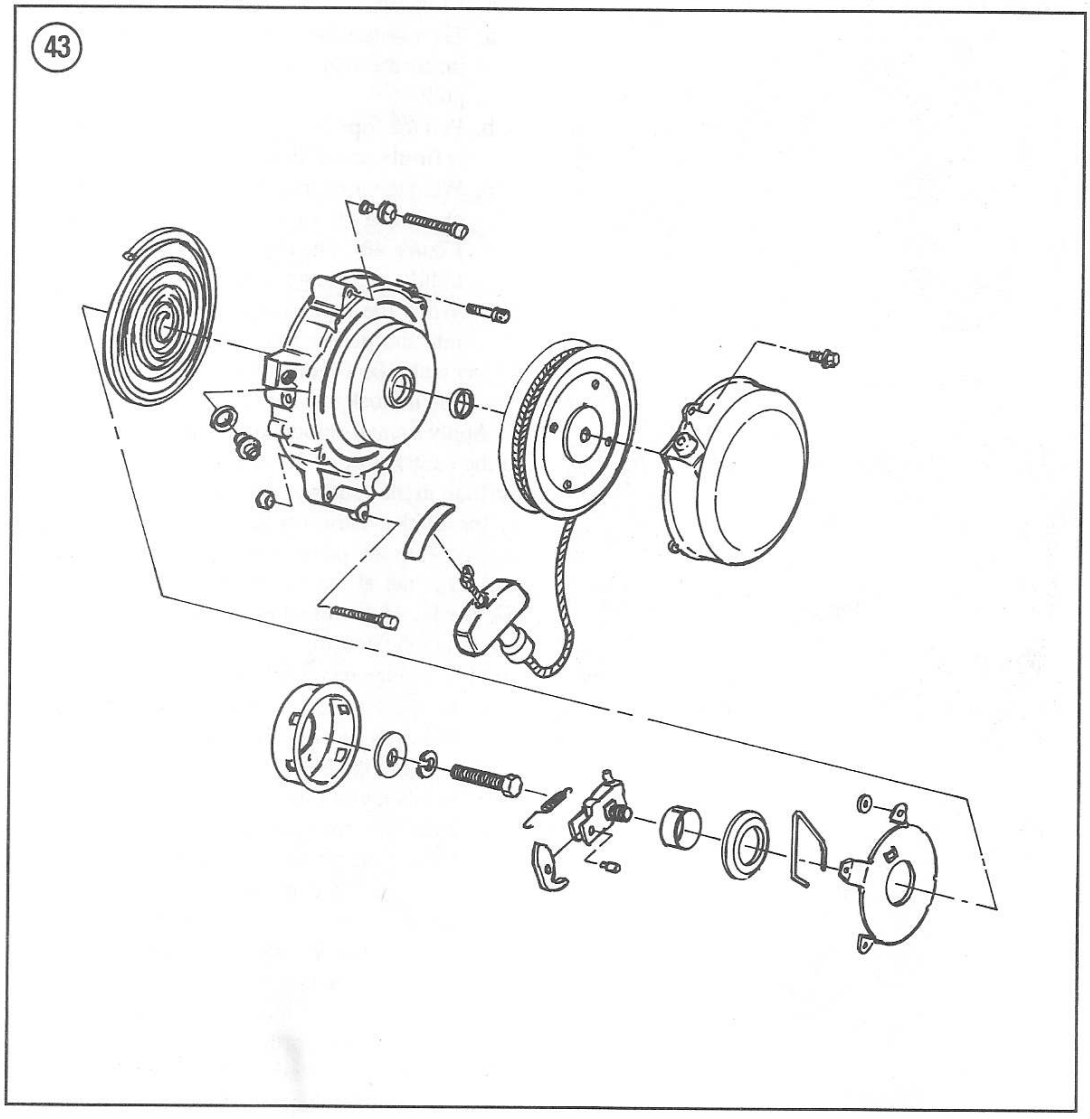
15. Attach the handle to the starter rope and check operation of the recoil starter. If the rope is the correct length, but does not hold the handle against the housing, refer to Step 10 and preload the spring another turn. If the rope is too long, the coils of the rope may extend outside the pulley groove and bind against the housing.

RECOIL STARTER (ALL 300, 350L AND 400L MODELS AND LATE 250 MODELS)

Refer to the following for service to the recoil starter used on late 250 models and all 300, 350L and 400L models. Refer to **Figure 43**.

Removal/Installation

1. Place the ATV on a level surface and block the wheels to keep it from rolling.

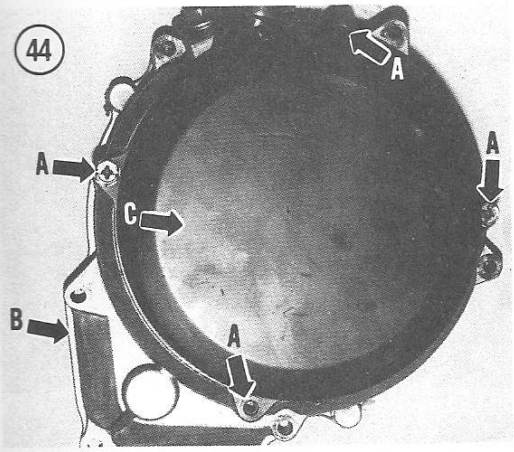


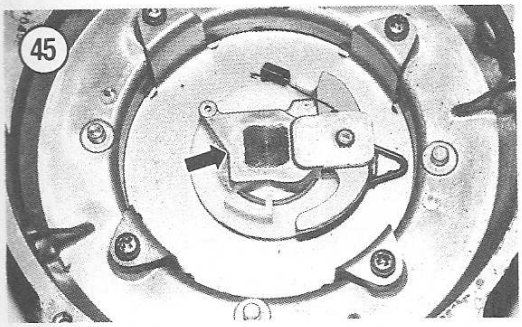
2. Remove the screws attaching the recoil starter, then remove the starter and gasket.

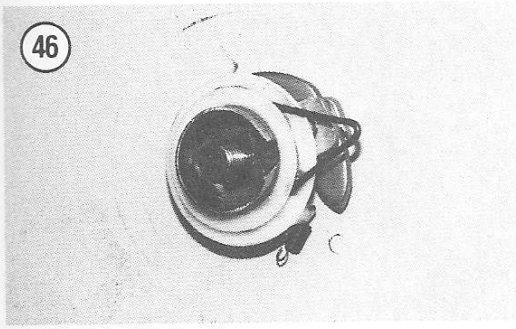
NOTE

The electric starter reduction drive assembly should remain with the engine. One end of the reduction drive assembly pilots in the rewind starter housing.

3. Install the recoil starter assembly and tighten the retaining screws.







Rope Removal and Installation

The starter rope can be removed and a new rope installed as follows, without removing the starter assembly from the engine.

1. Remove the 4 screws (A, **Figure 44**) which attach the rope housing to the flywheel housing (B, **Figure 44**). If the rope is not broken, allow the rope housing to unwind slowly.
2. Lift the rope housing (C, **Figure 44**) from the starter and unwind the rope from the pulley.
3. Remove the starter handle from the rope and detach the rope from the pulley.
4. Attach a new rope to the pulley, thread the end of the rope through the rope housing (C, **Figure 44**), then attach the handle.
5. Pull the rope out of the rope housing as far as possible, then position the rope housing over the pulley.

NOTE

*If the flywheel housing (B, **Figure 44**) is removed from the engine, hold the housing to keep it from turning while winding the rope onto the pulley in Step 6.*

6. Turn the rope housing (C, **Figure 44**) clockwise until the handle is against the housing.
7. Turn the rope housing approximately three additional turns to preload the recoil spring and to point the handle in the correct direction. Align the holes in the rope housing with the threaded holes in the flywheel housing, then install the four screws (A, **Figure 44**).

Disassembly, Inspection and Assembly

1. Unbolt the flywheel housing (B, **Figure 44**) from the engine, then remove the complete flywheel housing and starter assembly.
2. Remove the starter rope as described in this chapter.
3. Clamp the ratchet pawl bracket (**Figure 45**) in a vise. Be careful not to damage the spring.
4. Hold the rope pulley with a cloth belt type strap wrench and remove the pulley by turning it counterclockwise.
5. Lift the ratchet pawl bracket, spring hook, ratchet friction ring and friction spring from the housing as an assembly. Refer to **Figure 46**.

6. Remove the 4 retaining screws (**Figure 47**) and lift the spring retainer plate from the housing.

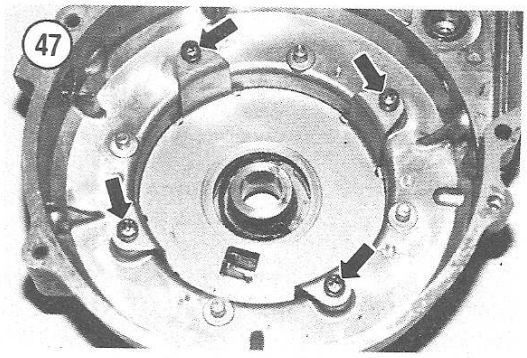
CAUTION

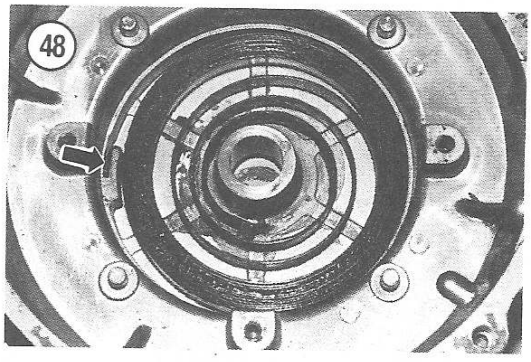
*The recoil spring (**Figure 48**) is under pressure and may jump from the housing during disassembly. Its edges are sharp and may cut or cause eye injury. Wear safety glasses or a face shield and gloves when disassembling and assembling.*

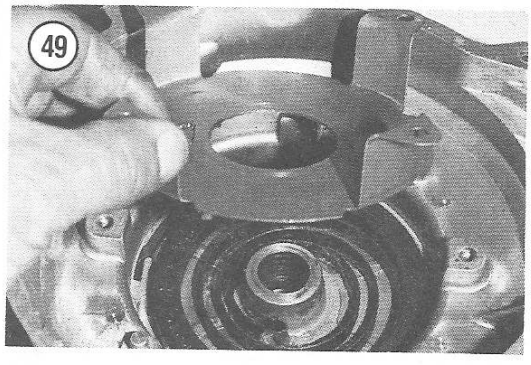
7. Carefully lift the starter spring from the starter housing.
8. Clean all parts and dry thoroughly.
9. Inspect the friction plate, friction spring, ratchet pawl and pawl spring (**Figure 45** and **Figure 46**) for damage. The friction spring should grip the friction plate securely.
10. Check the rope for fraying or other damage. It is usually a good practice to replace a rope with even slight damage before it breaks.
11. Inspect the tabs at the ends of the recoil spring.
12A. Reinstall the old recoil spring as follows:
   a. Hook the outer end of the recoil spring in the housing as shown in **Figure 48**.
   b. Wind the spring into the housing in a counterclockwise direction until the spring is completely in the housing. Hold the coils in place while winding the spring in place.
   c. The installed spring should be as shown in **Figure 48**.

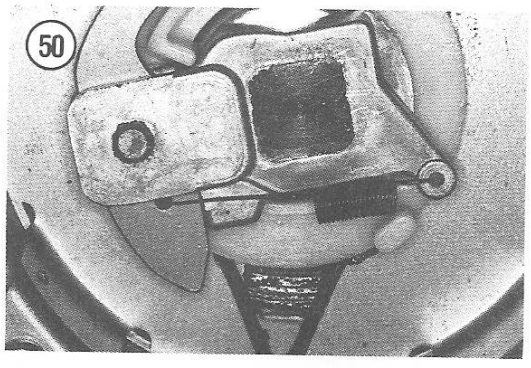
12B. New recoil springs are held compressed by a wire. Use the following instructions to install the new spring.
   a. Position the new spring in the housing so that it spirals inward in a counterclockwise direction and attach the outer end of the spring to the housing as shown in **Figure 48**.
   b. Hold the spring in place and cut the retaining wire. The installed spring should be as shown in **Figure 48**.

