troubleshooting motorcycle carburetor and electrical systems

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CHAPTER ONE

GENERAL INFORMATION

This book was written to provide complete service information on motorcycle carburetors and electrical systems. Operating principles, adjustment procedures, and troubleshooting methods are discussed in detail.

SERVICE HINTS

All procedures described in this manual can be performed by anyone who is reasonably handy with tools. Special tools are required for some procedures; their operation is described and illustrated. Sources of supply for special tools are suggested, together with their approximate cost. It should be borne in mind that many of these tools will pay for themselves after the first or second usage.

Service will be far easier if the machine is clean before beginning work. There are special cleaners for washing the engine and related parts. Just brush or spray on the cleaning solution, let it stand, then rinse it away with a garden hose. Clean all oily or greasy parts with cleaning solvent as they are removed. *Never use gasoline as a cleaning agent*, as it presents an extreme fire hazard. Be sure to work in a well-ventilated area when using cleaning solvent. Keep a fire extinguisher handy, just in case.

Before undertaking a job, read the entire section in this manual which pertains to it. Study the illustrations and text until you have a good idea of what is involved. If special tools are required, make arrangements to get them before starting. It's frustrating and sometimes expensive to get under way and then find that you are unable to complete the job.

TOOLS

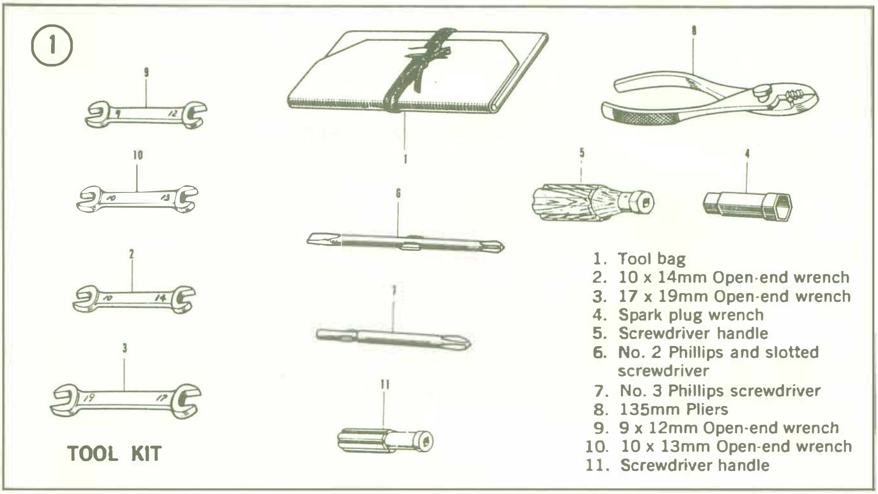
Every motorcyclist should carry along a small tool kit in order to make minor roadside adjustments and repairs. A suggested kit, available through most dealers, is shown in **Figure 1**.

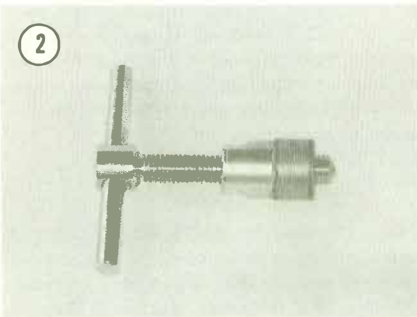
An assortment of ordinary hand tools is also required. As a minimum, have the following available:

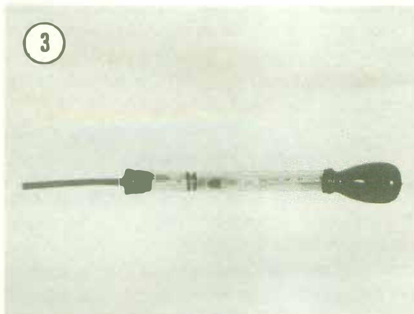
1. Combination wrenches
2. Socket wrenches
3. Assorted screwdrivers
4. Pliers
5. Feeler gauges
6. Small hammer
7. Plastic mallet
8. Parts cleaning brush

Some procedures require a few special tools. Serious motorcycle hobbyists will probably have many of them.

1. *Flywheel puller* (**Figure 2**). Almost every single-cylinder, 2-stroke bike requires that the flywheel be removed to gain access to the ignition points. A flywheel puller costs around $6,





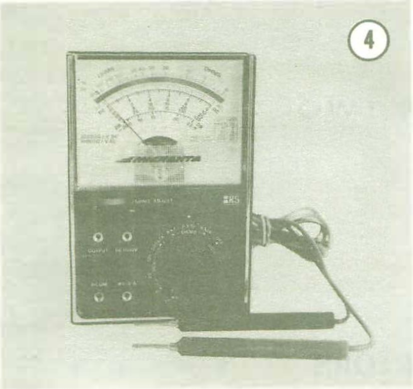


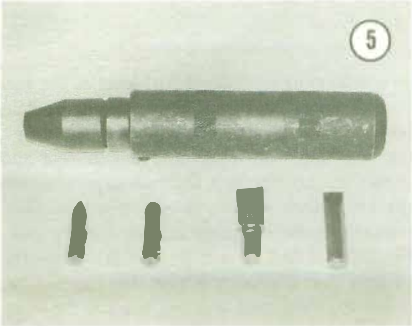
and is available at most motorcycle shops and and also by mail order from accessory dealers. Be sure to specify the make and model of your machine when ordering. There is no satisfactory substitute for this tool, but there have been many unhappy owners who have had to buy expensive new crankshafts and flywheels after trying makeshift flywheel removal methods.

2. *Hydrometer* (**Figure 3**). This instrument measures the state of charge of the battery, and tells much about battery condition. Such an instrument is available at any auto parts store and through most larger mail order outlets, and costs less than $3.

3. *Multimeter, or VOM* (**Figure 4**). This instrument is invaluable for electrical system troubleshooting and service. A few of its functions may be duplicated by locally fabricated substitutes, but for the serious hobbyist, it is a must. Its uses are described in the applicable sections of this book. Prices start at around $10 at electronics hobbyist stores and mail order outlets.

4. *Impact driver* (**Figure 5**). This tool might have been designed with the motorcyclist in mind. It makes removal of engine cover screws easy, and eliminates damaged screw slots. Good ones run about $12 at larger hardware stores.





EXPENDABLE SUPPLIES

Certain expendable supplies are also required. These include grease, oil, gasket cement, wiping rags, cleaning solvent, and distilled water. Cleaning solvent is available at many service stations. Distilled water, required for battery service, is available at every supermarket. It is sold for use in steam irons, and is quite inexpensive.

SAFETY PRECAUTIONS

Professional mechanics can work for years without sustaining serious injury. If you observe a few rules of common sense and safety, you can also enjoy many safe hours servicing your own machine. You can also hurt yourself or damage the bike if you ignore these rules:

1. Never use gasoline as a cleaning solvent.
2. Never smoke or use a torch near flammable liquids, such as cleaning solvent in open containers.
3. Never smoke or use a torch in an area where batteries are charging. Highly explosive hydrogen gas is formed during the charging process.
4. If welding or brazing is required on the machine, remove the fuel tank to a safe distance, at least 50 feet away.
5. Be sure to use properly sized wrenches for nut turning.
6. If a nut is tight, think for a moment what would happen to your hand should the wrench slip. Be guided accordingly.
7. Keep your work area clean and uncluttered.
8. Wear safety goggles in all operations involving drilling, grinding, or use of a chisel.
9. Never use worn tools.
10. Keep a fire extinguisher handy. Be sure that it is rated for gasoline and electrical fires.

CHAPTER TWO

CARBURETORS

This chapter discusses carburetor operating principles, adjustment, and troubleshooting. Also included are step-by-step disassembly procedures for numerous carburetors representative of most makes and types.

CARBURETOR OPERATION

For proper operation, a gasoline engine must be supplied with fuel and air, mixed in the proper proportions by weight. A mixture in which there is an excess of fuel is said to be rich. A lean mixture is one which contains insufficient fuel. It is the function of the carburetor to supply the proper mixture to the engine under all operating conditions.

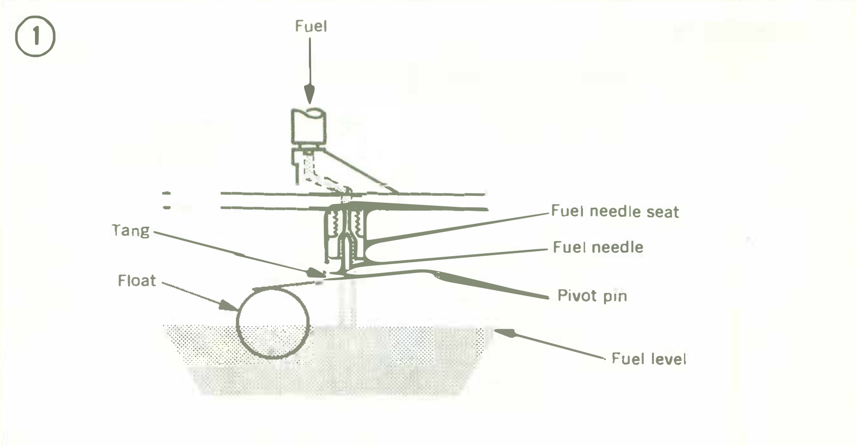
Essential functional parts of most carburetors are a float and float valve mechanism for maintaining a constant fuel level in the float bowl, a pilot system for supplying fuel at low speeds, a main fuel system which supplies the engine at medium and high speeds, and a starter system, which supplies the very rich mixture needed to start a cold engine. Operation of each system is discussed in the following paragraphs.

Float Mechanism

Figure 1 illustrates a typical float mechanism. Proper operation of the carburetor is dependent on maintaining a constant fuel level in the carburetor bowl. As fuel is drawn from the float bowl, the float level drops. When the float drops, the float valve moves away from its seat and allows fuel to flow past the valve and seat into the float bowl. As this occurs, the float rises, pressing the valve against its seat, thereby shutting off fuel flow. It can be seen from this discussion that a small piece of dirt trapped between the valve and seat can prevent the valve from closing and allow fuel to rise beyond the normal level, resulting in flooding. **Figure 2** illustrates this condition.

Pilot System

Under idle or low speed conditions, at less than one-eighth throttle, the engine doesn't require much fuel or air, and the throttle valve is almost closed. A separate pilot system is required for operation under such conditions. **Figure 3** illustrates pilot system operation. Air is drawn through the pilot air inlet and controlled by the pilot air screw. This air is then mixed with fuel drawn through the pilot jet. The air/fuel mixture then travels from the pilot outlet into the main air passage, where it is further mixed with air prior to being drawn into the engine. The pilot air screw controls the idle mixture.



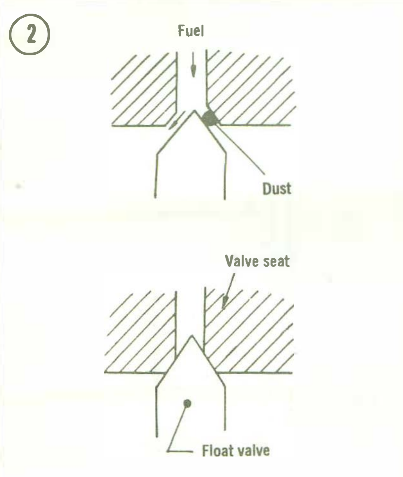


Table 1 **PILOT SYSTEM TROUBLESHOOTING**

Too Rich
Clogged pilot air intake
Clogged air passage
Clogged air bleed opening
Pilot jet loose
Starter lever not returned
Starter plunger not closed
Starter cable misadjusted
Too Lean
Obstructed pilot jet
Obstructed jet outlet
Worn throttle valve
Carburetor mounting loose

If the proper idle and low speed mixture can not be obtained within the normal adjustment range of the idle mixture screw, refer to **Table 1** for possible causes.

Main Fuel System

As the throttle is opened still more, up to about one-quarter open, the pilot circuit begins to supply less of the mixture to the engine, and the main fuel system, illustrated in **Figure 4**, begins to function. The main jet, needle jet, jet needle, and air jet make up the main fuel circuit.

As the throttle valve opens more than about one-eighth of its travel, air is drawn through the main port, and passes under the throttle valve in the main bore. Air stream velocity results in reduced pressure around the jet needle. Fuel then passes through the main jet, past the needle jet

THROTTLE OPENING — 0 TO 1/8

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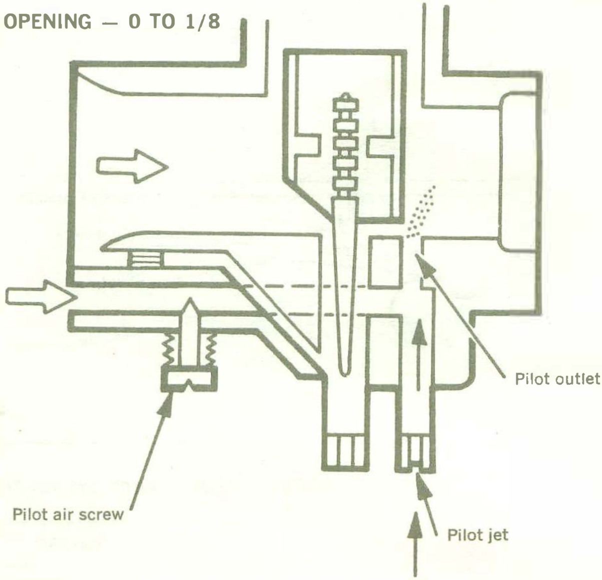

THROTTLE OPENING — 1/8 TO 1/4

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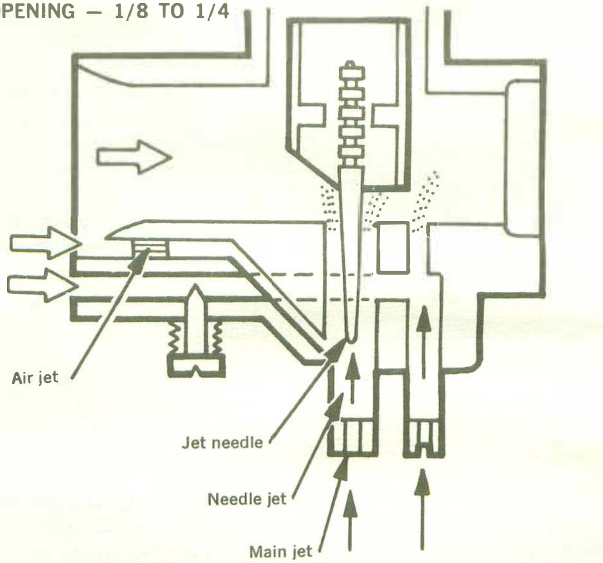


and jet needle, and into the air stream where it is atomized and sent to the cylinder. As the throttle valve opens, more air flows through the carburetor, and the jet needle, which is attached to the throttle slide, rises to permit more fuel to flow.

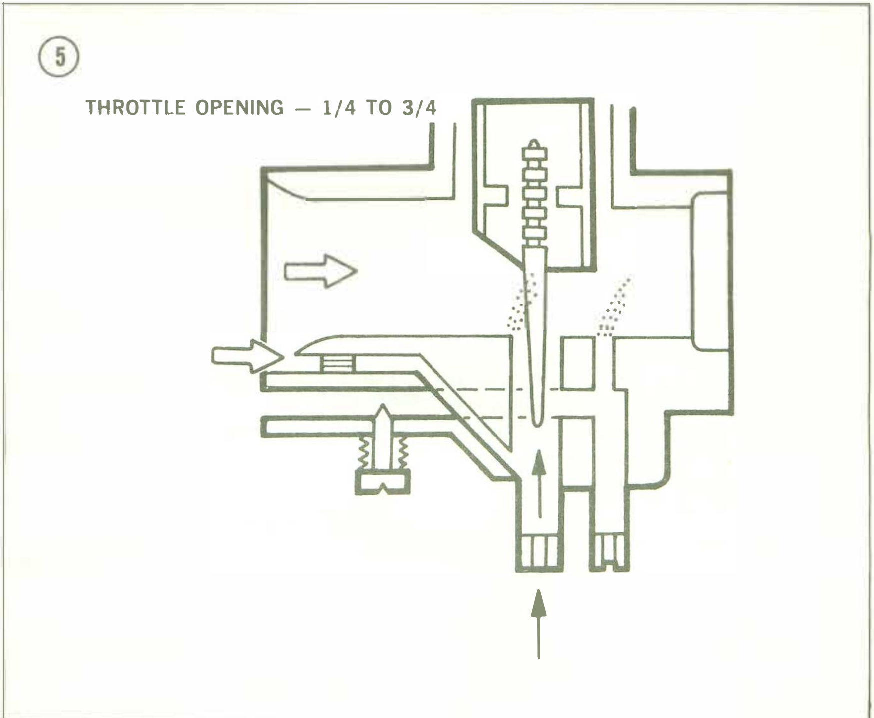
A portion of the air bled past the air jet passes through the needle jet bleed air inlet into the needle jet, where the air is mixed with the main air stream and atomized.

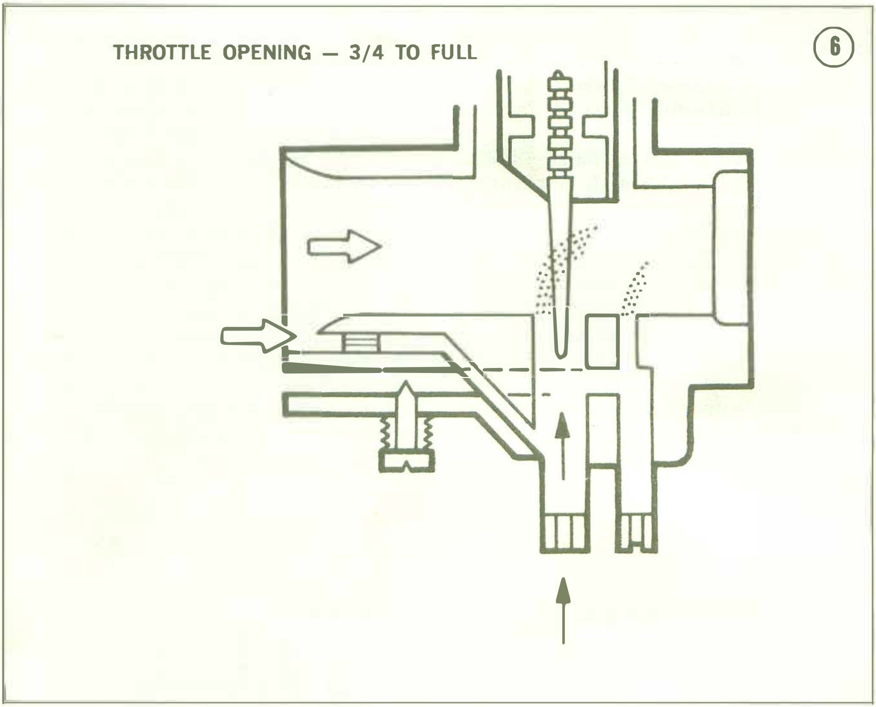
Airflow at small throttle openings is controlled primarily by the cutaway on the throttle slide.

As the throttle is opened wider, up to about three-quarters open, the circuit draws air from two sources, as shown in **Figure 5**. The first source is air passing through the venturi; the second source is through the air jet. Air passing through the venturi draws fuel through the needle jet. The jet needle is tapered, and therefore allows more fuel to pass. Air passing through the air jet passes to the needle jet to aid atomization of the fuel there.

Figure 6 illustrates the circuit at high speeds. The jet needle is withdrawn almost completely from the needle jet. Fuel flow is then controlled by the main jet. Air passing through the air jet continues to aid atomization of the fuel as described in the foregoing paragraphs.

Any dirt which collects in the main jet or in the needle jet obstructs fuel flow and causes a lean mixture. Any clogged air passage, such as the air bleed opening or air jet may result in an overrich mixture. Other causes of a rich mixture are a worn needle jet, loose needle jet, or loose main jet. If the jet needle is worn, it should be replaced, however it may be possible to effect a temporary repair by placing the needle jet clip in a higher groove.





Starter System

A cold engine requires a very rich mixture. The three most common methods for enriching the mixture are a tickler system, which operates by flooding the float chamber; a choke system, which blocks airflow into the carburetor; and a starter system, which uses engine vacuum to draw extra fuel into the carburetor through a starter jet. These systems are used singly or in combination to suit the needs of various carburetor/engine combinations.

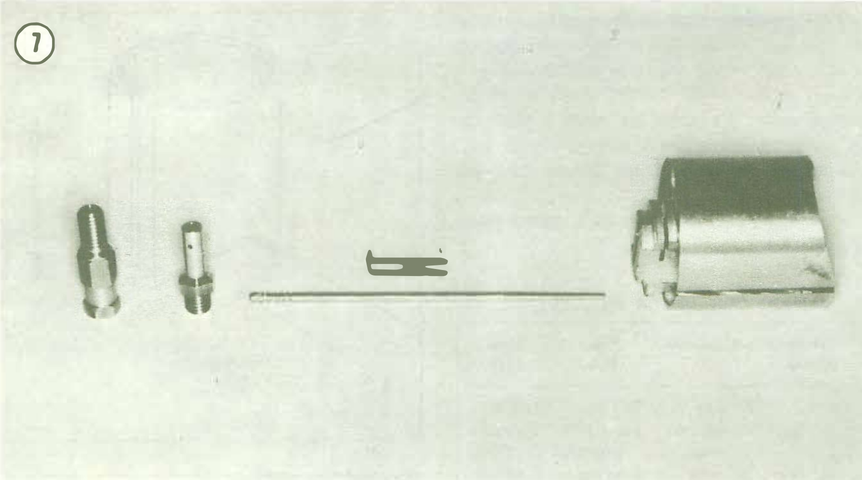
CARBURETOR ADJUSTMENT

The carburetor was designed to provide the proper mixture under all operating conditions. Little or no benefit will result from experimenting. However, unusual operating conditions such as sustained operation at high altitudes, or unusually high or low temperatures, may make modifications to the standard specifications desirable. The adjustments described in the following paragraphs should only be undertaken if the rider has definite reason to believe they are required. Make the tests and adjustments in the order specified.

Figure 7 illustrates those carburetor components which may be changed to meet individual operating conditions. Shown left to right are the main jet, needle jet, jet needle and clip, and throttle valve.

Make a road test at full throttle for final determination of main jet size. To make such a test, operate the motorcycle at full throttle for at least two minutes, then shut the engine off, release clutch, and bring machine to a stop.

If at full throttle, the engine runs "heavily," the main jet is too large. If the engine runs better by closing the throttle slightly, the main jet is too small. The engine will run at full throttle evenly and regularly if the main jet is of the correct size.



After each such test, remove and examine the spark plug. The insulator should have a light tan color. If the insulator has black sooty deposits, the mixture is too rich. If there are signs of intense heat, such as a blistered white appearance, the mixture is too lean.

As a general rule, main jet size should be reduced approximately five percent for each 3,000 feet (1,000 meters) above sea level.

Table 2 lists symptoms caused by rich and lean mixtures.

Adjust the pilot air screw as follows.

1. Turn the pilot air screw in until it seats lightly, then back it out about one and one-half turns.
2. Start the engine and warm it to normal operating temperature.
3. Turn the idle speed screw until the engine runs slower and begins to falter.
4. Adjust the pilot air screw as required to make the engine run smoothly.
5. Repeat Steps 3 and 4 to achieve the lowest stable idle speed.

Next, determine the proper throttle valve cutaway size. With the engine running at idle, open the throttle. If the engine does not accelerate smoothly from idle, turn the pilot air screw in (clockwise) slightly to enrich the mixture. If the condition still exists, return the air screw to its original position and replace the throttle valve with one having a smaller cutaway. If engine operation becomes worse by turning the air screw, replace the throttle valve with one having a larger cutaway.

Table 2 CARBURETOR TROUBLESHOOTING

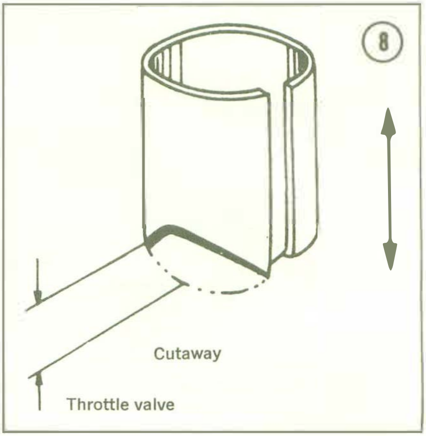
Condition	Symptom
Rich mixture	Rough idle Black exhaust smoke Hard starting, especially when hot "Blubbering" under acceleration Black deposits in exhaust pipe Gas-fouled spark plugs Poor gas mileage Engine performs worse as it warms up
Lean mixture	Backfiring Rough idle Overheating Hesitation upon acceleration Engine speed varies at fixed throttle Loss of power White color on spark plug insulator Poor acceleration

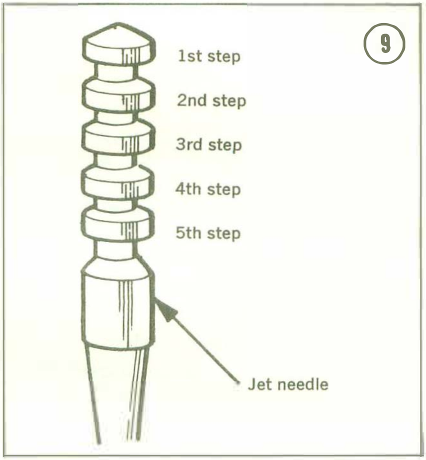
For operation at one- to three-quarters throttle opening, adjustment is made with the jet needle. Operate the engine at half throttle in a manner similar to that for full throttle tests described earlier. To enrich the mixture, place the jet needle clip in a lower groove. Conversely, placing the clip in a higher groove leans the mixture.

A summary of carburetor adjustments is given in **Table 3**.

Table 3 CARBURETOR ADJUSTMENTS

Throttle Opening	Adjustment	If too Rich	If too Lean
0 - 1/8	Air screw	Turn out	Turn in
1/8 - 1/4	Throttle valve cutaway	Use larger cutaway	Use smaller cutaway
1/4 - 3/4	Jet needle	Raise clip	Lower clip
3/4 - full	Main jet	Use smaller number	Use larger number





CARBURETOR COMPONENTS

The following paragraphs describe the various components of the carburetor which may be changed to vary the performance characteristics.

Throttle Valve

The throttle valve cutaway (**Figure 8**) controls airflow at small throttle openings. Cutaway sizes are numbered. Larger numbers permit more air to flow at a given throttle opening and result in a leaner mixture. Conversely, smaller numbers result in a richer mixture.

Jet Needle

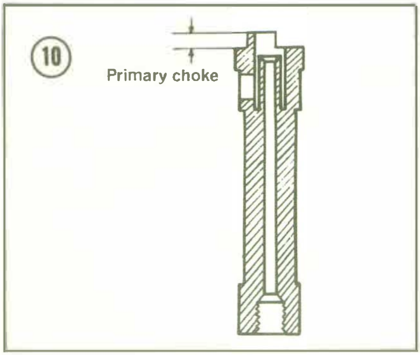
The jet needle (**Figure 9**), together with the needle jet, controls the mixture at medium speeds. As the throttle valve rises to increase airflow through the carburetor, the jet needle rises with it. The tapered portion of the jet needle rises from the needle jet and allows more fuel to flow, thereby providing the engine with the proper mixture at up to about three-quarters throttle opening. The grooves at the top of the jet needle permit adjustment of the mixture ratio in the medium speed range.

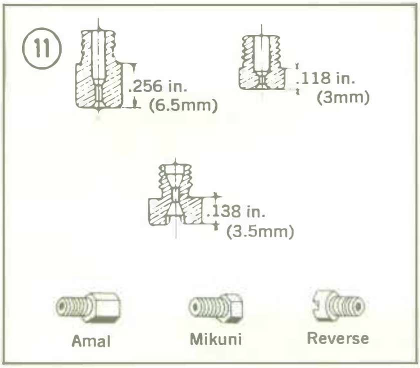
Needle Jet

The needle jet (**Figure 10**) operates with the jet needle. Several holes are drilled through the side of the needle jet. These holes meter the airflow from the air jet. Air from the air jet is bled into the needle jet to assist in atomization of the fuel.

Main Jet

The main jet (**Figure 11**) controls the mixture at full throttle, and has some effect at lesser





throttle openings. Each main jet is stamped with a number. Fuel flow is approximately proportional to the number. Larger numbers provide a richer mixture.

MISCELLANEOUS CARBURETOR PROBLEMS

Water in the carburetor float bowl and sticking carburetor slide valves can result from careless washing of the motorcycle. To remedy the problem, remove and clean the carburetor bowl, main jet, and any other affected parts. Be sure to cover the air intake when washing the machine.

Be sure that the ring nut on top of each carburetor is neither too tight nor too loose. If the carburetor mounting cinch bolt is loose, the carburetor can pivot, resulting in an improper mixture because the float level is changed.

If gasoline leaks past the float bowl gasket, high speed fuel starvation may occur. Varnish deposits on the outside of the float bowl are evidence of this condition.

Dirt in the fuel may lodge in the float valve and cause an overrich mixture. As a temporary measure, tap the carburetor lightly with any convenient tool to dislodge the dirt. Clean the fuel tank, petcock, fuel line, and carburetor at the first opportunity, should this occur.

Check the starter plunger occasionally on carburetors so equipped. The neoprene seal on the bottom may become damaged. If this occurs, fuel will leak into the chamber and eventually work its way into the carburetor venturi, causing the machine to run rich.

CARBURETOR OVERHAUL

There is no set rule regarding frequency of carburetor overhaul. A carburetor used on a machine used primarily for street riding may go 5,000 miles without attention. If the machine is used in dirt, the carburetor might need an overhaul in less than 1,000 miles. Poor engine performance, hesitation, and little or no response to idle mixture adjustment are all symptoms of possible carburetor malfunctions. As a general rule, it is good practice to overhaul the carburetor each time you perform a routine decarbonization of the engine.

Remove the carburetor from the engine and disassemble it. Shake the float to check for gasoline inside. If fuel leaks into the float, the float chamber fuel level will rise, resulting in an overrich mixture. Replace the float if it is deformed or leaking.

Replace the float valve if its seating end is scratched or worn. Press the float valve gently with your finger and make sure that the valve seats properly. If the float valve does not seat properly, fuel will overflow, causing an overrich mixture and flooding the float chamber whenever the fuel petcock is open.

Clean all parts in carburetor cleaning solvent. Dry the parts with compressed air. Clean the jets and other delicate parts with compressed air after the float bowl has been removed. Use new gaskets upon reassembly.

Never blow compressed air into any assembled carburetor; doing so may result in damage to the float needle valve.

The remainder of this chapter is devoted to step-by-step disassembly procedures for various types of carburetors. A broad enough sampling of types and models has been chosen so that no bike owner need fear carburetor disassembly.

AMAL CARBURETORS

Amal carburetors are built in both England and Spain, and are standard equipment on most bikes manufactured in those countries. They are available in both Monobloc (**Figure 12**) and concentric (**Figure 13**) styles.

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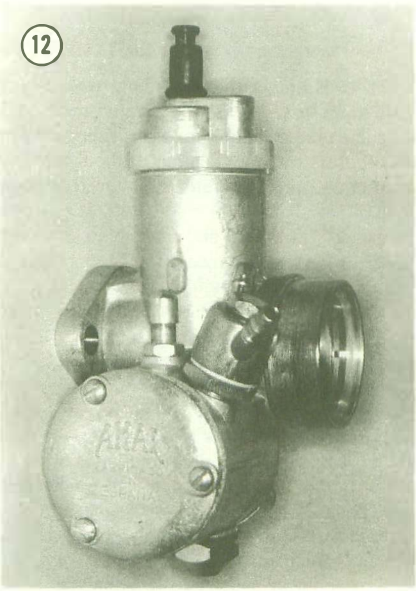


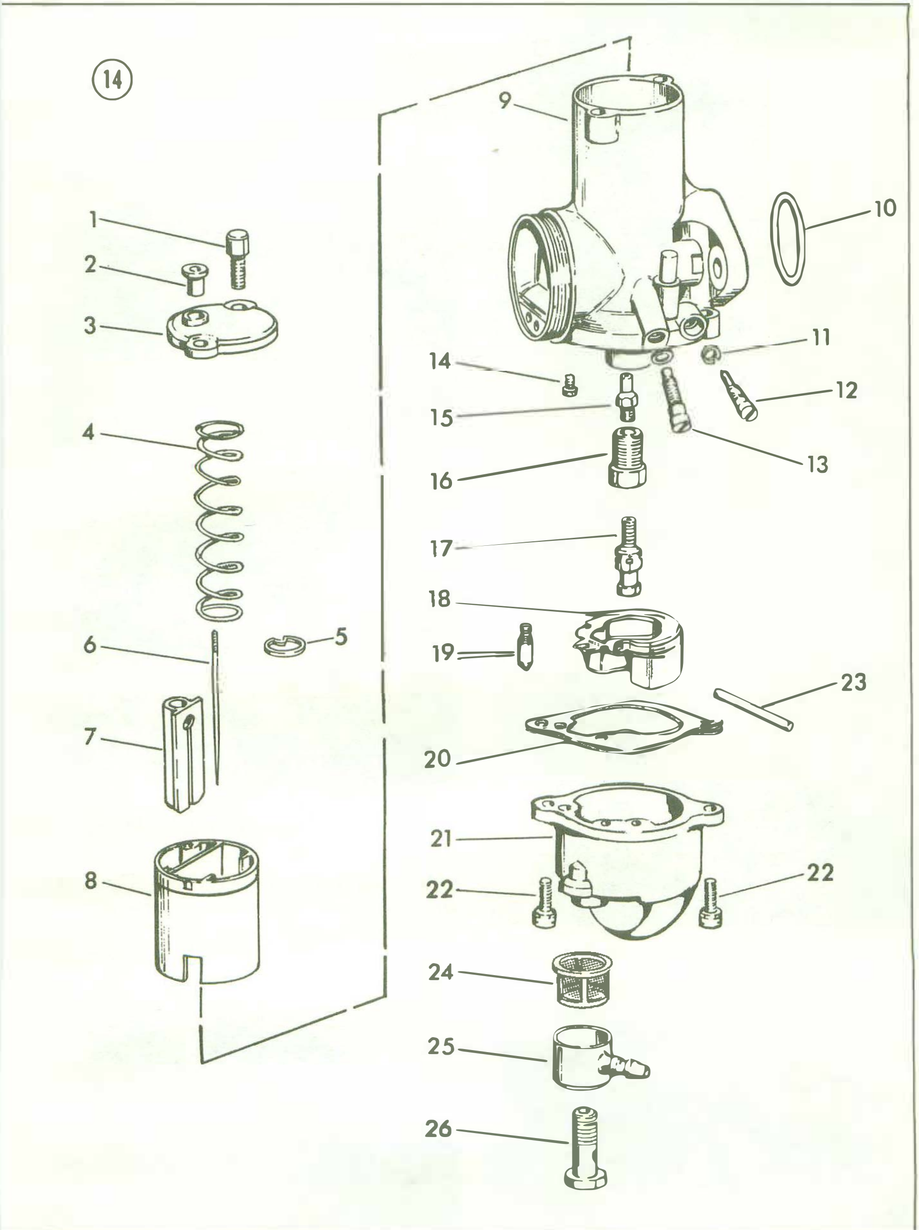
Disassembly, Concentric Carburetors

Figure 14 is an exploded view of a typical Amal concentric carburetor. Not all carburetors are equipped with choke valves (item 7).

1. Remove the mixing chamber cap (**Figure 15**) if this step has not been performed previously.
2. Withdraw the throttle valve (**Figure 16**).

AMAL CARBURETOR

1. Screw
2. Ferrule
3. Mixing chamber cap
4. Spring
5. Jet needle clip
6. Jet needle
7. Choke valve
8. Throttle valve
9. Mixing chamber body
10. O-ring
11. O-ring
12. Pilot air screw
13. Throttle stop screw
14. Pilot jet
15. Needle jet
16. Jet holder
17. Main jet
18. Float
19. Float needle
20. Gasket
21. Float bowl
22. Screw
23. Float pivot
24. Filter screen
25. Banjo
26. Banjo bolt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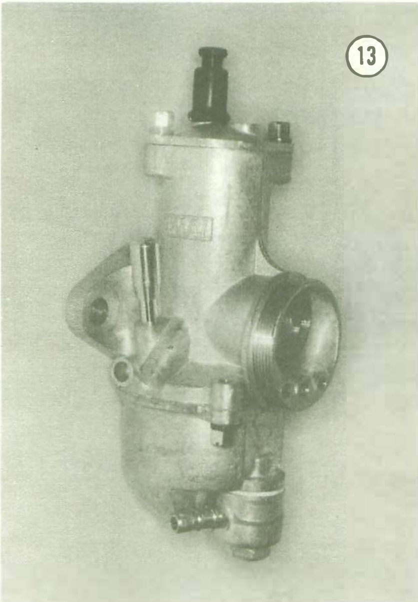
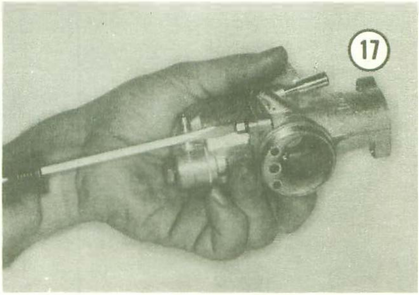
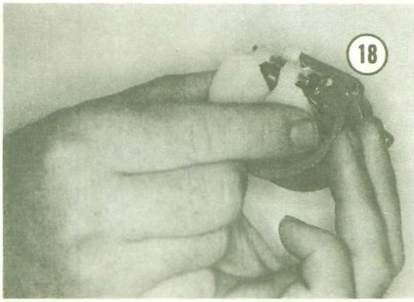


Don't lose the spring or spring plate. Note the position of each part as it is removed.

3. Remove the float bowl (**Figure 17**).

4. Remove the float and float needle together (**Figure 18**).





5. Remove the banjo bolt (**Figure 19**), then the fuel inlet banjo fitting (**Figure 20**).

6. Carefully remove the filter screen (**Figure 21**). Do not crush the screen as you remove it.

7. Remove the main jet (**Figure 22**).

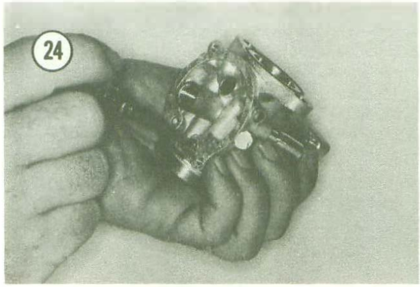
8. Remove the jet holder (**Figure 23**). Unscrew the needle jet from the jet holder if necessary.

9. Remove the pilot jet (**Figure 24**).

10. Remove the mounting flange O-ring.

11. Remove pilot air screw, throttle stop screw, and tickler assembly.

12. Reverse the disassembly procedure to reassemble the carburetor. Always use new gaskets upon reassembly.



Troubleshooting Concentric Carburetors

Tickler buttons occasionally become stuck from dirt or corrosion, causing flooding. If such is the case, remove and clean the tickler button assembly.

If flooding still occurs, check the float needle valve assembly for wear or dirt. If dirty, clean the fuel tank, petcock, fuel strainer, and fuel line. Replace the needle valve in the event of scratches or wear of either the needle or seat.

Fuel occasionally leaks into the float, causing flooding. Shake the float to check for gasoline inside. Replace the float if this condition exists.

The engine may not slow to idle speed, even with slack in the throttle cable and the idle speed screw fully out. Check the following items.

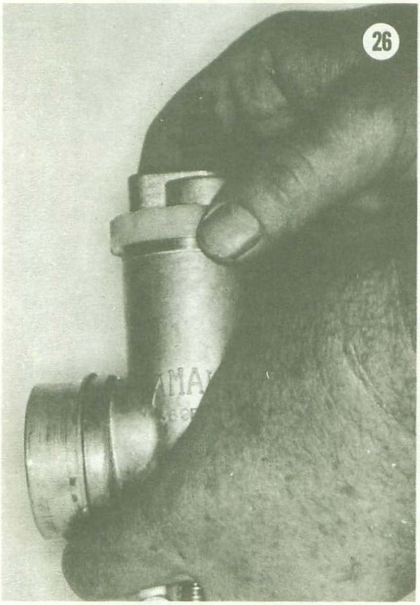
1. Be sure that the throttle slide is not worn. If it fits too loosely in the carburetor body, leakage will occur. Replace the slide and/or carburetor body in this event.

2. Air leaks at the carburetor mounting will make proper idling adjustment impossible. Be sure that there are no leaks in this area.

Disassembly, Monobloc Carburetor

Figure 25 (next page) is an exploded view of a typical Monobloc carburetor. Refer to this illustration during carburetor disassembly.

1. Remove the top ring nut (**Figure 26**).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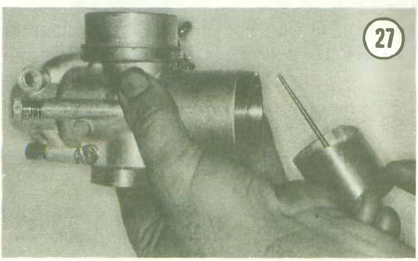
2. Remove throttle slide assembly (**Figure 27**).
3. Note which jet needle groove the clip is in, then remove the jet needle clip and pull the jet needle from the throttle valve.
4. Remove the float chamber cover (**Figure 28**).
5. Remove the spacer from the float pivot shaft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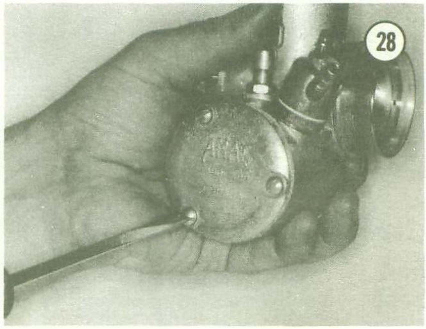
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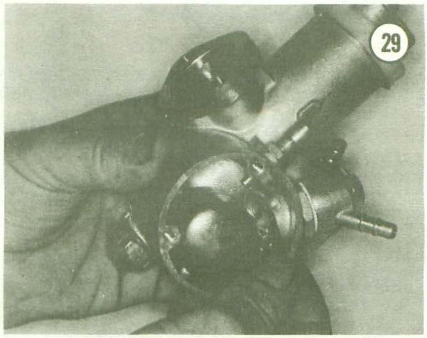
(**Figure 29**). Note the manner in which the float is installed, then pull it from the pivot shaft (**Figure 30**).

6. Remove the float needle (**Figure 31**), then the float needle seat.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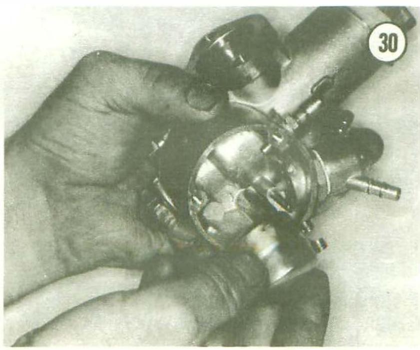
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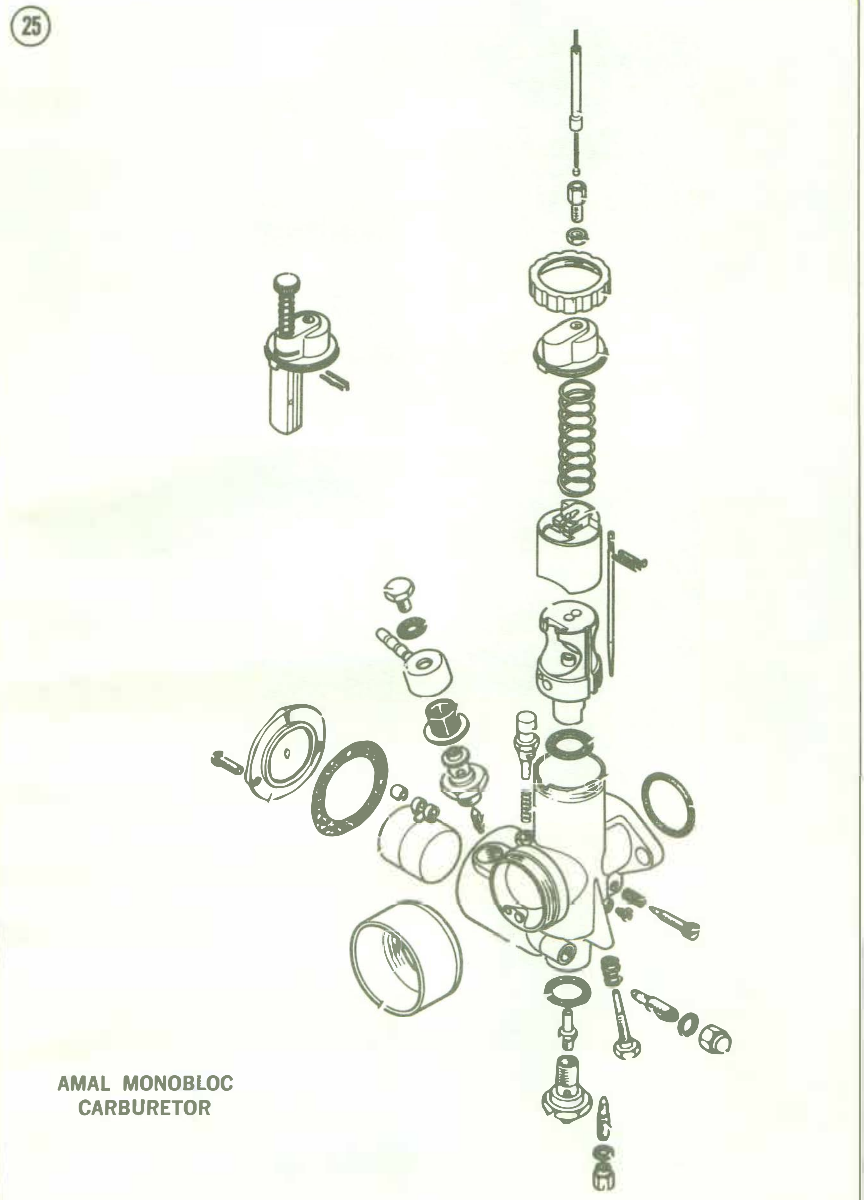
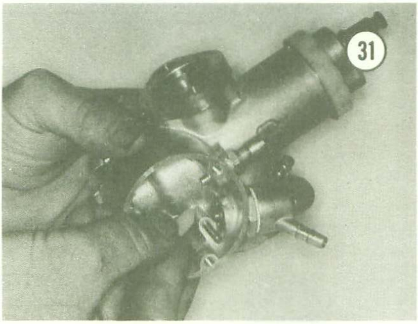
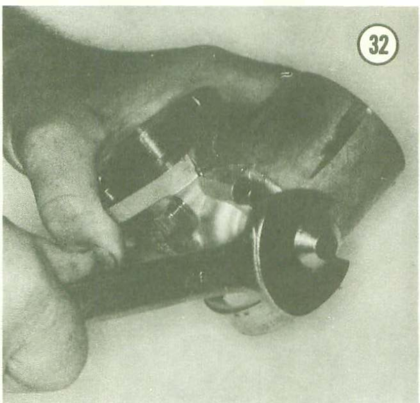


AMAL MONOBLOC
CARBURETOR



31

7. Remove the main jet cover (**Figure 32**), then remove the main jet together with its gasket (**Figure 33**).



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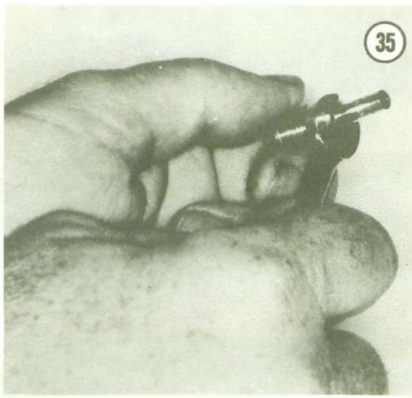
33

8. Remove the jet holder (**Figure 34**), then unscrew needle jet from jet holder (**Figure 35**).

34



35

9. Remove the pilot jet cover (**Figure 36**), then the pilot jet (**Figure 37**).

36

10. Remove fuel inlet banjo fitting (**Figure 38**).

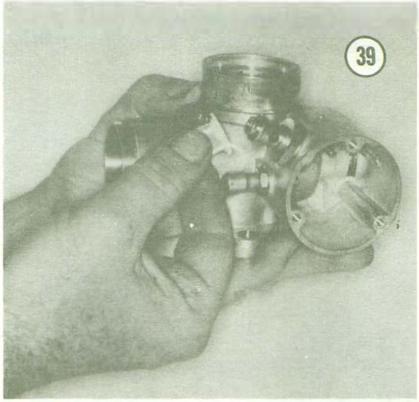
11. Remove the fuel strainer (**Figure 39**), then the float needle seat.

12. Remove the pilot air screw, tickler button, and throttle stop screw.

Troubleshooting Monobloc Carburetors

Tickler buttons occasionally become stuck from dirt or corrosion, causing flooding. If such is the case, remove and clean the tickler button assembly.

If flooding still occurs, check the float needle valve assembly for wear or dirt. If dirty, clean the fuel tank, petcock, fuel strainer, and fuel line. Replace the needle valve in the event of scratches or wear of either the needle or seat.



Fuel occasionally leaks into the float, causing flooding. Shake the float to check for gasoline inside. Replace the float if this condition exists.

If the float pivot shaft spacer is too long, the float may bind, causing flooding. This condition is not likely to exist on an older carburetor, unless the float chamber gasket is replaced with a much thinner one. If this condition exists, shorten the spacer by filing. Be sure to clean up any metal particles before assembly.

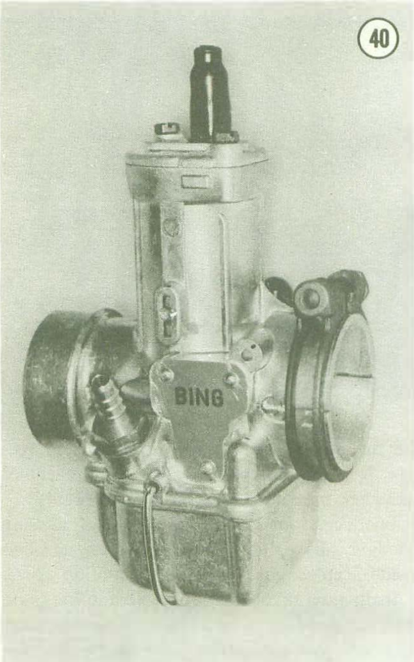
The engine may not slow to idle speed, even with slack in the throttle cable and the idle speed screw fully out. Check the following items.

1. Be sure that the throttle slide is not worn. If it fits too loosely in the carburetor body, leakage occurs. Replace the slide and/or carburetor body in this event.

2. Air leaks at the carburetor mounting will make proper idling adjustment impossible. Be sure that there are no leaks in this area.

BING CARBURETORS

Bing carburetors are original equipment on many European motorcycles. Although there are numerous design variations, they can be grouped generally as slide valve (**Figure 40**) and diaphragm (**Figure 41**) types.



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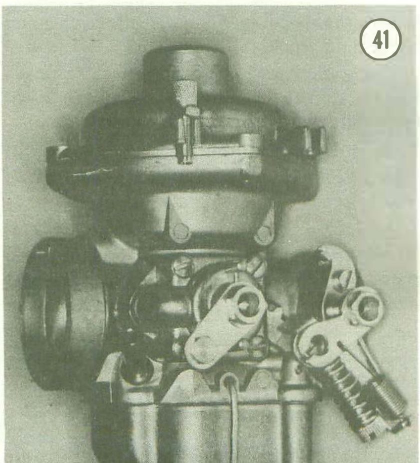

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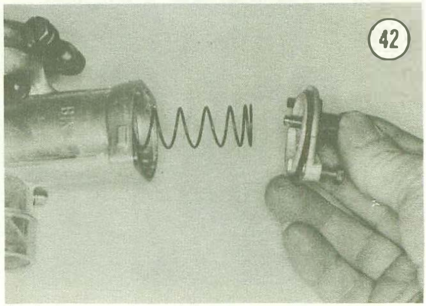
Slide Valve Carburetor Disassembly

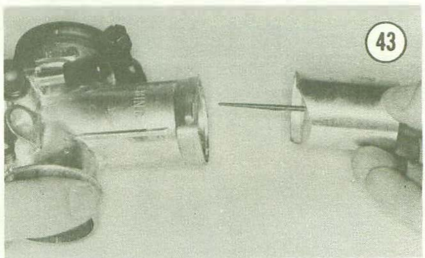
1. Remove two retaining screws, then the mixing chamber top (**Figure 42**). Be careful; the cover is under spring pressure.



42

2. Remove the spring, then the throttle slide (**Figure 43**).

3. Push the float bowl retaining bail toward the carburetor inlet (**Figure 44**).



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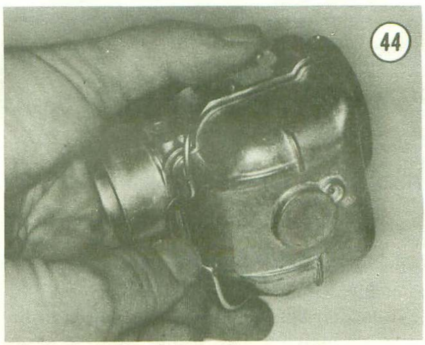
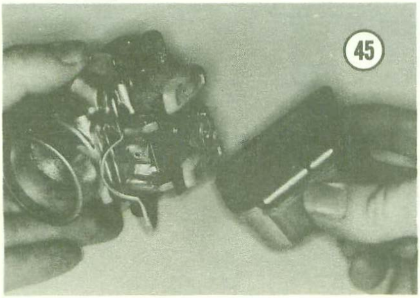
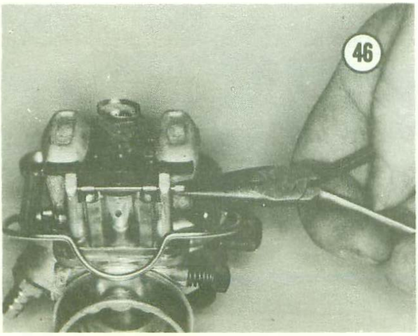


44

4. Remove the float bowl (**Figure 45**).

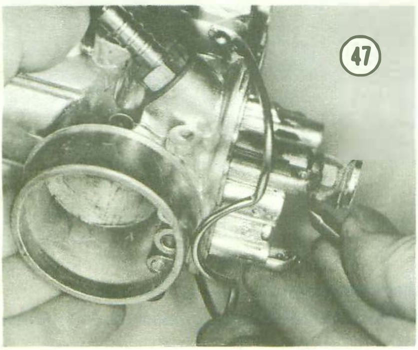
5. Pull out the float pivot pin (**Figure 46**), then gently remove the float assembly.

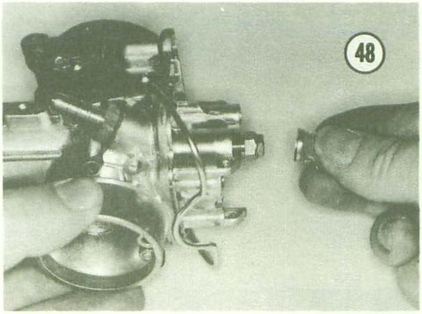




6. Pull out the float needle (**Figure 47**).

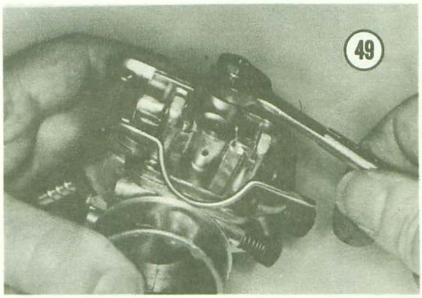
7. Carefully remove the strainer from the main jet (**Figure 48**).

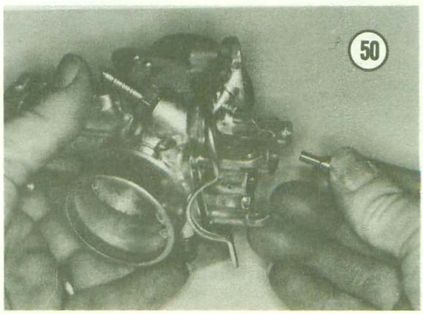




8. Remove the jet holder (**Figure 49**).

9. Turn the carburetor upright. The needle jet will drop out (**Figure 50**). Push it out with a plastic rod if necessary.

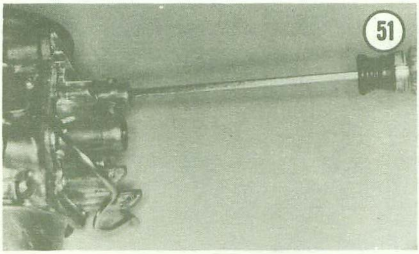


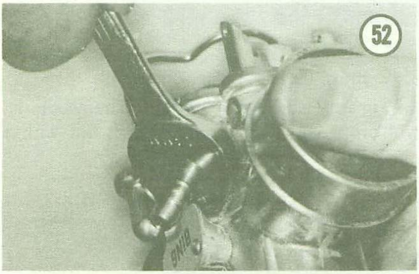


10. Remove the pilot jet (**Figure 51**).

11. Remove the fuel inlet fitting (**Figure 52**).

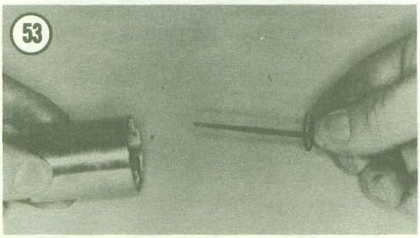
12. Remove the idle mixture screw.





13. Remove the idle speed screw.

14. Remove the jet needle from the throttle valve (**Figure 53**).



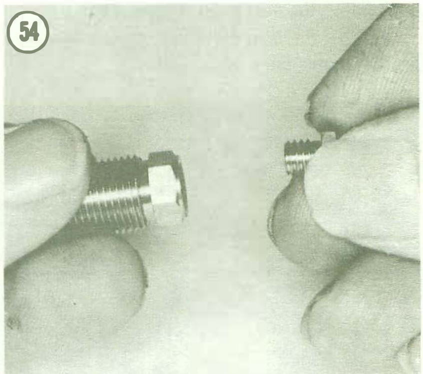
15. Unscrew the main jet from the jet holder (**Figure 54**).

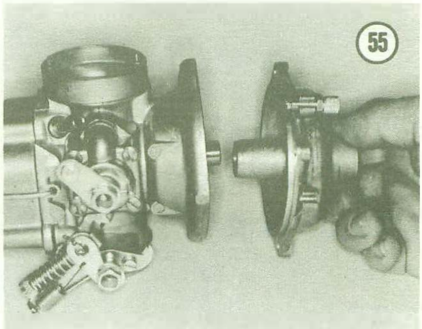
16. Reverse Steps 1-15 for reassembly.

