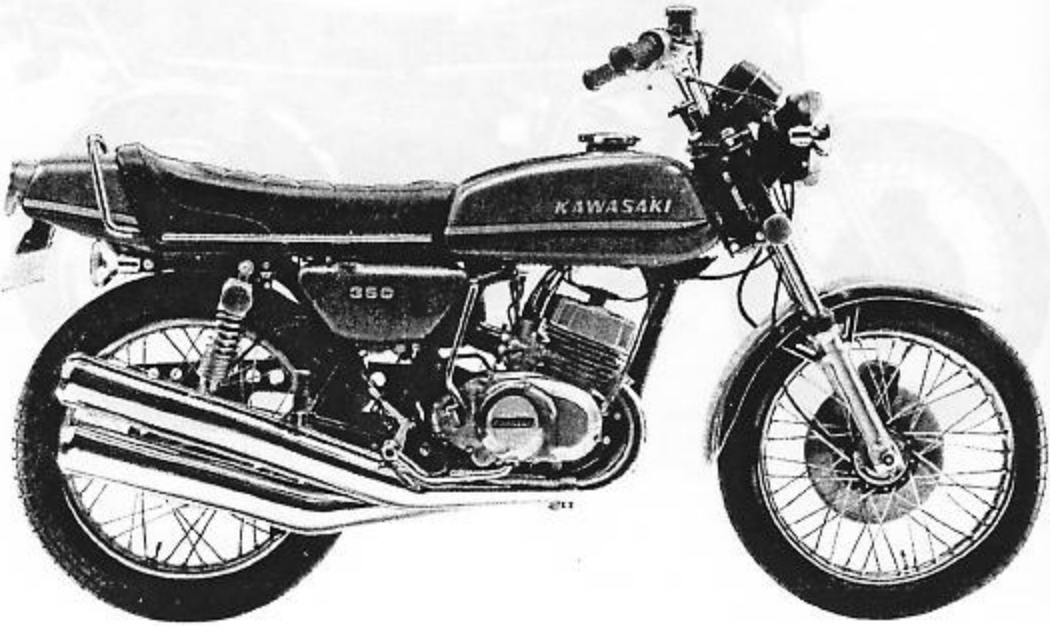
SHOP MANUAL

S1, S1A, S1B, S1C,
KH250-A5, KH250-B1 (1972～1976)
S2, S2A (1972～1973)
S3, S3A, KH400-A3 (1974～1976)

Kawasaki

KH(S) Series


KAWASAKI
KH250


KAWASAKI
350

Foreword

This shop manual covers maintenance and repair of all models in the S Series and KH Series.

Before starting to service a motorcycle, careful reading of the applicable section is recommended to eliminate unnecessary work.

Wiring diagrams, and an alphabetical index can be found at the rear of the manual.

MODEL APPLICATION

Year	Model	Begin Frame No.	Major Changes
1972	S1	S1F-00001~	
1973	S1A	S1F-04691~	
1974	S1B	S1F-12001~	Brake lining wear indicator added
1975	S1C	S1F-16300~	
1976	KH250-A5	S1F-24400~	
1976	KH250-B1*	S1F-24400~	Disc brake adopted
1972	S2	S2F-00001~	
1973	S2A	S2T-00001~	Disc brake adopted
1974	S3	S3F-00001~	
1975	S3A	S3F-14300~	Spark plug
1976	KH400-A3	S3F-26200~	C.D.Ignition; Clutch release; Air cleaner, Muffler and assoc. parts for sound level control

*European model

Table of Contents

I. Specifications

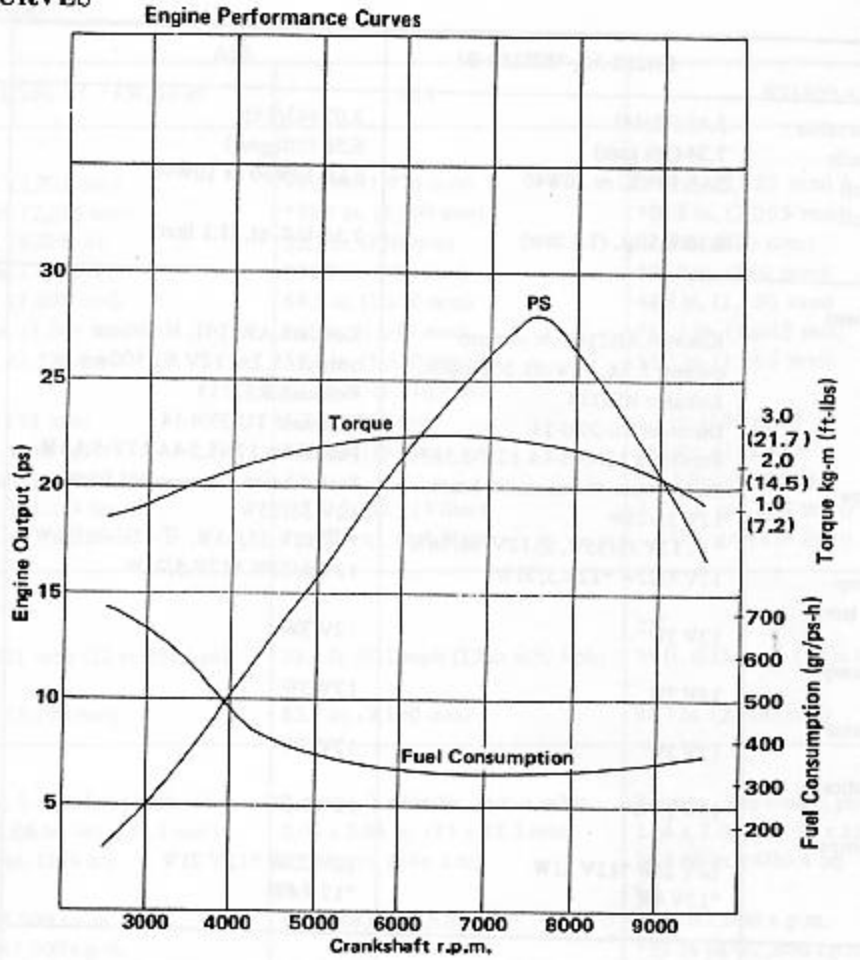
	KH250-A5, *KH250-B1	S2A	KH400-A3
Dimensions			
Overall length	79.7 in. (2,025 mm) *82.1 in. (2,085 mm)	77.5 in. (1,970 mm) *78.7 in. (2,000 mm)	79.7 in. (2,025 mm) *80.9 in. (2,055 mm)
Overall width	32.2 in. (820 mm) *29.9 in. (760 mm)	32.3 in. (820 mm) *32.3 in. (770 mm)	32.3 in. (820 mm) *29.9 in. (760 mm)
Overall height	43.1 in. (1,095 mm) *41.1 in. (1,045 mm)	44.5 in. (1,130 mm) *41 in. (1,045 mm)	44.5 in. (1,130 mm) *41.1 in. (1,045 mm)
Wheelbase	54.1 in. (1,375 mm)	52.5 in. (1,330 mm) *51.5 in. (1,310 mm)	53.7 in. (1,365 mm)
Road clearance	6.1 in. (155 mm)	6.3 in. (160 mm)	5.9 in. (150 mm)
Dry weight	348 lbs. (158 kg) *353 lbs. (160 kg)	335 lbs. (152 kg)	357 lbs. (162 kg) *364 lbs. (165 kg)
Fuel tank capacity	3.7 U.S. gal. (14 liters)	3.7 U.S. gal. (14 liters)	3.7 U.S. gal. (14 liters)
Oil tank capacity	1.6 U.S. qt. (1.5 liters)	1.6 U.S. qt. (1.5 liters)	1.6 U.S. qt. (1.5 liters)
Performance			
Climbing ability	27°	40°	27°
Braking distance	39 ft. @31 mph (12 m @50 kph)	39.4 ft. @31 mph (12 m @50 kph)	39 ft. @31 mph (12 m @50 kph)
Minimum turning radius	82.7 in. (2,100 mm)	82.7 in. (2,100 mm)	82.7 in. (2,100 mm)
Engine			
Type	2-stroke, 3 cylinder, piston valve	2-stroke, 3 cylinder, piston valve	2-stroke, 3 cylinder, piston valve
Bore and stroke	1.77 x 2.06 in. (45 x 52.3 mm)	2.09 x 2.06 in. (53 x 52.3 mm)	2.24 x 2.06 in. (57 x 52.3 mm)
Displacement	15.2 cu.in. (249 cc)	21.2 cu.in. (346.2 cc)	24.4 cu.in. (400.4 cc)
Compression ratio	7.5	7.3	6.5
Maximum horsepower	28 ps @7,500 r.p.m. *26 ps @7,000 r.p.m.	44 ps @8,000 r.p.m.	38 ps @7,000 r.p.m. *Ⓒ 36 ps @7,000 r.p.m.
Maximum torque	19.5 ft-lbs (2.7 kg-m) @7,000 r.p.m. *19.5 ft-lbs (2.7 kg-m) @6,500 r.p.m.	28.9 ft-lbs (4.0 kg-m) @7,500 r.p.m.	28.2 ft-lbs (3.9 kg-m) @6,500 r.p.m. *Ⓒ 26.8 ft-lbs (3.7 kg-m) @6,500 r.p.
Port timing			
Intake – Open	74° BTDC	73° BTDC	73° BTDC
– Close	74° ATDC	73° ATDC	73° ATDC
Scavenge – Open	62° BBDC	58° BBDC	58° BBDC
– Close	62° ABDC	58° ABDC	58° ABDC
Exhaust – Open	83° BBDC	89° BBDC	86° BBDC
– Close	83° ABDC	89° ABDC	86° ABDC
Carburetor type	Mikuni VM22SC	Mikuni VM24SC	Mikuni VM26SC
Lubrication system	Superlube oil injection	Superlube oil injection	Superlube oil injection
Engine oil	2-stroke engine oil	2-stroke engine oil	2-stroke engine oil
Starting system	Kick starter	Kick starter	Kick starter
Ignition system	Battery and coil, mechanical	Battery and coil, mechanical	Electronic CDI
Ignition timing	23° BTDC	23° BTDC	23° BTDC @4,000 r.p.m.
Spark plugs	NGK B9HS	NGK B9HS	NGK B8HS
Transmission			
Type	5-speed, constant mesh, return shift	5-speed, contant mesh, return shift	5-speed, constant mesh, return shift
Clutch	Heavy duty multiple disc, wet plate	Heavy duty multiple disc, wet plate	Heavy duty multiple disc, wet plate
Gear ratio			
1st	2.86 (40/14)	2.86 (40/14)	2.86 (40/14)
2nd	1.79 (34/19)	1.79 (34/19)	1.79 (34/19)
3rd	1.35 (31/23)	1.35 (31/23)	1.35 (31/23)
4th	1.12 (28/25)	1.12 (28/25)	1.12 (28/25)
5th	0.96 (26/27)	0.96 (26/27)	0.96 (26/27)
Primary reduction ratio	2.22 (60/27)	2.22 (60/27)	2.22 (60/27)

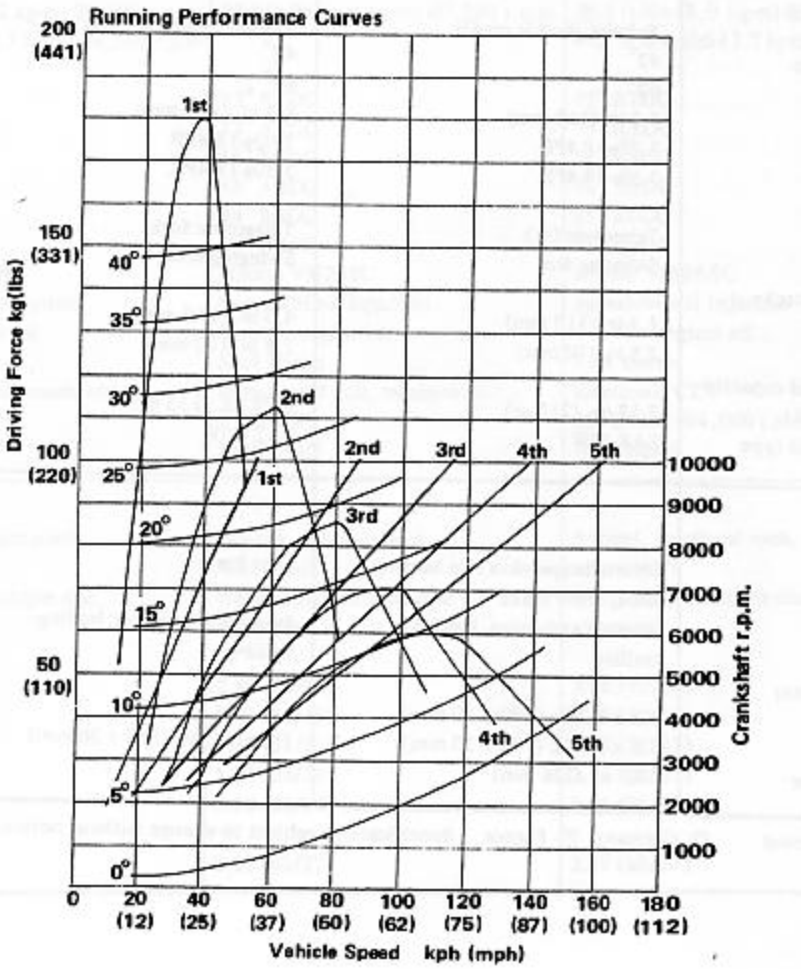
	KH250-A5, *KH250-B1	S2A	KH400-A3
Final reduction ratio	3.43 (48/14)	3.07 (43/14)	2.73 (41/15)
Overall drive ratio	7.34 (5th gear)	6.56 (5th gear)	5.85 5th gear)
Transmission oil	SAE 10W30 or 10W40	SAE 10W30 or 10W40	SAE 10W30 or 10W40
Transmission oil capacity	1.16 U.S. qt. (1.1 liter)	1.16 U.S. qt. (1.1 liter)	1.16 U.S. qt. (1.1 liter)
Electrical Equipment			
Generator	Kokusan AR2101, Minimum output: 5.3A, 12V @1,500 r.p.m.	Kokusan AR2101, Minimum output: 5.3A, 12V @1,500 r.p.m.	Kokusan FP6123, Minimum charging current 3.5A, 13V @1,500 r.p.m.
Regulator	Kokusan RS2114	Kokusan RS2114	Kokusan RS2126
Ignition coil	Diamond TU-29M-14	Diamond TU-29M-14	Kokusan IG3190～3192
Battery	Furukawa 12N5.5-4A 12V-5.5AH	Furukawa 12N5.5-4A 12V-5.5AH	Furukawa 12N5.5-4A 12V-5.5AH
Head lamp type	Sealed beam *Semi-sealed beam	Sealed beam *Semi-sealed beam	Sealed beam *Semi-sealed beam
Head lamp	12V 35/25W *Ⓖ 12V 35/35W, Ⓕ 12V 36/36W	12V 35/25W *Ⓖ 12V 35/35W, Ⓕ 12V 36/36W	12V 35/25W *Ⓖ 12V 35/35W, Ⓕ 12V 36/36W
Tail/Brake lamp	12V 8/23W *12V 5/21W	12V 8/23W *12V 5/21W	12V 8/23W *12V 5/21W
Speedometer lamp (two)	12V 3W	12V 3W	12V 3W
Tachometer lamp (two)	12V 3W	12V 3W	12V 3W
Neutral indicator lamp	12V 3W	12V 3W	12V 3W
High beam indicator lamp	12V 1.5W	12V 1.5W	12V 1.5W
Turn signal lamps (four)	12V 23W *12V 21W	12V 23W *12V 21W	12V 23W *12V 21W
*City lamp	*12V 4W	*12V 4W	*12V 4W
Frame			
Type	Tubular, double cradle	Tubular, double cradle	Tubular, double cradle
Steering angle	42°	42°	42°
Caster	62°	62°	62°
Trail	4.3 in. (110 mm)	4.3 in. (110 mm)	4.4 in. (112 mm)
Tires: Front	3.25s-18 4PR	3.00s-18 4PR	3.25s-18 4PR
Rear	3.50s-18 4PR	3.50s-18 4PR	3.50s-18 4PR
Suspension			
Front	Telescopic fork	Telescopic fork	Telescopic fork
Rear	Swinging arm	Swinging arm	Swinging arm
Suspension stroke			
Front	4.3 in. (110 mm)	4.3 in. (110 mm)	4.3 in. (110 mm)
Rear	2.8 in. (70 mm)	2.8 in. (70 mm)	2.8 in. (70 mm)
Front fork oil capacity (each fork)	7.17 oz. (212 cc)	5.24 oz. (155 cc)	7.17 oz. (212 cc)
Front fork oil type	SAE 10W	SAE 10W	SAE 10W
Brakes			
Type			
Front	Internal expansion two leading shoe, *Disc brake	Disc brake	Disc brake
Rear	Internal expansion, leading-trailing	Internal expansion, leading-trailing	Internal expansion, leading-trailing
Inside diameter			
Front	7.1 x 1.2 in. (180 x 30 mm)		
Rear	7.1 x 1.2 in. (180 x 30 mm)	7.1 x 1.2 in. (180 x 30 mm)	7.1 x 1.2 in. (180 x 30 mm)
Disc diameter	*8.9 in. (226 mm)		8.9 in. (226 mm)

* European model Ⓖ Germany Ⓕ France Specifications subject to change without notice.

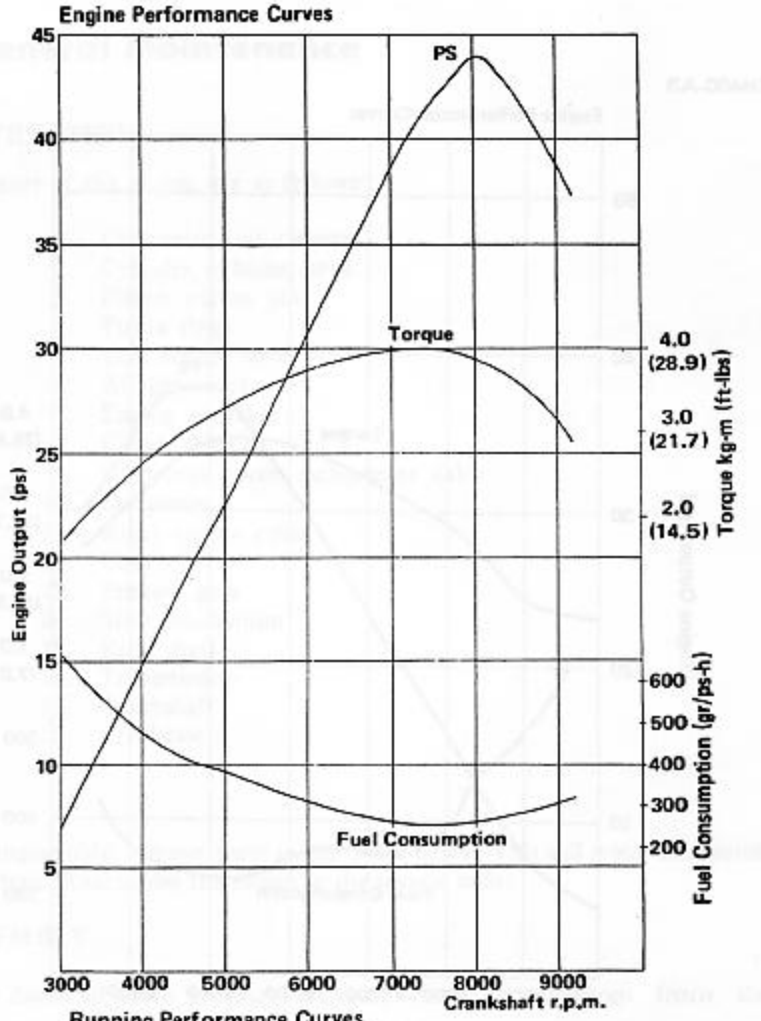
PERFORMANCE CURVES

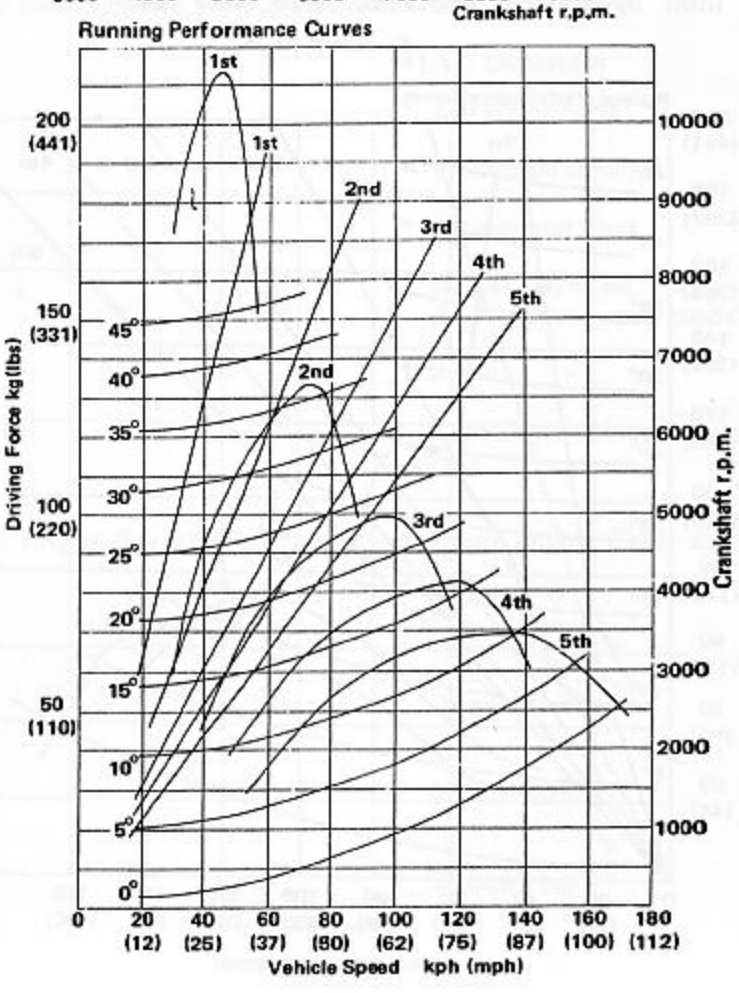
KH250-A5



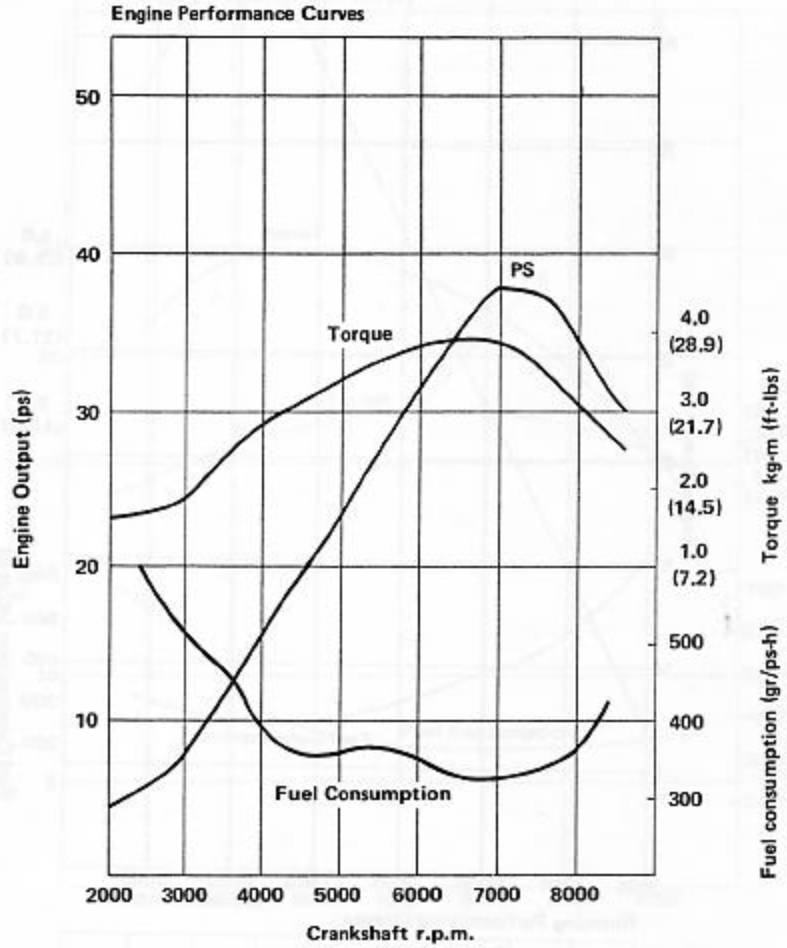


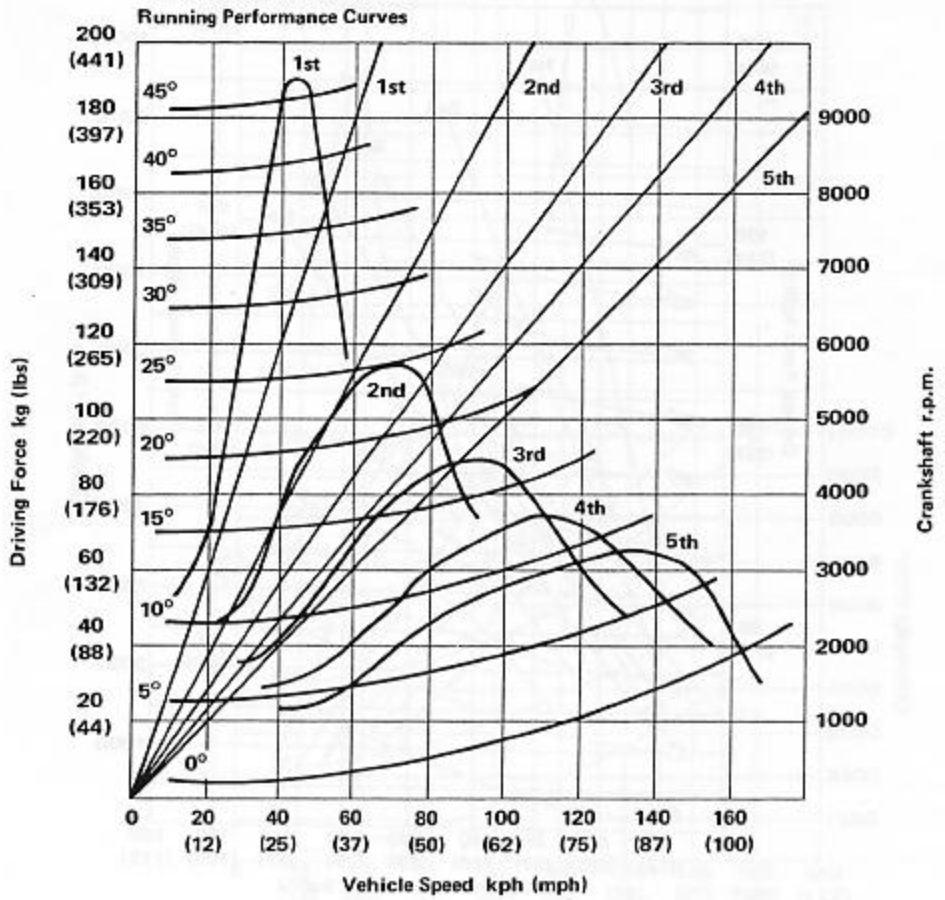
S2A


Engine Performance Curves
PS
Torque
Fuel Consumption
Engine Output (ps)
Torque kg-m (ft-lbs)
Fuel Consumption (gr/ps-h)
Crankshaft r.p.m.
45
40
35
30
25
20
15
10
5
4.0 (28.9)
3.0 (21.7)
2.0 (14.5)
600
500
400
300
200
3000 4000 5000 6000 7000 8000 9000


Running Performance Curves
1st
2nd
3rd
4th
5th
Driving Force kg (lbs)
Crankshaft r.p.m.
Vehicle Speed kph (mph)
200 (441)
150 (331)
100 (220)
50 (110)
45°
40°
35°
30°
25°
20°
15°
10°
5°
0°
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0 20 (12) 40 (25) 60 (37) 80 (50) 100 (62) 120 (75) 140 (87) 160 (100) 180 (112)

KH400-A3


Engine Performance Curves
Engine Output (ps)
50
40
30
20
10
PS
Torque
Fuel Consumption
4.0 (28.9)
3.0 (21.7)
2.0 (14.5)
1.0 (7.2)
Torque kg-m (ft-lbs)
500
400
300
Fuel consumption (gr/ps-h)
2000 3000 4000 5000 6000 7000 8000
Crankshaft r.p.m.


Running Performance Curves
Driving Force kg (lbs)
200 (441)
180 (397)
160 (353)
140 (309)
120 (265)
100 (220)
80 (176)
60 (132)
40 (88)
20 (44)
45°
40°
35°
30°
25°
20°
15°
10°
5°
0°
1st
2nd
3rd
4th
5th
9000
8000
7000
6000
5000
4000
3000
2000
1000
Crankshaft r.p.m.
0 20 (12) 40 (25) 60 (37) 80 (50) 100 (62) 120 (75) 140 (87) 160 (100)
Vehicle Speed kph (mph)

II. Engine : General Maintenance

1. ENGINE CONSTRUCTION

The major components of the engine are as follows:

1. Carburetor, air cleaner
2. Cylinder, cylinder head
3. Piston, piston pin
4. Piston rings
5. Left engine cover
6. AC generator
7. Engine sprocket
8. Clutch release
9. Oil pump cover, tachometer cable
10. Oil pump
11. Right engine cover
12. Clutch
13. Primary gear
14. Shift mechanism
15. Kick shaft
16. Transmission
17. Crankshaft
18. Crankcase

During engine disassembly, remove parts in the order listed. This will make disassembly easy and avert unnecessary steps. Reassemble the engine in the reverse order.

2. MINOR DISASSEMBLY

The engine can be disassembled to a certain extent without removing it from the frame.

1) Air Cleaner

* Left side cover
* Air inlet pipes
* Air cleaner

2) Carburetors

* Air inlet pipes
* Carburetors

3) Clutch Cable and Engine Sprocket

* Gear shift pedal
* Front chain cover
* Clutch cable
* Chain
* Engine sprocket

4) AC Generator

* Left engine cover
* Front chain cover
* AC generator wires
* Magneto Flywheel (C.D. Ignition system model)
* Stator
* Rotor (Contact breaker type model)

5) Right Engine Cover and Oil Pump

* Oil pump cover
* Tachometer cable
* Oil pump cable
* Oil inlet pipe
* Oil outlet pipes

* Right engine cover

NOTE: Before removing right engine cover, first drain transmission oil.

* Oil pump

6) Clutch and Primary Gear

* Spring plate, friction plates, clutch plates, spring plate pusher

* Oil pump pinion

* Primary gear

* Clutch hub

* Clutch housing

7) Pistons

* Exhaust pipes

* Cylinder heads

* Cylinders

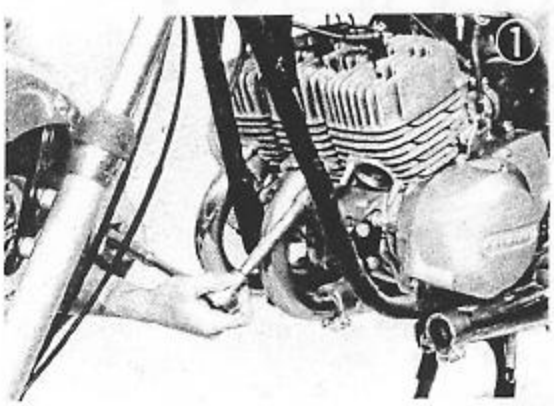
* Piston pins, pistons, small end needle bearings

* Piston rings

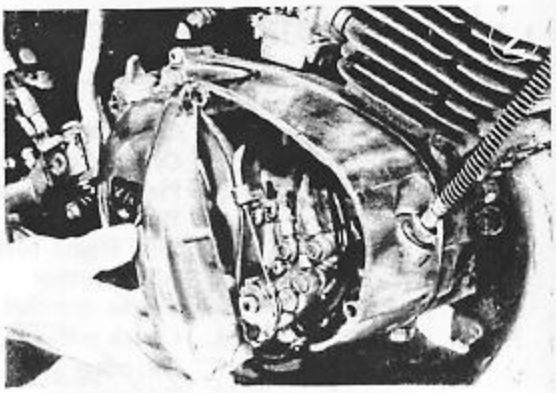
3. ENGINE REMOVAL

To remove the engine from the frame for replacement or disassembly, the order given shows the minimum amount of parts that it is necessary to remove. Any other order than that given here will involve more work and a greater number of parts to be removed.

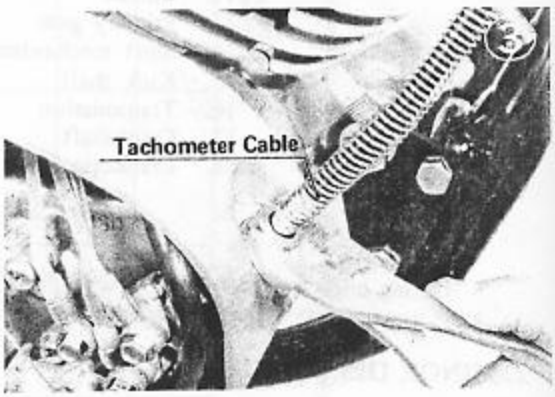
Exhaust pipes



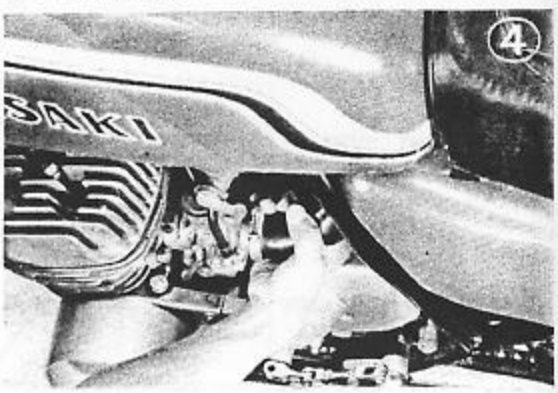
Oil pump cover



Tachometer cable

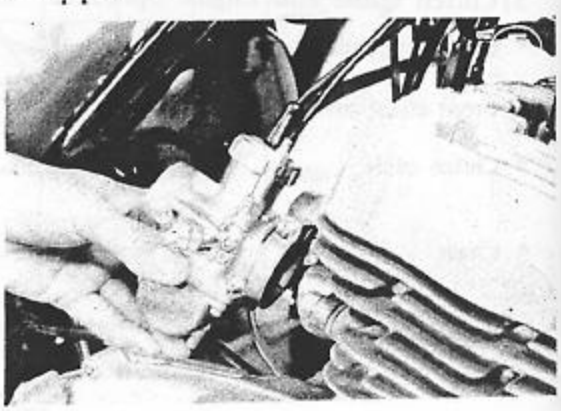


Air inlet pipes

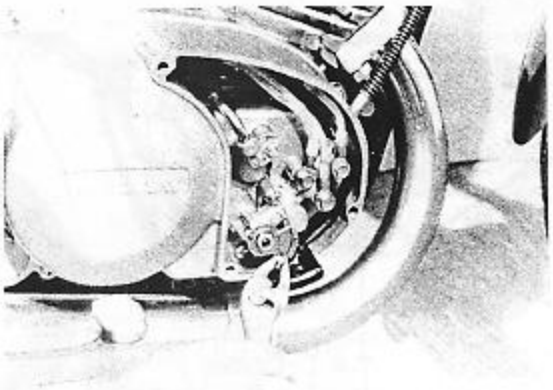


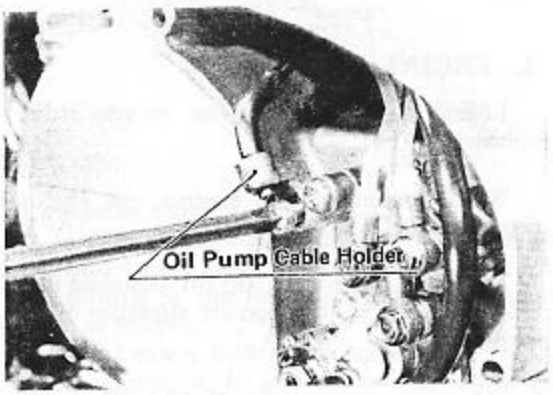
Carburetors

NOTE: First close the fuel tap and remove the fuel pipe.



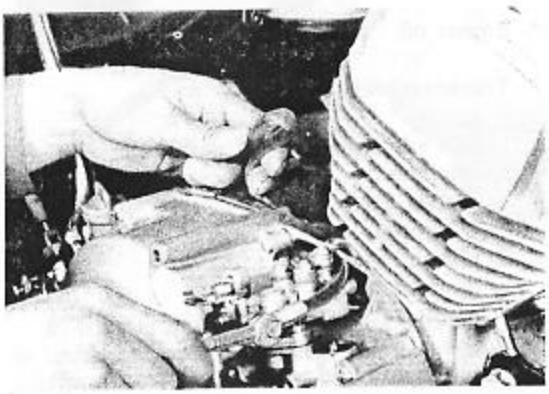
Oil pump cable

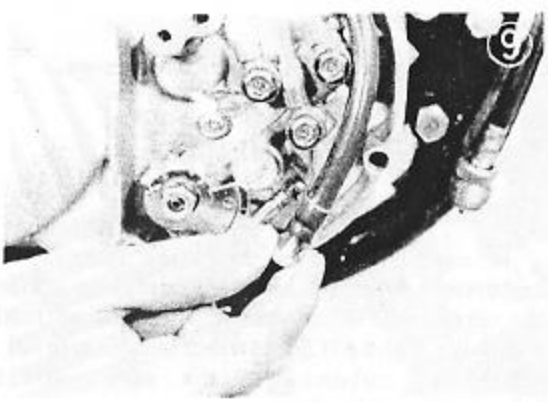




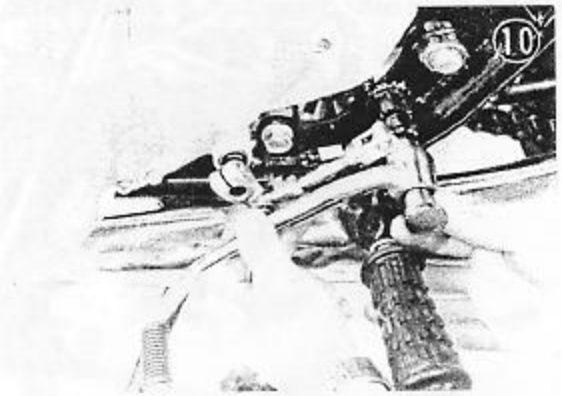
Oil inlet pipe

To prevent oil from leaking, remove the banjo bolt, take the banjo fitting out of the oil pipe, and insert a screw into the end of the pipe as illustrated.

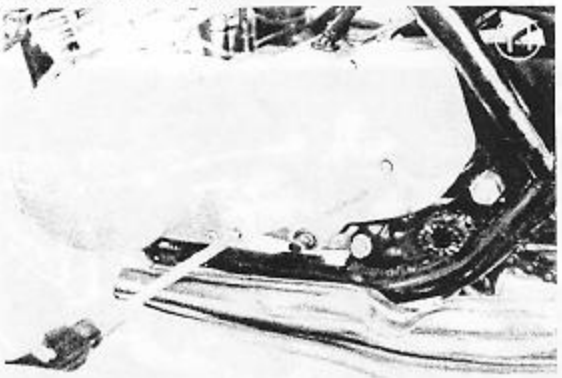




Shift pedal



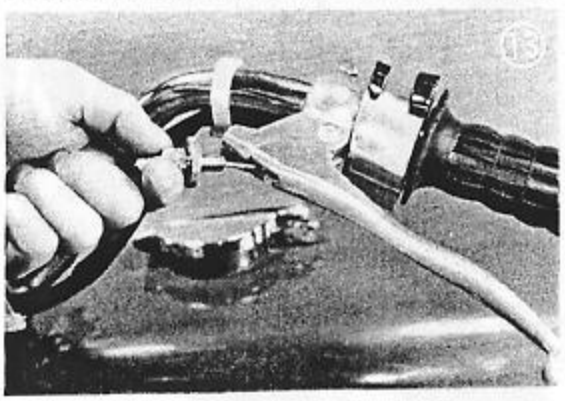
Front chain case cover

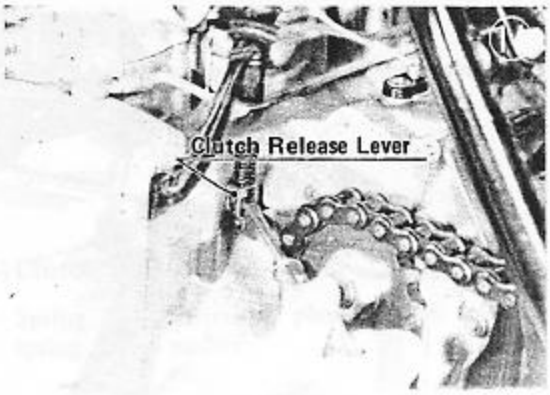


Drive chain

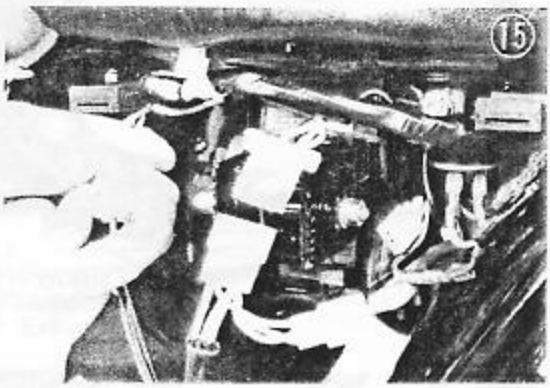
Clutch cable

To remove the clutch cable, loosen the clutch release lock nut, and giving the cable plenty of play with the adjusting screw, remove the inner wire of the clutch cable from the clutch release lever after straightening the lever tongue (Fig. 14).

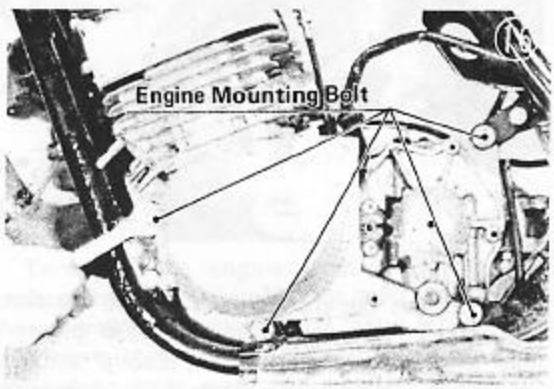




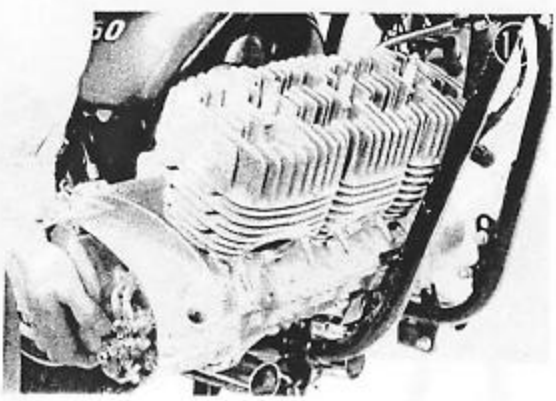
AC generator wiring



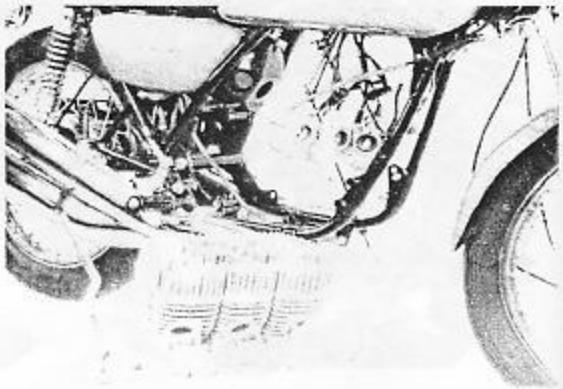
Engine mounting bolts



Engine



Completed disassembly



4. ENGINE MOUNTING

Engine mounting is in the reverse order of removal.

When mounting the engine, be especially careful of the following items:

* The open end of the clip on the chain master link must face in the opposite direction of chain movement.

* The wiring connections of the AC generator and high voltage cables.

* Tightening of the engine mounting bolts

When starting up the engine again, double check the following:

* Engine oil

* Transmission oil

* Engine adjustments
  a. Idle speed
  b. Starter cable
  c. Oil pump
  d. Clutch
  e. Ignition timing

* Frame adjustments
  a. Brake and brake lamp switch

  b. Drive chain

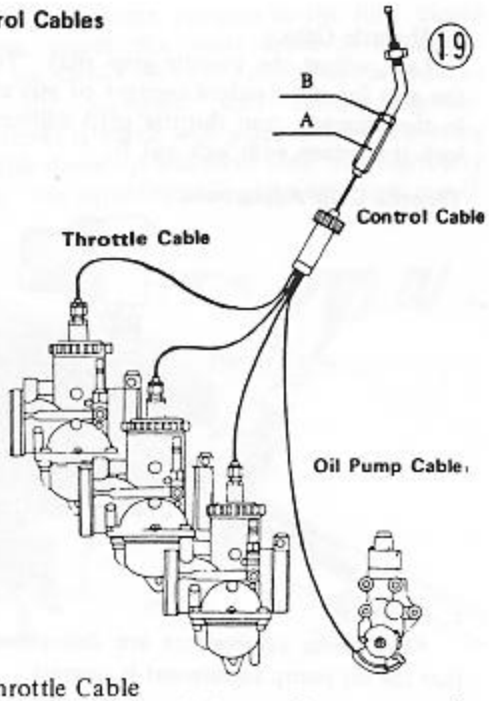
* Tightening of all nuts, bolts and screws.

5. ENGINE ADJUSTMENTS

1) Idling Adjustment

In engines of more than one cylinder, the carburetors must be adjusted evenly to achieve the correct idle adjustment. Especially with the 3 cylinder S and KH Series machines, be careful to adjust each carburetor to the same point by following the order given.

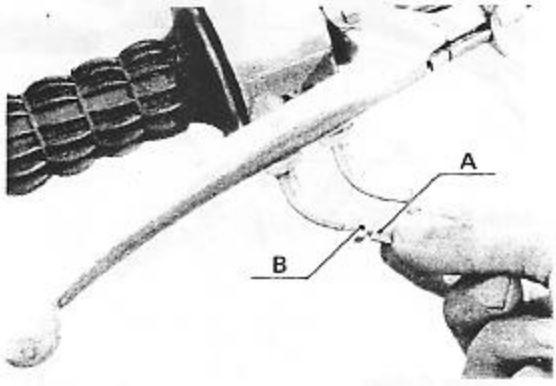
Control Cables



a. Throttle Cable

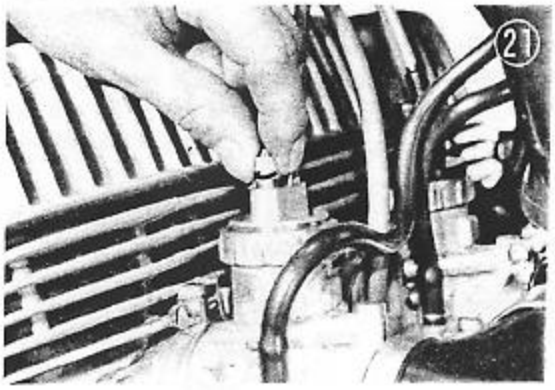
In order to have all three cables move together, the cables must all be adjusted for zero play with the throttle in the fully closed position. Adjust them as follows:

(1) Loosen lock nut B and screw in control cable adjuster A to give the throttle grip ample play.

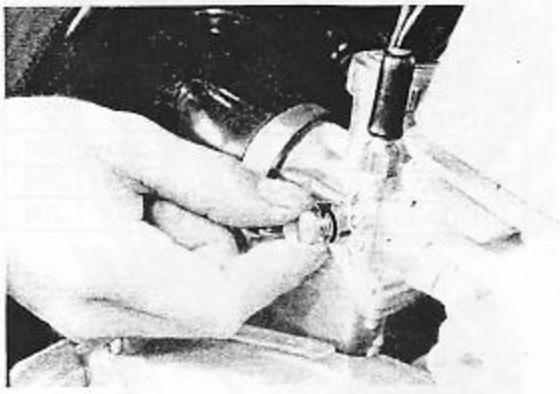


(2)

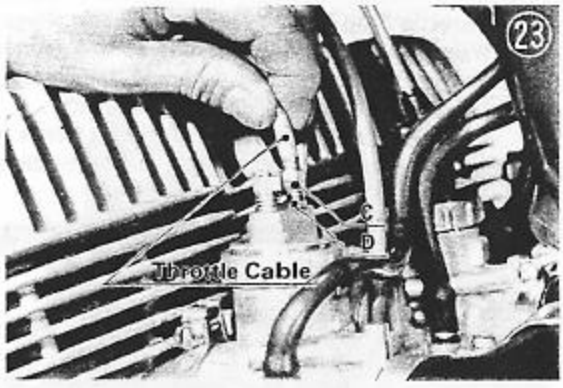
i. S1, KH250 : Turn each throttle stop screw in until the throttle valves are in the fully closed position.



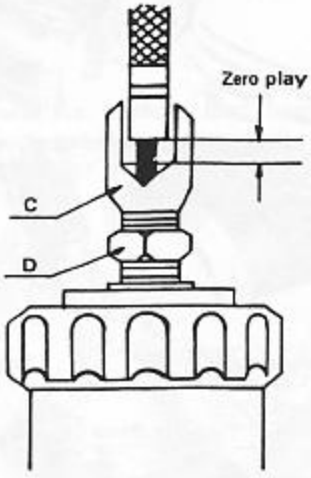
ii. S2, S3, KH400 : Back out each throttle stop screw until the throttle valves are in the fully closed position.



(3) With all the throttle valves fully closed, adjust the outer sleeve of each throttle cable for zero play. Accomplish this by turning throttle cable adjuster C right or left, while moving the cable sleeve up and down until no play is felt. Don't fail to tighten lock nut D after adjustment is made.



Throttle Cable Adjustment

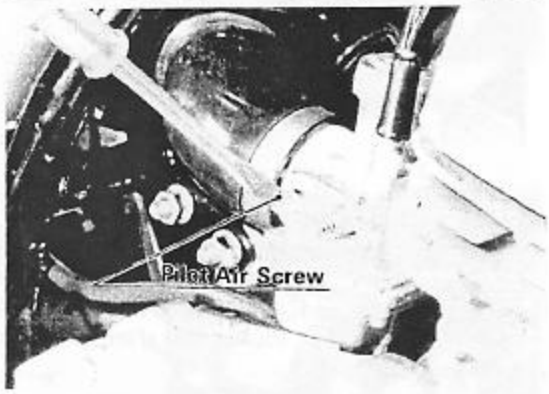


b. Air Screw

Turn each carburetor air screw fully in and back it out the number of turns called for in the table.

Table 1 Air Screw Setting

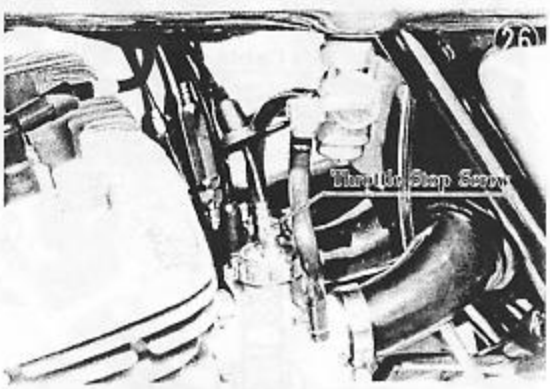
Model	Air Screw (turns out)	Idling Speed (r.p.m.)
S1	1¾	1,300~1,500
S1A, S1B	1¼	1,300~1,500
S1C, KH250-A5 KH250-B1	1½	1,200~1,300
S2, S2A	1½	1,300~1,500
S3, S3A	1¾	1,100~1,200
KH400-A3	1¼	1,100~1,200



c. Throttle Stop Screws

Warm up the engine for one or two minutes to bring engine up to normal temperature, where the gasoline will atomize properly.

Turn the individual throttle stop screws to bring the engine to the lowest stable rotational speed obtainable.

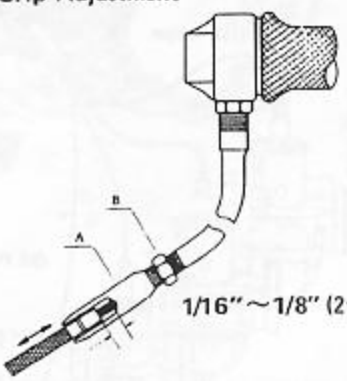


Hold your hands in back of the mufflers to check that the three exhaust pressures are equal. Make fine adjustments with the stop screws and/or air screws if this is necessary to obtain even exhaust pressure and stable idling.

d. Throttle Grip

Last, adjust the throttle grip play. To adjust the grip for the standard amount of play as shown in the diagram, turn throttle grip adjuster A and lock it in place with lock nut B.

Throttle Grip Adjustment (28)

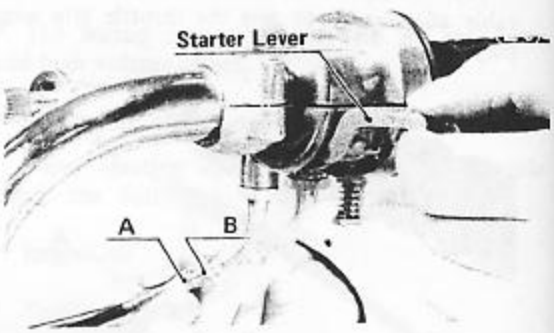


e. Oil Pump

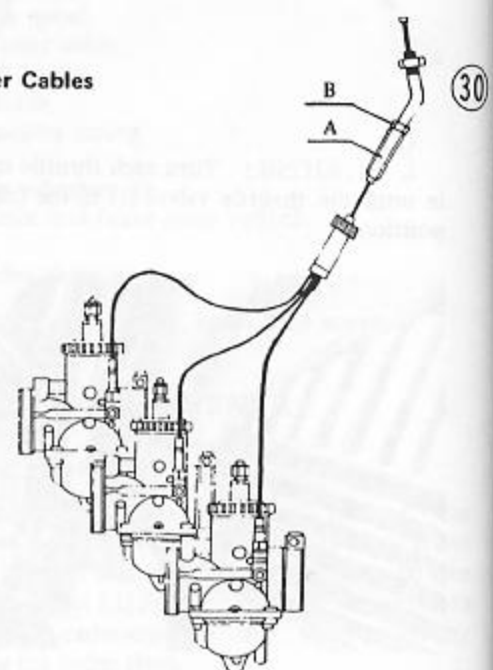
After these adjustments are completed, check that the oil pump adjustment is correct.

2) Starter Lever Adjustment

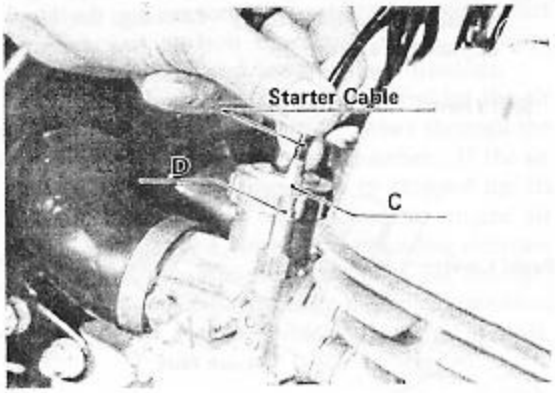
a. First give the starter lever sufficient play. Lever play is varied with starter lever adjuster A.



Starter Cables (30)



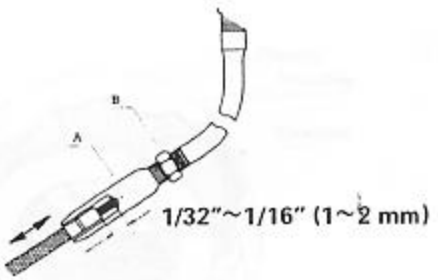
b. With the starter plungers in the fully closed position, adjust the outer sleeve of all starter cables for .04 – .08" (1–2 mm) play, in order to have all plungers start moving together. Adjustment is made with adjuster C while moving the cable sleeve up and down until only slight play is felt. Fix adjustment in place with lock nut D.



c. Last, adjust starter lever play as shown in the diagram. Turn starter lever adjuster A, locking it in place with lock nut B.

Starter Lever Adjustment

(32)



3) Oil Pump Adjustment

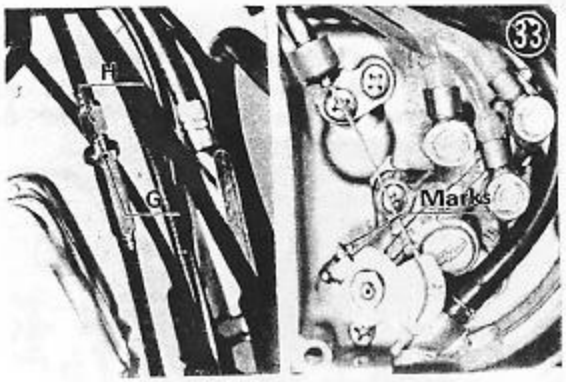
The oil pump must increase and decrease oil flow rate with throttle valve movement, minimum oil output corresponding to zero throttle valve opening.

With the throttle grip closed, use oil pump cable adjuster H to set the lever so that the mark on the oil pump lever and the mark on the lever stopper are aligned.

CAUTION:

1. Do not fail to tighten lock nut G after adjustment is made.

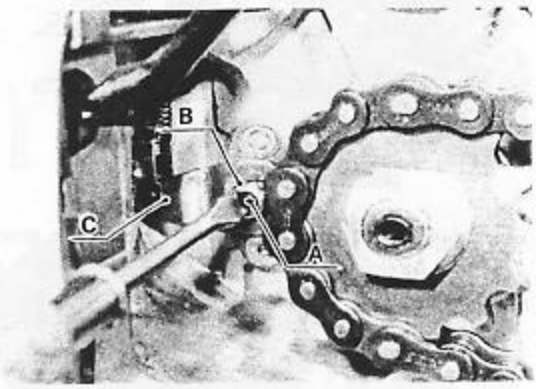
2. Be especially careful with this adjustment as improper adjustment may lead to piston seizure.



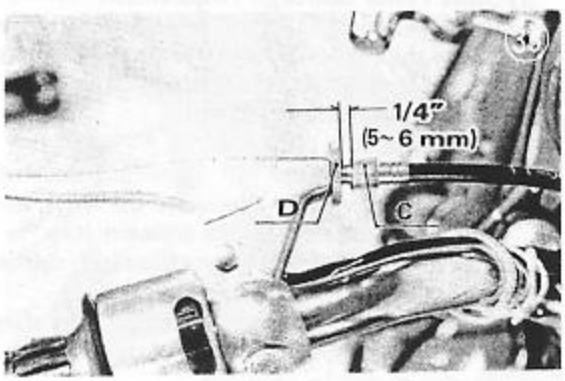
4) Clutch Adjustment

a. First adjust the release lever angle as outlined below.

(1) Loosen lock nut B and back out grooved screw A about 3 or 4 turns to give release lever C ample play.

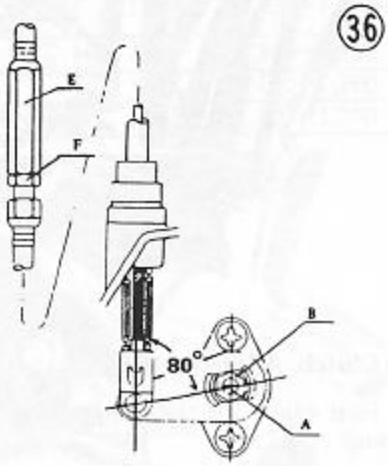


(2) Give the clutch hand lever play by loosening lock nut D and turning adjuster C, until the lever conforms with the measured position in the illustration.

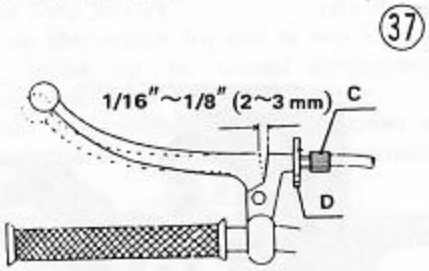


(3) Loosen lock nut F and turn clutch cable adjuster E until the release lever is at the 80° angle shown in the illustration. Hold the adjustment with lock nut F.

Release Lever Adjustment



Clutch Lever Adjustment



b. Next adjust the clutch itself. Turn in grooved screw A slowly until it suddenly becomes very hard to turn. This is where the clutch starts pushing on the screw and clutch operation begins. Hold the adjustment at this position with lock nut B.

c. Last adjust clutch lever play to the standard given in the illustration, by turning clutch lever adjuster C and locking it in place with lock nut D.

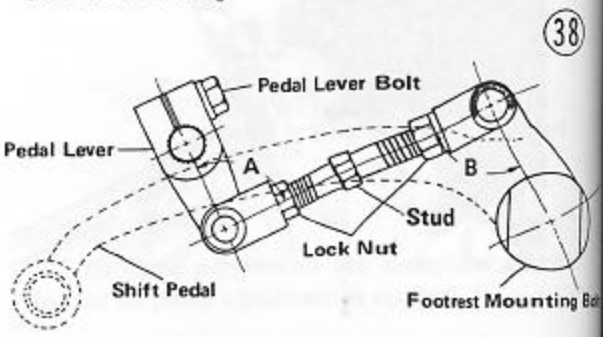
5) Shift Pedal Linkage Adjustment

To make the shift pedal function most effectively, the shift pedal links should be at 90° angles.

Improper angles of the shift pedal links may cause inaccurate shift operation.

a. First loosen both lock nuts.
b. Set angles A & B at 90° by turning the stud. Turning it clockwise decreases the angle, and turning it counterclockwise increases it.
c. After making the necessary adjustment, tighten the lock nuts.
   In case angle B can not be adjusted by only turning the stud, the position of the pedal lever serration should be changed.
d. Take out the pedal lever bolt.
e. Pull out the pedal lever. When the pedal lever can not be pulled out, loosen the footrest mounting bolt.
f. Reset the pedal lever so that angle B will be at 90°.
g. Screw in the pedal lever bolt, and tighten the footrest mounting bolt.
h. After making angle B adjustment, angle A should be adjusted by turning the stud as explained above.

Shift Pedal Linkage



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.

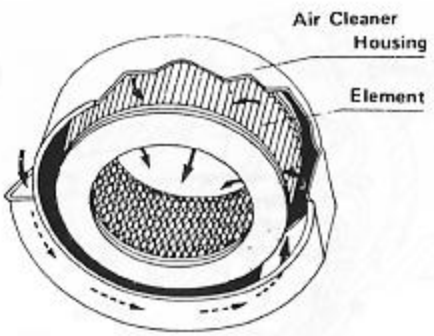
This dusty air must first be filtered by the air cleaner so that only clean air passes through the carburetor to the combustion chamber. If the air cleaner element becomes dirty or stopped up, its filtering efficiency is reduced and the engine air intake is hampered, with a corresponding decrease in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

1) Construction

Figures 39 is a cross-sectional view of the S Series air cleaner. Air flow is in the direction of the arrows and is filtered by the element in the center.

