YAMAHA

9.90

XS1 (1970) XS1B (1971) XS2 (1972)

TX650 (1973) TX650A (1974)

COMBINED

Service Manual

LIT 11613-06-01

NOTICE

This manual has been written by Yamaha Motor Company for use by Authorized Yamaha Dealers and their qualified mechanics. In light of this purpose it has been assumed that certain basic mechanical precepts and procedures inherent to our product are already known and understood by the reader.

Without such basic knowledge, repairs or service to this model may render the machine unsafe, and for this reason we must advise that all repairs and/or service be performed by an Authorized Yamaha Dealer who is in possession of the requisite basic product knowledge.

Other information is produced by the U.S. distributor, Yamaha International Corporation, and is necessary to provide total technical coverage regarding the product.

The Research, Engineering, and Service Department of Yamaha are continually striving to further improve all models manufactured by the company. Modifications are therefore inevitable and changes in specifications or procedures will be forwarded to all Authorized Yamaha Dealers and will, where applicable, appear in future editions of this manual.

YAMAHA 650 SERIES SERVICE MANUAL

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BUENA PARK, CALIF. 90620

LIT - 11613-06-01

FOREWORD

This service manual has been designed to furnish all dealers and service personnel with specific information concerning this series, including disassembly and assembly procedures, inspection and analyzation of worn parts, and subsequent repair or adjustment procedures.

The manual should be thoroughly read. This will provide full familiarity with the design of this machine and all correct repair procedures.

Because Yamaha engineers are constantly searching for new and more efficient engine advancements, it is possible that some of this information may be modified in the future. Any significant change in design, adjustments, or repair procedures will be forwarded to all Authorized Yamaha dealers.

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GENERAL SPECIFICATIONS XS1–XS1B

(See page 121 for XS2-TX650, page 158 for TX650A)

Dimensions:	
Overall Length	85.4 in (2170 mm)
Overall Width	35.6 in (905 mm)
Overall Height	45.3 in (1150 mm)
Wheelbase	55.5 in (1410 mm)
Min. Ground Clearance	5.9 in (150 mm)
Weight (Net)	**XS1B-409 lbs. (XS1-439 lbs.)**
Weight Distribution	**XS1B-Front 182, Rear 227 lbs. (XS1-Front 195, Rear 244 lbs.)**
Performance:	
Max. Speed	**110 + mph**
Fuel Consumption (on paved level road)	82.5 mpg at 37 mph (35 km/l at 60 km/h)
Climbing Ability	26 degrees
Minimum Turning Radius	98.4 in (2500 mm)
Braking Distance	46 ft. at 31 mph (14 m at 50 km/h)
Engine:	
Weight (Dry)	135 lbs.
Type	Twin cylinder Air-cooled 4 stroke W/S.O.H.C.
Lubrication System	Pressure lubricated, wet sump.
Bore and Stroke	75x74 mm (2.953x2.913 in.)
Displacement	39.8 cu.in. (653 cc)
Compression Ratio	8.7 : 1 **(8.4:1 XS1B E/N 23129–)**
Compression Pressure	145 lbs/in^2 **(AVE)**
Maximum Power	53 BHP/7000 rpm
Maximum Torque	40.1 ft-lbs/6000 rpm (5.5 kg-m/6000 rpm)
Cylinder Description	Twin parallel cylinders, aluminum with cast iron sleeves.
Camshaft Timing	Intake BTDC 47° (Open) ABDC 67° (Close)
	Exhaust BBDC 60° (Open) ATDC 41° (Close)
Valve Clearance (cold)	**IN: .076 mm (.003 in.)**
	EX: 0.15 mm (.006 in.)
Sump Capacity	3.2 Qt. (3.0 L)
Ignition Timing (fully retarded)	**13°– 17° B.T.D.C. (40° BTDC Fully advanced ±2°)**
Piston Clearance	0.002–0.0022" (0.050–0.055 mm)
Starting System	Kick Starter
Carburetor:	
Type	**BS38 x 2**
Manufacturer	**MIKUNI**
Venturi Size	**30.6 mm diameter**
Main Jet	**#130**
Needle Jet	**Z-6**
Pilot Fuel Jet	**42.6**
Starter Jet	**0.6**
Jet Needle	**4JN19 – 4th Stage**
Fuel Valve Seat	**2.5**
Float Level	**25 mm**
Air Screw	**1 turn out**
I. D. Mark	**E3**
Pilot Outlet	**0.7 ϕ**
Pilot Bypass #1	**0.8 ϕ**
Pilot Bypass #2	**1.0 ϕ**
Air Jet	**1.2 ϕ**
Cutaway	**–**
Air Vent	**4.0 ϕ**

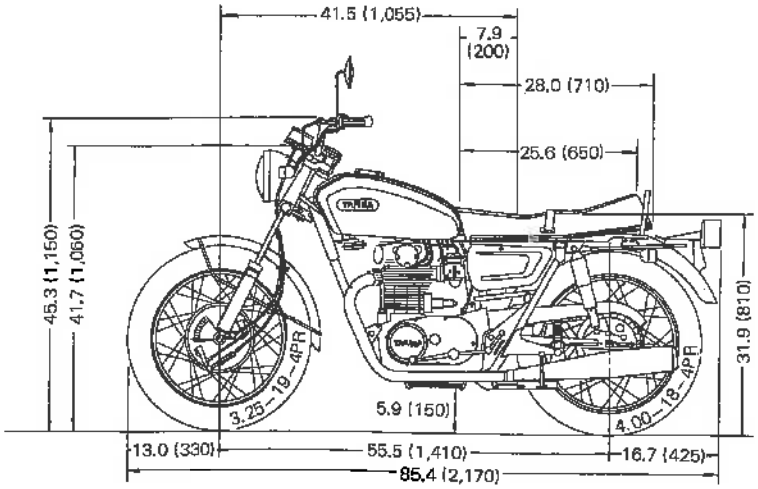
2 GENERAL SPECIFICATIONS

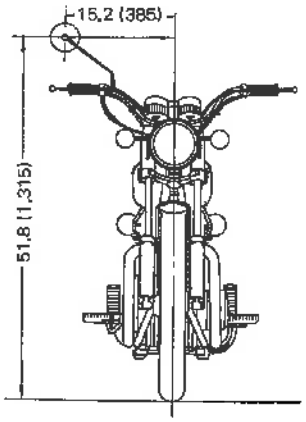
Air Filter:	**Dry, paper filter X2**	
Clutch:		
Type	Wet, multi-disc. (6 friction + 5 metal plates.)	
Primary Drive: Type:	Spur gear (straight cut)	
Reduction Ratio (gear and total)	72/27 (2.667 : 1)	
Transmission: Type:	Constant mesh, five speed, wide-ratio	
1st	31/14 = 2.214 (5.904)	Internal engine ratio (Pri. x Trans.) Multiply by drive chain ratio for overall gearing
2nd	27/17 = 1.588 (4.235)	
3rd	26/20 = 1.300 (3.466)	
4th	23/21 = 1.095 (2.920)	
5th	22/23 = 0.956 (2.550)	
Oil	SAE 20W/40	
Secondary Reduction System:		
Type	Single Row Chain	
Secondary Reduction Ratio:	34/17 = 2.0 : 1	
Chassis:		
Frame Type	Tubular steel, double cradle type	
Fuel Tank Capacity	3.3 U.S. gals. (12.5 L)	
Suspension System, Rear	**Swing Arm w/oil damped, adjustable shocks**	
Fork Travel	130 mm	
Fork Oil Quantity (each)	**223cc (7.5 oz.)**	
Caster	63°	
Trail	98 mm (3.9 in.)	
Front Rim Size	1.85B x 19	
Spoke Diameter, Length & Number	Inner 3.5ϕ x 160.5 mm. Outer 3.5 x 160 mm.	
Front Tire		
Size	3.25 - 19 4PR	
Tread design	K70	
Inflation pressure	23 - 25 lbs/in^2	
Rear Rim Size	2.15B x 18	
Spoke Diameter, Length & Number	Inner 4ϕ x 152.0 mm. Outer 4ϕ x 151.5 mm.	
Rear Tire		
Size	4.00 - 18 4PR	
Tread design	K70	
Inflation Pressure	28 - 30 lbs/in^2	
Front Brake Type	Internal expansion, double leading shoe	
Diameter & width	200 mm x 35 mm (7.9 in. x 1.38 in.)	
Rear Brake Type	Internal expansion, single leading shoe	
Diameter & width	180 mm x 30 mm (7.1 in. x 1.18 in.)	
Generator:		
Type	Alternator	
Model	LD 115	
Manufacturer	HITACHI	

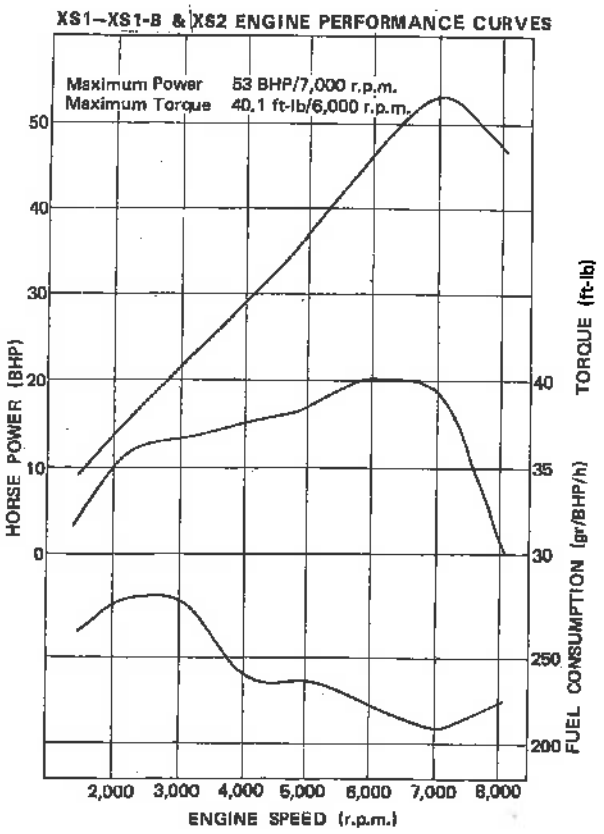
Rectifier:		
Model		SD6D-9
Manufacturer		HITACHI
Regulator:		
Model		TLIZ - 49
Manufacturer		HITACHI
No load voltage rate		14.5 volt/2000 RPM
Ignition System:		
Type		Battery ignition
Ignition Timing (fully retarded)		13° – 17° BTDC (Fully retarded) (40° ± 2° BTDC Fully advanced)
Breaker Point Gap		0.30–0.40 mm (0.012–0.016 in.)
Spark Plug	Manufacturer	N.G.K.
	Heat Range	B-8ES
Ignition Coil	Manufacturer	HITACHI
	Voltage output	10kV. @4,000 RPM
Battery:		
Model		12N 5.5-3B
Manufacturer		G.S.
Capacity		12V 5.5 A.H.
Dimensions		5.36 x 2.36 x 5.16" (134 mm x 59 mm x 129 mm)
Lighting System:		
Headlight		- 12V - 50W/40W
Taillight		12V/8W
Stoplight		12V/23W
Neutral Light		12V/3W
Flasher Indicator Light		12V/3W
Flasher Light		12V/27W
High Beam Indicator		12V/2W
Speedometer Light		12V/3W
Tachometer Light		12V/3W

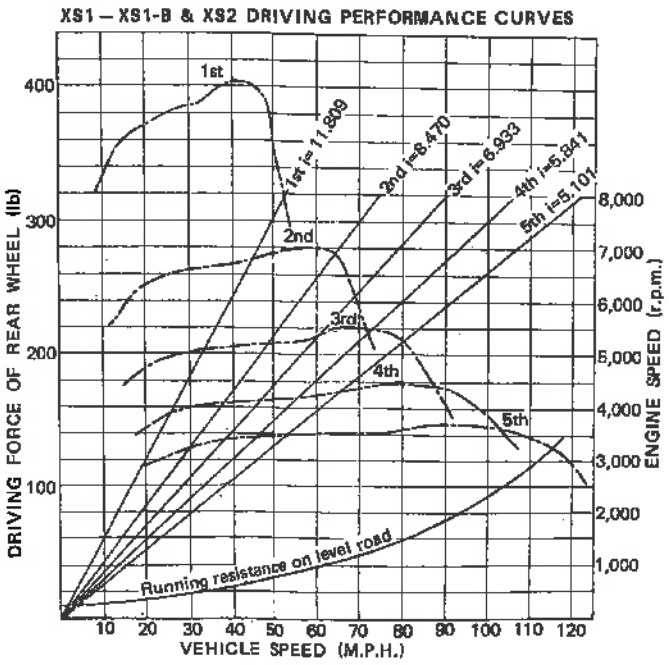
EXTERNAL VIEWS

(Dimensions typical – may vary slightly model to model.)



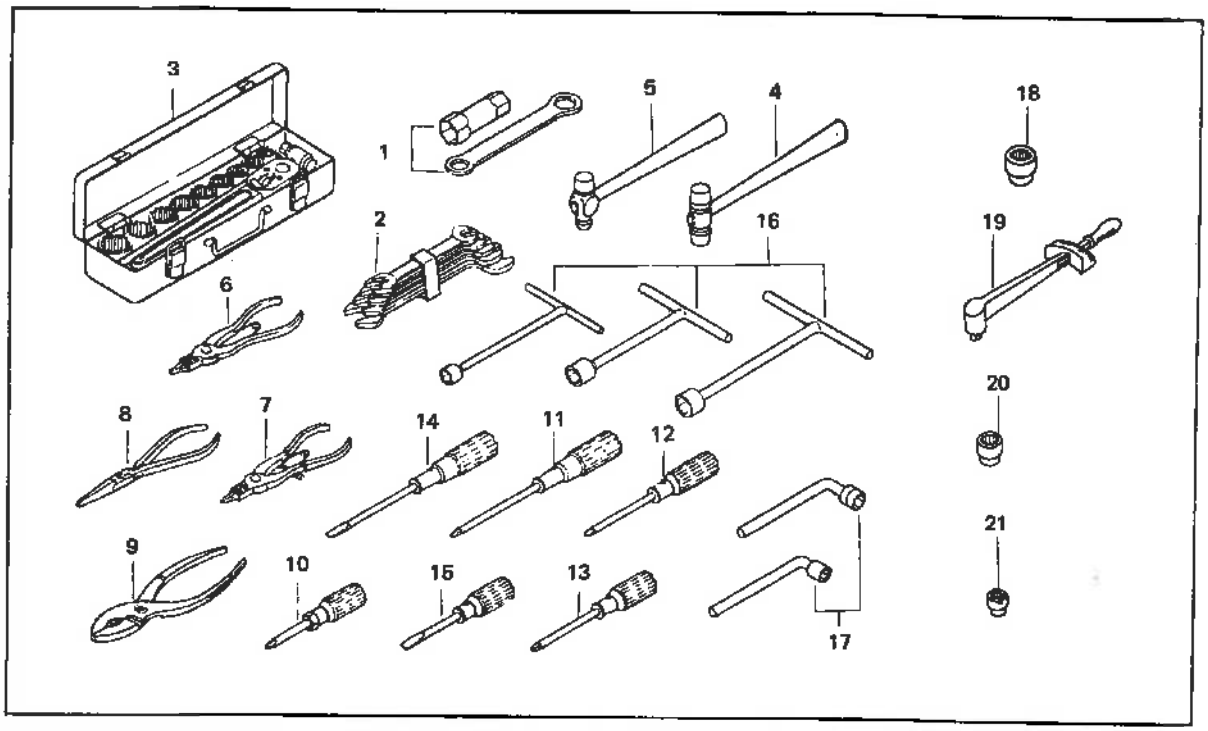






SERVICE TOOLS

1. Standard Tools



1. Plug wrench
2. Open-end wrenches
3. Socket wrenches
4. Soft-faced hammer
5. Steel hammer
6. Circlip pliers ST type
7. Circlip pliers RT type
8. Needle nose pliers
9. Pliers
10. Phillips-head screwdriver
11. Phillips-head screwdriver (Large)
12. Phillips-head screwdriver (Medium)
13. Phillips-head screwdriver (Small)
14. Slot-head screwdriver (Medium)
15. Slot-head screwdriver (Small)
16. T-type socket wrench
17. Socket wrench
18. Socket wrench (29mm)
19. Torque wrench
20. 13mm Socket (for Torque wrench)
21. 10mm Socket (for Torque wrench)

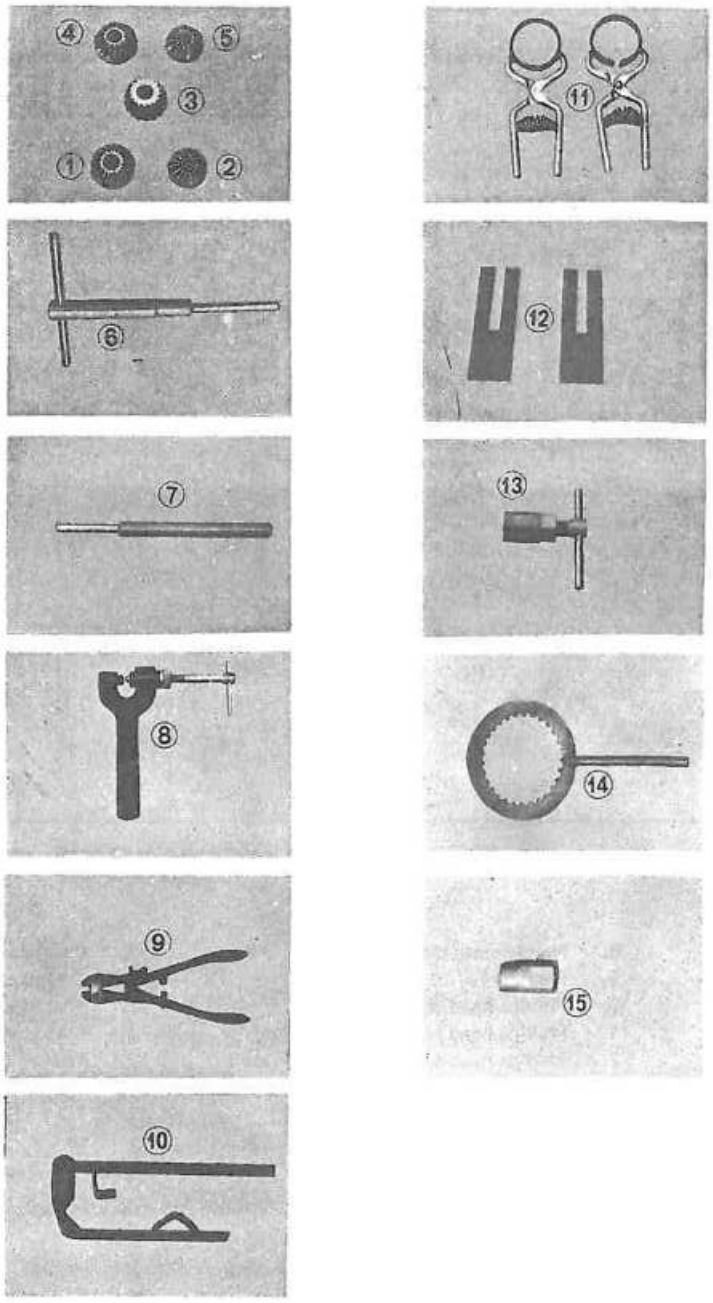
In addition to the above tools, the YAMAHA electrotester, tachometer (engine speedometer) and battery specific gravity hydrometer.

2. Miscellaneous Tools



1. Grease
2. YAMAHA Gear oil
3. YAMAHA Bond (No. 5)
4. Wiping materials
5. Overhauling stand
6. Parts tray
7. Oil drain pan
8. Oil cup
9. YAMAHA (Bond No. 4)

3) Special Tools



Valve seat cutters:

1. 45°—40mm dia. (intake)
2. 45°—34mm dia. (exhaust)
3. 65°—42mm dia. (exhaust/intake)
4. Radius—intake
5. Radius—exhaust
6. Seat Cutter Pilot 8.0mm
7. Valve Guide Installation and Removal Tool
8. Cam Chain Link Cutter
9. Cam Chain Link Riveter
10. Valve Spring Compressor
11. Piston Ring Compressors
12. Piston Support Plates
13. Armature Puller
14. Clutch Holding Tool
15. Fork Tube Adaptor (For DS3 Type Tool / XS1-XS1B)

MAINTENANCE & LUBRICATION CHARTS

Interval recommendations and lubricant types listed in the Maintenance and Lubrication Charts are based upon general averages. Extremes in environment or usage may dictate shorter maintenance intervals, different lubricants, or shorter lubrication intervals.

Therefore, all recommendations regarding types and intervals are to be considered a guide only. Intervals should not be exceeded but may be shortened as required. Lubricant types may be up-graded, but never down-graded.

PERIODIC MAINTENANCE INTERVALS

Page	Item		Remarks	Initial				Thereafter Every	
				250	500	1000	2000	1000	2000
89	Brake system (complete)	ALSO PREOPERATION CHECK	Check/Adj. as req'd. - repair as req'd.		0	0	0		0
65	Clutch		Check/Adjust as required		0	0	0		0
99	Battery		Top-off/Chk. spec. gravity monthly, or →	0		0		0	
114	Spark Plug(s)		Inspect/Clean or replace as req'd.	0	0	0	0		0
87	Wheels & Tires		Pressure/Spoke Tension/Runout	0	0	0		0	
79	Fittings & Fasteners		Tighten before each trip and/or →	0	0	0		0	
97	Drive Chain		Tension/Alignment ②	0	0	0		0	
10	Engine Oil Level Check		Unit level-Engine warm	0	0	0		0	
—	Air Filter		Foam type - See Service Notes ①	0	0	0		0	
78	Air Filter(s)		Dry type - Clean/Replace as req'd.			0	0		0
66	Fuel Petcock(s)		Clean/Flush tank as req'd.	0		0	0		0
115	Ignition Timing		Adjust/Clean or replace pts. as req'd.		0	0	0		0
77	Carburetor Adjustment		Check operation, synch., fittings		0	0	0		0
75	Carburetor Overhaul		Clean/Repair as req'd.						4,000
64	Cylinder Compression		Preventive Maintenance Check	0	0	0	0		0
25	Decarbonize Engine		As Required (Includes Exhaust System)				0		4,000
32	Camshaft Drive Chain		Adjust tension	0		0	0		0
45	Primary Oil Filter(s)		Clean/Replace as required	0		0	0		0
44	Oil Filter System (Complete)		Clean All - Includes traps, etc.				0		4,000
31	Valves		Adjust/Regrind as required			0	0		0

SERVICE NOTES:

1. Foam element air filters must be damp with oil at all times to function properly. Remove, clean and oil filter at least once per month or every 500-1,000 miles; more often if possible. See "Lubrication Intervals" for additional details.

   Note: If unit is subjected to extremely hard usage, such as dirt riding, etc., clean and lube filter.

2. Drive chain must also be lubricated every 200-250 miles. If unit is subjected to extremely hard usage, such as racing or dirt riding, chain tension, alignment, lubrication and cleanliness must be checked constantly. See "Lubrication Intervals" for additional details.

LUBRICATION CHART

Page	Item		Remarks	Type	Initial				Thereafter Every		
					250	500	1000	2000	1000	2000	4000
10	Engine Oil	PREOP. CHECK	Warm engine before draining	#1	0		0	0		0	
98	Drive Chain		Lube/Adjust as req'd.	#2			See			Notes	
98	Drive Chain		Remove/clean/lube/adjust	#2				0		0	
–	Air Filter		Foam type	#9			See			Notes	
–	Control & Meter Cables		All - apply thoroughly	#3		0	0			0	
–	Throttle Grip & Housing		Light Application	#4			0			0	
–	Tach & Speedo Gear Hsgs.		Light Application	#4				0			0
–	Rear Arm Pivot Shaft		Apply until grease shows	#5			0			0	
–	Brake Pedal Shaft		Light Application	#4			0			0	
–	Change Pedal Shaft		Light Application	#4			0			0	
–	Stand Shaft Pivot(s)		Light Application	#4			0			0	
85	Front Forks		Drain comp./chk. specs.	#2		chk		0			0
–	Steering Ball Races		Inspect thoroughly/med. pack	#6				0			0
111	Point Cam Lubr. Wick		Very light application	#7			0				0
130	Hyd. Brake Fluid Res.		See Notes	#8	chk		chk		chk		
88	Wheel Bearings		Do not over-pack	#6				0			0

1. For average operation at ambient temperatures of 30-90°F. use Yamalube 4-cycle or SAE 20W-40 type "SE" motor oil.
2. Use SAE 10W-30 type "SE" motor oil. (If desired, specialty type lubricants of quality manufacture may be used.)

   Note: Drive chain must be lubricated every 200-250 miles. If unit is subjected to extremely hard usage, chain must be inspected constantly and serviced as required.
3. Use SAE 10W-30 type "SE" motor oil. (If desired, or at ambient temperatures below 30°F., a graphite base "dry" lubricant of quality manufacture may be used.)
4. Light duty: Lithium soap base (white) grease. Heavy duty: Standard 90 wt. lube grease. (Do not use lube grease on throttle/throttle housing.)
5. Use standard lube grease — smooth, not coarse.
6. Medium-weight wheel bearing grease of quality manufacture – preferably waterproof.
7. Light-weight machine oil.
8. Change yearly or 8,000 miles. Use quality manufacture corresponding to D.O.T. #3 specifications. Keep clean. Do not allow water, etc., to contaminate. Do not mix types when adding.
9. Use SAE 10W-30. Must be damp with oil at all times to function properly. Always clean before oiling. Apply oil moderately, do not over-oil. Clean and oil monthly or every 500-1,000 miles; more often if possible. If unit is subjected to extremely hard usage, such as dirt riding, etc., clean and lube filter daily.

FEATURES

I. ENGINE

A. Valve and Camshaft Mechanism
The use of a single overhead camshaft is beneficial in two ways: First, it contacts the rocker arm in a more positive manner than standard push rod valve arrangements, which allows the engine to rev higher. Secondly, there are less moving parts to wear. Also, the overhead camshaft is driven by a long-lasting single row endless chain that is directly connected to the crankshaft.

B. Twin, Constant Vacuum Carburetors
The throttle slide in this type carburetor is raised by engine vacuum, not a cable. The amount of vacuum to the carburetor is controlled by a butterfly valve in the carburetor venturi.

C. Trochoidal Oil Pump
The XS650 used a rotary valve type oil pump. It is operated by a set of gears which connect the pump directly to the crankshaft. This means that oil is pumped under constant pressure to the engine at all times.

D. Five Speed Transmission
The wide ratio five speed synchromesh transmission permits full usage of engine power under all conditions.

II. FRAME

A. Design
The frame incorporates the double down tube, full-cradle type design which provides strength for proper engine support and rigidity to prevent flexing.

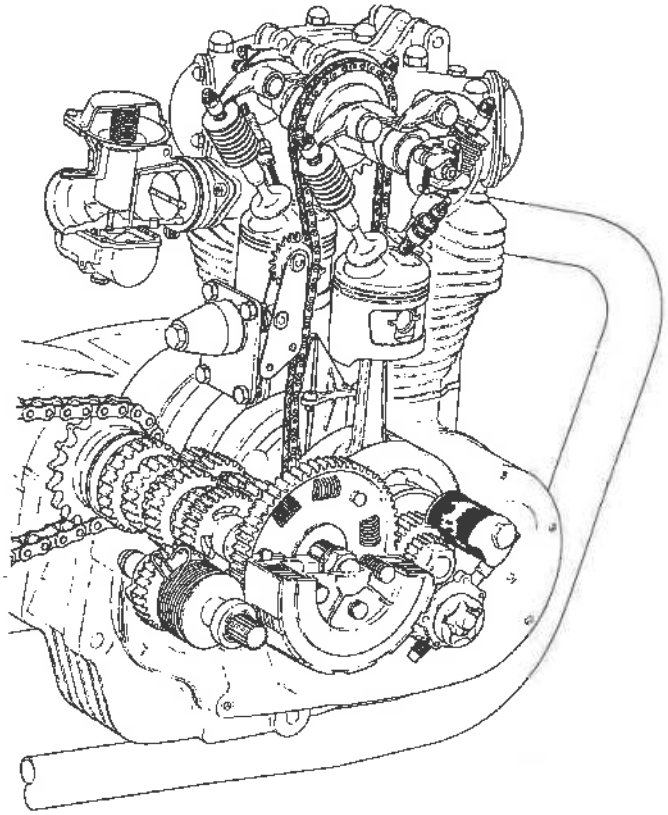
B. Brakes
The front wheel is fitted with a double leading shoe with 200 sq. in. of braking surface. The hub also has a fully functional air scoop for cooling. (XSI-XSIB)

PRE-OPERATION CHECK CHART

Item	Routine	Page
BRAKES	Check Operation/Adjustment/Hyd. Reservoir (XS2-TX650)	125
CLUTCH	Check Operation/Lever Adjustment	65
ENGINE OIL	Top-off as required	64
DRIVE CHAIN	Check Alignment/Adjustment/Lubrication	97
BATTERY	Check Electolyte Level Weekly/Top-off Monthly	99
SPARK PLUG(S)	After Break-In, Check Color/Cond'n. Weekly/1,000 mi.	114
AIR FILTER(S)	Dry Type - Must be clean	78
WHEELS & TIRES	Check Pressure/Runout/Spoke tightness/Axle nuts	87
FITTINGS/FASTENERS	Check All - Tighten as necessary	SEE TORQUE TABLE
LIGHTS/SIGNALS	Check Headlight/Tail-stop lights/Turn signals, etc.	117

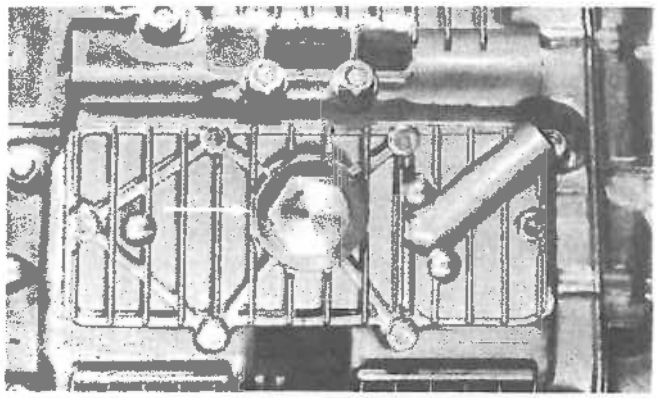
Preoperation checks should be made each time the machine is used. Such an inspection can be thoroughly accomplished in a very short time; and the added safety it assures is more than worth the time involved.

CHAPTER 1. ENGINE

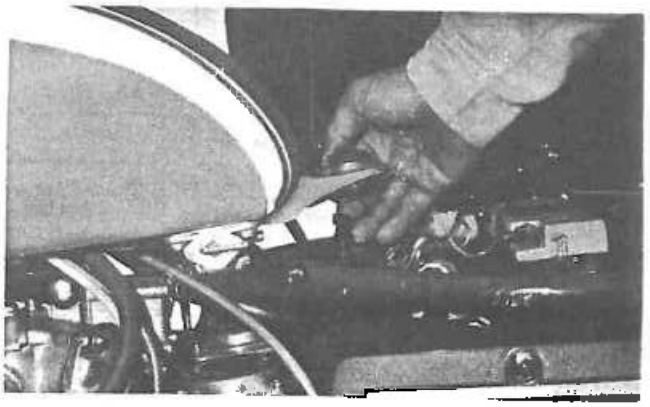


A) Removing Engine from Frame

1) Drain the oil. Two drain plugs in the bottom of the crankcase must be removed to entirely drain both the engine and the transmission.
Refill: 3.2 qts. Yamalube 4-cycle or SAE 20W/40 "SE"

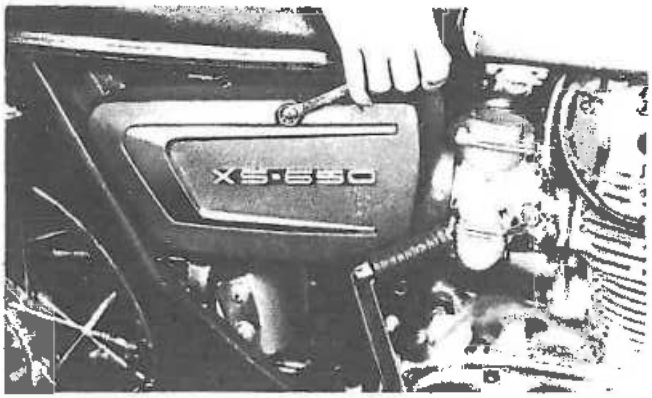


2) Shut off both fuel petcocks and disconnect the fuel crossover tube. Lift the seat.
Lift the rear of the tank to clear the mounting bushing from the anchor pin, then slide the tank back to free it from the front tank mounts.

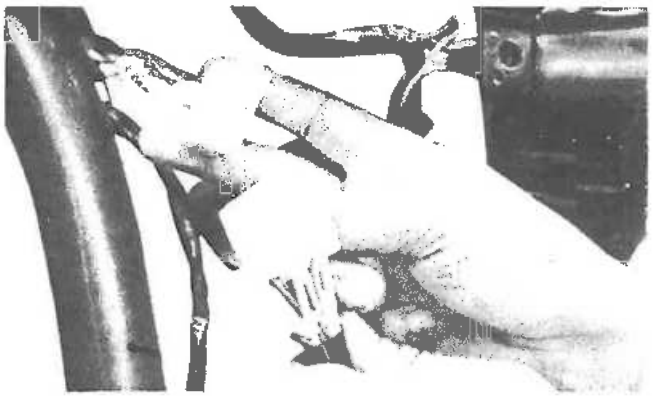


3) Remove both frame side covers.

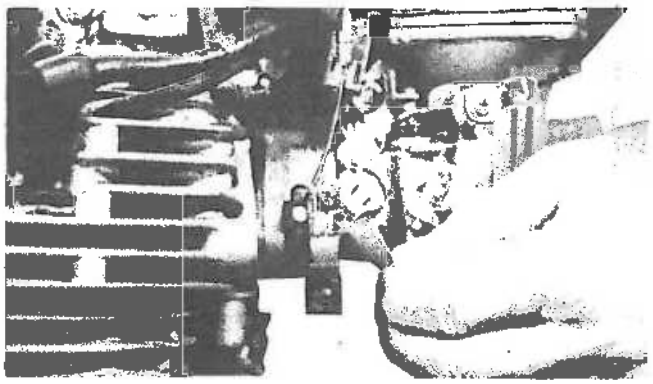
NOTE: The cover is secured by a 13 mm bolt. Under the head are a flat washer, spring washer, and flat washer. Reinstall in the same order.



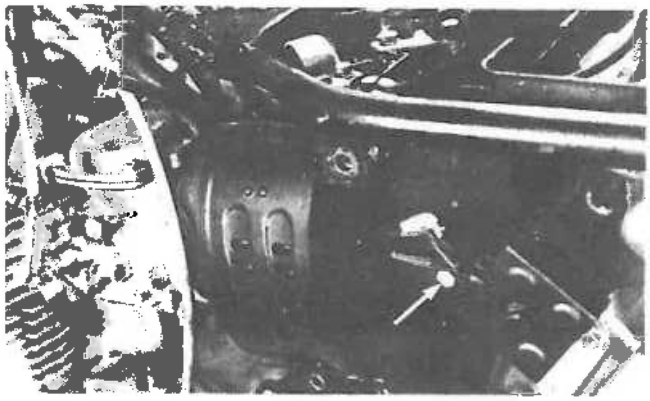
4) Disconnect the alternator wire loom at the multiple connector. It is located just behind the air filter housing.



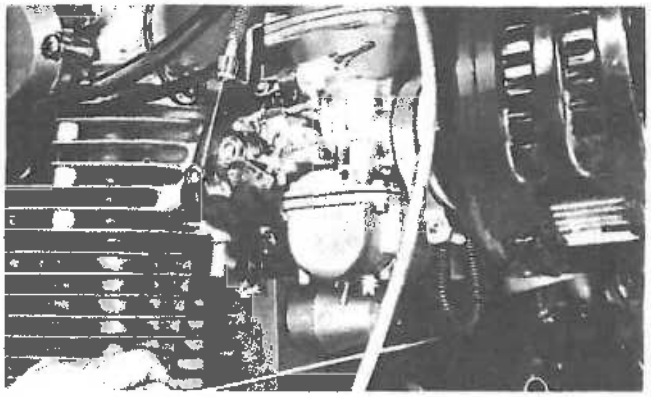
5) Remove the throttle cable from each carburetor.



6) Disconnect the air cleaner mounting bolts: one on top, under the seat, one on the side cover.



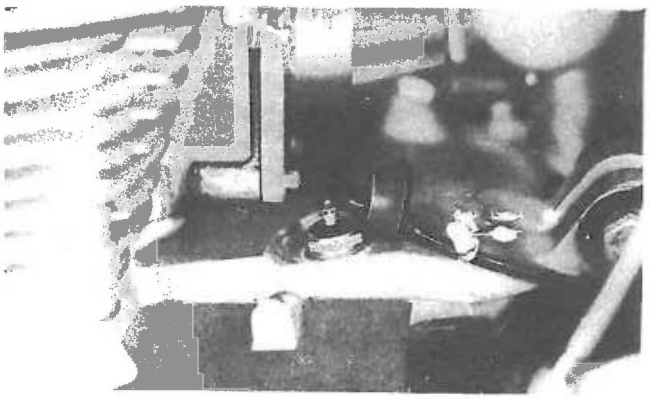
7) Disconnect the fuel balance tube (#2) between the carburetor float bowls. Pay strict attention to the linkage between the carburetor starter levers so that it is not damaged during removal. Loosen screw #1 and remove the left carburetor (with air cleaner attached). Repeat this procedure for the right carburetor.



#1 Carb. Tightening Screw
#2 Fuel Balance Tube

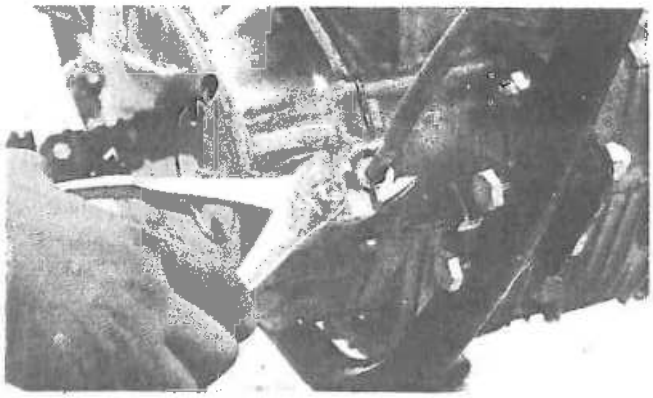
8) Disconnect the engine breather tube which is located above and between the carburetors.

9) Remove the neutral light lead on top of the engine.

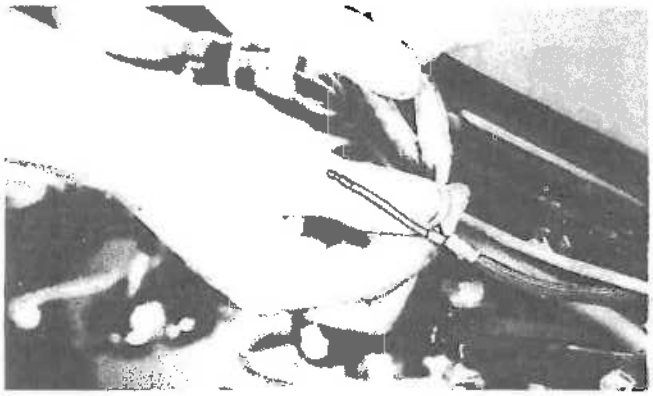


10) Remove both spark plug high tension leads.

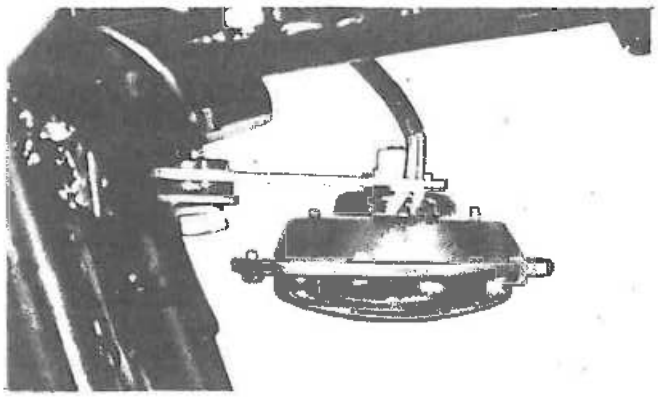
11) Remove the tachometer cable from the engine right front side.



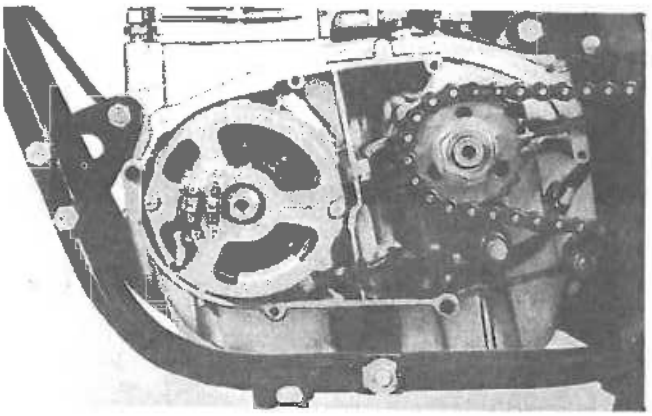
12) Disconnect the point wires at the condenser and ignition switch multiple connectors. (under tank)



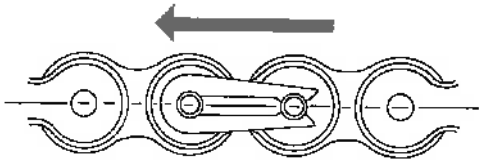
13) Remove the horn. It is located directly behind the steering head and below the secondary ignition coil. When removing this part, it is easiest to take off the horn and bracket as a unit.



14) Remove the left-hand engine case cover. This eases drive chain removal and installation



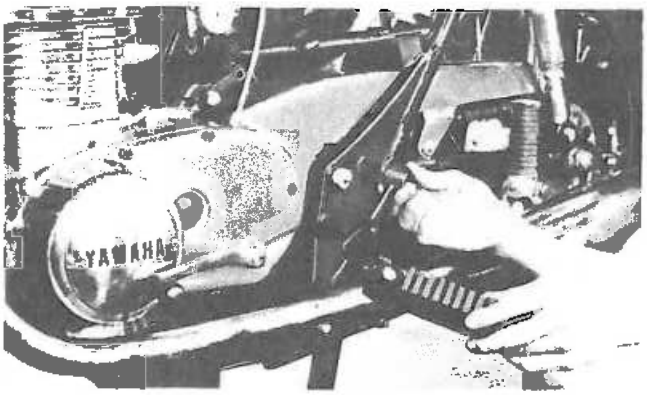
15) Remove the drive chain. During assembly be sure to position the master link retaining clip so it faces the direction of chain travel.



Direction of Travel

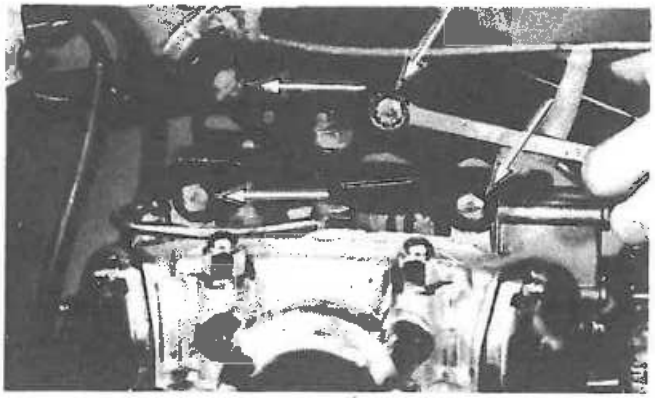
Master Link Clip Position

16) Remove the left foot peg. It is mounted over two rubber bushings. These bushings will come off with the foot peg. When installing the foot peg, insert the rubber bushings into the foot peg with the lip end of the bushings on the outside of the mounting hole.

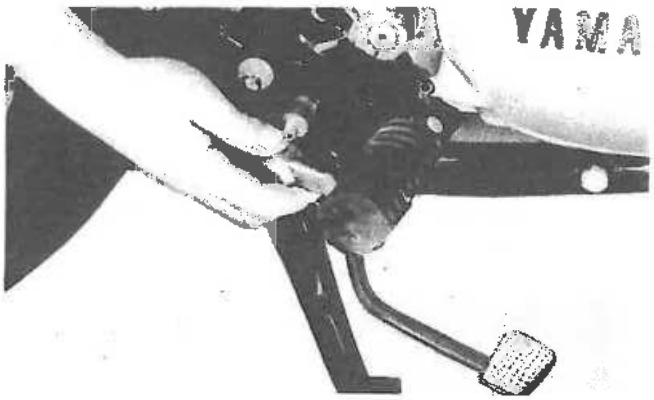


17) Remove both exhaust pipe assemblies.

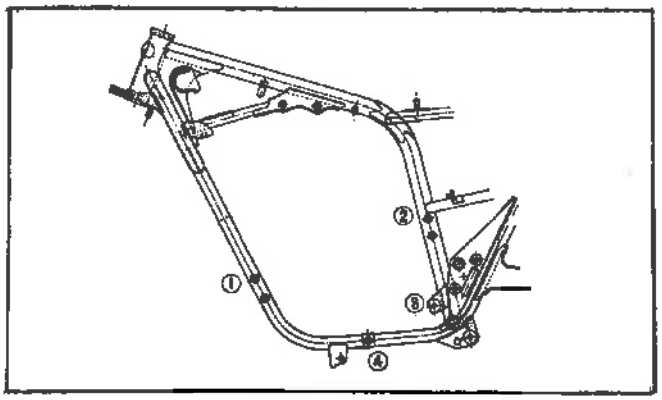
18) Remove the top center engine mounting brackets. Remove them in the manner shown in this picture as reassembly is easier and faster than if the bracket is removed in individual pieces.



19) Remove the brake pedal to provide access to the lower rear engine mounting bolt.

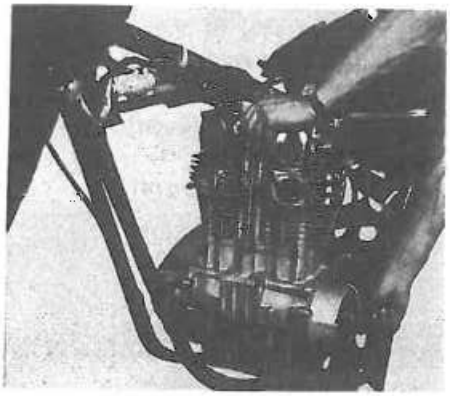


20) Remove all other engine mounting bolts and brackets in order of the number sequence as shown in the drawing below. Remove the bottom center bolt last.



21) XS2 – Remove decompression lever cable at cylinder head.

22) Remove the engine. Lift it out the left hand side.



B) Installing the Engine into the Frame

Engine installation is basically a reversal of the removal procedure. To make installation easier, it is best to position the engine in the frame and insert the bottom middle bolt first. The remaining engine mounting bolts and brackets can then be installed. When tightening engine mounting bolts, torque the 10mm bolts to 3.5–4.0 kg/m (25–28 ft/lbs) and the 8mm bolts to 2.0–2.5 kg/m (14–18 ft/lbs).

C) Engine Disassembly Notes:

1) Keep all parts in separate sections to aid in reassembly.
2) All gaskets, cotter pins, O-rings, and circlips, if damaged or worn, should be replaced.
3) Always use proper tools (as listed in the Tools Section) and proper repair techniques. A set of metric Allen wrenches must be available due to the use of Allen-head screws.
4) Clean all parts with solvent, and if any part has a drilled oil passage, blow the passage out with compressed air.
5) Tighten all nuts and bolts in proper rotation (in cases such as head nuts or case bolts) beginning with the larger bolts (if any) and then going back over and tightening the smaller bolts in the proper sequence.
6) Always check the torque specifications section for correct torque, and use a torque wrench.
7) After completing each section check to make sure every procedure has been done properly and completely to avoid having to go back and do it again.
8) Occasionally, after several hours operation on a rebuilt engine, oil leaks will develop. This is caused by gasket compression. Re-torque all cylinder holding bolts should this occur.

In addition, other fittings MAY loosen during the "settling in" period after a rebuild. Make a point of checking motor mounts, brackets, etc., after 20 – 30 hours engine operation.

D) Cylinder Head Cover (Disassembly)

Removal and disassembly of the cylinder head cover requires the removal of the engine from the frame.
The cylinder head cover consists of:

1. Oil delivery tube (connected to cover at top)
2. Rocker covers (4)
3. Rocker shaft hole covers (4)
4. Rocker shaft
5. Rocker arm
6. Cylinder head cover sleeves and O-rings.

In addition, the cylinder head cover helps to support:

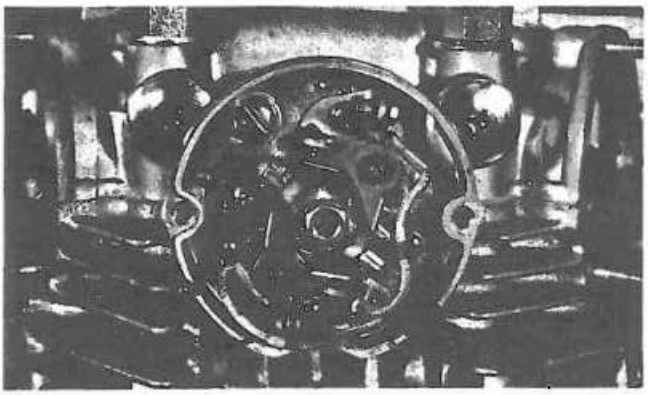
1. Ignition point assembly
2. Governor unit (centrifugal ignition advance unit)

1) Oil Delivery Line Removal

The oil delivery line is located at the front of the engine between the cylinders. Disconnect it at the crankcase and at the head where it is held in place by two banjo bolts.

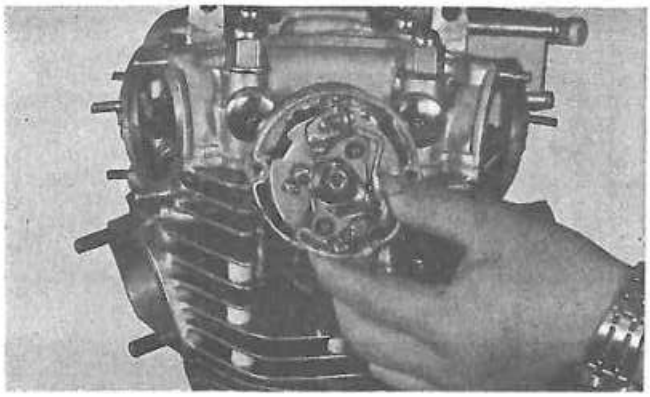
2) Ignition Breaker Point Removal

a) Although the ignition system has a dual point arrangement they are, in effect, mounted on a single backing plate. The points can be removed as a unit.



b) The point assembly backing plate is held in place by two slotted-head screws. Remove the screws and the plate assembly will slip off.

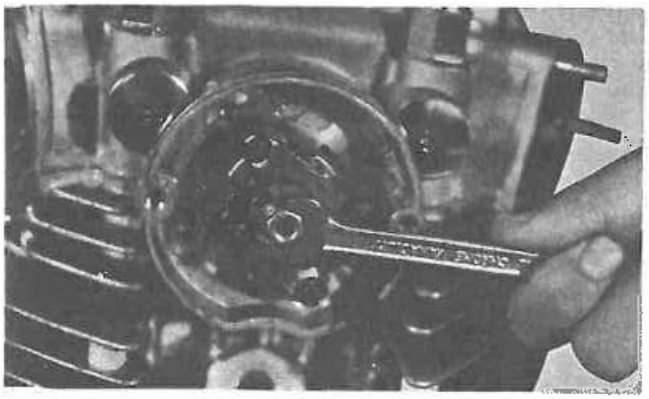
c) Remove the three Phillips screws anchoring the point housing. The housing can now be tapped loose and removed.



3) Advance (Governor) Unit

a) Remove the lock nut (1) and notched plate (2).

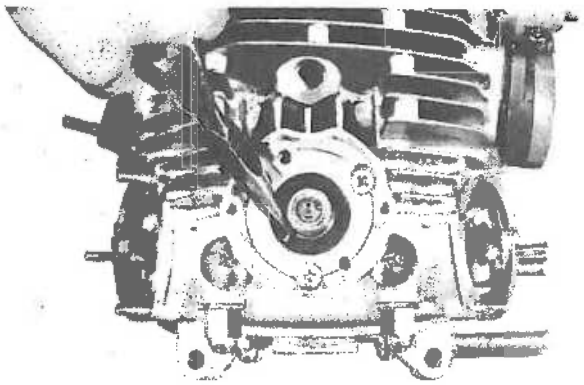
b) Pull the advance rod out the left camshaft side (point side). To aid in future assembly, it is best to reassemble the notched plate, lock washer, and lock nut onto the rod and set it aside.



c) Use a punch and hammer to loosen the ring nut that secures the entire ignition advance unit. As this ring nut is loosened, slide the advance unit out; otherwise the ring nut will bind up.



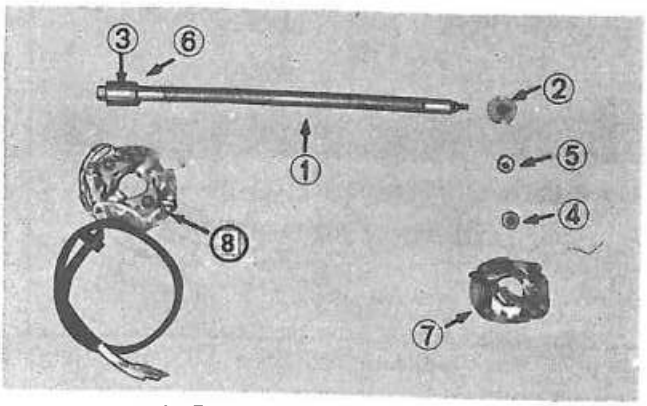
d) Remove the advance unit locating pin.



e) Finally, remove the advance unit housing which is held in place by three phillips-head screws. The housing might need a light tap to break it loose from gasket adhesion. Use a soft-head hammer.

4) **Governor (Advance) Rod Unit**

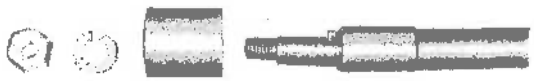
a) Description:
The entire unit consists of the advance rod, a notched ignition advance disk, an ignition point cam, two locating pins, and a lock washer and nut for each end.



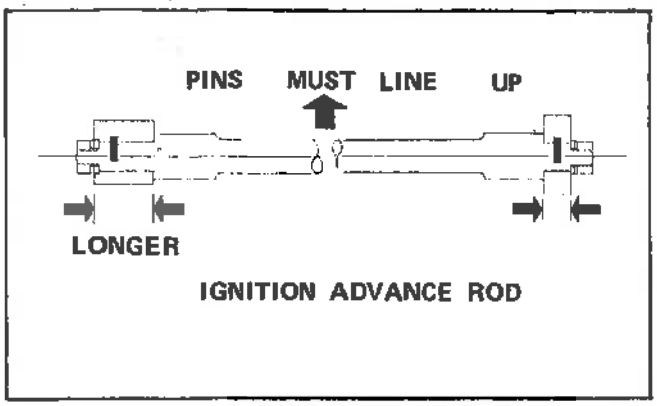
1. Governor rod
2. Disk
3. Point cam
4. Lock washer
5. Nut
6. Shim(s)
7. Governor
8. Point Ass'y.

b) Disassembly procedure:

b-1) The notched disk, lock washer, and lock nut have already been removed. The point cam can be removed next. It is held by a lock washer and nut. Remove these pieces and slip the point cam off. A spacing washer behind the cam should also be removed, if one is present.



b-2) Two locating pins are pressed into drilled holes in the rod. Normally there is no need to remove them. However, if one should come out, it must be pressed back into its hole so that it lines up with the other locating pin.



c) Assembly procedure:

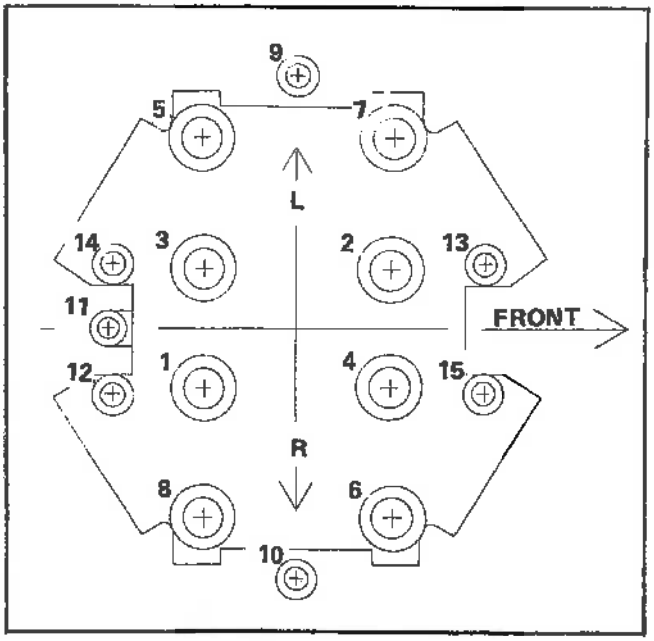
c 1) Both ends of the advance rod appear to be identical. However, one machined end is longer than the other. The point cam slips onto the longer end. The advance disk fits over the shorter end. The point cam and its spacing washer both have locating grooves that must line up with the locating pin. This prevents improper assembling.

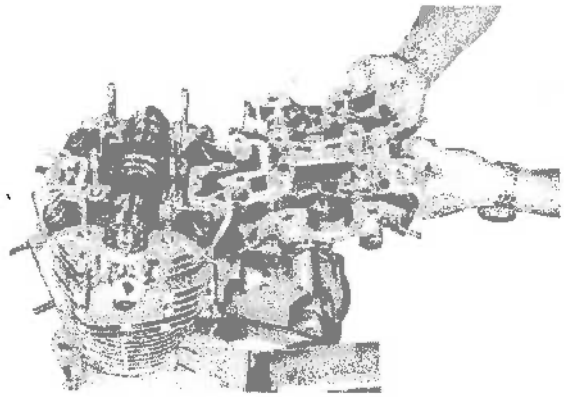
5) Cylinder Head Cover Removal

a) Remove all four tappet covers. Then remove the eight head cover retaining nuts and four retaining bolts. Remove the cover. Tap around the edges with a rubber hammer to free the cover if necessary. Never use a metal-head hammer.

CAUTION

Loosen the nuts and bolts in sequence, starting with the inner nuts.

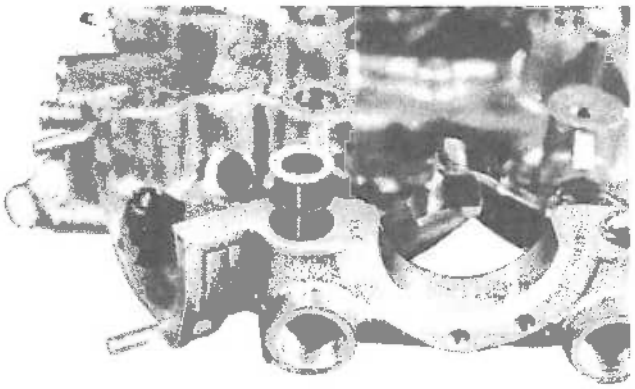




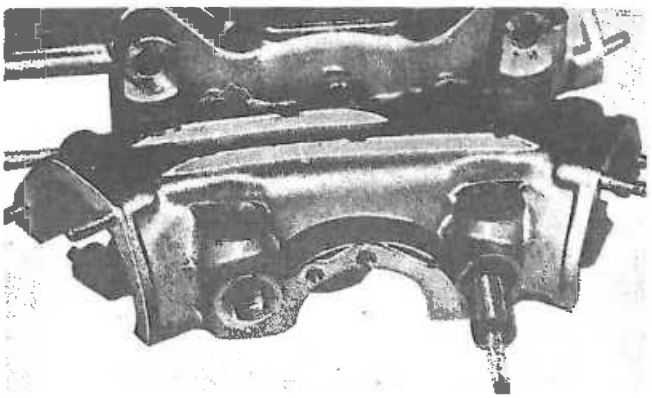
6) Rocker Arm and Rocker Shaft Removal

a-1) First, remove all four rocker shaft covers. Then remove the shouldered sleeves and O-rings (see picture). Insert a 6 mm screw into the tapped shaft, and withdraw the rocker shaft. It should slide out easily. Lift the rocker arm out of the head cover. Repeat this procedure for each rocker assembly.

Note:
Keep each mating rocker arm and shaft assembly separated. Reinstall them as a unit.

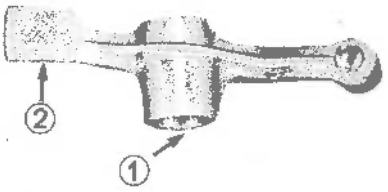


a-2) Reinstall the shafts using the 6 mm screw. That way, the threaded hole will be properly positioned for future disassembly; without the hole and screw it is very difficult to remove the shaft.

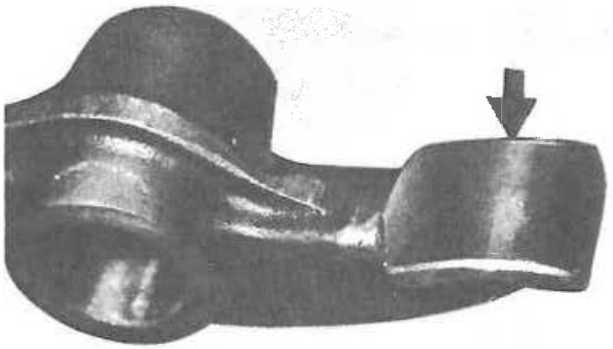


b) Rocker Arm and Rocker Shaft Wear

b-1) The rocker arm usually wears at two spots: (1) at the rocker shaft hole where it rubs against the rocker shaft, and (2) at the cam lobe contacting surface.

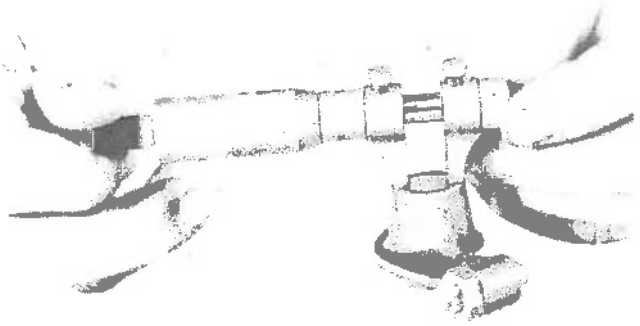


b-2) Check the cam lobe contacting surface of the rocker arm for grooves in the surface, for deep and obvious scratches, flaking of the hardened surface, or a blue discoloration of the metal (obvious evidence of too much heat). Check the mating cam lobes in the same manner.



b-3) If any grooves are readily apparent, replace the rocker arm. Do not try to repair the surface by cleaning with an oil stone or emery cloth as this will change the curvature of the follower and thereby the rate of valve opening.

b-4) Measure the rocker shaft hole in the rocker arm Standard size is 15.03 mm.



5) Rocker shaft diameter measures 14.98 mm when new. The shaft has been hardened and it should not wear excessively. If a groove has developed in its surface that can be felt, or if it shows a blue discoloration, then the shaft should be replaced and the lubrication system (pump and passages) checked.



6) Standard clearance between the rocker shaft and hole should be 0.05 mm. If measurement shows more than 0.10 mm clearance, replace either or both parts as necessary.

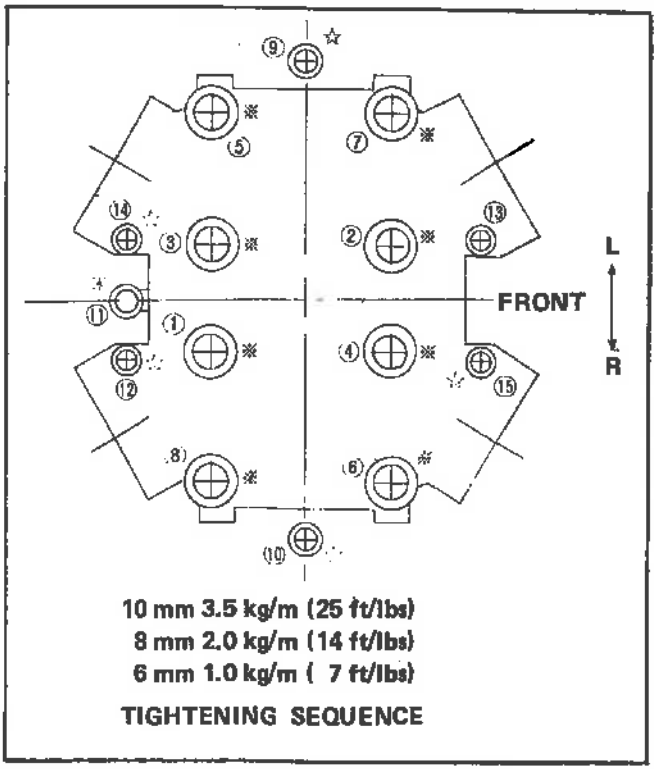
7) **Assembling the Cylinder Head Cover**

a) All head cover components can be installed in the head cover in reverse order of removal, beginning with rocker arms and rocker shafts. Be sure to coat all surfaces with oil as the parts are reassembled.

b) All rocker arms are identical and all rocker shafts are identical, which makes them interchangeable. However, try to keep the arms and shafts together as four individual sets (one arm and one shaft to a set) and to reinstall them in the head cover in their original location. Also, when installing the rocker shafts, see that the drilled and tapped end points outward to facilitate future disassembly. Complete this phase of assembly by installing the shaft hole covers.

8) **Installing the Cylinder Head Cover and Attached Parts**

a) Coat the head and cover mating surfaces with a non-hardening sealant (Yamaha Bond #4) and slip the head cover into position on the head. Install all head cover retaining nuts and retaining bolts and thread them down until lightly seated. USE A TORQUE WRENCH to tighten these nuts and bolts to the proper torque setting, and in proper torque sequence. Tightening torque for 10 mm studs is 3.5 kg/m (25 ft/lbs), for 8 mm it is 2.0 kg/m (14 ft/lbs), and for 6 mm it is 1.0 kg/m (7 ft/lbs).



10 mm 3.5 kg/m (25 ft/lbs)
8 mm 2.0 kg/m (14 ft/lbs)
6 mm 1.0 kg/m (7 ft/lbs)

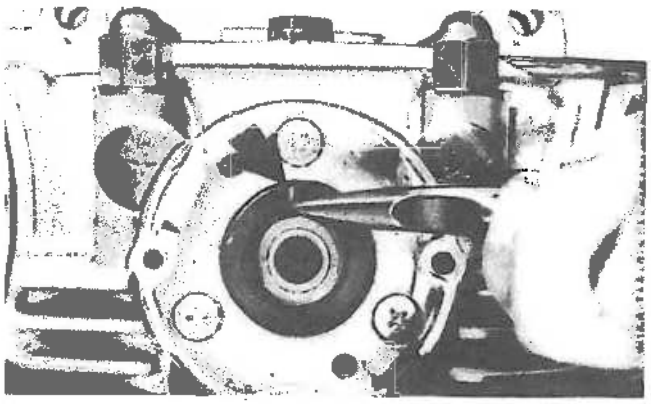
TIGHTENING SEQUENCE

CAUTION

If the stud threads are not lubricated prior to cylinder head cover assembly, it is possible to shear a stud when tightening cover nuts. Therefore, apply a liberal coating of 30 weight oil to all threads first, and then torque the head cover down.

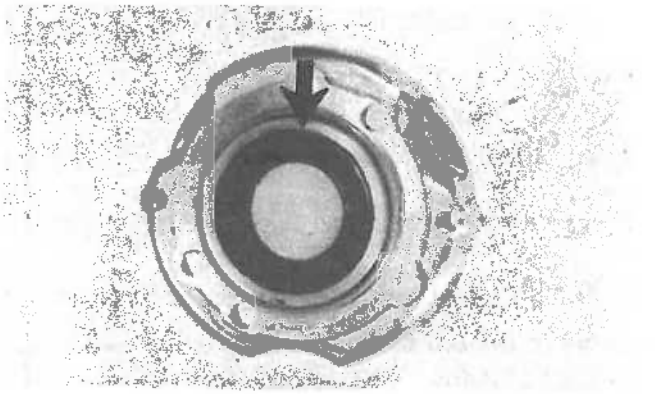
b) Install the ignition points housing and the centrifugal advance housing. These housings are identical and can only fit on the machine one way.

c) Install the Centrifugal advance unit locating pin.

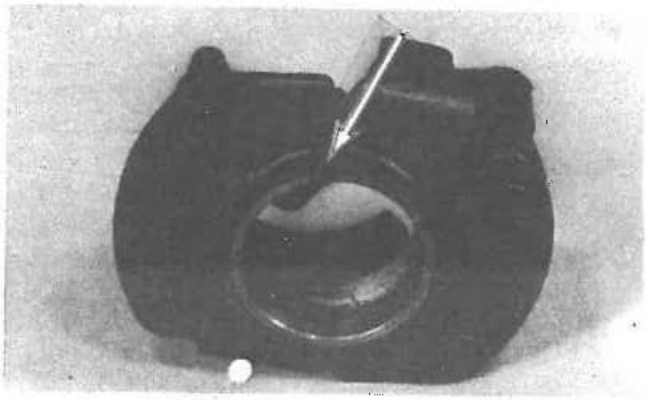


d) If necessary, insert a new gasket between the housing and head covers. Also, if any oil residue is found on the ignition points, then the rubber seal may be leaking. Check the seal for grooves, creases, or any deformity that would permit oil to leak past. If found, replace the seal.

NOTE:
Grease the seal lip before installing the housing.

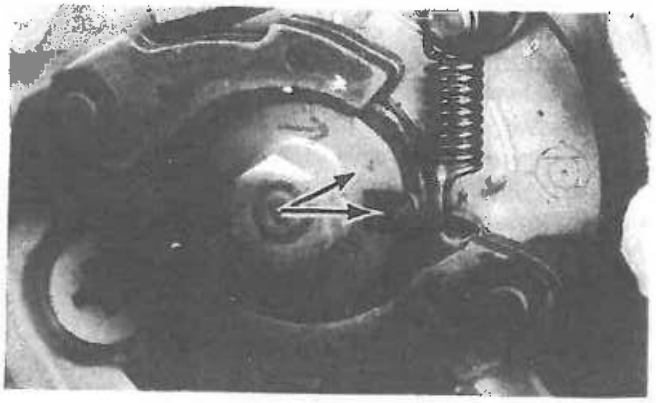


e) Mount the governor (centrifugal advance) unit in its housing. It can only fit one way as there is a notch in the back of the unit that must line up with the locating pin. Next, screw the ring nut onto the camshaft end until tight and then use a punch and hammer to completely tighten the ring nut.

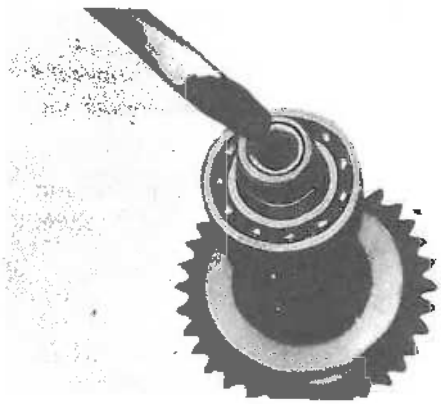


f) Place the disk into position and engage the centrifugal weight arms into the proper disk slots.

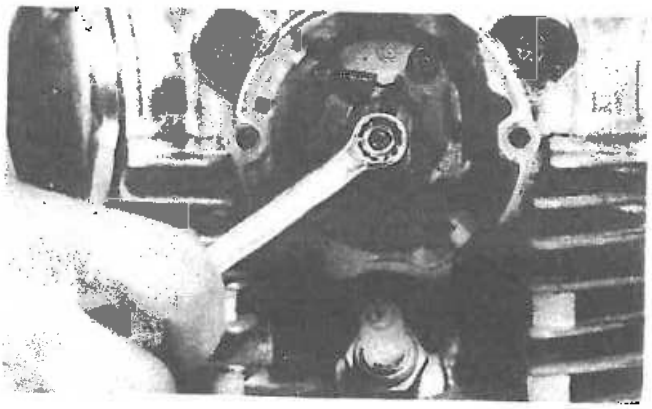
CAUTION: Make sure the disk surface with the arrow showing direction of rotation faces outward. Also, there is a color mark on the backing plate and the notched disk. The color marks must be aligned and the weight arms located in the slots. If the notched disk is installed 180° out of rotation, or if the directional arrow on the disk is not facing out, operation of the advance unit will be impaired.



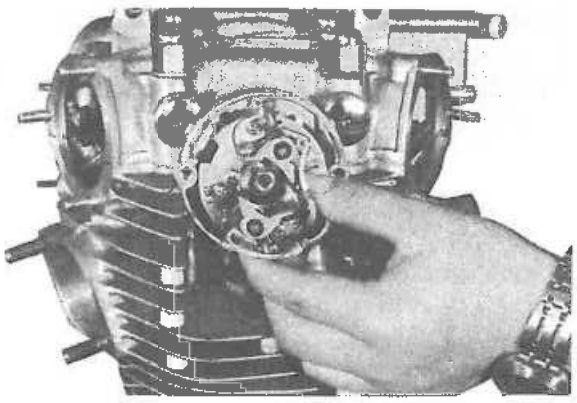
g) Before inserting the governor rod, both supportive needle bearings (located inside each end of the camshaft) should be lubricated with a light-weight grease. These bearings support the point cam rod and every time this unit is taken apart these bearings should be greased.



h) Slide the governor rod into the camshaft from the ignition points side. A locating pin sticks up at the threaded end of the governor rod. Install the rod and rotate it until this locating pin slips into the inner notch in the governor unit disk. Next install and tighten the lock nut.



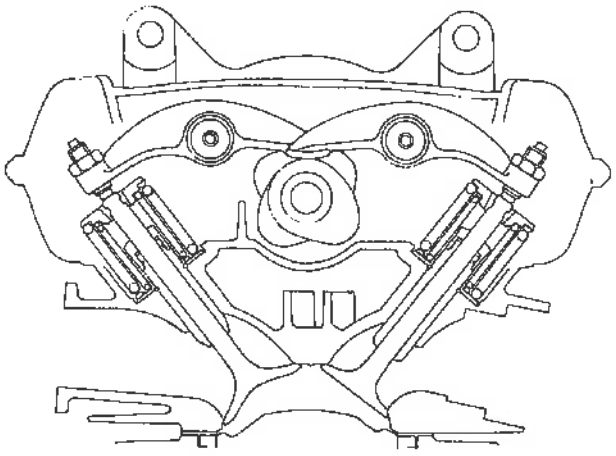
i) Install the ignition point assembly. Do this by expanding the two sets of points and slipping the assembly over the point cam. The point assembly is designed to fit only one way. Position the right cylinder points (stamped "R" on the plate just below the points) at the top of the housing. Install and tighten both securing screws.



j) Make sure the point wire rubber grommet is in good condition and installed correctly, then secure the point housing cover in place.

k) Install the oil delivery line. (After the engine has run sufficiently to warm up to operating temperature, check for oil leaks at this point if necessary.)

E) Cylinder Head

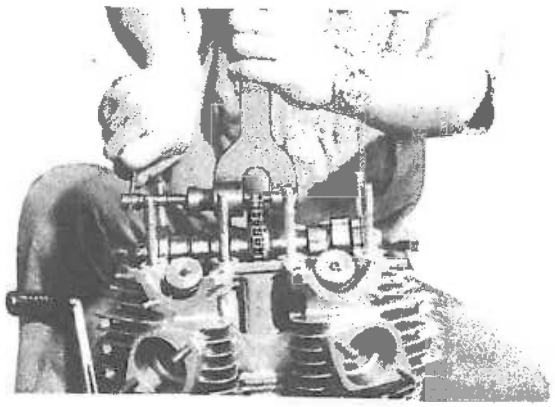


Cutaway View of Cylinder Head

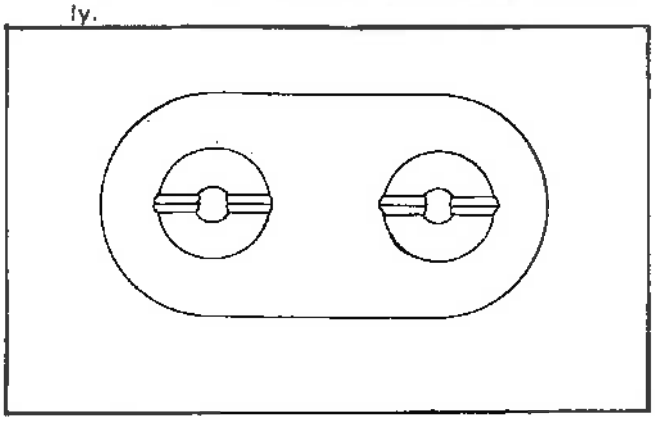
1) Cam Chain Removal

a) The single row cam drive chain connects the camshaft to the crankshaft. The chain is "endless" in that there is no master link to disassemble it, other than the link riveted at the factory when the chain was first installed.

b) A chain breaker (in Special Tool kit) must be used to remove a selected link. Place a rag around the sprocket to prevent metal chips from falling into the engine.

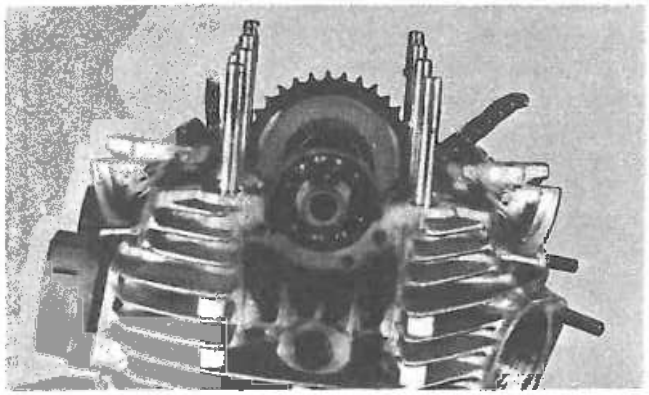


c) Separate the chain link that was originally riveted at the factory. The rivet heads on this link have punch marks and slots across the heads. Replace this unit with new parts during reassembly.



CAUTION

d) Attach a wire to a chain link on each side of the link to be separated. Do this before separating the chain to prevent the chain from dropping into the crankcase. After separating the chain anchor both retaining wires to prevent the chain from dropping down.



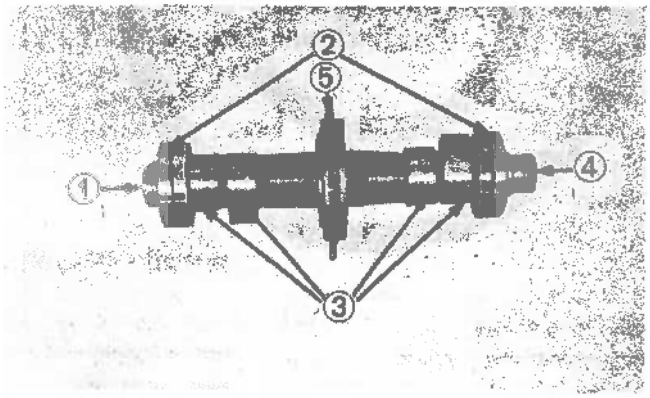
1) Remove the chain, clean it in solvent, then examine for wear.

2) If the engine is not to be disassembled, pull a length of wire through with the chain during removal in order to provide a means of reinstalling the chain after cleaning and checking.
It is also a good idea to have a mechanic's mechanical claw on hand to help feed the chain around the guide bars on the lower drive sprocket during reassembly.

NOTE:
Checking Cam Chain Wear:
Check the cam chain using the same methods as when the secondary drive chain is checked.

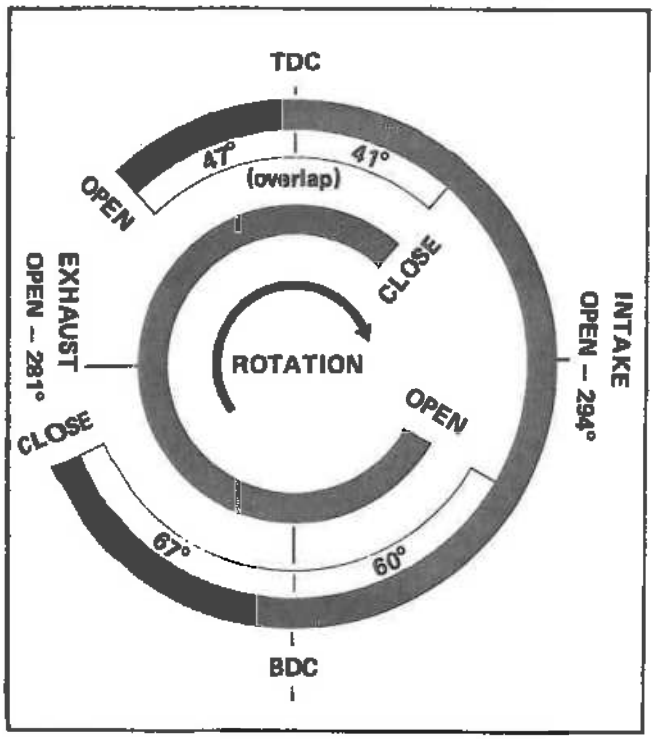
2) Camshaft

a) The XS650 engine uses a single overhead camshaft. All four cam lobes (2 intake and 2 exhaust) are located on one shaft. The cam lobes have been specially tempered to resist wear. The camshaft is connected to the crankshaft by a single row endless chain. Sprocket ratio is 2:1, which turns the camshaft at half crankshaft rpm. The camshaft is supported on top of the cylinder head by four single row ball bearings, two at each end.



1. Needle bearing
2. Single row ball bearings (4)
3. Cam lobes
4. Governor mounting threads
5. Camshaft sprocket (34 teeth)

b) The ignition points fit against, but do not mount directly to, the left end of the camshaft. The camshaft right end is threaded and the ignition governor (centrifugal advance) unit mounts directly to this end. The shaft is hollow and the governor rod slips through this passage to link the governor unit with the ignition points unit. Each end of this drilled passage is fitted with a needle bearing to support the rod and a small labyrinth seal to prevent governor rod lubricating oil from leaking into both units, especially the ignition points unit.



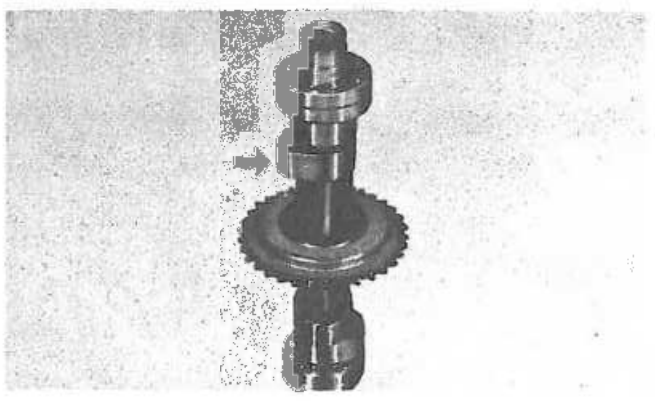
c) The intake valve opens 47° before top dead center and closes 67° after bottom dead center, which means the intake valve is held open 294°. The exhaust valve opens 60° before bottom dead center and closes 41° after top dead center. It remains open for a duration of 281°. From 67° ABDC to 60° BBDC on the compression stroke, both valves are closed for combustion.

3) Camshaft Removal

a) With the camshaft drive chain removed (or held away by safety wire), the camshaft can be lifted out of the head.

4) Camshaft Wear

a) The cam lobe metal surface may have a blue discoloration due to excessive friction. The metal surface could also start to flake off or become pitted. This is due to poor lubrication, incorrect clearances (from poor adjustment or valve bounce), or due to normal wear.

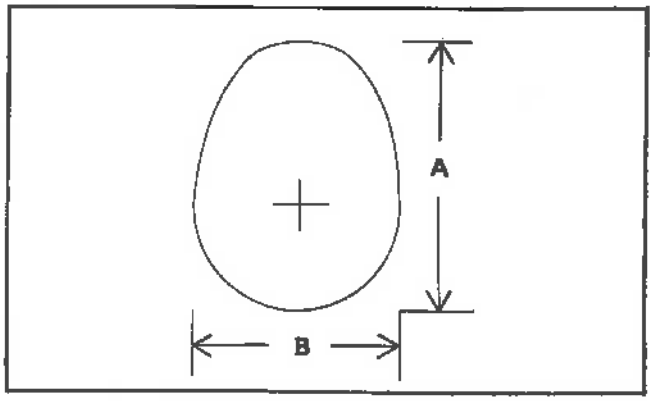


b) If any of the above wear conditions are readily visible, the camshaft should be replaced. Also, the corresponding rocker arm contacting surface should be checked for similar wear and replaced if obvious wear is noted.

c) Even though the cam lobe surface appears to be in satisfactory condition, the lobes should be measured with a micrometer. If wear exceeds a predetermined amount, valve timing and lift are affected. Replace the camshaft if wear exceeds the limits listed below.

	Cam Lift (A)		Base Circle Diameter (B)	
	Standard Value	Wear Limit	Standard Value	Wear Limit
Intake	39.88 ± 0.05	39.75	32.19 ± 0.05	32.12
Exhaust	40.03 ± 0.05	39.79	32.24 ± 0.05	32.17

(All dimensions given in millimeters.)



d) All camshaft bearings should be removed, cleaned, dried, and the races visually checked for pits, rust spots or chatter marks where the balls have dragged. If any of these conditions exist the bearing(s) should be replaced.

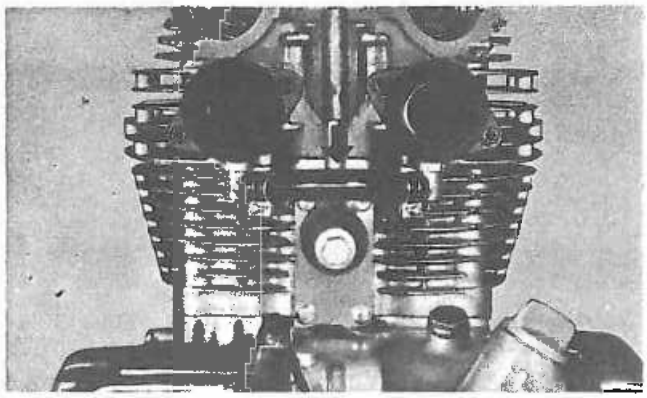
NOTE:
Lubricate the bearings immediately after examining them to prevent rust formation.

5) Carburetor Manifold Removal

The rubber manifolds are secured to the head by two Allen-head screws each. Remove the screws and the manifolds.

6) Intake Port Equalizer Tube

Check for cracks or collapsed sections. If any defective section is found, replace the tube.

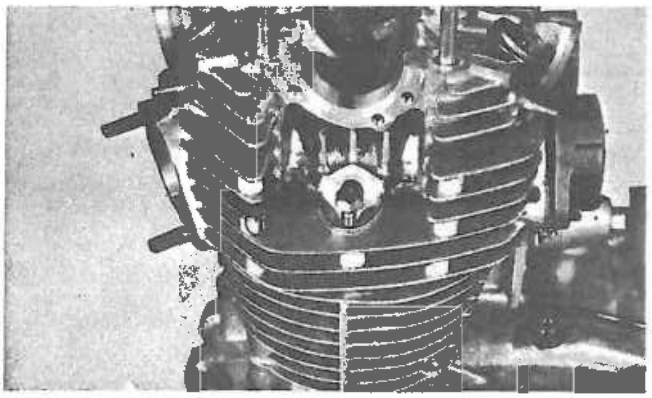


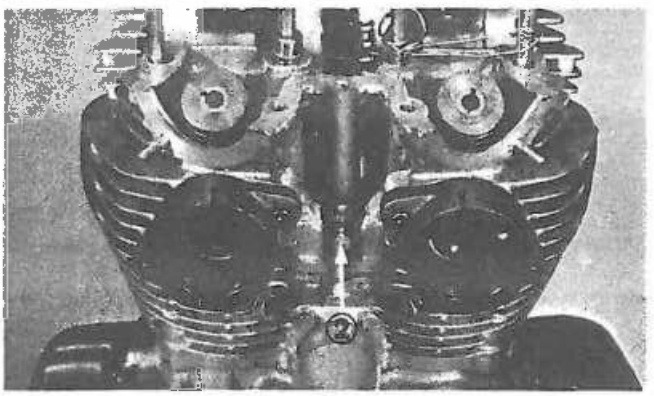
NOTE:

Make sure the coil spring is present inside the tube, this spring is necessary in order to keep the tube from collapsing.

7) Cylinder Head Removal

a) The head is now held in place by two hex-head screws (#1) beneath each spark plug hole and one 6 mm screw (#2) which is located between the intake manifolds. Remove the bolts and slide the cylinder head up over the studs. While performing this operation, hold the safety wires so the cam chain does not fall into the crankcase.





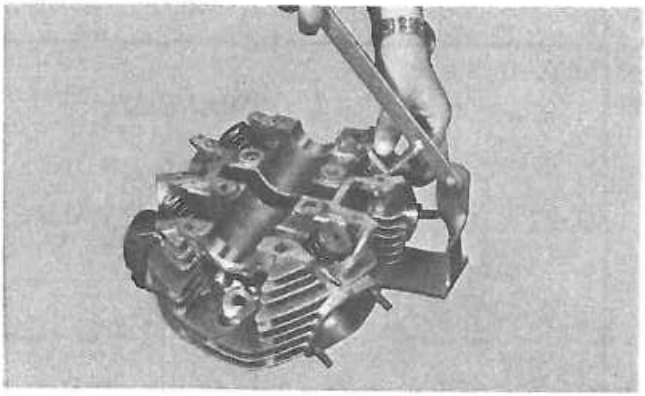
8) Cylinder Head Wear

a) There must be no head warpage. Clean the head thoroughly with solvent, dry it, and lay it on a machined surface plate. If warpage is extreme, the head will rock back and forth. Check for lesser warpage by running a .001" – .002" feeler gauge under the head mating surface. If the gauge slips in between the head and the surface plate anywhere around the perimeter, then the head must be re-surfaced.

b) Place a sheet of #400 grit emery paper on the surface plate and slide the head mating surface across this paper in a figure 8 pattern to remove any measureable warpage. If more than .0025" needs to be removed, the head should be taken to a machine shop for milling. **Milling should not exceed .010" as this will affect valve head/piston dome clearance.**

9) Valve Removal

a) A valve spring compressor is available in the Special Tool kit. Compress the valve spring and then remove both keepers. Remove the compressor and lift off the collar and springs.



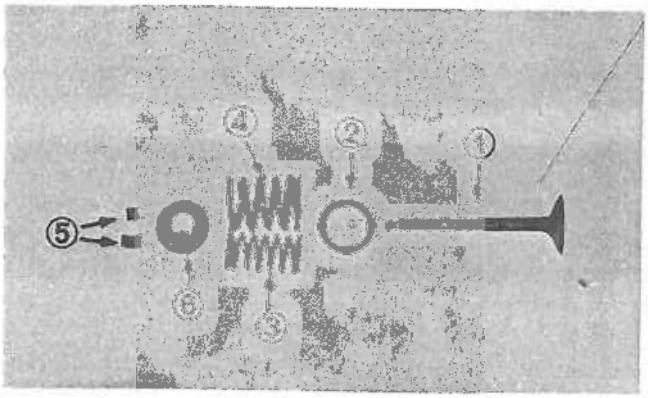
NOTE:

The keepers might be partially stuck in the collar. Use a rubber hammer to tap the edge of the collar a few times to loosen the keepers.

b) Pull the valve out. If the stem tip or keeper groove edges are slightly expanded, causing difficult removal, do not force the valve out as the valve guide inner diameter might be damaged. First, use a fine file to remove any lip that exists on the stem and then remove the valve.

