III. Engine : Detailed Maintenance

1. AIR CLEANER

In order for gasoline to burn efficiently, it requires about 15 times its own weight in air. If this air is supplied directly from the dust-filled atmosphere, cylinder, piston and piston rings wear rapidly, carburetor air passages become dirt plugged, and carbon may build up in the combustion chamber and cause various troubles.

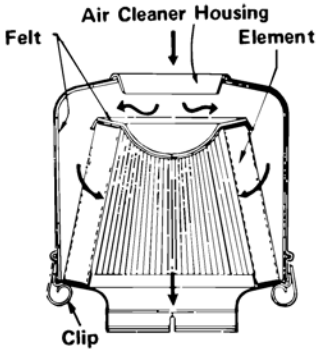
This dusty air must first be filtered by the air cleaner so that only clean air passes through the carburetor to the combustion chamber. If the air cleaner element becomes dirty or stopped up, its filtering efficiency is reduced and the engine air intake is hampered, with a corresponding decrease in combustion efficiency (and thus gas mileage) and output power. Therefore the air cleaner must be inspected and cleaned at regular intervals.

1) Construction

Figure 41 is a cross-sectional view of the H Series air cleaner. Air flow is in the direction of the arrows and is filtered by the element in the center. Some models are equipped with a silencer to reduce noise at the engine intake side.

Air Cleaner

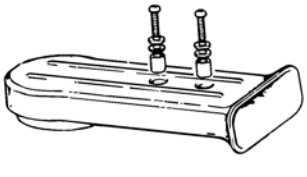
(41)

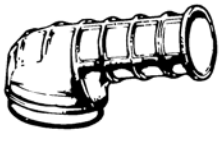


Silencer

(42)

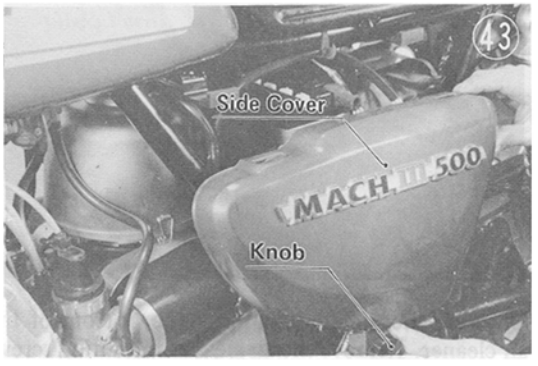
H1 H2





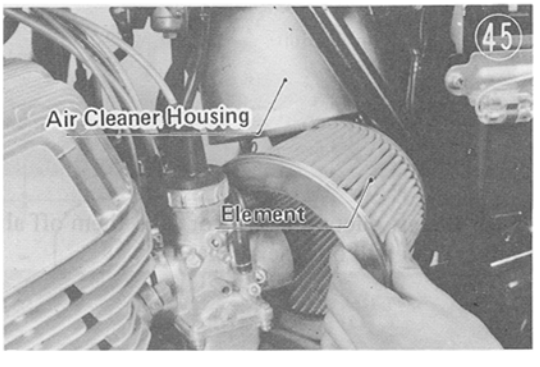
2) Disassembly

a. H1
Remove side cover.



Loosen air duct clamps. Remove air cleaner mounting screw. Remove air ducts.

Undo clips and pull element out through left side of frame.

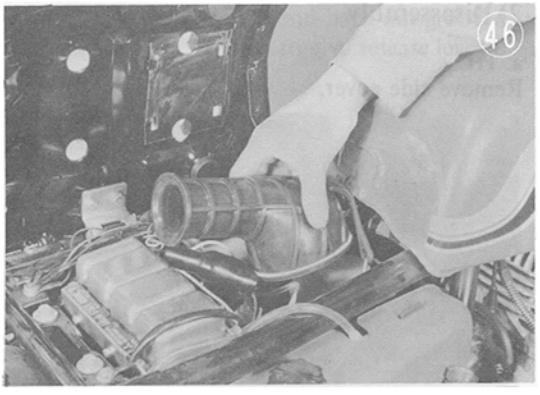


The air cleaner housing of the H1 cannot be removed without first unmounting the left carburetor.

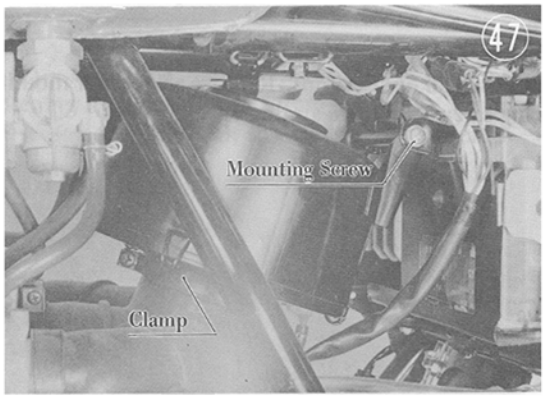
The H2 air cleaner element alone can be removed, but the easiest method is to remove the element and housing together after first taking off the front mounting bracket for the left side cover. This procedure is illustrated on the following page.

b. H2

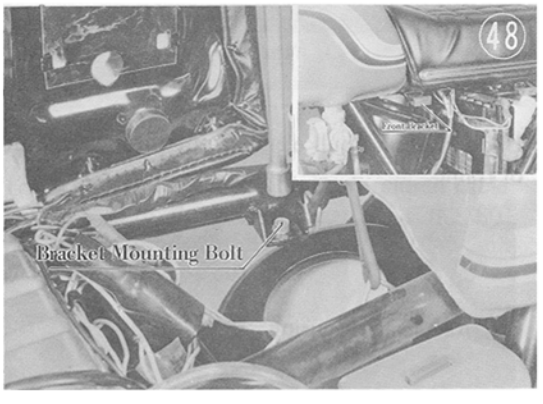
Remove the left side cover. Open the seat and pull off the rubber silencer.



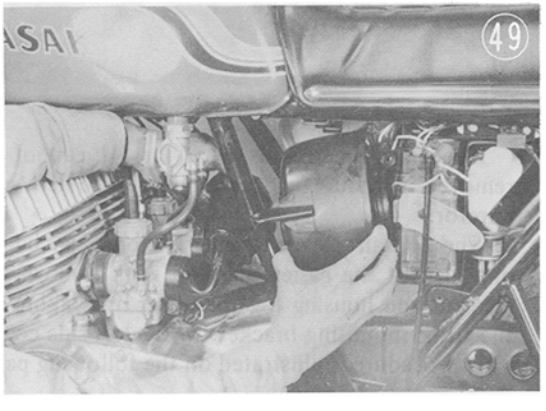
Unscrew the air duct clamp at the bottom of the air cleaner. Remove the air cleaner mounting screw.



Unscrew and take off the front mounting bracket for the left cover.



Push the air ducts forward (or take them off altogether) and pull out the air cleaner.

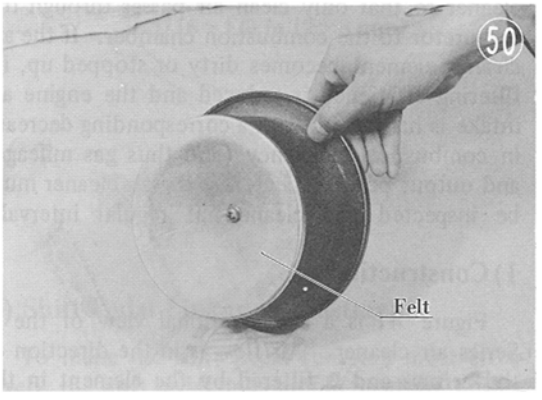


3) Overhaul

About every 2,000 miles, check the air cleaner element and clean it with gasoline. If the element is damaged, replace it.

CAUTION: The air cleaner element is a dry type; oil or gasoline/oil mixture should not be used to clean it.

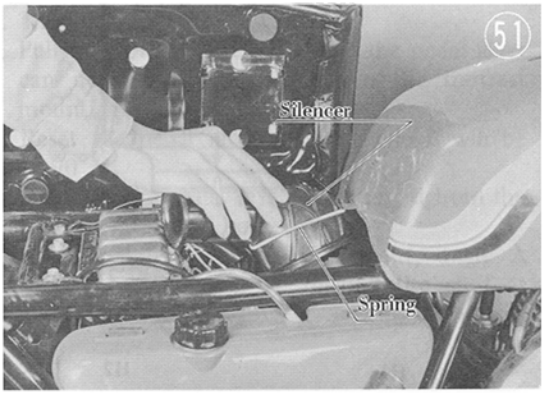
Clean the **felt** portions with gasoline, and wet them with a small amount of oil, keeping oil off the element. If the felt is loose, glue it back on securely.



4) Assembly

Assembly is the reverse of disassembly. After assembly make sure all clamps are tight.

To remount the silencer on the H2 air cleaner, take off the spring and fit the rubber on the air cleaner first. Then slide the spring clamp down into place.



2. CYLINDER · CYLINDER HEAD

The cylinder and cylinder head constitute the combustion chamber, and are exposed to extremely high temperatures while the engine is running. To prevent piston seizure; to prevent heat transformation of the shape or molecular structure of the cylinder, cylinder head, piston,

piston ring, connecting rods, etc.; and to prevent preignition due to overheating, the cylinder and cylinder head are made of an aluminum alloy with good conductivity, and fins are provided on the exterior to further increase cooling efficiency.

If carbon formed by incomplete combustion accumulates heavily on the inner surface of the cylinder head, not only does this hinder heat radiation, but the carbon becomes red hot and causes overheating and preignition.

Compression in the combustion chamber has a direct relationship with engine output power; if the cylinder head is tightened down with less than normal torque, or if the head bolts are not tightened evenly, the head will warp and leaks will develop, with a resultant lowering of compression. Again, cylinder, piston and piston ring wear will cause a decrease in compression and consequently limit engine performace.

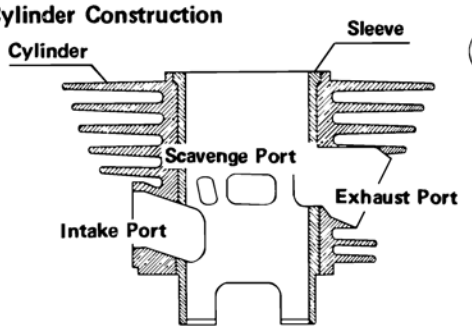
In the case of cylinder wear or piston seizure, restoration is possible with boring and honing.

1) Construction

The cylinder itself is light – made of aluminum alloy with a high cooling coefficient – and its inner surface is made wear resistant by casting into it a surface-hardened cast iron sleeve. The special fusion process by which the sleeve is bonded to the aluminum, averts the formation of any air pockets which might reduce heat conduction and decrease cooling efficiency.

In the inner surface of the cylinder, exhaust, scavenge and intake ports are provided, and these are opened and closed by the sides of the piston as it moves up and down inside the cylinder.

Cylinder Construction (52)



Port Timing (53)

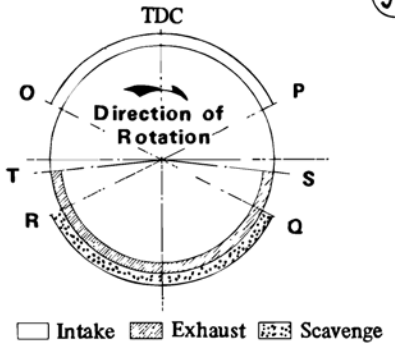


Table 2 Port Timing

Model		H1	H2
Intake	Open O°	76° BTDC	75° BTDC
	Close P°	76° ATDC	75° ATDC
Scavenge	Open Q°	59°30′ BBDC	58° BBDC
	Close R°	59°30′ ABDC	58° ABDC
Exhaust	Open S°	89° BBDC	89° BBDC
	Close T°	89° ABDC	89° ABDC

Port Measurements (54)

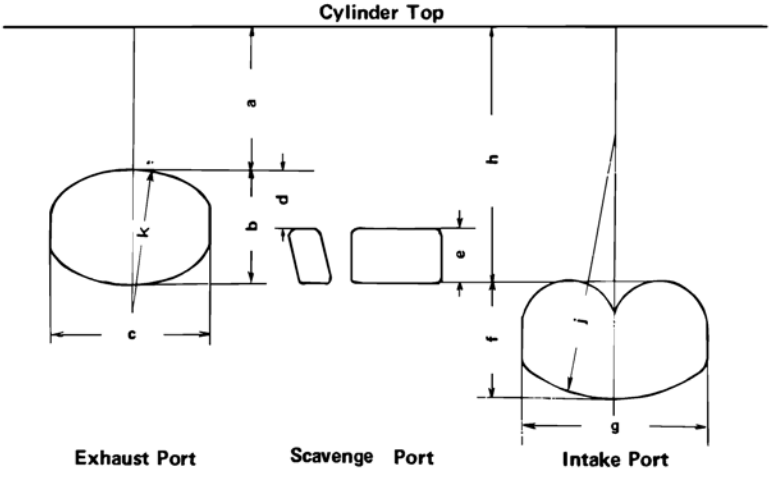


Table 3 Port Measurements [mm (inch)]

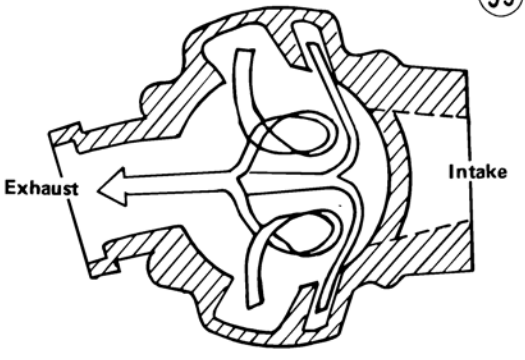
Model	A	B	C	D	E	F	G	H	J	K
H1	35.4 (1.394)	26.8 (1.055)	39.0 (1.535)	13.4 (.528)	12.6 (.496)	27.5 (1.083)	41 (1.614)	65.4 (2.575)	100 (3.937)	60 (2.362)
H2	36.8 (1.449)	29.3 (1.154)	43 (1.693)	14.9 (.587)	14.1 (.555)	29.8 (1.173)	48.5 (1.909)	66.1 (2.602)	100 (3.937)	65 (2.559)

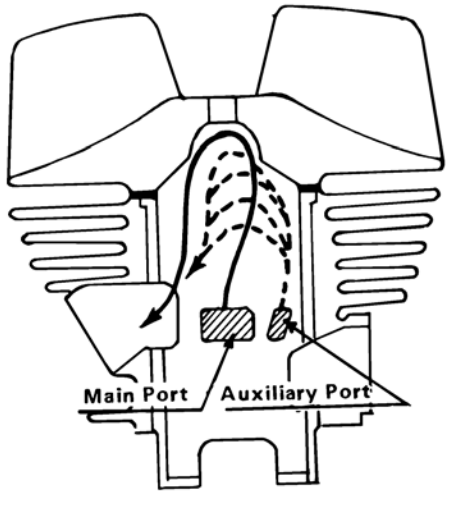
In the H Series, a four-port scavenge method is employed to increase output power.

Scavenging is the process of replacing the gas left over from the last combustion cycle, with new gasoline mixture. With this four-port scavenge method, as shown in the diagram, the two main scavenge ports are supplemented by two auxiliary ports, providing an ideal gas circulation pattern and raising the scavenge efficiency level far above that of the two-port scavenging used in most of the piston valve engines up until now.

Scavenge Gas Flow Pattern (Four port system)

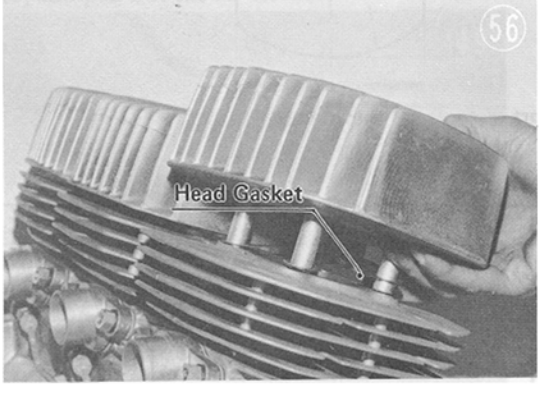
(55)



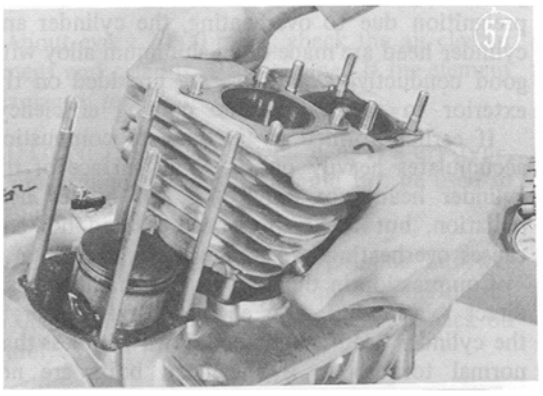


2) Disassembly

Remove head bolts. Remove cylinder heads and head gaskets.



Pull the cylinder off the studs.

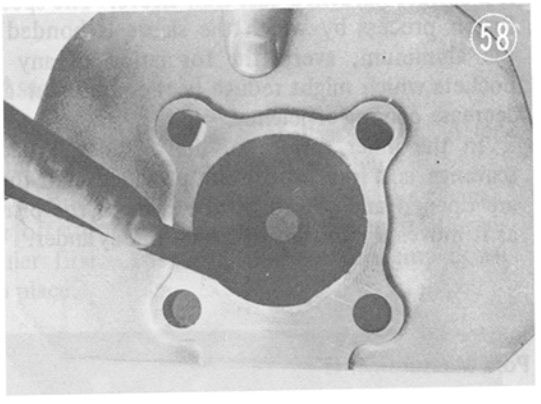


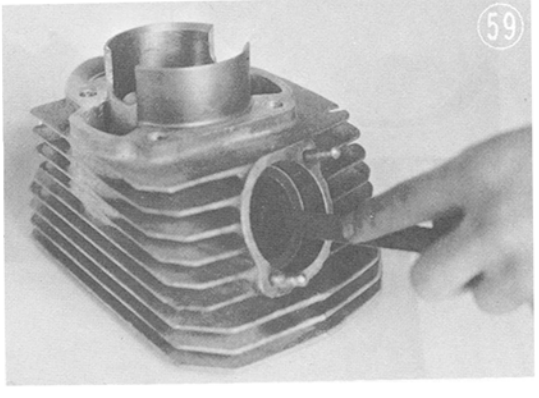
3) Overhaul

a. Carbon Removal

The cylinder head and the cylinder exhaust ports are very easy places for carbon to build up. Check the condition of these parts and carefully scrape off any accumulated carbon.

CAUTION: When removing carbon, take ample care not to scratch the head gasket surfaces or the cylinder walls.





b. Cylinder Damage

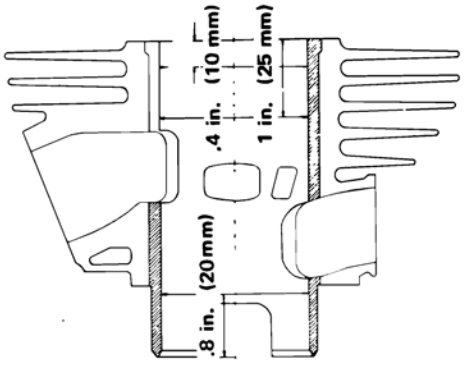
Inspect the cylinder walls for damage due to piston seizure. Correct any minor scratches or damage with fine emery cloth. If the cylinder is badly damaged, if must be bored and honed, or replaced.

c. Cylinder Wear

Pressure from the piston, the piston rings and combustion, causes heavy wear at the points shown to be measured.

Using an inside micrometer or cylinder gauge, take two measurements (front to back, side to side) at each of the three points indicated. If any of the six measurements is out of tolerance, or if any two measurements vary by more than .0020 in. (0.05 mm) bore and hone the cylinder, or replace it.

Cylinder Measurement



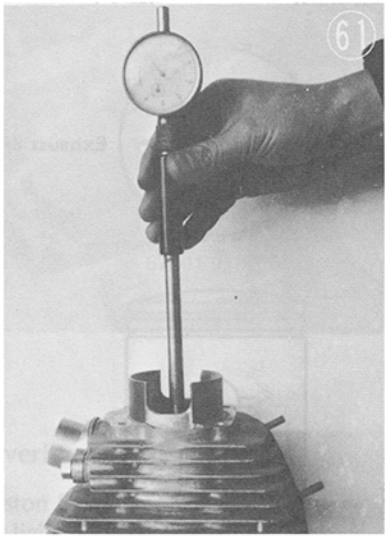


Table 4 Cylinder Diameter

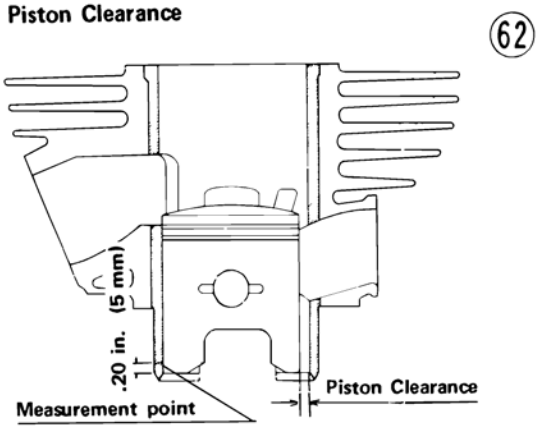
Model	Standard Diameter	Service Limit
H1	$60\ ^{+0.019}_{-0}$ mm	60.15 mm
	$2.3622\ ^{+0.0007}_{-0}$ in	2.3681 in
H2	$71\ ^{+0.019}_{-0}$ mm	71.15 mm
	$2.7953\ ^{+0.0007}_{-0}$ in	2.8012 in

d. Piston/Cylinder Clearance

While the engine is running, the piston is subjected to constant high temperature and expands much more than the cylinder which can radiate a certain amount of its heat. Therefore, the piston and cylinder are made with a certain amount of clearance between them. Piston seizure, slap, lubrication oil consumption, compression, etc., are all closely related to this clearance.

When the cylinder is honed or if the cylinder is replaced, the piston clearance must be measured and the standard value maintained. Measure the cylinder inside diameter and the piston diameter at the points indicated in Fig. 62; the difference between these two measurements is the piston/cylinder clearance. Compare the measured clearance with standard values in Table 5 .

Piston Clearance



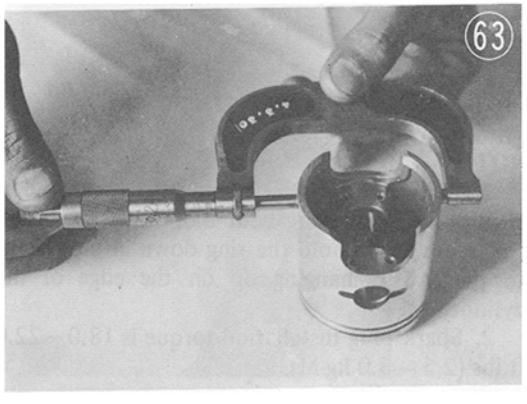


Table 5 Piston Clearance

Model	Standard Clearance
~'73 H1	0.0024~0.0028 in. (0.062~0.070 mm)
~'74 H1	0.0022~0.0026 in. (0.057~0.065 mm)
H2	0.0028~0.0031 in. (0.070~0.078 mm)

e. Compression

Confirm that the head is tightened down with the standard torque, and that there is no compression leadage at the head gasket. Standard torque is 14.5 – 17.5 ft-lbs (2.0 – 2.4 kg-M) for the H1, and 30 ft-lbs (4.2 kg-M) for the H2. Then thoroughly warm up the engine to bring piston clearance to normal, and to be sure of sufficient lubrication oil between the piston and cylinder.

Next remove all spark plugs and insert a compression gauge firmly into one spark plug opening at a time, allowing no compression

leakage. Then kick the engine over hard several times for maximum compression gauge reading. If there is more than 14 lbs/sq in (1.0 kg/cm^2) difference between any two cylinders, or if compression is less than 70% of the specified value, piston, piston rings or cylinder is worn.

Table 6 Compression

Model	Standard	
H1, H2	142 lb/sq in (10 kg/cm2)	engine kicked hard several times

f. Boring · Honing

If the cylinder gets out of tolerance due to wear or to damage from piston seizure, it can be restored to a usable condition by boring and honing. When honing, all cylinder diameter measurements must be within .0004 inch (0.01 mm) of each other. Oversize pistons are available in two sizes: 0.5 and 1.0 mm (.0197 and .0394 in.) oversize.