Air Cleaner

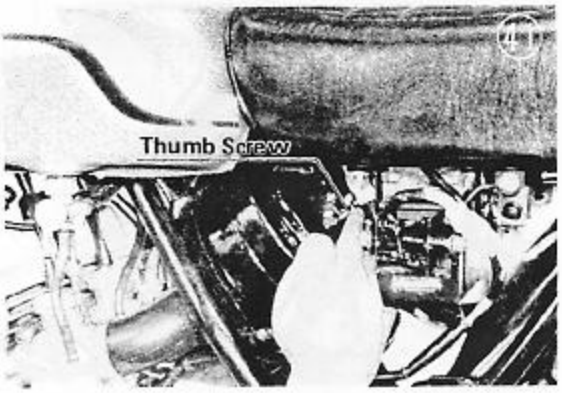
(39)



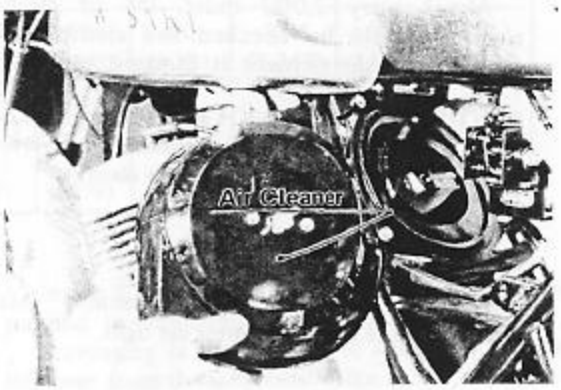
2) Disassembly

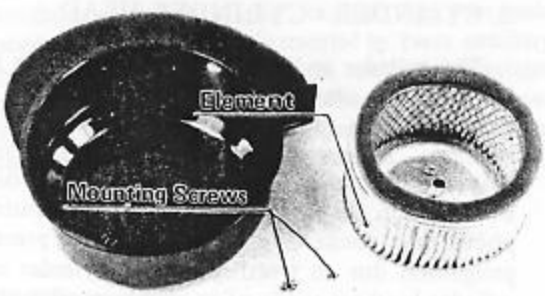
Remove side cover.

Loosen thumb screw.

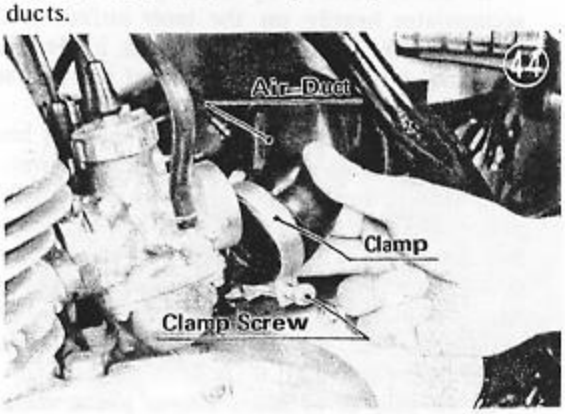


Pull air cleaner out through left side of frame. Take out two element mounting screws, remove element.

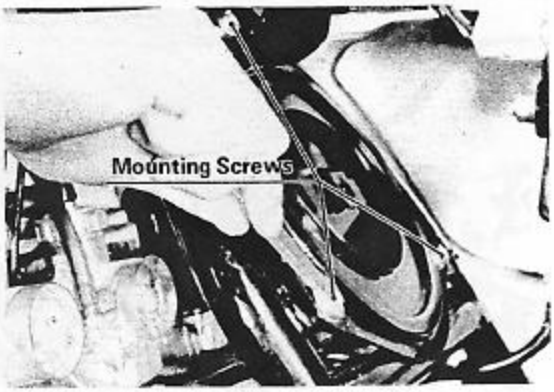




Remove three hose clamps and pull off air inlet ducts.



Take out three mounting bolts to remove air cleaner base plate from frame.



3) Overhaul

About every 2,000 miles, the air cleaner element should be checked and cleaned with gasoline. If the element is damaged, replace it.

CAUTION: The S and KH series element is a dry type; oil or gasoline/oil mixture should not be used to clean it.

4) Assembly

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

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 performance.

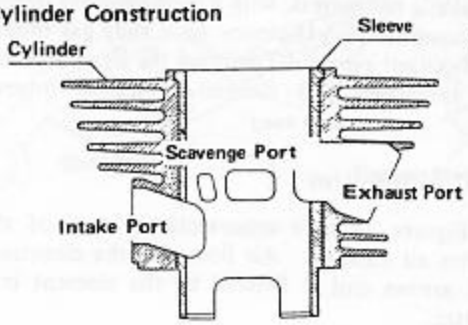
In the case of cylinder wear or piston seizure, restoration is possible with boring and honing.

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 (46)



Port Timing (47)

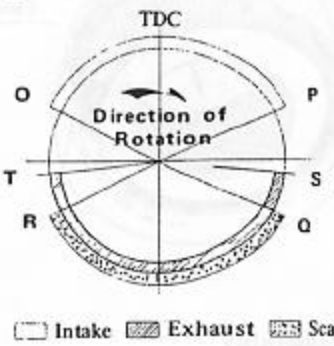


Table 2 Port Timing

Model		S1, KH250	S2	S3, KH400
Intake	Open 0°	74° BTDC	73° BTDC	73° BTDC
	Close P°	74° ATDC	73° ATDC	73° ATDC
Scavenge	Open Q°	62° BBDC	58° BBDC	58° BBDC
	Close R°	62° ABDC	58° ABDC	58° ABDC
Exhaust	Open S°	83° BBDC	89° BBDC	86° BBDC
	Close T°	83° ABDC	89° ABDC	86° ABDC

Port Measurements

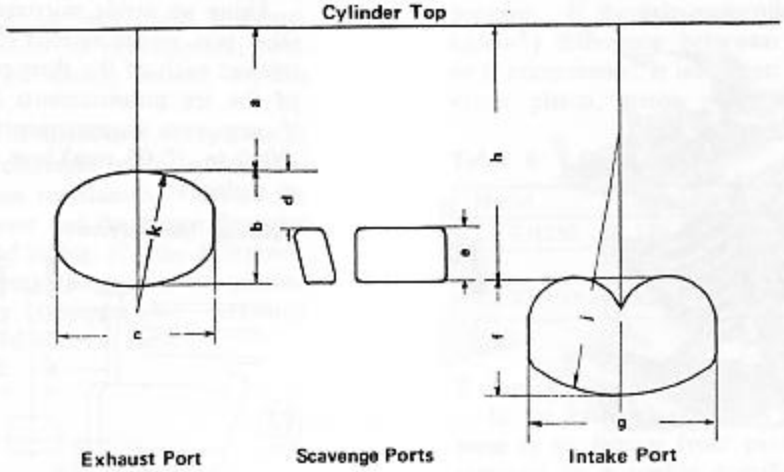


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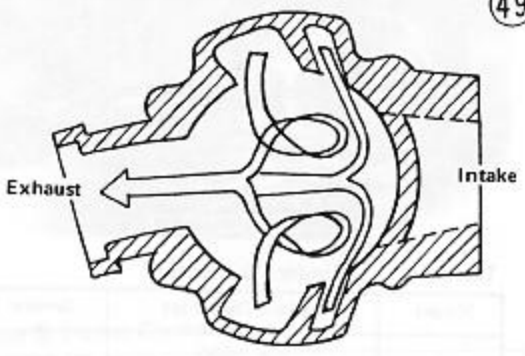
Table 3 Port Measurements [mm (inch)]

Model	A	B	C	D	E	F	G	H	J	K
S1, KH250	33.7 (1.327)	22 (.866)	30 (1.181)	8.4 (.331)	12.4 (.488)	22.6 (.890)	30 (1.181)	59.5 (2.343)	90 (3.543)	50 (1.969)
S2	31.0 (1.220)	24.0 (0.945)	35.5 (1.398)	12.5 (.492)	11.0 (.433)	22.6 (.890)	36 (1.417)	59.0 (2.323)	90 (3.543)	50 (1.969)
S3, KH400	33.0 (1.299)	22.5 (0.886)	36 (1.417)	11.0 (.433)	11.5 (.453)	22.6 (.890)	36 (1.417)	55.5 (2.185)	90 (3.543)	70 (2.756)

Scavenge Gas Flow Pattern (Four port system)



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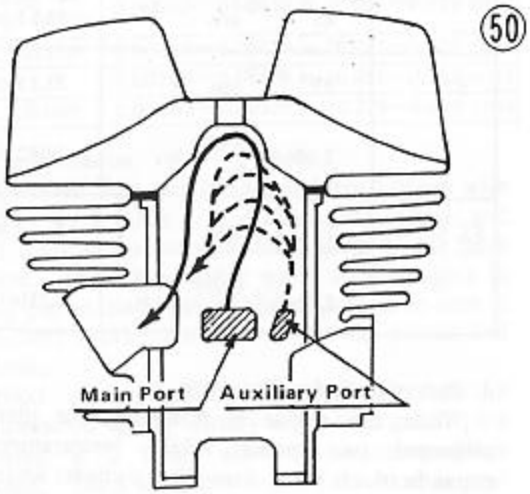


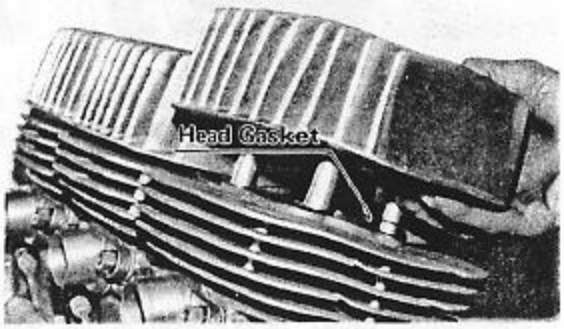
50

In the S and KH Series, the four-port scavenge method is employed to increase output power.

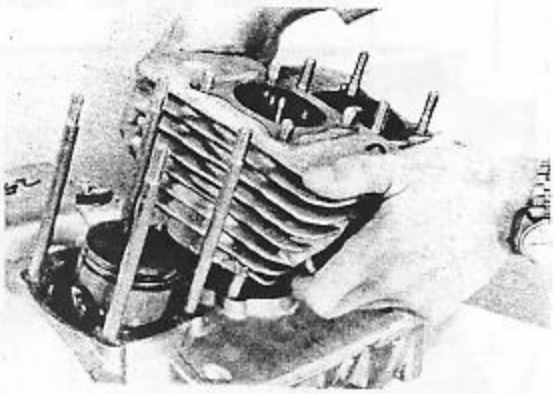
Scavenging is the process of replacing the gas left over from the last combustion cycle, with new gasoline mixture. With this four-port scavenge method, as shown in the diagram, the two main scavenge ports are supplemented by two auxiliary ports, providing an ideal gas circulation pattern and raising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

2) Disassembly

Remove head nuts. Remove cylinder heads and head gaskets.



Pull the cylinder off the studs.

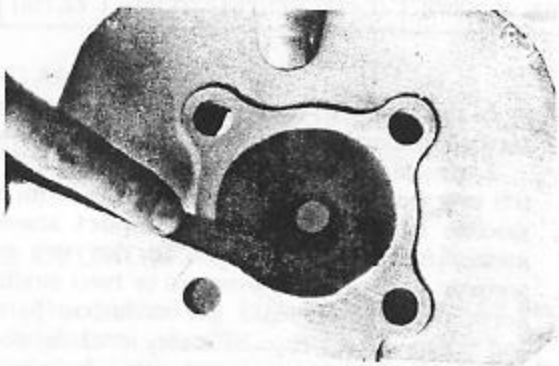


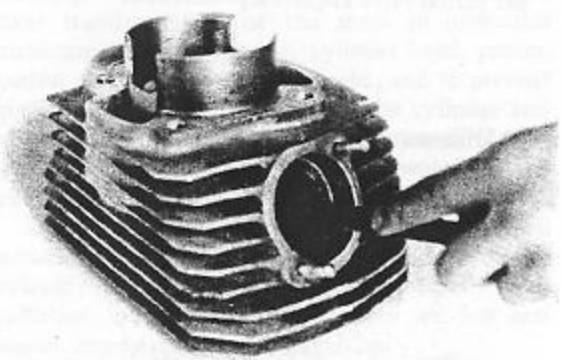
3) Overhaul

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 and 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. it 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

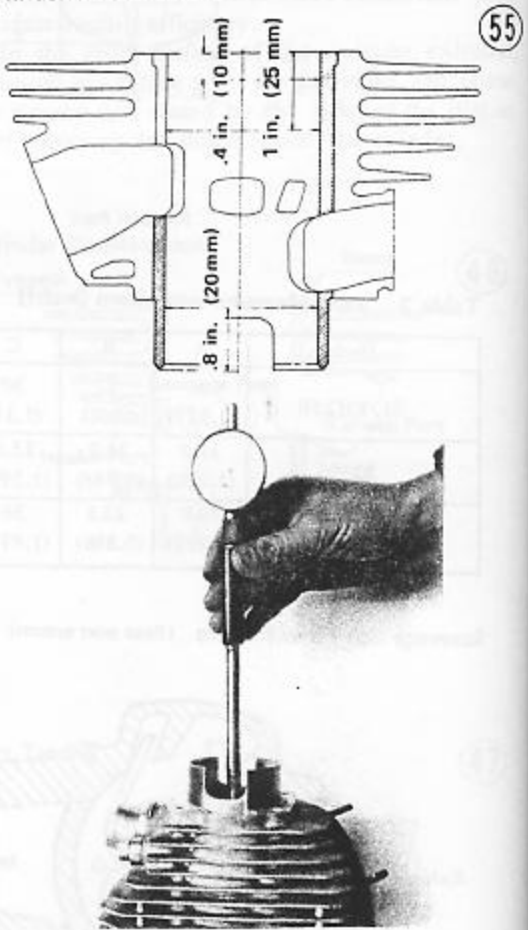


Table 4 Cylinder Diameter

Model	Standard Diameter	Service Limit
S1, KH250	$1.7717^{+.0006}_{-0}$ inch	1.7776 inch
	$45^{+.016}_{-0}$ mm	45.15 mm
S2	$53^{+.019}_{-0}$ mm	53.15 mm
	$2.0866^{+.0007}_{-0}$ in.	2.0925 in.
S3, KH400	$57^{+.019}_{-0}$ mm	57.15 mm
	$2.2441^{+.0007}_{-0}$ inch	2.2500 inch

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. 57 ; the difference between these two measurements is the piston/cylinder clearance. Compare the measured clearance with standard values in Table 5 .

Piston Clearance

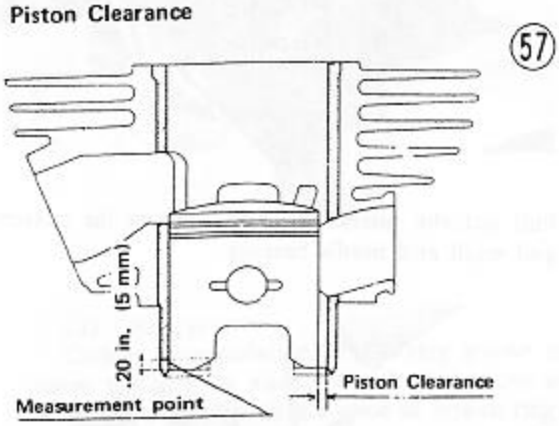


Table 5 Piston Clearance

Model	Standard Clearance
S1 Eng. No. 0~04593	0.00083~0.00114 in. (0.021~0.029 mm)
S1, KH250	0.00047~0.00079 in. (0.012~0.020 mm)
S2	0.00106~0.00138 in. (0.027~0.035 mm)
S3, KH400	0.00307~0.00339 in. (0.078~0.086 mm)

e. Compression

Confirm that the head is tightened down with 14.5 – 17.5 ft-lbs (2.0 – 2.4 kg-M) torque, and that there is no compression leakage at the head gasket. 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 with the throttle full open, and read compression. If there is more that 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
S1, KH250	170 psi (12.0 kg/cm^2)/700 r.p.m.
S2	156 psi (11.0 kg/cm^2)
S3, KH400	155 psi (10.9 kg/cm^2)/640 r.p.m.

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.

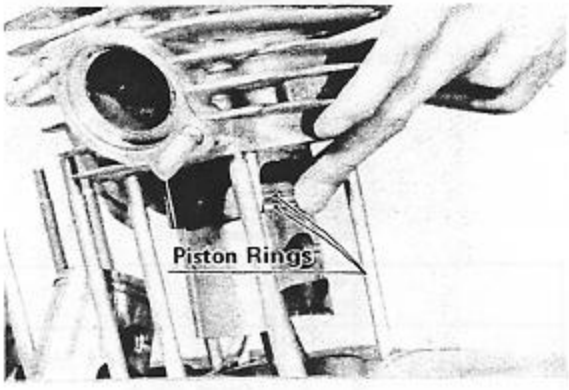
CAUTION: When the cylinder is bored, or when a new cylinder and piston are installed, the engine must be properly broken in, in the same manner as for a new vehicle.

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. 60), so that under normal running conditions its shape becomes almost perfectly cylindrical, and thus piston seizure due to piston expansion is averted.

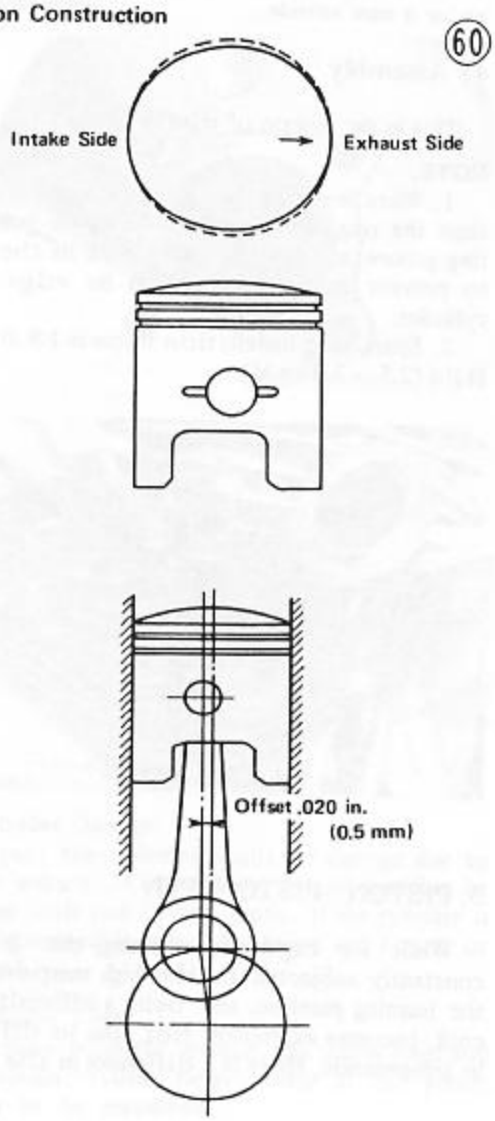
The piston is cast of light-weight, high-strength aluminum/silicon alloy with an extremely low heat expansion coefficient, and high resistance to heat and wear.

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.

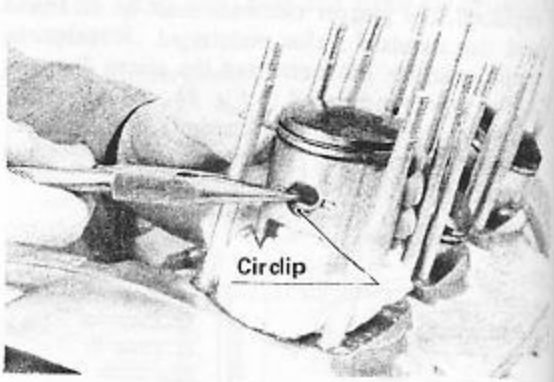
The pin is offset .020 in. (0.5 mm) toward the inlet side of the piston to minimize piston slap that occurs near bottom dead center of the combustion cycle.

Piston Construction

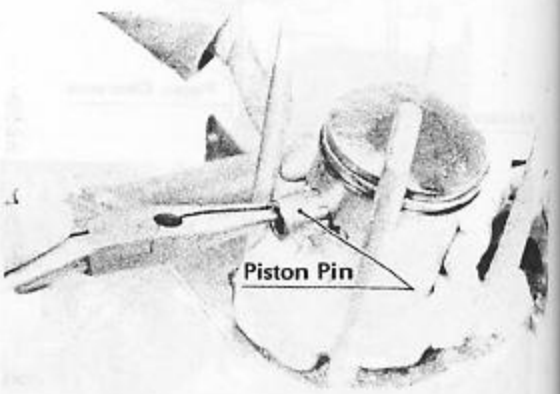


1) Disassembly

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.



Pull out the piston pin, and remove the piston and small end needle bearing.



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.

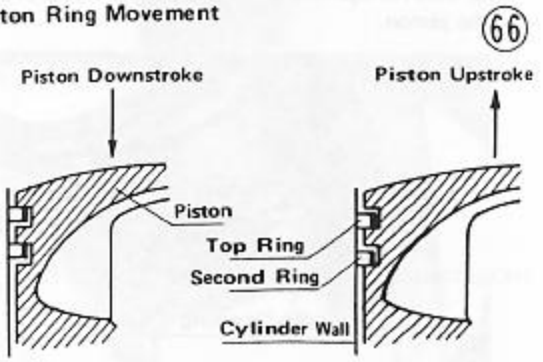
(2) Ring groove

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



(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 21.

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)

Table 7 Piston Specifications

	Model	Skirt Dia.	Top Groove width x depth	Second Groove width x depth
S1 KH250	inch	$1.7707\ ^{+0.0002}_{-0.001}$	$.0591\ ^{+.0039}_{+.0031} \times .0991 \pm .0020$	$.0591\ ^{+.0024}_{+.0016} \times .0991 \pm .0020$
	mm	$44.975\ ^{+0.005}_{-0.025}$	$1.5\ ^{+0.10}_{+0.08} \times 2.516 \pm .05$	$1.5\ ^{+0.06}_{+0.04} \times 2.516 \pm .05$
S2	inch	$2.0856\ ^{+0.0002}_{-0.001}$	$.0591\ ^{+.0039}_{+.0031} \times .0984 \pm .0039$	$.0591\ ^{+.0024}_{+.0016} \times .0984 \pm .0039$
	mm	$52.975\ ^{+0.005}_{-0.025}$	$1.5\ ^{+0.10}_{+0.08} \times 2.5 \pm 0.1$	$1.5\ ^{+0.06}_{+0.04} \times 2.5 \pm 0.1$
S3 KH400	inch	$2.2415\ ^{+0.0002}_{-0.001}$	$.0591\ ^{+.0039}_{+.0031} \times 0.1019 \sim 0.1040$	$.0591\ ^{+.0024}_{+.0016} \times 0.1019 \sim 0.1040$
	mm	$56.934\ ^{+0.005}_{-0.025}$	$1.5\ ^{+0.10}_{+0.08} \times 2.591 \sim 2.641$	$1.5\ ^{+0.06}_{+0.04} \times 2.591 \sim 2.641$

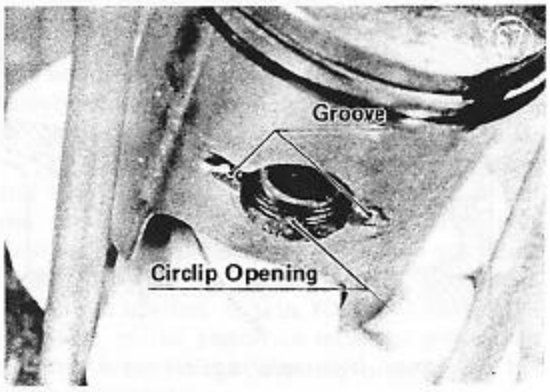
3) Assembly

This is the reverse of disassembly.

CAUTION:

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

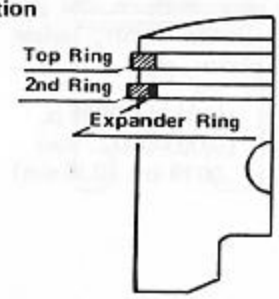
2. Use a new piston pin circlip in place of the one removed during disassembly. Align the circlip so that its opening does not face either groove in the piston.



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.

Ring Position (68)



1) Disassembly

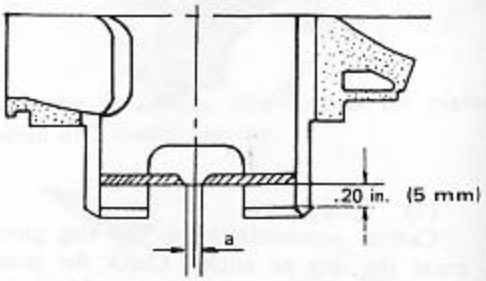
Spread the opening of the piston ring with both thumbs, and push up the opposite side of the ring.

2) Overhaul

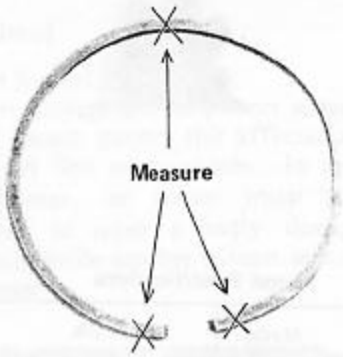
a. Piston Ring Wear

(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 .006 – .014 in. (0.15 – 0.35 mm). If the gap exceeds .028 in. (0.7 mm) replace the ring.

Piston Ring End Gap (70)



(2) There is a difference is 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 (72)

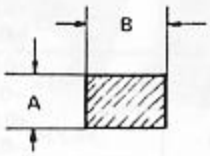


Table 8 Piston Ring Dimensions

Model			A	B
S1, KH250	Top	inch	.0591 $^{-.0004}_{-.0012}$	.0827 ± .0039
		mm	1.5 $^{-0.01}_{-0.03}$	2.1 ± 0.1
	2nd	inch	.0591 $^{-.0004}_{-.0012}$	.0827 ± .0039
		mm	1.5 $^{-0.01}_{-0.03}$	2.1 ± 0.1
S2	Top	inch	.0591 $^{-.0004}_{-.0012}$	.0906 ± .004
		mm	1.5 $^{-0.01}_{-0.03}$	2.3 ± 0.1
	2nd	inch	.0591 $^{-.0004}_{-.0012}$	.0906 ± .004
		mm	1.5 $^{-0.01}_{-0.03}$	2.3 ± 0.1
S3, KH400	Top	inch	.0591 $^{-.0004}_{-.0012}$	.0945 ± .004
		mm	1.5 $^{-0.01}_{-0.03}$	2.4 ± 0.1
	2nd	inch	.0591 $^{-.0004}_{-.0012}$	.0787 ± .004
		mm	1.5 $^{-0.01}_{-0.03}$	2.0 ± 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)

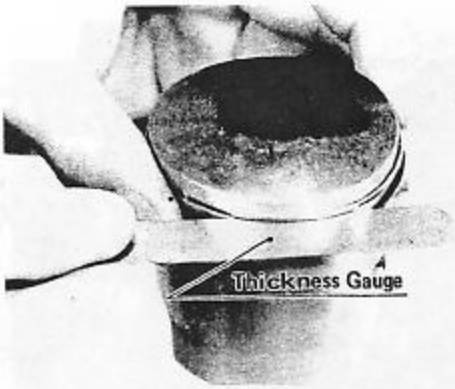
Model		Top	2nd
S1 KH250	inch	.24	.24
	mm	6	6
S2	inch	.256	.256
	mm	6.5	6.5
S3 KH400	inch	.24	.335
	mm	6	8.5

c. Piston Ring/Groove Clearance

This clearance is too 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. Meaure clearance "A" at several points around the piston to determine the extent of piston or ring wear.

Table 10 Ring/Groove Clearance

Groove		Standard	Service Limit
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:

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.

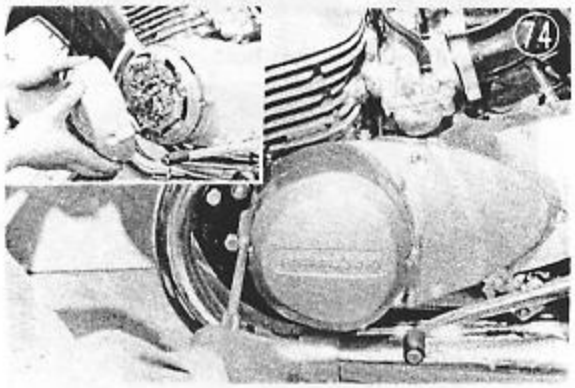
NOTE: Regarding the AC generator, removal and remounting only are explained here. For generator construction, overhaul and adjustment, see page 105 or 111. Also, for clutch release mechanism removal and overhaul, see the clutch section (page 29).

1) Disassembly (Contact breaker type model)

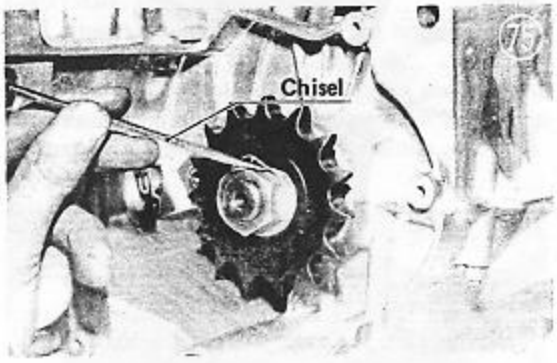
See page 11 for removal of front chain case cover and gear shift pedal.

a. Left Cover

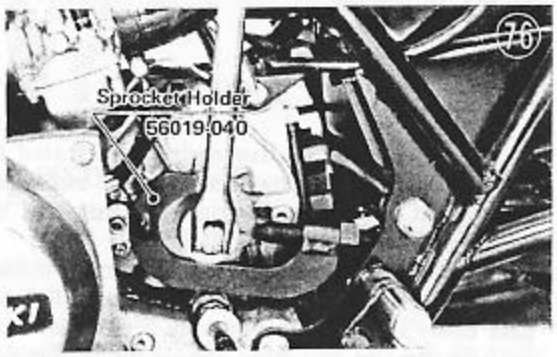
Remove the two mounting screws and pull off the left cover.



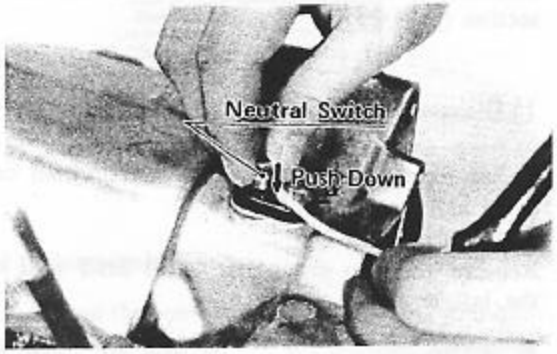
b. Engine Sprocket
Straighten the bent washer with a cold chisel or similar tool.



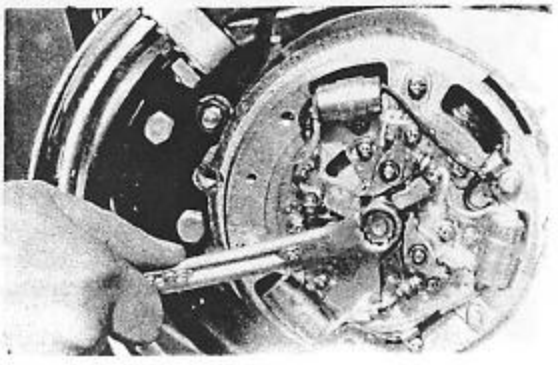
Hold the sprocket with a sprocket holder (special tool) to remove the sprocket nut, and then remove the sprocket.



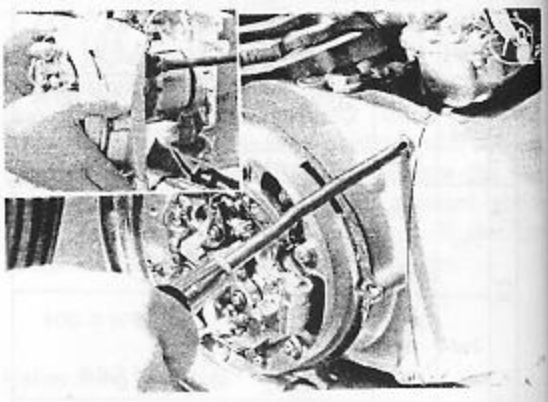
c. AC Generator
Stop the crankshaft from turning and follow these steps:
Remove neutral indicator switch wire.



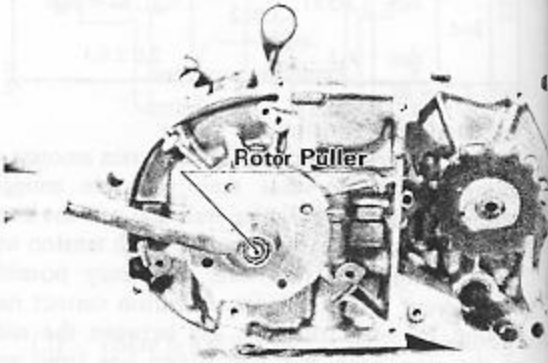
Remove the timing cam bolt.



Remove the mounting screws and pull off the yoke assembly.

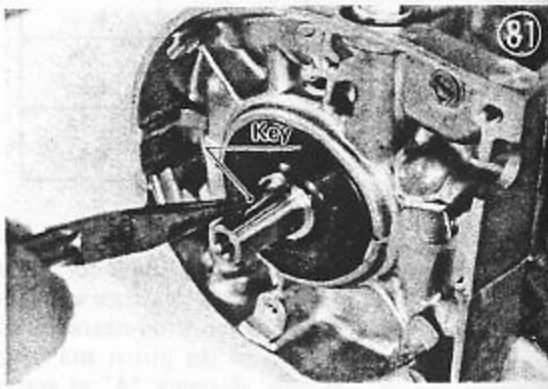


With a rotor puller (special tool), remove the rotor.



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

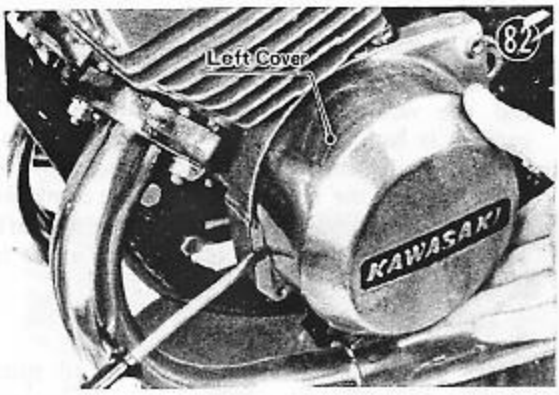
Remove the key from the crankshaft.



2) Disassembly (C.D. Ignition system model)

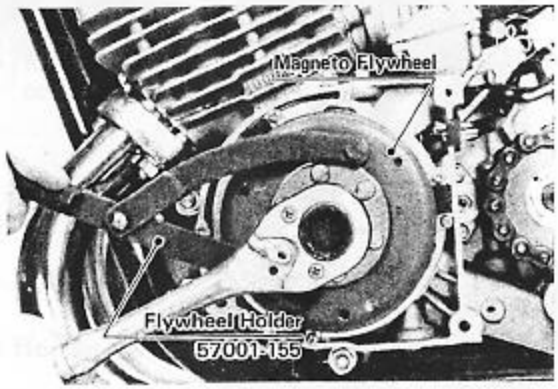
See page 11 for removal of front chain case cover and gear shift pedal.

a. Engine Sprocket
b. Left Cover
Remove the three mounting screws. With a screwdriver, pry at the gap in the front side of the left cover to free it from the crankcase.

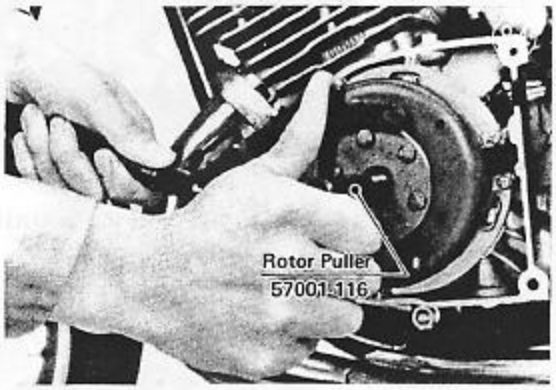


(82)

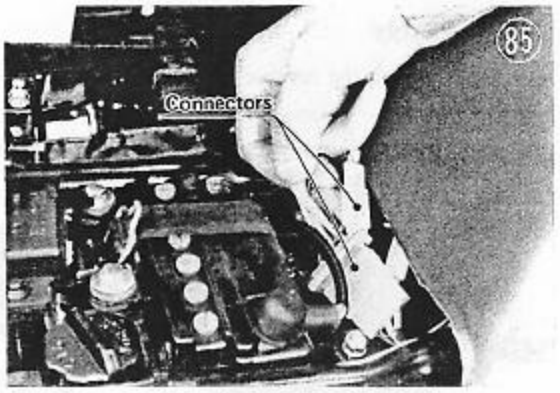
c. Magneto Flywheel
Using the magneto flywheel holder (special tool) to hold the magneto flywheel stationary, remove the bolt with its lock washer and flat washer.



With the rotor puller (special tool) remove the magneto flywheel.
CAUTION: Do not hit the flywheel magneto to pull it off.

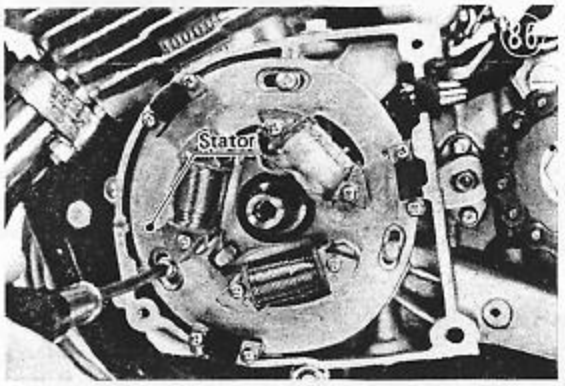


d. Magneto Stator
Swing the seat open, and disconnect the 6-pin and 3-pin connectors from the magneto stator. Remove the neutral indicator switch wire (Fig. 77). Free the magneto wiring harness from the frame. If necessary, remove the chain cover out of place to pull out and free the wiring harness.



(85)

Remove the three screws and lock washers, and the stator from the side of the crankcase.



(86)

3) 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, replace it.

Engine Sprocket

(87)

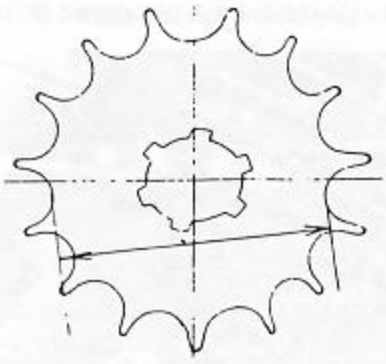


Table 11 Sprocket Diameter [inch (mm)]

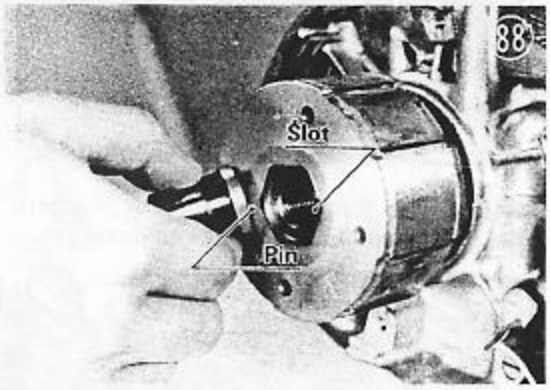
Teeth	Standard	Service Limit
14	2.4087 (61.18)	2.3779 (60.4)
15	2.5898 (65.78)	2.5591 (65.0)
16	2.8035 (71.21)	2.7716 (70.4)

4) Assembly

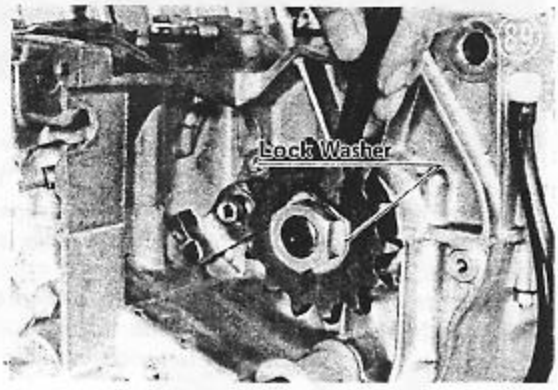
Assembly is the reverse of disassembly.

NOTE:

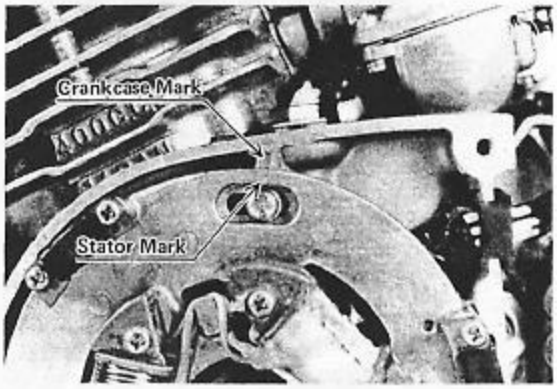
1. Align the timing cam pin with the key slot on the rotor when mounting it.



2. 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.



3. Install the magneto stator so that its mark and the crankcase mark are aligned (KH400A3).



6. RIGHT COVER

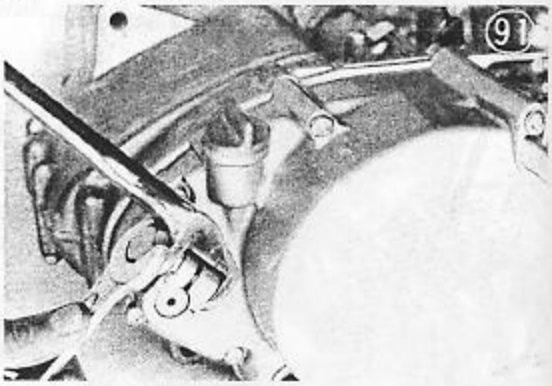
The right cover includes the oil pump, tachometer cable, and the pinions for these parts.

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.

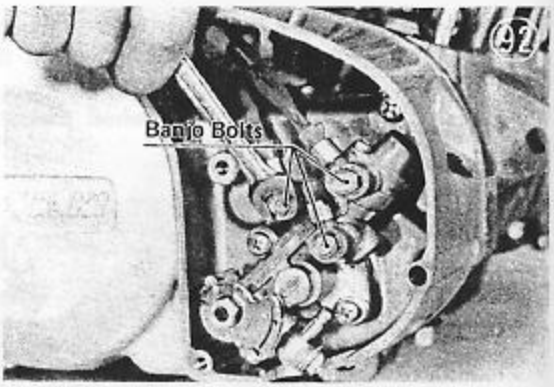
1) Disassembly

See Page 10 for removal of the oil pump cover, oil pump cable, oil inlet pipe, and tachometer cable.

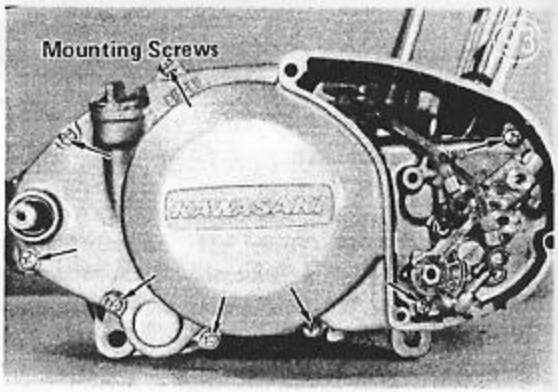
a. Right Engine Cover
Remove the kick pedal.



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



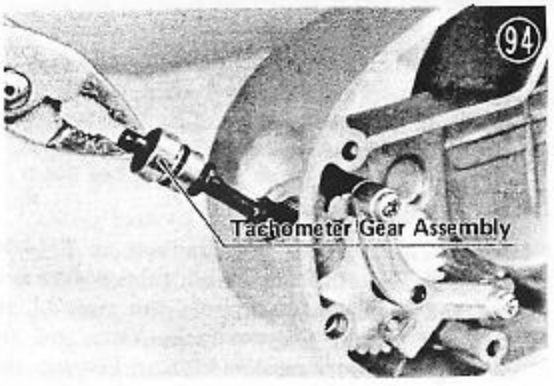
Drain the transmission oil. Remove the mounting screws and take off the right cover.



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.

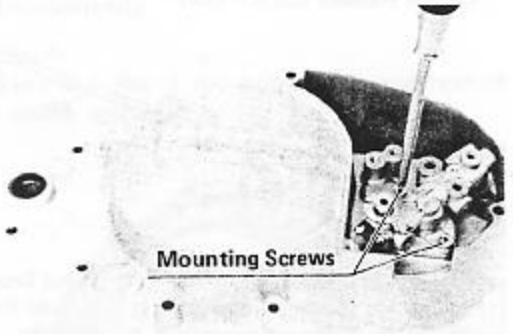
b. Tachometer Gear

Pull out the tachometer gear assembly with pliers.

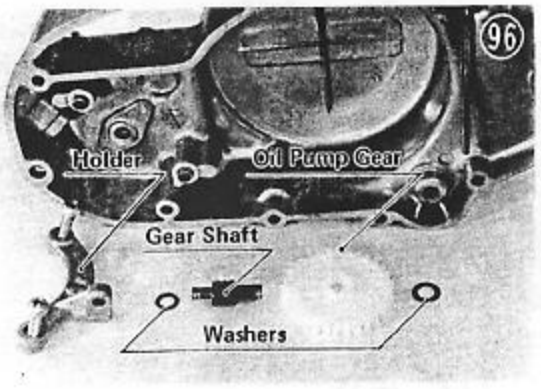


c. Oil Pump

Remove the mounting screws and take off the oil pump.

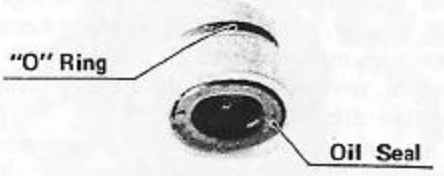


Take out the tachometer gear mounting bracket screws and remove the bracket, oil pump gear, shaft, and thrust washer.



2) Overhaul

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



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

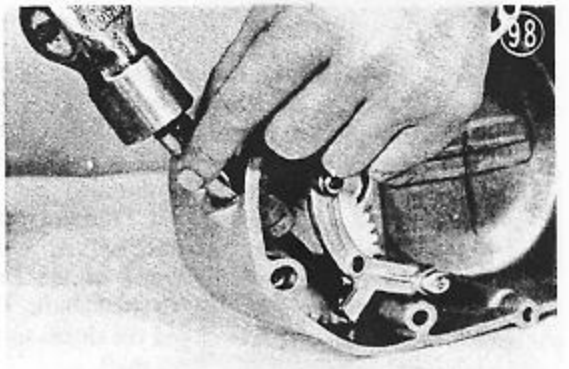
3) Assembly

Assembly is the reverse of disassembly.

NOTE:

1. 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.



2. 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

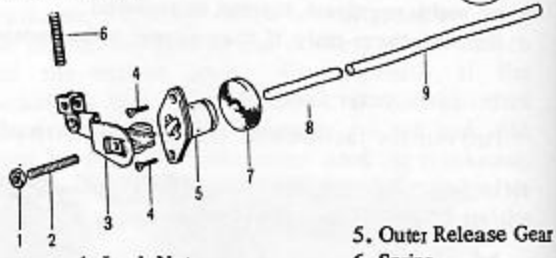
a. Clutch

Fig. 101 is a breakdown diagram of the S and KH Series clutch. It is a wet-type, multiple-plate clutch with 6 friction plates and 5 clutch steel plates, and is mounted on the right end of the drive shaft. In addition, to increase clutch disengagement effectiveness, steel rings are installed between the clutch plates and friction plates. The clutch housing is fixed to the reduction spur gear with rivets cushioned with rubber.

b. Clutch Release

Fig. 99 is a breakdown diagram of a clutch release mechanism on S Series and KH250. 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.

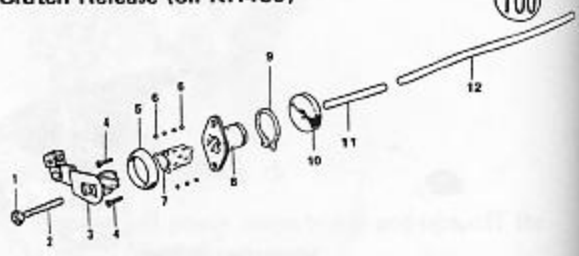
Clutch Release (99)



1. Lock Nut
2. Adjuster Screw
3. Inner Release Gear
4. Mounting Screw
5. Outer Release Gear
6. Spring
7. Oil Seal
8. Push Rod A
9. Push Rod B

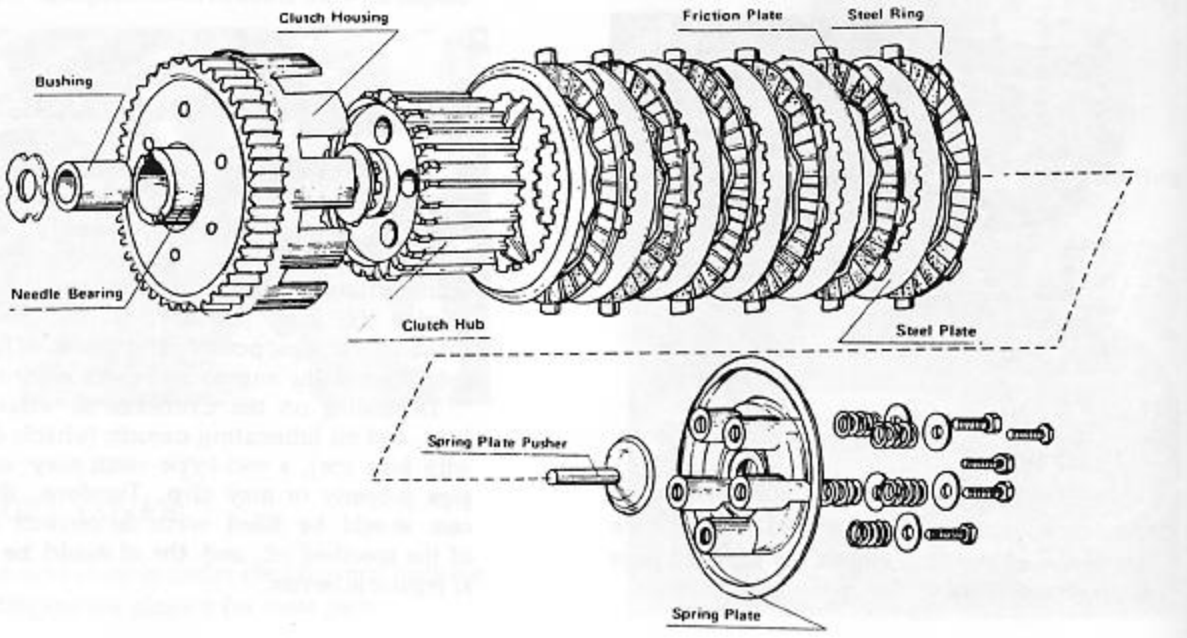
The clutch release mechanism on KH400 is shown in Fig. 100. The clutch release outer worm gear and the inner worm gear are made of steel. Balls are installed between the outer and inner worm gears to reduce the friction between them. Assembled into the center of the release inner gear is the clutch adjusting screw, which pushes on the push rod and spring plate pusher the drive shaft to release the clutch.

Clutch Release (on KH400) (100)



1. Lock Nut
2. Adjuster Screw
3. Inner Release Gear
4. Mounting Screw
5. Oil Seal
6. Steel Ball
7. Ball Retainer
8. Outer Release Gear
9. Circlip
10. Oil Seal
11. Push Rod A
12. Push Rod B

Clutch (101)



2) Operation

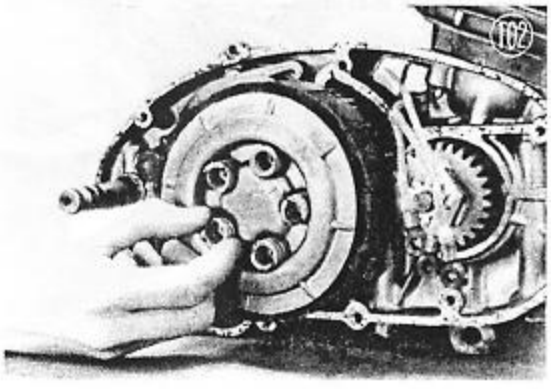
The transfer of motion from the crankshaft to the transmission is interrupted by the action of the friction plates and clutch steel plates. When the clutch is engaged, the spring plate, by clutch spring tension received via the spring guides, forces the friction and clutch plates together. And by friction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

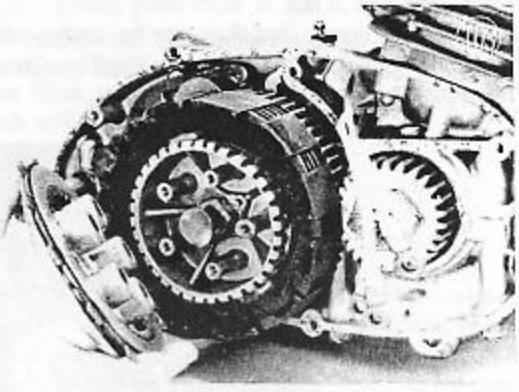
3) Disassembly

a. Clutch

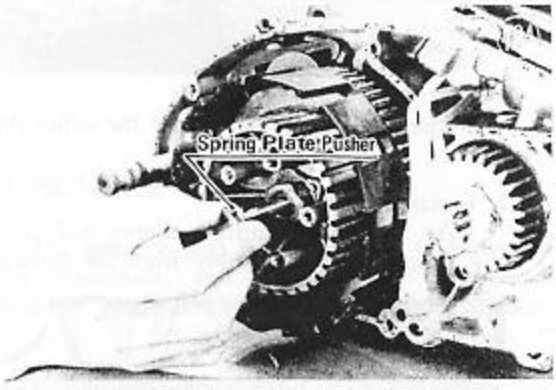
Take out the 5 mounting bolts, and remove the clutch springs.



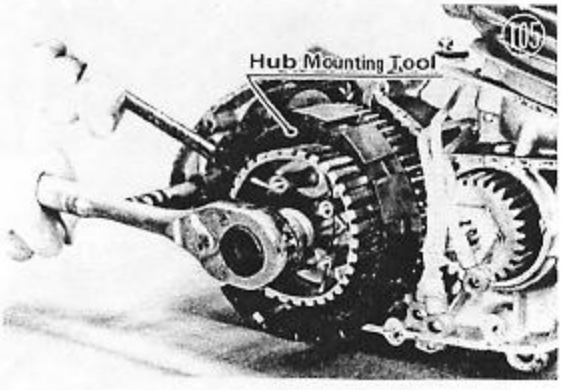
Remove the spring guides, spring plate, steel plates, friction plates and steel rings.



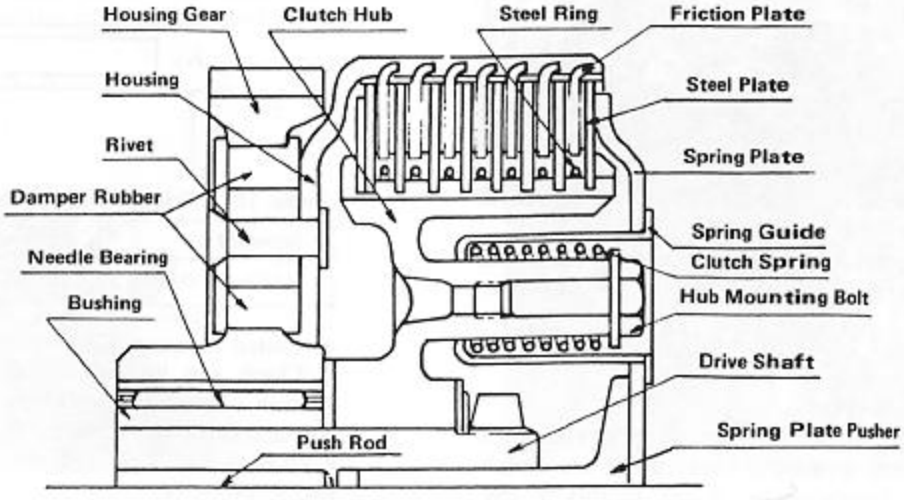
Take out the spring plate pusher.



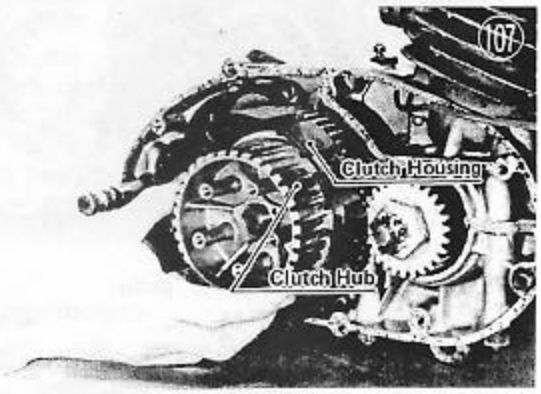
Using a clutch hub mounting tool (special tool), hold the clutch hub and housing and remove the mounting nut.



Clutch



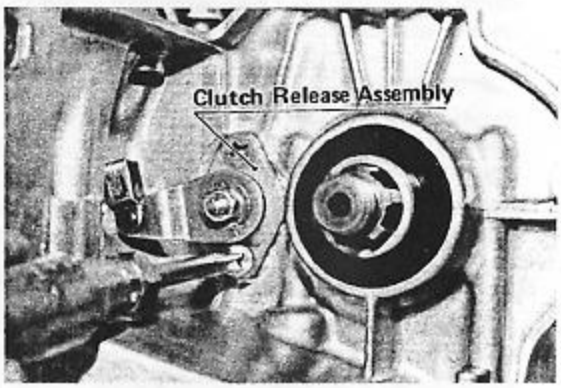
Take off the lock washer and flat washer. Remove the clutch hub, thrust washer and clutch housing from the drive shaft in that order.



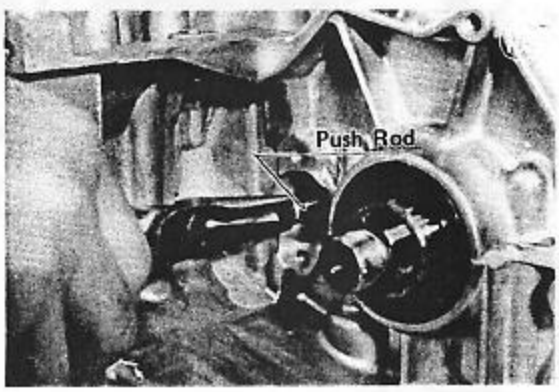
Last, pull off the bushing and the other thrust washer.

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.

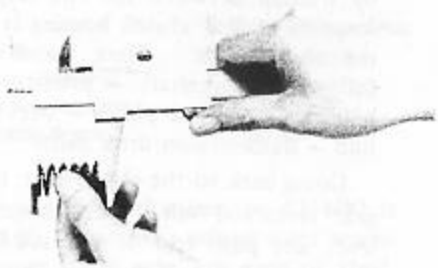


Table 12 Spring Length

Model	Standard	Service Limit
S1 KH250	1.358 in. (34.5 mm)	1.280 in. (32.5 mm)
S2, S3, KH400	1.130 in. (28.7 mm)	1.051 in. (26.7 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 112

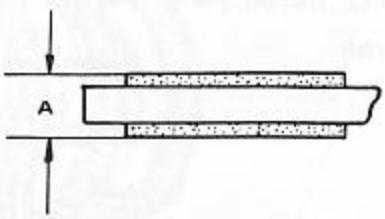


Table 13 Friction Plate Thickness

Standard	Service Limit
.118 in. (3.0 mm)	.106 in. (2.7 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.

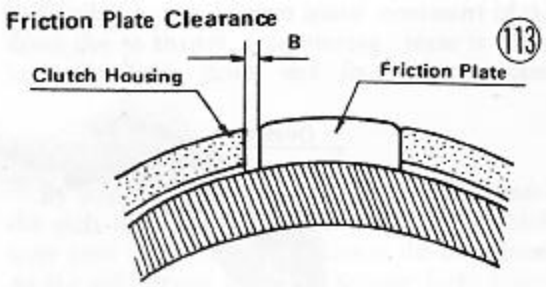


Table 14 Clutch Housing/Plate Clearance

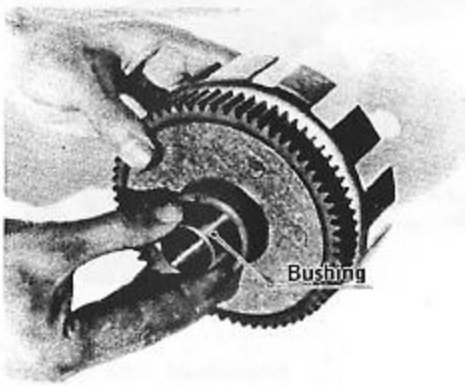
Standard
.0020 – .0177 in. (0.05 – 0.45 mm)

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.

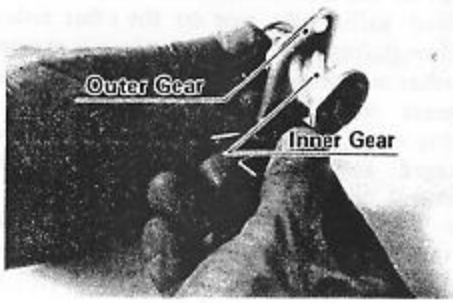
e. Needle Bearing

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.

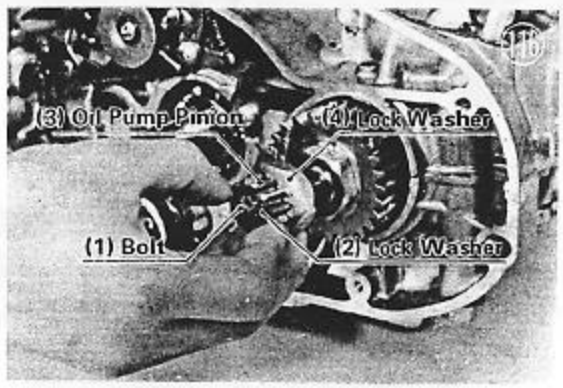
NOTE: Assemble the inner and outer release gears and then mount them in the crankcase, being careful of the release lever angle. If the outer release gear is mounted in the crankcase beforehand, the inner release gear cannot be fitted into it. Also take ample care to tighten the two mounting screws evenly.

8. PRIMARY GEAR

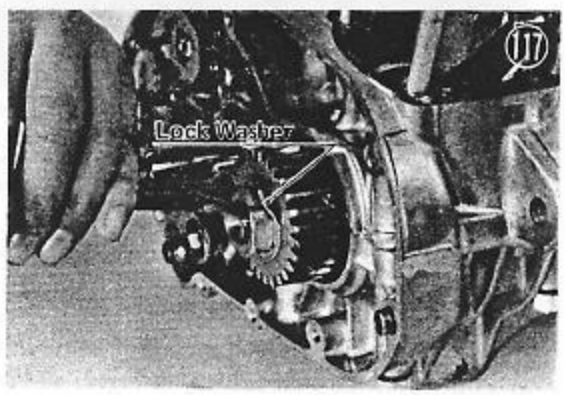
The primary gear is mounted on the right of the crankshaft, and together with the clutch housing gear, performs the primary reduction.

1) Disassembly

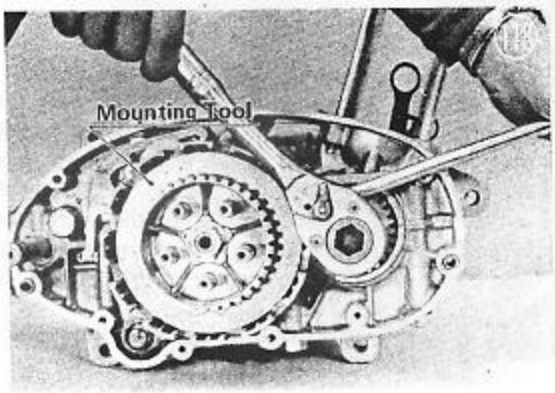
Remove the mounting bolt and lock washer, and take off the oil pump pinion and lock washer.



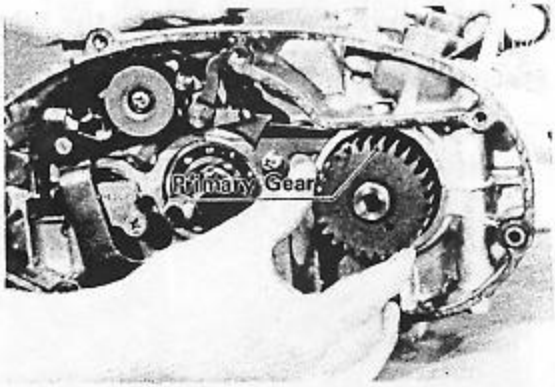
Straighten out the lock washer.



