AMF

Harley-Davidson

SERVICE MANUAL

1978½ to 1980

Electra Glide - FL/FLH
Super Glide - FX/FXE/FXEF/FXS

Part No. 99482-80

IMPORTANT NOTICE

Harley-Davidson motorcycles produced after January 1, 1978, conform to all applicable U.S.A. Federa Motor Vehicle Safety Standards and U.S.A. Environmental Protection Agency regulations effective on the date of manufacture.

To maintain the safety, dependability and emission control performance it is essential that the procedures, specifications and service instructions in this manual are followed.

Any substitution, alteration or adjustment of emission system components outside of factory specifications may be prohibited by law.

AMF Harley-Davidson Motor Co., Inc

FOREWORD

This service and repair manual has been prepared with two purposes in mind. First, it will acquaint the reader with the construction of the Harley-Davidson product and assist him in performing basic maintenance and repair. Secondly, it will introduce to the professional Harley-Davidson mechanic the latest field-tested and factory-approved major repair methods. We sincerely believe that this manual will make your association with Harley-Davidson products more pleasant and profitable.

HOW TO USE YOUR SERVICE MANUAL

Your Service Manual is arranged for quick, easy reference. This manual is divided into numbered sections. Sections are then divided into sub-sections. Use this manual as follows:

1. Check the TABLE OF CONTENTS located in the front of each section to find subject desired.

2. Page number is listed across from subject. Page number consists of section number and page number.

3. Information is presented in a definite order as follows:

   Minor adjustments
   Minor maintenance or repair
   Complete disassembly
   Cleaning
   Major maintenance or repair
   Assembly

In figure legends, the number following a name of a part indicates the quantity necessary for one complete assembly.

All information for servicing a part should be read **before** repair work is started to avoid needless disassembly.

NOTE: All information, photographs and illustrations are based on the latest product information available at the time of publication.

SERVICE BULLETINS

In addition to the information given in this Service Manual, Service Bulletins are issued to Harley-Davidson Dealers from time to time, which cover interim engineering changes and supplementary information. Service Bulletins should be consulted for complete information on the models covered by this manual.

USE GENUINE REPLACEMENT PARTS

To ensure a satisfactory and lasting repair job, follow the manual instructions carefully and use only genuine Harley-Davidson replacement parts.

WARNING — Gasoline is extremely flammable and highly explosive under certain conditions. Always stop engine, and do not smoke or allow open flame or sparks when refueling or servicing the fuel system, or when using gasoline as a cleaning solvent where specified in this manual.

IMPORTANT NOTICE!

Statements in this manual preceded by the following words are of special significance:

WARNING — means there is the possibility of personal injury to yourself or others.

CAUTION — means there is the possibility of damage to the vehicle.

Other information of particular importance has been placed in italic type.

We recommend you take special notice of these items.

1978½ to 1980 FL/FLH FX/FXE/FXEF/FXS

SERVICE MANUAL

The information in this manual applies to the 1978½ to 1980 FL/FLH/FX/FXE/FXEF/FXS Models manufactured after January 1, 1978.

PART NO. 99482-80

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PRODUCT 1

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GENERAL

SPECIFICATIONS

DIMENSIONS

	FL-80	FLH	FLH-80	FX/FXE	FXS
Wheel Base	61.12	61.12	61.12	63	63.5
Overall Length	89.0	92.88	92.88	91.5	92
Overall Width	42.5	42.5	42.5	33.75	29
Overall Height	63.25	63.25	63.25	45.75	41.75

VEHICLE WEIGHTS (as shipped from the factory)

FL-80 722
FLH 722
FLH-80 722
FX 548
FXE/FXEF 586
FXS 586

VEHICLE WEIGHT RATINGS

NOTE

Gross Vehicle Weight Ratings (GVWR) and Gross Axle Weight Rating (GAWR) are found on a label on the right front frame downtube.

	FL-80	FLH	FLH-80	FX/FXE FXEF	FXS
GVWR	1180	1180	1180	1085	1085
GAWR – Front	410	410	410	390	390
GAWR – Rear	770	770	770	695	695

CAPACITIES

		Total	Reserve
Fuel Tanks: (U.S. Gal.)	FL/FLH	3.5 or 5	1 or 1.2
	FX/FXE	3.6	0.6
	FXS/FXEF	3.5	1.0
Oil Tank		4 Quarts (U.S.)	
Transmission		1-1/2 Pints (U.S.)	

ENGINE

Model Designation Letters ..... FL-80, FLH, FLH-80
Number of Cylinders 2
Type ..... 4 Cycle, 45 Degree V Type
Horsepower ..... FL-80 — 60 hp @ 4800 rpm
FLH — 60 hp @ 5200 rpm
FLH-80 — 65 hp @ 5400 rpm
Bore ..... 1200 cc — 3.438 in. (87.3 mm)
1340 cc — 3.498 in. (88.8 mm)
Stroke ..... 1200 cc — 3.968 in. (100.8 mm)
1340 cc — 4.250 in. (108.0 mm)
Piston Displacement ..... 1200 cc — 73.66 cu in.
1340 cc — 81.6 cu in.
Torque ..... FL-80 — 67 lb-ft @ 3600 rpm
FLH — 70 lb-ft @ 4000 rpm
FLH-80 — 71.5 lb-ft @ 3800 rpm
Compression Ratio ..... FL-80 — 7.4 to 1
FLH — 8 to 1
FLH-80 — 8 to 1
Spark Plug ..... See ELECTRICAL SPECIFICATIONS

VEHICLE IDENTIFICATION NUMBER

The vehicle identification number (V.I.N.) is stamped on the right side of the engine crankcase, right side of frame steering head, and on a label on the right front frame downtube. It consists of a model code, a serial number, a manufacturer's identification and model year as shown in the table. The manufacturer's identification used for model years 1978 and 1979 is an H. 1980 and later model years use the letter J.

Model	First Two Digits (Model)	Next Five Digits (Sequential Number)	Second Last Digit (Manufacturer)	Last Digit (Model) (Season)
FLH-1200	2A		Harley-Davidson	
FX-1200	2C			
FXE-1200	9D			
FXEF-1200	5E			
FXEF-80	6E		H	9
FXS-1200	2F	10,000		(1979)
FLH-80	3G	and		
FXE-80	6G	up		
FXS-80	7G			
FXWG-80	9G			
FLH-80 Classic	3H			
FLHS-80	5H			
FL-80	6H		J	0
FLH-1200 Police	7H			(1980)
FLH-1200 Shrine	8H			
FLH-80 Police	9H			
FLH-80 Shrine	1K			

Examples: 1979 FLH-1200, 2A12141H9
1980 FLH-1200 2A12151J0

Always give this V.I.N. number when ordering parts or making an inquiry.

TRANSMISSION

Type ..... Constant mesh, 4 speeds forward

Internal Ratios

	4 Forward	
	FL-80/FLH FLH-80	FX/FXE FXEF/FXS
1st	3.00	2.45
2nd	1.82	1.82
3rd	1.23	1.23
4th	1.00	1.00

Engine Sprocket Teeth 24, 23, 22
Clutch Sprocket Teeth 37
Transmission Sprocket Teeth ..... FL Models - 22
FX Models - 23
Rear Wheel Sprocket Teeth 51
Overall Gear Ratios

	Engine Sprocket					
	4 Speed					
	24		23		22	
	FL	FX	FL	FX	FL	FX
1st	10.74	8.38	11.19	9.91	11.68	10.33
2nd	6.50	6.24	6.79	6.51	7.09	6.80
3rd	4.39	4.21	4.59	4.40	4.79	4.60
4th	3.57	3.42	3.73	3.57	3.90	3.73

NOTE

23 and 22 tooth engine sprockets are used for sidecar operation.

TIRE DATA

The following tire inflation pressures are based on rider and passenger weights of approximately 150 lbs. each. For each 50 lbs. extra weight, increase pressure of rear tire 2 psi, front tire 1 psi, and sidecar tire 1 psi.

		Tire Pressure — PSI (Cold)		
		Front	Rear	Sidecar
Solo rider	FL Models FX Models	20 24	24 26	
Rider and one passenger	FL Models FX Models	20 24	26 28	
Rider and one sidecar passenger or 150 lbs.	(FL/FLH Only)	22	26	20

WARNING — The maximum cold inflation pressure of these tires is 32 psi.

WARNING — For your own personal safety, tires and tubes must be correctly matched to wheel rims. Tires and tubes listed below must be used exclusively for replacement. Mismatching tires, tubes and rims may result in damage to the tire bead during mounting or may allow the tire to slip on the rim, damaging the tube, causing rapid tire deflation. In addition, using tires and tubes other than those specified may adversely affect motorcycle stability. Use only tube type tires on all Harley-Davidson cast and laced (wire spoked) wheels. Protective rubber rim strips must be used on laced (wire spoked) wheels.

FL MODELS — All Years
Cast or Laced

16 Inch Front and Rear

Harley-Davidson Tire Series ..... TTT
Tire Size MT90-16
Tire Mfg. & Type ..... Goodyear, Speed Grip
Tube
Goodyear, G5.10-16 - fits 5/8" (.625) dia. valve stem hole
Goodyear, H-16 (MT90-16) - fits 11/32" (.345) valve stem hole

FX MODELS — 1979 and Earlier
Laced Wheels

19 Inch Front

Tire Size MM90-19T
Tire Mfg. & Type ..... Goodyear, Sport Rib
Tube ..... Goodyear, V18/19

16 Inch Rear

Tire Size MT90-16
Tire Mfg. & Type ..... Goodyear, Speed Grip
Tube ..... Goodyear, G5.10-16

FX MODELS — 1980 and Later
Laced Wheels

19 Inch Front

Harley-Davidson Tire Series ..... YYY
Tire Size MJ90-19
Tire Mfg. and Type ..... Goodyear, Eagle A/T
Tube ..... Goodyear, V18/19

16 Inch Rear

Harley-Davidson Tire Series ..... WWW
Tire Size MT90-16
Tire Mfg. & Type ..... Goodyear, Eagle A/T
Tube ..... Goodyear, G5.10-16

FX MODELS — All Years — Cast Wheels

19 Inch Front		16 Inch Rear	
Harley-Davidson Tire Series	YYY	Harley-Davidson Tire Series	WWW
Tire Size	MJ90-19	Tire Size	MT90-16
Tire Mfg. & Type	Goodyear, Eagle A/T	Tire Mfg. & Type	Goodyear, Eagle A/T
Tube	Goodyear, V18/19	Tube	Goodyear, G5.10-16

SERVICE

SERVICING A NEW MOTORCYCLE

WARNING

For the rider's personal welfare, all the listed service and maintenance recommendations should be followed, because they may affect the safe operation of the motorcycle.

Service operations to be performed before delivery to customer are specified in the Predelivery and Setting Up Instructions and Important Instructions included with each new motorcycle.

The performance of new motorcycle initial service is required to keep new motorcycle warranty in force, and to ensure proper emissions systems operation.

After a new motorcycle has been driven its first 500 miles and again at approximately 1250 miles, a Harley-Davidson dealer should perform the following initial service operations.

CHECK AT FIRST 500 MILES

1. Change engine oil.
2. Replace oil filter.
3. Clean tappet oil screen.
4. Clean primary chain housing magnetic drain plug.
5. Change transmission oil.
6. Inspect air cleaner and service as required.
7. Check and adjust chains.
8. Check battery electrolyte level. Check and clean connections.
9. Check rear brake pedal adjustment.
10. Inspect brake fluid level and condition.
11. Check brake pad linings and discs for wear.
12. Check clutch adjustment.
13. Clean tank fuel valve screen.
14. Check fuel valve, lines and fittings for leaks.
15. Check oil lines and brake system for leaks.
16. Change front fork oil.
17. Check rear chain oiler adjustment.
18. Lubricate rear chain (if required).
19. Oil the following: Front brake handlever, throttle control cable, choke control cable, clutch control cable and handlever, seat suspension bushings, seat post roller and bolt.
20. Grease the following: foot shift lever brg., seat bar brg.*, seat post*, rear fork pivot brgs.
21. Check front and rear fork bearing adjustment.
22. Check tightness of all fasteners.
23. Check wheel spoke tightness.*
24. Check tire pressure and inspect tread.
25. Check engine low and high idle speed adjustment.
26. Check throttle and choke controls.
27. Check chain case vacuum.
28. Check operation of all electrical equipment and switches.
29. Road test.

*If applicable to equipment.

CHECK AT FIRST 1250 MILES

1. Check engine oil level.
2. Check transmission oil level.
3. Inspect air cleaner and service as required.
4. Check and adjust chains.
5. Check battery electrolyte level. Check and clean connections.
6. Check rear brake pedal adjustment.
7. Inspect brake fluid level and condition.
8. Check brake pad linings and discs for wear.
9. Check clutch adjustment.
10. Check fuel valve, lines and fittings for leaks.
11. Check oil lines and brake system for leaks.
12. Check rear chain oiler adjustment.
13. Lubricate rear chain (if required).
14. Check tightness of all fasteners.
15. Check wheel spoke tightness.*
16. Check tire pressure and inspect tread.
17. Check engine low and high idle speeds.
18. Check throttle and choke controls.
19. Check operation of all electrical equipment and switches.
20. Road test.

*If applicable to equipment.

REGULAR SERVICE INTERVALS

The following chart outlines recommended Maintenance and Lubrication intervals after performance of service on a new motorcycle and the initial break-in period. Refer to the following figures when using the chart; Figure 1-1 and 1-1A.

IMPORTANT

To prevent over-greasing, use hand grease gun on all grease fittings.

REGULAR SERVICE INTERVAL
Suggested Operations Following the Initial Break-In Period

Regular Service Intervals	Index No.	Grease	Index No.	Oil	Index No.	Service
Every 300 miles			1	Rear chain (if required)		
Every 1250 miles					7	Service air cleaner
					8	Check and adjust chains
					9	Check battery electrolyte level/check and clean connections
					27	Check rear brake pedal adjustment
					11	Check brake pad linings and discs for wear
					12	Check fuel valve, lines and fittings for leaks
						Inspect oil lines and brake system for leaks
					14	Check rear chain oiler adjustment
						Check tightness of all fasteners
					16	Check tire pressure and inspect tread
					17	Check wheel spoke tightness*
						Check all electrical equipment and switches
Every 2500 miles	2	Speedometer drive*	18	Front brake handlever	23	Replace oil filter element
	3	Foot shift lever bearing*	19	Throttle control cable	24	Clean tappet oil screen
	4	Rear brake pedal bearing*	20	Choke control cable	25	Clean chain housing magnetic plug
			21	Clutch control cable and handlever	26	Replace spark plugs
					27	Inspect brake fluid level and condition
			22	Seat suspension bushings*	21	Check clutch adjustment
		Seat bar bearing*			12	Check tank fuel valve screen
	5	Seat post*		Seat post roller and bolt*	28	Check ignition timing
	6	Rear fork pivot bearings			29	Check engine low and high idle speeds
						Check low speed mixture setting*
					30	Check carburetor controls
Every 5000 miles	30	Throttle control grip sleeve			32	Change front fork oil
					33	Check rear shock rubber bushings
	31	Speedometer cable			6	Check front and rear fork bearing
					34	Lubricate ignition advance*
Every 10,000 miles	35	Wheel bearings				
Weekly						Check tires and battery

* If applicable to equipment

SERVICE INTERVAL ENGINE AND TRANSMISSION

	300 Miles	1250 Miles	2500 Miles	5000 Miles or 1 Year	Spring and Fall
Engine Oil	Check	Check	Change		Change
Transmission Oil		Check		Change	Change

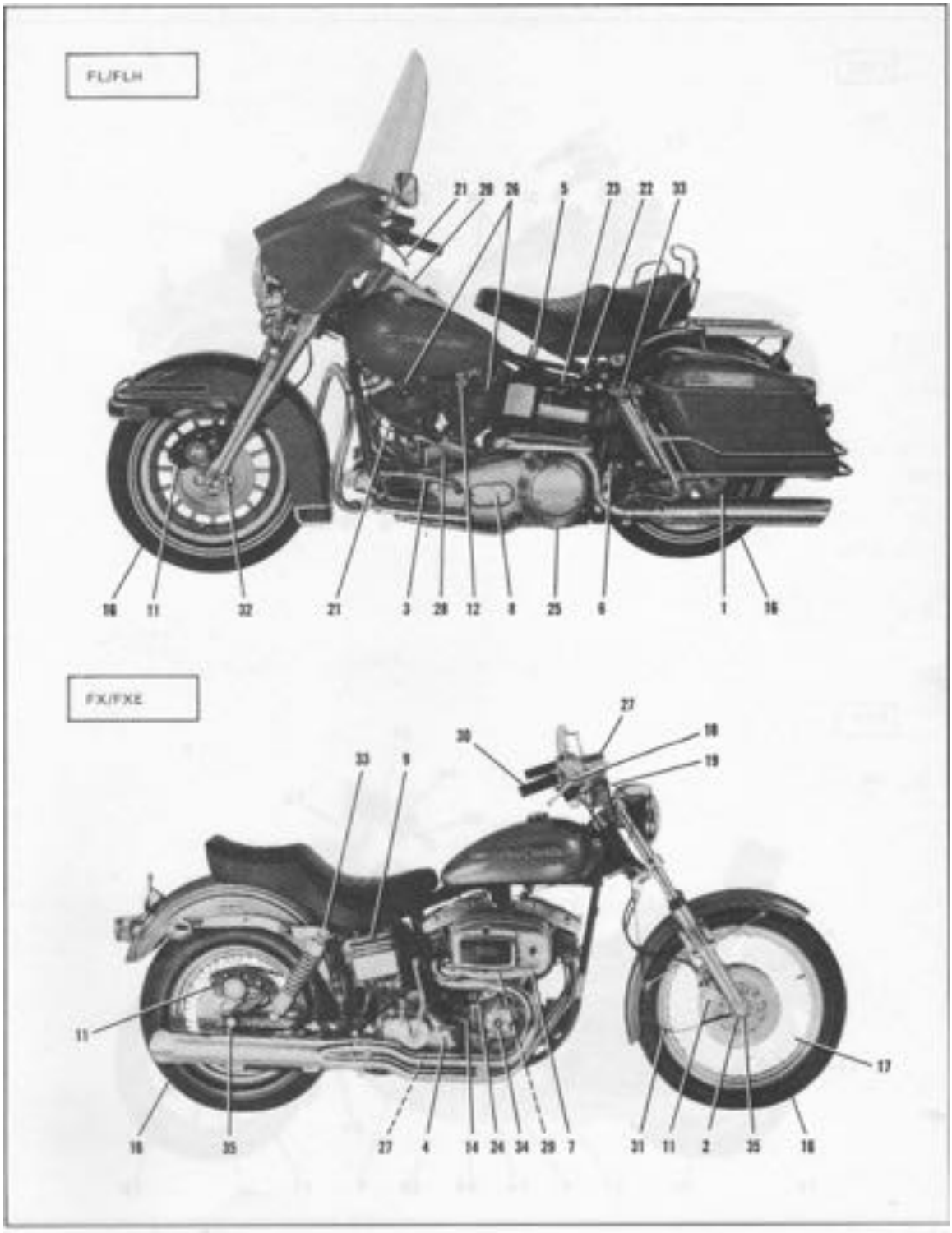


Figure 1-1. Lubrication and Service Chart

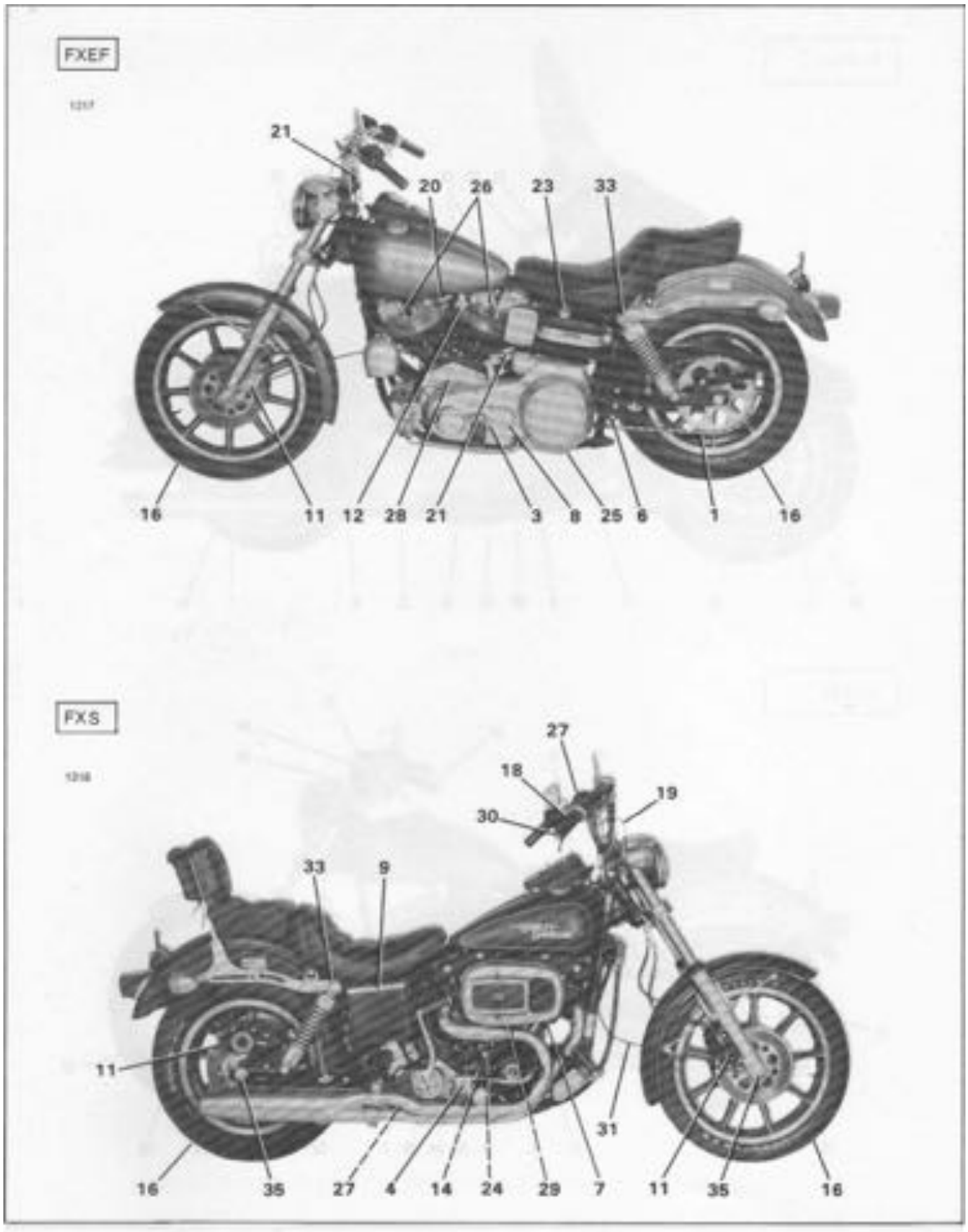


Figure 1-1A. Lubrication and Service Chart

TORQUE REQUIREMENTS

GENERAL FASTENER TIGHTENING SPECIFICATIONS

Torque specifications for specific components are listed below. For all other fasteners, use the values listed in the table below. Torque figures are in ft-lbs except those marked with an asterisk (*) which are in in-lbs.

FASTENER	TYPE	MINIMUM TENSILE STRENGTH	MATERIAL	Body Size or Outside Diameter														
				2	3	4	5	6	8	10	¼	5/16	⅜	7/16	½	9/16	⅝	¾	1
	SAE 2 STEEL	74,000 PSI	LOW CARBON								6	12	20	32	47	69	96	155	206	310
	SAE 5 STEEL	120,000 PSI	MEDIUM CARBON HEAT TREAT						14*	22*	10	19	33	54	78	114	154	257	382	587
	SAE 7 STEEL	133,000 PSI	MEDIUM CARBON ALLOY								13	25	44	71	110	154	225	368	570	840
	SAE 8 STEEL	150,000 PSI	MEDIUM CARBON ALLOY								14	29	47	78	119	169	230	388	600	700
	SOCKET HEAD CAP SCREW	160,000 PSI	HIGH CARBON QUENCHED TEMPERED								16	33	54	88	125	180	250	400	640	970
	SOCKET SET SCREW	212,000 PSI	HIGH CARBON QUENCHED TEMPERED					9*	16*	30*	70*	140*	18	29	42	63	100	146		
	STUDS	Use SAE 2, 5 and 8 values when grade is known, with nut of sufficient strength.																		

SPECIFIC FASTENER TIGHTENING SPECIFICATIONS

The following is a list of torque specifications for specific components. The values given are in ft-lbs unless otherwise specified.

WHEELS

Axle nuts 50
Sprocket mounting bolts or nuts ..... 34 to 42
Brake disc mounting — 16 in. wheel ..... 21 to 27
19 in. wheel 16

BRAKES

Rear brake anchor nuts 50
Caliper mounting bolts — FL front and rear ..... 30 to 34
FX front ..... 115 to 120 in-lbs

FORKS

Upper bracket pinch bolt ..... 22 to 26
Lower bracket pinch bolts ..... 22 to 26
Slider cap nuts 11

HANDLEBAR

Throttle control clamp screws ..... 12 to 16 in-lbs
Handlebar clamp screws — FL 30
FX 20
Riser mounting bolts — FL ..... 40 to 45
FX ..... 55 to 70

ENGINE

Sprocket shaft nut 400
Crank pin nuts 200
Pinion shaft nut ..... 140 to 160
Pinion gear shaft nut ..... 35 to 45
Oil pump cover bolt or nut with plastic gasket 45 to 50 in-lbs
with paper gasket 95 to 100 in-lbs
Cylinder head bolt 55-60
Cylinder base nut ..... 32 to 36
Rocker arm cover nut ..... 12 to 15
Upper engine mounting bracket nut ..... 35 to 40
Stator mounting screw ..... 30 to 40 in-lbs
Crankcase stud nut ..... 12 to 15
Crankcase bolt ..... 22 to 26
Tappet adjusting locknut 10

TRANSMISSION

Primary chain case bolts	18 to 22
Clutch hub nut	50 to 60
Starter cover nuts	13 to 16
Transmission sprocket locknut	140 to 150
Fork shaft nut	25
Shifter finger	50 to 60
Mainshaft ball bearing nut	6 to 9
Countershaft nut	55 to 65

ELECTRICAL

Ignition sensor mounting screws (1979 and earlier)	5 to 7 in-lb
Timer plate screws	12 to 16 in-lb
Trigger rotor bolt	20 to 24 in-lb
1979 and earlier	20 to 24 in-lb
1980 and later	75 to 80 in-lb
Spark plugs	18 to 22 ft-lb

FLUID REQUIREMENTS

HARLEY-DAVIDSON OIL

Use Harley-Davidson Power Blend Super Premium Oil for normal and severe usage in air temperatures between 20°F and 90°F. For other conditions, or if Power Blend Super Premium is not available, use oils as shown in the chart below.

Air Temperature (Cold Engine Starting Conditions)	Use Harley-Davidson Oil Grade
20°F. to 90°F. - Normal and severe operating conditons	Power Blend Super Premium
Above 40°F. Below 40°F. Severe operating conditions at air temperatures above 90°F.	75 Medium Heavy 58 Special Light 105 Regular Heavy

HARLEY-DAVIDSON CHAIN GREASE, CHAIN SAVER AND CHAIN SPRAY.

Designed especially as a chain lubricant. Penetrates inner bearings for a long chain life.

GASOLINE

For 1980 models use a good quality leaded or unleaded premium grade gasoline (94 pump octane or higher). 1978½-1979 models should use leaded premium grade only. "Pump Octane" is the octane number usually shown on the gas pump.

BRAKE FLUID

Use only D.O.T. 5 brake fluid.

HARLEY-DAVIDSON/LOCTITE PRODUCTS

The Harley-Davidson/Loctite products listed below are designed to increase the reliability of fasteners and to aid in minor repairs.

WARNING — Follow the directions listed on all Harley-Davidson/Loctite products. Read all labels, warnings and cautions carefully before using.

Application	Product	Part No.	Size
Lock fender braces, master cylinder bolts, brake anchors, exhaust flanges and general body hardware.	Lock N' Seal® Adhesive	99625-77	6 ml tube on card
Secure upper and lower fork assemblies, shock absorber mounts, fittings, axle nuts, shift lever screws, cylinder head and crankcase studs, and handle bar clamps.	Stud N' Bearing Mount Adhesive	99626-77	6 ml tube on card
Lock adjustment screws and assembled parts. Secure foot rests and kick starters.	Wick N' Lock™ Adhesive	99627-77	6 ml tube on card
Retain brake pedal bushings, main shaft sprockets, counter shafts, oil seals, drive train, linkage, clutch hub and sprocket assemblies.	Retaining Compound	99628-77	10 ml tube on card
Bond brake pedal and kick starter pads. Secure loose hand grips. Repair loose windshield moldings, and other rubber, vinyl and plastic parts.	SuperBonder® Adhesive	99629-77	3 ml tube on card
Seal threaded fuel line fittings, hydraulic brake line fittings and engine plugs.	Pipe Sealant with Teflon*	99630-77	6 ml tube on card
Make emergency gaskets on-the-spot. Seal crankcase covers, cylinder blocks to crankcase, fuel and oil pumps, and rocker arm covers.	Gasket Eliminator™ Sealant	99633-77	24 ml tube on card
Prevent galling, seizing and corrosion on oil drain plugs, spark plugs, front fork and shock assemblies and chain slides.	Anti-Seize Lubricant	99632-77	12 oz. aerosol can
Dissolve grease, dirt and oil from parts quickly and safely. Prepare mating surfaces for Loctite products.	Safety Solvent	99631-77	12 oz. aerosol can

*Reg. TM DuPont Corp.

LOCATING TROUBLES

The following check list of possible operating troubles and their probable causes will be helpful in keeping your motorcycle in good operating condition. More than one of these conditions may be causing the trouble and all should be carefully checked.

WARNING — The troubleshooting section of this manual is intended solely as a guide to diagnosing problems. Carefully read the appropriate sections of this manual before performing any work. Observe all cautions and warnings.

ENGINE

CRANKING MOTOR DOES NOT OPERATE OR DOES NOT TURN ENGINE OVER

1. Engine run switch in "Off" position.
2. Ignition switch not on.
3. Discharged battery or loose or corroded connections (solenoid chatters).
4. Starter control circuit, relay or solenoid defective.
5. Electric starter shaft pinion gear not engaging.

ENGINE TURNS OVER BUT DOES NOT START

1. Gas tank empty.
2. Gasoline valve turned off.
3. Gasoline valve or filter clogged.
4. Discharged battery or loose or broken battery terminal connections.
5. Fouled spark plugs.
6. Spark plug cables in bad condition and leaking or cable connections loose.
7. Ignition timing badly out of adjustment.
8. Loose wire connection at coil.
9. Defective ignition coil.
10. Defective ignition module or sensor.
11. Sticking or damaged valve or tappets too tight.
12. Engine flooded with gasoline as a result of overchoking.
13. Engine and transmission oil too heavy (winter operation).

STARTS HARD

1. Spark plugs in bad condition or have improper gap or are partially fouled.
2. Spark plug cables in bad condition and leaking.
3. Battery nearly discharged.
4. Loose wire connection at one of the battery terminals or at coil.
5. Carburetor controls not adjusted correctly.
6. Defective ignition coil.
7. Engine and transmission oil too heavy (winter operation).
8. Timing advance weight sticking in advanced position (1979 and earlier).
9. Ignition not timed properly.
10. Gasoline tank cap bent or plugged, or carburetor fuel line closed off restricting fuel flow.
11. Water or dirt in fuel system and carburetor.
12. Choke disc stuck in open position.
13. Air leak at intake manifold.

STARTS BUT RUNS IRREGULARLY OR MISSES

1. Spark plugs in bad condition or partially fouled.
2. Spark plug cables in bad condition and leaking.
3. Spark plug gap too close or too wide.
4. Defective ignition coil.
5. Defective ignition module, or sensor.
6. Battery nearly discharged.
7. Damaged wire or loose connection at one of battery terminals or coil.
8. Intermittent short circuit due to damaged wire insulation.
9. Water or dirt in fuel system and carburetor or filter.
10. Gasoline tank cap vent plugged or carburetor vent line closed off.
11. Carburetor controls misadjusted.
12. Weak or broken valve springs.

13. Air leak at intake manifold or air cleaner.
14. Damaged intake or exhaust valve.
15. Incorrect valve timing.

A SPARK PLUG FOULS REPEATEDLY

1. Incorrect spark plug for the kind of service.
2. Piston rings badly worn or broken.
3. Fuel mixture too rich (see carburetor trouble chart).
4. Valve guides badly worn.

PRE-IGNITION OR DETONATION (Knocks or Pings)

1. Excessive carbon deposit on piston head or in combustion chamber.
2. Incorrect spark plug for the kind of service.
3. Defective spark plugs.
4. Ignition timing advanced.
5. Fuel octane rating too low.

OVERHEATING

1. Insufficient oil supply, or oil not circulating.
2. Leaking valves.
3. Heavy carbon deposit.
4. Ignition timing retarded.
5. Low power — timing advance weights sticking in retarded position (1979 and earlier).

VALVE TRAIN NOISE

1. Low pressure caused by oil feed pump not functioning properly or oil screen obstructed.
2. Hydraulic tappets not adjusted properly.
3. Defective hydraulic tappets.
4. Bent push rod.
5. Cam or cam gears worn.
6. Rocker arm binding on shaft.
7. Valve sticking in guide.
8. Excessive cold oil pressure.

EXCESSIVE VIBRATION

1. Upper mounting bracket loose or broken or improperly spaced.
2. Lower mounting bolts loose.
3. Broken frame.
4. Front chain badly worn or links tight as a result of insufficient lubrication.
5. Transmission and/or transmission sub-mounting plate loose in chassis.
6. Wheels and/or tires defective.
7. Internal engine problem.

LUBRICATION SYSTEM

OIL DOES NOT RETURN TO OIL TANK

1. Oil tank empty.
2. Scavenger pump gear key sheared.
3. Oil feed pump not functioning.
4. Restricted oil lines or fittings.

ENGINE USES TOO MUCH OIL OR SMOKES EXCESSIVELY

1. Breather valve incorrectly timed.
2. Piston rings badly worn or broken.
3. Chain oiler adjusting screw adjusted for an excessive amount of oil.
4. Insufficient chain case vacuum.
5. Valve guides worn.

ENGINE LEAKS OIL FROM CASES, PUSH RODS, HOSES, ETC.

1. Loose parts.
2. Imperfect seal at gaskets, push rod cover, washers, etc.
3. Restricted oil return line to tank.
4. Restricted breather hose to air cleaner.

EXCESS OIL OUT OF CRANKCASE BREATHER (AIR CLEANER)

1. Insufficient chain case vacuum.
2. Oil not returning to oil tank.
3. Oil lines or passages restricted.
4. Gearcase cover gasket not sealing.
5. Leakage between passages and pockets in gearcase cover and gearcase.

EXCESS OIL OUT OF CRANKCASE BREATHER WHEN STARTING ENGINE

1. Oil pump check ball stuck open.
2. Poor seal between feed and return gears in pump.

ELECTRICAL SYSTEM

ALTERNATOR DOES NOT CHARGE

1. Defective regulator-rectifier module.
2. Module not grounded.
3. Loose or broken wires in charging circuit.
4. Defective stator coils.
5. Defective rotor.

ALTERNATOR CHARGE RATE IS BELOW NORMAL

1. Defective regulator-rectifier module.
2. Defective stator coils.
3. Weak or defective battery.
4. Loose or corroded connections.

CARBURETOR

FLOODS

1. Inlet valve sticking.
2. Inlet valve and/or valve seat worn or damaged.
3. Dirt or other foreign matter between valve and its seat.
4. Excessive "pumping" of hand throttle grip.
5. Leaky or defective float.
6. Float misadjusted.

TRANSMISSION

SHIFTS HARD

1. Bent shifter rod.
2. Clutch dragging slightly.
3. Transmission oil too heavy (winter operation).
4. Shifter forks (inside transmission) sprung.
5. Corners worn off shifter clutch dogs (inside transmission).

JUMPS OUT OF GEAR

1. Shifter rod improperly adjusted.
2. Shifter forks (inside transmission) improperly adjusted.
3. Shifter engaging parts (inside transmission) badly worn and rounded.

CLUTCH

SLIPS

1. Clutch controls improperly adjusted.
2. Insufficient clutch spring tension.
3. Worn and/or soaked friction discs.

DRAGS OR DOES NOT RELEASE

1. Clutch controls improperly adjusted.
2. Clutch spring tension too tight.
3. Friction discs gummy.
4. Clutch shell keys or hub studs badly worn.
5. Clutch discs warped.

CHATTERS

1. Clutch hub friction disc rivets loose.
2. Friction discs or steel discs worn or warped.

BRAKE

DOES NOT HOLD NORMALLY

1. Master cylinder low on fluid.
2. Brake line contains air bubbles.
3. Master or wheel cylinder piston worn or parts defective.
4. Brake pads impregnated with grease or oil.
5. Brake pads badly worn (1/16 minimum lining thick ness).
6. Brake disc badly worn or warped.
7. Brake fades due to heat build up - brake pads drag ging or excessive braking.
8. Brake drags - insufficient brake pedal or hand leve free play.

CHASSIS

2

TABLE OF CONTENTS

CHAINS

GENERAL

Chain adjustment must be checked at regular intervals of 1250 miles. As chains stretch and wear, they run tighter at one spot than another. Always adjust free movement at tightest spot in chain to allow specified play midway between sprockets. Do not adjust tighter. Running chains too tight will result in excessive wear.

Inspect chains frequently for cracked, broken, or badly worn links. The rear chain may be taken apart for replacement at the connecting, or master link. The front chain does not have a connecting link. It is necessary to remove the compensating and clutch sprockets before the chain is removed for replacement. Repair of the front chain is not recommended. See "Disassembling Clutch," Section 3, for removal of sprockets.

FRONT CHAIN ADJUSTMENT (Figure 2-1)

Remove rear pivot bolt from left footboard and swing rear end of footboard down, away from chain cover. Remove 8 cover attaching screws and remove cover. Front chain tension is adjusted by means of a shoe (1) which is raised or lowered underneath the chain to tighten or loosen it. The shoe support bracket (2) moves up or down in slotted backplate (3) after loosening center bolt (4) in backplate nut. Adjust shoe support as necessary to obtain specified up and down free movement in upper strand of chain midway between sprockets and retighten bolt securely.

Front chain adjustment:
5/8 to 7/8 in. chain slack with cold engine
3/8 to 5/8 in. chain slack with hot engine.

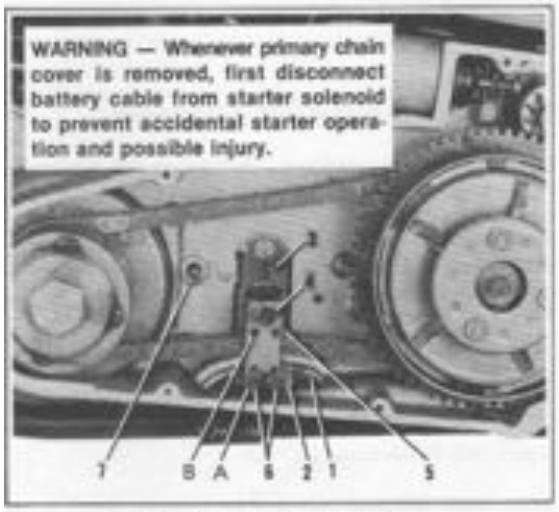
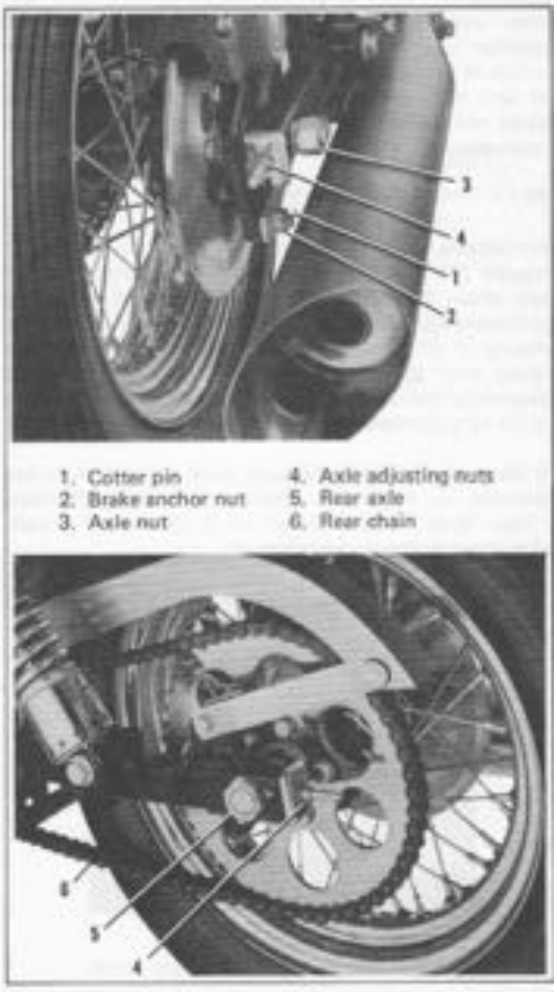


Figure 2-1. Adjusting Front Chain

Shoe support bracket (2) and outer plate (5) have two sets of shoe attaching holes (A and B) so that entire assembly can be inverted to accommodate various sprocket sizes or chain lengths. To change over, remove center bolt (4), remove two shoe attaching capscrews (6) from set of holes (A), invert shoe and attach to alternate set of holes (B) with capscrews (6). Invert support bracket and outer plate and reattach with center bolt engaged in backplate nut.

REAR CHAIN ADJUSTMENT (Figure 2-2)

Remove cotter pin (1) and loosen brake anchor castle nut (2). Loosen axle nut (3). Turn adjusting nuts (4) as necessary to move axle and correctly readjust the chain. Turn each nut an equal number of turns in order to keep wheel in alignment. To move axle (5) forward it will be necessary to tap lightly on ends of studs.



1. Cotter pin
2. Brake anchor nut
3. Axle nut
4. Axle adjusting nuts
5. Rear axle
6. Rear chain

Figure 2-2. Adjusting Rear Chain

With weight of rider on motorcycle, a correctly adjusted rear chain should have 1/2 in. free play (up and down movement) halfway between transmission sprocket and rear wheel sprocket. Check correct alignment of the wheel to see that the tire runs about midway between rear fork and also that the rear sprocket runs centrally in the chain.

When readjustment is completed, tighten axle nut (3) to 50 ft-lbs torque. Tighten brake anchor nut (2) finger tight. Install cotter pin (2).

FRONT CHAIN LUBRICATION

A fixed amount of oil is supplied through an oil line from metering orifice in the oil pump. Oil drops on front chain from oiler outlet tube (7, figure 2-1). Excess oil collects at rear of chain compartment and is drawn back into engine gearcase breather.

When the front chain adjustment is checked at 1250 mile intervals, also check to see that oil comes out of oiler tube when engine is running, when viewing through cover inspection hole. If oil does not come from oiler, the supply orifice at pump is probably blocked due to accumulation of dirt, and requires cleaning. To do this, remove orifice screw and washer from oil pump and blow out passage to chain compartment with compressed air.

REAR CHAIN LUBRICATION (Figure 2-3)

Motorcycle is equipped with a rear chain oiler. At regular 300 mile intervals, make a close inspection of rear chain. If rear chain does not appear to be getting sufficient lubrication, or if there is evidence of an oversupply of oil, readjustment should be made with rear chain oiler adjusting screw. The rear chain oiler is located on the oil pump as shown below. Normal setting is 1/4 turn open which provides 2 or 3 drops per minutes.

If chain oiler is not being used, brush dirt off chain and lubricate at 1250 mile intervals with Harley-Davidson "Chain Saver," "Chain Spray" or "Chain Grease" if available; if not available, use engine oil.

1. Rear chain oiler adjusting screw
2. Cover plug for tappet oil supply screen

Figure 2-3. Rear Chain Oiler Adjustment

If the motorcycle is operated under extremely dusty or dirty conditions, thorough cleaning and lubrication of the rear chain may be advisable from time to time. Under these conditions, proceed as follows:

CLEANING CHAIN OILER

Normal setting of adjusting screw is 1/4 turn open. If orifice becomes blocked it will be necessary to clean as follows:

Turn adjusting screw inward until it bottoms on its seat. Keep a count of the number of turns.

Remove adjusting screw and clean orifice with compressed air.

Re-install adjusting screw and turn it inward until it bottoms on its seat.

Turn adjusting screw outward the same number of turns determined in step 2.

LUBRICATION – UNUSUAL CONDITIONS

If motorcycle is operated under extremely dusty conditions, additional lubrication of the rear chain may be advisable from time to time. Under these conditions remove chain from motorcycle. Soak and wash thoroughly in a pan of solvent such as kerosene. After removing chain from kerosene, allow kerosene to drain off or blow off with air hose. After chain is completely dry apply Harley-Davidson "Chain Spray," "Chain Saver," or "Chain Grease," following instructions on container label. Wipe all surplus lubricant from surface of chain. Install chain on motorcycle. Inspect connecting link and spring clip closely for bad condition. Replace if at all questionable. Be sure clip is correctly and securely locked on pin ends with open end of clip trailing direction of chain travel.

REMOVING AND INSTALLING REAR CHAIN

Locate and remove spring on connecting link. Connecting link having press fit in side plate can be pressed apart with Chain Tool, Part No. 95020-38 which is supplied in accessory rider tool kit. A Shop Tool is available under Part No. 95021-29 for this purpose. To install new press fit connecting link, use Rear Chain Assembling Tool, Part No. 95020-66.

GAUGING REAR CHAIN WEAR

When chain has been removed for cleaning, check it for elongation caused by wear as follows:

1. Lay chain on a flat surface.

2. Take up the play in the links by pushing the chain ends toward each other, a few links at a time.

3. When the chain is fully compressed, measure its length. Stretch the chain to its full length and measure again. Replace rear chain if play exceeds 1 in.

GAUGING FRONT CHAIN WEAR

Front chain is not equipped with a connecting link so it cannot be opened for checking. Replace chain when it has worn to the point that it cannot be properly adjusted.

REMOVING AND INSTALLING FRONT CHAIN

Remove chain housing cover and lower front chain tensioner shoe as previously described under "Front Chain Adjustment." Then remove engine sprocket and clutch sprocket as described in "Disassembling Clutch," Section 4.

NOTE

Engine sprocket is aligned with clutch sprocket by a selection of spacers beteen sprocket and alternator rotor. Reinstall same thickness of spacers as you removed, or determine correct spacer size as follows:

With clutch disassembled from clutch hub and compensating sprocket disassembled from sprocket shaft as shown, determine spacer (4, figure 2-4) thickness as follows:

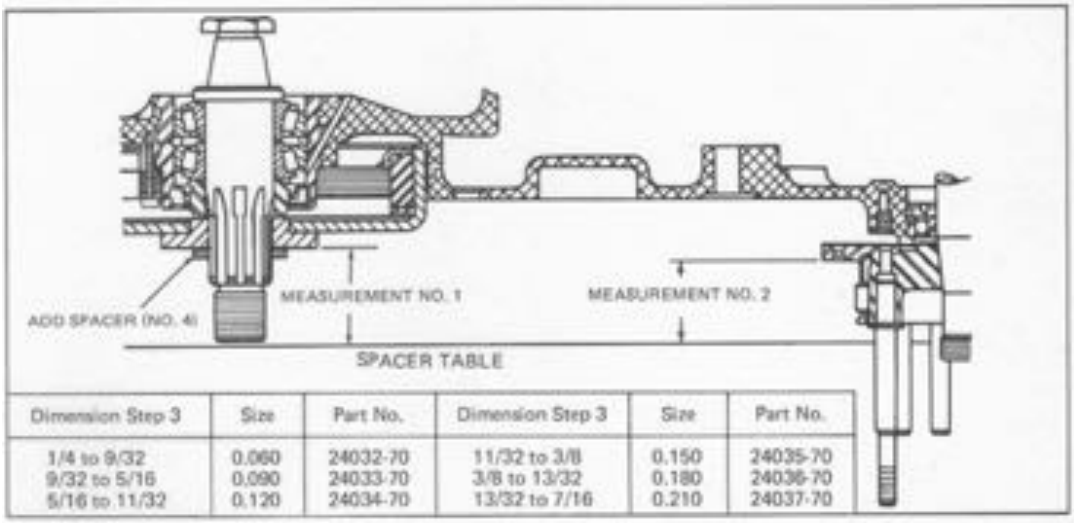
Example (refer to figure 2-4)

1. Measure from chain cover surface to alternator rotor flange ..... 1-3/4 in.

2. Measure from chain cover surface to clutch disc friction surface ..... 1-7/16 in.

3. Subtract measurement (Step 2) from measurement (Step 1) ..... 5/16 in.

4. Spacer thickness from table ..... 0.120 in.



SPACER TABLE

Dimension Step 3	Size	Part No.	Dimension Step 3	Size	Part No.
1/4 to 9/32	0.060	24032-70	11/32 to 3/8	0.150	24035-70
9/32 to 5/16	0.090	24033-70	3/8 to 13/32	0.180	24036-70
5/16 to 11/32	0.120	24034-70	13/32 to 7/16	0.210	24037-70

Figure 2-4. Determining Engine Sprocket Spacer Thickness to Secure Chain Alignment

WHEELS

GENERAL

Maximum tire mileage and good handling qualities are directly related to care given wheels and tires. A front tire kept in continuous service will wear irregularly and peaked and may affect handling, especially if over-inflated. It is important that correct tire pressure be maintained at all times. Tire pressure should be checked before riding when the tires are cold.

CHECK LIST

At regular intervals of approximately 5000 miles or if the motorcycle develops handling irregularities at high speed, check the following list for possible causes:

1. Loose wheel axle nuts. Tighten to 50 ft-lbs maximum.

2. Excessive wheel hub bearing play.

3. Loosened spokes.

4. Rear wheel out of alignment with frame and front wheel.

5. Rims and tires out-of-true sideways (tire run-out should not be more than 3/64 in.).

6. Rims and tires out-of-round or eccentric with hub (tire run-out should not be more than 3/32 in.).

7. Irregular or peaked front tire tread wear. Replace tire if handling is affected.

8. Tires over-inflated. Check "Tire Data" Section. Do not over-inflate.

9. Tire and wheel unbalanced. Static balancing alone may be satisfactory if dynamic balancing facilities are not at hand, however both are recommended. See "Wheel and Tire Balancing."

10. Steering head bearings loose or tight. Correct adjustment and replace pitted or worn bearings and races. See "Forks."

11. Shock absorber not functioning normally. Check possible causes. See "Forks."

12. Rear fork bearings loose. Check possible causes. See "Forks."

13. Heavy front end loading. Non-standard equipment on the front end such as heavy radio receivers, extra lighting equipment or luggage, tends to cause unstable handling. Extra equipment on the front end should be held down to a minimum.

In most every case, high speed handling faults are caused by one or more of the foregoing conditions being present on the motorcycle. The possible exception will be the case where there is serious frame or fork misalignment.

Keeping tires inflated to recommended pressure is of major importance. In many cases, this attention alone applied to a solo motorcycle will remedy faulty handling at high speeds.

It is advisable to rebalance wheels and tire, at least statically, whenever the tire and/or tube is replaced.

FRONT WHEEL

FL – REMOVING AND INSTALLING (Figure 2-5)

Block motorcycle under frame until front wheel is clear of ground. Disassemble in following order:

Remove axle caps (1), axle nut (2), lockwasher (3), and flat washer (4). Loosen the two slider cap nuts (5) and remove axle (6). The front wheel is now free to come out. Note position of hub cap (7) and spacer (8).

CAUTION – Do not operate the front brake lever when the front wheel is removed because the brake caliper piston may be forced out, requiring disassembly of the brake system to get it properly reseated.

When replacing the wheel, reverse the removal procedure. Align the brake pads while installing the wheel so that brake disc goes between the pads. Tighten axle nut (2) to 50 ft-lbs torque and then tighten the two slider cap nuts (5) to 11 ft-lbs torque.

1. Axle cap (2)
2. Axle nut
3. Lockwasher
4. Flat washer
5. Cap nuts (2)
6. Axle
7. Hub cap
8. Spacer
9. Bleed fitting
10. Brake disc
11. Brake caliper

Figure 2-5. Front Wheel Removal — FL

1. Left side caliper
2. Right side caliper
3. Caliper mounting hardware (2 sets)
4. Slider cap hardware (2 sets)
5. Axle
6. Axle nut
7. Lock washer
8. Washer
9. Speedometer drive
10. Brake discs

Figure 2-6. Front Wheel – FX

FX – REMOVING AND INSTALLING (Figure 2-6)

Support motorcycle underneath frame with front wheel raised. Detach both the right and left caliper assemblies from the fork sliders by removing mounting hardware (3). Let caliper assemblies hang down loose out of the way as shown in figure. Remove axle nut (6), lock washer (7) and washer (8). Loosen slider cap hardware (4). With a soft hammer tap left end of axle (5) to loosen it and start it out. Pull axle (5) out of fork assembly. Remove front wheel assembly and speedometer drive (9). To reinstall wheel, reverse above procedure. Be sure speedometer drive (9) ear engages hole in wheel hub when installed. Securely tighten axle nut (6) to 50 ft-lbs and then tighten slider cap hardware (4) and caliper mounting bolts (3) to 11 ft-lbs torque. This will insure correct alignment of the fork sides.

CAUTION – Do not operate front brake lever when the front wheel is removed because a brake caliper piston may be forced out, requiring disassembly of the brake system to get it properly reseated.

REAR WHEEL

REMOVING AND INSTALLING (Figure 2-7)

Support rear end of motorcycle with rear wheel off the ground. Disconnect rear chain at connecting link (3) by removing spring clip (1) and side plate (2). Remove brake anchor nut cotter pin (5) and loosen castle nut (6).

Remove axle nut (7), lock washer (8), and washer (9). With a soft hammer, tap right end of axle (10) to loosen it and start it out. Pull axle out of fork assembly, noting position of spacer (11) between sprocket and fork side. Wheel is then free to come out the rear.

CAUTION – Do not operate rear brake pedal when rear wheel is removed because the brake caliper piston may be forced out of the bore, requiring disassembly of the brake system to get it properly reseated.

When reassembling wheel, reverse the removal procedure. Adjust rear chain (see "Rear Chain Adjustment"). Tighten axle nut to 50 ft-lbs torque. Tighten castle nut (6) finger tight. Install cotter pin (5).

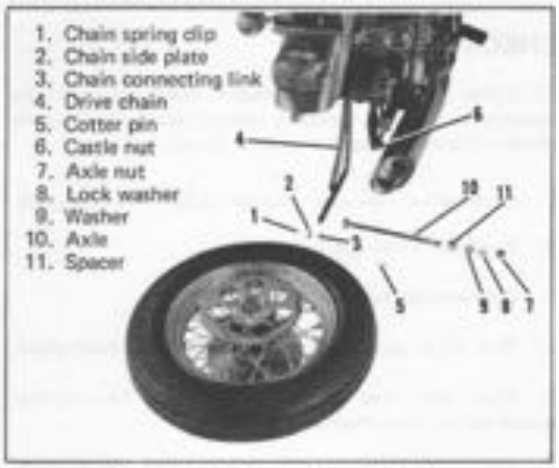


Figure 2-7. Removing Rear Wheel

1. Ram — Snap-on* Part No. CG-45-4
2. Collet — Snap-on* Part No. CG-45-6

Figure 2-7A. Snap-on Bearing Puller

WHEEL HUBS

DISASSEMBLING AND ASSEMBLING 16 INCH WHEEL HUBS (Figures 2-8, 2-9)

Remove 2 retaining rings (1), washers (2), oil seals (3), spacers (4), and bearing cones (5).

Clean all parts in solvent and inspect for damage or wear. Replace parts as necessary. If bearing cones or cups need replacing, replace as a set. Use a standard bearing puller, such as the Snap-on* puller shown in Figure 2-7A, to remove the bearing cups (6) from hub (8). Inspect brake discs for warping, scoring or worn running surfaces. Replace as necessary. On spoked wheels, check spoke flanges for bent or damaged condition.

Reassembly is basically the reverse of disassembly with the following exceptions: Apply a liberal amount of grease to bearing cones before assembly. Lubricate lip of oil seal (3) before assembly. Press oil seal (3) into hub until it is 3/16 to 1/4 in. below outside edge of hub. Bearing end play should be 0.004 to 0.018 in. when axle nut is tightened to 50 ft-lbs torque. If end play is not correct, substitute a slightly longer or shorter spacer (7) as necessary.

If brake disc (11), spacer (12) and sprocket (15) have been disassembled, make sure all mounting surfaces are clean and flat before reassembly. Tighten sprocket mounting nuts or bolts to 34 to 42 ft-lbs torque. Tighten brake disc mounting bolts to 21 to 27 ft-lbs torque.

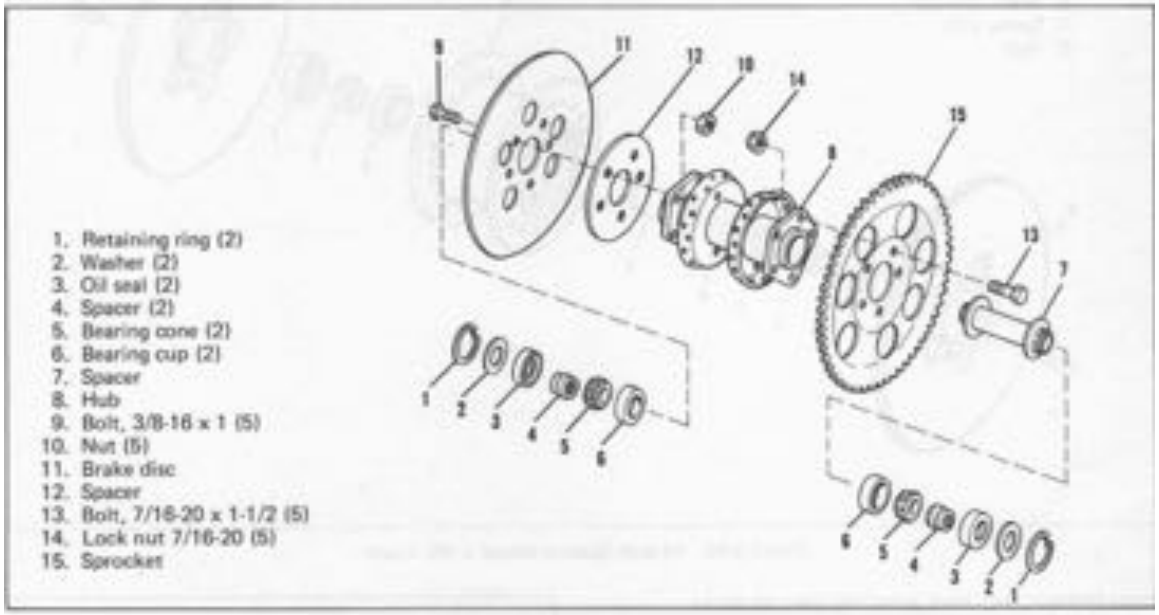


Figure 2-8. 16 Inch, Spoked Wheel — FL Front and Rear, FX Rear

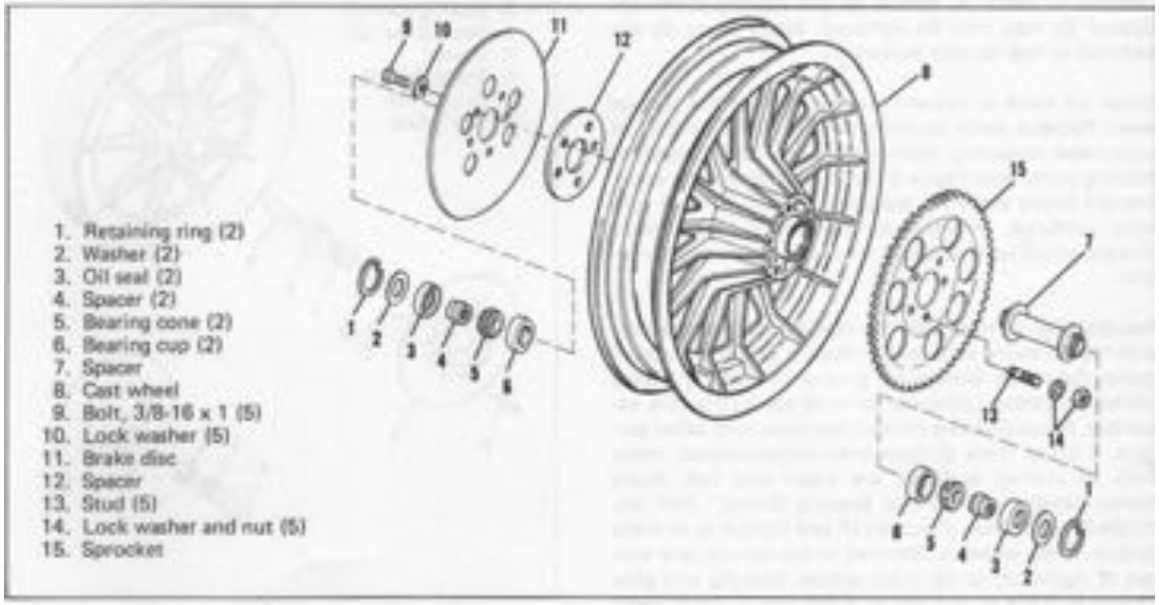


Figure 2-9. 16 Inch Cast Wheel — FL Front and Rear, FX Rear

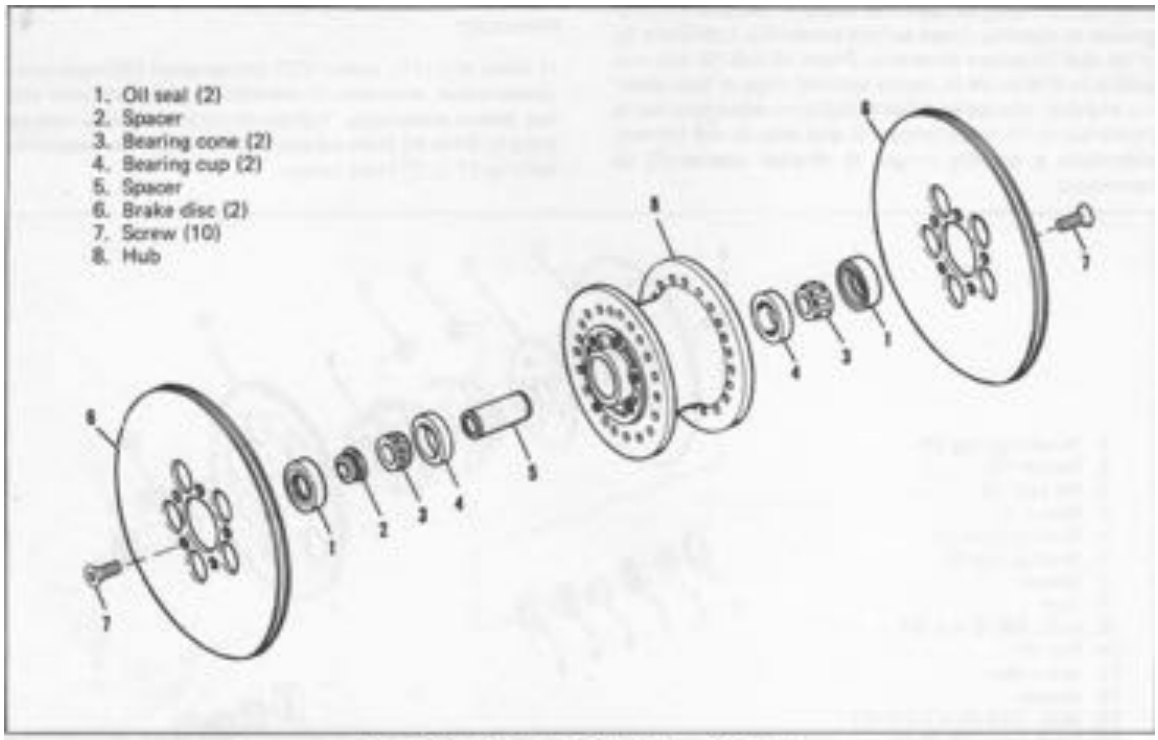


Figure 2-10. 19 Inch Spoked Wheel — FX Front

DISASSEMBLING AND ASSEMBLING 19 INCH WHEEL HUBS (Figures 2-10, 2-11)

Remove oil seals (1), spacer (2) and bearing cones (3). Spacer (5) may now be removed. Brake discs (6) are secured to hub (8) with screws (7).

Clean all parts in solvent and inspect for damage or wear. Replace parts as necessary. If bearing cones or cups need replacing, replace as a set. Use a standard bearing puller (see Figure 2-7A) to remove bearing cups. Inspect brake discs for warping, scoring or worn running surfaces. Replace as necessary. On spoked wheels, check spoke flanges for bent or damaged condition.

Reassembly is basically the *reverse* of disassembly with the following exceptions: Apply a liberal amount of Harley-Davidson Grease-All grease to bearing cones before assembly. Lubricate lip of oil seals (1) before assembly. Press oil seals (1) into hub flush with other surface. If brake discs (6) have been disassembled, make sure all mating surfaces are clean and flat. Apply Harley-Davidson "Stud and Bearing Mount," Part No. 99626-77, to threads of screws (7) and tighten to 16 ft-lbs torque. When wheel is mounted to motorcycle and axle nut is tightened to 50 ft-lbs torque, bearing end play should be 0.004 in. to 0.018 in. If end play is not correct, substitute a slightly longer or shorter spacer (5) as necessary.

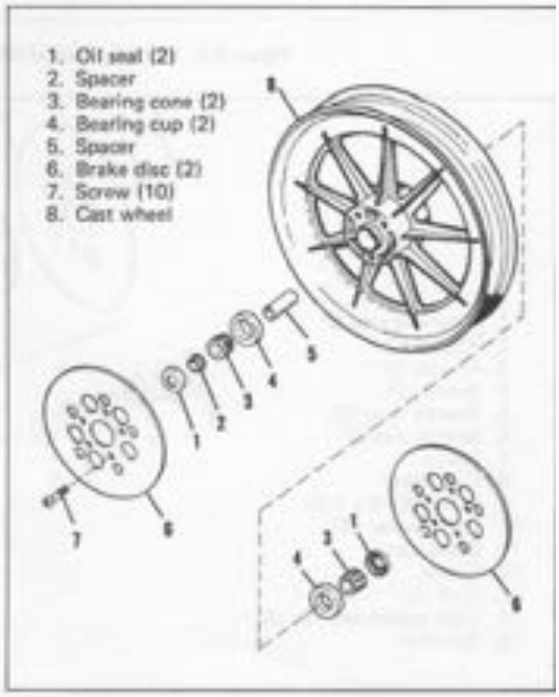


Figure 2-11. 19 Inch Cast Wheel — FX Front

SPOKING WHEELS — 16 INCH

WHEEL LACING

1. There are two styles of 16" wheel hubs and they are identified as follows:

   Early Style Hub - See Figure 2-12. Pick any outside spoke hole and sight straight across the hub. The first spoke hole to the right of the centerline is an inner spoke hole. Also, with the wheel assembled, all inner spokes on opposite sides of the wheel angle in the same direction and all outer spokes on opposite sides of the wheel angle in the same direction. See Figure 2-12B.

   Late Style Hub - See Figure 2-12A. Pick any outside spoke hole and sight straight across the hub. The first spoke hole to the right of the centerline is an outside spoke hole. Also, with the wheel assembled, all inner spokes on opposite sides of the wheel cross and all outer spokes on opposite sides of the wheel cross. See Figure 2-12C.

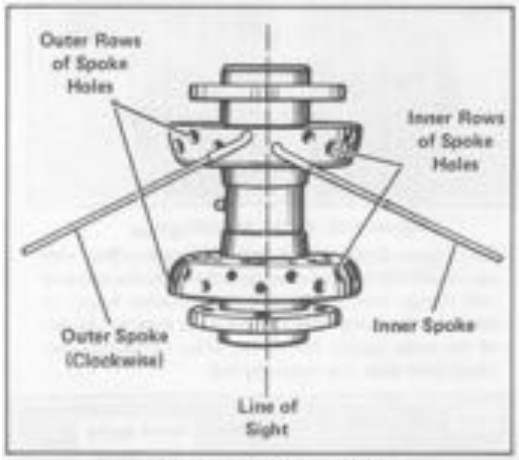


Figure 2-12. Early Style Hub

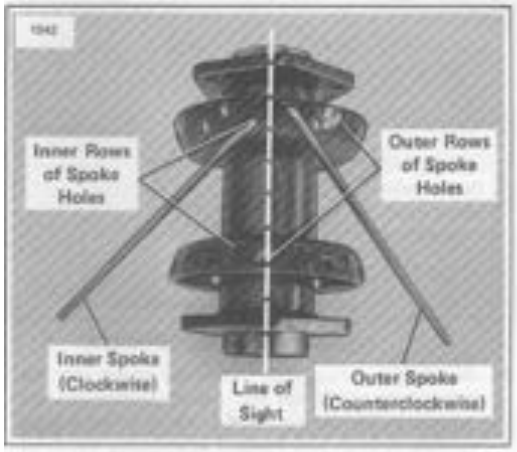


Figure 2-12A. Late Style Hub

2. There are two thread patterns used on the spokes and nipples. Align all the spokes next to each other on a table. Match the fine-threaded spokes with fine-threaded nipples and coarse-threaded spokes with coarse-threaded nipples. Do not intermix the thread patterns. Also, straighten or replace any bent spokes.

3. Place the hub on the bench with either flange up.

4. See Figure 2-12 and 2-12A. Insert 10 spokes into the upper flange inner spoke holes. Swing the loose ends clockwise as far as they will go.

   NOTE

   When lacing an old style hub, inner spokes may be started clockwise or counterclockwise because all inner spokes angle in the same direction.

5. See Figure 2-12B and 2-12C. The rim is divided into ten groups of spoke holes, 4 holes to a group. In each group, only one hole will be angled toward each upper flange inner spoke. Place the rim over the hub, either side up, and insert the spokes into these holes. Secure each spoke with a nipple screwed on the end about 3 turns, just enough to hold it in place.

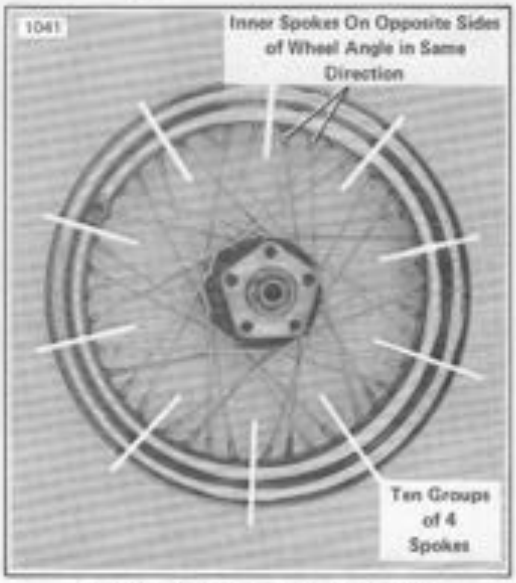


Figure 2-12B. Early Style Laced Wheel

6. When all 20 inner spokes are installed, insert a spoke into an outside spoke hole on the same flange side. See Figure 2-12 and 2-12A.

7. See Figure 2-13. Swing the outer spoke in the opposite direction crossing over 4 inner spokes, and secure the spoke in the nearest hole angled towards it. Repeat the procedure for all outer spokes.

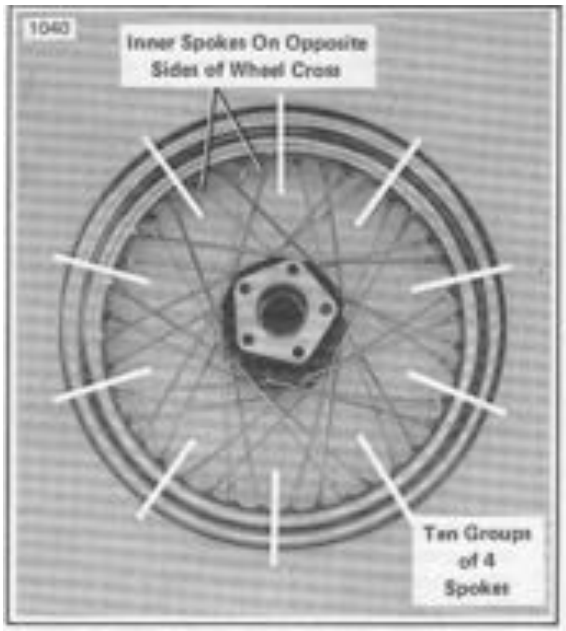


Figure 2-12C. Late Style Laced Wheel

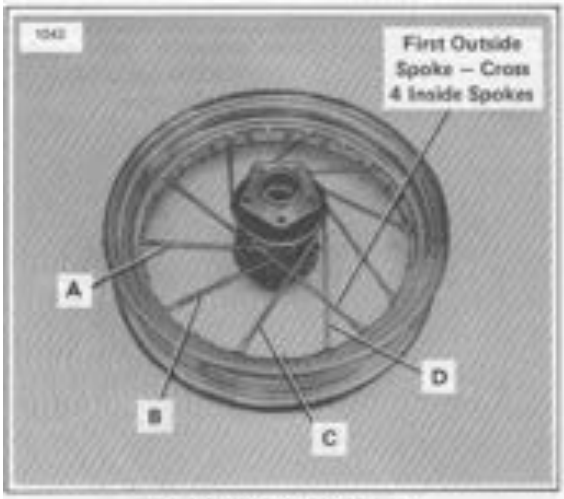


Figure 2-13. Cross-4 Pattern

NOTE

All Harley-Davidson laced wheels use a "cross-4" pattern. Each outer spoke must cross 4 inner spokes before entering rim hole.

8. Carefully flip the hub and rim assembly over and repeat the process. If lacing an early style hub, start by swinging the inner spokes in the same direction as the other side. On late style hubs, swing the inner spokes in the opposite direction as the other side so the inner spokes cross each other.

9. See "Truing Wheels."

SPOKING WHEELS — 19 INCH

NOTE:

The following procedure applies for both single and dual disc wheels.

1. See Figure 2-14. Divide spokes into 2 groups. Inner spokes have long heads, outer spokes have short heads. There are also fine and coarse threaded spokes and nipples. Match up fine-threaded spokes with fine-threaded nipples and coarse-threaded spokes with coarse-threaded nipples. Do not inter-mix the thread patterns.

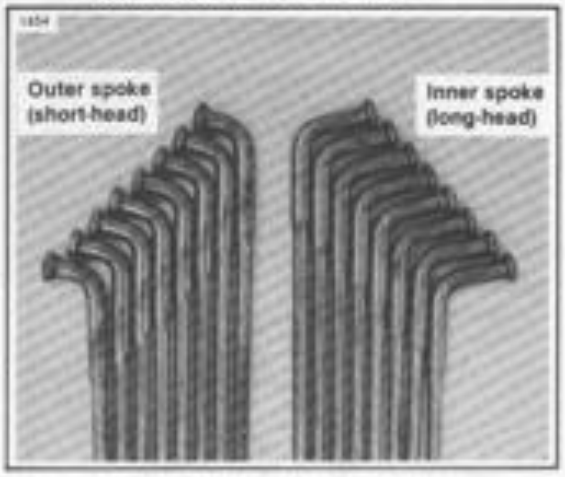


Figure 2-14. Spoke Identification

2. See Figure 2-14A. Place hub on bench either side up. Insert one outer spoke (short-head)into any bottom flange hole and swing it clockwise. Insert an inner spoke (long-head) in the next hole to the left of the outer spoke. Swing the inner spoke counter-clockwise over the outer spoke.

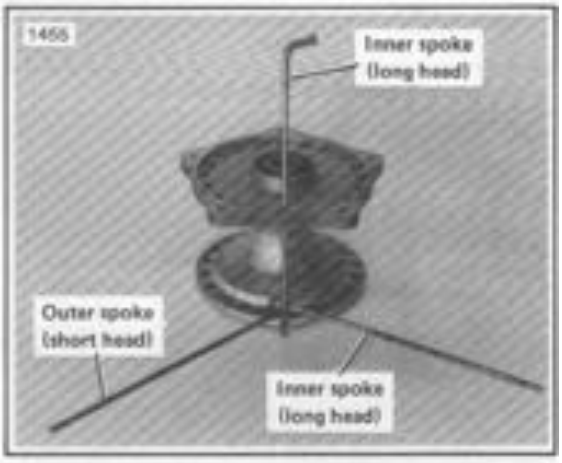


Figure 2-14A. Lacing 19" Wheel

3. See Figure 2-14A. Insert an inner spoke into the hole on the top flange that directly bisects the two spokes in the bottom flange. Insert all remaining spokes in both hub flanges alternating the inner and outer spokes.

4. See Figure 2-14B. With all 40 spokes inserted in hub, group all spokes on top flange into 2 bundles. Secure each group with throttle grips or tape to keep the spokes together.

5. Swing all bottom flange outer spokes (short-head) clockwise. Swing the inner spokes (long-head) counterclockwise, crossing over the outer spokes. Angle all spokes as far as they will go without overlapping the next "like" spoke. For instance, swing an outer spoke (short-head) clockwise as far as it will go before crossing another outer spoke.

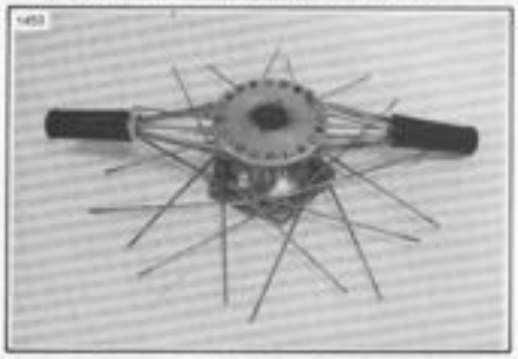


Figure 2-14B. Bundling Top Spokes

6. Center the rim over the hub assembly. Undo each top bundle and fan the spokes out around the top rim edge.

7. See Figure 2-14C. The rim is divided into ten groups of spoke holes, 4 holes to a group. Each group has two holes on the left and two holes on the right, angled inward towards each other. Only one hole in each group will be angled toward the bottom flange inner spoke (long-head). Lace all bottom flange inner spokes into these holes. Secure each spoke with a nipple screwed on the end about 3 turns.