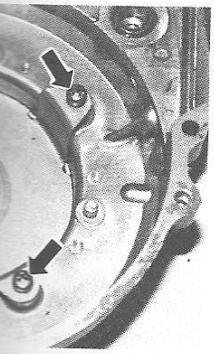
13. Lubricate the spring with a light, low-temperature lubricant.
14. Install the spring retainer plate (**Figure 49**).
15. Assemble the ratchet pawl bracket, spring hook, ratchet friction ring and friction spring as shown in **Figure 46**.
16. Apply a small amount of low-temperature grease to the center post, then insert the ratchet pawl

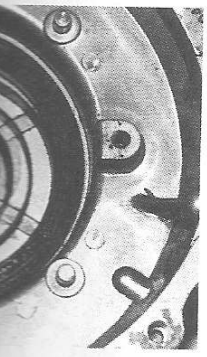


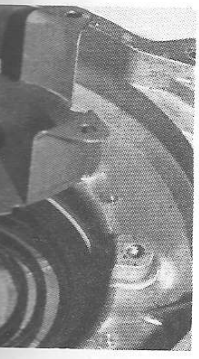


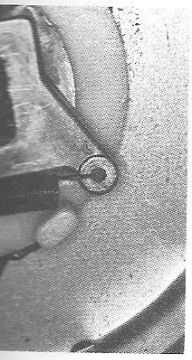


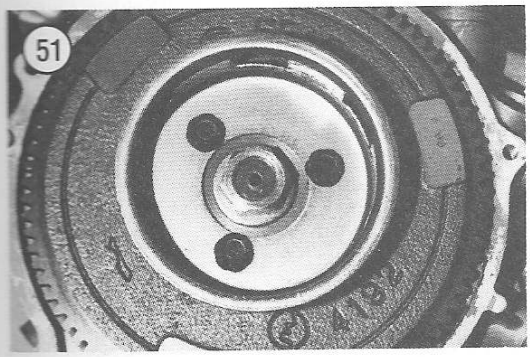


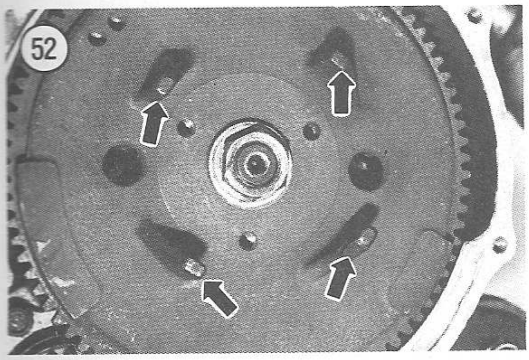


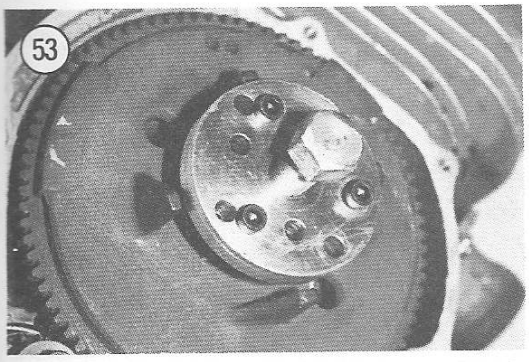


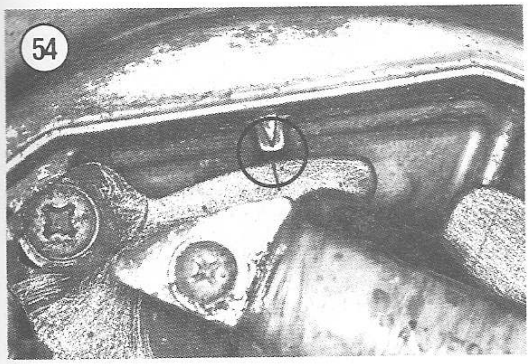












and friction assembly into the housing (**Figure 50**). Engage the spring hook with the end of the spring.

17. Hold the ratchet pawl tight against the housing and install the starter pulley on the threaded outer end.

18. Refer to *Rope Removal and Installation* to install the rope and preload the recoil spring.

19. The starter pulley cup on some models is attached to the flywheel as shown in **Figure 51**. On other models, the starter engagement dogs are cast into the flywheel as shown in **Figure 52**.

20. Apply Loctite 515 Gasket Eliminator to the mating surfaces and attach the starter assembly to the engine.

FLYWHEEL AND STATOR PLATE

Removal/Installation

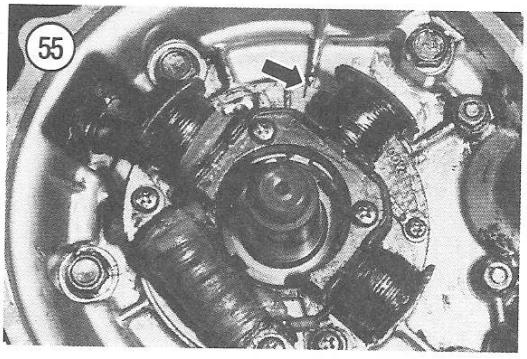
Before removing the flywheel and stator plate, clean the engine, frame and work area thoroughly. If water is used, be sure blow or wipe the engine dry before beginning removal.

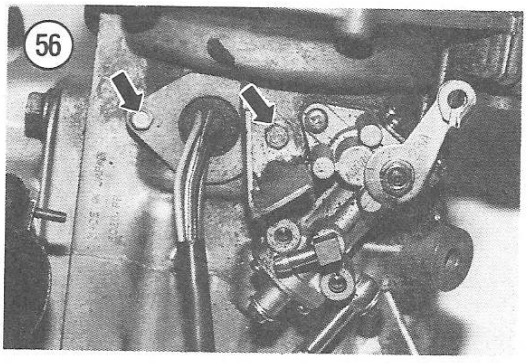
1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Disconnect the ground wire from the negative terminal of the battery.
3. Refer to Chapter Three to drain oil from the engine and the reservoir.
4. Detach the spark plug high tension lead from the spark plug.
5. Remove the recoil starter as described in this chapter.
6. Remove the flywheel nut and washer. Then use a suitable puller (**Figure 53**) to remove the engine flywheel.
7. The mark on the stator plate should be aligned with the pointer on the engine crankcase. Refer to **Figure 54** and **Figure 55** for typical marks. If the stator plate is not already marked, mark the position of the stator plate in a similar way so the stator can be reinstalled at the same ignition timing position.

CAUTION

Use care to prevent damage to seals, crankshaft, stator plate, armature wires or other parts when removing the stator plate and stator assembly.

8. Remove the stator retaining screws and the screws (**Figure 56**) attaching the clamp for the sealing ring around the wires.
9. Carefully guide the stator wires out through the opening as shown in **Figure 57**.
10. Install the stator plate, making sure that the previously affixed timing marks (**Figure 54** or **Figure 55**) are aligned. Be sure that the stator is fully seated and tighten the retaining screws.
11. Seal the stator wire grommet (**Figure 56**) with an appropriate sealer.
12. Make sure that the Woodruff key is in place, then install the flywheel. Tighten the flywheel retaining nut to the torque recommended in **Table 2**.
13. Install the recoil starter and tighten the retaining screws.





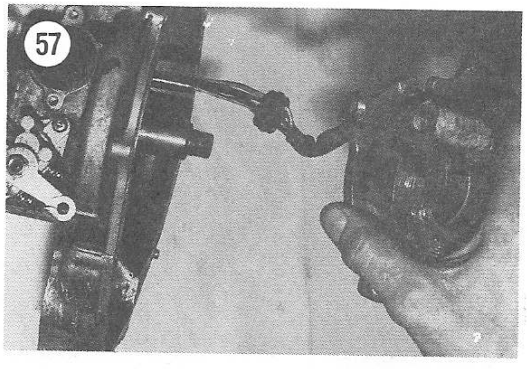
COOLANT PUMP

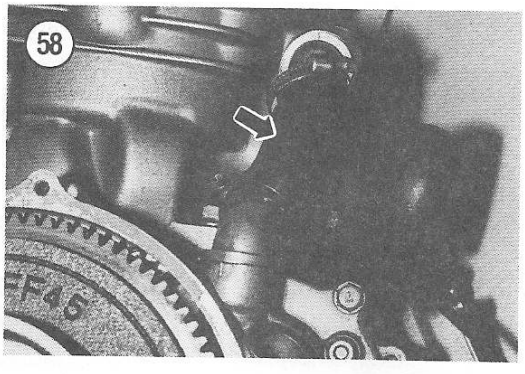
The liquid coolant of 350L and 400L models is circulated by a pump located in the lower right side of the engine crankcase. The engine must be removed from the frame before the coolant pump shaft, seals and impeller can be serviced.

Remove the balance shaft as described in this chapter to service the coolant pump drive shaft. The coolant pump shaft is an extension on the right end of the balance shaft.

Removal/Installation

1. Remove the engine as described in this chapter.
2. Remove the rewind starter as described in this chapter.
3. Remove the flywheel and stator plate as described in this chapter.
4. Remove the electric starter as described in Chapter Eleven.
5. Loosen the clamps on the coolant transfer hose (**Figure 58**), then remove the hose.

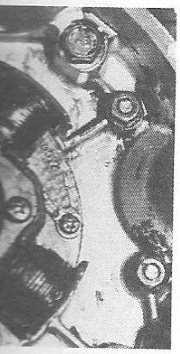


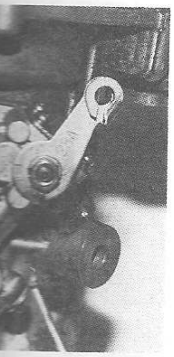


NOTE

*The slotted nut (**Figure 59**) has left hand threads and is removed by turning the nut clockwise. A special tool, part No. 2870967, for removing this nut is available from Polaris dealers.*

6. Remove the slotted nut (**Figure 59**) from the right end of the crankshaft.



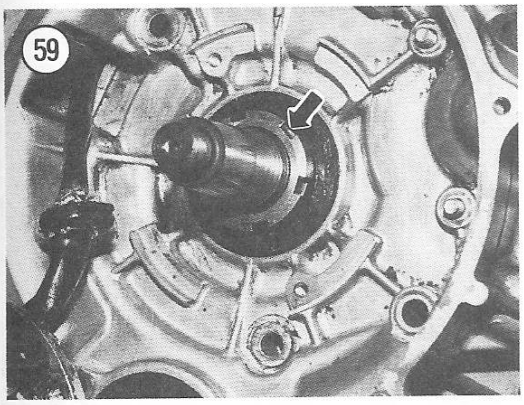


7. Remove the four nuts (8-11, **Figure 60**) with a 10 mm socket wrench.

8. Remove the two screws (6 and 7, **Figure 60**) with a 10 mm socket wrench.

9. Remove the five screws from position (1-5, **Figure 60**) with a 12 mm socket wrench.

10. Remove the cover from the right side of the engine. It will probably be necessary to use a soft-faced hammer to separate this cover from the crankcase.



NOTE

Shims may be located behind the impeller to adjust the clearance between the impeller blades and the cover. Do not lose these shims when removing the impeller.

11. Remove the retaining nut (A, **Figure 61**), then slide the impeller (B, **Figure 61**) and pump housing from the shaft.

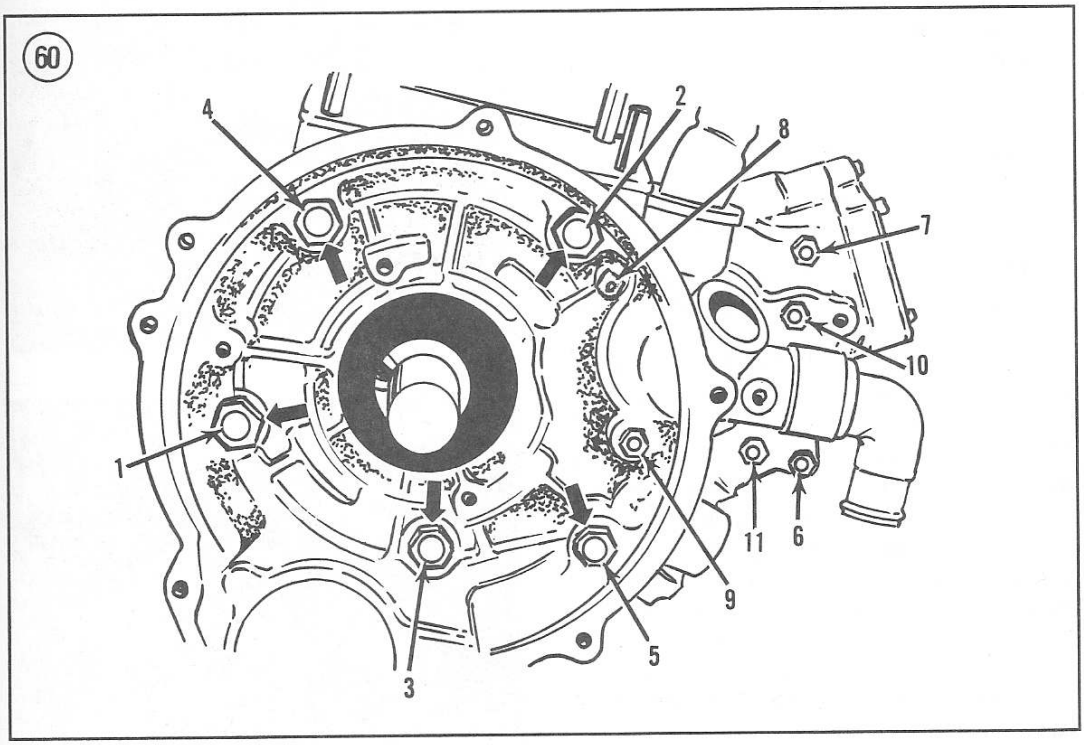
12. Remove the seal collar (A, **Figure 62**), O-ring (B) and guide washer (C) from the engine crankshaft (D).

13. If additional disassembly is necessary, refer to the procedure described in this chapter for removing the balance shaft.

14. Inspect seals (**Figure 63**) for leakage. Install new seals and inspect the shaft for damage. Refer to the procedure described in this chapter for removing the balance shaft if the shaft is damaged.