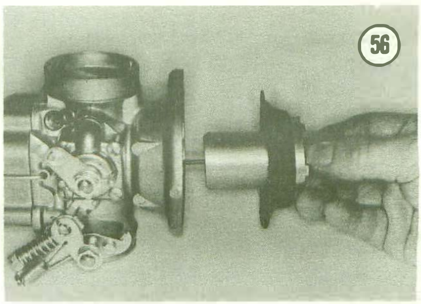
Vacuum Piston Carburetor Disassembly

1. Remove 4 screws, then pull off the diaphragm cover (**Figure 55**).

2. Pull out the diaphragm and piston as a unit (**Figure 56**). Note carefully how the piston fits into its bore.



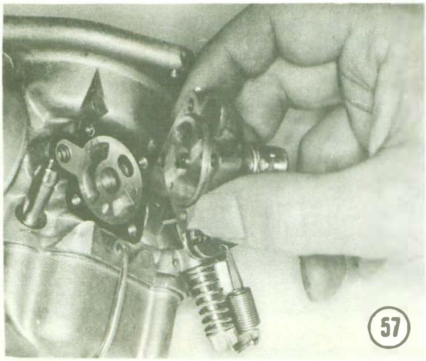




3. Remove 4 screws, then the choke cover and its gasket (**Figure 57**).

4. Push the bail toward the carburetor inlet, then remove the float bowl (**Figure 58**).

5. Remove 2 screws to disassemble the piston assembly (**Figure 59**).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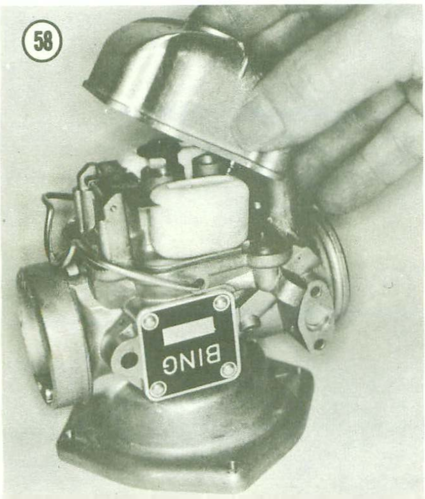
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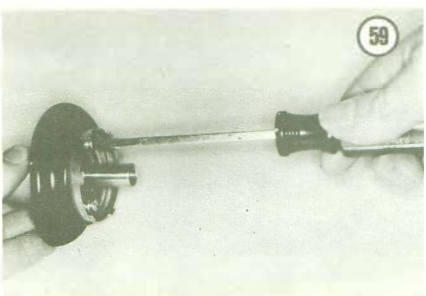
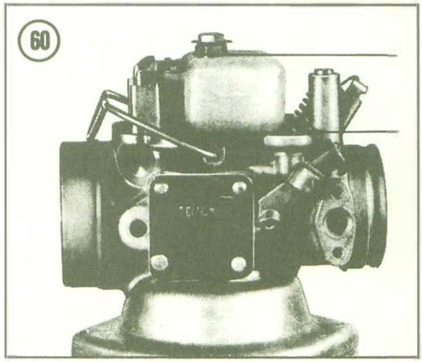

59

6. The remaining steps are similar to slide valve types.

7. Reverse Steps 1 through 6 for reassembly. Be sure that the diaphragm locating tab is in position, and that the vent hole in the diaphragm cover is clean.

Float Adjustment

Adjust floats on Bing carburetors so that the bottom side of the float is parallel to the float bowl mounting surface, when the float assembly is resting against the needle valve (**Figure 60**).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DELLORTO CARBURETORS

Dellorto carburetors are standard equipment on most Italian bikes. The most common types may be described as "square" and "round" throttle slide configurations.

Square Slide Models

Figure 61 is an exploded view of a typical carburetor of this type. Refer to it during disassembly and service.

1. Remove the air cleaner inlet adapter (**Figure 62**).

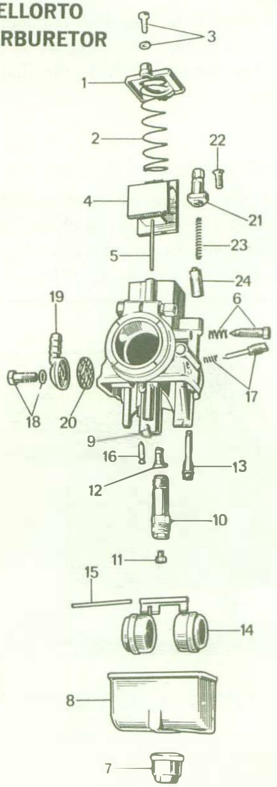
2. Remove both screws, then pull out the throttle slide, spring, and mixing chamber top as a unit (**Figure 63**).

3. Pull out the starter piston (**Figure 64**) after removing its retaining screw. Be careful; the retainer is spring loaded.

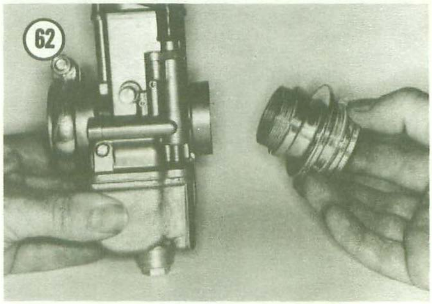
4. Remove main jet access cover (**Figure 65**).

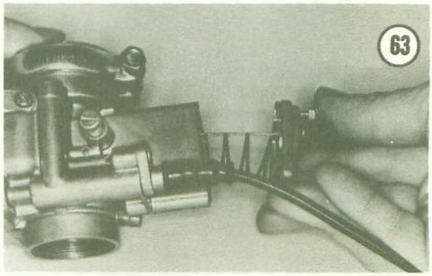
DELLORTO CARBURETOR

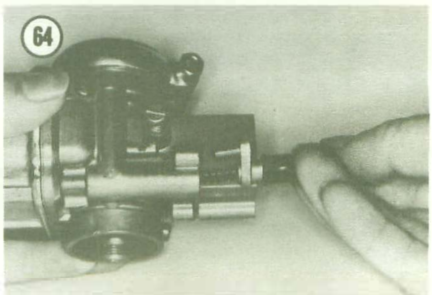
61



1. Mixture chamber cover
2. Cable adjusting nut and spring
3. Screws
4. Throttle slide
5. Taper needle
6. Throttle slide stop screw and spring
7. Plug and washer
8. Bowl
9. Pilot jet
10. Acceleration pump
11. Main jet
12. Atomizer
13. Atomizer
14. Float
15. Securing pin
16. Needle
17. Pilot air screw and spring
18. Adaptor screw and washer
19. Adaptor
20. Adaptor filter
21. Air control plug with screw and nut
22. Plug securing screw
23. Spring
24. Air control plug

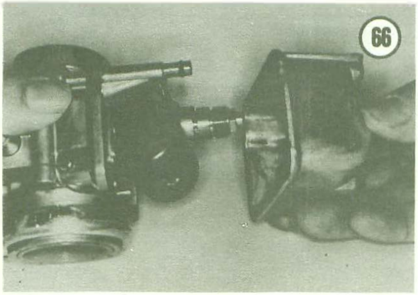






5. Remove the float bowl (**Figure 66**).

6. Carefully remove the float assembly by pulling out its pivot shaft (**Figure 67**).



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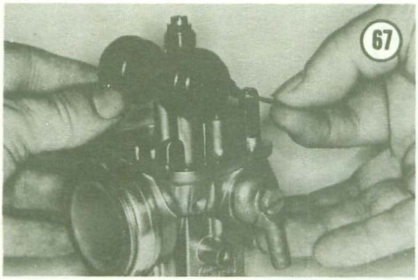
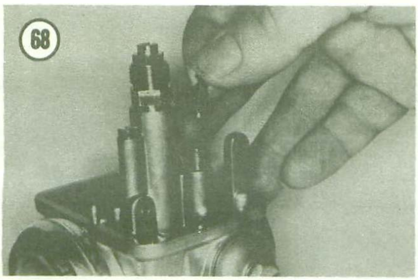


67

7. Remove the float needle (**Figure 68**).

8. Remove the main jet (**Figure 69**).

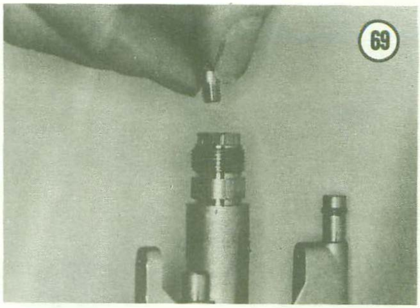
9. Remove the accelerator pump (**Figure 70**).



68

10. Remove the needle jet (**Figure 71**) by pushing it out from the top with a fiber or plastic tool. Do not use any metal tool.

11. Remove the pilot jet, which is located next to the accelerator pump bore.



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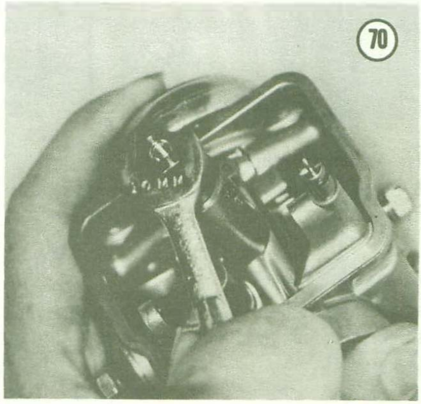

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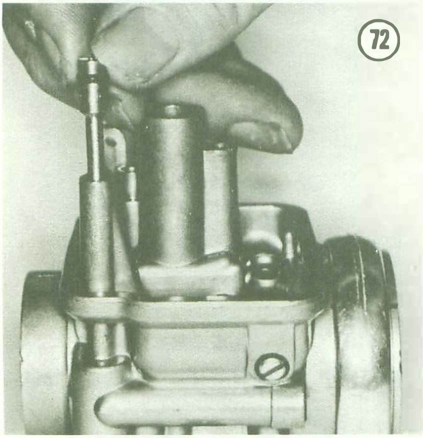
12. Remove the starter jet (**Figure 72**).

13. Remove the pilot air screw and its spring.

14. Remove the idle speed screw and its spring.

15. Remove the fuel inlet fitting after taking out its retaining bolt.

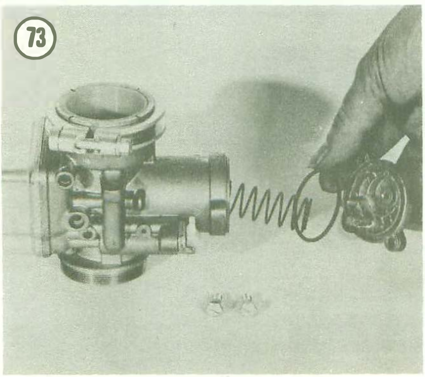


16. Remove the fuel strainer.

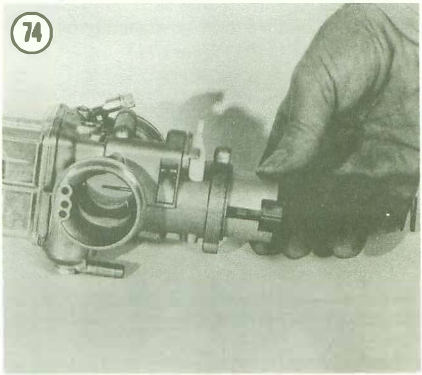
17. Reverse Steps 1 through 16 to reassemble the carburetor.

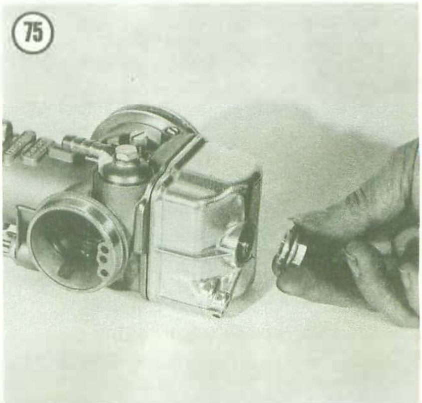
Round Slide Models

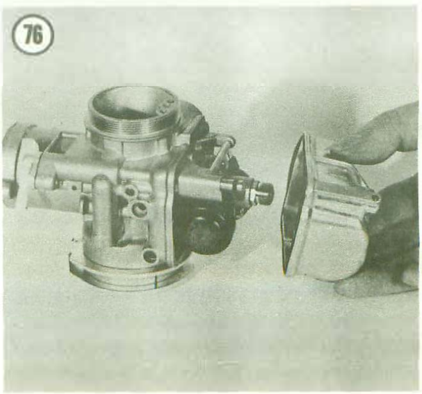
1. Remove both mixing chamber cap retaining screws, then mixing chamber cap and its O-ring (**Figure 73**).



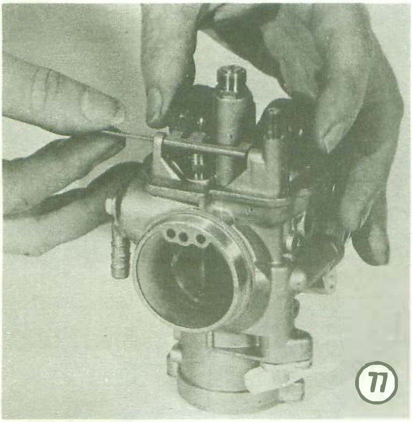
2. Pull out throttle slide together with its return spring (**Figure 74**).
3. Remove main jet cover (**Figure 75**).
4. Remove float bowl together with its O-ring (**Figure 76**).







5. Pull out float pivot pin (**Figure 77**), then remove float assembly and float needle together (**Figure 78**). Take care not to bend float during this step.



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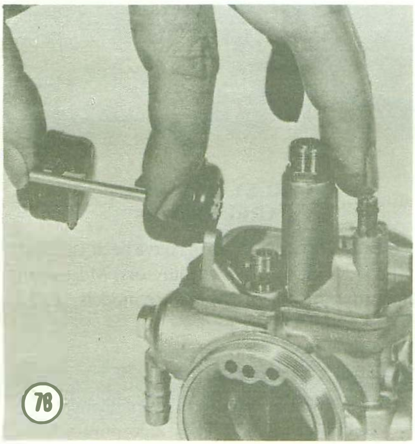

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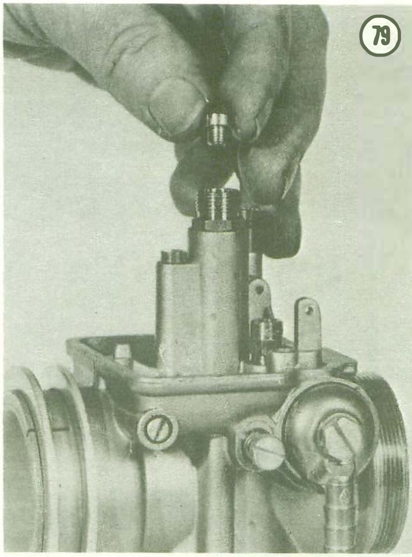
6. Remove main jet (**Figure 79**).
7. Remove jet holder (**Figure 80**).
8. Remove needle jet (**Figure 81**).
9. Remove float valve seat (**Figure 82**).
10. Remove slow speed jet (**Figure 83**).
11. Remove starter jet (**Figure 84**).
12. Remove idle mixture and idle speed screws.



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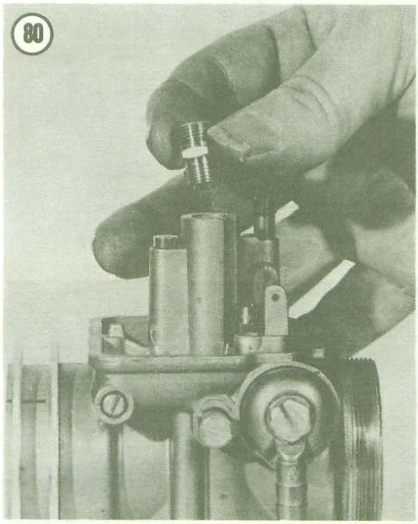
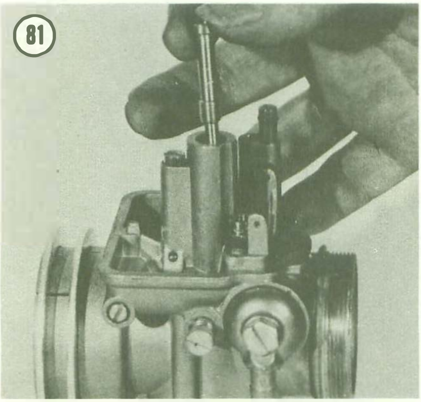
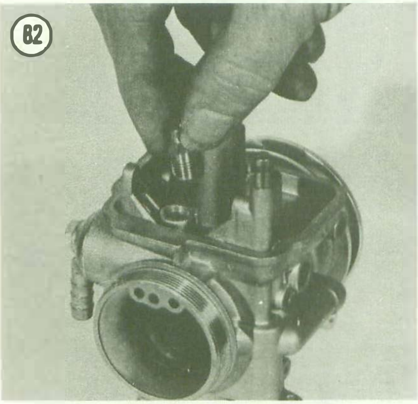
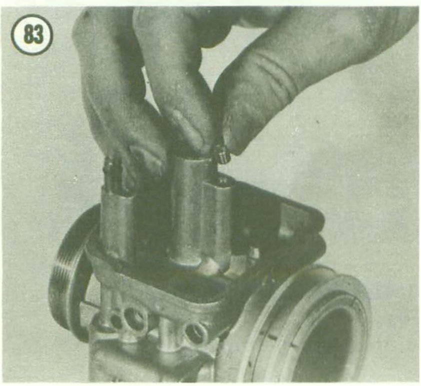


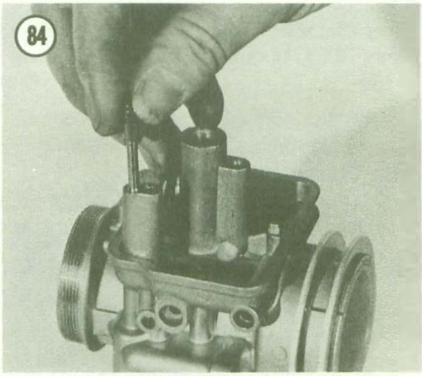
80

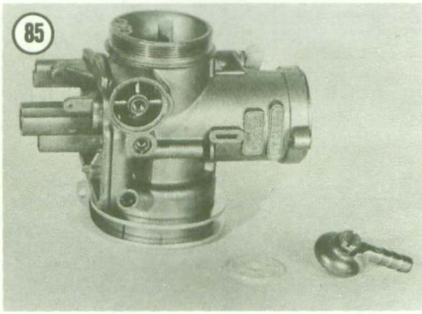
13. Remove fuel inlet fitting and strainer (**Figure 85**).
14. Reverse Steps 1 through 13 to reassemble the carburetor.











HARLEY-DAVIDSON CARBURETORS

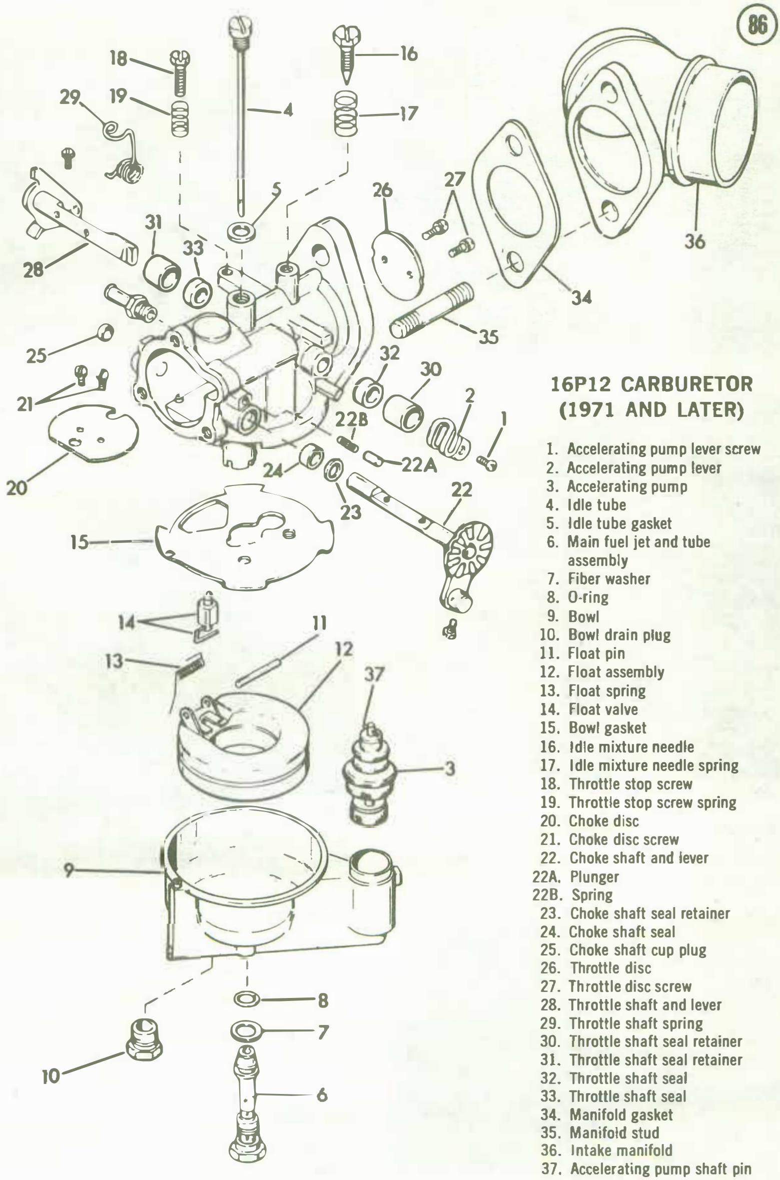
Harley-Davidson V-twins have been variously equipped with different carburetors. Most popular during the past 10 years are models 16P12, HD, DC, and M.

Model 16P12 Carburetor

Model 16P12 carburetors are installed on 1971 and later models. They incorporate floats, accelerator pumps, and idle mixture and speed controls. **Figure 86** is an exploded view of this carburetor. Refer to that illustration during disassembly and service.

Disassembly

1. Remove pump lever screw (**Figure 87**).
2. Remove accelerator pump as an assembly (**Figure 88**).

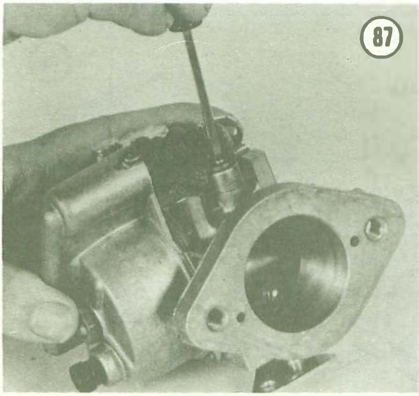


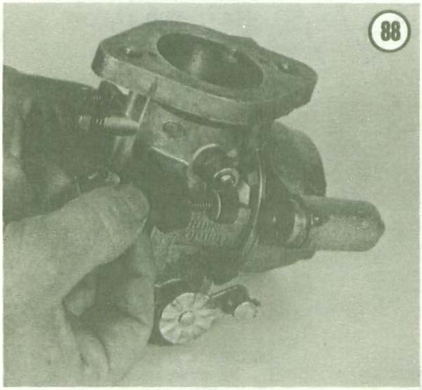
16P12 CARBURETOR (1971 AND LATER)

1. Accelerating pump lever screw
2. Accelerating pump lever
3. Accelerating pump
4. Idle tube
5. Idle tube gasket
6. Main fuel jet and tube assembly
7. Fiber washer
8. O-ring
9. Bowl
10. Bowl drain plug
11. Float pin
12. Float assembly
13. Float spring
14. Float valve
15. Bowl gasket
16. Idle mixture needle
17. Idle mixture needle spring
18. Throttle stop screw
19. Throttle stop screw spring
20. Choke disc
21. Choke disc screw
22. Choke shaft and lever

22A. Plunger
22B. Spring

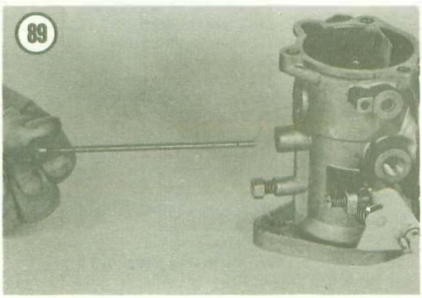
23. Choke shaft seal retainer
24. Choke shaft seal
25. Choke shaft cup plug
26. Throttle disc
27. Throttle disc screw
28. Throttle shaft and lever
29. Throttle shaft spring
30. Throttle shaft seal retainer
31. Throttle shaft seal retainer
32. Throttle shaft seal
33. Throttle shaft seal
34. Manifold gasket
35. Manifold stud
36. Intake manifold
37. Accelerating pump shaft pin

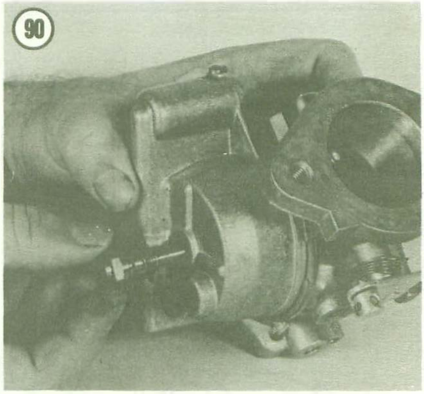




3. Remove idle tube and its gasket (**Figure 89**).

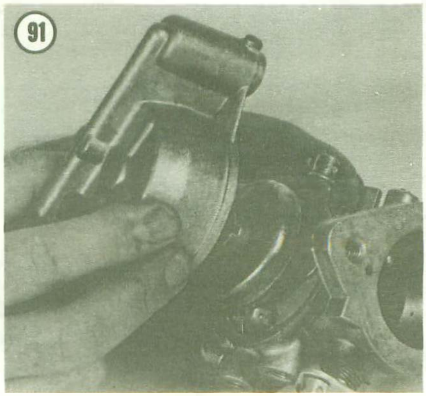
4. Remove jet and tube assembly (**Figure 90**). It may be necessary to give this assembly a firm





tug to pull it from its bore. After pulling it out, remove its fiber washer and O-ring.

5. Remove float bowl (**Figure 91**).



6. Carefully remove float pivot pin (**Figure 92**).

7. Remove float, float needle, float needle clip, and float spring as an assembly (**Figure 93**).

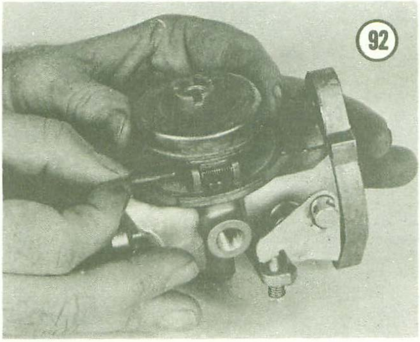
8. Remove float bowl gasket.

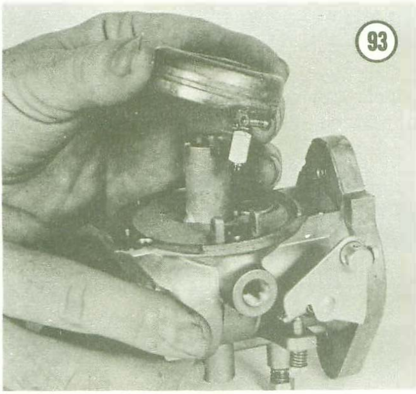
9. Remove idle mixture screw.

10. Remove idle speed screw.

Inspection

Clean all metals parts in carburetor cleaning solvent. Do not use any wire or metal tools to clean jets or passages; doing so may change their





calibration. Replace any parts that are damaged or worn. Be sure that the idle mixture needle tip is not worn or scored, also check the float needle and its seat carefully.

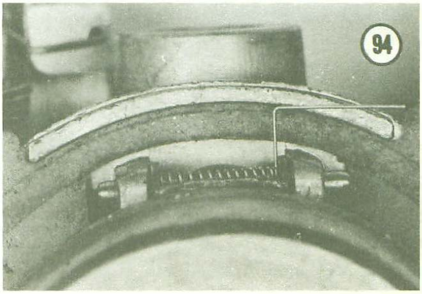
Reassembly

Reverse the disassembly procedure to assemble the carburetor. Pay particular attention to the following notes.

1. Be sure that float needle clip is attached to float tang.

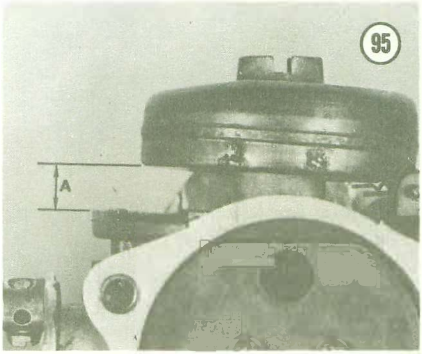
2. Upon assembly, be sure that float spring is installed as shown in **Figure 94**. When installing float bowl, bend end of spring up so that it rests against inside of float bowl.

3. Be sure to check and adjust float level, if necessary, before installing float bowl.



Adjustment

Float level must be checked and adjusted each time carburetor is disassembled. To do so, refer to **Figure 95**. With carburetor inverted, bottom surface of float must be 3/16 in. from carburetor gasket surface. A 3/16 in. drill may be used as a gauge. If adjustment is required, bend float tang (**Figure 96**) as required, using long-nose pliers.



A. Float level

Remaining adjustments are performed with the carburetor installed on the motorcycle. Refer to **Figure 97**, then proceed as follows:

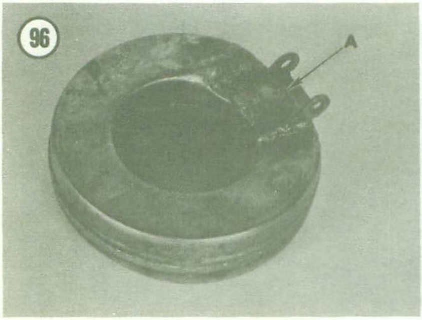
1. Turn low speed needle fully clockwise until it seats lightly, then back it out 1½ turns.

2. Start engine and warm it thoroughly.

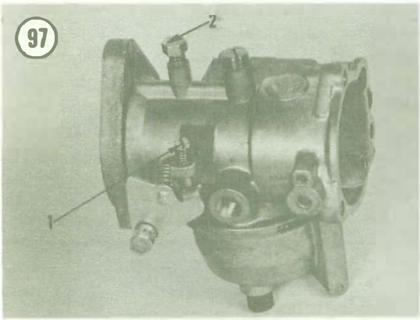
3. Adjust idle speed screw so that engine runs at 700-800 rpm with throttle fully closed.

CAUTION

Never adjust engine idle to slowest possible speed. Very slow idle speed



A. Bend tang to adjust float level



1. Idle speed screw 2. Low speed needle

results in bearing wear, oil consumption, and poor acceleration from idle.

4. Adjust low-speed needle to make engine accelerate and run smoothly at idle.

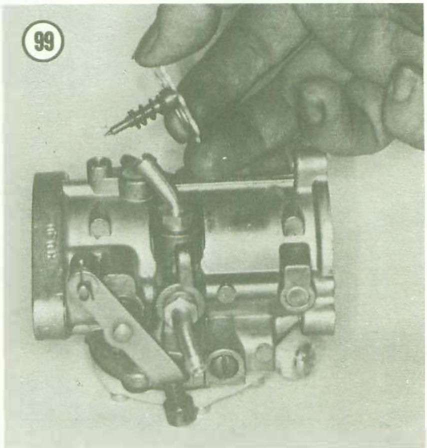
5. Make final adjustment of idle speed screw, if required, to obtain 700-800 rpm idle.

Model HD Carburetor

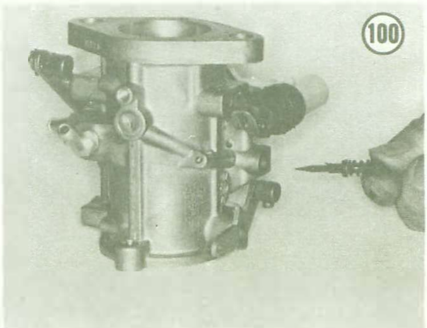
Model HD carburetors were used from 1967 to 1970. These are dual-venturi, diaphragm-type carburetors with automatic economizers and accelerator pump. **Figure 98** (page 34) is an exploded view of this carburetor. Refer to that illustration during disassembly and service.

Disassembly

1. Remove idle mixture needle and spring (**Figure 99**).



2. Remove intermediate mixture needle and spring (**Figure 100**).



3. Remove diaphragm cover (**Figure 101**).

4. Remove diaphragm and gasket together (**Figure 102**).

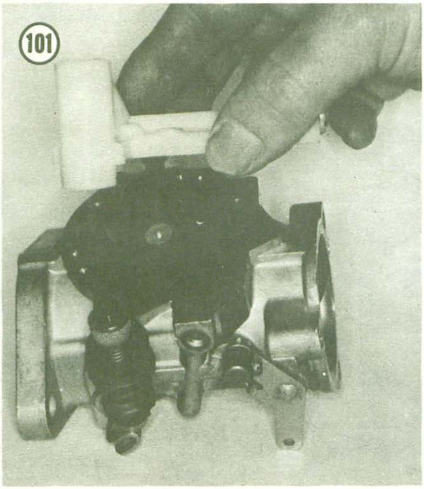
5. Separate diaphragm and gasket (**Figure 103**).

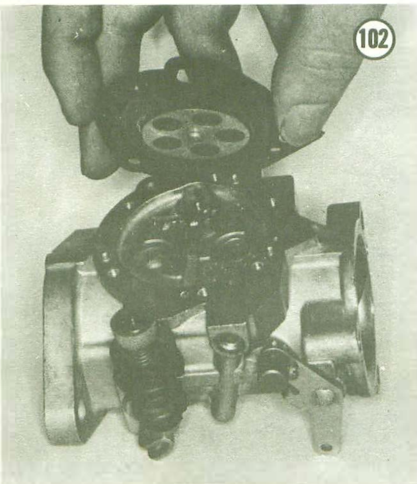
6. Remove accelerator pump plunger (**Figure 104**) after taking out its retaining screw.

7. Remove accelerator pump channel plug screw (**Figure 105**).

8. Remove metering lever pivot shaft retaining screw (**Figure 106**).

9. Remove metering lever shaft, metering lever, and needle as an assembly (**Figure 107**).



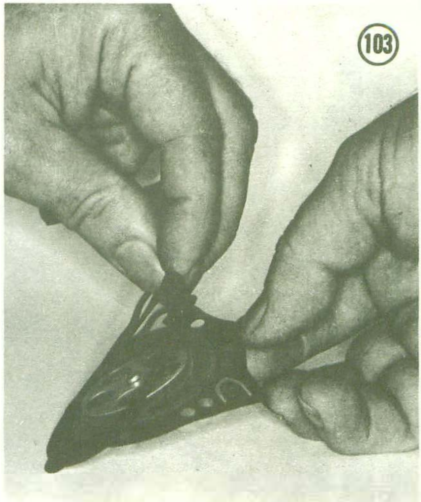


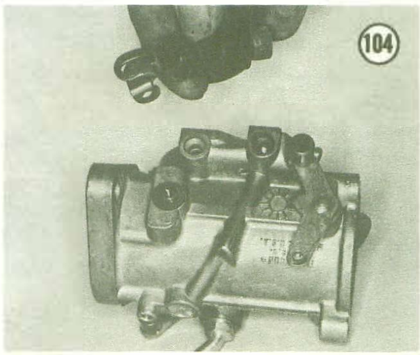
10. Remove metering lever spring (**Figure 108**). Be sure that the spring engages the dimple on the metering lever upon reassembly.

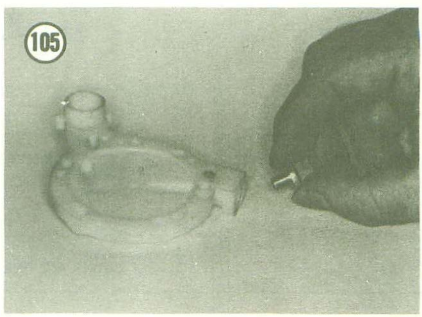
11. Remove inlet valve seat (**Figure 109**), then pull out its gasket, using a bent wire.

12. Remove main jet plug screw (**Figure 110**).

13. Remove main jet (**Figure 111**) and its gasket.







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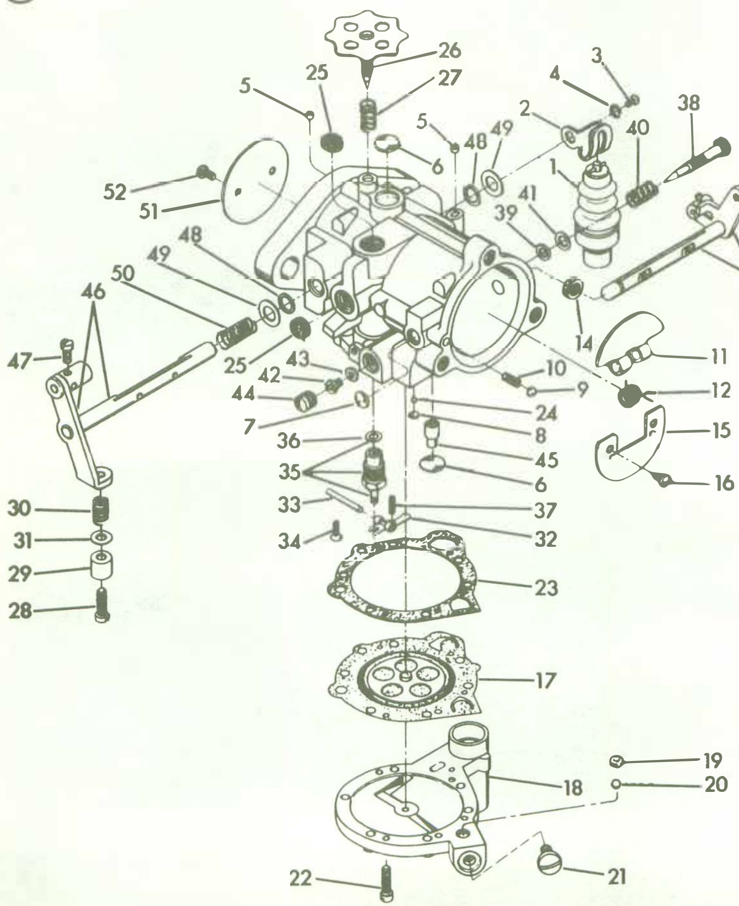
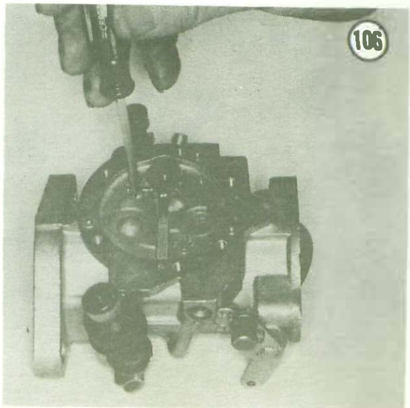


HD CARBURETOR — 1967-1970

1. Accelerating pump
2. Accelerating pump lever
3. Accelerating pump lever screw
4. Accelerating pump lever screw L.W.
5. Channel plug
6. Welch plug
7. Welch plug
8. Welch plug
9. Choke shaft friction ball
10. Choke shaft friction spring
11. Choke shutter (top)
12. Choke shutter spring
13. Choke shaft assembly
14. Choke shaft dust seal
15. Choke shutter (bottom)
16. Choke shutter screws
17. Diaphragm
18. Cover
19. Accelerating pump check ball retainer
20. Accelerating pump check ball
21. Diaphragm cover plug screw
22. Diaphragm cover screws
23. Diaphragm cover gasket
24. Economizer check ball
25. Fuel filter screen
26. Idle adjustment screw
27. Idle adjustment screw spring
28. Throttle stop screw
29. Throttle stop screw cup
30. Throttle stop screw spring
31. Throttle stop screw spring washer
32. Inlet control lever
33. Inlet control lever pin
34. Inlet control lever screw
35. Inlet needle and seat
36. Inlet needle seat gasket
37. Inlet control lever tension spring
38. Intermediate adjusting screw
39. Intermediate adjusting screw packing
40. Intermediate adjusting screw spring
41. Intermediate adjusting screw washer
42. Main jet
43. Main jet gasket
44. Main jet plug screw
45. Main nozzle check valve
46. Throttle shaft assembly
47. Throttle lever wire block screw
48. Dust seal
49. Washer
50. Throttle shaft spring
51. Throttle shutter
52. Throttle shutter screws
53. Gasket overhaul set
54. Overhaul repair kit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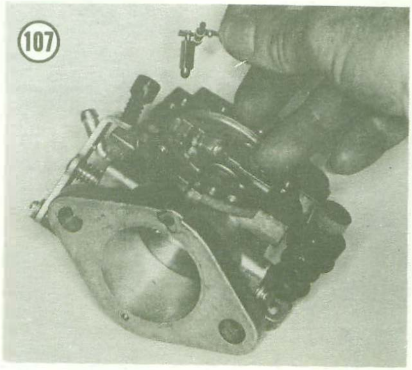
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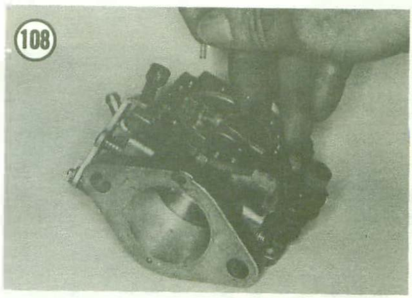
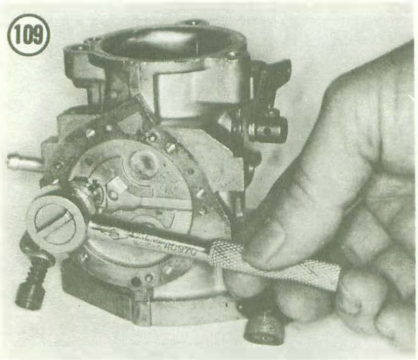
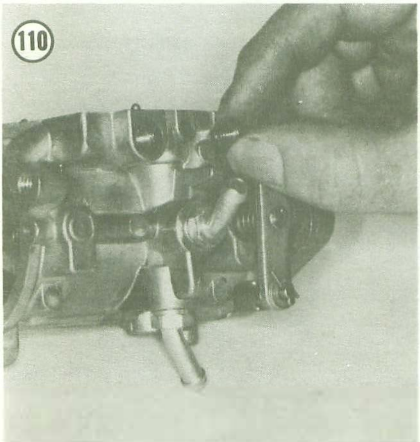
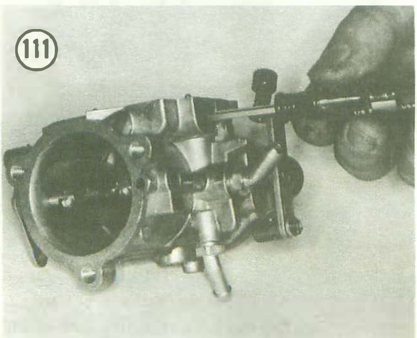
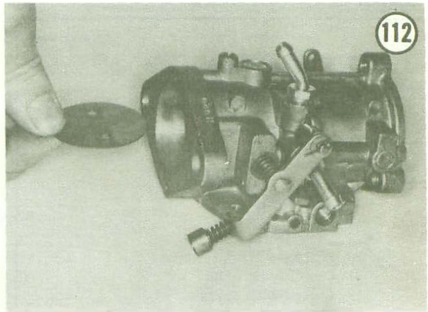

108

14. Carefully note how the throttle butterfly is installed, then remove both retaining screws and pull it out (**Figure 112**).

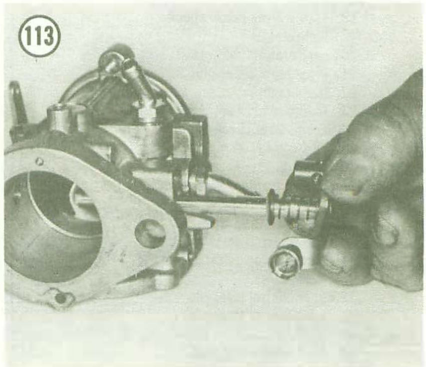








15. Pull out throttle shaft (**Figure 113**). Don't lose the washers and dust seals.



16. Remove the choke valve and its shaft.

There are 2 other jets, each located under welch plugs. These jets should not normally require removal. If removal is necessary, carefully drill a hole in each plug, then pry them out to gain access to the jets. Drive new plugs in flush.

Inspection

Clean all metal parts in carburetor cleaning solvent, then blow dry with compressed air. Do not use wire or metal tools to clean jets or passages; doing so may cause them to lose calibration.

1. Be sure that accelerator pump lever is in good condition, and that its spring is in place. Be sure that accelerator pump check ball is free.

2. Inspect the diaphragm and its gasket. The diaphragm must not be stretched or rippled. Check that the metal washer attached to the diaphragm is firmly attached. If it rotates freely, diaphragm must be replaced. When reassembling diaphragm and gasket, be sure that the gasket is between the diaphragm and carburetor body.

3. Carefully examine idle needle and its seat for distortion or a cracked seat.

4. There must be no burrs on contact end of metering lever.

5. Be sure that seating end of inlet needle is in good condition.

Reassembly

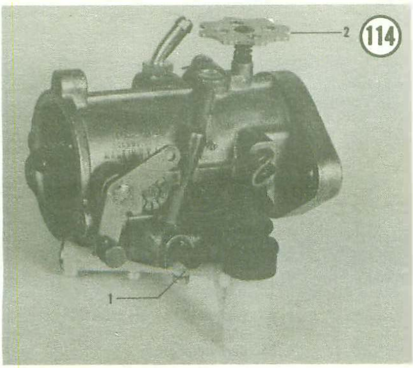
Reverse the disassembly procedure to reassemble the carburetor. Take note of the following points.

1. Adjust the metering lever so that it is flush with the metering chamber floor.

2. Torque accelerator pump channel plug to 23-28 in.-lb.

Adjustment

Carburetor adjustment is performed with the carburetor installed on the motorcycle. Refer to **Figure 114**.



1. Intermediate speed needle 2. Low speed needle

1. Make sure that throttle wire from handlebar grip fully closes throttle lever on carburetor.

2. Turn low-speed needle clockwise until it seats lightly, then back it out about ⅞ turn.

3. Turn intermediate needle in until it seats lightly, then back it out ⅞ turn also.

4. Start engine and warm it thoroughly.

5. Adjust idle speed screw so that engine runs at approximately 2,000 rpm.

6. Slowly turn intermediate needle in whichever direction is necessary to produce the highest engine speed without missing or surging. Then turn intermediate needle counterclockwise ⅛ turn from that point.

7. Back off idle speed screw until engine idles at 900-1,100 rpm.

8. Alternately adjust low-speed needle and idle speed screw to produce a smooth idle at 900-1,100 rpm.

Model DC Carburetor

Model DC carburetors were installed on 1966 models. This carburetor is equipped with adjustable high- and low-speed needles. There are no moving parts in this carburetor other than throttle and float assemblies.

Figure 115 is an exploded view of this carburetor. Refer to that illustration during service.

Disassembly

1. Remove throttle body screws and lockwashers (1), gasket (2), plug (3), low-speed needle (4), washer (5), and spring (6).

2. Remove screws (7) and disc (8).

3. Remove screw (9) from throttle lever (10), then take off throttle shaft spring (11) and throttle shaft washer (12). Pull out throttle shaft (13).

4. Remove bowl mounting screws (16), then pull off bowl (17). Also remove gasket (18).

5. Remove float nut (19) from float rod, then pull off float (20).

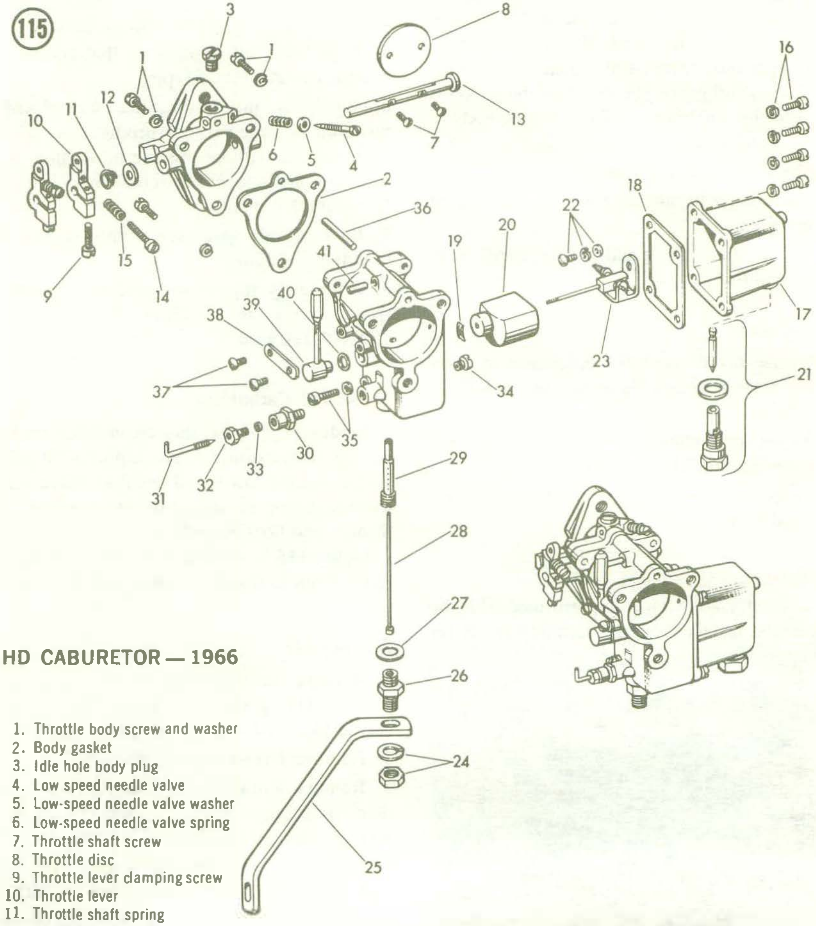
6. Remove float valve and seat assembly (21).

7. Remove float lever screw and washers (22), then float lever and bracket assembly (23).

8. Remove support bracket nut and lockwasher (24) and support bracket (25). Note that this step does not apply to all models.

9. Remove bowl nut (26) and gasket (27).

NOTE: *If idle tube (28) comes out with bowl nut (27), do not attempt to*



HD CABURETOR — 1966

1. Throttle body screw and washer
2. Body gasket
3. Idle hole body plug
4. Low speed needle valve
5. Low-speed needle valve washer
6. Low-speed needle valve spring
7. Throttle shaft screw
8. Throttle disc
9. Throttle lever clamping screw
10. Throttle lever
11. Throttle shaft spring
12. Throttle shaft washer
13. Throttle shaft
14. Throttle lever stop screw
15. Throttle lever stop screw spring
16. Bowl mounting screw
17. Bowl
18. Bowl gasket
19. Float nut
20. Float
21. Float valve and seat
22. Float lever screw and washers
23. Float lever and bracket assembly
24. Support bracket nut and lockwasher
25. Support bracket
26. Bowl nut
27. Bowl nut gasket
28. Idle tube assembly
29. Main nozzle
30. High-speed needle valve extension housing
31. High-speed needle valve
32. High-speed needle valve packing nut
33. High-speed needle valve packing
34. Carburetor jet
35. Drain plug and gasket
36. Idle passage tube
37. Throttle shaft screw
38. Vent clamp
39. Vent housing
40. Vent gasket
41. Idle bleed tube

remove it. Usually the idle tube will remain in the carburetor body.

10. Carefully pull out idle tube (28) from carburetor body by gently tugging and moving it from one side to the other.

11. Unscrew main nozzle (29). It is recommended that a screwdriver be ground to fit exactly. The screwdriver slot in the main jet is 0.051 in. wide.

12. Remove high-speed needle extension housing (30), then needle (31), packing nut (32). and packing (33).

13. Remove jet (34).

14. Remove drain plug (35) and its gasket.

15. Remove idle passage tube (36).

16. Remove screws (37) and clamp (38), then take off vent housing (39), gasket (40), and idle bleed tube (41).

Inspection

1. Clean all parts except gaskets and float in carburetor cleaner. Dry with compressed air. Replace shaft (13) if it is worn or loose (0.002 in. clearance) in its bearings.

2. If after long service, idle port holes next to throttle disc (8) become crusted, and solvent does not clean them, open them up with a drill of the exact size specified.

Model	Drill Size
DC-1, -1L, -1M, -10	70 (0.028 in.)
DC-2	56 (0.0465 in.)

Use only the exact drill specified, and take extreme care not to enlarge the holes.

3. Clean idle jet hole with a No. 57 drill, and the angular hole it meets with a No. 52 drill. Again, take extreme care during this step.

4. Clean nozzle bleed holes with a No. 54 (0.055 in.) drill. Clean the main passage with a No. 17 (0.173 in.) drill.

5. Clean high-speed needle seat holes with a No. 55 (0.052 in.) drill for all models but DC-2. On model DC-2, use a No. 70 (0.028 in.) drill.

6. Be sure that both carburetor body vents are open.

7. Replace needle valve and seat (21) if the assembly leaks.

Adjusting Float Rod

1. Assemble float valve and seat (21).

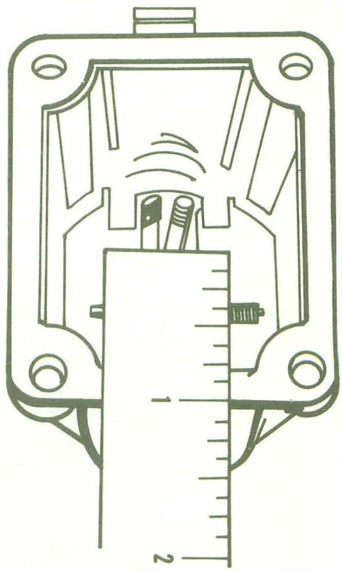
2. Install screw (22), but do not tighten it, so that bracket may be adjusted.

3. Insert float valve and seat assembly (21) partially into bowl (17), then align float lever fingers with the groove on the float valve. Screw float valve assembly into bowl.

NOTE: *Never screw valve and seat assembly into bowl with bowl attached to the carburetor body. Fingers on the lever will be damaged if not engaged properly.*

4. Refer to **Figure 116**. Hold bowl inverted, then measure distance between top of float rod and outer edge of bowl flange opposite fuel inlet fitting. Note that this measurement must be made just as float valve seats lightly. This point may be determined by moving lever up and down gently.

116



If measurement obtained is not 1-1/16 in., adjust slotted lever bracket, then tighten screw (22). Recheck and readjust as required.

Reassembly

Reassemble the carburetor in inverse order of disassembly. Observe the following notes:

1. Assemble high-speed needle (31), packing (33) and packing nut (32), and housing (30). Tighten packing nut (32) just enough to keep needle (31) from turning freely.

CAUTION

When installing this assembly into main body, always back out needle (31) so that its point will not enter the valve hole in the main body.

2. With carburetor body inverted, drop in idle tube (28), small end first. It may be necessary to jiggle the body until the idle tube locates itself in position. Then press on end of tube until it seats.
3. If it is necessary to replace throttle disc (8), use only a replacement disc having the same number on its face.
4. Install idle passage tube (36) with its chamfered end out.
5. Carburetor-to-manifold flange gasket thickness is critical. Always use a new gasket, and be sure that mounting screw does not bottom against throttle body screw (1).
6. Adjust carburetor.

Carburetor Adjustment

Adjust the carburetor with the engine fully warm. As an initial adjustment, turn in low-speed needle (4) until it seats lightly, then back it out 1½ turns. Turn high-speed needle (31) in until it seats lightly, then back it out one turn.

1. Make sure that throttle cable is adjusted so that throttle lever (10) opens and closes freely with handlebar grip movement.
2. Start engine and warm it thoroughly.
3. With engine idling, turn low-speed needle (4) in ⅛ turn at a time until engine falters, then back it out ⅛ turn, or until engine runs regularly at idle speed with spark fully advanced.
4. Adjust idle speed screw (14) as required until engine idles at 900-1,100 rpm.

CAUTION

Never adjust engine idle to slowest possible rpm. Very slow idle results in bearing wear, oil consumption, and poor acceleration from idle.

5. Repeat Steps 3 and 4 as required.
6. Operate motorcycle at various speeds between 20 mph and maximum speed. Turn high-speed needle (31) in or out a little bit at a time until best overall performance is obtained. This point should occur with needle backed out between ¾ and 1¼ turns open.

Model M Carburetor

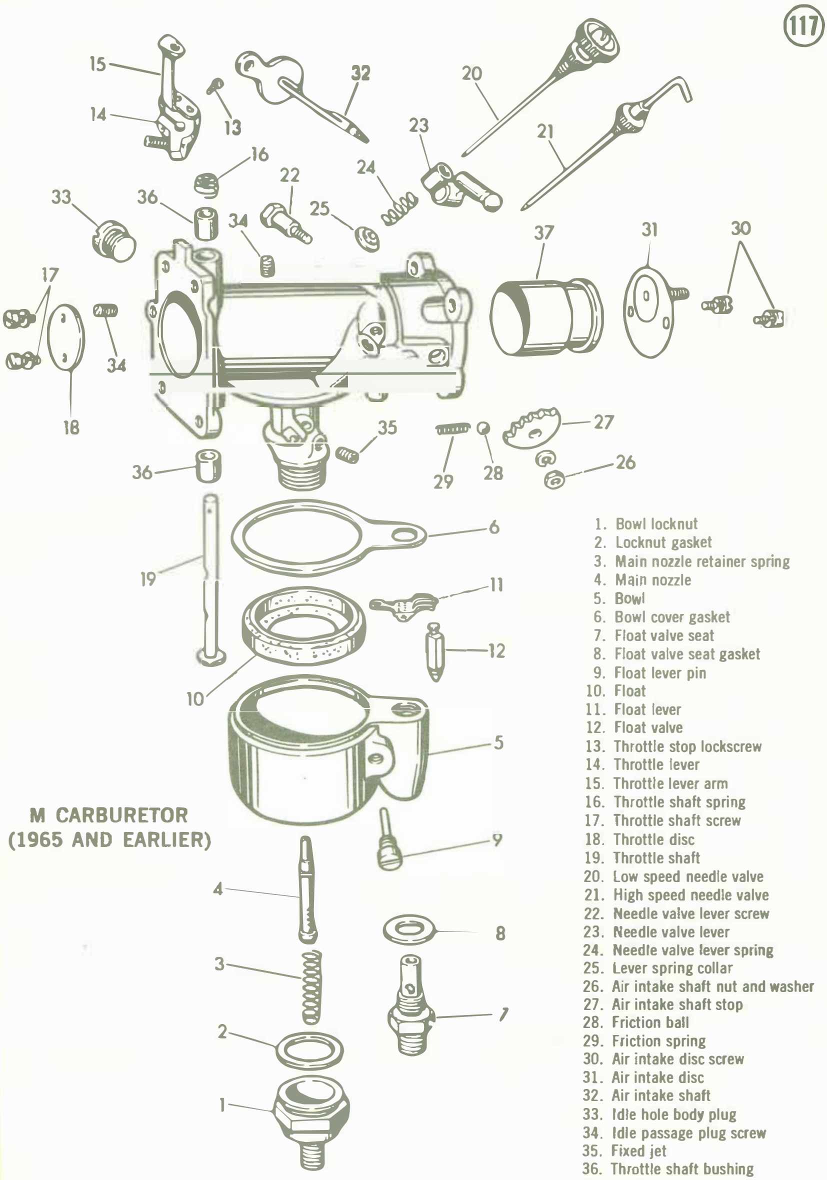
Model M carburetors were installed on 1965 and earlier models. Needle valves control low- and high-speed mixtures. **Figure 117** is an exploded view of this carburetor. Refer to it during disassembly and service.

Disassembly

1. Remove locknut (1), gasket (2), spring (3), and nozzle (4).
2. Remove bowl (5) and its gasket (6).
3. Remove float valve seat (7) and its gasket (8).
4. Unscrew float lever pin (9), then remove float (10), lever (11), and float valve (12).
5. Loosen screw (13), then remove lever (14), arm (15), and spring (16).
6. Remove screws (17), then slip throttle disc (18) from slot in shaft. Remove shaft (19).
7. Remove low-speed needle (20).
8. Remove high-speed needle (21).
9. Remove screw (22), lever (23), spring (24), and collar (25).
10. Remove nut and washer (26), stop (27), ball (28), and spring (29).
11. Remove screws (30) and disc (31). Pull out shaft (32).
12. Remove plug (33), screws (34), and jet (35).