NOTE

Hub and spoke assembly may have to be spun slightly within the rim to allow proper spoke-to-rim alignment. Keep the bottom flange spokes crossed in correct position when spinning the hub. Also, keep the top flange spokes fanned around the rim. If they fall off the rim and become tangled in the bottom flange spokes, the hub will not rotate and it might be necessary to unlace the wheel to untangle them.

8. Next lace the 10 bottom flange outer spokes (short-head). Only one hole in each group of rim spoke holes will be angled toward these spokes. Secure each spoke with a nipple screwed on about 3 turns.

NOTE

All Harley-Davidson laced wheels use a "cross-4" pattern. Each outer spoke must cross 4 inner spokes before entering rim hole.

9. Lace all the top flange inner spokes, one at a time leaving the outer spokes resting on the rim. Swing the top flange inner spokes clockwise.

10. Now lace the top flange outer spokes. Swing them counterclockwise and make sure each one crosses 4 inner spokes before securing it to the rim.

11. See "Truing Wheels."

TRUING SPOKED WHEEL

1. See Figure 2-15. Divide the wheel spokes into 4 groups of 4 and mark the center of each group with a piece of tape. The groups should be directly across from one another and approximately 90° apart. Tighten the spokes in these four groups finger tight, leaving all others loose.

2. Install truing arbor in wheel hub and place wheel in Wheel Truing Stand, Part No. 95500-29A. Tighten arbor nuts so hub will turn on its bearings.

3. See Figure 2-16 and 2-17. The hub must be centered sideways with the rim. Lay a straightedge across the hub brake disc flange and one of the

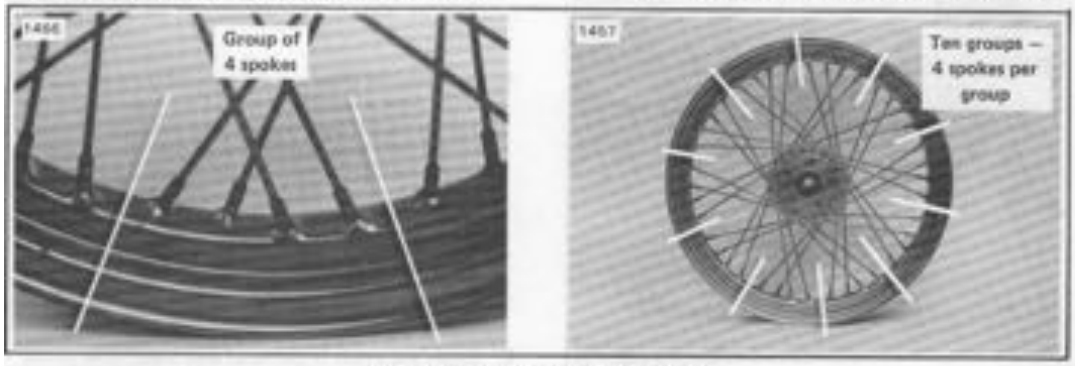


Figure 2-14C. Grouping the Spokes

Figure 2-15. Marking Spoke Groups

marked spoke groups. Measure the distance from the straightedge to the rim as shown. If this dimension is not equal on both sides of the wheel, loosen and tighten the 4 spokes accordingly. Use Spoke Wrench, Part No. 94681-39.

Example: If the measurement on the rim right side is greater than the left side, loosen the two spokes attached to the **hub** left side and tighten the two spokes attached to the **hub** right side. Turn all 4 spokes an equal number of turns until dimension is equal to within 1/32" for both sides.

Figure 2-16. Centering 16" Hub

CAUTION

Always loosen the appropriate spokes before tightening the other two. Reversing this procedure will cause the rim to become out-of-round.

Figure 2-17. Centering 19" Hub

4. Repeat Step 3 for all four groups on the wheel.

5. See Figure 2-18. After rim has been centered sideways it must be checked and trued radially. Adjust truing stand gauge to the rims tire bead seat as shown. The rim should be trued within 1/32".

6. Spin the rim slowly. If the rim contacts the gauge on or near a marked group of spokes, loosen the spokes in the marked group on the opposite side of the rim. Now tighten the spokes in the group where the rim makes contact. Loosen and tighten spokes an equal number of turns.

   If the rim contacts the gauge between two marked groups, loosen the spokes in both opposite groups and tighten the spoke groups on the side of the rim that makes contact.

7. When the wheel is centered and trued, start at the valve hole and tighten the rest of the spoke nipples one turn at a time until they are snug.

8. Seat each spoke head in the hub flange using a flat nose punch and hammer. Then check wheel trueness again and tighten the nipples accordingly.

CAUTION

Do not tighten spokes too tight or nipples may be drawn through rim, or hub flanges may be distorted. But if spokes are left too loose, they will continue to loosen when wheel is put into service.

9. File or grind off ends of spokes protruding through nipples to prevent puncturing tube when tire is mounted.

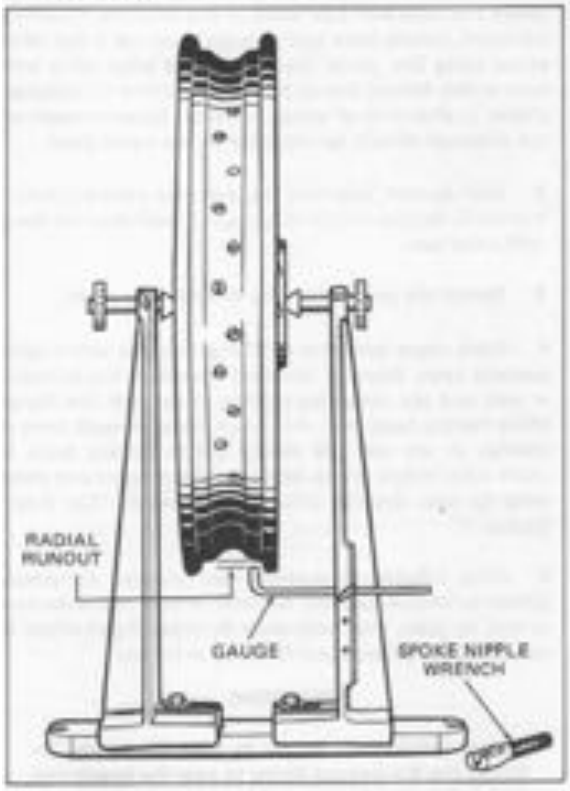


Figure 2-18. Truing Rim Radially

CHECKING CAST RIM RUNOUT

The die-cast wheels should be checked for lateral and radial runout before installing a new tire or tube.

1. See Figure 2-18A. Install arbor in the wheel hub and place wheel in the truing stand. To check rim lateral runout, place a gauge rod or dial indicator near the rim bead. If lateral runout exceeds 3/64 in., replace the wheel.

2. See Figure 2-18B. Check for radial runout as shown here. Replace the wheel if runout exceeds 1/32 in.

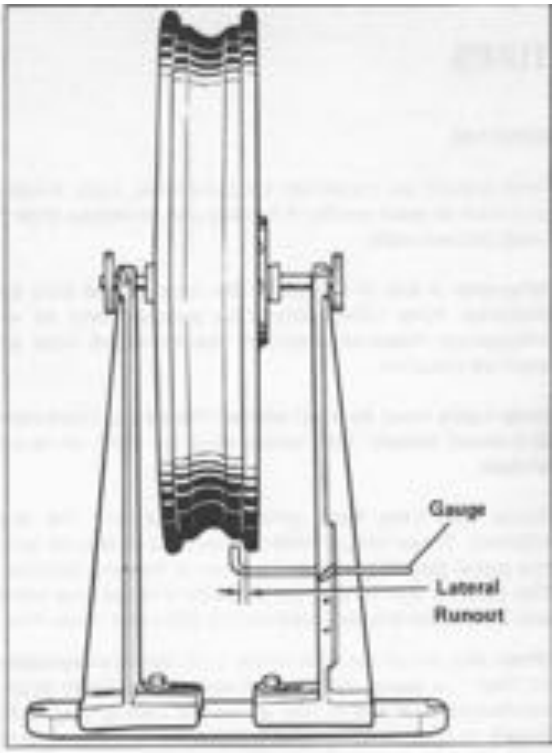


Figure 2-18A. Checking Cast Rim Lateral Runout

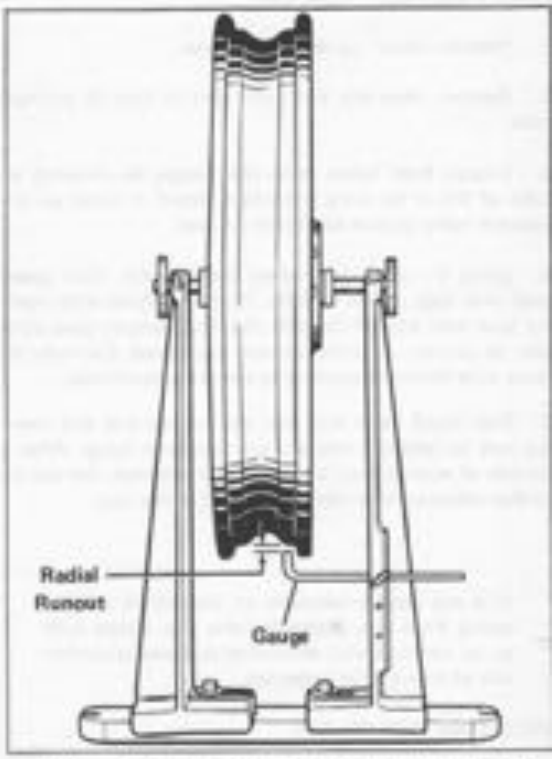


Figure 2-18B. Checking Cast Rim Radial Runout

TIRES

GENERAL

Tires should be inspected for punctures, cuts, breaks and wear at least weekly if in daily use, or before trips if used occasionally.

Whenever a tire is replaced, the tube should also be replaced. Inner tubes should be patched only as an emergency measure. Replace the damaged tube as soon as possible.

Inner tubes must be used with all Harley-Davidson cast and laced wheels. Rim bands must be used on laced wheels.

Some rear tires have arrows molded into the tire sidewall. These tires should be mounted on the rim with the arrow pointing in the direction of forward rotation. The colored dot on the tire sidewall is a balance mark and should be located adjacent to the valve stem hole.

Wheel rims are of the drop-center type, having a depression or "well" in center of rim. Rim well, being smaller in circumference than rest of rim, allows one casting bead to fit loosely in it while other bead is being worked over edge of rim.

REMOVING TIRE FROM RIM

1. Remove wheel; lay wheel on its side.

2. Remove valve cap and valve core to free all air from tube.

3. Loosen both beads from rim flanges by stepping on sides of tire or by using a tire tool. Stand or kneel on tire opposite valve to push bead into rim well.

4. Using tire tools (not sharp instruments), start upper bead over edge of rim at valve. Don't use force when starting bead over edge of rim with tire iron, because bead wires may be broken or stretched and tire ruined. Carefully remove tube before attempting to remove second bead.

5. Push lower bead into rim well on one side and insert tire iron on opposite side and pry bead over flange. After a portion of second bead is started over rim edge, tire can be further removed from rim without aid of tire iron.

NOTE

It is not always necessary to completely remove casing from rim. Removing one side allows tube to be removed and reinstalled and also allows inside of casing to be inspected.

MOUNTING TIRE ON RIM

Before installing tube in tire, all dust and dirt, particularly hard particles which might chafe an inflated tube, must be removed. Wipe tube and inside of tire thoroughly with clean, dry cloth. If rim is dirty or rusty, clean with a stiff wire brush. Be sure to examine a used tire carefully for fabric injuries that may damage tube.

Before mounting tire, see that rubber rim strip is in place in rim well, and that rim strip valve hole registers with valve hole in rim.

WARNING -- Use correct inner tube for tire size. See "Tire Data" Section 1.

1. Insert tube in tire, placing valve at tire balance mark. Swab thoroughly all around base of tube, between the tube and side walls of tire with tire mounting lubricant. Inflate tube just enough to round it out. With wheel lying flat, place tire on rim and align valve with hole in rim. Mount tire on rim so that arrow on sidewall points in direction of wheel rotation. Balance mark on tire sidewall should be adjacent to the valve stem.

2. Push bottom bead into rim well near valve and hold in well while forcing remaining portion of bead over rim flange with a tire tool.

3. Spread tire and insert valve through hole in rim.

4. Force upper bead over rim flange and into well at point opposite valve. Stand or kneel on this side of tire to hold it in well and pry remaining portion of tire over rim flange. While forcing bead over rim flange, keep as much bead as possible in rim well. Be careful not to damage beads or pinch tube. Inflate tire to recommended pressure and check valve for leak. See tire inflation pressures in "Tire Data," Section 1.

5. After inflating to recommended pressure, completely deflate to smooth out any wrinkles in tube and allow tube to find its place, free from strain or stress. Again inflate to recommended pressure and check valve for leak.

WARNING

Do not inflate over 40 psi to seat the beads. Inflating the tire beyond 40 psi to seat the beads can cause the tire-rim assembly to burst with force sufficient to cause personal injury. If the beads fail to seat at 40 psi, deflate and relubricate the bead and rim and reinflate to seat the beads but do not exceed 40 psi.

CHECKING TIRE TRUENESS SIDEWAYS (LATERAL RUNOUT)

1. Check runout by turning wheel on axle, measuring amount of sideways displacement from a fixed point near the tire (see figure 2-19).

2. Tire tread runout should be no more than 3/64 in. If tire tread runout is more than 3/64 in., remove tire from rim and check rim bead side runout to see if rim is at fault (see "Truing Wheel").

3. If rim side runout is less than 1/32 in., tire is at fault and should be replaced. If rim side runout is more than 1/32 in., correct by tightening selected spoke nipples as outlined previously, reinstall old tire and recheck tire tread lateral runout.

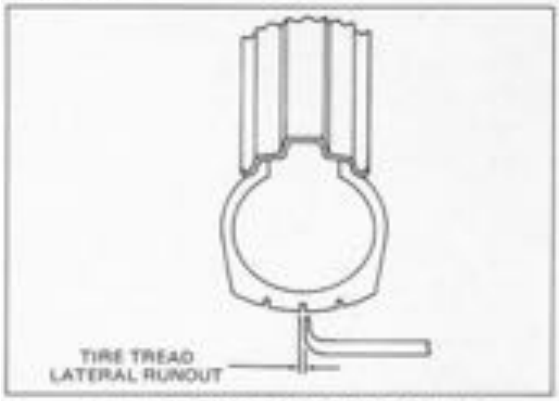


Figure 2-20. Checking Tire Radial Runout

CHECKING TIRE ROUNDNESS (RADIAL RUNOUT)

1. Check runout by turning wheel on axle, measuring tread runout (see figure 2-20).

2. Tire tread runout should be no more than 3/32 in. If tire tread runout is more than 3/32 in., remove tire from rim and check rim bead runout to see if rim is at fault (see "Truing Wheel").

3. If rim bead runout is less than 1/32 in., tire is at fault and should be replaced. If rim bead runout is more than 1/32 in., correct by tightening selected spoke nipples as outlined previously, then reinstall tire and recheck tire tread runout.

WHEEL ALIGNMENT

NOTE

Rims and tires must be true before checking wheel alignment, as outlined in previous paragraphs.

Front and rear wheels should be in perfect alignment. This can be checked on the motorcycle with a straight wooden board or length of string by placing against rear tire side wall as far up toward axles as possible. Straightedge should be parallel to tires (see Figure 2-21). On FL models, the front tire should be offset 3/16 inch to the right of the rear tire. Adjust rear wheel in axle clips as necessary to correct misalignment.

WHEEL BALANCING

Wheel balancing is recommended to improve handling and reduce vibration, especially at high road speeds.

Harley-Davidson has made available the following spoke balance weights which press over the spoke nipple.

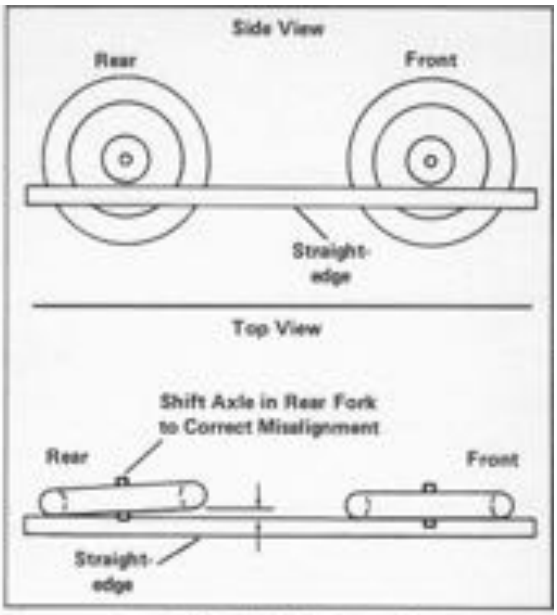


Figure 2-21. Wheel Alignment Diagram

1 oz. weight, Part No. 95582-47
3/4 oz. weight, Part No. 95581-47
1/2 oz. weight, Part No. 95578-41

Cast aluminum wheels require the special self-adhesive weights listed below:

Aluminum color
1 oz. weight, Part No. 95588-75
1/2 oz. weight, Part No. 95587-75

Black
1 oz. weight, Part No. 95591-77
1/2 oz. weight, Part No. 95590-77

Self adhesive wheel weights should be applied to the flat surface of the rim. Make sure that area of application is completely clean, dry and free of oil and grease. Remove paper backing from weight and press firmly in place so that arrow on weight points in the direction of wheel rotation. If 1 oz. or more of weight must be added at one location, split the amount so that half is applied to each side of the rim. Wheel should not be used for 48 hours to allow adhesive to cure completely.

In most cases, static balancing using wheel truing stand, Part No. 95500-29A, will produce satisfactory results. However, dynamic balancing, utilizing a wheel spinner, can be used to produce finer tolerances for best high speed handling characteristics. Follow the instructions supplied with the balance machine you are using. The maximum weight permissible to accomplish balance is 3-1/2 oz. total weight applied to the rim. Wheels should be balanced to within 1/2 oz. at 60 mph.

HANDLEBAR THROTTLE CONTROL

GENERAL

Control must operate freely and carburetor throttle must return to closed (idle) position with friction adjusting screw (10, figure 2-22) backed off. If control becomes stiff and does not return properly, it should be disassembled, cleaned and inspected.

DISASSEMBLING THROTTLE CONTROL (Figure 2-22)

To disassemble and inspect throttle control assembly, remove the two screws (1) holding the upper throttle clamps (2) to the lower throttle clamp (3). Unhook ferrule (4) from ball on end of cable (5) and from throttle grip (6). Disconnect opposite end of cable from carburetor.

Turn out the hex fitting securing the cable (5) to the lower clamp (3) and remove cable assembly from motorcycle.

Remove the friction spring (7), set screw (8), spring (9) and adjusting screw (10) from lower clamp.

INSPECTION AND CLEANING

Clean all metal parts in non-flammable cleaning solvent. Blow dry with compressed air. Replace any broken, cracked, or worn parts. Replace cable assembly if it is frayed, kinked, or bent.

ASSEMBLING THROTTLE CONTROL

After inspection, position cable assembly (5) on motorcycle. Apply a light coat of graphite to handlebar (11) and inside surface of clamps (2 and 3). Attach lower throttle clamp (3) to cable assembly. Insert set screw (8), adjusting screw (10) and spring (9) in lower clamp. Place friction spring (7) in clamp. Be sure hole in spring (7) engages adjusting screw (10).

Place ridge of throttle (6), positioned on handlebar, into groove of lower throttle clamp (3). Position ferrule (4) over ball of cable (5) and seat in throttle notch. Secure with upper clamp (2) and two screws (1). Tighten screws (1) to 12 to 16 in-lbs torque.

ADJUSTMENT

1. When turned by hand and then released, the throttle lever must return throttle grip (6) to the closed or idle position. If throttle grip (6) does not return to idle position freely, back off of adjusting screw (10) until this is accomplished. If the throttle grip turns stiffly, it should be disassembled, cleaned and inspected thoroughly.

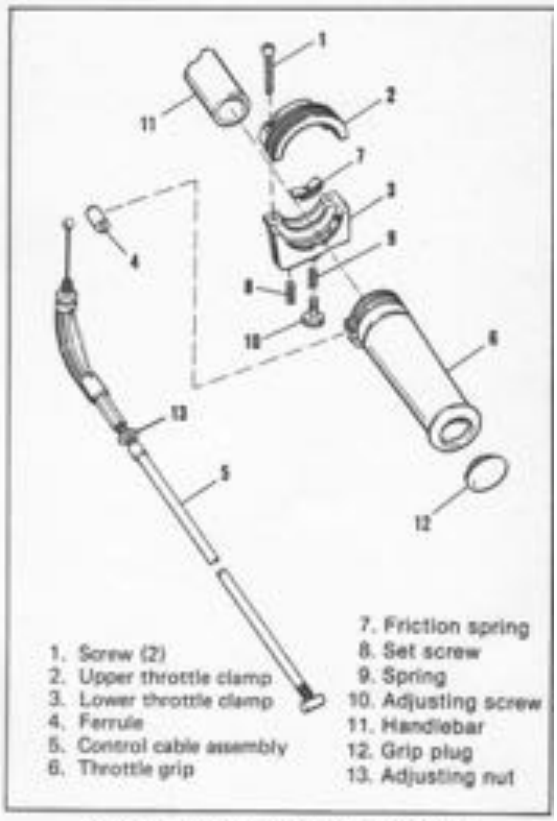


Figure 2-22. Handlebar Throttle Control

WARNING

Do not overtighten the friction screw. Operation with the friction screw overtightened is not recommended because of possible hazard involved when the engine will not return to idle position automatically in an emergency.

2. Adjust throttle cable "free play" by turning adjusting nut (13) to desired position. The cable should not put pressure on the carburetor lever when handlebars are turned to left and right stops.

3. With handlebars in straight ahead position, adjust grip travel limit. To adjust for grip travel limit, turn throttle to open position and adjust set screw (8) with a 2mm (Allen) wrench. The throttle grip should be in fully open position as the carburetor lever reaches fully open position.

CAUTION

This adjustment is necessary to prevent excess stress and potential failure of the throttle cable.

FRAME

GENERAL

To rough check a frame for correct alignment, see figure 2-23. The dimensions shown will provide basic information to determine whether a frame is enough out of alignment to require a major realigning job or replacement.

Because straightening a badly bent frame requires special tools and fixtures for holding, bending and gauging, this service is only offered by some of the larger dealerships.

NOTE

Replace all bent or broken frames. The cost of repair would be prohibitive.

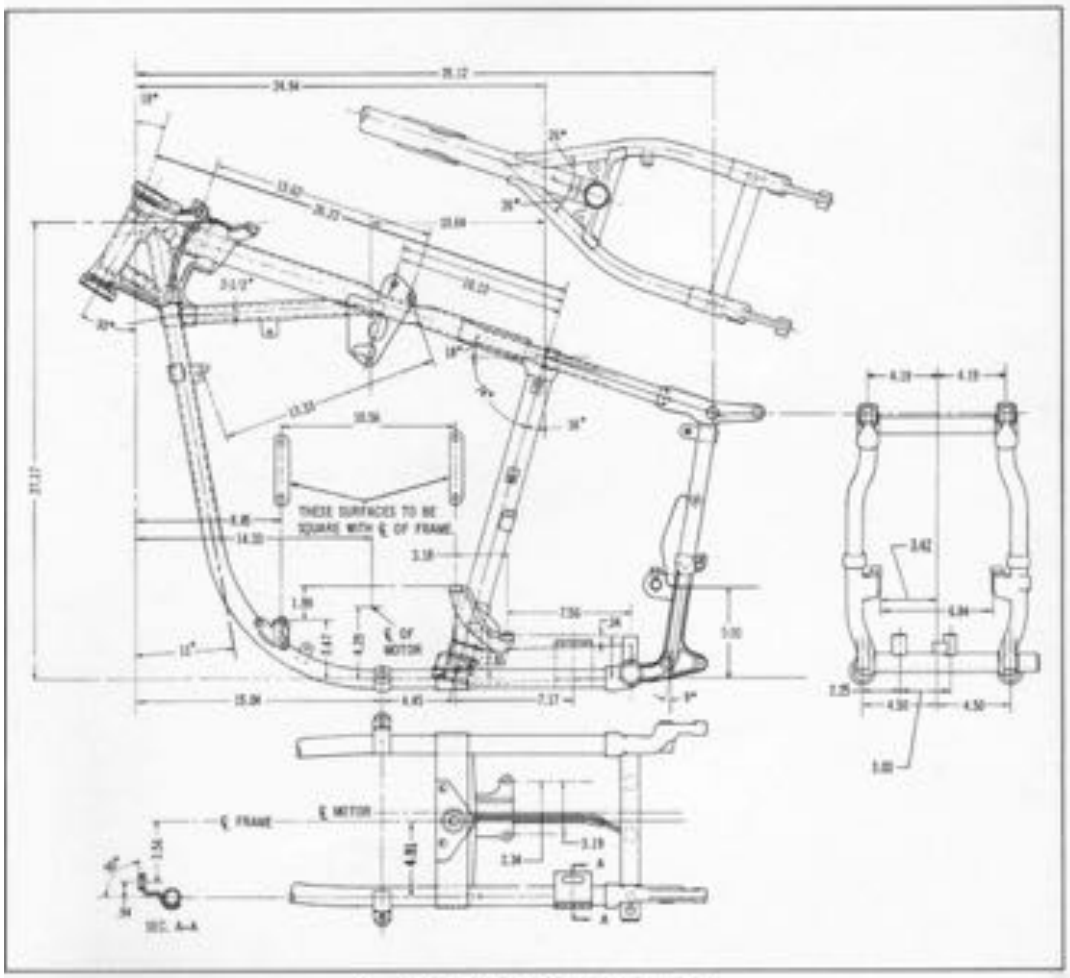


Figure 2-23. Frame with Basic Dimensions

FORKS

GENERAL

The front fork is comprised of two sets of telescoping tubes that work against springs, with an oil filled (hydraulic) dampening mechanism to control the action. The unit is engineered to give long service with a minimum of repair. Front fork oil should be changed at the initial 500 mile interval and at 5000 mile intervals thereafter.

Non-adjustable forks are for use on a solo motorcycle. The fork "trail" (the distance, at ground level, from the fork stem axis to a perpendicular through the wheel axle) is set and cannot be adjusted.

The adjustable fork is for use on a motorcycle which operates with and without a sidecar. It is essentially the same as the non-adjustable fork except it has a two-position bracket that allows the trail to be changed for best solo or sidecar-equipped operation and a steering damper adjusting mechanism which dampens the steering for operation with sidecar. All other adjustments and repairs are made exactly as on the non-adjustable fork. This fork may be recognized by the reversible bracket bolt washers, bolt and stem design (18, 19, 20, figure 2-27) as described in "Adjusting Front Fork Trail."

CHANGING OIL

Remove fork upper bracket bolt or filler screw and washer. Remove drain plug at the outside bottom of each slider tube and drain. Draining speed will be increased by gently flexing the fork as it empties. Replace drain plugs and pour specified amount of Harley-Davidson Type E Fork oil into each tube. Measure amount very carefully. Flow of oil into tubes will be increased if fork is worked up and down during filling operation. Replace upper bracket bolts and tighten securely.

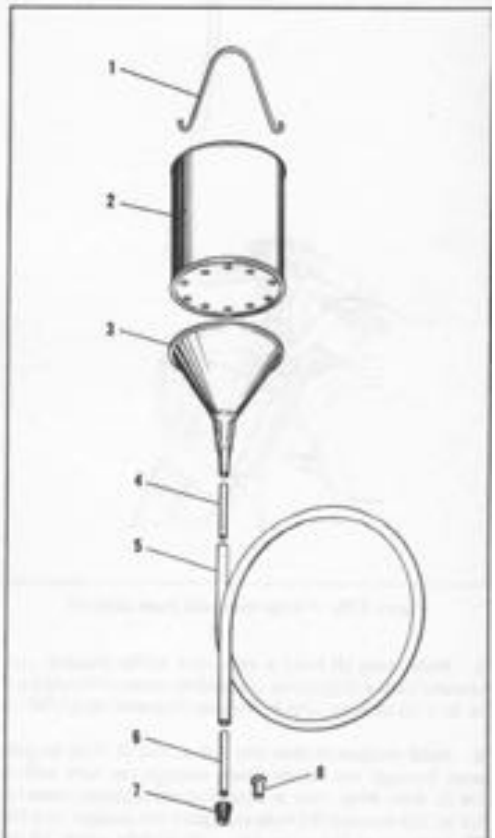
	Amount		Fork Oil Type
	Wet	Dry	
FL	7⅞ oz.	8½ oz.	Harley-Davidson Type E
FX	5 oz.	6 oz.	Harley-Davidson Type E

The difference in the amount of oil required between a DRY and a WET fork is due to oil cling.

The fork filling device shown in figure 2-24 will hasten and simplify the filling operation. The unit consists of a Neoprene (not rubber) stopper to fit the hole in the top of the fork, a length of flexible tubing, a funnel and an appropriate size can, soldered to the top of the funnel.

1. To make a filler can, drill a dozen 1/4 in. holes in the bottom of a one quart tin can (2), near the outside edge. Shape the bottom of the can with a light hammer so that it is dished upward to assure complete draining of oil through the holes.

2. Select a tin funnel (3) with the funnel mouth about the same size as the bottom of can (2). Swage and shape the funnel spout so that a piece of 1/4 in. metal tubing (4), about 2 in. long, (a piece of fuel line is suitable) can be soldered into it. Solder (3) onto the bottom of (2). Improvise and attach bail (1) to the filler can.



1. Bail
2. Filler can
3. Tin funnel
4. Metal tubing
5. Flexible tubing
6. Metal tubing
7. Rubber plug
8. Fork tube cap

Figure 2-24. Fork Filler Can Components

Figure 2-25. Filling Hydraulic Fork with Oil

3. Make plug (7) from a neoprene bottle stopper purchased from a drug store. Neoprene stopper should be 1 in. to 1-1/8 in. long, and its largest diameter about 5/8 in.

4. Hold stopper in vise and drill a 3/32 in. hole lengthwise through the center. Then enlarge the hole with a 1/4 in. drill. After hole is drilled in the stopper, insert a 1/4 in. rod through the hole and grind the stopper to a 5/8 in. diameter at the large end, and slightly under 1/2 in. diameter at the small end, straight taper between ends, to form the plug.

5. Slightly flare one end of a piece of 1/4 in. tubing (6), about 2 in. long and insert into plug (7). Attach filler can to plug with transparent flexible tubing (5) about 2 feet long. See figure 2-25.

6. Push the plug into the filler hole in fork top, figure 2-25. Pour exact amount of oil into can. Work fork up and down. Air escaping through oil in filler can as fork is pushed downward will cause the oil to bubble violently, but because the bottom of the can serves as a baffle, no oil will be lost. Compressing the fork forces air out, releasing it draws oil into fork.

7. After the can appears to be empty, allow several minutes for can to completely drain, then work fork once more. This assures getting into fork side the full quantity of oil poured into can.

INSPECTION PROCEDURE

If the hydraulic fork does not work properly or an appreciable amount of oil leakage should develop, inspect the fork as follows:

Check the oil level in each fork side by completely draining and refilling fork as described in "CHANGING FORK OIL." Be sure correct amount of oil is used to refill fork tubes. An insufficient or excess supply of oil will result in faulty recoil action. When draining oil, check for signs of water in the oil. Oil will appear emulsified, aerated or light brown in color. Leakage of oil from forks would indicate replacement of seals and O-rings is needed. See "DISASSEMBLING FRONT FORKS."

If action of front forks remains unsatisfactory after oil change, completely disassemble and inspect forks.

ADJUSTING STEERING DAMPER

Turn steering damper adjusting screw (26, figure 2-27) clockwise to apply dampening action and counterclockwise to reduce dampening action. Apply steering damper only when operating under conditions where some degree of dampening stabilizes steering. It is best to keep the damper set a little snug when operating with a sidecar.

ADJUSTING FRONT FORK TRAIL – ADJUSTABLE FORK (Figure 2-27)

To adjust fork trail for use with sidecar, turn off nut on bracket bolt (35). Tap bolt head back far enough to pry out washer (36). Grasp fork tubes and pull forward sharply. It may be necessary to loosen upper bracket bolts (2) to move fork forward or backward. Revolve bracket bolt washers 180 degrees until pin on washer is forward. Seat washer pin in slot in bracket (22) boss. Tap bracket bolt (35) into position and turn on nut.

To adjust fork for solo riding, follow same procedure except push fork tubes back and insert washer (36) so pins are rearward.

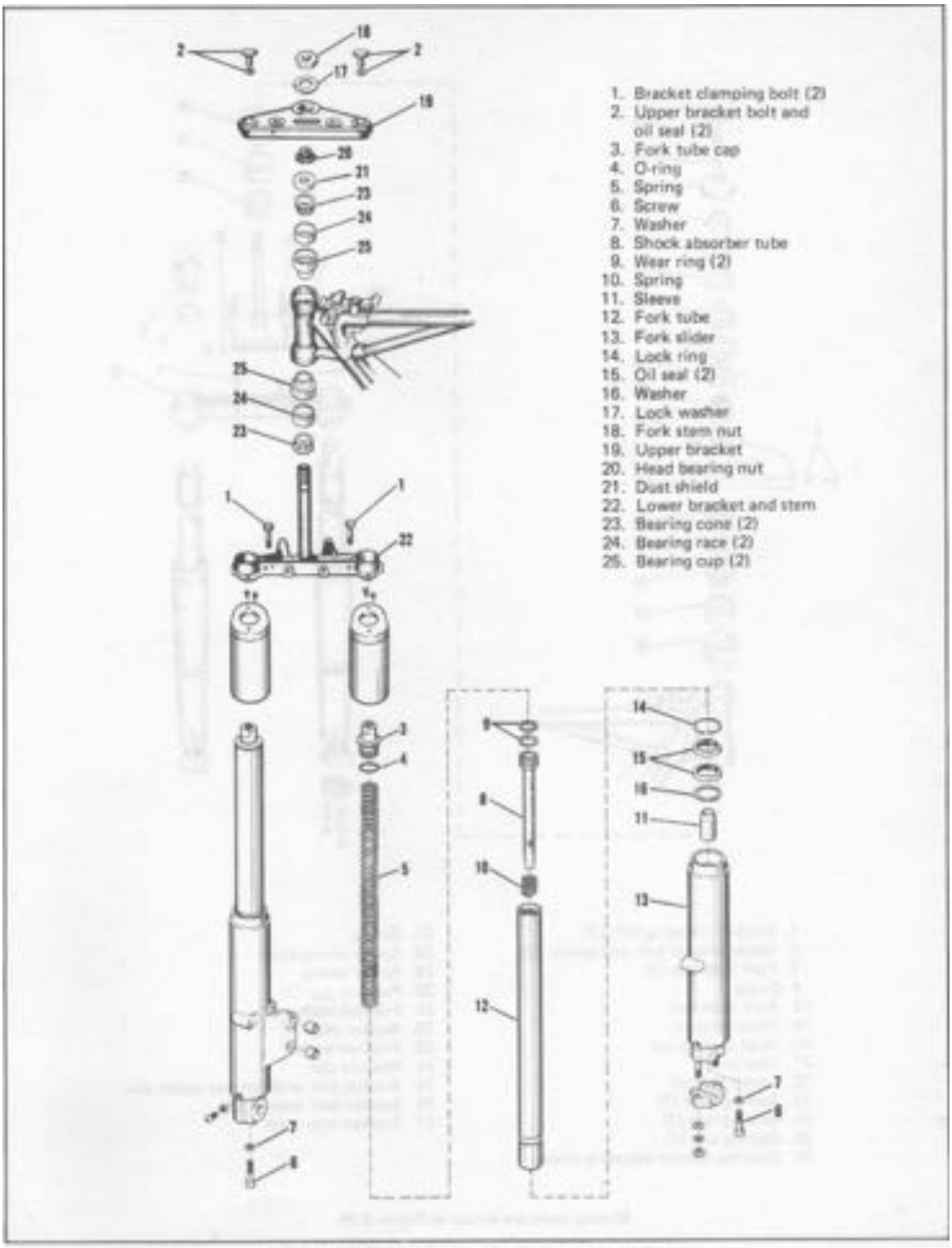
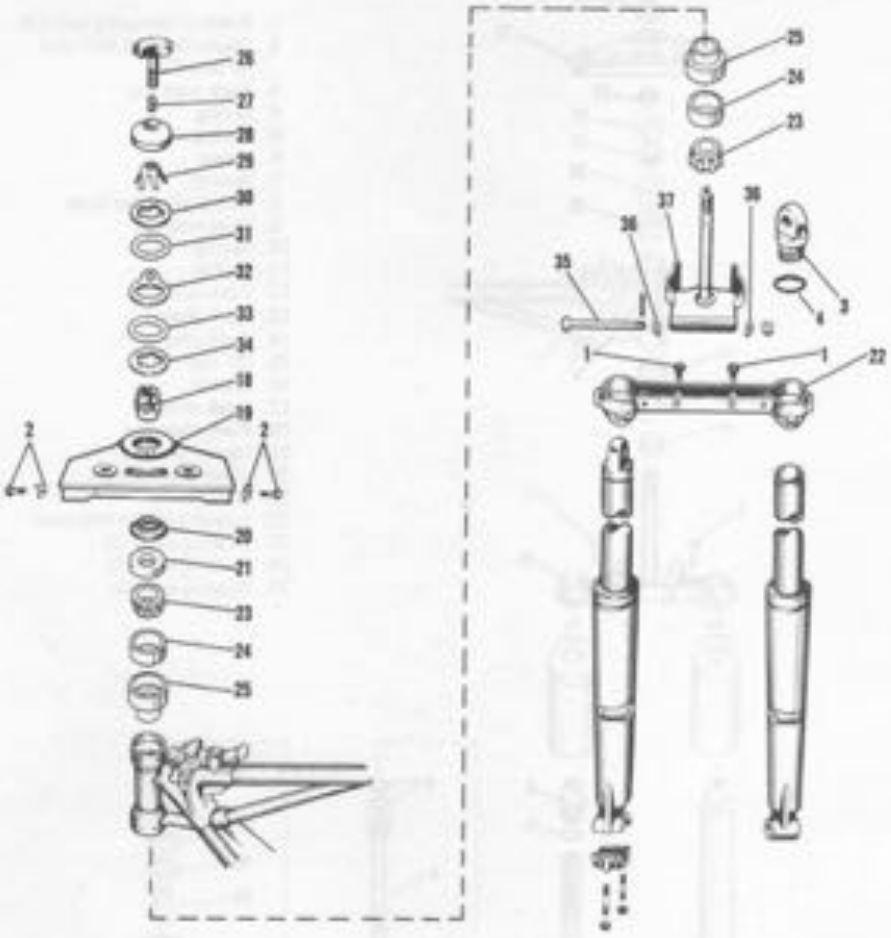


Figure 2-26. FL Non-Adjustable Fork — Exploded View



1. Bracket clamping bolt (2)
2. Upper bracket bolt and washer (2)
3. Fork tube cap (2)
4. O-ring
18. Fork stem nut
19. Upper bracket
20. Head bearing nut
21. Dust shield
22. Lower bracket
23. Bearing cone (2)
24. Bearing race (2)
25. Bearing cup (2)
26. Steering damper adjusting screw
27. Spring
28. Spider spring cover
29. Spider spring
30. Pressure disc (2)
31. Friction washer (2)
32. Anchor plate
33. Friction washer
34. Pressure disc
35. Bracket bolt with nut and cotter pin
36. Bracket bolt washer (2)
37. Bracket with stem

Missing items are shown in Figure 2-26

Figure 2-27. FL Adjustable Fork — Exploded View

FL FRONT FORK

REMOVING FORK SIDES (Figures 2-26, 2-27)

If necessary repairs involve only fork sides, the entire fork need not be disassembled.

To remove fork side, proceed as follows:

1. Remove the fairing, windshield, headlamp, headlamp housing, front wheel, brake caliper assembly, and front fender.

2. Loosen fork bracket clamping bolts (1). Remove fork upper bracket bolt oil seal or bolt and lock washer (2). Pull fork side out bottom of lower fork bracket.

DISASSEMBLING FORK SIDE (Figures 2-26, 2-27)

Remove fork tube cap (3). Remove O-ring (4) from cap. Remove spring (5) and drain oil from fork side. Remove screw (6) and washer (7). Shock absorber tube (8) may now be pulled from fork side. Remove wear rings (9) from slots in shock absorber tube. Remove spring (10) and sleeve (11).

Separate fork tube (12) and fork slider (13) by pulling the two apart. Remove seals (15) only if they are to be replaced. Remove lock ring (14) and then pry out seals (15). Discard the damaged seals. Remove washer (16).

Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should either be replaced or repaired.

Inspect seals (15) for wear. If they were removed, they must be replaced. Inspect wear rings (9) on damper tube (8) and replace if excessively worn or damaged. Replace springs (5 and 10) if broken or distorted.

Inspect small hole in groove in lower end of fork tube (12) and see that it is not obstructed.

Make sure O-ring (4) is in good condition, without any irregularities, and that it provides proper sealing when in place.

Check washer (7) to see that it provides a good seal when used with its respective screw (6) to prevent oil leakage.

Repair bent or damaged fork tube (12) as described in "Straightening Fork Tubes" later in this section.

REMOVING FORK STEM AND BRACKET ASSEMBLY FROM STEERING HEAD

Non-Adjustable Fork (Figure 2-26)

Remove fork sides as described previously. Remove horn. Remove flasher mounting hardware.

Bend tab on lock washer (17) down and remove fork stem nut (18). Lift up upper bracket (19) and handlebar assembly and set it aside. Use wrench, Part No. 96219-60 to remove head bearing nut (20). Remove dust shield (21). Pull lower fork bracket and stem (22) out bottom of frame steering head. Remove bearing cones (23).

Adjustable Fork (Figure 2-27)

Remove fork sides as described previously. Remove horn. Remove flasher mounting hardware.

Turn out steering damper adjusting screw (26) and lift out parts 27 through 34. Parts 30 and 34 may be loosened by inserting a screwdriver tip between parts and prying upward.

Remove stem nut (18). Lift up upper bracket (19) and handlebar assembly and set it aside. Remove head bearing nut (20) using special wrench, Part No. 96219-50. Remove dust shield (21). Pull lower fork bracket and stem (22) out bottom of steering head. Remove bearing cones (23).

REPAIRING STEERING HEAD AND BEARINGS

Each steering head bearing consists of two pieces, the bearing outer race, and the roller bearing with inner race. The outer races are pressed into the steering head cups in the frame head. The lower roller bearing is assembled over the fork stem and the upper roller bearing is held in place on the fork stem by the upper fork bracket and nut on the upper threaded end of the fork stem.

After fork is removed inspect bearings and races for pitting, roughness or wear. Roughness of the roller bearings can be determined by rolling the bearings on the bearing races by hand. If bearings or races require replacement it is best to replace them in sets.

To replace bearing races, knock head cup from steering head using a suitable drift. Press new bearing race in new head cup and then press assembly into frame head.

ASSEMBLING FORK SIDES (Figure 2-26, 2-27)

Assembly is the reverse of disassembly with the following exception: Fill fork sides with exactly 8½ ounces of Harley-Davidson, Type B, fork oil.

INSTALLING FORK STEM AND BRACKET ASSEMBLY, FORK SIDES AND ADJUSTING STEERING HEAD BEARINGS (Figures 2-26, 2-27)

Assembly is the reverse of disassembly. Apply a heavy coating of grease to bearing cones.

After fork sides are assembled to upper and lower bracket, tighten fork bracket clamping bolts (1) to 22 to 26 ft-lbs torque.

Assemble front fender, brake caliper and wheel to motorcycle before checking head bearing adjustment.

Fork should have free movement to either side. There should be no noticeable shake or sideways movement of the front fork. To adjust steering head bearings, tighten or loosen head bearing nut (20) as required, while tapping on bracket (22).

When bearings are correctly adjusted, install fork stem nut (18) and bend up tab on lock washer (17).

FX FRONT FORK

REMOVING FORK SIDES (Figure 2-28)

Remove front wheel and brake assembly as described in WHEEL section of this manual. Remove front fender. Remove bracket that attaches headlamp to the upper fork bracket and let hang loose by wiring harness.

Remove two screws (1) so cover (2) can be slid up out of the way, exposing the lower fork bracket. Loosen fork tube pinch bolts (3). Loosen screw (9) in upper fork bracket (5). Unscrew fork tube cap (6) from fork tube. Remove fork side (7) completely by sliding down and out of both upper and lower fork brackets. Drain oil from fork side.

DISASSEMBLING FORK SIDE (Figure 2-29)

Remove O-ring (3) from inner groove in tube cap (1) and slide off washer (4). Pull spring (5) out of fork tube (2).

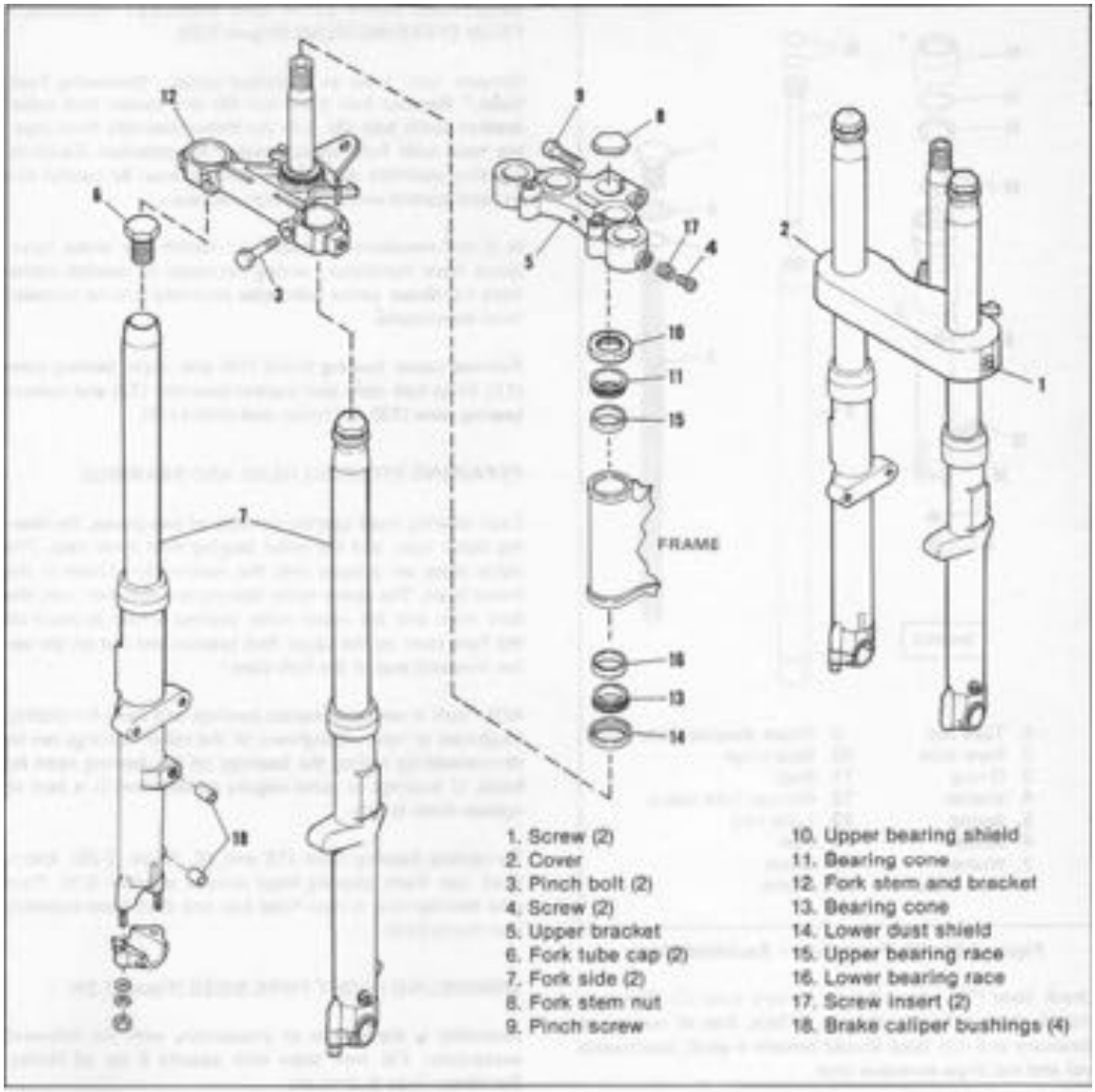


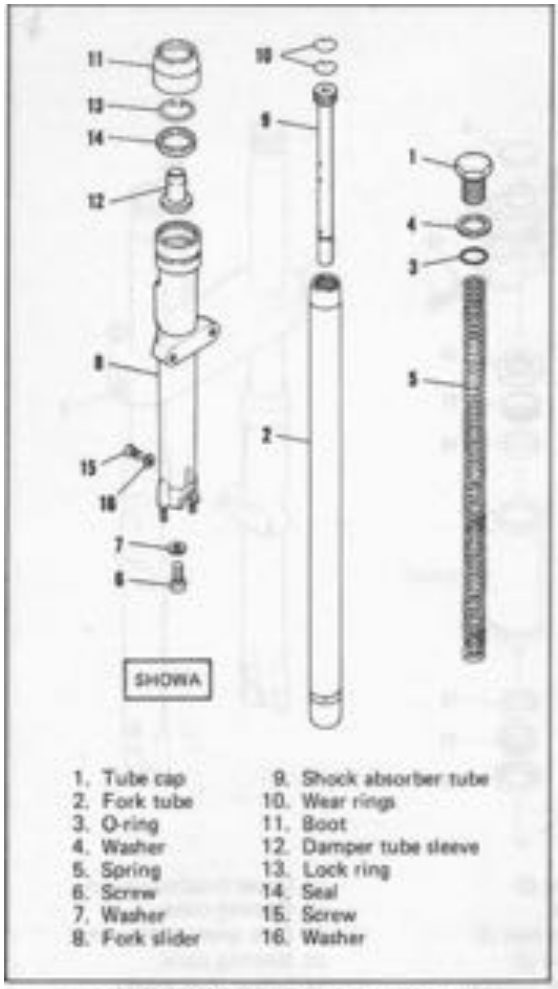
Figure 2-28. FX Front Fork – Exploded View

Using an allen wrench, remove screw (6) along with washer (7) from bottom end of fork slider (8). This will free shock absorber tube (9) so that it can be removed from fork tube (2). Remove both fiber wear rings (10) from slots in shock absorber tube (9).

Separate fork tube (2) and fork slider (8) by pulling the two apart. Slip fork boot (11) off end of fork slider (8). Remove damper tube sleeve (12) from inside fork slider (8) by carefully pulling out past seal (14). Remove seal (14) only if it is to be replaced. Remove lock ring (13) and then pry out seal (14), discarding the damaged seal.

Thoroughly clean and inspect each part. If inspection shows that any parts are bent, broken or damaged, those parts should be either repaired or replaced.

Inspect seal (14) for wear. If seal was removed, a new one must be installed. Inspect both wear rings (10) on damper tube (9) and replace if worn excessively or damaged.



1. Tube cap
2. Fork tube
3. O-ring
4. Washer
5. Spring
6. Screw
7. Washer
8. Fork slider
9. Shock absorber tube
10. Wear rings
11. Boot
12. Damper tube sleeve
13. Lock ring
14. Seal
15. Screw
16. Washer

Figure 2-29. FX Front Fork – Exploded View

Check boot (11) where it rubs on fork tube (2). The tube should show a bright, shining surface, free of scoring or abrasions and the boot should present a good, continuous seal and not show excessive wear.

Replace spring (5) if broken.

Inspect small hole in groove in lower end of fork tube (2) and see that it is not obstructed.

Make sure O-ring (3) is in good condition, without irregularities, and that it provides proper sealing when in place.

Check both washers (7 and 16) to see that they provide a good seal when used with their respective screws (6 and 15) to prevent oil leakage.

Repair bent or damaged fork tube (2) as described in "Straightening Fork Tubes" later in this section. Reassemble parts in reverse order of disassembly.

REMOVING FORK STEM AND BRACKET ASSEMBLY FROM STEERING HEAD (Figure 2-28)

Remove fork sides as described under "Removing Fork Sides." Remove fork stem nut (8) and loosen fork upper bracket pinch bolt (9). Lift handlebar assembly from steering head with fork upper bracket (5) attached. Carefully position assembly away from working area. Be careful not to bend control wires more than necessary.

It is not necessary to disconnect clutch and brake handlevers from handlebar, wiring harnesses or control cables from handlebar unless handlebar assembly is to be removed from motorcycle.

Remove upper bearing shield (10) and upper bearing cone (11). Drop fork stem and bracket assembly (12) and remove bearing cone (13) and lower dust shield (14).

REPAIRING STEERING HEAD AND BEARINGS

Each steering head bearing consists of two pieces, the bearing outer race, and the roller bearing with inner race. The outer races are pressed into the steering head cups in the frame head. The lower roller bearing is assembled over the fork stem and the upper roller bearing is held in place on the fork stem by the upper fork bracket and nut on the upper threaded end of the fork stem.

After fork is removed inspect bearings and races for pitting, roughness or wear. Roughness of the roller bearings can be determined by rolling the bearings on the bearing races by hand. If bearings or races require replacement it is best to replace them in sets.

To replace bearing races (15 and 16, figure 2-28), knock head cup from steering head using a suitable drift. Press new bearing race in new head cup and then press assembly into frame head.

ASSEMBLING FRONT FORK SIDES (Figure 2-29)

Assembly is the reverse of disassembly with the following exceptions: Fill fork sides with exactly 6 oz. of Harley-Davidson, Type B, fork oil.

INSTALLING STEM AND BRACKET ASSEMBLY, FORK SIDES AND ADJUSTING STEERING HEAD BEARINGS (Figure 2-28)

Assembly of the fork is the reverse of disassembly. Assemble the head cups, races, bearing cones and dust shields. Apply a heavy coating of Harley-Davidson Grease-All grease to bearing cones.

Insert fork lower bracket stem (12) up through steering head and assemble upper bracket (5) and stem nut (8) loosely. Install fork sides (7). With forks correctly aligned, tighten fork tube caps (6) with pinch bolts (3) loose. Install front fender and front wheel.

With fork sides, wheel and fender reassembled, fork should have smooth free movement to either side. There should be no appreciable shake or sideways movement of the front fork. To adjust steering head bearings, tighten or loosen stem nut (8) as required, while tapping on bracket (5). When bearings are correctly adjusted, tighten pinch bolts (3, and 9) to 22 to 26 ft-lbs torque.

STRAIGHTENING FORK TUBES

Straightening fork tubes requires several special tools including hydraulic or arbor press, dial indicator and straightening blocks.

Never attempt to straighten a fork tube that has a sharp angle bend. It should be scrapped because the metal is stretched.

1. Before beginning the straightening operation, clean the fork tube. Locate bends with dial indicator. A fork tube is usually bent in two or three places, seldom only one. Place fork tube on straightening blocks. Correct bend in tube with an arbor or hydraulic press.

2. Find the highest point out-of-round with a dial indicator (figure 2-30) and mark with chalk. Press high point as shown in figure 2-31. Repeat indicating and pressing operations until tube is within 0.003 in. to 0.004 in. of being straight.

Figure 2-30. Indicating High Point

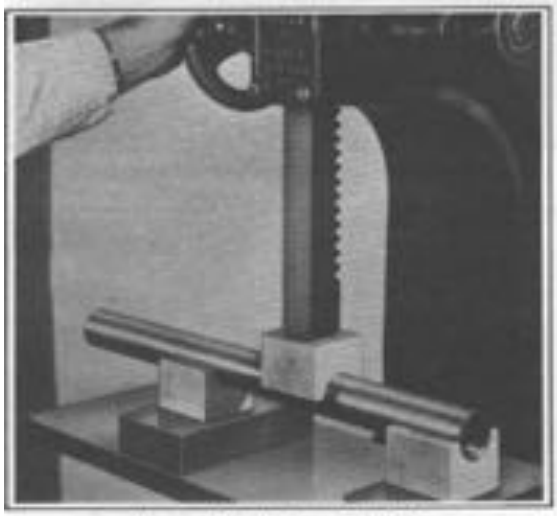


Figure 2-31. Pressing High Point

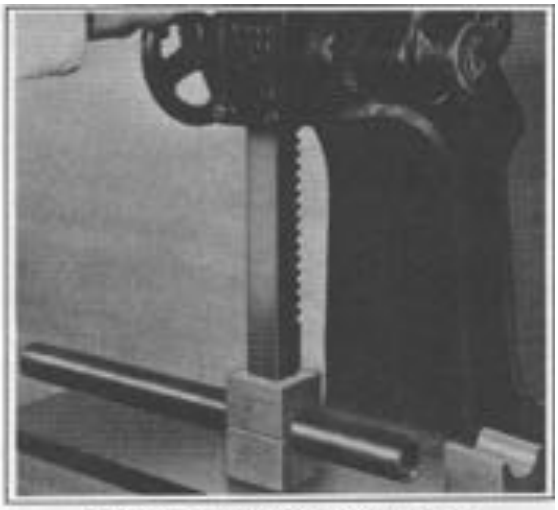


Figure 2-32. Pressing Fork Tube Round

3. Sometimes fork tubes are out-of-round, especially at the point it is clamped in the fork bracket. Place tube in straightening blocks and press until perfectly round as shown in figure 2-32, checking with dial indicator and micrometer. Finally, check tube by inserting in new fork slider. Work tube up and down. If it does not bind, it is straight.

STRAIGHTENING FORK STEM AND BRACKET ASSEMBLY

Straightening a fork stem and bracket assembly requires a great deal of skill, experience and several tools and fixtures. Special tools necessary include Fork Tube Straightening blocks, Part No. 96246-50, four blocks are needed; Bending Bar, Part No. 96806-40; Fork Stem and Bracket Aligning Gauge, Part No. 96245-51. In addition, the following pieces of bar stock are needed: Two bars, 1-5/8 in. diameter, about 12 in. long; two bars 1 in. x 4 in. x 12 in. (approximately); assorted pieces of rectangular bar stock to use in transmitting arbor press pressure to unit to be straightened.

To straighten stem and bracket, proceed as follows:

1. Insert the two 1-5/8 in. x 12 in. bars in fork bracket and secure with two clamping studs. Sometimes the bracket is so badly bent that the bars cannot be inserted. In this case, press the bars into place with an arbor press, then press on the front edge of bracket to correct the "bow" distortion as shown in figure 2-33.

2. A bracket assembly is usually out of alignment along the horizontal centerline, with one or both legs bent.

NOTE

Reference to vertical and horizontal centerlines applies to bracket and fork stem as positioned on arbor press (see figure 2-33).

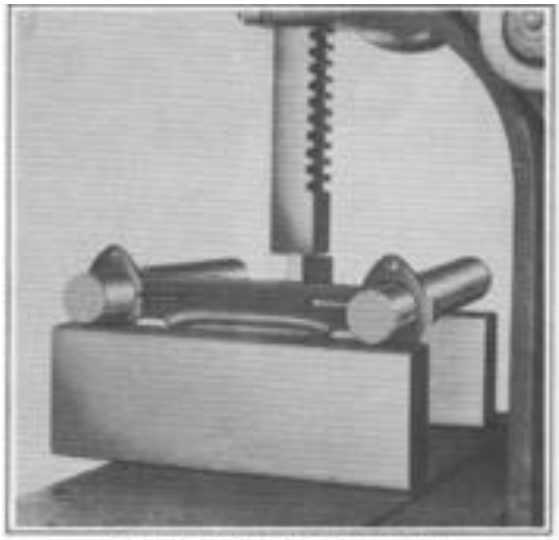


Figure 2-33. Correcting Bracket Bow

If both legs are twisted, place bracket assembly on arbor press as shown in figure 2-34 with blocks placed under two low legs only (A and B). With press block placed across bracket and bar assembly, press until high legs (C and D) are in alignment.

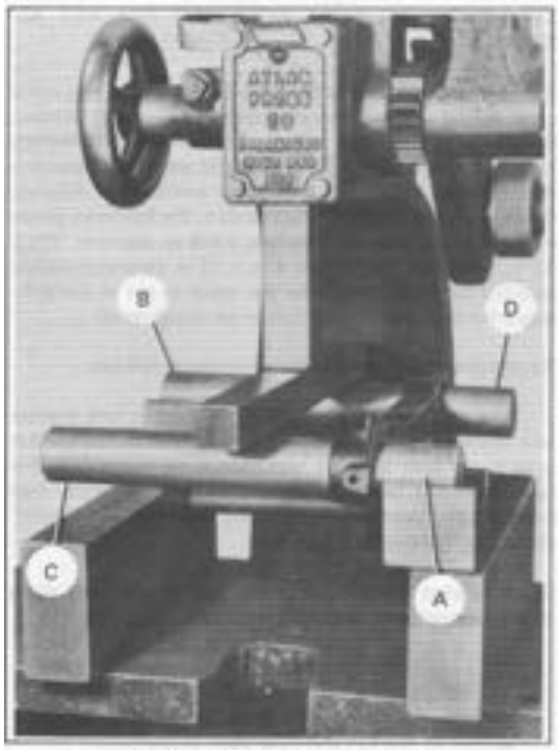


Figure 2-34. Straightening Two Twisted Legs

3. If one leg is bent, place bracket and bar assembly on three straightening blocks, two blocks under straight leg and one block under low end of other leg. Place press block diagonally across bracket assembly to high leg until high leg is forced down and into alignment with the other three leg ends.

4. Place the fork stem and bracket assembly on the four straightening blocks located on the surface plate (see figure 2-35). If the legs rest squarely on straightening blocks, the bracket assembly is correctly trued on a horizontal plane. If bracket is not true, press again, checking alignment after each operation.

5. Use a square to check if bracket assembly is bent, distorted or out of parellel on a horizontal plane as shown in figure 2-36. Place bracket and bar assembly in a heavy vise and straighten using the Bending Bar.

6. Check fork stem alignment with Fork Stem and Bracket Aligning Gauge as shown in Figure 2-37. Use Bending Bar to bring stem into position. Recheck the fork completely.

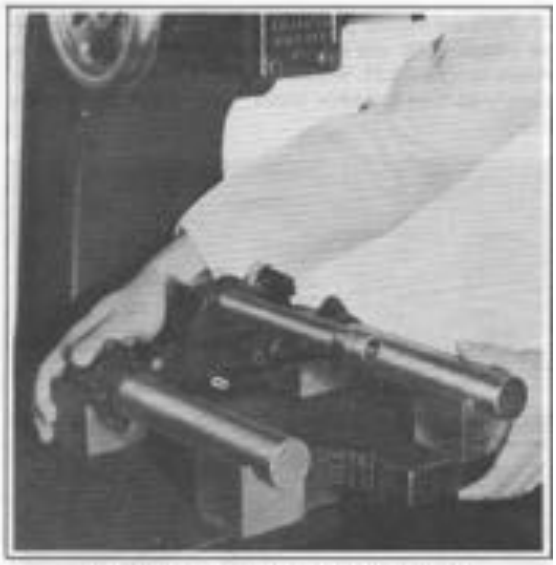


Figure 2-35. Checking Bracket Alignment

Figure 2-36. Bending Bracket Legs Parallel

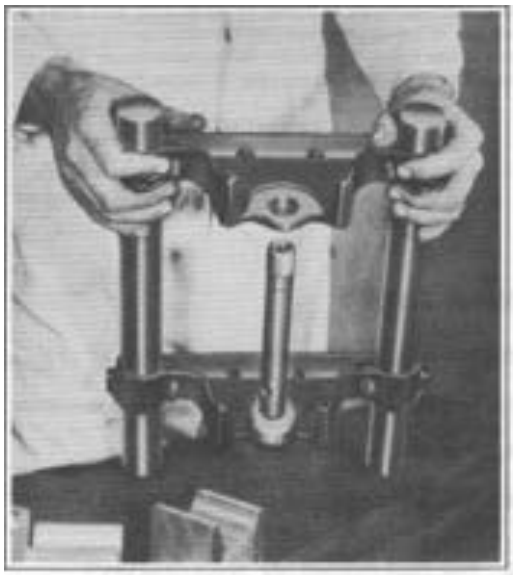


Figure 2-37. Checking Stem Alignment With Gauge

REAR SHOCK ABSORBER

ADJUSTING REAR SHOCK ABSORBER SPRING

1. The rear shock absorber springs can be adjusted to three positions for the weight the motorcycle is to carry. The average weight solo rider would use the extended spring position (off cam); when in low position (off cam), the cam lobes should be next to each other: that is, single lobes and double lobes matched. If necessary, rotate the cam to line them up properly. A heavy solo rider might require the position with springs slightly compressed (first cam step); buddy seat riders require the fully compressed spring position (second cam step).

2. To adjust the rear shock absorber springs, turn cushion spring adjusting cam to desired cam position with Spanner Wrench, Part No. 94700-52B. Both cushion spring adjusting cams must be adjusted to the same position. Always back off cam in opposite direction when releasing spring tension to intermediate or solo position.

NOTE

If shock cam is turned too far so that it falls off top position, it will not be matched correctly with other cam. To correct this condition, continue 180 degrees in same direction until it falls off again and then adjust to desired position.

DISASSEMBLING REAR SHOCK ABOSRBER (Figure 2-38)

Position motorcycle on Service Stand, Part No. 96810-63

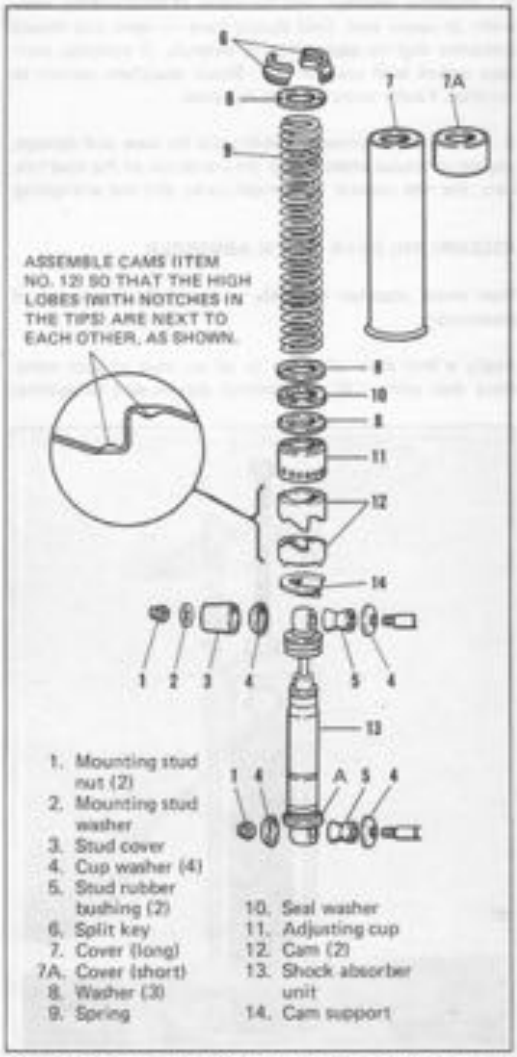


Figure 2-38. Later Rear Shock Absorber — Exploded View

Remove top and bottom mounting stud nut (1), mounting stud washer (2), upper stud cover (3) and cup washer (4). Slip shock absorber assembly off upper and lower studs. Push rubber bushings (5) from shock absorber mounting eyes. Place shock absorber in Rear Shock Absorber Tool, Part No. 97010-52A with split key (6) up. Compress absorber spring enough to remove each half of split key (6) from flange on shock eye as shown in figure 2-39. Release spring compression and remove absorber assembly from tool. Remaining items can be removed in order shown in figure 2-38.

INSPECTING

1. Examine absorber unit for traces of fluid leaking, especially at upper end. Unit should have no leaks and should compress slightly easier than it extends. If possible, compare action with unused unit. Shock absorbers cannot be repaired. Faulty units must be replaced.

2. Clean and examine all other parts for wear and damage, paying particular attention to the condition of the stud rubbers, the ride control adjustment cams, dirt seal and spring.

ASSEMBLING REAR SHOCK ABSORBER

Rear shock absorber assembly is essentially the reverse of disassembly.

Apply a thin coat of grease to all surfaces of both cams. Note that cams (12) are identical and be sure to position cam lobes correctly as shown in figure 2-38 inset. Place assembly in compressor tool and compress spring enough to install key halves (6). Release spring compression. Keys will lock into place in inside diameter of covers 7 or 7A.

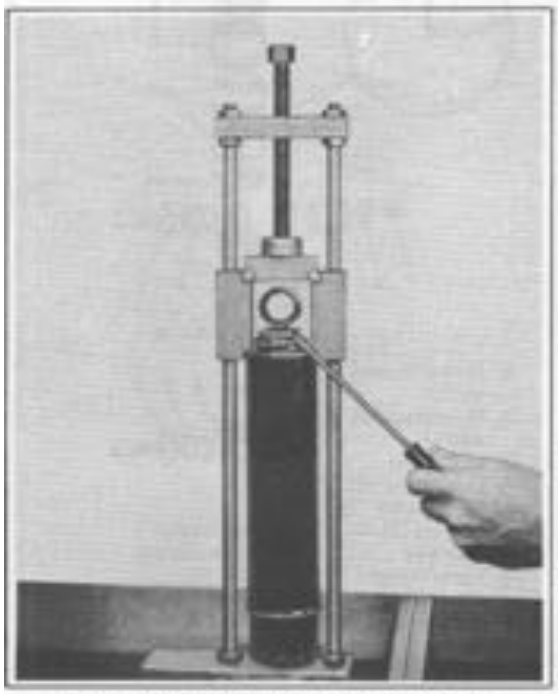


Figure 2-39. Disassembling Shock Absorber

IMPORTANT

Install each shock absorber on motorcycle with slot in cam support (A, figure 2-38) facing toward wheel.

REAR FORK

DISASSEMBLING REAR FORK (Figure 2-40)

To disassemble rear fork, first remove following assemblies:

1. Rear wheel (see "Wheels").

2. Rear brake mounting bracket and torque arm (see "Brakes").

3. Rear shock absorbers (see "Shock Absorbers").

4. See figure 2-40. Turn back locking ear on pivot bolt lock washer (2) and turn out pivot bolt (1). Remove fork (3) from frame. With appropriate size arbor pin, push out bearing spacer (4), bearing seal (5) and bearing with outer race (6) from each side of fork pivot bearing.

INSPECTING AND SERVICING

1. Clean pivot bolt hole in fork and bearing parts. Check for wear of bearing, bearing race and bearing seal.

2. Rough check the rear fork for correct alignment. Dimensions shown in figure 2-40 will provide enough information to determine if fork is far enough out of alignment to require realigning or replacement. Straightening a badly bent fork requires special tools and fixtures for holding, bending and gaging.

ASSEMBLING REAR FORK

1. Press outer bearing races into fork. Grease bearings with Harley-Davidson "Grease-All" grease and insert. Apply additional grease to outside face of bearing so that space between bearing and seal will be filled when seal is installed. Grease bearing seals in groove between sealing lips and press into place. Put bearing spacers over seals.

NOTE

Apply additional quantity of grease to fitting in fork pivot housing with hand grease gun to fill space between bearings. A very small quantity of

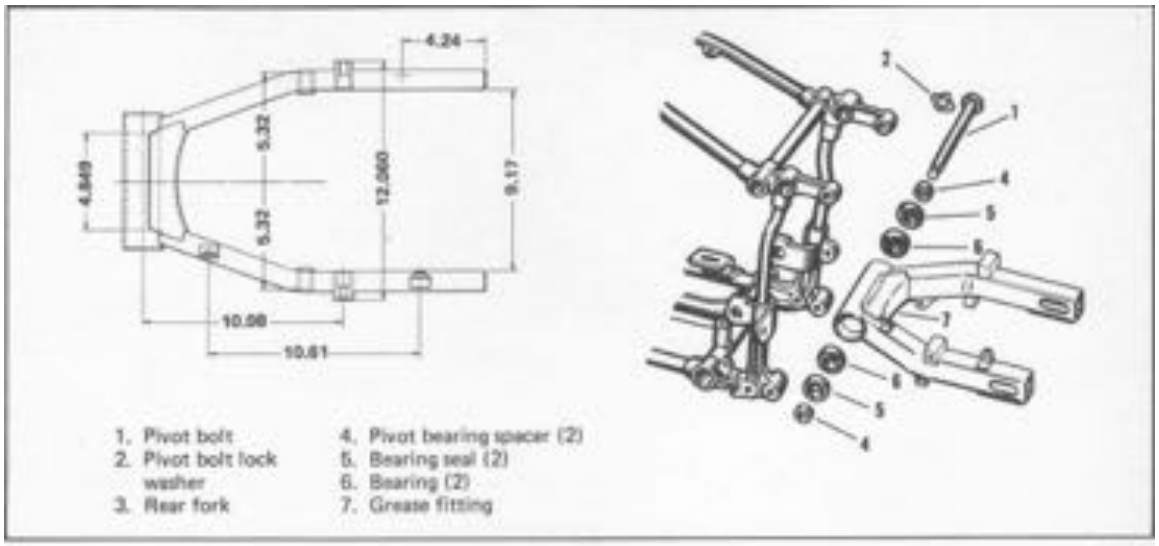


Figure 2-40. Rear Fork — Exploded View

grease should be applied to fitting with hand grease gun at 2500 mile intervals.

2. Assemble pivot bolt with lock washer and tighten bolt to preload bearings one to two pounds as follows:

3. With bearings free, weigh extreme rear end of fork by attaching a spring scale and raising the fork to a horizontal position. Tighten bearing pivot bolt just enough to increase bearing drag one to two pounds.

For example, if fork with bearings free weighs four pounds, tighten pivot bolt until fork movement to horizontal position registers five to six pounds on scale. Lock pivot bolt lock washer.

BRAKES

GENERAL

The front and rear brakes are fully hydraulic disc brakes and require little maintenance. Every 1250 miles, check master cylinders for proper fluid levels and check brake pads and discs for wear. If brake pads are worn to 1/16 in. or less they should be replaced. Minimum brake disc thickness is stamped on the side of the disc. When filling master cylinders, use only D.O.T. 5 Hydraulic Brake Fluid which is approved for use in hydraulic brake systems. When removing master cylinder filler plug or cover, make sure that all dirt is removed to prevent entrance into reservoir. 1978 to early 1979 rear brake master cylinders should be filled to 1/4 in. from the top. Late 1979 and later rear brake master cylinders should be filled to 1/8 inch from the gasket surface. Front brake master cylinder should be filled to the gasket surface with the reservoir in a level position.

The front brake master cylinder is an integral part of the brake hand lever assembly. The rear brake master cylinder is located on the right side of the motorcycle near the brake pedal.

Every 1250 miles, check the rear brake master cylinder plunger to see that it has 1/16 in. free play.

CHECK LIST

Use the following check list to help determine probable cause of poor brake operation.

1. Excessive lever or pedal travel or spongy feel.
   - Air in system – bleed brake.
   - Master cylinder low on fluid – fill master cylinder with approved brake fluid.
2. Chattering sound when brake is applied.
   - Worn or defective pads – replace brake pads.
   - Loose mounting bolts – tighten bolts.
   - Warped disc – replace disc.
3. Ineffective brake – lever or pedal travels to the limit.
   - Low fluid level – fill master cylinder with approved brake fluid.
   - Piston seal defective – replace O-ring in brake piston.
4. Ineffective brake – lever or pedal travel normal.
   - Distorted disc – replace brake disc.
   - Distorted or contaminated brake pads – replace brake pads.
5. Brake pads drag on disc – will not retract.
   - Piston in master cylinder not uncovering relief port – check master cylinder.
   - Rear brake pedal linkage out of adjustment – re-adjust.

BLEEDING HYDRAULIC SYSTEM

After servicing hydraulic brake system where any hydraulic line or cylinder is opened, it is necessary to bleed the system to expel all air.

WARNING — D.O.T. 5 brake fluid can cause eye irritation. In case of contact with eyes, flush with plenty of water and get medical attention. KEEP BRAKE FLUID OUT OF THE REACH OF CHILDREN!

Slip a length of appropriate size plastic tubing over wheel cylinder bleeder valve with other end in a clean container. Turn handlebars so that bleeder valve is nearly vertical. Open bleeder valve by rotating counterclockwise about one-half turn. With master cylinder full of fluid at all times, slowly depress brake pedal or lever once until fluid stops flowing from tubing. Close the bleeder valve. Allow pedal or lever to return slowly to release position. Repeat operation until brake system is free of air bubbles. Add fluid to master cylinder to bring to original level. Do not reuse fluid unless it is clear and free from sediment and bubbles.

NOTE

Hydraulic brake fluid bladder type pressure equipment can be used to fill brake master cylinder through the bleeder fitting, providing master cylinder cover is removed so that system cannot pressurize. Do not use pressure bleeding equipment when the hydraulic system is sealed with master cylinder cover and gasket in place.

REAR BRAKE PEDAL ADJUSTMENT

FL MODELS — 1978 - Early 1979 (Figure 2-41)

Work brake pedal (1) back and forth by hand to determine free play before push rod contacts piston in master cylinder. Free play of push rod should be approximately 1/16 in. Adjustment is made by loosening master cylinder rear bolt

1. Rear brake pedal
2. Pedal stop plate bolt
3. Pedal stop plate
4. Master cylinder rear bolt
5. Master cylinder fill plug

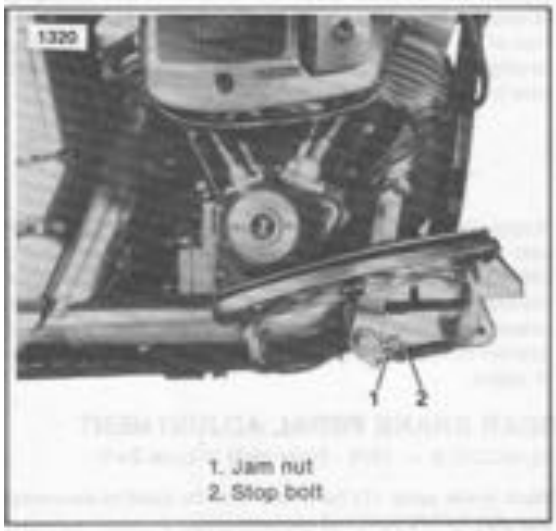
Figure 2-41. Adjusting Rear Brake Pedal — FL, 1978 and Early 1979

(4) and brake pedal stop plate bolt (2). Move front end of plate (3) down to decrease free play, or up to increase free play. Retighten bolts (2) and (4).