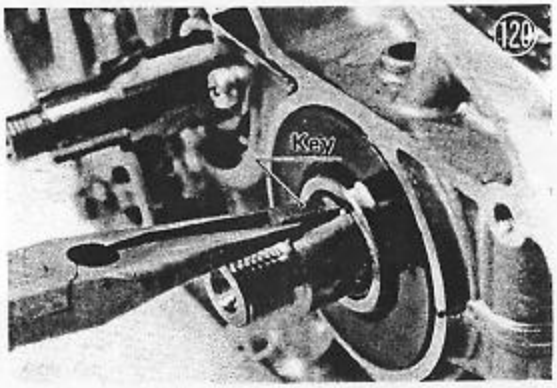
Temporarily mount the clutch housing and clutch hub, and holding the crankshaft stationary with a clutch hub mounting tool (special tool), remove the nut.



Remove the lock washer and primary gear.



Remove the key.



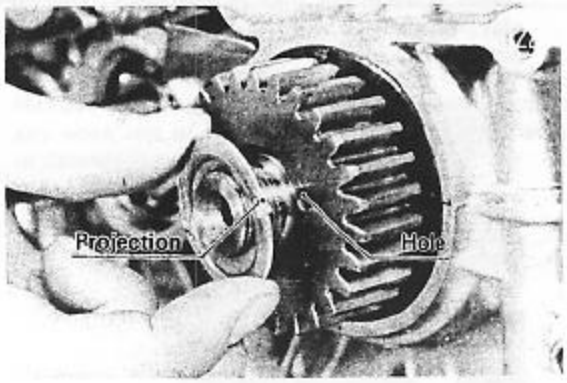
2) Overhaul

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 over-turning, 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.

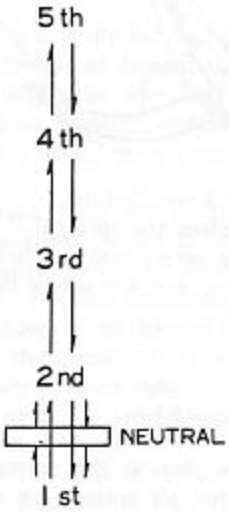
In addition, to prevent lateral movement of the drum due to thrust, a positioning plate is fitted into the shift drum and fixed to the case.

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 order of gear shift is shown in the diagram.

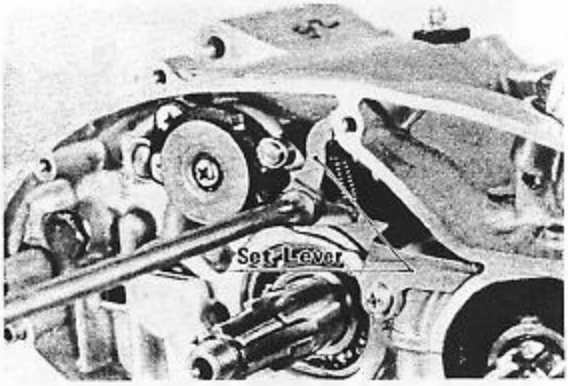
Gear Shifting Order (123)



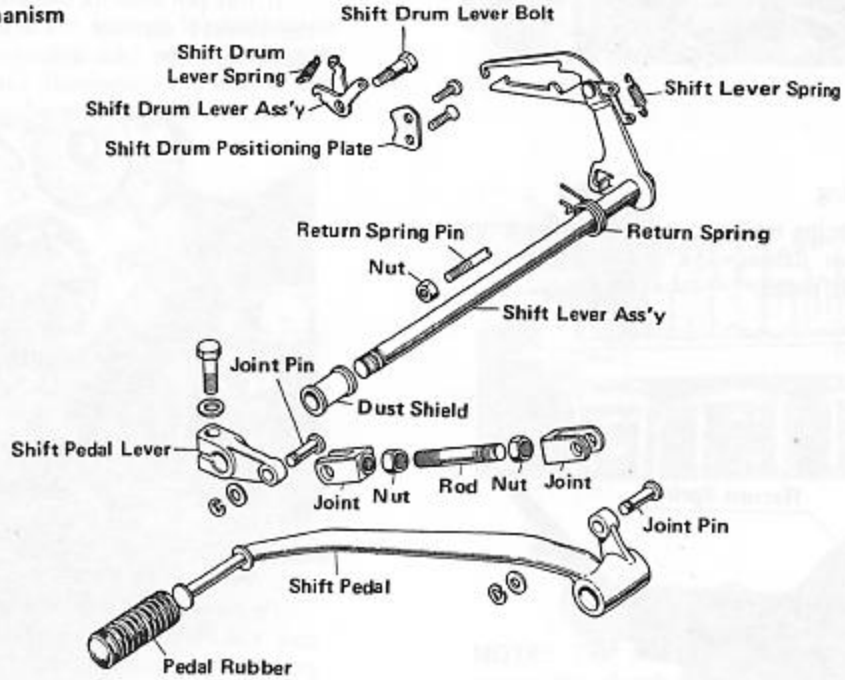
2) Disassembly

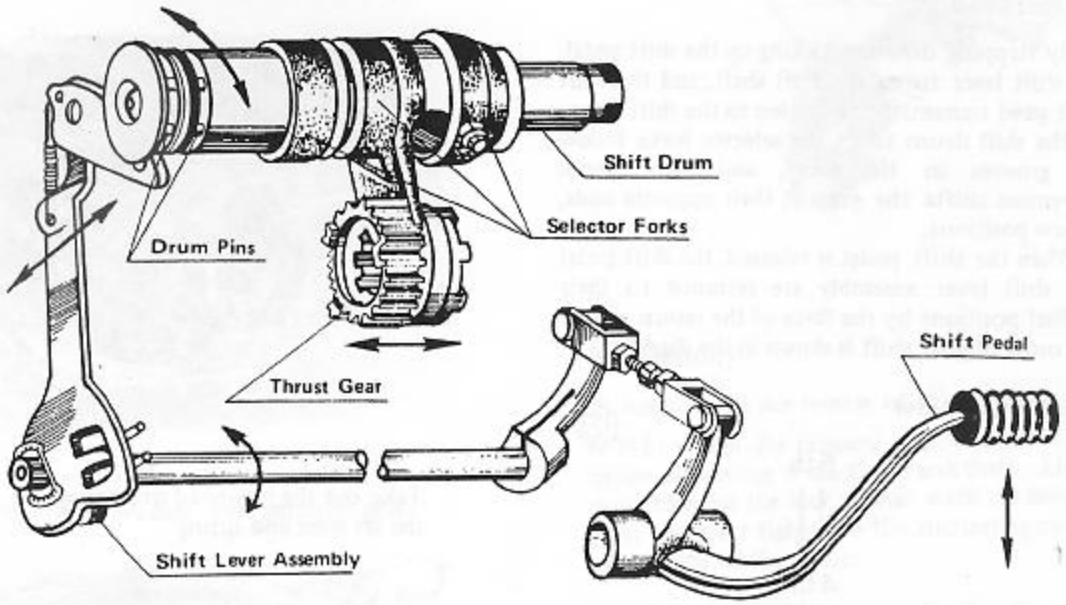
Disengage the shift lever pawl from the shift drum pins, and remove the shift lever assembly from the crankcase.

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

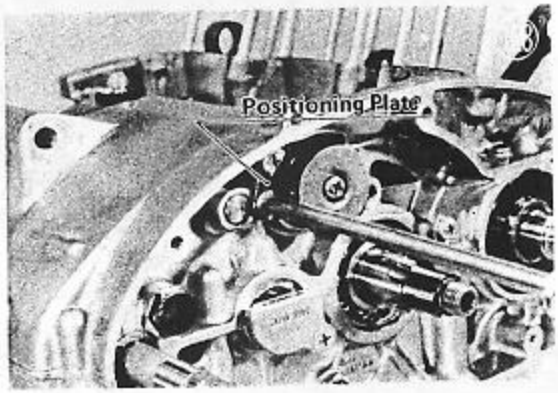


External Shift Mechanism (126)





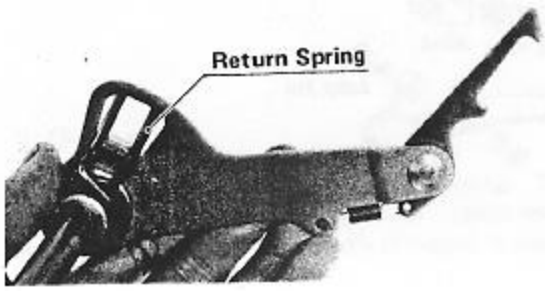
Take out the mounting screws, and remove the positioning plate.



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.

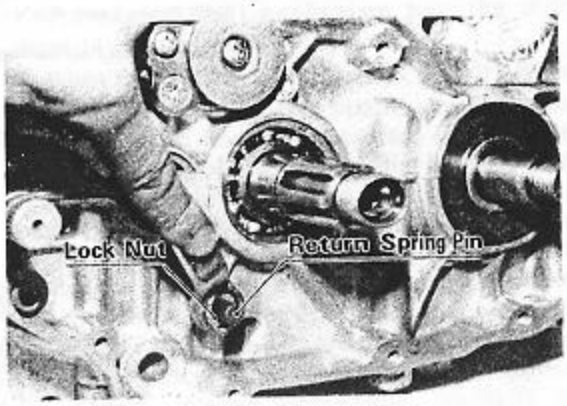
4) Assembly

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

NOTE:

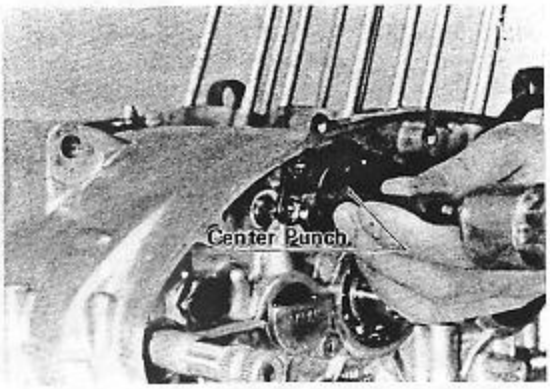
1. Return spring pin

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

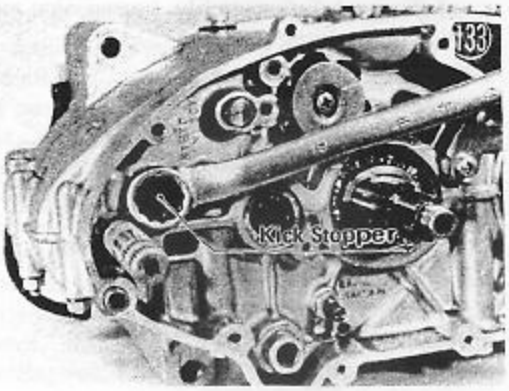


2. Positioning plate

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



Loosen the kick stopper.



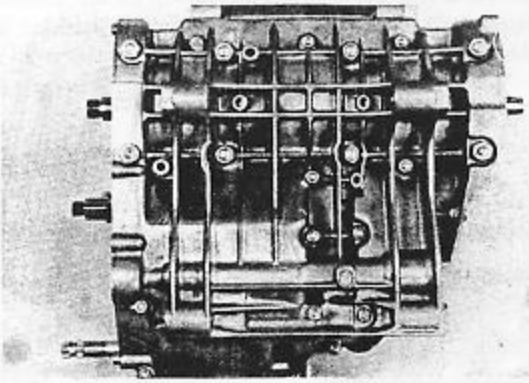
10. CRANKCASE

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

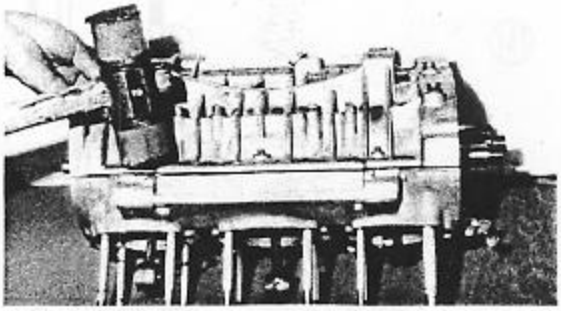
Gasoline/air mixture from the carburetor is drawn into the crankcase, where it undergoes preliminary compression prior to entering the combustion chamber. For that reason each crank chamber in the crankcase is partitioned from the next by oil seals on the crankshaft, making each chamber independently 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.

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

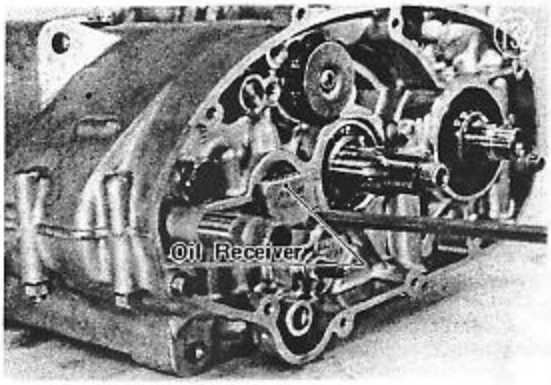


Tap the lower crankcase and shift shaft mounting lightly with a mallet, so that all the shafts, etc. remain in the upper crankcase when it is disassembled.



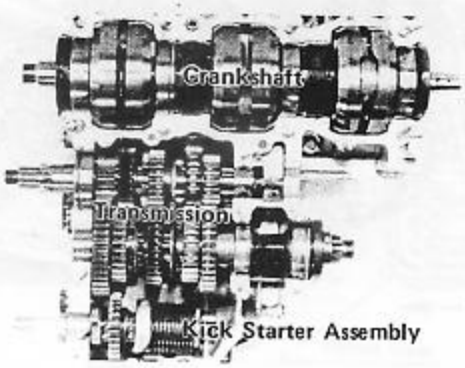
1) Disassembly

Remove the output shaft oil receiver.



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

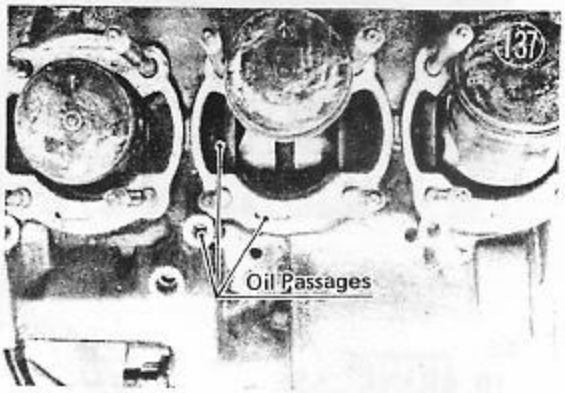
Taking off the lower crankcase permits removal of the crankshaft assembly, transmission assembly. kick shaft, drum, etc.



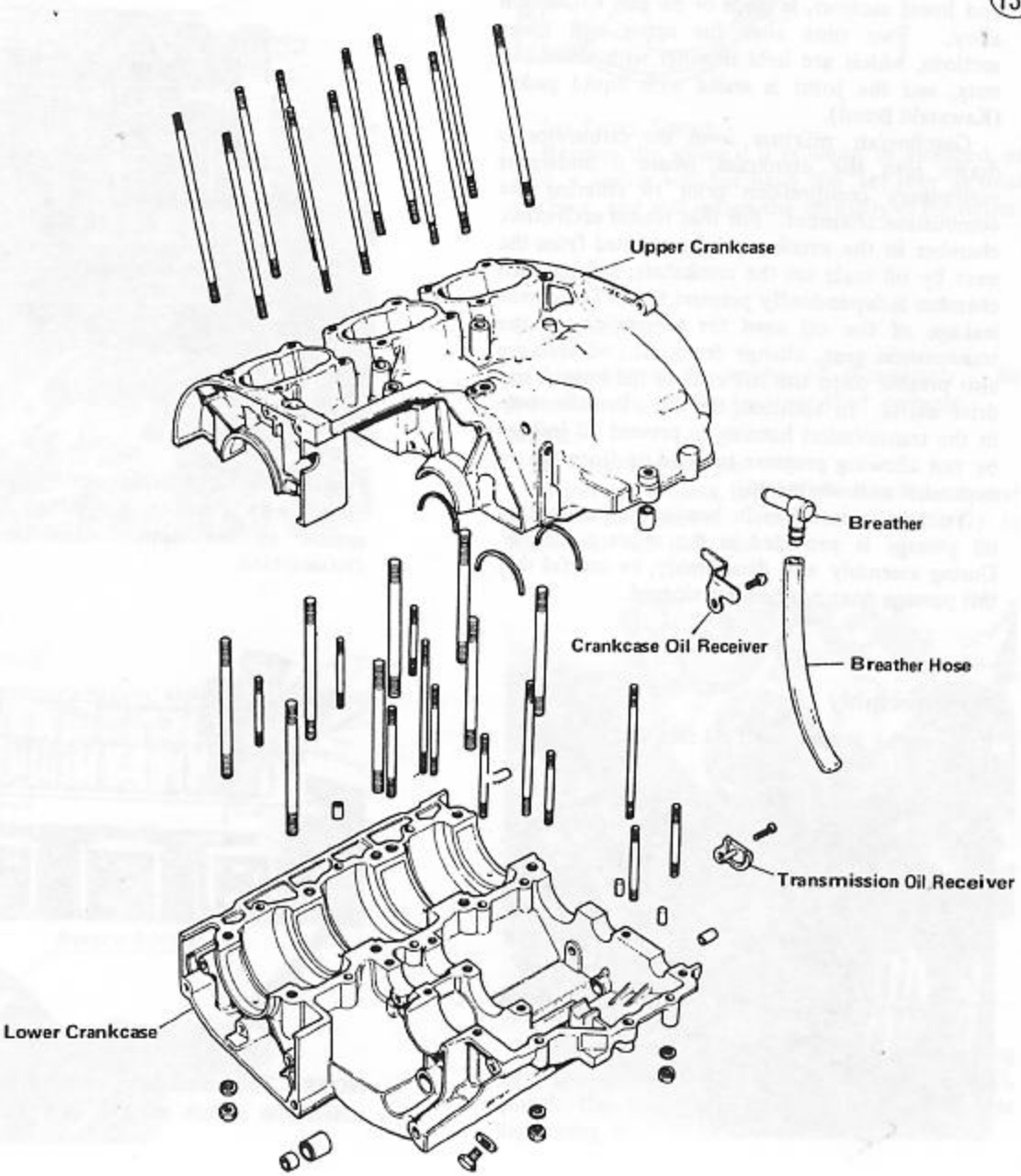
2) Overhaul

a. Oil Passages

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



Crankcase Assembly



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

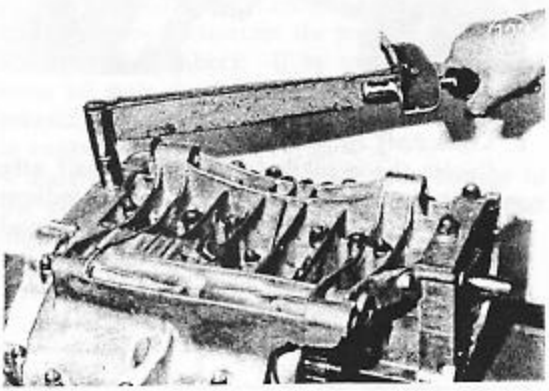
Assembly is the reverse of disassembly.

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:

Table 15

Nut Size	Torque
8 mm	19.0 – 25.0 ft-lbs (2.6 – 3.5 kg-M)
6 mm	11.5 – 16.0 ft-lbs (1.6 – 2.2 kg-M)



11. CRANKSHAFT

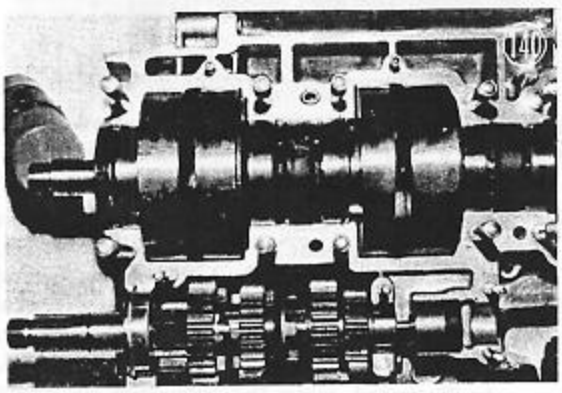
The intermittent force of exploding gasoline hammers on the pistons, and the resultant up and down motion of the pistons is received by the crankshaft and changed into shaft rotation. Due to the powerful force involved, crankshaft play or runout will cause damage to the crankcase, bearings, etc., and 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 high a degree of technical skill is necessary.

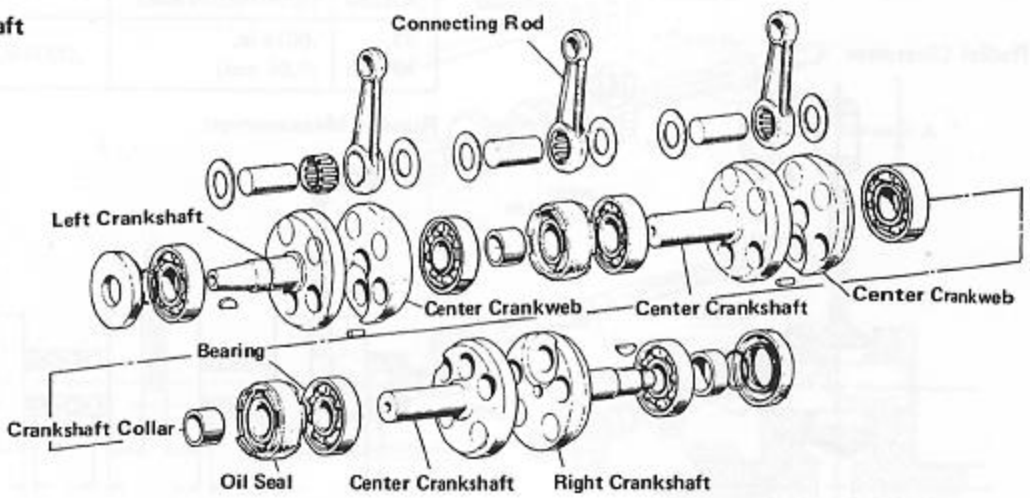
This manual deals only with common crankshaft troubles, and the manner in which the various checks are performed. If any parts are out of tolerance, or if inspection indicates that repair is necessary, it is recommended that the crankshaft be replaced as an assembly.

1) Disassembly

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



Crankshaft (141)



2) Inspection

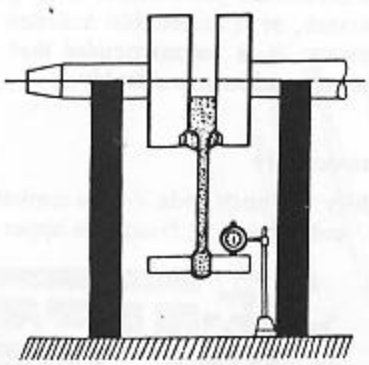
a. Connecting Rod Warp

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.

Warp Measurement

(142)



Under 0.0020 in. (0.050 mm)/4 in. (100 mm)

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.

(1) Radial clearance

As illustrated, move the connecting rod up and down find the difference between the two dial readings.

Big End Radial Clearance

(143)

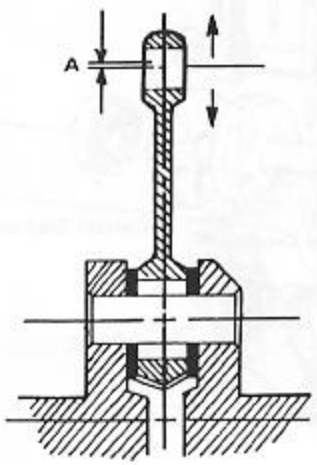


Table 16 Radial Clearance

Model	Standard	Limit
S1, S2, KH250	.00098-.00138 in. (0.025-0.035 mm)	.0039 in. (0.10 mm)
S3, KH400	.00095-.00134 in. (0.024-0.034 mm)	.0039 in. (0.10 mm)

(2) Side clearance

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

Table 17 Side Clearance

Standard	Service Limit
.0157 – .0197 in. (0.40 – 0.50 mm)	.0276 in. (0.70 mm)

c. Crankshaft Runout

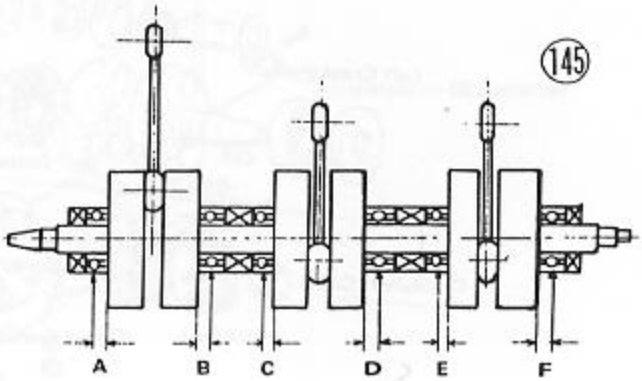
Center the crankshaft in a crankshaft aligner and set the dial gauge to the points indicated. Turn the crankshaft lightly and note the reading variation, which is crankshaft runout.

Table 18 Crankshaft Runout

Model	Standard	Maximum
S1, S2, KH250	.0016-.0020 in. (0.040-0.050 mm)	.0039 in. (0.10 mm)
S3, KH400	.0016 in. (0.04 mm)	.0039 in. (0.10 mm)

Runout Measurement

(145)



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.

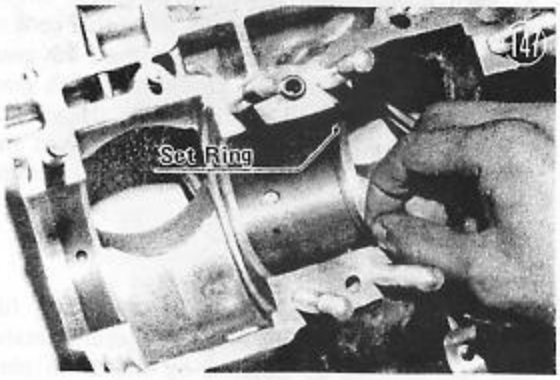
f. Crankshaft Oil Seals

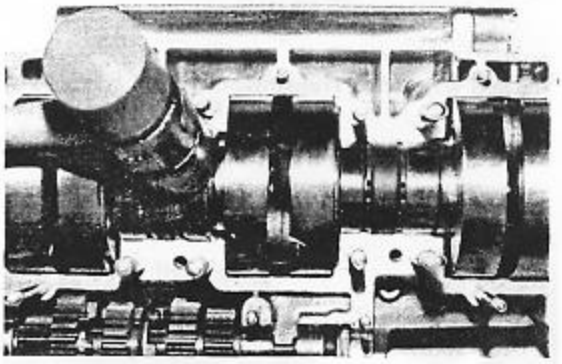
The four oil seals, one on either side of each crank chamber, maintain the pressure differences among the chambers. If by any chance any of these oil seals should be damaged, primary compression leakage will occur and cause a reduction in engine performace.

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 very lightly with a mallet.

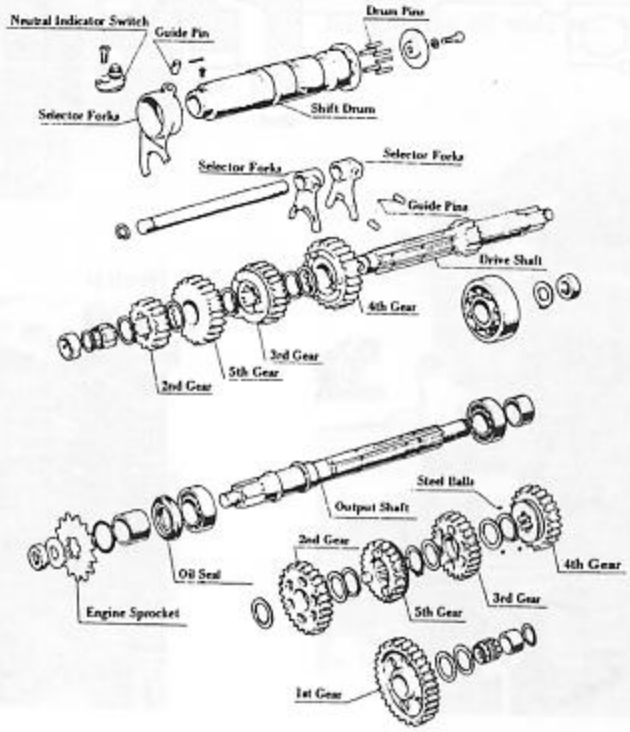




12. TRANSMISSION

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.

Transmission



1) Operation

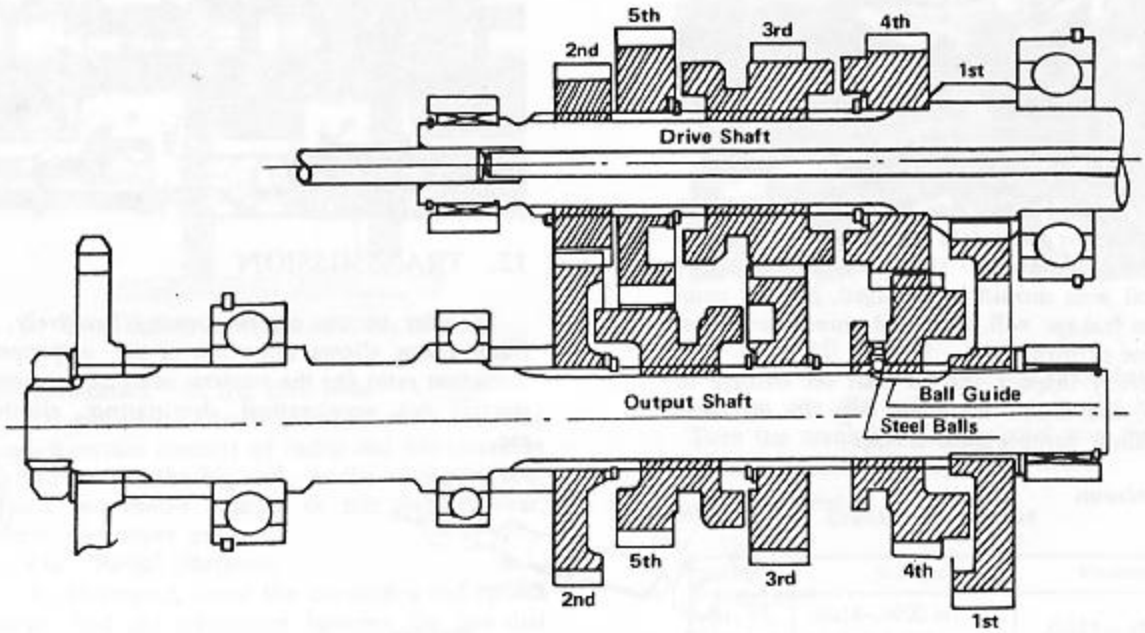
The diagrams below show the 5-speed, constant-mesh, return change type transmission of the S and KH Series.

Each selector fork is kept in its groove on the gear shift drum by a guide pin. The other ends of the three forks set 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 Location

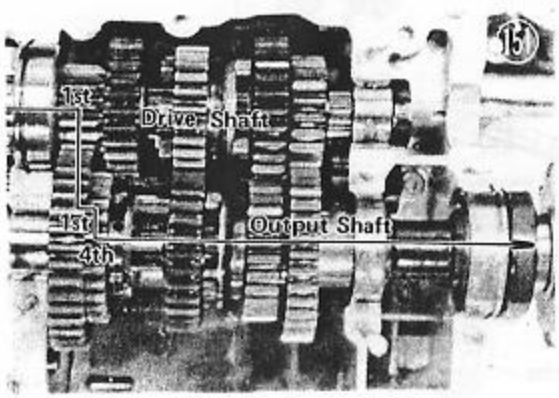
When the shift pedal is operated one full step either down or up, the shift drum rotates one full interval, as decided by the drum pins. Neutral, however is located halfway between first and second, so to make this half-step operation easily possible, three steel balls are contained inside the output shaft fourth gear, and three grooves are cut into the output shaft where fourth gear rides. When the output shaft is turning, inertia keeps the balls away from the shaft and out of the grooves. But when the shaft is at rest, one or more of the balls drop down into the shaft groove. When shifting from low to neutral, fourth gear moves along the output shaft until the ball or balls inside it hit the end of the groove and stop the gear. Since the groove extends only half the length of the fourth gear's travel, this gear stops halfway, and its selector fork is stopped by the gear, thus preventing the change drum from turning fully. And therefore other gears do not mesh and all gears stop in the neutral position.

S and KH Series Transmission Gears

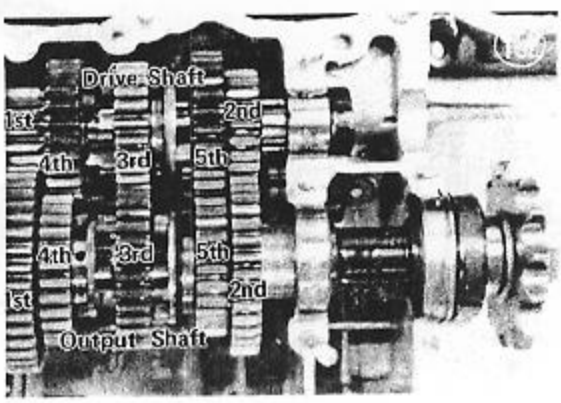


Transmission Gear Positions

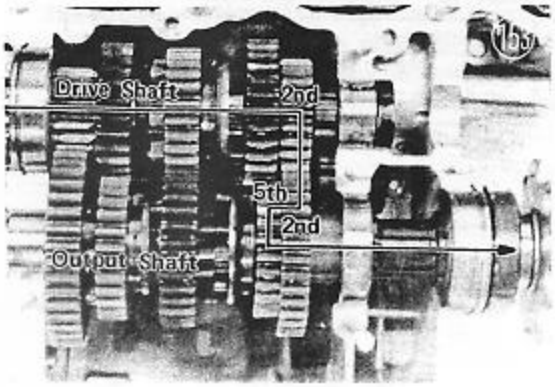
First Gear



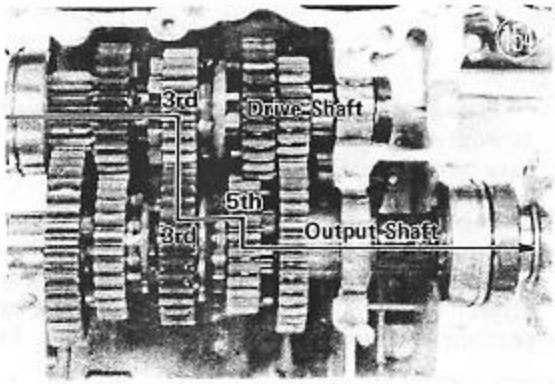
Neutral



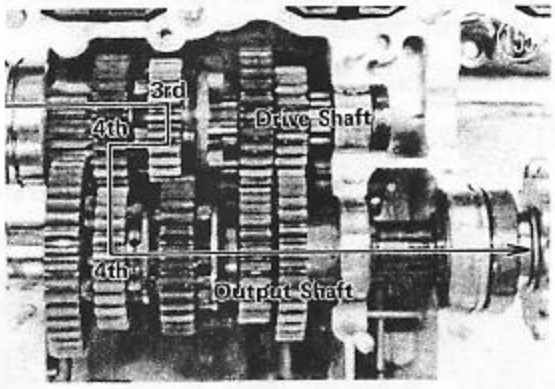
Second Gear



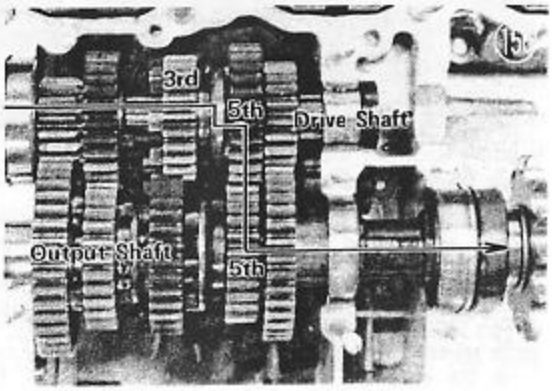
Third Gear



Fourth Gear



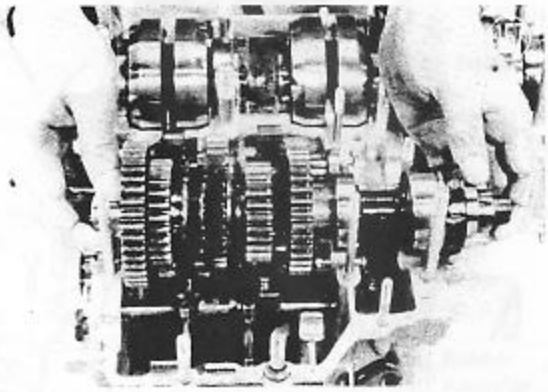
Fifth Gear



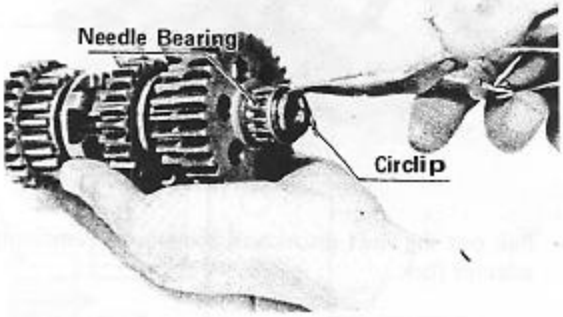
2) Disassembly

a. Drive Shaft Output Shaft Assemblies

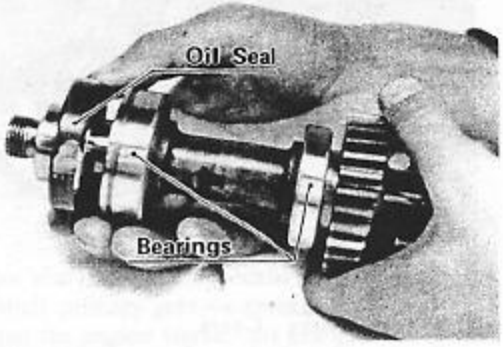
Remove each shaft assembly from the upper crankcase.



Take off their respective circlips to remove the needle bearings and gears.



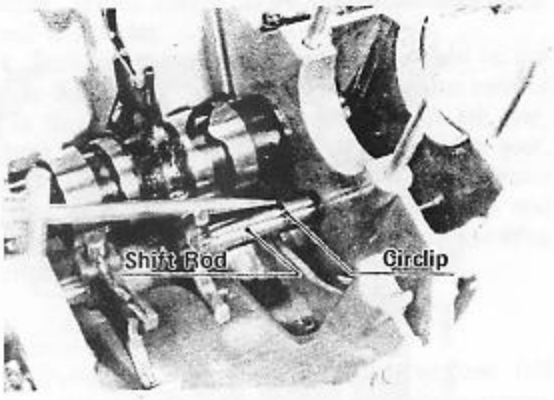
Remove the oil seals and bearings.



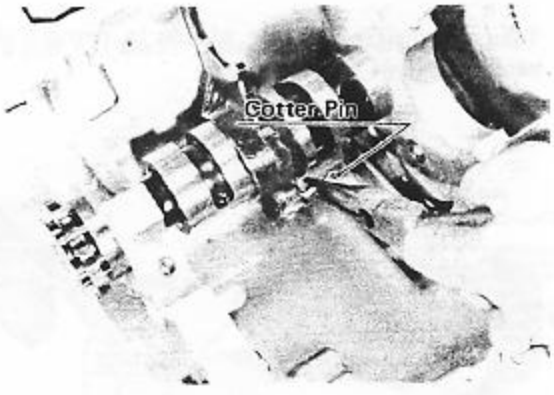
b. Shift Drum

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

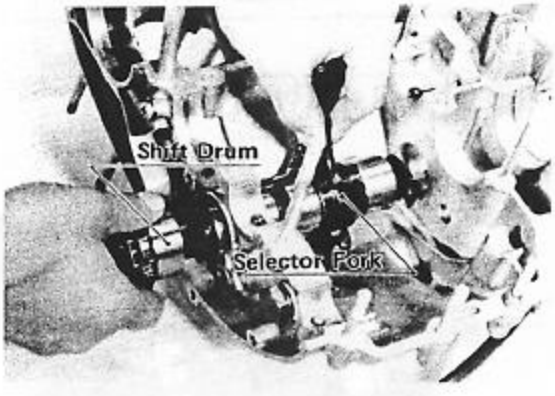
Pull off the circlip and remove the shift rod. The two end shift forks can then be taken out.



Remove the cotter pin and pull out the guide pin.



Pull out the shift drum and remove the remaining selector fork.



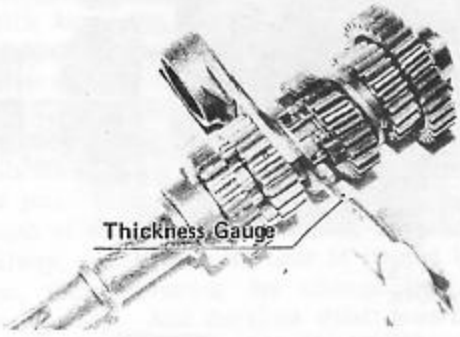
3) Overhaul

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

Standard	Service Limit
.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 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

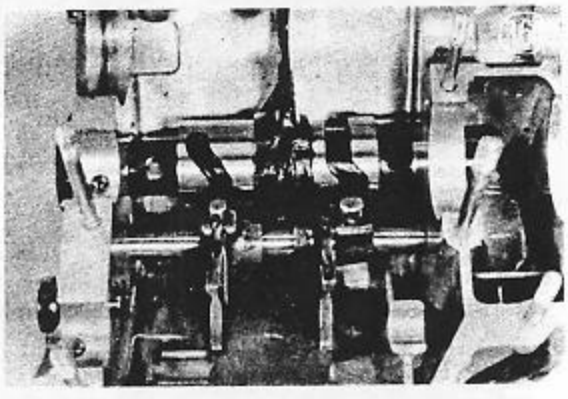
Since there is a constant supply of oil in the transmission, cracked or damaged oil seals will allow leakage. Inspect the lips of the seals and replace any damaged ones.

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.

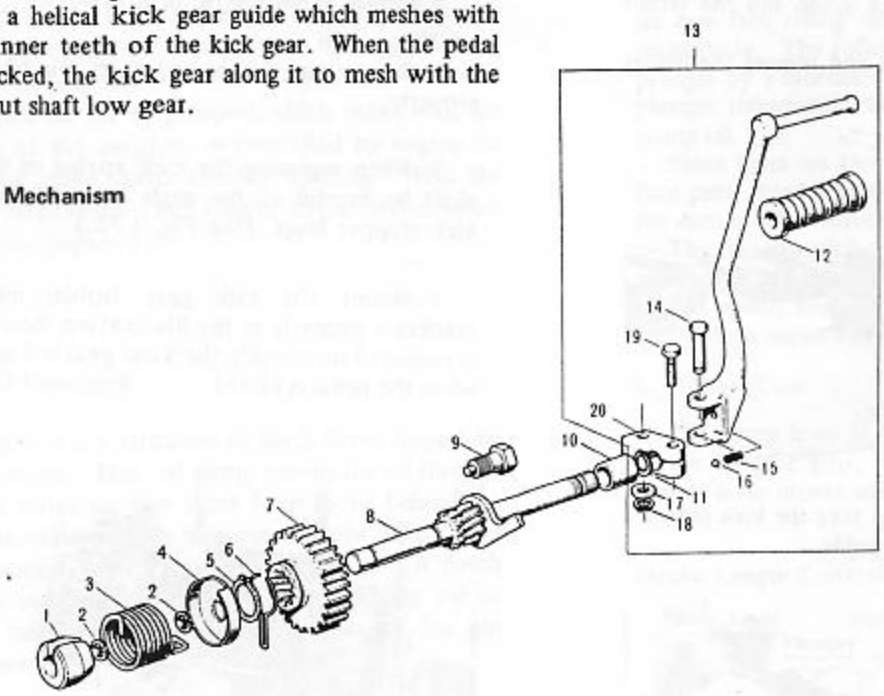
3. When replacing fourth gear on the output shaft, do not use grease to hold the three steel balls in place. If any grease is stuck to them, wash it off with gasoline. As previously explained, these balls must move smoothly to be effective.

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

13. KICK STARTER

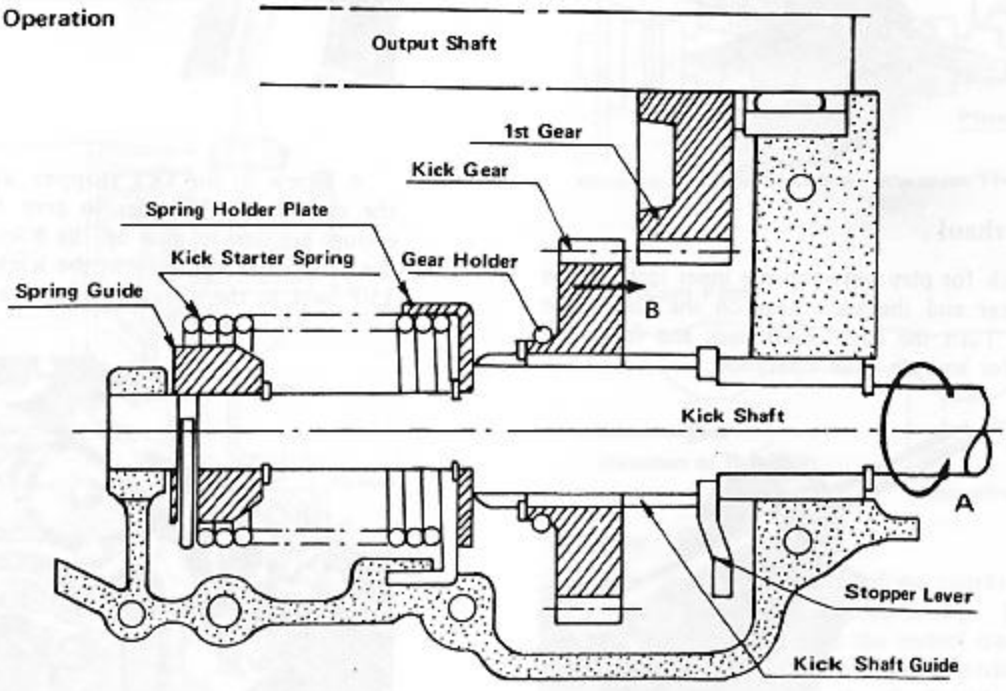
The middle portion of the kick shaft is provided with a helical kick gear guide which meshes with the inner teeth of the kick gear. When the pedal is kicked, the kick gear along it to mesh with the output shaft low gear.

Kick Mechanism



1. Spring Guide
2. Clip
3. Kick Spring
4. Spring Holder Plate
5. Circlip
6. Gear Holder
7. Kick Gear
8. Kick Shaft
9. Kick Stopper
10. Bushing
11. Circlip
12. Pedal Rubber
13. Pedal Assembly
14. Pin
15. Pedal Spring
16. Steel Ball
17. Washer
18. Clip
19. Bolt
20. Pedal Boss

Kick Starter Operation



1) Operation

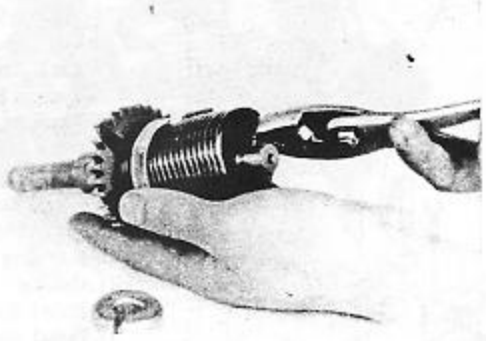
Following the diagram, when the kick pedal is pushed down, the kick guide on the shaft turns in the direction of arrow A, and the kick gear turns around the kick shaft and slides in the direction of arrow B, meshing with the output shaft low gear.

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.

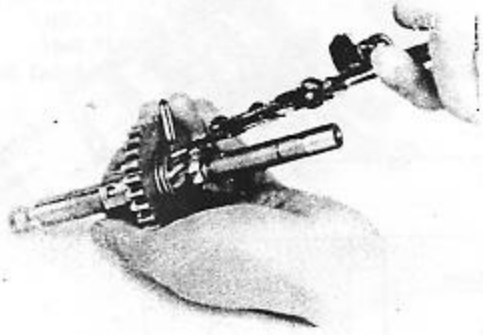
When the engine starts, the kick gear is turned by low gear and slides back to its original position, out of mesh with low gear. And when the pedal is released, the tension of the kick spring turns the kick shaft and the pedal returns to its original position. At this point the kick shaft stopper lever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



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



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.

4) Assembly

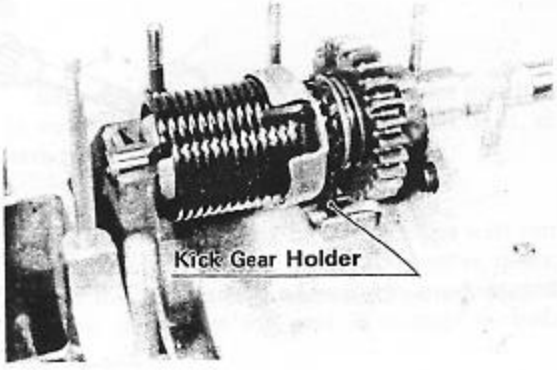
Assembly is the reverse of disassembly.

NOTE:

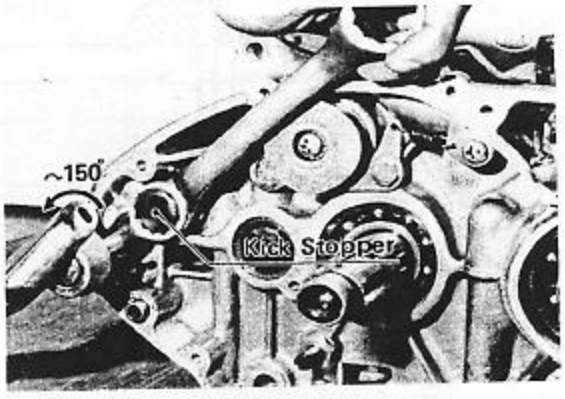
1. Be sure the circlips and snap ring are seated properly.

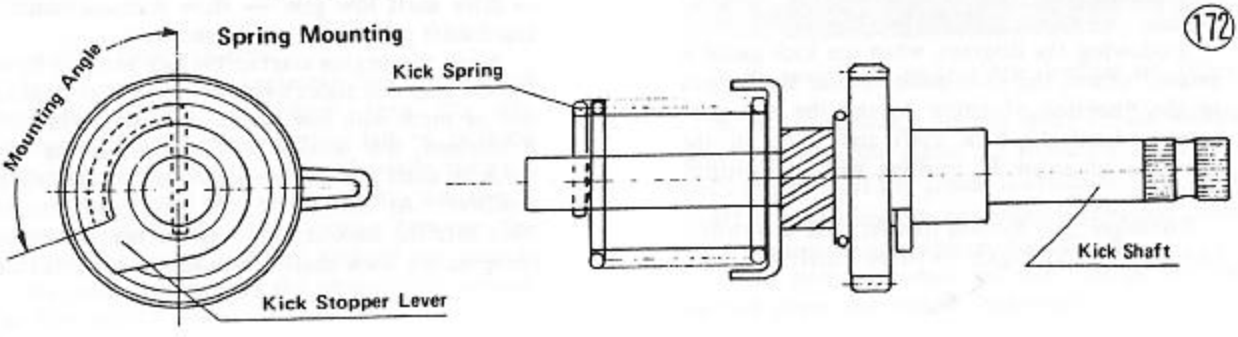
2. When replacing the kick spring on the kick shaft be careful of the angle it makes with the kick stopper lever. (See Fig. 172.)

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.



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.





(172)

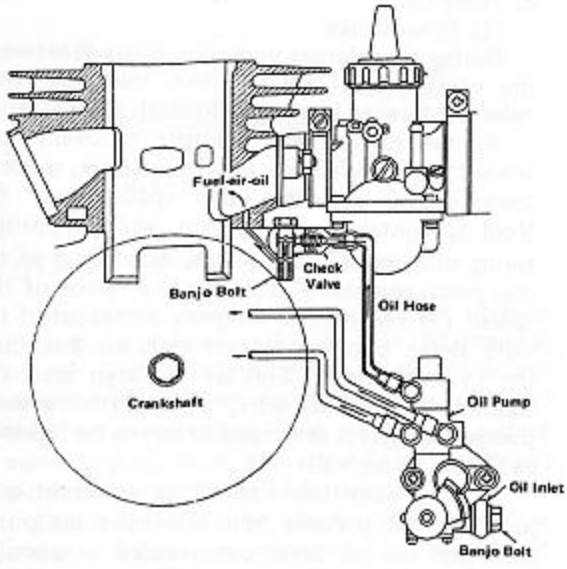
14. LUBRICATION SYSTEM

The lubrication system used is the Kawasaki Superlube. In this system, oil is kept in a separate tank, from which it is pumped to the engine by the oil pump and mixed with the gasoline. 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.

1) Oil Passages

Fig. 173 is a diagram of the S Series Superlube oil passages. The oil pump pumps the oil through check valves to the three banjo bolts behind the engine. From there it is injected into the cylinder intake port to be mixed with gasoline. A notch is cut into the big end of the connecting rod so that the gasoline/oil mixture can reach the pin and bearing.

Oil Passages (173)



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.

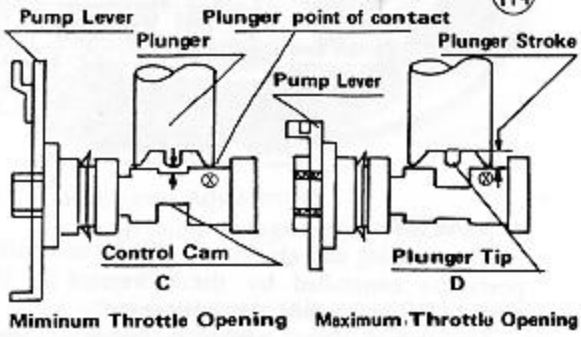
Since there are two high points on the plunger face cam, there are two complete pumping cycles for each single revolution of the plunger.

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.

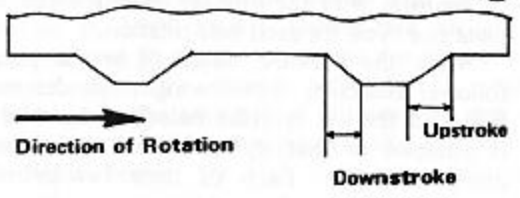
b. Plunger/Cam

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.

Stroke Length Control (174)



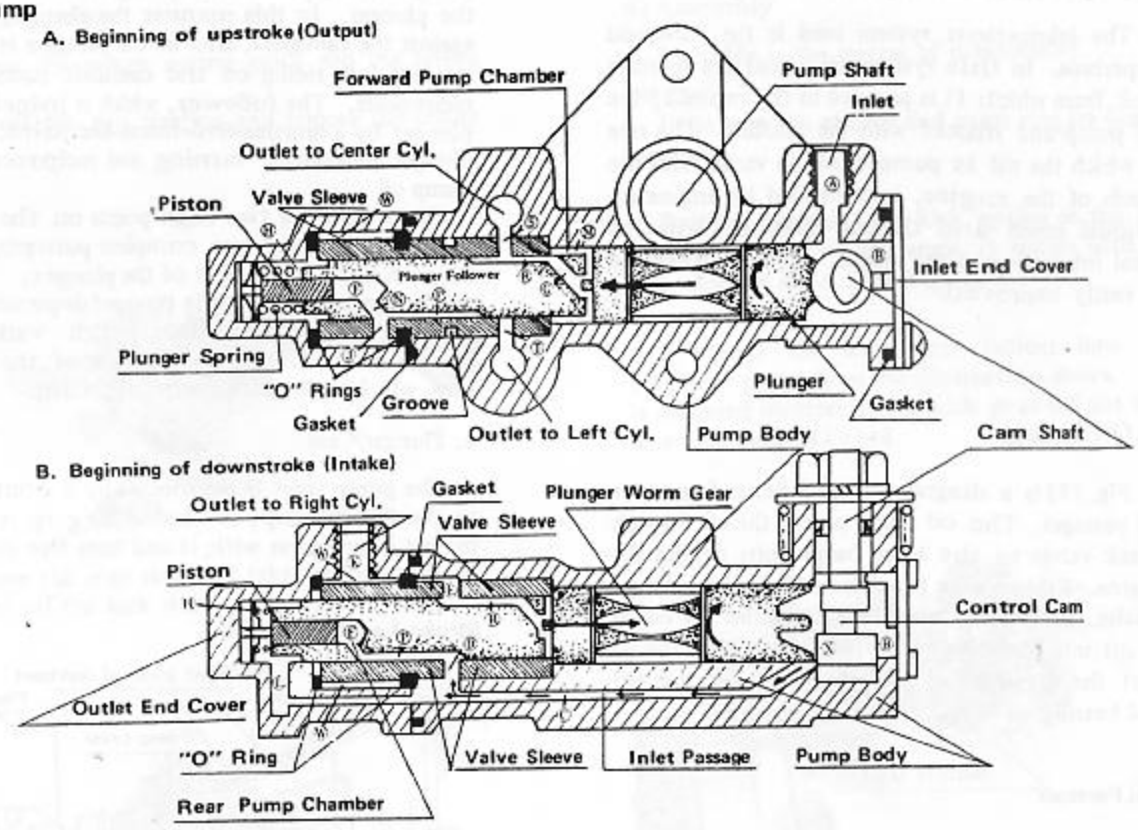
Plunger Cam Face (175)



When the lowest part of the control cam is facing the plunger as shown in Fig. 174D, 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. 174C 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 Fig. 174C.

Oil Pump



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 right 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 center cylinder. This part of the pump supplies oil to the center 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 Ⓜ.

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.

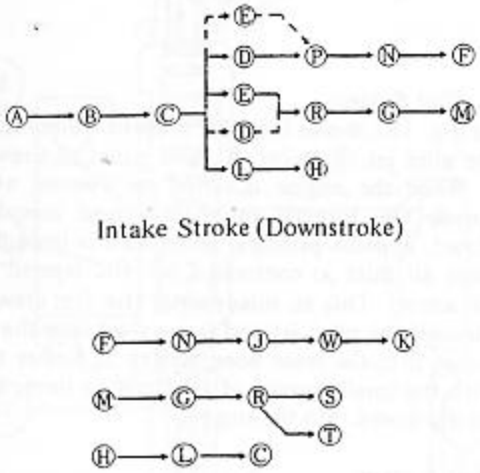
The plunger starts pushing the plunger follower back inside the valve sleeve, closing up the forward pump chamber Ⓜ. This forces oil back out passage Ⓖ, and by way of notch Ⓡ into either Ⓢ or Ⓣ to the right or left cylinder outlet.

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 center 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.

Oil Flow Chart

(177)

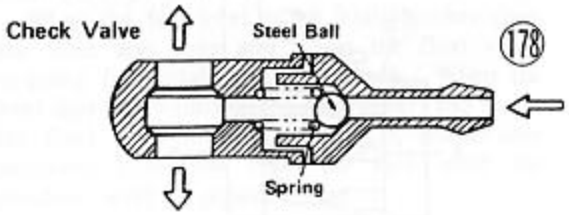


3) Check Valves

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.

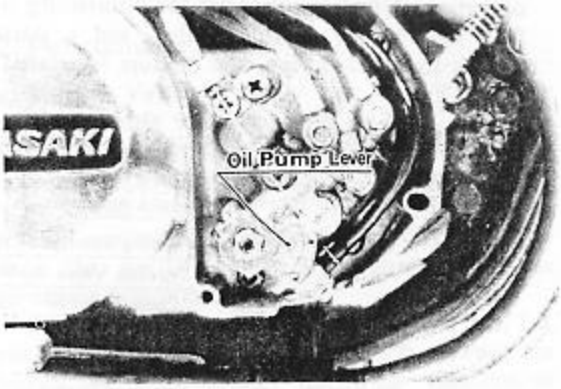


(178)

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 15.

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.
S1, S2*	.108 – .128 oz. (3.20 – 3.79 cc)
S2, KH250	.127 – .150 oz. (3.75 – 4.43 cc)
S3, KH400	.109 – .128 oz. (3.21 – 3.79 cc)

*Pumps marked "S1" or "S2-2" on lever.

5) Superlube Oil

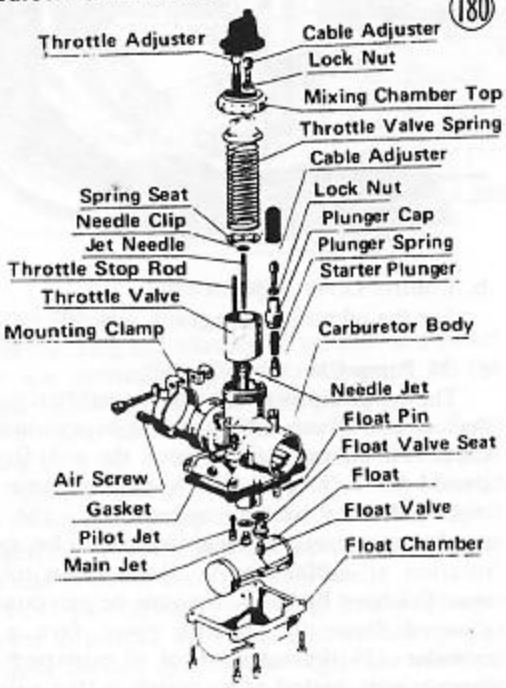
Use any good quality 2 cycle engine oil that is recommended for air-cooled engines.