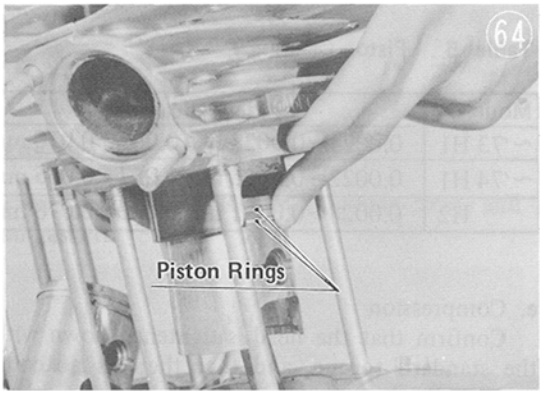
CAUTION: When the cylinder is bored, or when a new cylinder and piston are installed, the engine must be properly broken in, in the same manner as for a new vehicle.

4) Assembly

This is the reverse of disassembly.

NOTE:

1. When inserting the piston into the cylinder, align the ring opening with the knock pin in the ring groove, and hold the ring down in the groove to prevent its hanging up on the edge of the cylinder.
2. Spark plug installation torque is 18.0 – 22.0 ft.lbs (2.5 – 3.0 kg-M).



3. PISTON · PISTON PIN

While the engine is running, the piston is constantly subjected to the high temperature of the burning gasoline, and being a difficult part to cool, becomes extremely hot. Due to differences in temperature, there is a difference in the amount of expansion of the piston top as compared to the skirt portion, and again a difference between front/rear expansion and side to side expansion.

Calculating these expansion differences beforehand, the piston is made elliptical in shape with an inward taper toward the top (Fig. 65.), so that under normal running conditions its shape becomes almost perfectly cylindrical, and thus piston seizure due to piston expansion is averted.

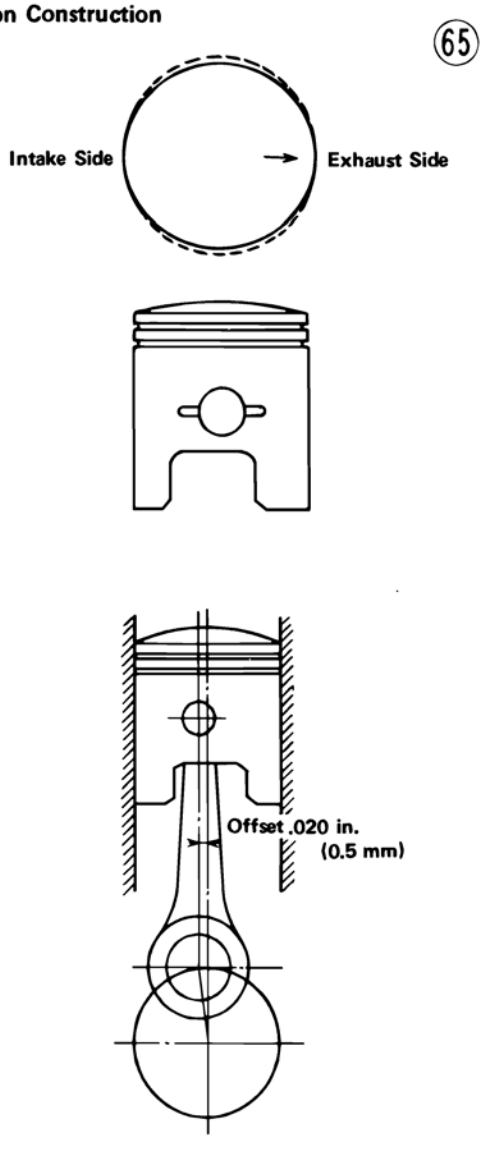
The piston is cast of light-weight, high-strength aluminum/silicon alloy with an extremely low heat expansion coefficient, and high resistance to heat and wear.

The piston pin is made of high-strength chrome molybdenum steel, and its surface is heat-treated for hardening.

The ends of the piston pin support the piston, and the center of the pin holds the small end of the connecting rod. All parts are fitted in a floating type arrangement, the piston pin being held by two circlips to prevent side movement.

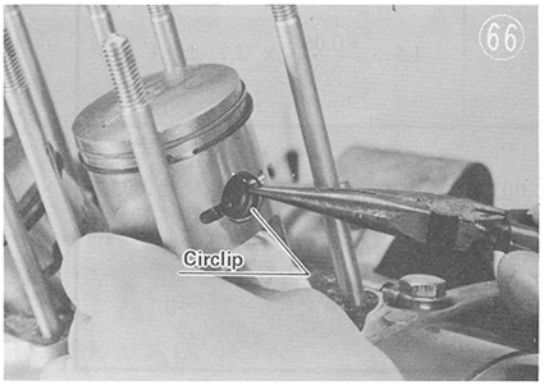
The pin is offset .020 in. (0.5 mm) toward the inlet side of the piston to minimize piston slap that occurs near bottom dead center of the combustion cycle.

Piston Construction

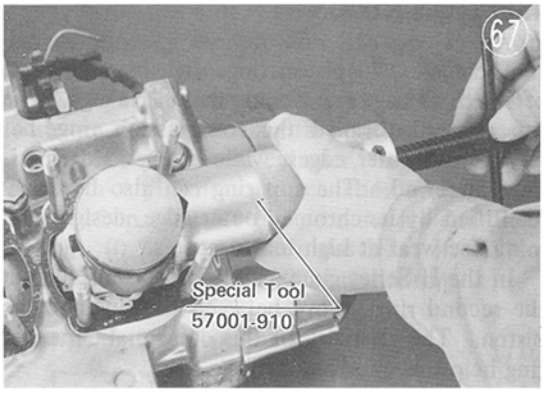


1) Disassembly

Cover the crankcase opening with a rag to keep parts and dirt from falling into it. Pull a circlip off either end of the piston pin.



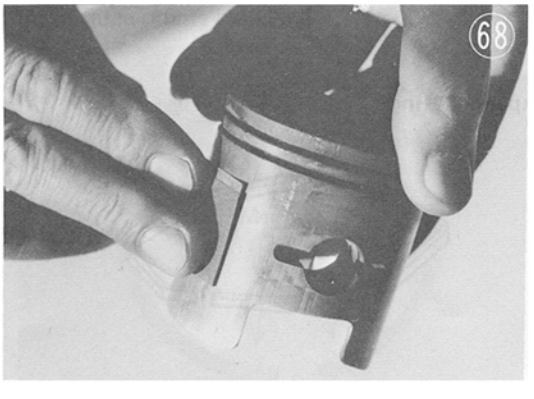
Remove each piston by pushing its piston pin out the side that snap ring was removed. Use the piston pin puller and adapter "A" (special tools) if necessary.



2) Overhaul

a. Piston Seizure Damage

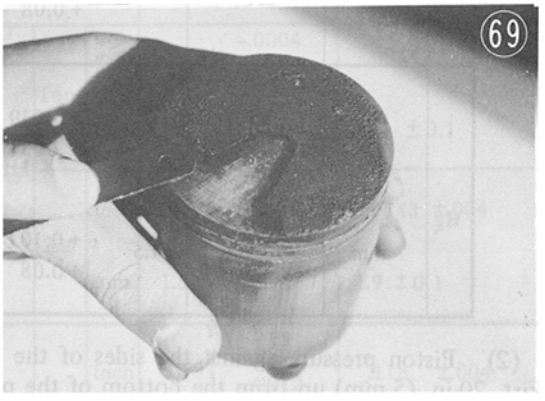
If light damage due to piston seizure or other causes is found, smooth the affected area of the piston with fine emery cloth. In the event of heavy damage, the piston must be replaced. Attempting to repair a badly damaged piston would only invite another piston seizure or cause engine noise.



b. Carbon Removal

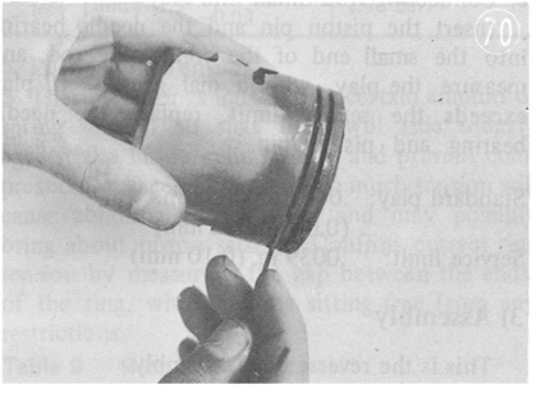
(1) Piston top

Check the top of the piston for carbon, and scrape off any accumulation with a screwdriver or hacksaw blade. This carbon reduces the cooling capacity of the piston, and as the carbon turns red hot, causes the piston to overheat and possibly melt.



(2) Ring groove

Carbon accumulation in the ring groove can cause the ring to stick. Check the groove and remove any carbon with a piece of broken ring or other thin tool.



c. Piston wear

(1) As the diagram shows, the piston ring grooves become worn due to ring movement. Since this leads to compression leakage and a drop in output power, replace the piston if groove measurement indicates excessive wear. Also if either of the ring grooves is worn unevenly, or if the groove has changed in shape, the piston must be .replaced.

Piston Ring Movement

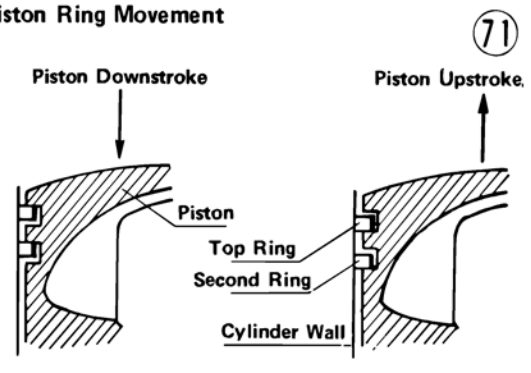


Table 7 Piston Specifications

Model		Skirt Dia.	Top Groove width x depth				Second Groove width x depth			
H1	inch	2.36122	.0591	+.0039 +.0031	x .1063	±.0039	.0591	+.0024 +.0016	x .1063	±.0039
	mm	59.975	1.5	+0.10 +0.08	x 2.7	±0.1	1.5	+0.06 +0.04	x 2.7	±0.1
H2	inch	2.79314	.0591	+.0039 +.0031	x .1272	±.0039	.0591	+.0024 +.0016	x .1272	±.0039
	mm	70.946	1.5	+0.10 +0.08	x 3.23	±0.1	1.5	+0.06 +0.04	x 3.23	±0.1

(2) Piston pressure against the sides of the cylinder causes piston wear. Measure piston diameter at the skirt .20 in. (5 mm) up from the bottom of the piston, at right angles to the piston pin.

d. Piston Clearance

If the piston is replaced, piston clearance of the new piston must be measured. See page 17

e. Connecting Rod Small End Play

Insert the piston pin and the needle bearing into the small end of the connecting rod, and measure the play with a dial gauge. If play exceeds the service limit, replace the needle bearing and piston pin.

Standard play: .00012-.00088 in. (0.003-0.022 mm)
Service limit: .0039 in. (0.10 mm)

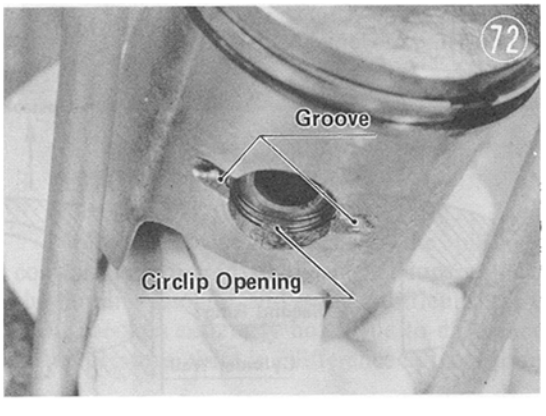
3) Assembly

This is the reverse of disassembly.

CAUTION:

1. Insert the piston so that the arrow stamped on the top points to the exhaust side.

2. Use a new piston pin circlip in place of the one removed during disassembly. Align the circlip so that its opening does not face either groove in the piston.

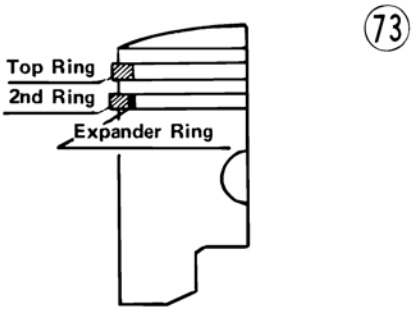


4. PISTON RINGS

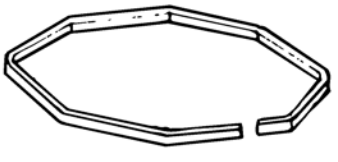
There are two piston rings, the main function of which is to prevent compression leakage. The top ring, also called the compression ring, has chamferred outer edges, while the second ring is un-chamferred. The top ring can also be easily identified by its chromed outer edge, designed to minimize wear at high temperatures.

In the H Series, an expander ring is installed in the second ring groove between the ring and the piston. The elasticity of this octagonal expander ring helps check piston slap.

Ring Position

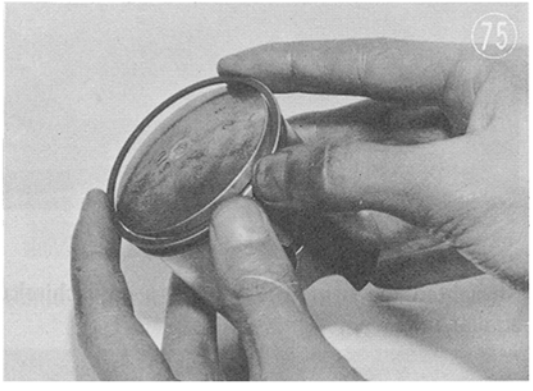


Expander Ring



1) Disassembly

Spread the opening of the piston ring with both thumbs, and push up the opposite side of the ring. To remove the expander ring, spread the opening with a small screwdriver.

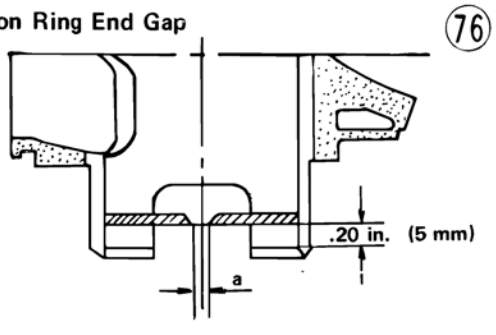


2) Overhaul

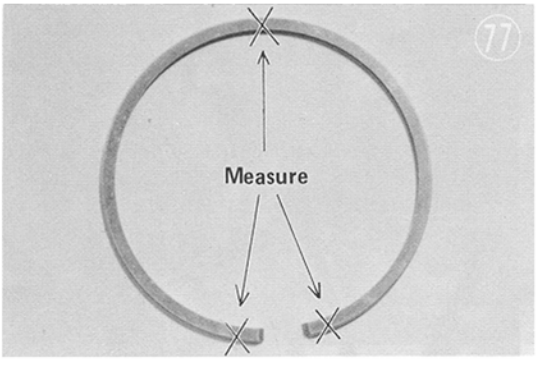
a. Piston Ring Wear

(1) As the ring wears, the end gap grows larger, allowing compression leakage. Following the illustration, insert the ring .20 inch (5 mm) into a cylinder with a standard inside diameter. With the ring in a horizontal position with respect to the bottom of the cylinder, measure the end gap with a thickness gauge. The standard gap is .008-.012 in. (0.2-0.3 mm) for the H1 and .008-.016 in. (0.2-0.4 mm) for the H2. If the gap exceeds .031 in. (0.8 mm) replace the ring.

Piston Ring End Gap



(2) There is a difference in tension between the ends of the ring and the center, and consequently a difference in wear. Therefore, measure "A" and "B" with vernier calipers or a micrometer at the three points indicated.



Ring Measurement

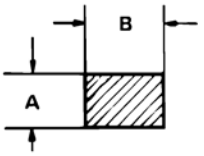


Table 8 Piston Ring Dimensions

Model			A	B
H1	Top	inch	.0591 $^{-.0004}_{-.0012}$	.0984 ±.004
		mm	1.5 $^{-0.01}_{-0.03}$	2.5 ±0.1
	2nd	inch	.0591 $^{-.0004}_{-.0012}$	.0748 ±.004
		mm	1.5 $^{-0.01}_{-0.03}$	1.9 ±0.1
H2	Top	inch	.0591 $^{-.0004}_{-.0012}$	.118 ±.004
		mm	1.5 $^{-0.01}_{-0.03}$	3.0 ±0.1
	2nd	inch	.0591 $^{-.0004}_{-.0012}$	.106 ±.004
		mm	1.5 $^{-0.01}_{-0.03}$	2.7 ±0.1

b. Piston Ring Tension

The piston rings must have a certain amount of spring tension so that they will ride snuggly against the inside cylinder wall and prevent compression leakage. However, too much tension will cause abnormally fast wear, and may possibly bring about piston seizure. Confirm correct ring tension by measuring the gap between the ends of the ring, with the ring sitting free from any restrictions.

Table 9 Ring End Gap (free)

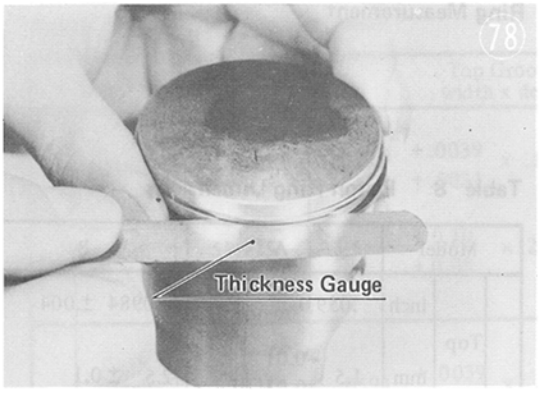
Model		Top	2nd
Hi	inch	about .276	.374
	mm	about 7.0	9.5
H2	inch	about .315	.315
	mm	about 8.0	8.0

c. Piston Ring/Groove Clearance

This clearance is to allow room for piston ring expansion. But too much clearance will allow compression leakage, and too little clearance will cause the ring to stick to the piston and invite piston seizure. Measure clearance "A" at several points around the piston to determine the extent of piston or ring wear.

Table 10 Ring/Groove Clearance

Model	Groove		Standard	Service Limit
H1, H2	Top	inch	.0035 – .0051	.0067
		mm	0.09 – 0.13	0.17
	2nd	inch	.0020 – .0035	.0047
		mm	0.05 – 0.09	0.12



3) Assembly

Assembly is the reverse of disassembly.

NOTE:

1. Be sure the opening in the expander ring is aligned with the knock pin before inserting the second ring.
2. Make certain that the first and second rings are in their correct grooves.

5. ENGINE, LEFT SIDE

On the left side of the engine are located the left cover, the front chain case cover, and inside are the AC generator, engine sprocket and the clutch release mechanism.

The engine sprocket, which transmits motion to the rear wheel via the chain, collects dirt and sand easily and is therefore made of special wear-resistant steel to minimize damage from this dirt.

NOTE: Regarding the AC generator, removal and remounting only are explained here. For generator construction, overhaul and adjustment see page101. Also, for clutch release mechanism removal and overhaul, see the clutch section.

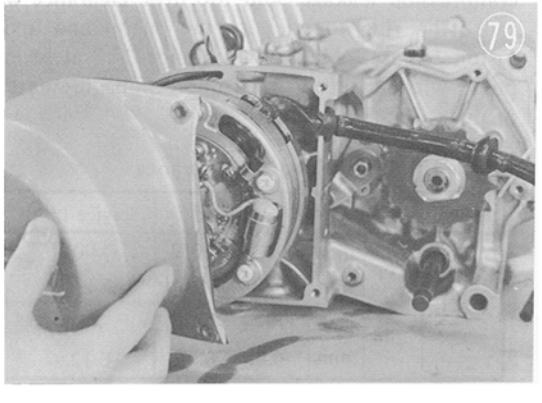
1) Disassembly

Remove front chain case cover and gear shift pedal. (Page 7)

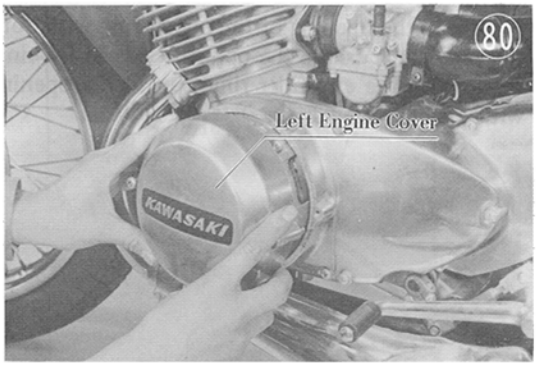
a. Left Cover

Remove the three mounting screws and pull off the left cover.

H1

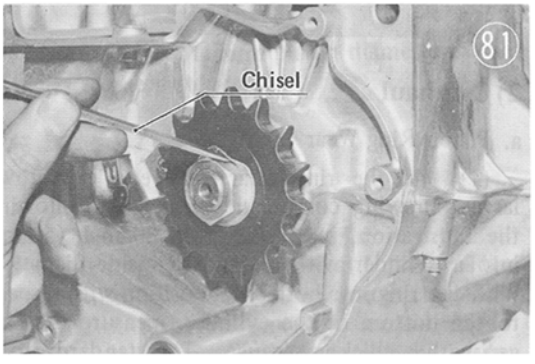


H2 (H2 has only two screws.)

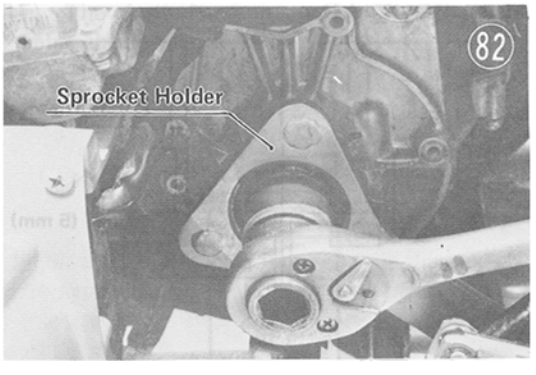


b. Engine Sprocket

Straighten the bent washer with a cold chisel or similar tool.



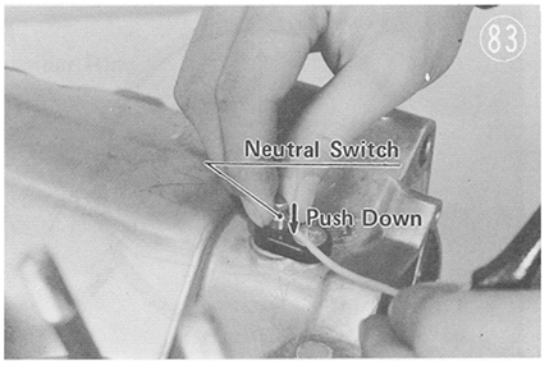
Hold the sprocket with a sprocket holder (special tool) to remove the sprocket nut, and then remove the sprocket.



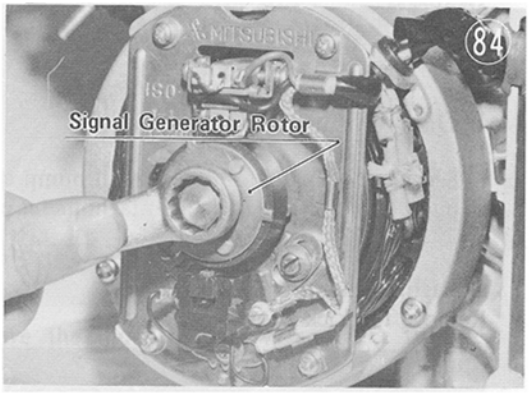
c. AC Generator

Stop the crankshaft from turning and follow these steps:

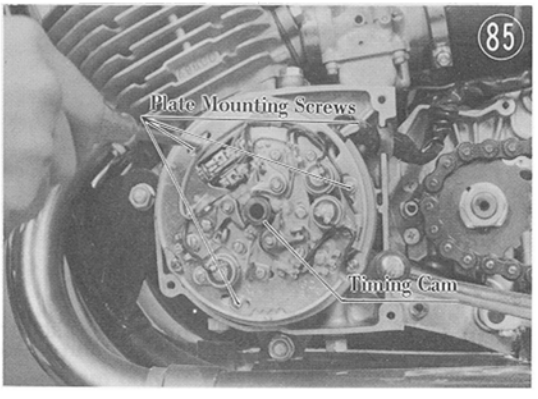
Remove neutral indicator switch wire.