NOTE:

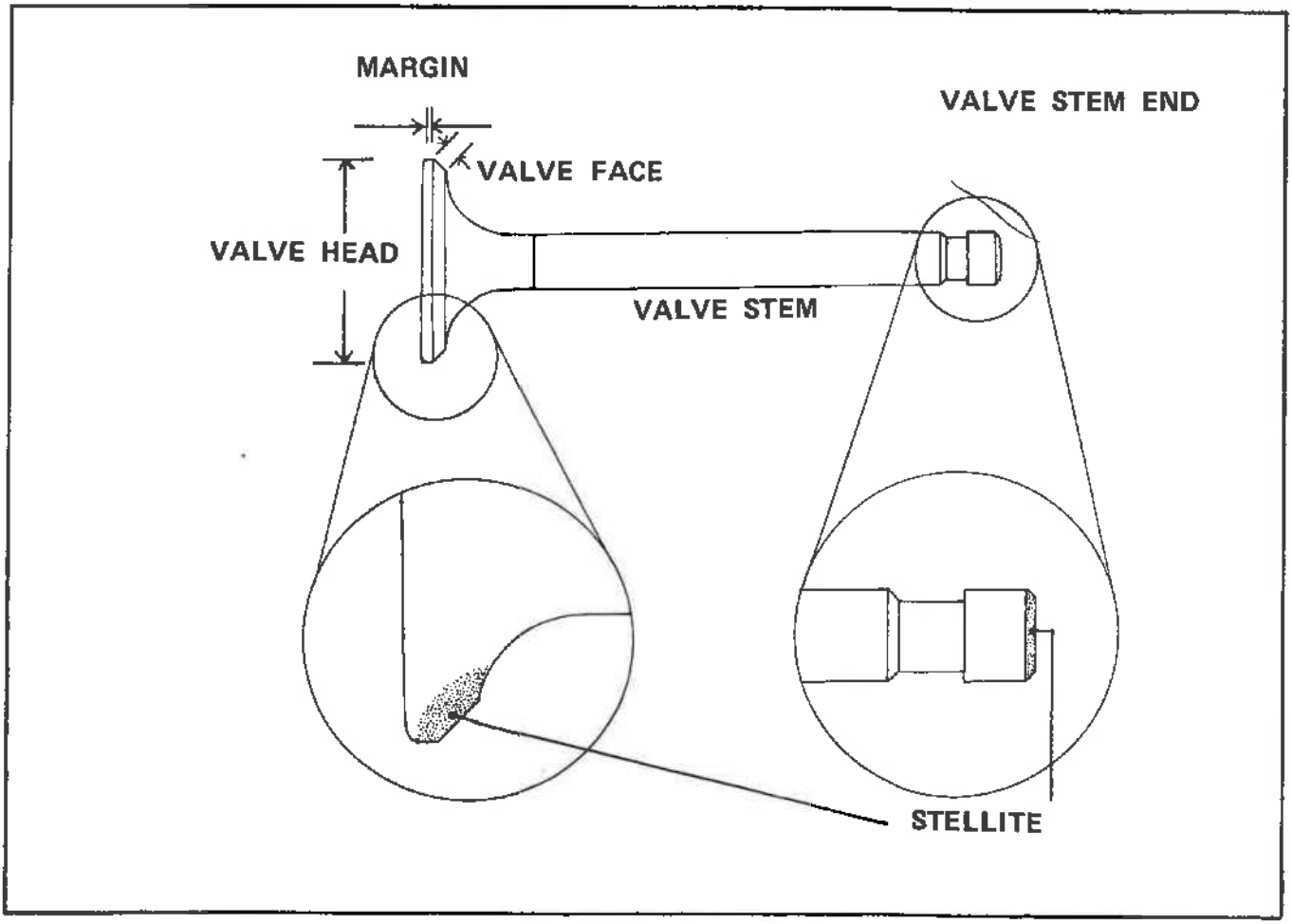
Be sure to remove the valve stem seal before removing the valve. Otherwise the seal could be damaged.



1. Valve
2. Valve spring seat
3. Inner valve spring
4. Outer valve spring
5. Keepers
6. Collar

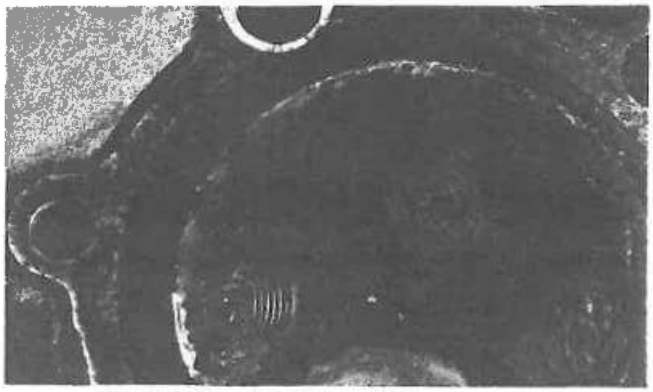
10) Valve Description

The head is equipped with four valves; two intake valves and two exhaust. The stem tip and valve face of each is plated with Stellite (hardened metal) to keep wear at a minimum. The intake valve head diameters are larger to provide less restriction for the incoming fuel/air change.

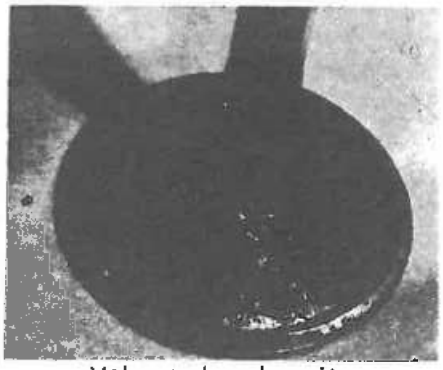


11) Decarbonization of the Head and Components

Carbon deposits build up in the combustion chambers, on the valves, and in the exhaust ports. Thoroughly clean all parts with a blunt scraper, then wash in solvent and dry with compressed air. The parts can then be examined and measured for wear.



Combustion chamber carbon deposits.



Valve carbon deposits.

12) Valve Wear

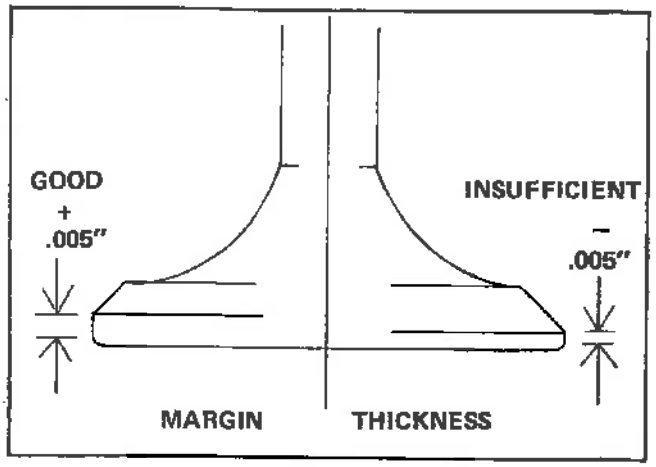
a) Check the valve stem tip for an indentation caused by the adjustor constantly striking the tip. If this indentation is .4-.5 mm (.015"-.020") deep, or more, then regrind the tip surface flat. Remove only the material necessary, no more. Use a commercial valve grinder with the appropriate adaptor mounted on it to grind the tip.

b) Valve stem wear must be measured and then combined with valve guide measurements to arrive at a stem-to-guide clearance. This clearance must be within the tolerances shown below. If it exceeds the maximum limit, then replace either or both parts as required.

c) The valve should also be checked for a bent stem. Roll the stem along the edge of a surface plate and visually check for stem warpage. Replace the valve if any warpage exists.

NOTE:
When checking the stem for warpage, be sure all carbon has been cleaned off.
Otherwise, an accurate check cannot be made.

d) Check the valve for pits, carbon deposits, warpage (including the entire head), and actual chips broken off the margin. If warpage exists or if the surface is chipped, replace the valve. If it is just pitted and/or carboned up, lap it to the valve seat. If it does not clean up by lapping then use a mechanical grinder to resurface the valve face. After grinding, check valve margin thickness. If it has been reduced to a sharp edge because of grinding, the valve should be replaced as this thin edged margin can readily heat up and cause pre-ignition.



e) Check the stem for scratches. These occur when carbon collects in the valve guide and then hardens. As the stem continually rubs against this hard carbon, scratches are worn in the stem. Replace the valve if deep scratches are found.

			Original Clearance	Replacement Clearance
Intake	Valve Guide ID	* 8mm $^{+.019}_{+.010}$	.020 – .044mm	.100mm
	Valve Stem OD	8mm $^{-.010}_{-.025}$		
Exhaust	Valve Guide ID	* 8mm $^{+.019}_{+.010}$	.035 – .059mm	.120mm
	Valve Stem OD	8mm $^{-.025}_{-.040}$		

*NOTE: XS2-106692~: GUIDE I.D. : 8mm $^{+0.040}_{+0.030}$ =

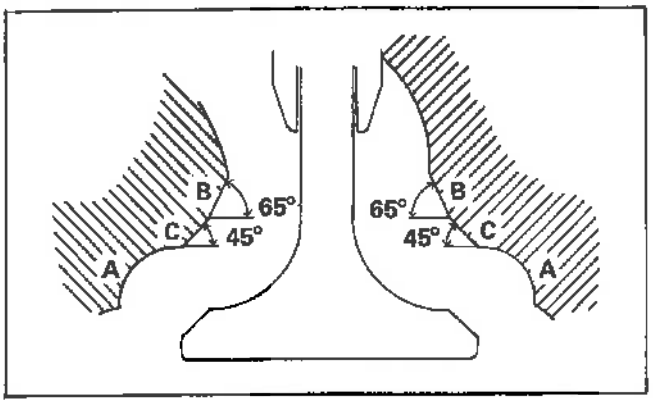
INT.	.040–.065mm	.110mm
EXH.	.055–.080mm	.130mm

13) Grinding the Valve Seat

a) The valve seat is subject to severe wear similar to the valve face. Whenever the valve face is resurfaced, the valve seat should also be resurfaced at a 45° angle. In addition, if a new valve guide has been installed (without any valve repair), the valve seat should be checked to guarantee complete sealing between the valve face and seat.

CAUTION

If the valve seat is obviously pitted or worn, it should be cleaned with a valve seat cutter. Use the 45° cutter, and when twisting the cutter, keep an even downward pressure to prevent chatter marks.



If cutting section 'A' of the intake valve seat, use cutter int. 3R (radiused cutter). If cutting section 'A' of the exhaust valve seat, use cutter EXH 8R (also radiused).

If cutting section "B", use the 65° cutter.

If cutting section "C", use the 45° cutter.

b) Measure valve seat width. Apply mechanic's blueing dye (such as Dykem) to the valve face, apply a very small amount of fine grinding compound around the surface of the valve seat, insert the valve into position, and spin the valve quickly back and forth. Lift the valve, clean off all griding compound, and check valve seat width. The valve seat will have removed the blueing wherever it contacted the valve face.
Measure the seat width with vernier calipers. It should measure approximately 1.3 mm. Also, the seat should be uniform in contact area. If valve seat width varies, or if pits still exist, then continue to cut with the 45° cutter. Remove just enough material to achieve a satisfactory seat.

c) If the valve seat is uniform around the perimeter of the valve face, but is too wide or not centered on the valve face, it must be altered. Use either the "R" (radius), 45°, or 65° cutters to correct the improper seat location in the manner described below:

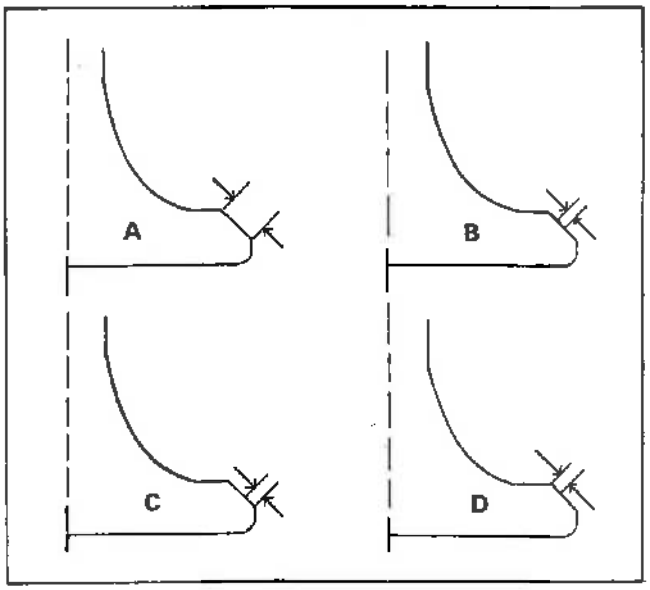
	Standard Width	Wear Limit
Seat Width	1.3mm (.051")	2.0mm (.078")

(A) If the valve face shows that the valve seat is centered on the valve face, but too wide, then lightly use both the "R" and the 65° cutters to reduce the seat width to 1.3 mm.

(B) If the seat shows to be in the middle of the valve face, but too narrow, use the 45° cutter until the width equals 1.3 mm.

(C) If the seat is too narrow, and right up near the valve margin, then first use the "R" cutter and then the 45° cutter to get the correct seat width.

(D) If the seat is too narrow and down near to bottom edge of the valve face, then first use the 65° cutter and then the 45° cutter.



14) Lapping the Valve/Valve Seat Assembly

a) The valve-valve seat assembly should be lapped if; (1) neither the seat nor the valve face are severely worn, or: (2) if the valve face and valve seat have been resurfaced and now require a final light grinding operation for perfect sealing.

b) Apply a small amount of coarse lapping compound to the valve face. Insert the valve into the head. Rotate the valve until there is a burnished spot all the way around the valve face. Clean off the coarse compound, then follow the same procedure with fine compound. Continue lapping until the valve face shows a complete and smooth surface all the way around. Clean off all compound material. Apply blueing dye to the valve face and rotate the valve face for full seat contact which is indicated by a shiny surface all around the valve face where the blueing has been rubbed away.

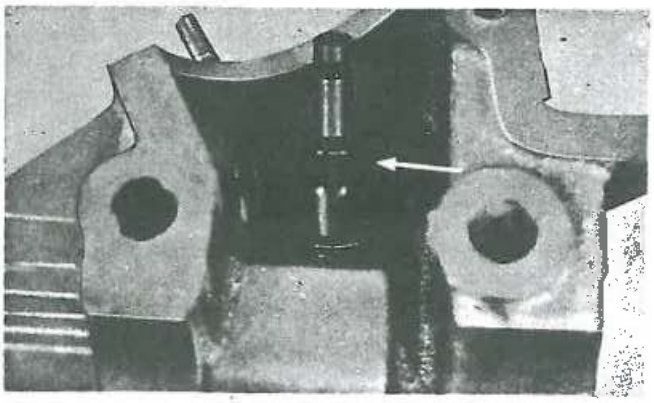
NOTE:
The valve can most easily be rotated if a section of flexible rubber hose of 5/16" ID is slipped over the valve stem and spun.

15) Valve Leakage Check

a) After all work has been performed on the valve and valve seat, and all head parts have been assembled, check for proper valve-valve seat sealing by pouring solvent into each of the intake ports, then the exhaust ports. There should be no leakage past the seat. If this fluid leaks, disassemble the valve assembly and continue to lap with fine compound. Clean all parts thoroughly, reassemble and check again with solvent. Repeat this procedure as often as necessary to obtain a satisfactory seal.

16) Valve Stem Seal

a) This seal slips down over the valve stem to prevent excessive amounts of oil from passing down stem and into the combustion chamber. If this seal is cracked, split, or hardened, replace it.



16) Valve Springs

a) Both inner and outer springs must sit vertical when on a flat surface. Check with a square. If not vertical, replace, as spring will cause valve to "cock" in guide, causing excessive wear.

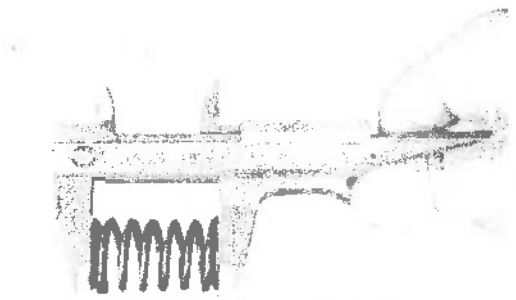
b) Both inner and outer springs are "Butt-ground" to provide verticality (see 17-a, above) and full seating. If less than 3/4 of the O.D. of the spring fits flush against its seat or collar, replace it. Otherwise, the condition in 17-a, may occur.

c) The XS650 engine uses two springs of different size to prevent valve float or surging.
The chart below shows the basic value characteristics.

VALVE SPRING SPECIFICATION CHART

	OUTER	INNER
Diameter of wire	4.2 mm.	2.9 mm.
Direction of winding	Right Hand	Left Hand
Total Winding	6.25	8.0
Free Length	42.55 mm.	42.0 mm.
Installed Length (Valve Closed)	37 mm.	35.0 mm.
Installed Pressure	17.7 ±1.25 kgs. (39.02 ± 2.75 lbs.)	10 ± 0.7 kgs. (22.05 ± 1.54 lbs.)
* Compressed Length (Valve Open)	27.5 mm.	25.5 mm.
Compressed Pressure	57.5 ± 4.0 kgs. (126.78 ± 8.82 lbs.)	27.2 ± 1.9 kgs. (59.97 ± 4.19 lbs.)
* Measured without collar. Tolerance: ± 3%		

d) Even though the spring is constructed of durable spring steel, it gradually loses some of its tension. This is evidenced one way by a gradual shortening free length. Use a vernier caliper to measure spring free length. If the free length of any spring has reduced more than 2 mm (.080") from its specification, replace it.

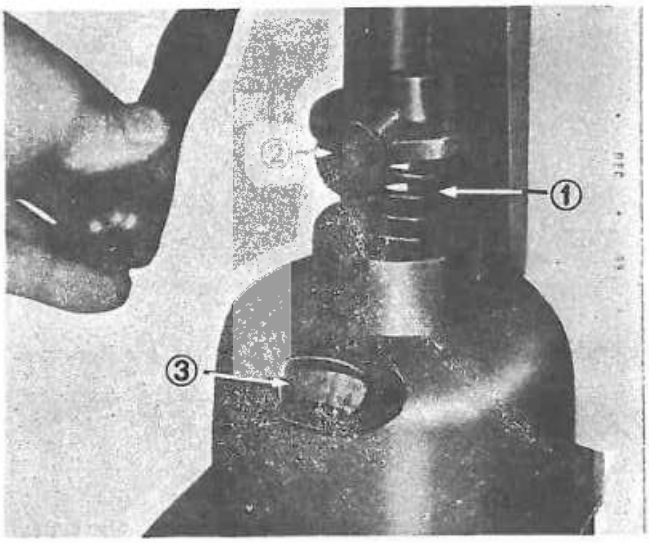


e) Another symptom of a fatigued spring is insufficient spring pressure when compressed. This can be checked using a valve spring compression rate gauge.

(1) Individual spring

(2) Length measuring scale

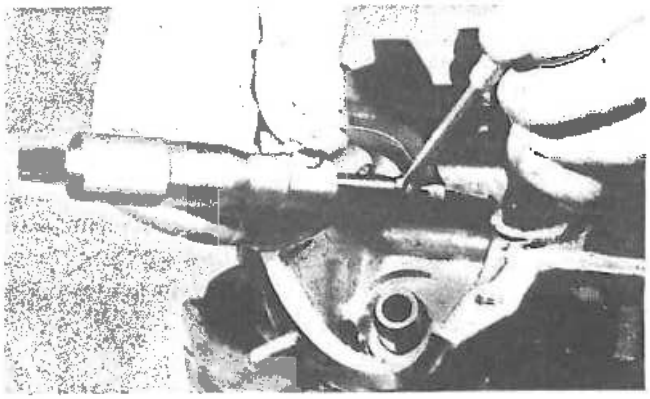
(3) Pounds pressure scale



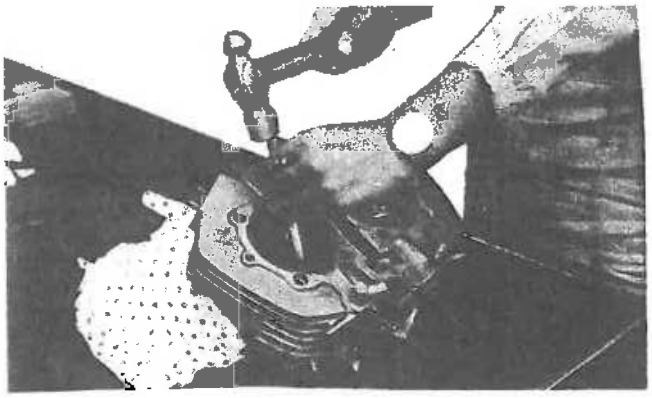
Test each spring individually. Place it in the gauge and compress the spring first to the specified compressed length with the valve closed (all spring specifications can be found in previous section, Valve Spring) then to the length with the valve open. Note the poundage indicated on the scale at each setting. This procedure must be performed on the outer springs, then the inner springs. Take several readings and "average" results.

18) Valve Guide

a) The inside diameter must be measured with a ball gauge. Measure at each end and in the center of the drilled passage. Compare this measurement, using the largest measurement of these spots, with factory specifications listed in Valve Description. If this measurement exceeds the maximum tolerance, replace the guide.



b) The valve guide is replaceable. It is held in the head by an interference fit of approximately .04 mm (.0015"). To ease guide removal and reinstallation, and to maintain the correct interference fit, heat the head to 200~400° Farenheit. If possible, use an oven to avoid any possibility of head warpage due to uneven heating.

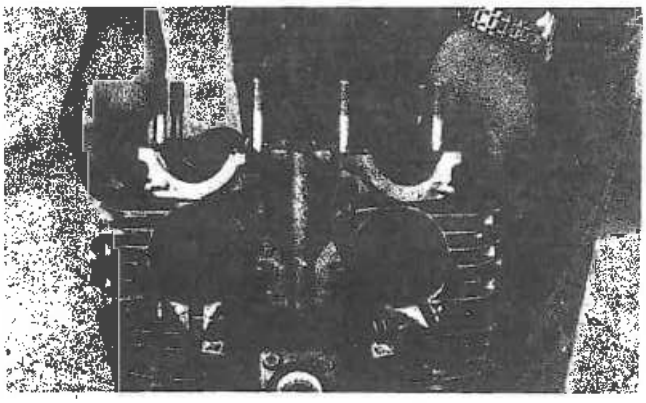


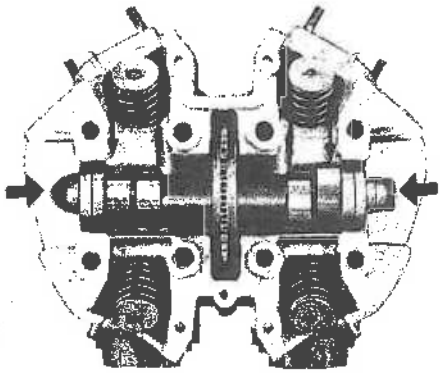
c) Use the appropriate shouldered drift (Special Tools Kit) to drive the old guide out and the new guide in.

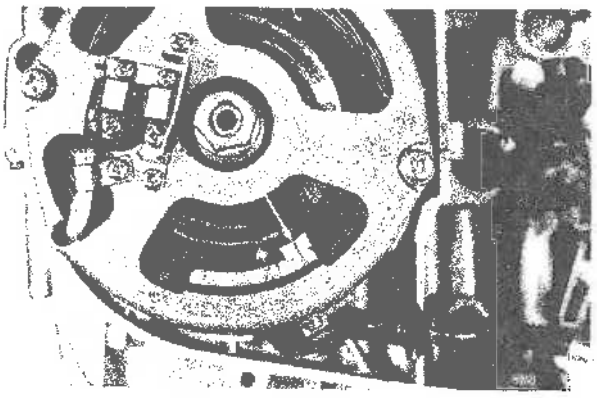
19) Installing the Head

a) A new head gasket must be installed. The gasket can correctly fit only one way. Slip the cylinder head over the studs and onto the cylinder.
b) While performing this step push the cam chain safety wires up through the slot in the head and pull the cam chain up. Install and tighten both retaining bolts and the one 6 mm screw.

NOTE:
After completing this phase, plug the spark plug holes to prevent anything from dropping into the cylinder.

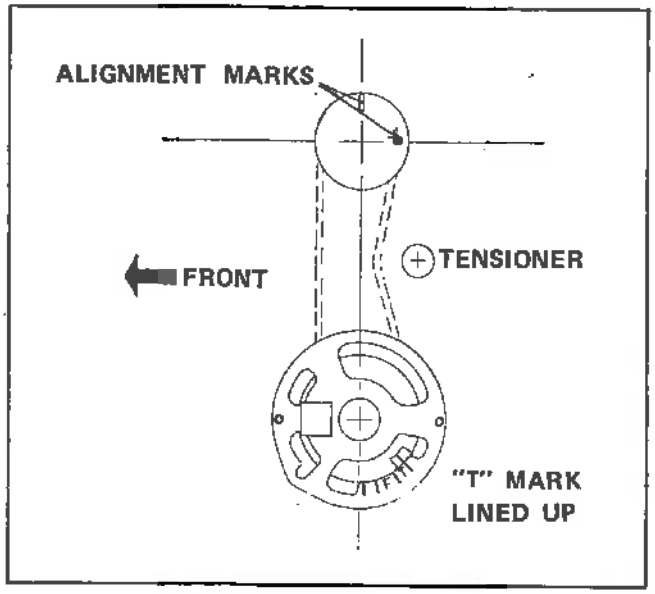






b) Next, rotate the pistons to TDC, as varified by lining up the rotor timing mark with the "T" (top) mark on the stator.

If the stator has been removed, use the "dowel pin" process described in the Valve Timing section carefully equalizing the "dead point" of piston travel by turning the crankshaft forward and backward a few degrees at TDC. Make sure the piston is at the top of its compression stroke first. Otherwise, an opening valve may catch the dowel pin.



20) Installing and Timing the Camshaft

a) Slide all cam bearings in toward the center of the camshaft as far as possible. Place the camshaft into position with the camshaft threaded end on the right-hand side. Holding both cam bearings in toward the cam sprocket, move the cam back and forth until the cam chain driven sprocket is aligned with the crankshaft drive sprocket. This can be determined by observing the position of each cam bearing in its bearing boss. The inner bearing on each side must be overlapping equal distance from the inner edge of the cam bearing bosses.

c) There is a groove in the left side of the cam sprocket. Position this groove so that it lines up with the sprocket centers. This can be checked. The punch mark on the camshaft sprocket must be parallel with the head gasket surface. Lay a straight edge across the head surface and check the punch mark.

d) Reconnect the cam chain. The chain tensioner has been loosened during disassembly. Therefore, the cam chain will have excessive slack. To avoid incorrect timing, the cam chain should be installed with no slack in the cam chain on the front portion (opposite side from the tensioner). Any slack on the back chain portion can be taken up with the tensioner.

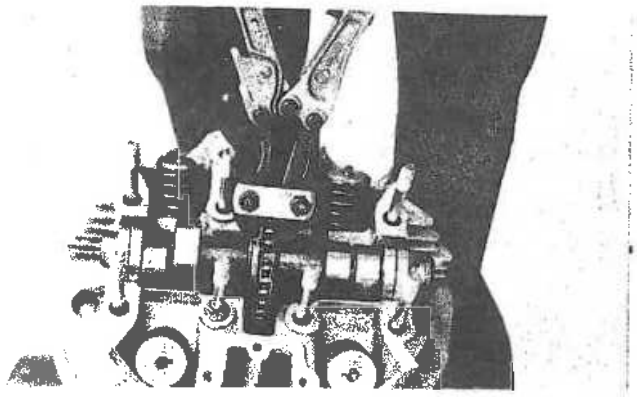
e) Join the chain together by installing and riveting a new chain link. Always use a new link each time the chain is reconnected. (Use a chain riveter, not a hammer and punch, to mushroom the rivet ends). The Parts Book lists the replacement link to use.

IMPORTANT

Make the proper chain tension adjustment.

f) **After completing the cam chain adjustment recheck the rotor timing mark and cam sprocket timing groove positions to guarantee that they did not rotate out of position during chain installation.**

(See #25)



21) Checking Valve Timing With a Degree Wheel

If the camshaft is not timed to open the valves in correct relation to crankshaft rotation, performance will be poor and engine misfire can occur.

a) Important. Make sure the cam chain tensioner has been properly adjusted.

b) Adjust all valves to special valve timing clearances. (.012" Intake; .012" Exhaust; engine COLD.)

c) Remove the left-hand case cover and stator. Mount the degree wheel to the rotor lock bolt.

d) Remove a spark plug and a place wooden dowel pin in the hole. Rotate the engine in a counterclockwise direction (from left side) and find Top Dead Center on the compression stroke (valves are both closed) by watching the piston rise and fall as indicated by dowel pin position.
Mount a pointer at the degree wheel so that it points to "O" on the wheel with the engine at TDC.

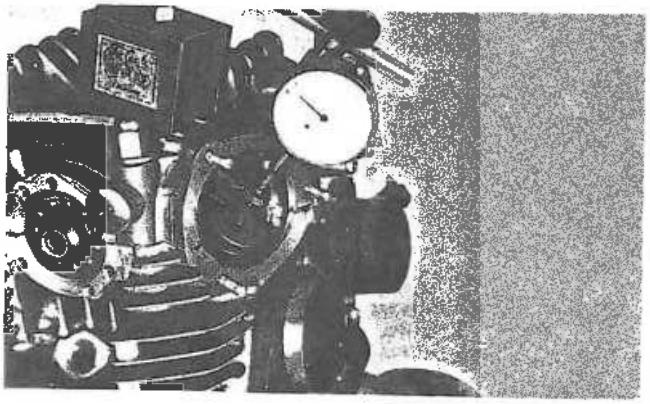
e) Mount the dial indicator over an intake valve tappet adjustor.

f) Rotate the crankshaft in a counter-clockwise direction (from left side). Watch the mounted dial indicator. Note when all clearance is taken up and the valve just starts to open.

g) Check the pointer position (in degrees on the wheel). The dial indicator should show the valve open 47° before top dead center after all valve tappet clearance has been taken up. Remember, "O" on the degree wheel is Top Dead Center. The intake valve must close 67° after bottom dead center; a total of 294°.

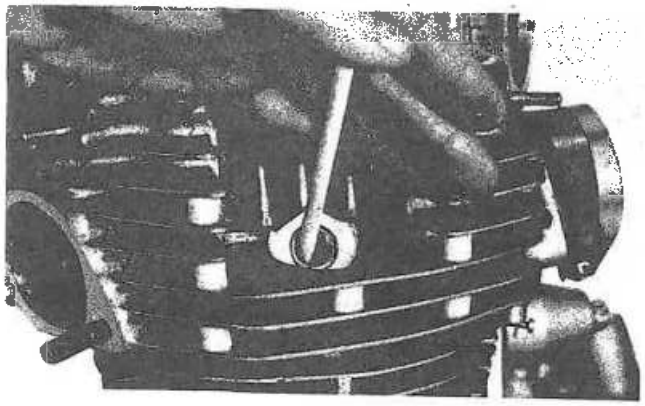
h) If the valve starts to open 37° or 57° before top dead center, the camshaft sprocket is one tooth off in its alignment with the crankshaft sprocket. The cam chain must be loosened and the camshaft rotated to its correct position.

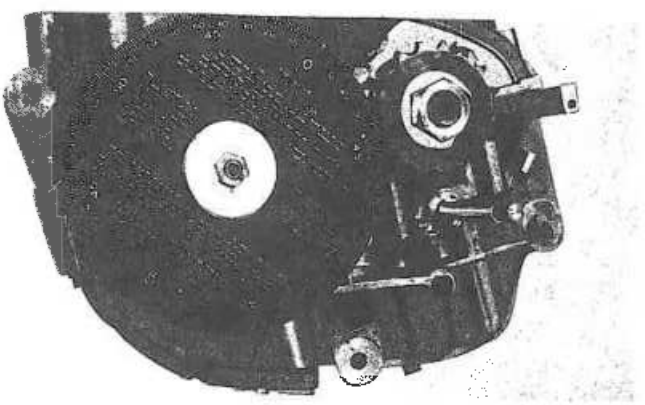
i) **Reset the valve clearance back to standard specifications .003" intakes .006" exhaust.**



NOTE:

Valve timing is off by approximately 10° for every tooth the camshaft sprocket is misaligned. Always reset valves to "Running" tolerances after checking timing.



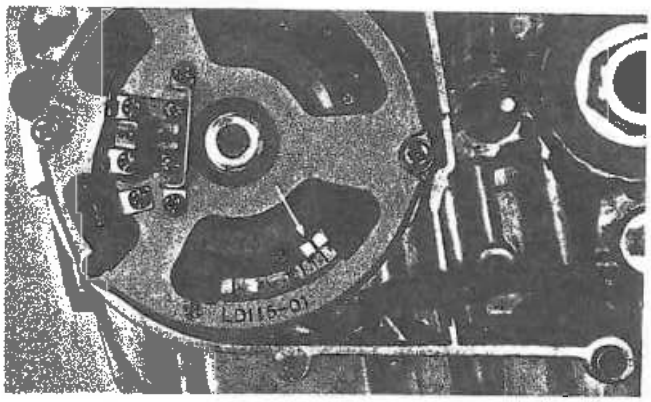


22) Valve Adjustment

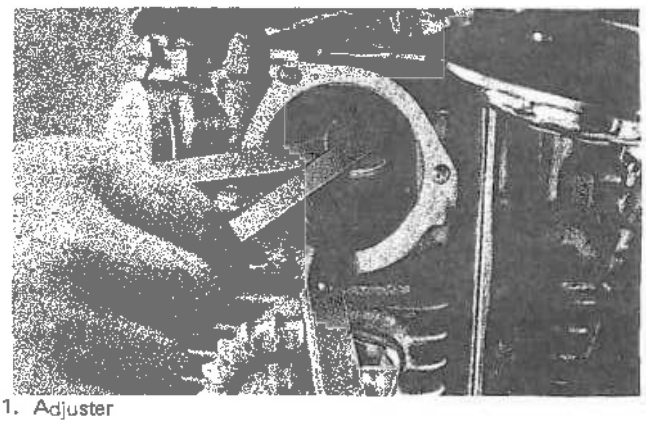
Improper valve clearance causes poor engine performance and possible engine damage. If there is too little clearance, the valve is held partially open. This permits blowby past the valve and drop in compression. If there is too much clearance there will be excessive engine noise and the valve will not open fully which will create partial blockage of airflow at the port.

a) Remove all four tappet covers and the alternator cover.

b) Next, align the "T" mark on the stator with the timing mark on the rotor. This places the pistons at top dead center. One of the cylinders is now at the top of its compression stroke. The cylinder that is on the compression stroke has both valves shut. This can be noted by observing which cylinder has clearance at both valve adjustors.



c) Use a feeler gauge to determine the existing clearance. The exhaust valve clearance should measure .15mm (.006"), the intake clearance should measure .076mm (.033"). (engine cold)



1. Adjuster
2. Lock nut
3. Tappet clearance

d) Loosen the lock nut and use the valve adjusting tool found in the XS1B Tool kit. Turn the adjustor in or out to obtain the correct clearance. Hold the adjustor solid to prevent it from moving and thoroughly tighten the lock nut. Recheck the clearance after tightening.

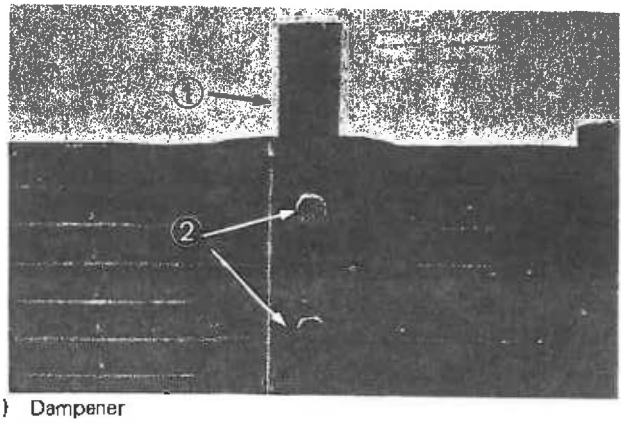
e) Rotate the crankshaft one complete revolution and once again line up the rotor and stator marks. The valve train of the other cylinder is now in position for adjustment.

CAUTION

ADJUST TAPPET CLEARANCE ONLY WHEN THE ENGINE IS COLD.

23) Cam Chain Vibration Dampener (opposite the tensioner)

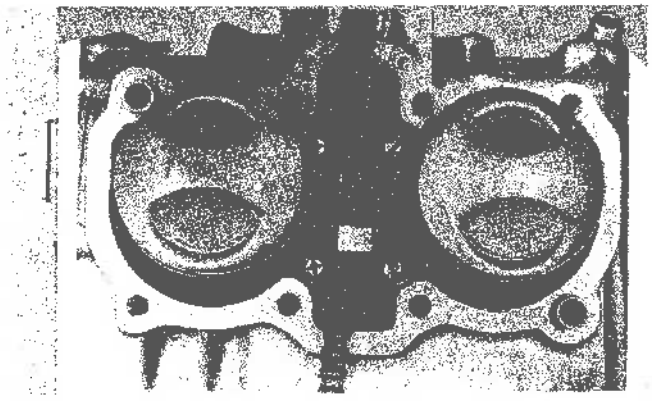
a) This rubber dampener (1) prevents the cam chain from bowing out because of chain weight and engine rpm. It is located in the hollow cavity between the cylinders and to the front, opposite the tensioner. It receives little abuse from the chain and should last indefinitely. However if the cam chain loosens sufficiently to rub hard against the rubber dampener it could wear out. It is held in place by two bolts (2) at the front of the cylinder. Remove these two bolts to lift the dampener out.



(1) Dampener
(2) Set screws

24) Cam Chain Idler Assembly (in engine case)

a) The rubber faced dampener supports the cam chain, helping to keep it running straight between the camshaft sprocket and crankshaft sprocket.



b) The entire unit mounts in the top engine case half; in the center cavity between the two pistons. Remove the four securing screws and (after the cylinders are removed) the unit can be removed.
Check for tearing or excessive wear.

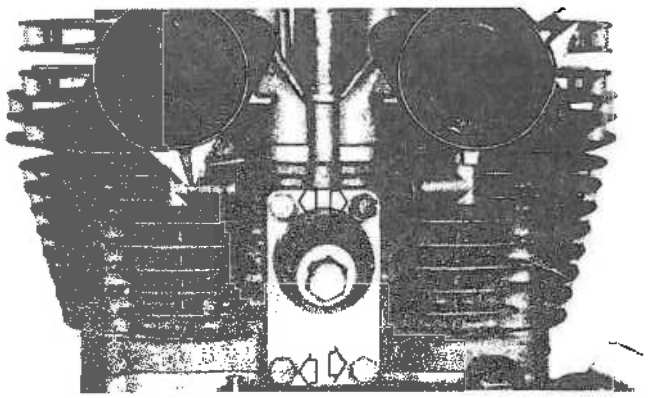
c) Note the position of the two slotted screws, these have a tapered shoulder for proper location in the cases, during reassembly replace as shown.

25) Chain Tensioner

a) The chain tensioner consists of a steel wheel that is held against the cam chain by a spring and a locked in-place push rod. This roller (which spins on needle bearings) takes up any free play in the chain. In addition, a rubber dampener solidly mounted to the tensioner arm, just below the steel wheel, helps to guide the cam chain. Because of gradual chain wear, an adjustment is required periodically.

b) Four 6 mm bolts hold the tensioner housing in place. Remove these and pull the unit out of the cylinder.

c) Reverse this procedure to install the unit. During installation, install a new gasket coated on both sides with Yamaha Bond #4.

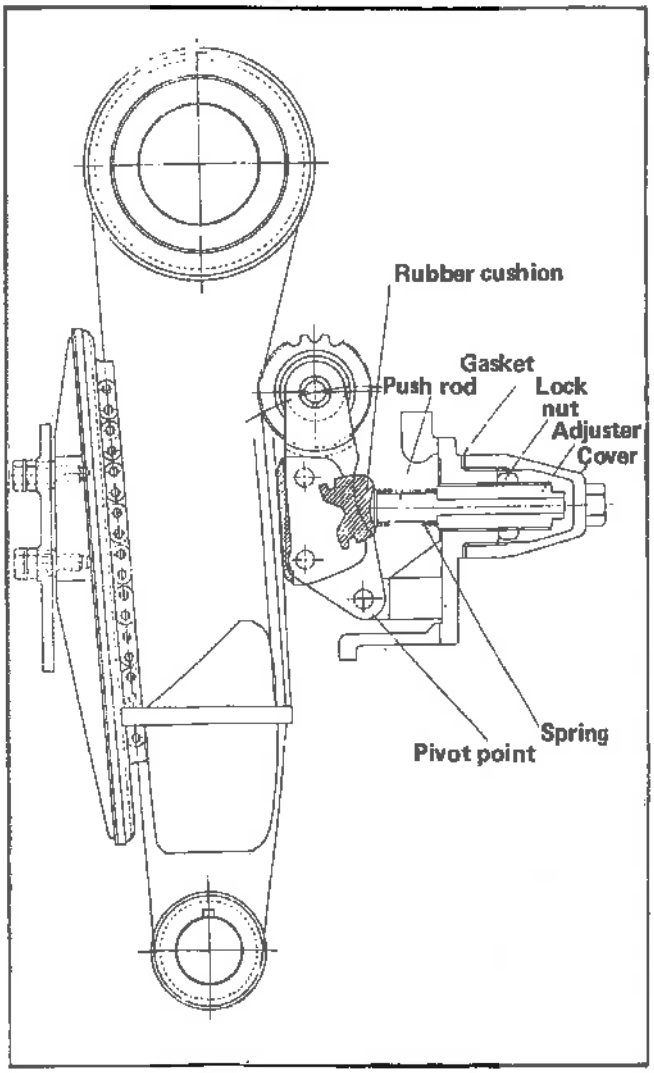


d) **Rotate the crankshaft in a counterclockwise direction (from the left side of the engine) to place all slack in the area of the chain tensioner.**

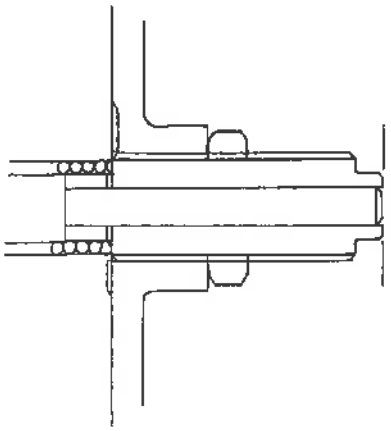
e) Remove the cast metal protective cover.

f) Loosen the tensioner lock nut.

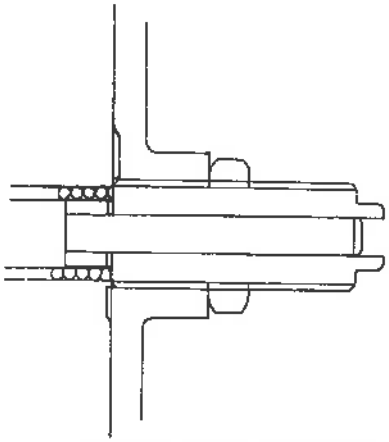
g) Use a 22 mm wrench to turn the adjustor in until the push rod (inside adjuster) is flush with the end of the adjustor.



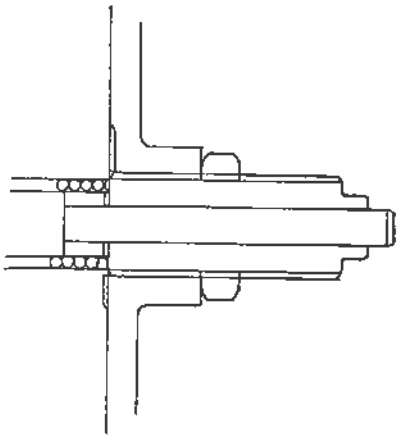
h) Tighten the lock nut and install the cover. Check this adjustment every 2,000 miles.



Tensioner correct



Tensioner needs adjustment



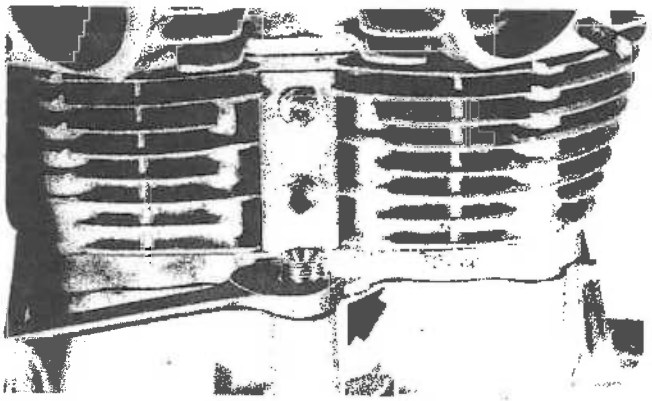
Tensioner needs adjustment

F) Cylinder & Piston Assembly

The cylinder is constructed of aluminum with cast iron sleeves. It has a cavity down the center of the cylinder that serves two purposes. First, it provides a channel for the cam chain to run in between the camshaft and the crankshaft. Secondly, it provides a space for air circulation that aids in cooling both cylinders.

1) Cylinder Removal

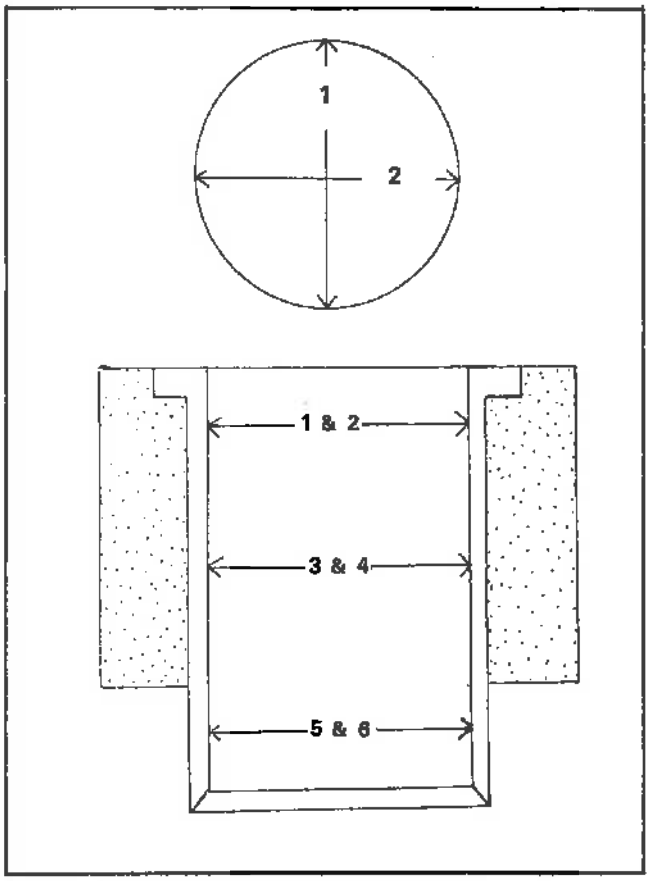
a) With the head cover and cylinder head removed, remove the oil line fitting at the front base of the cylinder. The cylinder is now free to be lifted off. The cylinder might have to be tapped a few times with a rubber hammer to break the base gasket adhesion. As the cylinder is lifted for removal, place shop rags in the crankcase opening beneath both pistons to keep any contamination or parts (such as circlips) from dropping into the crankcase.



2) Cylinder Wear and Repair Procedures

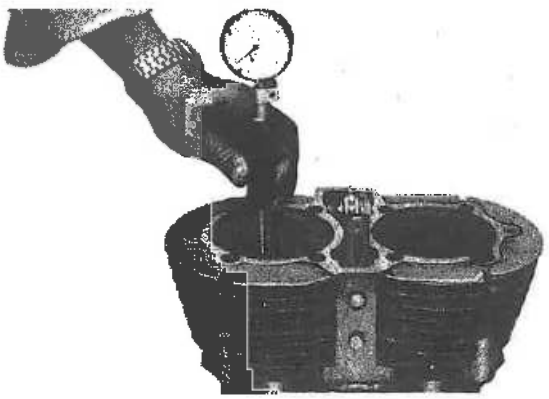
a) Constant friction between the bore and piston, plus microscopic particles of contamination that enter through the intake, cause a gradual wear of the bore. This wear can be detected by measuring various points in the bore and comparing these measurements against standard specifications.

b) This drawing shows the places to take bore measurements with a cylinder measuring gauge (tool available through Yamaha International).



c) Subtract the bottom bore measurement from the top bore measurement. The difference between these two dimensions is called the cylinder "taper". Check to see if the amount of taper is still within specified limits.

	Standard	Wear Limit
Cylinder Bore (mm)	75	75.1
Cylinder Taper (mm)	.005	.05



d) The bore might be lightly damaged with scratches or nicks. Run a hone through the bore a few times to see if the bore cleans up. If these scratches are too severe, a hone cannot remove them, and a cylinder rebore would be necessary. (Pistons are available in four oversizes: .25mm, .50mm, .75mm and 1.0mm.)

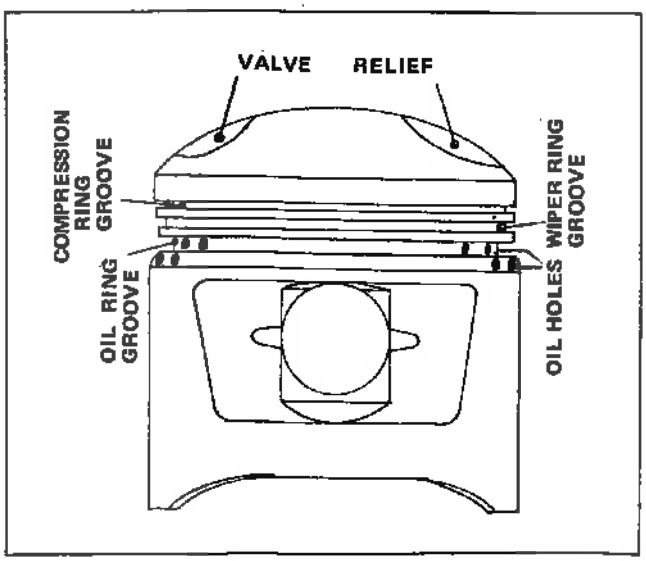
NOTE:
The hone should be used in a low rpm drill and the hone should be moved back and forth through the entire bore at an even speed. This should result in a "cross-hatch" pattern which aids ring seating.

e) If the cylinder has been in use many miles, a ridge may form at the upper edge of the bore. This is mostly carbon. Normally this ridge can be removed by scraping with a soft scraper (to prevent damage to the bore). This ridge is automatically removed if the cylinder is bored out. Care should be taken that the ridge is completely removed if the cylinder is just to be honed. If scraping does not remove the ridge, previous to honing, a ridge reamer must be used to finish removing the ridge (reamer is commercially available).

3) Piston

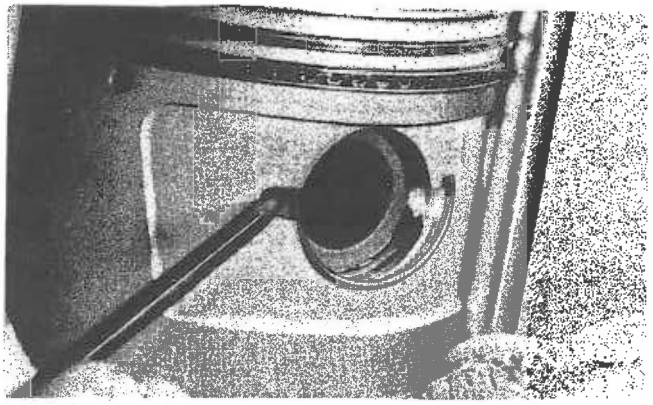
The piston crown is domed. It also has two relief areas for valve head clearance during engine operation. The relief areas are unequal in size since the intake valve is larger than the exhaust. An arrow is stamped on the crown to indicate piston position for installation. The piston should be installed with the arrow pointing forward.

Oil drain holes have been drilled in the oil scraper ring groove and in the piston wall just beneath the bottom groove. This provides an escape path for oil scraped off the cylinder wall. It also provides a path for lubrication to the piston pin and bearing.

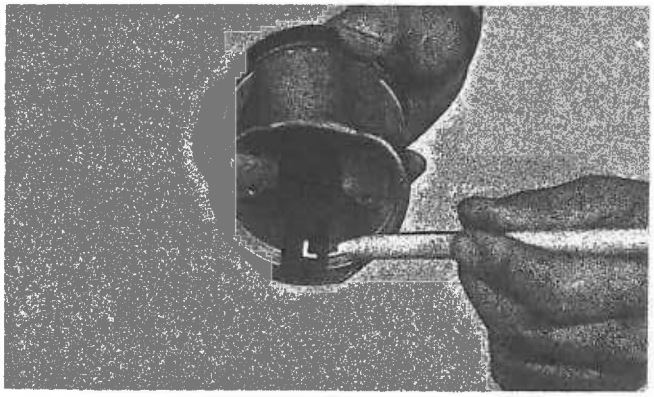


4) Piston Removal

a) Remove the outer circlip from each piston. Support the piston by hand and push out the piston pin using a soft drift (do not use a hammer). Lift the piston off and set it to one side with the piston pin.



b) Each piston must be marked as to which cylinder it came from to ensure identical match-up during re-installation. Lightly scribe an "L" inside the left piston skirt and an "R" inside the right piston skirt.



5) Piston Wear

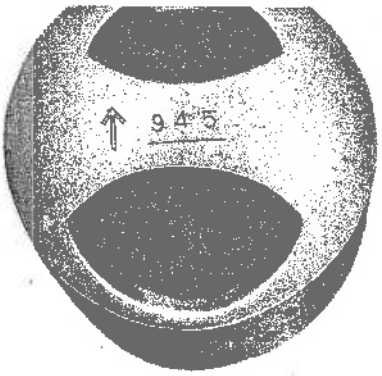
a) First, check the piston for cracked or broken sections; including the crown, ring lands, and skirt. Also check the piston crown for possible metal disintegration due to excessive heat in the combustion chamber.

b) If severe score marks are found on the skirt, this can be attributed to insufficient lubrication sometime during engine operation or improper clearance. If these marks can be removed with fine emery cloth the piston can be used again.

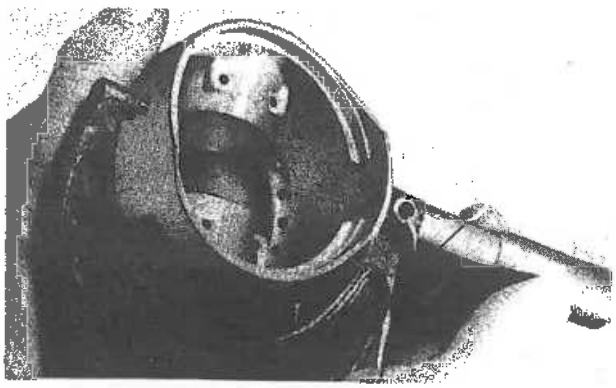
c) All of the above wear conditions may require piston replacement (except as noted). If a defective piston is reinstalled, the engine will not perform satisfactorily and premature engine failure may occur.

d) Check for additional wear by measuring piston diameter 20 mm (3/4") from the bottom of the skirt and at right angles to the piston pin holes. Piston standard size is 75 mm.

e) Standard piston wear usually does not exceed .02 mm. This measurement is important when determining piston-to-cylinder clearance.



Piston size mark



Measuring maximum piston diameter

6) Piston Clearance

a) Piston-to-bore clearance is the difference between minimum cylinder bore measurement and maximum piston diameter. Standard clearance is .050—.055 mm (.0020"—.0022"). If measurements prove that the clearance equals .10 mm or more, it is excessive, and one of two corrective measures must be taken to bring the clearance back within tolerances.

b) **First if cylinder taper is within tolerances, and if** the cylinder can be cleaned up by honing, then obtain a larger size standard piston that is large enough to obtain the correct clearance.

c) **Secondly bore and hone out the cylinder to the size of a first oversize piston, plus the correct clearance.**

d) **How to Calculate Standard Size Piston-to-Cylinder Clearance from Stamped Numbers**
Nominal piston standard size is 75 mm. The number stamped on the piston crown is the actual size. (The 74 is dropped.)

EXAMPLE:

.954 on crown really means 74.954 mm piston diameter, or .046 mm undersize.

Cylinder standard bore size is marked in large numbers on the very bottom of the cylinder. It equals 75 mm PLUS the amount marked.

EXAMPLE:

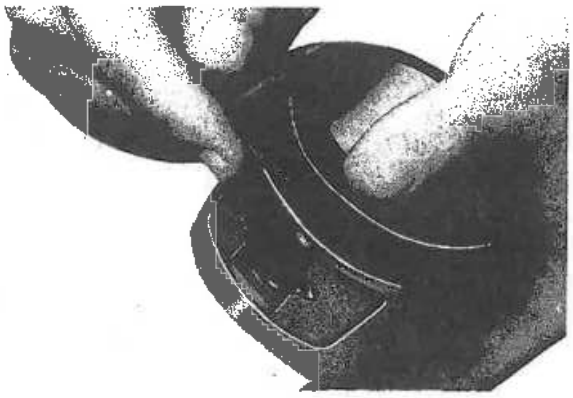
.007 marked on cylinder really means 75.007 mm cylinder bore, or .007 mm oversize.
If the above piston is used with this cylinder, total clearance would be .053 mm (.0021").

EXAMPLE:

75.007 (Cylinder)
—74.954 (Piston)
.053 (Clearance)

7) Cleaning Piston Ring Grooves

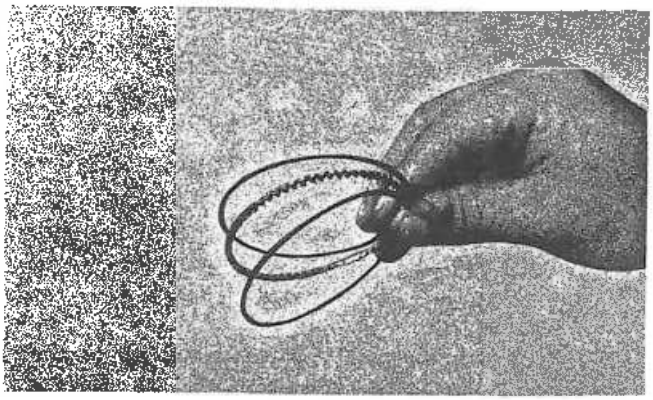
a) Carbon and varnish gradually build up in the ring grooves. Remove the rings and use the blunt end of a discarded ring to clean all carbon from the grooves. The oil ring (bottom) should not require this procedure. Check to make sure the oil relief holes are not blocked.



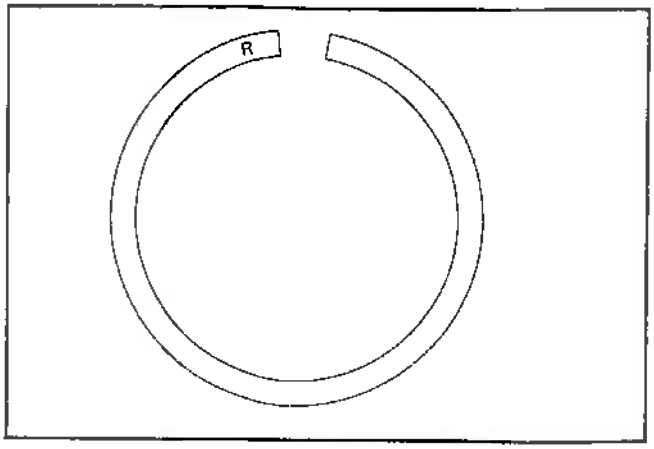
8) Piston Ring Removal and Installation

The piston is equipped with three rings. Remove them in sequence, starting with the top ring. Installation of these rings is basically a reversal of the above process, except for the bottom (oil control) ring.

a) Oil control Ring Installation (Installed first):
The oil control ring consists of three separate parts, two identical rails and one expanding spacer. First, slip the spacer over the piston, and into the bottom groove. Neither rail has a particular top side. So, install one rail into the bottom part of the groove and then position the last rail, either side up, into the top part of the groove. Finally, position the three end gaps approximately 120° from each other.

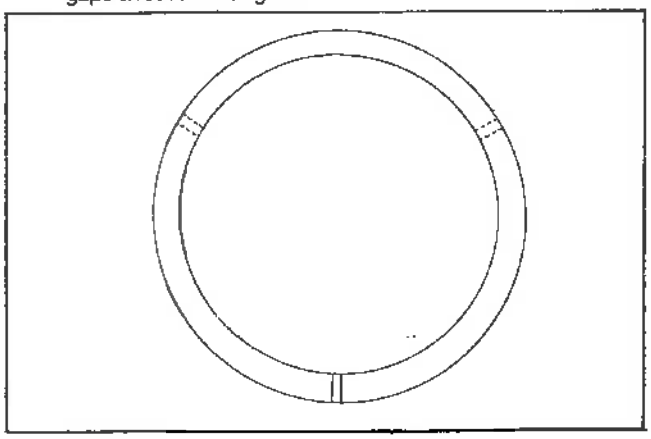


b) Middle and Top Ring Installation:
Install the middle ring and top ring. Each ring is stamped with an "R" on one side that must face up toward the piston crown when installed.



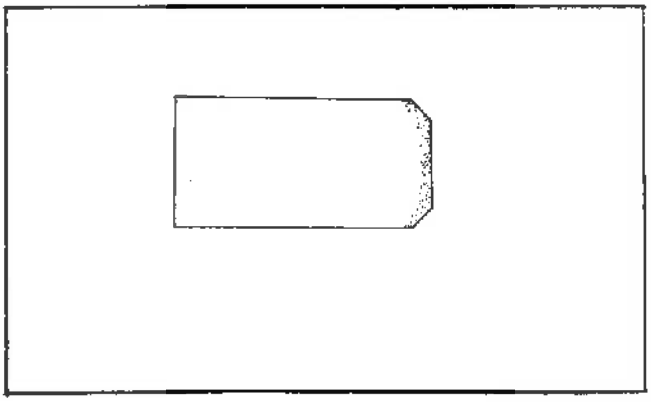
c) Spacing of All Ring End Gaps:
All ring end gaps must be off-set from one another to prevent the leakage of compression and oil.
Stagger their positions evenly around the perimeter of the piston.

NOTE:
The oil control ring has three gaps. Use the top rail's gap to judge where the compression and wiper ring gaps should be aligned.

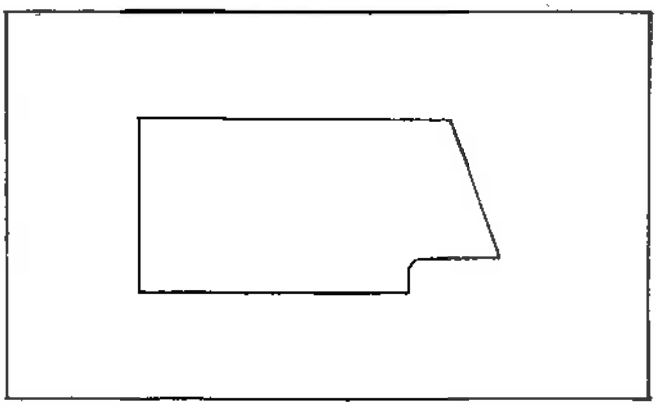


9) Piston Ring Description

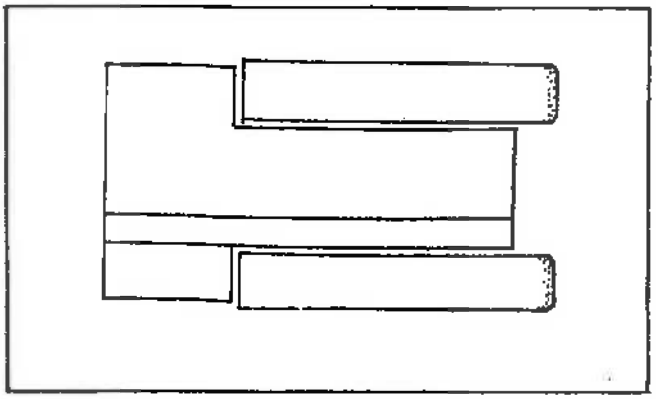
a) Top ring:
This is the compression ring. It must provide efficient sealing and must be able to withstand the greatest amount of heat. The outer edge is chrome plated for wear and heat resistance. Both outer edges of this ring are beveled (see the drawing of ring cross-sectional view) to provide a good compression sealing edge.



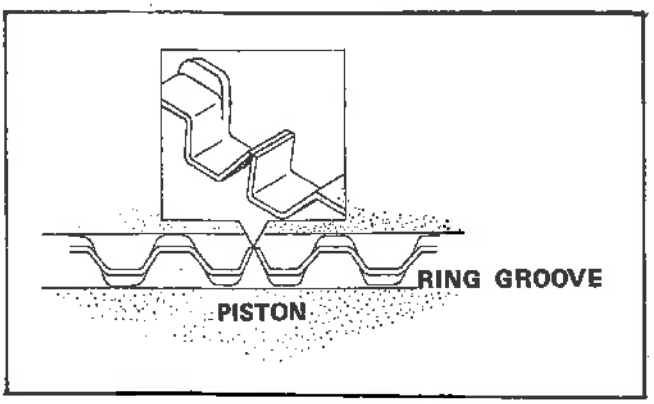
b) Middle ring:
This second ring is cast iron. It serves as a "wiper" ring to scrape excess oil from the cylinder wall. The bottom of the ring is notched to aid this process. It flexes slightly, which provides a narrow and effective scraping edge.



c) Bottom ring:
This ring's purpose is to trap and remove oil from the cylinder wall. The ring consists of three separate components: top and bottom spring steel rails, and a stainless steel wave type expanding spacer. Oil is trapped between the two rails and is forced out the holes drilled in the piston ring groove. The rail outer edge is chrome plated to resist wear.

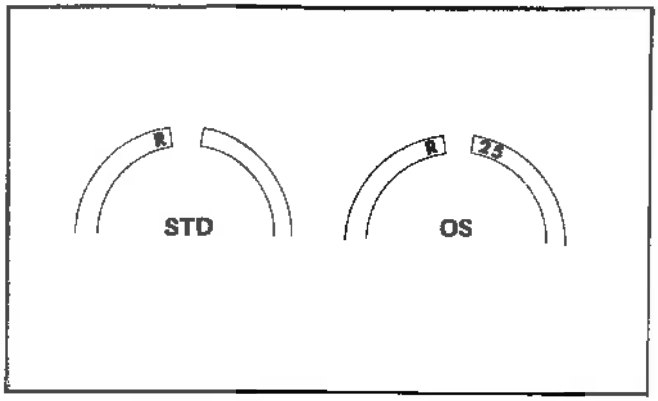


d) The expander spacer, because of its design, pushes both rails against the ring groove sides. In addition, the spacer is equipped with a projecting inner lip that pushes both rails out, creating an excellent oil trapping action.



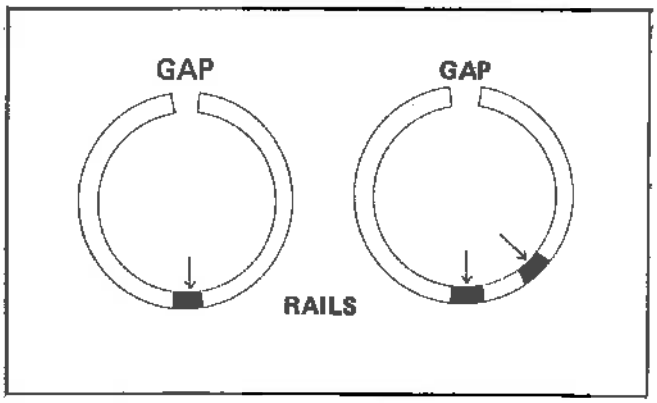
10) Piston Ring (standard and oversize) Identification Code

a) The oversize top and middle ring sizes are stamped on top of the ring.



SIZE (mm)		MARK
Standard		None
Oversize	1st	25
	2nd	50
	3rd	75
	4th	100

b) All three pieces of the bottom (oil control) ring are color-coded to identify sizes. The color marks are painted on the ring, 180° opposite the end gap (see next page).



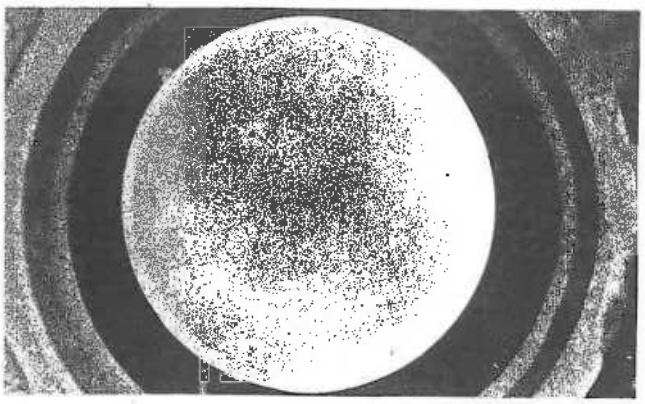
SIZE		COLOR	
Standard		Blue	(1 mark)
Oversize 1st	25 (0.25mm)	Blue	(2 marks)
2nd	50 (0.50mm)	Red	(1 mark)
3rd	75 (0.75mm)	Red	(2 marks)
4th	100 (1.0 mm)	Yellow	(1 mark)

11) Piston Ring Wear

a) All three rings experience the same type of wear. Any check applied to one ring can be used to also test the others.

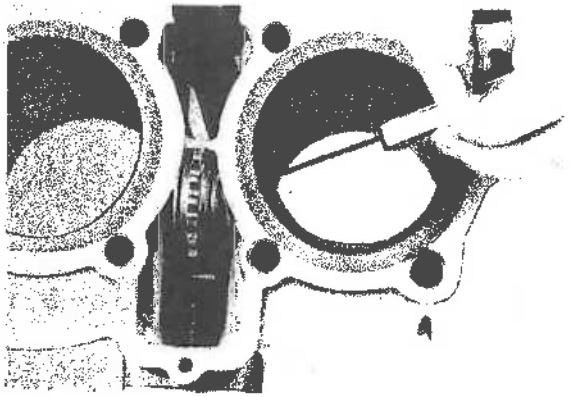
b) Before checking for wear, clean all carbon from the ring surface. This insures an accurate wear check.

c) Check for gaps between the ring contacting edge and the cylinder wall. Push the ring into the bore (with an inverted piston to make sure it is not cocked). Slip a piece of white paper beneath the cylinder bore (for visual contrast) and check the outer perimeter for visible gaps between the ring and the cylinder wall.



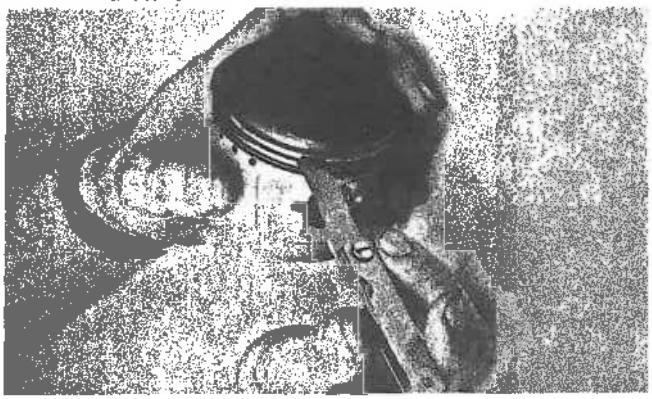
d) With the ring still positioned in the bore, check end gap clearance with a feeler gauge. Standard specifications and maximum wear limits are listed below.

NOTE:
The end gap on the expander spacer of the oil control ring is unmeasurable. If the oil control ring rail(s) show excessive gap all three components should be replaced.



	Standard Gap(mm)	Wear Limit
Compression Ring	.2 – .4	.8
Wiper Ring	.2 – .4	.8
Oil Control (Rails)	.3 – .6	1.0

e) Piston ring/ring groove fit must have correct clearance. If the piston and ring have already been used in the engine, the ring must be removed, the ring groove cleaned of carbon, and then the ring should be reinstalled. Use a feeler gauge to measure the gap between the ring and the land. The standard tolerance is .0016" (0.04 mm) to .0032" (0.08 mm). The wear limit is .006" (.15 mm) maximum allowable clearance.



f) NOTE: There must be no side gap clearance at all on the oil control ring. If any clearance exists, the expander spacer has become fatigued. Replace the ring.

g) If any of the previous three wear checks prove any of the rings to be worn beyond acceptable tolerances, REPLACE THE ENTIRE SET.

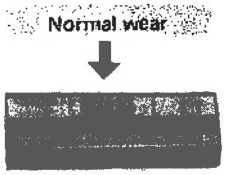
CAUTION

Whether the rings are new or used, they must always be checked for correct ring end gap clearances. This applies to all three piston rings.

12) Piston Pin

NOTE: Early XS1's utilized a needle-type wrist pin bearing. This was dropped in favor of "bushing-type" design.

a) The piston pin does not spin in a bearing. Instead, the small end of the connecting rod has been hardened so that the rod small end boss acts as an integral bushing type bearing for the pin. If continuous operation creates a groove in the pin surface, replace the pin and examine the rod small end boss for possible replacement. A dull finish at the center section of the pin may be noticed. This is normal operating wear and does not indicate a defective pin (unless this dull surface is pitted).



b) Check the pin for blue discoloration. This discoloration is caused by heat and is an indication of inadequate lubrication. The pin should be replaced and the lubrication system and rod checked.

CAUTION

Whenever the piston pin is replaced, check the connecting rod small end for wear which might require rod replacement.

13) Piston Installation

a) Lubricate the piston pin with oil prior to piston installation.

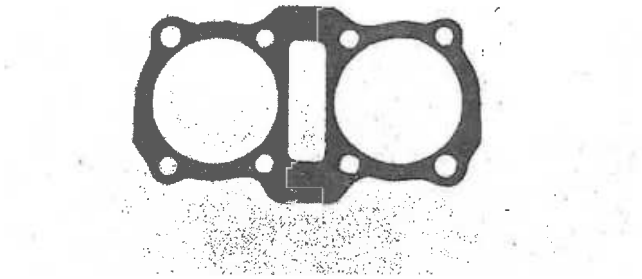
b) Mount the piston (rings installed) onto the connecting rods. Be sure the arrow stamped on the piston crown points forward. Also make sure that the left piston (already marked during removal) is fitted to the left-hand connecting rod. This guarantees that all previous clearances remain unchanged unless new parts are installed or cylinder work is done.

NOTE:

The piston pin should be a thumb-press fit into the piston. After the pin has been installed, lock it in place with two new circlips. Never use old circlips.

14) Cylinder Installation

a) Make sure the crankcase and cylinder bottom matching surfaces are clean, then install a new base gasket.

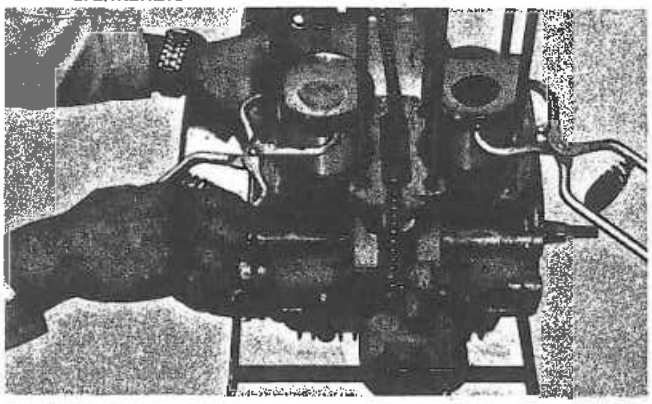


b) Check to see that the cylinder base O-rings are in place. Replace as necessary to avoid oil leakage.

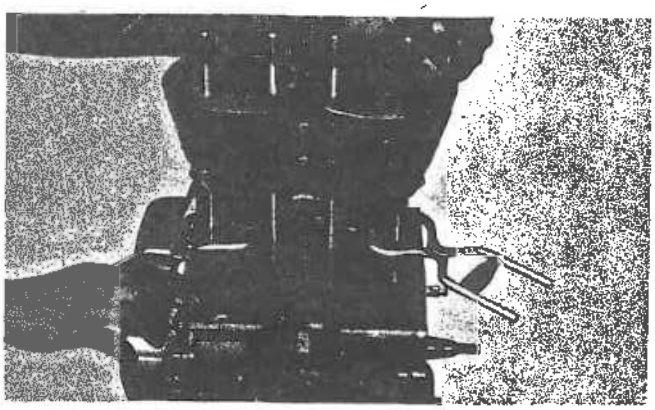


c) Slip a piston support plate (found in Special Tool Kit) under each piston skirt. This prevents the pistons from being pushed down during cylinder installation. Place a rag under each support plate to protect the new bare gasket.

crankshaft



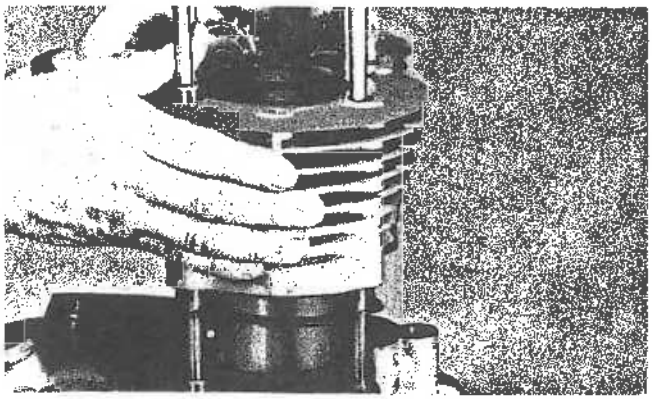
d) Lubricate the piston, pin and rings. Position and tighten the ring compressors (found in Special Tool Kit) so the rings can slip up into the cylinder without catching on the bottom of the cylinder. Lubricate both bores. Slip the cylinder down over the studs until it slips over the pistons and rests on the ring compressors.



e) Rotate the crankshaft so that the pistons slide up into the bores. Remove the ring compressors and piston bases, then push the cylinder down until it butts against the crankcase.

NOTE:

All parts should be well lubricated during assembly. When a newly rebuilt engine is started for the first time the oil supply passages will be empty and there will be a short period when no oil is delivered to various parts. It is a good idea to kick the engine over several times prior to starting to fill these passages.

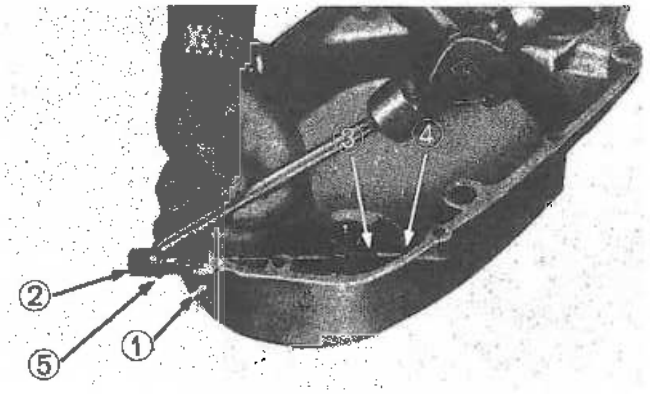


G) Primary Case

1) Tachometer Drive Removal

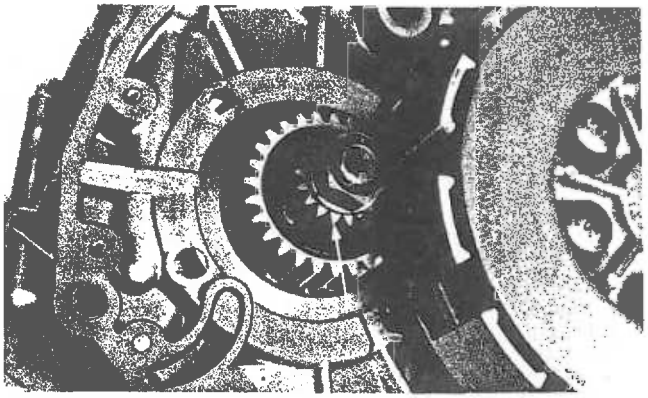
The tachometer gearing is located in the inside section of the right-hand engine case cover. Remove the case cover to remove the gears.

a) Completely unscrew the tachometer shaft lock nut (1). Drive the tachometer housing (2) out with a hammer and punch.
b) Lift the tachometer driven gear (3) out of the case.
c) Install the shaft in reverse order. Make sure the copper washer (4) is seated under the shaft. Also, check the housing O-ring (5) and replace if necessary.

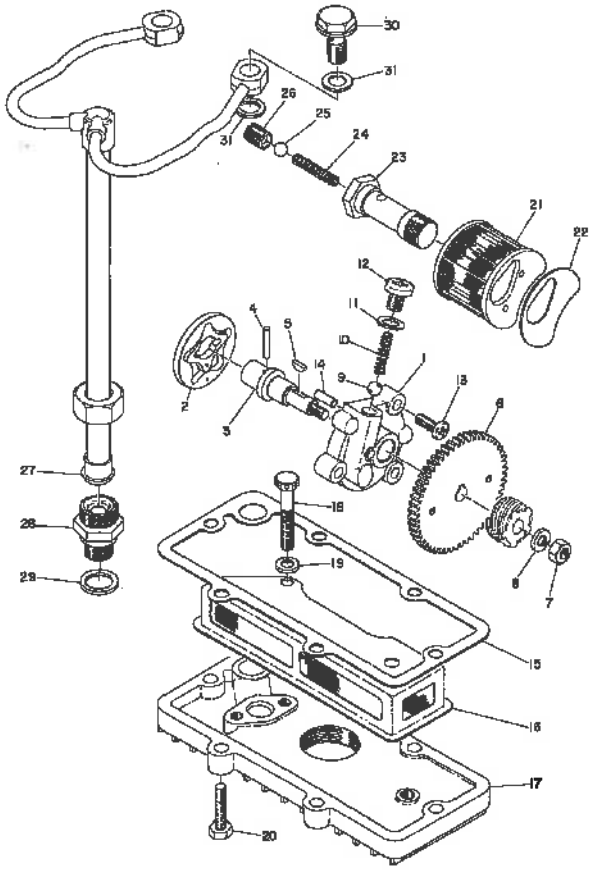


2) Oil Pump Drive

a) The pump is driven by a straight cut gear fitted to the crankshaft (outside the primary drive gear).

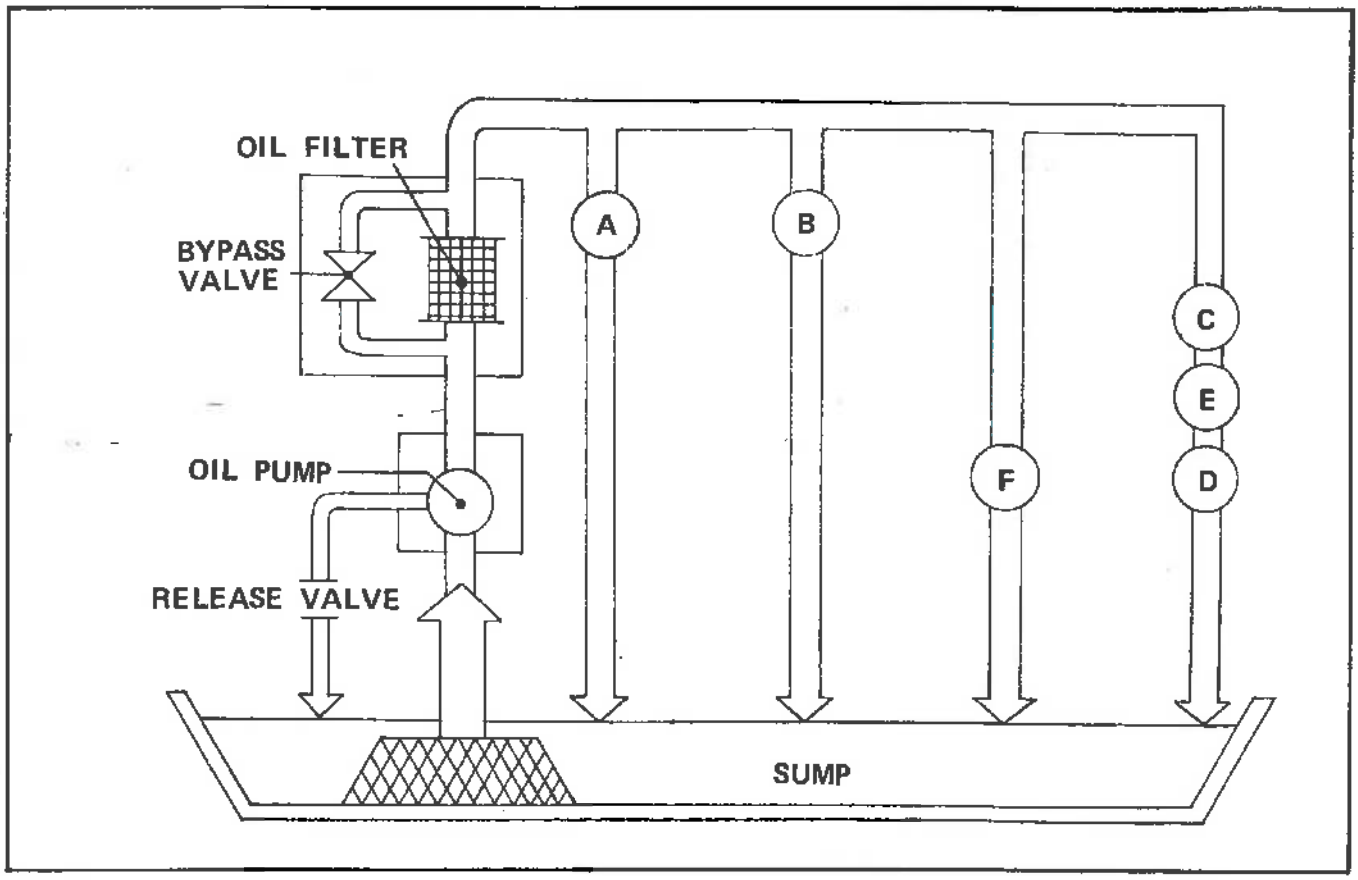


OIL PUMP



1. COVER, pump
2. ROTOR ASS'Y.
3. SHAFT
4. PIN, dowel (3-16.8)
5. KEY, woodruff
6. GEAR, driven (43T)
7. NUT
8. WASHER, spring
9. BALL (¼")
10. SPRING, release
11. GASKET
12. SCREW, pan head
13. SCREW, pan head
14. PIN, dowel
15. GASKET, strainer
16. STRAINER
17. COVER, strainer
18. BOLT
19. WASHER, spring
20. BOLT
21. ELEMENT, oil
22. GASKET, element
23. SCREW, element
24. SPRING, bypass
25. BALL (¼")
26. SCREW, spring
27. PIPE, delivery 1
28. BOLT, banjo 1
29. GASKET, banjo bolt 1
30. BOLT, banjo 2
31. GASKET, banjo bolt 2

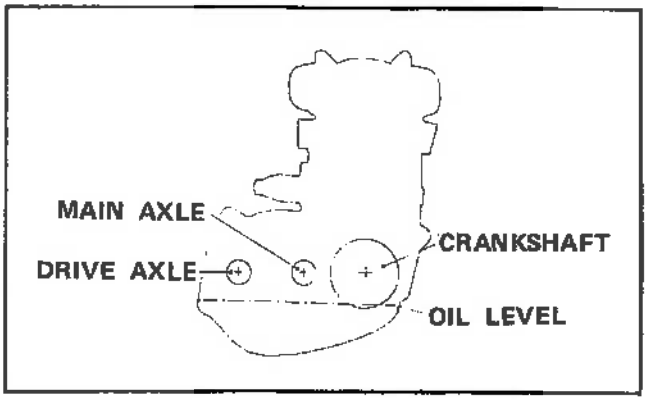
3) Oil Lubrication System



a) This machine has a "wet sump", pressure feed oiling system. Oil is stored in the crankcase. Oil passes through a wire screen filter in the bottom of the crankcase to the trochoidal oil pump (rotary type rather than plunger type). Because of pump design, oil pump pressure pulses are so frequent as to provide constant, unfluctuating oil pressure to all vital parts.

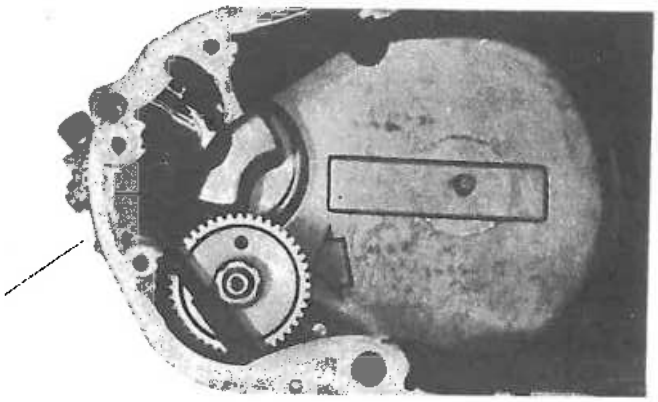
b) Oil from the pump is pushed through a fine wire mesh filter into oil passages in the cases and delivered under pressure to the following parts:
   (a) Crankshaft main bearings
   (b) Connecting rod big end
   (c) Transmission main axle
   (d) Clutch bearing
   (e) Shift fork guide bar
   (f) Rocker arms

c) The following parts are lubricated by "oil splash":
   (a) Crankshaft
   (b) Connecting rod small end
   (c) Cam chain
   (d) Piston and cylinder walls
   (e) Primary drive and driven gears

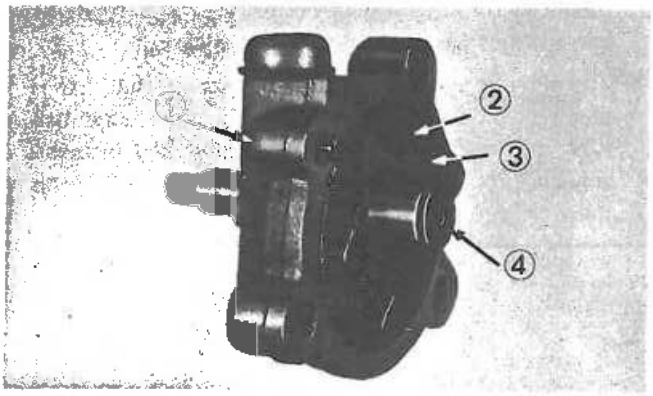


d) The oil pump is fitted with a bypass valve (check ball and spring) that permits the oil from the pump to be redirected back to the oil reservoir in case of excessive pressure in the delivery passages.

e) The oil pump fits into a cavity at the inner front portion of the right-hand case cover (behind the tachometer drive unit).



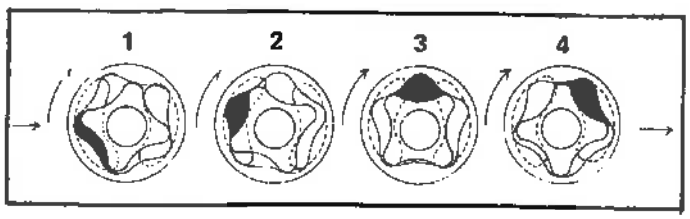
f) This is a picture of the pump after it has been removed from the cavity. The cover is constructed of aluminum and all other pump parts are made of steel.



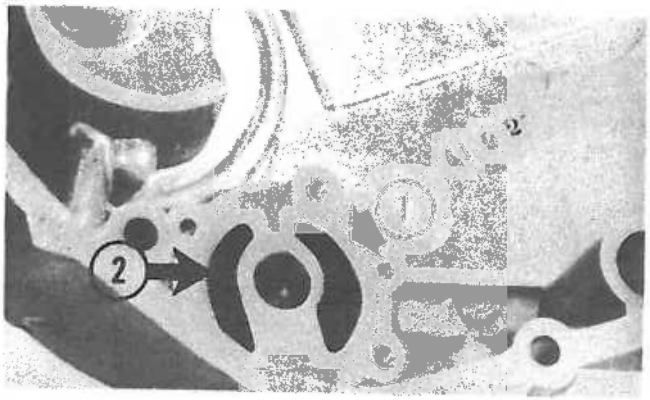
1. Aluminum Cover
2. Outer rotor
3. Inner rotor
4. Shaft

g) The shaft (#4), spins in the cover (#1). A four-pointed inner rotor (#3) is turned by the shaft. The outer rotor (#2) has five rounded notches. As the inner rotor spins, it turns the outer rotor (just like two gears intermeshed). The inner and outer rotor spin at different speeds thereby creating a changing gap between them. The gap is the oil chamber.

h) **Steps 1 through 4 (below)** show how the oil chamber first increases in size as it sucks in oil (intake passage shown in dotted outline), and then pushes the oil out the outlet passage (also shown in dotted outline). Because the rotor is equipped with four tips, there are always four stages of pumping strokes occurring, supplying a constant pressure.

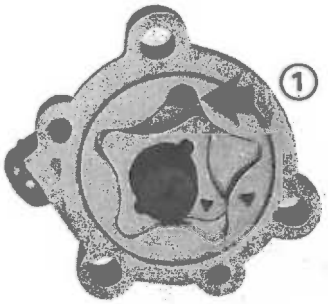


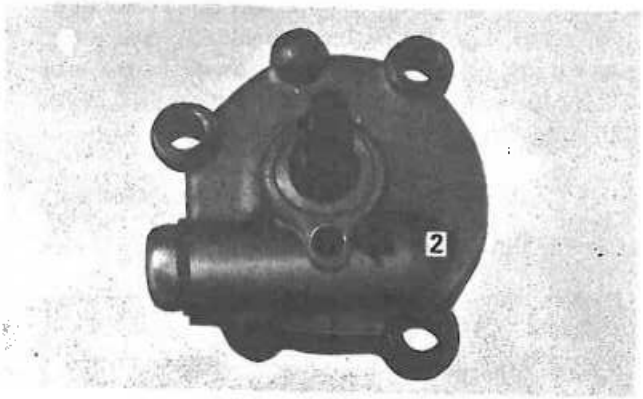
i) This picture shows the intake cavity (1) and the outlet cavity (2). Oil flows through the intake passage, into the pump. The oil pump forces it out, through the oil filter, into the oil delivery passages.



Oil inlet and outlet holes
(pump removed)

j) The cover has a drilled hole (1) that leads to a pressure relief check ball. If too much pressure develops the check ball valve releases oil back into the crankcase (2).

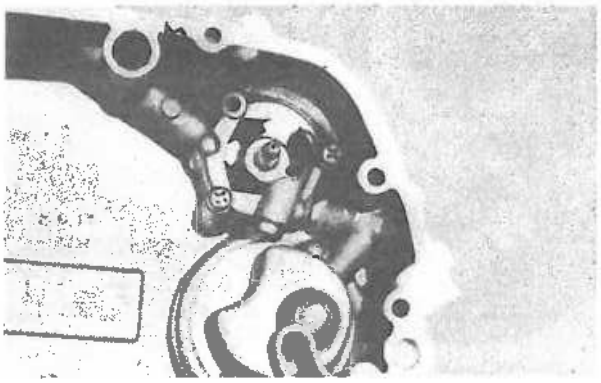




Removal and Installation

1 The oil pump driven gear slips off the shaft after the tachometer drive gear has been removed. The key in the shaft must also be removed.