15. Clean all old gasket material and sealer from the coolant pump housing, the mating surface of the crankcase and from the engine cover.

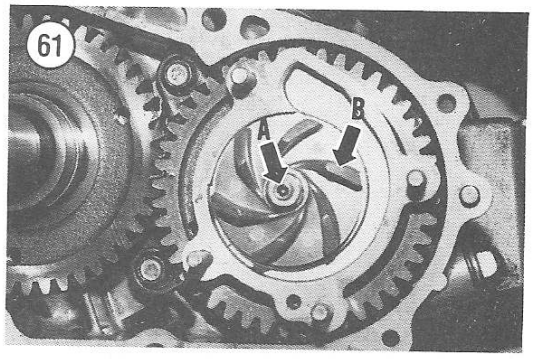
16. The impeller can be installed using the original shims if only new seals were installed. If other parts were installed or if clearance between the impeller

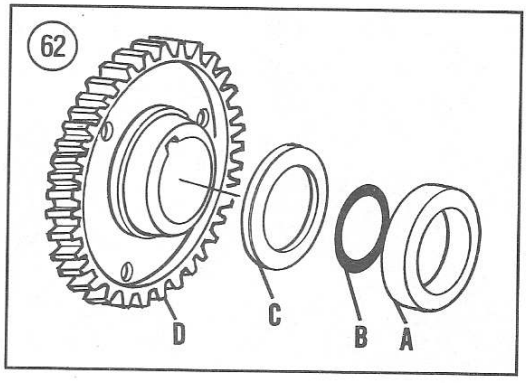


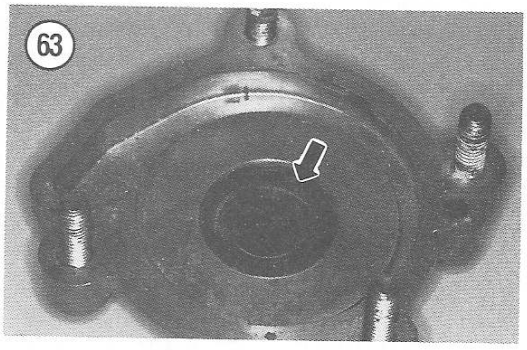
blades and the housing may have been wrong, measure the clearance as follows.

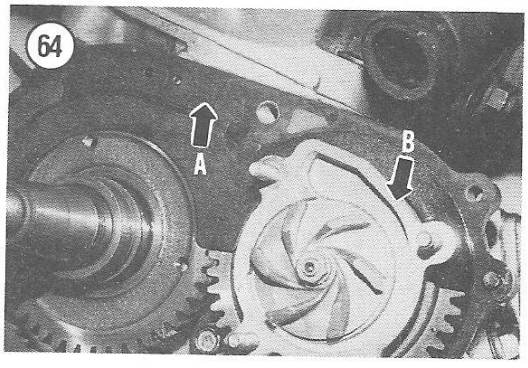
a. Install the impeller using the shims that were originally installed between the shaft and the back of the impeller. Tighten the retaining nut securely.
b. Stick a small amount of soft modeling clay on one impeller blade.
c. Temporarily install the engine right side cover and tighten screws (1, 4, 5 and 6, **Figure 60**).
d. Remove the four retaining screws and the engine right cover, then measure the thickness of the clay located on the impeller blade.
e. Compare the measured clearance with the limit specified in **Table 3**. If the clearance is too small, the blades may grind against the cover. If the clearance is too great, the pump will cavitate.
f. If the measured clearance is outside the limit, remove the impeller and change the thickness of the shims located between the shaft and the impeller. Recheck clearance by repeating substeps 16a through 16e.
g. After the correct thickness of shims has been determined, remove the engine cover, impeller retaining nut, impeller and shims, then proceed to Step 17.

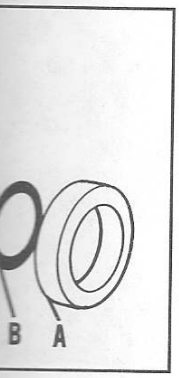
17. Lubricate the coolant pump shaft and install the pump housing and seals (**Figure 63**).
18. Install the selected shims and the pump impeller (B, **Figure 61**).
19. Apply Loctite 242 to the threads of the impeller retaining nut, then install and tighten the nut (A, **Figure 61**).
20. Coat the engine crankshaft with engine oil and install the collar, O-ring and guide washer (**Figure 62**).
21. Install a new gasket (A, **Figure 64**) and coat the mating surface of the pump housing (B, **Figure 64**) with Loctite Gasket Eliminator.
22. Coat the seal collar (**Figure 62**) and the seal in the engine right side cover with engine oil, then install the cover. Tighten the retaining screws and nuts in the order shown in **Figure 60**.
23. Install the slotted nut (**Figure 59**) and tighten the nut to the torque specified in **Table 2**.
24. The remainder of assembly is the reverse of the disassembly procedure. Fill the cooling system with a mixture of antifreeze and water as described in Chapter Three.

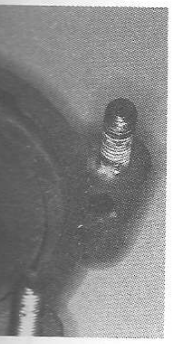


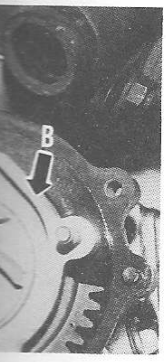






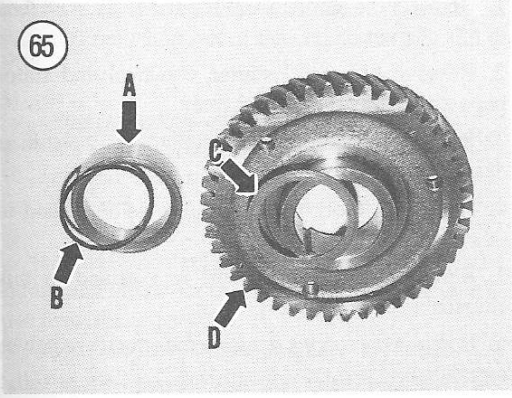


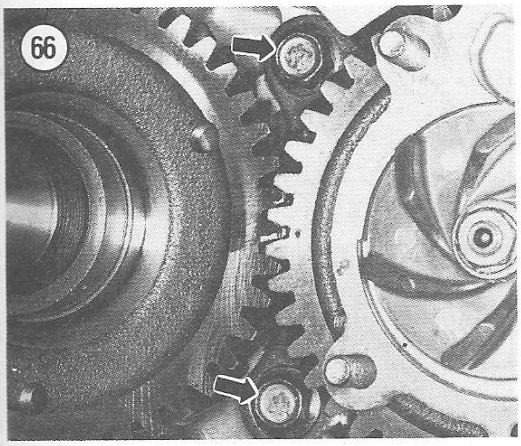


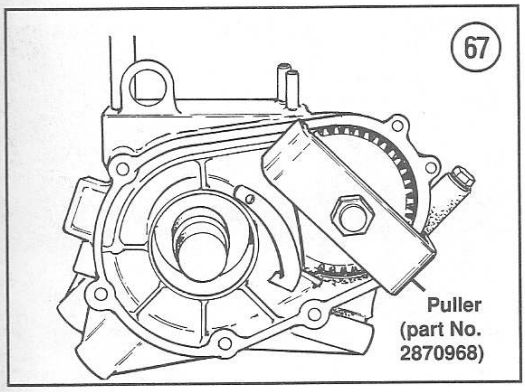


ENGINE BALANCER

Engine models 350L and 400L are equipped with a balance shaft that rotates at the same speed as the engine crankshaft. The engine must be removed and the coolant pump must be removed, as described in this chapter, before removing the balance shaft. The coolant pump shaft is an extension on the right end of the balance shaft.







Removal/Installation

1. Remove the engine from the frame as described in this chapter
2. Remove the engine right side cover and coolant pump as described in this chapter. Be careful not to damage the impeller (B, **Figure 61**) or the pump housing (B, **Figure 64**). Do not lose the shims located behind the pump impeller.
3. Remove the seal collar (A, **Figure 65**), O-ring (B, **Figure 65**), guide washer (C, **Figure 65**) and gear (D, **Figure 65**) from the engine crankshaft.
4. Remove the oil injection pump as described in this chapter.

CAUTION

Damage will result if attempts are made to remove the balance shaft before removing the oil pump or the counterbalance bracket.

5. Remove the two screws (**Figure 66**) attaching the counterbalance bracket.

CAUTION

The balance shaft can be damaged severely by improper handling. Failure to heat the crankcase sufficiently or not using the correct puller may result in damage.

6. Attach a puller (part No. 2870968) to the balance shaft as shown in **Figure 67**. Tighten the puller to apply tension, but do not attempt to pull the balance shaft without heating the crankcase as described in Step 7.

WARNING

If the crankcase is heated with an open flame, be extremely careful to prevent damage or injury. Gasoline, oil and some other materials located in or around the engine are extremely flammable. The amount of heat suggested by the manufacturer is 1-2 minutes with a small propane torch no closer than 2.5 cm (1 in.) from the crankcase.

7. Heat the crankcase at the locations indicated in **Figure 68**, while keeping tension on the attached puller.
8. Continue heating the crankcase, while tightening the puller until the balance shaft and bearings slide from the crankcase. Refer to **Figure 69**. If the inner (left) bearing remains in the crankcase, the crankcase should be separated to remove the bearing.

NOTE

The counterbalance retainer bracket must be in position when installing the balancer shaft assembly.

9. Position the counterbalance bracket (**Figure 66**) and guide the balancer and bearings assembly into the crankcase. When installing the balance shaft, it is necessary to heat the crankcase near the bearings as described in Step 7.
10. Install the crankshaft gear over the Woodruff key, aligning the marked tooth with the marked tooth of the balancer shaft gear as shown in **Figure 70**.

NOTE

After servicing the balance shaft, it is important to measure the clearance between the impeller blades and the cover. Refer to installing the coolant pump in this chapter.

11. Select the correct thickness of shims to install behind the coolant pump impeller as described in this chapter.
12. Install the coolant pump as described in this chapter.
13. Install the oil injection pump as described in this chapter.
14. The remainder of assembly is the reverse of the disassembly procedure. Fill the cooling system with a mixture of antifreeze and water as described in Chapter Three.

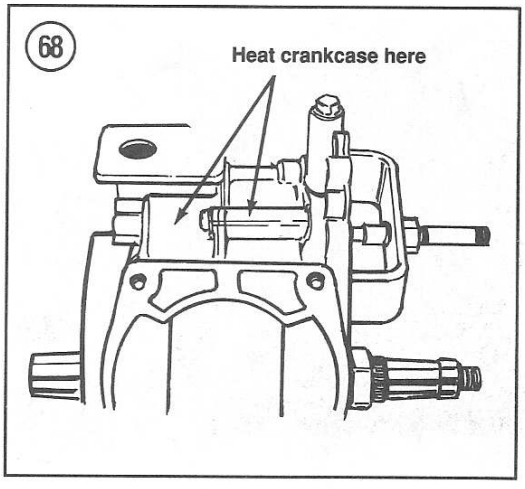
CRANKCASE

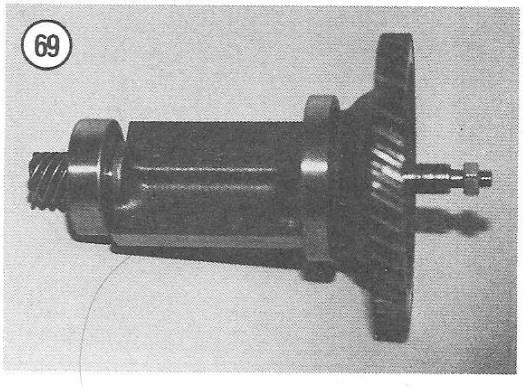
Disassembly

The crankcase contains the crankshaft and connecting rod assembly. The crankcase must be separated to remove the crankshaft. Service to the crankcase, crankshaft and connecting rod is often better performed by properly trained technicians. Use caution whenever you separate and rejoin the crankcase halves. The importance of absolute cleanliness cannot be over-emphasized when servicing internal parts of the engine.

Separation

1. Remove the engine from the frame as described in this chapter.
2. Remove the recoil starter, flywheel and stator plate as described in this chapter.
3. Remove the cylinder head, cylinder and piston as described in this chapter.
4. Remove the oil injection pump as described in this chapter.
5. Remove the balance shaft as outlined in this chapter.
6. Remove the screws securing the crankcase halves together.