FL MODELS — LATE 1979 AND LATER
(Figure 2-41A)

Work brake pedal lever back and forth by hand to determine free play before the plunger contacts the piston in the master cylinder. Free play of the plunger should be approximately 1/16 inch.

Adjustment is made by loosening jam nut (1) and turning stop bolt (2) either in our out to adjust free play. Tighten jam nut to 10 ft-lbs torque.



1. Jam nut
2. Stop bolt

Figure 2-41A. Adjusting Brake Pedal — FL, Late 1979 and Later

FX (Figure 2-41B)

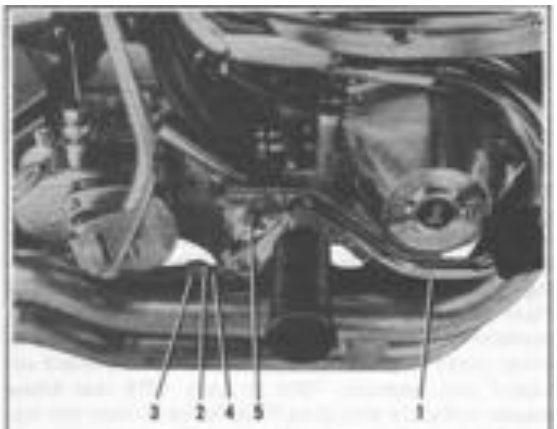
On FX models, free play of master cylinder plunger should be approximately 1/16 in. Adjustment is made by loosening lock nut (2) and turning brake rod (3) on clevis threads (4) - forward to increase free play or rearward to decrease free play.

DISC BRAKE CALIPERS

GENERAL

All late 1980 FL and FX motorcycles above VIN 26625-J0 have quad (4-sided) seal calipers installed on both the front and rear brake systems of the FL and the rear brake system of the FX models. Instead of the spring retractor system, used on 1978 to early 1980 models, the caliper features a square cross section seal.

To identify front and rear and make the square seal calipers distinguishable from the old style spring retractor units, the front caliper assembly is marked with an additional letter "F" on the piston side subassembly.



1. Rear brake pedal lever
2. Lock nut
3. Master cylinder plunger
4. Clevis
5. Grease fitting

Figure 2-41B. Adjusting Rear Brake Pedal — FX

The rear caliper assembly is marked with an additional letter "R" on the piston side subassembly.

WARNING

Front and rear calipers are not interchangeable because of a difference in piston retraction. Braking can be affected if calipers are not installed as marked.

The square seal sits in a machined groove in the caliper bore. As the piston is forced out, the seal moves against the chamfer of the caliper groove. When the brake lever is released, the seal springs back, retracting the piston.

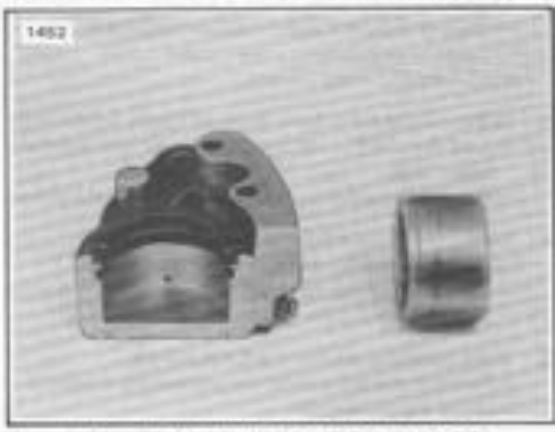
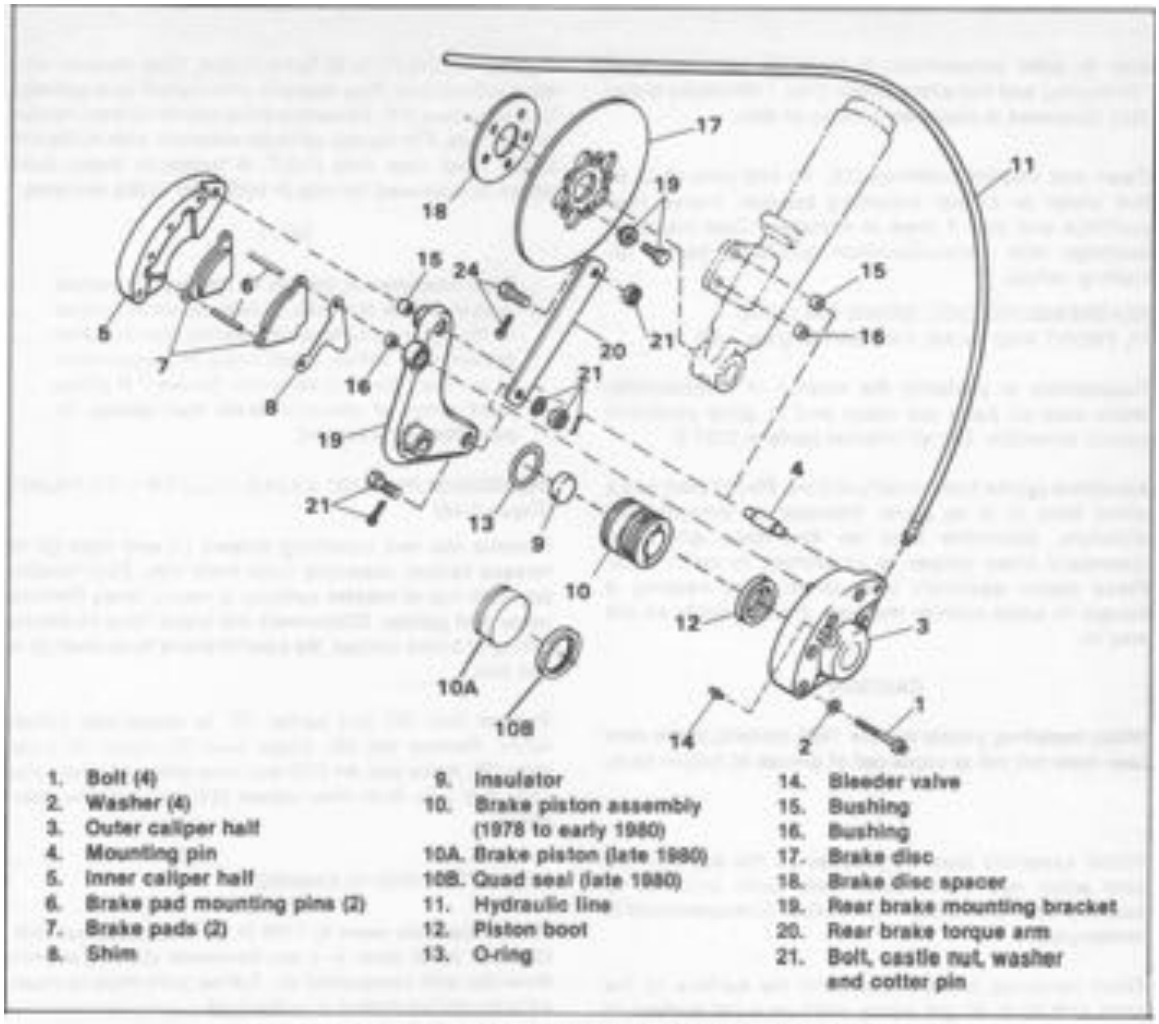


Figure 2-42. Late Style Caliper and Piston

DISASSEMBLING DISC BRAKE CALIPERS — FL FRONT AND REAR, FX REAR
(Figure 2-43)

If only the caliper assembly is to be removed, it is not necessary to remove the wheel. To remove the caliper



1. Bolt (4)
2. Washer (4)
3. Outer caliper half
4. Mounting pin
5. Inner caliper half
6. Brake pad mounting pins (2)
7. Brake pads (2)
8. Shim
9. Insulator
10. Brake piston assembly (1978 to early 1980)
10A. Brake piston (late 1980)
10B. Quad seal (late 1980)
11. Hydraulic line
12. Piston boot
13. O-ring
14. Bleeder valve
15. Bushing
16. Bushing
17. Brake disc
18. Brake disc spacer
19. Rear brake mounting bracket
20. Rear brake torque arm
21. Bolt, castle nut, washer and cotter pin

Figure 2-43. Disc Brake – Exploded View, FL Front and Rear, FX Rear Only

assembly proceed as follows: Remove hose clamp. Remove 4 bolts (1) and washers (2). Remove outer caliper half (3). Remove mounting pin (4) and inner caliper half (5). Remove brake pad mounting pins (6), brake pads (7), shim (8) and insulator (9). Check the pads (7) for wear, damage and looseness. Replace both pads if thickness of friction material is less than 1/16 in. Check to see that the metal backing plate is flat. If it is at all bowed replace the brake pad.

NOTE

Brake pads should only be replaced as a set.

With hydraulic system connected to outer caliper half assembly (3), use a dial indicator to check piston retraction.

Mount dial indicator on back of outer caliper with indicator plunger on the piston face. Apply brake. Set dial indicator on zero. Release brake. Front brake piston stamped "F" should retract 0.020 to 0.025 in. Front brake piston stamped "MF" should retract 0.026 in. to 0.031 in. Rear brake piston stamped "R" should retract 0.033 in. to 0.038 in. If it does not, replace piston assembly (9). Do not remove piston assembly unless there are signs of hydraulic fluid leakage or if piston is not operating properly.

To remove piston (10, 10A), pump brake hand lever until piston will move no farther. Remove hydraulic line (11). Push piston boot (12) back from groove in piston and pull piston the rest of the way out. Remove O-ring (13) on 1978 to early 1980 models. On late 1980 models, remove seal (10A) from caliper..

Remove bleeder valve (14). Clean all parts and inspect. Replace any parts that are worn, or damaged. Inspect cylinder bore. If it is badly scored replace outer caliper half (3). When reassembling use new O-ring (13).

Inspect the brake disc (17). If it is warped, or badly scored it must be replaced. See "WHEELS" section. If

disc is worn excessively, it must be replaced. See "Removing and Installing Brake Disc." Minimum brake disc thickness is stamped on side of disc.

Clean and inspect bushings (15, 16) and pins (4, 6) in fork slider or caliper mounting bracket. Install new bushings and pins if worn or damaged. Coat inside of bushings with Harley-Davidson Anti-Seize before installing caliper.

REASSEMBLING DISC BRAKE CALIPERS — FL FRONT AND REAR, FX REAR (Figure 2-43)

Reassembly is basically the reverse of disassembly. Make sure all parts are clean and in good condition before assembly. Dip all internal parts in DOT 5.

Assemble piston boot to caliper bore. Piston boot has a small hole in it to allow drainage of accumulated moisture. Assemble boot so that hole will point downward when caliper is assembled to motorcycle. Press piston assembly into caliper bore keeping it square to avoid scoring the bore. Push it firmly all the way in.

CAUTION

When installing piston on late 1980 models, make sure seal does not roll or come out of groove in caliper bore.

NOTE

Piston assembly must be pressed all the way into the bore when new brake pads have been installed to assure proper clearance when caliper is reassembled to motorcycle.

When replacing brake pads, sand the surface of the pads with 60 or 80 grit emery cloth on a flat surface to break up the surface glaze. Also, use emery cloth to slightly round off the leading edge of the brake pads. Make sure the shim (8) is positioned between the caliper piston and the outer brake pad so that the direction of wheel rotation is into the "notch."

For best braking efficiency, brake disc on wheel must be parallel with brake pads in caliper assembly. On the rear brake, this is achieved by bending bracket (19), which mounts caliper assembly, until it aligns properly with disc. Insert Alignment Gage, Part No. 97168-77 into holes in bracket (19). Check to see that all three gage pins either touch or are within 1/32 in. of surface of brake disc (17). If one or more pins do not fall within these limits, note which ones and remove gage. Insert Bending Tool, Part No. 97169-77, into bracket holes. Using tool, bend bracket until all three gage pins do either touch or are within 1/32 in. of surface of brake disc (17). A small misalignment of the FL front caliper can be corrected by reaming or changing the bushings (15, 16) in the slider. Severe misalignment may require changing the fork slider.

Install bleeder valve (14). Apply Anti-Seize to 4 bolts (1) before assembly. Assemble caliper unit to fork side. Tighten 4 bolts (1) to 35 ft-lbs torque. Coat threads with Harley-Davidson Pipe Sealant with Teflon and connect hydraulic line (11). Assemble hose clamp to front fender or rear fork. Fill master cylinder reservoir with hydraulic brake fluid. Use only D.O.T. 5 hydraulic brake fluid which is approved for use in hydraulic brake systems.

NOTE

Turn handlebar to the left so that top of reservoir is level. Check for leaks. If leaks persist at hydraulic fittings, coat surfaces with Harley-Davidson Pipe Sealant with Teflon. Bleed brake to purge system of air. See "Bleeding Hydraulic System." If after a short period of operation brake feels spongy, repeat bleeding procedure.

DISASSEMBLING DISC BRAKE CALIPER — FX FRONT (Figure 2-44)

Remove the two mounting screws (1) and nuts (2) to release caliper assembly from front fork. Turn handlebar until top of master cylinder is nearly level. Remove cover and gakset. Disconnect the brake hose hydraulic fitting at brake caliper. Be careful brake hose seat (3) is not lost.

Remove bolt (4) and washer (5) to disassemble caliper halves. Remove seal (6), piston boot (7), piston (8) outer plate (9), brake pad set (10) and inner plate (11) from pins (12). Pull pins from inner caliper (13) for complete disassembly.

INSPECTION AND CLEANING

If brake pads are worn to 1/16 in. or less, replace set (10). Clean all metal parts in a non-flammable cleaning solvent. Blow dry with compressed air. Rubber parts must be cleaned in denatured alcohol or brake fluid.

WARNING

Use a non-flammable cleaning solvent for cleaning metal parts. DO NOT use gasoline or other flammable substances.

Always clean brake system rubber parts by washing in denatured alcohol or brake fluid. DO NOT use mineral base cleaning solvents such as gasoline or paint thinner. Use of mineral base solvents will cause deterioration of the parts and would continue to deteriorate after assembly which could result in component failure.

Inspect all components carefully for excessive wear or damage. Discard old seal (6) and replace with a new one.

Inspect brake discs bolted to wheel assembly and replace if warped or badly scored. See "WHEELS" for disassembly procedure.

WARNING — The front brake and the rear brake pads must be replaced in pairs only for correct and safe brake operation.

ASSEMBLING DISC BRAKE CALIPER — FX FRONT (Figure 2-44)

Place the two pins (12) in the inner caliper (13). Slide the inner plate (11), brake pad set (10) and outer plate (9) onto the pins.

Dip the seal (6), piston boot (7) and piston (8) into brake fluid before assembly. Use silicone base D.O.T. 5 type fluid. Place the seal, boot and piston into the outer caliper (14).

NOTE

Piston assembly must be pressed all the way into the bore when new brake pads have been installed to assure proper clearance when calipers are reassembled to motorcycle.

When replacing brake pads, place pads on a flat surface and sand the surface of the pads with 60 or 80 grit emery cloth to break up the surface glaze. Also, use emery cloth to slightly round off the leading edge of the brake pads. Make sure the outer plate (9) is positioned between the caliper piston and the outer brake pad so that the direction of wheel rotation is into the "notch."

Position the outer caliper on the pins (12) and secure to inner caliper assembly with washer (5) and bolt (4). Tighten to 45 to 50 ft-lbs torque.

Install bleed fitting (15), if removed, and brake hose seat (3) into outer caliper. Connect brake hose to caliper. Install front wheel, if removed. See "WHEELS."

Mount the caliper assembly to the front fork with two mounting screws (1) and locknuts (2). Tighten screws to 115 to 120 in-lbs torque.

NOTE

New lock nuts should be used as this type of nut tends to lose its holding power when reused. If new lock nuts are not available, Loctite Lock N' Seal (Harley-Davidson Part No. 99625-77) should be used on threads.

Turn handlebar until top of master cylinder is nearly level. Slowly fill reservoir with D.O.T. 5 type hydraulic brake fluid, to gasket level. Reservoir may be filled with pressurized equipment, see "BLEEDING HYDRAULIC SYSTEM."

NOTE

Check for leaks. If leaks persist at hydraulic fittings, coat surfaces with Harley-Davidson "Pipe Sealant with Teflon," Part No. 99630-77. Use only this sealant to avoid contamination of hydraulic system. Bleed brake to purge system of air.

FRONT BRAKE MASTER CYLINDER

DISASSEMBLING FRONT DISC BRAKE MASTER CYLINDER (Figure 2-45)

The master cylinder (1) is located on the right handlebar. Remove from motorcycle as follows: Remove master cyl-

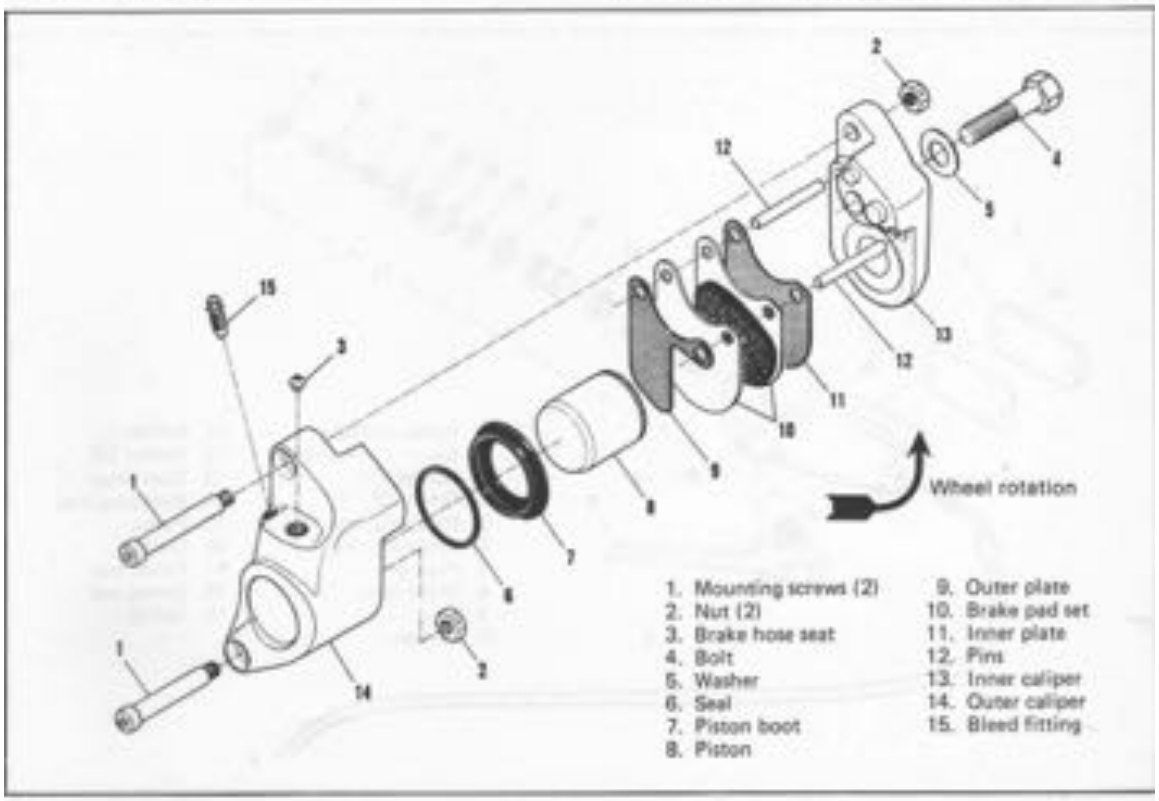


Figure 2-44. FX Front Brake Caliper (Left) — Exploded View

inder cover (2) and gasket (3) by removing 2 screws (4). Disconnect hydraulic line (5) from master cylinder. Remove handlebar switch assembly and disconnect stoplamp wires. Remove retaining ring (6) and pivot pin (7). Pull out brake lever (8), pin (9), plunger (10), spring (11), 2 washers (12), and dust wiper (13). Remove retaining ring (14) with retaining ring pliers, Harley-Davidson Part No. 96215-49. Pull out piston (15) and O-ring (16) assembly, piston cup (17), spring cup (18), and piston return spring (19).

INSPECTING AND SERVICING (Figure 2-45)

Inspect piston cup (17), and O-ring (16) for wear, softening, and enlarging. Examine cylinder walls for scratches and grooves. Gasket (3) should have no tears, punctures or breaks which would allow leakage. Replace if necessary.

Make sure vent hole in master cylinder cover is open.

ASSEMBLING FRONT DISC BRAKE MASTER CYLINDER (Figure 2-45)

Assemble master cylinder in reverse order of disassembly. If repair kit is installed, use all new parts, not just those that look worn. Dip all internal parts in brake fluid before assembly. Lightly grease pivot pin (7) and pin (9) before assemby. Fill system with DOT 5 hydraulic brake fluid and bleed brake system. See "Bleeding Hydraulic System." Install gasket (3) with flat side down.

IMPORTANT

Before adding DOT 5 hydraulic fluid, check to see that relief port in master cylinder is uncovered when brake lever is released.

NOTE

Hydraulic brake fluid bladder type pressure equipment can be used to fill front brake master cylinder at the bleeder fitting providing master cylinder cover is removed so that system cannot pressurize. Do not use pressure bleeding equipment when the front hydraulic system is sealed with master cylinder cover and gasket in place.

REAR BRAKE MASTER CYLINDER

1978 and Early 1979

DISASSEMBLING (Figure 2-46)

It is not necessary to remove master cylinder from motorcycle to remove piston assembly if replacement is required. Remove rear brake rod clevis pin (1). Pull out plunger (4 or 4A) and remove boot (5), stop wire (6), stop washer (7), piston assembly (8), cup (9), spring (10), valve (12), and valve seat (13).

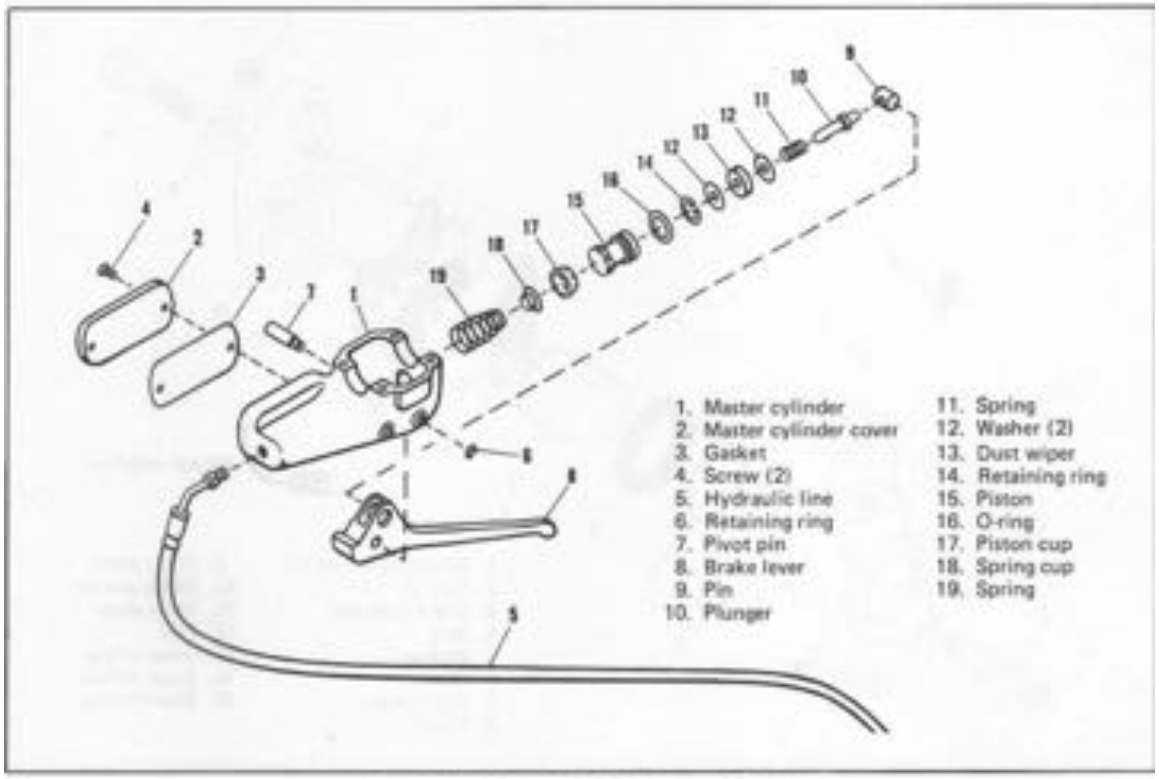
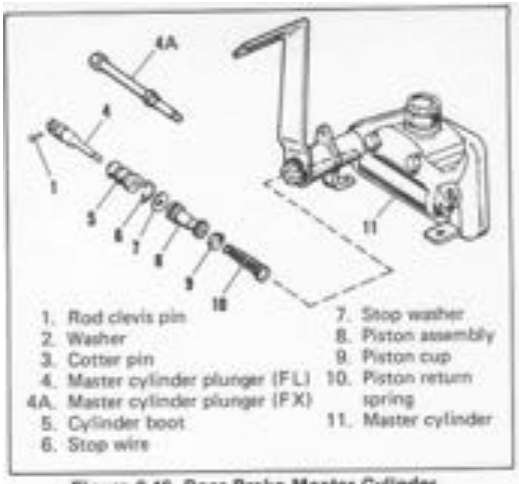


Figure 2-45. Front Disc Brake Master Cylinder



1. Rod clevis pin
2. Washer
3. Cotter pin
4. Master cylinder plunger (FL)
4A. Master cylinder plunger (FX)
5. Cylinder boot
6. Stop wire
7. Stop washer
8. Piston assembly
9. Piston cup
10. Piston return spring
11. Master cylinder

Figure 2-46. Rear Brake Master Cylinder 1978 and Early 1979 — Exploded View

INSPECTING AND SERVICING (Figure 2-46)

Inspect cup (9) and piston rubber parts for wear, softening and enlarging. Examine cylinder walls for scratches and grooves.

ASSEMBLING (Figure 2-46)

Assemble master cylinder in reverse order of disassembly. If repair kit is installed, use all new parts, not just those that look worn. Dip all internal parts in brake fluid before assembly. Replace fluid and bleed brake system. Adjust rear brake pedal as described under "Adjusting Rear Brake Pedal."

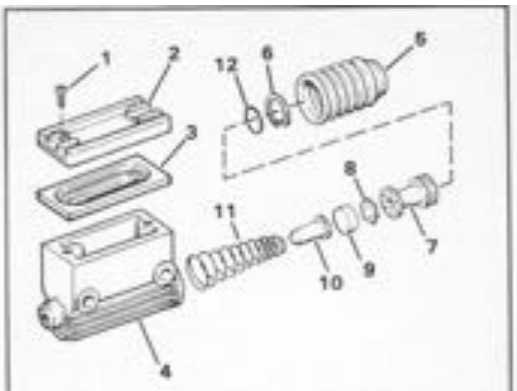
Late 1979 and Later

ASSEMBLING (Figure 2-46)

Assemble master cylinder in reverse order of disassembly. If repair kit is intalled, use all new parts, not just those that look worn. Dip all internal parts in DOT 5 brake fluid before assembly. Fill with DOT 5 fluid and bleed brake system. Adjust rear brake pedal as described under "Adjusting Rear Brake Pedal."

DISASSEMBLING (Figure 2-46A)

Disconnect the brake line at the master cylinder and remove the master cylinder from the motorcycle. Remove the cover screws (1), cover (2) and gasket (3). Drain



1. Cover screw (2)
2. Cover
3. Gasket
4. Master cylinder
5. Boot
6. Retaining ring
7. Piston
8. Wafer
9. Piston cup
10. Spring seat
11. Spring
12. O-ring

Figure 2-46A. Rear Brake Master Cylinder (Late 1979 and Later)

the fluid from the master cylinder (4). Pull off boot (5). Remove retaining ring (6), piston assembly (7), wafer (8) piston cup (9), spring seat (10) and spring (11). Remove the O-ring (12) from the piston (7).

INSPECTION AND SERVICING

Clean parts and inspect piston cup for wear, softening or swelling. Examine cylinder wall and piston for grooves and scratches. Gasket should be replaced if torn or punctured. Replace parts as necessary. When rebuilding master cylinder, replace all of the parts found in the rebuilding kit, not just those that appear to be damaged.

Make sure vent hole in cover is open.

ASSEMBLING (Figure 2-46A)

Dip all internal parts in D.O.T. 5 brake fluid before assembly. Assemble master cylinder parts in reverse order of disassembly. Replace the brake fluid and bleed the brake system. Adjust the rear brake pedal as described under "ADJUSTING REAR BRAKE PEDAL."

SEAT

SOLO SADDLE

SEAT POST SPRINGING

Two seat post spring arrangements are available for this model. A standard spring set is suitable for rider weighing up to 220 pounds. A heavy spring set for weights over that amount include heavier springs and longer guide collars. The heavy set is indicated by a letter "D" stamped on the upper end of the seat post plunger. See figure 2-47 for cutaway view of seat post springing arrangement.

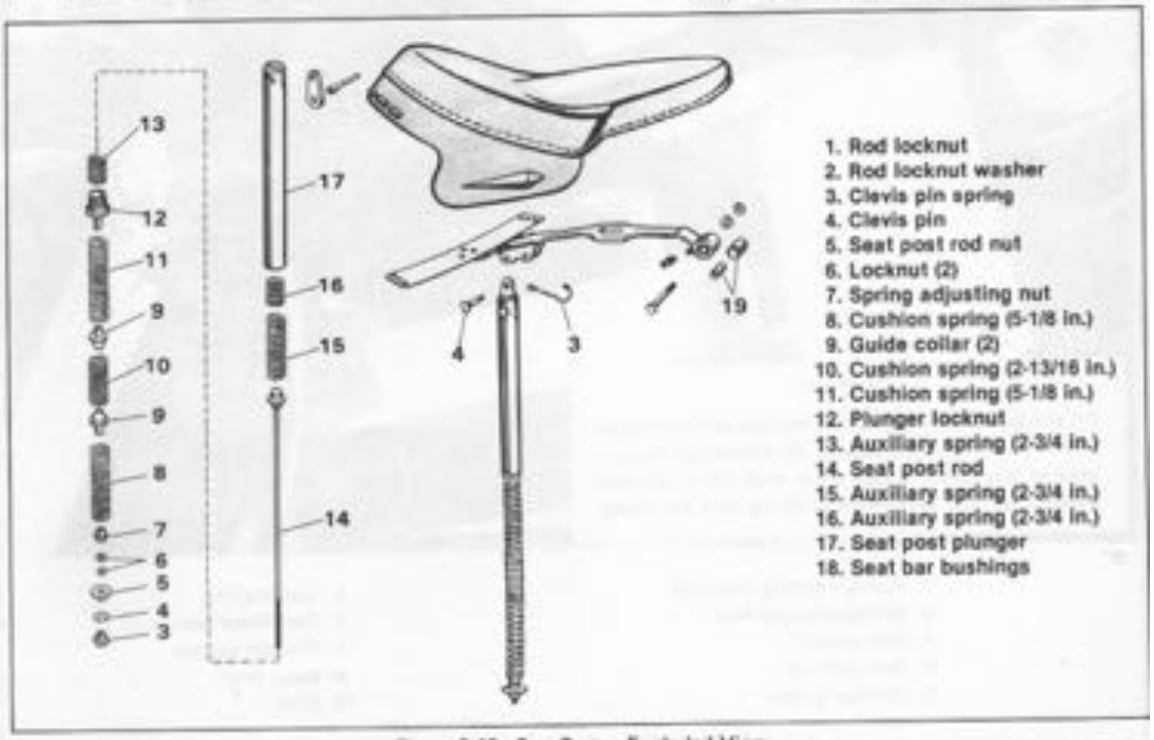
DISASSEMBLING SEAT POST (Figure 2-48)

Remove rod locknut (1) and washer (2) from bottom of frame seat post tube. Pull back of seat upward sharply to break seat post rod nut (5) loose at the base of seat post tube. Unsnap clevis pin spring (3) and pull out clevis pin (4). Tip seat forward and lift out seat post assembly. Disassemble remaining parts in order indicated.

INSPECTING AND SERVICING

Wash and air dry all parts. Inspect for broken or "set" springs. New spring length appears in Figure 2-48 listing. Replace seat bar bushings (18) if worn appreciably.

Figure 2-47. Cutaway of Seat Post Springing



1. Rod locknut
2. Rod locknut washer
3. Clevis pin spring
4. Clevis pin
5. Seat post rod nut
6. Locknut (2)
7. Spring adjusting nut
8. Cushion spring (5-1/8 in.)
9. Guide collar (2)
10. Cushion spring (2-13/16 in.)
11. Cushion spring (5-1/8 in.)
12. Plunger locknut
13. Auxiliary spring (2-3/4 in.)
14. Seat post rod
15. Auxiliary spring (2-3/4 in.)
16. Auxiliary spring (2-3/4 in.)
17. Seat post plunger
18. Seat bar bushings

Figure 2-48. Seat Post – Exploded View

ASSEMBLING SEAT POST (Figure 2-48)

Seat post assembly is reverse of disassembly. Apply liberal coating of "Grease-All" grease to parts, working it into the springs.

For correct spring preloading, draw up spring adjusting nut (8) to compress total visible spring length to 11 in. for standard spring and 10-1/2 in. for "D" heavy springs. Lock with one locknut (6). Turn on other locknut. Position rod nut (5) on rod so bottom end of rod extends through rod nut exactly 3/4 in. Lock adjustment with second locknut.

COMFORT FLEX SEAT

The Comfort Flex seat is adjustable for seat spring firmness and seat spring damping. In addition, a raised position is provided for access to the oil tank and battery located under the seat.

CAUTION

Do not leave lower shaft (9) in the rear position shown when riding or friction damper (8) will contact the suspension structure. Always place shaft (9) in forward position of slot (10) when lowering seat for riding.

1. Spring adjusting cross rod
2. Spring adjusting slots
3. Seat springs
4. Seat post pin
5. Friction washer
6. Locking ring
7. Castellated nut
8. Friction damper
9. Cross shaft
10. Slot

Figure 2-49. Seat Adjustments

ADJUSTMENT

Seat Spring Firmness Adjustment (Figure 2-49)

Seat firmness is adjustable to accommodate varying amounts of rider weight by moving upper cross-shaft (1) either forward or rearward into spring adjustments slots (2). Five different slots apply varying amounts of preload to seat springs (3). The front slot provides the greatest firmness - suitable for the heaviest rider/passenger combination. The rear slot provides the least firmness -suitable for the lightest rider without passenger.

Seat Spring Damping Adjustment

Seat spring damping is controlled by friction damper (8) located on left side of seat. The tightness of nut (7) determines the loading on the damper friction washer. Tightening nut (7) increases damping; loosening nut decreases damping. It is recommended that nut (7) be set "finger tight" initially and increased as necessary to prevent any objectionable spring rebounding when traveling over rough surfaces. Remove locking ring (6) to make adjustments and replace when finished.

Raising Seat

To place seat in raised position for access to oil tank and battery, remove seat post pin (4), lift seat up toward rear and place lower cross-shaft (9) into upper position of slot (10).

REMOVING AND INSTALLING SEAT ASSEMBLY (Figure 2-50)

Pull out pin (1) from seat post (2). Lift seat up into raised position. Remove two bolts (3), nuts and washers which attach bracket (4) to fender through holes (5). Remove two clamps (6) which attach seat to frame cross tube (7). The seat will now be freed and can be lifted off the motorcycle.

To reinstall seat assembly, reverse the procedure given above for removal while observing for correct clear

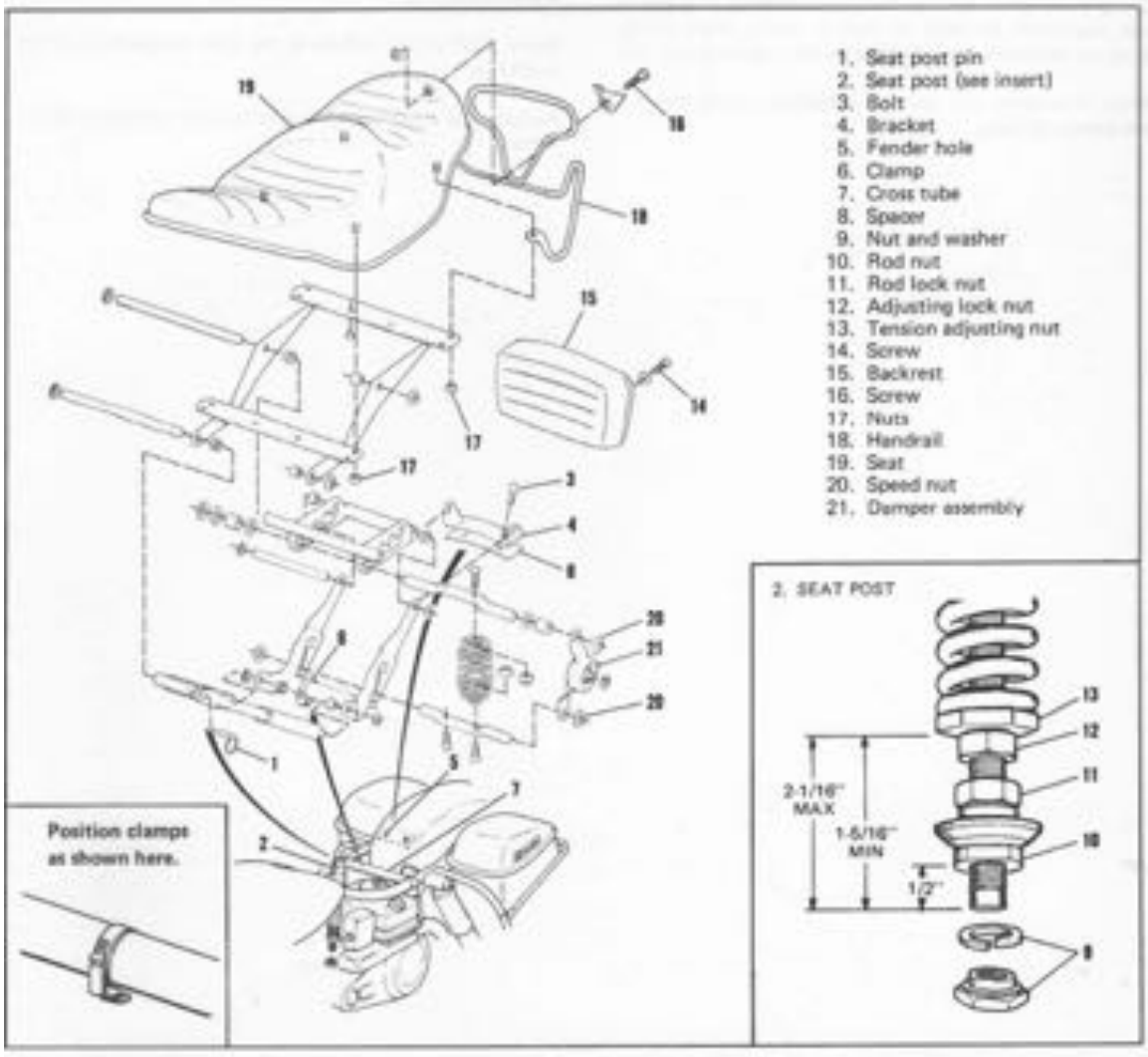


Figure 2-50. Comfort Flex Seat – Exploded View

ances. The seat post height should be 3 ± 1/16 in. from seat post frame to centerline to post pin hole. With upper shaft (1, Figure 2-49) in fifth or rear most slot, the seat should compress fully to its stops and the gas tank clearance must be 1-1/2 in. minimum. There should be adequate clearance between seat and fender, luggage carrier with Tour-Pak, and saddlebags. If seat post height requires adjustment, proceed as follows. Refer to Figure 2-50, remove nut and washer (9) from bottom of seat post and remove seat post from motorcycle. Adjust rod nut (10) to obtain 1/2 in. dimension shown in figure. This dimension should give the seat the correct dimension of 3 ± 1/16 in. Note that adjusting locknut (12) can be removed completely from the assembly and not used at all if necessary to achieve the 3 ± 1/16 in. dimension.

The 1-5/16 in. dimension shown in the figure gives minimum compression on the seat post spring stack which, in turn, allows maximum seat suspension adjustments. The 2-1/16 in. dimension applies some preload to the seat post spring stack which reduces available deflection of springs in seat suspension assembly for heavier riders. These dimensions are determined by adjusting tension adjusting nut (13).

When reinstalling seat post in motorcycle, make sure it is adequately greased.

To establish clearance between the seat assembly and the other parts of the motorcycle, spacers may be required between bracket (4) and fender, and between cross tube (7) and seat base. Minor changes can be made by simply adding shim stock at these two locations.

DISASSEMBLY AND ASSEMBLY

After removal from motorcycle, the seat assembly is partially disassembled by removing items 14 through 20 in the order shown in Figure 2-50. Reassemble in reverse order.

WARNING

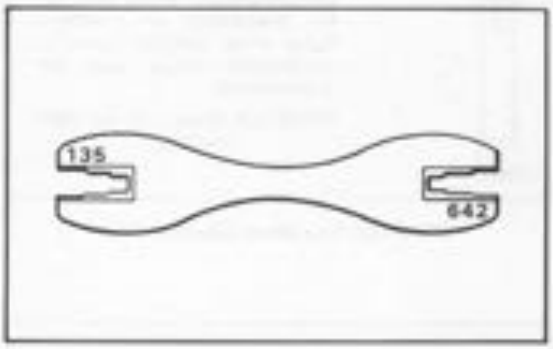
When reassembling suspension assembly, position clamps (6) so screws face to the front of the motorcycle and upwards. Improper positioning could cause the clamps to contact the support brackets and break.

MAINTENANCE

Every 2500 miles, lubricate the seat suspension pivot bushings.

Periodically, check mounting bolts and clamps for tightness.

TOOLS



94681-80 Spoke Nipple Wrench

Used to install press-fit connecting link sideplate supplied with replacement chains.

95020-88 Rear Chain Connecting Link Press Tool

Removes press fit roller pins from all chains.

95021-29 Disassembling Chain Tool

Adjustable stand for truing spoked wheels. Includes arbor.
95515-30A Arbor for wheels. (Can be used to convert old stand 95500-29).

95500-80 Wheel Truing Stand

Special pliers for removing and replacing retaining rings.
95017-61 Large for external lock rings.
96215-49 Small for internal lock rings.
96216-49 Large for internal lock rings.

Lock Ring Pliers

Fits head cone lock nut and head bearing adjusting cone.

96219-50 Frame Head Bearing Adjusting Cone, and Lock Nut Wrench

Used with fork tube straightening blocks (96246-50) when fork stem is being aligned.

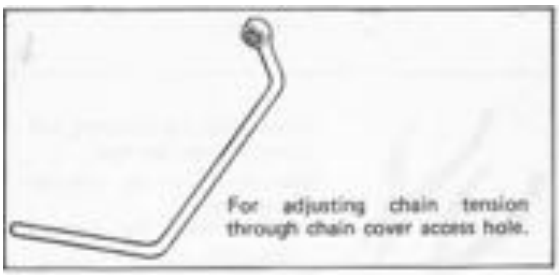
96245-51 Fork Stem and Cross Member Aligning Gage

Three recommended for use to support fork tubes while straightening on an arbor press.

96246-50 Fork Tube Straightening Block for FL Front Fork

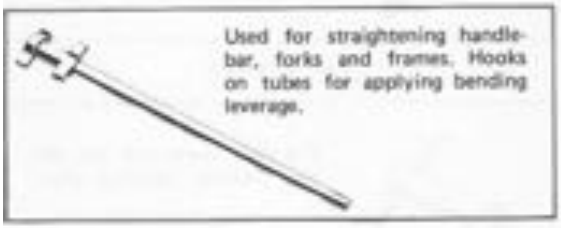
Three recommended for use to support fork tubes while straightening on an arbor press.

96247-64 Fork Tube Straightening Block for FX Front Fork



For adjusting chain tension through chain cover access hole.

94644-65 Chain Adjuster Shoe Bolt Wrench

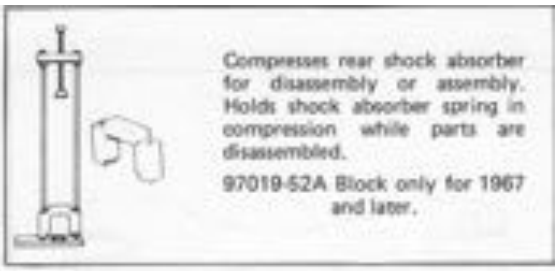


Used for straightening handlebar, forks and frames. Hooks on tubes for applying bending leverage.

96806-40 Bending Bar

Used to support motorcycle on shop or showroom floor to provide sturdy support. Lock bar with curved end slips through motorcycle frame cross tube below transmission. Operating bar fits into socket on either side providing leverage to raise or lower motorcycle rear end.

96810-63 Motorcycle Shop Stand

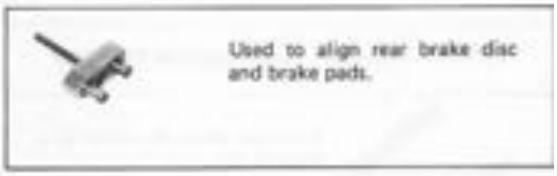


Compresses rear shock absorber for disassembly or assembly. Holds shock absorber spring in compression while parts are disassembled.

97019-52A Block only for 1967 and later.

97010-52A Rear Shock Absorber Tool

97168-77 Alignment Gage



Used to align rear brake disc and brake pads.

97169-77 Bending Tool

ENGINE 3

TABLE OF CONTENTS

GENERAL

SPECIFICATIONS

VALVES

Fit in guide (EX)	.0035 - .0055 in.
Fit in guide (IN) 1979 and earlier	.0018 - .0038 in.
1980 and later	.0020 - .0040 in.
Spring (outer)	104 - 120 lbs. at 1-3/8 in. (closed)
	179 - 195 lbs. at 1 in. (open)
Free length	1-31/32 in.
(inner)	26 - 32 lbs. at 1-3/16 in. (closed)
	69 - 81 lbs. at 51/64 in. (open)
Free length	1-23/64 in.
Tappet adjustment	Hydraulic tappet unit compressed 1/8 in. from fully extended position.

ROCKER ARM

Fit in bushing	.0005 - .002 in loose
End clearance	.004 - .025 in.

PISTON

Fit in cylinder	.001 - .002 in. loose
Ring gap	.010 - .020 in.
Compression ring side clearance	.004 - .005 in.
Oil ring side clearance	.003 - .005 in.
Piston pin fit	Light hand press at 70°F

CONNECTING ROD

Piston pin fit	.0008 - .0012 in. loose
End play between flywheels	.005 - .025 in.
Fit on crankpin	.001 - .0015 in. loose

OIL PUMP PRESSURE

At normal operating temperature and engine speed of 2000 rpm oil pressure should be	12 - 35 psi

IGNITION TIMING

Ignition timer air gap	
1979 and earlier	.004 to .006 in.
1980 and later	not adjustable
Ignition timing	
(Fully Retarded)	3°BTC (1/64 in. BTC)
(Automatic Advance)	35°BTC (7/16 in. BTC)
Spark plug gap setting	.038-.043 in.

TAPPETS

Guide fit	.0025 tight - .0025 loose
Fit in guide	.001 - .002 in. loose
Roller fit	.0005 - .001 in.
Roller end clearance	.008 - .010 in.

GEARCASE

Breather gear end play	.001 - .005 in.
Cam gear shaft in bushing	.0008 - .0018 in.
Cam gear shaft in bearing	.0005 - .003 in.
Cam gear end play	.001 - .005 in.
Oil pump drive shaft (crankcase bushing)	.0008 - .0012 in.

FLYWHEEL ASSEMBLY

Gear shaft nut torque	170 ft-lbs
Sprocket shaft nut torque	400 ft-lbs
Crank pin nuts torque	200 ft-lbs
Runout (flywheels)	.003 in. maximum at rim
Runout (mainshaft)	.001 in. maximum

SPROCKET SHAFT BEARING

Cup fit in crankcase	.0012 - .0032 in. tight
Cone fit on shaft	.0002 - .0015 in. tight
End play	.001 - .006 in.

PINION SHAFT BEARINGS

Roller bearing fit	.0004 - .0008 in. loose
Cover bushing fit	.0005 - .0012 in. loose

DESCRIPTION

The engine is a two-cylinder, four-cycle, air cooled, overhead-valve, V-type engine. It has three major component assemblies: cylinder, crankcase and gearcase.

Cylinder assemblies include cylinder head, valves, rocker arms and piston. Cylinders mount on the engine crankcase in a 45 degree "V," with both connecting rods connected to a single crank pin.

The reciprocating, linear motion of the piston in the cylinder is converted to circular motion in the crankcase. The built-up crankshaft consists of an off-center crank pin interposed between two counterweighted flywheels which rotate on two end shafts (pinion and sprocket shafts) supported by antifriction roller bearings. The lower end of the rear

cylinder connecting rod is forked to fit around the single-end front cylinder connecting rod, allowing a single connecting rod-crankpin connection to the flywheel.

Flywheel rotation is clockwise (viewing engine from right side). Using the front cylinder firing position as a starting point, the rear cylinder fires at 315 degrees rotation (360 degrees minus the 45 degrees between cylinders). The front fires in an additional 405 degrees (360 degrees plus the 45 degrees between cylinders), completing the 720 degrees of flywheel rotation necessary for the four piston strokes.

The gearcase is located on the right side of the crankcase and houses a gear train which operates and times the valves, and crankcase breather. The rotary crankcase breather valve is located between crankcase and gearcase compartments and functions to relieve crankcase pressure caused by downstroke of pistons, and controls the flow of oil in the lubrication system. Air exausted from crankcase is fed into carburetor air intake system.

A single cam shaft with four cam lobes is gear driven. The engine valves are opened and closed through the mechanical linkage of tappets, push rods and rocker arms. Tappets serve to transmit the cam action to the valve linkage. Hydraulic lifters installed in the tappets automatically compensate for heat expansion to maintain a no-lash fit of parts. Valve and breather timing are obtained by meshing gearcase gears with timing marks aligned.

Ignition spark is produced by the operation of an electronic ignition system. Both spark plugs fire each crankshaft revolution. However, the spark in one cylinder occurs ineffectually during its exhaust stroke.

Most other engine components function similar to usual internal combustion engine design. For further description of part function, see pertinent manual sections.

GASOLINE

For 1979 and earlier models use a good quality leaded "Premium" grade gasoline (94 pump octane or higher). For 1980 models, use a good quality, leaded or unleaded, "Premium" grade gasoline (94 pump octane or higher). "Pump octane" is the octane number usually shown on the gas pump.

LUBRICATION

The engine is lubricated by a pressure system circulating oil from the tank through the moving parts and back to tank. For adequate lubrication the tank must contain an ample supply of clean oil at all times.

Oil consumption should be approximately 250 to 500 miles per quart depending on the nature of service, solo or sidecar, fast or moderate driving, how well the engine is kept tuned, and chain oiler adjustment. If mileage is not within this range, see following engine overhaul section.

Remove tank cap and check oil supply at not more than 300 miles after each complete refill. If level is down near "Refill" mark on gauge rod, add oil. When level is down to "Refill" mark, add two quarts. Engine will run cooler and usage will be less with oil level well up in tank.

The oil tank capacity is 4 quarts. The tank is full when the oil level is about one inch from top with motorcycle in an upright position off the jiffy stand. Do not fill above this level because the tank needs some air space. Tighten the cap securely to prevent leakage.

Change oil in new engine after first 500 miles, and at about 2500 mile intervals thereafter. Completely drain oil tank of used oil and refill with fresh oil. If service is extremely hard, hot, on dusty roads or in competition, drain and refill at shorter intervals. Draining should be done while oil is hot. It is not necessary to drain the crankcase for it does not accumulate more than about 5 oz. of oil at any time. At the time of the first oil change, and along with at least every second oil change thereafter, thoroughly flush and clean out tank with kerosene to remove any sediment and sludge that may have accumulated.

OIL COOLER (Model FXS)

The FXS model is equipped with an oil cooler as standard equipment. Oil cooler does not require periodic maintenance. When operating the motorcycle in temperatures below 50 °F (10 °C), it is recommended that the oil cooler cover, provided with your motorcycle, be installed; otherwise engine will not warm up to proper operating temperaure.

WINTER LUBRICATION

Combustion in any engine generates water vapor. When starting and warming up in cold weather, especially in freezing or cold weather, the vapor that gets into the crankcase condenses to water before the crankcase is hot enough to exhaust the vapor through the outside breather. If engine is run often enough to get the crankcase thoroughly warmed up, most of this water is again vaporized and blown out through the breather. A moderately driven engine, making short runs and seldom allowed to thoroughly warm up, will accumulate increasing amounts of water in the oil tank. This water will, in freezing weather, become slush or ice and if allowed to accumulate, will block oil lines and damage the engine. Water mixed with oil for some time forms sludge that is harmful to the engine and causes rapid wear of various working parts. In winter the oil should be changed more often than in normal weather. Any engine used for short runs, particularly in commercial service, must have oil changed frequently and tank thoroughly flushed to remove water and sludge, before new oil is put in tank. The farther below freezing the temperature drops, the shorter the oil change interval should be.

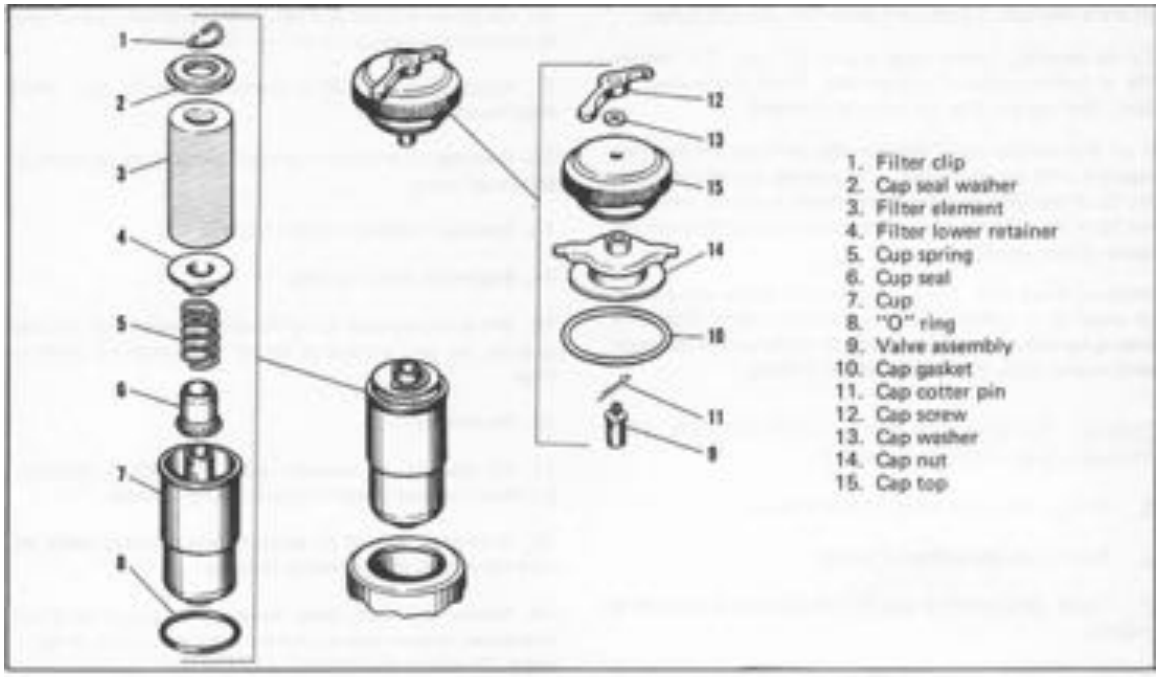


Figure 3-1. Oil Tank Filter – Exploded View

CHANGING OIL

Run engine until it is fully warm. Remove oil tank plug from bottom of tank at right rear corner. Allow all oil to drain. Replace plug. Pour a quart of kerosene into tank and agitate by rocking motorcycle from side to side. Remove plug and drain. Replace plug and fill with recommended grade oil as follows:

Air Temperature (Cold Engine Starting Conditions)	Use Harley-Davidson Oil Grade
20° to 90°F - Normal and severe operating conditions	Power Blend Super Premium
Above 40°F Below 40°F Severe operating conditions at air temperatures above 90°F	75 Medium Heavy 58 Special Light 105 Regular Heavy

OIL PRESSURE SIGNAL LIGHT

The oil signal light indicates oil circulation.

If the oil signal lights fails to go off at speeds above idling, it is usually due to low or diluted oil supply. In freezing weather the oil feed pipe may clog with ice and sludge, preventing circulation of oil. A grounded oil signal switch wire, faulty signal switch, or trouble with oil pump will also cause the light to stay on. If the oil signal light fails to go off, always check the oil supply first. Then, if oil supply is normal, look inside the oil tank to determine if oil returns to the tank from the oil return pipe outlet located at front of oil tank near filler hole when the engine is running. If it is returning to the tank there is some circulation, and engine may be run a short distance if necessary. If no oil returns, shut off engine until trouble is located and corrected.

OPERATING OIL PRESSURE

Operating oil pressure may be checked as follows:

Fill oil tank to proper level. Disconnect oil pressure switch wire at top of switch and remove switch. Install Oil Pressure Gauge, Part No. 98921-52. Attach gauge to motorcycle and road run or simulate road running until engine is completely warmed. A full operating temperature is essential for accurate gauging. Oil pressure should be 12 - 35 psi at 2000 rpm with oil at normal operating temperature.

An acceptable alternate method of checking oil pressure is to connect the gauge, by means of an adapter, at the tappet oil screen.

OIL FILTER (Figure 3-1)

The tank is equipped with a large mouth filler opening and a screw cover with oil filter attached.

Oil filter element (3) should be replaced at every oil change. To service filter element, remove cap from oil tank, remove filter clip (1), washer (2) and pull out filter. Make certain "O" ring (8) is positioned against filter cup flange (7) when filter is installed in tank.

SERVICING OIL TANK CAP AND FILLER OPENING

To disassemble, follow order shown in figure 3-1. Assembly is reverse order of disassembly. Clean and inspect all parts. Replace any that are worn or damaged.

If oil leak should occur between the tank cap and the filler opening, with cap and gasket in serviceable condition, check the lip of the filler opening. A cap drawn too tight will bend the lip of the filler opening resulting in an imperfect seal between gasket and lip.

Drain oil from tank. Using a mallet as a driver and a block of wood as a cushion, bend the lip down until flush with sealing surface of tank cap. Remove nicks and rough spots with emery cloth. Flush tank before refilling.

ENGINE OILING AND BREATHER SYSTEM (The Following Steps Apply to Figure 3-2)

1. Gravity feed from oil tank to feed pump.

2. Feed (pressure) section of pump.

3. Check valve prevents gravity oil drainage from tank to engine.

4. Oil is filtered through oil screen and forced through passages or external oil lines to lubricate rocker arm bushings, shafts, valve stems, valve springs and push rod sockets. A branch passage supplies oil to the hydraulic lifters.

5. Pressure regulating valve maintains correct pressure in system. When oil reaches rocker arms and lifters, regulating valve lifts and allows pressurized oil to flow to pinion gear shaft.

6. Oil is forced through pinion gear shaft to lubricate lower connecting rod bearings from which oil splashes to cylinder walls, piston, piston pin, and main bearings. During cold engine start-up, pressure regulating valve (5) lifts further to allow excess oil to return directly to oil tank.

7. Oil drains from cylinder rocker housing through passage in each cylinder, then flows through hole in the base of each cylinder, lubricating cylinder walls, piston, piston rings and main bearings.

8. Some oil drains from the rocker housing through push rod covers into the gearcase compartment, lubricating push rods and tappets.

9. Rotary breather valve is timed to open on the downstroke of pistons, allowing crankcase exhaust air pressure to expel scavenge oil from the flywheel compartment through the breather valve into gearcase. Breather valve closes on upward stroke of pistons, creating a vacuum in the flywheel compartment.

During piston upstroke, the small port in breather valve lines up with passage in crankcase and vacuum draws oil from the crankcase breather oil trap.

10. Oil blown and drained into timing gearcase (steps 8 and 9), lubricates timing gears and gear shaft bearings.

11. Front chain oil. Oil is blown into chain case when breather valve is open.

12. Gearcase oil settling in gearcase sump flows to scavenge section of pump.

13. Scavenge (return) section of pump.

14. Engine oil return to tank.

15. Crankcase exhaust air baffle and gearcase cover transfer passage. Air and oil mist is forced into crankcase breather trap.

16. Breather oil trap.

17. Oil transfer to breather valve. On piston upstroke, crankcase vacuum draws trapped oil into breather.

18. Crankcase exhaust air escapes from gearcase and is fed into the rear of the air cleaner housing.

19. Return line from chain housing. On piston upstroke, crankcase vacuum draws oil from chain housing to breather valve. On piston downstroke, oil in breather valve is forced into gearcase.

20. Vent line to oil tank and chain housing.

21. Rear chain oiler.

22. Pressure switch fitting.

REPAIR AND DIAGNOSTIC PROCEDURE

GENERAL

When an engine needs repair, it is not always possible to definitely determine beforehand whether the engine can be repaired by disassembling only cylinders and heads, only gearcase; or whether engine must be completely disassembled for crankcase section repair.

Usually, only upper-end repair is needed and it is recommended procedure to first strip motorcycle for cylinder head, cylinder and piston repair as described in "Stripping Motorcycle for Engine Repair," steps 1 through 9.

After disassembling cylinder head and cylinder it may be found that lower end repair is necessary. This requires removal of engine crankcase from frame as described in steps 10 through 16 in "Stripping Motorcycle for Engine Repair."

In cases where it has been definitely determined beforehand that the lower portion of engine (crankcase) is in need of repair, remove complete engine from chassis before starting disassembly as described in steps 1 through 16 of "Stripping Motorcycle for Engine Repair."

Symptoms indicating a need for engine repair are often misleading, but generally if more than one symptom is

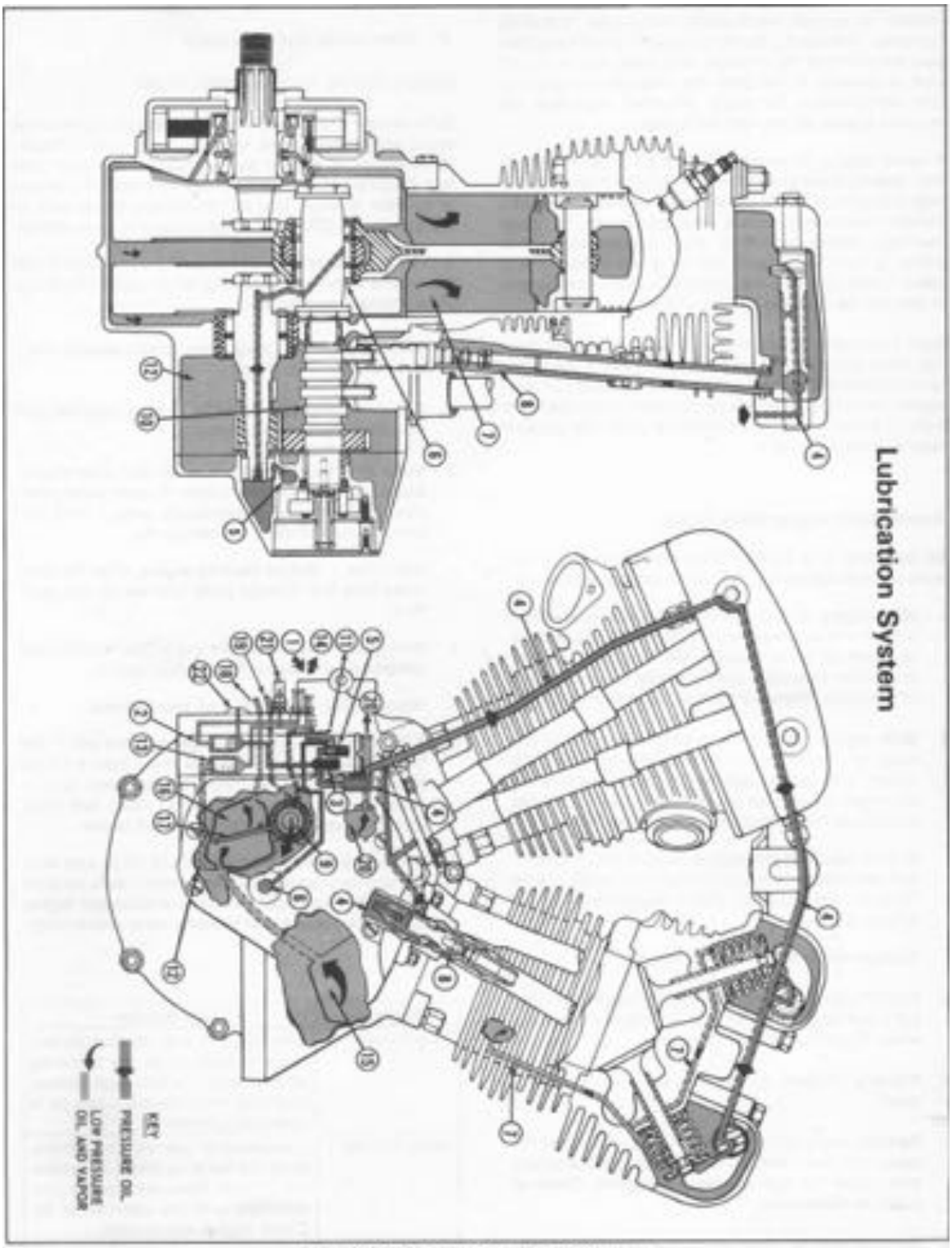


Figure 3-2. FL/FLH/FX Lubrication System

present, possible symptom causes can be narrowed down to make at least a partial trouble diagnosis. An above normal consumption of oil, for example, could be caused by several mechanical faults (see "Locating Troubles," Section 1). But when accompanied by a blue-gray smoke from the exhaust, and when low compression is present, it indicates the rings need replacing. Low compression by itself, however, indicates improperly seated valves, not worn rings.

A noisy engine is usually caused by loose bearings. Main bearings are generally more durable than rod bearings or bushings so the latter should be suspected first. Certain "knocking" noises may be caused by loose bearings, others by piston slap, a condition where piston or cylinder or both are worn out of round and loose fitting, allowing the piston slap from front to rear of cylinder as it moves up and down.

Most frequently, valves, rings, pins, bushings and bearings need attention at about the same time. If the symptoms can be narrowed down through the process of elimination to indicate any one of the above components is worn, it is best to give attention to all of the cylinder head and cylinder parts.

DIAGNOSING VALVE TRAIN NOISE

To diagnose and correct noisy hydraulic lifters and valve train components, use the following procedures:

1. With engine and oil at normal operating temperature, check oil pressure at 3000 rpm. If oil pressure is above 50 psi or below 5 psi, inspect oil pump, crankcase passages and oil hoses for restrictions or blockage. Repair or replace parts as necessary.

2. With engine running, raise push rod cover at the noisy lifter and check to see that oil is reaching the tappet. If oil is not reaching the tappet, inspect the passages in the tappet, tappet block and right crankcase for restrictions or blockage.

   If oil is reaching the tappet, remove the hydraulic unit and inspect per procedure listed under "Valve Tappets and Guides." Clean tappet bore of all foreign material.

   Replace hydraulic unit if necessary.

3. Examine push rod, hydraulic unit, tappet and tappet block for proper fits and any signs of unusual wear. Replace parts as necessary.

4. Visually inspect camshaft lobes for abnormal wear.

5. Remove camshaft and pinion gear, clean and inspect for wear and fit. Measure pitch diameters and check for out of round condition. Replace parts as necessary.

6. Remove cylinder head and rocker box assemblies. Check rocker arm end play and check for binding. Inspect valve stems for scuffing and check stem to guide clearance. Check valve seats for signs of looseness or shifting.

7. Grind valves and valve seats.

COMPRESSION TESTING PROCEDURE

Satisfactory engine performance depends upon a mechanically sound engine. In many cases, unsatisfactory performance is caused by combustion chamber leakage. A compression test can help determine the source of cylinder leakage. Use a compression tester such as the Sun model UTC-48 that has a screw-in type adapter.

A proper compression test should be performed with the engine at normal operating temperature when possible. Proceed as follows:

1. Disconnect spark plug wires, clean around plug base and remove plugs.

2. Connect compression tester to front cylinder per manufacturer's instructions.

3. Make sure transmission is in neutral. With choke and carburetor throttle plates in wide open position, crank engine continuously until 5 to 7 full compression strokes are completed.

   CAUTION — Before starting engine, after the test, make sure that throttle plate is in the closed position.

4. Note gauge readings at the end of the first and last compression strokes. Record test results.

5. Repeat steps 2 through 4 on rear cylinder.

6. If the final readings are 100 psi or more and if the final readings do not indicate more than a 10 psi variance between cylinders, compression is considered normal. If compression does not meet specifications, see diagnostic chart below.

7. Inject approximately 1/2 oz. of SAE 30 oil into each cylinder and repeat the compression tests on both cylinders. Readings that are considerably higher during the second test indicate worn piston rings.

Diagnosis	Test Results
Ring Trouble	Compression low on first stroke, tends to build up on the following strokes but does not reach normal. Improves considerably when oil is added to cylinder.
Valve Trouble	Compression low on first stroke, does not build up much on following strokes. Does not improve considerably with the addition of oil. Check tappet adjustment.
Head Gasket Leak	Same reaction as valve trouble.

CYLINDER LEAKAGE TEST

The cylinder leakage test will pinpoint engine problems including leaking valves, worn, broken or stuck piston rings and blown head gaskets. The cylinder leakage tester applies compressed air to the cylinder at a controlled pressure and volume and measure the percent of leakage from the cylinder.

Use a cylinder leakage tester such as the Sun, model CLT-228 or equivalent. Follow the specific instructions supplied with the tester.

The following are some general instructions that apply to Harley-Davidson V-twin engines:

1. Run engine until it reaches normal operating temperature.

2. Stop engine. Clean dirt from around spark plugs and remove the spark plugs.

3. Remove the air cleaner and set the carburetor choke and throttle in the wide open position.

4. Remove the timing inspection plug from the crankcase.

5. The piston in the cylinder being tested must be at top dead center during the test.

6. To keep the engine from turning over when air pressure is applied to the cylinder, engage transmission in fourth gear and lock the rear brake.

7. Following the manufacturer's instructions, perform a cylinder leakage test on the front cylinder. Make a note of the percent leakage.

8. Listen for air leaks at carburetor intake, tailpipe, head gasket and timing inspection hole. Air escaping through carburetor indicates leaking intake valve. Air escaping through exhaust pipe indicates leaking exhaust valve. Air escaping through timing inspection hole indicates leaking, worn or broken piston rings, worn piston and/or cylinder. Listen around head gasket area to checking for leaking gasket.

NOTE: If air is escaping through valves check valve adjustment.

9. Repeat procedure on rear cylinder.

CAUTION — Make sure throttle plate is in the closed position before starting engine.

DIAGNOSING SMOKING ENGINE OR HIGH OIL CONSUMPTION

Perform Compression or Cylinder Leakage Test as described previously. If further testing is needed proceed as follows:

1. Remove one clutch cover screw and install Vacuum Gauge, Part No. 96950-68.

2. Start engine and let idle, gauge should read 9 to 11 inches of water minimum.

3. Pinch chaincase vent line (3/8 in. hose running from primary case to tee). Gauge reading should be 25 inches of water minimum at 1500-2000 rpm.

4. If chaincase vacuum is low, check for leaks by pressurizing chaincase with compressed air.

CAUTION — Use 10 psi pressure maximum for leak test. Before applying air pressure through the clutch cover screw hole pinch all oil lines running to chaincase near case.

5. With chaincase pressurized, listen for leaks at following locations:
   - All gasket surfaces
   - O-ring surfaces
   - Hose fittings
   - Oil seals (between engine and chaincase and transmission and chaincase)
   - Solenoid mounting
   - Starter drive mounting
   - Clutch cover seal
   - Chain inspection cover seal

If primary chaincase vacuum is within specifications and the Compression and Cylinder Leakage Tests show no problems, the oil supply to the heads can be blocked to determine if the oil consumption/smoking is due to a problem in the cylinder head area.

CAUTION

The oil supply to the cylinder heads should not be blocked for an excessive amount of time (2 minutes maximum) or damage will result. Do not run the engine above idle speed while oil supply is blocked.

1. With engine at normal operating temperature, block off the overhead oil supply line to the cylinder heads.

2. Start engine and let idle for no more than 2 minutes. If the smoking stops during this period the problem is in the cylinder head area.

3. Remove suspect head(s) and inspect the following:
   - Gasket surface of both head and cylinder
   - Oil return passages for clogging
   - Cylinder head casting porosity allowing oil to drain into combustion chamber
   - Valve guide to valve stem clearance
   - Check that lip on top of cylinder does not contact combustion chamber. To check this, place head on cylinder without gasket. The head gasket surface must contact the cylinder gasket surface all the way around.

STRIPPING MOTORCYCLE FOR ENGINE REPAIR

Use the following procedure to strip the motorcycle for either cylinder head and cylinder removal for repair with engine in chassis, or for engine removal for complete overhaul.

WARNING

Disconnect battery cables (negative cable first) before performing the following steps to avoid accidental start-up of vehicle and possible personal injury.

1. Remove seat.
2. Drain gas tank. Disconnect fuel line and remove gas tank.
3. To remove instrument cover take out mounting base center screw and pry off cover side plate located at trip mileage set screw.
4. Remove upper cylinder head bracket. Note washer(s) between bracket and frame lug, use same washer(s) when bracket is assembled.
5. Remove spark plugs to avoid damaging.
6. Remove air cleaner cover, filter element, air cleaner back plate and air cleaner back plate support bracket from carburetor body.
7. Disconnect throttle and choke controls from carburetor. Remove carburetor.
8. Remove carburetor intake manifold clamps.
9. Remove exhaust pipes.

At this stage, the cylinder heads and cylinders may be removed.

To remove engine crankcase or complete engine, continue stripping motorcycle as follows:

10. Remove pivot bolt from left foot board and swing rear end of foot board down away from chain case cover. Remove chain case cover. Remove compensating sprocket shaft nut.

    Remove clutch and sprocket assemblies as described in "Disassembling Clutch," Section 4.

11. Remove four bolts, attaching inner chain housing to engine.

    Loosen the 4 bolts attaching the primary to the transmission.

    Remove chain oiler hose at oil pump. Remove other hoses from connections at back of inner primary housing.

    Remove starter, starter housing and inner primary housing.

    Remove alternator rotor using puller tool, Part No. 95960-52A. See "Alternator," Section 5.

12. Disconnect timer wires at coil or connector. Disconnect alternator plug from crankcase and remove rectifier/regulator.
13. Remove footboard rear stud nut from inside of frame member and front footboard mounting stud bolts from brake master cylinder by removing nut and lockwasher on back side. Remove brake master cylinder attaching stud bolt which passes through master cylinder and frame with a lockwasher and nut on back side of frame member. Remove brake master cylinder sideplate bolt located behind master cylinder plunger boot. Swing master cylinder and sideplate assembly down away from engine crankcase. For FX models, remove footrest, brake, pedal assembly.
14. Remove exhaust system.
15. Disconnect wire from oil pressure switch. Drain oil tank and remove oil lines from oil pump. Remove crankcase breather pipe.
16. Remove two front and two rear engine mounting bolts. Engine is now completely stripped and may be removed from right side of motorcycle.

Assembly is essentially the reverse order of disassembly.

1. Install engine in chassis. Tighten mounting bolts to 35-40 ft-lbs torque.
2. Loosen transmission mounting bolts.
3. Install new O-ring on crankcase.
4. Check inner primary housing bearing. Replace if necessary using Harley-Davidson "Stud and Bearing Mount," Part No. 99626-77 in bearing recess. Install new oil seal.
5. Connect chain case hose and install inner primary case on transmission mainshaft.
6. Loosely assemble chain case mounting bolts (finger tight) to crankcase.
7. On 1978 to 1979 models, install chain housing four nuts on transmission studs and tighten to 30-35 ft-lbs torque. On 1980 models, install two nuts and two bolts. Do not tighten yet.
8. Tighten chain case to engine mounting bolts to 18-22 ft-lbs torque. Install new safety wire on chain case to engine two rear mounting bolts.
9. Tighten transmission mounting nuts to 18-22 ft-lbs torque. Make sure transmission mainshaft turns freely.
10. Tighten the inner primary case to transmission mounting bolts to 18-22 ft-lbs torque.
11. Install starter motor and housing.
12. Install clutch, compensating sprocket, primary chain and chain adjuster.
13. Install chain case cover, using a new gasket.

14. Assemble remainder of components in reverse order of disassembly.

IMPORTANT

After reassembly, chain housing must be airtight. Check using Vacuum Gauge, Part No. 96950-68. Remove one of the four screws securing the front chain inspection cover and in its place screw in the threaded fitting of the gauge. Then, with engine idling check gauge to see that there is a reading indicating 9-11 inches water minimum. Perform check with vent hose vacuum pinched closed with a pliers between inner primary and tee fitting. The reading should now be 25 inches of water or more. A lower reading indicates an air leak into chain housing either at gasket, solenoid, starter shaft or hoses.

CYLINDER HEAD

REMOVING (Figure 3-3)

Before removing cylinder head assembly, strip motorcycle as described in "Stripping Motorcycle For Engine Repair."

Disconnect overhead oil feed line (1) and cylinder interconnecting oil line (4) at fittings.

Remove spring cap retainers (8) on push rod covers by prying down and out on cover spring cap with screwdriver. Crank engine until valves are closed.

Remove five head bolts (5) from each head. Lift cylinder head enough to slip out push rods (6) and push rod covers (7). Mark push rods so that they will be reassembled in same location. Remove cylinder head (9). Remove cylinder head gasket (10).

