SERVICE MANUAL

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KAWASAKI HEAVY INDUSTRIES, LTD.

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SERVICE MANUAL

——CONTENTS——

FOREWORD

This Shop Manual comprises the proper servicing procedures for Kawasaki Models A1, H1 and similar Models with Multi Cylinders two stroke engines. Following the steps described in this Manual will result in perfect maintenance with less trouble and time consumed. Also, the mechanics working on these models in accordance with the instructions contained in this Manual will be assured of providing the best service because the Manual specifies the limit and standards for all corrective steps in maintenance work. Careful reading of all sections before beginning work is recommended. Mechanics are also requested to use only genuine Kawasaki parts when replacing parts.

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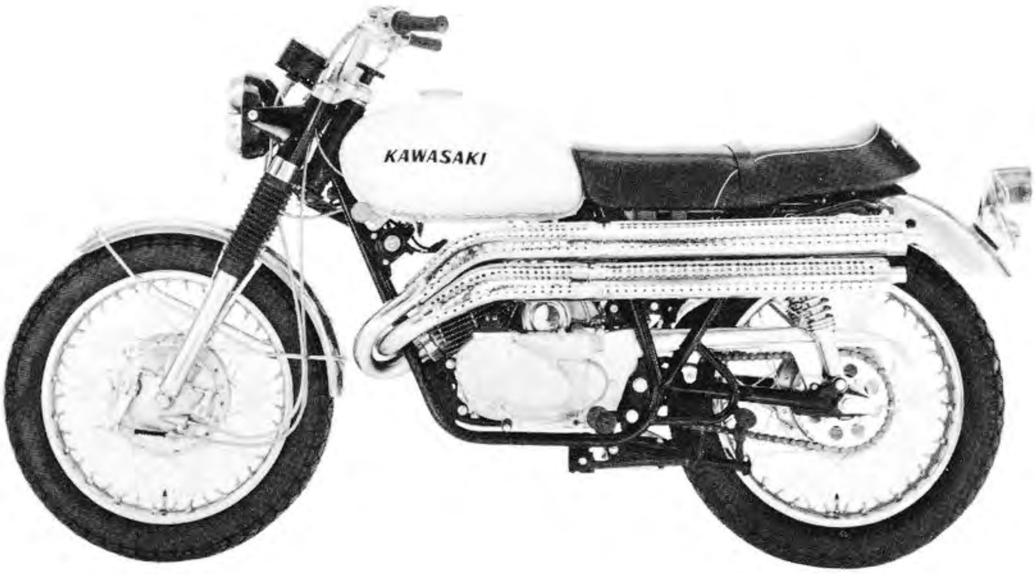

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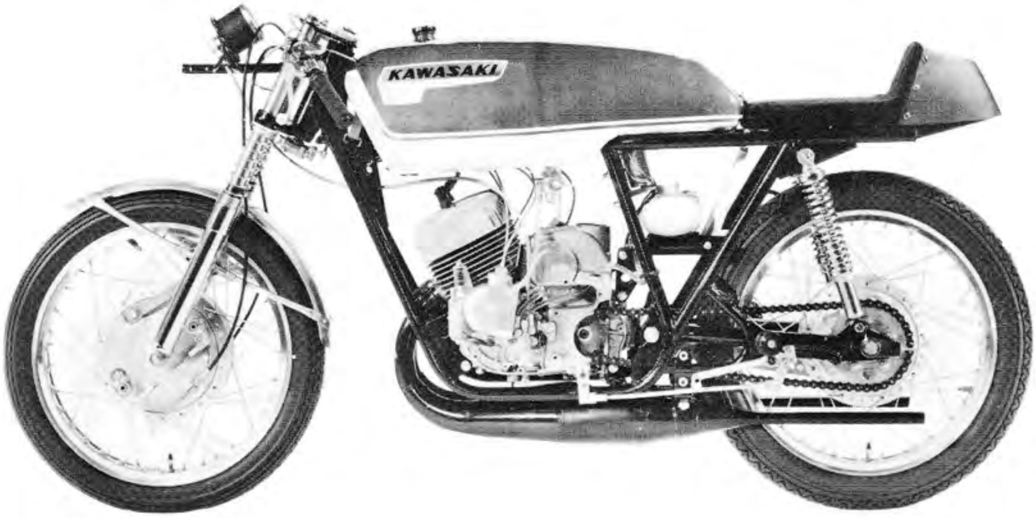

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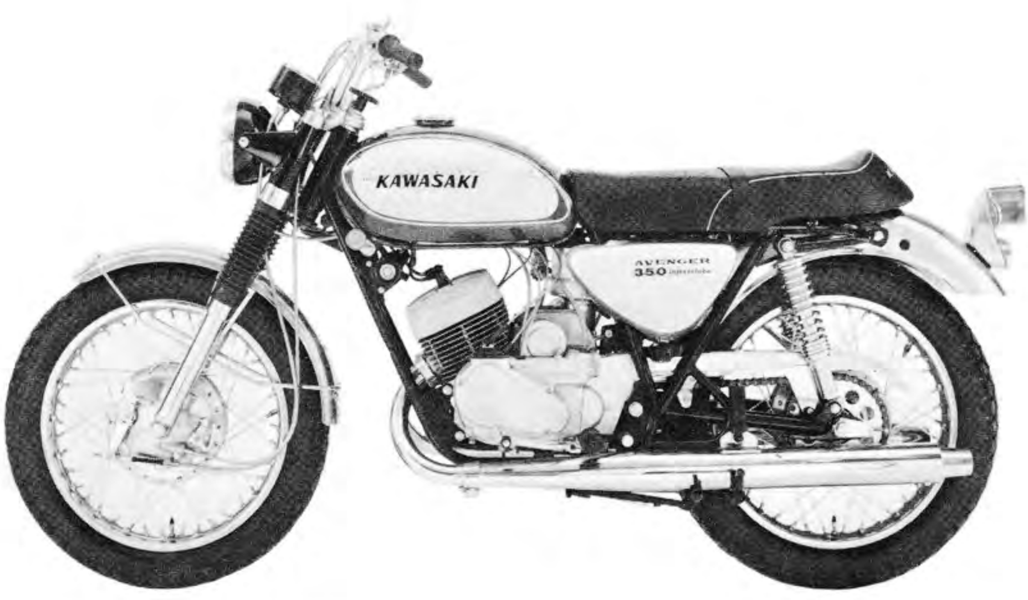

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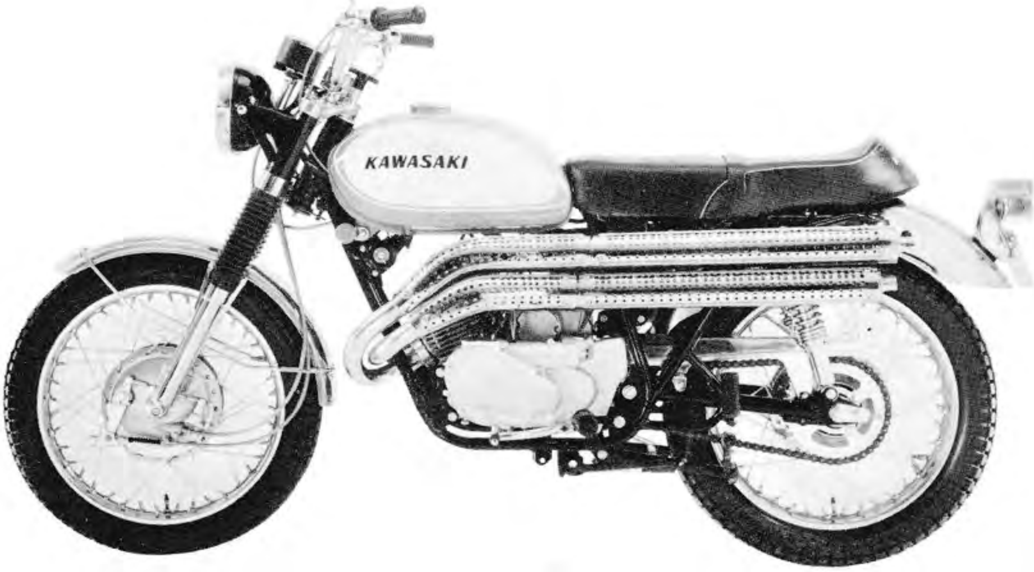


H 1

I. SPECIFICATIONS

1. Specifications

Series / Item		250 cc			350 cc
		A 1	A 1 S S	A 1 R	A 7
Dimension	Overall Length	78.3 in (1,990mm)	78.3 in (1,990mm)	75.4 in(1,915mm)	79.1 in (2,010mm)
Dimension	Overall Width	31.9 in (810mm)	32.6 in (830mm)	22.8 in(580mm)	31.9 in (810mm)
Dimension	Overall Height	43.1 in (1,095mm)	42.5 in (1,080mm)	37.2 in(945mm)	43.5 in (1,105mm)
Dimension	Wheelbase	51.2 in (1,300mm)	51.0 in (1,300 mm)	51.0 in(1,295mm)	51.0 in (1295mm)
Dimension	Road Clearance	6.5 in (165mm)	6.7 in (170mm)	4.9 in(125mm)	6.5 in (165mm)
Dimension	Dry Weight	318.5 lb (145kg)	323.3 lb (147kg)	239.7lb (109kg)	327.7 lb (149kg)
Performance	Maximum Speed	103mph(165 kph)	103mph(165 kph)	125mph(200 kph)	109mph(175 kph)
Performance	Fuel Consumption	80mie/ℓ(35km/ℓ)	80mie/ℓ(35km/ℓ)	—	80mil/ℓ(35km/ℓ)
Performance	Climbing Ability	38°	39°	—	40°
Performance	Braking Distance	39 ft/31 mph(12m/50 kph)	39 ft/31 mph(12m/50 kph)	—	39 ft/31 mph(12m/50 kph)
Performance	Minimum Turning Radius	86.6 in(2,200mm)	86.6in (2,200mm)	150.0 in(3,808mm)	86.6 in(2,200mm)
Engine	Type	2-cycle 2 cylinder Rotary Disc Valve	2-cycle 2 cylinder Rotary Disc Valve	2-cycle 2 cylinder Rotary Disc Valve	2-cycle 2 cylinder Rotary Disc Valve
Engine	Bore x Stroke	2.09×2.21 in(53×56mm)	2.09×2.21 in(53×56mm)	2.09×2.21 in(53×56mm)	2.44×2.21 in(62×56mm)
Engine	Displacement	15.07 cu-in(247cc)	15.07 cu-in(247cc)	15.07 cu-in(247cc)	20.63 cu-in(338cc)
Engine	Compression Ratio	7.0 : 1	7.0 : 1	8.0 : 1	7.0 : 1
Engine	Maximum Horsepower	31 hp/8,000 rpm	31 hp/8,000 rpm	40 hp/9,500 rpm	42 hp/8,000 rpm
Engine	Maximum Torque kg-m/ft-lb /rpm	21.1/2.92/7,500	21.1/2.92/7,500	21.7/3.00/8,500	28.9/3.99/7,000
Engine, Valve Timing	Inlet Open BTC	112°	112°	130°	112°
Engine, Valve Timing	Inlet Close ATC	65°	65°	70°	65°
Engine, Valve Timing	Scavenging Open BBC	58°	58°	62°	60°
Engine, Valve Timing	Scavenging Close ABC	58°	58°	62°	60°
Engine, Valve Timing	Exhaust Open BBC	89°	89°	94.5°	91°
Engine, Valve Timing	Exhaust Close ABC	89°	89°	94.5°	91°
Engine	Carburetor Type (MIKUNI)	(2) VM22SC	(2) VM22SC	(2)M26R	(2)VM28SC
Engine	Fuel Tank Capacity	3.5gal(13.5liters)	3.5gal(13.5liters)	5.3gal(20liters)	3.5gal(13.5liters)
Engine	Lubrication System	Super Lube Oil Injection	Super Lube Oil Injection	Super Lude and Gasoline Oil -	Inject Lube Oil Injection
Engine	Engine Oil	2-stroke engine oil	2- stroke engine oil	(15:1)Mixing	2-stroke engine Oil
Engine	Oil Tank Capacity	2.4qt(2.2 liters)	2.4qt(2.2 liters)	1.05qt(1 liters)	2.4qt(2.2 liters)
Engine	Starting System	Kick Starter	Kick Starter	Push bump or Kick	Kick Starter
Engine	Ignition System	Battery and Coil	Battery and Coil	Magneto	Battery and Coil
Engine	Ignition Type	Convention / C. D. I	Convention / C. D. I	Covention / C. D. I	Convention / C. D. I
Engine	Ignition Timing (Before TDC)	23° / 25°	23° / 25°	23° / —	23° / 25°
Engine, Spark Plug	N G K	B-9HC / —	B-9HC / —	B-10EN / —	B-9HC / —
Engine, Spark Plug	HITACHI	— / —	— / —	— / —	— / —
Engine, Spark Plug	DENSO	— / —	— / —	— / —	— / —
Engine, Spark Plug	CHAMPION	L-60T / UL-19V	L-60T / UL-19V	L-55T / —	L-60T / UL-19V
Engine, Spark Plug	AUTOLITE	— / —	— / —	AE-403 / —	— / —
Engine, Spark Plug	BOSCH	W340T16 / —	W340T16 / —	W370T16 / —	W340T16 / —
Engine, Spark Plug	K L G	F290 / —	F290 / —	— / —	F290 / —
Engine, Spark Plug	LODGE	R-50 / —	R-50 / —	— / —	R-50 / —

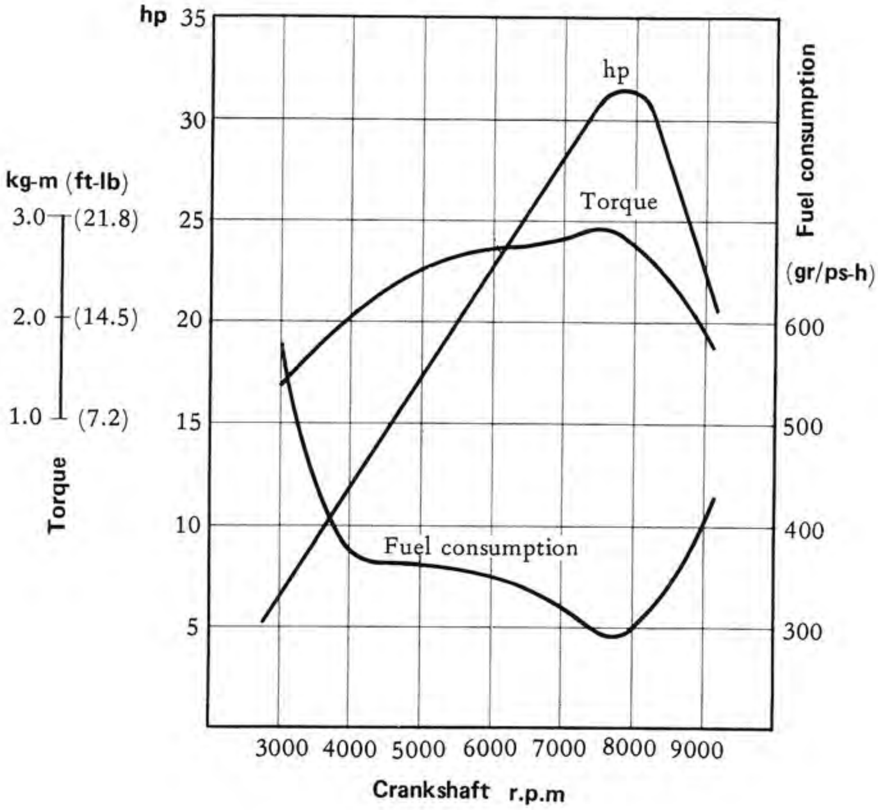
Item \ Series		350 cc A7SS	350 cc A7R	500 cc H1
Dimension	Overall Length	78.7 in (2,000mm)	75.4 in (1,915mm)	82.5 in (2,095mm)
	Overall Width	32.7 in (830mm)	22.8 in (580mm)	33.1 in (840mm)
	Overall Height	42.0 in (1,070mm)	37.2 in (945mm)	42.5 in (1,080mm)
	Wheelbase	51.0 in (1,295mm)	51.0 in (1,295mm)	55.1 in (1,400mm)
	Road Clearance	6.7 in (170mm)	4.9 in (125mm)	5.3 in (135mm)
	Dry Weight	329.0 lbs(149kg)	240.0 lbs(109kg)	382.0 lbs(174kg)
Performance	Maximum Speed	109mph(175 kph)	138mph(220 kph)	190 kph(118mph)
	Fuel Consumption	80mil/ℓ(35km/ℓ)	—	33km/ℓ(55mil/gal)
	Climbing Ability	40°	—	40°
	Braking Distance	39 ft/31mph(12m/50 kph)	—	10.5m/50 kph(34.5 ft/31mph)
	Minimum Turning Radius	86.6 in(2,200mm)	150.0 in(3,808mm)	90.5 in(2,300mm)
Engine	Type	2-cycle 2 cylinder Rotary Disc Valve	2-cycle 2 cylinder Rotary Disc Valve	2-cycle 3 cylinder Piston Valve
	Bore x Stroke	2.44×2.21 in(62×56mm)	2.48×2.21 in(63×56mm)	2.36×2.31in(60×58.8mm)
	Displacement	20.63 cu-in(338cc)	21.30 cu-in(349cc)	30.4 cu-in(498cc)
	Compression Ratio	7.0 : 1	7.7 : 1	6.8 : 1
	Maximum Horsepower	42 hp/8,000 rpm	53 hp/9,500 rpm	60 hp/7,500 rpm
	Maximum Torque kg-m / ft-lb /rpm	28.9 / 3.99 /7,000	29.2 / 4.04 /9,500	4 23 / 5.85 /7,000
	Valve Timing: Inlet Open BTC	112°	130°	76°
	Valve Timing: Inlet Close ATC	65°	70°	76°
	Valve Timing: Scavenging Open BBC	60°	63°	59.5°
	Valve Timing: Scavenging Close ABC	60°	63°	59.5°
	Valve Timing: Exhaust Open BBC	91°	98.5°	89°
	Valve Timing: Exhaust Close ABC	91°	98.5°	89°
	Carburetor Type (MIKUNI)	(2) VM28SC	(2) M29	(3) VM28SC
	Fuel Tank Capacity	3.5gal(13.5liters)	5.3gal(20liters)	4.0gal(15liters)
	Lubrication System	Inject Lube Oil Injection	Inject Lube and Gasoline Oil (15:1)Mixing	Inject Lube Oil Injection
	Engine Oil	2-stroke engine oil		2-storoke engine oil
	Oil Tank Capacity	2.4 qt(2.2 liters)	1.05 qt(1 liters)	2.5qt(2.3 liters)
	Starting System	Kick Starter	Push bump or Kick	Kick Starter
	Ignition System	Battery and Coil	Magneto	Battery and Coil
	Ignition Type	Convention / C. D. I	Convention / C. D. I	Convention / C. D. I
	Ignition Timing (Before TDC)	23° / 25°	27° / —	25° / 25°
	Spark Plug: N G K	B-9HC / —	B-10EN / —	B-9HC / —
	Spark Plug: HITACHI	— / —	— / —	— / —
	Spark Plug: DENSO	— / —	— / —	— / UL-19V
	Spark Plug: CHAMPION	L60T / UL-19V	L-55T / —	L-60T / —
	Spark Plug: AUTOLITE	— / —	AE403 / —	— / —
	Spark Plug: BOSCH	W340T16 / —	W370T16 / —	W340T16 / —
	Spark Plug: K L G	F290 / —	— / —	F290 / —
	Spark Plug: LODGE	R-50 / —	— / —	R-50

Item		Series: 250 cc A 1	250 cc A 1 S S	250 cc A 1 R	350 cc A 7
Transmission	Type	5-speed, constant mesh, return change	5-speed, constant mesh, return change	5-speed, constant mesh, return change	5-speed, constant mesh, return change
Transmission	Gear Ratio Low	2.50	2.50	2.06 (33/16)	2.50
Transmission	Gear Ratio 2nd	1.53	1.53	1.47 (28/19)	1.53
Transmission	Gear Ratio 3rd	1.13	1.13	1.18 (26/22)	1.13
Transmission	Gear Ratio 4th	0.92	0.92	1.00 (24/24)	0.92
Transmission	Gear Ratio 5th	0.78	0.78	0.89 (23/26)	0.78
Transmission	Primary Reduction Ratio	3.40 (51/15)	3.40 (51/15)	3.35 (57/17)	3.40 (51/15)
Transmission	Final Reduction Ratio	2.46 (37/15)	2.60 (39/15)	1.81 (29/16)	2.40 (36/15)
Transmission	Overall Drive Ratio	6.32	6.52	5.38	6.36
Transmission	Transmission Oil	SAE#30	SAE#30	SAE#10W30	SAE#30
Transmission	Transmission Oil Capacity	1.27qt(1.2ℓ)	1.27qt(1.2ℓ)	1.27qt(1.2ℓ)	1.27qt(1.2ℓ)
Clutch	Type	Heavy duty multiple disk, Wet plate	Heavy duty multiple disk, Wet plate	Heavy duty multiple disk, Wet plate	Heavy duty multiple disk, Wet plate
Electrical Equipment	Ignition Type	Convention C. D. I	Convention C. D. I	Convention C. D. I	Convention C. D. I
Electrical Equipment	Generator Made By	KOKUSAN MITSUBISHI	KOKUSAN MITSUBISHI	KOKUSAN —	KOKUSAN MITSUBISHI
Electrical Equipment	Generator Type	EN10 AW2010A	EN10 AW2010A	EN04	EN8 AW2010A
Electrical Equipment	Regurator Made By	KOKUSAN MITSUBISHI	KOKUSAN MITSUBISHI	— —	KOKUSAN MITSUBISHI
Electrical Equipment	Regurator Type	ZR 905 RL2128T	ZR 905 RL2128T		ZR 905 RL2128T
Electrical Equipment	Ignition Coil Made By	DIAMOND DIAMOND	DIAMOND DIAMOND	KOKUSAN —	DIAMoND DIAMoND
Electrical Equipment	Ignition Coil Type	TU-25M-7 TU-51-1	TU-25M-7 TU-51-1	ST-70	TU-25M-7 TU-51-1
Electrical Equipment	Battery Type	12N6-4A	12N6-4A	—	12N6-4A
Electrical Equipment	Battery Capacity	12V 6AH	12V 6AH		12V 6AH
Electrical Equipment	Head Lamp Type	Semi-sealed beam	Semi-sealed beam	—	Semi-sealed beam
Electrical Equipment	Head Lamp Bulb	12V, 35/25W	12V, 35/25W	—	12V, 35/25W
Electrical Equipment	Tail/Brake Lamp Bulb	12V, 8/25W(4/32 cp)	12V, 8/25W(4/32 cp)		12V, 8/25W(4/32cp)
Electrical Equipment	Speedometer Lamp Bulb	12V, 3W	12V, 3W	—	12V, 3W
Electrical Equipment	Neutral Indicator Lamp Bulb	12V, 3W	12V, 3W	—	12V, 3W
Electrical Equipment	Tochometer Indicator Lamp Bulb	12V, 3W	12V, 3W	—	12V, 3W
Electrical Equipment	Charge Indicator Lamp Bulb	12V, 3W	12V, 3W	—	12V, 3W
Electrical Equipment	High Beam Indicator Bulb	12V, 1.5W	12V, 1.5W	—	12V, 1.5W
Electrical Equipment	Turn Signal Lamp Bulb	12V, 8W	12V, 8W	—	12V, 8W
Frame	Type	Tubular, double cradle	Tubular, double cradle	Tubular, double cradle	Tubular, double cradle
Frame	Steering angle	40°	40°	40°	40°
Frame	Caster	63°	63°	63°	63°
Frame	Trail	3.4 in(86mm)	3.4 in(86mm)	3.4 in(86mm)	3.6 in(91mm)
Frame	Tire Size Front	3.00−18, 4PR	3.00−18, 4PR	2.75−18, 4PR	3.25−18, 4PR
Frame	Tire Size Rear	3.25−18, 4PR	3.50−18, 4PR	3.00−18, 4PR	3.50−18, 4PR
Frame	Suspension Front	Telescopic Fork	Telescopic Fork	Telescopic Fork	Telescopic Fork
Frame	Suspension Rear	Swinging Arm	Swinging Arm	Swinging Arm	Swinging Arm
Frame	Damperstrok Front	4.3in(110mm)	4.3in(110mm)	4.7 in(120mm)	4.3 in(110mm)
Frame	Damperstrok Rear	2.8in(70mm)	2.8in(70mm)	2.8 in(70mm)	2.8 in(70mm)
Frame	Front Fork Oil Capacity (each fork)	0.22 qt(200cc)	0.22 qt(200cc)	0.24qt(200cc)	0.22 qt(200cc)
Frame	Mixing Ratio Mobil Oil : Spindle Oil	8 : 2	8 : 2	8 : 2	8 : 2
Brake	Diameter width in Front	7.1×1.2in(180×30mm)	7.1×1.2in(180×30mm)	7.9×0.8 in(200×20mm)	7.1×1.2in(180×30mm)
Brake	Diameter width in Rear	7.1×1.2in(180×30mm)	7.1×1.2in(180×30mm)	7.1×1.4 in(180×36mm)	7.1×1.2in(180×30mm)

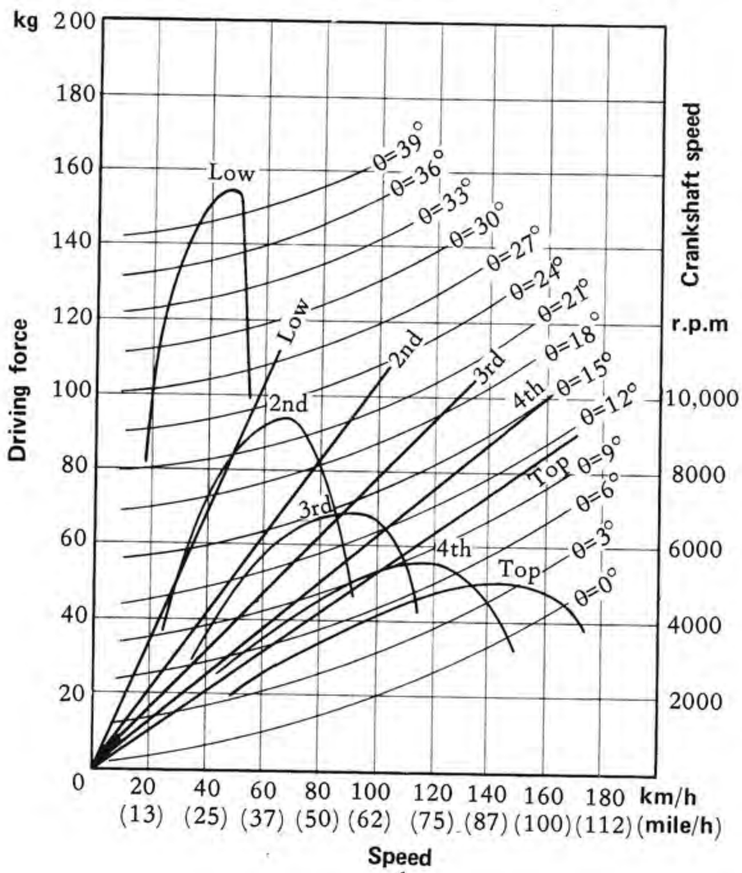
Item			Series: 350 cc A7SS	350 cc A7R	500 cc H1
Transmission	Type		5-speed, constant mesh, return change	5-speed, constant mesh, return change	5-speed, constant mesh, return change
	Gear Ratio	Low	2.50	2.06 (33/16)	2.20
		2nd	1.53	1.47 (28/19)	1.40
		3rd	1.13	1.18 (26/22)	1.09
		4th	0.92	1.00 (24/24)	0.92
		5th	0.78	0.89 (23/26)	0.81
	Primary Reduction Ratio		3.40 (51/15)	3.35 (57/17)	2.41 (65/27)
	Final Reduction Ratio		2.40 (36/15)	1.81 (29/16)	3.00 (45/15)
	Overall Drive Ratio		6.36	5.38	5.84
	Transmission Oil		SAE #30	SAE #10W30	SAE #10W30
	Transmission Oil Capacity		1.27qt(1.2 ℓ)	1.27qt(1.2 ℓ)	1.70qt(1.6 ℓ)
Clutch	Type		Heavy duty multiple disk, Wet plate	Heavy duty multiple disk, Wet plate	Heavy duty multiple disk. Wet plate
Electrical Equipment	Ignition Type		Convention C. D. I	Convention C. D. I	Convention C. D. I
	Generator	Made By	KOKUSAN MITSUBISHI	KOKUSAN —	MITSUBISHI MITSUBISHI
		Type	EN8 AM2010A	EN04	AZ-2010M AZ-2010A
	Regurator	Made By	KOKUSAN MITSUBISHI	— —	MITSUBISHI MITSUBISHI
		Type	ZR905 RL2128T		RL-2128T RL-T
	Ignition Coil	Made By	DIAMOND DIAMOND	KOKUSAN —	DIAMOND DIAMOND
		Type	TU-25M-7 TU-51-1	ST-70	TU-25 TU-51-2
	Battery	Type	12N 6—4A	—	12N 9—4B
		Capacity	12V 6AH		12V 9AH
	Head Lamp Type		Semi-sealed beam	Semi-sealed bam	Semi-sealed beam
	Head Lamp Bulb		12V 35/25W	—	12V 35/25W
	Tail/Brake		12V8/25W(4/32cp)	—	12V8/25W(4/32 cp)
	Speedometer Lamp Bulb		12V, 3W	—	12V, 3W
	Neutral Indicator Lamp Bulb		12V, 3W	—	12V, 3W
	Tochometer Indicator Lamp Bulb		12V, 3W	—	12V, 3W
	Charge Indicator Lamp Bulb		12V, 3W	—	12V, 3W
	High Beam Indicator Bulb		12V, 1.5W	—	12V, 1.5W
	Turn Signal Lamp Bulb		12V, 8W	—	12V, 8W
Frame	Type		Tubular double crade	Tubular, double cradle	Tubular, double cradle
	Steering angle		40°	40°	42°
	Caster		63°	63°	61°
	Trail		3.6 in(91mm)	3.6 in(91mm)	4.3 in(110mm)
	Tire Size	Front	3.25—18, 4PR	2.75—18, 4PR	3.25—19, 4PR
		Rear	3.50—18, 4PR	3.00—18, 4PR	4.00—18, 4PR
	Suspension	Front	Telescopic Fork	Telescopic Fork	Telescopic Fork
		Rear	Swinging Arn	Swinging Arn	Swinging Arn
	Damperstrok	Front	4.3in(110mm)	4.7 in(120mm)	5.5 in(140mm)
		Rear	2.8in(70mm)	2.8 in(70mm)	2.8 in(70mm)
	Front Fork Oil Capacity (each fork)		0.22 qt(200cc)	0.24 qt(220cc)	0.25 qt(230cc)
	Mixing Ratio	Mobil Oil / Spindle Oil	8 : 2	8 : 2	6 : 4
Brake	Diameter widthin	Front	7.1×1.2 in(180×30mm)	7.9×0.8 in(200×20mm)	7.9×1.4in(200×35mm)
		Rear	7.1×1.2 in(180×30mm)	7.1×1.4 in(180×36mm)	7.1×1.4in(180×35mm)

2. Performance Curves

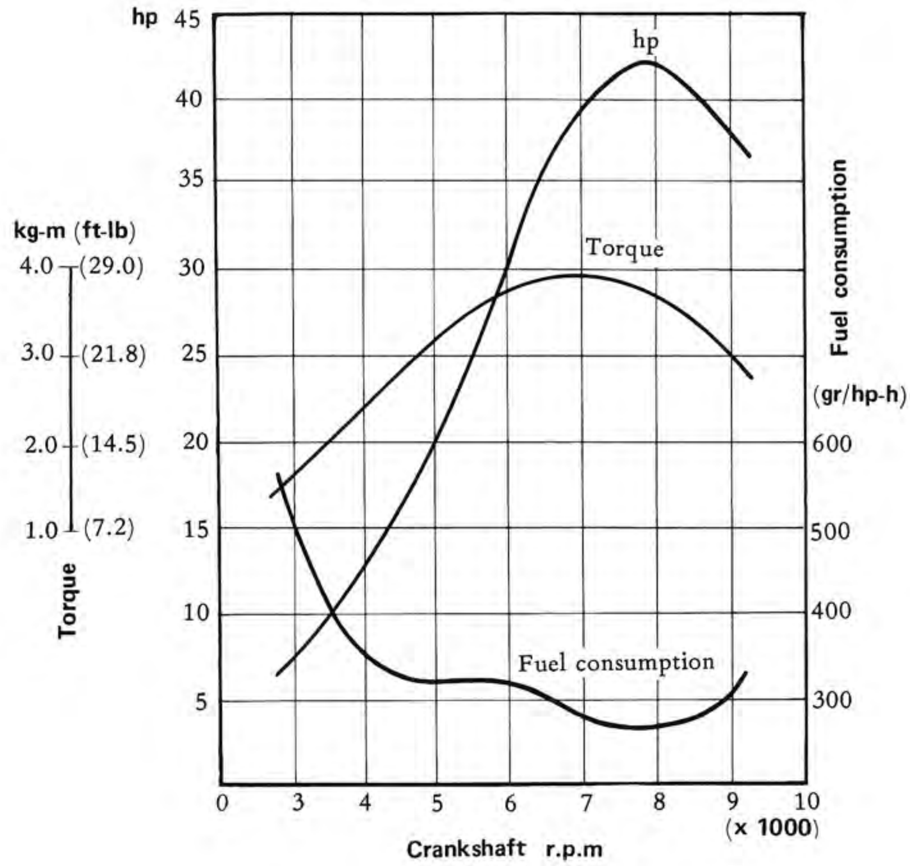
A 1 Series Engine Performance Curves



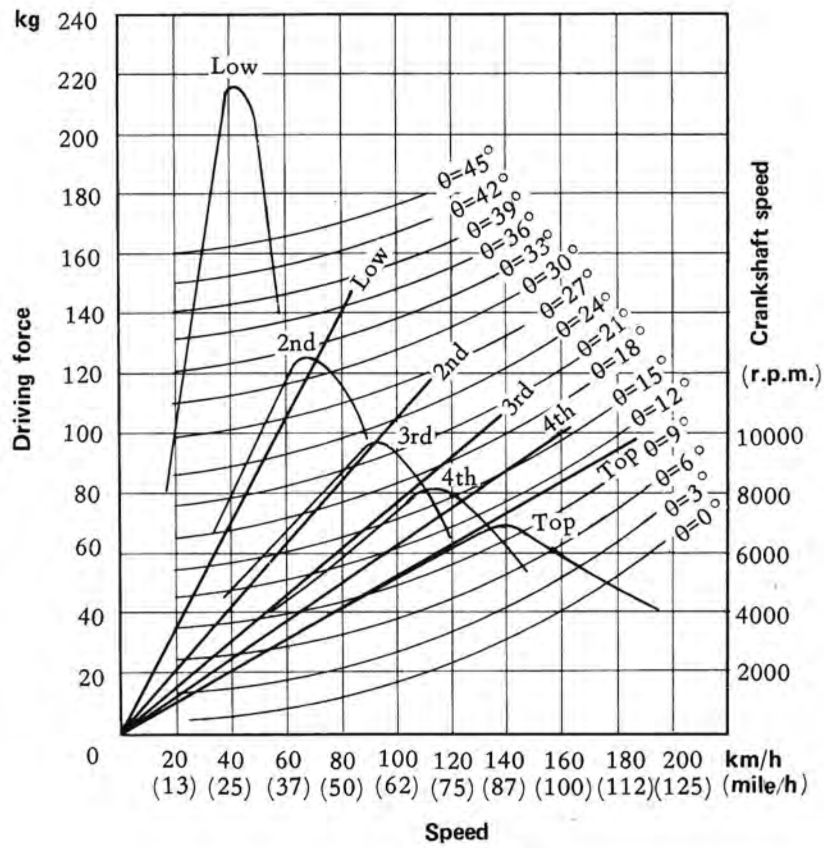
A 1 Series Running Performance Curves



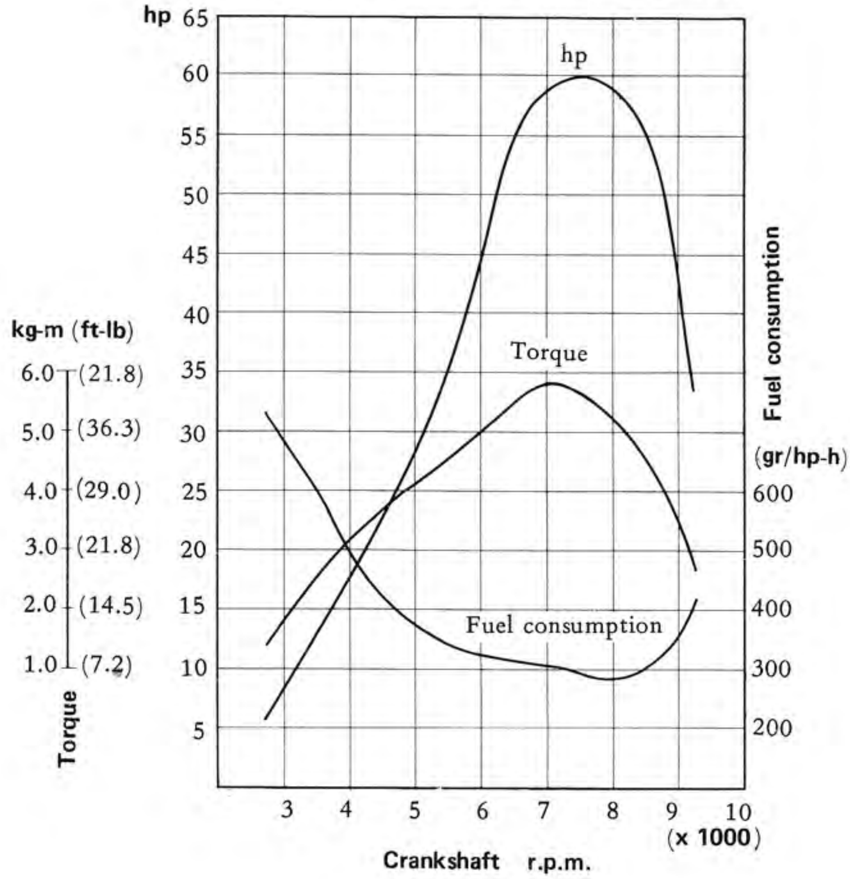
A 7 Series Engine Performance Curves



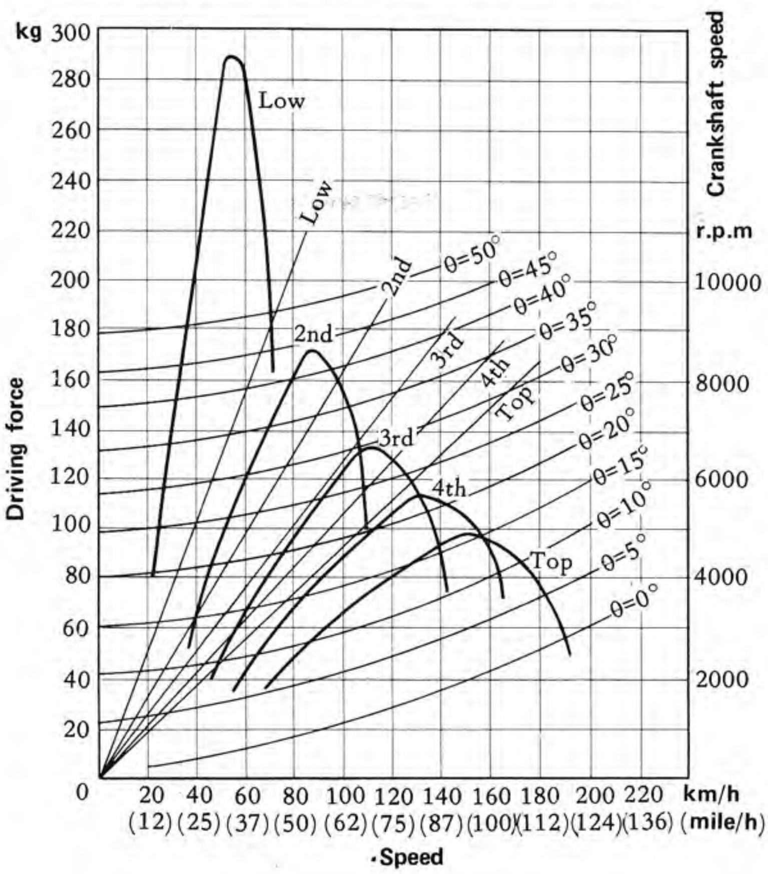
A 7 Series Runing Performance Curves



H 1 Series Engine Perfomance Curves



H 1 Series Running Performance Curves



II. DISMANTLING, INSTALLATION, AND ADJUSTMENT OF ENGINE

1. Components of the engine

The engine can be roughly divided into the following components.

[H series]

Fig. 2-1

1) Air cleaner
2) Cylinders, Cylinder heads
3) Pistons, Piston pins
4) Piston rings
5) R.H. engine cover, Distributor
6) Oil pump
7) Clutch release
8) Primary gear
9) Clutch
10) Gear change mechanism
11) AC generator
12) Engine sprocket
13) Crankcase
14) Crankshaft
15) Transmission gears
16) Kickstarter
17) Carburetors

[A series]

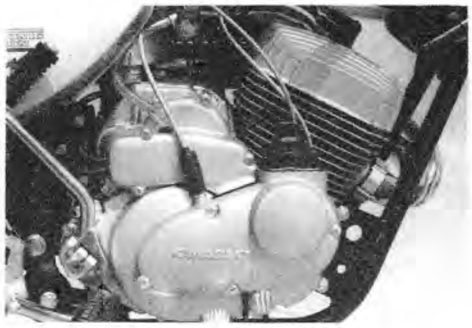


Fig. 2-2

1) Air cleaner
2) Cylinders, Cylinder heads
3) Pistons, Piston pins
4) Piston rings
5) R.H. engine cover
6) Oil pump
7) Clutch release
8) Primary gear
9) Clutch
10) L.H. engine cover
11) Rotary disc valves
12) Gear change mechanism
13) AC generator
14) Engine sprocket
15) Crankcase
16) Crankshaft
17) Transmission gears
18) Kickstarter
19) Carburetors

NOTE

When completely disassembling the engine, follow the order listed above.

2. Minor disassembly of the engine

The engine can be disassembled to a certain extent without removing it from the frame. Inspect and repair it according to the following procedure.

[H series] **[A series]**

1) **Cylinder head** → cylinder → piston ring
→ Piston pin → Piston
→ Small end needle bearing

Fig. 2-3

Fig. 2-4

2) **Oil pump cover**
↓ Distributor cap. → Oil pump

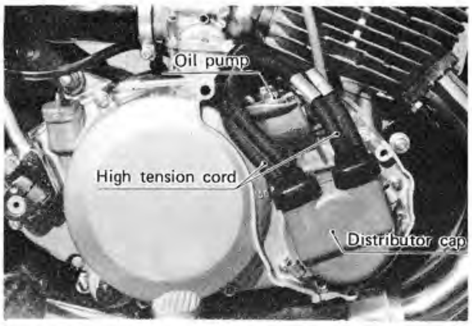


Fig. 2-5

2) **R.H carburetor cover**
↓ R.H carburetor. → Clutch release

Fig. 2-6

R.H engine cover
↙ clutch. ↘ Primary pinion

R.H engine cover
↙ Clutch. ↘ Primary pinion

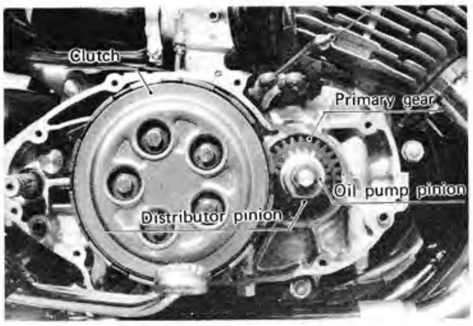


Fig. 2-7

Gear change mechanism

3) L.H Engine cover

AC generator

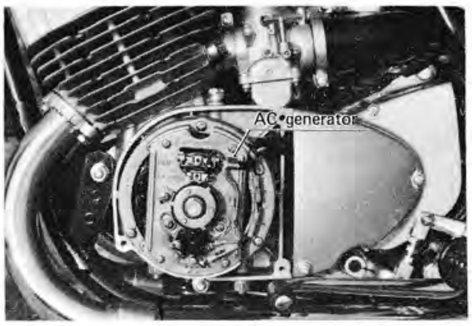


Fig. 2-9

4) Front chain cover

Drive chain
Engine sprocket ——> Clutch release.

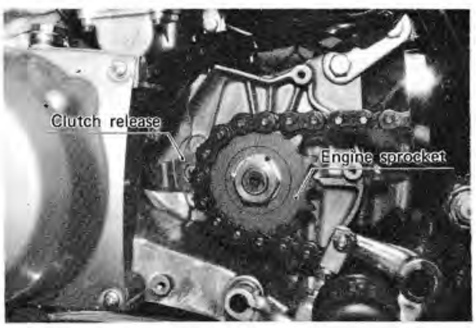


Fig. 2-11

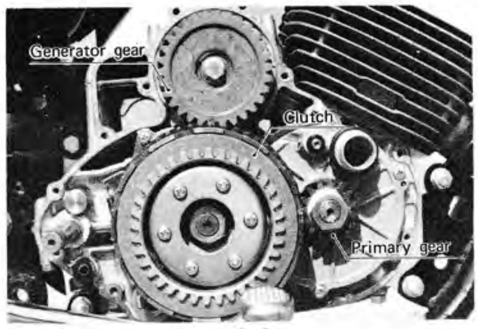


Fig. 2-8

R.H rotary disc valve cover.
↓
R.H rotary disc valve

Gear change mechanism

3) L.H carburetor cover

↓
L.H carburetor → Oil pump
↓

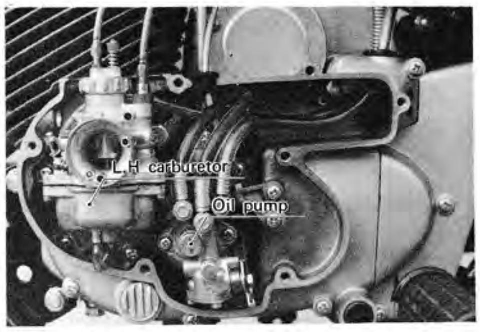


Fig. 2-10

↓
L.H. rotary disc valve cover cap
↓
L.H engine cover

Drive chain cover

Drive chain
↓
Engine sprocket

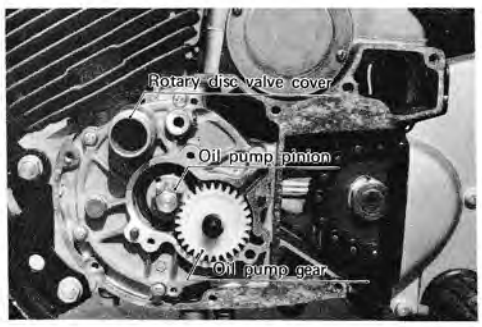


Fig. 2-12

5) L.H side cover

↓

Air inlet pipe

↓

Air cleaner element

Fig. 2-14

↓

L.H rotary disc valve cover

↓

L.H rotary disc valve

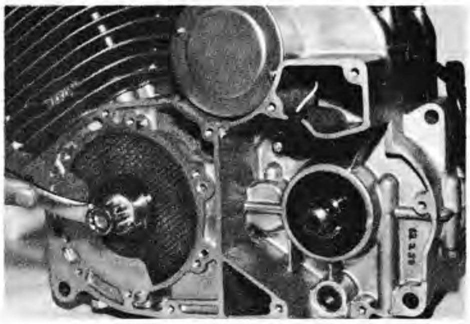


Fig. 2-13

4) L.H side cover

↓

Air cleaner

Fig. 2-15

3. Removing the engine

Before removing the engine from frame, remove the fuel tank (only in H series), exhaust pipes, air cleaner, carburetors, drive chain, change pedal, cables (clutch, oil pump and tachometer), wirings of the AC generator and high tension cords. According to the following procedure, they can be removed quickly and efficiently.

[H series]

1) Removing the fuel tank

a. Turn the fuel cock to ON, pull out the fuel pipes from the carburetors.

[A series]

NOTE

It is not necessary to remove the fuel tank in the A series.

b. Open the seat and remove the fitting bolts to take off the fuel tank.

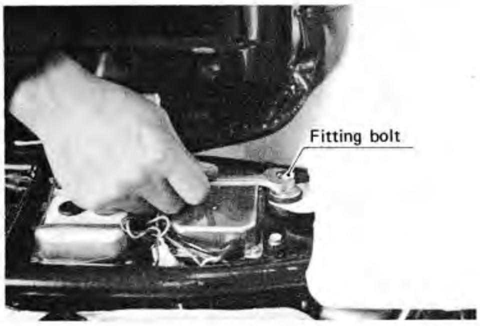


Fig. 2-16

2) Removing the exhaust pipes.

Remove fitting bolts on the each exhaust pipe and the muffler, take off the exhaust pipes with the muffler.

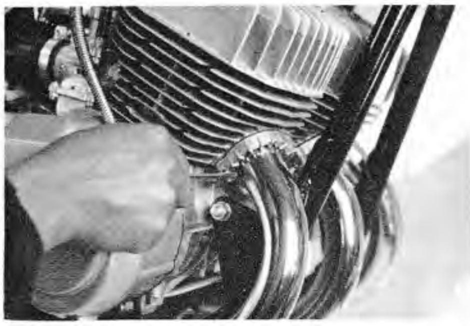


Fig. 2-17

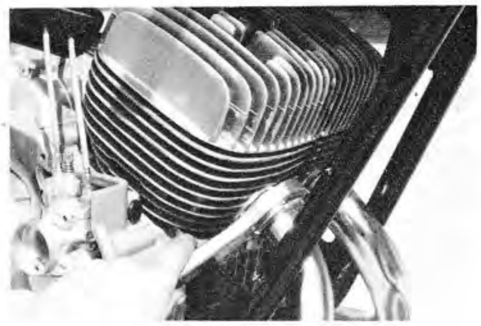


Fig. 2-18

3) Removing the air cleaner

a. Remove the left side cover.
b. Remove the air intake rubber, take off the air cleaner cover and the element.

3) Removing the air cleaner

a. Remove the left side cover, loosen the fitting screws and take off the air cleaner.

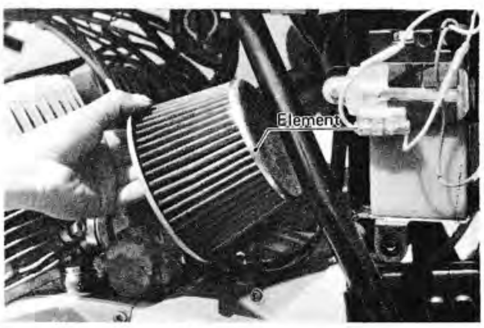


Fig. 2-19

Fig. 2-20

4) Removing the carburetors

a. Loosen fitting bolts to take off the left, center and right carburetors.

Fig. 2-21

5) Removing the oil pump and tachometer cable.

a. Remove the grommet of the tachometer.

b. Remove the fitting screws to take off the oil pump cover.

c. Remove the fitting screws to pull out the tachometer cable.

Fig. 2-23

4) Removing the carburetors.

a. Remove the R.H carburetor cover, change pedal, and the L.H carburetor cover.

b. Turn the fuel cock to OFF and remove the fuel pipe.

c. Loosen the fitting clips to remove the carburetors.

Fig. 2-22

5) Removing the oil pump and tachometer cable.

a. Remove the fitting screw, pull out the tachometer cable.

Fig. 2-24

d. Remove the oil pump cable from the oil pump control lever.

Fig. 2-25

e. Remove the banjo bolt from the oil pump, take off the inlet oil pipe.

b. Remove the oil pump cable from the oil pump control lever.

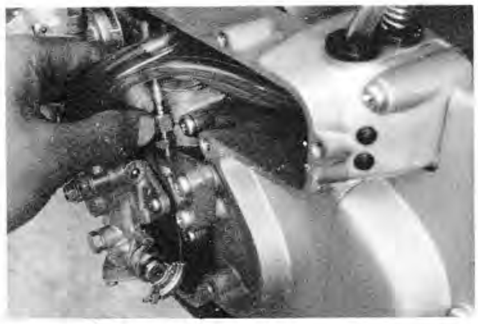


Fig. 2-26

c. Remove the banjo bolt from the oil pump, take off the inlet oil pipe.

NOTE

When inlet pipe has been removed, it is necessary to plug the pipe to prevent the oil from flowing out of the oil tank.

6) Removing the clutch cable

a. Take off the front chain cover.

b. After giving sufficient slack in the outer cable, remove the inner cable from the clutch release lever, and remove the clutch cable.

Fig. 2-27

6) Removing the clutch cable

a. After giving sufficient slack in the outer cable, remove the inner cable from the clutch release lever, and remove the clutch cable.

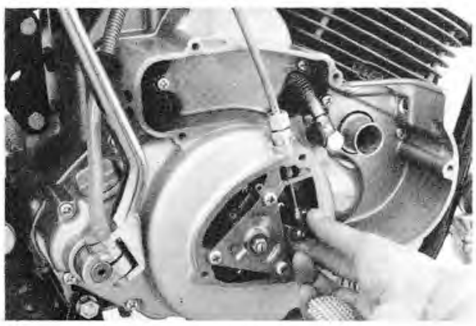


Fig. 2-28

7) Removing the drive chain

a. Remove the chain clip, take off the drive chain.

7) Removing the drive chain

a. Take off the front chain cover.

b. Remove the chain clip, take off the drive chain.

Fig. 2-29

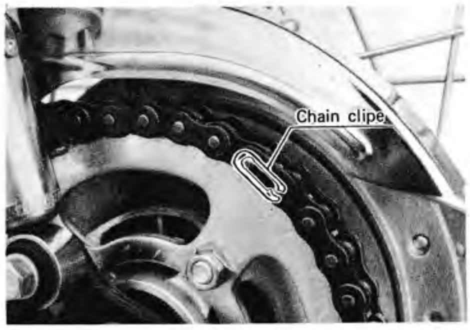


Fig. 2-30

8) Remove wirings of the AC generator from the main harness.

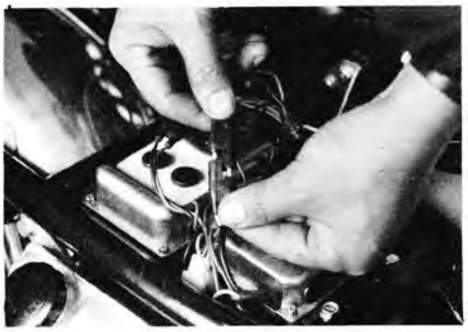


Fig. 2-31

Fig. 2-32

9) Remove the high tension cord.

a. Remove the high tension cord from ignition coil.

9) Remove the high tension cords.

a. Remove the plug caps.

Fig. 2-33

Fig. 2-34

10) Remove the engine mounting bolts and take off the engine from the frame.

4. Installing the engine

Install the engine in the reverse order of removing it. In the case of installing the engine, pay special attention to the following items.

1) Installing the chain clip of the drive chain.
2) Connecting the AC generator wirings.
3) Installing the plug caps.
4) Tightening the engine mounting bolts.

Check the following points again for trial running.

1) Engine oil level.
2) Transmission oil level.
3) Adjustments of the engine.

a. Carburetor idling adjustment .... (Refer to II–5)
b. Adjusting the starter cable .... (Refer to II–5)
c. Adjusting the oil pump .... (Refer to II–5)
d. Adjusting the clutch .... (Refer to II–5)
e. Adjusting the ignition timing .... (Refer to V–4)

4) Adjustments of the frame

a. Adjusting the brake .... (Refer to IV–4)
b. Adjusting the drive chain .... (Refer to IV–13)
c. Adjusting the air pressure of the tire .... (Refer to IV–3)

5) Tightening the fitting bolt or nut in each part

5. Adjustments

1) Adjusting idling speed

a. Adjusting throttle cables

To adjust idling speed for multicylinder engine such as A series (twin carburetors) or H series (three carburetors) models correctly, throttle valve opening of each carburetor is necessary to be zero at first.

(1) Loosen lock nut "B" and to let throttle grip have enough play, turn in cable adjuster "A".

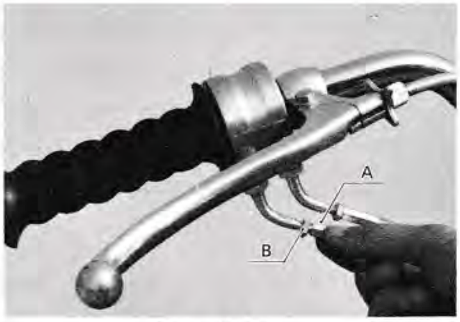


Fig. 2-36

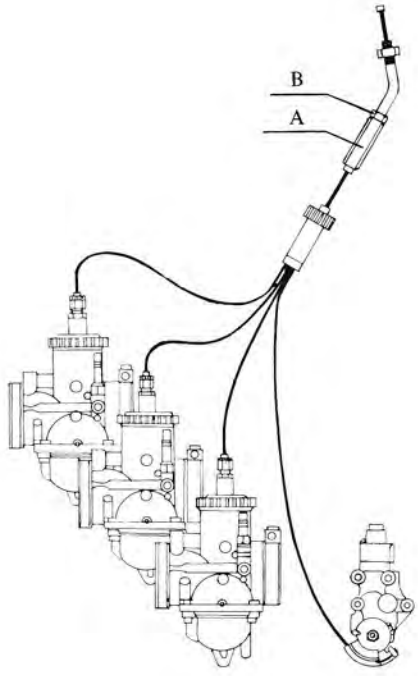


Fig. 2-35

(2) To operate all throttle valves equally, adjust outer cable play of each throttle cable to be zero at fully closed position of each throttle valve. This play can be adjusted by turning throttle cable adjuster "C" to right or left sifting outer cable with fingers as shown in Fig. (36).

NOTE

Be sure to tighten lock nut "D" after adjustment.

Fig. 2-37

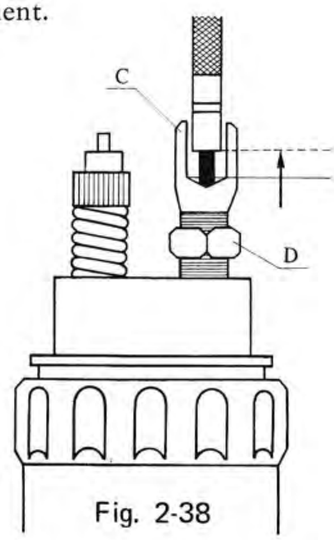


Fig. 2-38

b. Starting engine

NOTE

Warm up engine for 1 to 2 minutes to make gasoline atomize well in the carburetors.

c. Adjusting carburetors

(1) Check how many turns each air adjusting screw backed out from completely screwed in position.

Model	Air screw
A1 series	1¼
A7 series	1.0
H1 series	1¼

Fig. 2-39

(2) Adjust engine speed to be 1,500 to 1,800 rpm by turning each throttle stop screw "F" to right or left. (Fig. 40)

The stable idling speed of engine can be easily found by applying hands to exhaust muffler ends and adjusting each exhaust pressure to be equal by turning throttle stop screw as shown in (Fig. 41).

Fig. 2-40

Fig. 2-41

d. Adjusting throttle grip play by throttle grip adjuster "A".

Standard play is as shown in (Fig. 42). Be sure to tighten locknut B after adjusting.

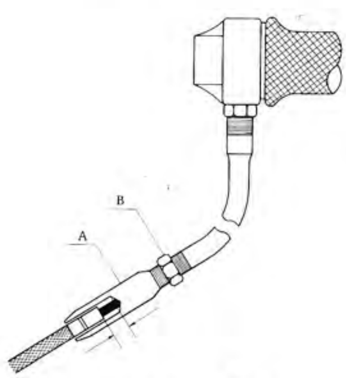


Fig. 2-42

2) Adjusting starter

a. Check the starter lever for play. This play can be adjusted by turning starter lever adjuster "A" right or left.

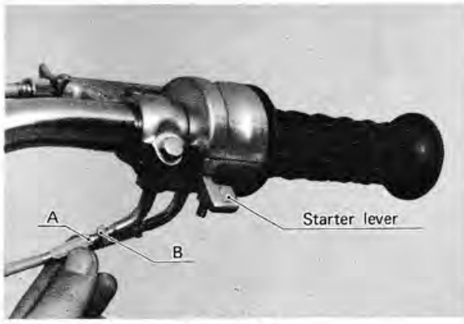


Fig. 2-44

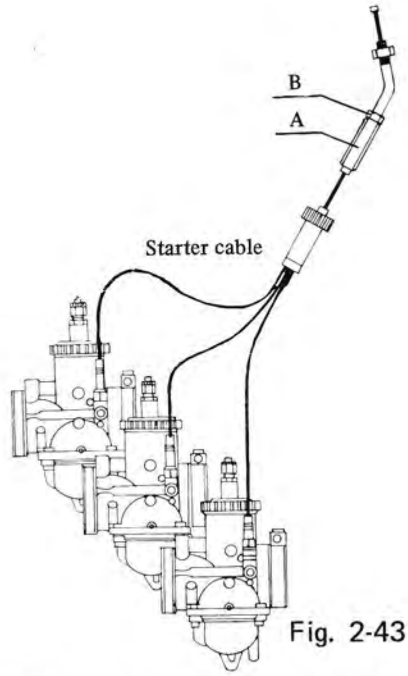


Fig. 2-43

b. To operate all starter plungers equally, adjust outer cable play of each starter cable to be zero at fully closed position of starter plunger. This play can be adjusted by turning starter cable adjuster "C" right or left sifting outer cable with fingers as shown in (Fig. 45).

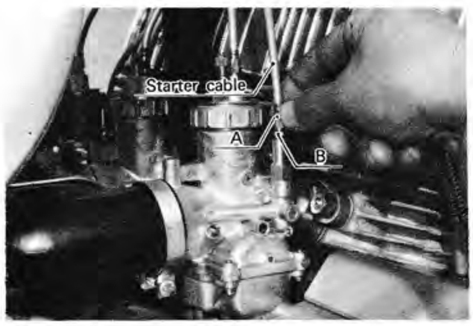


Fig. 2-45

c. Finally, adjust starter lever play by starter lever adjuster "A", the standard play is as shown in (Fig. 46), and tighten the lock nut "B" securely.

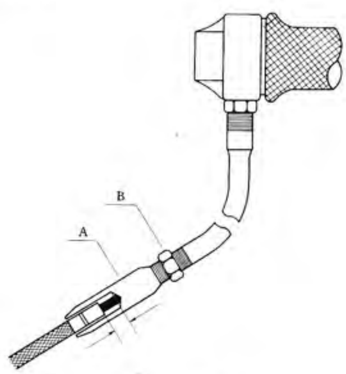


Fig 2-46

3) Adjusting oil pump

Oil pump operates synchronzedly with throttle valves as shown in Fig. (35), and it must be set so that the minimum opening of the pump lever corresponds to the zero opening of the throttle valves. Accordingly, it is necessary to adjust throttle cable for the correct adjustment of the oil pump.

a. Adjust the throttle cable as shown in Fig. (47).

NOTE

If the idling speed of the engine is already adjusted in the order given in the paragraph 5. 1), it is not necessary to adjust the throttle cables as stated above, that is, it is engough to adjust only oil pump minimum opening in that case.

Fig. 2-47

b. Loosen lock nut "F", and to let oil pump outer cable have a play, turn the control lever adjuster "E" in.

c. With punched marks on control lever stopper and control lever aligned, adjust the outer cable play of oil pump cable to be zero. This play can be adjusted by turning control lever adjuster "E" to right or left sifting outer cable by fingers as shown in (Fig. 48).

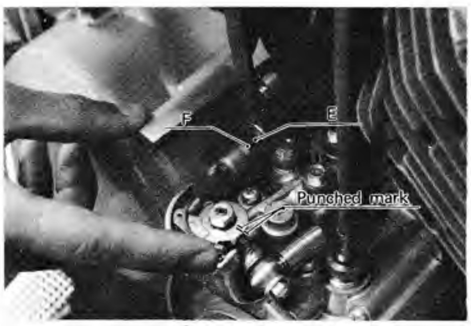


Fig. 2-48

NOTE

Do not forget to tighten lock nut "F" after adjustment.

4) Adjusting Clutch

H series

a. Adjust the angle of release lever as follows.

(1) Loosen lock nut "B", and unscrew clutch adjusting screw 3 to 4 turns back, then the release lever comes to be free.

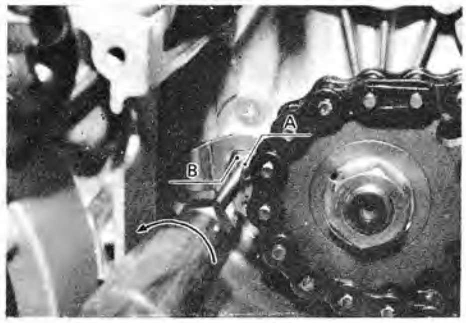


Fig. 2-49

(2) To give the play to clutch lever enough to adjust it later properly, loosen lock nut "D" and adjust the position of clutch lever as shown in Fig. (50) by turning clutch lever adjuster "C" right or left.

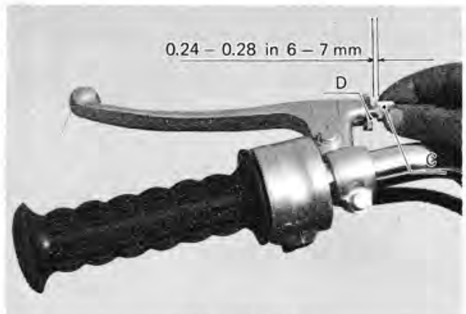


Fig. 2-50

(3) Loosen lock nut "F", and adjust the angle of release lever to 100 degrees as shown in Fig. (51) by turning clutch cable adjuster "E" right or left.

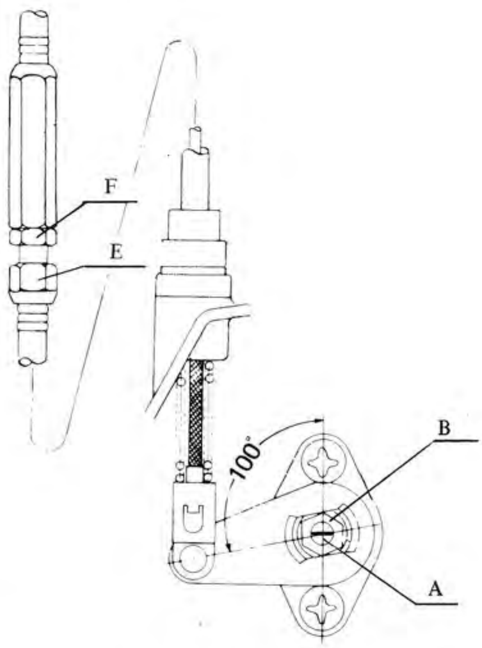


Fig. 2-51

b. Adjusting clutch

There is a screw position that turning torque increases suddenly on the way of screwing in clutch adjusting screw "A". This position shows that the clutch begins to operate, then stop turning at the position and tighten the screw with lock nut "B".

c. Adjust clutch lever play by clutch lever adjuster "C".

The standard play is as shown in Fig. (52), and fasten it tightely with lock nut "D".

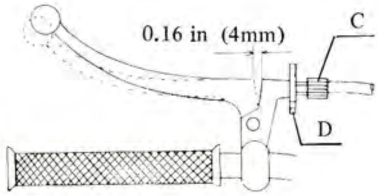


Fig. 2-52

A series

a. Loosen both, lock nut "D" and "F" and make release lever free by turning in both clutch lever adjuster "C" and clutch cable adjuster "E" completely and pull inner cable inside right cover.

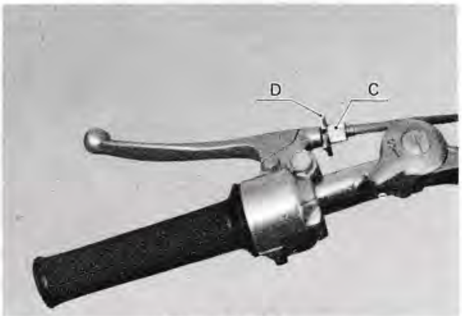


Fig. 2-54

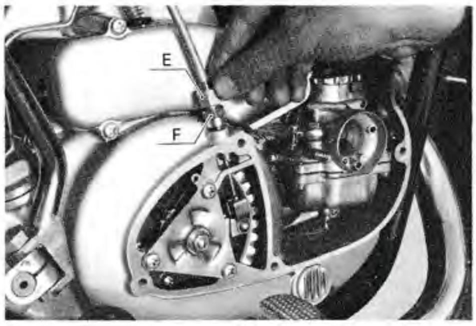


Fig. 2-53

b. Clutch is adjusted by clutch adjusting screw "A" after loosening lock nut "B". There is a screw position that turning torque increases suddenly on the half way of turning in clutch adjusting screw "A". This shows the clutch begins to operate. Then screw it back about 1/4 to 1/2 turn from the position and tighten the lock nut "B" securely.

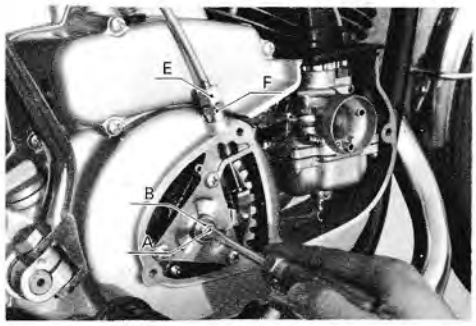


Fig. 2-55

c. Finaly, adjust clutch lever play by clutch cable adjuster "E", the standard clutch lever play is shown in Fig. (55), and fasten tightely with lock nut "F".

III. MAINTENANCE OF ENGINE COMPONENTS

1. Air cleaner
2. Cylinders, cylinder heds
3. Piston, Piston pin
4. Piston ring
5. Right hand engine cover
6. Clutch release system
7. Clutch
8. Primary reduction gears
9. L.H. engine cover
10. Engine sprocket
11. Generator
12. Change mechanism
13. Rotary disc valve
14. Lubricating system
15. Crankcase
16. Crankshaft
17. Trans mission
18. Kick starter
19. Caburetor

1. Air cleaner

If particles in the air, such as dust or sand, are inhaled into a cylinder, they remain between the piston and the cylinder, and they act as avrasives, scratching the cylinder wall. Therefore, an air cleaner is needed to filter and clean the dusty air inhaled into the carburetor. Also the air cleaner functions to eliminate noise during inhalation.

1) Structure

Fig. 3-1 shows a section of the A series air cleaner. The incomming air is filtered through three stages as shown by arrow marks; the first stage in which particles in the air adhere to the half-ball shaped cavity (felted) by collision, the second in which the air is filtered by the inside circumference wall (felted) of the case body, and the third in which the air is filtered by a wet unwoven cloth element.

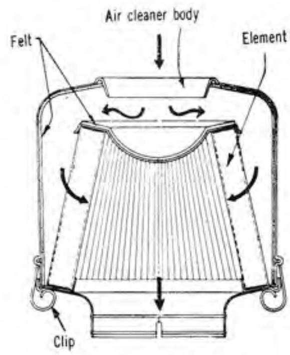


Fig. 3-1

2) Removal

H series

a. Take off the left side cover.

b. Loosen the clamps of the carburetors (3) and the air cleaner, and remove the air inlet pipe.

c. Take off the clips (2) on the lower part of the air cleaner (2). Disassemble the element and the case cover, and pull them out.

NOTE

It is impossible to take off the air cleaner itself without removing the left and center carburetor.

Fig. 3-2

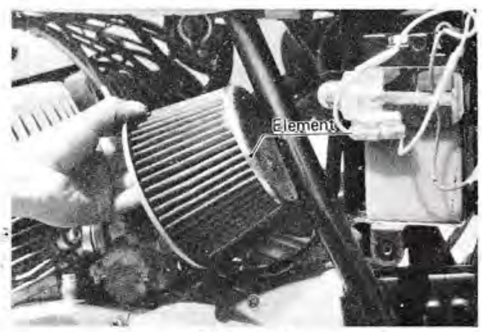


Fig. 3-3

A series

a. Take off the left side cover.

b. Loosen the clamps, and take off the air cleaner assembly.

