

**250/260 LIQUID COOLED**



# *ENGINE REPAIR MANUAL*

**1995-PRESENT**

**Updated 02/2015**

**ATK-130062**





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Technical Data - ATK 250/260																							
Design	Rotax single cylinder, two stroke, reed-valve engine, pneumatic exhaust valve, balance shaft, watercooled, integrated water pump, 6-speed gearbox, oil-in-fuel lubrication																						
Bore/Stroke 250	67.5 mm/69.8 mm																						
Bore/Stroke 260	68.0 mm/69.8 mm																						
Displacement 250	249.8 cm3																						
Displacement 260	253.5 cm3																						
Power Output	36.8 kW (50 hp) at 9250 r.p.m.																						
Torque	38.0 Nm at 8250 r.p.m.																						
Idle r.p.m.	1500 r.p.m.																						
Maximum allowed operation r.p.m.	10,000 r.p.m.																						
Piston 250	cast aluminium piston with one 1 mm rectangular piston ring <table><tr><td></td><td>Part no.</td><td>Tolerance group</td><td>Diameter</td></tr><tr><td>standard:</td><td>294 850</td><td>red</td><td>67.44 mm</td></tr><tr><td></td><td>294 850</td><td>green</td><td>67.45 mm</td></tr><tr><td>1st oversize:</td><td>294 851</td><td>-</td><td>67.46 mm</td></tr><tr><td>2nd oversize:</td><td>294 852</td><td>-</td><td>67.47 mm</td></tr></table>				Part no.	Tolerance group	Diameter	standard:	294 850	red	67.44 mm		294 850	green	67.45 mm	1st oversize:	294 851	-	67.46 mm	2nd oversize:	294 852	-	67.47 mm
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Piston 260	cast aluminium piston with one 1 mm rectangular piston ring <table><tr><td></td><td>Part no.</td><td>Tolerance group</td><td>Diameter</td></tr><tr><td>standard:</td><td>294 855</td><td>red</td><td>67.94 mm</td></tr><tr><td></td><td>294 855</td><td>green</td><td>67.95 mm</td></tr><tr><td>1st oversize:</td><td>294 856</td><td>-</td><td>67.96 mm</td></tr><tr><td>2nd oversize:</td><td>294 857</td><td>-</td><td>67.97 mm</td></tr></table>				Part no.	Tolerance group	Diameter	standard:	294 855	red	67.94 mm		294 855	green	67.95 mm	1st oversize:	294 856	-	67.96 mm	2nd oversize:	294 857	-	67.97 mm
	Part no.	Tolerance group	Diameter																				
standard:	294 855	red	67.94 mm																				
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1st oversize:	294 856	-	67.96 mm																				
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Cylinder 250	light alloy cylinder, NIKASIL plated, with pneumatic exhaust valve (adjustable) <table><tr><td></td><td>Part no.</td><td>Tolerance group</td><td>Diameter</td></tr><tr><td>standard:</td><td>223790</td><td>A</td><td>67.500 - 67.510 mm</td></tr><tr><td></td><td>223790</td><td>AB</td><td>67.510 - 67.515 mm</td></tr><tr><td></td><td>223790</td><td>B</td><td>67.515 - 67.525 mm</td></tr></table>				Part no.	Tolerance group	Diameter	standard:	223790	A	67.500 - 67.510 mm		223790	AB	67.510 - 67.515 mm		223790	B	67.515 - 67.525 mm				
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standard:	223795	A	68.00 - 68.01 mm																				
	223795	AB	68.01 - 68.015 mm																				
	223795	B	68.015 - 68.025 mm																				
Switch point of exhaust valve	7000 r.p.m.																						
Piston/cylinder clearance:	0.06 - 0.08 mm																						
Piston center protruding over cylinder top	3.3 mm																						
Cylinder head	Volume of cylinder head = 28.2 cm3 +/- 0.5 cm3 (2 cm3 for the spark plug threaded hole)																						
Combustion chamber volume	21.7 cm3 +/- 0.9 cm3 (2 cm3 for the spark plug threaded hole)																						
Squish gap	1.6 mm +/- 0.2 mm																						



Compression	theoretical: 12.5 +/- 0.5 effective: 7.04																														
Ignition unit	breakerless SEM magneto generator with electronic spark advance																														
Ignition timing	Up to engine serial no. 460 861: stator plate, part no. 265 965 ignition coil, part no. 265 987 (SEM TM14-04) adjustment: 2.05 mm +/- 0.23 mm (= 17.5° +/- 1°) BTDC (Before Top Dead Centre) = 2.05 mm (= 17.5°) at 6000 r.p.m.																														
	Starting with engine serial no. 460 862: stator plate: part no. 265967 ignition coil. part no. 265 982 (SEM TM 14-06) adjustment: 0.21 mm +/- 0.07 mm (= 5.5° +/- 1°) ATDC (After Top Dead Centre) = 1.62 mm (= 15.5°) BTDC at 2000 r.p.m.																														
Generator output	12V/160W. AC																														
Spark plug	NGK - B8 ES, thread M14 x 1.25																														
Electrode gap	0.5 - 0.6 mm																														
Spark plug cap	NGK - TB 05 EMA (resistance 5 k Ohms)																														
Fuel	premium gas (unleaded)																														
Engine lubrication	oil in fuel lubrication, specification: API TC mixing ratio 1:50 (= 2%) mixing ratio 1:25 (= 3.8%) for break-in procedure (minimum 1 hour)																														
Gear lubrication	slash lubrication, SAE 80 W 600 cm3 at operation in bike																														
Cooling system	water-cooled, integrated water pump for water circulation, closed water circuit																														
Cooling float rate	35 l/min at 8000 r.p.m.																														
Thermostat	45°C																														
Clutch	multi-plate, in oil bath																														
Gear shifting	left side shifting, neutral gear between 1st and 2nd speed, 1st speed down, 2nd - 6th speed up																														
Transmission	6-speed gear box, constant mesh, dog engagement																														
Primary drive ratio	(69:25) 2.760																														
Transmission ratio	<table><tr><td>1st speed</td><td>(34:10)</td><td>3.400</td><td>1st speed</td><td>9.380</td></tr><tr><td>2nd speed</td><td>(30:13)</td><td>2.308</td><td>2nd speed</td><td>6.370</td></tr><tr><td>3rd speed</td><td>(27:16)</td><td>1.688</td><td>3rd speed</td><td>4.660</td></tr><tr><td>4th speed</td><td>(25:19)</td><td>1.316</td><td>4th speed</td><td>3.630</td></tr><tr><td>5th speed</td><td>(23:21)</td><td>1.095</td><td>5th speed</td><td>3.020</td></tr><tr><td>6th speed</td><td>(21:22)</td><td>0.955</td><td>6th speed</td><td>2.640</td></tr></table>	1st speed	(34:10)	3.400	1st speed	9.380	2nd speed	(30:13)	2.308	2nd speed	6.370	3rd speed	(27:16)	1.688	3rd speed	4.660	4th speed	(25:19)	1.316	4th speed	3.630	5th speed	(23:21)	1.095	5th speed	3.020	6th speed	(21:22)	0.955	6th speed	2.640
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5th speed	(23:21)	1.095	5th speed	3.020																											
6th speed	(21:22)	0.955	6th speed	2.640																											
Starter	kickstarter																														
Weight, dry	approx. 24 kg (without exhaust system and carburetor)																														



Cylinder Head/Cylinder/Piston		
Item	Standard	Service limit
Cylinder head warpage limit		Check sealing face for planeness Note: The sealing face forms a slight taper of 0.03 mm from diameter 83.2 mm
Cylinder inside diameter, 250	A $\varnothing$ 67.500 - 67.510 mm AB $\varnothing$ 67.510 - 67.515 mm B $\varnothing$ 67.515 - 67.525 mm	$\varnothing$ 67.570 mm $\varnothing$ 67.580 mm $\varnothing$ 67.590 mm
Cylinder inside diameter, 260	A $\varnothing$ 68.000 - 68.010 mm AB $\varnothing$ 68.010 - 68.015 mm B $\varnothing$ 68.015 - 68.025 mm	$\varnothing$ 68.700 mm $\varnothing$ 68.800 mm $\varnothing$ 68.900 mm
Cylinder out-of-round limit	0.0075 mm	0.02 mm
Piston outside diameter, 250	red $\varnothing$ 67.44 mm green $\varnothing$ 67.45 mm oversize "1" (yellow) $\varnothing$ 67.46 mm oversize "2" (blue) $\varnothing$ 67.47 mm	$\varnothing$ 67.37 mm $\varnothing$ 67.38 mm $\varnothing$ 67.39 mm $\varnothing$ 67.40 mm
Piston outside diameter, 260	red $\varnothing$ 67.94 mm green $\varnothing$ 67.95 mm oversize "1" (yellow) $\varnothing$ 67.96 mm oversize "2" (blue) $\varnothing$ 67.97 mm	$\varnothing$ 67.87 mm $\varnothing$ 67.88 mm $\varnothing$ 67.89 mm $\varnothing$ 67.90 mm
Piston measurement point	27 mm from bottom of skirt	
Piston-to-cylinder clearance	0.06 - 0.08 mm	0.15 mm
Piston pin bore inside diameter	$\varnothing$ 18.001 - $\varnothing$ 18.005 mm	$\varnothing$ 18.01 mm
Piston pin outside diameter	$\varnothing$ 17.997 - $\varnothing$ 18.000 mm	$\varnothing$ 17.990 mm
Piston-to-piston pin clearance	0.001 - 0.008 mm	0.015 mm
Piston ring to groove clearance	0.05 - 0.082 mm	0.15 mm
Piston ring end gap	0.1 - 0.3 mm	0.8 mm
Crankshaft		
Item	Standard	Service Limit
Connecting rod radial clearance	0.025 - 0.036 mm	0.050 mm
Connecting rod axial play	0.59 - 0.937 mm	1.3 mm
Crankshaft runout	0.015 mm	0.03 mm
Crankshaft side clearance	0.17 - 0.62 mm	0.2 - 0.5 mm
Clutch		
Item	Standard	Service Limit
Clutch spring free length	34.1 +/-0.4 mm	31.6 mm
Clutch plate warpage	0.1 mm	0.15 mm

Friction plate thickness	2.6 +/- 0.05 mm	2.40 mm
Assembled clutch plate thickness	old version (1995-1998): 9 x friction plate 9 x inner plate 31.5 - 33.3 mm	30.5 mm
	new version (1999-): 9 x friction plate 8 x inner plate 30.55 - 32.32 mm	29.5 mm
Transmission		
Item	Standard	Service Limit
Shaft runout limit	0.01 mm	0.03 mm
Maintshaft outside diameter at needle bearing position	ø 20.9935 - 21.0065 mm	ø 20.98 mm
Clutch shaft outside diameter at needle bearing operatin positions	ø 19.9935 - 20.0065 mm	ø 19.98 mm
Exhaust Valve		
Item	Standard	Service Limit
Compression spring free length limit	52.5 mm	45.0 mm
Thermostat		
Thermostat operating temperature	At water temperature of 45 C the pin must start lifting and reaches at approx. 50 C its maximum stroke of 2.5 - 4.5 mm.	2.5 mm pin stroke

## SERVICE MANUAL FOR ATK TYPE 257GS AND 287GS ENGINES

This manual lists information on servicing the ATK 257GS and 287GS engines.

### GENERAL INFORMATION

- Before servicing the engine, clean it thoroughly to prevent abrasive material from entering the crankcase.
- If the top end is being removed with the engine mounted in the frame, wrap a cloth around the upper frame tube to prevent dirt and other abrasive material from entering the crankcase.
- Do not pry the parts when removing them.
- Take care when removing gasket material from the engine mating surfaces.
- When troubleshooting the engine, perform a 2-stroke leak down test (Figure 1) before disassembling the engine.
- When servicing the engine on the workbench, support the engine with the trestle assembly (part No. 277 917) or on wooden blocks.
- The special tools called out in this manual are designed to remove and install specific components without damage. Always use the special tool or its equivalent.
- To help simplify reassembly, mark parts as required so that they can be installed in their original position and order.
- Always replace non-reusable parts (gaskets, O-rings and circlips) during reassembly.

### ENGINE REMOVAL

1. Clean the engine.
2. Remove the side covers and seat.
3. Remove the exhaust system.
4. Remove the carburetor.
5. Disconnect the clutch cable at the engine.
6. Disconnect the drive chain.
7. Disconnect the magneto leads.
8. Disconnect the spark plug cap at the spark plug.

#### NOTE

*Plug the exhaust port and intake manifold if the engine is not going to be disassembled.*

#### WARNING

**Do not open the radiator cap or drain the coolant when the engine is hot; otherwise, you can be severely injured by scalding coolant and steam. Wait until the engine cools down.**

9. Remove the coolant drain plug and radiator cap and drain the cooling system.
10. Remove the nuts and bolts securing the engine to the frame, then remove the engine.

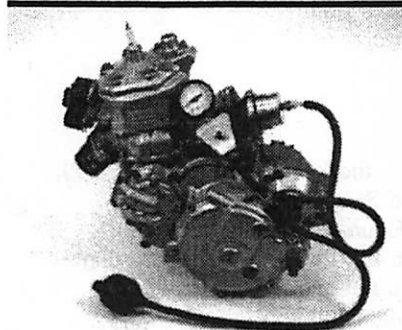
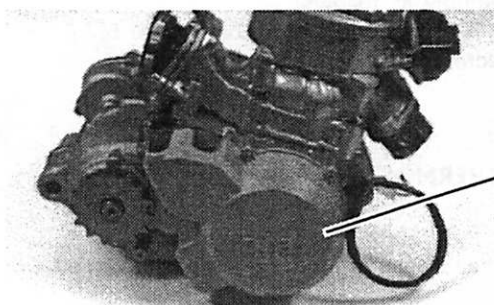
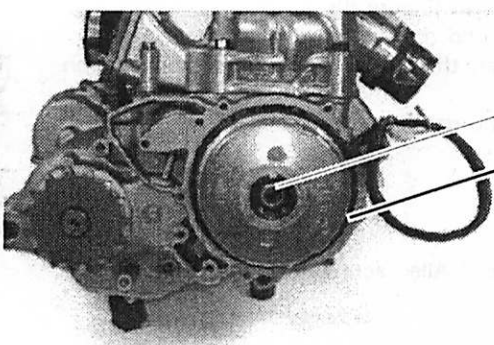


Figure 1



Cover

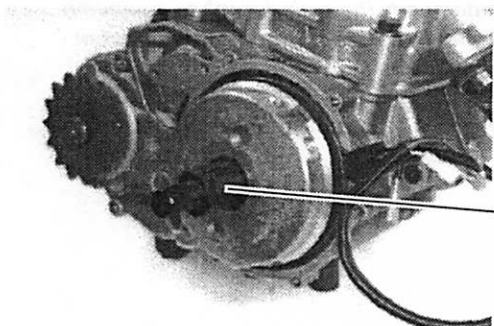
Figure 2



2

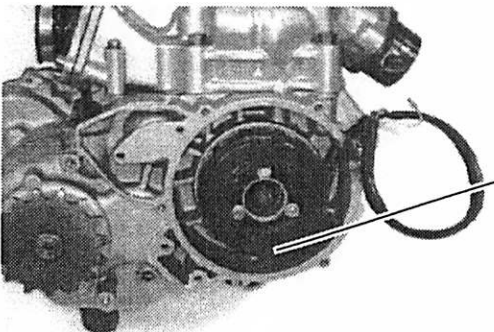
1

Figure 3



Puller

Figure 4



Stator  
Coil

Figure 5

## ENGINE DISASSEMBLY

### IGNITION SYSTEM

1. Remove the 6 Allen screws and the ignition cover (Figure 2).
2. Remove the flywheel (1, Figure 3) as follows:
  - Remove the flywheel nut (2, Figure 3) and lockwasher.
  - Screw the puller (part No. 276 807) into the flywheel (Figure 4). Then operate the puller and remove the flywheel.
  - Replace nut to prevent crank damage.
3. Remove the Woodruff key from the crankshaft keyway.
4. Remove the stator assembly as follows:
  - Remove the 3 screws, washers and stator coil (Figure 5).
  - Remove the 4 Allen screws, washers and stator plate (Figure 6).

### CYLINDER HEAD AND THERMOSTAT

1. Loosen the spark plug.
2. Loosen the 6 cylinder head bolts in a crisscross pattern, then remove the bolts.
3. Remove the cylinder head (Figure 7) and two O-rings (Figure 8).
4. To remove the thermostat (Figure 9):
  - Remove the 2 screws and the water outlet socket.
  - Remove the thermostat, thermostat holder and compression spring.
  - Remove and discard the gasket.