DISASSEMBLING (Figure 3-3)

Free the rocker arm cover (13) and gasket (14) from cylinder head by removing stud nuts (11). Before further disassembly, carefully check the rocker arm pads and ball sockets for pitting and excessive wear. Also, check the rocker arm shaft (17) for proper end play.

Remove rocker arm shaft screw and "O" ring (18), acorn nut and washer (15). Discard shaft screw "O" ring. Tap rocker arm shaft (17) from cover and remove rocker arm (20) and spacer (16). Mark rocker arm shaft and arm in some manner so all parts may be returned to respective locations during assembly.

Compress valve springs using Valve Spring Compressor, Part No. 96600-36, and remove valve keys (23) from ends of valve stems as shown in Figure 3-4. Mark keys to identify them with their respective valves. Remove valve spring collars (24 and 27), springs (25 and 26) and valves (28). Reassemble valves in same cylinder head from which they were removed. Before removing, mark valves in some manner to identify them with front and rear cylinder head.

CLEANING AND INSPECTION

Clean outside of cylinder head with a wire brush. Bead blast or scrape carbon from head, top of cylinder, top of bore above ring path, and inlet and exhaust valve ports. When scraping carbon, be careful to avoid scratching or nicking cylinder head and cylinder joint faces or bore. Blow off loosened carbon or dirt with compressed air.

Wash all parts in solvent. Blow out oil passages in head. Be sure they are free of sludge and carbon particles. Remove loosened carbon from valve head and stem with a wire wheel. Never use a file or other hardened tool that will scratch or nick valve. Polish valve stem with very fine emery cloth or steel wool. Check valve stem for excessive wear.

Valve head should have a seating surface about 1/16 in. wide and should be free of pit marks and burn spots. Exhaust valves should contain carbon that is black or dark brown. White or light buff carbon indicates excessive heat and burning.

Valve seats are also subject to wear, pitting and burning. They should be resurfaced whenever valves are refinished. Clean valve guides with an appropriate expansion reamer. Check for valve wear and valve stem clearance.

Inspect spark plug port threads for damage. If threads in head are damaged, a special plug insert can be installed using a standard spark plug port repair kit.

Inspect valve springs for broken or discolored coils. Check free length or check tension of each spring. If a spring is more than 1/8 in. shorter than a new spring, or tension shows spring to be below low limit tension of new spring, replace it with a new spring. Check valve spring compression with valve spring tester against tolerances shown in "Engine Specifications."

Examine push rods, particularly the ball ends. Replace any rods that are bent, worn, discolored or broken. Check cup at end of rocker arm to make certain there are no chips broken out.

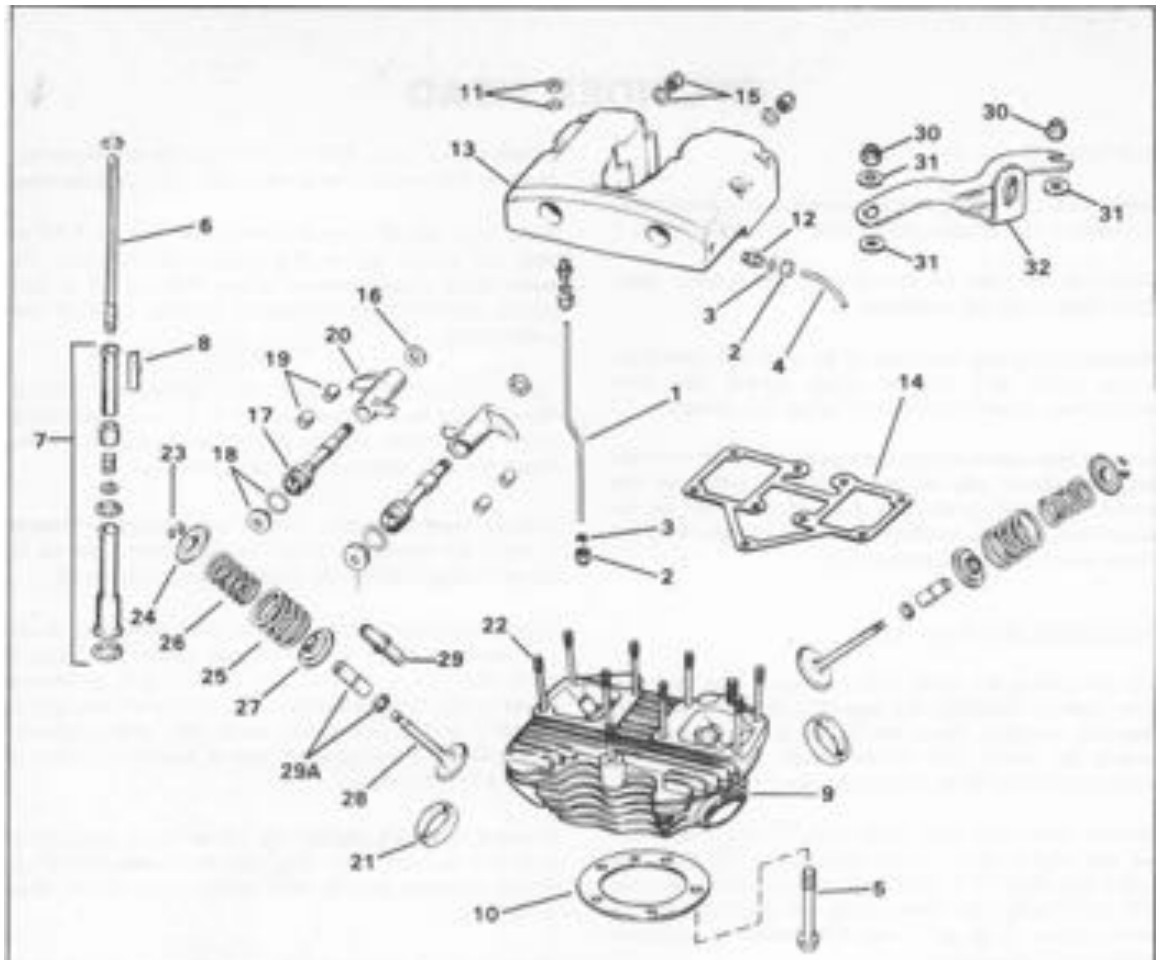
Blow out oil passages in rocker arms, rocker arm bushings and rocker arm covers.

If the rocker arm pads show uneven wear or pitting, dress on a grinder, maintaining original curve. If possible, compare with a new unit during this operation to insure a correctly contoured surface.

Carefully check the rocker arm and shaft for wear. Replace rocker arm bushings if shaft is over .002 in. loose in bushings, as described in "Repairing Rocker Arms and Bushings."

REPAIRING ROCKER ARMS AND BUSHINGS (Figure 3-3)

To replace worn bushings (19), press or drive them from the rocker arm. If bushing is difficult to remove, insert a 9/16-18 tap into bushing. From opposite side of rocker arm, drive out bushing and tap. Press replacement bushing into rocker arm, flush with arm end, oil hole correctly aligned and split portion of bushing towards top of arm. Using remaining old bushing as a pilot, ream new bushing with Harley-Davidson Reamer Tool, Part No. 94804-57. Repeat for other end of rocker arm. When reassembling rocker arm housing, install new O-rings (18).



1. Overhead oil feed line
2. Feed line nut (3)
3. Feed line rubber sleeve (3)
4. Cylinder interconnecting oil line
5. Head bolt and washer (5)
6. Push rod (2)
7. Push rod cover (2)
8. Spring cap retainer (2)
9. Cylinder head
10. Cylinder head gasket
11. Rocker housing nut and washer (5)
12. Oil feed line nipple
13. Rocker arm housing
14. Rocker housing gasket
15. Rocker arm shaft acorn nut and washer
16. Rocker arm spacer (2)
17. Rocker arm shaft (2)
18. Rocker arm shaft screw and O-ring (2 each)
19. Rocker arm bushing (4)
20. Rocker arm (2)
21. Valve seat insert (one exhaust, one intake)
22. Rocker housing stud (8)
23. Valve key (2)
24. Upper valve spring collar (2)
25. Outer valve spring (2)
26. Inner valve spring (2)
27. Lower spring collar (2)
28. Valve (one exhaust, one intake)
29. Valve guide, shouldered (2) (1978-1979)
29A. Valve guide and snap ring (2) (1980)
30. Nut
31. Washer
32. Upper engine mount bracket

Figure 3-3. Cylinder Head – Exploded View

REPLACING VALVE GUIDES

Replacing valve guides if necessary, must be done before valve seat and face are ground since the valve stem hole in valve guide is the basis from which all face and seat grinding is done. Valve stem-valve guide clearances are listed on page 3-1. If valve stems and/or guides are worn to exceed the maximum tolerance by more than .002 in., new parts must be installed.

Tap out valve guides with shouldered drift pin (from chamber side) and insert replacement guide on arbor press. Be particularly careful to press replacement guide squarely into hole.

NOTE: On cast iron guides, install a new snap ring on guide before pressing in.

New valve guides are reamed to correct size. However, when guides are pressed into cylinder heads they may close up slightly; also the ends may be burred. Therefore, after new guides are in place, they should be sized and cleaned with an expansion reamer.

It is of prime importance that valve guides fit tightly in cylinder heads, or valves may not seat properly. If original guide or new standard guide is not a tight press fit, an oversize guide must be installed. Steel guides are available in the following oversizes: intake - .001, .002, .003, .004, .008; exhaust - .001, .003, .004, .006, .008

Cast iron guides are available in the following oversizes: intake and exhaust - .001, .002, .003, .004, .006, .008 and .025

The number of grooves on O.D. indicates number of thousandths of an inch press diameter is oversize.

RECONDITIONING OR REPLACING VALVE SEATS

After installing valve guides, valve seats must be refaced to true them with guides.

If valves have been reseated several times, valve seats may have become too wide and/or valve may be seating itself too deeply in head. When valve seat becomes wider than 1/16 in. (see Figures 3-5, 3-5B) valve seat relief must be counterbored or ground to reduce seat to 1/16 in. Counterbore dimensions are shown. Tools for this purpose are available commercially. To determine if valve is seating itself too deeply in head, measure distance from shoulder of valve guide to end of valve stem. See dimensions in Figure 3-5 and 3-5A. When valve stem extends through guide in excess of maximum shown, valve seat inserts must be replaced.

For 1979 and earlier models, a special gage is available under Part No. 96490-59A, which is used to measure this dimension. The tool consists of gage valves and gage which is placed over the valve stem as shown. If top end of gage valve stem is between steps on gage, the valve seat location is satisfactory.

Replacement inserts are available from the factory. Installation requires accurate boring equipment to machine correct counterbore in head for installation with .004 to .006 in. interference fit.

GRINDING VALVE FACES AND SEATS

Valve seat tools and fixtures are available commercially. Seat each valve in same port from which it was disassembled. Correct valve seat angles are shown in Figures 3-5 and 3-5B.

Figure 3-4. Compressing Valve Spring

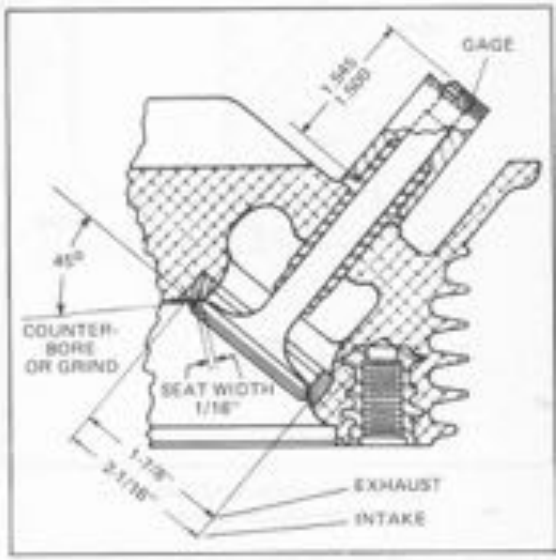


Figure 3-5. Valve Seat — Early 1980 and Earlier

Valve face angle is 45° for both intake and exhaust valves, and if a valve refacing grinder is used, it must be adjusted exactly to this angle. It is important to not remove any more metal than is necessary to clean up and true valve face. If grinding leaves the edge of valve very thin or sharp, install a new valve. A valve in this condition does not seat normally, will burn easily and may cause pre-ignition. There is also danger of cracking. Valves that do not clean up quickly are probably warped or too deeply pitted to be used. If end of valve stem shown uneven wear, true end of stem on a valve refacing grinder equipped with suitable attachment.

Intake valves are marked "IN" on head; exhaust valves are marked "EX."

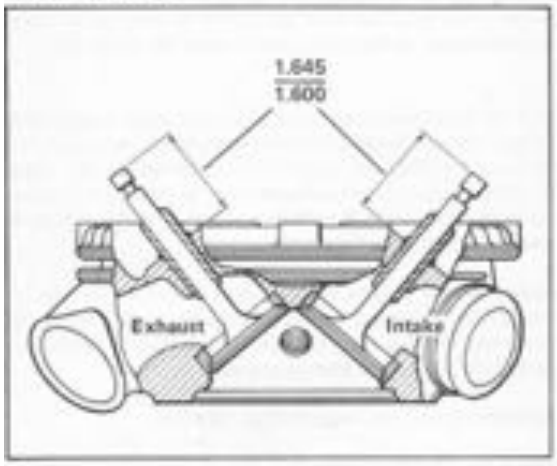


Figure 3-5A. Measuring Valve Depth — Late 1980 and Later

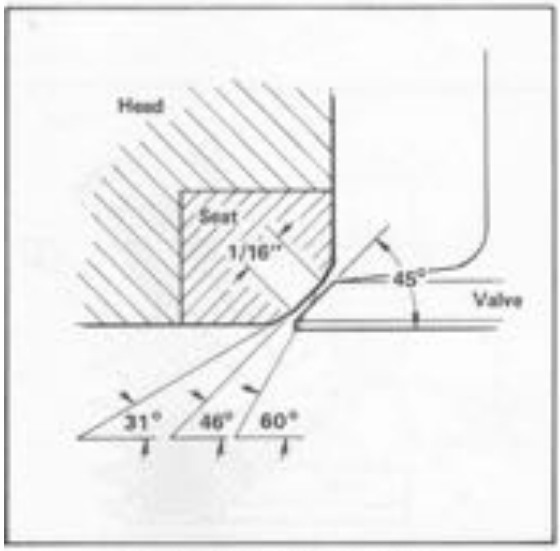


Figure 3-5B. Valve Seat Angles — Late 1980 and Later

LAPPING VALVE FACES AND SEATS

If valve faces and seats have been smoothly and accurately refaced, very little lapping will be required to complete operation. Apply a light coat of fine lapping compound to valve face, insert valve in guide and give it a few turns with Valve Lapping Tool, Part No. 96550-36. Lift valve and rotate it about 1/3 of a turn. Repeat lapping procedure as shown in Figure 3-6. After full turn remove valve, wash valve face and seat, and dry with cloth that is immediately discarded so grinding compound cannot be transferred to engine parts. If inspection shows an unbroken lapped finish of uniform width around both valve and seat, valve is well seated. If lapped finish is not complete, further lapping or grinding and lapping is necessary.

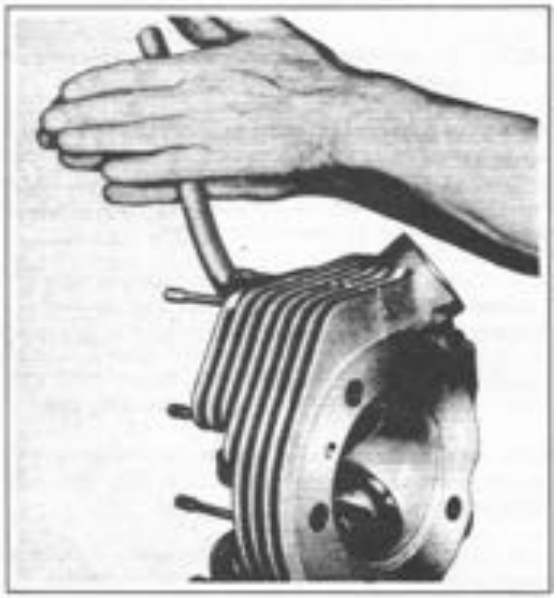


Figure 3-6. Lapping Valves

ASSEMBLING CYLINDER HEAD (Figure 3-3)

Replace valve and valve spring assemblies using Valve Spring Compressor, Part No. 96600-36. Position valve keys so spaces between key halves are equal.

Replace rocker arm assemblies. Rocker arms must be free or hydraulic lifters will not fill with oil. Replace rocker arm cover. New cover gaskets (14) should be used and cover nuts must be tightened evenly to 15 ft-lbs.

CAUTION

Be sure to see that rocker arm ends do not jam against valve stems as rocker box is installed on head studs. Use a screwdriver to raise valve end of arm when cover assembly is installed.

Install each cylinder head with a new cylinder gasket and position rear head. Start cylinder head bolts.

First turn bolts snug, then using a torque wrench tighten each 1/4 turn at a time until all are drawn to 55-60 ft-lbs.

Install push rods as described in the next procedure.

Installing and Adjusting Push Rods

1. Before installing or adjusting push rods, remove and clean all hydraulic tappets. Make sure each tappet is clean and free from oil before installing it in the guide. See "Valve Tappets and Guides."

2. See Figure 3-7. Remove the spark plugs and turn the engine until the front piston is at the top of its compression stroke. With front piston in this position the advance timing mark (1) will align with the timing inspection hole.

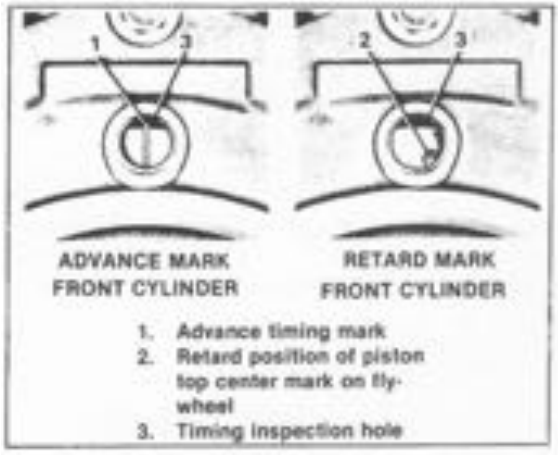


Figure 3-7. Timing Marks

3. Install front cylinder push rods and covers (6, 7 Figure 3-3). Always use new push rod cover gaskets or O-rings when re-assembling. Clean sealing surfaces with greaseless solvent. Greasy joint surfaces will make it difficult to remove gaskets or O-rings during next disassembly.

4. See Figure 3-7A. Turn one push rod adjusting screw (2) downward until the ball end of rod is seated in hydraulic lifter and has just no noticeable shake. Hold the push rod flats (3) with one wrench to keep rod from turning and with a second wrench turn the adjusting screw down slowly until all noticeable shake is taken up. Turn it downward until push rod bottoms then turn it up exactly 1½ turns. Lock the adjustment by turning locknut (1) against push rod and tightening the locknut to 10 ft-lbs torque. Repeat for the other front cylinder push rod.

5. See Figure 3-7. Now turn the engine over until the rear piston is at the top of its compression stroke. With the rear cylinder in this position the front cylinder retard mark (2) will align with the timing inspection hole.

6. Repeat the procedure for the with the rear cylinder push rods.

7. Re-install the spark plugs.

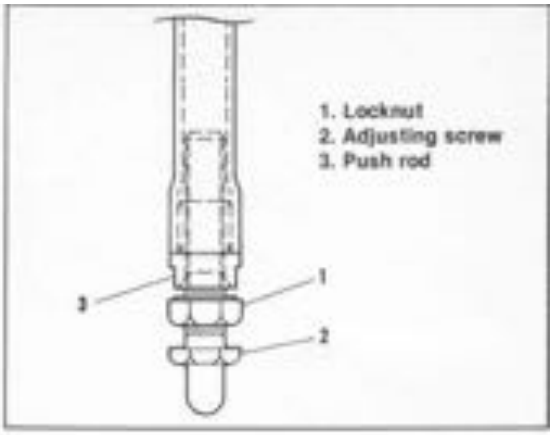


Figure 3-7A. Push Rod Adjustment

Checking Push Rod Adjustment

Push rod adjustment may be checked using the Push Rod Adjustment Gauge, Part No. 94438-79.

1. With the appropriate piston at the top of the compression stroke (see INSTALLING AND ADJUSTING PUSH RODS), raise the push rod cover to expose the hydraulic lifter.

2. See Figure 3-7B. Place the gauge on the lifter as shown. The top of the lifter should be even with the top of the gauge.

3. If gauge and lifter do not line up, follow the procedure for INSTALLING AND ADJUSTING PUSH RODS.

Figure 3-7B. Checking Push Rod Adjustment

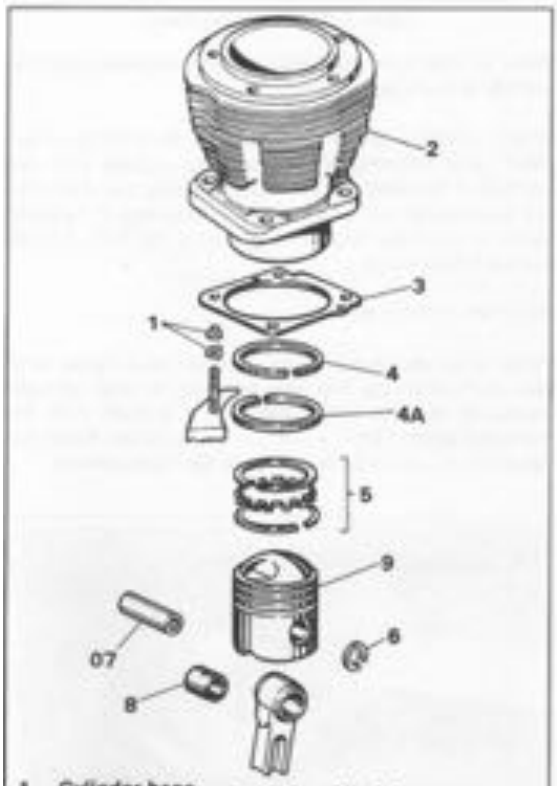
CYLINDER AND PISTON

DISASSEMBLING CYLINDER AND PISTON (Figure 3-8)

Strip motorcycle as described in "Stripping Motorcycle for Engine Repair."

Remove cylinder head as described in "Disassembling Cylinder Head."

Remove all cylinder base stud nuts and spacers (1) except one on rear cylinder using Cylinder Base Nut Wrench, Part No. 94585-30. Raise front cylinder and piston enough to permit placing a cloth over crankcase opening. This will prevent dirt or pieces of broken ring from falling into crankcase. With piston at bottom of stroke, remove cylinder (2). Remove remaining stud nut from rear cylinder. Remove rear cylinder in same manner. Discard cylinder to crankcase gasket (3).



1. Cylinder base nut and spacer (4)
2. Cylinder
3. Cylinder base gasket
4. Compression ring (1st groove)
4A. Compression ring (2nd groove)
5. Oil piston ring
6. Piston pin lock ring (2)
7. Piston pin
8. Piston pin bushing
9. Piston

Figure 3-8. Cylinder – Exploded View

Spring piston rings (4) outward until they clear ring groove in piston and lift off. Use a commercial ring expander if necessary. Remove piston pin lock rings (6) using internal lock ring pliers, Part No. 96215-49. Support piston and tap out piston pin (7) with a suitable drift.

CLEANING AND INSPECTING

Place cylinders and pistons in "Gunk Hydro-Seal" or other carbon and gum dissolving agent until deposits are soft. Scrub piston dome and outside of cylinder to remove deposits. Where carbon deposit is thick and hard, it is advisable to scrape carbon before cleaning. Use a putty knife or ground tip on an old file. Use care to keep from scraping into aluminum of piston.

Wash all parts in solvent and blow dry with compressed air. Force air through feed and return oil passages in cylinder. Clean piston ring grooves with a piece of compression ring ground to a chisel shape.

Examine piston pin to see that it is not pitted or scored. Check the piston pin bushing to see that it is not loose in connecting rod, grooved, pitted or scored. A piston pin, properly fitted, is a light hand press fit in piston and has .001 in. clearance in connecting rod upper bearing. If piston pin to bushing free fit exceeds .002 in., replace worn parts, (see "Connecting Rod Bushings").

Check piston pin lock rings to make sure they fit tightly in lock ring grooves. Make sure lock ring grooves are clean.

Examine piston and cylinder for cracks, burrs, burned spots, grooves and gouges.

Check rods for up and down play on lower bearings. When up and down play is detected, lower bearing should be refitted. This requires removing and disassembling engine crankcase.

REFINISHING CYLINDERS

Gauge pistons and cylinders to see if they are worn to the point where cylinders must be rebored and oversize pistons installed. Inside and outside micrometers used for piston to cylinder fitting should be checked together to be sure they are adjusted to read exactly the same. Subtract piston measurement from bore measurement to obtain clearance. Bore measurement of a cylinder should be taken in ring path, starting about 1/2 in. from the top of cylinder, measuring front to rear then side to side. Repeat procedure at the center and at the bottom of ring travel (see figure 3-9). This process will determine if cylinder is out of round or "egged" and will also show any cylinder taper or bulge.

Pistons are measured front to rear at base of piston skirt as shown in figure 3-10. Pistons are cam ground to an egged or oval shape so only front and rear surfaces are touching cylinder wall.

If cylinders are not scuffed, scored and are worn less than .002 in., it is not necessary to rebore oversize at time of cylinder repair. It may be done at time of next complete engine overhaul. If desired, a new piston may be installed to reduce clearance for more quiet operation.

If cylinders show more than .002 in. wear, they should be rebored and/or honed to next standard oversize and refitted with corresponding pistons and rings.

Cylinders can be refinished oversize with a hone only, or with a boring bar followed by a finishing hone. In general only cylinders not scored and not badly worn are refinished entirely with a hone. Cylinders badly worn or deeply scored are first rebored to nearly the required oversize using a Sunnen Roughing Stone (70 grit) and Medium Finishing Stone Set (220 grit). Then finish hone to exact size, using Polishing set (280 grit). Exact final size of the cylinder bore is determined by size of the piston to be used in that cylinder. Measure piston diameter accurately as described previously, then add desired piston clearance in cylinder. This will equal the exact final size to which cylinder bore should be refinished, example: the 1200cc .020 in. oversize piston to be used measures 3.4575 in., adding .0015 in. (desired clearance) equals 3.4590 in. (finish-honed size). When cylinders require reboring to beyond .070 in. oversize to clean up, their oversize limit has been exceeded and the cylinders must be replaced.

Figure 3-9. Measuring Cylinder Bore

Figure 3-10. Measuring Piston

When cylinders are worn less than the 0.002 in. maximum, and reboring is unnecessary, unless they are scuffed or grooved the same pistons may be used with the replacement of rings and the roughing of cylinder walls to facilitate ring seating. Use a 240 S.C. (Silicon Carbide) Flex Hone.

FITTING PISTON RINGS

Piston rings are of two types – compression (plain face) and oil control ring. The two compression rings are positioned in the two upper piston ring grooves with the stamped word "TOP," a dot (.) or a (-) upward. Rings are regularly supplied to fit standard oversize pistons.

Figure 3-11. Measuring Ring Side Clearance

Compression rings must have proper side clearance in ring grooves. Check with thickness gauge as shown in figure 3-11.

See Figure 3-11A. Taper face type compression rings are being used in the 2nd from top ring groove of 1340cc engines beginning with crankcase no. 1479-345-165, and in 1200cc engines beginning with crankcase no. 179-023-001.

The new ring replaces the chrome ring formerly used in the 2nd ring groove, and is identifiable by the black color instead of chrome on the outer edge. When installed in the ring groove, the lower edge of the ring seals against the cylinder wall to improve compression and oil control.

The bottom oil ring is a three piece oil control ring using a spring expander.

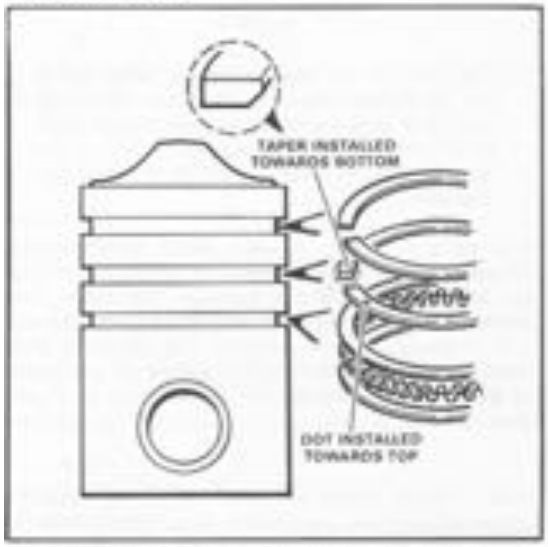


Figure 3-11A. Late Style Compression Ring

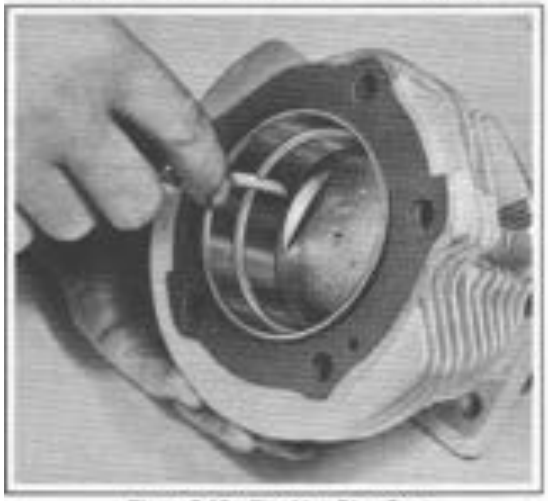


Figure 3-12. Checking Ring Gap

Ring gap (space between ends) must also be as specified, see "Specifications," Section 3.

To check ring gap, place a piston in cylinder with top end of piston about 1/2 in. from top of cylinder. Place ring in cylinder bore squarely against piston and check gap with thickness gauge (see figure 3-12).

Use only standard size rings and piston in standard bore, and only matching oversize rings and piston in the same oversize bore.

If gap is less than specified, ring ends may butt under expansion, and be scored or broken. Compression ring gap may be increased by filing with fine-cut file.

Use a commercially available piston ring expander (figure 3-13) to guide and slip rings over the piston into their respective grooves without over expanding or twisting rings and damaging the finely finished piston surface.

Figure 3-13. Assembling Rings with Ring Expander

See Figure 3-14. Ring gaps should be staggered on either side of the piston pin. Do not place ring gaps at thrust surfaces of piston. Also, gaps on the oil control ring top and bottom rails, shoud be spaced 1" either side of the oil control expander ring gap.

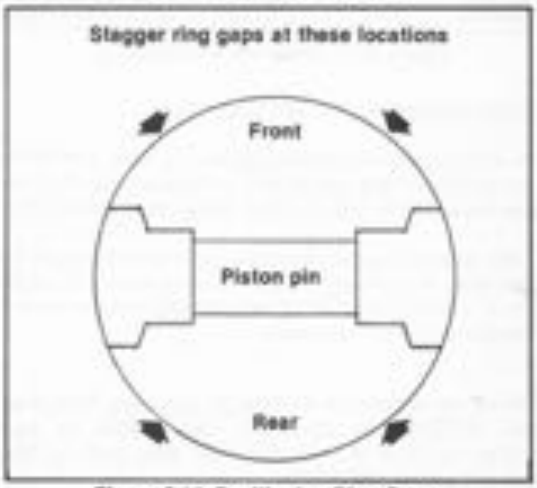


Figure 3-14. Positioning Ring Gaps

PISTON PIN BUSHING

When piston pin bushing is tight in rod but is worn to excessive pin clearance (0.002 in. or more) it is possible to service by reaming oversize and fitting an oversize pin. However, in most cases, it is recommended that a new bushing be installed and reamed to fit a standard pin. The objection to fitting upper end oversize is that considerably more time is required for the job. New pistons, standard or oversize, obtained from factory are supplied correctly fitted with standard pin, and may be installed in a short time if the rod bushing is already reamed to standard size. If bushing has been reamed oversize, either a new bushing must be installed and reamed to standard size or piston must be reamed oversize to fit an oversize pin, which involves extra time.

When replacing bushings in connection with only a top overhaul, use Harley-Davidson special tools as shown in Figure 3-15, Bushing Tool, Part No. 95970-32A and Connecting Rod Clamping Fixture, Part No. 95952-33. Be careful to start new bushing with bushing oil slot in alignment with oil slot in rod.

Ream new bushing to size with Special Reamer, Part No. 94800-26. A properly fitted pin should have 0.001 in. clearance; with this clearance, pin will have just noticeable shake in bushing. Fitting tighter is likely to result in a seized pin or bushing loosened in rod. A 0.004 in. oversize pin is available for use with worn bushing. Ream old bushing to correct size for oversize pin.

Figure 3-15. Replacing Rod Bushing

STRAIGHTENING CONNECTING RODS

In refitting and reassembling connecting rods, and finally fitting pistons, rods may be bent or twisted, throwing upper bearing and lower bearing out of alignment with each other.

After pistons have been installed, rods must be checked and re-aligned as necessary. If a rod is bent or twisted, piston has a "cocked" relation to cylinder bore and the result is excessive noise and rapid wear.

Check rod alignment with Piston Squaring Plate, Part No. 96179-18, as shown in Figure 3-16. Be sure crankcase face is clean and free from burrs so that squaring plate seats fully.

Figure 3-16. Checking Rod Alignment

NOTE

Piston skirt is cut away at bottom (below piston pin) for flywheel clearance, therefore, it cannot be used with squaring plate for checking rod alignment. Temporarily install special piston with flat bottom skirt, Part No. 96180-76, to check rod alignment.

If a rod is in perfect alignment piston bottom will rest squarely on plate when flywheels are turned so that crank pin is in forward and rear position. This check, to be accurate, depends upon checking with crank pin alternately in both forward and rear positions. It is the change of rod angle, resulting from changing crank pin from one position to the other that influences the seat of piston on squaring plate and thus indicates whether or not rod is in alignment.

Insert narrow strips of paper of equal thickness underneath piston, one on each side, below piston pin, as shown in Figure 3-16. Press piston down lightly with finger tips resting on center of piston head and pull first one paper, then the other, partially from underneath piston. If piston is perfectly square (rod in alignment), both will have the same amount of drag.

If rod proves to be out of alignment, it can be straightened by means of a bar inserted through piston pin, as shown in Figure 3-17. Use a bar with a diameter as close to the hole diameter in the piston pin as possible. The manner in which piston seats on squaring plate indicates as follows:

1. Piston high on same side, both crank pin positions; rod is bent.

2. Piston high on opposite sides as crank pin position is changed; rod is twisted.

3. Piston square or nearly square with crank pin in one position and high on one side with crank pin in other position; rod is bent and twisted.

Correct as follows:

1. To straighten a bent rod, insert straightening bar through piston pin hole on low side of piston and apply upward force.

2. To straighten a twisted rod, insert straightening bar through piston pin hole on high side of piston, and if crank pin position is to front apply force to rear – if crank pin position is to rear apply force to front.

3. To straighten a rod that is bent and twisted, remove bend first and then remove twist.

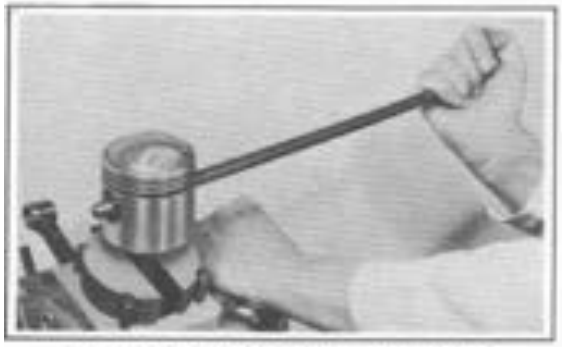


Figure 3-17. Straightening Connecting Rod

After rods have been aligned check to see that pistons center in crankcase cylinder opening, without side pressure on upper rod ends. If further realigning is necessary to center pistons, correct by dressing off end of rod bushing on interfering side with a file. This allows the piston to shift slightly on rod to find a more suitable alignment of rod, piston, and cylinder bore.

ASSEMBLING CYLINDER AND PISTON

Attach piston to connecting rod with a piston pin. If the piston is heated in boiling water, the pin may be inserted into piston as a slip fit.

After installing piston pin to connecting rod, install new piston pin lock ring using Internal Lock Ring Pliers, Part No. 96215-49. The numbered side of the lock ring should face the outside of the piston.

Figure 3-18. Slipping Cylinder over Piston

Make sure ring groove is clean and that ring seats firmly in groove. If it doesn't, discard the ring and install a new one. A lock ring loosely installed will rapidly loosen further in service and finally will come out of piston groove, resulting in both piston and cylinder soon being damaged beyond repair. Never install a used lock ring or a new one if it has been installed and then removed for any reason. Always use a new lock ring.

Lubricate cylinder walls, pistons, pins and rod bushings with engine oil. Turn engine until crank pin is at bottom center. Install new cylinder base gasket. Position Piston Inserter Ring Tool, Part No. 96333-51A on rear piston and slip rear cylinder down over piston as shown in Figure 3-18.

Install spacers (one side of the spacers is marked "up"). Install nuts and tighten them down evenly. Torque nuts to 32 to 36 ft-lbs. Repeat process to assemble front cylinder.

Assemble cylinder heads and remaining portions of motorcycle as indicated in "Assembling Cylinder Heads," and reverse order of "Stripping Motorcycle for Engine Repair."

GEARCASE

OIL PUMP

GENERAL

The oil feed pump and scavenger (oil return) pump are gear type pumps housed in one pump body and located on rear of gearcase on right side of motorcycle. The feed pump incorporates an automatic relief valve that re-routes surplus oil (above the amount needed to lubricate the engine) directly to the oil tank. A check valve ball is located ahead of the pressure regulating valve to prevent oil drainage from tank, and to operate the pressure switch.

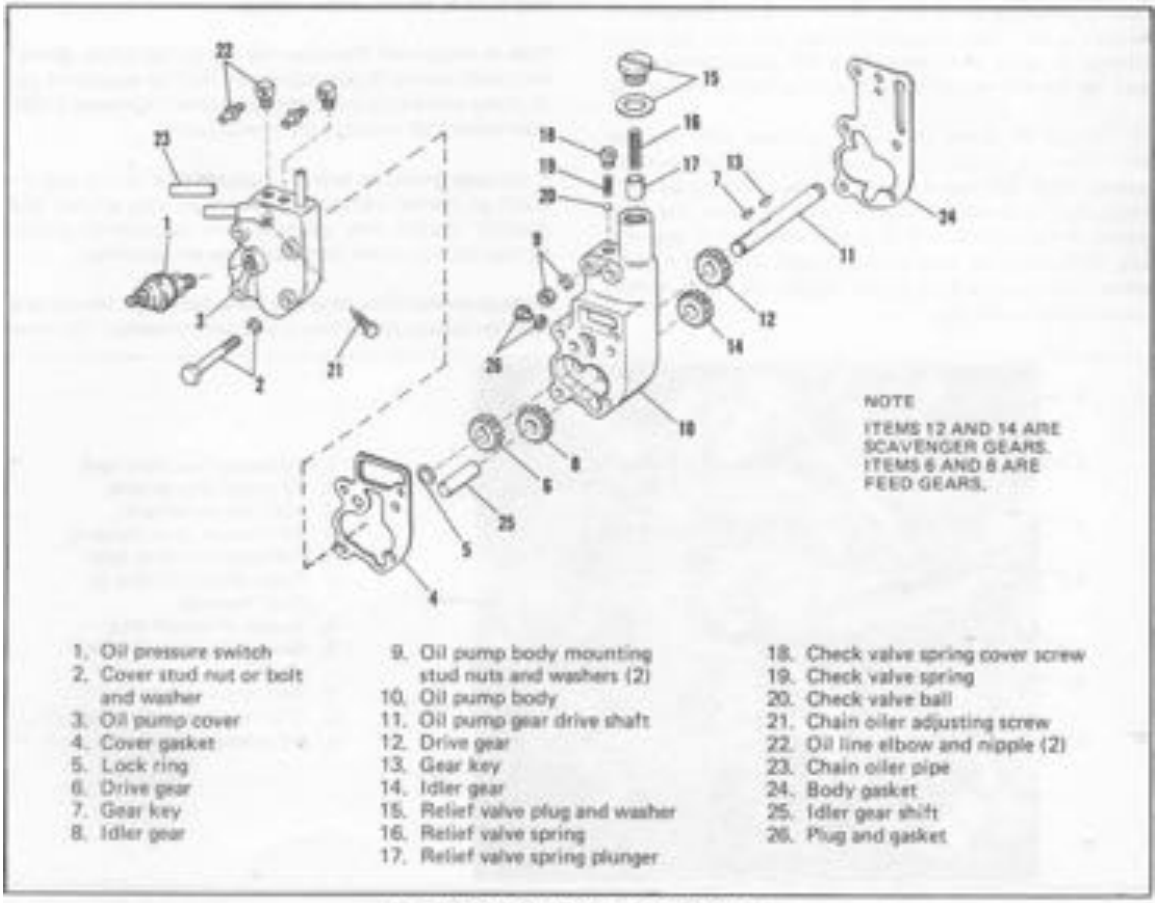
Under normal operating conditions, the pump is a comparatively trouble free unit. The most common trouble with pump operation is the introduction into the pump of a metal or hard carbon chip. If either gets between the gear teeth, it is possible to shear a key, fracture a gear or break off a gear tooth.

If oil fails to return to the tank, check the scavenger pump drive gear key (7). When the engine receives no lubrication (oil remains in tank), the drive shaft key or the feed pump drive gear may be sheared. Both conditions together could be caused by shearing of the oil pump (gearcase) drive gear key. In cold weather, ice slush formed from moisture condensation in oil may block oil passages and cause any of above troubles.

DISASSEMBLING (Figure 3-19)

The oil pump may be removed from the motorcycle as a unit after gearcase cover is removed. The oil pump may be disassembled, piece-by-piece without removing gearcase cover, with engine in chassis as follows:

Disconnect oil lines and oil pressure switch (1) from pump. Remove bolts and lock washers (2) from gearcase studs, that hold oil pump cover in place. Remove oil pump cover (3) and gasket (4). Remove lock ring (5), drive gear (6),



1. Oil pressure switch
2. Cover stud nut or bolt and washer
3. Oil pump cover
4. Cover gasket
5. Lock ring
6. Drive gear
7. Gear key
8. Idler gear
9. Oil pump body mounting stud nuts and washers (2)
10. Oil pump body
11. Oil pump gear drive shaft
12. Drive gear
13. Gear key
14. Idler gear
15. Relief valve plug and washer
16. Relief valve spring
17. Relief valve spring plunger
18. Check valve spring cover screw
19. Check valve spring
20. Check valve ball
21. Chain oiler adjusting screw
22. Oil line elbow and nipple (2)
23. Chain oiler pipe
24. Body gasket
25. Idler gear shift
26. Plug and gasket

Figure 3-19. Oil Pump – Exploded View

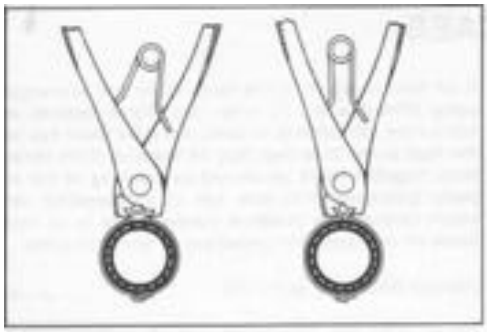


Figure 3-20. Hose Clamp Connection

gear key (7) and idler gear (8). Loosen relief valve plug (15) and check valve spring cover screw (18). Remove two oil pump body mounting stud nuts (9) and slip pump body (10) off studs and gear drive shaft (11). Remove drive gear (12), key (13) and idler gear (14).

Turn relief valve plug (15) out of pump body and remove relief valve spring (16) and valve (17). Remove check valve spring cover screw (18), valve spring (19) and ball (20). Turn in adjusting screw (21). Count the turns necessary to bottom screw, then remove. Bottom and turn out same number of turns when assembling. Oil pump elbows (22) may be turned out of pump cover to facilitate cleaning.

To remove oil pump unit from gearcase with gearcase cover removed, remove ignition timer parts, gearcase cover screws, cover and gasket. (See "Gearcase Timing Gears.") Use a right angle lock ring pliers to remove lock ring from groove in pump drive gear shaft and remove drive gear and key. Remove pump body nuts and bolts (2 and 9) and slip pump with drive shaft (11) out of gearcase. Pump is then disassembled as above.

CLEANING AND INSPECTING

Thoroughly clean all parts in cleaning solvent and blow pump body passages clear with compressed air. Inspect valves and valve seats for pitting and wear. Replace pump having worn or damaged valve seat. Inspect keys and keyways. Inspect scavenger and feed pump gear teeth for gouging or cracking caused by foreign materials going through pump. Pump shafts and bushings normally last for lifetime of engine.

ASSEMBLING

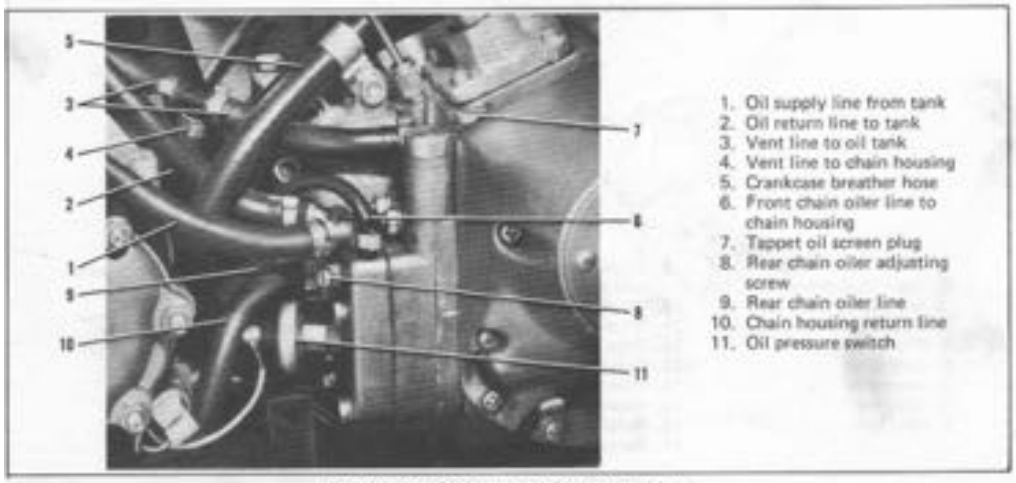
Oil pump is assembled in reverse order of disassembly. Do not mix gears and keys — return to correct location. Oil pump gaskets should always be replaced. Use only "factory made" gaskets. Lock rings are often damaged when removing them. It is advisable to install a new lock ring using a lock ring pliers when assembling pump. Make sure ring is engaged and seated in retaining groove.

If pump is assembled with plastic gaskets, bolts and nuts must be drawn down evenly to approximately 45 in-lbs, but no more than 50 in-lbs torque (4 to 5 ft-lbs). If pump is assembled with paper gaskets, tighten bolts and nuts to 90-100 in-lbs torque.

This is important because the oil pump cover gasket and body gasket if overtightened, will be squeezed out of place and eliminate pump gear side clearance which may seize and damage the pump parts.

If leakage problem exists, disassemble pump and inspect all gasket surfaces making sure they are flat and smooth. Install new gaskets and reassemble pump, tightening four bolts and two nuts as specified.

Oil hose connections have one piece band type clamps and must be replaced each time hoses are connected. Use Hose



1. Oil supply line from tank
2. Oil return line to tank
3. Vent line to oil tank
4. Vent line to chain housing
5. Crankcase breather hose
6. Front chain oiler line to chain housing
7. Tappet oil screen plug
8. Rear chain oiler adjusting screw
9. Rear chain oiler line
10. Chain housing return line
11. Oil pressure switch

Figure 3-21. Oil Pump and Connecting Lines

Clamp Tool Part No. 97087-65 to squeeze clamps tight as shown in figure 3-20.

VALVE TAPPETS AND GUIDES

GENERAL

The tappet assembly consists of tappet, roller and hydraulic unit. The tappet and roller, under compression force from valve spring, follow the surface of the revolving cam. The linear motion produced is transmitted to the valve stem by the hydraulic unit, push rod and rocker arm. The hydraulic unit contains a piston or plunger and cylinder plus a ball check valve which allow the unit to pump itself full of engine oil to take up all play in the entire valve train.

When hydraulic units are functioning properly the assembly operates with no tappet clearance. The units automatically compensate for heat expansion to maintain a no-clearance condition.

It is normal for tappets to click when engine is started after standing for some time. Hydraulic units have a definite "leak down" rate which permits the oil in the hydraulic unit cylinder to escape. This is necessary to allow units to compensate for various expansion conditions of parts and still maintain no-clearance operation. Hydraulic units are functioning properly if they become quiet after a few minutes of engine operation.

DISASSEMBLING TAPPETS (Figure 3-22)

If engine cylinder head is not disassembled, remove push rod cover spring cap retainer. Lift push rod covers and retract push rod adjusting screw until push rod may be lifted out of ball sockets.

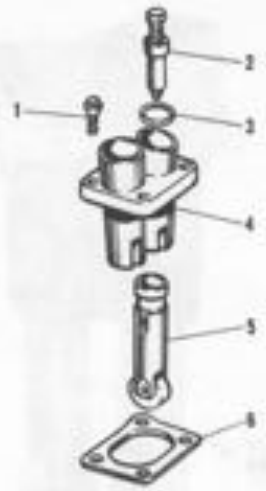
Remove tappet and guide assembly. Be careful to avoid dropping a tappet through guide mounting hole and into gearcase. Slip push rod cover cork washers (3) or O-ring (3A) out of top of tappet guide (4). Pull tappet and roller (5) out bottom of tappet guide and remove tappet guide gasket (6).

Remove tappet and guide assembly. Be careful to avoid dropping a tappet through guide mounting hole and into gearcase. Slip push rod cover cork washers (3) out of top of tappet guide (4). Pull tappet and roller (5) out bottom of tappet guide and remove tappet guide gasket (6).

CLEANING AND INSPECTING

Wash all parts except hydraulic units and gaskets in grease solvent. Hydraulic unit parts are selectively fitted and may not be interchanged so they must be individually and separately washed. Twist and pull hydraulic piston and spring from cylinder and wash parts.

Blow out oil passages in tappets, tappet guides and hydraulic units with compressed air. Insert a length of wire into oil channel openings in tappet guide to make sure passages are open. Air dry all parts.



1. **Tappet guide screw (4)**
2. **Hydraulic unit (2)**
3. **Cork washer (2) (1978 to early 1979)**

3A. O-ring (2) (Late 1979 to 1980)

4. **Tappet guide**
5. **Tappet and roller assembly (2)**
6. **Tappet guide gasket**

Figure 3-22. Tappet Assembly — Exploded View

Examine cams through tappet guide holes in gearcase for nicked, grooved or chipped condition. Examine tappet-guide matching surfaces for scuffing or grooving.

When tappet fit in guide exceeds maximum tolerance shown in "Engine Specifications" by 0.001 in. or more, replace worn parts. If roller is loose, force out pin on arbor press, insert new parts and peen or stake pin ends.

Check roller end clearance. Replace all units exceeding tolerances listed in specifications.

CHECKING HYDRAULIC UNITS (2, Figure 3-22)

Hydraulic units may be checked as follows: Wash and air dry piston and cylinder. Blow out cylinder from bottom to make sure ball and seat are dry. Insert piston in cylinder. Hold in an upright position and press down piston, until spring touches cylinder, without covering hole in bottom of cylinder. Hold for count of 6 and release. If piston bounces back, unit is serviceable. If piston does not bounce back, cover hole in bottom of cylinder and repeat above process. If piston does not bounce back, unit is worn and must be replaced. If piston bounces back, ball is not seating, and unit should be replaced. Before replacing hydraulic units, check possibility of plugged or partially plugged screen under large cap screw (7, Figure 3-21) located near rear tappet guide. Remove screen as described in "Disassembling Gearcase," and clean or replace it if it is dirty.

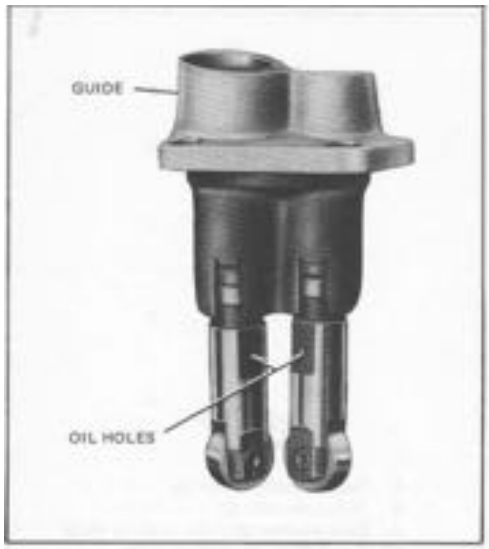


Figure 3-23. Inserting Tappets in Guide

ASSEMBLING TAPPETS (Figure 3-22)

Assemble tappets as follows: Slip tappets (5) into guide (4) so flat surfaces on tappets are toward center of guide as shown in figure 3-23. If flat surfaces with holes are not toward center of guide, engine oil will not feed across and one hydraulic unit cannot fill with oil. Assemble tappet guide gasket dry and insert tappet assembly in place on gearcase, holding tappets in place with thumb and forefinger as when unit was removed.

Assemble push rod cover cork washers or O-rings, push rod hydraulic units and tappet guide screws. Torque tappet guide screws to 10 ft-lbs.

Assemble remainder of push rod assembly in same order disassembled.

Adjust tappet clearance as described in "Cylinder Head."

GEARCASE COVER AND TIMING GEARS

GENERAL

The gearcase, located on the right side of the engine crankcase, contains a train of gears which transmit engine power to the cam shaft and ignition timer, crankcase breather and oil pump. The gearcase is lubricated with engine oil through the by-pass circulatory system and through the breather valve from engine crankcase.

Shafts run in bushings except the crankcase side of the cam shaft which operates in a needle roller bearing.

DISASSEMBLING GEARCASE (Figure 3-24)

Before disassembling gearcase, it is advisable to remove push rods, tappets, push rod hydraulic units and tappet guides as described in "Disassembling Tappets."

1. Remove oil screen cap (1), O-ring (2), screen spring (3) and screen (4).

2. Remove ignition system components as described in Section 5.

3. Remove gearcase cover screws (13, 14 and 15).

4. Tap gearcase cover with wood or rawhide mallet to loosen and remove gear cover (16) and gearcase cover gasket (17).

5. Remove breather gear spacing washer (18) and breather gear (19).

6. Remove cam gear (20), spacing washer (21), and thrust washer (22).

7. Remove pinion gear shaft nut (23) which has a left-hand thread. Use Gear Shaft Nut Socket Wrench, Part No. 94555-55A. Pull pinion gear (24) using Pinion Gear Puller and Installer, Part No. 96830-51 as shown in Figure 3-25. Tool has lefthand threads.

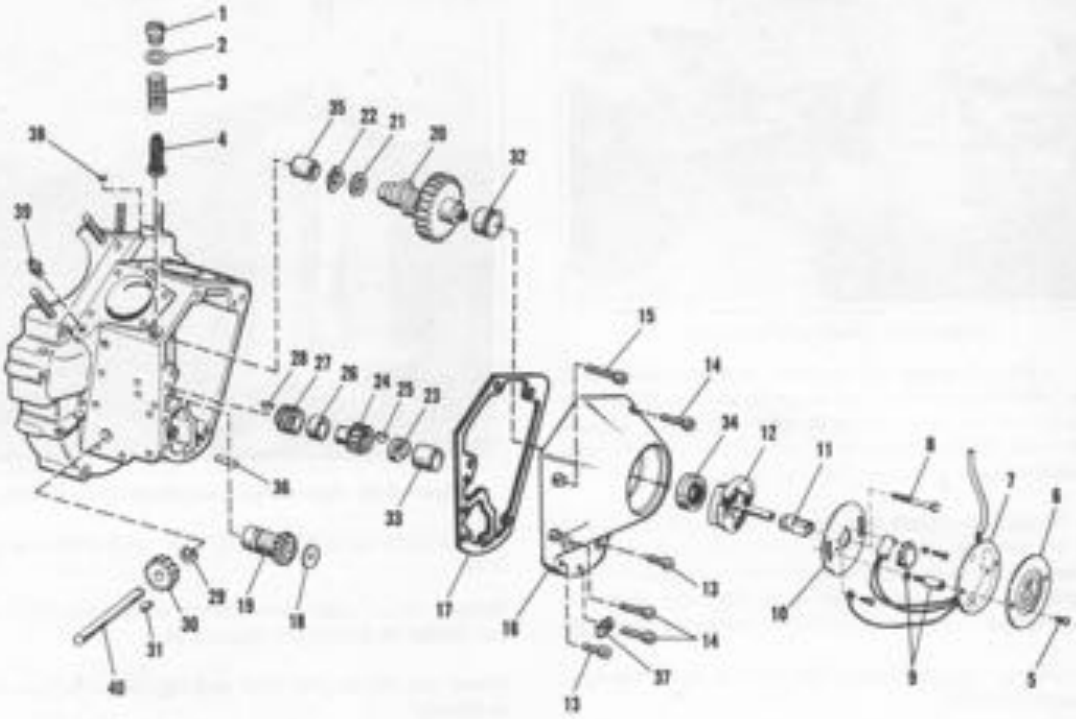
8. Remove key (25), gear shaft pinion spacer (26), oil pump pinion shaft gear (27) and key (28).

9. Use a lock ring pliers such as Snap-On No. Pr129A and remove oil pump drive gear shaft lock ring (29), drive gear (30) and drive gear key (31).

10. If necessary, remove oil pump stud nuts and washers and remove oil pump from gearcase. See "Dissassembling Oil Pump."

CLEANING AND INSPECTING (Figure 3-24)

1. Wash and air-dry all parts. Wash inside of case. If crankcase is to be disassembled, wash parts after complete disassembly. If it is not to be repaired, be careful to get no grease or solvent into crankcase when washing gearcase.



1. Oil screen cap
2. O-ring
3. Oil screen spring
4. Oil screen
5. Ignition timer cover screws (2)
6. Ignition timer cover
7. Ignition module
8. Trigger rotor bolt
9. Timer plate screw and lockwasher (2)
10. Timer plate
11. Trigger rotor
12. Timer advance assembly
13. Gear cover screw, 1 in. (2)
14. Gear cover screw, 1-1/4 in. (3)
15. Gear cover screw, 1-3/4 in. (1)
16. Gear cover
17. Gear cover gasket
18. Thrust washer
19. Breather gear
20. Cam gear
21. Cam gear spacing washer
22. Cam gear thrust washer
23. Gear shaft nut
24. Pinion gear
25. Pinion gear key
26. Pinion gear spacer
27. Oil pump pinion shaft gear
28. Oil pump pinion shaft gear key
29. Oil pump drive gear lock ring
30. Oil pump drive gear
31. Oil pump drive gear key
32. Gear cover camshaft bushing
33. Gear cover pinion shaft bushing
34. Camshaft oil seal
35. Camshaft needle bearing
36. Cover dowel pin (2)
37. Wire clip
38. Welch plug
39. Oil line fitting
40. Oil pump shaft

Note: 1979 and earlier ignition system components are shown in this illustration. 1980 and later components are shown in Figure 5-22A.

Figure 3-24. Gearcase -- Exploded View

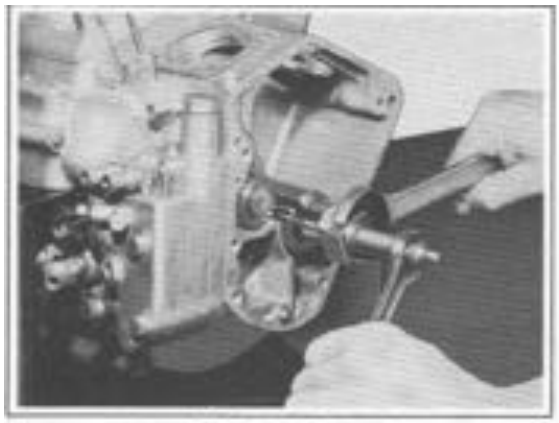


Figure 3-25. Pulling Pinion Gear

2. Inspect oil screen (4) carefully to make sure mesh is open. Holding screen to light is not an absolute check. It is possible for oil screen to be plugged or partially plugged with tiny lint-like fibers and still permit light to pass. Replace plugged or partially plugged screen.

3. Inspect cam shaft and pinion shaft bushings (32 and 33) in gearcase cover for pitting, scuffing and grooving. Determine amount of pinion and cam shaft wear in cover bushings. If it exceeds maximum tolerance shown in "Engine Specifications," by 0.001 in., install new bushings.

4. Inspect cam gear oil seal (34) in cover to see that lip is in good condition.

5. Attach dial indicator to gearcase cover mounting screw hole and determine amount of pinion shaft play in right main roller bearing. When tolerance in "Engine Specifications" is exceeded by 0.001 in., bearings should be replaced.

6. Inspect needle bearing (35) for wear, broken or gouged bearings. If end of cam shaft shows any appreciable wear (0.003 in. or more), needle bearing is probably worn to a point where replacement of bearing and cam shaft are advisable.

7. Needle bearing can be removed and installed in crankcase without disassembling crankcase with Puller Tool, Part No. 95760-69 as shown in figure 3-29. Press needle roller bearing into crankcase with Tool, Part No. 97272-60 as shown in figure 3-29. Press from heavier end having the manufacturer's name only. Pressing from opposite end will crush roller race and bind rollers. Pinion shaft main roller bearing may be replaced only when crankcase is disassembled (see "Disassembling Crankcase").

8. Inspect gears for wear. Assemble pinion and cam gears to respective positions in gearcase. Omit cam gear end spacer for the purpose of checking gear mesh. Attach cover with at least 3 cover screws. Mesh is considered ideal when no play between gears can be felt and cam gear can be moved back and forth along shaft axis with slight drag.

Figure 3-26. Removing Pinion Shaft Cover Bushing

REPLACING GEARCASE COVER BUSHINGS (Figure 3-24)

Remove pinion shaft cover bushing using Puller Tool, Part No. 95760-69 as shown in figure 3-26.

Install new pinion gear shaft bushing (33) in hole in cover as follows:

Position bushing in cover so flat on bushing is in line with oil hole in cover. Press in bushing on arbor press until top of bushing is flush with cast bushing boss on cover. Locate and center punch new dowel pin location 1/8 in. or more from original location. Drill No. 31 hole 3/16 in. deep. Press in bushing until it bottoms on shoulder in cover boss hole. Continue drilling dowel pin hole to depth of 9/32 in. from top of bushing. Drive in new dowel pin and carefully peen edges of hole to lock pin in place.

To replace cam shaft cover bushing (32), proceed as follows:

Use Puller Tool, Part No. 95760-69, to extract old bushing. Make a mark on outside of bushing boss to locate original dowel pin hole. Press in new bushing with arbor press until shoulder is against cover boss. Locate new dowel pin hole at least 1/8 in. from original hole, centerpunch and drill No. 31 hole exactly 9/32 in. deep. Drive in new dowel pin and peen bushing edges over dowel to secure it.

Drill lubrication oil hole through wall of bushing with 5/32 in. drill, using oil hole in bushing boss as a drill guide.

Pinion shaft and cam shaft bushings must be line reamed to remove burrs and irregularities from hole and to insure perfect alignment. If crankcase is not disassembled, use another right crankcase side. Fasten cover in place with at least three screws.

To ream pinion shaft bushing, insert reamer pilot in right crankcase roller race as shown in figure 3-27. Insert 9/16 in. Pinion Shaft Cover Bushing Reamer, Part No. 94895-57 through pilot and push into cover bushing until it bottoms, then give reamer one complete turn to size bushing.

Rotate reamer the same direction (clockwise) during extraction.

To ream cam gear cover bushing, use a 1 in. expansion reamer and ream to 1.003/1.002 in. diameter.

ASSEMBLING

1. Before assembling gear train, determine amount of end play in breather gear as follows: Assemble breather gear and old compressed dry cover gasket to gearcase. Select thrust washer (use washer disassembled unless it is known to give incorrect spacing) and position on end of breather gear. Place a steel straightedge across gearcase at spacer. With thickness gauge, measure distance between straightedge and spacer. If new gasket is used subtract 0.006 in. (amount gasket will compress) from this figure to determine gear end play. An end play tolerance of 0.001 to 0.005 in. is correct. If end play exceeds maximum, insert thicker spacer. Breather valve and gear spacer washers are available 0.110, 0.115, 0.120, 0.125, 0.130, 0.135, 0.140, 0.145 in. thick.

2. To establish proper cam gear end play, install thrust washer, spacing washer and cam gear. Position cover gasket and secure cover with at least four screws. Measure cam shaft end play between cam gear and cover bushing with thickness gauge through tappet guide hole in gearcase. End play should be from 0.001 to 0.005 in. If measurement is under or over tolerance, remove cover and replace spacing washer with one to give suitable clearance. Cam gear spacing washers are available 0.050, 0.055, 0.060, 0.065, 0.070, 0.075, 0.080, 0.085, 0.090, 0.095 in. thick.

3. Make final gearcase assembly including all parts in reverse order of disassembly order. Make sure that

Figure 3-27. Line Reaming Cover Bushing

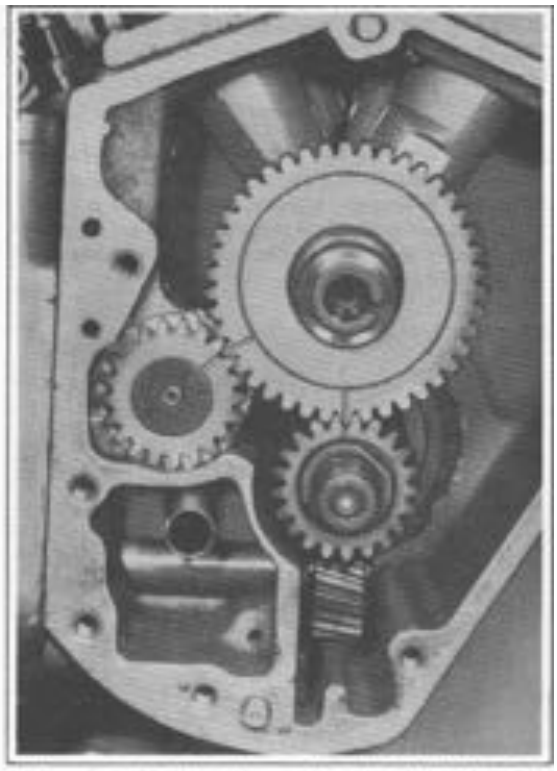


Figure 3-28. Timing Gears with Timing Marks Aligned

chamfer on oil pump pinion shaft gear (27) faces toward the inside. Tighten pinion gear shaft nut (23, Figure 3-24) to 35 to 45 ft-lbs. Make sure that gear shaft pinion spacer (26) has noticeable end play, indicating that the

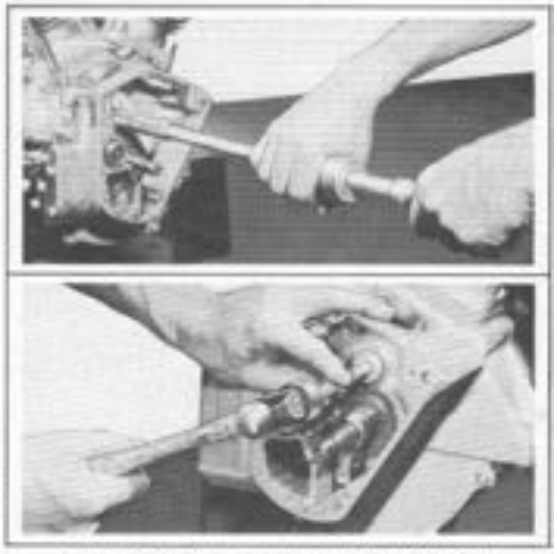


Figure 3-29. Removing and Installing Cam Gear Needle Bearing

pinion gear is properly seated on the shaft taper. Breather, cam and pinion gears contain timing marks which must be aligned or matched as shown in Figure 3-28. Rotate gear train and note if it revolves freely. A bind indicates gears are meshed too tightly.

NOTE

Pinion gears and cam gears are color coded according to their pitch diameters. When replacing only one of these gears, it is advisable to replace it with a gear having the same color code. If gears are not matched according to their color, lifter noise or gear whine may result.

4. Apply a coat of non-hardening gasket sealer to crank case and cover gasket surface. Position new cover gasket and secure cover with all cover screws. Pour about 1/4 pint of engine oil over gears to provide initial lubrication before securing cover.

5. Assemble remainder of gearcase, and ignition timer in reverse of order removed. When assembling ignition timer, set sensor air gap and ignition timing as described in "Ignition System" Section 5.

CRANKCASE

GENERAL

When rod bearings, pinion shaft bearings or sprocket shaft bearings are in need of repair, the engine must be removed from the motorcycle as described in "Stripping Motorcycle for Engine Repair." It is recommended procedure to check and make repairs to cylinder heads, cylinders and gearcase at the same time, or in other words, perform an entire engine overhaul.

Flywheel End Play Check:

After engine has been removed from motorcycle and before removing crankcase bolts, assemble Sprocket Shaft Bearing Tool, Part No. 97225-55, tightly against bearing inner race (60 ft-lbs). Remove gear side cover, fasten dial indicator to gear side crankcase and place dial indicator stem on end of gearshaft. Find flywheel end play in bearing by turning and holding crankcase on one side, and reading dial indicator at extremes of travel. Turn crankcase over and repeat. If play exceeds 0.006 maximum allowable end play, bearings must be replaced if found worn or damaged. If not worn, shimming can be used to take up end play.

The sprocket shaft bearing is locked in place with a combination lock ring-spacer which is located in a groove between the two bearing outer races. If any part of the bearing set requires replacement the entire bearing assembly, including bearings, races, lock ring and inner race spacer, must be replaced as a set.

DISASSEMBLING CRANKCASE

1. Remove cylinder heads as described in "Disassembling Cylinder Head."

2. Remove cylinders as described in "Disassembling Cylinder and Piston."

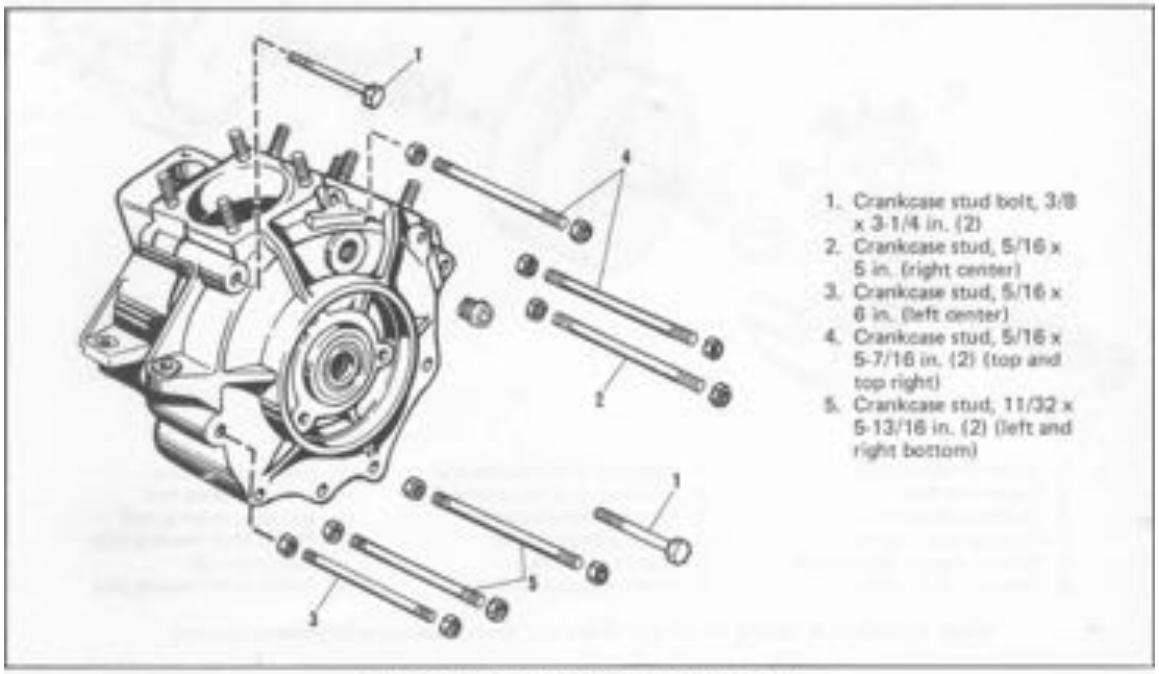
3. Remove gearcase parts as described in "Disassembling Gearcase." Check flywheel end play as described previously.

Refer to figure 3-30 and proceed as follows:

4. Remove crankcase bolts and studs (1, 2, 3, 4, 5). It is necessary to remove only one stud nut and slip stud and other nut out opposite side of crankcase.

Refer to figure 3-31 and continue disassembly:

5. Position crankcase with gearcase (right side) up. Tap crankcase with rawhide or soft metal mallet to loosen top half. Lift right crankcase half (1) off pinion shaft main bearings. Remove spiral lock ring (2) from pinion shaft with tip of screwdriver. Lift bearing washers (3 and 5) with bearings and bearing retainers (4) off pinion shaft.



1. Crankcase stud bolt, 3/8 x 3-1/4 in. (2)
2. Crankcase stud, 5/16 x 5 in. (right center)
3. Crankcase stud, 5/16 x 6 in. (left center)
4. Crankcase stud, 5/16 x 5-7/16 in. (2) (top and top right)
5. Crankcase stud, 11/32 x 5-13/16 in. (2) (left and right bottom)

Figure 3-30. Crankcase Studs — Exploded View

6. Mount flywheel and left case assembly on press table supporting case on parallel bars (figure 3-33) and press on end of sprocket shaft with arbor press until flywheel assembly (8) drops out. Remove seal (7), freeing sprocket side bearing half (9), spacer (6) and spacer (10).

7. If left main bearing is to be replaced, tap out bearing races (11 and 13) from opposite sides of crankcase hole, using a brass drift and hammer. Remove lock ring-spacer (12) using a pin punch or similar tool. Rotate lock ring in groove so that one edge covers oil hole. Insert tool into oil hole with tapered end underneath lock ring. Tap on tool to force one end out of groove as shown in Figure 3-34. Starting at this free end, push ring out of bearing bore.

8. If flywheels are to be disassembled, grip pinion shaft in vise and pull bearing (15) from sprocket shaft using claw puller and wedge attachment. Place wedge halves behind bearing and pull bearing off by tightening roller screw against sprocket shaft center as shown in Figure 3-35. Keep bearings in a set with proper bearing outer races.

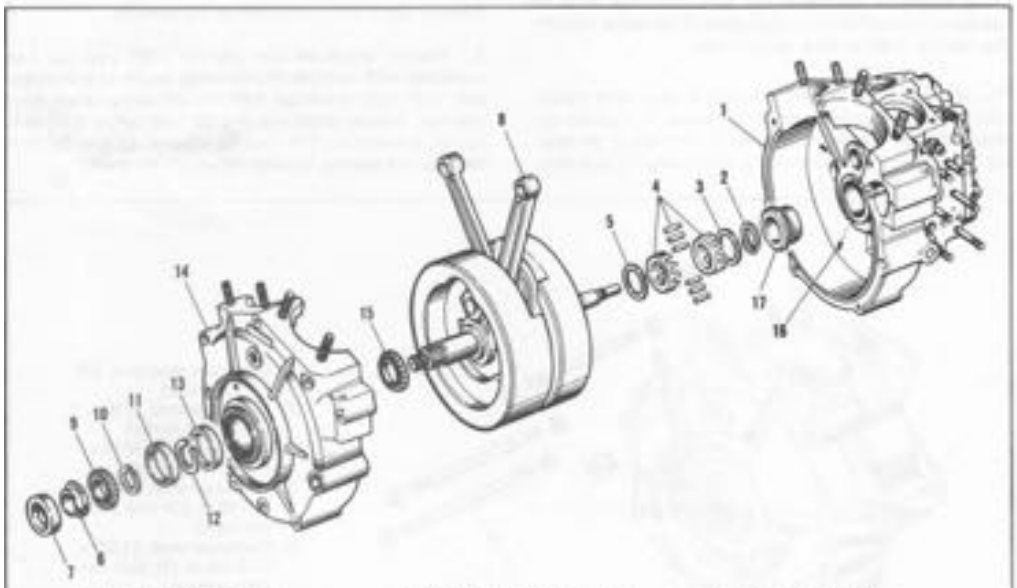
FLYWHEELS

DISASSEMBLING FLYWHEELS (Figure 3-36)

1. Grip pinion shaft in copper covered vise jaws so shafts are in vertical position. Insert a rod about 5 in. long and 1/2 in. in diameter through holes in flywheels to keep them from turning. Remove crank pin nut (1) with Flywheel Nut Wrench Part No. 94546-41. Strike left flywheel with soft metal mallet at about 90 degrees from crank pin hole on wheel periphery to loosen. Lift left flywheel (2) off crank pin.

2. Hold down bearing assembly with a short length of pipe or tubing so connecting rods (3) may be slipped off bearings. Remove bearings (4). Hold together in set until bearings are washed and refitted to crank pin.