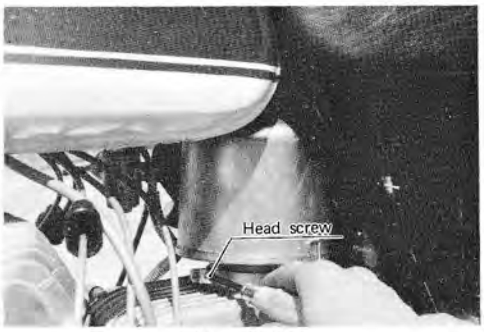


Fig. 3-4

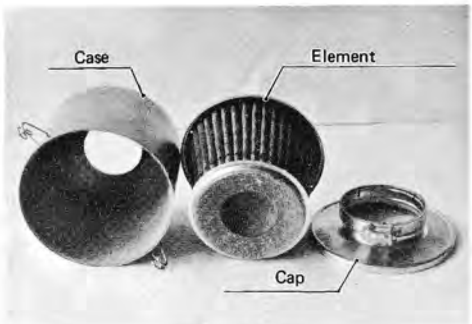


Fig. 3-5

3) Inspection

a. Check the element for damages. Replace the filter if it has pin-holes.

b. Check for clogging of the filter meshes and dirt on the felt. If there is dirt or clogging, wash out the dust with gasoline and then apply oil (SAE 30-40) to the felt.

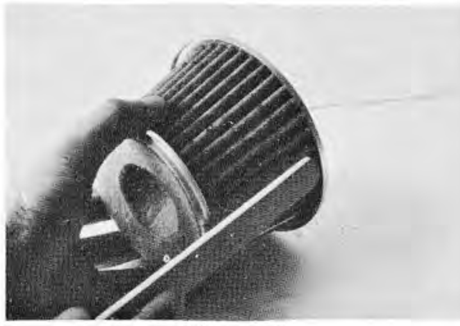


Fig. 3-6

NOTE

After washing the felt with gasoline, soak it in mixed oil (20 : 1) and then set it in place.

c. Check for adhesion of the felt. If it is coming off, glue it on again with a quality binding agent.

4) Installation

Installation follows the reverse order of removal.

NOTE

The installation of the carburetor and the air intake pipe (H series) should be carefully carried out.

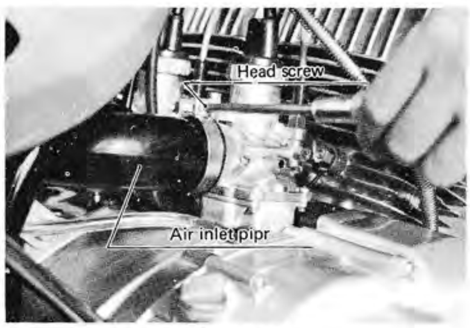


Fig. 3-7

2. Cylinders, Cylinder heads

1) Mechanism

The cylinder is made of a light-weight aluminum alloy which has a high cooling efficiency. A special cast sleeve is cast into the cylinder. The aluminum alloy and the cast sleeve are fused together through strong metal layer by means of a special casting (cast-in-bond). Location of the ports of cylinder differs between A series and H series, depending on the intake methods.

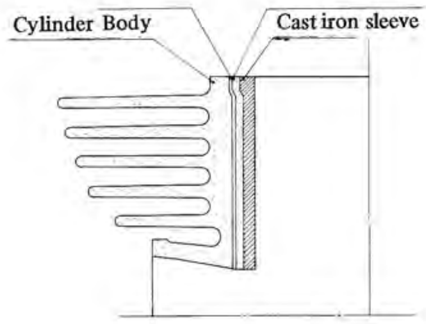


Fig. 3-8

H series (piston-port method)

Exhaust, scavenging and inlet ports are located on the inner wall of the cylinder. The opening and closing of these ports are conducted by the side wall of the piston which reciprocates in the cylinder.

The timing of opening and closing of the ports are symmetric to the top dead center of the piston. Fig. 3-10 shows the port timing of the H series.

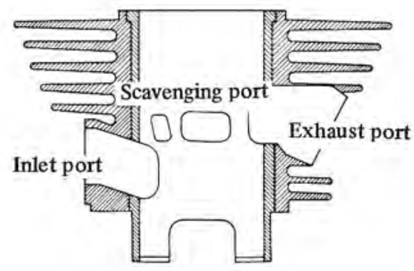


Fig. 3-9

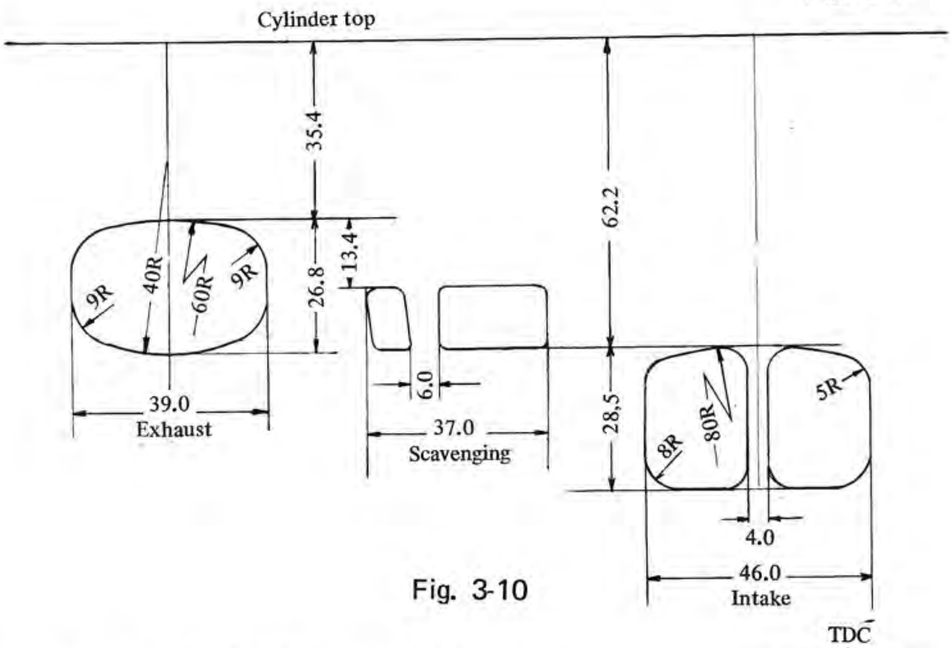
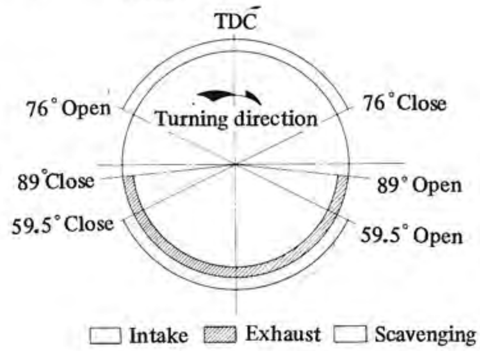
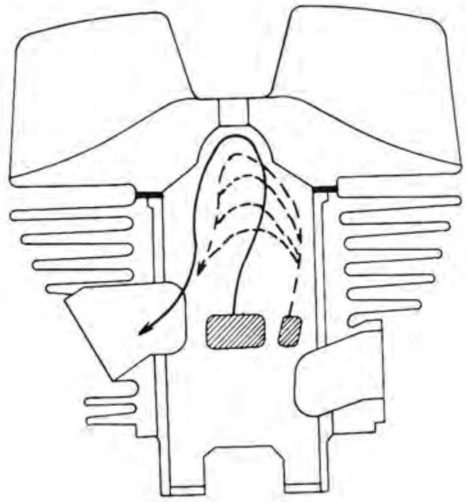


Fig. 3-10

The scavenging method of H series is the 4-port method, which has auxiliary scavenging ports to increase the engine output. Scavenging is the process of replacing the remaining gas in the cylinder with a new mixture gas. The conventional 2-port scavenging widely used in piston-porting, has exhaust gas remains at the port "a", as is shown in the upper half



of Fig. 3-11. This fact affects the scavenging performance adversely and is a very important factor influencing the engine output. The 4-port method is the scavenging method which has been developed to solve this problem. In this method two auxiliary scavenging ports are located beside the main scavenging ports. The ideal scavenging performance retained in port "a" of the 2-port method is completely blown off by the jet flow from the auxiliary scavenging ports.



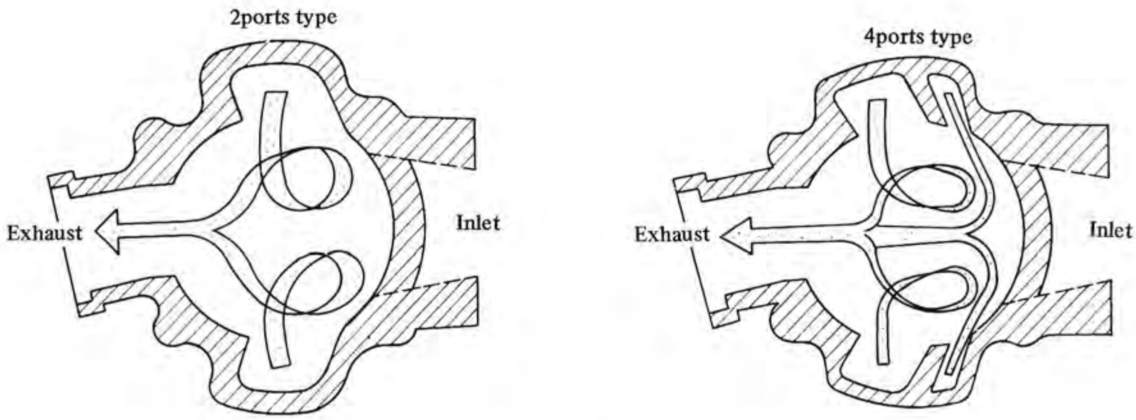


Fig. 3-11

A series (rotary valve method)

Exhaust and scavenging ports are located on the inner wall of the cylinder as in the H series (piston-port method), but the intake system is different. The intake port is made in the side wall of the crankcase to control the intake of gas. Not only A series but also all types of KAWASAKI Motorcycles which employ the rotary valve method utilize the disc whereby the opening and closing of the intake port is carried out by the opening of the disc rotating with the crankshaft.

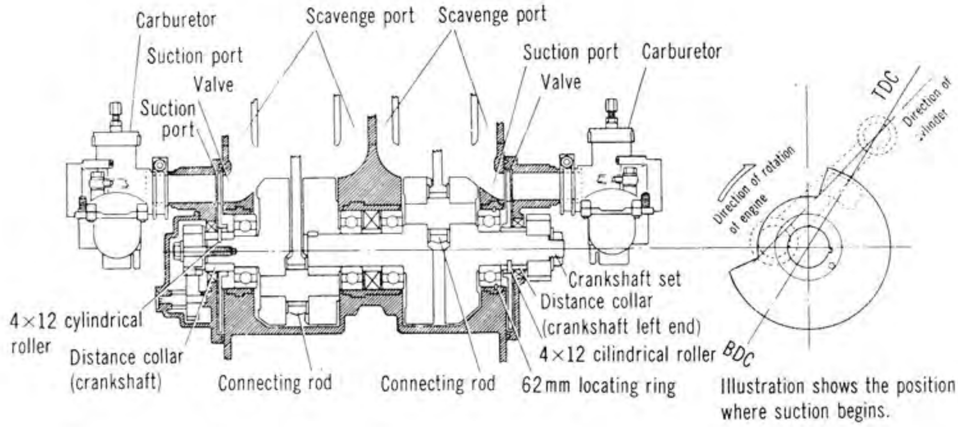


Fig. 3-12

NOTE

Refer to the paragrph of the instructions on the rotary disc valve.

Fig. 3-13 shows the actual port timings for the A series.

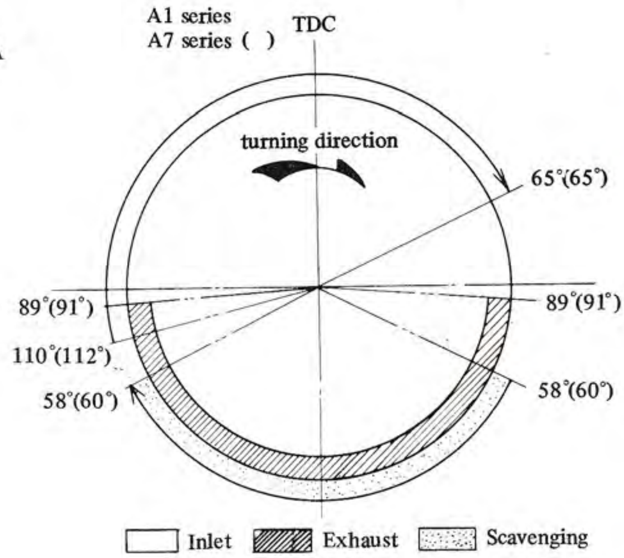


Fig. 3-13

2) Removal

a. Remove the cylinder head and gasket.

b. Take off the cylinder along with the stud-bolts.

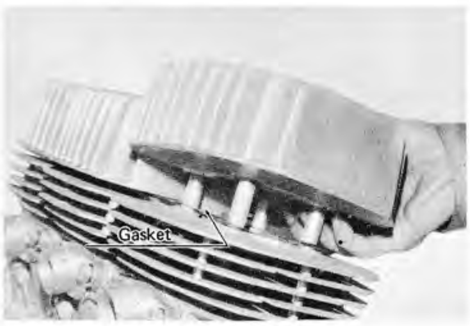


Fig. 3-14

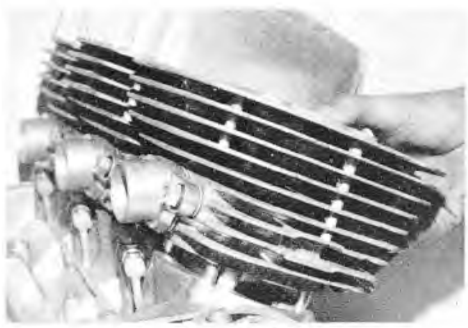


Fig. 3-15

3) Inspection

a. Cylinder head

When heavy carbon has accumulated in the combustion chamber, it causes preignition, overheating and increases fuel consumption, influencing the engine performance considerably. Check the carbon accumulation and remove it.

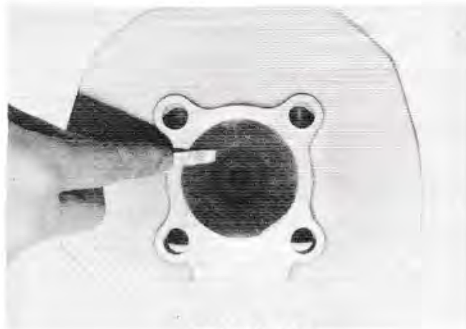


Fig. 3-16

NOTE

Be careful not to damage the gasket surface.

b. Cylinder

(1) Removal of carbon from cylinder.

Carbon is very likely to accumulate at the exhaust port of the cylinder. Check the accumulation and remove it carefully by using a scraper.

Fig. 3-17

(2) Checking of cylinder inner wall.

Check the cylinder inner wall to see if it is damaged. Use No. 400 emery paper or the equivalent to repair the damage. If the damage is serious, replace the cylinder or have it bored or honed.

Fig. 3-18

(3) Measuring of cylinder inner diameter.

Use a micrometer or a cylinder gauge for inner diameter measurement. Be sure to measure the 6 points indicated in Fig. 3-19. When the measurement exceeds the allowable limit, replace the cylinder or have it bored.

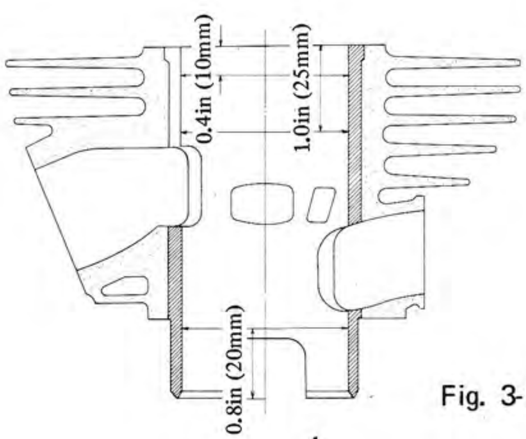


Fig. 3-19

Item	Standard	Maximum limit
inner diameter		
A1	2.09 in (53.0mm)	Over 0.006 in
A7	2.44 in (62.0mm)	(0.15mm)
H1	2.36 in (60.0mm)	

Table 3-1

i) Boring of cylinder

After boring, hone the cylinder and finish it with the roughness below 1.5S (honing thickness should be 0.002mm). There are two size of piston, 0.5mm and 1.0mm oversize. If boring is necessary more than 1.0mm, replace the cylinder.

ii) Measurement and adjustment of clearance between piston and cylinder.

Measure the clearance after boring or replacing the cylinder.

iii) In case of boring the cylinder;

Clearance is obtained by the difference between the inner diameter of the cylinder and the diameter of the skirt of the oversize piston at a position 5mm from the bottem.

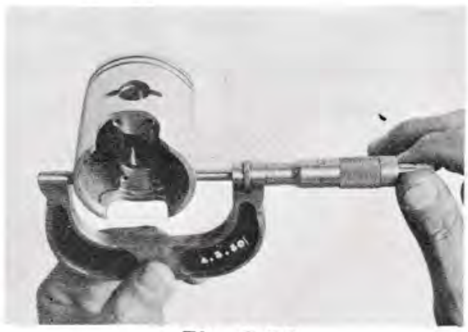


Fig. 3-20

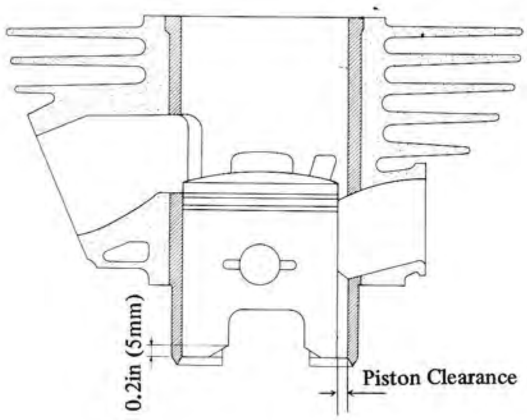


Fig. 3-21

Table 3-2 shows standard clearances.

Item	Standard
Piston clearance	
A1	0.0015 in (0.037mm)
A7	0.0032 in (0.081mm)
H1	0.0022 in (0.056mm)

Table 3-2

4) Assembly

Follow the reverse steps for removal.

When inserting the piston into the cylinder, be sure that the piston goes in smoothly by pressing the piston rings inside the grooves after setting the ring ends at the piston ring locating pins in the ring grooves.

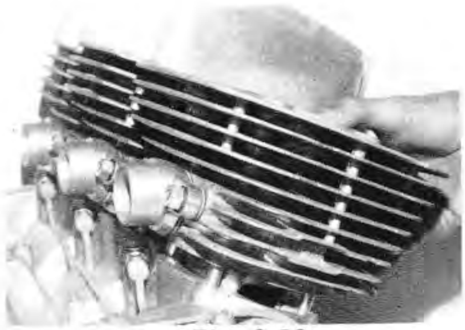


Fig. 3-22

3. Piston, Piston pin

During the operation, the temperature of the piston increases greatly, thus, the top of the piston and the piston pin expand. In consideration of the expansion ratio, the piston has a taper design and is cast in an egg-shape in its cross sectional area. Material of the piston is high silicon aluminum which has a low thermal expansion ratio, high heat resistance and high abrasion resistance.

The piston pin is a full floating type and both ends are fixed to the piston by circlips. The piston pin is offset to the inlet side about 0.5mm from the axis of the piston (shown in Fig. 3-24). The strongest point of the explosion pressure is around the top dead center; thus, by changing the position of lateral pressure of the piston, it is possible to avoid pressure, and reduce piston slap noise.

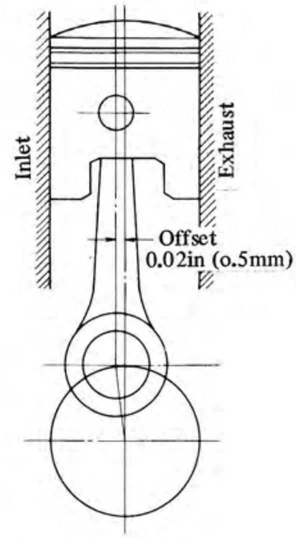


Fig. 3-24

1) Removal

a. Remove the piston pin circlips.

Fig. 3-25

b. Pull out the piston pin using the piston pin tool (special tool) and remove the piston and small end needle bearing.

NOTE

Carefully remove the circlips, be sure not to drop them into the crankcase.

Fig. 3-26

2) Inspection

a. Inspection for scratches and damage

When you find scratches which occur due to seizure etc., polish them with M400 emery paper. If the surface is too deeply scratched, replace or rebore the cylinder.

Fig. 3-27

b. Cleaning of carbon

(1) Check the deposit of carbon on top of the piston and clean it off with scraper or emery cloth etc.

Fig. 3-28

(2) Ring striking will occur if carbon deposit is heavy on the ring slots; check for deposit and clean with used rings etc.

NOTE

Carefully clean carbon, do not make scratches on the surface of piston.

Fig. 3-29

c. Small end clearance

Put the piston pin and the small end needle bearing into the conecting rod, measure the radial play. Replace the needle bearing or piston pin if measurement shows it is over its service limit or if there are scratches on the surface of piston pin.

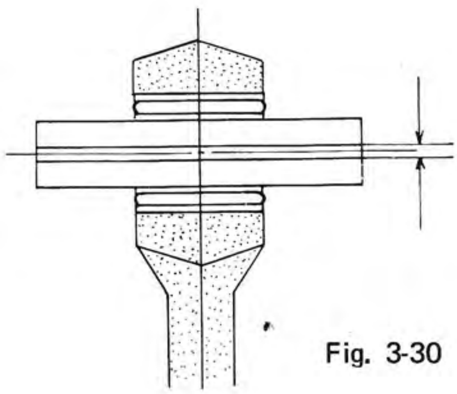


Fig. 3-30

Small end radial play

Item / Model	Standard	Max. limit
A1 A7 H1	0.00012 – 0.00086 in (0.003 – 0.022mm)	more than 0.004 in (0.10mm)

Table 3-3

d. Measurement of clearance between piston and cylinder. Refer to paragraph III-2-3.

3) Installation

Follow the reverse order of removal.

NOTE

Install piston so that its top arrow mark points toward the exhaust port.

Fig. 3-32

4. Piston ring

Two kinds of piston rings, a top ring and a second ring, are assembled in the piston; the former being more lustrous than the latter. The top ring, which is chrome-plated, serves to prevent compression leakage when the piston is working, hence the name compression ring. The second ring, which also serves as compression ring, is chemically treated on the surface so as to obtain smooth contact with the cylinder.

Besides the top and second rings, an expander ring is inserted under the second ring (ref. Fig. 3-33). The expander ring is a highly flexible, octagonal band. It has an auxiliary function of a piston ring to keep the piston in the right position and prevent it from hitting against the cylinder (slap noise).

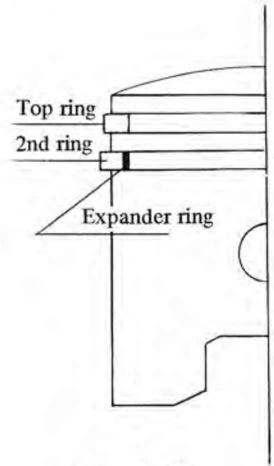


Fig. 3-33


Fig. 3-34

1) Removal

Remove the piston ring by opening the ends of it with both thumbs and pushing up the opposite side with forefingers. Open the end of the expander ring by using a screw driver to remove it.


Fig. 3-35

2) Inspection

a. Checking the end-gap

Measure the end-gap to determine the degree of wear. Measure it with a thickness gauge, as shown in Fig. 3-34, at the position where the piston ring is horizontally inserted 5mm from the bottom of cylinder. Replace the piston ring if the measurement exceeds the maximum limit shown in Table 3-5.

Fig. 3-36

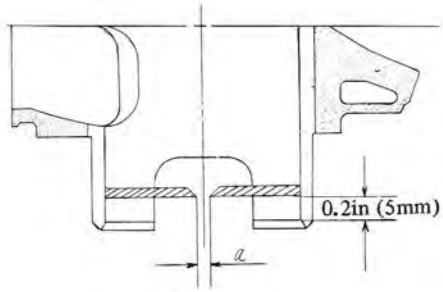


Fig. 3-37

Assembly gap

Item / Series	Standard	Max. limit
A1 A7 H1	0.008 – 0.012 in (0.2 – 0.3mm)	more than 0.0315 in (0.8mm)

Table 3-5

3) Assembly

a. Put the expander ring in the groove of the second ring, making the ring end set at the ring locating pin (for H series only).

b. Follow the same method as mentioned for the above order from the top of cylinder.

Make sure that the ring ends set at the ring locating pin.

NOTE

Be sure to locate the side of the ring having number and letter upward.

5. Right hand engine cover

H series

The right hand engine cover contains the distributor, the oil pump, the tachometer a

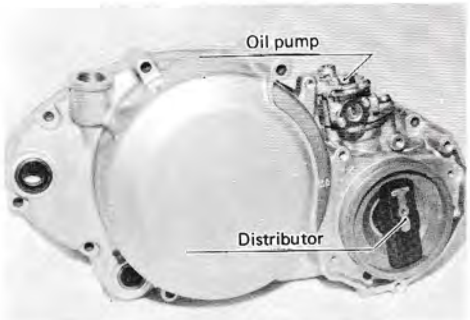


Fig. 3-38

1) Removal

a. Take off the oil pipe banjo bolt and the oil inlet pipe.


Fig. 3-39

b. Take off the kick pedal.


Fig. 3-40

c. Remove the right cover after taking off its screws.


Fig. 3-41

NOTE

Distributor and oil pump can be removed with the cover.

2) Disassembly

a. Distributor

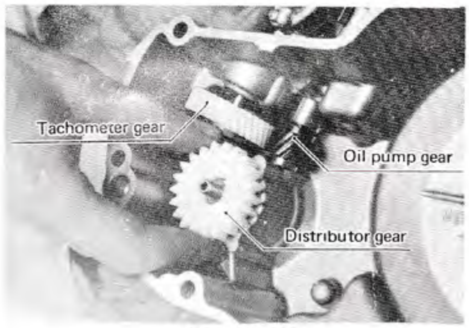


Fig. 3-42

(1) Pull out the pinion gear after taking off its bolts.

(2) Take off the knock pin, and pull out the distributor shaft by softly striking the pinion gear with plastic hammer.

(3) Remove the distributor rotor from the shaft after taking off the screws.

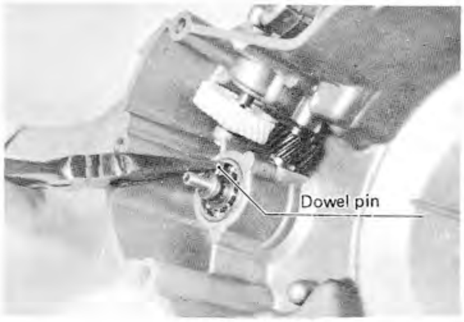


Fig. 3-43

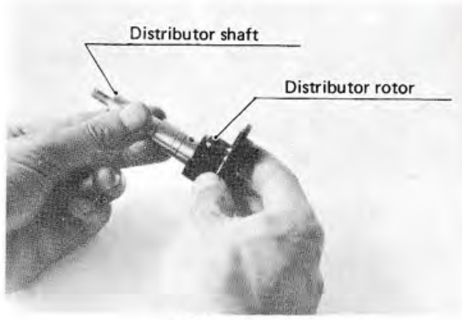


Fig. 3-44

b. Oil pump gear

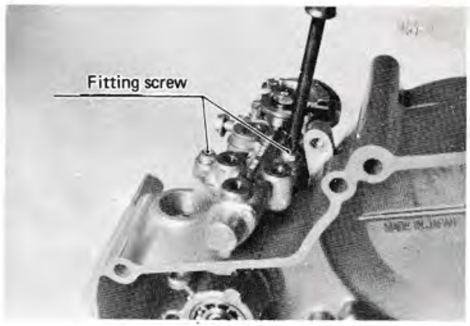


Fig. 3-45

(1) Take off the oil pump after removing its screws.

(2) Pull out the bushing from the fitting part of the pump by prying both sides of the gear shaft bushing with a screw driver.

(3) Take off the shaft (containing the oil pump gear) and the washer.

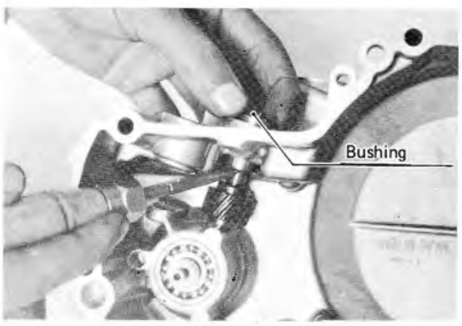


Fig. 3-46

Fig. 3-47

c. Tachometer

(1) Pull out the gear shaft and the bushing from the fitting part of the cable.

(2) Take off the tachometer gear and the shim washer.

Fig. 3-48

3) Inspection

a. Distributor

See paragrph V electrical Equipment.

b. Oil pump, Tachometer bushing

Each of these has O ring and an oil seal. Check the outside surface of the O ring and the lip of the oil seal. If there is any damage, replace them to prevent oil leakage.

Fig. 3-49

c. Kick pedal, oil seal of shift shaft

Check the lip of the oil seal, etc. If necessary replace them.

4) Assembly

Follow the reverse order of disassembly and removal for assembling gear.

Fig. 3-50

NOTE

Shim washers must be inserted when installing the tachometer gear and the oil pump gear.

6. Clutch release system

H series

The spiral parts of the outer release and inner release are made of resin. Push rod A, push rod B are inserted in the center of the inner release, and each of them is installed in the drive shaft.

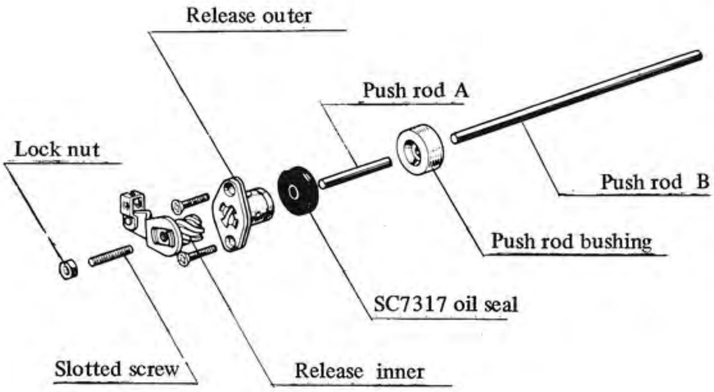


Fig. 3-51

1) Operation

By holding the clutch lever, the inner release operates in rotation with the clutch cable and the release lever; thus, the clutch adjusting screw, the push rods A and B and spring plate pusher operate the spring plate.

2) Removal

Remove drive chain and clutch cable. Take off the screws on outer release and pull out assembly.

NOTE

Never remove outer release by prying with a screw driver etc.

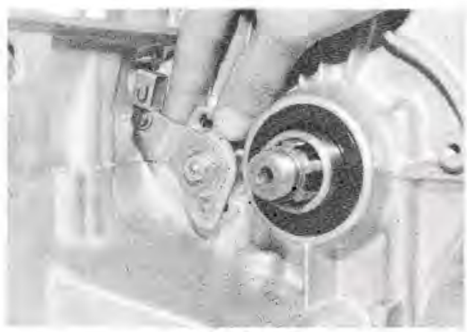


Fig. 3-52

3) Inspection

Install inner release and outer release and check for loss by moving the inner release. Replace the release, if it has large cracks or scratches. These things cause bad clutching action.

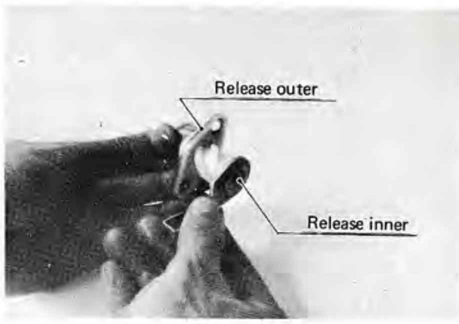


Fig. 3-53

4) Installation

Carefully mount the inner release to the outer release in respect to angle of the release lever and install the outer release to the crankcase. Tighten the two screws evenly. If the screws are tightened irregularly, the outer release will change its shape.

NOTE

It is impossible to put it in by inner release.

Fig. 3-54

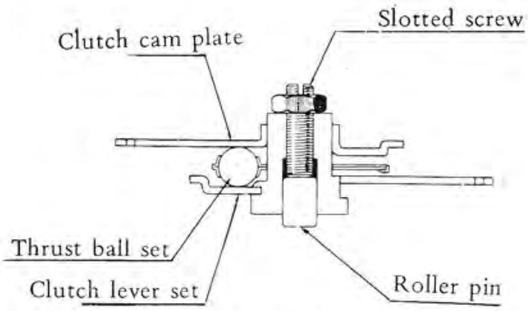


Fig. 3-55

A series

Fig. 3-51 shows section of clutch release.

Steel ball (3) set is installed between clutch lever set and clutch concave knee plate. Adjusting screw and roller pin are installed in the center of clutch lever set.

1) Operation

By grasping clutch lever, the lever is set and simultaneously the thrust ball set operates by rotating. The ball rises from clutch concave knee plate, which is fixed to right cover, and pushes clutch ball holder with adjusting screw and roller pin.

2) Removal

Remove screws and the return spring ring and take off the assembly.

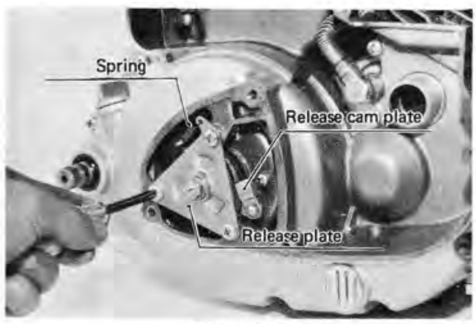


Fig. 3-56

7. Clutch

The clutch is between the crankshaft and the transmission gears. Its mechanism functions to stop transmission of the power when starting or shifting gears.

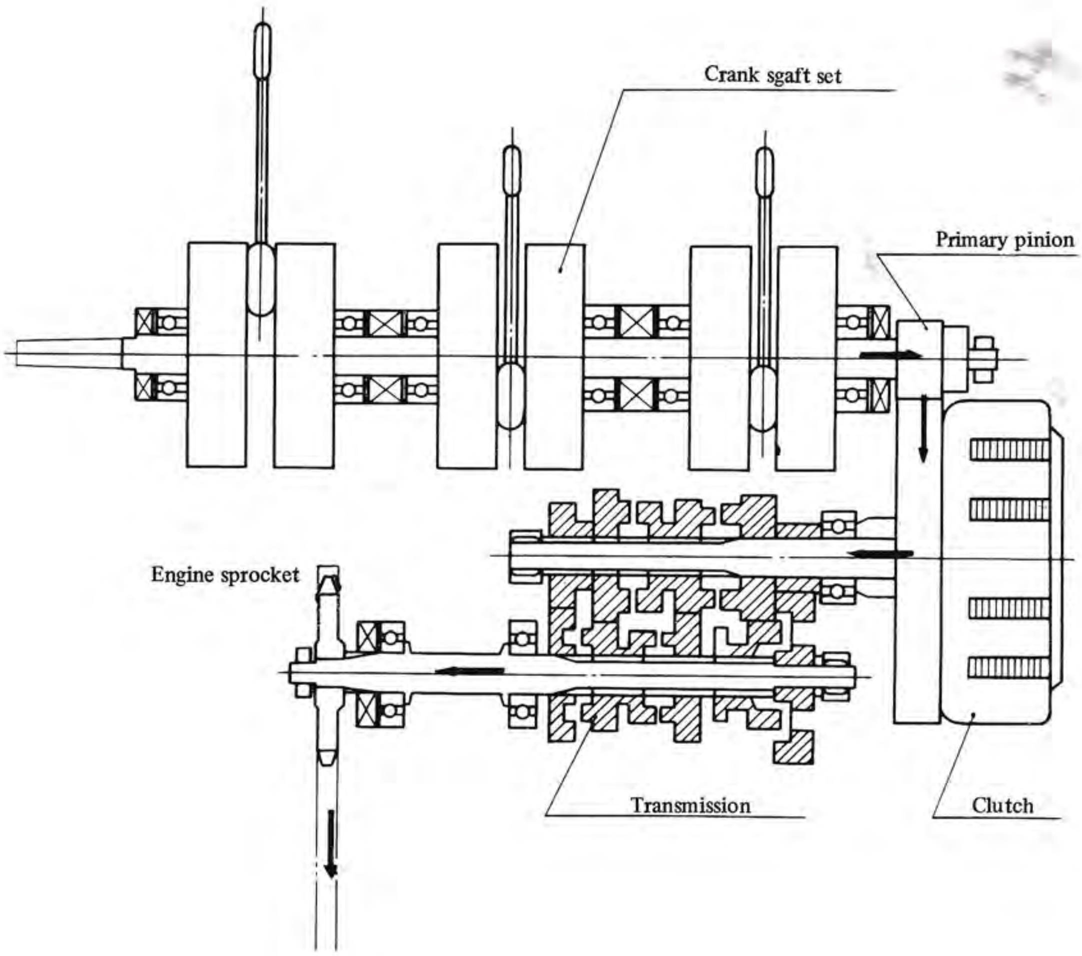


Fig. 3-57

1) Structure

Fig. 3-58 is the diagram of the clutch of H series.

This wet multi-plate type clutch which is composed of 7 friction plates (5 for A1, 6 for A7) and 6 steel plates (4 for A1, 5 for A7) is installed at the right end of the drive shaft.

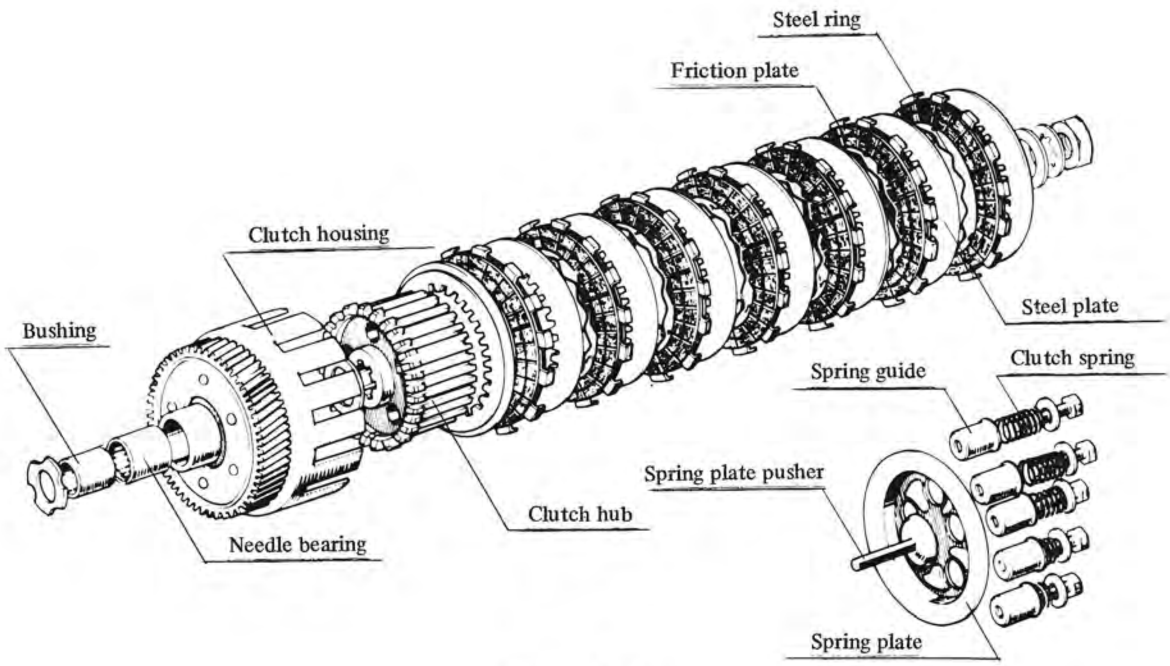


Fig. 3-58

The clutch housing consists of a reduction gear and a housing which are rivetted with through the damper rubbers. As for the reduction gear, a spur gear is used for H series, and a helical gear for A series. The primary reduction ratio and the number of the gear teeth are shown in Table 3-6.

Item / Series	Primary gear	Clutch housing gear	Ratio
A1	15	51	3.40
A7	15	51	3.40
H1	27	65	2.40

Table 3-6

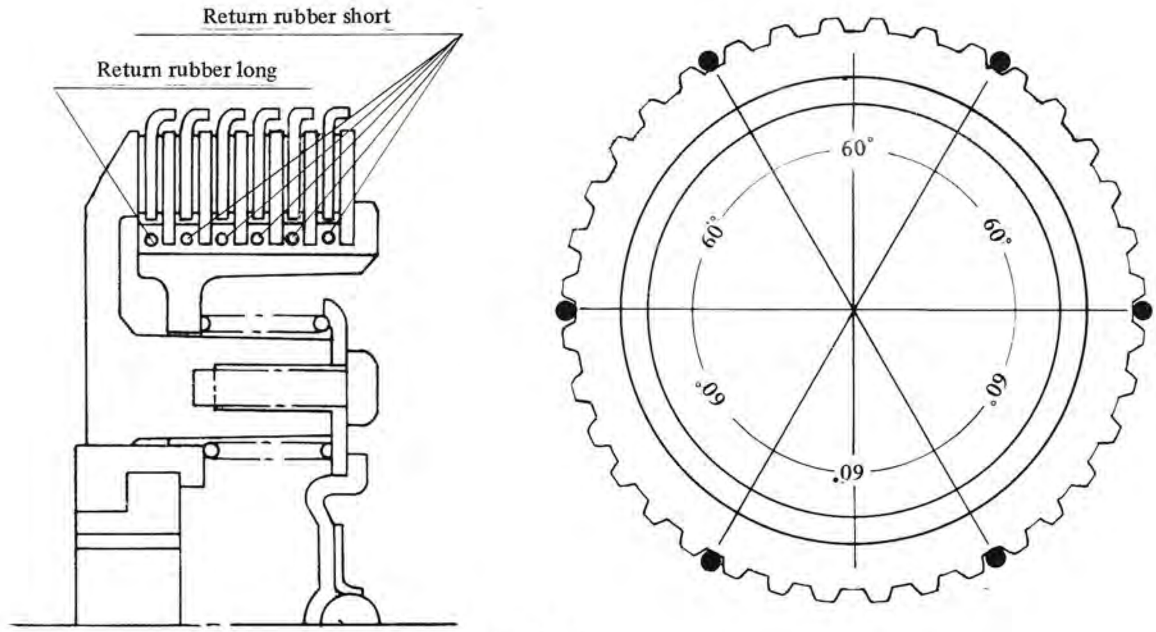


Fig. 3-59

To increase the disengaging effect of the clutch, steel rings are inserted for H series, and return rubbers for A series, between the friction plates and the steel plates, as shown in Table 3-7.

Items / model	Part name		Quantity
A1	Return rubber	short	24
		long	6
A7	Return rubber	short	30
		long	6
H1	Steel ring		7

Table 3-7

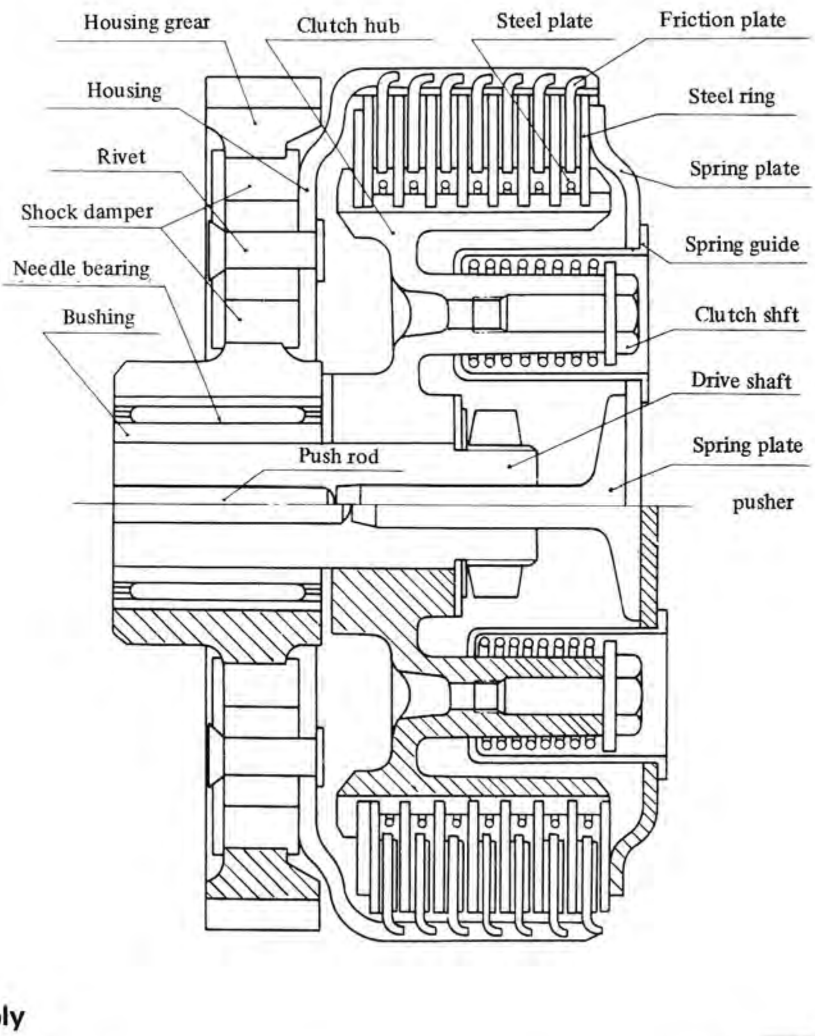
2) Operation

The clutch functions with the frictional force between the friction plates and the steel plates to turn on and off the power which is transmitted from the crankshaft to the drive shaft.

When the clutch is on, the spring plate and the clutch hub connect the friction plates and the steel plates from both sides by the force of the springs. As the results frictional force is generated, and the clutch housing and the clutch hub become securely locked and rotate together. Accordingly, the power is transmitted as follows;

crankshaft → primary gear → clutch housing →
friction plate → steel plates →
clutch hub → transmission drive shaft

When holding the clutch lever, the spring plate can be pushed with the function of the clutch release. At this time, the clutch springs are compressed, and consequently contact of the friction plates and the steel plates is weakened. When the frictional force goes out, each of them becomes free, that is, the transmission of power from the clutch housing to the clutch hub is cut off.



3) Disassembly

H series

a. Remove the clutch spring and the spring guide. Afterwards remove the bolts.

Fig. 3-61

b. Remove the spring plate, the friction plates and the steel rings in this order.

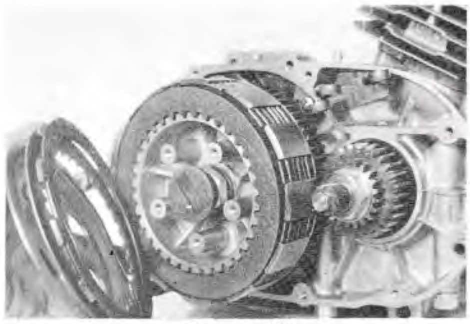


Fig. 3-62

c. Pull out the spring plate pusher.

Fig. 3-63

d. While fixing the clutch housing with a special tool (clutch hub fitting tool), remove its nut.

Fig. 3-64

e. Remove the clutch hub and the clutch housing from the drive shaft.

f. Finally, pull out the bushing, and remove the thrust washer.

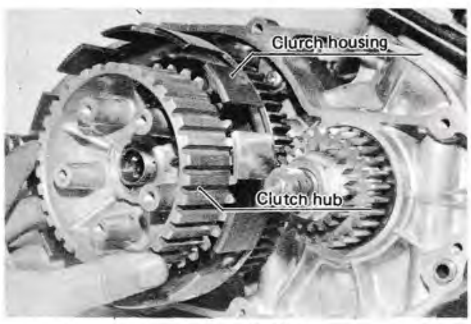


Fig. 3-65

A series

a. **Remove the clutch ass'y**

While fixing the clutch with a special tool (clutch fitting tool), remove the fitting nuts.

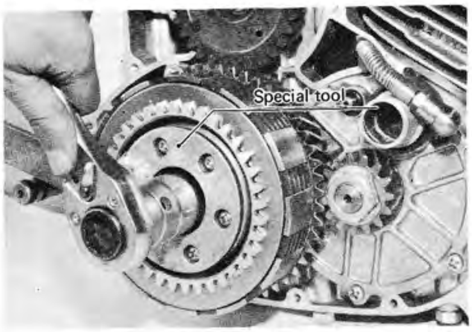


Fig. 3-66

b. Remove lock washer. and thrust washer.

c. Pull out the clutch housing and the clutch assembly.

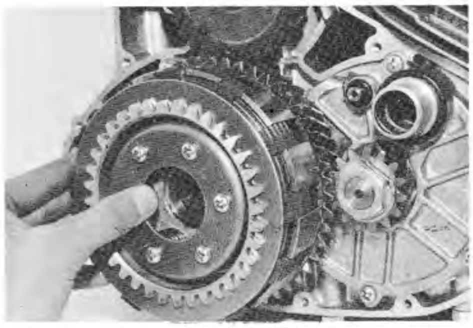


Fig. 3-67

d. Finally, pull out the bushing, and remove thrust washer.

Fig. 3-68

e. **Disassembly of clutch**

If the bolts (6) are removed, the spring plate, the steel plates, the friction plates and the rubber rings can be taken off.

NOTE

Take care not to lose rubber rings when disassembling.

4) Inspection

a. **Clutch springs**

The free length of the springs is measured to judge the deterioration of quality. If the measured value is over the service limit, the springs must be replaced.

Fig. 3-69

Free length

Model \ Items	Standards	Repair limit
A1	1.18 in (29.5mm)	1.10 in (28.0mm) or less
A7	1.20 in (30.0mm)	1.13 in (28.5mm) or less
H1	1.40 in (36.0mm)	1.32 in (34.5mm) or less

Table 3-8

b. Friction plates

Check for abrasion and burn-out of the surface of the cork. Measure it as shown in Fig. 3-70. If the measured value is over the limit shown in Table 3-7 or there is partial abrasion, replace it. Also, if it is scorched, replace it.

Fig. 3-70

Model	"A" Dimension	
	Standards	Repair limit
A1 A7 H1	0.16 in (4.0mm)	0.14 in (3.65mm) or less

Table 3-9

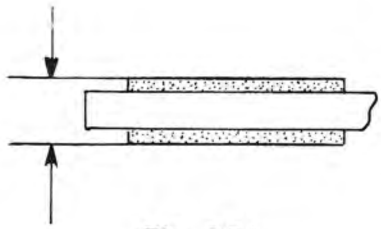


Fig. 3-71

c. Clutch housing, Friction plates

Check the gap B, as shown in Fig. 3-68, between the projection of the friction plates and the fit of the clutch housing.

When the gap is too large, loud noise is generated during running. On the other hand, an excessively small gap makes the functioning of the clutch inadequate.

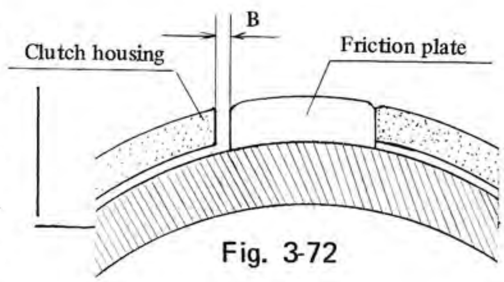


Fig. 3-72

Model	"B" Dimension
	Standards
A1 A7 H1	0.002 – 0.012 in (0.05 – 0 3mm)

Table 3-10

d. Clutch housing

Check for scratches or dents on the teeth. If there are scratches or dents which cause gear noise, they must be honed with an oilstone.

e. Needle bearing

Check clearance between bushing and needle bearing assembled into clutch housing, as shown in Fig. 3-73.

In case this clearance is excessive, it causes to gear noise. Replace it if necessary.

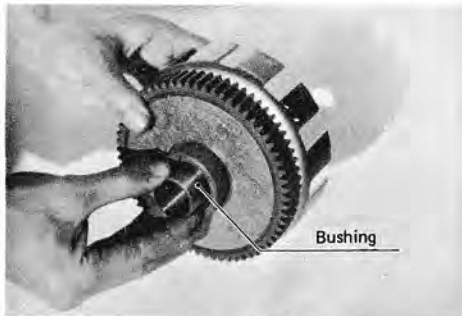


Fig. 3-73

5) Assembly and Installation

Follow the reverse order of disassembly and removal.

NOTE

When assembling the clutch of A1 or A7 series, be sure of the proper positions of the return rubbers (long and short ones).

Also, when mounting the clutch housing, set the timing marks which are marked on the gear sides of the primary gear the dynamo gear and the clutch gear.

Fig. 3-74

8. Primary reduction gears

H series

The primary gear, the distributor pinion, and the oil pump pinion are installed in this order to the right end of the crankshaft.

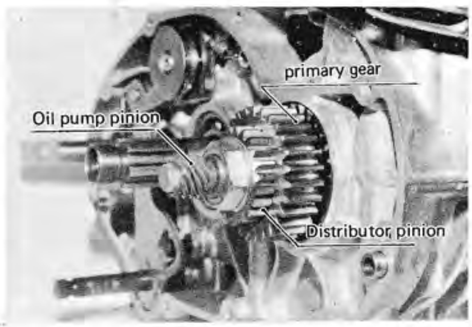


Fig. 3-75

A series

The helical gear is used for the primary gear, and the tachometer pinion is installed on the left end of the crankshaft in the case of the A series engine.

Fig. 3-76

1) Disassembly

H series

a. Take off the oil pump pinion.

Fig. 3-77

b. Straighten the washer with a chisel.


Fig. 3-78

c. Take off the nuts, holding the crankshaft by a special tool (the clutch housing fitting tool).

Fig. 3-79

d. Pull out the distributor pinion and the primary gear.

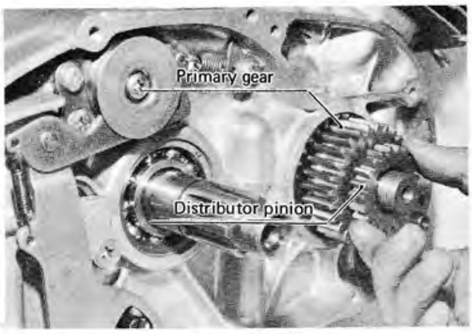


Fig. 3-80

e. Finally, pull out the key.

A series

a. Straighten the tongued washer with a chisel

b. Take off the nut, holding the crankshaft by a special tool (clutch housing fitting tool).

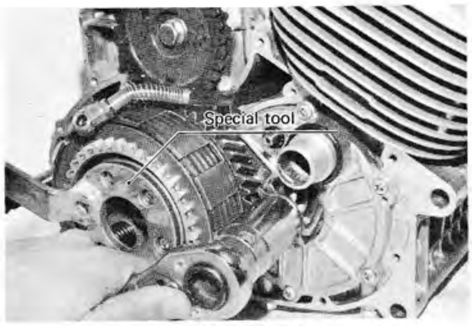


Fig. 3-81

2) Inspection

Check for scratches or dents on the teeth. These scratches or dents are the cause of noise, therefore polish them with an oil-stone. Replace it if the scratches are large.

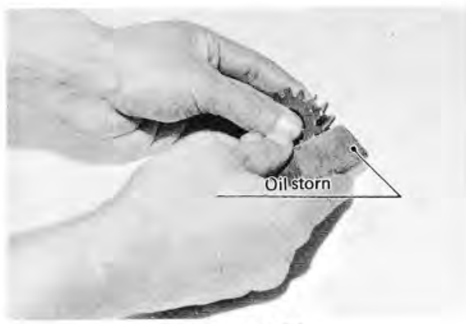


Fig. 3-82

3) Installation

Follow the reverse order of the removal.

NOTE

Bend the lock washer tab around the nut.

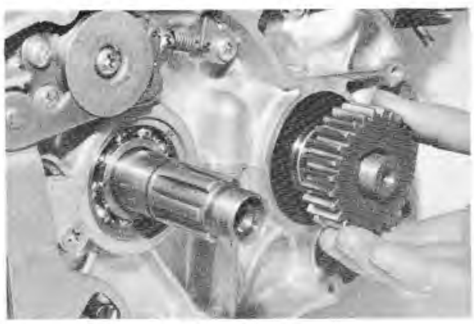


Fig. 3-83

9. L.H. engine cover

Carburetor, oil pump and tachometer guide are set on the rotary valve cover and the cap. Inside the rotary valve cover cap there is the oil pump pinion, oil pump gear tachometer pinion and tachometer gear.

1) Removal

a. Remove the L.H engine cover.

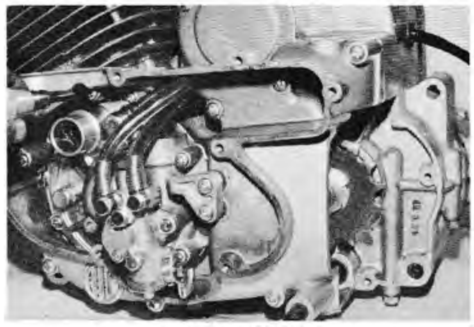


Fig. 3-84

b. Remove banjo bolt and oil pipes from the oil pump. Remove the oil pump itself.

Fig. 3-85

c. Remove the screws and the rotary valve cover cap. At the same time, tachometer pinion and oil pump gear should be removed.

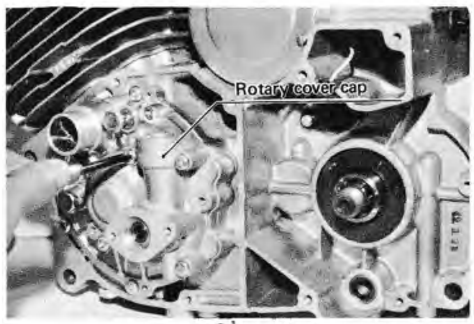


Fig. 3-86

d. Remove the screw and the oil pump pinion.

Fig. 3-87

2) Inspection

a. Check the oil seal which is inserted in the tachometer gear bushing. Replace the oil seal which has been worn or has scratches on its surface. This worn lip or scratches will causes to oil leakage.

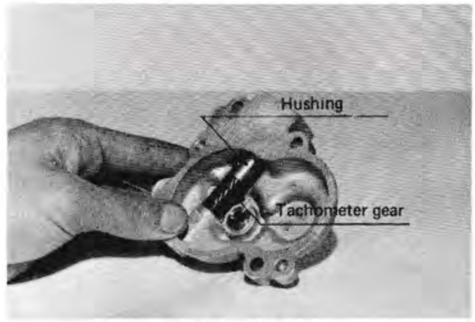


Fig. 3-88

3) Installation

Follow the reverse order of removal.

NOTE

Oil pump should be installed by fitting its convex shaft end into the concave shaft end of the oil pump gear. Tighten the screws identically.

10. Engine Sprocket

The engine sprocket runs the chain, but sand and dust are collected easily on this sprocket. Therefore, special abrasion resisting steel is used, and the gear is cut as involute tooth.

Fig. 3-89

1) Removal

a. Straighten the lock washer tab by a chisel.

Fig. 3-90

b. Take off the nut on the sprocket by holding the rotation of the sprocket with special tool (sprocket push tool). Take off the sprocket.


Fig. 3-91

2) Inspection

Check the abrasion of the teeth of the sprocket. If the abrasion is too great, the condition of gearing of the drive-chain becomes defective, and makes an irregular noise and shortens the service life of the chains. Measure the root diameter of the teeth. Replace it if its value is over the service limit.

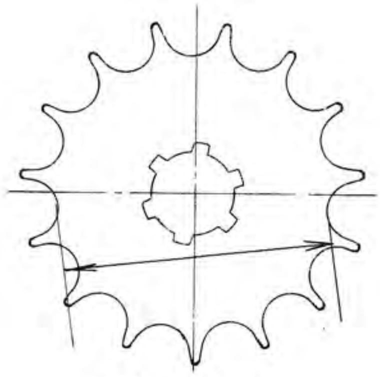


Fig. 3-92

Root diameter of teeth

Items	Standard	Repair limit
15T	2.60 in (65.8mm)	2.55 in (65.0mm) or less
16T	2.80 in (71.2mm)	2.75 in (70.4mm) or less

Table 3-11

3) Installation

Follow the reverse order of disassembly.

NOTE

Bend the lock washer tab to the nuts.

11. Generator

1) Removal

A series

a. Remove the nut and pull out the dynamo gear.

b. Remove the generator cover from the crankcase and take off the generator.

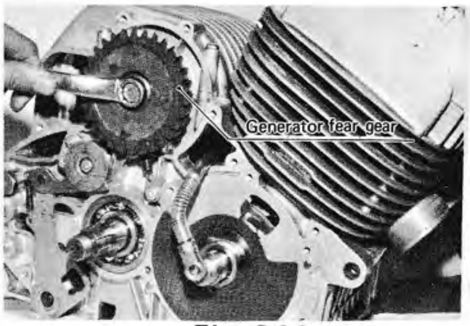


Fig. 3-93

Fig. 3-94

H series

a. Remove the R.H. engine cover.

b. Remove the SG rotor, after taking off bolt on the rotor.

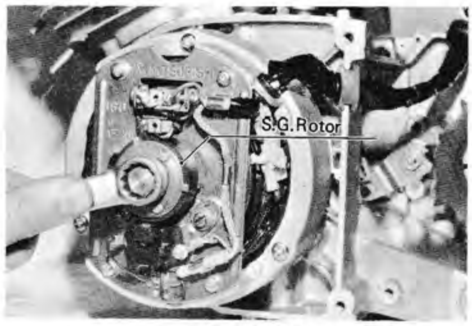


Fig. 3-95

c. Remove the screws and take off the yoke

d. Pull out the rotor by using special tools.

e. Finally, take out the key.

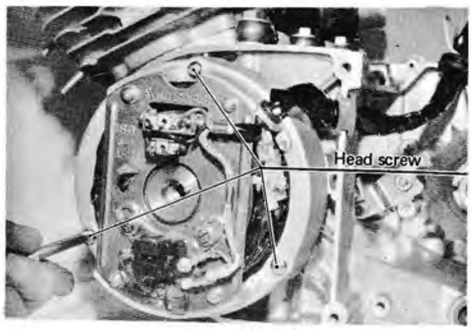


Fig. 3-96

NOTE

Never hit the rotor to remove.

Fig. 3-97

2) Installation

Follow the reverse order of disassembly.

A series

Follow the reverse order of removal.

On each dunamo gear, clutch housing gear and primary gear, the fitting mark is punched.

Align and install the punch mark of the dynamo gear to the punch mark of the clutch housing gear and primary gear. Refer to the paragraph V.

Fig. 3-98

NOTE

Mount the rotor, after fixing the key slots of the rotor to the key of the crankshaft. In the case of the SG rotor, fit after fixing the knock pin of the rotor shaft.

Fig. 3-99

12. Change mechanism

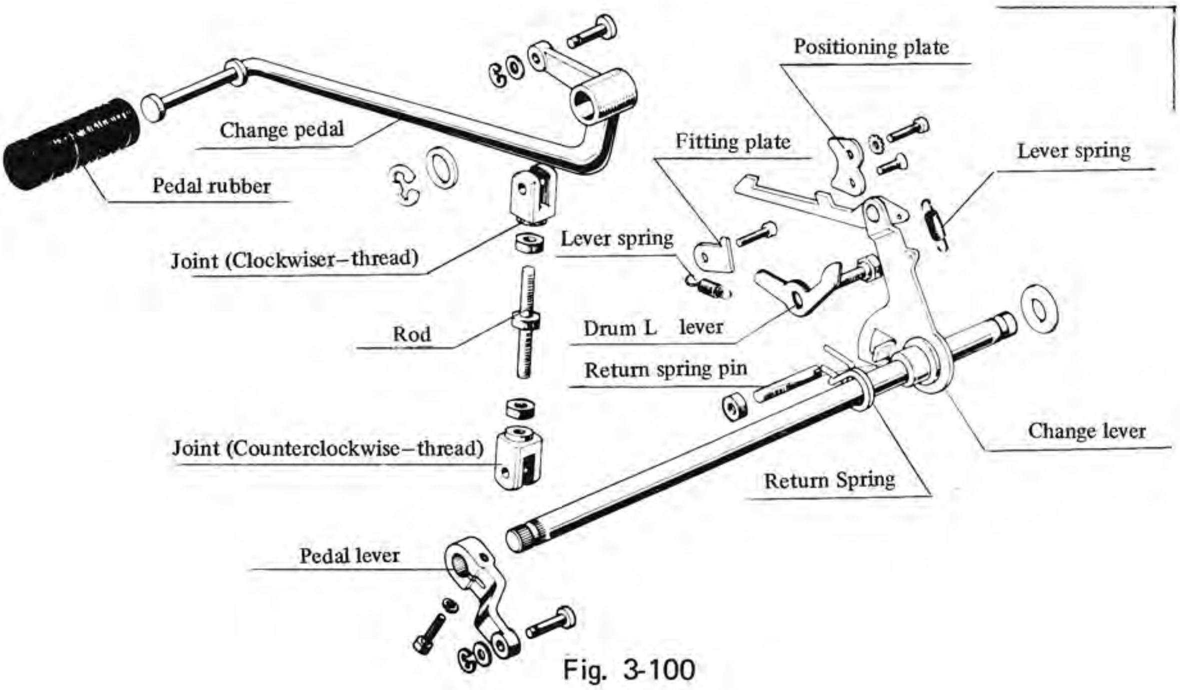


Fig. 3-100

1) Operation

When kicking the change pedal, the shift-lever set moves on the shift shaft. And the shift lever pushes the change drum pin. By this operation, the change drum rotates and the gear change will be executed by the selector forks. When stepping on or kicking up, the change pedal returns to the former position by the return-spring. 7 change drum pins are set in equal angles around the change drum. And, one step on the change pedal causes the change drum to rotate one sixth. That is to say, the six stages of neutral, low, second, third. forth and high are changed by the 5/6 rotation of the change drum. Around the outside of the change drum, slots are cut in, and according to these slots, the selector forks operate and each step is geared.

After the change gear operation, the spring force of the set lever pushes the lower part of the change drum pin to keep the change drum completely in position.

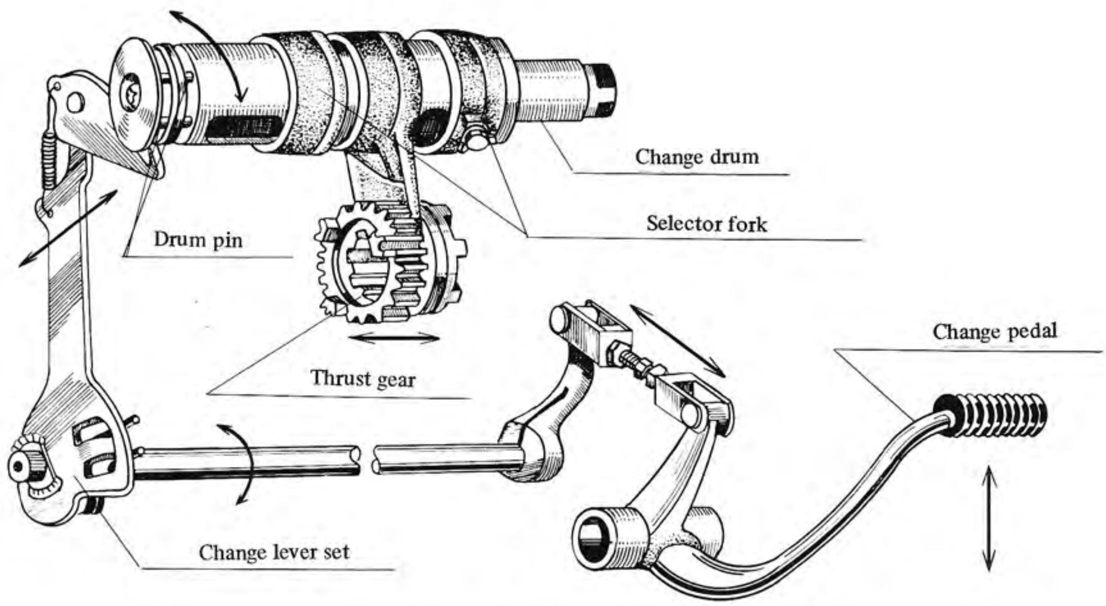


Fig. 3-101

2) Removal

a. Remove the lever and the shift lever set after freeing the lever from the change drum pin.

Fig. 3-102

b. Remove the hexagon headed bolt from the set lever. Also take off the set lever and the spring.

Fig. 3-103

3) Inspection

a. Return-spring

Check the tension of the spring. Replace it if it has no tension or if there are cracks.

Fig. 3-104

b. Set lever spring

No tension or a broken spring will prevent it from moving forward or returning completely during the change operation.

c. Set pin of return spring

Check the looseness of the lock nuts.

If the set pin loosen, the gear change becomes uncertain.

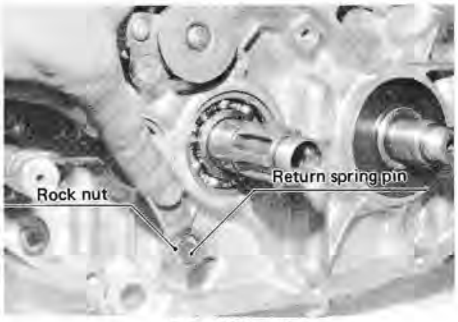


Fig. 3-105

4) Installation

Follow the reverse order of removal.

13. Rotary disc valve

1) Structure

Disc valve is fixed to the crankshaft and rotates with it. Through the opening of the cut-away part of the disc passes the fuel through the section hole of the crankcase side, into the crankcase.

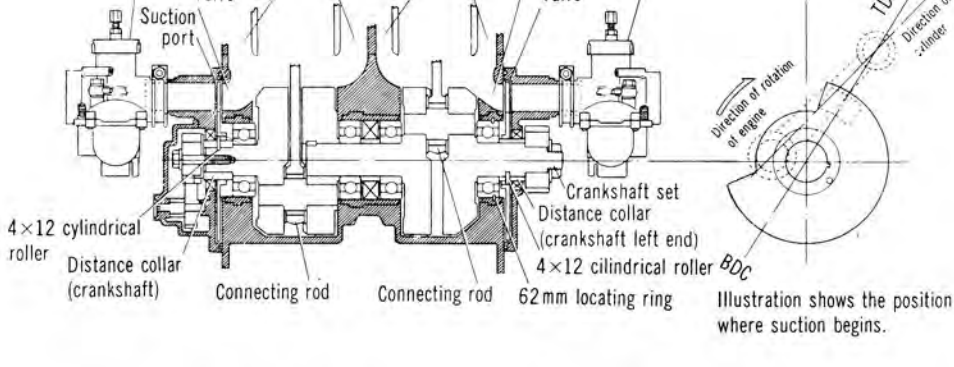


Fig. 3-106

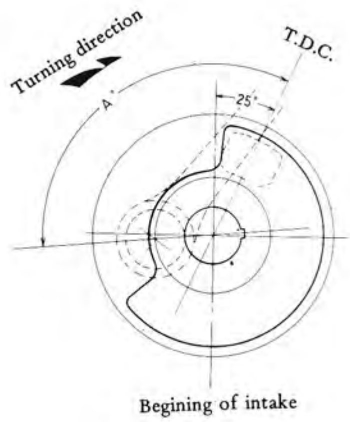


Fig. 3-107

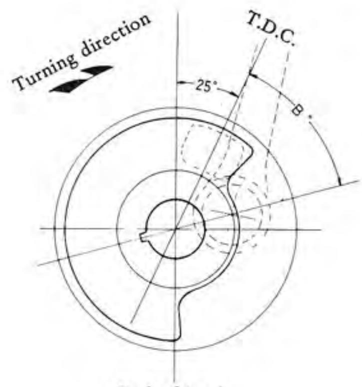


Fig. 3-108

The rotary valve is made of heat harden phenol resin and it is (0.196 in) 5mm thick. The center of the valve is of cast steel.

2) Removal

a. Take off the valve cover after removing screws.

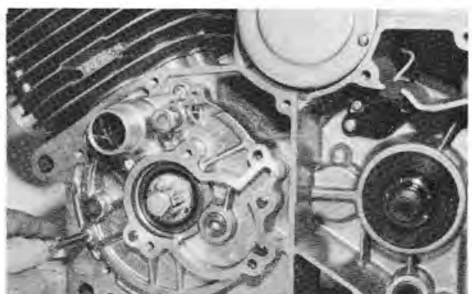


Fig. 3-109

b. Take off the collar and O ring.

c. Pull out the rotary disc valve.

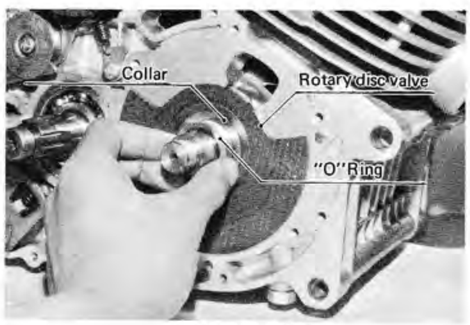


Fig. 3-110

d. Finally, pull out the roller pin.

3) Inspection

a. Valve cover

Oil seal 120mm O ring and oil injection pipe are installed on the valve cover.