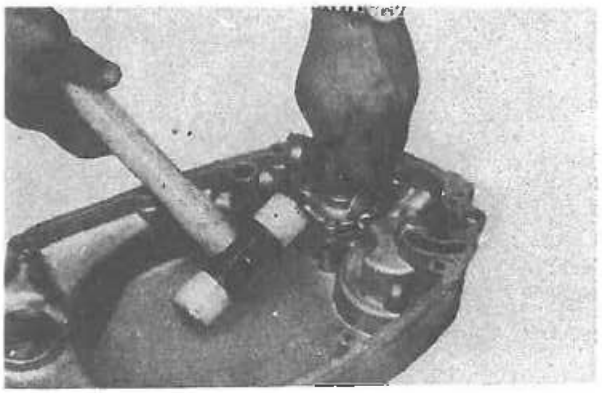
1 Remove the three Phillips-head retaining screws.



oving oil pump set screws

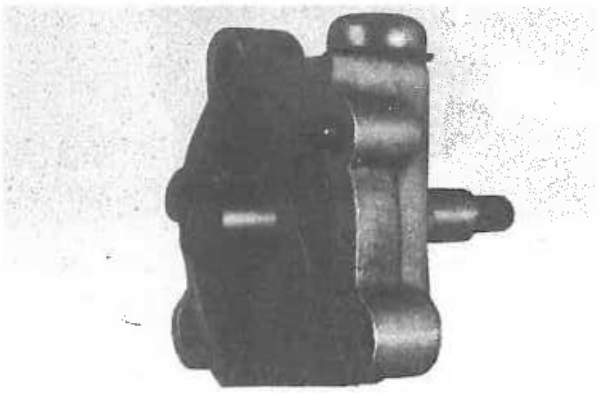
Pull up on the pump shaft while tapping on the pump until the unit comes loose.

1 Lift out the inner and outer rotors if they do not come out as a unit.

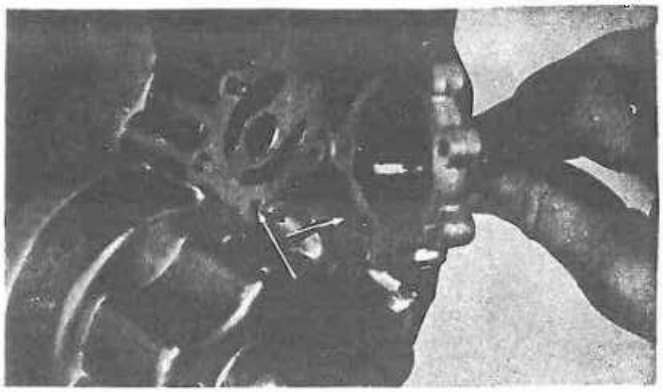


r about to be removed

Installation of the oil pump is basically a reversal of the removal procedure. Install the shaft, inner rotor, and outer rotor into the pump cavity in the case cover (be sure the notch in inner rotor lines up with the pin in the shaft).



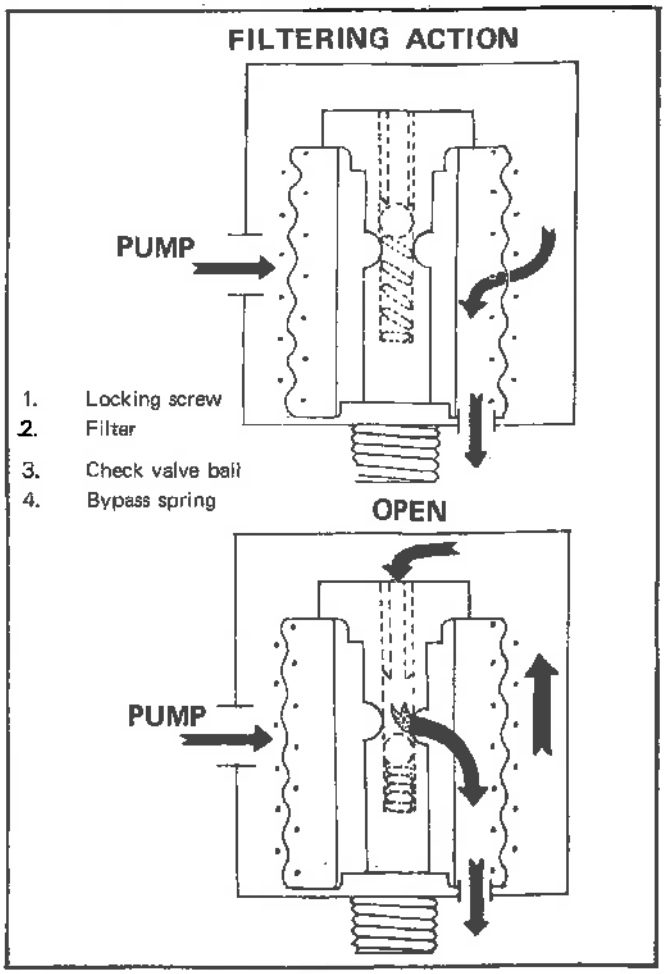
f) Slip the cover into place, using the locating pin to position the unit.



5) **Oil Filter**

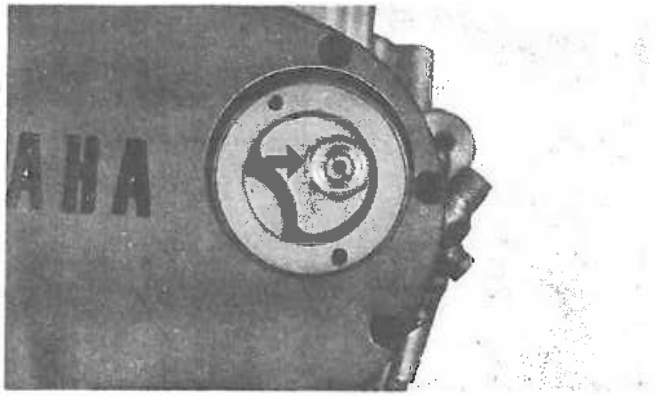
a) The stationary type oil filter, which is bolted into a recessed well in the outer right-hand cover, is constructed of fine wire mesh. Oil from the pump is forced in through the outer surface of the filter and into a drilled passage leading to the engine.

b) The filter is equipped with a bypass. If the filter is plugged, oil is forced through a spring-loaded ball type check valve in the locking bolt and into the engine delivery passage. In this manner, oil delivery to the engine will not be stopped by a clogged filter.

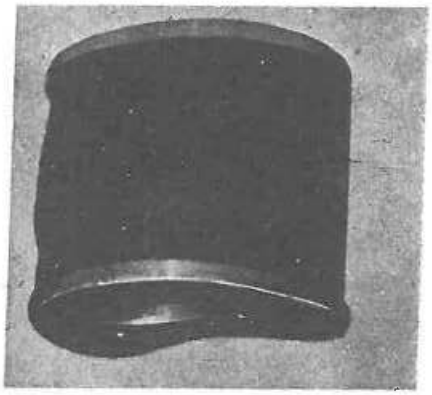


6) Oil Filter Servicing

a) The oil filter cavity in the right-hand case cover is covered by a plate held in place by two Allen screws. A circular groove cut in the plate mating surface holds an "O" ring for sealing purposes. Removing the cavity plate reveals the oil filter retaining bolt. Remove the bolt and slip the filter out.



Filter securing bolt removal



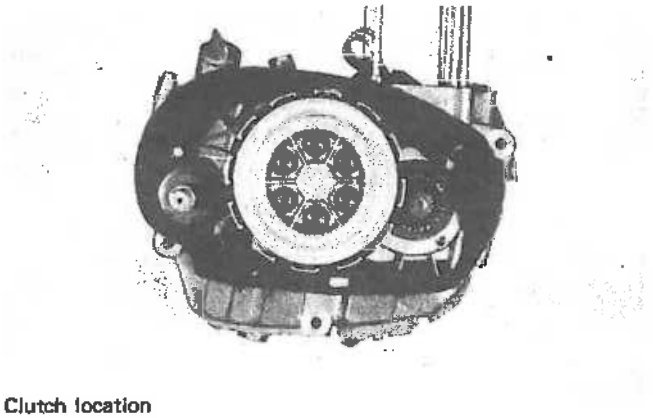
Dirty oil filter

b) With the filter out of the machine, check the rippled outer surface for trapped particles. Thoroughly clean the filter with solvent and high pressure air. Also, after the filter has been removed from the machine, clean out the oil filter cavity in the case cover.

c) Installation is accomplished by reversing the above procedure. Do not overly tighten the filter securing bolt or the filter could collapse. Also, check the cover O-ring and replace it if it is damaged.

7) Clutch & Drive Gear

a) The primary drive assembly, located on the right-hand side, consists of straight cut primary drive and driven gears with a ratio or 72/27 (2.666:1). The clutch is mounted directly to the primary driven gear. The entire clutch assembly is bolted to the transmission main axle.

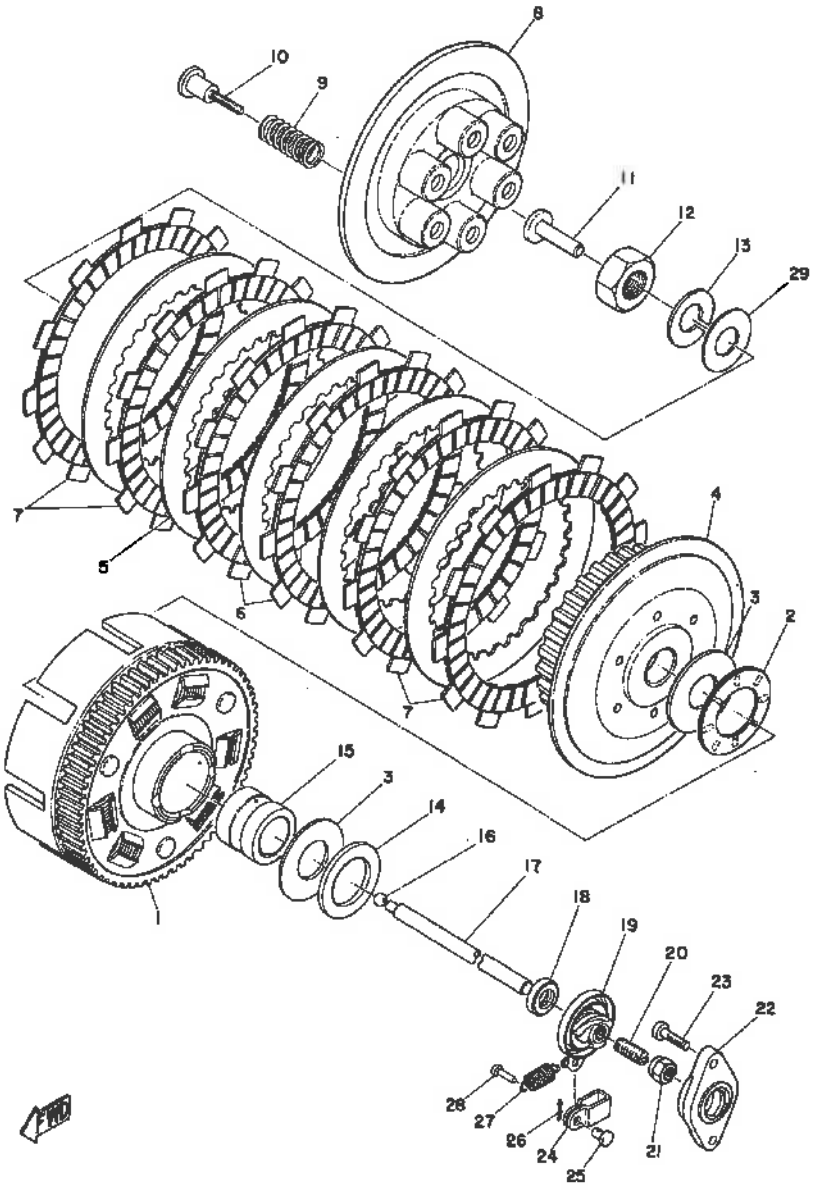


Clutch location

b) The wet, multi-plate clutch consists of five metal clutch plates and six friction plates. All six friction plates use cork friction material, but on four plates the cork is mounted on a fiber plate, while the remaining two plates consist of cork mounted on aluminum.

Six clutch springs provide the tension to hold all plates against one another. The clutch hub bushing is pressure oil fed from the main axle.

CLUTCH

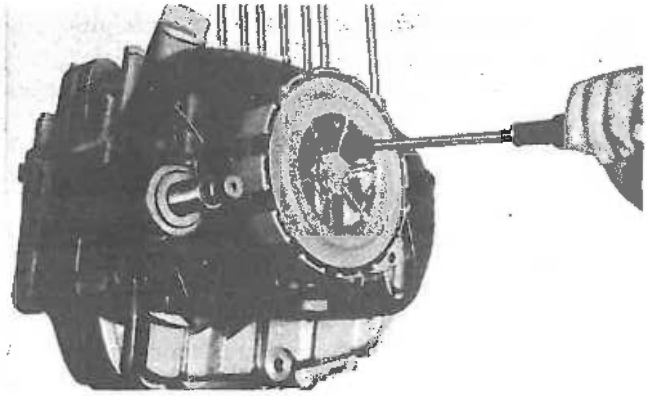


1. Driven Gear ass'y (72T)
2. Bearing
3. Thrust (2) Plate (25-50-2.0)
4. Clutch Boss
5. Clutch Plate
6. Friction plate (1)
7. Friction plate (2)
8. Pressure plate
9. Clutch spring
10. Spring screw
11. Push (1) rod
12. Lock nut
13. Spring washer
14. Plain washer (24.2-36-1.0)
15. Spacer
16. Ball (5/16")
17. Push rod
18. Oil seal (SD-8-25-6)
19. Push lever ass'y
20. Adjusting screw
21. Adjusting nut
22. Push screw housing
23. Panhead screw
24. Joint
25. Pin
26. Cotter pin
27. Return spring
28. Spring hook
29. Plain washer

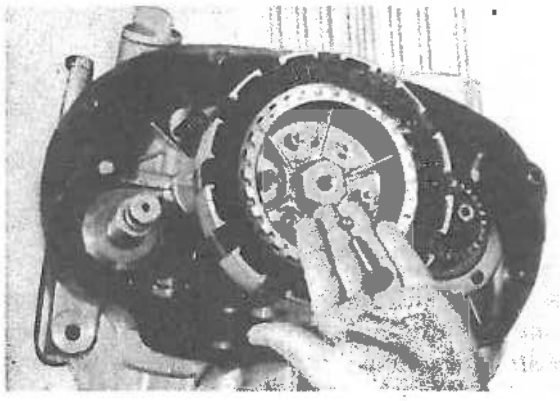
8) Clutch Removal

a) Remove all six clutch spring screws and pull off the pressure plate

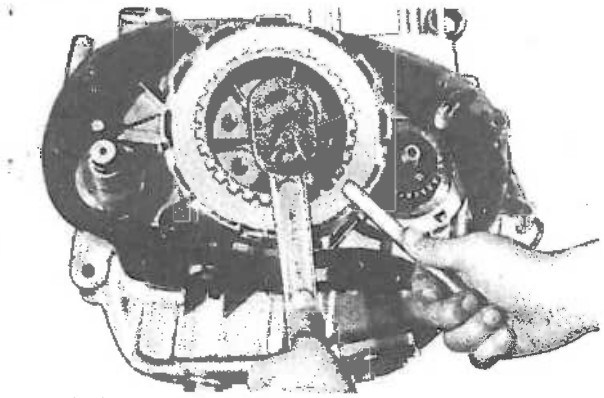
NOTE:
Loosen the screws in easy stages using a cross pattern.



b) Pull out the push crown, the ball directly behind the push crown, and the push rods behind the ball. It is most easily removed from the other end of the main shaft.



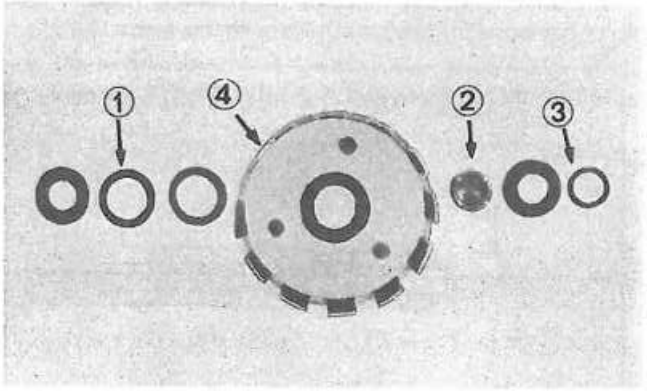
c) Hold the clutch unit with the holding tool (found in the Special Tool kit), and unscrew the clutch boss lock nut.



Removing lock nut. Clutch held stationary.

d) Slide out the clutch boss and clutch plates. Behind the boss are two thrust washers with a flat thrust bearing in between. Remove these parts.

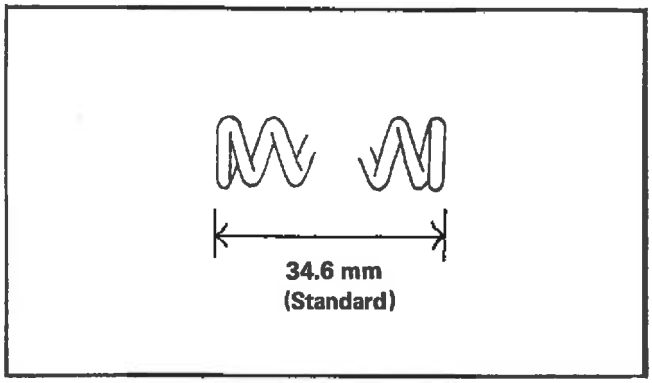
e) The clutch housing is now free. After pulling the housing off, slide off the clutch bushing spacer and thrust washer(s) behind the spacer.

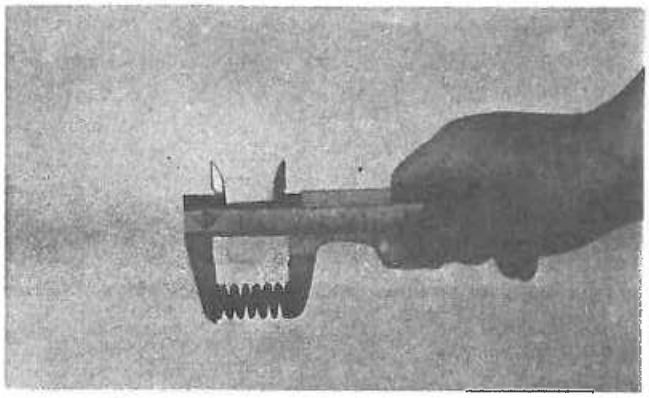


1. Thrust bearing and washers (between clutch boss and housing)
2. Bushing spacer
3. Washers (right against axle bearing)
4. Clutch housing

9) Clutch Spring Wear

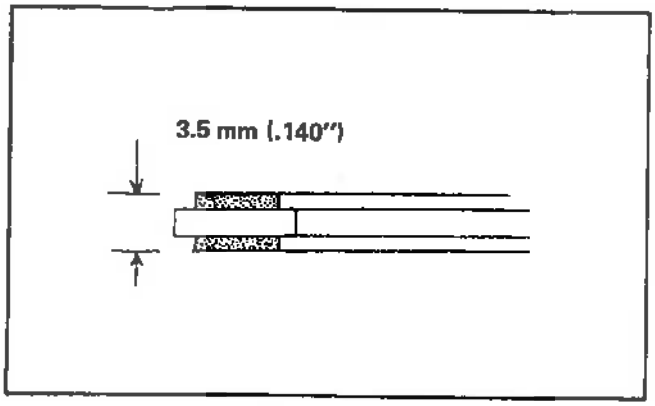
a) Measure the spring free length with vernier calipers. If standard length has shortened by 1 mm (.04") or more, replace the spring.





10) Friction Plate Wear

a) Standard thickness is 3.5 mm (.140"). If wear has decreased the thickness to 3.1 mm (.122") replace the plate (measure at two or three points).





11) Clutch Plate Wear

a) These plates must be flat. Lay each one on a surface plate and check both inner and outer edges for signs of "dishing" (a bow in the plate surface). Replace the plate if warpage exists.

b) Run a feeler gauge around the inner and outer edges. Replace any plate that is warped sufficiently to permit a .2 mm (.008") feeler gauge to slide under either edge.

12) Push Rod

a) Roll the push rod over a surface plate. If the rod is bent, or if deep grooves have been worn in the rod, replace it.

13) Clutch Installation

a) Reverse the clutch removal sequence. Tighten the clutch boss lock nut to 13 kg/m (93 ft/lbs).

(See page 162 for TX650A information.)

CAUTION

Be sure the two flat thrust washers and one flat thrust bearing are installed behind the clutch boss. Also, grease the flat thrust bearing and thrust washer closest to the clutch housing to prevent these parts from sliding forward, out of position, during clutch boss installation.

b) When installing the clutch spring bolts, screw them in until they bottom fully (approximately .8 kg/m – 5 ft/lbs. torque).

IMPORTANT NOTE: When installing the six friction plates (between the metal clutch plates), install two fiber-backed plates, then both aluminum-backed plates, and finally the remaining two fiber-backed friction plates, with the appropriate clutch plates between each friction plate.

14) Primary Drive Gear

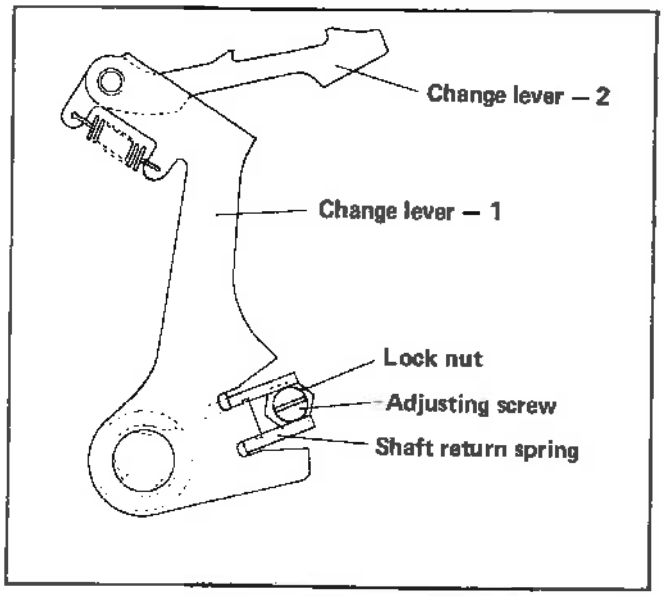
a) A nut and lock washer hold the primary drive gear (and pump drive gear in front of it) on the crankshaft. Remove the nut and washer and slide the primary drive gears off. Use a gear puller if the primary drive gear does not come off easily. A square-shaped key fits into a crankshaft keyway to prevent the drive gear from spinning.

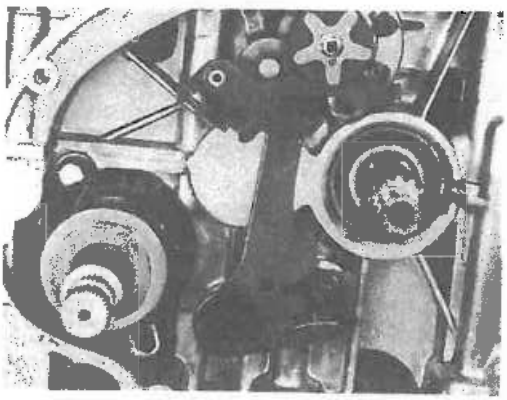
b) To install the primary drive gear, slide it onto the crankshaft. Next, line up the keyways in the gear and the shaft and insert the square-shaped key. Install and tighten the lock nut to 12 kg/m (85 ft/lbs).

CAUTION

If the primary drive gear and primary driven gear teeth do not match up fully (if there is visible tooth overlay to one side), check the possibility of incorrect clutch installation.

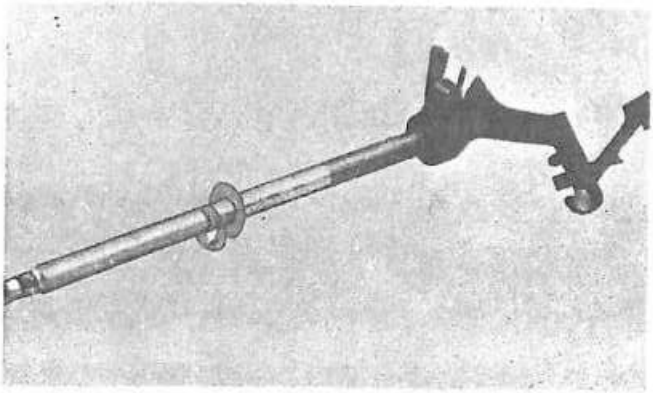
15) Shift Shaft Assembly Removal





Shift shaft unit in neutral position

a) Remove the shift shaft retaining "C" clip and washer (left-hand side), then pull the entire assembly out from the right-hand side.

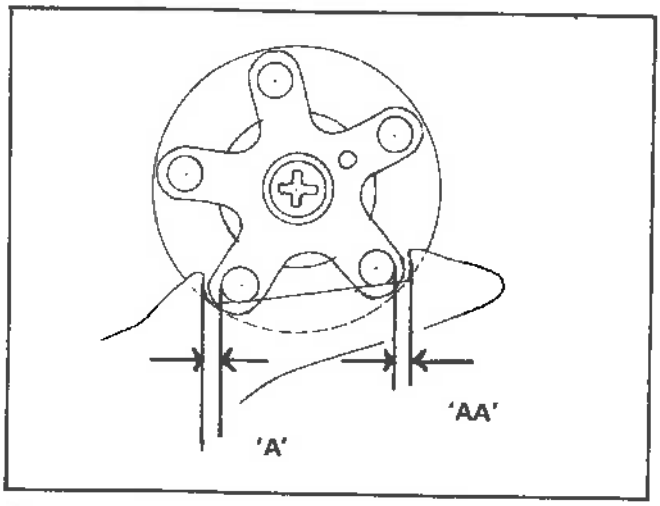


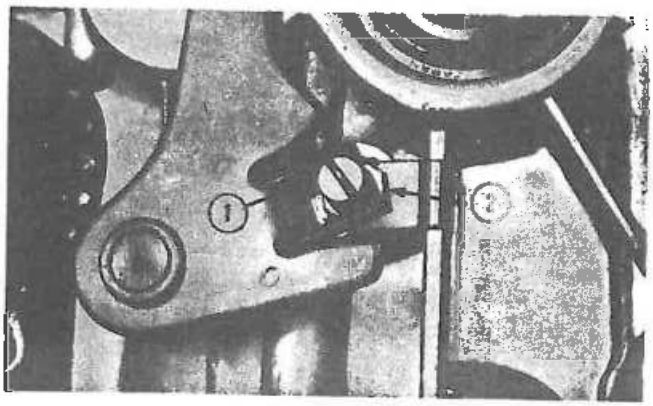
b) Installation is accomplished by inserting the shift shaft from the right-hand side and installing the washer and "C" clip.

16) Shift Adjustment

a) If shifting adjustment is correct, distances "A" and "AA" will be equal (see this page). It these are not equal, loosen the screw lock nut (2) and rotate the eccentric screw (1) until "A" and "AA" become equal. Retighten the lock nut and bend up the tab.

NOTE:
Make this adjustment in second, third, or fourth gear.

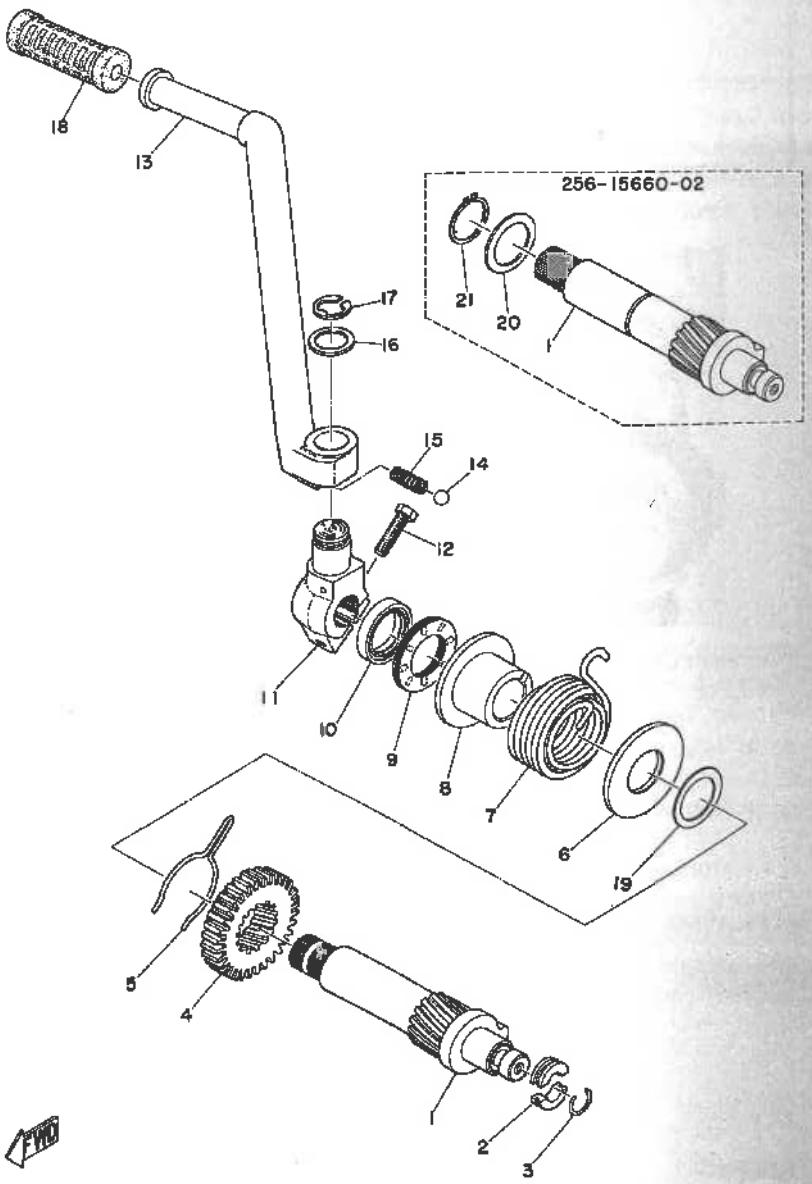




17) Kick Starter Assembly

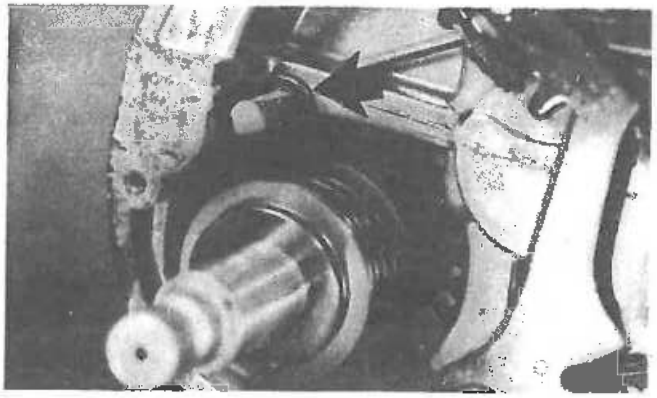
(See page 162 for TX650A information.)

STARTER



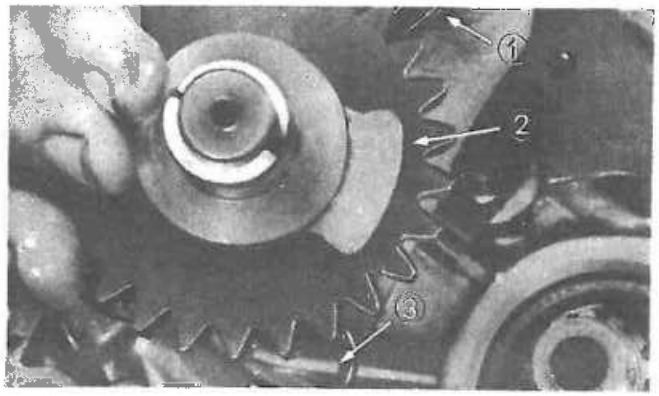
1. Kick axle ass'y
2. Holder
3. Clip
4. Kick gear
5. Kick clip
6. Spacer (25.4—53-4)
7. Skick spring
8. Spring guide
9. Thrust bearing
10. Oil seal (SD-25-35-7)
11. Kick crank boss
12. Bolt
13. Kick crank
14. Ball (5/16")
15. Boss stopper spring
16. Washer
17. Circlip (E-12)
18. Kick lever cover
19. Shim (25.5-35-0.5)
20. Shim (25.2-36-1.0)
21. Circlip (S-25)

a) Slip the bent spring end off its anchor point and pull the kick starter assembly out of the case.



Anchor point of kick spring

b) To install the kick assembly, partially insert the assembly until the return spring (#3) can be slipped over its anchor point, then rotate the kick clip (#1) until it slips into the appropriate recessed area in the case. Attach the kick lever and rotate the kick axle 1/2–3/4 revolution in a counter-clockwise direction. Push the axle in. The kick stopper (#2) will slip into its recessed area in the case. The kickstarter is now pre-loaded to achieve positive kick return.

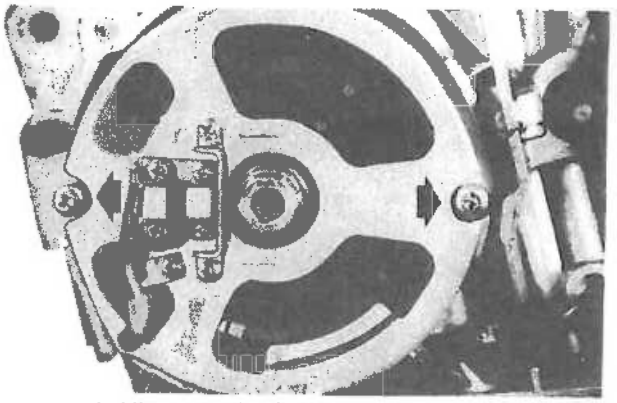


1. Kick clip
2. Kick stopper
3. Return spring

H) Alternator Case Cover

1) Stator Removal and Installation

a) The stator is held in place by two bolts. Remove the bolts and slide off the stator assembly. Take care that the wiring loom does not catch on any corners.

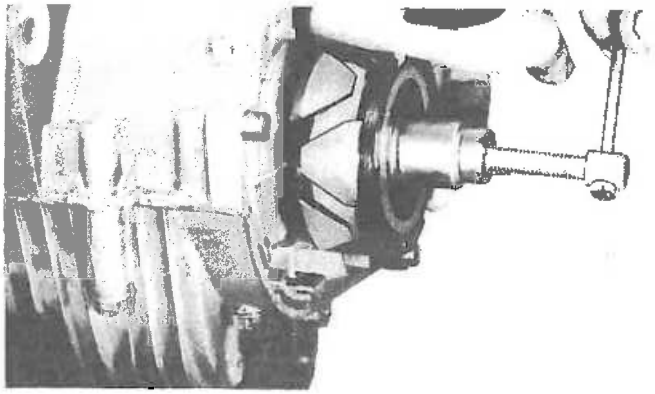


Two screws holding stator in place

b) Reverse these steps to install.

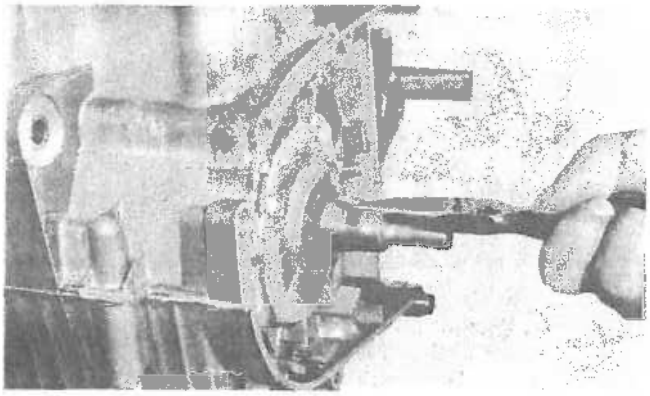
2) Rotor Removal and Installation

a) Remove the rotor securing nut and lock washer. Mount the rotor pulling tool (found in Special Tool Kit) onto the rotor and pull the rotor off.



b) Immediately after pulling the rotor, remove the rotor shaft key so that it cannot be lost.

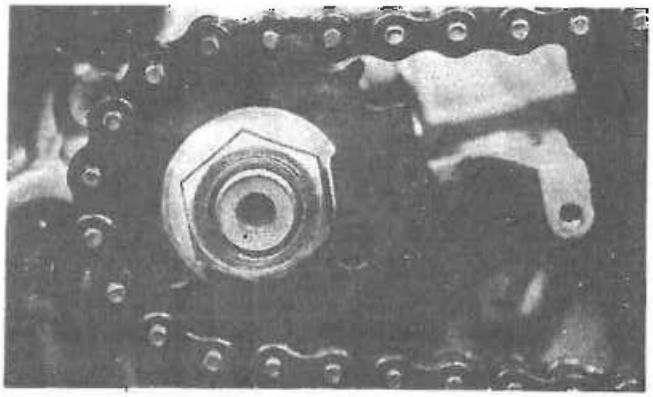
c) Installation: Slide the key into the keyway, lubricate the shaft taper with a light grease, line up the key slot on the rotor with the key and push the rotor on. Always lube the end of the shaft to make future disassembly easier.



Removing rotor shaft key

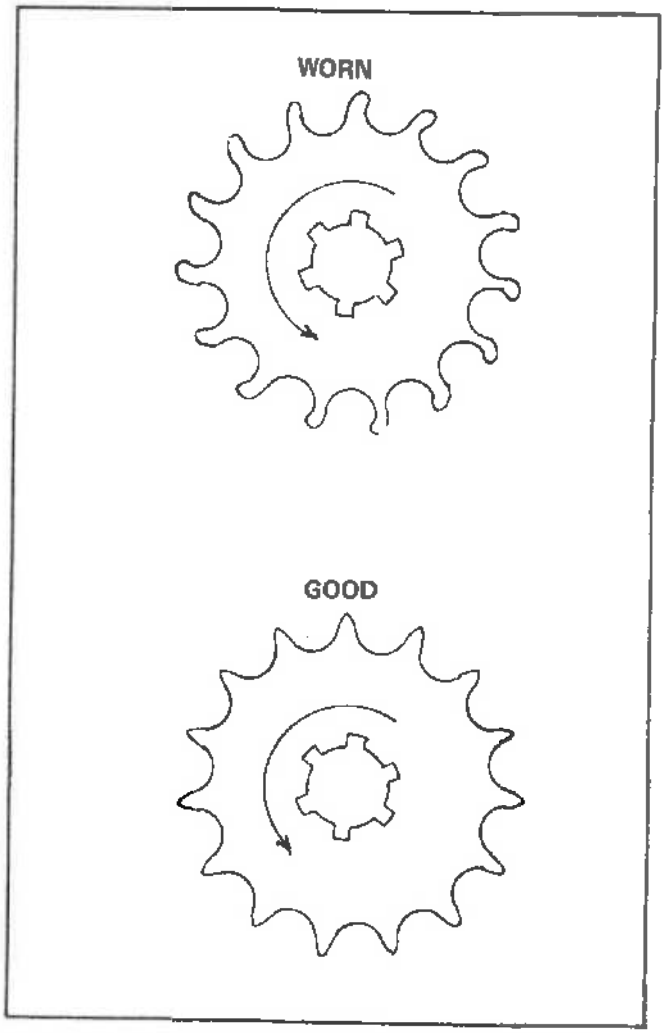
3) Drive Sprocket

a) Flatten the bent lock tab. Place the transmission into gear (to keep the shaft from rotating) and remove the lock nut. The drive sprocket need only be removed if transmission repair is necessary. In addition, it can be removed prior to removing the engine from the frame. Reverse the above procedures to install the sprocket. Be sure to bend the lock tab back up.



Drive sprocket

b) Constant tension and friction from the drive chain eventually wears away the base of the sprocket teeth. The weakened teeth bend and do not mesh correctly with the chain. Replace an excessively worn sprocket.



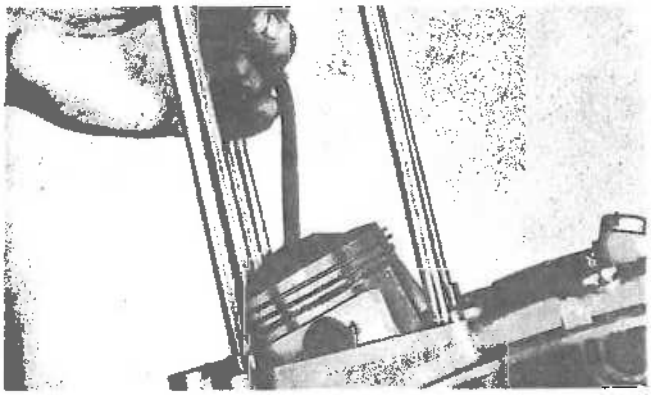
NOTE: If the sprocket shows sufficient wear to warrant replacement, check the drive chain and rear wheel sprocket. Replace as necessary.

I) Crankcases

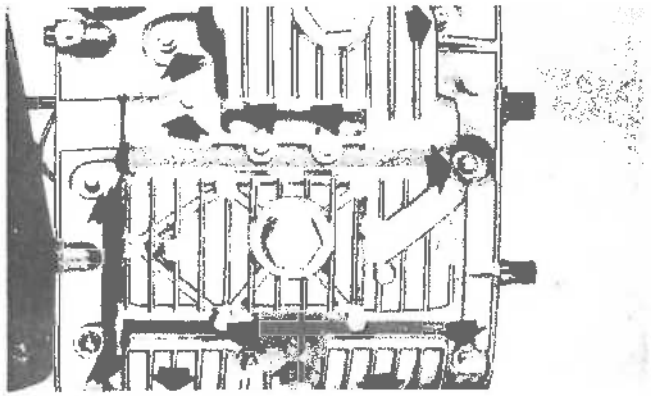
The XS 650 unit construction crankcase contains the transmission, crankshaft, oil sump, and associated parts such as oil strainer (in crankcase sump), etc.

1) Separating Crankcases

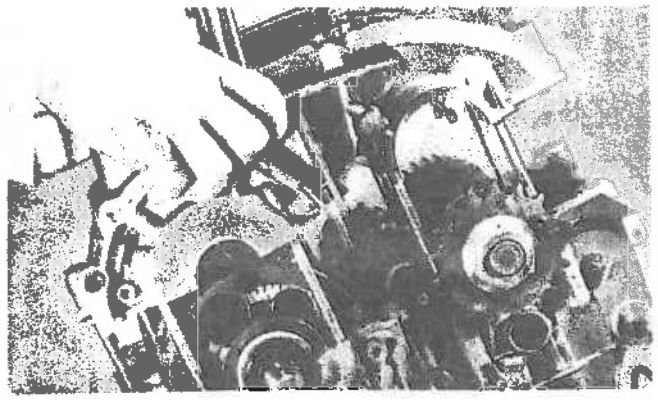
a) Pull out the cam chain (if not already removed).



b) Loosen and remove all case securing bolts located on the bottom of the case plus the case bolts around the dip stick on top. Start with #18 and loosen each bolt to #1. Loosen each bolt 1/4 turn at a time to avoid case warpage.

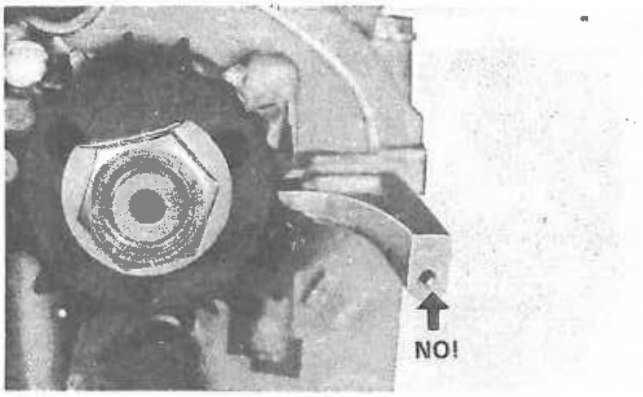


c) Separate the cases by lifting the top case. It might be necessary to tap the top case loose with a rubber hammer.

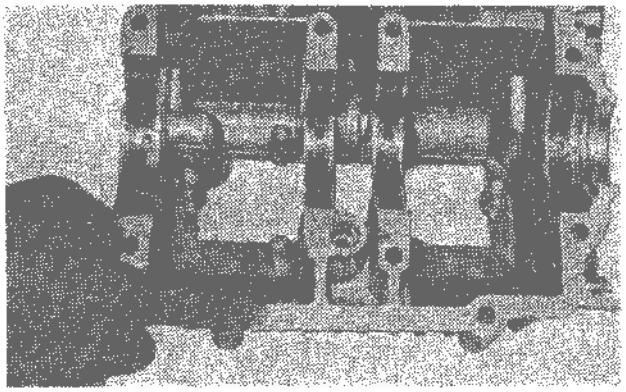


CAUTION

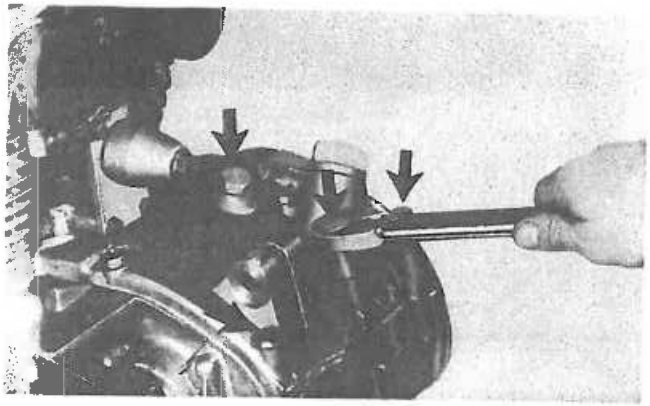
Do not hammer on the case cover mounting flange; it could easily break off.

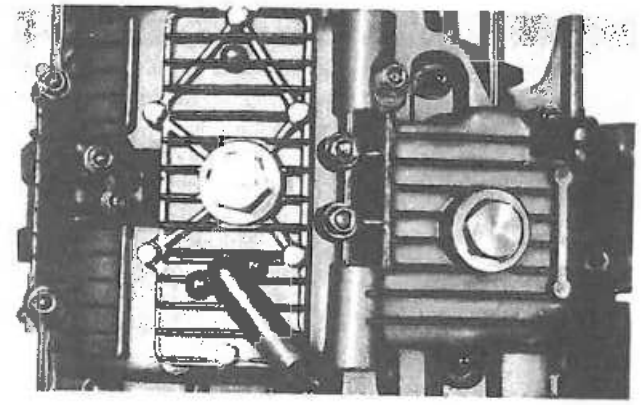


d) Assembling top and bottom cases:
The shifting mechanism, transmission, and crankshaft have already been installed in the top case. Make sure both case mating surfaces are clean, then apply Yamaha Bond #5 (non-drying, rubber base sealer) to the gasket surfaces. Slide the cases together.

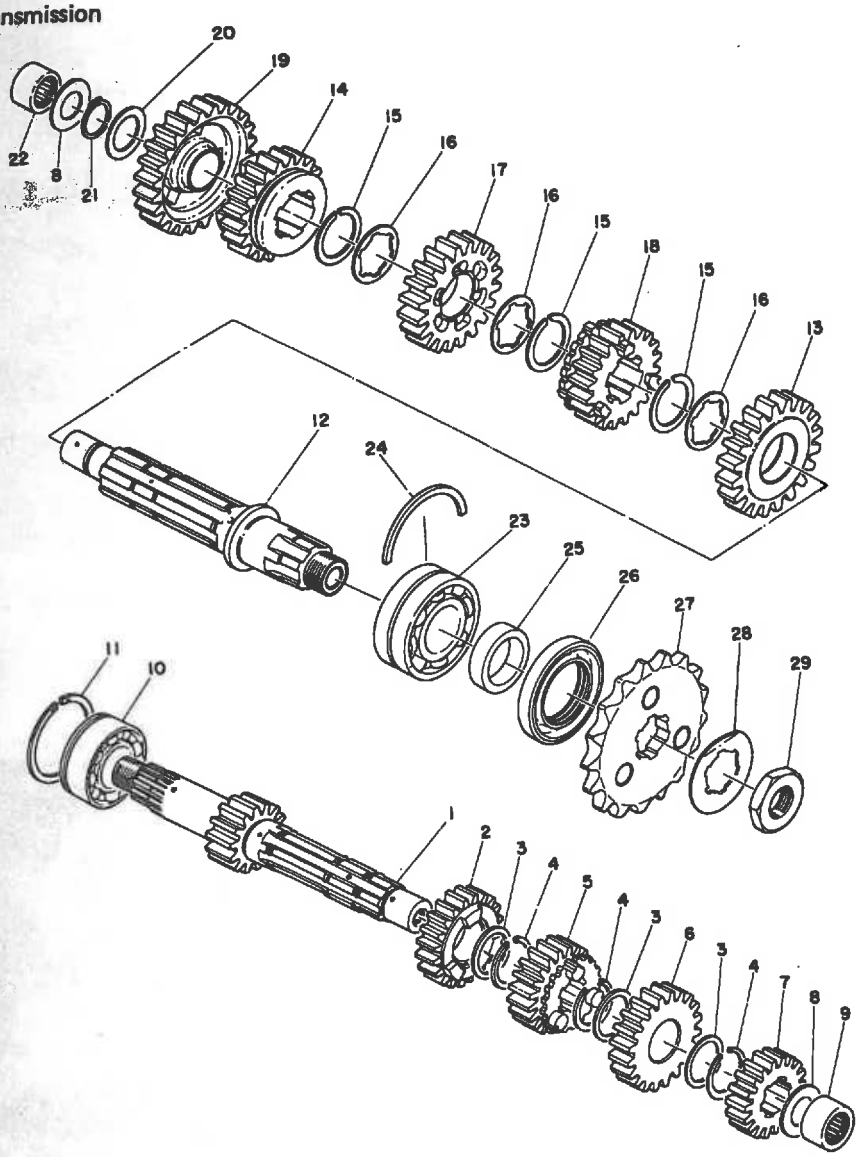


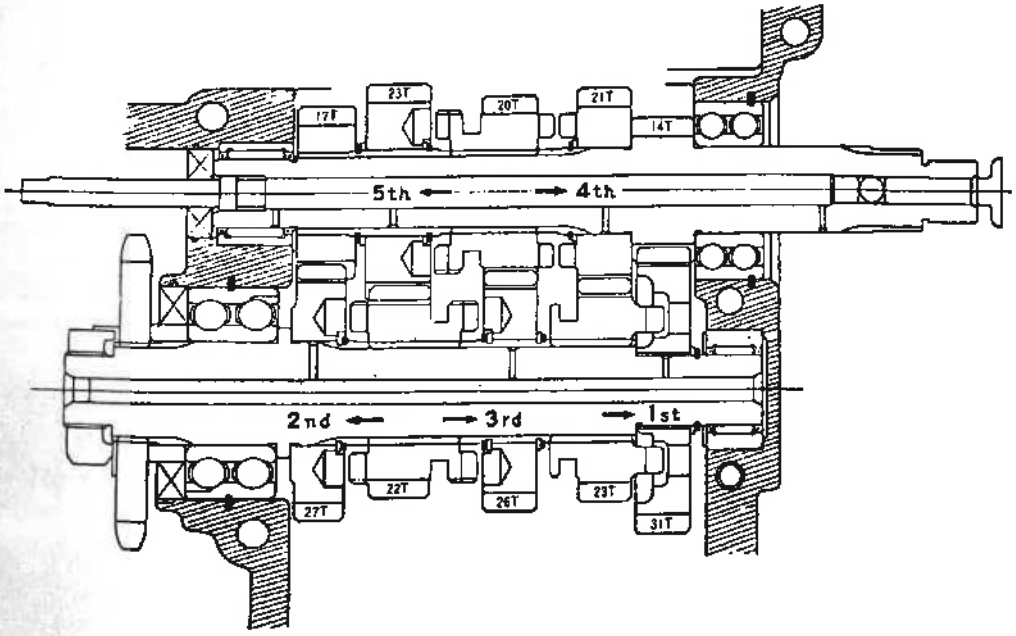
e) Complete the crankcase assembly by installing and tightening all crankcase securing nuts and bolts to 2 kg/m (14 ft/lbs), following the tightening sequence numbers stamped on the case next to each nut. (1 through 18; tighten in 3 gradual stages.).





2) Transmission

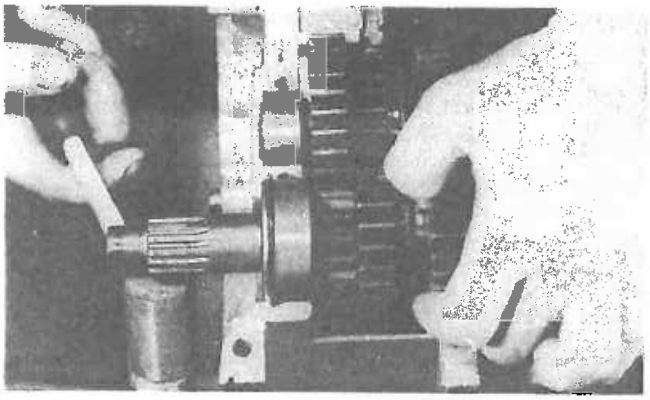




1. Main axle (Low2 13 t
2. 4th pinion gear 21 t
3. Gear hold (5) washer (25.2-30-1.X)
4. Circlip (C-25) or (S-25)
5. 3rd pinion gear 20 t
6. 5th pinion gear 23 t
7. 2nd pinion gear 17 t
8. Drive axle shim (20.2-33-X.X)
9. Bearing
10. Bearing (5205)
11. Circlip (C-52)
12. Drive axle
13. 2nd wheel gear 27 t
14. 4th wheel gear 23 t
15. Circlip (C-30)
16. Gear hold (3) washer (26.2-34-1.X))
17. 3rd wheel gear 26 t
18. 5th wheel gear 22 t
19. 1st wheel gear 31 t
20. Gear hold washer (20-25-1.0)
21. Circlip (S-20)
22. Bearing
23. Bearing (5206)
24. Circlip
25. Distance collar
26. Oil seal (SD0-40-62-9)
27. Drive sprocket
28. Lock washer
29. Lock nut

3) Transmission Removal

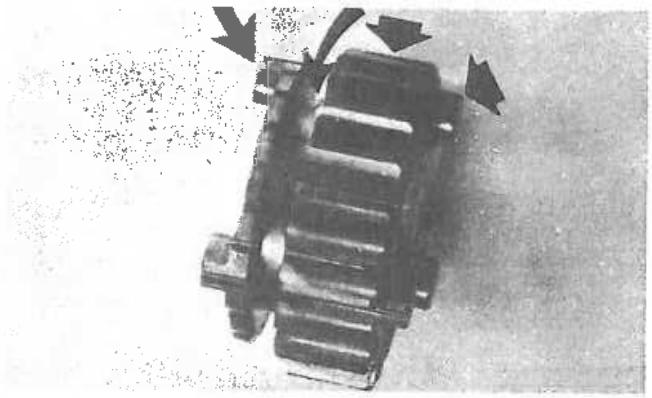
a) Tap lightly with a rubber hammer to loosen the transmission, then lift it out.



Removing transmission

b) Check the gears for chipped teeth.
Check engagement dogs and slots for rounded edges. Check the sliding gear fork grooves for a blue discoloration. If any of the above mentioned conditions are obviously noticeable, replace the gear(s).

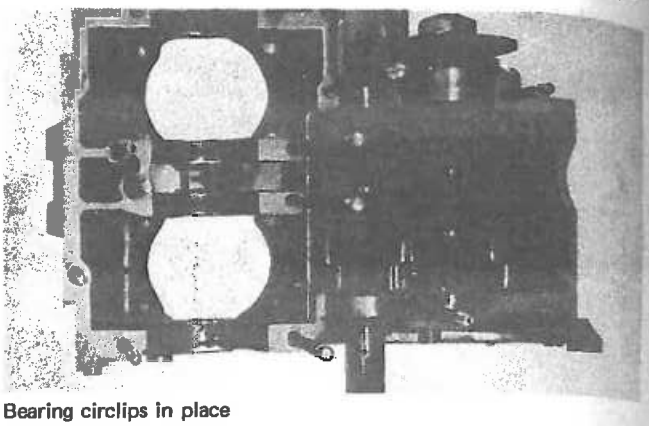
NOTE:
Especially in the case of damaged engagement dogs, check the mating gear for damage or excessive wear. It is sometimes necessary to replace the parts as a set.



Gear wear points

c) Installation
With both shafts assembled, including all bearings and seals, fit the transmission into the TOP CASE. This permits the shift forks to slip over the sliding gears easily. Be sure both transmission shaft circlips are fitted to the bearings and the circlips have been positioned in the circlip grooves.

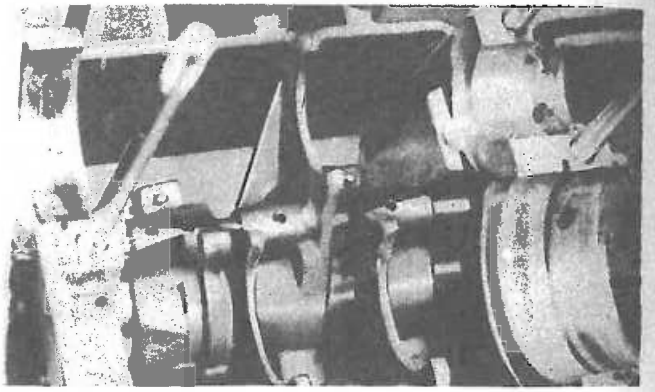
NOTE: Transmission installation is easier if the shift drum is rotated to the neutral position.



Bearing circlips in place

VERY IMPORTANT
Check for smooth and complete shifting through all gears after installing the shift drum, shift forks, guide bar, and transmission. At the same time check for complete engagement of all engaging dogs into the appropriate gear slots.

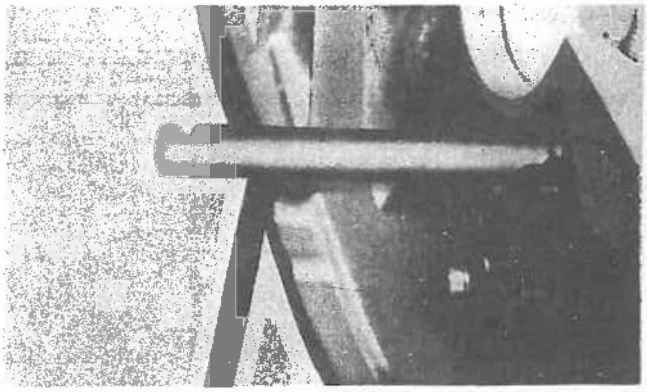
4) Shift Drum Assembly



Shift forks and drum in position

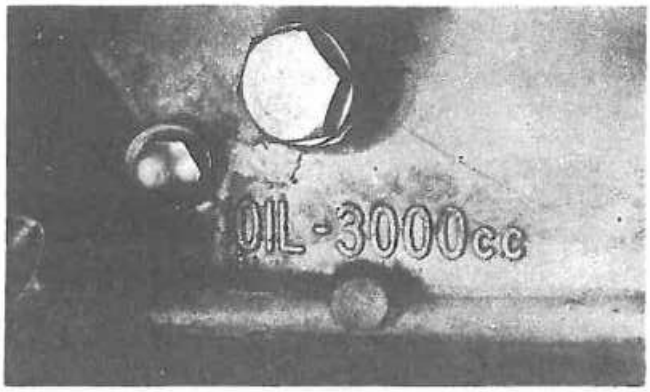
a) Fork Guide Bar Removal and Installation
The fork guide bar is held in place by the shift drum stopper plate. With the plate removed, the bar can be pulled out.

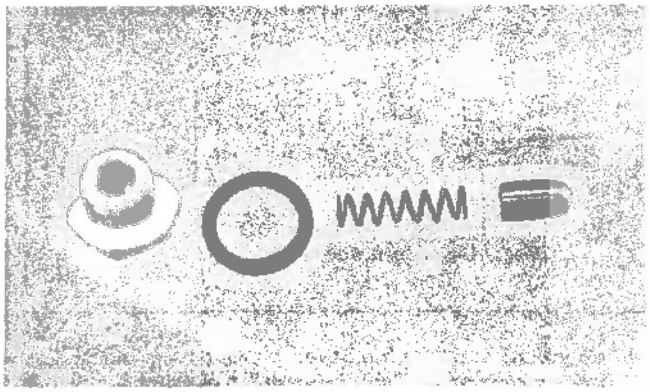
CAUTION
Note that the stopper plate has a locking tab to secure the two bolts holding the plate in place. During reassembly, always make sure the locking tabs are bent up firmly around the securing bolt heads.



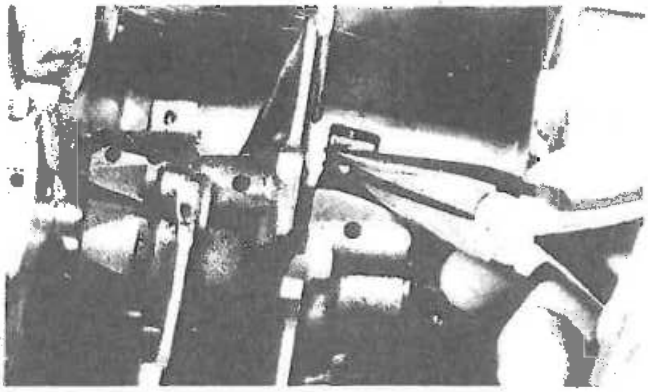
b) Check the guide bar for alignment. Roll it over a surface plate and check for bends. If it is bent, replace it.

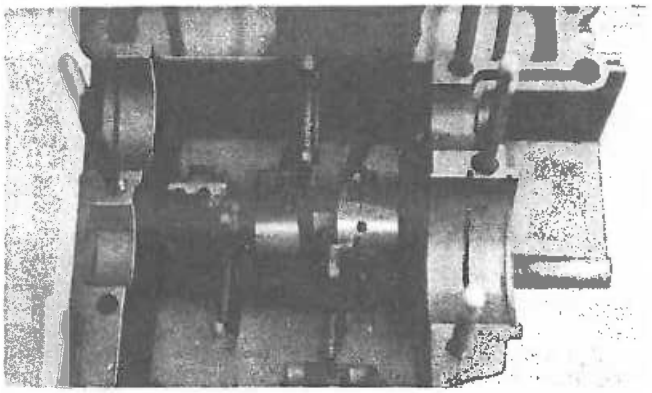
c) Shift Drum Removal
Remove the neutral detent unit.



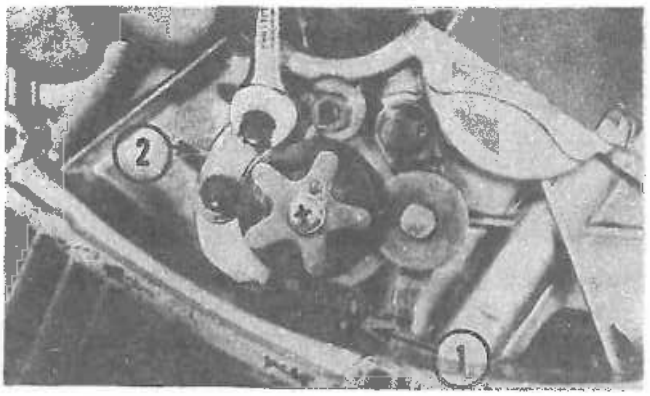


d) A cam follower pin and cam follower roller mounted in each fork is held in place by cotter pin.

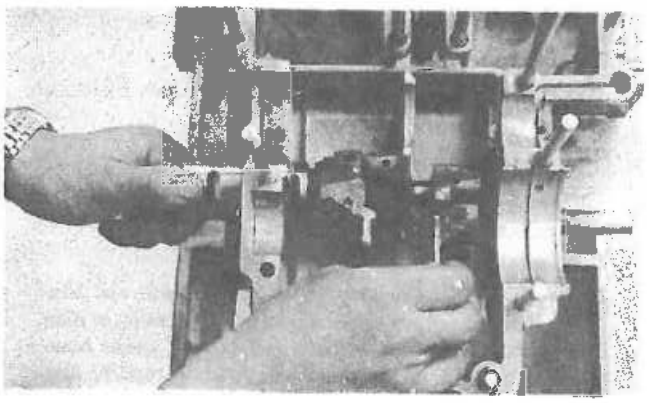




e) On the exterior section of the right-hand case is the shift drum stopper. Release the stopper spring (#1) and remove the stopper unit. Bend the lock tabs down on the locating plate bolts and remove the plate (#2).



f) Pull out the shift drum and remove all three shift forks from the case. Take care, when removing the shift drum to catch all three cam follower rollers that rest in the grooves in the drum.

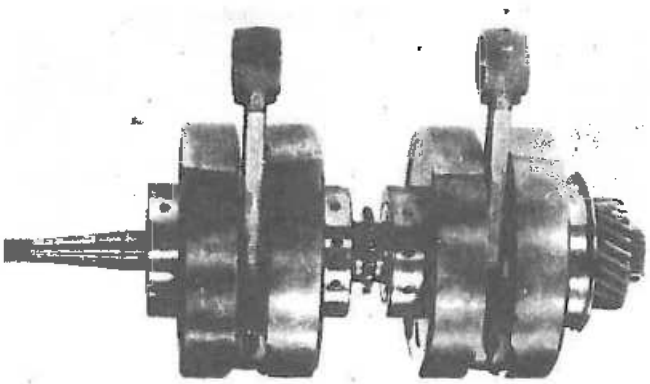


g) Shift Drum and Shift Fork Installation:
Installation of this unit is a reversal of the previous steps. Be sure to lubricate the shift drum and forks before installation. When installing the cam follower pin, always use new cotter pins. After bending the cotter pins, make sure the bent pin ends do not drag. Check for smooth fork movement on the shift drum after assembly.

h) Pay particular attention to the direction and order of fork installation. Fifth gear wheel shift fork has a clearance notch machined into one side to allow clearance for the neutral light button. Fourth gear wheel shift fork is also notched on one side to provide clearance for the neutral position stopper. If these shift forks are incorrectly installed, the neutral stopper and neutral light button will not fit into position.

5) Crankshaft

The crankshaft is built up of pressed together parts. It has four full circle crank wheels. The entire unit runs in four main bearings, three roller and one ball bearing (the ball bearing is the outer right-hand bearing). The rods run parallel (360° crank) on needle bearings over hollow center crank pins. The left and right crank halves are pressed together with the cam chain drive sprocket between the halves.



Completely assembled crankshaft

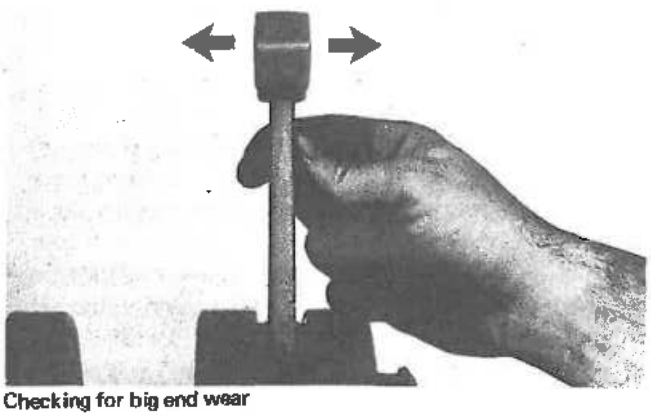
a) Crankshaft removal:
Tap the crankshaft with a rubber hammer to loosen it, then lift it out.

b) Crankshaft main bearing wear
Though the crankshaft main bearings are heavy duty and will withstand much abuse, they should still be checked for wear.

c) Clean the bearing in solvent and dry it with air. Visually inspect all friction surfaces for obvious pits, scratches, chatter marks, or rust. Any of these bearing conditions that are bad enough to be readily seen should be sufficient cause for bearing replacement. Immediately oil the bearing after inspection.

d) Measure connecting rod axial looseness at the small end to determine the amount of wear in the big end (crank pin and big end bearing). Hold the big end stable to prevent it from sliding, then rock the small end.

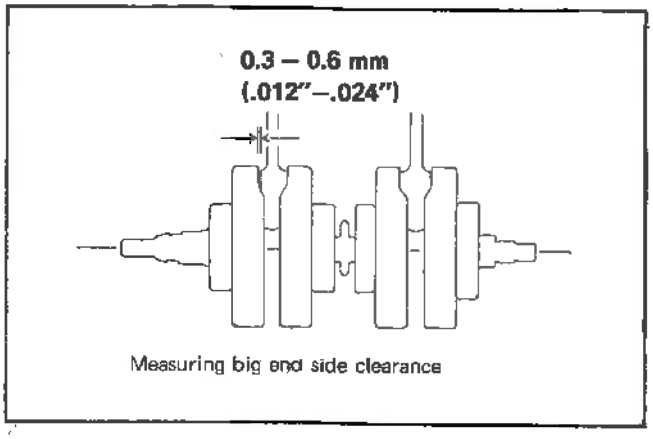
Maximum Allowable Tolerance: 2 mm Small End Play



Checking for big end wear

e) If small end side play exceeds 2mm, disassemble the crankshaft and check the connecting rod, crank pin, and needle bearing for wear. Replace worn parts and recheck small end play. It should measure no more than 1.0mm with new parts.

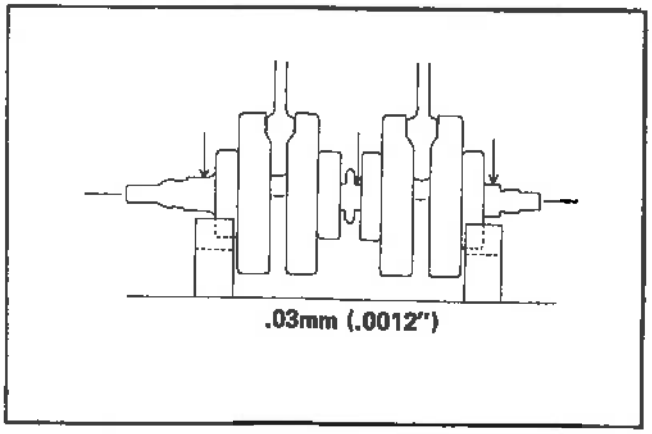
f) Check for correct connecting rod big end side play. Slide the big end to one side and insert a feeler gauge between the crankwheel and rod big end. It should measure between .3mm (.012") and .6mm (.024"). If it exceeds .65mm (.026"), the connecting rod big end should be closely checked for excessive wear. In addition, total crankshaft width should be measured.



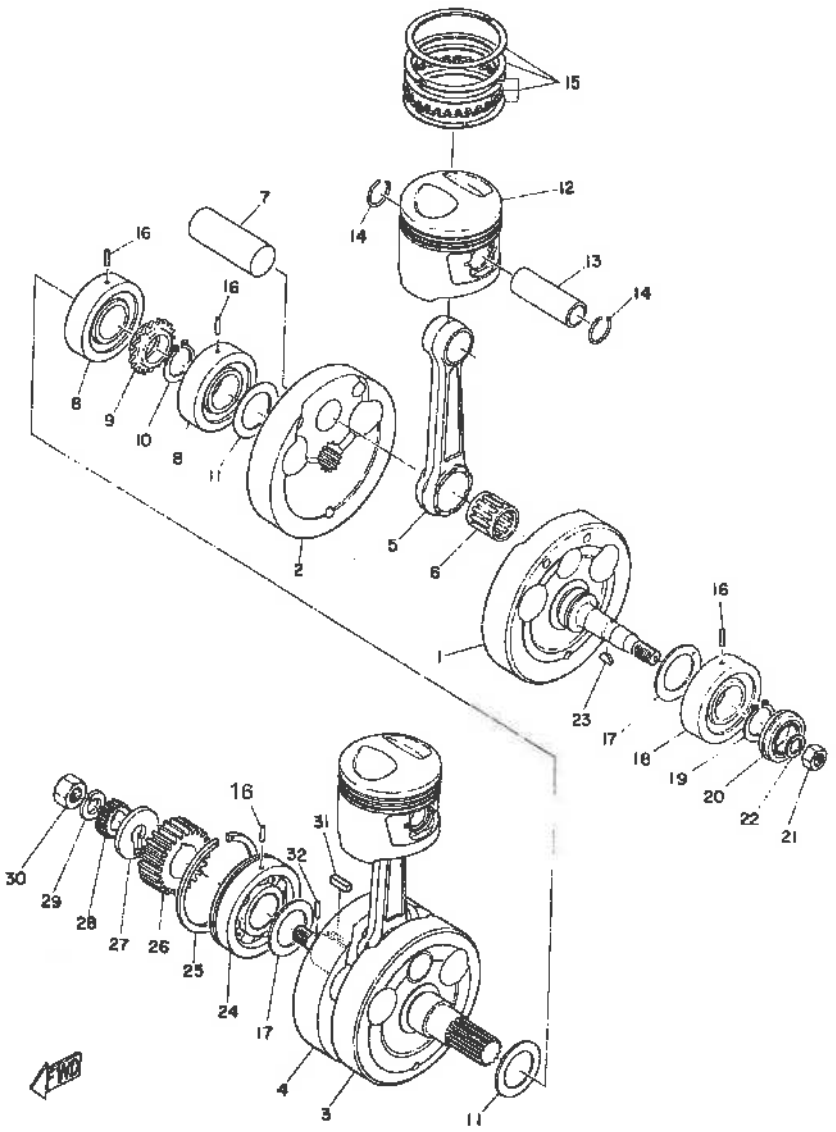
Measuring big end side clearance

g) Check the crankshaft unit for excessive run out. Mount the crankshaft in live centers and check for run out using a dial indicator. Run out at all measurement points should not exceed .0012" (.03mm).

Circlip Crankshaft nut



6) Crankshaft Repair



1. Crank (1) left
2. Crank (1) right
3. Crank (2) left
4. Crank (2) right
5. Connecting rod
6. Connecting rod big end bearing
7. Crank pin
8. Bearing
9. Cam chain sprocket
10. Circlip (S-32)
11. Crank shim (32.2-44-1.0)
12. Piston
13. Piston pin
14. Piston pin clip
15. Piston ring set
16. Dowel pin (4.5-11.8)
17. Crank shim (32.2-44-1.0)
18. Bearing
19. Circlip (S-32)
20. Oil seal (SW-25-40-10.1)
21. Crank shaft nut
22. Spring washer
23. Woodruff key
24. Bearing (6306C3)
25. Circlip (C-78)
26. Primary drive gear
27. Lock washer
28. Drive gear
29. Spring washer
30. Crankshaft (1) nut
31. Primary drive gear key
32. Pump gear locating pin (3-16.8)

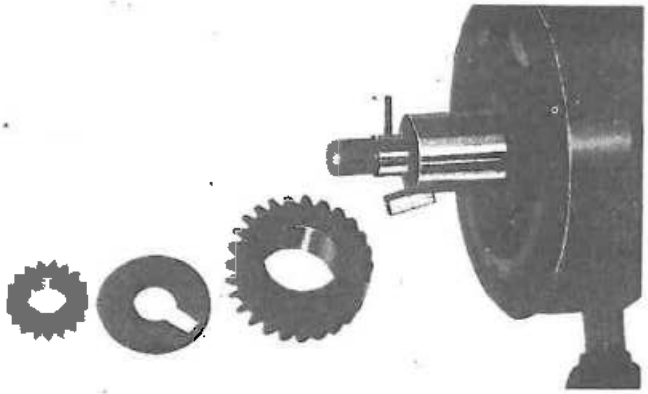
NOTE: EARLY XS1 USED NEEDLE WRIST PIN BEARING SINCE DISCONTINUED.

NOTE:

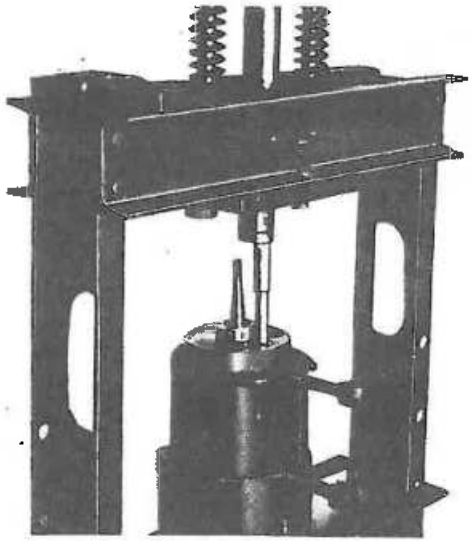
Unless the roller main bearings are to be replaced, do not remove them from the crankshaft as the aluminum roller cage can be damaged. The crankshaft can be disassembled with bearings in place; just remove the outer race to provide pressing clearance.

If removing the bearings, use a guillotine type bearing puller.

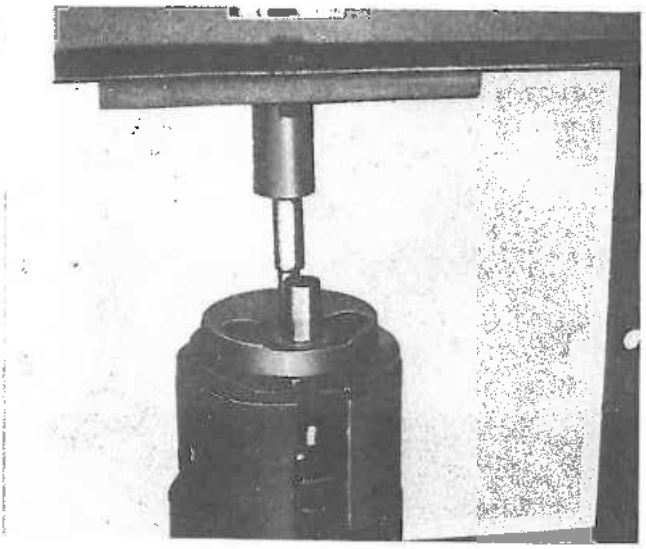
a) Remove (in order): the pump drive gear; pump gear locating pin (located in a hole in the shaft), thick washer, primary drive gear, and square primary drive gear key. Both gears are a slip fit on the crankshaft end, but the gear puller could be used to aid in their removal. DO NOT use a screwdriver or chisel to pry them off as gear teeth can be chipped.



b) Press off the LEFT-HAND OUTER crank wheel (mounting point for the alternator). This pressing procedure, and those to follow, require a crankshaft support fixture (available from Yamaha International Corp.). A length of pipe with an inside diameter wide enough to slip the crank into and squared at both open ends can be used. Cut a slot the entire length of the pipe wide enough for the connecting rod to fit through. Drop the crank into the fixture, place support plates beneath the left-hand outer crank wheel, and push the crank pin out of this wheel.

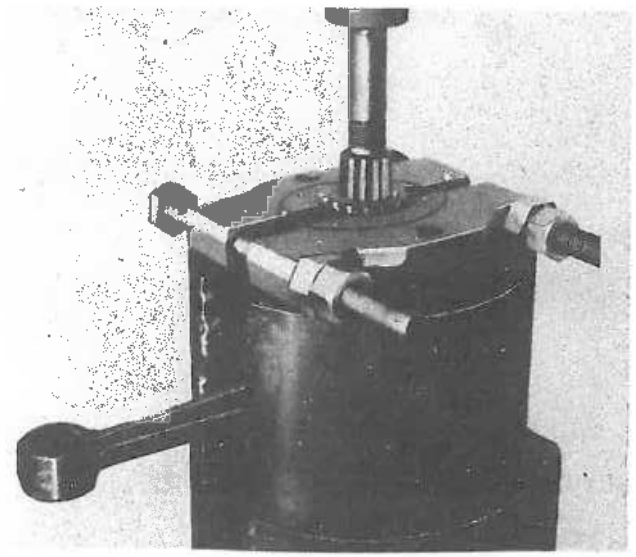


c) Remove the connecting rod and rod bearing, lift the remaining crankshaft section up, place support plates beneath the LEFT-HAND INNER crank wheel, and press the center male splined end out of the supported wheel.



d) Support the left-hand inner wheel and press out the crank pin.

e) If desired, the cam chain sprocket can be pressed off the right-hand crank half. Support the sprocket as shown, using the bearing puller flat side, and press down on the splined end. Do not remove the cam sprocket unless the special assembly tool is on hand to use during reinstallation.

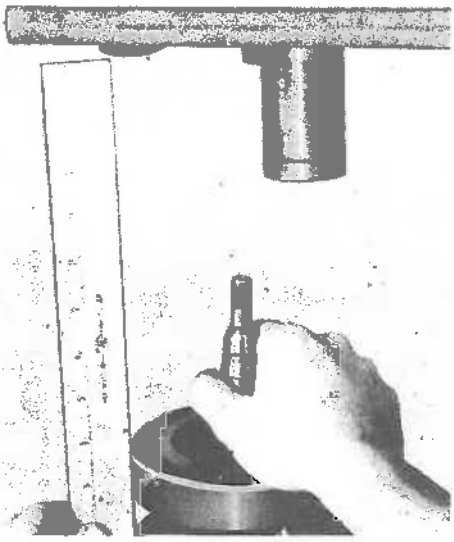


f) To disassemble the crankshaft right half, repeat steps b, c, and d.

7) Crankshaft Assembly Procedures

NOTE: First assemble the right crank half, then the left half, and finish by pressing the two halves together.

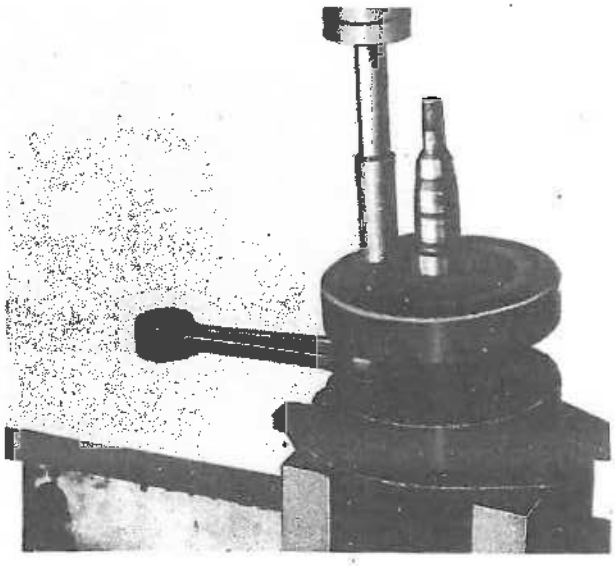
a) Support the right-hand outer crank wheel pin installed; then install the rod bearing and connecting rod, crank pin pointing up. Position the right hand inner wheel over the pin, use a machinist's square or straight edge to accurately line up both wheels, and tap the inner wheel down onto the pin to prevent the wheel moving from out of alignment.



b) Press the right-hand inner wheel straight down onto the pin until each set of wheels measure 66mm total width (the wheel must be pressed straight down or the pin will enter the hole on a slant, resulting in damage).

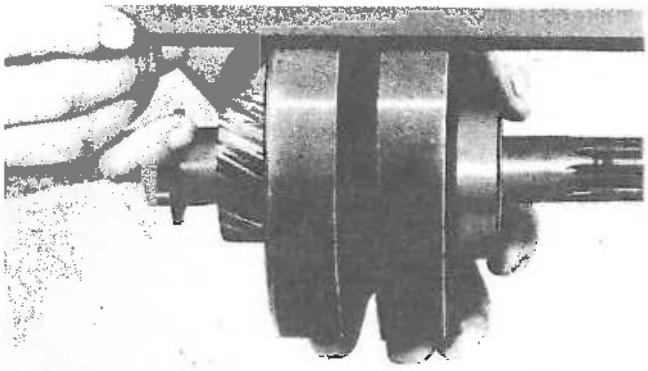
NOTE:

Measure across the machined surfaces of each set.



c) Repeat steps 1 & 2 to assemble the left-hand crank half.

d) Lay a straight edge across both wheels of each crank half at two points 90° opposite the crank pin. Both wheels must be parallel to each other. If they are not, tap the high wheel with a brass hammer. Align each crank half before pressing both halves together.



NOTE: CAM CHAIN DRIVE SPROCKET REINSTALLATION

If the cam chain drive sprocket was previously removed, perform the following sprocket installation procedure before pressing both crank halves together.

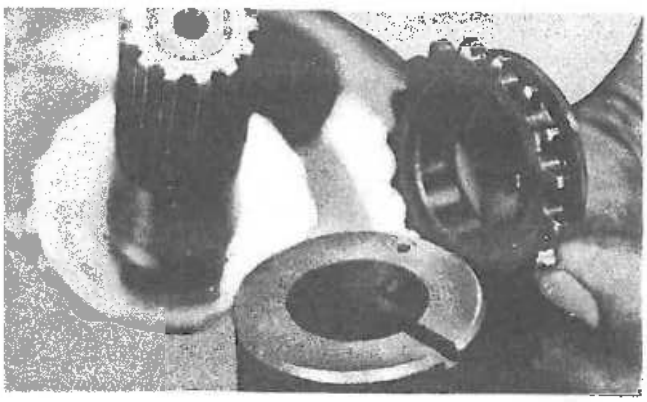
1) Support the right-hand crank half and drop the sprocket down over the splined end, the locating pin sticking out (will slide only to end of splines).

2) A sprocket alignment tool found in the XS650 Crankshaft Rebuilding kit is next dropped down over the splined end. The tool is notched; locate the sprocket locating pin in this notch.

3) Match the alignment pin (jutting out inside the special tool) with the center of the crankpin.

4) Press down on the special tool until it "bottoms" (sprocket now aligned and partially installed), then remove the tool and continue with crankshaft reassembly.

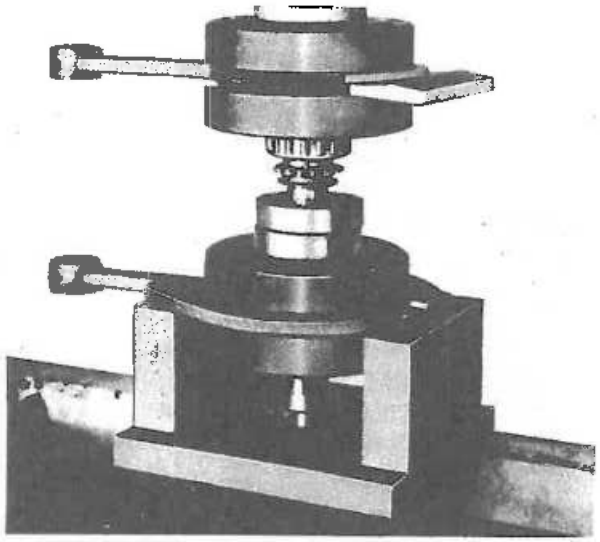
As the halves are pressed together, check that the sprocket locating pin does correctly slip into the notch in the left-hand female splined end.



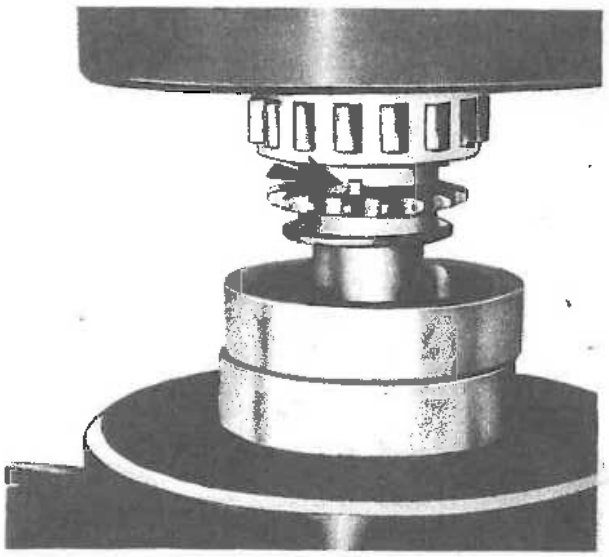
e) Press both crank halves together. Make sure both inner bearings are in place. If the cam chain sprocket has not been removed, line up both crank pins (360° crankshaft) and slip the splined shaft into the splined hole. Lightly force a metal wedge (#1) between both wheels of the top crankshaft half, 180° opposite the crank pins, to prevent the wheels from collapsing when pressure is applied. Finally, place support plates (#2) beneath the bottom inner crank wheel.

f) With the wedge in place, press the left-hand half onto the splined shaft until total crankshaft width is 186mm, +0mm, −0.3mm (measured across all wheels).

IMPORTANT NOTE
To avoid possible damage, do not press directly down on the crankshaft threads. Fit a bearing installation tool over the shaft and press down on this.



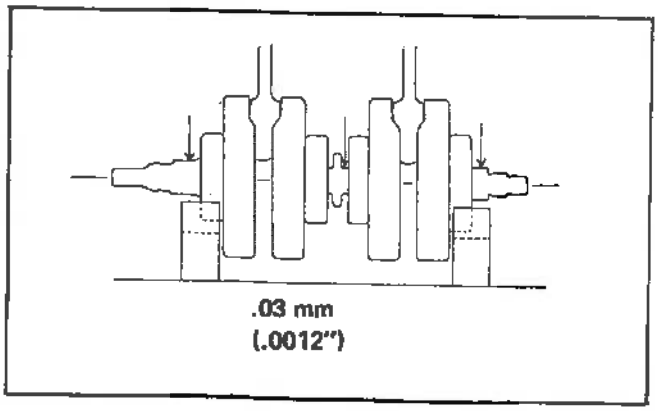
g) As the halves near final width, check that the cam chain sprocket locating pin lines up exactly with its notch in the left-hand crank female end.



8) Crankshaft Alignment

See 5g, page 58

O.A. Width = 186, + 0-0.3
Each half = 66 + .0
−.5



9) Primary Drive Gear and Pump Gear Installation

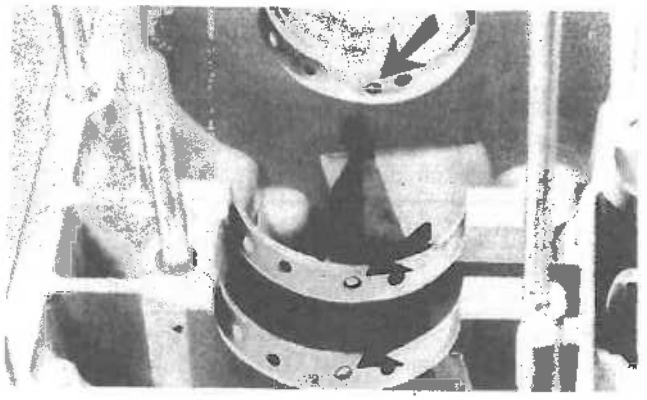
a) Slide the primary drive gear onto the right-hand shaft, recessed surface facing out. Line up the gear and shaft keyways and tap the square key into place. Fit the 2.5mm thick washer into the recessed gear area. Insert the locating pin and push the pump gear into place against the primary drive gear.

10) Crankshaft Installation (including cam chain)

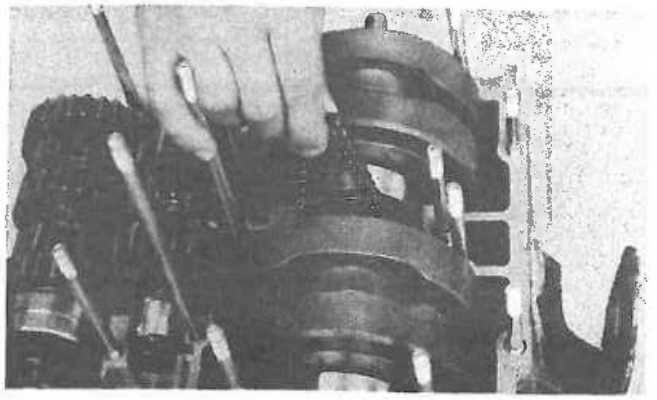
NOTE:

Prior to crankshaft installation, make sure the left-hand crank seal is mounted on the crankshaft, teflon lip facing out.

a) Lubricate all crank bearings, then install the crankshaft into the top case. Make sure that each main bearing outer race fits in place over its locating pin in the case. DO NOT STRIKE THE CRANKSHAFT OR MAIN BEARINGS WITH A HAMMER TO SEAT THE CRANKSHAFT but rather fit each bearing over each locating pin and push the crankshaft into position by hand. Each bearing outer race has a punch mark, and lining this mark up with the crankcase mating surface helps the bearing race to fit in the locating pin.

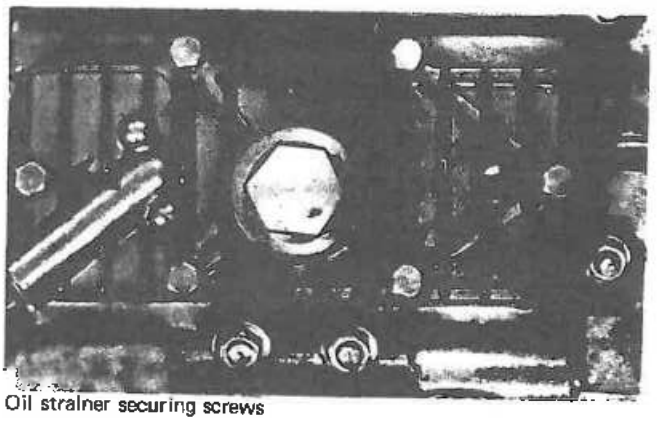


b) Fit the chain over the crankshaft cam sprocket so that it drops into the center slot. Attach safety wire to each end of the cam chain and tie it off to prevent the chain from dropping back into the cases during further engine assembly.



11) Oil Strainer in Bottom Case

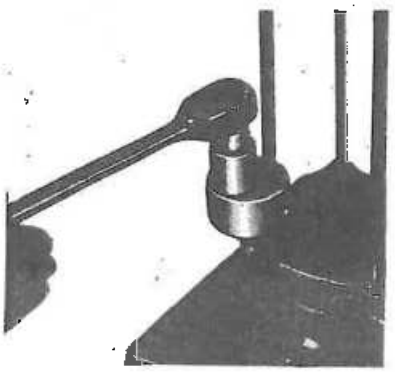
a) A wire mesh oil strainer mounts on a removable plate at the bottom of the lower engine case. The strainer can be removed for cleaning. The oil strainer mounting plate is held to the case by six bolts. When the plate is removed the gasket surfaces must be thoroughly cleaned. A new gasket must be used when the plate is installed back on the lower case. Apply Yamaha bond #4 to both gasket surfaces prior to reassembly.