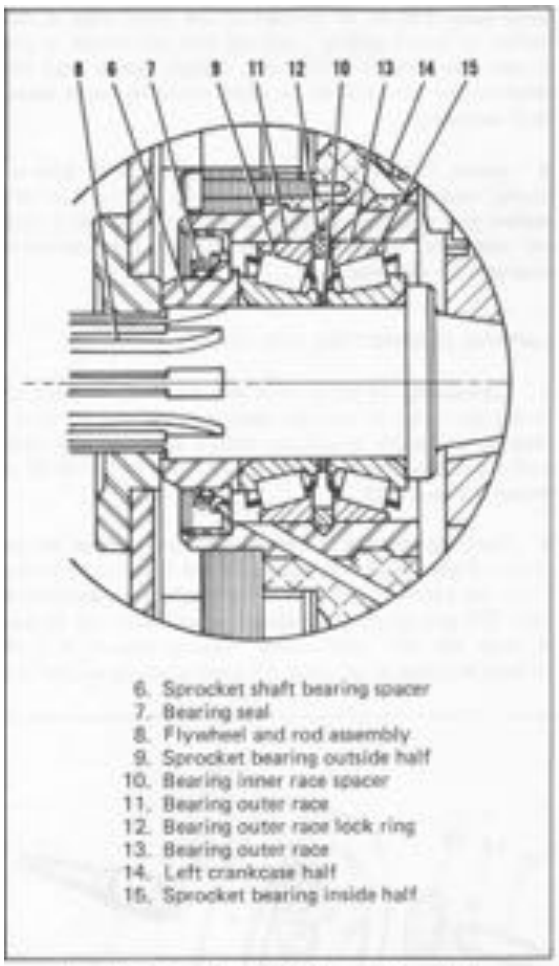
3. Remove gear shaft nut (5). Tap pinion shaft (7) out of flywheel (6). Remove key (8) from shaft.



1. Right crankcase half
2. Spiral lock ring
3. Bearing washer (2)
4. Bearings and retainer
5. Bearing washer (see item 3)
6. Sprocket shaft spacer
7. Sprocket shaft bearing seal
8. Flywheel and rod assembly
9. Sprocket bearing half
10. Bearing inner spacer
11. Bearing outer race
12. Outer race snap ring
13. Bearing outer race
14. Left crankcase half
15. Sprocket bearing half
16. Pinion shaft bearing race lock screw (2)
17. Pinion shaft bearing race

Note: Keep parts 9, 10, 11, 12, 13 and 15 as a set. Do not transpose or interchange parts.

Figure 3-31. Crankcase – Exploded View



6. Sprocket shaft bearing spacer
7. Bearing seal
8. Flywheel and rod assembly
9. Sprocket bearing outside half
10. Bearing inner race spacer
11. Bearing outer race
12. Bearing outer race lock ring
13. Bearing outer race
14. Left crankcase half
15. Sprocket bearing inside half

Figure 3-32. Sprocket Shaft Bearing Assembly — Section View

4. Clamp crank pin in vise. Remove crank pin nut (9). Tap crank pin (10) out of flywheel and remove key (11).

5. Grip sprocket shaft in vise and remove sprocket shaft nut (12). Use Snap-On Socket, Part No. S6202, for 1-5/8 in. hex nut. Remove sprocket shaft (13) by tapping it out of flywheel.

CLEANING AND INSPECTING FLYWHEELS

1. Wash all parts in grease solvent and blow dry with compressed air. Examine crank pin for wear, grooving and pitting. If the surface is at all worn, replace with new pin. Examine flywheel washer (14 and 15). If either washer is worn and grooved, it should be replaced.

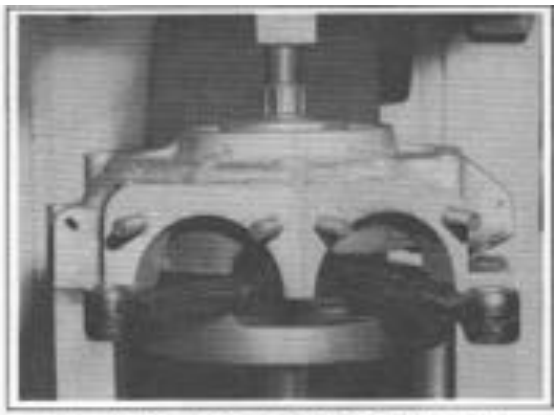


Figure 3-33. Pressing Flywheels Out of Crankcase.

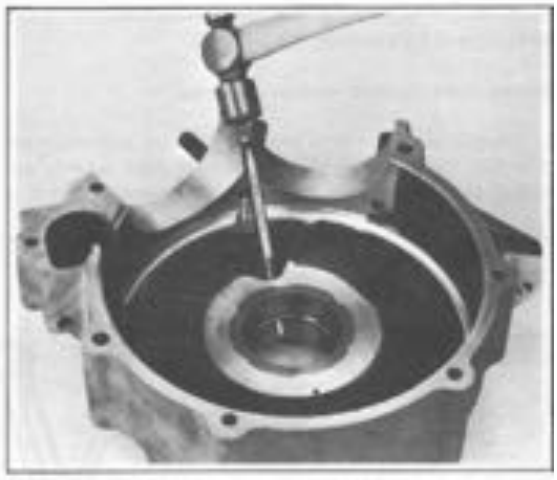


Figure 3-34. Removing Lock Ring

2. Examine connecting rod lower races. If they appear slightly grooved or shouldered where edge of bearing rollers ride, they may be lapped out and oversize bearing rollers installed. If they appear badly worn, grooved or pitted, new rods should be installed, preferably as an assembly with new bearings and crankpin.

3. Examine pinion shaft and right crankcase bearing race (see 17, figure 3-31) for pitting, grooving and gouging at point where right main roller bearings ride. A shaft that is worn must be replaced. If bushing is worn beyond repair, replace as described in "Truing and Sizing Pinion Shaft Main Bearing."

4. Examine sprocket shaft outer races for wear, grooving, and pitting. Examine bearing rollers for wear, pitting, grooving and heat discoloration. The sprocket shaft Timken tapered roller bearings are manufactured in selectively fitted sets. The same serial number appears on all parts. If any part is unusable, the complete set must be replaced.

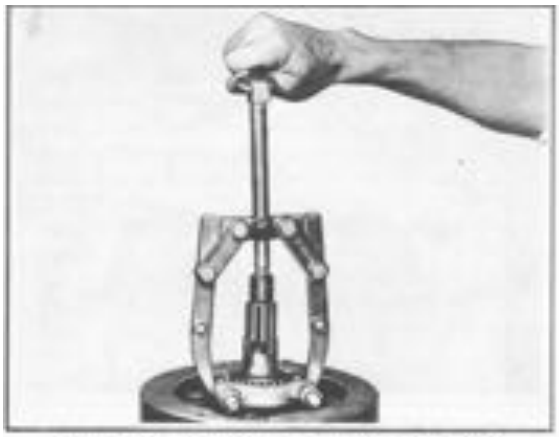


Figure 3-35. Pulling Bearing from Sprocket Shaft

REPLACING FLYWHEEL WASHERS

Replace worn flywheel washers as follows:

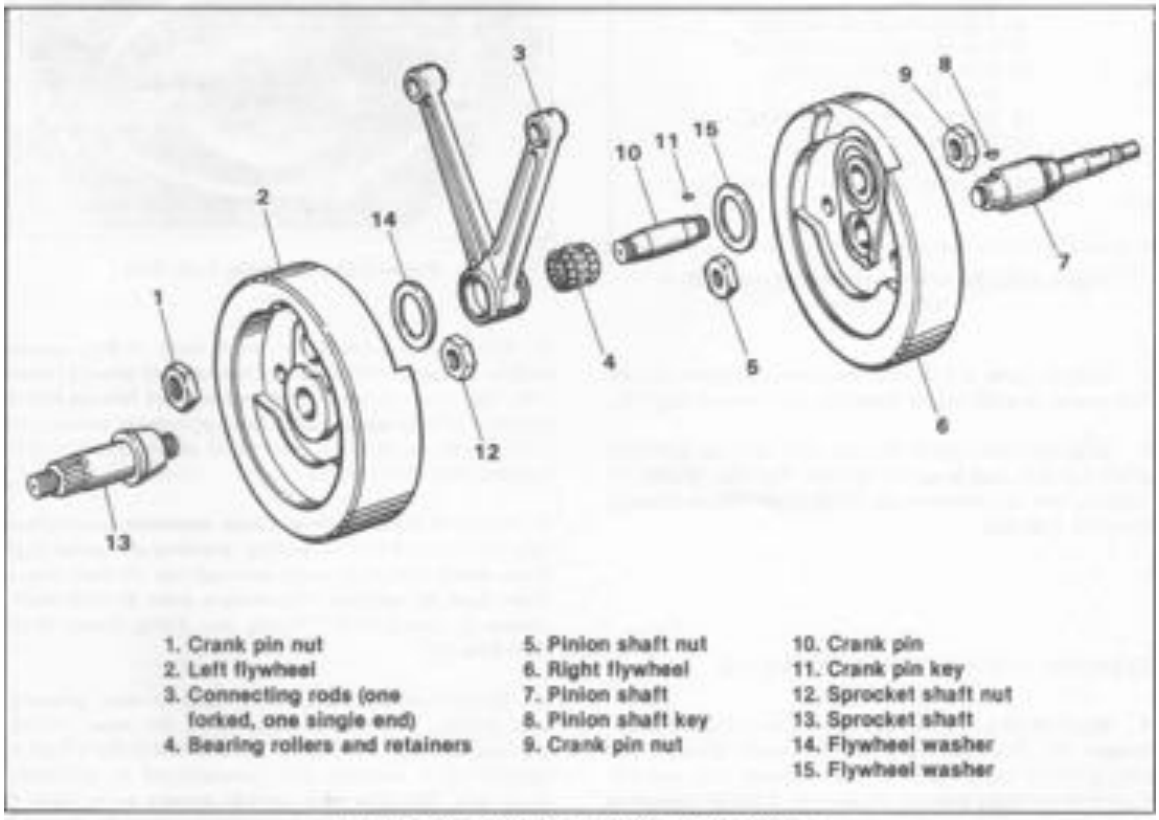
1. Washer is a close fit in recess in flywheel and is secured originally by punching flywheel metal tight against the washer at several points. It is usually necessary to drill a small hole (1/8 in. or smaller) at the outer edge of the washer to permit getting a pointed tool underneath to pry it out. The hole is drilled only slightly deeper than the thickness of the washer to avoid removing more metal than necessary.

2. Before installing new washer, scrape outer edge of washer recess where metal was punched against it so new washer may seat fully against recess bottom. If washer does not seat fully, forked rod is not likely to have necessary clearance for side play.

LAPPING CONNECTING ROD RACES

1. Connecting rod lower races that are likely to clean up within the range of oversize bearing rollers and are otherwise in serviceable condition, should be trued and sized with Connecting Rod Lapping Arbor, Part No. 96740-36 as shown in figure 3-37.

2. Turn lap in lathe at 150 to 200 rpm. Adjust lap by means of adjusting nut to a dragging but free fit in rod race. Clean lap before using, then apply fine lapping compound (No. 220 grit grinding compound mixed with oil) to lap. A loose lap will "bell mouth" bearing race so it must be kept adjusted at all times. To avoid grooving or tapering



1. Crank pin nut
2. Left flywheel
3. Connecting rods (one forked, one single end)
4. Bearing rollers and retainers
5. Pinion shaft nut
6. Right flywheel
7. Pinion shaft
8. Pinion shaft key
9. Crank pin nut
10. Crank pin
11. Crank pin key
12. Sprocket shaft nut
13. Sprocket shaft
14. Flywheel washer
15. Flywheel washer

Figure 3-36. Flywheel Assembly – Exploded View

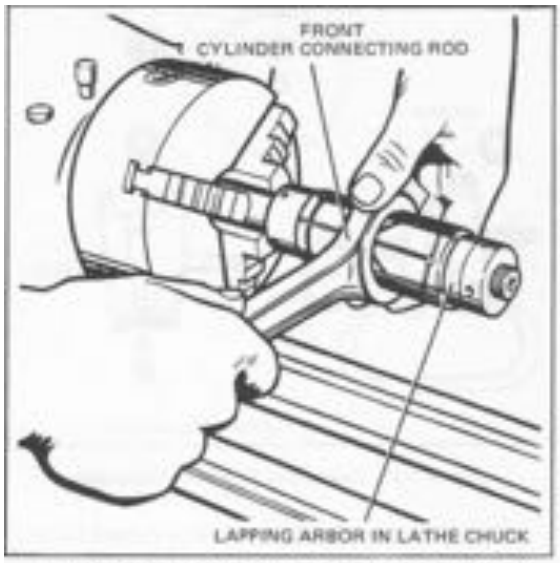


Figure 3-37. Lapping Connecting Rod Bearing Race

lapped surface in rod, work rod back and forth the full length of the lap holding rod as near race end as possible. Lap rods individually.

3. When rods are lapped true and all traces of pit marks or grooving are cleaned up, wash rods and blow dry. Surface should have a soft velvety appearance and be free of shiny spots.

FITTING ROD BEARINGS

Oversize rollers are available in 0.0002, 0.0004, 0.0006, 0.0008 and 0.0010 in. oversize.

There are two ways to determine which oversize rollers to use that will result in properly fitted bearings if applied correctly.

1. Use a micrometer to measure the outside diameter of the crank pin at its center. Use an inside micrometer or telescoping hole gauge to measure the inside diameter of the rod races. Subtract the diameter of the crank pin from the inside diameter of the bearing race. Subtract from this figure the standard allowance for bearing running fit size. This answer, divided by two will give proper roller size. To find oversize amount of bearing, subtract from this figure the diameter of a standard roller.

Example:

The rod bearing race measures 1.6263 in. after lapping and truing. The crank pin is slightly worn and measures 1.2485 in. Subtract 1.2485 in. from 1.6263 in. The answer, 0.3778 in., represents the diameters of both rollers (one on each side) plus clearance for running fit. Subtract minimum clearance for running fit (0.001 in.). The answer, 0.3768 in., is then divided by two to get the diameter of each oversize roller. In this case it would be 0.1884 in. To find how much oversize each roller must be, subtract from this figure the diameter of a standard roller, or 0.1875 in. Rollers must be 0.0008 in. oversize.

2. Install any new set of oversize rollers to bearing races and position on crank pin. Slip rods over bearings. If they will not fit, it is obvious rollers are too large and a smaller size must be tried. If they fit and spin freely, install a larger set of rollers. Try various roller sizes until the rods will turn with a very slight drag. This is a plug fit. Determining running fit is merely a matter of subtracting one half the desired running fit clearance (0.0075 in.) from the roller size.

It may be easier to gauge a plug fit as follows:

Fit any size rollers into races. Position bearings in rods. Support rods and bearings with left hand. Drop crank pin (not attached to flywheel) through crank pin hole. Plug fit has been achieved when crank pin will slide slowly through hole from its own weight. Running fit is then determined by subtracting one half running clearance from oversize of rollers to make plug fit.

ASSEMBLING FLYWHEELS (Figure 3-36)

After correct connecting rod bearing fit has been attained, clean and assemble parts as follows:

NOTE: Use Loctite RC-40 on all tapers, and Harley-Davidson Wick N' Lock (green), Part No. 99627-77 on all threads.

1. Wipe all tapers perfectly clean and free of oil. Assemble sprocket shaft (13) to left flywheel (2). See "Engine Specifications" for proper torque. Assemble pinion shaft (7) and crank pin (10) to right flywheel (6) making sure that keys (8, 11) are in proper position. See "Engine Specifications" for proper torque. Check to

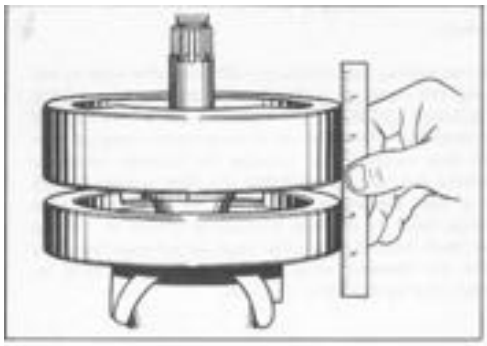


Figure 3-38. Squaring Flywheel Faces

make sure oil passages through pinion shaft, right flywheel and crank pin are clear by blowing compressed air into hole near end of pinion shaft.

2. Position right flywheel assembly in vise, crank pin up. Wipe crank pin taper clean. Slip bearings and connecting rods over crank pin with forked rod to rear cylinder. Wipe crank pin hole in left flywheel clean and dry. Install left flywheel and tighten nut lightly. Hold steel straightedge along outer face of wheel rims at 90 degrees from crank pin as shown in figure 3-38. Tap outer rim of top wheel until wheels are concentric. Tighten nut, recheck with straightedge at frequent intervals. Use soft metal hammer to realign wheels. To prevent flywheel assembly from turning in vise while tightening nut, insert a rod 5 in. long and about 1/2 in. in diameter through holes in flywheels and between vise jaws so that rod bears against some part of the vise.

3. When nut is fairly tight, install flywheel assembly in Flywheel Truing Device, Part No. 96650-30. Adjust so centers are snug. Wheels must turn freely but shafts may not be loose in centers. If flywheel assembly is either loose or squeezed, indicators will not indicate accurately. Adjust indicators to take reading as near to flywheels as possible, so pointers read at about the middle of the scales.

4. Turn flywheels slowly and observe the movement of indicator pointers. Movement toward flywheels indicate high points of shafts. Find highest point of each shaft and chalk-mark flywheel rims at those points. Remove flywheel from stand and make corrections as follows:

5. See Figure 3-39. Flywheels may be out of true three ways, A, B and C, or a combination of two of the three ways.

6. When wheels are both out of true as indicated in "A," tighten a C-clamp on rims of wheels opposite crank pin and lightly tap the rim at the crank pin with lead or copper mallet.

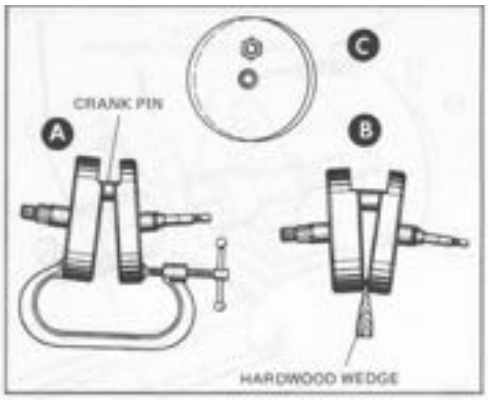


Figure 3-39. Correcting Flywheel Alignment

7. When wheels are both out of true as indicated in "B," drive a hardwood wedge between the wheels opposite the crank pin and lightly tap the rims near the crank pins with a mallet.

8. When wheels are out of true as indicated in "C," strike the rim of the wheel a firm blow at about 90 degrees from crank pin on high side (see figure 3-40).

9. When wheels are out of true in a combination of any of conditions shown, correct A or B first, tapping rim of offending wheel only, and then correct condition C.

10. The number of blows required and how hard they should be struck depends on how far shafts are out of true and how tight nuts are drawn. Never strike wheels near crank pin. This could result in a broken crank pin. Never hit on the pinion side.

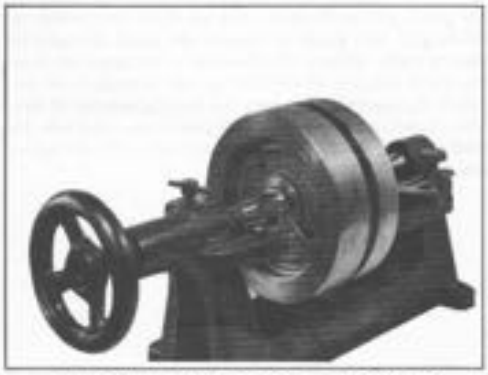


Figure 3-40. Truing Flywheels on Truing Stand

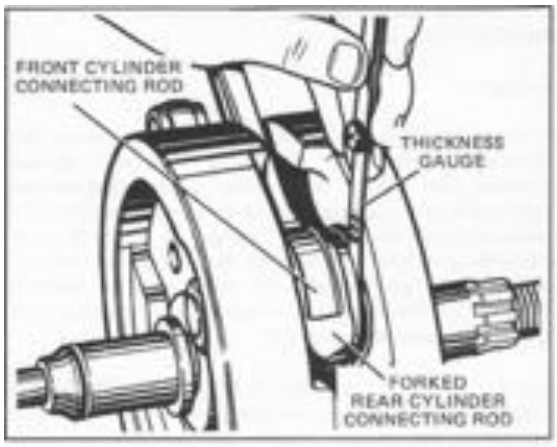


Figure 3-41. Checking Connecting Rod Sideplay

11. Readjust centers, revolve wheels and take reading from indicator. Repeat truing operation until indicated run out does not exceed 0.001 in. (each graduation on indicator is 0.002 in.).

12. If it is impossible to true wheels, check for a cracked flywheel, damaged or enlarged tapered hole, or a sprocket or pinion shaft worn out of round at surface where indicator reading is being taken. When wheels are true, position in vise and draw crank pin nuts very tight using Crank Pin and Flywheel Nut Wrench, Part No. 94546-41. Use torque wrench to finish tightening to 200 ft-lbs torque. Check connecting rod side play with thickness gauge as shown in figure 3-41. If it is greater than tolerance shown in "Engine Specifications," draw up crank pin nuts until within tolerance. Insufficient play between rods and flywheel face is caused by one of the following conditions:

a. Flywheels and crank pin assembled with oil on tapers and nuts over-tightened. Disassemble, clean, reassemble.

b. New flywheel washers installed and not fully seated. Disassemble, inspect, replace deepest seating flywheel or exchange crank pin. As last resort, grind down width of forked rod.

c. Taper holes enlarged as a result of having been taken apart several times. Replace both flywheels.

d. Cracked flywheel at tapered hole. Replace both flywheels.

If sides of forked rod are ground to get desired clearance, backs of bearing retainers must be ground down to remain narrower than width of female rod.

After rod sideplay is checked and adjusted, crank pin nut tightened to specified torque, and lock plate and screw installed, again recheck wheel trueness on truing device. Correct any run-out as above.

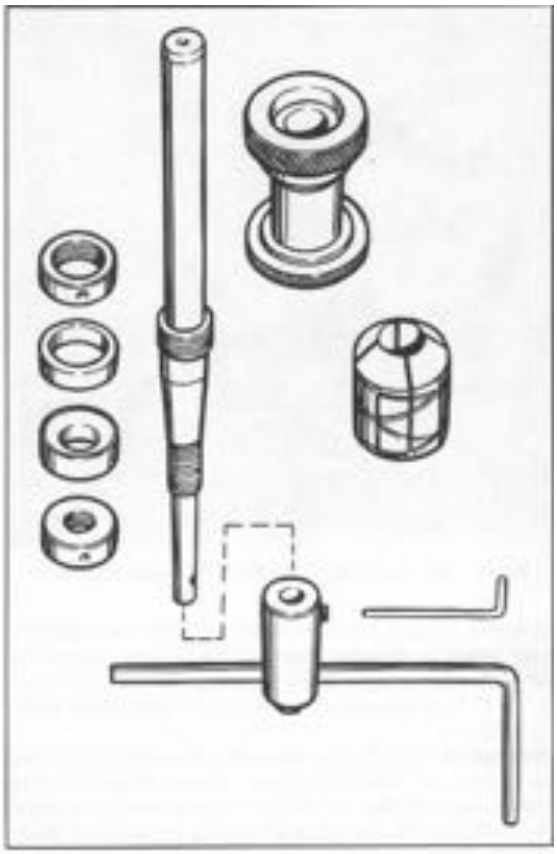


Figure 3-42. Main Bearing Lapping Tools

TRUING AND SIZING PINION SHAFT MAIN BEARING

Before fitting new pinion shaft main bearings, lap bearing race in crankcase to true it and remove traces of wear shoulder at sides of roller paths. Using Crankcase Main Bearing Lap, Part No. 96710-40 consisting of lapping shaft, handle, lapping arbor and guide sleeve (figure 3-42).

A race that is worn beyond limits of oversize bearings must be replaced. To remove worn bearing race, remove two bearing race lock screws (16, figure 3-31) from inside of case. Heat case to 275 - 300 degrees F. Heating expands case and makes it possible to remove bearing race using less force. Press worn race (17, figure 3-31) out and new race in. New race must be lapped slightly to true and align with left case bearing, and to attain a size compatible with roller sizes available.

LAPPING ENGINE MAIN BEARINGS (Figure 3-43)

Secure right and left crankcase halves with three crankcase stud bolts (top center and bottom left and right). The sprocket shaft bearing outer races and large spacer must be installed in left crankcase.

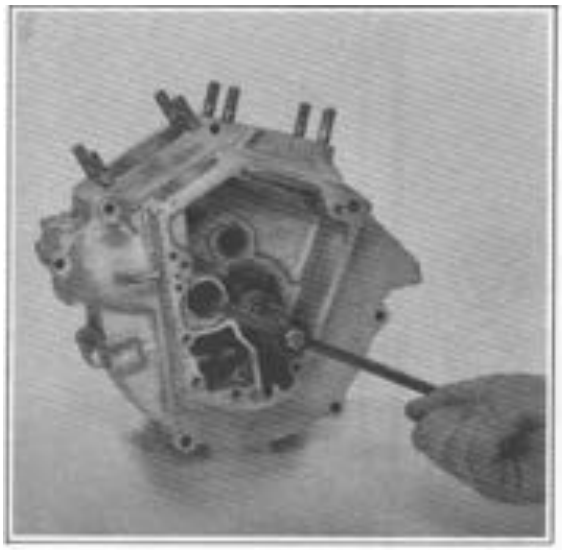


Figure 3-43. Lapping Pinion Shaft Main Bearing Race

Assemble lapping arbor to lapping handle and assemble guide sleeve to sprocket shaft bearing bushing. Sleeves for use with tapered bearing, are assembled to case with bearings and small spacer collar. Turn sleeve parts finger tight.

Insert lap shaft with arbor assembled through pinion bearing bushing and into guide sleeve. Tighten arbor expansion collars using a length of 5/32 in. rod as spanner until arbor begins to drag. Do not adjust arbor snug in bushing or bushing will "bell," a condition where hole is larger at ends than it is in the center.

Withdraw arbor far enough to coat lightly with fine lapping compound. Do not apply a heavy coat. Reposition lap in bushing and turn handle at moderate hand speed. Work lap back and forth in bushing as it is revolved to avoid grooving and tapering.

At frequent intervals, remove lap from crankcase, wash and inspect bushing. Lapping is completed when entire bushing surface has a dull, satin finish rather than a glossy, smooth appearance. If necessary, flush off lap in cleaning solvent, air dry and apply fresh, light coat of fine lapping compound.

FITTING PINION SHAFT BEARING

The fitting of pinion shaft bearing is done in much the same way as fitting lower rod bearings (see "Fitting Rod Bearings"). A plug fit is first determined using the pinion shaft that will be used on engine being overhauled, or spare shaft of exactly same size. When a plug fit has been found, pinion shaft will enter bearing slowly under its own weight, will turn with only a very light drag and will have no perceptible shake.

A running fit is determined from a plug fit by subtracting one half the desired running fit clearance from the size o the plug fit rollers.

Example:

Running fit clearance is 0.0005 to 0.001 in. loose. Se "Engine Specifications," Section 3. If a plug fit wa achieved with 0.0006 in. oversize rollers, subtract on half running fit clearance from plug fit roller oversize. Us figure representing middle or average of tolerance span 0.00075 or 0.0008 in. One half the average of tolerance (0.0004 in.), subtracted from roller oversize (0.000 in.), indicates that 0.0002 in. oversize rollers should be use to produce a suitable running fit.

Oversize rollers are available in 0.0002, 0.0004, 0.0006, 0.0008 and 0.001 in. sizes. All calculations should therefor be made to nearest available even-numbered size. In the ex ample above, it would be possible to arbitrarily decide upo 0.0006 in. as a running fit rather than the 0.0008 in. i desired. Final decision would rest largely upon intended us of motorcycle. For highspeed work, the more free fit woul be better, while the closer tolerance is suited to road use a average speeds. This consideration may be made in fittin all tolerances.

All fitting must be done with bearings that are clean an dry. Oiled surfaces will take up some clearance and give a false reading.

FITTING SPROCKET BEARING

If flywheel end play is within tolerance and if Timke tapered roller bearings and races pass visual check and hav no apparent wear, the same set may be reinstalled. Mak certain all parts of bearing are installed in exactly the sam order they were removed. If any part of bearing assembly is worn, entire assembly should be replaced.

ASSEMBLING CRANKCASE (Figure 3-31)

Install flywheel side outer race snap ring (12) in case. When properly installed, oil hole in snap ring groove will be centered in snap ring gap. Use arbor press and Outer Race Press Plug, Part No. 97194-57 to press outer race parts into crankcase bushing one at a time. Press the races into the case, one from each side, with the widest ends outward to match taper of bearings. Be sure each race bottoms on the snap ring.

Position flywheel assembly, sprocket shaft up, in vise with copper jaws. Press bearing (15) on sprocket shaft using Bearing Installing Tool, Part No. 97225-55. Sprocket shaft spacer 24036-66 may be needed with bearing installing tool as shown in figure 3-44. Press the parts on using sprocket shaft spacer as a pressing tool only. Turn tool screw onto sprocket shaft thread and tighten securely. Remove tool and slip the bearing, small end up, over sprocket shaft, starting it squarely. Install the small bearing spacer (10) and tool sleeve and press bearing against flange on flywheel

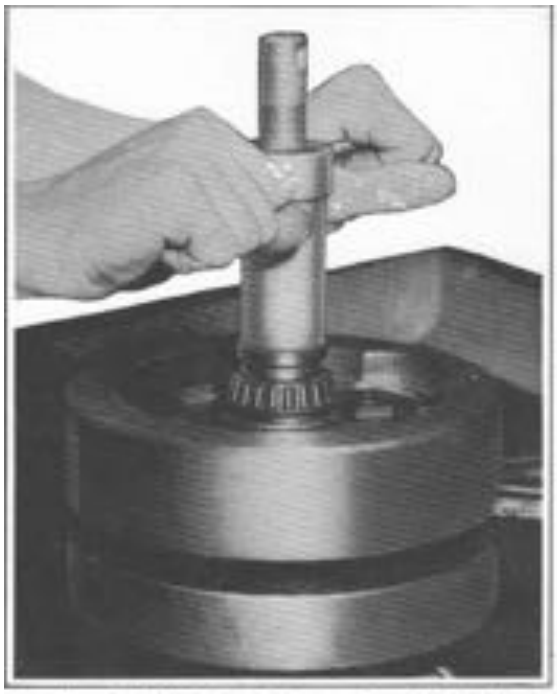


Figure 3-44. Pressing Bearing on Sprocket Shaft

using the tool as shown in figure 3-44. Slip crankcase half, with outer race parts installed, over shaft. Slip bearing over tool screw, small end down toward bearing inner spacer. Position tool sleeve and turn on driver. Turn driver down against sleeve pressing bearings tightly together as shown in figure 3-45. Bearings must be tight against the bearing spacer to provide correct bearing clearance.

Figure 3-45. Pressing Flywheel into Crankcase

Before loosening tool, check to see that the bearing is not preloaded by shaking crankcase half and feeling for a slight amount of play of crankcase half on bearing. Note that if there is no noticeable shake, or if flywheel assembly does not rotate freely in bearing, disassemble bearing and add a 0.003 shim, Part No. 23741-55, on one side of inner race spacer (10, figure 3-31). Again install bearing with tool and recheck for slight play in bearing.

Remove assembly from vise and install bearing washer (5), bearings (4) and bearing washer (3) on pinion shaft. Install new spiral lock ring (2) on groove in pinion shaft. Slip right case half over bearing and against left case half after applying a coat of non-hardening gasket sealer to parting surfaces.

See figure 3-30. Align case halves and tap crankcase studs (5) into holes. These two studs properly align the case halves and must be installed before remaining studs. Start nuts and tighten until snug. Assemble remaining studs, bolts and nuts. Tighten nuts on studs to 12 to 15 ft-lbs torque. Tighten nuts on bolts to 22 to 26 ft-lbs torque.

Check exact amount of flywheel end play with a dial indicator as directed at the beginning of this Section to determine if within specified limits. See figure 3-46.

Install spacer (6, Figure 3-31) in seal (7). Press seal (7) into crankcase with lip toward outside (See Figure 3-31).

Install compensating sprocket shaft extension, see Section 3, "General."

NOTE

Compensating sprocket must be aligned with rear sprocket through use of correct thickness sprocket spacers. Method for checking and determining correct spacer thickness is given in Section 2, "Drive."

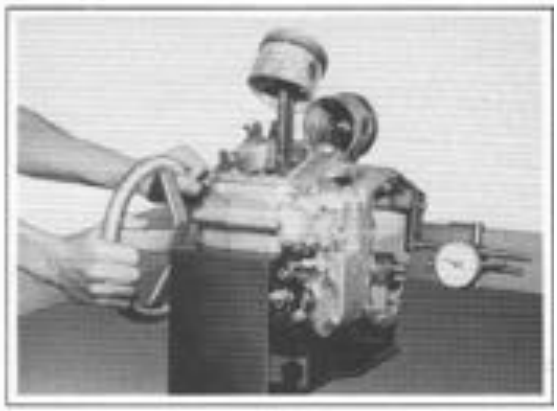


Figure 3-46. Checking Flywheel End Play

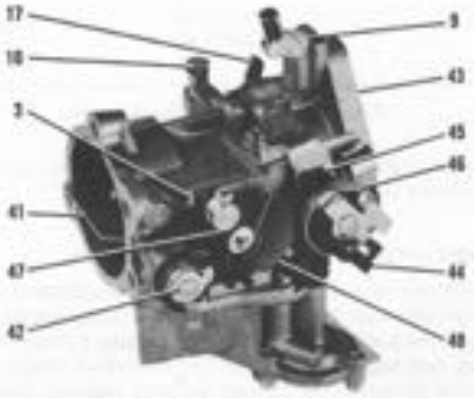
CARBURETOR

DESCRIPTION

The Keihin carburetor is a horizontal, gravity fed type with a float operated inlet valve, an accelerating pump, a throttle stop screw for low idle speed adjustment, and choke system with a high idle speed adjustment.

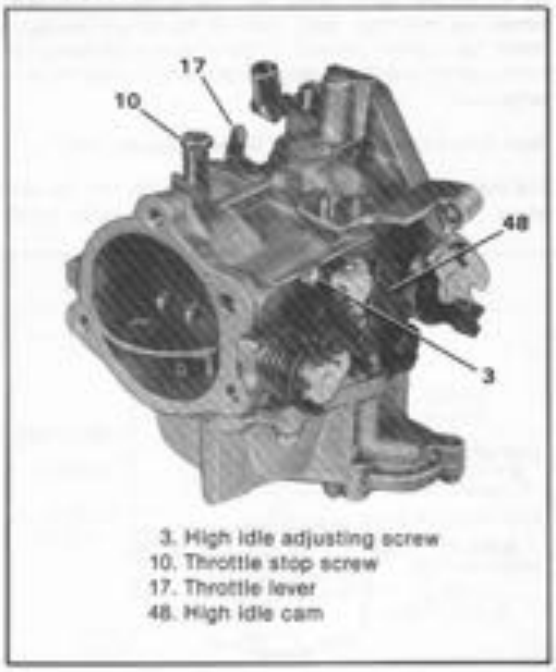
The high idle speed cam operates in conjunction with the choke to progressively raise the idle speed as the choke disc closes.

CAUTION — This carburetor has been designed to control exhaust emissions. Any carburetor modifications or adjustments other than specified in this section may be in violation of Federal or state regulations.



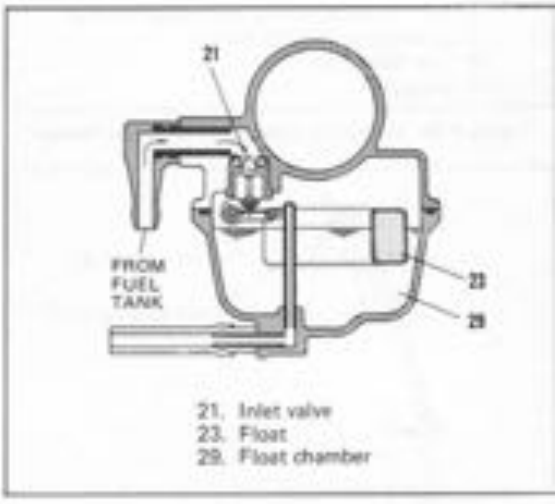
3. High idle adjusting screw
9. Limiter cap
10. Throttle stop screw
17. Throttle lever
41. Choke plate
42. Choke lever shaft
43. Mounting flange
44. Accelerating pump lever
45. Rocker arm
46. Rocker arm spring
47. Intermediate lever
48. High idle cam

Figure 3-46. Carburetor - 1979 and Earlier



3. High idle adjusting screw
10. Throttle stop screw
17. Throttle lever
48. High idle cam

Figure 3-47. Carburetor - 1980 and Later



21. Inlet valve
23. Float
29. Float chamber

Figure 3-48. Fuel Supply System

OPERATION

Fuel Supply System (Figure 3-48)

Fuel from gas tank passes through inlet valve (21) into float chamber (29). The fuel entering causes float (23) to rise until it shuts off fuel valve, stopping flow at a level pre-determined by float level setting.

Low Speed System (Figure 3-49)

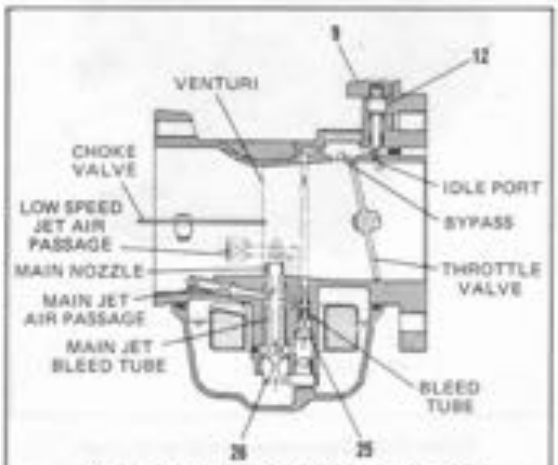
The low speed system functions at idle, low and intermediate speeds when the throttle valve is closed or only partially open. Fuel is first metered at the main jet (26) and then is metered a second time as it flows through the low speed jet (25). When the throttle valve is closed, fuel flows into the venturi almost entirely through the idle port where it is metered by the low speed mixture screw (12). As the throttle gradually opens, fuel flows through bypass passages to the bleed tube portion of the low speed jet (25) where it mixes with the air from the low speed air passages.

Mid-Range System (Figure 3-50)

As the throttle valve opens, the edge of the throttle valve passes the mid-range port. Fuel in the bypass passage is drawn by negative pressure in the venturi, metered by the mid-range jet and discharged into the venturi from the mid-range port.

High Speed (Main Metering) System (Figure 3-49)

The main metering system functions when the throttle valve opens past the mid-range system. The fuel metered by the



9. Limiter cap (1978 to 1979 models only)
12. Low speed mixture screw
25. Low speed jet
26. Main jet

Figure 3-49. Carburetor Low Speed and Main System

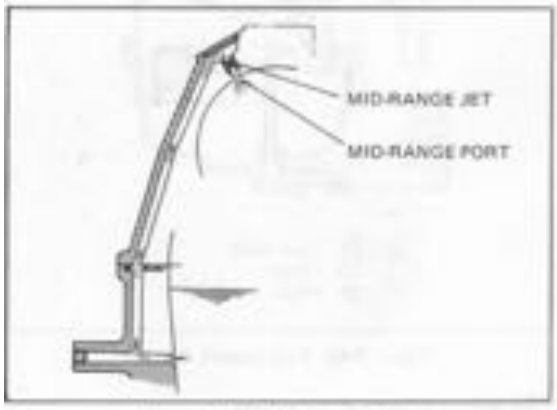


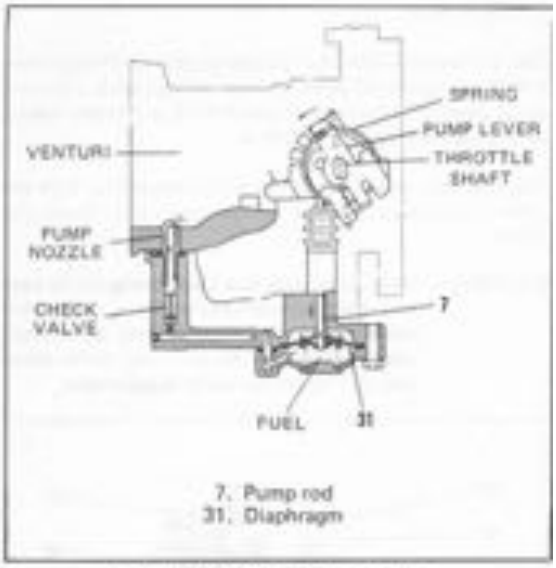
Figure 3-50. Mid-Range System

main jet (26) enters the bleed tube portion of the main nozzle where it mixes with air from the main jet air passage. This fuel/air mixture is then discharged into the venturi from the main nozzle.

ACCELERATING SYSTEM (Figure 3-51)

The accelerating pump system uses sudden throttle openings (rapid accelerations) to quickly inject fuel into carburetor to provide extra fuel for smooth acceleration.

Rapid throttle action pushes pump rod (7) down, flexing diaphragm (31). This flexing action forces fuel past a check valve into the venturi. The check valve prevents backflow during this stroke. A spring then returns diaphragm to its



7. Pump rod
31. Diaphragm

Figure 3-51. Accelerating System

original position and a new supply of fuel flows in under diaphgram for the next acceleration.

CHOKE SYSTEM (Figure 3-46)

The choke system is composed of a choke plate (41) and a high idle cam (48). The choke is manually set by pulling choke button out. By adjusting choke button, choke valve and high idle cam can be positioned either completely closed (fully choked for cold engine), partially open, fully open with fast idle, or fully open (off for warm engine).

The high idle cam increases engine idle speed progressively as the choke knob is pulled out. The choke knob has four operating positions. In the first position (choke knob all the way in), the choke plate is fully open and engine operates at low idle speed setting controlled by throttle stop screw (10). When choke knob is pulled out to first detent, choke plate remains fully open and high idle cam (48) moves throttle valve to high idle position. This setting is controlled by screw (3). At the second detent, choke plate is half-closed and throttle plate opens more. With the choke button pulled all the way out, choke plate is fully closed for cold engine starting.

The choke plate is spring loaded to permit the engine to continue to run after cold starting without the need to push the choke knob in until the engine begins to warm up.

Carburetor Adjustment (Figure 3-46, 3-47)

CAUTION — Carburetor modifications or adjustments other than specified in this section may be in violation of Federal or state regulations.

The carburetor has been adjusted at the factory for maximum performance and minimum emissions of hydrocarbons and carbon monoxide.

Low Speed Mixture Adjustment (1979 and Earlier)

NOTE: On 1980 and later models, the low speed mixture is set at the factory and sealed.

In normal service, the low speed mixture limiter cap (9) should not be removed. Low speed mixture may be adjusted within the limited range of the cap if necessary.

If the limiter cap has been removed and low speed mixture altered, proceed as follows:

Carefully turn low speed mixture screw (12) all the way in, clockwise, until just seated. Do not overtighten. Back screw out to specification found in figure 3-52. With screw in this position, install limiter cap (9) in central position on adjusting screw.

With the engine warm and the choke off, adjust the throttle stop screw (10) so that engine idles at 900 rpm. Turn the limiter cap (9) clockwise for a richer mixture, counterclockwise for a leaner mixture. The mixture should be adjusted to the leanest setting that results in a smooth idle.

Recheck slow idle speed setting and readjust to 900 rpm if necessary.

Model	Carburetor Part No.	Turns Open
FX-1200	27468-78	1-1/8
FLH-1200	27467-78	1-1/8
FLH-80	27466-78	3/4

Figure 3-52. Low Speed Mixture Screw Setting

Slow and Fast Idle Speed Adjustments (Figure 3-46, 3-47)

With engine at normal operating temperature and choke in fully open position (choke knob all the way in) adjust throttle stop screw (10) so that engine idles at 900 rpm. Pull choke knob out to first detent position (choke plate fully open, fast idle cam contacting throttle shaft lever). Turn screw (3) in or out, as required to set engine fast idle at 1500 rpm. With choke knob all the way in, recheck slow idle speed.

DISASSEMBLING CARBURETOR (Figure 3-53)

WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system.

Remove air cleaner assembly.

Turn off gas tank valve and disconnect fuel line at carburetor. Disconnect throttle wire and choke wire from their respective levers. Remove carburetor from engine by removing nuts and washers on mounting studs. Note position of gaskets.

Disassemble accelerating pump as follows: Remove accelerating pump housing by removing three sets of screws and washers (34 and 35). Remove spring (32), diaphragm (31) and O-ring (30), taking care when lifting off housing (33) to catch spring (32). Be careful not to damage housing gasket surface to prevent fuel leakage when reassembling.

Disassemble float chamber as follows: Detach float chamber (29) from body by removing three sets of screws and washers (34). Remove screw (6) which retains float pin (5) and remove float (23). Slip inlet valve (21) off metal clip on float. If needed, remove clip (22) from inlet valve (21). Take care not to damage rubber needle portion of inlet valve. Be careful not to damage pump nozzle and overflow pipe which are built into the float chamber. Remove gasket (28) from slot in float chamber wall.

The removal of the float chamber will allow pump rod (7) and boot (8) to be removed.

Disassemble carburetor body as follows: Pull plug (27) out of tube above low speed jet (25). Unscrew low speed jet (25) and main jet (26).

Remove nut (19) and washer (18). Pull throttle lever (17) and spring (16) off throttle shaft.

Remove limiter cap (9). Remove throttle stop screw (10) and low speed mixture screw (12) along with associated springs (11) and (13), respectively. Remove washer (40) and O-ring (39).

As required, remove brackets (2) and (15) by removing screws and washers (1) and (14).

The throttle valve assembly (shaft, valve, plate and associated parts) usually are not disassembled. These parts are matched to the individual carburetor during manufacture. In both cases, screws securing plates to shafts have peened ends, the threads of which would be destroyed if screws are removed. The bypass hole was positioned precisely to match lip of valve and would be changed if taken apart and reassembled. If problems arise involving these assemblies, the complete carburetor is usually replaced.

This completes disassembly of carburetor. Clean and inspect before reassembling.

CLEANING AND INSPECTING

CAUTION

Never scrape carbon deposits from carburetor parts with knife or other steel instrument. Also, do not use wires or drills to clean small holes. To do so may cause burrs or change hole sizes. This is particularly important to observe when cleaning jet openings.

1. Screw and washer
2. Bracket
3. High idle adjusting screw
4. Screw
5. Float pin
6. Screw
7. Rod
8. Boot
9. Limiter cap *
10. Throttle stop screw
11. Spring
12. Low speed mixture screw*
13. Spring*
14. Screw and washer
15. Bracket
16. Spring
17. Throttle lever
18. Washer
19. Nut
20. Insulator block
21. Inlet valve
22. Clip
23. Float assembly
24. Screw and nut
25. Low speed jet
26. Main jet
27. Plug
28. Gasket
29. Float bowl
30. O-ring (2)
31. Diaphragm
32. Spring
33. Housing
34. Screw and washer (5)
35. Screw and washer
36. Clip
37. Hose
38. Fitting
39. O-ring *
40. Washer *
41. Choke plate (not shown)
42. Choke lever shaft
43. Mounting flange
44. Accelerating pump lever
45. Rocker arm
46. Rocker arm spring
47. Intermediate lever
48. High idle cam
49. Stud
50. Nut and washer
51. Intake manifold
52. Seal
53. Clamp

* 1979 and earlier

Figure 3-53. Carburetor — Exploded View

Clean carburetor body in solvent such as "GUNK" to remove varnish and carbon stains from fuel and air passages. Blow body dry with compressed air. Reverse air flow through each passage to ensure removal of all dirt particles.

Inspect all parts and replace any that are damaged or worn. The most important checks are as follows.

Check accelerating pump. Inspect diaphragm (31) for pinholes, cracks or deformation and replace if necessary. Inspect rod (7) for bending and boot (8) for cracks. Any dirt in accelerating pump passage should be blown out from side opposite nozzle or check valve will close making cleaning impossible.

Check for dirt clogging overflow hose (37). If clogged, fuel may not flow out and instead flood engine, causing poor starting.

Check low speed mixture screw (12) (1979 and earlier). Inspect for carbon lodging on tip and for damage to taper or screw, itself.

ASSEMBLING CARBURETOR (Figure 3-53)

Assembling the carburetor is essentially the reverse of disassembly with the following exceptions:

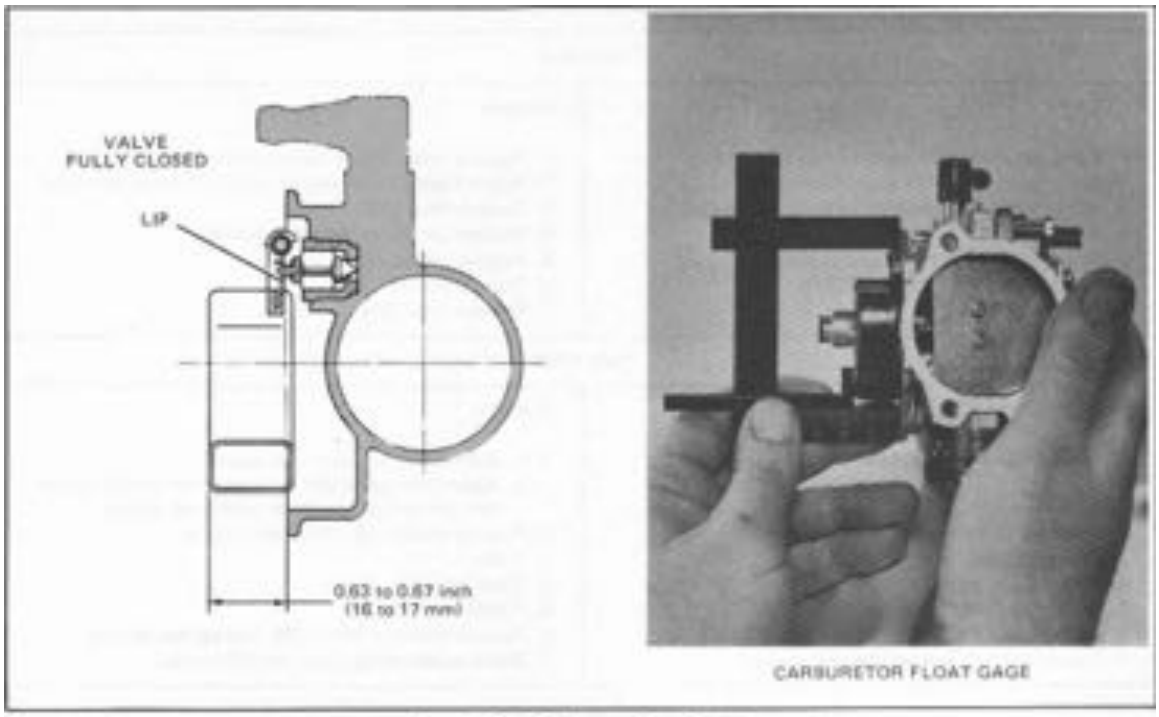


Figure 3-54. Carburetor Float Setting

When assembling the carburetor, use new gaskets and O-rings. Check and adjust, if necessary, float level as shown in figure 3-54, using Float Level Gage, Part No. 94752-77. The adjustment is made by carefully bending the metal tab on the float. Check float level while holding carburetor so the float is in a vertical position as shown in Figure 3-54.

INSTALLING CARBURETOR ON MOTORCYCLE

Position insulator block (20, figure 3-53) and carburetor on mounting studs. Secure with nuts and washers (50). Tighten nuts to 19 ft-lbs torque.

Insert throttle wire through slot in bracket (15) and place throttle wire and ferrule end in hole in throttle lever (17). Make sure wire is seated in groove in throttle lever.

Check operation by twisting throttle control on handlebar. Throttle should open and close fully with handlebar grip movement.

With choke lever in the fully open position, attach choke wire to lever. Check operation of choke knob and lever.

Attach fuel line from gas tank to carburetor inlet. Position overflow tube (37) downward so any fuel overflow will drip away from hot engine. Open fuel valve and check for fuel leakage.

Adjust carburetor as described under "ADJUSTING CARBURETOR."

Install air cleaner as described under "AIR CLEANER."

KEIHIN CARBURETOR TROUBLE CHART

Overflow	
Check for:	Remedy:
1. Worn fuel valve (21) or dirty fuel valve seat. 2. Improper fuel level in float chamber (29). 3. Worn float (23) mounting tabs. 4. Worn float pin (5) or loose screw (6). 5. Damaged float chamber gasket (28). 6. Loose float chamber screws (34). 7. Deformed float (23).	1. Replace valve (21) or clean valve seat. 2. Adjust float (29) mounting tabs for correct fuel level. 3. Replace float (23). 4. Replace pin (5) or tighten screw (6). 5. Replace gasket (28). 6. Tighten screws (34). 7. Replace float (23).
Poor Idling	
Check for:	Remedy:
1. Idling improperly adjusted. 2. Damaged low speed mixture screw (12). 3. Clogged bypass or idle port. 4. Clogged low speed jet (25). 5. Loose low speed jet (25). 6. Air leaking into system. 7. Excessive fuel from accelerating pump.	1. a. Adjust fast and slow idle speeds. b. Adjust low speed idle mixture screw limiter cap to full rich or full lean limit. (1979 and earlier) 2. Replace screw (12). (1979 and earlier) 3. Clean. 4. Clean jet (25). 5. Tighten jet (25). 6. Replace insulator block (20) and tighten screws. 7. Check accelerating pump rod (7) length.
Poor Fuel Economy	
Check for:	Remedy:
1. Fuel level too high. 2. Clogged bleed tubes. 3. Loose jets. 4. Idling improperly adjusted. 5. Choke not opening fully. 6. Dirty air cleaner.	1. Adjust level of float (23). 2. Clean. 3. Tighten. 4A. Adjust fast and slow idle speeds. B. Adjust low speed mixture cap within its limits (1979 and earlier). 5. Inspect choke and choke wire and adjust or replace. 6. Clean.
Poor Acceleration	
Check for:	Remedy:
1. Clogged accelerating system. 2. Damaged accelerating pump diaphragm (31). 3. Low speed system improperly adjusted. 4. Clogged low speed jet (25) or bleed tube. 5. Fuel level too low.	1. Clean. 2. Replace diaphragm (31). 3. Adjust low speed system (1979 and earlier). 4. Clean. 5. Adjust level of float (23).
Hard Starting	
Check for:	Remedy:
1. Choke plate (41) not operating properly. 2. Generally dirty carburetor. 3. Loose carburetor mounting nuts. 4. Fuel overflow.	1. Adjust choke system. 2. Disassemble and clean. 3. Tighten mounting nuts. 4. Inspect float (23) and fuel valve (21) and adjust or replace.

KEIHIN CARBURETOR TROUBLE CHART (CONT)

Poor Performance On Road	
Check for:	Remedy:
1. Idling improperly adjusted.	1. Adjust idle.
2. Fuel overflow.	2. Inspect float (23) and fuel valve (21) and adjust or replace.
3. Main jet (26) loosened.	3. Inspect main jet (26) and tighten.
4. Air leak in intake system.	4. Check air cleaner backing plate and manifold mounting.
5. Faulty operation of accelerating pump.	5. Correct rod (7) length.
6. Dirty or clogged carburetor or air cleaner.	6. Clean.
Poor High Speed Performance	
Check for:	Remedy:
1. Loose main jet (26).	1. Inspect main jet and tighten.
2. Improper fuel level in float chamber (29).	2. Adjust float (23) mounting tabs for correct fuel level.
3. Dirt lodged in strainer in fuel tank.	3. Clean strainer.
4. Clogged main jet (26) or main jet air passage.	4. Clean.
Abnormal Combustion (Fuel Mixture)	
Check for:	Remedy:
1. Generally dirty carburetor.	1. Disassemble and clean.
2. Dirty or clogged fuel line.	2. Clean fuel line or replace.
3. Air leaking into system.	3. Check mounting nuts for tightness or replace insulator block (20).
Loss of Power (Fuel Insufficient)	
Check for:	Remedy:
1. Clogged fuel line.	1. Clean.
2. Dirty fuel tank.	2. Clean.
3. Air leaking into system.	3. Check mounting nuts for tightness or replace insulator (20).
4. Accelerating pump not working.	4. Repair and adjust.
5. Clogged fuel strainer in fuel tank.	5. Clean strainer.
6. Generally dirty carburetor.	6. Disassemble and clean.
Loss of Power (Air Insufficient)	
Check for:	Remedy:
1. Dirty air cleaner.	1. Clean or replace air cleaner element.
2. Throttle cable not working.	2. Check throttle cable and adjust or replace.
3. Correct jetting for high altitude operation.	3. Install high altitude kit.
4. Loose jets.	4. Tighten jets.

AIR CLEANER

GENERAL

The air cleaner consists of a backing plate, filter element, baffle plate and cover, arranged so all air drawn into the carburetor passes through the filter. A plastic foam element traps air borne dust to keep it from entering carburetor and engine.

Remove air cleaner cover and inspect filter element at least every 1250 miles, or more often under dusty service conditions.

SERVICING AIR CLEANER (Figure 3-55)

The carburetor air cleaner is equipped with a plastic foam element which is oil saturated. To inspect and service filter element (5), remove 3 socket head screws and washers (1 and 2). Pull air cleaner cover (3) off to release baffle plate (4) and filter element (5). The need for servicing is indicated by the appearance of the outside surface of the filter. Filter should be cleaned and re-oiled if a film of dirt has built up covering the surface pores, or if light spots show on the surface which means that dust is drying out the oil. A dirty, dark appearance is normal, as long as pores in the filter remain open and covered with an oil film.

To clean filter, remove the foam element from the wire mesh core and wash it in a non-flammable petroleum solvent or detergent and water. Allow to dry thoroughly and saturate with same weight oil as recommended for the engine crankcase. Apply oil to element liberally, working it in until element is uniform in color indicating uniform saturation. After excess oil has drained off, replace element on screen.

Before reassembling air cleaner, make sure socket head screws (7) are tightened to 75 to 85 in-lbs torque. Make sure seal strip (6) is in place. Assemble remaining parts in reverse order of disassembly.

INSTALLING AIR CLEANER (Figure 3-55)

Check backing plate (14) gasket surface to make sure it is flat. Assemble mounting brackets (13) to rocker arm covers with bolts (10) finger tight. Hold backing plate (14) in place on carburetor and move brackets (13) so they are flat against backing plate. Remove backing plate and tighten bolts (10) to 12 to 15 ft-lbs torque. If mounting brackets are not adjusted properly, the backing plate will be distorted when it is mounted and air leaks will develop at the carburetor mounting flange. Slip crankcase vent hose on backing plate fitting. Assemble gasket (12) and backing plate (14) to carburetor using socket head screws (7). Tighten screws to 75 to 85 in-lbs torque. Secure backing plate to mounting brackets using bolts and washers (9) and nuts (8). Tighten nuts to 12 to 15 ft-lbs torque.

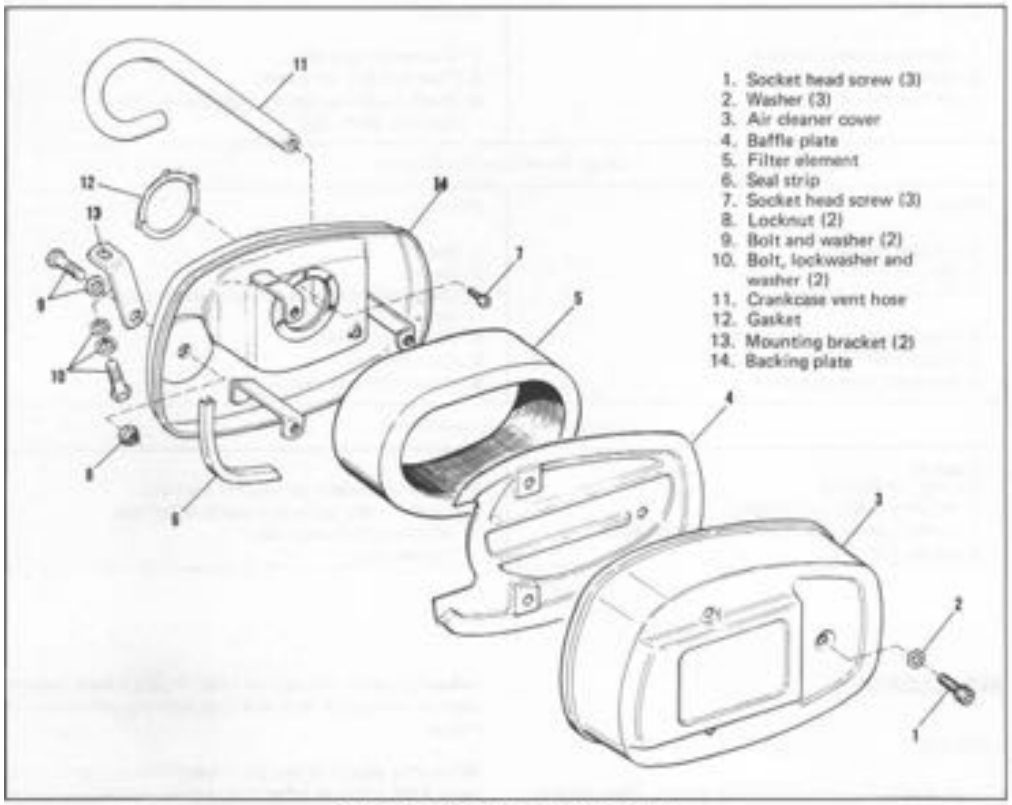


Figure 3-55. Air Cleaner – Exploded View

Install seal strip (6) on backing plate. Assemble filter element (5), baffle plate (4), cover (3), screws (1) and washers (2). Tighten cover screws to 12 to 15 ft-lbs torque.

FUEL TANK

GENERAL

The fuel tanks are of welded steel construction. Fuel tanks are treated to resist rusting. However, when the motorcycle is not operated for any length of time (e.g. over winter), tanks should be drained and the tank interior bathed with an oil-fuel mixture of equal proportions. The fuel will evaporate leaving a protective oil film on tank walls.

REPAIRING LEAKING TANKS

Many tank leaks may be repaired with epoxy type materials. Follow manufacturers instructions.

Tank leaks may be arc welded, gas welded or soldered. However, only firms or persons qualified to make such repairs should be entrusted with the operation.

WARNING — If ALL traces of fuel are not purged, an open flame repair may result in a tank explosion. Extreme caution in all tank repair is recommended.

FUEL SUPPLY VALVE

The fuel supply valve is located under the fuel tank. Gasoline to carburetor is shut off when the handle is in a horizontal position. Turning the handle down to vertical position turns on the main gasoline supply; turning the handle up to the vertical position turns on the reserve supply. Valve should always be in the off position when the engine is not running.

WARNING

Always close valve when engine is not running to prevent accidentally flooding engine or surroundings with gasoline.

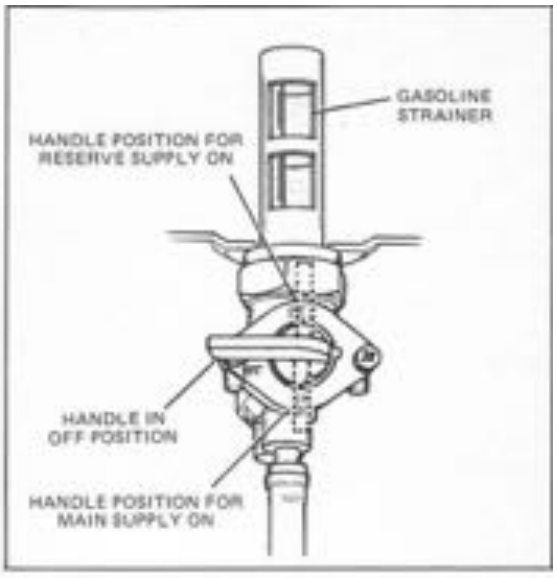


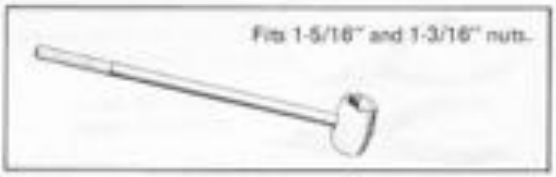
Figure 3-56. Fuel Supply Valve and Strainer

A fuel strainer is located on top of the supply valve inside the fuel tank. When fuel flow restriction is suspected, remove hose at carburetor and open valve to the reserve position to drain fuel into a suitable container.

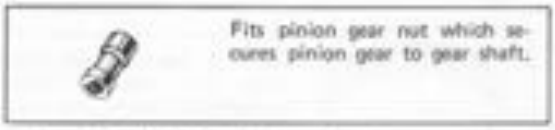
WARNING — Gasoline is extremely flammable and highly explosive under certain conditions. Do not smoke or allow open flame or sparks when refueling or servicing the fuel system.

Remove fitting from tank, clean or replace screen and flush tank to remove all dirt. Before reinstalling, coat threads with Harley-Davidson Pipe Sealant with Teflon, Part No. 99630-77.

TOOLS

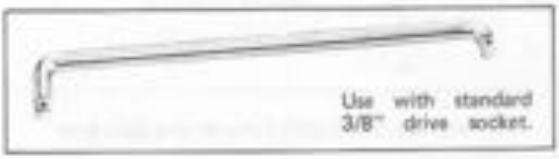


Part No. 94546-41 Flywheel Shaft Nut Wrench

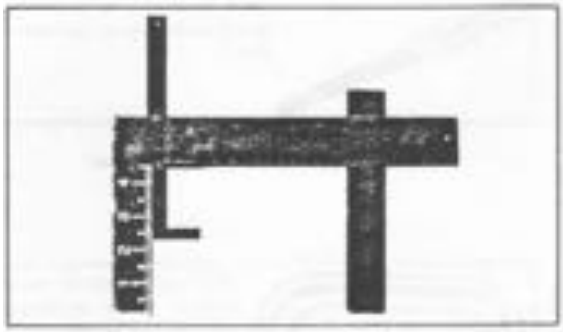


Part No. 94555-55A Gear Shaft Nut Socket Wrench

Part No. 94589-29A Cylinder Base Nut Wrench (9/16")

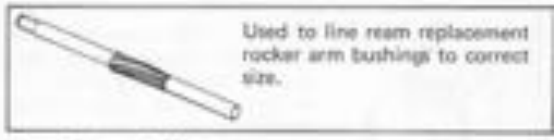


Part No. 94590-73 Cylinder Head Bolt Socket Handle (3/8" Square Drive)



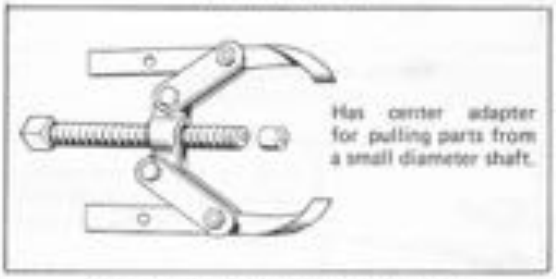
Float Gage Part No. 94752-77

Part No. 94800-26 Spiral Expansion Reamer

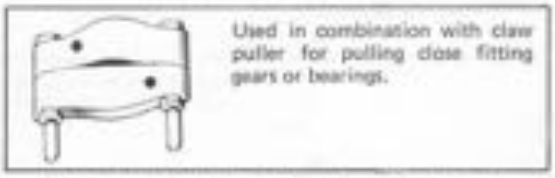


Part No. 94804-57 Rocker Arm Bushing Reamer

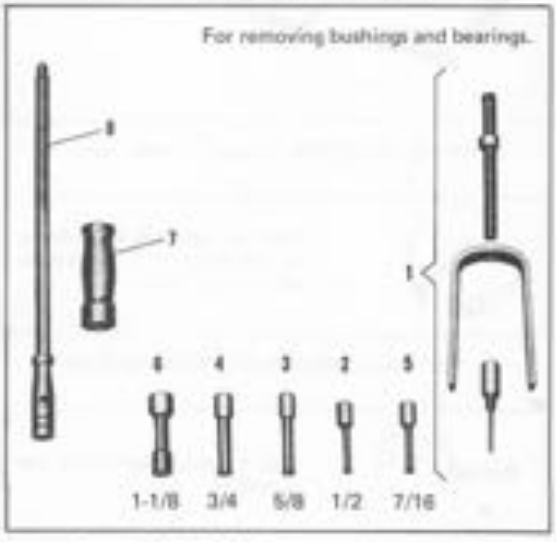
Part No. 94805-57 Pinion Shaft Bushing Reamer and Pilots



Part No. 95635-46 All Purpose Claw Puller



Part No. 95637-46 Wedge Attachment for Claw Puller



Part No. 95760-69 Bushing and Bearing Puller Tool Set (Includes items 1, 2, 3, and 4.) Items 5 (95768-69), 6 (95769-69), 7 (95770-69) and 8 (95771-69) are optional extras.

Used to hold connecting rod firmly so accurate work can be done when fitting piston pin bushing without disassembling crankcase.

Part No. 95952-33 Connecting Rod Clamping Tool

Four holes fit clutch hub studs. Four bolts fit tapped holes in chain housing.

Part No. 95960-41A Clutch Hub and Chain Housing Puller

Used to remove and replace piston pin bushings without removing connecting rod from crankcase.

Part No. 95970-32A Piston Pin Bushing Tool

Used with arbor press to press Timken bearing onto sprocket shaft.

Part No. 96137-52A Flywheel Support Plate

Used on assembled crankcase to determine if a connecting rod is out of true.

Part No. 95180-80 Piston Squaring Plate

Used to check connecting rod alignment.

Part No. 96180-76 Special Piston with Pin

Special pliers for removing and replacing retaining rings.

96215-49 Small
96216-49 Large

Internal Lock Ring Pliers

Used to insert pistons with rings into cylinders. Tool compresses rings to bore size.

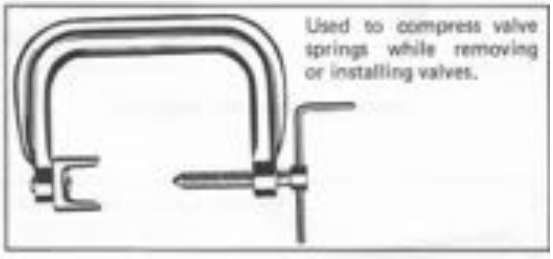
Part No. 96333-51A Piston Inserter Ring Tools

For checking valve seat location. Tool consists of two valves and gage having a step to show limits to which valve seat should be ground.

Part No. 96490-59A Valve Seating Gage Seat

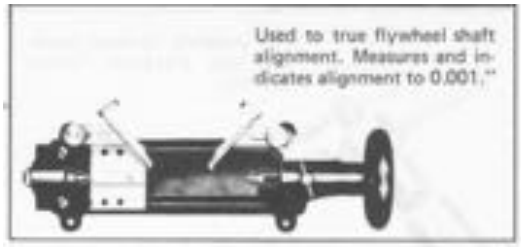
Used to rotate valve when grinding or lapping seat surfaces.

Part No. 96550-36 Valve Lapping Tool



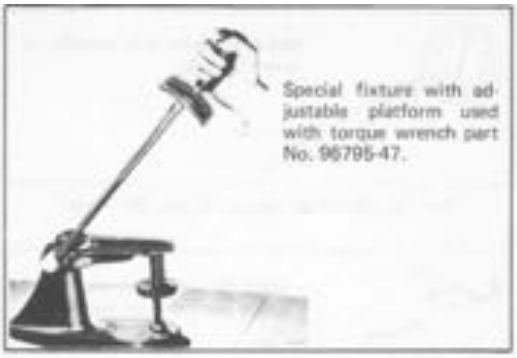
Used to compress valve springs while removing or installing valves.

Part No. 96600-36 Valve Spring Compressor



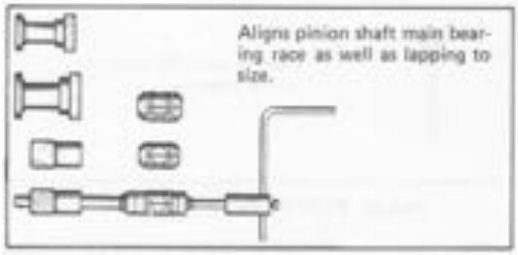
Used to true flywheel shaft alignment. Measures and indicates alignment to 0.001."

Part No. 96650-30 Flywheel Truing Stand



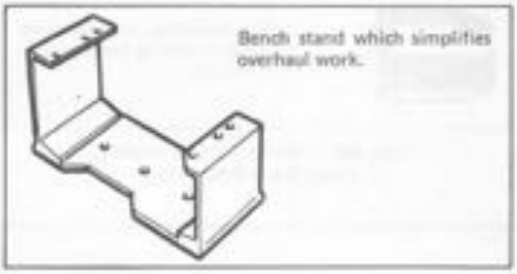
Special fixture with adjustable platform used with torque wrench part No. 96795-47.

Part No. 96796-47 Valve Spring Tester



Aligns pinion shaft main bearing race as well as lapping to size.

Part No. 96710-40 Crankcase Main Bearing Lap



Bench stand which simplifies overhaul work.

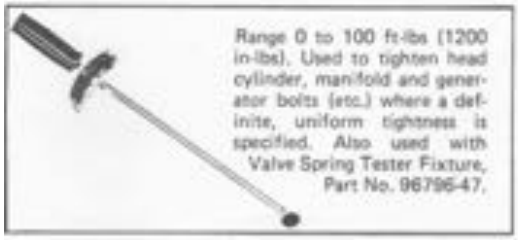
Part No. 96815-46 Engine Repair Stand

Used to lap connecting rod bearing races when fitting new rollers.

Part No. 96740-36 Connecting Rod Lapping Arbor

Used to install and remove pinion gear.

Part No. 96830-51 Pinion Gear Puller and Collars



Range 0 to 100 ft-lbs (1200 in-lbs). Used to tighten head cylinder, manifold and generator bolts (etc.) where a definite, uniform tightness is specified. Also used with Valve Spring Tester Fixture, Part No. 96796-47.

Part No. 96795-47 Torque Wrench

Used to check oil pump pressure under actual operating conditions. Attaches to motorcycle. Graduated 0-60 pounds.

Includes adapter to attach hose fitting to 1/8 NPT thread oil pump outlet.

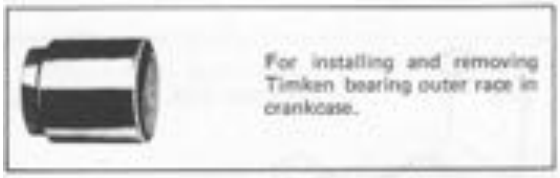
Part No. 96921-52 Oil Pressure Gauge

Measures chain case vacuum to detect air leaks.

Part No. 96950-68 Vacuum Gauge, 30" Water

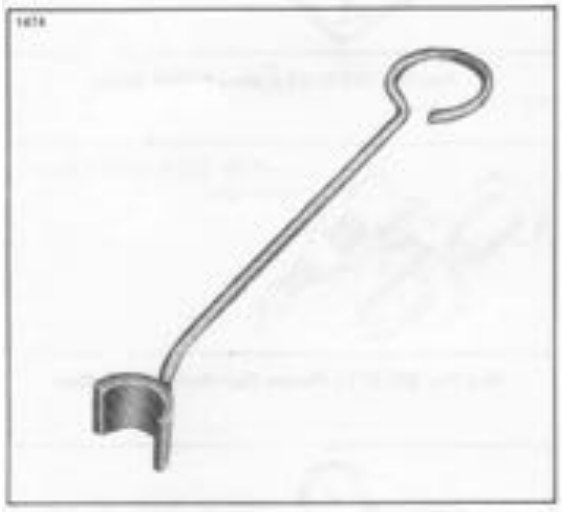
Used for tightening band type metal clamps on oil lines.

Part No. 97087-65A Hose Clamp Pliers

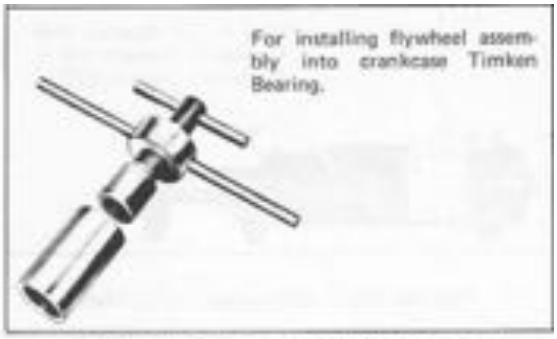


For installing and removing Timken bearing outer race in crankcase.

Part No. No. 97194-57 Timken Bearing Outer Race Press Plug

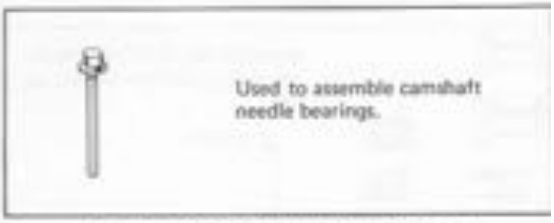


Push Rod Adjustment Gauge, Part No. 94438-79



For installing flywheel assembly into crankcase Timken Bearing.

Part No. 97225-55 Sprocket Shaft Bearing Tool



Used to assemble camshaft needle bearings.

Part No. 97272-60 Needle Bearing Tool

TRANSMISSION 4

TABLE OF CONTENTS

GENERAL

SPECIFICATIONS

CLUTCH

Type	Dry-multiple disc
Capacity	206 ft-lbs torque
Spring pressure (total)	315 lbs.
Spring adjustment	1-1/32 in. from spring collar edge to outer disc surface.

CHAIN

Type (primary)	5/8-7/8 in. pitch, double
Looseness	1/2 to 15/16 in. slack (cold engine) 3/8 to 5/8 in. slack (hot engine)

MAINSHAFT MAIN DRIVE GEAR

Drive gear end play	0.0025 – 0.0135 in.
Bushing on mainshaft	0.0018-0.0032 loose

MAINSHAFT

Low gear end bearing	
In housing	0.0013 in. loose – 0.0001 in. press
On shaft	0.001 in. loose – 0.0007 in. press
Housing in case	0.0005 in. loose – 0.0010 in press
Third gear	
End play	0.000 to 0.017 in.
Gear on shaft	0.0012 – 0.0023 in. loose
Bushing in gear	Press fit

COUNTERSHAFT

Drive gear end bearing	0.0005 – 0.0019 in. loose
Low gear end bearing	0.0005 – 0.0019 in. loose
Gear end play	0.007 – 0.012 in.
Second gear	
End play	0.003 – 0.017 in.
Bushing on shaft	0.000 – 0.0015 in. loose
Bushing in gear	0.0005 – 0.0025 in. loose
Low gear	
Bushing on shaft	0.000 – 0.0015 in. loose
Bushing in gear	0.0005 – 0.0025 in. loose
Shifter clutch	
Low and second	0.080 – 0.090 in.
Third and high	0.100 – 0.110 in.
Gear backlash	0.003 – 0.006 in.