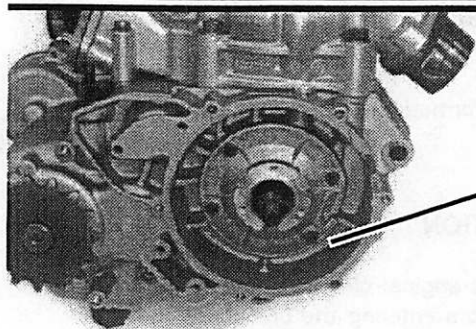
### CYLINDER

1. Loosen and remove the 2 Allen screws and the 4 cylinder base nuts and washers.

#### NOTE

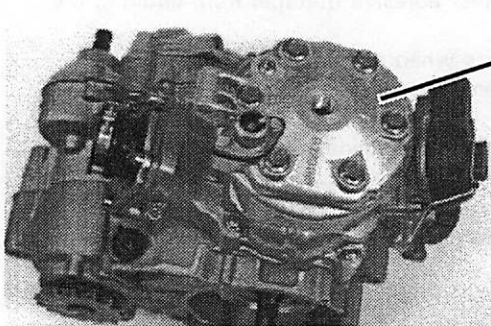
*Install a clean shop rag underneath the cylinder when removing it in Step 2. Doing so will prevent pieces from a broken piston ring from falling into the crankcase.*

2. Remove the cylinder (Figure 10) and base gasket. Discard the base gasket.



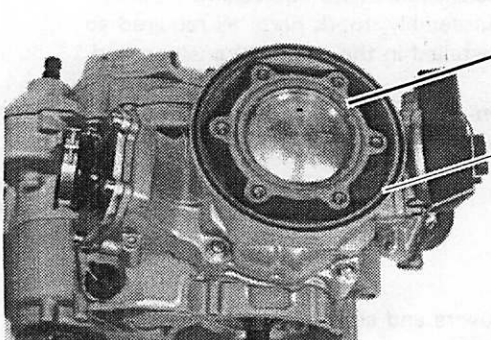
Stator  
Plate

Figure 6



Cylinder  
Head

Figure 7



O-Ring

O-Ring

Figure 8

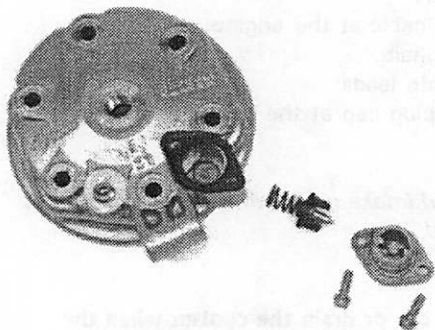


Figure 9

Cylinder

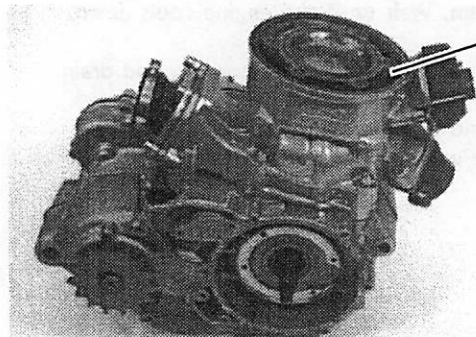


Figure 10



Figure 11

## PISTON

1. Cover the crankcase opening with a clean shop rag.
2. Remove the piston circlips (Figure 11) and discard them.
3. Hold the piston and push the piston pin (Figure 12) out of the piston. Use a suitable size socket and extension or wooden dowel pin.

### CAUTION

If the piston pin is tight, do not drive it out as the force may damage the connecting rod. Remove the piston pin with a piston pin removal tool.

4. Remove the piston (Figure 12) and needle bearing.

## DRIVE SPROCKET

Remove the retaining ring (Figure 13) and the drive sprocket (Figure 13). Remove the O-ring from the groove in the mainshaft.

## KICKSTARTER LEVER

Remove the pinch bolt and the kickstarter lever.

## CLUTCH COVER ASSEMBLY

The clutch cover (1, Figure 14) is a sub-assembly consisting of the clutch release cover (2), clutch release mechanism (3) and water pump (4).

1. Remove the clutch release cover (1, Figure 15) as follows:
  - Remove the 3 Allen screws and the clutch release cover.
  - Remove the O-ring (1, Figure 16).
2. Remove the water pump housing (2, Figure 15) as follows:
  - Remove the 4 Allen screws and copper washer.
3. Remove the clutch cover (2, Figure 16) as follows:
  - Remove the 11 Allen screws and copper washer.
  - Remove the clutch cover.
  - Check the back of the clutch cover for washers that may have come off of the kickstarter shaft and shift shaft. Reinstall these washers back onto their respective shafts. The kickstarter washer is larger than the shift shaft washer.

### NOTE

Service the clutch release mechanism and water pump as described under Engine Inspection.

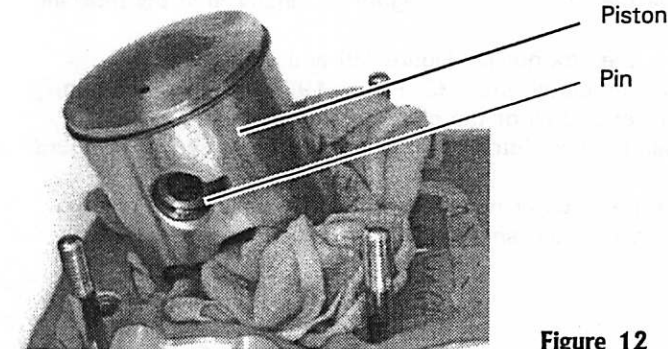


Figure 12

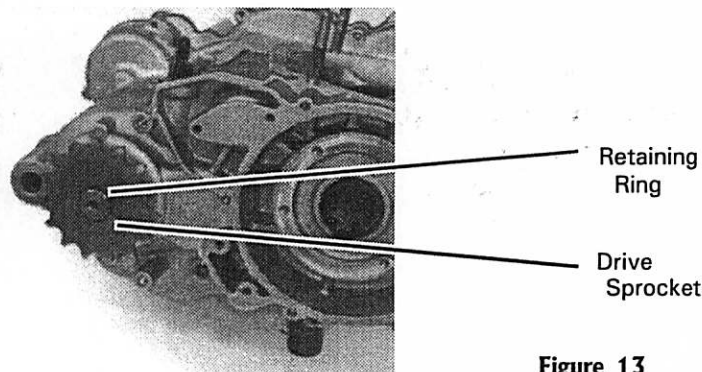


Figure 13

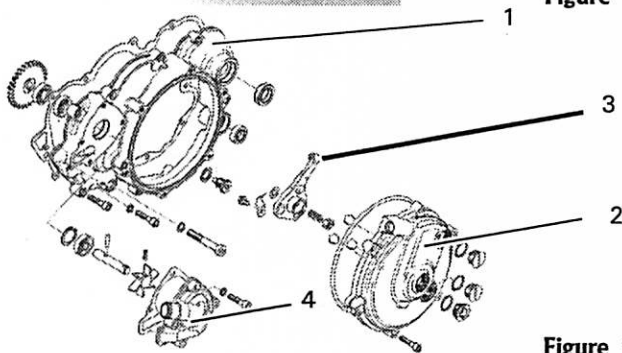


Figure 14

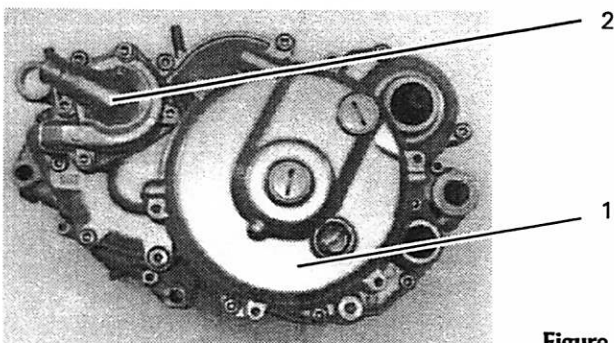


Figure 15

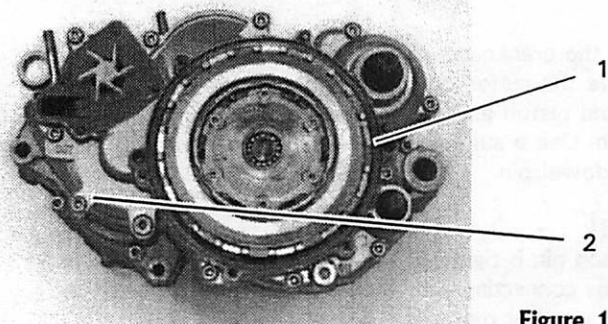


## CLUTCH

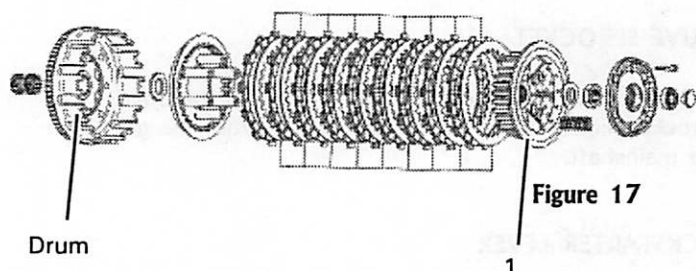
Refer to Figure 17 when servicing the clutch.

**NOTE**

*The retaining plate (Figure 18) is under spring pressure.*

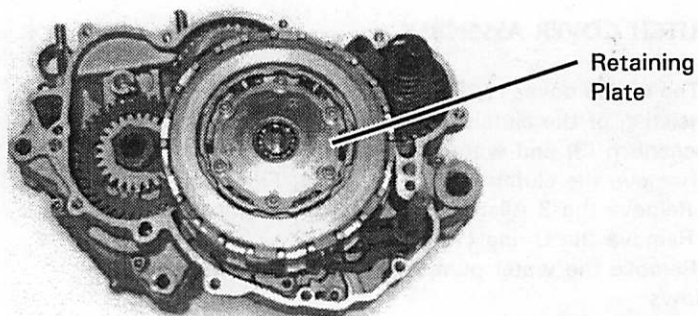


**Figure 16**

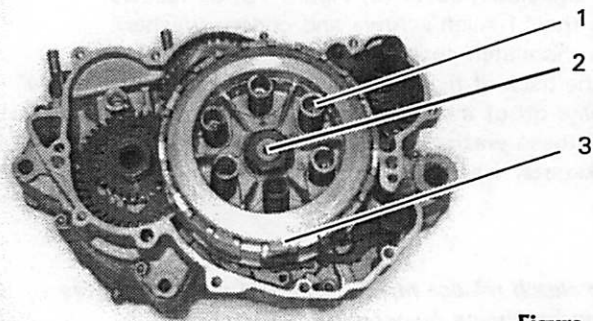


**Figure 17**

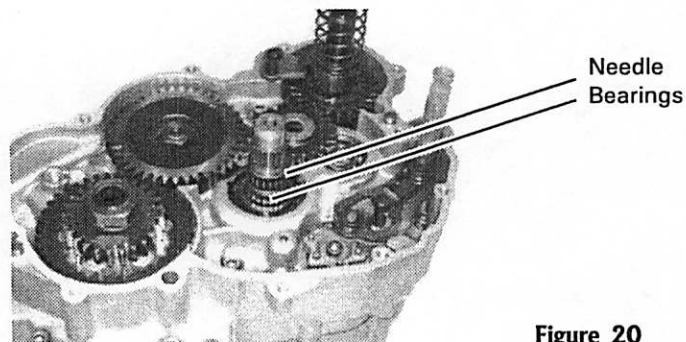
1. Loosen the 6 retaining plate Allen screws in a crisscross pattern and in several steps.
2. Remove the retaining plate (Figure 18) and the 6 clutch springs (1, Figure 19).
3. Remove the thrust hub (1, Figure 17) installed in the retaining plate.
4. Remove the hex nut (2, Figure 19) and spring washer.
5. Remove the clutch drum (3, Figure 19) with the clutch hub, thrust washer and all of the clutch plates.
6. Disassemble the clutch assembly in the order shown in Figure 17.
7. Unhook the 2 outer needle bearings (Figure 20) and remove them from the clutch shaft.



**Figure 18**



**Figure 19**



**Figure 20**

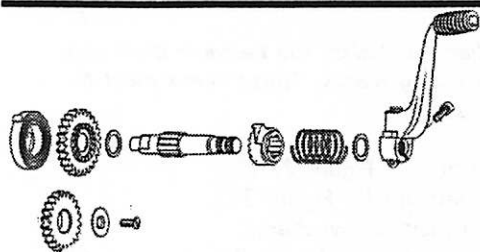


Figure 21

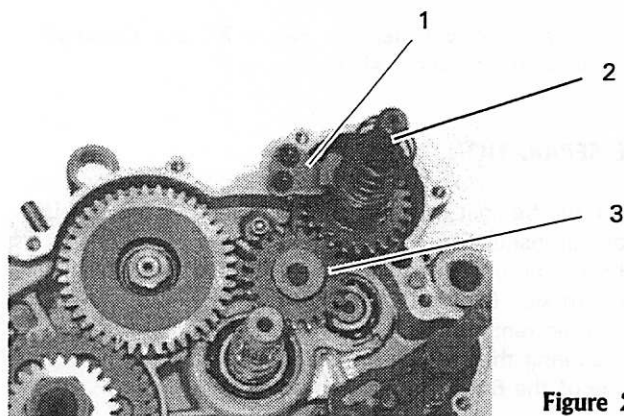


Figure 22

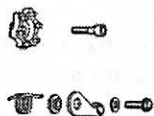
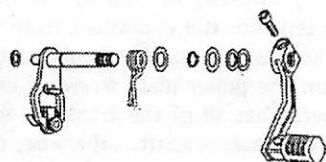


Figure 23

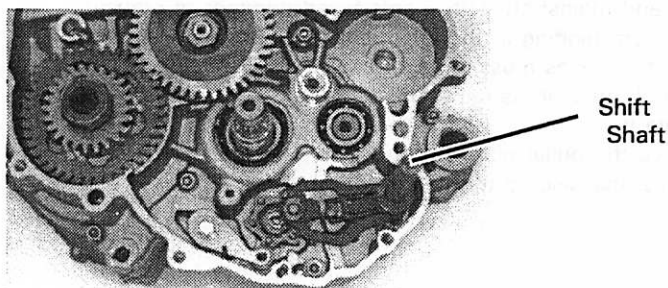


Figure 24

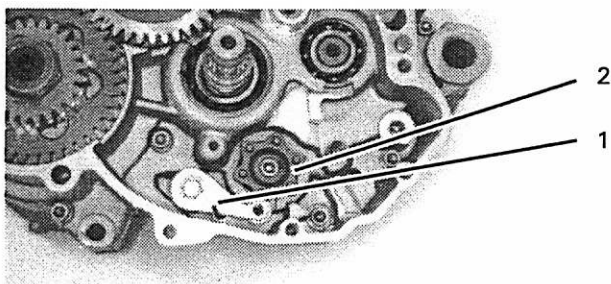


Figure 25

## KICKSTARTER ASSEMBLY

Refer to Figure 21 when removing the kickstarter assembly

### NOTE

*The kickstarter is under spring pressure and will rotate counterclockwise when the ratchet gear stop is removed in Step 1.*

1. Remove the 2 Allen screws and the ratchet gear stop (1, Figure 22).
2. Remove the kickstarter shaft assembly (2, Figure 22).

### NOTE

*The 2 kickstarter shaft shims (3, Figure 21) are identical (same part number).*

3. Disassemble the kickstarter shaft assembly in the following order:

- Shim.
- Compression spring.
- Ratchet gear.
- Kickstarter shaft.
- Shim.
- Kickstarter gear.
- Kickstarter spring.

## IDLER GEAR

Remove the countersunk screw, thrust washer and idler gear (3, Figure 22).

## EXTERNAL SHIFT MECHANISM

The shift shaft is equipped with 3 different washers and may be equipped with one or more shims. Note the size and location of each washer and shim (if used) so you don't mix them up during reassembly. See Figure 23.

1. Remove the shift shaft (Figure 24) and its washers and shims (if used).

2. Remove the index lever assembly (1, Figure 25) in the following order:

*Index lever is under tension - BE CAREFUL*

- Bolt.
- Washer.
- Index lever.
- Step ring.
- Index spring.

3. Remove the Allen screw and the shift drum cam (2, Figure 25).

## BALANCER AND PRIMARY DRIVE GEARS

The balancer drive assembly consists of a drive gear (mounted on the crankshaft) and driven gear (mounted on the balancer shaft). Both gears are indexed for proper installation. The primary drive gear is mounted onto the crankshaft. Each gear is keyed to its respective shaft with a Woodruff key. See Figure 26.