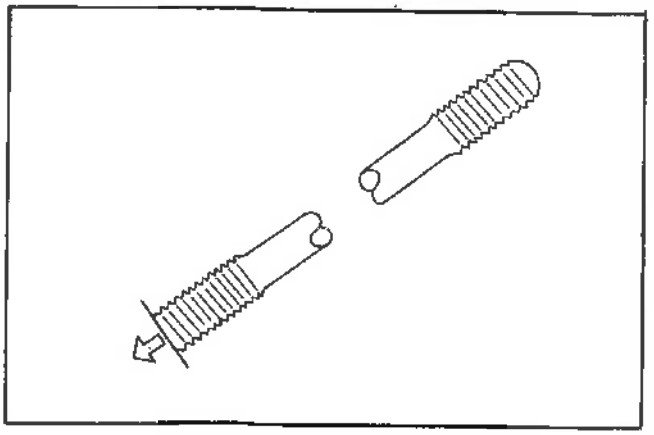
Oil strainer securing screws

12) Replacing Cylinder Mounting Studs

a) The studs are replaceable. They can be removed with a standard stud puller.



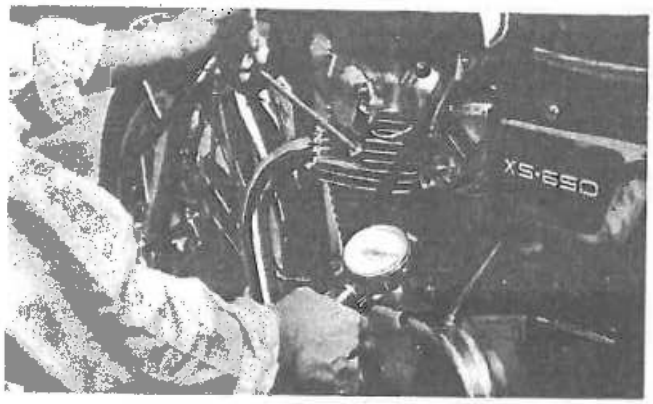
b) If a cylinder stud must be replaced, be sure the flat stud end is screwed into the case.



J) Service Checks/Adjustments

1) Cylinder Compression Check

a) Low cylinder compression means the combustion area is not sealing correctly. A leakage exists at one of the following points: Past one of the valves; out a defective gasket; through a warped head; down past the rings.



b) Remove both spark plugs and screw the compression gauge adaptor tightly into either spark plug hole.

c) Twist the throttle grip FULLY OPEN and kick the engine over several times.

d) With 5 or 6 full kicks the gauge should register 10.5-11.5kg/cm² (145-160 lbs./in²), but it could measure as low as 9.5 kg/cm² 135 lbs./in²) and still be considered adequate. If compression reads lower than 9.5 kg/cm² (135 lbs/in²), then a failure has occurred to one of the parts directly associated with the combustion chamber. The compression figures above apply to all models including XS1-B and XS2 machines utilizing the newer "low-dome" pistons. See M/C PNB #313 in Appendix D for further information.

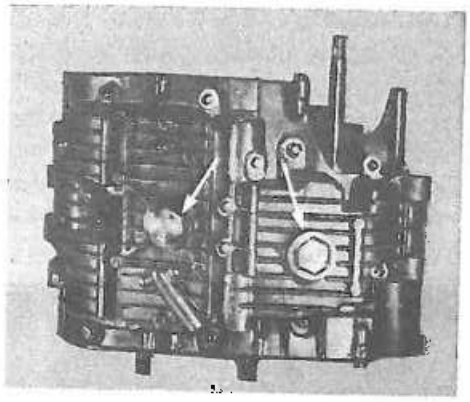
e) If cylinder compression reads more than 11.5 kg/cm² (160 lbs/in²), then carbon has built up on the combustion chamber or piston crown, reducing combustion chamber volume. This in turn creates a higher compression ratio. This situation must be corrected by decarbonizing or excessive heat will develop.

f) Perform steps c) through e) on the other cylinder.

2) Changing or Adding Engine/Transmission Oil

a) Engine and transmission oil is contained in a single reservoir in the bottom engine case.

b) Remove both oil drain plugs on the bottom of the engine. Immediately reinstall and tighten both plugs after the compartments have drained.



c) Remove the oil dip stick and add oil.

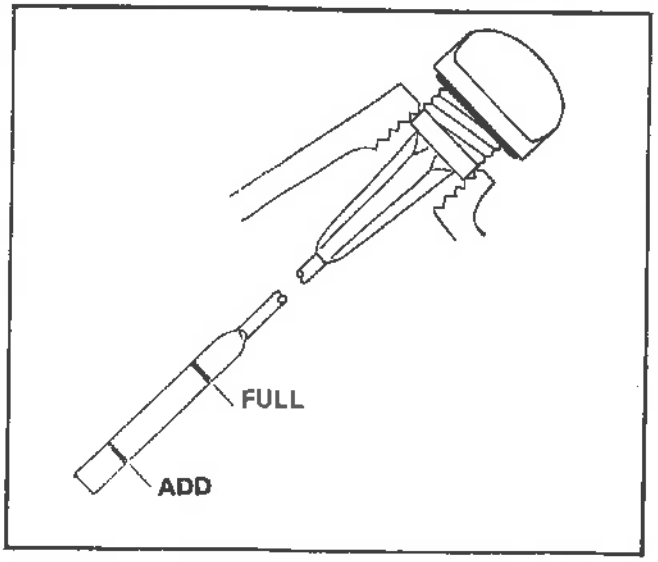
	XS1 - XS1B	XS2 - TX650
SUMP CAPACITY	3.2 qts. (3.0 liters)	2.6 qts. (2.5 liters)

d) If oil is merely being added, use the dip stick to measure existing oil level. Then add sufficient oil to bring the oil up to its proper level, as indicated by the mark on the dip stick. (Machine on center stand to measure.)

e) Finally, let the engine run for several minutes. Stop, let set for one minute, and recheck oil level. Check level with machine on mainstand and level.

f) Recommended oil: Motor oil SAE "SE" or simular quality.

Viscosity: For all seasons = SAE 20W-40
Summer (55°F or higher) = SAE #40
Winter (below 55°F) = SAE #20



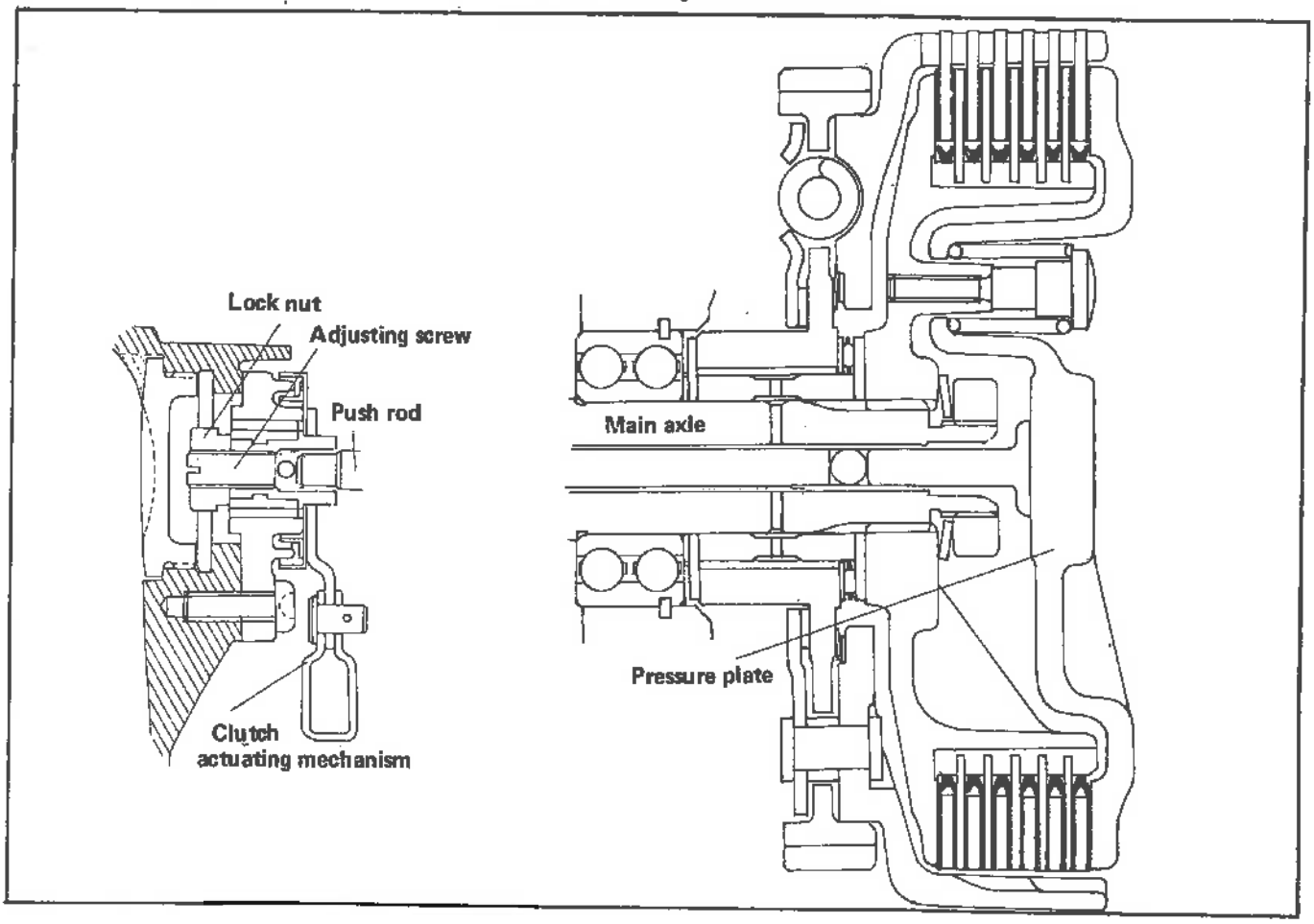
3) Clutch Adjustment

a) Two clutch adjustments are possible, depending on the action of the clutch and clutch lever. If clutch slippage or incomplete clutch disengagement occurs, adjustment is required at the clutch actuating mechanism.

b) The clutch adjustor is situated behind the large threaded plug located in the center of the left-hand engine case cover. Remove the plug.

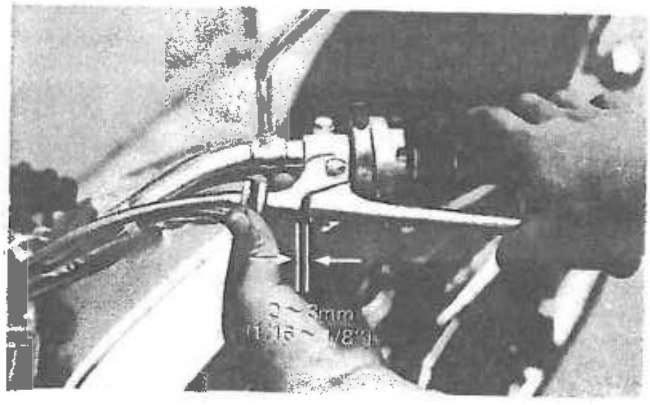


c) The adjustor consists of an adjustment screw and a lock nut. Loosen the lock nut. Turn the adjustment screw in until the screw lightly touches bottom. Back off 1/4 turn and tighten the lock nut.



d) Reinstall and tighten the adjustor plug.

e) The second adjustment at the clutch lever controls the amount of cable free play. Loosen the adjustor lock nut and turn the adjustor to obtain 2 – 3 mm (1/16" – 1/8") cable slack at the lever Pivot Point.



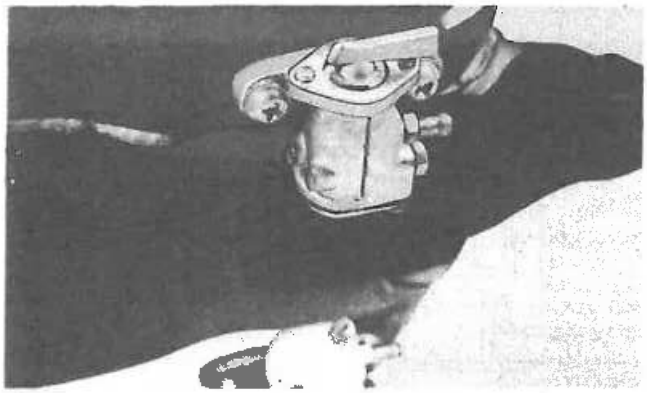
CHAPTER 2. FUEL SYSTEM

The fuel system consists of fuel tank, (petcock with integral filter), fuel delivery lines, and two constant vacuum carburetors. Each section of the fuel system should be checked for possible incorrect operation. Trace for fuel flow from the tank, through the petcock, and through the carburetor. Also check for possible air restrictions or leaks.

A) Petcock

1) Removal and Installation

a) The two petcocks are bolted to the rear underside of the fuel tank. Remove the two screws holding each petcock.

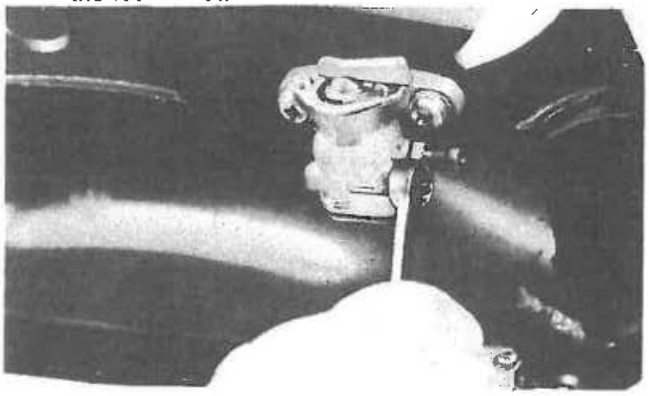


b) A neoprene O-ring fitted into a groove in the petcock mating surface seals the petcock to the fuel tank. Check the condition of this O-ring and replace it if it is broken, flattened, or chipped.

c) Petcock installation is accomplished by fitting the O-ring in position and securing the petcock with the two screws.

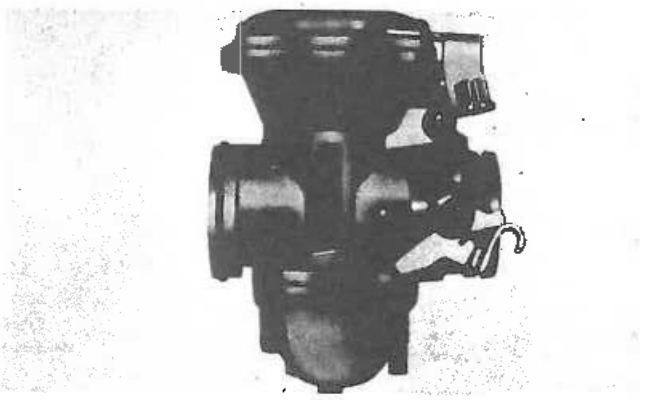
2) Cleaning

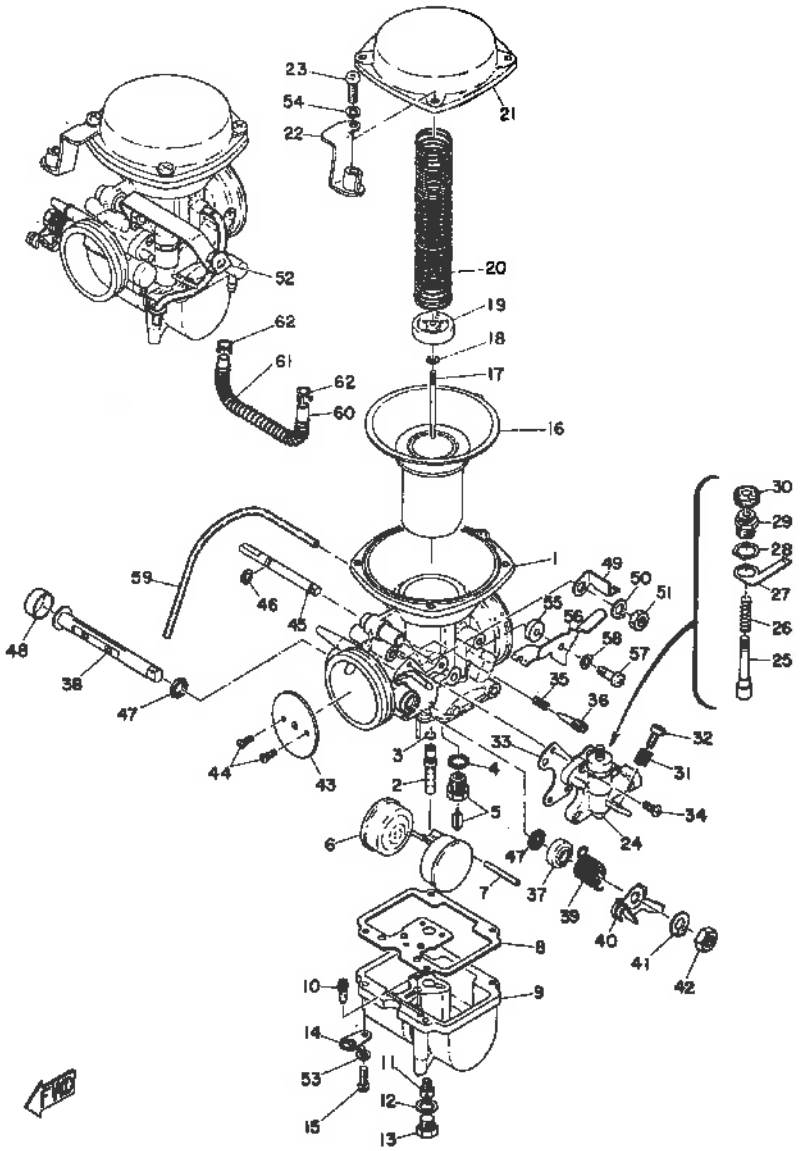
a) Sediment from the fuel tank (including water) can collect in the petcock chamber. A bolt beneath the fuel outlet can be removed to drain the petcock chamber. Larger obstructions can be removed by removing the screw-held plate at the opposite side of the fuel outlet.



B) Carburetor

The XS650 is equipped with two "constant vacuum" carburetors (design is similar in operation to the SU type carburetor) mounted on rubber intake manifolds. Air flow through the venturi is controlled by a throttle slide (vacuum piston). The slide is lifted and lowered by engine vacuum rather than a cable directly linked to the throttle grip.





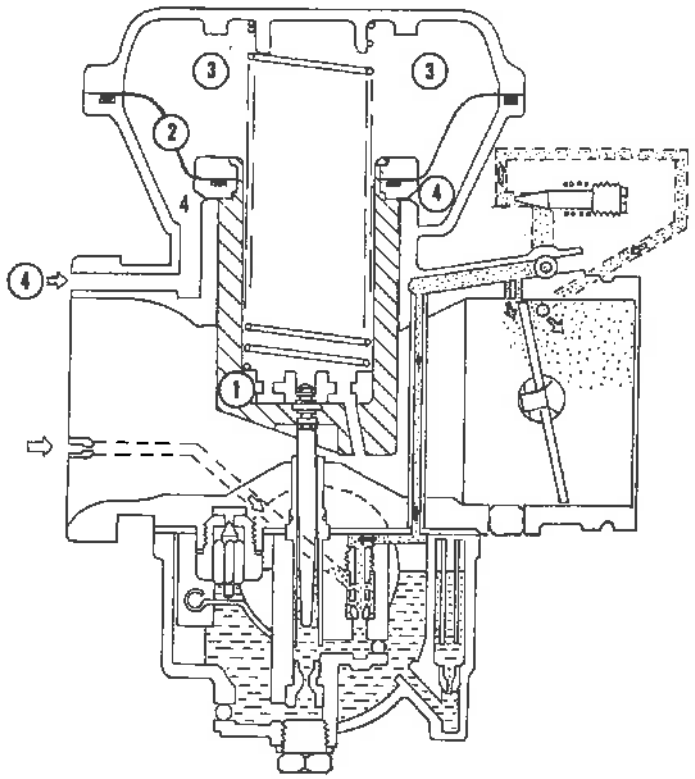
1. Body assembly (left)
2. Main nozzle
3. "O" ring
4. Washer
5. Valve seat assembly
6. Float
7. Float pin
8. Float chamber packing
9. Float chamber body
10. Pilot jet
11. Main jet
12. Washer
13. Plug screw
14. Plate
15. Pan head screw
16. Diaphragm assembly
17. Needle
18. Clip
19. Needle set plate
20. Diaphragm spring
21. Diaphragm cover
22. Throttle bracket (left)
23. Pan head screw
24. Starter body assembly
25. Starter plunger
26. Plunger spring
27. Set lever starter spring
28. Washer
29. Plunger cap
30. Plunger cap cover
31. Throttle stop spring
32. Throttle stop screw
33. Starter packing
34. Flat head screw
35. Pilot screw spring
36. Pilot screw
37. Cap
38. Throttle assembly shaft
39. Throttle spring
40. Throttle lever
41. Washer
42. Nut
43. Throttle valve
44. Oval head screw
45. Starter shaft
46. Clip
47. Seal
48. Cap
49. Starter lever
50. Washer
51. Nut
52. Connector lever
53. Spring washer
54. Spring washer
55. Ring
56. Lever assembly
57. Pan head screw
58. Spring washer
59. Over flow pipe
60. Fuel pipe
61. Spring
62. Pipe clip

Carburetor Specifications (SEE APPENDIX 'C')

Type	
Manufacturer	
Venturi Size	30.6 mm
Main Jet	130
Jet Needle	4JN19-4
Needle Jet	Z-6
Pilot Jet	42.5
Butterfly (throttle) valve	125
Starter Jet	0.6
Float Level	25 mm
Pilot Screw (turns out)	1
Fuel Valve Seat	2.5
ID Mark	E.3
Pilot Outlet	0.7ϕ
Pilot Outlet Bypass #1	0.8ϕ
Pilot Outlet Bypass #2	1.0ϕ
Air Jet	1.2ϕ
Cutaway	Φ
Air Vent	4.0ϕ

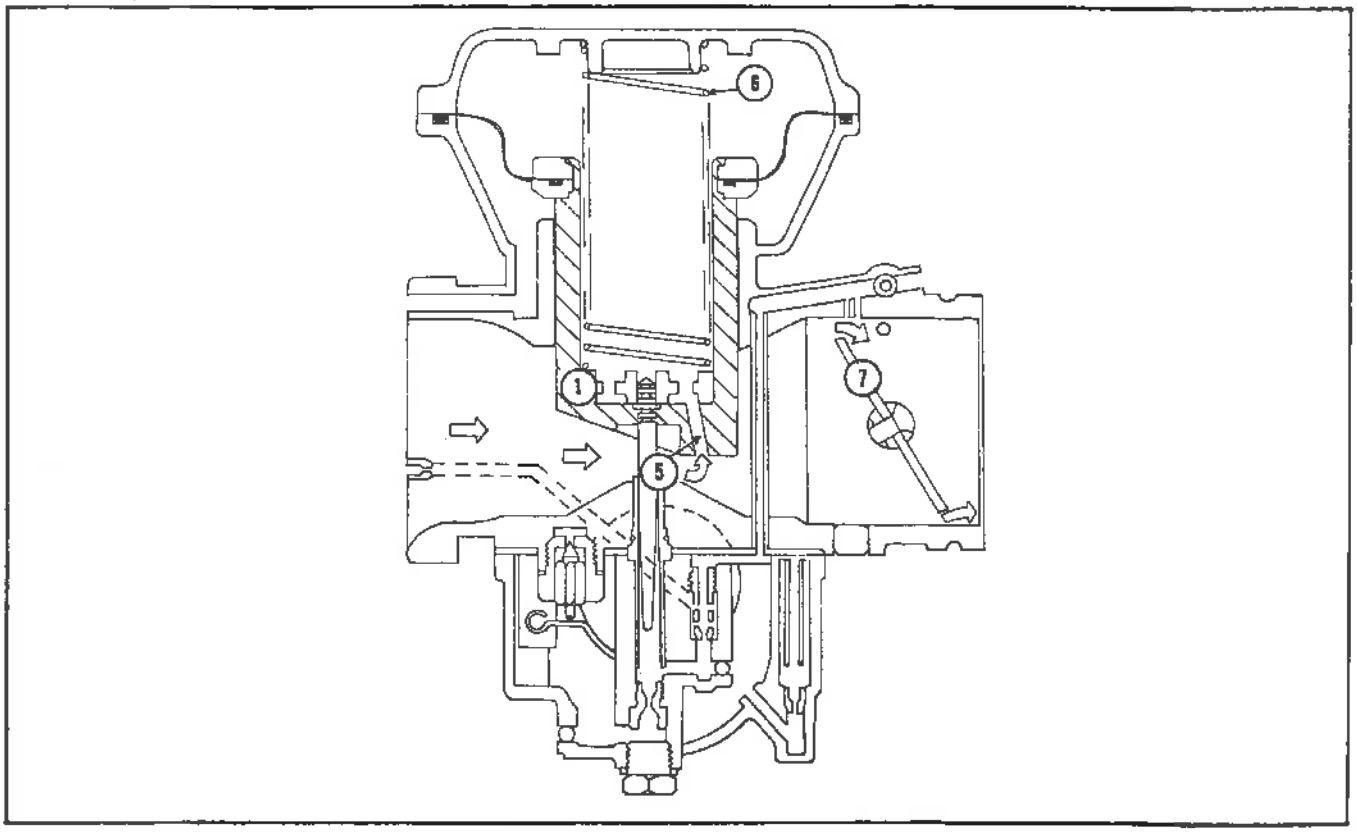
1) Method of Operation

a) Vacuum piston actuation:
The vacuum piston (#1) is lifted by engine vacuum. A flexible rubber diaphragm (#2) is attached to the piston top and to the housing. This diaphragm divides the top part of the carburetor into a vacuum chamber (#3) above the diaphgragm, and an atmospheric pressure chamber (#4) below the diaphragm.



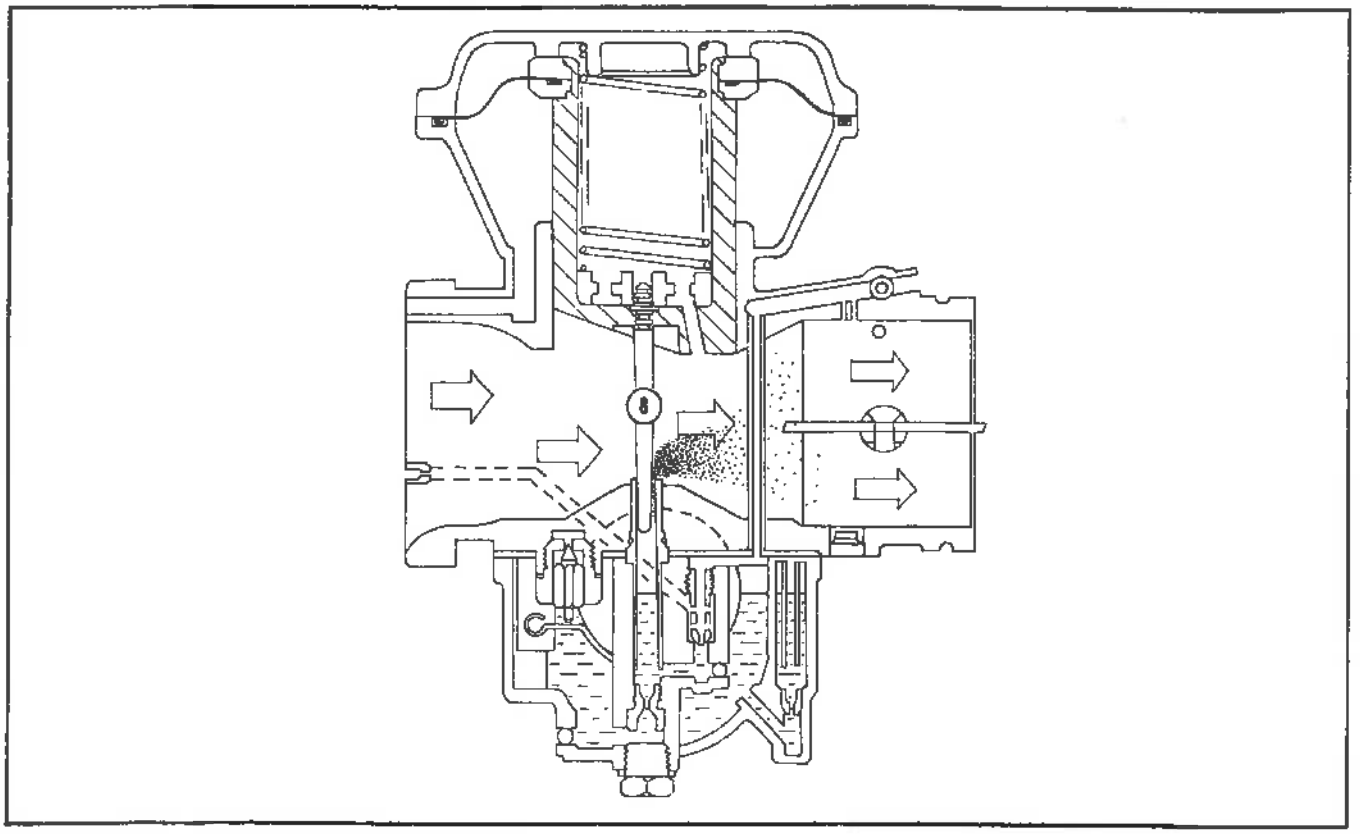
b) Atmopheric air pressure (approximately 15 lbs/in^2) passes through the air passage #4 and occupies the space below the diaphragm. A drilled hole in the vacuum piston (#5 next page) provides an unobstructed path up to the vacuum chamber. As air is pulled past the vacuum piston by engine vacuum—creating a low pressure area at this point — the piston hole permits this low pressure to fill the vacuum chamber. Unequal air pressure exists on either side of the diaphragm.
Atmospheric pressure pushes up on the diaphragm, lifting the vacuum piston (#1) as well. The diaphragm (and piston) continue to lift until the vacuum piston return spring (#6 next page) and the low air pressure match the pushing atmospheric pressure below.

c) Air speed through the venturi, which controls the amount of low pressure in the vacuum chamber, is controlled by a butterfly valve (#7 next page). A cable connects the throttle grip directly to this butterfly valve. Twisting the grip opens the butterfly valve.



d) As the butterfly valve opens, engine vacuum sucks air through the venturi at a greater speed. Faster air speed causes a greater air pressure drop. This dropping pressure immediately occupies the vacuum chamber, lifting the vacuum piston higher. The vacuum piston will continue to lift as the butterfly is opened further.

e) When the vacuum piston lifts it also lifts the jet needle (#8 below). This permits additional fuel to flow up the fuel outlet nozzle and to the engine in the standard method.

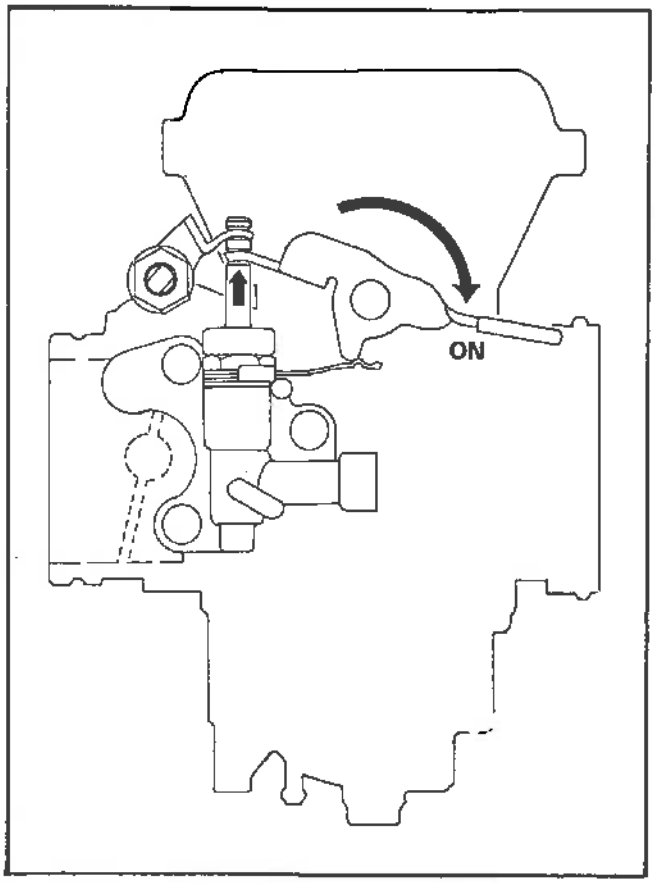


2) Starter System

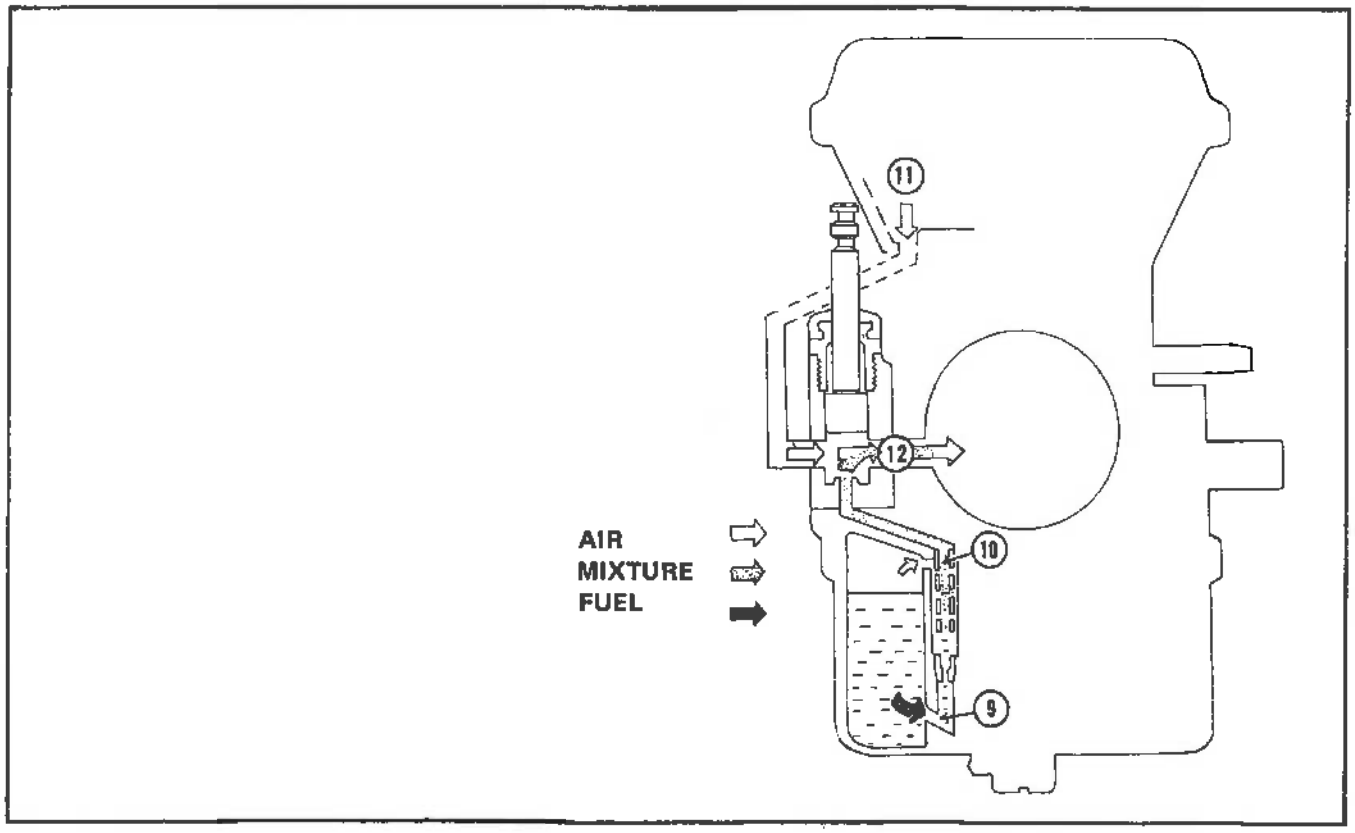
a) This system is identical to the starter system used on all our two-stroke Yamahas. It consists of a separate fuel/air circuit that enriches the fuel/air mixture for easier starting. The starter housing, however, can be removed from the main carburetor body.

When the starter lever is pushed down, a rich starting mixture ratio of approximately 9 : 1 enters the engine.

b) Fuel for this starter system comes from the float bowl, through a drilled passage (#9) through the starter jet. The fuel continues up through a mixing chamber (#10) where air begins to mix with the fuel. Air for the starter system is drawn down through a passage (#11) from the atmospheric chamber below the diaphragm.



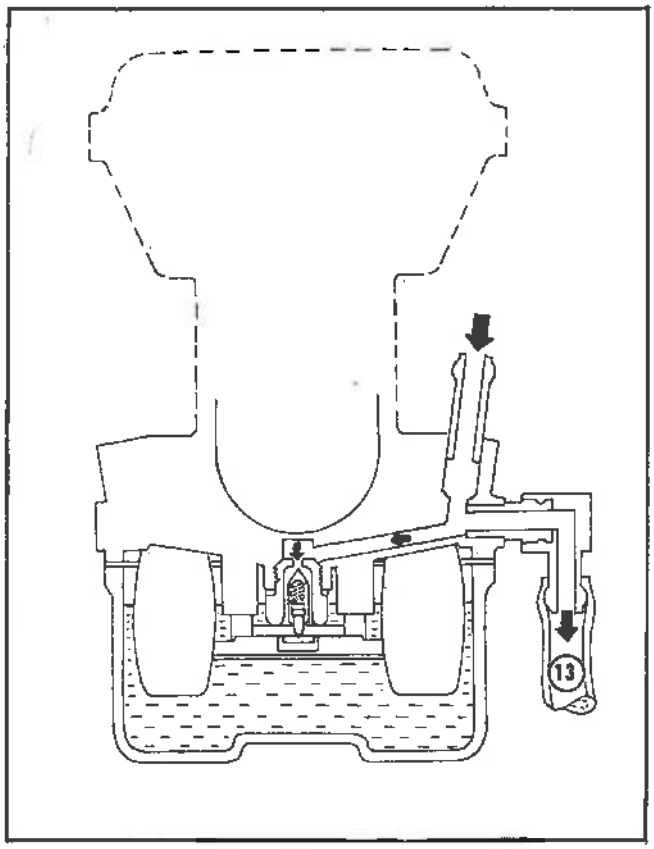
c) The fuel and air meet and mix at the starter plunger chamber and are sucked out through the outlet passage (#12) into the venturi.



3) Float System

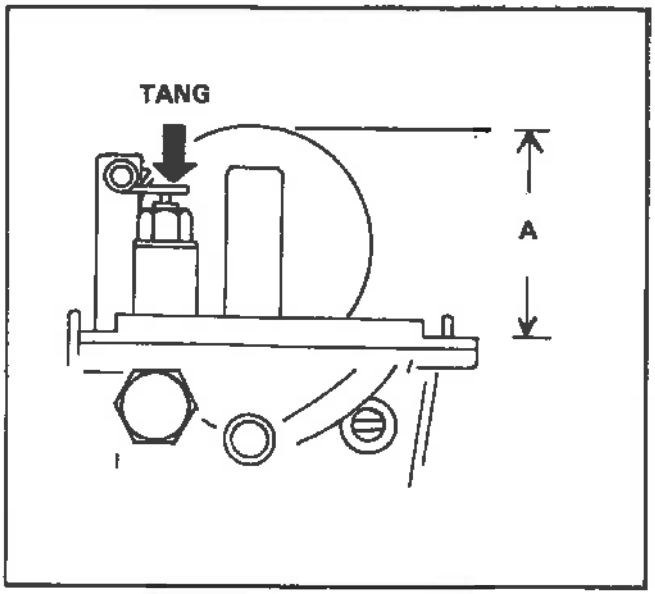
a) Proper fuel level is maintained in the float bowl via the standard method. Two interconnected floats pivot when the level of fuel rises until float/fuel level is high enough to force the inlet valve firmly against its seat. This shuts off the fuel supply from the gas tank.

b) An interconnecting fuel equalizer tube (#13) between both carburetors permits fuel to flow between them.



c) Gas flows from the tank, through both petcocks, and then to each carburetor. If fuel should cease to flow from one petcock, due to any sort of stoppage, fuel will still continue to flow to both carburetors through the equalizer tube. This eliminates the danger of one cylinder running lean due to lack of fuel.

d) Float level adjustment
The float level may change because of a worn needle valve or a bent float arm. If the fuel level rises above a specified level, the air/fuel mixture becomes rich. If the fuel level drops, the mixture becomes lean.



e) Remove the float chamber body and float bowl gasket. Invert the mixing chamber body. Slowly lower the float with your fingers until the float just contacts the top of the float needle; do not compress the spring in the float needle.

f) Measure height "A" from the top of the float to the chamber gasket seat (gasket removed).
Standard measurement: 25 mm (0.98 in.)

g) Bend the tang (which contacts the inlet needle) so that a correct measurement is obtained.

CAUTION

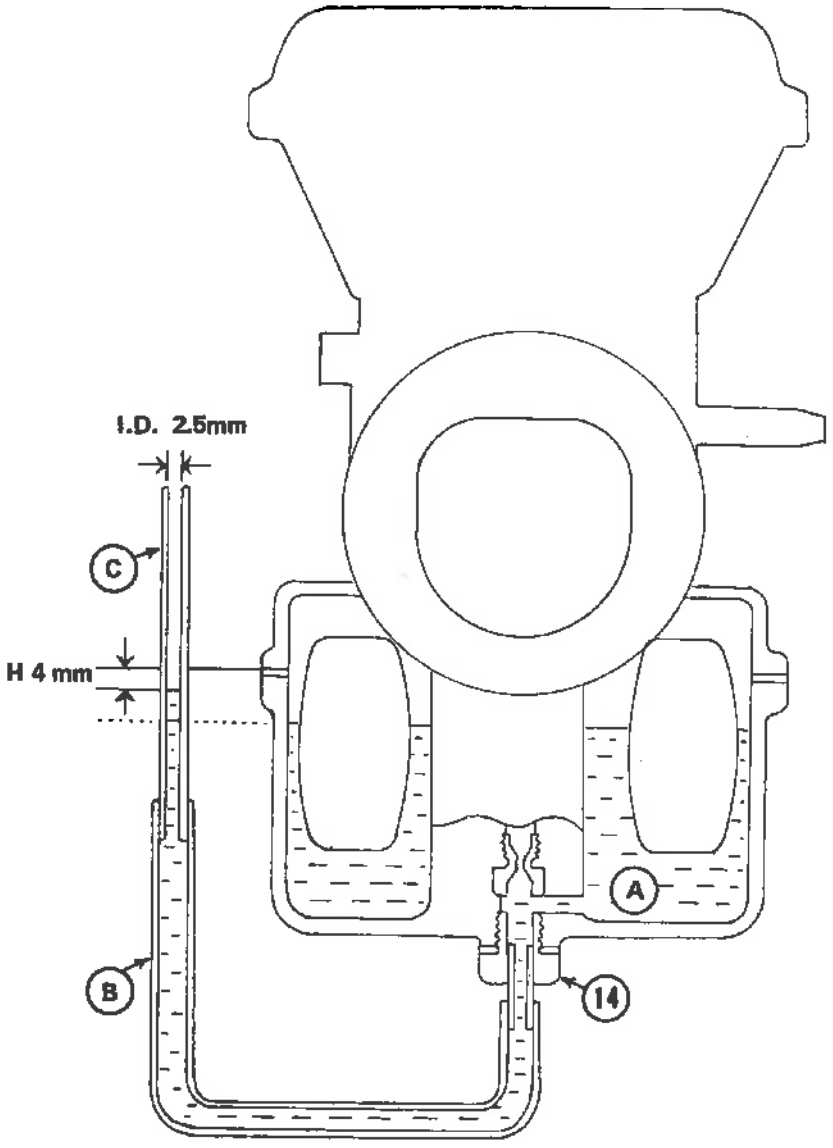
Both floats must be identical in height. If they are not, carefully bend the interconnecting bar between both floats until they have identical heights.

h) Carburetor fuel level can also be checked without removing the float bowl. Construct a special tool using a spare main jet cover nut (#14), rubber tubing (B), and a short length of clear plastic tubing (C). It MUST have an inside diameter of 2.5 mm (.100").

i) After constructing and installing the special tool, hold the clear tubing to the float bowl gasket surface on the main body (see drawing). The fuel level in the tubing must be 4 mm (.160") below the main body gasket surface (can be checked with the engine stopped).

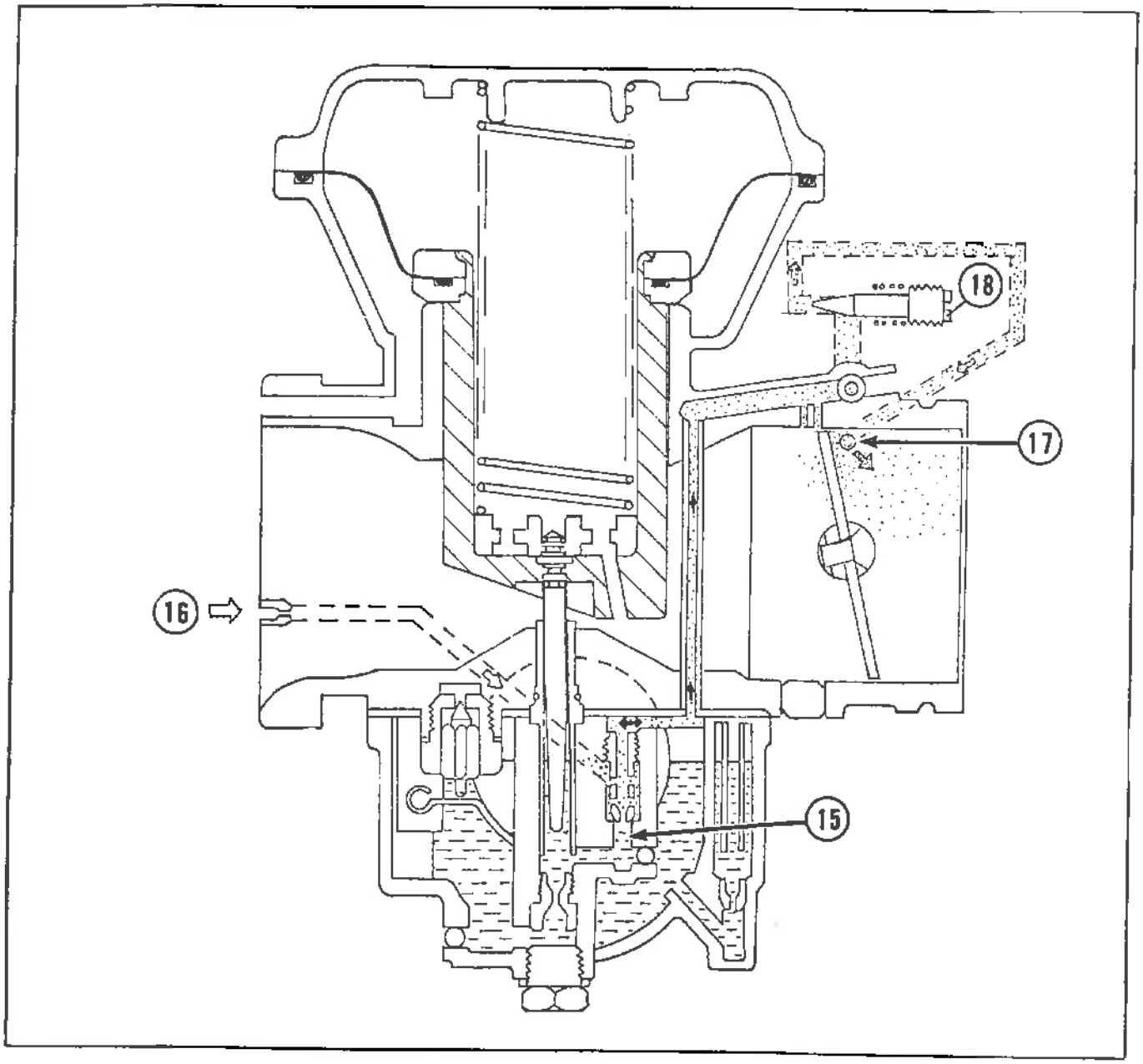
NOTE:

The carburetor must be positioned straight up (not tilted to one side, forward, or backward) to obtain an accurate reading. Also, if the clear tubing inside diameter is other than 2.5 mm (.100"), the fuel level shown will not be accurate.



14. Adaptor A. Fuel B. Flexible tubing C. Clear plastic tubing

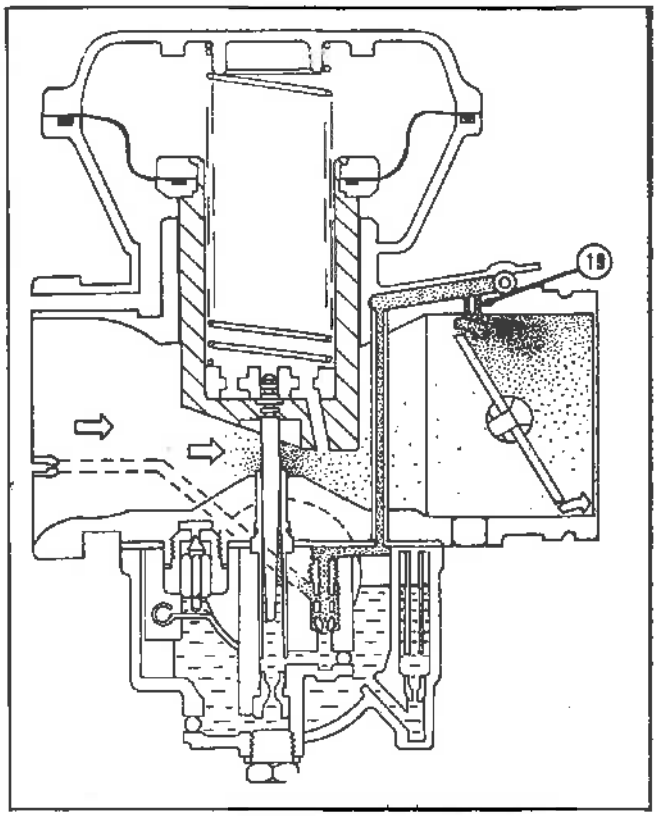
4) Idle Circuit



a) At idling rpm, air pressure in the venturi is not sufficiently low enough to draw fuel flow up through the needle jet nozzle. Fuel travels up through the main jet to the pilot jet (#15). At the same time air passes through the pilot air jet (#16) down through a drilled passage to the pilot jet, where it mixes with the fuel. This mixture passes up through a drilled passage to the pilot outlet (#17) at the upper edge of the venturi, just in front of the butterfly. The amount of fuel/air mixture to the engine is controlled by the pilot screw (#18).

b) To increase engine rpm the butterfly valve is opened further. The top edge of the butterfly uncovers first one bypass outlet (#19) (next page) and then a second bypass outlet. This permits more fuel to progressively enter the venturi and to mix with the additional air that begins to flow past the partially opened butterfly valve. In addition, fuel still flows out the pilot outlet.

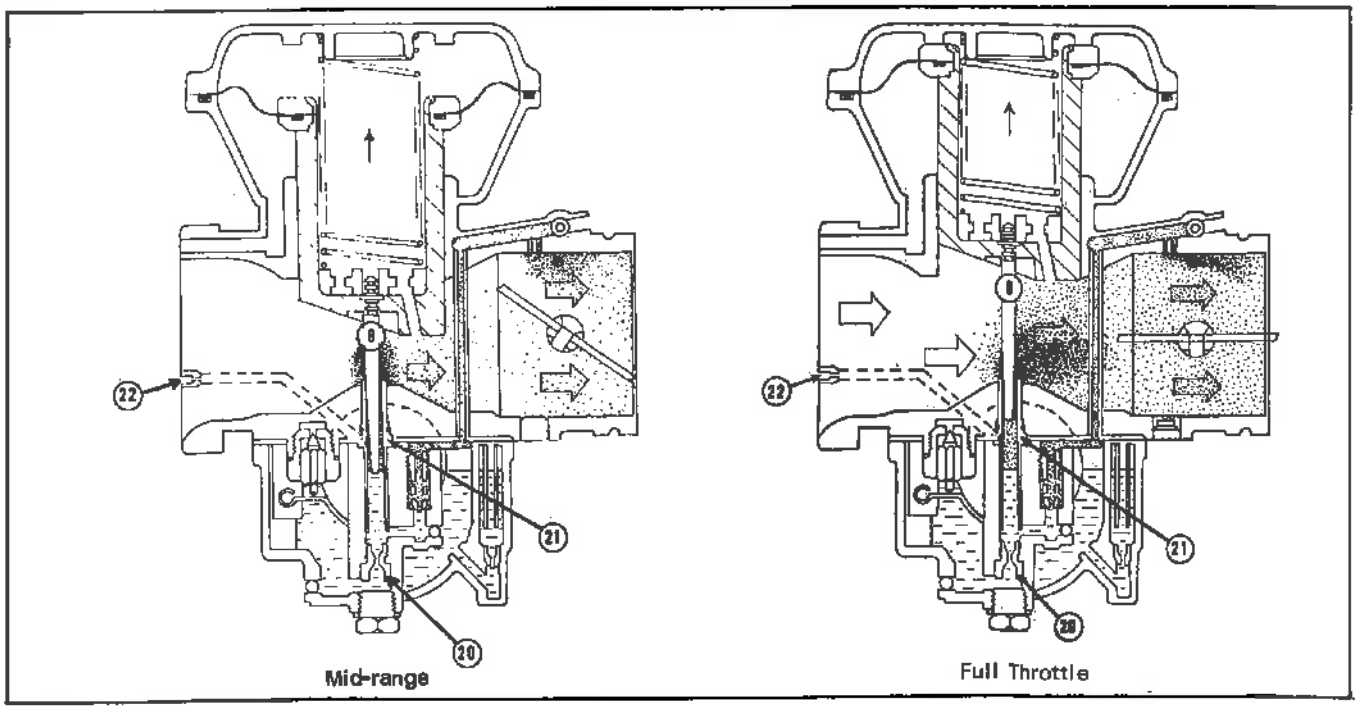
c) Fuel quantity through both bypass outlets is controlled by the diameter of the drilled passages. Both bypass outlets are drilled from the venturi straight into the pilot fuel/air mixture delivery passage.



5) Mid and High Speed System

a) Fuel flow for mid-range and high speed operation comes through the main jet (#20), through the needle jet (#21), and around the jet needle (#8) into the venturi. As engine rpm increases, (the butterfly valve is opened further), venturi vacuum also increases. This causes the vacuum piston to lift, which in turn lifts the tapered jet needle. More fuel flows past the needle and to the engine.

b) Air enters the primary air jet (#22) and travels down a drilled passage to the needle jet. It mixes with the fuel at this point. Final air/fuel mixing is accomplished when this primary air/fuel mixture enters the venturi and mixes with the air passing through.



6) Disassembly and Assembly Procedure
(for replacement or cleaning)

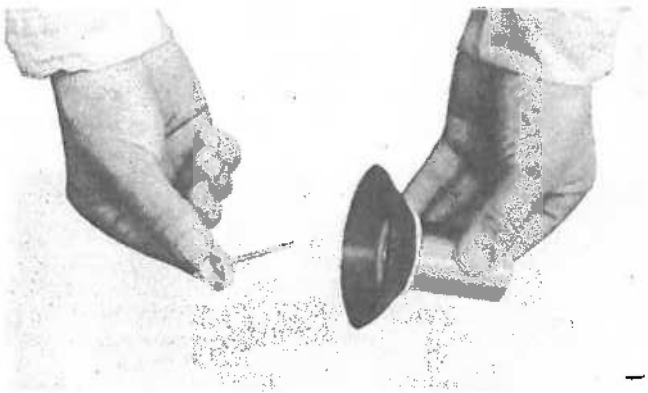
a) The vacuum chamber cover on top is held in place by four screws. Remove these screws and lift off the chamber cover.

NOTE:
When installing the set screws, be sure to correctly position the throttle cable anchor bracket.

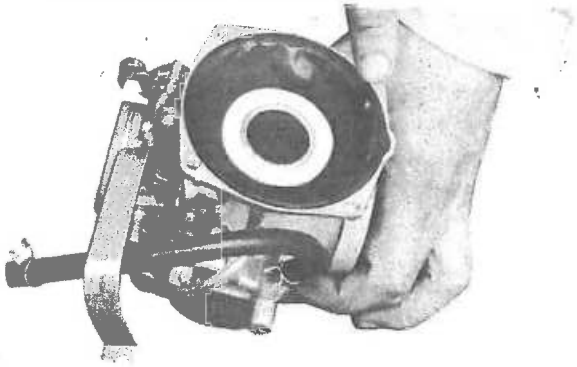


Cover securing screws

b) Once the cover has been removed, the spring, jet needle retainer, jet needle, and vacuum piston can be removed.

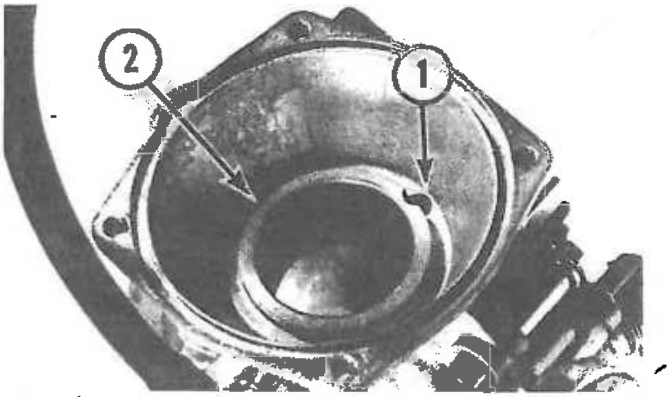


c) Installation of the vacuum piston is accomplished by inserting it into the carburetor body and lining up the small projection on the outer edge of the rubber diaphragm with the corresponding notch in the outer edge of the carburetor top mating surface.



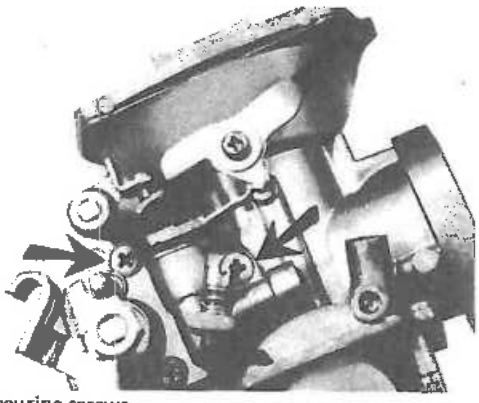
Vacuum piston and associated parts

d) With the top removed, the inlet passage (#1) and air passage to the starter jet (#2) are visible.



View of atmospheric pressure chamber

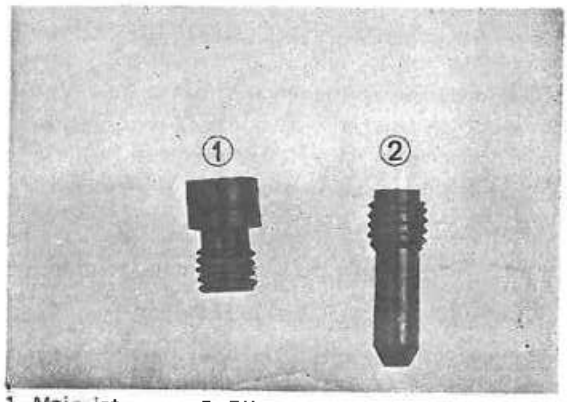
e) The starter jet housing mounts to the left side of the carburetor. It is held by three screws. A gasket fits between the starter jet housing and main housing.



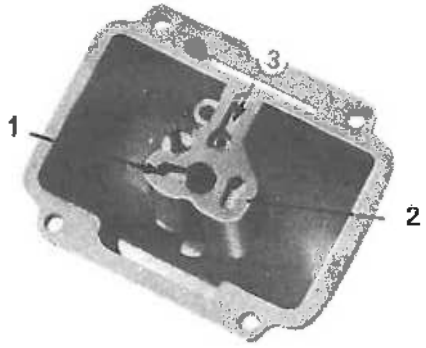
Starter housing securing screws

f) The float bowl mounts to the bottom of the main housing. Remove the four retaining screws and then remove the float bowl.

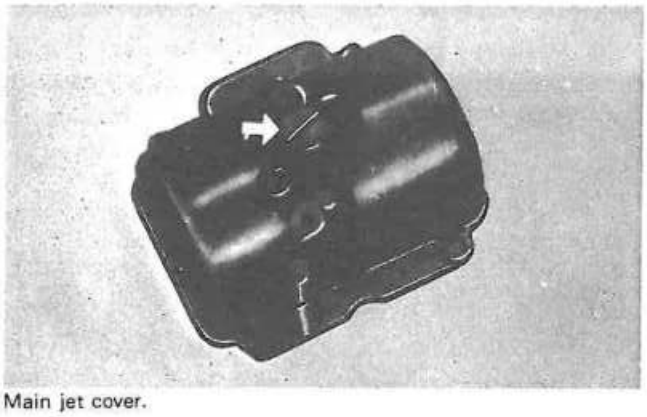
g) Both the pilot jet and the main jet are screwed into orifices in the float bowl. The pilot jet is removed from the inside, the main jet is removed from the bottom, after first removing the cover screw.



1. Main jet 2. Pilot jet



1. Primary air passage to needle jet
2. Pilot air passage to pilot jet
3. Pilot jet.



Main jet cover.

h) Turn the carburetor upside down, pull out the float pivot pin, and remove the float.

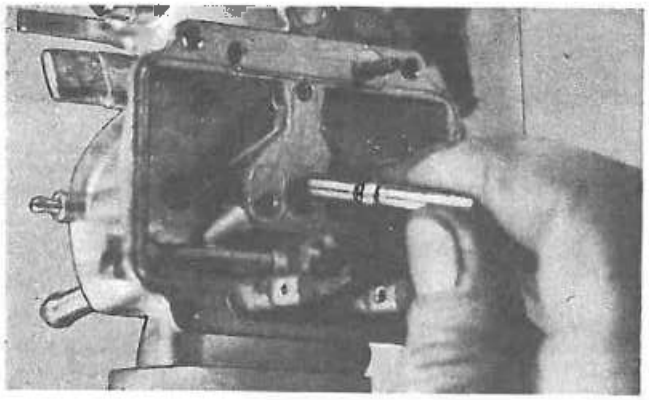


1. Pivot pin
2. Float level adjustment tang

CAUTION

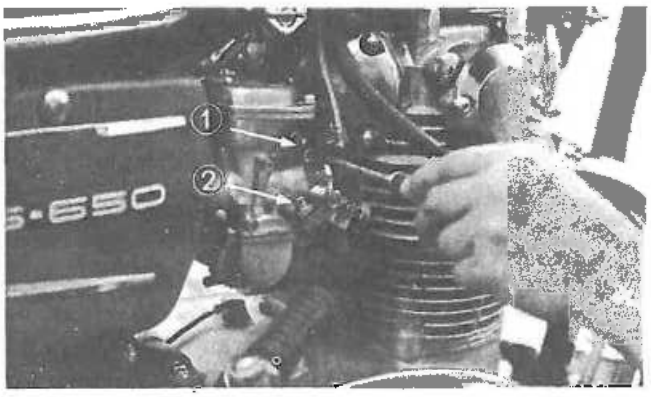
Directly beneath the float adjustment tang is the float valve. Remove this part immediately to prevent its loss.

i) The needle jet fits into the main housing from the bottom. If removal is required, pull it down and out by hand. Reverse this procedure to install the needle jet.



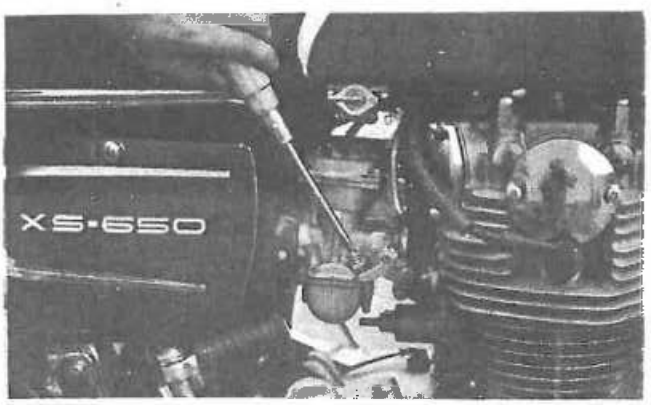
7) Adjustments

a) Idle mixture: turn the idle mixture screw in until it lightly seats, then back it out 1 turn.

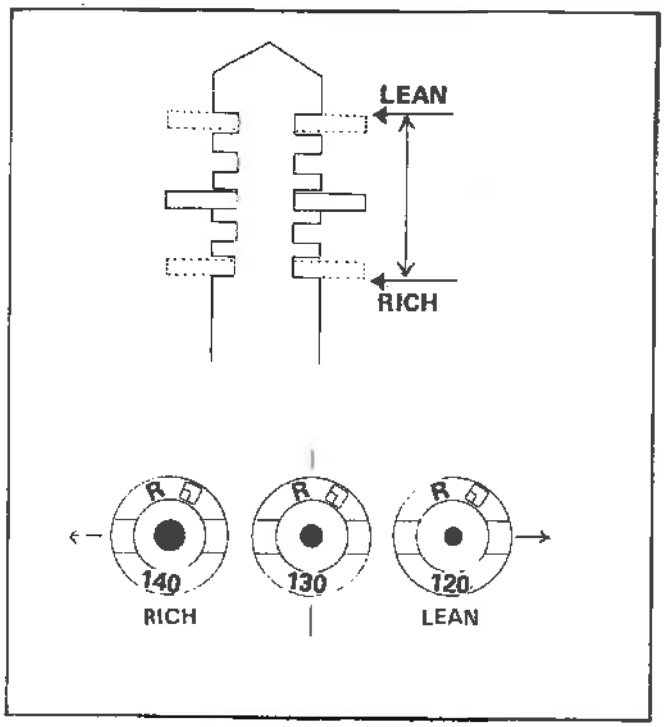


1. Pilot mixture adjusting screw.
2. Idle speed adjusting screw.

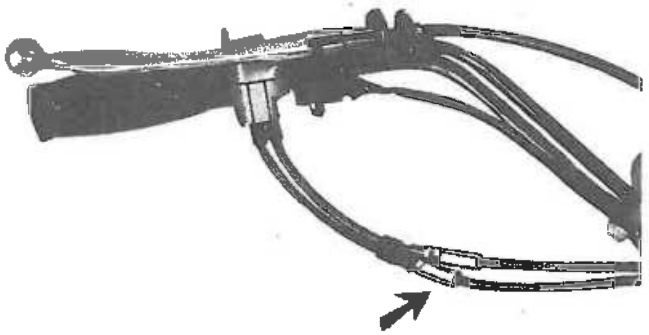
b) Idle speed:
Set both idle screws so the engine idles fast. Pull off one spark plug high tension lead. Back out the idle speed screw on the running cylinder until the engine dies. Hook up the spark plug lead, start the engine, and pull off the opposite spark plug lead. Slowly back off the idle speed screw of the running cylinder until the engine dies. Attach the loose spark lead and start the engine. Both cylinders should be idling at the same speed, pulling evenly. If engine rpm is too high, back off both idle speed screws an even amount until idle is 1,000~1,200 rpm.



c) Jet needle (mid-range): Mid-range fuel supply is controlled by the position of the needle in the needle jet. The needle clip comes standard in the 4th groove from the top (4th stage). To lean out the mid-range mixture, move the clip one groove higher (dropping the needle). To richen the mixture, place the clip one groove lower (raising the needle).



d) Main jet (high speed): The carburetor comes equipped with a #130 main jet. Install a one step larger main jet (#140) to richen the high speed mixture. Install a one step smaller main jet (#120) to lean out the mixture.



e) Butterfly synchronization: Both butterfly valves must be adjusted to open and close simultaneously. Fully close the throttle grip so that both butterfly valve actuator mechanisms rest against their throttle stop screws. Slowly twist the throttle grip and note whether both butterfly valves start to open at the same time. If this does not occur simultaneously, use the cable adjustor to lengthen or shorten one cable until correct action is achieved. In addition, with the throttle fully closed, both throttle cables should have approximately 1 mm free play before both butterfly valves start to lift simultaneously.

NOTE:

Idle speeds on both carburetors MUST BE SET before synchronizing butterfly operation.

8) Troubleshooting

a) Fuel overflowing out of carburetor:
This condition is due to dirt holding the fuel valve open or a defective fuel float filling with gasoline and not shutting the fuel valve. Dirt can be quickly cleaned out of the fuel valve and valve seat. A punctured float, however, must be replaced.

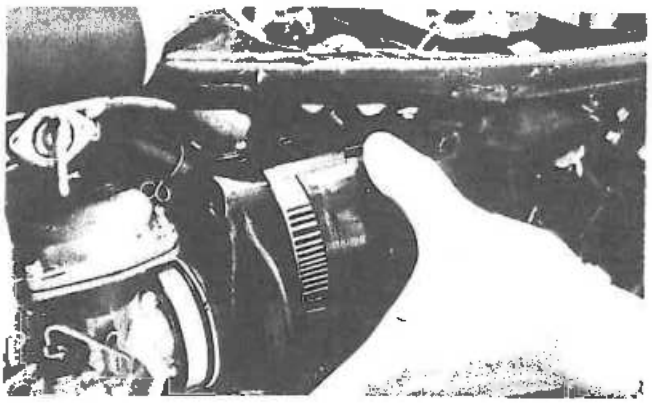
b) Vacuum slide lifting slowly or not at all:
If the throttle cable is properly opening the butterfly valve, but the vacuum slide still does not lift during engine operation, check the vacuum slide diaphragm. If this diaphragm is cracked or punctured, no vacuum will develop above the diaphragm as it should. Replace the vacuum slide/diaphragm unit.

c) Fuel flowing to carburetor but not to engine:
First, water droplets can block up the main jet. Secondly, an improperly adjusted float level holds the fuel level too low to be picked up by vacuum over the fuel outlet nozzle. Third, if the jet needle clip slips off, the jet needle drops down into the needle jet. This prevents any fuel from entering the venturi.

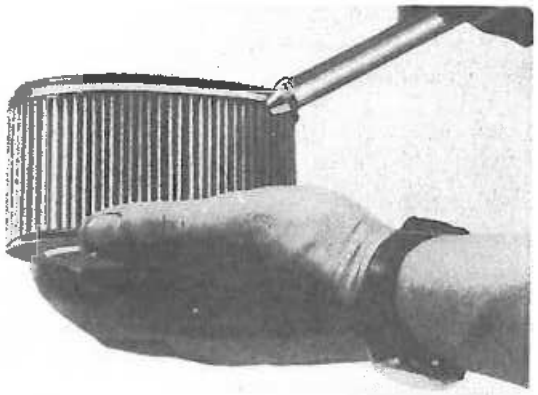
CAUTION
If a passage is blocked, and high pressure air must be used to clear it, it is absolutely necessary that the float bowl be removed first. If this is not done, high pressure air can enter the float bowl and crush both floats.

C) Air Filter

1) Two, dry paper-type air filters are housed in separate metal containers located under the seat. Remove both frame side covers. Push down on the spring clip on the top of the filter container and the cover will pivot down, permitting removal.

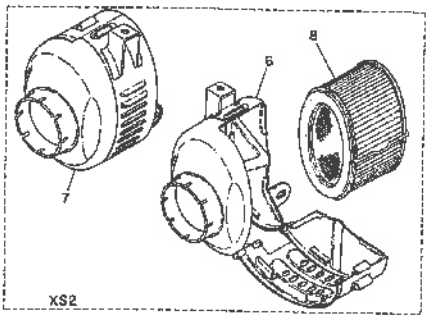


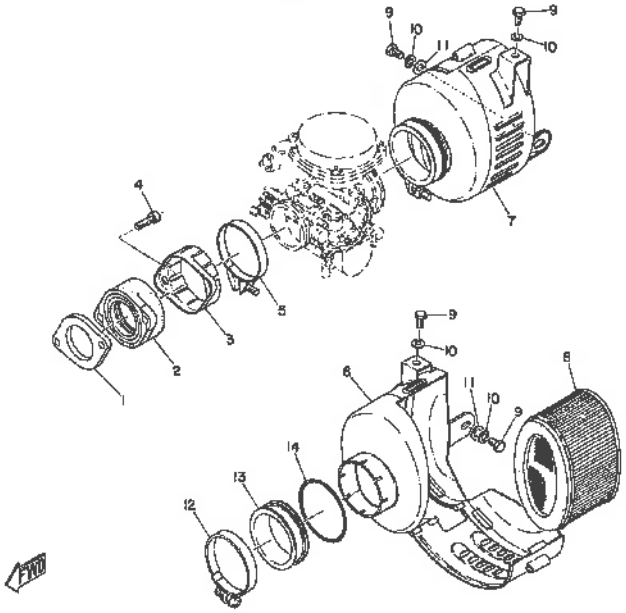
2) The air cleaner is the dry paper type and it must not be cleaned with any type solvent. High pressure air removes most dust and grit. If the contamination adheres to the filter element, use a soft brush to dislodge the particles, then blow the filter with air.



(TX650A: See page 163)

INTAKE



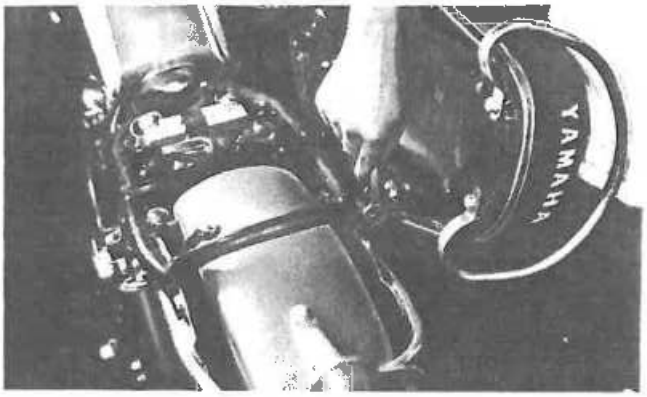


CHAPTER 3. FRAME

1. The basic frame design consists of double down tubes and a single large top tube. The engine is fully enclosed in the frame.

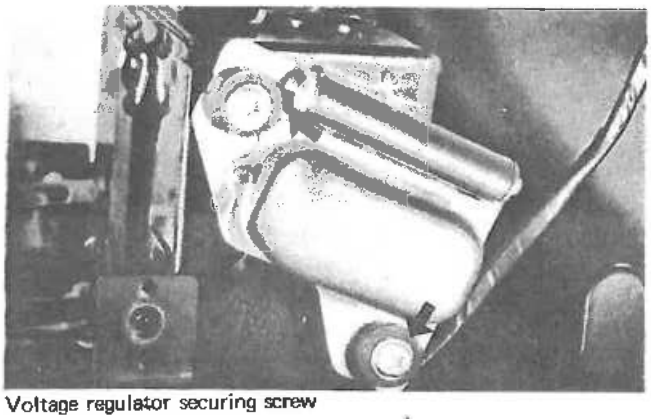
A) Seat Removal

Lift the seat and disconnect the seat support bracket. Next, remove the rear pivot pin nut and slide the seat forward until the pivot pins slide clear of the bushings.



B) Voltage Regulator Removal

The unit is mounted to the right side of the battery box. Disconnect the multiple wiring connector and remove both mounting screws.



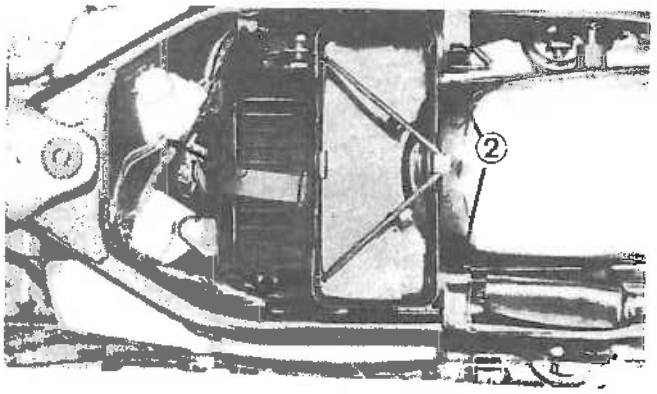
Voltage regulator securing screw

C) Battery Box (and tool box combined) Removal

CAUTION

Disconnect flasher unit wiring (bottom of box) before removing the box.

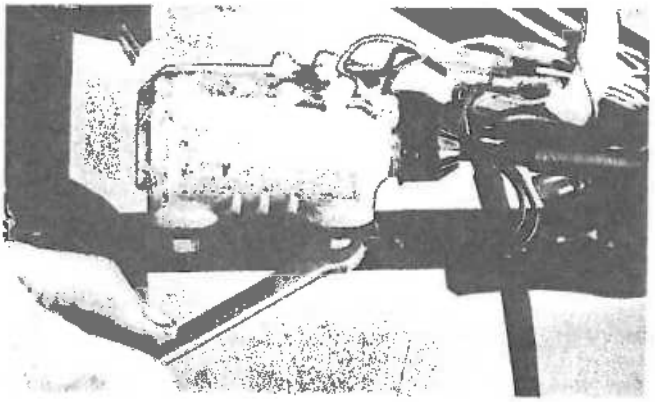
The battery box is held in place by two anchor pins (2) and two securing bolts (1). Remove the two retaining bolts, slide the unit forward until both anchor pins clear the bushings, then lift the box up.



1. Battery/tool box securing screws
2. Anchor pins

D) Secondary Ignition Coil Removal

Each of the two secondary ignition coils is mounted to a frame bracket by two nuts. Remove the gas tank wire loom connections and two 10 mm nuts.

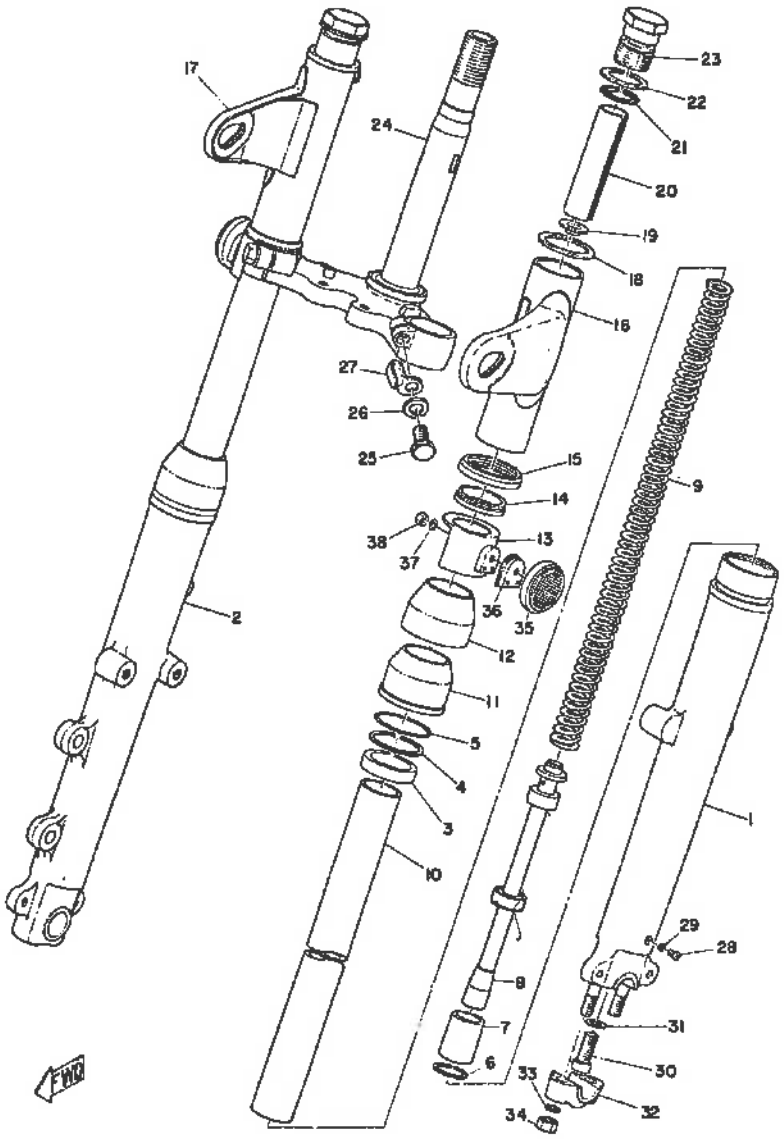


E) Front Forks

The front forks consist of two individual fork legs, each one having a two-way hydraulic dampening action and an internal spring to extend the fork leg during operation. In addition, the forks are held solidly in place by an underbracket and top bracket commonly called the triple clamp.

(See page 164 for TX650A fork information.)

FRONT FORK (XS2)

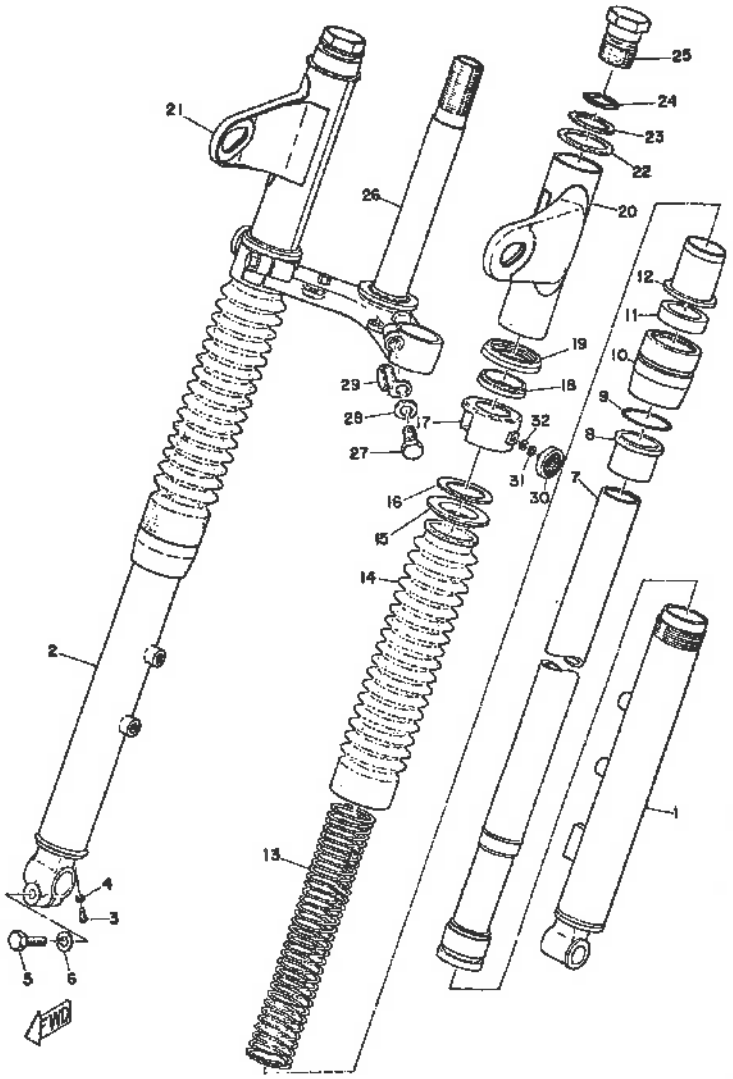


XS2

1. TUBE, outer left
2. TUBE, outer right
3. OIL SEAL
4. WASHER, oil seal
5. CLIP, oil seal
6. CIRCLIP (R-28)
7. PISTON, front fork
8. CYLINDER COMP.
9. SPRING, fork
10. TUBE, inner
11. SEAL, dust
12. COVER, dust seal
13. COVER, outer
14. PACKING
15. GUIDE, cover under
16. COVER, upper left
17. COVER, upper right
18. GUIDE, cover upper
19. SEAT, spring upper
20. SPACER
21. PACKING
22. WASHER, cap
23. BOLT, cap
24. UNDER BRACKET COMP.
25. BOLT, under bracket
26. WASHER, spring
27. HOLDER, wire
28. PLUG, drain
29. GASKET, drain plug
30. BOLT
31. PACKING
32. HOLDER, axle
33. WASHER, spring
34. NUT
35. REFLECTOR
36. COVER, reflector stay
37. WASHER, spring
38. NUT

NOTE: Typical for TX650-RGF. 1, outer tube, left has fittings cast on for optional dual disc brake.

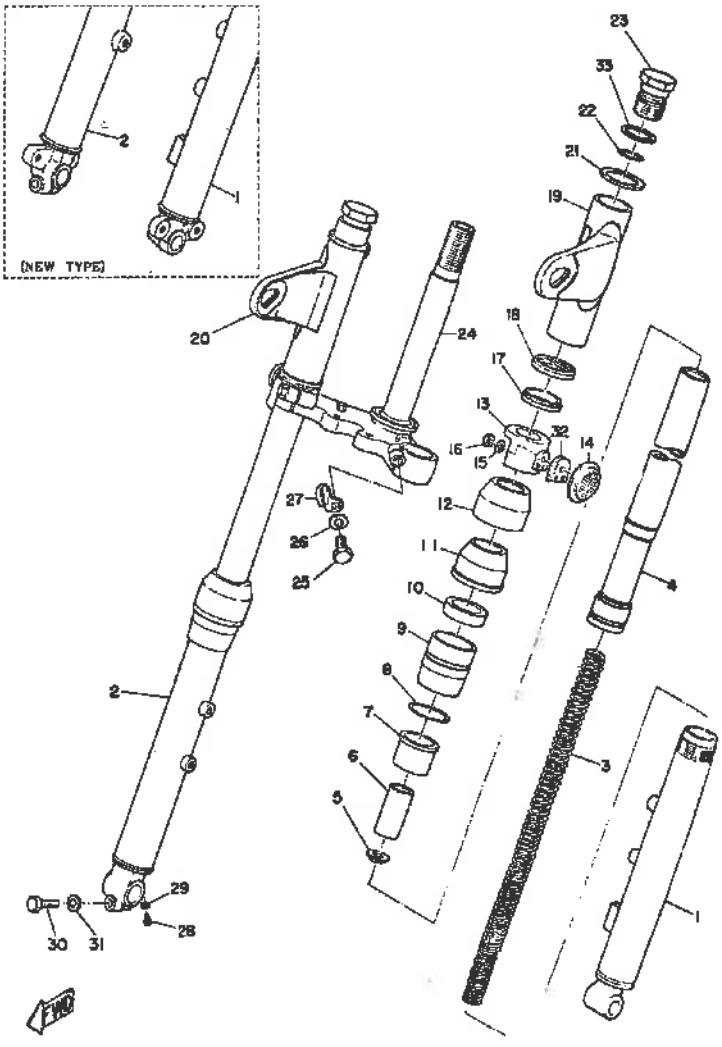
FRONT FORK (XS1)



XS1

1. TUBE, outer left
2. TUBE, outer right
3. PLUG, drain
4. GASKET, drain plug
5. BOLT
6. WASHER, spring
7. TUBE, inner
8. METAL, slide
9. O-RING
10. OUTER NUT COMP.
11. OIL SEAL
12. SEAT, spring under
13. SPRING, fork
14. BOOT
15. SEAT, spring upper
16. WASHER, oil seal
17. COVER, outer
18. PACKING, lamp stay
19. GUIDE, cover under
20. COVER, upper left
21. COVER, upper right
22. GUIDE, cover upper
23. WASHER, cap
24. O-RING
25. BOLT, cap
26. UNDER BRACKET COMP.
27. BOLT, under bracket
28. WASHER, spring
29. HOLDER, wire
30. REFLECTOR 1
31. WASHER, spring
32. WASHER, plain

FRONT FORK (XS1B)



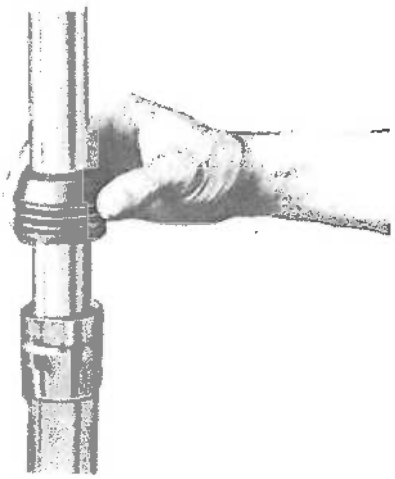
XS1B

1. TUBE, outer left
2. TUBE, outer right
3. SPRING, fork
4. TUBE, inner
5. SEAT, spring upper
6. SPACER
7. METAL, slide
8. O-RING
9. OUTER NUT COMP.
10. OIL SEAL
11. SEAL, dust
12. COVER, dust seal
13. COVER, outer
14. REFLECTOR
15. WASHER, spring
16. NUT
17. PACKING, (lamp stay)
18. GUIDE, cover under
19. COVER, upper left
20. COVER, upper right
21. GUIDE, cover upper
22. PACKING
23. BOLT, cap
24. UNDER BRACKET COMP.
25. BOLT, under bracket
26. WASHER, spring
27. HOLDER, wire
28. PLUG, drain
29. GASKET, drain plug
30. BOLT
31. WASHER, spring
32. COVER, reflector stay
33. WASHER, cap

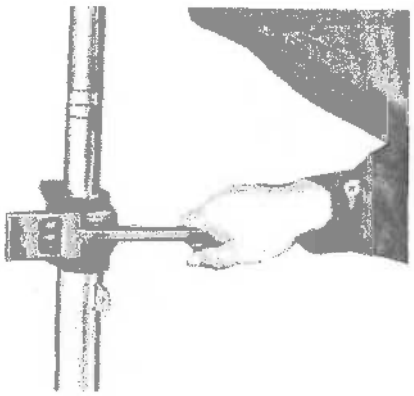
1) Outer Fork Leg Removal

NOTE: Remove the front wheel and front fender before starting this procedure. The forks need not be removed from the machine.

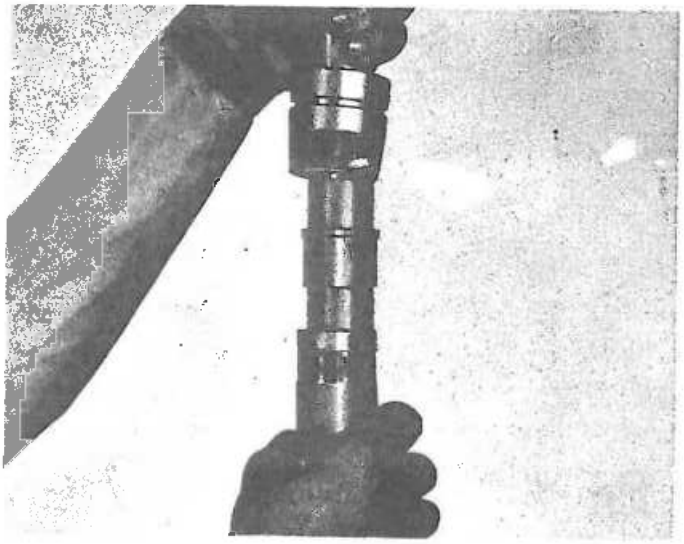
a) Pull up the dust seal.



b) Unscrew the outer nut. To do this, grip the nut with a strap wrench, (if a metal strap wrench is used, first place a thick sheet of rubber around the nut to protect the chrome). Hold the outer tube to prevent it from spinning, (reinstalling the axle helps), then unscrew the outer nut (right hand thread).



c) The outer tube can now be pulled down and off the fork leg unit. After the tube has been removed, drain the oil.

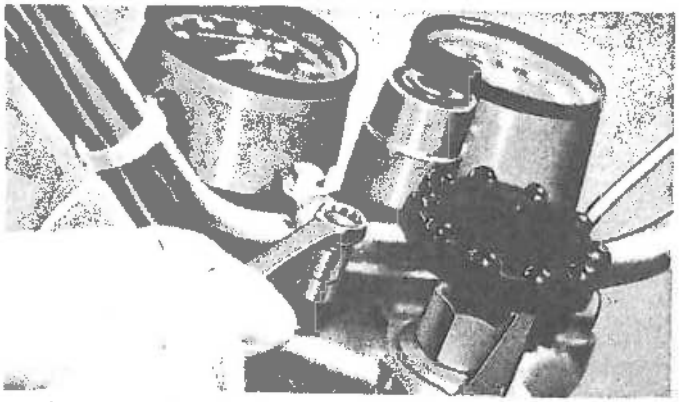


2) Inner Fork Leg Removal

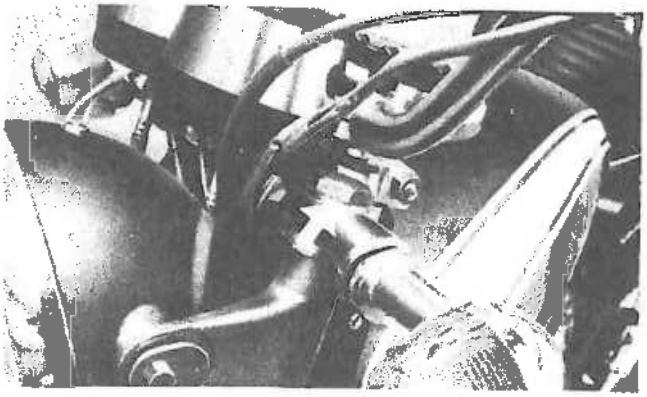
NOTE:

If fork leg disassembly is not necessary, these steps can be followed to remove the entire fork leg (inner and outer tubes) from the machine.

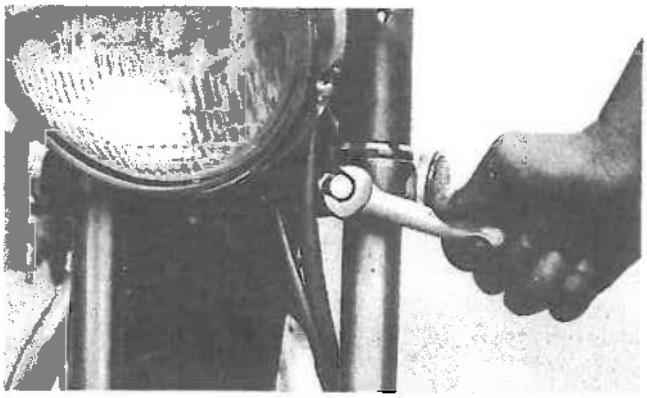
a) Loosen the handlebar mounting bolts, and pull the handlebar downward.