SHIFTER CAM

End play	0.0005 – 0.0065 in.

DESCRIPTION

The transmission has four major assemblies: the clutch, gear box, gear shifter and starter. Each is a part of power transmission from engine to rear wheel or a means of power control.

CLUTCH

The clutch is made up of a drum or shell which is integral with the primary drive chain sprocket and which has inside a series of alternately positioned lined and unlined discs. The lined discs are doweled to the clutch hub which is keyed to the transmission shaft while the steel (unlined) discs are keyed to the clutch shell. When the clutch pressure plate is seated, a group of springs press the steel and lined discs together making a non-slipping connection between the engine and transmission.

GEAR BOX

The gear box contains a series of gears on a mainshaft and countershaft which may be powered in a selection of ratios according to speed and load requirements.

GEAR SHIFTER

The gear shifter is a unit mounted to the gear box which shifts the gear box components into desired ratios by means of shifting forks that slide gears into and out of mesh along shafts.

STARTER

Electric starter motor and Bendix type drive unit engages a ring gear on the clutch. The primary chain transmits the force through the front sprocket.

REPAIR PROCEDURE

When operating troubles develop in a transmission component, it is recommended procedure to first check the following adjustments.

1. Adjusting Clutch Control
2. Adjusting Clutch
3. Adjusting Shifter Linkage
4. Adjusting Shifter Cover

If the above adjustments do not correct trouble, disassemble and repair as described in repair sections. See "Locating Operating Troubles," Section 1, for aids to diagnosing trouble. It is not necessary to remove transmission from chassis to disassemble clutch, starter, transmission mainshaft, ball bearing, main drive gear oil seal or clutch release mechanism. However, extensive repairs are often easier and more quickly made if transmission unit is removed to bench as described in following section, "Stripping Motorcycle for Transmission Repair."

STRIPPING MOTORCYCLE FOR TRANSMISSION REPAIR

WARNING

Disconnect the battery cables (negative cable first) to avoid accidental start-up of the vehicle and possible personal injury.

1. Remove transmission drain plug and drain the oil from the case.

2. Remove foot shifter lever and cover plate. Remove chain housing cover. Remove compensating sprocket nut.

3. Remove clutch as described in "Disassembling Clutch.

4. Remove mainshaft key. Loosen the five transmission base mounting nuts. Remove the four bolts attaching chain housing to engine crankcase and four bolts attaching housing to transmission. Remove the two chain housing stud nuts attaching starter housing to chain guard. Remove wires connected to starter solenoid terminals. Pull inner chain housing loose from mainshaft. Care must be taken to be sure housing moves out squarely as front end is snug fit on shoulder of crankcase. As housing is pulled out, shake starter assembly shaft to free it from gear in starter motor housing. Remove chain oiler hose at oil pump. Remove chain housing oil return hose at rear of chain guard, vent hose at T-connection and move housing away. On FX, remove foot shifter lever linkage from chain housing and shifter pawl lever on transmission cover. Remove battery carrier bracket from right side of transmission. Remove right passenger footrest bracket. Remove starter motor bracket and pull starter motor out left side.

5. Disconnect clutch cable from clutch release arm.

6. Disconnect shifter release lever from transmission cover by removing nut and bolt.

7. Remove exhaust pipe.

8. On FL models, disconnect speedometer drive cable and housing from transmission.

9. Disconnect neutral indicator switch wire clip.

10. Remove rear chain connecting link and chain. Remove bolt which secures transmission to support bracket on right side of frame.

11. Remove bolts and cap screws which secure transmission mounting plate to chassis.

12. Remove complete transmission with mounting pate.

Fill the transmission with 1½ pints of SAE 40 engine oil. Tighten the drain plug to 12-15 ft-lbs torque.

Reassembly is the reverse of disassembly with the following exceptions:

The four nuts securing the transmission to mounting plate as well as the bolt which secures transmission to frame support bracket should be left loose to facilitate easy alignment of the chain housing with engine crankcase and transmission bolts.

Primary chain case bolts on engine and transmission should be tightened evenly to 18 to 22 ft-lbs torque so housing does not bind on transmission mainshaft or shoulder on engine crankcase. Final tightening should start at three bolts at engine crankcase, then four bolts at transmission, then four base mounting nuts and bolts securing transmission to chassis bracket.

IMPORTANT

After reassembly, chain housing must be airtight. Check using Vacuum Gage Part No. 96950-68. Remove one of the four screws securing the front chain inspection cover and in its place screw in the threaded fitting of the gage. Then, with engine running, check gage to see that there is a reading indicating 9-11 inches of water minimum. Perform check with vent hose from tee fitting to inner primary pinched closed with a pliers. The reading should now be 25 inches of water or more. A lower reading indicates an air leak into chain housing either at gasket, solenoid, starter shaft, or hoses.

CLUTCH

GENERAL

The clutch or clutch control mechanism needs attention when the clutch slips under load, or drags in released position. For causes of slipping clutch see "Locating Operating Troubles," Section 1. Before disassembling clutch when repair is indicated, readjust gear shifter control and clutch spring tension. It is not necessary to remove transmission from chassis to adjust or repair clutch.

ADJUSTING HAND CLUTCH LEVER (Figure 4-2)

Adjust control cable sleeve (1) as required to maintain approximately 1/4 in. free hand lever movement before clutch starts to disengage. To adjust, loosen adjusting sleeve locknut (2), turn threaded sleeve out for less hand lever free play or into bracket (3) for more hand lever free play and retighten lock nut to 25 ft-lbs torque.

If sleeve adjustment has been all taken up or there are other indications of incorrect clutch operation such as slipping clutch or gear clash due to dragging clutch when shifting, the following adjustments should be made in the order shown.

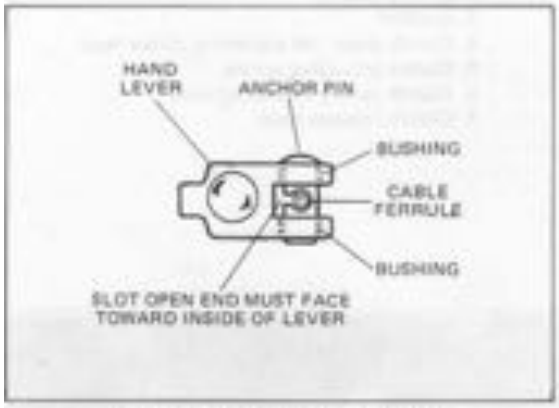


Figure 4-1. Clutch Hand Lever Cable

See Figure 4-2. Move end of lever (7) on transmission forward until it becomes firm, indicating that all slack in the actuating mechanism has been taken up.

Measure clearance as shown in Figure 4-2. If not within this range, adjust as follows:

Loosen control coil adjusting sleeve locknut (2, Figure 4-2) and turn control coil adjusting sleeve (1) all the way into bracket. Remove chain housing cover, loosen clutch push rod screw locknut (4) and turn screw (5) outward. Turn adjusting sleeve (1) outward until proper lever (7) clearance is obtained. Turn screw (5) inward until contact is made with push rod. Then back off 1/8 turn. Tighten locknut (4) and reinstall chain housing cover.

NOTE

A gage for setting clearance can be made out of light gauge sheet metal. Cut a strip 13/16" wide and remove all burrs. Make a 90° bend about 1/4 inch from one end. Hook the gage over the clutch cable and between the transmission lever and the transmission tower.

IMPORTANT

Chain housing must be airtight with cover reinstalled — use new cover gasket and gasket sealer.

To disassemble cable from hand lever at anchor pin, turn sleeve into bracket (3) and remove cable from side slot as shown in figure 4-1. When reassembling cable ferrule in hand lever anchor pin with side slot, be sure slot is toward inside as shown.

Adjust clutch hand lever for 1/4 in. free movement as described above.

ADJUSTING CLUTCH

If the clutch slips after adjusting clutch controls, increase spring tension on the three clutch spring guide stud nuts (6, figure 4-2). Remove clutch cover and tighten all three nuts one-half turn at a time until clutch holds. Test after each half turn by cranking the engine. Usually a clutch that holds without noticeable slipping when cranking the engine will hold under normal road conditions. Do not increase spring tension any more than is necessary to make clutch hold.

A new clutch is assembled so the distance from inner edge of spring collar (2, figure 4-3) to the surface of the outer disc (8) is exactly 1-1/32 in. If springs are compressed so this distance is 7/8 in. or less, the clutch probably cannot be fully disengaged. Check this dimension at several points to make sure that releasing disc is parallel with plates.

Re-adjust cable and lever (7).

When clutch will not hold without tightening beyond this limit, disassemble the clutch for inspection of the clutch discs. Discs may be worn or oil soaked and in need of replacement or washing.

DISASSEMBLING CLUTCH (Figure 4-4)

Remove primary chain housing cover.

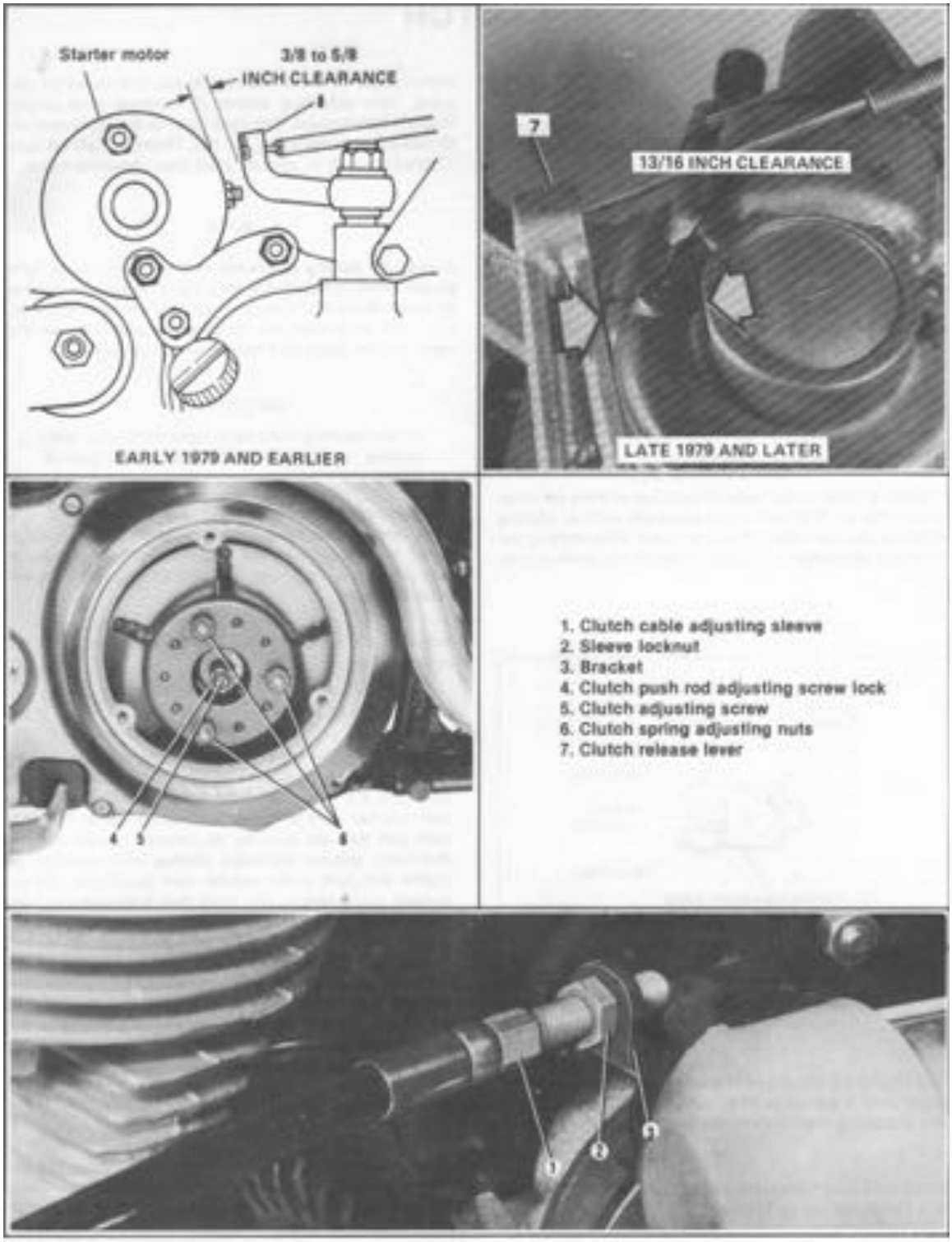
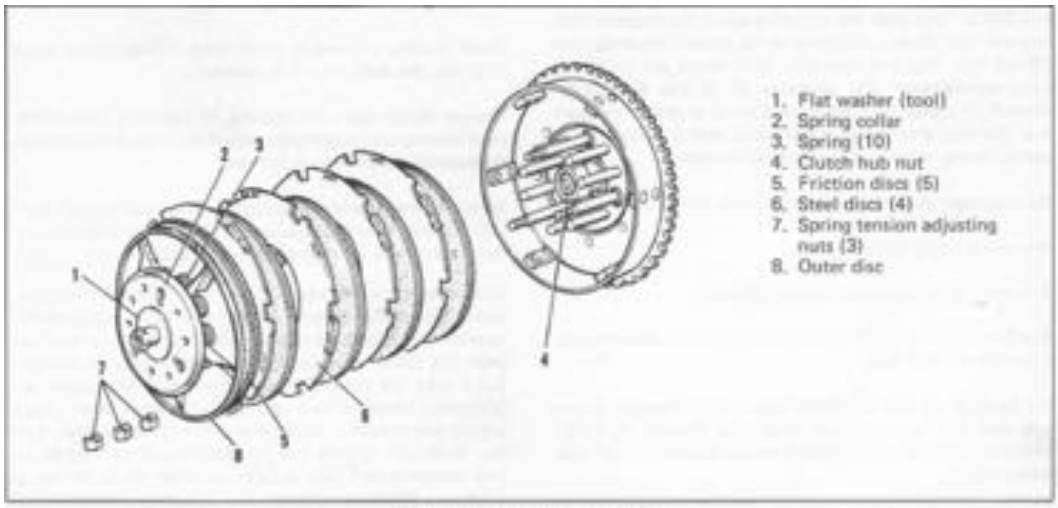
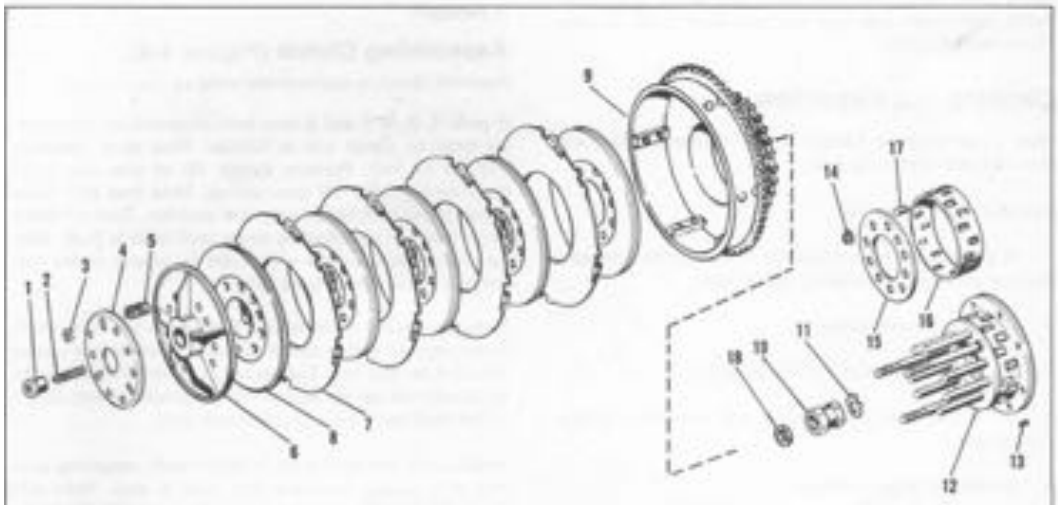


Figure 4-2. Adjusting Clutch



1. Flat washer (tool)
2. Spring collar
3. Spring (10)
4. Clutch hub nut
5. Friction discs (5)
6. Steel discs (4)
7. Spring tension adjusting nuts (3)
8. Outer disc

Figure 4-3. Removing Clutch



1. Push rod adjusting screw lock nut
2. Adjusting screw
3. Spring tension adjusting nut (3)
4. Spring collar
5. Springs (10)
6. Outer disc (pressure plate)
7. Steel disc (4)
8. Friction disc (5)
9. Clutch shell
10. Clutch hub nut (left hand thd.)
11. Hub nut lock washer
12. Clutch hub
13. Clutch hub key
14. Bearing plate spring (3)
15. Bearing plate
16. Bearing retainer
17. Bearing roller
18. Hub nut seal

Figure 4-4. Clutch Assembly – Exploded View

Remove push rod adjusting screw lock nut (1). Place a flat washer about 1/8 in. thick with 1-3/4 in. outside diameter and 3/8 in. hole over the adjusting screw (2). Replace lock nut and turn down until three spring tension adjusting nuts (3) are free. The nuts may then be removed and the spring collar-springs-outer disc assembly (4, 5 and 6) may be slipped off clutch hub dowels and studs as shown in figure 4-3. Do not disassemble these parts unless necessary for spring, spring collar or outer disc replacement.

Remove steel discs (7) and lined friction discs (8).

Remove primary chain adjuster.

Remove engine compensating sprocket nut.

Remove clutch shell (9) compensating sprocket and primary chain from clutch hub.

Pry back ear on clutch hub nut lock washer. Remove clutch hub nut (10) using Clutch Hub Nut Wrench, Part No. 94645-41. Thread is left hand. Remove clutch hub nut lock washer (11).

Remove clutch hub (12) using Clutch Hub Puller, Part No. 95960-41A. Turn tool center bolt back until puller plate may be slipped over clutch hub studs and against ends of clutch hub pins. Secure puller plate with the three clutch spring guide stud nuts. Turn down tool center screw until clutch hub breaks free from gear box shaft taper. Remove clutch hub key (13).

Cleaning and Inspection

Wash all parts except friction discs in cleaning solvent and blow dry with compressed air.

Examine friction discs for:

1. A glazed surface which may be recognized by a smooth, shiny and sometimes darkened appearance.

2. Worn or grooved surface.

3. Lining worn down to 1/32 in. or less.

4. Oil impregnated linings which will sometimes accompany glazing.

5. Cracked or chipped linings.

Glazed and oil soaked linings may sometimes be reconditioned by soaking in solvents of various types for several hours, blowing dry with compressed air and roughing with medium coarse sandpaper. This procedure may not be successful because oil retained in pores of lining material may come to the surface due to heat developed during normal operation. Grooved linings and excessively worn linings must be replaced. Chipped or cracked linings must also be replaced. Badly glazed and burned linings are probably beyond reconditioning and should be replaced.

Steel discs that are grooved or warped should be replaced. Depress steel disc buffer balls with fingertip. If they do not snap back in place, spring is worn and buffer assembly must be replaced.

Check bearing race inside clutch shell. If it appears grooved or pitted, the shell should be replaced.

Revolve clutch hub roller bearing. If it sticks or feels rough inner bearing race is probably pitted and should be replaced. Disassemble clutch hub as follows:

Remove three bearing plate springs (14), slip bearing plate (15) off hub pins and remove bearing retainer (16). If inner race thus exposed proves to be worn, replace hub.

Clutch springs occasionally set or become fatigued especially when excessive heat has been produced by operating motorcycle with a slipping clutch. If this has been the case, or if clutch discs are in good condition but it was not possible to obtain a suitable clutch adjustment, check clutch spring free length. Also check spring compression using the Valve Spring Tester, Part No. 96797-47. Spring free length should be 1-45/64 in. and compression test should be from 30 to 38 lbs at 1-1/4 in. Replace springs not meeting compression specifications, those with a free length below specified figure, and those having compression testing to near low tolerance range figure.

Lip type seal (18) should be inspected and replaced if worn or damaged.

Assembling Clutch (Figure 4-4)

Assemble clutch in approximate order of disassembly.

If parts 1, 2, 4, 5 and 6 have been disassembled, preassemble them on clutch hub as follows: Place clutch releasing disc (6) on hub. Position springs (5) on pins and studs. Place spring collar (4) over springs. Note that stud holes are arranged so it fits in only one position. Turn adjusting screw lock nut on adjusting screw until head is flush, then turn into pressure plate with 1-3/4 in. washer under nut. Remove this assembly from hub.

Place key in slot in mainshaft. Slip clutch hub onto shaft. Install new oil seal in clutch hub nut. Position lock washer followed by hub nut. Tighten nut to 50 to 60 ft-lbs torque. Bend over the ear on washer matching hub nut flat. Grease clutch shell bearing and install clutch shell.

Install lined and steel discs in clutch shell, staggering position of steel disc buffers in key slots in shell. Make sure steel discs are installed with side stamped "OUT" facing outward.

Install pressure plate assembly. Draw down adjusting nut until stud nuts may be started. Turn down stud nut until 1-3/4 in. washer is loose. Remove washer and replace adjusting nut.

Draw down stud nuts evenly until distance from back of pressure plate to front of clutch releasing disc is 1-1/32 in.

Make final adjustments to clutch as described in "Adjusting Clutch Foot Control," or "Adjusting Clutch Hand Control," and "Adjusting Clutch."

ELECTRIC STARTER

GENERAL

The Bendix type drive shaft and gear assembly, located in starter housing between starting motor (Figure 4-6) and clutch ring gear, provides automatic means of engaging the starter shaft drive pinion with the ring gear on the clutch sprocket for cranking the engine and for disengaging the drive pinion from the ring gear after the engine starts.

When the starter motor is not operating, the drive shaft worm pinion is disengaged from the ring gear. When the starter switch button closes starting circuit, the solenoid armature shaft (1) pulls shifter lever (2). Fingers on lever engage groove in shifting collar (3) which forces pinion gear (4) into engagement with clutch ring gear (5). At the same time, solenoid also closes starter motor circuit, thus turning the ring gear and cranking the engine. After the engine starts and switch button is released, spring return on solenoid shaft returns lever so that pinion gear disengages from ring gear and starter motor shuts off. There are matching spiral threads on starter shaft (6) and pinion gear (4) so pinion will shift if mating teeth do not line up for going into mesh. If starter button is not released after engine starts, pinion gear will turn freely by means of overrunning clutch (7) to prevent damage to starter.

DISASSEMBLING STARTER SHAFT AND SOLENOID (Figure 4-6)

Remove solenoid as follows:

WARNING

Disconnect battery cables (negative cable first) to avoid accidental start-up of vehicle and possible personal injury.

Disconnect battery ground wire from battery terminal post. Remove cover (1) and disconnect wires from starter solenoid terminals held by nuts and lockwashers (2) and (3).

Remove chain housing cover.

Depress retainer cup (4), remove pin (5) from hole in plunger (11) shaft. Remove spring (6).

Remove solenoid attaching bolts and lockwasher (7) and spacer bar (8). Remove solenoid (13) with boot (9), gasket (10), plunger (11), and plunger spring (12).

Rotate starter shifter lever (25) end forward and disengage lever fingers from pinion gear shifting collar (20). Pull pinion gear and shaft assembly (14) from housing. Note drive gear (28) will remain in drive shaft housing (29).

To disassemble pinion gear and shaft assembly (14), remove thrust washer (15). Place nut (16) between copper jaws in a vise and unscrew from shaft which has a left hand thread. Remove pinion gear assembly (17). Remove lock ring (18) to separate gear (19), shifter collar (20), and spacer (21) from shaft (22).

To remove starter shifter lever (25), it is necessary to either remove inner chain housing (See "Stripping Motorcycle for Transmission Repair") or remove oil tank.

Remove screw (24) and lever (25) from chain housing.

Remove starter shaft housing (29) from chain housing studs as follows:

Remove starter motor and housing as an assembly by removing nuts and lockwashers (23) from chain housing studs. (See "Starter Motor," Section 5.)

Remove oil deflector (26) and gear (28) from starter shaft housing (29). Needle bearings (30) and (31) are pressed into housings at shaft ends.

To service starter motor see Section 5.

ASSEMBLING STARTER SHAFT AND SOLENOID (Figure 4-6)

Assembly is essentially the reverse of disassembly except as follows:

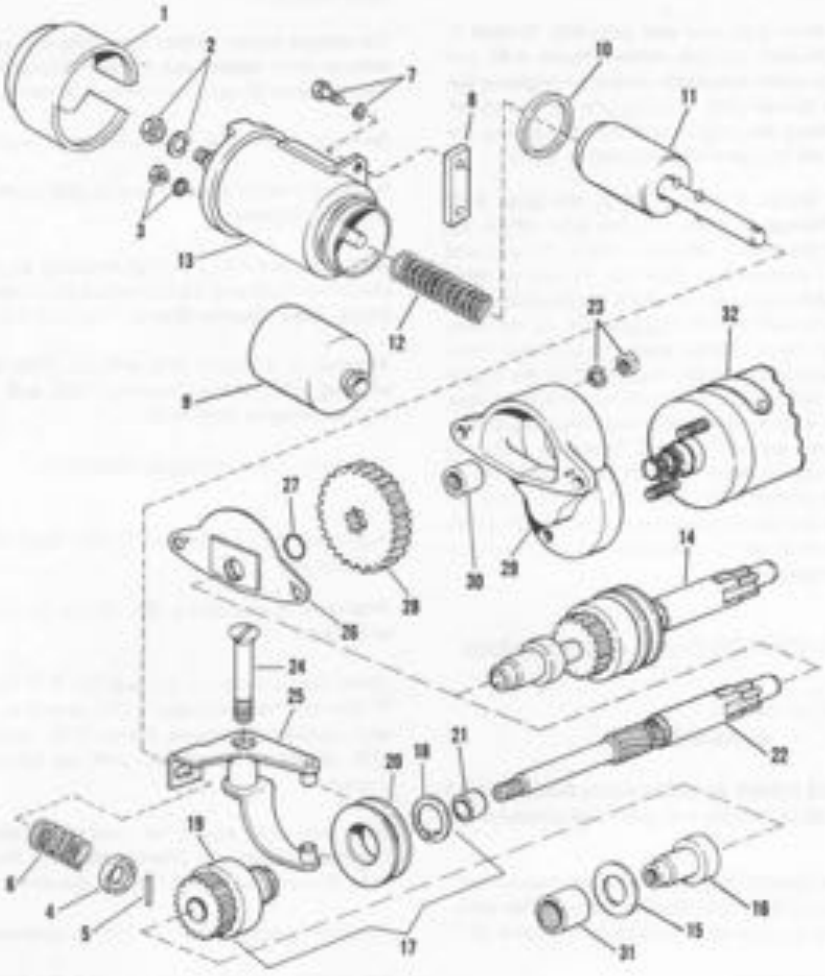
Clean needle bearings (30 and 31) and repack with grease. If replaced, needle bearing (31) should be pressed in flush with outside of housing. Pinion (19), spacer (21) and shaft (22) should be assembled with no lubrication on worm threads.

Shaft nut (16) should be secured to shaft with Harley-Davidson "Stud and Bearing Mount," Part No. 99626-77 after cleaning parts with "Safety Solvent."

Connect battery cable to longest solenoid terminal stud.

CAUTION —If cables are reversed, the solenoid will remain in battery circuit.

Figure 4-5. Starter Drive



1. Cover
2. Terminal nut and lockwasher (2)
3. Terminal nut and lockwasher
4. Retainer cap
5. Pin
6. Spring
7. Bolt and lockwasher (2)
8. Spacer bar
9. Boot
10. Gasket
11. Plunger
12. Plunger spring
13. Solenoid
14. Pin gear and shaft assembly
15. Thrust washer
16. Pinion shaft nut
17. Pinion and shifter collar assembly
18. Lock ring
19. Pinion gear
20. Shifter collar
21. Spacer
22. Shaft
23. Nut and lockwasher (2)
24. Shifter lever screw
25. Shifter lever
26. Oil deflector
27. Oil deflector O-ring
28. Drive gear
29. Starter shaft housing
30. Needle bearing
31. Needle bearing (pressed into inner primary cover
32. Starter motor

Figure 4-6. Starter Shaft, Housing and Solenoid – Exploded View

KICK STARTER

DISASSEMBLING KICK STARTER (Figure 4-7)

Remove kick starter assembly from gear box as follows:

Place oil drain pan under transmission. Remove starter cover nuts (1) and plain washers (2). Loosen clutch adjusting screw (2, Figure 4-4). If transmission is in chassis, remove clutch lever rod from left end of clutch release lever. Remove exhaust pipe and other components mounted on transmission cover studs. Cover assembly with clutch release lever assembly is then free to be pulled off mounting studs. With starter cover removed, push rod assembly (3) is free to be pulled out of mainshaft.

Clamp crankshaft (8) in vise, bend ear of lockwasher (6) away from flat of starter crank nut (5) and remove nut and lockwasher (6). Remove starter gear (7) using the Harley-Davidson All Purpose Claw Puller, Part No. 95635-46. If puller is not available, remove starter crank from vise, and drive starter crank out of starter gear with rawhide mallet. Be sure to hold starter crank and cover from swinging when shaft is free from gear.

With starter gear removed, crankshaft (8) can be pulled out of cover. Thrust washer (9) is installed between starter crank spring (10) and cover (11) with chamfered side of washer facing spring.

Remove nut (12) and lockwasher (13), and pull release lever (14) from end of clutch release lever shaft (15) using All Purpose Claw Puller.

Remove retaining ring (16) and plain washer (17) from lower end of release lever shaft, which can then be pulled out of cover, freeing release finger (18) and thrust washer (19).

CLEANING, INSPECTION AND REPAIR (Figure 4-7)

Wash all parts in a grease solvent and blow dry.

Insert starter crankshaft in starter cover and check play. If play is appreciable, press out bushings (20) and install new parts. If transmission was leaking oil out starter crank, install new oil seal (21). Bushings are pressed in with outside ends just flush with bushing boss and outer surface of cover.

Bushings (22 and 23) rarely need replacement. However, check fit of release lever shaft and replace bushings if shake is considerable.

Check clutch push rod bearing (3C) for wear. Replace unit that grinds, feels rough or loose when rotated.

Check cam plate and gear pin on starter gear (7) to be sure they are in good condition, especially if starter crank bushings were replaced.

ASSEMBLING KICK STARTER (Figure 4-7)

Install release lever shaft (15) and release finger (18) in cover with thrust washer (19) located between finger and bushing (23), and plain washer (17) and retaining ring (16) on end of shaft.

Install starter crank spring (10) and thrust washer (9) on starter crankshaft (8) with chamfer side of washer facing spring. Apply a film of light grease on oil seal (21) and starter crankshaft before installing. Install starter crank gear. When viewing end of gear, notch on crankshaft (8) should be in 12 o'clock position and dowel pin gear should be in 7 o'clock position. Install lockwasher (6) and nut (5) and tighten nut to 50 to 60 ft-lbs torque. Bend tab on washer up against flat on nut.

Before starter cover is installed, push rod assembly (3) is inserted into cover. Insert small diameter end of push rod into mainshaft. With oil slinger (3A) in cover and using push rod as a guide, move cover assembly into place. Dowel pin on starter gear must clear front of starter crank stop (33). Tighten all cover nuts (1) to 13 to 16 ft-lbs torque. Install starter crank (8A) and tighten crank bolt (8B) to 25 to 30 ft-lbs torque. Wind spring by turning it with a pliers clockwise and hooking end onto starter crank stud (32).

Refill unit with 1-1/2 pints of same grade oil used in engine.

Adjust clutch.

Adjust rear brake pedal.

DISASSEMBLING STARTER CLUTCH (Figure 4-7)

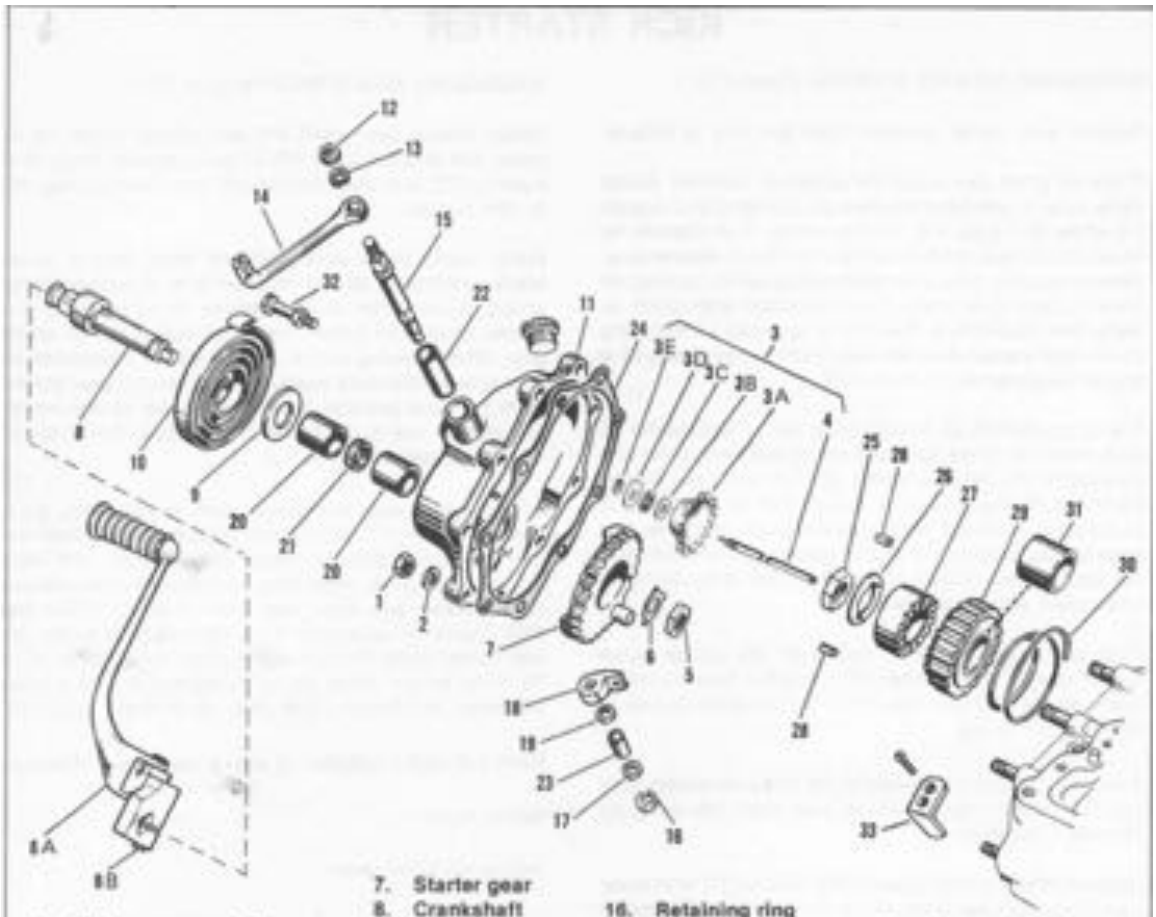
Remove starter cover assembly as described in "Disassembling Starter," and proceed as follows:

Bend ear of lockwasher (26) away from flat of starter clutch nut (25) and remove nut and washer. Pull starter clutch (27) from mainshaft taper with Starter Clutch Puller, Part No. 95650-42. With starter clutch removed, starter clutch keys (28), starter mainshaft gear (29) and starter clutch spring (30) are free to be removed from mainshaft.

CLEANING, INSPECTION AND REPAIR (Figure 4-7)

Wash all parts except gasket (24) in grease solvent and blow dry with compressed air.

Examine teeth on starter clutch (27) and starter gear (29). Teeth should be sharp edged. If teeth are rounded or mushroomed and rider has experienced ratchet slip, replace worn parts. If starter clutch has previously been drawn down too tight, starter clutch may be cracked. If cracked, replace it.



1. Starter cover nut (9)
2. Plain washer (9)
3. Push rod assembly (3A to 4)
3A. Oil slinger
3B. Thrust washer
3C. Thrust bearing
3D. Thrust washer
3E. Lock ring
4. Push rod
5. Starter crank nut
6. Eared lockwasher
7. Starter gear
8. Crankshaft
8A. Crank
8B. Bolt
9. Thrust washer
10. Starter crank spring
11. Starter cover
12. Release lever nut
13. Lockwasher
14. Release lever
15. Release lever shaft
16. Retaining ring
17. Plain washer
18. Release finger
19. Thrust washer
20. Starter crank bushing (2)
21. Oil seal
22. Release lever bushing (upper)
23. Release lever bushing (lower)
24. Starter cover gasket
25. Starter clutch nut
26. Starter clutch washer
27. Starter clutch
28. Starter clutch key
29. Starter mainshaft gear
30. Starter clutch spring
31. Mainshaft gear bushing
32. Starter spring stud
33. Starter crank stop

Figure 4-7. Kick Starter and Clutch Release Assembly – Exploded View

Position mainshaft gear (29) on shaft and check play. If obviously loose, replace bushing (31).

ASSEMBLING STARTER CLUTCH
(Figure 4-7)

Coat gasket (24) with gasket sealer and position on transmission case. Lubricate mainshaft with engine oil and slip spring (30) and mainshaft gear over shaft. Bushing should be loose enough on mainshaft to allow gear to slide under force of compressed starter clutch spring. If necessary, line ream bushing to achieve free fit.

Position starter clutch, drive in starter clutch keys and assemble remainder of parts in reverse order of disassembly.

Tighten nut (25) to 50 to 60 ft-lbs torque.

TRANSMISSION CASE

ADJUSTING SHIFTER LINKAGE

FOOT SHIFT. The foot shift linkage normally requires adjustment only to compensate for wear or when transmission has been moved. Only the shifter rod needs adjustment to maintain correct pedal position and prevent interference with crankcase.

Remove cotter pin and clevis pin, securing the shifter rod to the shifter cover. Loosen the locknut and adjust the threaded ends on rod. Adjustment is important, as any interference will prevent full movement of foot lever and full engagement of shifting parts inside transmission. Securely tighten locknut after adjustment is made. Reinstall clevis pin and cotter pin.

ADJUSTING FOOT SHIFTER COVER. When it is impossible to shift mechanism into all gears, adjust as follows:

Disassemble shifter cover parts 1 through 12 as described in "Disassembling Shifter Cover," see Figure 4-12. Time shifter notches as illustrated in Figure 4-14. Loosen screw (14, Figure 4-12) and rotate adapter plate (16) until timing notch (Figure 4-14) in adapter plate, located at bottom of shifter gear hole, lines up with notch between two shifter gear teeth. Make alignment exact, then tighten adapter plate bracket screw to lock in position. This adjustment can be made with shifter in any gear (not neutral).

Assemble shifter cover in reverse order of disassembly.

REPLACING MAIN DRIVE GEAR OIL SEAL

Main Drive Gear Oil Seal Tool, Part No. 95660-42, (Figure 4-8) enables removing worn or damaged oil seal and installing new seal without removing or disassembling transmission. It may be used on transmission removed from chassis as well. To use, transmission must be assembled with the exception of clutch and transmisison sprocket.

REMOVING OIL SEAL

Shift transmission into low gear and lock rear wheel to prevent parts from turning while disassembling.

Remove inner primary cover, compensating sprocket, front chain, clutch assembly, inner primary case, transmission sprocket and rear chain.

Place sleeve (C, Figure 4-8) on end of main drive gear. Slide body (B) over sleeve with body stop rod downward. Turn body clockwise until stop bears against transmission case or mounting plate. Hold body in this position and insert center punch (E) through each of the three holes in body and center punch oil seal as shown in Figure 4-9.

Remove body (B) and drill a 3/32 in. hole through metal face of oil seal at each punch mark. Replace body and insert the three self-tapping screws (D) through body and into oil seal. Tighten screws until body is against oil seal.

Turn actuating screw (A) into body and continue turning as shown in figure 4-11 until oil seal is free. Discard oil seal and oil seal cork washer found behind seal.

INSTALLING OIL SEAL

Remove burrs with scraper from outer edge of oil seal recess in transmission where metal was staked to secure seal. Position new cork gasket.

Apply a light coat of Harley-Davidson "Gasket Eliminator Sealant," Part No. 99633-77 to the outside diameter of the new oil seal. Coat lip of seal with oil or grease to prevent damage when installing.

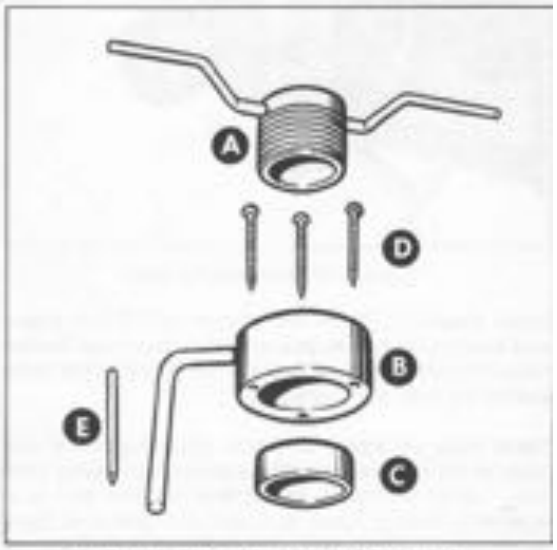


Figure 4-8. Main Drive Gear Oil Seal Tool

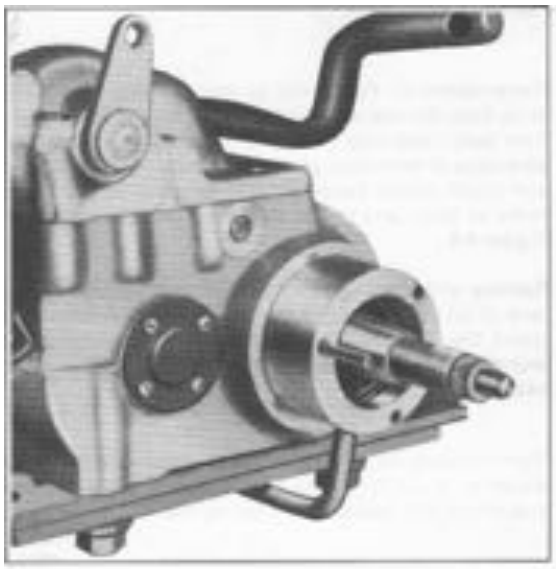


Figure 4-9. Centerpunching Screw Hole Locations

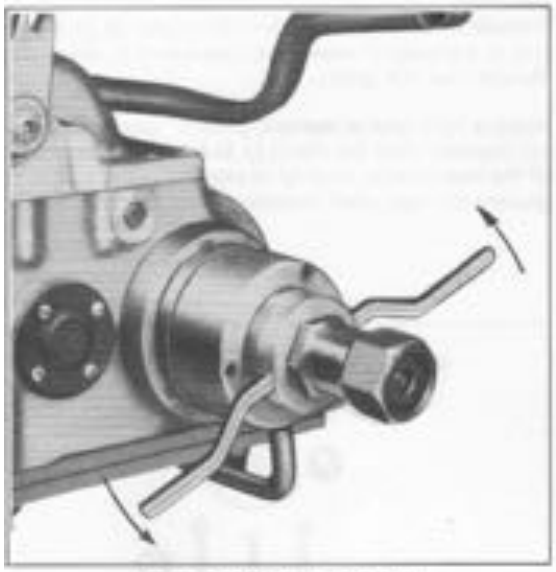


Figure 4-10. Installing Oil Seal

Insert sleeve (C, Figure 4-8) into oil seal. Place sleeve and seal on main drive gear with lip side of seal toward transmission case. Turn seal so it will not stake at same points old seal was staked.

Place body on sleeve and turn actuating screw into body as far as it will go without pulling body away from seal. Install mainshaft clutch hub nut and turn it in against actuating screw as shown in Figure 4-10. Back out actuating screw as shown in Figure 4-10. Back out actuating screw until body has pushed oil seal into

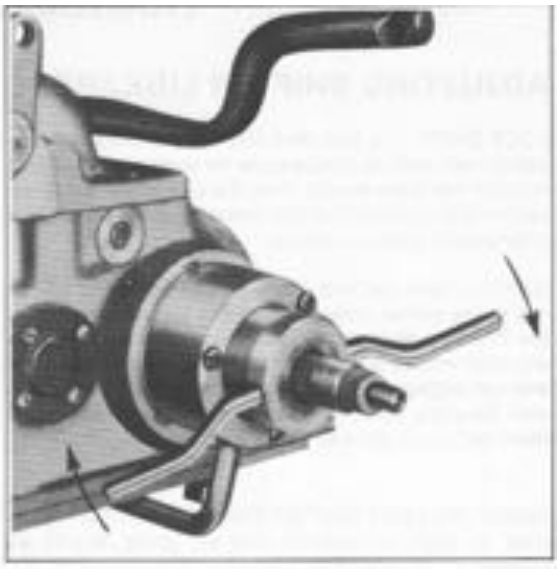


Figure 4-11. Pulling Oil Seal

place and body is tight against end of transmission case.

CAUTION

Take care not to plug the oil hole at the base of the recess with sealant.

Remove tool and stake case into notches in seal.

After assembly is complete, check clutch control adjustment.

REPLACING MAINSHAFT BALL BEARING

Transmission mainshaft ball bearing (6, Figure 4-20) may be replaced without removing transmission from motorcycle by using the following procedure: Remove transmission side cover (24, Figure 4-19) as described in "Disassembling Kick Starter." Remove 1 through 5 in Figure 4-20. Using a screwdriver, pry out bearing shield. Use hooked end of Puller, Part No. 95659-42 to pull the bearing out by engaging bearing inner race with hooks on puller. Use centering button to avoid damaging shaft. Carefully tap in new bearing using care not to damage bearing shield.

SHIFTER COVER — DRUM SHIFTER EARLY 1979 AND EARLIER

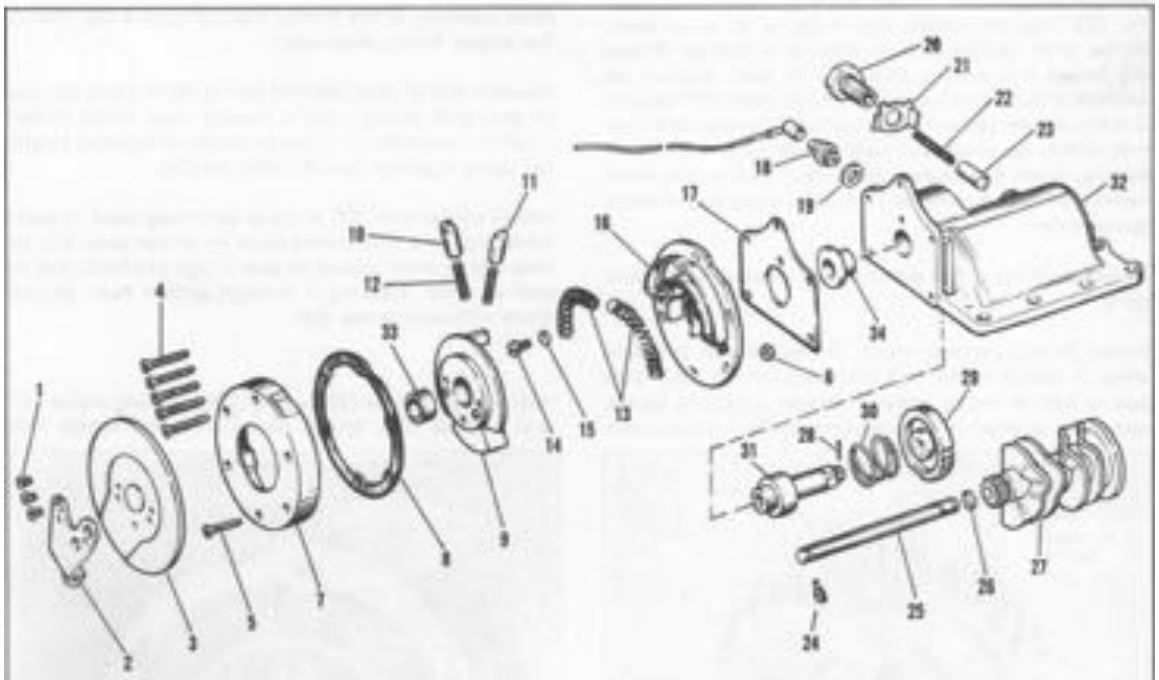
REMOVING SHIFTER COVER

Remove transmission from chassis as described in "Stripping Motorcycle for Transmission Repair."

Remove the 12 screws securing shifter cover to transmission case. Shifter cover is registered on two dowel pins. Two of the screws are extra long. Notice that the screw in hole nearest the dowel pin on right side of transmission is vented to relieve gear box heat expansion pressure. This screw must be installed in the same hole when assembling shifter cover or transmission oil may be forced into clutch.

DISASSEMBLING SHIFTER COVER (Figure 4-13)

Remove three shift lever screws (1), and remove lever and bushing (2) and dust shield (3). Remove five long shifter cover screws (4) and one short screw (5) by removing nut (6) located on rear of adapter plate (16). The pawl carrier cover (7), gasket (8), and pawl carrier (9) are then free to be removed. The pawls (10 and 11), pawl springs (12), and pawl carrier springs (13) are under compression and will pop out when pawl carrier is removed. Remove adapter plate bracket screw (14) and washer (15) to free adapter plate (16) and gasket (17).



1. Shift lever screw (3)
2. Shift lever and bushing
3. Dust shield
4. Shifter cover screw (5)
5. Shifter cover screw (short)
6. Cover screw nut
7. Pawl carrier cover
8. Cover gasket
9. Pawl carrier
10. Pawl (right)
11. Pawl (left)
12. Pawl spring (2)
13. Pawl carrier spring (2)
14. Adapter plate screw
15. Adapter plate washer
16. Adapter plate
17. Adapter plate gasket
18. Neutral indicator switch
19. Washer
20. Cam follower retainer
21. Cam follower washer
22. Spring
23. Cam follower
24. Lock screw
25. Cam shaft
26. Oil seal
27. Shifter cam
28. Cotter pin
29. Shifter gear
30. Shifter gear spring
31. Shifter shaft
32. Shifter cover
33. Pawl carrier bushing
34. Shifter shaft bushing

Figure 4-12. Foot Shifter Cover — Exploded View

Remove neutral indicator switch (18) and washer (19) from cover. Bend back ear on cam follower retainer washer (21) and remove retainer (20), washer (21), spring (22) and cam follower (23).

Remove cam shaft lock screw (24) from left side of shifter cover joint face. Using a suitable drift, tap cam shaft (25) from cover. Tap O-ring end of shaft so O-ring is not damaged. Shifter cam (27) may be lifted out of cover.

Remove cotter pin (28) from end of shifter shaft. Remove shifter gear (29) and spring (30) from shaft and pull shaft (31) out of cover (32).

CLEANING, INSPECTION AND REPAIR (Figure 4-12)

Clean all parts except gaskets (8 and 17), and neutral indicator switch (18) in grease solvent. Clean switch with "Gunk" or solvent.

Inspect fit of shaft (31) in bushings (33 and 34). If there is considerable side play, replace bushings. Pawl carrier bushing (33) may be pressed out of carrier on arbor press. Shifter shaft bushing (34) is removed as follows: Thread 5/8 in. tap into bushing about 1/2 in. deep. Remove tap and heat shifter cover around bushing to about 300 degrees. Quickly replace tap and clamp tap handle in vise. With rawhide mallet, tap cover near bushing until cover is driven off bushing. Insert new bushing with arbor press or soft metal hammer and wood block. Be sure bushing shoulder is seated against cover.

Inspect teeth on shifter gear and cam. Replace badly worn parts.

Inspect neutral indicator switch. Depress plunger in base of body. It should spring back without a bind. If panel light fails to light in neutral position, plunger is sticking. Switch cannot be repaired, it must be replaced. Do not test switch by passing current through it without having a neutral indicator panel light bulb in the circuit series.

Inspect all springs. Inspect tips of cam follower (23) and shift pawls (10 and 11). If tips are rounded and worn, replace parts. To function properly these parts must have reasonably sharp tips.

Inspect all parts generally for cracks, bent parts and any wear that would impair intended functions. If hole in pawl carrier bushing (33) is elongated, bushing must be replaced or mechanism will not shift properly.

ASSEMBLING SHIFTER COVER
(Figure 4-12)

It is necessary to time the shifter shaft (31) to the shifter gear (29), and the shifter gear to the cam gear on the shifter cam (27). If this is not done correctly, it will be impossible to shift into all gears.

Note position of the timing mark (Figure 4-13). This is the proper timing alignment.

Position shifter gear (29) and spring (30) in case, so side of gear with timing mark is toward case. Insert shifter shaft (31) so parts are timed as shown in Figure 4-13 and tap parts together. Insert cotter pin (28).

Install shifter cam (27) in cover so timing mark or short tooth registers with timing mark on shifter gear. Slip oil seal (26) on inner groove on end of cam shaft (25) and insert in cover, passing it through shifter cam. Secure shaft with lock screw (24).

Install cam follower (23), spring (22), retaining washer (21) and retainer (20). Install neutral indicator switch (18)

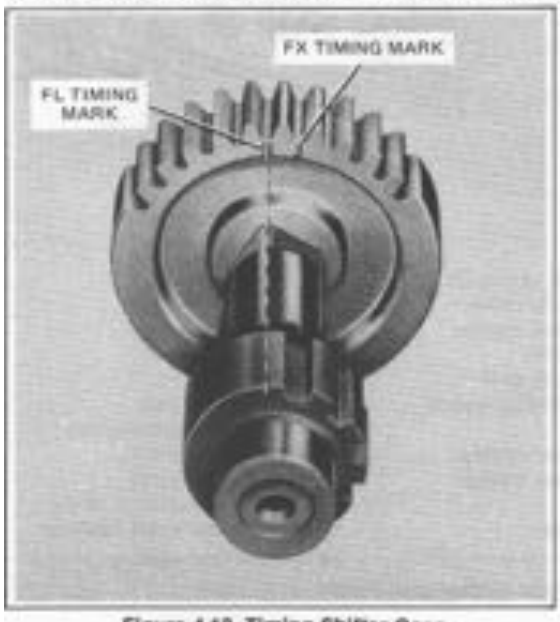


Figure 4-13. Timing Shifter Gear

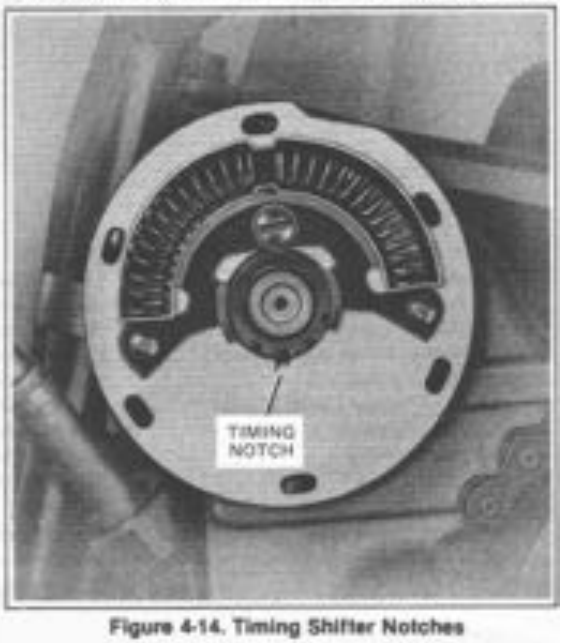
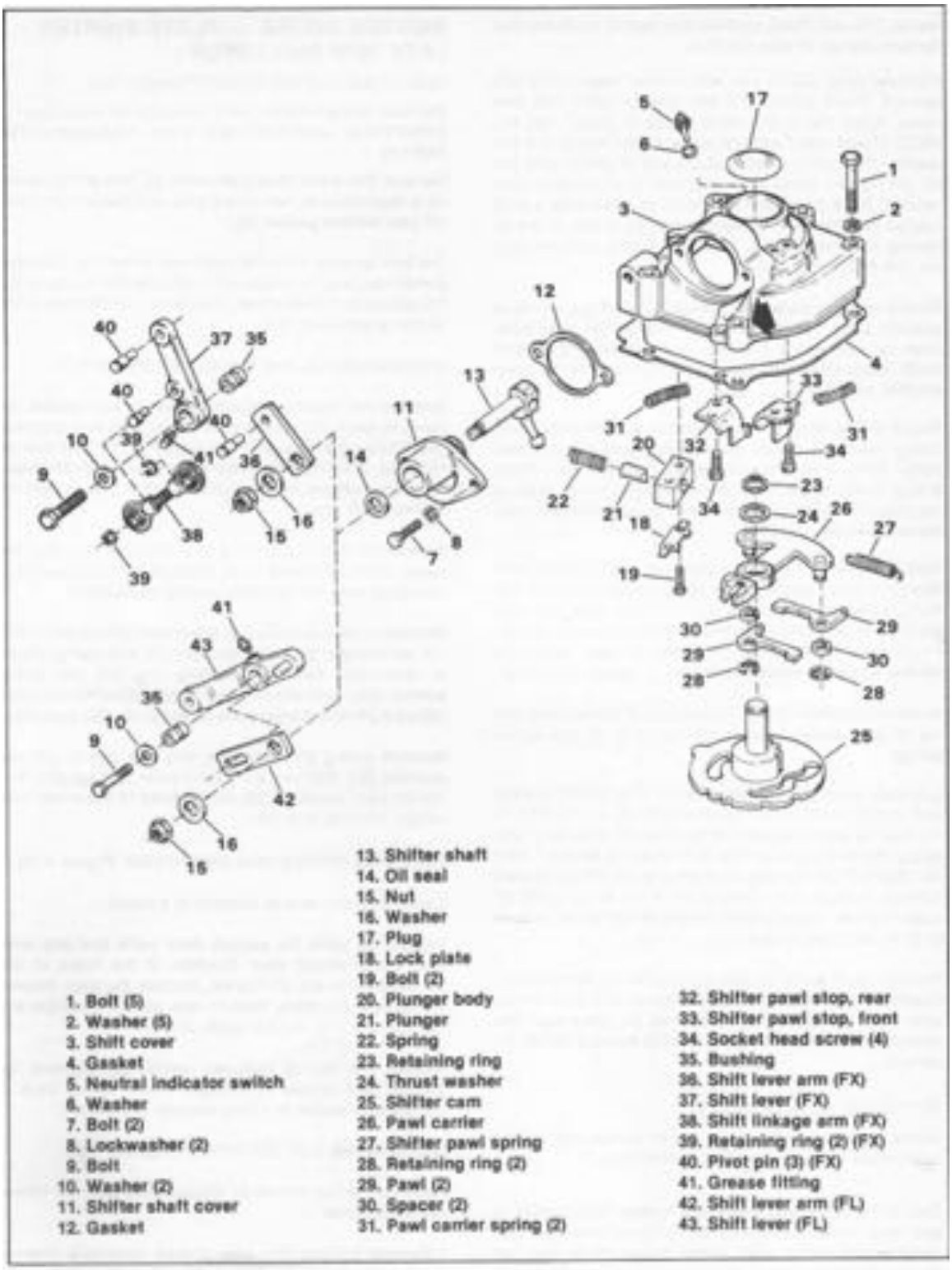


Figure 4-14. Timing Shifter Notches



1. Bolt (5)
2. Washer (5)
3. Shift cover
4. Gasket
5. Neutral indicator switch
6. Washer
7. Bolt (2)
8. Lockwasher (2)
9. Bolt
10. Washer (2)
11. Shifter shaft cover
12. Gasket
13. Shifter shaft
14. Oil seal
15. Nut
16. Washer
17. Plug
18. Lock plate
19. Bolt (2)
20. Plunger body
21. Plunger
22. Spring
23. Retaining ring
24. Thrust washer
25. Shifter cam
26. Pawl carrier
27. Shifter pawl spring
28. Retaining ring (2)
29. Pawl (2)
30. Spacer (2)
31. Pawl carrier spring (2)
32. Shifter pawl stop, rear
33. Shifter pawl stop, front
34. Socket head screw (4)
35. Bushing
36. Shift lever arm (FX)
37. Shift lever (FX)
38. Shift linkage arm (FX)
39. Retaining ring (2) (FX)
40. Pivot pin (3) (FX)
41. Grease fitting
42. Shift lever arm (FL)
43. Shift lever (FL)

Figure 4-15. Shifter Cover — Late 1979 and Later

washer (19) and check to make sure button on shifter gear contacts plunger in base of switch.

Position cover (32) in vise with shifter mechanism end upward. Place gasket (17) and adapter plate (16) over cover. Apply Harley-Davidson "Lock N' Seal," Part No. 99625-77 and insert adapter plate bracket screw (14) and washer (15) in hole directly above end of shifter gear but do not tighten. Move gear shift cam to any position but neutral. Rock cam back and forth to make sure spring loaded cam follower is seating exactly in one of the indexing notches, or "V's," that determine cam position for one of the four gears.

Rotate adapter plate until timing notch (Figure 4-14) in adapter plate, locked at bottom of shifter gear hole, lines up with notch between two bottom shifter gear teeth. Make alignment exact, then tighten adapter plate bracket screw (14).

Rotate shifter drum making sure that at each index point timing notch on adapter plate aligns exactly between two shifter teeth. If alignment is correct, tighten screw (14) to 6 to 9 ft-lbs torque. If alignment is not correct, drum is not properly timed to shifter gear. Disassemble and align marks as explained above.

Apply "Grease-All" grease to curved springs (13) and insert them in slots on adapter plate. Grease ratchet end of shifter shaft. Lubricate pawls (10 and 11) with light oil after checking to see if they are free in holes in pawl carrier (9). Install pawl springs (12) and pawls in pawl carrier so notches in end of pawls face inward or toward each other.

Install pawl carrier with pawls over end of shifter shaft with lug on pawl carrier inserted between ends of pawl carrier springs.

Lubricate back of pawl carrier with "Grease-All" grease and install cover gasket (8) and cover (7) so notches at top line up with corresponding notch on adapter plate. Apply Harley-Davidson "Stud N' Bearing Mount," Part No. 99626-77 to threads of shorter screw (5) and insert through bottom hole. Secure with nut (6) on back of adapter plate. Apply Lock N' Seal and tighten all screws to 20 to 24 in-lbs torque.

Position dust shield (3) over dowel pins on pawl carrier. Position shift shaft lever (2) over dowel pins and secure with three shift shaft lever screws (1). Also treat the threads of these screws with Loctite sealant before inserting.

REPLACING SHIFTER COVER

Before replacing shifter cover, check shifter fork spacing as described under "Assembling Shifter Forks."

Coat shifter cover gasket with gasket sealer and position on gear box. Install assembled shifter cover over gear box opening and secure with twelve screws. Note that two screws are longer. They are inserted in holes adjacent to bulge in cover over shifter gear. The short cover screw with vent hole is inserted in hole nearest locating dowel pin on right side of transmission case.

SHIFTER COVER — PLATE SHIFTER LATE 1979 AND LATER

REMOVING SHIFTER COVER (Figure 4-15A)

Remove transmission from chassis as described in STRIPPING MOTORCYCLE FOR TRANSMISSION REPAIR.

Remove five bolts (1) and washers (2). The shifter cover (3) is registered on two dowel pins. Lift the shifter cover off and remove gasket (4).

The bolt located in the left-side rear mounting hole (see arrow) can only be loosened to remove the top cover (3). To remove bolt from cover, it is necessary to remove the shifter shaft cover (11).

DISASSEMBLING SHIFTER COVER (Figure 4-15)

Remove the neutral indicator switch (5) and washer (6). Remove bolts (7), lockwasher (8), bolt (9) and washers (10). Shifter shaft cover (11) and gasket (12) may now be removed. If shifter shaft (13) or oil seal (14) is damaged or worn, remove nut (15) and washer (16) to remove shifter shaft (13).

Remove plug (17) by drilling a 1/4 inch hole through the center of it and prying it out. Discard the old plug (17). A new plug must be installed during reassembly.

Bend tabs on lock plate (18) down and remove bolts (19). Lift out plunger body (20), plunger (21) and spring (22) as an assembly. Remove retaining ring (23) and thrust washer (24). Turn shifter cover over and pull shifter cam (25) straight out. Remove the pawl carrier (26) assembly.

Remove spring (27), retaining ring (28), pawls (29) and spacers (30). Remove the pawl carrier springs (31). The shifter pawl stops (32,33) are secured to the cover with socket head screws (34).

CLEANING, INSPECTION AND REPAIR (Figure 4-15)

Clean all parts except gaskets in solvent.

Inspect all parts for cracks, bent parts and any wear that would impair their function. If the holes in any pivoting parts are elongated, replace the part. Inspect all springs. Compare them to new parts if possible and replace any that appear weak or worn.

Inspect the neutral indicator switch (5). Depress the plunger and release it. Plunger should spring back. If the plunger sticks or binds, replace the switch.

ASSEMBLING SHIFTER COVER (Figure 4-15)

Assembly is the reverse of disassembly with the following exceptions:

Lubricate springs (31) with grease. Lubricate internal parts with motor oil. Before installing plug (17), run a bead of Seal All sealant around the lip. Secure the plug in place by striking it sharply in the center with a ball peen hammer.

NOTE

Before installing shifter shaft cover (11), insert bolt into mounting hole with arrow or it will be impossible to install the bolt later on in the assembly procedure.

SHIFTER FORKS

NOTE:

The disassembly and assembly procedure is the same for early and late style transmissions. However, on late 1979 and later transmissions, the shifter fork assemblies are reversed on the shifter shaft, that is, the side with the nuts (5) face the center of the shaft. See Figure 4-16.

REMOVING SHIFTER FORKS (Figure 4-16)

Remove shifter cover and transmission side cover as described in "Removing Shifter Cover."

Shifter fork shaft (2) is held in position by lock ring (1). With lock ring (1) removed, shaft may be driven out by means of a drift inserted in hole in starter cover joint face transmission case. Notice that a rubber oil seal (3) is assembled in groove next to lock ring.

Mainshaft and countershaft shifter fork assemblies are not interchangeable. Note exactly the arrangement of parts and components in each. Keep parts separate to avoid needless adjusting when reassembling. If inspection shows fork assemblies are not damaged, worn or bent, it may not be necessary to disassemble them unless shifter clutches are replaced. Adjustments are described in "Assembling Shifter Forks."

DISASSEMBLING SHIFTER FORKS (Figure 4-16)

If it is necessary to disassemble shifter forks, lift off shifter finger rollers (4), pry back ear on lockwasher (6) and turn off nut (5). Lift shifter fork (7, 8) and variable number of spacing shims (9) off shifter finger (10).

CLEANING, INSPECTION AND REPAIR

Clean all parts in cleaning solvent and blow dry with compressed air.

If shifter forks are bent or worn, replace them. Straightened forks are weak. They may break and cause extensive damage to transmission parts.

Check fit of shifter fingers on shaft. If they are loose enough to give fork action lash, replace them. Check replacement part fit on shaft.

Lap out shifter fingers if they bind. Shifting will be difficult unless fingers work freely on shaft.

ASSEMBLING SHIFTER FORKS

Assemble shifter forks in reverse of disassembly order making sure parts are not transposed. Tighten nuts (5) to 25 ft-lbs torque.

Bend top tab of lockwasher down against flat on nut so lockwasher tab does not interfere with shifter cam.

Place shifter forks in transmission case and install shifter fork shaft. Fork with narrow opening is for high gear shifter clutch.

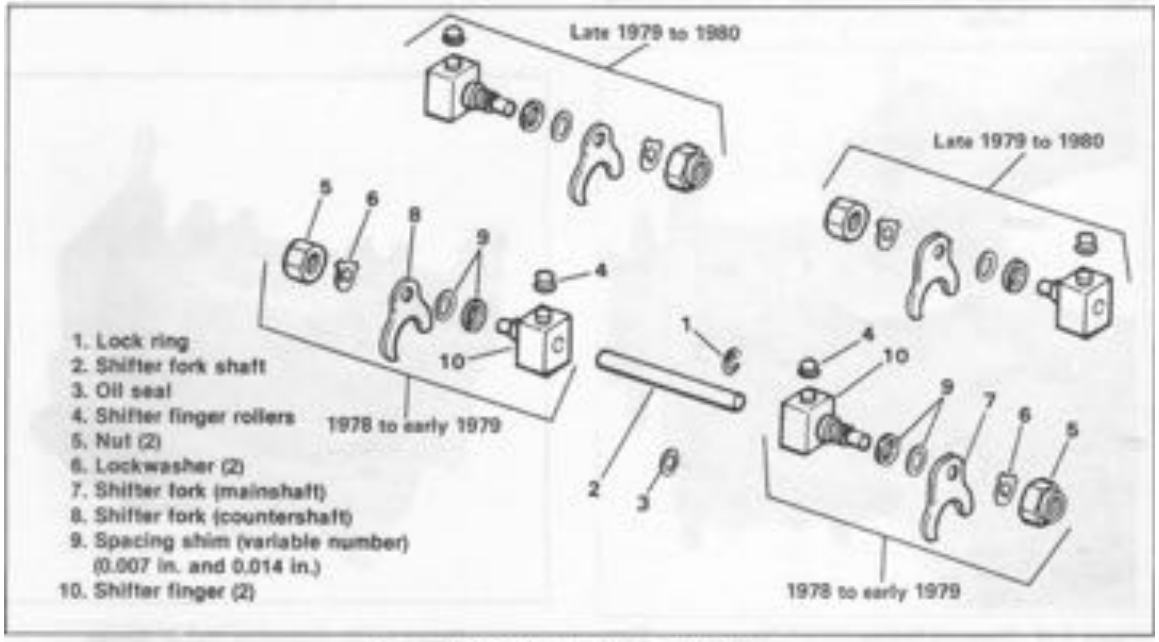


Figure 4-16. Shifter Fork – Exploded View

SETTING GAUGE — EARLY 1979 AND EARLIER

With shifter cam in neutral, check adjustment of shifter forks with Fork Shifter Gauge, Part No. 96384-39, by placing shifter gauge on shifter cover as shown in Figure 4-17. With the 3/8 in. gauge rod furnished, set tool gauge block in exact alignment with straight section of one cam slot in shifter cam. Lock gauge block in place with thumb screw. Rotate shifter cam and repeat for other cam slot.

Remove tool from cover, turn it over, and place it on transmission case with shifter fingers engaged in slots on gauge blocks as shown in figure 4-18. Be sure shifter finger rollers are in place on shifter fingers.

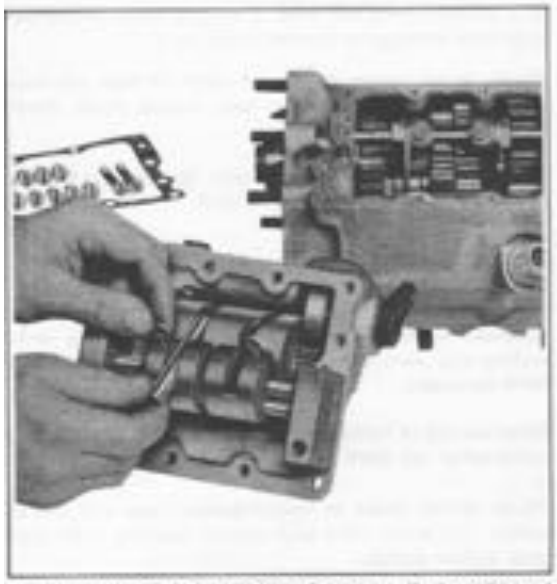


Figure 4-17. Adjusting Shifter Gauge — Early 1979 and Earlier

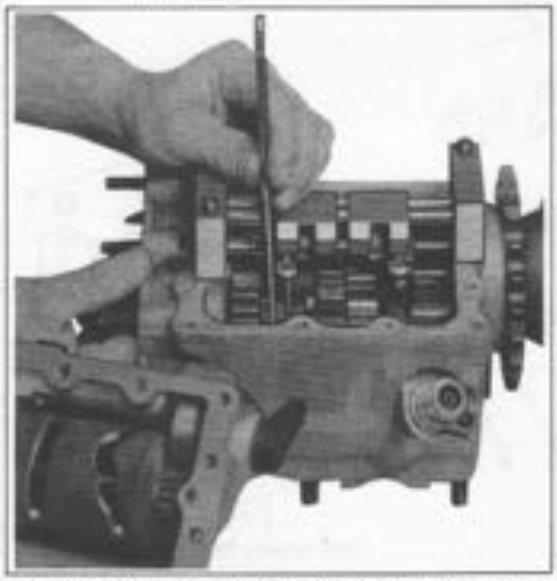


Figure 4-18. Checking Shifter Clutch Clearance — Early 1979 and Earlier

SETTING GAUGE — LATE 1979 AND LATER

See Figures 4-18A and 4-18B. With shifter cam in neutral, check adjustment of shifter forks with Fork Shifter Gauge, Part No. 96385-78 as follows:

Place tool on cover, adjusting sliding blocks of tool so that the hubs enter cam slots in shifter plate. Tighten lock screws.

See Figure 4-18C. Remove tool from cover, turn it over, and place it on the transmission case with shifter fingers engaged in slots of sliding blocks. With suitable thickness gauges, check the clearance of shifting members.

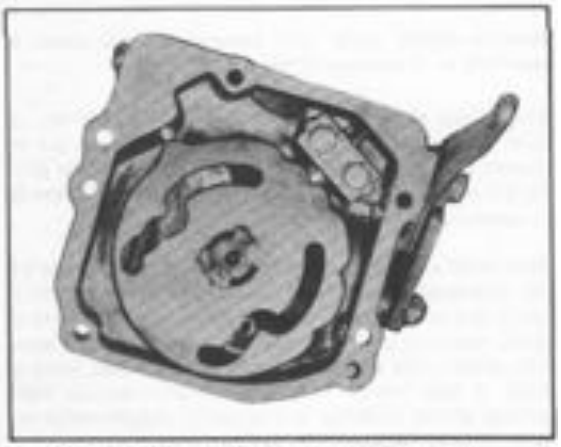


Figure 4-18A. Shifter Cam in Neutral Position — Late 1979 and Later

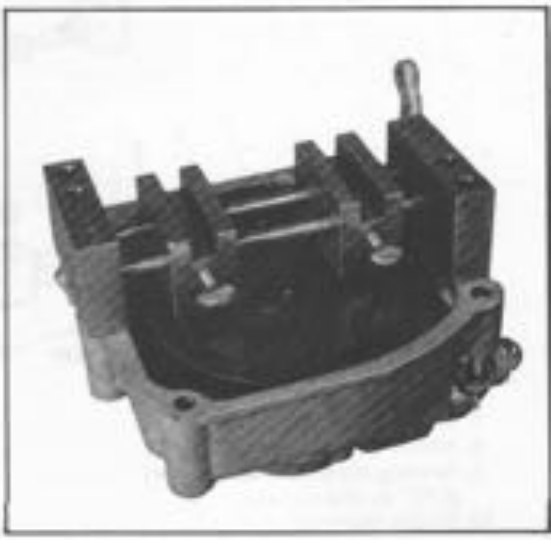


Figure 4-18B. Adjusting Shifter Gauge — Late 1979 and Later

Figure 4-18C. Check Shifter Clutch Clearance — Late 1979 and Later

CHECKING FORK ADJUSTMENT

With thickness gauges, check clearance on both sides of shifting clutches. All shifting clutches must be centered.

Clearances between shifter clutch and gear for all models are as follows:

Countershaft low and second gear: When centered between gears to have 0.080 to 0.090 in. clearance on both sides.

Mainshaft third and high gear: When centered between gears to have 0.100 to 0.110 in. clearance on both sides.

Where shifter clutch engagement is with dogs protruding from face of gear, turn gear so dogs on shifter clutch and dogs on gear are overlapping each other about 1/8 in. before checking clearance.

When clearances are not equal and correct, fork assemblies must be corrected by increasing or decreasing the number of shims between shifter fork and shifter finger. To make this adjustment, remove shifter fork assemblies from transmission. Shims are available in 0.007" and 0.014" thick.

After taking out or adding shims, be sure fork assembly locknut is tightened to 25 ft-lbs torque. Excessive tightening may close up shifter finger so it is no longer a free sliding fit on shaft. Bend top tab on lockwasher down against flats on nut so lockwasher tab does not interfere with shifter cam.

TRANSMISSION CASE

DISASSEMBLING

Remove transmission from chassis as described in "Stripping Motorcycle for Transmission Repair."

Remove shifter cover. Slide shifter forks together so that two gears engage, locking transmission. Remove kick starter clutch as described under "Kick Starter." If main drive gear is to be removed from transmission, remove rear chain sprocket nut (left hand thread) and sprocket while transmission is locked. Remove shifter forks as described under "Removing Shifter Forks."

DISASSEMBLING COUNTERSHAFT (Figure 4-19)

For 1978-1979 models bend tabs on lockwasher (2) flat. Remove countershaft nut (1), lockwasher (2), and lock plate (3). On 1980 models, remove retaining plate (3A). Tap countershaft (4, 4A) out just far enough so that countershaft washer (8) may be lifted out with a piece of stiff wire shaped like a hook. Push countershaft the rest of the way out. Remove countershaft gear cluster. Slide low gear (7), bearing washer (9) and shifter clutch (10) off countershaft gear (15). Remove retaining ring (11), washer (13) and gear (13).

On FL models, remove speedometer drive housing screw (16) and washer (17) and lift out speedometer drive unit (18) and gasket (19) from gear case.

DISASSEMBLING MAINSHAFT (Figure 4-20)

Remove the four bearing housing retaining plate screws (1), oil deflector (2) and retaining plate (3, 3A).