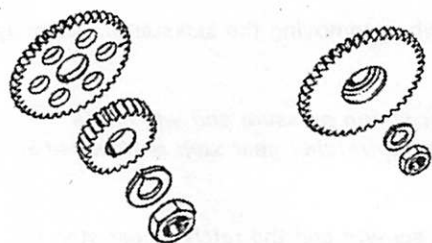


Figure 26

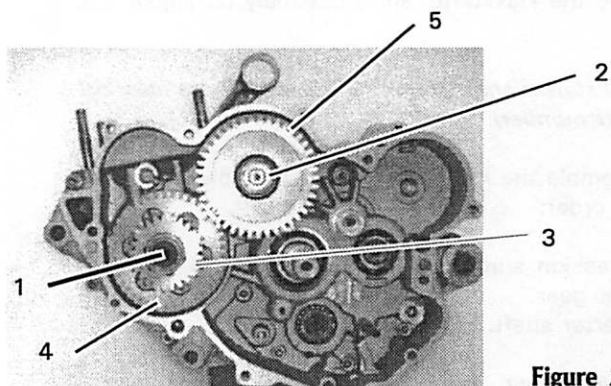


Figure 27

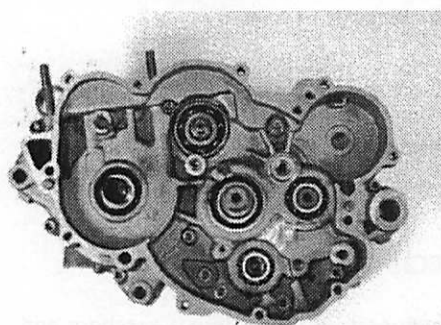


Figure 28

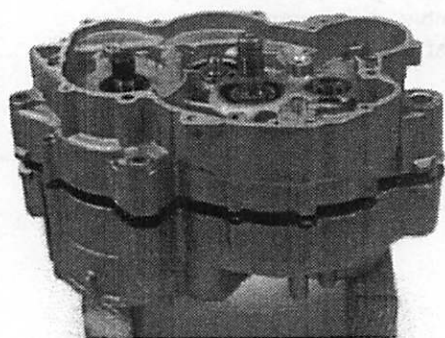


Figure 29

**NOTE**

*Turn the crankshaft by hand and align the balancer drive gear and balancer driven gear timing marks. These marks must be aligned during engine reassembly.*

1. Loosen the crankshaft nut (1, Figure 27).
2. Loosen the balancer shaft nut (2, Figure 27).
3. Remove both nuts and their lockwashers.
4. Remove the primary drive gear (3, Figure 27), balancer drive gear (4, Figure 27) and Woodruff key from the end of the crankshaft.
5. Remove the balancer driven gear (5, Figure 27) and Woodruff key from the end of the balancer shaft.

**CRANKCASE SEPARATION**

The engine must be split to repair the crankshaft, internal shift mechanism and transmission.

1. Position the engine on the trestle, or lay it on wooden blocks, with the magneto side (Figure 28) facing down.
2. Loosen and then remove the 12 Allen screws and lockwashers securing the crankcase halves. Note the flat washer used under one of the 6 x 70 mm Allen screws.

**CAUTION**

Separate the crankcase halves very carefully in Step 3. Use the puller plate (or similar tool) to separate the crankshaft from the left crankcase main bearing. Crankcase separation should require a little more than hand pressure on the puller plate screw. If extreme pressure is needed, stop and check that all of the crankcase screws were removed. Do not pry the case halves apart; otherwise, the cases will leak and require replacement.

3. Remove the left crankcase as follows:
  - Mount the puller plate (part No. 277 162) over the crankshaft. Then operate the puller plate screw to split the 2 crankcase halves apart.
  - As the 2 crankcase halves split, gently tap on the clutch shaft and mainshaft with a soft faced hammer to prevent them from binding in the left crankcase. During this step, both crankcases must remain parallel (Figure 29).
  - When all pressure is removed from the left crankcase, remove it.
  - Remove the puller plate from the left crankcase.
4. Remove and discard the center joint gasket.

## BALANCER SHAFT, TRANSMISSION, SHIFT FORKS AND SHIFT DRUM

### NOTE

*After removing the fork spindles and shift forks in Steps 2-5, slide the forks onto their respective fork spindles to keep them together, or mark them so that they can be reinstalled in the same position.*

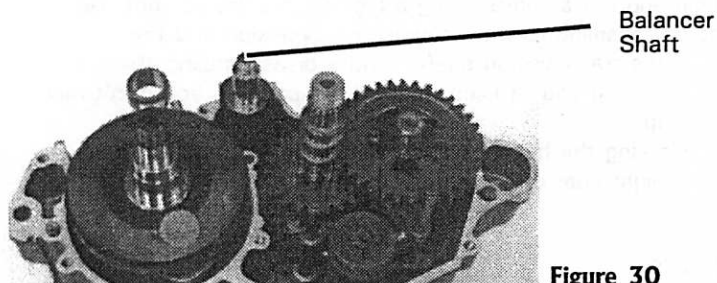


Figure 30

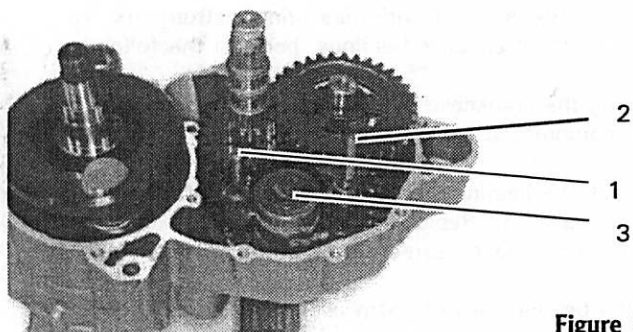


Figure 31

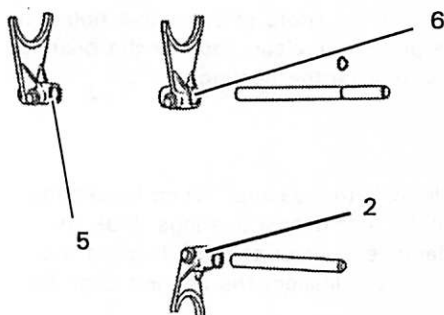


Figure 32

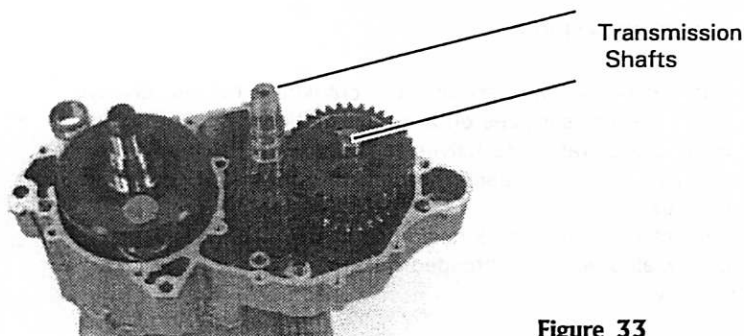


Figure 33

1. Remove the balancer shaft (Figure 30) from the right crankcase. The balancer shaft does not use any spacer shims.
2. Remove the short fork spindle (1, Figure 31) and the 5th/6th speed shift fork (2, Figure 32).
3. Remove the long fork spindle (2, Figure 31).
4. Disengage the 2 shift forks from the shift drum, then remove the shift drum (3, Figure 31).
5. Remove the 1st/3rd speed shift fork (5, Figure 32) and the 2nd/4th speed shift fork (6, Figure 32).
6. Remove the transmission shafts (Figure 33) as follows:
  - Position the right crankcase so that you can hold both transmission shafts with one hand.
  - Tap on the mainshaft (sprocket end) and remove both transmission shafts (Figure 34) from the crankcase. If a gear falls off of a shaft, immediately install it back onto its shaft and facing in its correct position.

### CRANKSHAFT

1. Position the engine on the trestle, or lay it on wooden blocks, with its magneto side facing up.

### NOTE

*If wooden blocks are used, they must be deep enough to allow removal of the crankshaft (Figure 35) without the left crank end contacting the workbench.*

2. Install the protection cap (part No. 276 790) over the crankshaft threads.
3. Mount the puller plate (part No. 277 162) onto the left crankcase and over the crankshaft.
4. Support the crankshaft with one hand then operate the puller plate screw to press out the crankshaft (Figure 35).
5. Remove any spacer shims mounted on the crankshaft (magneto side).
6. Remove the puller plate from the crankcase.

### ENGINE INSPECTION

### GENERAL INFORMATION

When measuring and inspecting the parts as described in this section, replace parts that are severely worn or show damage.

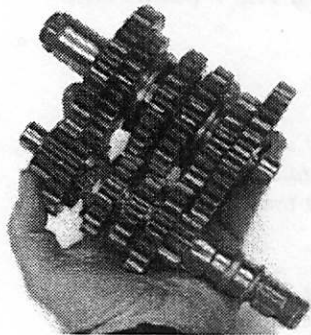


Figure 34

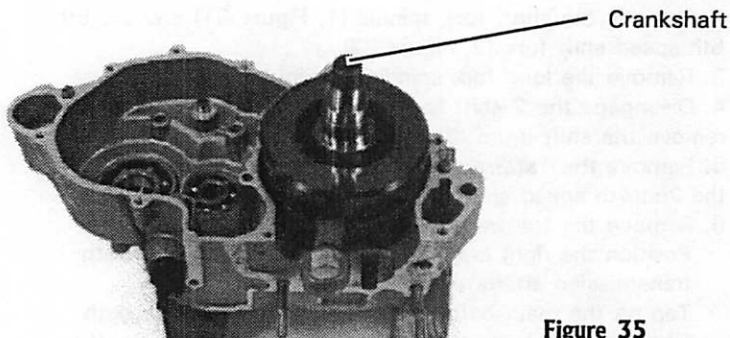


Figure 35

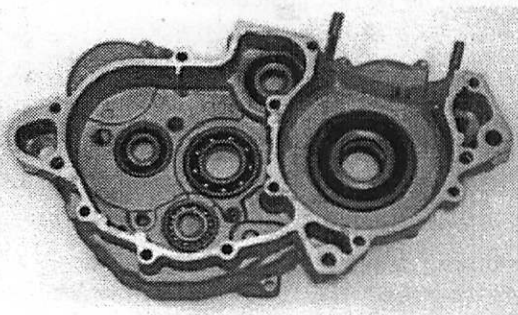


Figure 36

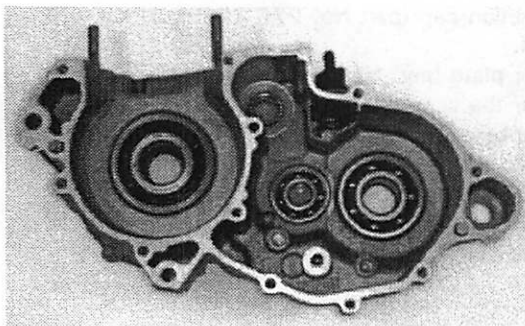


Figure 37

## CLEANLINESS

Dirt is the number one enemy of the engine, both during its operation and when service work is being performed. Once the engine has been disassembled, all of the parts must be cleaned and then kept clean until reassembly. Cleaned parts are also easier to inspect and measure when determining their condition and wear. Dirt or any type of abrasive material left on a part can cause rapid engine wear and damage. When cleaning parts, note the following:

- Take care when removing gasket material from the engine mating surfaces.
- Clean and dry all parts using a high-flash point solvent. Do not use gasoline as it may cause an explosion and fire.
- Clean the transmission shafts before disassembling them. This will help you to keep track of the parts so you don't mix them up.
- After drying the bearings and cylinder bore, lubricate them with a light coat of oil to prevent rust.

## BEARINGS

### Ball Bearings

Because ball bearings are made to close tolerances, bearing wear is judged by feel and not with measuring instruments. To clean and inspect the crankcase bearings, perform the following steps:

1. After cleaning the crankcase halves, reclean the bearings and then dry with compressed air. Do not spin the bearings when drying them.
2. Visually check the bearings for any type of defect, color change or abnormal wear. Replace any bearing that is damaged or shows severe wear. Overheated bearings will have a blue discoloration.
3. Lubricate the bearings with transmission or engine oil, depending on the bearings position in the crankcase.
4. Spin the bearing's inner race by hand to check it. The bearing should turn smoothly with no rough spots or excessive noise. If one of these conditions are present, reclean and dry the bearing. If the condition still persists, replace the bearing.

### Needle Bearings

Needle bearing wear is difficult to measure. When inspecting the connecting rod and clutch shaft needle bearings, look for any type of visible wear, damage or color change. Inspect the rollers for flat spots and corrosion. Inspect the bearing cage for cracks or other defects.

## CRANKCASE HALVES

1. When handling and servicing the crankcase halves, always place the gasket surfaces on a rubber mat or wooden blocks.
2. Inspect the crankcase halves for any type of damage. If necessary, repair or replace the crankcase halves. See Figure 36 and Figure 37.
3. Inspect the bearings as described in this section.
4. Check all studs and threaded holes for damage. Repair as necessary.



## CRANKCASE BALL BEARING REPLACEMENT

Refer to Figure 38 when replacing the crankcase bearings and oil seals.

1. Remove the oil seals.
2. Heat the crankcase to 60-80 degrees C, then remove the 2 dowel pins.
3. Support the crankcase on a rubber mat or wooden blocks and remove the bearing(s) with a suitable bearing removal tool.
4. After removing the clutch shaft bearing from the left crankcase, remove the clutch shaft shim.
5. If the magneto side main bearing remained on the crankshaft, remove it with bearing puller No. 876 298, ring halves No. 977 475 and ring No. 977 490.
6. Install both crankshaft bearings with the closed side of the bearing cage facing toward the crankshaft.

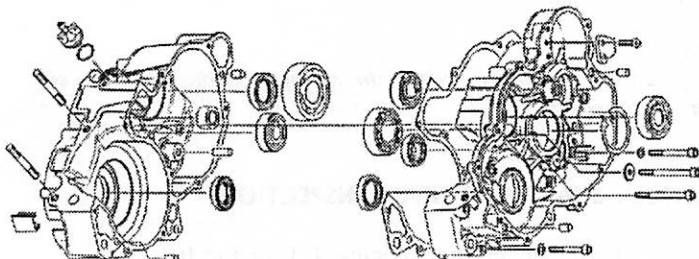


Figure 38

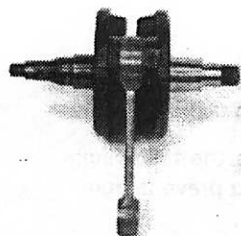


Figure 39

## CRANKSHAFT INSPECTION

The following table lists crankshaft (Figure 39) service specifications.

Item	Specification (New) Limit	Service Limit
Crankshaft runout	0.015 mm	0.03 mm
Connecting rod axial play	0.59 - 0.937 mm	1.30 mm
Connecting rod radial play	0.025 - 0.036 mm	0.050 mm

1. Measure the crankshaft runout with V-blocks and a dial indicator.
2. Measure the connecting rod radial play with a feeler gauge. Measure between the crankshaft and connecting rod big end.
3. Measure the connecting rod axial play.
4. Inspect the crankshaft (Figure 39) for:
  - Damaged threads.
  - Cracked Woodruff keyway.
  - Pitted or damaged oil seal surfaces.
  - Severely worn or damaged bearing surfaces.
  - Severely worn or damaged connecting rod and bearing assembly.

## Crankshaft Axial Play

When replacing the crankcase or crankshaft, the crankshaft axial play (end-float) must be measured and the correct shims installed (if necessary).

1. Install the crankshaft oil seals and main bearings into the crankcase halves. Make sure the bearings are fully seated in their mounting bores.
2. Measure the distance between the crankcase gasket surface and the outer bearing race with a depth gauge (Figure 40). Record the distance.
3. Repeat Step 2 for the other crankcase half.
4. Add the values recorded in Step 2 and Step 3, plus the thickness of a **used** crankcase gasket. This is the crankcase width value.
5. Place the existing crankshaft shim onto the magneto side of the crankshaft. Then measure the overall width of the

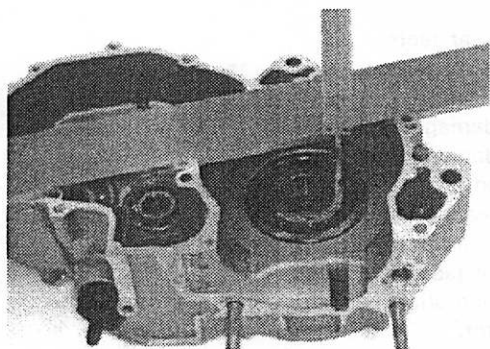


Figure 40

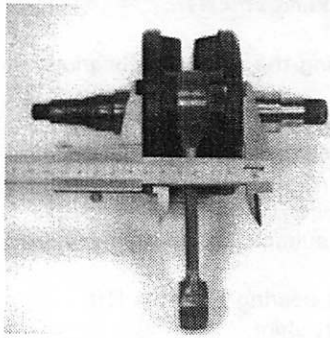


Figure 41



Figure 42

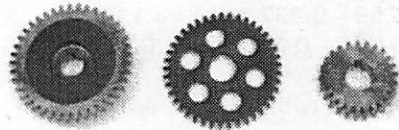


Figure 43

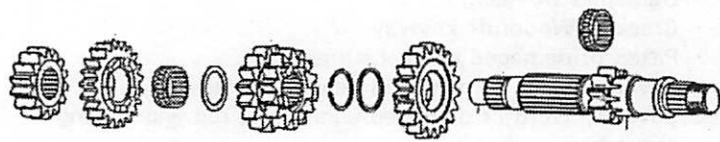


Figure 44



Figure 45

crankshaft halves (including the shim) with a micrometer or caliper (Figure 41). This is the crankshaft width value.

6. Subtract the crankshaft width valve from the crankcase width value to obtain the crankshaft axial play measurement. The correct rod axial play measurement is 0.17 - 0.52 mm. If the axial play measurement is incorrect, install the correct size or number of shims.