Remove the mounting bolt and pull off the signal generator rotor. **(CDI models)**



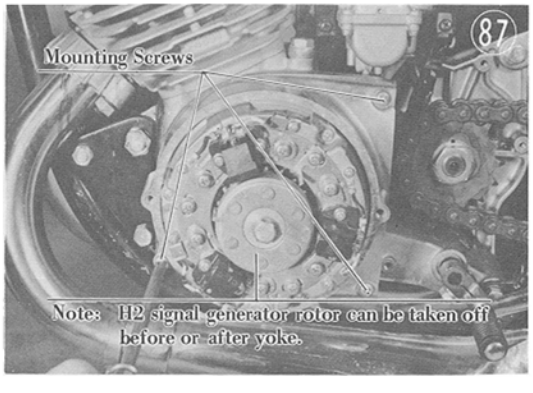
Remove the timing cam bolt and timing plate. **(H1 without CDI)**



Remove the mounting screws and pull off the yoke assembly and cam.

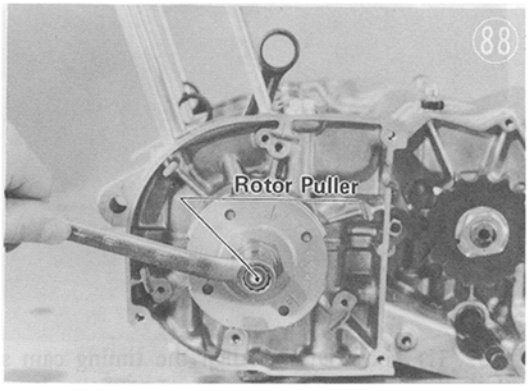
H1 (all models)

H2



With a rotor puller (special tool), remove the rotor.

CAUTION: Do not hit the rotor to pull it off.



Remove the key from the crankshaft.

2) Overhaul

Inspect the sprocket teeth for wear. If the teeth are badly worn, they will not mesh properly with the chain, and the chain will be noisy and soon wear out.

Measure the diameter of the sprocket at the base of the teeth, according to the diagram. If the sprocket is worn out of tolerance, or if it is badly worn on one side of the teeth, replace the sprocket and chain together. (See page 94.)

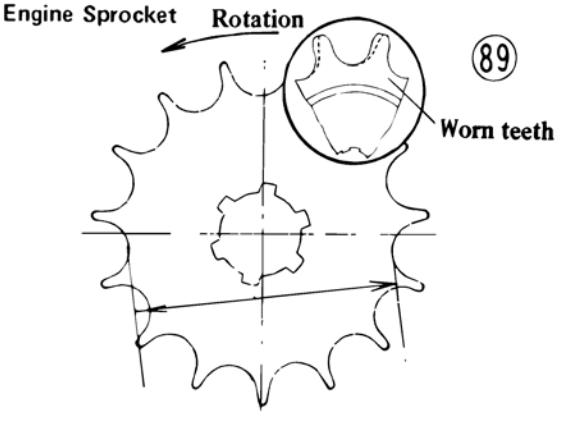


Table 11 Sprocket Diameter [inch (mm)]

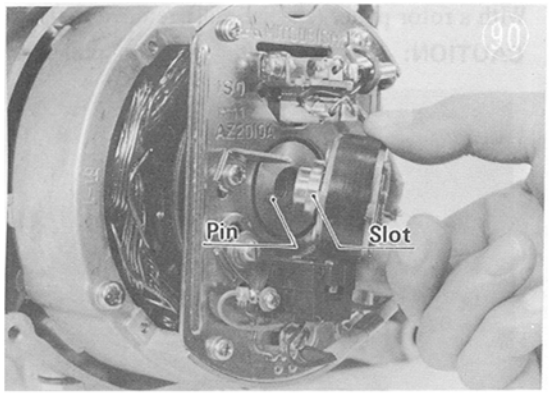
Teeth	Standard	Service Limit
14	2.4087 (61.18)	2.3779 (60.4)
15	2.5898 (65.78)	2.5591 (65.0)
16	2.8035 (71.21)	2.7716 (70.4)

3) Assembly

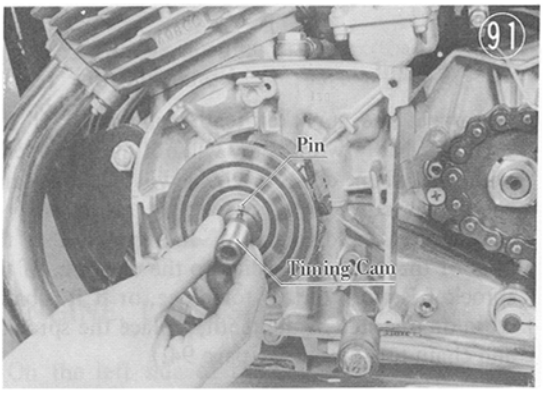
Assembly is the reverse of disassembly.

NOTE:

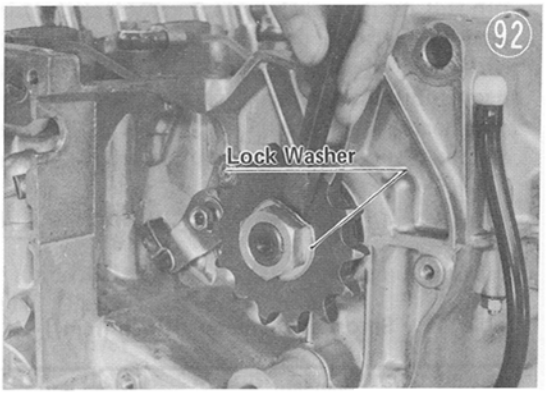
1. CDI models – Before mounting the rotor, first make sure the key slot is aligned with the crankshaft key. Also, align the signal generator rotor slot with the alignment pin on the generator rotor, then tighten down the mounting bolt.



2. H1 (no CDI) – Align the timing cam slot with the pin on the rotor when mounting it.



3. Align the projection on the engine sprocket lock washer with the hole in the sprocket, tighten down the mounting nut, and bend up one side of the lock washer.



6. RIGHT COVER

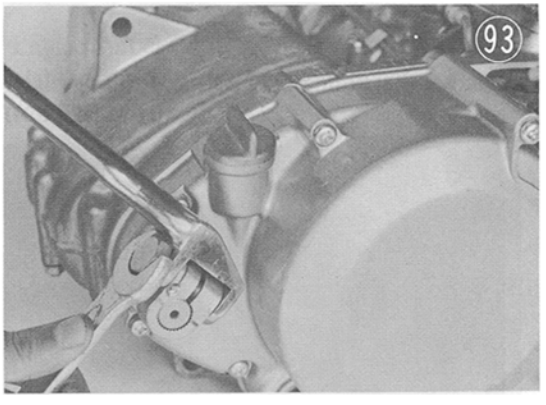
The right cover includes the distributor (H1 with CDI), oil pump, tachometer cable, and the pinions for these parts.

In addition, the right cover, together with the crankcase, forms the clutch housing, and contains the oil for lubrication and cooling of the clutch and the various gears. Consequently, if the packing is bad or if the cover is not tightened down with the correct torque, oil will leak out from between the right cover and the crankcase. So assemble this portion very carefully, and after assembly, check that there is sufficient oil in the crankcase.

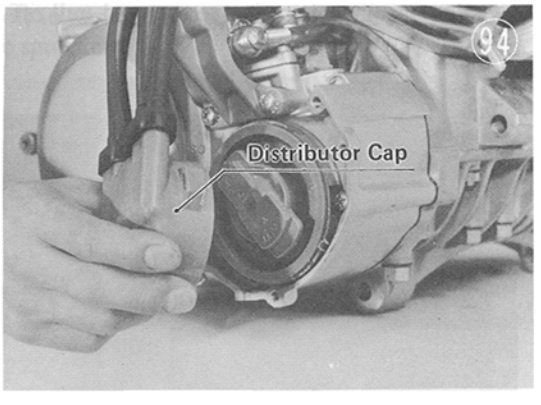
1) Disassembly

See page 7 for removal of the oil pump cover, oil pump cable, oil inlet pipe, and tachometer cable.

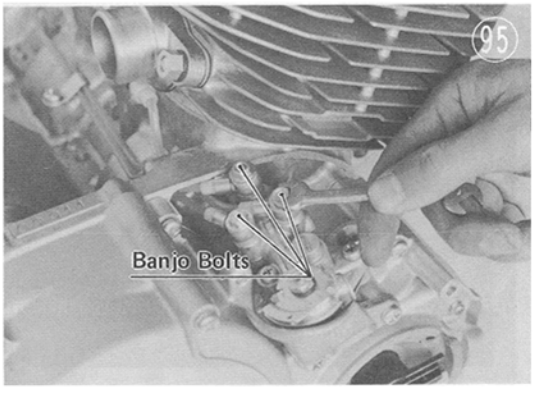
a. Right Engine Cover
Remove the kick pedal.



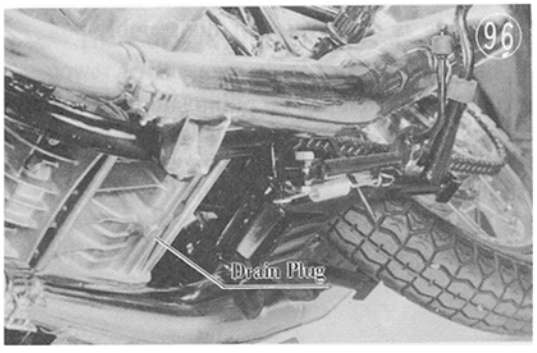
Remove the distributor cap mounting clamp, and the distributor cap. **(H1 CDI only)**



Remove the oil pump banjo bolts and take off the three outlet oil pipes.

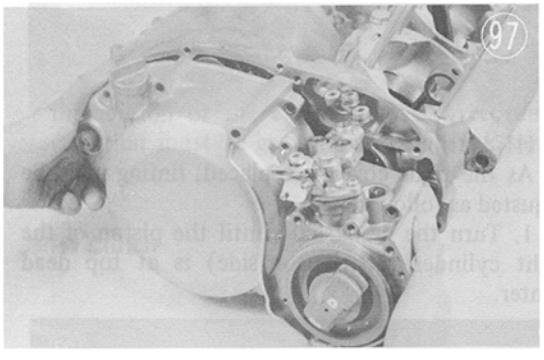


Drain the transmission oil.



Remove the mounting screws and take off the right cover.

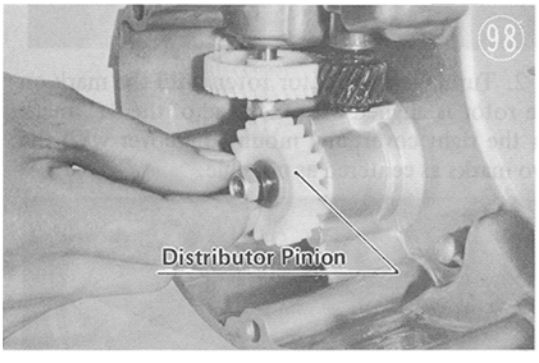
H1 (CDI)



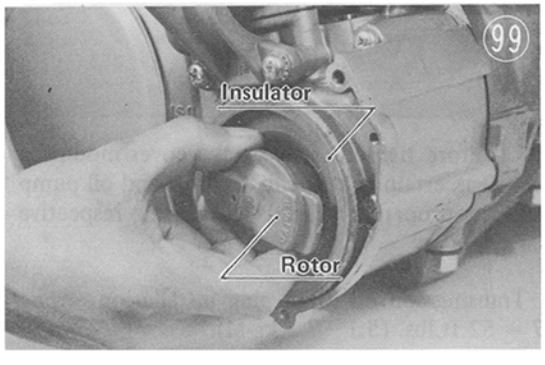
CAUTION: If the kick shaft or gear change shaft oil seal is removed, it must be replaced. Remove them only if they appear to be damaged.

b. Distributor **(H1 CDI)**

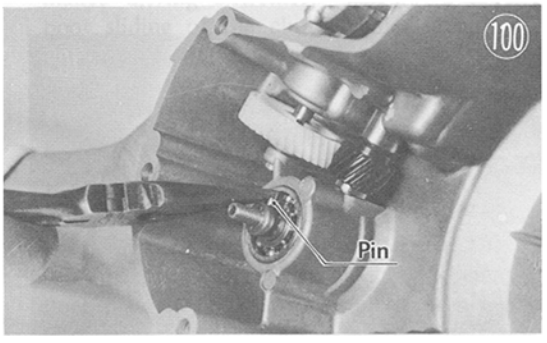
Hold the rotor to stop the distributor shaft from turning, remove the pinion gear mounting nut and take the gear off the shaft.



Pull the distributor rotor off the distributor shaft. Then remove the distributor insulator from the right cover.



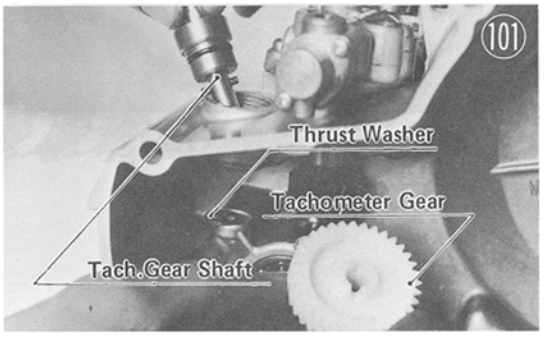
Remove the pin from the distributor shaft. With a mallet, lightly strike the distributor shaft on the inside end to remove it.



CAUTION: Do not remove the oil seal unless it is damaged.

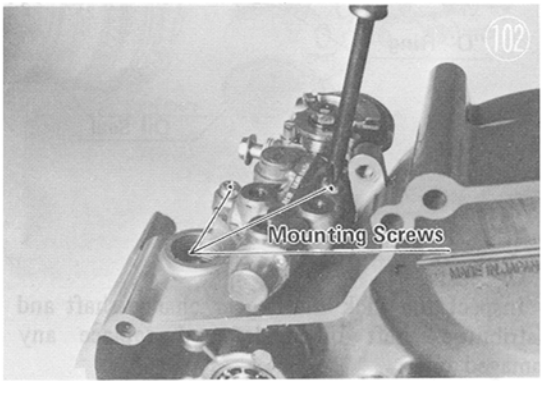
c. Tachometer Gear

Take the shaft and the guide bushing from the cable opening, and the gear and thrust washer can be removed.

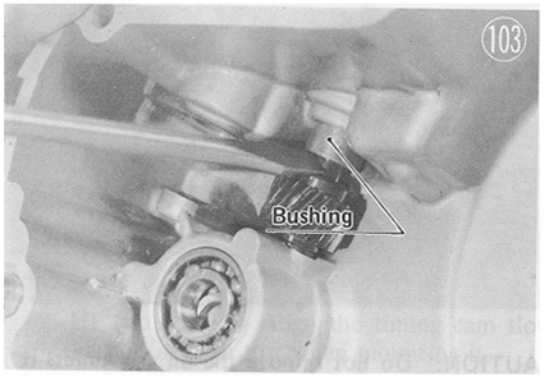


d. Oil Pump

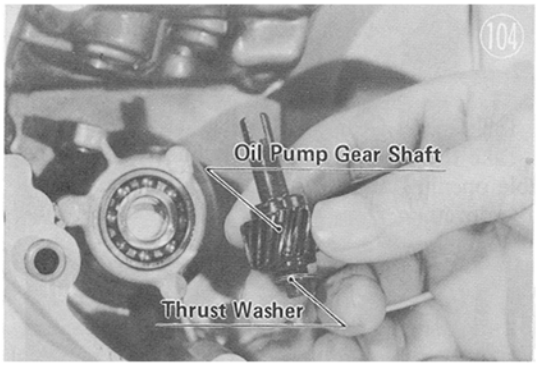
Remove the mounting screws and take off the oil pump.



Push the end of the guide bushing with a screwdriver to remove it from the oil pump mounting opening.



Remove the gear shaft and thrust washer.

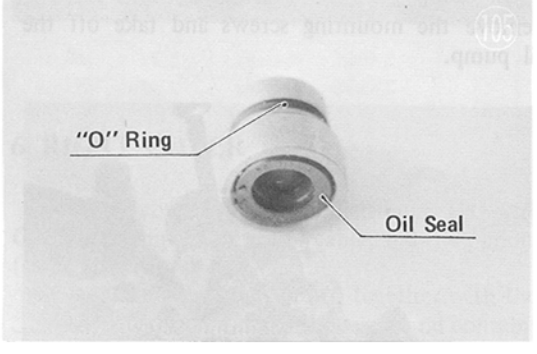


2) Overhaul

a. Distributor
See page 108.

b. Bushings

An "O" ring and an oil seal are fitted on the oil pump and tachometer bushings. Inspect the O ring and the lips of the oil seals, and replace any damaged parts to prevent oil leakage.



c. Oil Seals

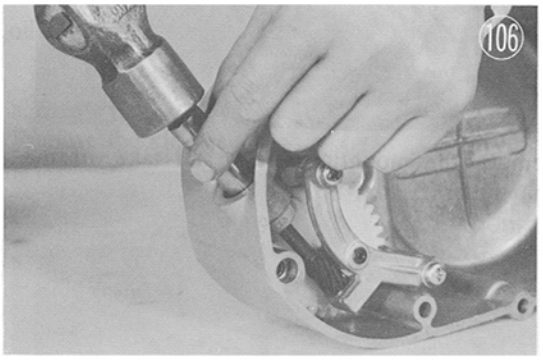
Inspect the kick shaft, gear change shaft and distributor shaft oil seals, and replace any damaged ones.

3) Assembly

Assembly is the reverse of disassembly.

a. Bushings

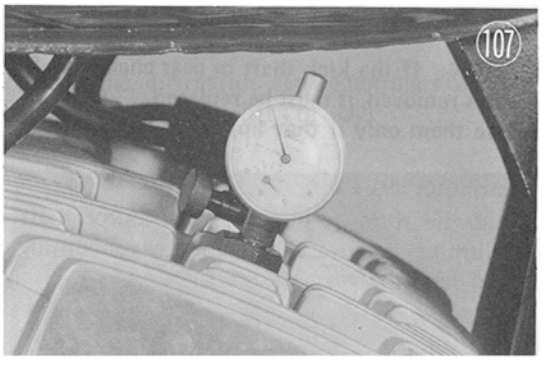
When pressing on the oil pump and tachometer bushings, be careful not to damage the lip part. Press them on as far as they will go, following the illustration.



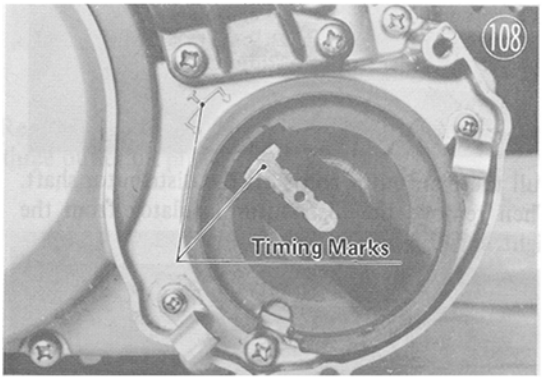
b. H1 distributor timing

As the right cover is replaced, timing must be adjusted as follows:

1. Turn the crankshaft until the piston of the right cylinder (distributor side) is at top dead center.



2. Turn the distributor rotor until the mark on the rotor is aligned with the head of the "T" mark on the right cover, and mount the cover with the two marks as centered as possible.



3. Before tightening down the cover mounting screws, ascertain that the distributor and oil pump gear are properly meshed with thier respective gears.

c. Transmission oil drain plug installation torque 37 – 52 ft.lbs. (5.1 – 7.2 kg-M).

7. CLUTCH · CLUTCH RELEASE

The clutch enables the transmission of engine power to the rear wheel to be interrupted at any time for smooth starting, stopping and gear shifting If the clutch does not disengage well, gear shifting becomes difficult and the transmission will incur damage. On the other hand, if the clutch slips, power transmission efficiency is reduced and the engine and clutch may overheat.

Depending on the crankcase oil viscosity, oil level, and oil lubricating capacity (which decreases with long use), a wet-type clutch may not disengage properly or may slip. Therefore, the crankcase should be filled with the correct quantity of the specified oil, and the oil should be changed at regular intervals.

The clutch engages and disengages engine power transmission by friction between the clutch plates and friction discs, which are forced together by the tension of the clutch springs. Accordingly, attention must be given to possible weak springs, uneven tension among the various springs, and friction disc wear.

In the case of sudden clutch engagement, which makes driving extremely dangerous, check for poor sliding of the clutch cable, seizure of the clutch push rod with the drive shaft etc.

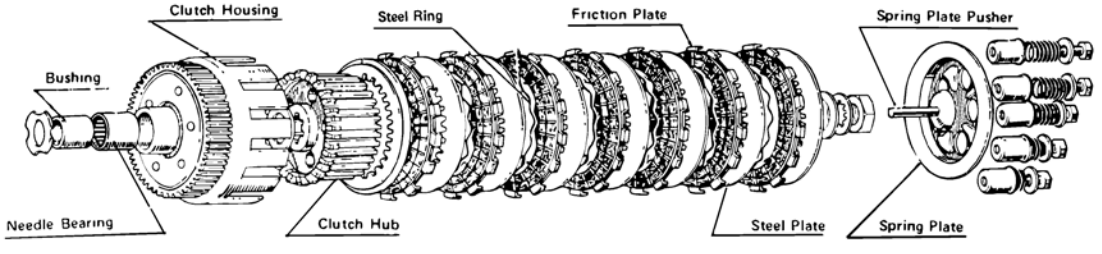
1) Construction

a. Clutch

Figures 109 and 110 are breakdown diagrams of the H1 and H2 clutches. The clutch is a wet-type, multiple-plate with 7 friction plates and 8 steel plates. To increase clutch disengagement effectiveness, steel rings are installed between the steel and friction plates. The clutch housing is fixed to the reduction spur gear with rubber-cushioned rivets. The H2 clutch has a steel band which is located beneath the first friction plate around the outside of the clutch housing. Its purpose is to prevent the housing "fingers" from spreading.

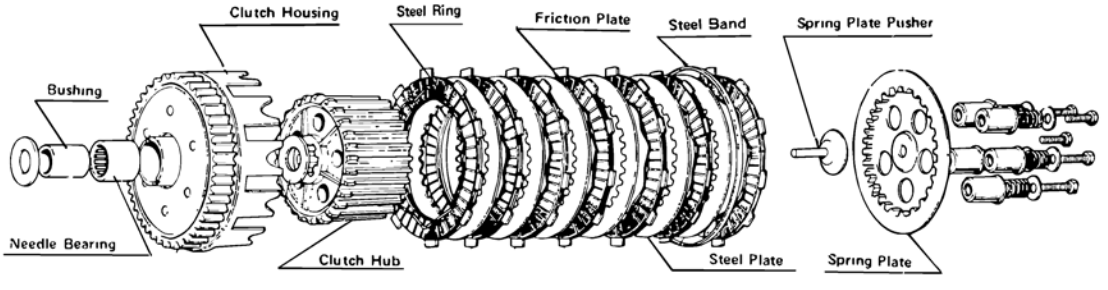
(109)

H1 Clutch



(110)

H2 Clutch



b. Clutch Release

Fig. 111 is a breakdown diagram of the H1 clutch release mechanism. The toothed portions of the inner and outer clutch release gears are made of nylon. The inside of the inner release gear is partially threaded and an adjusting screw is screwed into it. The end of the screw transfers motion to push rod A, which is inserted into the opposite end of the inner release gear, and extends into the drive shaft. This rod in turn moves push rod B and the clutch spring plate pusher, also inside the drive shaft.