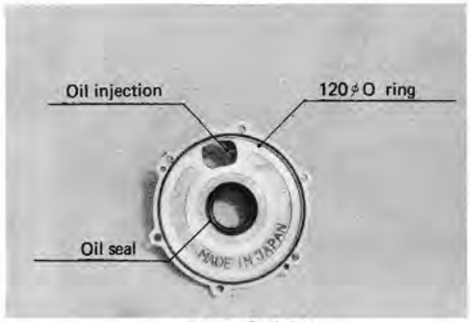


Fig. 3-111

(1) Oil Seal
Check the scratches, damages and deformation of the lip and replace it if needed.

(2) O rings.
Check the scratches, damages and deformation of the O rings and replace bad ones.

(3) Oil injection
Check for clogging of the nozzle.

(4) Abrasion of the surface of the valve or the depth of the valve cover. Replace the valve cover if the depth of the cover is over the service limit, or if it is much scratched or damaged.

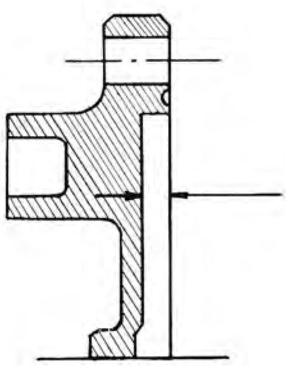


Fig. 3-113

Standards	Repair limit
0.14 in (3.5mm)	Over 0.16 in (4.0mm)

Table 3-12

b. Abrasion of disc valve

As for the standard of the abrasion, measure the thickness of the resin discs. Replace the disc valve, if it wears over the service limit or if there are scratches or damages on its surface.

Standards	Repair limit
0.14 in (3.5mm)	0.12 in (3.0mm) or less

Table 3-13

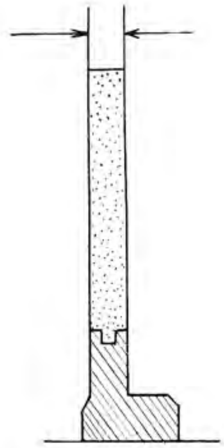


Fig. 3-114

4) Installation

Follow the reverse order of removal.

Before installing the disc valve, soak it well with a quality oil. Fit the 120mm O rings properly to the slot of the valve cover.

14. Lubricating system

1) General

The ordinary two cycle engine is designed in consideration its most loaded condition for it. In that condition, mixed fuel, which consists of oil and gasoline mixed in rate of 20 : 1, is supplied to the engine from the carburetor.

This is the easiest mechanism, for it is unnecessary to have an oil pump as is widely used in two cycle engine. Mixed ratio of oil and gasoline is always constant in any load condition of engine. Thus, in low and middle speed operation (in light load condition), more oil is supplied to the engine than is needed. Then, engine wastes oil uselessly and exhausts much oil mist, which causes increase of carbon deposit in exhaust pipe, muffler and combustion chamber. By this increase of carbon, compression ratio, drop of engine cooling efficiency, abnormal combustion and pre-ignition may occure.

To Improve these failures, the KAWASAKI super lube and the injectolube (which is called the separated lubrication system) have been developed.

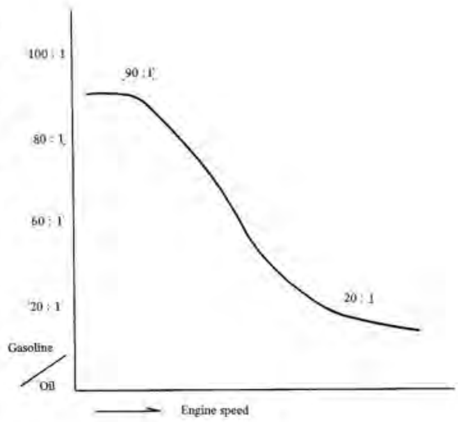


Fig. 3-116

In the case of climbing, the engine is more loaded than usual driving. Thus, high mixed ratio of oil and gasoline is needed. In this separate lubrication system, supplying ratio of oil is adjusted automatically according to engine revolution and opening of the throttle volve. Thus, the problem of exhaust and the choice of mixed ratio are solved perfectly. Efficiency of engine is superior to the other type, particularly, the injectolube type which lubricates directly supplying needed fresh and high viscosity oil to main bearings. Thus, durability of the two stroke big displacement engine is very much improved.

2) Oil passage

a. Superlube type (A1)

Oil flows into the check valve through the outlet oil pipe from the oil tank is injected into the intake pipe inside the valve cover through the nozzle. This oil is sprayed and mixed with flowing mixed gas from the carburetor and lubricates the crankcase, main bearing, large and small ends of connecting rods, cylinder walls, pistons and piston rings.

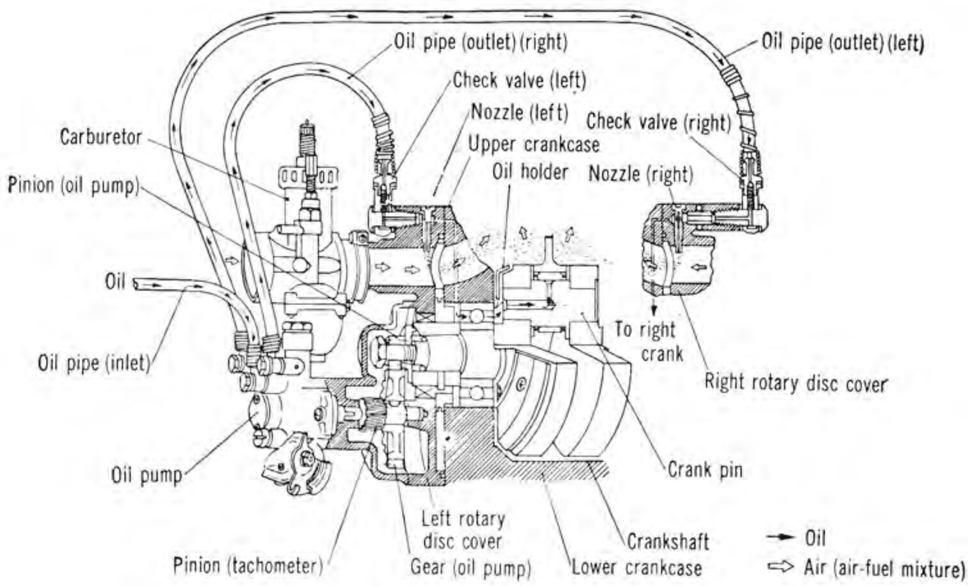


Fig. 3-117

b. Injectolube type (A7, H)

Oil is supplied by the oil pump to the engine through two oil routes from the check valve. One oil route is for supplying the oil into fuel mixture, which injects oil into gas from a nozzle through inlet pipe. The other route is a oil hole machined in the crankcase; oil is directly injected to main bearings as shown in Fig. 3-122. Through these two routes oil lubricates each part of engine.

H series is piston port type, therefore, the routes from the oil pump are different from the A series (they are called rotary valve type).

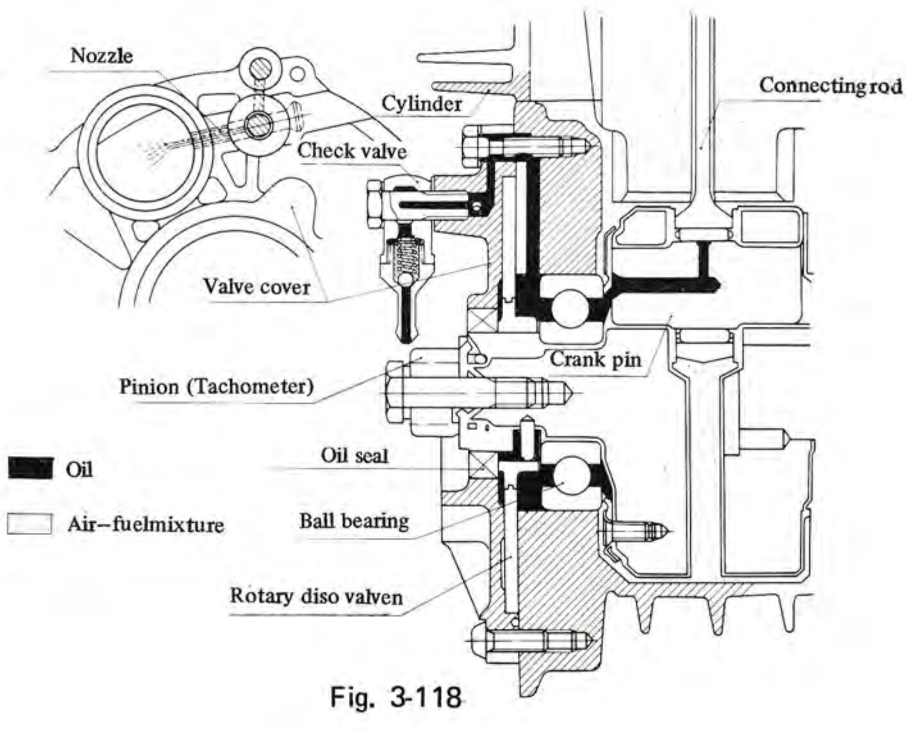


Fig. 3-118

In the piston port type, oil is fed to the crank case through the holes in the rear of the cylinders after the check valve from the oil pump. It flows to the cylinders through the crankcase and the oil hole in the each cylinder as shown in the diagram.

Oil is injected into the mixed gas which is supplied from the carburetor.

Through the nozzle of check valve oil is injected into the main bearings from the oil holes in the crankcase.

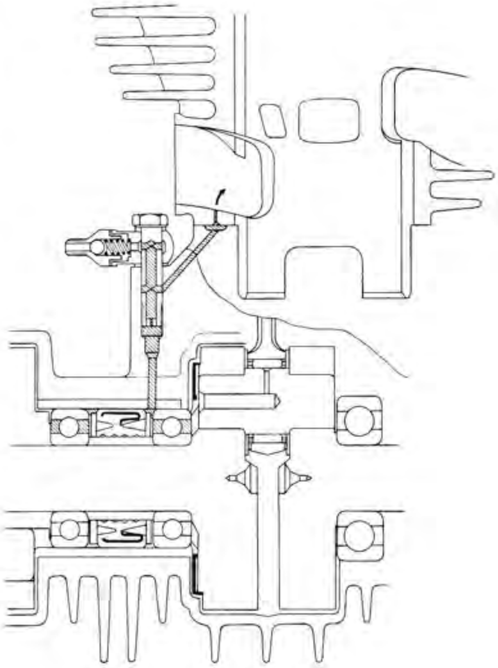


Fig. 3-119

3) Oil pump

The oil pump of multi-cylinder engine is complicated because of increasing discharge holes according to number of cylinders; however, operation and action of the pump itself is the same as single cylinder engine.

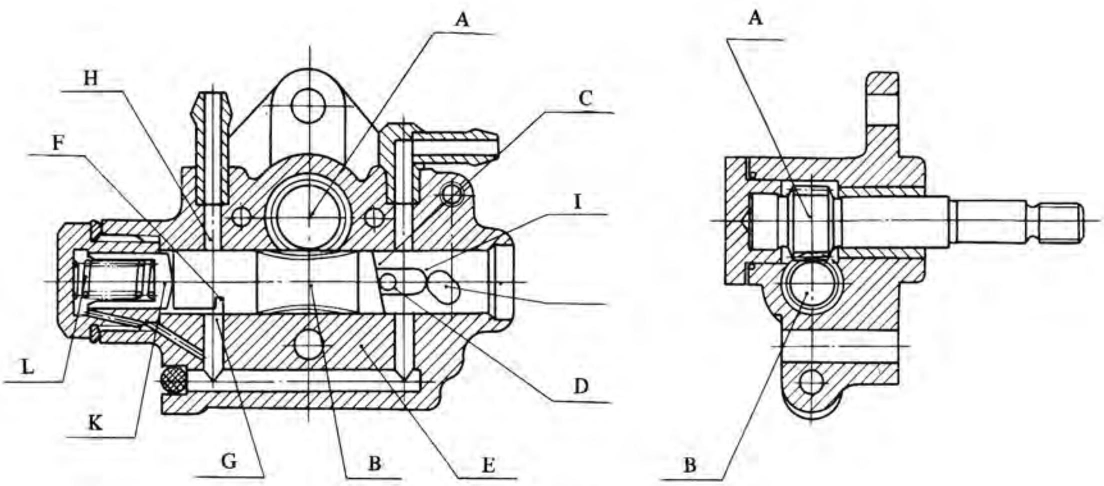


Fig. 3-120

a. Structure

Rotation of the engine is reduced by driving worm (A) and is transmitted to plunger (B) by oil pump gear. This plunger has teeth in its center and interlocks with a worm gear. The plunger guide (D) of cam (C) is fixed to the pump body. Notch (F) of plunger (G) and closes (H) suction and exhaust valves of pump body (E) operating according to plunger rotation.

The top (I) of the plunger is attached to cam (J) which controls the discharge ratio and the bottom of which is pressed by a plunger spring (L) with differential plunger (K).

b. Action

(1) Suction stroke (plunger down stroke)

After discharge stroke, plunger rises in rotation. By this rising stroke, pressure in cylinder becomes low; thus, it is easy to suck in new oil.

(2) Suction stroke (Near plunger bottom dead center).

Inlet port of cylinder overlaps the notch of the plunger by this stroke and oil is sucked into the cylinder in which the pressure is already low from former stroke.

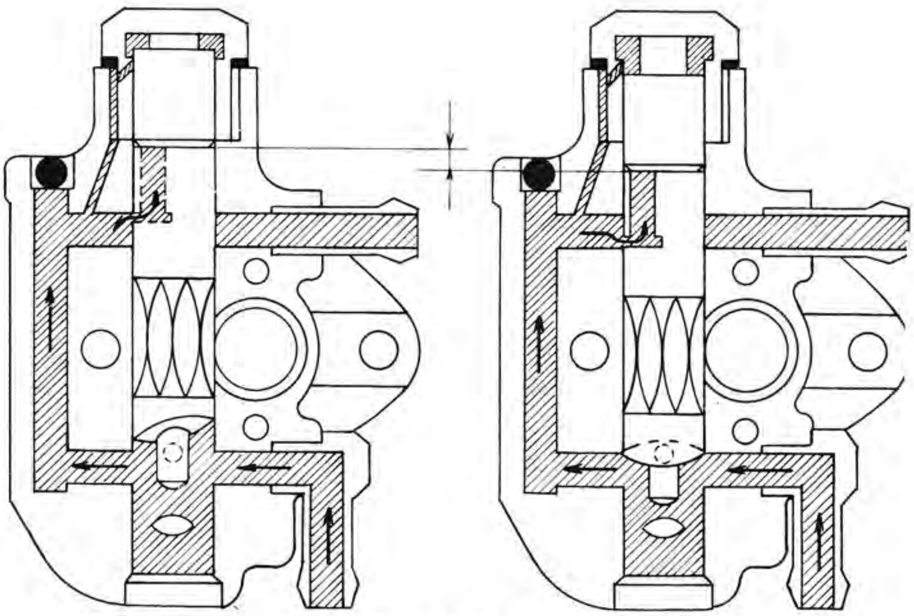


Fig. 3-121

(3) Pre-compression stroke (Plunger up stroke)
After suction stroke, plunger changes to up stroke and begins to compress oil.

(4) Discharge stroke the outlet port of the pump and cylinder aligns to the notch of the plunger by this stroke and compressed oil is discharged. This plunger takes above mentioned four strokes in its one rotation and finishes its work in one revolution.

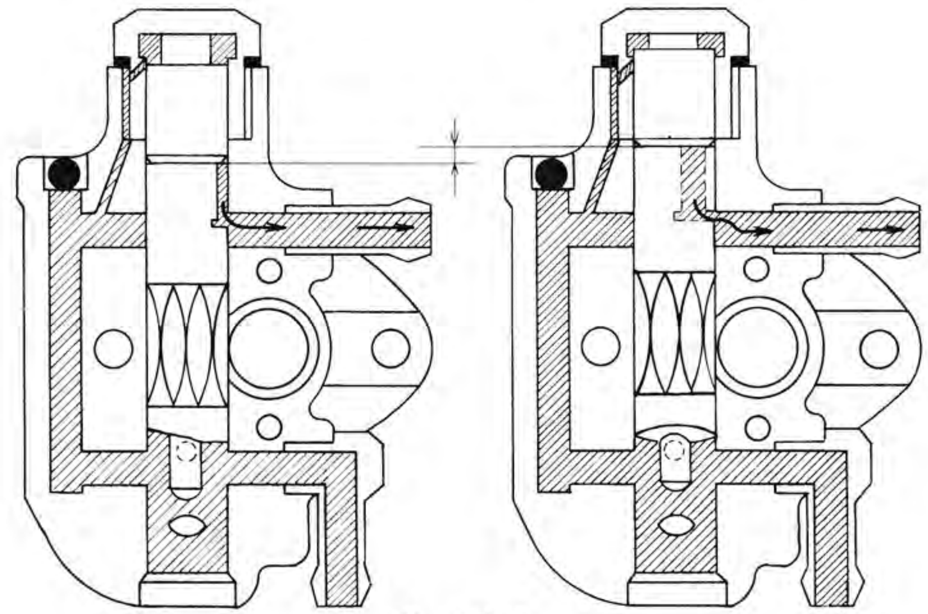


Fig. 3-122

c. Control of discharge flow

The discharge flow of oil increases according to the number of revolutions of the engine. However, necessary consumption for engines are different; thus, control according to throttle opening is needed and the cam controls it with the control lever.

Fig. 3-122 shows lead part which rotates the plunger. This plunger is pushed by a differential spring and is attached to the plunger guide and cam. This cam is linked with the throttle valve.

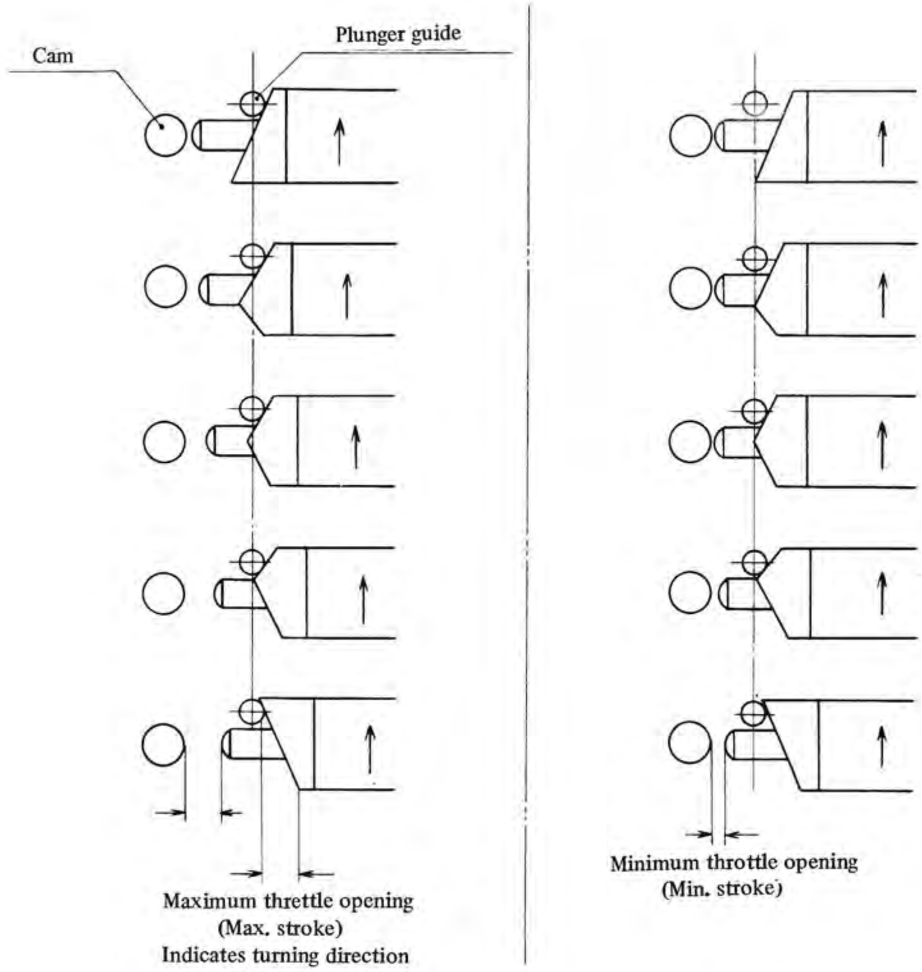


Fig. 3-123

In right figure, the upper part of this cam comes to the plunger side, thus in the (1) plunger bottom dead point, plunger cannot move to the left due to the control of the cam. (2) (3), the plunger guide does not attach to plunger. In the (4), plunger moves away from cam and moves to top dead center point along the plunger guide. Thus the stroke (5) of the plunger between the cam and plunger is top dead center.

In the left figure, the lower part of the cam comes to the plunger side, this plunger is not controlled by the cam at its bottom dead center, and moves along the plunger guide.

3) Oil for Superlube and Injectolube

The most important requirements for superlube oil is to have good liquidity at low temperatures as well as being compounded exclusively for 2-stroke engines.

4) Maintenance and inspection of oil pump

a. Oil pump main body

Never disassemble oil pump for it is very precisely adjusted. Checking the efficiency of the oil pump is done in the following.

Remove check valve (outlet pipe). Run engine and keep its revolutions at 2,000 rpm. Measure volume of oil, three minutes after pulling up the control lever of oil pump fully. The proper discharge oil volume is shown in the table 3-14

Model	A1	A7	H1
Discharge volume in 3mm.	3.9 – 4.6 cc	4.7 – 5.5 cc	5.1 – 5.8 cc

Table 3-14

NOTE

Use mixed fuel to run the engine during above testing.

b. Adjustment of the control lever opening angle

Refer to the item on oil pump in II-5-3

c. Air bleeding.

Air bubbles existing in outlet pipes from pump to check valve and in inlet pipe from tank to pump when removing oil pump or oil pipes prevents oil from flowing:

(1) Outlet pipe

Run engine and keep its revolution at about 2,000 rpm till there is no air in pipe when pulling up control lever of oil pump. (full open)

If air bubbles are still in the pipe, check the following parts.

(i) Connecting part of suction, discharge hole of oil pump and banjo connection, especially looseness of banjo bolt.

(ii) Connecting part of banjo connection and pipe.

Fig. 3-125

(2) Inlet pipe

Loosen the banjo bolt of the oil pump suction side and fill the pipe with oil till no bubbles appear.

d. Check valve

If check valve is pressed to arrow direction by pressure of more than 0.2kg/cm , oil flows to the arrow direction and never flows backwards. Thus, check valve stops oil flowing when engine stops. Never remove check valve. If it is removed, the check valve will not perform its function properly.

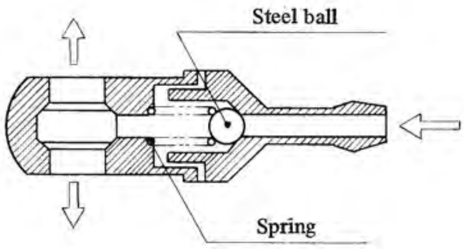


Fig. 3-126

15. Crankcase

The upper and lower crankcase are of the aluminum alloy die casting. Both crankcases are connected with two knock pins and are secured with stud bolts.

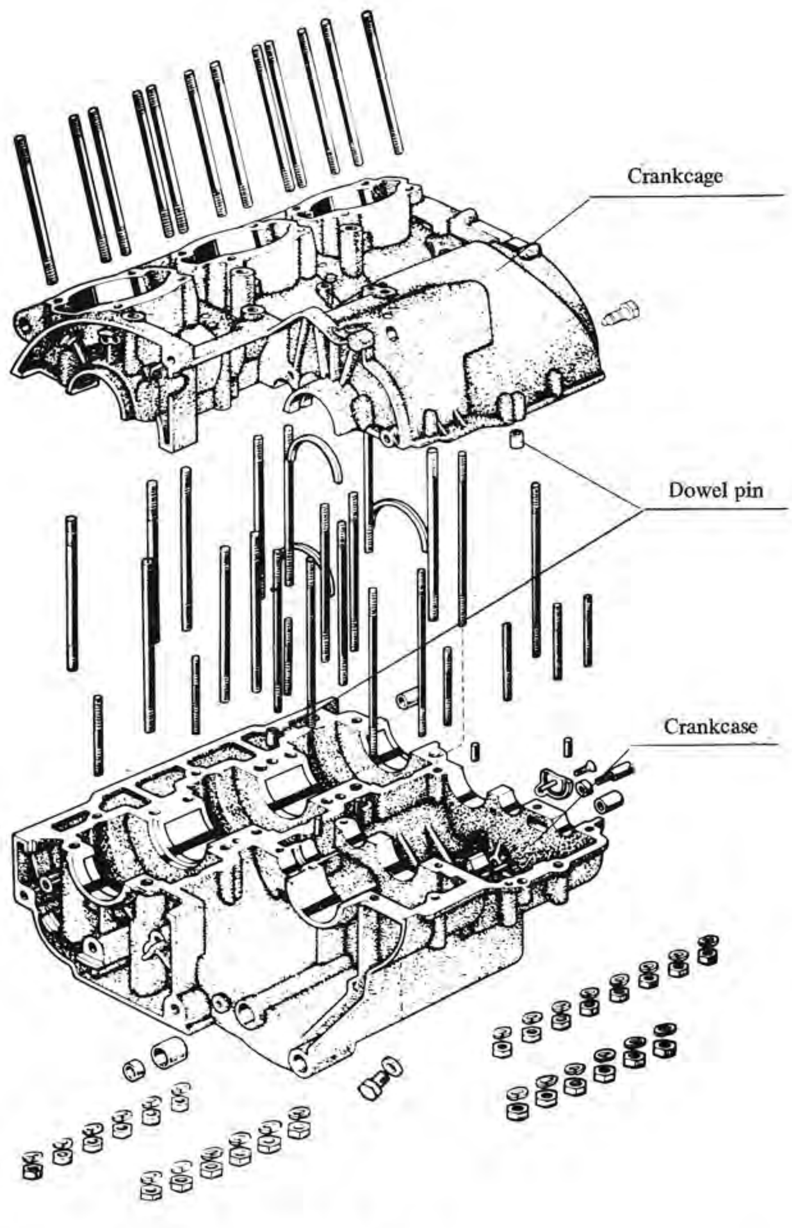


Fig. 3-127

The front part of the crankcase is divided into three parts (A1, A7 are into two), and each divided parts is separated with bulkhead and is sealed with an oil seal.

In the rear of the crankcase, transmission gear case, the breather hole is set to the upper crankcase. This breather hole is to relieve the internal pressure when the temperature rises.

The crankcase supports the crankshaft, drive shaft and output shaft bearings etc;

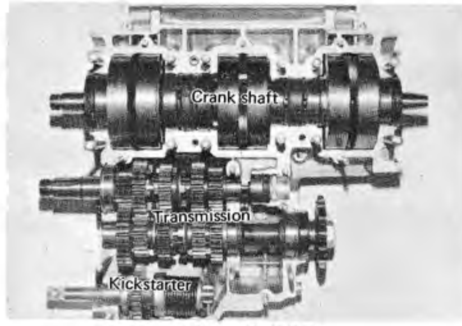


Fig. 3-128

NOTE

In the crankcase, lubrication oil passages are machined, thus, never permit dirt to enter this passage when installing or removing the engine. If the oil passage has clogged or is blocked with dirt, blow them out with the air compressor.

2) Removal

a. Remove oil rerservoir of the output shaft.

Fig. 3-129

b. Take off the nuts on the crankcase by moving the upper crankcase upside down.

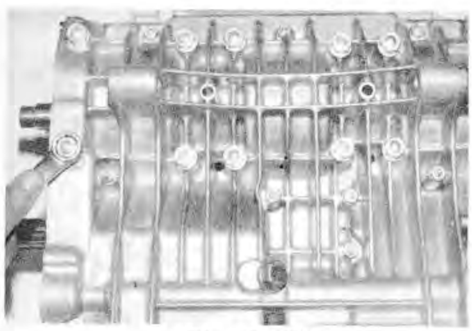


Fig. 3-130

NOTE

Before disassembling the crankcase, remove the clutch release set (H series).

c. Disassemble the crankcase to take out all shafts in upper crankcase by tapping softly both sides of the lower crankcase and shift shaft boss with a plastic hammer.

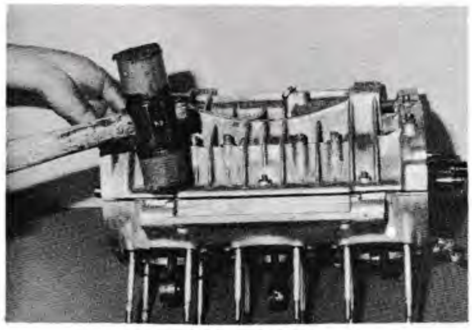


Fig. 3-131

d. Remove the lower crankcase; then it is possible to remove the crankshaft assy, transmission gears, kick starter shaft, release guide and change drum, etc.

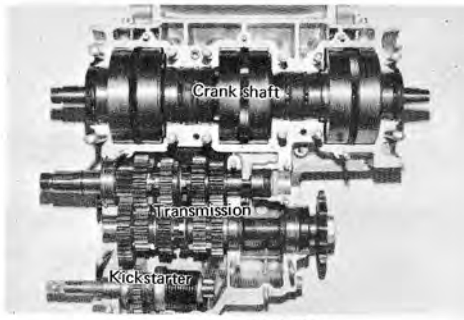


Fig. 3-132

2) Inspection

a. Oil supply hole

Check each oil supply hole. If the holes are clogged, blow them out with air.

b. Breather hole

Check the breather hole. If the breather hole is clogged with dust and dirt etc., it is impossible to let out the internal pressure.

This will cause oil leakage.

3) Installation

Clean the liquid gasket of the surface of the case with gasoline etc. Before installing the lower case, apply evenly the KAWASAKI bond.

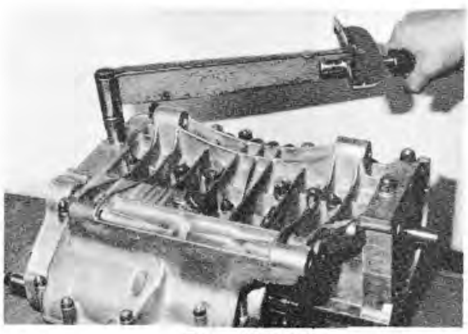


Fig. 3-133

NOTE

Tighten the bolts as specified.

16. Crankshaft

1) Structure

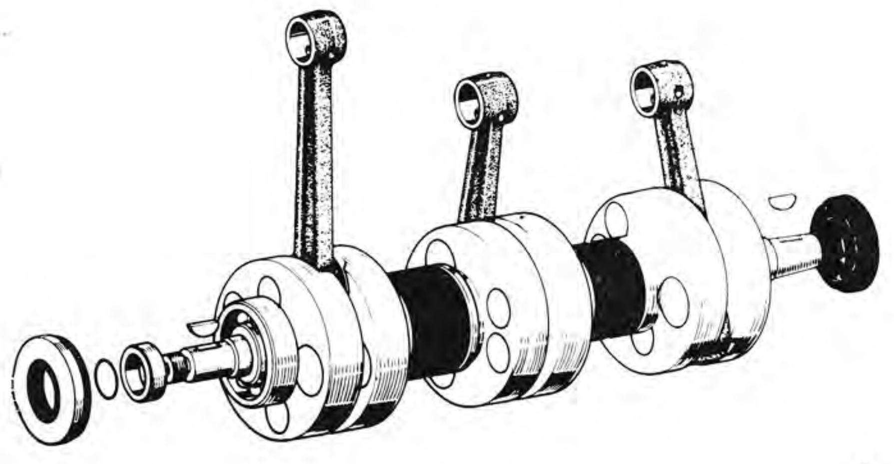


Fig. 3-135

Each connecting rod of H1 is installed at regular intervals of 120° against the single rotation of crankshaft (360) as shown in fig. 3-136.

Ball bearings (H1 is six, A1, A7 are four) are used for bearing the shaft and set by a slotted ball bearings with setting rings.

Side clearance of each connecting rod is specified to 0.40 – 0.50mm (0.0157 – 0.0197 in).
0.0197 in).

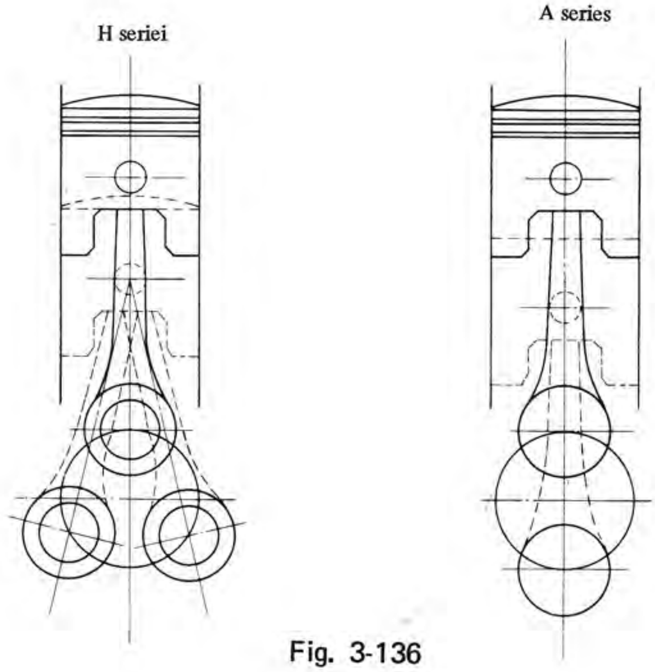


Fig. 3-136

2) Removal

Remove crankshaft, striking softly both ends with a plastic hammer.

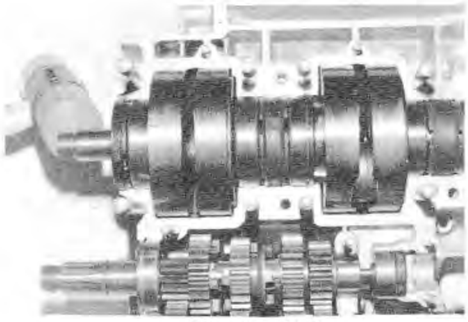


Fig. 3-137

3) Disassembly

The crankshaft assy which contains crank pin, big end needle bearing, connecting rod, crank web, main bearings and center oil seals cannot be disassembled.

If failure occurs in these parts, replace the crank shaft assy itself.

But, both end (left, right) oil seals are removable.

Fig. 3-138

3) Inspection

a. Main bearing

(1) The noise of bearing will be simply checked by spinning the bearing. Spin the outer race of the bearing and let it run until it stops.

Fig. 3-139

NOTE

Clean the bearing thoroughly for inspection. The bearings being tested must be lubricated using a qualified engine oil before putting it to use to prevent damage at the rolling contact surface.

b. Crankshaft oil seal

Each oil seal (left, right and center) is to prevent leakage of each crankcase. If this oil seal is damaged, compression leakage (primary compression) will occur, which decreases efficiency of engine.

Check the fitting part of oil seal, for oil spot caused by compression leakage and find the damages of oil seal lip.

Fig. 3-140

NOTE

When assembling crankcase, oil seal outer surface is slighthy pinched by crankcase fitting surface, but these scratches are usually not supposed to result in damages.

c. Runout of crankshaft

Place the crankshaft on crankshaft aligner supporting both ends. Read the indication of dial gauge which is pointed to each measuring point while rotating crankshaft slowly.

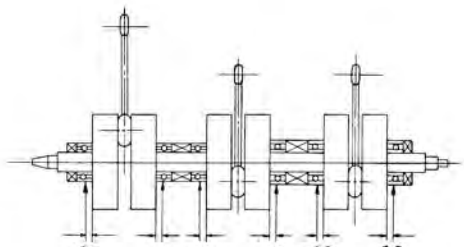


Fig. 141

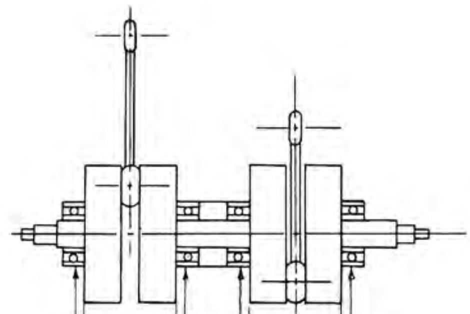


Fig. 3-142

Model	Measuring point	Standard	Maximum limit
A	ABCD	0.0008 in (0.02mm)	0.0024 in (0.06mm)
H	ABCDEF		

Table 3-15

d. Connecting rod big end

(1) Set the dial gauge as shown in Fig. 3-148 Measure the radial clearance of connecting rod big end.

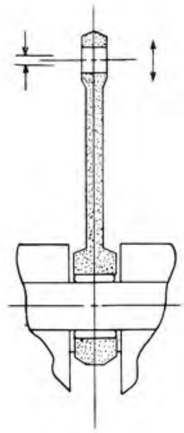


Fig. 3-143

NOTE

Hold the big end by hand so as not to affect the dial gauge by the side clearance of connecting rod big end.

Items	Standard	Maximum limit
Big end radial clearance	0.00016 – 0.00047 in (0.004 – 0.012mm)	0.002 in (0.05mm)
Big end side clearance	0.008 – 0.013 in (0.07 – 0.33mm)	0.0024 in (0.6mm)

Table 3-16

4) Installation

Fix properly the setting ring (which is fitted in the slot on the ball bearing) to the upper crankcase, Install by lightly tapping the bearings with a plastic hammer.

Fig. 3-144

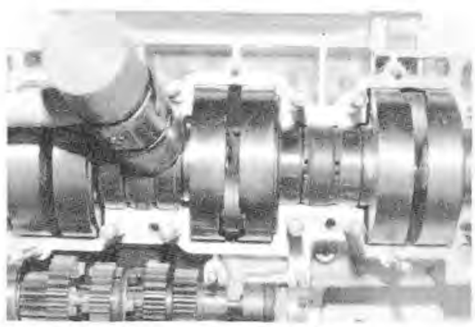


Fig. 3-145

17. Transmission

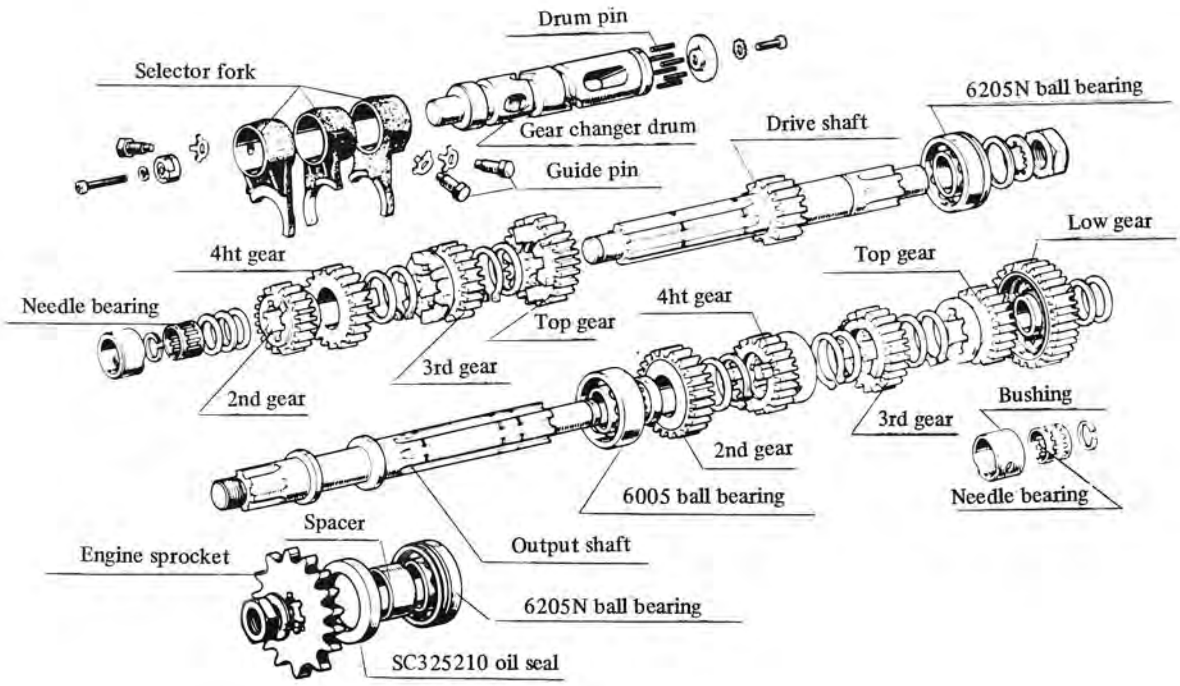


Fig. 3-146

The transmission is of the five speeds return change, constant mesh. Fig. 3-146 shows its components and Fig. 3-147 shows the section of the teeth.

Three selector forks are set on the third gear (drive shaft), fourth gear (output shaft) and top gear (output shaft) and each selector fork set pin is installed in each cam groove which is cut around the change drum.

The drive shaft is supported with two bearings and the output shaft with three; but A series are supported with two. The plain bearings used on A series model transmission shafts are replaced with the needle bearings in the case of the model H. Each of them is fixed with the setting rings.

Transmission gears are basically the same construction regardless the models. In this section, the description is given for the model H1.

Reduction ratio	A series	H series
Low	1 : 2.50	1 : 2.20
2nd	1 : 1.53	1 : 1.40
3rd	1 : 1.13	1 : 1.09
4th	1 : 0.92	1 : 0.92
top	1 : 0.78	1 : 0.81

Table 3-17

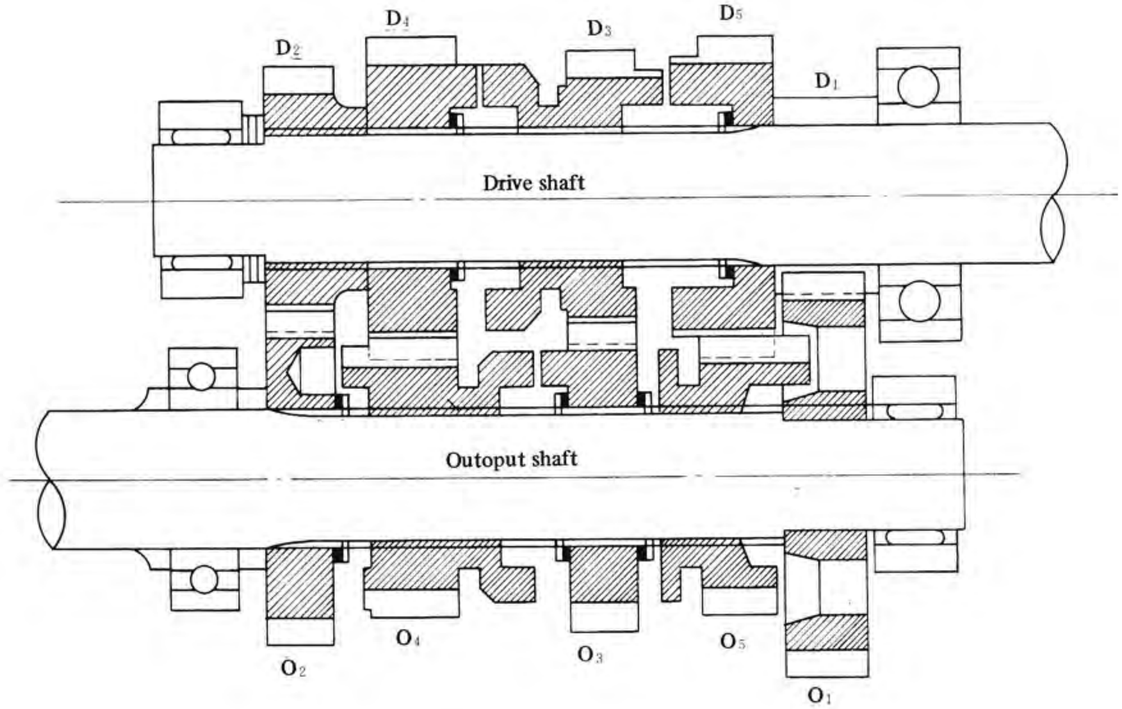


Fig. 3-147

1) Operation

The principle of the transmission is to reduce and transmit the rotation of drive shaft to the output shaft by sliding the shift gears, and interlocking with the chosen gear with its dog clutch.

D1 in the Fig. 3-147 is fixed to the drive shaft but D2, D3, O4, and O5 can move in the axial direction and D4, D5, O1, O2, and O3 can only rotate free. D3, O4 and O5 are shifted to the shaft direction by selector forks, and D3 interlocks to D4, D5, and O4 interlocks to O2, O3 and O5 interlocks to O1 when changing gears. For example, when shifting the gears to 3rd, O4 slides to shaft direction and connects with O3 and D3 also interlocks to O3.

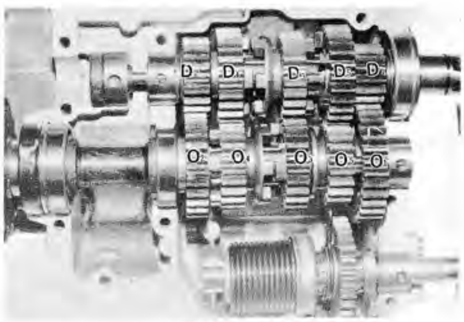


Fig. 3-148

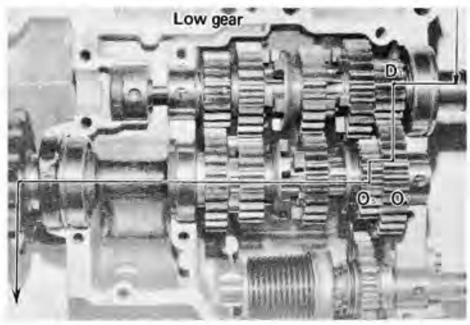


Fig. 3-149

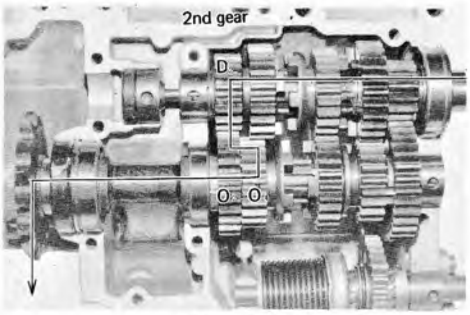


Fig. 3-150

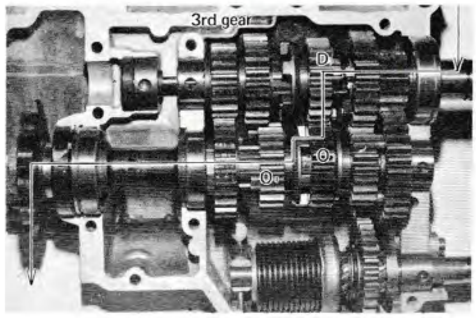


Fig. 3-151

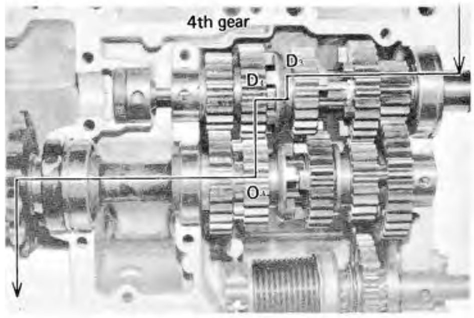


Fig. 3-152

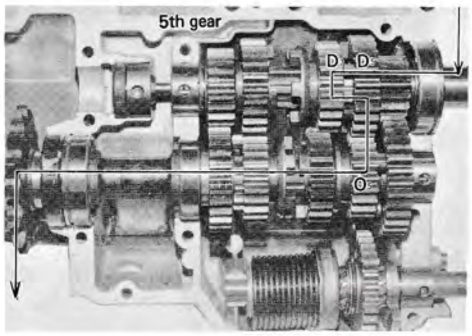


Fig. 3-153

2) Removal

Before removing the change drum, take off the guide pins of selector forks. Then the change drum can be removed to the direction indicated with the arrow.

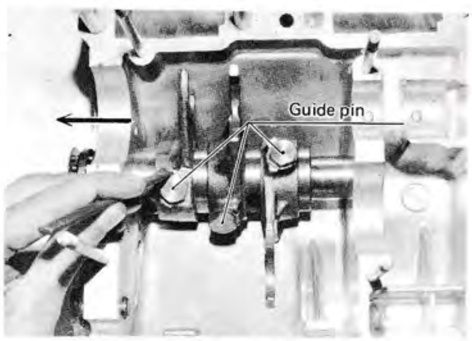


Fig. 3-154

3) Disassembly

Take off the circlips of the needle bearings and remove each gear one by one snapping off the circlips by special tool.

Each ball bearing can be taken off by hand.

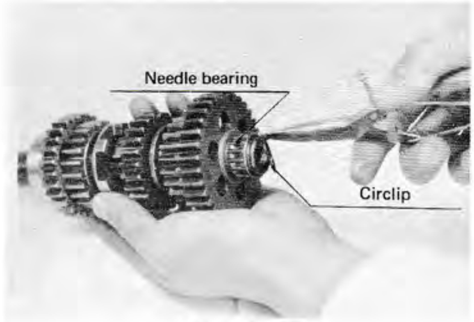


Fig. 3-155

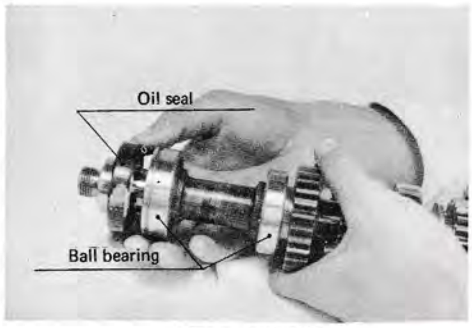


Fig. 3-156

4) Inspection

a. Flaking or scratched gears accelerate the abrasion of other gears and is the cause of noise: Thus, such gears should be ground by oil stone etc. If they are not, replace the gear.

b. Inspection of shift groove and selector fork.

If the shift groove on the gear where the selector fork is inserted is worn the gear may not engage fully and therefore disengage during operation. Insert a thickness gauge between the shift groove on the gear and the selector fork to measure the clearance. If the clearance is beyond the permissible limit, replace gear or selector fork.

Also if the selector fork is burnt or damaged, replace it.

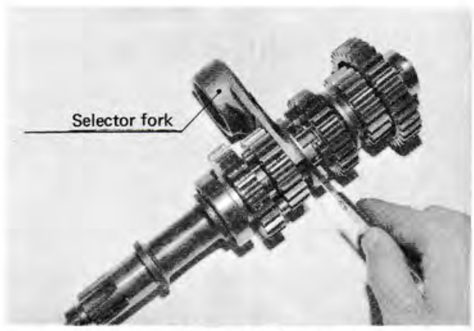


Fig. 3-157

Standard limit	Repair limit
0.0039 – 0.01 in (0.1 – 0.25mm)	Less than 0.023 in (0.6mm)

Table 3-18

5) Assembly

Follow the reverse order of disassembly and removal.

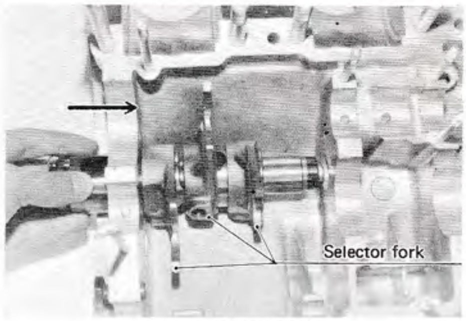


Fig. 3-159

Carefully fix the circlips of gears and needle bearings to the shafts.

Before installing the selector fork to the change drum, properly install the bearing setting rings (2 ea) and bend lock washer tabs of guide pins.

Fig. 3-160

18. Kick starter

H series

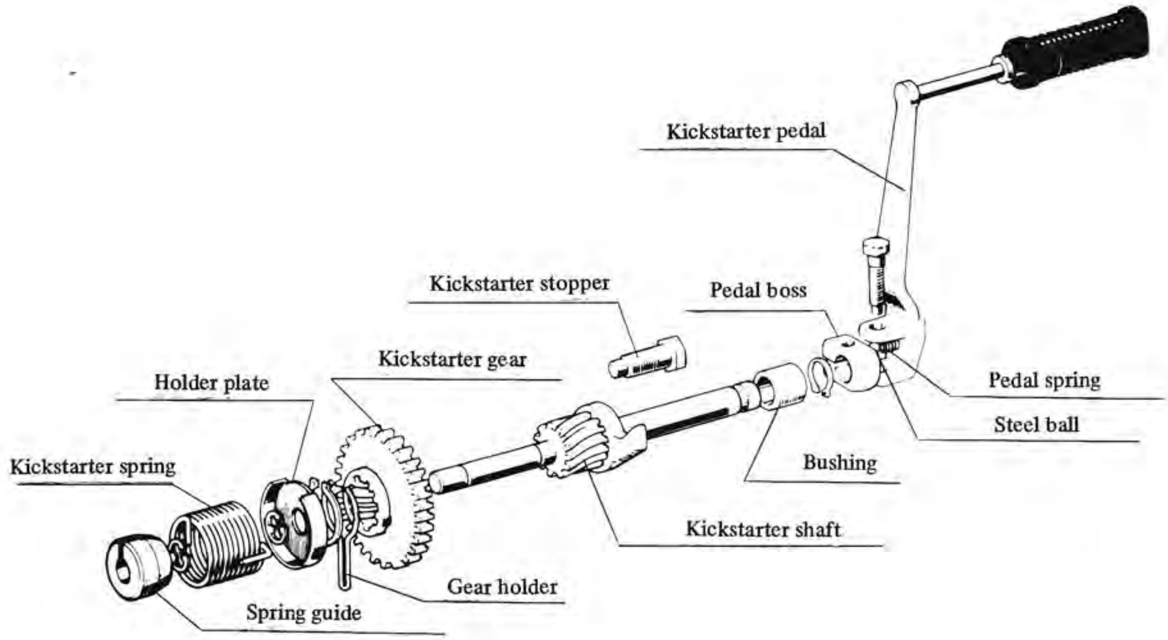


Fig. 1-161

The construction of the kick starter of the H series is very simple but reliable.

The mechanism of this system is as follows:

In the center of the kick starter shaft, the threaded guide are installed, on which internal teeth of the kick gear is interlocked. According to the rotation of the kick shaft, the kick gear can slide on the kick shaft guide in the axial direction. Thus, the kick gear and the low gear on the output shaft are engaged only with a kick. During engine runs, the engagement does not occur and the kick gear returns to its normal position.

1) Operation

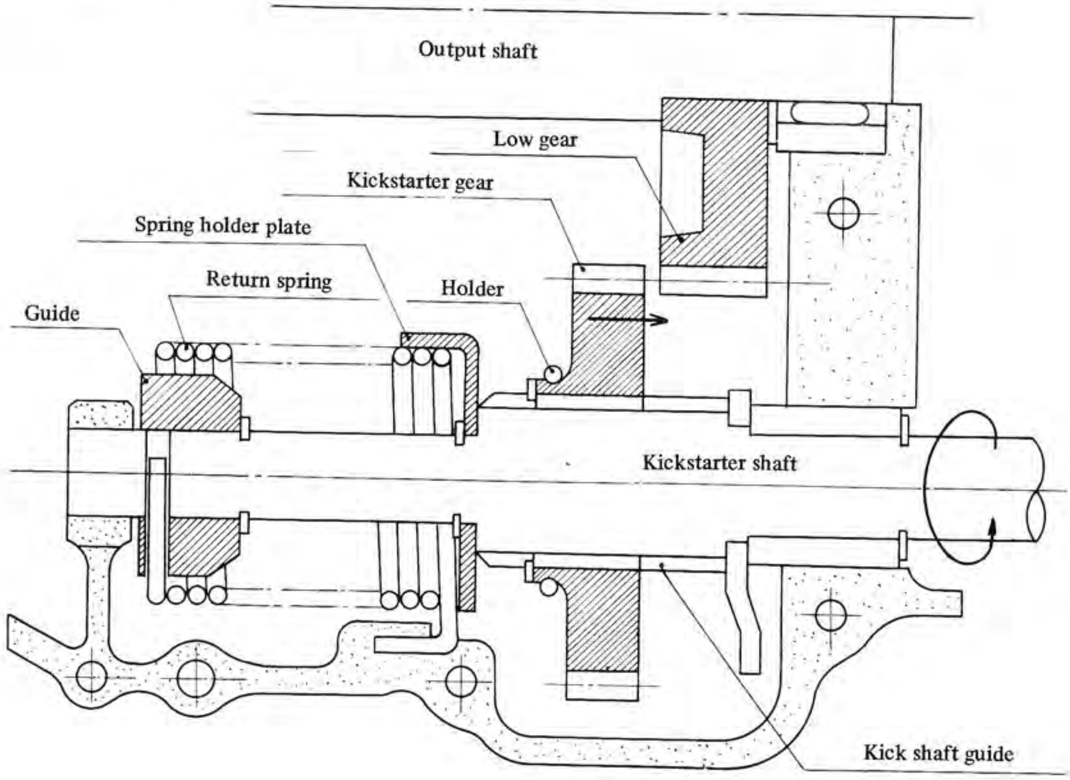


Fig. 3-162

The kick shaft rotates to the arrow direction A by stepping on the kick starter pedal, and the kick gear slides into rotation with the guide of the kick shaft and interlocks to the low gear of the output shaft. Thus, the torque of the kick pedal is transmitted in the following order.

kick shaft – kick gear – output shaft (low gear) – driven shaft (low gear) – clutch – crank shaft (primary gear)

When engine starts, kick gear slides to the arrow direction C by the guide of kick shaft, which is rotating with the output shaft (low gear). Thus, interlock of the kick gear disengages. By stepping off the kick pedal, the kick shaft is rotated clockwise by the kick return spring, and the kick gear is returned to its original position by the kick stopper.

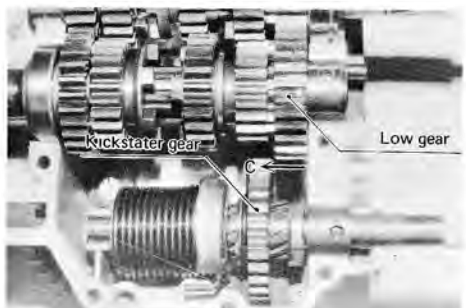


Fig. 3-163

2) Disassembly

a. Remove the spring guide and the spring

Fig. 3-164

b. Remove the circlips (2) and spring holder plate.

c. Remove the snap rings and the kick gear from the kick shaft guide.

Fig. 3-165

3) Inspection

Check the kick shaft guide and kick gear inner ring for loosening. Check kick gear by rotating the kick shaft for abnormal contact.

Fig. 3-166

4) Assembly

.Follow the reverse order of disassembly. Install properly each circlip to the slot.

After assembling the crankcase, install the kick stopper. Pre-set the kick pedal, and install the kick stopper in twisting position about 150° to the arrow direction as shown in Fig. 3-172.

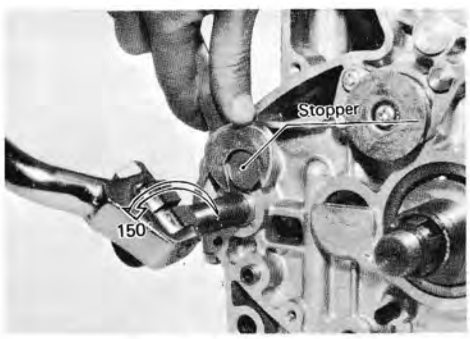


Fig. 3-167

A series

The kick starter of A series is of constant engagement type and the same as explained in SM-1, which means that the ratchet mechanism is installed in the kick gear. During operation, to make the ratchet mechanism free from transmission gears, kick pawl must be pushed kick shaft by kick stopper and kept in the normal position of the kick pedal.

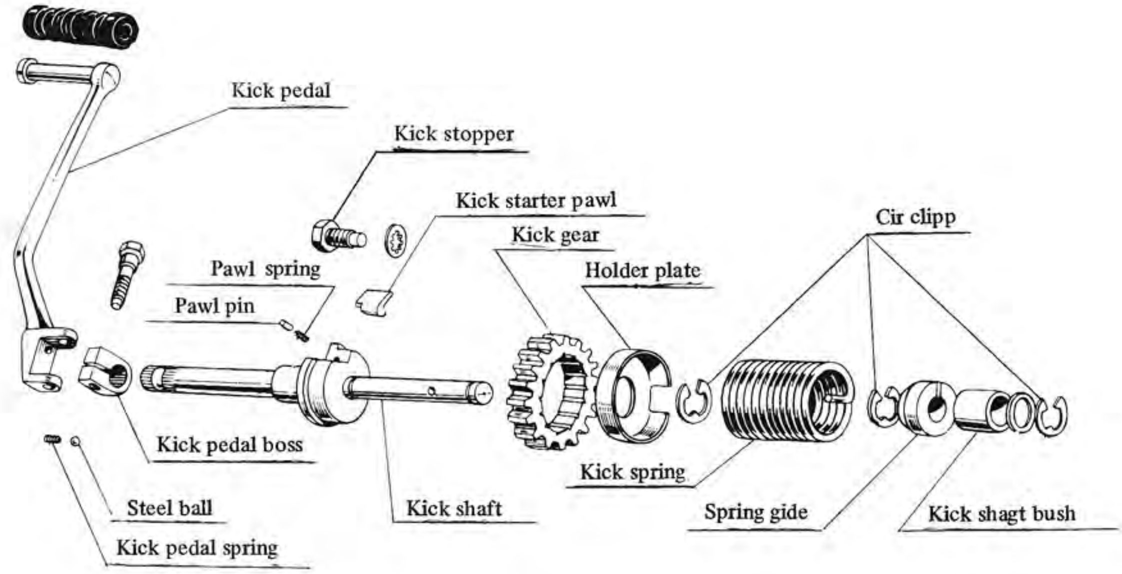


Fig. 3-168

1) Operation

Kick shaft rotates to arrow A by stepping on the kick pedal. Therefore, kick pawl can be pushed to the inner teeth of kick gear, resulting in driving it by spring of pawl push pin which is installed to the kick shaft boss.

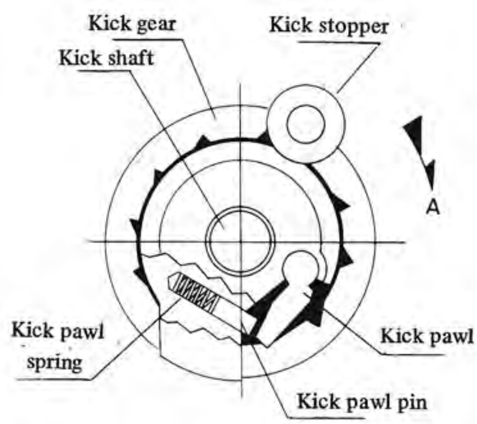


Fig. 3-169

When engine starts, rotation of output shaft (low gear) is transmitted to kick gear by the ratchet mechanism in the kick gear; this rotation is not transmitted to the kick shaft. When releasing the kick pedal, kick shaft returns to arrow B by kick spring, and kick pawl is pushed in by kick stopper. Thus, interlock of kick shaft and inner teeth of kick gear are disengaged and kick gear rotates freely.

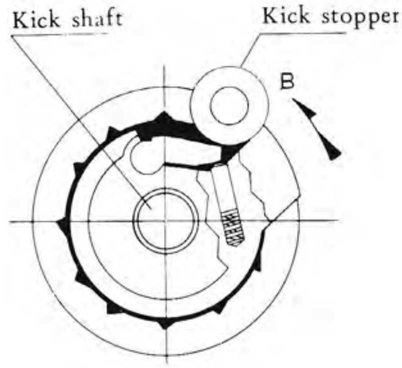


Fig. 3-170

2) Disassembly

a. Take off the thrust washer, bushing, spring guide and spring by removing the circlip.

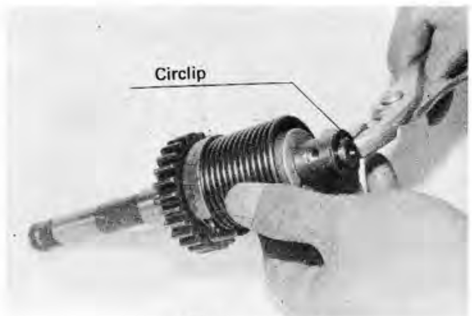


Fig. 3-171

b. Remove the kick gear from the kick shaft by removing the circlip and holder plate.

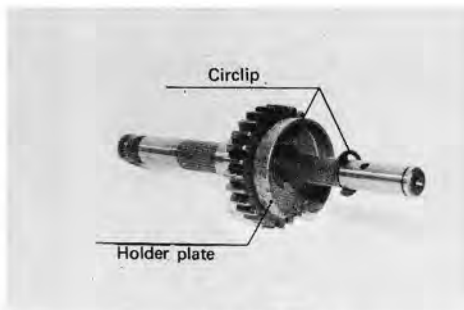


Fig. 3-172

c. Remove the kick pawl, pin and spring from the kick shaft.

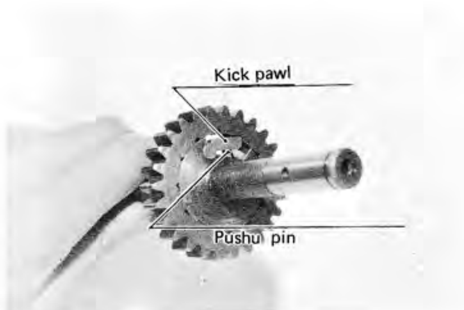


Fig. 3-173

3) Inspection

a. Kick gear

The inside of the kick gear has machined as internal gear. If teeth inside kick gear are worn out pawl cannot engage with it and causes to slippage in kicking.

Fig. 3-174

b. Kick pawl

Check wearness of top end of the kick pawl which also causes to slippage in kicking.

c. Kick pawl push pin and spring

If there are foreign substances between the kick pawl spring and the kick pawl push pin which is inserted into the hole of kick shaft boss, push pin does not move, and pawl also does not move resulting in kick slips. Install spring and push pin to the kick shaft as shown in Fig. 3-175 and check whether they operate smoothly by pushing them.

Fig. 3-175

4) Assembly

Install the kick pawl spring and the kick pawl push pin in the kick shaft boss and insert it into crankcase.

Screw the kick stopper after assembling crankcase with the kick shaft twisted by about 150° to the direction of the arrow as shown in Fig.

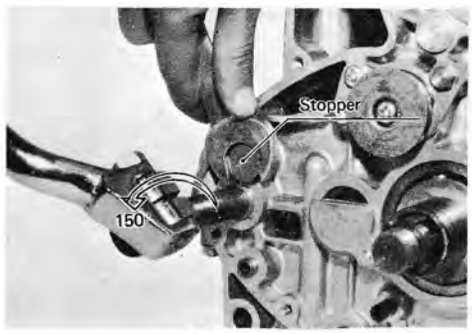


Fig. 3-176

19. Carburetor

Structure and function of carburetor has already been explained briefly in SM-1; therefore, SM-2, mainly explains about function of each component, and countermeasures and adjustments against defects.

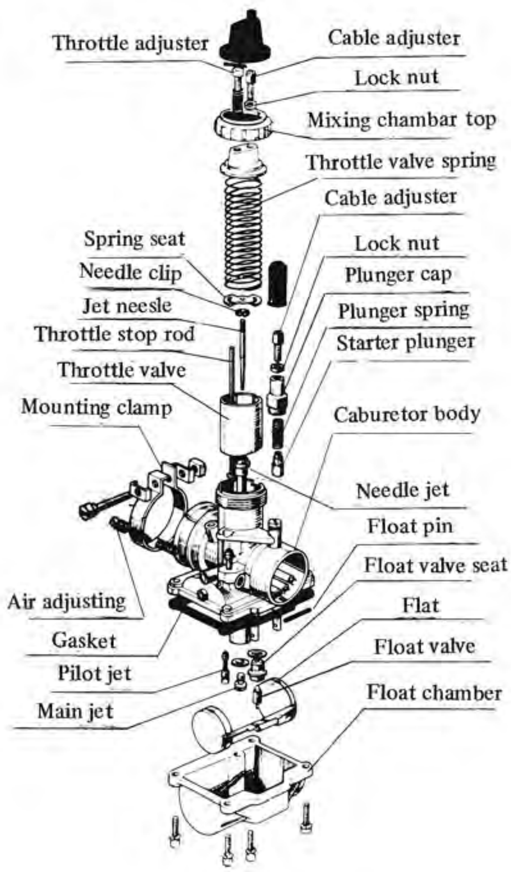


Fig. 3-177

1) Components

a. Throttle valve (C.A)

Throttle valve controls air to engine, main bore sectional area of mixing chamber sliding vertically.

Throttle valve has a cut-away which controls flowing speed of air and adjusts injection flow ratio of fuel. This cut-away has several degrees, and its degree is indicated by number. Large number cut-away can get lean mixed air and small number cur-away can get rich mixed air. Number is indicated in the bottom of throttle valve as 1.0, 1.5, 2.0, ... , 4.0, 4.5, etc. according to the degree of cut-away.

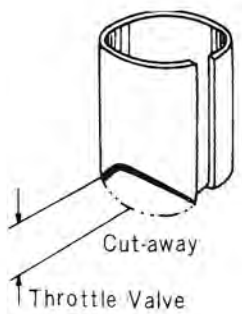


Fig. 3-178

b. Jet needle (J.N)

In the top of the jet needle, 5 grooves are provided. The needle clip is installed to the groove and is fixed to center of throttle valve. Tapered part is inserted in the needle jet.

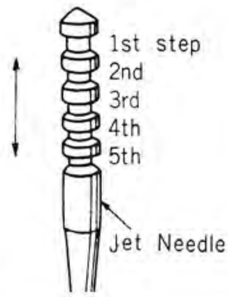


Fig. 3-179

Except when full open or full close of throttle valve, tapered position and its wear affect closely to fuel flow ratio. By lowering the clip down, rich mixed air is supplied, and lean mixed air is obtained in the reverse way. Identification mark is indicated in the bottom of step grooves.

Identification of the jet needle is as follow (example: 5GL-3)

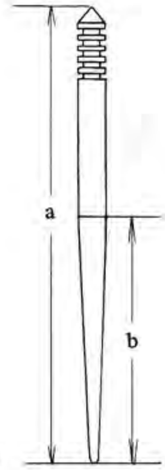


Fig. 3-180

(1) The first number is shown the overall length of the jet needle. Number 5 is classified as 50mm to 60mm, and 4 stands for 40mm to 50mm.

(2) The second letter is shown the degree of the needle taper. There are 26 different taper of the jet needle designating A. B. C. ....Z at intervals of 15′. (A=0° 15′ B= 0° 30′ C=0° 45′ D=1° E=1° 15′ F=1° 30 G1° 45′ ....Z=6 30′)

(3) The third letter and/or number is shown manufacturing badge number.

(4) The fourth number is shown groove position since there are 5 grooves in the jet needle. Beginning with the top groove, they are counted 1, 2, 3 on down.

e. Needle jet (N.J)

Needle jet controls fuel flow ratio with jet needle. Several breather holes are machined to the side of needle jet. These breather holes are metering the air flow from the air jet to the needle jet and accelerate mixing of air and fuel, and atomizing action.

Fig. 3-181

	0	1	2	3	9
A	1,900	1,905	1,910	1,915	1,945
B	1.950	1,955	1,960	1,965	1,995
C	2,000	2,005	2,010	2,015	1,045
D	2,050	2,055	2,060	2,065	2,095
E	2,100	2,105	2,110	2,115	2,145
O	2,600	2,605	2,610	2,615	2,645

Table 3-21

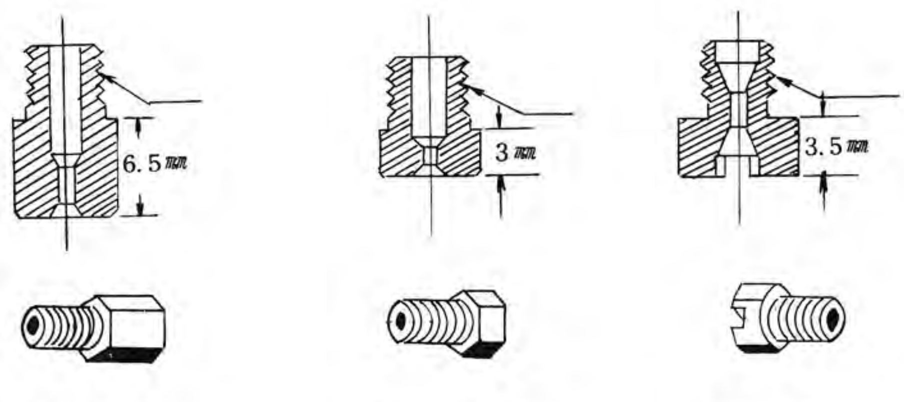
The identification mark of the NJ indicates its inner diameter, which is coded with a letter and a digit. In the case of the model H1, 0-2 is used and it stands for 2.610mm.

d. Main jet (M.J)

Main jet is the most important part in controlling fuel flow ratio which mixes with air and has an influence on the mixing ratio, mostly when throttle valve is full open. Identification number shows flow ratio in one minute in a specified condition.