#### NOTE

*During engine assembly, install the shim(s) on the magneto side of the crankshaft.*

### BALANCER SHAFT AND GEARS INSPECTION

1. Inspect the balancer shaft (Figure 42) for the following conditions:

- Damaged threads.
- Severely worn or damaged bearing surfaces.

2. Inspect the balancer gears (Figure 43) for:

- Missing or damaged gear teeth.
- Cracked or severely worn keyway.

3. Replace the balancer gears as a set every 15,000 km.

### TRANSMISSION

#### Inspection and Disassembly

When servicing the transmission shafts, note the following:

1. Work on one transmission shaft at a time to prevent from intermixing the parts.
2. Spin each spinning gear on its shaft. It should turn smoothly with no rough spots or binding.
3. Slide each sliding gear on its shaft. It should move smoothly with no rough spots or binding.
4. When removing the snap rings, note the direction in which the sharp edge face for proper installation.
5. When replacing a gear, replace its mating gear at the same time.
6. Disassemble the transmission shafts in the order shown on the exploded drawing. See Figure 44 and Figure 45.
7. Inspect the gears for:
  - Missing or damaged gear teeth.
  - Excessively worn or damaged gear dogs, gear dog recesses and gear dog holes.
  - Excessively worn or damaged splines.
  - Excessively worn or damaged gear bores.
8. Check the transmission shafts for:
  - Scored or damaged bearing surfaces.
  - Cracked or otherwise damaged circlip grooves.
  - Severely worn or damaged splines.
9. Mount each transmission shaft between centers and measure runout with a dial indicator.
10. Check each washer for galling, color change or other damage.

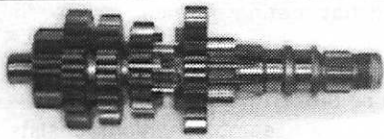


Figure 46

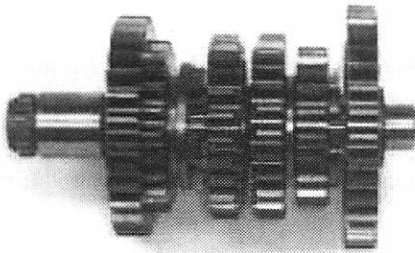


Figure 47

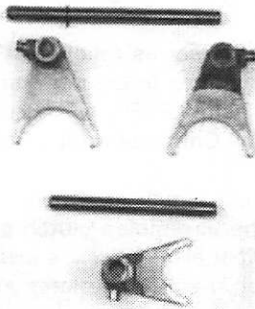


Figure 48

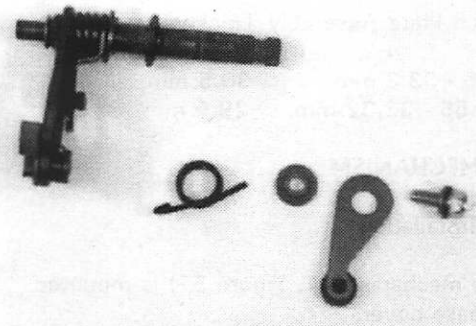


Figure 49



Figure 50

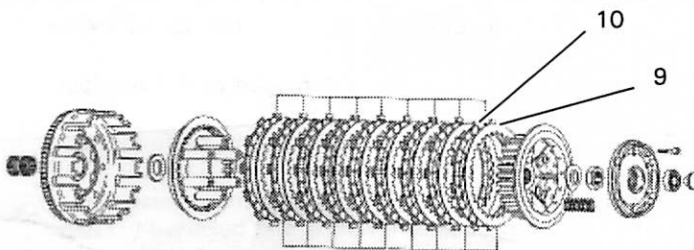


Figure 51

## Reassembly

When reassembling the transmission shafts, note the following:

1. Discard all snap rings. Install new ones during reassembly.
2. When replacing parts, compare the used and new part.
3. Refer to the exploded drawing and photograph for the correct placement of each part:
  - Clutch shaft: Figure 44 and Figure 46.
  - Mainshaft: Figure 45 and Figure 47.
4. After installing a snap ring in its groove, make sure it is seated completely.

## GEARSHIFT MECHANISM INSPECTION

1. Check the condition of each shift fork (Figure 48). Look for signs of bending, twisting or damaged bores. Check the engagement pegs for severe wear or damage.
2. Check the fork spindles (Figure 48) for galling, severe wear and bending. Check the retaining ring and groove in the long fork spindle for damage.
3. Check the index lever assembly (Figure 49) for:
  - Weak or damaged index spring.
  - Damaged step ring.
  - Seized or damaged index lever roller. The roller must turn freely.
4. Check the shift shaft (Figure 49) for:
  - Weak or damaged pawl or index springs.
  - Severely worn or damaged pawl arms.
  - Bent or twisted splines and shaft.
  - Severely worn or damaged thrust washers and shims.

## SHIFT DRUM INSPECTION

1. Check the condition of the shift drum grooves (Figure 50). Look for signs of severe wear, galling, cracks or other damage.
2. Check the shift drum cam for:
  - Severely worn or damaged cam ramps.
  - Cracks or other damage.

## CLUTCH INSPECTION

Refer to Figure 51 when inspecting the clutch assembly.

1. Check the needle bearings (14, Figure 51) for severe wear or damage.
2. Check the friction plate slots in the clutch drum (1, Figure 52) for steps, cracks or severe wear.
3. Check the retaining plate and each friction and clutch plate for flatness. These parts must be perfectly flat; otherwise, clutch drag will result.
4. Check the condition of the clutch hub (1, Figure 53). Check the splines where the clutch operate for grooves, severe wear or other damage. Severely worn or damaged splines will cause erratic clutch operation. Check the flat surface on the clutch hub for severe wear or damage.
5. Check the inner plate (2, Figure 53) for:
  - Damaged spring towers.
  - Dirty or stripped threads.

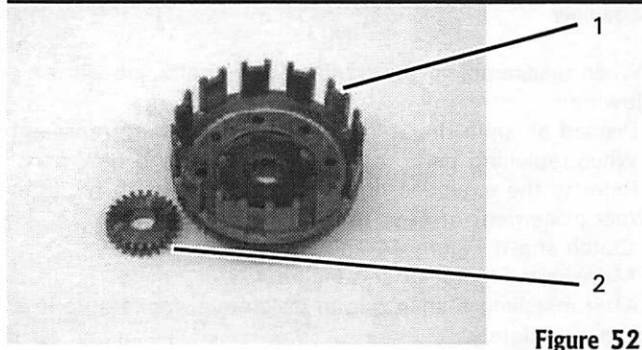


Figure 52

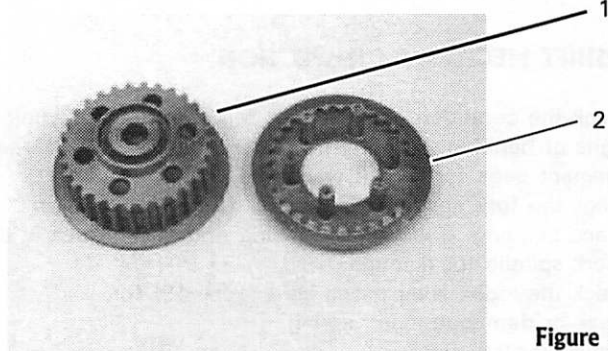


Figure 53

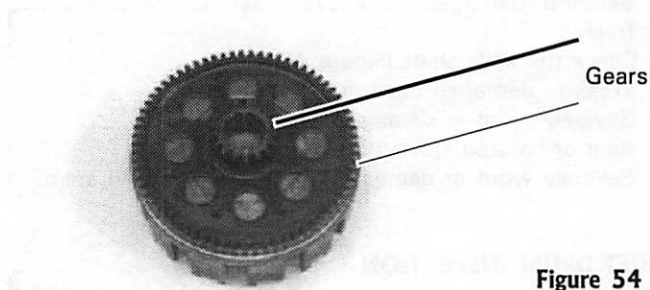


Figure 54



Figure 55

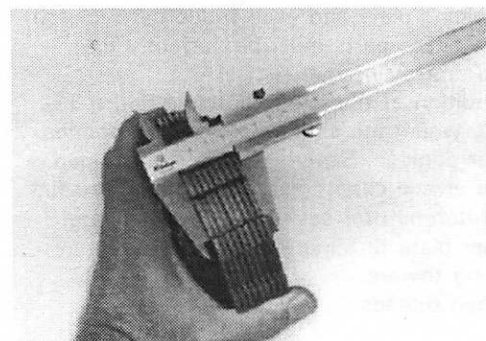


Figure 56

- Severely worn or damaged flat mating surface.
- Damaged tab slots.

6. Inspect the primary drive gear assembly (2, Figure 52 and Figure 54) for chipped, worn or broken gear teeth. If any damage is found, the primary drive assembly, which consists of the primary drive gear and clutch drum, must be replaced at the same time.

#### NOTE

*The primary drive gear assembly is a matched set. Do not replace these parts separately.*

7. Measure the free length of each clutch spring (Figure 55). If any one spring is too short, replace all 6 clutch springs at the same time.

Clutch Spring Free Length	
Standard	Service Limit
34.1 +/- 0.4 mm	31.6 mm

8. Measure the clutch plates for wear as follows:

- Install all of the clutch plates onto the clutch hub, starting with a driven (steel) clutch plate (9, Figure 51) and then a friction plate (10, Figure 51). Continue until all of the clutch plates are installed in order.
- Install the inner plate onto the clutch assembly.
- Measure the thickness of the assembled clutch plates with a vernier caliper (Figure 56). If the thickness is less than specified, discard the friction and clutch plates and install a new set.

Clutch Plate Assembly Thickness		
Standard		Service Limit
1995 - 1998	31.5 - 33.3 mm	30.5 mm
1999 -	30.55 - 32.32 mm	29.5 mm

## CLUTCH RELEASE MECHANISM

### Removal/Inspection/Installation

The clutch release mechanism (1, Figure 57) is mounted inside the clutch release cover.

- To remove the clutch release mechanism, perform the following:
  - Remove the Taptite screw (2, Figure 57), leaf spring and thrust washer.
  - Remove the release cam and balls (quantity: 3).
  - Loosen the nut and remove the adjust screw.
- Inspect the condition of the release cam and balls. Look for severely worn or damaged balls ramps on the release cam and clutch release cover. Check the balls for flat spots, cracks or other damage.
- Replace the leaf spring if it is damaged or if it has lost tension.
- To install the clutch release mechanism, perform the following:
  - Install the adjust screw and nut into the release cover.
  - Lubricate the release cam ramps and balls with clutch oil.
  - Install a ball into each of the release cover ball ramps.
  - Install the release cam, thrust washer and leaf spring.

Apply Loctite 221 (violet) onto the Taptite screw threads. Then install and tighten the Taptite screw (2, Figure 57) securely.



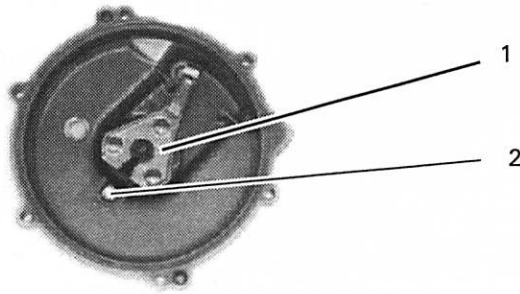


Figure 57

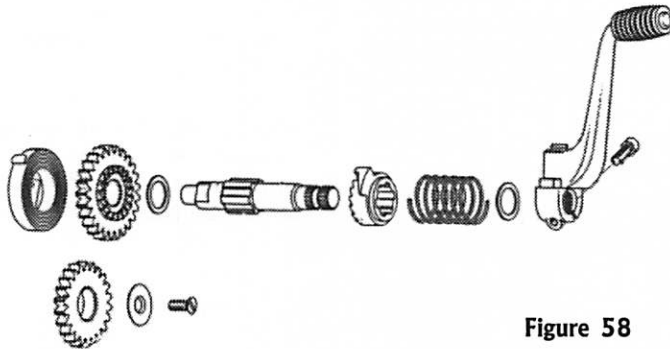


Figure 58

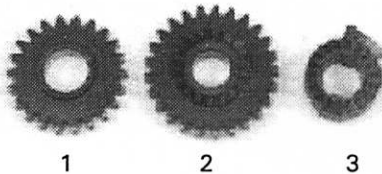


Figure 59

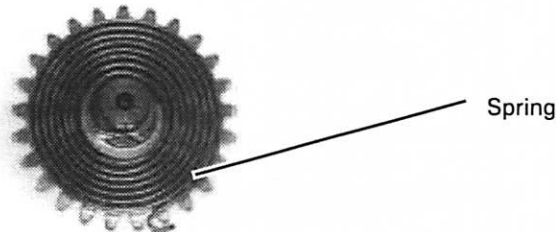


Figure 60

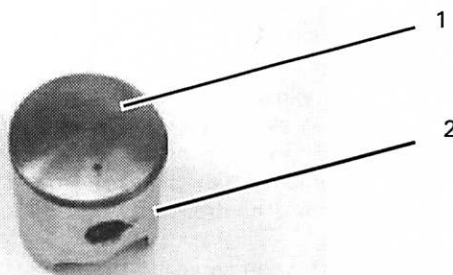


Figure 61

## KICKSTARTER DRIVE AND IDLE GEAR

1. Disassemble the kickstarter assembly as shown in Figure 58.
2. Check all gears (Figure 59) for broken, chipped or worn teeth.
3. Check the idler gear (1, Figure 59) and kickstarter gear (2, Figure 59) bores for severe wear or damage.
4. Check the ratchet gear (3, Figure 59) for severely worn or damaged splines.
5. Check the ratchet teeth on the kickstarter gear (2, Figure 59) and ratchet gear (3, Figure 59) for severe wear, cracks or other damage. The ratchet teeth must be sharp.
6. Check the kickstarter shaft for:
  - Twisted or damaged splines. If the splines are damaged, check the kickstarter lever splines for the same conditions.
  - Bent or twisted shaft.
  - Severely worn or damaged splines.
7. Check for a weak or damaged kickstarter spring.
8. Check for a weak or damaged compression spring.
9. Assemble the kickstarter assembly in the order shown in Figure 59. Install the kickstarter spring onto the kickstarter shaft as shown in Figure 60.

## PISTON

### Cleaning and Inspection

#### CAUTION

Never remove carbon residue from the piston crown when the piston and cylinder are assembled onto the engine. Carbon particles are very abrasive and can fall between the piston and cylinder wall. This can cause rapid piston, ring and cylinder bore wear.

1. Remove the piston ring from the piston ring groove.
2. Remove all carbon residue from the piston crown (1, Figure 61).
3. Inspect the piston crown for pitting, heat erosion or other damage.
4. Inspect the piston skirt (2, Figure 61) for cracks or other damage.
5. Remove any carbon residue from the piston ring groove. When doing so, do not remove any piston material from the ring groove. Use a broken piston ring or suitable tool to clean the groove.
6. Check the condition of the piston ring locating pin (Figure 62). Check the pin for tightness. Check the piston for cracks leading around the pin.

### Piston Outer Diameter

Measure the piston outer diameter with a micrometer. Measure at the bottom of the skirt and at a right angle to the piston pin bore (Figure 63).

Piston Outer Diameter

Refer to page 4

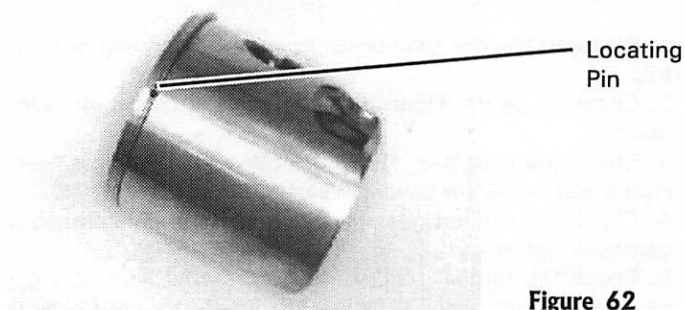


Figure 62

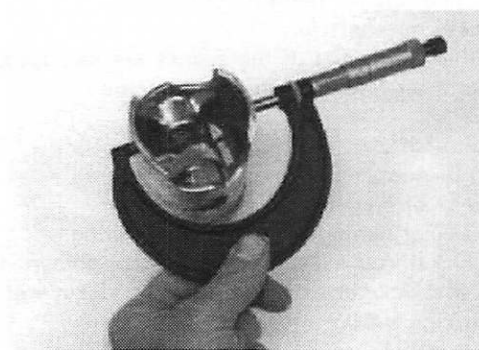


Figure 63

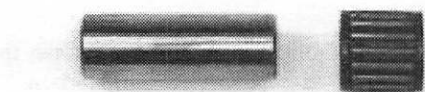


Figure 64

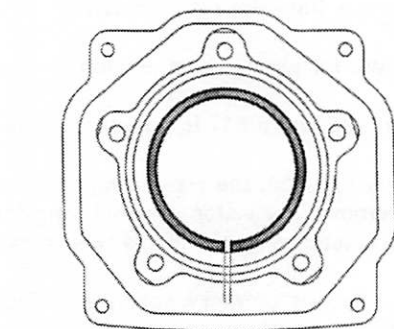


Figure 65

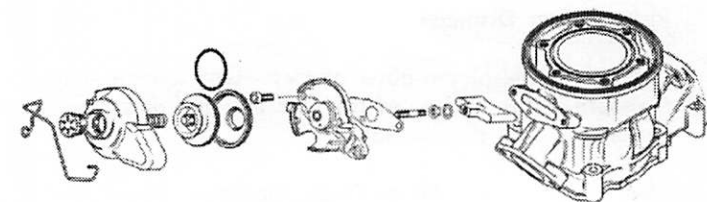


Figure 66

## Piston/Cylinder Clearance

Subtract the piston outer diameter from the maximum cylinder bore inside diameter.