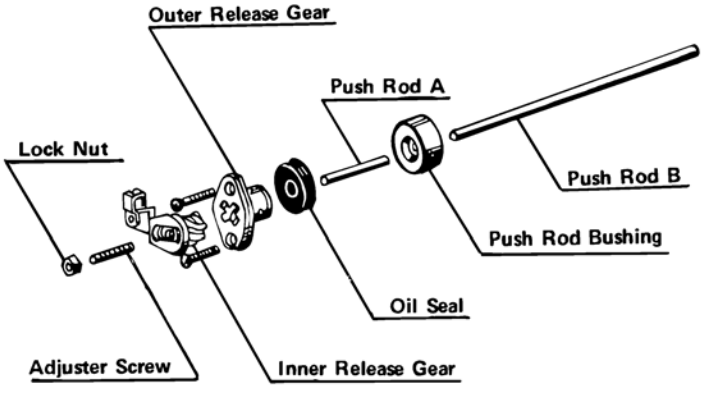
2) Operation

The transfer of motion from the crankshaft to the transmission is interrupted by the action of the friction plates and clutch steel plates. When the clutch is engaged, the spring plate, by clutch spring tension received via the spring guides, forces the friction and clutch plates together. And by friction between the two sets of plates, the rotation of the clutch housing is transmitted to the clutch hub. Thus, the drive train is as follows: crankshaft → primary gear → clutch housing → friction plates → steel plates → clutch hub → transmission drive shaft.

Going back to the clutch lever, the inner release gear is turned via the clutch cable and release lever, and push rod A, push rod B, clutch spring plate pusher and spring plate are pushed against the spring tension. Because of this, tension holding clutch and friction plates together is relaxed, friction is reduced so the plates turn freely of each other, and consequently power transmission between the clutch housing and the clutch hub is interrupted.

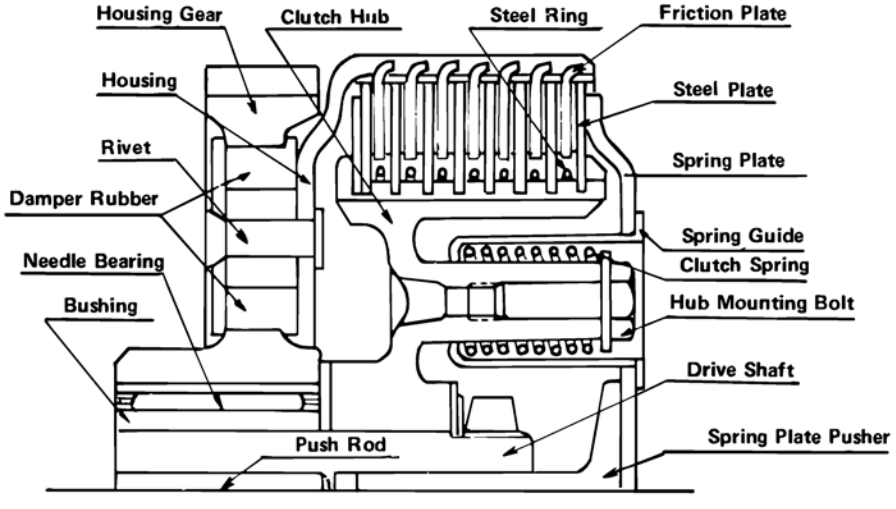
H1 Clutch Release

(111)



Clutch

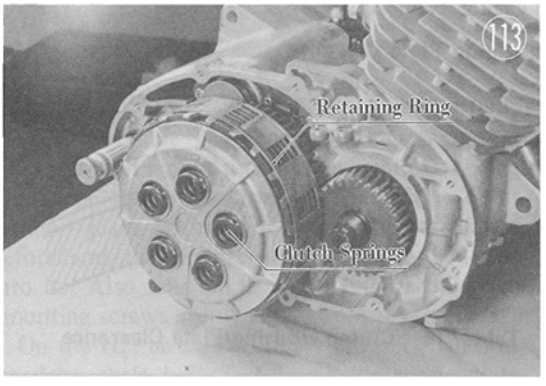
(112)



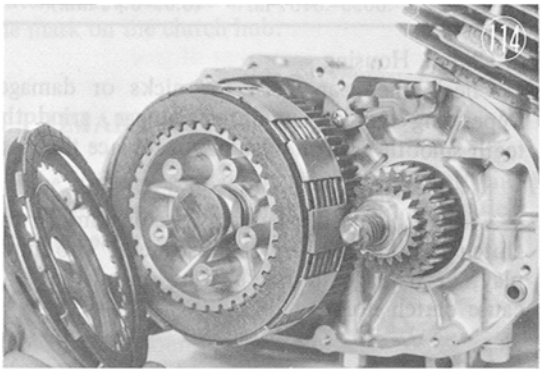
3) Disassembly

a. Clutch

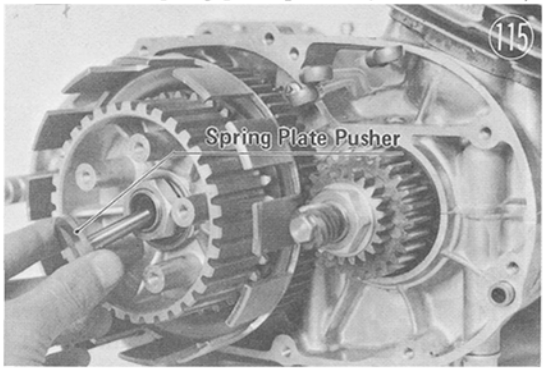
Take out the 5 mounting bolts, and remove the clutch springs (and H2 retaining ring).



Remove the spring guides, spring plate, steel plates, friction plates and steel rings.

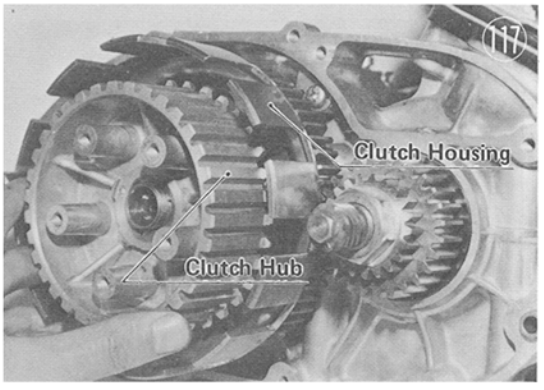


Take out the spring plate pusher (and ball – H2).



Using a clutch hub mounting tool (special tool), hold the clutch hub and housing and remove the mounting nut.

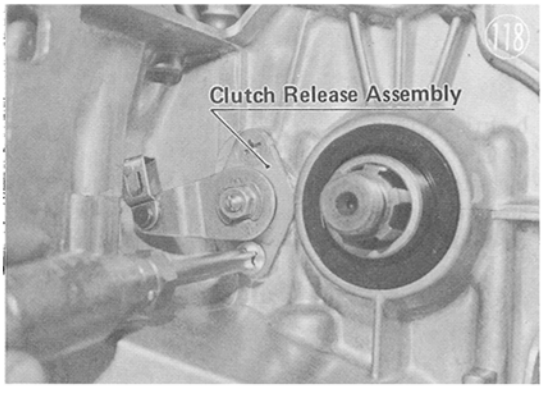
Take off the lock washer and flat washer. Remove the clutch hub, thrust washer and clutch housing from the drive shaft in that order.



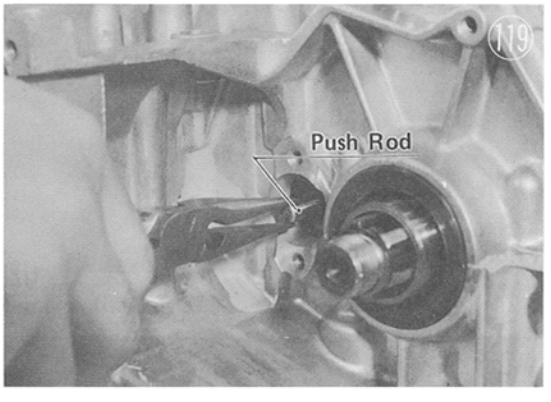
Last, pull off the bushing and the other thrust washer.

b. Clutch Release

Take out the mounting screws and remove the clutch release assembly from the crankcase.



Remove A and B push rods.



NOTE: Removal of the oil seal or push rod bushing necessitates disassembly of the crankcase.

4) Overhaul

a. Clutch Springs

If the free length of the clutch springs becomes shorter, spring tension is reduced and the clutch

may slip. Furthermore, if the lengths of the springs differ, the clutch will be difficult to disengage. Measure the free length of each spring and replace any one not in tolerance.

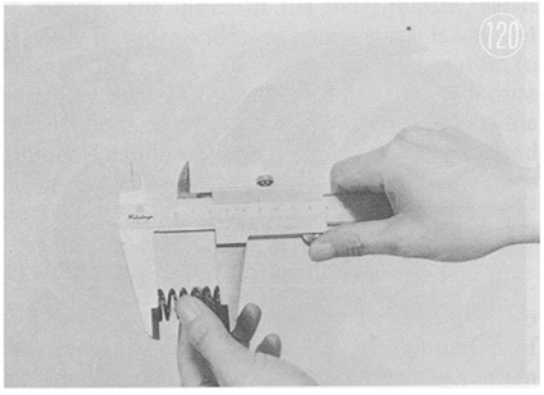
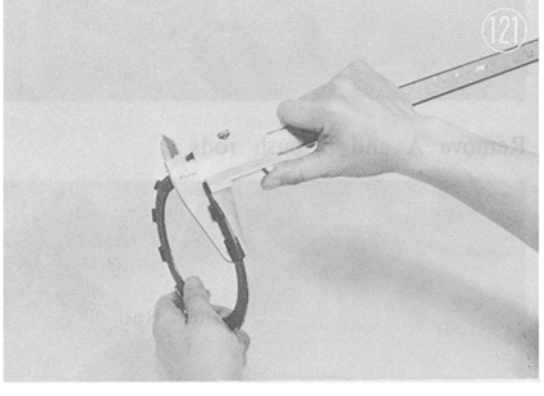


Table 12 Spring Length

Model	Standard	Service Limit
H1	1.417 in. (36.0 mm)	1.339 in. (34.0 mm)
H2	1.26 in. (32 mm)	1.18 in. (30 mm)

b. Friction Plates

Check the cork portion for wear or damage. Measure the thickness of the plates and replace any worn out of tolerance, or where uneven wear or damage is evident.



Friction Plate Thickness

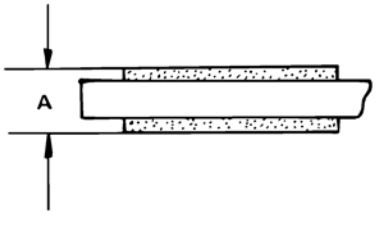


Table 13 Friction Plate Thickness

Model	Standard	Service Limit
H1, H2	.110 $^{+}_{-}$ .004 in. (2.8 $^{+}_{-}$ 0.1 mm)	.098 in (2.5 mm)

c. Clutch Housing and Friction Plates

Check gap B between the projections on the friction plates and the clutch housing. Too wide a clearance will cause clutch noise, and too narrow a clearance will prevent the clutch from disengaging properly.

Friction Plate Clearance

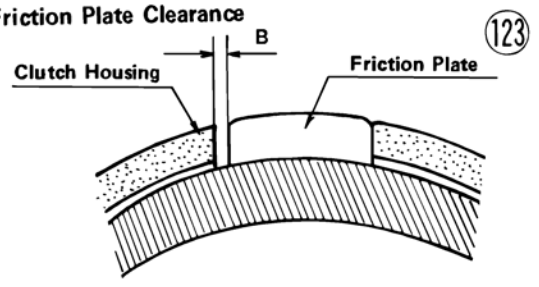


Table 14 Clutch Housing/Plate Clearance

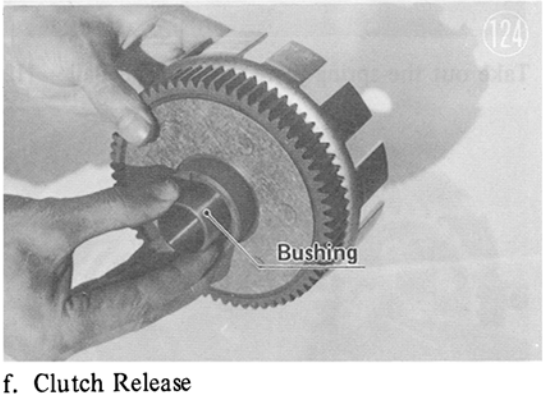
Model	Standard
H1	.0039 – .0157 in. (0.10 – 0.40 mm)
H2	.0035–.0157 in. (0.09–0.40 mm)

d. Clutch Housing

Check the gear teeth for nicks or damage. Depending on the extent of damage, grind the teeth smooth with an oilstone, or replace the gear.

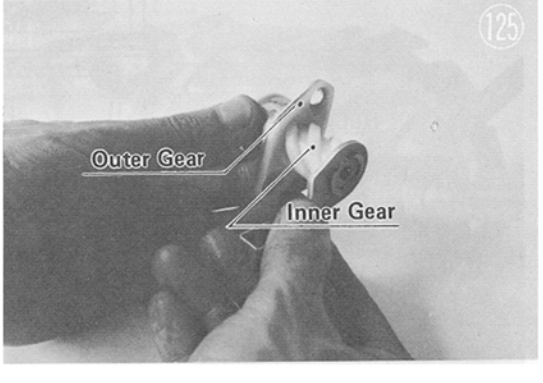
c. Needle Bearing

Check the needle bearing and bushing in the clutch housing for play as illustrated. Too much play, or damage to the bearing or bushing will cause clutch noise.



f. Clutch Release

(1) Put the inner and outer clutch release gears together and move them back and forth to check for play. Too much play, or cracks or other damage will prevent smooth operation of the clutch. If this is the case, replace the two gears as a set.



(2) Check push rods A and B, and depending on the extent of any damage, correct it or replace the rods. Check the adjustment screw for wear; when there is no more room for adjustment, the clutch will fail to disengage.

5) Assembly

This is the reverse of disassembly.

NOTE: Assemble the inner and outer release gears and then mount them in the crankcase, being careful of the release lever angle. If the outer release gear is mounted in the crankcase beforehand, the inner release gear cannot be fitted into it. Also take ample care to tighten the two mounting screws evenly.

On the H2, be sure to insert the steel ball into the drive shaft before replacing the spring plate pusher.

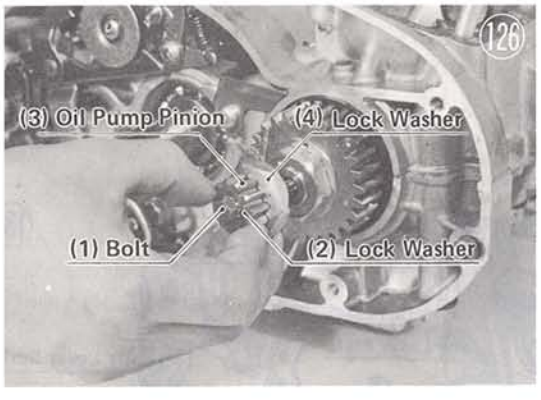
When mounting the H2 spring plate into the clutch hub, point the arrow on the spring plate to the mark on the clutch hub.

8. PRIMARY GEAR

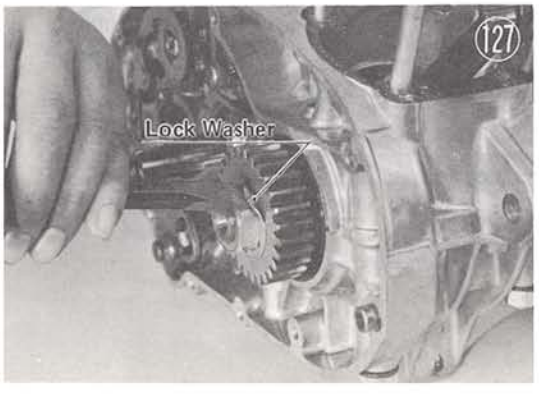
The primary gear is mounted on the left and of the crankshaft, and together with the clutch housing gear, performs the primary reduction.

1) Disassembly

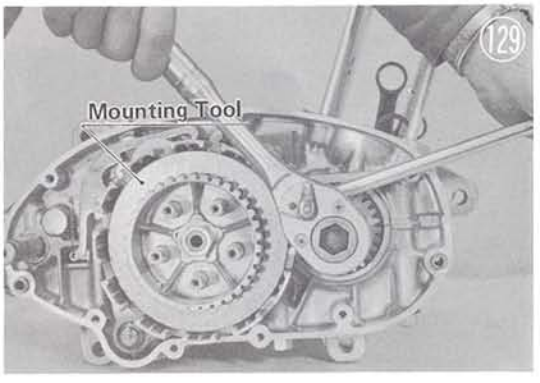
Remove the mounting bolt and lock washer, and take off the oil pump pinion and lock washer.



Straighten out the lock washer.

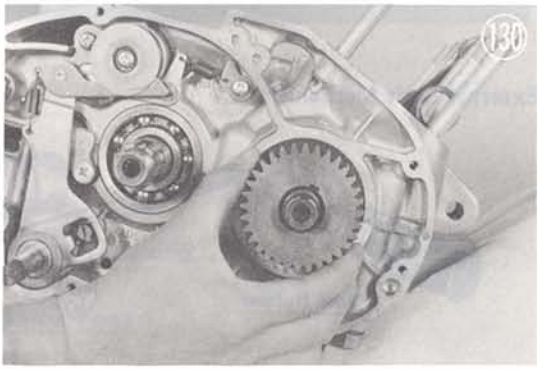


Temporarily mount the clutch housing and clutch hub, and holding the crankshaft stationary with a clutch hub mounting tool (special tool), remove the nut.

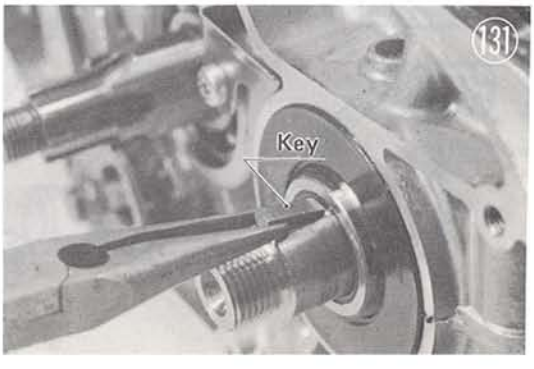


Remove the lock washer, distributor pinion and primary gear. **(H1)**

Remove the lock washer and primary gear. **(H2)**

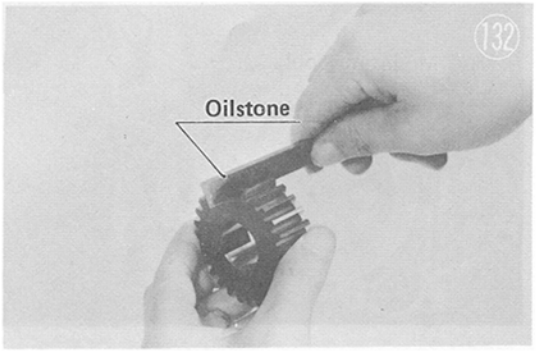


Remove the key.



2) Overhaul

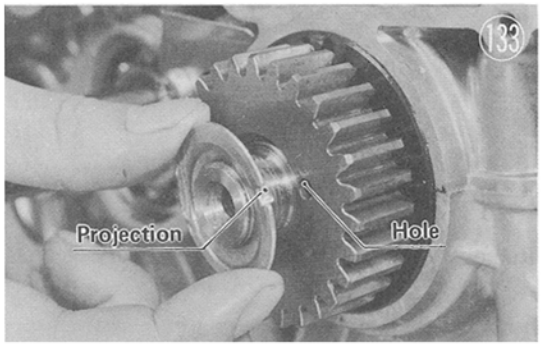
Inspect the gear tooth surfaces for damage. To prevent gear noise, correct any minor faults with an oilstone. If the gear is badly damaged, replace it.



3) Assembly

Assembly is the reverse of disassembly.

NOTE: Align the primary gear with the key slot before mounting it on the crankshaft. Align the projection on the lock washer with the hole in the gear, and after tightening the mounting nut, bend up one side of the washer.



9. EXTERNAL GEAR SHIFT MECHANISM

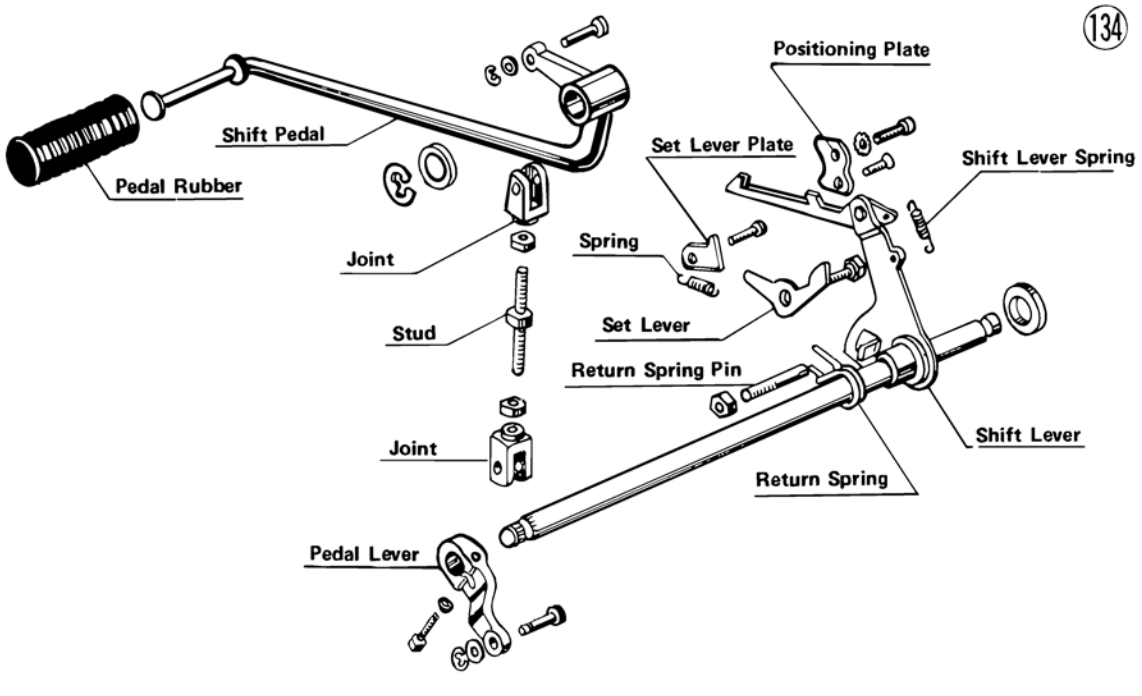
The external shift mechanism turns the shift drum to change gears.

When the shift pedal is operated, the shift drum is turned by the shift lever pushing on the drum pins. The shift drum pins inserted in the drum are spaced at equal intervals so that the pins (and thus the drum) are moved an equal amount for each operation. To keep the drum from overturning, the return spring pin protrudes through a window in the shift lever, and when the drum has rotated sufficiently, one or the other side of the window strikes the pin and the lever is stopped from further movement. If the drum is not turned the correct interval each time, overshift or misshifting may result, the transmission gears will be damaged, and the engine may overrun and incur general overall damage.

After gears are shifted, the set lever, held against the pins by spring tension, holds the drum in position. If this lever is not set correctly, the transmission may jump out of gear.

In addition, to prevent lateral movement of the drum due to thrust, a positioning plate is fitted into the shift drum and fixed to the case.

External Shift Mechanism



1) Operation

By stepping down or kicking up the shift pedal, the shift lever turns the shift shaft, and the shift lever pawl transmits this motion to the shift drum. As the shift drum turns, the selector forks follow the grooves in the drum, and their lateral movement shifts the gears at their opposite ends to new positions.

When the shift pedal is released, the shift pedal and shift lever assembly are returned to their original positions by the force of the return spring.

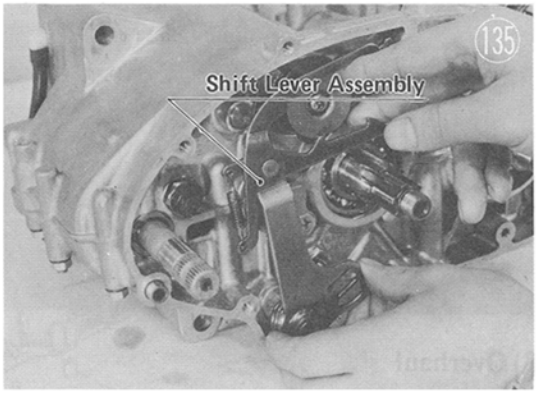
The H Series motorcycles have a "return" type shift with neutral at the lowest position (~ '75 model).