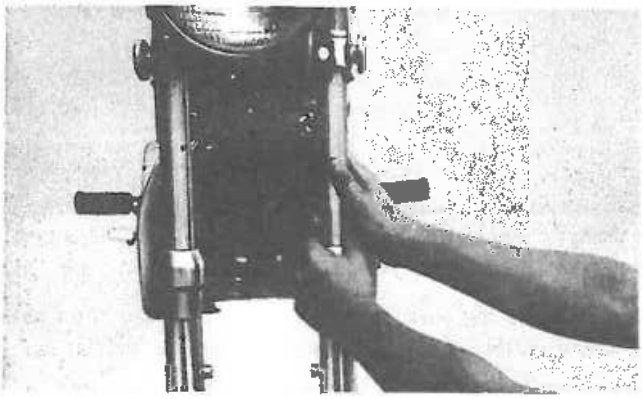
b) Remove the cap bolt,



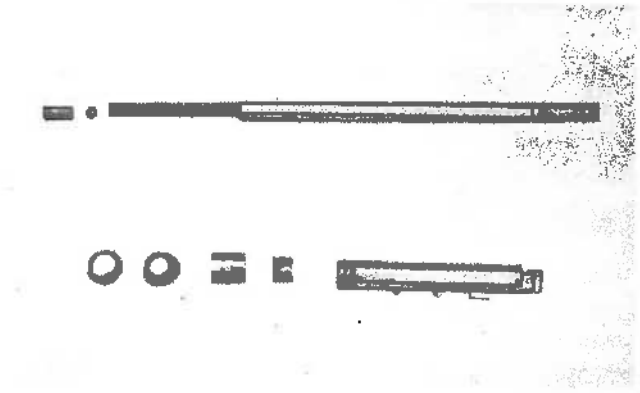
c) Loosen the underbracket bolt.



d) Pull the inner fork tube out of the mounting brackets.



e) Remove the outer nut, dust seal and cover, spring, top spring seat, and metal spacer from the inner fork tube.



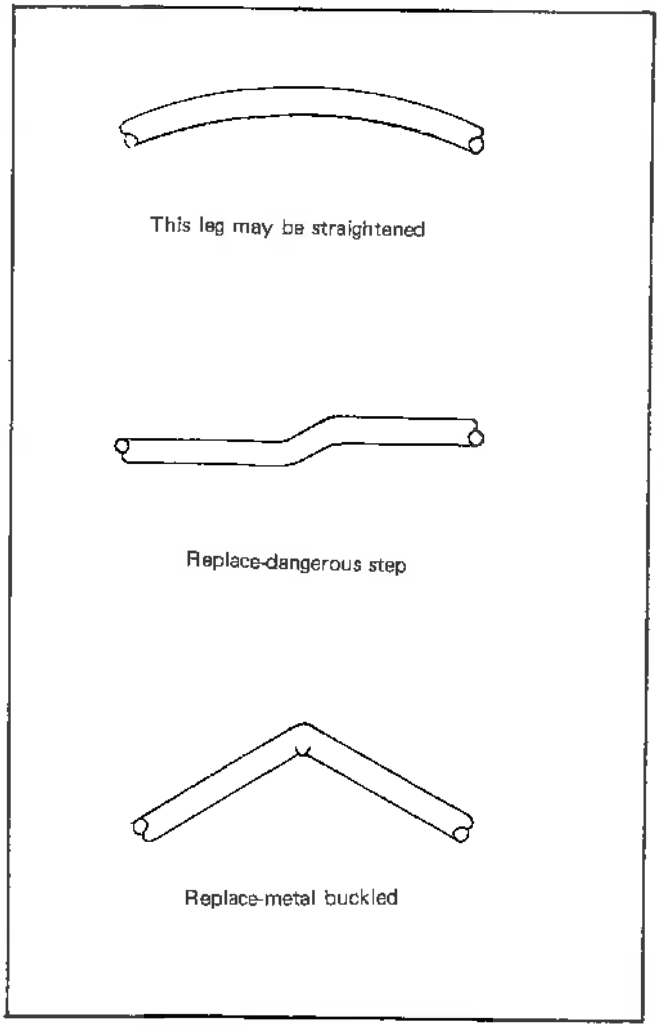
3) Fork Wear

a) Inner fork tube:

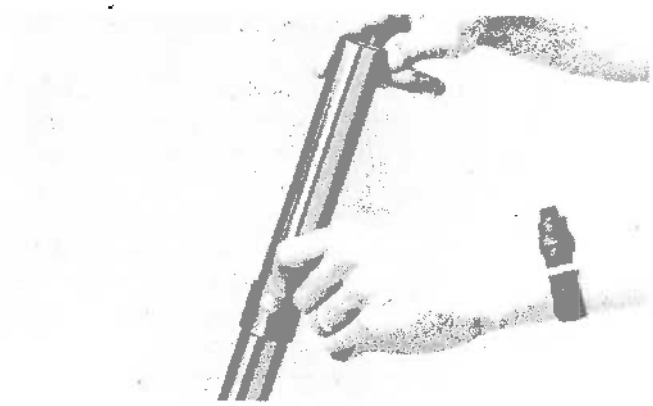
1) The inner fork tube must be checked for surface wear and bends. The tube gets scratched from dirt working past the seal and continually rubbing against the tube. In addition, the tube can become deeply grooved if it is bent.

2) Deep grooves, or nicks, can quickly wear out the seal lips and permit oil to blow past the seal. Replace the tube if these deep grooves are evident.

3) Also check for a bent tube. If the tube is found to be bent for any reason, the safest procedure is to replace it. Slightly bowed tubes may be straightened but there is no way of knowing if the metal has weakened.



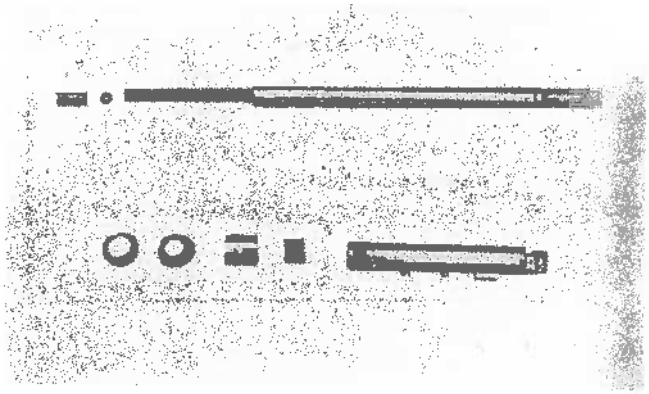
b) Slide Metal (inner fork tube)
Check for a sliding fit of this bushing over the inner fork tube. These parts when new have approximately .2 mm (.008") clearance. If this clearance is found to be more than .5 mm (.020"), the slide bushing should be replaced. Check the inner fork tube for wear due to the friction developed by this excessive clearance.



c) Oil Seal
The oil seal that is pressed into the top of the outer nut should be replaced whenever the forks are disassembled.



d) Rubber Spring Protector
Replace the rubber boot if it is cracked or torn.

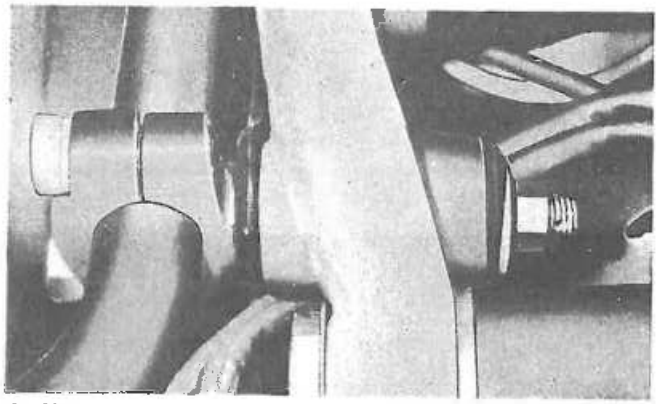


d) O-RING
The O-Ring fitted to the outer nut should also be replaced.

4) Handle Crown/Underbracket

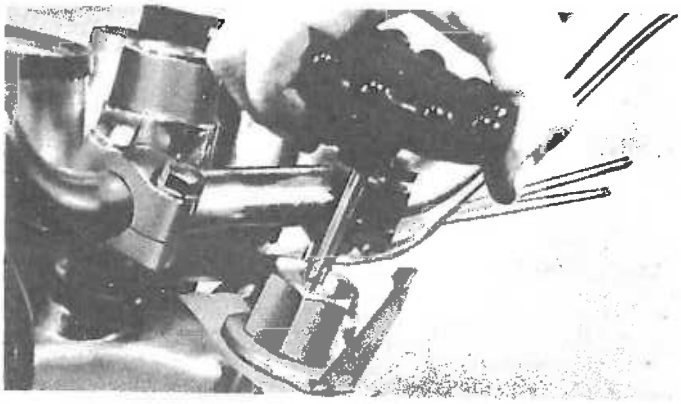
NOTE:
The following procedures can be performed with the entire fork unit still attached.

a) The handlebar holders are rubber mounted in the top handle crown. Remove the handlebar holder retaining nuts (1), then pull out the holders and rubber cushions (2).

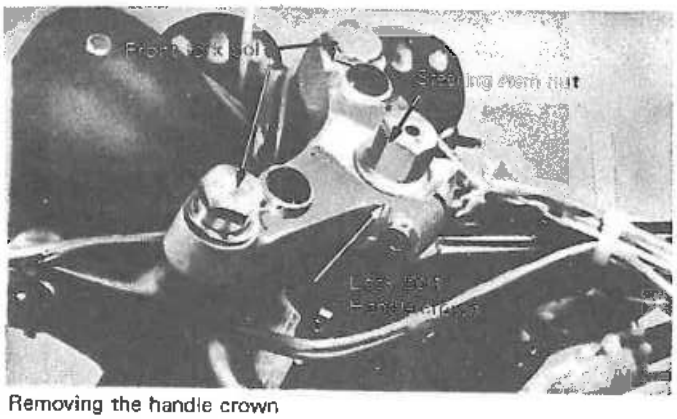


1. Nut
2. Rubber cushion

b) Remove the steering friction dampener unit. Pull out the cotter key. Completely remove the damper rod.

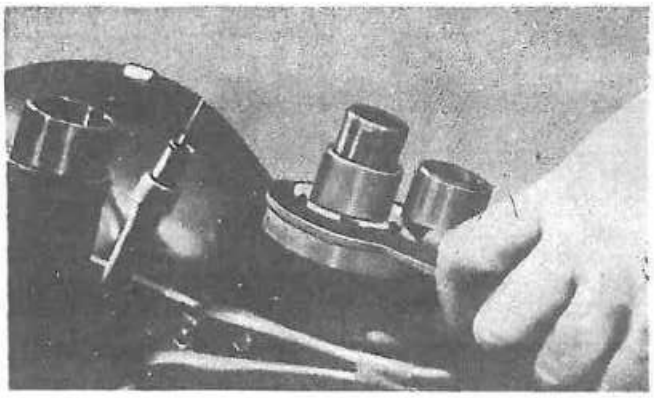


c) Loosen the handle crown lock bolt and unscrew the steering stem nut. Remove the front fork bolts. The handle crown can now be removed.



Removing the handle crown

d) Beneath the handle crown is one stem ring nut that holds the underbracket in place. Remove it.



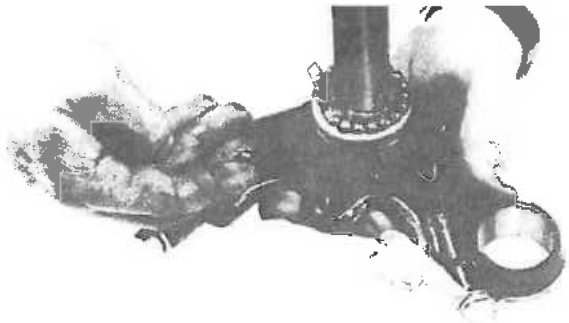
e) Take care when removing the ring nut as the underbracket will begin to drop down, away from the steering head.

CAUTION

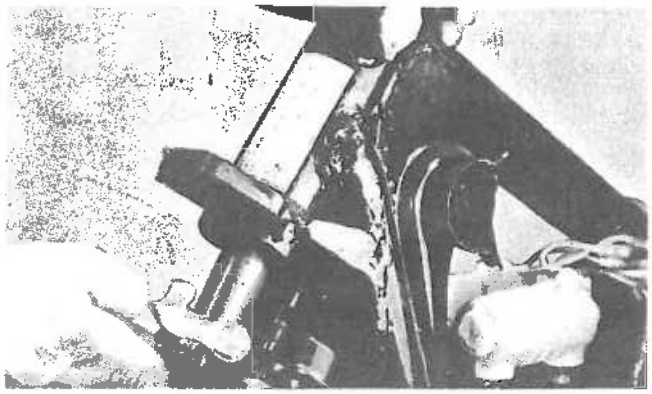
The top and bottom steering head balls (including top and bottom races for each set of balls) are held in place by the underbracket and ring nut. Take care when removing the underbracket that none of the balls drop out and become lost.

f) Examine the balls for pits or partial flattening. If one is found defective, the entire set (including both races) should be replaced. If either race is pitted, shows rust spots, or is damaged in any way, replace both races and all balls.

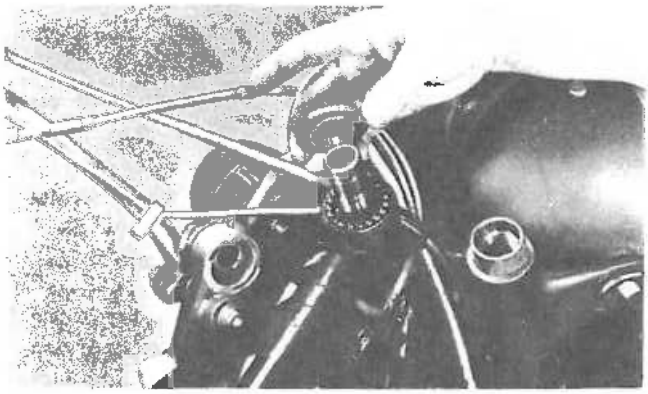
g) Mount both bottom races and the balls onto the underbracket (balls completely greased).



h) Carefully slip the underbracket stem up into the steering head.



i) Install both top races and balls into the top of the steering head. Be sure the balls are completely greased during installation.



j) Thread the ring nut down over the stem to hold the underbracket in place.

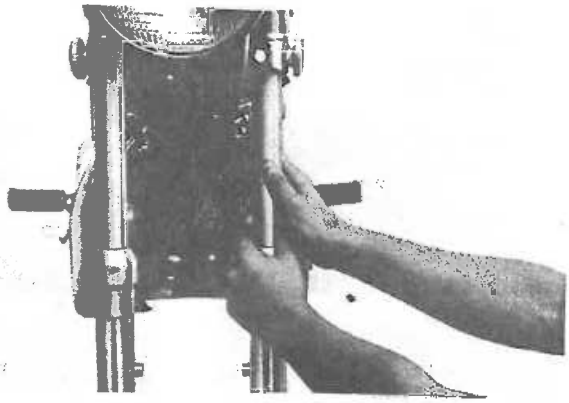
IMPORTANT

Tighten this ring nut so that all free play is taken up, but so the bracket can still pivot freely from lock to lock. Recheck for free play after the entire fork unit has been reassembled. Front end wobble could result from loose steering head bearings.

k) Set the handle crown into position over the ring nut. Locate both crown arms over the upper covers and lock in place by threading on and tightening the stem lock nut.

5) Fork Installation

a) Install the slide bushing, outer nut (oil seal installed), bottom spring retainer, spring, rubber protector, top spring retainer and flat metal washer over the inner tube.



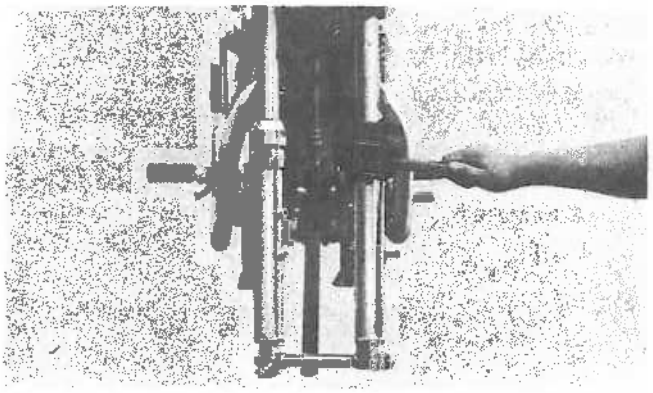
b) Slide the inner fork leg up through the underbracket and handle crown. Thread in and fully tighten the fork cap bolt into the inner fork tube. It may be necessary to use the DS3 fork tube installing tool with the XS1 adaptor.

c) Tighten the underbracket bolt. This firmly locks the inner tube in place.

CAUTION

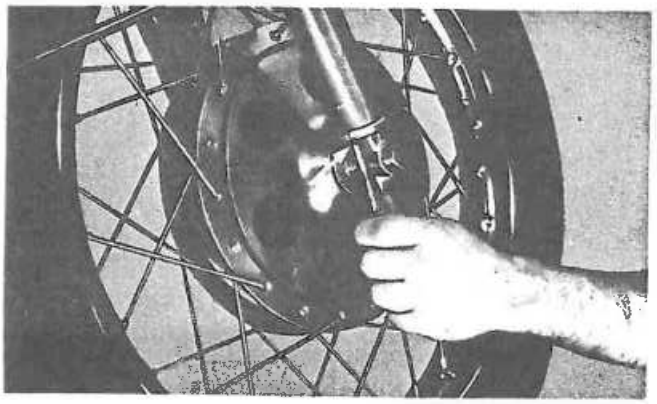
Always tighten the fork cap bolt and THEN the underbracket bolt, in that order. If the inner tube wants to turn during fork cap bolt tightening — hold the inner tube with a strap wrench.

d) Slide the outer tube up over the inner tube until the outer nut and tube can be threaded together. Thoroughly tighten this outer nut with a strap wrench.



6) Changing Fork Oil

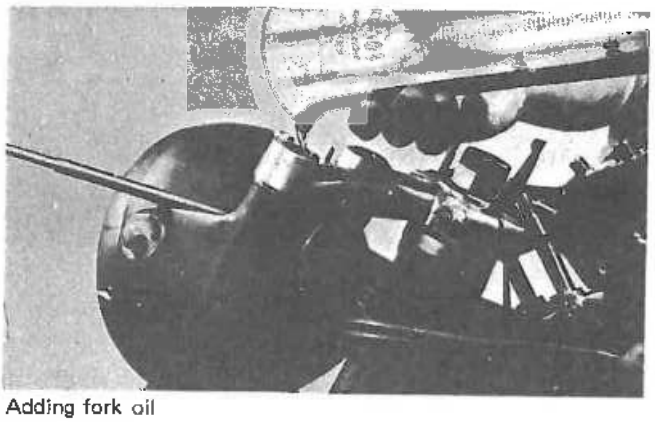
a) Remove the drain screw from the bottom of both forks and allow the oil to drain out. Push down on the handlebar a few times to compress the forks and pump out any remaining oil.



b) Install both drain screws, then unscrew both fork cap screws. Pour (7.5 fl. oz.) of 30 wt. oil (20 wt. below + 40°F) into each fork leg. See table below for quantity. Install both cap screws.

Front Fork Oil Capacity:

XS1, XS1B	223cc – 7.5 fl. oz.
XS2, TX650	135cc – 4.6 fl. oz.



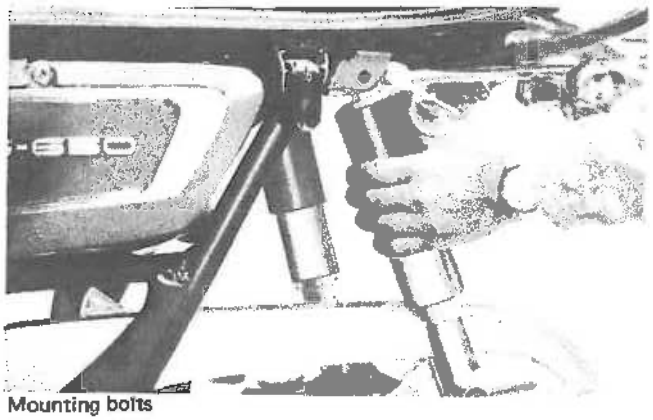
Adding fork oil

c) Special, non-foaming fork oil is available commercially and is recommended if approximately 30 wt.

F) Rear Suspension

1) Removing Both Mounting Bolts

Remove both mounting bolts and pull the suspension unit out of the frame and swing arm mounts.



Mounting bolts

2) Wear

A unit that has lost its suspension qualities will compress quite easily and rebound quickly. To test the effectiveness of the unit, compress it as far as possible and then immediately take all weight off the shock. A suspension unit that is working properly will rebound quickly half-way and then slowly expand the second half. A defective shock will rebound to its fullest length without hesitation.

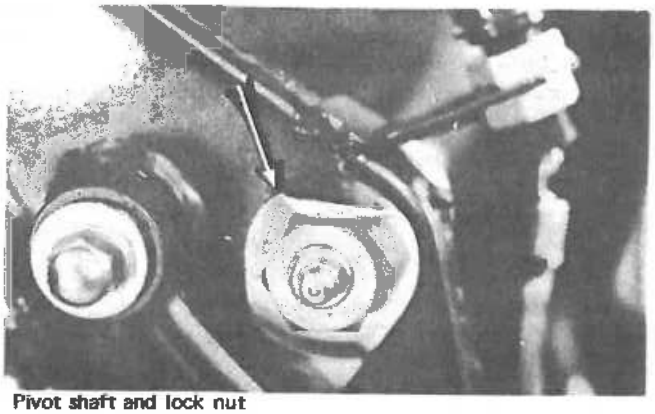


3) Swing Arm Removal

NOTE:

The rear wheel assembly must be removed before the swing arm can be removed.

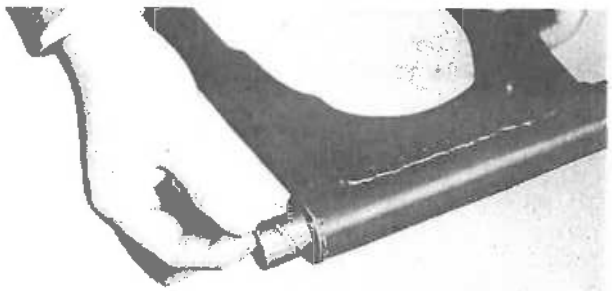
The swing arm is held to the frame by a pivot shaft. Bend the shaft lock tab down, remove the lock nut, and pull out the pivot shaft. The swing arm can now be removed from the frame.



Pivot shaft and lock nut

4) Wear

Wear of the swing arm pivot shaft bushings can cause wheel hop and wobble. With the swing arm installed (rear shocks and wheel removed) grasp the swing arm, twist slightly to feel for excessive shaft play in the bushings. There should be virtually no play at all for the bushings to be useable. If play exists, the bushings are worn. Drive them out of the swing arm and install new ones.



5) Lubrication

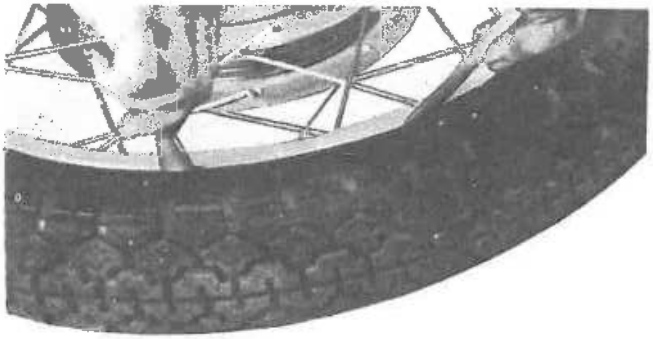
The swing arm pivot shaft end is fitted with a grease zerk fitting. Pressure feed a small amount of grease into this fitting after the first 1,000 miles and thereafter every 2,000 miles.

G) Wheels

1) Tire and Tube Removal and Installation

a) Whether it is the front tire or the rear tire to be changed, the procedure of tire and tube removal is identical. The explanation that follows is the proper method for both wheels.

b) Remove the valve cap, valve stem, and valve stem lock nut. Use two tire irons (with rounded edges) and begin to work the tire bead over the edge of the rim, starting opposite the tube stem. Take care to avoid pinching the tube. After one bead of the tire has been completely worked off the rim, slip the tube out. Be very careful not to damage the stem as it is pushed back out of the rim hole.

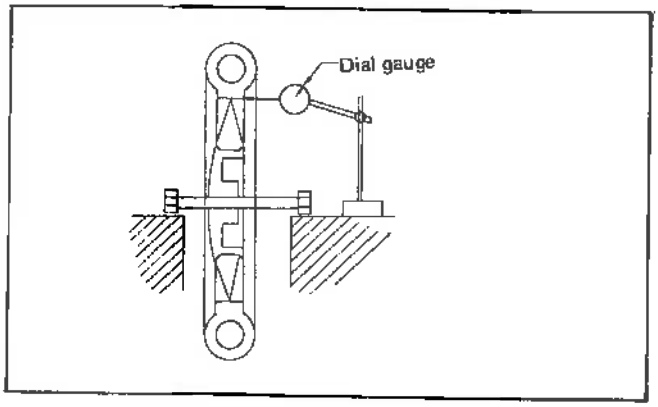


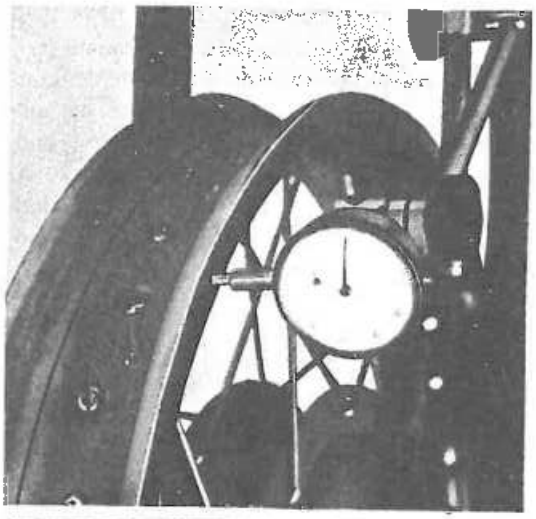
c) If the tire is to be completely removed, then work the remaining bead off the same rim edge.

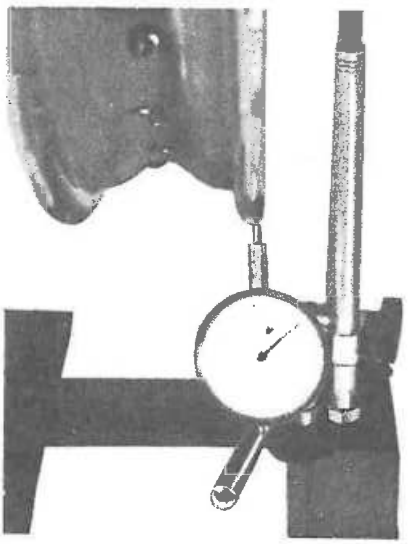
d) Installing the tire can be accomplished by reversing the disassembly procedure. The only difference in procedure would be to inflate the tube momentarily before both tire edges have been completely slipped onto the rim. This removes any creases that might exist. After the tire has been completely slipped onto the rim, check to make sure that the stem is squarely in the center of the hole in the rim. Then inflate the tube to 40 + psi several times. Check for leaks, and set at prescribed pressure.

2) Rim and Spokes

a) A rim can develop warpage. It is due to (1) running the wheel into an object and bending the outer rim, or (2) one or more spokes loosening.





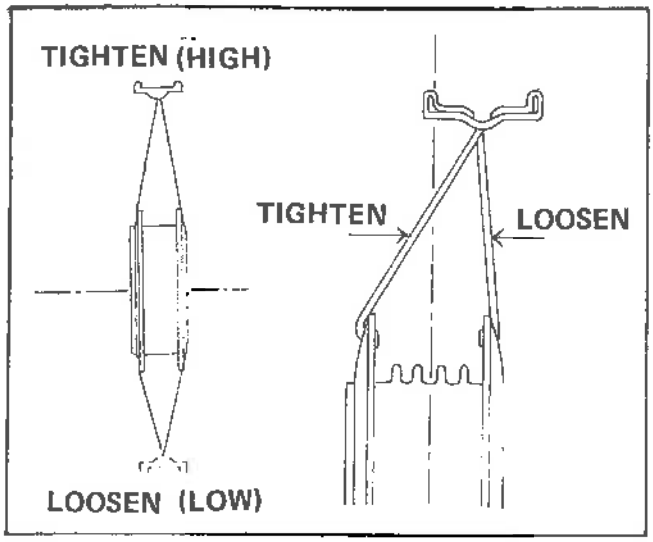


b) Check for warpage by mounting the wheel on a stand (or, if the wheel is attached to a motorcycle, it can be blocked up and held in place). Use some device to measure or detect movement then slowly spin the wheel and note the amount of rim "run-out". It should not exceed 1/16".

c) If all the spokes are tight, and the rim shows no obvious signs of damage, and yet run out is still excessive, do the following:

1) If the run out is up and down, loosen the spokes opposite the high spot and tighten the spokes at the high spot.

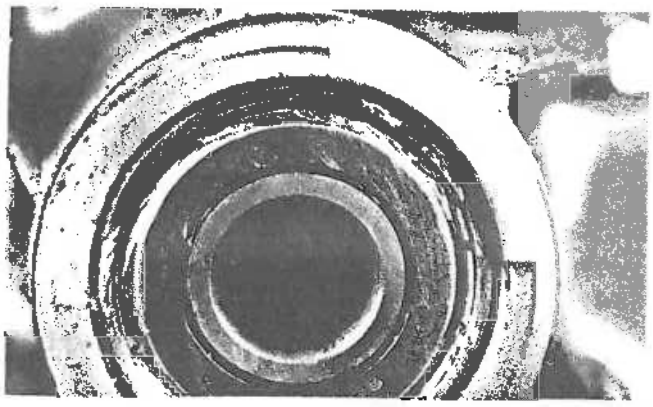
2) If the run out is sideways, loosen the spokes at the high spot, and tighten the spokes opposite the high spot.



3) Seals and Bearings

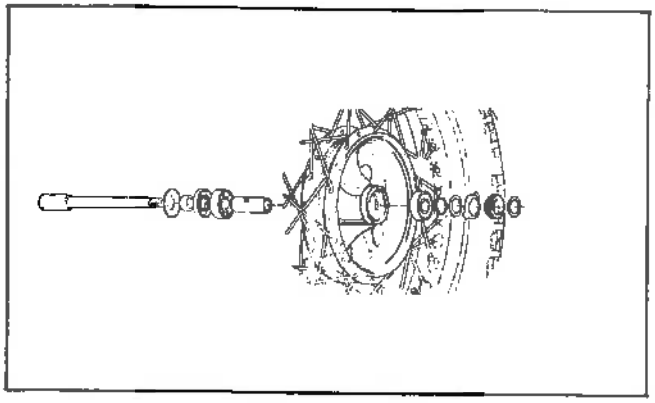
a) Wheel hub seals should be replaced every time they are pried out during repair, or if broken, cracked, or damaged in any way.

b) Check for smooth wheel bearing rotation. Dirt, rust spots, or any irregular surfaces will cause the bearing to hang up (will not spin smoothly). Remove the bearing, clean it, and check again. If the bearing still does not spin freely, replace it.

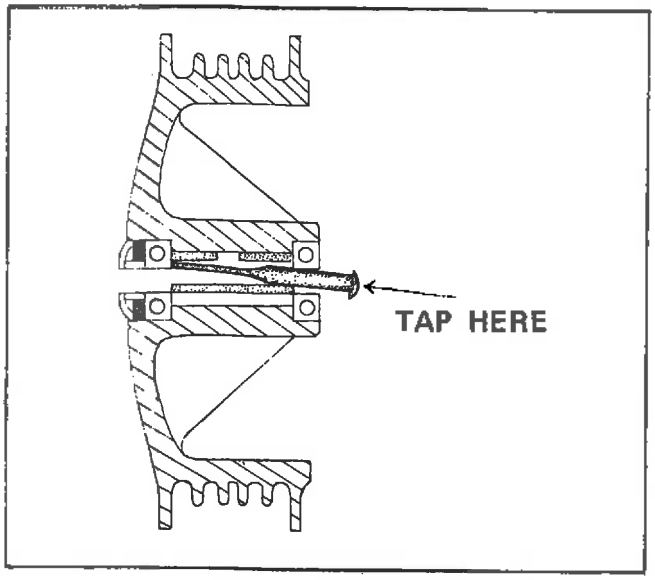


NOTE ON BEARING INSTALLATION: Be sure to grease the bearing before installation, using a quality bearing grease. In addition, during installation, protect the bearing to prevent dirt or contamination of any sort from entering the bearing.

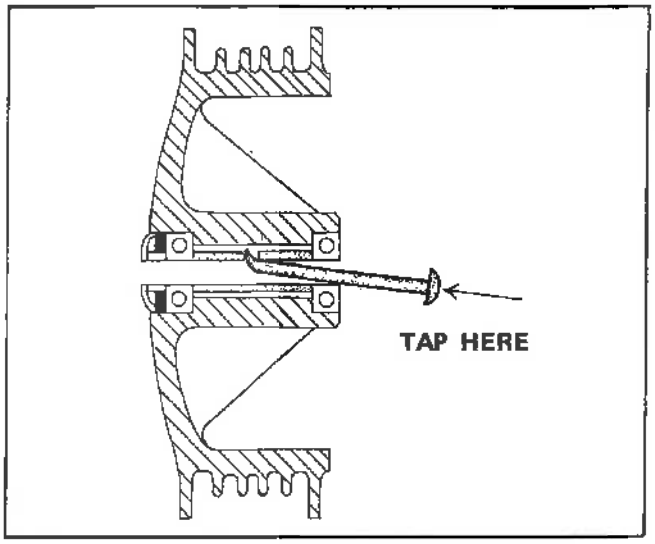
c) The wheel hub houses both bearings, a spacer between the bearings, an outer seal, and a metal cap outside the seal. Removal of the outer bearings requires that the seal be pried out.



d) Drive the bearing out by pushing the spacer to one side (the spacer "floats" between the bearings) and tapping around the perimeter of the bearing inner race with a soft metal drift pin and hammer. Either or both bearings can be removed in this manner.



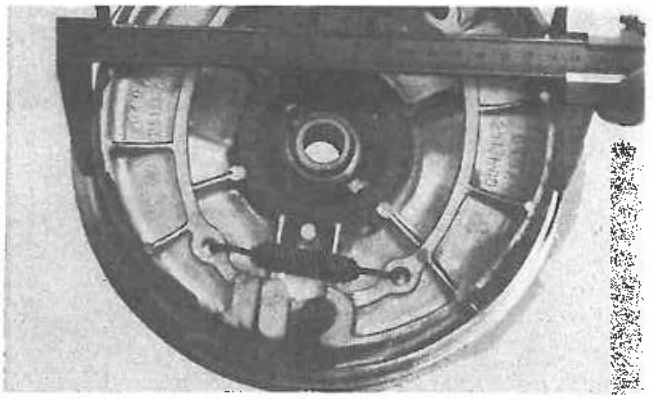
e) An alternative method of removing the bearings is to use a rod with a bent end. Insert the bent end into the hole drilled in the middle of the spacer and tap the other rod end with a hammer, driving the spacer (and bearing in front of it) out of the hub.



NOTE ON BEARING AND SEAL INSTALLATION: Be sure to use the special bearing installing tool which helps to prevent the bearing from going into the hub crooked and the seal from being bent during installation.

4) Brake Shoes

a) Use a vernier caliper to measure the outside diameter of the installed brake shoes and individual shoe linings. If either measurement proves any part of the brake unit to be excessively worn, replace both shoes with a new set.



	FRONT WHEEL		REAR WHEEL	
	STD.	Wear Limit	STD.	Wear Limit
Shoe Outside Diameter	192mm (7.556")	188mm (7.400")	172mm (6.772")	168mm (6.612")
Lining Thickness	4mm (.160")	2mm (.080")	4mm (.160")	2mm (.080")

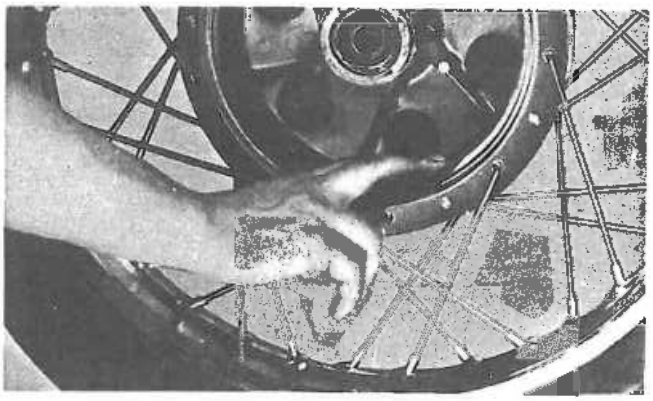
c) Check for brake shoe high spots that cause uneven contact with the brake drum. Remove these high spots with a file or emery cloth.

b) Friction heat can glaze the brake shoe surface. This causes less than maximum stopping efficiency. Use a file or rough emery cloth to evenly rough up the surface.

5) Brake Drum

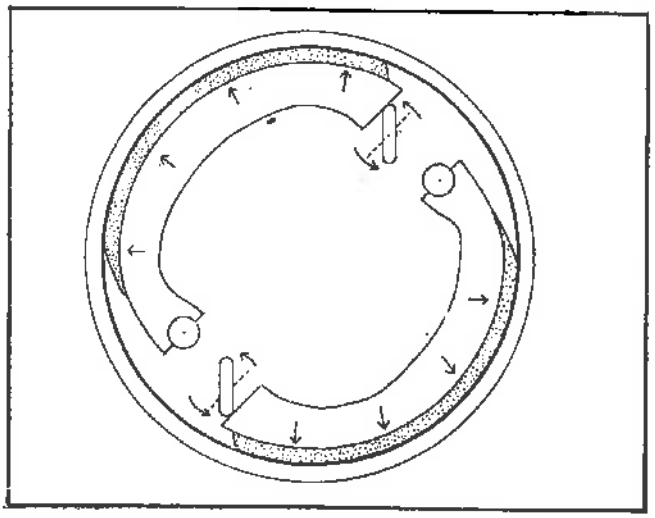
a) Grease on the brake drum causes improper braking performance. Thoroughly clean the surface with a rag soaked in solvent if any grease is found on the drum.

b) Any ridges or glazing that might exist on the brake drum surface can impair the operation. Use emery cloth to lightly sand out any ridges.

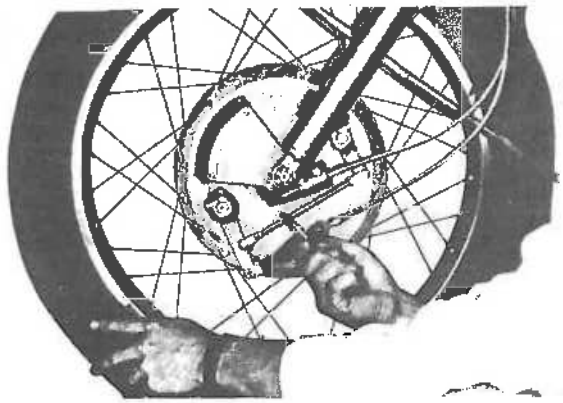


6) Brake Adjustment

a) The front brake utilizes a double leading shoe design. It has two brake shoe actuating cams interconnected by an adjustable length rod. When adjusted properly, this rod forces both brake cams to push the brake shoes out simultaneously. Yamaha double leading shoe brakes have a "crisp" feel during actuation. If actuation is hesitant or "spongy", it is probably due to one shoe being out of adjustment and operating first.

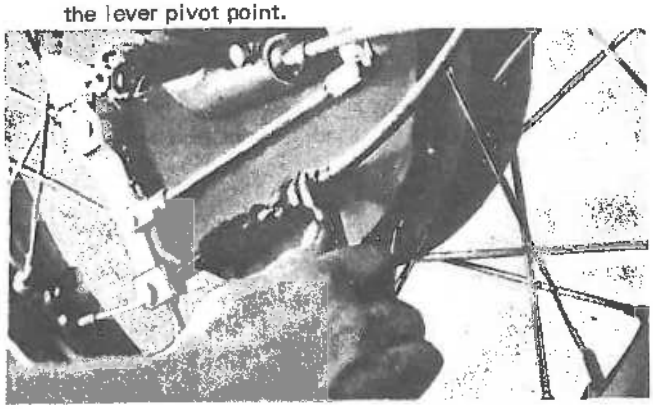


b) Unhook the brake cable at the handle lever. Next, loosen the interconnecting rod lock nut. The rod is threaded with a left-hand thread on one end, a right-hand thread on the other. If the rod is turned, this threading will pull both brake cam actuating arms together or spread them apart. Twist the rod so that both arms spread away from each other until all free play has been taken up, but no more. Tighten down the lock nut. Now both brake shoes will start to spread simultaneously when actuated. Complete this adjustment by rehooking the cable to the lever.



c) Check the adjustment by spinning the wheel while turning out on the cable adjustor. Eventually, the brake shoes will start to contact the drum. You should be able to hear each shoe (front and rear) scrape the drum. If not, the inter-connecting rod is **incorrectly adjusted. Loosen adjust rod — adjust front shoe with cable adjuster until shoe just begins to contact drum — turn rod until rear shoe contacts drum. Lock jam nuts on rod, make final adjustment with cable adjuster.**

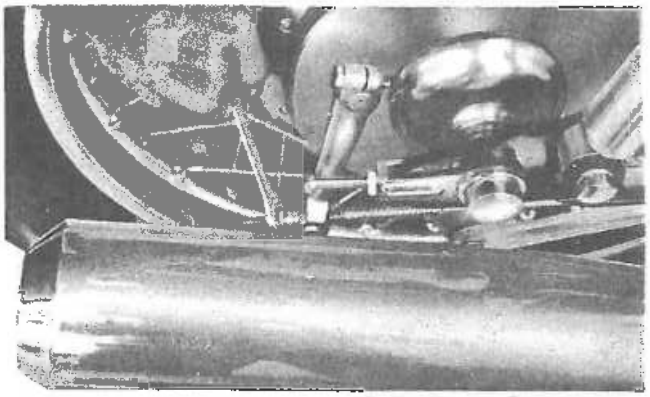
d) When the adjustment is correct, back in on the cable adjustor until there is approximately 6 mm (1/4") cable slack. Final adjustment (according to rider preference) can be made with the adjustor at the lever. **Lever adjustment should allow 2–3 mm slack at the lever pivot point.**



e) The single leading shoe rear brake is actuated by the right-side foot pedal. A rod connects the pedal to the brake. The adjustor is at the end of this rod. Spin the adjustor in or out, whichever direction is required to obtain approximately 1" (25 mm) of pedal free play.

NOTE:

Rear brake adjustment should be checked any time the rear wheel is removed or the drive chain is adjusted.



7) Rear Stoplight Switch Adjustment

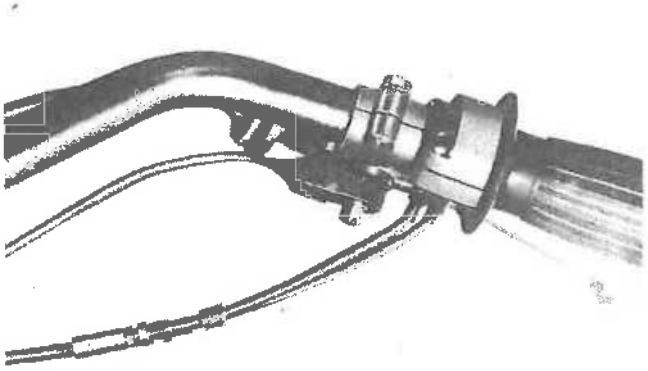
a) The rear brake stoplight switch mounts to the frame just behind the right-hand case cover. A thin rod connects the switch to the brake pedal.



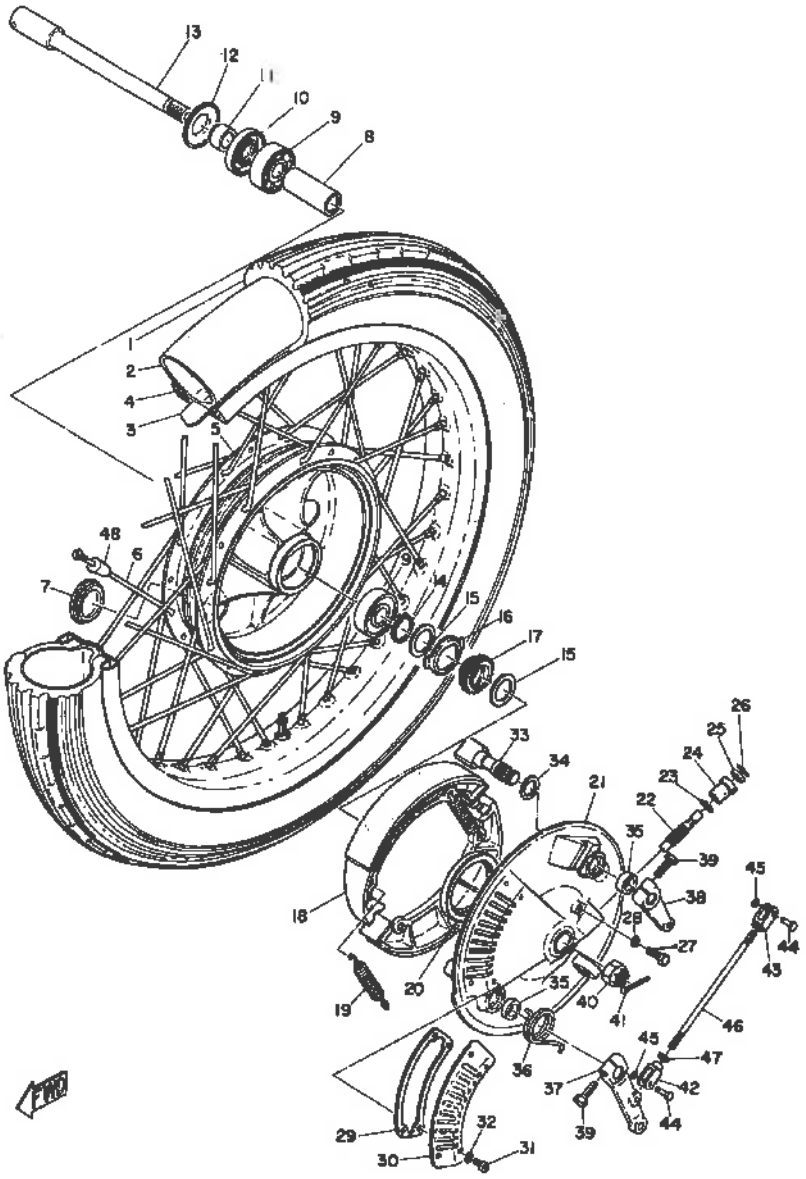
b) To make an adjustment, loosen one lock nut and spin the other nut. To raise the switch, loosen the bottom nut. To lower the switch, loosen the top nut.

c) Check rear stoplight switch adjustment whenever the rear brake is adjusted or the rear wheel is moved.

d) The stoplight is also actuated by a front brake switch at the handle lever. Lever movement must be far enough to close the contacts on this switch.



H) Front Wheel XS1 — XS1B

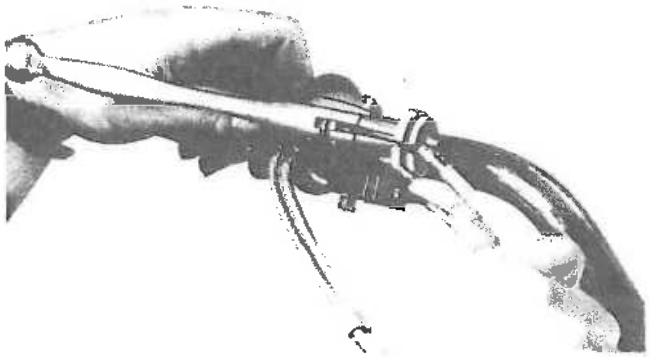


SEE ALSO XS2, TX650 SUPPLEMENTS.

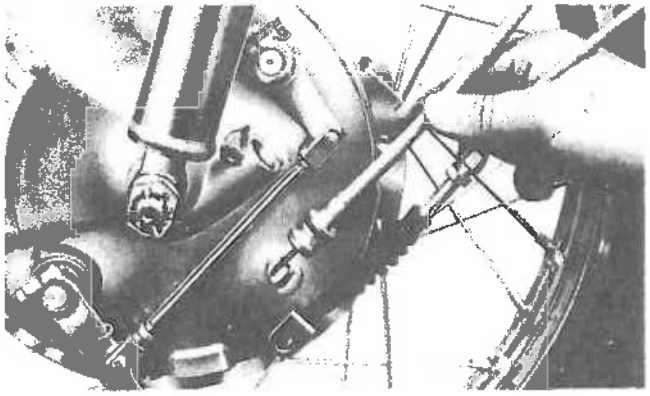
1 TIRE
2 TUBE
3 BAND, rim
4 RIM (1.85B-19)
5 HUB
6 SPOKE SET
7 PLUG, blind
8 SPACER, bearing
9 BEARING (6303Z)
10 OIL SEAL (SD-25-47-7)
11 COLLAR, wheel shaft
12 COVER, hub dust
13 SHAFT, wheel
14 CIRCLIP (S-25)
15 WASHER, thrust (25-32-1.0)
16 CLUTCH, meter
17 GEAR, drive
18 BRAKE SHOE COMP.
19 SPRING, shoe return
20 OIL SEAL (SD-60-72-7)
21 PLATE, brake shoe
22 GEAR, meter
23 WASHER, thrust (7-12-0.8)
24 BUSHING
25 OIL SEAL (SD-7-14-4)
26 O-RING (2.4-13.8)
27 BOLT
28 WASHER, spring
29 SEAL, plate dust
30 COVER, plate dust
31 SCREW, pan head
32 WASHER, spring
33 CAM SHAFT
34 SHIM, cam shaft (14.2-24-0.5)
35 SEAL, cam shaft
36 SPRING, lever return
37 LEVER, cam shaft (1)
38 LEVER, cam shaft (2)
39 BOLT
40 NUT, shaft
41 PIN, cotter
42 END, rod (1)
43 END, rod (2)
44 PIN, rod end
45 CIRCLIP (E-4)
46 ROD, connecting
47 NUT
48 BALANCER, wheel

1) Removal

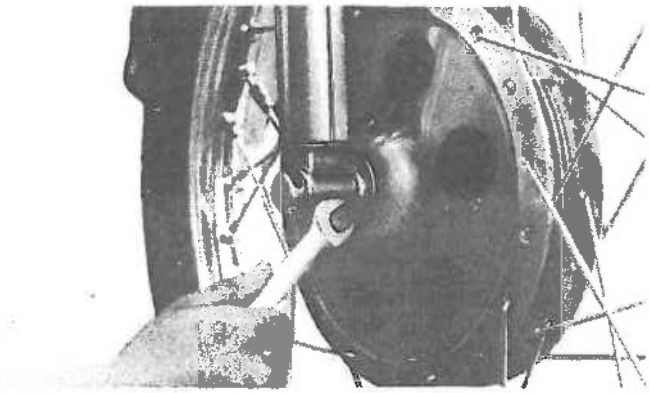
a) Disconnect the brake cable at the front brake lever.



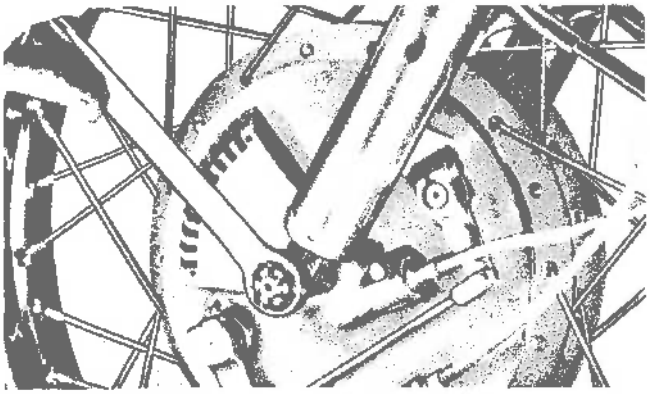
b) Disconnect both the brake cable and speedometer cable from the front wheel hub plate.



c) Loosen the front wheel axle lock bolt.

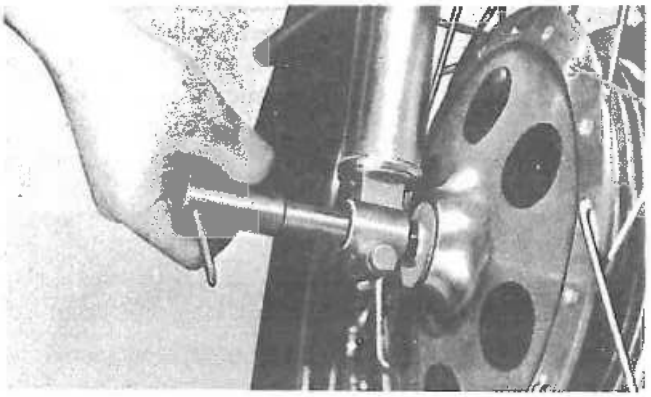


d) Remove the front wheel nut.

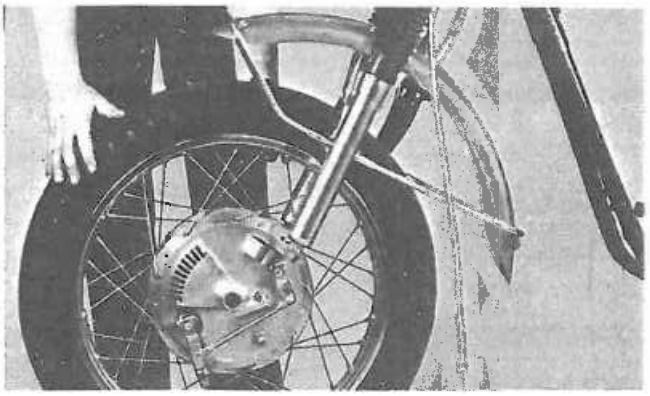


e) Brace the front of the machine off the ground.

f) Remove the front axle by simultaneously twisting and pulling out on the axle.

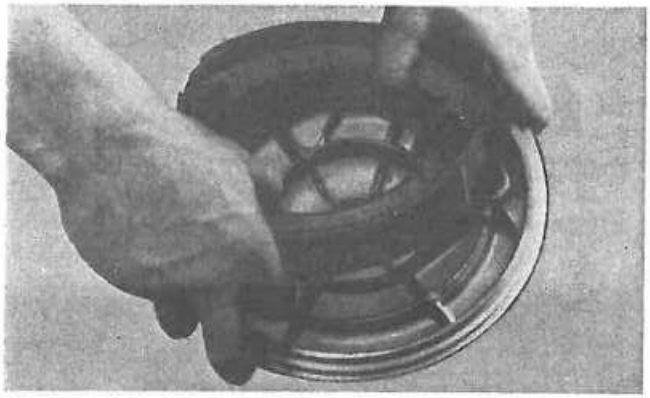


g) Remove the wheel assembly.

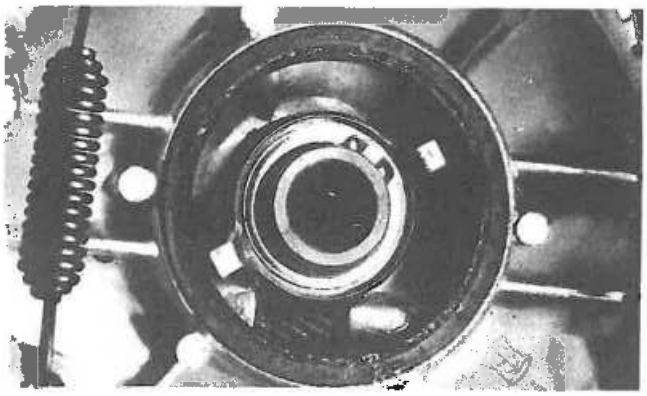


2) **Disassembly and Assembly**

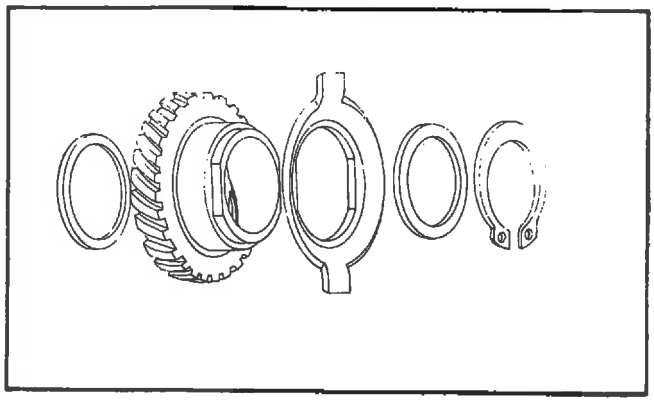
a) With the front wheel assembly out of the frame, the brake plate can be slipped out. Both brake shoes of the double leading shoe unit are mounted to the brake plate. They can be removed with the return springs intact by lifting up and out on the brake shoe outer edge.



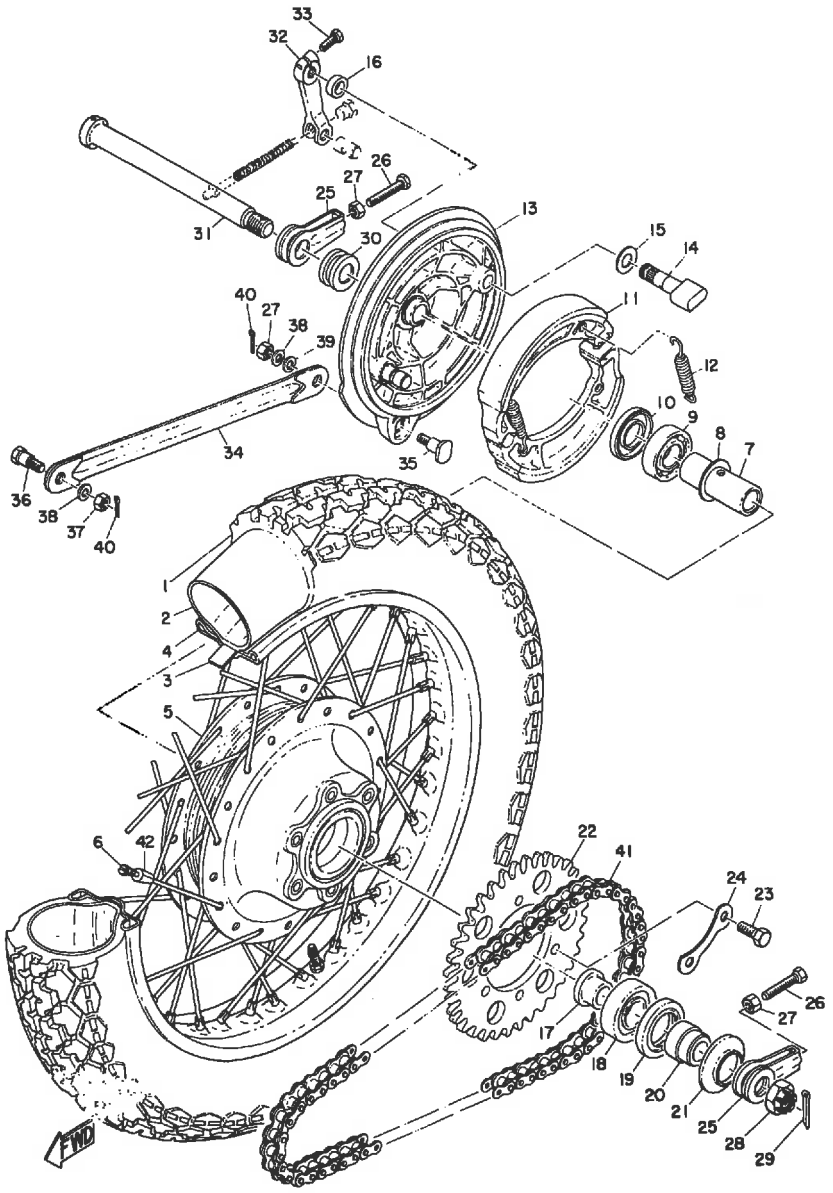
b) The brake plate also houses the speedometer drive gear. It is held in place by a cup shaped washer with two projecting tangs, a flat washer, and a circlip. Remove the circlip, pull off the two washers and slide out the gear.



NOTE ON SPEEDOMETER GEAR INSTALLATION: The cup-shaped washer must be installed with the inside of the cup visible. Then install the flat washer at the base of the cup.



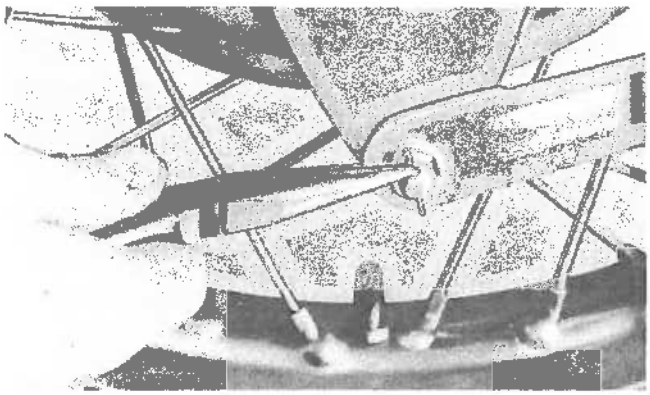
I) Rear Wheel

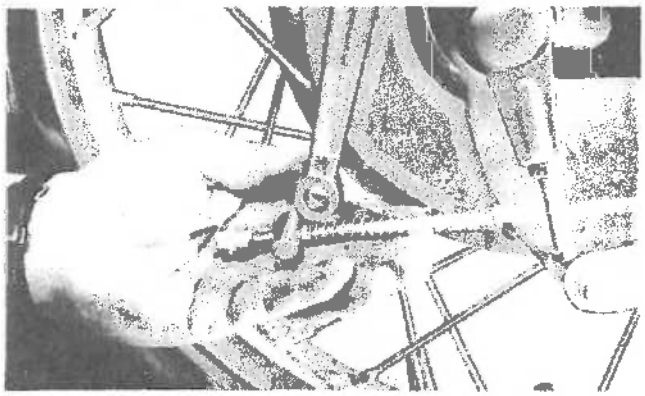


1 TIRE (4.00-18-4PR)
2 TUBE (4.00-18)
3 BAND, rim (4.00-18)
4 RIM (2.15B-18)
5 HUB
6 SPOKE SET
7 SPACER, bearing
8 FLANGE, spacer
9 BEARING (6304Z)
10 OIL SEAL (SO-27-52-5)
11 BRAKE SHOE COMP.
12 SPRING, return
13 PLATE, brake shoe
14 CAM SHAFT
15 SHIM, cam shaft (14.2-24-0.5)
16 SEAL, cam shaft,
17 COLLAR,
18 BEARING (6305Z)
19 OIL SEAL (SD-35-62-9)
20 COLLAR, shaft
21 COVER, dust
22 GEAR, sprocket wheel
23 BOLT, fitting
24 WASHER, lock
25 PULLER, chain
26 BOLT, chain puller
27 NUT
28 NUT, shaft
29 PIN, cotter
30 COLLAR, wheel shaft
31 SHAFT, wheel
32 LEVER, cam shaft
33 BOLT
34 BAR, tension
35 BOLT, tension bar (2)
36 BOLT, tension bar (1)
37 NUT
38 WASHER, spring
39 WASHER, plain
40 PIN, cotter
41 CHAIN
42 BALANCER, wheel

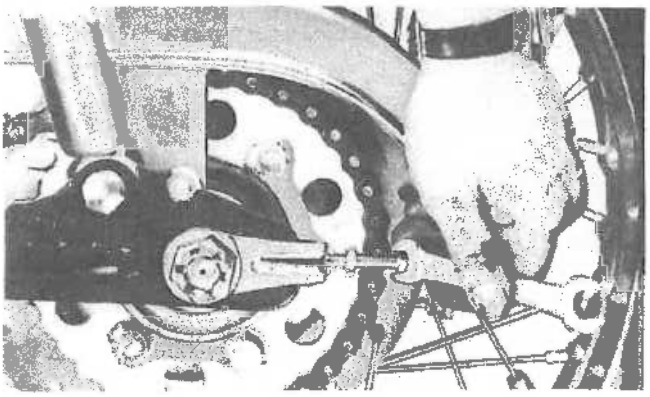
1) Removal

a) Disconnect the tension bar and the brake rod from the rear shoe plate. Pay strict attention to the presence and location of the tension bar lock washer and cotter key. These are safety parts and must be included during assembly.

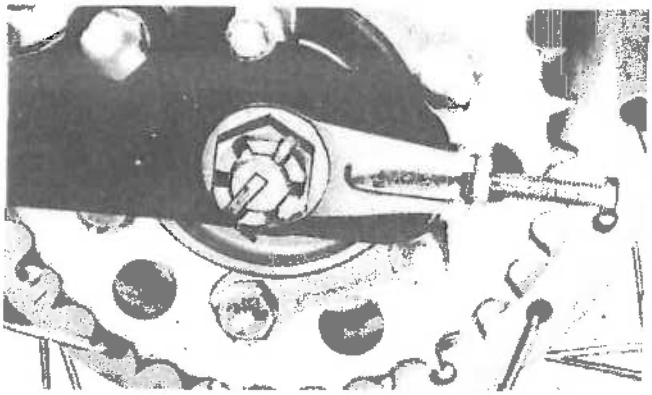




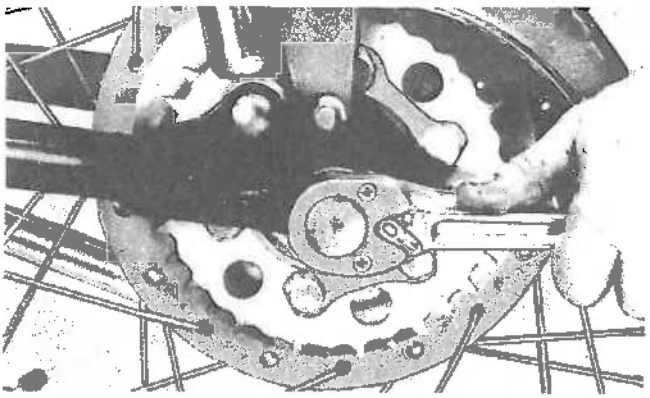
b) Loosen the chain tension adjusting nuts and bolts on both right and left sides.



c) Remove the rear axle cotter pin.



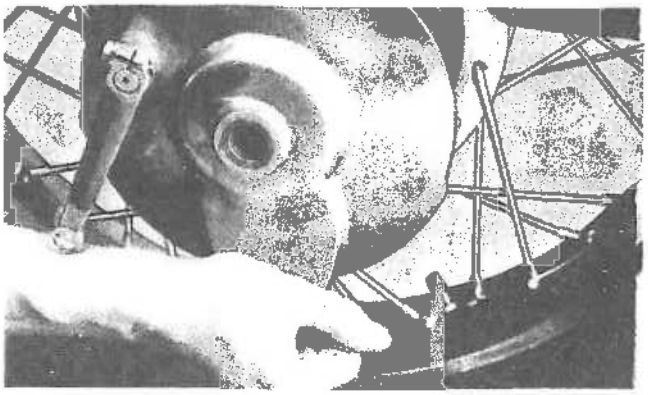
d) Remove the rear axle securing nut.



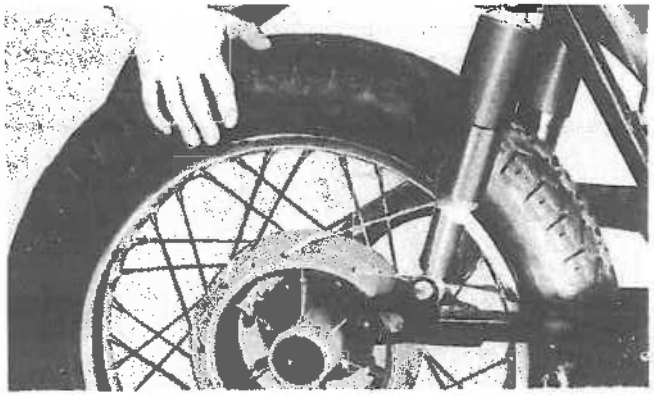
e) Remove the right-hand chain adjustor and distance collar.



f) Remove the rear brake plate.

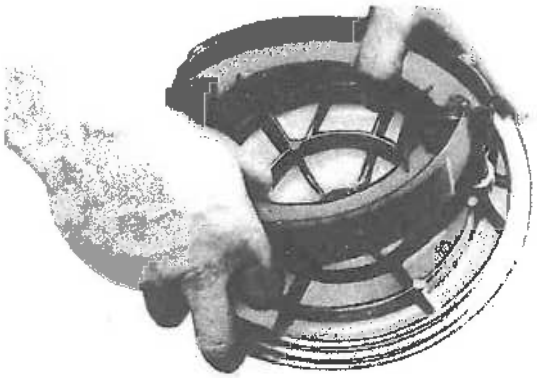


g) Lean the machine to the left, slip the chain off the sprocket and remove the rear wheel assembly.



2) Disassembly and Assembly

a) Both sides of the single leading shoe unit are mounted on the brake plate. To remove the shoes, pull them out and away from the anchor pin and brake actuating cam.



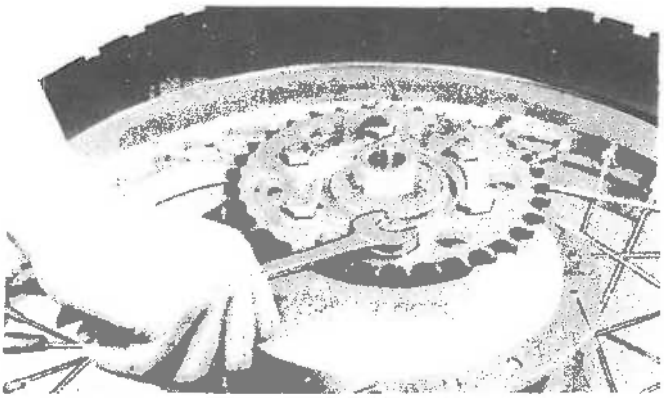
b) Both wheel bearings are mounted in the hub. Their removal can be completed by following the removal procedures explained just previously in the "Seals and Bearings" section, except that the rear wheel has two seals, located one outside each bearing.

3) Rear Wheel Sprocket

a) Bend the lock washer ears flat.

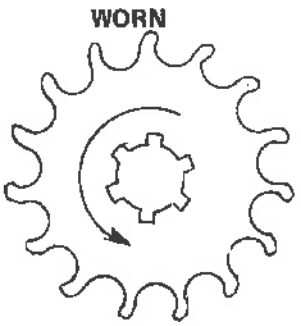


b) Remove the sprocket mounting bolts. Check the lock washer and bolt for damage. If the lock washer is not bent over the hexagon bolt head, or is broken, or the bolt is loose, the sprocket can come loose.



NOTE ON INSTALLATION: Check that all bolts are fully tightened. Be sure that all lock tabs are not cracked or broken and that they are all bent up against the bolts.

c) Constant friction and force from the chain creates wear on the sprocket teeth. If wear has progressed to the extent shown in this illustration, replace the sprocket.



Sprocket with wear spots

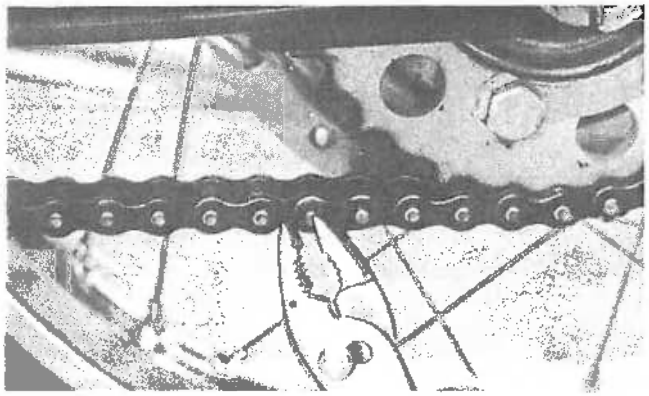


Unworn sprocket

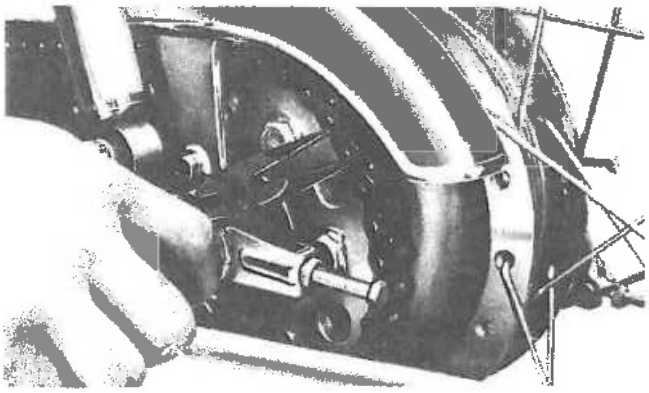
J) Drive Chain

1) Removal and Installation

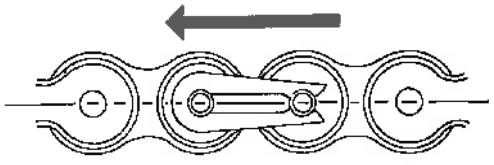
a) Rotate the rear wheel unit the master link is on the sprocket then pry off the master link clip and pull out the master link.



b) To aid in installation lay the chain free ends over the rear wheel sprocket. This holds both chain ends solidly to permit master link insertion. Complete the installation by installing the master link clip.

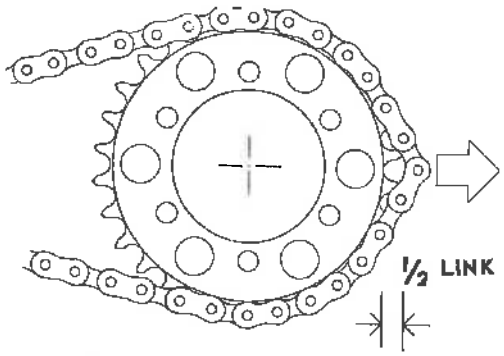


c) Whenever installing the chain, always install the master link retaining clip so that the rounded closed end faces the direction of travel.



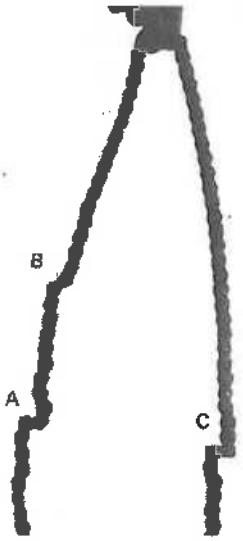
2) Wear

a) With the chain still on the motorcycle, lift the chain away from the rear wheel sprocket. A chain is defective if it can be pulled away from the sprocket more than half the length of a link.



Checking for excessively worn chain

c) Check the chain for binding caused by dirt or rust. Hang the chain straight down and check all links for indications of binding (A, B & C in the picture). If soaking in a strong solvent does not remove the binding situation then replace the chain.



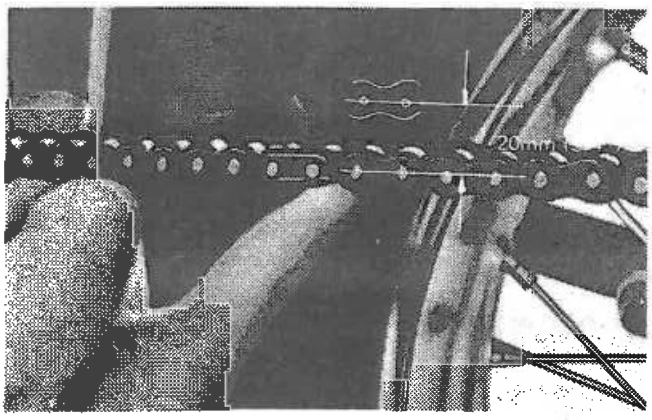
3) Maintenance

a) Lubrication: There are several pressure can lubricants available. Use a rag to wipe off any accumulation of dirt, then spray a liberal amount of lubricant on the chain at least every 200 miles. **See lube chart.**

b) Cleaning: The chain has to be periodically removed from the machine and soaked in cleaning solvent. Drain and dry the chain. Immediately after the chain has dried completely, lubricate to prevent any rust from forming.

4) Adjustment

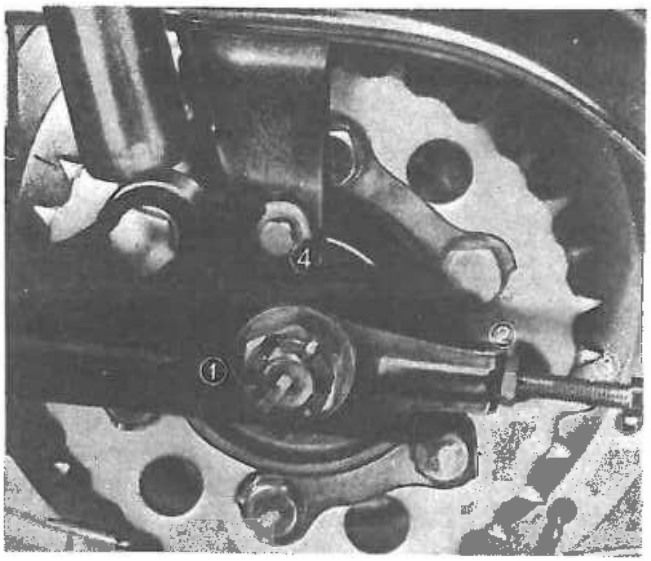
a) Proper drive chain up and down free play with the rider in position and both wheels on the ground should equal 20 mm (3/4") when measured at the center of the lower section of chain. Follow these steps to obtain the correct free play:



b) Remove the cotter pin and loosen the rear wheel nut (1).

c) Loosen the chain adjusting bolt lock nut (2) on each side.

d) Rotate both adjusting bolt (3) to obtain the correct free play, and at the same time make sure that both ends of the axle are positioned evenly. This can be done by matching the marks on the sides of the swing arm (4) just above and to the rear of the rear wheel nuts.



1. Lock nut
2. Adjustor lock nut
3. Adjustor
4. Alignment marks

e) After completing the adjustment, retighten all lock nuts and install a new cotter pin.

f) Finally, check for correct brake pedal and stoplight operation as they could have changed due to the chain adjustment.

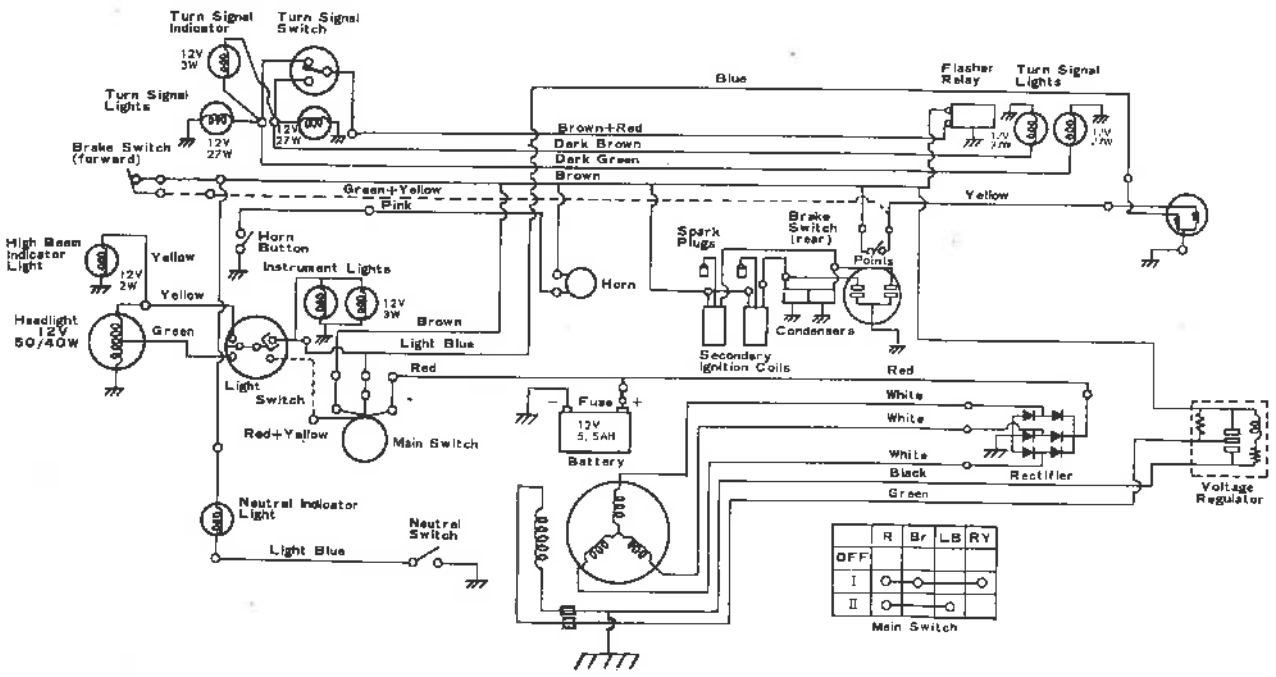
NOTE:
A worn chain causes wear to both sprockets. If either sprocket is excessively worn, it can cause a new chain to wear out prematurely. Strict attention should be paid to the condition of all three components if any one is replaced. Possibly two or all three components might require replacement if wear is excessive.

CHAPTER 4. ELECTRICAL

The XS650 electrical system uses an alternator to generate voltage which is then rectified to direct current. This direct current voltage is controlled by a voltage regulator which is set to maintain a 14~15V DC constant.

When the engine is stopped, DC current to energize the lighting and ignition circuits is supplied by the battery; when running, it is supplied by the alternator/rectifier/regulator circuit. Excess output is shunted to the battery, if necessary, for recharging. If unneeded, the voltage regulator will decrease alternator output.

XS1 – XS1B



A) Battery

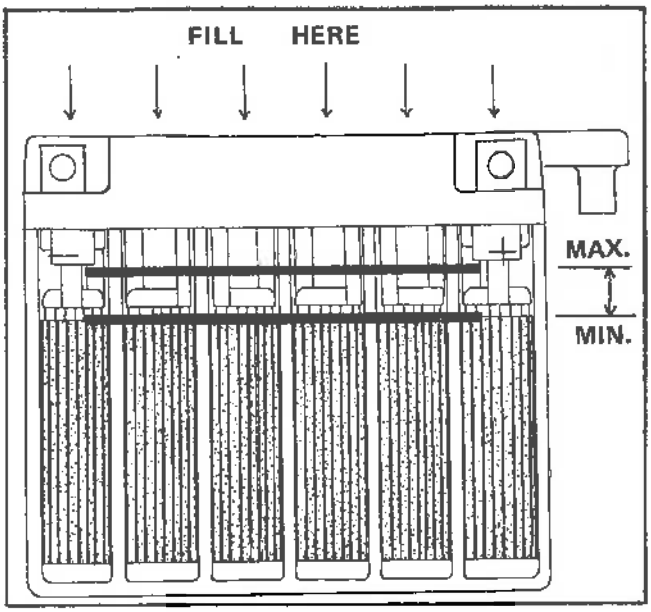
1) Servicing a new battery

a) Check the housing for cracks or other damage. Fill the battery with electrolyte and let set for an hour. This allows the acid to soak into the plates. With the caps off, hook up a trickle charger to the battery and charge it at 1 amp/hour rate or less. Check the specific gravity. A fully charged battery should have a rating of 1.260~1.280. If the electrolyte has dropped below minimum level after charging, add electrolyte (rating of 1.260~1.280).

2) Battery maintenance

a) Periodic inspection can determine the condition of the battery housing and the condition of the internal parts. Check for cracks or holes in the housing. Check for broken plates, sulfation, low fluid level, or corroded terminals.

b) The battery housing is marked with a minimum and maximum fluid level. If any cell fluid level drops below the minimum level, fill with distilled water to correct height. Check once a month or more often in hot weather. DO NOT use tap water.



3) Charging

a) Remove the battery and check the specific gravity of the battery fluid. A fully charged battery reads between 1.260~1.280. If the rating is less than 1.260, the battery needs charging.

b) Fill the battery to the proper level with distilled water. Leave the fill caps off until battery charging has finished. Use a battery charger that has a maximum output of 1 amp. The XS650 battery uses a 5.5 amp/hour battery. DO NOT exceed a one amp input as excessive heat may be generated within the battery.

NOTE:

Battery fluid level sometimes drops during charging. Refill if necessary, using distilled water. Always charge battery in a well ventilated area. Keep open flame away from vents and cap holes.

4) Troubleshooting

a) Excessive fluid evaporation from cells: Normal battery operation requires fluid to be added to the cells approximately once a month. If distilled water must be added every week or two, the battery is possibly being overcharged. Check voltage input from the alternator.

b) Low fluid level in one cell: If one cell continuously loses more fluid than others, check for a shorted cell. A shorted cell creates abnormal fluid evaporation. Check with a hydrometer for excessive difference in specific gravities between the cells.

c) Won't hold a charge:

1) First check the alternator output to eliminate the possibility of a low charging rate. Next, check for loose terminal connections (creating high resistance), or a build up of material in the bottom of the housing that could short the plates. Nothing can be done about loose terminals themselves except to replace the battery.

Sediment at the bottom of the housing can sometimes be removed by flushing the battery out several times with distilled water, if the cell is discharged, flush with electrolyte if fully charged. Dry the battery off and recharge for a few hours. If enough loose sediment is flushed out, the battery could hold a charge. If the battery still cannot hold a full charge, replace it.

d) Sulfation: Sulfation, in the form of a white, scaly material, gradually forms on the plates and at the bottom of the housing. It is created over a period of time as the sulfuric acid combines with the lead plates to produce lead sulfate (white particles of **sulfation**). It is a product of age and use. The battery usually needs to be replaced when sulfation reaches the point of shorting out the plates.

e) Make sure that the wires are hooked to the proper battery terminals. The red wire must be hooked to the "positive" terminal, the black lead must be hooked to the "negative" terminal. If the wires are reversed, the battery will quickly loose its charge. Very likely the battery will be destroyed if the reversed hook-up is left connected for any length of time.

5) Storage

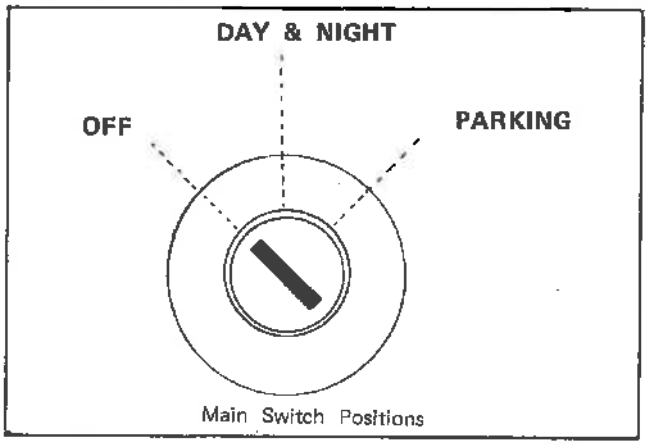
a) Whether it is a new battery or one that has been in service, preparation for storage of either one is almost identical. When new, the battery is dry charged (no electrolyte). Keep it away from moisture and heat. A stored dry-charged battery can last several months without losing a great deal of its **charge.**

b) A used battery should be filled to the maximum level with distilled water, given a complete charge and stored in a cool area (coldness slows the process of battery discharge). It should be given a booster charge every two months. When preparing to place a stored battery back into service, check for sufficient electrolyte and fully charge the battery. Never store a "wet" battery in an area where temperatures of 32° or less will occur.

B) Main Switch

1) Main Switch

The XS650 uses a three position switch that directs current from the battery (or alternator) to the various lighting and ignition circuits.



Main Switch Positions

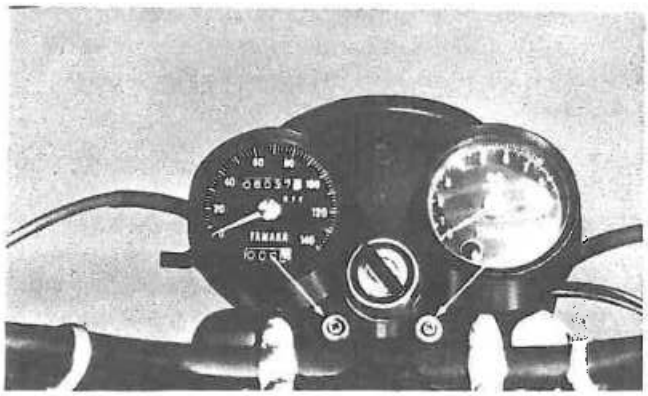
1st position: Prevents current from flowing to any circuit.

2nd position: Supplies current to all day and night circuits, including (1) horn, (2) ignition coils, (3) front and rear stop switches, (4) turn signal switches, (5) all indicator lights, (6) and headlight/taillight switches.

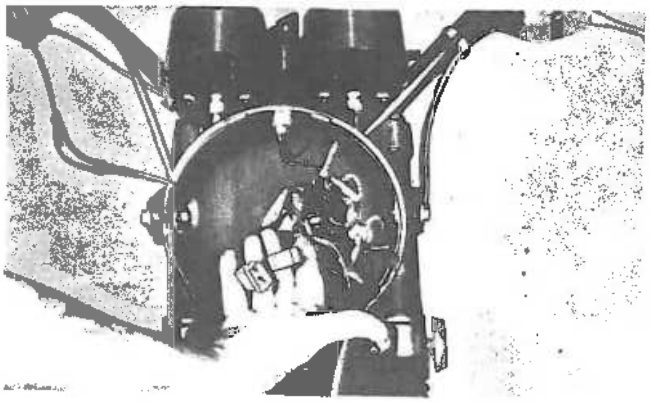
3rd position: Only the parking light is activated.

2) Location and Replacement

a) The switch is mounted on the tachometer/speedometer bracket. Remove both Phillips-head screws.



b) Remove the headlight. Two Phillips-head screws at the bottom of the shell hold it in place. Reach inside the headlight shell and disconnect the main switch multiple connector. The main switch can now be removed from the machine.

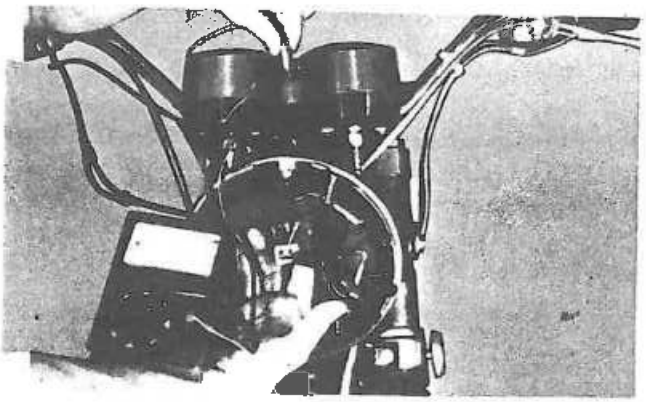


3) Troubleshooting

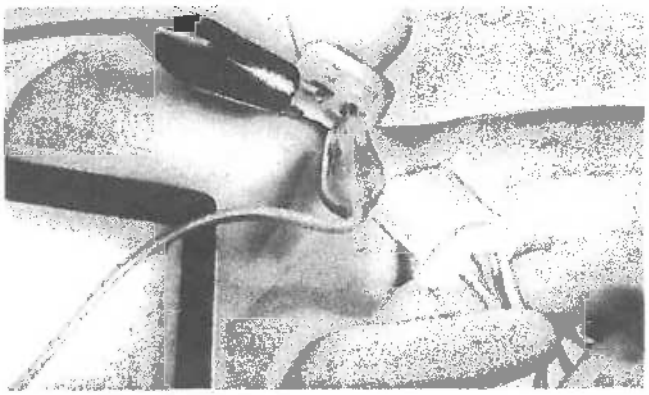
a) If voltage from the battery (or alternator) reaches the main switch (through the red wire), but the same voltage does not pass through the switch, then it should be checked.

b) Use a pocket tester or electro-tester with the meter set to register continuity (Ohms x 1). The switch does not have to be removed from the machine but its multiple connector in the headlight must be disconnected. Make all continuity checks at this main switch multiple connector.

c) Four wires hook into the multiple connector; red, blue, brown, and red/yellow. Hook one lead of the tester to the red wire and use the other as a probe. First, check that there is no continuity between the red wire and the switch housing.



d) Turn the switch to the "Day-Night" position. Probe with the unattached meter lead. Touch the brown wire end and then the red/yellow wire end. Continuity must exist.