Piston/Cylinder Clearance	
Standard	Service Limit
0.06 - 0.08 mm	0.15 mm

## Piston Pin, Needle Bearing and Pin Bore Clearance

1. Visually check the piston pin (1, Figure 64) for any type of defect, cracks, color change or abnormal wear. An overheated piston pin will have a blue discoloration.
2. Inspect the needle bearing (2, Figure 64) for damage.
3. Determine the piston pin-to-piston bore clearance as follows:
  - Measure the piston pin bore inside diameter.
  - Measure the piston pin bore outside diameter.
  - Calculate the piston pin-to-pin bore clearance.

Piston Pin-to-Piston Clearance	
Standard	Service limit
0.001 - 0.008 mm	0.015 mm

## Piston Ring End Gap

Insert the piston ring into the top of the cylinder and measure its end gap (B, Figure 65) with a feeler gauge. Use the piston to square the ring in the cylinder. If the clearance is excessive, and the piston-to-cylinder clearance is within specification, replace the piston ring.

Piston Ring End Gap	
Standard	Service Limit
0.1 - 0.3 mm	0.8 mm

## Piston Ring Groove Clearance

1. Install the piston ring into the piston ring groove with its mark facing up.
2. Insert a feeler gauge between the piston ring and piston ring groove and measure the groove clearance. If the clearance is excessive, remeasure with a new piston ring. If the clearance is still excessive, replace the piston.

Piston Ring Groove Clearance	
Standard	Service limit
0.05 - 0.082 mm	0.15 mm

## EXHAUST VALVE (RAVE II)

The height of the exhaust port can be varied by the exhaust valve, which is driven by exhaust gas pressure. Pressure passes from the exhaust port to the exhaust valve mechanism via a small bore. The optimum r.p.m. switching point for the actuation of the valve is controlled by pre-tension of the compression spring.

Refer to Figure 66 when servicing the exhaust valve.

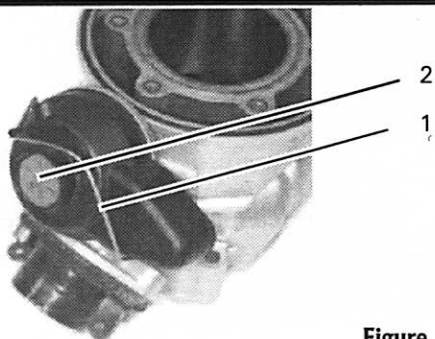


Figure 67

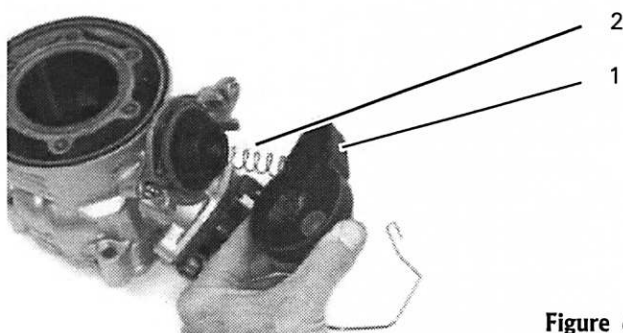


Figure 68

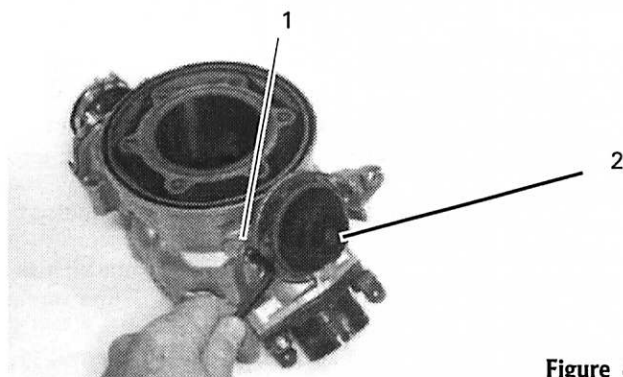


Figure 69

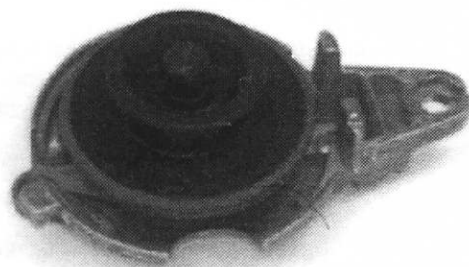


Figure 70

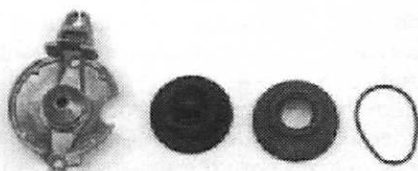


Figure 71

## Disassembly

1. Unhook the spring clip (1, Figure 67) and pivot it away from the valve cover. Then remove the valve cover (1, Figure 68) along with the adjustment screw and compression spring (2, Figure 68).
2. Remove the 2 Allen screws (1, Figure 69) securing the valve rod housing to the cylinder.
3. Unscrew the exhaust valve piston (2, Figure 69), then remove the piston and the valve rod housing from the cylinder (Figure 70).
4. Turn and pull the exhaust valve piston, bellows and hose spring off of the valve rod housing (Figure 71).
5. Remove the gasket and the exhaust valve assembly (1, Figure 72).
6. Loosen the hex nut (1, Figure 73) and unscrew the valve rod (2, Figure 73) with its washer (3, Figure 73) from the exhaust valve (4, Figure 73).

## Inspection

1. Remove all Loctite residue from the threaded surfaces.

### CAUTION

Before cleaning non-metallic parts of the RAVE assembly, make sure the chemical is compatible with non-metallic materials. Some chemicals can cause permanent damage.

2. Inspect the exhaust valve (4, Figure 73) for:

- Cracks.
- Deep scoring.
- Heat discoloration.

### CAUTION

Do not enlarge or damage the cylinder valve port or the valve rod housing bore when cleaning them in Steps 3 and 4.

3. Clean the exhaust valve and the valve port in the cylinder of all carbon deposits and residue.
4. Clean the valve rod housing (1, Figure 71) bore of all carbon deposits and residue. Then check the bore for excessive wear or damage.
5. Inspect the valve rod housing (1, Figure 71) for damage.
6. Check the condition of the exhaust valve piston (2, Figure 71). Look for damage caused by overheating or deformation (due to excessive tightening).
7. Inspect the bellows (3, Figure 71) for cracks and other damage.
8. Inspect the compression spring (2, Figure 68) for stretched or unequally spaced coils, flat spots or other damage. If the compression spring shows no visible damage, check it as follows:
  - Measure the compression spring free length with a vernier caliper.

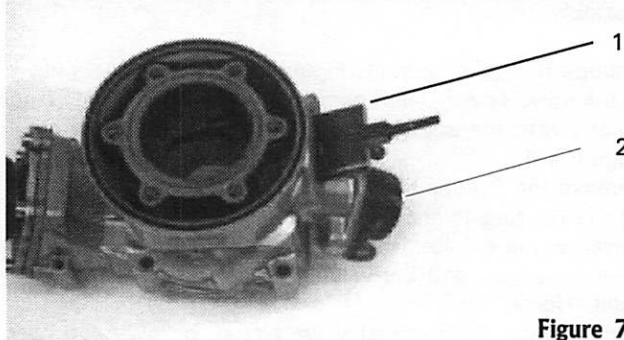


Figure 72

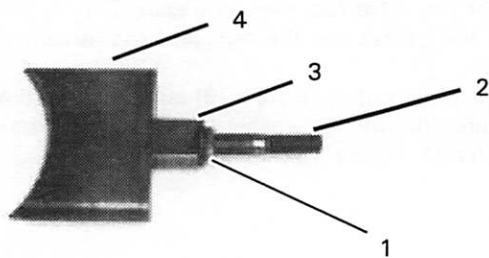


Figure 73

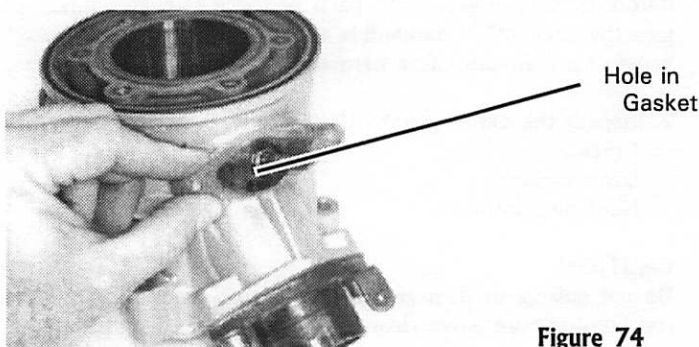


Figure 74

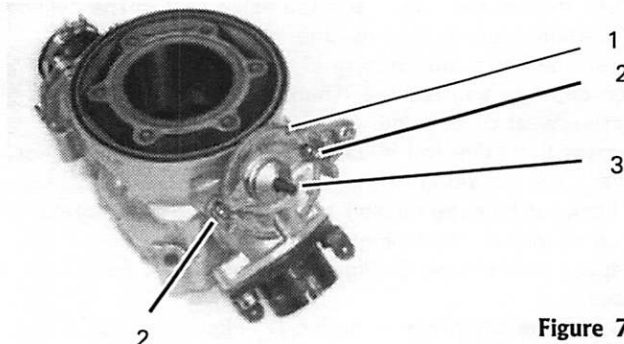


Figure 75

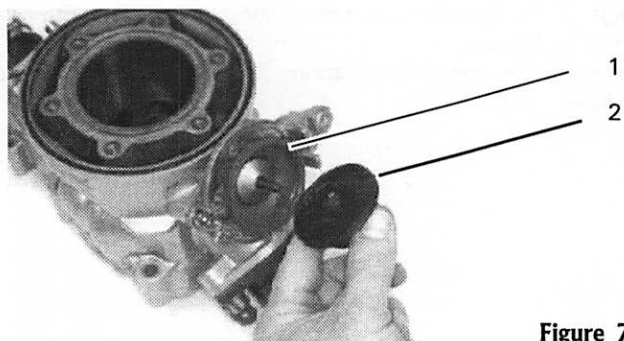


Figure 76

#### Compression Spring Free Length

Standard  
52.5 mm

Service limit  
45.0 mm

#### NOTE

**A weak or damaged compression spring will effect the overall operation of the exhaust valve assembly. Replace the compression spring if there is any question about its condition or operation.**

9. Because the exhaust valve assembly is dependent on exhaust gas pressure, a leaking exhaust socket (2, Figure 72) will reduce its efficiency and operation. Check the exhaust socket for signs of leakage, cracks or other damage. If necessary, remove the exhaust socket and replace its gasket and/or the exhaust socket. Note the following:

- If removed, remove all carbon residue from the exhaust socket.
- Check the exhaust socket base for flatness.
- Apply Loctite Anti-Seize 76710 onto the exhaust socket Allen screw threads to prevent thread galling.
- Tighten the 2 Allen screws to 20 N.m (175 in.-lb.).

#### Reassembly

1. Assemble the exhaust valve as follows:

- The valve rod (2, Figure 73) has one long and one short threaded end. Install the nut on the long threaded end.
- Install the washer (3, Figure 73) over the valve rod and seat it against the nut. This washer must seat between the nut and exhaust valve.
- Apply Loctite 648 (green) onto the valve rod so that it will contact the hex nut and exhaust valve threads. Then thread the exhaust valve all the way onto the rod.
- Secure the exhaust valve in a vise, then tighten the nut (1, Figure 73) securely against the exhaust valve.

#### CAUTION

**The exhaust valve and hex nut must be secured with Loctite 648 (green) and tightened together securely. If the nut loosens, the exhaust valve could drop into the cylinder and cause severe engine damage.**

2. Install the exhaust valve (1, Figure 72) into the cylinder port with its tapered side facing up.

3. Install a new valve rod housing gasket. Align the hole in the gasket (Figure 74) with the hole in the cylinder block.

4. Install the valve rod housing (1, Figure 75) and secure it with its 2 Allen screws (2, Figure 75). Tighten the screws to 10 N.m (85 in.-lb.).

5. Move the valve rod (3, Figure 75) by hand to check for binding. If necessary, loosen the 2 Allen screws (2, Figure 75) and reposition the valve rod housing (1, Figure 75). Retighten the Allen screws as specified in Step 4.

6. Slide the boot (1, Figure 76) over the valve rod housing. Seat the boot shoulder into the housing groove.

7. Screw the exhaust valve piston onto the exhaust valve rod until it bottoms out. Then install the hose spring (Figure 77) to secure the boot to the exhaust valve piston.



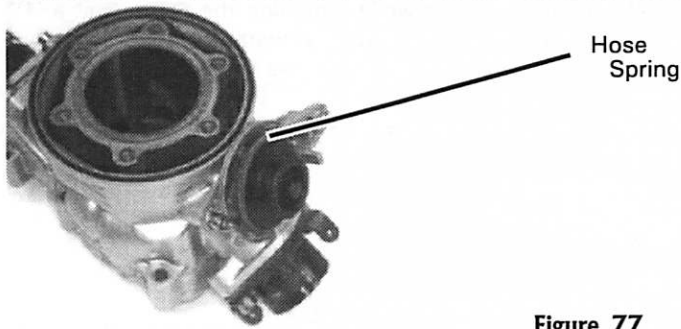


Figure 77

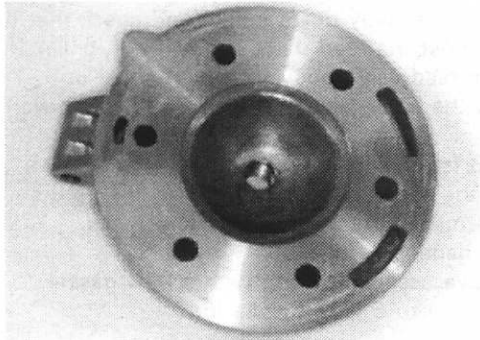


Figure 78

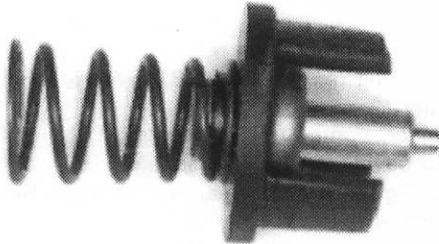


Figure 79

8. Install the compression spring (2, Figure 68) and the valve cover (1, Figure 68), then secure the valve cover with the spring clip (1, Figure 67).

9. Tighten the red adjustment screw (2, Figure 67) until it is level with the valve cover.

10. Check the exhaust valve for free movement. Then check that the exhaust valve does not protrude into the cylinder bore. With the exhaust valve closed all the way, there must be a 0.4 mm clearance between the edge of the exhaust valve and the cylinder bore. Check the clearance with a straightedge and 0.4 mm diameter wire.

- If the exhaust valve clearance is less than 0.4 mm, remove the exhaust valve assembly and check it for proper installation.

### CAUTION

**Do not start the engine if the exhaust valve clearance is less than 0.4 mm. Severe engine damage will occur if the exhaust valve contacts the piston.**

### CYLINDER

1. Clean the cylinder bore. Then inspect the cylinder bore for scratches and scoring.

2. Check all sealing surfaces with straightedge and feeler gauge. All surfaces must be perfectly flat.

3. Measure the cylinder bore inside diameter at 3 different positions—in line with the piston pin and at 90 degrees to the pin. Use the maximum bore measurement to determine cylinder wear.

Cylinder Bore Inside Diameter

Refer to page 4

4. Compare the different cylinder measurements to determine cylinder taper and out-of-round.

Taper and Out-of-Round

Service limit  
0.02 mm

5. After cleaning the cylinder bore and making these checks, lubricate the cylinder bore with engine oil to prevent rust.

### CYLINDER HEAD AND THERMOSTAT

1. Decarbonize the combustion chamber (Figure 78) and clean all of the cylinder head gasket sealing surfaces.

2. Clean and dry the cylinder head.

3. Measure the cylinder head warpage with a straightedge and feeler gauge. The cylinder head must be perfectly flat.

4. Test the thermostat (Figure 79) as follows:

- Suspend the thermostat in a container of water.
- Suspend a thermometer in the water.