Only on '76 KH500 model, the transmission neutral position is located halfway between 1st and 2nd gears, and shifting into neutral is done by moving the shift pedal a half-stroke from either 1st or 2nd gear.

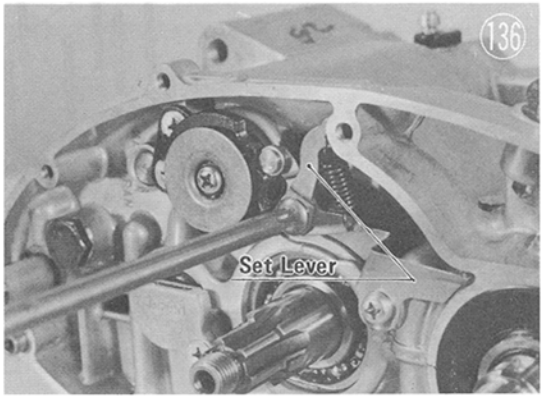
H Series (~'75 model)	KH500
5th	5th
↑↓	↑↓
4th	4th
↑↓	↑↓
3rd	3rd
↑↓	↑↓
2nd	2nd
↑↓	↑↓
1st	Neutral
↑↓	↑↓
Neutral	1st

2) Disassembly

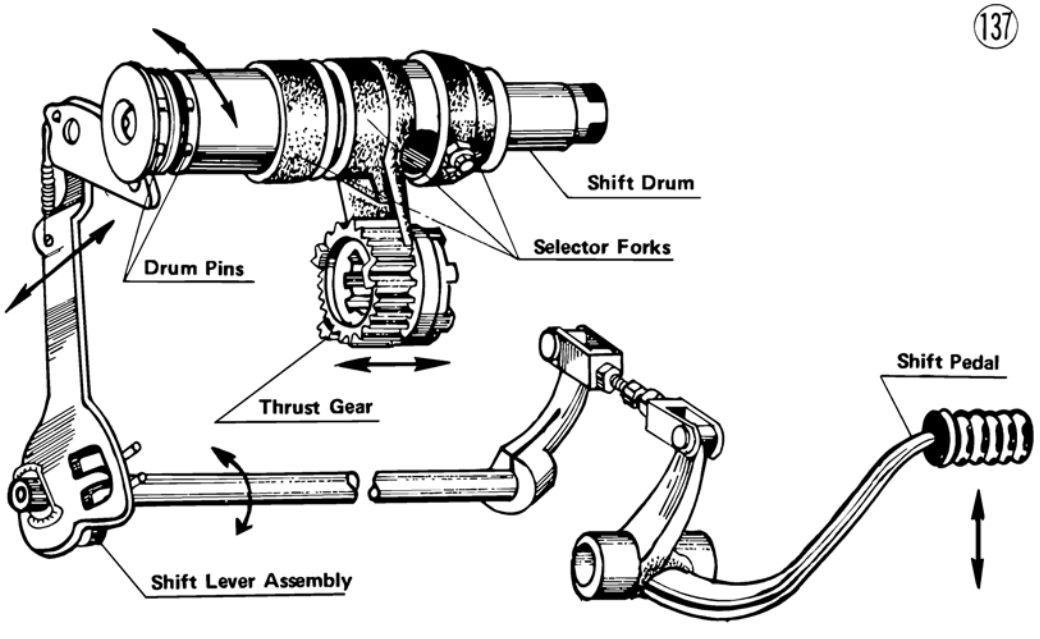
Disengage the shift lever pawl from the shift drum pins, and remove the shift lever assembly from the crankcase.



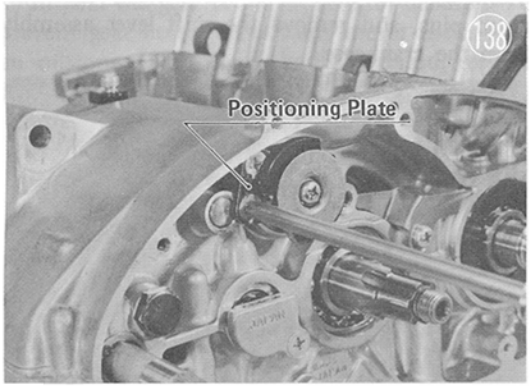
Take out the hex-head mounting bolt, and remove the set lever and spring



Shift Operation



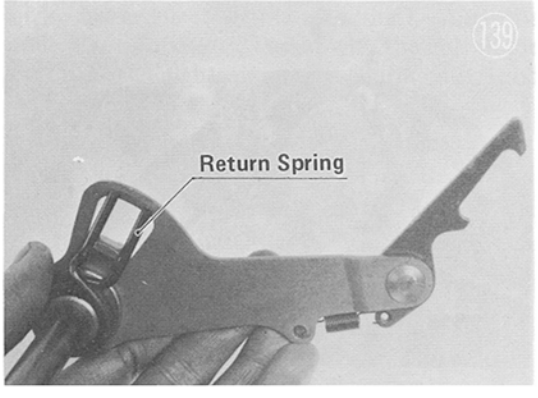
Take out the mounting screws, and remove the positioning plate.



3) Overhaul

a. Return Spring

Check the spring tension, and replace the spring if it is weak or damaged; a bad spring will not return the shift pedal.



b. Set Lever Spring

Replace the spring if it is weak or damaged, as such a spring will not hold the set lever against the pins, and will reduce the stability of the drum.

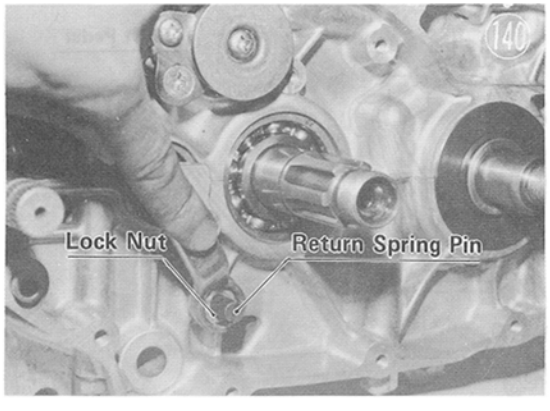
4) Assembly

Assembly is the reverse of disassembly. Be sure that all springs are installed correctly.

NOTE:

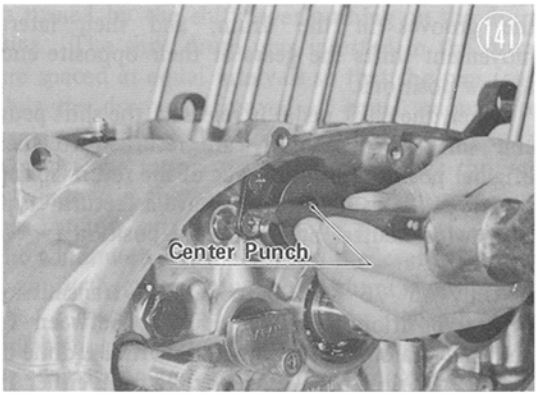
1. Return spring pin

If this pin loosens, the shift lever will not travel the correct distance. Lock the pin securely in place with the lock nut.



2. Positioning plate

To prevent the positioning plate from loosening and allowing drum movement along the shaft, punch the head of the mounting screw after tightening it.



10. CRANKCASE

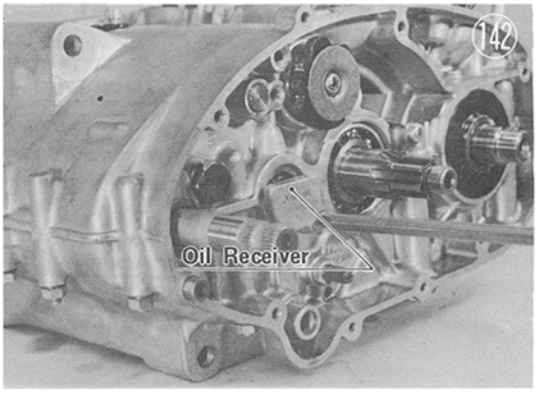
The crankcase, which is divided into an upper and lower section, is made of die cast aluminium alloy. Two pins align the upper and lower sections, which are held together with studs and nuts, and the joint is sealed with liquid gasket (Kawasaki Bond).

Gasoline/air mixture from the carburetor is drawn into the crankcase, where it undergoes preliminary compression prior to entering the combustion chamber. For that reason each crank chamber in the crankcase is partitioned from the next by oil seals on the crankshaft, making each chamber independently pressure tight. To prevent leakage of the oil used for lubrication of the transmission gear, change drum, etc., oil seals are also pressed onto the left ends of the output and drive shafts. In addition, there is a breather hole in the transmission housing to prevent oil leakage by not allowing pressure to build up from the oil expansion as it warms up.

To take care of main bearing lubrication, an oil passage is provided in the upper crankcase. During assembly and disassembly, be careful that this passage does not become clogged.

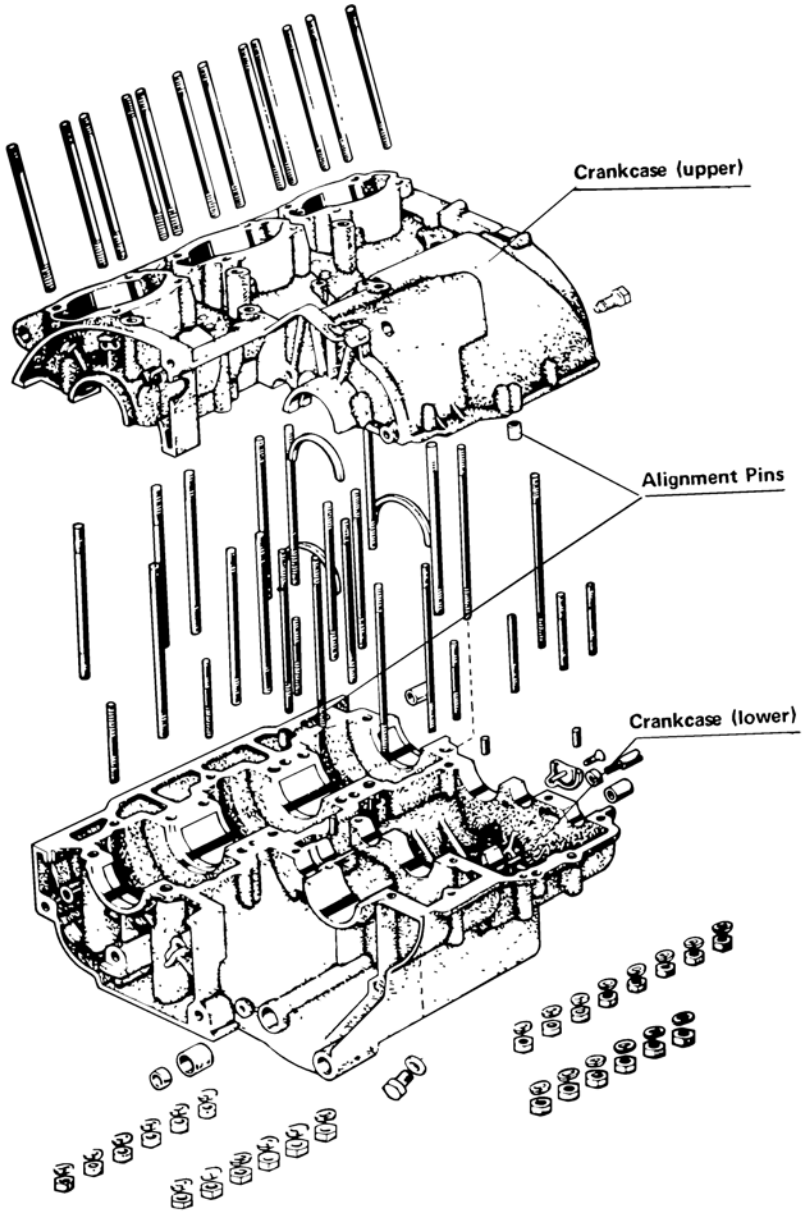
1) Disassembly

Remove the output shaft oil receiver.

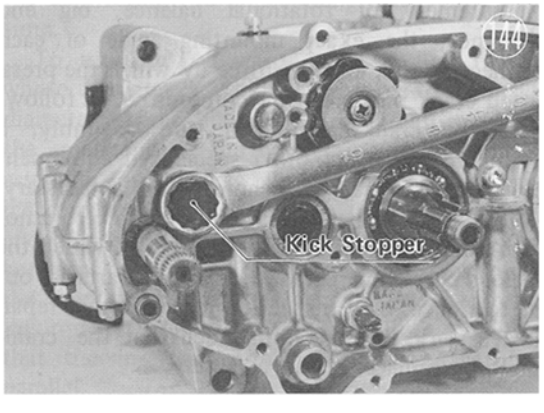


Crankcase Assembly

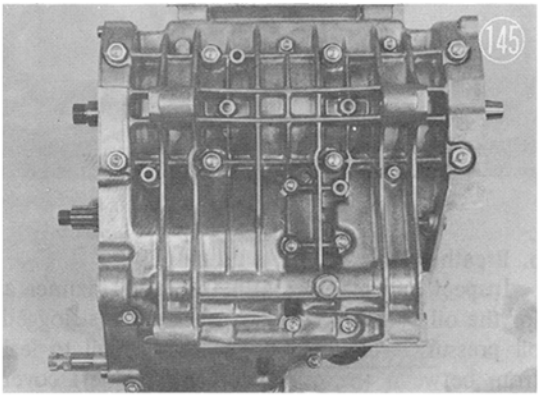
(143)



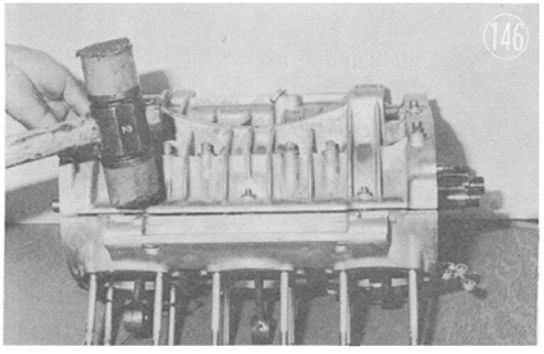
Loosen the kick stopper.



Turn the crankcase assembly upside down and remove the mounting nuts.

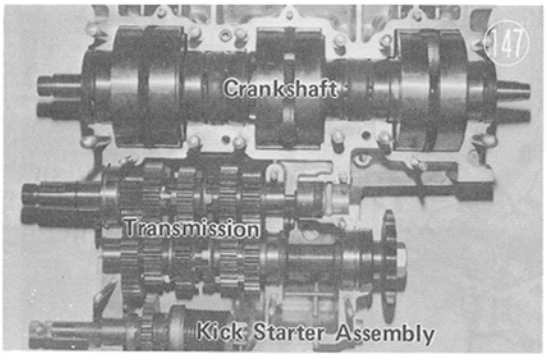


Tap the lower crankcase and shift shaft mounting lightly with a mallet, so that all the shafts, etc. remain in the upper crankcase when it is disassembled.



NOTE: The crankcase cannot be disassembled unless the clutch release is first removed.

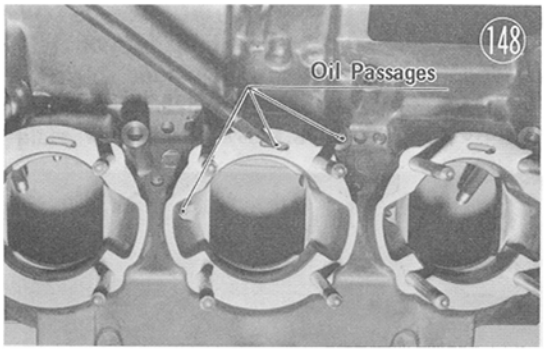
Taking off the lower crankcase permits removal of the crankshaft assembly, transmission assembly, kick shaft, drum, etc.



2) Overhaul

a. Oil Passages

Inspect the oil passages for clogging, and blow them out with compressed air.



b. Breather Hole

Inspect and clean this in the same manner as for the oil passages. If this hole becomes clogged, oil pressure will build up and cause oil to leak from between the crankcase and the left cover.

3) Assembly

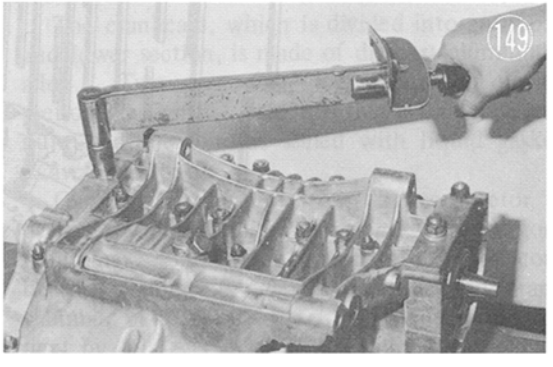
Assembly is the reverse of disassembly.

NOTE:

1. To avert any possible oil leakage, clean the crankcase gasket surfaces thoroughly with gasoline, wipe them dry, and apply an even layer of Kawasaki Bond sealer on the lower crankcase gasket surface.
2. When replacing the mounting nuts, starting from the center of the crankcase and working to the outside ends, tighten the nuts with a torque wrench to this tightness:
3. Be careful that the oil seals are installed at right angles to the crankcase, and see that they do not protrude beyond the outer crankcase surface.

Table 15

Nut Size	Torque
8 mm	16.0 – 19.5 ft.lbs. (2.2 – 2.7 kg.M)
6 mm	11.0 – 11.5 ft.lbs. (1.5 – 1.6 kg.M)



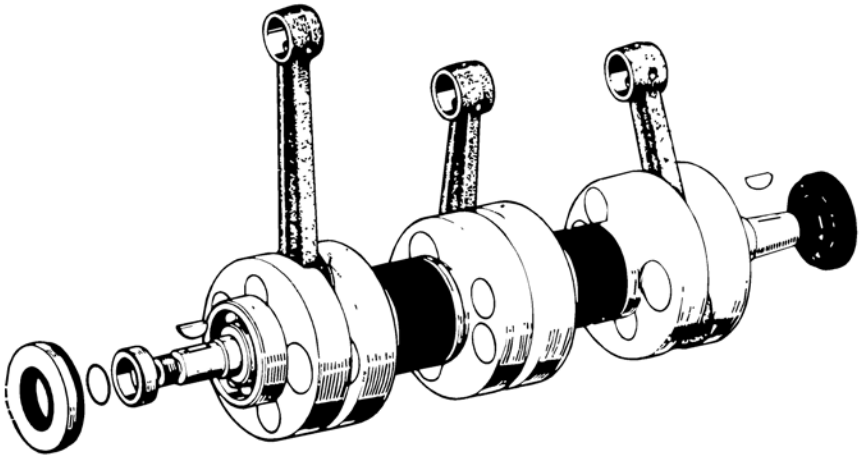
11. CRANKSHAFT

The intermittent force of exploding gasoline hammers on the pistons, and the resultant up and down motion of the pistons is received by the crankshaft and changed into shaft rotation. Due to the powerful force involved, crankshaft play or runout will cause damage to the crankcase, bearings, etc., and will produce noise, vibration, and result in a loss of power. It is therefore of critical importance to overall engine life to make necessary repairs as early as possible.

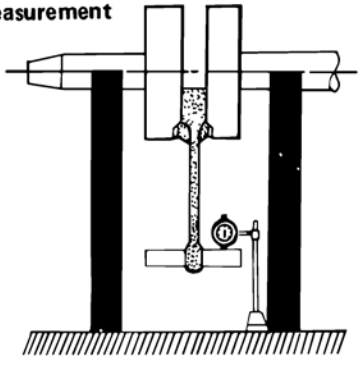
However, crankshaft assembly demands precise measurement of rotational balance, big end clearance, the exact mounting angle of each connecting rod, and the force by which the press-fitted crank pins are being compressed. It follows that for crankshaft repair and assembly, a hydraulic press and other specialized equipment plus a high degree of technical skill is necessary.

This manual deals only with common crankshaft troubles, and the manner in which the various checks are performed. If any parts are out of tolerance, or if inspection indicates that repair is necessary, it is recommended that the crank shaft be replaced as an assembly.

H Series Crankshaft

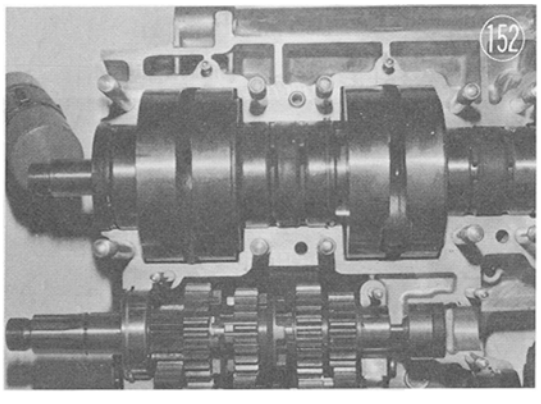


Warp Measurement



1) Disassembly

Lightly tap both ends of the crankshaft with a mallet, and remove it from the upper crankcase.



2) Inspection

a. Connecting Rod Warp

When the piston, piston rings or cylinder is worn unevenly, or there is a strong slapping sound, the connecting rod is becoming bent at the same time.

To measure rod warp, insert a shaft (arbor) whose diameter is as close as possible to the inside diameter of the connecting rod small end, into the small end of the connecting rod. Set this assembly on blocks over a surface plate, and measure the distance between the plate and each end of the rod with a dial gauge. The difference between the two readings gives an indication of the amount the rod has bent. Also check that the rod has not twisted, by visually ascertaining that the inserted rod and the crankshaft are parallel.

b. Connecting Rod Big End Wear

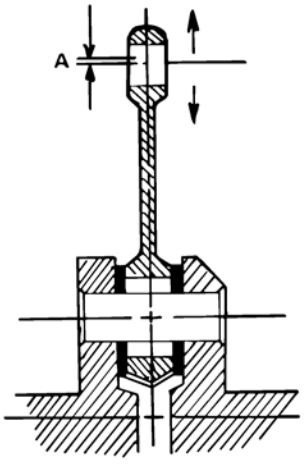
To ensure smooth rotation of the connecting rod, a certain amount of radial and side clearance is provided at the big end. As the connecting rod, crank pin needle bearing or side washers wear, these clearances increase.

Move the connecting rod up and down as illustrated; the amount of movement equals radial clearance. Note that H2 standard clearance is slightly different (.023-.041 mm) from the table.

Table 16 Radial Clearance

Model	Standard	Limit
H1, H2	.00098 – .00138 in. (0.025 – 0.035 mm)	.0039 in. (0.10 mm)

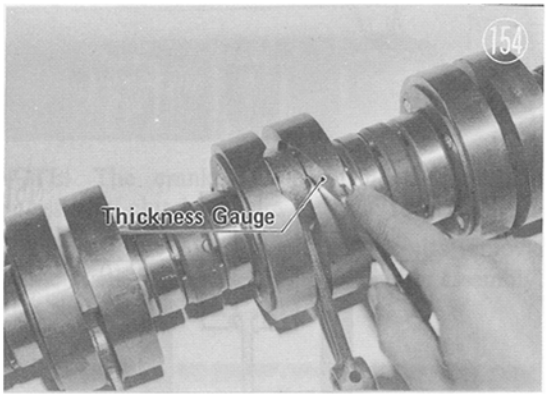
Big End Radial Clearance



Move the connecting rod to one side and measure side clearance with a thickness gauge as illustrated.

Table 17 Side Clearance

Model	Standard	Service Limit
H1, H2	.0157 – .0197 (0.40 – 0.50 mm)	.0276 in. (0.70 mm)

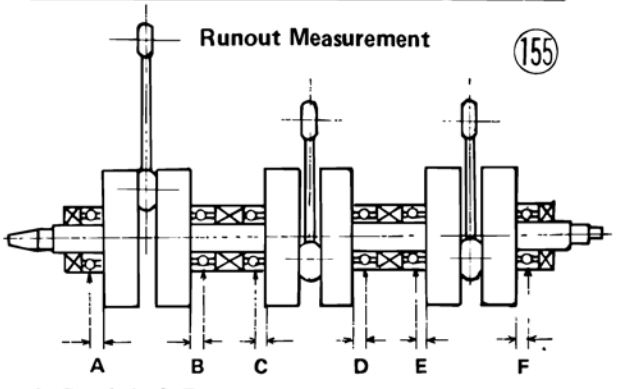


c. Crankshaft Runout

Center the crankshaft in a crankshaft aligner and set the dial gauge to the points indicated. Turn the crankshaft lightly and note the reading variation, which is crankshaft runout.