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 (180)



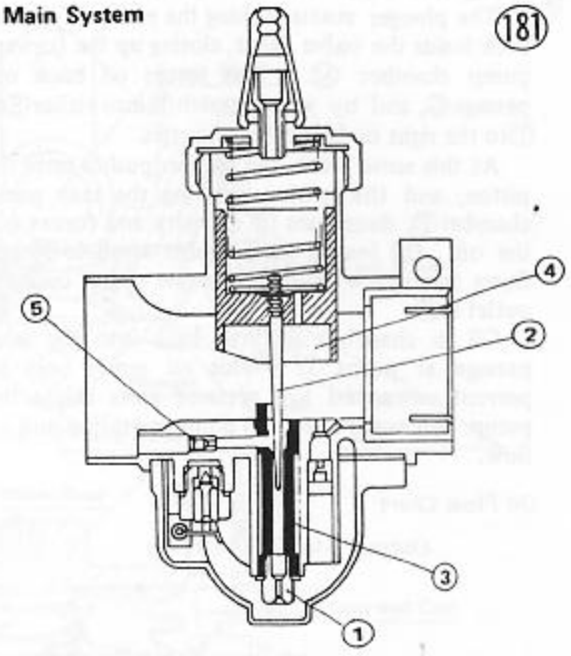
1) Construction and Operation

a. Main System

As Fig. 181 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 (181)

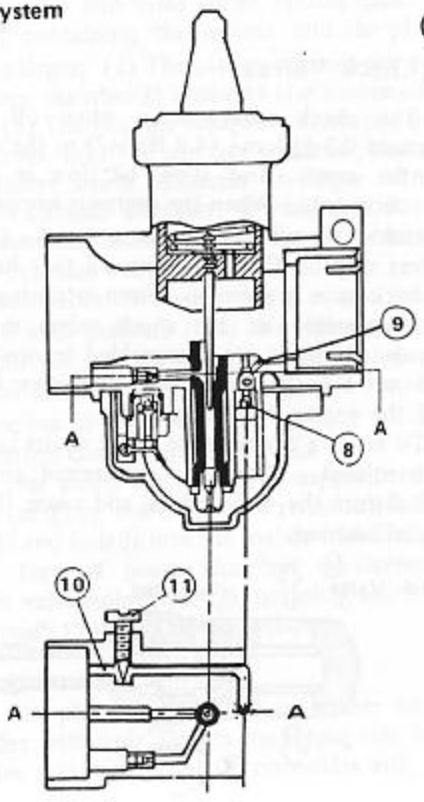


b. Pilot System

Fig. 182 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 (182)

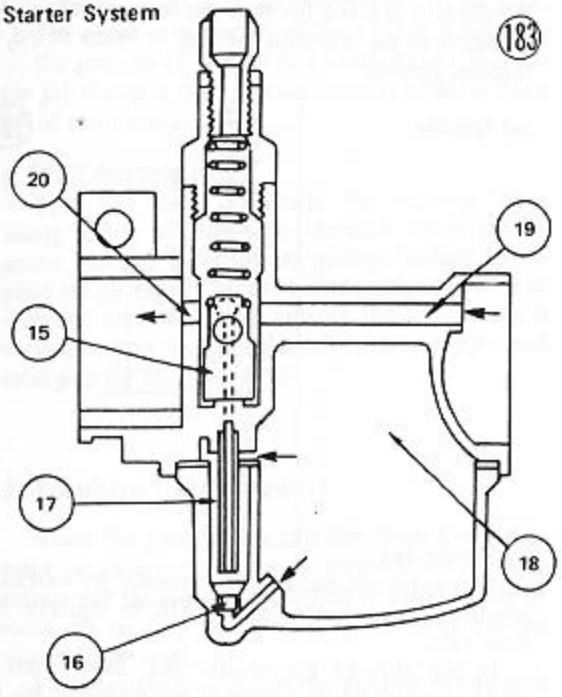


c. Starter System

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 ⑱③



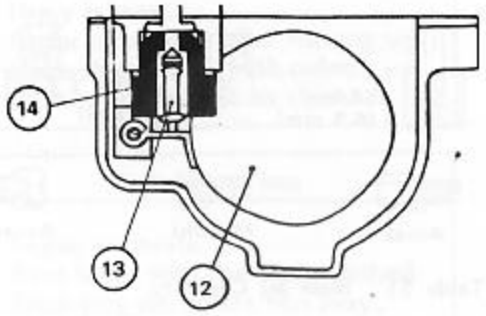
d. Float Mechanism

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 ⑱④



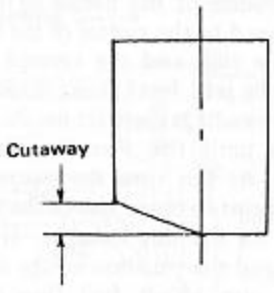
2) Functional Parts

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 ⑱⑤



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

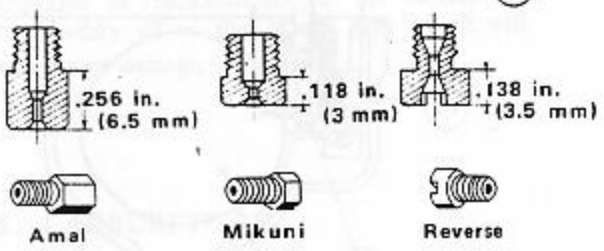
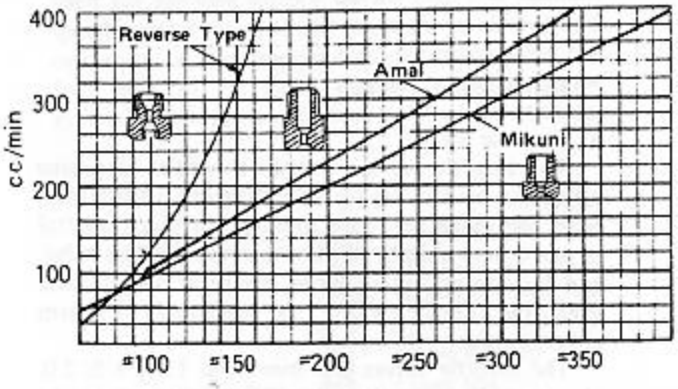


Table 21 Main Jet Capacity



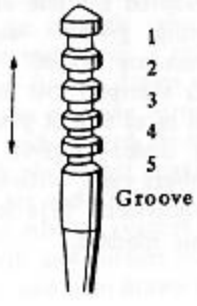
d. Jet Needle

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



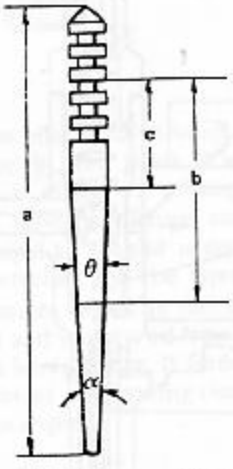
(1) The first number indicates the length of dimension "a". The 5 in the example stands for 50 mm and over, but under 60 mm. A four would mean from 40 up to 50 mm and so on.

(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



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

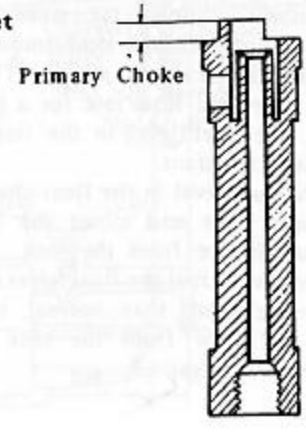


Table 22 Needle Jet Inside Diameter

	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.

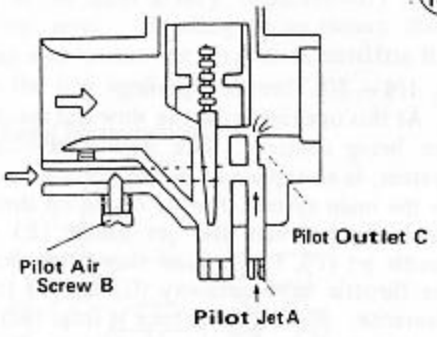
Mixture too lean
Engine overheats. Runs better with the starter pushed. Spark plug electrodes burn away. Fluctuations in engine speed. No power.

a. 0 – 1/4 Throttle Opening

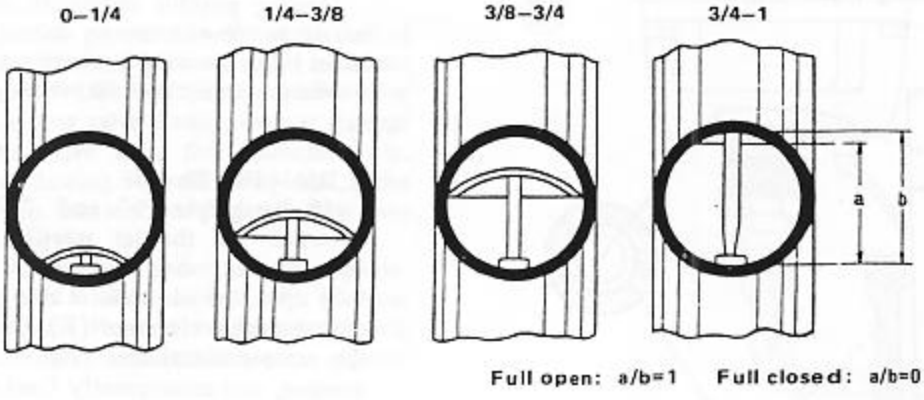
At this throttle opening, the fuel measured by the pilot jet (A) mixes with air adjusted by pilot air screw (B), producing a rich mixture output from pilot outlet (C). This rich mixture is then further blended with the small air flow in the main air flow in the main bore and fed into the engine. This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

Throttle Opening 0–1/4 (190)



Throttle Opening (191)



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. Start lever returned but starter plugner not fully closed.

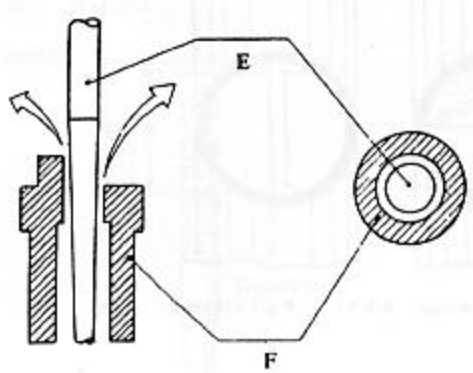
Too lean
Throttle valve has worn and developed play. Carburetor mounting is loose, allowing air to leak in.

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.

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.

Throttle Opening 1/4 – 3/8 (192)



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.

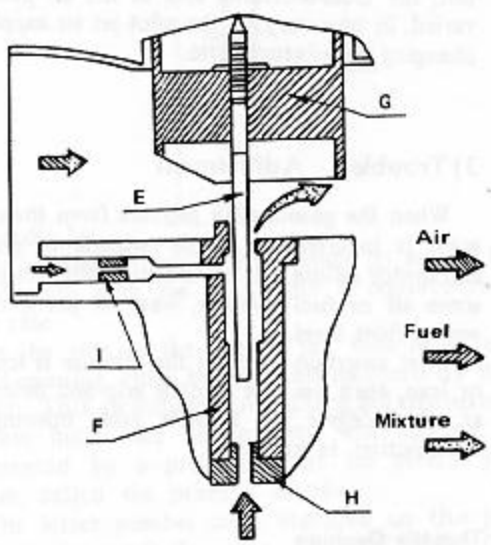
c. 3/8 – 3/4 Throttle Opening

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.

Throttle Opening 3/8 – 3/4 (193)

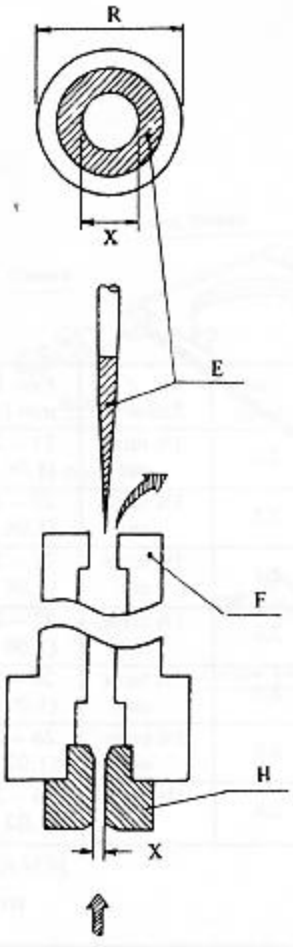


Among possible causes of faulty functioning would be obstruction or loose mounting of the main jet or needle jet, clogging of the air jet or needle jet, and jet needle wear.

d. 3/4 – Full Throttle

In paragraphs "b" and "c", fuel flow was governed by the jet needle/needle jet (E/F) opening, but when throttle valve (G) is 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.

Throttle Opening 3/4 – Full (194)



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.

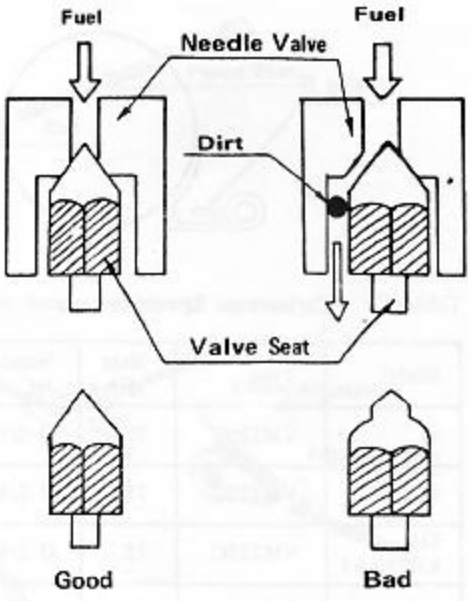
With the reversible type jet, the standard jet can be varied *2.5 at a time. To make the mixture leaner use the next lower numbered jet; the next higher numbered jet will produce a richer mixture.

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.

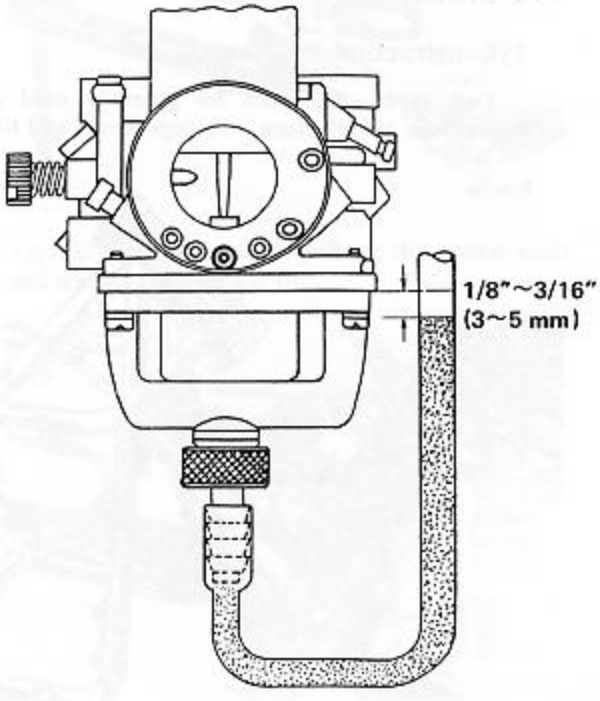
Turn the fuel tap off, and remove the carburetor from the intake manifold with the fuel hose left in place. Remove the float bowl, and install the fuel level measurement device (special tool) in its place.

Needle and Seat (195)



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 0.12~0.20 in. (3~5 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.

Fuel Level Measurement (196)



Float Level Adjustment (197)

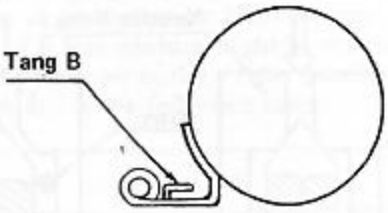


Table 23 Carburetor Specifications

Model	Type	Main Jet*	Needle Jet	Jet Needle	Pilot Jet	Cut-away	Air Screw	Fuel Level mm (in.)	I.D. Mark
S1	VM22SC	75	O-0/4	4EJ8-3	20	2.0	1¾ turns out	27 – 29 (1.06 – 1.14)	S1-1
S1A, S1B	VM22SC	75	O-2/4	4EJ9-3	17.5	2.5	1¼ turns out	27 – 29 (1.06 – 1.14)	S1-U
S1C, KH250-A5	VM22SC	75	O-2/4	4EJ9-3	20	2.5	1½ turns out	27 – 29 (1.06 – 1.14)	S1U-1
KH250-B1	VM22SC	67.5	O-2/4	4EJ9-3	20	2.5	1½ turns out	27 – 29 (1.06 – 1.14)	S1E-1
S2, S2A	VM24SC	85	O-2/4	4EJ4-3	25	2.0	1½ turns out	26 – 28 (1.02 – 1.10)	S2U-0
S3, S3A	VM26SC	85	O-2/4	4EJ4-3	22.5	2.0	1¾ turns out	26 – 28 (1.02 – 1.10)	S3
KH400-A3	VM26SC	77.5	O-6/4	4EJ4-3	20	2.5	1¼ turns out	26 – 28 (1.02 – 1.10)	KH4

*Reverse type.

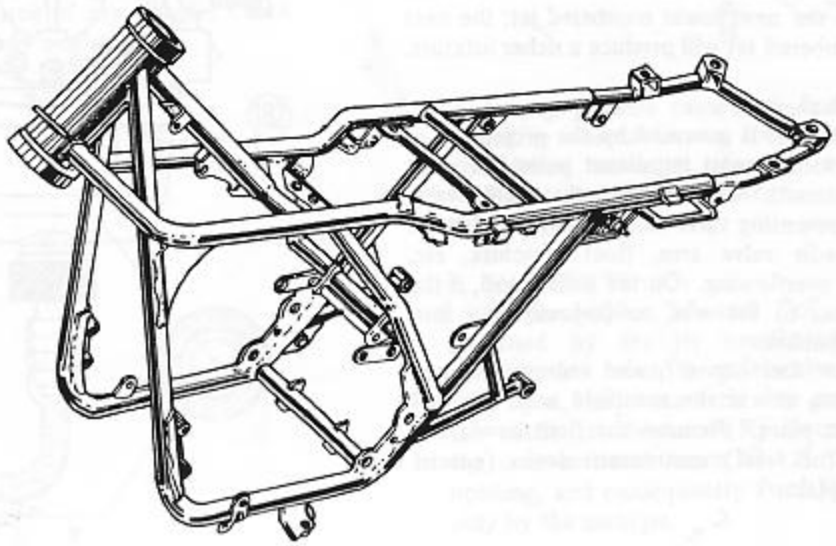
IV. Frame

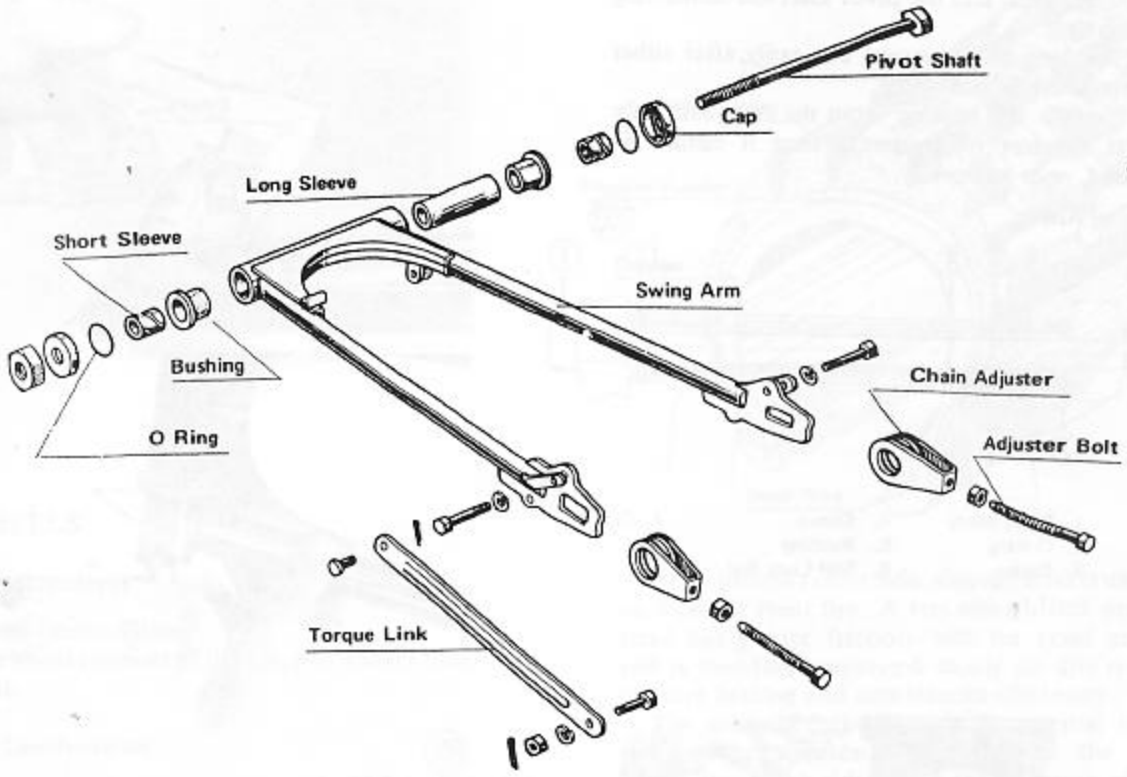
1. FRAME

1) Construction

Two types of frames are generally used in motorcycle manufacture, the pipe frame and the pressed steel frame. In the S and KH Series machines, a rigid, light-weight double cradle pipe frame is used.

Frame (198)





2. SWING ARM

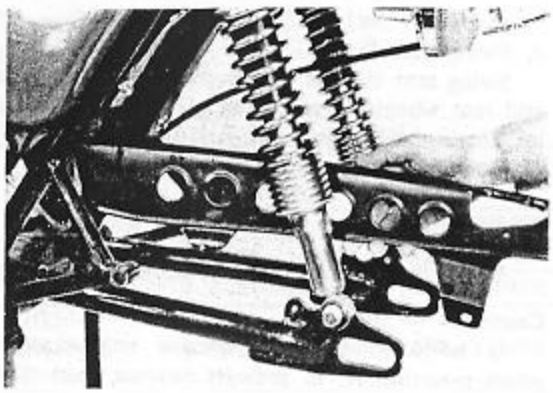
1) Construction

The swing arm works together with the rear shock absorbers as a buffer device. The front of the swing arm is attached to the frame by the pivot shaft, and the rear part through the shock absorber, moving up and down with the pivot shaft as a reference.

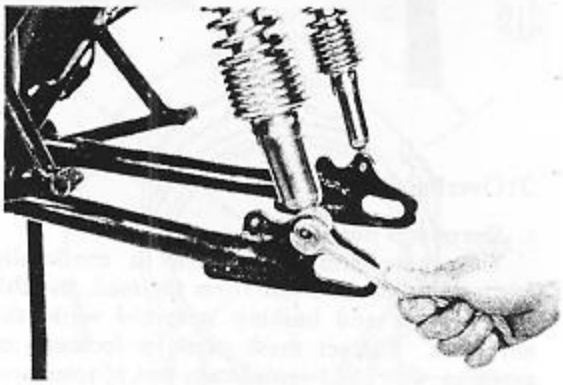
2) Disassembly

First the rear wheel and coupling must be disassembled. For disassembly procedure see page 61 or 62.

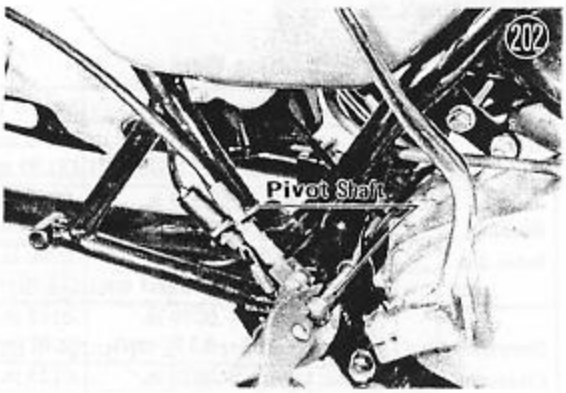
First remove the left muffler since the chain cover screws are difficult to loosen otherwise, then remove the chain cover.



Remove right mufflers and then the rear shock absorbers.



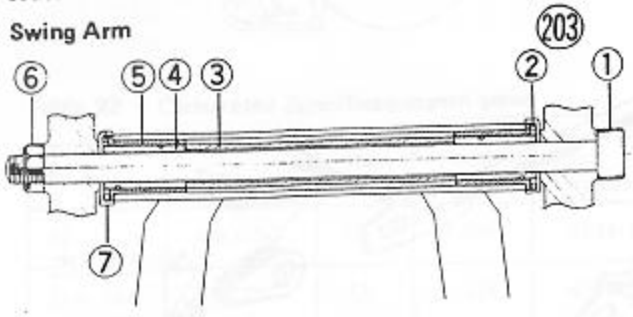
Take off the lock nut, pull out the pivot shaft and remove the swing arm.



Remove the short sleeves by inserting a rod or starting punch into the pivot shaft and hammering it lightly.

The long sleeve comes out easily after either short sleeve is removed.

Remove the bushing from the swing arm only if it requires replacement, since it cannot be reused once removed.



1. Pivot Shaft
2. O Ring
3. Collar
4. Sleeve
5. Bushing
6. Self Lock Nut
7. Cap

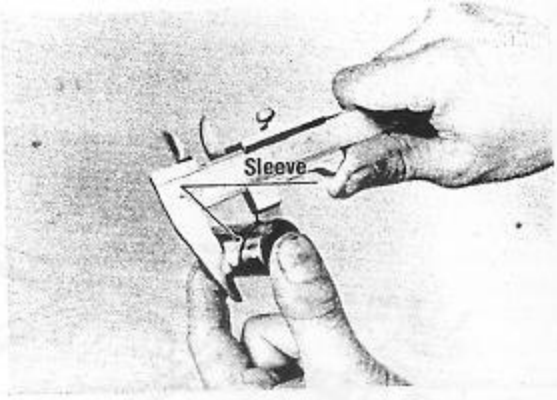
3) Overhaul

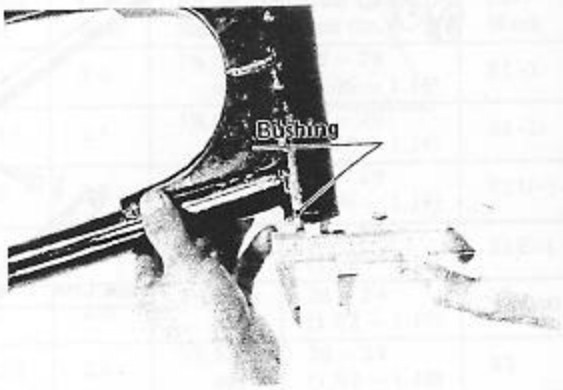
a. Sleeve and Bushing

The swing arm pivot point is continually moving due to vibration from the road, and this causes sleeve and bushing wear and works the nut loose. Inspect these parts for looseness or excessive wear, and replace any out of tolerance. Be especially attentive to wear of the bushing on the chain side, as this bushing wears more than the other. Play in either bushing will cause wheel vibration.

Table 24 Sleeve, Bushing Wear

	Model	Standard	Service Limit
Sleeve Outer dia.	All	.8653 ~ .8661 in. (21.979 ~ 22.000 mm)	.8641 in. (21.95 mm)
Bushing Inner dia.	S1, KH250	.8712 ~ .8719 in. (22.128 ~ 22.171 mm)	.8807 in. (22.37 mm)
	S2, S3, KH400	.8673 ~ .8686 in. (22.030 ~ 22.063 mm)	.8780 in. (22.30 mm)
Sleeve/Bushing Clearance	S1, KH250	.0051 ~ .0076 in. (0.128 ~ 0.192 mm)	.0165 in. (0.42 mm)
	S2, S3, KH400	.0012 ~ .0033 in. (0.030 ~ 0.084 mm)	.0139 in. (0.35 mm)



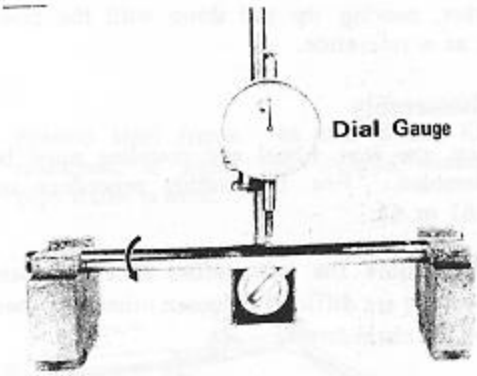


b. Pivot Shaft

Measure pivot shaft runout with a dial gauge.

Table 25 Pivot Shaft Runout

Standard	Service Limit
Under .004" (.1 mm)	0.008 in. (0.2 mm)



c. Swing Arm Warp

Swing arm warp or bending will cause the front and rear wheels to go out of alignment, resulting in steering difficulty and handlebar oscillation. If the swing arm is warped, replace it.

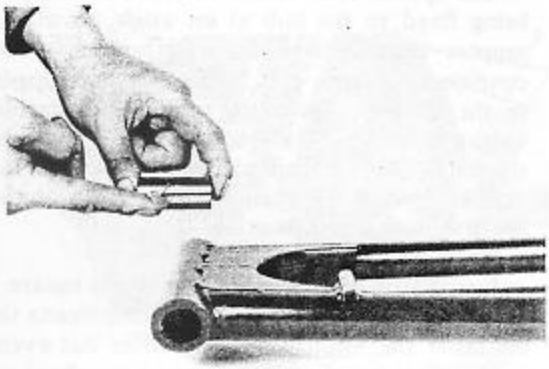
4) Assembly

Assembly is in the reverse order of disassembly.

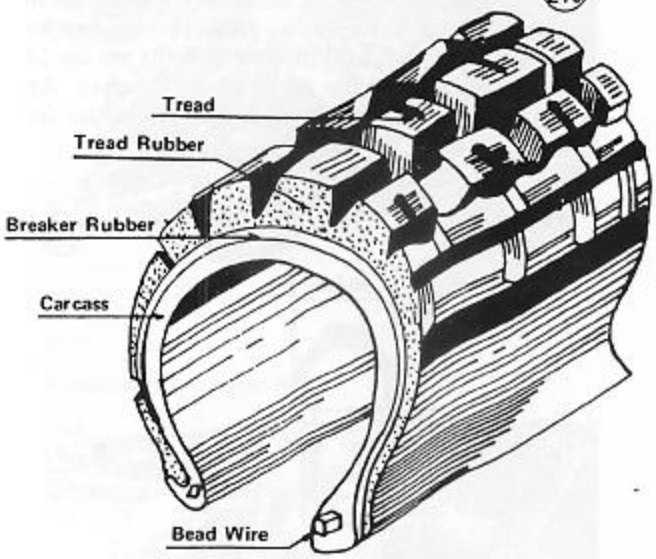
Caution:

1. Use a good quality grease on the sleeve when inserting it, to prevent seizure from overheating.

2. Pivot shaft lock nut torque is 43 – 72 ft-lbs (6.0 – 10.0 kg-M).



Tire Construction (210)



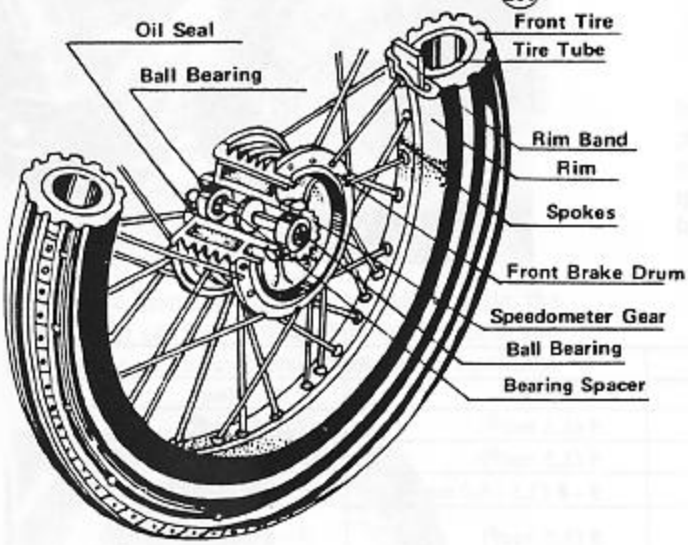
3. WHEELS

1) Construction

a. Wheel Construction

The wheel consists of the tire, rim, spokes tube, and hub.

Wheel Construction (209)



b. Tire Construction

Below is a cross-sectional diagram of a tire. Depending on the use of the tire, various tread patterns are used.

A rib pattern resists side slippage, and is usually used on the front tire. A tire with a block pattern tread has greater friction with the road surface and is therefore employed chiefly on the rear to improve braking and acceleration efficiency.

The crown of the tire is the normal riding surface; the shoulder portion holds the road during turns; the side walls absorb much of the shock from the road surface, and the bead holds the tire in the rim.

Tire Cross Section (211)

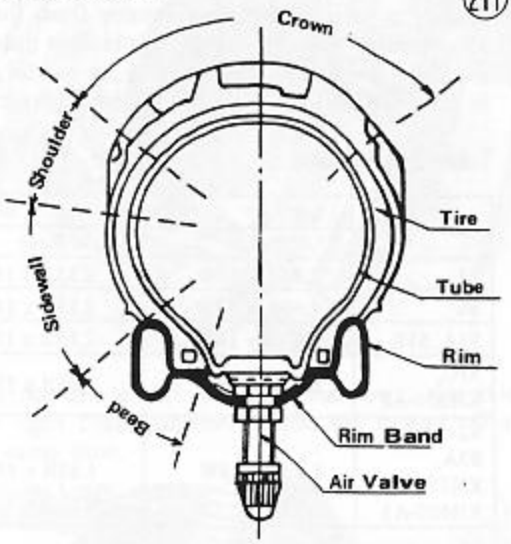
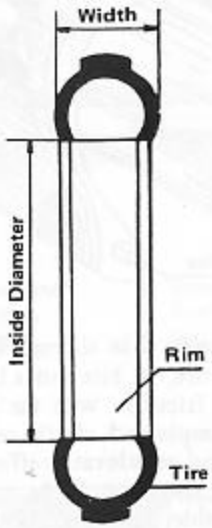


Table 26 Tires

Model	Tire Size		Air Size	
	Front	Rear	Front	Rear
S1, S1A, S1B	3.00S – 18 4PR	3.25S – 18 4PR	24 psi (1.7 kg/cm²)	31 psi (2.2 kg/cm²)
S2, S2A	3.00S – 18 4PR	3.50S – 18 4PR	24 psi (1.7 kg/cm²)	31 psi (2.2 kg/cm²)
S1C, S3, S3A	3.25S – 18 4PR	3.50S – 18 4PR	24 psi (1.7 kg/cm²)	31 psi (2.2 kg/cm²)
KH250-B1 KH250-A5 KH400-A3	3.25S – 18 4PR	3.50S – 18 4PR	25 psi (1.75 kg/cm²)	28 psi (2.0 kg/cm²)

The tire size marking shows tire dimensions in inches. For example a 3.00–18 tire has an overall width of 3.00 inches, and fits on an 18 inch rim, i.e. its inside diameter is 18 inches. An "S" after the width number indicates a tire for high speed use.

Tire Size (212)



c. Rim

The outside edge of the rim is curved toward the center so that the tire bead will catch on it, staying in place by outward tension from the tire air pressure. Since this type of tire does not keep the tube from sitting against the rim, a rim band is provided to guard the tube from damage.

d. Spokes

The spokes connect the rim and the hub, and being fixed to the hub at an angle, are able to support the vehicle and load force under any conditions. Figure 206 shows the force applied to the spokes: Spokes A support the standing weight of the vehicle and receive the force of road shocks; spokes B work during acceleration and normal forward movement; spokes C receive their heaviest load during braking.

e. Wheel Balance

Inertia of the wheel increases as the square of the angular speed of the wheel, which means that the faster the wheel turns, the more that even a small difference of weight around the wheel will affect stability. To maintain wheel stability and prevent vibration at high speeds, wheel balancing weights are fixed to the outer end of the spokes.

2) Disassembly

a. Front Wheel (on drum brake models)

Remove the front brake cable.

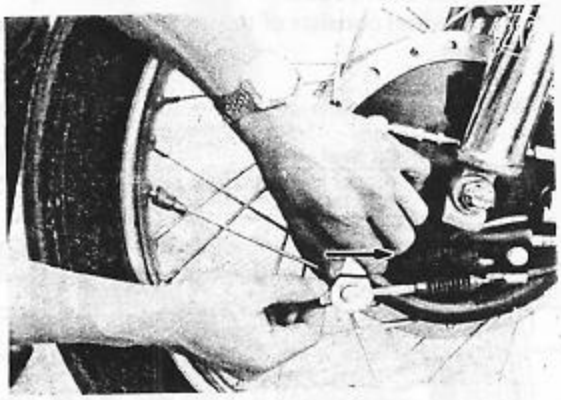
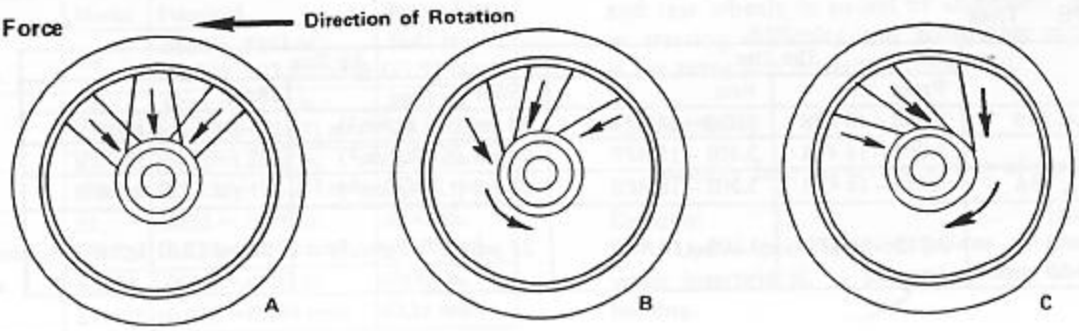


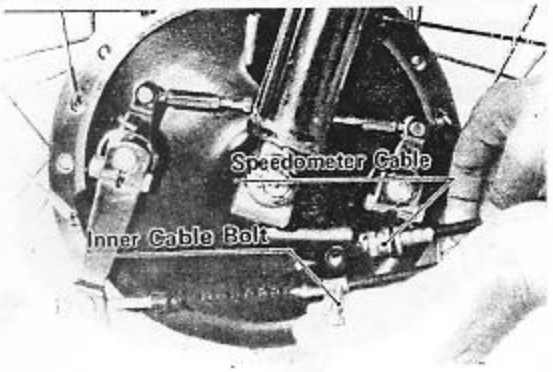
Table 27 Wheels

Model	Rim Size		Spoke Size	
	Front	Rear	Front	Rear
S1	1.85B x 18W	2.15B x 18W	9 (3.5 mmΦ)	9 (3.5 mmΦ)
S2	1.60A x 18W	2.15B x 18W	9 (3.5 mmΦ)	9–8 (3.5–4.0 mmΦ)
S1A, S1B	1.60A x 18W	2.15B x 18W	9–8 (3.5–4.0 mmΦ)	9–8 (3.5–4.0 mmΦ)
S1C, KH250-A5	1.85B x 18W	1.85B x 18W	9 (3.5 mmΦ)	9–8 (3.5–4.0 mmΦ)
S2A, S3 S3A, KH250-B1 KH400-A3	1.85B x 18W	1.85B x 18W	9–8 (3.5–4.0 mmΦ)	9–8 (3.5–4.0 mmΦ)

Spoke Force (214)

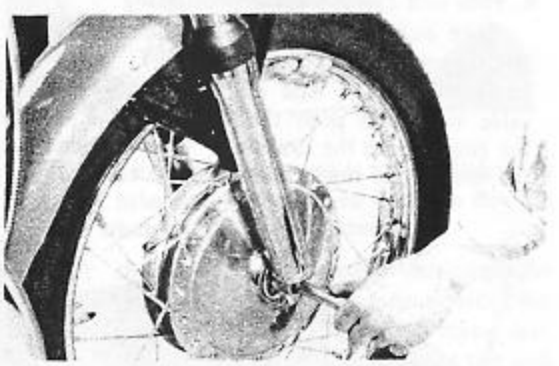


Remove the inner cable bolt and pull the speedometer cable from the brake panel.



Remove the front axle bolt.

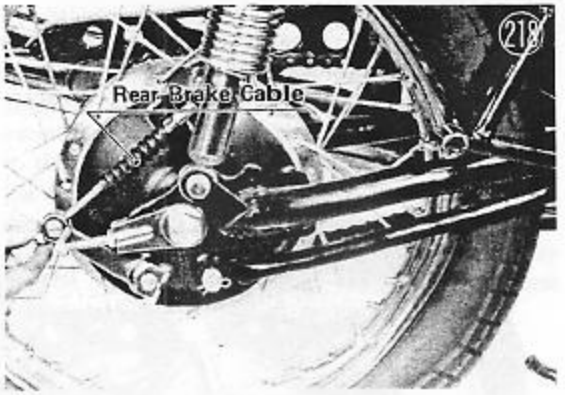
Place a stand under the engine to raise the front wheel off the ground. Pull out the axle, and remove the wheel and brake panel as an assembly.



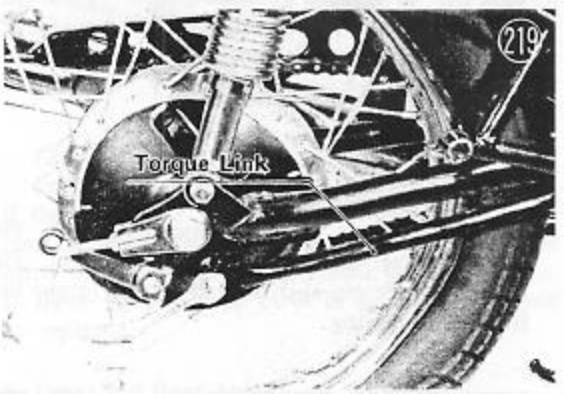
b. Rear Wheel ('72~'73 models)

Refer to page 104 first for removal of right mufflers.

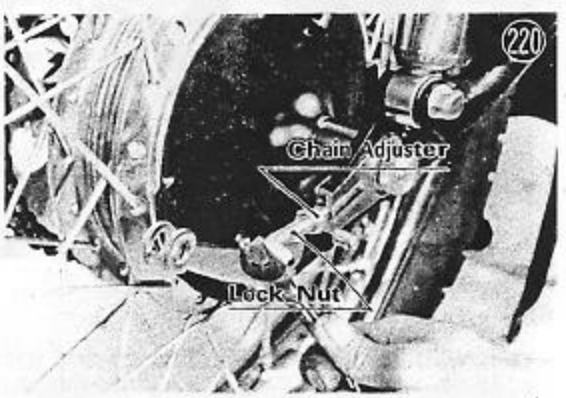
Remove the rear brake cable.



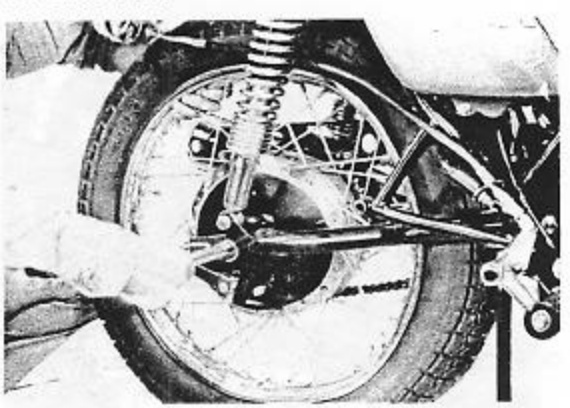
Remove the torque link.



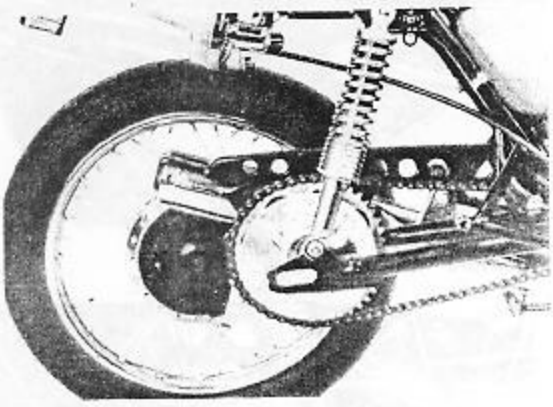
To make reassembly easy, loosen the chain adjuster lock nut and back off the adjuster screw 2 or 3 turns.



Pull out the cotter pin and take out the axle. The right chain adjuster collar will come off at the same time.

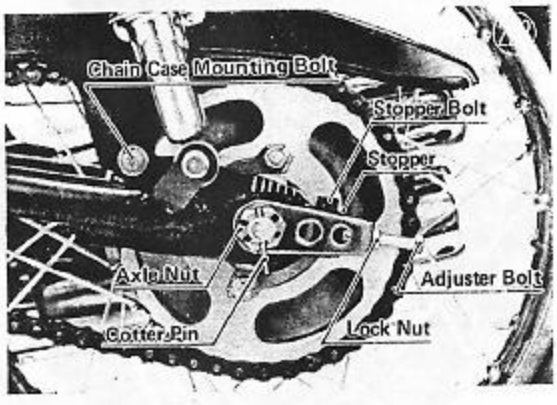


The coupling is separate from the wheel and drum, so when removing the wheel it is not necessary to remove the coupling.

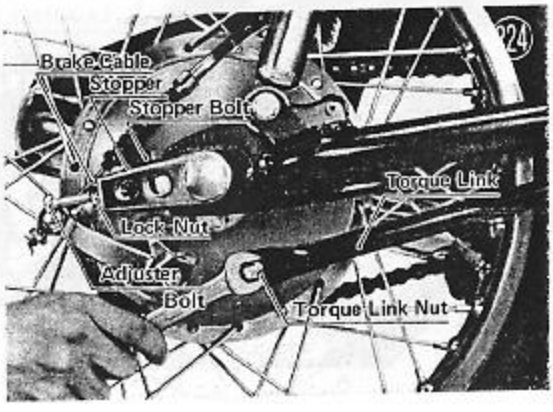


c. Rear Wheel (from '73 models)

Loosen the chain case rear mounting bolt. Pull out the cotter pin and loosen the axle nut. Pull out the cotter pin and disconnect the torque link from its mounting.

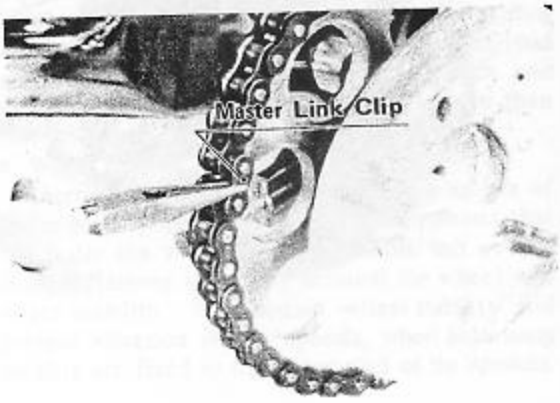


Disconnect the brake cable from the cam lever. Fully loosen both chain adjusters. Remove their bolts and take out the chain adjuster stoppers. Push the wheel forward to slip the chain off the sprocket, and then pull off the wheel.



d. Coupling

Remove the master link clip from the master link with pliers. Take out the master link and remove the chain.

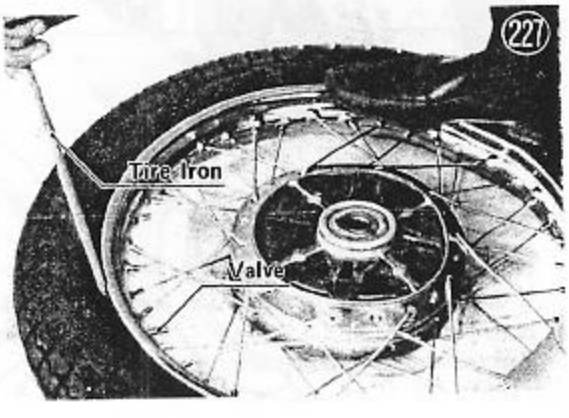


Remove the sleeve nut, and take off the coupling as assembled with the rear sprocket, and take off the left chain adjuster.

e. Tube and Tire Removal, Mounting

Take out the valve core and let out all the air, and remove the tube valve nut.

Stand on the side of the tire opposite the valve stem and push the bead to the center of the rim to give the tire play. Use tire irons to pry the tire off the rim, starting at the valve.

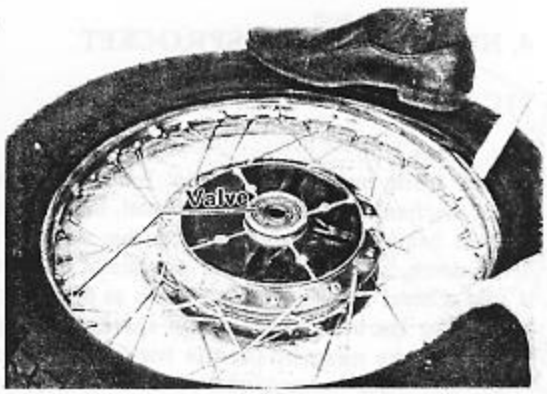


Remove the tube.

NOTE:

1. When removing the tube, spread cardboard or rags on the ground to prevent hub or rim damage and to keep dirt from getting into the bearings.
2. Lay the wheel with the drum side down to make it more stable and easy to work with.
3. It is only necessary to pry one side of the tire off the rim to remove the tube.

When mounting the tire/tube, first push the tube valve through the valve opening and hold it in place by turning its nut down two or three turns. Put a small amount of air in the tube to straighten it out and pry the tire back onto the rim in the reverse order of unmounting, starting at the side opposite the valve.



NOTE: If the valve stem nut is put on tightly at first, the tube may get pinched between the tire and rim when the tire is mounted.

After the tire is completely mounted on the rim, put air in a little at a time, stopping every so often and hitting the tire to make sure the tube does not get caught between the tire and rim. Tighten the valve nut.

3) Inspection

a. Tire

For running stability and long tire life, tires should be chosen to match their use and riding conditions, and tire air pressure set to the correct level. If tire pressure is too high the center of the tire will wear excessively, the tire will get damaged easily, it may slip on the road, and every small irregularity in the road surface will be transmitted to the rider. If tire pressure is too low the sides of the tire crown will wear badly, the cord may be damaged and the tire may crack. Steering will be difficult, gas mileage will drop, and the tire may slip on the rim and damage the tube (for those models without the bead protector).

(1) Wear

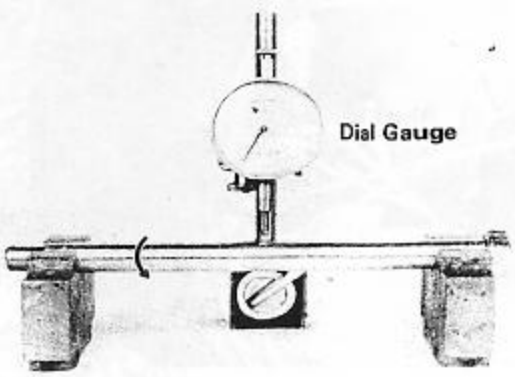
A worn tire is very dangerous in that it will slip easily during sudden braking or on curves, and becomes punctured easily. Judge tire wear by the depth and condition of the tread at the center of the tire.

(2) Cuts

Even small cuts in the tire can cause a blowout if they are deep. Wash the tire and check it for cuts, at the same time removing any stones or other foreign objects imbedded in the tire surface. If there are any deep cuts in the tire, it should be replaced.

b. Front and Rear Axles

A bent axle will cause wheel vibration and unstable handling. Check axle runout with a dial gauge. If runout is over .028" (0.7 mm) and cannot be corrected to within this tolerance, replace the axle. A new axle has under .008" (0.2 mm) runout.

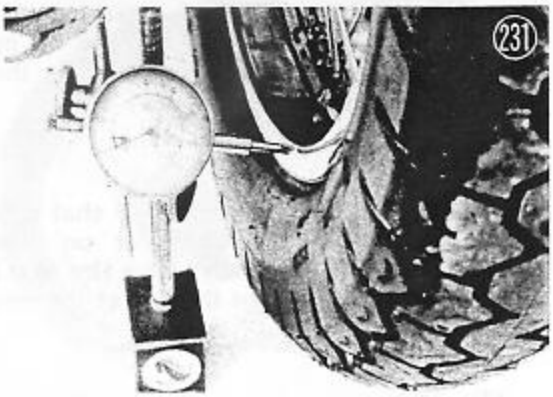


c. Spokes, Rim Warp

Check that all spokes are tightened evenly. Generally loose or unevenly tightened spokes will not only hasten spoke and spoke nipple wear, but will cause the rim to warp and spokes to break. Conversely, a certain degree of rim warp can be corrected by tightening the spokes properly. As illustrated, spin the wheel and check runout with a dial gauge. If runout exceeds the service limit and is not correctable, replace the rim. Also replace any bent spokes.

Table 28 Rim Runout

	Standard	Service Limit
Axial	under .04 in. (1 mm)	.12 in. (3 mm)
Radial	under .04 in. (1 mm)	.08 in. (2 mm)



d. Wheel Balance

Wheels out of balance will vibrate and cause handlebar oscillation. The balance is checked with the wheel mounted, and in the case of the rear wheel, with the chain removed. Spin the wheel lightly and see if it will stop in any position of its own accord. If it will not, attach a balance weight to the lightest side and spin the wheel again. Repeat the process as necessary until the difference between the lightest and heaviest side is less than 1/3 ounce (10 grams). Then attach the weights firmly with pliers. Balance weights are available in 10, 20 and 30 gm. sizes (1/3, 2/3 and 1 oz.).

4) Assembly

Assembly is in the reverse order of disassembly.

NOTE:

1. When mounting the rear wheel, align the wheels and adjust the chain at the same time with the chain adjusters. Wheel alignment is accomplished by making the right and left chain adjuster marks coincide with the alignment marks on the swing arm. (See page 98)
2. Be sure the torque link is firmly fastened to the brake panel.
3. Tightening torque for the front axle is 51 – 65 ft-lbs (7.0 – 9.0 kg-M), and tightening torque for the rear axle is 72 – 101 ft-lbs (10 – 14 kg-M).
4. Ensure that the brakes are adjusted properly as outlined in the next section.
5. Ensure that the spokes are tightened with 17 – 35 in-lbs (0.2 – 0.4 kg-M) of torque.

4. HUBS · BRAKES · SPROCKET

1) Construction

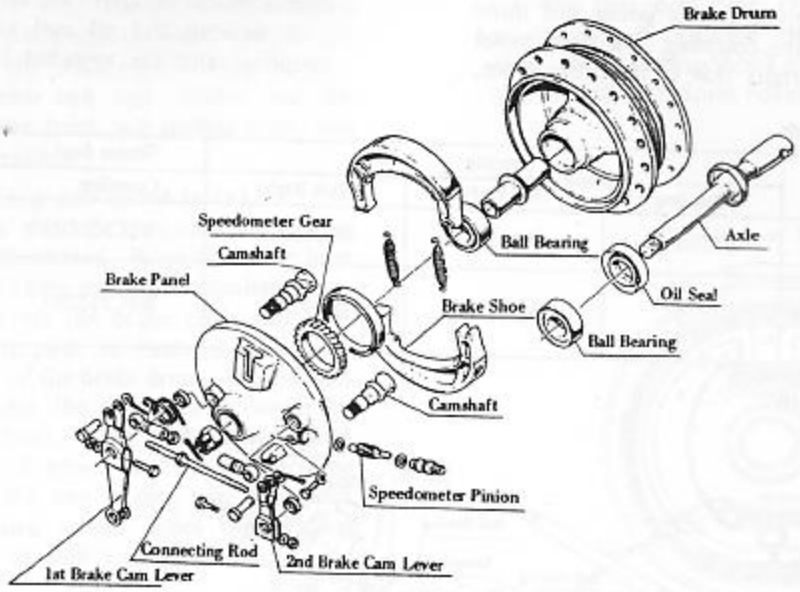
a. Front Hub

The front hub includes the brake drum and brake mechanism – the brake panel, brake shoes, etc. A bearing is pressed into either side of the brake drum, and on the inner surface of the drum is cast a steel sleeve, which serves as the braking surface for the brake shoes. The speedometer gear and pinion are mounted on the inside of the brake panel, and these transmit the rotation of the front wheel to the speedometer via the speedometer cable.

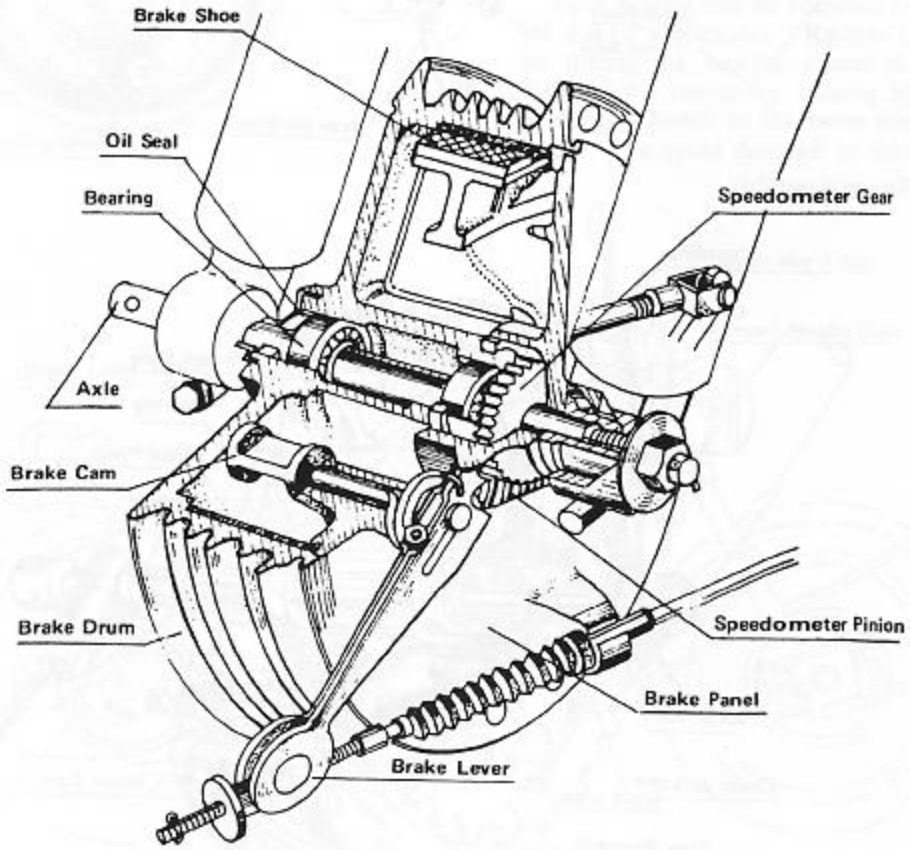
Table 29 Front Hub

Model	Bearing		Grease Seal		
	Hub Left	Hub Right	Gear Box	Hub Left	Hub Right
S1, S1A, S1B, S1C, KH250-A5 S2, S2A	#6302Z	#6302	———	WOC556807	WTC254208
S3, S3A	#6302	#6302	OJ324806	———	WTC254208
KH250-B1 KH400-A3	#6203	#6203	PJA304208	———	PJA254008

Front Hub Mechanism



Front Brake Drum Assembly



b. Rear Hub

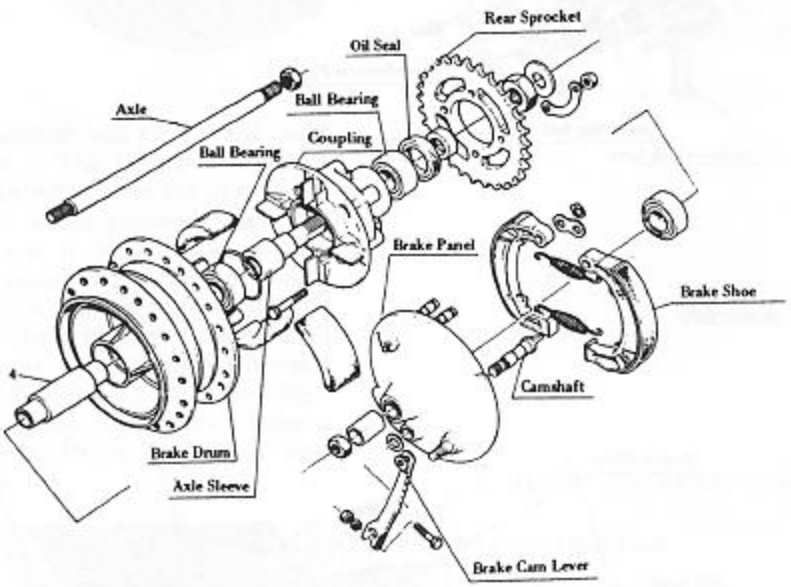
The rear hub consists of the brake drum; rear brake mechanism – brake panel, brake shoes; the sprocket which receives engine power and turns the rear wheel; and the coupling. The brake panel is mounted on the right side of the brake drum, and the coupling on the left side. The rear brake drum, which is of the same construction as the front drum, fits against the coupling separated by rubber shock dampers that buffer torque changes.

A bearing and oil seal are pressed into the coupling, and the sprocket is bolted against it.

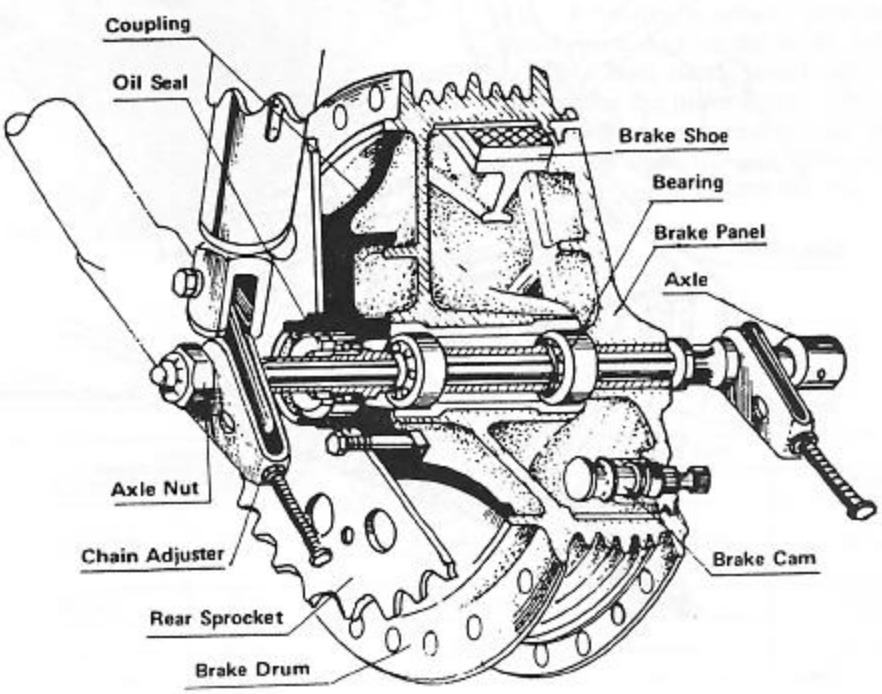
Table 30 Rear Hub

Model	Bearing			Grease Seal
	Coupling	Hub Left	Hub Right	Coupling
S1, S1A, S1B, S1C, S2, S2A, S3, S3A	#6205	#6205	#6205Z	WTC355207
KH250-A5 KH250-B1 KH400-A3	#6205	#6303	#6303Z	WTC355207

Rear Hub Mechanism (235)



Rear Brake Drum Assembly (236)



c. Brake Mechanism

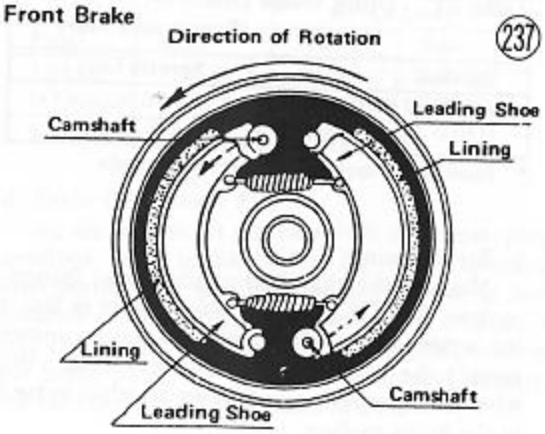
The brake mechanism consists of the brake lever or brake pedal, the brake panel assembly, and the brake drum. The brake panel assembly comprises the cam lever, cam shaft (two levers and shaft for the front brake), brake shoes, brake shoe springs, and the brake panel itself.

Both the front and rear brakes are the expansion type; the front two leading shoe, and the rear leading trailing.

(1) Two leading shoe (front brake)

The two brake shoes fit symmetrically against the two cams as illustrated. When the brake lever is pulled, the two cams are turned simultaneously by the cam lever via the brake cable and lever link, and the cams push the brake shoes against the inside surface of the brake drum. The friction of the shoe against the drum slows down the rotation of the wheel. Since both shoes expand in the direction of wheel rotation this braking method is called the two leading shoe type, and has about one and a half times the braking capacity of the leading trailing type.

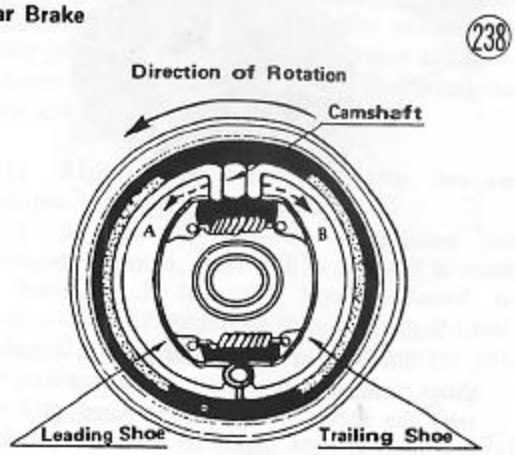
Front Brake



(2) Leading trailing (rear brake)

When the pedal is stepped on, the brake cable pulls the cam lever, which turns the cam shaft that forces the shoes to expand against the drum. At this time one shoe (trailing shoe), expands in direction B opposite drum rotation, and the other shoe (leading shoe) expands in direction A, the direction of drum rotation.