Inspection

Clean all parts except float and gaskets in carburetor cleaning solvent, then blow dry with



M CARBURETOR
(1965 AND EARLIER)

1. Bowl locknut
2. Locknut gasket
3. Main nozzle retainer spring
4. Main nozzle
5. Bowl
6. Bowl cover gasket
7. Float valve seat
8. Float valve seat gasket
9. Float lever pin
10. Float
11. Float lever
12. Float valve
13. Throttle stop lockscrew
14. Throttle lever
15. Throttle lever arm
16. Throttle shaft spring
17. Throttle shaft screw
18. Throttle disc
19. Throttle shaft
20. Low speed needle valve
21. High speed needle valve
22. Needle valve lever screw
23. Needle valve lever
24. Needle valve lever spring
25. Lever spring collar
26. Air intake shaft nut and washer
27. Air intake shaft stop
28. Friction ball
29. Friction spring
30. Air intake disc screw
31. Air intake disc
32. Air intake shaft
33. Idle hole body plug
34. Idle passage plug screw
35. Fixed jet
36. Throttle shaft bushing
37. Venturi

compressed air. Blow out all passages. Never scrape away deposits with any metal tool.

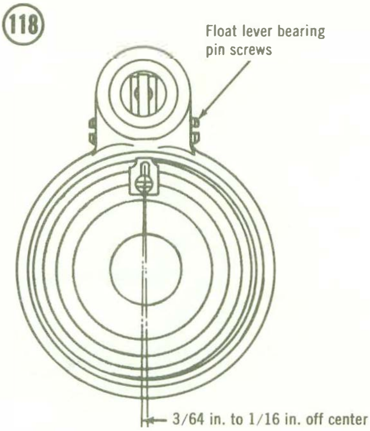
Check that shaft (19) is not loose in bushings (36). If clearance exceeds 0.003 in., replace bushings. Line-ream replacement bushings after installation, using a 0.250-in. drill.

Replace float valve and seal if they leak. To check for leakage, assemble items (7) through (12) into bowl (5). Invert bowl so that float valve closes, then suck on bottom of float valve seat (7).

Replace float (10) if it is soaked with fuel or damaged. To replace it, refer to **Figure 118**.

1. Cut cement seal from around screw which secures float to float lever.
2. Replace float, but leave screw loose.
3. Position bowl upright, with fuel inlet away from you.
4. Pull float toward you to limit of slot in float lever, and about 1/16 in. to left of centerline. This operation provides clearance for float in float bowl.
5. Tighten float screw.
6. Seal screw to float with any cement which will not be attacked by gasoline.
7. Adjust float level.

118

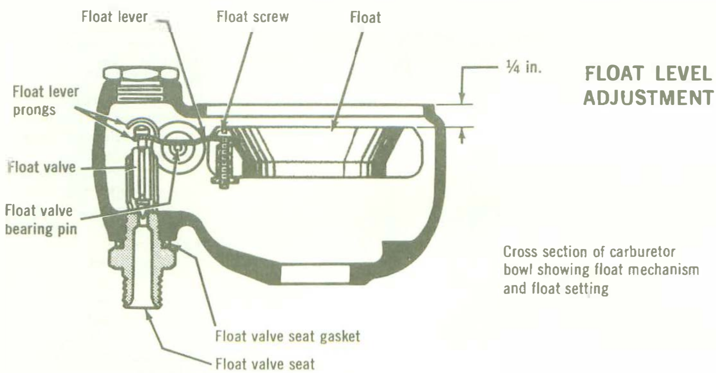


Top view of carburetor bowl showing float mechanism and offset of float

Float Level Adjustment

Refer to **Figure 119**. With float bowl inverted, measure distance from lip of float bowl to top

119



Cross section of carburetor bowl showing float mechanism and float setting of float at a point directly opposite float lever. This distance should be exactly ¼ in.

If not exactly ¼ in., remove float lever and bend it as required, rechecking each time. Do not bend lever when it is installed in bowl.

Reassembly

Assemble carburetor in inverse order of disassembly, observing the following notes.

1. Install venturi (37) with small end toward air intake.

2. Be sure that disc (18) seats all around carburetor throat.

3. Throttle lever and shaft should operate with slight drag. If operation is too loose, loosen screw (13), then compress parts on shaft with fingers while retightening screw.

4. Adjust carburetor.

Carburetor Adjustment

Refer to **Figure 120** during carburetor adjustment. Final adjustment must be made with the engine warm.

1. Turn high-speed needle (1) in until it seats lightly, then back it out 2 turns.

2. Turn low-speed needle (2) in until it seats lightly, then back it out 5 turns.

3. Start engine, then ride the bike long enough to warm it thoroughly.

4. With engine at operating temperature and spark advanced, turn low-speed needle (2) in one notch at a time until engine falters and misses. Then back it out 5-10 notches, or until engine runs smoothly with throttle closed and spark advanced.

5. Adjust engine idle to 900-1,100 rpm by turning throttle stop screw (5).

6. Repeat Steps 4 and 5. Overall operation will be better with idle mixture slightly rich (counterclockwise movement of needle).

7. Retard spark fully. Engine will continue to run evenly, but slower, if adjustment is correct.

8. Operate motorcycle at various road speeds, then turn high-speed needle (1) in or out as required to obtain best overall performance.

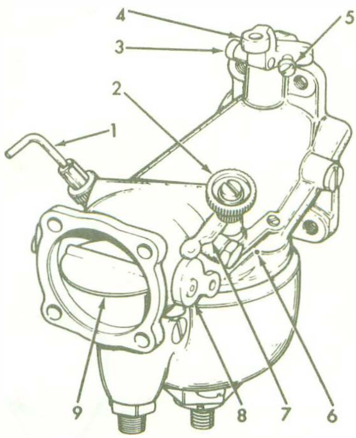
IRZ CARBURETORS

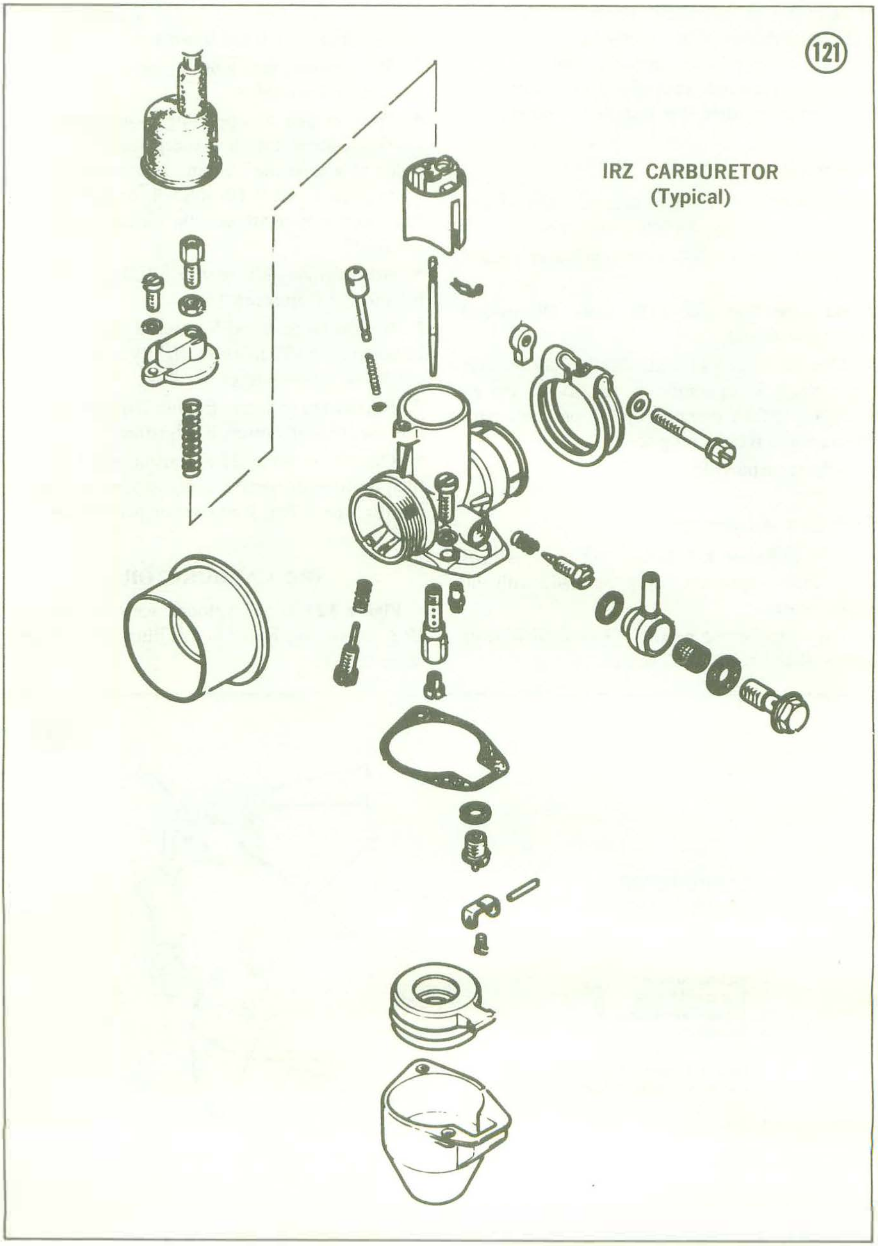
Figure 121 is an exploded view of a typical IRZ carburetor. Refer to this illustration during disassembly.

120

CARBURETOR ADJUSTMENT

1. High speed needle
2. Low speed needle
3. Throttle lever lockscrew
4. Throttle lever
5. Throttle stop screw
6. Carburetor bowl vent
7. Low speed needle lift lever
8. Choke lever
9. Choke disc

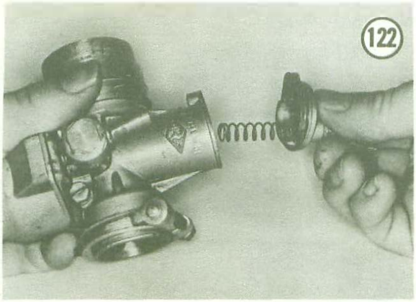


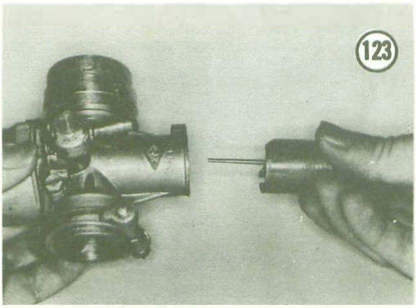

121
IRZ CARBURETOR
(Typical)

1. Remove carburetor from motorcycle.

2. Remove screw from carburetor top, then remove top (**Figure 122**).

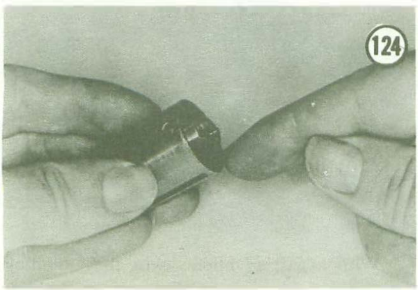
3. Withdraw throttle slide (**Figure 123**).



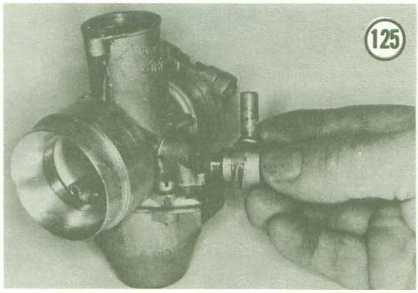


4. Compress slide return spring, then unhook cable end from slide.

5. Note which groove the jet needle clip is in, then remove clip and pull jet needle from throttle valve (**Figure 124**).



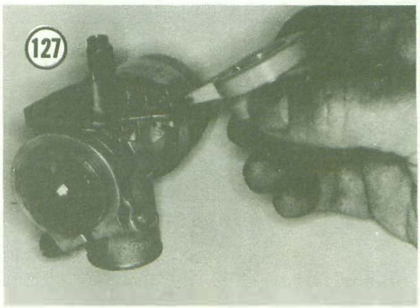
6. Remove fuel inlet banjo bolt, then banjo and filter element (**Figure 125**).



7. Remove pilot air screw and its associated spring.

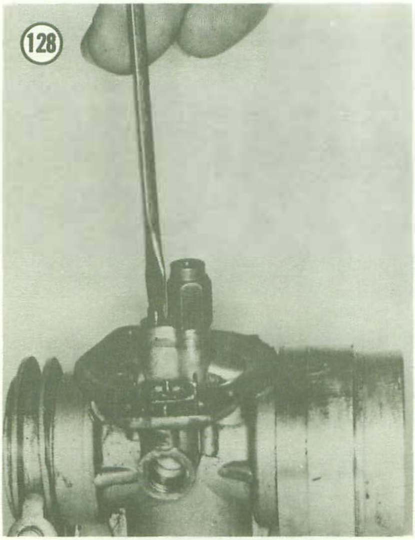
8. Remove the 2 float bowl attaching screws, then the float bowl (**Figure 126**).

9. Press out float pivot shaft, then remove float (**Figure 127**).



10. Unscrew pilot jet (**Figure 128**).

11. Remove needle jet from the jet holder (**Figure 129**).

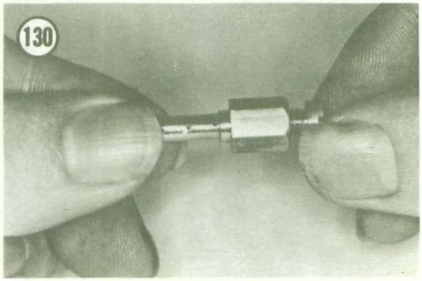


128

129

12. Unscrew the main jet from the needle jet (**Figure 130**).

13. Unscrew float needle assembly, using a pair of duckbill pliers on the ridge running across the center (**Figure 131**). Do not squeeze the ridge too tightly.



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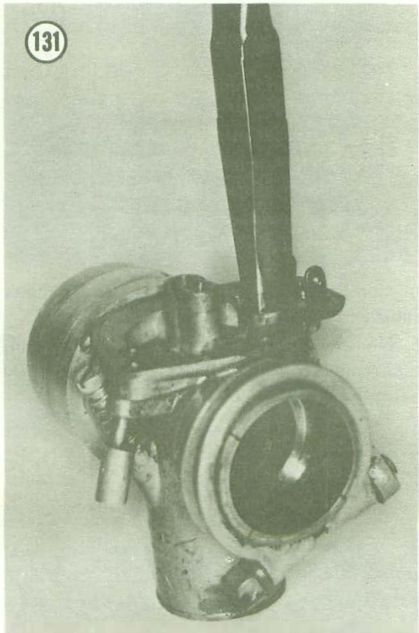


131

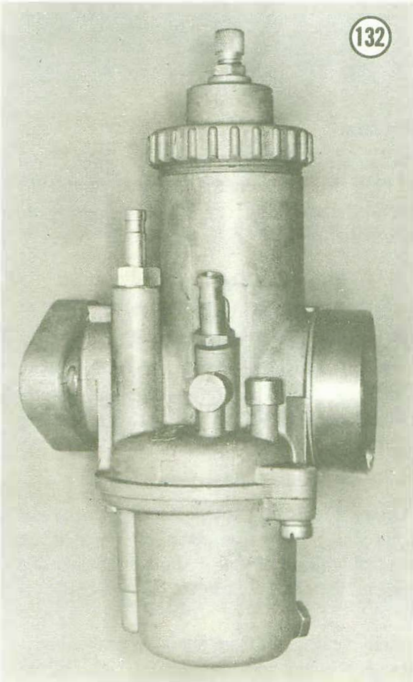
14. With a pair of pliers, twist the mounting clip on the tickler button, then remove the clip. Pull out tickler button and spring.

15. Remove idle stop screw and spring.

16. Reverse the disassembly procedure to reassemble the carburetor.

JIKOV CARBURETORS

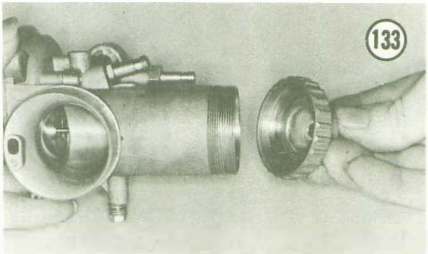
Jikov carburetors (**Figure 132**) are standard equipment on all CZ motorcycles. The operating principles are similar to other Amal-type carburetors.



132

Disassembly

1. Remove ring nut from top of carburetor (**Figure 133**).
2. Remove throttle slide (**Figure 134**).
3. Remove 2 retaining screws, then float bowl (**Figure 135**).
4. Pull float bowl from its shaft (**Figure 136**).
5. Remove main and needle jets together by unscrewing needle jet (**Figure 137**).
6. Unscrew the main jet from the needle jet (**Figure 138**).



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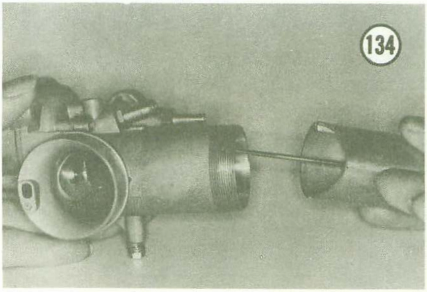

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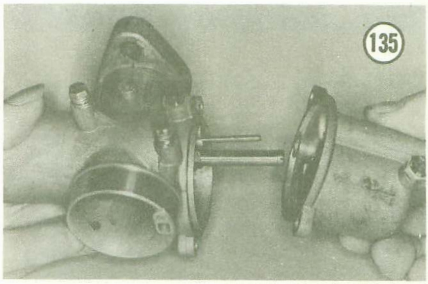

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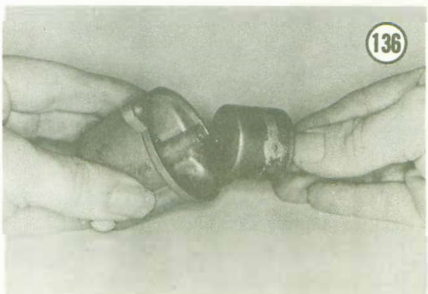

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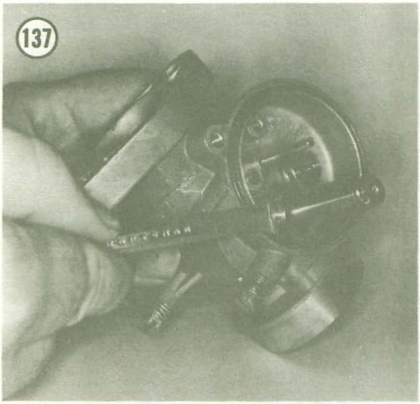

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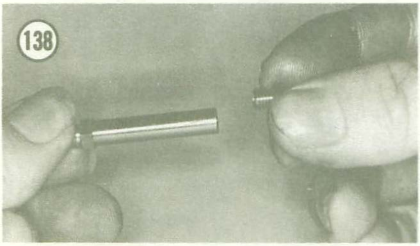
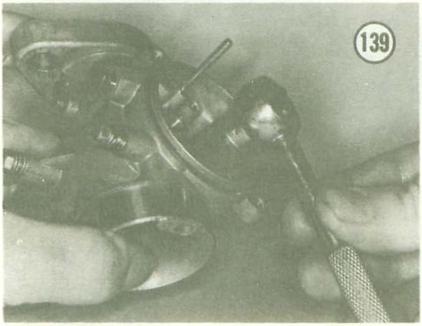


138

7. Remove the float needle valve assembly (**Figure 139**).



139

8. Remove pilot jet (**Figure 140**).
9. Remove pilot air screw.
10. Remove idle speed screw.
11. Reverse Steps 1 through 10 for reassembly.

140

Inspection

Clean all parts in carburetor cleaning solvent and blow dry with compressed air. Examine the float needle assembly for wear on the needle tip. Be sure that no fuel has leaked into the float.

KEIHIN CARBURETORS

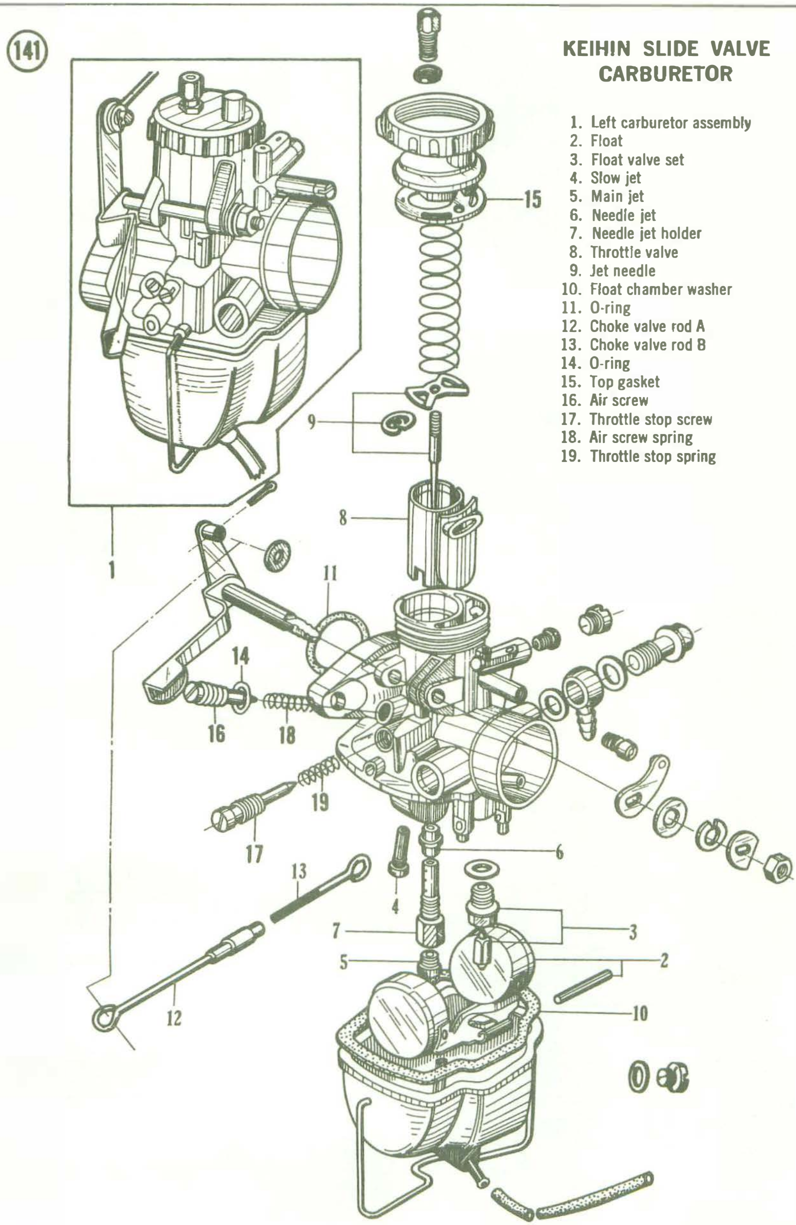
Keihin carburetors are original equipment on Honda motorcycles. Operation is similar to other Amal-type carburetors. Keihin carburetors may be classed as slide valve or vacuum piston types.

Disassembly, Slide Valve Carburetor

Figure 141 is an exploded view of a typical Keihin slide valve carburetor. Some models are equipped with power jets and power air jets. To disassemble these carburetors, proceed as follows.

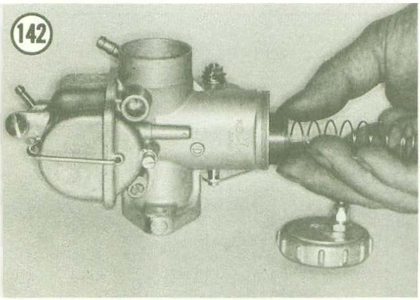
1. Remove ring nut from mixing chamber body. There is a heavy spring under the ring nut; do not allow the nut to fly away.
2. Remove the spring and the throttle slide (**Figure 142**).
3. Remove float bowl after pushing aside its retaining bail (**Figure 143**).
4. Gently pull out float pivot shaft, then remove float assembly (**Figure 144**).
5. Remove float needle (**Figure 145**).
6. Remove main jet and needle jet holder as a unit (**Figure 146**).
7. Push out needle jet, using a fiber or plastic tool (**Figure 147**).

(141)



KEIHIN SLIDE VALVE CARBURETOR

1. Left carburetor assembly
2. Float
3. Float valve set
4. Slow jet
5. Main jet
6. Needle jet
7. Needle jet holder
8. Throttle valve
9. Jet needle
10. Float chamber washer
11. O-ring
12. Choke valve rod A
13. Choke valve rod B
14. O-ring
15. Top gasket
16. Air screw
17. Throttle stop screw
18. Air screw spring
19. Throttle stop spring



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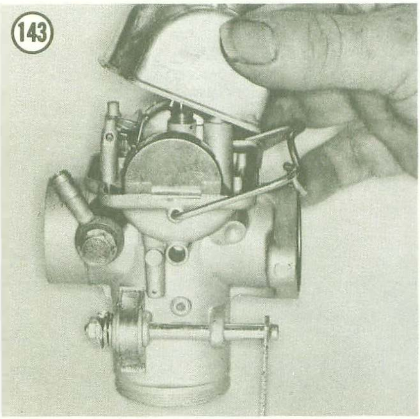

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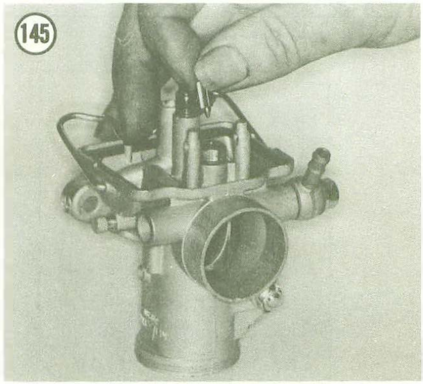

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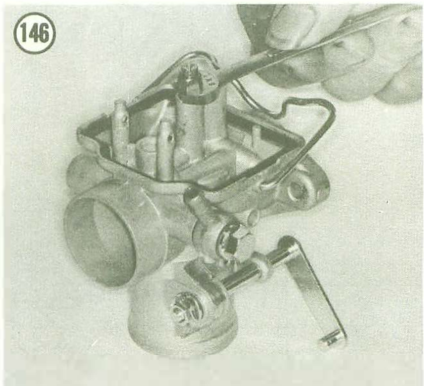

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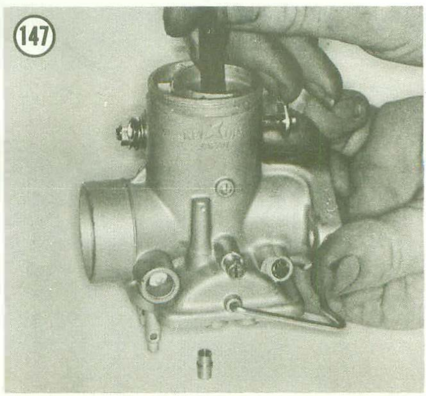
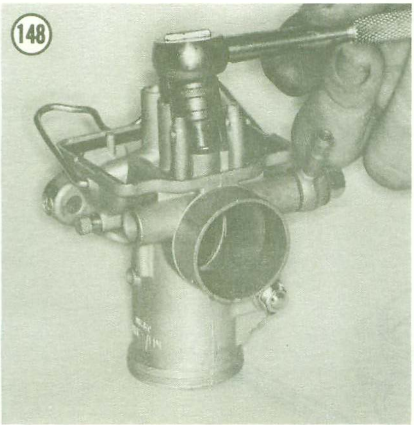
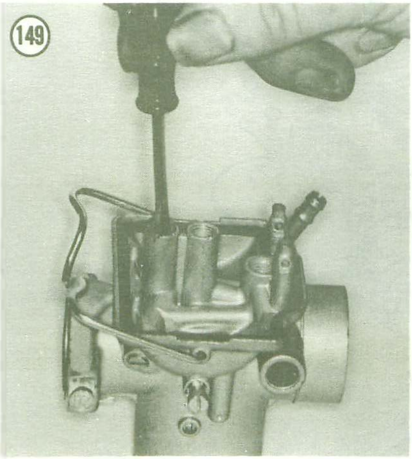


147

8. Remove float needle valve seat and its gasket (**Figure 148**).

9. Remove pilot jet (**Figure 149**).





10. Remove power jet cover, then power jet (if installed).

11. Remove power air jet (if installed).

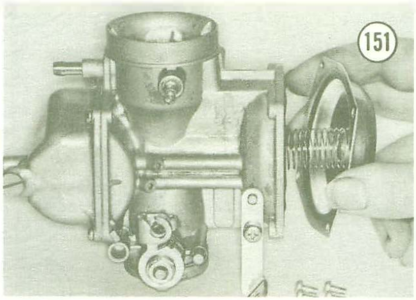
12. Carefully note how much choke lever retaining nut is tightened, then flatten its lockwasher. Remove choke lever assembly.

13. Reverse Steps 1 through 13 to reassemble the carburetor.

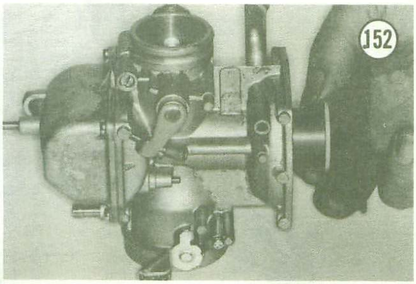
Disassembly, Vacuum Piston Carburetor

Figure 150 illustrates a typical Keihin vacuum piston carburetor. Note that in this type carburetor, slide position is controlled by vacuum.

1. Remove 4 retaining screws, then pull off the diaphragm cover (**Figure 151**). Don't allow the spring to fly away.



2. Note that there is a locating tab on the diaphragm, near the throttle cable bracket. Pull out the diaphragm and slide as an assembly (**Figure 152**).



3. Remove 4 screws, then take off float bowl (**Figure 153**).

4. Pull out float pivot shaft. Be careful not to bend float assembly.

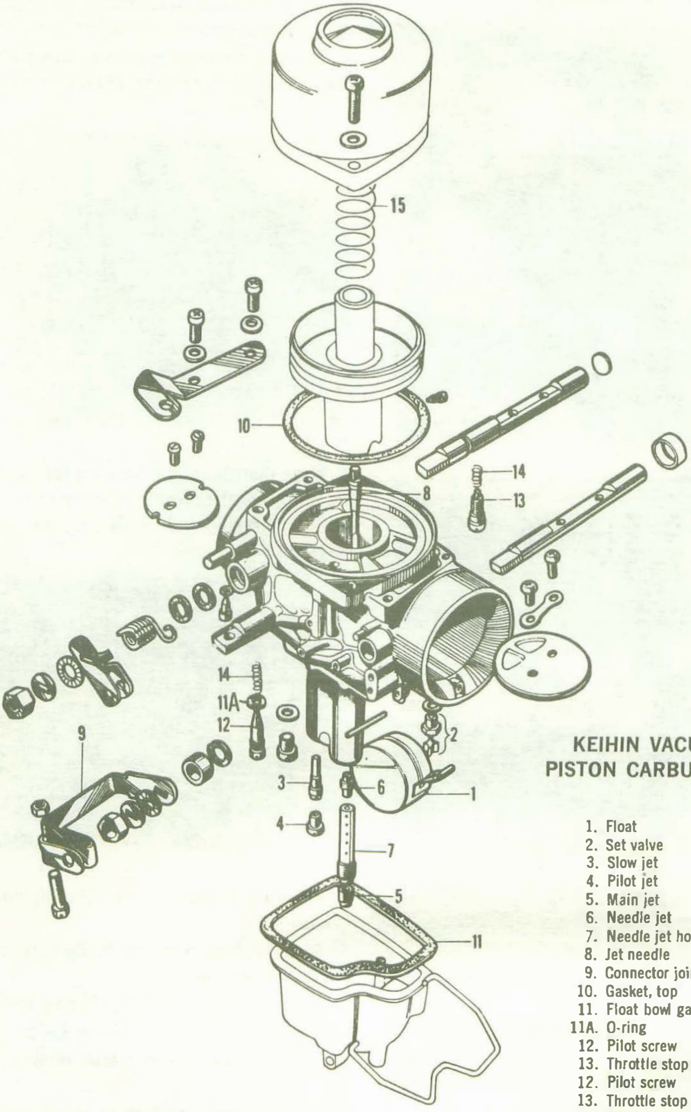
5. Remove float assembly (**Figure 154**).

6. Remove float needle (**Figure 155**).

7. Remove float needle seat retaining screw and clip.

8. Tape the jaws of a pair of needle nose pliers, then pull out float needle seat (**Figure 156**). Always replace the O-ring upon reassembly.

(150)

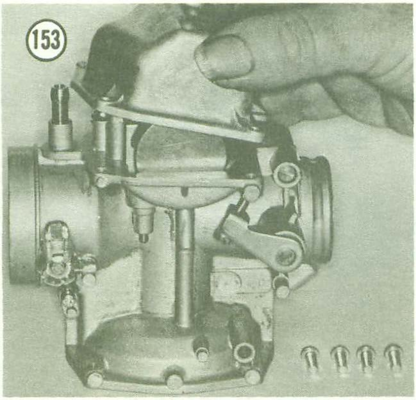


KEIHIN VACUUM PISTON CARBURETOR

1. Float
2. Set valve
3. Slow jet
4. Pilot jet
5. Main jet
6. Needle jet
7. Needle jet holder
8. Jet needle
9. Connector joint
10. Gasket, top
11. Float bowl gasket

11A. O-ring

12. Pilot screw
13. Throttle stop screw
12. Pilot screw
13. Throttle stop screw
14. Air screw spring
15. Vacuum piston spring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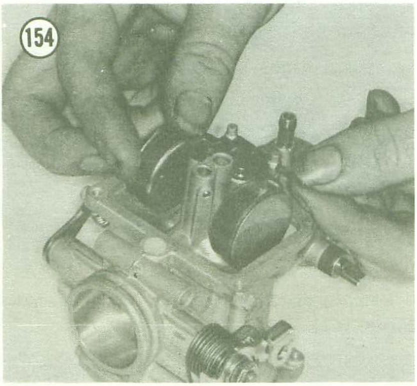
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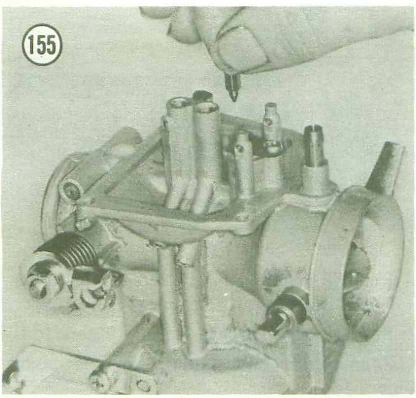
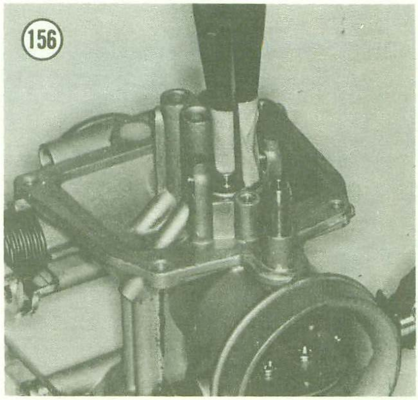
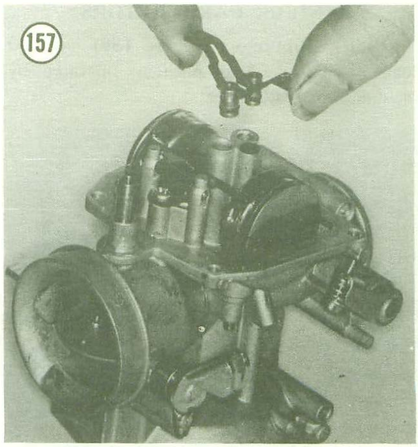

155


156

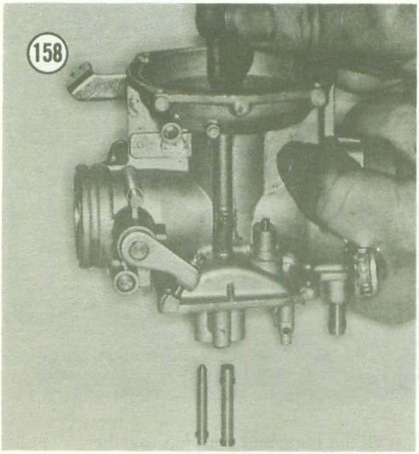
9. Pull out main and pilot jets together, by pulling on their retainer (**Figure 157**). Although these jets appear to be similar, they may be distinguished by size; the main jet is larger, and will not fit into the pilot jet bore. Always replace O-rings upon reassembly.


157

10. Turn carburetor right side up. The needle jet will drop out.

11. Using a plastic or fiber tool, push out the slow-speed jet (**Figure 158**).

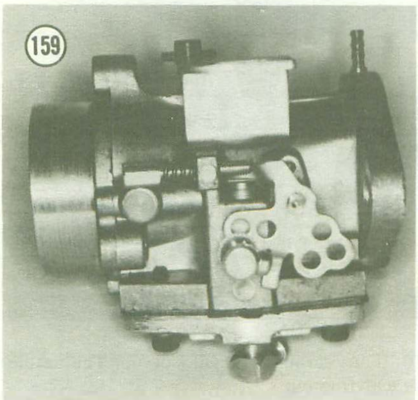
12. The slide and diaphragm assembly may be disassembled by compressing the jet needle retaining clip with a pair of long-nose pliers.



13. Reverse the foregoing steps to reassemble the carburetor. Always use new gaskets and O-rings upon reassembly.

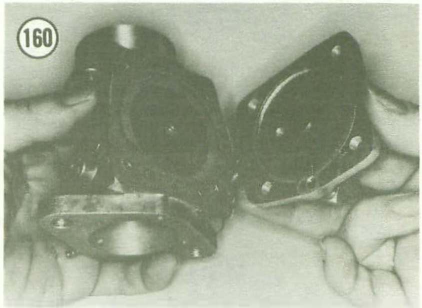
KENDICK CARBURETORS

Kendick carburetors (**Figure 159**) have no float mechanism. A diaphragm, operated by vacuum, replaces the float.

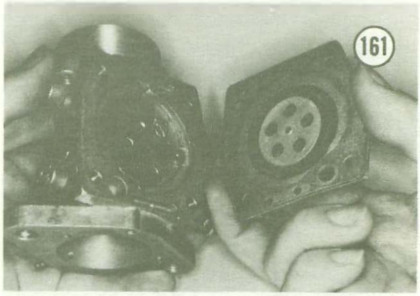


Disassembly

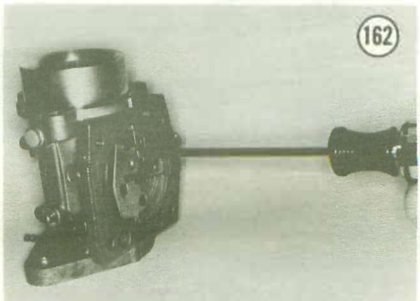
1. Remove 4 socket head screws, then diaphragm cover (**Figure 160**). Note that there is a flat washer under each screw.



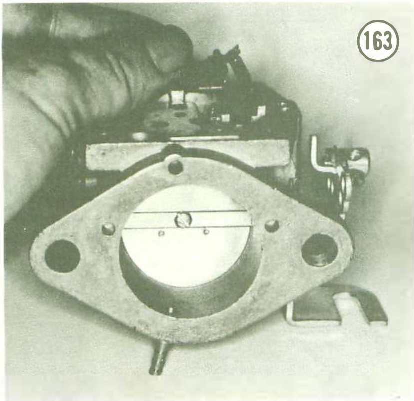
2. Remove diaphragm and its gasket as an assembly (**Figure 161**).

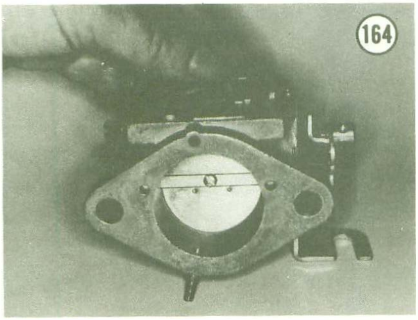


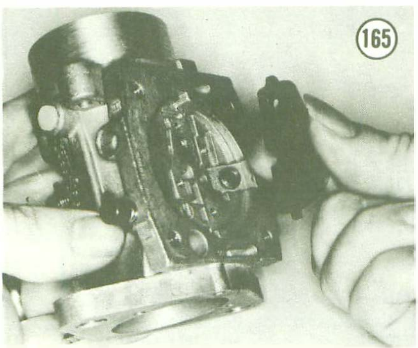
3. Remove metering lever pin retaining screw (**Figure 162**).



4. Remove metering lever, metering lever pin, and needle valve as an assembly (**Figure 163**).
5. Remove metering lever spring (**Figure 164**).
6. Remove the circuit plate and its gasket (**Figure 165**).







7. Turn idle mixture screw in until it seats lightly. Count the number of turns required and record for an initial setting when the carburetor is reassembled. Then remove screw together with its spring and sealing washers.

8. Repeat Step 7 with the power needle.

9. Remove throttle cable bracket.

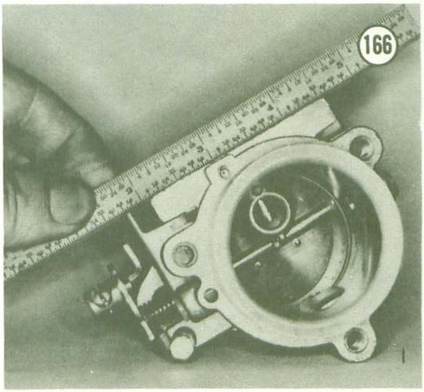
10. Further disassembly should not be required, but should present no difficulty.

Reassembly

Reverse Steps 1 through 10 to reassemble the carburetor. Be sure that the metering lever spring engages the dimple on the metering lever.

Adjustment

Other than mixture adjustment which is made on the bike, the only other adjustment required is that of setting the metering lever. Bend it so that it just barely inteferes with a straightedge drawn across the lower carburetor surface (**Figure 166**).



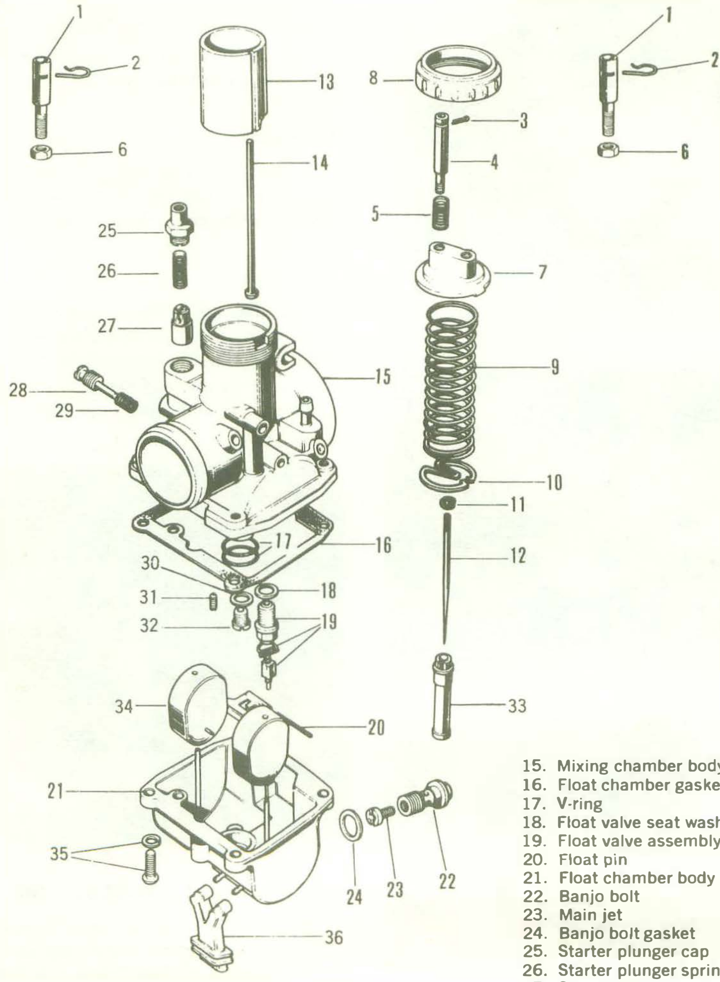
MIKUNI CARBURETORS

Mikuni carburetors are supplied as standard equipment on many models of Japanese motorcycles. They can be classified by float type; some models have independent floats, and others have single-unit, or twin floats.

Disassembly, Independent Float Type

Figure 167 is an exploded view of this type of carburetor. Refer to that illustration during disassembly and reassembly.

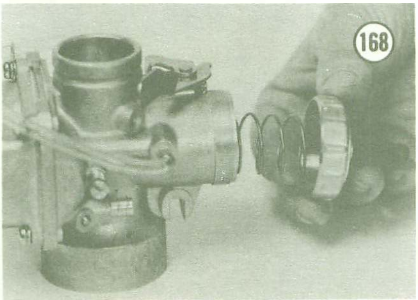
(167)



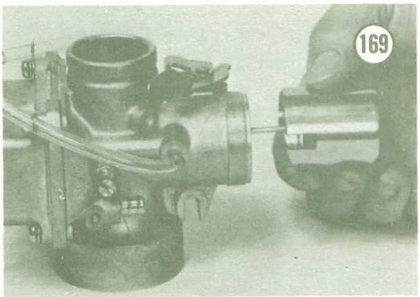
MIKUNI INDEPENDENT FLOAT CARBURETOR

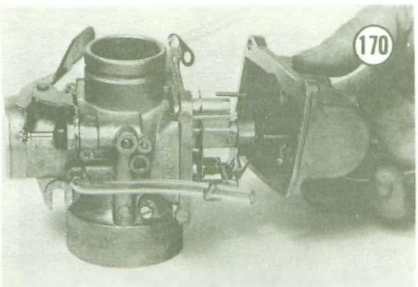
1. Cable adjuster
2. Circlip
3. Cotter pin
4. Throttle stop screw
5. Throttle stop screw spring
6. Cable adjuster lock nut
7. Mixing chamber top
8. Mixing chamber cap
9. Throttle valve spring
10. Throttle valve spring seat
11. Circlip
12. Jet needle 5EH7
13. Throttle valve
14. Throttle valve stop rod
15. Mixing chamber body
16. Float chamber gasket
17. V-ring
18. Float valve seat washer
19. Float valve assembly
20. Float pin
21. Float chamber body
22. Banjo bolt
23. Main jet
24. Banjo bolt gasket
25. Starter plunger cap
26. Starter plunger spring
27. Starter plunger
28. Pilot air adjust screw
29. Pilot air screw spring
30. Main jet washer
31. Jet pilot
32. Main jet
33. Needle jet
34. Float
35. Float chamber screw
36. Overflow pipe grommet

1. Remove mixing chamber cap (**Figure 168**). There is a spring under the cap; don't allow any parts to fly away.

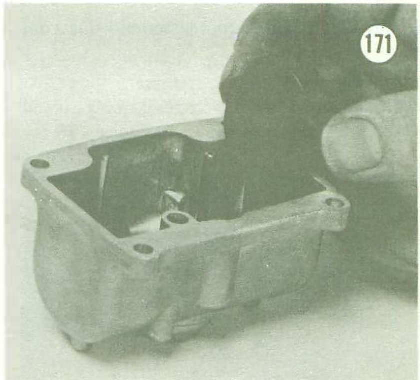


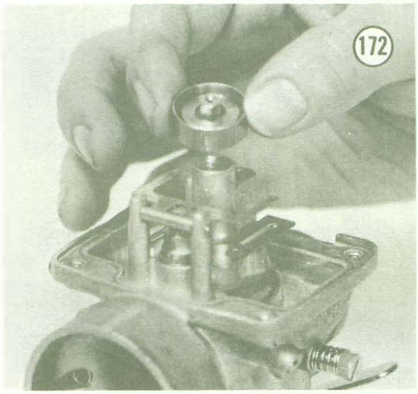
2. Remove throttle slide assembly (**Figure 169**).
3. Remove float bowl (**Figure 170**).

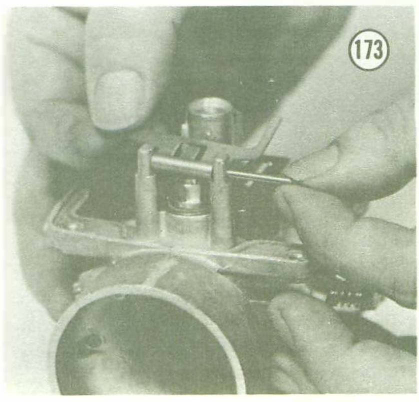




4. Remove floats (**Figure 171**).
5. Remove main jet (**Figure 172**).
6. Remove pivot pin and float lever (**Figure 173**). Note carefully how float lever is in-

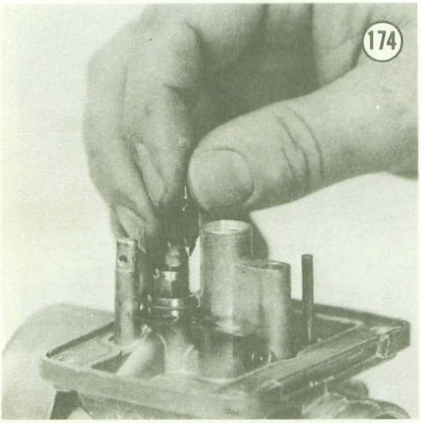


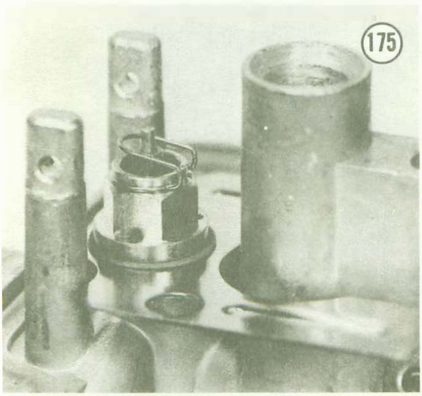




stalled; it is possible to reassemble this component upside down.

7. Remove float needle retainer, then float needle (**Figure 174**). Upon reassembly, install float needle retainer as shown in **Figure 175**.



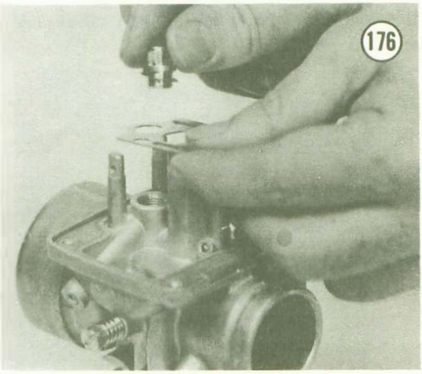


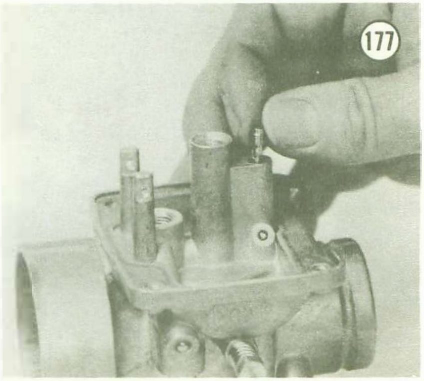
8. Remove float valve seat. If there is a plate underneath it, remove it also (**Figure 176**). Note how washer is installed.

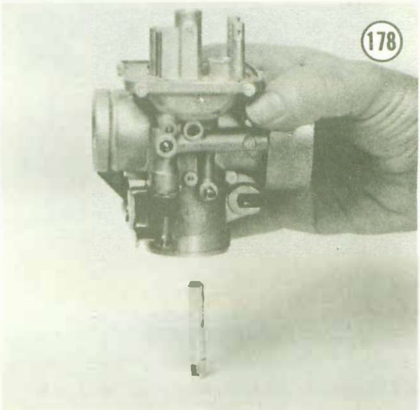
9. Remove pilot jet (**Figure 177**).

10. Invert carburetor, then push out needle jet (**Figure 178**). Do not use any metal tool for this operation.

11. Remove idle speed and mixture screws.

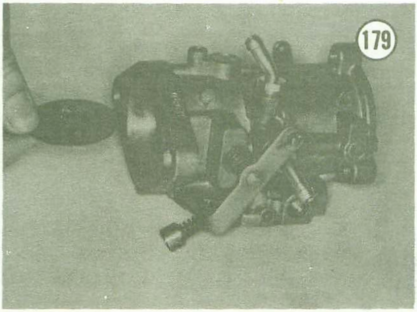




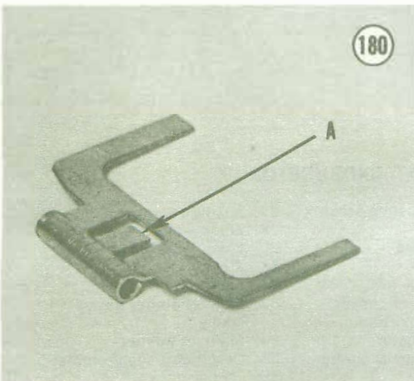


Independent Float Level Adjustment

Mikuni carburetors with independent floats leave the factory with float levels properly adjusted. Rough riding, a worn needle valve, or a bent float arm can cause the float level to change. To adjust float level on these carburetors, refer to **Figure 179**, then proceed as follows.



1. Remove the float bowl and floats, then invert the carburetor body. Allow the float lever to rest on the needle by its own weight.
2. Measure distance A from the float arm to the carburetor body surface.
3. Bend the tang on the float arm (**Figure 180**) as required for adjustment.



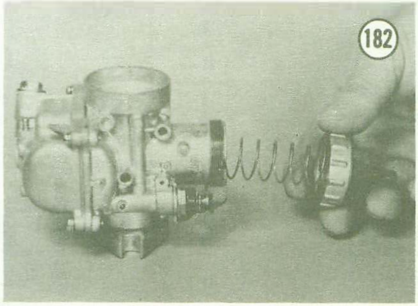
A. Bend tang to adjust float level

4. Float levels are specified in the tune-up section for the individual bike in question.

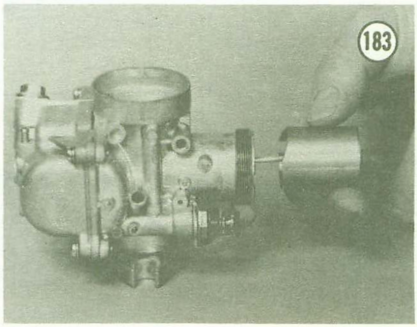
Disassembly, Single-Unit Floats

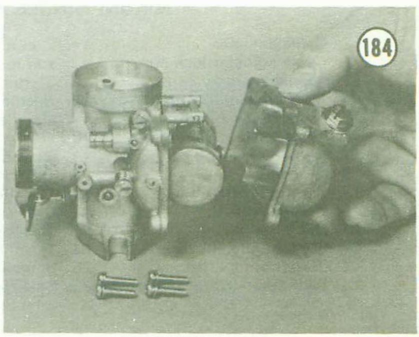
Figure 181 is an exploded view of a typical carburetor of this type. Refer to that illustration during disassembly and reassembly.

1. Remove mixing chamber cap (**Figure 182**).



2. Remove throttle valve assembly (**Figure 183**).
3. Remove float bowl (**Figure 184**).





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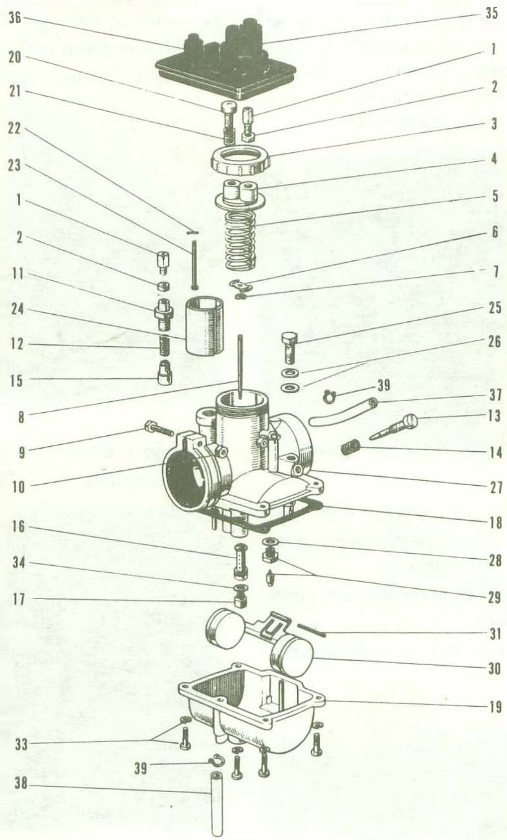
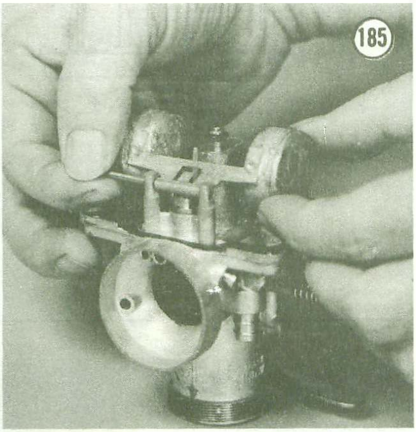


MIKUNI SINGLE FLOAT CARBURETOR

1. Cable adjuster
2. Cable adjuster lock nut
3. Mixing chamber cap
4. Mixing chamber top
5. Throttle valve spring
6. Throttle valve spring seat
7. Needle clip
8. Jet needle
9. Carburetor mounting clamp screw
10. Nut
11. Starter plunger cap
12. Starter plunger spring
13. Pilot air adjusting screw
14. Pilot air adjusting screw spring
15. Starter plunger
16. Needle jet
17. Main jet
18. Float chamber gasket
19. Float chamber body
20. Throttle adjuster
21. Throttle adjuster spring
22. Cotter pin
23. Throttle valve stop rod
24. Throttle valve
25. Banjo bolt
26. Gasket
27. Mixing chamber body
28. Float valve seat washer
29. Float valve complete
30. Float
31. Float pin
33. Float chamber fitting screw
34. Main jet washer
35. Carburetor cap grommet
36. Carburetor cap
37. Fuel overflow pipe
38. Air vent pipe
39. Circlip

4. Remove pivot pin and float (**Figure 185**). Take care not to bend float assembly.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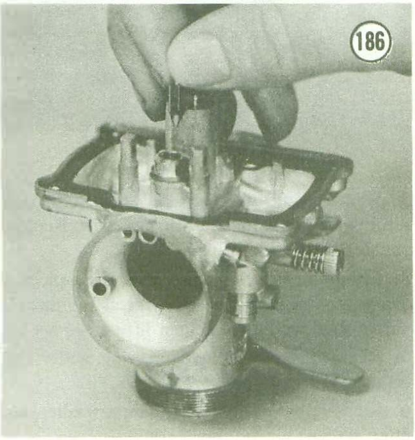
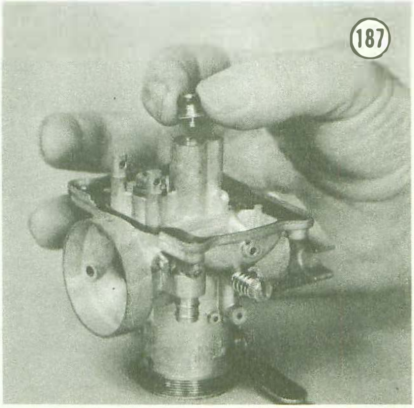
5. Remove float needle (**Figure 186**).
6. Remove main jet and its washer (**Figure 187**).