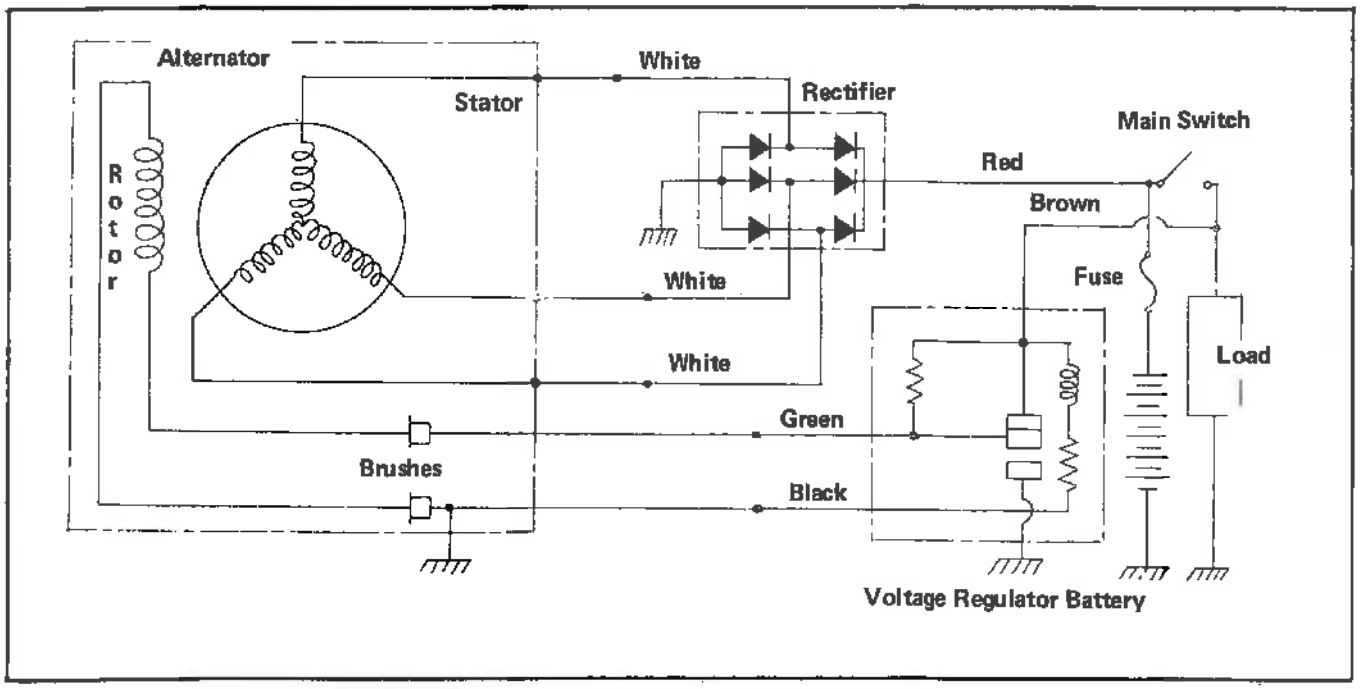


e) Turn the switch to the "Parking" position and touch the probe to the blue wire end. Continuity must exist.

f) If any of the previous tests reveal no continuity to exist check all main switch wires. If these wires appear to be in satisfactory condition (not broken or shorted to the frame), then the main switch itself is defective internally and must be replaced.

C) Charging Circuit

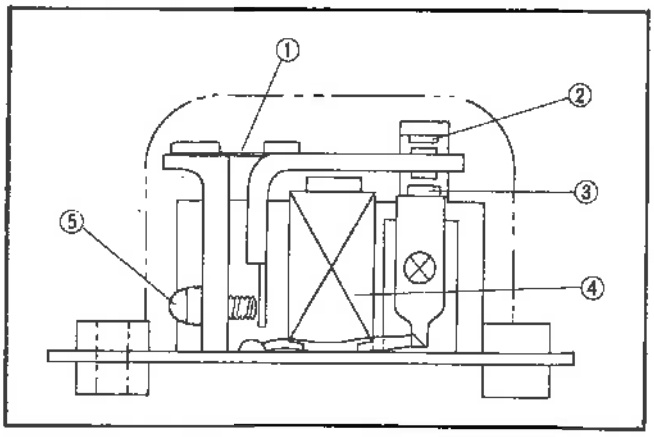
This circuit consists of the battery (to first provide voltage to the rotor field windings) regulator, ACG (alternating current generator), rectifier, and main switch.

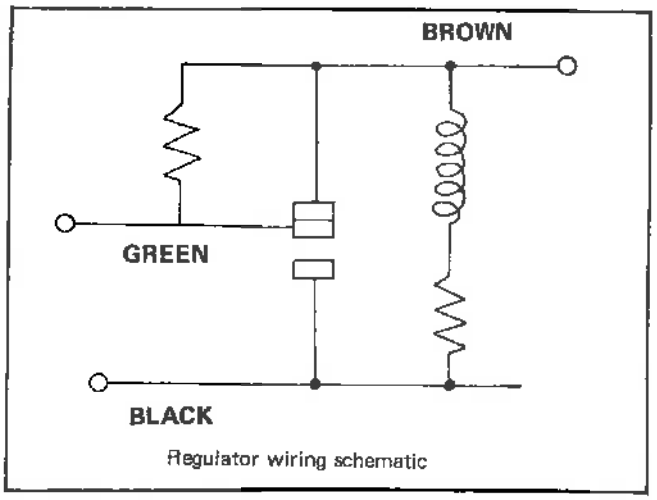


1) Regulator

This circuit consists of the battery to first provide voltage to the rotor field windings, regulator, ACG (alternating current generator), rectifier, and main switch.

a) The regulator's function is to pass a controlled amount of voltage to the rotor windings which create a magnetic field that produces charging voltage in the stator.

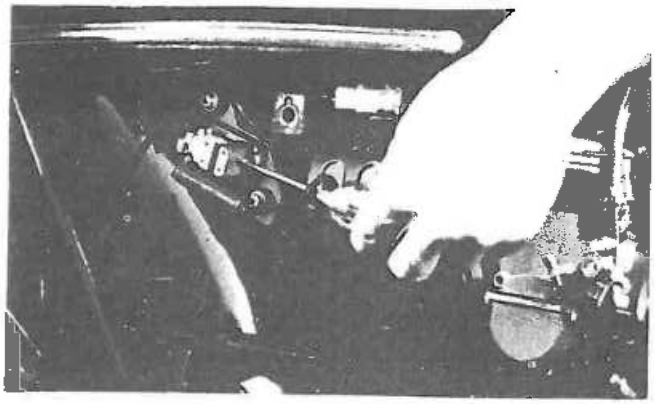




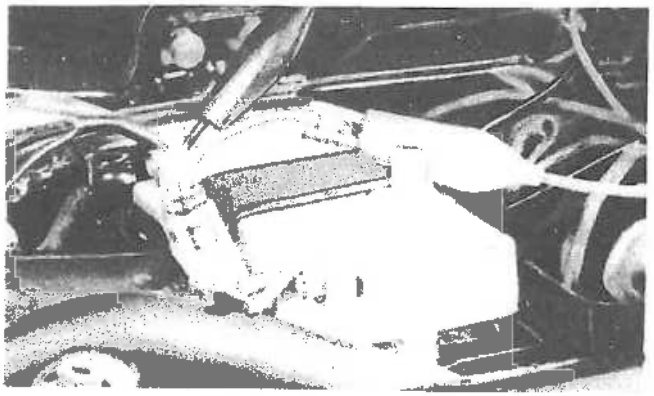
Regulator wiring schematic

b) The regulator operates as a magnetic switch. As charging voltage rises, part of this voltage is routed through an electro-magnet in the regulator. Rising voltage creates greater regulator magnetism, which in turn pulls the central contact point through different positions. Different resistors are switched into the circuit as this central contact point moves. These resistors cut down the amount of voltage passing to the rotor windings, which reduces the charging voltage output.

c) Charging voltage output can be controlled at the regulator. Inside the housing is a screw that pushes against a flat spring steel plate. This is the adjusting screw.



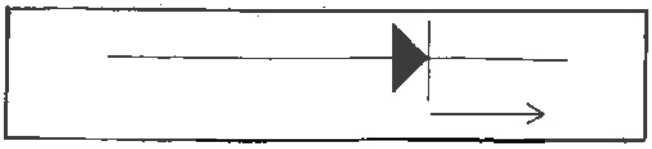
d) Start the engine. Disconnect the fuse box wire leading to the battery and hook up a voltmeter from the fuse box to ground. Accelerate the engine to 2,500 rpm. The voltmeter should read 14.5~15 volts DC. If it varies from this amount twist the adjusting screw in to raise the charging voltage or out to reduce the voltage. Make sure the locknut on the adjusting screw is securely tightened.



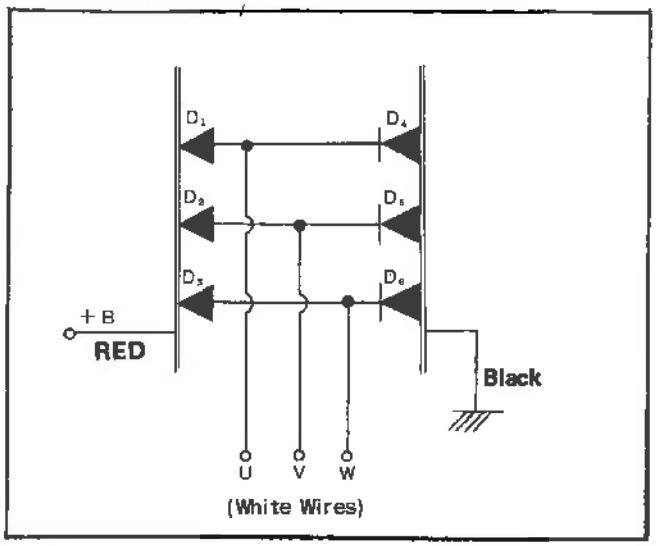
No load voltage test hook up.

2) Rectifier

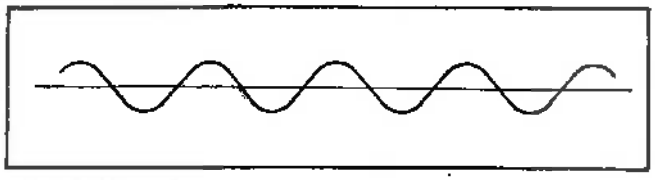
a) The XS650 unit is a full wave rectifier which changes alternating current (AC) generated by the alternator to direct current (DC) by passing the AC through six silicon diodes. The diodes permit only one-way current flow. DC is sent to the battery and main switch.



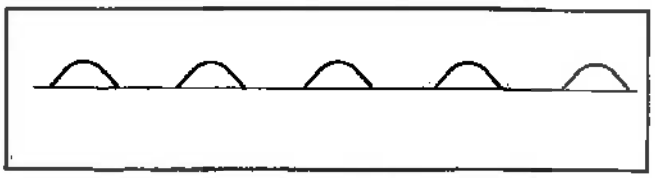
b) This symbol indicates a one-way diode. Current flows in the direction the sign is pointing.



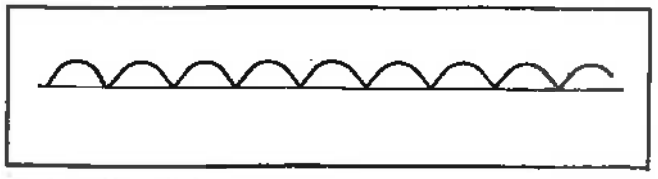
c) Schematic representation of the three phase, fullwave rectifier in the XS650 generating circuit.



d) Wave form of standard alternating current.



e) Wave form of alternating current after rectification by one diode (now direct current)



f) Wave form of AC after full wave rectification.

3) Rotor (Alternating Current Generator)

The rotor of the ACG (Alternating Current Generator-alternator) is the source for the magnetic field which induces current flow in the stator windings. Current for the rotor windings comes from the voltage regulator and is supplied either by the battery (when the machine is not running) or by the stator windings themselves.

NOTE:

In order to make the explanation easier remember that current flows as a result of voltage (electromotive attraction). Current flows from Negative to Positive. Voltage does not "flow" but is instantly present when a circuit is closed. However, we shall discuss the operation of this circuit in terms of voltage "flow". As soon as voltage is present on a circuit, and there is a complete path for current to flow, it will. The amount of current flow is dependent upon the amount of voltage present to act upon the electrons and the amount of resistance present to oppose electron flow.

a) When the ignition switch is turned on, voltage flows from the battery, through the closed contacts in the voltage regulator, bypassing the dropping resistors in the voltage regulator.

b) From the voltage regulator, voltage passes through the positive brush, to the single rotor winding. If the winding is intact, and the negative brush has good electrical contact, current will begin to flow through the rotor winding.

c) When this current flows, it creates a magnetic field around the wire it flows in. Wind this wire into a tightly concentrated coil and the magnetism will become quite intense. The rotor has now become an electromagnet.

d) The rotor is attached directly to the crankshaft. When the crankshaft revolves, the magnetic field surrounding the rotor windings (due to current flow through the windings) rotates also. The brushes and slip ring on the rotor are necessary in order to maintain electrical contact and current flow during this rotation.

4) Stator (Alternating Current Generator)

The stator consists of three windings of wire surrounding the rotor assembly. It is within the stator windings that current is generated for recharging the battery and running the various electrical circuits on the machine.

a) When the magnetic field surrounding the rotor winding begins to spin, its lines of magnetic flux (force) intersect the windings within the stator. As this takes place, current is generated within the stator windings.

b) This current flow is in the form of alternating current. It is transmitted on the three (white) stator winding wires to the rectifier where it is changed to direct current by the diodes of the rectifier.

c) The stator assembly also holds the brushes for the rotor circuit.

5) Troubleshooting

Troubleshooting the electrical system is relatively simple if a few basic facts are kept in mind.

First; the entire electrical system is composed of the following assemblies.

1. Rotor
2. Stator
3. Rectifier
4. Voltage regulator
5. Turn signal relay
6. Ignition points/condensors
7. Ignition coils
8. Spark plugs
9. Main switch
10. Battery/fuse
11. Accessory switch
12. Light bulbs
13. Wiring loom
14. Horn

In the majority of instances where a failure occurs the assembly is replaced. This includes lights, switches, coils plugs, relays, points, condenser and, in most cases, horn.

Second; in the assemblies, remember that they are made out of wire and only two things can go wrong with a piece of wire:

1. It can break in,, two stopping current flow. (Lose continuity)

2. Its insulation can be lost causing it to short circuit with ground or another wire. This can be a direct short with zero ohms between or "insulation leakage" with as much as two million ohms between.

Our troubleshooting list defines the steps taken to search for these two possibilities.

NOTE:

ALL THESE TESTS CAN BE COMPLETED WITH THE PARTS STILL ATTACHED TO THE MACHINE. THERE SHOULD BE NO NECESSITY TO REMOVE ANYTHING EXCEPT INSPECTION COVERS OR MISCELLANEOUS ITEMS TO GET TO THE PART.

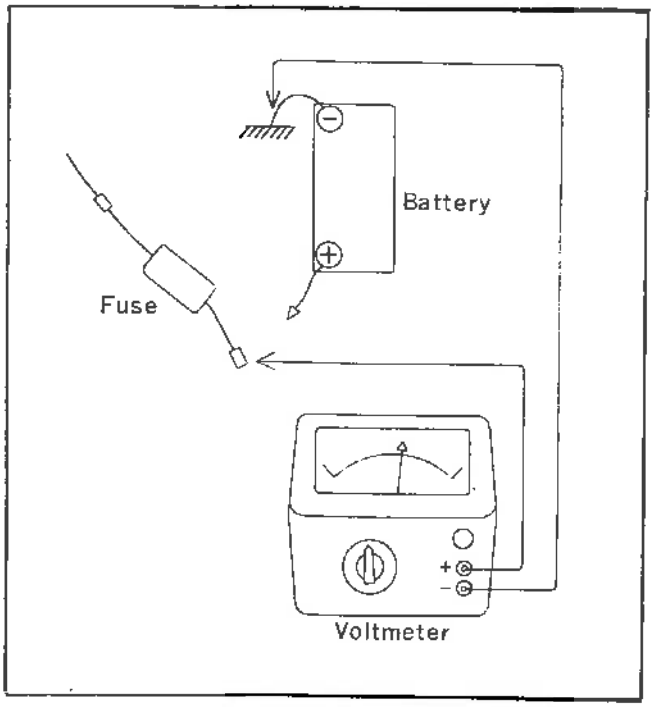
a) Charging voltage output

1) Start the engine.

2) Disconnect the red wire at the fuse box. Hook up a voltmeter from the regulator side of the fuse box to ground.

3) Accelerate the engine to approximately 2,500 rpm and check the generated voltage. It must read between 14.5~15 DC.

4) If voltage output is off, (and not correctable by regulator adjustment), then each part of the charging circuit must be checked to locate the defective part. Perform these checks in the sequence listed below.



CAUTION

BEFORE EACH RESISTANCE TEST, BE SURE THAT THE OHMMETER DIAL HAS BEEN SET AT THE CORRECT POSITION AND NEEDLE ADJUSTED TO ZERO.

b) Broken Wires

1) Check for obviously broken wires or separated connectors (especially multiple connectors). Pay particular attention to any parts that are subject to wear or might be subjected to vibration.

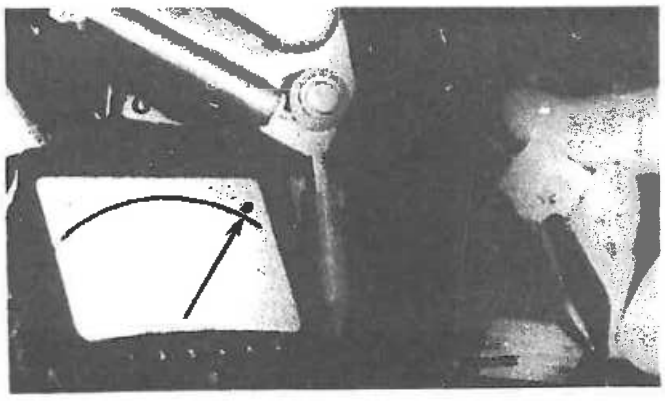
c) Regulator

1) A defective regulator can cause abnormally low or high voltage output. Remove the regulator cover and examine all internal parts for signs of failure. All point surfaces should be reasonably clean. If they are very pitted, or if the central contact point has fused to a stationary point, then this is the trouble spot. Clean the points if possible. If this does not help, replace the regulator. Also, if any wire is broken, and cannot be soldered back in place, replace the regulator.

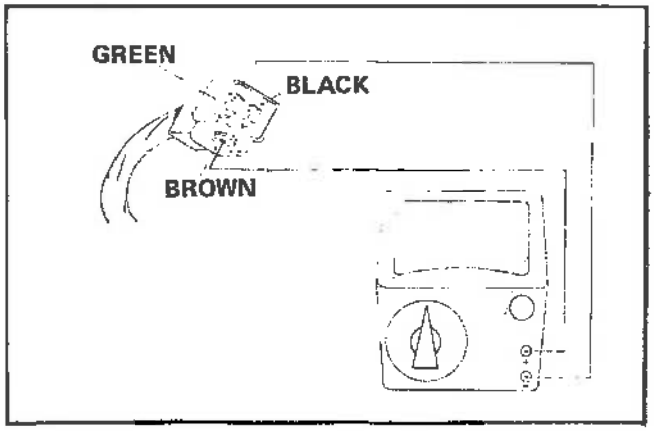
2) If visual inspection does not locate any trouble spot then check for proper resistance through all regulator circuits. This is done by separating the regulator multiple connector and measuring resistance through the green, black, and brown wires at the multiple connector.

3) Hook up an ohmmeter, (0~20 ohms), one probe attached to the black wire and one probe to the regulator base. It must read zero ohms resistance. Several ohms resistance indicates a frayed or broken black wire.

NOTE: Voltage output will be excessively high if this black wire is broken anywhere between the regulator and the stator.

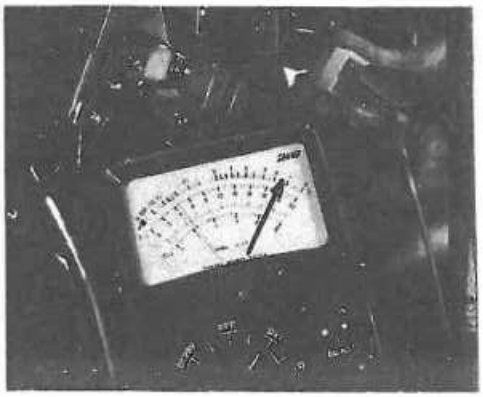


4) Hook one meter probe to the brown wire and the other probe to the green wire.

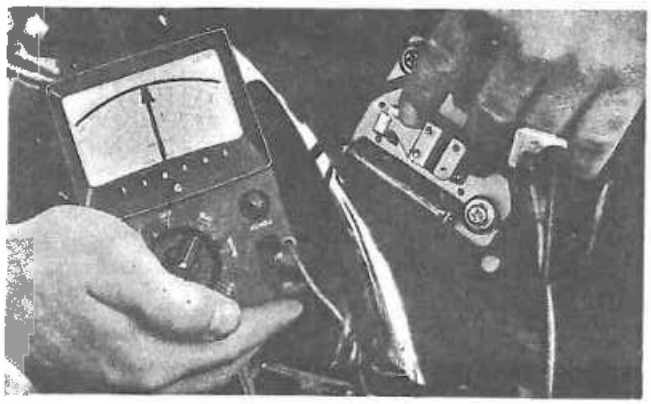


5) Remove the regulator cover.

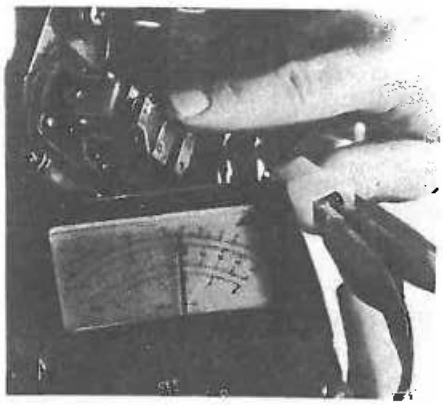
6) With the central contact point held against the top point by the spring (as in the low rpm position), the meter should show no resistance at all (two ohms resistance is too much). If high resistance exists, one of the wires is broken, a soldered joint has separated, or the points are burned. The unit usually requires replacement if the problem cannot be cured by cleaning the points.



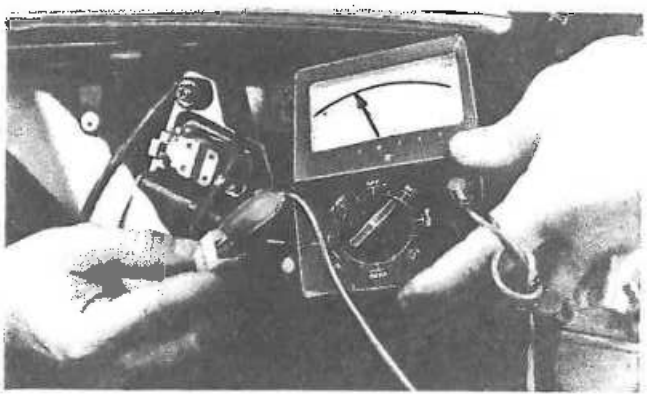
7) Maintain the same meter hook-up as step four. Push the central point arm until the point is positioned mid-way between the top and bottom points. The meter must read 9~10Ω resistance. If the observed resistance varies from this figure, the 10Ω regulator resistor has failed; either internally or at its solder points.



8) Maintain the same meter hook-up as step four. Push the central point down until it contacts the bottom point. The meter must show a 7~8Ω resistance value. Check the condition of both contact points as burnt points can cause an improper reading.



9) At the multiple connector, hook the ohmmeter to the black and brown wires. Permit the central point to spring up against the top point and measure the resistance. It must measure 36~38Ω resistance.

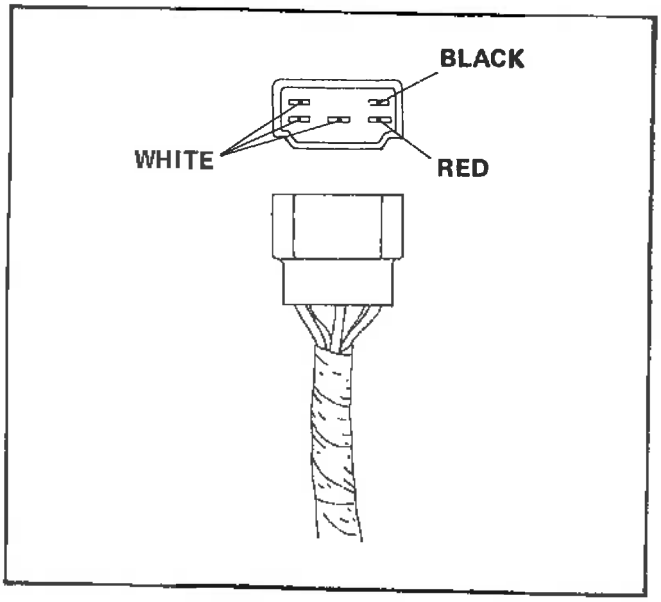


10) A correctly operating regulator will give the resistance values as listed in each test. If the measured values differ, and the variation cannot be blamed on a broken or disconnected wire (that can be resoldered), replace the regulator unit. If a complete regulator resistance test shows all circuits to have correct resistance, the regulator is probably not the cause of improper voltage output. The next charging circuit component must be checked.

d) Rectifier

1) Check the rectifier for proper one-way electrical flow through the diodes. Trace the rectifier wiring back to its multiple connector and disconnect it. Inside the connector are five metal prongs.

2) The prongs are connected to three white wires (that hook up to the alternator wires), one black wire (to ground) and one red wire (to battery and main switch). Perform the following tests, using an ohmmeter (0~1000Ω scale) to check the condition of the rectifier.



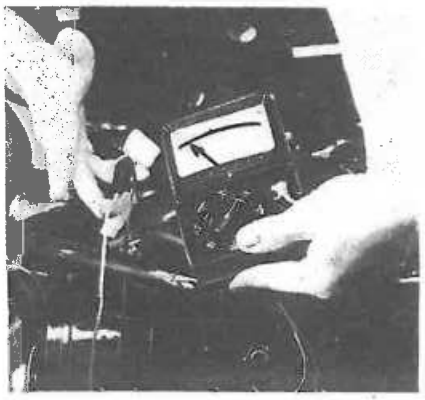
3) Visually check all rectifier wires for breaks.

NOTE: The black rectifier lead, which starts at the rectifier and passes through the main wiring loom, is grounded to one of the secondary ignition coil bolts. If this black wire breaks, voltage output will increase radically. Remember this point when troubleshooting.

4) Clamp the black probe to the black wire and touch the other positive test lead to each white wire in the connector. Next, reverse the position of the meter probes and again touch each of the white wires. For these diodes to be good the meter must show a small resistance (75~150) reading one way and almost infinite resistance with the probes reversed.



5) Attach one meter probe to the red wire and again touch each white lead with the other probe. Reverse the probes and again touch each white lead. The resistance readings must be identical to those in 4).

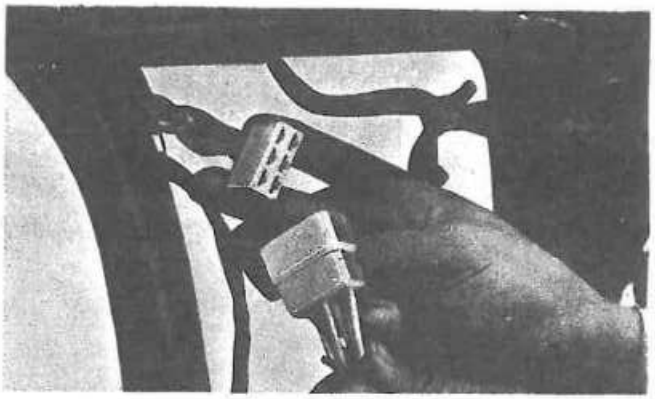


6) All rectifier wires directly attached to the diodes are fully insulated. If any are broken, replace the unit.

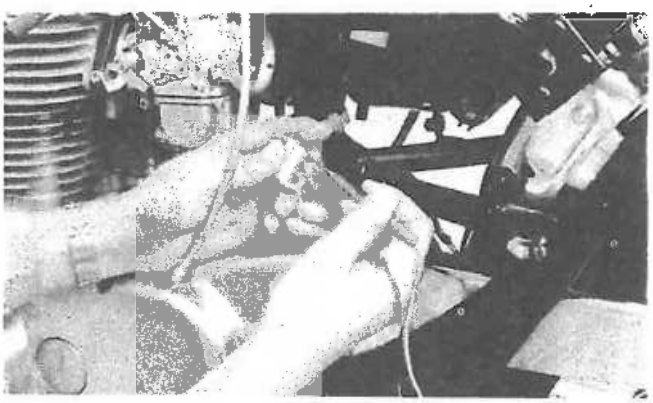
7) If resistance results of steps 4) and 5) show that current can flow both ways, or neither way, then one or more diodes have been damaged. Replace the unit.

e) **Stator Winding**

1) Trace the ACG wiring up to the multiple connector. Disconnect the connector and perform the following test to the three white wire ends at the multiple connector (there are a total of six wire ends in the connector).



2) All three white wires are interconnected in the stator windings. Use an ohmmeter to check resistance between any two white wires (three possible combinations). Each of the three measurements should show 0.8~1.0Ω resistance.



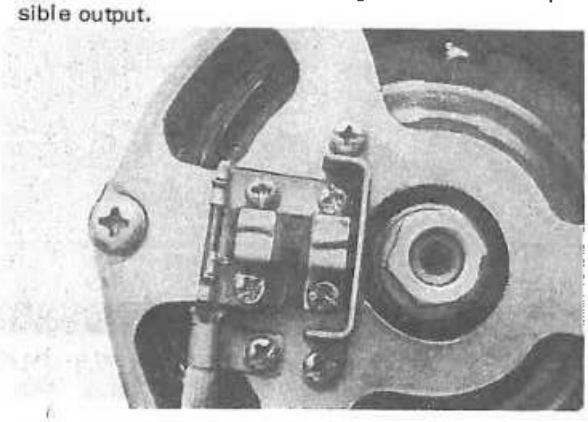
3) Set the ohmmeter scale to read at least in kilo-ohms. Clamp the ohmmeter probe to the stator housing and touch each white wire with the other probe. There should be infinite resistance.

4) If resistance values in steps two & three vary from those specified, then the stator windings are broken, shorted together, or shorted to the housing. Replace the entire unit.

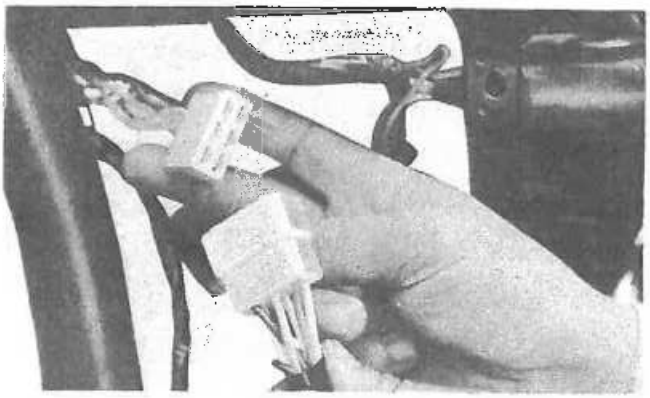
f) Carbon Brushes

1) If the carbon brushes do not function correctly, electricity cannot pass to the rotor field windings. This reduces alternator output.

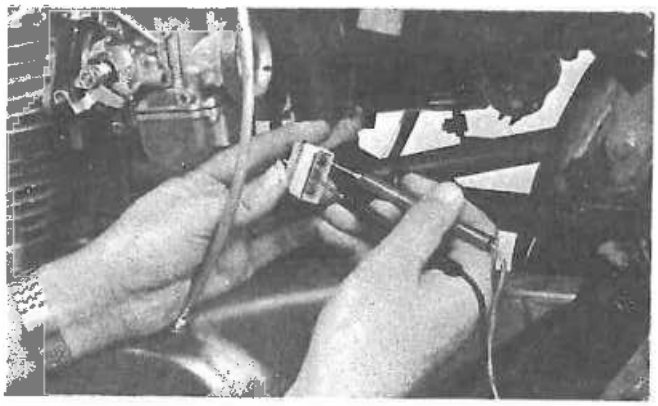
2) Visually inspect the carbon brush holder and brushes for obvious breakage or wear. Standard brush length is 14.5 mm (.572"). Wear limit is 7.0 mm(.276"). Also check for carbon dust that could 'short out' the insulated brush, thereby cutting down maximum possible output.



3) Both carbon brush wires (black and green) are located in the same wiring loop as the three white stator wires. They share the same multiple connector which has already been disconnected.



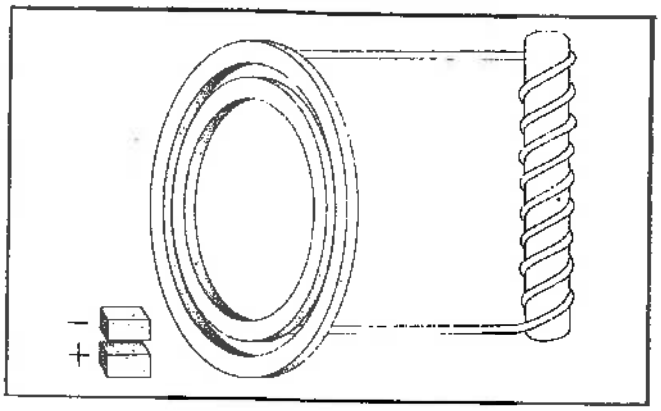
4) Check wiring resistance from the multiple connector to the carbon brush first through the green wire and then the black wire. There must be zero resistance.



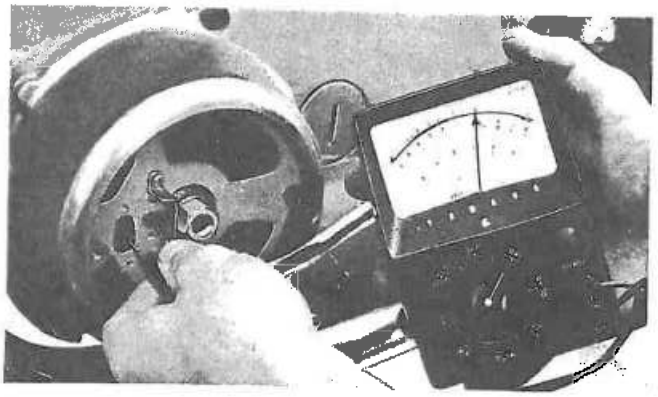
5) If high resistance exists in either wire, it is frayed or broken. Repair or replace the entire wire.

g) Rotor Windings

1) The field windings are one continuous coil of wire, each end attached to an insulated slip ring.

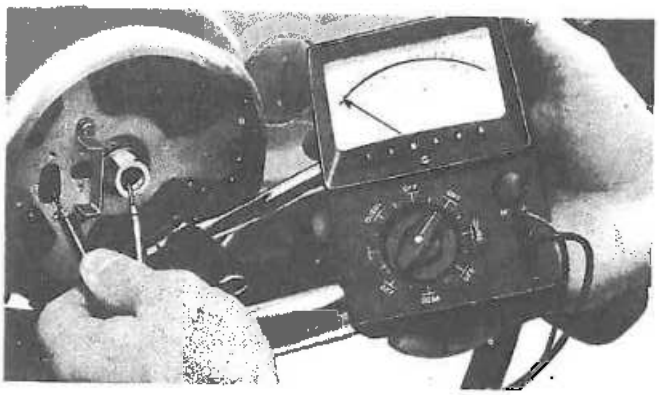


2) Use an ohmmeter (Ω x 1) to check resistance from one slip ring to another. Resistance should measure 5~7Ω.



NOTE:
Both slip rings must be clean or an inaccurate reading will result.

3) Use an ohmmeter set to register at least kilo-ohms resistance. Measure insulation between each slip ring and the rotor core. This must show infinite resistance.



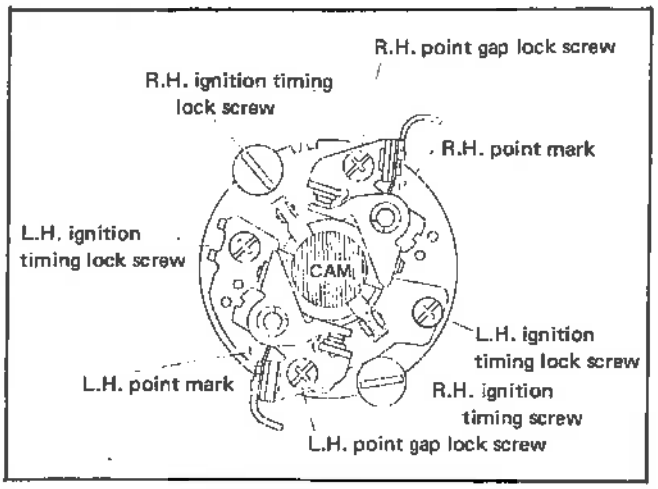
4) If resistance measurements differ greatly from those specified, the winding is either broken, shorted to itself, or shorted to the core. Replace it.

D) Ignition Breaker Points

This unit is equipped with two independent sets of ignition points; one for each cylinder. They are both located in a single housing mounted on the left end of the camshaft.

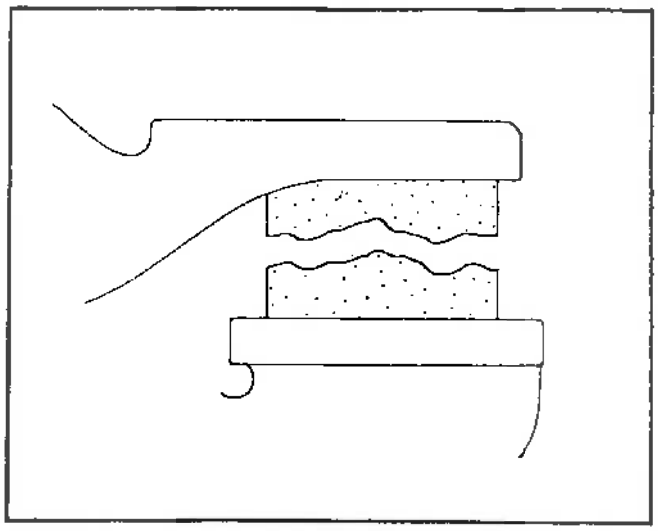
The points act as circuit breakers for the ignition system. A point cam spins counterclockwise in the center of the ignition unit. A lobe on the cam controls the opening and closing of the points.

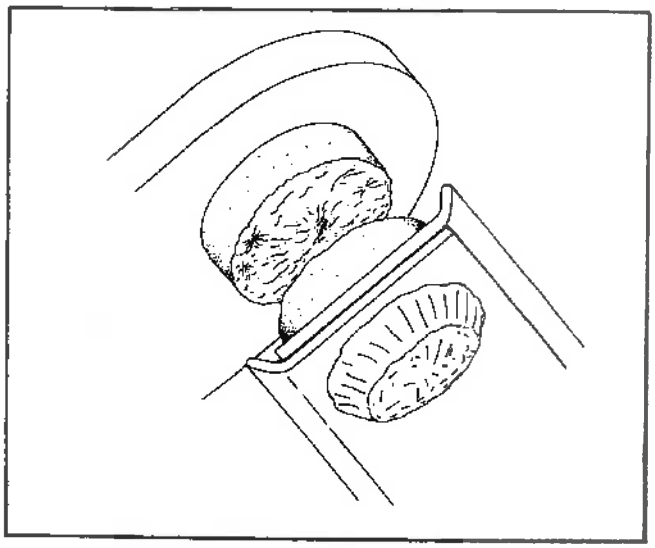
When the points are closed, current flows to the primary coil (which begins to build a magnetic field). At a precisely calculated point of crankshaft rotation, the cam forces the points apart, which stops current flow to the primary winding in the ignition coil. High voltage is then generated in the coil's secondary winding and causes a spark to jump the plug electrodes.



1) Wear

a) The points gradually become burnt and pitted. This is normal wear. However, metal from one point might transfer to the other. If this metal build-up cannot be cleaned off with a point file, the points should be replaced.





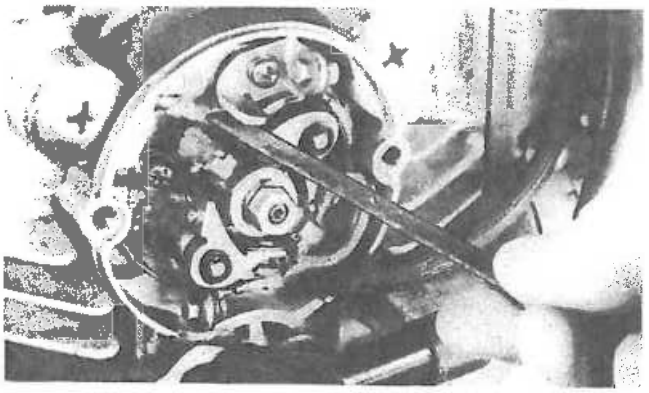
b) Oil may gradually seep past the seal and coat the points or wiring. This will burn onto the points creating an insulating film. It must be cleaned off with ignition cleaning solvent.

c) The fiber cam follower mounted on the pivoting point arm rubs against the cam. Eventually this block wears down which results in a reduction of the point gap and retarded timing of that cylinder. The remedy is to regap the points and check the timing (timing should be checked any time the points are re-gapped.)

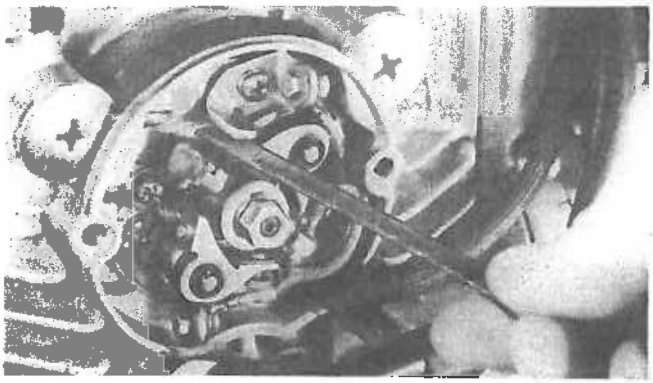
d) If a point return spring becomes weak or broken, the pivoting point will bounce. Timing will become erratic and ignition firing will be uneven. Measure spring tension by attaching a scale (measured in grams) to the pivoting point. It should take 700~800 g to cause the points to separate. (Use a point checker to measure the separation electrically).

2) Repair

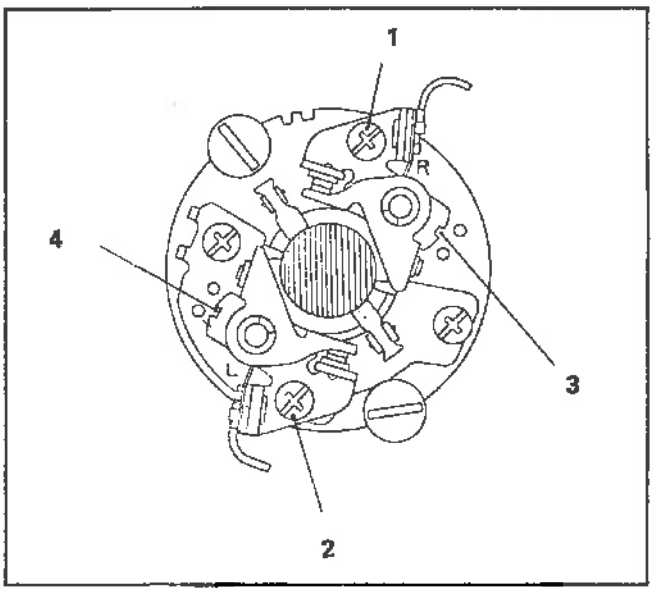
a) Point gap on each set of points must be set at .3~.4 mm (.012"~.016"). Constant electrical arcs across the points cause some metal to burn away, changing point gap. Clean and regap the points every 2,000 miles. Check timing after re-gapping.



b) To clean the points, run a point file between the points until the grey deposits and pits have been removed. Spray the points with ignition point cleaner or lacquer thinner, then snap the points shut on a white business card (or paper of hard texture) and repeatedly pull the card through until no more carbon or metal particles come off on the card. (The card may be dipped in laquer thinner or other cleaner to facilitate this procedure)



c) To gap the points, first rotate the engine until the ignition cam opens the points to their widest position. Slip a .4 mm (0.16") feeler gauge into the gap. It must be a tight slip fit. If an adjustment is necessary, loosen the point lock screw (1 or 2) as shown in the accompanying drawing, insert a screwdriver into the adjustment slots (3 or 4), and open or close the points until the feeler gauge indicates the correct gap. Retighten the lock screw and recheck the gap.



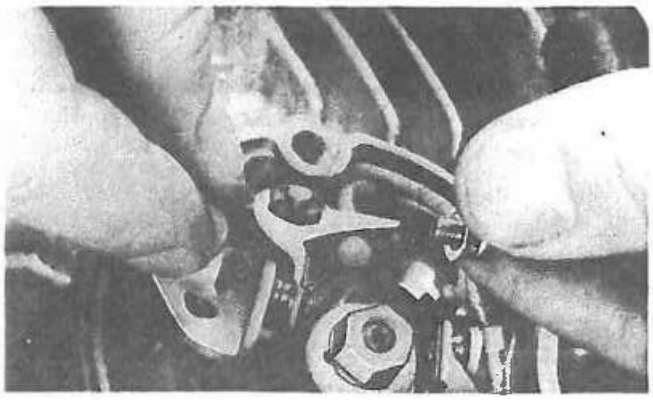
d) Next, rotate the camshaft until the second set of points opens to its widest point. Then perform the same steps as described in the previous paragraph.

NOTE:

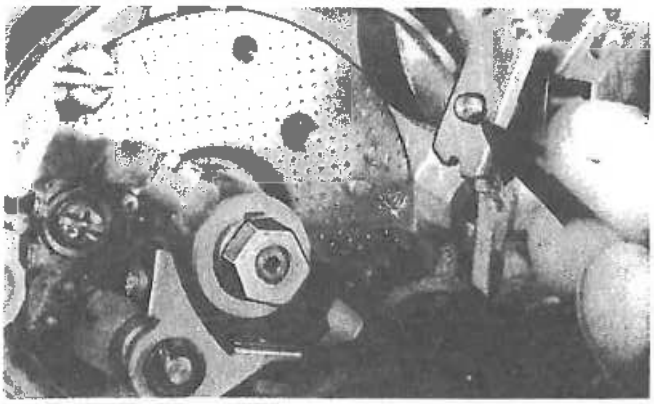
Add a few drops of light-weight oil onto the felt rubbing pad after each point adjustment to lubricate the point cam surface. Do not overoil.

3) Replacement

a) Unscrew the point wire securing screw. Completely remove the point lock screw. Lift the entire point assembly up off the point base plate.

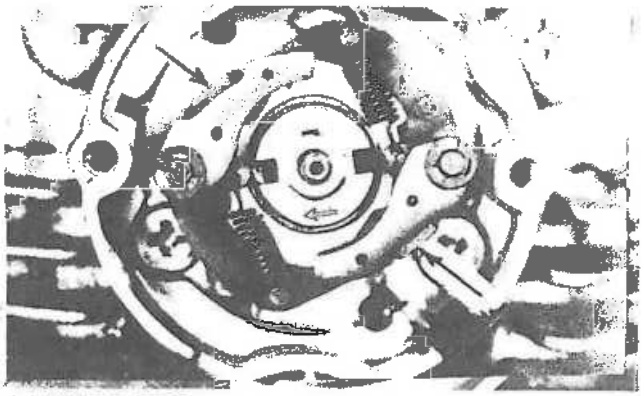


b) Locate the new set of points into position by slipping the point assembly locating pin into the appropriate locating hole in the base plate.

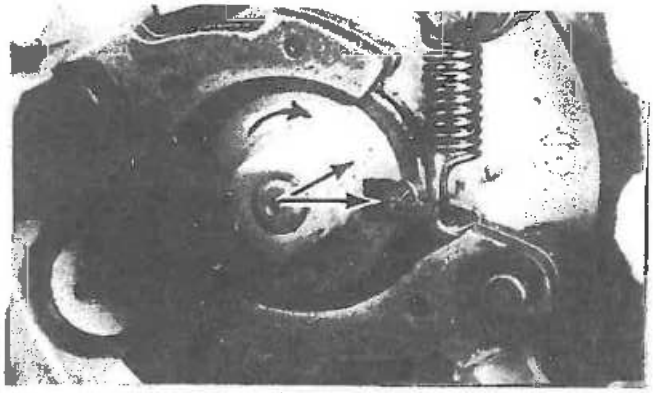


c) Insert and tighten the point lock screw. Finish this replacement by attaching the point wire to the stationary point and re-gapping the new point assembly.

E) Advance Assembly



Advance arm stops



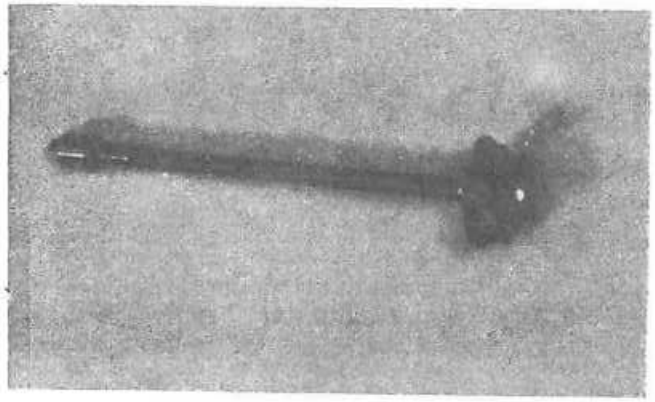
Proper assembly procedure (direction arrow)

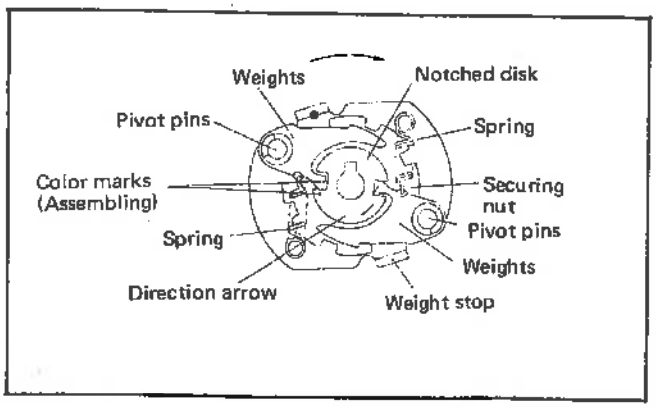
1) The governor rod is threaded at one end and a notched disk is attached to it by a nut. Around this disk is the advance unit which mounts directly to the end of the camshaft (a ring nut holds it in place).

   Two centrifugal weights pivot on pins. Each weight has a small extension that fits into the disk notch. As engine rpm increases, both weights begin to swing out on their pivot pins due to centrifugal force acting on the rotating unit. The weights continue to swing outward as rpm's increase until the weights are stopped by fixed stopper pins. As these weights pivot, the extensions in the disk notches cause the disk to rotate. Since the disk is directly attached to the point cam rod, the ignition point cam also rotates, which causes ignition timing to advance.

2) Both weights must pivot smoothly or ignition advance will not occur at the proper rpm, nor will it advance to its fullest extent. On occasion, light-weight grease must be applied to the weight pivot pins.

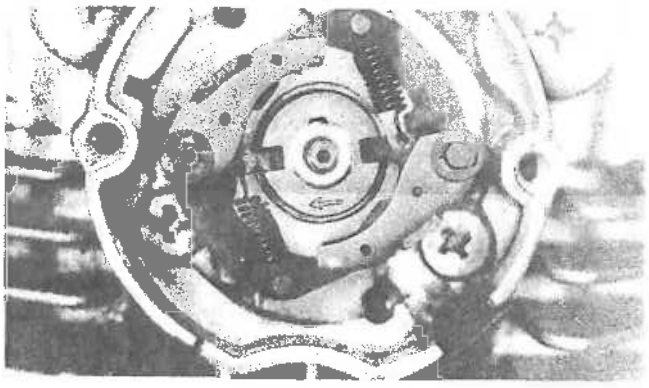
3) The advance unit mechanically changes ignition firing from 13—17° BTDC at low rpm to 40° BTDC at high rpm (full advance). The ignition point cam is attached to one end of a rod that travels completely through the center of the camshaft. The rod is connected squarely to the camshaft. The point cam opens and closes the points. The other rod end provides a mounting point for the advance unit.





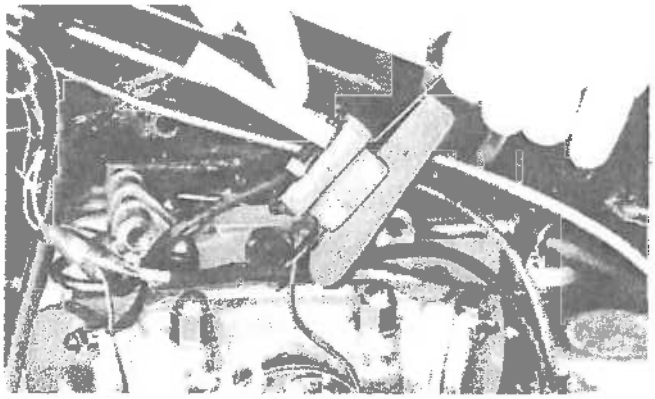
4) If a return spring is broken, the ignition timing will advance too quickly. This condition causes poor performance and excessive engine heat.

5) If the notched disk has been installed incorrectly, timing will be advanced too early. A groove in the mounting hole that fits over a pin in the rod, plus the color marks that have been matched up, prevents the disk from being installed 180° off. However, the direction of rotation arrow must face outward or the disk will be installed incorrectly. •

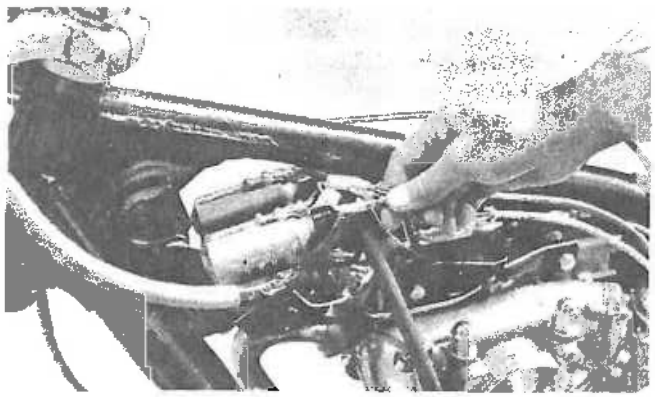


F) Condenser

1) The ignition condensers are located on the left-hand side of the top engine mounting bracket. The two condensers are mounted as a single assembly and must be replaced as a set in the event of failure.

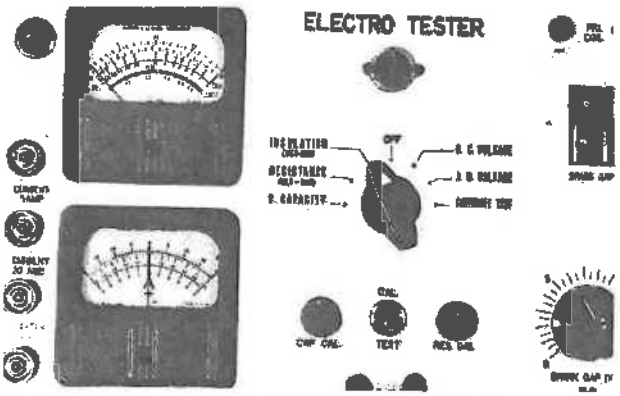


2) The condensers serve as a storage device to decrease arcing across the ignition points. Should one fail there could be either no spark or severe point pitting due to arcing. In the event of severe arcing there is also the possibility that the strength of the ignition spark may be decreased.

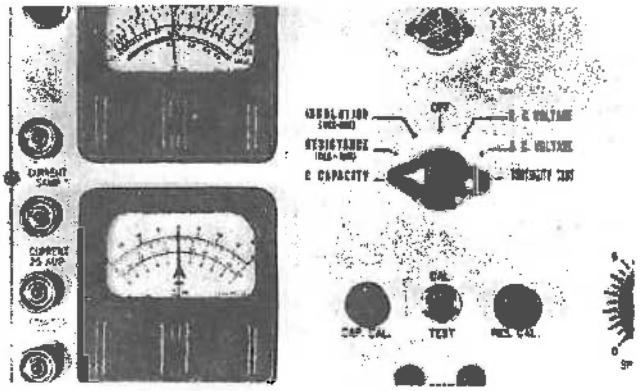


3) To test the condition of either condenser, pull the male/female connection apart.

4) Hook an ohmmeter or your electro tester to the condenser. Black (Neg) lead to the condenser case, Red (Pos) lead to the wire running from the center of the condenser. There will be a momentary flow of current and then the condenser should show at least 5+million ohms resistance between the positive terminal and ground.

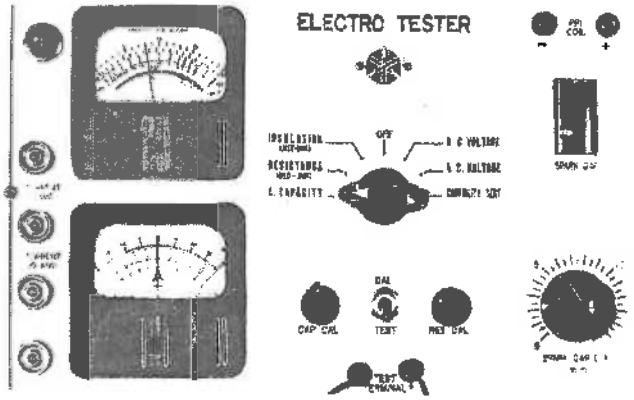


5) Next, hook up an electrotester to the condenser. (Leads in the same position). Turn the main function switch to "Capacitance" and the calibration switch to "Cal".



6) Turn the "Cap. Cal." knob until the meter needle is mid-range (in the black) on the red meter section for "Capacitance".

7) Turn the Calibration switch to "Test". The needle should stay in approximately the same position. If it moves very far into the red, replace the condenser assembly.

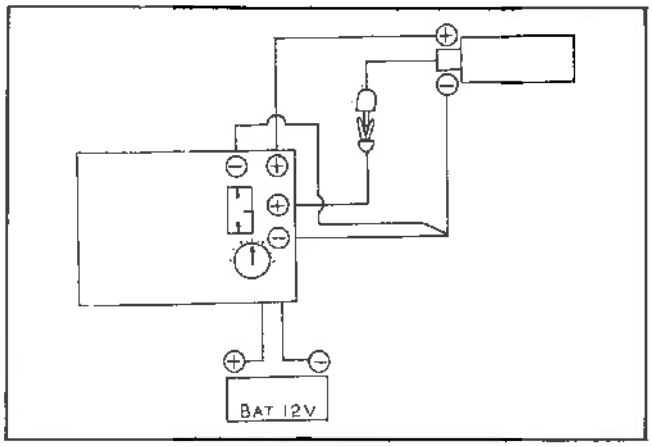


G) Ignition Coil

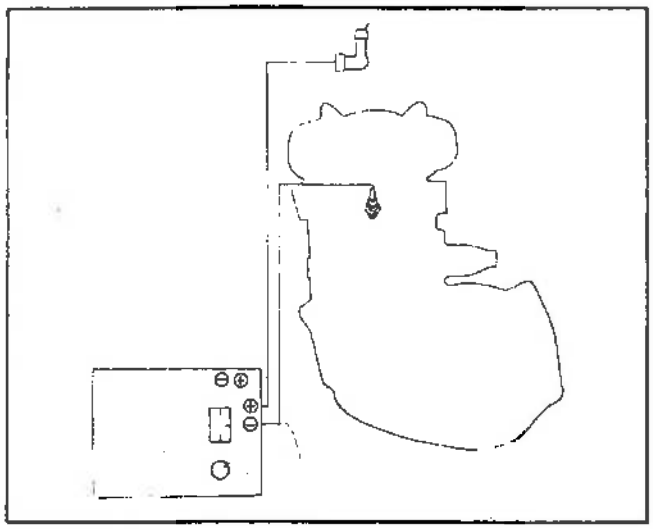
1) Location
The ignition coils are mounted to a bracket directly in back of the steering head. They can not be removed until the gas tank is removed.

2) The ignition coils can be checked on the machine. It is not necessary to remove either the coil or the gas tank unless the coil is defective and needs replacing.

3) Static Test:
Follow the diagram shown below to check the coil. Leave the ignition key off and block the points open with a piece of paper. The coil should show at least 8 mm spark gap. (Instructions for setting up the Electrotester can be found on the Electrotester cover.)



4) Dynamic Test:
Follow the diagram shown below for setting up. Close the point gap on the Electrotester to zero. Turn the ignition on and start the machine. Rev the machine to 2~3,000 rpm (or the rpm you wish to test at) and begin opening the tester's point gap. When the engine begins to misfire, close the point gap until it runs smooth again. Point gap should be at least 7 mm.



H) Spark Plug

1) Standard spark plug is an NGK B-8E which is a 14 mm, 3/4" reach, fairly cold plug.

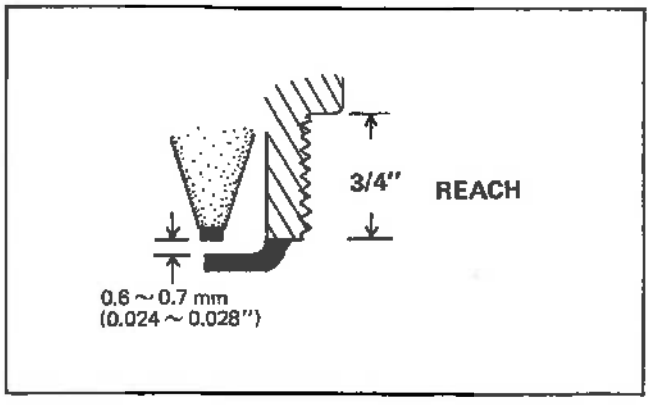
2) Under normal conditions the spark plug should show no deposits on the porcelain insulator around the positive electrode. The porcelain should be a light-to-medium tan color. After 2,000~4,000 miles fuel deposits will begin to build up on the plug. Fuel deposits are easily cleaned off but as this is the period for a tune-up it is advisable to replace the spark plug.

3) If one or both plugs are wet, black, and/or heavily sooted, this is an indication that temperatures within the combustion chamber are too low. Check with the rider as to his habits. The plug is designed to give best performance during moderate to medium-high speed cruising.

4) If one or both plugs are white, blistered, and/or the electrode has melted away, this is an indication of excessive combustion chamber temperature.

5) Under normal circumstances it is best to tune carburetion to achieve a correct spark plug reading. However, if the situation is only slightly incorrect then one step hotter (B-7E) or colder (B-9E) spark plug can be installed. If the machine is being driven under extremely adverse conditions it may be necessary to change carburetion, timing, and one or more heat ranges in the plug.

6) Servicing
Clean the electrodes of carbon and adjust the electrode gap to 0.6~0.7 mm (0.024"~0.028"). Be sure to use the specified plug, B-8E, when replacing.

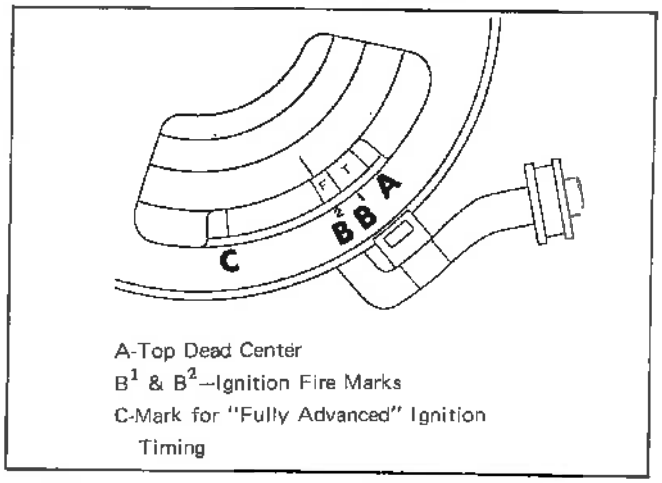


I) Setting Ignition Timing

CAUTION
In order to obtain accurate ignition timing, in relation to piston position, the cam chain must first be adjusted.

1) Ignition timing is checked by observing the position of the timing marks on the rotor in relation to the timing marks on the stator.

2) The rotor has one timing mark. The stator has four timing marks. The first mark is identified by the letter "T". This means the piston is at "Top Dead Center". The next two marks, identified by the letter "F" stamped between them, is the point of proper ignition timing when fully retarded (engine stopped or idling). When setting ignition timing, set it so both cylinders fire between the marks (both ignition advance weights completely closed).



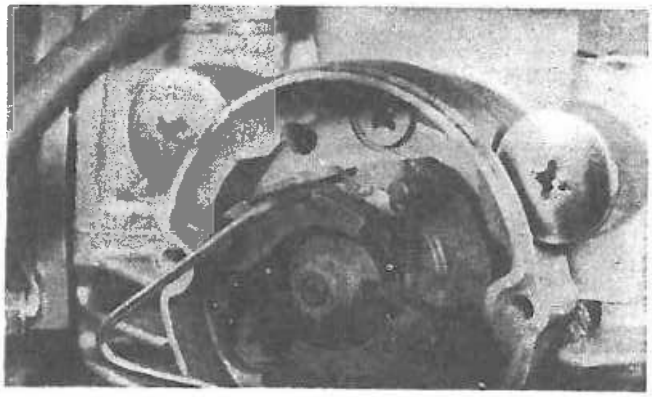
A-Top Dead Center
B^1 & B^2—Ignition Fire Marks
C-Mark for "Fully Advanced" Ignition Timing

3) The fourth timing mark indicates 40° before TDC, the fully advanced ignition position.

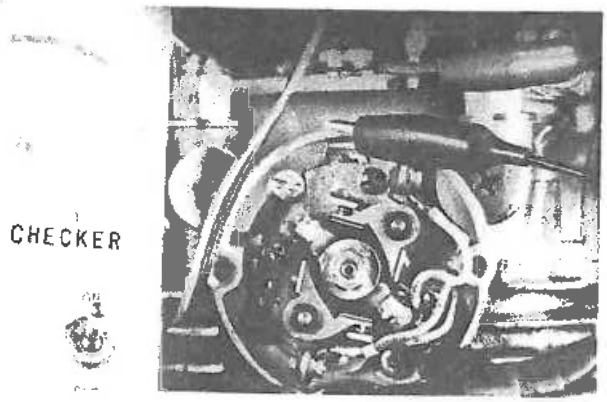
NOTE:
Each point gap should be checked first, and adjusted, if necessary. Then proceed with the timing adjustment.

4) Remove the alternator inspection plate, ignition points cover, and ignition advance unit cover.

5) Securely anchor the igniton advance weights into the "fully retarded" position (weights held inward).

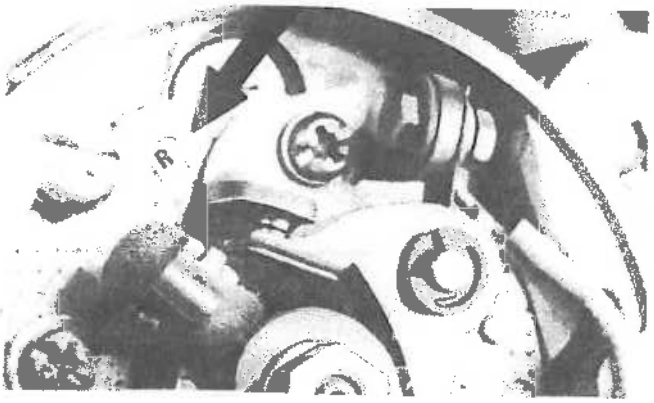


6) Check the point checker for full scale deflection (Infinity to Zero resistance), then hook the black lead to a good ground; the red lead to the grey point wire (right cylinder).



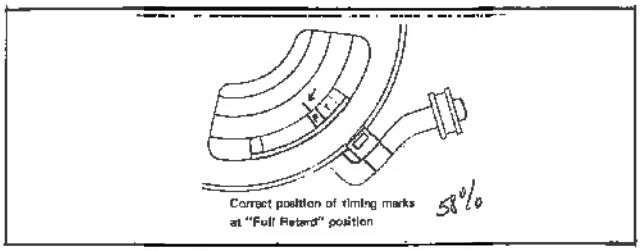
CAUTION
Ignition timing for each cylinder is set separately. However, it is absolutely necessary that the right cylinder points are timed BEFORE the left cylinder points. The right cylinder points are mounted directly to the ignition point base plate. The left cylinder points, however, mount on a separate plate that is in turn mounted to the ignition base plate. If the left cylinder points are timed first, they will shift out of position when the base plate is pivoted to time the right cylinder points.

7) The letter "L" (for left cylinder) is stamped next to one set of points, the letter "R" (for right cylinder) is stamped next to the other set. This indicates which set of point fires which cylinder.

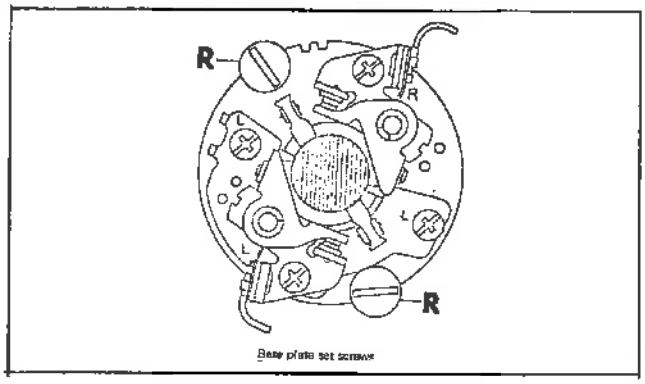


8) Rotate the crankshaft in the direction of running rotation (counterclockwise when viewed from the left side) until the right-hand set of points just start to open, as indicated by the point checker.

9) Check the rotor timing mark position. If the righthand points are timed correctly, the rotor mark will line up exactly between the two "F" stamped timing marks on the stator. If these marks do not line up, a corrective adjustment must be made to the points.

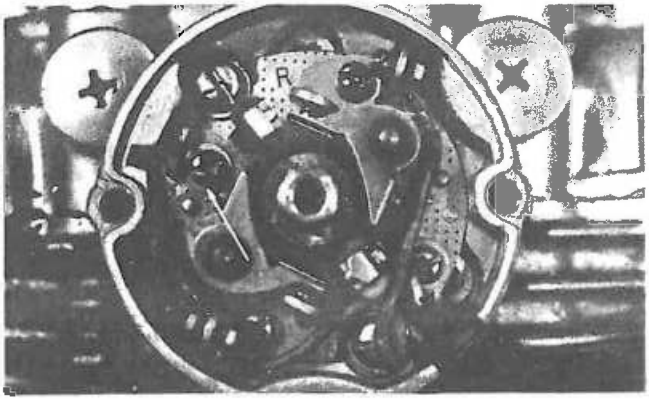


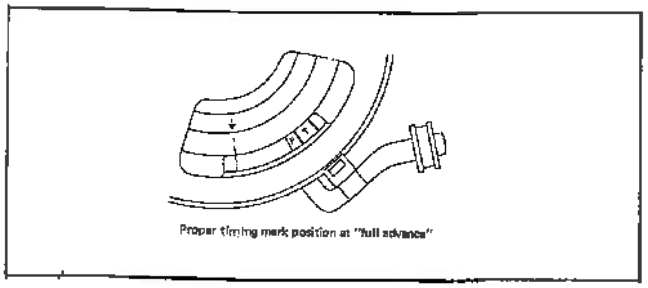
10) With the timing marks lined up correctly, loosen both base plate lock screws. Pivot the entire plate until the right cylinder points just start to open, (as indicated by the point checker).



11) Tighten down both lock screws and check the timing again to make sure the base plate has not moved.

12) To set left cylinder timing, repeat steps 6 thru 10, except to switch the point checker probe from the grey wire to the orange wire. The left cylinder points are held in place on the base plate by two different lock screws. Loosen both lock screws as shown in the accompanying figure and make the necessary adjustments.





13) As the XS650 will normally be ridden at an average speed above 3,000 rpm, ignition timing must also be checked at the "fully advanced" position. In fact, it can also be set at this position. To check:

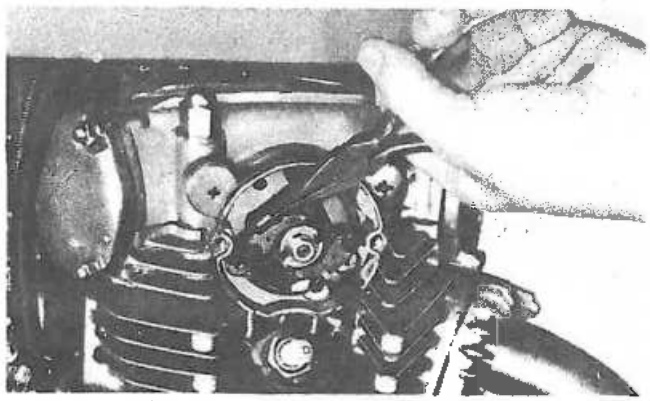
a) Wedge the ignition advance weights fully open. Repeat steps #8 and #9. The points should just start to open when the rotor timing mark is within 1mm (.040") of the stator full advance mark.

b) The above check can also be made with the engine running. Hook up the Electro Tester dual timing light to both spark plugs. Start the engine. At idle to about 1,500 rpm the unit should remain retarded. From approximately 1,500 rpm to about 3,000 rpm the unit should advance. At approximately 3,000 rpm, the unit should show full advance and both cylinders should be firing within 1mm (.040") of the full advance stator mark. Continue to check ignition operation to rpm redline, if desired.

NOTE: The "b" method allows you to check your work and the actual operation of the ignition.

14) If the ignition does not show complete advance, or too much, the advance mechanism must be checked. Check for proper assembly and spring tension. In addition, check the advance weight stoppers. Total advance should be 40° ± 2°. If this is not the case, and the springs, etc., check out, replace the governor assembly.

NOTE: It is possible to change the amount of advance by bending the weight stoppers. Remove the governor assembly and heat it prior to bending the stoppers as they may fracture if cold. Do not over-heat as this may make the stoppers lose their rigidity, causing them to bend during operation. Bending the stoppers out, away from the weights, increases the amount of advance. Normal advance amount is approximately 27°. It should not be necessary to bend the stoppers more than 0.7mm (.030") in either direction. More than that may weaken them.



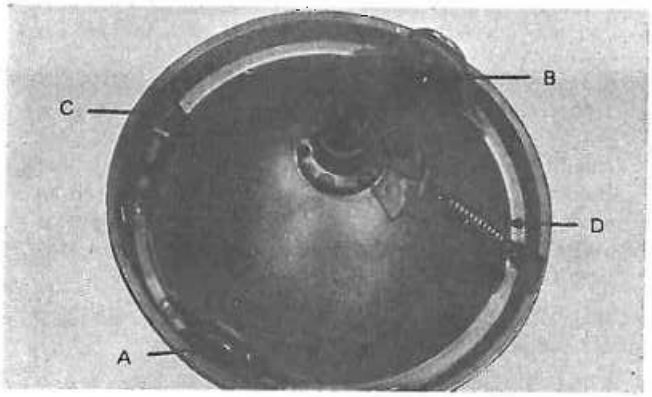
15) Finally, it is a good idea to re-check your results, especially in the case where the engine has not been running correctly.

J) Lighting Circuit

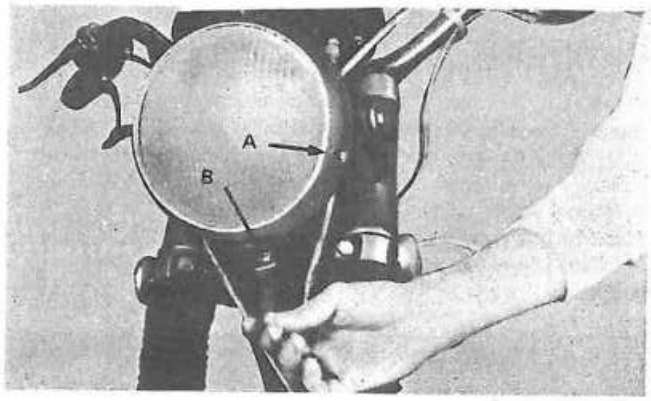
1) Headlight

a) The headlight is a semi-sealed unit with a non-replaceable filament. If the headlight burns out, replace the entire headlight bulb unit.

b) Replacement:
Remove screws "A", "B" and "C" ("C" is the side adjustment screw). Unhook spring "D" and pull the defective unit out of its shell. Slip a new unit into position and install parts "A", "B", "C" and "D".



c) Adjustment:
Screw "A" controls side-to-side headlight movement. Screw it in or out until the headlight beam is centered. (See below)

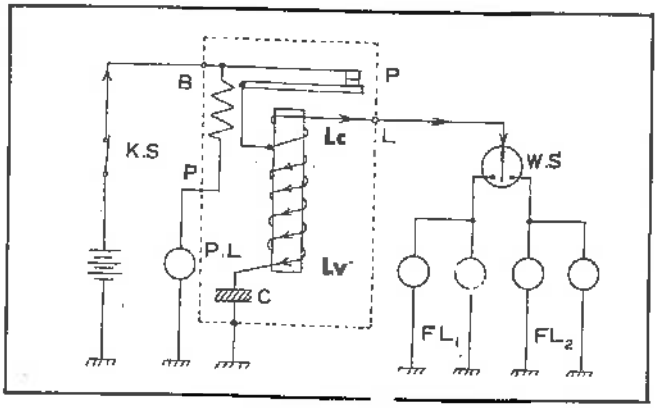


d) Headlight up and down movement is controlled by bolt "B". Loosen this bolt and tilt the headlight into position, then retighten the bolt.

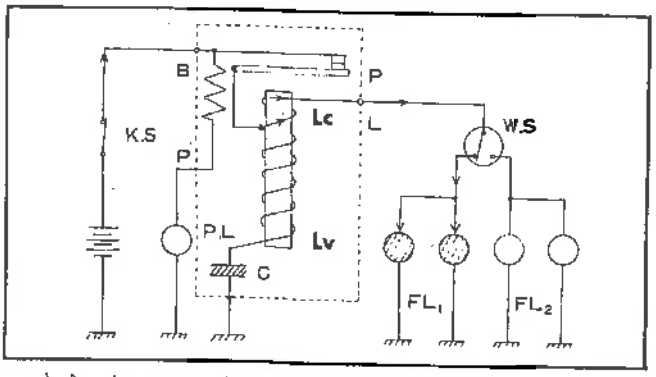
NOTE: Occasionally, the headlight bolts "C" will require loosening first.

2) Turn Signals

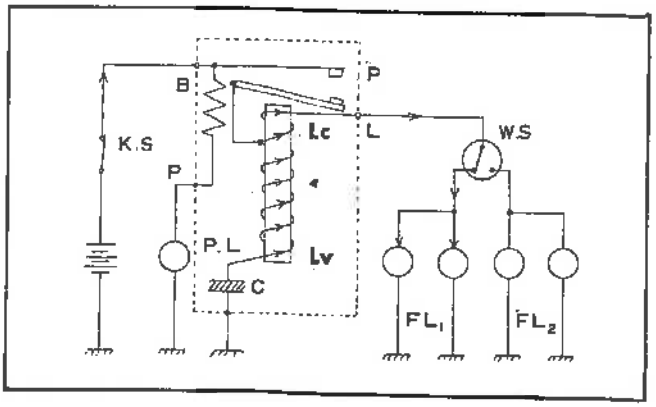
a) Voltage flows from battery to the relay condenser. The condenser becomes fully charged (including wire to flasher switch) and all voltage flow stops in the relay.



b) When the relay switch is activated, voltage flows from the battery through the "Lc" winding and causes the flasher to light.



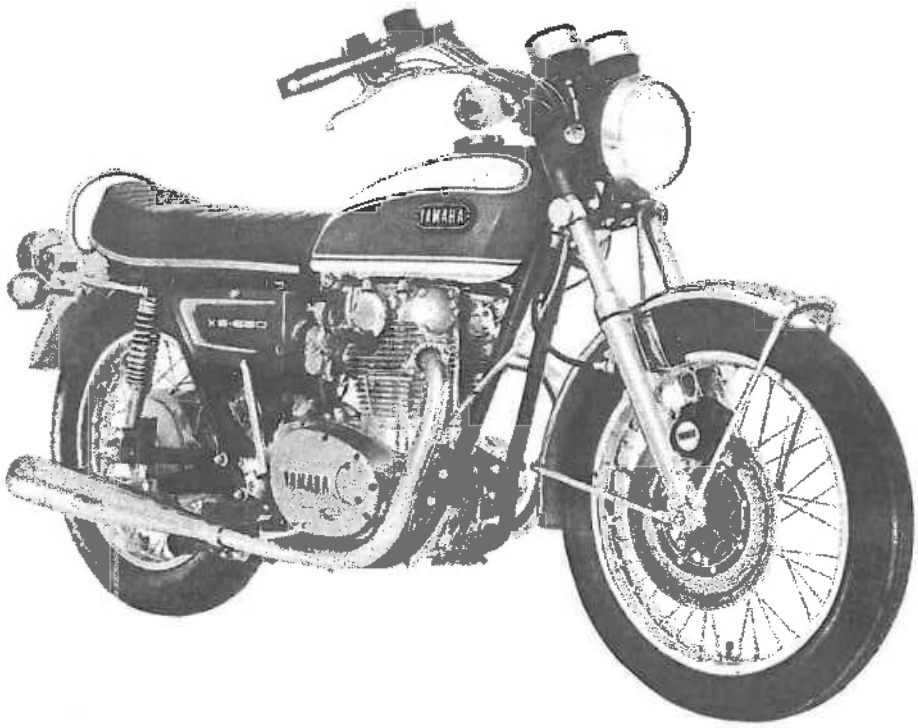
c) At the same time that voltage lights the flasher, the "Lc" winding around the metal core creates an electro-magnet that pulls the contact points apart. Voltage flow stops and the flasher lights go out. Magnetism to hold the points apart is momentarily maintained because the stored electrical charge in the condenser discharges back through "Lv" and "Lc" windings. The stored condenser amperage, however, is not sufficient to light the flasher lights (due to their being a high resistance load), so both flasher lights do not light again.



YAMAHA

XS2–TX650

SUPPLEMENTARY INFORMATION

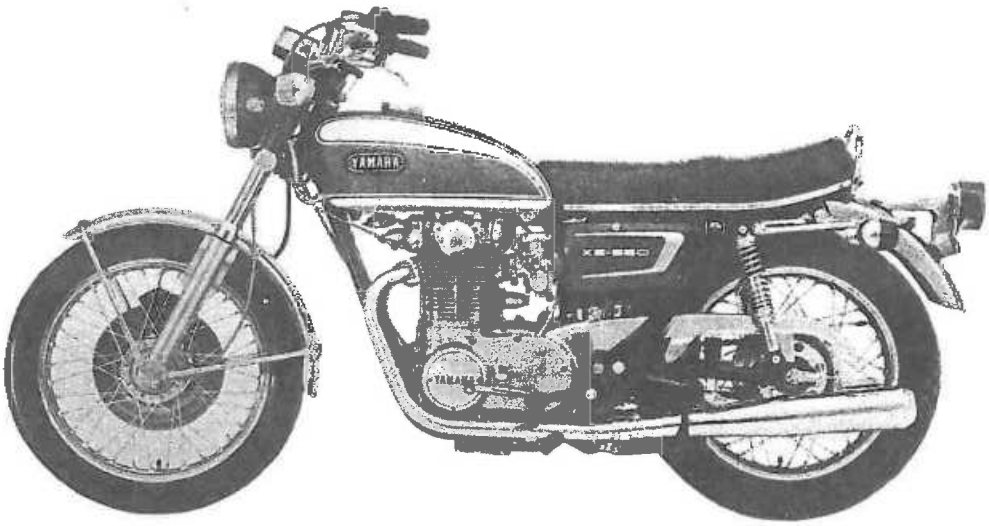


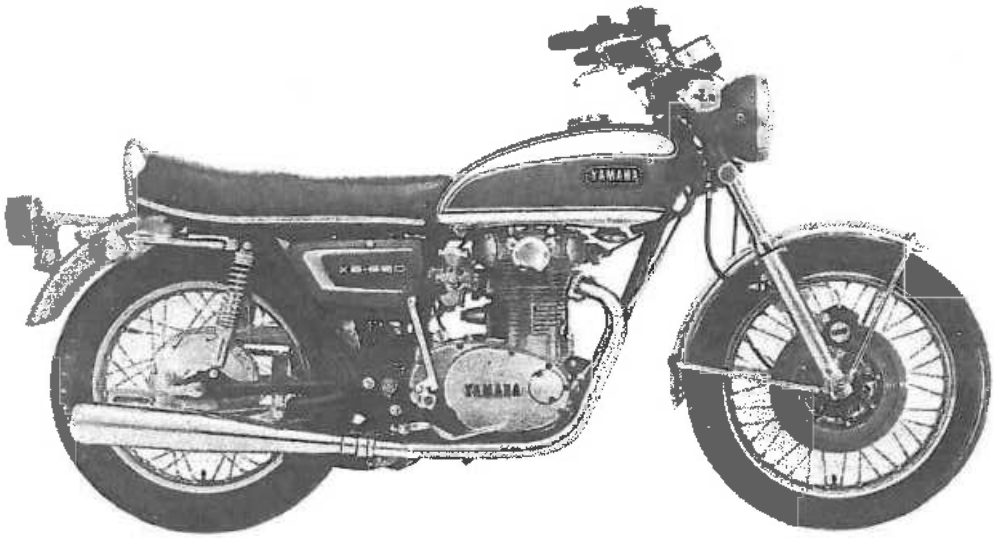
FOREWORD

Yamaha's XS2 is an improved version of the XS1 and equipped with additional components - electric starter and front wheel disc brake.

This XS2 Supplementary Information describes the construction of the electric starter and the disc brake and the procedures for inspection and maintenance.

PROFILE VIEWS





Dimensions.	
Overall Length	85.6 in. (2175 mm)
Overall Width	35.6 in. (905 mm)
Overall Height	45.9 in. (1165 mm)
Wheelbase	55.5 in. (1410 mm)
Min. Ground Clearance	5.9 in. (150 mm)
Weight (net)	427 lbs. (194 Kg)
Performance:	
Max. Speed	115 + mph
Fuel Consumption (on paved level road)	82.5 mpg at 37 mph (35 km/l at 60 km/h)
Climbing Ability	26 degrees
Minimum Turning Radius	98.4 in (2500 mm)
Braking Distance	46 ft. at 31 mph (14 m at 50 km/h)
Engine:	
Type	Twin cylinder Air-cooled 4 stroke W/S.O.H.C.
Lubrication System	Pressure lubricated, wet sump.
Bore and Stroke	2.953x2.913 in. (75x74 mm)
Displacement	39.85 cu. in. (653 cc)
Compression Ratio	8.7 : 1
Maximum Power	53 BHP/7000 rpm
Maximum Torque	40.1 ft-lbs/6000 rpm (5.5 kg-m/6000 rpm)
Oil Sump Capacity	2.6 qts. (2.5 l)
Valve Clearance	Cold IN: 0.15 mm (0.006 in.) EX: 0.30 mm (0.012 in.)
Idle Speed	1000 ~ 1200 rpm
Carburetor:	
Type	BS38x2
Needle Jet	4JN19-4th Stage
Pilot Fuel Jet	42.5
Air Filter	Dry paper filter
Clutch:	
Type	Wet, multi-disc. (6 friction + 5 metal plates.)
Primary Drive: Type:	Spur gear (straight cut)
Reduction Ratio (gear and total)	72/27 (2.667)
Transmission: Type:	Constant mesh, five speed, wide-ratio
Oil	SAE 20W/40
1st	32/13 = 2.461 (5.904)
2nd	27/17 = 1.588 (4.235)
3rd	26/20 = 1.300 (3.466)
4th	23/21 = 1.095 (2.920)
5th	22/23 = 0.956 (2.550)
	Internal engine ration (Pri. x Trans.) Multiply by drive chain ration for overall gearing
Secondary Reduction System:	
Type	Single Row chain
Secondary Reduction Ratio:	34/17 = 2.0

Chassis:		
Fuel Tank Capacity		3.7 U.S. gals. (14.0 ℓ) (3.7 gals. — TX650)
Caster		63°
Trail		3.9 in (101 mm)
Front Tire		
Size		3.50 - 19 - 4PR
Fork Oil Quantity (each)		135cc(4.6 oz.)
Rear Tire		
Size		4.00 - 18 - 4PR
Front Brake Type		Hydraulic Disc Brake
Rear Brake Type		Internal expansion, single leading shoe
Generator		
Type		Alternator
Model		LD115
Manufacturer		HITACHI
Ignition System		
Spark Plug	Manufacturer	N.G.K.
	Heat Range	B-8ES
Battery		
Model		(12N12-4A-1) x 1
Manufacturer		G. S.
Capacity		12V. 12 AH.
Dimension		5.36 x 2.36 x 5.16 ins. (134 mm. x 59 mm. x 129 mm.)
Lighting System		
Headlight		12V, 50W/40W
Taillight		12V/8W
Stoplight		12V/23W
Neutral Light		12V/3W
Flasher Indicator Light		12V/3W
Flasher Light		12V/27W
High Beam Indicator		12V/2W
Speedometer Light		12V/3W
Tachometer Light		12V/3W

NOTE: TX650 SPECIFICATIONS IDENTICAL TO XS2 UNLESS OTHERWISE NOTED.

SEE ALSO XS1/XS1B SPECIFICATIONS.

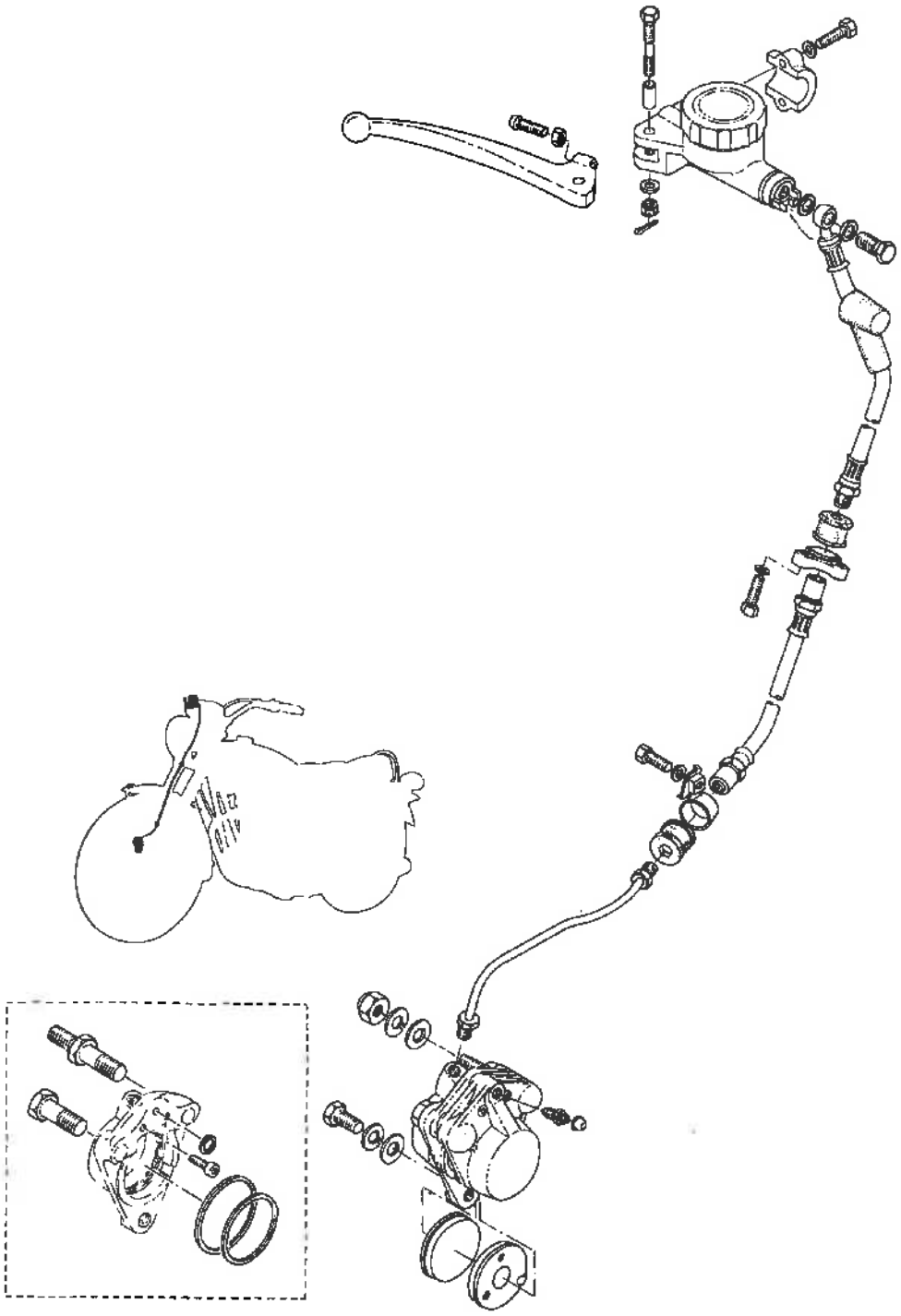
DISC BRAKE

(See page 165 for TX650A)

1. Construction

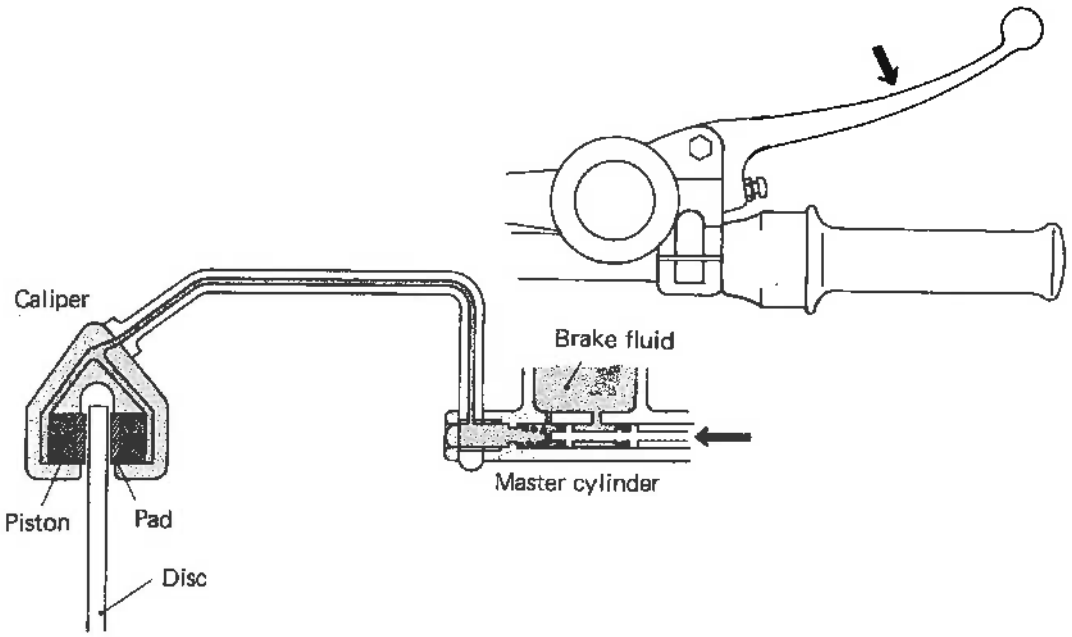
Construction

A fixed-caliper type disc brake, in which the two flat shoes grip the rotating disc, is in use. The right part of the handlebar has a brake lever and a master cylinder. The calipers are installed on the front fork, while the brake disc is mounted on the front hub. The master cylinder is connected to the calipers by a brake hose and pipe.