### NOTE

**Support the thermostat and thermometer so that they do not contact the sides or bottom of the container.**

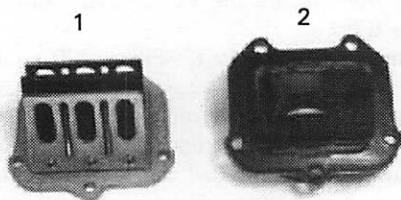


Figure 80

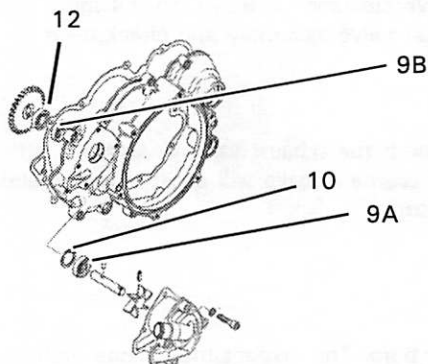


Figure 81

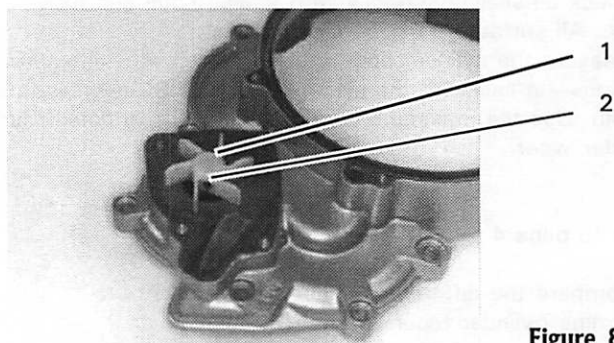


Figure 82

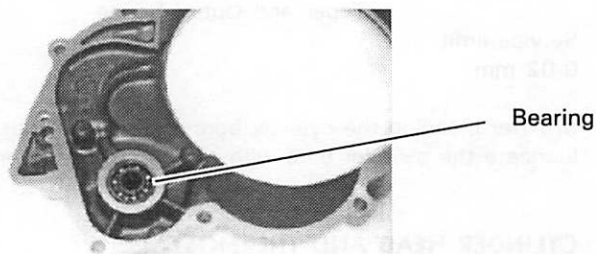


Figure 83

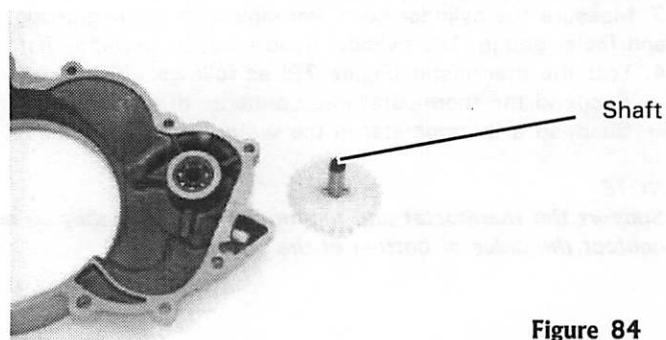


Figure 84

- Slowly heat the water while watching the thermostat and thermometer. When the water temperature reaches approximately 55-60 degrees C, the thermostat should be completely open.
- 5. Inspect the spring and thermostat holder (Figure 79) for damage.

## REED VALVE

1. Remove the reed valve assembly.
2. Check the reed valve petals (1, Figure 80) for cracks or other defects.
3. Hold the reed valve assembly up to a light and check that the reed petals lie flat against the reed valve body. If not, check the rubber coating on the reed valve body for severe wear or damage. Then check the reed valve. Replace the severely worn or damaged part.
  - Apply Loctite 648 (strong) to the reed valve Allen screws with and tighten the screws securely.
4. Inspect the intake manifold (2, Figure 80) for cracks, warpage or other damage.
5. Install the reed valve assembly along with a new gasket. Tighten the Allen screws to 6 N.m (50 in.-lb.).

## WATER PUMP

Refer to Figure 81 for this procedure.

1. Remove the slotted spring pin (1, Figure 82) with a punch, then remove the impeller (2, Figure 82).
2. Remove the pump gear, pump shaft and peg.
3. Inspect the parts for severe wear or damage.
4. Inspect the bearing (Figure 83) for wear and damage. Replace the oil seals and bearing as follows:
  - Remove the outer oil seal (9A, Figure 81).
  - Remove the snap ring (10, Figure 81).
  - Press out the inner oil seal (9B, Figure 81) and bearing (12, Figure 81) together from the clutch cover.
  - Clean the bearing mounting bore and check it for cracks or other damage.
  - Install the snap ring into the clutch cover groove.
  - Grease both oil seal lips with MOLYKOTE 111.

## NOTE

*The inner and outer oil seals (9A and 9B, Figure 81) are identical. Install both oil seals with their open side facing out (away from engine). Be careful not to damage the oil seal lips during installation.*

- Press in the inner oil seal (9B, Figure 81) until it bottoms out against the snap ring.
  - Press a new bearing (12, Figure 81) into the clutch cover until its outer surface is flush with its mounting bore outer surface.
  - Press in the outer oil seal (9A, Figure 81) until it bottoms out against the snap ring.
5. Install the peg into the pump shaft then install the peg into the slot in the pump gear (Figure 84).
  6. Install the pump gear and shaft through the bearing and oil seals.
  7. Install the impeller (2, Figure 82) over the pump shaft, then secure the impeller with the slotted spring pin (1, Figure 82).

## IGNITION COIL AND STATOR

See Figure 85 and Figure 86.

### Values for checking the stator

green - black	=	170 ohms +/- 1%
black - stator mass	=	<0.5 ohms
green - red	=	not measurable
red - black	=	1.76 k ohms +/- 10%
yellow - yellow	=	0.2 - 0.4 ohms
yellow - black	=	inf.

### Values for checking the ignition coil

red - orange	=	<0.5 ohms
red - black	=	not measurable
green - black	=	not measurable
orange - black	=	not measurable
black - ignition cable	=	2.15 k ohms +/- 10%

In case of doubt, test with new ignition coil.



Figure 85

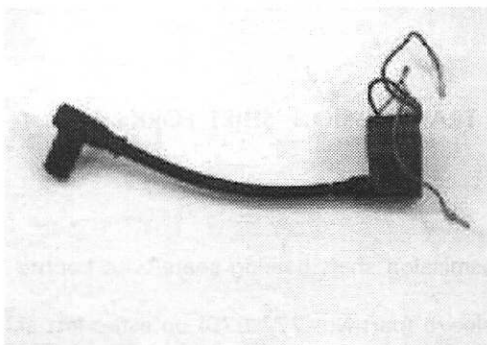


Figure 86



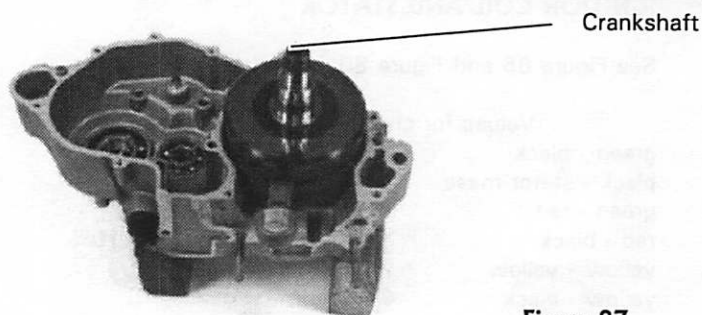


Figure 87

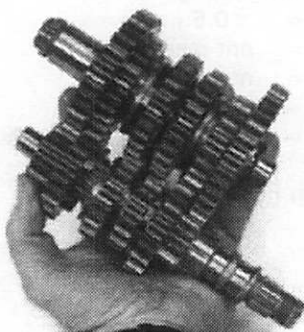


Figure 88

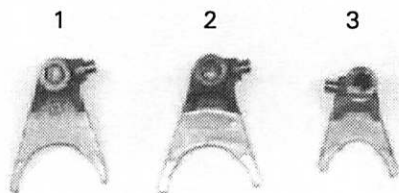


Figure 89

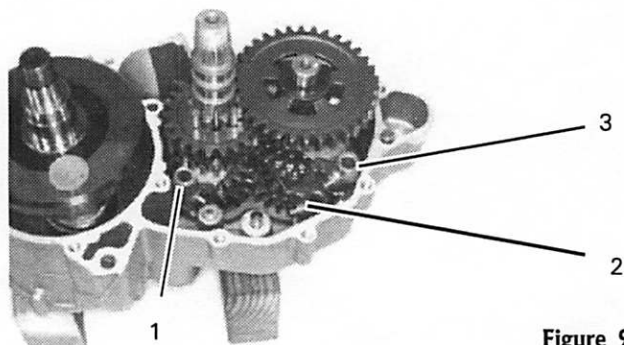


Figure 90

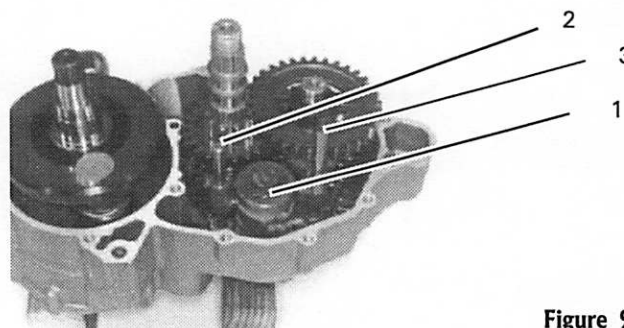


Figure 91

## ENGINE REASSEMBLY

### CRANKSHAFT INSTALLATION

1. Install the crankcase main bearings and oil seals.
2. Support the magneto side crankcase in a press on wooden blocks.

#### CAUTION

When installing the crankshaft in Step 3, do not let the connecting rod contact the crankcase.

3. Install the crankshaft (Figure 87) into the crankcase using a press.

### BALANCER SHAFT, TRANSMISSION, SHIFT FORKS AND SHIFT DRUM

#### INSTALLATION

1. Lubricate the transmission shaft bearing seats with Loctite Antiseize.
2. Install the guide sleeve (part No. 277 970) onto the left side of the mainshaft.
3. Mesh the clutch shaft and mainshaft gears (Figure 88), then install them into the right crankcase. Gently tap the mainshaft to install it through its bearing. Make sure both shafts bottom out.
4. Remove the guide sleeve and check the oil seal for damage.
5. Refer to Figure 89 to identify the shift forks. Note the following:
  - The 1st/3rd speed shift fork (1, Figure 89) is installed with its 113 mark facing up (away from the crankcase).
  - The 2nd/4th (2, Figure 89) and 5th/6th (3, Figure 89) speed shift forks are installed with their flat side facing down (toward crankcase).
6. Install the 5th/6th speed shift fork (1, Figure 90) and engage it with the clutch shaft 3rd/4th gear groove.
7. Install the 2nd/4th speed shift fork (2, Figure 90) and engage it with the mainshaft 5th gear groove.
8. Install the 1st/3rd speed shift fork (3, Figure 90) and engage it with the mainshaft 6th gear groove.
9. Install the shift drum (1, Figure 91).
10. Engage the shift fork pins with the shift drum grooves as follows:
  - Engage the 5th/6th speed shift fork (1, Figure 90) with the center shift drum groove.
  - Engage the 2nd/4th speed shift fork (2, Figure 90) with the lower (right side) shift drum groove.
  - Engage the 1st/3rd speed shift fork (3, Figure 90) with the upper (left side) shift drum groove.
11. Install the short fork spindle (2, Figure 91) through the 5th/6th speed shift fork.
12. Install the retaining ring onto the long fork spindle, if removed.
13. Install the long fork spindle (3, Figure 91) thorough the 2 mainshaft shift forks.

#### NOTE

Make sure both fork spindles bottom out when installing them.

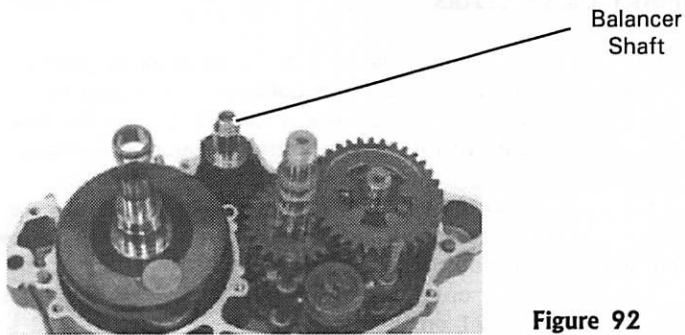


Figure 92

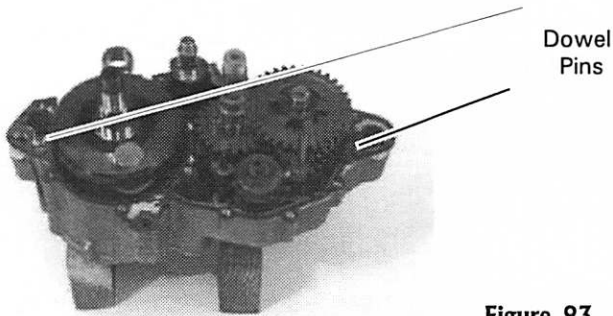


Figure 93

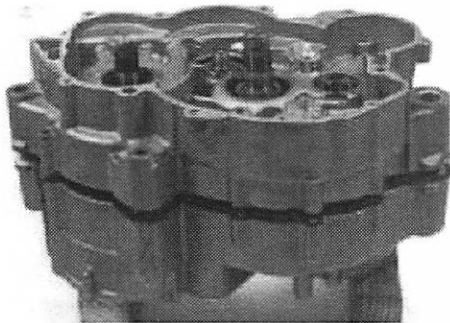


Figure 94

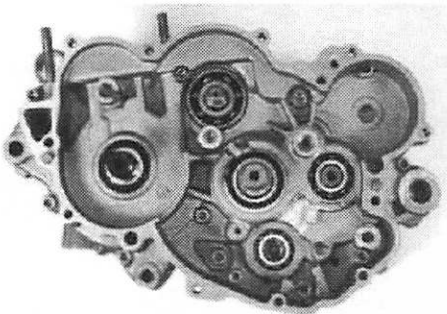


Figure 95

14. Lubricate all of the transmission components with transmission oil. Then turn the shift drum and mainshaft and shift the transmission into all 6 gears.

15. Lubricate both balancer bearing seats with Loctite Antiseize. Then install the balancer shaft (Figure 92) into the magneto side crankcase. No spacer shims are used.

16. Install a new gasket on the magneto side crankcase, aligning the gasket with the dowel pins (Figure 93). Trim the gasket to remove the bridge across the cylinder and base gasket opening.

#### NOTE

*If the gasket shrunk during storage and is too small, dip it into water and then position it onto the crankcase with some oil.*

17. Install the opposite crankcase half (Figure 94) and gently tap it into place. Do not tap against any sealing surfaces.

18. Install and tighten all of the crankcase Allen screws and lockwashers (Figure 95). Turn the crankshaft and both transmission shafts. There must be no binding or roughness.

## PRIMARY DRIVE GEARS

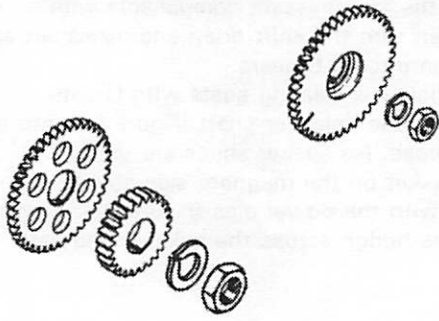


Figure 96

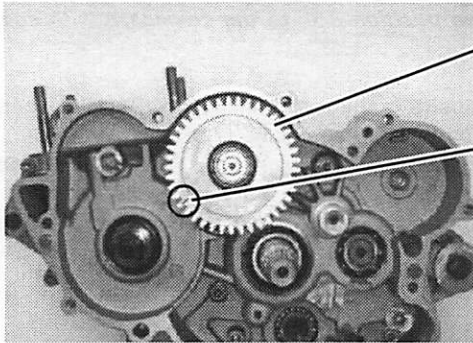
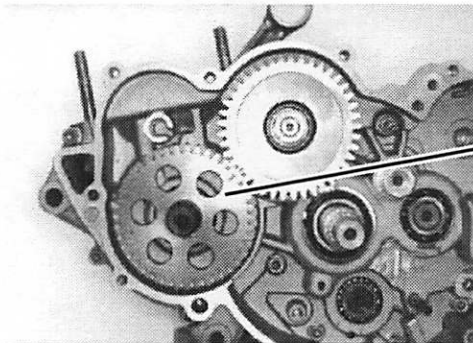
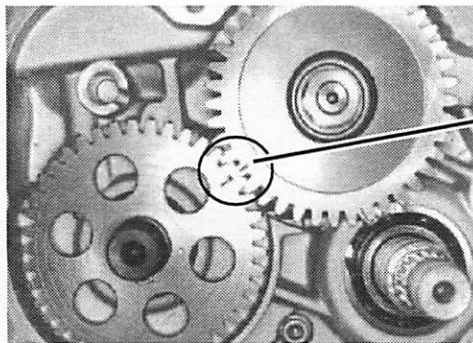


Figure 97



Balancer  
Drive  
Gear

Figure 98



Timing  
Marks

Figure 99

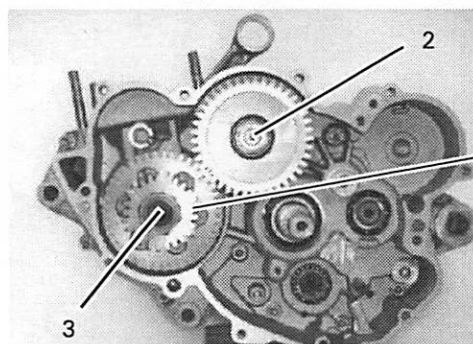


Figure 100

- Refer to Figure 96 when installing the primary drive gears.
1. Install the Woodruff key and the balancer driven gear (1, Figure 97), lockwasher and nut. Apply Loctite 221 on the hex nut. Install the gear with its timing mark (2, Figure 97) facing out.
  2. Install the Woodruff key and the balancer drive gear (Figure 98). Align the balancer drive gear timing mark with the balancer driven gear timing mark (Figure 99).
  3. Install the primary drive gear (1, Figure 100), lockwasher and nut. Apply Loctite 221 on the hex nut.
  4. Tighten the balancer driven gear nut (2, Figure 100) to 70 N.m. (52 ft.-lb.).
  5. Tighten the balancer drive gear nut (3, Figure 100) to 120 N.m (88 ft.-lb.).