Rear Brake

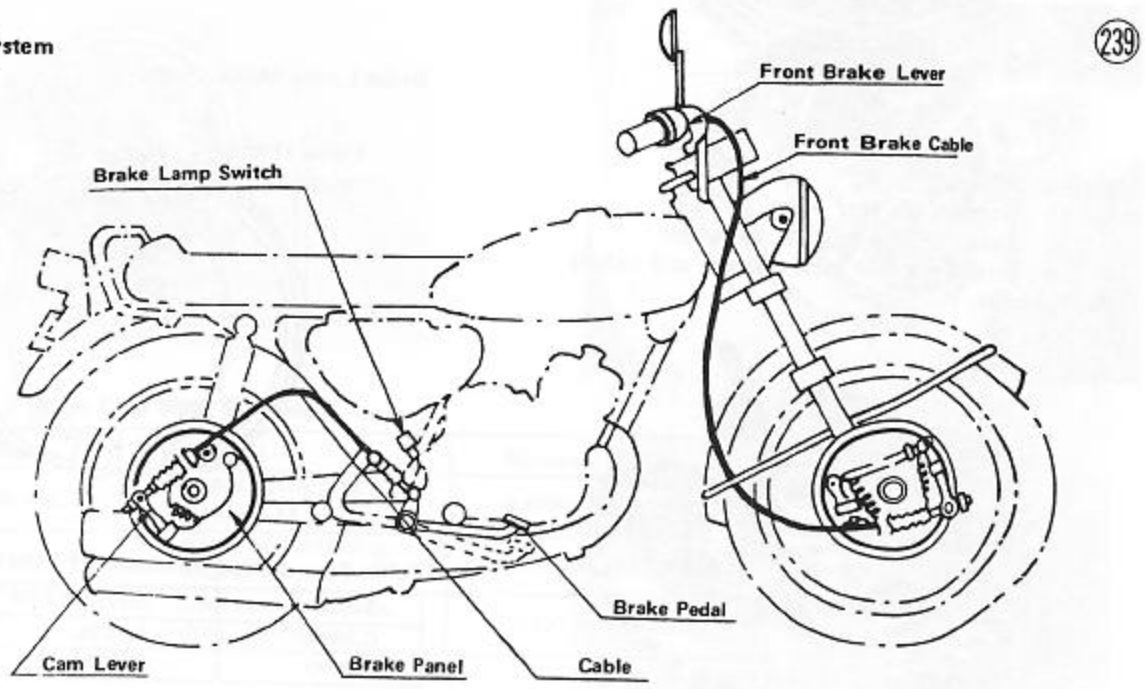


2) Disassembly

a. Bearing and Oil Seals

Each bearing can be removed together with its oil seal (if applicable). Remove the first bearing by hitting the bearing spacer to knock it out. Remove the remaining bearing by setting a rod or starting punch to its inner side and knocking it out. To avoid damage to the surface against

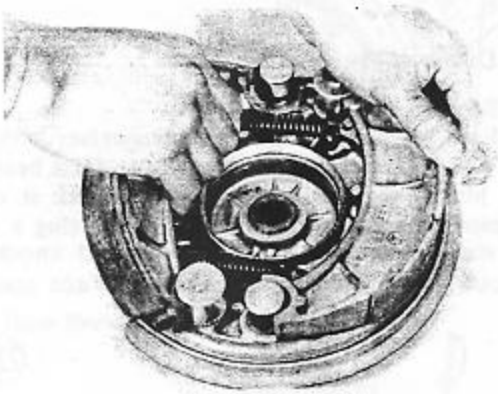
Brake System



which the bearing sits, tap the bearing evenly around its circumference.

b. Brake Shoes

If the front or rear brake panel is removed, the shoes, cam, cam lever, etc. come out with it. To take the shoes off the front panel, pull up one side first, at right angles to the brake panel. With the rear brakes, pull both shoes straight up off the pivot studs and remove them together. The linings are bonded to the shoe and cannot be removed.

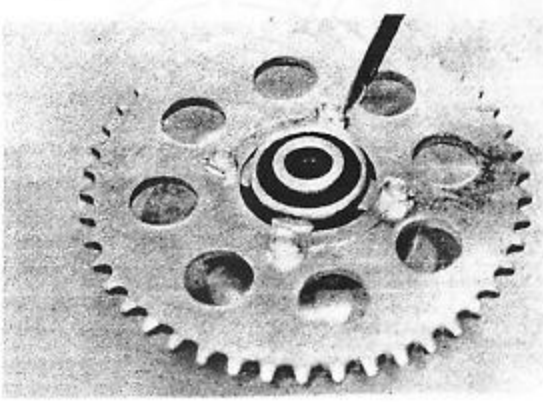


c. Rear Sprocket

(1) Remove the rear wheel.

(2) Take the coupling off the wheel.

(3) Straighten the lock washers and unbolt the sprocket.



3) Overhaul

a. Brake Drum

After long use, the inner surface of the brake drum wears down from friction with the brake shoes. Measure the inside diameter of the drum and replace it if it is worn out of tolerance.

Table 31 Drum Inside Diameter (Front and Rear)*

Standard	Service Limit
7.087 – 7.094 in. (180.0 – 180.2 mm)	7.116 in. (180.75 mm)

* Same values apply to all drum-type brake.

b. Brake Linings

Measure the thickness of the brake linings and replace them if they are worn down to less than the service limit. If the linings are worn unevenly, correct the high spots with emery cloth. With a wire brush, remove any foreign particles imbedded in the lining surface.

Brake Lining Measurement (244)

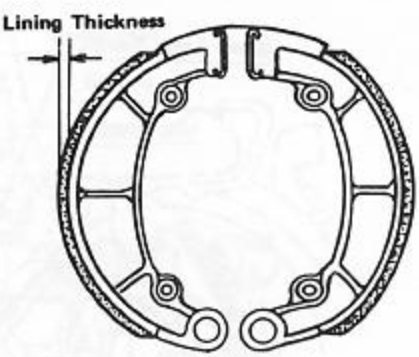


Table 32 Lining Thickness (Front and Rear)*

Standard	Service Limit
0.20 in. (5 mm)	0.08 in. (2 mm)

* Same values apply to all drum-type brake.

c. Brake Shoe Springs

Check the free length of the brake shoe springs with vernier calipers. If the springs are stretched out of tolerance they will not return the shoes properly, causing them to continually drag on the drum. Replace the springs if they are excessively stretched.

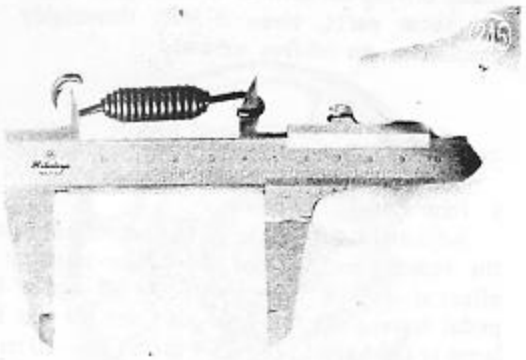


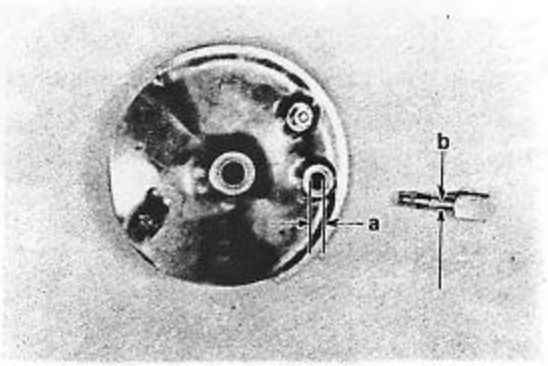
Table 33 Spring Length*

Standard		Service Limit	
Front	Rear	Front	Rear
1.85 in. (47 mm)	2.20 in. (56 mm)	1.97 in. (50 mm)	2.32 in. (59 mm)

* Same values apply to all drum-type brake.

d. Brake Cam Shaft Play

As the cam shaft and cam shaft hole wear, play develops, the brake shoes are not expanded effectively, and positive braking action is not ensured. Measure the diameter of the cam shaft and the inside diameter of the cam shaft hole in the brake panel. If clearance is excessive, replace the cam shaft and brake panel as a set.



e. Bearings

Excessive bearing clearance or damage will cause wheel vibration and bearing noise. Clean the bearing with gasoline and check that there is no rust on the race or balls; ascertain that clearance is not excessive; oil the bearing and spin it to check that it turns smoothly.

f. Oil Seals

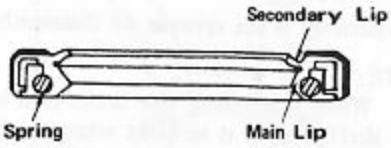
As Fig. 241 shows, the oil seal is constructed from a metal ring, spring and packing. The main lip of the seal prevents the lubrication grease from leaking out from inside the hub, and the auxilliary lip keeps dirt and water from contaminating the grease and damaging the bearing.

(1) Replace the oil seal if the lips are misshapen or otherwise damaged.

(2) If the seal lips have hardened and developed clearance, dust will be allowed to reach the bearing. If the lips have hardened, or deteriorated and changed in color, replace the seal.

(3) If the metal ring is misshapen or cut, replace the seal.

Oil Seal (247)



g. Shock Dampers

Inspect the shock damper rubber and replace it if it is shrunken or cracked. If the rubber is shrunken, a gap is formed between the damper and brake drum; when power is transmitted to the rear wheel it is received with a jolt due to the gap, and thus buffering action is lost.

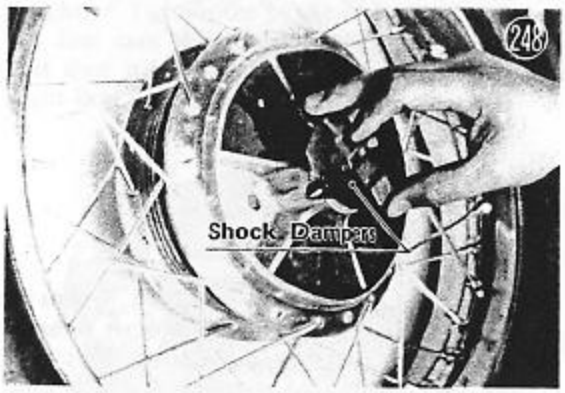


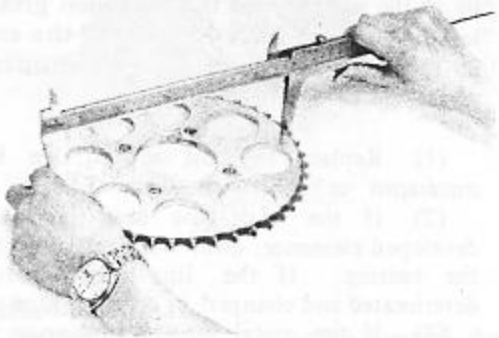
Table 34 Brake Cam Shaft Clearance*

Measurement	Standard	Maximum
Shaft hole dia.	0.5906 in. – 0.5916 in. (15.000 – 15.027 mm)	0.6004 in. (15.25 mm)
Cam shaft dia.	0.5889 in. – 0.5899 in. (14.957 – 14.984 mm)	0.5807 in. (14.75 mm)
Clearance	0.0008 in. – 0.0028 in. (0.02 – 0.07 mm)	0.0197 in. (0.50 mm)

*Same values apply to all drum-type brake.

h. Rear Sprocket

Worn sprocket teeth will cause the chain to slip off under power, or break. Measure the sprocket diameter at the base of the teeth and if it is worn out of tolerance, replace the sprocket together with the chain.



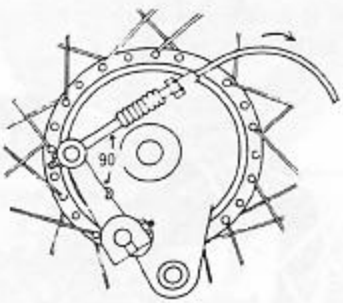
4) Assembly

Assembly is the reverse of disassembly.

NOTE:

1. When assembling the brake cam lever to the cam shaft, mount it so that when the brakes first start to take effect the brake cable will be at about right angles to the cam lever.

Brake Lever Adjustment (250)



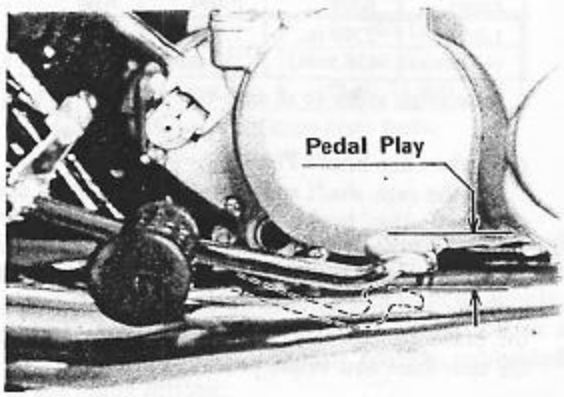
2. When pressing the bearings and oil seals into the brake drums, use a press or other means to ensure that the bearings/seals are at right angles to the drum hole, and therefore with the axle.

3. After cleaning the brake drum replenish the grease at the bearing, oil seal, front panel speedometer pinion gear, and any other surfaces where friction must be reduced. Do not allow grease on the brake linings or drum braking surface as this will prevent the brakes from holding and make driving dangerous. If any grease should get on these parts, clean it off thoroughly with gasoline or an oil-free solvent.

5) Adjustment

a. Rear Brake

Adjust the rear brake with the adjuster nut on the brake panel so that the brake starts to take effect after 3/4 – 1 1/4 inch (20–30 mm) of brake pedal travel. At this time also set the rear brake lamp to light after 5/8 – 3/4 inch (15 – 20 mm) – depending on the brake adjustment – of pedal movement, using the adjusting nut on the switch body. Do not turn the switch body as the wires may break off.



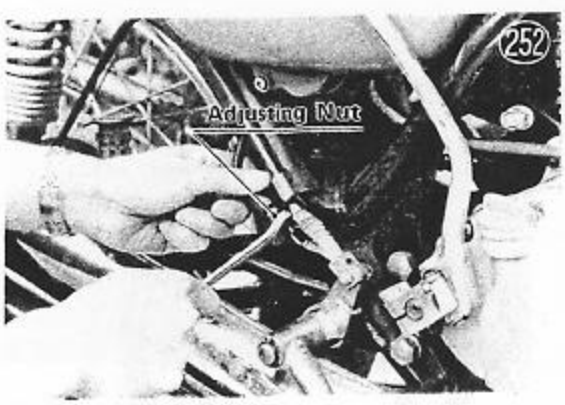


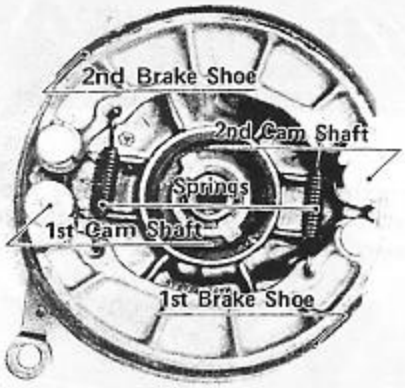
Table 35 Rear Sprocket Diameter

Model	No. of Teeth	Dia. at base of teeth	
		Standard	Limit
S1, KH250	48	9.16 in. (232.6 mm)	9.07 in. (230.5 mm)
S2	43	8.16 in. (207.3 mm)	8.09 in. (205.5 mm)
S3, KH400	41	7.76 in. (197.2 mm)	7.70 in. (195.5 mm)
	*37	*6.97 in. (177.0 mm)	*6.91 in. (175.5 mm)

*European model

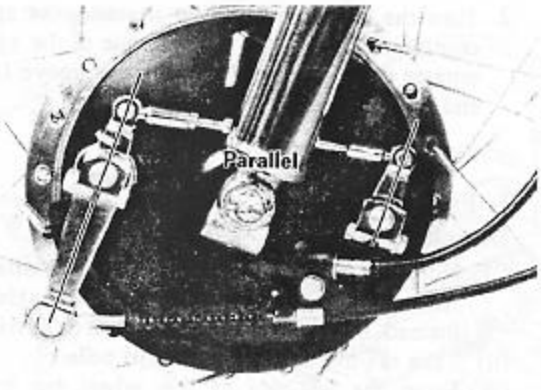
b. Front Brake

The two leading shoe type front brake must be adjusted so that both shoes contact the drum at the same time. When the brake cam, brake shoes or related parts are replaced, the brake should be completely readjusted according to the following procedure to avoid uneven shoe contact and realize good braking performance.



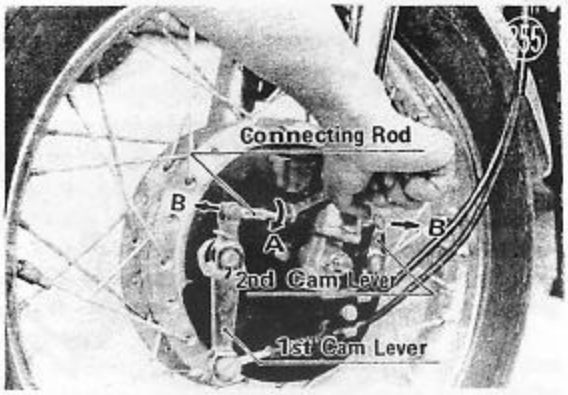
(1) Brake cam levers

Align the first cam lever with the serrations in the cam shaft, and mount it so that it is at a 90° angle to the brake cable when the brake first starts to take effect. Install the second cam lever on its cam shaft parallel to the first lever.



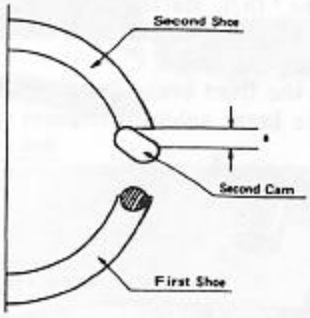
(2) Second cam play

(i) With the connecting link free (so that it turns easily with the touch of a finger), turn the rod with an 8 mm wrench about one turn in direction A. This results in the second cam lever being pushed in direction B, the direction opposite in which it moves when the brake is applied. This procedure backs off the second brake shoe so that it will not operate when the first shoe is adjusted in paragraph (3).



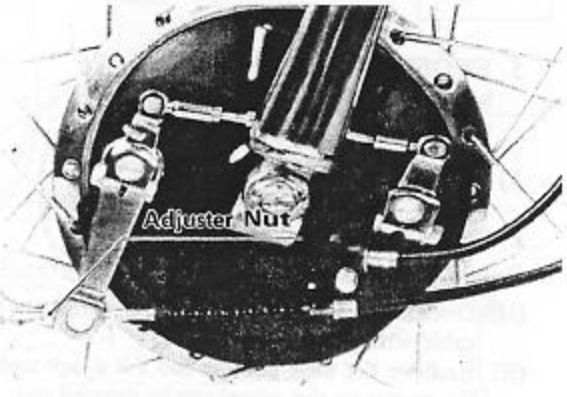
(ii) The second cam is now in the position shown in Fig. 256. Measurement "a" is the second cam's play, this amount being sufficient to avert second shoe contact with the drum when the front brake is operated.

Second Cam play (256)



(3) First brake shoe

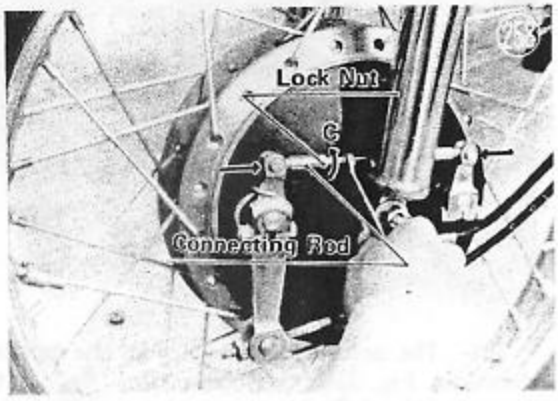
Raise the front wheel off the ground and spin it lightly. Tighten the brake cable adjuster nut on the first cam lever side to the point where the first shoe starts touching the drum and there is a slight drag on the wheel.



(4) Second brake shoe

Spin the front wheel and turn the connecting rod in direction C until the second brake shoe just

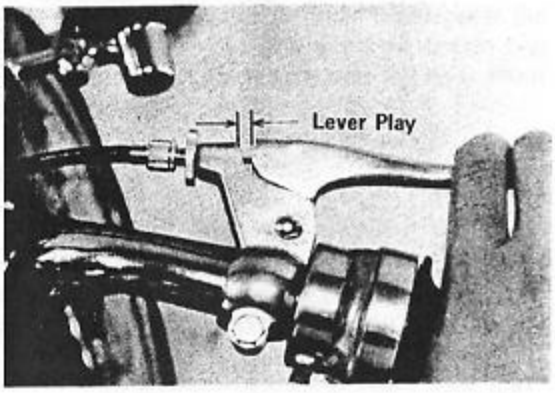
starts dragging on the drum. Fix the rod securely in this position with the lock nut.



(5) Brake lever play

Use the brake panel cable adjuster to set brake lever play at 1/4 – 3/8 inch (7–10 mm) measured as shown in the illustration at the point where the brake first starts to take effect. Fine adjustment can be made with the adjuster on the handlebar.

Since the front brake lamp switch is contained inside the brake cable, it requires no adjustment.



5. FRONT WHEEL (on Disc Brake Models), DISC BRAKE, BRAKE LINING WEAR INDICATOR

1) Front Wheel

a. Front Wheel Disassembly

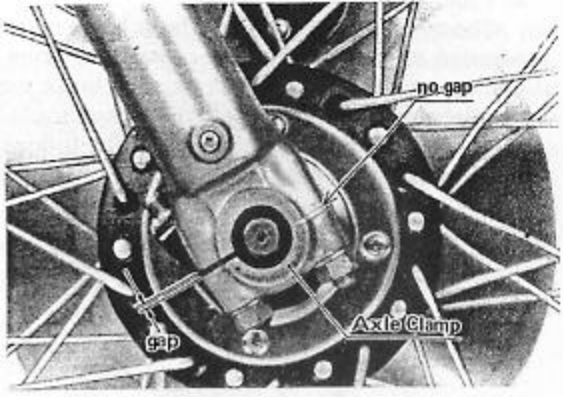
Removal:

(i) Disconnect the lower end of the speedometer cable with pliers.

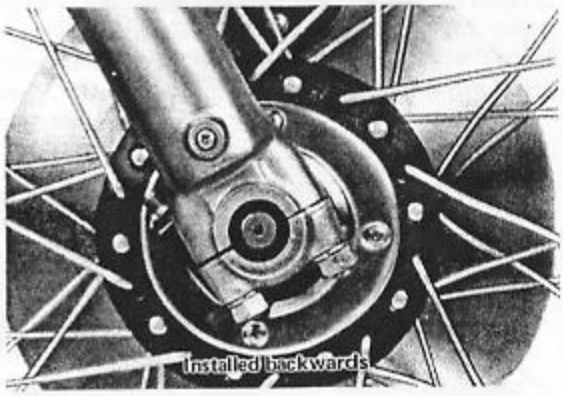
(ii) Remove the axle clamps and use a jack under the engine so the wheel can be dripped out.

Installation notes:

1. Using 11.5 – 16 ft-lbs (1.6 – 2.2 kg-M) torque, first tighten the front axle clamp nut and then the rear nut for each side, so that there will be a gap at the rear after tightening.



The axle clamp has a front and rear. If it is installed backward, the gap at the rear will be uneven.



2. Turn the front wheel while inserting the speedometer cable so that the tongue of the speedometer drive shaft will seat in the groove in the end of the cable.

b. Front Hub

Disassembly:

(i) Hold the gear box ⑪ stationary and unscrew the axle ⑲. If the axle is held stationary instead, the speedometer gear will be damaged.

(ii) Take off the wheel cap ⑳ and collar ㉑.

(iii) From the left side of the wheel, tap evenly around the inner race of the right bearing ④ and knock it out.

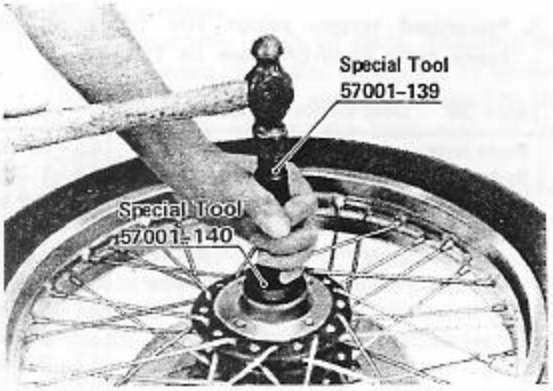
(iv) Remove the distance collar ⑤.

(v) Remove the oil seal ⑧.

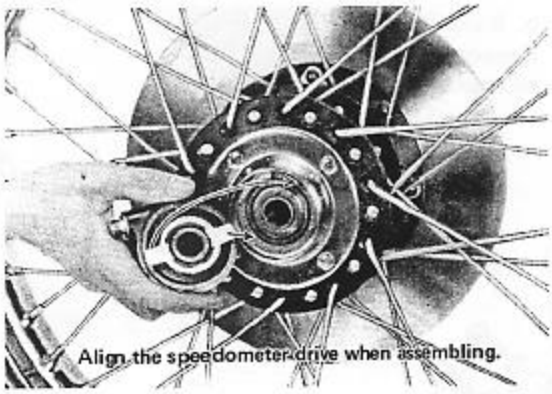
(vi) Take out the retaining ring ⑦, and from the right side of the wheel, tap evenly around the inner race of the left bearing ⑥ and knock it out.

Assembly notes:

1. Replace the oil seal with a new one, and use a special purpose tool for oil seal and bearing installation.



2. Align the parts as illustrated.



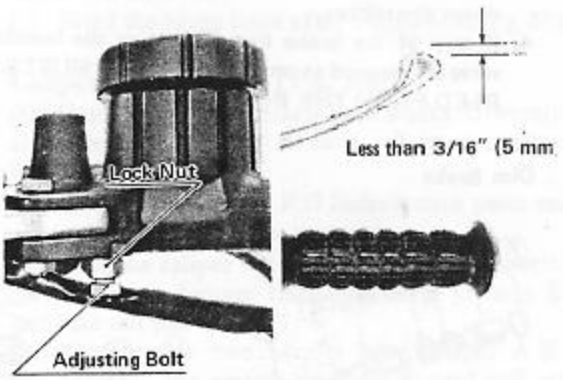
3. Hold the gear box stationary and screw in the axle. Don't hold the axle instead; otherwise, the speedometer gear drive will be damaged.

c. Front Brake Lever Adjustment

The front brake itself is adjusted automatically during use, and if it needs additional adjustment, parts are probably excessively worn or defective.

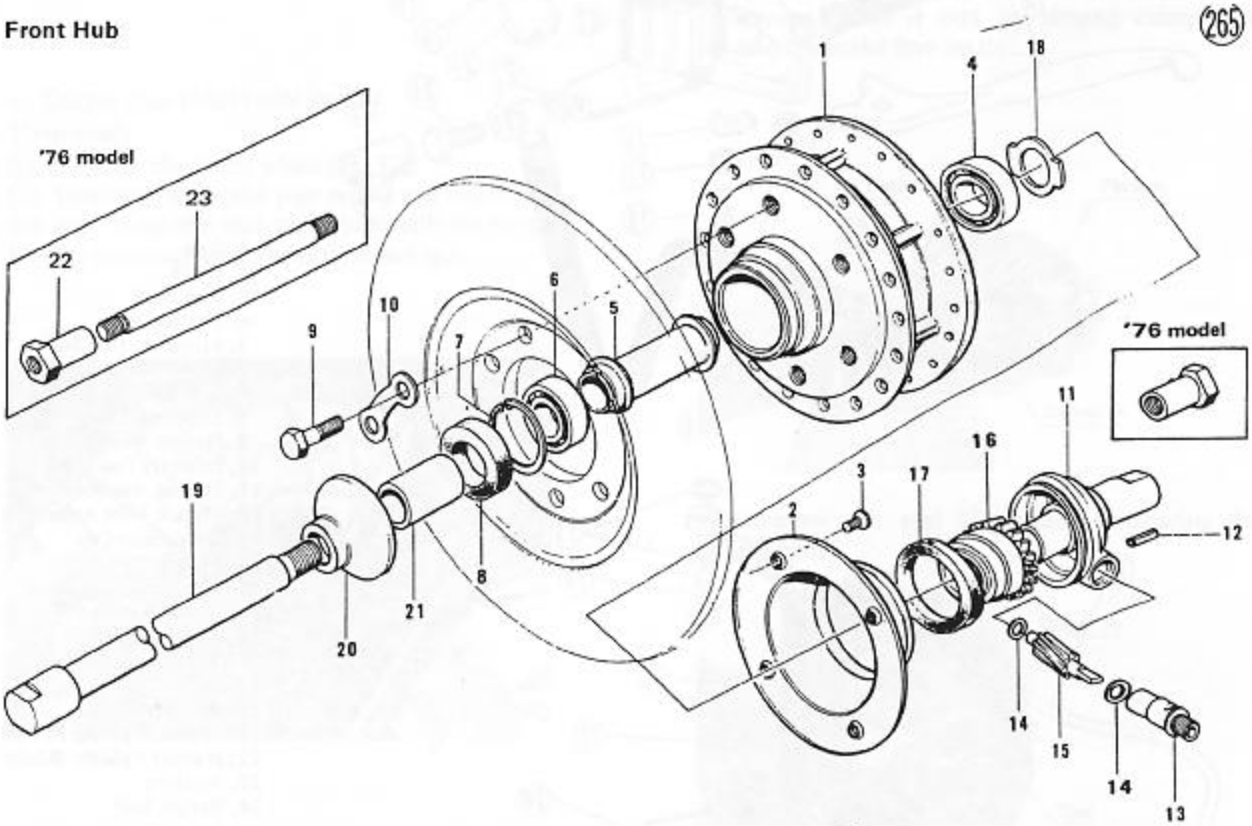
Play in the brake lever can be adjusted out to keep the lever from vibrating, but a small amount of play must be left in to ensure a full braking stroke.

To adjust lever play, loosen the lock nut, turn the adjusting bolt a fraction of a turn so that the lever has less than $^{3}/_{16}$ inch (5 mm) play, and tighten the lock nut.



Front Hub

(265)



1. Drum
2. Wheel Cap
3. Screws
4. Ball Bearing
5. Distance Collar
6. Ball Bearing
7. Retaining Ring
8. Oil Seal
9. Bolts
10. Lock Washer
11. Gear Box
12. Spring Pin
13. Speedometer Cable Bushing
14. Washer
15. Speedometer Pinion
16. Speedometer Gear
17. Oil Seal
18. Speedometer Gear Drive
19. Axle
20. Wheel Cap
21. Collar
22. Axle Nut ('76 model)
23. Axle ('76 model)

2) Disc Brake

a. Disc Brake Disassembly

CAUTION:

1. Use only disc brake fluid, isopropyl alcohol or ethyl alcohol for cleaning brake parts, but do not allow rubber parts to remain in contact with these fluids for a long period of time.
2. Brake fluid will damage painted surfaces; any spilled fluid should be wiped off immediately.
3. Do not use gasoline, motor oil, or any other mineral oils near disc brake parts; these oils cause deterioration of rubber brake parts. If oil spills on any brake parts it is very difficult to wash off and will eventually reach and break down the rubber.
4. If any of the brake line fittings or the bleeder valve is loosened at any time, the AIR MUST BE BLED FROM THE BRAKE (Pg. 80).

5. Prescribed torque values for tightening disc brake parts mountings are as follows:

Table 36 Disc Brake Torque

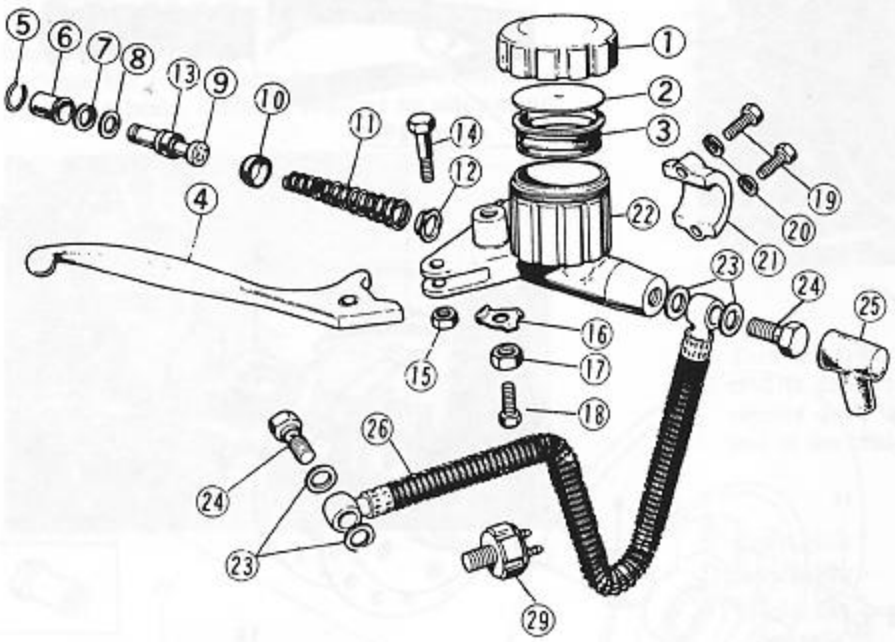
Brake lever	43 – 61 in-lbs	0.5 – 0.7 kg-M
Brake lever adjuster	69 – 104 in-lbs	0.8 – 1.2 kg-M
Master cylinder clamp	52 – 78 in-lbs	0.6 – 0.9 kg-M
Fitting (banjo) bolts	21 – 22 ft-lbs	2.9 – 3.1 kg-M
Brake pipe nipple	12.0 – 13.5 ft-lbs	1.7 – 1.9 kg-M
3-way fitting mounting	43 – 52 in-lbs	0.5 – 0.6 kg-M
Pressure switch	19 – 22 ft-lbs	2.6 – 3.6 kg-M
Caliper shafts	22 – 26 ft-lbs	3.0 – 3.6 kg-m
Caliper mounting	25 – 33 ft-lbs	3.4 – 3.6 kg-M
Bleeder valve	61 – 87 in-lbs	0.7 – 1.0 kg-M
Disc mounting bolts	25 – 33 ft-lbs	3.4 – 4.6 kg-M

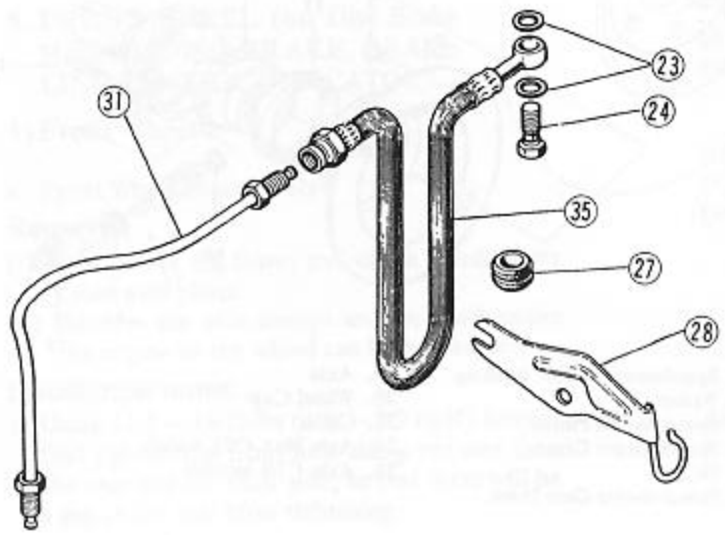
b. Brake Pads (See CAUTION)

Removal:

•Remove the front wheel (Pg. 72).

Disc Brake

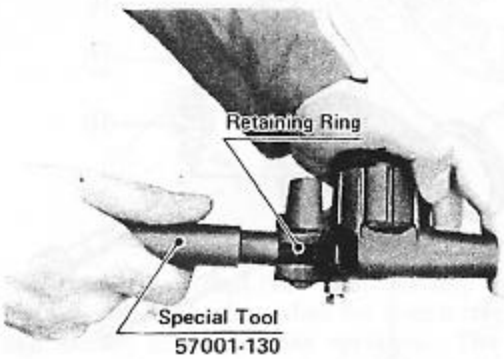




1. Cap
2. Plate
3. Cap Seal
4. Brake Lever
5. Stopper, Dust Seal
6. Dust Seal
7. Circlip
8. Stopper, Piston
9. Piston Assembly
10. Primary Cup
11. Spring Assembly
12. Check Valve Assembly
13. Secondary Cup
14. Bolt
15. Nut
16. Lock Washer
17. Nut
18. Bolt
19. Bolt
20. Washer
21. Master Cylinder Mounting
22. Master Cylinder Body
23. Washer
24. Banjo Bolt
25. Dust Cover
26. Hose
27. Grommet
28. Bracket
29. Pressure Switch
30. Brake Pipe
31. Hose

Assembly notes:

1. Before assembly wash all parts, including the master cylinder, with disc brake fluid or alcohol (See **CAUTION**), and apply brake fluid to the removed parts and to the inner wall of the cylinder.
2. Be sure that the primary cup and check valve are not installed backwards, and that they are not turned sideways after insertion.
3. Use a new retaining ring for assembly, pushing it into place in the cylinder wall groove with a special purpose tool. Use the same tool for installing the boot and boot stopper.

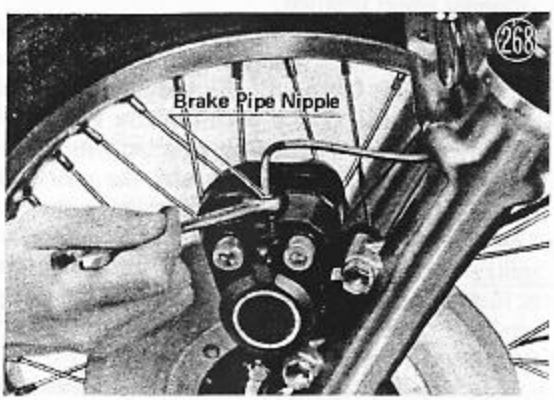


c. Caliper (See **CAUTION** Pg. 74)

Removal:

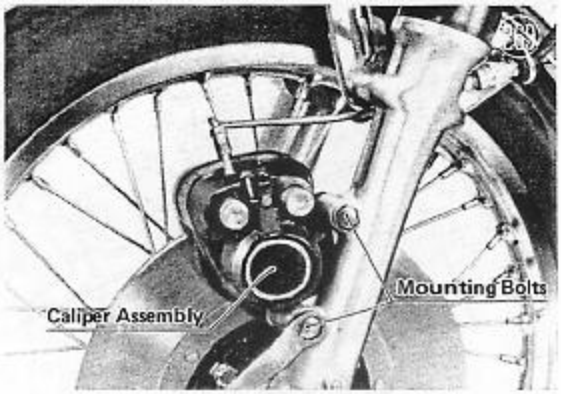
(i) Remove the fornt wheel (Pg. 72).

(ii) Unscrew the brake pipe nipple and disconnect the pipe. Cap the end of the pipe with the rubber bleeder valve cap to prevent fluid leakage.



(iii) If the caliper is to be disassembled, loosen the Allen head shafts now.

(iv) Remove the mounting bolts and take off the caliper assembly.



Installation note:

(i) Bleed the brake lines after installation (Pg. 80).

Caliper disassembly: (Fig. 268)

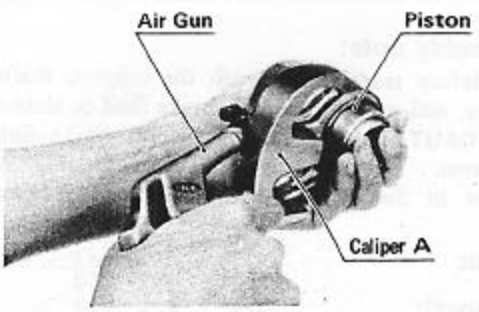
(i) Unscrew the two Allen head shafts ① evenly, alternately a little at a time. Remove caliper B ② and pad B ③.

NOTE: The caliper on KH Series is one piece and cannot be separated into two parts.

(ii) Take the caliper holder ④ off the shafts, being careful not to damage the boots ⑤ or O rings ⑥, and take out pad A ⑦.

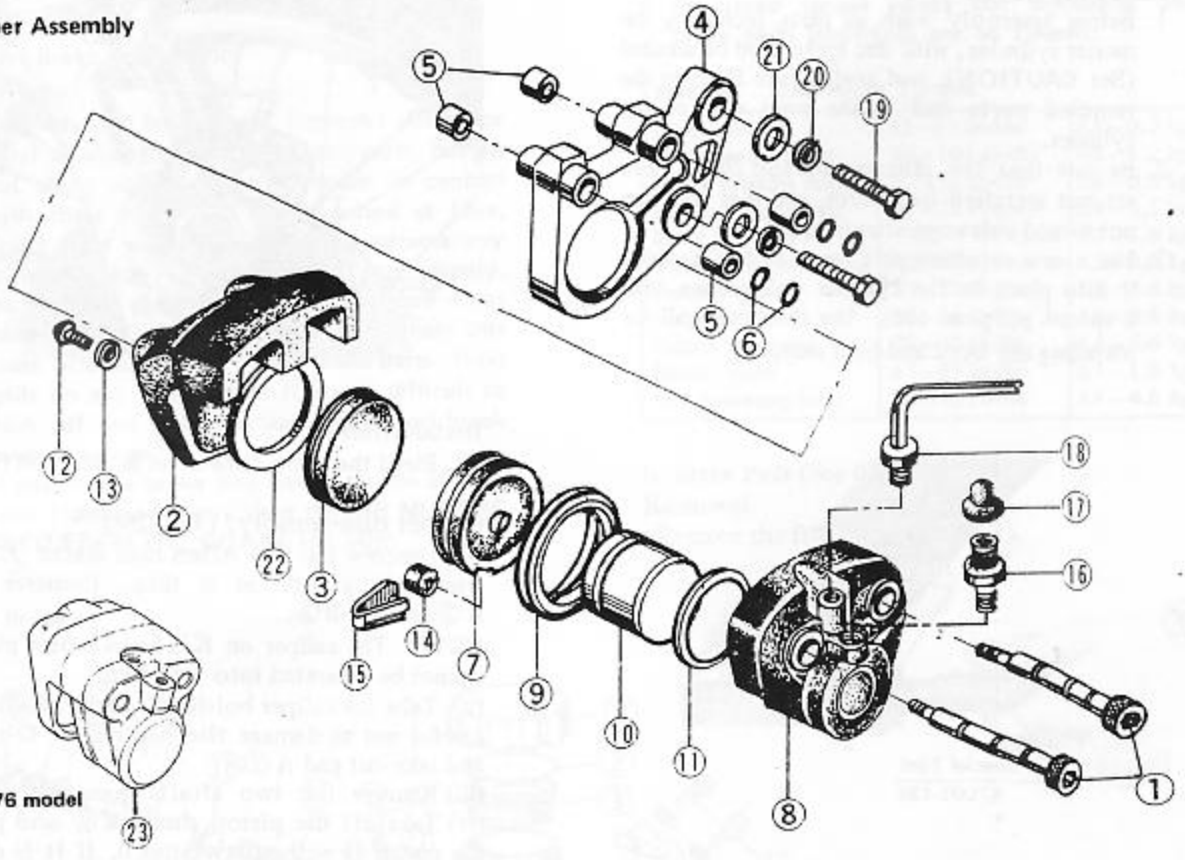
(iii) Remove the two shafts from caliper A ⑧.

(iv) Take off the piston dust seal ⑨ and pull out the piston ⑩ without twisting it. If it is difficult to remove, force it out by blowing compressed air into the brake line outlet.



(v) Remove the seal ⑪ without damaging the cylinder wall.

Caliper Assembly



1. Allen-head Shaft
2. Caliper B
3. Pad B
4. Caliper Holder
5. Boots
6. O Ring
7. Pad A
8. Caliper A
9. Piston Dust Seal
10. Piston
11. Seal
12. Screw
13. Lock Washer
14. Bushing
15. Stopper
16. Bleeder Valve
17. Bleeder Valve Cap
18. Nipple
19. Mounting Bolt
20. Lock Washer
21. Washer
22. Ring
23. Caliper (from '76 model)

Assembly note:

(i) Before reassembly, wash the calipers, shafts, holder, seal and piston with brake fluid or alcohol (see **CAUTION**, Pg. 74), and apply brake fluid to them. Be especially careful in cleaning the groove in the seal, and the shaft guide holes.

d. Disc

Removal:

(i) Remove the front wheel (Pg. 72).
(ii) Flatten the bent up ears of the lock washers and remove the disc mounting bolts ② to take off the disc ③.

Installation note:

(i) Tighten the disc mounting bolts with 25 – 33 ft-lbs (3.4 – 4.6 kg-M) torque and bend up the lock washer firmly against each bolt.

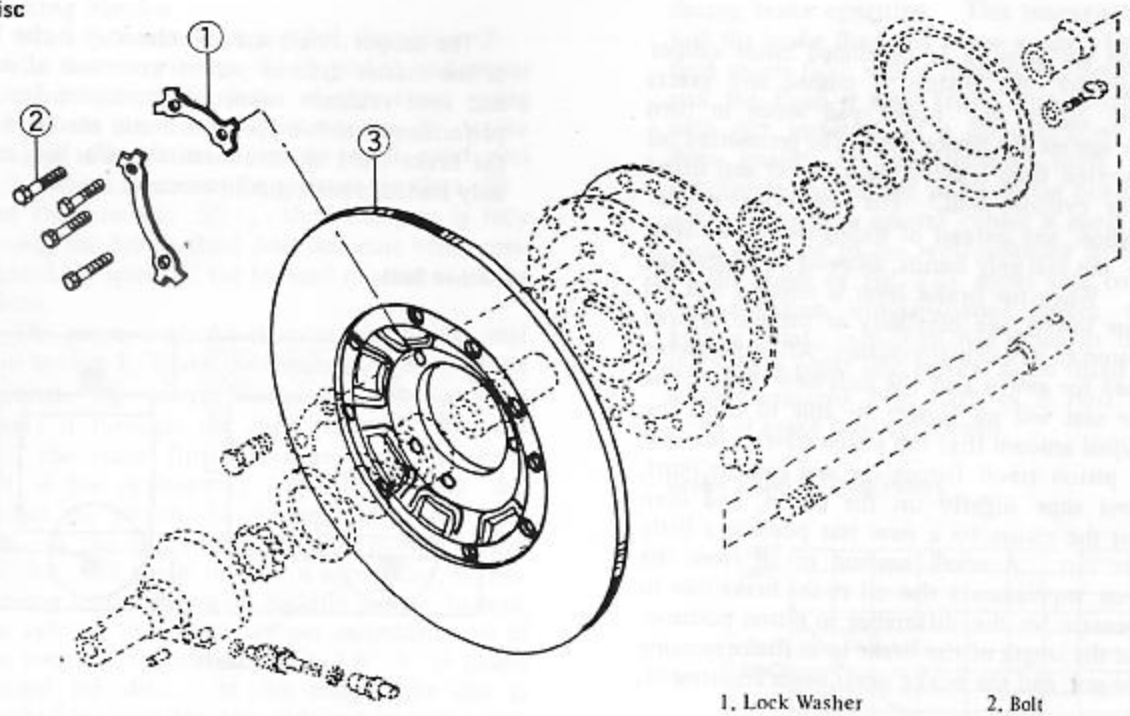
e. Front Brake Maintenance

A hydraulic disc brake is used on the front wheel for its superior braking performance and high reliability. The major components of the disc brake are the brake lever, master cylinder, brake fluid pressure switch, brake line, caliper assembly and disc. The brake lever is pulled to move a piston in the master cylinder and pressurize the brake fluid. Fluid pressure operates the brake lamp pressure switch and is transmitted by the brake line to operate the calipers. The switch turns on the brake lamp, and the calipers grip the disc attached to the front wheel, thereby stopping wheel rotation.

The brake fluid is an extra heavy duty type with a high boiling point to withstand the heat produced from friction of the caliper pads on the disc. Since the fluid's performance and boiling point would be reduced by contamination with water vapor or dirt from the air, the reservoir is sealed with a rubber diaphragm under the cap. This cap seal also prevents fluid evaporation, and spillage should the motorcycle fall over. The fluid is further protected by dust covers in the caliper assembly and at the master cylinder brake line fitting.

The master cylinder assembly includes the reservoir, piston, primary and secondary cups, non-return valve, check valve, and spring. The reservoir has two holes at the bottom: a relatively large supply port to supply fluid to the lines, and a small relief port to admit excess fluid from the line. The primary and secondary cups stop the oil from leaking back around the pistion while the piston is moving forward to pressurize the lines.

Disc



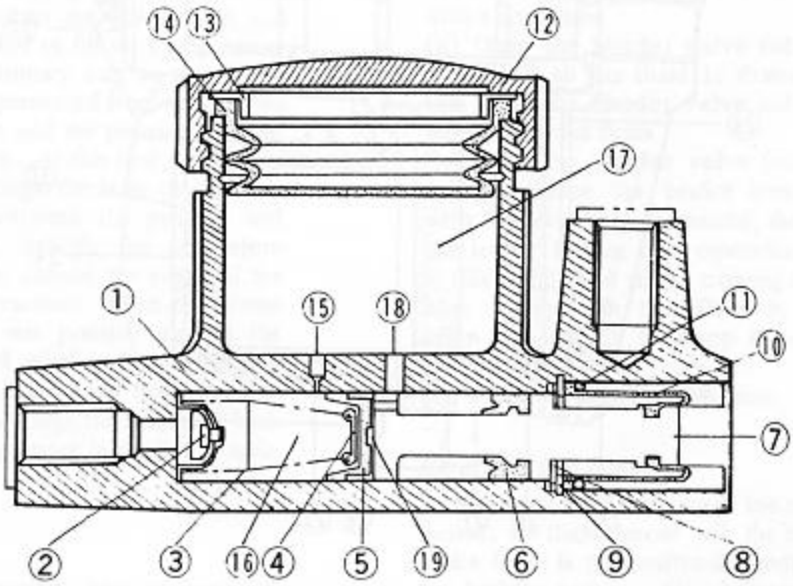
1. Lock Washer 2. Bolt 3. Disc

The check valve stops fluid from suddenly returning from the brake line when the lever is released, and thereby smooths brake operation. The non-return valve is in the head of the piston; it stops backward fluid flow when the brake is applied, but allows flow around the cup to fill the vacuum in front of the piston so that the piston can return easily when the brake lever is released.

The caliper assembly comprises the piston, A and B pads, and A and B calipers. The calipers are held together by two shafts, which also pass through the caliper holder to mount the assembly on the front fork. When the calipers move, the shafts slide back and forth through the holder and keep the brake pads parallel with the disc.

Unlike drum-type brakes, the components of the disc brake which perform the actual braking action, i.e. the disc and pads, are open to direct contact with the air flow past the motorcycle. This provides for excellent dissipation of the heat from brake friction, and minimizes any possibility of brake fade common to drum brakes.

Master Cylinder

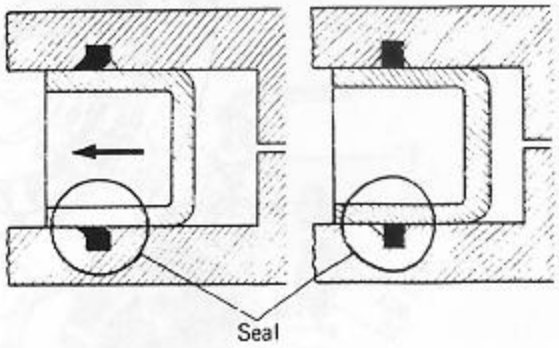


1. Master Cylinder Body
2. Check Valve
3. Spring
4. Spring Seat
5. Primary Cup
6. Secondary Cup
7. Piston
8. Stopper, Piston
9. Circlip
10. Dust Seal
11. Stopper, Dust Seal
12. Cap
13. Plate
14. Cap Seal
15. Relief Port
16. Pressure Chamber
17. Reservoir
18. Supply Port
19. Non-return Valve

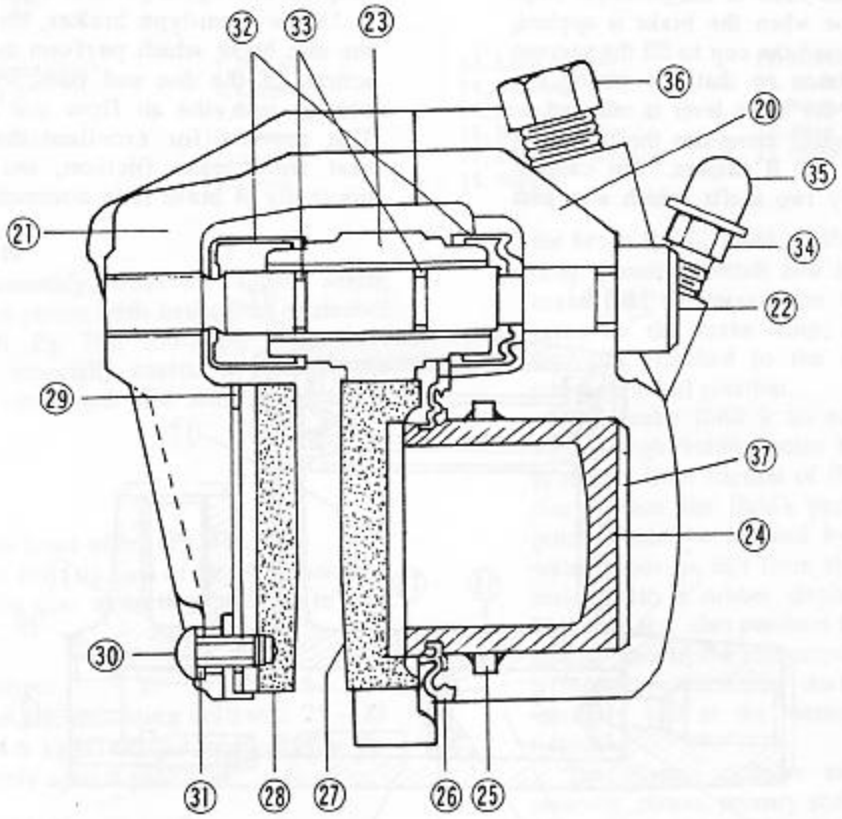
When oil pressure is developed inside caliper A's cylinder, the piston is pushed and exerts pressure against the brake pad which in turn presses against the brake disc. The pressurized oil is prevented from leaking by a rubber seal fitted into the cylinder wall. The seal presses against the pistion, and instead of sliding when the piston moves, the seal only bends, allowing no oil leakage at all. When the brake lever is released and oil pressure lowers, the elasticity of the seal returns the piston to its original position. After the brakes are used for awhile and the pads wear slightly, the rubber seal will no longer be able to bend the additional amount that the piston travels. Instead, when piston travel forces the seal past its limit, the seal slips slightly on the piston, and then returns the piston to a new rest position a little further out. A small amount of oil from the reservoir supplements the oil in the brake line to compensate for the difference in piston position, so that the length of the brake lever stroke remains unchanged, and the brake never needs adjustment.

The caliper A oil seal and the cup at the head of the master cylinder piston are made of an oil and heat resistant rubber composition for best performance and to prevent their contaminating the brake fluid by deterioration. For this reason only standard parts should be used.

Rubber Seal (275)



Caliper Assembly (276)



20. Caliper A
21. Caliper B
22. Allen-head Shaft
23. Caliper Holder
24. Piston
25. Oil Seal
26. Dust Seal
27. Pad A
28. Pad B
29. Ring
30. Screw
31. Lock Washer
32. Dust Seal
33. O Ring
34. Bleeder Valve
35. Bleeder Valve Cap
36. Nipple
37. Cylinder

Braking Stroke

When the brake lever is pulled, the piston ⑦ in the master cylinder ① is pushed and moves forward against the force of the return spring ③ . At this time, the primary cup ⑤ at the head of the piston closes the small relief port ⑮ which connects the pressure chamber ⑯ and the reservoir ⑰ . Until this port is fully closed, the brake fluid does not start being pressurized, in spite of the forward movement of the piston.

The pressure stroke starts as soon as the relief port is closed. Brake fluid being used as a pressure medium, the piston compresses the fluid and forces it through the check valve ② and out into the brake line. Pressure from the line is felt in the cylinder ㉗ of caliper A ㉚ and pushes the piston ㉔ toward the disc. Pad A ㉗ at the end of the piston is pushed against the disc, but since the disc is immovable, further pressure cannot move the pad any further. Instead, the cylinder and entire caliper assembly move in the reverse direction so that pad B ㉘ is pulled toward the disc. In this manner the disc is pinched between the two pads and braking action is performed.

Braking Release Stroke

When the brake lever is released, the piston in the master cylinder is quickly returned toward its rest position and brake fluid pressure in the line and in the caliper master cylinder drops. The elasticity of the oil seal ㉕ in caliper A's cylinder then pulls back the piston. This leaves no pressure against either pad A or B so that slight friction against the disc pushes them both a hairbreadth away from the disc.

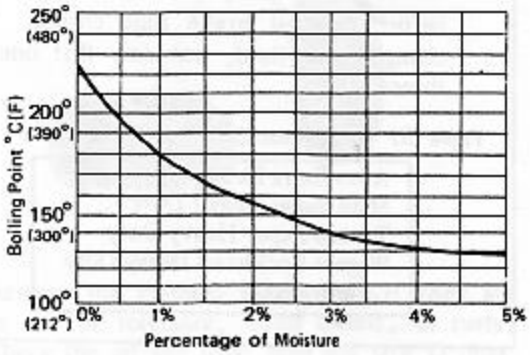
As the master cylinder piston moves back further, the brake fluid in the line (which still has some pressure) rushes to fill the low pressure area in front of the primary cup at the piston head. But the fluid is prevented from moving too fast by the check valve and the pressure in front of the piston drops lower. At this time, fluid from the reservoir flows through the large supply port ⑱ into the space between the primary and secondary cups ⑥ , through the non-return valve ⑲ , and escapes around the edges of the primary cup to fill the vacuum. When the piston finally returns to its rest position against the stopper ⑧ , the small relief port is uncovered and the brake fluid still returning from the line pushes any excess fluid through the relief port back into the reservoir until pressure in the line is again normal.

Brake Fluid

When the brake is applied, heat is generated by the friction between the disc and the brake pads. While much of this heat is dissipated, the rest is transmitted to the brake fluid and may raise fluid temperature to as high as 300°F (150°C) during brake operation. This temperature could boil the brake fluid and cause a vapor lock in the lines unless fluid with a high boiling point is used, and the fluid is kept from being contaminated with dirt, moisture, or a different type of fluid. Poor quality or contaminated fluid can also deteriorate the rubber parts of the brake mechanism, although a special rubber is used to make them resistant to the recommended brake fluids.

The graph of Fig. 277 shows how brake fluid contamination with moisture lowers the fluid boiling point. Although not shown in the graph, the boiling point also lowers as the fluid gets old, is contaminated with dirt, or if two different types of brake fluid are mixed.

Brake Fluid Boiling Point (277)



Changing the brake fluid

The brake fluid should be changed once a year or every 6,000 miles (10,000 km), whichever comes sooner, or if it becomes contaminated with dirt or water.

(i) Attach a clear plastic hose to the bleeder valve at the caliper, and run the other end of the hose into a container.

(ii) Open the bleeder valve and pump the brake lever until all the fluid is drained from the lines.

(iii) Close the bleeder valve and fill the reservoir with new brake fluid.

(iv) Open the bleeder valve (counterclockwise is open), squeeze the brake lever, close the valve with the lever held squeezed, then quickly release the lever. Repeat this operation until the brake is filled and fluid starts coming out of the plastic hose. Replenish the fluid in the reservoir as often as necessary to keep it from running completely out.

(v) Bleed the air from the lines.

Bleeding the brake

The brake fluid has a very low compression coefficient, so that almost all the movement of the brake lever is transmitted direclty to the caliper for braking action. Air, however, is easily compressed and when air enters the brkae lines, brake lever movement will be partially used in compressing the air. This will make the lever feel spongy, and there will be a loss in braking power.

WARNING

When working with the disc brake, observe the precautions listed below.

1. Never re-use old brake fluid.
2. Do not use fluid from a container that has been left unsealed, or that has been open a long time.
3. Do not mix two types of fluid for use in the brakes. This lowers the brake fluid boiling point and could cause the brake to be ineffective. It may also cause the rubber brake parts to deteriorate. Recommended fluids are shown in the table.
   NOTE: The type of fluid originally used in the disc brake is not available in most areas, but it should be necessary to add very little fluid before the first brake fluid change. After changing the fluid, use only that one type thereafter.

Table 37 Recommended Disc Brake Fluid

Atlas Extra Heavy Duty
Shell Super Heavy Duty
Texaco Super Heavy Duty
Wagner Lockheed Heavy Duty
Girling Amber

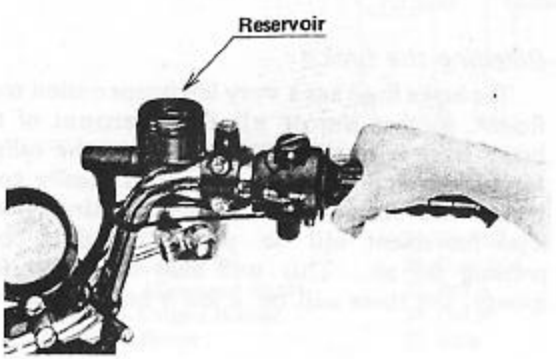
The correct fluid will come in a can labeled D.O.T.3. Do not use fluid that does not have one of these markings.

4. Don't leave the reservoir cap off for any length of time as moisture may be absorbed into the fluid.
5. Don't change the fluid in the rain, or when a strong wind is blowing,
6. Use only disc brake fluid, isopropyl alcohol or ethyl alcohol for cleaning brake parts, but do not allow rubber parts to remain in contact with the alcohol for more than 30 seconds.
7. Brake fluid will damage painted surfaces; any spilled fluid should be wiped off immediately.
8. Do not use gasoline, motor oil, or any other mineral oils near disc brake parts, these oils cause deterioration of rubber brake parts. If oil spills on any brake parts it is very difficult to wash off and will eventually reach and break down the rubber.
9. If any of the brake line fittings or the bleeder valve is loosened at any time the **AIR MUST BE BLED FROM THE BRAKE** (Pg. 80)
10. Prescribed torque value for tightening disc brake parts mountings are listed on Pg. 74

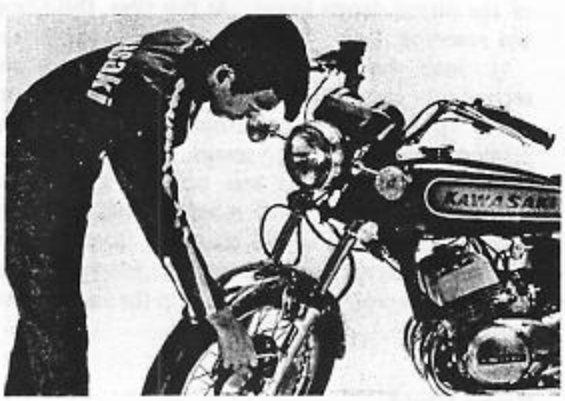
Bleed the air from the brakes whenever brake lever action feels soft or spongy, after the brake fluid is changed, or whenever a brake line fitting has been loosened for any reason.

(i) Remove the reservoir cap and check that there is plenty of fluid in the reservoir. The fluid level must be checked several times during the bleeding operation and replenished as necessary. If the fluid in the reservoir runs completely out at any time during bleeding, the bleeding operation must be done over again from the beginning since air will have entered the line.

(ii) With the reservoir cap off, slowly pump the brake lever several times until no air bubbles can be seen rising up through the fluid from the holes at the bottom of the reservoir. This bleeds the air from the master cylinder end of the line.

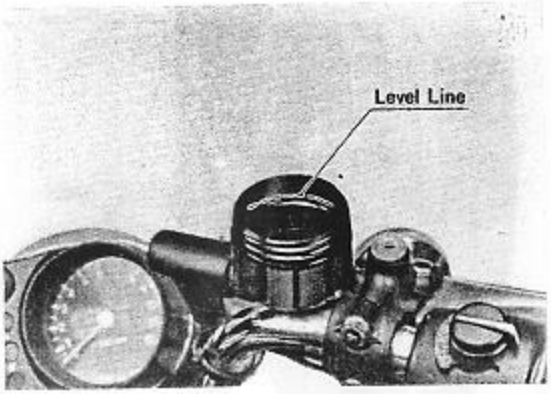


(iii) Replace the reservoir cap, and connect a clear plastic hose to the bleeder valve at the caliper, running the other end of the hose into a container. Pump the brake lever a few times until it becomes hard and then, holding the lever squeezed, quickly open (turn counterclockwise)and close the bleeder valve. Then release the lever. Repeat this operation until no more air can be seen coming out into the plastic hose. Check the fluid lever in the reservoir every so often, replenishing it as necessary.



(iv) If a double disc brake is used, repeat the previous step one more time for the other side.