CAUTION

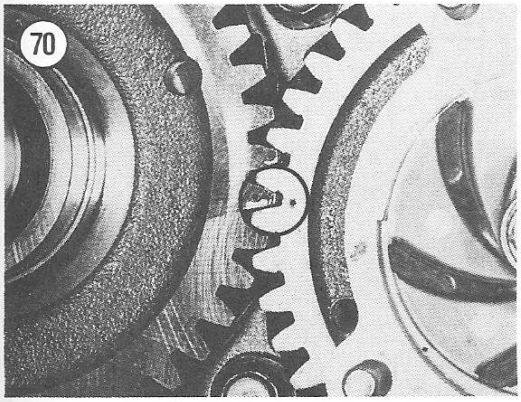
The crankshaft can be easily damaged by pounding on its end while attempting to force the crankshaft and main bearing from the case. Using a puller as shown in ***Figure 71*** *reduces the risk of damage.*

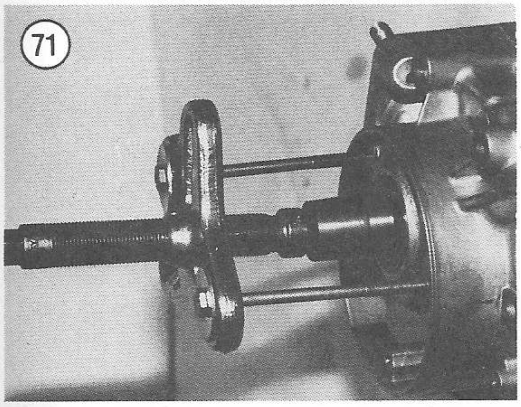
7. Attach a suitable puller as shown in **Figure 71** to push the crankshaft out of the crankcase.

CAUTION

Shims washers may be located between the crankshaft and main bearings. Be careful not to lose or damage these washers.

8. Heat the crankcase around the main bearing area and tighten the puller (**Figure 71**) to pull the crankcase from the crankshaft.
9. After removing one crankcase half, attach a puller to the opposite side and push the crankshaft from that side in a similar way.





Assembly

Crankshaft end play is adjusted by changing the thickness of shims located between the inner races of the main bearings and the crankshaft. Refer to **Table 3** for recommended crankshaft end play. Refer to *Crankshaft* section in this chapter to determine the correct thickness of shims to install.
1. Make sure that all the oil seals are removed from the crankcase and that the crankcase is clean.
2. Heat one half of the crankcase around the main bearing bore and insert the crankshaft and main bearing assembly. Make sure that the bearing is fully seated.
3. Apply Loctite Gasket Eliminator 515 Sealant to the crankcase mating surface.

NOTE

If the crankcase has been heated sufficiently, it will not require excessive force to install it over the bearings.

4. Heat the uninstalled crankcase half around the main bearing bore and position it over the end of the crankshaft. Align the case halves and push the two halves together.
5. Apply a light coat of oil to the crankcase screw threads before installing them.
6. Install the crankcase screws and tighten by hand.
7. Tighten the screws attaching the halves together to the torque listed in **Table 2**. Make sure that the screws are tightened evenly.
8. Fill the lip cavities of the crankshaft seals with a low-temperature lithium base grease, then install the seals in the crankcase bores.
9. The remainder of the assembly is the reverse of the separation procedure.

CRANKSHAFT, BEARINGS AND SHIMS

Inspection/Adjustment

CAUTION

The crankshaft bearings are damaged during removal. Carefully inspect the bearings while still installed on the crankshaft. Do not remove the bearings unless replacement is necessary.

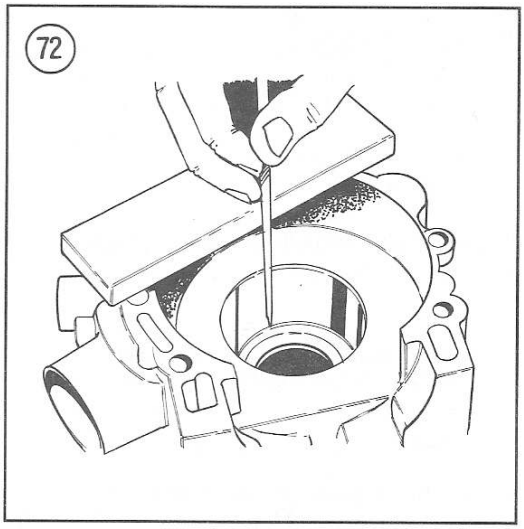
1. Use a suitable puller to remove the bearings and seals from the crankcase or crankshaft. Note the original direction of the shaft seals.

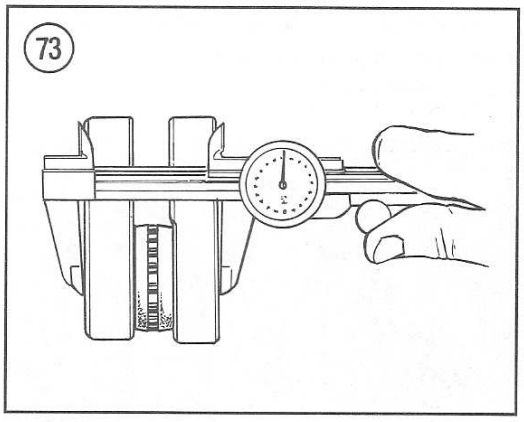
2. Clean the crankcase halves, both inside and out with a suitable solvent and dry thoroughly. Be sure to remove all traces of old gasket material and sealer from the mating surfaces.

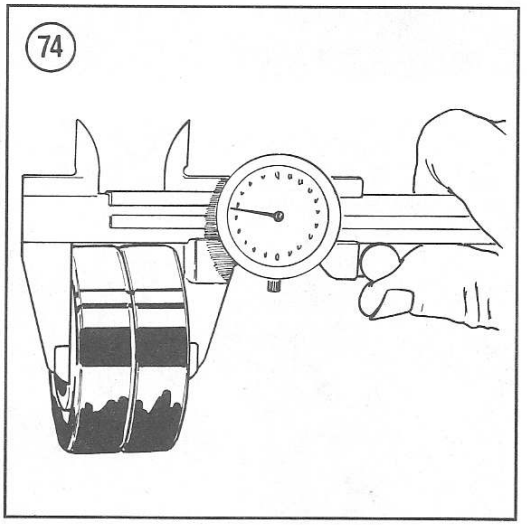
3. Inspect the crankcase halves carefully for cracks, fractures or other damage. Inspect the bearing bores for damage.

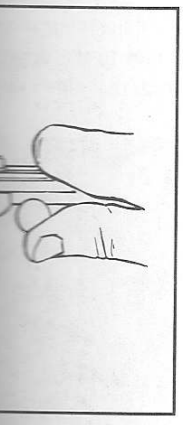
4A. If new bearings are being installed, determine the correct thickness of the shims necessary to limit the end play of the crankshaft as follows.

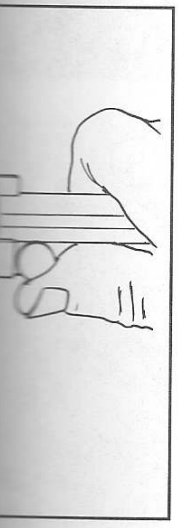
a. Position a straightedge across the crankcase as shown in **Figure 72** and use a dial caliper to measure the distance from the top of the straightedge to the bottom of the bearing bore.
b. Measure the thickness of the straightedge.
c. Subtract the thickness of the straightedge (measured in sub-step b) from the distance measured in sub-step a to determine the actual depth of the main bearing bore from the crankcase parting surface. *Record this distance.*
d. Measure the depth of the similar main bearing bore in the other crankcase half following sub-steps a through c. *Record the calculated depth of this bearing bore.*
e. Add the depth recorded in sub-step c and the depth recorded in sub-step d. This is the distance between the bearing bores of the assemble crankcase.
f. Measure the distance between the shoulders at the ends of the crankshaft (**Figure 73**). *Record the measured length.*
g. Measure the thickness of all of the main bearing outer races (**Figure 74**). Add all of the measured thicknesses to obtain the total main bearing thickness. *Record this total thickness.*
h. Add the length of the crankshaft determined in sub-step f to the thickness of the main bearings calculated in sub-step g. This total is the total length of the crankcase and main bearings.
i. Subtract the length of the crankshaft and main bearings (sub-step h) from the distance between the main bearing bores (sub-step e). This is the measured end play without shims.
j. Select shims that will not cause the shaft to bind but will reduce the amount of end play to within the limit recommended in **Table 3**.
k. Position the shims on the crankshaft, then use a suitable press to install the main bearings on the crankshaft.









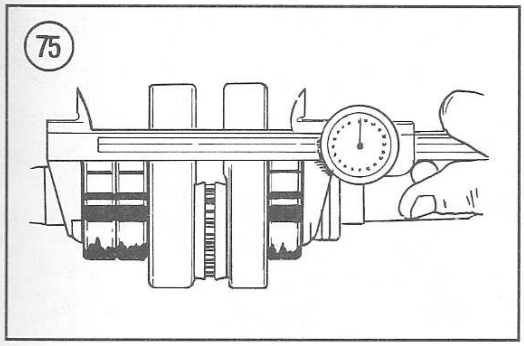


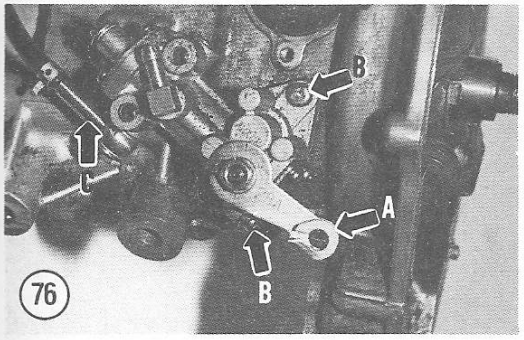
4B. To check if the crankshaft end play is correct, proceed as follows.

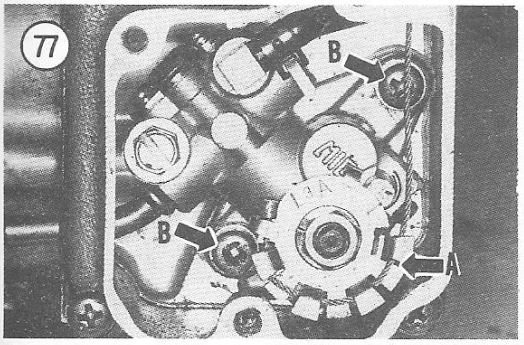
a. Position a straightedge across the crankcase as shown in **Figure 72** and use a dial caliper to measure the distance from the top of the straightedge to the bottom of the bearing bore.

b. Measure the thickness of the straightedge.

c. Subtract the thickness of the straightedge (measured in sub-step b) from the distance measured in sub-step a to determine the actual depth of the main bearing bore from the crankcase parting surface. *Record this distance.*







d. Measure the depth of the similar main bearing bore in the other crankcase half following sub-steps a through c. *Record the calculated depth of this bearing bore.*

e. Add the depth recorded in sub-step c and the depth recorded in sub-step d. This is the distance between the bearing bores of the assembled crankcase.

f. Make sure that the main bearings are fully seated on the crankshaft. Then measure the distance between the outer races of the main bearings (**Figure 75**). *Record the measured length.*

g. Subtract the length of the crankshaft and main bearings (sub-step f) from the distance between the main bearing bores (sub-step e). Compare the measured end play with the recommended limit listed in **Table 2**.

h. If the end play is not correct, the main bearings must be removed from the crankshaft to change the thickness of the shims. Add or remove shims equal to the amount necessary to correct the end play.

OIL INJECTION SYSTEM

The oil injection pump typical of air cooled 250 and 300 models is located on the rear of the crankcase as shown in **Figure 76**. The oil injection pump typical of liquid cooled 350L and 400L models is located at the front of the engine crankcase as shown in **Figure 77**.

It is important that the correct amount of oil is delivered to the engine. Refer to Chapter Three for adjusting the control cable and bleeding air from the system. Engine performance is adversely affected by improper oil delivery.

Pump
Removal/Installation

1. Detach the control cable from the control lever (A, **Figure 76** or A, **Figure 77**).
2. Disconnect the oil lines from the pump fittings and plug the lines.
3. Remove the two mounting screws (B, **Figure 76** or B, **Figure 77**).
4. Withdraw the pump from the bore in the crankcase.

CAUTION

Do not lose shims which may be located between the spigot at the bottom of the pump drive and the pump driven gear. These shims are used to set pump end play. Excessive end play may cause a noticeable noise when the engine is running at slow speed.

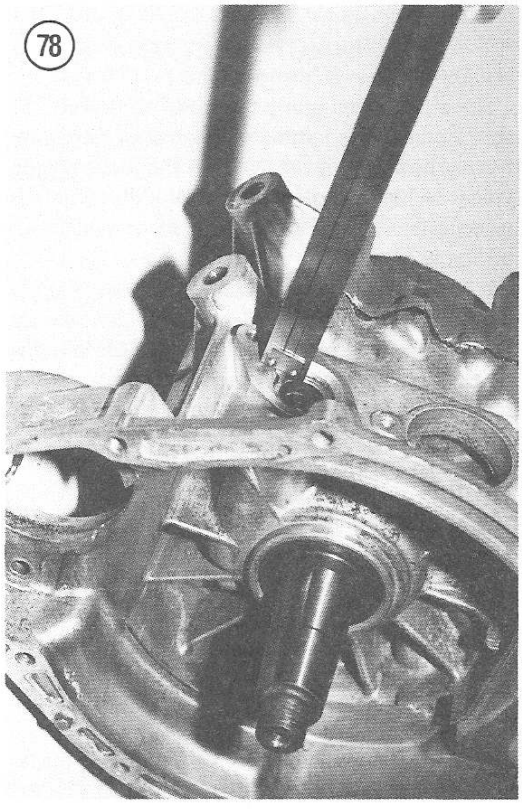
5. Withdraw the pump driven gear from the bore in the crankcase.