186

7. Remove float valve seat and its washer (**Figure 188**).
8. Remove pilot jet (**Figure 189**).
9. Push out needle jet, using a plastic or fiber tool (**Figure 190**).
10. Remove idle speed and idle mixture screws. Take care not to lose their springs.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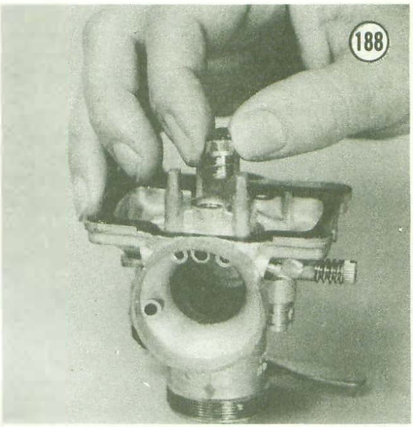
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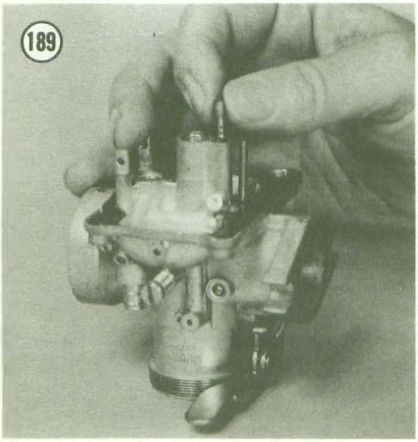
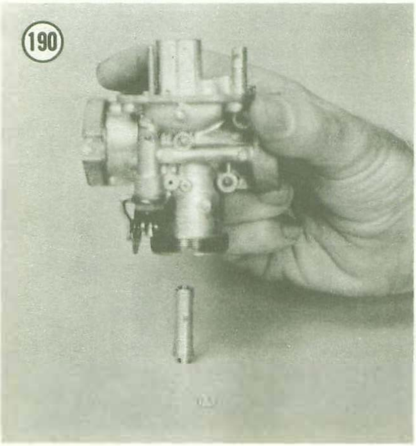
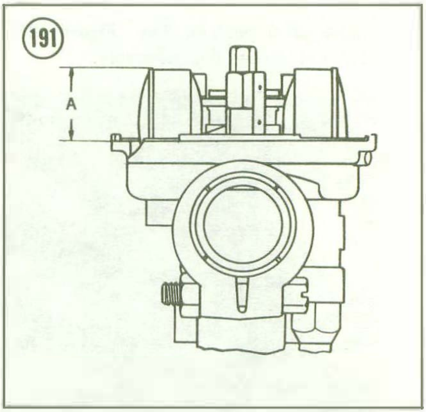
Single-Unit Float Adjustment

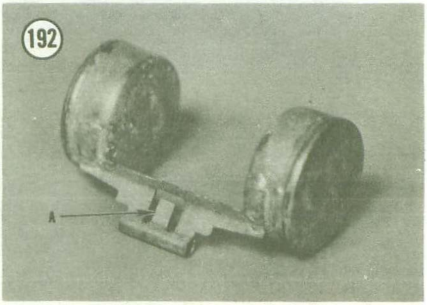
Refer to **Figure 191**, then proceed as follows.

1. Remove the float chamber and invert the mixer body. Allow the float arm to rest on the needle valve by its own weight, without compressing the float needle spring.
2. Measure distance A from the top of the floats to the float bowl gasket surface. Note that this distance must be equal for each float.
3. Bend the tang on the float arm (**Figure 192**) as required for adjustment.









A. Bend tang to adjust float level

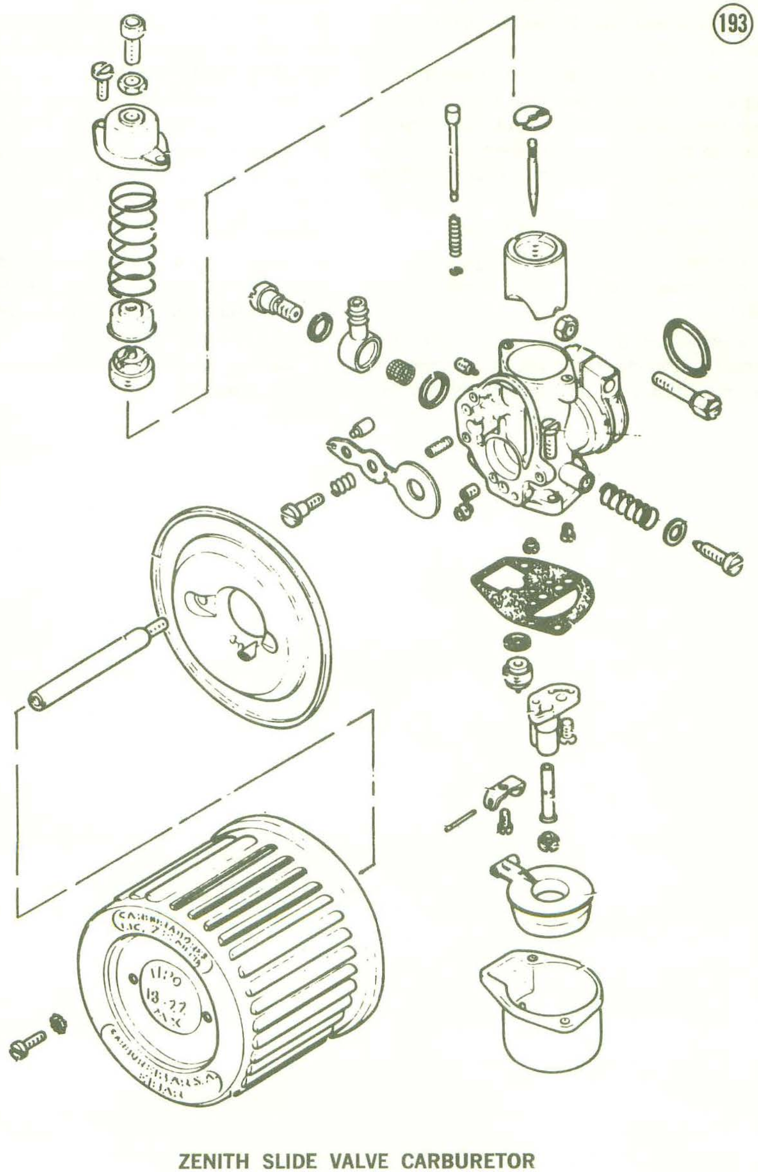
ZENITH SLIDE VALVE CARBURETORS

Zenith slide valve carburetors are used principally on older Bultaco motorcycles. **Figure 193** is an exploded view of this carburetor.

Disassembly

1. Remove carburetor from the motorcycle.
2. Remove 2 attaching screws, then remove carburetor top.
3. With throttle valve upside down, pull slide return spring away from throttle valve. Remove cable from throttle valve.
4. Clamp throttle valve in a vise. Use a piece of heavy leather or rubber to protect the throttle valve. Remove hex nut, then lift out jet needle.
5. Remove brass cup, return spring, and carburetor top from cable.
6. Remove banjo bolt, then banjo, washer, and filter screen.
7. Remove throttle stop screw, washer, and spring.
8. Remove 2 attaching screws, then float bowl and gasket.
9. Push out float pivot shaft by pressing on end of the shaft that protrudes from slotted ear on mounting bracket.

193



ZENITH SLIDE VALVE CARBURETOR

10. Remove clip from bottom of tickler shaft. Then remove tickler button and spring.

11. Remove float pivot bracket by removing its attaching screw.

12. Insert a 1/16 in. drill bit into each of the 2 holes in the float valve assembly. Insert a screwdriver blade between the 2 drill bits, perpendicular to them. With screwdriver, rotate drill bits counterclockwise to unscrew float valve from carburetor body.

13. Unscrew main jet from jet holder.

14. Remove attaching screw, then jet holder.

15. Press needle jet out from bottom of jet holder.

16. Remove the 2 remaining small jets from bottom of carburetor body. The fuel metering jet is closer to the float needle assembly; the mixture metering jet is closer to the carburetor mounting flange.

17. Remove the 2 air cleaner attaching screws, then strike air cleaner with your hand to remove it from its mounting plate.

18. Remove the 2 mounting posts, then remove air cleaner mounting plate from carburetor body.

19. Remove choke lever mounting screw and spring, then choke lever. Do not attempt to remove choke lever spring; it is molded into the carburetor body.

20. Remove the unmarked jet from center of 3 holes below mouth of carburetor. This is the air lift jet; its function is to feed air to needle jet as part of midrange booster system.

21. Reverse the disassembly procedure to reassemble carburetor.

CHAPTER THREE

ELECTRICAL SYSTEM

This chapter discusses operating principles and troubleshooting procedures for motorcycle ignition and electrical systems. Pages 65 through 95 describe generalized procedures; the remainder of chapter is devoted to specific makes of bikes.

BATTERY IGNITION

Some single cylinder and most multicylinder motorcycles are equipped with a battery and coil ignition system, similar in many ways to that of a conventional automobile.

CIRCUIT OPERATION

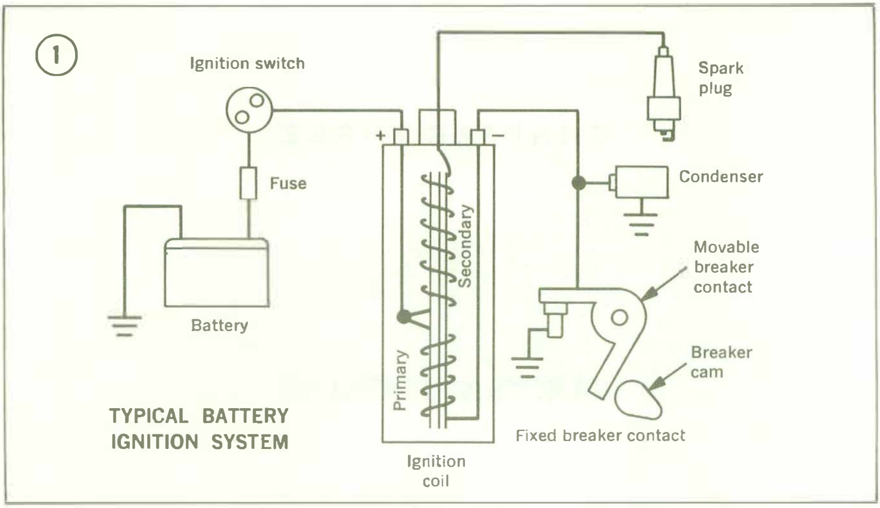
Figure 1 illustrates a typical battery ignition system as used on a single cylinder motorcycle. For two-stroke machines, the circuit is duplicated for each cylinder, except for the fuse, battery, and ignition switch.

When the breaker points are closed, current flows from the battery through the primary winding of the ignition coil, thereby building a magnetic field around the coil. The breaker cam rotates at crankshaft speed and is so adjusted that the breaker points open as the piston reaches the firing position.

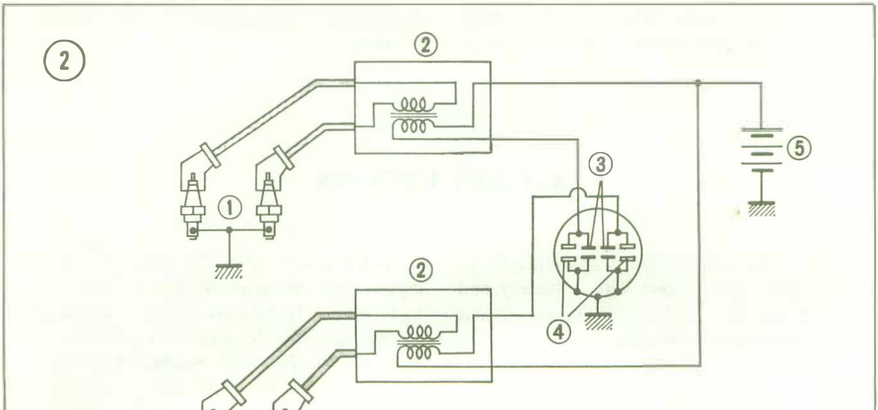
As the points open, the magnetic field collapses. When the magnetic field collapses, a very high voltage is induced (up to approximately 15,000 volts) in the secondary winding of the ignition coil. This high voltage is sufficient to jump the gap at the spark plug.

The condenser assists the coil in developing high voltage, and also serves the points. Inductance of the ignition coil primary winding tends to keep a surge of current flowing through the circuit even after the points have started to open. The condenser stores this surge and thus prevents arcing at the points.

Some four-stroke multicylinder models use a variation of this circuit, shown in **Figure 2**. Note that all components are similar, except that the coil has two high voltage outputs, each of which goes to one spark plug. Both spark plugs fire simultaneously with this circuit. The system is



TYPICAL BATTERY IGNITION SYSTEM



BATTERY IGNITION SYSTEM VARIATION

1. Spark plugs
2. Ignition coils
3. Condensers
4. Contact breaker
5. Battery

feasible because in a twin cylinder four-stroke engine, one cylinder is on its exhaust stroke when the spark plug fires in the other cylinder. Larger models, such as Honda and Kawasaki fours, use two such circuits.

TROUBLESHOOTING

Ignition system problems can be classified as no spark, weak spark, or improperly timed spark. These conditions can affect any or all cylinders of a multicylinder engine. Note that on models in which a single coil fires two spark plugs, a problem affecting one cylinder, such as a fouled plug, will affect its companion cylinder also. **Table 1** lists common causes and remedies for ignition system malfunctions.

On multicylinder models, if the problem is no spark at any cylinder, it is almost certainly because current is not reaching any coil. Since the only current path is through the battery connections and the main switch, the defect will be easy to locate.

Ignition failures confined to one cylinder are also easy to isolate.

1. Rotate the engine until the points associated with the affected cylinder are closed.
2. Disconnect the high voltage lead from the affected spark plug and hold it one-quarter inch away from the cylinder head. Turn on the ignition. With an insulated tool, such as a piece of wood, open the points. A fat, blue-white spark should jump from the spark plug lead to the cylinder head. If the spark is good, clean or replace the spark plug. If there is no spark, or if it is thin, yellowish, or weak, continue with Step 3.
3. Connect the leads of a voltmeter to the wire on the points and to a good ground. Turn on the ignition switch. If the meter indicates more than ⅛ volt, the problem is defective points. Replace them.
4. Open the points with an insulated tool, such as a piece of wood. The voltmeter should indicate battery voltage. If not, there are three possibilities:
   a. Shorted points
   b. Shorted condenser
   c. Open coil primary circuit
5. Disconnect the condenser and the wire from the points. Connect the ungrounded (positive on most bikes) voltmeter lead to the wire which was connected to the points. If the voltmeter does not indicate battery voltage, the problem is an open coil primary circuit. Replace the suspected coil with a known good one. You may borrow one from another cylinder. If that coil doesn't work, the problem is in the primary wiring.
6. If the voltmeter indicates battery voltage in Step 5, the coil primary circuit is okay. Connect the positive voltmeter lead to the wire which goes from the coil to the points. Block the points open with a calling card or similar piece of cardboard. Connect the negative voltmeter lead to the movable point. If the voltmeter indicates any

Table 1 IGNITION SYSTEM TROUBLESHOOTING

Symptom	Probable Cause	Remedy
No spark, or weak spark, all cylinders	Discharged battery	Charge battery
	Defective fuse	Replace
	Defective main switch	Replace
	Loose or corroded connections	Clean and tighten
	Broken wire	Repair
No spark, or weak spark, one cylinder only	Incorrect point gap	Reset points. Be sure to readjust ignition timing
	Dirty or oily points	Clean points
	Spark plug lead damaged	Replace wire
	Broken primary wire	Repair wire
	Open winding in coil	Replace coil
	Shorted winding in coil	Replace coil
	Defective condenser	Replace condenser
Misfires	Dirty spark plug	Clean or replace plug
	Spark plug is too hot	Replace with colder plug
	Spark plug is too cold	Replace with hotter plug
	Spring on ignition points is weak	Replace points, reset timing
	Incorrect timing	Adjust timing

voltage, the points are shorted and must be replaced.

7. If the foregoing checks are satisfactory, the problem is in the coil or condenser. Substitute each of these separately with a known good one from another cylinder to determine which is defective.

Ignition Coil

The ignition coil is a form of transformer which develops the high voltage required to jump the spark plug gap. The only maintenance required is that of keeping the electrical connections clean and tight, and occasionally checking to see that the coil is mounted securely.

If coil condition is doubtful, there are several checks which may be made.

1. Measure coil primary resistance, using an ohmmeter, between both coil primary terminals (**Figure 3**). Resistance should measure approximately five ohms. Some coils, however, have a primary resistance of less than one ohm. Compare the measurement obtained with that of a known good coil.

2. Measure resistance between either primary terminal and the high voltage terminal (**Figure 4**) on coils with a single high voltage terminal. Resistance should be in the range of 10,000 to 25,000 ohms. On coils with two high voltage terminals, measure between them.

3. If the coil has a metal housing, scrape paint on the coil housing down to bare metal. Set the ohmmeter to its highest range, then measure insulation resistance between this bare spot and the high voltage terminal (**Figure 5**). Insulation resistance must be at least 3 megohms (3 million ohms).

4. If these checks don't reveal any defects, but coil condition is still doubtful, substitute a known good one.

Be sure to connect all wires to their proper terminals when replacing the coil.

Condenser

The condenser is a sealed unit that requires no maintenance. Be sure that both connections are clean and tight.

Two tests can be made on the condenser.

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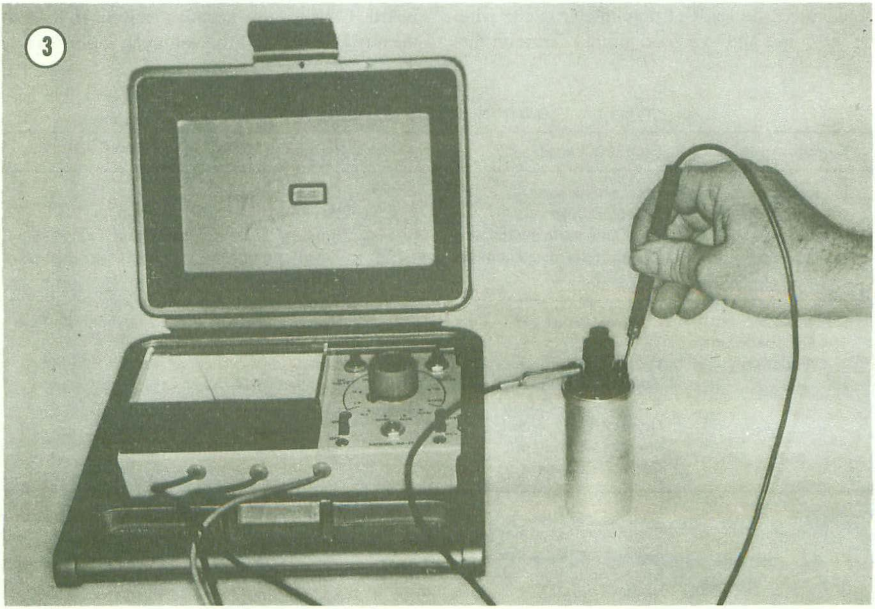

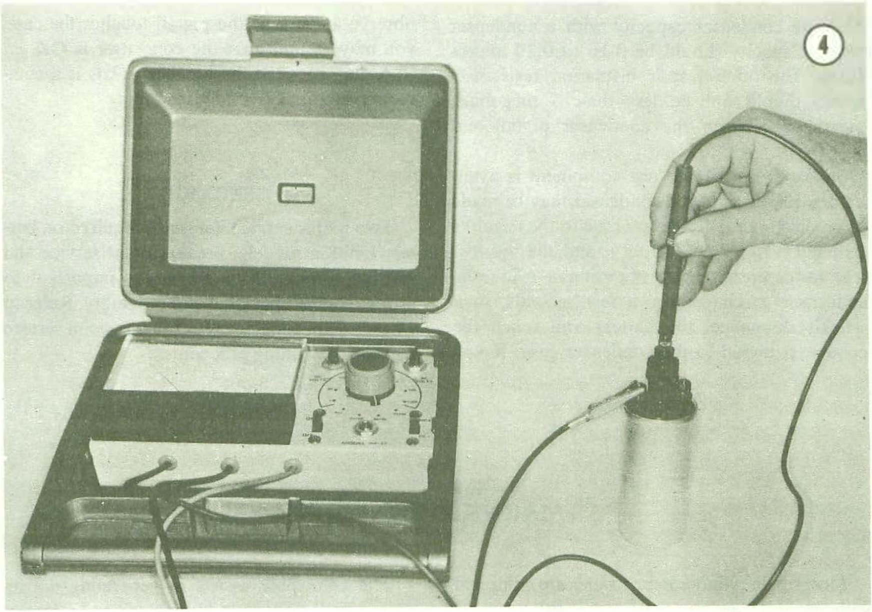

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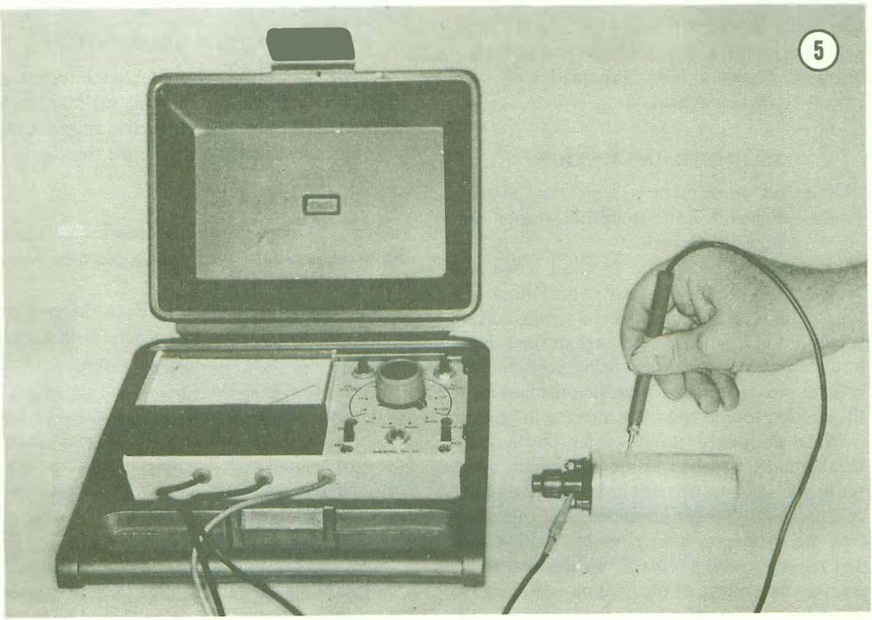

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Measure condenser capacity with a condenser tester. Capacity should be 0.16 to 0.20 microfarad. The other test is insulation resistance, which should not be less than 5 megohms, measured between the condenser pigtail and case.

In the event that no test equipment is available, a quick test of the condenser may be made by connecting the condenser case to the negative terminal of a 12-volt battery, and the positive lead to the positive battery terminal. Allow the condenser to charge for a few seconds, then quickly disconnect the battery and touch the condenser pigtail to the condenser case. If you observe a spark as the pigtail touches the case, you may assume that the condenser is OK.

Arcing between the breaker points is a common symptom of condenser failure.

SERVICE

Two major service items are required on battery ignition models; breaker point service and ignition timing. Both are vitally important to proper engine operation and reliability. Refer to Chapters Six and Seven for breaker point service and ignition timing procedures.

MAGNETO IGNITION

Most single cylinder motorcycles are equipped with flywheel magnetos to furnish ignition power. Magnetos are simple, rugged devices which require little service. On many models, the magneto also furnishes power for lights and battery charging. **Figure 6** is an exploded view of a typical flywheel magneto.

MAGNETO OPERATION

A circuit diagram of a typical magneto is shown in **Figure 7**. Refer to this illustration during the following discussion.

Magnets attached to the flywheel move past the ignition source coil as the flywheel turns. The source coil is so positioned that a strong current is induced in it when the crankshaft, and therefore the piston, approaches firing position. The breaker points are closed, causing the current in the ignition source coil to be shorted to ground.

When the piston reaches firing position, the breaker cam, attached to the crankshaft, opens the breaker points. Current in the ignition source coil is then no longer grounded, and must flow into the primary winding of the ignition coil. The ignition coil is a form of transformer, which steps up the voltage of the ignition source coil to a very high value, sufficient to fire the spark plug.

The condenser assists in generating the required high voltage, and also serves to protect the ignition points from burning and pitting.

MAGNETO TROUBLESHOOTING

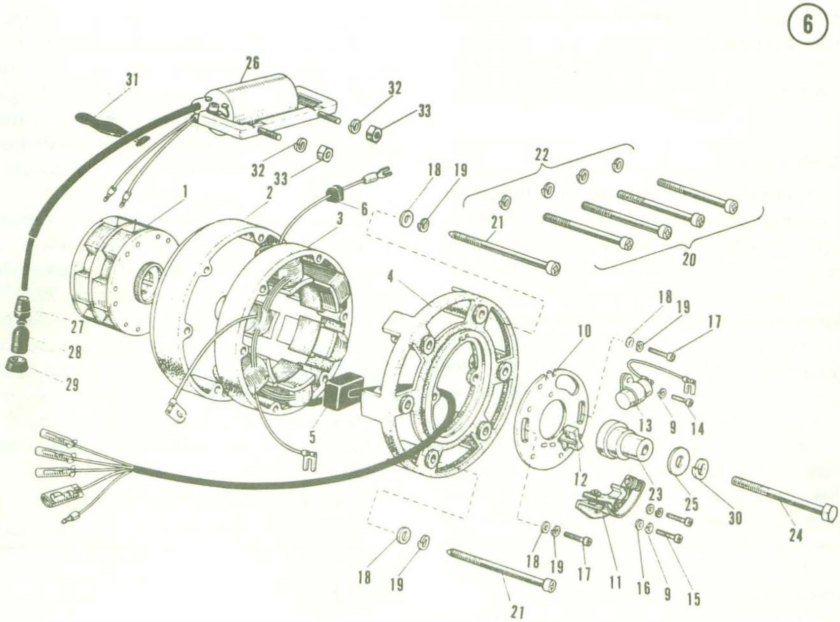
Magnetos rarely give trouble. In the event that an ignition, lighting, or charging malfunction is believed to be caused by a defective magneto, the following checks should isolate the trouble.

Ignition Source Coil

1. With the magneto wiring disconnected, block the breaker points open with a piece of paper such as a business card.
2. Measure the resistance between the ignition source coil output wire and ground with a low-range ohmmeter. If resistance is about 0.5 ohm, the coil is probably good.
3. If possible, disconnect the ground wire between the ignition coil and the magneto base. Measure insulation resistance betwene the iron core and the coil. Insulation resistance should be at least 5 megohms.

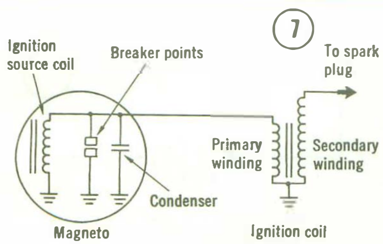
Condenser

Measure the capacity of the condenser, using the condenser tester. The value should be in the



TYPICAL MAGNETO

1. Rotor
2. Rear cover
3. Stator
4. Front cover
5. Engine wiring harness grommet (A)
6. Engine wiring harness grommet (B)
9. Spring washer
10. Contact breaker plate
11. Contact breaker assembly
12. Oil felt
13. Condenser
14. Pan head screw
15. Pan head screw
16. Plain washer
17. Pan head screw
18. Plain washer
19. Spring washer
20. Pan head screw
21. Pan head screw
22. Spring washer
23. Cam
24. Hex head bolt
25. Plain washer
26. Ignition coil
27. Spark plug cap grommet (B)
28. Spark plug cap
29. Spark plug cap grommet (A)
30. Spring washer
31. Rubber band
32. Spring washer
33. Nut



range of 0.18 to 0.25 microfarad. With the condenser ground wire disconnected, measure insulation resistance between the outer case and the positive terminal. Insulation resistance should be over 5 megohms.

In the event that test equipment is not available, a quick test of the condenser may be made by connecting the negative lead to the negative terminal of a 6-volt battery, and the positive lead to the positive terminal. Allow the condenser to charge for a few seconds, then quickly disconnect the battery and touch the condenser leads together. If you observe a spark as the leads touch, the condenser is good.

Arcing between the breaker points is a common symptom of a defective condenser.

Breaker Points

Check that the insulation between the breaker contacts and the contact breaker base is not defective. A short circuit will prevent the machine from running. To test for this condition, disconnect the wire or wires on the points, and with the points still blocked open, measure insulation resistance between the movable point and a good ground, using the highest range on the ohmmeter. If there is any indication at all on the ohmmeter, the points are shorted.

Contact surfaces may become pitted or worn from normal use. If they are not too damaged, they can be dressed with a few strokes of a clean point file. Do not use sandpaper, as particles may remain on the points and cause arcing and burning. If a few strokes of the file don't smooth the points completely, replace them.

Oil or dirt may get on the points, resulting in premature failure. Common causes for this condition are defective crankshaft seals, improper lubrication of the rubbing block, or lack of care when the crankcase cover is removed and replaced.

If the point spring is weak or broken, the points will bounce, causing misfiring at high speeds.

Lighting and Charging Coils

Measure resistance from each coil output lead to ground. For most coils, resistance should be in the range of 0.3 to 0.6 ohm. If possible, disconnect the ground wire from each coil, then measure insulation resistance between the coil and ground. Any indication of less than 0.5 megohm means that the coil is shorted.

Note that some magnetos have built-in diode rectifiers for battery charging current. If such is the case, charging coil resistance should be very high measured in one direction, and very low in the other. Resistance values will vary, so it is not possible to specify any figures in such cases.

Rectifier

Machines with batteries are also equipped with a rectifier. The rectifier serves two purposes. First, it converts alternating current generated by the magneto into direct current for charging the battery. Second, it prevents the battery from discharging through the charging coil in the magneto when the engine is not running, or is running too slowly to charge the battery.

To test the rectifier, refer to **Figure 8**. Connect the test circuit shown, using the motorcycle battery and a small 6-volt lamp. If the lamp lights with the rectifier leads connected one way, but not when the leads are reversed, the rectifier is OK. If the lamp lights when the leads are connected either way, the rectifier is shorted. If the lamp does not light at all, the rectifier is open. Replace the rectifier if it is shorted or open.

An alternate test method is to use an ohmmeter:

1. Disconnect all wires from the magneto.
2. Connect one ohmmeter lead to the battery

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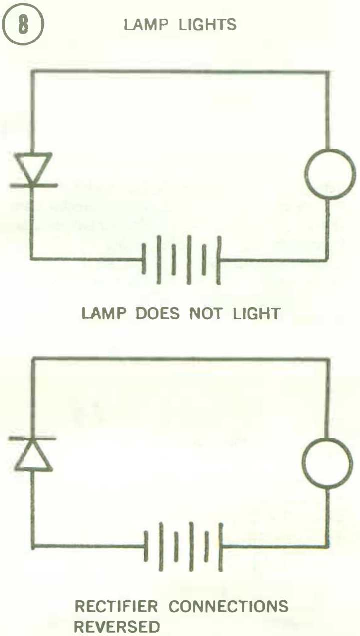

charging wire coming from the magneto. Connect the other ohmmeter lead to ground.

3. Note the ohmmeter indication.

4. Reverse the test connections, then again note the ohmmeter indication.

5. If resistance indications were the same, either high or low, in Steps 3 and 4, the rectifier is faulty. If one reading was high and the other low, the rectifier is OK.

Ignition Coil

The ignition coil is a form of transformer which develops the high voltage required to jump the spark plug gap. The only maintenance required is that of keeping the electrical connections clean and tight, and making sure that the coil is mounted securely.

If the condition of the coil is doubtful, there are several checks which should be made:

1. Measure resistance with an ohmmeter between the positive and negative primary terminals. Resistance should indicate approximately five ohms for most coils on these machines. Some coils, however, have a primary resistance less than one ohm.

Other coils have only one primary terminal. In this case, measure between that terminal and ground to measure primary resistance.

2. Measure resistance between either primary terminal and the secondary high voltage terminal. Resistance should be in the range of 5,000 to 11,000 ohms.

3. On coils with two primary terminals and metal housings, scrape the point from the coil housing down to bare metal. Measure resistance between this bare spot and the high voltage terminal. Insulation resistance must be at least 3 megohms (3 million ohms). This test is not possible on coils with only one primary terminal.

4. If these checks don't reveal any defects, but coil condition is still doubtful, replace the coil with a known good one.

Be sure to connect the primary wires correctly.

Some coils have permanently attached high voltage leads. If so, it is worth a try to cut off one-quarter inch from the end of the lead, then reattach the spark plug connector. It sometimes happens that a poor connection at this point exhibits symptoms of a defective coil.

ELECTRONIC IGNITION

Many motorcycles are equipped with electronic ignition systems. These have the advantage of no moving parts to wear out or change adjustment. Although they differ in details, operation is essentially the same in that a storage capacitor stores electrical power, which is then discharged very quickly into the primary winding of the ignition coil, where it is stepped up to a voltage sufficient to fire the spark plug.

SUZUKI ELECTRONIC IGNITION

Some models are equipped with a pointless electronic ignition (PEI) system, commonly known as a capacitor discharge system. The capacitor discharge system, unlike conventional ignition systems, uses no breaker points or other moving parts. **Figure 9** illustrates the system.

Alternating current from exciter coil (1) is rectified by a diode (2) and charges capacitor (3). As the piston approaches the firing position, a pulse from signal coil (5) is rectified, shaped, and then used to trigger the thyristor (4), which in turn allows the capacitor to discharge quickly into the primary circuit of the ignition coil, where the voltage is stepped up in order to fire the spark plug.

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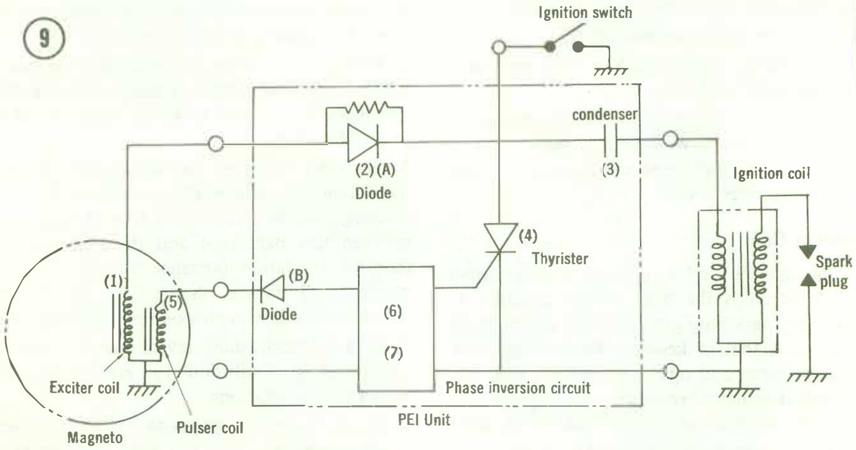

Troubleshooting

If there is no spark, or if the engine misfires, check the magneto first. Refer to **Figure 10**, then make the following measurements with the magneto wiring disconnected.

1. Measure the resistance between the black/red wire and the magneto base plate. Resistance should be approximately 220 ohms (315 ohms for model TM400).
2. Measure the resistance between the red/white wire and the magneto base plate. Resistance should be approximately 75 ohms (80 ohms for model TM400).

There are two methods for testing the ignition coil. One requires a special PEI coil tester. If this tester is available, follow the instructions with it. If the PEI coil tester is not available, measure resistance of each coil winding. Primary winding resistance should be approximately 0.7 ohm (1.5 ohms for model TM400). Secondary resistance

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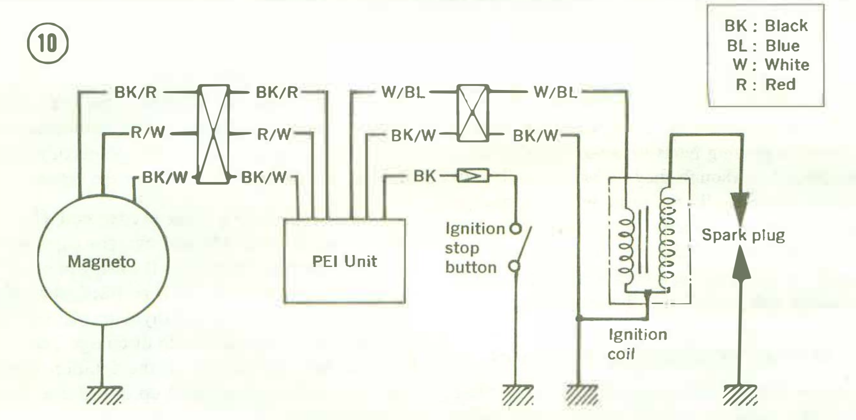


should be approximately 12,000 ohms (20,000 ohms for model TM400).

It is possible to check the PEI unit with an ohmmeter. With the leads connected as specified in **Table 2**, the indications should be as specified. Replace the unit if any check does not agree with the table. Reverse the connections if the Suzuki Electro Tester is used to make the measurements.

Table 2 PEI UNIT TESTING

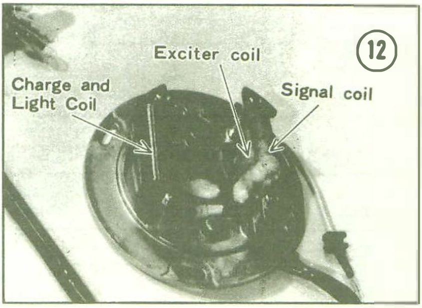
Test	Ohmmeter negative terminal connection	Ohmmeter positive terminal connection	Indication
1	Black/yellow (Stop)	Black/white (Ground)	No continuity
2	Black/yellow (Stop)	Black/red (Exciter coil)	Approximately 2 megohms
3	Black/yellow (Stop)	White/blue (Coil)	Pointer defects, then returns
4	Red/white (Pulser coil)	Black/white (Ground)	No continuity
5	Black/white (Ground)	Red/white (Pulser coil)	100-500 ohms
6	Black/red (Exciter coil)	Black/yellow (Stop)	Continuity
7	Black/white (Ground)	Black/yellow (Stop)	Continuity

KAWASAKI SINGLES ELECTRONIC IGNITION

Some models are equipped with a capacitor discharge (CD) ignition system. This solid state system, unlike conventional ignition systems, uses no breaker points or other moving parts.

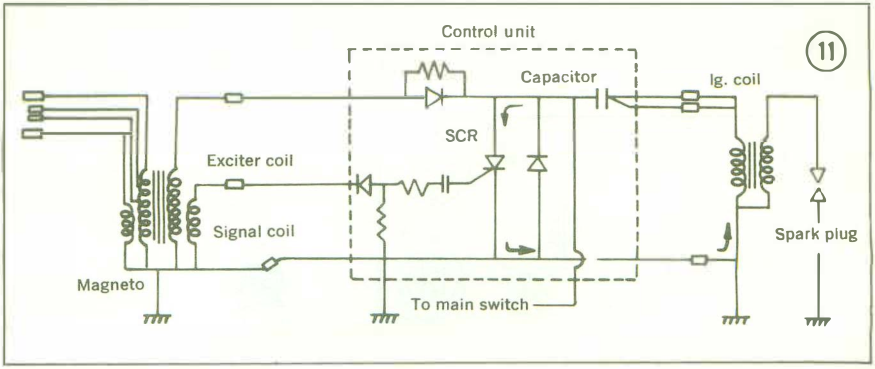
Figure 11 illustrates the capacitor discharge system.

Alternating current from the exciter coil is rectified and used to charge the capacitor. As the piston approaches the firing position, a pulse from the signal coil is rectified, shaped, and then used to trigger the silicon controlled rectifier (SCR) which in turn allows the capacitor to discharge quickly into the primary circuit of the ignition coil, where the voltage is stepped up to a value sufficient to fire the spark plug. **Figure 12** illustrates components of the magneto used with the capacitor discharge ignition system.



Magneto

To check the magneto, disconnect the wires from the main switch, the rectifier, and the control unit. Measure the resistance between each listed lead and the black lead with an ohmmeter.



A schematic diagram of the magneto is shown in **Figure 13**. Resistance of each coil should be approximately as shown in **Table 3**.

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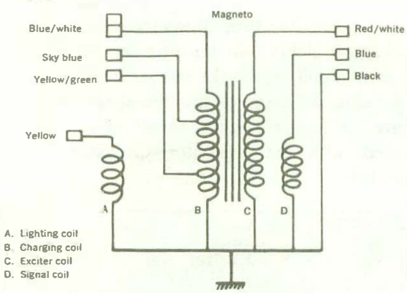

Table 3 MAGNETO COIL RESISTANCE

Coil	Connection	Resistance (ohms)
Exciter	Red/white	220
Signal	Blue	75
Charging	Blue/white	0.23
Lighting	Yellow	0.23

Ignition Coil

Check the ignition coil by measuring the resistance between each winding and the black terminal. See **Table 4**.

Table 4 IGNITION COIL TESTING

Winding	Connection	Resistance (ohms)
Primary	Green/white	0.21
Secondary	Output terminal	1800

Ignition Coil and Control Unit Tests

The control unit tester shown in **Figure 14** is required to test these units. To check the ignition coil with the tester, proceed as follows.

1. Insert power cord (K) into receptacle (B) on the tester. Connect the power cord into a standard 110-volt outlet. Be sure power switch (D) is OFF.
2. Insert the connector of accessory cord (H) into receptacle (A) on the tester.
3. Insert the high voltage cable of the ignition coil into receptacle (E). Connect the 2-pole connector on cord (H) to the ignition coil.
4. Set switch (L) to COIL.

After you test the coil, remove it from the tester, then test the control unit.

1. Perform Steps 2 and 3 above.
2. Connect the 3-pole connector on cord (H) to the receptacle on the control unit.
3. Set switch (L) to UNIT.
4. Press switch (D) to ON.
5. Press pushbutton (C). Pilot lamp (G) will light, and there will be a strong spark discharge in the 3-needle spark plug gap if the control is

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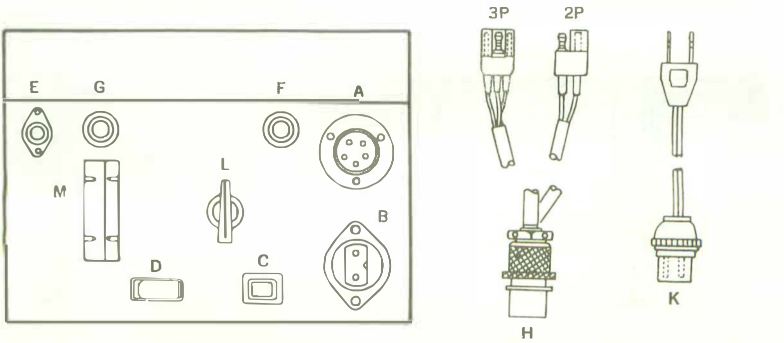

good. If there is no spark, replace the control unit.

It is also possible to test the control unit and ignition coil together.

1. Perform Steps 1 and 2 of the coil test.
2. Connect both the coil and the control unit to the tester using the terminals on cable (H).
3. Connect the high voltage cable from the coil to receptacle (E) on the tester.
4. Set switch (L) to UNIT.
5. Set switch (D) to ON.
6. Press pushbutton (C).
7. If there is a spark discharge at spark gap (M), and pilot lamp (G) lights, both the ignition coil and the control unit are good. If there is no spark, each unit must be tested separately.

KAWASAKI TWINS ELECTRONIC IGNITION

Some models are equipped with a capacitor discharge ignition system (CDI). This system, unlike battery or magneto ignition systems, uses no breaker points or other moving parts. Special surface-gap spark plugs are used with this system. Because of the extremely fast rise time of the high voltage, effects of spark plug fouling are minimized.

CDI Operation

Figure 15 is a schematic diagram of the capacitor discharge system. Battery voltage is converted to alternating current, then stepped up, and rectified into high voltage direct current in the DC to DC converter. This current charges the capacitor (condenser) in the condenser discharge circuit.

A small magnet attached to, and rotating with, the alternator shaft generates a pulse in the signal pickup coil in the alternator. This pulse is amplified, then shaped, and used to trigger the thyristor. When the thyristor is triggered, it conducts, and thereby provides a discharge path for the capacitor.

The capacitor discharges very quickly into the primary circuit of the ignition coil, where it is stepped up to approximately 20,000 volts.

CDI Cautions

Certain measures must be taken to protect the capacitor discharge system. Instantaneous damage may occur to semiconductors in the system if the following precautions are not observed:

1. Never connect the battery backward. If battery polarity is wrong damage will occur to the alternator and rectifier.
2. Do not disconnect battery when engine is running. A voltage surge will occur which will damage the rectifier and possibly burn out lights.
3. Keep all connections clean, uncorroded, and tight. Be sure that cable connectors are pushed together firmly.
4. Do not substitute another type of ignition coil or battery.
5. Each unit is mounted with a rubber vibration isolator. Always be sure that the isolators are in place when replacing any unit.

CDI Troubleshooting

Problems with the capacitor discharge system fall into one of the following catergories. See **Table 5**.

a. Weak spark
b. No spark
c. Sparks occur at random

Unit Tests

Although the most conclusive test can be made by substituting a known good unit for a suspected one, some tests may be made with a voltmeter, ammeter, and ohmmeter.

1. See **Figure 16**. Measure resistance between the black wire and the green or gray wire on unit "A". The ohmmeter must indicate infinite resistance.
2. Reverse the meter connections. The meter must again indicate infinite resistance.

CAUTION

Unit "B" develops high voltage. Follow the procedure exactly to avoid shock hazard.

KAWASAKI TWINS CAPACITOR DISCHARGE SYSTEM

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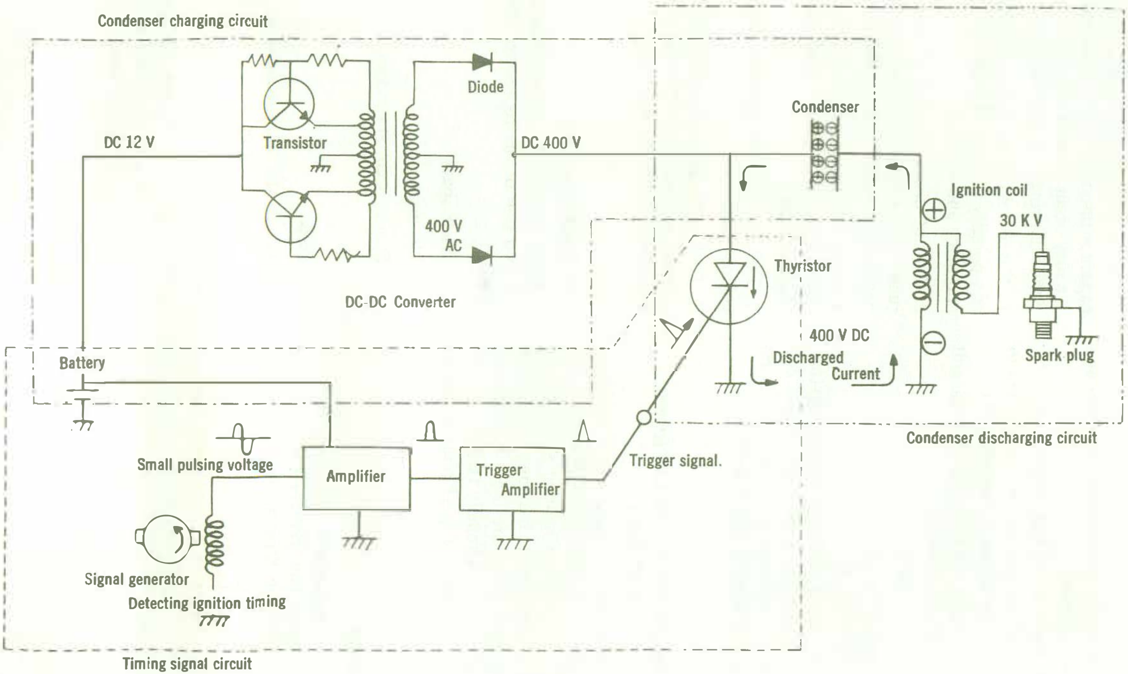
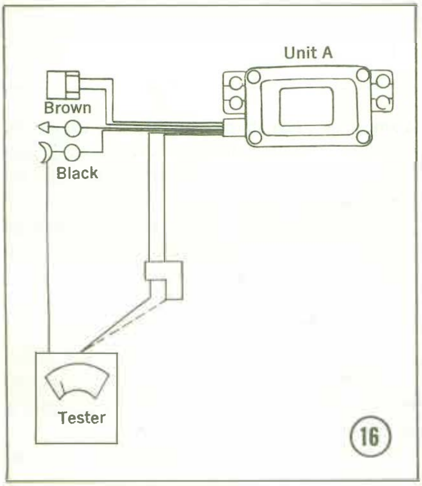
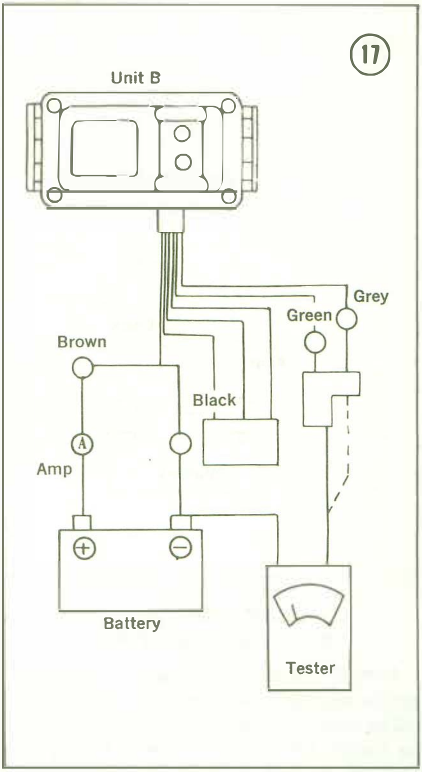


Table 5 CDI TROUBLESHOOTING, KAWASAKI TWINS

Symptom	Probable Cause	Remedy
Weak spark	Low battery	Charge battery
	Poor connections	Clean and tighten connections
	High voltage leakage	Replace defective wire
	Defective coil	Replace coil
	Unit "B" defective	Replace
No spark	Discharged battery	Charge battery
	Fuse burned out	Replace fuse
	Wiring broken	Repair wire
	Defective coil	Replace coil
	Unit "A" or "B" defective	Replace defective unit
	Defective signal generator coil	Replace signal generator coil
Random sparks	Unit "A" or "B" defective	Replace defective unit





3. Connect unit "B" as shown in **Figure 17**. Connect the brown wire to the negative terminal of the ammeter. Connect the positive terminal of the 12-volt battery to the positive terminal of the ammeter. Connect the black wire to the negative battery terminal.

4. The ammeter must indicate 1.8± 0.5 amperes, and not fluctuate.

5. Disconnect the brown wire from the battery. Connect the negative lead on the voltmeter to the negative battery terminal. Connect the positive voltmeter lead to the green or gray wire.

6. Reconnect the brown wire to the battery. The voltmeter must indicate 370 to 500 volts.

7. It is normal that the unit emits a tone.

8. Disconnect the battery, then the voltmeter.

9. Connect both units together, as shown in **Figure 18**, but do not connect the battery.

10. Connect the voltmeter to the green or gray wire. It may be necessary to fabricate some suitable wires to connect the plugs and the voltmeter.

11. Connect the battery as in Step 3.

12. If unit "B" checked OK earlier, but the ammeter does not indicate 1.8 plus or minus 0.5 amperes, or the voltmeter does not indicate 370 to 500 volts, unit "A" is defective.

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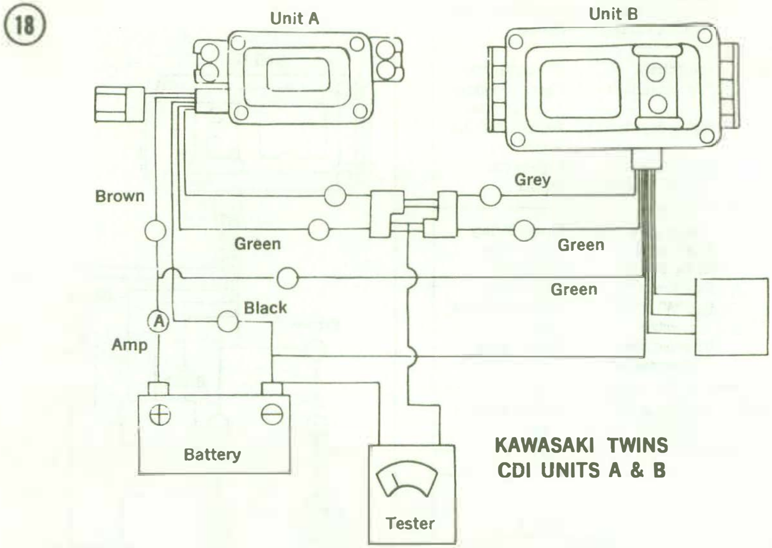


KAWASAKI TWINS
CDI UNITS A & B

KAWASAKI H1 ELECTRONIC IGNITION

Some H1 models are equipped with a capacitor discharge ignition system (CDI). This system, unlike battery or magneto ignition systems, uses no breaker points or other moving parts. Because of the extremely fast rise time of the high voltage, effects of spark plug fouling are minimized.

Since there are no components to wear, ignition timing should not change for the life of the bike.

CDI Operation

Figure 19 is a schematic diagram of the capacitor discharge system. Battery voltage is converted to alternating current, then stepped up, and rectified into high voltage direct current in a DC-to-DC converter which is part of the "B" unit. This current charges the capacitor (condenser) in the capacitor discharge circuit.

A small magnet attached to and rotating with the alternator shaft generates a pulse in the signal pickup coil in the alternator. This pulse is amplified, then shaped, and used to trigger the thyristor. When the thyristor is triggered, it conducts, and thereby provides a discharge path for the capacitor.

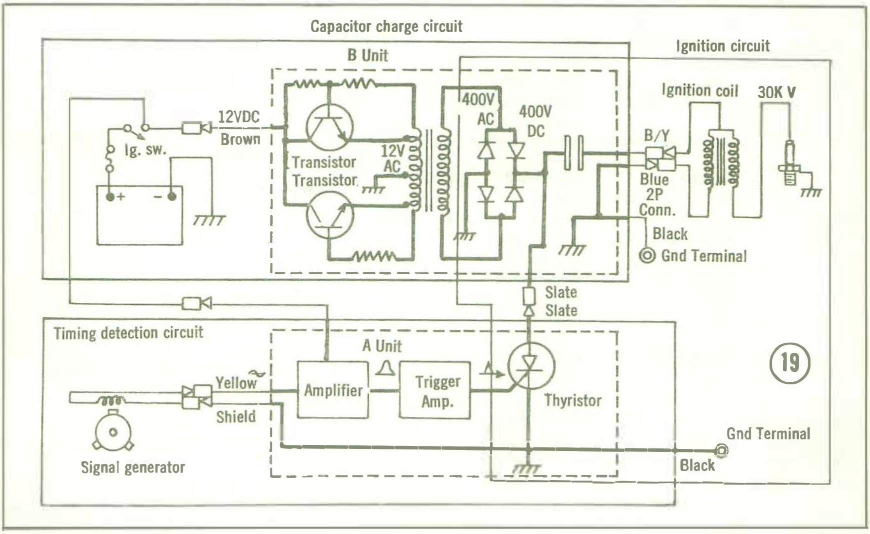
The capacitor discharges very quickly into the primary circuit of the ignition coil, where it is stepped up to as much as 30,000 volts.

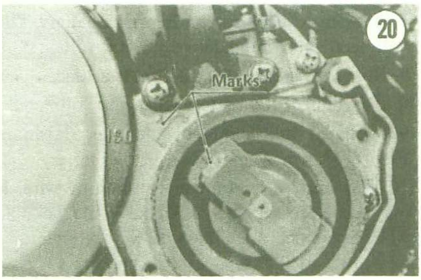
H Series Distributor

The distributor is a form of switch which directs the high voltage developed by the coil to the proper spark plug. The distributor rotor is driven by the crankshaft.

To install and adjust the distributor, proceed as follows:

1. Position the piston of the right-hand cylinder at top dead center.
2. Refer to **Figure 20**. Press the rotor into the shaft by hand so that the line of the rotor aligns with the center of the timing mark. It may happen that the line on the rotor does not align exactly with the center of the mark. In such a case, its position is satisfactory as long as the line on the rotor falls within the tolerance (T) marks on either side of the center.





CDI Cautions

Certain measures must be taken to protect the capacitor discharge system. Instantaneous damage to the semiconductors in the system will occur if the following precautions are not observed.

1. Never connect the battery backward. If battery polarity is wrong, damage will occur to the rectifier, alternator, and CDI system.

2. Do not disconnect the battery when the engine is running. A voltage surge will occur which will damage the rectifier and possibly burn out the lights.

3. Keep all connections between the various units clean and tight. Be sure that the wiring connectors are pushed together firmly.

4. Do not substitute another type of ignition coil or battery.

5. Each unit is mounted with a rubber vibration isolator. Always be sure that the isolators are in place when replacing any unit.

CDI Troubleshooting

Problems with the capacitor discharge system fall into one of the following categories. See **Table 6**.

a. Weak spark
b. No spark
c. Sparks occur at random

Unit Tests

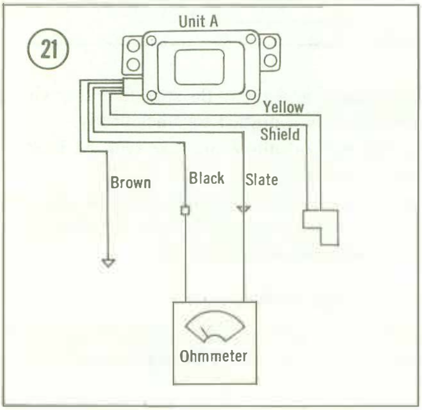
Although the most conclusive test can be made by substituting a known good unit for a suspected one, some tests can be made with a voltmeter, ammeter, and ohmmeter.

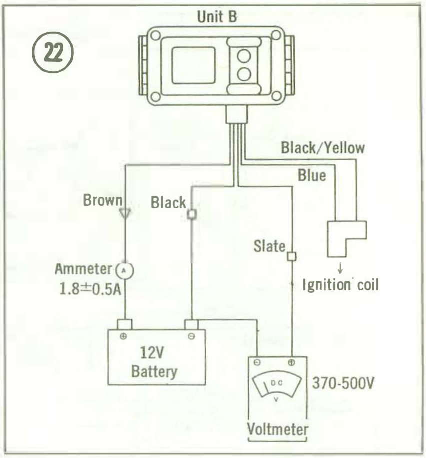
1. Refer to **Figure 21**. Measure resistance between the black wire and gray wire on unit "A". The ohmmeter must indicate infinite resistance.

2. Reverse the meter connections. The meter must again indicate infinite resistance.

Table 6 CDI TROUBLESHOOTING, KAWASAKI H1

Symptom	Probable Cause	Remedy
Weak spark	Low battery	Charge battery
	Poor connections	Clean and tighten connections
	High voltage leakage	Replace defective wire
	Defective coil	Replace coil
	Unit "B" defective	Replace
No spark	Discharged battery	Charge battery
	Fuse burned out	Replace fuse
	Wiring broken	Repair wire
	Defective coil	Replace coil
	Unit "A" or "B" defective	Replace defective unit
	Defective signal generator coil	Replace signal generator coil
Random sparks	Unit "A" or "B" defective	Replace defective unit





CAUTION

Unit "B" develops high voltage. Follow the procedure exactly to avoid shock hazard.

3. Connect unit "B" as shown in **Figure 22**. Connect the brown wire to the negative terminal of the ammeter. Connect the positive terminal of the 12-volt battery to the positive terminal of the ammeter. Connect the black wire to the negative battery terminal.

4. The ammeter must indicate 1.8± 0.5 amperes, and not fluctuate.

5. Disconnect the brown wire from the battery. Connect the negative lead of the voltmeter to the negative battery terminal. Connect the positive voltmeter lead to the gray wire.