## EXTERNAL SHIFT MECHANISM

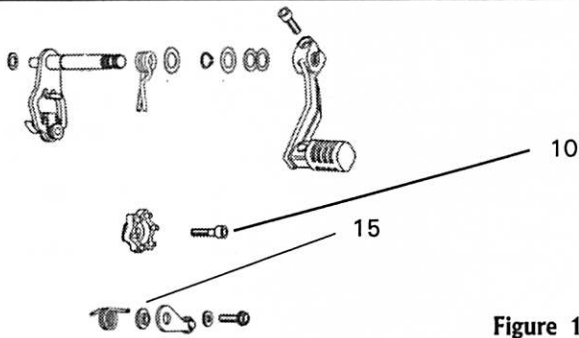


Figure 101

Refer to Figure 101 when installing the external shift mechanism.

1. Install the index spring over the crankcase boss (Figure 102).
2. Install the step ring (15, Figure 101) onto the backside of the index lever, then install the index lever, Taptite screw and washer (Figure 103). Hook the index spring onto the bottom of the index lever (Figure 103). Tighten the Taptite screw securely.

**NOTE**

*After tightening the Taptite screw, pivot the index lever by hand to make sure the step ring is centered properly against the index lever. If the index lever is tight, the step ring is not centered properly.*

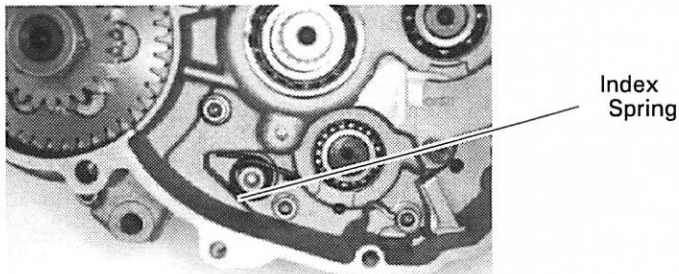


Figure 102

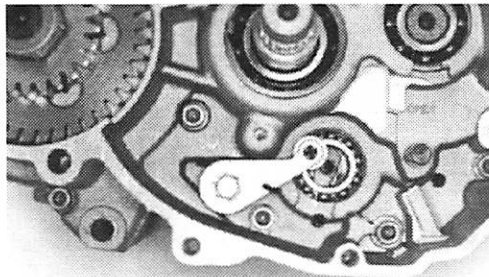


Figure 103

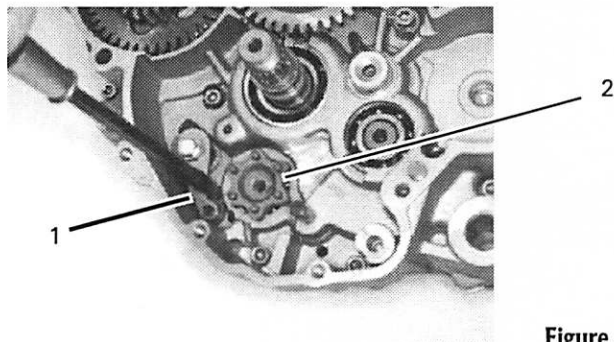


Figure 104

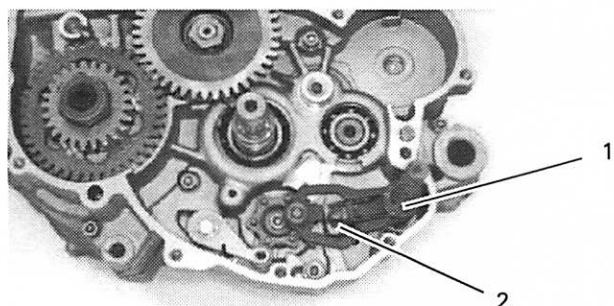


Figure 105

3. Apply Loctite 221 onto the shift drum cam Allen screw threads. Set the screw aside until reassembly.
4. Pull the index lever clockwise and hold it in place with a screwdriver (1, Figure 104), then install the shift drum cam (2, Figure 104) onto the shift drum. Align the curved part of the shift drum cam shoulder with the curved part of the shift drum groove.

5. Hold the shift drum cam with one hand, then slowly remove the screwdriver and allow the index lever to move out and contact the shift drum cam. Install the shift drum cam Allen screw (10, Figure 101) and tighten to 10 N.m (85 in.-lb.).

6. Apply Loctite Antiseize 76710 onto the shift shaft right side (short end). Apply a lithium base grease onto the shift shaft's left side (spline end).

7. Install the shift shaft (1, Figure 105) with its washers and shims (if used). Center the shift shaft spring (2, Figure 105) around the crankcase pin.

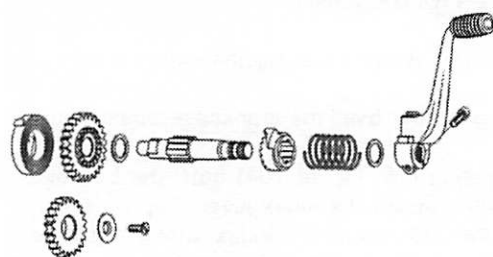


Figure 106

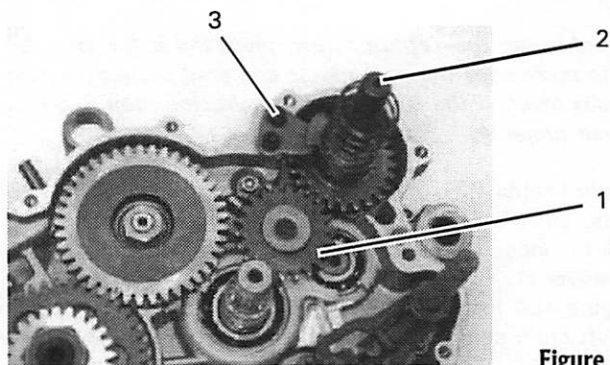


Figure 107

## IDLER GEAR

- Refer to Figure 106 when installing the idler gear assembly.
1. Lubricate the idler gear bore with Loctite Antiseize 76710.
  2. Install the idler gear (1, Figure 107) with its shoulder side facing out. Then install the thrust washer and countersunk screw. Apply Loctite 221 onto the screw threads. Tighten the countersunk screw to 8 N.m (65 in.-lb.).
  3. Spin the idler gear by hand. The gear must turn smoothly.

## KICKSTARTER ASSEMBLY

- Refer to Figure 106 when installing the kickstarter assembly.
1. Assemble the kickstarter assembly and install into the crankcase (2, Figure 107). Hook the return spring into the U-shaped boss cast into the top of the crankcase.
  2. Pivot the kickstarter clockwise, then install the ratchet gear stop (3, Figure 107) and secure it with its 2 Allen screws. Apply Loctite 221 onto the screw threads. Tighten the screws to 10 N.m (88 in.-lb.).



## CLUTCH

Refer to Figure 108 when installing the clutch.

1. Install the 2 needle bearings (Figure 109) into the clutch shaft grooves. Lubricate the needle bearings with oil.
2. Install the clutch drum (1, Figure 110) and thrust washer (2, Figure 110).

### NOTE

**Thoroughly lubricate new clutch plates with transmission oil before assembly.**

3. Preassemble the clutch plates onto the inner plate (11, Figure 108) and clutch hub (8, Figure 108) in the order shown in Figure 108. After assembling and aligning the clutch assembly (1, Figure 111), secure it in place with a clutch spring, Allen bolt and large flat washer (2, Figure 111).
4. Install the clutch plate assembly (1, Figure 112).
5. Remove the bolt, washer and spring (2, Figure 112), the position the outer friction plate so that its tabs fit into the clutch drum notches (Figure 113).
6. Install the spring washer and hex nut (1, Figure 114).
7. Tighten the hex nut to 120 N.m (83.3 ft.-lb.).
8. Install the 6 clutch springs (2, Figure 114) and retaining plate (1, Figure 115).
9. Install the 6 Allen screws (2, Figure 115) and tighten evenly in a crisscross pattern. Tighten to a final torque reading of 6 N.m (50 in.-lb.).
10. Install the thrust hub (3, Figure 115).

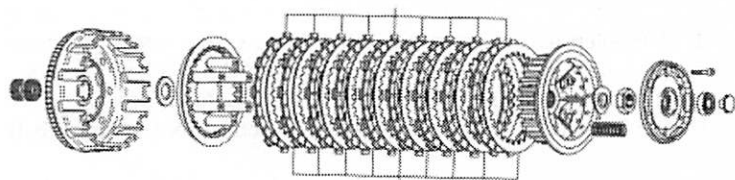


Figure 108

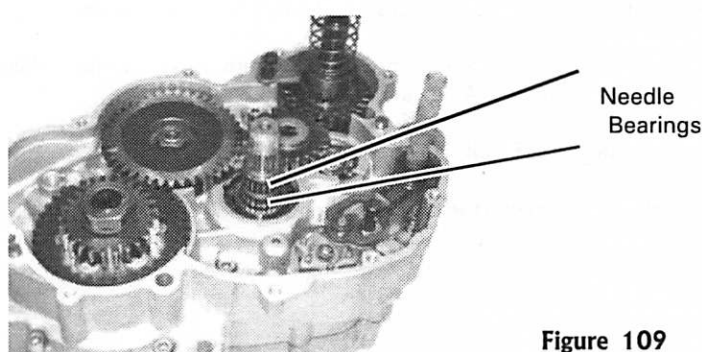


Figure 109

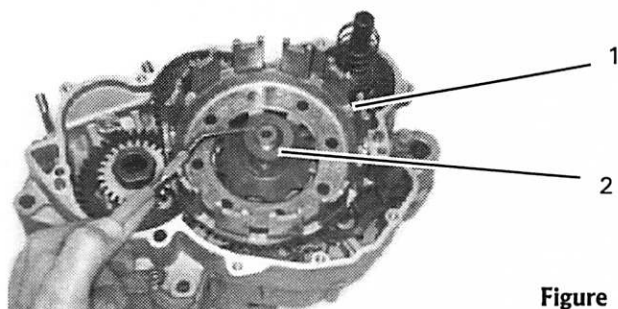


Figure 110

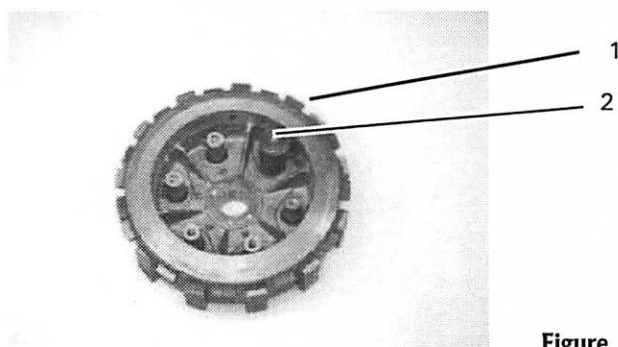


Figure 111

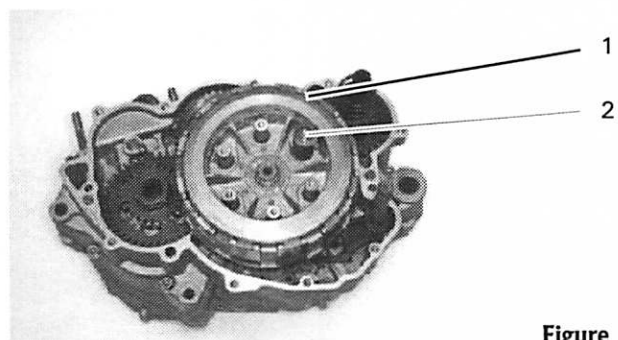


Figure 112

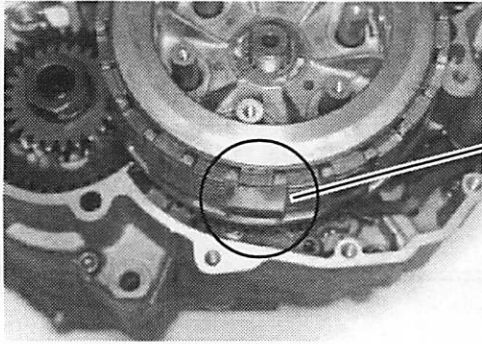


Figure 113

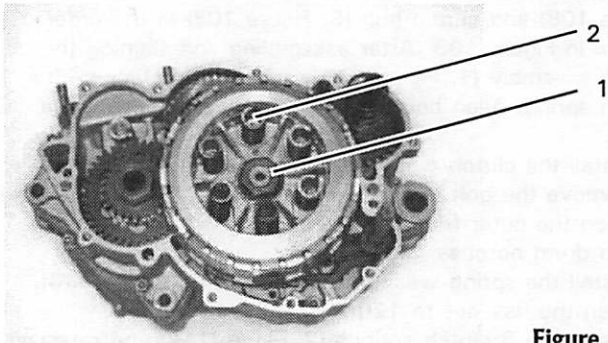


Figure 114

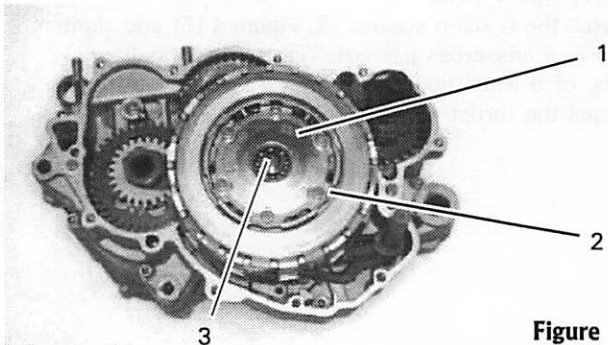


Figure 115

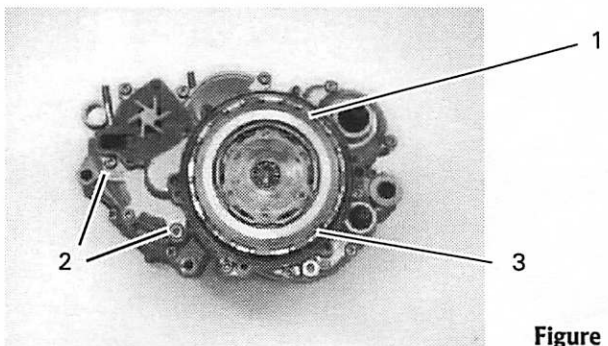


Figure 116

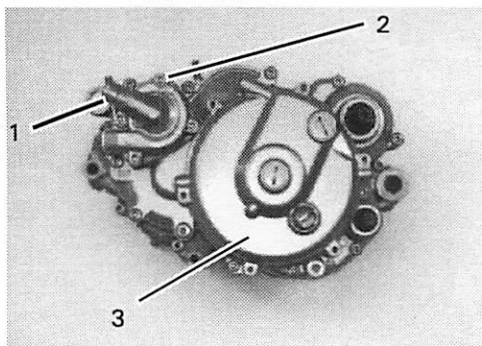


Figure 117

## CLUTCH COVER ASSEMBLY

1. Install a new clutch cover gasket.
2. Install the clutch cover (1, Figure 116) and secure it with the 11 M6 Allen screws and the 1 M8 Allen screw and use a new copper sealing gasket. Install washers on the 2 Allen screws identified in 2, Figure 116. Tighten the M6 Allen screws to 10 N.m (88 in.-lb.). Tighten the M8 Allen screw to 18 N.m (13 ft.-lb.).
3. Install the water pump housing (1, Figure 117) and its 4 Allen screws. Install the washer on the upper Allen screw (2, Figure 117). Tighten the Allen screws.
4. Install the O-ring (3, Figure 116) into the clutch cover groove.
5. Install the clutch release cover (3, Figure 117) and its 6 Allen screws. Tighten the Allen screws.

## KICKSTARTER LEVER

Install the kickstarter lever and pinch bolt. Tighten the pinch bolt securely.