Table 18 Crankshaft Runout

Model	Standard	Maximum
H1, H2	Under .0016 in. (Under 0.040 mm)	.0039 in. (0.10 mm)



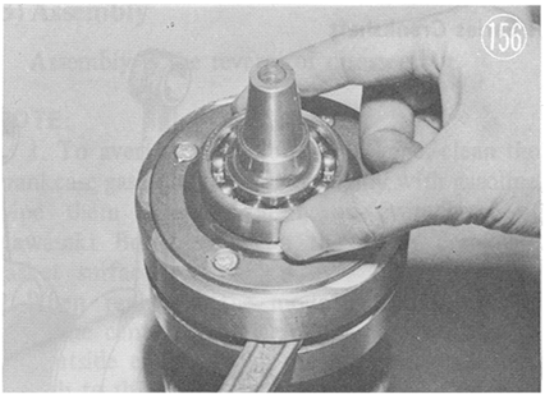
d. Crankshaft Damage

If there is heat seizure damage to the crank pin, connecting rod, big end side washers or needle bearing, or if any of the crankshaft journals are cracked or otherwise damaged, replace the entire crankshaft assembly.

e. Main Bearings

As the bearings wear, play develops and can cause crankshaft vibration.

Standard clearance between the ball and race is .00047 – .00087 in. (0.012 – 0.022 mm). But since such a small clearance is difficult to measure, clean each bearing with gasoline, lubricate it, and see that it turns smoothly.



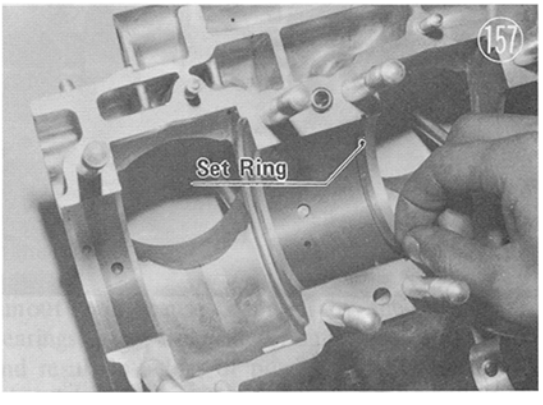
f. Crankshaft Oil Seals

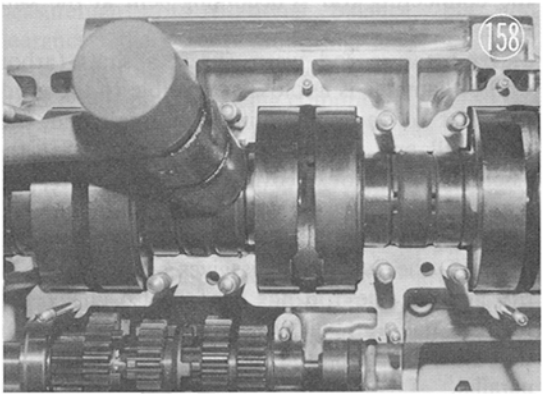
The four oil seals, one on either side of each crank chamber, maintain the pressure differences among the chambers. If by any chance any of these oil seals should be damaged, primary compression leakage will occur and cause a reduction in engine performace.

Carefully inspect the oil seals for damage to the lip, and check the outer edge for dirt that might allow compression leakage.

3) Assembly

Place the bearing set rings in the upper crankcase and align the groove in each ball bearing to its ring. Seat the crankshaft by tapping each bearing lightly with a mallet.





12. TRANSMISSION

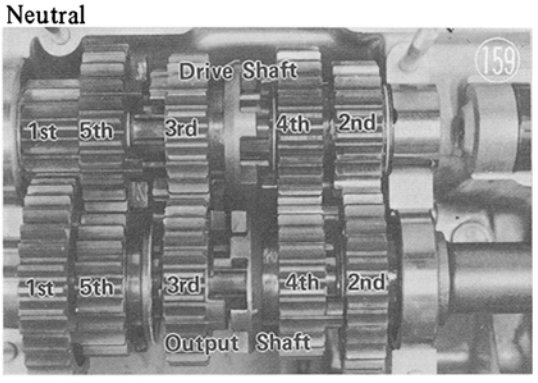
In order to use engine power effectively, the transmission allows selection of the appropriate reduction ratio for the various riding conditions – starting out, accelerating, decelerating, climbing, etc.

1) Operation

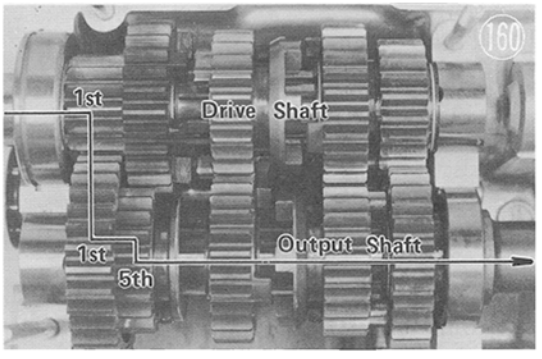
The diagrams below show the 5-speed, constant-mesh, return change type transmission of the H Series.

Each selector fork is kept in its groove on the gear shift drum by a guide pin. The other ends of the three forks sit astride output shaft 4th gear, drive shaft 3rd gear, and output shaft 5th gear, respectively. As the shift drum turns, the selector forks follow their slots, moving to the right and left and sliding the gears into different meshing arrangements.

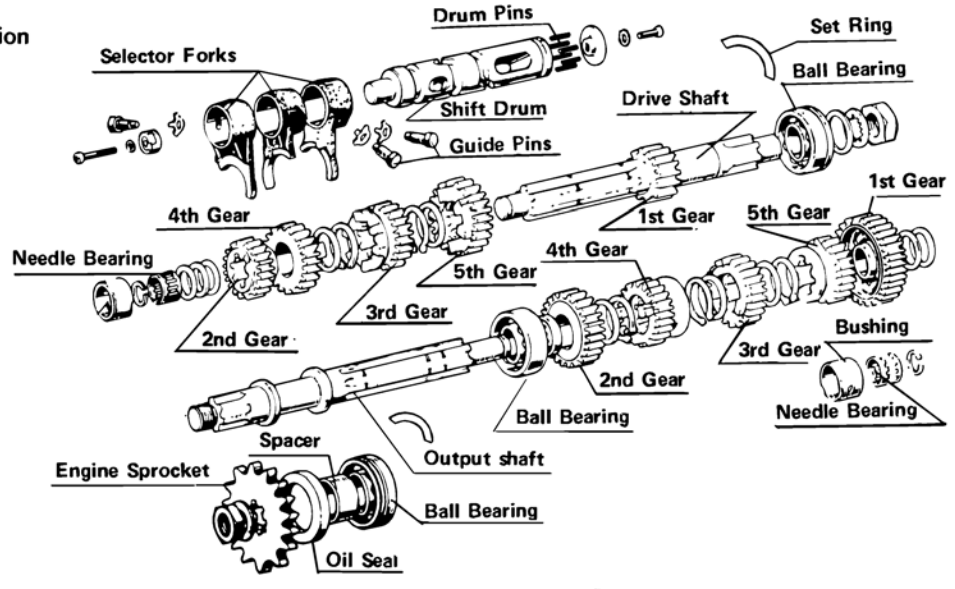
Neutral



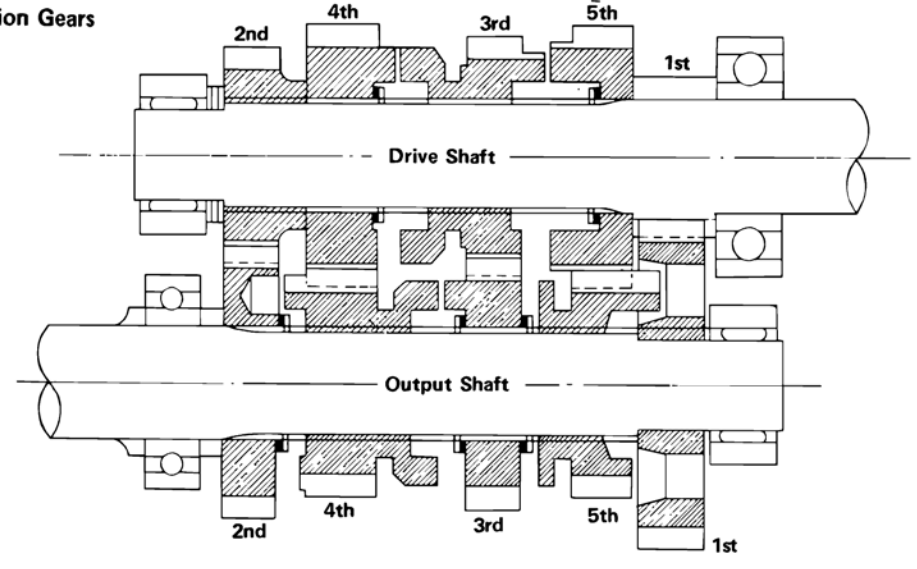
First Gear



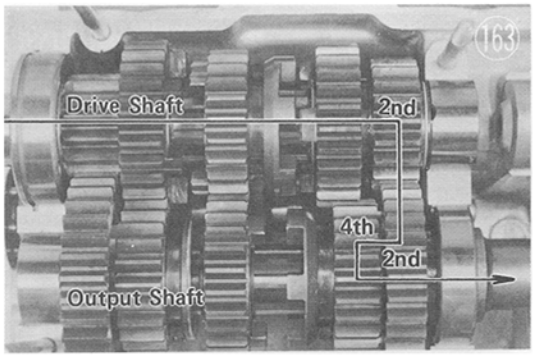
Transmission



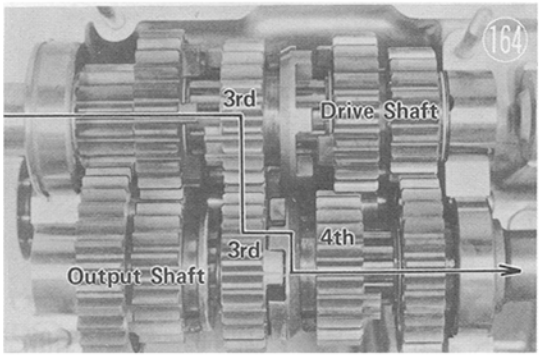
Transmission Gears



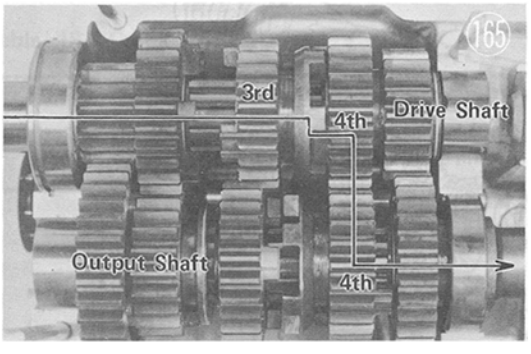
Second Gear



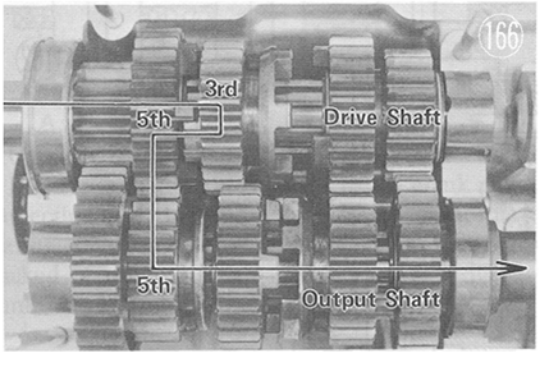
Third Gear



Fourth Gear



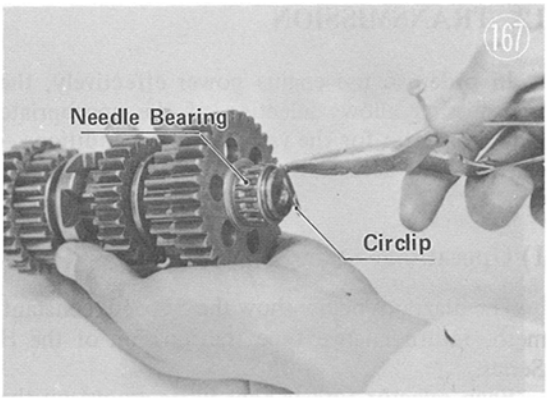
Fifth Gear



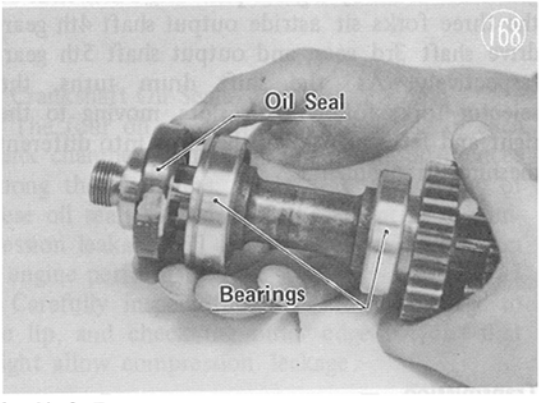
2) Disassembly

a. Drive Shaft · Output Shaft Assemblies

Remove each shaft assembly from the upper crankcase. Take off the circlips and remove the needle bearings and gears.



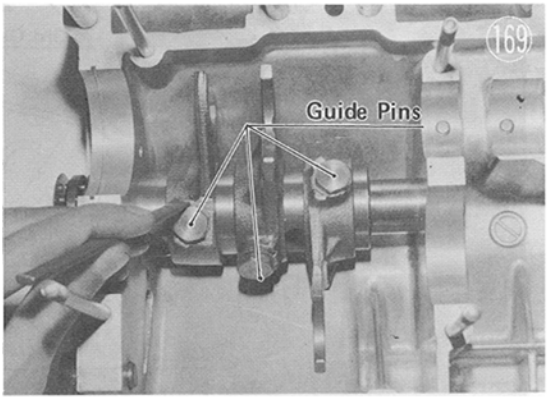
Remove the oil seals and bearings.



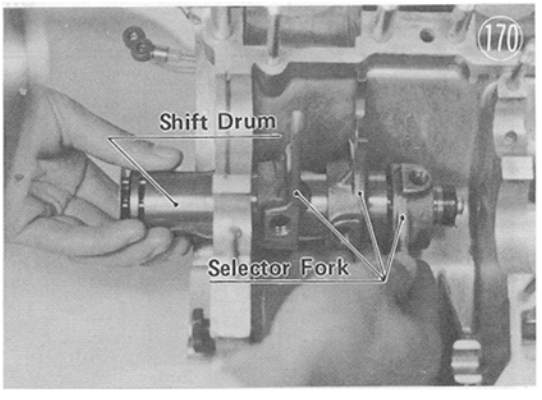
b. Shift Drum

NOTE: The drum lever and positioning plate must first be removed before the shift drum can be taken out.

Straighten the lock washers and pull out the guide pins.



Pull out the shift drum and remove the selector forks.



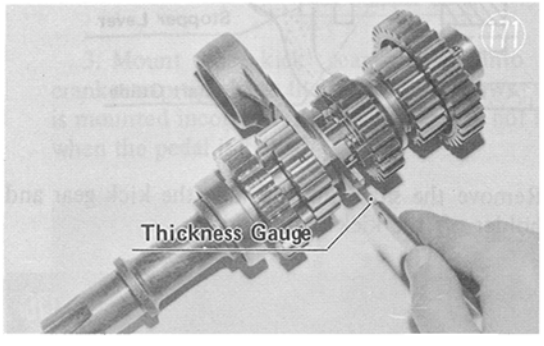
3) Overhaul

a. Selector Forks · Gears

From wear of the selector fork prongs and the gear groove in which they sit, play develops and the gears either fail to position properly, or jump out of mesh while running. This wear should be measured by inserting a thickness gauge into the space between the selector fork prong and the walls of the groove. If the clearance exceeds the service limit, replace the fork and/or gear.

Table 19 Groove/Fork Clearance

Model	Standard	Service Limit
H1, H2	.0020 – .0098 in. (0.05 – 0.25 mm)	.024 in. (0.6 mm)



Bent selector forks can cause the same troubles as worn ones. Replace any forks that are bent, or that have turned purple from overheating.

b. Gear Teeth

Gear teeth with nicks or rough edges will not only cause noise, but will wear down other gears. Inspect the gears and grind smooth any damaged portions, or replace the gear if damage is bad.

c. Oil Seals

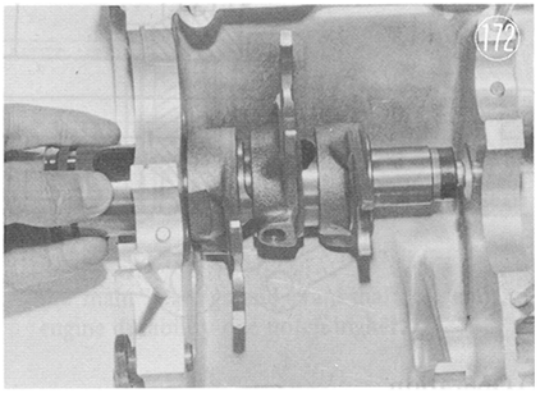
Since there is a constant supply of oil in the transmission, cracked or damaged oil seals will allow leakage. Inspect the lips of the seals and replace any damaged ones.

4) Assembly

Assembly is the reverse of disassembly.

NOTE:

1. Arrange the selector forks as illustrated.



2. Be certain to replace the bearing set rings.

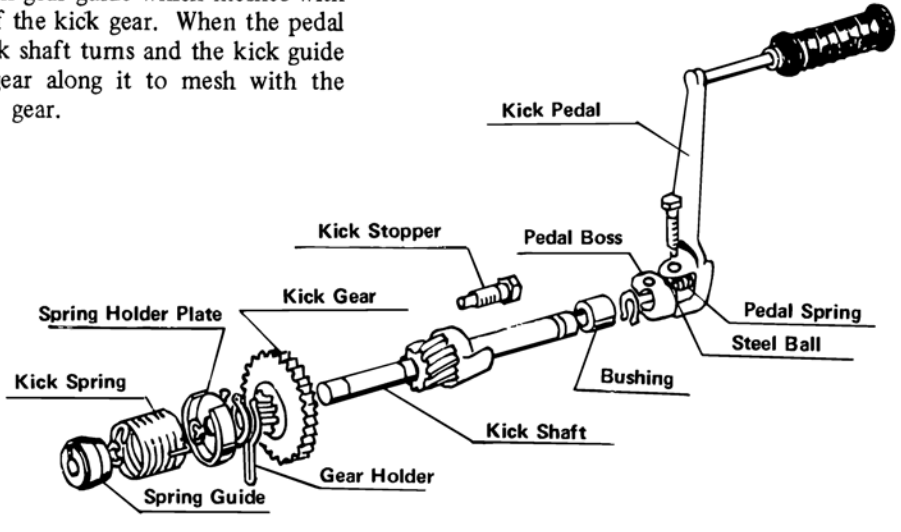
3. Be sure to install all the circlips to the various gears and needle bearings.

4. Check gear clearances at three points: (a) between drive shaft second gear and the bearing; (b) between output shaft first gear and the bearing; (c) between output shaft second gear and the fourth gear C ring. If the measurement is much over .020 inch (.5 mm), insert a .5 mm shim washer to take up the play. Do not insert the washer if it will make the shaft hard to turn or if it will make the dogs of any two gears hit. Part number is 92022-225 for the washer between second and fourth gears, and 92022-144 for the other two shims.

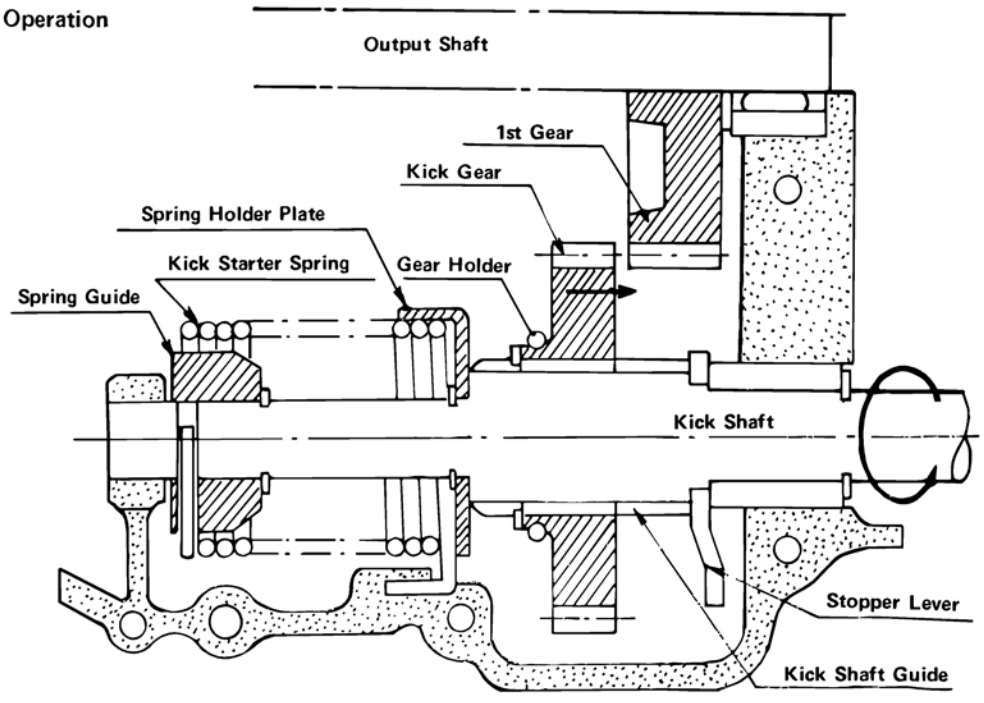
13. KICK STARTER

The middle portion of the kick shaft is provided with a helical kick gear guide which meshes with the inner teeth of the kick gear. When the pedal is kicked, the kick shaft turns and the kick guide slides the kick gear along it to mesh with the output shaft low gear.

Kick Mechanism



Kick Starter Operation



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1) Operation

Following the diagram, when the kick pedal is pushed down, the kick guide on the shaft turns in the direction of arrow A, and the kick gear turns around the kick shaft and slides in the direction of arrow B, meshing with the output shaft low gear.

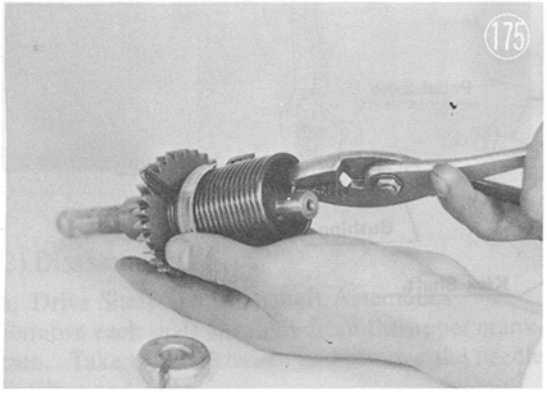
Consequently, motion transfer is in this order: kick shaft → kick gear → output shaft low gear → drive shaft low gear → drive shaft → clutch → crankshaft primary gear → crankshaft.

When the engine starts, the kick gear is turned by low gear and slides back to its original position, out of mesh with low gear. And when the pedal is released, the tension of the kick spring turns the kick shaft and the pedal returns to its original position. At this point the kick shaft stopper lever hits the kick stopper on the crankcase and prevents the kick shaft from turning any further.

2) Disassembly

Remove the return spring guide and the return spring.

Take off the two circlips and remove the holder plate.