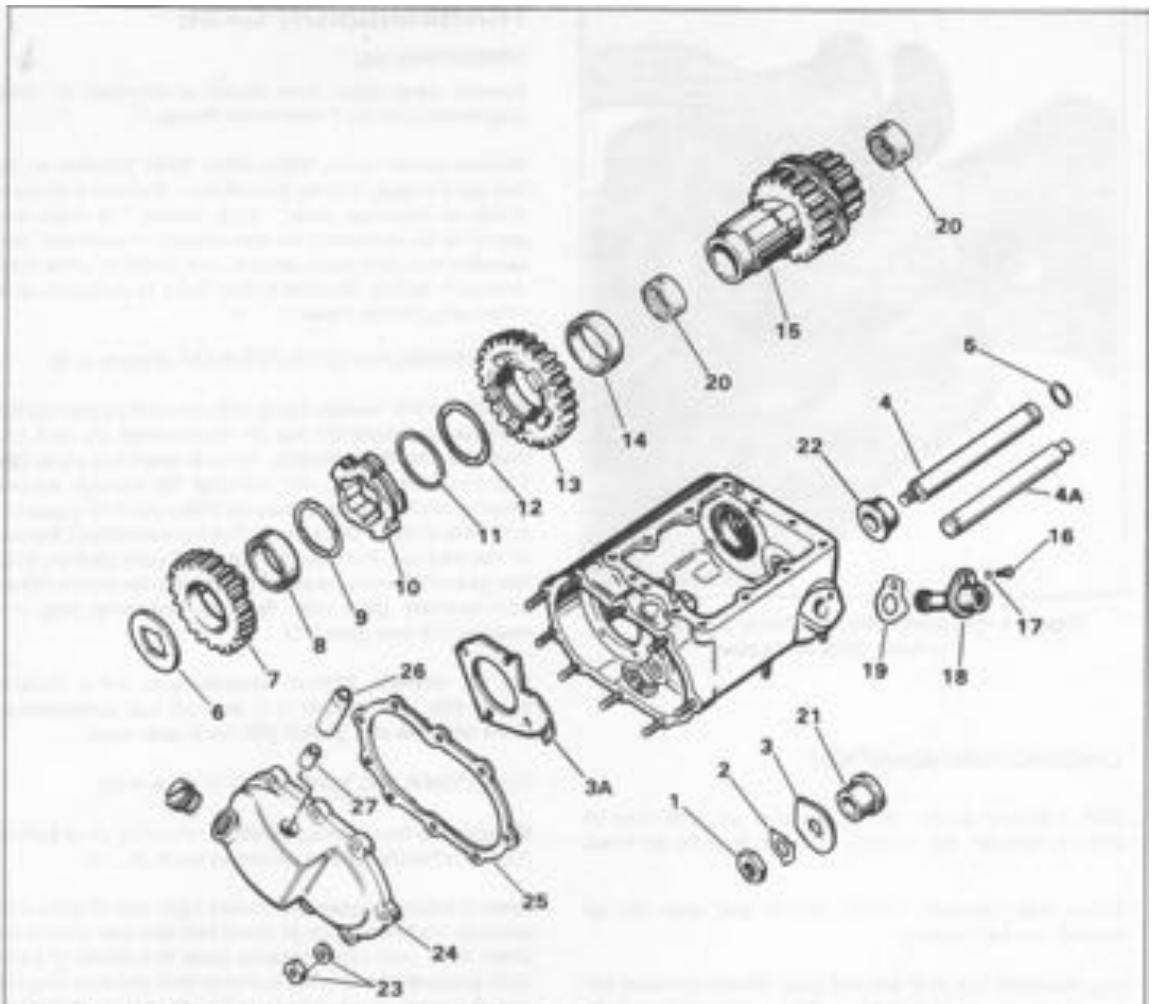
Drive mainshaft assembly toward right side of case with rawhide mallet or block of wood and hammer until mainshaft third gear (10) contacts boss in bottom of case. With screwdriver or other suitable tool, pry lock ring (12) out of groove in mainshaft and slide it onto mainshaft splines. Drive mainshaft assembly (9) and bearing race (7) out right side of case, slipping third gear (10), retaining washer (11), lock ring (12) and shifter clutch (13) off left end of mainshaft and out through shifter cover opening in case.

Disassemble the mainshaft gear (8) and ball bearing (6) assembly only if inspection shows a need for replacing worn or damaged parts.

Clamp mainshaft in copper-faced vise jaws. Bend ear of lockwasher (5) away from flat of nut (4) and remove nut and washer. Bearing (6) and gear (8) may then be removed with the All Purpose Claw Puller, Part No. 95635-46 or an arbor press. If using claw puller, insert Center Adapter, Part No. 95636-46 into end of shaft to prevent damage to shaft. Bearing and gear are removed separately.

DISASSEMBLING MAIN DRIVE GEAR (Figure 4-21)

When removing main drive gear with transmission assembled, lock transmission by engaging two gears at



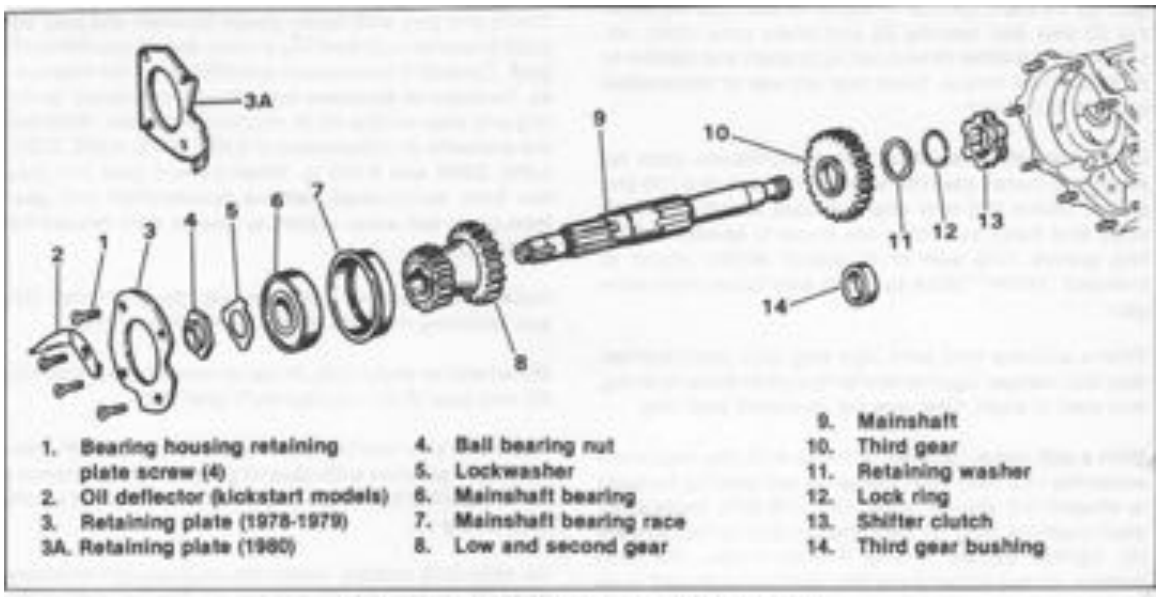
1. Countershaft nut (1978-1979)
2. Lockwasher (1978-1979)
3. Retaining plate (1978-1979)
3A. Retaining plate (1980)
4. Countershaft (1978-1979)
4A. Countershaft (1980)
5. O-ring
6. End play washer (variable)
7. Low gear
8. Low gear bushing
9. Low gear bushing washer
10. Shifter clutch
11. Retaining ring
12. Gear retaining washer
13. Countershaft second gear
14. Second gear bushing
15. Countershaft gear
16. Speedometer drive housing screw (FL models)
17. Washer (FL models)
18. Speedometer drive unit (FL models)
19. Drive unit gasket (FL models)
20. Needle bearing (2)
21. Countershaft mounting collar (starter side)
22. Countershaft mounting collar (starter side)
23. Side cover nut and washer (9)
24. Side cover
25. Side cover gasket
26. Side cover upper bushing
27. Side cover lower bushing

Figure 4-19. Countershaft and Case Assembly – Exploded View

once, then bend ear of lockwasher away from nut. Remove the nut (nut is left-hand thread) using Sprocket Nut Wrench, Part No. 94660-37.

When removing main drive gear with the transmission already disassembled, position transmission case in a vise. Position the chain on sprocket teeth and nail each end of the chain to the bench to prevent sprocket from turning.

Bend ear of lockwasher away from flat of nut and remove sprocket locknut (1) and washer (2) with Sprocket Locknut Wrench, Part No. 94660-37.



1. Bearing housing retaining plate screw (4)
2. Oil deflector (kickstart models)
3. Retaining plate (1978-1979)
3A. Retaining plate (1980)
4. Ball bearing nut
5. Lockwasher
6. Mainshaft bearing
7. Mainshaft bearing race
8. Low and second gear
9. Mainshaft
10. Third gear
11. Retaining washer
12. Lock ring
13. Shifter clutch
14. Third gear bushing

Figure 4-20. Mainshaft Assembly -- Exploded View

Remove sprocket (3) from gear. Push main drive gear (4) into case and withdraw it from top.

Remove main drive gear oil seal (7) and main drive gear spacer (8).

CLEANING, INSPECTION AND REPAIR

Clean all parts except gaskets (all gaskets should be replaced) with cleaning solvent and blow dry with compressed air.

Inspect all gears. If teeth are pitted, scored, cracked, chipped or if case hardening is worn through, replace with new gears. Replace sprocket if worn.

Inspect all bushings, bearings and shafts. If bent or worn, install new parts. If mainshaft ball bearing (6, figure 4-20) is worn to point where play is obviously too great, install new bearing.

If main drive gear (4, Figure 4-21) fit is excessively loose on mainshaft, replace bushing (10) and ream to 1.002 to 1.003 in. diameter to provide specified fit on mainshaft using a 1 inch dia. expansion reamer (See TRANSMISSION SPECIFICATIONS).

Oil seals (5 and 7) should not be reinstalled if they have been removed. An oil leak will probably develop. Use new parts.

Press new mainshaft seal (5) into drive gear recess, use a piece of 1 in. diameter thinwall tubing using mainshaft as a pilot. Before installing, apply a coat of Harley-Davidson "Retaining Compound," Part No. 99628-79, in recess to prevent any oil leakage.

Carefully check shifter clutches (10, Figure 4-19 and 13, Figure 4-20) and engaging dogs on gears. If they are rounded or battered appearing, they must be replaced.

Worn shifter clutch and gear dogs result from shifting abuses or from out-of-adjustment clutch that does not release fully. Damaged engaging dogs try to creep out of engagement under a steady load. This creeping action develops great side pressure that results in damage to shifting mechanism and all thrust points along shaft assemblies.

Check bearings (6, Figure 4-21, 6, Figure 4-20 and 20, Figure 4-19).

ASSEMBLING MAIN DRIVE GEAR

See Figure 4-21. Press needle bearing (6) into case using a suitable drift. Press on lettered side of bearing only. Press flush with outside of case. Install main drive gear (4) from inside case. Coat rollers lightly with grease. Install main drive gear spacer (8) in oil seal (7) and press in oil seal flush with case. Sprocket (3) may be assembled after mainshaft and countershaft are installed. 1978-1979 sprockets have a recess on one side which is installed towards the transmission case. 1980 sprockets are flat on both sides and can be installed either way.

ASSEMBLING MAINSHAFT

See Figure 4-20. Assemble parts 4 through 8 to mainshaft before installing mainshaft in gear case. Position

gear (8) on shaft splines. Press or hit ball bearing housing (7) over ball bearing (6) and press onto shaft. Assemble lockwasher (5) and nut (4) to shaft and tighten to 50 to 60 ft-lbs torque. Bend over one ear of lockwasher against flat of nut.

Insert mainshaft assembly into transmission case far enough to install gear (10) washer (11), lock ring (12) and shifter clutch (13) over shaft. Always install new lock rings and make sure they are properly seated in lock ring groove. One side of mainshaft shifter clutch is stamped "HIGH." Make sure this side faces main drive gear.

With a suitable tool, work lock ring onto shaft splines. Use tool wedged against shifter clutch to force lock ring into seat in shaft. Use care not to distort lock ring.

With a soft metal hammer or brass drift, tap mainshaft assembly into case until flange on ball bearing housing is shouldered against case. On 1978-1979 models, install retaining plate (3), oil deflector (2) and four screws (1). Tighten screws to 6 to 9 ft-lbs torque. On 1980 models, do not install plate (3A) until countershaft is installed.

ASSEMBLING COUNTERSHAFT (Figure 4-19)

Before installing countershaft gear train to shaft and case, it is necessary to check bearing fit and shaft end play.

If countershaft mounting collars (21 and 22) were removed for replacement, press or drive old parts out and new parts in after gear case has been heated to approximately 300 degrees to expand case and facilitate pressing.

Install needle bearings (20) in countershaft gear (15). Coat bearing rollers with grease.

Install countershaft gear in case holding end play adjusting washer (6) in place with daub of heavy grease. Install countershaft.

Check end play with feeler gauge between end play adjusting washer and bushing in case end of countershaft gear. Consult transmission specifications for tolerances. Increase or decrease end play as necessary by fitting end play washer (6) of required thickness. Washers are available in thicknesses of 0.074, 0.078, 0.082, 0.085, 0.090, 0.095 and 0.100 in. When correct gear end play has been established, remove countershaft and gear from case. Set aside adjusting washer until needed for assembly.

Install gear bushing (14), gear (13), thrust washer (12) and retaining ring (11) on countershaft gear (15).

Install shifter clutch (10), thrust washer (9), gear bushing (8), and gear (7) on countershaft gear (15).

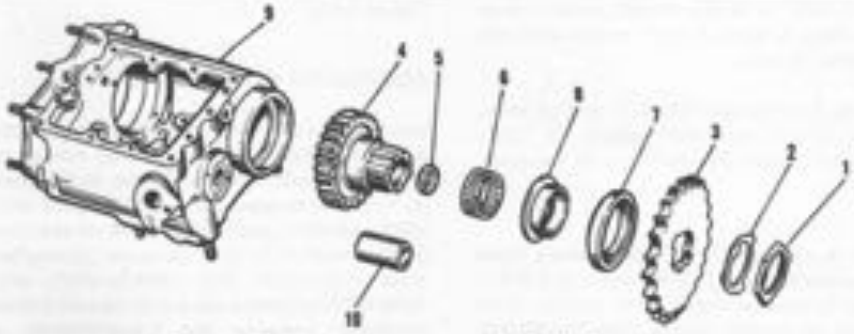
Place end play washer (6) on end of countershaft gear, holding in position with daub of grease. Position assembly in transmission case and insert countershaft (4, 4A) with O-ring (5).

On 1978-1979 models, install the countershaft retaining plate (3), lockwasher (2) and nut (1). The flat side of the retaining plate should fit against the mainshaft bearing retaining plate (3, Figure 4-20). Tighten the nut to 55-60 ft-lbs torque and bend one ear of lockwasher against nut flat.

On 1980 models, install the mainshaft bearing retaining plate (3A) so the ear fits into groove on end of countershaft. Secure the plate with the four screws.

On FL models, install gasket (19), drive unit (18), washer (17) and screw (16).

Install shifter forks as described under "Assembling Shifter Forks" and check spacing. Slide shifter forks together to lock transmission and install sprocket (if not on) lockwasher and nut. Tighten nut to 140 to 150 ft-lbs torque and bend tab on lockwasher against flat on nut. Install starter clutch and check shifter spacing. Install



1. Sprocket locknut
2. Sprocket lockwasher
3. Chain sprocket
4. Main drive gear
5. Main drive gear shaft seal
6. Needle bearing
7. Main drive gear oil seal
8. Main drive gear spacer
9. Transmission case
10. Main drive gear bushing

Figure 4-21. Main Drive Gear – Exploded View

side cover and shifter cover. Install all above items as described in pertinent sections.

Assemble transmission to motorcycle and connect control in reverse order of stripping procedure described in "Stripping Motorcycle for Transmission Repair."

to Remove chain sprocket
(left hand thread) (towards rear wheel.)

3/8 Ream for 79 heads for guides

Wires on Handle Bar.

Engine kit
white
yellow

Brown/white
Black Horn

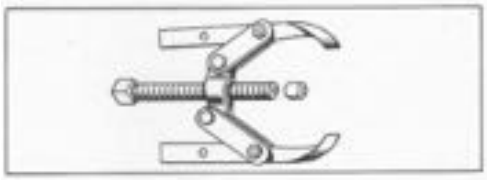
TOOLS

94635-41 Mainshaft Ball Bearing Lock Nut Wrench

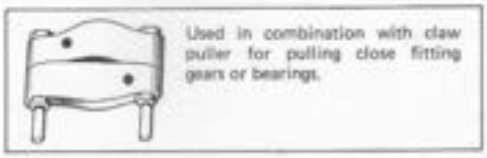
94645-41 Clutch Hub Nut Wrench

94660-37 Countershaft Sprocket Lock Nut Wrench

96385-78 Fork Shifter Gauge

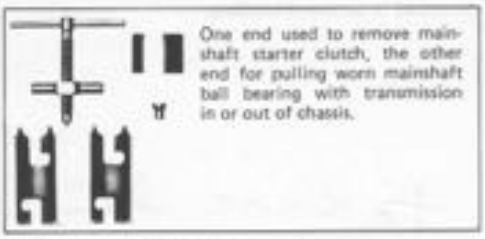


96635-46 All Purpose Claw Puller



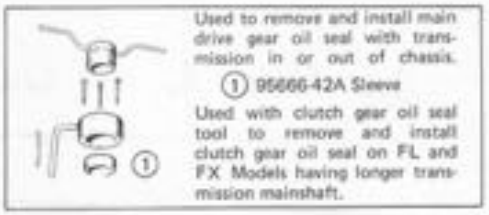
Used in combination with claw puller for pulling close fitting gears or bearings.

95637-46 Wedge Attachment for Claw Puller



One end used to remove mainshaft starter clutch, the other end for pulling worn mainshaft ball bearing with transmission in or out of chassis.

95650-42 Transmission
Mainshaft Starter Clutch and Bearing Puller

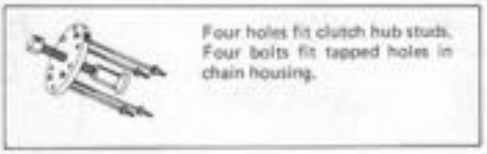


Used to remove and install main drive gear oil seal with transmission in or out of chassis.

① 95666-42A Sleeve

Used with clutch gear oil seal tool to remove and install clutch gear oil seal on FL and FX Models having longer transmission mainshaft.

95660-42 Main Drive Gear Oil Seal Tool

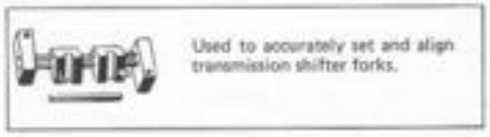


Four holes fit clutch hub studs. Four bolts fit tapped holes in chain housing.

95960-41A Clutch Hub and Chain Housing Puller

Special pliers for removing and replacing lock ring.

96216-49 Internal Lock Ring Pliers



Used to accurately set and align transmission shifter forks.

96384-39 Fork Shifter Gage

ELECTRICAL 5

TABLE OF CONTENTS

GENERAL

SPECIFICATIONS

Spark timing	35° BTC fully advanced 3° BTC fully retarded
Ignition timer air gap	
1979 and earlier	0.004 to 0.006 in.
1980 and later	not applicable
Spark plugs	
Size	14 mm
Gap	0.038 to 0.043 in.
Type	
1979 and earlier	Harley-Davidson No. 5A6A (Standard) Harley-Davidson No. 5R6A (Resistor type)
1980 and later	Harley-Davidson No. 5R6A

Note: Harley-Davidson No. 5A6 plug may be used in place of a No. 5A6A plug and a 5R6 plug can be used in place of a 5R6A plug if regapped to 0.038 to 0.043 in.

Battery	
FL/FLH	12 volt, 32 amp. hr.
FX	12 volt, 7.5 amp. hr.
FXE/FXEF/FXS	12 volt, 19 amp. hr.
Starter	
FL/FLH/FXE/FXEF/FXS	Electric, 12 volt Bendix drive
FX	Manual
Rectifier-regulator	Voltage control with ambient compensation
Alternator	Integral permanent magnet design – 225 watts
Horn	Electric vibrating
Lights	
Headlight (sealed beam)	
FL	50W lower, 60W upper
FX	35W lower, 45W upper
Stoplight	32 C.P.
Tail light	4 C.P.

WIRING

1978½-79 FL/FLH — WIRING DIAGRAM KEY

1. Front terminal board (terminals 1 to 11)
2. Switch (terminals 1 to 6)
3. Regulator-rectifier module
4. Alternator to module connector plug
5. Alternator stator
6. Tail and stoplight
7. Battery positive terminal
8. Battery negative terminal
9. Oil pressure signal switch
10. Headlamp beam switch
11. Horn switch
12. Ignition timer
13. Stoplight switch – rear
14. Starter solenoid
15. Starter motor
16. Ignition coil
17. Rear wiring harness connector
18. Speedometer light
19. Headlamp
20. Neutral indicator light
21. Neutral switch
22. Starter button
23. Oil signal light
24. Horn
25. High beam indicator lamp
26. Engine stop switch
27. Starter relay
28. Right turn signal switch
29. Turn signal flasher
30. Left front turn signal lamp
31. Right front turn signal lamp
32. Left rear turn signal lamp
33. Right rear turn signal lamp
34. Left turn signal pilot lamp
35. Right turn signal pilot lamp
36. Stoplight switch – front
37. Connector (11)
38. Terminal board mounting sc
39. Transmission stud
40. Frame lug bolt
41. Right handlebar harness
42. Left handlebar harness
43. Left turn signal switch
44. Lighting circuit breaker
45. Ignition circuit breaker
46. Accessories circuit breaker
47. Main circuit breaker
48. Emergency flasher
49. Emergency flasher switch
50. Handlebar clamp bolt

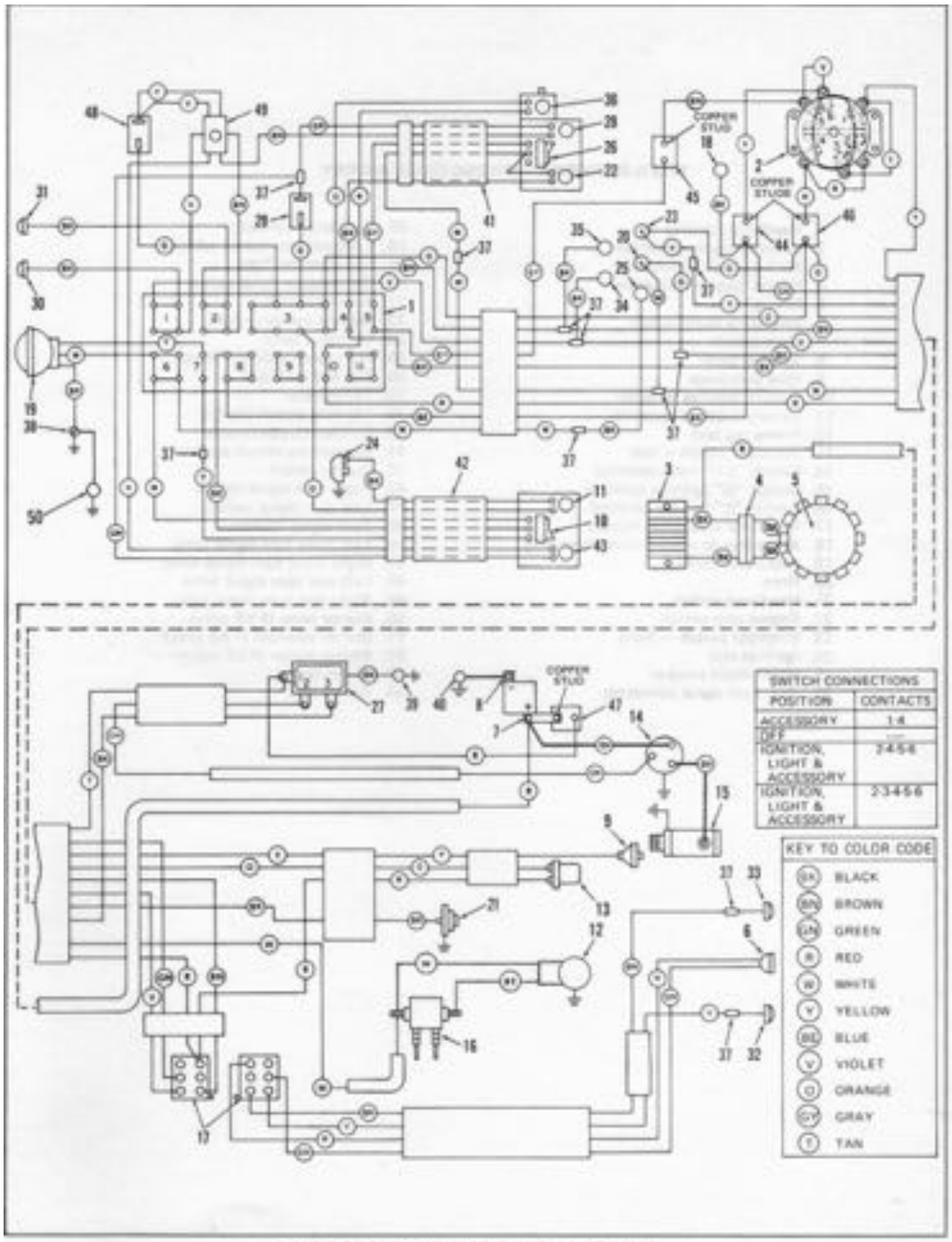


Figure 5-1. 1978½-79 FL/FLH Wiring Diagram

1978½-79 FX/FXE – WIRING DIAGRAM KEY

1. Headlamp housing
2. Socket-plug combination
3. Socket-plug combination
4. Socket-plug combination
5. Wiring harness
6. Headlamp beam switch
7. Horn switch
8. Ignition timer
9. Wire connector
10. Battery positive terminal
11. Battery negative terminal
12. Frame lug bolt
13. Stoplight switch – rear
14. Switch "ST" lights terminal
15. Switch "G" ignition terminal
16. Switch "B" battery terminal
17. Regulator – rectifier module
18. Alternator to module connector plug
19. Alternator stator
20. Horn
21. Headlamp socket
22. Engine stop switch
23. Stoplight switch – front
24. Ignition coil
25. Main circuit breaker
26. Rear turn signal connector
27. Tail lamp connector
28. Long stud on starter solenoid
29. Speedometer light
30. Oil pressure signal switch
31. Neutral switch
32. Neutral indicator light
33. Oil signal lamp
34. High beam indicator lamp
35. Tail and stoplight
36. Tachometer
39. Lighting circuit breaker
40. Ignition circuit breaker
41. Accessories circuit breaker
42. Starter switch
43. Right turn signal switch
44. Left turn signal switch
45. Turn signal flasher
46. Left front turn signal lamp
47. Right front turn signal lamp
48. Left rear turn signal lamp
49. Right rear turn signal lamp
50. Starter relay (FXE only)
51. Starter solenoid (FXE only)
52. Starter motor (FXE only)
53. Violet tag
54. Brown tag

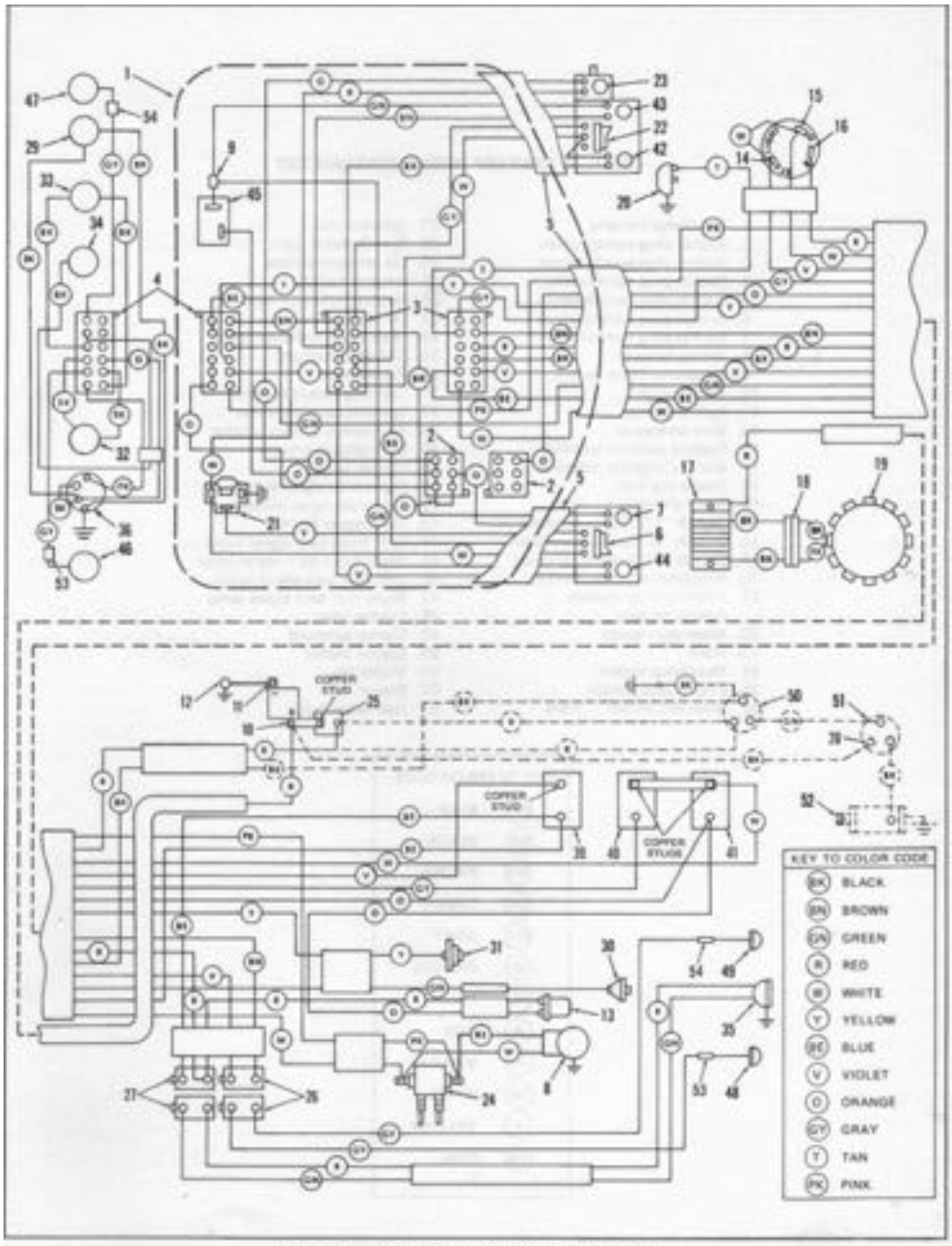


Figure 5-2. 1978½-79 FX/FXE Wiring Diagram

1978½-79 FXS/FXEF WIRING DIAGRAM KEY

1. Headlamp housing
2. Socket-plug combination
3. Socket-plug combination
4. Socket-plug combination
5. Socket-plug combination
6. Socket-plug combination
7. Socket-plug combination
8. Wiring harness
9. Headlamp beam switch
10. Horn switch
11. Ignition timer
12. Wire connector
13. Battery positive terminal
14. Battery negative terminal
15. Frame lug bolt
16. Stoplight switch – rear
17. Switch "ST" lights terminal
18. Switch "G" ignition terminal
19. Switch "B" battery terminal
20. Regulator-rectifier module
21. Alternator to module connector plug
22. Alternator stator
23. Horn
24. Headlamp socket
25. Engine stop switch
26. Stoplight switch – front
27. Ignition coil
28. Speedometer light
29. Oil pressure switch
30. Neutral switch
31. Neutral indicator lamp
32. Oil signal lamp
33. High beam indicator lamp
34. Tail and stoplight
35. Tachometer
36. Lighting circuit breaker
37. Ignition circuit breaker
38. Accessories circuit breaker
39. Main circuit breaker
40. Starter switch
41. Right turn signal switch
42. Left turn signal switch
43. Turn signal flasher
44. Left front turn signal lamp
45. Right front turn signal lamp
46. Left rear turn signal lamp
47. Right rear turn signal lamp
48. Starter relay
49. Starter solenoid
50. Starter motor
51. Violet tag
52. Brown tag
53. Handlebar bolt

KEY TO COLOR CODE	
BE	BLUE
BK	BLACK
BN	BROWN
GN	GREEN
GY	GRAY
O	ORANGE
PK	PINK
R	RED
V	VIOLET
W	WHITE
Y	YELLOW
TN	TAN

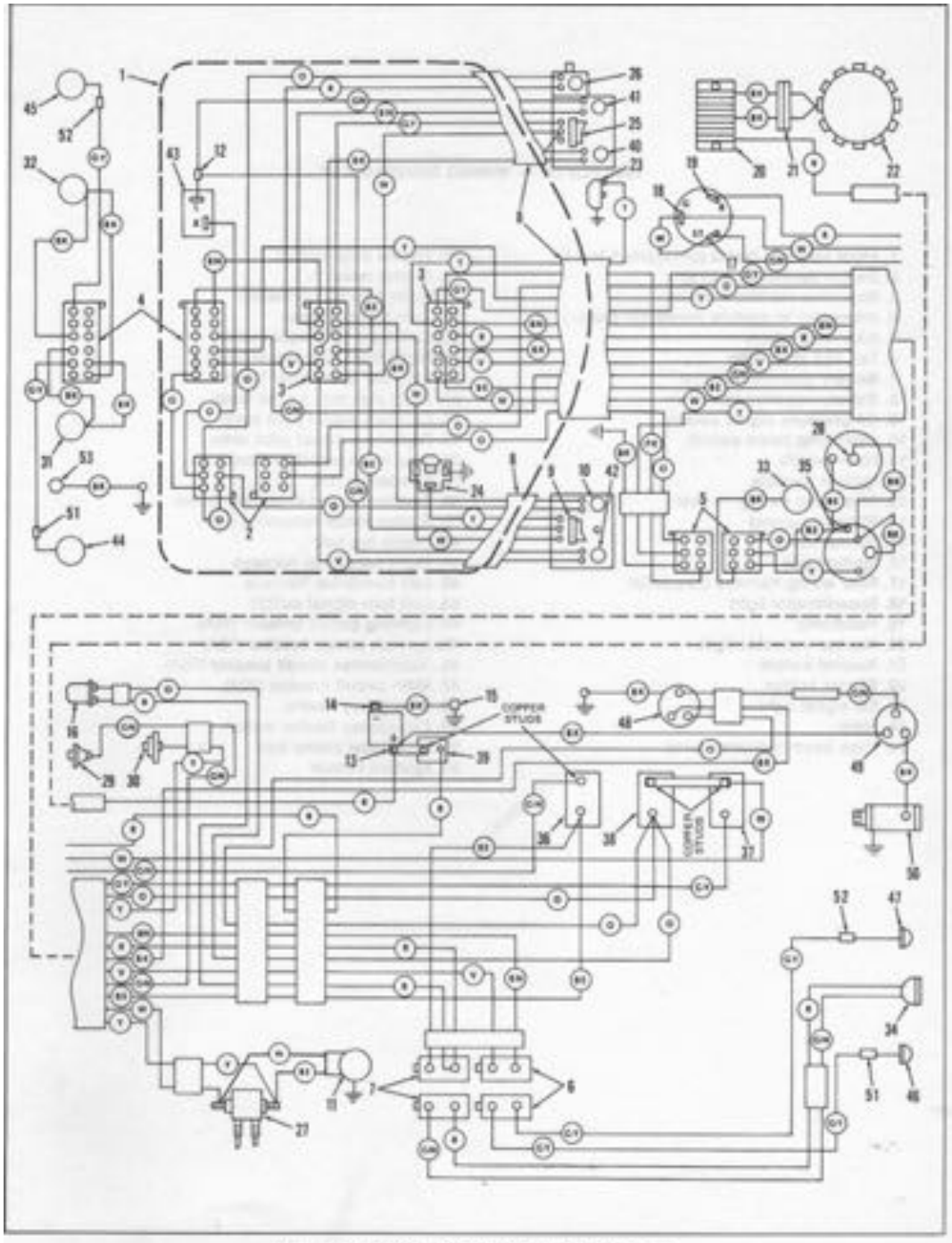


Figure 5-3. 1978½-79 FXS/FXEF Wiring Diagram

1980 FL/FLH — WIRING DIAGRAM KEY

1. Front terminal board (terminals 1 to 11)
2. Switch (terminals 1 to 6)
3. Regulator-rectifier module
4. Alternator to module connector plug
5. Alternator stator
6. Tail and stop lamp
7. Battery positive terminal
8. Battery negative terminal
9. Oil pressure signal switch
10. Headlamp beam switch
11. Horn switch
12. Ignition module
13. Stop lamp switch — rear
14. Starter solenoid
15. Starter motor
16. Ignition coil
17. Rear wiring harness connector
18. Speedometer light
19. Headlamp
20. Neutral indicator light
21. Neutral switch
22. Starter button
23. Oil signal light
24. Horn
25. High beam indicator lamp
26. Engine stop switch
27. Starter relay
28. Right turn signal switch
29. Turn signal flasher
30. Left front turn signal lamp
31. Right front turn signal lamp
32. Left rear turn signal lamp
33. Right rear turn signal lamp
34. Left turn signal pilot lamp
35. Right turn signal pilot lamp
36. Stop lamp switch — front
37. Connector (11)
38. Terminal board mounting screw
39. Starter motor mounting bolt
40. Frame lug bolt
41. Right handlebar harness
42. Left handlebar harness
43. Left turn signal switch
44. Lighting circuit breaker (15A)
45. Ignition circuit breaker (15A)
46. Accessories circuit breaker (15A)
47. Main circuit breaker (30A)
48. Emergency flasher
49. Emergency flasher switch
50. Handlebar clamp bolt
51. Ignition sensor

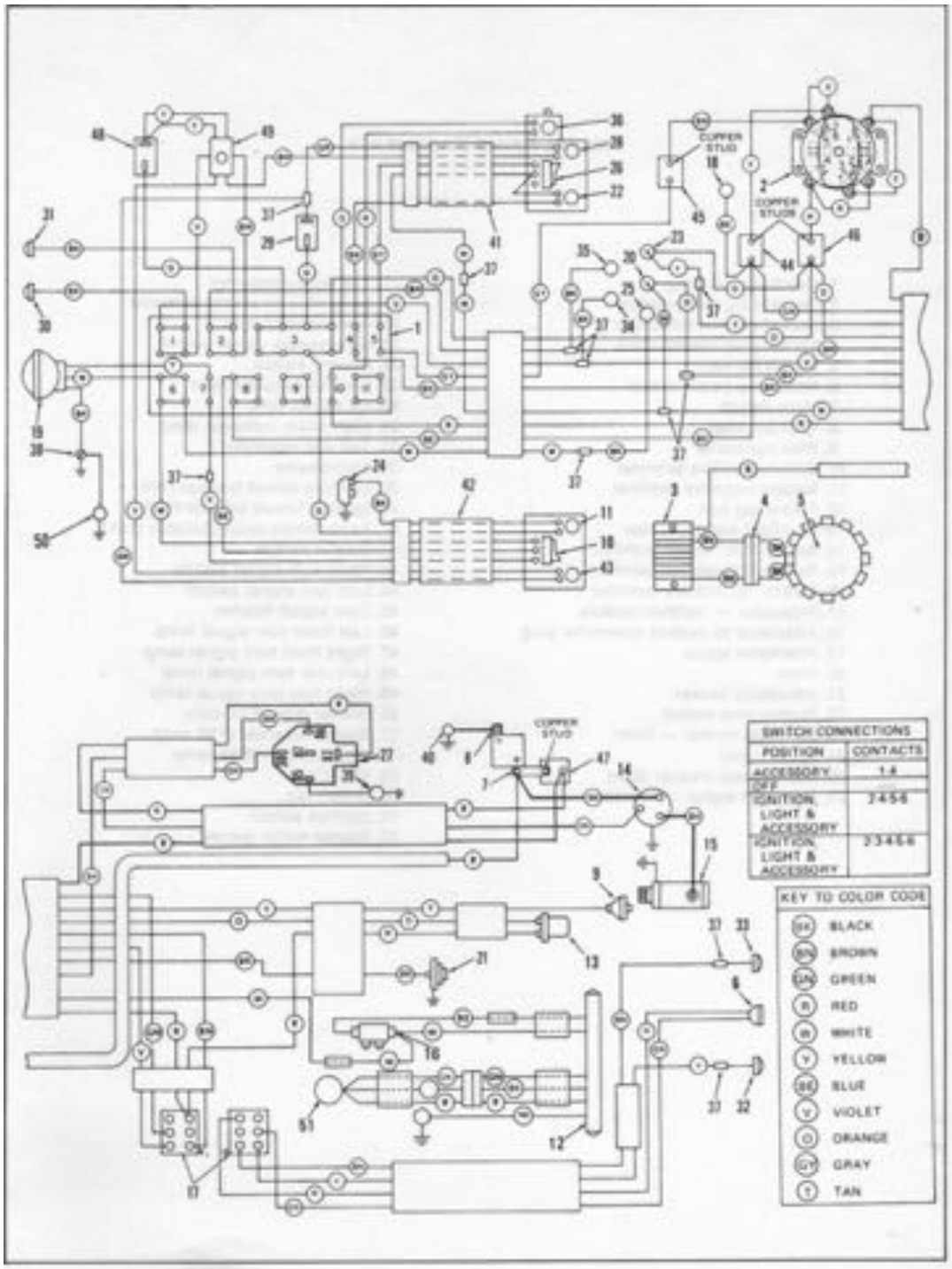


Figure 5-3A. 1980 FL/FLH Wiring Diagram

1980 FXE WIRING DIAGRAM KEY

1. Headlamp housing
2. Socket-plug combination
3. Socket-plug combination
4. Socket-plug combination
5. Wiring harness
6. Headlamp beam switch
7. Horn switch
8. Ignition timer
9. Wire connector
10. Battery positive terminal
11. Battery negative terminal
12. Frame lug bolt
13. Stoplight switch — rear
14. Switch "ST" lights terminal
15. Switch "G" ignition terminal
16. Switch "B" battery terminal
17. Regulator — rectifier module
18. Alternator to module connector plug
19. Alternator stator
20. Horn
21. Headlamp socket
22. Engine stop switch
23. Stoplight switch — front
24. Ignition coil
25. Main circuit breaker (30A)
26. Rear turn signal connector
27. Tail lamp connector
28. Long stud on starter solenoid
29. Speedometer light
30. Oil pressure signal switch
31. Neutral switch
32. Neutral indicator light
33. Oil signal lamp
34. High beam indicator lamp
35. Tail and stoplight
36. Tachometer
39. Lighting circuit breaker (15A)
40. Ignition circuit breaker (15A)
41. Accessories circuit breaker (15A)
42. Starter switch
43. Right turn signal switch
44. Left turn signal switch
45. Turn signal flasher
46. Left front turn signal lamp
47. Right front turn signal lamp
48. Left rear turn signal lamp
49. Right rear turn signal lamp
50. Starter relay (FXE only)
51. Starter solenoid (FXE only)
52. Starter motor (FXE only)
53. Violet tag
54. Brown tag
55. Ignition sensor
56. Starter motor ground

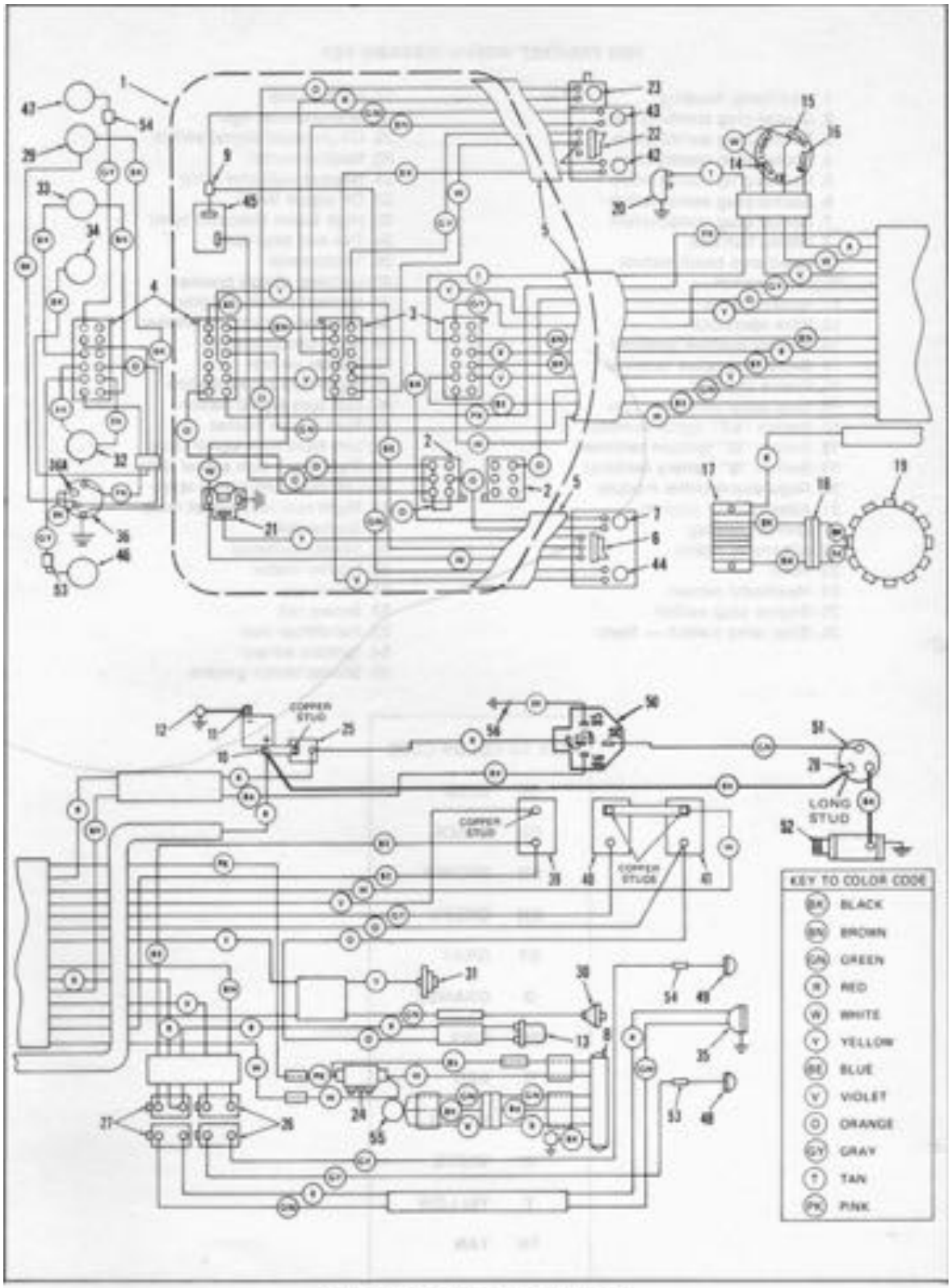


Figure 5-3B. 1980 FXE Wiring Diagram

1980 FXS/FXEF WIRING DIAGRAM KEY

1. Headlamp housing
2. Socket-plug combination
3. Socket-plug combination
4. Socket-plug combination
5. Socket-plug combination
6. Socket-plug combination
7. Socket-plug combination
8. Wiring harness
9. Headlamp beam switch
10. Horn switch
11. Ignition timer
12. Wire connector
13. Battery positive terminal
14. Battery negative terminal
15. Frame lug bolt
16. Stop lamp switch — rear
17. Switch "ST" lights terminal
18. Switch "G" ignition terminal
19. Switch "B" battery terminal
20. Regulator-rectifier module
21. Alternator to module connector plug
22. Alternator Stator
23. Horn
24. Headlamp socket
25. Engine stop switch
26. Stop lamp switch — front
27. Ignition coil
28. Speedometer light
29. Oil pressure signal switch
30. Neutral switch
31. Neutral indicator lamp
32. Oil signal lamp
33. High Beam indicator lamp
34. Tail and stop lamp
35. Tachometer
36. Lighting circuit breaker
37. Ignition circuit breaker
38. Accessories circuit breaker
39. Main circuit breaker
40. Starter switch
41. Right turn signal switch
42. Left turn signal switch
43. Turn signal flasher
44. Left front turn signal lamp
45. Right front turn signal lamp
46. Left rear turn signal lamp
47. Right rear turn signal lamp
48. Starter relay
49. Starter solenoid
50. Starter motor
51. Violet tag
52. Brown tag
53. Handlebar bolt
54. Ignition sensor
55. Starter motor ground

KEY TO COLOR CODE	
BE	BLUE
BK	BLACK
BN	BROWN
GN	GREEN
GY	GRAY
O	ORANGE
PK	PINK
R	RED
V	VIOLET
W	WHITE
Y	YELLOW
TN	TAN

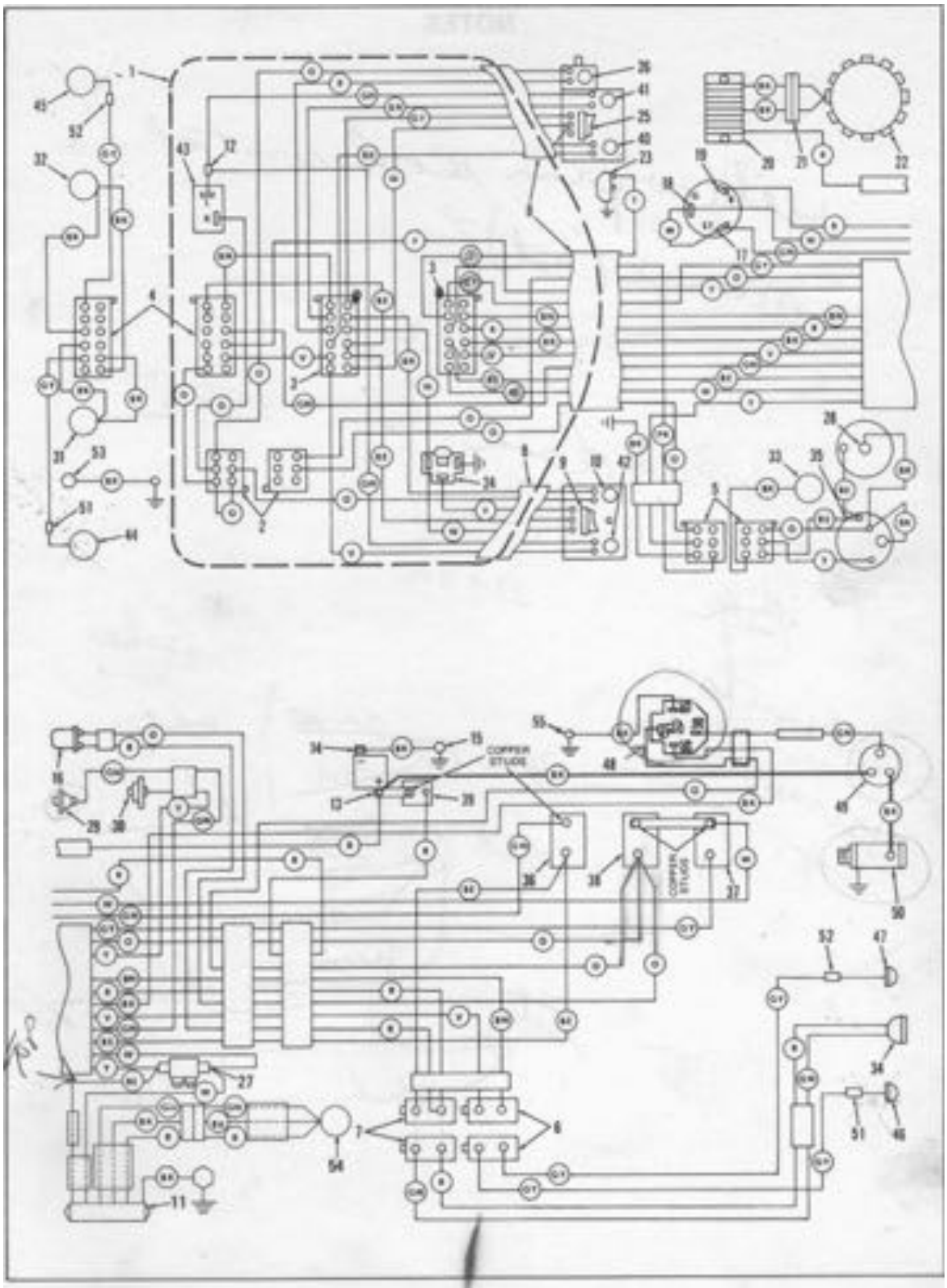


Figure 5-3C. 1980 FXS/FXEF Wiring Diagram

SWITCHES

IGNITION-LIGHT SWITCH

GENERAL

FL

The ignition-light switch is located on the instrument panel. Lift lock cover and use the key to lock or unlock. It is not necessary to keep the key inserted in the lock to operate this switch after it has been unlocked. The center position of the switch is the "OFF" position for both lights and ignition. The left (counterclockwise) of center position is for accessories only. There are two positions to the right (clockwise) of center position. For U.S.A. operation, both positions operate ignition and lights, with standard wiring. The switch can be locked only in the "OFF" and "ACCESSORIES" positions. The FL ignition switch may be disassembled for repair.

FX/FXE

The ignition-light switch is located below the gas tank on left side of motorcycle. From the "OFF" vertical position there are two positions to the right for ignition and lights. For U.S.A. operation, both positions operate ignition and lights, with standard wiring. Key can only be removed in the "OFF," locked position. The FX ignition switch is not repairable. It must be replaced if it is defective.

FXS/FXEF

The ignition switch is located at the rear of the oil tank, under the seat on the left side of the motorcycle. Operation is identical to the FX models.

DISASSEMBLING IGNITION–LIGHT SWITCH – FL

Remove instrument panel cover by prying out side-cover clip located at trip mileage set knob and turning out mounting base center screw located in the center of instrument panel below speedometer.

Disconnect all wires connected to switch terminals and remove four switch mounting screws.

See figure 5-4. All directions for disassembly apply with switch in an inverted position. Switch must be in "off" position and unlocked.

Grasp end of roller contact retainer with pliers and simultaneously move it upward and away from roller contact (1). Lift off roller contact and switch mounting plate assembly (2). Notice that this plate is positioned with the three-terminal side away from lock cover hinge.

Reinforcing plate (3) with contact bar holder (4) and roller contact retainer (5) can be removed from switch cover by slipping part assembly sideways until one set of tabs clears slot in switch cover, then lifting and sliding assembly the opposite direction to clear other tab.

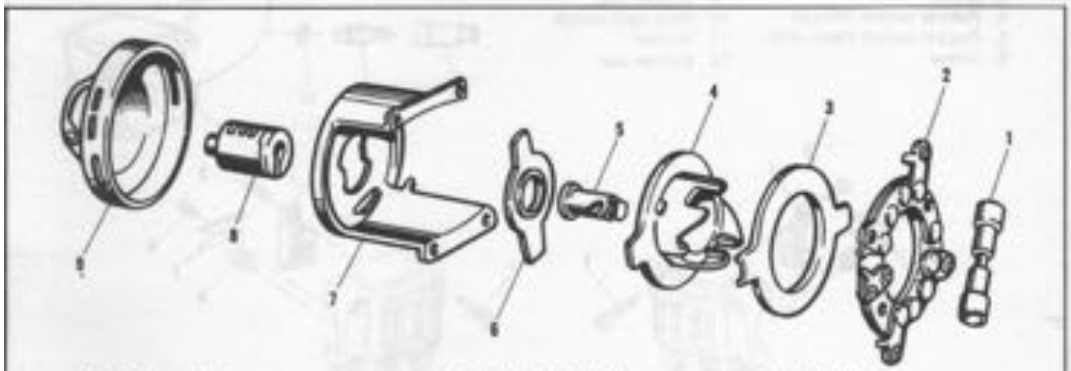
Switch base (7) and lock plate (6) can be removed from switch cover. Note that narrow end of elongated hole in lock, and lug on switch lock (8) which fits into hole in lock plate, are toward lock cover hinge.

Lock assembly (8) can now be lifted out of switch cover (9).

CLEANING, INSPECTION AND REPAIR

Wash all parts in cleaning solvent and dry with compressed air.

Inspect all parts, particularly roller contact and plate assembly for excessive wear of contacting brass buttons and roller surfaces. Extreme wear of these parts may allow head



1. Roller contact
2. Switch mounting plate assembly
3. Reinforcing plate
4. Contact bar holder
5. Roller contact retainer
6. Switch lock plate
7. Switch base
8. Ignition switch cylinder
9. Switch cover

Figure 5-4. Ignition Light Switch – FL

of roller contact retainer to short against switch lock plate. Loosened terminals on switch mounting plates may also cause a short or an inconsistent positive contact. Replace all worn or rusted parts.

ASSEMBLING IGNITION-LIGHT SWITCH

Apply a light coat of grease to head of roller contact retainer, lock plate, roller contact and contact buttons on switch mounting plate.

Assemble parts in reverse order of disassembly. If lock cylinder had to be removed from case for repair or replacement, it must be replaced in correct position or switch cannot be locked. To reassemble correctly, insert lock cylinder into housing with tumblers in any one of the four registers. While pressing cylinder into housing with fingertip, insert key and turn clockwise as far as possible. Remove key and complete assembly.

HANDLEBAR SWITCH ASSEMBLY

The left handlebar switch assembly, figure 5-5, contains a rocker arm switch (headlamp HI-LO beam) and two push-button switches (horn and left turn signal). The right handlebar switch assembly contains a rocker arm switch (RUN-OFF) and two pushbutton switches (engine start and right turn signal). Individual rocker arm and push button switches can be replaced if defective.

To replace individual switches, remove four screws (1, figure 5-5) and pull off cover (2) assemblies. Remove screws (3) and rocker switches (4 and 5) or screws (6), retainer (7) and pushbutton switch (8) as needed. Reassembly is the reverse of disassembly.

STOPLIGHT SWITCH

FRONT BRAKE SWITCH

To replace stoplight switch in right handlebar assembly (figure 5-5), remove cover (2) and rubber cap (9). Disconnect wires and unscrew switch (10) and washer (11) from housing. Switch must be replaced as a unit.

REAR BRAKE SWITCH

The rear stoplight switch is located in the rear brake hydraulic line. The stoplight switch is a normally open type switch which closes with hydraulic pressure. The switch parts are not serviceable and must be replaced as a unit.

Connect a test light of at least 21 CP (12v) between the orange wire at the terminal and ground. If the test bulb lights up, power is reaching the switch. Next, depress the brake lever and hold it. Connect the test bulb between red wire at the terminal and ground. If the test bulb doesn't light, switch is faulty and must be replaced.

STARTER RELAY SWITCH

Figure 5-10 shows a test circuit using a 12-volt battery and stop lamp bulb. Contacts should close and bulb should light when connection is made at positive post of battery and should go out when connection is broken.

TRANSMISSION NEUTRAL SWITCH

This switch (figure 5-6) is threaded into the transmission top cover. Switch plunger is depressed by a nub on the shifter drum or shifter gear only when the transmission is in neutral to complete the circuit. A variable number of spacing washers are used to close the circuit only when transmission is in neutral. Switch is permanently assembled

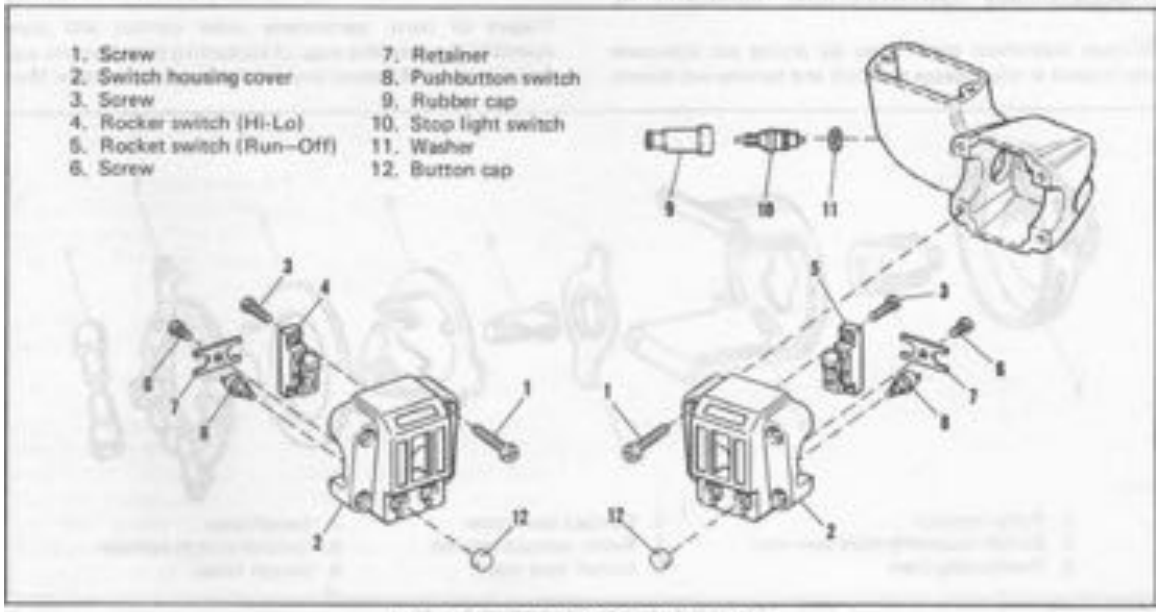


Figure 5-5. Handlebar Switch Assemblies

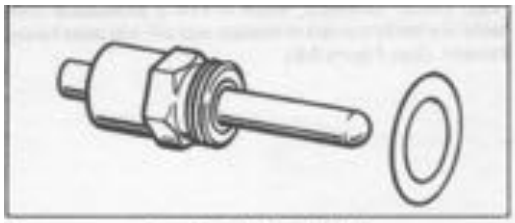


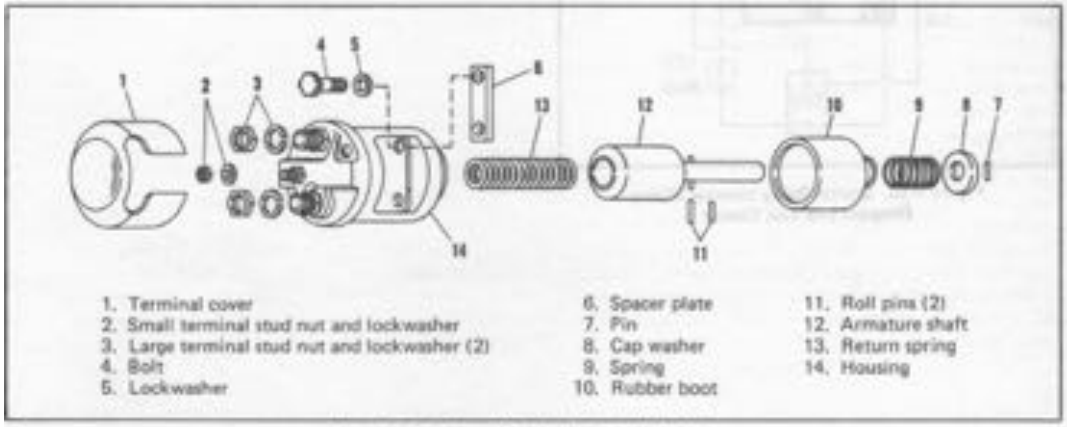
Figure 5-6. Neutral Switch

and if it fails to close the circuit when operating plunger is depressed, it must be replaced.

SOLENOID SWITCH

Solenoid switches are designed to close and open electrical circuits electro-magnetically. Switches of this type consist basically of contacts and a winding around a hollow cylinder containing a movable plunger. When the winding is energized by the battery through an external control circuit, the magnetism produced pulls the plunger into the coil. The contact disc attached to the plunger moves against two main switch contacts closing the circuit.

The solenoid switch individual parts are replaceable as shown in exploded view, figure 5-7. The control circuit wire from handlebar starter button is connected to small terminal stud. Battery cable must be connected to the large, longest stud and starter motor cable is connected to the large, shorter stud. If cables are reversed, solenoid coils will remain in circuit and drain battery. See solenoid internal wiring diagram, figure 5-9.



1. Terminal cover
2. Small terminal stud nut and lockwasher
3. Large terminal stud nut and lockwasher (2)
4. Bolt
5. Lockwasher
6. Spacer plate
7. Pin
8. Cap washer
9. Spring
10. Rubber boot
11. Roll pins (2)
12. Armature shaft
13. Return spring
14. Housing

Figure 5-7. Solenoid Switch – Exploded View

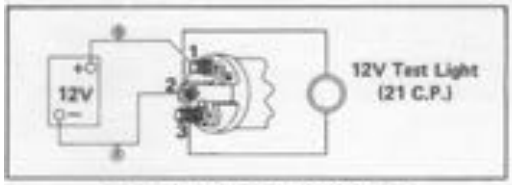


Figure 5-8. Test Circuit for Solenoid

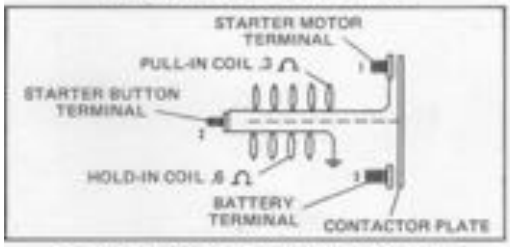


Figure 5-9. Solenoid Internal Wiring Diagram

TESTING SOLENOID SWITCHES

When it is suspected that a solenoid switch is defective, tests should be made of the solenoid coil winding and continuity through the main switch when contacts are in closed position. Using the test circuit described, these two tests can be made simultaneously.

With solenoid disconnected from control circuit, battery and motor, make test circuit connections as follows: (see figure 5-8).

Since solenoid coil requires 12V to actuate plunger closing main switch contacts, use a 12-volt battery. Leads A and B are connected to terminals 1 and 2 (coil terminals) to actuate solenoid with armature shaft in the solenoid. A sharp click should be heard from the solenoid switch when making this connection. No click or a heavy spark at the terminals when connecting wires would indicate either an open or short in the solenoid winding and solenoid switch must be replaced. If the

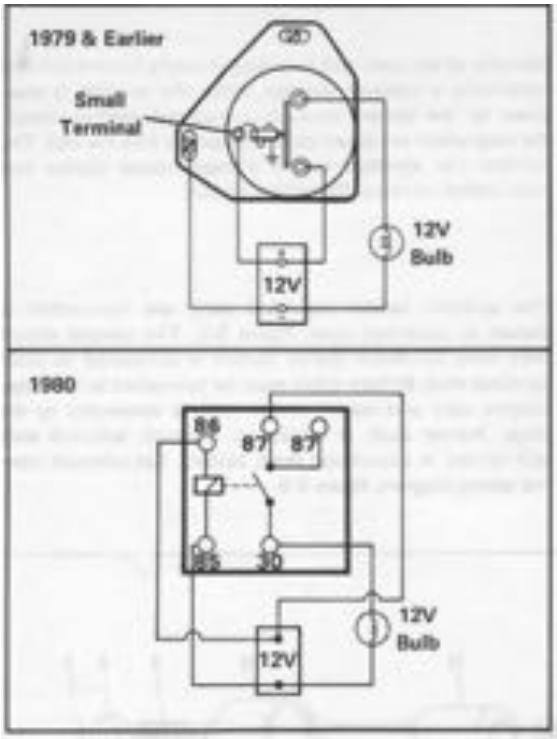


Figure 5-10. Starter Relay Internal Wiring Diagram and Test Circuit

solenoid winding checks good and plunger does close main switch contacts, there is still a possibility con tacts are badly burned or eroded and will not pass heavy current. (See Figure 5-9.)

LAMPS

HEADLAMP

The headlamp is a sealed beam type, specially designed and made for Harley-Davidson motorcycles. When replacement is required, use only the prescribed sealed beam unit. Do not attempt to use an automobile sealed beam unit because the current requirements for a motorcycle are much less and damage to battery or alternator may result. If either filament burns out, or the lens breaks, the entire unit must be replaced.

REPLACING HEADLAMP

1. Loosen door screw enough to remove headlamp door. Remove three retaining ring screws and retaining ring.

2. The sealed beam unit is now free from the headlamp body, and connector block can be removed from the unit by pulling connector block from the unit prongs.

3. Assembly is the reverse order of disassembly. Make sure connector block contacts are clean to ensure good electrical contact.

ADJUSTING BEAM

To get the greatest efficiency from the headlamp and to meet the requirements of the law, correctly adjust headlamp beam according to the following instructions.

Draw a horizontal line on a wall or screen exactly the same height as the center of the headlamp to be checked and adjusted. Then, position the motorcycle on a level surface with headlamp approximately 25 feet away from the test pattern. Have a rider sit on the motorcycle to simulate actual running conditions. Be sure tires are correctly inflated. Aim the headlamp directly at the screen and turn on the light switch. Set beam selector switch on the high beam position, and check beam for height and direction. The top of the main beam of light should register even with, but no higher than the horizontal line.

The lamp can be tilted up or down to aim it in relation to the horizontal line by turning vertical adjusting screw in or out. The lamp can be aimed to the right or left in relation to the front wheel by turning the horizontal adjustment screw in or out.

BULB CHART

LAMP DESCRIPTION	NO. OF BULBS REQUIRED	CANDLE POWER	HARLEY-DAVIDSON PART NUMBER
HEADLIGHT	1	60/50 C.P. 50/40 C.P.	67717-74 (FL) 67717-65A (FX)
TAIL AND STOP LIGHT Tail Light Stop Light	1	 3 C.P. 32 C.P.	68165-64 (FL) (FX)
TURN SIGNAL	4	32 C.P.	68572-64A (FL) (FX)
INSTRUMENT LIGHTS Speedometer Light Tachometer Light High Beam Indicator Neutral Indicator Oil Pressure Signal	 1 1 1 1 1	 2 C.P. 2 C.P. 2 C.P. 2 C.P. 2 C.P.	 71090-64 (FL) (FX) 71099-74 (FX) 68462-64 (FL) 71092-68A (FX) 68462-64 (FL) 67851-75 (FX) 68462-64 (FL) 68536-75 (FX)

CHARGING SYSTEM

ALTERNATOR

GENERAL

The alternator consists of two main components: the rotor (magnetic field) which is mounted on the engine sprocket shaft, and the stator (armature) which is bolted to the engine crankcase.

ROTOR

The rotor is circular in shape with an outer flange that extends over the stator. On the inside of the flange there are twelve (12) magnets in a plastic ring.

STATOR

The stator consists of twelve (12) coils, each wound over a laminated iron core. The coils are positioned radially around the engine crankshaft and bolted to the outside of the engine crankcase.

The stator has a single output winding.

RECTIFIER-REGULATOR

GENERAL

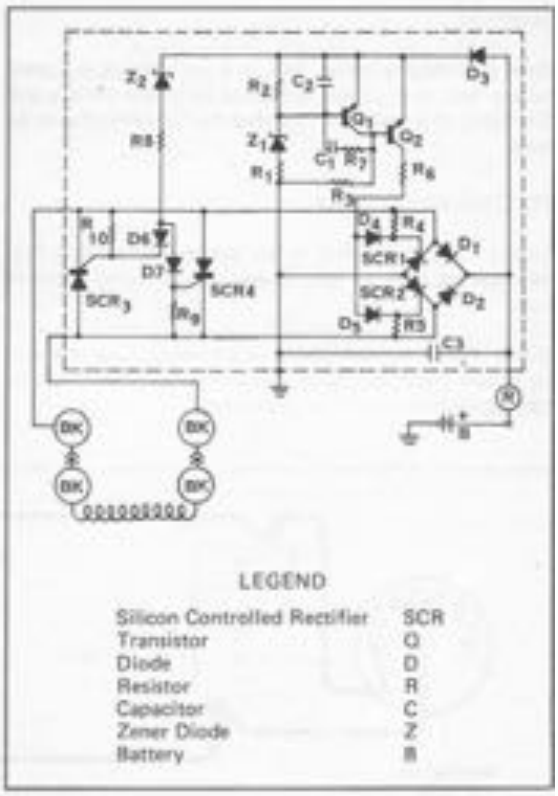
The rectifier-regulator, manufactured by Tympanium, is a series regulator with a shunt control. The circuit combines the functions of rectifying and regulating. Figure 5-11 shows the schematic diagram.

The circuit essentially is a full wave bridge made up of two SCR's (Silicon Controlled Rectifier) and two diodes — SCR1, SCR2, D1 and D2.

Each SCR has a control gate which turns it "on" or "off" (makes it conduct or not conduct). When the alternator voltage is too high, both SCR's turn "off," the current paths are blocked, and the battery is not charged. When the voltage lowers to an acceptable level, the opposite happens and the battery is charged.

The rectifier-regulator has a set, pre-determined "on-off" voltage built into it. This value is determined by Z1, R1 and R2. These components are factory adjusted so that when the voltage gets above 14.5 volts nominal, the SCR's are turned off.

The battery voltage is sensed through D3, R2, Z1, and R1. When the voltage at the point between Z1 and R2 exceeds 14.5 volts – it turns Q1 "on" which, in turn, turns Q2 "off." Thus, Q1 and Q2 form a flip-flop circuit where when one is "on" the other is "off" and vice versa. With Q2 "off," the current can't flow to the gates. This means the bridge essentially has been opened and there is no current flow to charge the battery.



LEGEND

Silicon Controlled Rectifier	SCR
Transistor	Q
Diode	D
Resistor	R
Capacitor	C
Zener Diode	Z
Battery	B

Figure 5-11. Tympanium Rectifier-Regulator — Schematic Diagram

As soon as the voltage gets below 14.5 volts at the point between Z1 and R1 the opposite happens. Q1 turns "off," Q2 turns "on," current flows to the gates, the bridge is closed and there is current flow to charge the battery.

In summary, the active elements of the regulating circuit are: Q1, Q2, SCR1, and SCR2. The elements of the sensing circuit are D3, R2, Z1, and R1.

One of the advantages of a series regulator is that there is automatic reverse polarity protection. If the battery is connected backward in a normal bridge, there will be a dead short. Not so in this circuit, because the SCR's simply can not be turned on.

To prevent high voltage build up, shunting SCR3 and SCR4 have been added. These SCR's simply short out the alternator winding when the voltage gets too high. The shunt regulator voltage setting is 40 to 50 volts. When this voltage is reached, current flows through zener diode Z2 and resistor R8 which turns "on" the shunt SCR's. Turned "on," the output is directly shorted.

CHECKING CHARGING SYSTEM

GENERAL

When the charging system fails or is not charging at a satisfactory rate, as is visually evidenced by a weak battery and dim lights, it is recommended that the following checks be made.

PRELIMINARY CHECKS

Battery: Check for weak or bad battery. See Battery Section. Battery must be fully charged for following electrical tests.

Wiring: Check for corroded or loose connections in charging circuit. Rectifier-regulator base must have a good, clean, tight connection for proper grounding.

ELECTRICAL CHECKS

If the preliminary inspection shows components to be in good condition, make the following electrical checks.

Regulating Voltage Check: (See figures 5-12 and 5-13.) Connect an ammeter in series with the alternator output. Connect load rheostat (carbon pile) and voltmeter across battery. Check regulating voltage while running engine at 3600 rpm.

Adjust load rheostat (or carbon pile) to 3.5 amperes output. The voltage readings then should conform to the values given by the curves shown in figure 5-14 at the temperature measured at the time of testing. For example, if the air temperature was +75°F, the upper voltage (from upper curve) would be 15.0 volts and the lower voltage (from lower curve) would be 13.8 volts.

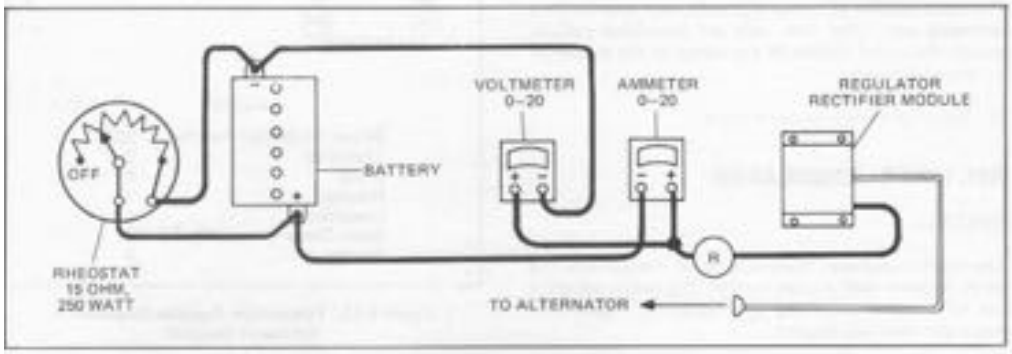


Figure 5-12. Test Arrangement with Individual Components

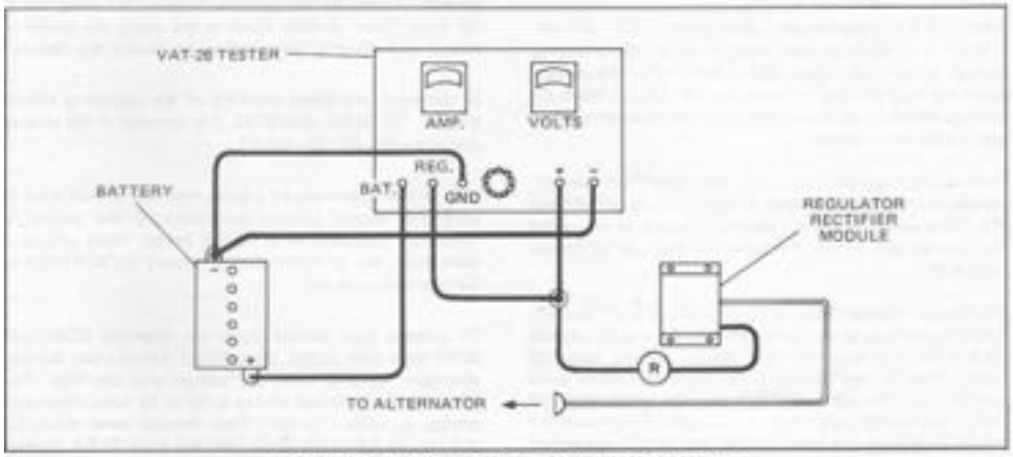


Figure 5-13. Test Arrangement with Sun VAT-26 Tester

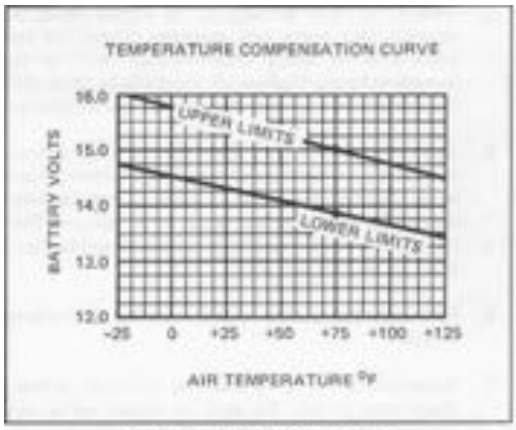


Figure 5-14. Regulating Voltage

Output Check: Run engine at 2000 rpm and adjust load rheostat (carbon pile) to obtain a constant 13.0 volts. The alternator output current should be 14 amperes minimum for 1978-1979 models and 15.5 for 1980 models.