There are three types of main jets (the Amal, the Mikuni and the Reverse). These three types have different standard flow ratios or identification numbers for fuel flow ratio in one minute according to their shape. Table 3-20 shows the comparison of standard flow ratio of each type, comparing with the Mikuni type.

Each type of main jet cannot be interchanged with one another.



Amal type Mikuni type Reverse type

Fig. 3-182

Standard flow cc/min	Amal type	Main jet number Mikuni type	Reverse type
80	80	80	82
100	97	100	90
150	135	150	108
200	177	200	123
240	211	240	133.5

Table 3-20

e. Pilot jet (P.J)

This pilot jet controls fuel supply ratio from idling to low speed operations. Several breather holes are provided in its side and they promote the atomizing action of the air.

Identification number shows flowing ratio in one minute in cc. in its specified condition.

Fig. 3-183

f. Pilot air screw (A.S)

Pilot air screw controls quantity of the air from idling to low speed operation.

Tapered part of pilot air screw end can change the sectional area of air suction passage, and controls the quantity of the air.

Fig. 3-184

3) Setting table

Item \ Model	A1		7SS		H1
Type	VM22SC	VM22SC	VM26SC	VM-28SC	VM-28SC
Quantity	2	2	2	2	3
Main jet	140	140	97.5R	97.5	100R
Needle jet	0 – 0	0 – 6	0 – 4	0 – 4	0 – 2
Jet needle	4J13 – 2	4J13 – 3	5E14 – 3	5E14 – 3	5GL1 – 3
Pilot jet	30	30	30	30	30
Cut away	2.5	2.5	2.5	2.5	3.0
Air screw	1½	1½	1½	1½	1¼
Engine number	11564 –	11814 –	15177 –	15177 –	00001 –

NOTE

After careful tests, these specifications have been decided; thus, never change far from standard adjustment except for a special purpose if there is no trouble.

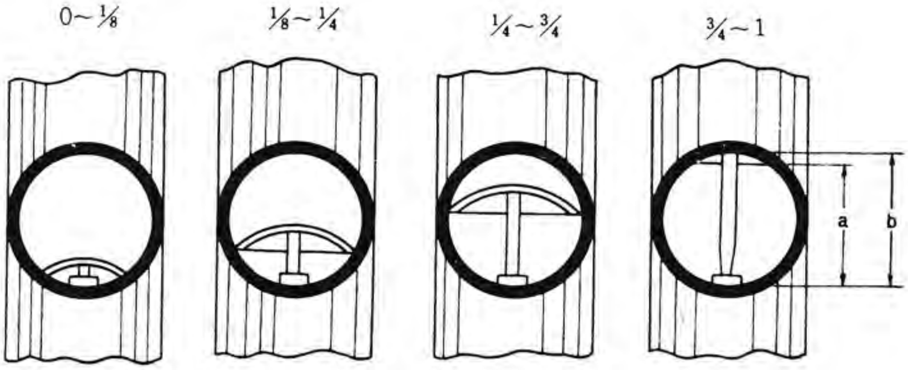
4) Adjustments

Failures of the carburetor, that is, abnormalities in the mixture ratio of fuel and air, are usually only due to clogging of foreign objects, abrasion of parts, and fluctuation of float level. An unsuitable mixture ratio causes the following disorders of the engine:

In the case of rich	In the case of lean
Rich Too much exhaust smoke. Engine turns heavy with some misfiring. Spar plug is fould and becomes black with carbon deposit. Engine performs worse as warmed up.	**Lean** Engine overheats. Revolution not smooth when idling. Poor acceleration. Engine performs better with starter lever open. Engine rpm is unsteady at constant throttle valve opening. Spark plug burns and becomes white.

While the engine is running, confirm whether the mixed gas is too rich or too lean (i.e. whether there is too much fuel or air). Using the throttle grip, check to see at which degree of opening of the throttle valve the engine shows signs of trouble. Depending on the opening of the valve, the trouble spots can be detected, because the mechanism of the carburetor is so designed that a different part functions at a different opening degree of the valve.

The following are the causes of difficulty and their adjusting methods at each opening degree of the throttle valve, which is divided into four steps, 0-1/8, 1/8-1/4, 1/4-3/4 and 3/4-full opening.



Example: Full throttle opening a/b=1
Throttle closed a/b=0

Fig. 3-185

a. The opening degree 0-1/8 (in idling)

In this stage of the opening degree, the fuel is controlled by the pilot jet and the air is adjusted by the pilot air screw which are mixed to make gas rich. The rich mixture of gas is jetted from the pilot orifice, mixed with a little air flowing from the main bore, and supplied to the engine. The pilot jet has a fixed capacity, while the pilot air screw changes the amount of air to be inhaled, thereby adjusting the concentration of the mixed gas. Therefore, it is most important to adjust the pilot air screw properly. As for clogging due to dust or dirt, if the gas is too rich, the air passage from the pilot air port to the pilot jet or the breathing hole of the pilot jet may be clogged. On the contrary, if too lean, the pilot jet or the pilot outlet may be clogged.

Other causes of trouble are as follows.

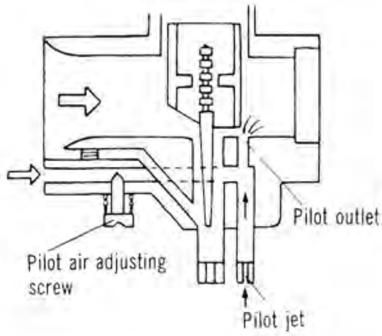


Fig. 3-186

In the case of being too rich	In the case of being too lean
The fixing of the pilot jet is loosened. The starter lever is not completely returned. The starter plunger is not fully closed, through the starter lever is properly returned.	The throttle valve with play due to excessive abrasion, inhales air from the main bore. Installation of the carburetor is loosened and air is inhaled.

In case of clogging, blow away the clogged matter by compressed air after washing with pure gasoline. In dusting the jet hole, do not insert something hard such as wire.

b. The opening degree 1/8-1/4 (In starting or low speed running)

In this step, the slow system and the main system function half and half. In the slow system, as in the above paragraph (a), fuel metered by the pilot jet and air adjusted by the pilot air screw are mixed and sprayed from the pilot outlet.

In the main system, the amount of fuel jetted depends on the gap between the jet needle and the needle jet and the position of the clip.

Thus, fuel is supplied through two systems. Therefore, the causes of trouble are divided into two systems. In the slow system, it is necessary to check for proper adjustment of the pilot air screw and clogging of the pilot jet, or the pilot outlet, etc. as in the (a). In the main system, if the gas is too lean, check for clogging of the main jet or the needle jet, etc.

Possible causes of troubles are; if the gas is too rich, clogging of the air jet passage a considerable gap in breathing hole of the jet due to abrasion of the jet needle.

If clogged; blow out by compressed air, as in (a). In case of abrasion of the jet needle and the needle jet, it is best to replace it with a new part; but it is possible to adjust it to certain extent by using a different grove of it.

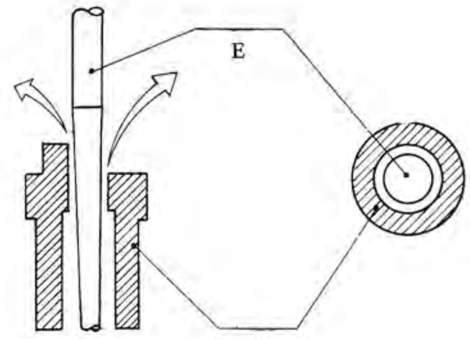


Fig. 3-187

c. The opening degree 1/4-3/4 (In normal running)

In previous paragraph (b) the slow system and the main system influence half and half on the amount of fuel sprayed, but in this step, it depends only on the main system. Fuel sucked up through the main system, and the inhaled air controlled by the air jet, is mixed in the needle jet to make rich gas. There the gas is controlled by the gap between the needle jet and the jet needle and sprayed into the main bore.

Possible causes of trouble are: If the gas is too rich, and there is clogging of the air jet (its passage or its breathing hole), or there is a considerable gap due to abrasion of the jet needle (outside) and the needle jet (inside), or the main jet or the needle have been loosened. On the other hand if the gas is too lean, clogging of the main jet or the

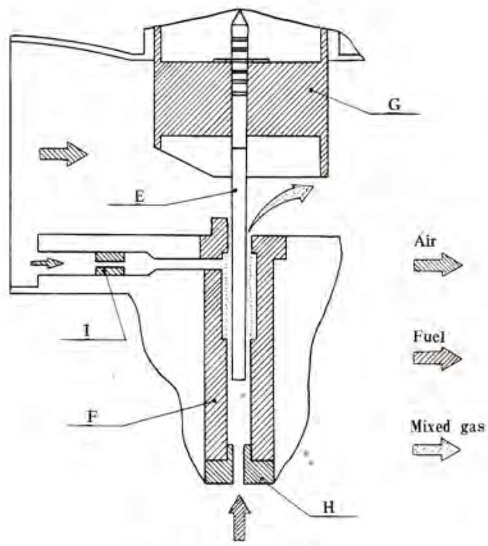


Fig. 3-188

needle jet is possible. If clogged, clear it off, and if worn out, replace with new parts.

d. The opening degree 3/4-full opening (In full power running)

In previous paragraph (c) fuel sprayed depends on the gap between the needle jet and jet needle; but in this step the fuel is metered by only the main jet. This is because the jet needle is raised as the valve approaches its full opening, and finally the gap area becomes greater than the hole of the main jet.

Signs of trouble are the following: The mixed gas is lean if the main jet or the needle jet is clogged. It is heavy if the breathing hole of the needle jet is clogged, or if the main jet or the needle jet are loosened.

If the engine is still not working properly after inspecting and repairing clogging or loosening (as mentioned above), adjust the main jet.

The main jet functions not only when the opening degree is 3/4-full opening of the throttle valve, but also in wider degree.

That is, in replacement, if the gas is lean, use the main jet of the one above the standard number, and if rich use the one below, as shown below.

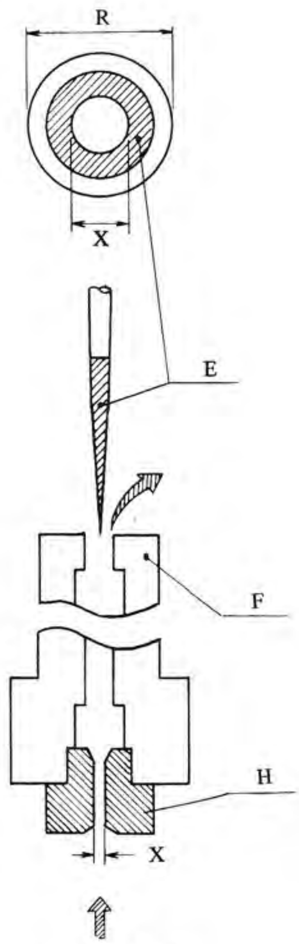


Fig. 3-189

e. Float mechanism

This mechanism consists of the float, the needle valve and the valve seat, etc.

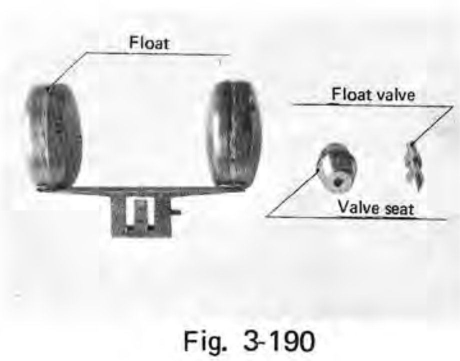


Fig. 3-190

This mechanism is so designed that the fuel level is adjusted by the tang on the float. It is most important in adjusting the fuel level properly.
Over-flow due to higher fuel level is caused by clogging between the needle valve and the valve seat, abrasion and scratches of the contact area of the needle valve, or a puncture in the float. Also, if the needle valve sticks to the valve seat, fuel cannot flow into the mixing chamber. In case of abrasion of the needle valve, puncture of the float and adherence of the needle valve, replace them with new parts. If there is clogging anywhere, clear it up. If the fuel level of the float is at an abnormal height, adjust it in the following manner.

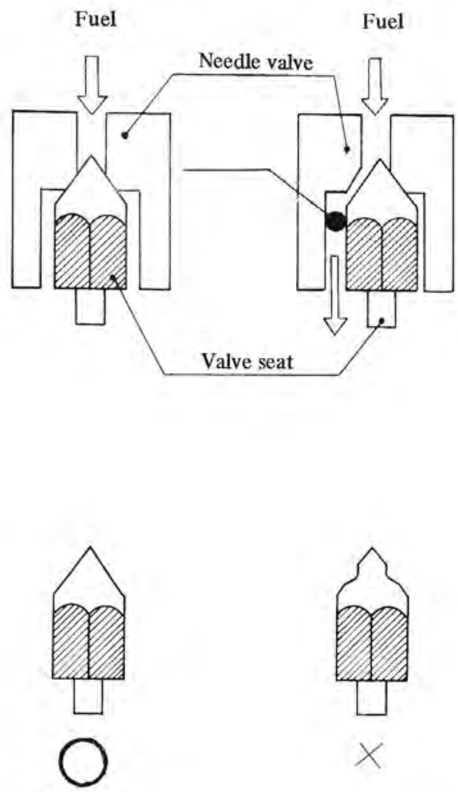


Fig. 3-191

Remove the float chamber body. Place the mixing chamber body upside down. Measure the distance between the mixing chamber body fitting surface (gasket surface) and the top of the float. When measuring the distance, remember to keep the floats free, and do not press the floats. If the float level is not proper, adjust by bending the tang on the float arm illustrated. Since the floats are likely to be disfigured, full care should be used when adjusting the float level.

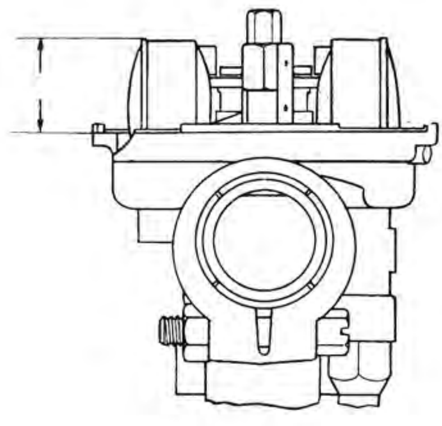


Fig. 3-192

Models	Height of float
A1	0.87 – 0.94 in (22 – 24mm)
A7	0.94 – 1.02 in (24 – 26mm)
H1	1.14 – 1.22 in (29 – 31mm)

Table 3-22

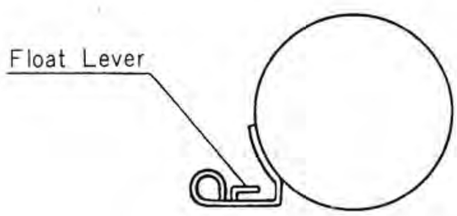


Fig. 3-193

IV. MAINTENANCE OF FRAME COMPONENTS

1. Frame
2. Handlebar
3. Wheels, brake drum
4. Brake
5. Front fork
6. Rear shock absober
7. Front fender, Rear fender
8. Swinging arm
9. Fuel tank, oil and fuel cock
10. Dual seat
11. Center stand, side stand, foot rest and rear foot rest
12. Exhaust pipe and muffler

1. Frame

The frame is constructed of pipe. It is of double loop design for light weight and excellent rigidity. The steering head functions as the connecting point for the front fork assy. (Fig. 4-1)

NOTE

The H series is designed so the rider may select right or left braking and shifting.

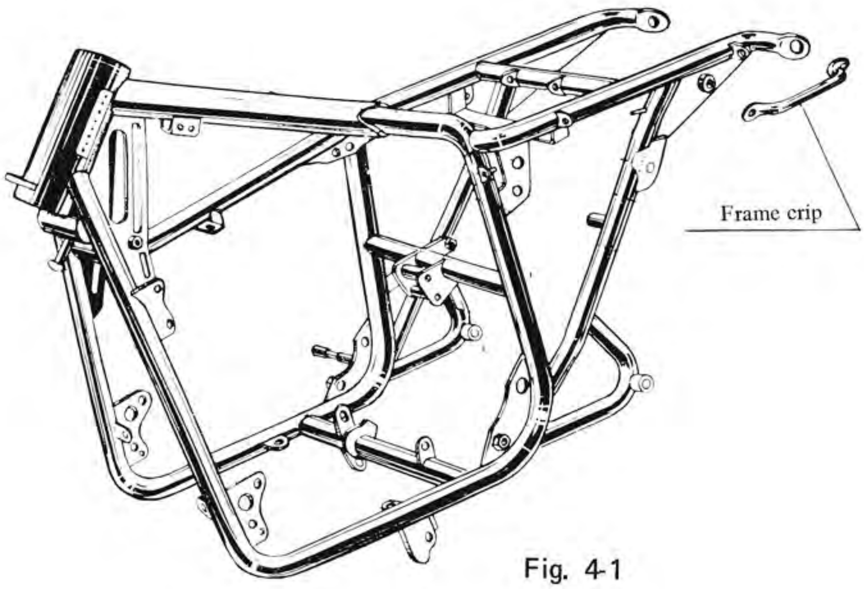


Fig. 4-1

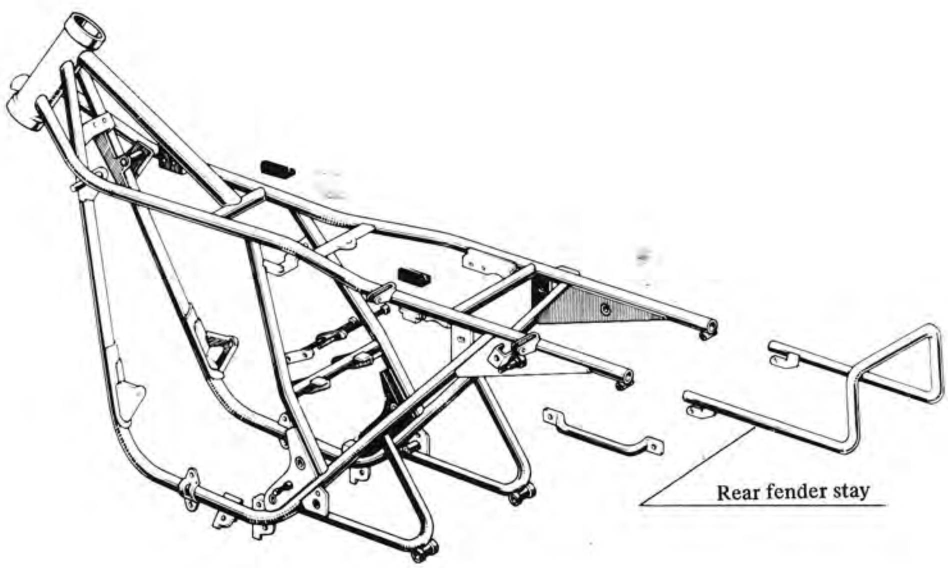


Fig. 4-2

2. Handlebar

1) Construction

The handlebar is fabricated from seamless steel pipe. The shape is designed for consideration of long-distance travel, high speed travel and safety driving.

a. Model A series

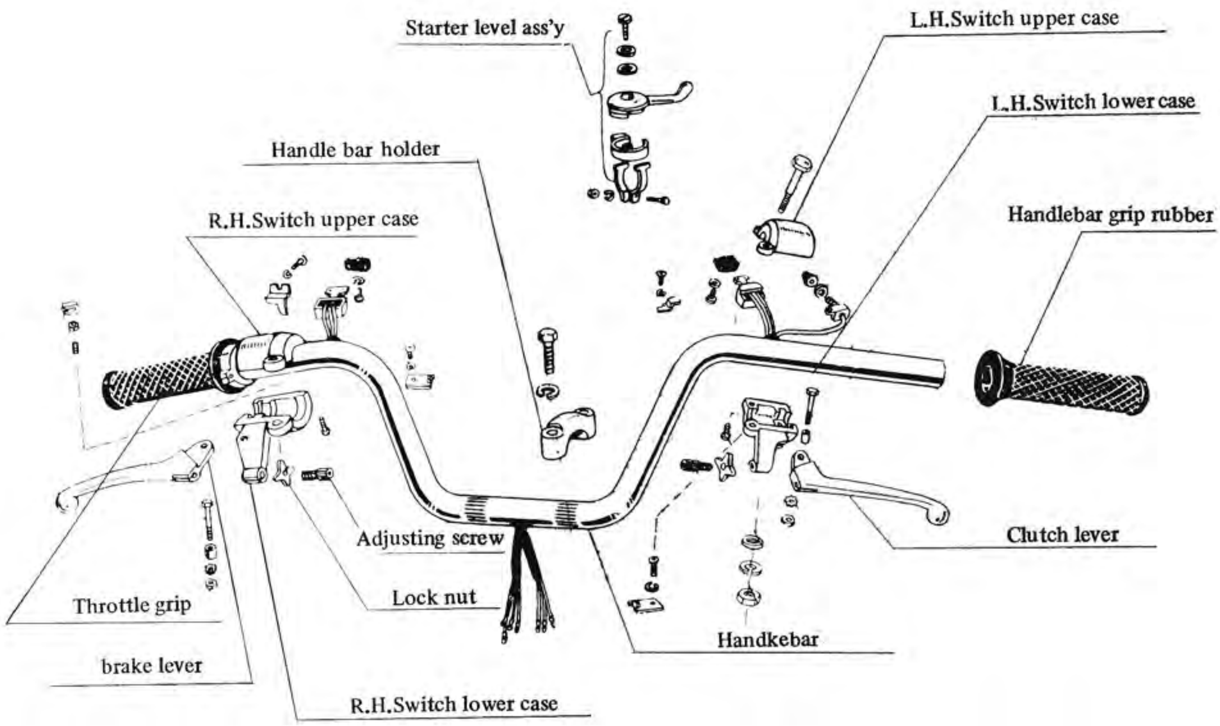


Fig. 4-3

b. Model H series

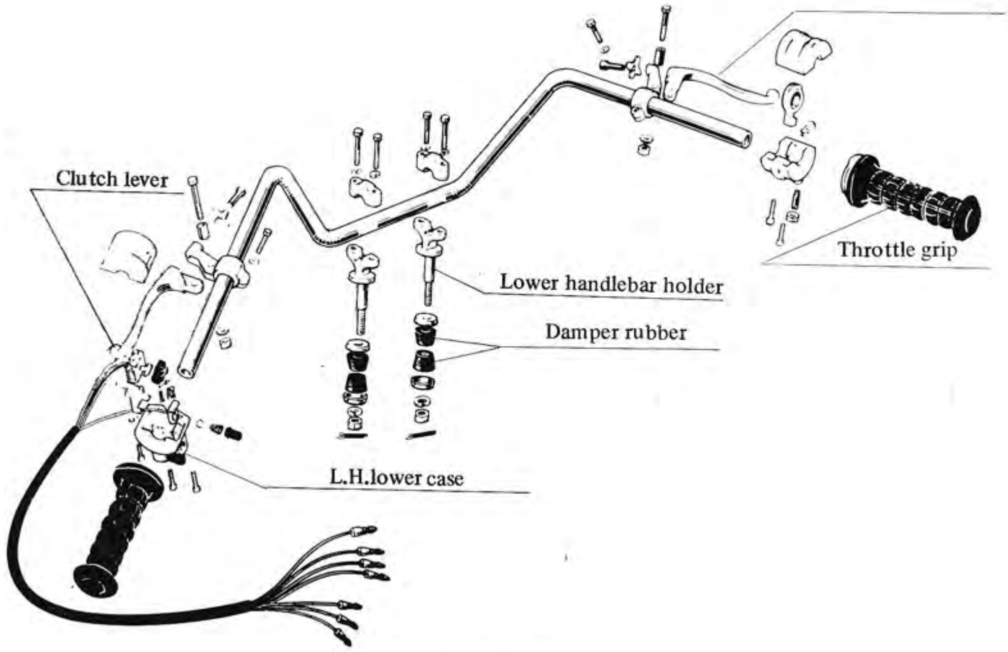


Fig. 4-4

On the right side of the handlebar is equipped with the front brake lever, throttle grip and the right grip set which includes the starter lever. On the left side of the handlebar, it has the left grip set which includes the flasher, horn and head light switch.

2) Disassembly

a. Removal of clutch cable

Loosen the clutch cable lock nut and turn in the clutch cable adjusting bolt to provide the clutch inner wire with sufficient slack and remove the clutch cable from the clutch lever.

Fig. 4-6

b. Removal of front brake

Model A series

Loosen the adjusting nut of the front brake, remove the brake cable from the brake lever.

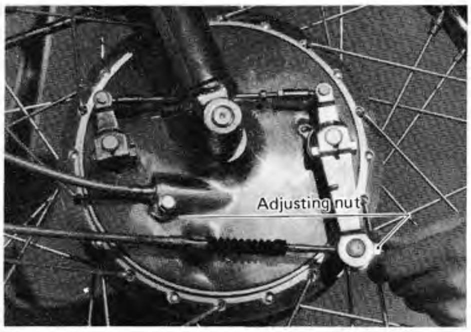


Fig. 4-7

Fig. 4-8

Model H series

The stop lamp switch is built into the front brake cable. Disconnect the stop lamp switch leading wire (in the head lamp) from the main wire harness. Remove the front brake cable from the brake lever.

Fig. 4-9

c. Removal of throttle cable.

First, remove the throttle cables from the carburetors. Disassemble the R.H case assembly (the throttle grip holder) and remove the control cable from the R.H case assembly (the throttle grip holder).

Fig. 4-10

Fig. 4-11

d. Removal of starter cable

Model A series

Disassemble the starter lever and remove the starter cable.

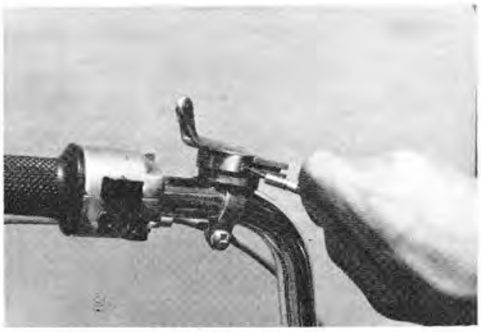


Fig. 4-12

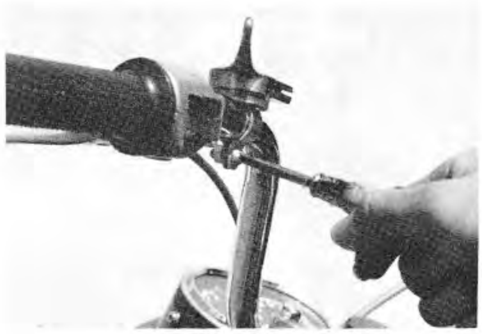


Fig. 4-13

Model H series

The control cables and the starter cables are built in the R.H throttle assembly. (Refer to Fig. 4-11)

e. Disassembling L.H case assembly

Remove the connector of each leading wire for the horn, flasher and head light from the main wire harness inside the head lamp, disassemble the L.H case assembly.


Fig. 4-14

NOTE

The flasher switch in the A series is built into the right grip assy.

f. Removing the handlebar

Take off the upper holder, remove the handlebar from the upper bracket.

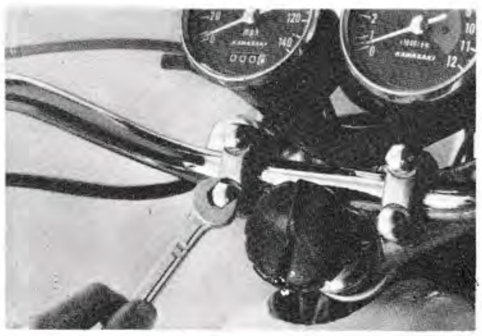


Fig. 4-15

3) Inspection

a. Handlebar

Check the handlebar for bends or cracks. Straighten or replace as required.

5) Adjustments

a. Adjusting the throttle cables.

Refer to II–5

b. Adjusting the clutch lever.

Refer to II–5

c. Adjusting the front brake lever.

Refer to IV-4-(5) Adjusting.

d. Adjusting the throttle grip.

Loosen the lock nut under the R.H lower case, adjust it with the adjuster screw as required

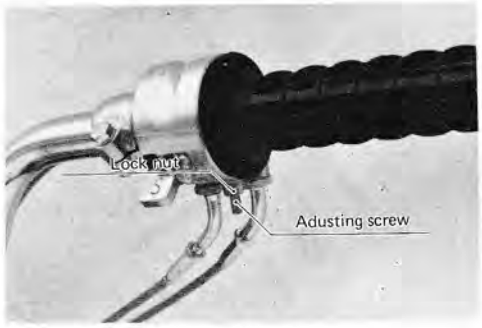


Fig. 4-17

3. Wheels, brake drum

1) Construction

The wheel consists of the tire, tube, rim, spoke, hub, etc.

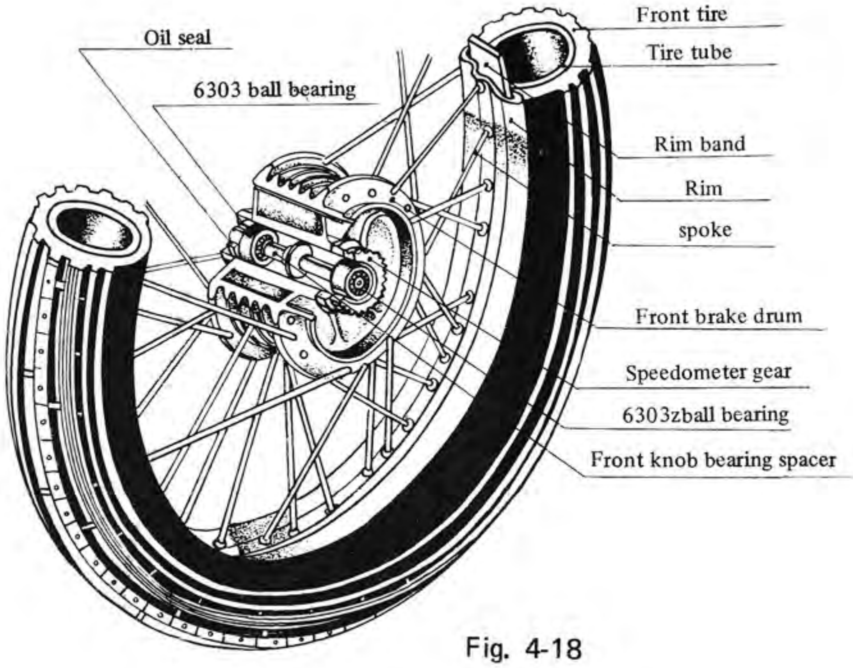


Fig. 4-18

a. Construction of the tire

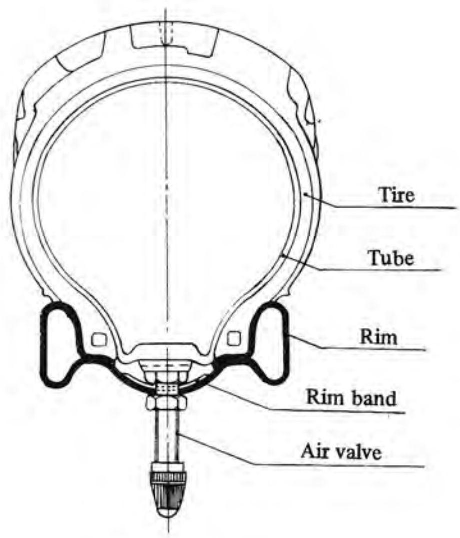


Fig. 4-19

These parts of the tire have the following respective functions. The crown contributes to driving and braking in the case of ordinary running. The shoulder part contributes to driving and braking when the frame is inclined. The side section functions as a cushion. The bead section is combined with the rim. The cross section of the tire,shows that the surface is made of tread rubber under which there is a cushion layer and a cord layer which is called a carcass. In the innermost part, there is an inner lining to make the tube slide smoothly. There are various kinds of patterns in the treads of the tires.

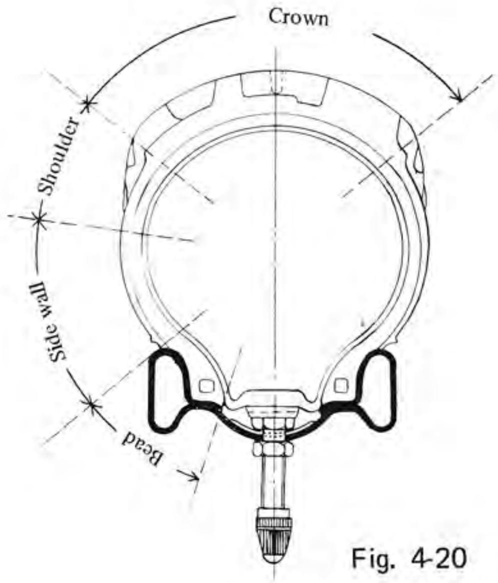


Fig. 4-20

There are breaks of rubber dispersed in the tread. These are called knife cuts. Water is exhausted through them when there is water between the tire and the road surface.

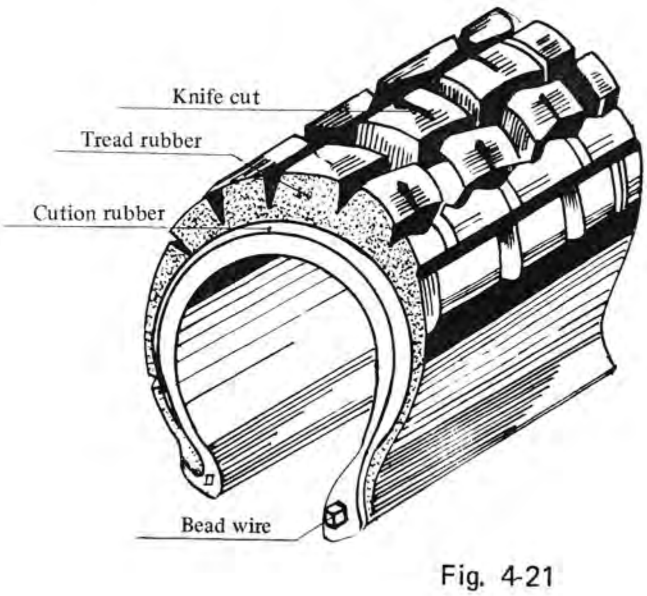


Fig. 4-21

c. Spokes

The spokes support the weights of the motorcycle and load. The head of the spoke is inserted into the rib of the brake drum and tightened inside the rim. The figure shows this function. The spoke (A) supports the weights of the motorcycle and other loads. Spoke (B) works when the wheel turns forward. Spoke (C) absorbs shock when braking.

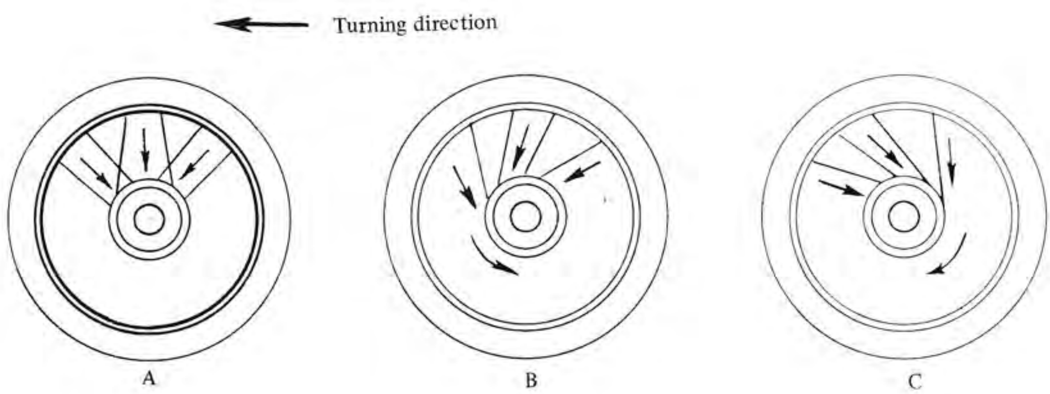


Fig. 4-23

Table 4-1 Tire specifications

Model	Tire size		Tire air pressure	
	Front	Rear	Front	Rear
A1	3.00 – 18 4PR	E3.25 – 18 4PR	23.8 lb/in (1.7 kg/cm)	31.2 lb/in (2.2 kg/cm)
A1SS	3.00 – 18 4PR	3.50 – 18 4PR	23.8 lb/in (1.7 kg/cm)	31.2 lb/in (2.2 kg/cm)
A7	3.25 – 18 4PR	S3.50 – 18 4PR	23.8 lb/in (1.7 kg/cm)	31.2 lb/in (2.2 kg/cm)
A7SS	S3.25 – 18 4PR	S3.50 – 18 4PR	23.8 lb/in (1.7 kg/cm)	31.2 lb/in (2.2 kg/cm)
H1	3.25 -19 4PR	4.00 - 18 4PR	25.5 lb/in (1.8 kg/cm)	

Table 4-2 Rim and spoke specifications

Model	Rim sizes		Spoke size	
	Front	Rear	Front	Rear
A1	1.60A x 18	1.85B x 18W	0.138″ (3.5mm)	
A1SS	1.60A x 18	1.85B x 18W	0.138″ (3.5mm)	
A7	1.85B x 18W	1.85B x 18W	0.138″ (3.5mm)	
A7SS	1.85B x 18W	1.85B x 18W	0.138″ (3.5mm)	
H1	1.85B x 19W	2.15B x 18W	0.138″ (3.5mm)	

d. Bead protector

H series

Since the Model H series motorcycle is designed as a high-speed motorcycle, the front wheel and the rear wheel are equipped with a bead protector to prevent the tire from slipping. Therefore the tire will not damage the mouthpiece section of the tube when the tire slips on the rim in braking during high-speed running.

e. Wheel Balancing

(1) In order to balance the wheel for high speed running, the spoke is provided with a balance weight.

When the wheel turns at high speeds, centrifugal force is generated in the wheel according to the square of the speed. Therefore, in an unbalanced wheel, the tire violently beats the road surface or jumps; it often vibrates right and left and safe running is not assured. Since this is very dangerous, especially in heavy motorcycles, the balance weight is applied to balance the tire completely.

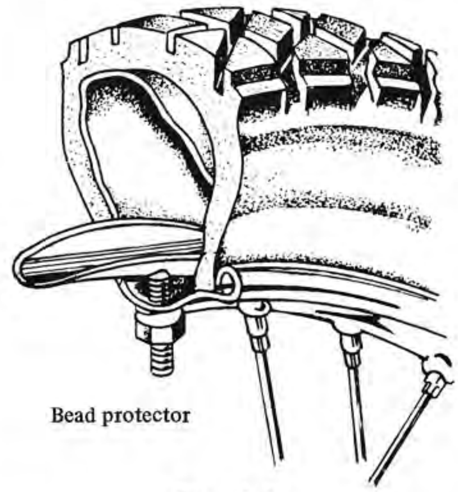


Fig. 4-24

(2) Before balanceing, ensure the wheel is completely free and revolves easily. With the wheel cleared of the ground, spin it slowly and allow it to stop on its own. If it is out of balance, attach balance weights to the lighter spokes as required. Ascertaining the balance, try to change the weight until it balances completely.

Fig. 4-25

f. Front hub

The front hub consists of the brake drum which plays a part as the bearing section of the front wheel, brake panel with the brake mechanism and brake shoes. Bearings are inserted into each side of the hub shaft hole. The brake drum turns as the bearing for the front wheel. The drum is cast inside the hub and functions on the braking surface of the brake shoe. The speedometer gear and pinion are installed inside the brake panel. The rotation of the front wheel is transmitted to the speedometer through the speedometer cable.

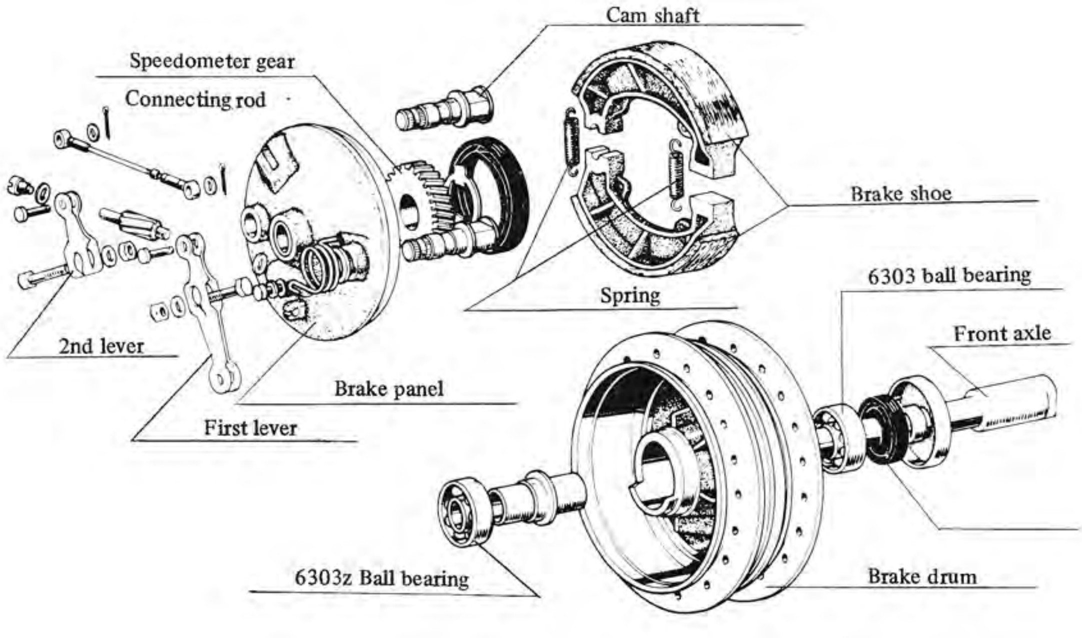


Fig. 4-26

g. Rear hub

The rear hub consists of three parts; they are the rear brake drum which acts as the bearing surpace of the rear wheel, the rear brake panel is equipped with the brake mechanism, and sprocket coupling, which receives the engine power and drives the rear wheel. The brake panel is installed in the right side of the rear brake drum, and the coupling is installed in the left side. The structure of the rear brake drum is similar to that of the front wheel. The bearing and oil seal are inserted into the hub shaft hole of the coupling. In addition, the sprocket is fixed with bolts in this coupling. The Model H series rear hub panel is provided with an air ventilator. Refer to IV-4-1-c.

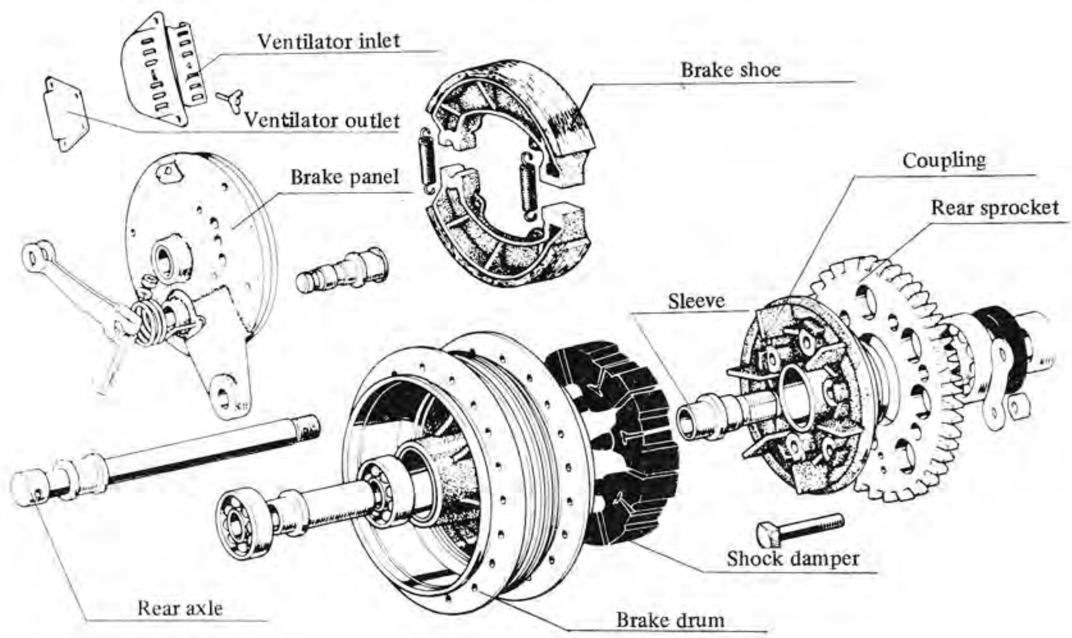


Fig. 4-27

Table 4-3 Recommended bearings and oil seals

Model	Bearing		Oil seal	
	Brak drum	Front panel	Brak drum	Front panel
A1 A1SS A7 A7SS	#6302z	#6302	25428	0055687
H1	6303 6303z	—	254708	—

2) **Disassembly**

a. **Removal of the front wheel**

(1) Take off the speedometer cable.

The speedometer cable is inserted into the front brake panel. After taking off the fixed bolt of the speedometer cable, pull the speedometer cable from the panel.

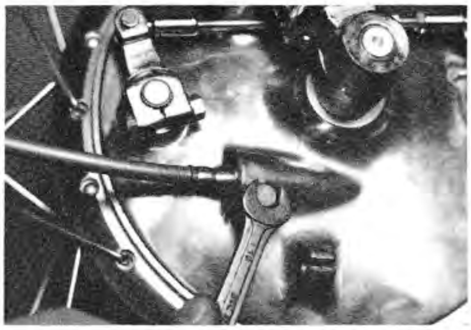


Fig. 4-28

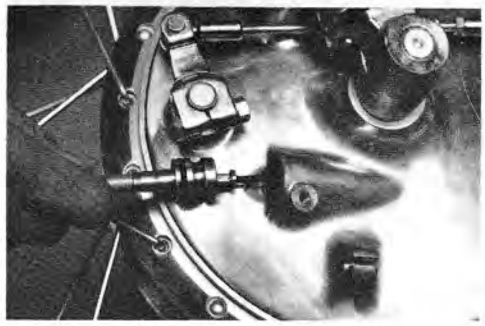


Fig. 4-29

(2) Taking off the front brake cable. Refer to IV-2-2-(b).

(3) Taking off the front wheel.

Placing the stand under the engine, remove the nut which fastens the front axle. Pull out the front axle, take off the front wheel together with the front brake panel assembly.

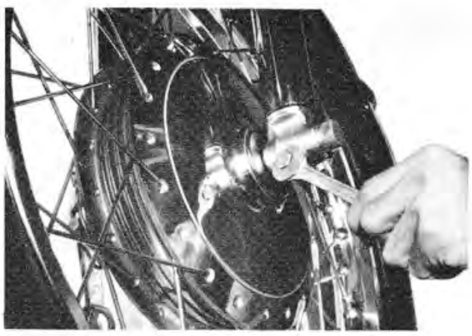


Fig. 4-30

Fig. 4-31

b. **Removal of the rear wheel**

(1) Taking off the rear brake cable.

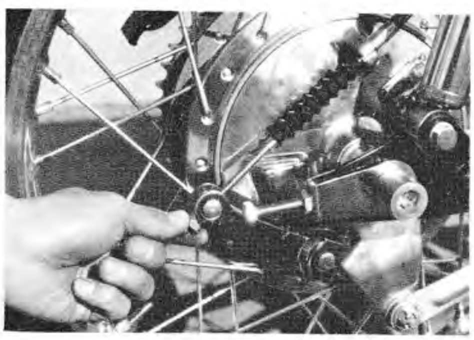


Fig. 4-32

(2) Taking off the torque arm.

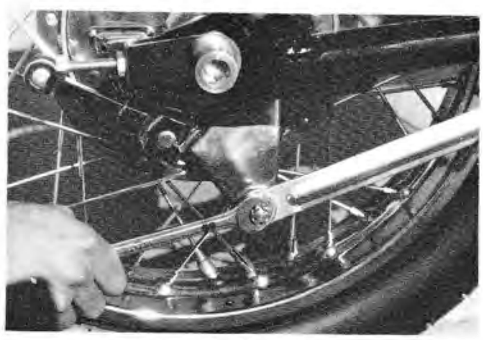


Fig. 4-33

(3) **Taking out the rear wheel**

Fig. 4-34

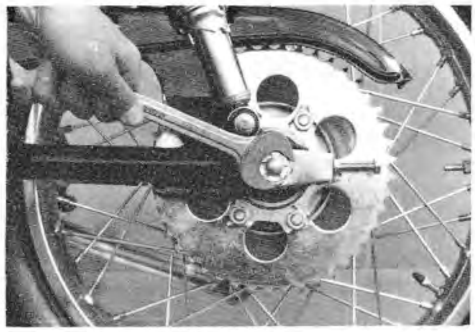


Fig. 4-35

After loosening the chain adjust bolt, pull out the rear hub shaft. Take off the rear wheel together with the rear brake panel assembly.

Fig. 4-36

c. **Disassembling the brake panel**

(1) **Taking off the brake shoe**

Lift up both brake shoes, and they will come out from the brake panel together with the springs.

Fig. 4-37

(2) **Take out the bearing and oil seal**

In the case of taking out the bearing and oil seal from the brake drum, insert the bar from inside the brake drum and tap the bar with a hammer while pressing on the inner race of the bearing.

Fig. 4-38

NOTE

Tap the inner race of the bearing uniformly on the whole circumference. Care should be taken to avoid any damage on the hub shaft hole.

4) Inspection

It is very important to inspect and maintain the parts related to the wheel and the hub. If anything is wrong with them, it may result in instability during driving. Correct and careful work are always required for inspection and maintenance.

a. Hub shaft

If the hub shaft is bent, the wheel vibrates and handling becomes difficult. Check the hub shaft for run out with a dial gauge.

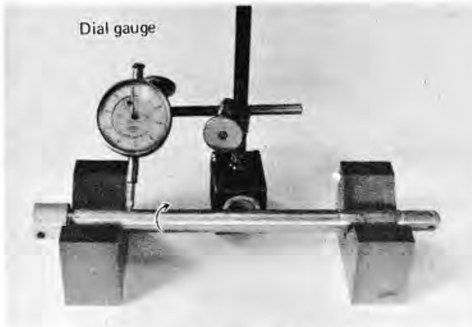


Fig. 4-39

Table 4-4 Runout of the hub shaft

Model	Standard value	Service limit
A1 – A1SS A7 – A7SS H1	Under 0.004" (0.1mm)	0.02" (0.5mm)

b. Rim

If rim run out exceeds the specified limit, handling becomes difficult.

Excessive run out of the rim is mainly due to the fact that spokes are not fastened uniformly, or firmly.

Fig. 4-40

Table 4-5 Runout of the rim

Item	Standard value	Service limit
Rim runout	Under 0.04" (1mm)	0.12" (3mm)

Damaged or bent spokes make the frame unstable and lead to accidents. They have to be repaired as often as necessary for safety.

c. **Bearing and oil seal**

Refer to SM-1 IV-3-4-d and (V-3-4)-e.

d. **Shock damper**

Refer to SM-1(IV-3-4)-f.

5) Assembly

a. The operations for assembling are subject to those for disassembling in the reverse order. In the case of inserting the bearing and oil seal into the brake drum, use an arbor press, etc. and pay attention to the squareness of the hub shaft hole. After insertion, be sure to apply grease to the lips of the oil seal and bearing.

b. Be sure not to apply any oil to the brake lining of the brake shoe. Since oil makes the braking operation difficult and dangerous, clean it with gasoline or thinner.

c. Since the shock damper rubber is tapered, take care not to reverse when inserting it. The Model H series shock damper has a projection in the center. Insert this projection into the hole of the rear brake drum.

Fig. 4-41

d. **Front axle torque value**

Models A series	44-58 ft-lb (6- 8 kg.m)
Model H series	65-93 ft-lb (9-13 kg.m)

e. **Rear axle torque values**

All models	65-93 ft-lb (9-13 kg.m)

4. Brake

1) Construction

The brake consists of the brake lever (or brake pedal), brake cable, brake panel assembly and brake drum. The brake panel consists of the cam lever, cam shaft, brake shoe, brake show spring, and brake panel body.

The brake shoe is an internal expanding type, both in the front brake and in the rear brake. The two leading shoe system is applied to the front brake while the leading-trailing system is applied to the rear brake.

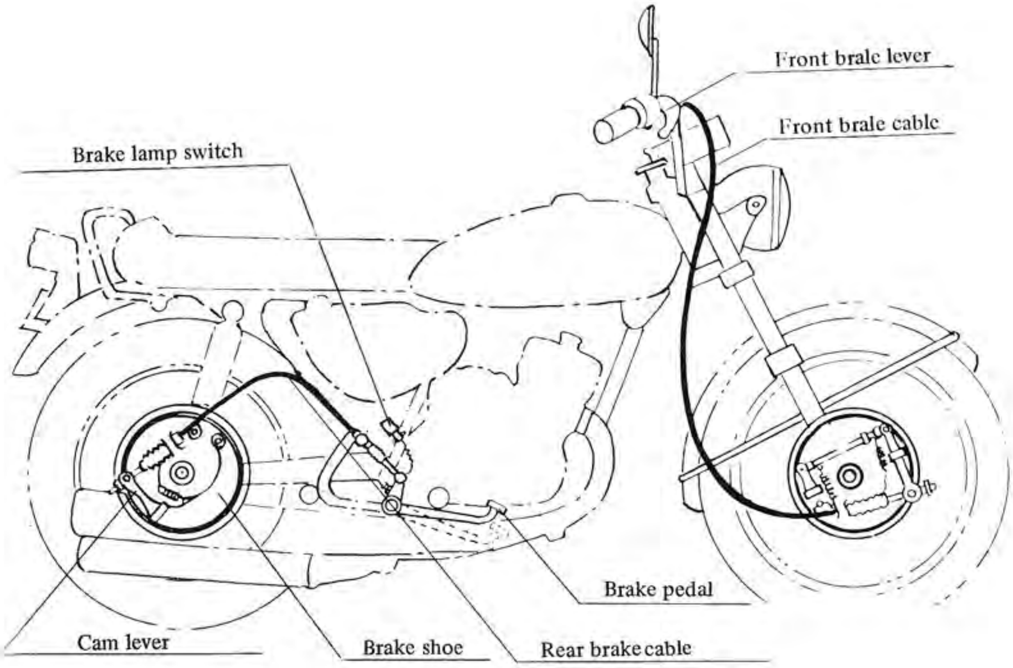


Fig. 4-42

a. Two leading shoe system (front brake)

As shown in Fig. 4-43, two cam shafts, which are separated by 180°and installed in the brake panel, are in contact with two brake shoes symmetrically. If the brake lever is pulled, the two cams operate simultaneously through the brake cable and the cam lever. The brake shoe is pressed against the brake drum. In this case, the wheel is braked by means of friction between the brake drum and the surface of the brake shoe. Therefore, two brake shoes extend in the direction of rotation of the brake drum (i.e. function as a leading shoe) so that they are called double leading shoe. This double leading shoe system is about one and a half times stronger in the braking force than that of the leading-trailing system.

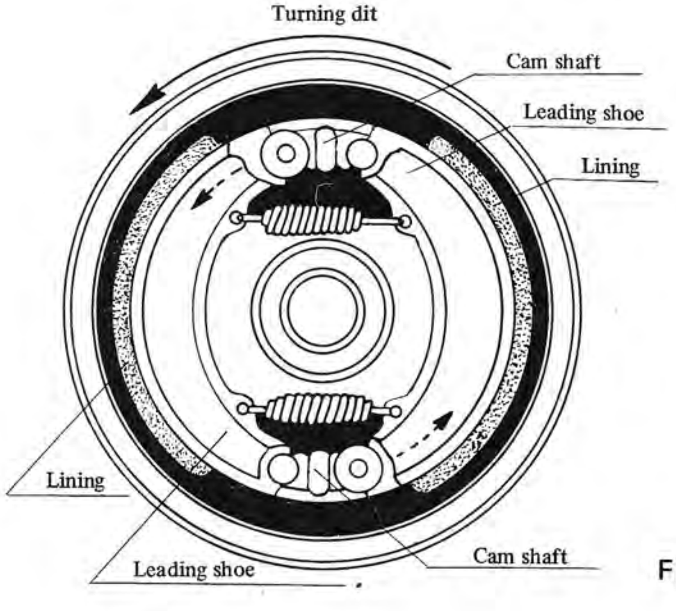


Fig. 4-43

b. Leading trailing system (rear brake)

As shown in Fig. 4-44, there is only one cam shaft in the brake panel. Therefore, two brake shoes which are placed symmetrically work with the same cam shaft.

When the brake pedal is stepped on, the cam shaft begins operation through the brake cable and the cam lever, extends the two brake shoes. In this case, one brake shoe begins contact (leading shoe) in the reverse direction of rotation of the brake drum, while the other brake shoe begins contact in the direction of rotation of the brake drum (in other words, operating as a trailing shoe).

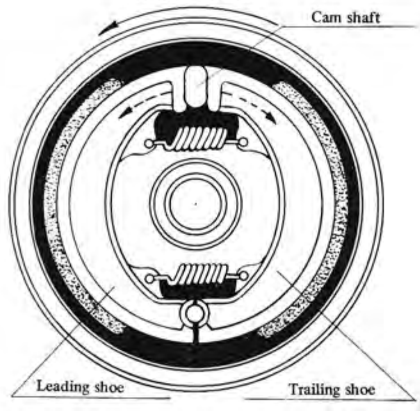


Fig. 4-44

To assure safety during driving, both the front brake and the rear brake are equipped with a stop light respectively.

Fig. 4-45

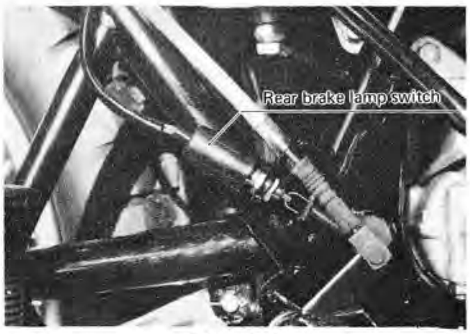


Fig. 4-46

c. Ventilator

The Model H series rear brake panel is equipped with a ventilator in which the air shutter can be opened or closed. As shown in the structure of the brake, braking means that the rotation of the brake drum is stopped by rubbing the brake shoe with the inner surface of the brake drum. However, frequent braking heats the drum and the brake shoe. Therefore, both the drum and the brake shoe begin slipping and lowers in stopping power. The ventilator is provided to eliminate this problem and assure stable braking performance. The ventilator consists of the inlet and the outlet. If the switch type air shutter at the inlet is turned to "OPEN", the air enters

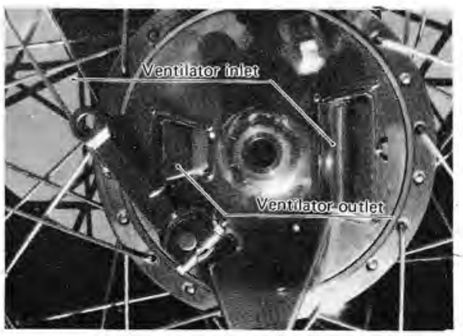


Fig. 4-47

the brake drum, circulates in it, cools it and discharges hot air through the outlet. Therefore, both the drum and the brake shoe are also cooled. Generally, when stopping in driving on a highway or descending a long steep hill, the brakes become overheated, so the air shutter should be opened.

If the air shutter is left open in the rain, dust enters the brake drum and some loss of braking will occure. Water makes the drum and brake shoe slip. In these cases, the air shutter should be closed.

Fig. 4-48

2) Disassembly

a. Removal of the front brake cable

Refer to paragraph 2-2-b

b. Removal of the front wheel and panel

Refer to paragraph 3-2-a and b

c. Removal of the rear brake wire

d. Removal of the brake pedal

Pull out the cotter pin, take off the brake pedal.

Fig. 4-49

3) Inspection

a. Brake drum

The inner sleeve of the brake drum is damaged due to friction with the brake shoe after a long period of service. Measure the inside diameter of the brake drum with a slide calipers.

Fig. 4-50

Table 4-6 Standard drum inside diameters

Model	Standard value		Service limit	
	Front	Rear	Front	Rear
A1. A1SS A7. A7SS		7.08″ (180mm)	7.12″ (180.75mm)	
H1	7.87″ (200mm)	7.08″ (180mm)	7.90″ (200.75mm)	7.12″ (180.75mm)

b. Brake lining

If the abrasion of the brake lining is very great, measure the thickness of the lining. If the lining is half in contact, it will reduce the braking effect and make abnormal noise. In this case, correct the lining with sandpaper or emery cloth. If there is foreign matter on the surface of the lining, take it off with a wire brush.

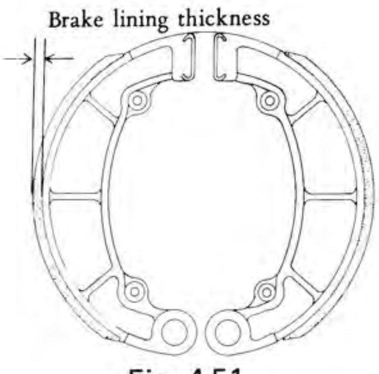


Fig. 4-51

Table 4-7 Lining thicknesses

Model	Standard value		Service limit	
	Front	Rear	Front	Rear
A1. A1SS A7. A7SS H1	0.192″ (5mm)	0.192″ (5mm)	0.118″ (3mm)	

c. Brake shoe spring

If the shoe spring is stretched out, the brake shoe cannot return completely and the brake may be trailed. Measure the free length of the spring.

Fig. 4-52

Table 4-8 Free length of brake shoe spring

Model	Standard value		Service limit	
	Front	Rear	Front	Rear
A1. A1SS A7. A7SS	1.8″ (46mm)	2.2″ (56mm)	1.92″ (49mm)	2.32″ (59mm)
H1	2.4″ (60mm)	2.62″ (66.5mm)	2.48″ (63mm)	2.74″ (69.5mm)

d. Gap between the brake cam shaft and the brake panel bushing

When the gap between the brake cam shaft and the brake panel bushing widens, the cam shaft has play and cannot extend the brake shoe completely, resulting in incomplete braking.

Table 4-9 Gaps between the brake cam shaft and the bushing

Model	Standard value		Service limit	
	Front	Rear	Front	Rear
A1. A1SS A7. A7SS H1	0.0008″ – 0.0028″ (0.02 – 0.07mm)		0.02″ (0.5mm)	

e. Ventilator

If dust remains in the ventilator, the sleeve in the brake drum or brake shoe is damaged and worn rapidly. Especially after driving on bad roads, clean the interiors of the ventilator and brake drum.

4) Assembly

The order of assembly is subject to the reverse order of disassembly.

a. Fitting angle of the brake cam lever

When fitting the brake cam lever, install it so that the brake cable will become perpendicular to the cam lever when braking.

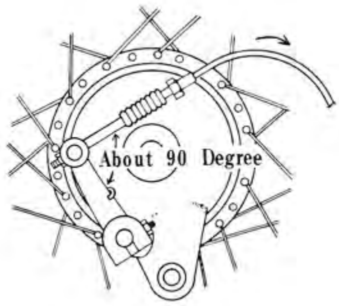


Fig. 4-54

b. Apply grease to the bearing of the brake pedal, brake lever, and the brake cam shaft bearing in the brake panel.

5) Adjustments

a. Play of the front brake lever

Adjust the front brake lever with the cable adjusting nut on the brake panel so that the brake will begin operation when pulling the front brake lever by 0.8"–1.2" (20-30mm). Fine adjustment is done by the adjusting screw on the handlebar. No adjustment is required for the front brake stop lamp since the switch is built in the front brake cable.

Fig. 4-55

b. Play of the rear brake lever

Adjust the rear brake lever with the adjusting nut of the rear brake panel so that the brake will begin operation when stepping on the rear brake lever by 1.0"–1.4" (25-35 mm). In this case, adjust the upper and lower adjusting nuts in the main body of the brake lamp switch so that the brake lamp may light when applying the brake pedal by 0.6' – 0.8' (15-20mm).

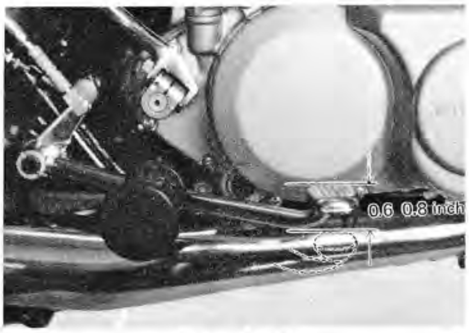


Fig. 4-56

Fig. 4-57

c. No adjustment is usually required for the connecting rod of the front brake lever. According to the following procedures, adjust the rod when changing the brake lining.

(1) With the front wheel cleared of the ground and turning the connecting rod until the brake lining begins contact, operate the first lever and the second lever.

(2) Spinning the wheel lightly, fasten the brake cable adjusting nut and lock it when the brake begins operation.

(3) Spinning the wheel again, adjust the connecting rod. Pulling the first lever and the second lever, fix the connecting rod in the position where the rotation of the wheel becomes heavier.

5. Front fork

1) Construction

a. Model A series

The front fork is a holding device for the front wheel and absorbs the vertical shock of the front wheel through the spring and oil. The front fork consists of an inner tube and an outer tube which slide against each other. There is an oil orifice in the center of the lower end of the inner tube. Oil chambers are formed between the inner tube and the outer tube in the place which is surrounded by the inner tube and the spacer.

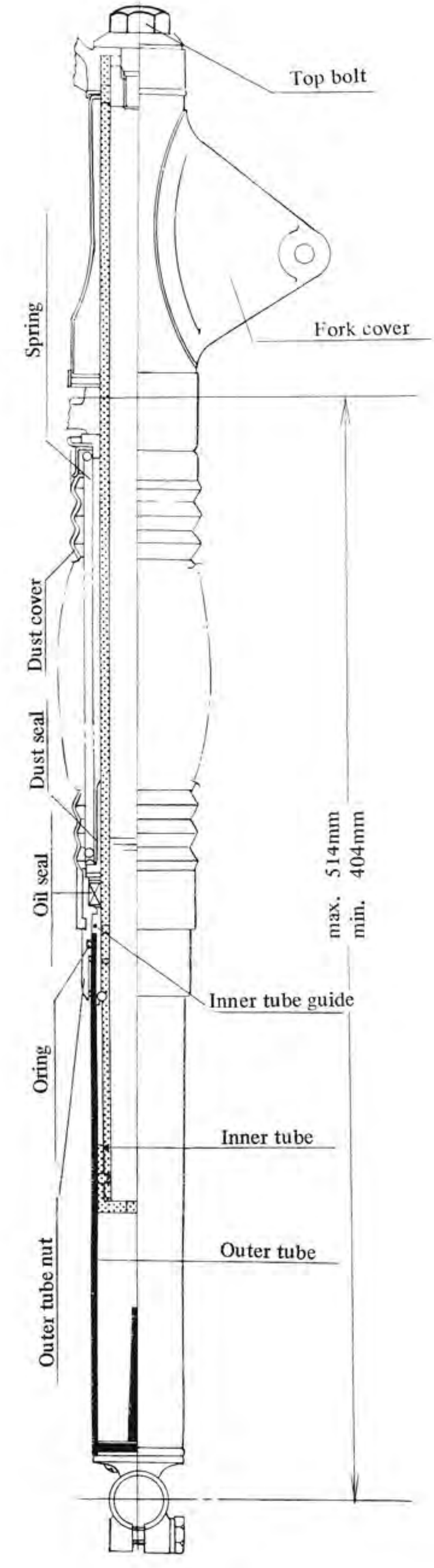


Fig. 4-58

b. Model H series

The front fork which is employed in the Model H motorcycle is called "ceriani type". The spring and the inner tube guide are placed inside the inner tube. The lower part of this inner tube forms an orifice between the lower part of the inner tube and the upper part of the inner tube guide.

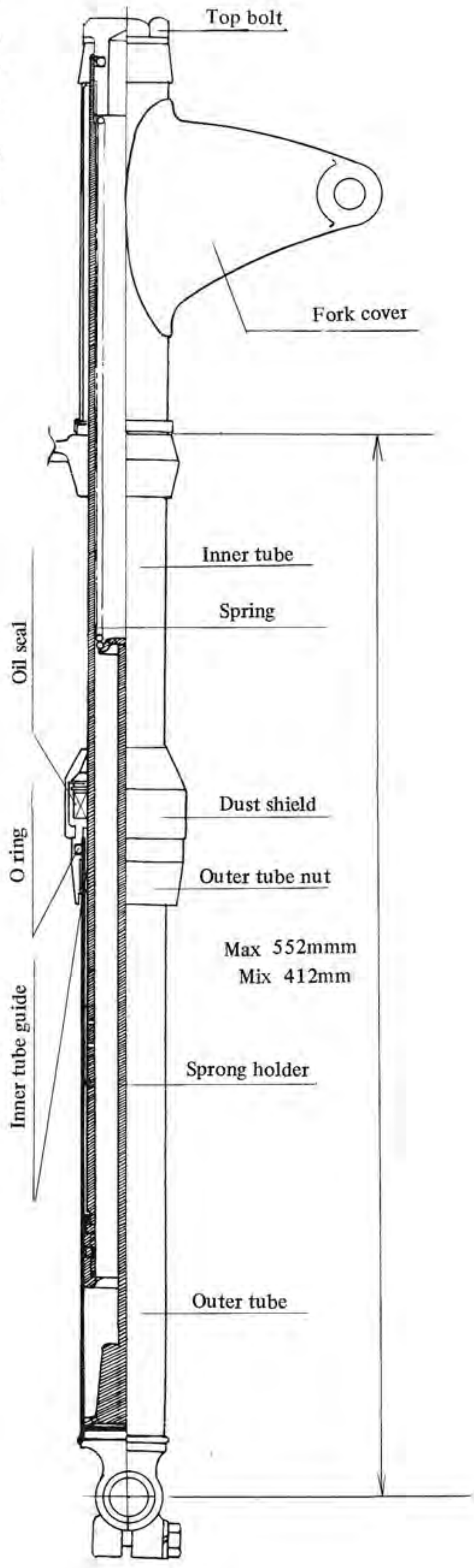


Fig. 4-59

2) Operation

a. In the case of receiving a load

If the front fork is loaded, the spring is compressed and deflected. Since the outer tube is pushed up at the same time, oil in the outer tube flows into the inner tube through the piston orifice of the inner tube. Oil partially enters the gap between the inner tube and the outer tube through the orifice on the side wall of the inner tube. Since the oil flow makes the space smaller in the upper part of the inner tube, internal air is compressed. Also, the front fork increases the flow resistance of the oil which flows between the piston orifice and the orifice guide of the outer tube (in the case of the Model H, the inner tube and the orifice guide of the inner tube) and reaches the oil lock state immediately before the whole compression stroke so that noise is prevented in the full stroke.

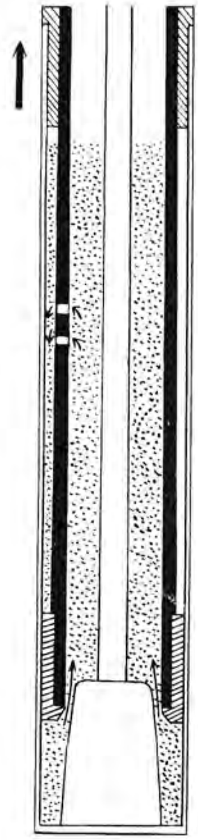


Fig. 4-60

b. Stretching

The front fork stretches by the reaction of the spring. At the same time, damping is conducted due to oil resistance, when oil between the inner tube and the outer tube counterflows into the inner tube. When it stretches more, oil increases its flow resistance greatly and reaches the oil lock state since the orifice on the side wall of the tube is closed by the tube guide. Thus, the stroke is finished.

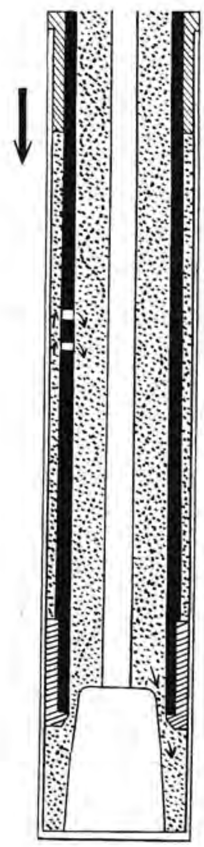


Fig. 4-61

3) Steering stem construction

The steering stem supports the right and left front forks, and works as a center axle in the frame head peace when the handlebar is moved right or left. There are steering ball race inner and ball cup on and under the shaft of the steering stem. The steel balls in it assure smooth operation in the case of steering. When the handlebar does not move easily, adjust by tighting the steering damper knob.