When air bleeding is finished, replace the rubber cap on the bleeder valve, and check that the brake fluid is filled to the line marked in the reservoir (handlebars turned so that the reservoir is level).



Caliper parts wear

Inspect the pads for wear. If the surface of either pad is worn down through the red line, replace both pads as a set. If any grease or oil spills on the pads, wash it off with trichlorethylene or gasoline. If the oil cannot be thoroughly cleaned off, replace the pads.

The oil seal around the piston maintains the proper pad/disc clearance. If this seal is bad one pad will wear more than the other, pad wear will increase, and constant pad drag on the disc will raise brake and brake fluid temperature.

Master cylinder parts wear

When master cylinder parts are worn or damaged, proper brake fluid pressure cannot be obtained in the lines, and the brake will not hold.

If the small relief port becomes plugged, especially with swollen or damaged primary cup, the brake pads will drag on the disc.

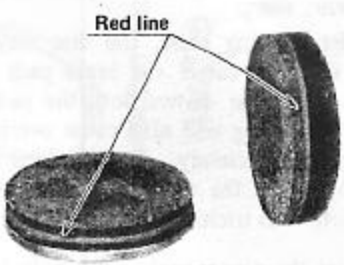
(i) Check that there are no scratches, rust or pitting on the inside of the master cylinder, and that it is not worn to outside the service limit.

(ii) Check the piston for these same faults.

(iii) Inspect the primary and secondary cups. If a cup is worn, damaged, softened (rotted), or swollen, replace it. When inserting the cup into the cylinder see that it is slightly larger than the cylinder (standard values given in the table). If oil leakage is noted at the brake lever, the cups should be replaced. (The secondary cup is part of the piston assembly, so replace the piston if this cup is bad.)

(iv) Check that the spring is not damaged and is not shorter than the service limit.

(v) Replace the rubber dust seal if it is damaged.



Replace the cylinder and piston if they are worn out of tolerance, badly scored, or rusty.

Check the oil and dust seals and the O rings, replacing any that are cracked, worn, swollen or otherwise damaged.

Replace the oil seal under any of the following conditions: (a) oil leakage around pad A; (b) brakes overheat; (c) there is a large difference in A and B pad wear; (d) the seal is stuck to the piston. Also replace the seal every other time the pads are changed.

Table 38 Caliper Parts

Model	Part	Standard	Service Limit
S2A S3 S3A	Cylinder inside diameter	1.5031 – 1.5039 in. (38.180 – 38.200 mm)	1.5045 in. (38.215 mm)
	Piston outside diameter	1.5006 – 1.5019 in. (38.180 – 38.200 mm)	1.5002 in. (38.105 mm)
KH400-A3	Cylinder inside diameter	1.6870 – 1.6890 in. (42.850 – 42.900 mm)	1.690 in. (42.92 mm)
KH250-B1	Piston outside diameter	1.6846 – 1.6858 in. (42.788 – 42.820 mm)	1.683 in. (42.75 mm)

Table 39 Master Cylinder Parts

Measurement	Standard	Service Limit
Cylinder inside diameter	.5512~.5529 in. (14.000~14.043 mm)	.5543 in. (14.080 mm)
Piston outside diameter	.5495~.5506 in. (13.957~13.984 mm)	.5472 in. (13.900 mm)
Primary, secondary cup diameter	.5768~.5965 in. (14.650~15.150 mm)	.5709 in. (14.500 mm)
Spring length (free)	2.169 in. (51.1 mm)	1.890 in. (48.0 mm)

Brake line damage

The high pressure inside the brake line can cause oil to leak or the hose to burst if the line is not properly maintained.

Bend and twist the rubber hose while examining it. Replace it if any cracks or bulges are noticed.

The metal pipes are made of plated steel, and will rust if the plating is damaged. Replace the pipe if it is rusted, cracked (especially check the fittings), or if the plating is badly scratched.

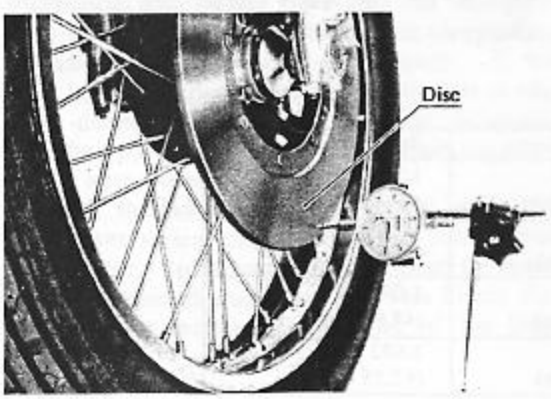
Disc wear, warp

Besides wearing thin, the disc may warp. A warped disc will cause the brake pads to drag on the disc and wear down both the pads and disc quickly. Dragging will also cause overheating and poor braking efficiency. Poor braking can also be caused by oil on the disc. Oil on the disc must be cleaned off with trichlorethylene or gasoline.

Jack up the motorcycle so that the front wheel is off the ground, and turn the handlebars fully to one side. Set up a dial gauge against the disc as illustrated, and measure disc runout. If runout exceeds the service limit, replace the disc.

Table 40 Disc Runout

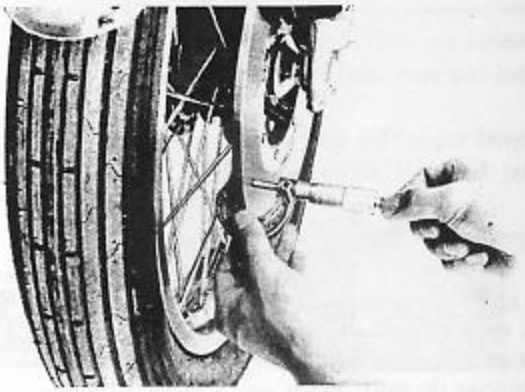
Standard	Service Limit
under .004 in. (under .1 mm)	.012 in. (.3 mm)



Measure the thickness of the disc at the point where it is most worn, and replace it if it is worn down to under the service limit.

Table 41 Disc Thickness

Standard	Service Limit
.276 in. (7.0 mm)	.217 in. (5.5 mm)



3) Brake Lining Wear Indicator (from '74 Models)

On the outside of the drum-brake panel, there is a brake lining wear indicator. Whenever the indicator has gone past USABLE RANGE, the brake shoes must be immediately replaced and the other brake parts examined. Adjustment alone cannot compensate for the wear of a brake worn past USABLE RANGE.

Once the shoes have been replaced, fit the indicator on the serration so that it points to the extreme left of the USABLE RANGE plate in case of the rear brake and to the extreme right of the USABLE RANGE plate in case of the front brake.

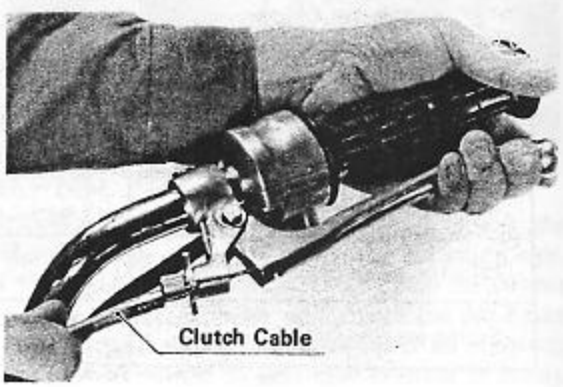
6. HANDLEBARS

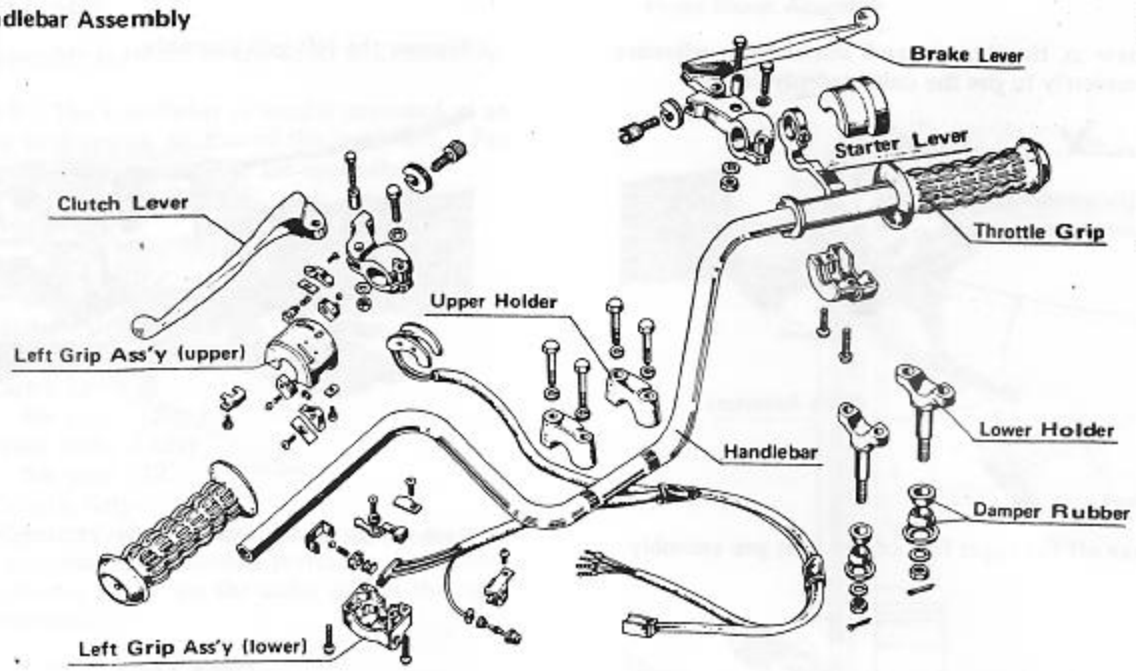
1) Construction

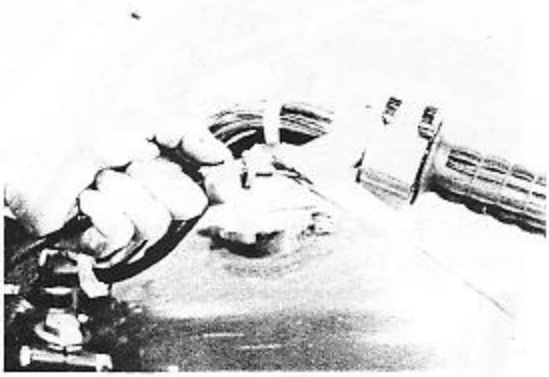
The handlebars are manufactured from drawn steel pipe, the shape of which is designed with consideration to rider comfort during long rides, to high speed riding, and to general riding safety. On the right side of the handlebars are the starter lever, throttle grip assembly, and front brake lever. Mounted on the left side are the turn signal, horn and headlight switches in the left grip assembly, and the clutch lever.

2) Disassembly

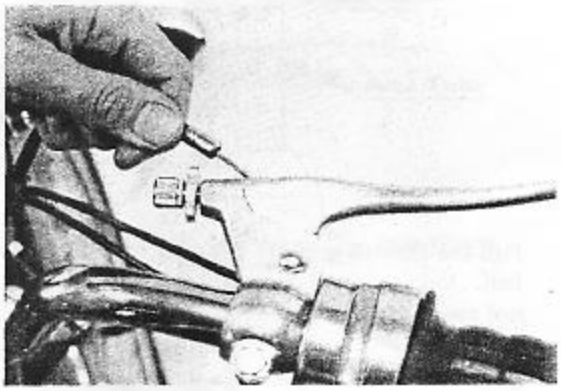
Loosen the clutch cable lock nut, and screw in the clutch cable adjusting bolt. This gives the cable sleeve enough play to enable removal of the cable from the clutch lever. To take off the cable, grab the cable outer sleeve with one hand and pull in the clutch lever with the other. While pulling on the cable, release the lever slowly, and pull the cable out of its slot.



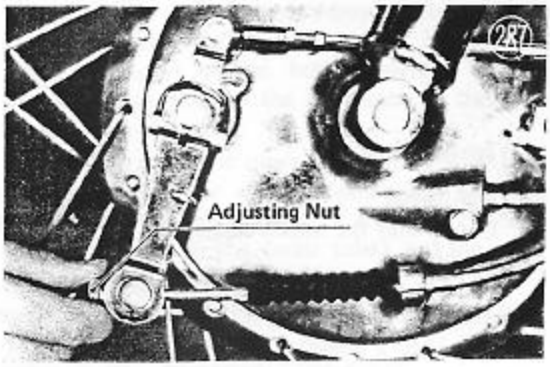


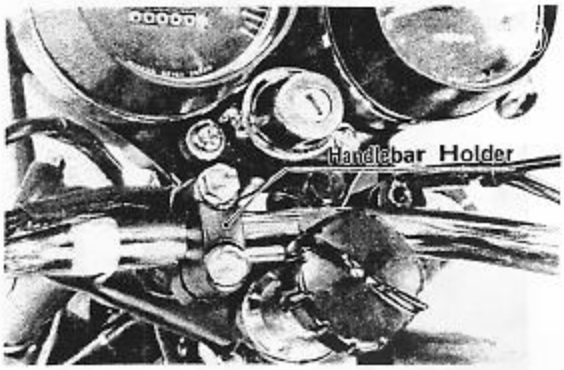


Loosen the front brake adjusting nut and pull the cable off the brake lever.

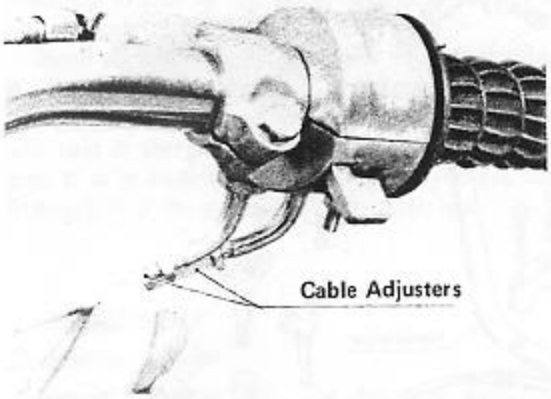


Loosen the handlebar mountings, remove the right upper mount, move the handlebar to the left for easy cable removal, and tighten the left mounting.

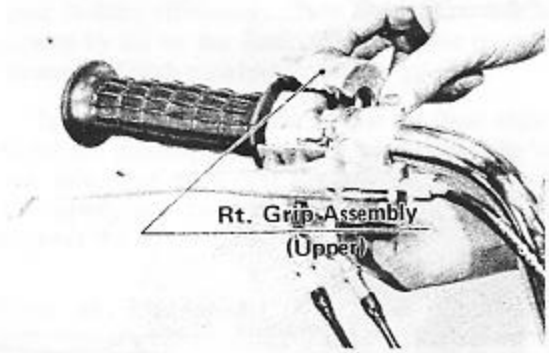




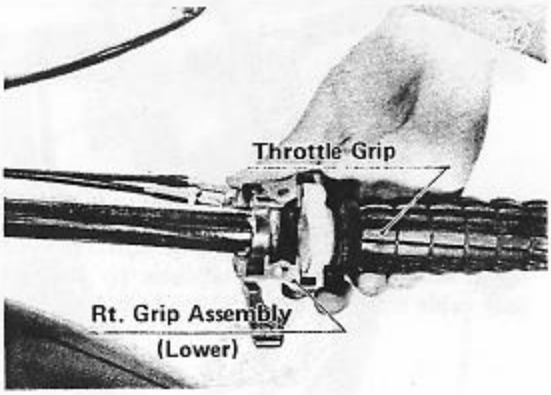
Screw in the throttle and starter cable adjusters completely to give the cables plenty of play.



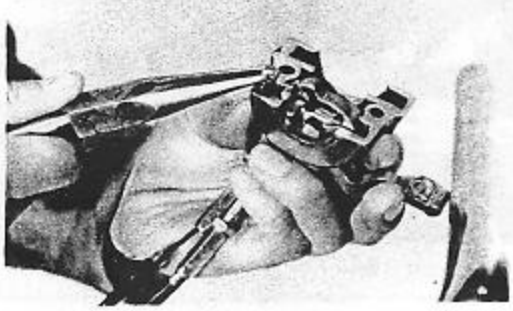
Take off the upper half of the right grip assembly.



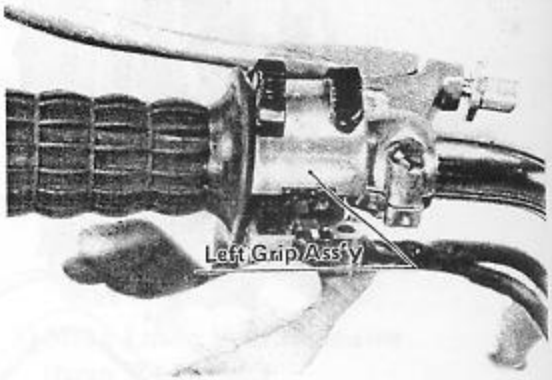
Pull the throttle grip off together with the bottom half.



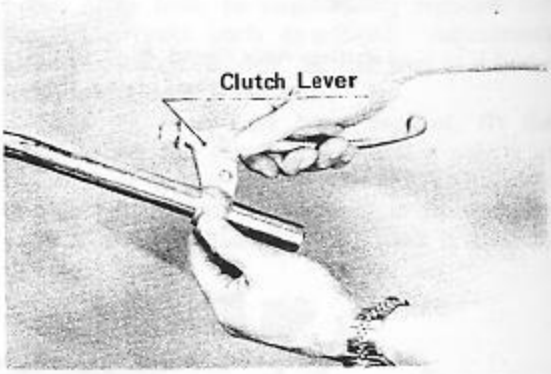
Remove the throttle and starter cable wires.



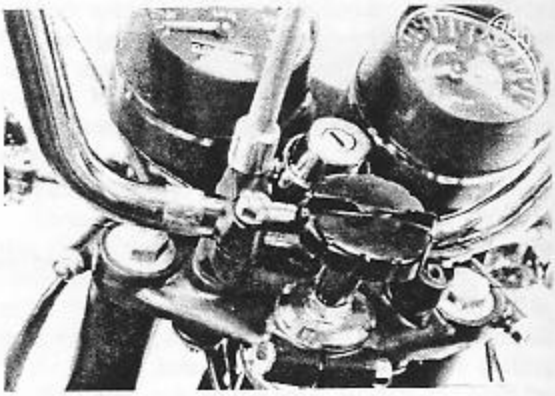
Remove the left grip assembly.



Remove the clutch and brake lever assembly.



Unbolt the upper half of the left mounting and remove the handlebar.



3) Inspection

a. Handlebar
Check that the handlebar is not bent or cracked.

b. Bushings
Inspect the rubber bushings and replace any bushing that has deteriorated, cracked or become worn. Such a bushing will not effectively perform its function of dampening shock and vibration to the handlebar.

4) Assembly

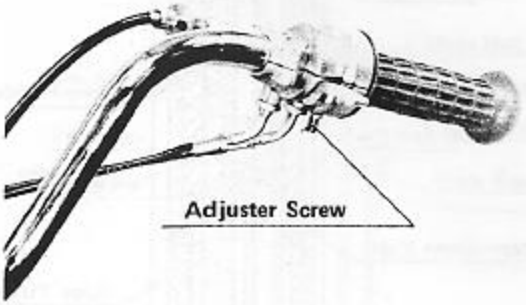
Assembly is in the reverse order of disassembly.

NOTE: The handlebar is usually mounted at an angle conforming to that of the front fork. For mounting bolt torque, see the appendix.

5) Adjustment

a. Throttle Cable
See page 13.
b. Starter Cable
See page 14~15.
c. Clutch Lever
See page 15~16.
d. Front Brake Lever
See page 72.
e. Throttle Grip

Adjust the tension or stiffness of the throttle grip according to individual preference by turning the adjuster screw on the under side of the right grip assembly.



7. FRONT FORK (on Drum Brake Models) · STEERING STEM

1) Construction · Operation

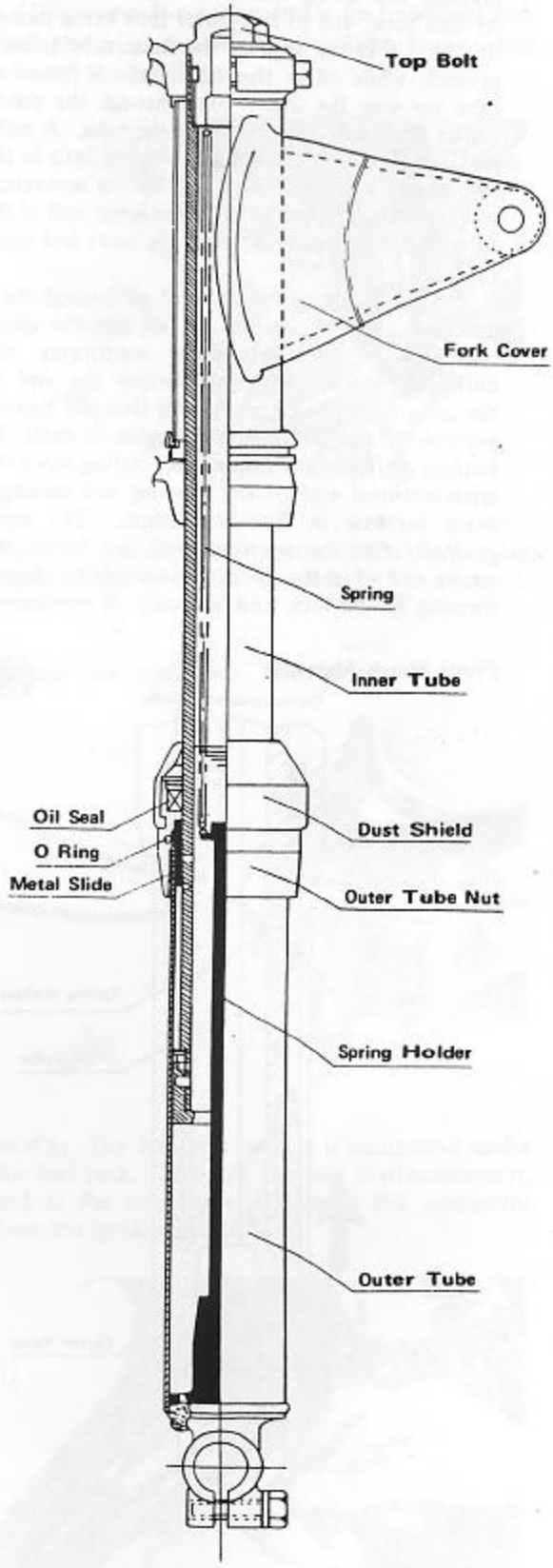
a. Fork

The front fork serves as the shock absorbing device for the front wheel. The fork consists of two telescopic tubes mounted to the frame head pipe with brackets via the steering stem.

The shock absorbing telescopic tubes include the inner tube, outer tube, spring holder and spring, damping action being provided by the spring tension and by the resistance of the flow of oil inside the tube.

As illustrated, the inner tube is fitted into the outer tube, and the spring is positioned between the seat on the upper part of the spring holder (which is fixed to the outer tube) and the inner tube top bolt.

A nut containing an oil seal is screwed onto the outer tube, and this nut serves as the seal between the inner and outer tubes.



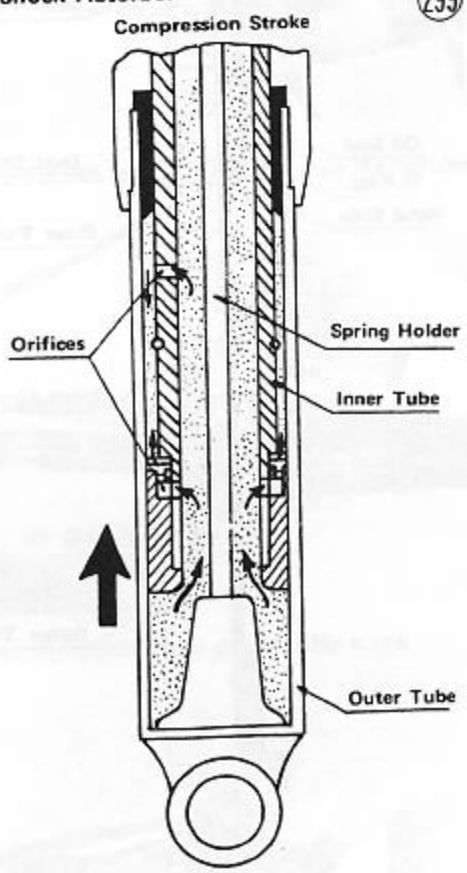
b. Fork Operation

(1) Compression

When the front fork receives a load and is compressed, the spring inside it is also compressed. At this time, due to the outer tube being pushed up, the air in the top of the inner tube is compressed, while oil in the outer tube is forced to flow up into the inner tube through the piston orifice in the bottom of the inner tube. A small amount of oil also flows through the hole in the side of the inner tube and through the non-return valve openings in the side of the lower end of the tube, into the space between the inner and outer tubes.

The resistance to the flow of oil through these apertures, in addition to the air and the spring resistance to compression, constitutes the buffering action until just before the end of the compression stroke. At this time the tapered portion of the spring holder begins to enter the bottom orifice of the inner tube, cutting down the cross-sectional area of the opening and causing a sharp increase in flow resistance. The taper gradually fills the opening until just before the stroke end when the opening is completely closed, forming an oil lock and stopping all movement.

Front Shock Absorber (299)

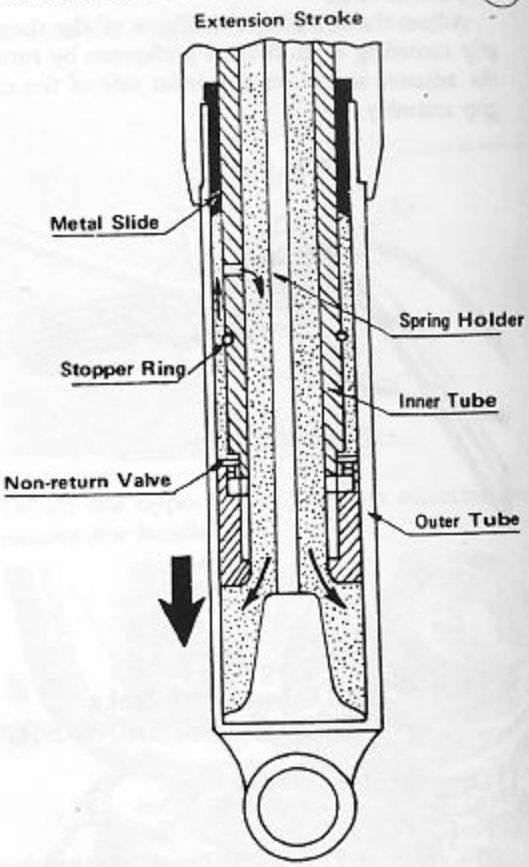


(2) Extension

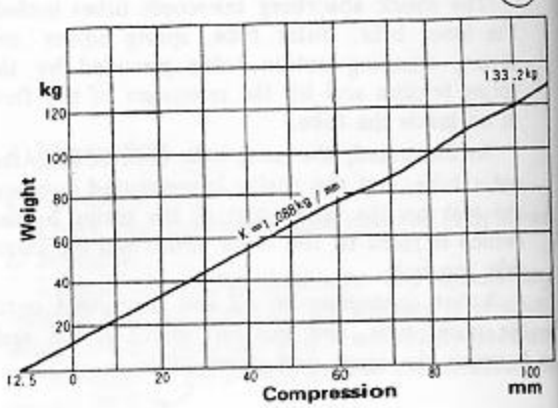
Spring tension returns the outer tube to its original position, the return dampered by the flow resistance of the returning oil through the upper side aperture in the inner tube, and out through the bottom opening. The non-return valve is closed during extension and does not allow oil passage. If the fork extends further, the side orifice reaches the metal slide which covers it and stops oil flow. This results in an oil lock, and fork extension ceases.

NOTE: In a badly worn or defective fork where the metal slide will not close the upper hole, or where the non-return valve does not close, the oil lock will not occur and a metal-striking-metal sound will be heard as the stopper ring of the inner tube hits the metal slide.

Front Shock Absorber (300)



Front Spring Force (301)

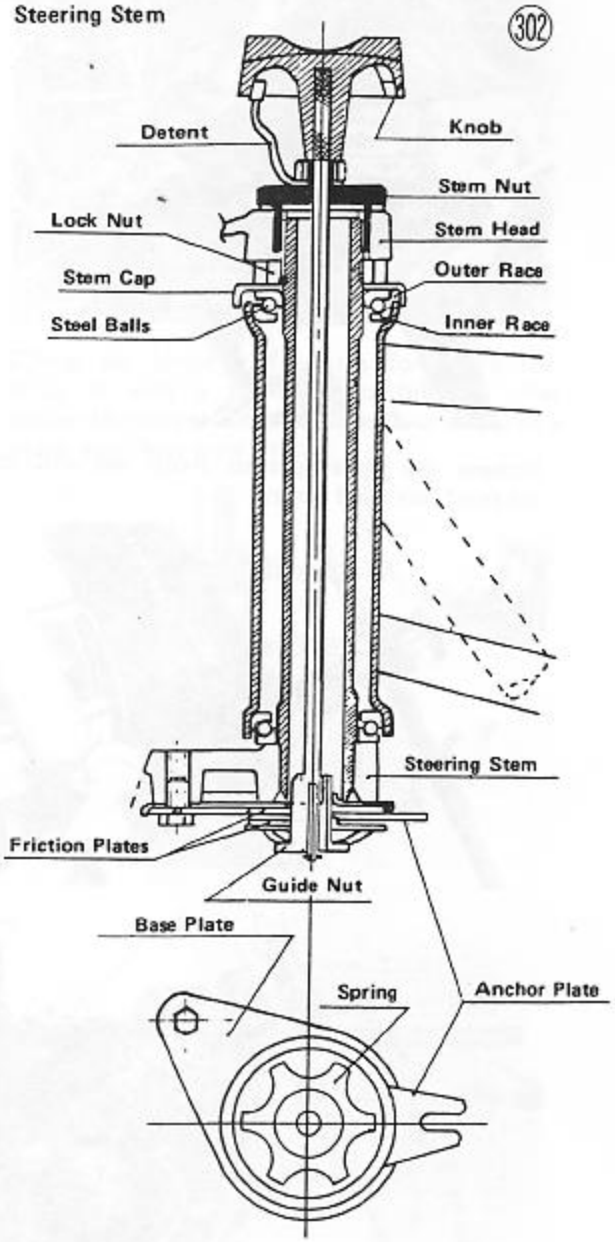


c. Steering Stem

The steering stem supports the front fork, and acts as its pivot. When the handlebars are turned, the stem turns inside the frame head pipe, friction being reduced by the ball bearings at its upper and lower ends.

Steering stiffness can be adjusted by turning the damper knob at the top of the steering stem. Stiffness results from friction between the upper and lower steel plates and the anchor plate between them, friction being transmitted indirectly by the friction plates. The anchor plate is held stationary with respect to the frame, by a projection of the frame that fits into the plate notch; the steel plates turn with the handlebars. When the knob is turned in, the damper spring is pulled up, increased spring tension forces the steel, friction and anchor plates harder together, and the increased friction stiffens steering.

Steering Stem

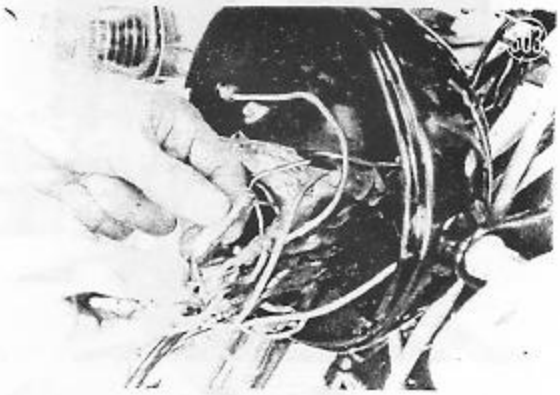


2) Disassembly

The front fork and steering stem are removed after first taking off the front wheel and fender.

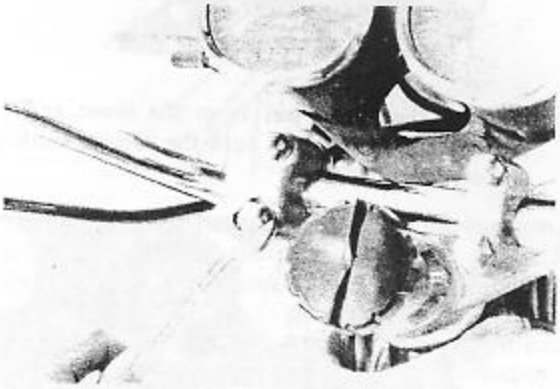
a. Front Fork

Disconnect the wiring inside the headlight and pull the wires out of the headlight body, then remove the headlight.

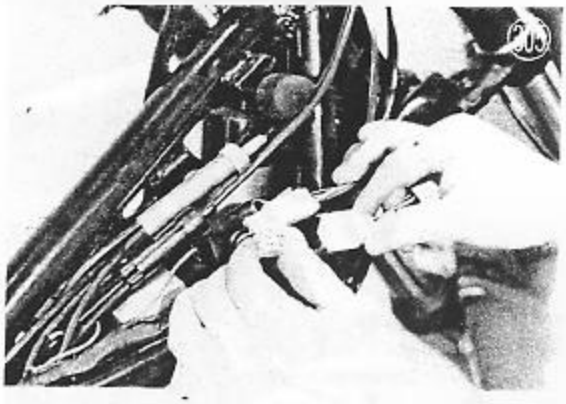


Remove the starter, throttle, clutch and front brake cables from the handlebar.

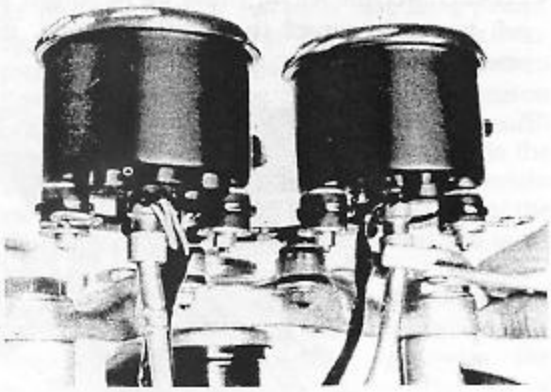
Unbolt the handlebar and remove it.

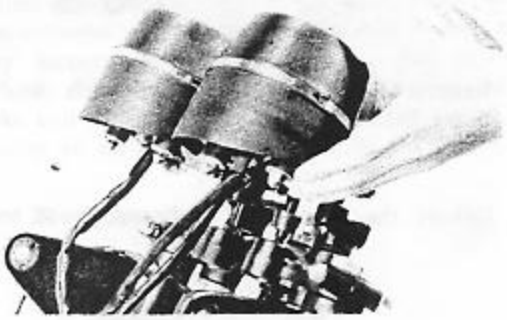


NOTE: The left grip wiring is connected under the fuel tank. Take off the tank to disconnect it, and at the same time disconnect the connector from the ignition switch.

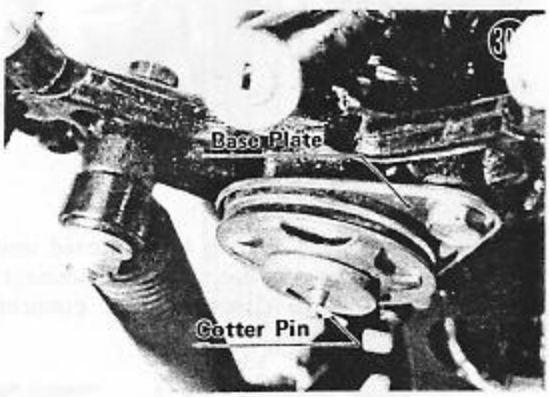


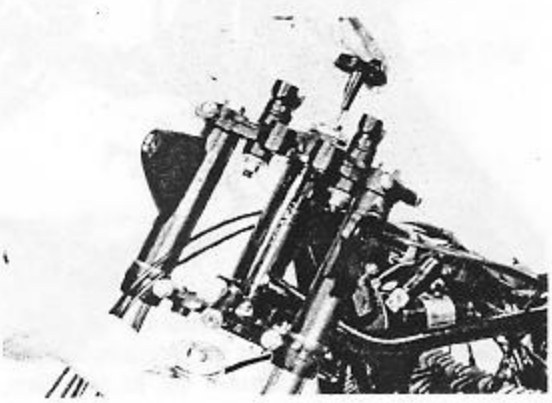
Take off the speedometer and tachometer cables and remove the two meters from the bracket together.



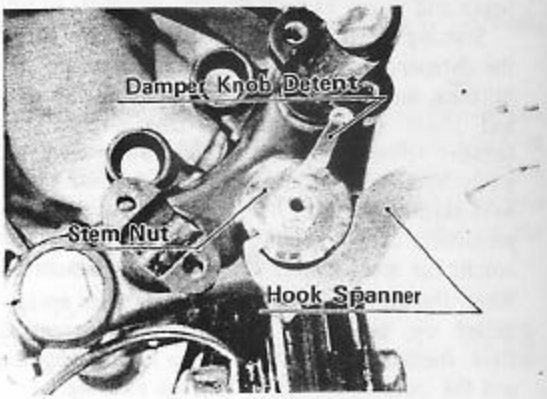


Pull out the cotter pin from the lower end of the steering damper and turn the damper knob to the left to remove it.

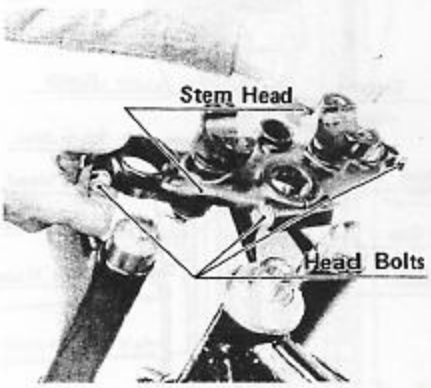




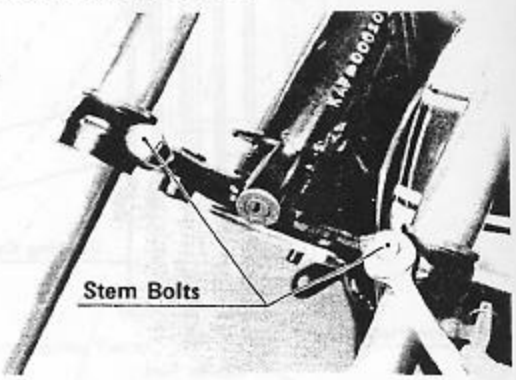
Using a hook spanner (special tool), loosen the steering stem nut and remove it. It is not necessary to remove the damper knob stopper and nut from its top.

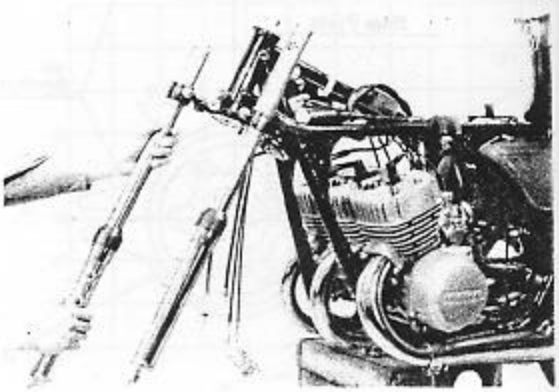


Take out the steering stem head bolts and remove the stem head.

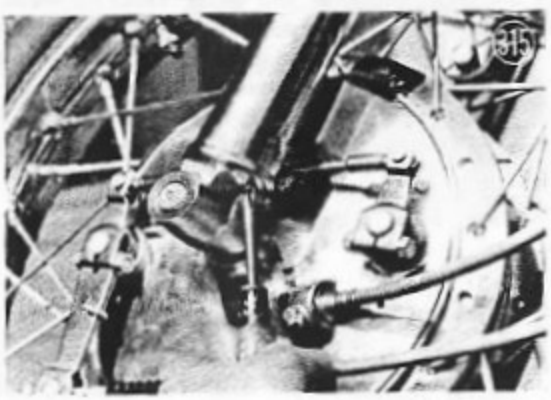


Remove the steering stem bolts and pull out the front forks and covers.

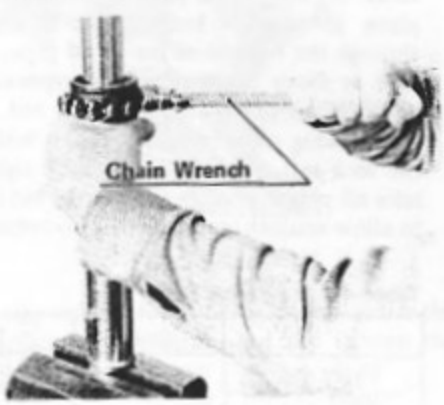


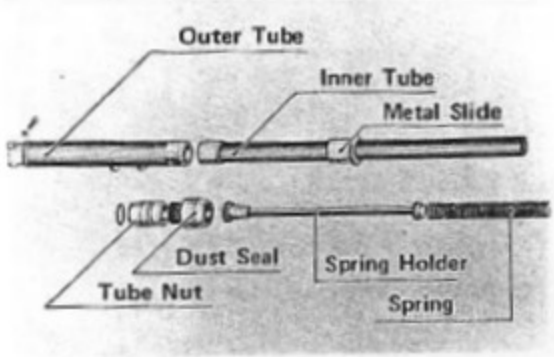


Take out the spring and pour out the oil. The oil can also be removed with the fork still attached to the frame, by removing the screw at the bottom of the fork and draining the oil.



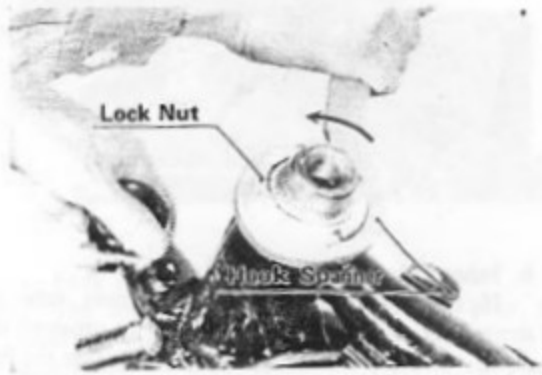
Clamp the lower end of the fork in a vise. Wrap it with a piece of tire tube or other rubber to prevent scratching, and loosen it with a chain wrench or pipe wrench.



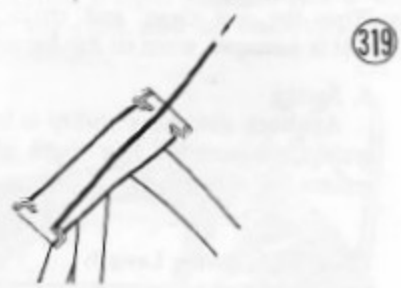


b. Steering Stem

Remove the steering stem lock nut with a hook spanner (special tool) and pull the steering stem out of the head pipe. When pulling this out be careful not to lose the balls from the upper and lower bearings, since their inner and outer races separate when the stem is pulled.



When removing the upper and lower outer races from the head pipe, insert a bar or starting punch into the pipes, as shown in the illustration, and knock them out.

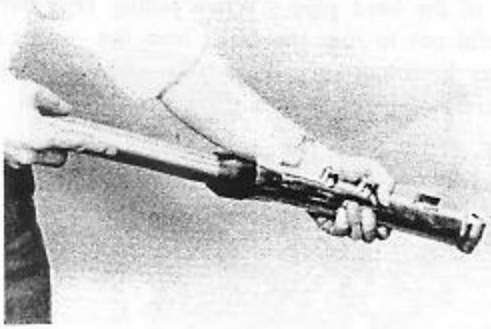


To remove the inner race from the steering stem, set a cold chisel to the point where the race and stem meet and hammer on the chisel lightly, moving it to different points so as to remove the race evenly. Be careful not to hammer too heavily as the stem will become misshapen.

3) Inspection

a. Inner and Outer Tubes

Fit the outer and inner tubes together with the metal slide in place. Move the inner tube in and out, checking for smooth movement.



b. Inner Tube

If the sliding surface of the inner tube is dented, scratched or bent, it must be repaired or replaced as the uneven surface will damage the lip of the oil seal and cause oil leakage.

c. Dust Seal

Any hard foreign particles, or dust or dirt that gets past the dust seal will scratch the sliding surface of the inner tube and damage the oil seal. Wipe the seal clean and check it, replacing it if it is damaged, worn or has hardened.

d. Spring

As shock absorbing ability is impaired by weak springs, measure the free length of each spring and replace it if it is out of tolerance.

Table 42 Spring Length

Standard	Service Limit
14.21 in. (361 mm)	13.78 in. (350 mm)

e. Fork Oil

The forks must be filled with the correct amount of clean, good quality oil to ensure effective operation. Dirty, oxidized oil loses its lubricating capacity and speeds up wear and breakdown of the fork. If the oil level is low, the fork will be noisy; a high oil level will make the cushion harder.

Measure the fork oil level with no weight on the fork (front wheel raised off the ground). Unscrew the top bolt, insert a rod into the inner tube, and measure the distance from the top of the inner tube to the surface of the oil. This measurement, along with the amount of oil to pour into an empty fork, is given in the table below.

Table 43 Front Fork Oil

Standard Quantity	Level from Top Oil
7.1 oz. (210 cc)	14¾ in. (375 mm) SAE 10W

f. Steering Stem

Inspect the steering stem and straighten it or replace it if it is bent.

g. Ball Bearings

Check the inner and outer races for wear or pitting. This will cause uneven pressure on the balls and make the steering stiff. Check the balls for wear, pitting or cracks. If any damage or wear is apparent in either the balls or races, it is recommended that balls and races be replaced as a set.

4) Assembly

a. Steering Stem

Press in the upper and lower outer races and the lower inner race with a press or similar means, taking care to exert even pressure around the race circumference.

Spread grease on the upper and lower outer races in the head pipe, and set the balls in place in them. Insert the steering stem up through the bottom of the head pipe, fit the upper race in from the top and temporarily hold the assembly in place with the lock nut. Then move the steering stem back and forth while tightening the lock nut. The nut should be tight enough to take all play out of the steering, but loose enough to allow smooth, easy steering movement.

Table 44 Bearing Balls

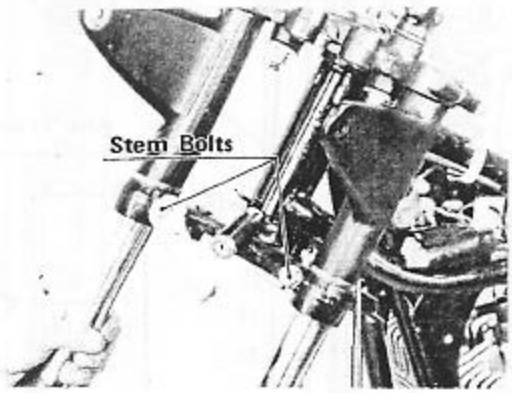
	Size	Quantity
Upper and lower	¼ inch	19 each bearing

b. Fork

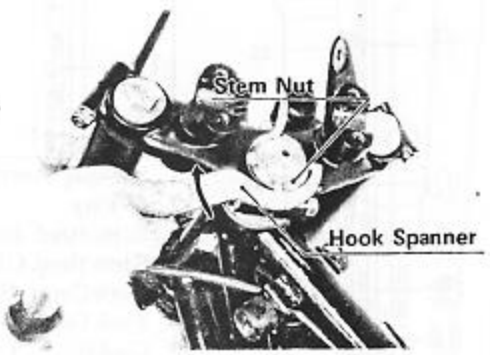
Whenever the front fork is disassembled, the oil seal and O ring in the outer tube must be replaced.

Mount the steering stem head on the head pipe and hold it in place with stem nut. Leave the nut loose for easy fork assembly.

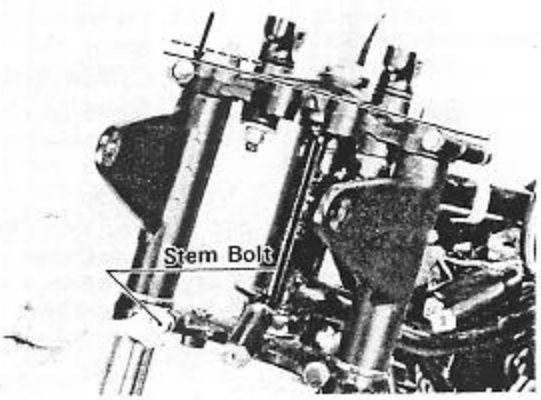
Put on the fork covers; insert each fork up through the stem until it is even with the upper surface of the stem, holding it in place temporarily with the steering stem bolt.



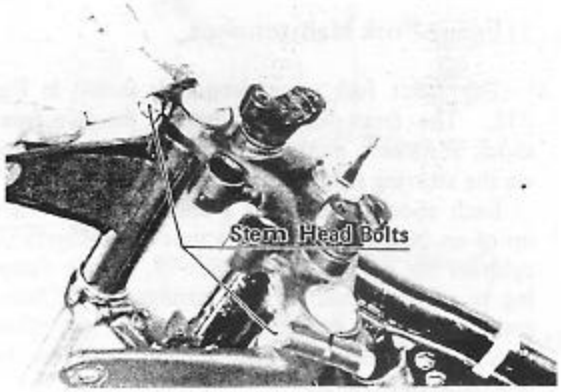
Tighten down the steering stem nut.



Align the tops of the tubes evenly with the upper surface of the stem head and tighten the stem bolts.



Tighten the three steering head bolts.

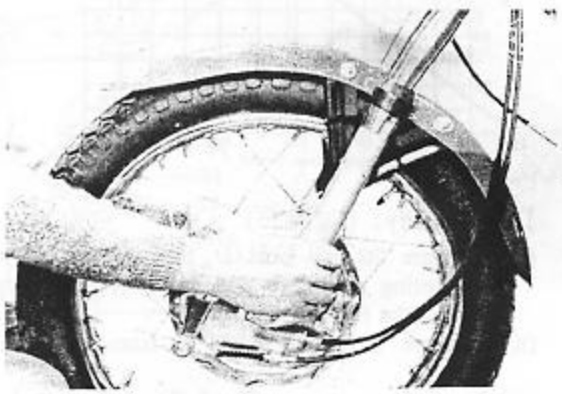


c. Fork Assembly Inspection

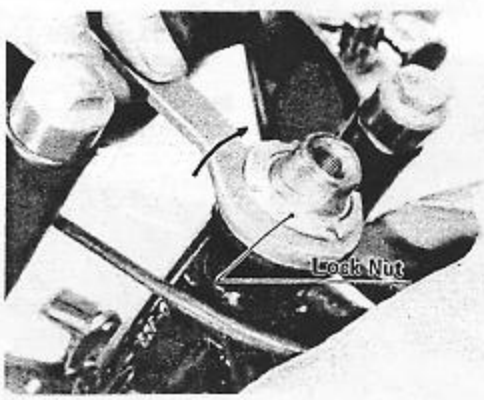
The lower bracket must have no play, and steering must be smooth and easy. After assembling the front fork and wheel to the frame, check this in the following manner:

Move the forks back and forth to see that there is no play in the stem.

With the front wheel lifted up off the ground, give the handlebars a light push and see if they will move to the right and left smoothly under their own momentum.



If the preceding inspection revealed play in the steering stem, the lock nut is not tightened sufficiently; if the steering was stiff, the lock nut is too tight and must be loosened.



8. FRONT FORK (on Disc Brake Models)

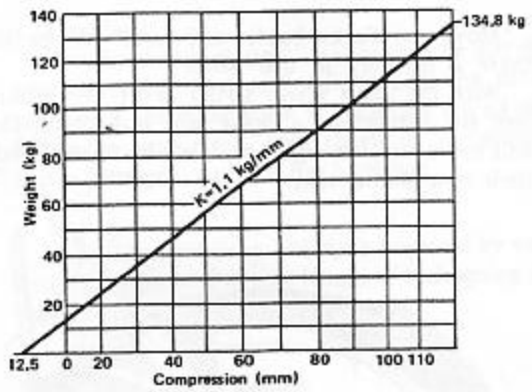
1) Front Fork Maintenance

The front fork construction is shown in Fig. 332. The front fork consists of the two front shock absorbers, mounted to the frame head pipe via the steering stem and stem head.

Each shock absorber is a telescopic tube made up of an inner tube ⑨, outer tube ⑩, springs ⑮ ⑰, cylinder ⑯, piston ⑲ and valve ⑱. Shock damping is accomplished by the springs, by air being compressed in the tubes, and by the flow resistance of the fork oil flowing between the inner and outer tubes.

Oil is prevented from leaking out of the tubes by an oil seal ⑭ on the upper part of the outer tube. A dust shield ⑪ on the outside of the tubes stops dirt and water from entering and damaging the oil seal and the tube surfaces.

Front Spring Force



Disassembly: (Fig. 333)

(i) Remove the top bolt ①, take out the spacer ⑱, spring guide ⑲ and spring ⑳, and then empty the fork oil.

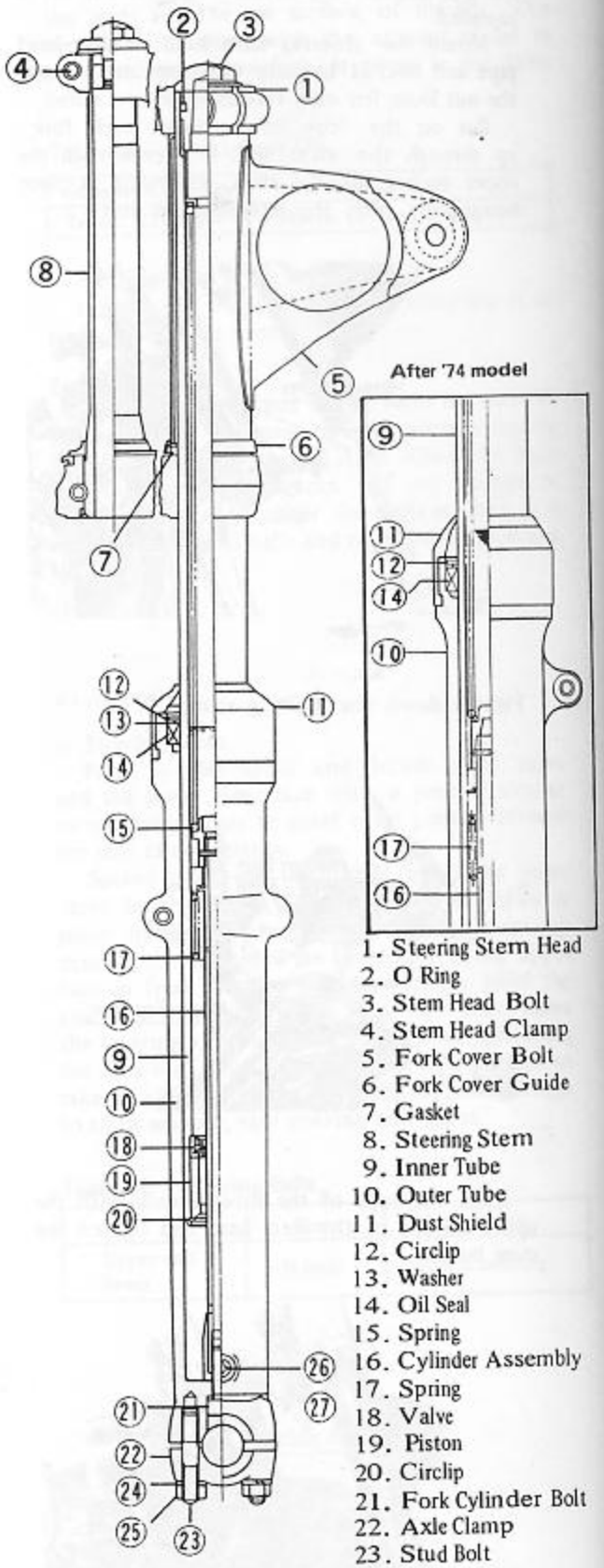
(ii) Remove the dust shield ㉕ from the outer tube.

(iii) Stop the upper part of the fork cylinder assembly ㉒ from turning by using special tools, unscrew the Allen bolt ㉓ from the lower part of the outer tube, and pull out the inner tube ㉑.

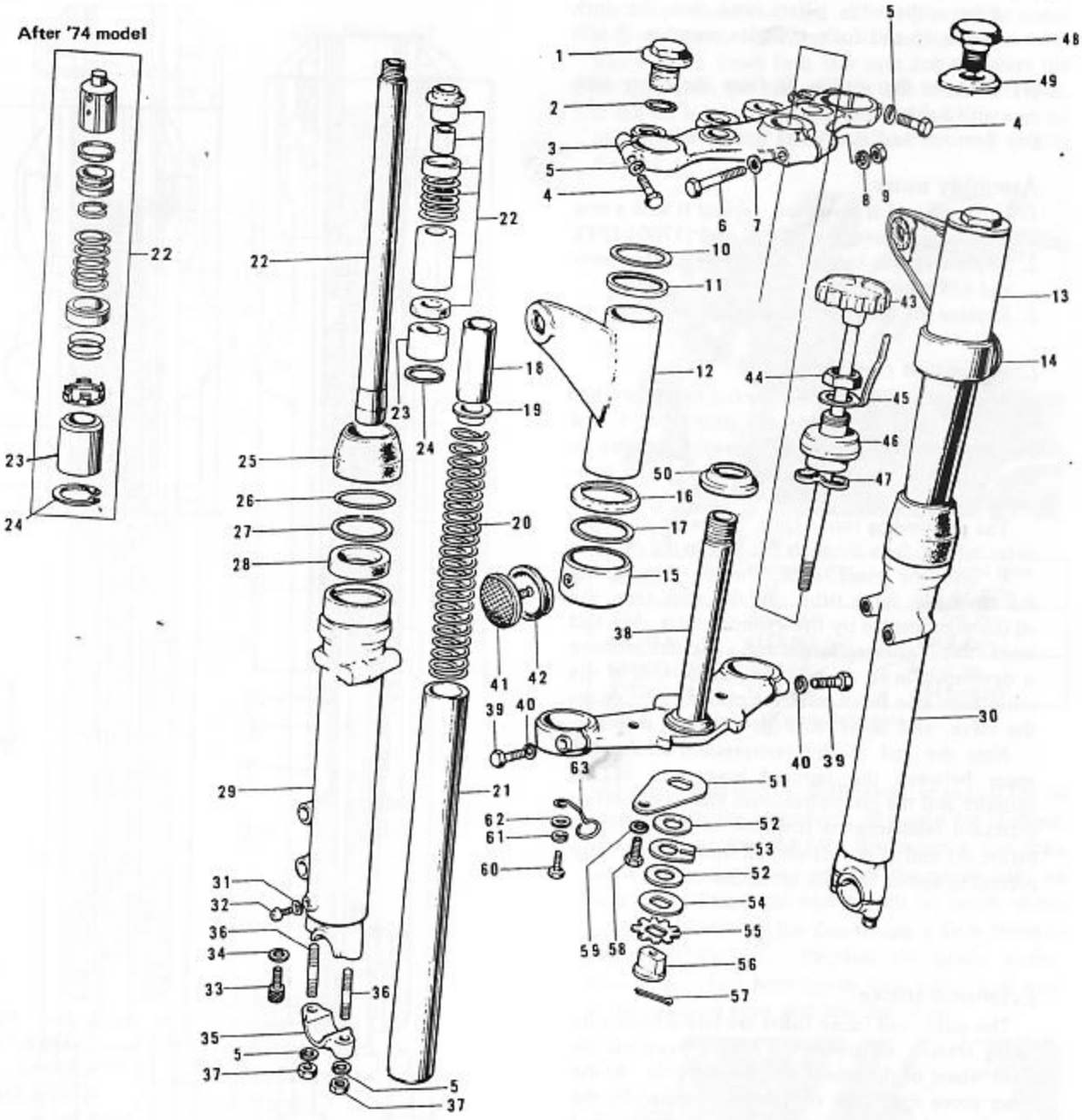
Special tools

S2A: 57001-183 + 57001-175

After '74 models: 57001-142 or 57001-183 + 57001-176



1. Steering Stem Head
2. O Ring
3. Stem Head Bolt
4. Stem Head Clamp
5. Fork Cover Bolt
6. Fork Cover Guide
7. Gasket
8. Steering Stem
9. Inner Tube
10. Outer Tube
11. Dust Shield
12. Circlip
13. Washer
14. Oil Seal
15. Spring
16. Cylinder Assembly
17. Spring
18. Valve
19. Piston
20. Circlip
21. Fork Cylinder Bolt
22. Axle Clamp
23. Stud Bolt
24. Lock Washer
25. Nut
26. Gasket
27. Screw



1. Top Bolt
2. O Ring
3. Stem Head
4. Bolt
5. Lock Washer
6. Bolt
7. Lock Washer
8. Washer
9. Nut
10. Fork Cover Gasket
11. Fork Cover Guide
12. Fork Cover (L.H.)
13. Fork Cover (R.H.)
14. Fork Cover Guide (R.H.)
15. Fork Cover Guide (L.H.)
16. Fork Cover Guide
17. Fork Cover Gasket
18. Spacer
19. Spring Guide
20. Spring
21. Inner Tube
22. Fork Cylinder Assembly
23. Fork Piston
24. Circlip
25. Dust Shields
26. Circlip
27. Washer
28. Oil Seal
29. Outer Tube (L.H.)
30. Outer Tube (R.H.)
31. Gasket
32. Screw
33. Allen Bolt
34. Gasket
35. Axle Clamp
36. Stud
37. Nut
38. Steering Stem
39. Bolt
40. Lock Washer
41. Front Reflex Reflector
42. Damper Rubber
43. Steering Damper Knob (S2A)
44. Nut
45. Steering Damper Spring (S2A)
46. Steering Stem Nut (S2A)
47. Wave Washer (S2A)
48. Head Bolt (S3)
49. Stem Head Washer (S3)
50. Inner Race (S2A)
51. Steering Damper Steel Plate (S2A)
52. Steering Damper Friction Plate (S2A)
53. Steering Damper Anchor Plate (S2A)
54. Steering Damper Steel Plate (S2A)
55. Steering Damper Spring (S2A)
56. Steering Damper Guide Nut (S2A)
57. Cotter Pin (S2A)
58. Bolt (S2A)
59. Lock Washer (S2A)
60. Bolt
61. Lock Washer
62. Washer
63. Cable Clamp

(iv) Remove the fork piston circlip ㉔ from the inner tube with pliers, and then the fork piston ㉓ and fork cylinder assembly ㉒ will come out.
(v) Remove the circlip ㉖ from the outer tube with a sharp hook.
(vi) Remove the flat washer ㉗ and oil seal ㉘.

Assembly notes:

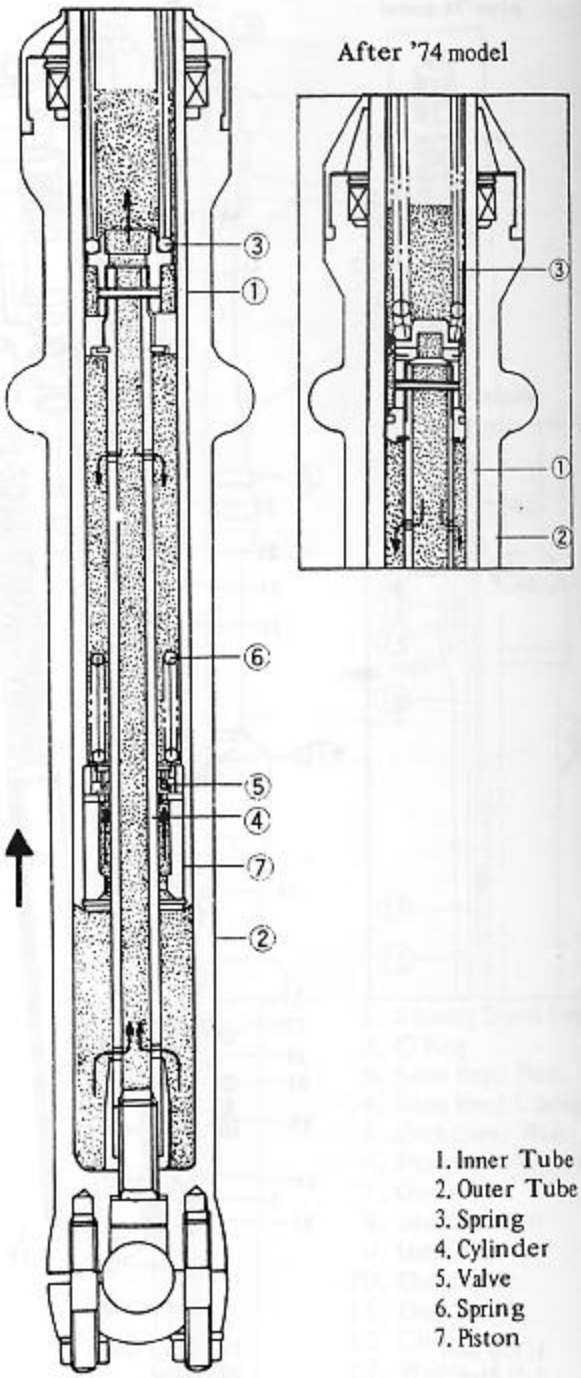
1. If the oil seal is removed, replace it with a new one using a press or special tool (57001-191).
2. Apply Loctite to the Allen bolt in the lower end of the outer tube.
3. Replace the top bolt O ring if it is damaged.