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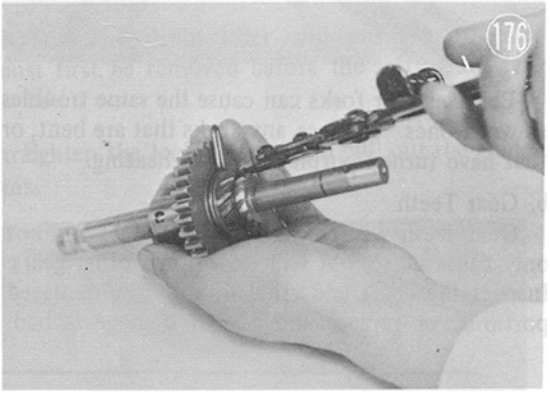
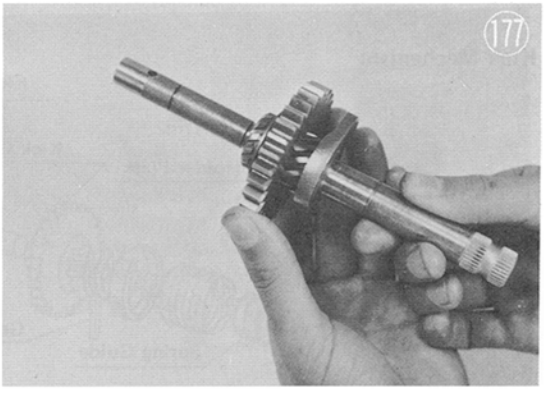
Remove the snap ring and take the kick gear and holder off the kick shaft guide.



176

3) Overhaul

Check for play between the inner teeth of the kick gear and the kick gear on the kick guide shaft. Turn the kick shaft back and forth and check for smooth gear operation.



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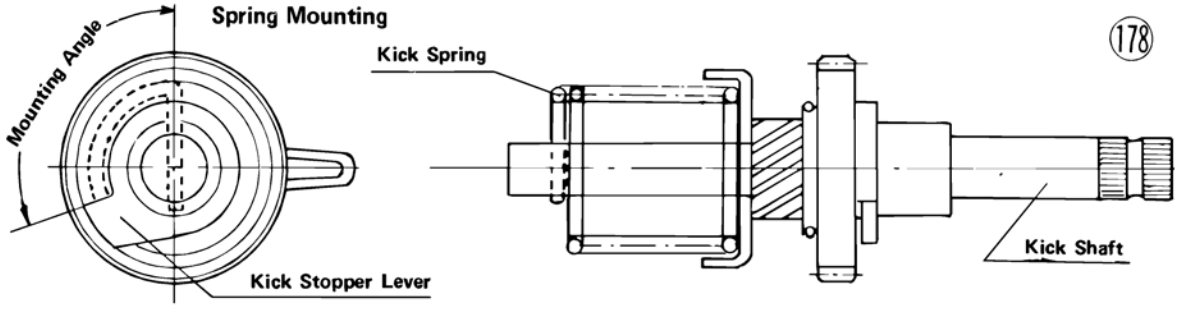
4) Assembly

Assembly is the reverse of disassembly.

NOTE:

1. Be sure the circlips and snap ring are seated properly.
2. When replacing the kick spring on the kick shaft be careful of the angle it makes with the kick stopper lever.



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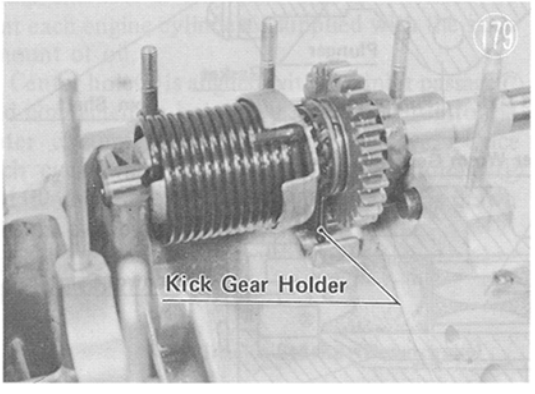
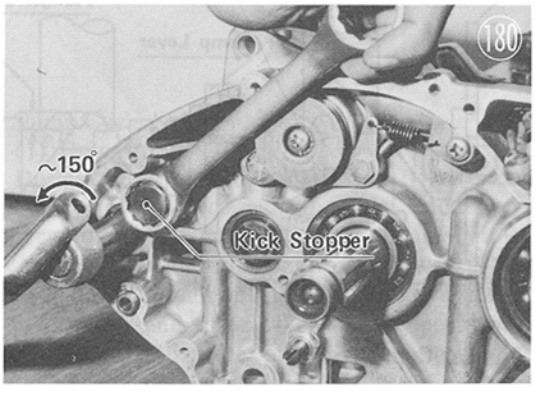
3. Mount the kick gear holder into the crankcase properly as the illustration shows. If it is mounted incorrectly, the kick gear will not slide when the pedal is kicked.



179

4. Screw in the kick stopper after assembling the crankcase. In order to give the kick spring enough tension to raise up the kick pedal, put on the kick pedal and screw in the kick stopper about 150° back in the direction of the arrow.



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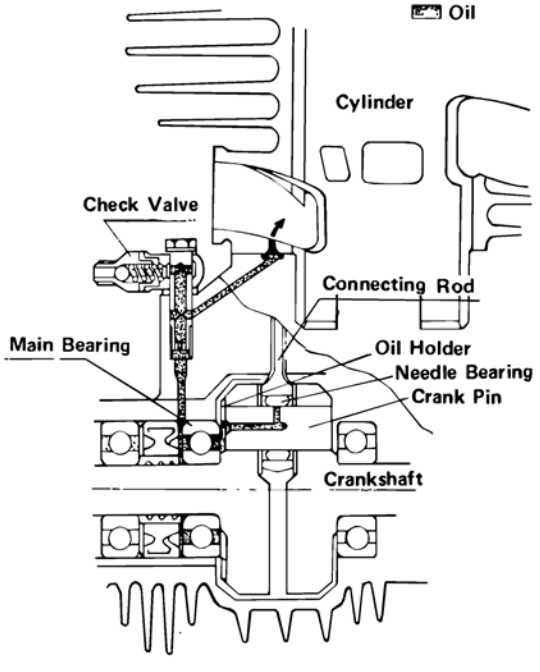
14. LUBRICATION SYSTEM

The lubrication system used in the H Series machines is Injectolube. In this system, oil is kept in a separate tank from the gasoline, from which it is pumped to the engine by the oil pump and mixed with the gasoline there. The rate at which the oil is pumped, which varies with the needs of the engine, is controlled by engine rotational speed and throttle opening. With the ideal lubrication that results engine performance is vastly improved, and the fresh, high viscosity oil supplied directly to the main bearings and crankshaft big ends, raises engine durability one notch higher.

1) Oil Passages

Figure 181 is a diagram of the Injectlube oil passages. The oil pump pumps the oil through check valves to the three banjo bolts behind the engine. One path is for oil injection into the cylinder intake port to be mixed with gasoline, and the other passage leads to the crankcase beneath the banjo bolt where the oil lubricates the connecting rod big end via the crank bearing, oil holder and crank pin, in that order.

Oil Passages



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2) Oil Pump

a. General Construction and Operation

Crankshaft rotational speed is reduced by the oil pump pinion on the right end of the crankshaft, meshing with the oil pump gear on the oil pump shaft. The other end of the shaft turns the pump worm, which meshes with the worm gear teeth cut into the center portion of the plunger. The plunger spring pushes the plunger follower against the plunger. In this manner the plunger is kept against the camshaft, and as the plunger is turned, its cam face riding on the camshaft causes it to reciprocate. The follower, which is joined to the plunger by a mortise-and-tenon-like joint, follows plunger movement, turning and reciprocating to pump oil.

Since there are two high points on the plunger face cam, there are two complete pumping cycles for each single revolution of the plunger.

The rate at which oil is pumped depends on the speed of plunger rotation, which varies with engine speed, and on the position of the control cam, which varies with throttle opening.

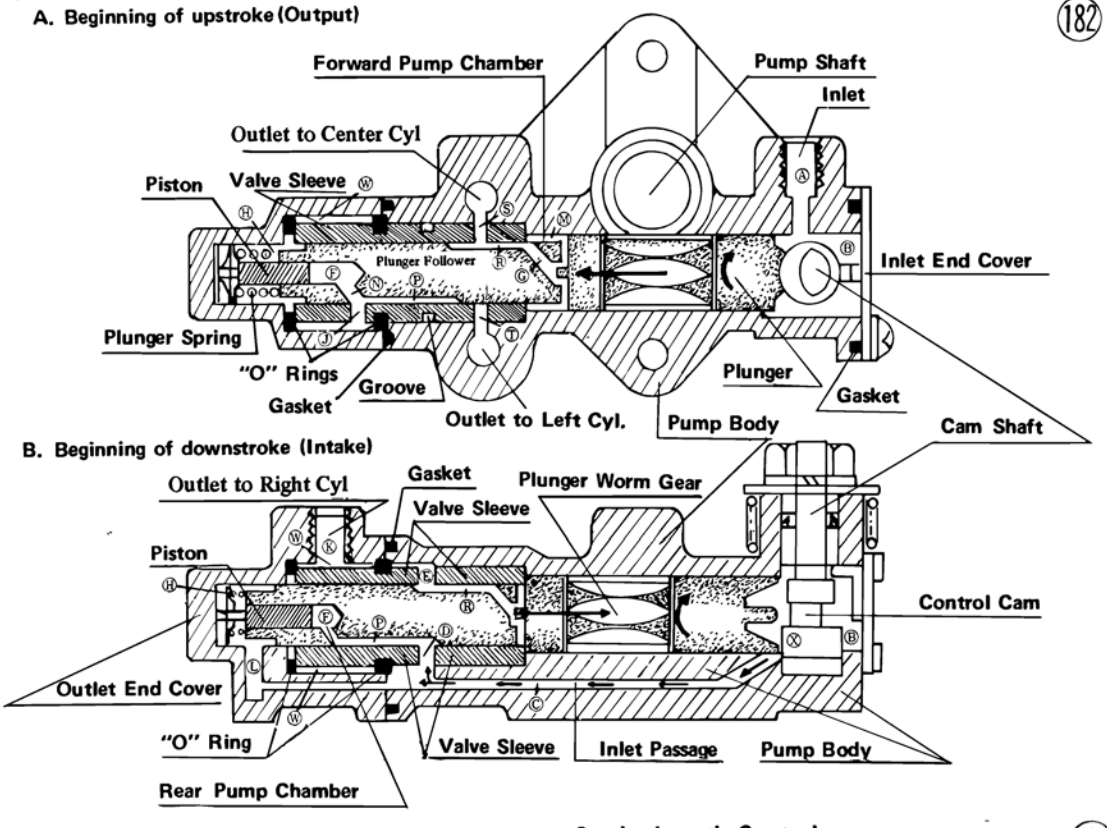
b. Plunger/Cam

The pump lever is connected by a control wire to the throttle grip, so that as the grip is twisted the set lever moves with it and turns the camshaft.

When the lowest part of the control cam is facing the plunger as shown in "D", the plunger tip never touches the control cam and the cam on the plunger face can ride at point Ⓧ from its highest to lowest point – the distance between the arrows. Accordingly, maximum plunger stroke occurs at maximum throttle opening.

In Fig. 183 "C" the motorcycle is idling with the throttle grip fully closed, and the highest part of the control cam is toward the plunger. When the plunger moves down, the plunger tip hits the control cam and stops the plunger before it reaches the bottom of its cam, thus preventing the plunger from making a full stroke. At this time the plunger can only move the distance between the arrows in Figure 183 "C".

Oil Pump



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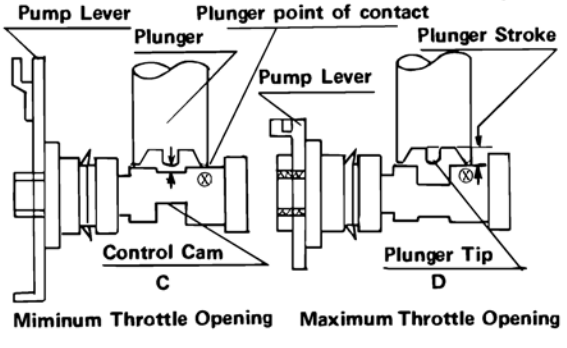
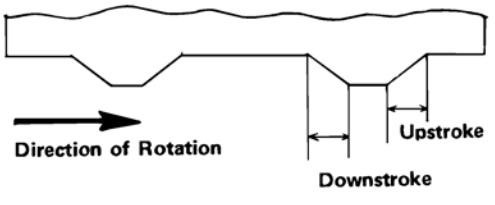
Stroke Length Control



183

Plunger Cam Face



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c. Valve Sleeve

The opening and closing of oil inlet and outlet ports are controlled by the movement of the plunger follower inside the valve sleeve.

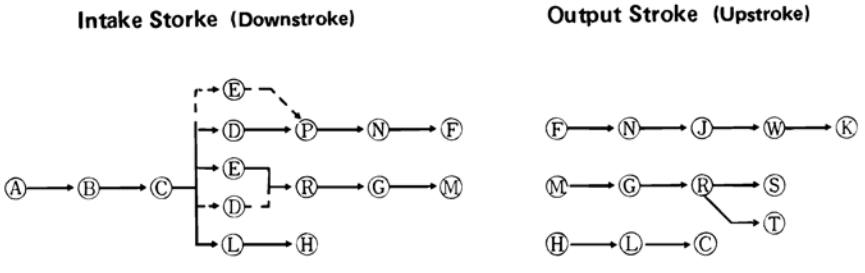
The valve sleeve, which is prevented from turning by a pin in one side, contains three sets of two holes, a total of six holes. The two holes in each set are spaced opposite each other 180° apart to conform with the plunger operation and complete one cycle for each half rotation.

When the forward notch Ⓡ in the plunger follower coincides with the center cylinder outlet hole Ⓢ or the left cylinder hole Ⓣ in the valve, oil is pumped to that cylinder from the forward pump chamber. Each of these two cylinders receives oil every other cycle, or once per plunger rotation.

When the rear notch Ⓟ coincides with either of the two rear holes Ⓙ oil is pumped into the space Ⓦ between the valve sleeve and the inside of the outlet end cover. From space Ⓦ the oil travels around to outlet Ⓚ and from there to the right cylinder. This part of the pump supplies oil to the right cylinder once every cycle, i.e. twice per plunger rotation, but the capacity of the rear pump chamber is only half that of the front, so that each engine cylinder is supplied with the same amount of oil.

Center hole Ⓓ is aligned with the inlet passage Ⓒ and connected to hole Ⓔ by a groove cut into the outer circumference of the valve sleeve. Once each cycle when the plunger follower notches Ⓟ and Ⓡ coincide with holes Ⓓ and Ⓔ, oil is drawn into the two pump chambers Ⓕ and Ⓜ.

Oil Flow Chart



d. Pump Cycle

(1) Downstroke

During the plunger upstroke, space Ⓑ between the plunger cam face and the inlet end cover enlarges, drawing in new oil through the inlet at Ⓐ.

As the plunger and plunger follower move toward the camshaft on the downstroke, space Ⓑ grows smaller and three other spaces open: (1) Void Ⓗ containing the piston and the plunger spring enlarges; (2) The piston moving out of the rear pump chamber Ⓕ increases the volume of this space; (3) The plunger follower moves out of the valve sleeve into the plunger cylinder, but since the cylinder inside diameter is larger than the follower outside diameter, a void (the forward pump chamber) is developed between the follower and the cylinder wall.

Suction from these expanding spaces, in conjunction with pressure from the oil at the pump inlet and the oil being compressed in space Ⓑ, draws oil into the inlet passage Ⓒ, and moves it in the direction of the arrows.

Oil enters chamber Ⓗ at point Ⓛ.

The rear pump chamber Ⓕ is supplied via valve hole Ⓓ (or Ⓔ on the other half rotation), follower notch Ⓟ and hole Ⓝ into the inside of the follower.

The forward pump chamber Ⓜ receives oil through valve hole Ⓔ (or Ⓓ), notch Ⓡ and hole Ⓖ cut through to the tip of the follower.

(2) Upstroke

As the plunger starts its upstroke, notch Ⓟ coincides with hole Ⓙ or its matching hole on the opposite side; and notch Ⓡ coincides with either hole Ⓢ or hole Ⓣ in the valve sleeve.

The plunger starts pushing the plunger follower back inside the valve sleeve, closing up the forward pump chamber Ⓜ. This forces oil back out passage Ⓖ, and by way of notch Ⓡ into either Ⓢ or Ⓣ to the center or left cylinder outlet.

At this same time, the plunger pushes onto the piston, and the piston entering the rear pump chamber Ⓕ, decreases its capacity and forces out the oil. Oil leaves the chamber via hole Ⓝ and flows into space Ⓦ to the engine right cylinder outlet at Ⓚ.

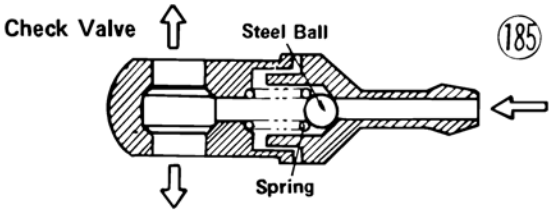
Oil in chamber Ⓗ flows back into the inlet passage at point Ⓛ. This oil serves only to prevent unwanted low pressure areas inside the pump, and ensure smooth pump operation and oil flow.

3) Check Valves

The check valves open when oil pressure exceeds 0.3 kg/cm^2 (4.3 lbs/in^2) in the direction of the arrow, and allow oil flow in the one direction only. When the engine is stopped – and therefore the oil pump is also stopped – the check valves stop oil flow, and any oil that has passed a check valve is prevented from returning.

Disassembly of the check valves should be avoided; if these are reassembled incorrectly, oil will not flow in the correct quantities, if at all, and the engine will be damaged.

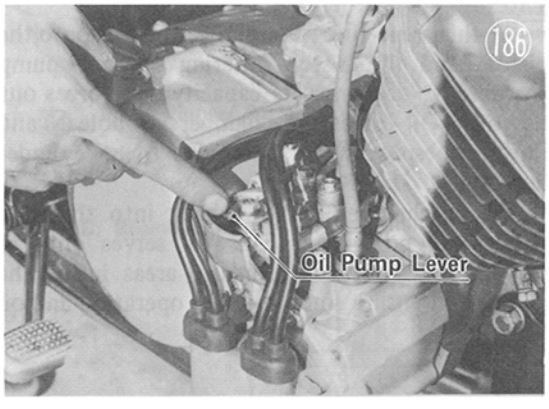
To clean a check valve, use a squirt can filled with solvent. Never use compressed air as this will distort the valve spring and cause the valve to malfunction.



4) Inspection and Adjustment

a. Bleeding the Oil Pump

When the oil pump or oil pipes are removed, air becomes trapped inside the pipes and obstructs the flow of oil. See that oil flows from the inlet pipe before connecting it to the pump. Bleed air from the outlet pipes by idling the engine (below 2,000 r.p.m.), and holding the oil pump control lever full open by hand, i.e. to maximum plunger stroke. Keep the engine idling until the air is completely pumped out. If air bubbles continue to appear in an outlet pipe, check the oil pipe inlet and outlet connections, oil pipe connections to the banjo bolts, and banjo bolt fittings.



b. Control Lever Adjustment

See the oil pump paragraph, page 11-12.

c. Oil Pump Check

The oil pump is a carefully assembled precision device, and disassembly should be avoided. To check oil pump performance, the oil flow rate should be measured for a given engine speed.

Detach the check valve from the upper crankcase. Start the engine and set the speed of rotation at 2,000 r.p.m. Holding the oil pump lever full open by hand, measure the amount of oil pumped from the pump outlet for a single cylinder. If the amount of oil pumped over a three-minute period corresponds to the amount in the table below, the oil pump is operating correctly.

CAUTION: While checking the oil pump, a 20:1 gasoline/oil mixture should be used in place of the pure gasoline normally used.

Table 20 Oil Pump Output

Model	Output/3 minute period @ 2,000 r.p.m.
H1	.171 – .197 oz. (5.05 – 5.83 cc)
H2	.228-.255 oz. (6.75-7.53 cc)

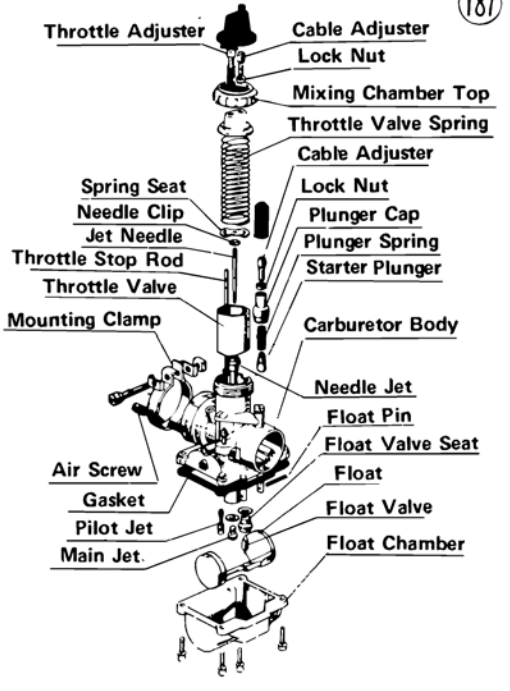
5) Injectolube Oil

Use any good quality 2 cycle engine oil that is recommended for air-cooled engines. Ordinary motor oil, transmission oil, etc. are not acceptable as replacements for the correct oil. Poor quality oil or the wrong type of oil will cause engine damage.

15. CARBURETORS

Each carburetor is comprised of a main system used for gasoline supply during high and medium speed operation, a pilot system for low speed operation, a float mechanism for maintaining the fuel level in the float chamber, and a starter system to supply a rich fuel mixture for starting.

Carburetor Construction



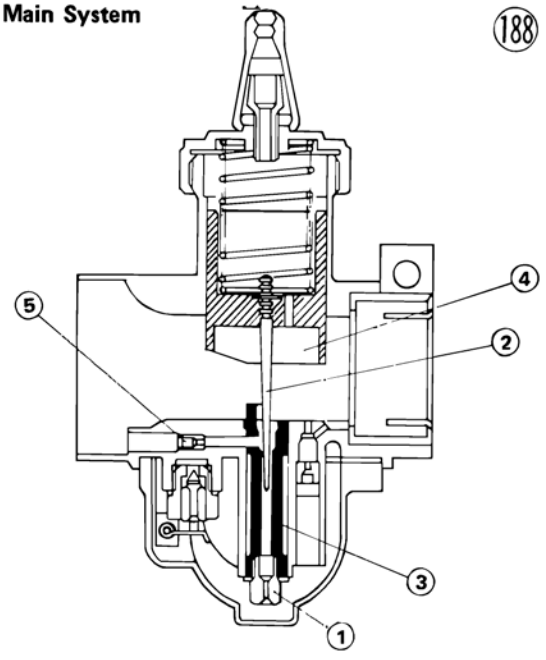
1) Construction and Operation

a. Main System

As Fig. 188 shows, the main system consists of the main jet ①, jet needle ②, needle jet ③, throttle valve ④, and the air jet ⑤.

When the throttle valve is more than 1/4 open, air is taken in principally through the main bore, flowing beneath the throttle valve. Due to this air flow, a low pressure area is produced around the jet needle, and fuel is drawn up through the main jet through the opening between the needle jet and jet needle and toward the main bore. Air coming in through the air jet mixes with the fuel inside the needle jet and expedites the atomizing process. When the mixture reaches the main bore, it is combined with and further atomized by the main stream of air, and then drawn into the engine.

Main System (188)

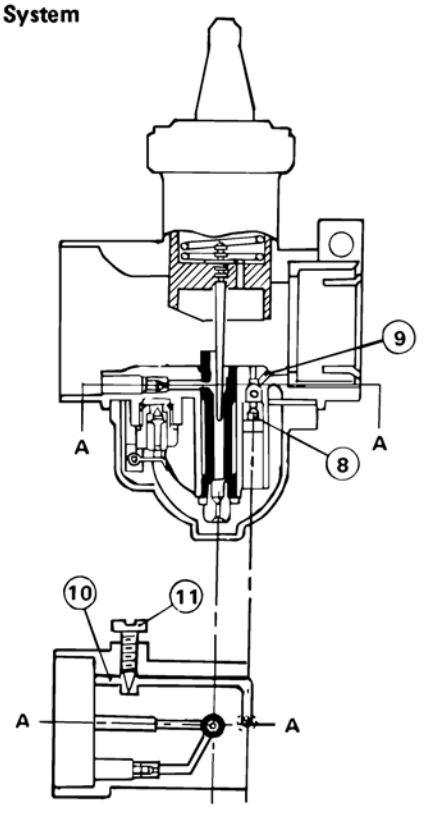


b. Pilot System

Fig. 189 shows the pilot system which includes the pilot jet ⑧, pilot ⑨, and pilot air screw ⑪.