6. Reconnect the brown wire to the battery. The voltmeter must indicate 370 to 500 volts.

7. It is normal that the unit emits a tone.

8. Disconnect the battery, then the voltmeter.

9. Connect both units together, as shown in **Figure 23**, but do not connect the battery.

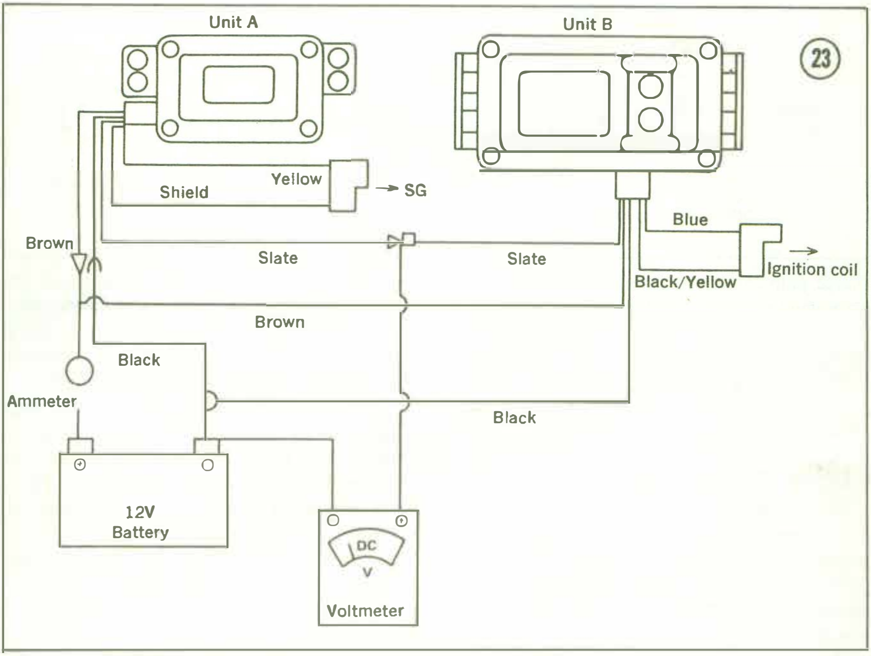
10. Connect the voltmeter to the gray wire. It may be necessary to fabricate some suitable wires to connect the plugs and the voltmeter.

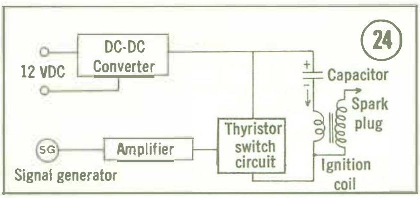
11. Connect the battery as in Step 3.

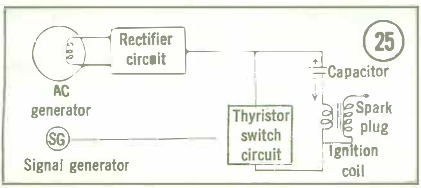
12. If unit "B" checked OK earlier, but the ammeter does not indicate 1.8 plus or minus 0.5 amperes, or the voltmeter does not indicate 370 to 500 volts, unit "A" is defective.

H2 IGNITION SYSTEM

Model H2 machines are equipped with a magneto CDI system. **Figures 24 and 25** compare battery and magneto CDI systems. Unlike the H1 CDI system, which charges the ignition capacitor through a DC-to-DC converter, the H2 system obtains the necessary power directly from the magneto. Another major difference is that pulses from the signal generator are of sufficient amplitude to trigger the spark without amplification.







The alternator contains two high voltage windings (**Figure 26**). One winding is used at low speeds; the other at high speeds.

The low speed windings have a large number of turns so that high voltage can be generated at relatively low engine speeds. As engine speed rises, however, these windings cannot supply sufficient current to charge the capacitor, so the high speed winding takes over.

At the point where low speed winding voltage begins to fall off, the voltage from the high speed winding rises sufficiently to supply charging current for the capacitor. The high speed windings have fewer turns and much lower resistance, and consequently do not become loaded down so much at high speeds.

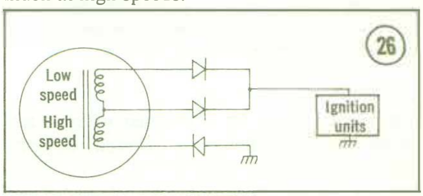
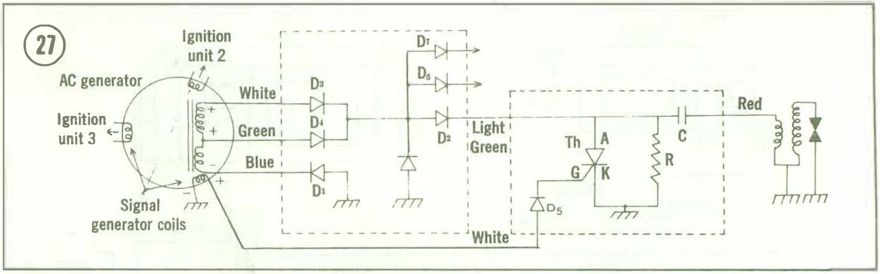


Figure 27 is a schematic diagram of one channel of the H2 ignition system. The capacitor (C) charges through diodes D2, D3, and D4. The positive pulse from the signal generator coil turns on the thyristor (Th), which completes the dis-



charge path for the capacitor through the primary winding of the ignition coil. The resistor (R) bleeds the charge from the capacitor when the machine is not running.

The ignition units for the two remaining cylinders operate in the same manner. They are supplied through diodes D6 and D7.

H2 Ignition Troubleshooting

The first step in troubleshooting this system is to narrow down the failure to the smallest possible area. Testing of individual CDI components is frequently possible without elaborate equipment. **Table 7** lists symptoms and possible causes.

If the engine will not start at all, first pull off the spark plug wires and test for a good spark at each cylinder, using known good spark plugs. Connect each spark plug to its cable and observe each spark plug as the engine is cranked briskly.

CAUTION

Battery failure is not listed as a possible ignition trouble source because the motorcycle will start and run without the battery. However, prolonged operation without the battery connected will result in eventual failure of the ignition unit.

Unit Tests

Some tests may be performed without test equipment. The following paragraphs describe such tests.

To check the spark, pull off a plug wire and connect it to a plug known to be good. Lay the plug against the engine where you can observe it and crank the engine briskly. If a strong blue-white spark jumps the gap, then the ignition spark is good.

If you suspect a bad spark plug, check the spark as described in the foregoing paragraph, then substitute the suspected plug. If the spark is then weak or nonexistent with the suspected plug, you can be sure that the plug was faulty.

The engine will not start if the spark plug wires are not connected to the proper plugs, or if one of the ignition unit red or white wires is transposed with another of the same color. These wires are clearly marked as to left, center, or right cylinder connection.

If the spark appears to be grounding out, examine the high voltage wiring and replace any that show broken or cracked insulation. If no cracks are visible, run the engine in a dark place to see where the spark is jumping.

WARNING

Do not run the engine inside a closed area. Carbon monoxide gas is generated whenever the engine runs. This gas is deadly.

When there is no spark at any cylinder, the trouble can sometimes be caused by failure of a single ignition unit. In this case, the trouble can be isolated without test equipment.

1. Disconnect the three light green wires from the ignition rectifier unit to the ignition units.
2. Reconnect one light green wire at a time to its associated ignition unit and check for a spark at that cylinder.
3. If two of the cylinders will spark when connected alone, the ignition unit for the remaining cylinder is defective.

If there is no spark, or a weak spark, at one cylinder, the first step is to check the spark plug and wiring. If those are not at fault, there are only four possibilities: coil, ignition unit, ignition

Table 7 IGNITION TROUBLESHOOTING, H2

Strong spark, all cylinders	Problem not in ignition system Plugs firing in wrong order because of improper wiring Original plugs defective
Weak spark, all cylinders	Defective alternator Defective ignition rectifier unit
No spark at any cylinder	Defective alternator Defective ignition unit Defective ignition rectifier Defective wiring
Engine Hard to Start, Lacks Power at Low Speeds	
Strong spark, all cylinders	Trouble is not in ignition system Defective or dirty plugs Timing incorrect
Weak spark, all cylinders	Defective alternator (especially low speed windings) Defective ignition rectifier unit
Weak spark, one cylinder	High voltage insulation lead Defective ignition coil Defective signal generator coil
No spark, one cylinder	Faulty wiring Insulation leak Defective coil Defective ignition unit Defective ignition rectifier Defective signal generator
Machine Misses, Lacks Power at High Speeds	
Strong spark, all cylinders	Problem not in ignition system Defective or dirty plugs Timing misadjusted Defective alternator (high speed windings)
Weak or no spark, one cylinder	Defective alternator Defective ignition unit Defective ignition coil Defective wiring Defective signal generator

rectifier unit, or signal generator. To isolate the unit, proceed as follows:

1. There are three light green wires which go from the ignition rectifier unit to each ignition unit. Take the light green wire which goes to the bad cylinder ignition unit and transpose it with the light green wire which goes to either remaining good cylinder ignition unit. If the trouble has now shifted to the previously good cylinder, the ignition rectifier unit is defective. If the trouble remains in the previously bad cylinder, go on to Step 2.

2. Transpose the spark plug wires between the bad cylinder and either good cylinder. There are three red wires, one from each ignition unit to its associated coil. Transpose the red wires for the bad cylinder and the good cylinder. If the trouble has not shifted from the bad cylinder to the previously good cylinder, replace the coil for the bad cylinder. If the trouble still remains in the bad cylinder, go on to Step 3.

3. Return the spark plug wires to normal but leave the red wires transposed. Each ignition unit has a white wire coming from it. Transpose the white wires from the bad cylinder ignition unit and the white wire from another ignition unit. If the trouble is now in the previously good cylinder, the ignition unit for the bad cylinder is defective. If the trouble remains in the bad cylinder, the bad cylinder signal generator coil is defective.

FEMSA ELECTRONIC IGNITION

Some European models are equipped with a Femsa electronic ignition system. This system uses no breaker points, cams, or other moving parts. Because of the extremely fast rise time of the generated high voltage, effects of spark plug fouling are minimized.

System Operation

Figure 28 is a wiring diagram of a typical system. Alternating current developed by a source coil within the magneto is rectified by a diode within the electronic unit. This current then charges a capacitor. A trigger pulse from a signal coil in the magneto is developed each time the piston reaches firing position. This pulse is applied to the gate of a trigger diode between the capacitor and coil primary. When this diode conducts, it provides a discharge path for the capacitor through the coil primary. Capacitor voltage (approximately 400 volts) is then stepped up by the ignition coil to a value sufficient to fire the spark plug.

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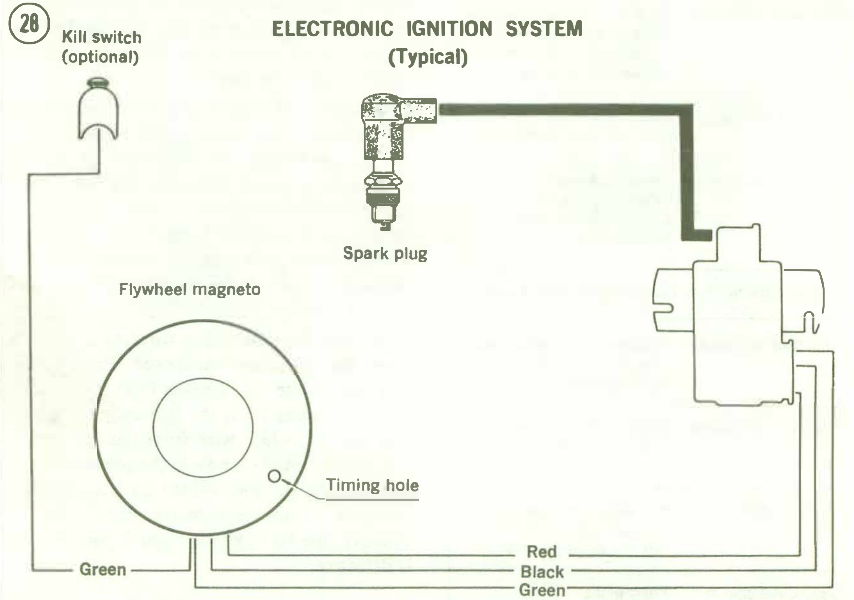

Electronic Ignition Maintenance

No maintenance is required on the electronic ignition system other than occasional checks to be sure that all connections are clean and secure. Be sure that the mounting bracket on the electronic unit makes good electrical contact with the motorcycle frame. Failure to maintain a good connection at this point may result in ignition system malfunction.

Electronic Ignition Troubleshooting

Since the electronic ignition system units are sealed, troubleshooting of individual units is best accomplished by substitution. Tests that may be made are listed below.

1. Clean and tighten all connections. Be sure that the connection between the coil mounting bracket and the motorcycle frame is clean, free of corrosion, and tight.
2. Disconnect the spark plug cable and hold it approximately one-quarter inch (6 millimeters) from the cylinder head.
3. Crank the engine briskly. If a strong, blue-white spark jumps between the cable and cylinder head, the ignition system is okay.
4. If there was no spark, or if it was weak, connect one test lead from an ohmmeter to ground, and the other lead to the inside terminal of the spark plug cap. The ohmmeter should indicate approximately 3,000 ohms.
5. If the reading obtained in Step 4 was much greater than 3,000 ohms, try cutting off the end of the high tension lead and again attaching the spark plug cap. If resistance readings are still high, and there is a good ground connection between the electronic unit and the motorcycle frame, replace the electronic unit.
6. Grasp the flywheel firmly and shake it to detect any looseness. Any movement will be a result of defective engine bearings or looseness in the flywheel mounting itself. Correct any such condition immediately.

Electronic Ignition Bench Checks

There are a few checks that may be made on both the feeder (magneto) and electronic units.

GAC6-1 Feeder

1. Measure resistance between both green wires. If resistance is appreciably different from 870 plus or minus 60 ohms, replace the feeder unit.

2. Resistance between the red wire and ground should be approximately 1 ohm.

GAC-3, -5, -6, and -7 Feeders

1. Measure resistance between both green wires. Resistance should be 1,920±200 ohms. Replace the feeder unit if the measured value differs greatly from this figure.

2. Resistance between the red wire and ground should be approximately 1.5 ohms.

GEA Type Feeders

1. Measure resistance between the green wire and ground. Replace the unit if resistance is appreciably different from 450±35 ohms.

2. Measure resistance between the red and black cables. Resistance must be about 0.35 ohm.

GEB Type Feeders

1. Measure resistance between the green and yellow wires. Replace the unit if resistance is appreciably different from 235±30 ohms.

2. Measure resistance between the red and black wires. Resistance should be about 0.25 ohm.

GED Type Feeders

1. Measure resistance between both green wires. Replace the unit if resistance is appreciably different from 1,800±200 ohms.

2. Measure resistance between the red wire and ground. Resistance should be about 3 ohms.

It is also possible to make some tests on the electronic unit with an ohmmeter. Disconnect the connector at the coil, then measure resistance between the terminals indicated. **Figure 29** identifies the terminals.

> NOTE: *The following procedure (see Table 8) specifies that positive and negative ohmmeter leads be placed on specific terminals. On many ohmmeters, polarity is reversed for resistance measurements, that is, red test leads are negative and black leads are positive. It is necessary to determine ohmmeter polarity before meaningful readings may be obtained.*

If the coil or feeder fails any of the foregoing tests, it must be replaced. Since both units are sealed, it is not possible to make repairs.

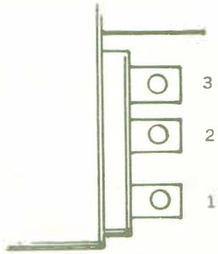

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Table 8 ELECTRONIC IGNITION TESTING

ELA TYPE COIL

Positive Lead	Negative Lead	Correct Indication	Incorrect Indication
1	Ground	Inf.	Less than Inf.
Ground	1	Inf.	Less than Inf.
2	3	Inf.	Less than Inf.
3*	2	40,000	Much greater or less than 40,000
HV lead	Ground	3,500	Much greater or less than 3,500

ELB TYPE COIL

Positive Lead	Negative Lead	Correct Indication	Incorrect Indication
2	3	Inf.	Less than Inf.
3	2	Inf.	Less than Inf.
2	Ground	Inf.	Less than Inf.
3	Ground	Inf.	Less than Inf.
Ground	2	80**	0 or Inf.
Ground	3	80**	0 or Inf.
1	Ground	40,000	Inf. or much less than 40,000
Ground	1	Inf.	Less than Inf.
HV lead	Ground	3,500	Much greater or much less than 3,500

*Resistance may vary somewhat because of other components in circuit.

**Value is typical, but may vary greatly. Any value but shorted or open is OK.

Electronic Ignition Cautions

The electronic ignition is simple and should give no trouble. Damage can occur, however, if certain precautions are not observed.

1. Never stop the machine by disconnecting the spark plug lead.
2. Connect a kill button, if required, to the green wire only.
3. Do not interchange any wires.
4. Keep all connections clean and tight. Be sure that the mounting bracket to frame connection is clean and tight.

MOTOPLAT ELECTRONIC IGNITION

Some European machines are equipped with the Motoplat electronic ignition system. This system uses no breaker points, cams, or other moving parts. Because of the extremely fast rise time of the generated high voltage, effects of spark plug fouling are minimized.

System Operation

Figure 30 is a schematic diagram of the electronic ignition system. Alternating current is developed in the source coil (1) as magnets within the flywheel rotate past the coil. This current is rectified by diode (2), and then charges capacitor (3). Thyristor (4) is normally in a nonconducting state, and prevents discharge of the capacitor. A small magnet attached to the magneto flywheel moves past signal coil (7) as the piston approaches firing position, and thereby induces a small voltage in the signal coil. This voltage is applied to the trigger electrode in the thyristor, which then immediately conducts, providing a discharge path for the capacitor through the primary winding of ignition coil (8). Ignition voltage is stepped up in the ignition coil to a value sufficient to fire spark plug (9). Resistor (6) acts as a limiter.

Figure 31 illustrates system connections. Note that a kill button must be connected to the blue terminal only.

Electronic Ignition Maintenance

No maintenance is required on the electronic ignition system other than occasional checks to be sure that all connections are clean and secure. Be sure that the mounting bracket on the electronic converter unit makes good electrical contact with the motorcycle frame. Failure to maintain a good connection at this point may result in ignition system malfunction.

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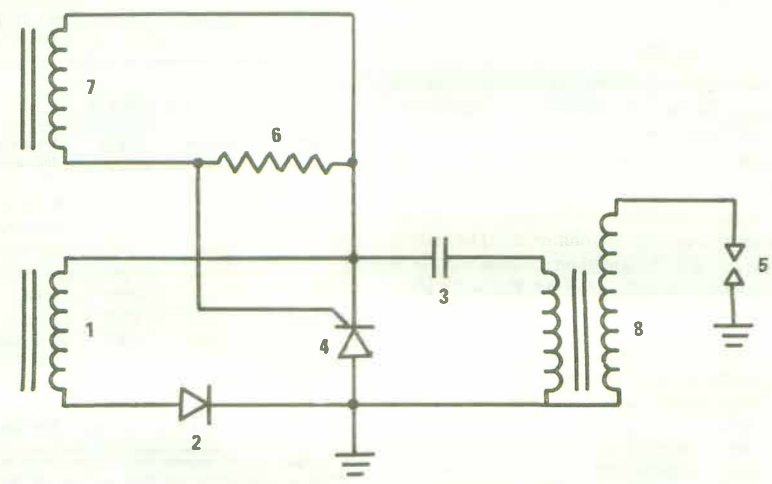

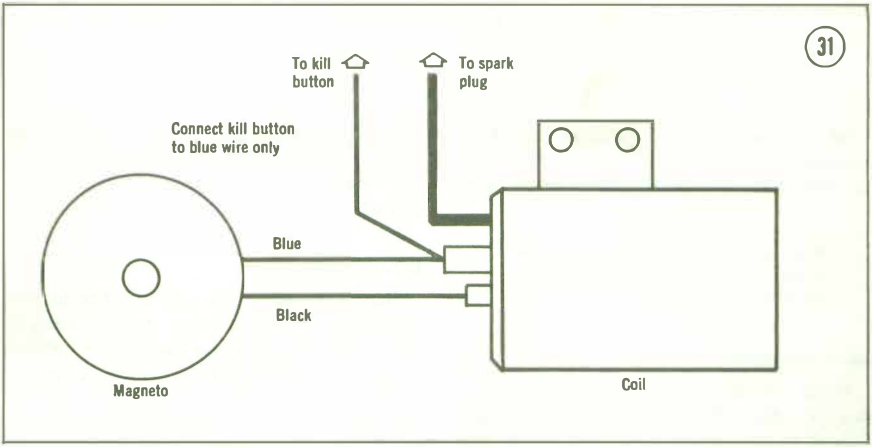

Troubleshooting

Since the electronic ignition system units are sealed, troubleshooting of individual units is best accomplished by substitution. Tests that may be made are listed below.

1. Clean and tighten all connections. Be sure that the connection between the coil mounting bracket and the motorcycle frame is clean, free of corrosion, and tight.
2. Disconnect the spark plug cable and hold it approximately ¼ in. (6mm) from cylinder head.
3. Crank the engine briskly. If a strong, blue-white spark jumps between the cable and cylinder head, the ignition system is OK.

Measurements made with an ohmmeter are not conclusive. Resistance measurements will vary, depending on ohmmeter type, range used, and battery voltage. Some typical values are presented in the following tests. Note that for some ohmmeters, lead color does not indicate polarity of test current.

1. Connect the negative lead from the ohmmeter to ground. Connect the positive lead in turn to the blue and black wires. Resistance should indicate 200-800 ohms. If an electronic ohmmeter is used, resistance may read as high as 25,000 ohms.
2. Reverse the ohmmeter leads, and repeat each measurement. Resistance should be essentially infinite.
3. Measure resistance between the black and blue leads. Resistance should be 10 ohms in either direction.
4. Connect either ohmmeter lead to the coil mounting bracket. Connect the other lead to the spark plug lead. Resistance should be about 10,000 ohms.
5. Connect one ohmmeter lead to the mounting bracket. Set the ohmmeter to its highest range. Carefully observe the meter, then connect the other test lead to the blue terminal. The ohmmeter needle should flick downscale momentarily, then settle at infinity.
6. Repeat Step 5, but testing the black terminal.

Motoplat Ignition Cautions

The electronic ignition is simple and should give no trouble. Damage can occur, however, if certain precautions are not observed.

1. Never stop the machine by disconnecting the spark plug lead.
2. Connect a kill button, if required, to the blue wire only.
3. Do not interchange the blue and black wires.
4. Keep all connections clean and tight. Be sure that the mounting bracket to frame connection is clean and tight.

BATTERY SERVICE

Many motorcycles are equipped with lead-acid storage batteries smaller in size but similar in construction to batteries used in automobiles.

WARNING

Read and thoroughly understand the section on safety precautions before doing any battery service.

Safety Precautions

When working with batteries, use extreme care to avoid spilling or splashing electrolyte. This electrolyte is sulphuric acid, which can destroy clothing and cause serious chemical burns. If any electrolyte is spilled or splashed on clothing or body, it should immediately be neutralized with a solution of baking soda and water, then flushed with plenty of clean water.

Electrolyte splashed into the eyes is extremely dangerous. Safety glasses should always be worn when working with batteries. If electrolyte is splashed into the eye, force the eye open, flood with cool clean water for about 5 minutes, and call a physician immediately.

If electrolyte is spilled or splashed onto painted or unpainted surfaces, it should be neutralized immediately with baking soda solution and then rinsed with clean water.

When batteries are being charged, highly explosive hydrogen gas forms in each cell. Some of this gas escapes through the filler openings and may form an explosive atmosphere around the battery. *This explosive atmosphere may exist for several hours*. Sparks, open flame, or a lighted cigarette can ignite this gas, causing an internal explosion and possible serious personal injury. The following precautions should be taken to prevent an explosion:

1. Do not smoke or permit any open flame near any battery being charged or which has been recently charged.
2. Do not disconnect live circuits at battery terminals, because a spark usually occurs where a live circuit is broken. Care must always be taken when connecting or disconnecting any battery charger; be sure its power switch is off before making or breaking connections. Poor connections are a common cause of electrical arcs which cause explosions.

Battery Capacity

Battery capacity is usually specified in ampere-hours, one ampere-hour being a current of one ampere delivered by a battery over a period of one hour. Ability of the battery to deliver power depends on its rate of discharge—battery capacity decreases at higher discharged rates and increases at lower discharge rates. For this reason, battery capacity is specified at some standard discharge rate, usually 10 hours for motorcycle batteries. Therefore a battery rated at 9 ampere-hours can supply 0.9 ampere for 10 hours. As a battery ages, its capacity becomes less as a result of loss of active material from its plates.

Motorcycle batteries range typically from 4 to 30 ampere-hours capacity.

Dry Charged Batteries

Many replacement batteries are sold "dry charged." Such a battery is fully charged at the factory, then its plates are thoroughly washed and dried. It contains no electrolyte when it leaves the factory, and has a long storage life. When put into service, it is only necessary to add the electrolyte, which comes in a separate container, then give the battery an initial slow charge. This charging procedure is important, for if the battery is put into service without it, there is a good chance of considerable reduction in capacity and useful life.

Wet Charged Batteries

Wet charged batteries are shipped from the factory fully charged and filled with electrolyte. However, a wet charged battery will not maintain its charge during storage, so it must be recharged periodically. During storage, a slow chemical reaction takes place which causes the battery to lose its charge. This reaction is called self-discharge. The rate at which self-discharge occurs varies greatly with temperature. To reduce self-discharge, store wet batteries in a cool place, but do not allow the battery to freeze. Recharge it every 30 days, as described in *Battery Charging*.

Electrolyte Level

Battery electrolyte level should be checked regularly, particularly during hot weather. Most batteries are marked with electrolyte level limit lines (**Figure 32**). Always maintain the fluid level between the 2 lines, using distilled water as required for replenishment. Distilled water is available at almost every supermarket. It is sold for use in steam irons and is quite inexpensive.

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Overfilling leads to loss of electrolyte, resulting in poor battery performance, shoft life, and excessive corrosion. Never allow the electrolyte level to drop below the top of the plates. That portion of the plates exposed to air may be permanelty damaged, resulting in loss of battery performance and shortened life.

Excessive use of water is an indication that the battery is being overcharged. The 2 most common causes are high battery temperature or high voltage regulator setting. It is advisable to check the voltage regulator, on machines so equipped, if this situation exists.

Cleaning

Check the battery occasionally for presence of dirt or corrosion. The top of the battery, in particular, should be kept clean. Acid film and dirt permit current to flow between terminals, which will slowly discharge the battery.

For best results when cleaning, wash first with diluted ammonia or baking soda solution, then flush with plenty of clean water. Take care to keep filler plugs tight so that no cleaning solution enters the cells.

Battery Cables

To ensure good electrical contact, cables must be clean and tight on battery terminals. If the battery or cable terminals are corroded, the cables should be disconnected and cleaned separately with a wire brush and baking soda solution. After cleaning, apply a very thin coating of petroleum jelly to the battery terminals before installing the cables. After connecting the cables, apply a light coating to the connection. This procedure will help to prevent future corrosion.

Battery Charging

WARNING

Do not smoke or permit any open flame in any area where batteries are being charged, or immediately after charging. Highly explosive hydrogen gas is formed during the charging process. Be sure to re-read Safety Precautions *in the beginning of this section.*

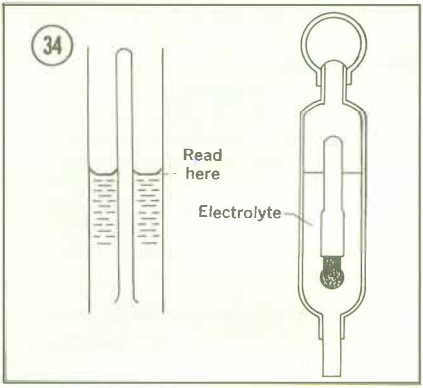
Motorcycle batteries are not designed for high charge or discharge rates. For this reason, it is recommended that a motorcycle battery be charged at a rate not exceeding 10 percent of its ampere-hour capacity. That is, do not exceed 0.5 ampere charging rate for a 5 ampere-hour battery, or 1.5 amperes for a 15 ampere-hour battery. This charge rate should continue for 10 hours if the battery is completely discharged, or until specific gravity of each cell is up to 1.260-1.280, corrected for temperature. If after prolonged charging, specific gravity of one or more cells does not come up to at least 1.230, the battery will not perform as well as it should, but it may continue to provide satisfactory service for a time.

Some temperature rise is normal as a battery is being charged. Do not allow electrolyte temperature to exceed 110°F. Should temperature reach that figure, discontinue charging until the battery cools, then resume charging at a lower rate.

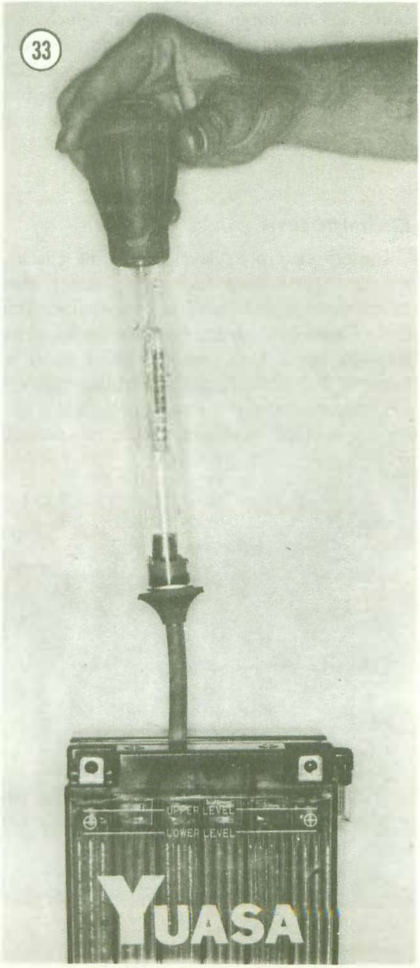
Testing State of Charge

Although sophisticated battery testing devices are on the market, they are not available to the average motorcycle owner, and their use is beyond the scope of this book. A hydrometer, however, is an inexpensive tool, and will tell much about battery condition.

To use a hydrometer, place its suction tube into the filler opening and draw in just enough electrolyte to lift the float (**Figure 33**). Hold the instrument in a vertical position and read specific gravity on the scale, where the float stem emerges from the electrolyte (**Figure 34**).



Specific gravity of the electrolyte varies with temperature, so it is necessary to apply a temperature correction to the reading so obtained. For each 10° that battery temperature exceeds 80°F, add 0.004 to the indicated specific gravity. Likewise, subtract 0.004 from the indicated value for each 10° that battery temperature is below 80°F.



Repeat this measurement for each battery cell. If there is more than 0.050 difference (50 points) between cells, battery condition is questionable.

State of charge may be determined from following **Table 9**.

Table 9 STATE OF CHARGE

Specific Gravity	State of Charge
1.110 - 1.130	Discharged
1.140 - 1.160	Almost discharged
1.170 - 1.190	One-quarter charged
1.200 - 1.220	One-half charged
1.230 - 1.250	Three-quarters charged
1.260 - 1.280	Fully charged

Don't measure specific gravity immediately after adding water. Ride the machine a few miles to ensure thorough mixing of the electrolyte.

It is most important to maintain batteries fully charged during cold weather. A fully charged battery freezes at a much lower temperature than does one which is partially discharged. **Table 10** illustrates the relationship between specific gravity and battery freezing temperature.

Table 10 BATTERY FREEZING TEMPERATURE

Specific Gravity	Freezing Temperature Degrees F
1.100	18
1.120	13
1.140	8
1.160	1
1.180	—6
1.200	—17
1.220	—31
1.240	—50
1.260	—75
1.280	—92

LIGHTS AND SIGNALS

Motorcycles intended for street use are equipped with lights and horns. These devices should be checked periodically for proper operation, and any necessary adjustment or repair made at once.

LIGHTS

Figure 35 is an exploded view of a typical headlight assembly. It consists primarily of a headlight lens and reflector unit, rim, and related hardware.

In the event of lighting troubles, first check the affected bulb. Poor ground connections are another cause for lamp malfunctions.

Headlights and taillights on many magneto-equipped motorcycles operate from alternating current supplied by the magneto. If one lamp burns out or has a loose or poor connection to it, excess current will be diverted to remaining lamps in the circuit, causing rapid failure.

Turn signals usually operate from direct current supplied by the battery. When replacing signal bulbs, always be sure to use the proper type. Erratic operation or even failure to flash may result from the use of wrong bulbs.

Stoplights usually operate from direct current also. Stoplight switches should be adjusted so that the lamp comes on just before braking action begins. **Figure 36** illustrates a typical stoplight switch. Front brake stoplight switches are frequently built into the front brake cable, and are not adjustable.

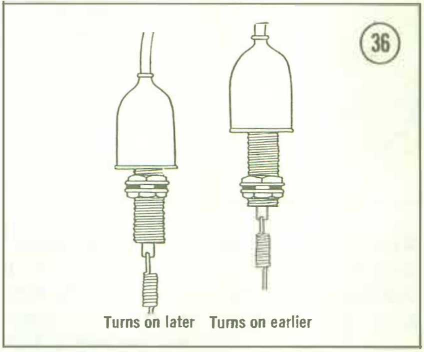
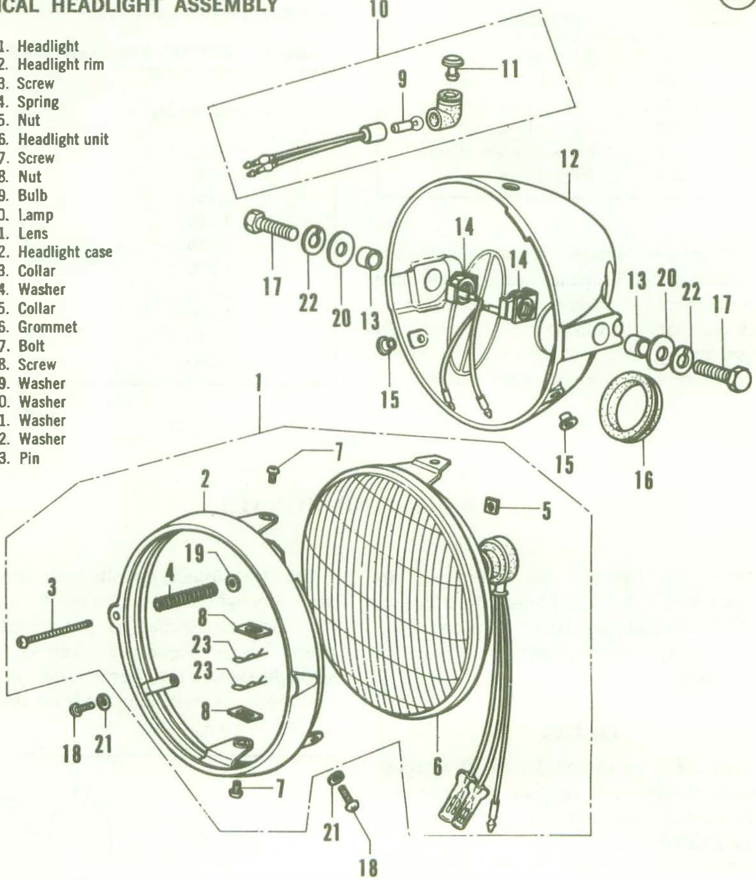


Figure 37 illustrates a typical stoplight circuit for a machine without a battery. Note that both stoplight switches are in the ignition circuit.

(35)

TYPICAL HEADLIGHT ASSEMBLY

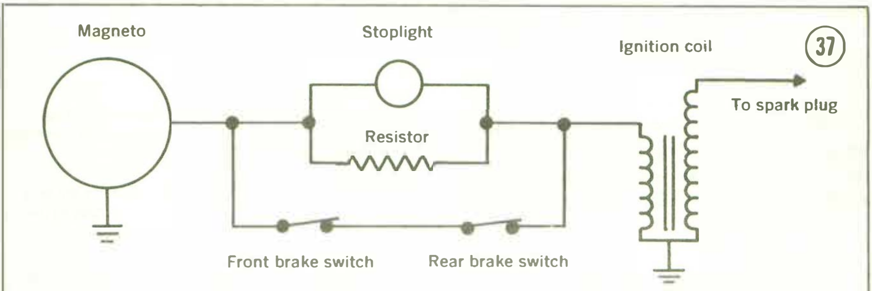
1. Headlight
2. Headlight rim
3. Screw
4. Spring
5. Nut
6. Headlight unit
7. Screw
8. Nut
9. Bulb
10. Lamp
11. Lens
12. Headlight case
13. Collar
14. Washer
15. Collar
16. Grommet
17. Bolt
18. Screw
19. Washer
20. Washer
21. Washer
22. Washer
23. Pin



When the rider presses the foot pedal, the normally closed stoplight switch opens, forcing ignition return current to flow through the stoplight bulb and bypass resistor. This bypass resistor helps absorb electrical overloads at high rpm. Note that if the stoplight is burned out, the engine may misfire at low rpm when the brake pedal is pressed and the switch is open, because in the absence of the bulb, an inadequate path for ignition current exists.

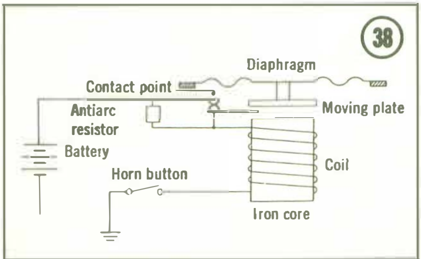
HORN

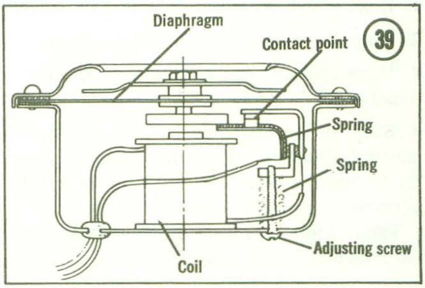
Figure 38 is a typical horn circuit. Current for the horn is supplied by the battery. One terminal is connected to the battery through the main



STOPLIGHT CIRCUIT

1. Brake switches are normally closed.
2. Brake operation opens either switch.
3. When either switch is open, ignition primary current must flow through resistor and stoplight.
4. Resistor absorbs excess current and also provides path for ignition primary current if stoplight burns out.



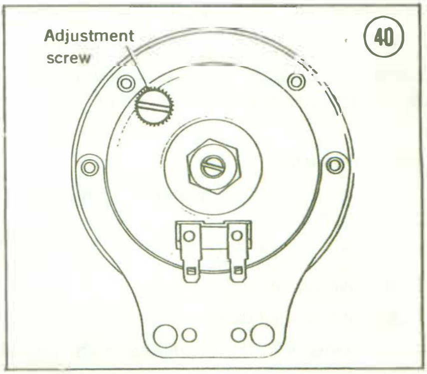


switch. The other terminal is grounded when the horn button is pressed.

When the rider presses the horn button, current flows through the coil; the core then becomes magnetized and attracts the moving plate, or armature. As the armature moves toward the coil, it opens the contact points, cutting off current to the coil. The diaphragm spring then returns the armature to its original position. This process repeats rapidly until the horn button is released. The action of the armature striking the end of the core produces sound, which is amplified by the resonator diaphragm (**Figure 39**).

Horn tone on most bikes may be adjusted by turning the adjuster screw (**Figure 40**). Loosen the locknut before adjustment, and be sure to tighten it after adjustment is complete.

The horn will not sound if its contact points are burned. Dress them, if necessary, using a small point file or flex stone. Adjust horn tone after dressing its contact points.



BMW TWINS

BMW motorcycles are equipped with battery ignition, regulator-controlled alternators, and self-starters. Ignition system operation and troubleshooting is described in *Battery Ignition*.

CHARGING SYSTEM

The charging system consists of an alternator, voltage regulator, battery, and interconnecting wiring. If the warning lamp remains on when the engine is running, it is usually a simple matter to determine whether the alternator or regulator is at fault.

1. Remove the fuel tank.

2. Unplug the connector from the regulator.

3. Using a suitable jumper wire, short leads D+ (blue) and DF (black) together.

4. Start the engine, then run it at approximately 2,000 rpm. If the warning lamp goes out, the regulator is defective; if it remains on, the alternator is probably defective.

Table 11 lists symptoms, probable causes, and remedies for charging system malfunction.

Table 11 CHARGING SYSTEM TROUBLESHOOTING

Symptom	Cause	Remedy
Noisy alternator	Brushes squeaking	Remove slip rings or brushes and replace
Warning lamp glows dimly	Poor contact in lead connection	Check wiring connections and leads
	Faulty regulator	Replace regulator
	Faulty brushes	Replace brushes
	Rectifier diode shorting	Replace rectifier diode
	Stator shorting	Replace stator
	Rotor shorting periodically	Replace rotor
Battery is overcharged	Poor contact between regulator and alternator	Check wiring connection to regulator and alternator
	Faulty regulator	Replace regulator
Warning lamp glows brightly	Faulty regulator	Replace regulator
	Interruption or short circuit wiring	Check wiring connections and leads
	Faulty brushes	Replace brushes
	Faulty rotor winding	Replace rotor
	Field current circuit interrupted	Check lead connections
	Faulty diodes or diode board	Check diodes or diode board and replace where necessary

STARTER

BMW motorcycles are equipped with self-starters very similar to those in automobiles. Service procedures are likewise similar.

Starter Removal

All service procedures require that the starter first be removed.

1. Disconnect the battery.

2. Remove the air filter element.

3. Remove the fuel tank.

4. On model R75/5, disconnect both choke cables at the carburetors, then lay aside the left-hand air cleaner shell together with the choke cable.

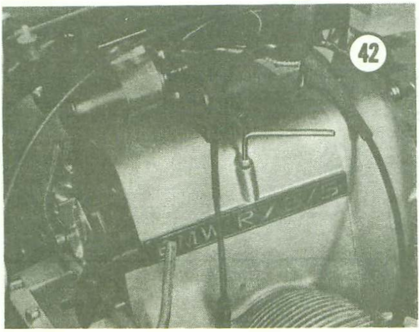
5. Refer to **Figure 41**. Unscrew nut (1), loosen bolt (2), then remove the right-hand half of the air cleaner housing. Push the breather hose to the rear when removing the housing.

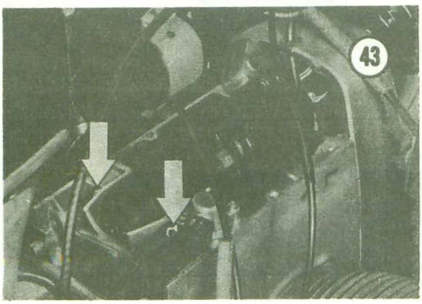
6. Loosen 2 socket head screws (**Figure 42**), then tilt the starter cover to the right.

7. Detach all starter wiring.

8. Remove both rear starter retaining screws.

9. Refer to **Figure 43**. Loosen the top horn retaining screw and 3 retaining screws, then take off the front engine cover.



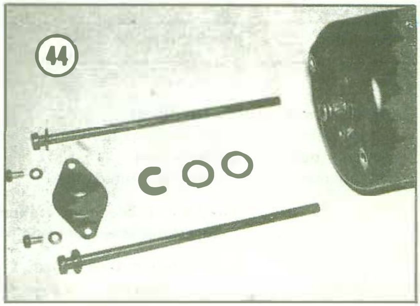


10. Loosen the front starter retaining bolt.

11. Lift the starter forward from its guide to remove it.

Brush Replacement

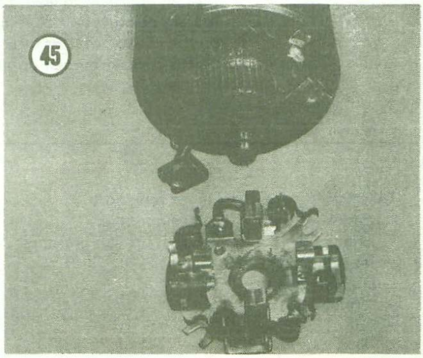
1. Refer to **Figure 44**. Remove 2 retaining screws and the shaft dust cover.



2. Remove the lockwasher, end play adjustment shim, and gasket.

3. Remove 2 thru-bolts, then pull off end cover.

4. Refer to **Figure 45**. Lift out the positive brush, then remove the brush holder assembly.



5. Unsolder the old brush leads.

6. Reverse Steps 1 through 5 for installation. Use only rosin core solder when replacing the brushes.

Examine the commutator for wear, roughness, and high mica at this time. If these conditions exist, have the armature overhauled professionally. Do not turn the commutator down to a diameter of less than 1.30 in. (33mm). Commutator insulators should be undercut to a depth of 0.02 in. (0.5mm).

Starter Troubleshooting

Table 12 lists possible starter malfunctions, causes, and remedies.

Table 12 STARTER TROUBLESHOOTING

Problem	Test/Cause	Remedy
Starter fails to turn when starter button is operated	Switch on light.	
	Light does not burn.	Measure battery charge.
	Battery dead.	Recharge battery.
	Battery feed interrupted.	Check battery leads and terminals.
	Light burns, becoming gradually dimmer as starter is actuated.	Battery dead. Recharge battery.
	Light burns but extinguishes immediately when starter is actuated. Oxidized battery terminals or ground connection.	Clean battery terminals or ground connection.
	Light burns normally. Bridge terminals 50 and 30 on the starter. The starter turns. Ignition/starter switch defective or input leads defective.	Replace ignition/starter switch, remedy defect.
	Light burns normally. Solenoid switch actuates, starter fails to turn. Bridge with an appropriate lead from the battery positive pole to terminal 30 on the starter. Starter turns. Solenoid switch contact burned or pitted.	Replace solenoid switch.
Starter fails to turn when lead is laid directly from the battery positive pole to terminal 30	Brushes too short.	Replace brushes.
	Brushes jammed.	Release jamming.
	Inadequate brush pressure.	Replace thrust springs.
Starter turns too slowly; fails to turn engine	Commutator fouled.	Clean commutator.
	Faulty armature or energizer coil.	Repair starter.
Starter turns at high speed; engine remains stationary or turns over jerkily	Drive pinion faulty.	Replace drive pinion.
	Spur gear faulty.	Replace flywheel.
	Drive pinion failing to disengage. Coarse thread fouled or damaged.	Repair starter.

BSA TWINS

BSA motorcycles use conventional battery and coil ignition systems. Troubleshooting and operating principles are described in *Battery Ignition*.

CHARGING SYSTEM

Figure 46 is a typical wiring diagram. All electrical accessories are operated by direct current, supplied by the battery. An alternator is the source of electrcial power. Alternator output is converted to direct current in a full-wave bridge rectifier, then used for battery charging. If charging system problems are encountered, the fault may lie in the alternator, rectifier, or zener diode. Test those components in that order. If a capacitor is installed in place of the battery, it might also be at fault.

Alternator Troubleshooting

If alternator problems are suspected, test the alternator as follows:

1. Disconnect both alternator output wires. One wire is green/white and the other is green/yellow. Connect a one-ohm, 100-watt resistor across the 2 leads, and also connect a 0-20 AC voltmeter to the 2 wires.

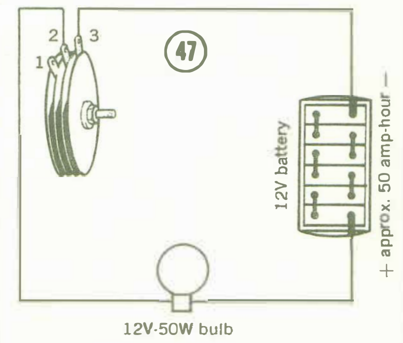
NOTE: *The resistor may be a commercial product, or may be fabricated locally.*

2. Start the engine and run it at 3,000 rpm. If the voltmeter indicates 9 volts or higher, the alternator is OK.
3. If alternator output is low, check for damaged wires or shorted coils. If no problem is found in the stator, rotor magnets may be weak.

Rectifier Troubleshooting

If the alternator checks out OK, test the rectifier.

1. Connect the rectifier test circuit shown in **Figure 47**. Do not connect any leads to the rectifier yet.



2. Connect the 2 test wires to terminals 1 and 2 on the rectifier, then reverse test wires. Do not leave the wires on for longer than 30 seconds. The lamp should light with the wires connected one way, but not with them connected in reverse.
3. Repeat Step 2 with the test wires connected both ways to each of the following pairs of terminals:

Bolt and 1
Bolt and 3
2 and 3

In each case, the lamp should light connected one way, but not in reverse. If the lamp fails to light in either direction, or lights when connected either way, replace the rectifier.

Zener Diode Troubleshooting

1. Disconnect the cable from the diode. Connect an ammeter in series with the diode terminal and the cable. The ammeter positive terminal connects to the diode terminal.
2. Connect a voltmeter to the zener diode and air cleaner box, with the positive terminal to the air cleaner box.
3. Start the engine, then gradually increase its speed and observe both meters. There should be

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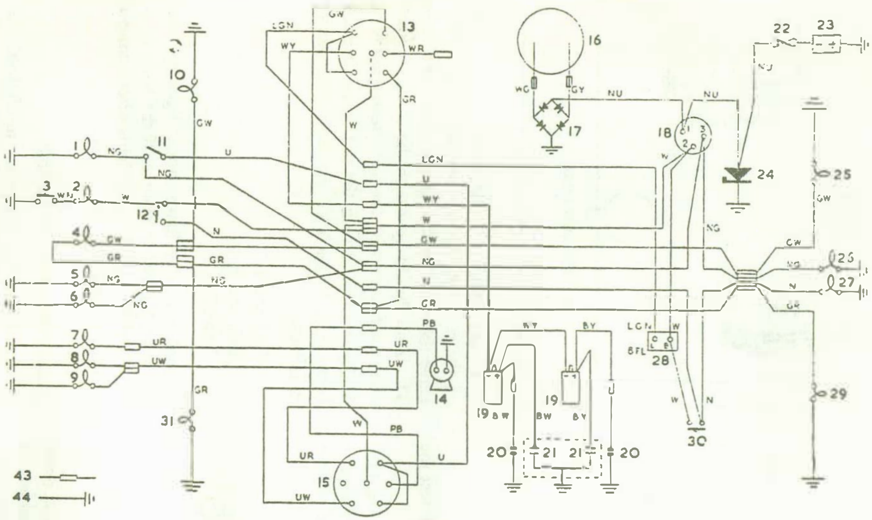


TYPICAL BSA WIRING

1. Parking (pilot) light
2. Oil pressure warning light
3. Oil pressure switch
4. Direction indicator warning light
5. Speedometer light
6. Tachometer light
7. Low beam
8. High beam
9. High beam indicator light
10. Right turn signal indicator (front)
11. Switch
12. Front brake stoplight switch
13. Right handlebar switches
14. Horn
15. Left handlebar switches
16. Alternator
17. Rectifier
18. Ignition lighting switch
19. Ignition coils
20. Contact breakers
21. Condensers, 2 CP
22. Fuse
23. Battery
24. Zener diode
25. Right turn signal indicator light (rear)
26. Taillight
27. Stop light
28. Turn indicator unit
29. Left turn signal indicator light (rear)
30. Rear brake switch
31. Left turn signal indicator light (front)
43. Snap connectors
44. Ground connectors (via fixing bolt)

COLOR CODE

B = Black
U = Blue
N = Brown
R = Red
P = Purple
G = Green
S = Slate
W = White
Y = Yellow

zero amps up to 12.75 volts. Increase engine speed until the indication is 2 amperes. Voltage should then be between 13.5 and 15.5.

4. If the ammeter registers any current before the voltmeter indicates 12.75, replace the zener diode. If voltage goes higher than 15.5 before 2 amperes is reached, replace the zener diode.

CAPACITOR IGNITION SYSTEM

A capacitor kit is available as part number 00-4402. It allows the motorcycle to be run with or without the battery. Without the battery, the engine will readily start and run and the lights will work. When the engine is stopped, the lights will not work.

The capacitor has 2 terminals. The smaller is positive (ground) and is marked with a spot of red paint. The larger double terminal is negative.

Observe the following notes if a capacitor kit is installed.

1. If the battery is disconnected, remove the fuse from its holder and insert some insulation into the holder. This precaution will prevent the battery from shorting to ground.

2. Never run the motorcycle with the zener diode disconnected, as excessive voltage can damage the electrical system.

3. If a capacitor is installed for emergencies only, and the battery left connected for lights with the engine off, disconnect the battery periodically to check the capacitor.

4. If the engine will not start with the battery disconnected, check the wiring between the capacitor and rectifier. If everything appears all right, install another capacitor to test starting.

5. If the engine will not start with the battery connected, disconnect the capacitor to test for a short circuit.

BULTACO

Most Bultaco motorcycles have no electrical system other than that required for ignition. Ignition is either by conventional flywheel magneto, discussed in *Magneto Ignition*, or electronic ignition, discussed in *Electronic Ignition*.

CHARGING SYSTEM

If charging system problems are suspected, proceed as follows:

1. Remove the cover from the side of the machine to expose the battery.

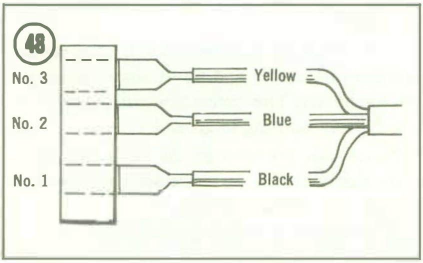
2. Connect a 0-10 DC voltmeter between the positive (yellow wire) battery terminal and ground. Start the engine and run it at approximately 7,000 rpm. If the voltmeter indicates approximately 8.4 volts, charging system is OK.

3. If the reading obtained in Step 1 was much less than 8.4 volts, disconnect the battery, and measure the voltage between the yellow wire which goes to the front of the machine and ground. If the voltmeter now indicates properly, the problem lies with the battery or ignition switch.

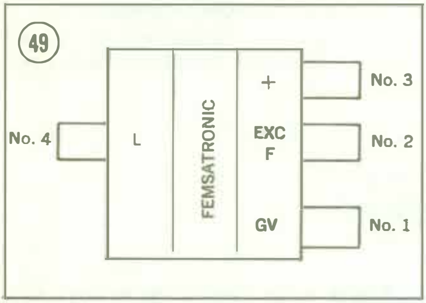
4. If an unsatisfactory indication was obtained in Step 2, test the rectifier and generator.

5. Disconnect the 3-terminal connector at the rectifier (**Figure 48**). With the engine running at 7,000 rpm, connect an AC voltmeter between terminal 1 (black) and ground, then between terminal 2 (blue) and ground. If the meter indicates at least 18 volts, the generator is OK and the rectifier or associated wiring is faulty.

6. If no indication, or a low indication was obtained in Step 4, remove the magneto cover and repeat the test by piercing the insulation on the blue and black wires coming from the magneto. Proper indications now mean a break in the wiring. No indication means that the magneto is defective, and must be replaced.



Rectifiers on machines with Femsa electronic ignition systems may be checked out with an ohmmeter. Refer to **Figure 49** during the following checks:



1. Disconnect all wiring from the rectifier, which is on the frame under the fuel tank.
2. Connect the negative ohmmeter lead to terminal 1 and the positive lead to terminal 4. The meter must indicate continuity.
3. Reverse the ohmmeter leads. That is, place the positive lead on terminal 1 and the negative lead on terminal 4. The meter must indicate no continuity.
5. Reverse the ohmmeter leads. The meter must now indicate no continuity.
4. Place the negative ohmmeter lead on terminal 2 and the positive lead on terminal 3. The meter must indicate continuity.
6. If the rectifier fails any of the tests of Steps 2 through 5, it is defective and must be replaced.

HEADLIGHTS AND TAILLIGHTS

These lights are controlled by a switch on the handlebar. The lighting system is adequate if the rider does not overspeed the engine when lights are on. A kit which replaces the headlight with a sealed beam unit, and also incorporates a zener diode for voltage regulation, is available from Bultaco dealers. Installation of this kit will result in better light at all speeds.

HARLEY-DAVIDSON LIGHTWEIGHTS

Some Harley-Davidson lightweight models are equipped with a battery and its associated charging circuit. A solid state rectifier-regulator module controls battery charging voltage. This module also controls a charging system indicator light.

If charging system problems are suspected, first be sure that the battery is in good condition and is fully charged, then test the rectifier module. Using an ohmmeter, check continuity between each of the points listed in **Table 13**. Note that for some ohmmeters, test polarity is reversed. Replace the module if any of the following indications are not obtanied.

Table 13 CHARGING SYSTEM TROUBLESHOOTING

Ohmmeter Positive Lead	Ohmmeter Negative Lead	Continuity
Ground	Each input terminal	Yes
Each input terminal	Ground	No
Each input terminal	B+ terminal	Yes
B+ terminal	Each input terminal	No
Ground	B+ terminal	Yes
B+ terminal	Ground	No
Each input terminal	S termnial	Yes
S terminal	Each input terminal	No

HARLEY-DAVIDSON V-TWINS

Harley-Davidson twins are equipped with either DC generators or alternators, regulators, and batteries. Electra-Glide and Sportster models have 4-brush starter motors; early Servi-cars are equipped with 2-brush starters. Battery and coil ignition systems are used on all recent models.

DC GENERATORS

NOTE: *Whenever any DC generator charging system wiring has been disconnected, always polarize the generator before starting the engine. To do so, momentarily connect a wire or screwdriver between the GEN and BAT terminals on the regulator. On Bosch regulators, momentarily connect terminals D+ and B+.*

Charging system problems usually fall into one of 3 categories: no charge, low charge, or overcharge. Complete system testing requires sophisticated test equipment no readily available except to shops specializing in such work. Some checks may be made with simple equipment.

Generator Test

If generator output is low or nonexistent, trouble may lie in either the generator, regulator, or interconnecting wiring. First, be sure that the battery is in good condition and that it is at least half charged (1.220 specific gravity or greater), then proceed as follows:

1. With the engine off, disconnect the wire from terminal F on the generator. Connect terminal F to a good ground.
2. Disconnect the wire or wires from generator terminal A. Connect the positive terminal of a 0-30 DC ammeter to terminal A. Do not connect the wire or wires which were removed. Do not disconnect this wire or wires if no ammeter is available. If no ammeter is available, connect the positive terminal of a 0-10 DC voltmeter (6-volt system) or 0-20 DC voltmeter (12-volt system) to generator terminal A. Connect the negative voltmeter terminal to a good ground.
3. Start engine and run it at about 2,000 rpm.
4. Momentarily connect a heavy wire between the ammeter negative terminal and the positive terminal of the battery.
5. Observe the ammeter or voltmeter. If the ammeter indicates at least 15 amperes for a 6-volt generator, or 10 amperes for a 12-volt generator, the generator is OK. If the voltmeter indicates at least 7 volts (6-volt system) or 14.5 volts (12-volt system), there is no problem with the generator. Generator removal and further testing will be required if generator output is not as specified.

After disassembly, make the following checks:

1. Be sure that brushes are not worn out, gummy, or sticking in their holders. Replace both brushes if either one is worn down to ½ in.
2. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. Replace the armature if this condition exists. Also be sure that there is continuity between each adjacent pair of commutator segments.
3. If the commutator is worn, rough, or burned, turn it down, then undercut the mica insulators. This is a job best left to an auto electrical or small motor specialist.
4. With the generator disassembled, use the highest range of an ohmmeter to determine that there is no continuity between terminal F and generator frame.
5. Using the highest ohmmeter range, determine that there is no continuity between generator terminal A and generator frame.

If the generator passes the foregoing checks, but its condition is still doubtful, professional service is required.

VOLTAGE REGULATOR

Proper voltage regulator testing requires sophisticated equipment, and is best left to a professional. A few checks, however, can be made with simple equipment.

1. Connect an accurate voltmeter across the battery terminals. Battery must be at or near full charge for this check.

2. Start the engine and run it at approximately 2,000 rpm.

3. If the voltmeter indicates approximately 7.5 volts (6-volt systems) or 14-15 volts (12-volt systems), the regulator is probably OK.

If a charging system problem has been definitely isolated as a misadjusted or defective regulator, it is usually better to replace rather than repair it. Bosch regulators are not repairable; they must be replaced if defective.

ALTERNATOR

Late model machines are equipped with alternators which consist of a stator, attached to the crankcase, and a rotor, which is mounted on the engine sprocket. The rotor is permanently magnetized; no slip rings are required. A solid state rectifier-regulator controls alternator output to meet varying load and ambient temperature conditions.

Alternator Cautions

1. Never connect battery with reverse polarity. Instantaneous damage to the rectifier-regulator and alternator stator can result.