Check Stator and Rotor: Make resistance checks. The coil resistance should check 0.2 to 0.4Ω (very low) across the contacts of the plug with an accurate ohmmeter. If found to be either open or shorted, the unit is defective. Also using an ohmmeter, check each pin to ground. There should be no continuity to ground (open circuit) as indicated by a reading of 1/2 megohm minimum.

Check AC output voltage with an AC voltmeter. It should be 19 to 26 volts per 1000 rpm. If there are shorted turns, the voltage will be reduced.

If the above checks are unsatisfactory, stator and rotor should be disassembled and checked for physical damage. As a final check, substitute components known to be good and check again. If the substituted units perform okay, the original units probably were defective.

Check the Rectifier-Regulator: If the rectifier-regulator appears to be the defective component, check it by replacing it with a unit that is known to be good and check again. Electrically disconnect the unit to be checked, then temporarily connect in the new unit. If the output is now okay, the original rectifier-regulator was defective and should be replaced. If the output is still unsatisfactory, the original unit was probably okay and the problem lies elsewhere.

REMOVING THE ALTERNATOR

WARNING

Disconnect the battery cables (negative cable first) to avoid accidental start-up of vehicle and possible personal injury.

1. FX Models — Remove the foot shift pedal.
   FL Models — Remove the footboard, muffler and exhaust pipe from the left side.
2. Remove the clutch, primary chain and compensating sprocket. See "Disassembling Clutch."
3. Remove the starter motor and housing and disconnect wires from solenoid.
4. Remove the four mounting bolts securing the inner primary housing to the engine. The two rear bolts are safety wired.
5. Remove the four nuts and washers securing the inner primary to the transmission. Loosen the transmission to frame mounting hardware.

   NOTE

   On some 1980 models, the two rear studs, washers and nuts have been replaced by washers and bolts.
6. Disconnect the hoses attached to the rear of the chain housing and remove the housing. Remove the O-ring from the engine.
7. See Figure 5-15. Using Puller, Part No. 95960-52A, pull the alternator rotor from the engine sprocket shaft.
8. Remove the two screws securing the starter plug. Remove the four screws, two lock plates and stator.

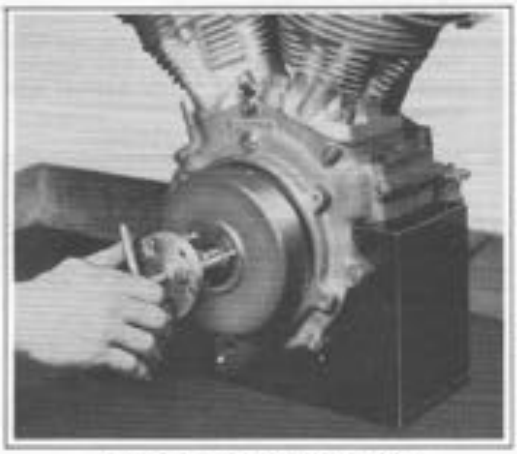


Figure 5-15. Pulling Alternator Rotor

CLEANING AND INSPECTING ALTERNATOR

The alternator rotor or stator may be replaced individually if either is damaged. The stator windings can be checked out with an ohmmeter as described previously in this section.

Remove all foreign particles from rotor magnets and clean rotor and stator before reassembling to engine. Rotor can

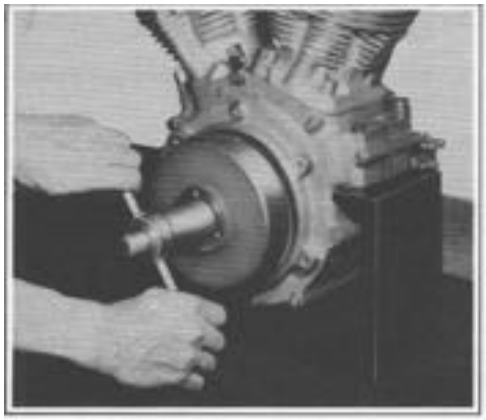


Figure 5-16. Installing Alternator Rotor

be cleaned in petroleum solvent but do not clean stator in this solvent. Clean stator by wiping with clean cloth; do not use liquid cleaner of any kind.

INSTALLING THE ALTERNATOR

1. Install a new O-ring on the engine groove. Assemble the stator to crankcase securing with two lockplates and four screws. Install the plug retaining plate and screws.

   After assembling stator to crankcase, use tool, Part No. 97225-55, to press rotor onto sprocket shaft so that it bottoms tightly against seal spacer. See Figure 5-16.

2. Attach the hoses to the inner primary housing and install the housing.

3. Attach the transmission to the inner primary using the four nuts and washers; or two nuts with washers and two bolts with washers. Do not tighten this hardware yet.

4. Attach the inner primary to the engine using the original four bolts and washers. Place the two bolts with the heads drilled through into the rear mounting holes. Tighten all four bolts to 18 to 22 ft-lbs torque. Safety wire the two rear bolts together.

5. Align the transmission case so the inner primary does not bind on the mainshaft or mounting hardware. Tighten the inner primary to transmission mounting hardware to 18-22 ft-lbs torque. Then tighten the transmission to frame mounting hardware to 18-22 ft-lbs, also.

6. Re-install the starter motor housing and starter motor.

7. Reassemble the compensating sprocket, primary chain and clutch. Be sure to install same size spacers behind the compensating sprocket to ensure correct sprocket alignment. See "Removing and Installing Front Chain," Section 2.

8. Adjust the primary chain. See "Front Chain Adjustment," Section 2.

9. Re-install the inner primary cover and gasket.

10. Reconnect the solenoid wires and battery cables.

NOTE

After reassembly, primary housing must be airtight. Check using a Vacuum Gage, Part No. 96950-68. Remove one of the four chain inspection cover screws and install the vacuum gage in the hole. Pinch the vent hose shut between the inner primary and tee fitting. With the engine running at approximately 1500 rpm the gage should read 25-30 inches or more water vacuum. A significantly lower reading indicates an air leak into the chain housing.

11. Check the clutch adjustments. See "Clutch," Section 4.

IGNITION SYSTEM — 1979 AND EARLIER

IGNITION TIMER

DESCRIPTION

The ignition system is a breakerless inductive discharge ignition system. It has two circuits, the primary circuit and the secondary circuit. The primary circuit consists of the battery, switch, primary coil winding, ignition timer and associated wiring. The secondary circuit consists of the secondary coil, the spark plugs and associated wiring. See schematic diagram, figure 5-17.

The ignition timer is located in the gearcase cover on the right hand side of the motorcycle. It has two functions. First, it opens and closes the low voltage circuit between the battery and ignition coil causing the coil to produce high voltage discharge to the spark plugs. Second, the ignition timer times discharge for proper engine firing.

The ignition timer includes a trigger rotor, sensor, electronic control module and advance mechanism. A single ignition coil fires both spark plugs at the same time, but one spark occurs in the exhaust stroke of one cylinder and the other spark fires the combustible gases in the other cylinder to produce the power stroke.

The advance mechanism is an extension on the camshaft and operates at half crankshaft speed. The trigger rotor is advanced automatically as engine speed increases and retarded as speed decreases through the action of flyweights in the advance mechanism. This ensures correct spark timing to suit starting, low and high speed requirements.

OPERATION (Figure 5-17)

The trigger rotor (1) has two lobes, the small lobe fires the front cylinder and the large lobe fires the rear cylinder. The sensor (2) consists of a number of turns of fine wire wound on a core and is mounted on the timer plate so that the lobes on the trigger rotor pass in close proximity. The air gap must be adjusted to 0.004"-0.006."

The electronic control module (3) contains all of the solid state components used in the ignition system. Within the control module is an integrated circuit chip (4) which contains oscillator and demodulator circuits. The control module is fully enclosed in a silicone material to protect it from vibration, dust, water or oil. The unit is a non-repairable item. If it fails, it must be replaced.

When the ignition switch (5) and engine stop switch (12) are on, current flows from the battery (6) to the control module (3). An oscillator section in the integrated circuit chip (4) sets up a signal in the sensor (2). This creates a field around the sensor. When a trigger rotor (1) lobe leading edge enters the sensor's field, it reduces the strength of

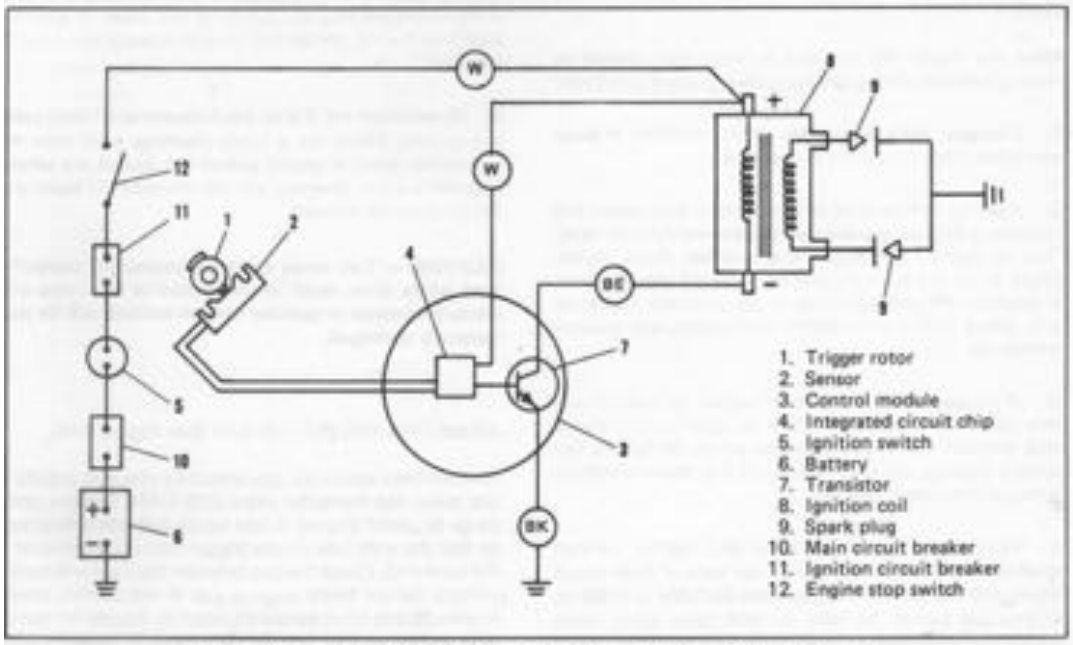


Figure 5-17. Breakerless Inductive Discharge Ignition System — Schematic Diagram

the oscillating signal. This weakened sensor signal is detected by what is called a demodulator circuit in the integrated circuit. The demodulator controls a transistor (7) which turns off the current in the ignition coil (8) primary circuit. This causes a high voltage to be induced in the secondary of the coil which in turn causes a spark at the spark plug gaps (9).

The time of spark plug firing is when the leading edge of each lobe aligns approximately with the center of the sensor as shown in Figure 5-18.

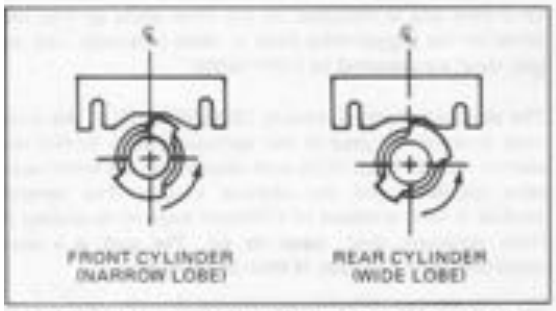


Figure 5-18. Trigger Rotor Position for Ignition Timing

TROUBLESHOOTING

Refer to figure 5-17 and to the appropriate vehicle wiring diagram.

When the engine will not start or when hard starting or missing indicates a faulty ignition system, proceed as follows:

1. Disengage spark plug cables. Check condition of plugs and cables. Clean or replace as necessary.

2. Insert an extension adapter into spark plug nipple and establish a 3/16 in. gap between adapter and cylinder head. Turn on ignition and engine stop switches. Crank engine. Check to see if a spark is obtained across the gap. If a spark is obtained, the problem is not in the electronic system or coil. Check carburetion, choke, spark plugs, and advance mechanism.

3. If no spark is obtained, check battery voltage and battery connection condition. Turn on ignition and engine stop switches and with a voltmeter across the battery and current flowing, voltage should be 11.5 or above. If voltage is low, battery needs charging.

4. Remove the timer case cover and position ignition module to one side. Check the air gap between both trigger lobes and the sensor. Air gap must be 0.004 to 0.006 in. If this gap cannot be held on both rotor lobes, timer mechanism shaft and/or trigger rotor have excessive runout and should be replaced or straightened. Check to make sure that control module ground black lead is securely fastened to timer plate and that wires are in good condition.

NOTE:

Whenever sensor air gap is adjusted, the ignition advanced timing should be checked and adjusted if necessary. See "Adjusting Advanced Timing with Strobe Timing Light." If spark is still not evident, continue with the following voltmeter checks.

Position trigger rotor so that the center of the sensor is between two lobes.

5. Connect voltmeter between ignition positive coil terminal (white wires) and engine ground. With ignition and engine stop switches on, the voltmeter reading should equal battery voltage within 0.5 volt. If not, trouble lies in circuit between battery and ignition coil. Check the connections at or in circuit breakers and ignition switches.

6. Disconnect blue wire from coil negative terminal. Connect voltmeter between coil negative terminal and ground. With ignition and engine stop switches on, the voltmeter reading should equal battery voltage. If not, ignition coil primary is defective. Replace coil. Retest for spark after corrections are made.

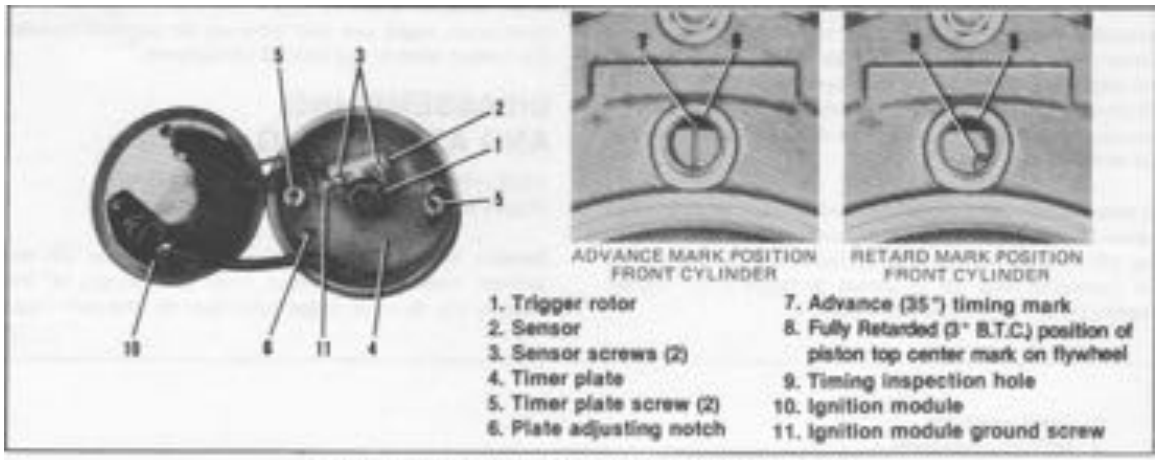
7. Reconnect blue wire to coil negative terminal. Connect voltmeter between coil negative terminal and ground. Reading should be 1 to 2 volts. Place the blade of a screwdriver against the face of the sensor. If the voltmeter reading switches up to 11.5 to 13 volts, proceed to step 8. If the voltmeter does not switch up and down or does not read 1 to 2 volts, the ignition module is faulty and must be replaced.

8. Re-establish the 3/16 in. gap between spark plug cable and ground. Check for a spark discharge each time the screwdriver blade is placed against the face of the sensor. If sparks are not observed, the coil secondary is faulty and the coil must be replaced.

CAUTION — Coil wires must be connected correctly. Both white wires must be connected to the same coil primary terminal or ignition control module will be permanently damaged.

ADJUSTING SENSOR AIR GAP (See Figure 5-19)

Ignition timer sensor air gap should be checked initially at 500 miles and thereafter every 2500 miles. Remove spark plugs to permit engine to turn easily and rotate flywheels so that the wide lobe on the trigger rotor (1) is centered in the sensor (2). Check the gap between the rotor and sensor using a narrow feeler gage. If gap is not correct, loosen screws (3) and move sensor as required. Repeat for narrow lobe setting so that gap for both lobes in between 0.004 and 0.006 in. Tighten screws (3) to 5 to 7 in-lbs torque.



1. Trigger rotor
2. Sensor
3. Sensor screws (2)
4. Timer plate
5. Timer plate screw (2)
6. Plate adjusting notch
7. Advance (35°) timing mark
8. Fully Retarded (3° B.T.C.) position of piston top center mark on flywheel
9. Timing inspection hole
10. Ignition module
11. Ignition module ground screw

Figure 5-19. Ignition Timer and Flywheel Timing Marks

CHECKING ADVANCE TIMING WITH STROBE TIMING LIGHT (Figure 5-19)

Ignition timing should be checked initially at 500 miles and thereafter every 2500 miles.

Before checking timing, check sensor air gap as described above.

Use a strobe flash timing light (timing gun) to view advanced timing (7) on flywheel through accessory plastic view plug, Part No. 96295-65, screwed into timing inspection hole (9). Make sure view plug does not touch flywheels. Timing light leads should be connected to the front spark plug, ground and battery positive terminal. Start engine and set engine speed at 2000 rpm. Light will flash each time spark occurs (see figure 5-20). Loosen timer plate screws (5) just enough so that plate (4) can be shifted using a screwdriver in notch (6) as light aimed into inspection hole (9) stops timing mark (7) in center of hole. Timing will retard 30° automatically when engine is at idle speed or is stopped.

Rear cylinder advance timing mark is a single large drilled dot which should appear on or near the front cylinder advance timing mark while viewing with timing light. See figure 5-20.

Figure 5-20. Checking Timing with a Strobe Light

SETTING RETARDED TIMING WITH CIRCUIT TESTER (See Figure 5-19)

IMPORTANT

This procedure will result in approximate timing and engine can be operated in an emergency for a short period of time. Advanced timing should be checked and set under running conditions as soon as possible using a strobe timing light as described in preceding section.

Whenever ignition components have been disassembled, such as during engine disassembly and reassembly, or if a strobe timing light is not available, approximate timing can be obtained by using the following procedure.

Remove screw plug from timing inspection hole (9) in left side of crankcase. Then remove front push rod cover so that opening and closing of valve can be observed.

Turn engine in direction in which it runs until front piston is on compression stroke (just after front intake valve closes), and continue turning engine very slowly (less than 1/2 revolution) until piston top dead center timing mark (8) on flywheel is aligned in the inspection hole as shown.

With timer rotor fully retarded, the leading edge of the narrow rotor lobe should be aligned with the center of the

sensor body as shown in figure 5-18. At this point the retarded front cylinder ignition spark occurs. A circuit tester, such as a 12-volt light bulb (No. 57) can be used to determine the exact point of ignition firing as follows: Disconnect the blue wire from the ignition coil primary terminal and connect test light to this terminal and to end of removed blue wire.

Loosen timer plate screws (5) just enough to shift timer plate (4) using a screwdriver in notch (6), so light goes on or off when piston top dead center timing mark is aligned in inspection hole (9) as shown in figure 5-19. Tighten screws (5) to 12 to 16 in.-lbs. torque.

When reinstalling the control module and timer compartment cover, make sure that wires are not pinched between the control module and internal components.

DISASSEMBLING AND ASSEMBLING

REMOVING IGNITION TIMER COMPONENTS (Figure 5-21)

Remove ignition timer cover screws (1), cover (2) and ignition module (3). Remove timer plate screws (4) and washers (5). Remove trigger rotor bolt (6) and pull trigger

1. Cover screw (2)
2. Ignition timer cover
3. Ignition module
4. Timer plate screw (2)
5. Washer (2)
6. Trigger rotor bolt
7. Trigger rotor
8. Advance assembly
9. Sensor
10. Shield
11. Timer plate
12. Screw and washer (2)
13. Flyweight spring (2)
14. Flyweight (2)
15. Advance assembly base
16. Flyweight roll pin (2)
17. Cam stop roll pin
18. Register roll pin
19. Camshaft oil seal
20. Ignition coil
21. Spark plug cable (2)
22. Ignition coil terminal (FL)
22A. Ignition coil terminal (FX)

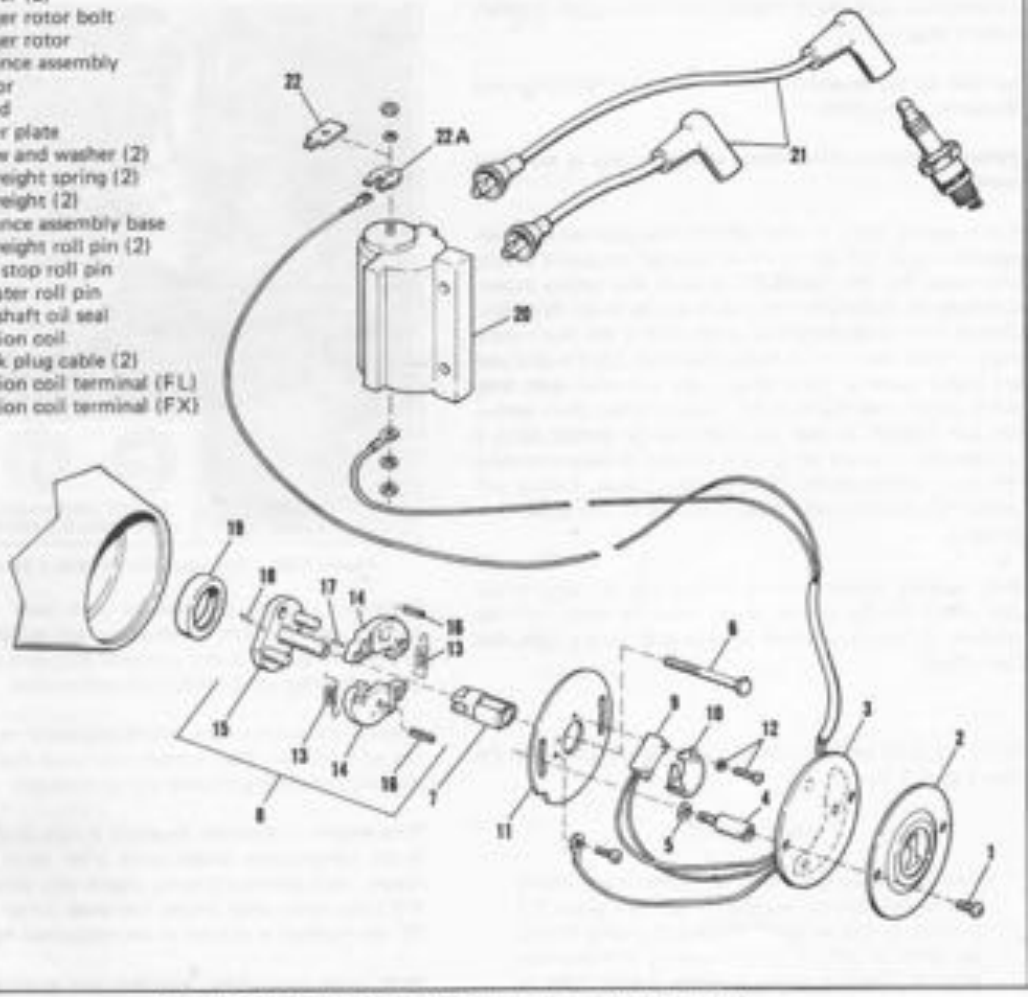


Figure 5-21. Ignition System Components — 1978½ to 1979

rotor (7) from advance assembly (8). Remove advance assembly from gearcase cover. To remove sensor (9) and shield (10) from timer plate (11), remove screws and washers (12).

To disassemble advance mechanism, unhook spring (13) from grooves in pivot pins and slip flyweights (14) with spring from pivot pins on advance base (15). Do not remove springs from flyweights unless they are to be replaced. Roll pins (16, 17, 18) are pressed in and can be replaced if necessary.

INSPECTING AND REPLACING PARTS (Figure 5-21)

Inspect lip of seal (19) and replace it if worn or rough. Also replace the seal if there is any evidence of oil leakage into the timer compartment.

Check flyweight springs (13), and if bent or stretched, replace them. When installing, be sure that bent end of each spring is hooked through bottom of hole, and that upper looped end grips groove in pin tightly. See figure 5-22. Check for looseness of rotor (7) on shaft (15) and wear on sides of flyweight (14) ears which engage slots in rotor.

Reassemble advance assembly and lubricate moving parts with Harley-Davidson "Anti-Sieze." Check operation by moving rotor in direction required to advance weights to their fully extended position. Then release the rotor and see if springs return to the fully retarded position. Correct causes of faulty action by cleaning and lubricating the shaft and flyweights with "Anti-Sieze" and replace weak springs. Lubrication of the advance assembly should be performed at 5000 mile intervals.

ASSEMBLING IGNITION TIMER COMPONENTS (Figure 5-21)

Assemble ignition timer parts in reverse order of disassembly with the following exceptions:

Advance assembly must seat squarely and firmly on end of camshaft.

Install trigger rotor (7) in correct position so that it engages both flyweights and flat side is next to roll pin (17). Tighten trigger rotor bolt to 20 to 24 in.-lbs.

Adjust sensor air gap and set retarded ignition timing as described in previous section. Check advanced ignition timing under running conditions as described in previous section.

CAUTION — When installing ignition module, make sure wires are not pinched.

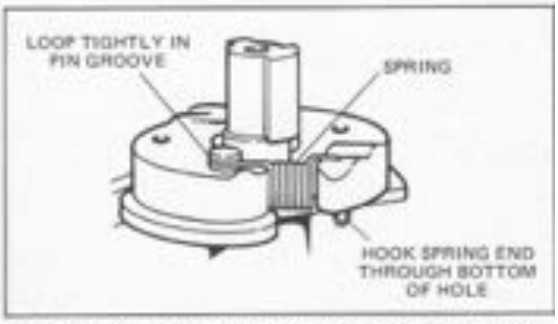


Figure 5-22. Advance Unit Flyweight Spring Assembly

IGNITION SYSTEM
1980 AND LATER

DESCRIPTION

The ignition system is a breakerless inductive discharge ignition system. It has two circuits, the primary circuit and the secondary circuit. The primary circuit consists of the battery, switch, primary coil winding, computerized ignition timer and associated wiring. The secondary circuit consists of the secondary coil, the spark plugs and associated wiring.

The computerized ignition system consists of two assemblies, the rotor and sensor plate and the computer microprocessor module. The rotor and sensor plate are located in the gearcase cover on the right side of the motorcycle. The computer module is mounted above the regulator at the front of the frame. The computer has two functions. First, it opens and closes the low voltage circuits between the battery and ignition coil to produce high voltage discharge to the spark plugs. Second, it computes the spark advance for proper ignition firing.

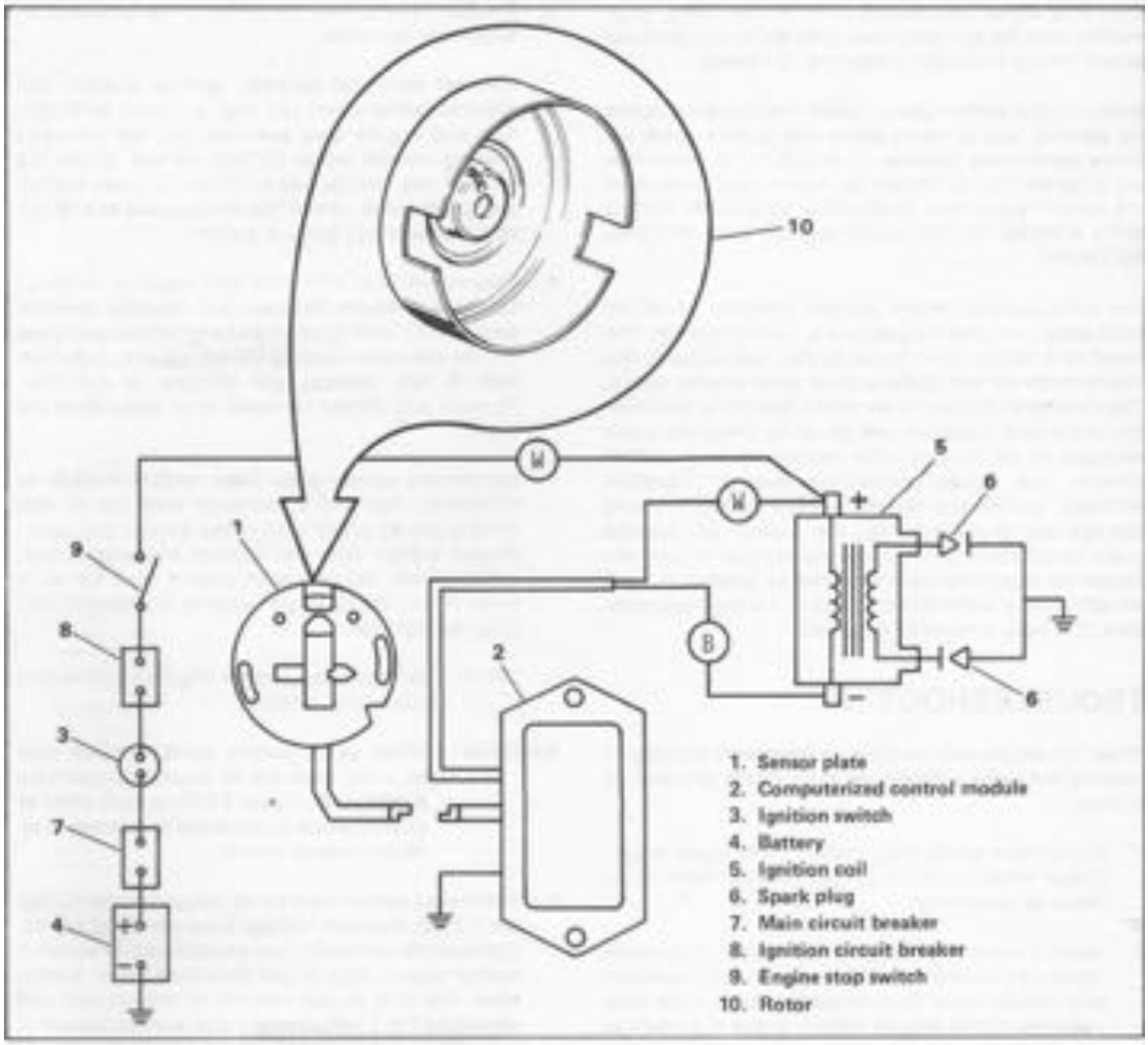


Figure 5-23A. Ignition System Components

The ignition timer includes a rotor, sensor plate, and a computerized microprocessor control module. A single ignition coil fires both spark plugs at the same time, but one spark occurs in the exhaust stroke of one cylinder, while the other spark fires the combustible gases in the other cylinder to produce the power stroke.

The rotor is bolted on to the camshaft and operates at one-half crankshaft speed. The computer module automatically advances the spark as the engine speed increases, and retards as the speed decreases without the action of flyweights, or an advance mechanism. This ensures correct spark timing to suit starting, low and high speed requirements.

As the rotor turns, slots in its external edge break the magnetic field to a Hall-effect device mounted on the sensor plate. The output of the Hall-effect device is a logic-type signal that corresponds to the timing information from the spinning rotor. This technique gives accurate timing information down to "0" speed.

Basically, the system gives a spark near top dead center for starting, and at rpm's above this gives a spark advance somewhere between 3° and 35°. The whole timing program can be shifted by mechanical rotation of the sensor plate. See CHECKING ADVANCE TIMING WITH STROBE TIMING LIGHT and SETTING RETARDED TIMING.

The computerized control module contains all of the solid state components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon engine speed. The programmed dwell is an added feature to keep battery drain to a minimum and yet gives adequate spark voltages at all speeds. (The microprocessor control module has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The system will operate down to 5.7 volts DC. The control module is fully enclosed in a polyurethane material to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

TROUBLESHOOTING

When the engine will not start, or when hard starting or missing indicates a faulty ignition system, proceed as follows:

1. Disconnect spark plug cables from spark plugs. Check condition of plugs and cables. Clean or replace as necessary.

2. Insert a conductive adapter into spark plug cable nipple and establish a 3/16 in. gap between adapter and cylinder head. Turn on ignition and engine stop switches. Crank engine. Check to see if a spark is obtained across the gap. If a spark is obtained, the problem is not in the electronic system or coil. Check carburetion, choke and spark plugs.

3. If no spark is obtained, check battery voltage and battery connection condition. Turn on ignition and engine stop switches with voltmeter across the battery, and current flowing, voltage should be 11.5 or above. If voltage is low, battery needs charging.

4. Check to make sure that ignition module (on front of frame above the regulator) ground (black lead) is securely fastened to the frame and that the ground wire from the battery to the frame is in good condition. If spark is still not evident, continue with the following voltmeter checks.

   NOTE

   Voltmeter should have a resistance of 20,000 ohm/volt or more in order to obtain correct readings.

5. Position rotor so that the center of the sensor is between the two slots.

   Connect voltmeter between ignition positive coil terminal (white wires) and engine ground. With ignition and engine stop switches on, the voltmeter reading should equal battery voltage within 0.5 volts. If not, trouble lies in circuit between battery and ignition coil. Check the connections at or in circuit breakers and ignition switch.

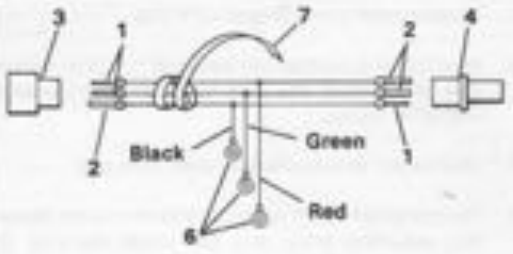
6. Disconnect blue wire from coil negative terminal. Connect voltmeter between coil negative terminal and ground. With ignition and engine stop switches on, the voltmeter reading should equal battery voltage. If not, ignition coil primary is defective. Replace coil. Retest for spark after corrections are made.

7. Disconnect sensor plate from ignition module at connector. Connect a voltmeter from pin #1 (red wire) to pin #2 (black wire) of the module connector (Figure 5-23B). With the ignition and engine stop switches on, the voltmeter should read 5.0 ± .5 volts. If not, the computer module is defective and must be replaced.

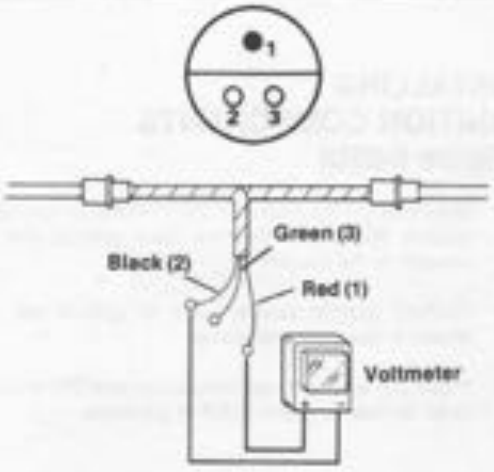
   NOTE: Fabricate jumper cable (Figure 5-23B) to test module and sensor.

CAUTION — When using jumper cable extreme care must be used not to touch exposed wire terminals (6, Figure 5-23B) to each other or ground which could result in damage to ignition module sensor.

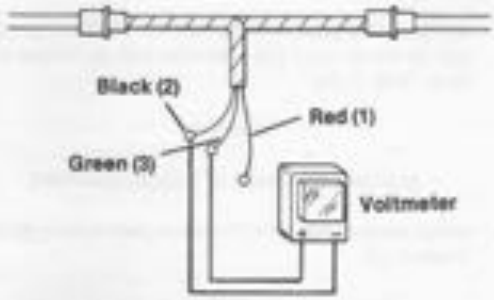
8. Reconnect sensor plate using the jumper cable (Figure 5-23B). Recheck voltage from pin #1 to pin #2. Connect the voltmeter from pin #3 to pin #2 to check sensor output. This output should be 5.0 ± .5 volts when the slot is not present at the sensor and should be 0 to 1 volt when the slot is at the sensor. A screwdriver blade can be used to check the sensor output. If these voltages are not present, the sensor plate must be replaced.



1. Pin connectors Part No. 74536-77 (3)
2. Socket connectors Part No. 74539-77 (3)
3. Body receptacle Part No. 72051-77 (1)
4. Body plug Part No. 74521-77 (1)
5. 18 gauge insulated wire (4 ft.)
6. Wire ring terminals Part No. 9857 (3)
7. Electrical tape



Ignition Module Check



Sensor Output Check

Figure 23-B. Fabricating and Using Jumper Cables

CAUTION — Coil wires must be connected correctly. Both white wires must be connected to the same coil primary terminal or ignition control module will be permanently damaged.

1. Advance timing mark
2. Retard position of piston top center mark on flywheel
3. Timing inspection hole

Figure 5-23C. Timing Marks

CHECK ADVANCE TIMING WITH STROBE TIMING LIGHT

(Figure 5-23C)

Ignition timing should be checked every 2500 miles.

Use a strobe flash timing light (timing gun) to view advanced timing of flywheel through accessory plastic view plug, Part No. 96295-65, screwed into timing inspection hole. Make sure view plug does not touch flywheels. Timing light leads should be connected to the front spark plug, ground and battery positive terminal. Start engine and set engine speed at 2000 rpm. Light will flash each time spark occurs. Loosen sensor plate screws just enough so that plate can be shifted using a screwdriver in notch as light aimed into inspection hole stops timing mark in center of hole. Timing will retard automatically when engine is at idle speed or is stopped. See table below. The small dot which appears on or near the front cylinder advanced timing mark indicates rear cylinder advanced timing.

TIMING ADVANCE

Engine RPM	Ignition Timing
0-600	3° BTDC
600-1600	21° BTDC
Above 1600	35° BTDC

SETTING RETARDED TIMING (Figure 5-23D)

CAUTION

This procedure will result in approximate timing and engine can be operated in an emergency for a short period of time. Advanced timing should be checked and set under running conditions as soon as possible using a strobe timing light as described in preceding section.

Whenever ignition components have been disassembled, such as during engine disassembly and reassembly, or if a strobe timing light is not available, approximate timing can be obtained by using the following procedure:

1. Set sensor plate (8) so that sensor plate screws (6) are centered in the slots. Snug down the screws (6).
2. Engine can now be started.
3. Adjust the advanced timing following procedure in the preceding section.

REMOVING IGNITION COMPONENTS (Figure 5-23D)

WARNING

To avoid accidental start-up of vehicle and possible personal injury, disconnect the battery cables, (negative cable first) before performing any of the following procedures.

1. Using a 3/8 in. drill bit, drill out outer cover rivets (1) and remove outer cover (2).
2. Remove inner cover screws (3) and remove inner cover (4) and gasket (5).
3. Remove sensor plate screws (6) and washers (7).
4. To remove sensor plate (8) from gearcase, disconnect connector (12) and remove connector from sensor plate wires. Pull wires through gearcase hole one at a time.

NOTE

It may be necessary to cut pin and sockets from wires to pull wires through hole in gearcase.

5. Remove rotor screw (9) and rotor (10).
6. Seal (11), if defective, can be pryed out from ignition side of gearcase. Use care not to damage camshaft end while prying.
7. Disconnect ignition module wires from coil.
8. To remove ignition module (13) from the frame, remove two mounting bolts, and the screw securing the ground wire to the frame.

INSPECTION AND REPLACING PARTS

Inspect lip of seal and replace if it worn or rough. Also replace the seal if there is any evidence of oil leakage into the timer compartment.

INSTALLING IGNITION COMPONENTS (Figure 5-23D)

1. Assemble ignition module (13) to front frame mounting bracket. Make sure that the black ground wire is secured to the bracket.
2. Connect ignition module wires to ignition coil as shown in the wiring diagrams.
3. If seal (11) was removed, install new seal (11) in gearcase, lip side to ignition side of gearcase.

CAUTION

Seal (11) must be pressed into gearcase until it stops. A seal that is not all the way in may leak.

4. Apply Loctite Lock 'N Seal, Part No. 99625-77 to rotor bolt (9). Install rotor (10) with rotor bolt (9). Torque bolt (9) to 75-80 in-lbs.

CAUTION

Use only the grade of Loctite specified.

5. Install sensor plate (8) with sensor plate screws (6) and washers (7).

NOTE:

If sensor plate (8) was completely removed it may be necessary to install new wire pins, sockets and body receptacle.

6. Set retarded ignition timing as described in previous section. Check advanced ignition timing

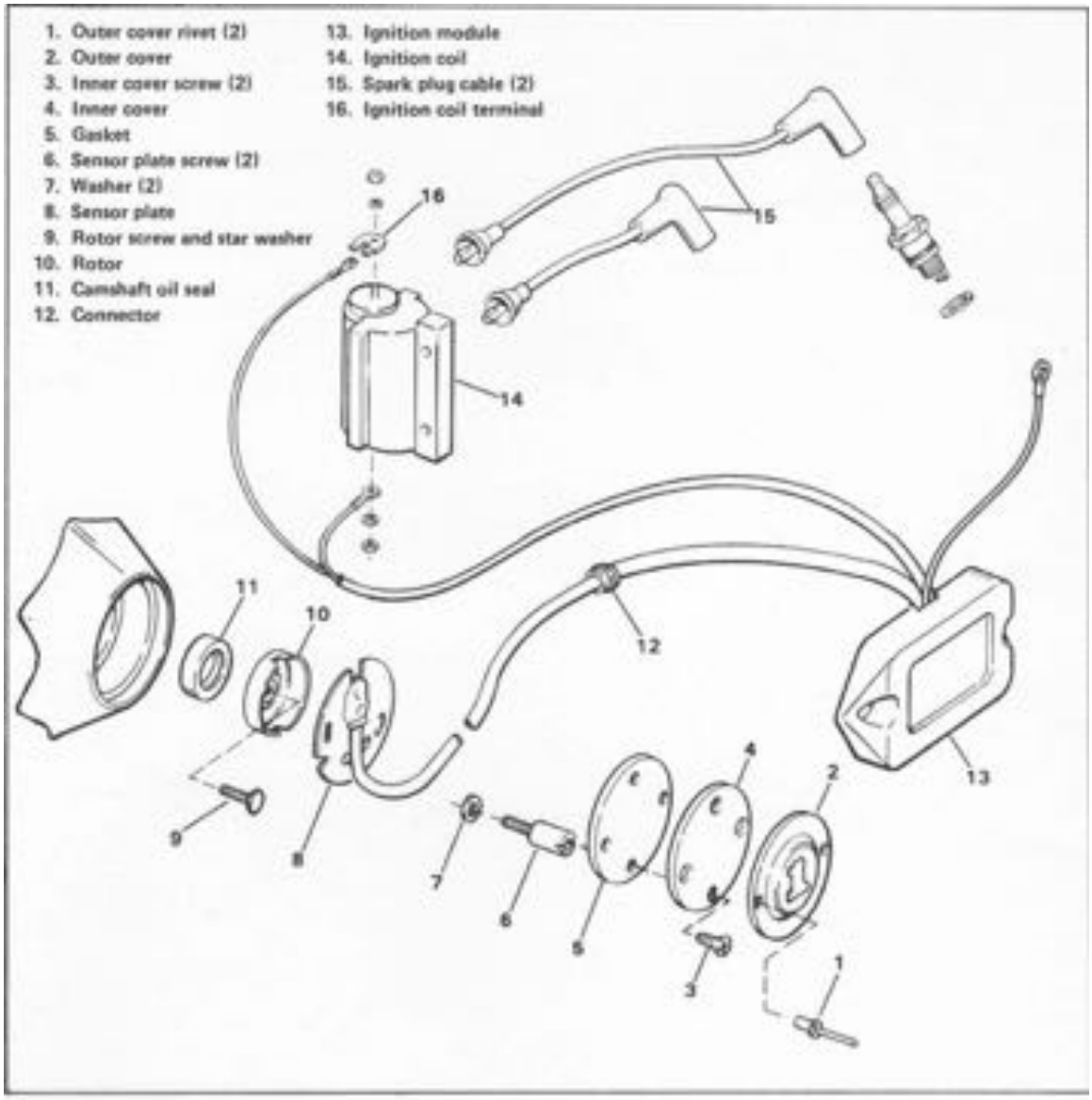


Figure 5-23D. Ignition Components — 1980 and Later

under running conditions as described in previous section.

7. Install gasket (5) and inner cover (4) with screws (3).

8. Rivet outer cover (2) to inner cover (4) with rivets (1).

CAUTION — Use only rivets Part No. 8699 to secure outer cover. (See Figure 5-23E.) Timing cover rivets are specially designed so there is no rivet end to fall off into timing compartment as with regular rivets. Use of regular rivets could cause damage to ignition components.

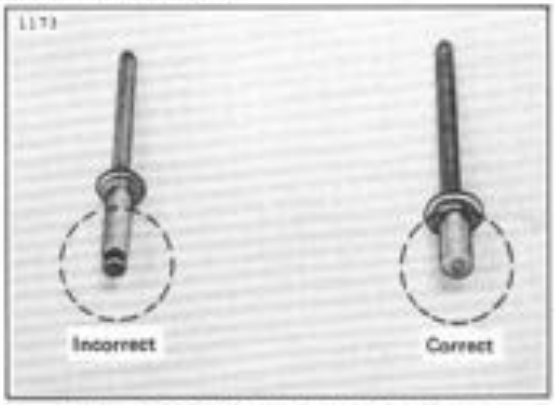


Figure 5-23E. Special Timing Cover Rivet

IGNITION COIL

DESCRIPTION

The ignition coil is a pulse type transformer that transforms or steps up low battery voltage to the high voltage necessary to jump the electrode at the spark plug in the cylinder head. Internally the coil consists of primary and secondary windings with a laminated iron core and sealed in waterproof insulating compound. The ignition coil cannot be taken apart or coil repaired. If the ignition coil is defective, it must be replaced.

CAUTION — On 1980 and later models, use only ignition coils marked ELECTRONIC ADVANCE. On 1979 and earlier models, use the old style coils. Interchanging these coils could cause a failure in the electronic components.

TROUBLESHOOTING

When engine will not start or when hard starting or missing indicates a faulty ignition system, follow the troubleshooting procedure listed under the respective ignition system sections. If condition persists, check primary and secondary resistance of ignition coil with an ohmmeter. Resistances should be within the following limits:

1979 and Earlier	
Primary	4.7 to 5.7 Ohms
Secondary	16,500 to 20,000 Ohms
1980 and Later	
Primary	3.3 to 3.7 Ohms
Secondary	16,500 to 19500 Ohms

If a coil tester is not available, temporarily substitute a new ignition coil by attaching it at any convenient point near old coil (coil will function without being securely grounded). Transfer terminal wires to new coil as shown in wiring diagram for that particular model.

CAUTION — Connect ignition coil wires as shown in wiring diagrams. Reversing polarity to the ignition control module will permanently damage the control module.

Attach new spark plug cables to coil and plugs. If ignition trouble is eliminated by the temporary installation of new coil, carefully inspect old coil for damaged cables and insulation. The insulation on cables may be cracked or otherwise damaged allowing high tension current to short to metal parts. This is most noticeable in wet weather or when motorcycle has been washed.

REPLACING SPARK PLUG CABLE

Resistor type high tension cables are used. This type has a carbon impregnanted fabric core instead of solid wire for radio noise suppression and improved reliability of electronic components. For this reason, it is recommended that the exact replacement cable is used.

Remove old cable from coil terminal and install new cable. Always be certain that cable boot or cap is securely tightened to the coil tower to prevent moisture and dirt from contacting the high tension lead. Replace boot or cap if damaged or loose fitting.

CAUTION — When disconnecting cable connector from spark plug terminal, do not pull on the cable itself because the cable carbon core will be damaged. Always pull on the rubber boot as close as possible to the spark plug terminal.

SPARK PLUGS

GENERAL

Spark plugs should be replaced every 2500 miles. Use only the replacement spark plugs listed on page 5-1.

The 5R6 and 5R6A plugs have a resistor element to reduce radio interference originating in the motorcycle ignition system. Only resistor type plugs should be used with 1980 and later ignition systems.

REMOVING SPARK PLUGS

Disconnect spark plug cables from plugs by pulling on molded connector caps. Connection is the simple snap-on type.

CAUTION — Do not pull on wires since this may damage internal conductor causing high resistance and reduction in firing voltage.

Use a deep socket wrench or special spark plug wrench to loosen plugs. Blow away all dirt from plug base with compressed air before removing plug.

INSPECTING SPARK PLUGS (Figure 5-23F)

Examine plugs as soon as they have been removed. The deposits on the plug base are an indication of the correctness of the plug heat range, efficiency and are a guide to the general condition of rings, valves, carburetor and ignition system.

A. A wet black and shiny deposit on plug base, electrodes and ceramic insulator tip indicate an oil fouled plug. The condition may be caused by worn rings and piston, loose valves, weak battery, faulty ignition or too cold spark plug heat range.

B. A dry fluffy or sooty black deposit indicates a too rich carburetor air-fuel mixture or long periods of engine idling.

C. An overheated plug can be identified by a light brown, glassy deposit. This condition may be accompanied by cracks in the insulator or by erosion of the electrodes. This condition is caused by too lean an air-fuel mixture, a hot running engine, valves not seating, improper ignition timing or too hot a plug for the service. The glassy deposit on the spark plug is a conductor when hot and may cause high speed misfiring.

   A plug with eroded electrodes, heavy deposits or a cracked insulator should be replaced.

D. A plug with a white, yellow or light tan to rusty brown powdery deposit indicates balanced combustion. The deposits may be cleaned off at regular intervals if desired.

Figure 5-23F. Types of Plug Base Deposits

SETTING SPARK GAP

Use only a wire type gauge. Bend the outside or grounded electrode so only a slight drag on the gauge is felt when passing it between electrodes. Never make adjustments by bending the center electrode. Set gap on all plugs to 0.038 - 0.040 in.

INSTALLING SPARK PLUGS

Before installing spark plugs, check condition of threads in cylinder head and on plug. If necessary soften deposits with penetrating oil and clean out with a thread chaser.

Install spark plug finger tight and then torque to 18 to 22 ft.-lbs. If a torque wrench is not available, tighten finger tight and then using a spark plug wrench, tighten an additional 1/4 turn.

Check and adjust, if necessary, engine idle speed and mixture setting.

BATTERY

GENERAL

The battery serves as a storage place for current used in starting the motorcycle, to operate accessories when the engine is not running and to provide additional current, when necessary, over the amount being generated. For a battery to remain in good condition, the current draw must be balanced by a current input. All Harley-Davidson batteries have lead plates and sulphuric acid electrolyte units of capacities suitable for load requirements under intended use.

NOTE

A new battery is shipped dry and must be activated by filling with battery grade sulphuric electrolyte before placing in service.

BATTERY CARE

Prompt and correct battery care determines the life span of the unit. Therefore, for a longer useful life, the battery solution level must be checked at weekly intervals. Add only pure distilled or approved water.

With a hydrometer or syringe, add water to each cell to raise level of solution up to level for type of battery as follows:

FL's — Fill to triangle or circle at base of filler hole.
FX's — Maintain level at upper level line on one side of battery.

Be careful not to overfill. Overfilling will result in some of the electrolyte being forced out through cap vent holes, diluting or weakening the solution strength. An overflow of battery solution will cause cables to corrode and motorcycle parts near the battery to be damaged.

WARNING — Batteries contain sulfuric acid. Avoid contact with skin, eyes or clothing.

ANTIDOTE — External — Flush with water.
— Internal — Drink large quantities of milk or water followed by milk of magnesia, vegetable oil, or beaten eggs. Call doctor immediately.
— Eyes — Flush with water and get immediate medical attention.

Clean battery and terminals when necessary with a baking soda-water solution. Be careful to avoid getting any of the solution into the cap vent holes. When solution stops bubbling, flush off battery with clean water.

Coat terminals with grease or oil felt terminal post washers after wires have been attached to retard corroding.

TESTING BATTERY

Use the following instructions for testing battery condition. As a guide for determining when to start or stop charging, check charge state in all cells (tests A and B). As a guide for determining battery condition, use load test B.

HOW TO TEST

Discharged, or less than 1/2 charged batteries (1.210 gravity) must be recharged in order to have charge sufficient for testing. Use hydrometer (A), or load tester (B), as follows:

A. Use of Hydrometer: (Refer to chart below)

BATTERY CHARGE CONDITION

State of Charge	Specific Gravity (A)
100%	1.250 – 1.270
75%	1.220 – 1.240
50%	1.190 – 1.210
25%	1.160 – 1.180

1. Be sure to correct reading for temperature extremes. For each 10° above 80°F. add 4 points, or deduct 4 points for each 10° below 80°F.

NOTE

Harley-Davidson Hydrometer, Part No. 96802-63, has built-in thermometer and correction chart and is recommended for testing all batteries.

2. Read gravity of each cell and record.

3. If any 2 cells vary more than 50 points, replace battery.

4. If cells are even or vary only slightly, battery is generally not "suspect."

B. Use of Load Tester

1. Never use on discharged batteries or batteries under 3/4 charged (1.240 sp. gr.).

NOTE

The Sun VAT-26 Tester (or equivalent) is recommended for load testing the battery.

2. Fully charge the battery before testing. Load battery to 3 x amp hour rating using the Sun VAT-26 Tester. (The Harley-Davidson 32 amperes hour battery should be loaded to 96 amperes and the 7 amperes hour battery to 21 amperes.) Voltage reading after 15 seconds should be 9.6 or more. Note that voltmeter leads must be connected directly to battery posts.

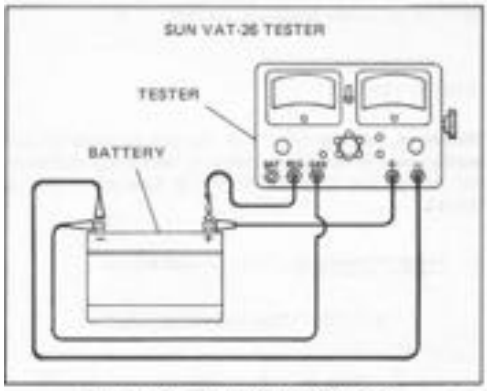


Figure 5-24. Testing Battery Capacity

CHARGING BATTERY

Never allow a battery to stand in a discharged condition. Start charging it at once at the recommended continuous charge rate. Be sure charger is properly connected and adjusted observing positive (+) and negative (–) polarity to battery.

To determine the amount or condition of a battery charge, check solution in each cell with a battery hydrometer. When hydrometer reading is 1.200 or less, battery is considered discharged and should be removed from motorcycle and charged at the following maximum continuous charge rate, using appropriate 12 volt charger.

12 volt 7 ampere hour battery – 1.5 amperes
12 volt 32 ampere hour battery – 4 amperes

A higher battery charge rate will heat and damage the battery. For this reason, do not allow the small motorcycle battery to be charged in the same line with large batteries. Hydrometer reading of a fully charged battery in good condition, with full strength electrolyte will be 1.270 or higher.

WARNING – Hydrogen gas, formed when charging, is explosive. Avoid open flame or electrical spark near battery.

Allowing a battery to remain in a discharged condition will shorten its life. It is important that a battery be kept well charged during below freezing weather.

RECLAIMING SULPHATED BATTERY

If a battery has been allowed to stand in a discharged condition for a period of time, the lead sulphate in the plates will crystallize and not take a charge at normal rates. Such batteries should be charged at half the specified continuous rate for twice the computed time. A longer charging time at a slower rate will many times break down the crystalline structure into active materials and restore the battery.

CHANGING ELECTROLYTE

In normal service with average care, it is never necessary to change electrolyte for the lifetime of the battery. However, if the battery solution is spilled, diluted as a result of careless water addition, or neutralized by the addition of an alkaline substance, the battery solution may be changed and in some cases near full capacity restored.

A weak acid solution may be detected by charging the battery until all cells gas freely and the gravity has not shown a rise for three successive readings taken at hourly intervals. "Gassing" is evidenced by a bubbling action in the electrolyte that may be detected by sight or sound. Do not change electrolyte in a battery with one or more cells that fail to gas. Such a condition indicates a structural failure.

Pour solution out of charged battery and fill with water. Charge battery again until maximum specific gravity is reached. Pour out this solution and add prepared battery electrolyte to specified level and charge again for a short length of time for full capacity.

Check specific gravity and add a little water if necessary to bring solution down to desired maximum limits.

The value of changing electrolyte in a fairly old battery is questionable. By tipping over such a battery to drain the solution, the sloughed-off waste materials accumulated by repeated charging and discharging actions might be dislodged from the sediment chambers in the bottom of the battery and deposited in the separators. This material is an electrical conductor and thus may "tree" or catch in the separators and cause a short circuit.

HORN

Horn is shown in figure 5-25. If the horn fails to blow or does not blow satisfactorily, check for loose, frayed or damaged wiring leading to horn terminals, discharged battery, etc. If these steps do not correct the trouble, turn in contact point adjusting screw, located back of horn, until horn just gives a single click – then retard screw until best tone is obtained. If horn fails to operate after moving adjusting screw, entire horn must be replaced because it is permanently riveted together. Mounting parts are replaceable.

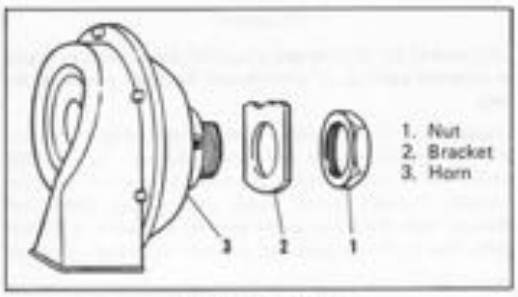


Figure 5-25. Horn

STARTER MOTOR

DESCRIPTION

The starter motor is a 12-volt, series field 4-pole drive motor which engages the clutch ring gear through a Bendix type drive and a reduction gear unit. A solenoid relay provides battery current directly to the motor. The solenoid is controlled by a button switch on the handlebar.

NOTE

Starter motor should never be operated continuously for more than 30 seconds without pausing to let it cool for at least two minutes. The motor is not designed for continuous operation and serious damage may result.

TROUBLESHOOTING

GENERAL

The starter motor is designed to be corrosion resistant and requires very little maintenance. However, to ensure satisfactory operation, periodic inspection of brushes and commutator should be made.

In the event starter motor fails to operate satisfactorily, the following checks should be made before removing motor for inspection:

WIRING

Make sure the mounting and wiring connections are tight and in good condition. The solenoid switch should be firmly mounted and all wiring connections should be clean and tight. Also inspect the connections to the battery and return circuit, as loose or dirty connections anywhere in the circuit will cause high resistance and reduced motor efficiency.

BATTERY

If the connections and wiring are found to be satisfactory, the battery should be checked to determine its state of charge (see "Changing Battery"). If the battery is charged and battery voltage is reaching the motor without any excessive losses in wiring or connections, the trouble may be attributed to either the engine or the starter motor itself.

SWITCHES

If the battery is charged but there is no current flow to motor at all, trouble is probably in handlebar button switch, RUN-OFF switch, or the solenoid switch. This can be determined by by-passing each switch with a heavy jumper (refer to "Wiring Diagram.")

ENGINE

Excessive friction in the engine from tight bearings or pistons or from heavy oil obviously makes engine harder to crank. However, if engine is known to be in normal condition and the rest of the starting system is satisfactory, the starter motor should be removed for further checking.

NOTE

Electrical tests to locate cause of starting system failures can be made using the Sun VAT-26® Tester or equivalent and applicable Service Bulletins.

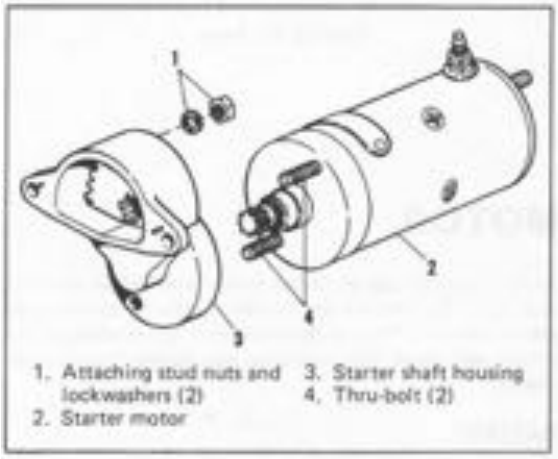
STARTER MOTOR AND DRIVE

REMOVING AND INSTALLING STARTER MOTOR

WARNING

Disconnect battery cables (negative cable first) to avoid accidental start-up of vehicle and possible personal injury.

Disconnect solenoid cable from starter motor terminal. Remove attaching nuts and lockwashers (1, figure 5-26) which fasten starter motor housing (3) to studs on chain housing. Remove starter motor end support plate (not shown) from transmission. It may be necessary to loosen and raise battery carrier to provide clearance. Remove starter motor (2) and starter shaft housing (3) from motorcycle as an assembly.



1. Attaching stud nuts and lockwashers (2)
2. Starter motor
3. Starter shaft housing
4. Thru-bolt (2)

Figure 5-26. Removing Starter Motor

PRESTOLITE STARTER MOTOR

DISASSEMBLING AND ASSEMBLING (Figure 5-27)

Remove thru bolts (1) with washers and lockwashers (2). Remove commutator end cover (3) holding brush plate (4) in place if necessary.

NOTE

End cover is marked with a double line next to the motor terminal. Also brush holder has a positioning notch which registers on the motor terminal insulator. See figure 5-28. Parts must be located correctly when reassembled.

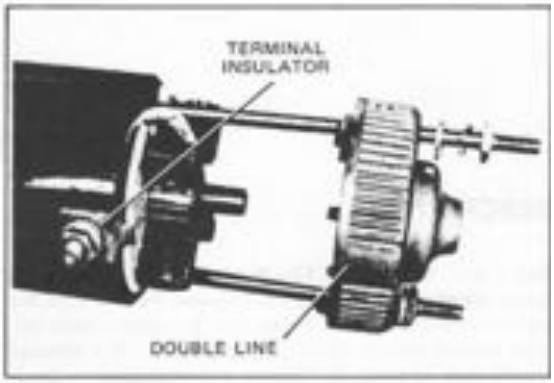
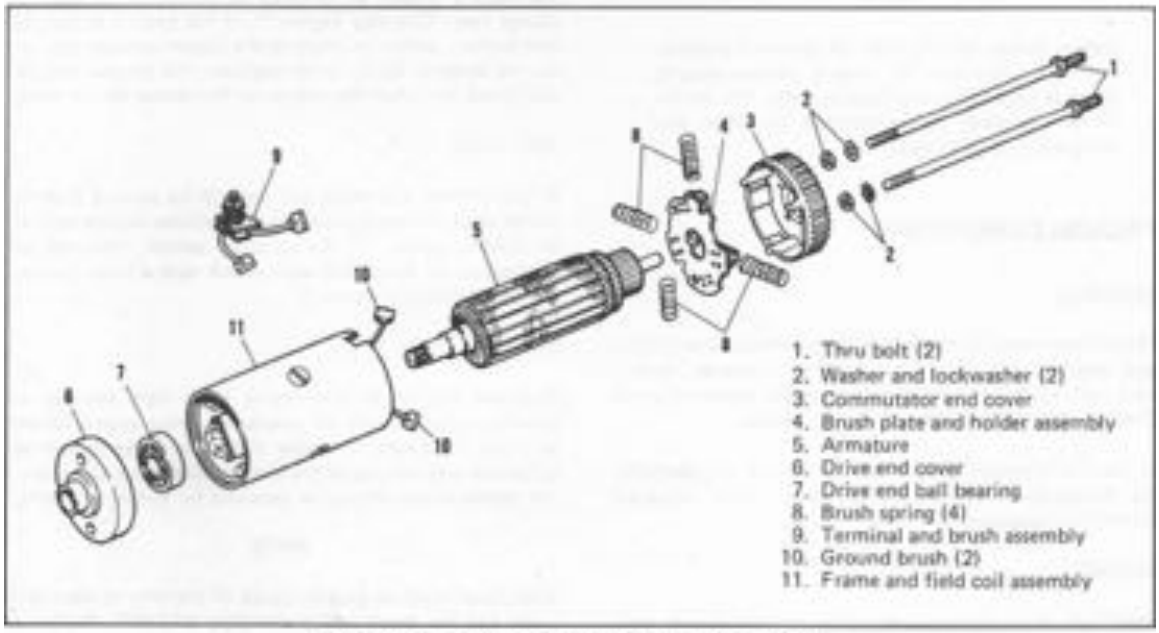


Figure 5-28. Positioning Prestolite Starter Motor Cover



1. Thru bolt (2)
2. Washer and lockwasher (2)
3. Commutator end cover
4. Brush plate and holder assembly
5. Armature
6. Drive end cover
7. Drive end ball bearing
8. Brush spring (4)
9. Terminal and brush assembly
10. Ground brush (2)
11. Frame and field coil assembly

Figure 5-27. Prestolite Starter Motor – Exploded View

Armature (5) and drive end cover (6) with bearing (7) are removed as an assembly. Bearing (7) is a light press fit on armature shaft and is staked in end cover (6).

NOTE

To prevent brushes from escaping holders, insert a spool of slightly larger diameter than the commutator underneath brushes when brushes are half exposed as armature is withdrawn from frame. In this way armature can be reinstalled without removing brushes from holders.

Reassembly is essentially the reverse of the disassembly procedure. If brushes (9 and 10) and springs (8) have been released from holder, use clips or clamps as shown in figure 5-29 to hold them in place while installing armature. Note that drive end of frame is notched to fit drive end cover. Line up positioning notch in the brush holder assembly with terminal insulator. Line up positioning mark on commutator end head with motor terminal. Install thru bolts, tightening to 20 to 25 in.-lbs. torque.

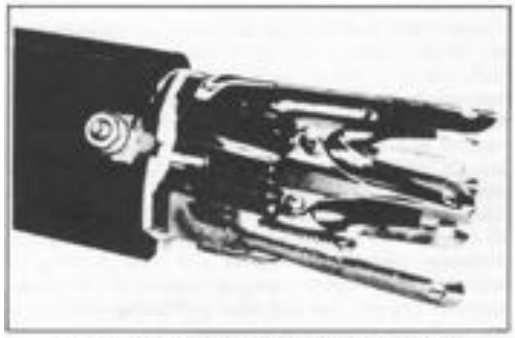


Figure 5-29. Using Clamps to Hold Prestolite Brushes in Place

HITACHI STARTER MOTOR

DISASSEMBLING AND ASSEMBLING (Figure 5-30)

Remove terminal nut, washer and lockwasher (1). Remove nuts and lockwashers (2) from thru bolts (3). Remove thru bolts with lockwashers (3). Remove two screws and lockwashers (4) fastening the rear cover.

Separate the rear cover (5) from the starting motor frame as follows: tap the rear cover with a soft hammer to make an opening between the rear cover and the frame. Next insert a screwdriver into the opening and push out the rear cover taking care to see that terminal and insulator (6) remain in place next to motor frame.

Lift the brushes from the commutator. As shown in Figure 5-31, pulling up the brush spring with a steel wire and pull out the brushes. Note that two negative brushes (7) have to be withdrawn slightly to be held in the brush-guide, making use of the action of the brush spring. The other two positive brushes (8) should be completely removed from the brush holder assembly (9) as shown in Figure 5-32.

Remove front cover (10), armature (11) with ball bearing (12) and thrust washer/s (13).

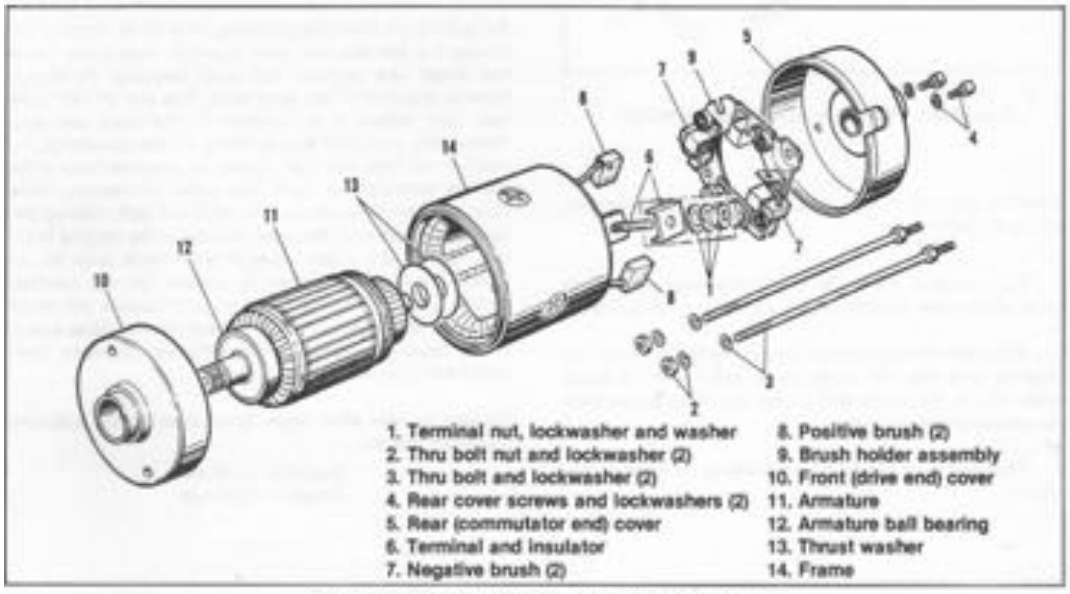


Figure 5-30. Hitachi Starter Motor – Exploded View

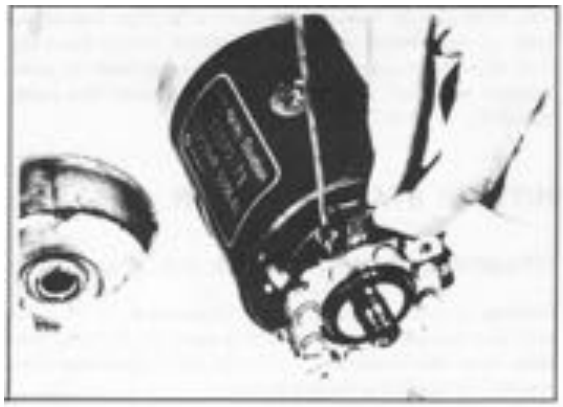


Figure 5-31. Removing Brushes – Hitachi Motor

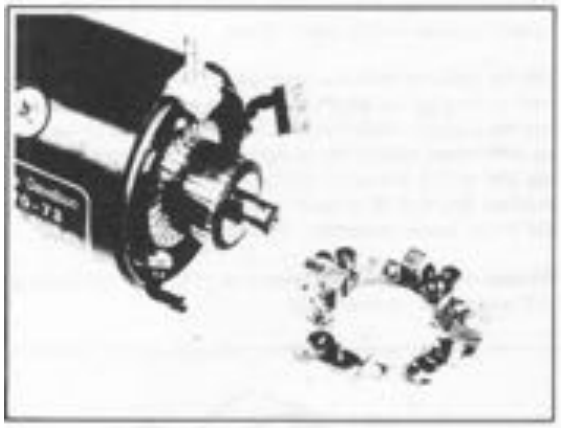


Figure 5-32. Hitachi Brushes and Brush Holder

Assemble starting motor in reverse order of disassembly; noting the following:

1. To determine the proper position of frame and front cover, align notch in cover with projected part of the frame.

2. After installing positive brushes in the brush holder and covering with the rear cover, align and fasten the brush holder to the rear cover with screws and lockwashers from the outside of the rear cover.

3. Thru bolt nuts should be tightened to 20 to 24 in.-lbs. torque.

PRESTOLITE AND HITACHI STARTER MOTORS

CHECKING FRAME AND FIELD ASSEMBLY

Due to the internal wiring and connections of the Prestolite frame and field assembly, there is no satisfactory field test to determine grounded or shorted field coils. If field coils are required on either Prestolite or Hitachi motors it is necessary, due to the method of installing field coils in this assembly, to replace the frame and field assembly. To test for field coils, using a test lamp, place one probe of test light against the frame. Place the other probe against each of the brushes attached to the field coils to indicate open or closed circuit.

REPAIRING ARMATURE

If commutator is dirty it can be cleaned by polishing with No. 00 sandpaper – not emery cloth. If commutator is worn, out of round or has high mica insulation between segments, commutator can be turned down in a lathe. Mica should then be undercut 1/32 in. deep with an undercutting machine and slots cleaned out to remove dirt or copper dust. If undercutting machine is not available, undercutting can be accomplished satisfactorily using a hacksaw blade. Commutator should then be sanded lightly with No. 00 sandpaper to remove any burrs left from undercutting procedure. Inspect commutator end cover bushing. If bushing is worn, replace complete commutator end cover assembly. Inspect drive end cover and bearing and replace bearing if worn to excessive looseness.

REPLACING BRUSHES

To replace the Prestolite insulated brushes (9, figure 5-27) remove the terminal and brush assembly from slot in frame and install new terminal and brush assembly. To replace brushes attached to the field coils, first cut off old brush lead wire where it is attached to the field coil lead. Thoroughly clean coil lead by filing off old connection. Insulation on field coil lead should be removed only as far back as necessary to make new solder connection. Using resin flux, solder brush lead to field coil lead, making certain brush lead is in the same position as the original brush lead. On Hitachi model negative brush leads must be unsoldered from brush holder to replace. Do not overheat brush leads or solder will run on wire strands and brush leads will no longer be flexible. Before reassembling motor, check brush connections for sufficient clearance from frame and from armature.

Replace brushes when worn down close to the following minimum lengths.

Prestolite – 1/4 inch
Hitachi – 7/16 inch

TOOLS

Order from Sun Electric Corp., Chicago, Ill.

Sun Power Timing Light, Model PTL-45

For testing state of charge of storage batteries. Specific gravity of electrolyte can be corrected for temperature extremes by means of built-in thermometer.

96802-63 Battery Hydrometer — with Temperature Correction Feature

Fits 14 mm spark plugs.

94575-58A Spark Plug Wrench

Clear plastic plug threads into crankcase timing hole for accurate ignition timing with strobe timing light.

96295-65 Timing Mark View Plug

95960-52A Alternator Rotor Puller

MISCELLANEOUS 6

TABLE OF CONTENTS

INSTRUMENTS

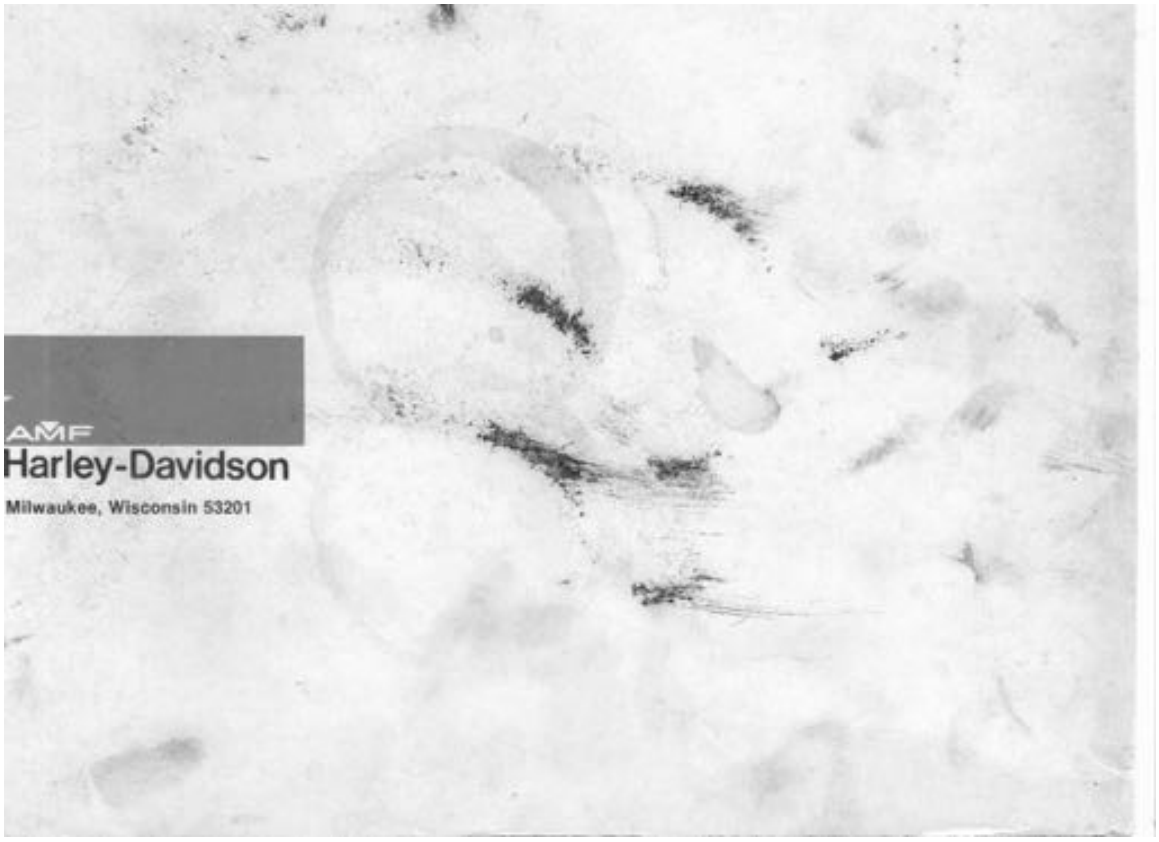
SPEEDOMETER

GENERAL

Lubricate cable core every 5,000 miles with graphite grease.

To lubricate the speedometer drive core or replace a damaged or broken core, proceed as follows:

On FL and FXS models, remove instrument panel cover. Remove screws that secure speedometer head to instrument panel base. Lift speedometer head as far as casing will permit, and with pliers, loosen case coupling nut from speedometer head. Withdraw core from casing. To free a broken core from casing, disconnect lower case coupling nut from speedometer drive unit. Withdraw core from lower case.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