6. Using a vernier caliper, measure the distance from the pump mounting surface to the drive gear as shown in **Figure 78**.

7. Measure the depth of the pump mounting flange as shown in **Figure 79**.

8. Subtract the depth measured in Step 7 from the distance measured in Step 6. The result is the end play of the oil pump drive gear.

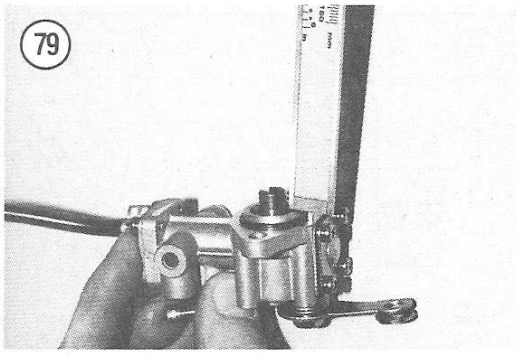
9. Compare the end play with the recommended end play listed in **Table 3**.

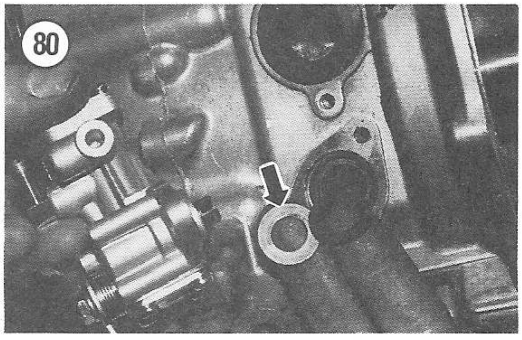


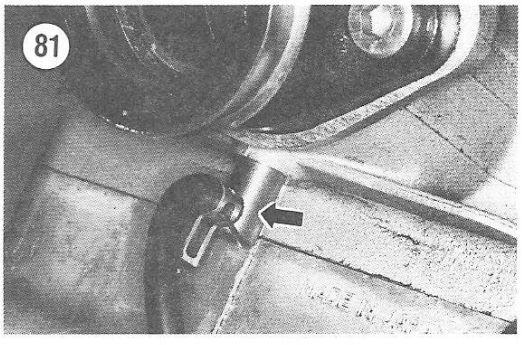
10. Add shims (**Figure 80**) between the pump drive gear and the pump mounting flange if clearance is excessive.

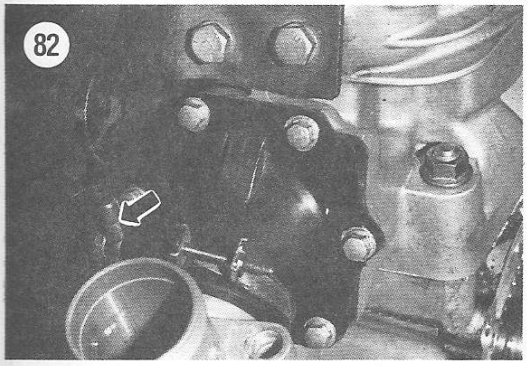
Oil Injection Check Valve

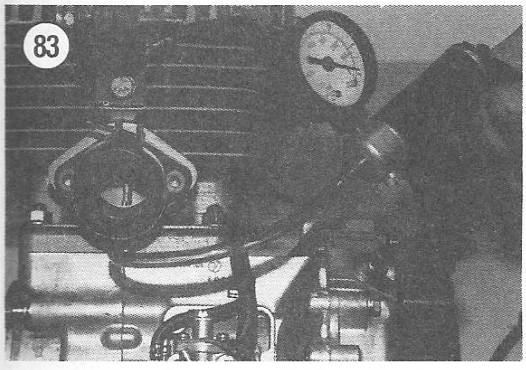
The oil injection check valve is located in the output line from the oil injection pump. The valve permits oil to be injected into the engine intake, but should stop crankcase pressure from entering the oil line. The check valve is located in the banjo fitting (C, **Figure 76**) on 250 models and in the injector











fitting (**Figure 81**), or in the banjo fitting (**Figure 82**) on all other models.

Test the check valve using a pressure tester (**Figure 83**). The valve should open when pressure exceeds 13.8-34.5 kPa (2-5 psi) in the direction of oil flow, but should close when a vacuum is applied. Install a new check valve if the old valve is faulty.

BREAK-IN PROCEDURE

If the rings are replaced, a new piston installed, the cylinder rebored or honed or major lower end work performed, the engine should be broken-in just as though it were new. The performance and service life of the engine depends greatly on a careful and sensible break-in.

For the first 5-10 hours of operation, use no more than one-third throttle and vary the speed as much as possible within the one-third throttle limit. Avoid prolonged steady running at one speed, no matter how moderate, as well as hard acceleration.

Following the first 5-10 hours use more throttle until the ATV has run for 100 hours. Then limit the throttle to short bursts of speed until 150 hours have been logged.

Table 1 2-STROKE ENGINE SPECIFICATIONS

Engine model	Bore mm (in.)	Stroke mm (in.)	Disp. cc (cid.)	Hp @ rpm
1985				
Scrambler				
EC25PF 01	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss				
EC25PF 01	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
1986				
Scrambler				
EC25PF 01	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss				
EC25PF 01	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss				
EC25PF 01	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000

(continued)

Table 1 2-STROKE ENGINE SPECIFICATIONS (continued)

Engine model	Bore mm (in.)	Stroke mm (in.)	Disp. cc (cid.)	Hp @ rpm
1987				
Trail Boss				
EC25PF 01, 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Cyclone				
EC25PF 02	72 (2.835)	60 (2.362)	244 (14.9)	30 @ 7,000
Trail Boss 4 × 4				
EC25PF 01, 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 01, 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 01, 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
1988				
Trail Boss 2 × 4				
EC25PF 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 03	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250 R/ES				
EC25PF 04	72 (2.835)	60 (2.362)	244 (14.9)	27@ 6,600
Trail Boss 250 R/ES				
EC25PF 04	72 (2.835)	60 (2.362)	244 (14.9)	27 @ 6,600
1989				
Trail Boss				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 4 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 4 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
1990				
Trail Blazer				
EC25PF 07	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000

(continued)

Hp @ rpm
22 @ 6,000
30 @ 7,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
27 @ 6,600
27 @ 6,600
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000

Table 1 2-STROKE ENGINE SPECIFICATIONS (continued)

Engine model	Bore mm (in.)	Stroke mm (in.)	Disp. cc (cid.)	Hp @ rpm
1990 (continued)				
Trail Boss 4 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 4 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
Trail Boss 4 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
1991				
Trail Blazer				
EC25PF 07	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 4 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 6 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
Trail Boss 4 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
1992				
Trail Blazer				
EC25PF 07	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 4 × 4				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 4 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000

(continued)

Table 1 2-STROKE ENGINE SPECIFICATIONS (continued)

Engine model	Bore mm (in.)	Stroke mm (in.)	Disp. cc (cid.)	Hp @ rpm
1992 (continued)				
Big Boss 6 × 6				
EC25PF 05	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 2 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
Trail Boss 4 × 4-350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
1993				
Trail Blazer				
EC25PF 07, 09	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250				
EC25PF 07, 09	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
2 × 4 250				
EC25PF 05, 08	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
2 × 4 350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @5 ,800
4 × 4 250				
EC25PF 05, 08	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
4 × 4 350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
Big Boss 6 × 6 250				
EC25PF 05, 08	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Big Boss 6 × 6 350L				
EC35PL 02	80 (3.152)	70 (2.758)	352 (21.5)	32 @ 5,800
1994				
Trail Blazer				
EC25PF 09	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss 250				
EC25PF 08	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
2 × 4 300				
EC28PF 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
4 × 4 300				
EC28PF 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
2 × 4 400L				
EC38PL 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
4 × 4 400L				
EC38PL 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700

(continued)

Hp @ rpm
22 @ 6,000
32 @ 5,800
32 @ 5,800
22 @ 6,000
22 @ 6,000
22 @ 6,000
32 @5 ,800
22 @ 6,000
32 @ 5,800
22 @ 6,000
32 @ 5,800
22 @ 6,000
22 @ 6,000
22 @ 6,000
22 @ 6,000
35 @ 5,700
35 @ 5,700

Table 1 2-STROKE ENGINE SPECIFICATIONS (continued)

Engine model	Bore mm (in.)	Stroke mm (in.)	Disp. cc (cid.)	Hp @ rpm
1994 (continued)				
Sport 400L				
EC38PL 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
Sportsman 4 × 4				
EC38PL 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
Big Boss 6 × 6 300				
EC28PF 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
Big Boss 6 × 6 400L				
EC38PL 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
1995				
Trail Blazer				
EC25PF 09	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
Trail Boss				
EC25PF 08	72 (2.835)	60 (2.362)	244 (14.9)	22 @ 6,000
2 × 4 300				
EC28PFE 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
4 × 4 300				
EC28PFE 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
2 × 4 400L				
EC38PLE 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
Scrambler				
EC38PLE 03	83 (3.270)	70 (2.758)	378 (23.1)	
Sport 400L				
EC38PLE 02	83 (3.270)	70 (2.758)	378 (23.1)	
Sportsman 4 × 4				
EC38PLE 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
Xplorer 4 × 4				
EC38PLE 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700
6 × 6 300				
EC28PFE 01	74.5 (2.935)	65 (2.561)	283 (17.3)	22 @ 6,000
6 × 6 400L				
EC38PLE 01	83 (3.270)	70 (2.758)	378 (23.1)	35 @ 5,700

Table 2 TIGHTENING TORQUES

	N·m	ft.-lb.
2-stroke engines		
Cylinder head	23-25	17-18
Cylinder base	34-39	25-29

(continued)

Table 2 TIGHTENING TORQUES (continued)

	N•m	ft.-lb.
Crankcase		
6mm	8-10	6-8
8mm	22-23	16-17
Crankshaft		
Right side slotted nut	39-60	29-44
Left side pulley screw	54	40
Flywheel nut		
Air cooled	60-84	44-62
Liquid cooled	39-60	29-44
Other 6mm bolts	8-10	6-8

Table 3 SERVICE SPECIFICATIONS

	mm	in.
Coolant impeller blade clearance		
Minimum limit	0.05	0.020
Maximum limit	0.1	0.040
Crankshaft		
End play	0.20-0.40	0.008-0.016
Alignment		
Preferred	0.05	0.002
Limit	0.15	0.005
Oil injection pump		
End play	0.20-0.40	0.008-0.016
Piston ring end gap		
1985-1990 models	0.20-0.41	0.008-0.016
1991-1993 models		
250 (air cooled)	0.23-0.46	0.009-0.018
350L (liquid cooled)	0.26-0.53	0.010-0.021
1994 models		
250 (air cooled)	0.23-0.46	0.009-0.018
300 (air cooled)	0.30-0.56	0.012-0.022
400L (liquid cooled)	0.18-0.38	0.007-0.015
1995 models		
250 (air cooled)	0.23-0.46	0.009-0.018
300 (air cooled)	0.30-0.56	0.012-0.022
400L (liquid cooled)	0.18-0.38	0.007-0.015
Piston skirt clearance		
1985-1989 models	0.036-0.071	0.0014-0.0028
1990 models		
250 (air cooled)	0.036-0.071	0.0014-0.0028
350L (liquid cooled)	0.061-0.094	0.0024-0.0037
1991-1993 models		
250 (air cooled)	0.028-0.053	0.0011-0.0021
350L (liquid cooled)	0.061-0.095	0.0024-0.0037
1994 models		
250 (air cooled)	0.028-0.053	0.0011-0.0021
300 (air cooled)	0.030-0.066	0.0012-0.0026
400L (liquid cooled)	0.058-0.094	0.0023-0.0037
1995		
250 (air cooled)	0.028-0.053	0.0011-0.0021
300 (air cooled)	0.030-0.066	0.0012-0.0026
400L (liquid cooled)	0.058-0.094	0.0023-0.0037
Reed stop height		
350L and 400L models	9.0	0.350
Maximum reed petal air gap		
350L and 400L models	0.4	0.015

CHAPTER FIVE

ENGINE (4-STROKE MODELS)

This chapter provides complete service and overhaul procedures, including removal, disassembly, inspection and reassembly on the 4-stroke engine used in Magnum models. Refer to Chapter Four for service on the 2-stroke engine used in other models.

Refer to **Table 1** for 4-stroke engine application. The one cylinder engine has a displacement of 425 cc and is liquid cooled. The single overhead camshaft is driven by a chain from the engine crankshaft. The two inlet and two exhaust valves are opened by rocker arms that are individually adjustable.

Before beginning any work, read the service hints in Chapter One. You will do a better job with this information fresh in your mind.

The text often refers to left and right sides of the engine as it sits in the ATV's frame, not as it happens to be sitting on your workbench. "Left" and "Right" refers to a rider sitting on the seat of the ATV facing in the normal direction (forward).

Tables 1-4 are at the end of this chapter.