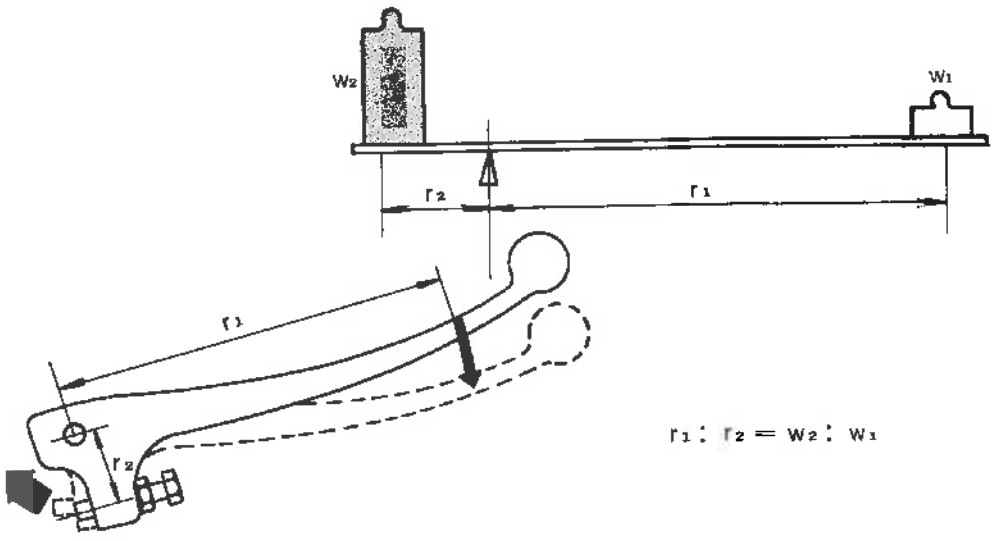
Operation

When the front brake lever is squeezed, it forces the master cylinder piston to move. As the piston cup moves past the compensating port, it traps the brake fluid in the cylinder. Pressure rises rapidly, and the fluid is forced through the brake hose to the caliper cylinders. The brake fluid forced into the caliper cylinders pushes against the pistons in the cylinders, and the pads (or "pucks") located on each side of the disc are forced against the disc. The friction between the pads and revolving disc then provides the braking action. As the brake lever is released, both brake lever and pistons are forced back to their respective original positions by the force of return springs.



Brake Lever

When the brake lever is squeezed, it produces a force at the master cylinder piston about four times greater than the force applied to the brake lever.

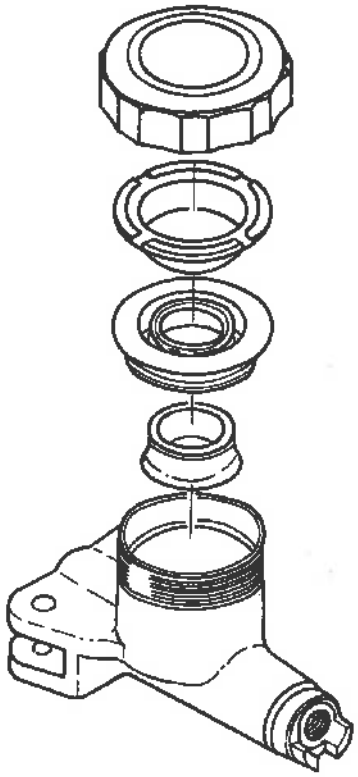


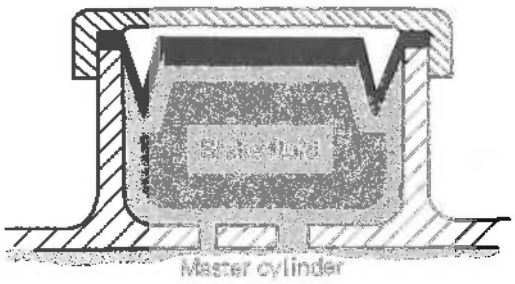
Master Cylinder

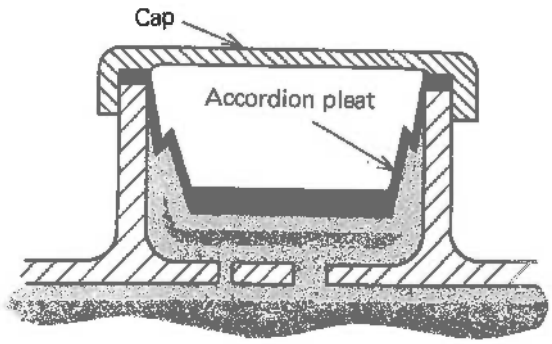
The master cylinder piston is linked to the brake lever. When the brake lever is squeezed, the piston forces the brake fluid through the hose and pipe to the calipers.

Reservoir Tank

As wear on the brake pads increases, the amount of brake fluid must be increased to maintain proper hydraulic pressure. The reservoir tank supplies this brake fluid. (tank capacity is approximately 30cc). To prevent air from entering the brake line when the brake fluid level lowers, especially on a rough road or in an inclined position, a compensating diaphragm is provided for the reservoir tank.

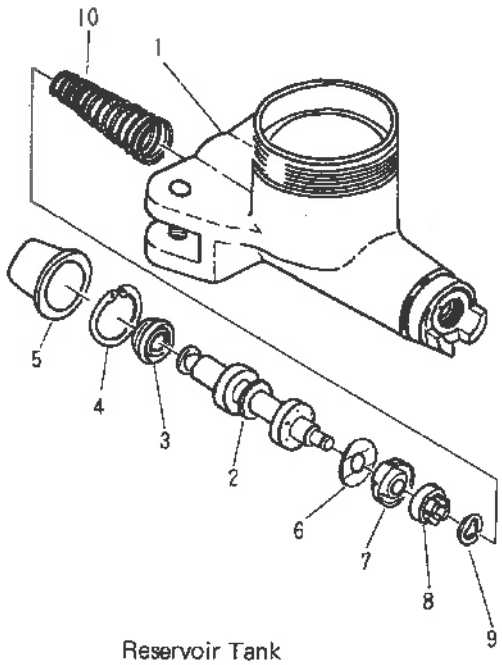






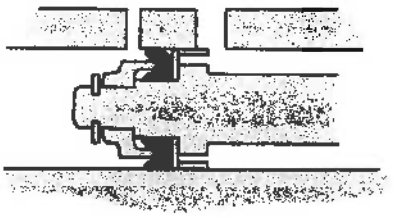
Piston

The master cylinder piston has two cups; one maintains good sealing between the cup and the cylinder wall of the master cylinder, and the other prevents the brake fluid from leaking out from the cylinder to the brake lever side. The return spring forces the brake lever to its home position, when the lever is released.



1. Body Master cylinder
2. Piston
3. Cup
4. Circlip
5. Dust boot
6. Spacer
7. Cup
8. Retainer
9. Clip
10. Spring

Reservoir Tank



When the brake lever in squeezed



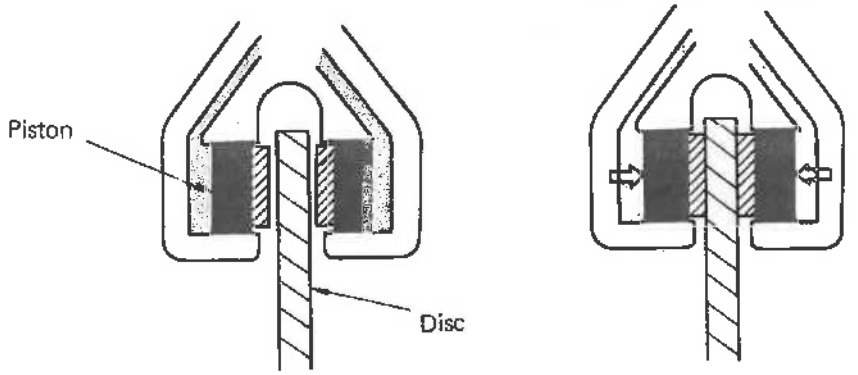
Brake hose and pipe

The brake hose and pipe carry hydraulic pressure to the calipers.
The brake hose is flexible and capable of withstanding a hydraulic pressure of 350 kg/cm² in conforming to SAEJ–1401.
The brake pipe is made of doubled steel tubing. For better corrosion resistance it is plated with zinc.

Calipers

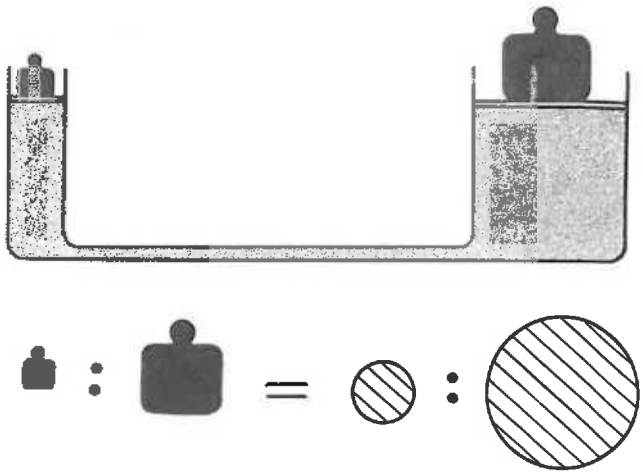
The hydraulic pressure carried to the calipers forces the caliper pistons out; by which action the pads are pushed out to grip the revolving disc.

When the brake is applied



Piston

The caliper pistons are forced against the brake pads by hydraulic pressure. The force created is about nine times the force applied to the master hydraulic cylinder piston. Combined with the mechanical advantage of the brake hand lever, the total force applied to the brake disc is approximately 36 times the force applied to the brake hand lever.

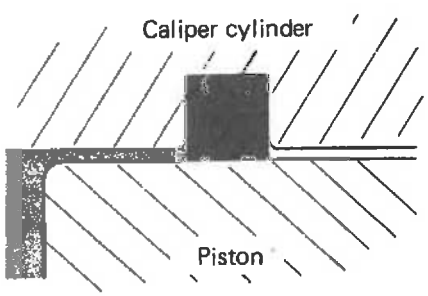


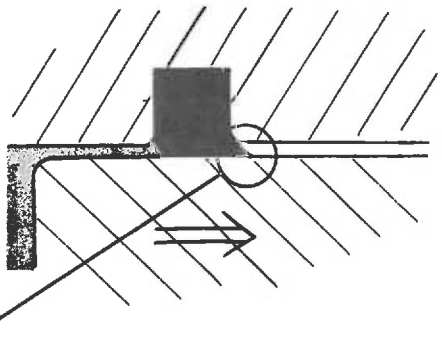
The applied force is proportional to the area ratio.

Seals

Each caliper cylinder has a piston seal (to maintain good sealing between the piston and the caliper cylinder wall) and a dust seal (to prevent dirt and water from entering the cylinder).

The piston seal is designed to move the piston back to its home position by making use of its tortional moment after the brake lever is released. The tortional moment is produced by the frictional force and elasticity of the piston seal. The piston seal also serves as an automatic adjuster of the clearance between the disc and the pad. (The clearance between the disc and the pad is normally 0.1 to 0.3 mm.)





The friction between piston seal and piston and elasticity of the seal cause the piston to return to its home position.

Pads

The pads are forced against the revolving disc by the caliper cylinder pistons to grip the disc. They are composed of resin mold asbestos.

Bleed Screw

Air in the hydraulic line impairs hydraulic action. To expel air out of the caliper cylinder, a bleed screw is provided on the caliper ass'y.

Disc

The stainless steel disk is held to the front wheel hub, and it is gripped by the pads located on each side of the disc.

Brake Fluid

The brake fluid is compressed in the master cylinder, and the hydraulic pressure thus produced is carried to the caliper cylinder pistons. In this sense, the brake fluid plays a very important role.
The brake fluid must meet the following requirements:

1. Proper viscosity and liquidity can be maintained at working temperatures.
2. Good stability is maintained. (That is, the fluid will not separate, change in viscosity, and/or precipitate.)
3. Boiling point is high. (No vapor lock will result.)
4. It will not deteriorate rubber.
5. Water resisting property is excellent.

Note that the disk brake fluid must be of genuine quality, because the fluid temperature tends to rise as compared with the drum brake.
Suggested brake fluid specifications: DOT 3 or 4.

NOTE: Do not mix brake fluids with different brand names. Some brake fluids are not compatible with others.

2. Disassembly

The tire and bearings can be disassembled without removing the brake disc. Do not attempt to remove the brake disc unnecessarily.
Tools and Parts required for Disassembly:

General service tools
Hexagon wrench, 5mm
Grip pliers
Air compressor
Rags
Torque wrench

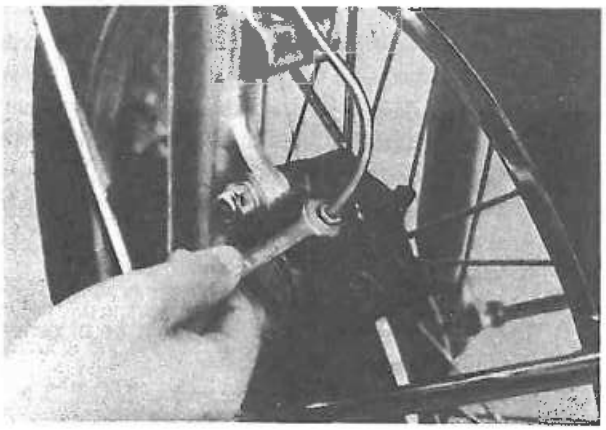
Caliper

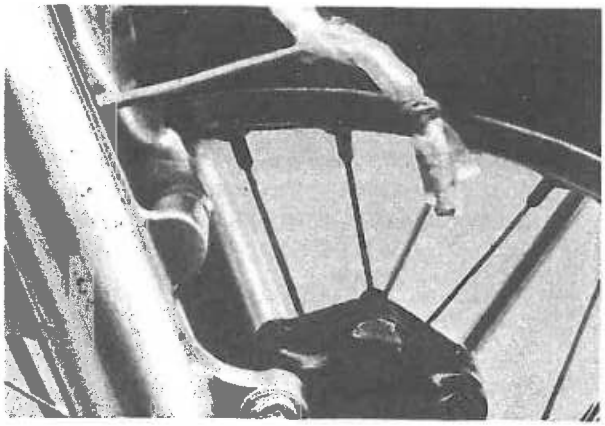
Removing the Caliper

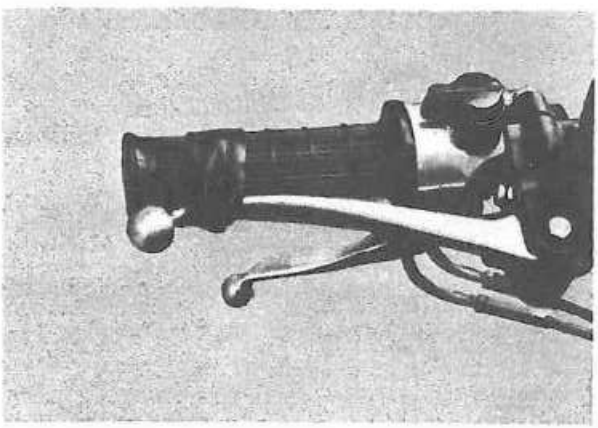
1. Remove the brake pipe from the caliper ass'y.
   Put the removed brake pipe in a clean vinyl bag so that it can be kept free from dust and dirt.

Note

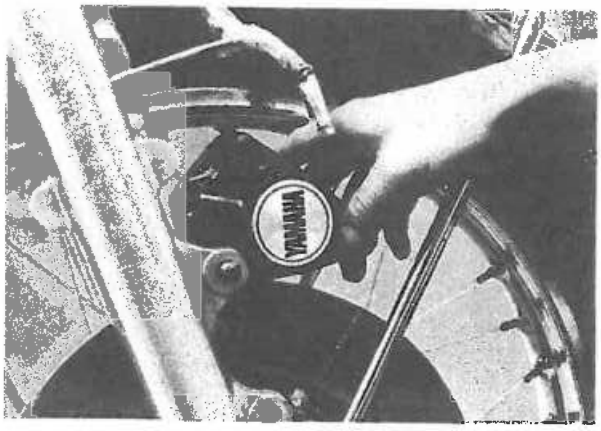
It is advisable to keep the brake lever squeezed, because this brake lever position prevents the fluid from leaking out of the reservoir. Place a heavy rubber band around the lever and handlebar grip.





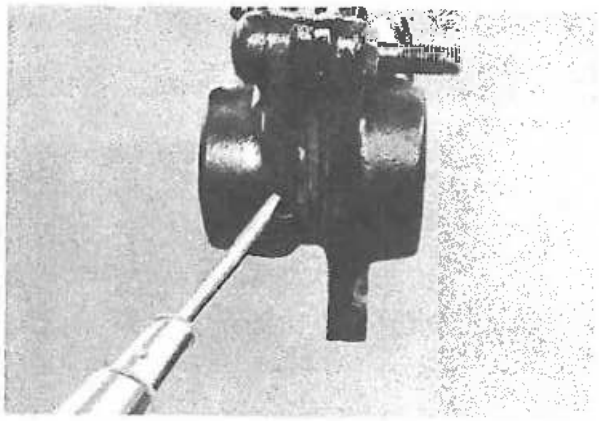


2. Remove the caliper mounting bolts and nuts.
3. Rotate the caliper ass'y upward, and remove it.



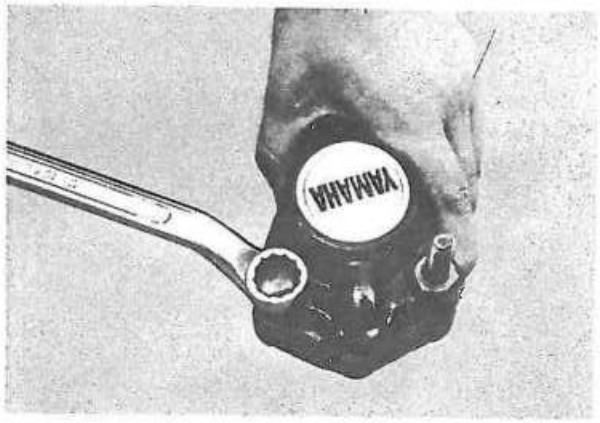
Removing the Pads

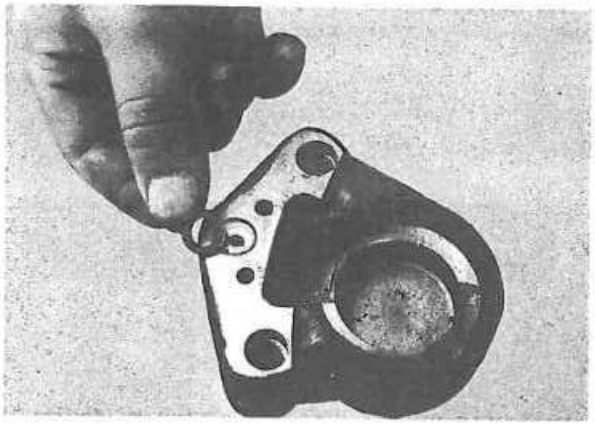
4. Remove the pads from their seats.



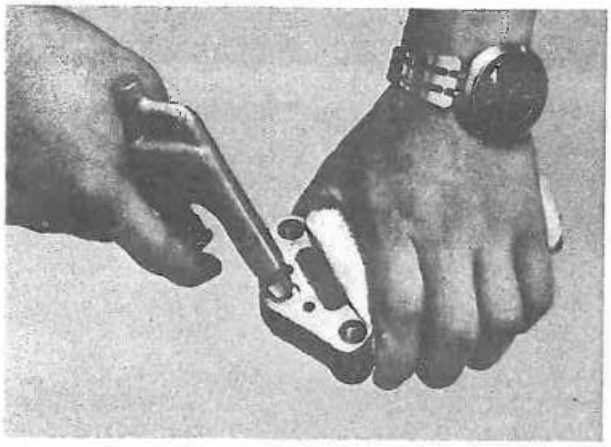
Removing the caliper Pistons and Seals:

5. Remove the two bridge bolts and two hexagon bolts.
6. Remove the caliper seal.





7. Force the piston from the caliper cylinder by feeding compressed air into the cylinder through the fluid inlet. Never attempt to push the pistons. with a screw driver.



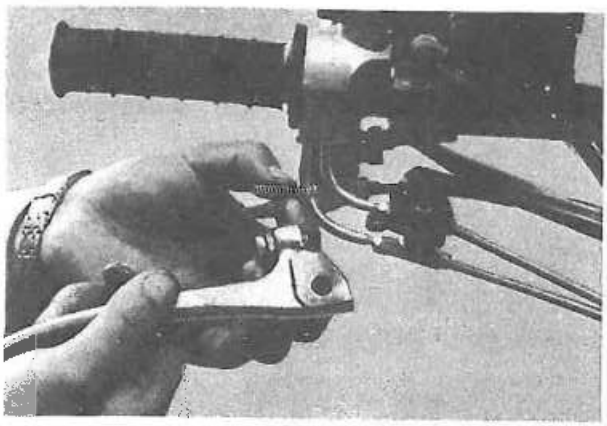
8. Remove the piston seal and dust seal from the caliper body.
   The foregoing applies to both pistons.

Note:
The removed parts should be kept free from gasoline, kerosene, engine oil, etc. If any oil attaches to a seal, it will swell up or deteriorate.

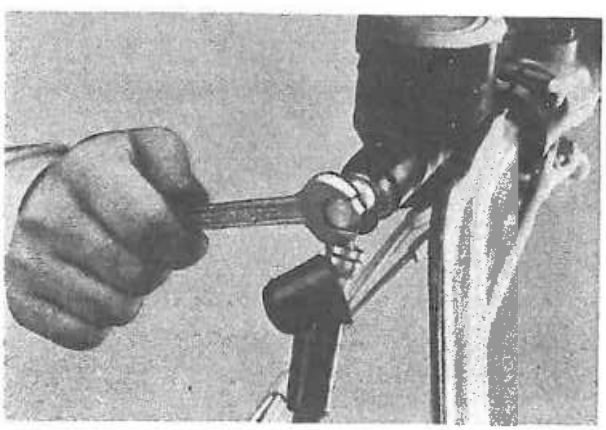


Master Cylinder

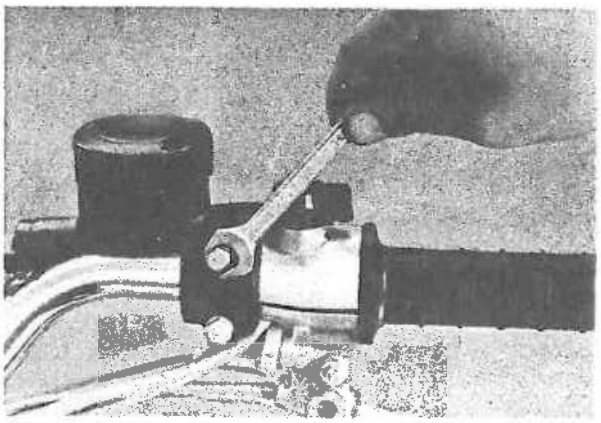
1. Remove the stop switch and brake lever.
   (Take care not to misplace the brake lever return spring.)



2. Remove the brake hose.



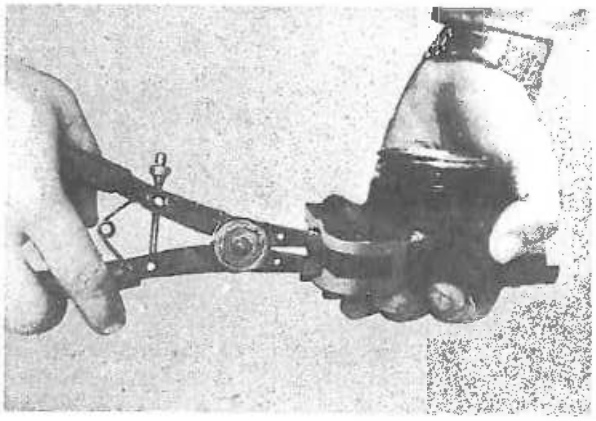
3. Remove the two master cylinder mounting bolts, and remove the master cylinder from the handlebar.
4. Remove the reservoir tank cap, and remove the diaphragm.
5. Drain the brake fluid from the reservoir tank.



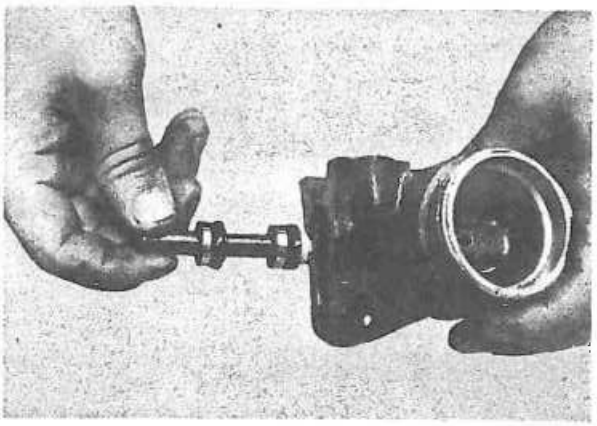
6. Remove the master cylinder boot.

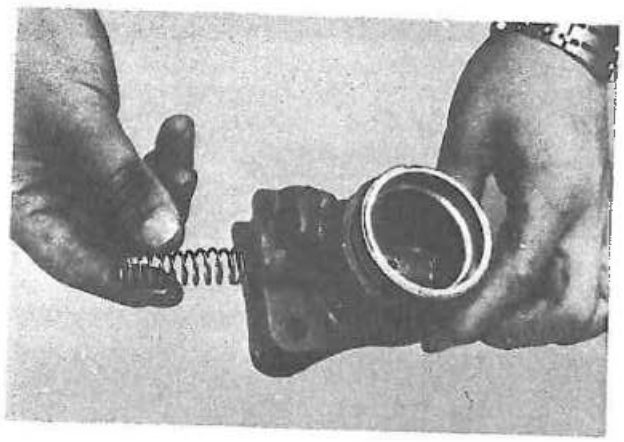


7. Remove the snap ring with clip pliers.

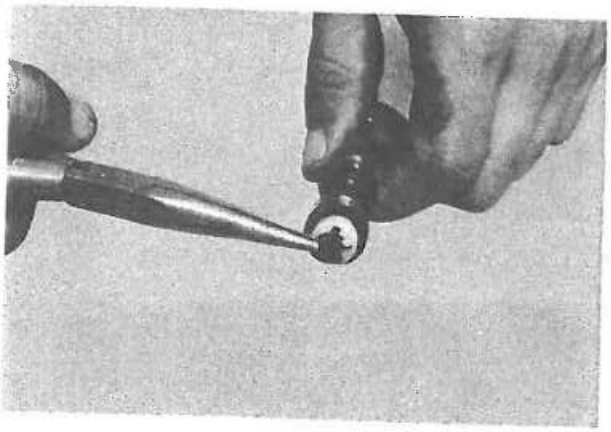


8. Remove the piston. (Note that a spring remains in the master cylinder.)

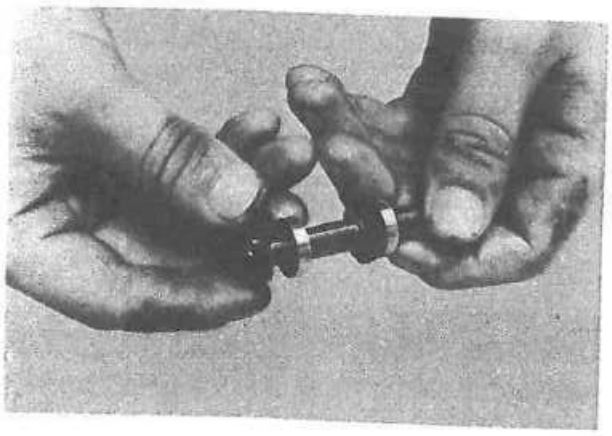




9. Remove the E clip, and remove the cylinder cup retainer.



10. Remove the cylinder cup.



3 . Inspection

Measuring Instruments required for Inspection

Dial gauge
Dial gauge adapter
Micrometer 0-25 mm
Vernier calipers 150mm

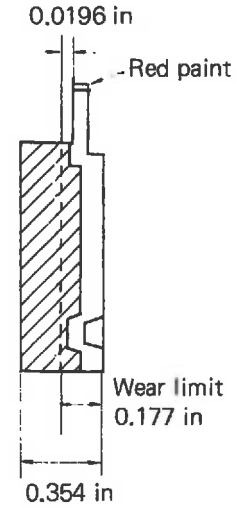
Pistons

Pistons

If any piston is found scratched or worn, replace it.

Pads

If any pad is found excessively worn, replace it.
Min allow pad thickness: 0.5 mm (0.0196'')



DISC PAD

Piston Seal and Dust Seal

If any seal is found damaged, replace it.
It is advisable to replace the seals every two years of use, whether they appear damaged or not.

Bridge Bolt

Replace the bridge bolts each time they are removed for disassembly, whether damaged or not.

Master Cylinder

Master Cylinder Body

1) If the master cylinder has any streak or grooved wear on its wall, replace it.
2) If the outlet end has any scratch or dent, replace it.
3) Check the compensating port for clogging.
4) Check for any foreign matter inside the cylinder and the reservoir tank.

Piston

1) If the piston has any streak or grooved wear, replace it.
2) If the piston has any rust, replace it.

Cylinder Cups

1) If any cylinder cup has a streak or grooved wear on its contacting surface, replace it.
2) If any cylinder cup is found to be swollen, replace it together with the other seal and rubber parts. Thoroughly wash all areas which are exposed to brake fluid in fresh, new, brake fluid.
3) Whether it shows wear or not, replace the cylinder cup every two years of use.

Reservoir Diaphragm and Master Cylinder Boot.

1) Check the flange and accordion pleats for damage, cracks and aging.
2) Check for swelling. (If swollen, take the same steps as in the case of the cylinder cup.)
3) Replace both every two years fo use, whether they are in good condition or net.

Conical Spring

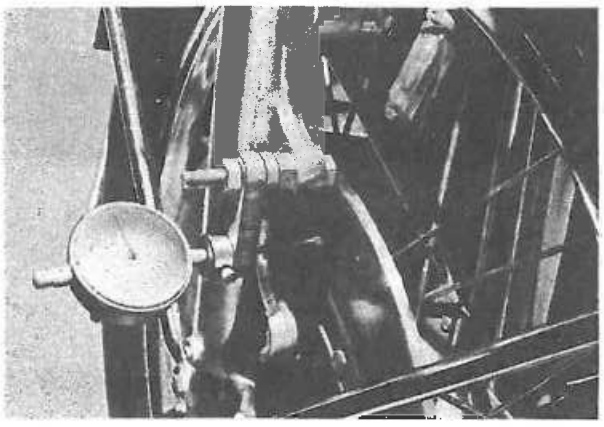
1) Check the spring for breakage and wear.

Brake Hose and Brake Pipe

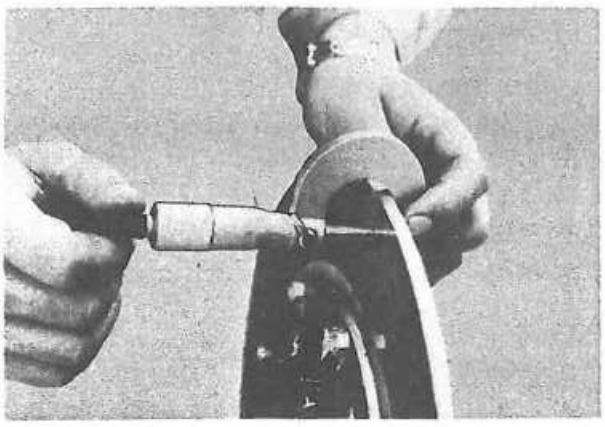
1) Check them for leakage and damage.
2) Replace the brake hose every four years of use, whether it appears to be in good condition or not.

Disc

1) Check the disc ass'y for run-out.
   If the disc shows a deflection of 0.15 mm or more, check the disk itself and the bearings.



2) If the disc has excessive wear or damage, replace it.
   Min allow disc thickness: 6.5mm



4. Assembly and Adjustment

Cleaning

All the removed parts should be washed in the following manner before they are installed.

1) A new brake fluid should be used as a cleaning detergent.
   (The use of any mineral oil should avoided, because it causes rubber parts to swell. The same can be said of alcohol. Any rubber dipped in alcohol will swell.)
2) If an oil of any other kind (such as mineral oil) is mixed in the system by mistake, the piston cups and seals should be replaced with new ones. All other parts should be washed with fresh, clean, new brake fluid. In addition, the lines, ports, passages, etc., should be thoroughly flushed with clean, new brake fluid.

Calipers

Piston Installation

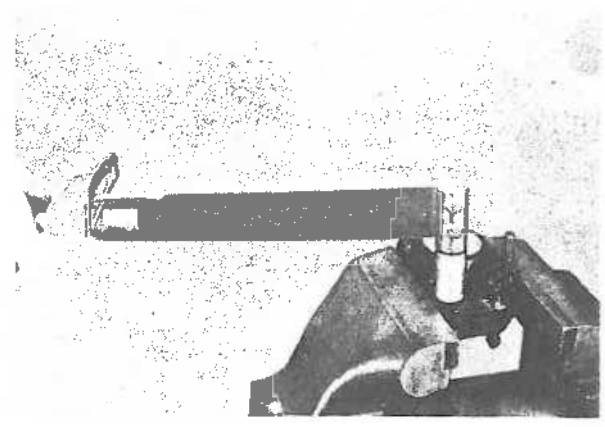
1) Install the piston seal and dust seal in their seats in the caliper cylinder.
2) Coat the caliper cylinder walls and piston with new brake fluid.
3) Insert the piston into the caliper cylinder with your hand.
   In inserting the piston, special care should be taken so that the piston goes into the cylinder smoothly.



Assembling the outer and inner calipers.

4) Install the caliper seal in their seat.

5) Put together the outer and inner calipers.
   (Make sure that no dust or dirt is attached to the mating surfaces.)
6) The two bridge bolts must be replaced with new ones. Tighten the two hexagon bolts. (The bridge bolts should be tightened later.)
   Tightening torque: 60~100 kg-cm



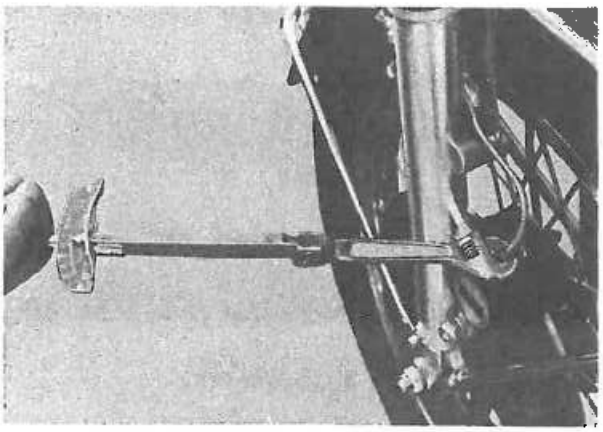
7) They are very important parts viewed from operational safety, and therefore, the removed bridge bolts should always be replaced. Be sure they are tightened with correct torque.
   Tightening torque: 750 - 950 kg-cm

Pad Installation

8) Install the pads in their seats.
9) When replacing the pads alone, it is necessary to push back the piston so that new pads can easily be installed. (When the piston is pushed back, and the compensating port is open, the brake fluid level in the reservoir tank will rise steeply. Loosen the bleed screw in necessary, and bleed off the excess brake fluid.

Installing the Calipers

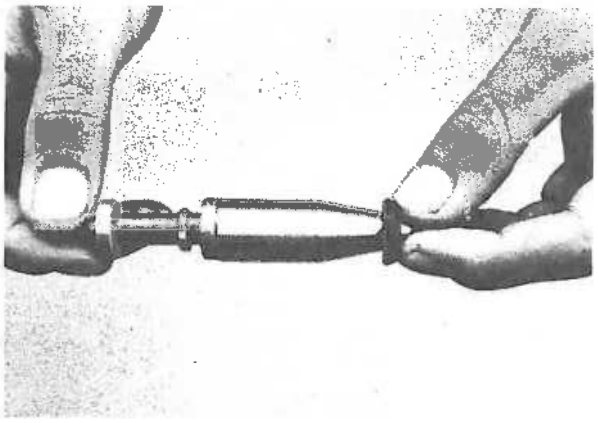
10) To install the calipers on the front fork, reverse the procedures for removal.
    Tightening torque: 400-500 kg-cm
11) Install the brake pipe.
    Tightening torque: 130-180 kg-cm

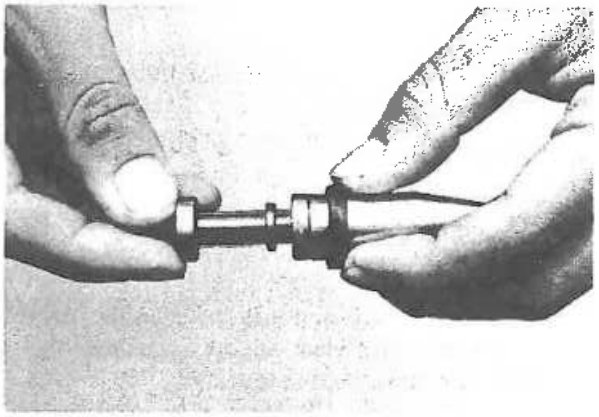


Master Cylinder

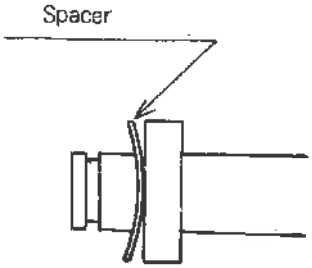
Installing the Cylinder Cup

1) Dip the cup in new brake fluid, and install it. Take care not to scratch the cup and the piston. (Use the jigs.)

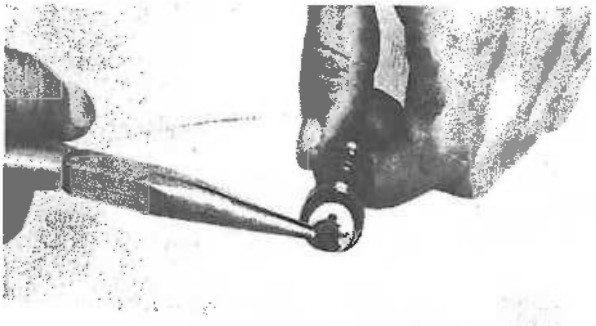




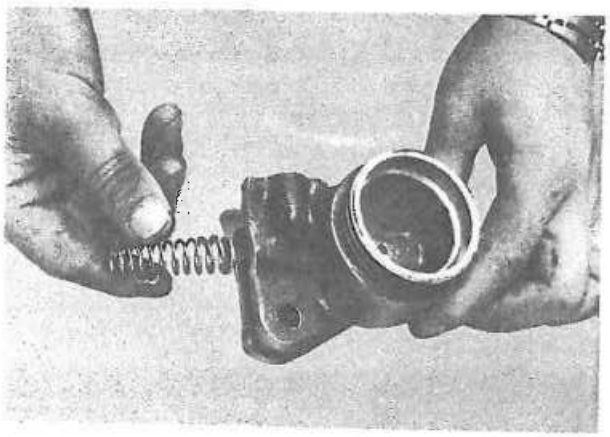
2) Install the spacer. Be sure that the spacer is positioned correctly.



3) Install the cup, retainer and E clip.



4) Insert the spring into the master cylinder body.



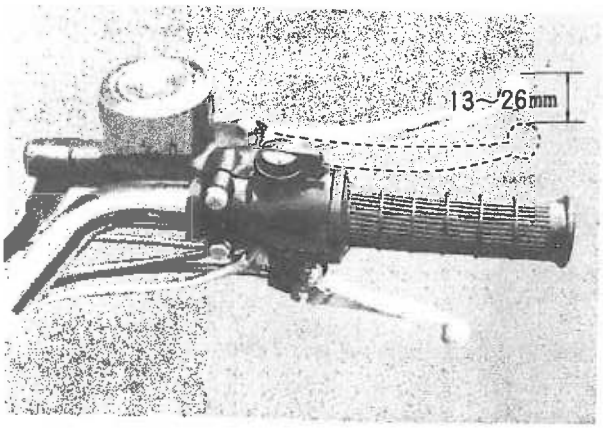
Installing the Piston

5) Check the piston surfaces and cup surfaces for scratches, and then, insert the piston into the cylinder.
   Avoid forcing the piston into the cylinder; otherwise, the cylinder wall will be scratched, thus allowing the brake fluid to leak past.
6) Install the snap ring.
7) Install the boot in the master cylinder groove and the piston groove, respectively.

Installing the master cylinder on the handlebar.

8) Install the master cylinder on the handlebar.
9) Adjust the clearance between the piston and the push rod.

Note:
Fully tighten the adjusting screw lock nut so that it will not become loose.



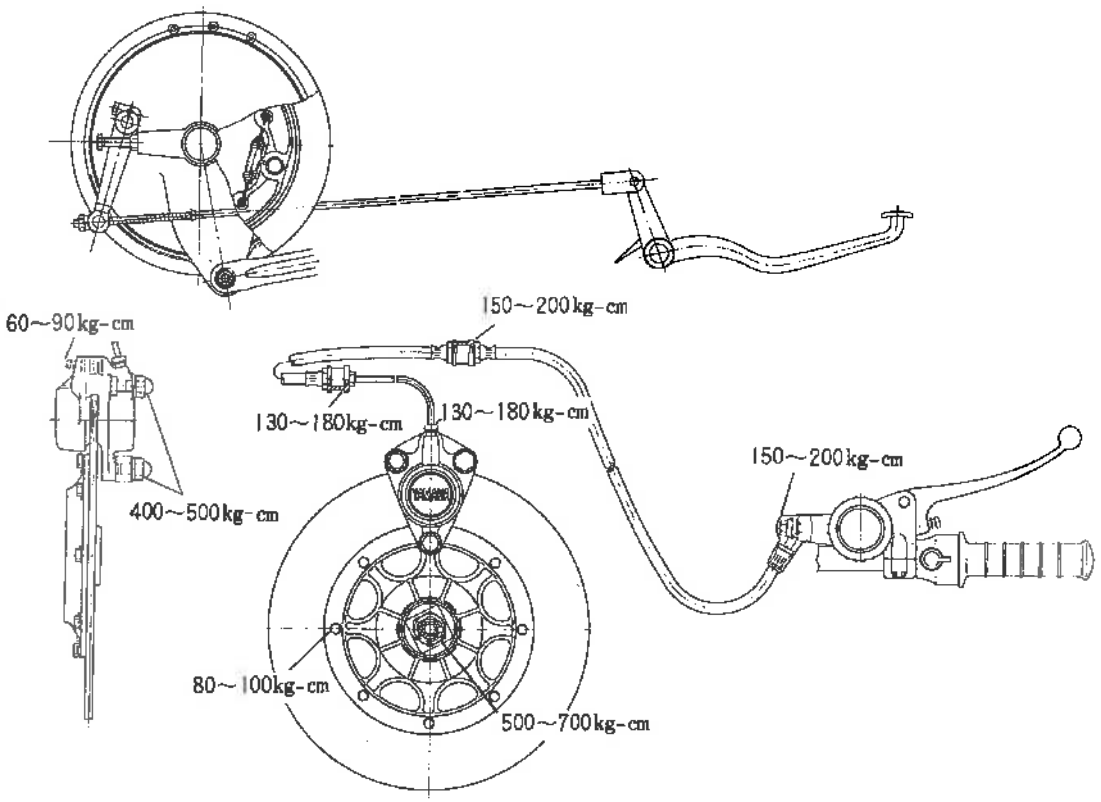
10) Fasten the brake hose to the master cylinder with the union bolt.

Note:
If the gasket is found scratched, it should be replaced.

11) Feed approximately 30cc brake fluid into the reservoir tank prior to bleeding.

Brake Hose and Brake Pipe

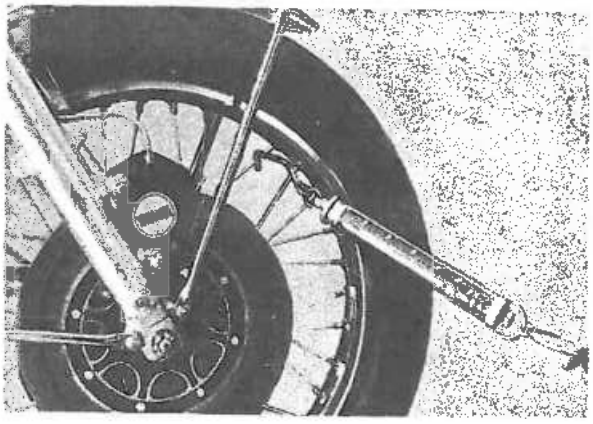
The brake hose and brake pipe fittings should be fastened with the following torque.



Disc

1) The disc mounting bolts should be tightened gradually and in pattern with correct torque. The lock tabs should be properly positioned and bent tightly over the bolt heads.
   Tightening torque: 80~100kg-cm
2) The deflection of the disc ass'y should be within the specified value. (0.15mm)
3) The disc trailing torque should be within the specified amount after it is assembled.
   Torque: 2~4 kg when assembled as shown in the figure on the right.
   If the value exceeds this limit, check the disc run out.

* On the disc brake, a slight drag can be neglected. A slight drag will not result in serious trouble, and will not develop into a worse condition.

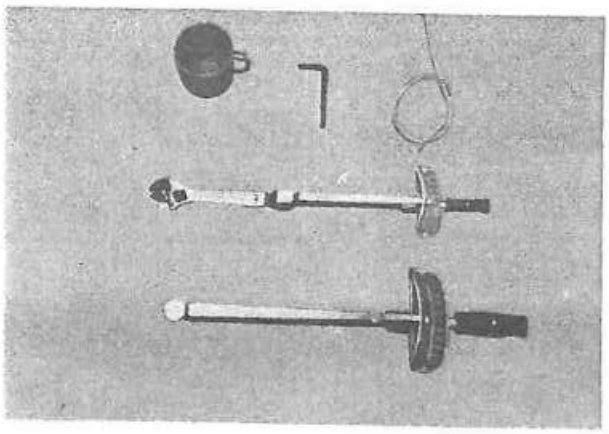


Air Bleeding

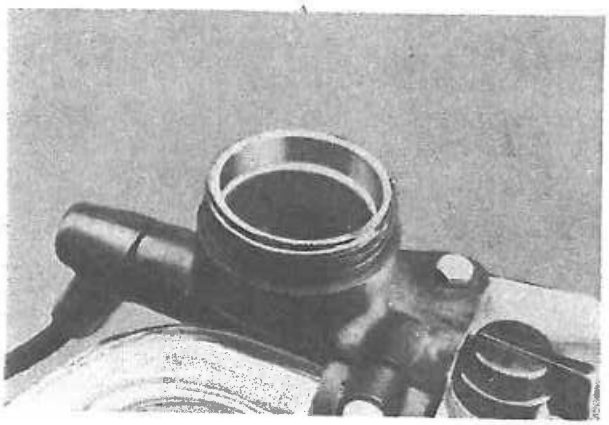
When any parts relating to the brake fluid are reinstalled, be sure that each metal fastener is fully tightened and then bleed the air.

Tools and Parts

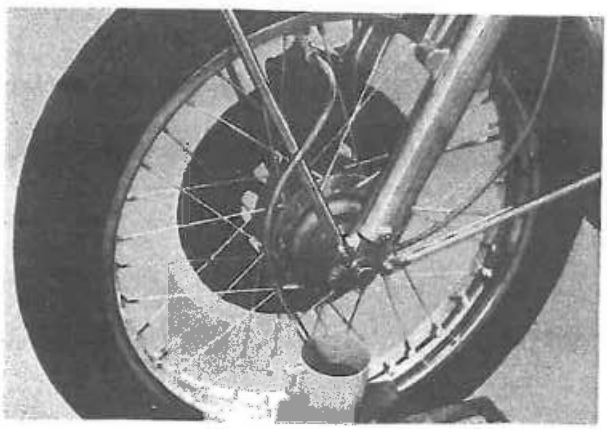
Wrench
Torque wrench
Vinyl tube Inside dia 4mm
Brake fluid (SAE grade#J1703B)
Brake fluid receiving vessel
Rags



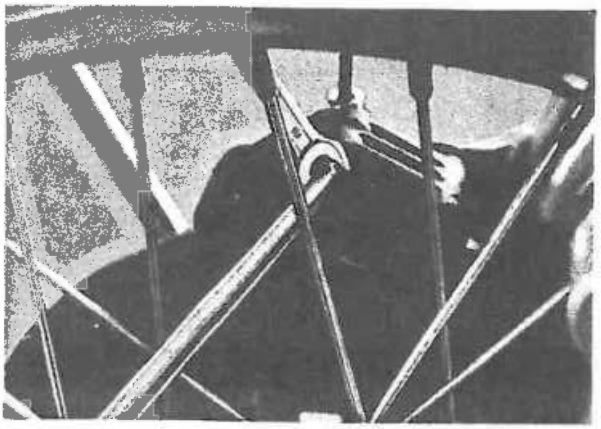
1) Fill with brake fluid so that the reservoir level reaches the specified line.
2) Install the diaphragm to prevent the brake fluid from escaping.



3) Connect the vinyl tube to the caliper bleed screw tightly so that no brake fluid will leak out.



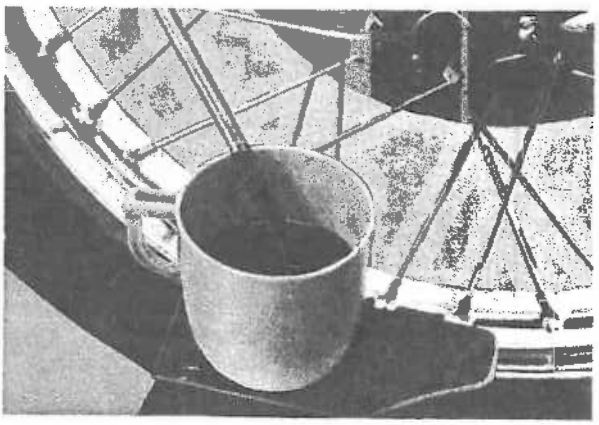
4) Place the brake fluid receiving vessel at the end of the vinyl tube.



5) Apply the brake lever slowly a few times. With the brake lever squeezed, loosen the bleed screw.
6. As fluid and air escape, the lever will close. Tighten the bleed screw before the lever bottoms on the handle bar grip.

Note:
When bleeding the air, do not operate the brake lever quickly. Otherwise, the air will turn into fine bubbles, thereby making the air bleeding difficult.

7) Repeat the procedures in 5) - 6) above until air bubbles will completely disappear in the vinyl tube.



Note:
Bleed screw tightening torque: 60-90 kg-cm

8) Refill with brake fluid so that the level will again reach the specified line.

9) The reservoir tank is of complete airtight design. When the pads become worn, the brake fluid level will lower, but the diaphragm will automatically adjust the brake fluid level by shifting its position. Therefore, when the reservoir tank is filled with the brake fluid, the diaphragm must be reset to its original position.

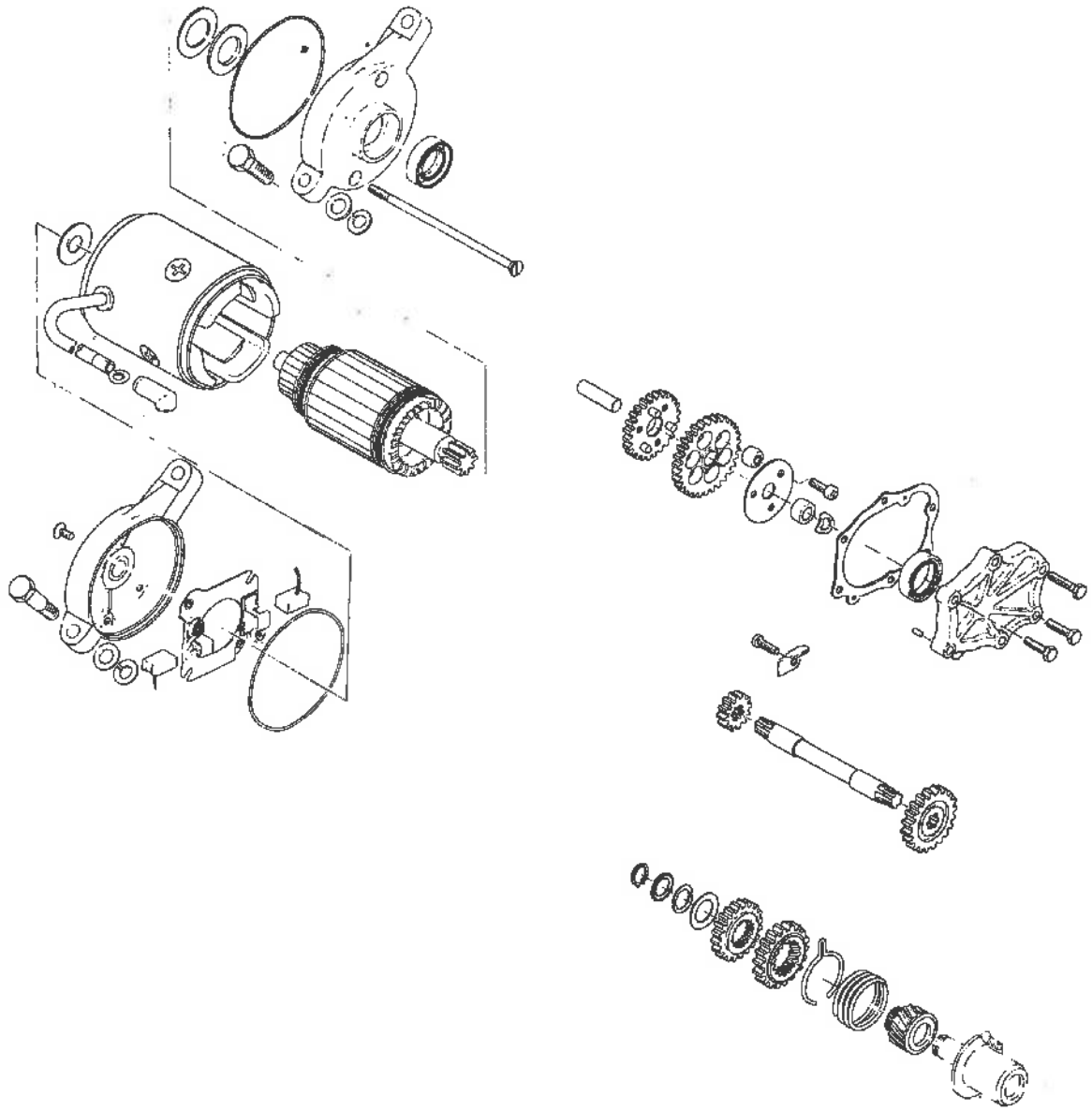




5. Specifications

1. Brake lever ratio	3.77
2. Caliper area ratio of master cylinder	9.15
3. Total lever ratio	34.5
4. Braking torque	3.45 F
(F denotes gripping force)	
5. At a reduced speed of 0.8 G	
a. Required braking torque	54.0 kg-m
b. Required gripping force	15.7 kg
c. Generated oil pressure	30.8 kg/cm^2
d. Pressure on lining surface	32.0 kg/cm^2
6. Dragging resistance of pad	13.5 kg-cm
7. Lining	
Material	Resin mold
Dimension	47.0ϕ x 5.3^t
Effective thickness	4.3^t
Wear coefficient	0.40
8. Brake hose	
Dimension	10.5ϕ x 3.1ϕ
Allowable compression	350 kg/cm^2 or more
9. Brake pipe	
Dimension	4.70ϕ x 0.7^t
Allowable compression	350 kg/cm^2
10. Disc	
Outside diameter	298ϕ
Effective friction radius	124.7
Thickness	7
Material	13-14 Cr stainless
Heat treatment	High frequency hardening
Master cylinder	
Inner diameter (bore)	15.875 ϕ
Stroke	16 mm
Reservoir capacity	31.5 cc
Material	LP cast AC2B
Type	Rockied type tightly sealed reservoir
Caliper	
Inner diameter	48.1
Material	FCD40
Type	Two opposing piston type
Others	Automatic clearance adjusting device for wear

ELECTRIC STARTER

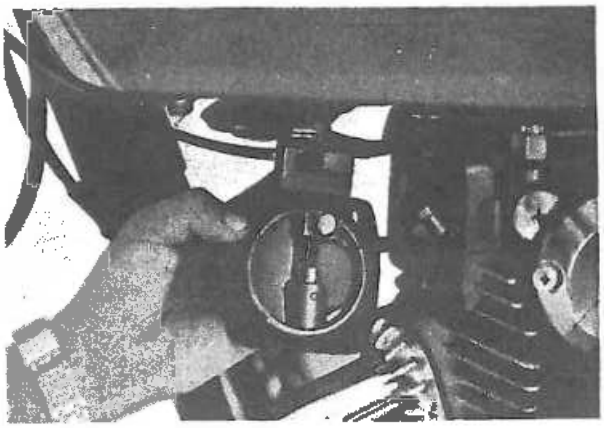


Construction

The starter motor is located under the crankcase.
An idler gear is attached to the shaft. Torque from the motor, during operation, is transmitted through the idler gear and the three reduction gears to the splined gear (gear 4). The gear works in the same manner as the splined kick gear, moving out to engage with the gear mounted on the outer half of the right half crankshaft. In this fashion, torque from the starter motor is transmitted to the crankshaft. As the engine starts, gear 4 is automatically disengaged from the crankshaft. The starter motor itself is a series-winding, 12 volt D.C. motor which draws 150 amps or less initially. A safety relay is incorporated within the starting circuit to automatically open the circuit when the engine fires. This provides for immediate disengagement of the starter motor gear train and, in addition, prevents the starter motor from over-revolving through a no-load condition as gear 4 disengages.

Operation

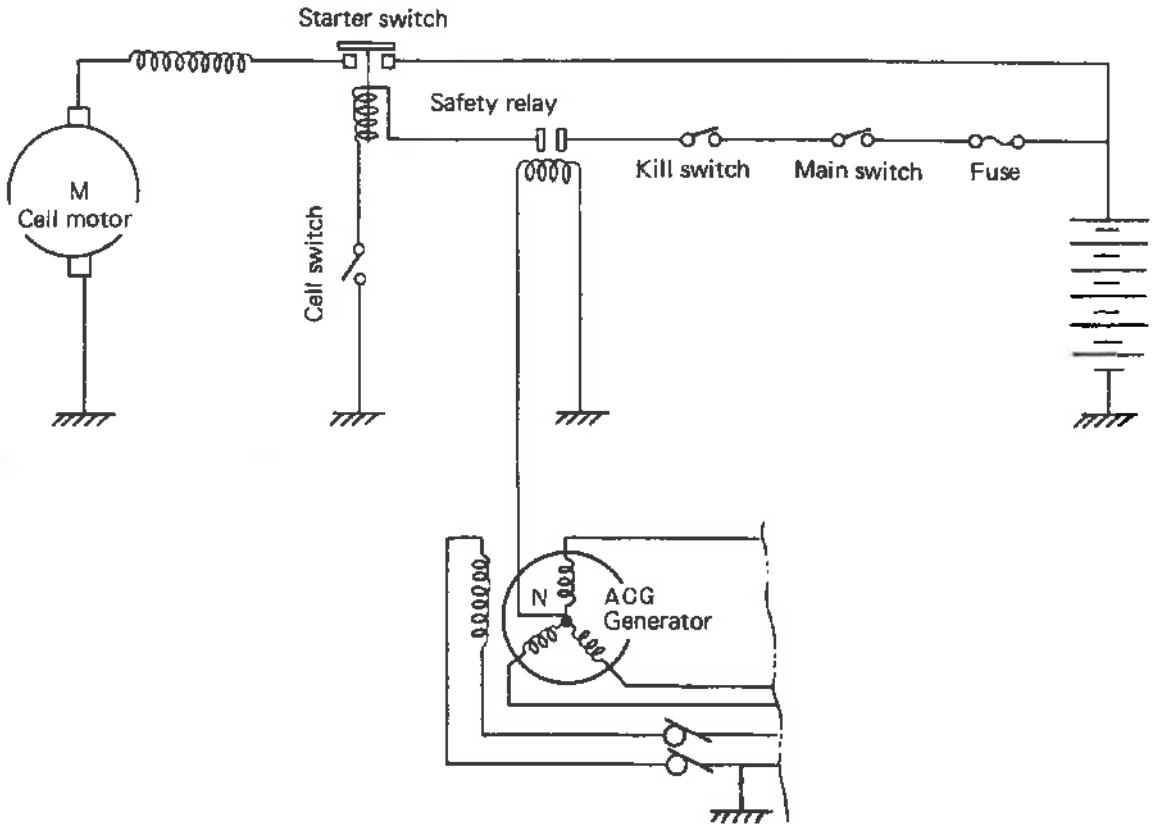
1) As the cell switch closes, current flow is created in the starter motor solenoid's windings and the solenoid closes.



2) When the solenoid (starting motor switch) closes, a direct circuit from the battery to ground through the motor circuit is created. Resistance is extremely low in this circuit and, consequently, a heavy current flow passes through the motor to ground, causing the motor to turn.

3) As the engine starts, the ACG begins to generate voltage. As voltage rises to 4V (±0.5V) the safety relay opens. This opens the circuit to the cell switch which in turn opens the circuit to the solenoid. With no current flow in the solenoid windings, the solenoid arm return spring opens the heavy duty circuit between the battery and starter motor. The starter motor stops turning and the splined engagement gear (gear 4) returns to the "rest" position.

4) Finally, the engine runs fully on both cylinders.



Specifications

NOTE: The following specifications should be referred to while disassembly and troubleshooting (explained in following chapters) is taking place.

COMPONENT	ITEM	MAINTENANCE STANDARDS	REMARKS
Motor			
FIELDS	Resistance	0.05 ohms (20°C)	
BRUSH	W x T x L	16 x 7 x 11 mm	
	Limit length	4.5 mm	
ARMATURE	Resistance	0.055 ohms (20°C)	No Grounded core
COMMUTATOR	Diameter	33 ϕ std	
	Wear limit	32 ϕ	
	Mica undercut	0.5~0.8 mm	
	Undercut limit	0.2 mm	
	Max. allow runout	±0.15 mm	Out of roundness
BRUSH SPRING		800 gr pressure std.	(+10%,-25%)
STARTER SWITCH	Yoke gap	———	(solenoid)
	core gap	1.5~1.88 mm	
	point gap	0.88~1.11 mm	
	magnet windings	3.5 ohms (20°c)	
	Cut in Voltage	6.5V	
	Cut out Voltage	4.0V	
	Coil circuit	4A Draw. (20°C)	
SAFETY SWITCH	Yoke gap	0.2 mm	
	Core gap	0.5~0.6 mm	
	Point gap	0 mm	
	Cut Out Voltage	2.5 V or less	
MISCELLANEOUS ELECTRICAL			
STARTER MOTOR DRAW:		35 A 12 V (20°C)	No load
FEATURE STANDARDS:			
LOAD:		8.3V 100A 3800 r.p.m	
CONSTRAINT:		4V 300A or less	
NOMINAL ENGINE R.P.M :		300 r.p.m at 75A or less	
		(When the decompression lever is squeezed, at 20°C)	

Disassembly

Starter motor

1. Drain the engine oil.

2. Remove the four motor mounting bolts. (8 mm)

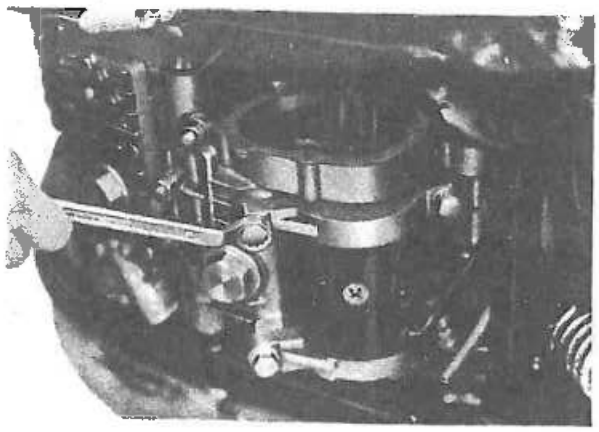
Note:

To ease removal, the machine should be placed on a lift or tilted towards the left.

3. Remove the motor. Pull straight back from its mounting location.

NOTE ON REASSEMBLY:

Make sure the gear shaft properly engages the reduction gear. Torque the 8 mm securing bolts evenly, in gradual stages, to a setting of 2.0 kg/m. Refill the sump with 2500 cc of SAE "SD" (MS) Motor oil.

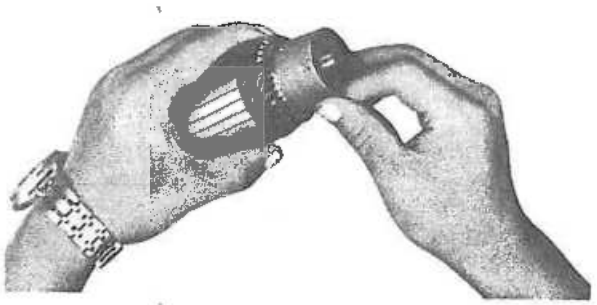


Servicing and troubleshooting

Armature

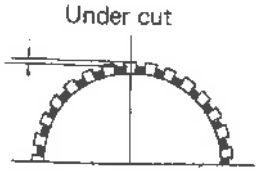
1. If the commutator surface is dirty, clean with #600 grit sandpaper as shown in the drawing at the right.

After sanding, wash thoroughly with electrical contact cleaner and dry with high-pressure air stream.



2. The mica insulation between commutator segments should be 0.5~0.8mm below the segment level.

If not, undercut to proper limits with appropriately shaped tool. (A hacksaw blade can be ground to fit).



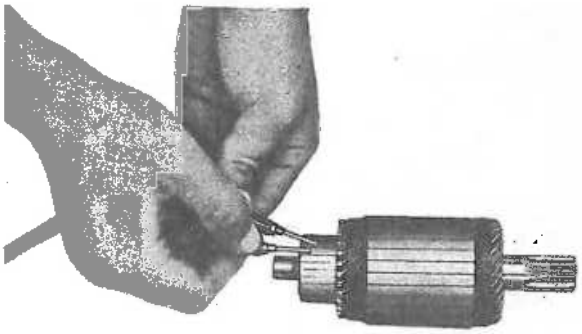
3. Each commutator segment should show zero ohms resistance to the others and at least three million ohms resistance to the core. If there is less than 2M ohms resistance to the core, or one of the segments is open, replace the armature.

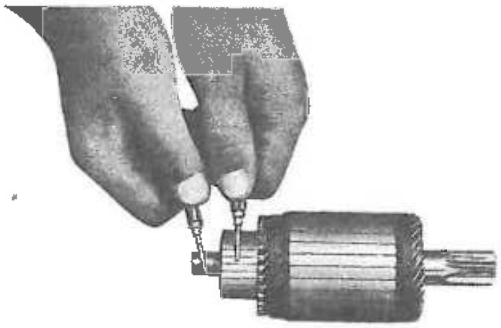
   In addition, the armature can be placed on a "growler" (testing device) and checked magnetically for internal shorts. Follow manufacturer's test recommendations.
4. If the armature shows signs of having been in contact with the yoke windings check the front and rear cover bearings.
   Replace as necessary.

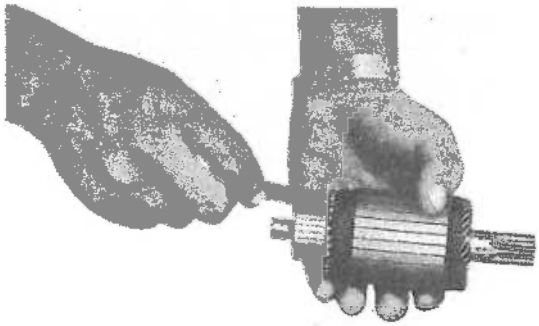
5. If the commutator surface shows heavy scoring it can be turned down on a lathe or commutator turning machine. Check the specification chart for minimum allowable commutator diameter. Recut the mica after.

NOTE:

Should turning be required, check the condition of the cover bearings, armature electrical properties, starter amperage draw and rpm and, finally, carbon brushes.







Carbon brushes

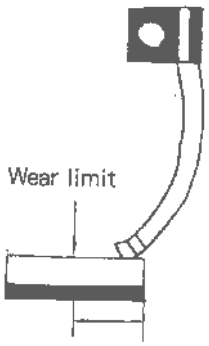
1. Check brush length and replace if at or near limits.

2. Check brush spring pressure. Replace if over/under specs.

NOTE:

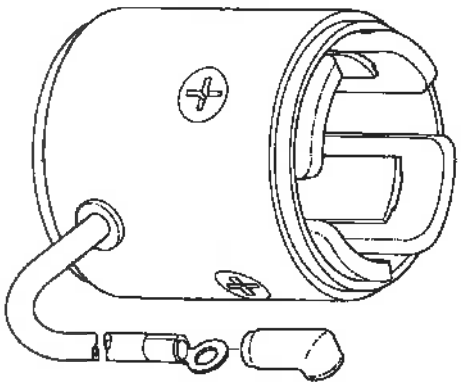
Spring pressure is measured with a nominal length brush installed. Lift until spring starts to lift off brush and note reading on scale. (Nominal: 800gr.)

3. Clean the brush holders thoroughly. Use clean solvent, a soft-bristled brush, and dry with high-pressure air stream.



Yoke

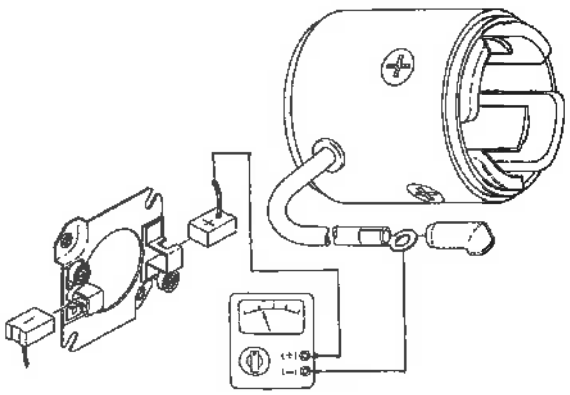
1. If the yoke area is dirty, clean with clean solvent and dry with high-pressure air.



2. Yoke coil resistance is 0.05 ohms.
   If coil resistance is more than 0.055 ohms or less than 0.045 ohms, replace it.

   If the yoke shows leakage to ground (resistance is less than 0.1 million ohms) replace it. (20°C)

NOTE:
Immediately after cleaning, the yoke may show some insulation leakage. Wait for it to thoroughly dry before checking or reinstalling.



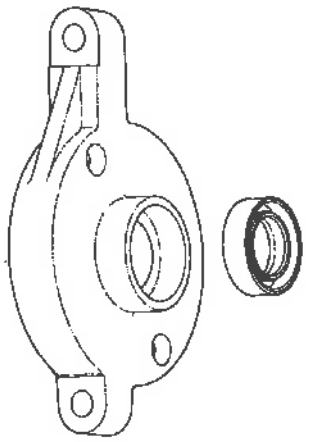
Covers

1. Check oil seals for hardening, cracking, worn lips. Replace as necessary.

NOTE:
During reassembly, pre-lube the lips of all seals with "white" grease. (lithium soap base grease)

2. Clean the bearings thoroughly, lightly oil each and check for hard spots during rotation, cracked or broken balls and/or races, etc.
   Replace as necessary.

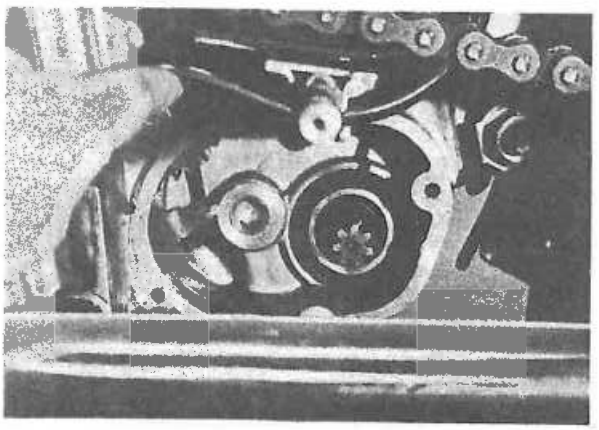
NOTE:
During reassembly, all non-sealed bearings should be given a light coating of 20W or 30W "SD" (MS) Motor oil.

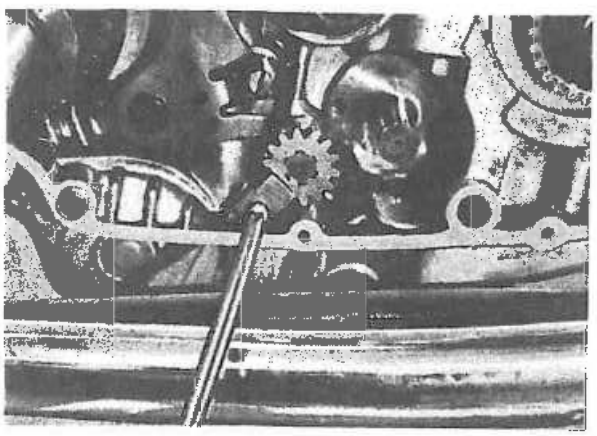


Starter reduction gears

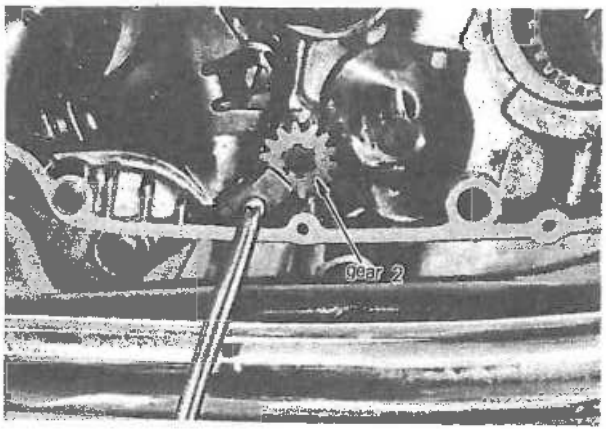
NOTE:
Additional disassembly details can be found in the Engine Section.

1. Drain the engine oil.
2. Remove the left crankcase cover.
3. Remove the gear train cover.
4. Remove the idler gear.
5. Remove the right crankcase cover.
6. Remove the clutch.
7. Remove the stopper plate mounting bolt and plate.

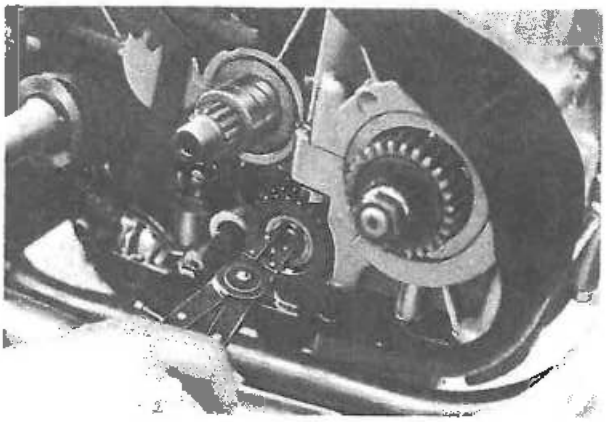




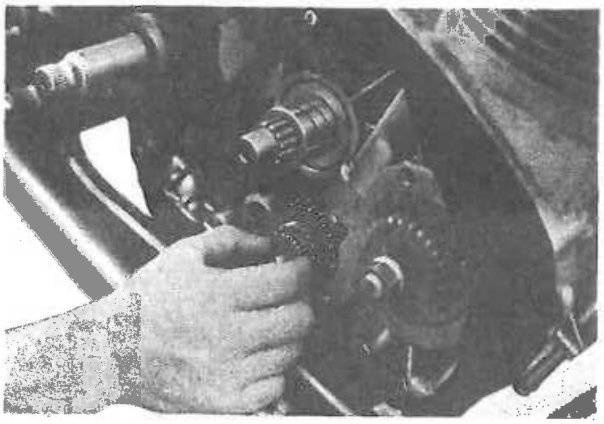
8. Remove the gear "2".



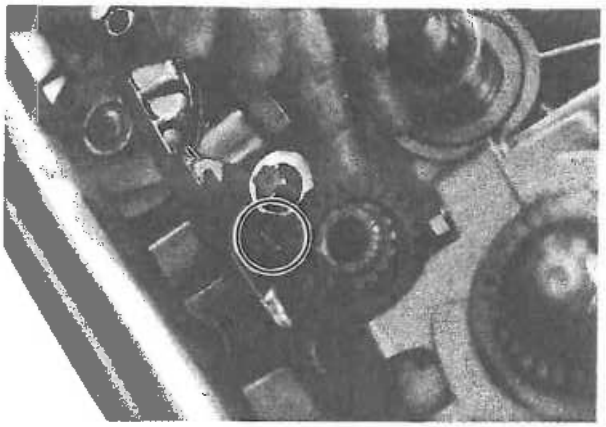
9. Remove the circlip.



10. Remove the gears "3" and "4". Remove the starter wheel.



Servicing and troubleshooting

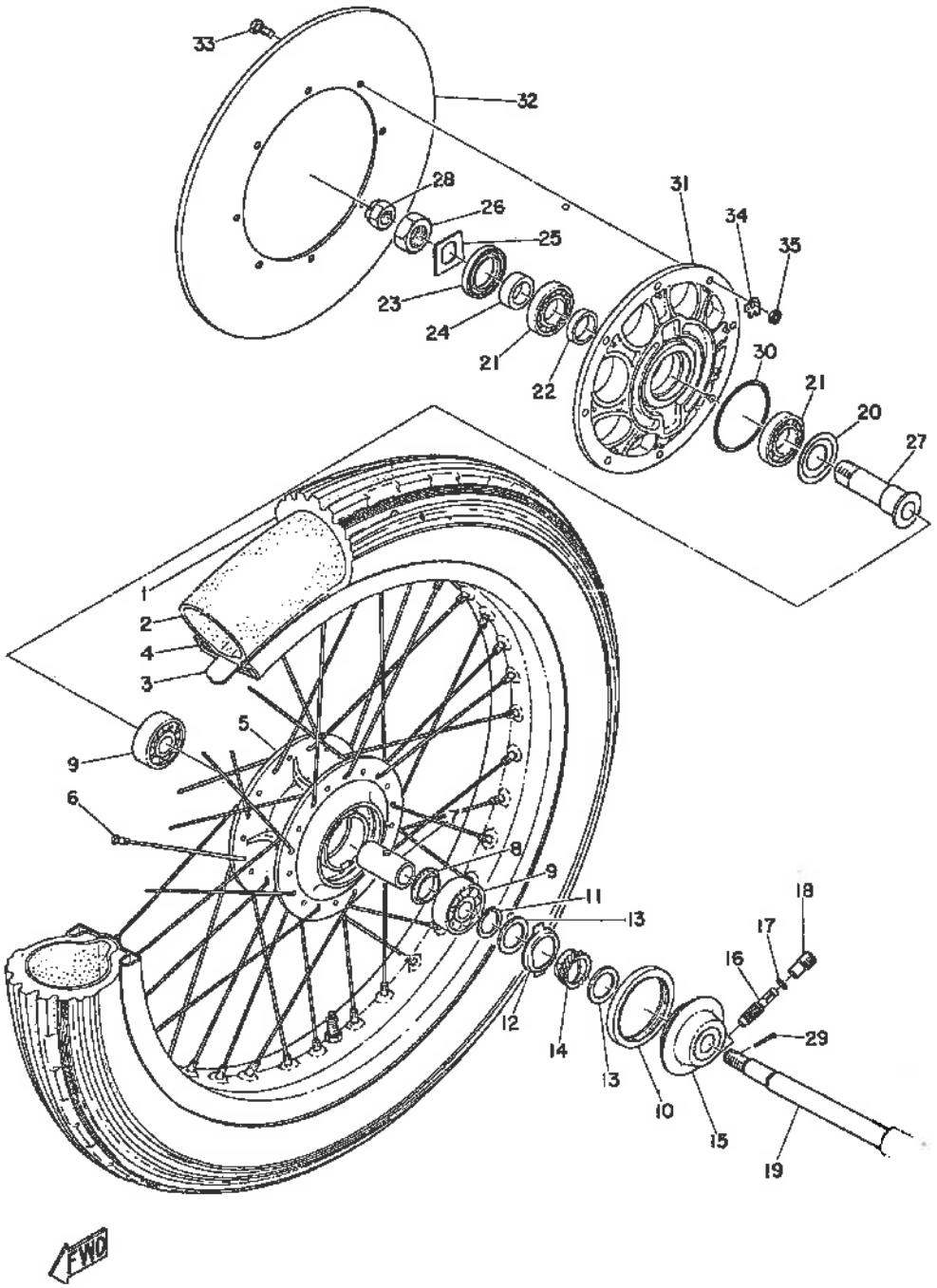


1. Gear "4" receives the most use. Check it thoroughly for signs of wear. Replace as necessary.
2. Check the return spring for fatigue. It should provide for positive return. Replace as necessary.
3. Check the remaining gears for chipped teeth, galling, etc. Replace as necessary.

NOTE ON REASSEMBLY:

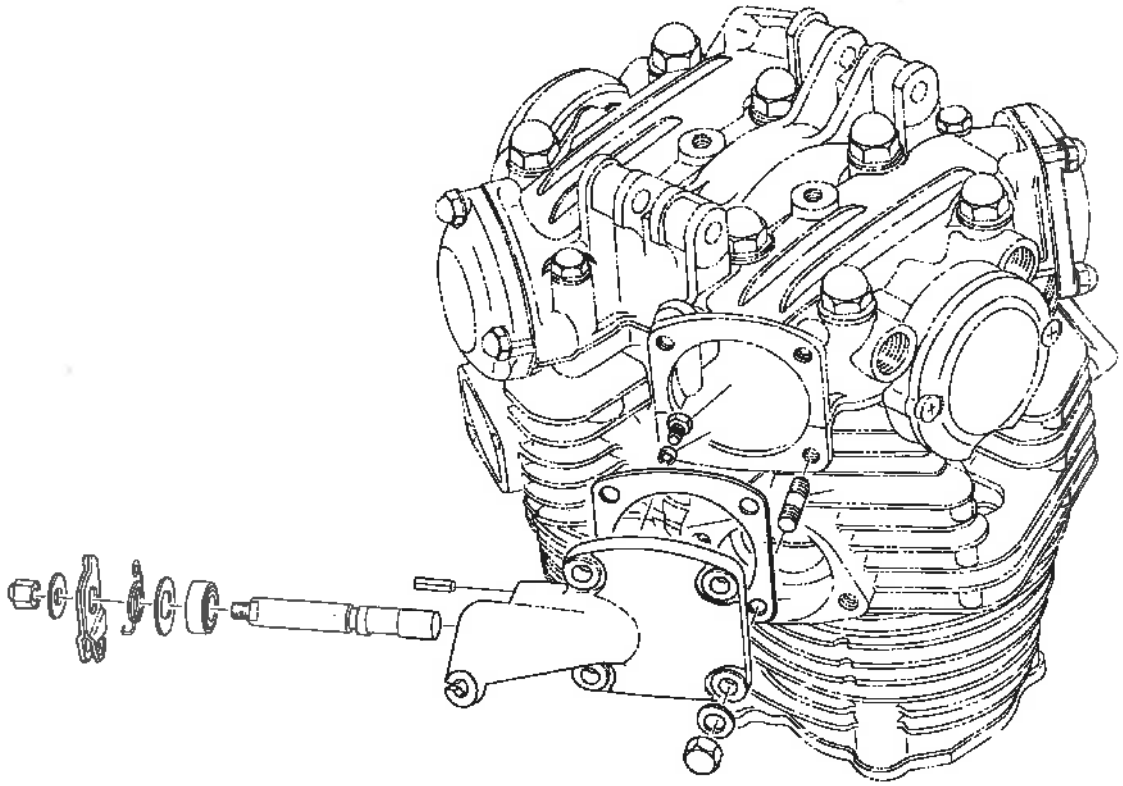
During reassembly, make sure the starter clip is firmly fitted in the crankcase groove.

FRONT WHEEL (XS2)



1	TIRE, front (3.50-19-4PR)	
2	TUBE (3.50-19)	.....
3	BAND, rim (3.50-19)	.....
4	RIM (1.85B-19)	.....
5	HUB, front	.....
6	SPOKE SET	.....
7	SPACER, bearing	.....
8	FLANGE, spacer	.....
9	BEARING (6303Z)	.....
10	OIL SEAL (SD-60-72-7)	...
11	CIRCLIP (S-25)	.....
12	CLUTCH, meter	.....
13	WASHER, thrust (25-32-1.6)	
14	GEAR, drive	.....
15	HOUSING, gear unit	.....
16	GEAR, meter	.....
17	WASHER (6.2-9.5-0.8)	....
18	BUSHING	.....
19	SHAFT, wheel	.....
20	COVER, dust	.....
21	BEARING (16005)	.....
22	SPACER, bearing (25-32-6)	.
23	OIL SEAL (DD-30-47-5)	....
24	COLLAR, shaft (22-30-10)	..
25	WASHER, special	
26	NUT, shaft	.....
27	SHAFT, disc	...
28	NUT, shaft	....
29	PIN, cotter	....
30	O-RING (3.0-56.2)	
31	BRACKET, disc	
32	DISC, brake	....
33	BOLT, fitting	..
34	WASHER, lock	
35	NUT	.....

CYLINDER HEAD



MODEL TX650

This supplement is for the exclusive parts for the TX650.

Please refer to XS2 and previous Parts Lists for parts not listed in this supplement.

Fig. 1 CYLINDER HEAD · CRANK · CRANKCASE

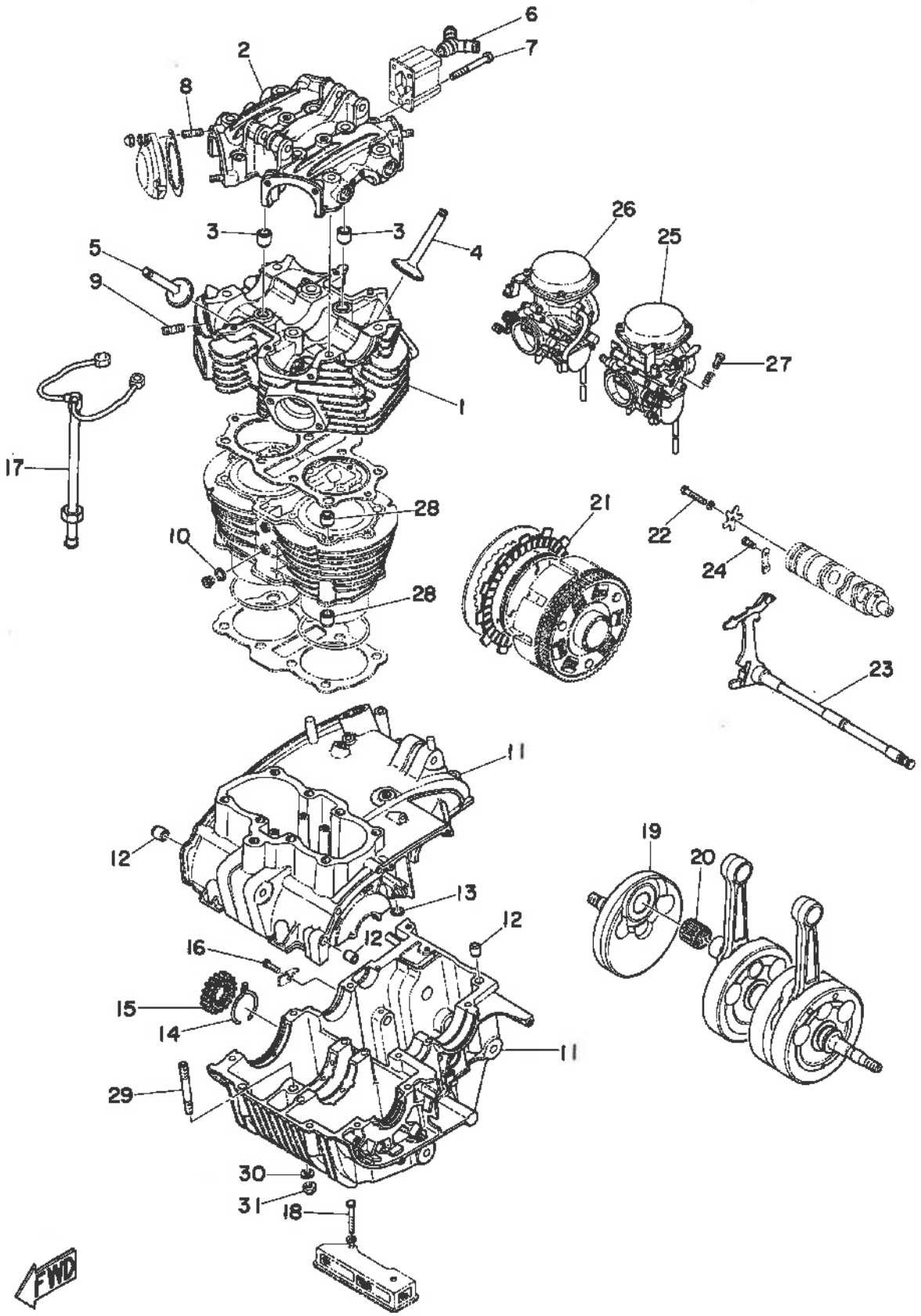


Fig. 3 FRONT FENDER · CALIPER · MASTER CYLINDER

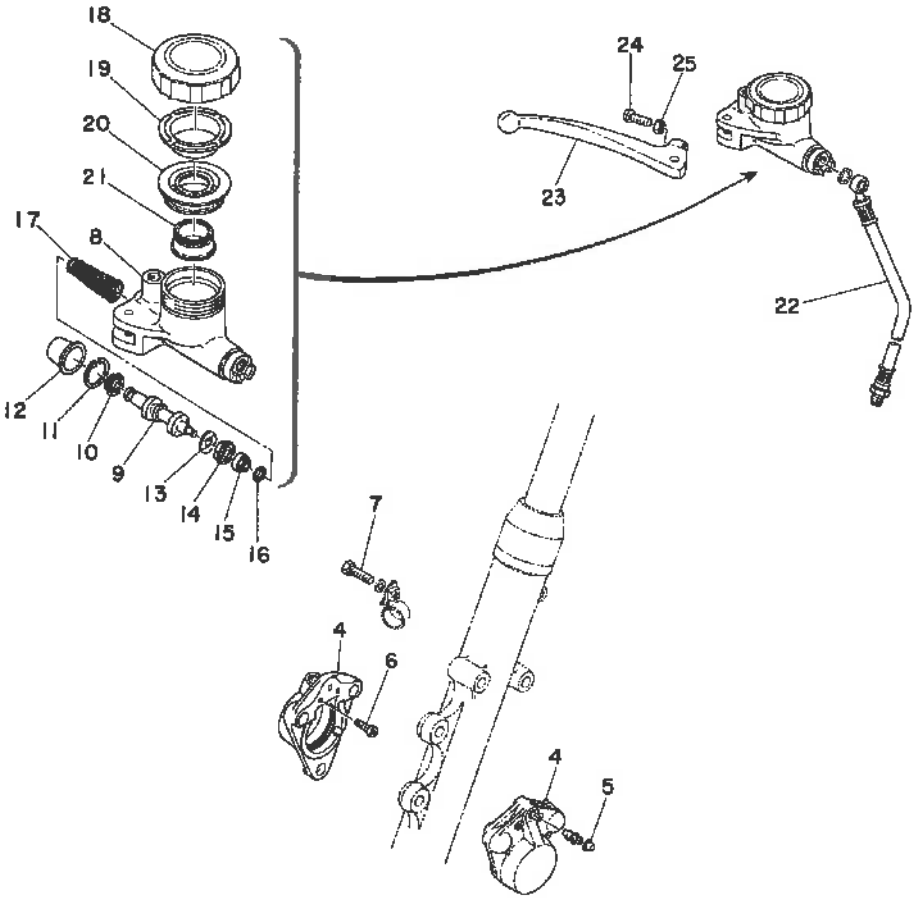


Fig. 4 FRONT FORK

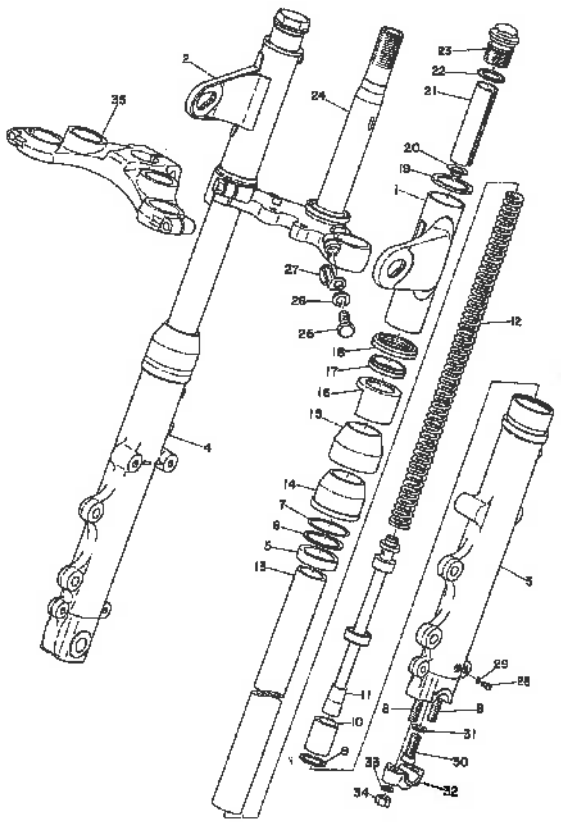
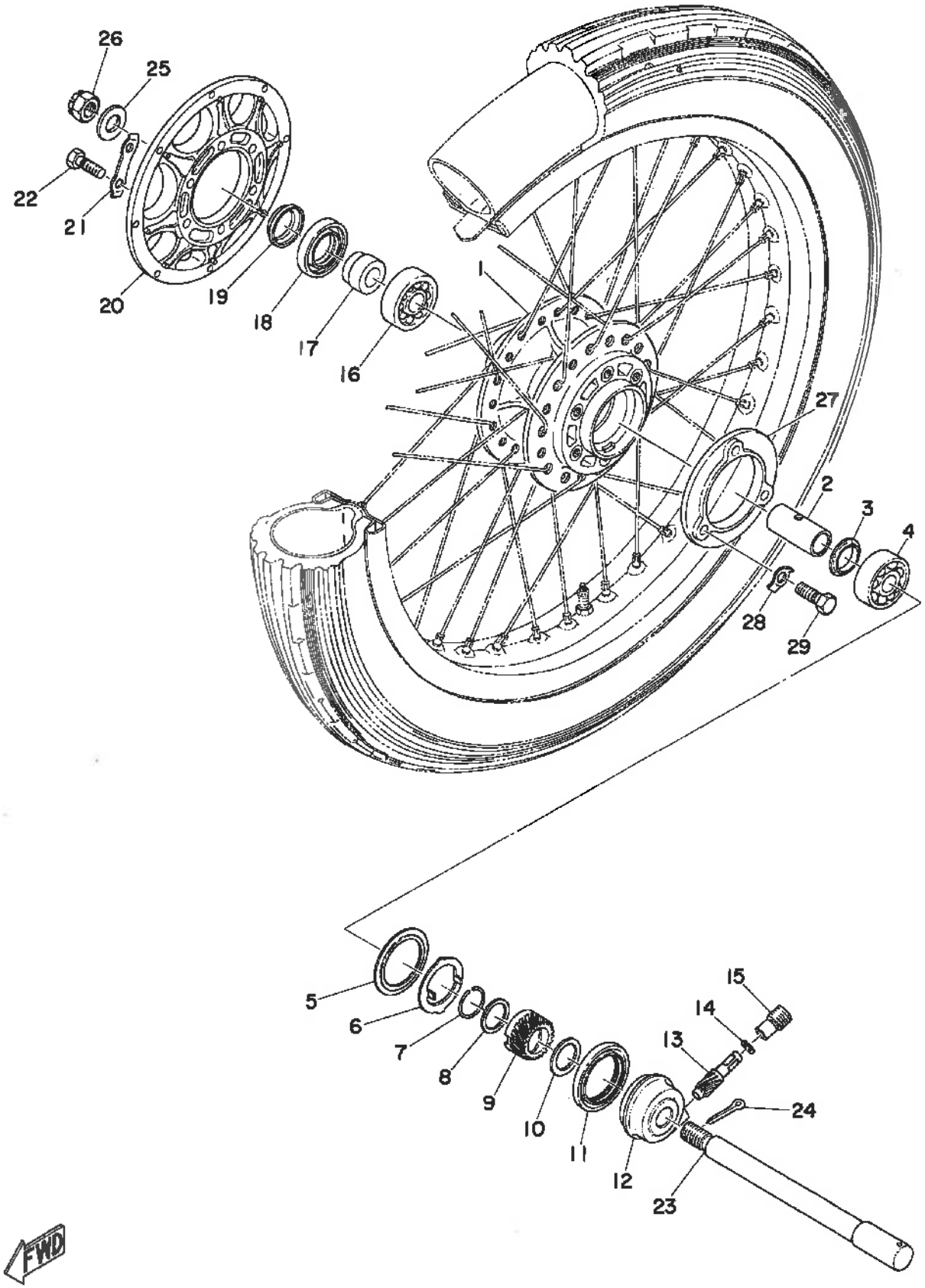
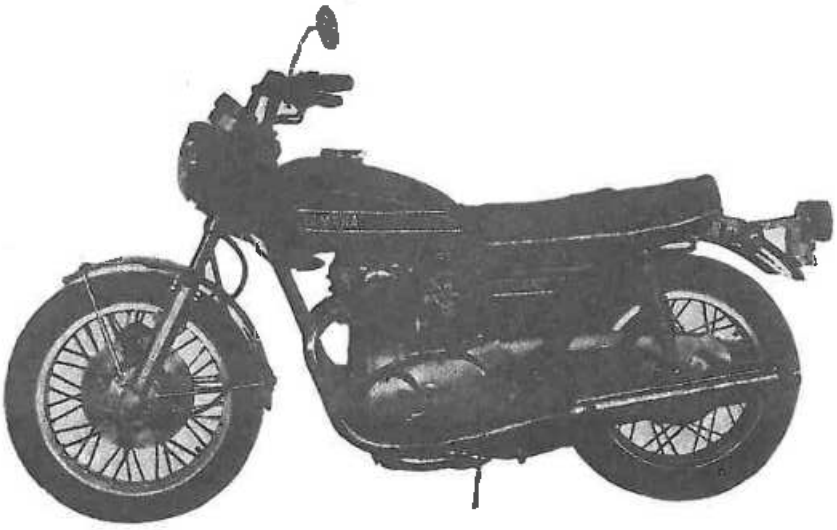


Fig. 5 FRONT WHEEL · DISC BRACKET



YAMAHA
SUPPLEMENTARY
SERVICE MANUAL
TX650A



FOREWORD

Yamaha's TX650A is an improved version of the TX650, thus certain specifications and data have been changed. For complete information on service procedure, it is necessary to use this Supplementary Service Manual together with the XS1B, XS2 and TX650 Service Manual. To help facilitate the use of this system, corresponding page numbers have been provided to refer the reader to the correct place in the XS1B, XS2 and TX650 Manual.