2. Never attempt to polarize an alternator.

3. If a booster battery is required, be sure to connect it properly; positive to positive, and negative to negative.

4. Never run engine with battery disconnected.

5. Never short any wires to ground.

6. Always disconnect the negative battery lead before connecting a battery charger.

7. Never use a fast charger to boost battery output for starting.

8. Never break any system connections when the engine is running.

9. Do not relocate rectifier-regulator module.

System Tests

Proper testing requires sophisticated equipment, and is best left to a professional. A few tests can be made, however, with simple test equipment. First, be sure that the battery is in good condition and fully charged.

Connect an accurate 0-20 DC voltmeter across the battery terminals. Start the engine and run it at 3,000 rpm. At an ambient temperature of 75°F, the voltmeter should indicate 13.8-15.0 volts. This value will vary slightly with temperature. The regulator is temperature compensated, and will increase output voltage about 0.5 volt for every 50° that temperature drops below 75°F, and decrease output voltage by about 0.5 volt for a 50° increase.

If system voltage was within tolerance, the charging system is probably OK. If not, trouble may lie in either the alternator or regulator. Test the alternator first:

1. With the engine off, unplug the alternator connector.

2. Using an ohmmeter, measure resistance between the 2 white wires. Resistance should be 0.3-1.0 ohm.

3. Measure resistance between each white wire and the blue wire. Resistance should be equal for both measurements.

4. Measure resistance between the blue and red wires. Resistance should be 1.5-2.0 ohms.

5. Using the highest ohmmeter range, determine that there is no continuity between any lead and ground.

6. Connect a 0-150 AC voltmeter between the 2 white wires. Start and run the engine at 2,000 rpm. The voltmeter should indicate 50-100 volts.

7. Shut off the engine, then connect the AC voltmeter between the blue and red wires. Start the engine and run it at 2,000 rpm. The voltmeter should indicate 75-125 volts.

If the foregoing checks were satisfactory, check the rectifier-regulator module. With an ohmmeter, check for continuity at the points listed in **Table 14**. Bear in mind that test lead color is not necessarily indicative of ohmmeter polarity. Replace the module if it fails any check.

STARTER

Harley-Davidson motorcycles are variously equipped with Delco, Prestolite, or Hitachi starters. Service procedures for all are similar, except for field coil testing on Prestolite starters.

Table 14 RECTIFIER/REGULATOR CHECKS

Positive Lead	Negative Lead	Indication
Each white	Ground	Infinity
Ground	Each white	3 to 15 ohms
Blue	Black	3 to 15 ohms
Black	Blue	Infinity
Red	Ground	Infinity
Ground	Red	Infinity

Starter overhaul is a job for professionals, but some checks can be done with simple equipment.

1. Remove and disassemble the starter motor.
2. Remove both brushes and measure the length of each. Replace both brushes if they are worn excessively.
3. Examine the commutator for roughness or burning. Minor roughness may be smoothed with fine sandpaper. After smoothing, be sure that the mica insulators between commutator segments are undercut to a depth of 1/32 in.
4. Use an armature growler or ohmmeter to determine that no commutator segment is shorted to the shaft.
5. Using an ohmmeter, determine that there is continuity between every adjacent pair of commutator segments.
6. With the starter disassembled, determine that there is continuity between each ungrounded brush holder and the starter terminal.
7. On Delco starters, using the highest ohmmeter range, determine that there is no continuity between the starter terminal and starter motor housing. Prestolite starters are so designed that this test is not meaningful.

If the starter motor passes the foregoing checks, but its operation is still unsatisfactory, have it serviced professionally.

HONDA SINGLES

Honda singles are variously equipped with magneto or battery ignition systems. Battery and magneto ignition system service is discussed in *Battery Ignition* and *Magneto Ignition*, respectively. Some models are equipped with electric starters.

CHARGING SYSTEM (50-70cc MODELS)

Additional coils within the flywheel magneto generate alternating current, which is then rectified and used for battery charging. Before checking for possible charging system malfunctions, be sure that the battery is in good condition and is at least half charged. To check the charging coil in the magneto, proceed as follows:

1. Disconnect the green wire which runs from the magneto to the rectifier. Connect a small 6-volt lamp between the wire from the magneto and a good ground.
2. Crank the engine briskly with the kickstarter. The bulb should light briefly each time the engine turns over. If not, replace the lighting-charging coil in the magneto.

If the magneto proves to be OK, check the rectifier. To do so, proceed as follows:

1. Disconnect the 2 wires to the rectifier.
2. Using an ohmmeter, check for continuity through the rectifier, then reverse the ohmmeter leads, and check again. The ohmmeter should indicate very high resistance in one direction and very low resistance in the other. If resistance was very high or very low in both directions, replace the rectifier.

CHARGING SYSTEM (90cc MODELS)

Charging systems on these models consist of an alternator, full-wave bridge rectifier, battery, and interconnecting wiring. If charging system problems are suspected, first check the alternator, then the rectifier.

To test the alternator, proceed as follows:

1. Disconnect the red/white charging wire from the alternator. Connect a short length of wire to the charging wire.

2. With the engine running at about 2,000 rpm, quickly brush the free end of the test wire against a good ground. There should be a small spark.

3. Turn on the lights. Again brush the test wire against a good ground. There should be a larger spark.

If there was no spark in either Steps 2 or 3, connect a 6-volt test lamp to the pink and yellow wires coming from the alternator. Crank the engine briskly. The lamp should light briefly each time the engine turns over. Then connect the lamp between the pink and white wires, and again crank the engine. The bulb should light again. If the bulb does not light in each test, replace the alternator stator assembly.

To test the rectifier, measure continuity, using an ohmmeter, between each pair of wires listed. Then repeat each measurement with the ohmmeter leads reversed.

Green and pink
Pink and red/white
Green and yellow
Red/white and yellow

For each pair of measurements, the ohmmeter should indicate continuity in one direction and no continuity in the other. Replace the rectifier if any pair of measurements showed continuity in both directions, or no continuity in both directions.

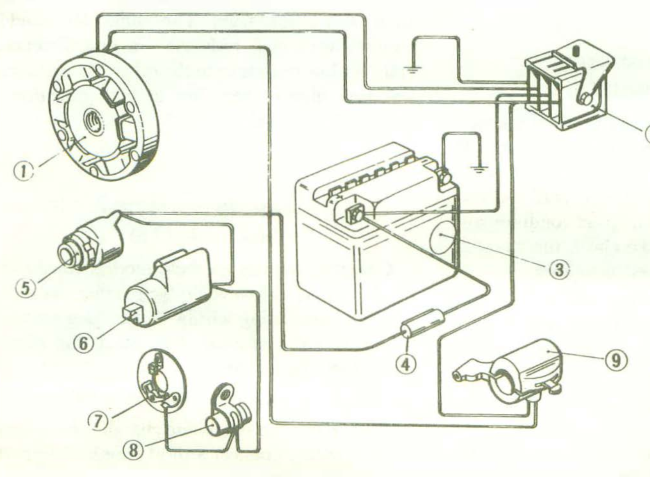
CHARGING SYSTEM (100cc AND 125cc MODELS)

Charging systems on these models consist of an alternator, full-wave bridge rectifier, battery, and interconnecting wiring. **Figure 50** is a pictorial diagram of the charging and ignition systems on these models.

Charging System Test

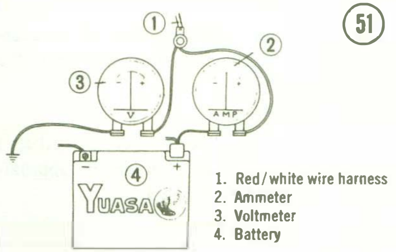
Connect an ammeter and voltmeter into the charging circuit as shown in **Figure 51**. Disconnect the red/white wire from the positive battery terminal, then connect the wire which was removed to the positive terminal of a 0-5 DC ammeter. Connect the negative ammeter terminal to the battery positive terminal. Connect the positive terminal of a 0-10 DC voltmeter to the red/white wire and the negative terminal to a good ground.

Start the engine and run it at 5,000 rpm under each of the conditions listed in **Table 15**. The voltmeter and ammeter should indicate approxi-



HONDA 100-125 CHARGING SYSTEM

1. Alternator
2. Selenium rectifier
3. Battery
4. Fuse
5. Combination switch
6. Ignition coil
7. Breaker points
8. Condenser
9. Lighting switch



1. Red/white wire harness
2. Ammeter
3. Voltmeter
4. Battery

Table 15 CHARGING SYSTEM TESTING 100 AND 125cc MODELS

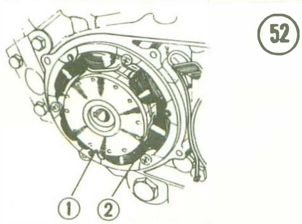
	Light Switch	Dimmer Switch	Ammeter	Voltmeter
100cc	Day	—	1.3	7.8
	On	High	1.3	7.8
	On	Low	1.3	7.2
125cc	Day	—	1.7	7.9
	On	Low	1.3	7.8

mately as specified. Note that the battery should be fully charged for results of this test to be meaningful. If the system does not meet specifications, test the stator and rectifier individually.

Stator Test

Remove the stator (**Figure 52**), then check for continuity between each pair of leads:

Orange and white
Orange and yellow
White and yellow



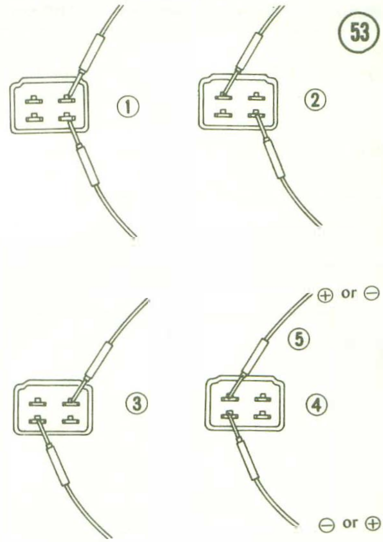
1. Rotor 2. Stator

Check for damaged insulation or wires on the stator. Replace it if either of these conditions exist, or if there is no continuity between any pair of wires.

Rectifier Test

To test the rectifier, measure continuity, using an ohmmeter, between each listed pair of wires (**Figure 53**). Then repeat each measurement with the ohmmeter leads reversed.

Green and pink
Green and yellow
Pink and red/white
Red/white and yellow



1. Green and pink leads
2. Pink and red/white leads
3. Green and yellow leads
4. Red/white and yellow leads
5. Tester leads

The ohmmeter should indicate high resistance in one direction and low resistance in the other direction for each pair of measurements. Replace the rectifier if any pair of measurements was either high or low in both directions.

CHARGING SYSTEM (250cc AND 350cc MODELS)

Charging systems on these models consist of an alternator, rectifier, voltage regulator, battery, and interconnecting wiring (**Figure 54**).

As a quick check of the charging system, connect an ammeter and voltmeter as shown in Figure 51. Run the engine under each of the following conditions. Output voltage and current should be approximately as specified in **Table 16**. The battery must be in good condition and fully charged before testing.

Table 16 CHARGING SYSTEM TESTING 250cc MODELS

Condition	Charging Begins	Charging 5,000 rpm	Current 8,000 rpm
Day	1,000 rpm	1.5 amperes 8.0 volts	4.0 amperes 8.9 volts
Night	2,500 rpm	1.2 amperes 7.5 volts	1.3 amperes 8.3 volts

If results were appreciably different from those specified, check the alternator.

Alternator Checks

Figure 55 is an exploded view of the alternator. Refer to that illustration during the following steps.

1. Remove the stator.
2. Measure resistance between each listed lead and the stator. Resistance should be approximately as specified in **Table 17**.

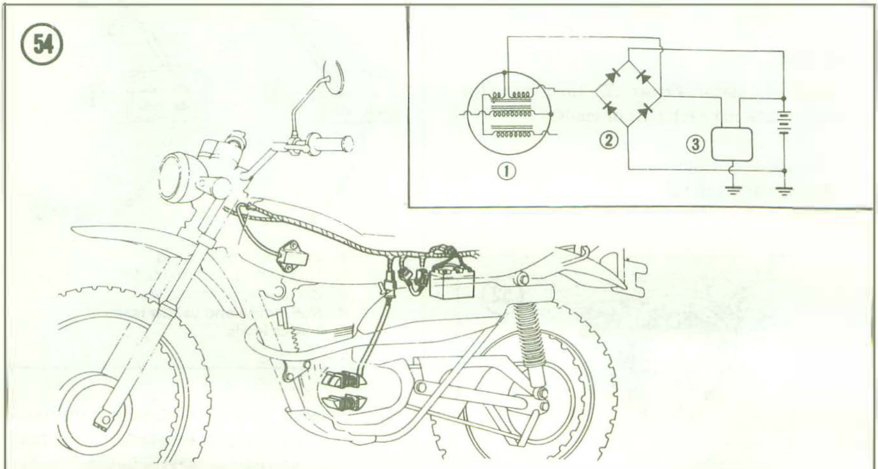
Table 17 ALTERNATOR RESISTANCE CHECKS

Lead	Resistance
Black/white	2.3 ohms
White/yellow	0.4 ohm
Pink	0.6 ohm

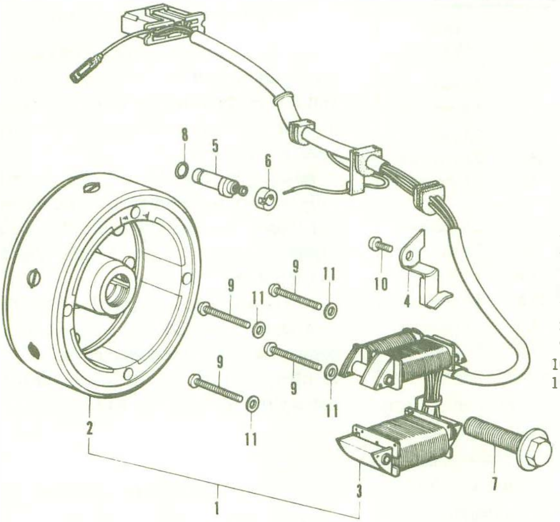
3. Examine each coil for evidence of chafing, damaged insulation, or other condition which might cause impaired performance. Repair or replace as necessary.

Rectifier

Output current from the alternator is converted to direct current in a full-wave bridge rectifier, then used for battery charging. Rectifier testing is identical to that of the 100cc and 125cc models.



1. Alternator 2. Silicon rectifier 3. Voltage regulator



55

HONDA 250 ALTERNATOR

1. A.C. Alternator
2. Flywheel
3. Stator
4. Clamper
5. Contact
6. Neutral switch spacer
7. Bolt
8. O-ring
9. Screw
10. Screw
11. Washer

HONDA TWINS

All models are equipped with alternators and full-wave bridge rectifiers. Alternator output on some models is controlled by a solid state regulator.

CHARGING SYSTEM TEST

In any case where charging system problems are suspected, the first item to check is the battery. It must be in good condition and at least ½ charged (1.220 specific gravity) before meaningful interpretation of test results can be made.

Test Connections

Connect 0-15 DC voltmeter and 0-10 DC ammeter as shown in Figure 51. Connect the positive ammeter terminal to the battery charging wire from the rectifier, and the negative ammeter terminal to the positive battery terminal. Connect the voltmeter positive lead to the battery charging lead and the negative terminal to a good ground.

CAUTION

If the ammeter is connected between the battery positive terminal and the starter cable, do not attempt to start the engine with the electric starter. Starter current will burn out the ammeter.

Start the engine and run it at the speeds listed in **Table 18**. Observe the voltmeter and ammeter and compare their indications with the specifications. All measurements are made with the lights on.

If charging current was considerably lower than specified, check the alternator and rectifier. Less likely is that charging current was too high; in that case, the regulator is probably at fault.

Alternator Check

1. Remove the alternator stator, then check for continuity between each pair of leads coming from it. If resistance between any pair of leads

Table 18 CHARGING SYSTEM TEST

Engine Size	Charging Starts	Test RPM	Voltage	Current (Amperes)
125cc	1,900	5,000	7.0	2.0 minimum
		10,000	8.3	4.0 maximum
160-200cc	2,800	5,000	13.0	0.5 minimum
		10,000	16.5	3.0 maximum
160-200cc (6-volt system)	2,800	10,000	8.3	3.5 maximum
350cc	2,000	5,000	14.8	1.5 minimum
		10,000	15.5	4.0 maximum
360cc	2,100	5,000	14.8	1.2 minimum
		10,000	15.5	4.0 maximum
450cc	1,800	5,000	14.0	1.6 minimum
		10,000	15.5	3.2 maximum

differs greatly, say by a factor of 4 to 1, from the remaining pairs, the stator is faulty.

2. Check all coils and wiring for chafing, broken connections, etc. Repair or replace as required.

3. It occasionally happens that alternator rotors lose magnetism as a result of old age, presence of strong magnetic fields, or a sharp blow. Should this situation occur, the rotor must be replaced.

Rectifier Test

All models are equipped with full-wave bridge rectifiers. There are 2 principal types of rectifiers; both operate the same, but they differ in lead colors and connections.

Some rectifiers mount by one terminal. The other terminals are leads, colored yellow, brown, and red/white. To test this rectifier, disconnect it from the motorcycle, then using an ohmmeter, measure resistance in both directions between the following pairs of terminals:

Yellow and ground
Brown and ground
Yellow and red/white
Brown and red/white

The second type rectifier has 4 leads, colored green, yellow, red/white or brown/white, and pink. To test this rectifier, measure resistance between each pair of wires listed:

Green and yellow
Green and pink
Yellow and red/white or brown/white
Pink and red/white or brown/white

On either type rectifier, resistance between each pair should be very high in one direction and low in the other. If resistance is either very high or very low in either direction, replace the rectifier assembly.

Always handle the rectifier assembly carefully. Do not bend or try to rotate the wafers. Do not loosen the screw which holds the assembly together. Moisture can damage the assembly, so keep it dry.

Never operate the engine without the battery or a load connected in the circuit. If a lead becomes loose or disconnected at the battery or rectifier, or if the motorcycle is started with the battery out, the rectifier will be damaged.

STARTER MOTOR

Figure 56 is a cutaway view of a typical starter motor. In the event of trouble, remove and disassemble the starter.

1. Examine the brushes for wear, and replace if necessary.

2. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. Replace the armature if this condition exists. Also be sure that there is continuity between each adjacent pair of commutator segments.

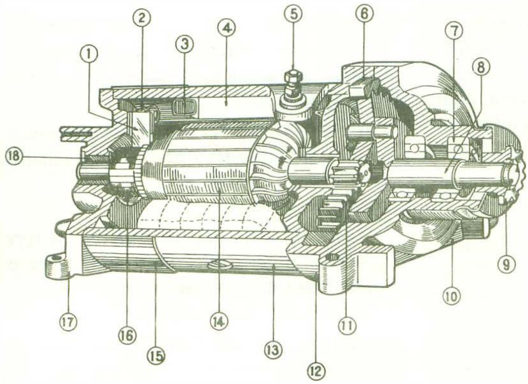
3. If the commutator is worn, rough, or burned, turn it down, then undercut the mica insulators. This is a job best left to an auto electrical or small motor specialist.

4. With the starter disassembled, be sure that there is continuity between the cable terminal and the ungrounded brush holder.

5. Using the highest ohmmeter range, determine that there is no continuity between the ungrounded brush holder and the starter housing.

STARTER SOLENOID

Figure 57 is a cutaway view of a typical starter relay, or solenoid, used on these models. The purpose of the starter solenoid is to make and



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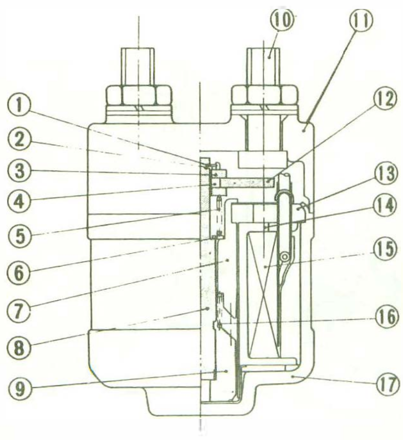
HONDA STARTER

1. Brush
2. Brush spring
3. Field coil
4. Pole core
5. Terminal
6. Internal ring
7. Ball bearing
8. Sprocket shaft
9. Sprocket
10. Gear housing
11. Planetary gear
12. Center bearing holder
13. Yoke
14. Armature
15. Cover band
16. Commutator
17. Commutator end frame
18. Bushing



57

STARTER SOLENOID

1. Stopper
2. Stopper holder
3. Washer
4. Roller A
5. Contact spring
6. Flat washer
7. Plunger holder
8. Plunger shaft
9. Plunger
10. Contact bolt
11. Case
12. Contact plate
13. Yoke
14. Coil bobbin
15. Coil
16. Return spring
17. Body

break the heavy current drawn by the starter. When the rider presses the starter switch, current flows through the solenoid coil, and causes large internal contacts to close, completing a current path between the battery and starter.

The starter may fail to operate when the solenoid contacts become pitted or burned from normal use. Should this situation occur, disconnect the battery, then disassemble the solenoid and lightly dress its contacts.

HONDA PARALLEL FOURS

Honda 4-cylinder models are equipped with alternators, electromechanical voltage regulators, and starters. Service procedures are similar for all models; differences are pointed out where they exist. All models use battery ignition systems, described in *Battery Ignition*.

CHARGING SYSTEM

The charging system (**Figure 58**) consists of an alternator, electromechanical voltage regulator, battery, and interconnecting wiring. If charging system problems are suspected, first be sure that the battery is in good condition and that it is well charged, then connect an ammeter and voltmeter as shown in **Figure 59**.

1. Locate the positive battery terminal and disconnect the red/white rectifier lead, and the red power lead. Connect both of these to the positive terminal of the ammeter.
2. Connect the positive terminal of the battery to the negative terminal of the ammeter.
3. Start the engine and observe both meters as the engine runs.

If charging current is not approximately as specified in **Table 19**, first check the alternator.

Alternator Checks

Figure 60 is an exploded view of a typical alternator. Refer to this illustration while performing the following procedures:

1. Disassemble the alternator.
2. Measure field coil resistance, using an ohmmeter. Replace the coil if measured values differ from those specified in **Table 20**.
3. Using the highest range on the ohmmeter, check that there is no continuity between the field coil and ground. Replace the field coil if it is shorted to ground.

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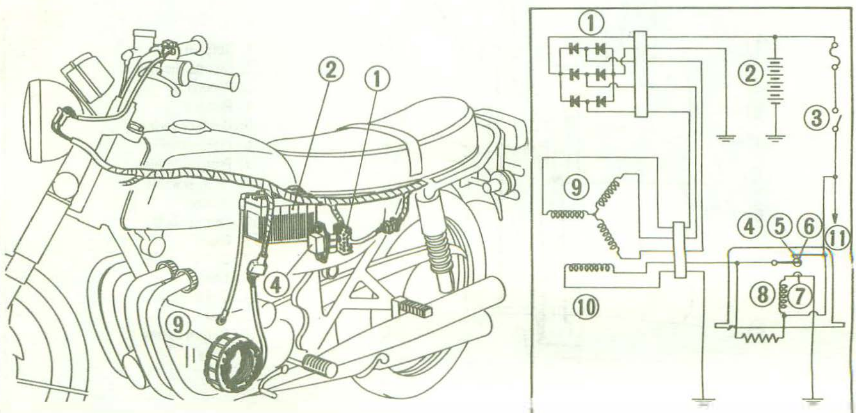


HONDA FOUR CHARGING SYSTEM

1. Silicon rectifier
2. Battery
3. Main switch
4. Regulator
5. Upper contact
6. Moving contact
7. Lower contact
8. Relay coil
9. Stator coil
10. Field coil
11. Load

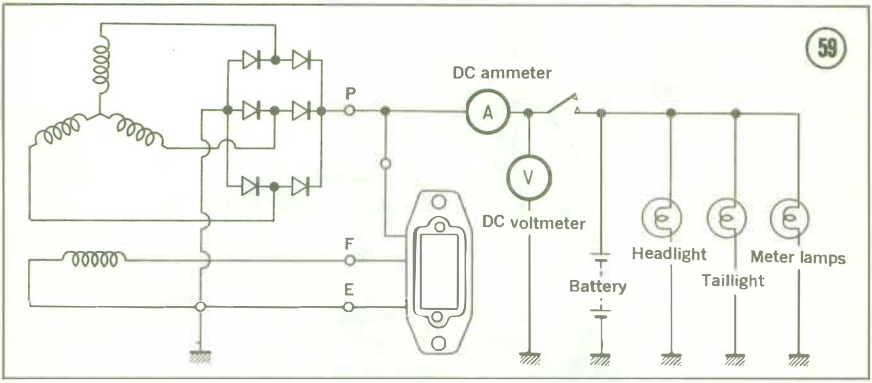


Table 19 CHARGING SYSTEM TESTING

CB350 & CB400 (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000
Day riding (amperes)	—	—	4.0	2.6	2.0	1.6	1.4	1.4
Night riding (amperes)	1.6	1.9	2.0	1.8	1.6	1.5	1.4	1.4
Voltage	12.5	14.2	15.0	15.0	15.0	15.0	15.0	15.0

CB500 & CB550 (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000
Day riding (amperes)	6.5	0	2.4	1.3	1.0	1.0	0.8	0.6
Night riding (amperes)	2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Voltage	12.0	12.4	13.2	14.5	14.5	14.5	14.5	14.5

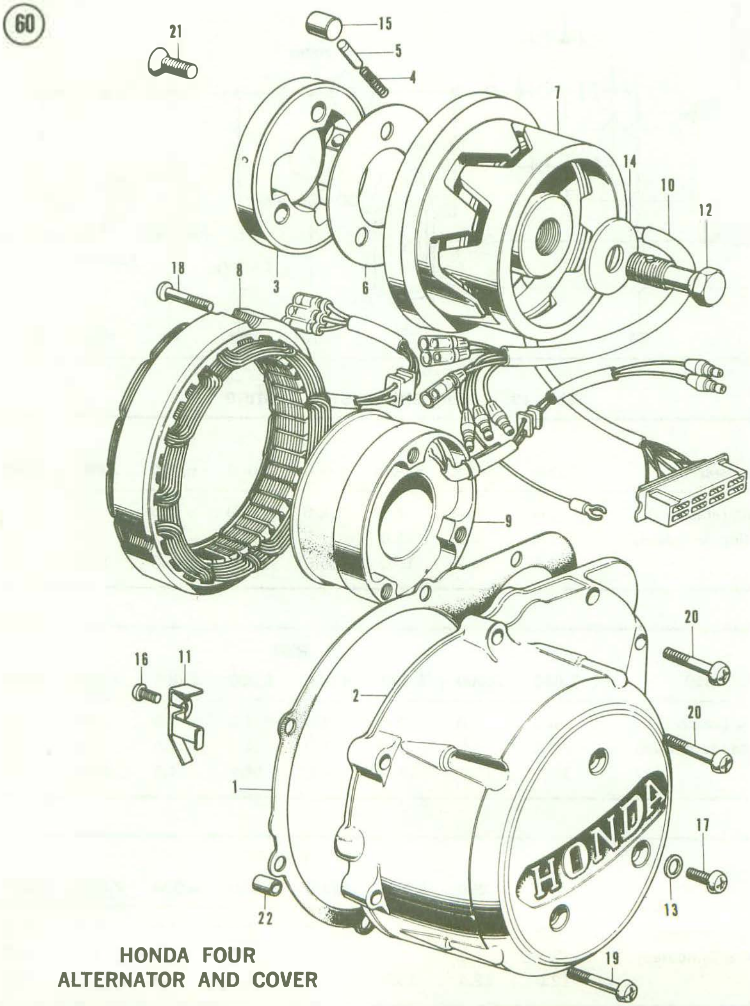
CB 750 (RPM)	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000
Day riding (amperes)	6.5	0	2.4	1.3	1.0	1.0	0.8	0.6
Night riding (amperes)	2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Voltage	12.0	12.4	13.2	14.5	14.5	14.5	14.5	14.5

Table 20 FIELD COIL RESISTANCE

Model	Resistance
CB350 and CB400	4.6 to 5.0 ohms
CB500 and CB550	4.4 to 5.4 ohms
CB750	6.5 to 7.9 ohms

4. Using a low-range ohmmeter, measure resistance of each pair of stator leads. Replace the stator if resistance is not as specified in **Table 21**.

5. Using the highest ohmmeter range, check that there is no continuity between any lead and ground. Replace the stator if it is shorted to ground.



HONDA FOUR ALTERNATOR AND COVER

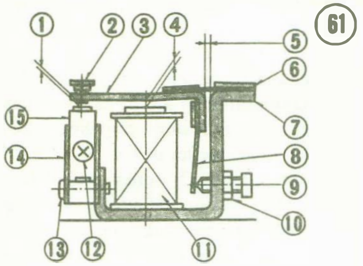
1. Dynamo cover gasket
2. Dynamo cover
3. Starting clutch
4. Starting clutch roller spring
5. Starting clutch roller spring cap
6. Starting clutch side plate
7. Rotor components
8. Stator components
9. Field coil components
10. A.C. generator wire harness
11. A.C. generator cord setting plate
12. Rotor set bolt
13. Washer
14. Washer
15. Roller
16. Pan screw
17. Pan screw
18. Pan screw
19. Pan screw
20. Pan screw
21. Flat screw
22. Dowel pin

Table 21 STATOR RESISTANCE

Model	Resistance
CB350, CB400	0.61 to 0.69 ohm
CB500, CB550	0.31 to 0.40 ohm
CB750	0.18 to 0.22 ohm

Voltage Regulator

Alternator output on these models is controlled by an electromechanical voltage regulator. **Figure 61** illustrates major parts of this unit.



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1. Point gap
2. Upper contact
3. Armature
4. Core gap
5. Yoke gap
6. Spring
7. Yoke
8. Adjusting spring
9. Voltage adjusting screw
10. Lock nut
11. Coil
12. Point gap adjusting screw
13. Core gap adjusting screw
14. Contact set
15. Lower contact

There are only 3 variables that control alternator output voltage: alternator speed, field current, and total alternator load. Output voltage is increased by an increase in alternator speed or field current, or a decrease in alternator load. The voltage regulator controls every alternator operating condition of speed and load by controlling field current.

The voltage regulator was properly adjusted at the factory, and normally should not require service. Should adjustment be required refer to **Figure 62**, then proceed as follows:

CB350 and CB400

1. Connect an ammeter into the field circuit of the charging system.

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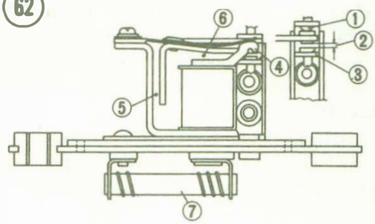


1. Point (high)
2. Point gap
3. Point (low)
4. Adjusting arm
5. Angle gap
6. Armature gap
7. Resistor

2. Gradually increase engine rpm until the maximum indication is obtained.

3. Continue to increase engine rpm until field current drops to ½ of the maximum current measured in Step 2. Measure output voltage.

4. Increase engine speed further to 4,000 rpm and measure output voltage again.

5. If the voltage readings are not in agreement with specifications in Table 19, adjust the regulator by bending the adjusting arm. The main switch should be turned off before removing the regulator cover.

6. If the adjusting arm correction is insufficient, adjust the gaps by bending the holder if the distances vary from the following minimum specifications:

Armature gap	0.012 in. (0.30mm)
Point gap	0.017 in. (0.45mm)
Angle gap	0.008 in. (0.20mm)

CB500 and CB550

1. Slowly increase engine rpm until a sudden increase of approximately 0.5 volt occurs. If measured voltage is not within tolerance, the regulator must be adjusted. If a sudden increase of more than 0.5 volt occurred, core gap must be adjusted.

2. To adjust voltage, shut the engine off, remove the regulator cover, loosen the locknut, then turn the adjusting screw a little bit at a time as required. Clockwise screw rotation increases out-

put voltage. Make final measurements with the regulator cover in place.

3. Core gap should be 0.02-0.04 in. (0.5-1.0mm). To adjust, loosen the adjusting screw and move the point body up or down as required. Dress contacts if necessary with a clean point file.

4. Point gap should be 0.008 in. (0.2mm). Adjust by loosening the retaining screw, then moving the lower point up or down as required.

CB750

1. Slowly increase engine speed until the voltmeter indicates a sudden increase of approximately 0.5 volt. This increase occurs when regulator operation transfers from the upper to the lower contacts.

2. If the voltmeter indicates between 14 and 15 volts at this point, voltage regulator operation is normal. If not within this range, the regulator must be adjusted. If the voltage increase was greater than 0.5 volt or if there was a drop, core gap must be adjusted.

3. To adjust the regulator, shut the engine off, then remove the regulator cover. After loosening its locknut, turn the adjustment screw clockwise to increase regulated voltage, and counterclockwise to decrease it. Be sure to tighten the locknut after adjustment. Make final measurements with the regulator cover in place.

4. Core gap should be 0.025-0.04 in. (0.6-1.0mm). Readjust if necessary.

5. Point gap should be 0.12-0.16 in. (0.3-0.4mm). Loosen the lock screw and adjust if necessary.

Rectifier

The rectifier consists of 6 silicon diodes, each of which has the property of permitting electric current to flow in only one direction. They are so arranged to convert output current from the alternator into direct current, which is used by all electrical accessories, and for battery charging.

To test the rectifier, measure resistance between each yellow wire and the red/white wire, then repeat each measurement with the ohmmeter leads reversed. After these measurements are completed, measure resistance between each yellow wire and the green wire, and again repeat each measurement with the ohmmeter leads reversed. Each pair of measurements should be high in one direction and low in the reverse direction. Replace the rectifier assembly if any pair of measurements was either high or low, or if any pair of measurements was greatly different from the other pairs.

STARTER

Figure 63 illustrates a typical starter circuit. When the rider presses pushbutton (9), current flows from the battery (10), through ignition switch (8), starter relay coil (7), and pushbutton switch (9) to ground. Current through relay coil (7) causes its plunger (11) to be pulled upward, thereby bridging the 2 heavy terminals in the starter relay, and completing the circuit from the battery to the starter motor (3).

The starter motor is series wound for high torque, and draws approximately 120 amperes under normal starting conditions. This figure can vary considerably, depending on engine temperature, starter condition, and other factors. **Figure 64** is an exploded view of a typical starter motor.

If starter problems are encountered, overhaul is best performed by a shop specializing in small rotor repair or auto electrical systems. Some checks and services can be done by the layman, however.

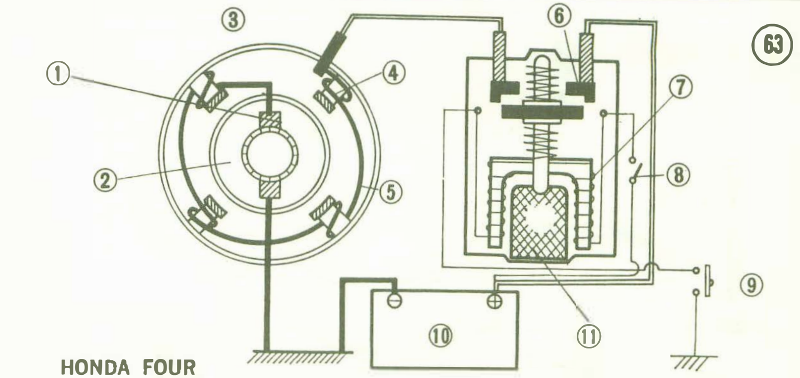
1. Remove and disassemble the starter motor.

2. Remove both brushes and measure the length of each. Replace both brushes if the length of either is 0.22 in. (5.5mm) or less.

3. Examine the commutator for roughness or burning. Minor roughness may be smoothed with fine sandpaper. After smoothing, be sure that the mica insulators between commutator segments are undercut to a depth of at least 0.012 in. (0.3mm), as shown in **Figure 65**.

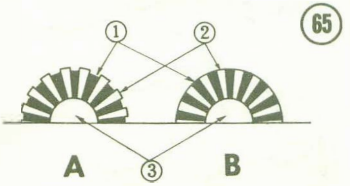
4. Use an armature growler or ohmmeter to determine that no commutator segment is shorted to the shaft.

5. Using an ohmmeter, determine that there is continuity between every adjacent pair of commutator segments.



HONDA FOUR STARTING CIRCUIT

1. Brush
2. Armature
3. Starting motor
4. Pole
5. Field coil
6. Starter magnetic switch
7. Electromagnet
8. Ignition switch
9. Starter button
10. Battery
11. Plunger



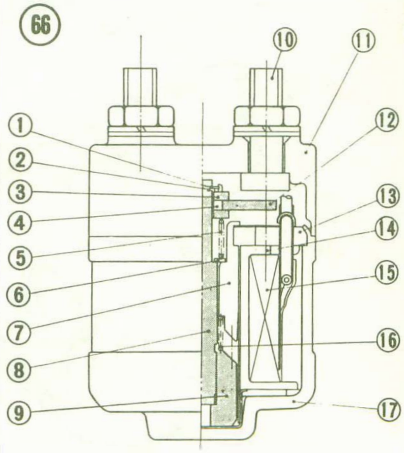
1. Mica piece
2. Commutator (copper)
3. Motor shaft

6. With the starter disassembled, determine that there is continuity between the ungrounded brush holder and the starter terminal.

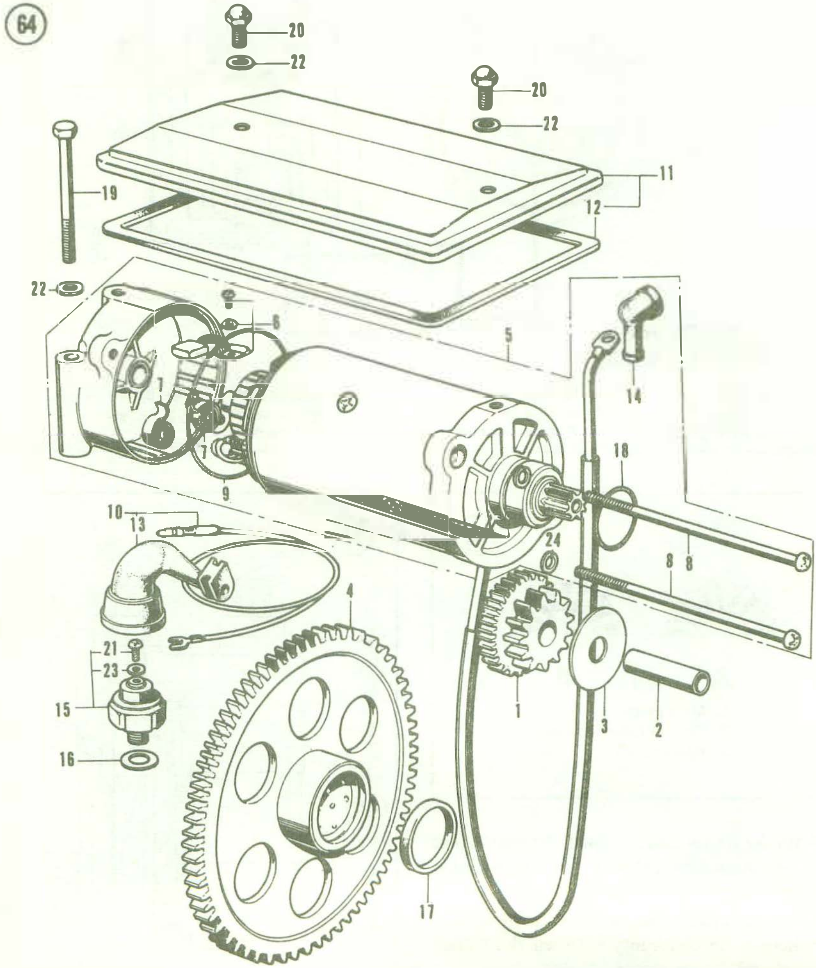
7. Using the highest ohmmeter range, determine that there is no continuity between the starter terminal and starter motor housing.

STARTER SOLENOID

Figure 66 is a cutaway view of the starter solenoid, or relay, used on 4-cylinder models. In the event this unit malfunctions, it is possible to disassemble it and lightly dress its contacts with a fine file. Replace it if the coil burns out.



1. Stopper
2. Stopper holder
3. Insulation washer
4. Insulation collar A
5. Contact spring
6. Flat washer
7. Plunger holder
8. Plunger shaft
9. Plunger
10. Contact bolt
11. Case
12. Contact plate
13. Yoke
14. Coil bobbin
15. Coil complete
16. Return spring
17. Body



HONDA FOUR STARTING MOTOR

1. Starting motor reduction gear
2. Starter reduction gear shaft
3. Starting gear setting plate
4. Starting clutch gear components
5. Starting motor assembly
6. Carbon brush set
7. Carbon brush spring
8. Gear cover setting bolt
9. O-ring
10. Oil pressure switch cord assembly
11. Starting motor cover components
12. Starting motor cover gasket
13. Oil pressure switch cord grommet
14. Starting motor terminal cover
15. Oil pressure switch assembly
16. Oil bolt washer
17. Oil seal
18. O-ring
19. Hex bolt
20. Hex bolt
21. Pan screw
22. Plain washer
23. Spring washer
24. Spring washer

KAWASAKI SINGLES

This section discusses principles and maintenance of Kawasaki single engine ignition, charging, and starting systems.

FLYWHEEL MAGNETO

A flywheel magneto provides electric power for the ignition and electrical systems of most of the machines covered by this manual. Separate coils within the magneto supply current for ignition, daytime and nighttime operation, and battery charging. Alternating current produced by the magneto is used for ignition and lights, except for stoplights and turn signals. A rectifier converts this alternating current into direct current for charging the battery and operating the horn and turn signals. **Figure 67** illustrates a typical magneto.

Figure 68 is a circuit diagram of a typical magneto, which operates the ignition, charging, and lighting systems. As the flywheel rotates, permanent magnets attached to the flywheel revolve past the various windings in the magneto, thereby inducing current in the windings.

When the contact breaker points are closed, current (approximately 4 amperes) developed in the ignition coil is grounded, and no current is delivered to the ignition coil. When the points open, this current is delivered to the primary winding of the ignition coil. The 200-300 volts across the coil primary winding is stepped up to the very high voltage (10,000-15,000 volts) required to jump the spark plug gap. A capacitor (condenser) is connected across the ignition points to assist the coil in developing high voltage, and also to prevent the points from arcing.

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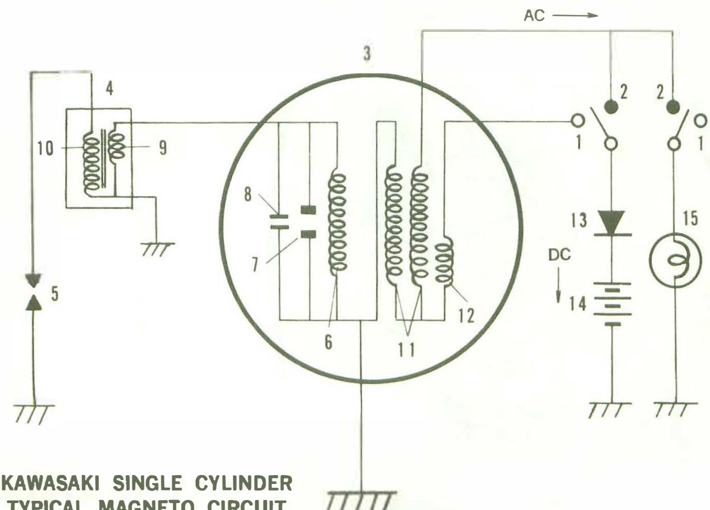
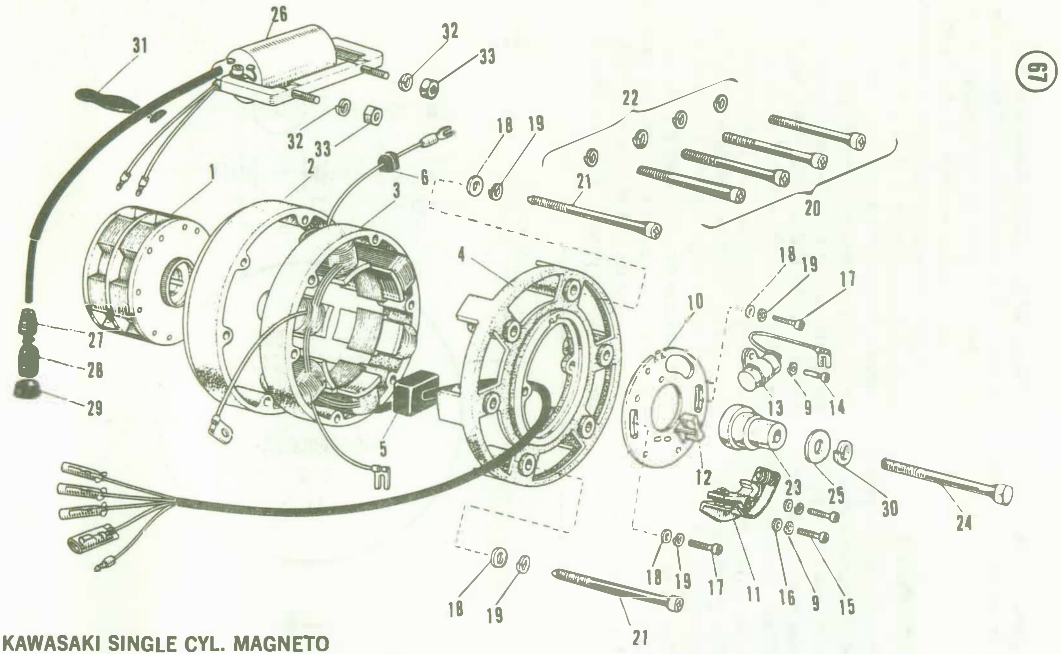


KAWASAKI SINGLE CYLINDER TYPICAL MAGNETO CIRCUIT

1. Daytime running
2. Nighttime running
3. Flywheel magneto
4. Ignition coil
5. Spark plug
6. Ignition primary coil
7. Contact breaker
8. Capacitor
9. Ignition primary coil
10. Ignition secondary coil
11. Lighting coil
12. Differential winding coil
13. Rectifier
14. Battery
15. AC lamp load (headlight and taillight)

67



TYPICAL KAWASAKI SINGLE CYL. MAGNETO

1. Rotor
2. Rear cover
3. Stator
4. Front cover
5. Engine wiring harness grommet (A)
6. Engine wiring harness grommet (B)
9. Spring washer
10. Contact breaker plate
11. Contact breaker assembly
12. Oil felt
13. Condenser
14. Pan head screw
15. Pan head screw
16. Plain washer
17. Pan head screw
18. Plain washer
19. Spring washer
20. Pan head screw
21. Pan head screw
22. Spring washer
23. Cam
24. Hex head bolt
25. Plain washer
26. Ignition coil
27. Spark plug cap grommet (B)
28. Spark plug cap
29. Spark plug cap grommet (A)
30. Spring washer
31. Rubber band
32. Spring washer
33. Nut

Nighttime riding imposes an additional load on the magneto because of the use of lights. To accommodate different current requirements, the lighting coil is tapped for both day and night loads.

The rectifier serves 2 purposes. It converts alternating current generated by the magneto into direct current for charging the battery, and it also prevents the battery from discharging through the magneto when magneto output voltage is too low to charge the battery.

Magnetos on some models have 3 charging taps. The pink wire is used during night operation. The blue or yellow/green wire is used for day operation. In cases where the battery is chronically undercharged, connect the blue wire from the magneto to the blue wire at the main switch. Connect the yellow/green wire to the blue wire at the main switch when the battery is overcharged.

Figure 69 is a simplified diagram of the system on models such as F5 and F9. The silicon voltage regulator (SVR) serves to control charging voltage under daytime riding conditions. Note that the SVR is not in the circuit during night riding conditions. If the DC load is reduced, as in the case of a burned out brake light, the battery may be overcharged.

Note that the lighting coil serves mainly to operate the headlight, but it also furnishes power to the speedometer, tachometer, and high beam indicator bulbs. If the headlight burns out, the other bulbs will burn out because of excess voltage.

Magnetos on models with CDI (**Figure 70**) are basically similar to those on the conventional magneto ignition models, except that the ignition coil is replaced with an exciter coil and a signal coil to meet the requirements of the capacitor discharge ignition system.

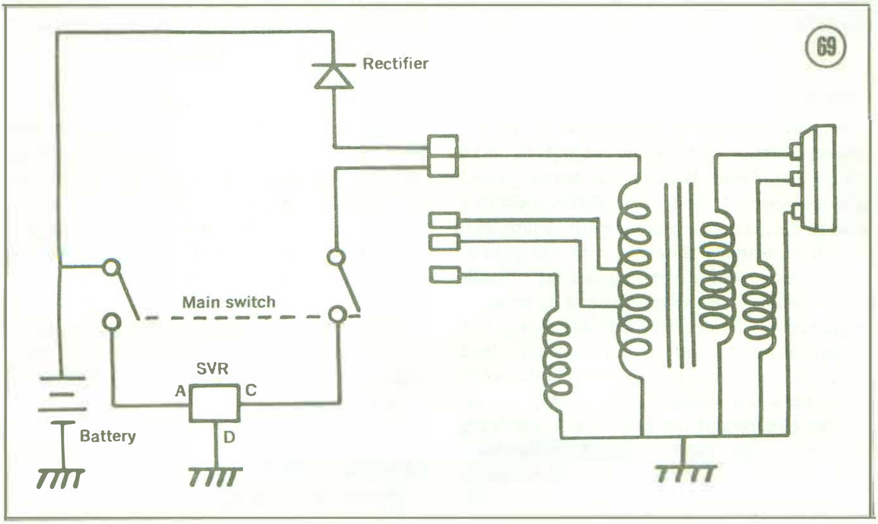
MAGNETO TROUBLESHOOTING

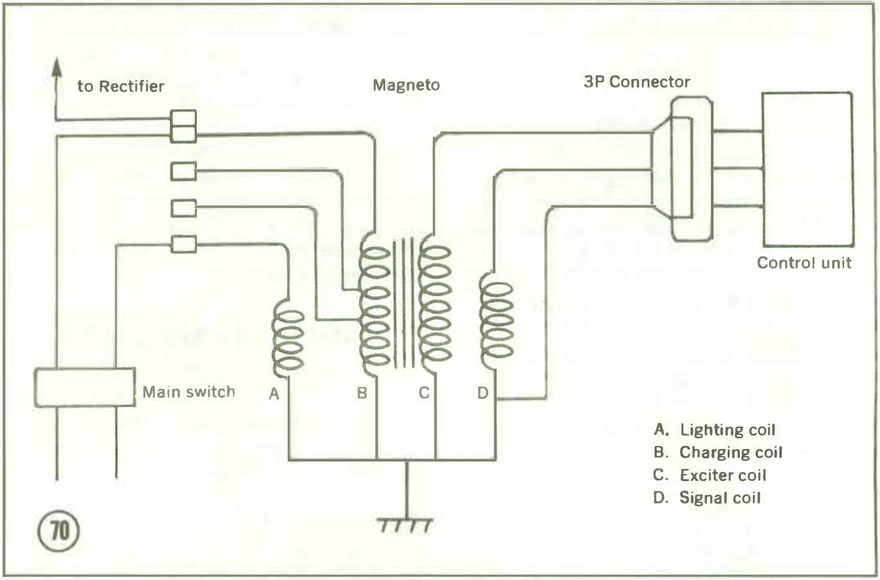
In the event that an ignition malfunction is believed to be caused by a defective magneto on models with breaker points, check the coils, condenser, and breaker points as described in the following paragraphs.

Magneto Ignition Coil

With the magneto wiring disconnected, block the breaker points open with a piece of paper such as a business card.

Measure resistance between the black wire and ground with a low-range ohmmeter. If resistance is approximately 0.5 ohm, the coil is good.





Disconnect the ground wire between the ignition coil and the magneto base. Measure insulation resistance between the iron core and the coil. Insulation resistance should be at least 5 megohms.

Condenser

Measure capacity of the condenser, using a condenser tester. The value should be 0.18 to 0.25 microfarad. With the condenser ground wire disconnected, measure insulation resistance between the outer case and the positive terminal. Insulation resistance should be over 5 megohms.

In the event that no test equipment is available, a quick test of the condenser may be made by connecting the negative lead to the negative terminal of a 6-volt battery, and the positive lead to the positive terminal. Allow the condenser to charge for a few seconds, then quickly disconnect the battery and touch the condenser leads together. If you observe a spark as the leads touch, you can assume that condenser is good.

Arcing between the breaker points is a common symptom of a defective condenser.

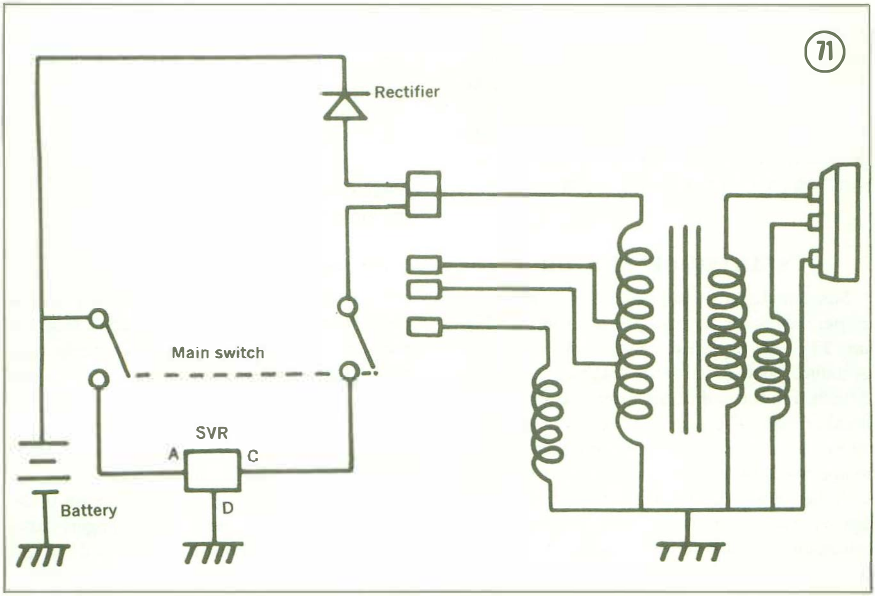
SOLID STATE VOLTAGE REGULATOR

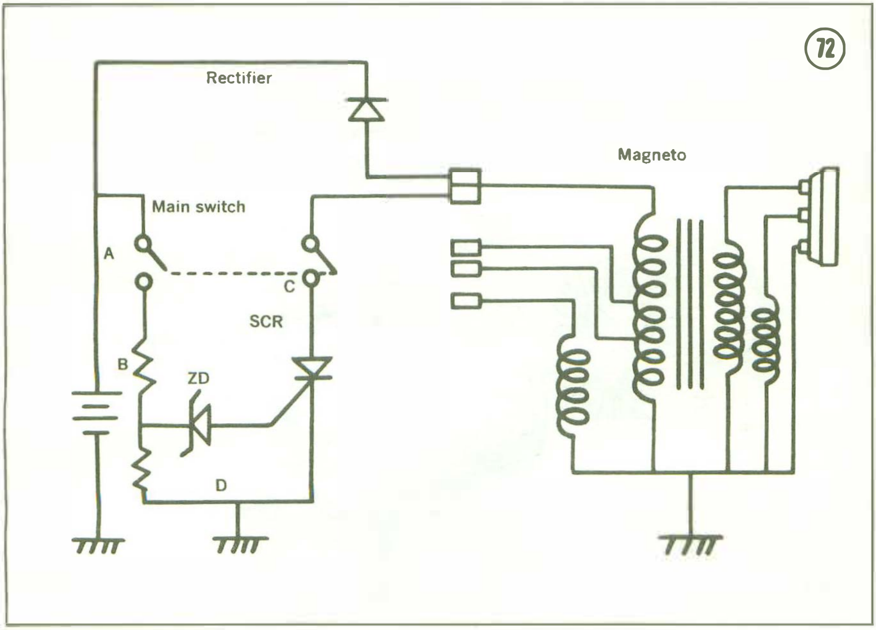
Some machines are equipped with a solid state unit which is used as a voltage regulator (SVR in **Figure 71**). This unit consists of a zener diode (ZD), a silicon controlled rectifier (SCR), and 2 resistors, as shown in **Figure 72**. Refer to that illustration during the following discussion.

Assume that the main switch is closed. As engine speed increases, output voltage from the magneto tends to increase. If the battery is fully charged, voltage at point A will tend to rise. If it reaches zener voltage (7.0±0.5 volts), the zener diode conducts in the reverse direction, thereby triggering the silicon controlled rectifier. When the silicon controlled rectifier conducts, magneto output is grounded, thereby reducing its output voltage to near zero. As the voltage at junction A drops, the zener diode ceases to conduct, and removes the trigger signal to the silicon controlled rectifier.

Checking the SVR

Connect a test lamp in series with a 6-volt battery, or use an ohmmeter to determine


71
Rectifier
Main switch
SVR
A
C
D
Battery


72
Rectifier
Magneto
Main switch
A
C
SCR
B
ZD
D

whether there is continuity between points C and D. The continuity test lamp should not light, or the ohmmeter should show no continuity. Reverse the continuity tester connections to the SVR. If the lamp lights or the ohmmeter indicates continuity, the unit is defective. Also be sure that terminal C is not shorted to the case.

STARTER/GENERATOR

Some models are equipped with a combination starter/generator instead of a magneto. **Figure 73** is an exploded view of this unit. The armature rotates with the engine crankshaft. Attached to the end of the armature shaft is the breaker cam. The unit operates as a generator when the engine is running, and as a starting motor when the engine is stopped. Associated with the starter/generator is a cutout relay, voltage regulator, and starter relay. **Figure 74** is a schematic diagram of the associated circuitry. Refer to that diagram during the following discussion.

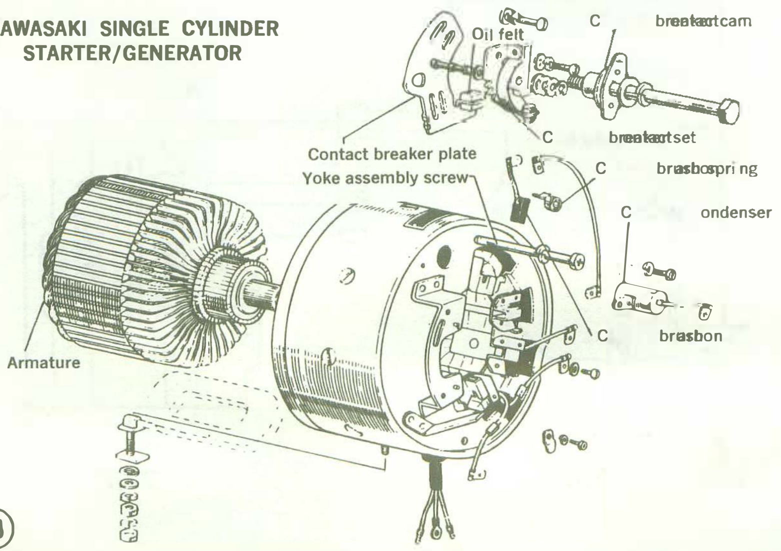
Starter Relay

The starter relay is enclosed within the voltage regulator unit. **Figure 75** illustrates the relay circuit. Pressing the starter switch energizes the relay coil and closes the relay contacts. Current then flows from the battery, through the relay contacts, and finally through the series field winding (M) of the starter/generator.