Compression stroke

When a load is placed on the front fork, or when the front wheel hits a bump, the inner tube 1 of the shock absorber moves downward (relative to the outer tube 2) and the spring 3 is compressed.

The descending inner tube, forces the oil in the outer tube to flow through the hole in the cylinder 4 into the inner tube, thereby compressing the air in the inner tube. At this same time, the oil chamber formed by the cylinder, valve 5 and inner tube is growing larger and a negative pressure is developed in it, so oil from the bottom of the outer tube also flows past the piston 7 , opens the valve, and flows through into that chamber.

Near the end of the compression stroke, the space between the tapered lower end of the cylinder and the piston becomes smaller and offers increased resistance to the flow of oil until, just before the end of the stroke, oil flow is completely prevented and an oil lock condition occurs.



1. Inner Tube
2. Outer Tube
3. Spring
4. Cylinder
5. Valve
6. Spring
7. Piston

Extension stroke

The outer and inner tubes are pushed apart by spring tension whenever the load is taken off the front wheel or the wheel drops into a hole. As the tubes move apart, the oil chamber formed by the cyliner , valve and inner tube grows smaller, but since the valve is a non-return type, the oil cannot return through the valve the way it came. Instead, it flows through a hole in the upper part of the cylinder, and the resistance to this flow through the hole dampens the fork extension. Near the end of the extension stroke, the cylinder spring ⑥ starts being compressed and further slows fork extension so that it does not suddenly top out.

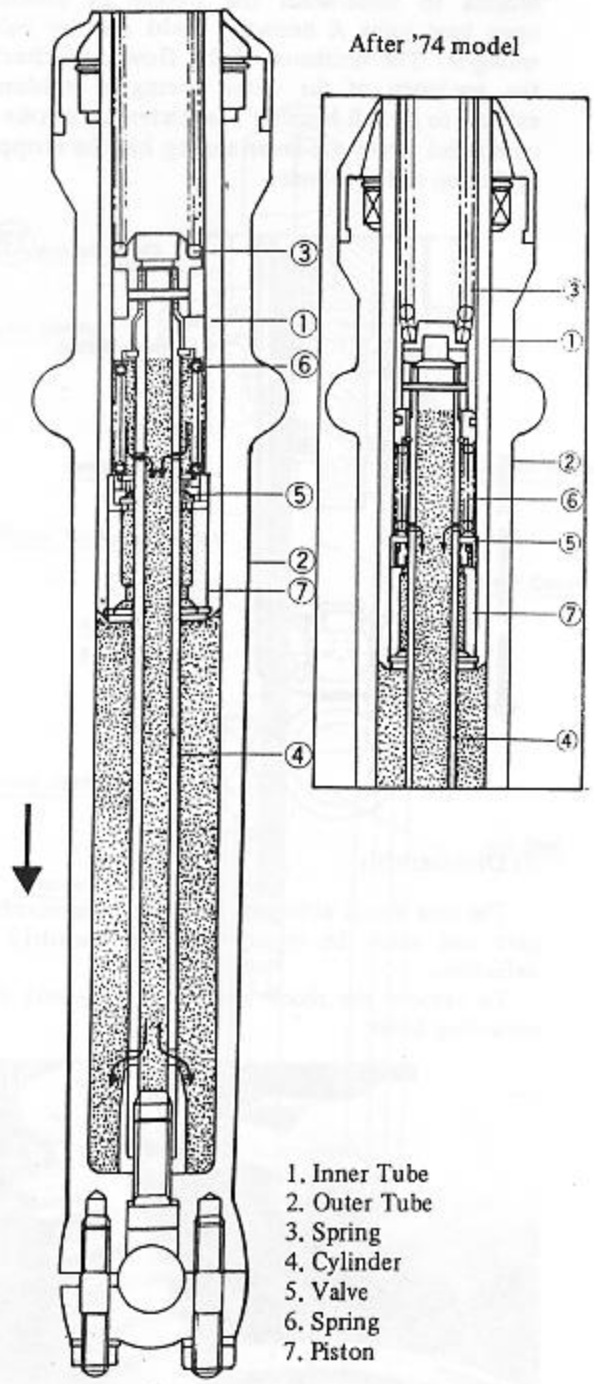
Either too much or too little oil in the forks will adversely affect their shock damping ability. If there is too much oil or if the oil is too heavy, the shock absorbers will be too hard; too little oil or too light an oil will make the fork soft and decrease damping ability, and may cause the fork to be noisy during operation.

If the inner tube becomes bent, detend, scored or otherwise damaged, it in turn will damage the oil seal and allow oil leakage. If the tube is bent badly enough, poor handling may also result.

Contaminated or deteriorated oil will also affect shock damping, and in addition will accelerate wear of the internal fork parts. For this reason it should be changed periodically.

Spring tension

Since the spring becomes shorter as it weakens, check its free length to find out if it is weark. If the spring of either fork is shroter than the service



limit, replace it. If the length of the replacement spring and that of the remaining old spring vary greatly, replace both old springs to keep the shock absorbers balanced and thereby maintain motorcycle stability.

Table 45 Fork Spring Free Length

Standard	Service Limit
10.18 in. (258.5 mm)	9.76 in. (248 mm)

Fork oil

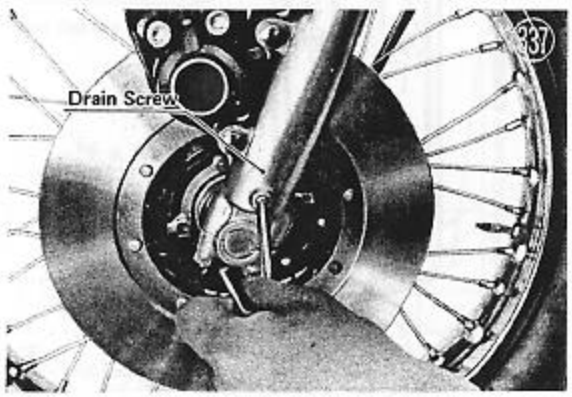
Place a jack or stand under the engine to that the front wheel is raised off the ground to check fork oil. Remove the top bolt from the inner tube. Insert a rod down into the tube and measure the distance from the top of the tube to the oil level. If the oil is below the correct level, add enough oil to bring it up to standard, but do not overfill the fork.

Table 46 Fork Oil*

Model	Amount per side	Oil level from top of tube
S2A, S3, S3A	5.24 oz. (155 cc)	13.98 in. (355 mm)
KH400-A3 KH250-B1	7.17 oz. (212 cc)	9.65 in. (245 mm)

* Oil type : SAE 10W non-detergent

Every 6,000 miles (10,000 km), or less if the oil appears dirty, the front fork oil should be changed. To drain out the old oil, first remove the drain screw from the lower end of the outer tube on each side. Stand the motorcycle on both wheels and push down on the handlebars a few times to pump out the oil. Replace the drain screws, remove the top bolt from each side, and pour in the specified type and amount of oil.



Inner tube damage

Visually inspect the inner tube and repair any damage or replace the tube if the damage is not repairable. Since inner tube damage will also damage the oil seal, replace the seal, too.

9. REAR SHOCK ABSORBERS

1) Construction

The shock absorbers constitute the rear suspension, protecting the rider and vehicle from road shock and vibration, and thereby increasing riding comfort and lengthening vehicle life. To further absorb vibration from small irregularities in the road surface, the shock absorbers are mounted with rubber bushings at the top and bottom.

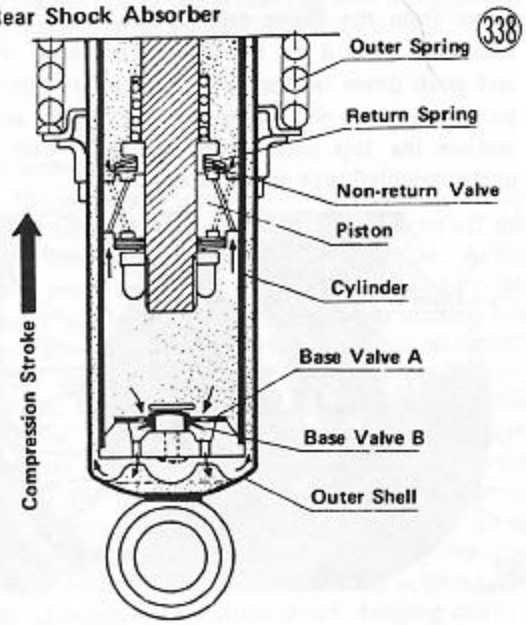
The shock absorber consists of springs, an inner cover, outer shell, cylinder, piston rod, piston, and shock absorbing oil. The basic tension of the spring (the initial load) is adjustable in three steps to comform with road and loading conditions, and rider comfort.

2) Operation

a. Compression

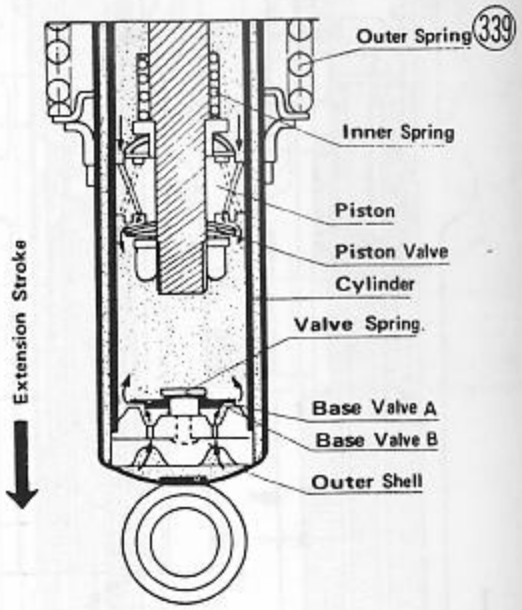
When the rear shock absorber receives a load, the outer spring is compressed, and at the same time the cylinder rising in the outer shell causes pressure on the oil underneath the piston. The oil flows through the piston orifice, pushes up the non-return valve held down by valve spring C, and enters the space above the piston. A small amount of oil also flows through the opening of base valve A, pushes down base valve B and enters the oil chamber between the cylinder and the outershell. The resistance to this oil flow, in addition to spring tension, constitutes buffering action. The compression stroke is terminated when the cylinder strikes the rubber at the top end of the piston rod.

Rear Shock Absorber (338)



b. Extension

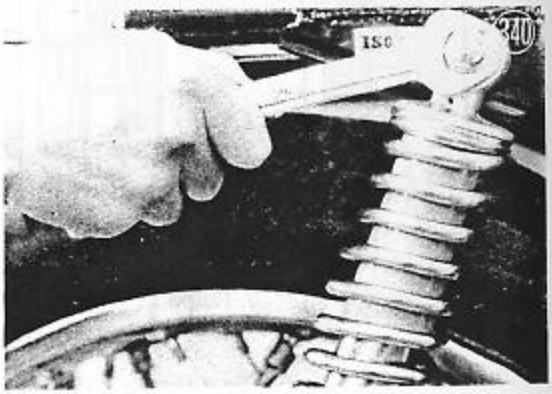
When the outer shell moves downward together with the cylinder due to spring force, the oil in the space above the piston goes through the piston orifice, pushes down the piston valve, goes through the valve and back into the space under the piston. At this same time, the oil in the space between the cylinder and the outer shell also returns to underneath the piston by pushing open base valve A normally held shut by valve spring D. The resistance of the flowing oil checks the tendency of the outer spring to suddenly expand to its full length. The extension stroke is completed when the inner spring hits the stopper at the top of the cylinder



3) Disassembly

The rear shock absorbers are a non-disassembly part and must be replaced as an assembly if defective.

To remove the shock absorbers, take out the mounting bolts.

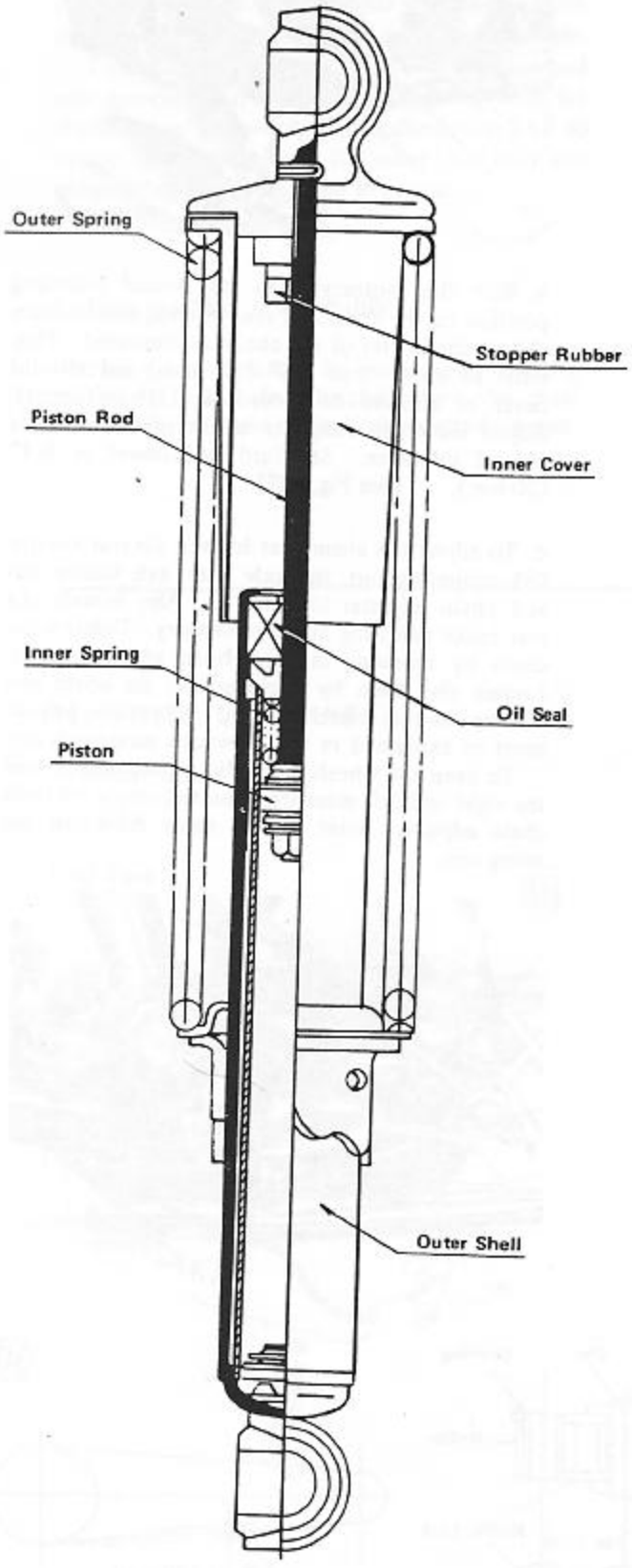


4) Inspection

a. Check the shock absorbers for leaking oil. A leaking unit should be replaced.

b. Since during compression the spring force is much greater than the oil damping force, this damping force is very difficult to check. The damping force during expansion can be easily inspected, however. Compress the shock absorber and release it. If it does not return smoothly without jerking or snapping back, or if other abnormalities are noted, replace it.

Rear Shock Absorber

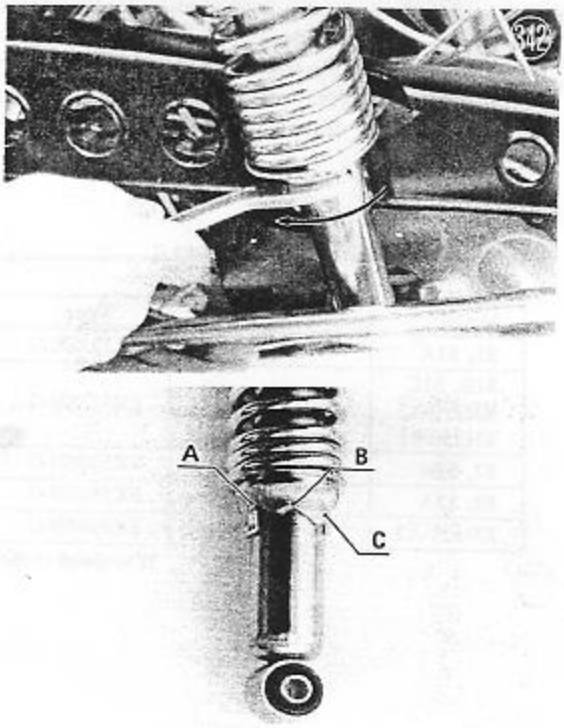


NOTE: Riding with one bad shock absorber will soon cause the other one to break down. If inspection reveals a defective shock, replace it as soon as practicable.

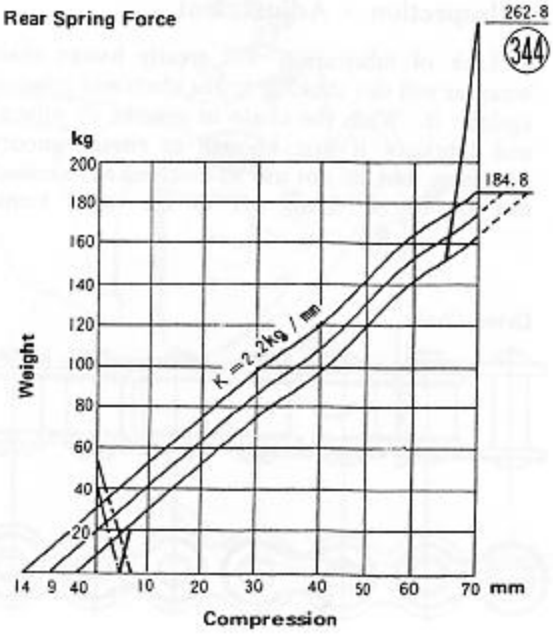
c. Check that the rubber shock absorber mountings are not worn, cracked or hardened.

5) Adjustment

By turning the outer spring seat, the spring seat is raised or lowered, increasing or decreasing minimum spring tension and changing the length of the spring stroke. Use a spanner (special tool) or screwdriver to turn the seat. Turning from A to B to C increases tension; turning in the opposite direction decreases tension. Minimum spring force for each position is given in the graphs.



Rear Spring Force



10. DRIVE CHAIN

1) Construction · Operation

The drive chain transmits engine power to the rear wheel and, together with the front and rear sprockets, performs secondary reduction. Chain construction is illustrated below. Wear occurs between the pin and bushing, and bushing and roller due to chain movement and tension, and causes the chain to lengthen. Chain slack is also produced from wear of the roller surfaces against the sprockets. If chain play becomes great enough it can cause the chain to snap or come off the sprocket, so this play should be checked and adjustment made at regular intervals. And along with chain adjustment, wheel alignment must also be taken into consideration. Misalignment will cause the chain to snap or slip off the sprocket, and cause abnormal chain and sprocket wear, reducing power transmission efficiency.

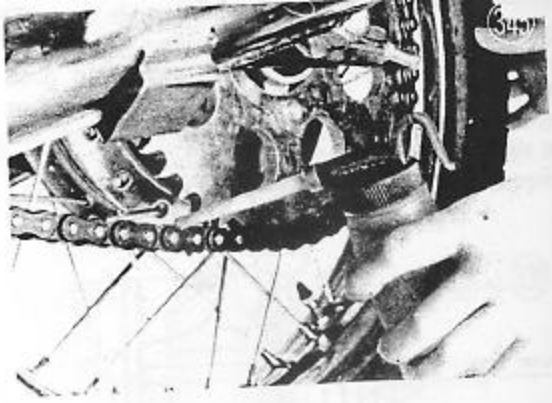
Table 47 Chain Specifications

Model	No. of Links	Type
S1, S1A	102	EK525SH-G
S1B, S1C KH250-A5 KH250-B1	108	EK525SH-G
S2, S2A	98	EK530SH-G
S3, S3A	104, 102*	EK530SH-G
KH400-A3	104	EK530SH-G

*European model

2) Inspection · Adjustment

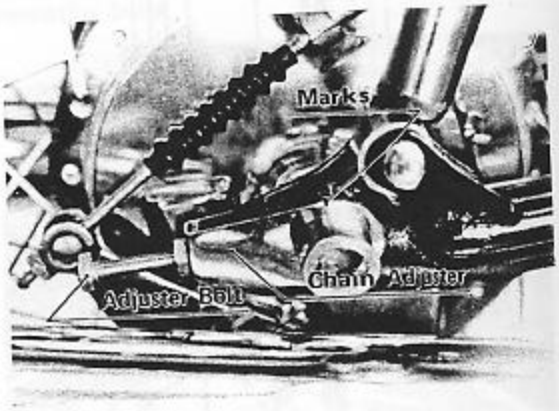
a. Lack of lubrication will greatly hasten chain wear, as will dirt sticking to the chain and grinding against it. Wash the chain in gasoline or solvent, and lubricate it just enough to ensure smooth operation, but do not use so much oil as to collect dirt or to be flung off as the chain turns.

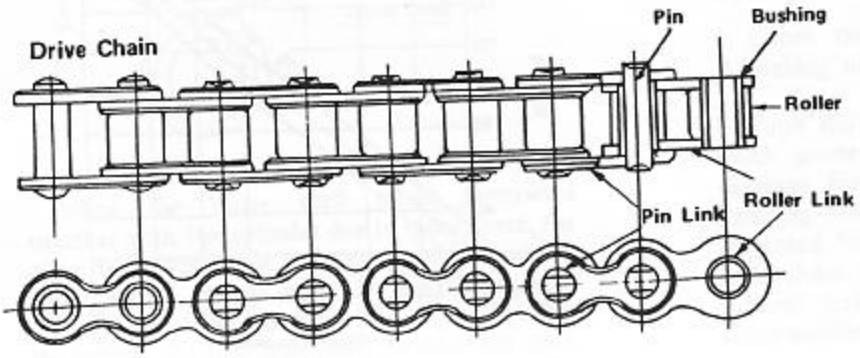


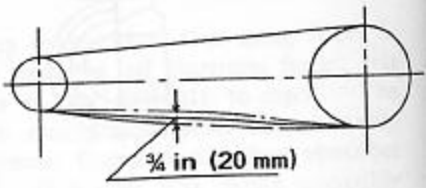
b. With the motorcycle in its normal standing position on the front and rear wheels, check chain play at the center of the chain as illustrated. Play must be more than 3/8" (10 mm) and should never be allowed to exceed 1 1/2" (40 mm). Adjust the chain using the chain adjusters if it is out of tolerance. Standard adjustment is 3/4" (20 mm). [See Fig. 347]

c. To adjust the chain first loosen the rear torque link mounting nut, the axle nut, axle sleeve nut and chain adjuster lock nuts. Also loosen the rear brake adjusting nut if necessary. Tighten the chain by screwing in the chain adjuster bolts. Loosen the chain by backing out the bolts and kicking the rear wheel forward. Check the adjustment as explained in the previous paragraph (b).

To keep the wheels properly aligned, make sure the right and left sides are adjusted evenly so both chain adjusters point to the same mark on the swing arm.







After adjustment, do not fail to retighten all the parts that were loosened. Also check rear brake adjustment.

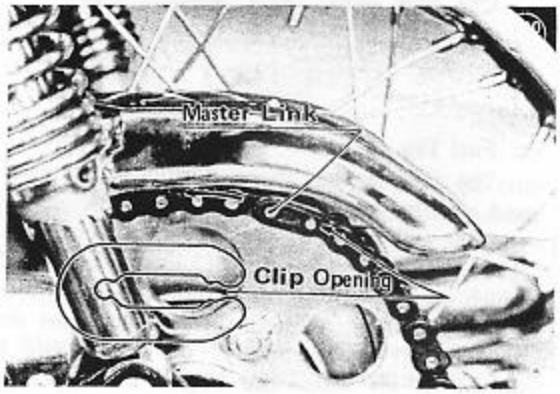
d. Replace the chain when it has stretched so much that correct adjustment is no longer possible.

To prolong chain life, check the engine and rear sprockets and replace them along with the chain if they are worn. Oil the chain with SAE 30 motor oil at least every 200 miles (300 km), and immediately after riding on wet roads.

3) Disassembly · Assembly

This is accomplished by removing or inserting the master link. It is helpful to give the chain some slack to make assembly/disassembly easier.

When replacing the master link clip, the open end should face in the opposite direction to chain movement, to keep the clip from coming off and causing the chain to break.



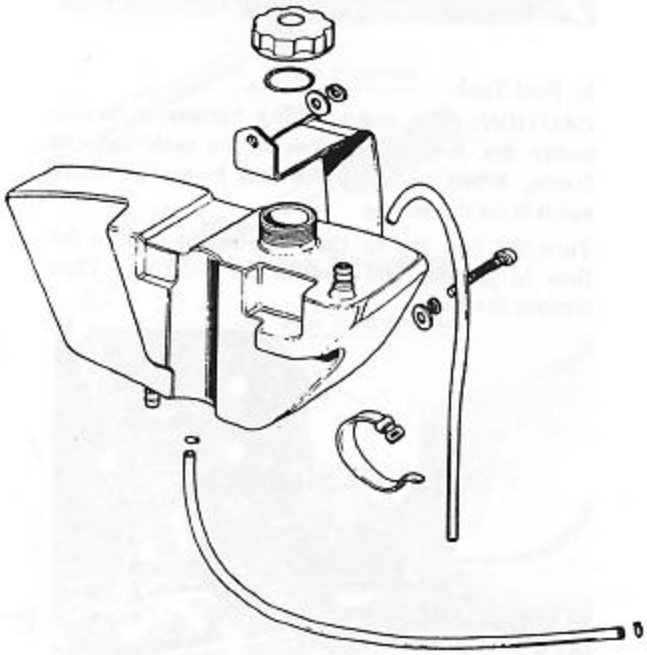
11. FUEL, OIL TANKS

1) Construction

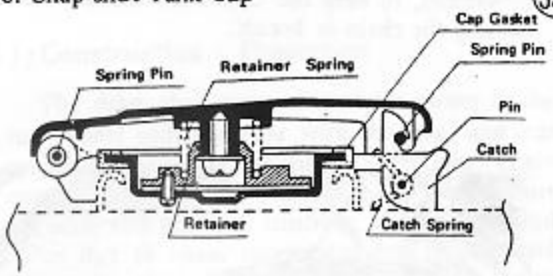
a. Tanks

Fuel Tank (349)

Oil Tank (350)



b. Snap-shut Tank Cap



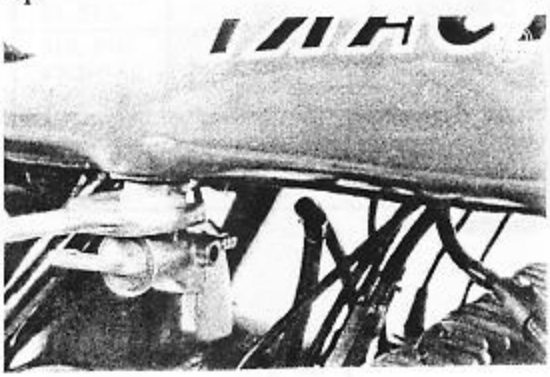
c. Fuel Tap

The fuel tap has three positions: on, reserve, and off. In the off positions the tap is closed and gasoline will not flow. In the on position gasoline flows until a 1/2 US gallon (2 liter) reserve is left, which can be tapped by turning the lever to the reserve position. Since this tap does not shut gasoline off automatically, the tap should be turned to off when the engine is stopped, to prevent possible carburetor overflow.

2) Disassembly

a. Fuel Tap

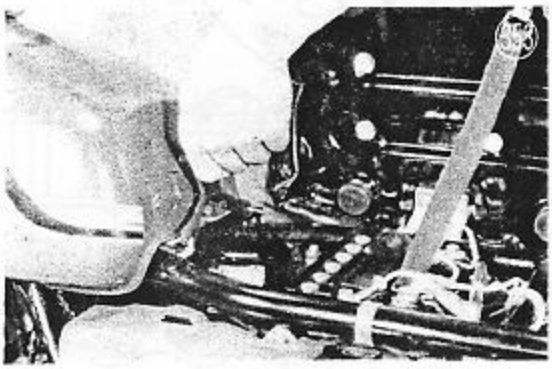
Pull off the fuel pipe and turn the tap to the reserve position fo drain the gasoline. Remove the tap.



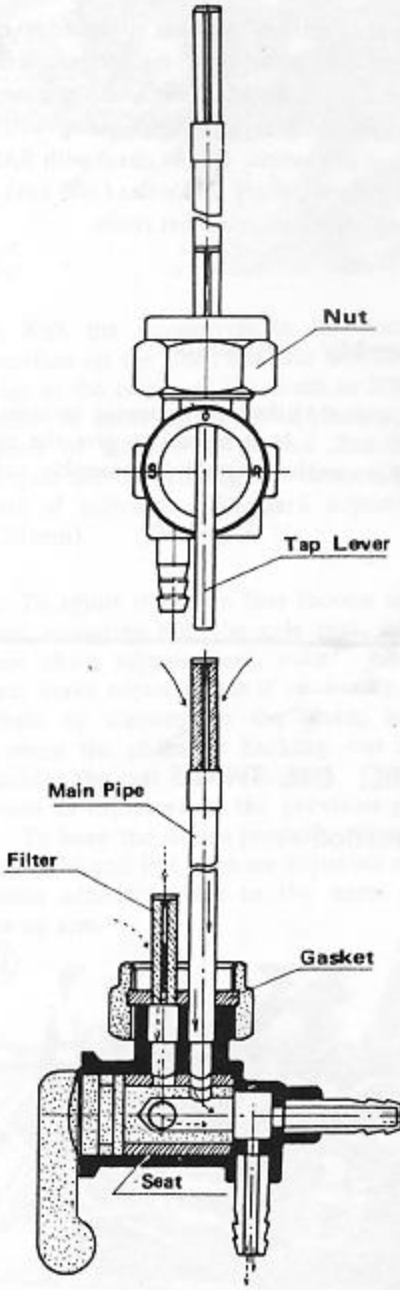
b. Fuel Tank

CAUTION: The main wiring harness is located under the fuel tank between the tank and the frame. When removing the tank be careful not to catch it on the wiring.

Turn the fuel tap to the off position to stop the flow of gasoline and remove the fuel pipe. Then remove the tank.



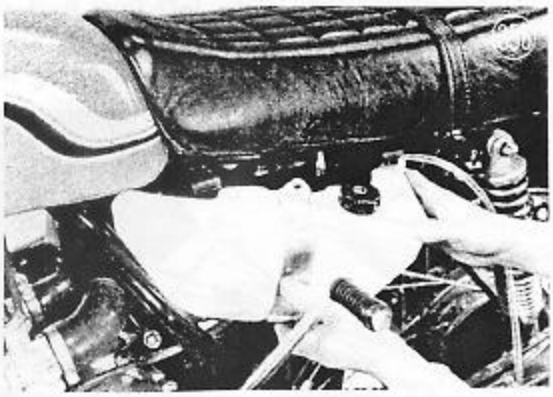
Fuel Tap



Lever Position "O", or "ON" ⟶
Lever Position "R", or "RES" ⟶

c. Oil Tank

Before removing the oil tank, plug the oil pipe to prevent spillage.



3) Inspection

a. Fuel, Oil Tanks

After the fuel and oil tanks are used for a long period, sediment collects in them and should be cleaned out to keep it out of the fuel tap and oil pump.

b. Fuel, Oil Tank Caps

The caps not only keep the gasoline and oil from spilling, but allow air to enter the tanks through a vent hole in the cap. If air does not enter the tank, a partial vacuum will form at the top of the tank and prevent the oil or gas from flowing out the bottom. Clean the caps and check that the vent is not plugged.

c. Oil Tank Cap O Ring and Banjo Bolt Gasket

Check these parts for damage which may cause oil leakage.

4) Assembly

Assembly is in the reverse order of disassembly.

NOTE: Be sure there is no air leakage at the vacuum pipe connections, as this will stop gasoline from flowing.

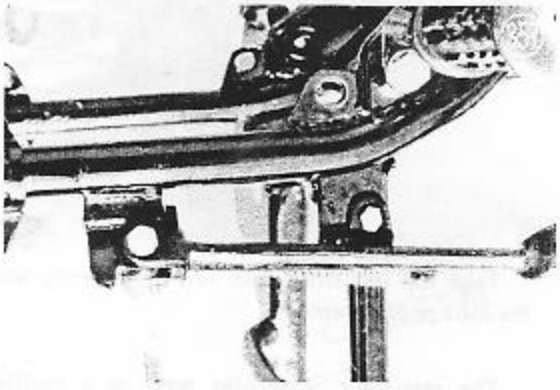
12. STANDS · FOOT RESTS

1) Construction

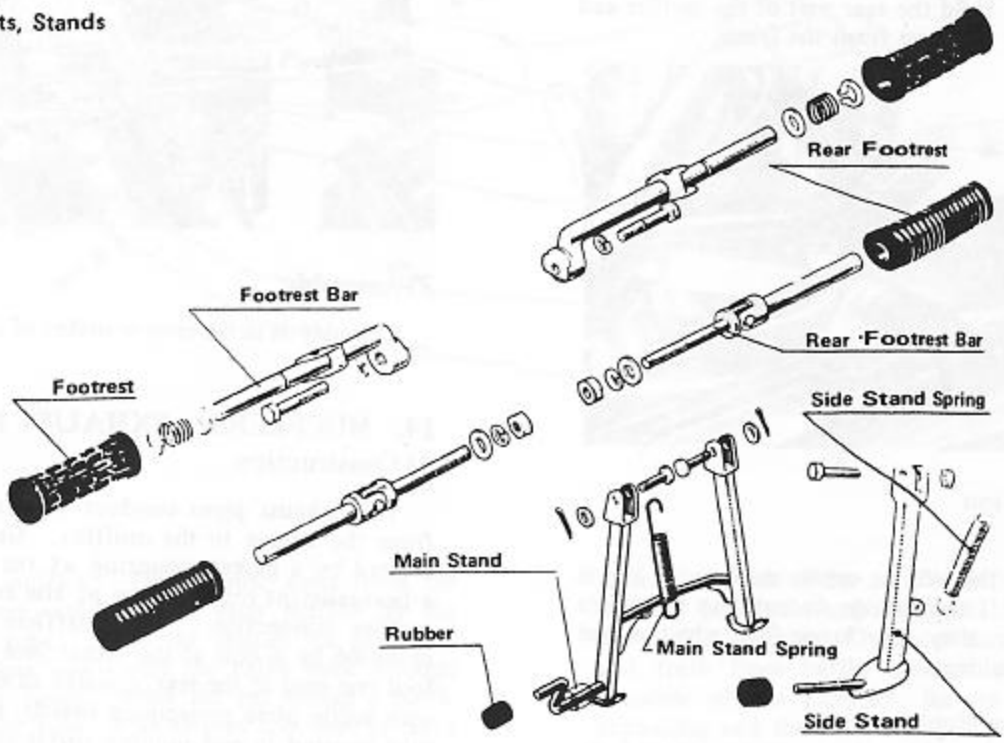
The center and side stands are of rigid construction to support the weight of the vehicle when it is parked.

2) Disassembly

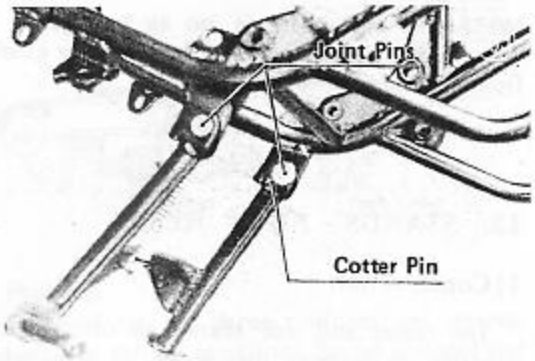
a. With the side stand kicked up, remove its mounting bolts, being careful not to damage the threads, and then remove the spring and stand.



Foot rests, Stands

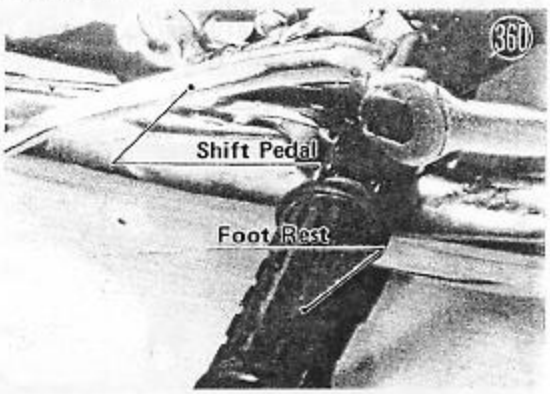


b. Take the spring off the center stand, pull out the cotter and joint pins, and remove the stand.



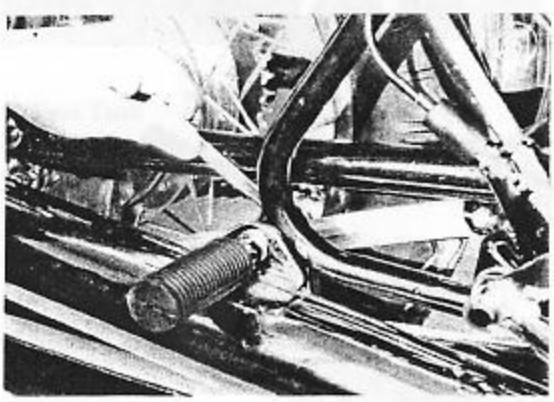
c. Foot Rests

Left Front



Take the left front foot rest off together with the shift pedal assembly.

The rear foot rests also serve as a muffler mounting. Hold the rear part of the muffler and remove the foot rest from the frame.



3) Inspection

a. Springs

Replace the side or center stand spring if it is stretched. If the springs do not keep the stands up properly, they may lower from vibration and cause an accident.

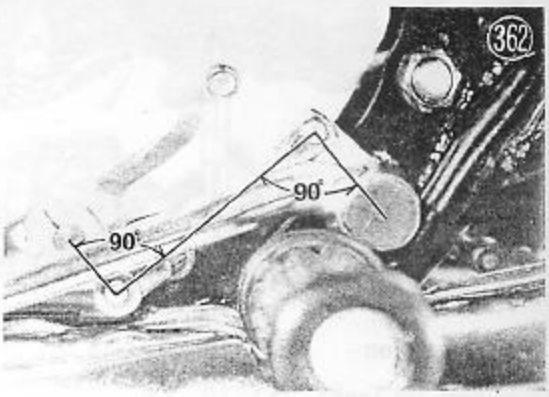
b. Foot Rest Rubber

Replace the rubber if it is worn or chewed up.

4) Assembly

Assembly is in the reverse order of disassembly.

NOTE: When replacing the left front foot rest, see that the shift pedal links are at 90° angles, making any adjustment with the adjusting bolt.



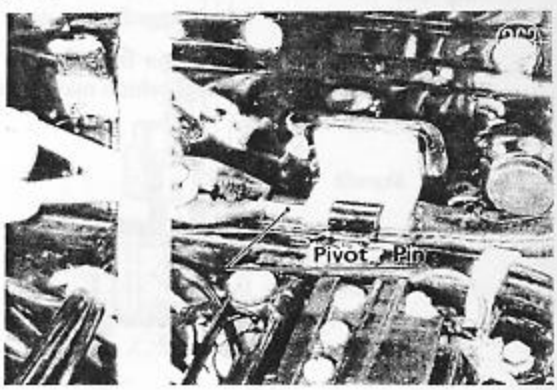
13. SEAT

1) Construction

The dual seat is packed with sponge rubber for riding comfort. It is held in place by pins on one side, and a catch on the other.

2) Removal

Remove the cotter pins and pull out the pivot pins.



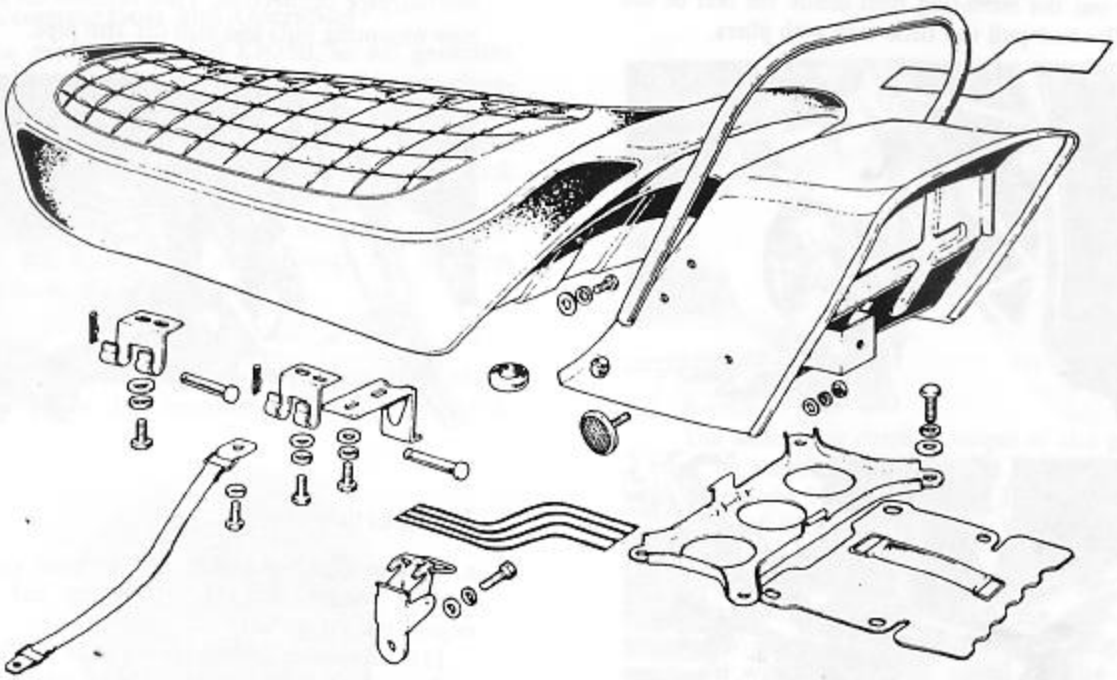
3) Assembly

Assembly is in the reverse order of disassembly.

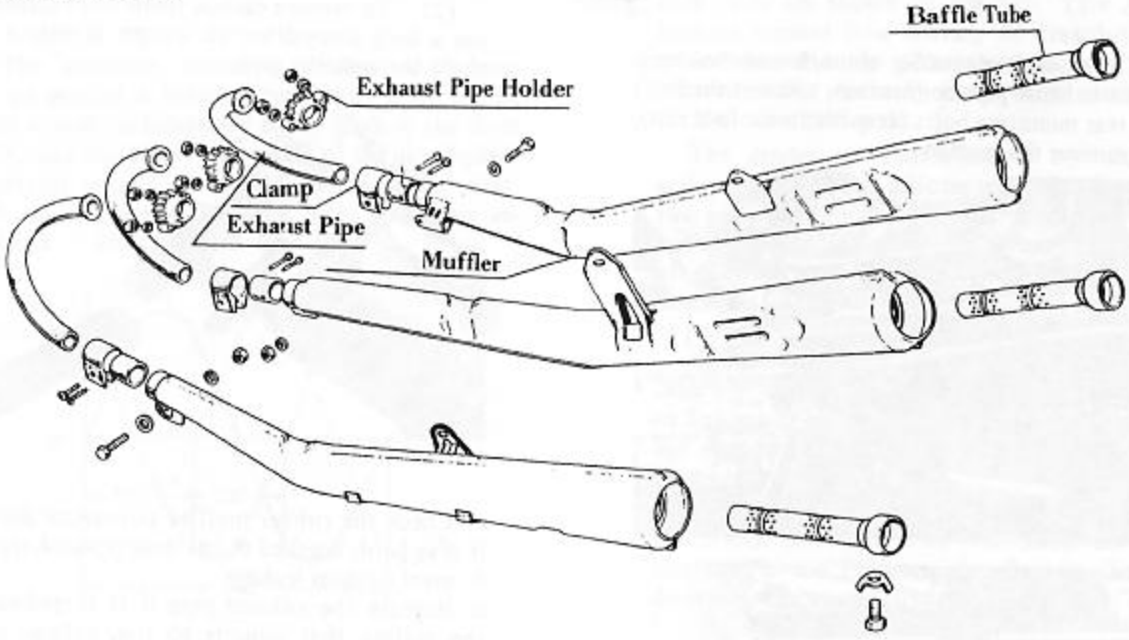
14. MUFFLERS · EXHAUST PIPES

1) Construction

The exhaust pipes conduct the exhaust gases from the engine to the muffler. Gas leakage is averted by a gasket mounting at the engine, and a heat-resistant rubber sleeve at the exhaust pipe/muffler connection. The mufflers, which are mounted by a bolt at the front end and by the foot rest stud at the rear, consist of an outer pipe with baffle plate projections inside, and a baffle tube inserted in and running most of the length



Muffler Assemblies

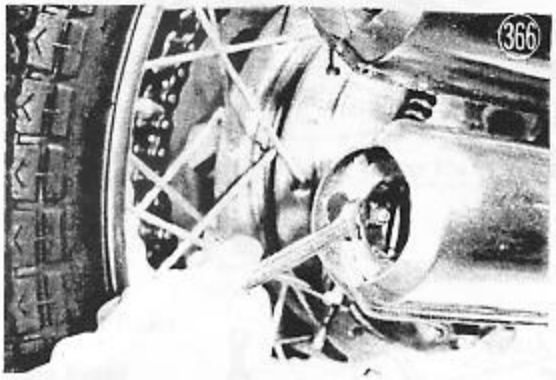


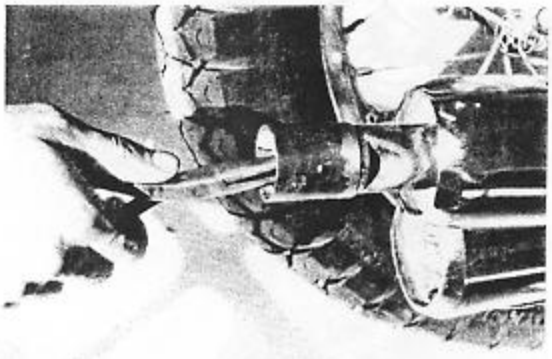
of the muffler. The exhaust gases from the engine are conducted to each muffler by the exhaust pipe. Inside the muffler the gas hits a baffle plate and enters the baffle tube through its many holes. When the gas strikes a baffle inside the tube, it exits into the muffler until it next hits one of the muffler baffles, then back into the baffle tube and so on until the gas reaches the muffler opening. During all this moving back and forth from baffle tube to each silencing chamber of the muffler, the gas is gradually expanding and the exhaust sound being muffled.

2) Removal

a. Baffle Tube

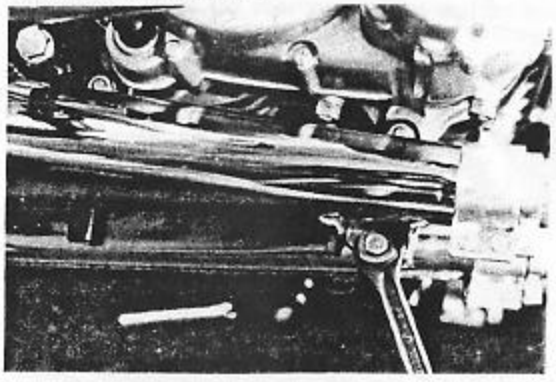
To remove the baffle tube for periodic cleaning, take out the mounting bolt inside the rear of the muffler and pull the tube out with pliers.

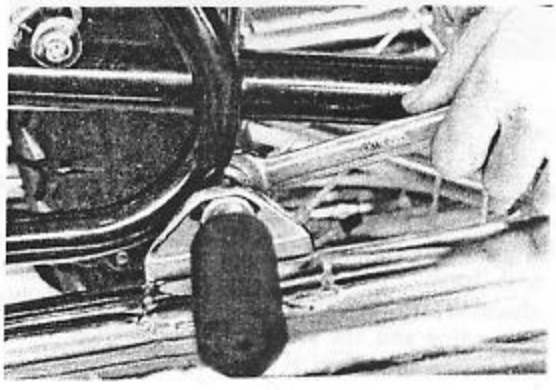




b. Muffler

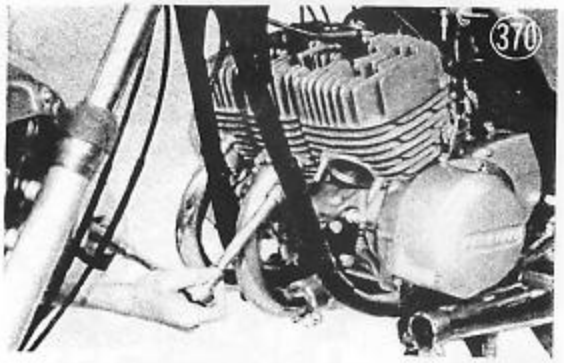
To remove the muffler alone, loosen the clamp at the exhaust pipe connection, take out the front and rear mounting bolts (rear bolt is the foot rest), and remove the muffler.





c. Exhaust Pipe

To remove the exhaust pipe alone, first loosen the muffler mountings and the clamp at the muffler/pipe connection. Then remove the exhaust pipe mounting nuts and pull off the pipe.

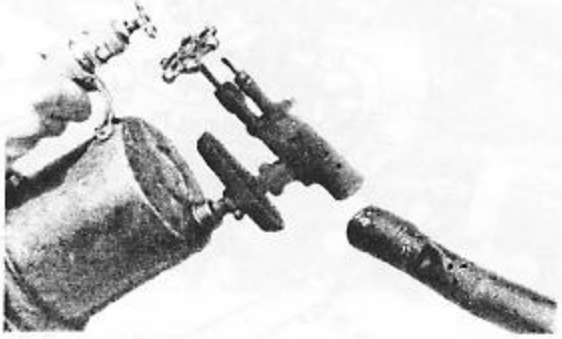


3) Inspection

a. Carbon build-up inside the exhaust pipe and muffler reduces exhaust efficiency and lowers engine output power.

(1) Remove carbon from the baffle tube with a wire brush. If the carbon is too thick to remove properly with the brush, burn it off with a torch or by setting the tube in a fire. After burning, the carbon will come off by striking the tube gently.

(2) To remove carbon from the exhaust pipe, use a long screwdriver to scrape it out, or run a chain through the pipe.



b. Check the rubber muffler connector sleeve and if it is hard, cracked or has deteriorated, replace it to avert exhaust leakage.

c. Replace the exhaust pipe if it is cracked, or if the surface that mounts to the cylinder is bent or damaged.

4) Assembly

Assembly is the reverse of disassembly.

NOTE: When the exhaust pipes are removed for inspection, repair, etc., it is recommended that the gasket at the cylinder end be replaced to prevent any possible exhaust gas leakage.

V. Electrical (on Contact Breaker Ignition System Models)

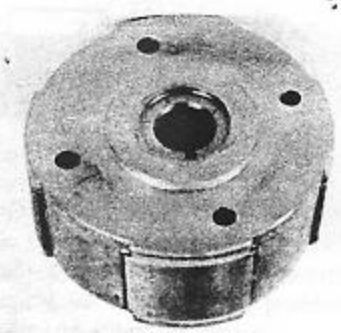
1. AC GENERATOR · RECTIFIER

1) Construction and Operation

In the S Series and KH250, an AC generator supplies all power for the ignition, lighting, charging circuits, etc. This AC generator differs from a DC generator in that in requires a rectifier, but its merit lies in its small size, light weight, and lack of parts liable to failure. In this generator, a magnetic field rotates inside the armature windings, and as the field cuts through the windings it induces voltage in them.

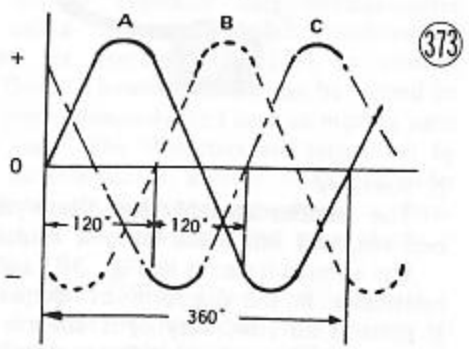
a. Field

The permanent magnet type field rotor which turns inside the armature is shown in Fig. 372.



b. Armature

The armature, which is constructed as part of the generator housing, consists of three sets of coils wound on laminated cores. Each of the three coils, and therefore each phase of the three-phase generator output, is set 120° ahead of the next, and the relationship of the three waveform resultants is illustrated in Fig. 373.

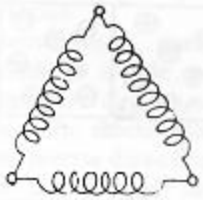


373

The three windings are delta connected as shown below.

Armature Winding Connection

374



Delta

c. Rectifier

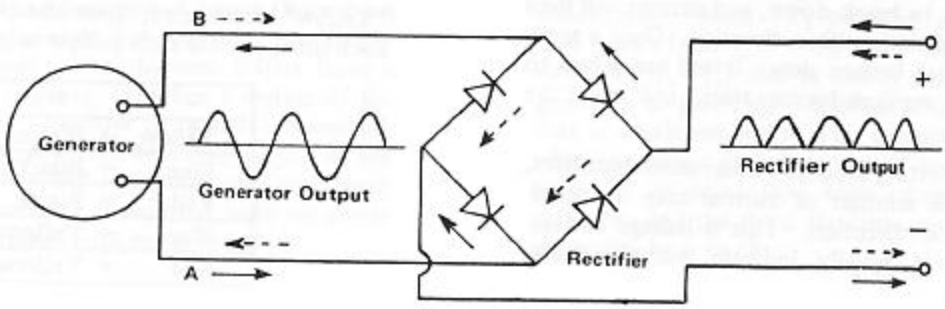
The alternating current output of the generator must be rectified, i.e. changed to direct current to charge the battery. Figure 375 is a simplified diagram of the circuit used for efficient full-wave rectification (rectification of both positive and negative halves of the AC cycle) of the AC generator output. Only one of the three phases is shown in the diagram, but with slightly additional wiring, all three phases can be rectified with this circuit.

The diodes used (four shown here) conduct current in only one direction, and the two different current paths for the first and second halves of each cycle are shown in Fig. 375. The A arrows indicate current flow during the first half of the cycle when the top generator lead is + and the bottom lead is –; the B arrows show current flow for the other half cycle.

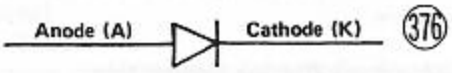
The diodes are manufactured by fitting together two pieces of silicon material. Each of the two pieces is impregnated with a different type of impurity, so that one piece always has a surplus of electrons (the N, or negative piece), and the other has a constant shortage of electrons (the P, or positive piece).

When a voltage is applied to the diode in the direction of the battery in Fig. 377 the surplus, or free, electrons are repelled by the negative voltage and attracted toward the positive voltage and current flows.

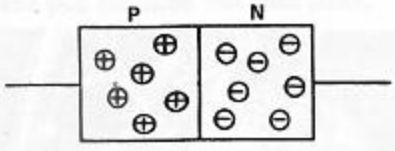
In Fig. 378 the voltage source is connected in the reverse direction, but since there are no free electrons in the P material to flow in the reverse direction, no current flows.

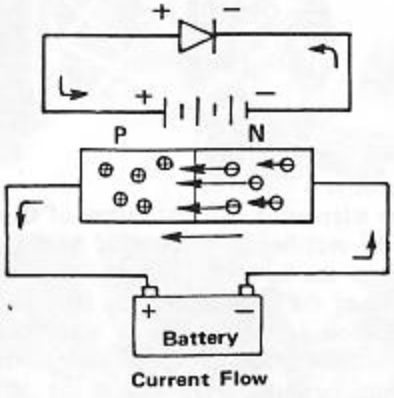


375

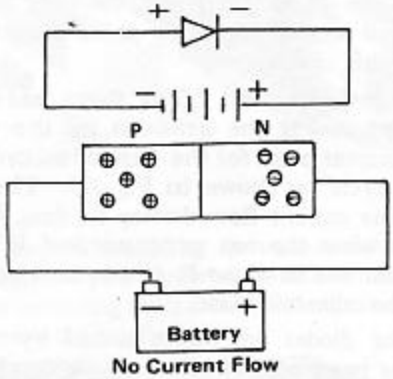


(376)





(377)
Current Flow



(378)
No Current Flow

From the preceding explanation it can be seen that if an alternating current is applied to the diode, it will conduct only on the half of the cycle when the polarity of the voltage corresponds with the polarity of the diode. Due to this half-conduction-only property of the diode, it is called a "semiconductor", and is used to change current flowing in both directions (AC) to single-directional current (DC). Other examples of semiconductors are transistors and thyristors, which are made from three or four pieces of a different type of semiconductor material.

NOTE:

1. Excessive heat or current in a semiconductor will cause it to break down, and current will then flow through it in either direction. Once a semiconductor has broken down it will not return to its former semiconductor state, and must be replaced.

2. When testing diodes or other semiconductors, a very small amount of current may be noted in the reverse direction. This is leakage current and does not usually indicate that the diode is defective.

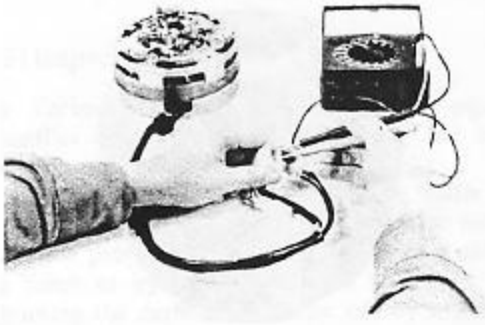
2) Inspection

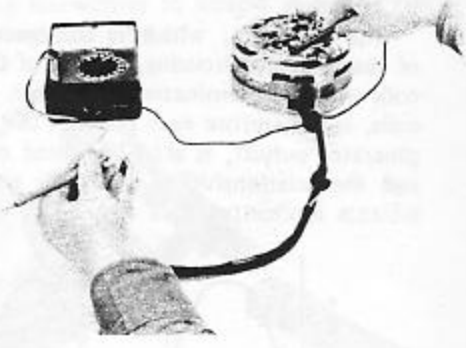
To completely test the generator and rectifier, various equipment is required the tests given here include only those practical with a hand tester, and are usually sufficient for the purpose.

a. Armature

Check for continuity – i.e. current flow – between all three of the yellow leads (the pink, yellow and white leads in the contact breaker ignition system models), setting the tester leads to two wires at a time.

Check that none of these leads is grounded out to the generator housing by touching one tester lead to the housing and the other to each lead. No current at all should flow.



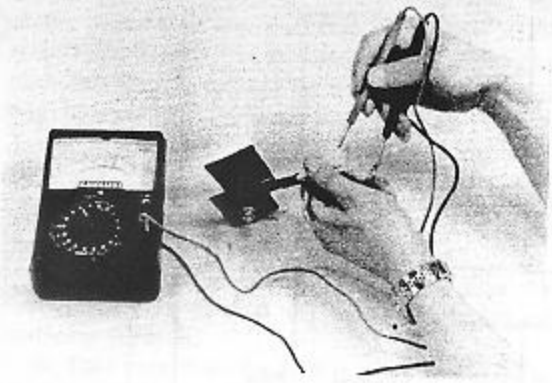


b. Rectifier

The rectifier assembly has three yellow leads, one red, and one black lead, a total of 5 leads.

Use a multi-tester as in Fig. 381 and check for continuity in the direction of the arrows only. If there is no continuity or if there is continuity in both directions, the rectifier is defective. Where "Yellow" is indicated, three checks must be made each time, one for each yellow wire.

–		+
Yellow	→	Black
Blue	→	Black
Red	→	Black
Blue	→	Yellow
Red	→	Yellow



NOTE: In some multi-testers (ohmmeters) the batteries in the tester are reversed so that the current flow will appear to be the reverse of that shown in the table.

2. VOLTAGE REGULATOR

1) General

As generator speed increases with engine speed, the magnetic field cuts through the armature windings faster, and generated voltage increases. It follows that at higher speeds the generator voltage will burn out the lights, overcharge the battery, and raise various other problems if it is not held down to a certain level.

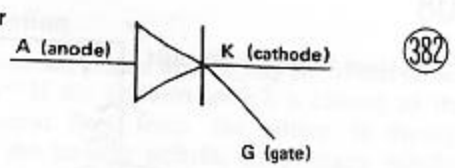
In the contact breaker ignition system models, permanent magnets supply the magnetic field to generate current. But since the magnet strength cannot be changed, the voltage in this case is regulated by a Silicon Voltage Regulator (SVR) which in effect returns any excess voltage to the generator.

2) Operation

This voltage regulator uses semiconductor devices called silicon controlled rectifiers, or thyristors, as electronic switches to control current flow. These thyristors can be turned on and off instantaneously, and have no moving parts to wear out. The thyristors are turned on by another semiconductor, a zener diode. In order to understand regulator operation, a basic knowledge of the thyristor and zener diode is necessary.

(1) Thyristor (Silicon Controlled Rectifier)

The thyristor is made of four pieces of semiconductor material (see page 105 for an explanation of semiconductors). Current flows from the cathode to anode but will not flow in the reverse direction. The thyristor differs from a diode in two respects: (a) when a voltage of the correct polarity –negative to cathode– is applied, it will conduct only after receiving a signal at the gate input; (b) it will not stop conducting, even when the gate voltage is removed, until the anode to cathode voltage is removed or reversed.



(2) Zener Diode

As in a normal diode, current will flow easily from the cathode to anode, and will not usually flow in the opposite direction. Unlike a normal diode, however, the diode will "break down", or conduct in the reverse direction, if enough voltage is applied in the reverse direction; when the voltage is lowered or removed, the diode will stop conducting and return to its normal state. The voltage at which the diode begins reverse conduction, is called the breakdown voltage, and can be set at the desired level when the diode is manufactured. This property of the zener diode makes it very useful in voltage regulator circuits.

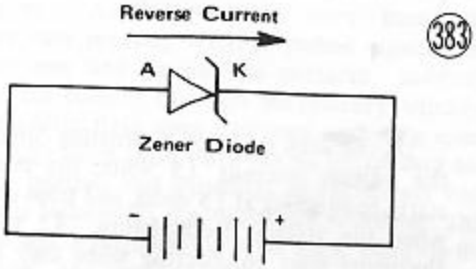
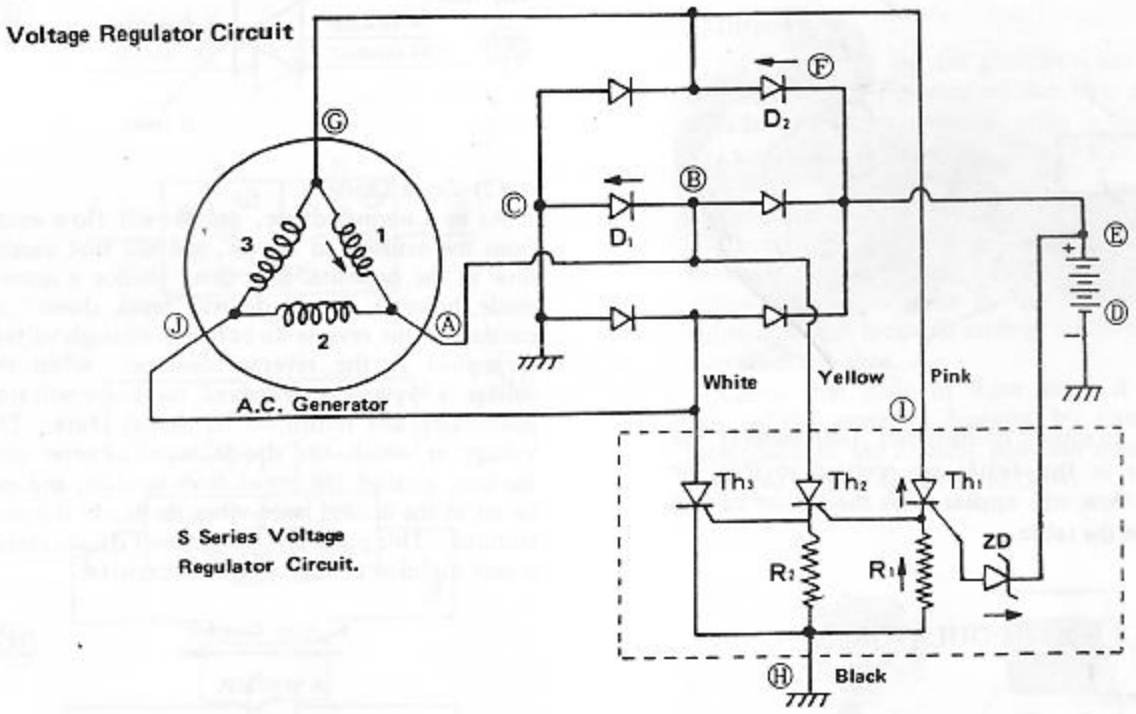


Fig. 384 is a slightly simplified schematic-diagram of the silicon voltage regulator as connected in the contact breaker ignition system models. The portion in the dotted lines is the regulator itself, and the letters at the regulator leads correspond to actual wiring colors.