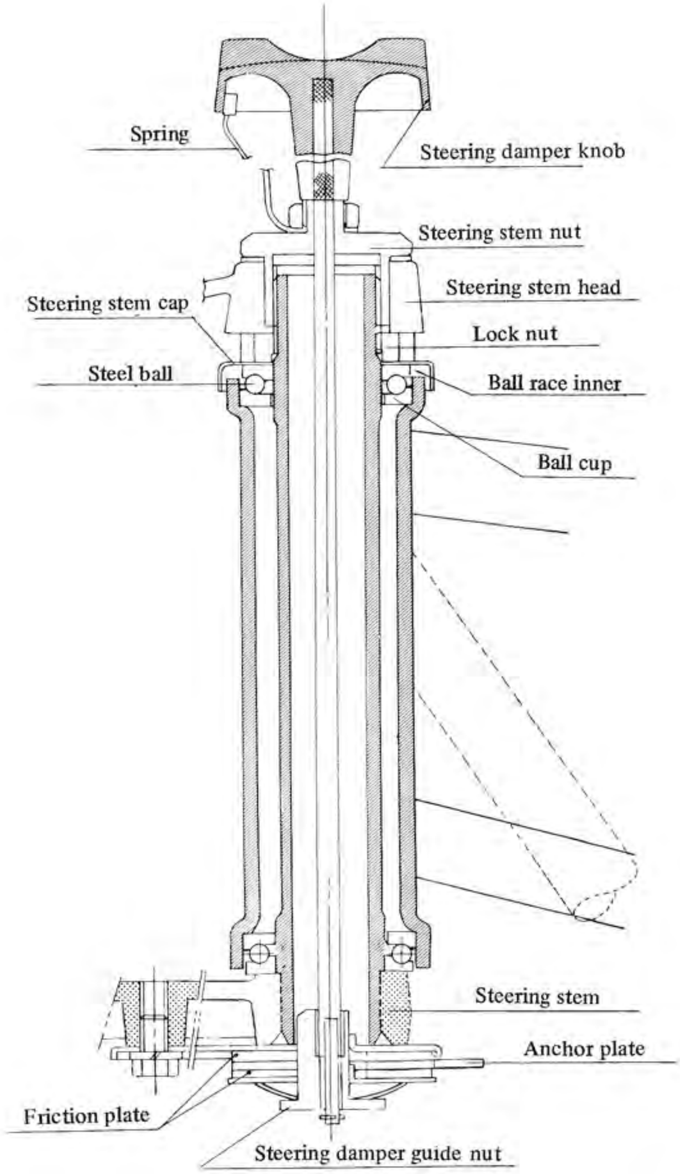


Fig. 4-62

4) Disassembly

Remove the front fork after taking off the front wheel and the front fender.

a. Taking off the head lamp

Remove all the leading wire connectors in the head lamp from the main wire harness and, pull out the main wire harness from the head lamp, remove the head lamp.

Fig. 4-63

b. Taking off the speedometer and the tachometer

After removing the cables of the speedometer and tachometer, take off the speedometer and the tachometer from the bracket.

Fig. 4-64

c. Taking off the upper holder

In the case of taking off the upper holder, remove three parts i.e., (1) steering damper, (2) steering stem nut and (3) top bolt.

Fig. 4-65

(1) Taking off the steering damper

By tighting or loosening the knob, the steering damper pushes the friction disc, which is set under the head pipe on the lower plain of the head pipe and controls the strength of operation. When the knob is tightened, the handling operation gradually becomes hard, while it becomes light by loosening the knob.

Fig. 4-66

In the case of taking off the steering damper, remove the cotter pin and the nut in the lower end of the steering damper rod. Next, loosen the knob to take off the steering damper.

(2) Taking off the steering stem nut

The steering stem nut fixes the rotary shaft of the upper bracket. The steering damper knob stopper is fixed with a nut.

Take off the steering stem nut by using a special tool. (Fig. 4-67, 68)

Fig. 4-67

NOTE

No steering damper stopper is installed in the A series.

Fig. 4-68

(3) Taking off the top bolt

Fig. 4-69

d. Taking off the front fork

After removing the steering stem bolt, take off the front forks legs one by one.

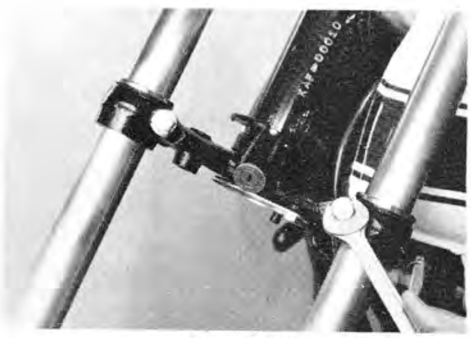


Fig. 4-70

e. Taking off the steering stem

After removing the steering lock nut with a special tool, take off the steering stem. This steering stem can also be taken off with the front fork.

Fig. 4-71

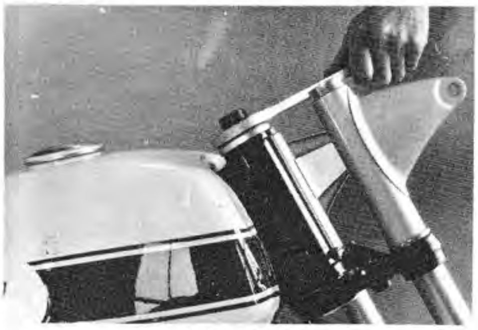


Fig. 4-72

f. Remove the bearing race of the steering stem and the ball cup in the head piece according to the following procedure.

(1) In the case of taking off the ball cup in the steering head, use a bar inserting it into the head pipe. Pressing the ball cup, tap the bar with a hammer.

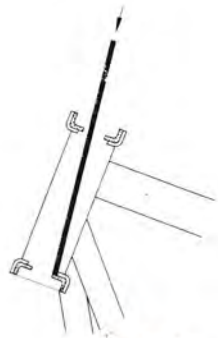


Fig. 4-73

(2) In the case of taking off the inner race which is pressed into the steering stem, put a chisel between the steering stem and the circumference of the inner race, and hit the chisel with a hammer.

Fig. 4-74

NOTE

Uniformly hit the circumferences of the ball cup and inner race.

g. Disassembling the front fork

(1) Discharge the oil in the front fork.

(2) Wrapping a tire tube or rubber around the outer tube nut, clamp it in a vice.

Fig. 4-75

NOTE

Take care not to damage the outer tube when clamping the outer tube nut in the vice.

Fig. 4-76

(3) Fitting the outer tube with the front axle and turning the front axle, the outer tube can be separated from the inner tube.

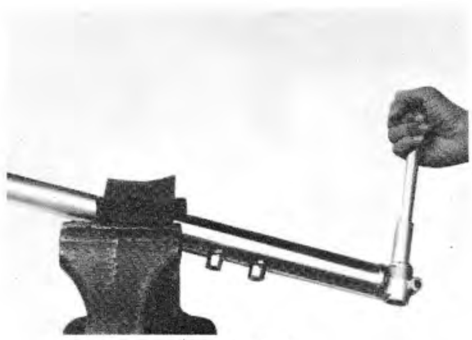


Fig. 4-77

5) Inspection

a. Inner tube and outer tube

Insert the inner tube into the outer tube and install the guide. In this position, check the inner tube and inspect whether it moves smoothly. Change it if there is play in the thrust part.

Fig. 4-78

b. Inner tube

If there is a scaratch or claw in the thrust place of the inner tube, the lip of the oil seal which is inserted into the outer tube will come damaged during operation and oil will leak. Inspect carefully the thrust place of the inner tube and rework or replace it if it is dented or scratched.

c. Dust seal

The dust seal prevents dust from entering the front fork. If it is broken and dust adheres to the thrust place of the inner tube or hard foreign matter enters it, the thrust place of the inner tube may be damaged or the lip of the oil seal may be cut. Oil may leak due to such failures. Inspect the dust seal carefully and replace it if it is broken. Clean it of dust and foreign matter.

d. Front fork spring

If the spring is damaged, the damping action of the front fork becomes worse. Hence, riding will be uncomfortable. Inspect the free length of the front fork spring.

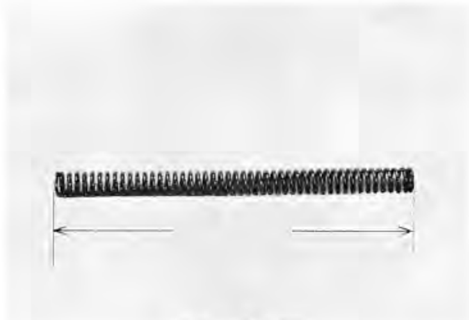


Fig. 4-79

Table 4-10 Spring free length

Model	Standard value	Service limit
A1. A1SS. A7. A7SS	8.0″ (202.5mm)	7.56″ (192mm)
H1	13.58″ (345mm)	13.18″ (335mm)

e. Steering stem

Inspect whether the steering stem shaft is bent or not. Repair or replace it if it is bent.

f. Inner race and the ball cup

Steel balls roll on the ball cup and inner race surfaces. If these surfaces are scratched or rough, the respective balls are not loaded with uniform force even if they are pressed with steering ball inner race. The rotation of the steering stem becomes heavy or play occurs in it. Replace ball cups and inner races if their surfaces are dented or uneven. Inspect each steel ball and replace it if the surface is cracked or uneven.

6) Assembly

a. Steering stem

Fig. 4-80

(1) Press the upper and lower ball cup and steering ball inner race by using a press. Apply force uniformly to their circumferences.

(2) Stick the steel ball (to which grease is applied) to the inner race of the steering stem and the ball cup of the head piece.

Insert the steering stem from under the head piece and fasten the lock nut temporarily.

Next, moving the steering stem right or left, fasten the lock nut until there is no play between ball cup or the inner race and the stem.

Table 4-11 Steel ball specifications

Model	Standard value	Service limit
A1 A1SS A7 A7SS H1	¼″	19 x 2

b. Front fork

(1) In the case of disassembling the front fork, be sure to change the "O" ring and oil seal installed in the outer tube nut.

(2) After changing the oil seal and "O" ring, set up the inner tube and the outer tube in the reverse order of disassembling.

7) Installing the front fork

a. A series

Fig. 4-81

After assembling the inner tube and the outer tube, install the front fork on the steering stem.

(1) Inserting the front fork from the lower part of the steering stem, pull up the front fork by using the special tool. After finishing this, fasten the steering stem bolt.

(2) Pulling up the front fork with the special tool, fasten the front fork with the top bolt. Loosen the steering stem bolt temporarily; inspect to check that there is no play in the front fork. Fastening the top bolt, retighten the steering stem bolt.

Fig. 4-82

b. H series

(1) Insert the front fork from the bottom of the steering stem. Pushing up the inner tube until the end point of the inner tube reaches the step portion in the steering stem head, fasten it with the top bolt.

(2) Next, fasten the steering stem bolt.

Fig. 4-83

c. Inspection

The under bracket must have no play and the handlebar must be easy to move. Inspect the front fork and the front wheel according to the following procedure after they are set.

(1) Moving the top of the front fork forward and backward, inspect that there is no play in the steering stem.

(2) With the front wheel cleared of the ground, try to move the handlebar lightly to the right or left side. Inspect whether the handlebar turns smoothly.

(3) If the steering stem has play after inspecting it according to the above procedure, it is due to the fact that the lock nut is not fastened completely. Adjust the lock nut and loosen it if the handlebar is hard to move, for it is fastened too tightly.

Front fork mixing ratio

Model	Working oil quantity	Mixing ratio	
		Mobil 30	Spindle 60
A H H1	 200 230	 8 6.5	 2 3.5

NOTE

If the working oil quantity is not proper, abnotmal noise occurs or the cushion stiffens. Be careful to maintain the proper oil quantity.

6. Rear shock absorber

1) Construction

The rear shock absorber consists of the spring, inner cover, outer shell, cylinder, piston rod, and oil seal in the cylinder. The piston rod is equipped with the piston, valve, bearing, packing case, cushion rubber, etc. When the shock absorber is at rest, oil is separated between the upper part and the lower part of the piston by the valve. When the shock absorber contracts or stretches, oil passes through the oil path in the piston, pushes up the valve which shuts the outlet, and moves to the lower chamber or the upper chamber.

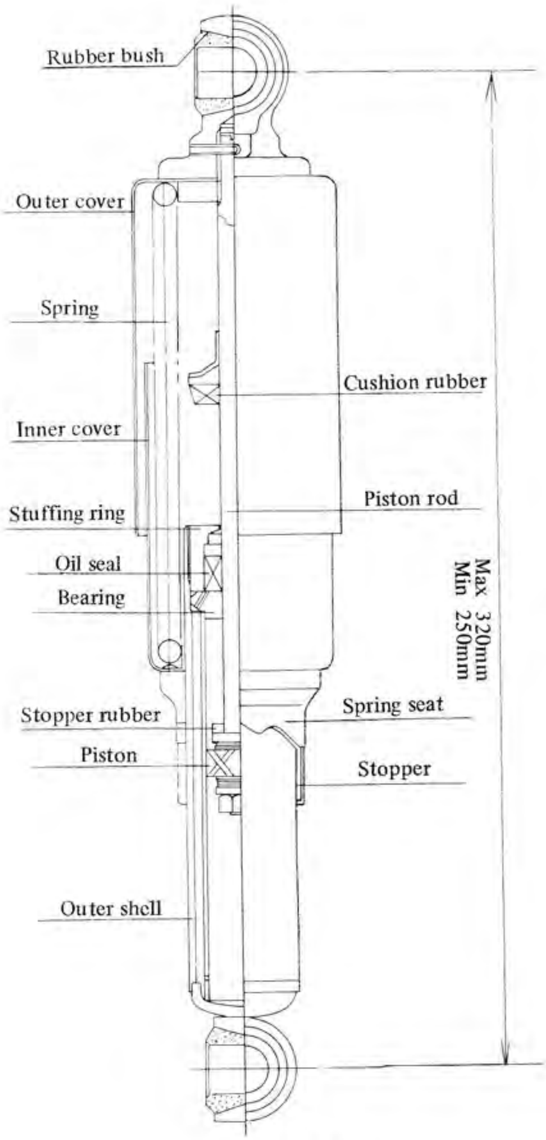


Fig. 4-84

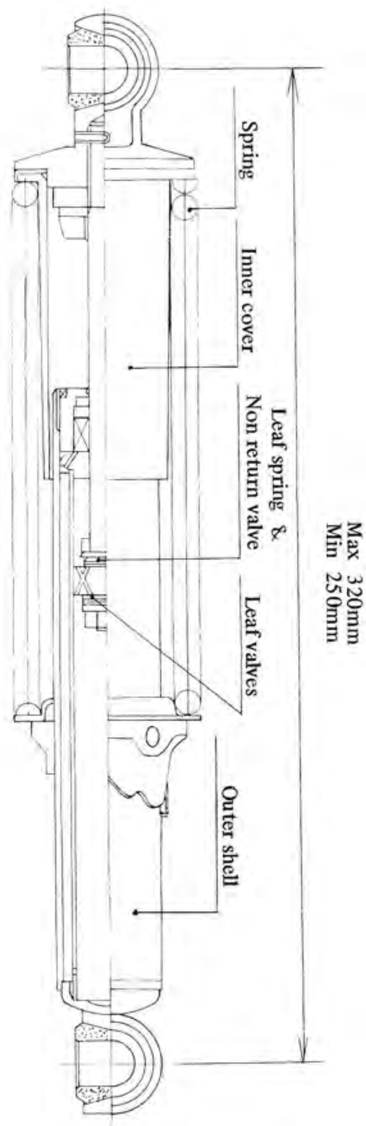


Fig. 4-85

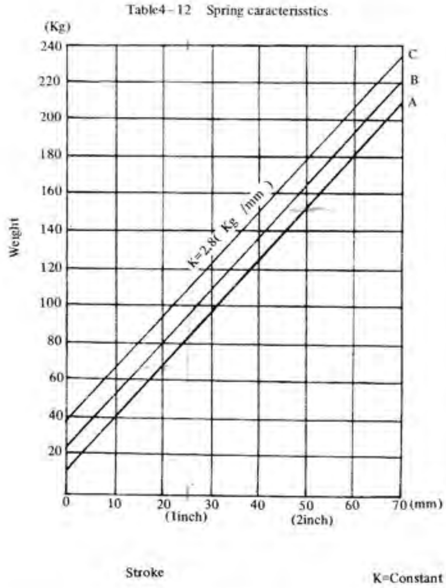
This shock absorbing action is conducted with the contraction and stretch of the spring and oil flow resistance which occurs when oil passes through the small oil path in the piston and pushes up the valve.

The rear shock absorber is designed carefully so that the initial pressure of the spring may be adjusted in three steps according to the load weight of the motorcycle and the road condition (uneven road or pavement). Therefore, a comfortable drive and excellent operation can always be obtained.

Namely, by shortening (or lengthning) the stroke of the spring, the pressure applied to the spring is increased (or decreased). When the adjuster of the spring seat is moved to the stopper of the outer shell as (A) → (B) or (B) → (C), the initial pressure of the spring increases as shown in Table 4-12.

On the other hand, it lowers when the adjustor is moved as (C) → (B) or (B) → (A).

Table4-12 Spring caracterisstics



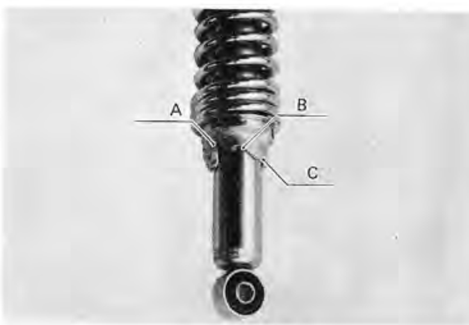


Fig. 4-86

2) Operation

As shown in Figs. 4-87 and 4-88, there are two oil paths in the piston; one is from the outer circumference on the upper part of the piston to the inner surface of the lower surface, the other is from the outer circumference of the lower surface of the piston to the inner circumference. Oil comes into the outer circumference of the piston and goes out to the inner circumference. There is a valve in the outlet of the oil path. When the shock absorber is at rest, it closes the oil path. The number of valves differs in the upper part and the lower part of the piston. There are three leaf valves in the lower part of the piston, and the upper part of the piston, while there is only one non-return valve that is pressed on the lead spring.

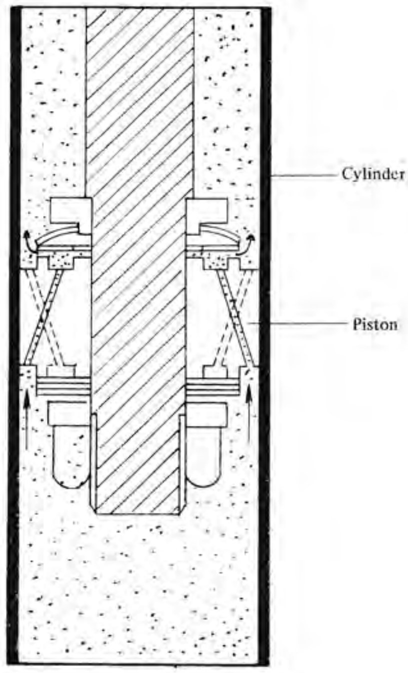


Fig. 4-87

a. When the rear shock absorber is contracted

When the rear shock absorber is contracted with a load, the outer shell and the cylinder in it goes up and the spring contracts. Pressure will be generated in the oil which is confined in the lower part of the piston by the non-return valve. It passes through the oil passage in the piston and pushes up the non-return valve with the oil pressure, which surpasses the tension of the leaf spring pressing the non-return valve. Then it moves to the upper part of the piston. When the shock absorber contracts and the spring is entirely contracted, the packing case comes into contact with the cushion rubber which is fixed on the upper part of the piston.

Thus, the contraction stroke is completed.

b. Expansion

Since in the expansion stroke of the rear cushion the spring expands and the outer shell and the cylinder fall, oil in the upper part of the piston tends to move and enters the oil path of the piston from the upper part of the piston. It pushes up three leaf valves and moves to the lower part of the piston. In the case of pushing up three leaf valves, oil resistance increases greatly and restricts the force of the spring which would tend to return violently.

Therefore, the spring expands slowly and free motion of the spring, i.e. "spring back" is prevented. This is called a damping action in the expansion stroke.

Since the cylinder falls in the final stage of the expansion stroke, the bearing comes into contact with the stopper in the upper part of the piston.

Thus, the stroke comes to an end. The rubber bushings in the upper and lower bottom absorb the vibration transmitted from the road surface.

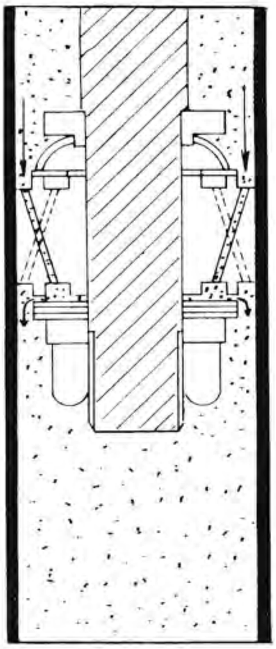


Fig. 4-88

3) Disassembly

a. Rear shock absorber

Supporting the swinging arm by hand, take off the rear shock absorber from the frame.

Fig. 4-89

4) Inspection

a. Since damping force acts in the expansion of the rear shock absorber, inspect damping force by pulling and pressing it.

b. Since there is oil in the rear shock absorber, replace it as a unit if it leaks.

NOTE

The rear shock absorber cannot be disassembled. Therefore, the unit has to be replaced if it is defective.

5) Assembly

a. The order of assembly is subject to the reverse order of disassembly.
b. After installing shock absorbers, inspect whether the right and left absorbers are parallel and whether the upper and lower fitting bolts are mutually perpendicular.

6) Adjustment

a. Make use of the spring seat to adjust the rear shock absorber. Inserting the thin bar into the hole on the spring seat, turn the spring seat to the left. The stopper of the spring seat will be moved as (A) ~ (B) and (B) ~ (C). In the case of returning it from (C) to (B) or (A), turn the spring seat to the right.

Fig. 4-90

7. Front fender, Rear fender

1) Construction

The front fender and the rear fender are independent on the respective frames. The front fender is fixed with a stay to the front fork while the rear fender is fixed to the frame through the bracket.

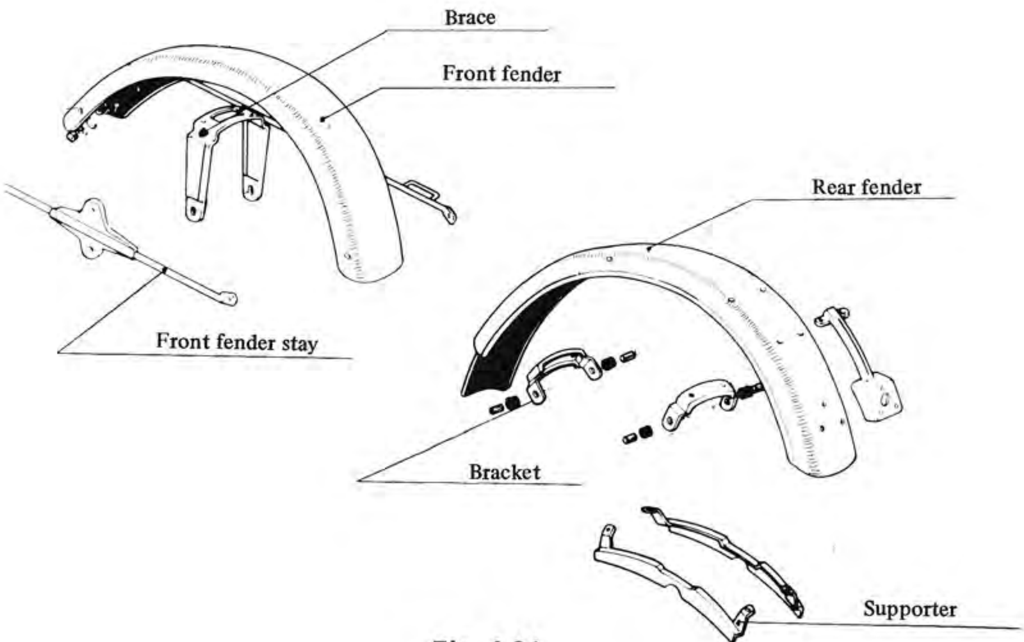


Fig. 4-91

2) Disassembly

a. Taking off the front fender

The front fender can be easily taken off after the front wheel is taken off.

Fig. 4-92

b. Taking off the rear fender

The rear fender can be easily taken off after the rear wheel is taken off.

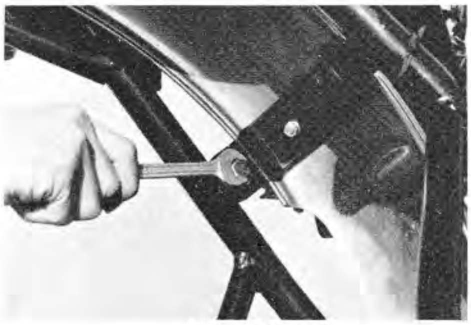


Fig. 4-93

3) Assembly

The order of assembly subject to the reverse order of disassembly.

8. Swinging arm

1) Construction

The swinging arm is a shock absorber for the rear part of the frame working with the rear damper units. The front part of the swinging arm is attached to the frame with the pivot shaft, while the rear part of the swinging arm is attached to the frame and operates up and down around the pivot shaft.

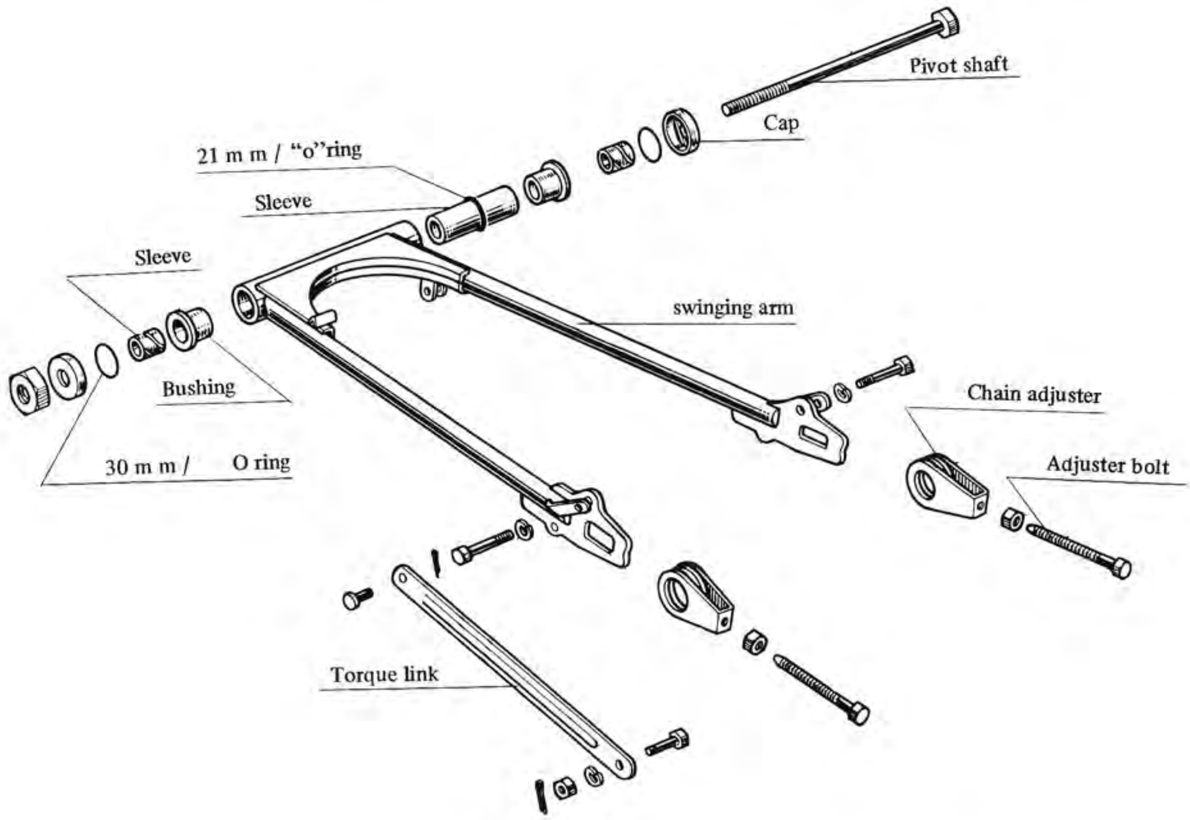


Fig. 4-94

2) Disassembly

a. **Taking off the rear sprocket and the coupling**

Since the rear sprocket is fixed with the bolts to the coupling, take off the drive chain at first. When removing the sprocket from the coupling, unfasten the caulking of the lock washer and remove the bolts.

Fig. 4-95

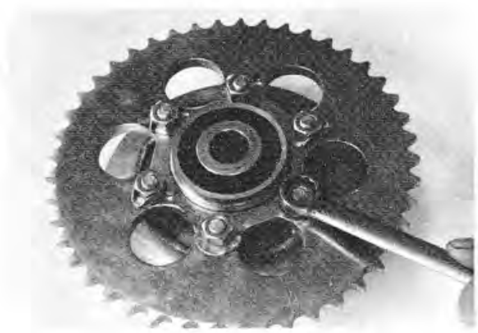


Fig. 4-96

b. **Taking off the swinging arm**

After taking off the pivot shaft, take off the swinging arm.

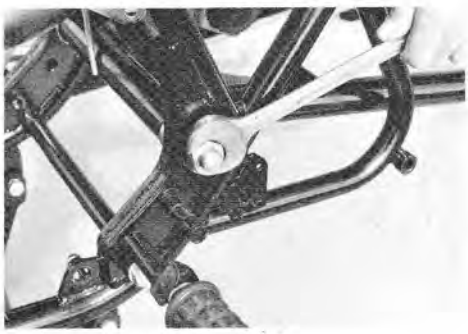


Fig. 4-97

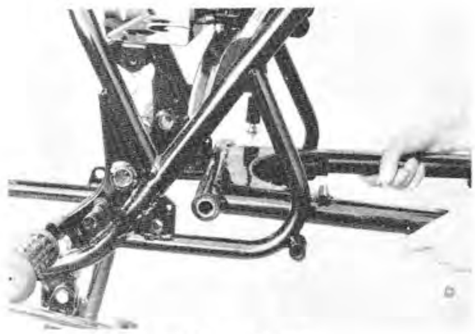


Fig. 4-98

3) Inspection

a. **Sleeve**

The pivot section (fitting part to the frame) of the swinging arm is always moved with the vibrating wheel. It bears almost the whole weight of the frame. Inspect carefully the fastening of the nut, abrasion of the sleeve, etc. The sleeve tends to be damaged especially in the drive side (loaded with the chain). If it has play in this part, driving becomes unstable.

Table 4-13 Gap between the sleeve and the bushing

Model	Standard value	Service limit
A1. A1SS A7. A7SS	0.0003 – 0.002″ (0.007 – 0.05mm)	0.008″ (0.2mm)
H1	0.005 – 0.007″ (0.13 – 0.19mm)	0.014″ (0.35mm)

b. Measure the bending of the pivot shaft with a dial gauge.

Table 4-14 Runout of the pivot shaft

Model	Standard value	Service limit
A1. A1SS A7. A7SS	Under 0.004″ (0.1mm)	0.02″ (0.5mm)
H1		

c. Bending of the swinging arm

If the arm of the swinging arm is bent, the center of the rear wheel is not in a proper alignment with that of the front wheel. Therefore, the handlebar becomes hard to operate. Inspect, repair or replace it if it is defective. Replace it if it is cracked in the welded part.

d. Runout and abrasion of the sprocket

(1) When the sprocket exceeds runout limit, not only the chain can not be adjusted but it also breaks or comes off from the sprocket during running. Inspect the runout of the sprocket with a dial gauge.

Table 4-15 Runout of the sprocket

Model	Standard value	Service limit
A1. A1SS A7. A7SS H1	0.12″ (Under 0.3mm)	0.2″ (0.5mm)

(2) When the tooth of the sprocket is worn, the chain may come off the sprocket during running, or teeth may be damaged. Measure the root diameter of the sprocket.

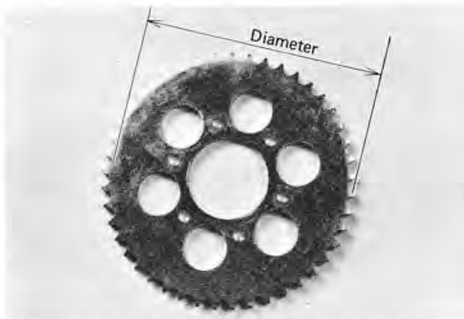


Fig. 4-99

Table 4-16 Root diameter of the sprocket

Model	Standard value	Service limit
A1	7.0″ (177.0mm)	6.88″ (175mm)
A1SS	7.36″ (187.1mm)	7.28″ (185mm)
A7. A7SS	6.76″ (171.9mm)	6.68″ (170mm)
H1	8.56″ (217.4mm)	8.48″ (215.5mm)

4) Assembly

The order of assembly is subject to the reverse order of disassembly.

a Self locking nut fastening torque valve.

A series	55 ft-lb	(7.5 kg-m)
H series	70 ft-lb	(11 kg-m)

9. Fuel tank, oil tank and fuel cock

1) Construction

a. Fuel tank

In the fuel tank, special steel plate which has excellent resistance to corrosion is used. In the lower part of the fuel tank, there is the fuel cock which filtrates gasoline and feeds it to the carburetor.

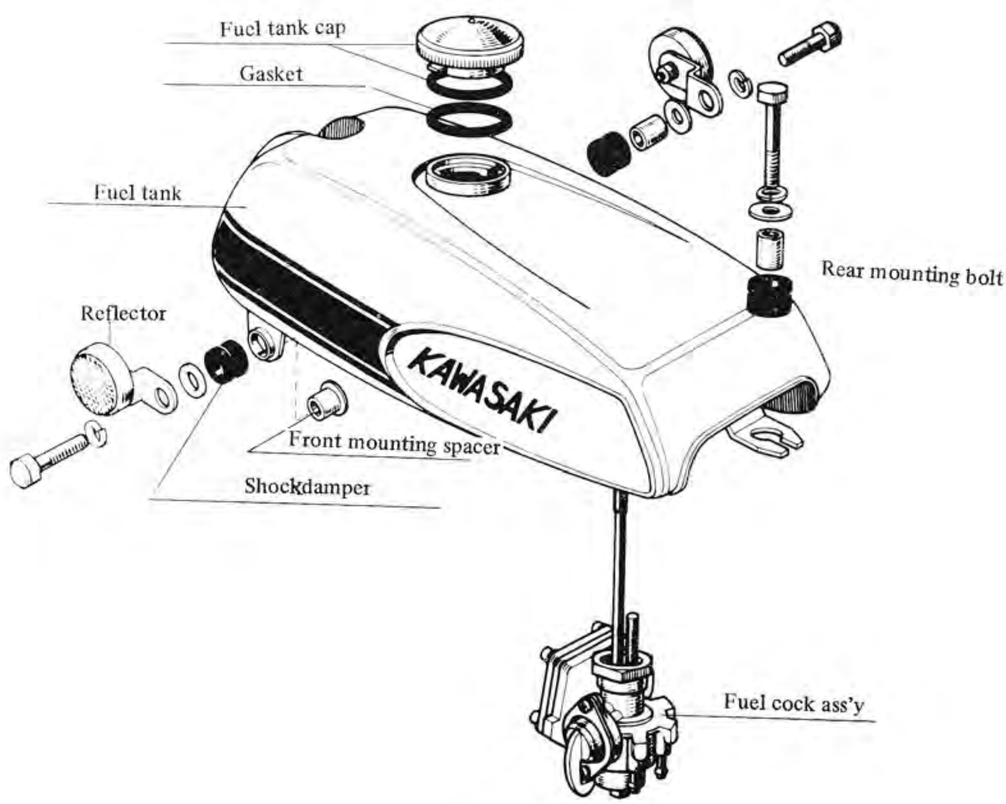


Fig. 4-100

b. Oil tank

The oil tank is located in the right lower part of the dual seat. Oil is fed forcibly by the oil pump in the engine to the crankcase (in the A1 series) or directly to the bearings of the crankshaft (in the A7 series or Model H1).

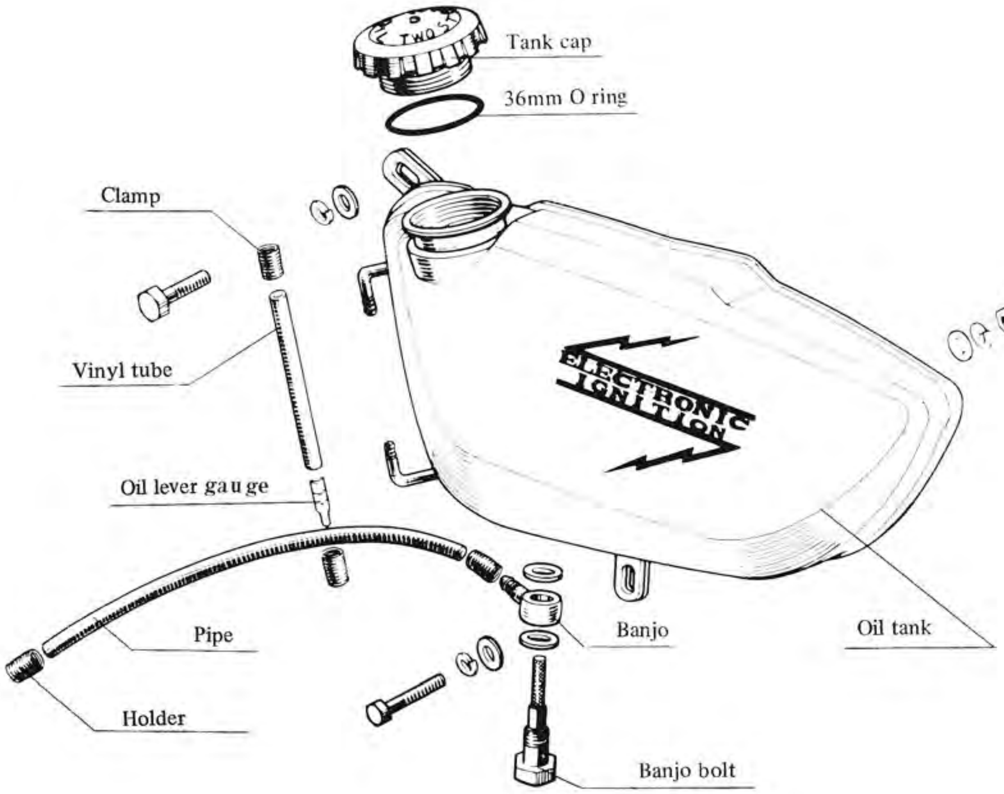


Fig. 4-101

Table 4-17 Fuel tank and oil tank capacities

Model	Fuel tank	Oil tank
A1 A1SS A7 A7SS	3.5 gaℓ (13.5ℓ)	2.4 qt (2.2 ℓ)
H1	4.0 gaℓ (15ℓ)	2.5 qt (2.3ℓ)

c. Fuel cock

(1) A series model

The fuel cock filtrates gasoline in the fuel tank and feeds it to the carburetors. The lever is used to send gasoline to the carburetor. If the fuel cock lever is switched to the number "1" or "2" (stamped on the fuel cock body), gasoline flows into the carburetor from the fuel tank. If the fuel cock lever is switched to "O", gasoline stops flowing. When there is plenty of gasoline left in the fuel tank, drive with the fuel cock lever adjusted to "1". If gasoline stops flowing at "1", switch the fuel cock lever to "2". "2" stands for RESERVE at which the fuel quantity in the fuel tank is less than about 1 liter.

Be sure to switch the fuel cock lever to "0" when the engine stops.

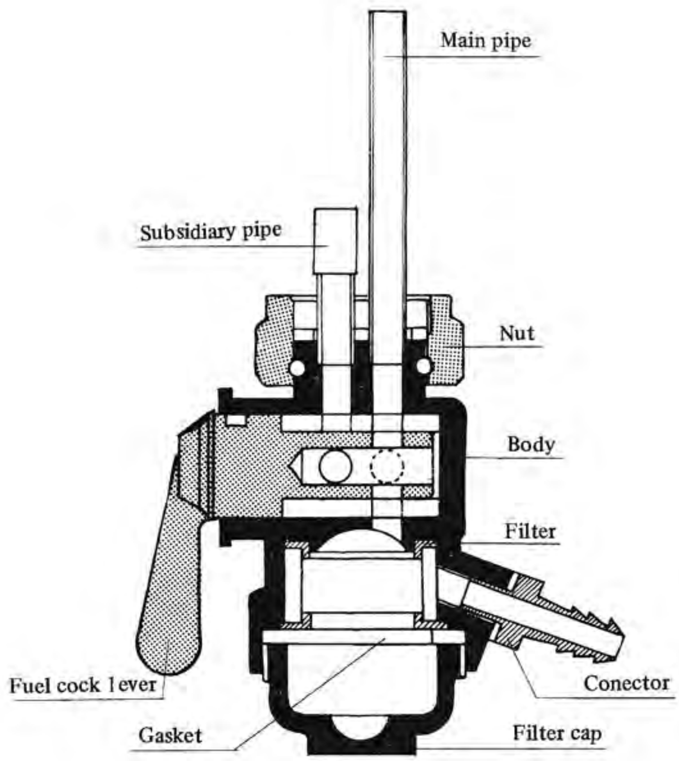


Fig. 4-102

(2) H series model

The fuel cock which is used in Model H is of automatic type. If the fuel cock lever is set to the position ON or RES, gasoline is automatically supplied as the engine runs or stops.

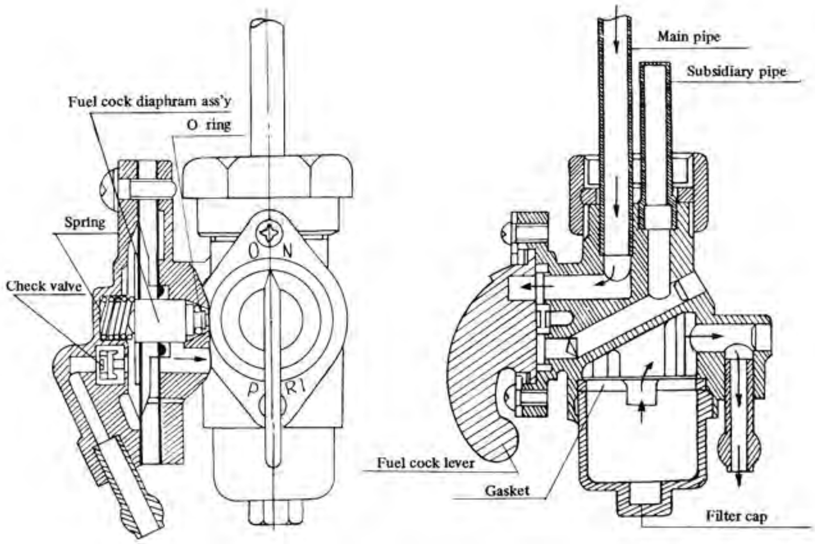


Fig. 4-103

Fuel enters the main pipe (1) and passes through the change-over cock path (2). The fuel path is made ON – OFF by the "0" ring (4) and seat formed in the end of the path (3). While the engine is in operation, the "0" ring separates from the seat, and the fuel passes the path (5) and enters the filter cup (6). It enters the carburetor through the cup filter (7) and the fuel pipe connection (8). When the engine stops, the fuel stops in the path (3) since the "0" ring (4) is in contact with the seat due to the tension of the spring (9).

The operation ON-OFF transmits the negative pressure which is generated in the inlet pipe during the operation of the engine to the check valve (10) of the auto-cock diaphragm through the guide from the negative pressure outlet of the carburetor; it is rectified, expanded, and enters the diaphragm chamber (11).

It surpasses the tension of the spring (9) and attracts the diaphragm completely (12) to the left side. Thus, the "0" ring (4) is separated from the seat and the fuel path becomes ON. When the engine stops, the negative pressure in the inlet pipe disappears, and the negative pressure in the diaphragm chamber (11) becomes identical to that in the inlet pipe through the pin hole in the disc valve. The fuel path becomes OFF since the spring (9) pushes it to the right. The reserve mechanism is as follows. When the fuel in the tank is consumed and the oil surface lowers under the top of the main pipe (1), the path (14) is opened by turning the lever of the change-over cock (13) to the position RES; the remainder of the fuel can entirely be utilized and at the same time it indicates that there is little fuel left in the tank.

The priming mechanism is as follows. By turning the lever of the change-over cock (13) to the position PRI, the fuel can be arbitraily fed to the carburetor even if the engine stops.

2) Disassembly

a. Taking off the fuel tank

First of all, switch the fuel cock lever to the "0" point (Stop) and pull out the fuel pipe from the fuel cock body, after stopping the gasoline. Next, take off the fuel tank.

NOTE

There is a harness between the pipe frame and the lining of the fuel tank. Therefore, be careful not to pick up the main wire harness with the fuel tank when taking off the fuel tank.

Since the fuel cock in the Model H is an auto-cock, the fuel cock lever has to be switched to the position "ON" or "RES".

Fig. 4-104

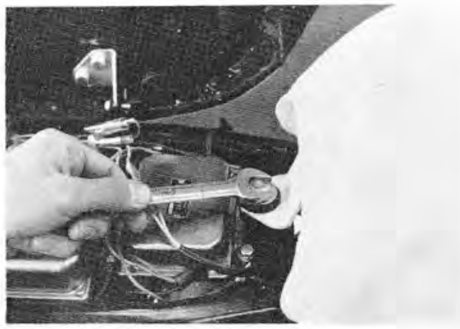


Fig. 4-105

b. Taking off the fuel cock

After draining gasoline from the fuel tank, take off the fuel cock.

Fig. 4-106

c. Taking off the oil tank

After draining the oil entirely from the oil tank or putting the spigot on the oil tank tube to stop the oil, take off the oil tank.

Fig. 4-107

3) Inspection

a. Fuel tank and oil tank

After a long period of service, dust gathers at the bottoms of the fuel tank and the oil tank, resulting in problems with the fuel cock and the oil pump. Wash periodically the interior of the fuel tank and the oil tank with gasoline.

b. Fuel tank cap and oil tank cap

The tank cap not only prevents oil or gasoline from leaking, but also feeds the air to the tank. If no air flows into the tank, neither gasoline nor oil flows. Inspect the air vent of the tank cap.

When the tank cap gasket expands, the air path is closed. Inspect the tank cap gasket and change it if it has expanded.

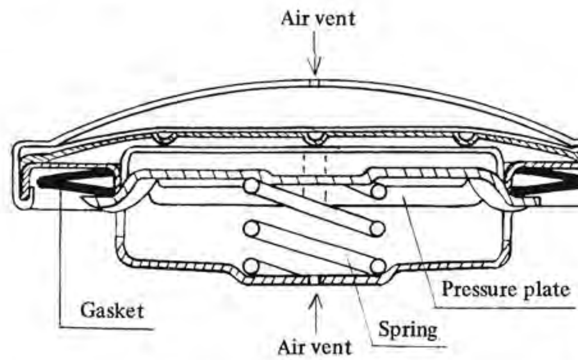


Fig. 4-108

c. Oil tank cap "0" ring and banjo bolt gasket

A damaged "0" ring or banjo bolt gasket will cause oil leakage. Replace them with new ones if they are damaged.

d. Fuel cock (A series)

(1) Inspect every part of the fuel cock, and replace a damaged gasket to prevent oil leakage.
(2) Since dust gathers in the cup under the fuel cock, remove and clean it occasionally.
(3) Clean the gasoline path with compressed air if it is clogged in the fuel cock body.

e. Fuel cock (H series)

If the fuel cock leaks, loosen the screw of the diaphragm cover; take off the diaphragm completely (·) from the body and clean the valve and seat section with fresh gasoline and compressed air.

* Take care to adjust the positions of the air holes in the spacer and diaphragm to the hole position in the body when assembling.

Take care not to leak the air in the boost tube which connects the fuel cock to the negative pressure outlet of the carburetor. Air leakage will cause the poor fuel supply.

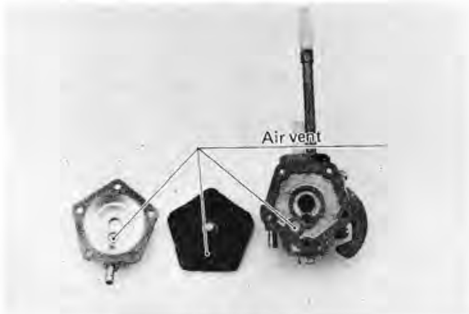


Fig. 4-109

4) Assembly

The order of assembling is subject to the reverse order of disassembling.

10. Dual seat

1) Construction

There is elastic sponge in the dual seat.

The dual seats in A1, A7 series are fixed to the frame with bolts but those in A1SS, A7SS and H1 models are fixed to the frame with pivot holders and hooks.

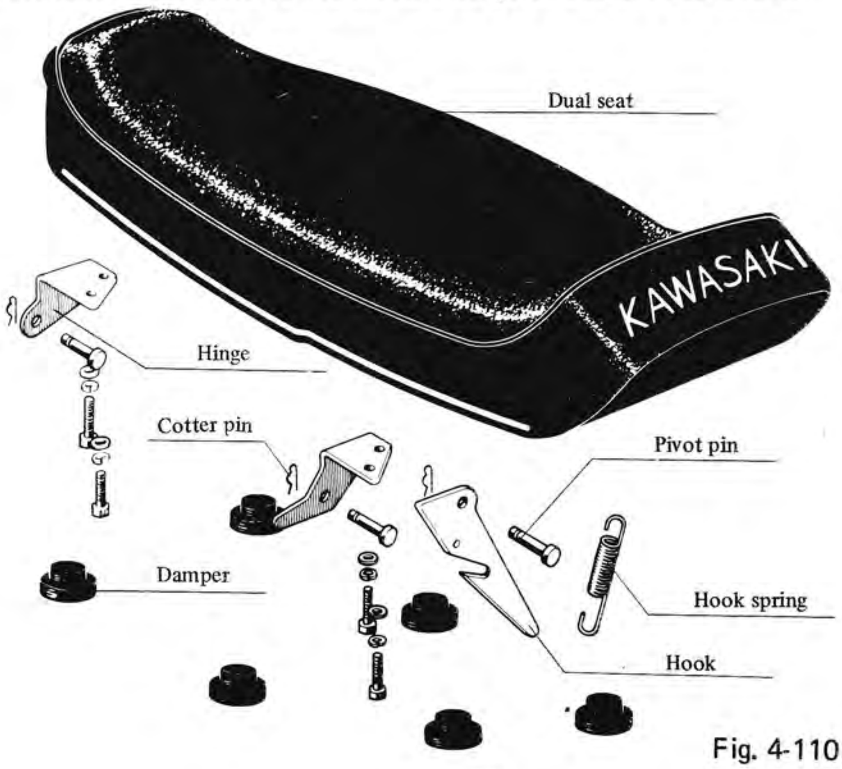


Fig. 4-110

2) **Disassembly**

Taking off the dual seat.

Open the dual seat and take it off in the case of A1SS, A7SS and H1 models.

Fig. 4-111 A1. A7

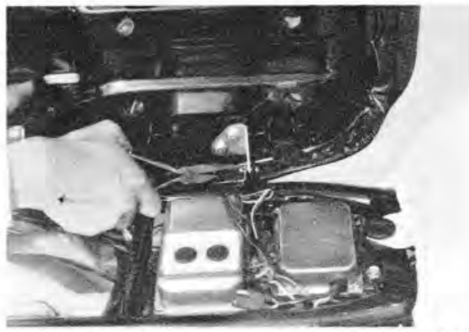


Fig. 4-112 A1SS. A7SS. H1

3) **Assembly**

The order of assembling is subject to the reverse order of disassembling.

11. Center stand, side stand, foot rest and rear foot rest

1) **Construction**

The center stand and the side stand support the whole weight of the motorcycle while it is stopped. They are made of materials which are highly resistant to bending.

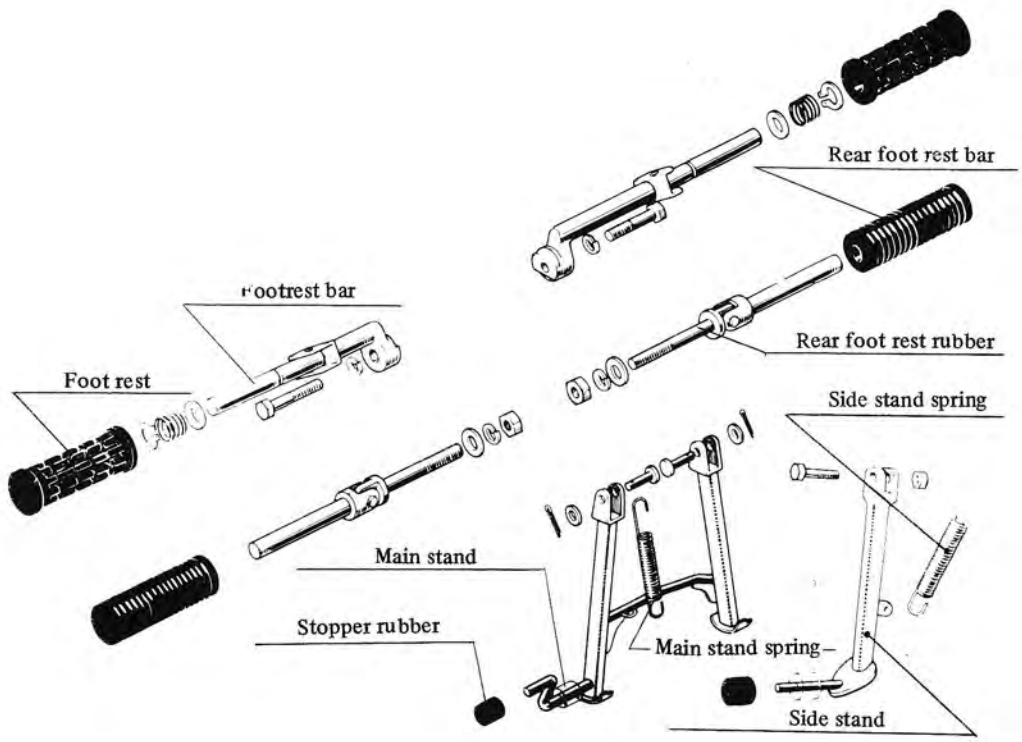


Fig. 4-113

2) Disassembly

a. Taking off the center stand

After removing the center stand, take off the center stand spring.

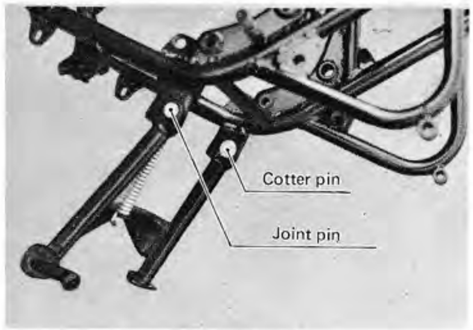


Fig. 4-114

b. Taking off the side stand

After removing the side stand, take off the side stand spring.

Fig. 4-115

c. Taking off the foot rest

The right and left foot rests are attached to the frame independently.

Fig. 4-116

d. Taking off the rear foot rest

The rear foot rest is a part of the shaft for installing the muffler. Supporting the back of the muffler by hand, take off the rear step foot rest.

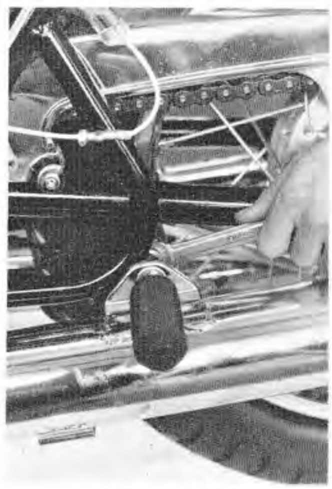


Fig. 4-117

3) Inspection

a. Side stand spring and center stand spring

If the spring is expanded and the stand is hard to return, replace the spring with new one.

b. Foot rest rubber

Replace a cracked or worn foot rest rubber with a new one.

4) Assembly

The order of assembling is subject to the reverse order of disassembling.

12. Exhaust pipe and muffler

1) Construction

The exhaust pipe guides the exhaust gas from the cylinder to the muffler. One end of the exhaust pipe is inserted in the exhaust port of the cylinder and the other is inserted into the muffler. The joint seal is employed in the joint section to prevent gas from leaking. The muffler consists of the baffle plate and the baffle tube and is attached to the footrest and the rear swing arm pivot shaft plate. Combustion gas in the engine passes through the exhaust pipe, enters the muffler and expands. It collides with the baffle plate, and its path is

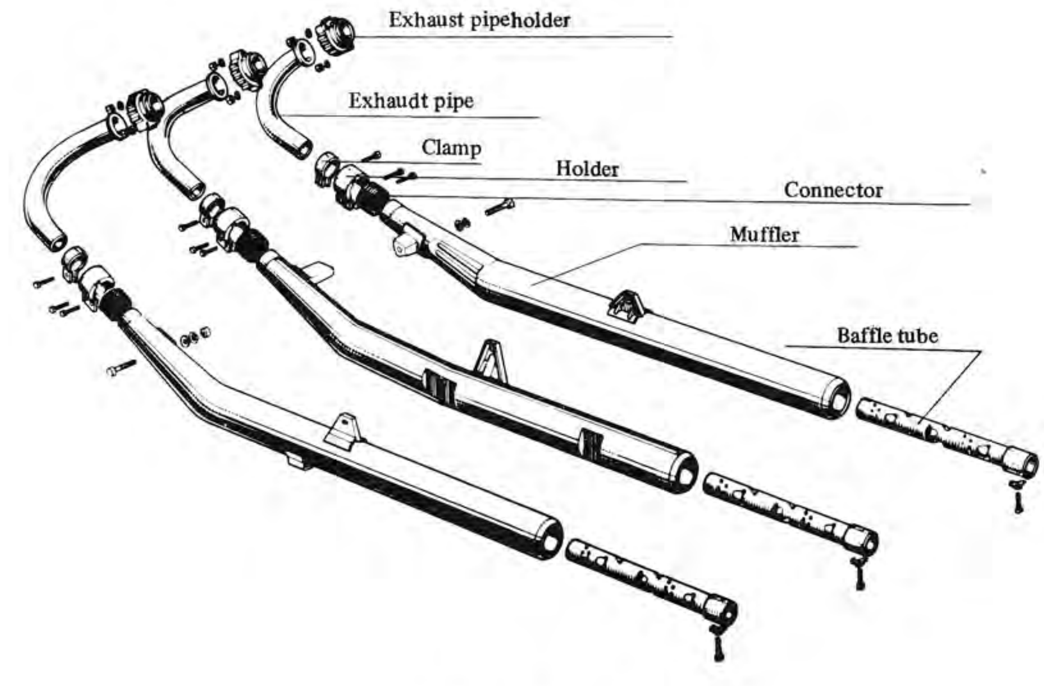


Fig. 4-118

obstructed. It enters the baffle tube. (Part of it enters the baffle tube directly.) The combustion gas in the baffle tube enters the resonant box (the chamber surrounded by the muffler body, baffle plate and baffle tube) through many holes in the baffle tube. Then it circulates in the baffle tube and the resonant box repeatedly. While it is being interfered with expanding, the sound is muffled and it is exhausted outside.

2) **Disassembly**

a. **Taking off the exhaust pipe (A1, A7, H1)**

Loosening the muffler, take off the exhaust pipe.

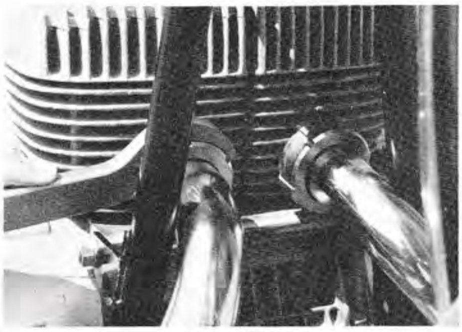


Fig. 4-119

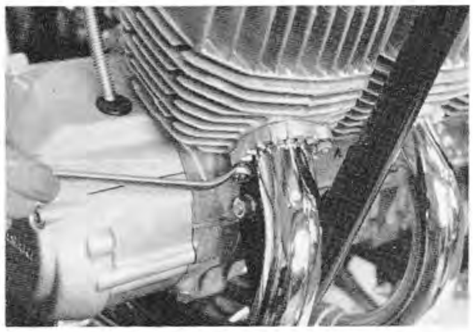


Fig. 4-120

b. **Taking off the muffler (A1, A7, H1)**

Loosen the front and rear parts of the muffler.

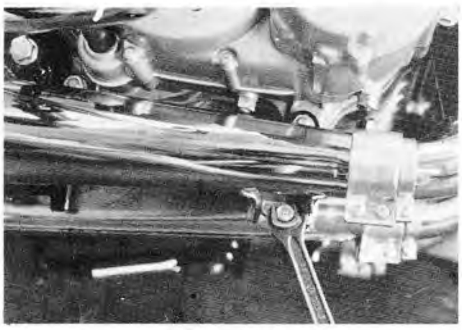


Fig. 4-121

Fig. 4-122

NOTE

The exhaust pipe in Models A1SS and A7SS is of a one body type.

c. **Taking off the baffle tube**

After removing the (+) screw at the back of the muffler, pull out the baffle tube with a pair of pliers.

Fig. 4-123

Fig. 4-124

3) Inspection

a. If carbon thickly adheres to the inside of the exhaust pipe or the muffler, the exhaust efficiency of combustion gas is reduced and the output of the engine is lowered. In the case of disassembling the muffler, clear the carbon according to the following procedure.

(1) By using a wire brush, clear carbon from the baffle tube. If it is too thick and cannot be removed with a wire brush, heat the baffle tube with a torch lamp, and then it can be removed by tapping it on the ground.

(2) Clean carbon from the exhaust pipe, by putting a slightly used chain or a long screw driver into it.

Fig. 4-125

b. When the muffler gets old, gas leaks from the joint section between the exhaust pipe and the muffler. Inspect the muffler and replace it with a new one if the rubber is old or broken.

NOTE

The muffler connector is not employed in A1SS, A7SS.

c. If the cylinder fitting surface of the exhaust holder is bent or cracked, replace it with a new one.

4) Assembly

The order of assembling is subject to the reverse order of disassembling.

NOTE

Be sure to replace the exhaust gasket and muffler connector with new ones. The gasket or muffler connector which has been previously used cannot uniformly connect the pipe. Therefore, gas may leak.

13. Drive chain

Generally, tension and friction due to sliding occur between the pin and the bushing of the drive chain, and the bushing and the roller, causing the chain to expand. In addition, abrasion due to sliding occurs on the surface of the roller and teeth of the sprocket. Therefore, careful maintenance is required for them.

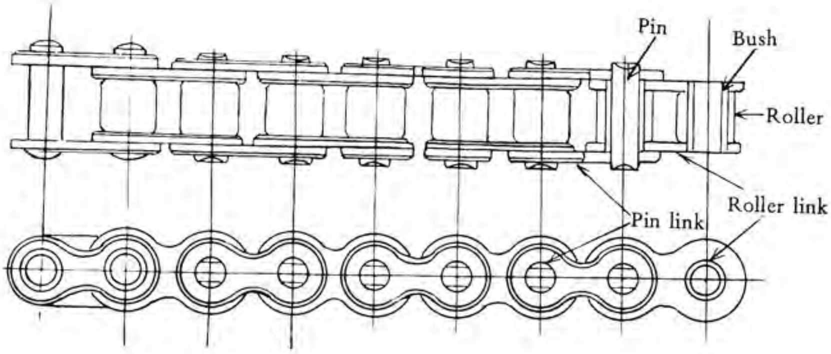


Fig. 4-126

Table 4-18 Specifications of sprocket and drive chain

Model	Number of teeth of the sprocket		Gear ratio (secondary)	Chain	
	Engine	Rear		Model	Links
A1 A1SS	15	37 39	2.46 2.60	EK525SH	92
A7 A7SS	15	36	2.40	EK530SH	90
H1	15 16	45	3.00 2.81	DID50HT	102

1) Inspection

If there is no oil left in the drive chain, joints become hard to move and adversely affect the sprocket. Lubricate it periodically.

a. If the roller or link plate of the drive chain is cracked, replace it with a new one.

b. Raising the center stand and grounding the wheel, adjust the tension of the drive chain. As shown in Fig. 4-129, inspect the center of the chain. If there is vertical play of over 40mm or under 10mm, adjust it again because it will adversely affect running.

Standard value 25mm

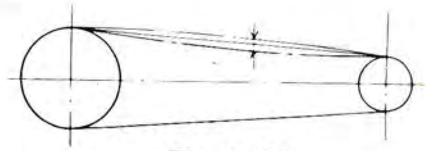


Fig. 4-127

Adjust the chain with the right and left chain adjuster bolts. In this case, taking advantage of the scales marked in the right and left sides of the swinging arm ends and the marks stamped on the chain tensioner, adjust the chain adjuster bolts so that the right and left marks of the chain tensioner may be positioned in the same places on the right and left scales. If the position of the chain tensioner is different on the right side and the left side, the rear wheel cannot be aligned. Since the brake adjusting varies according to the adjusted chain, be sure to adjust the brake after adjusting the chain.

Fig. 4-128

Fig. 4-129

c. If the chain cannot be adjusted due to over stretching, cut off one link of the drive chain with chain cutter and/or chisel.

Fig. 4-130

Fig. 4-131

2) Installing the joint chain

As shown in Fig. 4-132, install the chain joint so that the opening of the clip will face in the reverse direction rotation.

Fig. 4-132

NOTE

If it is reversed by mistake, the clip may come off during driving and the drive chain may break.

14. Steering oil damper

1) Construction

The steering oil damper absorbs the vibration of the handlebar during high speed driving. It is located between the frame and the steering stem. As shown in the illustration, the steering oil damper consists of the cylinder, piston, piston rod and oil in the cylinder. When the oil damper is compressed and the piston rod shifts from the right to the left as shown in the illustration, oil on the upper section of the piston is compressed and passes through a small path in the piston, moving to the lower section of the piston. When the oil damper expands, oil passes through the same small path in the piston and moves from the lower section to the upper section of the piston. Therefore, the handlebar is loaded with the same force when the oil damper is compressed or expands. The oil damper prevents vibration when the handlebar suddenly vibrates.

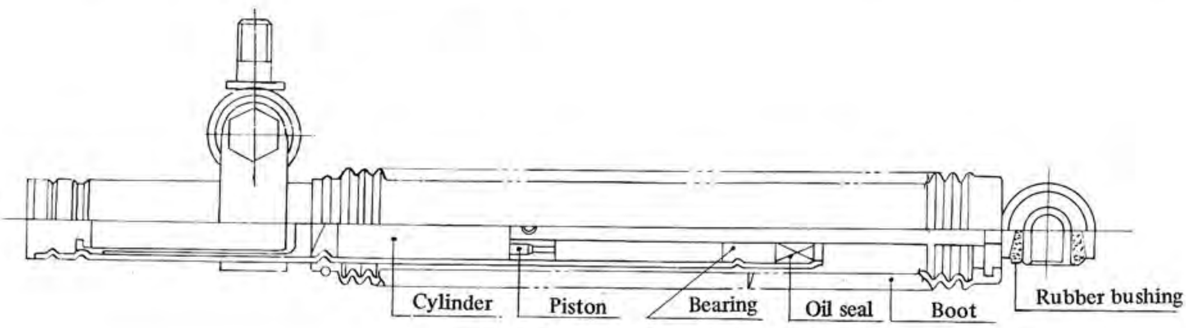


Fig. 4-133

2) Disassembly

a. Taking off the steering oil damper.

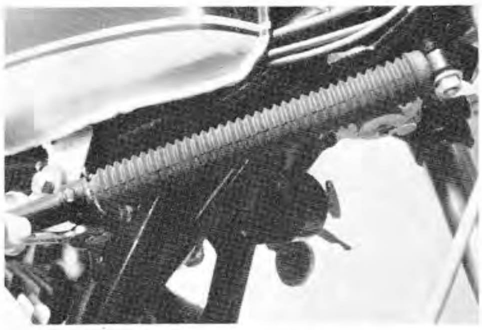


Fig. 4-134

3) Inspection

a. Since the steering oil damper cannot be disassembled, replace it.

V. ELECTRICAL EQUIPMENT

1. AC generator
2. Rectiffier
3. Volt age regulator
4. Ignition system

1. AC generator

The generator supplies electric power to the ignition circuit, lamp circuit, charging circuit, etc. The generator which is employed in the "A series" and "H series" as the power source requires a rectifier which is not necessary in the case of DC generator. Since it has no commutator, it is characteristically small in size, and light in weight in comparison with DC generators, besides being free from difficulties.

This AC generator consists of the armature inducing current and the field rotating inside it. As is well known, electric power is generated in the armature when it crosses the magnetic flux of the rotating field. Fig. 5-1 shows the cross section of the generator.

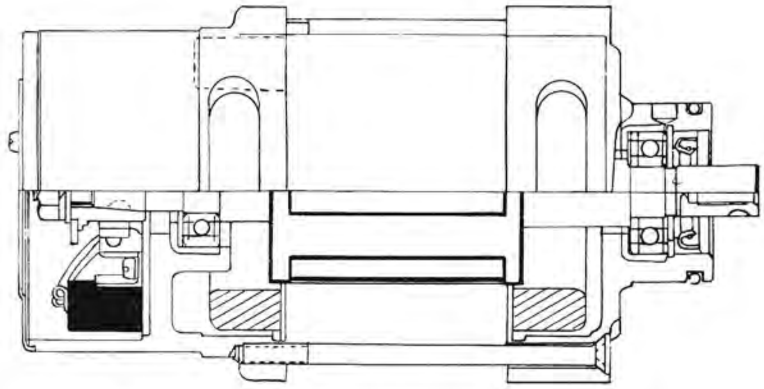


Fig. 5-1

The armature is also called a stator and consists of the coil wound around the laminated iron core which is a part of the generator housing. The field is supported by bearings in both ends of the housing, and driven by the crankshaft. Therefore, the field is also called a rotor. This field can be classified into two types in terms of structure.

This rotating field can be roughly divided into two types according to the construction. That is, the one is of the permanent magnet and the other is of the electromagnet.

The alternating current which is generated in the armature is converted to direct current through semiconductors such as a selenium rectifier or a silicon diode; then fed to the lamp circuit, ignition system, and supplied for battery charging , etc.

The generated voltage goes up as the engine speed increases. To control this, both the A series and H series are equipped with a voltage control circuit.

1) Construction

a. Field

The field rotates inside the armature, It is classified into two types in terms of structure, i.e. permanent magnet type and electromagnet type. Fig. 5-2 shows the permanent magnet type of the A series. Fig. 5-3 shows the electromagnet type which is employed in the A, H series; the exciting current flows to the exciting coil through the brushes and springs and magnetizes the rotor.

Fig. 5-2

Model A

Model H

Fig. 5-3

When starting, this exciting current is sent from the battery, however, when the rotating speed of the generator goes up, and the generated voltage exceeds the terminal voltage of the battery, it is directly sent from the generator. Generally, such an excitation method is called separate excitation.

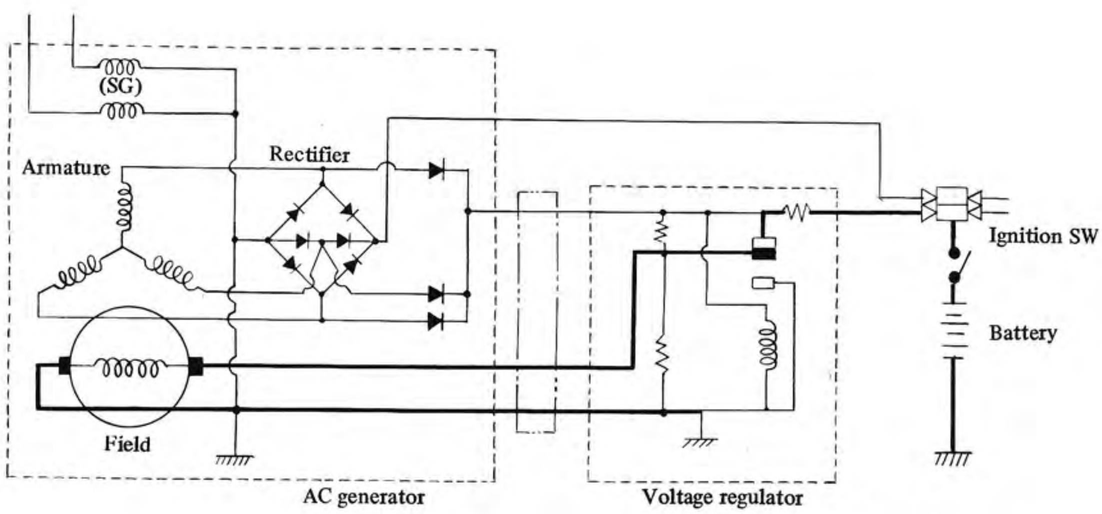


Fig. 5-4

b. Armature

The armature of the AC generator consists of the three element coils wound around the laminated iron core which is a part of the generator housing. There are two kinds of connection methods for a three phase winding. They are star connection and delta connection. The former method is adopted in this generator (Fig. 5-5).