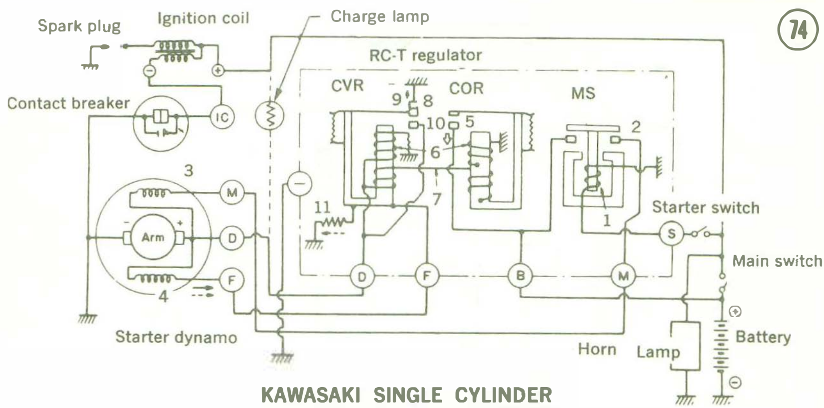
Cutout Relay

When the engine is off, or running at low speed, the battery must be disconnected from the generator to prevent it from discharging. The cutout relay performs this function. As engine speed increases, output voltage of the generator increases to a value sufficient to charge the battery. When this occurs, a voltage sensing coil in the cutout relay closes the relay contacts, permitting current to flow from the generator to the battery and external loads. As the engine slows down, generator output decreases, and current tends to flow from the battery to the generator. A second coil in the cutout relay senses this

KAWASAKI SINGLE CYLINDER STARTER/GENERATOR



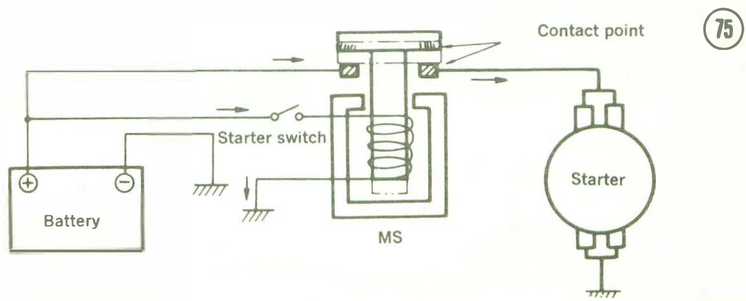
73



KAWASAKI SINGLE CYLINDER STARTER/GENERATOR CIRCUITRY

1. Excitation coil (MS)
2. Contact
3. Field coil (starter)
4. Field coil (generator)
5. Cut out point
6. Voltage coil
7. Current coil
8. Low speed point
9. Moving point
10. High speed point
11. Field resistance

Arm: Armature



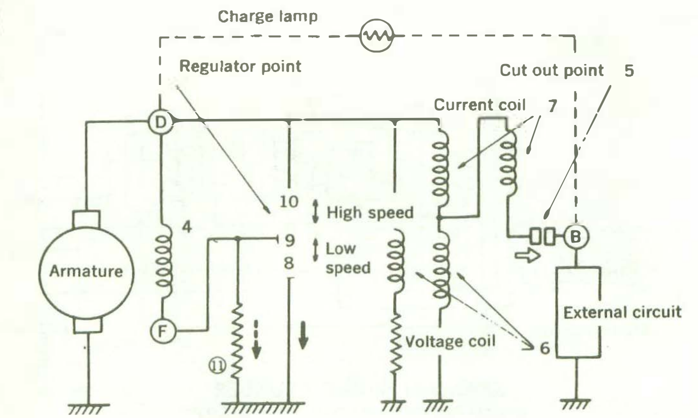
reverse current and allows the contacts to again open, thereby disconnecting the battery and generator.

Voltage Regulator

Varying engine speeds and electrical loads affect generator output. The voltage regulator maintains output voltage at a constant level by controlling field current in the generator. **Figure 76** illustrates its operation.

With contacts (8) and (9) closed, the field is grounded and the generator produces its maximum output. As output rises, voltage regulator coil (6) pulls contacts (8) and (9) apart, thereby inserting a resistance (10) into the field circuit. This resistance causes a decrease in field current, which results in less output from the generator. As output from the generator decreases, contacts (8) and (9) close again and the cycle repeats. This cycling action tends to maintain constant generator output.

76



At higher engine speeds and light electrical loads, action of contacts (8) and (9) may not be sufficient to limit generator output. If output voltage tends to go very high, coil (6) pulls contact (9) all the way to contact (10), thus short-circuiting the field and causing generator output to decrease to almost zero. Voltage regulation is then effected by cycling of contact (9) between midposition and contact (10).

Removal and Installation

To remove the starter/generator, proceed as follows:

1. Remove the gearshift pedal.
2. Remove the left crankcase cover.
3. Remove the screws which secure the yoke assembly, then the yoke.
4. Remove the armature with a suitable puller.
5. Remove the Woodruff key from crankshaft.

To install the starter/generator, reverse the removal procedure. Install the brushes and brush springs after the yoke is in place.

STARTER/GENERATOR TROUBLESHOOTING

Malfunctions within the starter/generator system can be divided into 3 main categories:

a. Starter does not work properly.
b. Generator output is too low, resulting in an undercharged battery.
c. Generator output is too high, resulting in an overcharged battery.

Starter Troubleshooting

Table 22 lists symptoms, probable causes, and remedies for starter malfunctions.

Generator Troubleshooting

In the case of charging system malfunctions, it is necessary to determine whether the generator or the regulator is at fault. To determine which, refer to **Figure 77**, then proceed as follows:

1. Disconnect the wires from terminals D and F of the regulator.
2. Connect the wire which was removed from terminal F to a good ground. Connect an accurate voltmeter (0-20 volts DC) between the wire removed from terminal D and ground.
3. Start the engine and run it at 2,200 rpm. If the voltmeter indicates more than 13 volts, it can be assumed that the generator is OK.

If the meter indication is not as specified, the starter/generator is faulty.

Table 22 STARTER TROUBLESHOOTING

Symptom	Probable Cause	Remedy
Starter does not work	Low battery	Recharge battery
	Worn brushes	Replace brushes
	Internal short	Repair or replace defective component
	Relay inoperative	Replace voltage regulator
	Defective wiring or connections	Repair wire or clean and tighten
	Defective switch	Replace switch
Starter action is weak	Low battery	Recharge battery
	Pitted relay contacts	Clean contacts or replace voltage regulator
	Brushes worn	Replace brushes
	Defective wiring or connections	Repair wire or clean and tighten connections
	Short in commutator	Replace armature
Starter runs continuously	Stuck relay	Dress contacts or replace voltage regulator

Checking the Yoke

Clean the yoke assembly of all foreign material, and remove it from the machine.

1. Use an ohmmeter set to its highest range to measure insulation resistance between the positive brush and ground. If the meter indicates continuity, check for a short circuit at the brush holder or terminal D. Note that the negative brush holder is not insulated.

2. Measure field resistance between terminals F and D. Field coil resistance should be between 5 to 8 ohms.

3. Set ohmmeter to its highest range. Measure insulation resistance between terminal F and a good ground. Insulation resistance should be essentially infinite.

If the measurements obtained in Steps 2 or 3 are not as specified, replace the yoke. If the yoke assembly is good, check brushes and armature.

Checking the Brushes

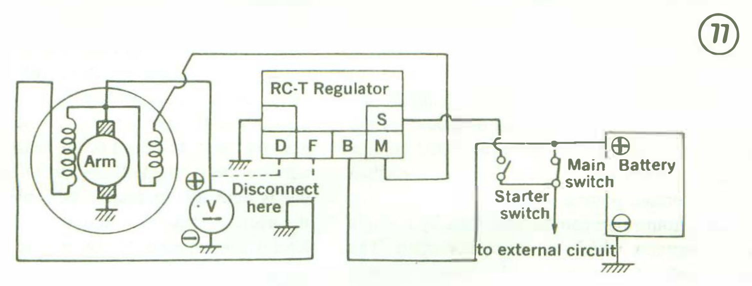
Poor brush condition is one of the most frequent causes of low generator output.Remove the brushes and examine them carefully. Each brush must contact the commutator with at least ¾ of its contact surface. If either brush is worn excessively, replace both brushes.

If the brushes and the commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if there are any burrs.

When you replace the brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure that the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

1. Clean commutator of oil, dust, and foreign material.



2. If the commutator is rough or covered with carbon dust, polish it with fine emery paper. If a light polishing does not clean up the surface, remove the armature and turn the commutator in a lathe. Do not reduce commutator diameter by more than 0.08 in. (2mm).

3. Undercut the mica segment between the commutator segments with a hacksaw blade to a depth of 0.02-0.04 in. (0.05-1.0mm). Remove the dust between the segments.

4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If any short exists, replace the armature.

Checking the Regulator

Varying engine speeds and electrical loads affect output of the generator. The regulator controls the generator output, and also disconnects the battery from the generator whenever generator output voltage is less than that of the battery, thereby preventing battery discharge through the generator.

Disconnect the wire from terminal B at the regulator. Be careful that you don't allow this wire to become grounded. Connect the voltmeter between terminal B of the regulator and ground. Start the engine and run it at 2,500 rpm. The voltmeter should indicate 14.7-15.7 volts.

Adjusting the Voltage Regulator

CAUTION

Disconnect the battery before removing the regulator cover. Do not make any adjustments with the battery in place.

Remove the regulator cover and adjust the regulator by bending the adjustment spring. Bending the spring downward raises the voltage setting. The voltage regulator can be identified by its 2 contact points.

The cutout relay can be identified by a single set of contacts which are normally open. The relay rarely, if ever, needs adjustment. Usually all that is required is to dress its contacts lightly to remove any corrosion or light pitting.

Should adjustment be required, bend the spring retainer up or down as required. Lowering the spring retainer raises the voltage setting.

Ignition Coil

The ignition coil is a form of transformer which develops the high voltage required to jump the spark plug gap. The only maintenance required is keeping the electrical connections clean and tight, and making sure the coil is mounted securely.

If condition of the coil is doubtful, there are several checks which should be made:

1. Measure resistance with an ohmmeter between the positive and negative primary terminals. Resistance should indicate approximately 5 ohms for most coils on these machines. Some coils, however, have a primary resistance less than one ohm.

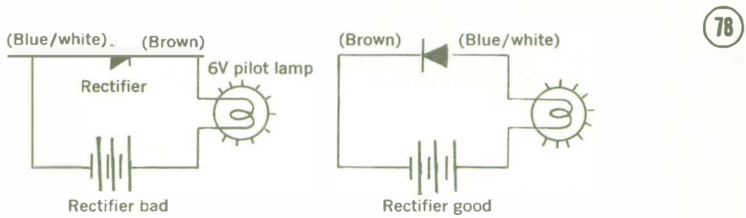
2. Measure resistance between either primary terminal and the secondary high voltage terminal. Secondary winding resistance must be at least 10,000 ohm.

3. If these checks don't reveal any defects, but coil condition is still doubtful, replace the coil with one known to be good.

RECTIFIER

The rectifier serves 2 purposes. First, it converts alternating current generated by the magneto into direct current for battery charging. Second, it prevents the battery from discharging through the charging coil in the magneto when the engine isn't turning fast enough to charge the battery.

To test the rectifier, refer to **Figure 78.** Connect the negative terminal of a 6-volt battery to the blue/white lead on the rectifier. Connect a small 6-volt bulb, such as a taillight bulb, in series with the positive battery lead, then connect the other terminal of the bulb to the brown wire on the rectifier. If the bulb lights, the rectifier is defective and must be replaced. Reverse the rectifier leads so that the negative battery lead is connected to the brown rectifier lead and the positive lead and lamp are connected to the blue/white lead. The lamp should not light. If lamp lights, replace the rectifier.



KAWASAKI 2-STROKE TWINS

This part discusses operating principles and troubleshooting procedures for electrical systems on Kawasaki twin-cylinder models. These machines are equipped with either a battery and coil ignition system or a capacitor discharge ignition system, which uses no breaker points. All models are equipped with alternators.

BATTERY IGNITION SYSTEM

The battery and coil system is used mostly on A1 series machines. Troubleshooting and operating principles are discussed elsewhere in this chapter.

CAPACITOR DISCHARGE IGNITION SYSTEM

Refer to *Electronic Ignition* for operating principles and troubleshooting procedures for capacitor discharge ignition systems.

ALTERNATOR

An alternator is a form of electrical generator in which a magnetized field called a rotor revolves within a set of stationary coils called a stator. As the rotor revolves, alternating current is induced in the stator. This current is then rectified and used to operate the electrical accessories on the motorcycle and for charging the battery. The rotor may be either permanently magnetized, or magnetized by a separate winding in the rotor. Kawasaki machines utilize both types. Alternators with permanently magnetized rotors are controlled by a solid state regulator. Alternators with externally excited field windings require a regulator similar to that in an automobile.

If alternator problems are suspected, as in the case of a chronically undercharged battery or dim headlights, check alternator output voltage:

1. Connect a 0-20 DC voltmeter across the battery terminals. Be sure to connect the positive voltmeter lead to the positive battery terminal, and the negative voltmeter lead to the negative battery terminal. Do not start the engine.
2. Observe the voltmeter indication and record it for reference during the next step. The voltmeter will indicate battery voltage.
3. Start the engine and run it at 5,000 rpm. Turn on the headlights.
4. Again observe the voltmeter. If the meter now indicates 1-1½ volts higher than the meter indication obtained in Step 2, the alternator is good, and no further checks are required.
5. If the indication obtained in Step 4 was less than one volt greater than the battery voltage obtained in Step 2, further checking will be required.

If further testing is required, perform the following steps:

> NOTE: *Steps 1 and 2 do not apply to alternators with permanently magnetized rotors.*

1. Measure field winding resistance between the slip rings. If resistance is not 3.5-5.5 ohms, replace the rotor.
2. Measure insulation resistance of the field winding. Set the ohmmeter to its highest range, then measure resistance between either slip ring and the rotor shaft. Insulation resistance must be essentially infinite.
3. On machines with conventional breaker contact ignition system, check for continuity between each pair of leads coming from the alternator. Measure between the leads listed:

Yellow and green
Yellow and green/yellow
Green and green/yellow

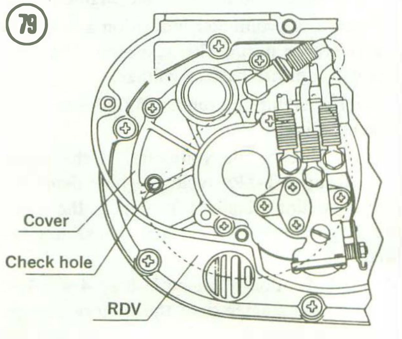
If all indicate continuity, measure insulation resistance between the yellow wire and the alternator housing. If the meter indicates infinite resistance, the stator coils are in good condition.

Adjusting a New Alternator

Whenever an alternator has been removed or installed on battery ignition models, it is necessary to make initial timing adjustments.

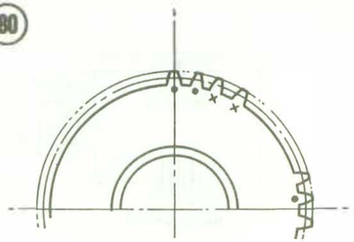
1. Refer to **Figure 79**. Align all the punched marks on the crankshaft primary gear, clutch primary gear, and alternator gear.

79



There are 2 types of timing marks on the clutch gear (**Figure 80**). Engines with idler gears must use EN09 alternator for A1 series, and EN11 alternators for A7 series. In this case, use

80


PRIMARY GEAR (CLUTCH)

the 2 teeth with the dotted marks to set the idler gear between the clutch gear and the alternator gear. On engines without idler gears, use alternator model EN04 for A1 machines, and model EN08 for A7 machines. Use the 2 teeth on the clutch gear having "X" marks to set the alternator gear and the clutch gear.

Alignment of the clutch gear and primary gear is always the same, regardless of whether or not an idler gear is used.

2. Position the alternator on the crankcase so that the dowel pin holes align with the dowels in the crankcase.
3. Adjust left-hand point gap and ignition timing.
4. Remove the bolt from the inspection hole.
5. Rotate the engine counterclockwise so that the cutaway in the left rotary valve is in the center of the inspection hole.
6. Adjust the ignition timing pointer so that it is aligned with the red mark on the timing plate.
7. Adjust ignition timing.

RECTIFIER

The rectifier assembly serves 2 purposes. It converts alternating current produced by the alternator into direct current which is used to charge the battery. It also prevents discharge of the battery through the alternator when the engine isn't running, or at other times when output voltage of the alternator is less than battery voltage.

To test the rectifier, proceed as follows:

1. With an ohmmeter, check for continuity between each yellow wire and the 2 red wires. Record the meter indications.

2. Reverse the ohmmeter leads and repeat the measurements of Step 1.

3. If each pair of measurements was essentially infinite in one direction and low in the reverse direction, proceed with Steps 4 and 5. If any pair of measurements showed either high or low resistance in both directions, replace the rectifier assembly.

4. Measure resistance between each yellow lead and the 2 black leads. Record meter indications.

5. Reverse the meter leads and repeat the measurements.

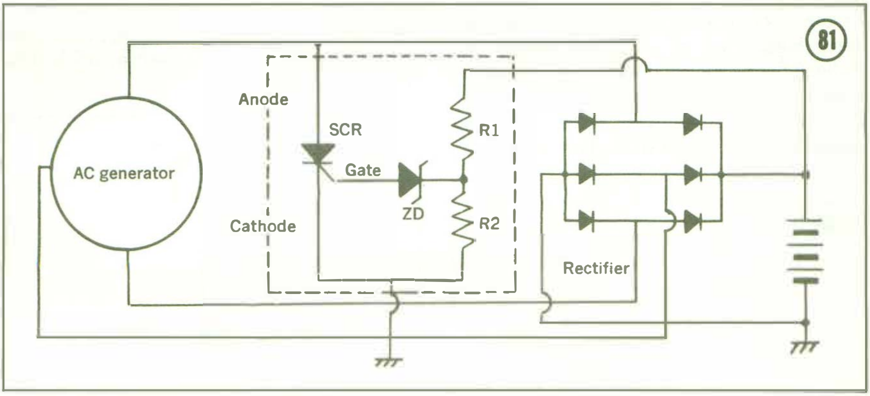
6. If any pair of measurements obtained in Steps 4 and 5 was either both high or both low, replace the rectifier assembly.

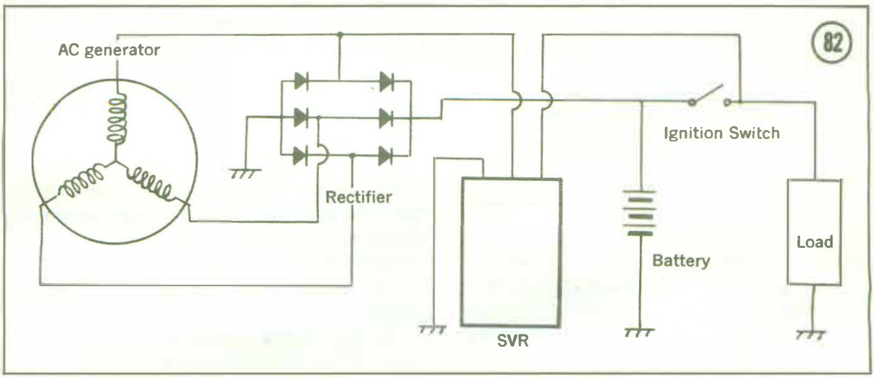
SOLID STATE VOLTAGE REGULATOR

Some machines are equipped with a solid state voltage regulator (SVR). This unit consists of a zener diode (ZD), a silicon controlled rectifier (SCR), and 2 resistors, as shown in **Figures 81 and 82**. Refer to those illustrations during the following discussions.

Operation

Assume that the main switch is closed. As engine speed increases, output voltage from the



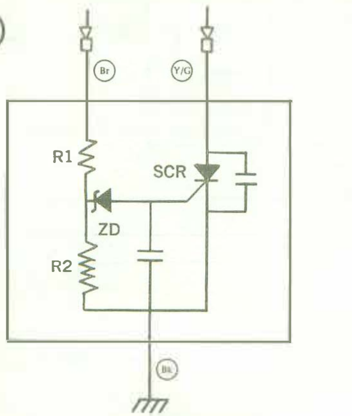


alternator tends to increase. If the battery is fully charged, voltage at the junction of R1 and R2 will tend to rise. If it reaches zener voltage, approximately 15 volts, the zener diode conducts in the reverse direction, thereby triggering the silicon controlled rectifier (SCR). When the silicon controlled rectifier conducts, alternator output is grounded, thereby reducing output voltage to near zero. As voltage at the junction of R1 and R2 drops, the zener diode ceases to conduct, and removes the trigger signal to the silicon controlled rectifier.

Checking the SVR

Refer to **Figure 83**. Connect a test lamp in series with a 12-volt battery, or use an ohmmeter to determine whether there is continuity between the yellow/green and black wires. The continuity test lamp should not light, or the ohmmeter should show no continuity. Reverse the continuity tester connections to the SVR. If the lamp lights or the ohmmeter indicates continuity, the unit is defective. Also be sure that the yellow/green wire is not shorted to the case.

83



Connect the positive terminal of a 12-volt battery or adjustable power to the brown wire and the negative terminal to the black wire. With the battery connected, there should be no continuity in either direction between the black and yellow/green wires.

Increase power supply voltage to 16 volts. The ohmmeter should indicate continuity between the black and yellow/green wires in one direction but not in the other.

ELECTROMECHANICAL VOLTAGE REGULATOR

Operation

Some alternators have separately excited field windings. As engine speed increases, the alternator output tends to increase. It is possible, however, to control alternator output by controlling its field current.

Figure 84 illustrates the situation at low engine speeds. Rectified alternator output is applied to coil B. However, since the output is low, the magnetic field developed by coil B is too low to open the black and white relay contacts. Under these conditions, field current is supplied by the battery through the ignition switch, and is at its maximum value.

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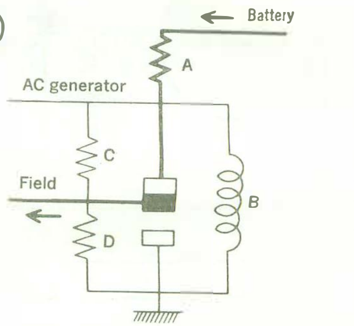
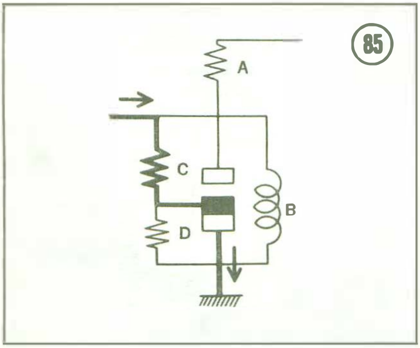
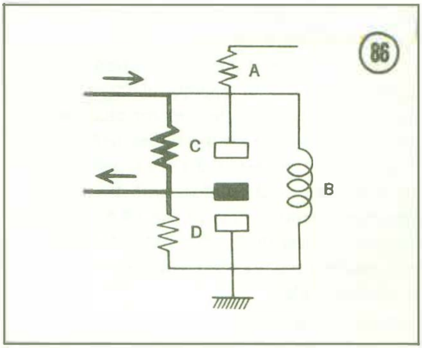


Figure 85 illustrates the circuit as engine speed increases. As alternator output voltage tends to increase, coil B generates more magnetic force, which breaks the black and upper white contact. Field current is then supplied from the alternator output, through resistor C. Resistor C limits field current, and thereby reduces alternator output so that the upper white contact and the black contact again close, repeating the cycle.

At high engine speeds and light electrical loads, action of the upper and center contacts is





insufficient to control alternator output. **Figure 86** illustrates regulator action under these conditions. As output voltage continues to rise, coil B pulls the movable (black) contact down to the lower contact. Under this condition the field is grounded, and alternator output drops to zero. As it drops, the movable and lower contacts separate, and the cycle repeats.

Testing the Regulator

The most common causes of voltage regulator trouble are open wires or short circuits. To check the regulator, proceed as follows:

1. Remove the 4 wires from the regulator.
2. With an ohmmeter, measure resistance between the terminals listed in **Table 23**. Resistance should be approximately as specified.

Table 23 REGULATOR CONTINUITY CHECKS

Terminals	Resistance
1 and 2	30 ohms
1 and 3	30 ohms
1 and 4	54 ohms

If measured values are greatly different from those specified, replace the regulator.

3. Remove the cover and inspect the contacts for pitting or burning.
4. Connect a voltmeter across the battery terminals. Reconnect the regulator.
5. Start the engine and run it at 5,000 rpm. If measured voltage is 14.5 ± 0.5, the regulator is OK.

KAWASAKI TRIPLES

This section discusses operating principles and troubleshooting procedures for the ignition, charging, and signal systems. Kawasaki triple-cylinder machines are equipped with either a conventional battery ignition system or a capacitor discharge system, which uses no breaker points. All models are equipped with alternators.

BATTERY IGNITION SYSTEM

A battery ignition system is used on some models. Operating principles and troubleshooting procedures are discussed elsewhere in this chapter.

CAPACITOR DISCHARGE IGNITION SYSTEM

Refer to *Electronic Ignition* for operating principles of the capacitor discharge ignition systems.

ALTERNATORS

An alternator is a form of electrical generator in which a magnetized field called a rotor revolves within a set of stationary coils called a stator. As the rotor revolves, alternating current is induced in the stator. The current is then rectified and used to operate electrical accessories on the motorcycle and for charging the battery. The rotor may be either permanently magnetized, or magnetized by a separate winding in the rotor. Alternators with permanently magnetized rotors are controlled by a solid state regulator. Alternators with externally excited field windings require a regulator similar to that in an automobile.

Exploded views of typical alternators, together with their associated electrical equipment, are shown in **Figure 87** (S series and H1—no CDI), **Figure 88** (H1—CDI), and **Figure 89** (H2).

If alternator or regulator problems are suspected, as in the case of a chronically undercharged battery or dim headlights, first check alternator output voltage.

1. Connect a 0-20 DC voltmeter across the battery terminals. Be sure to connect the positive voltmeter lead to the positive battery terminal, and the negative voltmeter lead to the negative battery terminal.
2. Start the engine and run it at 5,000 rpm. If the voltmeter indicates 14-15 volts, you may assume that the alternator and regulator are OK.
3. If the voltmeter does not indicate 14-15 volts, further checking will be required. Trouble may lie in the alternator, regulator, or wiring.

S Series Alternator Troubleshooting

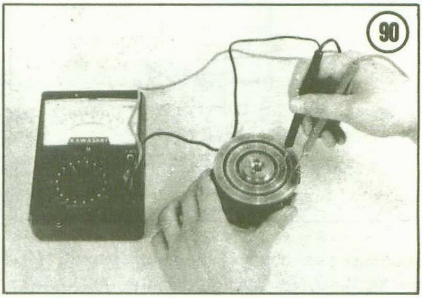
1. There are 3 stator leads from the alternator. Check for continuity between each pair of leads.

    Pink to yellow
    Pink to white
    Yellow to white

2. Set the ohmmeter to its highest range. Connect one lead to any stator wire, and the other to the alternator housing. The meter should indicate infinite resistance.
3. Replace the stator if the unit fails either test.

H1 Alternator Troubleshooting

1. Measure field winding resistance between the slip rings as shown in **Figure 90**. If resistance is not 3.5-5.5 ohms, replace the rotor.



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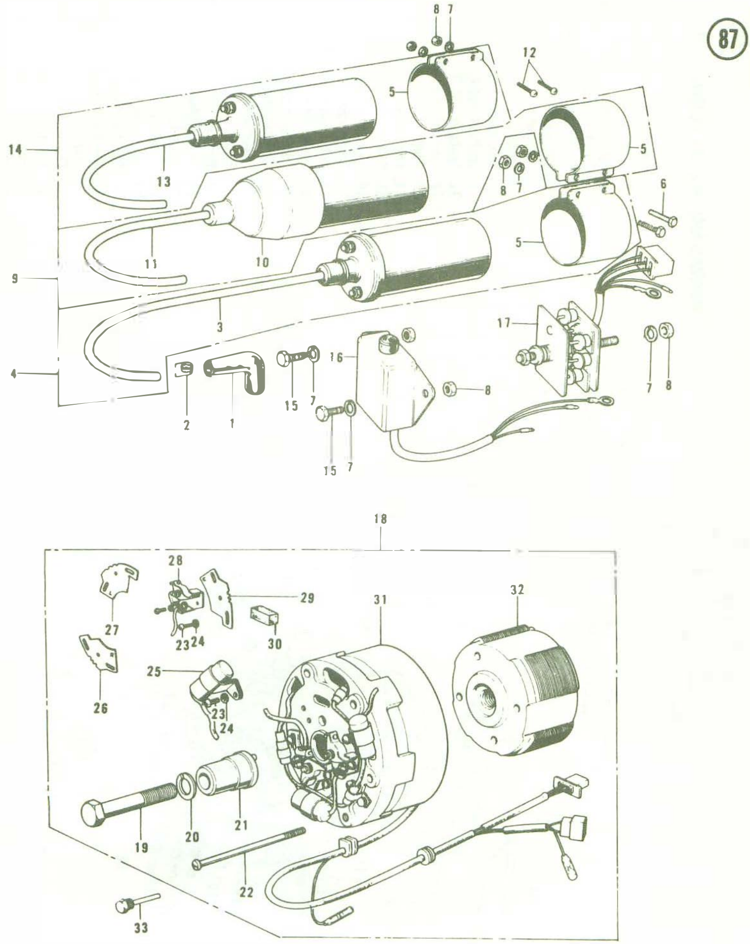
2. Measure insulation resistance of the field winding. Set the ohmmeter to its highest range, then measure resistance between either slip ring and the rotor shaft. Insulation resistance must be essentially infinite.
3. Inspect the brushes. Replace them if they are worn to ⅜ in. (9.3mm). Standard length for new brushes is 9/16 in. (14mm).
4. Check for continuity between each pair of yellow wires coming from the alternator stator.
5. Set the ohmmeter to its highest range, then measure insulation resistance between the stator housing and the 3 yellow leads. Insulation resistance must be essentially infinite.

H2 Alternator Troubleshooting

1. Measure resistance between both yellow leads. Resistance should be approximately 0.4 ohm.
2. With the ohmmeter set to its highest range, measure insulation resistance between either yellow lead and ground. Insulation resistance must be essentially infinite.
3. Measure resistance between the blue and green leads. Resistance should be approximately 5 ohms.
4. Measure resistance between the black lead and each white lead. Resistance should be approximately 200 ohms.

(87)



KAWASAKI S SERIES AND H1 ALTERNATOR

1. Spark plug cap
2. Spark plug cap spring
3. Left high tension cable
4. Ignition coil
5. Ignition coil holder
6. Hex bolt
7. Lockwasher
8. Nut
9. Ignition coil
10. Ignition coil cap
11. Center high tension cable
12. Pan head screw
13. Right high tension cable
14. Ignition coil
15. Hex bolt
16. Regulator
17. Rectifier
18. Alternator
19. Hex bolt
20. Lockwasher
21. Cam
22. Pan head screw
23. Pan head screw
24. Lockwasher
25. Condenser
26. Right contact breaker plate
27. Left contact breaker plate
28. Breaker points
29. Center contact breaker plate
30. Felt oiling block
31. Stator assembly
32. Rotor
33. Puller

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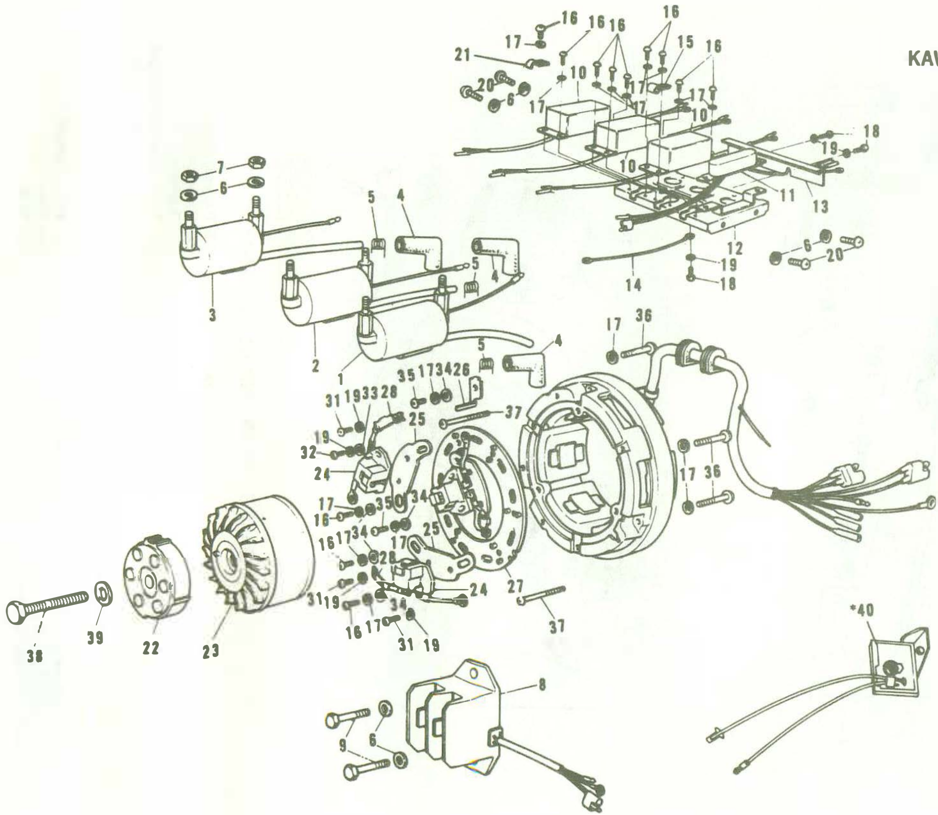

KAWASAKI H2 ALTERNATOR

1. Ignition coil
2. Ignition coil
3. Ignition coil
4. Spark plug cap
5. Spark plug cap spring
6. Lockwasher
7. Hex nut
8. Regulator
9. Hex bolt
10. Ignition unit A
11. Ignition unit B
12. Ignition unit plate
13. Plate
14. Lead wire
15. Clamp
16. Pan head screw
17. Lockwasher
18. Pan head screw
19. Lockwasher
20. Pan head screw
21. Oil breather clamp
22. Rotor cover
23. Rotor
24. Pickup
25. Pickup plate
26. Ignition timing pointer
27. Yoke plate
28. Lead wire clamp
31. Pan head screw
32. Pan head screw
33. Flat washer
34. Flat washer
35. Pan head screw
36. Pan head screw
37. Pan head screw
38. Hex bolt
39. Lockwasher
40. Rectifier

RECTIFIER

The rectifier assembly serves 2 purposes. It converts alternating current produced by the alternator into direct current which is used to charge the battery. It also prevents discharge of the battery through the alternator when the engine isn't running, or at other times when output voltage of the alternator is less than battery voltage.

S Series Rectifier Troubleshooting

The rectifier assembly has 3 yellow leads, one red lead, and one black lead.

1. Measure resistance between each yellow lead and red lead. Record each ohmmeter reading.
2. Reverse ohmmeter leads and repeat Step 1.
3. If each pair of measurements was essentially infinite in one direction and low in the reverse direction, proceed with Step 4. If any pair of measurements was either high or low in both directions, replace the rectifier assembly.
4. Measure resistance between each yellow lead and the black lead. Record all measurements.
5. Reverse the meter connections and repeat Step 4. If any pair of measurements was either high or low in both directions, replace the rectifier assembly.

H1 Rectifier Troubleshooting

The H1 rectifier is similar to that for S series models, except that it has one additional blue lead to be checked. Proceed as follows:

1. Measure resistance between each yellow wire and the red wire. Record each measurement.
2. Reverse the meter leads and repeat the measurements.
3. If each pair of measurements was essentially infinite in one direction and low in the reverse direction, proceed with Step 4. If any pair of measurements was either high or low in both directions, replace the rectifier.
4. Measure resistance between each yellow wire and the black wire. Record all measurements.
5. Reverse the meter leads and repeat the measurements. If any pair of measurements was either high or low in both directions, replace the rectifier. If OK, proceed with Step 6.
6. Measure resistance between the black and blue wires, then reverse the meter leads and repeat the measurement. If the meter indicates low resistance in one direction and high resistance with the leads reversed, the rectifier is OK. If both measurements are either high or low, replace the rectifier.

H2 Rectifier Troubleshooting

The H2 rectifier unit performs the dual functions of current rectification and voltage regulation. To check the unit, proceed as follows:

1. Refer to **Figure 91**. Measure resistance between the black and red leads, then repeat the measurement with the ohmmeter leads reversed. The meter should indicate approximately 70 ohms in one direction and 1,000 ohms in the other. If OK, proceed to Step 2.

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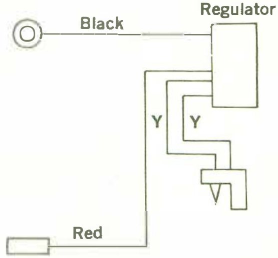
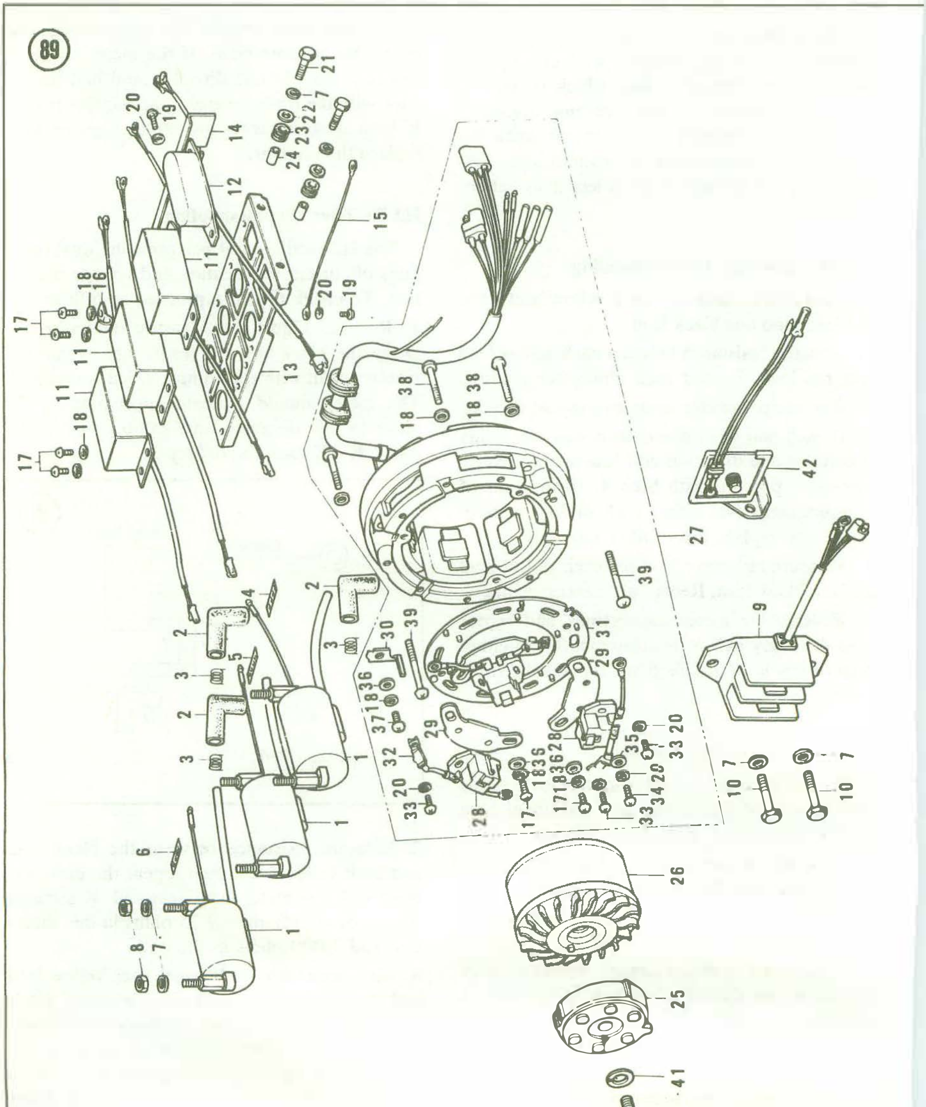
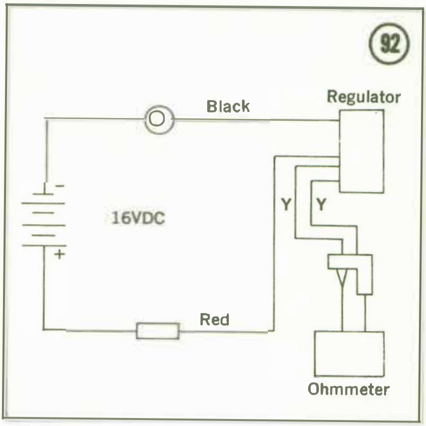


2. Measure resistance between the black lead and each yellow lead, then repeat the measurement with the meter leads reversed. Resistance should be approximately 25 ohms in one direction and 1,000 ohms in the other.
3. Measure resistance between each yellow lead and the red lead, then reverse the meter leads and repeat the measurements. Both sets of readings should be approximately 25 ohms in one direction. In the reverse direction, one reading should be approximately 1,000 ohms and the other should be approximately 4,000 ohms.
4. Connect the circuit shown in **Figure 92** using a suitable power supply. Then measure resistance between the 2 yellow leads. Resistance should be essentially infinite in one direction and



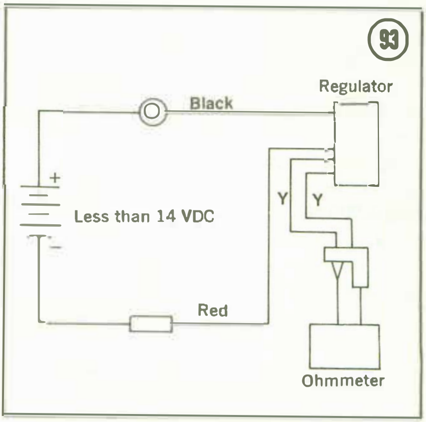
KAWASAKI H1 ALTERNATOR (WITH CDI)

1. Ignition coil
2. Spark plug cap
3. Spark plug cap spring
4. Identification plate
5. Identification plate
6. Identification plate
7. Lockwasher
8. Nut
9. Regulator
10. Hex bolt
11. Ignition unit A
12. Ignition unit B
13. Ignition unit plate
14. Plate
15. Lead wire
16. Clamp
17. Pan head screw
18. Lockwasher
19. Pan head screw
20. Lockwasher
21. Hex bolt
22. Flat washer
23. Damper rubber
24. Collar
25. Rotor cover
26. Rotor
27. Yoke assembly
28. Pickup
29. Pickup plate
30. Ignition timing pointer
31. Yoke plate
32. Lead wire clamp
33. Pan head screw
34. Pan head screw
35. Plain washer
36. Plain washer
37. Pan head screw
38. Pan head screw
39. Pan head screw
40. Hex bolt
41. Lockwasher
42. Rectifier



approximately 500 ohms with the ohmmeter leads reversed.

5. Reverse power supply polarity, and lower its output voltage, as shown in **Figure 93**. Measure resistance between both yellow leads. Resistance should be essentially infinite in both directions.

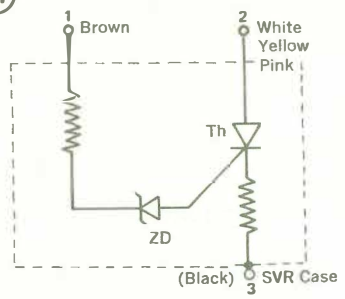


6. Replace the rectifier unit if it fails any of the foregoing tests.

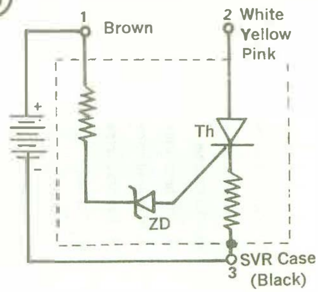
SOLID STATE VOLTAGE REGULATOR

Some machines are equipped with a solid state voltage regulator (SVR). This unit consists of a zener diode (ZD), a thyristor (Th), and 2 resistors, as shown in **Figure 94**.

94



95



Troubleshooting

If a malfunction of the solid state voltage regulator is suspected, it may be checked by the following tests. However, bear in mind that if the battery is low the regulator will not work properly even though it may be in good condition. Therefore, be sure that the battery is in good condition and at or near full charge before attempting to troubleshoot a suspected malfunction.

1. Measure resistance between the brown wire and the case. The resistance must be greater than 1,000 ohms.
2. Measure resistance in both directions between terminals 2 and 3. Resistance should be essentially infinite in both directions.
3. Connect the motorcycle battery to the regulator as shown in **Figure 95**. Be careful to observe proper polarity. No current should flow in the circuit. Measure resistance between terminals 2 and 3. Resistance should be essentially infinite.
4. Connect an additional 4- to 6-volt battery in series with the first battery, to make a total of over 16 volts across terminals 1 and 3. Then check for continuity between terminals 2 and 3. If there is no continuity, replace the regulator.
5. Replace the regulator if it fails any of the foregoing checks. If its condition is still doubtful, check it by trial replacement with a known good unit.

Handling Precautions

Certain precautions must be observed when handling or servicing the solid state regulator. Failure to observe these may result in damage to the unit.

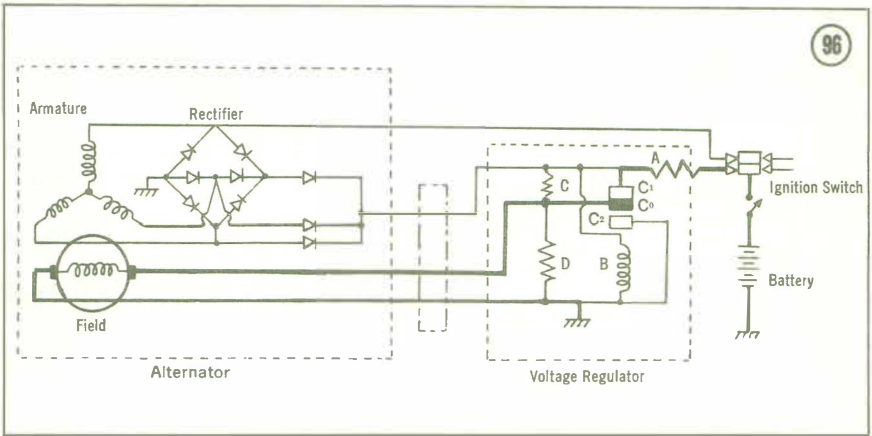
1. Be sure that all mounting screws are tight.
2. Always be sure that the main switch is off before connecting or disconnecting the unit.
3. Be sure that the unit is mounted securely.
4. Be sure that wires are connected properly. Improper wiring will result in damage to the battery and regulator.
5. The battery must be charged to near full capacity for the regulator to work properly. If battery is very low, charge it before installation.

ELECTROMECHANICAL VOLTAGE REGULATOR

Operation

Some alternators have separately excited field windings. Such alternators require a more complex regulator. As engine speed increases, alternator output tends to increase. It is possible, however, to control alternator output by controlling its field current, which is used for excitation.

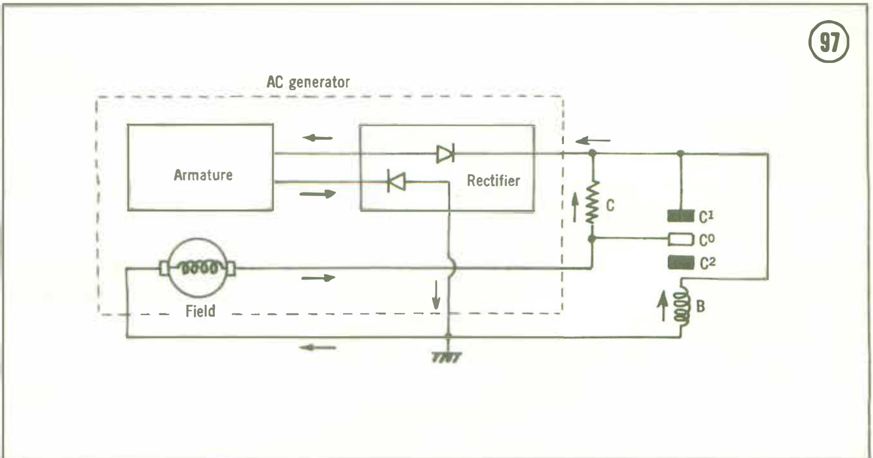
Figure 96 illustrates the situation at low engine speeds. Rectified alternator output is ap-

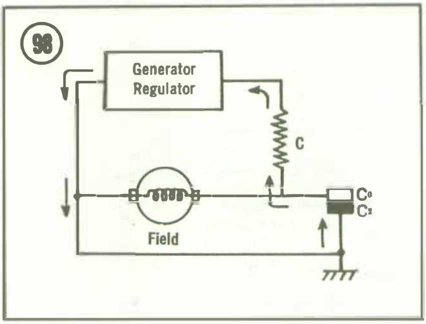


plied to coil B. However, since alternator output is low, the magnetic field developed by coil B is too weak to open contacts C_1 and C_0. Under these conditions, field current is supplied by the battery through the ignition switch, and is at its maximum value.

Figure 97 illustrates the circuit as engine speed increases. As alternator output voltage tends to increase, coil B develops more magnetic force, which breaks contacts C_1 and C_0. Field current is then supplied from the alternator output through resistor C. Resistor C limits field current, and thereby reduces alternator output so that contacts C_1 and C_0 again close, repeating the cycle.

At high engine speeds and light electrical loads, action of the upper and center contacts is insufficient to control alternator output. As output voltage continues to rise, coil B pulls movable contact C_0 down to lower contact C_2. Under this condition the field is grounded, and alternator output drops to zero (**Figure 98**). As it drops, the movable and lower contacts separate, and the cycle repeats.





Regulator Testing

The most common causes of voltage regulator trouble are open wires or short circuits. To check the regulator, proceed as follows:

1. Remove the regulator.
2. Measure resistance between the brown and black leads. Resistance should be approximately 55 ohms.
3. Connect a voltmeter across the battery terminals. Reconnect the regulator.
4. Start the engine and run it at 5,000 rpm. If measured voltage is 14.5 ± 0.5, regulator is OK.

KAWASAKI KZ SERIES

All models are equipped with 3-phase alternators, solid state rectifiers, and electromechanical voltage regulators. Refer to *Battery Ignition* in this chapter for ignition system troubleshooting.

CHARGING SYSTEM

If charging system problems are suspected, as in the case of dim lights or a chronically undercharged battery, the following tests should locate the problem. Before beginning any charging system testing, be sure that the battery is in good condition, and that it is at or near full charge.

Alternator Output Test

1. Remove left side cover and headlight unit.
2. Disconnect 6-pole connector from left side and 9-pole connector in headlight housing.
3. Disconnect white wire from rectifier at battery positive lead.
4. Connect the positive terminal of an accurate 0-20 DC voltmeter to the white wire which was removed. Connect the negative voltmeter lead to a good ground.
5. Remove right side cover.
6. Disconnect green and brown leads from voltage regulator. Temporarily connect these leads together. **Figure 99** illustrates test connections.

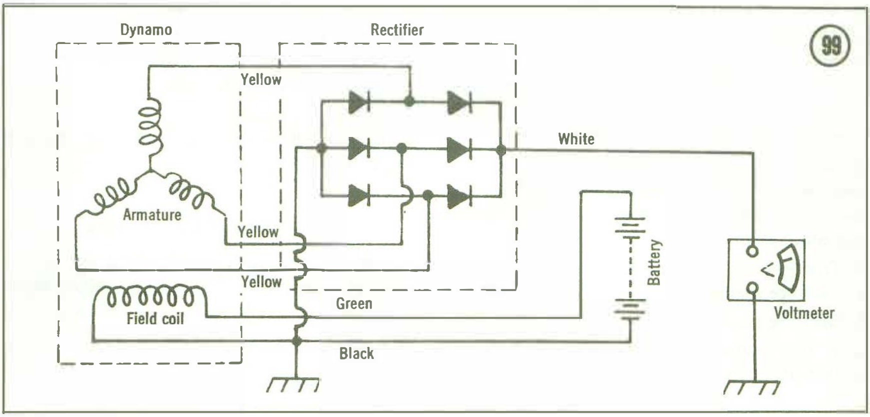
CAUTION

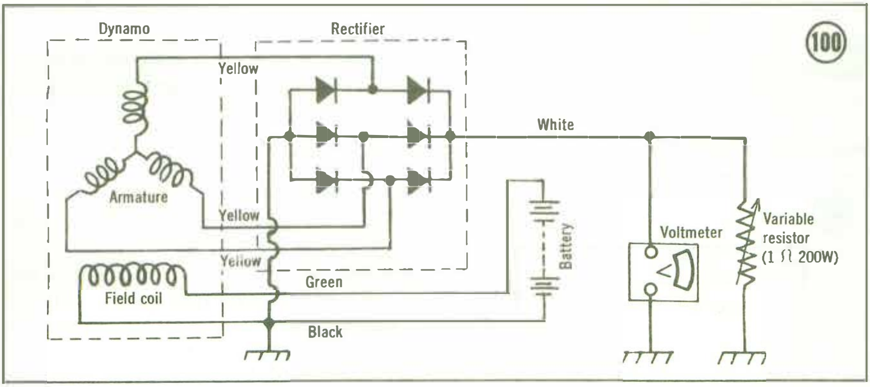
Do not allow these leads to touch anything. Also, do not leave them connected longer than is required to make this test.

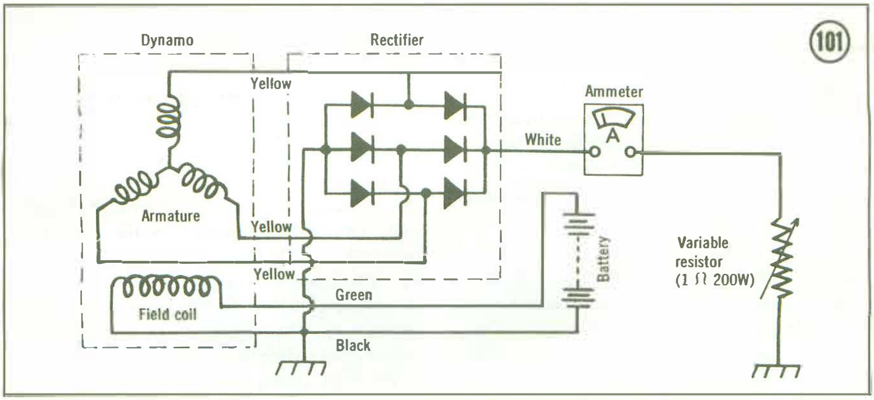
7. Start engine and run at idling speed, 1,100-1,300 rpm. Do not run it at a faster speed.
8. Observe voltmeter. If it indicates 14 volts or greater, the alternator is OK. If output voltage is lower than that, the alternator is defective.
9. Stop engine. Refer to **Figure 100**. Connect a one-ohm, 200-watt variable resistor, such as a commercial carbon pile, between the white wire and ground. Do not disconnect the voltmeter.
10. Start engine, then gradually increase its speed to 5,000 rpm; adjusting the resistor or carbon pile at the same time to maintain an indicated 14.5 volts.
11. Stop engine. Do not change resistor or carbon pile setting.
12. Connect a 0-20 DC ammeter in series with the white wire and carbon pile, as shown in **Figure 101**.
13. Start engine, then run it at 5,000 rpm.
14. If meter does not indicate 13 amperes or more, alternator is defective.

Alternator Bench Checks

If the alternator failed the tests of foregoing Steps 1 through 13, the following bench checks should isolate the problem.


99
Dynamo
Rectifier
Yellow
Yellow
Yellow
White
Armature
Field coil
Green
Black
Battery
Voltmeter


100
Dynamo
Rectifier
Yellow
Yellow
Yellow
White
Armature
Field coil
Green
Black
Battery
Voltmeter
Variable
resistor
(1 Ω 200W)


101
Dynamo
Rectifier
Yellow
Yellow
Yellow
Ammeter
A
White
Armature
Field coil
Green
Black
Battery
Variable
resistor
(1 Ω 200W)

1. Disconnect left-hand white plug below voltage regulator.

2. Measure resistance between each pair of yellow wires from alternator. Resistance should be 0.4-0.6 ohm. Replace stator if any pair of measurements differs from this amount.

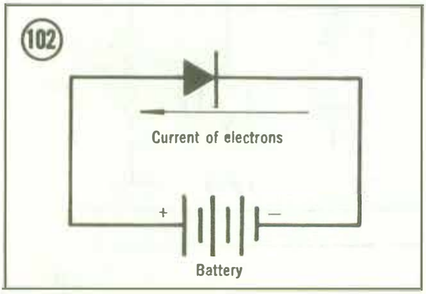
3. Using the highest ohmmeter range, measure insulation resistance between any yellow lead and ground. Replace stator if meter indicates any continuity.

4. Disconnect white plug on right-hand side below voltage regulator.

5. Measure resistance between green and black leads. If resistance is not approximately 5 ohms, replace field coil.

RECTIFIER

The rectifier (**Figure 102**) converts 3-phase alternating current from the alternator into direct current, which is used for battery charging and electrical accessory operation. It also prevents battery discharge through the alternator whenever the engine isn't running.



To test the rectifier, proceed as follows:

1. With engine off, remove left side cover, then disconnect white wire from rectifier at battery. Also disconnect black rectifier wire.

2. Remove right side cover, then disconnect left-hand white plug below voltage regulator.

3. Measure resistance between each yellow lead and the white lead; record each measurement.

4. Reverse ohmmeter leads, then repeat Step 3. Each pair of measurements must be high in one direction, and low in the other. It is impossible to specify exact meter indications, but each pair of measurements should differ by a factor of at least 10.

5. Repeat Steps 3 and 4, but make measurements between each yellow lead and the black lead.

6. Replace the rectifier if it fails any check of Steps 3, 4, or 5.

VOLTAGE REGULATOR

Varying engine speeds and electrical system loads affect alternator output. The voltage regulator controls alternator output by varying its field current.

Voltage Regulator Tests

Before making any voltage regulator test, be sure that the battery is in good condition, and is at or near full charge.

1. Remove left side cover and headlight unit.

2. Remove 6-pole connector from left side of motorcycle, and 9-pole connector from headlight housing.

3. Connect an accurate 0-20 DC voltmeter across battery terminals.

4. Start engine and run it at 1,600 rpm. Voltmeter should indicate 14.0-15.0 volts.

5. Gradually increase engine speed to 4,000 rpm. Voltmeter should again indicate 14.0-15.0 volts. Do not allow engine speed to decrease until second measurement is made.

It is suggested that a defective voltage regulator be replaced rather than repairs attempted. It may be possible to clean any corrosion from its contacts with emery cloth.

ELECTRIC STARTER

The starter circuit includes the starter button, starter relay, battery, and starter motor. When the button is pressed, a small amount of current flows through the switch and through the relay coil. This current magnetizes the relay core, which then pulls the armature to it and closes the relay contacts. The closed contacts complete a current path for the starter motor, and the motor turns. The reason for using a relay instead of using the switch to turn on the starter directly is the high current requirement of the starter motor. It is not practical to put a heavy switch on the handlebars and have large wires running to it, so the starter switch is made only to carry the light relay coil current, and heavy contacts inside the relay carry the starter motor current. **Figure 103** illustrates the starter circuit.

> NOTE: *Never continue pressing the starter switch if the engine does not turn over, because excess current through the starter motor will burn out its windings.*

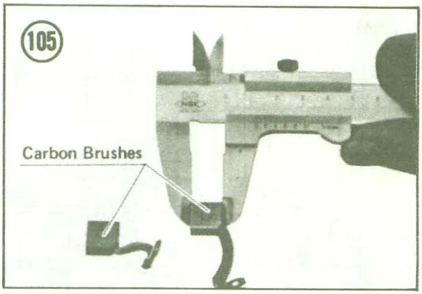
Figure 104 illustrates starter motor construction. These field coils are wound around 4 cores, forming the yoke. The armature windings are connected to the commutator and receive their current through the brushes. Field windings and armature windings are connected in series, and so if the brushes do not make good contact, no starter current will flow and the starter will not turn over. A short circuit or an open wire in either winding will also cause the starter to be inoperative. Dust from brush wear might be another cause of starter failure if it gets into bearings, making them overheat and seize.

Brushes

Worn brushes or weak brush springs can cause poor brush contact, resulting in starter motor malfunction. Measure the brushes (**Figure 105**) and replace them if they are worn to ¼ in. (6mm). Standard length for new brushes is about ½ in. (12mm).