When the engine is idling or running at low speed, the throttle valve is almost completely closed, and the principal air intake is through the pilot air inlet as controlled by the tapered pilot air screw. This air mixes with the fuel drawn up through the pilot jet and is spewed from the pilot outlet into the main bore, where it further mixes with the small current of air flowing there, and is finally drawn into the engine.

Pilot System (189)

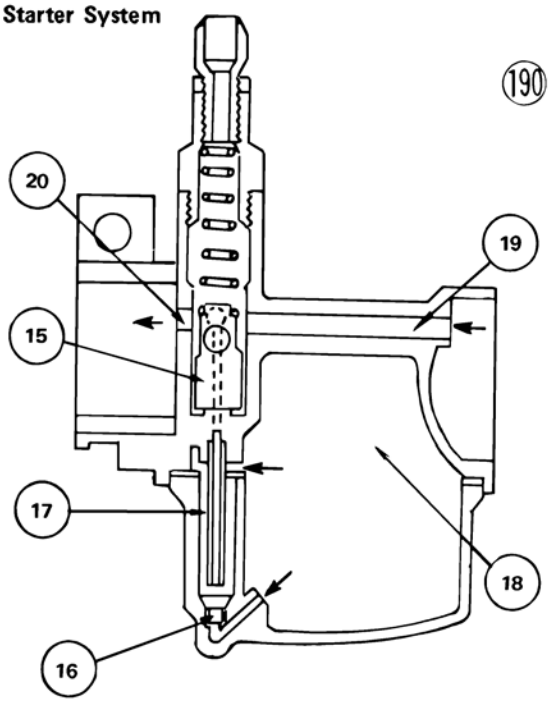


c. Starter System

The purpose of this system is to enable easy starting when the engine is cold, and replaces the choke system found on 4 cycle or old style 2 cycle engines.

The engine is started with the throttle fully closed and the starter lever pushed completely down. With the lever pushed, starter plunger ⑮ is pulled up. Fuel is drawn up through the starter jet ⑯ by the negative intake pressure, and mixes with air that comes from the float chamber ⑱ via the air bleed opening ⑰. It is then mixed with the air from the starter primary air passage, and jetted through the hole in the rear of the throttle valve into the main bore. Here it supplements the main fuel mixture supply from the pilot system and is drawn into the engine.

Starter System (190)



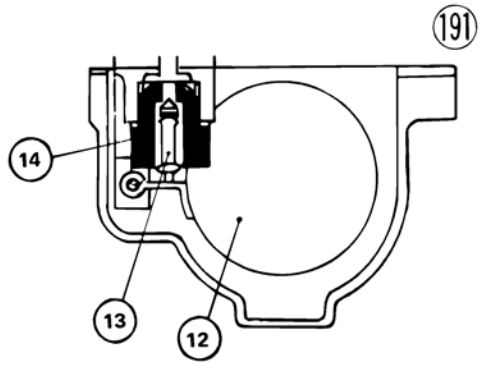
d. Float Mechanism

The float ⑫, needle valve ⑬ and valve seat ⑭ make up the float mechanism, whose purpose is to maintain a constant fuel level in the float chamber by metering the gasoline from the fuel tank.

As in the case of a hand pumped bug sprayer, when the fluid level in the sprayer reservoir (or float chamber) is low, the same amount of pumping will not yield the same amount of spray out as when the reservoir is full. Therefore to retain the same fuel flow rate for a given set of conditions, the fuel level in the float chamber must be kept constant.

When the fuel level in the float chamber rises, the float also rises and closes the float valve, stopping fuel intake from the tank. When the level dips below normal the float lowers and opens the float valve more than normal, temporarily increasing fuel flow from the tank until the standard level is regained.

Float Mechanism



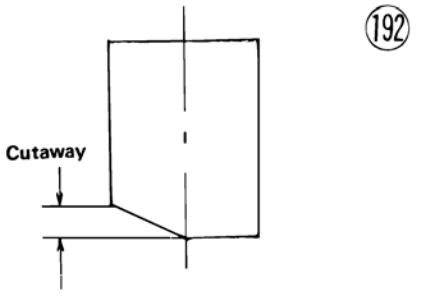
2) Functional Parts

a. Throttle Valve

The throttle valve controls the rate of engine air intake by moving up and down inside the main bore. At small throttle openings air flow control is performed chiefly by the cutaway in the valve, and by controlling air flow, the negative pressure over the needle valve is regulated, in turn governing fuel intake.

The throttle valves are numbered 1.0, 1.5, 2.0, etc., according to the size of the cutaway; the higher the number, the leaner the gasoline/air mixture.

Throttle Valve



b. Air Jet

The air jet measures the air sent to the needle jet for mixing.

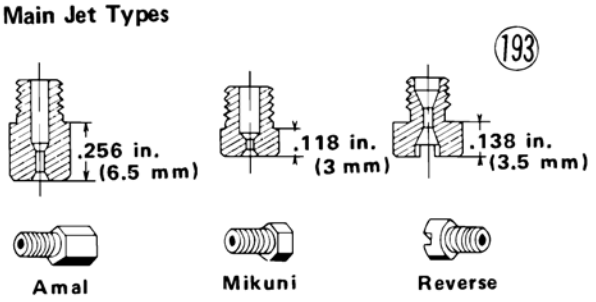
NOTE: The air jet, which is driven into the carburetor body, cannot be removed without damaging the carburetor, and is therefore not a replaceable part.

c. Main Jet

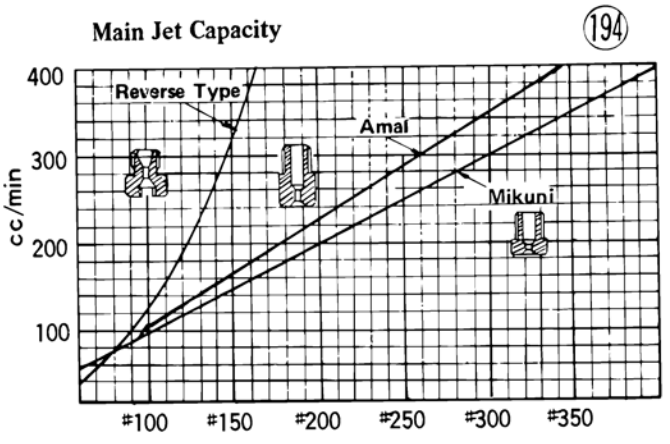
The fuel necessary for making the proper mixture is measured by the main jet, and as the throttle opening grows larger, has a great influence on mixture ratio.

The number stamped on the jet indicates the amount of fuel in cc's that passes through the jet in one minute under a given set of conditions. Since the numbers vary with the type of jet, the table shows equivalent jets for the three types used on various models.

Main Jet Types



Main Jet Capacity



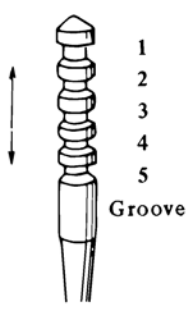
d. Jet Needle

The jet needle has 5 grooves for adjustment cut in the upper portion, and is tapered from approximately the middle of the needle to the lower end. The top is fixed to the center of the throttle valve by the needle clip, and the tapered end extends into the needle jet. Fuel flows through the space between the needle jet and jet needle, which space is unvarying until the throttle reaches the 1/4 open point. At this time the tapered portion of the needle begins to move out of the jet and affect fuel flow as the opening enlarges. It follows that taper wear, and the position of the needle clip in the grooves also affect fuel flow rate. If the needle clip is changed from the standard position to a lower groove, the needle taper starts coming out of the jet sooner, resulting in a richer mixture; moving the clip higher produces a leaner mixture.

Each jet needle is designated with a number/letter code, the meaning of which is explained below. Except for the last number ("3" in this example), this code is stamped on the needle directly below the 5 grooves.

Example: 5GL3-3

Jet Needle



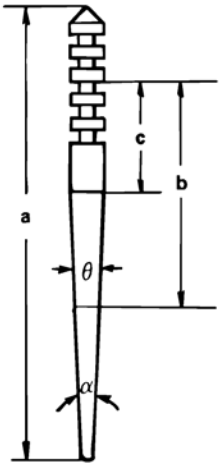
(1) The first number indicates the length of dimension "a". The 5 in the example stands for 50 mm and over, but under 60 mm. A four would mean from 40 up to 50 mm and so on.

(2) Each needle is tapered in two steps. The first letter indicates the angle of the upper taper θ; the next letter shows the angle of taper α, the lower taper. The letter A = 0°15′, and each successive letter is for an angle 15 minutes greater. By calculating for the example, then, G= 1°45′, and L = 3°00′.

(3) This is the manufacturer lot number (Lot No. 3, in this case), and will vary with the individual needle.

(4) The last number (the second 3 in this example) is not stamped on the needle. This is the number of the standard groove in which the needle clip is fixed for that particular model. A 3 shows that the standard setting is in the third, or middle, groove.

Jet Needle (196)



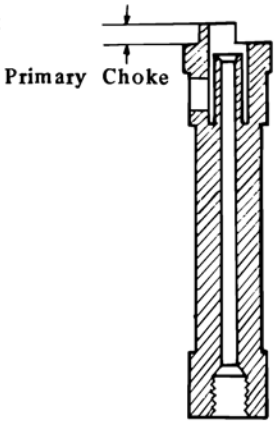
e. Needle Jet

As explained earlier, the needle jet works in conjunction with the jet needle to regulate fuel flow rate.

In the side of the needle jet, there is an air bleed opening which brings in air measured by the air jet. This air initiates the mixing and atomizing process inside the needle jet, and mixing is augmented by a projection at the needle jet outlet, called the primary choke.

The letter number code stamped on the jet indicates jet inside diameter. A "0-2" code, for example, means the inside diameter of the needle jet is 2.61 mm.

Needle Jet (197)



Needle Jet Inside Diameter

	0	1	2	3		9
N	2.550	2.555	2.560	2.565	–	2.595
O	2.600	2.605	2.610	2.615	–	2.645
P	2.650	2.655	2.660	2.665	–	2.695
Q	2.700	2.705	2.710	2.715	–	2.745

f. Pilot Jet

From idling to low speeds, the fuel supply is measured out chiefly by the pilot jet. In the sides of the pilot jet, there are several air bleed openings which serve the same purpose as the air bleed in the needle jet, that is, to reduce the fuel to mist.

The number stamped on the jet is an indication of the amount of fuel in cc's which passes through the jet during a one minute interval under a given set of conditions.

g. Pilot Air Screw

This air screw controls the mixture from idling to low speeds. The tapered tip of the air screw projects into the air passage leading to the pilot jet air bleeds, and by turning the screw in or out, the cross-sectional area of the air passage is varied, in turn varying the pilot jet air supply and changing the mixture ratio.

3) Troubles · Adjustment

When the gasoline/air mixture from the carburetor is incorrect, a rough estimate of possible carburetor failure can be limited to the clogging of some air or fuel passage, wear of parts, or the wrong float level.

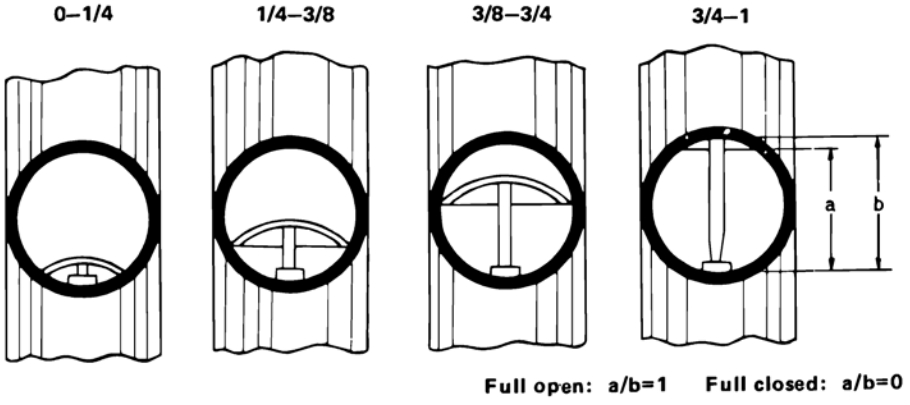
First ascertain whether the mixture is too rich or lean, then use the throttle grip and determine at what degree of throttle valve opening the malfunction is apparent.

Mixture too rich
Runs rough. Misses. Heavy exhaust. Engine runs worse after warming up. Spark plugs fouled with carbon. Runs better without air cleaner.

Mixture too lean
Engine overheats. Runs better with the starter pushed. Spark plug electrodes burn away. Fluctuations in engine speed. No power.

Throttle Opening

198



a. 0 – 1/4 Throttle Opening

At this throttle opening, the fuel measured by the pilot jet (A) mixes with air adjusted by pilot air screw (B), producing a rich mixture output from pilot outlet (C). This rich mixture is then further blended with the small air flow in the main air flow in the main bore and fed into the engine. This pilot system is generally called the "slow system".

Pilot jet (A) is of a fixed size, and overall mixture strength is varied by increasing or decreasing air intake with the air screw (B). Therefore the most important point is to achieve correct air screw adjustment.

If the mixture is too rich, causes of this trouble might be clogging of the pilot air intake, or of the pilot jet air passage or air bleed opening. Possible causes of a lean mixture might be obstruction of the pilot jet or jet outlet. Other possible failures are included in the following table.

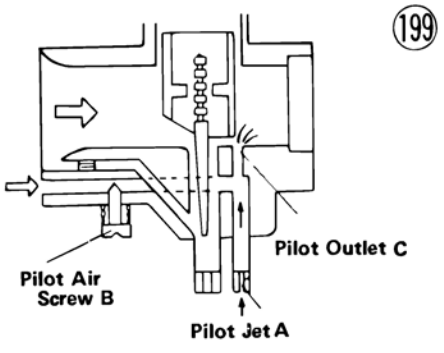
Too rich
Pilot jet mounting loose. Starter lever is not completely returned. Starter lever returned but starter plunger not fully closed.

Too lean
Throttle valve has worn and developed play. Carburetor mounting is loose, allowing air to leak in.

In the case of passage or jet clogging, clean the affected parts with pure gasoline and blow them out with compressed air. Under no circumstances should wire or other hard objects be used for cleaning. Never use compressed air to clean an assembled carburetor as this can damage the float and cause a rich fuel mixture.

0 – ¼ Throttle Opening

199



b. 1/4 – 3/8 Throttle Opening

At this opening both the slow and main systems are being utilized. The slow system, i.e. pilot system, is as explained in the previous paragraph. In the main system, fuel is drawn up through the clearance between the jet needle (E) and the needle jet (F), the rate of flow being decided by the throttle valve cutaway (G) and the jet/needle clearance. Since fuel intake is from two systems at this throttle opening, both systems must be investigated for the source of any trouble. Check the slow system as already explained.

Dirt collecting in the main jet (H), or in the needle jet would block the fuel flow and cause a lean mixture. Sources of trouble resulting in a rich mixture might be a blocked air passage, air jet (I), or the air bleed opening of needle jet (F); or an abnormally large needle jet/jet needle clearance due to needle jet wear; or a loose needle jet (F) or main jet (H). If a blocked passage or jet is found to be the source of trouble, remove the obstruction in the same manner as explained in paragraph "a". If jet needle wear is indicated, replacement of the needle is the best remedy, although changing the groove position of the needle clip may serve as a temporary expedient.

c. 3/8 – 3/4 Throttle Opening

At 1/4 to 3/8 throttle opening the main and slow systems together regulated fuel flow.

At 3/8 to 3/4 opening, however, flow rate is determined almost completely by the main system.

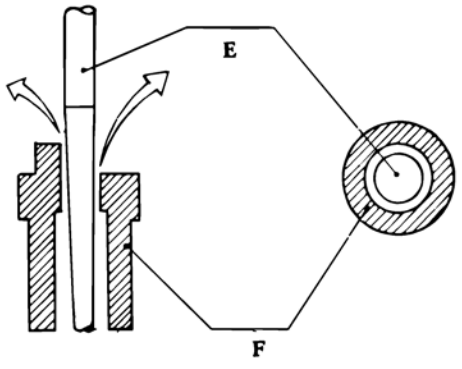
Fuel is drawn up through the main jet (H) and mixed inside the needle jet (F) with air from the

air jet (I). This rich mixture passes up between the needle jet and the tapered portion of the jet needle into the main bore.

Among possible causes of faulty functioning would be obstruction or loose mounting of the main jet or needle jet, clogging of the air jet or needle jet, and jet needle wear.

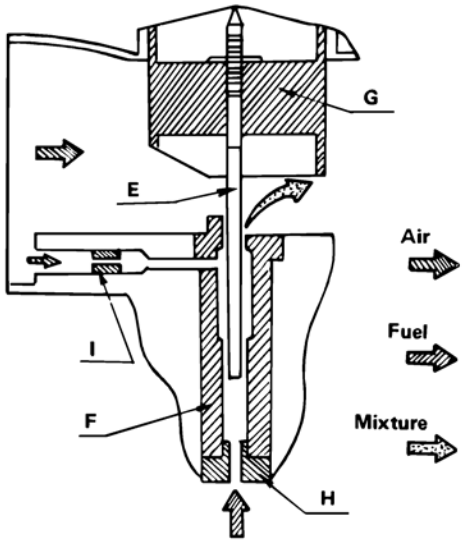
1/4 – 3/8 Throttle Opening

200



3/8 – 3/4 Throttle Opening

201



d. 3/4 – Full Throttle

In paragraphs "b" and "c" fuel flow was governed by the jet needle/needle jet (E/F) opening, but the when throttle valve (G) is this close to fully open, the jet needle is also pulled up high and the needle/jet clearance (R) becomes larger than the cross-sectional area (X) of the main jet (H) opening, and consequently fuel flow is controlled only by the main jet.

As in paragraph "c", any trouble might be due to clogging or loose mounting of the main jet, or blocking of the air jet, air passages, or needle jet, If after ascertaining the absence of clogging or loose mounting, the carburetor still does not function properly, the main jet must be adjusted by replacement. It should be kept in mind that the main jet is used during lower speeds as well as at open throttle, so there are limits to the amount of adjustment that can be made.

With the reversible type jet, the standard jet can be varied #2.5 at a time. To make the mixture leaner use the next lower numbered jet; the next higher numbered jet will produce a richer mixture.

¾ – Full Throttle Opening

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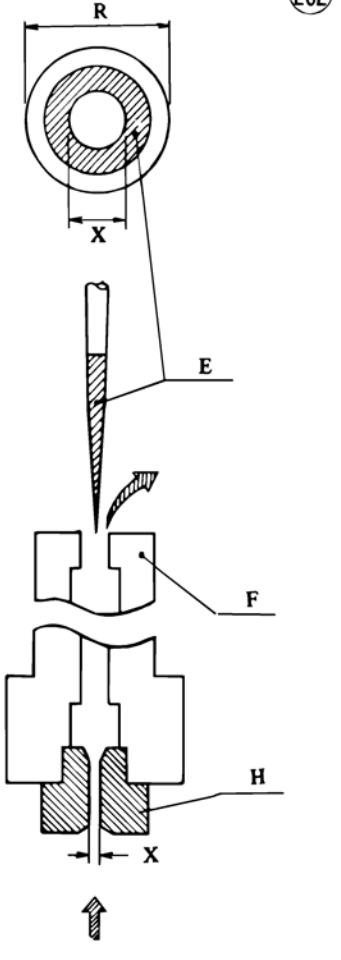
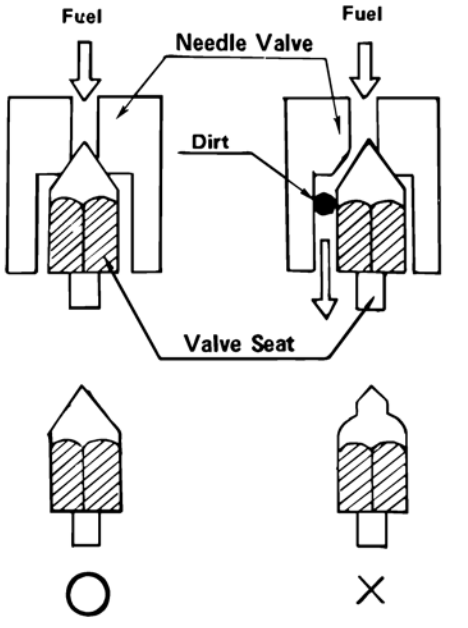


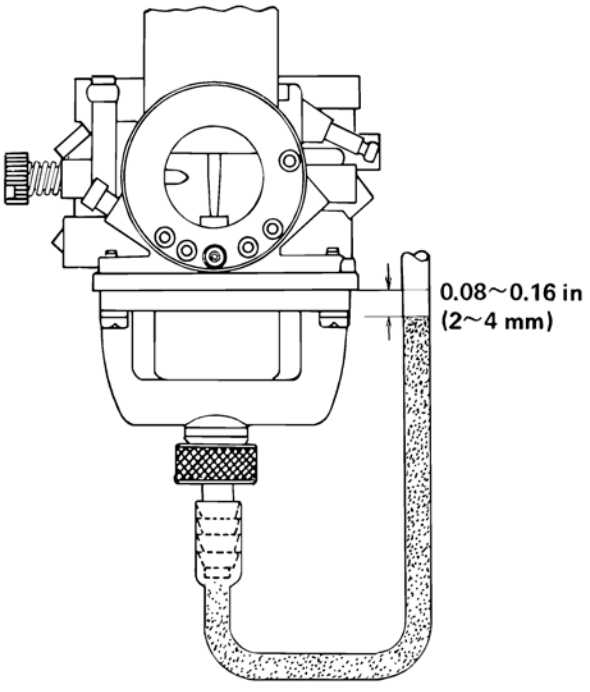
e. Float Mechanism

The fuel level is governed by the projection of the float, so the most important point is correct float adjustment. Dirt between the needle valve and seat preventing valve closing, wear or damage in the needle valve area, float puncture, etc. may cause overflowing. On the other hand, if the needle sticks to the seat, no fuel will flow into the float chamber.

Needle and Seat



Fuel Level Measurement



Turn the fuel tap off, and remove the carburetor from the intake manifold with the fuel hose left in place. Remove the float bowl, and install the fuel level measurement device (special tool) in its place.

Keeping the carburetor vertical, hold the plastic tube against the carburetor body, turn on the fuel tap, and read the fuel level. The fuel level in the hose should come up to 0.08~0.16 in. (2~4 mm) below the edge of the carburetor body. If the fuel level is incorrect, remove the special tool and the float (pull out the pivot pin to drop out the float, and catch the needle as it falls). Bend the tang on the float a very slight amount to change the fuel level. Bending it up closes the valve sooner and lowers the fuel level; bending it down raises the fuel level.

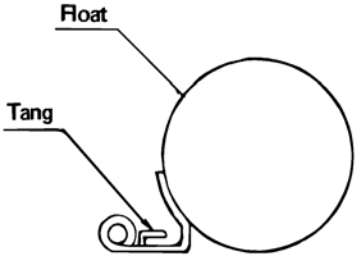


Table 21 Carburetor Specifications

Model	Type	Main Jet	Air Jet	Needle Jet	Jet Needle	Pilot Jet	Cut-Away	Air Screw	Fuel Level
old CDI H1	VM28sc	100	0.5	0–2	5GL3-3	30	3.0	1¼ turns out	30±1 mm (1.18±0.04 in)
old H1 without CDI	VM28sc	90	0.5	0–2	5EH7-3	30	2.5	1½ turns out	30±1 mm (1.18±0.04 in)
H1-B	VM28sc	95	0.5	0–4/8 *0–4	5DJ19-4	30	2.0 *2.5	1½ turns *1¼ out	30±1 mm (1.18±0.04 in)
H1-C	VM28sc	100	0.5	0–2	5GL3-3	30	3.0	1¼ turns out	30±1 mm (1.18±0.04 in)
H1-D/H1-E	VM28sc	92.5	0.5	0–4/8	5DJ19-4	30	2.5	1¼ turns out	30±1 mm (1.18±0.04 in)
H2/H2-A	VM30sc	97.5	0.5	0–6/8	5EJ15-3	35	2.5	1½ turns out	30±1 mm (1.18±0.04 in)
H2-B	VM30sc	102.5	0.5	0–6/8	5EJ15-4	40	2.5	1¾ turns out	30±1 mm (1.18±0.04 in)

*European model