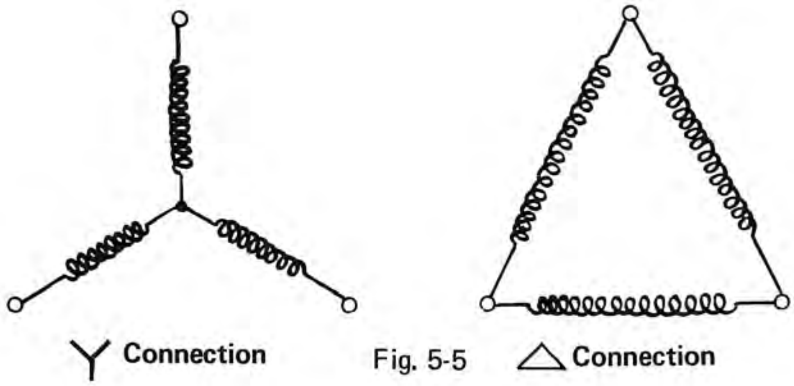


Fig. 5-5

As shown in Fig. 5-6, alternating current is generated in the terminals A, B and C with the phase shifting by 120°. This is the three-phase alternating current which is produced from the armature.

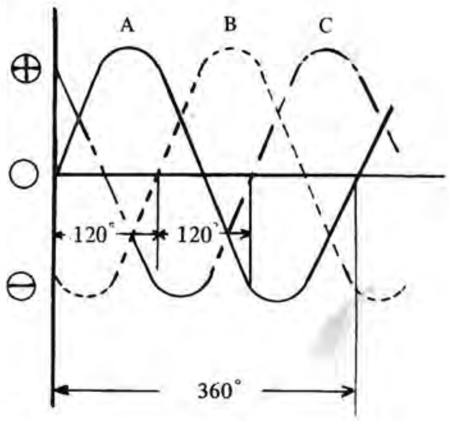


Fig. 5-6

2) Servicing

As with all motor vehicles A and H series models are specially equipped with structurally complicated and highly sensitive parts. Pay attention to the following points.

a. Since all electrical equipment is likely to be affected by water, oil and dust, wash or disassemble the car carefully.

b. Recent electrical equipment operates in combination with many electrical devices to achieve one function, therefore, wrong wiring or incomplete connection will damage related electrical devices.

c. Since many semiconductors such as silicon diode, zener diode, SCR, etc. are employed in the rectifier and regulator, excessive and/or wrong direction current will damage them or cause to internal short-circuit. Take off the battery terminals (+) (–) especially when charging the battery from other electrical source.

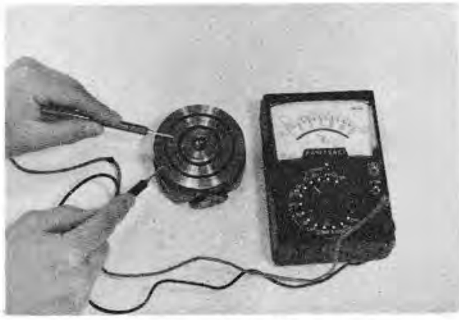
d. Since recent motorcycles are mainly designed to use at high speeds, electrical equipment is installed with damper rubber for fitting to the frame. If this rubber is not used for fitting, trouble will occur due to vibration. Be sure to use the rubber for it.

3) Testing AC generator

a. Field coil test

(1) It is normal if the resistance is 3.5Ω ~ 5.5 Ω when it is measured by setting a tester between rotor slip rings as shown in Fig. 5-7. If the resistance is none or less than specified, it means internal short-circuit.

A series



H series

Fig. 5-7

(2) The current in the field coils is normally about 1.5A ~ 3A and the resistance is 3.5 Ω ~ 5.5 Ω, so internal short-circuit may be occured if an exceesive current is made to flow between terminals of the rotor slip rings even in testing.

b. Armature coil test

(1) For the "A series" contact breaker ignition system, check the continuity by setting a tester between two yellow leading wires and one green leading wire going out of the generator, as shown in Fig. 5-8. If terminals are electrically connected, no wire has snapped. Next, setting a tester between the body and yellow terminal, check that no current flows. If nothing is abnormal with it, there is no broken wire in the armature or short-circuit between the armature and the body.

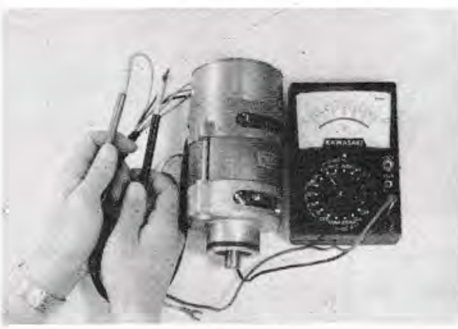


Fig. 5-8

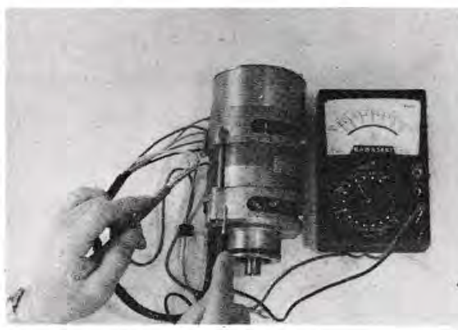


Fig. 5-9

(2) For the A series models which are equipped with CD ignition system, there is no way to check the armature with usual meters since silicon diodes are assembled in it.

(3) For the "H series"

Check Conductivity by setting a tester to three yellow leading wires coming out of the generator, as shown in fig. 5-10.

If terminals are electrically connected, no wire has snapped. Next, setting a tester between the body and terminals, confirm that no curent flows. If nothing is abnormal with it, there is no broken wire in the armature or short circuit between the armature and the body.

Fig. 5-10

2. Rectifier

In the output side of the generator in the A series and the H series models, a rectifier is required for the conversion of the alternating current generated in the armature to direct current.

Fig. 5-11 shows the conversion of the single-phase alternating current to direct current by using one rectifier.

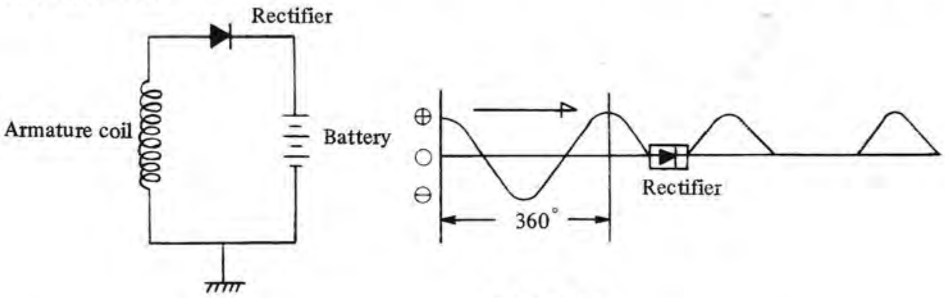


Fig. 5-11

This is generally refered to as single-phase half-wave rectification. When the rectifier is connected as shown in Fig. 5-12, single-phase full-wave rectification can also be achieved. The alternating current which is generated with the three-phase star connection can also be rectified full-wave through six rectifiers. Such a full-wave rectification circuit is generally called a bridge circuit and it is compared to the brushes and commutator of a DC generator. Since there is no moving part in it, no special maintence is required for it.

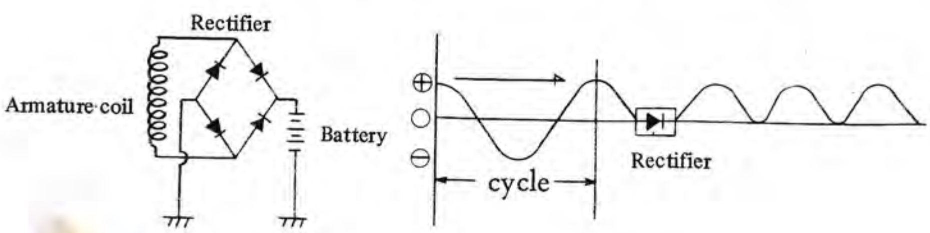


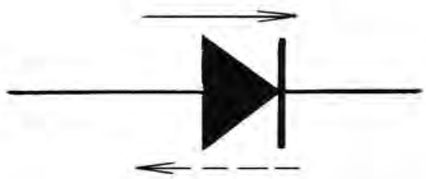
Fig. 5-12

1) Silicon rectifier

A semiconductor which has two poles and performs rectification between them is generally cold diode. The rectifier which employs the semiconductor silicon is usually called silicon rectifier. A semiconductor has properties which are just in between those of a conductor and those of an insulator. The great difference between a conductor and an insulator is based on the difference of the number of free electrons which can move freely inside. The current is made to flow due to the function of these free electrons.

There are very few free electrons in an insulator. Generally, the electrons in the semiconductor is going to be active and make the current flow only under certain conditions.

As shown in Fig. 5-13, the diode makes current flow in the direction indicated by the solid line with no resistance, however, when the current comes in the direction of the dotted line, a very large resistance appears and no current is allowed to flow. These characteristics are utilized in rectification.



The following figure shows an example of the characteristics of the silicon diode which has higher conductivity at high temperatures than at low temperatures, and has practically no conductivity in the opposite direction due to large resistence.

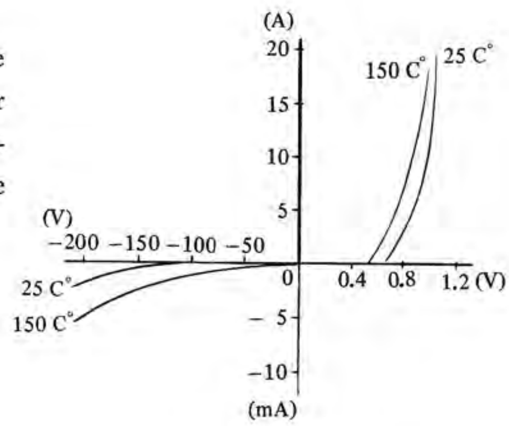


Fig. 5-13

The external appearance is shown in Fig. 5-14. The housing and the leading wire stand for the (+) pole and the (−) pole. There are two kinds of silicon diodes. According to the method of fitting the silicon element inside the housing, the current flows from the leading wire to the housing but no current flows in the reverse direction, on the other hand, in some diodes, the current flows from the housing to the leading wire, while no current flows in the reverse direction.

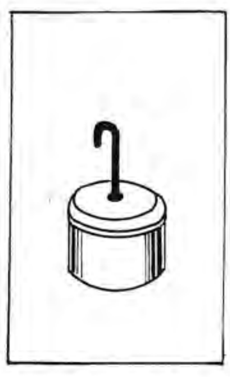


Fig. 5-14

2) Rectifier test

a. For "A series" contact breaker ignition system

As shown in Fig. 5-15, there are 7 leading wires which come from the rectifier; they are three yellow wires, two red wires and two black wires. In the normal state of the rectifier, the current flows in the directions of red – yellow, yellow – black. If it flows in the reverse direction, it is due to puncture.

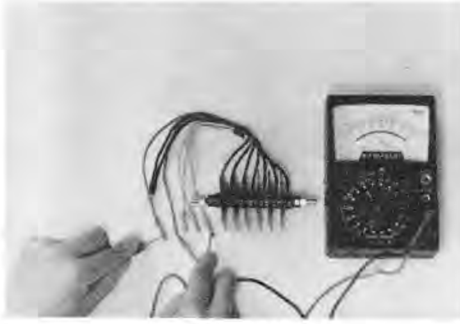


Fig. 5-15

b. For "A series" C.D ignition system

Here, the particulars are abbreviated since the diode can not be inspected without disassembling generator.

c. "H series" test

As shown in Fig. 5-16, the rectifier of the H series has three yellow, one red, one blue, and one black wires.

Confirm conductivity between respective terminals by using a tester. In the normal state, the current flows from red – yellow, yellow – black. If it flows in the reverse direction, it is due to puncture.

Fig. 5-16

3. Voltage regulator

The electricity which is generated in the generator increases as the rotating speed of the generator becomes high, and the exciting current which flows in the field increases accordingly. Therefore, if it is supplied directly, lamps will be burnt out or the battery will be overcharged. In order to avoid such troubles, it must be limitted below a certain value. This is the voltage regulator. The voltage regulator can be classified into two types. One is a contact points type regulator (constant-voltage relay), the other is a no-contact type regulator (silicon voltage regulator i.e. S V R).

1) S V R (no-contact type) of the "A series"

The A series voltage regulator is a kind of controlling rectifier where properties of a semiconductor, called as silicon controlled rectifier are put to use.

The semiconductor means an intermediate material between an insulator and a conductor.

A treated semiconductor is generally called a commutator and is used to make the current flow in only one direction, etc. The one which can be conductive only when a signal is sent to is called as SCR. Since this SCR is employed in the voltage regulator, there is no mechanically operated part and life is almost everlasting.

a. S V R operations

(1) The voltage regulator in the A series is called a silicon voltage regulator (S V R) and it works to control the terminal voltages of the AC generator under the set value (15.5V+0.5V). The wiring diagram is shown in Fig. 5-17.

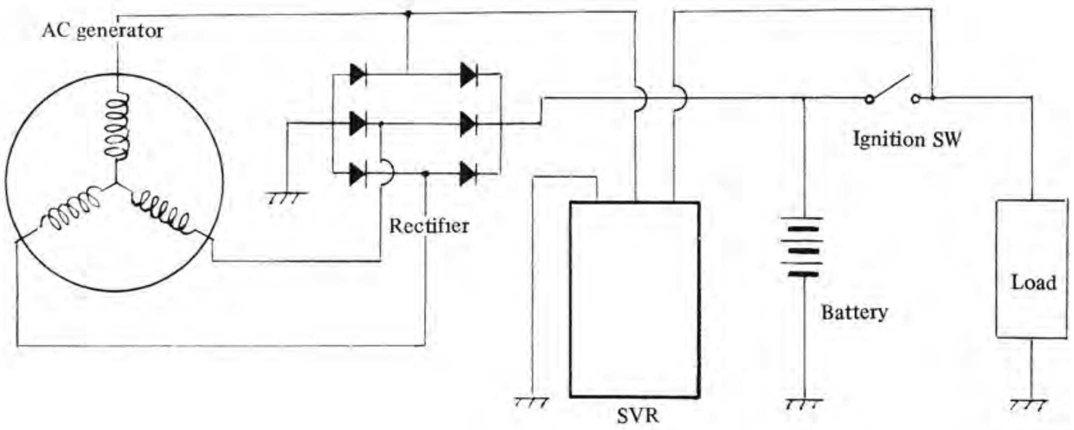


Fig. 5-17

When the rotating speed of the AC generator increases and the voltage in (a) exceeds 15.5V, a signal is sent from (b) to the S V R and opens the gate in SVR which shuts off the current in (c) resulting in allowing the current to flow down to the ground until the voltage is reduced well below 15.5V. When the voltage is lowered under 15.5V, the signal from (b) stops. Thus, the current (c) is automatically cut off and goes to (a) and the voltage begins to increase. This procedure is repeated to control the terminal voltage constant in the AC generator.

(2) SVR internal structure and wiring

Fig. 5-18 shows the internal wiring. The operation of each part is shown below.

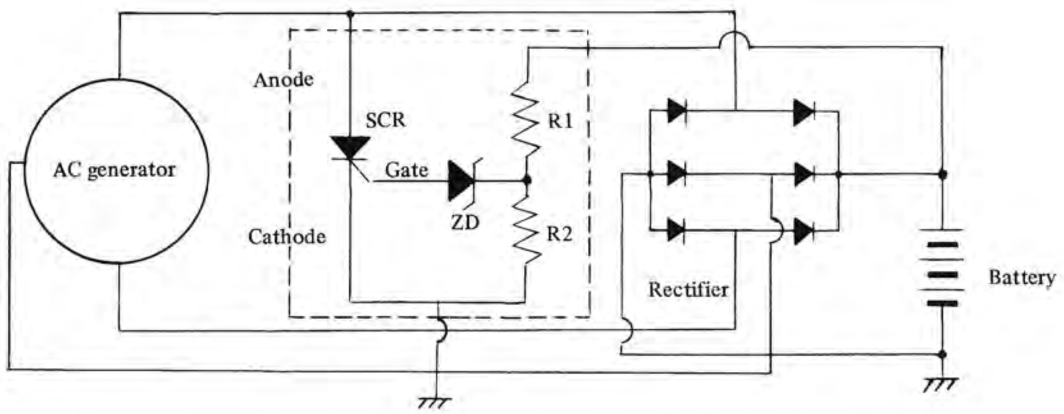


Fig. 5-18

(3) Z D (Zener diode)

In usual commutators, i.e. diodes, selenium, etc., the current flows only in the normal (positive) direction. However, in the Z.D, it also flows in the reverse direction when the voltage which exceeds a certain value is applied in the reverse direction (b).

(4) S C R (Silicon controlled rectifier)

No usual rectification is also performed unless the required charge is given to the gate from outside in the direction of the arrow which is shown in the symbol. In other words, when a certain current is given to the gate, the gate to allow the current from the anode to the cathode is opened and the current flows according to the symbol.

(5) Operation

When the battery is charged full, the voltage of the battery is likely to go up to 15V. At this time, if the AC generator is still charging the battery the terminal voltage (a) might naturally exceed 16V. Therefore, it has to pass the resistor (1) and go through the Zener diode in the reverse direction, sending a signal to the gate. The SCR which receives the signal opens the anode gate and the cathode gate and sends the generator output to the ground to prevent the battery from overcharging. If the abnormal current flows in (b), the Z.D will be damaged. For this reason, the current has to be sent to the ground through the resistor (2).

b. Servicing of the S.V.R.

(1) Take care not to take off the rubber cap which projects out of the S.V.R. body. Do not loosen the hexagon nut in the rubber cap. If this hexagon nut is loosened, the effect of heat radiation of the SCR is prevented and the SCR may be shorted.

(2) Be sure to turn off the main switch before wiring.

(3) Fix the body completely and be sure that the wiring is correct.
Wrong wiring will damage not only the SVR but also the battery.

c. S.V.R. test

When the S.V.R. is damaged due to careless handling, etc., problems occurs in electrical equipment. The main phenomena and usual method of inspection are shown below.

(1) When the rated voltage is not applied to the gate of (1), the current flows in

(2) anode	(3) cathode
(3) cathode	(2) anode
(2) anode	SVR casing

In the above cases, SCR or SVR itself is damaged.

Fig. 5-19

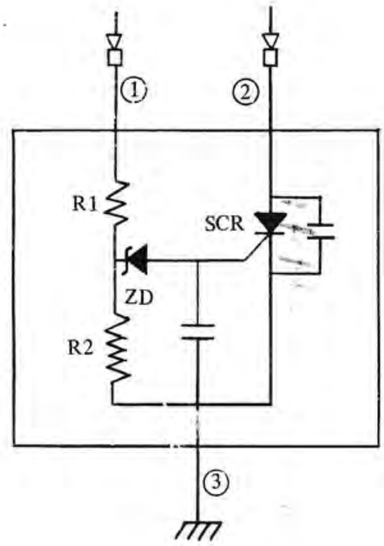


Fig. 5-20

(2) When the rated voltage is applied to the gate of (1), the current flows in (3) cathode to (2) anode.

In the above case, the battery DISCHARGES at all. The light is dark. In case of travelling at high speed, plugs will be fouled easily. Sometimes starting becomes difficult.

(3) When the rated voltage is applied to the gate of (1)

If no current flows in (2) anode – (3) cathode, it results is overcharging. The bulb may be burnt out.

2) Voltage regulator of the A.H series

As shown in Fig. 5-21 "Wiring diagram", this regulator is wired to control the exciting current which flows in the field. The voltage which is induced in the armature can be controlled by regulating the magnetic flux generated in the field.

a. Operation

(1) When the engine is just started, the terminal voltage of the generator is lower than that of the battery. When the main switch is turned on, the excitation current flows from the battery through Resistance "A" to the Field.

(2) When the generator increases its speed, the output voltage increases accordingly. When the generator output voltage becomes higher than that of the battery, coil B is excited and it breaks contact pulling the moving point to the midway position between the two stationery contact points. It results in supplying the field directly with the output of the generator through resistance C as long as it does not exceed 14.5V.

(3) When the output voltage continues to go higher and exceeds 14.5V, coil B is excited stronger. It results in pulling the moving point further until it reaches a lower stationery point.

As Shown in Fig. 23, the output current aimed to flow into the field is released to the ground through the lower stationary point.

Therefore, no excitation current flows through the field, which results in abruptly decreasing the magnetic flux of the field, and in turn, the output of the generator.

Thus, the output voltage of the generator is constantly adjusted to remain below the specified voltage of 14.5V.

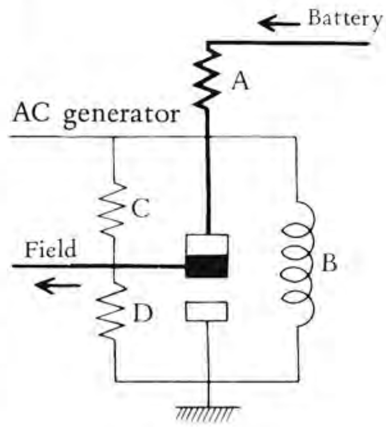


Fig. 5-21

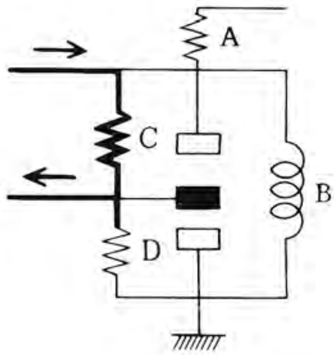


Fig. 5-22

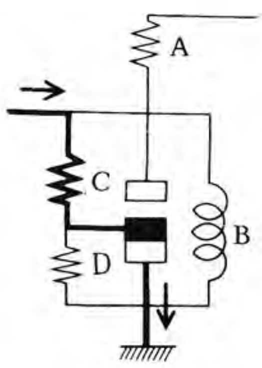


Fig. 5-23

(4) Fig. 5-24 shows the relation between the voltage and the rotating speed of the AC generator.

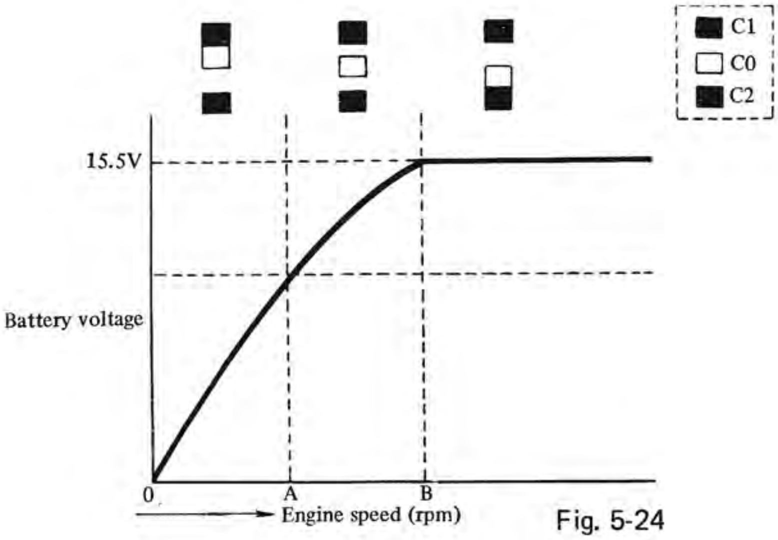


Fig. 5-24

NOTE

Each position of the contact points is shown above the diagram.

b. Servicing of the "A.H series" voltage regulator

Since the regulator is installed in the side of the battery case handling is very easy. Pay attention to the following points on handling.

(1) Do not make a mistake in wiring the generator, regulator, battery, etc.

(2) Be sure that the connector which connects the generator to the regulator is not loosened.

(3) Do not cut off the connecting wire between the generator and regulator or battery during running. The diode will be first to go if it is off.

c. "A.H series" voltage regulator test

The snapping and short-circuit of the wire in the regulator make the control of the generated power impossible, resulting in damaging the other electrical equipment.

(1) Resister and internal snapping check

Taking off four leading wires of the regulator, set a tester between terminals as shown in Fig. 5-26 and measure the resistance.

Fig. 5-25

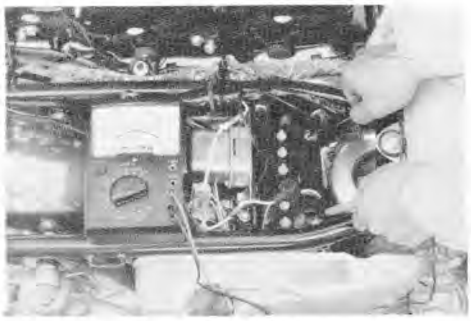


Fig. 5-26

The following values of the resistance were obtained with the ordinary hand tester.

The resistance between the terminals (1) and (2) is about 29.5

The resistance between the terminals (1) and (3) is about 29.5

The resistance between the terminals (1) and (4) is about 54

If the respective values of the resistance between terminals are different from the above values, it may be due to the snapping or short-circuit of a resister or a voltage coil.

Replace the regulator with a new one in this case.

(2) If nothing is wrong with terminals, inspect whether the internal contacts C1, C0 and C2 operate normally.

If the voltage indicates 14.5V+0.5V with the battery set between the terminals when increasing the engine speed up to 5000 rpm as shown in Fig. 5-26, the voltage coil is not snapped. If it is snapped, the voltage exceeds 14.5V and overcharging occurs.

4. Ignition system

In terms of mechanism, the gasoline engine intakes, compresses and ignites the mixed gas of gasoline and air in the cylinder, and it generates power through the expansion of the combustion gas.

The two stroke engine performs one cycle in two strokes, as is known from its name, i.e. intake, compression, combusition and exhaust. Therefore, in every rotation of the crankshaft, one spark is required for the combustion of the mixed gas in a cylinder. To spark timely, the electric igniter is prepared.

The electric igniter generally detects the time of ignition, and generates secondary high voltage current in the ignition coil. The current is discharged at the spark plug.

1) Contact breaker ignition method

This ignition method is mainly used in the A series model. As shown in Fig. 5-27, there is an contact breaker, ignition coil and spark plug in the circuit.

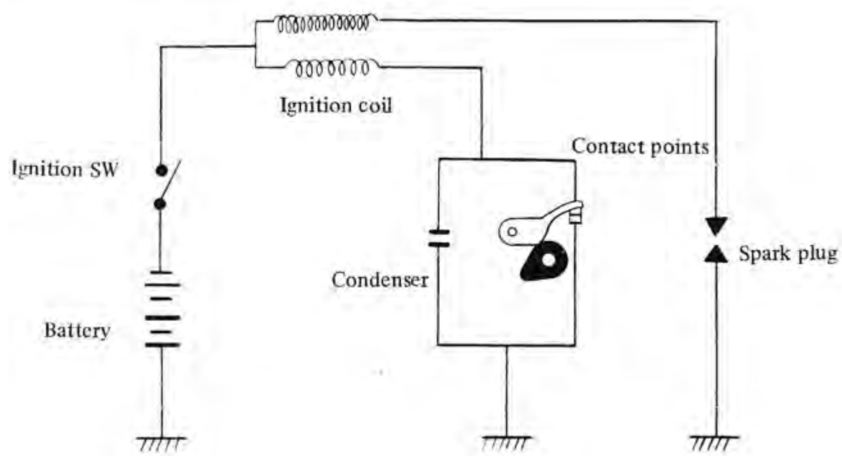


Fig. 5-27

a. Fig. 5-27 shows that the contact breaker points are closed. If the ignition switch is turned on in this state, the current from the battery goes to the contact breaker through the primary coil of the ignition coil and returns to the minus side of the battery. Therefore, the constant magnetic flux is generated in the ignition coil. When the cam by the contact breaker turns and the arm of it is pushed up, the contact points are opened and the current which flows in the primary side of the ignition coil is suddenly cut off. Consequently, the magnetic flux which is generated in the ignition coil lessens very rapidly, and the current in the direction of preventing the magnetic flux from changing is generated in the secondary coil. This is current of high voltage. The ignition coil is connected to the spark plug and discharges that current in the cylinder. The high voltage which is generated in the secondary coil depends upon the ratio of the primary windings to the secondary windings. At the moment when the contact breaker is opened, several hundred volts are generated in the primary coil. Since this current is generated in the direction to the contact breaker which is opened, discharging occurs between the contact points and sometimes sparking is generated. In this case, no effective high voltage can be induced in the secondary coil. To prevent it, usually a condenser is connected in parallel with the contact breaker to absorb such sparks.

b. Ignition timing

High performance can be obtained from the engine by burning the mixed gas and utilizing its expansion effectively. For this purpose, the pressure on the piston has to reach the maximum value at 8° – 10° after the top dead center.

In consideration of the time required for ignition and combustion, the ignition timing should be at 20° – 25° before the top dead center. This is generally called an angular advance which is also called ignition timing.

(1) **Model A series with contact breaker system**

(i) Adjusting point gap

Turn the rotor shaft of alternator by "F" with a wrench until the L.H. contact breaker point is fully open, and loosen two fitting screw "D" and "E". Then the L.H. contact breaker point can be adjusted by using screw driver applied to the adjusting screw "B" and the projection. Turning the adjusting screw counterclockwise increases gap and clockwise decreases gap. Standard gap is 0.012 to 0.016 in (0.3 to 0.4mm).

Tighten two fitting screws "D" and "E" after adjusting the L.H. point gap. R.H. contact breaker point gap can be adjusted in the same way as the L.H. contact breaker point gap counterclockwise decreases gap but it is not always necessary to adjust the R.H. point gap when the L.H. point gap is correct except to adjust opening timing mentioned in the next paragraph.

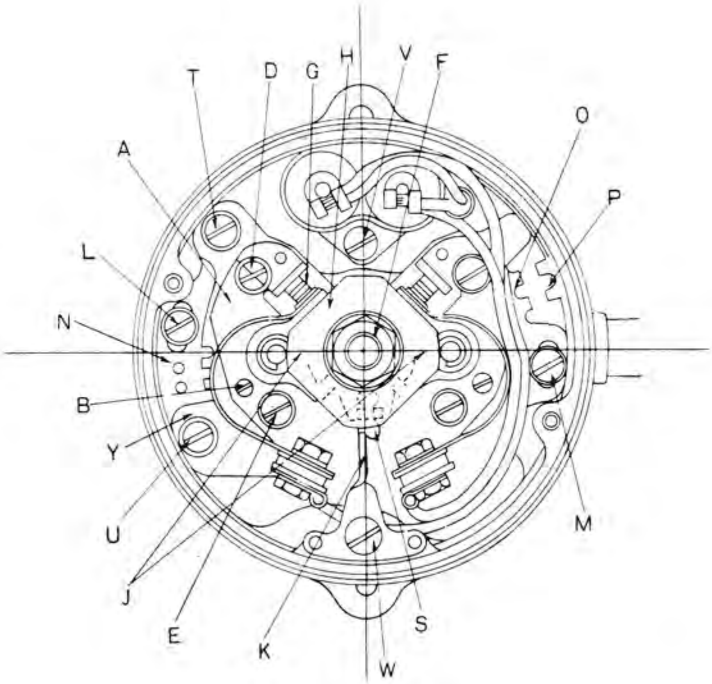


Fig. 5-28

(ii) Adjusting ignition timing

To adjust the L.H. ignition timing, first adjust the L.H. contact breaker point gap in the same way as mentioned in the last paragraph on the point gap adjusting.

Align ignition timing pointer "K" to the red painted mark "O" on the plate "P". When aligned, crankshaft is 23° before Top Dead Center which is the standard ignition timing.

Loosen two fitting screws "L" and "M" on base plate "N".

Then the L.H. ignition timing can be adjusted by turning the base plate "N" by the way of turning a screw driver which is inserted between the projections of rear cover "D" and the projection of baseplate "E" until the L.H. point is just about to open. Be sure to tighten two fitting screws "L" and "M" after adjusting. To adjust the R.H. ignition timing, turn the rotor shaft of alternator by 8mm nut "F" clockwise util the nonpointed marking "Q" aligns with ignition timing pointer "K". Then the R.H. ignition timing can be adjusted by adjusting the R.H. point so it is just about to open in the same way as mentioned in the last paragraph on the point gap adjusting.

NOTE

Check to be sure after adjusting that the L.H. point is exactly in the place just about to open with the red pointed marks "O" aligned with the ignition timing pointer "K" and the R.H. point when the painted marks "Q" are correctly adjusted to 23° before Top Dead Center. Apply high grade grease to cam felt "R" after every contact breaker adjusting or at periodical inspection.

(iii) Adjusting New Alternator

When the alternator has been replaced, make the ignition timing adjustment by the following procedure.

First, align all the punched marks of the crankshaft primary gear, clutch primary gear and alternator gear. Position the alternator in proper place on the upper crankcase with the dowel pin hole aligned with 8 x 12mm dowel pins pressed in the upper crankcase. upper crankcase.

Subsequently adjust the L.H. point gap by the same procedure as described in the paragraph 1-5.

After completing the L.H. point gap adjustment, adjust the ignition timing. In this case, first remove the 8 x 8 hex head bolt tightened on the L.H disc valve cover and turn the rotor shaft counter-clockwise to set the cutaway of the rotary valve (left) to the center of the ignition timing inspection hole. Correct the top end of the ignition timing pointer (K) so that the pointer may be aligned with the red painted mark (J) of the plate (H) in this position. In this case, if the amount of correction of the pointer (K) is to much, check to make sure that the punched marks of the aforementioned gears are properly aligned. Further adjustments must be carried out by the same procedure as stated above in the paragraph of "Ignition Timing Adjustment."

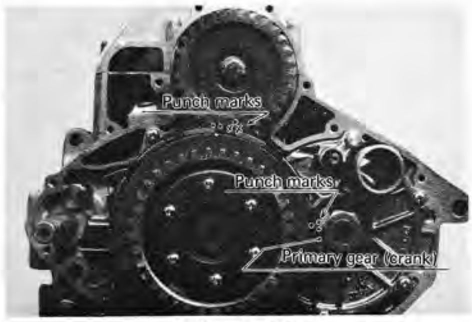


Fig. 5-29

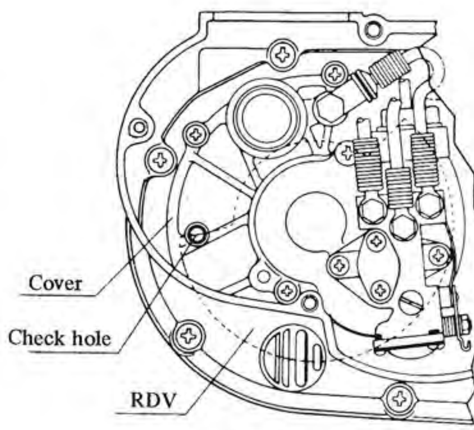


Fig. 5-30

Fig. 5-31

NOTE

The clutch gear has two kinds of timing marks as shown in Fig. 5-32. When assembling the gears, follow the instructions given here.

(1) The engine with the idle gear.
In this case the alternator must be the one indicated EN09 for the model A1 and EN11 for the model A7.
Use the two teeth having the dotted marks to set the idle gear between the clutch gear and the generator gear.

(2) The engine without the idle gear
In this case the atlernator is the EN04 for the model A1 and the EN08 for the model A7.
Use the two teeth having the mark "x x" to set the generator gear on the clutch gear.
Aligning the clutch gear to the primary gear is always the same regardless the idle gear is needed or not.

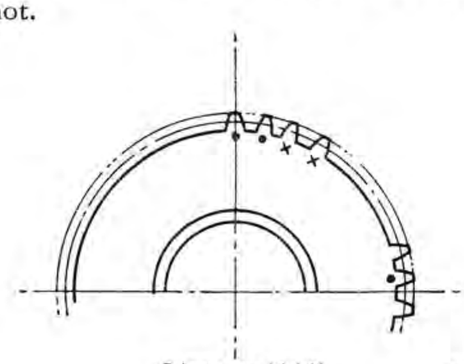


Fig. 5-32

(2) **Model H series with contact breaker system**

(i) Ignition timing adjustment

The ignition timing of the L.H. cylinder is first to be adjusted since the contact breaker for the L.H. cylinder is attacted directly on the base S on which the other contact breaker is installed with its timing plate (G1 and G2).

(1) Put the dial gauge in the spark plug hole on the L.H. cylinder.

(2) Place the L.H. piston at 3.45mm (in) before TOP DEAD CENTER by turning the crankshaft with a wrench applying on the fitting bolt A.
To start with, find the TOP DEAD CENTER of the L.H. cylinder then be sure to turn the crankshaft in the direction engine turns and stop it when the dial gauge reads 3.45mm before TDC, that is, 25 degree before TDC.
Where the contact breaker must begin to open.

(3) Loosen the fitting screws H to turn the base S left or right and adjust the contact breaker to be about to open (so it begins to open).
Base S can be moved by prying with a screw driver applying to the slit. Be sure to tighten the fitting screw after adjusting.
Turning the base S in the direction engine turns makes the ignition timing earlier and turning the base S reversely makes it later.

After adjusting the L.H. cylinder ignition timing, the timing pointer T must be aligned to the mark L which stands for L.H. cylinder ignition timing.

Timing pointer T can be easily corrected by loosening its fitting screw and retightening it.

R.H. cylinder and Center cylinder ignition timing can be adjusted in the following order.

Align the mark R or C on the timer M to the timing pointer T which is already adjusted at 25° degree before TDC.

Loosen fitting screws N to move the timing plate G and adjust the contact breaker to be about to open.

Turning the timing plate in the direction engine turns makes the timing earlier. After adjusting the ignition timings of the three cylinders, check if the contact breaker will begin to open exactly when the mark on the timer aligns to the ignition pointer T.

(ii) point gap adjustment

Point gap can be easily adjusted by moving contact breaker base. First, turn the crankshaft to left or right with a wrench applying to the armature fitting bolt and find the crankshaft position where maximum point gap can be obtained.

Loosen screw D1 to move contact breaker base B1 and adjust the gap to about 0.3mm – 0.4mm (0.012 – 0.016 in) by moving contact breaker base B1 to left or right without turning the crankshaft any more. Use the feeler gauge to adjust the gap exactly.

The contact breaker base can be easily moved by prying the slit E1 with a screw driver.

Turning the contact breaker base B1 to the direction engine turns increases the gap and turning it reversely decreases the gap.

Be sure to tighten the fitting screw D1 after adjusting the gap. That is how to adjust the point gap of the L.H. cylinder contact breaker.

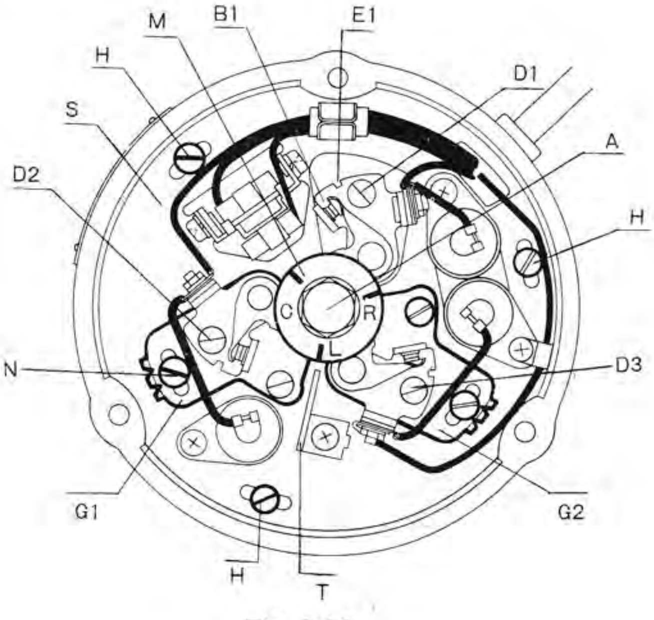


Fig. 5-33

Center cylinder and R.H. cylinder contact breaker C and R can be also adjusted in the same way as L.H. cylinder contact breaker.

After finding out the crankshaft position at where the maximum point gap is obtained adjust the gap to 0.3 – 0.4mm holding the crankshaft at that position by loosening fitting screw D2 or D3.

2) CD ignition system

The former ignition method is called contact method, where high voltage is generated in an ignition coil by switching the point. On the other hand, this CD ignition method (condenser discharge igniter) is a no-contact type CD (condenser discharge) ignition method.

a. Features of the CD ignition method

(1) Since no contact is used, there is neither dirtying nor abrading of a point. Once the ignition timing is accurately set, no inspection is required for it. Even in high speed rotation, power reduction due to the chatter of a point is prevented.

(2) Since there is no point or problem with it, electrical energy in the primary circuit of the ignition coil can be increased and the plug can be provided with strong sparks.

(3) By increasing spark energy, the surface gap spark plug can be put to use.

(4) Uniformly strong spark energy can be obtained regardless engine speed.

(5) Refer to APPENDIX-I for the structural features of the surface conduction spark plug.

b. Operation of the CD ignition (Refer to SM-2A for details)

The ignition circuit is shown in Fig. 5-34. It can be broadly divided into the ignition position detecting device, boosting transformer and spark circuit.

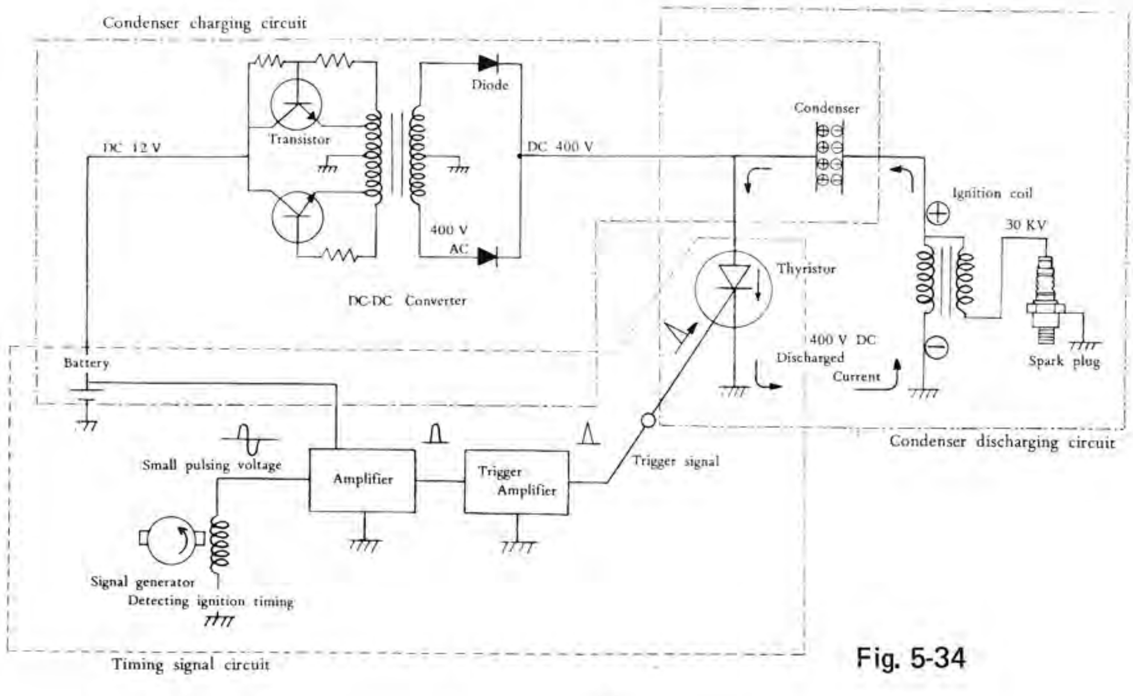


Fig. 5-34

(1) Ignition position detecting device

Just as in the case of a magnetic steel type AC generator, a permanent magnet turns inside the coil. When the coil crosses the magnetic flux, electricity is generated in the coil. This is the signal to spark. This apparatus is called a signal generator (SG). Since the voltage which is generated by the S.G is low, it is sent to the amplifier. However, this wave form has a round top so that it is not suitable for the transmission of a signal in terms of wave form. It is sent to a shaping circuit and reformed into a sharp wave. In this way, the signal to determine the ignition timing is prepared.

(2) Boosting transformer

The DC 12V from the battery is increased to 400V, by the boosting transformer. To increase the voltage, direct current has to be converted to direct current through the silicon diode and charged in the condenser.

(3) Spark circuit

Since the voltage of the condenser is 400V, as stated in (2), and the signal for ignition timing is completed with the wave shaper in (1), these two have to be combined and given a spark. First, the signal is sent to the semiconductor switch (thyristor) from the wave shaper. Then, the voltage of 400V which is charged in the condenser suddenly flows in the direction of the arrow and passes the primary side of the ignition coil. In the secondary coil, a high voltage of 30kV is generated due to mutual induction. Thus, a strong spark is given to the plug.

c. Ignition timing adjustment of the A series CD ignition

The ignition timing signal generator (S.G) is installed in the AC generator. Fig. 5-35 shows the structure.

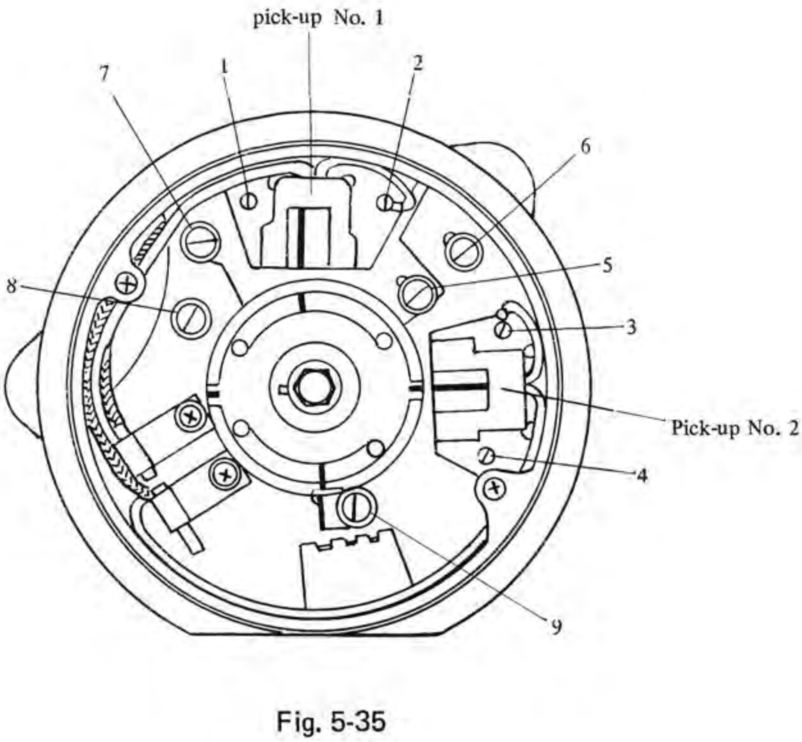


Fig. 5-35

(1) Gap adjustment

Loosening the fitting screws (1), (2), (3) and (4) in the No. 1 pick-up and the No. 2 pick-up, adjust the pick-ups in vertical directions so that there is a gap between the projection of the S.G rotor and the respective pick-ups. Fasten the fitting screws (1), (2), (3) and (4) after adjustment.

(2) Ignition timing adjustment

. Adjust the center of the pointer to the stamped line of the SG rotor (not in the projection) and fix the SG rotor as it is.

. Next, loosen the fitting screws (5), (8) and (9) on the SG plate, insert the (–) driver between the screw (9) and the projection of the SG plate and move the plate so that the stamped line of the projection of the rotor may be adjusted to the stamped line of the secondary pick-up. When they coincide, fasten the fitting screws (5), (8) and (9) in the SG plate.

. In order to adjust the primary pick-up, turn the rotor to the left by 90°, adjust the stamped line (in the projection) to the center of the pointer; loosen and adjust the fitting screws (6) and (7) in the primary pick-up so that the stamped line of the primary pick-up will coincide with the stamped line of the rotor. When they coincide, fasten the fitting screws (6) and (7). Thus, the ignition time is finally set at 25° before the upper dead point.

(3) When the dynamo is changed or entirely disassembled, the position of the pointer sides. Adjust it according to the following procedure.

. Inserting the dial gauge into the hole in the cylinder head for fitting the spark plug, set the piston to 3.28mm (25°) before the upper dead point. After confirming that the stamped line of the secondary pick-up faces that (in the projection) of the rotor, inspect whether the lowest rotor stamped line is in agreement with that of the pointer. If it is not in agreement with it, dend the top of the pointer with a plier and adjust it.

Thus, the position of the pointer is accurately determined. Then, adjust it according to the (2) ignition timing adjustment method.

. By doing this, the ignition timing adjustment is finished. Since this ignition timing is set to 25° before the upper dead point at 400 rpm in the number of rotations of the engine, set the number of rotations of the engine to 4000 rpm in this case condirming it with timing light.

d. "H" series CD ignition timing adjustment

The ignition timing signal generator (SG) is installed in the AC generator. Fig. 5-37 shows its stricture.

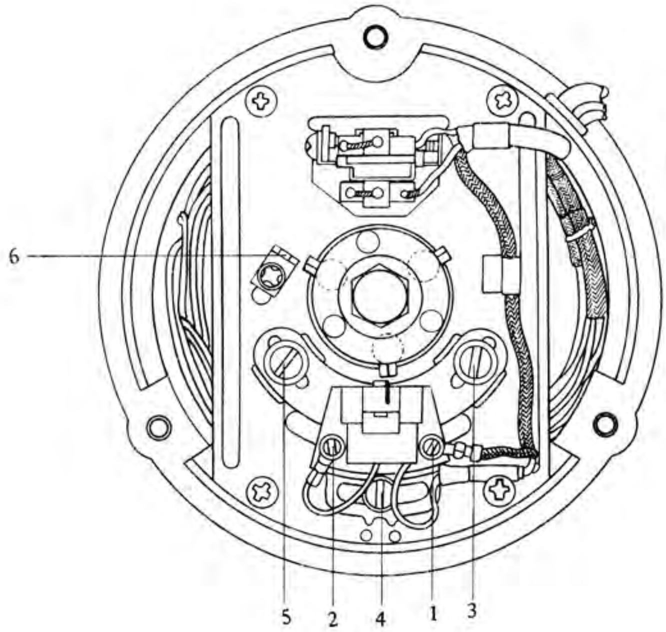


Fig. 5-37

(1) Adjust the gap

Loosening the fitting screws (1) and (2) of the pick-up, adjust the gap between the top of the pick-up and the projection of the SG rotor to 0.4 – 0.6mm and fasten the fitting screws (1) and (2) again.

(2) Adjusting the ignition timing

- Inserting the dial gauge into the hole to fit the spark plug, set the piston to 3.45mm (25) before the upper dead point.
- Loosening the fitting screws, (4) and (5) of the pick-up in this point, adjust the stamped line of the SG rotor to that of the pick-up and fasten the fitting screws (3), (4) and (5).
- Bend the pointer (6) in the above state so that another stamped line of the SG may coincide with the center of the pointer. Thus, the stamped line of the pick-up and the position of the pointer can be determined.

NOTE

In the case of confirming the ignition timing, measure it by adjusting the number of rotations of the engine to 4000 rpm.

In the case of fitting the engine cover, the stamped line of the rotor may sometimes deviate from the center of the timing mark more or less, since distri pinion gear has to be engaged in the distributor gear for setting up. So long as it is within the tolerance (stamped mark) it is satisfactory.

Fig. 5-38

e. Distributor "H series"

The distributor is employed to distribute accurately high voltage power generated in the secondary side of the ignition coil to the ignition plug of each cylinder according to the ignition order.

(1) Structure

The H series igniter consists of the distributor and the ignition position detecting device (which corresponds to the point in the former ignition system and fixed in the AC generator). The rotor in the distributor is turned by the pinion gear. The cap of the distributor is made of synthetic resin, which is excellent in resistance to heat, humidity and high voltage. The number of high voltage terminals is four being larger than that of cylinders by one. One of them is a high voltage cord coming from the ignition coil.

Fig. 5-39

(2) Operation

The rotor of the distributor is turned by the crankshaft, and in the place where it is confronted with the terminal of the high tension cord for ignition, the high voltage electric current passes the rotor end and flows to give a spark at the spark plug.

(3) Adjusting the distributor

When installing the engine cover the rotor angle of the distributor have to be adjusted. (Method of adjustment)

Place the R.H cylinder piston at the top dead center.

Since the timing mark is stamped on the right engine cover as shown in Fig. 5-38, press the rotor by hand so that the stamped line of the rotor may come to its center, and take off the engine cover.

NOTE

The spring which is shown in the figure is fitted to the end of the high tension cord and inserted into the plug gap. In the case of inserting the spring into the plug gap. set the position as shown in Fig. 5-40. Otherwise, the plug top will not be able to enter the plug cap terminal completely.

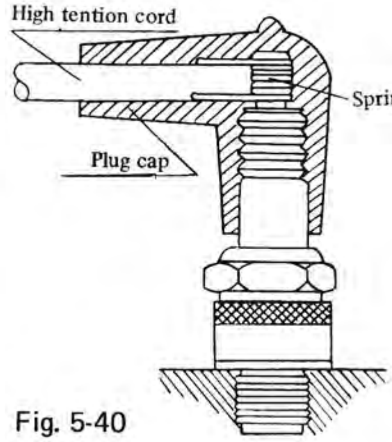


Fig. 5-40

f. Cautions on handling the CD ignition

(1) Take care not to make a mistake in choosing the polarity ((+) (−)) for the wiring of the battery. If the polarity is wrong, a large current flows in the silicon rectifier and damages the wiring in the body as well as the rectifier.

(2) Do not release the connection of the terminal (+) or (−) of the battery during operation. The surge voltage occurs, damages the silicon rectifier or snaps the filament of the lamp. If operation is continued and the rectifier is damaged, charging may be come incomplete.

(3) Pay attention to the connection between respective units.

Wrong wiring, insufficient wiring and no wiring result in incomplete performance the DC ignition or cause problems. Expecially in the case of wiring connectors, insert them firmly, or the water-proof device cannot be effective.

When running in the rain or washing the body, the starting operation may become difficult.

(4) Make use of the designated battery and ignition coil. Another battery or ignition coil lowers its performance.

(5) Each unit is protected from vibration with rubber. When it has been taken off, be sure to use the designated rubber in the designated place to replace it.

Since the inner part of the unit of each igniter is consolidated with epoxy resin to prevent the wiring from being snapped due to vibration, it cannot be disassembled. Note that even in the claim period, it is not accepted as a claim if it has been disassembled.

g. "A series" C.D ignition test

(1) Only the parts related to the igniter are shown here. The engine may be adversely affected by other systems as well as the igniter system. Begin checking at the simplest part.

Phenomenon	Situation		Cause	Action
The igniter does not work	Pulling the high voltage cord cap of the plug, fit another plug. Observe the spark which is generated at the plug in the case of kicking.	Strong spark	(1) Other systems than the igniter are defective. (2) High voltage distribution is reversed in the right and left sides. (3) The plug is dirty or moist.	(1) Inspect the other systems; (2) Exchange the right and left parts. (3) Inspect the plug.
		Weak spark	(1) The battery voltage is low. (2) The contact in the wiring is defective. (3) Leakage in the high voltage section. (4) The performance of the ignition coil is lowered. (5) The performance of the igniter unit B is lowered.	(1) Measure the voltage. (2) Inspect the wiring. (3) Inspect the high voltage circuit. (4) Inspect the ignition coil. (5) Inspect the unit B
		No spark	(1) The battery is overdis charged. (2) Incomplete wiring (The fuse has burned out.) (3) The ignition coil is defective. (4) The unit A or B is defective. (5) The SG is defective.	(1) Measure the voltage. (2) Inspect the wiring. (3) Inspect the related parts. (4) Inspect the related parts. (5) Inspect the related parts.
	Sparks are generated even without kicking.		(1) The unit A is defective. (2) The unit B is defective.	(1) Inspect the units A and B.

The igniter is hard to start.	Observe the spark of the plug.	Strong spark	(1) Other systems than the igniter system are defective. (2) The plug is dirty or moist. (3) The ignition position is wrong.	(1) Inspect other systems. (2) Inspect the plug. (3) Inspect the ignition position.
		Weak spark	(1) The voltage of the battery is low. (2) The contact in the wiring is not complete. (3) Leakage in the high voltage section. (4) The performance of the ignition coil is lowered. (5) The performance of the igniter unit B is lowered.	(1) Measure the voltage. (2) Confirm the wiring (3) Inspect the high voltage circuit. (4) Inspect the related parts. (5) Inspect the related parts.
		Sparks are generated only in one side.	(1) The wiring is not complate. (2) The ignition coil is defective. (3) The igniter unit A is defective.	(1) Inspect the wiring (2) Inspect the related parts. (3) Inspect the related parts.
The power is decreased.	Observe the spark of the plug.	Strong spark	(1) Other systems than the igniter system are defective. (2) The plug is dirty. (3) The ignition position is wrong.	(1) Inspect other systems. (2) Inspect the plug. (3) Inspect the ignition position.
		Sparks are generated only in one one side.	(1) The wiring is not complete. (2) The ignition coil is defective. (3) The igniter unit (A) is defective.	(1) Inspect the wiring (2) Inspect the related parts. (3) Inspect the related parts.
			(1) Other systems than the igniter system are defective. (2) The plug is dirty. (3) The igniter unit A or B is defective.	(1) Inspect other systems. (2) Inspect the plug. (3) Inspect the igniter unit.

(2) How to check the CD igniter

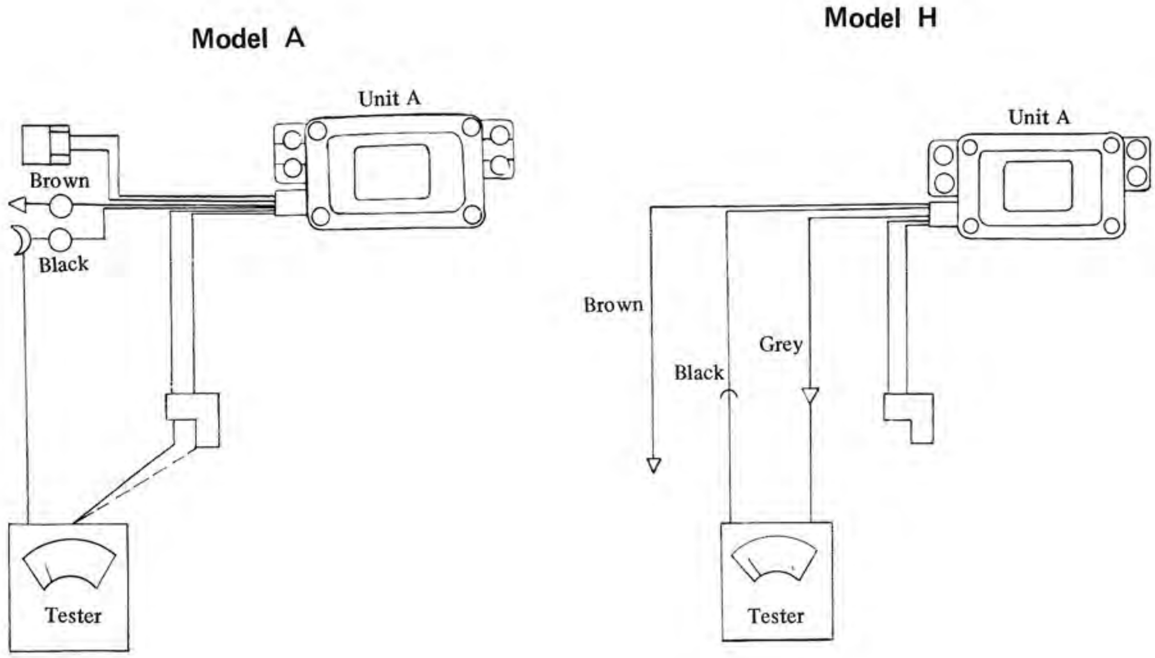


Fig. 5-41

Where to measure	Normal value
When connecting the black leading wire to (+) and the green or grey to (−)	Infinite resistance
When connecting the black leading wire to (−), and the green or grey to (+)	Infinite resistance

Applying (+) 12V (12 – 12.5V) to the brown leading wire, measure the current and volrage in the case of grounding the black leading wire.

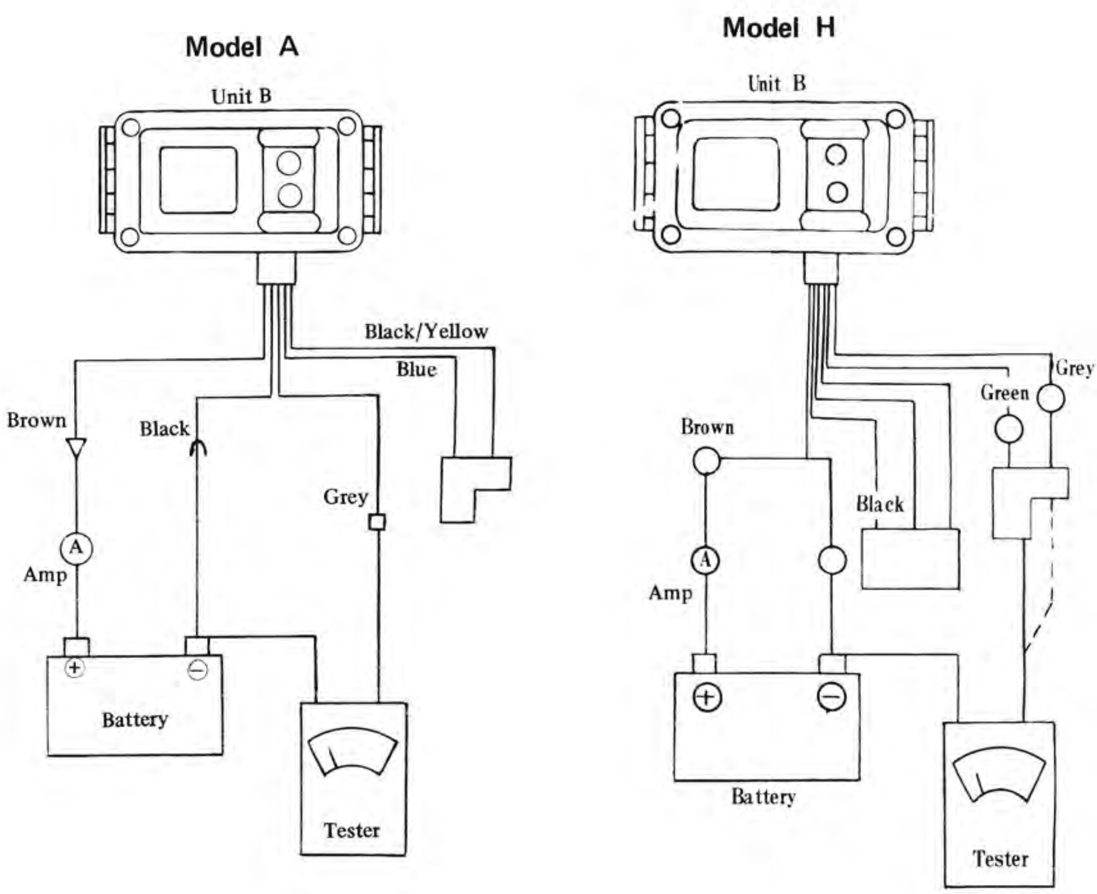


Fig. 5-42

Where to measure	Normal value
Response of the ammeter (A) (DC)	1.8+0.5A The indicator will not fluctuate.
Voltage (DC) between the green leading wire or grey leading wire and the ground.	370 – 500V

It is normal that the unit sounds "to––" continuously as a dial tone.

Measure the voltage and current, applying (+) 12V to the units A and B and the black leading wire to the ground.

(3) Couple check of the good ware with checks (1) and (2)

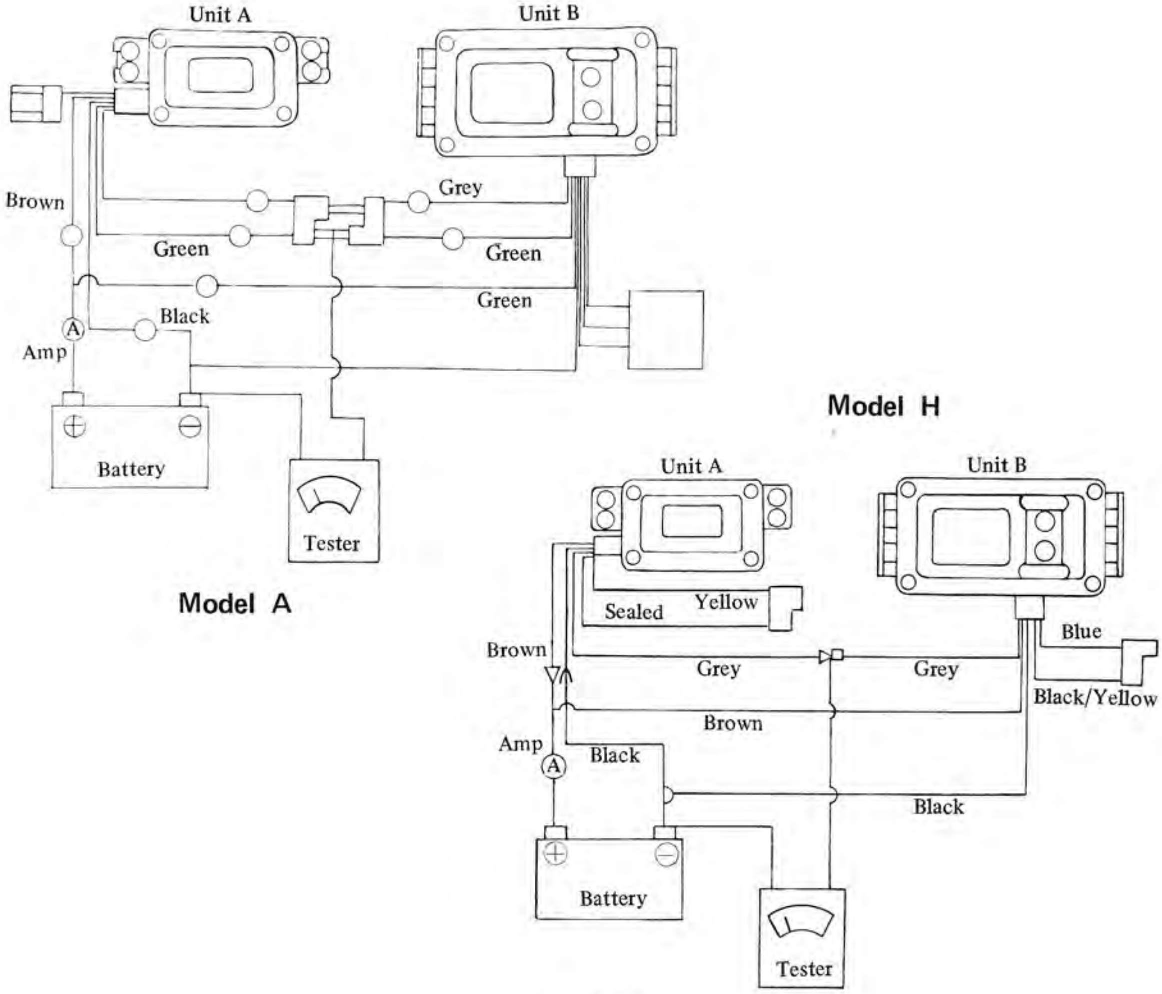


Fig. 5-43

"Judgement" If neither normal value nor continous dial tone appears, the unit A is defective.

The above procedure is a simple method of checking the CD igniter. Although it can be judged in this way, the wave form has to be observed for more accurate judgement by combining the SG units A, B and ignition coil as in the case of the actual unit and using a syncgroscope, etc.

SM-2A

SERVICE MANUAL

SUPPLEMENT

Capacitor Discharge Ignition System

KAWASAKI HEAVY INDUSTRIES, LTD.

This publication supplements 250A1·350A7 Service manual, dated 1, Apr. 1969

Contents

ELECTRICAL EQUIPMENT

I C-D ignition system

1. Why adopted the capacitor discharge ignition system?

To answer this question we'll have to briefly review the problems of high powered engines.

In recent years, Kawasaki motorcycles have been developed so that they give high performances. They are equipped with engines which produce high power from small displacements. Naturally, these high powered engines demand more accurate and frequent adjustments to attain good peak performances. Overheat and preignition are big problems for these high powered engines which are characterized by high compression ratios, fast engine rotation and high maximum speed.

Overheat and preignition are big problems

Fig. 1

※ How Kawasaki solved these two big problems.

These engines will work normally when cold type spark plugs are used. The cold type plug, as you already know, discharges heat rapidly thereby it avoiding hot spots around the plug tip.

However, because the cold type plugs can be cooled off easily, they are, on the other hand, liable to foul during low engine speed situations. Therefore, these high power engines require an ignition system strong enough to produce sufficient firing spark and yet operate without fouling at low engine speeds.

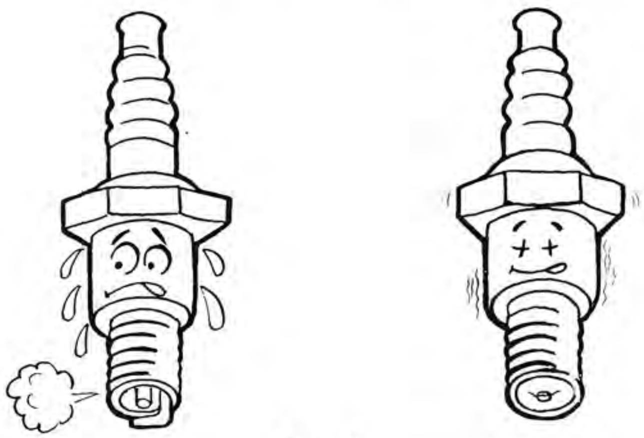


Fig. 2

The Kawasaki C-D ignition system is one of the most important break-through in the basic design of the ignition system in high power engines.

It is one of the most advanced features in racing machines and only Kawasaki has been successful in adopting this sophisticated device to mass production.

free from troubles with CD ignition

Fig. 3

2 Characteristic of C-D (Capacitor Discharge) ignition system

With this C-D ignition system, Kawasaki Avenger Model A7 and A7SS engines have been redesigned to obtain maximum performance at any speed range, free from plug fouling, overheat and preignition.

Another positive factor in this C-D ignition system is that neither contact breaker points nor other moving parts are used in the circuit.

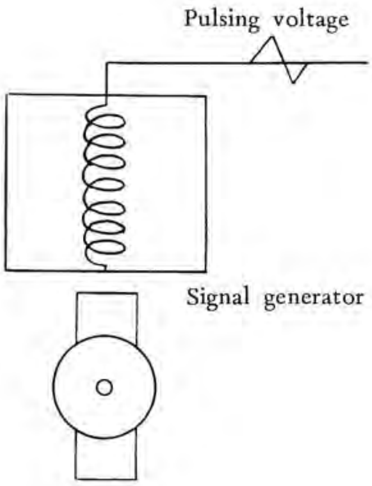


Fig. 4

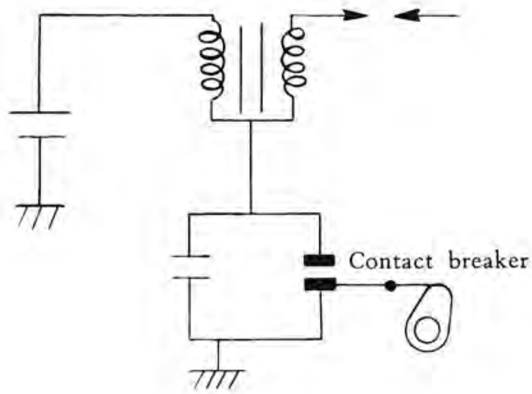


Fig. 5

The C-D ignition system has eliminated frequent checks and adjustments that were needed in coventional ignition systems.

In this system, ignition timing is detected electrically and converted into a pulsing voltage, which is transmitted to the next stage as an ignition timing signal. Therefore, ignition timing in this system is entirely free from the deviation which occurs due to worn, fouled or fluttering points in the conventional contact breaker system.

The C-D ignition system is practically maintenance free as far as the ignition timing is concerned.

3 Function

In short, the C-D ignition system charges the condensers with a high voltage DC and makes them discharge in a fraction of a second into the ignition coils, providing an ultra strong spark for the engines.

The schematic diagram given here shows the C-D ignition system including the battery as an electrical source.

The C-D ignition system can be roughly divided into three sections according to its functions, which are indicated with dotted lines in the schematic.

They are the condenser charging circuit, the timing signal circuit and the conderser discharging circuit.

1) Condenser charging circuit

The condenser charging circuit contains the battery, a DC-DC converter and condensers. The DC-DC converter, which consists of a primary windings with a pair of transistors and a secondary coil with two silicon diodes, boosts the voltage supplied from the battery up to 400 V DC for charging the condensers sufficiently.

The 12 V battery DC is connected to the primary windings of the DC-DC converter. But before it actually flows into them, it is changed into 12 V alternating current with a pair of transistors connected to the two ends of the primary windings.

This 12 V alternating current flowing through the primary windings actuates the transformer in this converter to induce a much higher voltage in the secondary windings. Induced voltage attains approximately 400 V AC.

However, since the condensers require DC voltage, this 400 V alternating current must be converted again into direct current before it is charged into the condensers. Two silicon diodes connected to the output end of the converter do the job.

Thus, the 0.8 μF condensers are charged full with 400 V direct current. Briefly, that is the condenser charging circuit.