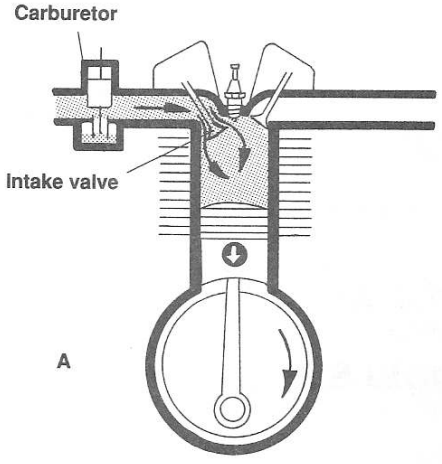
ENGINE PRINCIPLES

Figure 1 explains how a 4-stroke engine operates. Understanding the principles and knowing what must happen for the engine to run will help you troubleshoot problems when it doesn't.

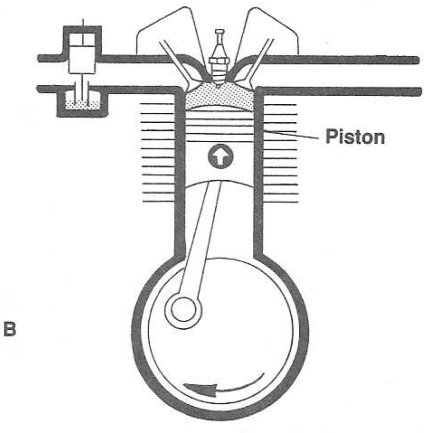
ENGINE COOLING

The engine is cooled by a mixture of antifreeze and water that is circulated by a pump through passages inside the engine and to a radiator located at the front of the engine. Refer to Chapter Three for cooling system maintenance and to Chapter Seven for service to the engine cooling system.

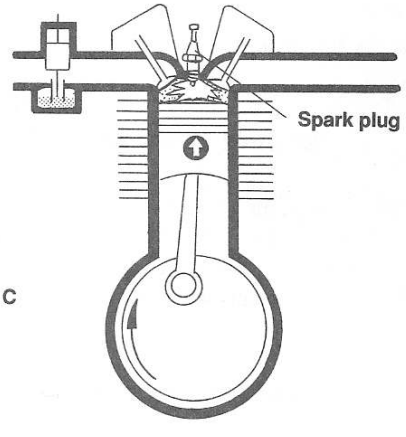
1



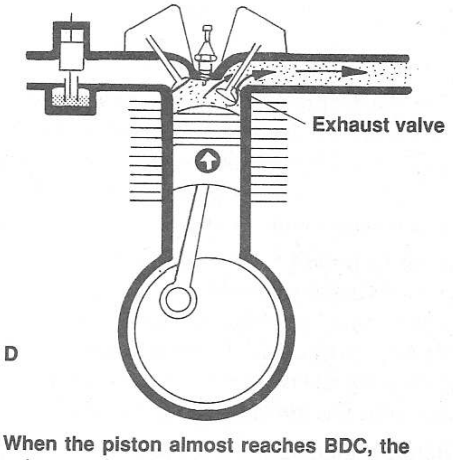
As the piston travels downward, the exhaust valve is closed and the intake valve opens, allowing the new air-fuel mixture from the carburetor to be drawn into the cylinder. When the piston reaches the bottom of its travel (BDC) the intake valve closes and remains closed for the next 1 1/2 revolutions of the crankshaft.



While the crankshaft continues to rotate, the piston moves upward, compressing the air-fuel mixture.



As the piston almost reaches the top of its travel, the spark plug fires, igniting the compressed air-fuel mixture. The piston continues to top dead center (TDC) and is pushed downward by the expanding gases.



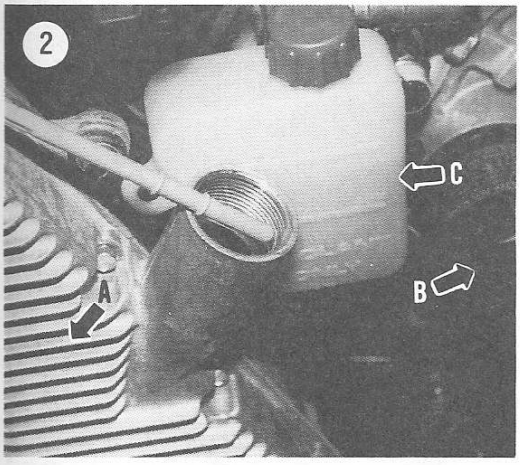
When the piston almost reaches BDC, the exhaust valve opens and remains open until the piston is near TDC. The upward travel of the piston forces the exhaust gases out of the cylinder. After the piston has reached TDC, the exhaust valve closes and the cycle starts all over again.

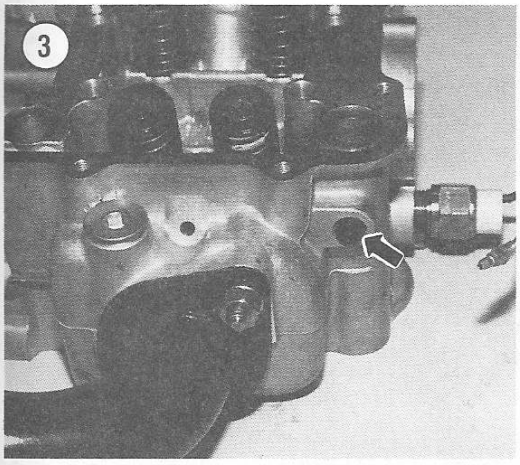
NOTE

*Cooling is also assisted by the fins (A, **Figure 2**) on the oil reservoir located on the left side. Some heat from the engine is transferred to the oil, then radiated to the air flowing past the cooling fins in the reservoir. Service to the lubrication system is included in this chapter.*

ENGINE LUBRICATION

Polaris 4-stroke engines are equipped with a dry sump type lubrication system that contains only a small (**Table 2**) amount of oil. The various components of the engine are lubricated by the oil as it is circulated within the engine, then back to the reservoir (tank). The oil is used over and over as the 4-stroke engine operates. Engine heat is transferred to the oil, then the oil is allowed to cool while it is in the reservoir (A, **Figure 2**). The oil also becomes contaminated as it circulates within the engine and a filter is used to trap some of the particles.





The oil flows through a screen in the bottom of the oil reservoir, then through the supply hose to the oil pump. The oil pump forces oil through a one-way (check) valve that stops oil from draining into the engine when it is not running. After passing the check valve, oil flows to the oil filter. If the oil filter (B, **Figure 2**) is obstructed, a bypass valve in the filter allows the oil to pass without being filtered. After flowing through (or around) the oil filter, the oil is divided into 2 separate paths.

Part of the pressurized oil flows through the stud at the left front of the cylinder head to lubricate the camshaft and valve operating mechanism.

Some of the lubricating oil is directed to the crankcase main oil gallery. Oil from the main oil gallery is used to lubricate the crankshaft, connecting rod and engine balancer assembly. Oil thrown off lubricates the cylinder, rings, piston, connecting rod, piston pin bearing, oil/coolant pump drive gears, cam chain and drive sprockets.

Refer to Chapter Three for servicing the lubricating oil and the oil filter.

Oil Pressure Test

Pressurized oil is directed up through the stud at the left front of the cylinder head to lubricate the camshaft and valve operating mechanism. To check the engine oil pressure, proceed as follows:

1. Stop the engine and make sure that the reservoir is full of oil. If the condition of the oil filter is questionable, refer to Chapter Three and install a new oil filter.
2. Remove the blind plug (**Figure 3**), located at the lower front part of the cylinder head.
3. Connect a suitable oil pressure gauge with a 1/8 in. NPT (National Pipe Thread) pipe fitting, to the oil port.
4. Start and run the engine until it reaches operating temperature.
5. Run the engine at 5,500 rpm and observe the pressure indicated by the installed gauge.

CAUTION

Low oil pressure will quickly damage engine parts. Low oil pressure should be corrected as soon as possible.

6. After checking the pressure, remove the oil pressure gauge.
7. Coat the threads of the blind plug (**Figure 3**) with sealer before installing. Refer to **Table 3** for recommended tightening torque for the oil pressure blind plug.

SERVICING THE ENGINE IN THE FRAME

The ATV's frame is a great holding fixture, especially when breaking loose stubborn bolts and nuts. The following components can be serviced while the engine is mounted in the frame.

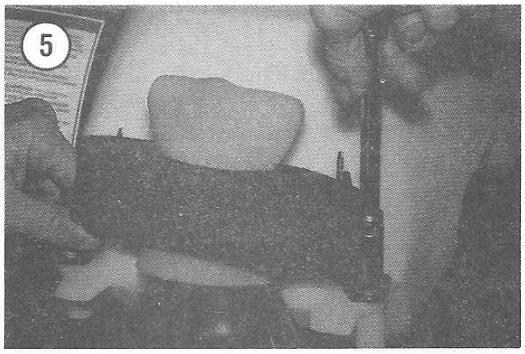
a. Alternator and stator.
b. Cam chain and sprockets.
c. Cam chain tensioner and guides.
d. Cylinder.
e. Cylinder head.
f. Flywheel.
g. Rocker arms.
h. Piston and rings.
i. Starter motor and drive.

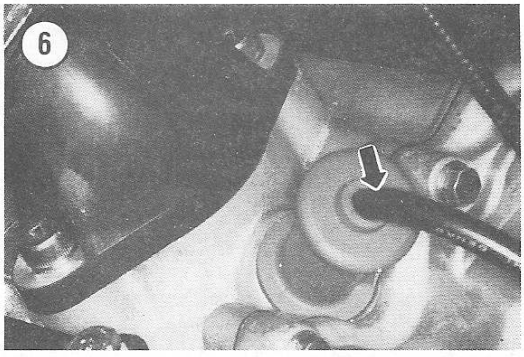
ENGINE REMOVAL AND INSTALLATION

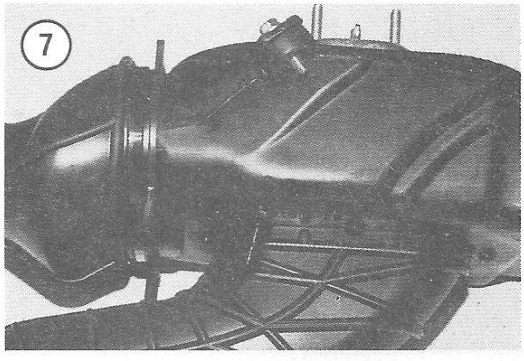
Depending upon the extent of the engine service, some mechanics prefer to remove the engine before servicing some internal components that do not require engine removal. Also, some disassembly of the engine before removal may make removal and installation easier. The engine must be removed from the frame to service the following components.

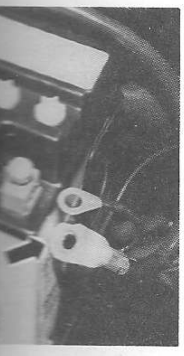
a. Connecting rod.
b. Coolant pump and mechanical seal.
c. Counterbalancer.
d. Crankcase.
e. Crankshaft.
f. Main bearings.
g. Oil pump.

Before removing the engine, clean the engine, frame and work area thoroughly. If water is used, be sure blow or wipe the engine dry before beginning removal.

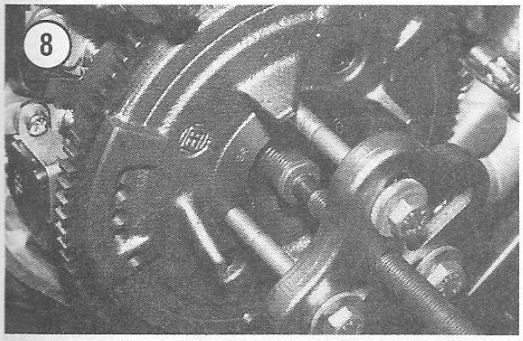


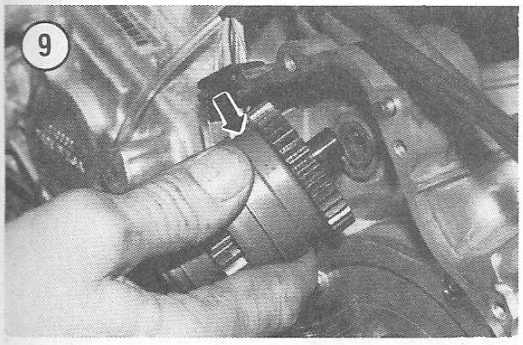


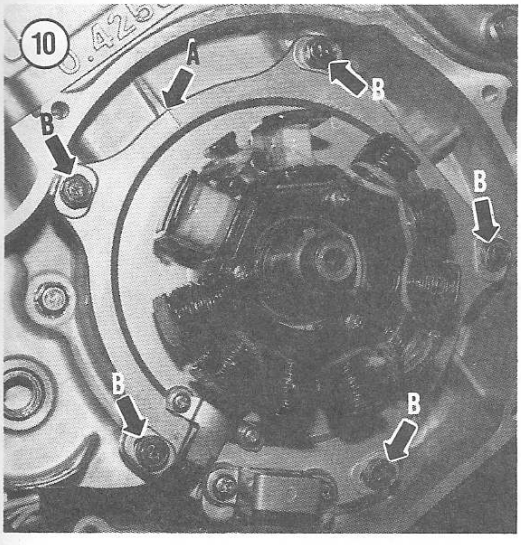




1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Refer to Chapter Fifteen to remove the seat, side covers, fuel tank cover, rear rack and rear cab.
3. Disconnect the ground wire from the negative terminal of the battery (**Figure 4**).