(Page 1) GENERAL SPECIFICATIONS

General Specifications have been changed as follows:

Item		TX650A
Engine	Valve Clearance	Cold IN: 0.10 mm. (0.004 in.) EX: 0.15 mm. (0.006 in.) Warm IN: 0.15 mm. (0.006 in.) EX: 0.20 mm. (0.008 in.)
Carburetor	Main Jet Needle Jet Pilot Fuel Jet	#127.5 4N8-4th stage #45
Battery	Model Manufacturer Capacity Dimension	YB14L YUASA 12V. 14 AH. 5.27 x 3.50 x 6.53 ins. (134 mm. x 89 mm. x 166 mm.)
Chassis	Fuel Tank Capacity	3.96 U.S. gals. (15.0 lits.)
Dimension	Wheelbase	56.5 ins. (1,435 mm.)

Recommended engine oil capacity	
Routine oil change:	2000cc (2.1 qt.)
Oil strainer cleaning:	2200cc (2.3 qt.)
Dry, overhauled engine:	2500cc (2.6 qt.)

(Page 22)

4) —c) Specifications have been changed as follows:

	Cam Lift (A)		Base Circle Diameter (B)	
	Standard Valve	Wear Limit	Standard Valve	Wear Limit
Intake	39.99 ± 0.05	39.75	32.19 ± 0.05	32.12
Exhaust	40.03 ± 0.05	39.79	32.24 ± 0.05	32.17

(All dimensions given in millimeters.)

(Page 27)

17) –a) Revision of Specifications

Valve spring specification chart has been changed as follows:

	OUTER	INNER
Diameter of wire	4.2 mm.	2.9 mm.
Direction of winding	Right Hand	Left Hand
Total winding	6.25	8.0
Free Length	42.55 mm.	42.0 mm.
Installed Length (Valve Closed)	37 mm	35.0 mm.
Installed Pressure	17.7±1.25 kgs. (39.02±2.75 lbs.)	10±0.7 kgs. (22.05±1.54 lbs.)
*Compressed Length (Valve Open)	27.5 mm.	25.5 mm
Compressed Pressure	57.5±4.0 kgs. (126.78±8.82 lbs.)	27.2±1.9 kgs. (59.97±4.19 lbs.)
*Measured without collar. Tolerance: ± 3%		

(Page 32)

25) Chain Tensioner has been changed as follows:

25) Chain Tensioner

a) Remove the cap, lock nut and ajustor bolt.
The vibration damper attached to the crankcase can be removed after the cylinder is pulled out.

b) It is not necessary to remove the bolts from the chain tensioner holder. Should the holder be removed, use a new gasket with both faces coated with Yamaha Bond No. 4 when the holder is re-installed.

c) To adjust the chain, remove the cap and loosen the tensioner lock nut. Turn the adjustor in until the push rod is flush with the end of the adjustor. Tighten the lock nut and install the cover.

d) Check the chain tension every 2000 miles. (In case of a new chain, check after the initial 250 miles and after 500 miles.)

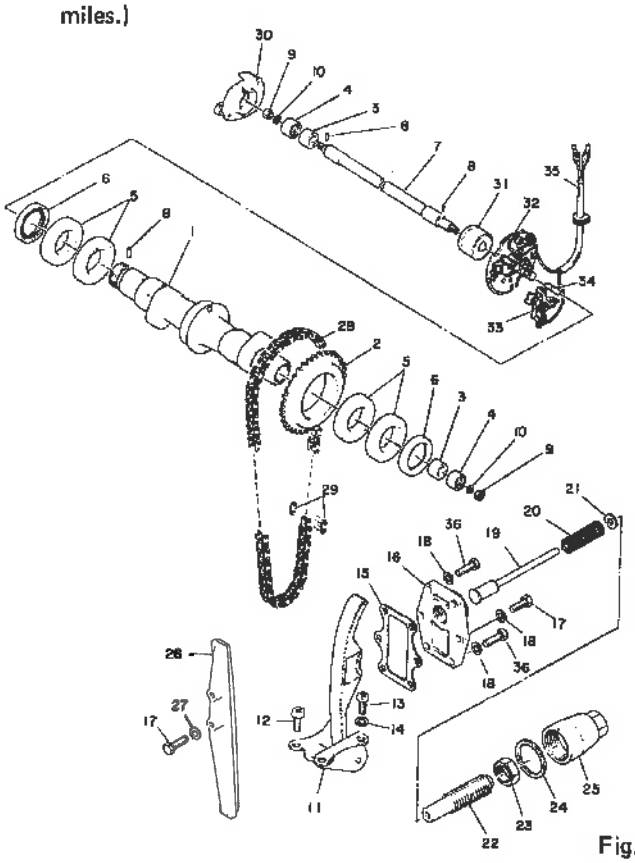


Fig. 1

1. Cam shaft
2. Sprocket
3. Breaker shaft bushing
4. Labyrinth seal
5. Bearing (16005 special)
6. Oil seal (S-25-40-6)
7. Breaker shaft
8. Dowel pin (3-7)
9. Nut
10. Spring washer
11. Stopper 2 guide
12. Reamer bolt
13. Pan head screw
14. Spring washer
15. Tensioner case gasket
16. Tensioner holder
17. Bolt
18. Plain washer
19. Rod
20. Spring
21. Damper
22. Bolt
23. Lock nut
24. O-ring (2.4-31.5)
25. Cap
26. Stopper 1 guide
27. Holder gasket
28. Chain (DK219FT 106L)
29. Chain joint
30. Governer assembly
31. Cam
32. Breaker plate assembly
33. Contact breaker
34. Lubricator
35. Lead wire 1
36. Bolt 2

(Page 48)

13) Clutch Installation

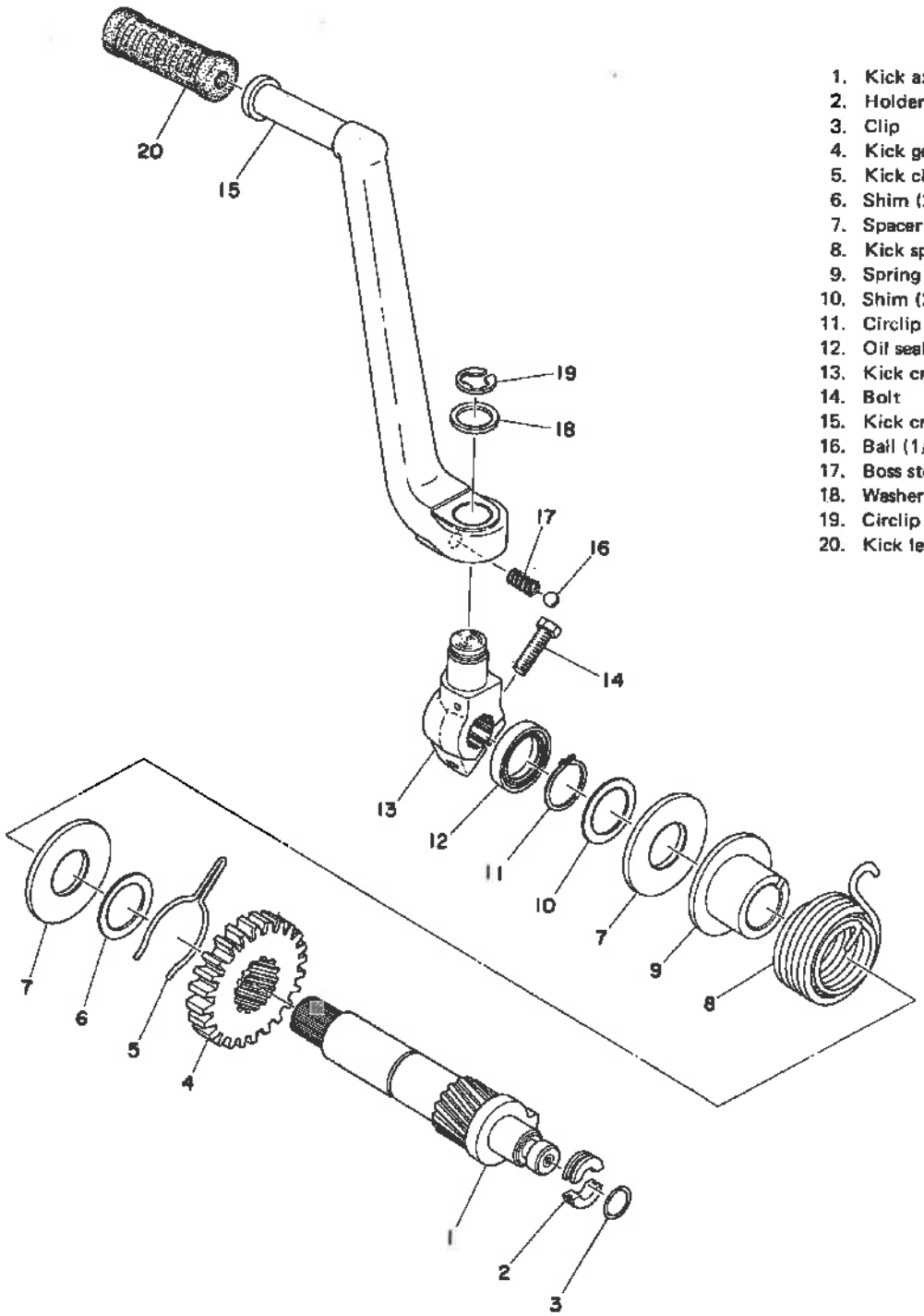
Item a) has been changed as follows:

a) Reverse the clutch removal sequence.
Tighten the clutch boss lock nut to 5 – 8 m-kgs. (36.17 – 57.82 ft-lbs.)

(Page 50)

17) Kick Starter Assembly

The illustration and construction of Kick Starter Assembly has been changed as follows:



1. Kick axle assembly
2. Holder
3. Clip
4. Kick gear (25T)
5. Kick clip
6. Shim (25.5-35-0.5)
7. Spacer (25.4-53-4)
8. Kick spring
9. Spring guide
10. Shim (25.2-36-1.0)
11. Circlip
12. Oil seal (SD-25-35-7)
13. Kick crank boss
14. Bolt
15. Kick crank
16. Ball (1/16 inch)
17. Boss stopper spring
18. Washer
19. Circlip
20. Kick lever cover

Fig. 2

(Page 78)

c) Air Filter

The description and illustration of Air Filter has been changed as follows:

1) Two air filters (foam rubber) are housed in separate metal cases located under the seat. Remove both mounting bolts and take both case caps off.

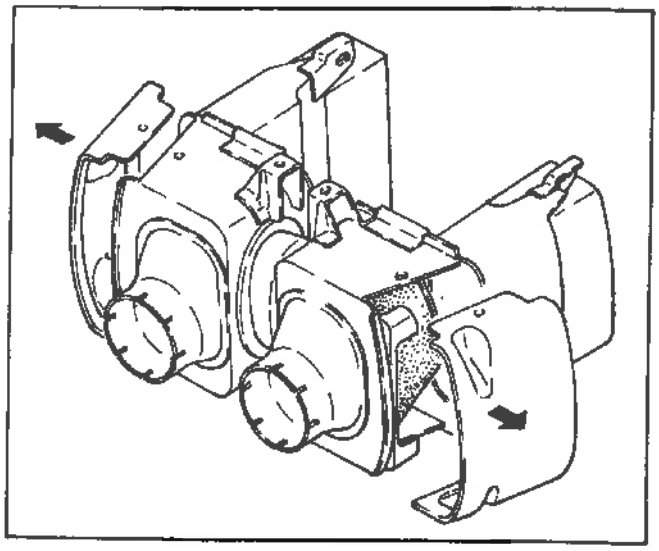


Fig. 3

2) This model is equipped with a washable oil impregnated foam rubber air filter.
It must be removed and cleaned at least once a month, more often if the motorcycle is ridden frequently in the dirt.
Wash the foam rubber filter thoroughly in solvent so that all dirt is removed.
Squeeze all the solvent out. Pour oil onto the filter (Motor oil 10W/30), work it completely in, and then squeeze out excess oil.

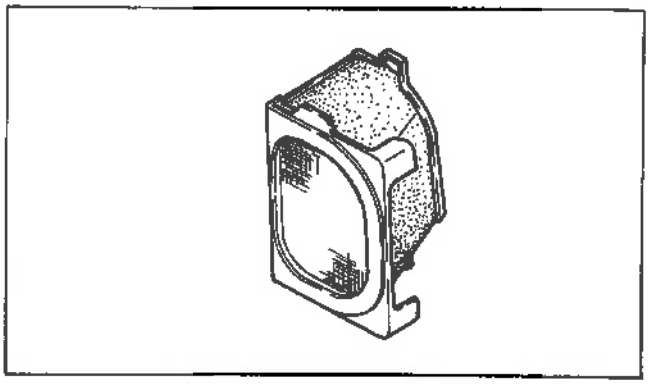


Fig. 4

(Page 80)

Front Forks (XS2, TX650)

Illustration and construction of Front Forks has been changed as follows:

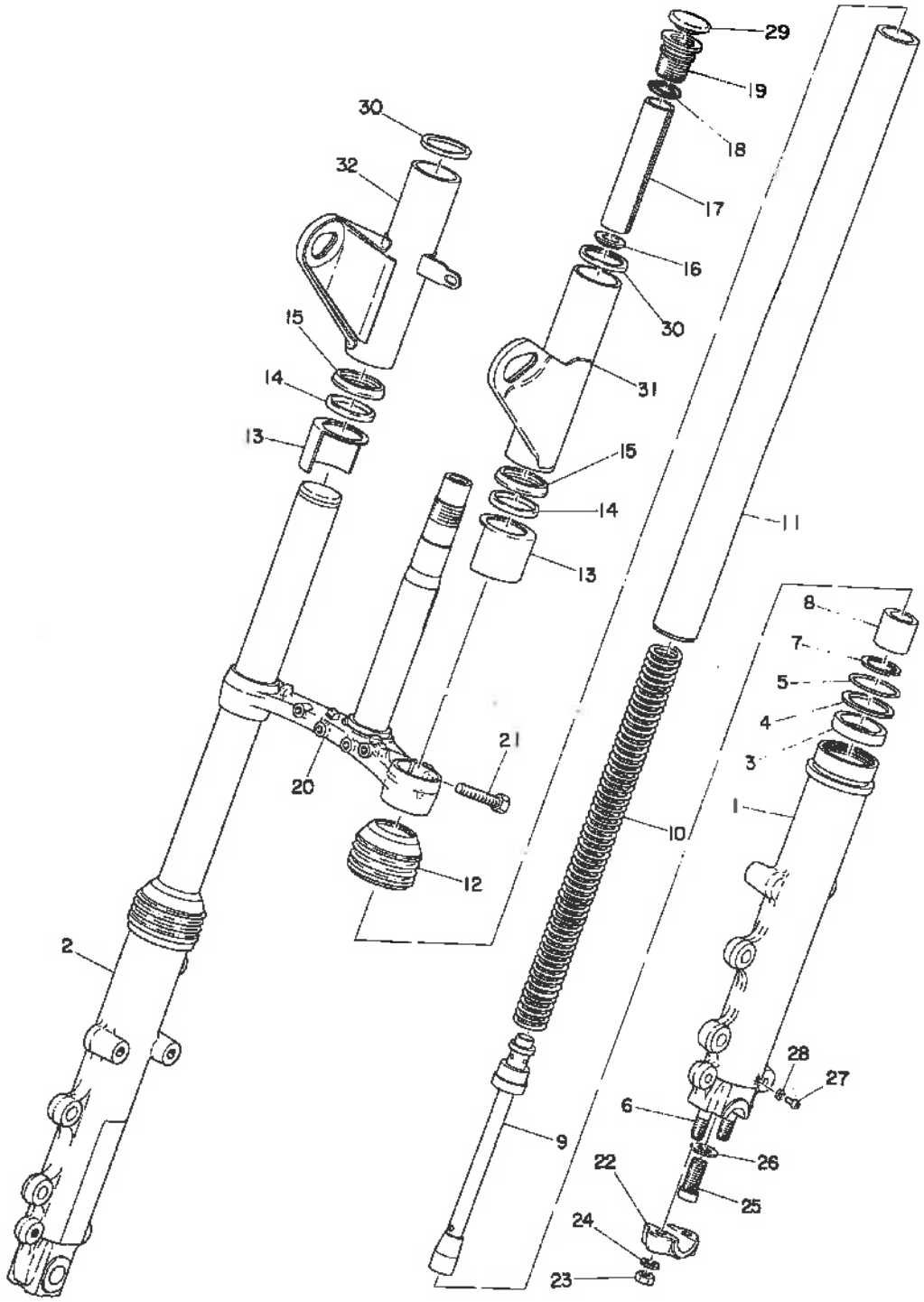


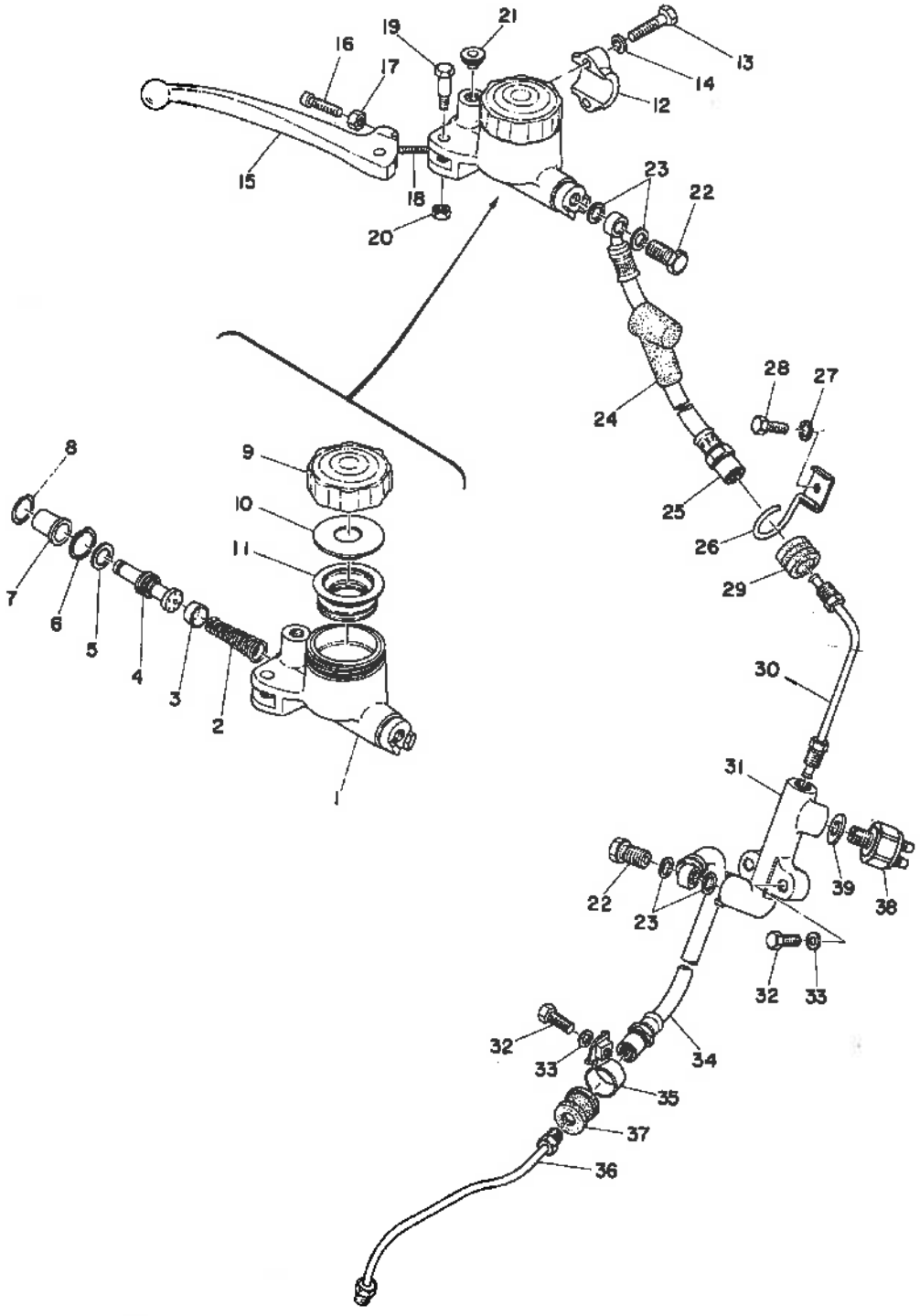
Fig. 5

1. Outer left tube
2. Outer right tube
3. Oil seal
4. Oil seal washer
5. Oil seal circlip
6. Bolt
7. Circlip
8. Piston
9. Cylinder complete
10. Spring
11. Inner tube
12. Dust seal
13. Outer cover
14. Packing
15. Cover under guide
16. Spring upper seat
17. Spacer
18. O-ring
19. Cap bolt
20. Under bracket complet
21. Bolt
22. Axle holder
23. Nut
24. Spring washer
25. Bolt
26. Packing
27. Drain plug
28. Packing
29. Cap
30. Cover upper guide
31. Upper left cover
32. Upper right cover

(Page 123)

1) Construction

Illustration and Construction of Disk Brake has been changed as follows:



1. Master cylinder body
2. Conical spring
3. Cylinder cup 1
4. Piston assembly
5. Spacer
6. Circlip
7. Master cylinder boot
8. Boot stopper
9. Reservoir cap
10. Diaphragm plate
11. Reservoir diaphragm
12. Master bracket
13. Bolt
14. Spring washer
15. Right lever
16. Adjusting screw
17. Adjusting nut
18. Lever return spring
19. Lever fitting screw
20. Nut
21. Blind plug
22. Oil bolt
23. Oil bolt washer
24. Master cylinder boot
25. Brake hose 1
26. Brake hose 3 holder
27. Spring washer
28. Bolt
29. Brake hose rubber
30. Brake pipe 3
31. Joint
32. Bolt
33. Spring washer
34. Brake hose 2
35. Brake hose 2 holder
36. Brake pipe 1
37. Brake hose rubber
38. Front stop switch assembly
39. Special washer

Fig. 6

(Page 131)

2) Master Cylinder

Item a) has been changed as follows:

a) Remove the brake lever.

(Take care not to misplace the brake lever return spring.)

(Page 117)

2) Specifications

"NOMINAL ENGINE R.P.M." has been changed as follows:

300 r.p.m. at 75A. or less

NEW ELECTRICAL EQUIPMENT

Stoplight Outage Indicator System

Should the stoplight burn out, an instrument cluster light flashes to warn the driver.

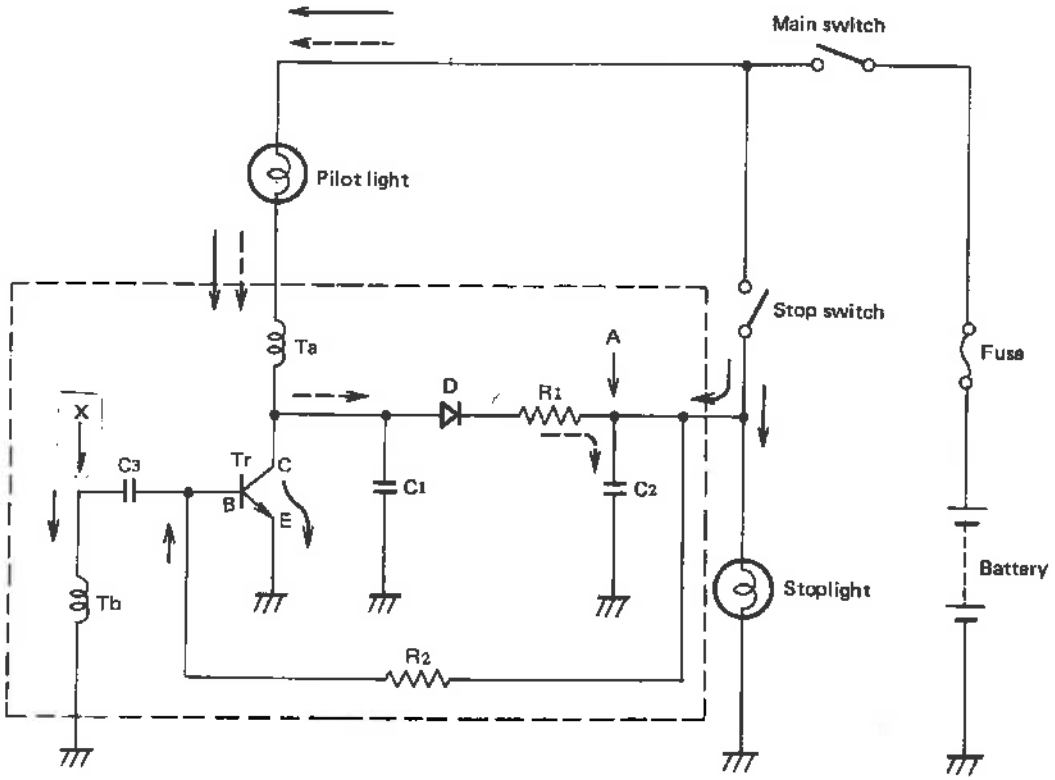


Fig. 7

1) Operation

a) When the stop switch closes (the stoplight is good), current flows through the following route:

Battery → Fuse → Main Switch → Stop Switch → R_2 → B (Transistor) → E (Transistor) → Ground

When the base current flows as described above, current flows from Pilot Light → Ta → C (Transistor) → E (Transistor) → Ground. Thus the pilot light lights up.

b) When the stop switch opens (the stoplight burns out), current flows through the following route:

Battery → Fuse → Main Switch → Pilot Light → Ta → D → R_1 → C_2 → Ground

As the condenser (C_2) begins to store current, the voltage at "A" increases. The moment that it reaches a specific level, C_2 begins to discharge, and the base current flows from the transistor. In other words, current flows from Pilot Light → Ta → C (Transistor) → E (Transistor) → Ground, and thus the pilot light turn off.

When C_2 has discharged, the voltage at A drops, and thus the base current stops flowing. Therefore, the current from the pilot light also decreases, and as a result, current is induced between "Ta" and "Tb", flowing in the direction opposing the magnetic flux. The voltage at "X" drops, and no current flows through the transitors. By repeating this operation, the pilot light goes on and off.

c) When the Stoplight burns out, but the pilot light is in good condition:

- Stoplight burns out
  - Brake pedal is applied ..... Pilot light is on.
  - Brake pedal is not applied ..... Pilot light turns on and off.
- Stoplight is good
  - Brake pedal is applied ..... Pilot light is on.
  - Brake pedal is not applied ..... Pilot light is off.

Alarm System

Rear Brake Lining

* If the rear brake lining wears more than 2 mm., the pilot light lights up.

1) Operation

a) If the brake lining wears more than 2 mm.: When the brake pedal is depressed, the cam shaft rotates and causes the cam shaft shim, having a cutaway (shaded area), to rotate, thus pushing the alarm switch buttom. This makes the pilot light turn on, warning the rider that the brake lining has worn beyond limits.

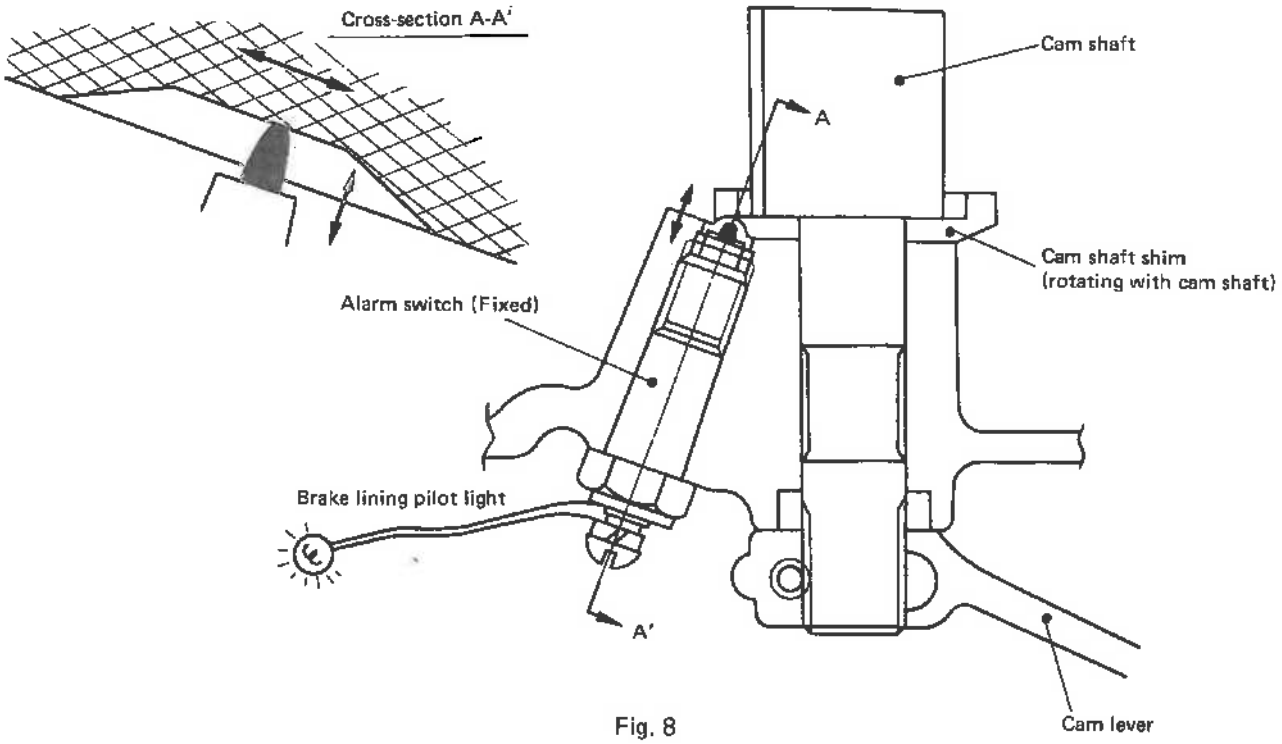


Fig. 8

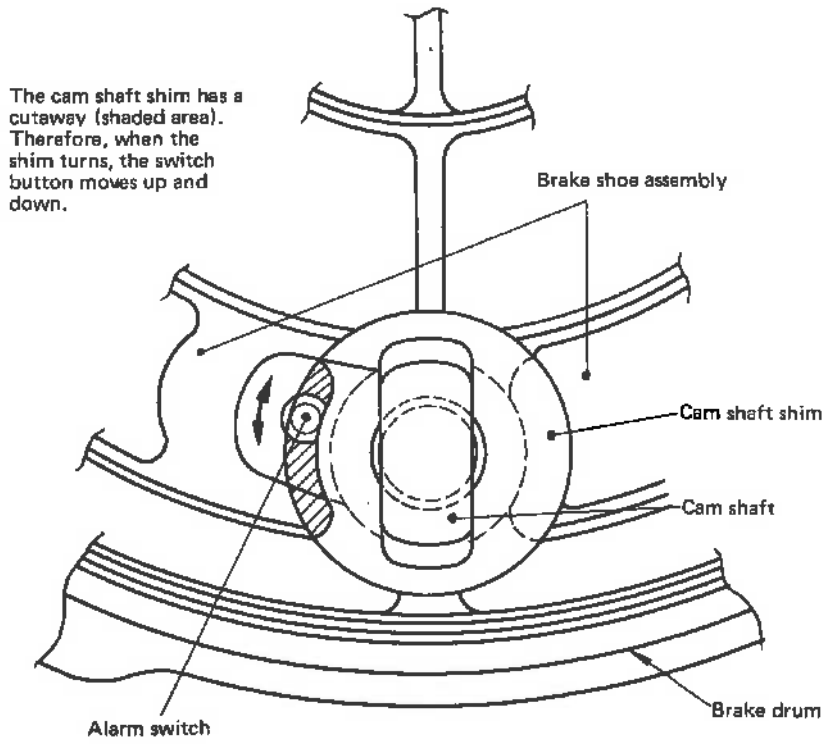


Fig. 9

b) When the main switch is turned on and the starter button is depressed, the brake lining wear warning light should go on. If not, the light is assumed to be burnt out.

Brake lining alarm system

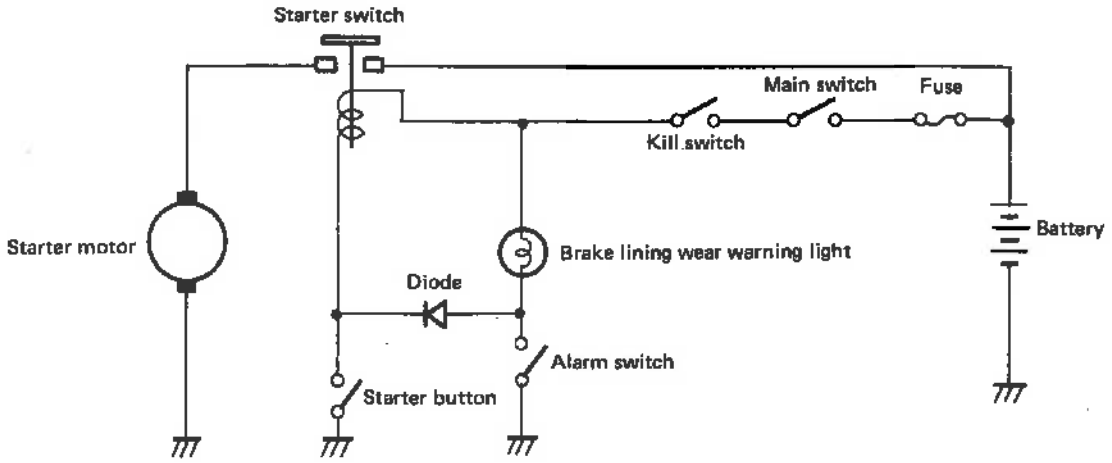
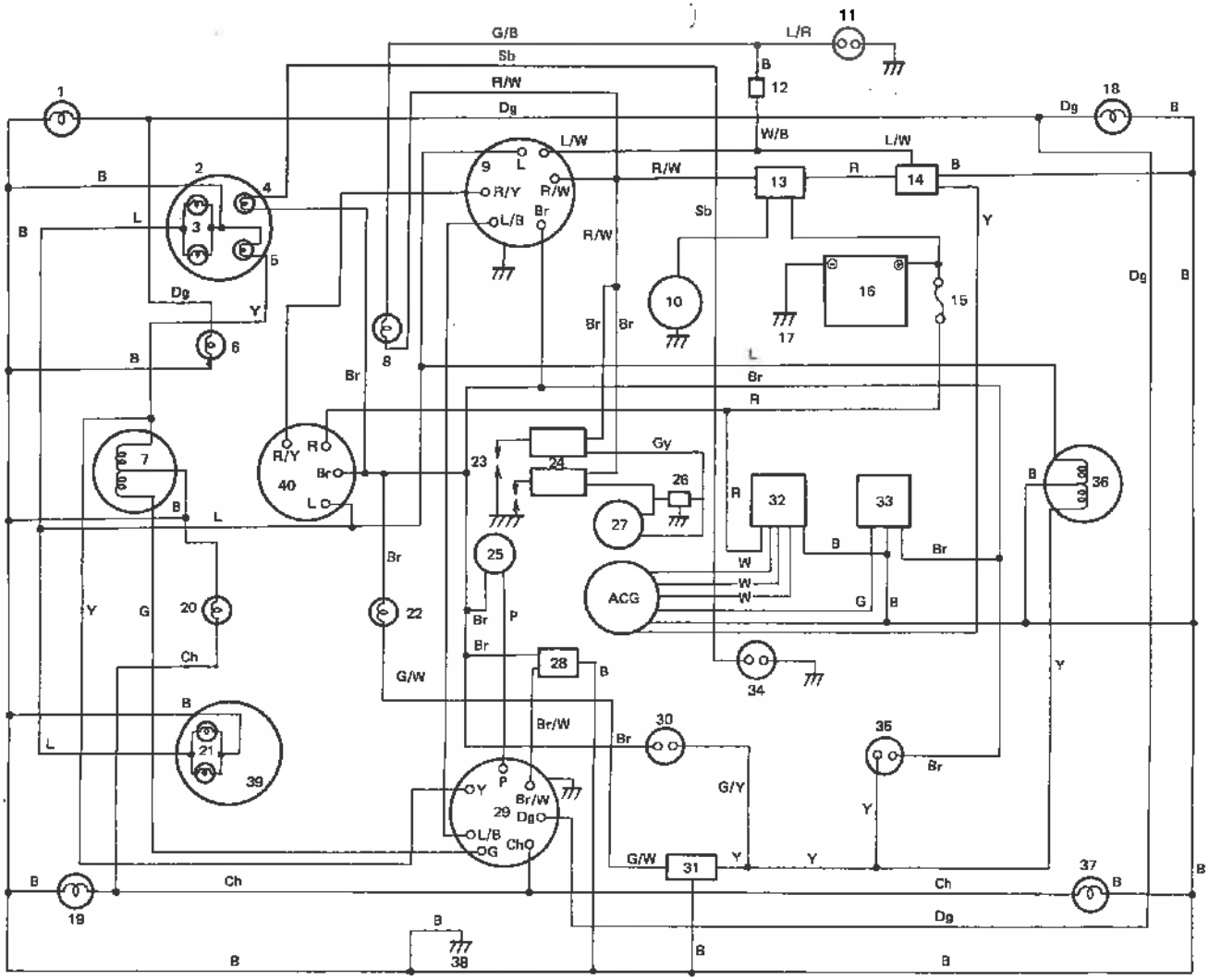


Fig. 10

TX650A Wiring Diagram



G/B	Green Black
B	Black
L	Blue
Y	Yellow
G	Green
Br	Brown
R	Red
G/W	Green/White
W/B	White/Black
L/R	Blue/Red
L/B	Blue/Black
R/Y	Red/Yellow
W	White
G/Y	Green/Yellow
L/W	Blue/White
R/W	Red/White
P	Pink
Br/W	Brown/White
Dg	Dark green
Ch	Chocolate
Sb	Sky blue

1. Front flasher light (R) 12V./27W.
2. Tachometer
3. Lamp 12V./3W.
4. Neutral pilot light 12V./3W. x 2
5. High beam pilot light 12V./3W.
6. Flasher pilot light 12V./3W.
7. Headlight 12V. 50/40W.
8. Brake lining pilot light 12V./3W.
9. Handle switch (R)
10. Starter motor
11. Brake lining alarm switch
12. Diode
13. Starter switch
14. Safety relay
15. Fuse
16. Battery YB14L
17. Ground to chassis
18. Rear flasher light (R) 12V./27W.
19. Front flasher light (L)
20. Flasher pilot light 12V./3W.
21. Light 12V./3W. x 2
22. Stoplight warning light 12V./3W.
23. Spark plug
24. Ignition coil
25. Horn
26. Condenser
27. Contact breaker
28. Flasher relay
29. Handle switch (L)
30. Front stop switch
31. Lamp checker
32. Rectifier
33. Regulator
34. Neutral switch
35. Rear stop switch
36. Tail/stoplight 12V., 32/3W.
37. Rear flasher light 12V./27W.
38. Ground to chassis
39. Speedometer
40. Main switch

Main switch

	R	Br	R/Y	L	Key
OFF					Removable
I	○	○	○		Unremovable
II	○			○	Removable

Dimmer switch

	Y	L/B	L
Hi	○	○	
Lo		○	○

Flasher switch

	Ch	Br/w	Dg
L	○	○	
N			
R		○	○

Horn switch

	P	Ground
OFF		
ON	○	○

Starter switch

	L/W	Ground
OFF		
ON	○	○

Light switch (R)

	L/B	R/Y	L
OFF			
ON	○	○	○

Kill switch

	Br	R/w	L/w
OFF			
RUN	○	○	○
OFF			

APPENDIX A

CLEANING AND STORAGE

A. CLEANING

Frequent thorough cleaning of your motorcycle will not only enhance it's appearance but will improve general performance and extend the useful life of many components.

1. Before cleaning the machine:

   a. Block off end of exhaust pipe to prevent water entry; a plastic bag and strong rubber band may be used.

   b. Remove air cleaner or protect it from water with plastic covering.

   c. Make sure spark plug(s), gas cap, oil tank cap, transmission oil filler cap and battery caps are properly installed.

2. If engine case is excessively greasy, apply degreaser with a paint brush. Do not apply degreaser to chain, sprockets, or wheel axles.

3. Rinse dirt and degreaser off with garden hose, using only enough hose pressure to do the job. Excessive hose pressure may cause water seepage and contamination of wheel bearings, front forks, brake drums, and transmission seals. Many expensive repair bills have resulted from improper high-pressure detergent applications such as those available in coin-operated car washes.

4. Once the majority of dirt has been hosed off, wash all surfaces with warm water and mild, detergent-type soap. An old tooth brush or bottle brush is handy to reach those hard-to-get-to places.

5. Rinse machine off immediately with clean water and dry all surfaces with a chamois skin, clean towel, or soft absorbent cloth.

6. Immediately after washing, remove excess moisture from chain and lubricate to prevent rust.

7. Chrome-plated parts such as handlebars, rims, spokes, forks, etc., may be further cleaned with automotive chrome cleaner.

8. Clean the seat with a vinyl upholstery cleaner to keep the cover pliable and glossy.

9. Automotive-type was may be applied to all painted and chrome-plated surfaces. Avoid combination cleaner-waxes. Many contain abrasives which may mar paint or protective finish on fuel and oil tanks.

10. After finishing, start the engine immediately and allow to idle for several minutes.

B. STORAGE

Long term storage (30 days or more) of your motorcycle will require some preventive procedures to insure against deterioration. After cleaning machine thoroughly, prepare for storage as follows:

1. Drain fuel tank, fuel lines, and carburetor float bowl(s).
2. Remove empty fuel tank, pour a cup of 10W to 30W oil in tank, shake tank to coat inner surfaces thoroughly and drain off excess oil. Reinstall tank.
3. Remove spark plug(s), pour about one tablespoon of 10W to 30W oil in spark plug hole(s) and reinstall spark plugs. Kick engine over several times (with ignition off) to coat cylinder walls with oil.
4. Remove drive chain. Clean thoroughly with solvent and lubricate with graphite-base chain lubricant. Reinstall chain or store in a plastic bag (tie to frame for safekeeping).
5. Lubricate all control cables.
6. Remove battery and charge. Store in a dry place and re-charge once a month. Do not store battery in an excessively warm or cold place (less than 32°F or more than 90°F).
7. Block up frame to raise both wheels off ground. (Main stands can be used on machines so equipped.)
8. Deflate tires to 15psi.
9. Tie a plastic bag over exhaust pipe outlet(s) to prevent moisture entering.
10. If storing in humid or salt-air atmosphere, coat all exposed metal surfaces with a light film of oil. Do not apply oil to rubber parts or seat cover.
11. Periodically (every 15-30 days) kick the engine over several times (ignition off). Operate all controls at this time also.

APPENDIX B

TROUBLESHOOTING

A) No Start or Difficult to Start

1) Ignition System

Possible Cause	Inspection and Repair
1. Carbon-fouled or worn out spark plug.	Clean plug (if possible) and gap to .6–.7mm
2. Gap incorrect or bridged.	" " " " " " "
3. Contact breaker point burned up or worn out	Clean or change points. Correct capacitor, etc.
4. Point gap incorrect.	Set point gap (.3–.4mm).
5. Ignition timing out of adjustment.	Set ignition timing. Pages 115 — 116
6. Ignition coil no good.	Use electro-tester to measure primary and secondary winding resistance. Also make a standard coil test.
7. Condenser shorted out.	Use electro-tester to check capacity and insulation.
8. Brown or red ignition wires broken or shorted.	Turn on main switch. Hit horn and stoplight. No operation means possible broken wire.
9. Main switch no good.	Check main switch.
10. Blown fuse.	Replace.
11. Battery discharged or defective.	Check specific gravity of each cell with hydrometer. Check voltage

2) Fuel System

Possible Cause	Inspection and Repair
1. No gas.	Disconnect fuel line at carburetor; turn fuel petcocks on; check for fuel to flow.
2. Tank cap vent hole plugged.	
3. Petcock defective.	
4. Fuel line plugged.	
5. Carburetor not level.	
6. Carb equalizer tube has hole or loose connection.	

3) Compression-Cylinder Compression Shows Low Pressure

Possible Cause	Inspection and Repair
1. Lack of tappet clearance; valve held open.	Adjust tappet.
2. Valve timing incorrect.	Camshaft improperly installed or cam chain loose.
3. Cylinder head gasket seal broken.	Check for combustion gases blowing out past gasket.
4. Valve seat defective.	See Valve Seat Repair Section.
5. Piston ring(s) defective.	Too much smoke under load. Especially blue smoke indicating oil burning. See individual wear sections for inspection methods.
6. Cylinder tapered or out of round.	
7. Valve guide(s) worn out.	
8. Guide seals bad.	

2) Fuel System

Possible Cause	Inspection and Repair
1. Butterfly valve not opening completely or in synchronization.	Make corrective adjustment.
2. Dirty air filter element.	Clean with high pressure air.
3. Carburetor float level incorrect.	Measure and change if required.
4. Incorrect main jet size.	Remove jet and check stamped size.
5. Incorrect jet needle notch.	Check position of clip in needle.
6. Cracked and leaking vacuum diaphragm.	Remove air cleaner and observe vacuum piston operation while running engine.
7. Carburetor not level.	Level carburetors.
8. Choke half on.	Check chokes.

3) Compression System

Possible Cause	Inspection and Repair
1. Weak or broken valve spring.	Make valve spring tests, replace if weak.
2. Valve timing (camshaft) incorrect.	Check cam chain tension.
3. Broken piston rings.	Compression below 9.0 kg/cm^2 (128 psi)

D) Engine Overheating

1) Ignition

Possible Cause	Inspection and Repair
1. Ignition timing too advanced or retarded.	Check timing.
2. Malfunctioning governor.	Check action of governor rod and pivot weights.
3. Too hot spark plug heat range.	Check heat range.

2) Fuel System

Possible Cause	Inspection and Repair
1. Too lean air-fuel mixture.	Any jet plugged or too small. Air leak in carburetion intake system.
2. Bad gasoline.	Listen for detonation; check for unusual deposits on spark plug.

3) Oil System

Possible Cause	Inspection and Repair
1. Oil level too low.	Check and refill.
2. Oil too thin.	Improper weight or too contaminated-change oil. 20w/40 "SE"
3. Oil pump defective.	Loosen oil delivery line to head and check for oil flow.
4. Oil passage(s) plugged.	Disassemble engine-squint solvent or oil through passages.

4) Too Much Blue Exhaust Smoke

Possible Cause	Inspection and Repair
1. Too much engine oil.	Check oil level and drain some if necessary.
2. Breather plugged up.	Check and clean if necessary.
3. Cylinder and/or piston rings worn.	Make necessary measurements and replace as necessary.
4. Worn or cracked valve guide.	Make necessary measurements and replace as necessary.
5. Cracked valve guide seals.	Make necessary inspection and replace as necessary.

APPENDIX C

(650cc)

PERTINENT PARTS and SERVICE BULLETINS

Note

THE FOLLOWING INFORMATION MUST BE USED AS A GUIDE ONLY TO INDICATE THE DIRECTION TAKEN BY VARIOUS MODIFICATIONS. IT IS INCLUDED ONLY AS AN AID TO SERVICING THE 650 SERIES AND, SHOULD A QUESTION ARISE REGARDING A CERTAIN PART, THE MECHANIC SHOULD REFER TO AN UP-TO-DATE MODEL PARTS BOOK, SERVICE OR PARTS NEWS BULLETIN, OR THE MANUFACTURER.

MOTORCYCLE PARTS NEWS

YAMAHA INTERNATIONAL CORPORATION
MONTEBELLO, CALIFORNIA
DATE 9/2/70

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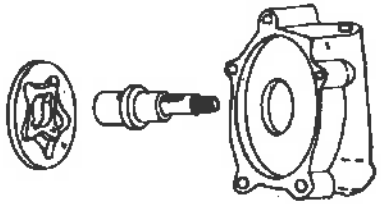
XS1 OIL PUMP MODIFICATIONS

To achieve more efficient pump operation for a greater length of time, the inner and outer rotor thicknesses have been increased. The pump shaft and pump cover have been modified as well to match the modified disks. Exact changes in dimensions are listed below.

These modified parts are installed as standard equipment on all XS1's from Engine Number 004130 and above.

Due to design differences, the standard pump parts and the modified pump parts are not interchangeable except as a set. Do not attempt to mix these two sets of parts as the oil pump's efficiency will be drastically reduced.

REF. NO.	DESCRIPTION	OLD PART NO.	NEW PART NO.	PRICE	& DISC.
8-0-1	Ass'y, Oil Pump		256-00001-00	10.40	50%
8-1	Cover, Pump	256-13316-00	256-13316-01	4.00	50%
8-2	Ass'y, Rotor	256-13310-00	256-13310-01	3.38	50%
8-4	Shaft	256-13314-00	256-13314-01	3.59	50%



XS1 MODIFIED O-RING FOR ROCKER SHAFT PLUG (XS1 PTS BK, PP. 17 & 18)

In order to ensure positive oil sealing at the rocker shaft plug, the thickness of the O-ring that fits over the plug has been increased. The larger O-ring will still fit onto the standard rocker shaft plug.

These larger O-rings are standard items on all XS1's after Engine Number 4322.

FIG. NO.	DESCRIPTION	OLD PART NO.	NEW PART NO.	PRICE & DISC.	REMARKS
7-13	O-ring	93210-16022	93210-17143	Same	Was 2x16 Now 2.4x15.4

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XS1 MODIFIED WASHER FOR CYLINDER STUD NUT (XS1 PTS BK., PP. 1 & 2)

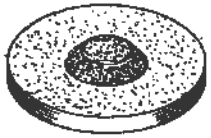
The washer placed beneath the cylinder stud nut used to be a plain flat washer. Now, there are improved washers, that are coated with a specially shaped layer of rubber, that appreciably reduce oil leaks up past the studs. Installation and torquing procedures remain the same.

These rubber covered washers are standard items on XS1s after Engine Number 4322.

FIG. NO.	DESCRIPTION	OLD PART NO.	NEW PART NO.	PRICE	DISC.	REMARKS
1-17	Washer	92901-10200	256-11173-00	.42	50%	4 machine

PLEASE SHOW YOUR SERVICE MANAGER THIS FOLLOWING PARAGRAPH:

One side of the rubber coated washer is built-up in a conical shape (see the drawing below for details). During installation, this conical rubber side must fit down against the head cover. When stud nut is tightened, the coned rubber oil seal will effectively fill any space between the stud, the stud hole, and the washer.



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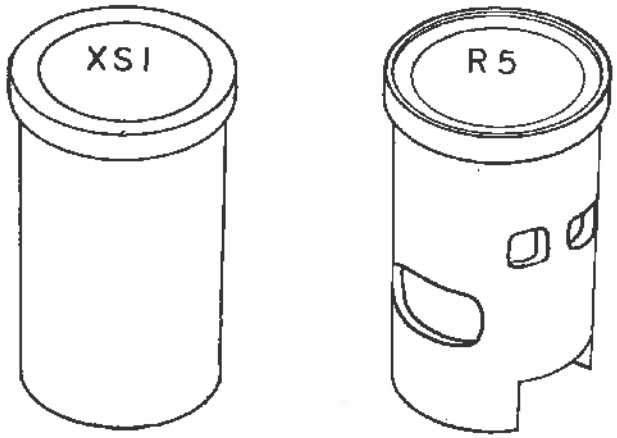
XS1 & R5 SERIES — REPLACEMENT CYLINDER SLEEVES (Accessory)

SUBJECT: Factory-made replacement cylinder sleeves for the XS1 series and the R5 series are now available from Yamaha Parts Department. These sleeves can help salvage cylinder assemblies having damaged original sleeves.

INSTALLATION: The old sleeve can be quickly removed (after heating cylinder) and new sleeve dropped in. The bore is slightly undersize, so it must be bored and honed to proper piston clearance (complete installation instructions given in Service News Bulletin #273 and #275).

ORDERING INFORMATION:

Fig. No.	Description	Part Ordering No.
1-47(Add to XS1A Parts Bk.)	SLEEVE, Cylinder	ACC011000800
1-30(Add to R5A Parts Bk.)	SLEEVE, Cylinder	ACC011000900



PLEASE BRING YOUR PARTS BOOKS AND ACCESSORY CATALOG UP TO DATE

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YAMAHA INTERNATIONAL CORPORATION
BUENA PARK, CALIFORNIA 90620
DATE 10/18/71

NUMBER 313

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XS1B — PISTON IMPROVEMENT

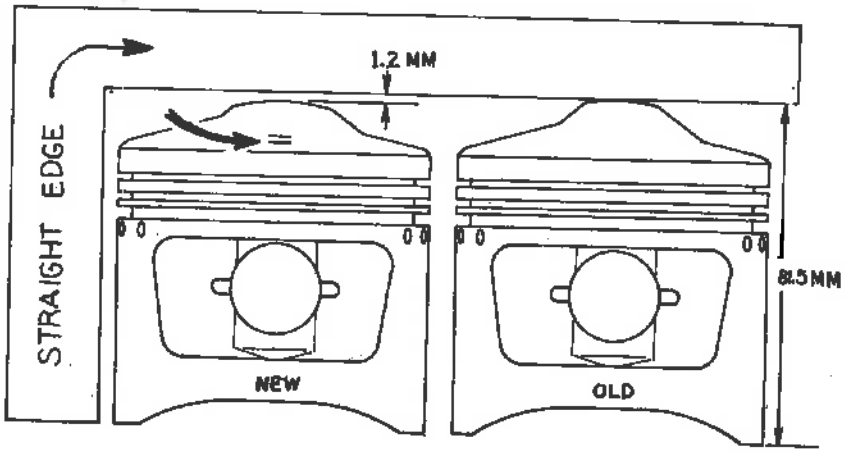
The XS1B piston crown has been changed in shape for a more stable idle. The new piston crown is 1.2mm lower. This, in effect, changes chamber volume from 42.2cc to 47.2cc, giving a compression ratio of 8.1:1 as opposed to 8.7:1 with the '-01' pistons.

The new pistons will be found in all models starting with Engine No. 23130~. The crown of the new piston is marked "//" as shown in the drawing. Although some of the pistons after frame No. 23130 may not be correctly marked, they will still be the new (-02) version.

We have been advised that there will be no adverse effect on performance by mixing old and new pistons on the same machine.

REF. NO.	DESCRIPTION	PART NUMBER	PRICE	DISC.	REMARKS
5-13	Piston	256-11631-01-96	same	A	~23129
5-13-1	Piston	256-11631-02-96	same	A	23130~
5-13-2	Piston	256-11635-02-00	same	A	(1st O/S)
5-13-3	Piston	256-11636-02-00	same	A	(2nd O/S)

Both types currently in stock. Type '-01' will not be restocked.



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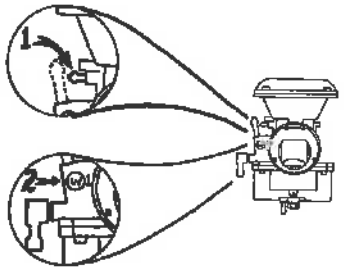
NUMBER 246

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XS1 ADDITIONAL SERVICE INFORMATION (Carburetion, oil, engine leaks, crankcases)

Carburetor specifications on the XS1 have been changed twice since production. The final change improves idling, shortens the warm-up time, and changes the low-load, low-rpm operating characteristics.

The rough sketches at the right show the I.D. marks that indicate which carb is which. Series 1 and 2 can be used on the same machine. Series 3 carbs must be used as a set. They cannot intermix with earlier types.



As an additional aid to identification, besides the series number (#2 in drawing), you can measure the inner diameter of the float bowl vent fitting (#1 in drawing). The chart below shows each of the changes and the engine numbers involved.

SPECIFICATIONS:

	ABBREV.	W1	E2	E3
Main Jet	MJ	130	Same	Same
Pilot Jet	PJ	45	Same	#42.6
Pilot Outlet	PO	0.8	Same	0.7 ø
Pilot Bypass #1	PB1	1.0	Same	0.8 ø
Pilot Bypass #2	PB2	0.6	Same	1.0 ø
Air Jet	AJ	1.0	Same	1.2 ø
Needle Jet	NJ	Z-6	Same	Same
Jet Needle	JN	4JN19-4	Same	Same
Cut Away	CA	- - -	- - -	- - -
Air Screw (turns out)	AS	½	1	1
Starter Jet	SJ	0.6	Same	Same
Float Level	FL	25mm	Same	Same
Air Vent	AV	2.5	3.0 ø	4.0 ø
I.D. Mark	ID	W1	E2	E3
Engine numbers in series		00101-02514	02515-03628	03629~

REMEMBER: Carburetors with an W1 or E2 marking will not intermix with an E3 on the same machine.

ENGINE OIL

For best all-around performance we now recommend that a 20W-40 detergent oil conforming to SAE "MS" specifications or better be used in the crankcase. This multi-grade oil is available at most larger stations. Use a name brand, quality oil.

MOTORCYCLE SERVICE NEWS

YAMAHA INTERNATIONAL CORPORATION
MONTEBELLO, CALIFORNIA
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XS1 ADDITIONAL SERVICE INFORMATION--continued

ENGINE OIL-continued

Each machine should have at least two or three complete oil changes within the first 2,000 miles in order to reduce the possiblity of oil contamination during break-in. Thereafter the oil should be changed every 2,000 miles or six months. Should the engine be used in an abusive manner these intervals must be reduced accordingly.

ENGINE LEAKS

The XS1, compared to many other designs on the market, is remarkably leak-free. However, it is our constant desire to correct possible leakage areas whenever they are reported to us.

Your Specifications Sheet and Service News Bulletin #230 give the torque specifications for all nuts and bolts on the model. In addition, Service News Bulletin #236 covers the treatment of certain areas of the engine to protect against oil leaks and seized threads.

There are additional points that you can cover during engine re-assembly which will provide further protection against leaks. These are, in particular, the cylinder head gasket, contacting surfaces between the cylinder head and cylinder head cover, breaker cover (1), cylinder head side cover, contacting surfaces between tensioner arm assembly and cylinder, and contacting surfaces between strainer cover and crankcase.

For all of the above we recommend Yamaha Bond #4 or #5 as the occasion demands and, where heat is a critical factor, a metallic gasket compound such as K & W Copper Coat.

Yamaha Bond #5 is a light, non-drying, rubber base sealant. Yamaha Bond #4 is heavier, more pressure resistant and more inclined to be tacky.

Other manufacturer's sealants, anti-sieze compounds, etc., are acceptable for use in areas where the Yamaha Bonds are inapplicable. They must be used strictly in accordance with the manufacturer's recommendations.

The cylinder head cover holding nuts have been modified and an oil seal added. New part number: 256-11173-00-00.

The chain tensioner cap (-01 type) should be installed with two gaskets.

CRANKCASES

Parts News Bulletin #288 (7/27/70) advised, among other things, that the main axle bearing and seat (Fig. 10-9, Parts Book) had been changed from 31 to 30mm OD. Information now in our possession indicates that the engine number of the change may be in error. In light of this fact, and the many other changes on the XS1 crankcases, we suggest that you very carefully measure all changed points on the crankcases prior to ordering a replacement part.

At some later date we will provide you with a bulletin which will delineate each change on this model in order to aid you during the ordering of replacement parts. For now, we suggest that your Parts and Service personnel thoroughly study the following bulletins: Motorcycle Parts News Bulletins #275, #280, #284, #288, #293, and Motorcycle Service News Bulletins #230, #231, #232, #236, #237, and #242.

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XS1 OIL PUMP AND/OR PRESSURE CHECK

The trochoidal oil pump in the XS1, due to its method of design, should never fail. However, there is the remote possibility of foreign matter jamming between the drive gears or into a delivery passage.

Should the drive gears fail, the tachometer will quit working. In order to locate the problem first remove the tachometer cable from the housing on the right front side of the crankcase. Start the engine and see if the gear shaft end (square) in the housing still rotates. If it does, the problem is in the tachometer cable or unit.

If doubt still exists, loosen the cylinder head oil delivery pipe jam nut at the fitting on the crankcase in front and between the cylinders. Start the engine and watch for excessive oil leaks. With the jam nut removed oil should spurt out from the fitting. If necessary, slightly raise the pipe from its housing. Do not rev the engine.

If either of the above tests indicates a problem in oil pressure or delivery the side cover will have to be removed and the pump inspected. In addition, the oil filter and sump oil strainer should be removed and cleaned.

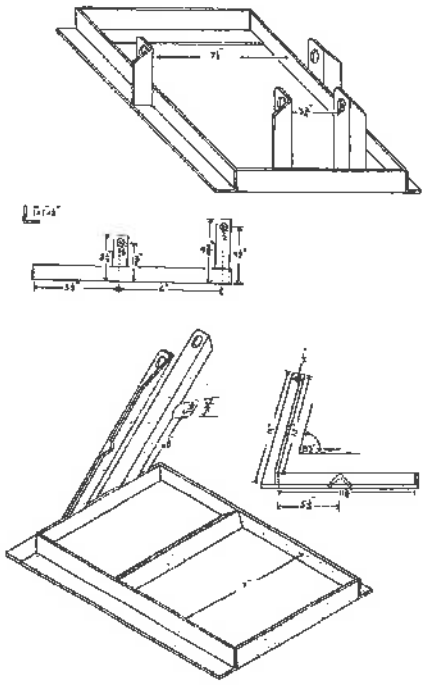
MOTORCYCLE SERVICE NEWS

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MONTEBELLO, CALIFORNIA
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XS1 ENGINE WORK STAND

Due to the greater weight and size of the XS1 650 engine, special engine mounting stands, for use on the work bench, have been designed. These stands will not be available from Yamaha International; however, diagrams illustrating their construction from 1 x 1 x 1/4 inch angle iron are provided below. We recommend you build these stands to facilitate servicing of the XS1.



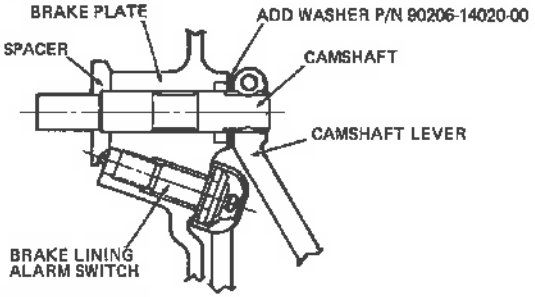
TX500A/TX650A/TX750

M4-005

REAR BRAKE CAMSHAFT, Addition of washer

Excessive lateral movement of rear brake camshaft may cause premature operation of the brake lining alarm switch and indicator lamp.

To prevent this a wave washer should be added between the brake shoe plate and the camshaft lever. See drawing below.



PARTS ORDERING

Please make the following addition to your TX500/TX500A, TX650A, and TX750 Parts Lists.

TX500/500A

PAGE	REF. NO.	NEW PART NO.	DESCRIPTION	QTY.	REMARKS
120	37-50	90206-14020-00	WASHER, wave	1	Addition (TX500A only)

TX650A

108	35-46	90206-14020-00	WASHER, wave	1	Addition

TX750

124	38-44	90206-14020-00	WASHER, wave	1	Addition

AFFECTED MACHINES

TX500A: F/N ~ 371-117805 — machines need washer.
F/N 371-118706 — washer installed by factory.

TX650A: All machines have washer installed by factory.

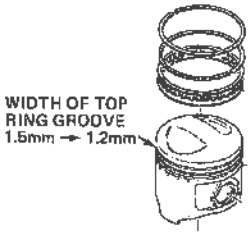
TX750: All machines need washer.

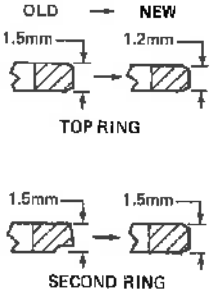
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TX650A, XS650B

PISTON AND PISTON RING DESIGN CHANGE

The piston and piston rings on TX650A and XS650B have been redesigned for better piston ring sealing. The new pistons and rings are interchangeable as a SET ONLY.





PARTS LIST

PAGE	REF. NO.	OLD PART NO.	NEW PART NO.	DESCRIPTION	QTY.
10	4-15	447-11631-00-96	447-11631-01-96	Piston (Std.)	2
		447-11635-00-00	447-11635-01-00	Piston (1st O/S)	2
		447-11636-00-00	447-11636-01-00	Piston (2nd O/S)	2
		447-11637-00-00	447-11637-01-00	Piston (3rd O/S)	2
		447-11638-00-00	447-11638-01-00	Piston (4th O/S)	2
10	4-16	256-11610-00-00	447-11610-00-00	Piston Ring Set (Std.)	2s
		256-11610-10-00	447-11610-10-00	Piston Ring Set (1st O/S)	2s
		256-11610-20-00	447-11610-20-00	Piston Ring Set (2nd O/S)	2s
		256-11610-30-00	447-11610-30-00	Piston Ring Set (3rd O/S)	2s
		256-11610-40-00	447-11610-40-00	Piston Ring Set (4th O/S)	2s

AFFECTED MACHINES

TX650A 010152 ~ have new style pistons and rings.

XS650B All machines have new style pistons and rings.

PLEASE BRING YOUR PARTS BOOK UP-TO-DATE!

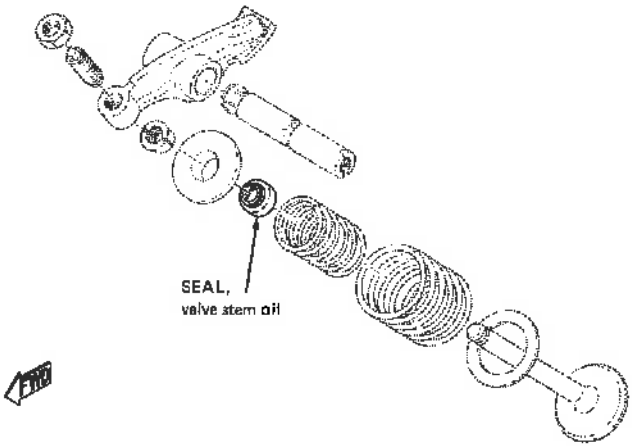
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TECHNICAL BULLETIN

MOTORCYCLE
M5-023

All 650cc Twins
VALVE GUIDE OIL SEALS

Valve stem oil seals are available for all 650cc twins.



ALL MODELS:

PART NUMBER	DESCRIPTION	QTY.	PRICE
341-12119-02-00	SEAL, valve stem oil	4	$1.18 - A

NOTES:

(1) XS1, XS1B, XS2 Parts List indicate P/N 256-12119-01-00. That number is superceded to the number above.

(2) TX650 Parts List supplement, TX650A and XS650B Parts List omitted these seals.

PLEASE BRING YOUR PARTS LIST UP-TO-DATE!

† † † †

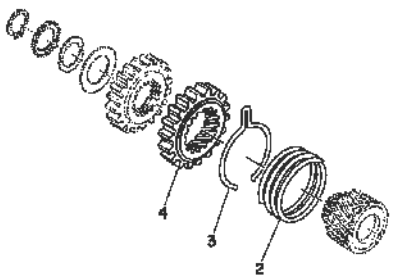
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TECHNICAL BULLETIN

MOTORCYCLE
M5-071

ALL ELECTRIC START 650's
ERRATIC STARTER ENGAGEMENT

Erratic electric starter engagement and disengagement on Yamaha 650 twins is often the result of the improper functioning of the three parts described below. Replacement of these parts with the indicated improved parts (only as a set), will generally cure erratic engagement problems.

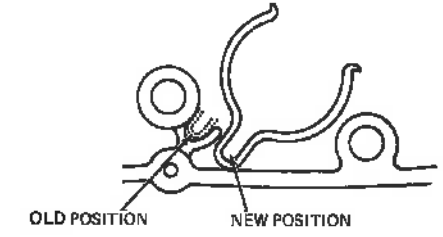


PARTS LIST (REFERENCE NUMBERS REFER TO TX650A PARTS LIST)

REF. NO.	NEW PART NUMBER	DESCRIPTION	QTY.	PRICE-DISC.
7-2	90501-15409-00	SPRING, compression	1	$ .54 - A
7-3	90468-29062-00	CLIP	1	.40 - A
7-4	447-15516-00-00	GEAR 4	1	4.80 - A

NOTE: These parts are standard XS650C parts. They may be used as a set only on all earlier 650 Yamaha twins with electric starters.

The clip (wishbone-shaped spring) position is changed as shown below.



† † † †

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9–1–A Metric to Inch System

	KNOWN	MULTIPLIER (Rounded off)	RESULT
TORQUE	kg-m	7.235	ft-lbs
	kg-m	86.82	in-lbs
	kg-cm	.0724	ft-lbs
	kg-cm	.8682	in-lbs
WT.	kg	2.205	lb
	g	.03527	oz
FLOW/DISTANCE	Km/l	2.352	mpg
	Km/hr	0.6214	mph
	Km	0.6214	mi
	m	3.281	ft
	m	1.094	yd
	cm	0.3937	in
	mm	0.03937	in
VOL./CAPACITY	cc (cm^3)	0.03381	oz (U.S. liq.)
	cc (cm^3)	0.06102	cu in
	1 (liter)	2.1134	pt (U.S. liq.)
	1 (liter)	1.057	qt (U.S. liq.)
	1 (liter)	0.2642	gal (U.S. liq.)
MISC.	kg/mm	56.007	lb/in
	kg/cm^2	14.2234	psi (lb/in^2)
	Centigrade	$(°C \times \frac{9}{5}) + 32$	Fahrenheit (°F)

9–1–B Inch to Metric System

	KNOWN	MULTIPLIER (Rounded off)	RESULT
TORQUE	ft-lbs	0.13826	kg-m
	in-lbs	0.01152	kg-m
	ft-lbs	13.825	kg-cm
	in-lbs	1.1518	kg-cm
WT.	lb	0.4536	kg
	oz	28.35	g
FLOW/DISTANCE	mpg	0.4252	Km/l
	mph	1.609	Km/hr
	mi	1.609	Km
	ft	0.3048	m
	yd	0.9144	m
	in	2.54	cm
	in	25.4	mm
VOL./CAPACITY	oz (U.S. liq.)	29.57	cc (cm^3)
	cu in	16.387	cc (cm^3)
	pt (U.S. liq.)	0.4732	1 (liter)
	qt (U.S. liq.)	0.9463	1 (liter)
	gal (U.S. liq.)	3.7853	1 (liter)
MISC.	lb/in	0.017855	kg/mm
	psi (lb/in^2)	0.07031	kg/cm^2
	Fahrenheit	$(°F-32) \times \frac{5}{9}$	Centigrade (°C)

DEFINITION OF TERMS

kg-m = Kilogram meters: usually torque.

g = Gram(s).

kg = Kilogram(s): 1,000 grams.

km = Kilometer(s).

l = Liter(s).

km/l = Kilometer(s) per liter: Mileage.

cc = Cubic centimeter(s) (cm^3): Volume or capacity.

kg/mm = Kilogram(s) per millimeter: usually spring compression rate.

kg/cm^2 = Kilogram(s) per square centimeter: pressure.

Millimeters to Inches

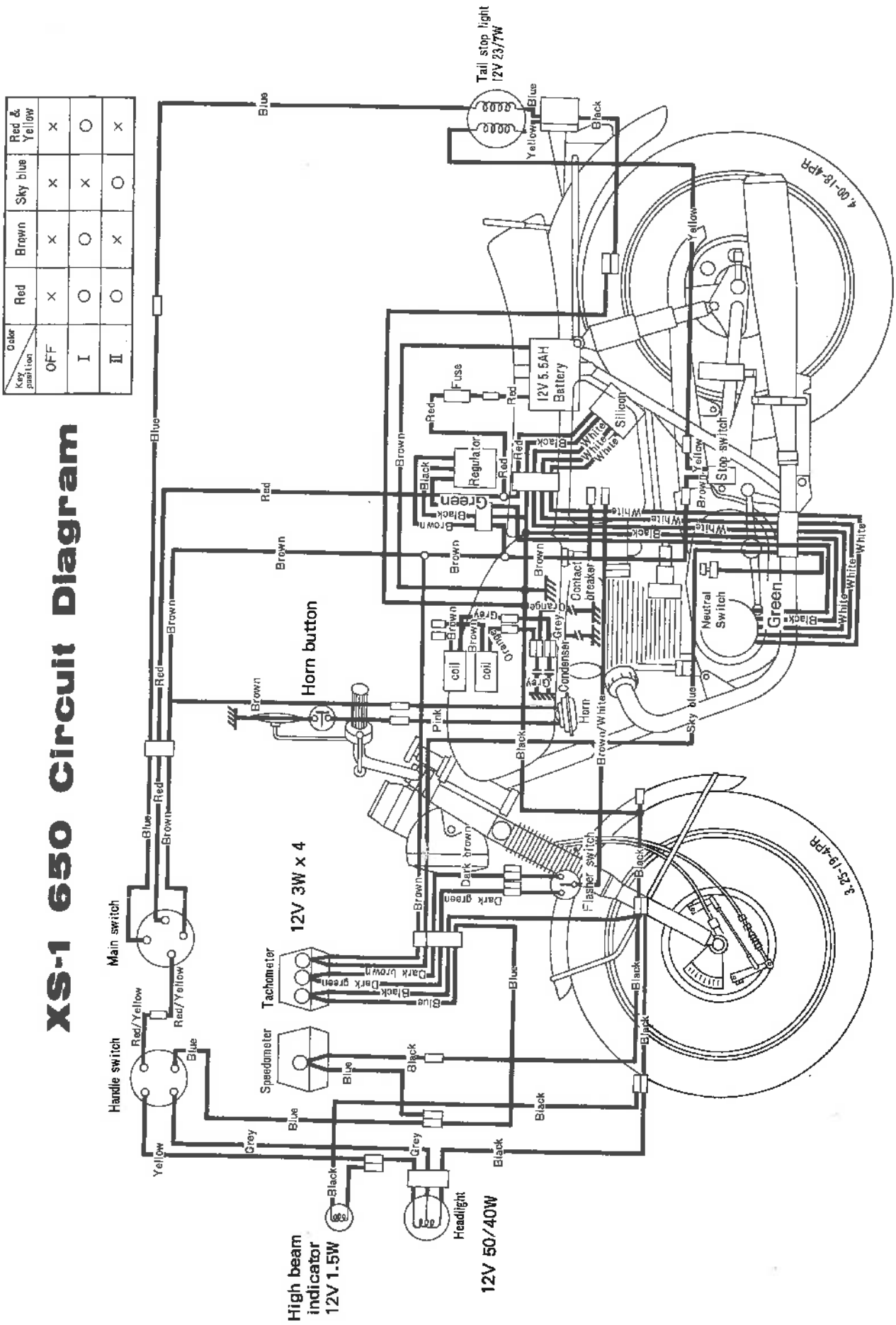
	0	.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0		.0039	.0079	.0118	.0157	.0197	.0236	.0276	.0315	.0354
1	.0394	.0433	.0472	.0512	.0551	.0591	.0630	.0669	.0709	.0748
2	.0787	.0827	.0866	.0906	.0945	.0984	.1024	.1063	.1102	.1142
3	.1181	.1200	.1260	.1299	.1339	.1378	.1417	.1457	.1496	.1535
4	.1575	.1614	.1654	.1693	.1732	.1772	.1811	.1850	.1890	.1929
5	.1969	.2000	.2047	.2087	.2126	.2165	.2205	.2244	.2283	.2323
6	.2362	.2402	.2441	.2480	.2520	.2559	.2598	.2638	.2677	.2717
7	.2756	.2795	.2835	.2874	.2913	.2953	.2992	.3031	.3071	.3110
8	.3150	.3189	.3228	.3268	.3307	.3346	.3386	.3425	.3465	.3504
9	.3543	.3583	.3622	.3661	.3701	.3740	.3780	.3819	.3858	.3898
10	.3937	.3976	.4016	.4055	.4094	.4134	.4173	.4213	.4252	.4291

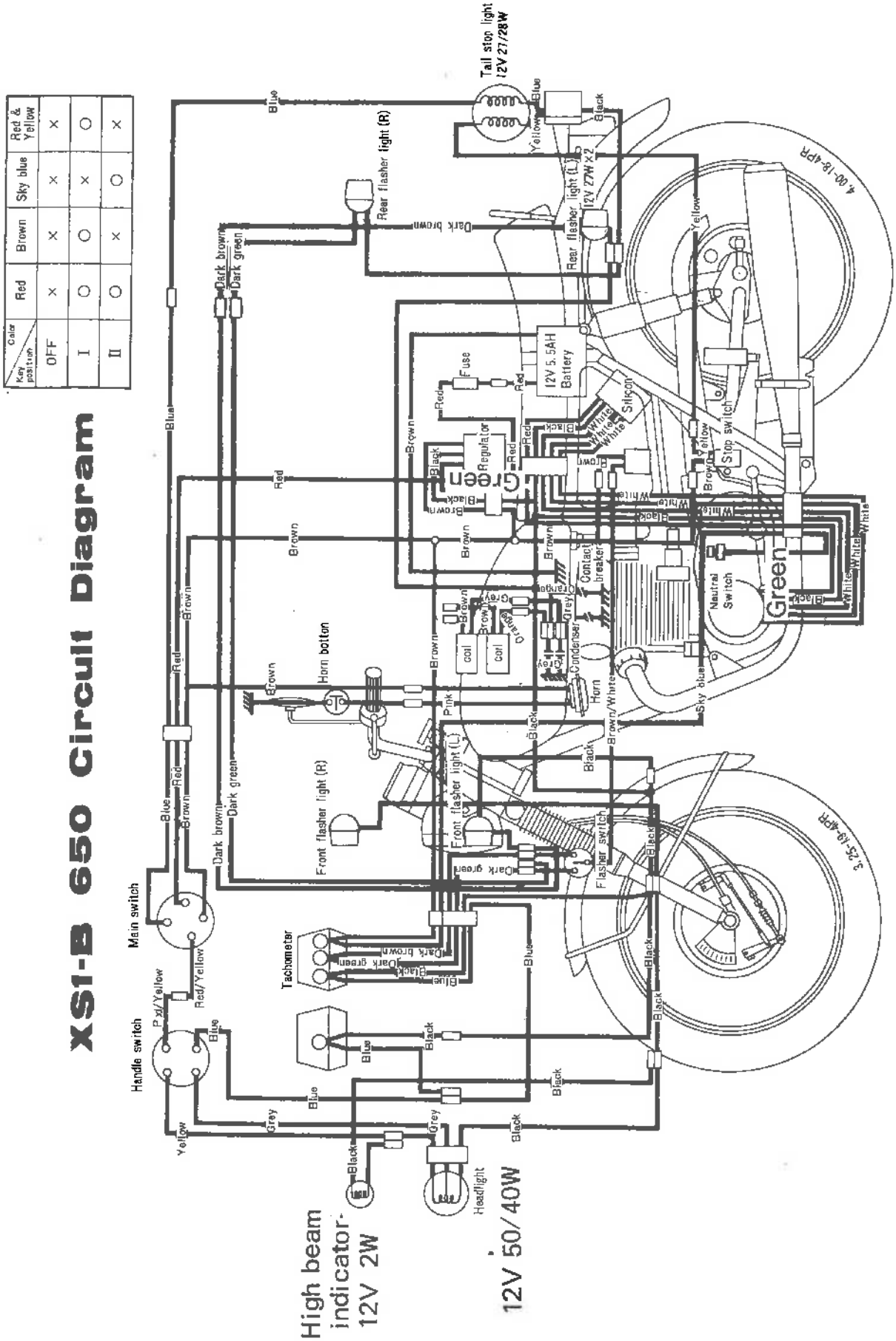
.01mm = .0004 .03mm = .0012 .05mm = .0020 .07mm = .0028 .09mm = .0035
.02mm = .0008 .04mm = .0016 .06mm = .0024 .08mm = .0031 .10mm = .0039

Inches to Millimeters

	0	.01	.02	.03	.04	.05	.06	.07	.08	.09
0		.254	.508	.762	1.016	1.270	1.524	1.778	2.032	2.286
.1	2.540	2.794	3.048	3.302	3.556	3.810	4.064	4.318	4.572	4.826
.2	5.080	5.334	5.588	5.842	6.096	6.350	6.604	6.858	7.112	7.366
.3	7.620	7.874	8.128	8.382	8.636	8.890	9.144	9.398	9.652	9.906
.4	10.160	10.414	10.668	10.922	11.176	11.430	11.684	11.938	12.192	12.446
.5	12.700	12.954	13.208	13.462	13.716	13.970	14.224	14.478	14.732	14.986
.6	15.240	15.494	15.748	16.002	16.256	16.510	16.764	17.018	17.272	17.526
.7	17.780	18.034	18.288	18.542	18.796	19.050	19.304	19.558	19.812	20.066
.8	20.320	20.574	20.828	21.082	21.336	21.590	21.844	22.098	22.352	22.606
.9	22.860	23.114	23.368	23.622	23.876	24.130	24.384	24.638	24.892	25.146
1.0	25.400	25.654	25.908	26.162	26.416	26.670	26.924	27.178	27.432	27.686

.001" = .0254mm .003" = .0762mm .005" = .1270mm .007" = .1778mm .009" = .2286mm
.002" = .0508mm .004" = .1016mm .006" = .1524mm .008" = .2032mm .010" = .254mm


XS-1 650 Circuit Diagram
Color / Key position
Red
Brown
Sky blue
Red & Yellow
OFF
I
II
Tail stop light
12V 23/7W
12V 5.5AH Battery
Fuse
Regulator
Silicon
Stop switch
Neutral Switch
Contact breaker
Condenser
Coil
Horn
Horn button
Flasher switch
Main switch
Handle switch
Tachometer
Speedometer
12V 3W x 4
High beam indicator 12V 1.5W
Headlight 12V 50/40W
4.00-18-4PR
3.25-19-4PR


XS1-B 650 Circuit Diagram
Color / Key position
OFF
I
II
Red
Brown
Sky blue
Red & Yellow
Tail stop light 12V 27/28W
Rear flasher light (R)
Rear flasher light (L) 12V 27W x2
4.00-18-4PR
3.25-19-4PR
12V 5.5AH Battery
Fuse
Silicon
Regulator
Green
Stop switch
Contact breaker
Condenser
coil
coil
Neutral Switch
Green
Horn button
Horn
Front flasher light (R)
Front flasher light (L)
Flasher switch
Main switch
Handle switch
Tachometer
High beam indicator 12V 2W
Headlight 12V 50/40W

XS2-TX650 CIRCUIT DIAGRAM

Circuit connected by main switch

Color / Position	R	Br	Bl	R/Y
OFF	×	×	×	×
I	○	○	×	○
II	○	×	○	×

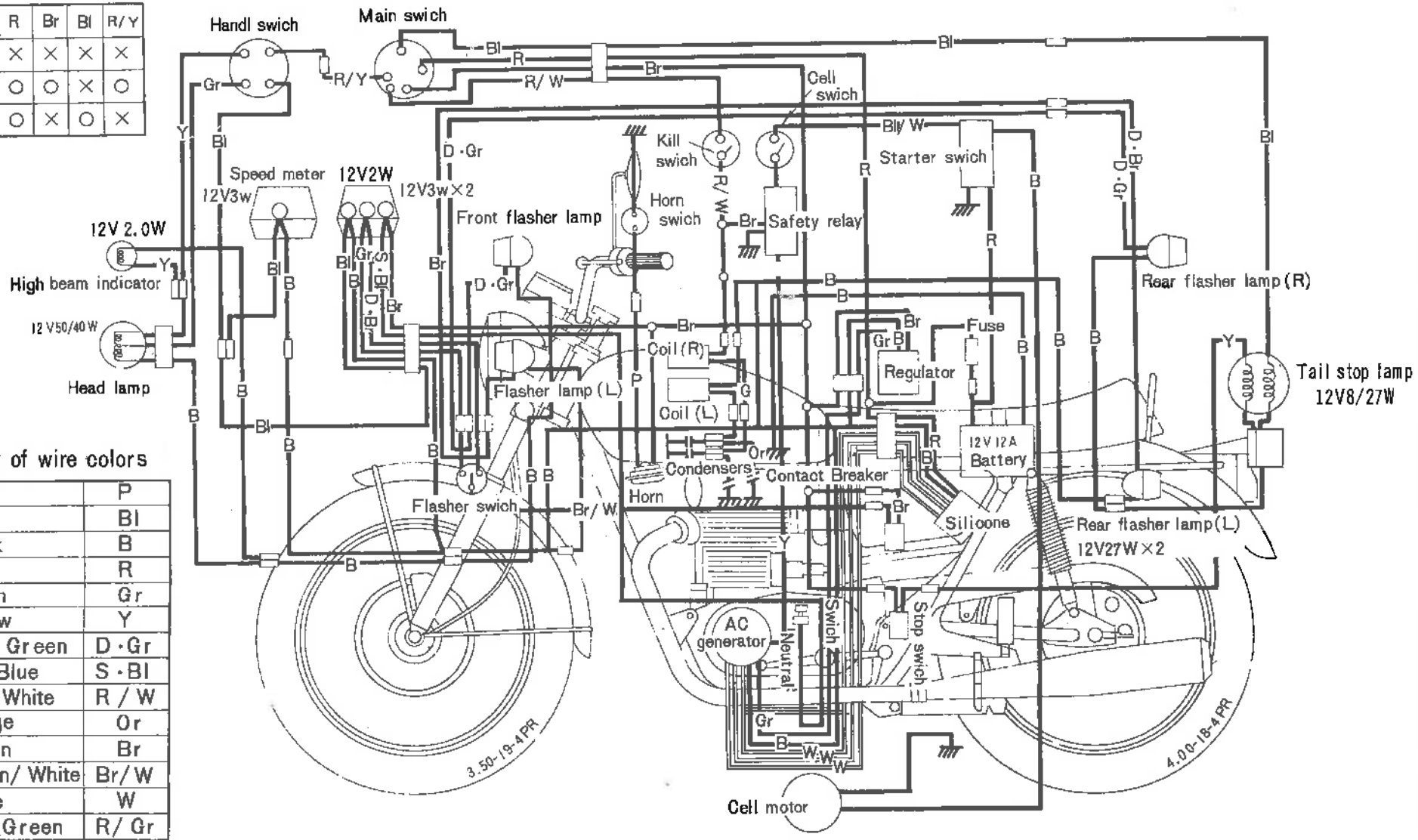


Chart of wire colors

Pink	P
Blue	Bl
Black	B
Red	R
Green	Gr
Yellow	Y
Dark Green	D·Gr
Sky Blue	S·Bl
Red/ White	R / W
Orange	Or
Brown	Br
Brown/ White	Br/ W
White	W
Red/ Green	R/ Gr
Grey	G

TIGHTENING TORQUE VALUES FOR ENGINE PARTS

PART NAME	SIZE (mm)	TORQUE (Kg-M)
Spark Plug	14	2.8 ± 0.1
Kick Crank Bolt	8	2.0 ± 0.1
Drain Plugs	30	3.0 ~ 3.5
Oil Delivery Pipe Bolt	10	2.3 ± 0.1
Air Cleaner Element Screw	6	1.0 ± 0.1
Drive Sprocket Nut	23	13.0 ± 0.1
Primary Drive Gear Nut	16	5.5 ± 0.1
Rotor Nut	12	12.0 ± 0.1
Yoke Screw	6	1.0 ± 0.1
Clutch Nut	18	13.0 ± 0.1
Clutch Springs Bolts	6	1.0 ± 0.1
Cylinder Head Cover Bolts	8	2.3 ± 0.1
Cylinder Head Cover Nuts	10	3.8 ± 0.1
Cylinder Head Side Cover Nuts	6	0.9 ± 0.1
Valve Adjusting Nuts	8	2.5 ± 0.1
Crankcase Cover Screws	6	1.0 ± 0.1
Crankcase Screws	8	2.0 ± 0.1
Cylinder Retaining Bolts	8	1.7 ± 0.1

TORQUE SPECIFICATIONS

Stud size	kg.-m	In-lbs *
6 mm	1.0	90
7	1.5	135
8	2.0	180
10	3.2–4.0	300–350
12	4.0–4.6	350–400
14	4.6–5.2	400–450
17	5.87–7.0	500–600
Spark Plug	**2.7-2.9**	**230-250**

*** Ft-lbs = in-lbs divided by 12**