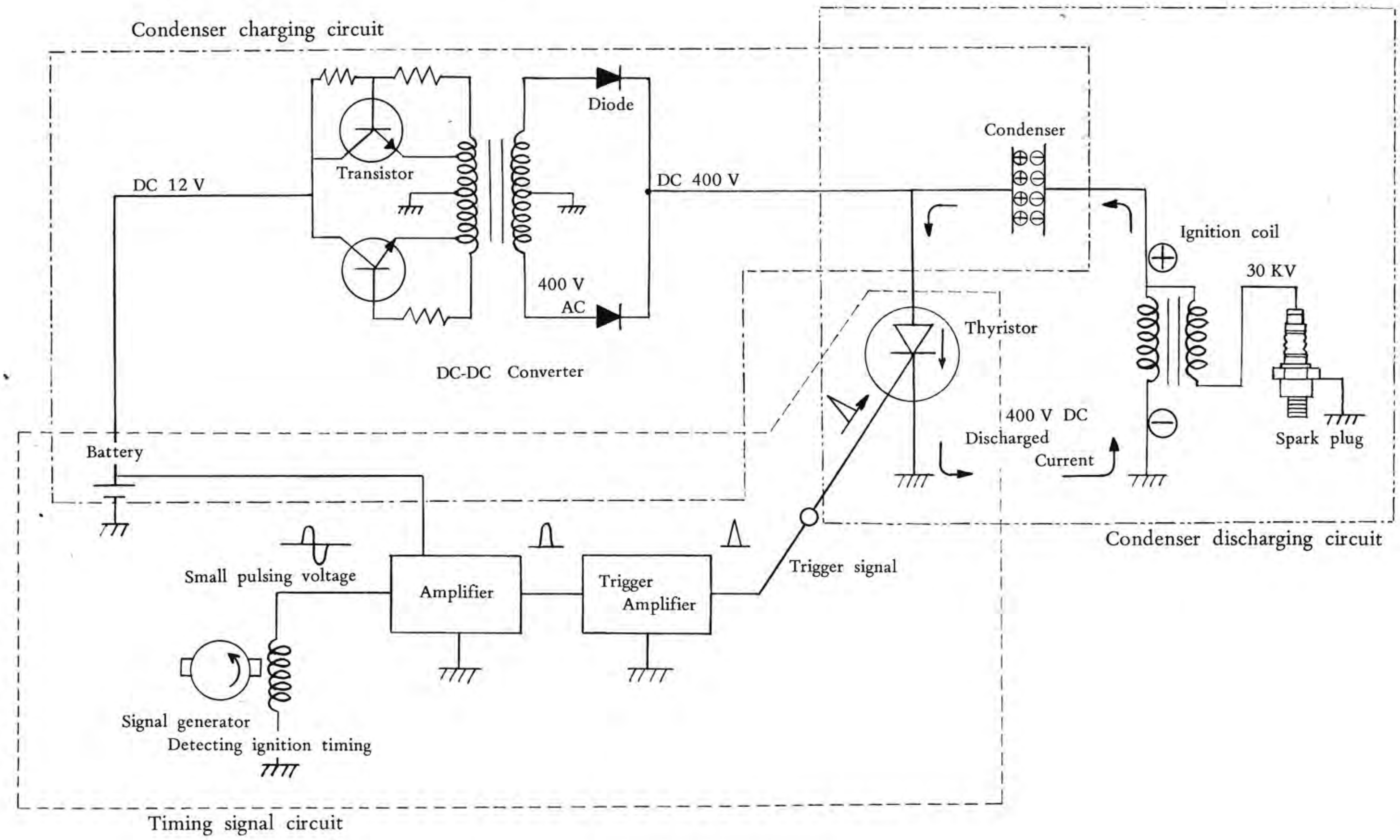


Fig. 6 *C-D ignition schematic diagram*

Note:

Transistors and diodes used in the DC-DC converter are generally called semi-conductor. They work as an electrical switching device and yet they have no moving part.

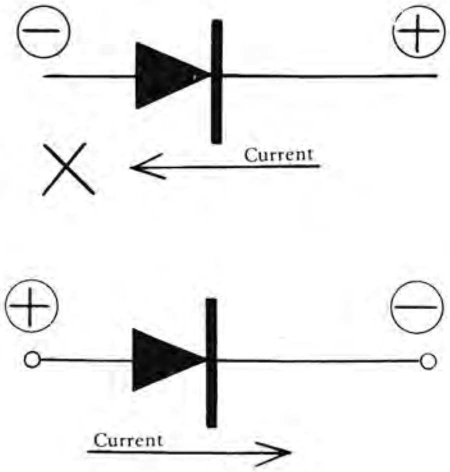


Fig. 7

The diode allows the current to flow through it only one direction but stops the current in the opposite direction. This function can be compared with a non-return valve. That is why a diode is generally used as a rectifier. In addition, it eliminates the need for a cut-out relay in the regulator when it is used in the battery charging system as it prevents reverse flow automatically.

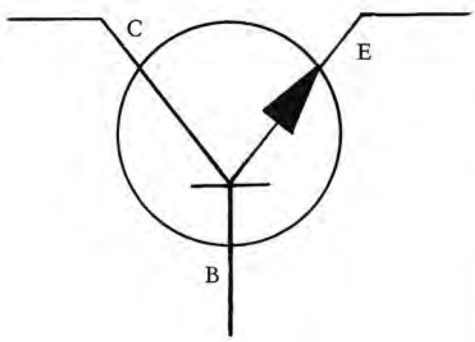


Fig. 8

The transistor, as illustrated here, has three electrical connections and acts as one-way switch. A small electric current given to the base actuates the transistor to permit the current flow in one direction, that is, the direction to the emitter from the collector as indicated with the arrow mark. When this small trigger current to the base is stopped, the larger current flowing through can also be stopped. The quantity of the flow depends on a size of this small trigger current.

Thus, a transistor can be used with a small current to control the flow of a larger current. A pair of transistors used for converting the 12 V DC to 12 V AC in the primary windings of the DC-DC converter works as the vibrator.

2) Timing signal circuit

This stage contains the signal generator, the amplifier and the trigger amplifier. It is generally known that the electric current is induced in a coil when it moves across the magnetic flux according to the magnetism principle.

The signal generator is developed from above principle to detect the ignition timing electrically.

The signal generator consists of a magnet attached to the generator rotor shaft and the two inducing coils which are attached to the generator housing end as shown in the fig. 9.

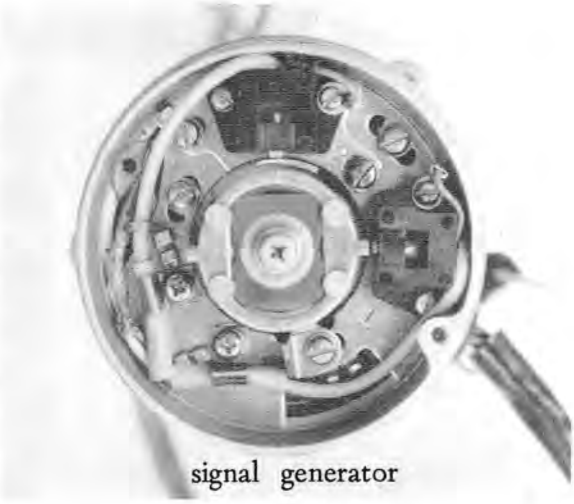


Fig. 9

The magnet and coils of this signal generator are placed in the same manner as the rotating field and armature in the AC generator. They are timed to align at the specified ignition timing. Therefore, when the signal generator magnet on the rotor shaft passes by one of the inducing coil, a small electrical pulsing is created which is in turn used as an electrical ignition timing signal.

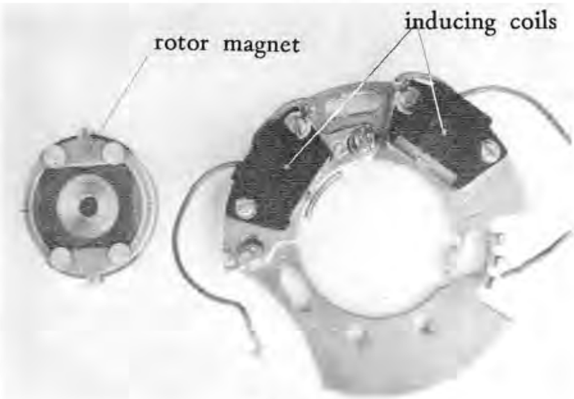


Fig. 10

This small pulsing current is obviously of low voltage so that it is necessary to boost it up to a higher voltage by using an amplifier.

After amplified, the pulse is immediately lead into another amplifier generally called trigger amplifier, where the pulse is adjusted to suitable pulsing wave as a signal, before going into the final stage.

Now, the ignition timing signal is sent, and the condenser is fully charged with 400 V DC. Both are ready for the firing at this stage.

3) Condenser discharging circuit

The final phase of this ignition system is the firing stage. It consists of the condensers, thyristor (silicon controlled rectifier) and the ignition coil including the spark plugs.

The final stage begins to work with the signal sent to the thyristor from the trigger amplifier.

The thyristor, which is also one of the semi-conductor, has a peculiar property not to allow the current to pass through it, while it is in a normal condition. But, when a certain signal is sent to the thyristor, it allows the current to pass through it. This function can be compared with the transistor. However, the thyristor, when once it is actuated with a small trigger signal, allows the current to flow through until the electric source is exhausted. In other word, the thyristor does not stop the current from flowing, if the signal is removed.

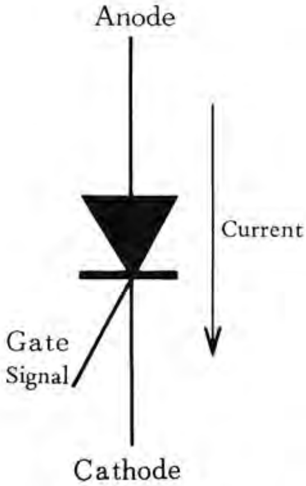


Fig. 11

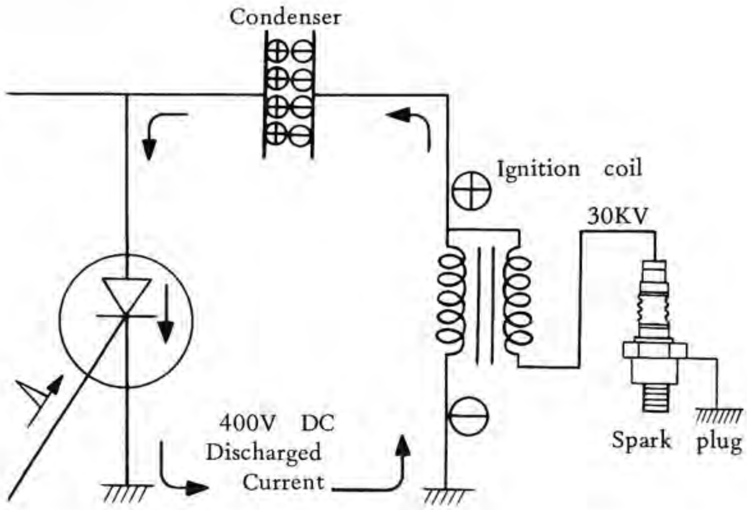


Fig. 12

Thus, the thyristor opens its gate with the signal sent from the trigger amplifier and allows the condensers to discharge the 400 V DC accumulated inside which results in setting up the circuit around the condensers, the thyristor and the primary windings of the ignition coil in a fraction of a second, in the direction indicated with arrows in fig. 12

Resulting from the above circuit, a high tension current about 30KV is induced in the secondary windings of the ignition coil, which is discharged inside the cylinder as a strong spark at the firing end of the spark plug.

30KV is an extremly high voltage to discharge at the spark plug for an ordinary ignition systems, but in this C-D system with the surface gap firing spark plug, 30KV results in a strong spark which insures good peak performance at all speed ranges.

The most important characteristic of this system is found in the high tension current induced in the ignition coil which is considerably higher than an ordinary ignition system.

Following diagram indicates the difference of the high tension current for the spark plug between the two ignition systems: conventional one is shown with dotted line.

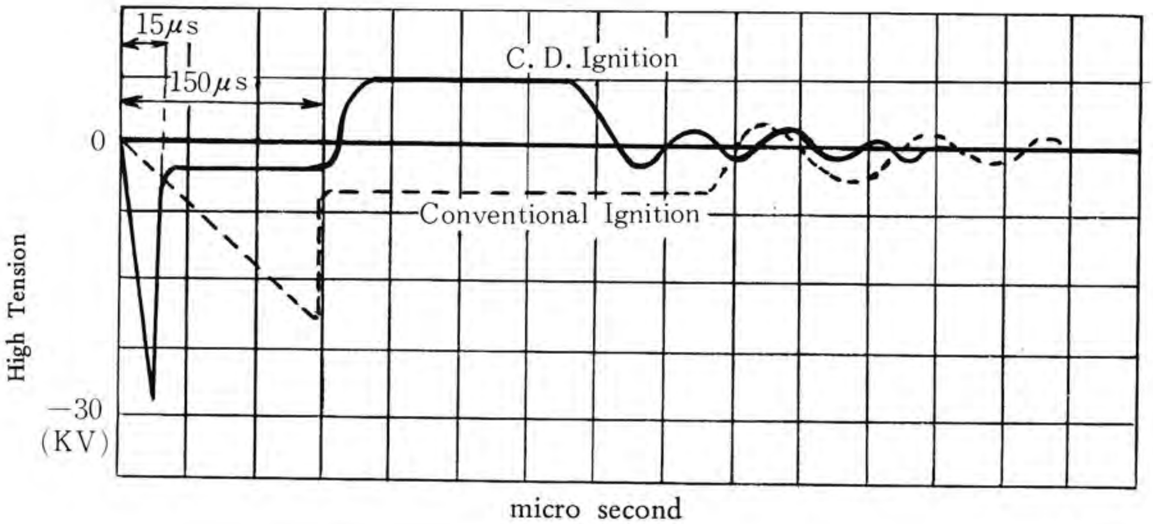


Fig. 13 - 1

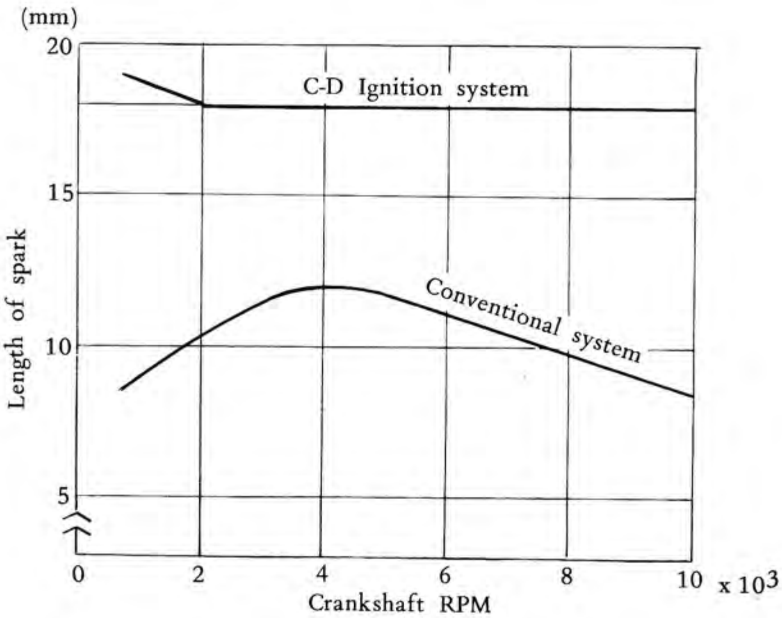


Fig. 13 - 2

4) Inspecting and servicing

1. When connecting the battery, be sure the terminals are correctly connected. Because if the terminals are connected reversely, the semi-conductors such as transistors, and thyristor in this system will be seriously damaged. (Fig. 14)
2. When replacing the battery and/or ignition coil, use only genuine Kawasaki parts to insure good performance of the ignition system.

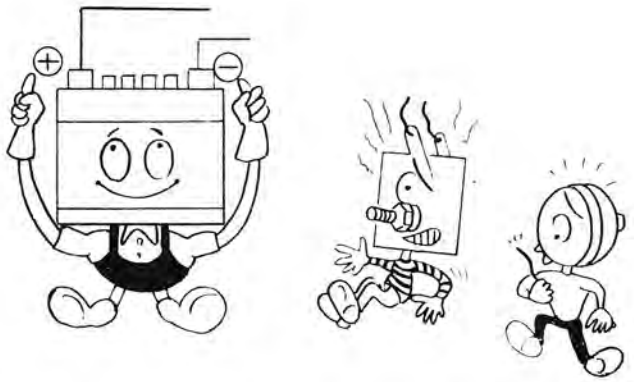


Fig. 14

3. Each unit of the C-D ignition system is cemented with a certain resin and it cannot be disassembled. (Fig. 15)
4. When installing the C-D unit, don't forget to use damper rubbers to protect it from vibration.

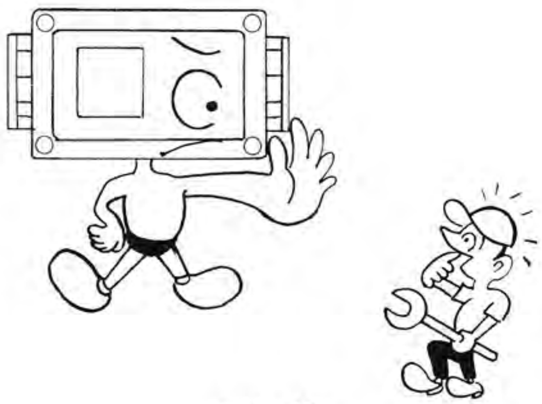


Fig. 15

5. Check to be sure that the main switch is turned off before working on the ignition system, because 400 Volt is being used in this system. (Fig. 16)

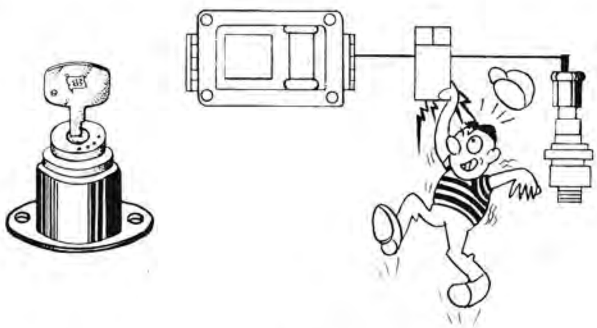


Fig. 16

II AC Generator

1. General

Electricity for the electrical equipment such as the charging system, the lighting system and the C-D ignition system is produced in a generator.

To begin with the electrical equipment of the model A7, let us briefly review how the electricity is generated.

When you place a magnet under a paper on which iron powder is scattered, the iron powder forms a pattern as illustrated here, that indicates graphically the passage of the magnetic flux, where the magnetic field lies. When a wire moves across these passages of the megnetic flux, electric current is induced in the wire. The direction of flow depends on which way the wire moves to cross the magnetic flux.

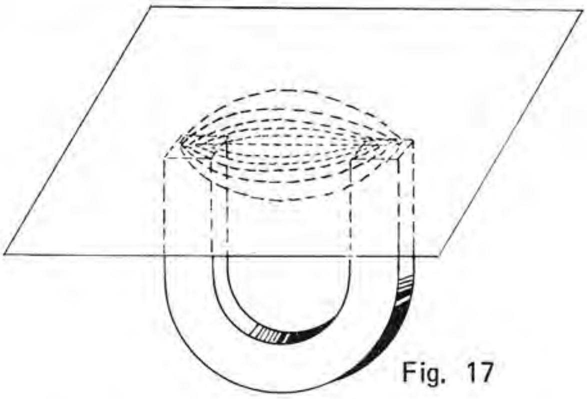


Fig. 17

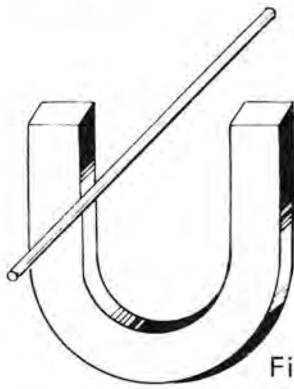


Fig. 18

The AC generator is designed to produce aternating current according to the characteristic you can see above.

The simplified schematic below shows how the direction of flow alternates in the AC generator.

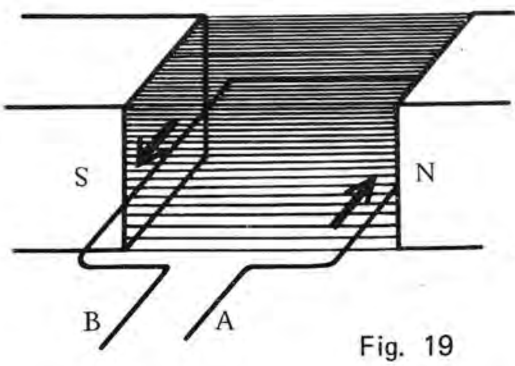


Fig. 19

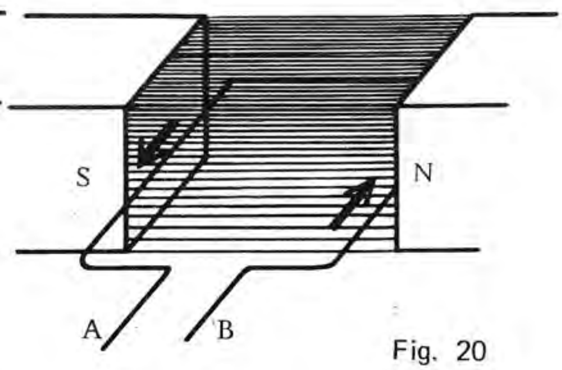


Fig. 20

When the armature coil A-B turns clockwise in the magnetic field between the field N and S, induced current flows in the direction indicated by the dotted arrows according to the induction principle.

When coil A turns clockwise into the left half of the magnetic field reaching field S, the direction coil A crossing the magnetic flux also turns oppsite, which results in inducing the current flows to the oppsite direction.

Thus the direction of flow changes continously every half turn of the coil: hence alternating current is generated.

The electric current in actual AC generator is usually induced in the windings on the laminated iron core which is described above as "a wire". The actual magnetic field is naturally produced by the magnet, however, in some cases, it is excited by using the windings wound on the iron core, supplying it with the electric current for excitation.

2. function.

The AC generator used in the Model A7;

In a generator, the part that induces the electric current is called armature and the part producing the magnetic field is simply called the field.

The rotor of this generator, which consists of several field pole windings is mounted on ball bearings in the generator housing.

The armature windings are located around the inside of a laminated iron core that forms part of the generator housing.

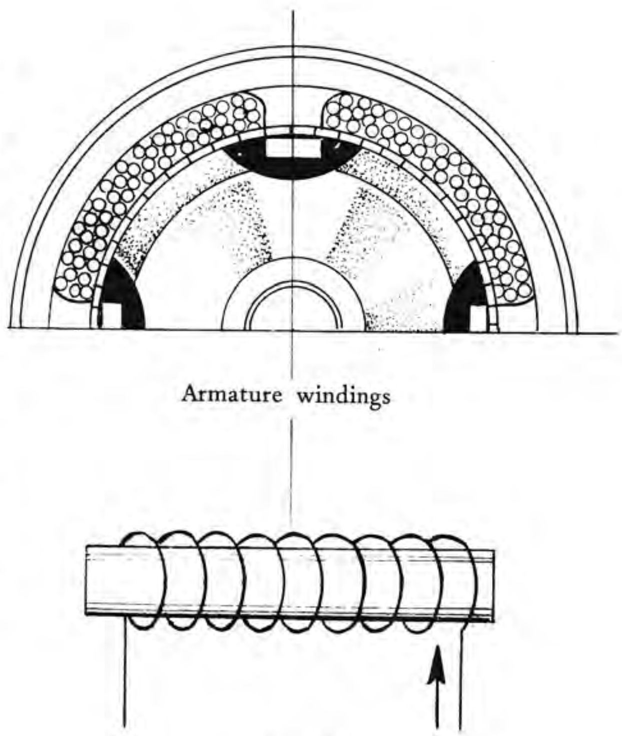


Fig. 21

This rotating field is excited to produce the magnetic field by connection to the battery through the two slip rings on the rotor with a pair of carbon brushes on the housing, that is, through which the field pole windings are supplied with the battery current for excitation.

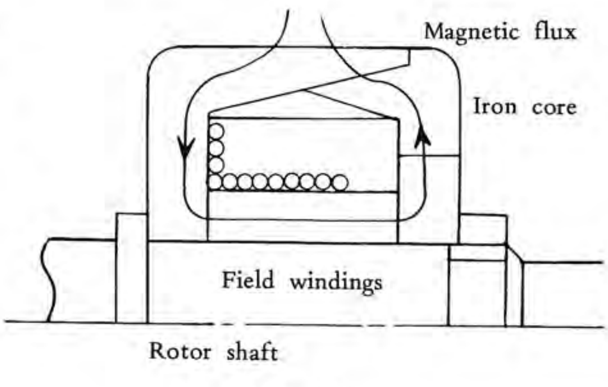


Fig. 22

When the rotary field turns inside the armature, the magnetic flux of the field crosses the stationery armature windings, which results in inducing the electric current in the armature windings as previously stated.

The armature windings are connected to the silicon diodes attached inside the generator housing. The diodes rectify the induced alternating current into direct current before releasing it to each system including the battery.

This diagram shows the actual electrical connection of the AC generator to the battery, the voltage regulator and each unit of the C-D ignition system including the ignition coil.

The armature windings are of three phase star connection, producing three phase alternating current. 9 silicon diodes are needed to completely rectify the induced current into direct current.

The voltage regulator, which is discussed later, is connected between the battery and the field windings on the rotor to control the excitation current.

When the engine increases speed, the rotor of the generator also increases its speed in proportion to the engine speed, which results in increasing the quantity of the magnetic flux passing through the stationery armature windings.

AC Generator & Ignition System

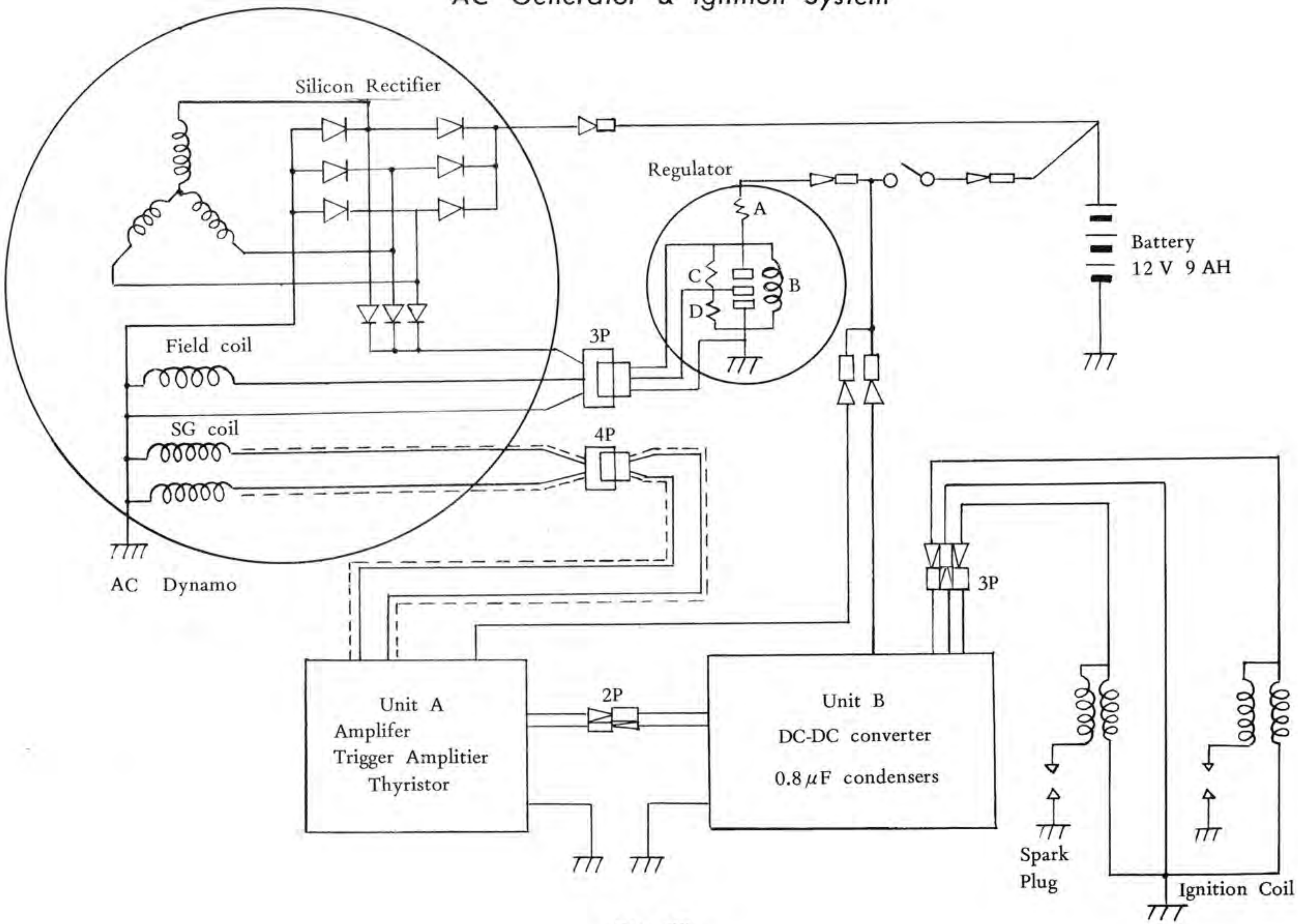


Fig. 23

The induced voltage varies only depending upon the quantity of the magnetic flux stated above, that is, it becomes higher as this quantity increases and lowers as it decreases.

In case the voltage increases, exceeding the limit at which the rest of the electrical equipment is designed to work, the whole electrical system is easily damaged. Sensitive semiconductors such as diodes, transistors and thyristor are the first to go.

To control the induced voltage within the electrical requirement, this quantity of the magnetic flux must also be adjusted and controlled within the specified limit.

The function of a voltage regulator is just that.

3. The voltage regulator

Before discussing the voltage regulator, we have to review how the field is excited.

When the coil wound on the iron core is supplied with electric current, the core is immediately excited to produce the magnetic flux. The quantity depends on the amount of the current supplied.

The rotating field of the A7 generator is designed with the above principle for producing the necessary magnetic flux.

Therefore, the out-put voltage of this generator can be controlled electrically by regulating the amount of excitation current that flows through the rotating field.

For that purpose, the voltage regulator is connected between the battery and the rotating field.

The voltage regulator decreases or cuts off the excitation current for the field whenever the output voltage of the armature coil exceeds 14.5 Volt.

The diagrams used here (Fig. 24, 25 and 26) show how the voltage regulator works.

When the main switch is turned on, the excitation current flows from the battery through Resistance "A" to the Field.

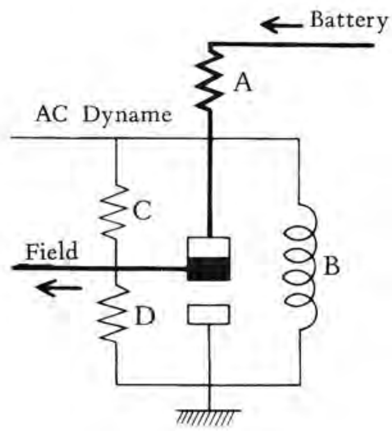


Fig. 24

When the generator increases its speed, the output voltage increases accordingly. When the generator output voltage becomes higher than that of the battery, coil B is excited and it breaks contact pulling the moving point to the midway position between the two stationery contact points. It results in supplying the field directly with the output of the generator through resistence C as long as it does not exceed 14.5 V.

When the output voltage continues to go higher and exceeds 14.5 V, coil B is excited stronger. It results in pulling the moving point further until it reaches a lower stationery point.

As Shown in Fig. 26, the output current aimed to flow into the field is released to the ground through the lower stationary point.

Therefore, no excitation current flows through the field, which results in abruptly decreasing the magnetic flux of the field, and in turn, the output of the generator.

Thus, the output voltage of the generator is constantly adjusted to remain below the specified voltage of 14.5 V.

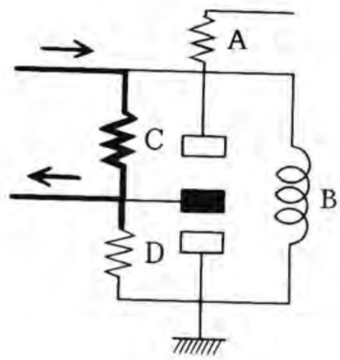


Fig. 25

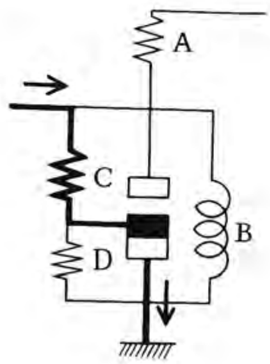


Fig. 26

4. Adjusting ignition timing

a. Inspecting ignition timing

The ignition timings are detected electrically with the signal generator in this ignition system which has, as previously explained, no moving contact.

Therefore, it is usually not necessary to adjust the ignition timing.

Before beginning the adjustment, read through this section and follow the steps in the order given to do it with less trouble and time consumed.

First inspect the ignition timing for the left cylinder.

To begin with inspecting, place the left crankshaft accurately at 25° before top dead center by turning rear wheel, with transmission gears engaged.

Turn the crankshaft until the cut-away end of left rotary disc appears in the inspection hole as illustrated here, which indicates the crankshaft is correctly placed

25° before top dead center.

The plug being screwed in the inspection hole must be removed before adjusting the crankshaft position.

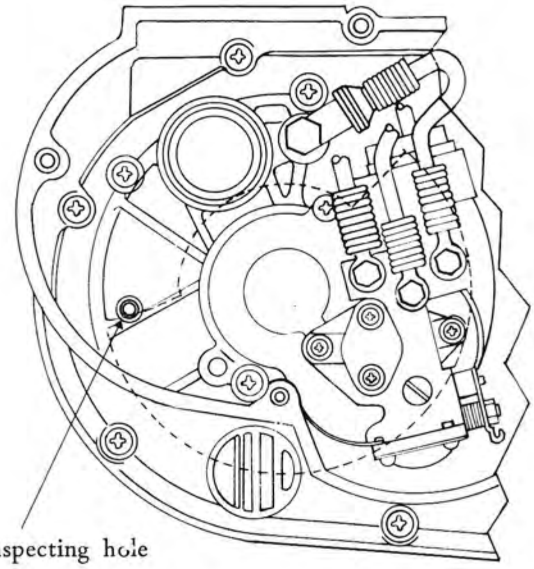


Fig. 27

Check the signal generator for left cylinder ingition timing. In case, timing mark "O" on the rotor is being aligned to mark "T1" on the No. 1 pick-up for the left cylinder, the ignition timing is considered to be not deviated, so it is not needed to be re-adjusted.

In case they are not aligned, the ignition timing must be adjusted following the steps below.

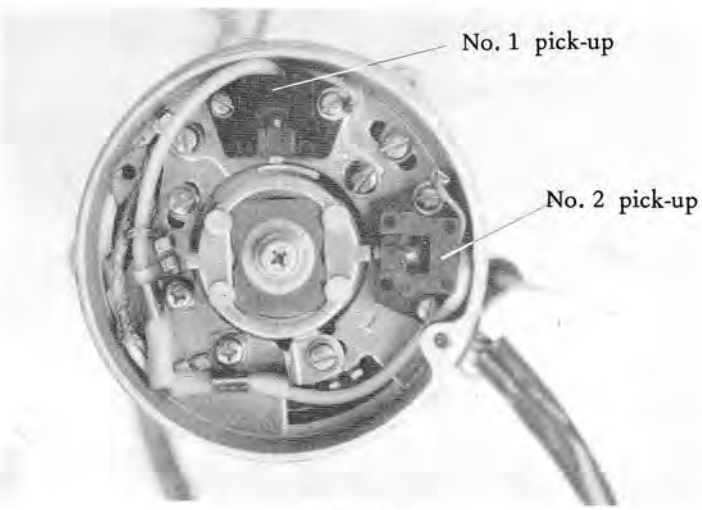


Fig. 28

b. Adjusting ignition timing

To adjust the ignition timing, the right crankshaft must be placed at 25° before top dead center, as in the inspecting left cylinder timing.

The illustration used here shows how to place the crankshaft at 25° before top dead center when ultimate accuracy is called for.

Insert the dial gauge through the spark plug hole in the right cylinder and turn the crankshaft slowly in the direction engine turns until the dial gauge indicates the piston is placed 3.28 mm before top dead center.

Be sure to check the dial gauge tip is securely located and moved smoothly on the piston crown before turning crankshaft.

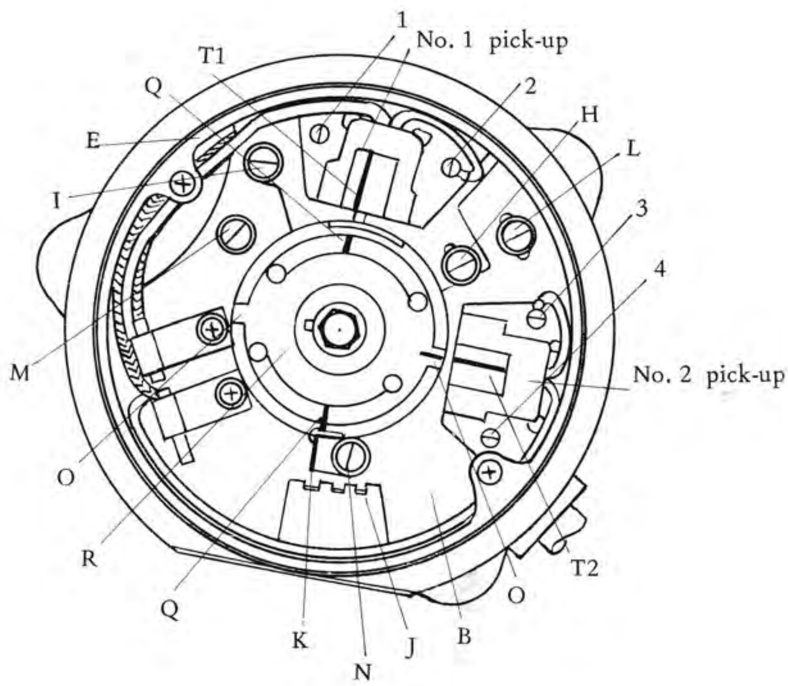


Fig. 29

When the dial gauge reads 3.28 mm, the right crankshaft will be correctly adjusted to 25° before top dead center, to where the right cylinder ignition timing designed to be adjusted.

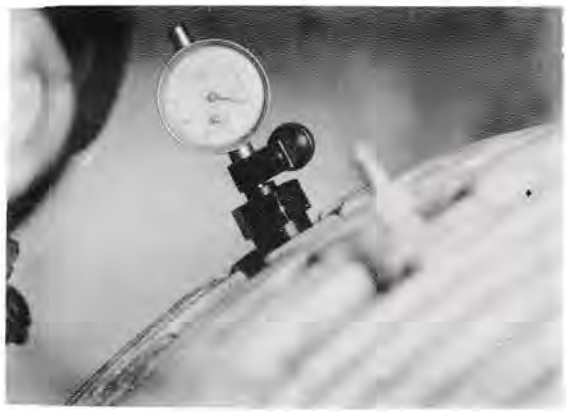


Fig. 30

Loosen the fitting screws L, M and N, then adjust the timing mark "O" to align to the mark T_2 on the No. 2 Pick-up by moving the base plate B to the left or right.

The base plate B can be easily moved by prying the notch J with a screw driver. Be sure to tighten the fitting screws L, M and N securely after adjusting No. 2 Pick-up.

When tightening the fitting screw N, align pointer K to mark Q on the rotor.

If the pointer is being adjusted correctly, the ignition timing can be inspected by aligning it to the mark Q, which eliminates placing the left crankshaft in position as stated in the inspecting procedure.

Next, adjust the ignition timing for the left cylinder aligning mark Q to mark T_1 on the No. 1 pick up as in the procedure of adjusting the right cylinder timing. Adjust the mark T_1 on the No. 1 Pick-up to align the mark Q by moving the pick-up base V, with the fitting screws H and I loosend.

Note: The pick-up base V can easily moved by prying the notch E with a screw driver. Be sure to tighten the fitting screws H and I after adjusting the No. 1 Pick-up.

After adjusting, check to be sure that the mark T_2 on the No. 2 Pick-up aligns to the mark 0 and the mark T_1 on the No. 1 Pick-up to the mark Q when the mark Q aligns to the pointer K.

If these points are exactly right, ignition timing will be correctly adjusted to 25° before top dead center.

Note: Brush off the signal generator rotor and the Pick-ups clean after adjusting.

Standard gap G between rotor magnet and the pick-up is specified to be 0.3-0.4mm for A series and 0.5-0.6mm for H series.

This gap can be easily adjusted by loosening the screws 1, 2, 3 and 4.

When adjusting the ignition timing, the gap must be also checked and corrected.

Caution:

This ignition system does not produce spark at the firing and of spark plugs until engine attains approximately 500 rpm.

To check ignition timing after adjusting, use the strobe light when engine attains 4,000 rpm, at where the ignition timing is designed to be 25° before top dead center.

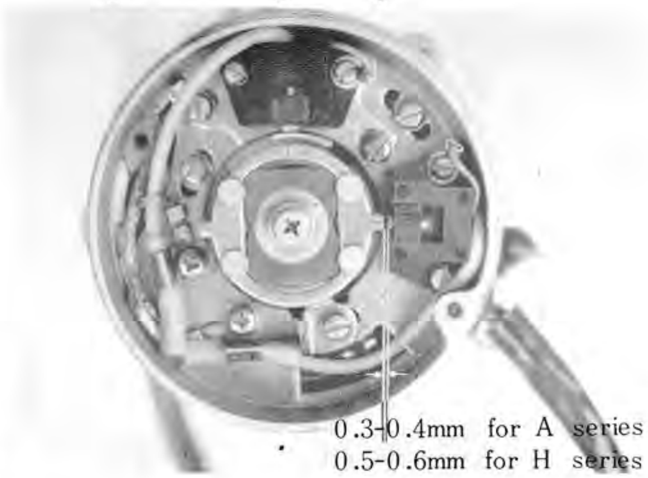


Fig. 31

Ⅲ Surface discharge type spark plug

As explained before, C-D ignition system is designed to give stronger spark than ordinary ignition system. For this reason, a surface discharge type spark plug, which is characterized by wide heat range, is used in this system.

The surface discharge type spark is designed for a high voltage ignition system, in other words, it can be used in wider heat range than a conventional spark plug. It is also effective against tip fouling as well as tip wearing. Under average conditions, it can be used about 5,000 miles. So you can see that there are many advantages for high power engines equipped with this C-D ignition system.

In addition, the center electrode of this spark plug is separated into two parts to obtain a gap called booster gap. It is designed to raise the voltage above the high tension originally supplied from the ignition coil.

The higher the voltage of the high tension current the better it is for obtaining strong spark. It is more effective too, for it burns the firing end of the spark plug clean.

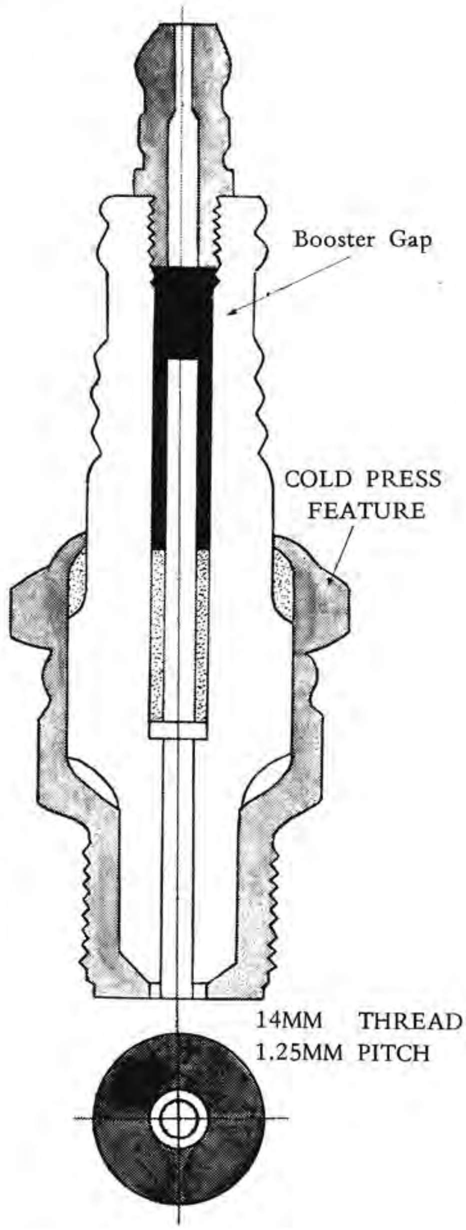


Fig. 32

Ⅳ TROUBLE SHOOTING

The situation of troubles and its causes listed in this section cover the C-D ignition system only. Always refer to the trouble shooting section in the A series Model Shop Manual before starting the repair work to find the cause of trouble quickly.

The basic points of the engine troubles, which in abovementioned shop Manual, are almost common to all A7 models.

Refer to the attached diagrams and instructions for how to check the Ignitor units.

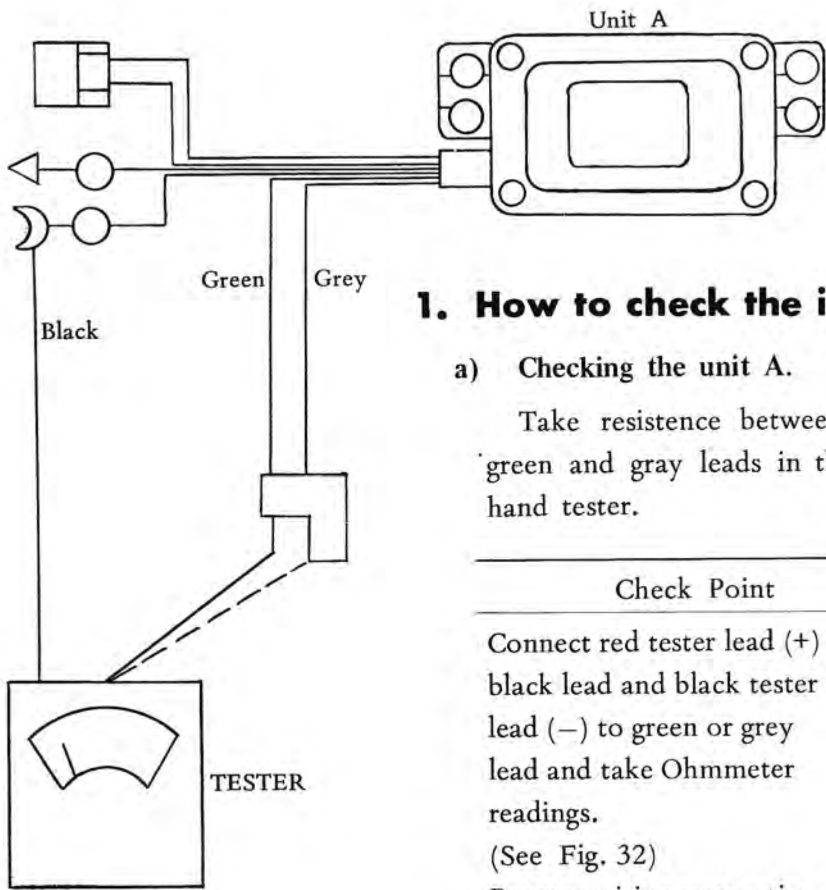


Fig. 33

1. How to check the ignitor units.

a) Checking the unit A.

Take resistence between black lead and green and gray leads in the connector with hand tester.

Check Point	Standard Value
Connect red tester lead (+) to black lead and black tester lead (−) to green or grey lead and take Ohmmeter readings. (See Fig. 32)	infinite
Reverse wiring connection above and take the readings	infinite

b) Checking the unit B.

Take ampare and voltage at the points illustrated in the schematic diagram applying 12 V DC to brown lead, with black lead grounded.

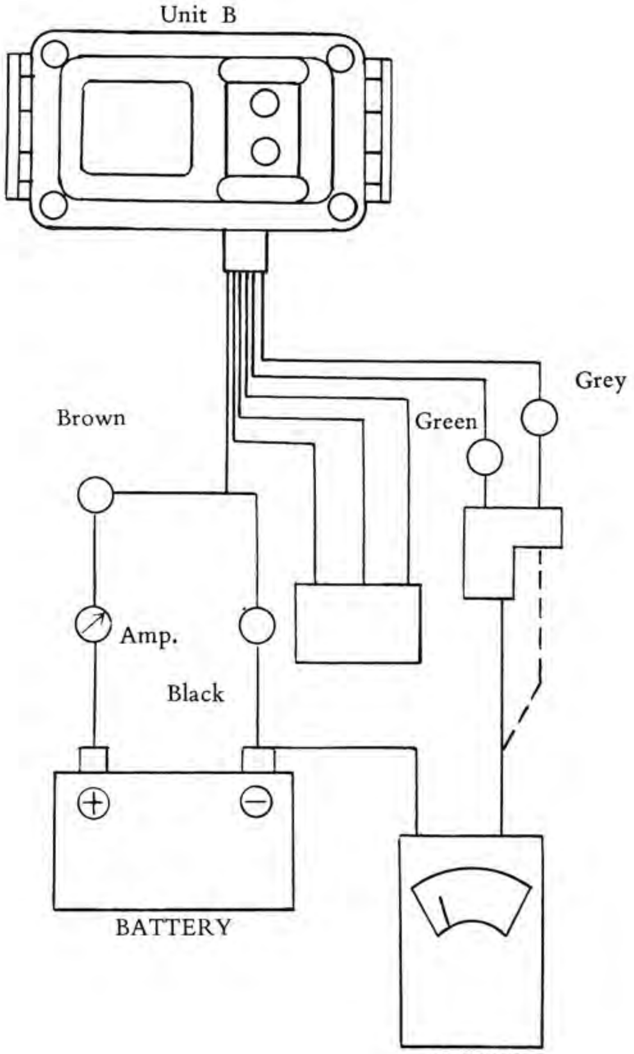


Fig. 34

Check Point	Standard Value
Ammeter (DC) reading	1.8±0.5A No Pointer fluctnation
Voltage (DC) reading	370 ~ 500 V Both green and grey leads

Note: This ignition unit, when in working normal, makes a high frequency sound continuously.

c) **Checking the two units connected.**

Check ampare and voltage as illustrated here in case these two units are separately. proven normal in step (a) and step (b).
In case standard valves and/or continous sound from unit B are not identified unit A is defective.

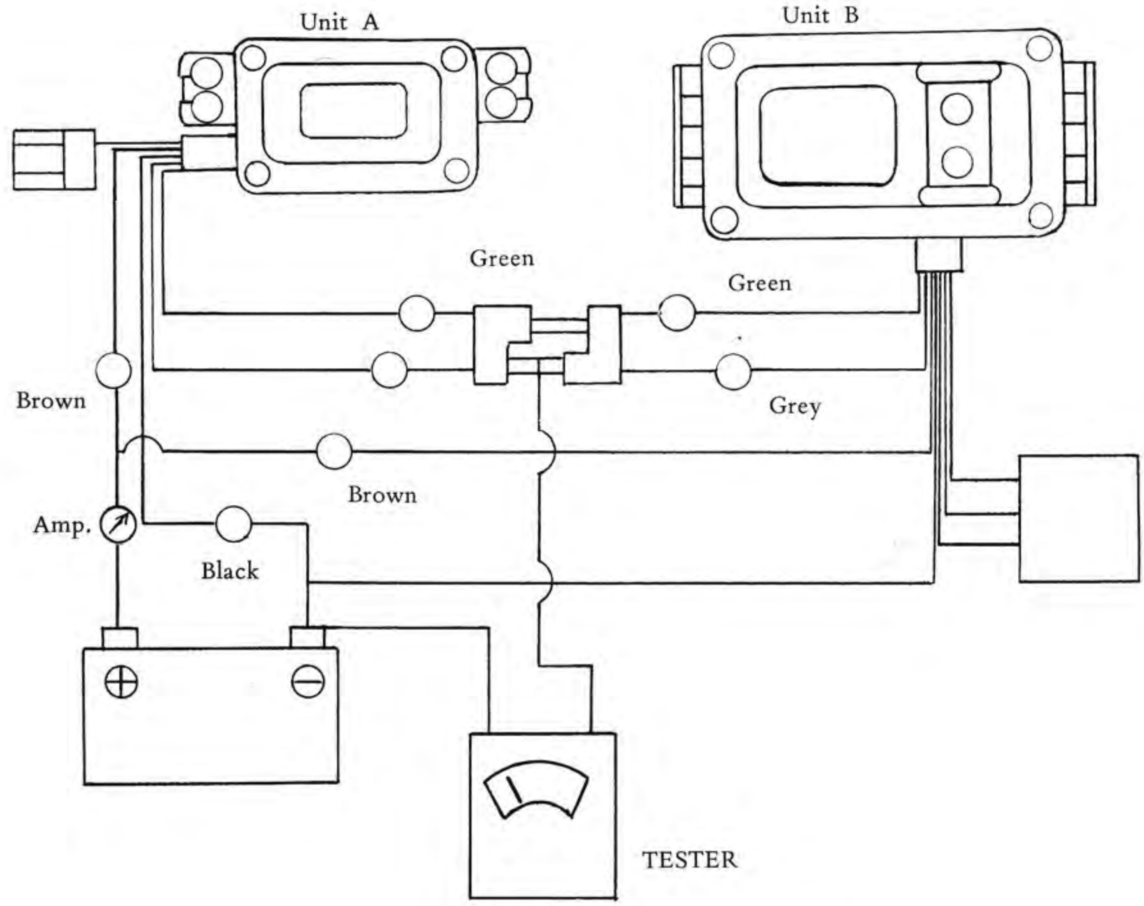


Fig. 35

2. TROUBLE SHOOTING

* Engine does not start.

Situation	Cause	Action
High frequency sound of Unit B is not identified.	Damaged Ignitor unit B Insufficient battery voltage	Replace Charge battery full
Strong sparks jumps in spark plugs	Reversely connected high tension cords	Correct
Weak sparks	Insufficient battery voltage Loose terminal connections High tension leaks Defective ignition coil Defective Ignitor unit B	Charge battery full Connect firmly Check high tension circuit Replace Replace
No spark	Loose or damaged wiring system Damaged ignition coil Damaged Ignitor unit A and/or unit B Damaged Signal generator	Check with tester and repair Replace Replace Replace
Sparks jump without kick	Damaged Ignitor unit A	Replace

* Engine hard to start

Situation	Cause	Action
Strong sparks jump in spark plug	Improper ignition timing	Adjust
Weak sparks	Insufficient battery voltage Loose terminal connections High tension leaks Defective ignition coil Defective ignitor unit B	Charge battery full Connect firmly Check high tension circuit Replace Replace
No spark in left or right engine	Loose or damaged wiring system Damaged ignition coil Defective Ignitor unit A Damaged Signal generator	Check with tester and repair Replace Replace Replace

* Improper performance when riding

Strong sparks jump in spark plugs	Improper ignition system	Adjust
No spark in left to right cylinder	As stated above.	
Misfiring	Damaged spark plugs Defective Ignitor unit A and/or unit B	Check and replace Replace

SERVICE MANUAL

APPENDIX- 1 SPARK PLUG

KAWASAKI HEAVY INDUSTRIES, LTD.

SERVICE MANUAL

APPENDIX-1 SPARK PLUG

CONTENTS

1. Construction of spark plug (Fig. 1)

Fig. 1

2. Function of spark plug

1) General

Spark plug is one of the most important parts of the engine and is largely responsible for the operation. High voltage spark of the plug generated by ignition coil or magneto ignities the previously compressed mixture gas.

2) Necessary function

a. CURRENT; Electric current flows through the shortest way, and always tries to spark out of spark gap. At normal temperature electric insulating character of insulation is sufficient, But at high temperature this character decreases. Therefore it is needed high insulation material which is hard to decrease its character even at high temperature.

b. EXPLOSION PRESSURE; Inside the cylinder, 35–45 atmosphetic pressure due to explosion always seeks path to escape. If air tightness of plug is inadequate, combustion gas of high temperature will penetrate inside it to loose its function due to overheating.

c. COMBUSTION HEAT; Combustion temperature will reach up to 2000 °C. (3632 °F) It is needed to dissipate this heat to bear high temperature and sooner to maintain good performance preventing over heating of plug, or burning electrode.

d. CARBON DEPOSITS If get dirty on the insulating part, engine will fail its smooth running due to high voltage leaks partially and poor sparking.

e. LEAD COMPOUND; 4-ethyl lead is contained in gasoline to control explosion, and lead oxidized compound is made due to combustion. If it is deposited on the plug, this compound becomes a medium having conductivity at high temperature and high voltage will escape as stated in paragraph a.

3. Heat ranges of spark plug

1) Favorable condition for plug function

Ignition part of plug is apt to be dirty by carbon produced by combustion gas during engine operation or by oil penetrated into the combustion chamber. This deposit is electric conductible itself, and makes short circuit of high voltage electricity. Accordingly poor spark to decrease engine power misfiring and in worst case will stop engine operation. To prevent such trouble insulator surface should be heated enough to clean carbon deposited, and this is called "self cleaning temperature." (about 450 – 600 °C according to engine condition) On the other hand, at more higher temperature, sparking part will become over heated point which makes harmful knocking to burn mixture gas before sparking the plug, which affect decreasing of engine power. Therfore it is required that spark plug temperature should be maintained less than that of premature sparking. (less than 800 °C) In other words, sparking part of plug is bad if too cooled also if too hot.

Note

Numbering system for heat range

The NGK spark plug numbering system on the insulators indicates the "heat range" of each type. The higher or larger numbers designate "colder" plugs which dissipate heat quickly for high speed and heavy load. The lower or smaller numbers designate "hotter" plugs which retain the heat for low speed and light load.

2) Dissipation of heat

Heat transferred from combustion gas dissipate as shown in the figure 2 and insulating part retain a certain temperature balancing heat volume dissipating and absorbing.

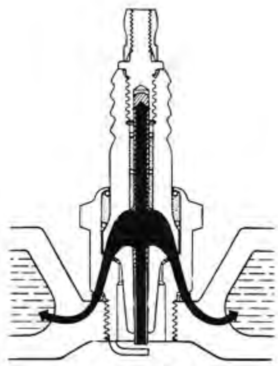
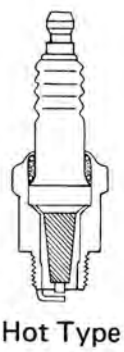


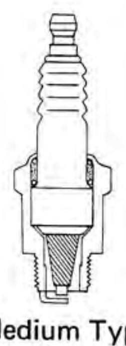
Fig. 2

3) Necessity of different heat range.

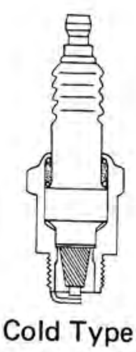
Heat volume of plug transfered from engine depend on feature of engine design (air cooled, water cooled, 2 cycle, 4 cycle compression ratio, shape of combustion chamber, and/or plug possition) and running condition (speed, loading, different fuel, flat or rough road) greatly. Therefore it is necessary to provide different types of plug to perform satisfactorily under each different operating condition. This rate of dissipating of heat is called "heat ranges of plug", and it is determined by its construction, form, dimension and material. Spark plug with short insulator nose transfers heat rapidly and prevents pre-ignition, over heating and/or piston crown failure. It is called as cold type. (for high temperature use) (Fig. 3-3)
Spark plug with long insulator retain heat enough to burn off oil deposits and remove the possibility of a short circuit. (for low temperature use) (Fig. 3-1)



Hot Type
Fig. 3–1



Medium Type
Fig. 3–2



Cold Type
Fig. 3–3

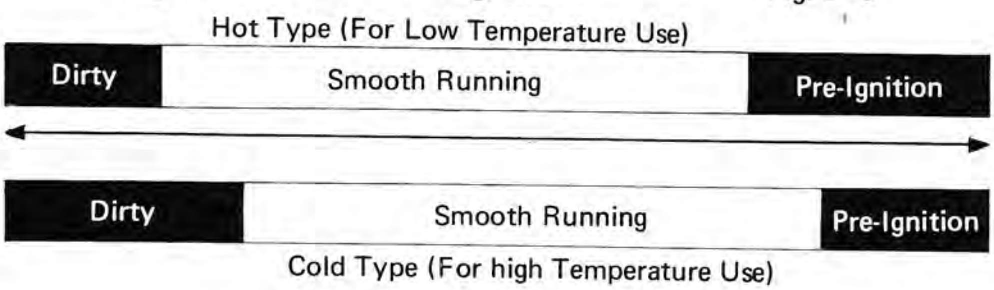


Fig. 4

4. Spark plug selection

A use of the uncorrect heat range

It is recommended that spark plug be selected the most suitable heat range for the engine conditions and new plug installed every 3000 km to 5000 km to prevent excessive fuel consumption. Hard starting loss of power, and other unnecessary trouble.

1) Spark plug diagnosis

Under normal conditions electrode & insulator of the plug will appear light brown to greyish deposit. (Fig. 5-2) When plug is fouled (Fig. 5-1), change to hotter plug. When overheating and corrosion of electrodes are indicated (Fig. 5-3), change to colder plug.

Foule (Too Cold)

Fig. 5-1

Normal

Fig. 5-2

Over Heat (Too Hot)

Fig. 5-3

2) Installation and removal

a. REMOVAL

To remove the plugs a spark plug wrench should be used and if any difficulty is encountered a small amount of penetrating oil will be applied at the base of the plug and time allowed for penetiation.

Note

When removing spark plugs from an engine identify each plug with the cylinder from which it was removed so that proper repair and/or adjustment can be made by cheeking the colour of the insulator.

b. INSTALLATION

Before installing the plug, clean washer and seating face in cylinder head as well.

Note

The spark plug should be made metal to metal contact with the cylinder head for good heat dissipation since 40% of the heat is transfer through this seat. Electrode also most be cleaned to prevent the possibility of a short-circuit with oil screw the plug in finger tight on to its gasket, then tighten ½ – ¾ turn with spark plug wrench, refer to table for torque value,

Table 1

Plug thread dia.	Torque value
10 mm plug	1.1 ~ 1.5kg–m
12 〃	2.1 ~ 2.6kg–m
14 〃	3.0 ~ 4.0kg–m
18 〃	3.5 ~ 4.5kg–m

3) Adjustment of electrode gap

Electrode gap of the spark plug most be periodically adjusted to keep the engine good condition since it will become big gap by wear.
The standard electrode gap setting for battery ignition is 0.7 mm (0.028″) and magneto ignition is 0.6 mm (0.024″). (Fig. 6)

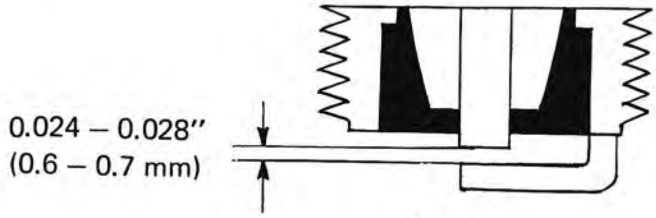


Fig. 6

4) Cleaning

Spark plug most be cleaned periodically to remove oil wet or carbon deposit.
It is not recommended to use burner and others to dry off, as it will have bad effect. It is recommended to use sand blast cleaner C-530 (fig. 7) which make cleaning of plugs easy, when cleaner is not available clean with wire brush or sharp pen and gasoline or other cleaning solvents and wipe off with air air blast.

Fig. 7

5. Trouble shooting .

Trouble1	Plug diagnosis	Cause	Remedy
(1) Hard starting (2) Irregular r.p.m. (3) Poor acceleration (4) Engine stop	(1) Heavy carbon deposits on insulate and electrode	(A) In the case of all plugs indicate carbon fouled (multi cylinders) 1 Unsuitable heat range 2 Low speed riding with much stopping 3 Dirty air cleaner element 4 Over choking 5 Incorrect mixture ratio 6 Late of ignition timing	 1 Change to hotter plug 2 Same as above 1) 3 Cleam element 4 Adjust 5 Adjust 6 Adjust
		(B) In the case of one plug indicate carbon fouled 1 Dirty of wear of breaker point 2 Valve stick 3 Fatigue failure of high tension ignition cord 4 Incorrect distribution of mixture gas (multi cylinder) 5 Incorrect spark gap	 1 Clean and/or replace 2 Polish 3 Replace 4 Change to hotter plug on the affected cylinder 5 Adjust
	(2) Oil fouled	1 Excessive clearance between piston & cylinder, wear of valve 2 New engine breaking engine	1 Change to hotter plug repair or overhaul engine 2 Clean plug
Drop power at high speed riding, climbing or accelerating	Ash white sometimes blistered	1 Pre-ignition 2 Fuel/air mixture too lean 3 Advance of ignition timing 4 Plug is loose in cylinder head. leak of gas	1 Change to colder plug 2 Adjust carburetor setting 3 Adjust 4 Tighten plug. replace gasket

6. Spark plug heat range comparison.

Thread size \ Manufacture	NGK	HITACHI	DENSO	CHAMPION	AC	AUTOLITE	BOSCH	KLG	LODGE
[Hot Type] ↑	B–4H	M47	W14F	L14	45F	AE6	W95T1	F50	CN
	B–6H	M46 M45	W17F	L85	44F	AE6 AE4	W145T1 W175T1	F70	HN
14m/m ½ Reach	B–7H	M44	W22F	L85	44F 43F 42F 42FF	AE3	W225T1	F75 PF70	2HN
	B–7HZ	M43	W24F	L81				PF80	2HN
	B–8H		W24F	L81		AE2	W240T1	F100	3HN
	B–8HC			L62R		AE903	W270T16		
	B–8HN			L62R				F260	R47
	B–9HC			L60T			W340T16	F290	R50
↓	B–10H								
[Cold Type]									
[Hot Type] ↑	B–4E	L47	W14E	N21 N18	47XL 46XL	AG9 AG7	W95T2 W125T2	FE20 FE30	BLN BL14
14m/m	B–6E	L46 L45	W17ES	N8 N6	46N 45XL 45N 44XL 44N	AG5 AG4	W145T2 W160T2 W175T2	FE50 PFE50 FE70 PFE70 FE75	CLNH CCL14 HBLN
¾ Reach	B–7E	L44	W22E	N4 N5	43N C42N	AG3 AG2	W225T2 W235P21 W240T2 W240T17	FE80 FE100	HLN 2HLN
	B–8E	L43	W24E	N3	42N	AG901	W250P21 W260T20 W280T2	FE220 FE250	3HLN
	B–9E			NA14		AG701	W340T17	FE290	RL50
↓	B–10E			NA18			W370T17	FE300	RL51
[Cold Type]	B–10EN			N83R					

7. Surface conduction spark plug [Use only for cdi (capacitor discharge ignition) engine.]

In modern engine, on account of a remarkable progress of specific output through its tendency of increasing the No. of cylinder, rising of compression ratio and revolution, cold type ignition plug is desired to prevent prefiring although it becomes hard to keep clean.
Otherwise, on account of frequent start and stop on street run for traffic congestion and much oppotunities of high speed run with an recent increase of high ways, range of engine operation has been extending.
It leads to corruption and misfiring of plug if high heat value plug that proper for a high speed run (heavy load) is used on street driving (light load). On the other hand, if low beat value plug is used on street driving, engine trouble such as output drop in high speed run or early waste of plug electrode and in the worst case blow-by will happen, conseouently, following are reouired in ignition system for modern high efficiency engine.

1. Super wide range: Ignition mechanism and plug operate sufficiently from high IMEP to low IMEP. (IMEP means INDICATED MEAN EFFECTIVE PRESSURE)
2. Long life: Ignition mechanism and plug operate for a long time without cleaning and adjustment.

Surface conduction spark plug, which is illustrated in Fig. 8, satisfies those requirement and it discharges along the surface of ceramic insulator. Further, booster gap is settled in center electrode to rise discharging electric voltage.

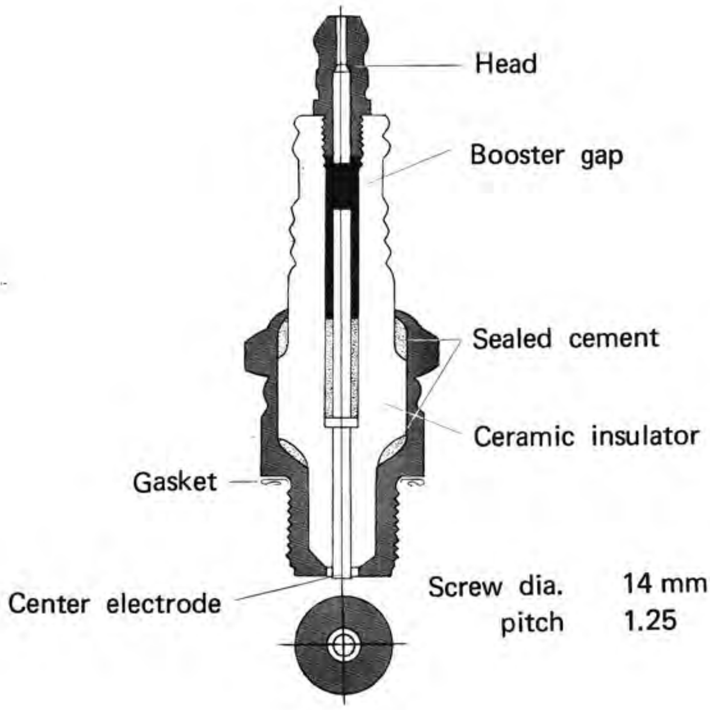


Fig. 8

Fig. 9

SERVICE MANUAL

APPENDIX-2 BATTERY

KAWASAKI HEAVY INDUSTRIES, LTD.

1. Battery construction

The battery used in automobiles or motorcycles is generally called the lead acid storage battery, which stores electrical energy in chemical form so that it can be released repeatedly as electricity.

Storing electrical energy in chemical form is called "charging" and releasing electrical energy stored in chemical form as electricity "discharging".

The battery, which is characterized by the fact that the discharging and charging of it can be repeated, is generally called the secondary battery. On the contrary the battery of which discharging and charging can not be repeated is usually called primary battery.

Many batteries different in size and shape are used as automotive batteries but their inside constructions are not so different.

The parts of the battery are illustrated in the Fig. 1.

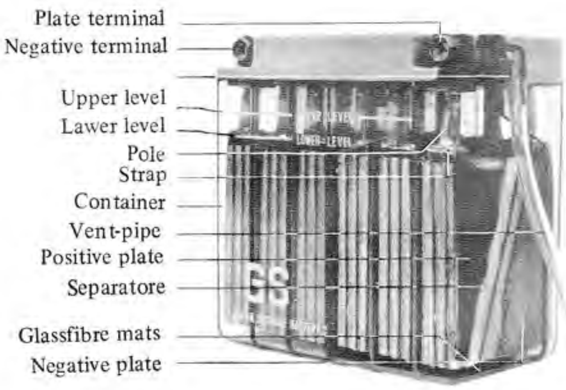


Fig. 1

1) Positive and negative plates

These plates which are most important parts in the battery consist of grid framework made of antimonial lead alloy in the meshes which are filled with the active materials by special electro-chemical processes.

Positive plates are filled with dark brown lead peroxide and negative plates are filled with gray sponge lead as the active material. These materials are made to provide a high degree of porosity in order to allow the electrolyte to penetrate freely inside of them.

2) Separators and glassfibre mats

Thin and porous sheets of non conducting material called separators are inserted between the negative and positive plates in order to prevent them from touching each other.

Separators are usually made of porous rubber, synthetic resin or wooden cellulose fibre.

As the active material in the positive plates is incorporated inferiorly to that of the negative plates, glassfibre retainer mats are placed between the separators and the positive plates to retard the loss of active material from the plate and to balance the life of active materials in the both plates.

The glassfibre mats protect the separators from oxidation too.

3) Electrolyte

The liquid filled inside of the battery is water solution of sulfuric acid called the electrolyte of which specific gravity is approximately 1.270 at 20°C. The solution at the condition of above mentioned has been proved to be best in conduction and good in anti-freeze.

The electrolyte of above specific gravity usually contains 35% ~ 38% sulfuric acid by weight.

4) Container and cover

Container, inside of which the plates, separators and electrolyte etc., are held, is usually made of synthetic resin or ebonite and divided into three spaces in 6 volt battery and six spaces in 12 volt battery, with partition walls.

Containers of small batteries as used in motorcycles are usually made of transparent plastic.

Cover of container is usually of the one piece molded type, made of ebonite or synthetic resin.

2. Battery characteristics

1) Chemical action of battery

a. Chemical action of discharge

When a cell is discharged by completing an external circuit, as in switching on the lights, the sulfuric acid acts on both positive and negative plate active materials to form a new chemical compound called lead sulfate. The sulfate is supplied by the acid solution (electrolyte) which becomes weaker in concentration as the discharge proceeds. The amount of acid consumed is in direct proportion to the amount of electricity removed from the cell.