4. Refer to Chapter Three and drain coolant.
5. Refer to Chapter Three to drain oil from the engine and the reservoir.
6. Shut the fuel off, disconnect the fuel lines, then unbolt and remove the fuel tank (**Figure 5**). Refer to Chapter Six.
7. Disconnect the spark plug high tension lead (**Figure 6**).
8. Detach the engine breather hose from the engine.
9. Remove the air filter and air box (**Figure 7**).
10. Detach the fuel lines and controls from the carburetor, then unbolt and remove the carburetor. Refer to Chapter Six. Insert a clean, lint free shop towel in the exposed port to prevent dirt from entering.
11. Detach the springs from the exhaust pipe, then remove the exhaust pipe.
12. On models with all wheel drive, refer to Chapter Ten and remove the center drive and driven sprockets, and chain.

CAUTION

Do not lose the spacers or the spacer retaining O-rings from the threaded ends of the screws that attach the PVT inner cover.

13. Refer to Chapter Eight and remove the PVT (Polaris variable transmission), drive belt, drive pulley, driven pulley and inner cover.
14. Unbolt and remove the recoil starter from the right side of the engine as described in this chapter.

CAUTION

Do not thread the puller attaching bolts into the flywheel more than 6 mm (1/4 in.), or the stator coils may be damaged.

15. Remove the flywheel nut and washer then use a suitable puller (**Figure 8**) to remove the engine flywheel.

NOTE

Do not lose the thrust washer located between the starter drive and the crankcase.

16. Remove the electric starter drive (**Figure 9**).
17. Mark the position of the stator plate on the crankcase (A, **Figure 10**), so the stator can be reinstalled in the same timing position.

CAUTION

Use care to prevent damage to seals, crankshaft, stator plate, armature wires or other parts when removing the stator plate and stator assembly.

18. Remove the stator retaining screws (B, **Figure 10**), then remove the stator plate and stator assembly.
19. Remove the sealing ring (**Figure 11**), then cover the end of the crankshaft with a clean, lint free shop towel to prevent damage or the entrance of dirt.
20. Detach the transmission shift linkage from the shift selector, then secure the linkage out of the way.
21. Detach the wire from the coolant temperature sender.

NOTE

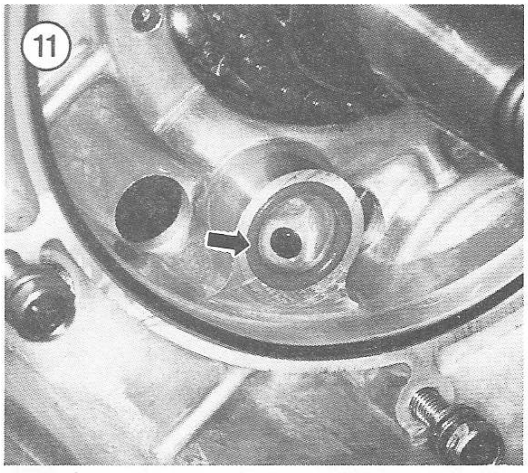
Observe the position of the starter cable before detaching it from the starter. It is important to reconnect the cable without causing it to bind and short out.

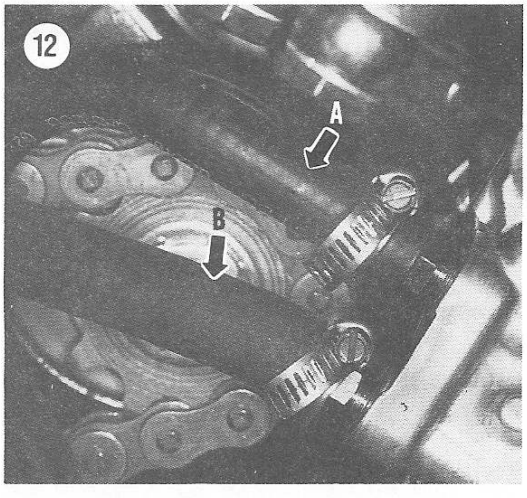
22. Unbolt and remove the electric starter motor.
23. Loosen the hose clamps, then detach the oil delivery hose (A, **Figure 12**) and the return hose (B, **Figure 12**). Cover fittings and plug the lines to prevent the entrance of dirt.
24. Unbolt and remove the oil reservoir (A, **Figure 2**) and the coolant tank (C, **Figure 2**). The coolant tank can be secured out of the way.
25. Loosen the hose clamp, then detach the cooling hose from the thermostat housing located on the left side of the cylinder head.
26. Remove the engine oil filter (B, **Figure 2**).

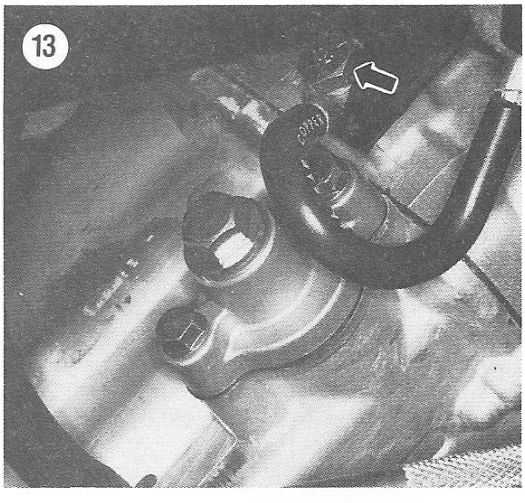
NOTE

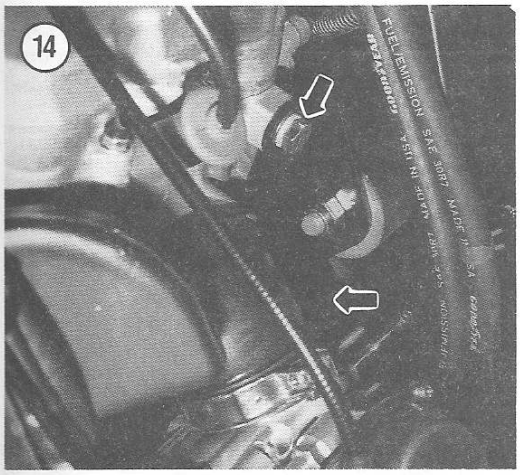
Mark the location of the engine mount bolts and studs before removing, to help with alignment when reinstalling the engine.

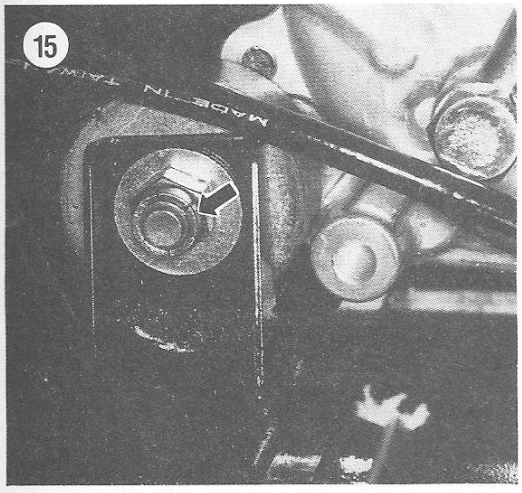
27. Remove the nut and disconnect the ground cable (**Figure 13**) from the upper right side engine mount.
28. Remove the two screws (**Figure 14**), then remove the engine mount and ground cable.
29. Remove the nut (**Figure 15**) and washer from the lower left engine mount bolt. Mark the location of the stud to help with alignment when installing.
30. Remove the nut from the rear engine mount (**Figure 16**).
31. Move the top of the engine to the left until the coolant supply hose clears the frame (on the right side), at the water pump.

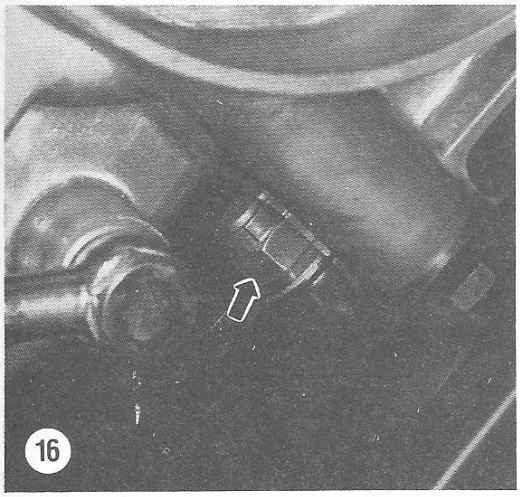












32. Lift and twist the engine clockwise until the engine mount stud at the left front is withdrawn from the frame mount and the coolant hoses (on the lower right side), are clear of the frame.
33. Support the engine with a board across the frame, under the engine.

WARNING

Coolant is slippery and can cause you to fall. Catch as much coolant as possible, then clean the work area after draining coolant.

34. Loosen the clamp on the upper coolant hose, detach the hose from the pump outlet and allow remaining coolant to drain. The hose can be reattached after draining.
35. Loosen both clamps and remove coolant pump lower (inlet) hose.
36. Lift the back of the engine while rotating the front clockwise, then remove the engine from the left side.
37. Install the engine from the left side. Install the rear engine mount washer and nut loosely before inserting into the slotted plate.
38. Attach the coolant hoses to the pump inlet and outlet, before final positioning of the engine.

NOTE

Make sure that coolant hoses and clamps are clear of the frame when engine is in position.

39. Locate the rear mount stud in the slotted plate, then roll the engine into position in the reverse of the removal procedure.
40. Install and tighten the engine mounts, aligning the previously installed marks.

NOTE

The drive pulleys should be temporarily installed to check the alignment of the engine in it mounts. If not aligned, it may be necessary to relocate the engine mounts.

41. Refer to Chapter Eight and temporarily install *and align* the drive pulleys.
42. Tighten the engine mount bolts and nuts, then remove the drive pulleys.
43. Complete assembly by reversing the removal procedure and observing the following.

a. Refer to this chapter to install the flywheel and stator plate.
b. Refer to Chapter Three to fill and bleed the cooling system.
c. Be sure that the oil feed hose from the oil tank is attached to the upper fitting (A, **Figure 12**) and the return hose to the oil tank is attached to the lower fitting (B, **Figure 12**).
d. Refer to Chapter Nine to adjust transmission shift linkage.
e. Coat all exhaust connections with high-temperature silicone sealer and make sure all retaining springs are in good condition.
f. Check and adjust engine controls if necessary.

CYLINDER HEAD COVER AND ROCKER ARM ASSEMBLY

Removal

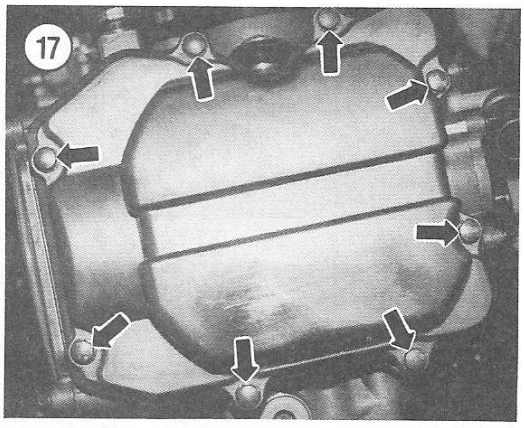
1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Refer to Chapter Fifteen to remove the seat, side covers and fuel tank cover.
3. Shut the fuel off, disconnect the fuel lines, then unbolt and remove the fuel tank (**Figure 5**). Refer to Chapter Six.
4. Disconnect the spark plug high tension lead (**Figure 6**) and remove the spark plug. Removing the spark plug will make it easier to rotate the engine.
5. Remove the screws attaching the cylinder head cover (**Figure 17**), then remove the cover.
6. Turn the engine until the cam sprocket pin (A, **Figure 18**) is straight up as shown. This will set the piston at (or near) top dead center on the compression stroke and all of the valves will be closed.
7. Loosen the rocker shaft retaining screw (B, **Figure 18**).

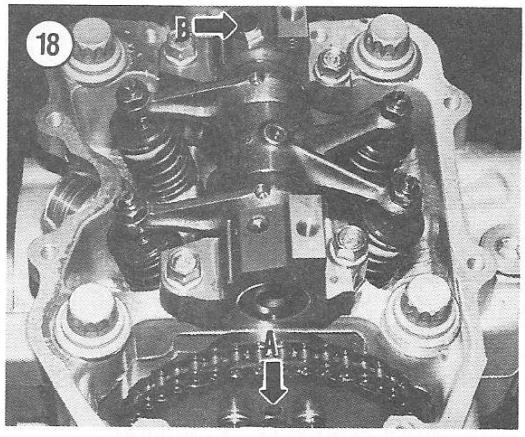
CAUTION
Do not lose the dowel pins when removing the rocker arm assembly.

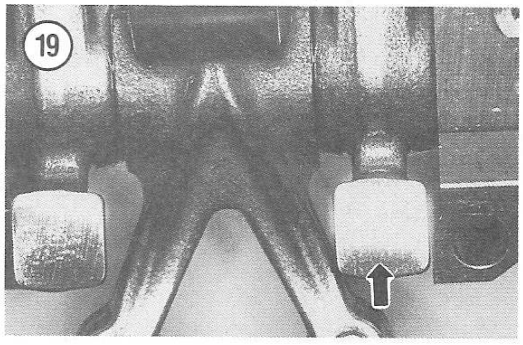
8. Remove the 4 screws attaching the rocker arm shaft brackets, then lift the rocker arms and shaft assembly from the engine.
9. Inspect the wear surfaces (**Figure 19**) on the rocker arms and mating surfaces on valves and camshaft.