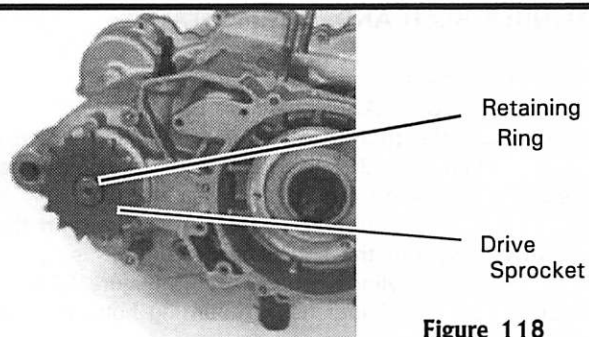


Figure 118

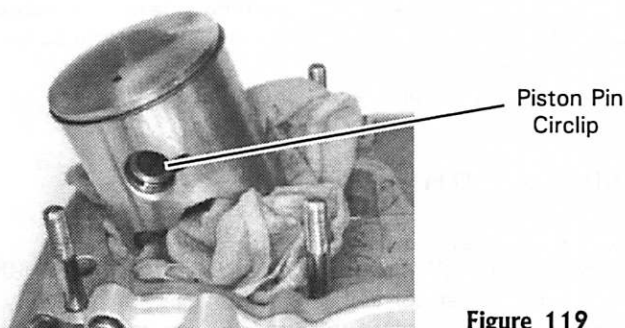


Figure 119

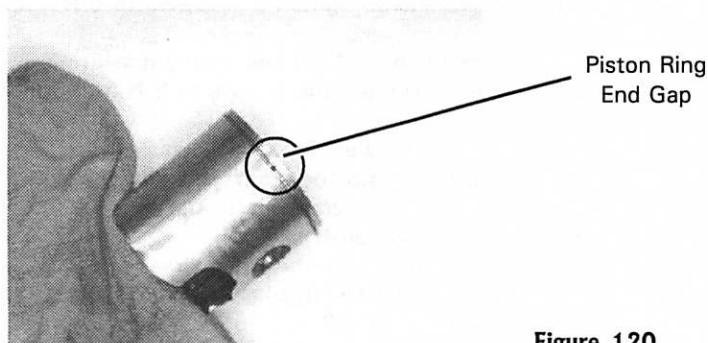


Figure 120

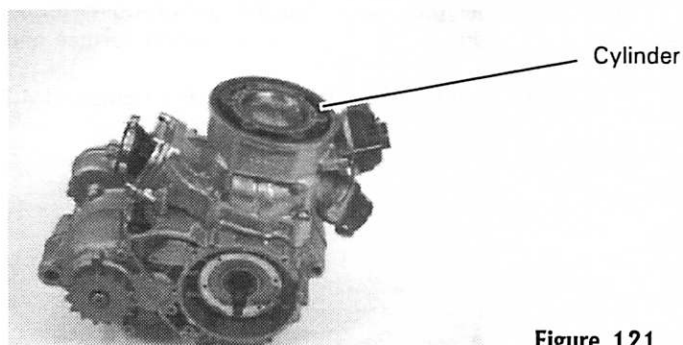


Figure 121

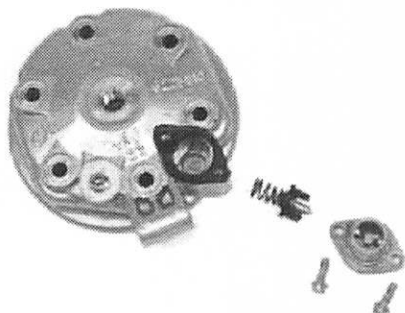


Figure 122

## DRIVE SPROCKET

1. Install the O-ring into the mainshaft groove.

### NOTE

*Install the retaining ring with its sharp edge facing out (away from engine).*

2. Install the drive sprocket and secure it with a new retaining ring (Figure 118). Make sure the retaining ring seats in the mainshaft groove completely.

## PISTON

1. Install the piston ring into the ring groove with its mark facing up.
2. Lubricate the needle bearing and piston pin with engine oil.
3. Install the needle bearing into the connecting rod.
4. Install the piston over the connecting rod with its arrow mark facing toward the exhaust port.
5. Hold the piston in place and install the piston pin through the piston.
6. Cover the crankcase opening with a clean shop rag.
7. Install new piston pin circlips (Figure 119). Use the circlip installation pusher (part No. 877 010) and the circlip installation sleeve (part No. 877 020). Position the circlips so that their opening faces down. Check that both circlips seat in their grooves completely.

## CYLINDER

1. If the engine was disassembled, trim any excessive crankcase gasket material away from the cylinder base surfaces. Do not allow any gasket material to fall into the crankcase.
2. Install the appropriate cylinder base gasket: 0.3, 0.5 or 0.8 mm.
3. Lubricate the piston, ring and cylinder bore with engine oil.
4. Align the piston ring end gap with the ring locating pin (Figure 120).

### CAUTION

**Do not turn the cylinder when installing it in Step 5 or the ring may catch in a port and break.**

5. Compress the piston ring and slide the cylinder (Figure 121) over the ring and piston.
6. Hold the cylinder down and operate the kickstarter. The piston should move smoothly through the bore. If the piston stops abruptly, the ring is caught in a port.
7. Install the 4 hex nuts and washers and the 2 Allen screws and tighten in a crisscross pattern in 2 or 3 steps. Tighten the hex nuts. Tighten the Allen screws securely.

## CYLINDER HEAD AND THERMOSTAT

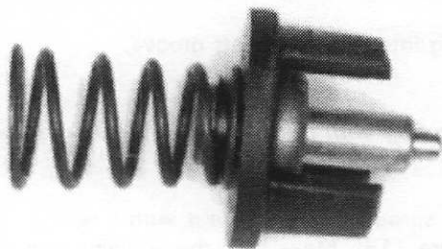


Figure 123

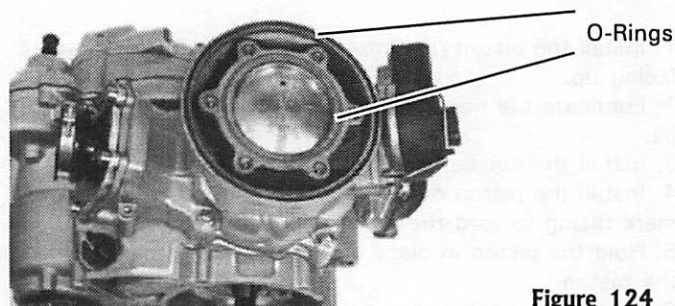


Figure 124

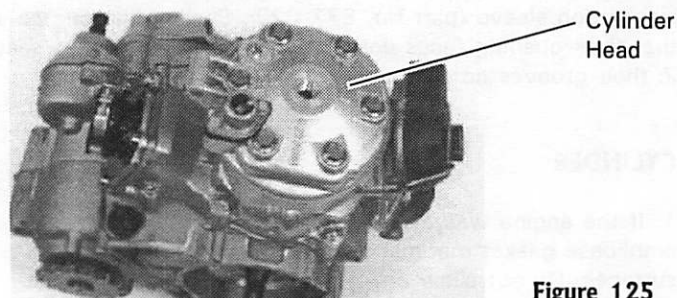


Figure 125

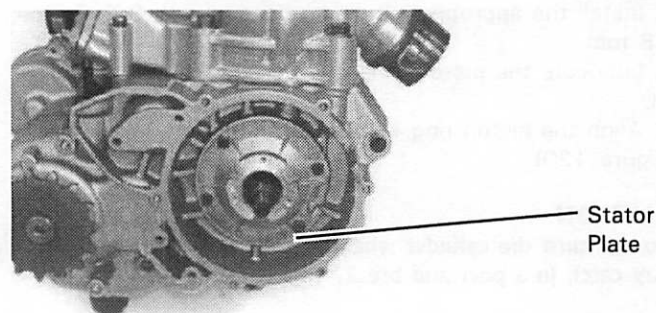


Figure 126

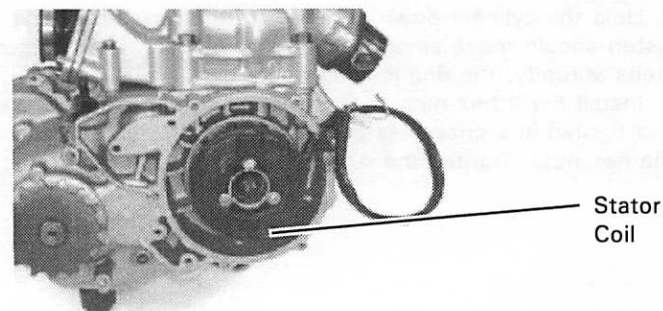


Figure 127

1. To install the thermostat (Figure 122):
  - Install a new gasket.
  - Assemble the thermostat, thermostat holder and compression spring (Figure 123) and install into the cylinder head with the spring end facing down.
  - Install the water pump socket and secure with the 2 Taptite screws. Tighten the screws securely.
2. Install 2 new cylinder head O-rings (Figure 124).
3. Lubricate the cylinder head mounting bolts with Loctite Antiseize.
4. Install the cylinder head (Figure 125).
5. Install the 6 cylinder head mounting screws and tighten in a crisscross pattern and in 2 or 3 steps. Tighten the screws to 20 N.m (14.6 ft.-lb.).
6. Install the spark plug and tighten securely.

## IGNITION SYSTEM

1. Install the stator assembly as follows:
  - Apply Loctite 221 to the 4 stator plate Allen screw threads and to the 3 stator coil screw threads.
  - Install the stator plate (Figure 126) and secure it with the 4 Allen screws and washers. Tighten the screws to 6 N.m (55 in.-lb.).
  - Install the stator coil (Figure 127) and secure it with its 3 screws and washers. Tighten the screws to 6 N.m (55 in.-lb.).
2. Install the flywheel (1, Figure 128) as follows:
  - Install the Woodruff key into the crankshaft keyway.
  - Install the flywheel onto the crankshaft. Align the keyway in the flywheel with the Woodruff key.
  - Apply Loctite 221 onto the flywheel nut threads.
  - Install the lockwasher and the flywheel nut (2, Figure 128). Tighten the flywheel nut to 70 N.m (52 ft.-lb.).
3. Install the ignition cover (Figure 129) as follows:
  - Install the 2 rubber grommets into the ignition cover grooves.
  - Apply RTV 732 onto the ignition cover mating surface and install the cover (Figure 129).
  - Secure the cover with its 6 Allen screws and tighten to 4.5 N.m (38 in.-lb.).

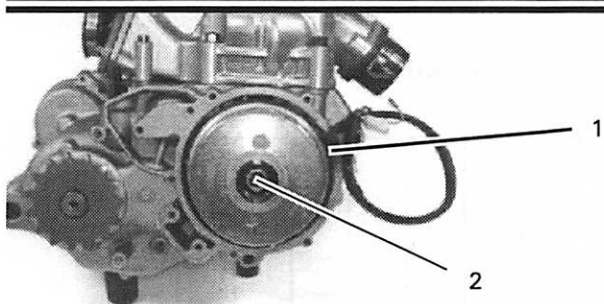


Figure 128

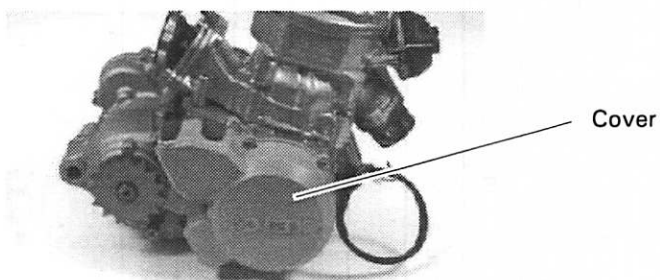


Figure 129

## ENGINE INSTALLATION

1. Install the engine into the frame and secure it with its bolts and nuts. Tighten securely.
2. Refill the cooling system with coolant. Check for any coolant leaks.
3. Install the exhaust system.
4. Reconnect the spark plug cap at the spark plug
5. Reconnect the magneto leads.
6. Reconnect the drive chain.
7. Reconnect and adjust the clutch cable.
8. Install the carburetor.
9. Install the frame covers and seat.
10. If new components were installed, break-in the engine following the procedures listed in your owner's manual.

Trouble	Possible cause	Remedy
Engine will not start or is hard to start	Shortcomings of operator	Replenish fuel, open petcock, kill button released
	No spark, insufficient spark	Check ignition unit / electric (method of elimination)
	Spark plug fouled, wet with fuel or bridging of electrodes	Clean or replace plug
	Spark plug, electrode gap too large	Set electrode gap to 0.7 mm or change plug
	Spark plug, wrong heat range	Replace plug (NGK BR 8 ES)
	No or inadequate fuel supply	Clean petcock, fuel lines, tank, tank venting, fuel filter and carburetor
	Reed valve / petal faulty	Replace
	Water in carburetor or jets blocked	Dismantle and clean carburetor
	Loose allen screw M8 x 50 (in clutch cover, for crankshaft locking in T.D.C.)	Tighten and/or replace copper washer
	Water in fuel, contaminated or too old	Exchange for fresh fuel
	Loose spark plug	Tighten
	Damaged O-ring on cylinder head	Change O-ring
	Faulty cylinder base gasket	Replace
	Cylinder or cylinder head not tightened	Tighten
	Piston rings worn, suffering fatigue or broken	Replace
	Piston rings stuck	Clean or replace
	Piston seized or damaged	Replace
	Cylinder wall damaged	Replace



Engine will not idle smoothly	Badly adjusted idle speed	Readjust idle speed
	Blockage of idle jet or idle air screw	Clean carburetor
	Choke piston does not close completely	Clean carburetor
	Carburetor flooded	Remove spark plug and kick engine until fuel dissipates via plug hole. Check float valve and petcock.
	Faulty ignition unit	Check ignition unit and spark plug
	Air filter, intake box leaking or contaminated	Clean or replace relevant parts
	Reed valve / petal defective	Replace
	Loose allen screw M8 x 50 (in clutch cover, for crankshaft locking in T.D.C.)	Tighten and/or replace copper washer
Engine not performing well in the lower speed range	Interruption in the fuel system	Clean fuel system and carburetor
	Clogged air filter	Clean or replace air filter
	Exhaust system leaking or blocked	Clean and inspect exhaust system, retorque exhaust flanges
	Compression too low	see 'Engine will not start'
	Electronic ignition control faulty	Check ignition unit, control of ignition timing
	Exhaust valve (RAVE) stuck in the open position	Check and clean exhaust valve, clean cylinder slot for exhaust valve
Engine not performing well in the higher speed range	Carburetor floating . level of float valve set too high	Clean carburetor, adjust float valve
	Sealing surface of float needle dirty or worn	Clean carburetor, replace float needle
	Carburetor jets blocked or loose	Clean carburetor, tighten jets
	Exhaust valve (RAVE) stuck in the closed position	Check and clean exhaust valve, clean cylinder slot for exhaust valve. Check rubber bellows
	Electronic ignition advance faulty	Check ignition unit, control of ignition timing

**TROUBLE SHOOTING CHARTS**

Pinging of engine at full load, traces of pinging on piston crown	Wrong type or heat range of spark plug	Replace plug
	Shortage of fuel	Check fuel system and carburetor (float level, petcock, tank venting, clean complete fuel system)
	Exhaust system or end silencer blocked	Clean and/or replace exhaust system
	Air intake system (air box, filter element) clogged or damaged	Clean air intake, replace with genuine ATK unit
	Compression ratio too high	Verify squish gap of 1.5 mm min (by solder wire), check compression and rectify with different base gasket thicknesses
	Compression ratio too high, carbon deposits on piston crown and combustion chamber	Clean piston and combustion chamber
	Octane fuel rating too low	Use at least 93 Octane fuel
	Too much ignition advance	Check ignition unit, verify ignition timing by stroboscopic lamp
Excessive engine vibration	Drive of balance shaft fitted incorrectly	Check balance shaft and balance gears, adjust as necessary
Overheating of engine	Incorrect type or heat range of spark plug	Replace plug with correct type
	Thermostat defective	Replace
	Incorrect carburetor calibration	Check for lean jetting and rectify
	Wrong level of float valve	Rectify
	Inadequate gear oil level	Check and rectify
	Defects on water pump or water pump drive	Inspect and replace as required
	Incorrect compression, carbon deposits in combustion chamber	Clean


Operating temperature of engine too low	Thermostat defective	Replace
Slipping clutch	Wrong adjustment of release lever or clutch handle	Verify clearance on clutch release lever and clutch handlebar lever, adjust as required
	Clutch springs suffering fatigue	Replace
	Worn fiber plates	Replace
	Shortcomings of clutch installation	Rectify
	Oil level too high	Drain to proper level
	Contaminated oil	Oil change
	Synthetic oil with inadequate friction coefficient	Use oil as specified (80 W Golden Spectro gear oil)
Clutch won't disengage	Wrong adjustment of release lever or clutch handlebar lever	Adjust to proper specifications
	Clutch springs of uneven stress	Replace
	Distortion of fiber or steel plates	Replace
	Clutch drum or clutch hub badly worn	Replace
	Too much axial clearance of clutch shaft	Reset axial clearance / tap bearing towards inside
	Incorrect gear oil	Replace as above
	Broken fiber plate	Replace

**TROUBLE SHOOTING CHARTS**

Operating temperature of engine too low	Thermostat defective	Replace
Slipping clutch	Wrong adjustment of release lever or clutch handle	Verify clearance on clutch release lever and clutch handlebar lever, adjust as required
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**TROUBLE SHOOTING CHARTS**





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