Since the AC generator is 3 phase, three thyristors are used, one for each coil. For ease of understanding, current flow is followed completely through for coil No. 1 only. When armature voltage is + at point Ⓖ and ⊖ at point Ⓐ, current to charge the battery flows from Ⓐ to Ⓑ through diode D_1 to Ⓒ to ground. Then from ground at point Ⓓ charge current flows up through the battery to point Ⓔ, Ⓕ, through D_2 and back to the generator at point Ⓖ. If the voltage at point Ⓔ (which corresponds electrically to point Ⓖ when diode D_2 is conducting) exceeds 16 volts, the zener diode breaks down and conducts in the direction of the arrow. Current flow at this time is up through R_1 to thyristor Th_1 cathode, out the gate lead and through the zener diode. This current gates the thyristor, that is, it gives it a push to start conducting. When Th_1 conducts, current from Coil 1 goes from Ⓐ → Ⓑ → Ⓒ → ground → Ⓗ → R_1 → Th_1 → Ⓘ and is finally returned to the generator at point Ⓖ. Voltage at the top of R_1 that is developed when Th_1 conducts, gates Th_2 which conducts to return excess voltage to the generator at point Ⓐ; then voltage across R_2 gates Th_3 and the third thyristor conducts excess electricity back to Ⓙ.



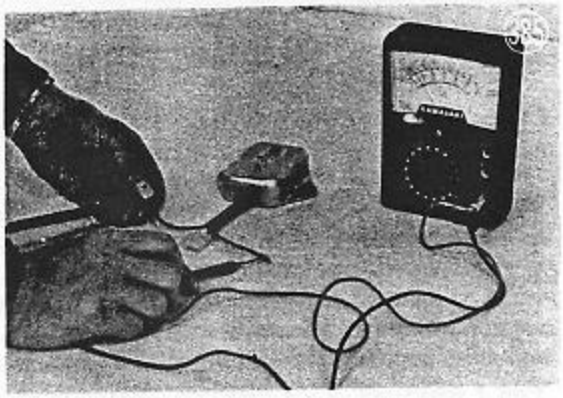
S Series Voltage Regulator Circuit.

During each cycle of alternating current where the voltage exceeds 15 volts, the zener diode starts conducting at 15 volts, and stops conducting when the voltage drops below 14.5 volts. The thyristors start conducting when they are gated, and stop conducting each time the voltage reaches the negative half of the cycle.

The result is that the voltage level is held down to a 15 volt maximum.

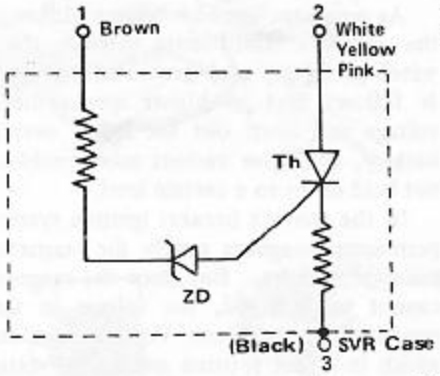
3) Inspection

Make the following checks in the order given, going on to the next step only if the previous one checks good. For testing, the white, yellow and pink leads from the thyristors can be grouped together as one.

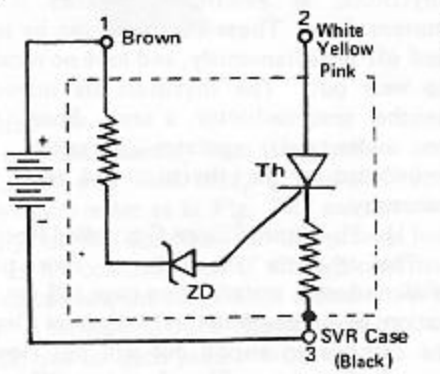


(1) Check that the resistance between ① (brown) and ③ (the case) is more than 1 KΩ. A resistance of less than this indicates a shorted component.

(2) Check that there is no current flow (i.e. high resistance) in either direction between ② and ③. Any significant current flow indicates that a thyristor is defective.



(3) Connect a 12 volt battery between ③ and ① with the negative lead to ③ and positive to ①, as shown in Fig. 387. Use an ohmmeter (tester) to see that current will not flow from ③ (−) to ①(+). If current flows, the zener diode is defective.



(4) Connect an additional 4 volts or so in series with the 12 volt battery, to make a total of over 16 volts, the breakdown voltage of the zener diode. Again check for current flow from ③ to ②. If current now flows, the regulator is operating correctly; if no current flows, either the zener diode or first thyristor is defective.

NOTE: If the regulator checks good with the above procedure but still does not appear to be operating correctly in the circuit, check it by trial replacement with a good unit.

CAUTION:

Handling the Silicon Voltage Regulator–

1. Do not let the screws get loose. This would reduce heat radiation efficiency, and could cause the semiconductors to overheat and short.

2. To avoid damage to the SVR, be sure the main switch is turned off before removing or replacing the unit.

3. Take care that the SVR is mounted firmly in place, and that the leads are connected correctly. A mistake in wiring will result in damage to the battery, as well as the SVR.

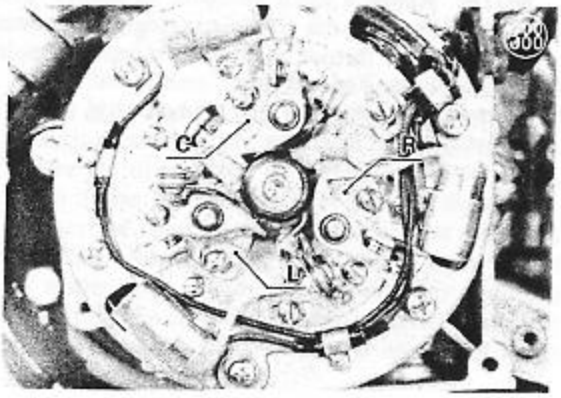
4. For the SVR to function properly, the battery must be charged to near capacity. If the battery is badly discharged, charge it before installing it in the motorcycle.

3. IGNITION SYSTEM

This system supplies the spark to ignite the gasoline mixture that is drawn into each cylinder. To enable efficient use of the exploding gas, the ignition system must supply a strong enough spark at the correct moment.

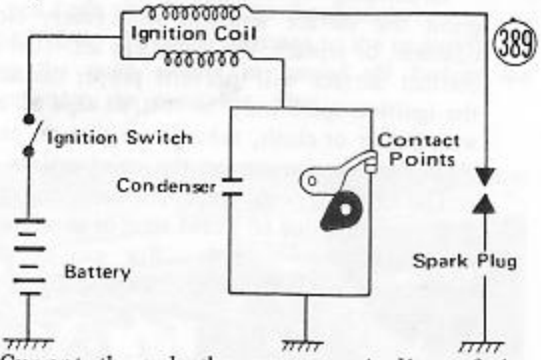
1) Construction

As the diagram shows, this ignition system consists mainly of the breaker arm, breaker cam, points, spring and capacitor. The rubbing end of the breaker arm is formed from bakelite, electrically insulating the points on the other end of it, from the plate on which the parts are mounted. Due to the eccentric rotation of the cam on the end of the generator rotor shaft, the breaker arm riding the cam is periodically pushed up to open and close the contacts. By adjusting the time at which the breaker arm is pushed, ignition timing can be changed. The points are made of tungsten steel, which has both electrical and mechanical durability. However, since it is impossible to completely avoid wearing of the points, they too are designed to be adjustable.



2) Operation

The contact points in Fig. 389 are in the closed position. If the ignition switch is closed at this time current flow from the battery is through ground, the breaker points, the primary winding of the ignition coil, and via the switch back to the battery.

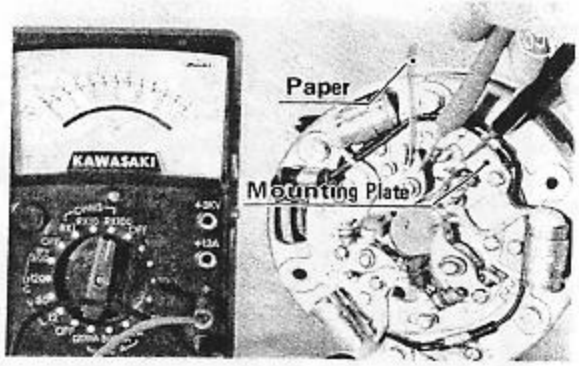


Current through the primary winding of the coil creates a magnetic field, strengthened by the iron core. As the generator rotor turns, the breaker cam rotating with it pushes against the breaker arm and opens the contacts, suddenly cutting off current through the primary winding. The magnetic field then collapses, and as a result of the high turns ratio between the secondary and primary ignition coil windings, an extremely high voltage is induced in the secondary winding. This high voltage is introduced to the spark plug via the plug cable, and causes a spark to jump across the spark plug point gap and ignite the gasoline mixture in the combustion chamber.

Besides the voltage induced in the secondary winding, self-induction also causes current to continue to flow in the primary winding even after the contacts have opened. This current builds up to a pressure of several hundred volts which, without the capacitor, would jump across the breaker contacts and gradually burn them away. To avoid this, a capacitor is connected in parallel with the contacts, and the self-induced current charges the capacitor instead of sparking at the contacts.

3) Inspection

a. Check that the breaker arm is insulated from the mounting plate when the points are open. If the breaker arm is not insulated due to poor mounting or damage, it will not be possible to interrupt primary current to produce the spark.



b. Check the contact points for wear or fouling. The points must be inspected periodically since they become worn after a long period of operation, and the slight sparking at each break gradually burns the surface.

Depending on the extent of point damage, grind the surface smooth with emery cloth or oilstone, or replace the points as set. Oil on the contact surface will prevent proper contact and the ignition spark may be lost, so wipe off any oil with paper or cloth, taking care that no paper or cloth particles remain on the point surface.

The contact point gap, and therefore ignition timing, change due to point wear or grinding down, and must be adjusted. For gap adjustment procedure, see the paragraph on ignition timing adjustment.

c. Capacitor

When the capacitor can or the internal insulation deteriorates or becomes punctured, the ignition spark may become weakened or the contacts might not break electrically. If a long blue-white spark can be seen jumping between the breaker contacts, the capacitor is most likely to be defective.

(1) Capacity

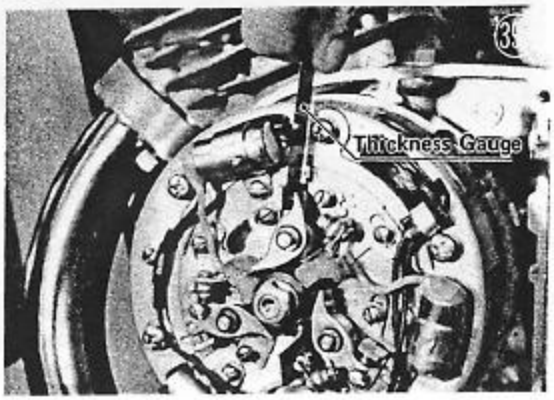
The capacitor capacity is .18μf. Check the capacity with a capacitor tester. If such a tester is not available, and the multitester used gives no instructions on capacitance testing with it, charge the capacitor with a direct voltage source, observing correct polarity. After giving the capacitor several seconds to charge, remove the voltage source and short the capacitor leads together. If a spark jumps between the leads at this time, the capacity is sufficient.

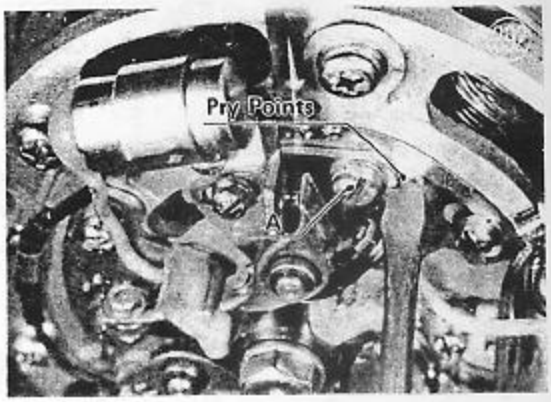
(2) Insulation resistance

Disconnect the capacitor ground and check for no continuity between the + side and the can. If there is a current path, the capacitor is shorted; if no current flows the capacitor is probably good.

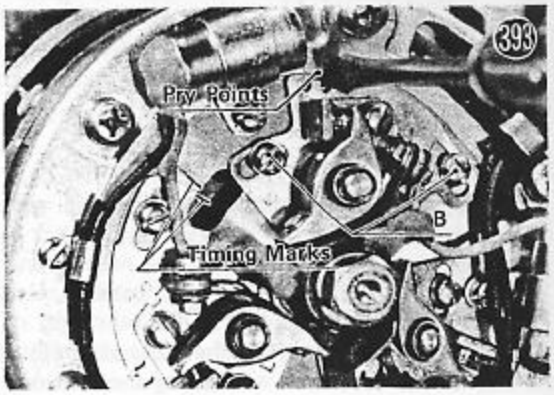
4) Ignition Timing Adjustment

First use a thickness gauge to see if the maximum contact opening for each of the three sets of contacts, is between .012" and .016" (0.3 – 0.4 mm). If the gap is incorrect, loosen screw A and adjust the gap to that value, as illustrated in Fig. 392.





Timing marks L, C, and R engraved in the rotor face can be seen by looking through the inspection window in the stator. If ignition timing is correct, the contacts are just beginning to open when the rotor and stator marks are aligned. To adjust the timing, loosen two screws B, insert a screwdriver between the pry points (..), and turn the screwdriver to move the contact plate back and forth so that the points just start to open when the timing marks are aligned.



This adjustment must be done for each of the three sets of points to completely set ignition timing. When the L marks are aligned, for example, the L contact breaker plate mounting screws should be loosened and plate L pried, etc.

When correctly set, timing is 23° BTDC, which in terms of piston position means the piston is 2.60 mm (.1024 inch) from Top Dead Center.

NOTE: Apply a small amount of quality grease to the felt. Use the grease sparingly, as excessive grease will be thrown off the cam onto the points, causing burning and pitting.

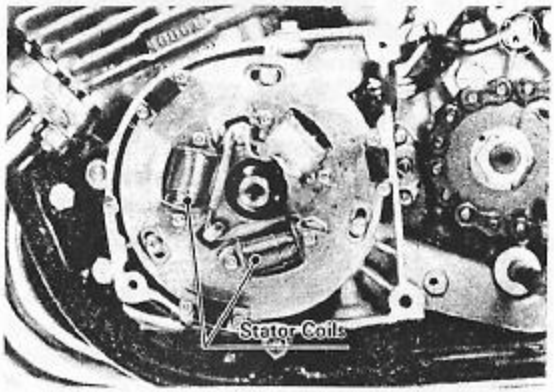
The spark plug gap is 0.024 – 0.028 inch (0.6 – 0.7 mm).

VI. Electrical (on C.D.Ignition System Model)

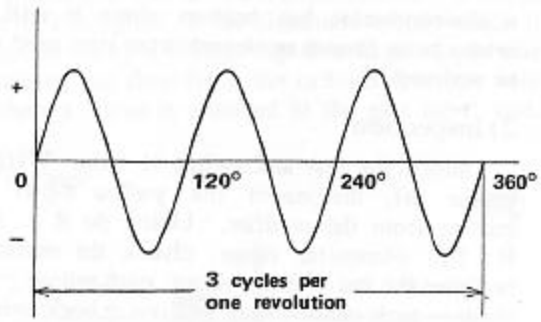
1. AC GENERATOR

1) Construction and Operation

The KH400 generator consists of a magneto flywheel and two stator coils. The magneto flywheel has 6 permanent magnets (3 sets of N and S) evenly spaced in its circumference. The two stator coils connected in series are mounted on the aluminum plate and are spaced at 120° so that the same magnetic polarity passes the two coils simultaneously generating an alternating current with 3 cycles per flywheel revolution.



Generator Output (395)



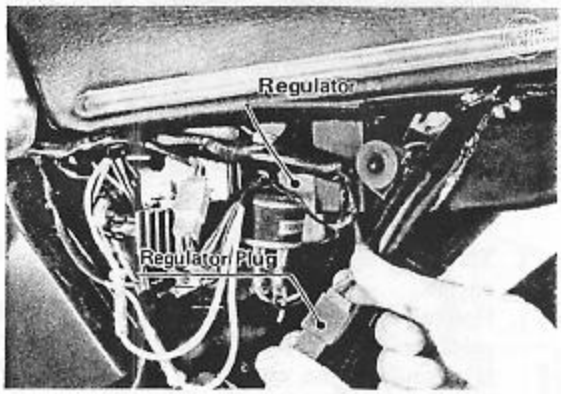
If the battery, rectifier and regulator are all good, but there is still low voltage or insufficient charging current, the generator may be defective. There are three types of generator failures: short, open (wire burned out), or loss of magnetism. A short or open in one of the coil wires will result in either a low output, or no output at all. A loss of magentism, which may be caused by dropping or hitting the flywheel magneto, leaving it near an electro-magnetic field, or just by aging, will result in low output.

2) Inspection

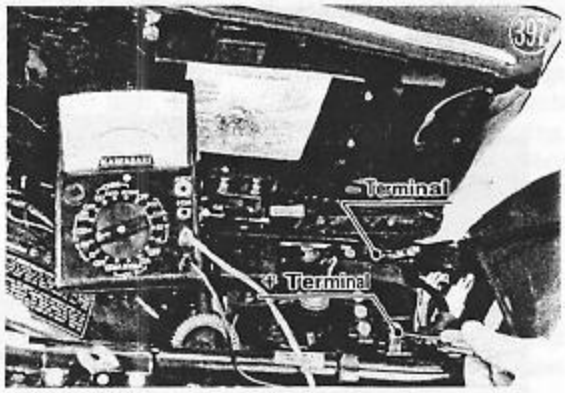
To make a dynamic test of the dynamo, the battery and rectifier must first be checked and known to be good. If battery voltage is less than 12 volts, first charge the battery.

a. Remove the left side cover and disconnect the red 3-pin plug leading to the regulator.

CAUTION: To avoid damage to the regulator, be sure the main switch is turned off before disconnecting the regulator plug.

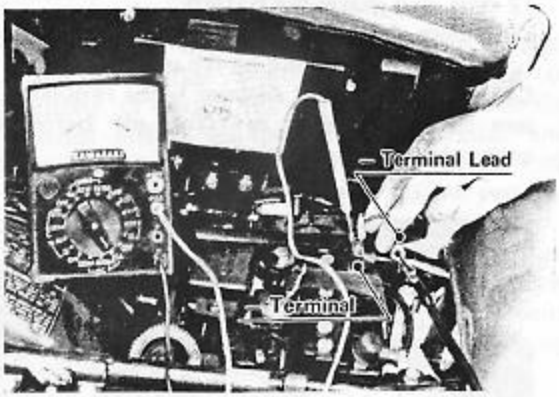


b. Make sure that all accessories (light, turn signals, etc.) are turned off.
c. Unlock the seat and swing it open.
d. Turn the multi-tester switch to the 30 VDC range and connect it across the battery, – meter lead to the battery – terminal, and + lead to the battery + terminal.

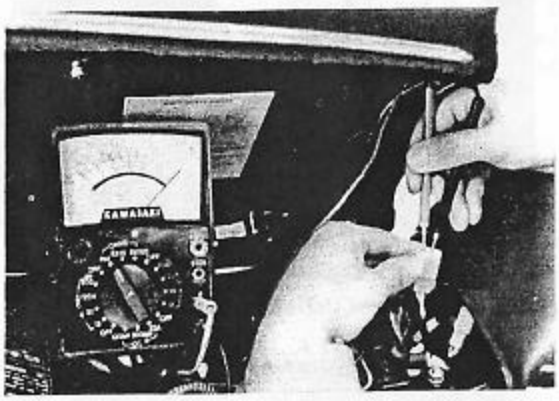


e. Start the engine, run it at 4,000 r.p.m. and note the meter reading. A voltage reading of 14 to 20 VDC is normal. A lower reading indicates the dynamo is defective.
f. Turn off the engine and disconnect the meter leads from the battery.
g. Set the meter to the 12 Amp DC range and plug the meter leads into the appropriate meter sockets.
h. Disconnect the battery – terminal lead and connect the + meter lead to the – terminal and – meter lead to the disconnected wire end.

This puts the ammeter in series with the rectifier and battery so that battery charging current can be measured.



i. Turn on the ignition switch and start the engine.
j. Holding engine speed at 4,000 r.p.m., note the meter reading. A reading of 4.0 – 6.5 amperes is normal; if the current is much lower, the dynamo is defective.
k. To determine whether the trouble is with the windings or with the flywheel magneto, first turn off the engine and disconnect the white 3-pin plug.
l. Using the R x 1 scale of the ohmmeter, measure resistance between the two yellow leads which comes from the generator. Resistance between the two leads should be 0.45 – 0.7 ohms. Less than this resistance means the coils are shorted; a higher resistance or no reading at all means the coils are open. If the coils are found to be open or shorted, replace the stator assembly.



m. Using the highest resistance scale of the ohmmeter, measure the resistance between each dynamo wire and chassis ground (the engine or frame, etc.). No reading (∞) is normal; any meter reading indicates a short, and the stator assembly must be replaced.
n. If the windings have normal resistance, but voltage and current checks showed the dynamo to be defective, then the rotor magnets have probably weakened, and the flywheel magneto must be replaced.

2. RECTIFIER

1) Construction and Operation

The rectifier is used to change the alternating current (AC) from the generator to direct current (DC) for the battery charging, lighting, and other circuits. If contains four diodes connected in a bridge circuit arrangement for efficient full-wave rectification. The new rectifier for KH400 is molded into an aluminum housing with many fins for better heat dissipation.

The reason that the diodes can change alternating current to direct current is that they only conduct in one direction from the – to + side.

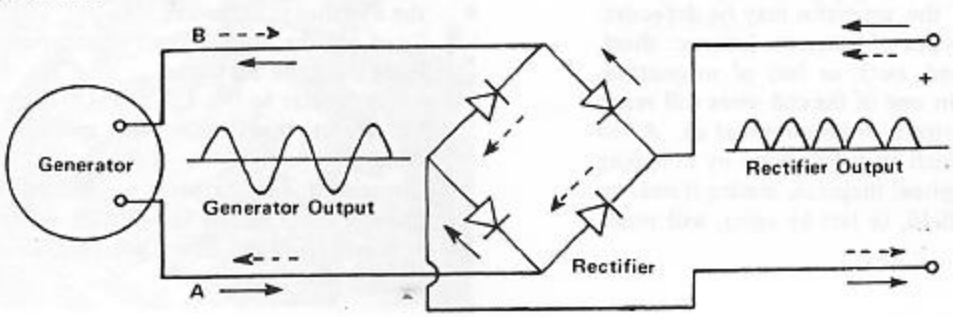
The figure shows the alternating current from the generator is rectified by the four diodes connected in a bridge. The A arrows indicate current flow during the first half of the cycle when the top generator lead is + and the bottom lead is –; the B arrows show current flow for the other half cycle.

CAUTION: Excessive heat or current in a semiconductor will cause it to break down, and current will then flow through it in either direction. Once a simiconductor has broken down it will not return to its former semiconductor state, and must be replaced.

2) Inspection

Unlock the seat and swing it open. With the engine off, disconnect the yellow 4-pin plug coming from the rectifier. Using the R x 10 or R x 100 ohmmeter range, check the resistance between the red → each yellow, each yellow → red, black → each yellow, each yellow → black wires, a total of 8 measurements. Resistance should be low in one direction and infinite (∞) in the reverse direction.

Rectifier Circuit



NOTE: The actual meter reading varies with the meter used and with the individual rectifier, but, generally speaking, the lower reading should be within 1/3 scale of zero ohm. If the meter reads low or high in both directions between any pair of wires, the rectifier is defective and must be replaced as an assembly.

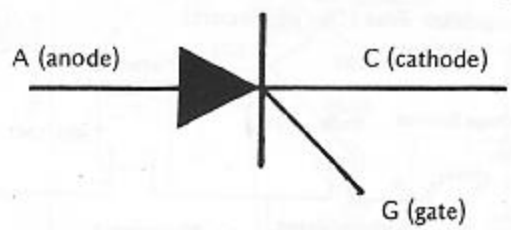
3 REGULATOR

1) Construction and Operation

The solid-state regulator limits voltage to a maximum of 13.5 – 14.5 volts. Since it contains no contacts or other moving parts, it does not wear out and never needs to be adjusted. It is therefore manufactured as a sealed unit, and must be replaced as a unit should it become defective. Internal regulator operation is explained here only to aid the technician in troubleshooting and in understanding test procedures.

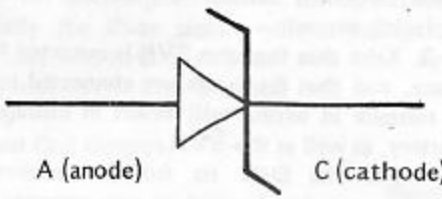
The main components of the circuit are thyristor (SCR) and a zener diode (ZD). The thyristor, or Silicon Controlled Rectifier (SCR) as it is also called, is an electronic switch which is turned on by a voltage signal to its gate lead. The current can flow from the cathode to anode only when a signal is received at the gate input lead.

Thyristor (402)



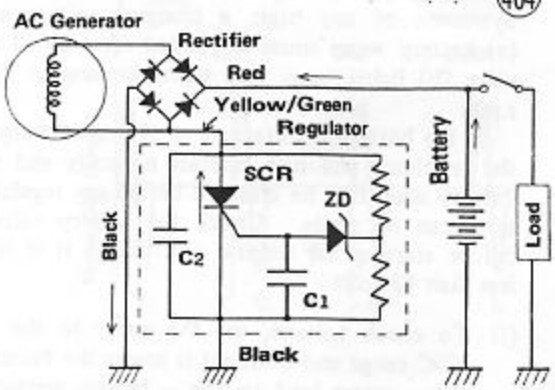
The zenor diode allows current flow from the cathode to anode. Unlike a normal diode, however, the zener diode will "break down", or conduct in the reverse direction, if enough voltage is applied in the reverse direction. The voltage at which the diode begins reverse conduction, is called the breakdown voltage and is set at the disired level when the diode is manufactured.

Zener Diode (403)



In a regulator, the zener diode is connected to the gate lead of the thyristor to signal the thyristor when charging voltage becomes too high. Detailed circuit operation is as follows:

Regulator Circuit (404)

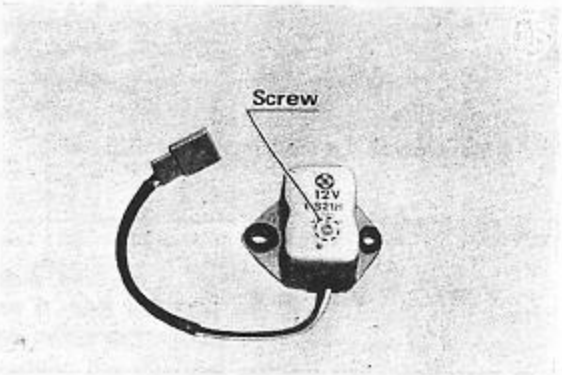


The alternating current from the generator is changed into direct current in the rectifier, and then it flows through the black lead to ground. From ground it goes up through the battery to charge it, and through the red lead and the rectifier up to the generator. When battery charging voltage gets too high, however, the zener diode conducts and signals the thyristor to start conducting. Then, instead of current going through the battery and overcharging it, it flows from ground up through the thyristor and then back to the generator.

CAUTION:

Handling the Silicon Voltage Regulator —

1. Do not let the screws get loose. This would reduce heat radiation efficiency, and could cause the semiconductors to overheat and short.



2. To avoid damage to the SVR, be sure the main switch is turned off before removing or replacing the unit.

3. Take care that the SVR is mounted firmly in place, and that the leads are connected correctly. A mistake in wiring will result in damage to the battery, as well as the SVR.

4. For the SVR to function properly, the battery must be charged to near capacity. If the battery is badly discharged, charge it before installing it in the motorcycle.

2) Inspection

a. In Circuit

If the battery continually discharges, or if it overcharges, the regulator may be defective. Symtoms of too high a charging voltage are: (a) battery water must be added often to all the cells; (b) lights burn out when running at high r.p.m.

If the battery is defective or if it is discharged, the regulator will not operate normally and the battery must first be charged before any regulator tests can be made. Check the battery voltage before starting the engine and charge it if it is less than 12 volts.

(i) To check voltage, set the meter to the 30 VDC range and connect it across the battery, the – meter lead to the – battery terminal, and the + meter lead to the + battery terminal (Fig. 397).

(ii) Start the engine and run it at 4,000 r.p.m. Switch on the headlight switch with the dimmer switch in high beam position. If the meter reads between 13.5 and 14.5 volts at this time, the regulator is operating normally. If it reads more than 14.5 volts, either the regulator is defective, or it is not properly connected into the circuit due to a loose connection, broken wire, etc.

Carefully check all connections before replacing the regulator. If the meter reading is less than 13.5 volts, either the dynamo or rectifier is defective, or the regulator is defective. This can be checked easily by leaving the meter connected to the battery as is, stopping the engine, disconnecting the red plug under the left side over, and restarting the engine. With the engine again running at 4,000 r.p.m., if the meter now reads between 14 and 20 volts, the regulator is defective; if the meter reads less than that, either the dynamo or the rectifier is defective.

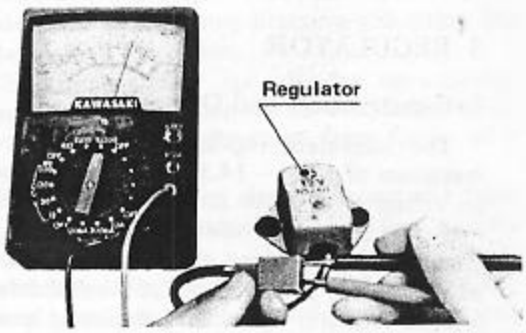
b. Out of Circuit

CAUTION: When the regulator is removed, make sure that the screw in the regulator body is not removed or loosened (Fig. 405). This screw aids in heat dissipation and the regulator will overheat if the screw is not properly installed.

NOTES: 1. To make this test, a voltage source which is variable from 8 – 14 volts and a 12V 3 – 6W bulb with a socket and leads are required. This is because the regulator can not be tested properly using just the multimeter as in the case of a mechanical regulator.

2. A battery is a good voltage source because of its constant output voltage. An alternate voltage source, such as a battery charger, can not be used to test the regulator, because its output voltage is not perfect direct current.

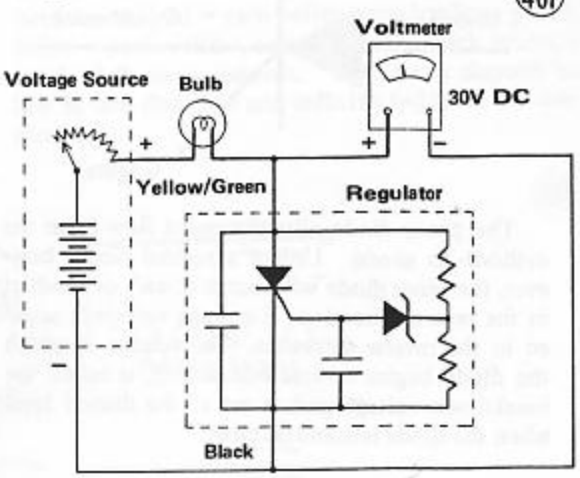
(i) To test the regulator out of circuit, first use an ohmmeter to check resistance between the two leads. With the meter on the R x 10 or R x 100 scale, there should be 1,000 – 1,200 ohms resistance between the black and yellow/green leads. If the resistance reading results are any other than this, the regulator is defective.



(ii) Connect the bulb between the regulator yellow/green lead and the voltage source + terminal. Connect the regulator black lead to the voltage source – terminal. Set the multi-tester to the 30 VDC range, connect the meter – lead to the regulator black lead, and connect the meter + lead to the regulator yellow/green lead.

The regulator and the bulb are connected in series, and the voltmeter is connected in parallel with the regulator.

Regulator Test (Out of Circuit) (407)



(iii) When the voltage source is turned on, the bulb should be unlit. While gradually increasing the voltage source output from 8 volts to 14 volts, the bult will light at a certain point. Note the exact voltage when the bulb light.

(iv) If the regulator is good, the bulb will light at the voltage between 10 – 12 volts. If the above check shows the regulator to be bad, replace it.

NOTE: If the regulator checks good with the above procedure but still does not appear to be operating correctly in the circuit, check it by trial replacement with a good unit.

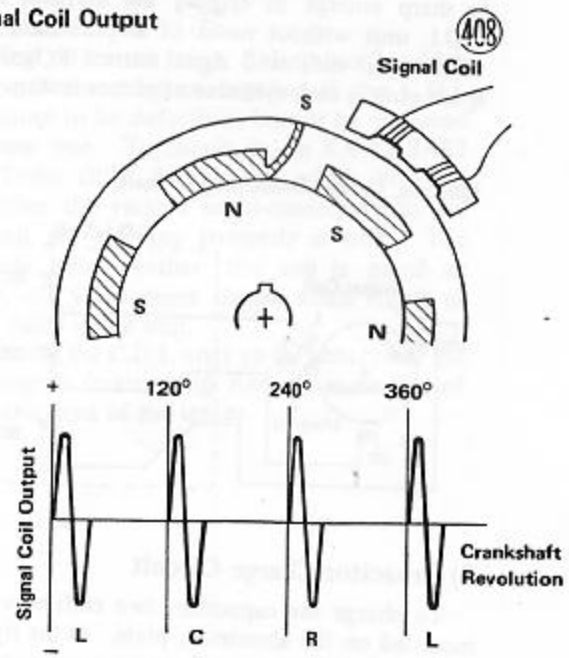
4. CAPACITOR DISCHARGE IGNITION

The ignition system of KH400 consists of three ignition coils, one C.D.I. unit, two exciter coils and three signal coils. And it can be roughly divided into the timing detection circuit, capacitor charge circuit, and the actual ignition spark producing circuit. Following is the diagram of the C.D.I. system of KH400.

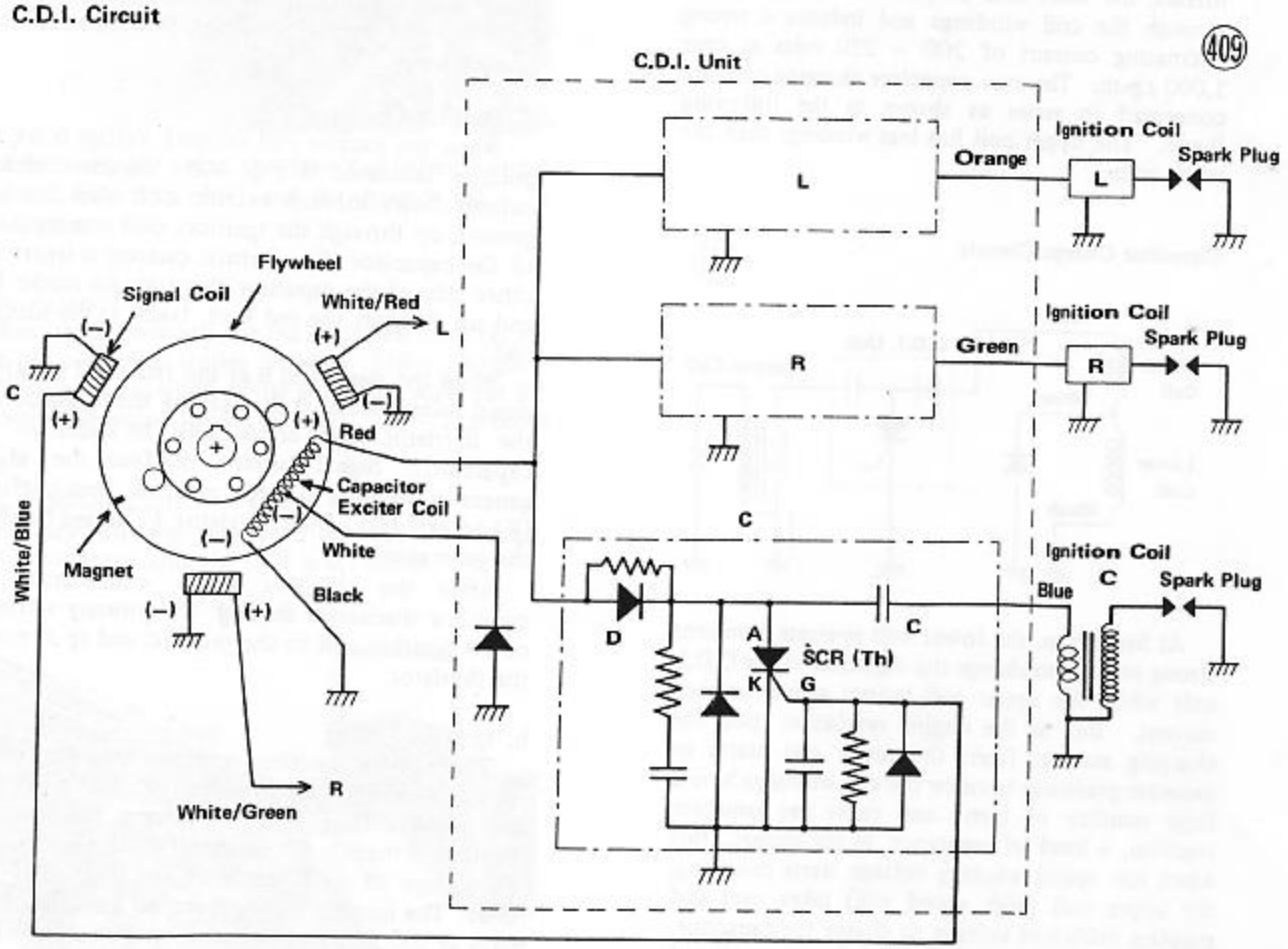
1) Ignition Timing Detection

Ignition timing is determined by a voltage signal produced by the three signal coils spaced at 120° each other. When the flywheel magneto rotates, the small chip of magnet on the circumference of the flywheel, which is actually the extention from one of the magnets inside the flywheel, passes rapidly the three signal coils inducing an intermittent alternating current with one cycle per flywheel revolution in each coil.

Signal Coil Output

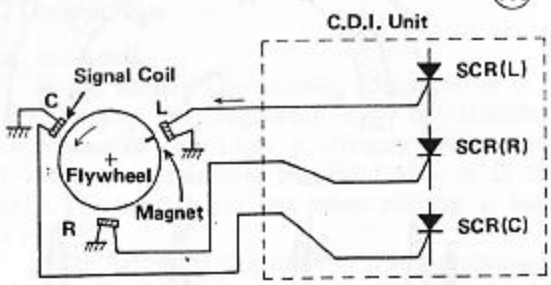


C.D.I. Circuit



The chip of magnet is very small, but it has a strong magnetic flux. So when it cut through the coils instantaneously, the magnetic field in the coils changes so rapidly that a strong and sharp sine wave current is generated. This pulse current is sharp enough to trigger the thyrister in the C.D.I. unit without need of amplification. The three signal coils send signal current to ignite the spark plug in each cylinder at proper timing.

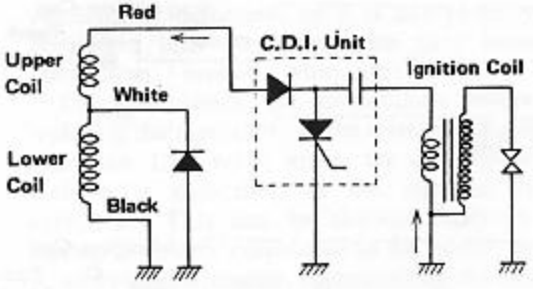
Ignition Timing Detecting Circuit (410)



2) Capacitor Charge Circuit

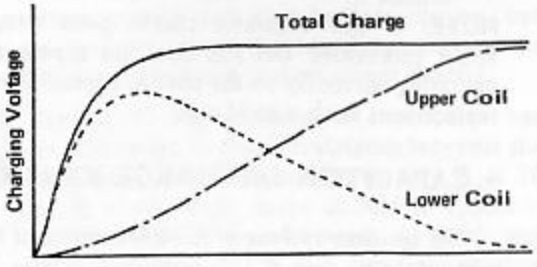
To charge the capacitor, two coils of wire are mounted on the aluminum plate. As the flywheel rotates, the three sets of permanent magnets cut through the coil windings and induces a strong alternating current of 200 – 220 volts at over 1,000 r.p.m. The two capacitor charging coils are connected in series as shown in the following figure. The upper coil has less windings than the lower coils.

Capacitor Charge Circuit (411)



At low r.p.m. the lower coil generate a current strong enough to charge the capacitor in the C.D.I. unit while the upper coil cannot supply enough current. But as the engine revolution rises, the charging current from the lower coil starts to decrease gradually because the coil windings have a large number of turns and cause the armature reaction, a kind of resistance, in the circuit. But when low speed winding voltage starts dropping, the upper coil (high speed coil) takes over and supplies sufficient voltage to charge the capacitor. The high speed windings have fewer turns and much lower resistance and consequently do not become loaded down when supplying charge current. The two coils are matched so that a steady voltage is supplied to the ignition units at all speeds.

Capacitor Charging Voltage (412)



3) C.D.I. UNIT

KH400 C.D.I. unit consists of three sets of capacitor, thyristor, and rectifying diode for each cylinder. When the thyristor is triggered, i.e. receives a gating pulse, it conducts and acts as a short circuit across the charged capacitor. Consequently, the capacitor suddenly discharges through the ignition coil primary winding. The fast rate of discharge in conjunction with the high turns ratio of the coil windings, produces a 32 KV ignition spark.

a. Detailed Operation

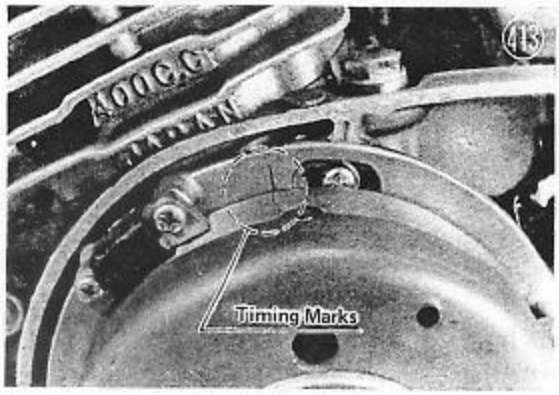
When the excitor coil output voltage is at the polarity indicated in Fig. 408, capacitor charge current flows through exciter coil black lead to ground, up through the ignition coil primary, and to the capacitor (C). Return current is from the other side of the capacitor through the diode (D) and up through the red lead, back to the exciter coil.

When the signal coil is at the indicated polarity, signal voltage is felt at the gate of the thyristor and the thyristor starts conducting to discharge the capacitor. Signal current is from the signal generator winding through ground, from cathode (K) to gate (G) of the thyristor (Th), and back to the generator.

After the thyristor starts conducting, the capacitor discharges through the primary winding of the ignition coil to the ground and up through the thyristor.

b. Ignition Timing

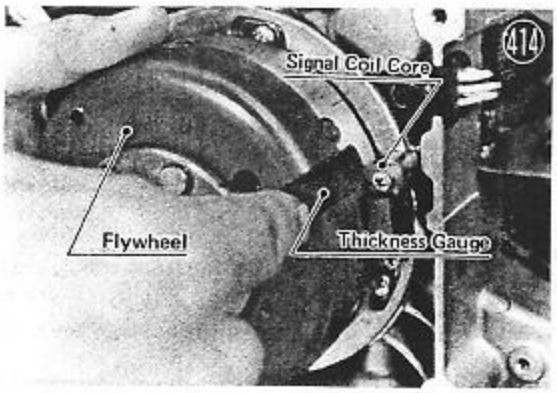
The KH400 ignition system does not incorporates automatic timing advance. This is because the signal voltage rises too sharp at all engine speeds and there is not much difference in time for the voltage to reach the level to trigger the thyristor. The ignition timing is set to ignite the spark plugs at 23° (2.6 mm at piston position) B.T.D.C. at 4,000 r.p.m. with a slight (max. 1°30') advance or retard at other speeds.



4) Inspection

a. Signal Coil

The clearance between the coil cores and the flywheel: 0.16 – 0.20 in. (0.4 – 0.5 mm)



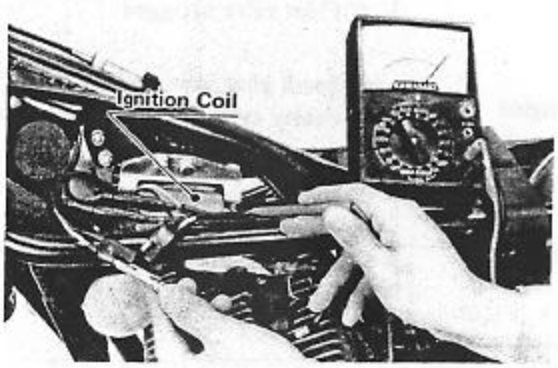
Resistance between the lead (white/red, white/green, or white/blue) and the ground: 60 – 75 ohms

b. Exciter Coil

Resistance between the red and black wires (at the 6-pin connector under the seat): 210 – 240 ohms
Resistance between white and black wires (at the 6-pin connector under the seat): 180 – 210 ohms

c. Ignition Coils

Primary winding resistance between the orange, blue or green and the core is 0.7 ohms.



Secondary winding resistance between the spark plug cap and the ignition coil core is 16 kΩ. If an inductance tester is available, inductance between the orange, blue or green and the core is 1.9 mh, and between the plug wire and the core it is 40 h.

d. C.D.I. Unit

As the C.D.I. unit is a "black box" which cannot be disassembled or repaired, if the C.D.I. unit is found to be defective, it must be replaced with a new one. To check it, use KAWASAKI Electro Tester (P/N. 57001-980) which will tell you whether the various semi-conductors in the C.D.I. unit are working properly or not. The tester only tells whether the unit is good or defective, and you cannot detect which diode or thyristor failed in the unit.

To connect the C.D.I. unit to the tester, use the special adaptor (connecting harness) as indicated in the instructions of the tester.

VII. Troubleshooting

ENGINE

Starting difficulty or failure to start

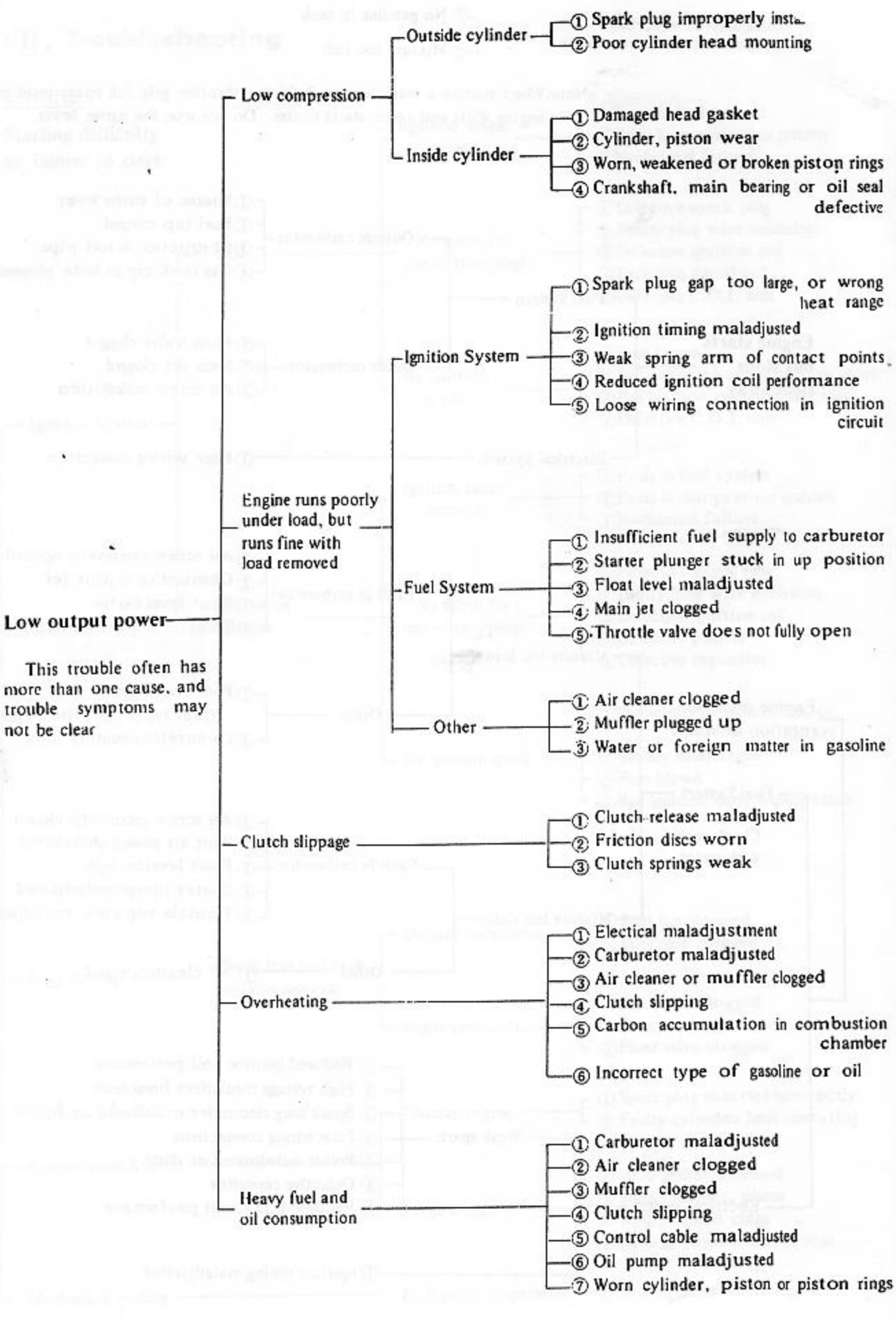
- **Ignition System**
  - **CDI**
    - Ignition spark present
      - ①Fault in fuel system
      - ②Fault in compression system
      - ③Mechanical failure
    - No spark for one or two plugs
      - ①Defective spark plug
      - ②Faulty plug wire insulation
      - ③Defective ignition coil
      - ④Defective signal coil
      - ⑤Defective C.D.I. unit
    - No ignition spark
      - ①Fuse blown
      - ②Bad wiring or connection, or short
      - ③Bad ignition switch connection
      - ④Defective C.D.I. unit
  - **Point-type ignition**
    - Ignition spark present
      - ①Fault in fuel system
      - ②Fault in compression system
      - ③Mechanical failure
    - No spark for one or two plugs
      - ①Defective spark plug
      - ②Faulty plug wire insulation
      - ③Defective ignition coil
      - ④Defective points
      - ⑤Defective capacitor
    - No ignition spark
      - ①Bad wiring or connection, or shart
      - ②Battery discharged
      - ③Fuse blown
      - ④Bad ignition switch conneciton
- **Fuel System**
  - Check that fuel tank contains gasoline
    - Outside carburetor
      - ① Fuel tap clogged
      - ② Fuel pipe clogged
    - Inside carburetor
      - ①Starter jet clogged
      - ②Pilot jet clogged
      - ③Float valve clogged
- **Compression System**
  - Outside engine
    - ① Spark plug inserted incorrectly
    - ② Faulty cylinder head mounting
  - Inside engine
    - ① Head gasket damaged
    - ② Worn cylinder, piston
    - ③ Worn, broken rings
    - ④ Defective crankshaft oil seal
- **Mechanical Failure**
  - Kick pedal inoperative
    - ① Broken parts inside engine

- Difficulty in re-starting engine after it is warmed up
  - ① No gasoline in tank
  - ② Mixture too rich

Note: When starting a warm engine, hold the throttle grip full open until the engine starts and r.p.m. starts to rise. Do not use the starter lever.

- Engine starts but stops right away
  - Fuel System
    - Outside carburetor
      - ① Misuse of starter lever
      - ② Fuel tap clogged
      - ③ Obstruction in fuel pipe
      - ④ Gas tank cap air hole plugged
    - Inside carburetor
      - ① Float valve clogged
      - ② Main jet clogged
      - ③ Air screw maladjusted
  - Electrical System
    - ① Poor wiring connection

- Engine misfires, rotation unstable
  - Fuel System
    - Check each carburetor
    - Mixture too lean
      - Fault in carburetor
        - ① Air screw excessively opened
        - ② Obstruction in pilot jet
        - ③ Float level too low
        - ④ Throttle stop screw maladjusted
      - Other
        - ① Poor fuel supply (fuel tap or fuel pipe clogged)
        - ② Carburetor mounting loose
    - Mixture too rich
      - Fault in carburetor
        - ① Air screw excessively closed
        - ② Pilot air passage obstructed
        - ③ Float level too high
        - ④ Starter plunger maladjusted
        - ⑤ Throttle stop screw maladjusted
      - Other
        - ① Air cleaner clogged
  - Electrical System
    - Weak spark
      - ① Reduced ignition coil performance
      - ② High voltage insulation breakdown
      - ③ Spark plug electrodes maladjusted or fouled
      - ④ Poor wiring connection
      - ⑤ Points maladjusted or dirty
      - ⑥ Defective capacitor
      - ⑦ Reduced C.D.I. unit performance
    - ① Ignition timing maladjusted


Low output power
This trouble often has more than one cause, and trouble symptoms may not be clear
Low compression
Outside cylinder
① Spark plug improperly insta
② Poor cylinder head mounting
Inside cylinder
① Damaged head gasket
② Cylinder, piston wear
③ Worn, weakened or broken piston rings
④ Crankshaft, main bearing or oil seal defective
Engine runs poorly under load, but runs fine with load removed
Ignition System
① Spark plug gap too large, or wrong heat range
② Ignition timing maladjusted
③ Weak spring arm of contact points
④ Reduced ignition coil performance
⑤ Loose wiring connection in ignition circuit
Fuel System
① Insufficient fuel supply to carburetor
② Starter plunger stuck in up position
③ Float level maladjusted
④ Main jet clogged
⑤ Throttle valve does not fully open
Other
① Air cleaner clogged
② Muffler plugged up
③ Water or foreign matter in gasoline
Clutch slippage
① Clutch release maladjusted
② Friction discs worn
③ Clutch springs weak
Overheating
① Electical maladjustment
② Carburetor maladjusted
③ Air cleaner or muffler clogged
④ Clutch slipping
⑤ Carbon accumulation in combustion chamber
⑥ Incorrect type of gasoline or oil
Heavy fuel and oil consumption
① Carburetor maladjusted
② Air cleaner clogged
③ Muffler clogged
④ Clutch slipping
⑤ Control cable maladjusted
⑥ Oil pump maladjusted
⑦ Worn cylinder, piston or piston rings


Abnormal engine sounds
During normal driving
① Slight piston seizure
② Piston ring broken or sticking
③ Primary gear and housing gear grinding
④ Oil pump gear and pinion gear grinding
⑤ Main bearing worn or damaged
⑥ Faulty clutch damping rubber
During sudden acceleration
① Excessive clearance between connecting rod small end and piston pin, or between pin and piston
② Excessive connecting rod big end clearance
Knocking
① Ignition timing too advanced
② Carbon accumulation in cylinder head
③ Poor quality gasoline
Stops when clutch disengaged
① Excessive clearance between clutch housing and friction plates
When the engine is idling while cold
① Excessive piston clearance
② Piston rings worn
③ Worn piston
④ Connecting rod bent, warped
Gear shift trouble
Doesn't go into gear
① Shift shaft rubbing against crankcase or left cover
② Return spring weak or broken
③ Shift lever broken
④ Return spring pin loose
⑤ Bent selector fork
⑥ Clutch will not release
Shift pedal doesn't return
① Shift shaft rubbing against crankcase or left cover
② Return spring weak or broken
③ Return spring pin loose
Jumps out of gear
① Set lever spring weak or broken
② Set lever pin loose
③ Worn selector fork pin
④ Worn selector fork
⑤ Drum positioning plate loose
Overshifts
① Set lever spring weak or broken
② Set lever bolt loose
③ Return spring pin loose

Clutch malfunction

- Doesn't disengage
  1. Clutch release maladjusted
  2. Friction or steel plates warped
  3. Tension uneven among clutch springs
  4. Transmission oil old or too heavy
  5. Too much transmission oil
  6. Seized clutch bushings
- Slips
  1. Clutch release maladjusted
  2. Frction plates worn
  3. Clutch steel plates worn
  4. Clutch springs weak

FRAME

Poor steering control

Special care must be taken in this area since faulty steering is dangerous.

- Handlebars hard to turn
  1. Steering stem nut too loose
  2. Bearings damaged or cracked
  3. Steering stem bent
  4. Front tire air pressure low
- Front or rear wheel wobbles
  1. Worn front or rear wheel bearings
  2. Spokes loose
  3. Front or rear wheel rim warped
  4. Swing arm bushing, sleeve worn
- Handlebars pull to one side
  1. Front or rear shock absorbers unbalanced
  2. Front and rear wheel misaligned
  3. Front or rear fork bent
  4. Frame twisted

Shock absorbing bad

- Too soft
  1. Front fork springs weak
  2. Front fork oil level low, or oil too light
  3. Rear shock absorbers maladjusted, springs weak, or oil leaking
- Too hard
  1. Front fork oil too heavy, old, or oil level too high
  2. Fork bent
  3. Rear shock absorbers maladjusted or defective
  4. Tire air pressure too high
  5. Seat cushions bad

Brakes don't hold

1. Brakes maladjusted
2. Brake linings worn, or only one side touching
3. Foreign matter. oil, water between brake lining and drum
4. Brake cam worn
5. Brake drum worn
6. Brake panel bushing worn
7. Brake cable defective

Periodic Maintenance Guide

Operation / Frequency	After initial 500 miles (800 km)	After initial 2,000 miles (3,000 km)	Every subsequent 2,000 miles (3,000 km)	Every subsequent 4,000 miles (6,000 km)
Adjust brakes	•	•	•	
Adjust drive chain	•	•	•	
Check, adjust clutch	•	•	•	
Check, adjust carburetors	•	•	•	
Check, adjust carburetor and oil pump cables	•	•	•	
Check spoke tightness and rim runout	•	•	•	
Tighten nuts and bolts	•	•	•	
Clean fuel system	•	•	•	
Clean, set spark plugs	•	•	•	
Adjust points, check timing (Point-type ignition)	•	•	•	
Check ignition timing (C.D.I.)	•	•	•	
Check steering play	•			•
Clean air cleaner element		•	•	
Carry out general lubrication		•	•	
Check tire wear		•	•	
Check drive chain wear		•	•	
Change transmission oil	•	Every subsequent 3,000 miles (5,000 km)		
Lubricate drive chain	Every 200 miles (300 km)			
Check brake wear	Every 4,000 miles (6,000 km)			
Check front fork oil level	Every 4,000 miles (6,000 km)			
Decarbon head and exhaust system	Every 4,000 miles (6,000 km)			
Change air cleaner element	Every 6,000 miles (10,000 km) or after cleaning 5 times			
Change front fork oil	Every 6,000 miles (10,000 km)			
Change brake fluid (Disc brake)	Every 1 year or 6,000 miles (10,000 km)			
Regrease wheel bearings	Every 2 years or 12,000 miles (20,000 km)			
Regrease brake camshaft(s)	Every 2 years or 12,000 miles (20,000 km)			
Regrease speedometer gear housing	Every 2 years or 12,000 miles (20,000 km)			
Lubricate steering stem bearings	Every 2 years or 12,000 miles (20,000 km)			

Torque Table

Tighten all bolts and nuts to the proper torque using an accurate torque wrench. A bolt or nut if insufficiently tightened may become damaged or fall out, possibly resulting in damage to the motorcycle and injury to the rider. A bolt or nut which is over-tightened may become damaged, strip an internal screw, or break and then fall out.

The following table lists the tightening torque for the major bolts and nuts:

Part Name	English	Metric	See Pg.
Crank Case Nut 8 mm	19 – 25 ft-lbs	2.6 – 3.5 kg-M	39
6 mm	11.5 – 16 ft-lbs	1.6 – 2.2 kg-M	39
Cylinder Head	14.5 – 17.5 ft-lbs	2.0 – 2.4 kg-M	21
Front Axle Clamp	11.5 – 16 ft-lbs	1.6 – 2.2 kg-M	72
Front Axle Nut	51 – 65 ft-lbs	7 – 9 kg-M	64
Ftont Fork Upper Clamp Bolt	11.5 – 16 ft-lbs	1.6 – 2.2 kg-M	–
Magneto Flywheel	14.5 – 17.5 ft-lbs	2.0 – 2.4 kg-M	–
Oil Hose Banjo Bolt (Engine oil pump)	35 – 43 in-lbs	0.4 – 0.5 kg-M	–
Pivot Shaft Nut	43 – 72 ft-lbs	6 – 10 kg-M	59
Rear Axle Nut	72 – 101 ft-lbs	10 – 14 kg-M	64
Rear Shock Absorber	19 – 25 ft-lbs	2.6 – 3.5 kg-M	–
Spark Plug	18.0 – 22 ft-lbs	2.5 – 3.0 kg-M	21
Spokes	17 – 35 in-lbs	0.2 – 0.4 kg-M	64
Steering Lock Nut	19.5 – 24 ft-lbs	2.7 – 3.3 kg-M	–
Torque Link Nut	19 – 25 ft-lbs	2.6 – 3.5 kg-M	–
Transmission Oil Drain Plug	37 – 52 ft-lbs	5.1 – 7.2 kg-M	29

The table below, relating tightening torque to thread diameter and pitch, lists the basic torque for the bolts and nuts used on Kawasaki Motorcycles. However, the actual torque that is necessary may vary among bolts and nuts with the same thread diameter and pitch. The bolts and nuts listed on Pg. 124 vary to a greater or lesser extent from what is given in this table. Refer to this table for only the bolts and nuts not included in the table on Pg. 124. All of these values are for use with dry solvent-cleaned threads.

Coase threads

dia (mm)	pitch (mm)	ft-lbs	kg-M
5	0.90	2.5 – 3.5	0.35 — 0.50
6	1.00	4.5 – 6.5	0.6 — 0.9
8	1.25	11.5 – 16.0	1.6 — 2.2
10	1.50	22 – 30	3.1 — 4.2
12	1.75	39 – 54	5.4 — 7.5
14	2.00	60 – 83	8.3 — 11.5
16	2.00	94 – 130	13 — 18
18	2.50	130 – 181	18 — 25
20	2.50	188 – 253	26 — 35

Fine threads

dia (mm)	pitch (mm)	ft-lbs	kg-M
5	0.50	2.5 – 3.5	0.35 — 0.50
6	0.75	4.5 – 5.5	0.6 — 0.8
8	1.00	10.0 – 13.5	1.4 — 1.9
10	1.25	19.0 – 25	2.6 — 3.5
12	1.50	33 – 45	4.5 — 6.2
14	1.50	54 – 74	7.4 — 10.2
16	1.50	83 – 116	11.5 — 16
18	1.50	123 – 166	17 – 23
20	1.50	166 – 239	23 – 33

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