NOTE
The ends of the adjusting screws are hardened and should not be resurfaced.

10. Separate the brackets, rocker arms and shaft. Inspect the shaft surface and the rocker arm bores for wear or scoring. Recommended shaft diameter

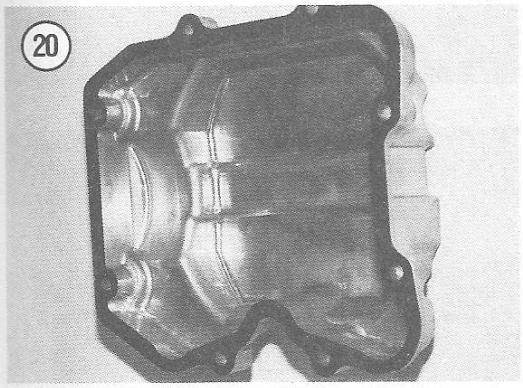


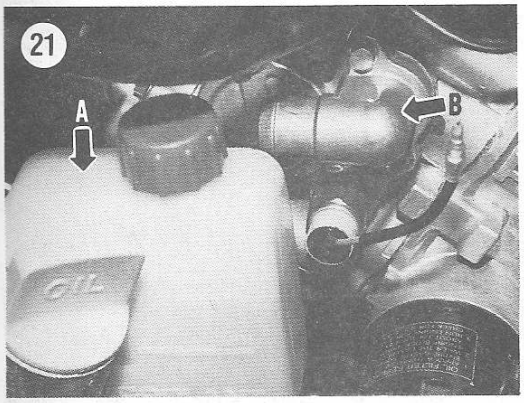


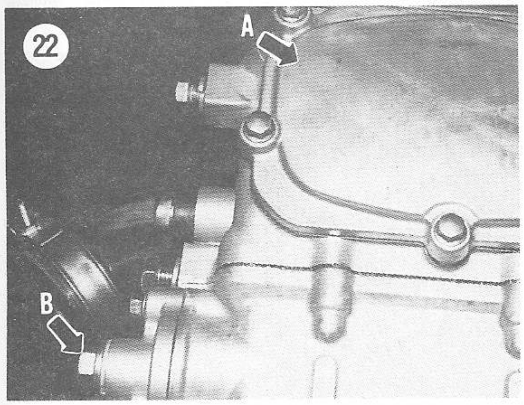


and bore clearance is listed in **Table 4**. Install new shaft and rocker arms if clearance exceeds the wear limit.

11. Coat the cam lobes and cam follower surfaces with molybdenum disulfide grease before installing the rocker arm assembly. Coat the threads of screws with a light film of engine oil.







NOTE

*If the camshaft has turned from top dead center on the compression stroke, turn the engine until the camshaft sprocket pin (A, **Figure 18**) is in the position shown.*

12. Install the rocker arm assembly, tightening the screws to the torque values listed in **Table 3**.
13. Adjust valve clearance as described in Chapter Three.
14. Clean the gasket surfaces of the cylinder head and cover, then install a new gasket (**Figure 20**) on the cylinder head cover.
15. Install the cylinder head cover and tighten the retaining screws to the torque listed in **Table 3**.
16. Complete assembly by reversing the disassembly procedure.

CAMSHAFT

Removal

1. Place the ATV on a level surface and block the wheels to keep it from rolling.
2. Refer to Chapter Fifteen to remove the seat, side covers and fuel tank cover.
3. Shut the fuel off, disconnect the fuel lines, then unbolt and remove the fuel tank (**Figure 5**). Refer to Chapter Six.
4. Clean the engine and frame thoroughly.
5. Remove the cylinder head cover and rocker arms as outlined in this chapter.
6. Drain the cooling system.
7. Remove the coolant reservoir (A, **Figure 21**).
8. Loosen the hose clamp, then detach the hose from the thermostat housing (B, **Figure 21**).
9. Unbolt and remove the thermostat housing (B, **Figure 21**) and thermostat. Observe the location of the bleed holes in the thermostat and housing. When assembling, bleed holes should be together.
10. Unbolt and remove the camshaft end cap from the left side of the cylinder head.
11. Unbolt and remove the sprocket cover (A, **Figure 22**) from the right side of the cylinder head.

CAUTION

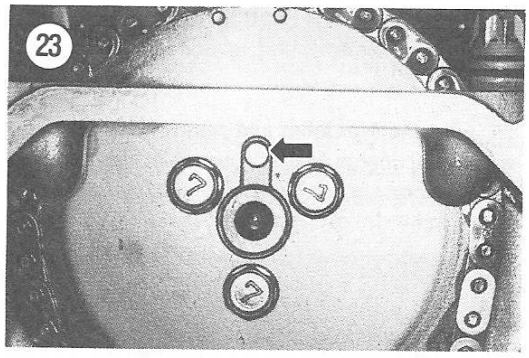
*Plug (B, **Figure 22**) is under spring pressure. Push against the plug while removing to keep it from flying off. In Step 12, the plug only needs to be loos-*

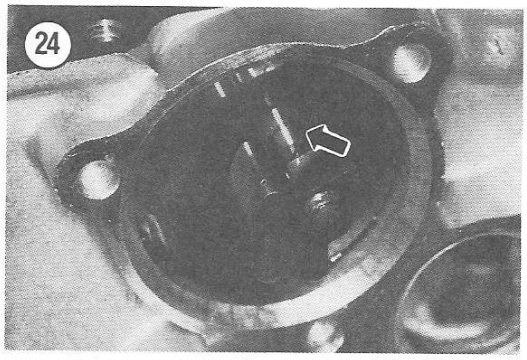
ened, but it must be removed later to set the tensioner.

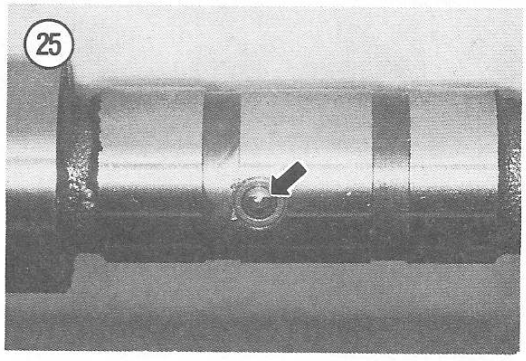
12. Loosen the plug (B, **Figure 22**), then remove the two screws attaching the tensioner assembly to the cylinder. Remove the tensioner assembly.
13. Turn the engine until the sprocket drive pin (**Figure 23**) is at the top. The engine will be at (or near) top dead center on the compression stroke.

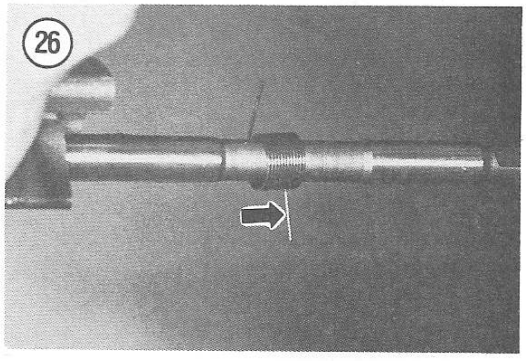
NOTE
The flywheel TDC mark will be in the center of the timing port of the recoil starter housing when the crankshaft is at exactly top dead center.

14. Stuff a clean shop cloth in the cavity below the cam sprocket, then remove the 3 sprocket retaining screws. Refer to **Figure 23**.
15. Slide the camshaft in (toward the left), then remove the sprocket from the dowel pin and camshaft. Hold the chain up and remove the sprocket from the chain and cylinder head.
16. Secure the cam chain with a wire to keep it from falling.
17. Remove the camshaft from the left (PTO) side of engine (**Figure 24**).



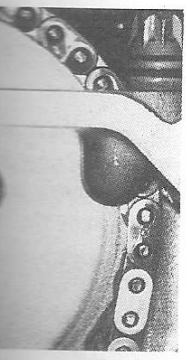


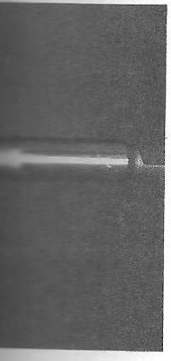


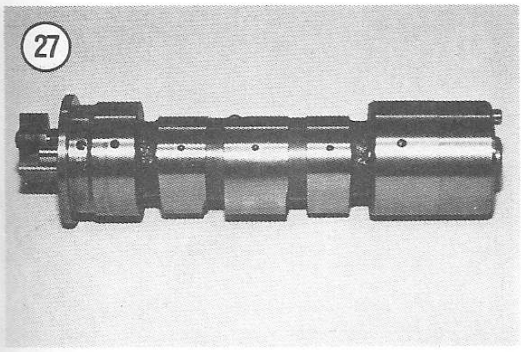


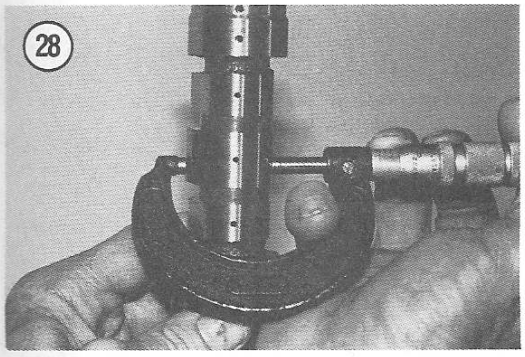
Inspection

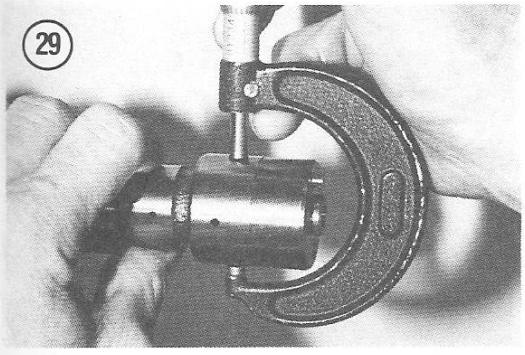
1. The automatic compression release mechanism, located in the camshaft, can be inspected as follows, without removing the camshaft from the engine.
   a. Twist the release mechanism (**Figure 24**) inside the camshaft and observe the smoothness of operation. There should be no roughness and the spring should return the weight against the stop pin.
   b. The actuator ball (**Figure 25**) should be held outward when the release mechanism is in the compression release position.
   c. Withdraw the release mechanism (**Figure 26**) from the camshaft. Inspect the shaft and spring for wear or damage.
   d. Inspect the lobe at the end of the release lever shaft (**Figure 26**) and the actuator ball for wear or damage. The actuator ball is not available separately from the camshaft.
2. Thoroughly clean the camshaft and visually inspect all surfaces of the camshaft for wear or dam-

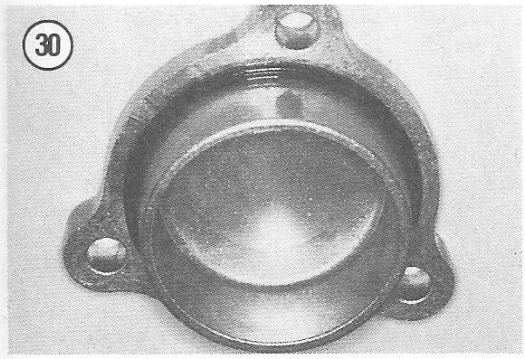












age. Be sure the oil feed holes (**Figure 27**) in the camshaft are open and clean.

3. Measure the height of each cam lobe (**Figure 28**) and compare with the specifications listed in **Table 4**.

4. Measure the diameter of the camshaft journals (**Figure 29**) and compare with the specifications listed in **Table 4**.

5. Calculate the bearing clearance by measuring the inside diameter of the bores in the cylinder head, then subtracting the journal diameters measured in Step 4.

6. Inspect the thrust face of the end cap (**Figure 30**) for wear. If the end cap is damaged, install new cap and carefully inspect the end of the camshaft.

5

Installation

CAUTION

The camshaft must be correctly synchronized to open and close the valves at exactly the right time in relation to the position of the crankshaft. This exact timing is accomplished by installing the chain on the crankshaft and camshaft sprockets with the shafts in specific positions. Very expensive damage could result from improper installation.

NOTE

*To install the automatic compression release mechanism (**Figure 26**), the actuator ball (**Figure 25**) must be held out. It may be necessary to use a small magnet to hold the actuator ball out while installing the compression release in the camshaft.*

1. Lubricate the automatic compression release with clean engine oil and install the mechanism with the ends of the spring positioned as shown in **Figure 31**. Check for correct operation before continuing assembly.

2. Coat the camshaft lobes and journals with molybdenum disulfide (or Polaris low temp grease part No. 2870577), then install the camshaft. Rotate the camshaft until the lobes are facing down, toward the cylinder head. The sprocket drive pin (**Figure 23**) will be straight up.

3A. If the alternator stator is not removed, time the camshaft as follows.