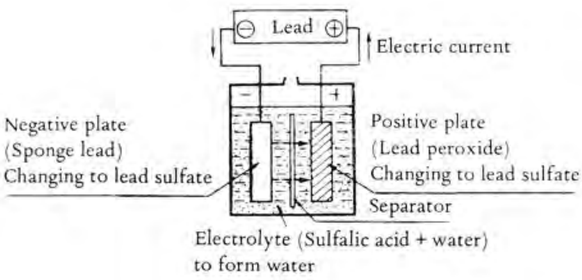
When the acid in the electrolyte is partially used up by combining with the plates, the battery can no longer deliver electricity at a useful voltage and the battery is said to be discharged.

This gradual weakening of the electrolyte in proportion to the electricity delivered is a very useful action because it allows us to use a hydrometer to measure how much unused acid remains with the water in the electrolyte and this information enables us to judge about how much electrical energy is left in the cell.

Fig. 2 shows the electro-chemical action in a battery on discharge.

$$Pb + 2H_2SO_4 + Pb\ O_2 \underset{\text{charge}}{\overset{\text{discharge}}{\rightleftarrows}} Pb\ SO + 2HO + Pb\ SO_4$$

Negative Plates	Positive plate Plates	Negative Plates	Positive Plates



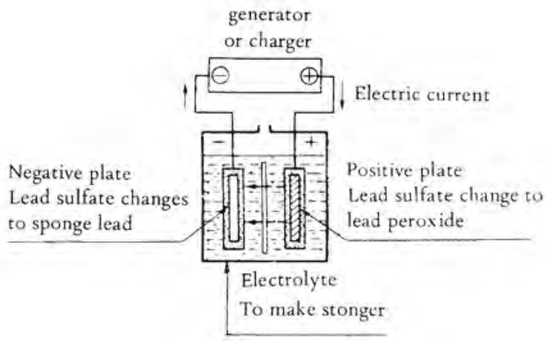


Fig. 2 Electro-chemical action on discharge **Fig. 3** Electro-chemical action on charg

b. Chemical action of charge

By supplying an electric current through terminals in a direction opposite to that of the discharge, the lead sulfate is decomposed. The sulfate is expelled from the plates and returns to the electrolyte, thereby gradually restoring it to its original solution. This action frees the plate active materials and they are restored to their original chemical condition, ready to deliver electricity again. Hydrogen and oxygen gases are given off at the negative and positive plates respectively as the plates approach the full charged condition. This is the result of the decomposition of water by an excess of charging current not utilized by the plates.

NOTE

The gases generated in charging are highly explosive and precautions must be taken to insure that no arc, or bare flame comes into contact with the generated gases.

The possibility of explosion is always present on exposure of the battery to sparks or flame, but is particularly hazardous at the end of the charging period.

2) Relation between specific gravity and extent of discharge

As the specific gravity of electrolyte falls in proportion to the current discharged, the approximate capacity still available in the battery can be detected by measuring the specific gravity of the electrolyte.

If the specific gravity was 1.180 at 20°C, for example, the amount of electricity approximately 50% of full charged is still stored 1.280(specific gravity at 20 C when full charged). full charged).

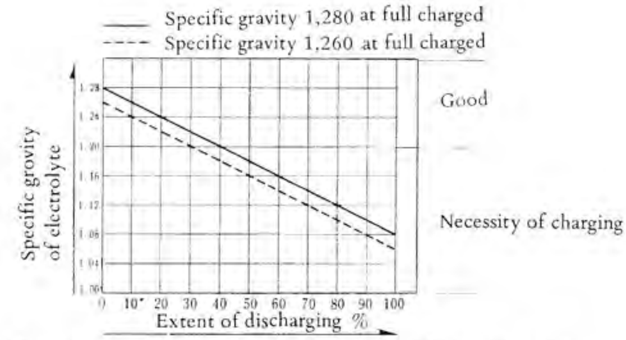


Fig. 4 Relation between specific gravity of electrolyte and extent of discharging

3) Measurement of the Specific gravity of Electrolyte

To measure the specific gravity of electrolyte, the instrument called Hydrometer is used. This consists of a glass barrel and bulb syringe for sucking up a sample of the electrolyte to float an enclosed glass hydrometer, the stem of which is calibrated to read in terms of Specific Gravity. See Fig. 5 (a).

The depth to which the float sinks in the liquid indicates the relative weight of the liquid compared to water and gives us a measure of the specific gravity of the liquid.

The hydrometer floats low in the liquid if the specific gravity is low and it floats high in the liquid if the specific gravity is high.

Fig. 5 (b) illustrates the correct method for reading a hydrometer. The eye should be on a level with the surface of the liquid in the hydrometer barrel.

Disregard the curvature of the liquid where surface rises against the float stem and the barrel, due to surface tension. Keep float vertical.

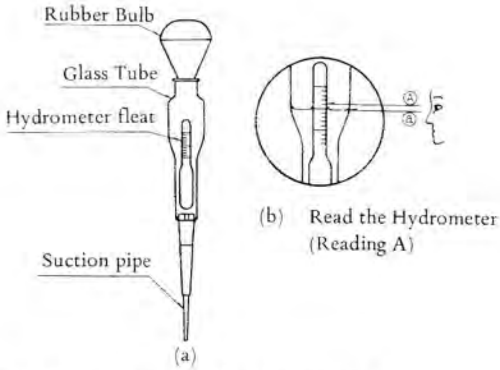


Fig. 5 Suction type hydrometer

4) Interrelation of specific gravity and temperature

The specific gravity of the electrolyte must be measured at 20 C

Therefore, when it is measured at different temperatures, it must be converted. The reason for this lies in the fact that when the acid is heated, the hydrometer float will not be raised as high in the normal temperature acid, and this will cause the reading to be low, and when it is cooled, the hydrometer float will be raised higher and the reading too high. The temperature correction can be made by the formula given below.

$S_{20} = St + 0.0007\ (t-20)$

S_{20} : Specific gravity at 20°C

St : Specific gravity at t°C

t : the temperature of electrolyte

5) Freezing Temperature

The electrolyte of a battery in various state of charge will start to freeze at temperatures as shown in Fig. 6. This Figure indicates the approximate points at which the first ice crystals begin to appear in the solution. The solution does not freeze solid until a lower temperature is reached. Solid freezing of the electrolyte may crack the container and damage the positive plates.

A 3/4 charged automotive battery is no danger of damage from freezing. Therefore, keep batteries at 3/4 charge or more, especially during winter weather.

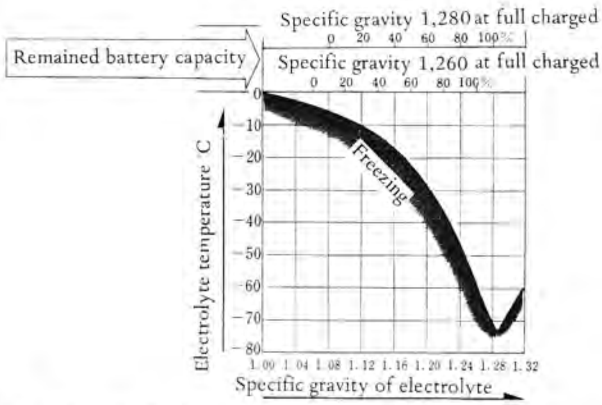


Fig. 6 Relation among remained capacity, specific gravity and freezing of electrolyte

6) Electromotive force (Open circuit voltage)

The voltage of a battery, as the circuit opened i.e. no electric current flowed, is called the electromotive force of a battery.

The electromotive force of a battery is about 2.1 volts per cell, regardless the size of battery or number of plates. While it is influenced by the specific gravity, temperature of electrolyte and the state of discharge.

7) Voltage change during the discharge

When a battery is discharging at constant ampere rate, the terminal voltage falls gradually as the discharge proceeds, reaching to a certain value under which the voltage drops very rapidly, as shown for a cell in Fig. 7.

Therefore, in the case of 12 volts battery which is made up of six cells, the terminal voltage is six times of that shown in Fig. 7.

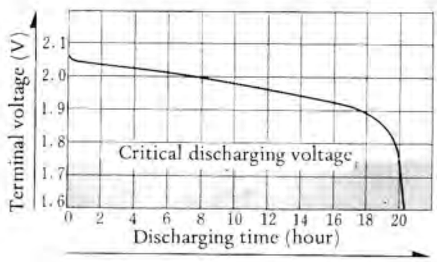


Fig. 7 Discharging curve

8) Voltage change during the charge

On charge of a battery, the terminal voltage rises rather gradually in early state, but rapidly as it begins to generate gases, reaching to the maximum terminal voltage at which state of charge, voltage is regularized to constand value for any further charge.

Fig. 8 shows how the terminal voltage per cell varies during the charge.

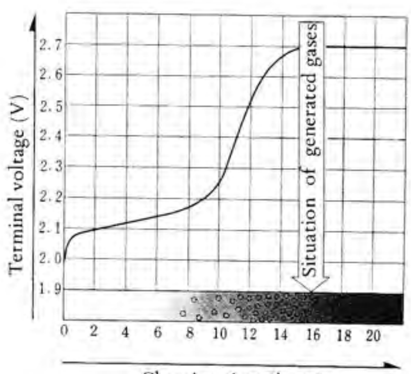


Fig. 8 Charge voltage curve

9) Limit voltage to stop discharge

The voltage of a battery on discharging, shows rapid dropping if it exceeds a certain state of discharge, reaching to zero volt at last. Such discharging up to zero volt, is not only unfit for use, but also have bad influence to a battery.

A certain limit of terminal voltage, beyond which a battery should not be discharged is, therefore, specified and called "the limit voltage to stop the discharge".

This limit voltage, which varies with ampere rate of the discharge, is provided as follows for discharge rating.

	discharge rating	limit voltage to stop discharge
Battery for automobiles	20 hour rating	1.75 volts per cell
Battery for motorcycles	10 hour rating	1.75 volts per cell

(Note) Refer to next item "Capacity of battery" on the term discharge rating (10 hour rating, 20 hour rating), which shows the ampere rate of the discharge.

10) Capacity of a battery

To show the electrical size of a battery, term "capacity" is generally used.

The capacity of a battery is indicated by the amount of electricity which can be discharged successively from a full charged battery at constant ampere rate, before the terminal voltage drops below the limit to stop discharge.

This is to say the capacity is the product of the ampere rate and the number of hours required for the discharge, and represented by Ampere-Hour, A.H.

Whenever the capacity of a battery is to be mentioned, the discharge rating that shows the ampere rate of discharge is always provided, as the capacity depends on the ampere rate of the discharge.

The discharge rating is indicated by the number of hours required for the terminal voltage of full charged battery or reach the limit voltage.

For example, the 20 hour rating indicates the rate at which a battery requires 20 hours to reach the limit voltage, in other words, the terminal voltage may drops in 20 hours to the limit voltage.

So the battery of 100 A.H in 20 hours rating capacity only means that it could be discharged for 20 hours at 20 hours rating, that is, at 5 ampere, and not that the battery could be discharged for 10 hours if discharged at 10 ampere.

Thus, it is necessary to see the discharge rating of batteries which are to be compared.

The capacity of a battery reduces as the ampere rate of the discharge becomes higher. This variation of a capacity is as shown in Fig. 9.

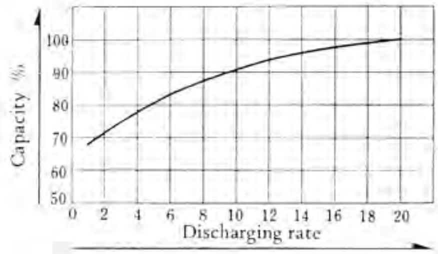


Fig. 9 Relation between battery capacity and discharging rate

In Fig. 9, the discharge rating in place of the rate of ampere is shown. The smaller the number of discharge rating is, the larger the ampere is.

As the capacity of a battery varies with the ampere rate of discharge, as above mentioned, it is meaningless to say the capacity without providing the discharge rating.

20 hour rating capacity is provided to the battery used in automobiles and 10 hour rating capacity in motorcycles.

Discharge at extremely high ampere rate, as at starting of engine, is called "high rating discharging", whose characteristic is too significant for the capacity of a battery, and is provided with conditions attached as well as the capacity at 20 hour rating or 10 hour rating.

Comparing the battery 10 hour rating 100 A.H. capacity with that of 20 hour rating 100 A.H. capacity, let us examine which one and how much is larger of the two.

It is known in Fig. 9 that the battery of 10 hour rating 100 A.H. capacity is as larger as 10% than that of 20 hour rating 100 A.H. capacity.

Why does the capacity decrease, as the ampere rate of discharge becomes higher?

It is because of the delaying of sulfuric acid supply necessary to chemical reaction, as the rate of chemical reaction becomes greater than that of electrolyte diffusion at higher ampere rate of discharge.

It becomes, however, possible to discharge again, after short rest of discharge during which as the diffusion of electrolyte preceeds.

Such amount of electricity as could be discharged after short rest of discharge is called "the surplus capacity".

This phenomenon is just like that a man, who can walk with a load weighing 10 kg as far as 1000m with ease, would be short breathed in less than 10m, if he has to carry such load as 100kg, but if he takes a short rest to restore vitality, he can again walk a little more.

This is why a starter must be switched on again after a short rest, if the engine does not start in about five seconds discharge to the starter.

The capacity of a battery varies with the temperature of electrolyte as shown in Fig. 10. The more the temperature falls, the more the capacity decreases. It is, therefore, necessary for the capacity of a battery to provide the temperature of electrolyte clealy in the same way for the gravity of electrolyte.

The capacity of a battery is usually indicated at 20 C.

Here, it should be noticed that 25 C of the temperature of electrolyte is provided for the battery capacity but 20 C for the specific gravity of electrolyte.

A battery, rated 50 A.H., for example, means more exactlt that this is the capacity at 20 hour rating or at 2.5 ampere rate of discharge and at 25 °C of electrolyte temperature.

When the capacity is stated as A.H., without any notice, it means the capacity at 20 hour rating and 25 °C in the case of the battery used in automobiles, and 10 hour rating 25 °C in motorcycles.

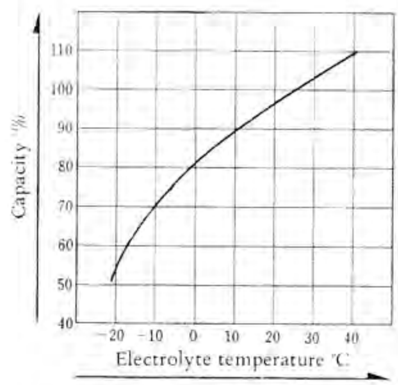


Fig. 10 Relation between battery capacity and electrolyte temperature

11) The efficiency of a battery

The amount of electricity, given to a battery on charging, is not always all stored in the battery, but some portion of it is changed to thermal energy, rising electrolyte temperature or being consumed to electrolyse the water in electrolyte.

On charging a battery, it is well known that electrolyte temperature rises and the bubble of the gases of hydrogen and oxygen forms.

Those energies, as above mentioned, which is not useful for chemical reaction of charge, is called "loss".

As only the balanced amount of electricity which is subtracted by loss from all that charged, is stored in a battery, extra energy corresponds to loss must given on charging.

Efficiency shows how much portion of the amount of electricity or electric power given to a battery on charge is stored effectively in the battery.

It is called Ampere Hour efficiency when it is stated by electricity, or Watt Hour efficiency when stated by electric power. Ampere Hour efficiency is the ratio of the amount of electricity discharged to that required for a battery to be charged to the same state at the beginning of discharge, and Watt Hour efficiency is the ratio of electric power discharged to that required for a battery to be charged to the same state at the beginning of discharge.

Those efficiencies are formulated as follows,

$$\text{Ampere Hour efficiency} = \frac{\text{Amount of electricity discharged}}{\text{Amount of electricity charged}} \times 100\%$$

$$\text{Watt Hour efficiency} = \frac{\text{Amount of electric power discharged}}{\text{Amount of electric power charged}} \times 100\%$$

Efficiency of new battery is generally about 90% in Ampere Hour efficiency, or 75% in Watt Hour efficiency.

12) Self discharging

It is often heard that a battery becomes deteriorated in spite of no use.

A battery, once charged, can not be stored for a long time without any change. A battery, once actuated on charge keeps on changing its chemical condition inside.

It is, therefore, well understood that a battery will get worse unless it is treated as just like living thing.

Although a battery is full charged, just when electrolyte filled and then charged, it may lose its energy gradually as time passes.

This is just like that a man would consume energy without any work.

This phenomenon, that is, the consumption of energy while a battery is not used, is called "self discharge".

The factors supposed to cause self dischargeare are as follows. That is, in the first place that a spongy lead as the active material in Negative plate may react directly with dilute sulpharic acid in electrolyte, resolving into lead sulphate gradually. Secondarily that with attaching of impure metals, remained in a battery, to the plate, a cell is constructed among attached impure metals, sulpharic acid and plates forming short-circuit to cause self discharge. Thirdly, that if the density and temperature of electrolyte are not uniform all over the plate surfaces, electromotive force differs with every point of plates, which cause to form short-circuit to self discharge. Fourth, that the direct contact or contact between both plates through active materials fall off or resin form materials reduced.

Lastly, the existence of hydrochrolic acid, nitric acid, organic acid and others are thought, too, to cause self discharge.

13) Extent of self discharge

The higher the temperature, the more the chemical reaction becomes active. Therefore, it is natural that the battery will discharge faster when warm than when cold. Fig. 11 shows the effect of temperature on self discharge. The upper most curve in the Fig. 11 represents the change of a battery capacity caused by time duration at temperature −15℃. This curve tells us that capacity loss of a battery is slightly at the temperature even past 90 days. This is for a reason that the self discharge is little because of very low chemical activity at the temperature.

If temperature of a battery is higher, the self discharge will increase with the temperature. The second curve from the top shows the change of battery capacity at temperature 15 C, the capacity decreases to 90% past after 90 days. The third curve from the top shows that the capacity decreases to 76% past after 90 days at temperature 25 C.

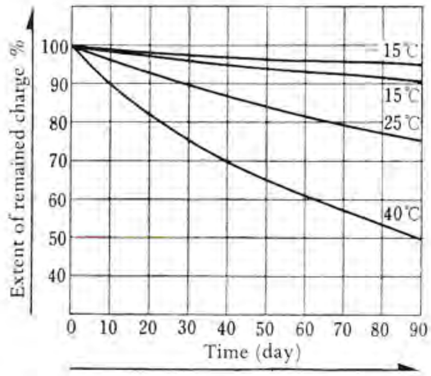


Fig. 11 Effect of time at various temperatures on discharging

Furthermore, for a battery kept at 40 C, self discharge is very remarkable i.e. the capacity decreases to 50% past after 90 days.

Above values of the battery capacity are for the new batteries, then for a inner shorted one or for a battery approached to end of its life, the battery capacity will become lower than the above corresponding value because of the self discharge is faster. It is possible to lose all capacity of a battery for only 5 days.

For decreasing self discharge, it is effective to keep the battery in low temperature or to use electrolyte and water of loss impurities.

14) Internal resistance

If the positive and negative terminal of a battery are connected with large size conductor, large electric current will circulate in a circuit formed with the conductor and the battery, and it may lead to melt down the terminal poles or the terminal clamps for heat generated with the electric current. This phenomenon occurs due to very small internal resistance of the battery.

Though the internal resistance of a battery is built up with each resistances of the plates, insulators, electrolyte, terminal clamps and terminal columns, it becomes larger value for electro-chemical action with electric current.

The internal resistance of a battery increases with discharge. This phenomenon is resulted from a bad electrical conductivity of lead sulfate turned from active material of the plates, and the less consistency of electrolyte during discharge.

Furthermore, the internal resistance increases with lowering of battery temperature, since the resistance of electrolyte increases with lowering temperature.

15) Battery life

According to JIS or JAS, the standards life of a battery is indicated with repeated numbers of the charge and discharge by lowering the battery capacity to some specified value of in specially fixed condition. It seems more reasonable that a battery life is showen with usable milage of the motorcycle. But it cannot be showen so simply because of the life is largely affected by a kind of the motorcycle, operating condition, operating circumstances, handling and the installed place etc. Specially, the electric equipment of the motorcycle, settled voltage of the voltage regulator and handling of the battery have very large effects on the battery life.

However, it is generally said that the battery life is 1 – 3 years for the private car, 6 – 15 months for the business car such as taxi, 1 – 3 years for the motorcycle and 1 – 4 years for the large size car such as buss and truck. The fact that the battery life scatter in wide range tells us prescribed valuable effects to the battery life.

In both cases of using the battery very cold area and of having electric load much beyond the standard value, such as the motorcycle being equipped wireless, the life is shortened of course.

It will boil down to good use if it is usable over a period of 1.5 years for private car, 1 year for business car, 1.5 years for motorcycle and 2 years for large size car.

3. Charging

1) First charging

The object of the first charge is to revive original state of the sponge lead which has changed for plumbic oxide, lead carbonate and hydrated lead by oxigen, carbonic acid gas and water in the air through manifacturing and keeping.

As mentioned above, necessity of the first charge is only grounded upon oxidation of active material of the negative plates. On the contrary, the lead peroxide which is an active material of the positive plates is stable chemically and then it subject to little change through long keeping period.

The initial charge for automotive battery is 60 hours on the first charging rate indicated by battery manufacturer or the rate of 20 hours rating i.e. electric current of the battery capacity divided by 20. But the initial charge is usually unnecessary on the dry charged battery for the motorcycle, since it has manufactured with a special processing, then may use with short time charging.

2) Dry charged battery

The dry charged battery is just what the name indicates. It is a battery containing charged plates in a dry condition. When dilled with sulfuric acid electrolyte, it turns on boost charged.

It is essentially the same as the conventional wet battery.

The manufacture of the dry-charged battery calls for special processing in the handling and drying of the plates separators.

The plates are manufactured by passing a direct current through them while immersed in an electrolyte of dilute sulfuric acid. The fully-charged plates are then removed from the electrolyte, washed in water, and completely dried without appreciable exposure of the negative plates to air or oxygen. This is necessary because the active material of the fully-charged negatives is finely divided sponge lead which oxidizes, that is, loses its charge when exposed to oxygen in the air in the presence of minute quantities of moisture.

In order to obtain dry-charged negatives, the plates must either be dried in an inert gas such as superheated steam, oxygen free products of combustion or a vacuum dryer, or dried so rapidly that excessive oxidation cannot take place.

Thorough drying of positive plates and separators is necessary in order to produce a battery free of moisture, the condition which is essential for a satisfactory dry-charged battery.

Positive and negative plates and separators may either be dried separately or as elements with the separators in plate.

When water-washed, charged plates and separators are dried together, the addition of a separator wetting agent at the end of the washing period is ordinarily required for satisfactory battery activation from the dry-charged to the wet-charged state.

After assembly of dry-charged batteries, proper precautions must be taken to prevent moisture from entering the battery during the period it remains in a dry, unfilled state.

Dry-charged batteries should be stored in a cool, dry place with humidity as low as possible; also with ambient temperature between 15°C and 35°C., as uniform as possible and not subject to frequent changes.

3) Filling of electrolyte

a. Unscrew the vent plugs. For the dry charged battery take off sealing cover of the vent plugs certainly.
b. Use electrolyte lower than 30°C.
c. Be sure not to allow the dust or dirt through filling.
d. Fill each cell of the battery to the pointed level such as UPPER LEVEL for transparent container, but less than the 10 – 15 mm upper from top of the separators for no pointed level.
e. Check level of electrolyte in all cells, since it may be lowering, for electrolyte will be absorbed in the plates and insulators, and adjust to prescribed level with additional electrolyte.

4) Directions of initial charging

a. Start the initial charge within 12 hours after filling of electrolyte in the battery.
b. Connect battery with the charger correctly.
c. Charging current of the battery should be set at the specified value of the initial charging

d. Charge 60 hours for an ordinary battery and about 10 hours for a dry charged battery. Initial charge of the dry charged battery is called sometimes boost charging.

e. Measure the voltage, specific gravity and temperature for all cells. On the way ofscharging, measure at proper time interval the selected pilot cell located middle of the battery.

When the specific gravity of the electrolyte is hard to measure because of less electrolyte, use the pointed electrolyte so the specific gravity will become regular value at the charge end.

f. If the temperature of the electrolyte rises up over 45 C on the charging, continue the charging with lesser current.

5) Aspects in first charging

Cell voltage: Voltage rises gradually in early time from about 2 volts and rise high to 2.3 – 2.4 volt, generated gases can be seen in this period, and then the voltage saturate at the value of 2.5 – 2.8 volts.

Specific gravity: Specific gravity of the electrolyte fall in early time of charging and after a while it rises gradually again with much generated gases, and reach at maximum saturated value.

6) Charging a discharged battery in using

Battery installed on a car is charged with the generator of the car. The output of the generator is required to supply sufficient current for keeping the full charged state of the battery. But when it is in the following states, and if the generator and regurator were normal, the battery can not be able to stay normal then the battery is apt to discharge, and for these cases you must charge immediately.

a. Very cold whether.
b. Very often stop and start operations.
c. Very short running for a day.
d. Having very much electric load.
e. Long running in the night.

There are 2 ways for the charging. One is the ordinary charging which needs for rather long time period, and another is the high rate fast charging which needs large current and for short time period.

7) Ordinary charging

Ordinary charging is a method doing with specified current of the manufacturer or with current of battery capacity divided by 10, and this method is used when there is sufficient time.

a. Wash away dust or mote with water on the battery, and clean specially the terminals.
b. Add distilled water if the electrolyte level has decreased from the reguler line. In this case, add water to a little lower than the reguler line because of the electrolyte level rise with the chargeing.
c. Connect battery to the charger correctly.
d. When you want to charge with the series connection for various capacities of the batteries, a charge current must before the smallest capacity in those batteries.
e. Regulate the charge current within the temperature 45℃ of the electrolyte.
f. The extent of charge must be 1.2 – 1.5 times as much as the extent of discharge.

$$\text{Charging time (hour)} = \frac{\text{Extent of the discharging (Ampere x Hour)}}{\text{Current of the charging (Ampere)}} \times (1.2 \sim 1.5)$$

Furthermore, extent of the discharging must be decided by the specific gravity of the electrolyte. When the specific gravity is hard to measure due to the less electrolyte, the battery should be regarded as full discharging.

8) Judgement in the state of complete charging of a battery

a. The specific gravity of the electrolyte becomes 1.250 ~ 1.290, keeping constant state more than an hour.

b. Voltage per one cell in charging becomes 2.5 ~ 2.8 volts, keeping constant state more than an hour.

c. Active occurence of gases.

d. Extent of charge (charging ampere x charging time) becomes one and half times of battery capacity.

It is almost complete charging when more than three in above four conditions are satisfied.

Usually, it shows full charging when conditions (a), (b) and (c) were satisfied. If the specific gravity is unmeasured for less electrolyte, however, it is possible to judge with conditions (b) (c) and (d).

9) Caution in charging

The gases coming from a charging battery are a mixture of hydrogen and oxygen gases and will explode with great violence and spraying of acid if a spark or flame is brought too near them. A room or compartment in which charging batteries are confined should be ventilated. Do not bring a flame or sparks near openings.

To avoid sparks, do not disturb connections between batteries while charging, first switch off at charger. The possibility of ignition of hydrogen gas by static electricity accumulated on the car, or on one's person, and discharging near the vent openings can be minimized if, immediately before working on the battery, a metal rod or wire is touched to the car bumper and tc the ground.

Another source of explosion lies in the reverse connection of charging equipment. This hazard is present with all types of chargers, particularly in the case of the High Rate equipment. It can only be eliminated by careful checking of the connections before operating the switch.

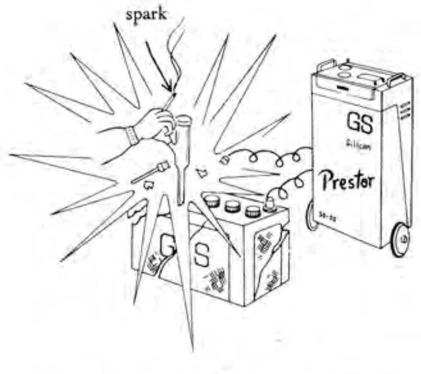


Fig. 12 Explosion of battery

10) Boost charging

Discharging gradually of itself without any use, charged battery in your keeping must be charged once a month (in summer) or two months (in winter). Those are called boost charging.

Boost charging has to be done completely as same as in the ordinary charging.

11) Supplement of water

Water is one of the essential chemicals of a lead-acid storage battery and under normal conditions of operation is the only component of the battery which is lost as the result of charging. It should be replaced as soon as the required level falls to the top of the separators. If the level is not replaced, and the plates are exposed, the acid will reach a dangerously high concentration that may char and disintegrate the separators and may permanently sulfate and impair the performance of the plates. Plates cannot take full part in the battery action unless they are completely covered by the electrolyte.

Sulfuric acid must never be added to a cell unless it is known to have been lost.

4. Service of a new battery up to operation

1) In acquiring a new battery

a. For battery delivered with charging, electrolyte in each cell is to be examined, and if the level is low, special care must be given. In this case, if no damage is found about container, it is required to replenish dilute sulfuric acid with a specific gravity equal to that of other cells.

b. When battery with charging is delivered sideways or upside-down, it is necessary to replenish same dilute sulfuric acid and to charge battery. As the specific gravity of electrolyte happens to rise in charging, it is to be adjusted up to a regular specific gravity.

c. It is good to keep battery with the state of storage by attaching tab with date of acquisition or by writing some sign on packing case in coloured chalk or something else.

2) Charged battery in storage

a. When a battery is delivered, check the specific gravity of electrolyte and boost charge to the state of full charge in case the battery is already discharged, since a battery may lose its charge to some extent by self discharging.

b. In case a battery is not placed at service at once, store it after it is completely charged and electrolyte level is adjusted to level mark indicated (or the highest level of electrolyte).

c. In storage of a battery, select such place of which temperature is not so high and shows little variation.

d. To make up the charge lost by self discharging over a period in storage, boost charge as follows.

Summer Boost charge once a month.

Winter Boost charge every two months.

e. A battery must be charged completely when it is placed at service after long storage.

3) Dry-charged battery in storage

a. When a battery is not offerd to use instantly, store it at the place dry, dark and cool. received state.

b. In storage of a battery, don't remove ventplugs or cut sealed part of ventilation pipe.

c. Just before a battery is installed on the motorcycle, the battery must filled with the electrolyte, and is required boost charging about 10 hours to reach the fully charged state.

d. After the dry-charged battery has been activated it must be serviced, handled and kept charged just like any other wet battery.

4) Installation of new battery

a. Check a battery if it is surely full charged before installation on the motorcycle. Only a fully charged battery can deliver the guaranteed performance.

b. It is better to mark the date on some proper place of the battery before installation, it may be useful when happend some trouble on the battery.

c. The battery should rest level in the cradle and be fastend securely in place by a suitable hold-down.

d. Replacement cables should be of sufficient length to reach the terminal posts without causing undue strain on the posts and covers.

e. For a battery with vinyl ventilation pipe, take care if the pipe is not depressed by a battery or pinched as shown in Fig. 13. In that case, the inside pressure of the battery is increased by gases which generate on charging, causing the explosion of container.

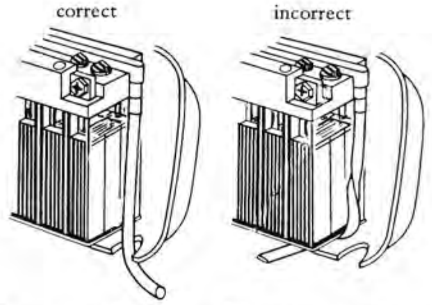


Fig. 13 Installation of battery with vent-pipe

f. Before connecting the cables, check the polarity of the terminals of the battery to be sure it is not reversed. Note that the tapered positive terminal of the battery is about 1.5 mm larger at the top diameter than that of the negative and the opening of the positive cable clamp terminal is correspondingly larger to fit.

g. When the cable clamp terminal is connected to the battery terminal, grind the terminals and applicate anti-rust grease on it.

h. Connect a negative cable lastly.

5. Trouble shooting

Battery installed in motorcycle can operate for rather long time, as long as first charging before installation is certainly executed and cares about daily handling are fulfilled.

On the other hand, it also occurs often that battery becomes unable to work by its own trouble or by other cause. Such new battery as installed a few days before happen to be unable to operate to its own discharge made.

In such cases, the state of trouble on battery has to be examined and pertinent attention must be given. Service for such trouble on battery is made in the below-mentioned order.

a. To check whether trouble on battery come from simple discharge.

b. To check the state of trouble when it is found on battery.

c. To check the cause of trouble, namely, whether it lies upon battery itself, whether on other electric equipments or whether upon erroneous handling.

d. To take pertinent measures when the state and cause of trouble are clear.

e. To charge battery when the cause comes from simple discharging, not trouble.

1) How to check whether some trouble on battery or simple discharging

There are many such cases as most batteries returned under some trouble remain in the state of simple discharging and not true trouble. In this case, further investigation are not necessary regarding such causes visible from breakage of container, cover, exhaust pipe, etc. For other causes they must be distinguished whether some trouble or not in the under-mentioned four steps.

a. Check of voltage, electrolyte level and specific gravity.

b. Charging test

c. Cracking power test.

d. Self discharging test.

By check (a) it becomes clear to a certain extent whether simple discharging or some trouble. If test (b) is executed and charging is fulfilled, it is in most cases certain that it is not an trouble. Further, if test (c) is carried out smoothly, there is no trouble on the battery. Test (d) is executed for confirmation only and not required to be atually carried out in general cases.

2) Check of appearance, voltage, electrolyte level and specific gravity

Before charging test is made, the following items have to be checked concerning battery returned.

1. Appearance	Anything abnormal about container, cover, cemented part, terminals, terminal clamps and exhaust pipe. Is the colour of pole-plates not whitened? No corrosion nor breakage on grids of positive plates? No short circuit owing to sediments piled down to the bottom of plates?

2. Voltage	Voltage of each cell or total voltage of all cells.
3. Electrolyte level	Normal, too low or too high.
4. Specific gravity of electrolyte	Is specific gravity of each cell more than 1.200?

From these records, troubles or something else are judged under the below-mentioned list.

	Part to be investigated	Battery in good state	Battery with impediment or with possible impediment	Attention to impediment
1	Pole plates	(+) plate: Chocolate colourd (–) plate: Gray colourd	White-colourd (Sulphation) Positive-plate grids are colourd and broken	Replace it with new battery.
	Sediments	little	Placed down to bottom part of pole-plate.	Replace it with new battery.
2	Voltage	Voltage more than 12 or 6 volts	Voltage below 12 or 6 volts. (Less than 1.95 volts in some cell)	Execute charging test.
3	Electrolyte level	Over plates.	Plates appear.	Execute charging test.
4	Specific gravity of electrolyte	More than 1.200 each cell. Irregularity below 0.02.	Some cells below 1.100. Irregularity over 0.02.	Execute charging test.

Regarding the item (4) in the above list, there are many cases that the specific gravity recovers by charging in case of specific gravity is between 1.200 1.100 and/or the differences between the cells are below 0.02. Such cases should not be thought troubles.

3) Charging test

It is to be examined whether charging is possible, if possible troubles are judged to exist from the voltage, level of electrolyte and specific gravity. Ampere rate for charging is ordinary charging rate appointed by battery manufacturer or the 10 hour rating, and investigation must be made by charging for 15 to 30 hours according to the state of discharge. Before charging, distilled water has to be replenished in case the level in each cell lowers. Replenishing quantity is a little less than prescribed level (highest level line).

Measurement of voltage and specific gravity is carried out just before charging, just after it in an hour, and afterward one or two times according to each case. These measurements are to be recorded for judging data.

a. Just after charging, there may be probable sulfation, if voltage of each cell shows over 2.3 (volt)

b. Just after charging, it is supposed to be no trouble about battery, provided voltage is approximately 2 (volt), rising gradually by half an hour or is an hour arriving at 2.1 ~ 2.2 (volt).

c. At closing time of charging, in case gas breaks out equally from each cell, voltage per cell shows more than 2.0 (volt) and specific gravity shows 1.250 ~ 1.290, it is considered safely that battery has no trouble.

d. There may be possible short circuit for such cells as no gas breaks out or specific gravity is low at closing time of charging.

e. There are many instances that it becomes normal by adjusting specific gravity, when the gravity exceeds 1.290 at closing time of charging.

f. It also becomes normal by adjusting specific gravity, as battery often has no trouble in the state that voltage rises over 2.5 (volt) and gas breaks out but in case the specific gravity stays under 1.250, at closing time of charging.

Generally speaking, at charging test, it can naturally be thought that there is no trouble on battery in case battery can be charged fully, voltage rises and specific gravity also rises. After charging, it can be made more certain if cranking power test is done.

4) Self-discharging test

Self-discharging test has to be carried out, if battery discharges in a few days despite installment with full charge. Any battery makes self discharging about one percent a day even in winter, but does not lose the capacity in a few days for this reason.
ty in a few days for this reason.

Self discharging test is executed by leaving a battery alone for two to seven days with full charg after cranking power test. The self discharging rate can be detected by comparing the specific gravity before and after the test. Further, confirmation is done by cranking power test. In case cranking power is judged perfect by this test, there is no trouble on battery. So, it is necessary to investigate electric equipment except battery.

5) Capacity reduction by cold

a. The extent of the reduction in cranking power when the temperature drops is so rapid that only about 65% of the full cranking power at 25 C is available at 0 C and 40% at −15 C, even for a battery in good working cond ition and fully charged.

b. Stiff engine oil by cold adds to the load of starting. The following Fig. 14 shows the relation of cranking power at temperatures corresponding to "summer", "freezing" and "zero" for an engine using SAE 10W-30 multi-viscocity engine oil. oil.
At 0°C the engine requires approximately one and half times more the power to crank than it required at 25°C, or twice at −15°C.

c. Battery becomes hard to be charged when the temperature drops. As apparent resistance of battery increases with lowering temperature. If the charging voltage is made constant, the charging ampere rate will decrease with the temperature drop.

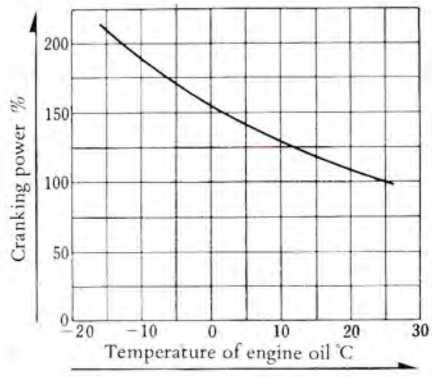


Fig. 14 Variation of cranking power with engine oil temperature.

6) How to take causes of troubles on battery

Troubles on battery break out from such causes as mentioned below:

a. Carelessness in handling.

b. Such an instance as battery is not in good state to operate the relating apparatuses (dynamo, regulator, starter, etc.)

c. Wrong ways of stock.

d. Specific running conditions of motorcycle.

e. Defect in materials and in making of the battery.

f. Installation of battery on such parts with excessive vibration or meeting hot wind.

g. Attachment of other apparatuses consuming much electricity.

Fig. 15 Plate with sulfation by short electrolyte

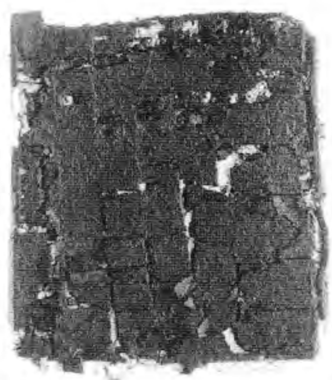


Fig. 16 Corroded positive plate

Fig. 17 Severely buckled positive plate

Fig. 18 Oxidized separator

7) Difective inside battery

Location of Trouble	Kinds of Trouble	Cause	Remedy
Positive Plates	Dropping of active material	a) Excessive charge cycling (charging and discharging) b) Excessive charging current c) Working at low temperatue d) High electrolyte density	Before deposits accumulate heavily, wash the inside of the battery and replace electrolyte.
	Buckling and expansion	a) Execssive discharge b) Excessive charge cycling at high currents c) Working at high temperatures d) Electrolyte contaminated with impurities	If a short circuit has occurred, the battery is useless. If impurities have contaminated the electrolyte, change the electrolyte.
	Grid broken due to corrosion	a) Battery worn-out b) Excessive temperature increasing battery density c) Electrolyte contaminated by nitric acid or organic acids d) Frequent charging	Replace the battery, no repair is possible.
Negative Plates	Shrinkage and solidification	a) Repeated high discharge rates b) Repeated charging at high currents c) Repeated overcharging	There is no positive countermeasure. If trouble is not serious, a slow, over-discharge followed by a careful recharging may help
	Sulfation	a) Battery left in discharged condition b) Battery left in fully charged condition for long period c) Working in a low state of charge d) Electrolyte level has decreased exposing plates e) High electrolyte density f) Electrolyte contaminated with electrolyte (oil or other organic compounds.)	If trouble is not serious, it can be corrected by overcharging at a current equal to 1/20 times the amp-hour capacity of the battery. For more serious trouble, repeat charging and discharging. In this case, start discharging at a current equal to 1/10 times the amp-hr. capacity of the battery and finish discharging at a rate equal to 1/20 times the capacity. Charge cycling as above with 1.05 specific gravity sulphuric acid, also helps. There is no countermeasure for extreme sulfation.
Separator	Carbonization	a) Excessive battery temperature b) High electrolyte specific gravity c) Buckling of positive plate	Impossible to cure.

Location of Trouble	Kinds of Trouble	Cause	Remedy
Electrolyte	Loss of Electrolyte	a) Cracked battery case b) Excessive battery cell temperature due to trouble such as a short circuit.	Discover and eliminate cause of temperature rise. Restore fluid level with distilled water. There is no pair for a damaged case
	Decrease in Specific gravity	a) Short circuit b) Insufficient charge c) Sulfation d) Excessive water added e) Water leaking in from outside	Inspect carefully for actual cause and take suitable steps to correct. If excess water has entered the battery, the specific gravity can be adjusted by adding additional electrolyte. The battery should be first charged until the specific gravity becomes constant.
	Contaminated by Impurities	a) Impurities such as sea water, hydrochloric acid, copper, iron nickel, or manganese have become mixed with electrolyte. b) Impure water has been added.	Discharge battery and drain electrolyte. Wash inside of cells with water several times and finally wash with distilled water Then, refill with electrolyte of specific gravity 0.03 to 0.05 higher than the electrolyte that was drained. Fully charge the battery and adjust specific gravity to the specific value.
Battery in General	Internal Short-Circuit	a) Short-circuit due to spongy lead at side or upper and lower portions of plates. b) Separator broken due to buckled plate c) Short-circuit at lower part of plates due to sediment d) Separator not correctly installed e) A metallic piece caught between plates f) Cell divider is broken	Impossible to cure.
	Self-Discharge	a) Impurities in electrolyte b) High electrolyte specific gravity when charged. c) High temperature	Replace contaminated electrolyte. Adjust improper specific gravity of electrolyte.
	Reverse Polarity	a) Battery was charged with reverse porarity	If trouble is not serious, recharging in the proper direction at low current will restore battery operation.

8) Troubles easy to break out and prevention

Couses and signs as to battery trouble are indicated in the preceoding list. You will see in Fig. 19 an instance after investigation about the states of troubles concerning out-of-order batteries, in which sulfations occupy more than half of all troubles. The causes apply to excessive discharging, long-time discharging (not replenished in charging in stock), insufficient charging made by generator and short electrolyte. Accordingly, you will understand how important it is to keep electrolyte level in the prescribed line and in fully charged state.

Percntage of battery troubles.

Fig. 19

9) Sulfation

It is generally called "sulfation" that white crystallized lead sulphate is generated on plates. If the battery is left in the state of discharging, fine-grains of lead sulphate dissolved in electrolyte become saturated, recrystallize when temperature lowers, and appear the crystallized lead sulphate outside as the crystallization of lead sulphate grows and advances.

Against such white-coloured crystallized lead, sulphate different from lead sulphate generated from simple discharging, it is difficult to recovery by charging.

Therefore it can be stated that sulfation is a fatal trouble to battery.

Also, sulfation breaks out when plates appear in the air due to short electrolyte. Besides, in the first filling of electrolyte into dry-charged battery, the inside of the battery changes white-coloured and shows similar aspect to sulfation if simple water is filled by mistake without sulphuric acid. But this is a little different in quality from sulfation. Yet it is quite same as sulfation in non-recovery even by charging.

SERVICE MANUAL

APPENDIX-3 TUNING UP

KAWASAKI HEAVY INDUSTRIES, LTD.

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SERVICE MANUAL

APPENDIX-3 TUNING UP

CONTENTS

1. Brief for tuning up

Although we call "tuning up" it is quite different according to the purposes, for professional and for amateur. In other words, components for "tuning" or necessary efficiencies which get from "tuning" are very different for the professional purpose of the factory racer and for the beginner. Thus the most important thing is to tune up according to the purpose of race and the technique of the driver, all in balance.

The KAWASAKI motorcycle has been selling the kit parts for cross country motorcycle and for road racer. These kit parts surely increase your engines power up, and thus we would recomend you to use kit parts for tuning up.

2. Cylinder head

An effective way to increase the compression ratio is to generate high power but if the compression ratio is increased too much an abnormal combustion (knocking) will occur and the output decrease. What is more it will be a cause of trouble such as damage of piston. Thus never increase the ratio beyond the specified limit.

1) Methods to increase the compression ratio are;

a. Use of a thin head gasket.
b. Grinding down the cylinder head, and
c. Grinding the upper part of the cylinder.

When you employ method b or c above, carefully grind to get a proper finish without having an incline or strain in the surface. Poor grinding may cause gas leakage and can not get a normal efficiency. Touch the finished surface on the surface plate and check whether both surfaces are closely touched or not for assuring if the surface is flat or not. Grind again or polish the un-flat part with sand-paper to get a flat surface if some part of the 2 surfaces do not touch closely each other or the finished plate totters on the surface plate. If the cylinder head or cylinder are extremely bored, the piston top may touch the inside of the cylinder head. Carefully bore, if it can not be helped, but not more than the specifiecated value.

2) Measurement of the compression ratio

a. Purpose

During the grinding process of the cylinder head or of the cylinder, each size is irregular a little for it is finished by hand, and so it is necessary to measure correctly the compression ratio to adjust for the rated valve.

b. Measurement of the capacity of the combustion chamber

Measure the capacity of the combustion chamber the following way. Set the piston to top dead center and inject oil (SAE #10~#20) up to plug setting level by burette or injector from plug hole as shown in Fig. 1.

Fig. 1

The injected oil capacity minus the plug screw capacity equals the capacity of combustion chamber.
Thus, capacity of combustion chamber
= Capacity up to plug level - Capacity of plug screw

Note

Capacity of plug screw is different from each type.
NGK, H type (Diameter of screw – mm) 1.1 cc

$$\text{Compression ratio} = \frac{\pi R^2 h + V}{V}$$

π: 3.14
R: ½ bore
h: height from cylinder top to top exhaust hole.
V: Capacity of combustion chamber.

c. Calculation method

The calculation of the compression ratio is made from the above mentioned capacity of combustion chamber, but the indication of compression ratio of a two cycle engine is different from that of a four cycle engine. In the two cycle engine, there is an exhaust port during the strokes, that indicates the practical compression ratio.

d. Example (90–GA)

(1) Standard: R=23.5 mm h=31.7 mm V=9.0 c.c.

$$\text{Compression ratio} = \frac{3.14 \times 2.35^2 \times 3.17 + 9.0}{9.0} = 7.11$$

(2) After tune up: R=23.5 mm h=27.9 mm V=7.2 c.c.

$$\text{Compression ratio} = \frac{3.14 \times 2.35^2 \times 2.79 + 7.2}{7.2} = 7.72$$

Model	Inside Dia. (mm)	Height from cylinder top to top exhaust hole (mm)	Capacity of combustion chamber (c.c.)	Comp. ratio
G 1 L (S.T.D)	49.0	31.5	10.4	6.7
(Modified)	49.0	27.8	8.5	8.0
G A (S.T.D)	47.0	31.7	9.5	7.1
(Modified)	47.0	27.9	7.2	7.7
B 1 L (S.T.D)	55.0	34.7	15.3	6.4
(Modified)	55.0	30.7	12.2	7.0
A 1 (S.T.D)	53.0	31.5	11.6	7.0
(Modified)	53.0	27.5	8.7	8.0
A 7 (S.T.D)	62.0	31.9	16.0	7.0
(Modified)	62.0	27.6	12.4	7.7

Table 1

3) Grinding of cylinder head

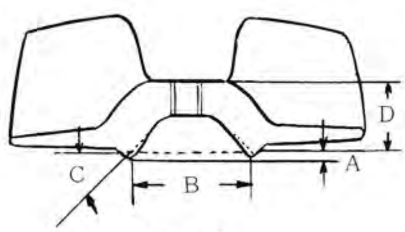

Fig. 2

Model	A	B	C	D	Remarks
G 1 L	1.0 mm	50 mm	20°		
G A	1.7 mm	47 mm	15°		
B 1 L	1.0 mm	56 mm	20°		
A 1	1.7 mm	53 mm	14°30	37.3 mm	
A 7	0.5 mm	62 mm	22°30	34.2 mm	

Table 2

3. Cylinder

1) Clearance between cylinder and piston

Before tuning the cylinder, decide the clearance between the piston and cylinder. If the clearance is too narrow, less than the specified value, the piston and the cylinder may seize; and if it is too wide, compression leakage may occur causing a decrease of power.

2) Port timing

Port timing of exhaust and scavenging ports of cylinder and the size of each port are closely related with engine output and efficiency; thus, carefully tune up.

See 4) "modification of cylinder" for the port change size of each kind.

3) Grinding of port

Compact high-speed grinder rotor, a unit file or sandpaper etc., are used according to the purpose for the grinding of ports. In using high-speed grinder, be careful not to overgrind. After grinding each port, file the passages with sandpaper to vent well, which has a good effect for increasing output. It is quite important to make the passage of each port smoothly to ventilate well and to rise the air supply ratio; thus it is possible to get high power. These things are well said in the G.P. racing machines, that their passage of ports are very smooth, like the surface of a mirror. Take chamfering (1 mm, Radius) around each port to prevent the break damages of piston ring.

4) Modification of cylinder

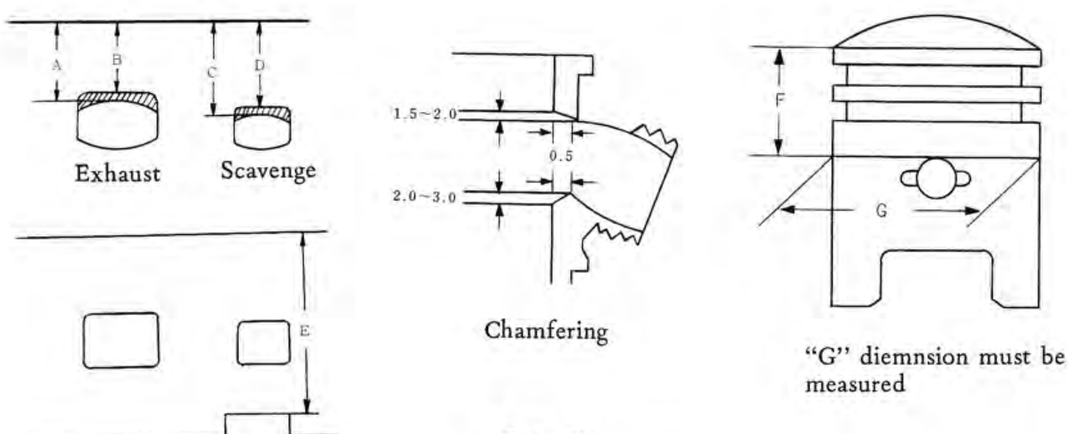

Fig. 3

Model	A	B	C	D	E	F	H (Clearance)	Remarks
G 1 L	31.5	27.5	38.3	36.8		25	0.135 – 0.140	
G A	31.7	29.7	42.2	40.3		25	0.135 – 0.140	
B 1 L	34.7	30.7	43.0	41.9		25	0.135 – 0.140	
A 1	31.5	29.5	44.7	44.0	87.5	25	0.130 – 0.140	Cut the upper of cylinder to 87.5 mm at "E". Use two sheet of cylinder base packing.
A 7	31.9	27.6	45.5	43.8	86.8	35	0.140 – 0.150	Cut the upper of cylinder to 86.8 mm at "E".

Table 3

4. Piston and piston ring

1) Piston

The most important thing in tuning the piston is to keep the proper clearance between the cylinder and the piston. Be sure to lap the piston pin inside the exhaust port to prevent possible seizure between the piston and the cylinder. Failure to do this results in the most common cause of seizure. As a result, the breaking-in period becomes short. Too much clearance, however, causes gas leakage and deteriorates the engine performance. The piston-pin hole should be so finished that the piston-pin can be inserted by pushing it in strongly by hand.

2) Ring

Racing-ring, which is commercially available in kit-parts, can withstand high revolution speed and high temperature and has a strong resistance against wear and loss of tensile strength. Since the thickness of a racing-ring is smaller than that of a standard ring, it becomes necessary to use a kit-parts piston in combination with the ring. Two each of standard 2nd ring can be used instead of the racing-ring. In this case proper fitting with the cylinder occurs sooner and the wearing of the cylinder lessens. These rings, however, should be replaced earlier because they have poor wear resistance.

5. Rotary valve

1) The rotary disc valve sucks the air and thus suction efficiency is much influenced by the notch angle of the disc valve. The shape of port and its timing of each suction, exhaust and scavenging are closely related mutually; thus if one of them changes it is hopeless to get a good effect. We changed before the shape of port and its timing of exhaust and scavenging; thus, suction of them must be changed too. Finish smoothly the notch part 8R of valve. The number of revolutions is continuously 9000 to 10000 rpm; thus slight scratches or cracks cause damage of the valve.

2) Modification of rotary valve

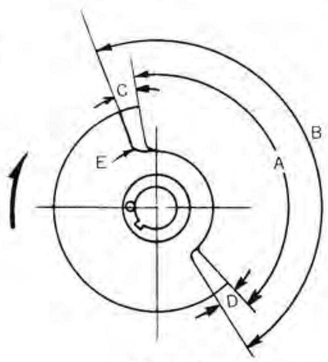

Fig. 4

Model	A	B	C	D	E	Remark
G 1 L		149°05	10.5mm	9.5mm	8 R	
G A		146°59	8.5mm	4.3mm	8 R	
B 1	119°07		15.5mm		8 R	Cut only "C" (Inlet close), leave "D" (Inlet open) as it is.
A 1	137°44	160°44	5.1mm	18.5mm	10 R	
A 7	137°44	160°44	5.1mm	18.5mm	10 R	At the sametime, enlarge on 35mm left and right crankcase (keep what had been done). Therefore the inlet angle extend 6 .

Table 4

3) **Valve timing**

Model		Inlet		Scavenging		Exhaust		Remark
		Open BTC	Close ATC	Open BBC	Close ABC	Open BBC	Close ABC	
G 1 L	Standard	110°	45°	56°40′		76°40′		
	Tune: up	120°	60°	64°55′		88°55′		
G A	Standard	120°	50°	57°30′		84°30′		
	Tune: up	140°	70°	65°		93°		
B 1 L	Standard	110°	45°	59°		80°		
	Tune: up	120°	55°	62°		89°		
A 1	Standard	112°	65°	60°05′		90°05′		
	Tune: up	130°	70°	62°		94°05′		
A 7	Standard	112°	65°	60°		91°		
	Tune: up	133°	73°	63°		98°30′		

Table 5

6. Valve retainer

Precautions in tuning the valve retainer. Inlet case of broading the inner hole of the valve retainer, pay attention to the following items for processing.

1) Broadening of the width A means that the inlet period becomes so much longer. In effect it is equivalent to widen the valve opening so much.

2) In the case of broadening the depth B, cut the bottom side slightly and grind the top side with grinding paper. If the length C becomes too short by overcutting the top side, compressed mixture gas will pass through it.

3) After the above works of 1 and 2, broaden the inlet port of the crankcase mating with the valve retainer hole.

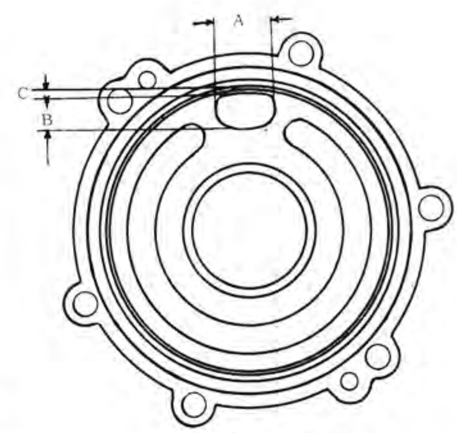

Fig. 5

7. Carburator

1) The output of the engine is proportionate to air intaking ratio; thus widen, the area of suction port and use large carburator. But there is a proper combination among suction, exhaust and scavenging and there is also limitation of width. If the carburator is very large, the spraying of fuel and combustion rate become bad. Install the carburator properly, for it is closely related to engine efficiency; therefore find the proper installing position by adjusting the main jet numbers and jet needle steps, judging from the degree of burnt out of plug and acceleration in repeating test runs. Mostly, proper efficiency can be get by adjusting the main jet and the jet needle. Adjust carefully; if the main jet is too small, seizure will occur.

2) Carburator setting

Model		Type	M J	N J	J N	P J	C A	A S	Remark
G 1 L	Standard	VM17SC	130	E–0	4H7–3	20	2.5	1½	
	Motocrosser	VM22SC	180	O–0	4 J 6–3	30	2.0	1¼	
G A	Standard	VM19SC	160	E–4	5 I 2–3	17.5	2.0	1½	
	Motocrosser	VM22SC	240	E–2	5 I 1–3	20	2.0	2.0	
	Road racer	VM22SC	260	E–4	5 I 2–4	17.5	2.0	1½	
B 1 L	Standard	VM22SC	190	O–0	4 J 6–2	30	2.0	1½	
	Motocrosser	VM24SC	220	O–0	5N1–3	45	2.5	1½	
A 1	Standard	VM22SC	150	O–6	4J13–3	30	2.5	1¼	
	Road racer	VM24SC		O–6	4 J 6–3	35	2.5	1¼	
A 7	Standard	VM26SC	190	O–4	4L6–3	40	2.5	1.0	
	Road racer	VM28SC		O–4	5E14–4	30	2.5	1½	

Table 6

8. Mixing ratio

Set the mixing ratio to 16 – 18:1 during the running-in period and 18 – 20:1 after the running-in period. Use high octane value gasoline. Mix it with the excellent quality oil which is specifically prepared for a 2 cycle engine. (Generally, "Castro R30" or "Super M" of Shell Petroleum Co., is used.) The mixing ratio of gasoline and oil is shown in the following table.

Oil / Mixing ratio / Gasoline	Oil (c.c.)					
	15 : 1	16 : 1	17 : 1	18 : 1	19 : 1	20 : 1
5 ℓ	330 c.c.	310 c.c.	300 c.c.	280 c.c.	260 c.c.	250 c.c.
6	4001	370	350	330	310	300
7	460	440	410	390	370	350
8	530	500	470	440	420	400
9	600	560	530	500	470	450
10	670	620	590	550	520	500

Table 7

9. Oil pump

In the case of modification of the standard model with a separate lubricating device into a moto-crosser, the oil pump gear and oil pump are not necessary because the moto-crosser employes the mixing-lubricating method. Since the transmission oil drains out if the oil pump is removed, suitable blind plate must be attached on its position.

10. Air cleaner

In the case of a road-racer, no air cleaner is required since the road is well paved. However, as for a moto-crosser, dust proofing, water proofing, etc., are necessary. The decrease of the inlet air quantity is rather worse even if water and dust can be perfectly shut out. The air cleaner of kit-parts is generally used as countermeasures.

11. Muffler

The term "tuning up" means to improve the efficiency by using exhaust inertia of muffler; thus the muffler is the most important element to improve efficiency. It is natural to test several hundreds mufflers for the tuning up of the G.P. racing mackines. Muffler for racing has not a silincer and looks very simple but it is made correctly to improve the filling up efficiency after repeating many examinations. When you make it for yourself, cut a mild steel plate of 0.8 1.0 mm in thickness, according to the specified dimension and finish it so that you riding pose may not be affected. After fabrication, apply black heat-resisting enamel to increase heat radiation.

Muffler dimension (mm)

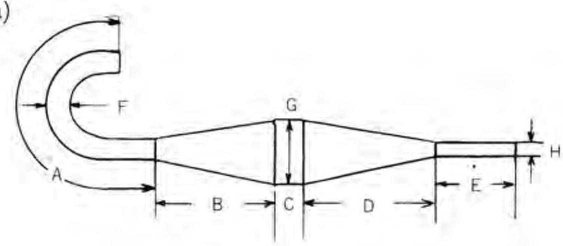

Fig. 6

Model	A	B	C	D	E	F	G	H	Remark
G 1 L	200	300	160	240	200	32⌀	80⌀	19⌀	
B 1 L	300	300	160	240	200	38⌀	80⌀	19⌀	
A 1	230	300	150	200	300	38⌀	100⌀	22⌀	
A 7	230	370	150	200	300	45⌀	100⌀	22⌀	

Table 8

12. Port inside and joint

In the case of cutting or grinding ports, it is necessary to fit the mating surface of the related parts tight; for example, the joint between the cylinder bottom and the cylinder base packing or the crankcase, the joint between the valve retainer and the inlet port of the crankcase.

Uneven joint means the protrusion where the flow resistance of mixture gas increases due to eddy. In the case of grinding the inner surface of the port, grind the whole passage entirely, or a large effect can not be assured.

13. Ignition method

There are two ignition methods, magneto ignition and battery ignition; both are accompanied by the charging system. As for the moto-crosser, remove the parts mentioned below to reduce the weight and obtain superior acceleration and deceleration characteristics.

1) Battery ignition method

a. Remove the coil from the armature, leaving the shaft only.
b. Remove the parts related to the field coil and the brush, leaving the yoke body, condenser, point and point cam.
c. Regulator assembly
d. Main switch (change it for a rotating type switch or push switch)

(1) In the case of changing the magneto ignition method to the battery ignition method, remove the lighting and ignition coils which will not be necessary, since the latter method uses a 12V battery as the power source. Take care not to cut off the wiring of the point and condenser, since they are still in need.

Remove the cam from the fly-wheel by taking out 6 rivets which fasten the two removing their heads by chipping or grinding, since the cam is needed to move the point. Replace the ignition coil of 6V by that of 12V. As the main switch, install the simple switch of either rotating or push type in which it is easy to know the on-off position.

2) Magneto ignition method

a. Rectifier
b. Battery
c. Main switch (stop the engine while the transmission gears are in operation.)

To adjust ignition timing, adjust point gap (ignition timing becomes advance with wide gap) or move the magneto base to left or right by enlarging two fitting holes.

To adjust ignition timing correctly, dial gauge (special tool) must be used to read piston position before T D C.

14. Spark plug

Use NGK's B–8HN, B–9HN or B–10HN for the sparking plug. Decide the proper one according to the degree of seizure in each test run. For example, use B–9HN if seizuring occurs, using B–8HN. (around the center electrode becomes white)

If it is raining, use a completely water-proof plug cap or bind with an insulation tape (vinyl tape) the connecting part of the sparking plug, the plug cap and the high voltage code, to prevent leakage between the plug cap and the cylinder head.

15. Enging sprocket and rear wheel sprocket

1) Engine sprocket

Model	Parts No. New	Parts No. Old	Secondary Chain No.	Teeth No.	Interchange-ability	Remarks
J1 Speed Kit	13144–007	2710–9113	420	12	yes	
J1M, G1M	13144–009	2610–3621		14		
J1, G1	13144–006	2010–3621		15		
J1TR, G1TR	13144–008	2210–3621		16		
D1 Speed Kit	13144–010	D1710–9161	428	13	yes	
B8M, B1M, F21M, F2 Speed Kit	13144–004	340–0621		14		
D1, C2SS, B1, B8, F1, F2	13144–005	310–0621		15		
C1, C2TR, F1TR, F2TR, F3	13144–016	F1250–0621		16		
GA Speed Kit	13144–031		428	13	yes	
GA1, GA2, G3	13144–014	725100–3643		14		
GA Speed Kit	13144–032			15		
Option	13144–033		525	14	yes	
F4	13144–028	758131–3621		15		
Option	13144–034			16		
Option	13144–017	A1010–3621–1	525	14	yes	
A1, A1SS	13144–025	–3621		15		
A1R	13144–018	–3621–2		16		
Option	13144–019	A1510–3621		17		
A7	13144–022	A7010–3621	530	15	yes	
Option	13144–023	A7010–3621–1		16		
W2SS	13144–024	W2320–3621		18		
K2, W1	13144–021	6010–3621		19		
Option	13144–035		530	14	yes	
	13144–030			15		
H1	13144–036			16		

* **Note** Don't use New Part No. for Parts ordering if old Part No. is available until next formal information.

Table 9

2) Rear wheel sprocket

Model	Parts No. New	Parts No. Old	Secondary Cheir No.	Teeth No.	Interchange-ability	Remarks
J1T	42041–008	2120–2481	420	34	yes	
G1	42041–038	G1020–2481		36		
J1, J1TR, G1TR	42041–007	2020–2481		37		
M10, M11	42041–002	0320–2481		39		
J1M, G1M	42041–011	2620–2481		44		
D1 Speed Kit		D1720–9165	428	28	yes	
D1	42041–015	D1140–2481		32		
C2SS	42041–019	C2320–2481		34		
GA2	42041–022	725610–2491		36		
C2TR	42041–020	C2320–8941		37		
GA1	42041–045	725612–2491		39		
G3TR	42041–051	725618–2491		42		
F2 (B11)	42041–025	F2180–2463	428	38	yes	
F3	42041–040	756831–2491		39		
B8S, F1	42041–023	330–2463		40		
B8, B1	42041–005	310–2463		42		
F1TR, F2TR, F3	42041–013	F1261–2491		44		
F21M	42041–031	F21420–2463		50		
B1M	42041–012	B1440–2463		53		
SG	42041–024	5020–6761	525	37	yes	
A1SS, F4	42041–029	A1320–2481		39		
K2, W1	42041–034	6020–6761	530	41	yes	
W1S, W2	42041–036	W2320–6761		42		
H1	42041–047		530	43	yes	
H1 Option	42041–046			45		

* **Note** Don't use New Part No. for Parts ordering if old Part No. is available until next formal information.

Table 10

16. Modification of frame

1) Removal parts

Remove unnecessary parts. Preserving the parts for rider according to the road traffic control law are dangerous in race; thus, remove the following parts according to the race rule (Motorcycle Association).

Lamps: Head lamp (speed meter), Tail lamp, Stop lamp, Flashing lamp
Back mirror
Stands: Main stand, Side stand, Parcel rack, Chain case, Metal fittings for number plate, Horn and Flashing relay, Wire harness, Head lock, Tandemstep and other unnecessary parts

2) Change for wheel

a. Knobby tire

The knobby tire intrudes strongly into the road fits better for unpaved road running. The rear driving wheel does not slip in the mud and shows a strong driving force. The air pressure of the tire should be rather high in solid road condition and in running fast, and be rather low in weak road condition (if there is plenty of mud in the course).

b. Bead stopper

If the air pressure of the tire is low and the drive force is strong, the tire bead slips on the rims and breaks the tube; thus use two bead stoppers in the rear wheel to stop slipping. It is unnecessary to use the stopper in the front wheel. If it is difficult to get the bead stopper, insert a rubber or a 50-100 mm used tube between the tire and the rim.

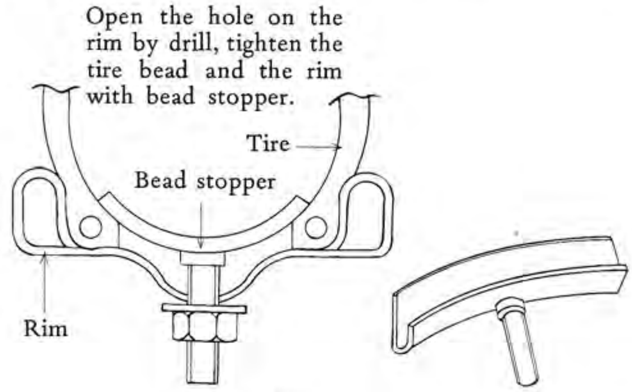

Fig. 7

c. Retighening of the spoke

Tighten the spoke strongly to keep its tension, which loosens easily by deformation of the rim in jumping or running on irregular roads. Tighten carefully not to damage the nipple and to distort the rim.

3) Change of the front and rear fenders

a. In the standard motorcycle, the gap between the front fender and the tire is about 15 mm and this is not sufficient. Install the fender under the bracket of the front fork in order to brake immediately without taking mud between the fender and the tire. Fender should be minimized up to only the necessary parts.

b. Rear fender

The rear fender should also be minimized as shown in Fig. 9 for the same reason as the front fender.

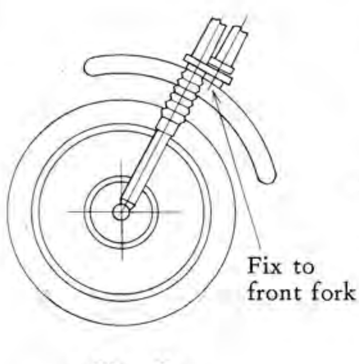

Fig. 8

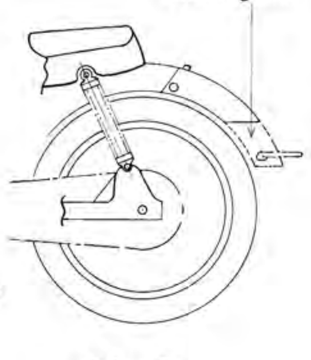

Fig. 9

4) Change of riding position

When racing in a bad road, rough driving is natural, sometimes there are jumps of the motorcycle, falls or tumbles, and thus the driving posture shakes rapidly in any direction. Change the riding position depending upon the shaking and strengthen the necessary parts.

a. Handle

With the up handle change it to be wide and strong. Connect the bars at right and left by about 16⌀ pipe as shown in Fig. 10 and the strength will improve very much. Take a light grip, and a small rotation angle (about 60°) in opening the throttle fully.

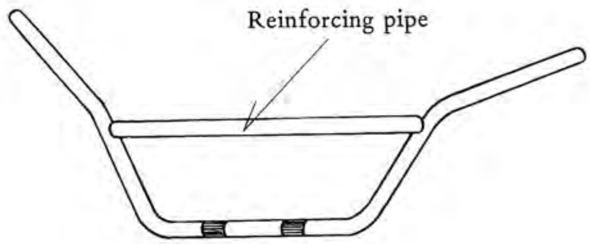

Fig. 10

Take a light grip, and a small rotation angle (about 60°) in opening the throttle fully.

b. Cables

If the shape of the handle changes, the cables of a standard motorcycle could be too short. The cables should have a proper length without pulling each other or slackening, passing through the required parts and fixed on them, in full steering the handle.

c. Seat

A semilong type should be used and a smooth surface leather is the most convenient to take a free riding posture.

d. Foot rest

Strengthen the foot rest so that it does not bend when the rider jumps on it with his full weight. Weld the 13⌀ steel pipe along to the foot rest bar and also weld the welding rod to the step part and have some paddings for non-slip. The width and height of the foot rest do not need any change, but if you feel some anxiety to touch the barriers, adjust the width and height which are ideal sizes for motocrosser. (Fig. 11) In order to minimize dangers finish the top edge of the foot rest bar in a round way.

Fig. 11

5) Fuel tank

Check and maintain the flow regularly, so that the fuel flows smoothly up to the carburator. If the filter of the fuel cock and the oil guide port get stuffed, or if the air passage port of the tank cap get stuffed, the motorcycle will stop by lack of gas and engine seizures will occur; therefore with a drill bore a 2 mm air passage to the upper tank cap.

6) Sprocket and chain

By increasing the 2nd speed reduction ratio, replace the sprocket in order to enlarge the driving torque of the rear wheel. The number of teeth should be chosen according to the condition of the course, engine efficiency or the rider's wish. Replace the chain according to the sprocket (increase the link number of chain). Bind the clip of chain joint by small wire not to loose. The clip should take the direction as shown in Fig. 12 against chain forward direction. If the output increases more than 50% of standard bike by tuning up the engine, replace the chain to 420 T. Then the strength and endurance of the chain are sufficient enough and if there is some caulking tool, it is possible to caulk pin, the same as link, endlessly.

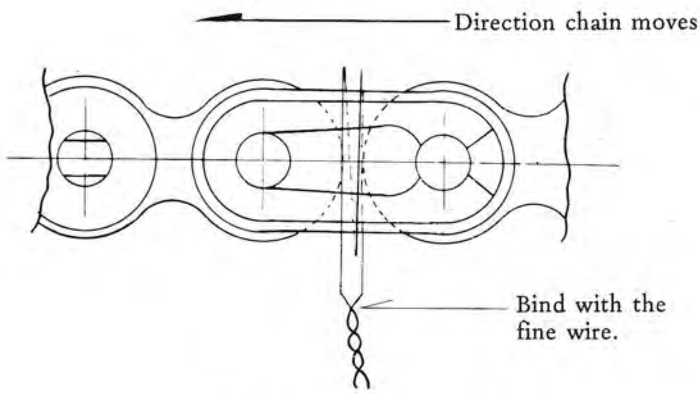

Fig. 12 Chain · joint