Spring tension should normally be 18-24 ounces (500-600 grams), measured with a spring gauge. The springs can be considered serviceable if they snap the brushes firmly into position.

105



Commutator

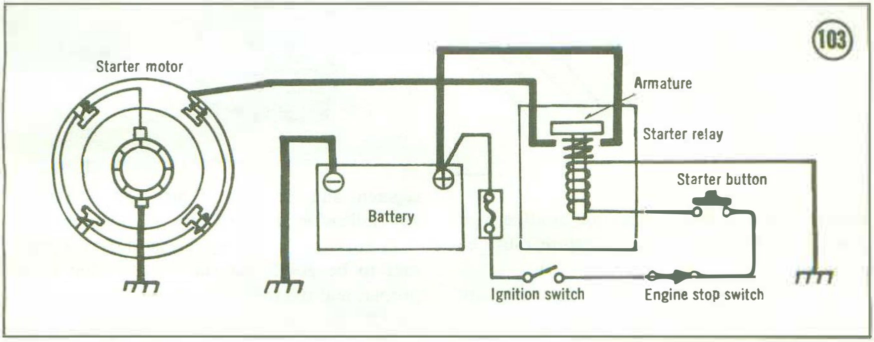
A dirty or rough commutator will result in poor brush contact and cause rapid brush wear. In addition, carbon dust resulting from brush wear accumulates between commutator segments and partially shorts out starter current.

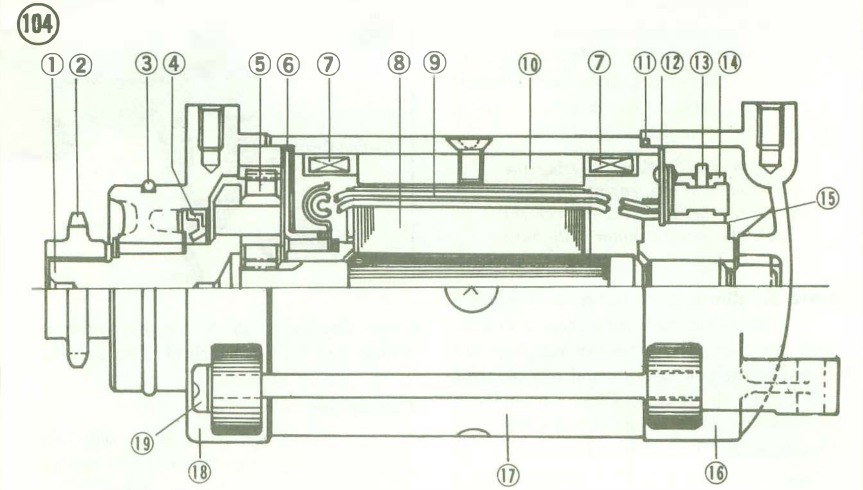
1. Clean the commutator of oil, dust, and foreign material.
2. If the commutator is rough or covered with carbon dust, polish it with fine sandpaper.
3. Refer to **Figure 106**. Replace the commutator if depth of insulator grooves between segments is less than 0.008 in. (0.2mm).

Armature

Using the lowest ohmmeter range, measure resistance between each 2 adjoining commutator segments (**Figure 107**). If there is high resistance

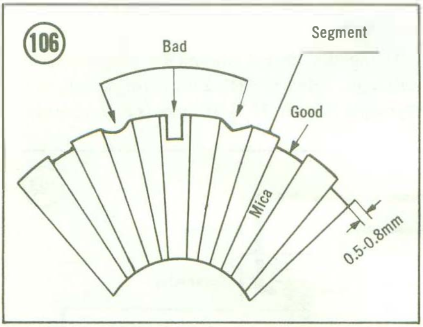
103

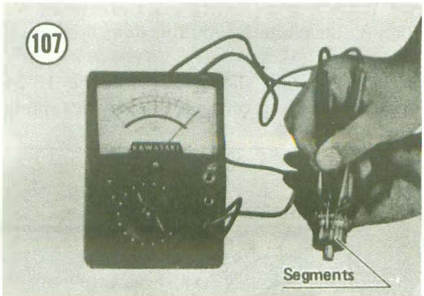




STARTER MOTOR

1. Shaft
2. Sprocket
3. O-ring
4. Grease seal
5. Gears
6. End plate
7. Field coil
8. Armature
9. Armature winding
10. Cores
11. Rubber ring
12. Brush plate
13. Spring
14. Brushes
15. Commutator
16. End cover
17. Yoke assembly
18. End cover
19. Screws

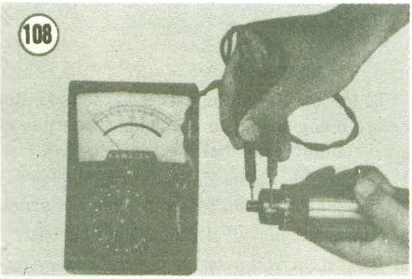


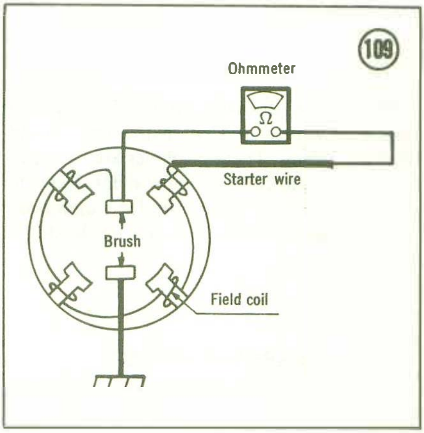


between any two, or no indication at all, a wire is open, in which case the armature must be replaced.

Using the highest ohmmeter range, measure insulation resistance between any commutator segment and the shaft (**Figure 108**). If there is any indication at all, replace the armature.

Even if the foregoing checks show the armature to be good, but starter operation is improper, and the following tests on the field coils are OK, the armature may be defective.





Field Coils

Using the lowest ohmmeter range, measure resistance between the positive brush and the starter wire (**Figure 109**). If the ohmmeter does not indicate zero or very close to zero, the field coils are open, in which case the yoke assembly must be replaced.

Using the highest ohmmeter range, measure insulation resistance between the positive brush and the starter housing. If there is any meter indication at all, the coils are shorted to ground. Replace the yoke in this case.

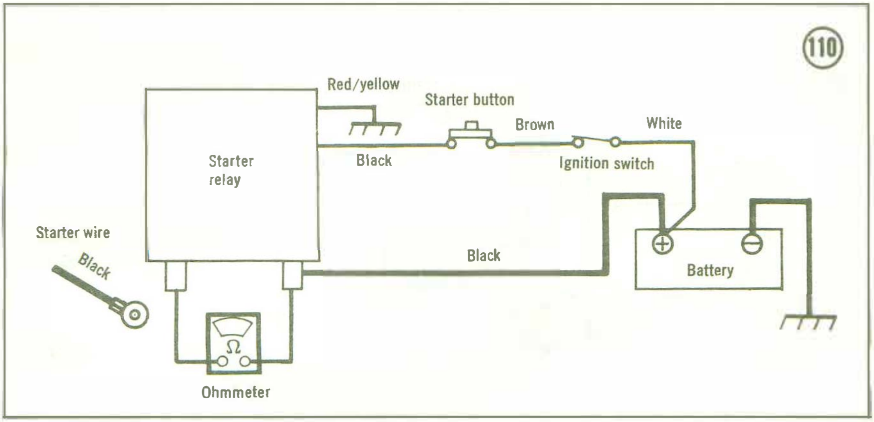
Starter Relay

1. Refer to **Figure 110**. Disconnect the starter wire from the starter relay. Connect the ohmmeter leads across the relay terminals.

2. Press the starter button. The relay should click and the ohmmeter should indicate zero resistance. If the relay clicks but the meter indicates any value greater than zero, replace relay.

3. If the relay does not click, disconnect the other 2 wires, then measure resistance across the relay terminals. If there is not close to zero resistance, the relay coil is defective.

4. If there is close to zero resistance, the relay may be good, but inoperative because no current is reaching it. Connect the positive voltmeter lead to the black wire and the negative meter lead to the black/yellow wire, then press the starter switch. If the meter indicates battery voltage, the relay is defective. If no voltage indication, the switch or wiring is defective.



KAWASAKI Z-1

This section discusses troubleshooting and service procedures for Kawasaki Z1 starting and charging systems. These machines are equipped with battery and coil ignition systems. Refer to *Battery Ignition* in this chapter for a discussion of battery ignition operation and troubleshooting.

CHARGING SYSTEM

A 3-phase, wye-connected alternator supplies all electrical power for Z1 models. Alternator output is controlled by a solid state regulator, which has no moving parts to wear out. Output current from the alternator is converted to direct current by a rectifier. **Figure 111** illustrates charging system wiring.

Alternator Troubleshooting

If alternator problems are suspected, the following tests will isolate the problem, if any. There are 3 types of alternator failure: short circuit, open circuit, or loss of rotor magnetism. A short or open circuit will result in either low output or no output at all. Loss of rotor magnetism may be caused by dropping or hitting the rotor, leaving it near a strong magnetic field, or by aging.

To test the alternator, proceed as follows. But before doing so, be sure that the battery is in good condition and that it is fully charged.

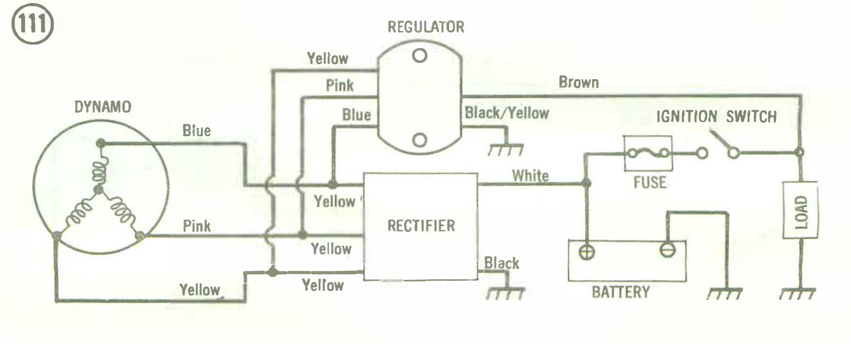
1. Remove the right side cover, then unplug the green regulator connector from connector panel.
2. Make sure that all electrical loads are off.
3. Connect a voltmeter across the battery terminals. Be sure to connect the positive meter lead to the positive battery terminal and the negative lead to the negative battery terminal.
4. Start the engine and run it at 4,000 rpm. A meter indication of 15-20 volts is normal. A lower figure indicates a defective alternator.
5. Stop the engine and disconnect the meter.
6. Connect a 0-15 DC ammeter as shown in **Figure 112**. Connect the positive meter lead to the white wire on the fuse side, and connect the negative lead to the white wire on the relay side.

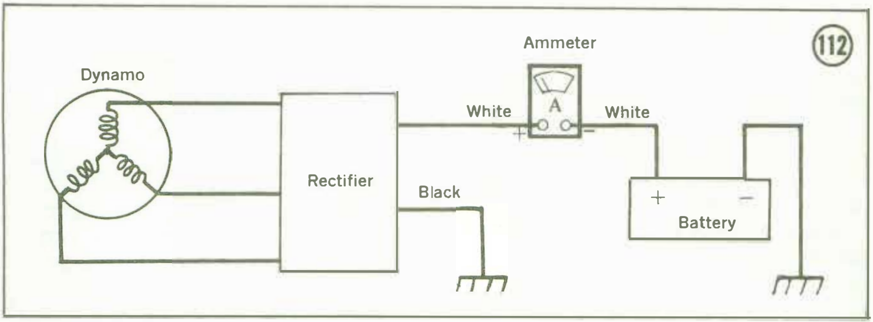
CAUTION

If the meter is connected at the battery instead of the points specified, do not use the electric starter. Starter current will burn out the meter.

7. Turn on ignition switch and start engine.
8. Run the engine at 4,000 rpm and note the meter indication. An indication of 9.5 amperes or more is normal; if considerably less, the alternator is defective.

111





9. To determine whether the rotor or stator is defective, stop the engine, then unplug the blue connector at the connector panel.

10. Using a low-range ohmmeter, measure resistance between each pair of alternator wires going to the plug:

Blue to pink
Blue to yellow
Yellow to pink

Resistance between each pair should be 0.45-0.60 ohm. Less than that resistance indicates a shorted coil; greater resistance, or no indication at all indicates an open winding. Replace the stator if any coil is either open or shorted.

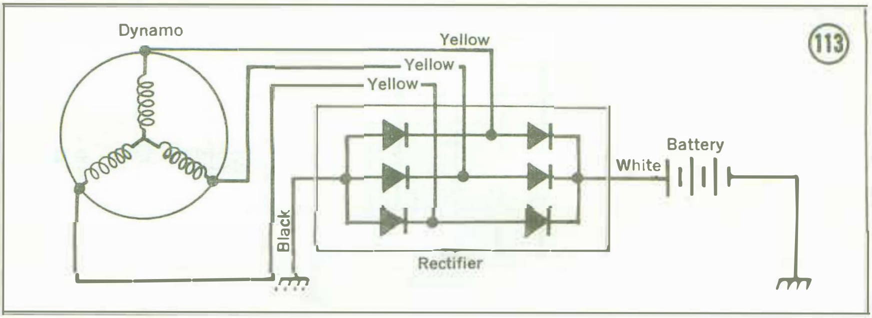
Using the highest ohmmeter range, measure insulation resistance between any alternator wire and a good ground, such as the engine. The ohmmeter must indicate infinite resistance. If not, replace the stator.

If the windings have normal resistance and are not shorted to ground, but voltage and current checks are below normal, the rotor magnets have probably weakened. If so, replace rotor.

Rectifier

The rectifier converts alternating current from the alternator into direct current for battery charging and for use by the bike's electrical accessories. **Figure 113** is a simplified diagram of the rectifier circuit.

The rectifier assembly consists of 6 diodes connected in a bridge circuit, to provide full-wave alternator output rectification. Diodes have the property of conducting current in only one direction, and so are able to convert alternating current into direct current. A defective diode may be either open or shorted. An open diode will not permit current to pass in either direction; a shorted diode permits current to flow through it either way. It is this property of diodes that makes it easy to check their condition with an ohmmeter.



To check the rectifier, proceed as follows:

1. With the engine off, unplug the white rectifier connector from the connector panel, and unplug the white lead which goes to the battery.
2. Measure resistance in both directions between the white wire and each yellow wire, and in each direction between the black wire and each yellow wire. Record each measurement.

Resistance should be low in one direction, and at least 10 times as high in the other. Actual meter indications will vary, depending on the type of meter used, but generally speaking the smaller indications should be within ⅓ scale of zero.

If any pair of readings was either high or low in both directions, replace the rectifier assembly.

Regulator

The solid state regulator limits alternator output to a maximum of 15-16 volts. Since it contains no contacts to burn or moving parts to wear out, it never requires adjustment.

Since the alternator produces 3-phase output current, each output circuit must be controlled. **Figure 114** is a simplified diagram of the regulator circuit for one phase.

Normally, current flows from A through diode D_2 to the battery, then through ground and back to the alternator through diode D_1. When battery charging voltage becomes too high, zener diode (ZD) conducts and triggers thyristor Th_1, which then conducts and diverts alternator output current from the battery to ground through resistor R_1.

114

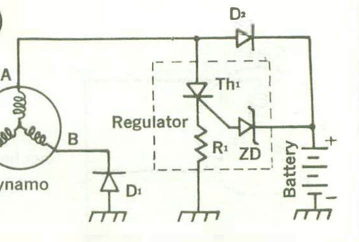


Figure 115 is a simplified circuit diagram of the entire charging system. After thyristor Th_1 starts conducting to regulate one phase, voltage at the junction of R_1 and Th_1 triggers Th_2 to regulate the second phase, and similarly for Th_3.

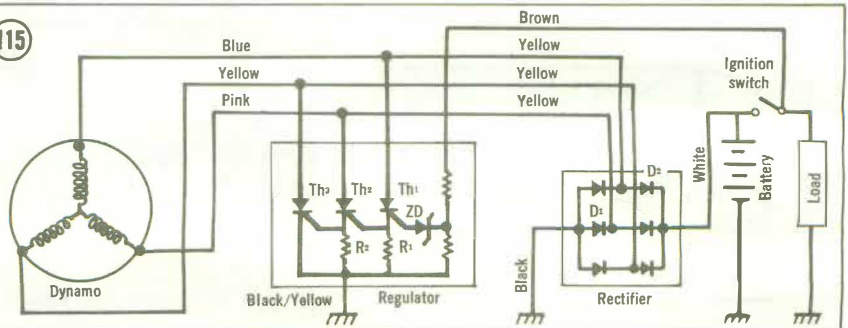
If the battery is chronically undercharged, and the alternator is known to be good, or if the battery overcharges, the regulator may be defective. Symptoms of overcharging are excessive use of water or lights burning out when engine rpm is high.

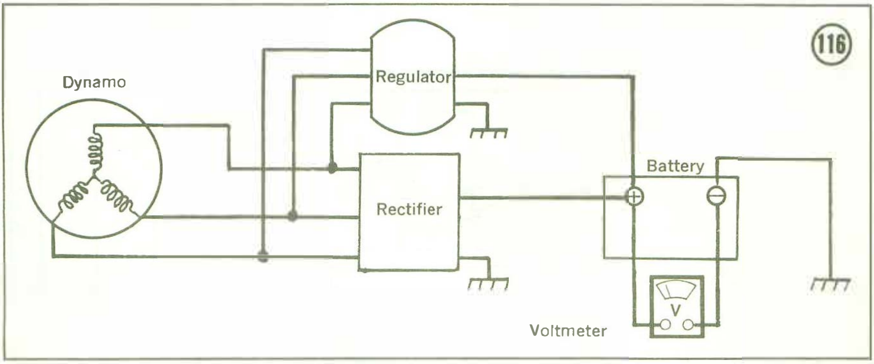
If the battery is defective or if it is low, the regulator will not operate properly, so be sure that it is fully charged before testing the regulator. Also, before checking the regulator, be sure that the alternator is working properly.

To test the regulator, proceed as follows:

1. Connect the positive terminal of a 0-20 DC voltmeter to the positive battery terminal, and connect the negative meter terminal to the negative battery terminal (**Figure 116**).
2. With all lights and other accessories off, start the engine and run it at 4,000 rpm.

115





3. Observe the voltmeter. If it indicates 15-16 volts, the regulator is operating normally. If it indicates more than 16 volts, either the regulator is defective, or it is not properly connected into the circuit. Check for loose connections or a broken wire before condemning the regulator as defective.

If the meter indicates less than 15 volts, either the alternator, rectifier, or regulator is defective. To determine if the fault lies with the regulator, proceed as follows:

1. Stop the engine, then unplug the green regulator connector at the connector panel. Leave the voltmeter connected to the battery.

2. Start the engine, and again run it at 4,000 rpm. If the voltmeter now indicates between 15 and 20 volts, the regulator is defective. If output voltage is still low, test the alternator and rectifier as described earlier.

It is also possible to make certain regulator checks with the unit disconnected.

NOTE: *When the regulator is removed, make sure that the screws in regulator body are not removed or loosened. These screws aid heat dissipation. The regulator will overheat if the screws are not properly installed.*

1. With the regulator disconnected, measure resistance between the black and brown leads. Resistance should be 1,000-1,100 ohms. The meter should indicate infinite resistance between any other 2 leads, and also between the brown or black leads and any other lead. Replace the regulator if it fails any of these checks.

For the second test, a DC power supply is required. Output voltage must be variable from 14-17 volts.

CAUTION

Be very careful not to apply more than 18 volts to the regulator at any time. Also, observe polarity carefully. Connecting the power supply or regulator with reverse polarity will cause instantaneous severe damage to the regulator.

1. Turn on the power supply and adjust its output to 14 volts.

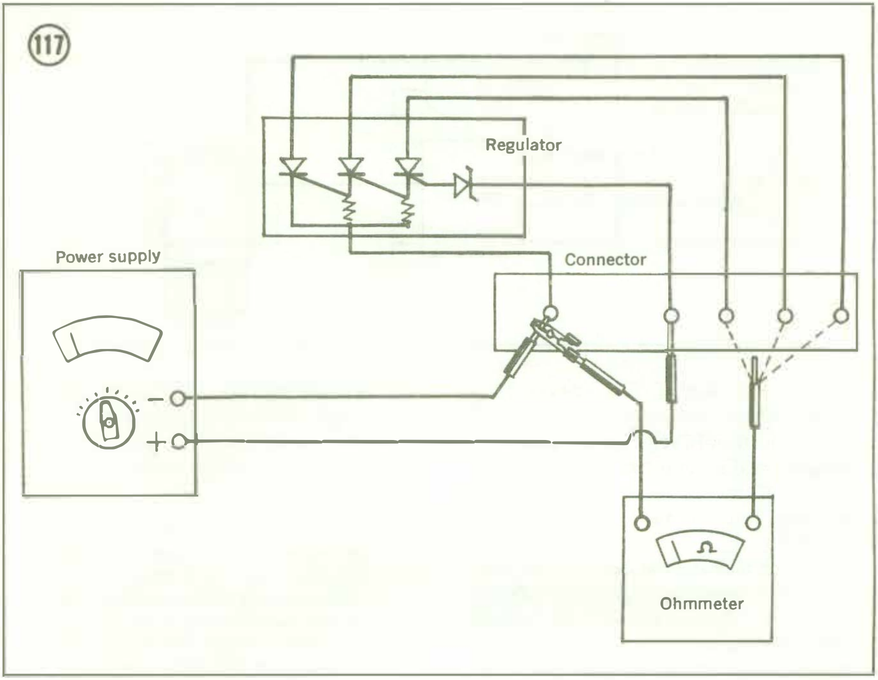
2. Refer to **Figure 117**. Connect the positive power supply terminal to the brown regulator wire. Connect the negative power supply terminal to the yellow/black regulator wire.

3. Using the Rx10 or Rx100 range of the ohmmeter, check that there is no continuity between the following pairs of wires:

Yellow/black and blue
Yellow/black and pink
Yellow/black and yellow

If continuity exists between any listed pair of wires, the regulator is defective.

4. Increase power supply output to 17 volts. With the ohmmeter on its Rx1 range, again check for continuity between the yellow/black wire and the blue, pink, and yellow wires, one at a time. There should be low resistance between each pair of wires. If no indication, or if



one indication is much higher than the other two, replace the regulator.

CAUTION

When making the foregoing checks, be very careful that the meter leads do not contact the yellow/black and brown leads at the same time. Should this situation occur, the ohmmeter will probably burn out.

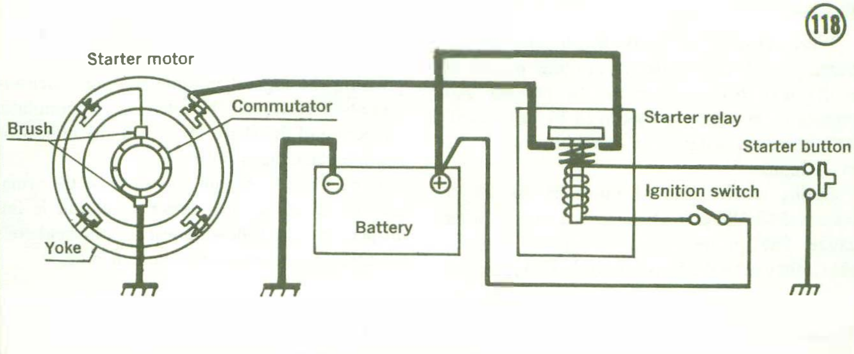
ELECTRIC STARTER

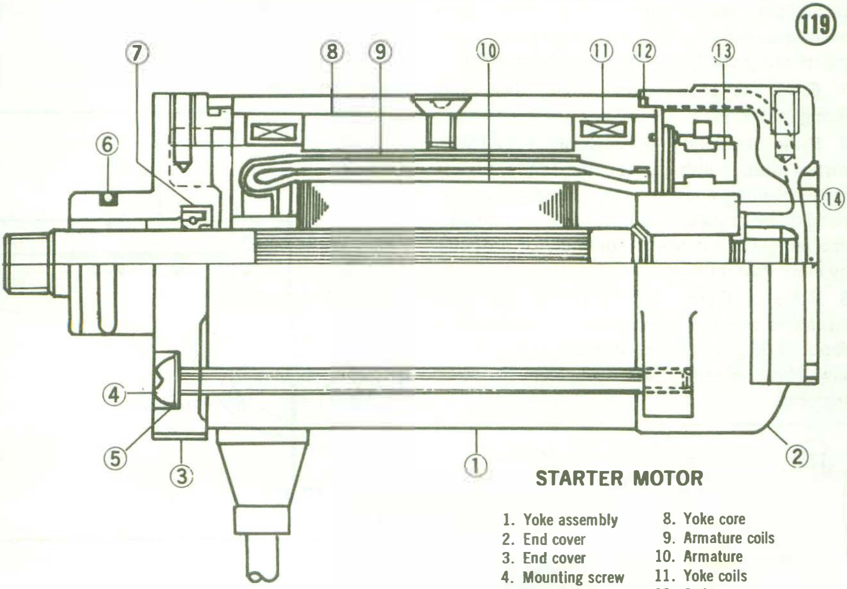
The starter circuit includes the starter switch, starter relay, battery, and starter motor. When the button is pressed, a small amount of current flows through the switch and through the relay coil. This current magnetizes the relay core, which then pulls the armature to it and closes the relay contacts. The closed contacts complete a current parth for the starter motor, and the motor turns. The reason for using a relay instead of using the switch to turn on the starter directly is the high current requirement of the starter motor. It is not practical to put a heavy switch on the handlebars and have large wires running to it, so the starter switch is made only to carry the light relay coil current, and heavy contacts inside the relay carry the starter motor current. **Figure 118** illustrates the starter circuit.

NOTE: *Never continue pressing the starter switch if the engines does not turn over, because excess current through the starter motor will burn out its windings.*

The starter motor is installed in a constant mesh arrangement, without a solenoid to engage and disengage the starter from the engine. In place of the solenoid used in automobiles, a clutch disengages the starter once the engine starts.

Figure 119 illustrates starter motor construction. These field coils are wound around 4 cores, forming the yoke. The armature windings are





STARTER MOTOR

1. Yoke assembly
2. End cover
3. End cover
4. Mounting screw
5. Lockwasher
6. O-ring
7. Oil seal
8. Yoke core
9. Armature coils
10. Armature
11. Yoke coils
12. O-ring
13. Brush
14. Commutator

connected to the commutator and receive their current through the brushes. Field windings and armature windings are connected in series, and so if the brushes do not make good contact, no starter current will flow and the starter will not turn over. A short circuit or an open wire in either winding will also cause the starter to be inoperative. Dust from brush wear might be another cause of starter failure if it gets into bearings, making them overheat and seize.

Brushes

Worn brushes or weak brush springs can cause poor brush contact, resulting in starter motor malfunction. Measure the brushes and replace them if they are worn to ¼ in. (7mm). The standard length for new brushes is ½ in. (12mm).

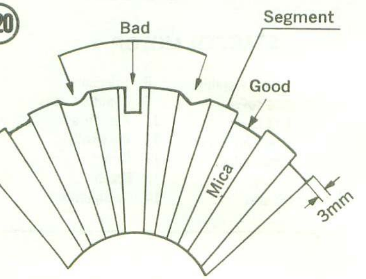
Spring tension should normally be 20-24 ounces (560-680 grams), measured with a spring gauge. The springs can be considered serviceable if they snap the brushes firmly into position.

Commutator

A dirty or rough commutator will result in poor brush contact and cause rapid brush wear. In addition, carbon dust resulting from brush wear accumulates between commutator segments and partially shorts out starter current.

1. Clean the commutator of oil, dust, and foreign material.
2. If the commutator is rough or covered with carbon dust, polish it with fine sandpaper. If light polishing does not clean up the surface, remove the armature and turn the commutator in a lathe. Do not reduce commutator diameter by more than 0.08 in. (2mm).
3. Refer to **Figure 120**. Undercut the mica insulators between commutator segments to a depth of 0.12 in. (3mm), using a broken hacksaw blade. Remove all dust from between segments.

120



Armature

Using the lowest ohmmeter range, measure resistance between each 2 adjoining commutator segments. If there is high resistance between any two, or no indication at all, a wire is open, in which case the armature must be replaced.

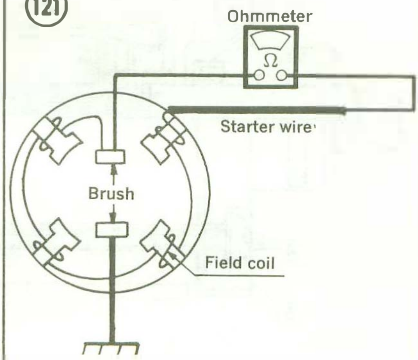
Using the highest ohmmeter range, measure insulation resistance between any commutator segment and the shaft. If there is any indication at all, replace the armature.

Even if the foregoing checks show the armature to be good, but starter operation is improper, and the following tests on the field coils are OK, the armature may be defective.

Field Coils

Using the lowest ohmmeter range, measure resistance between the positive brush and the starter wire (**Figure 121**). If the ohmmeter does not indicate zero or very close to zero, the field coils are open, in which case the yoke assembly must be replaced.

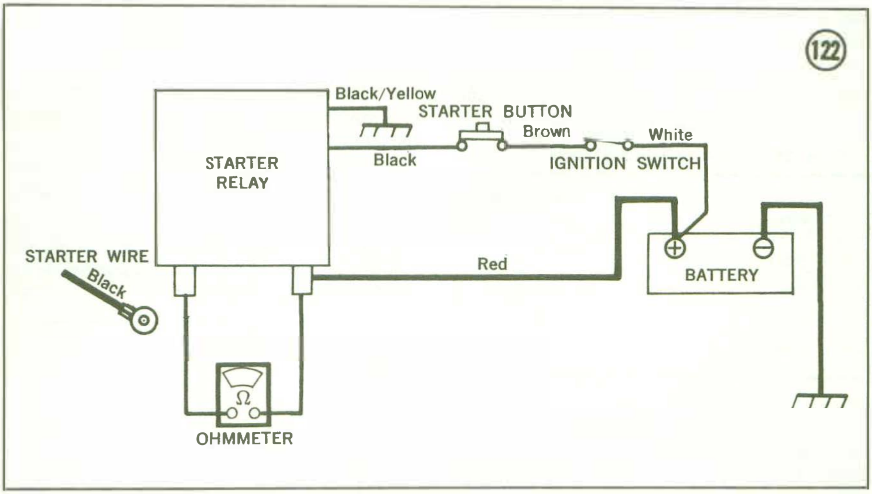
121



Using the highest ohmmeter range, measure insulation resistance between the positive brush and the starter housing. If there is any meter indication at all, the coils are shorted to ground. Replace the yoke in this case.

Starter Relay

1. Refer to **Figure 122**. Disconnect the starter wire from the starter relay. Connect the ohmmeter leads across the relay terminals.



2. Press the starter button. The relay should click and the ohmmeter should indicate zero resistance. If the relay clicks but the meter indicates any value greater than zero, replace relay.

3. If the relay does not click, disconnect the other 2 wires, then measure resistance across the relay terminals. If there is not close to zero resistance, the relay coil is defective.

4. If there is close to zero resistance, the relay may be good, but inoperative because no current is reaching it. Connect the positive voltmeter lead to the black wire and the negative meter lead to the black/yellow wire, then press the starter switch. If the meter indicates battery voltage, the relay is defective. If no voltage indication, the switch or wiring is defective.

MONTESA

Montesa motorcycles are equipped with either a conventional flywheel magneto, or a Motoplat electronic ignition system. A few models have lights and batteries. Flywheel magnetos are the source of electrical system power. Refer to *Electronic Ignition* for operating principles and troubleshooting information on Montesa electronic ignition systems.

MAGNETO TROUBLESHOOTING

The magneto is a simple, rugged device which should give little trouble. If malfunction is suspected, perform the following checks, with all wiring disconnected.

1. Block the ignition points open with a business card or similar piece of paper.

2. With an ohmmeter set to its highest range, check that the movable breaker point is not shorted to ground. Both wires must be disconnected from the points for this test. If there is any indication at all on the ohmmeter, replace the points.

3. Check the condenser. Replace it if there is any doubt about its condition.

4. Examine each coil for evidence of chafing. This condition is not likely to occur on late

model magnetos, but may be found on earlier ones.

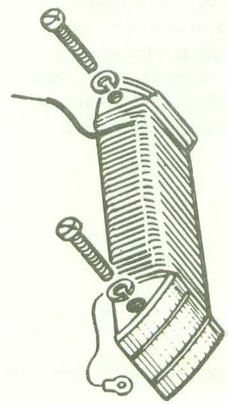
5. With the points blocked open, measure resistance between each lead from the magneto and ground. Typical values are listed in **Table 24**.

Table 24 MAGNETO RESISTANCE CHECKS

Wire	Resistance to ground (ohm)
Black	0.6
Pink	0.6
Yellow	0.3
Green	0.3

Sport models without lights may be equipped with the type of ignition source coil shown in **Figure 123A**. Resistance of this coil should be approximately 0.5 ohm.

123 A

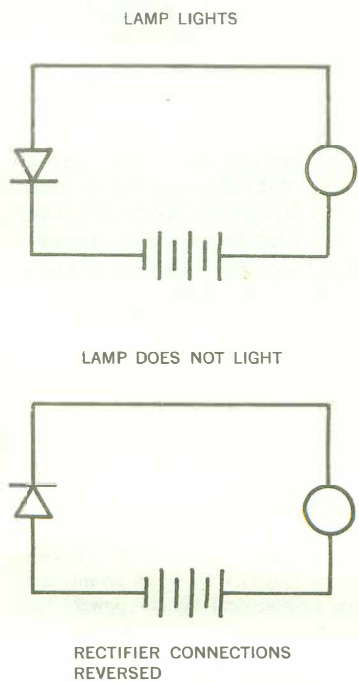


RECTIFIER

Machines with batteries are also equipped with a rectifier. The rectifier serves 2 purposes. First, it converts alternating current generated by the magneto into direct current for charging the battery. It also prevents the battery from discharging through the charging coil in the magneto when the engine is not running, or is running too slowly to charge the battery.

To test the rectifier, refer to **Figure 123B**. Connect the test circuit as shown, using the motorcycle battery and a small 6-volt lamp. If the lamp lights with the rectifier leads connected one way, but not when the leads are reversed, the rectifier is OK. If the lamp lights when the leads are connected either way, the rectifier is shorted. If the lamp does not light at all, the rectifier is open. Replace the magneto if the rectifier is shorted or open.

123 B



An alternate test method is to use an ohmmeter.

1. Disconnect all wires from the magneto.

2. Connect one ohmmeter lead to the red (low charge) wire coming from the magneto. Connect the other ohmmeter lead to ground.

3. Note the ohmmeter indication.

4. Reverse the test connections, then again note the ohmmeter indication.

5. If resistance indications were the same, either high or low, in Steps 3 and 4, the rectifier is faulty. If one reading was high and the other low, the rectifier is OK.

6. Repeat Steps 2 through 5 for the white (high charge) wire.

MOTO GUZZI

Moto Guzzi V7 series motorcycles are equipped with battery ignition, DC generators, and self-starters. Battery ignition service and troubleshooting is discussed in *Battery Ignition*.

CHARGING SYSTEM

The charging system consists of a belt-driven generator, voltage regulator, battery, and interconnecting wiring. If charging system problems are suspected, first be sure that the battery is in good condition and is fully charged. Also be sure that generator drive belt tension is adequate. If these items are OK, test the generator.

Generator Belt

To adjust the drive belt, refer to **Figure 124**, then proceed as follows:

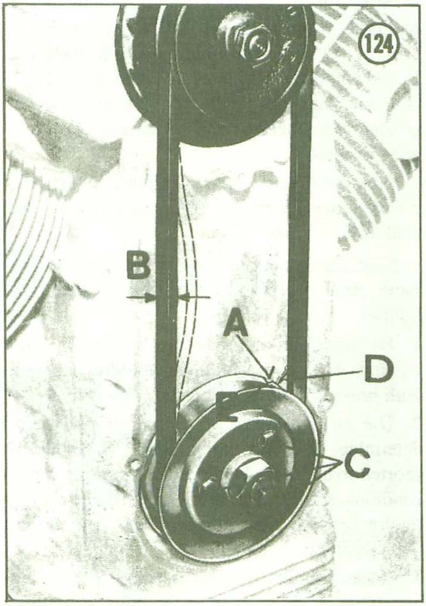
1. Press at point (B), using moderate thumb pressure. The belt should deflect about 0.4 in. (1 cm).

2. If adjustment is necessary, remove 3 bolts (C), then remove the outer pulley half.

3. Remove one or more adjustable shims. If more than one shim is removed, divide them equally between the front and rear sides of the pulley.

4. Replace the 3 bolts.

> NOTE: *Anytime when charging system wiring has been disconnected, it is good practice to polarize the generator before starting the engine. To do so, disconnect the field wire from its terminal at the regulator (DF), then momentarily connect the field wire to battery terminal 51 B+.*



Generator Test

Proper generator testing requires equipment not often available except in shops specializing in such work. Some tests, however, can be made with simple equipment. If the charging system is to be checked by an auto electric shop, be sure that the shop understands that the generator has an *internally* grounded field, or *B-type* circuit.

1. Disconnect the wire or wires from battery terminal 30/B+ of the regulator. Be careful that the wire which was removed does not short out to ground.

2. Connect the positive terminal of a 0-20 DC ammeter to battery terminal 30/B+ of the regulator. Connect the negative ammeter terminal to the wire or wires which were removed.

3. Connect the positive terminal of a 0-20 DC voltmeter to terminal D+/61 on the regulator. Connect the negative voltmeter terminal to a good ground.

4. Disconnect the generator field wire from terminal DF/67 at the regulator.

5. Start the engine and run it at approximately 2,500 rpm.

6. Momentarily connect the lead which was removed from terminal DF/67 to terminal D+/61. Observe the voltmeter and ammeter. If the voltmeter indicates 14 volts or greater, and the ammeter indicates 20 amperes or greater, the generator can be assumed to be in good condition.

7. Stop the engine, disconnect both meters, and polarize the generator before connecting the field lead.

If generator output was not as specified, remove and disassemble it, then proceed as follows:

1. Be sure that brushes are not worn out, gummy, or sticking in their holders. Replace both brushes if either one is worn excessively.

2. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. Replace the armature if this condition exists. Also be sure that there is continuity between each adjacent pair of commutator segments.

3. If the commutator is worn, rough, or burned, turn it down, then undercut the mica insulators. This is a job best left to an auto electrical or small motor specialist.

4. With the generator disassembled, measure field coil resistance between terminal DF and the generator housing. Resistance should be approximately 4.6 ohms.

5. Using the highest ohmmeter range, determine that there is no continuity between the generator terminal D+ and generator frame.

6. If the generator passes the foregoing checks, but its condition is still doubtful, professional service is required.

VOLTAGE REGULATOR

Proper voltage regulator testing requires sophisticated equipment, and is best left to a professional. A few checks, however, can be made with simple equipment.

1. Connect an accurate voltmeter across the battery terminals. The battery must be at or near full charge for this check.

2. Start engine and run it at about 2,000 rpm.

3. If voltmeter indicates approximately 14-15 volts, the regulator can be considered OK.

If a charging system problem has been definitely isolated as a misadjusted or defective regulator, it is usually better to replace than repair it.

STARTER

Figure 125 is a cutaway view of a Moto Guzzi starter. It is a conventional series-wound motor, with a drive mechanism engaged by a solenoid. Starter overhaul is a job for professionals, but some checks and services can be done with simple equipment.

1. Remove and disassemble the starter motor.

2. Remove both brushes and measure the length of each. Replace both brushes if they are worn excessively.

3. Examine the commutator for roughness or burning. Minor roughness may be smoothed with fine sandpaper. After smoothing, be sure that the mica insulators between commutator segments are undercut to a depth of 1/32 inch.

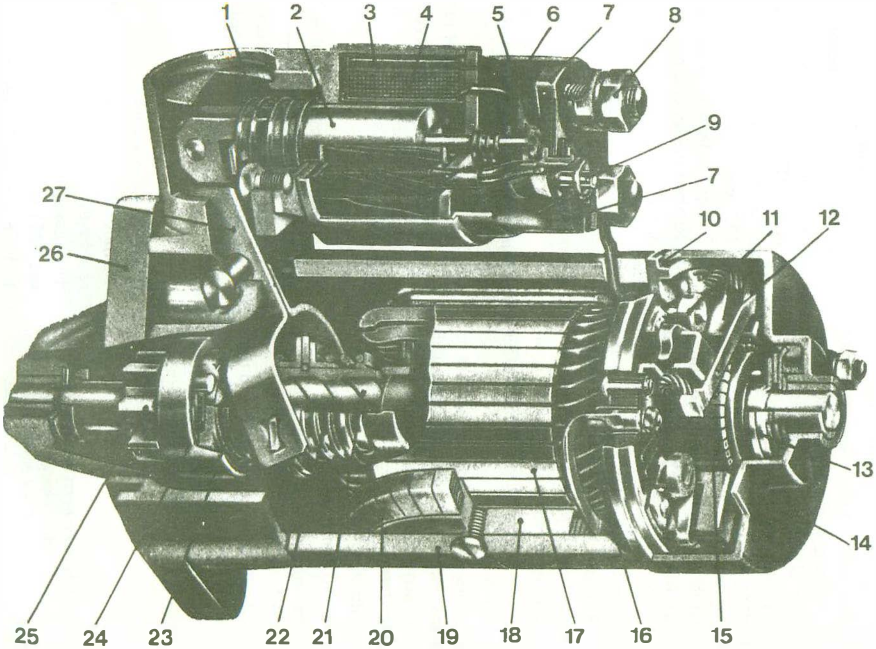
4. Use an armature growler or ohmmeter to determine that no commutator segment is shorted to the shaft.

5. Using an ohmmeter, determine that there is continuity between every adjacent pair of commutator segments.

6. With the starter disassembled, determine that there is continuity between the ungrounded brush holder and the starter terminal.

7. Using the highest ohmmeter range, determine that there is no continuity between the starter terminal and starter motor housing.

If the starter motor passes the foregoing checks, but its operation is still unsatisfactory, have it serviced professionally.



MOTO GUZZI STARTER

1. Keeper return spring
2. Solenoid keeper
3. Retaining coil
4. Coupling coil
5. Movable contact
6. Solenoid switch
7. Switch contacts
8. Battery connection terminal
9. Ignition key connection terminal
10. Brush holder ring
11. Brush spring
12. Brush
13. Disc brake
14. Commutator side end cover
15. Commutator
16. Rotor winding
17. Armature
18. Pole shoe
19. Casing
20. Field winding
21. Fast pitch thread
22. Release spring
23. Coupling spring
24. Roller freewheel
25. Pinion
26. Pinion side end cover
27. Coupling control lever

125

NORTON

These motorcycles are equipped with battery ignition systems, which are discussed in *Battery Ignition*. The charging system consists of an alternator, rectifier, zener diode for voltage regulation, battery, and interconnecting wiring.

CHARGING SYSTEM

The alternator produces alterating current by means of a 6-pole permanently magnetized rotor which rotates within a stationary 6-pole stator. Output from the alternator is converted into direct current by a full-wave bridge rectifier, and limited by a zener diode.

If charging system problems are suspected, first be sure that the battery is in good condition and at or near full charge, then proceed as follows:

1. Disconnect the brown/blue wire from the battery. On 1971 and later models, disconnect the green/yellow lead to the warning light control at the alternator green/yellow double connector. This connection must be broken during all charging system tests.
2. Connect the negative terminal of a 0-10 DC ammeter to the wire which was disconnected. Connect the positive ammeter terminal to the negative battery terminals.
3. Disconnect the zener diode.
4. Start engine and run it at about 3,000 rpm.
5. Observe the ammeter. It should indicate approximately 4.5 amperes.
6. Turn on the lights. The ammeter should indicate approximately one ampere.

If ammeter indications obtained were approximately as specified, or higher, the alternator and rectifier are OK. To test the zener diode, proceed as follows:

> NOTE: *The battery must be in good condition and fully charged before performing this test. If its condition is doubtful, temporarily replace it with one known to be good.*

1. Connect the positive terminal of a 0-5 DC ammeter to the Lucar blade terminal on the zener diode. Connect the negative ammeter terminal to the brown/white or brown/blue wire which normally connects to the zener diode.
2. Connect the negative terminal of a 0-20 DC voltmeter to the Lucar terminal on the zener diode. Connect the voltmeter positive terminal to ground.
3. With all lights and other electrical loads off, except for ignition, start the engine.
4. Slowly increase engine speed and observe both meters. The ammeter must indicate little or no current flow until the voltmeter indicates at least 12.7 volts. The ammeter must indicate at least 2 amperes before voltmeter indicates 15.5 volts. Replace the zener diode if these conditions are not met.

Alternator Tests

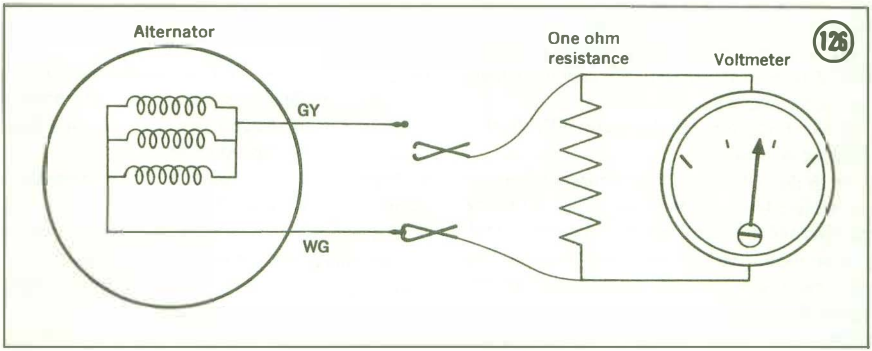
If system tests pointed to possible alternator problems, proceed as follows. Replace the stator if it fails either test.

1. Unplug alternator leads at their connections.
2. Connect a 1-ohm, 50-watt resistor and a 0-20 AC voltmeter together across the green/white and green/yellow alternator output leads (**Figure 126**).
3. Start the engine and run it at 3,000 rpm. The voltmeter must indicate at least 9 volts.
4. Connect the voltmeter between either lead and ground. The voltmeter must indicate zero.

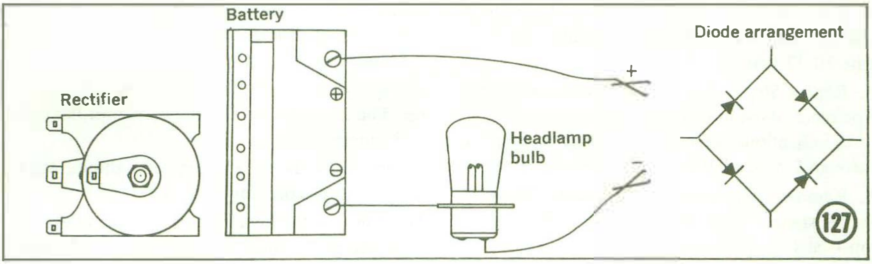
Rectifier

Alternator output is converted to direct current by the rectifier. Failure of this unit can be determined readily by use of a test light (**Figure 127**) or ohmmeter.

1. With the rectifier removed from the motorcycle, connect the test light across the following



126



127

pairs of terminals, then reverse the test connections. Replace the rectifier if there is continuity in both directions or neither direction for any listed pair of terminals.

1 and 2
1 and bolt
3 and bolt
2 and 3

When handling the rectifier, be very careful not to twist the plates in relation to one another. Such twisting will break internal connections, rendering the unit useless.

OSSA

Some Ossa models are equipped with a simple magneto and rectifier charging and lighting system. In the event of malfunction, the following checks should isolate the trouble.

1. Check all wiring, terminals, and connectors.
2. Be sure the fuse is good. It sometimes happens that the fuse element becomes disconnected internally; such a defect cannot be determined visually.
3. Be sure that the battery is charged.
4. Trace the red wire from the magneto to the connector where it joins the purple wire. Disconnect the purple and red wires.
5. Connect one ohmmeter lead to the red wire which was disconnected and the other ohmmeter lead to a good ground. Note the indication on the meter.
6. Reverse the ohmmeter leads, and again note the indication. One of the measurements should be about 15 ohms and the other should be essen-

tially infinite. If both were low, there is a slight possibility that the red wire is shorted somewhere along its length. If so, repair the short. Otherwise, if both readings were either low or high, replace the magneto.

If the foregoing checks were OK, further checking is required:

1. With the red wire still disconnected, connect the positive lead of a 0-50 DC voltmeter to the red wire, and the negative lead to a good ground.
2. Start the engine and run it at 6,000 rpm. The voltmeter should indicate 30-34 volts. If not, replace the magneto.
3. Reconnect the red and purple wires, but leave the voltmeter connected to their junction.
4. Start the engine and run it at 6,000 rpm, with the light switch off. The meter should now indicate 30-32 volts.
5. Repeat Step 4, but with the light switch on. The meter must indicate 7-9 volts.

If indications were not as given in Steps 1 through 5, check lighting system components:

1. Remove both wires from resistor. Measure its resistance, using an ohmmeter. Resistance must be 14.5-15.5 ohms.
2. Measure insulation resistance between either resistor terminal and ground. Replace the resistor if insulation resistance is less than 0.5 megohm.
3. Disconnect the black wire at the negative battery terminal, then remove the fuse. Connect one ohmmeter lead to the black wire which was connected to the battery negative wire, and the other test lead to a good ground.
4. Turn the ignition switch on. The ohmmeter should indicate continuity.
5. Replace the fuse and negative battery wire.
6. Disconnect the red wire at the battery. Connect the positive terminal of a 0-10 DC ammeter to the battery positive terminal, and the negative terminal to the red wire which was removed.
7. With the engine not running, and the ignition switch on, the ammeter should indicate zero. If not, there is a short in the electrical system. Look for chafed or pinched wiring.
8. Apply each brake until the stop light comes on. The ammeter should indicate approximately 3 amperes.
9. Sound the horn. The ammeter should again indicate approximately 3 amperes.
10. Turn on the headlight, then switch between high and low beams. The ammeter should indicate approximately 6 amperes under either condition.

SUZUKI SINGLES

This part discusses maintenance and troubleshooting procedures for major electrical system components on Suzuki single-cylinder models.

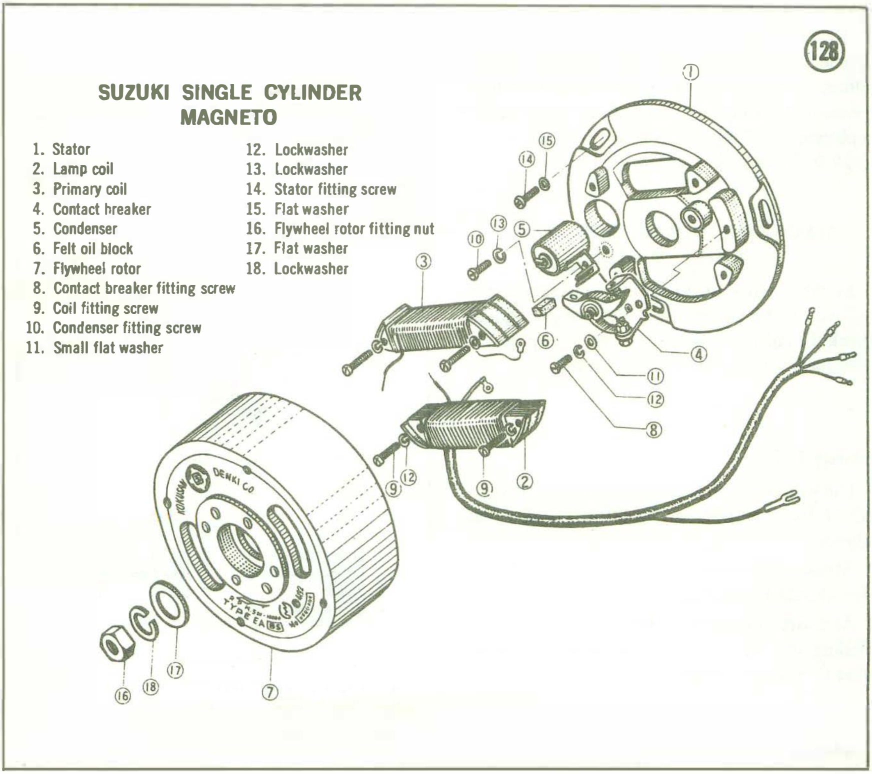
FLYWHEEL MAGNETO

A flywheel magneto is the source of electric power for the ignition and electrical systems of most machines covered by this manual. Separate coils within the magneto supply current for ignition, daytime and nighttime operation, and battery charging. Alternating current produced by the magneto is used for ignition and lights, except for stoplights and turn signals. A rectifier converts this alternating current to direct current to charge the battery and operate the horn, brake light, and turn signals. **Figure 128** is an exploded view of a typical flywheel magneto.

Magneto Operation

As the flywheel rotates, permanent magnets attached to the flywheel revolve past the windings in the magneto, thus inducing current in the winding.

When the contact breaker points are closed, current developed in ignition coil is grounded, and so current is delivered to the ignition coil. When the points open, current is delivered to the primary winding of the ignition coil. The voltage across the coil primary winding is stepped up to the very high voltage (10,000-15,000) required to jump the spark plug gap. A capacitor (con-



denser) is connected across the ignition points to prevent them from arcing as they open.

Nighttime lighting imposes an additional load on the magneto. To accommodate different current requirements, the lighting coil is tapped for both day and night loads.

Note that the lighting coil serves mainly to operate the headlight, but also furnishes power to the speedometer and high beam indicator bulbs. If the headlight burns out, the other bulbs will burn out because of the excess voltage available.

The magnetos on PEI (Pointless Electronic Ignition) models are similar to those on the conventional magneto ignition models, except that the ignition coil is replaced with an exciter coil and a pulser coil, to meet the requirements of the capacitor discharge ignition system.

Magneto Removal

Magneto removal is similar for all models. Proceed as follows:

1. Remove the gearshift lever, then left engine cover.
2. Remove the left frame cover.
3. Disconnect magneto wire harness.
4. Remove neutral indicator switch lead.
5. Hold flywheel in position, then remove the flywheel nut.
6. Screw flywheel rotor removal tool into center hole of flywheel. Note that this tool has a left-hand thread and that the tool must be screwed in at least 0.2 in. (5mm). Then hold wrench pads on tool, and turn center bolt clockwise to remove the flywheel.

7. Remove stator.

8. Reverse the removal procedure to install the magneto. Be sure that no iron or steel particles adhere to the magneto in the rotor. It will be necessary to adjust ignition timing after magneto replacement. Tighten flywheel retaining nut to 29 ft.-lb. (400 kg/cm).

MAGNETO TROUBLESHOOTING AND SERVICE

In the event that an ignition malfunction is believed to be caused by a defective magneto, check the coils, condenser, and breaker points as described in the following paragraphs.

Primary Coil

The primary coil ordinarily requires no service. If its condition is doubtful, check it as follows:

1. Measure resistance between its leads. Resistance should be approximately 1.1 ohms.

2. Measure insulation resistance between the winding and the iron core. Insulation resistance must be at least 5 megohms.

Condenser

Measure capacity of the condenser, using a condenser tester. Capacity should be 0.27-0.33 microfarad. With the condenser ground wire disconnected, measure insulation resistance between the outer case and the positive terminal. Insulation resistance should be over 10 megohms.

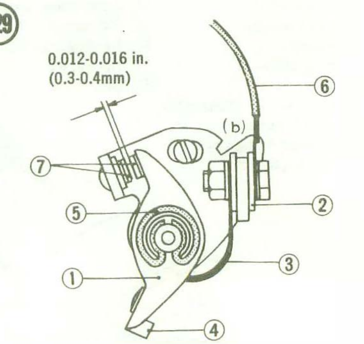
In the event that no test equipment is available, a quick test of the condenser may be made by connecting its negative lead to the negative terminal of a 6-volt battery, and its positive lead to the positive terminal. Allow the condenser to charge for a few seconds, then quickly disconnect the battery and touch the condenser terminals together. If you observe a spark as the leads touch, you may assume that the condenser is good.

Arcing between the breaker points is a common symptom of a defective condenser.

Breaker Points

Figure 129 illustrates typical breaker points. Check to be sure that the insulation between the breaker contacts and the contact breaker base is not defective. Defective insulation will prevent the machine from running.

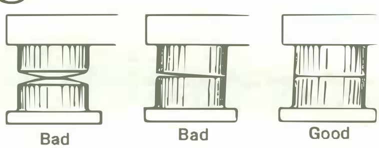
129



1. Contact breaker arm
2. Insulator
3. Spring
4. Cam follower
5. Circlip
6. Wire from primary coil
7. Contact breaker points

Surfaces of the contacts may become pitted or worn through normal use. If they are not too badly pitted, they can be dressed with a few strokes of a clean point file. Do not use sandpaper, as particles can remain on the points and cause arcing and burning. If a few strokes of the file don't smooth the points completely, replace them (**Figure 130**).

130

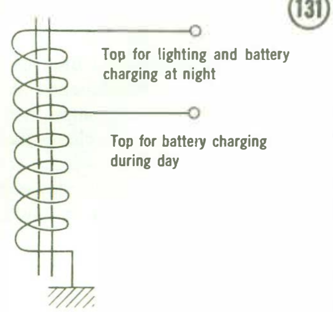


Oil or dirt may get on the points and cause premature failure. Common reasons for this condition are defective crankshaft seals, sloppy lubrication of the rubbing block, or lack of care when the crankcase cover is removed and replaced.

If the point spring is weak or broken, the points will bounce, causing misfiring at high speeds.

Lighting and Charging Coil

The lighting and charging coil is tapped (**Figure 131**) to provide outputs for both day and night riding conditions. The yellow wire is the tap for night operation and the green wire is the tap for day operation.



To check the operation of the coil, make the connections shown in **Figure 132**. Be sure that the battery is fully charged before you begin the test. **Table 25** lists typical values to be obtained.

Table 25 CHARGING SYSTEM TEST

	Day (Note 1)		Night (Note 2)	
	2,000 rpm	8,000 rpm	2,000 rpm	8,000 rpm
Charging current	Charging begins	Less than 2.5 amp	Over 1.0 amp	
Lighting voltage			More than 6.0 volts	Less than 9.0 volts

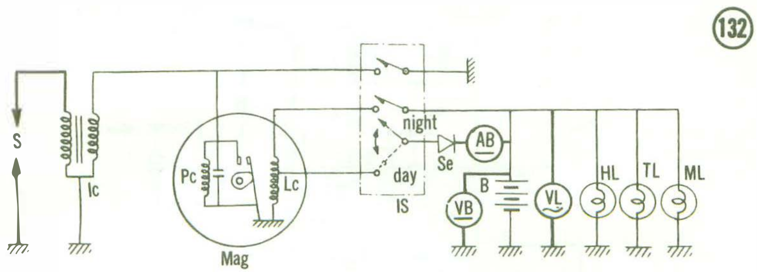
NOTES: 1. Neutral indicator lamp on.
2. All lamps except stop lamp on.

Ignition Coil

The ignition coil is a form of transformer which develops the high voltage required to jump the spark plug gap. The only maintenance required is that of keeping the electrical connections clean and tight, and making sure that the coil is mounted securely.

If the condition of the coil is doubtful, 2 quick checks should be made:

1. Measure resistance with an ohmmeter between the positive and negative primary terminals. Resistance should indicate approximately 2 ohms



Mag	Flywheel magneto	AB	D.C. ammeter (Charging current inspection)
LC	Lamp coil	VL	A.C. voltmeter (Ignition voltage inspection)
SE	Selium rectifier	VB	D.C. voltmeter (Battery voltage inspection)
B	Battery	S	Three-prong tester (Spark gap inspection)
HL	Headlamp	PC	Primary coil
TL	Tail lamp	LC	Lamp coil
ML	Speedometer lamps	IS	Ignition switch

for most coils on these machines. Some coils, however, have a primary resistance less than one ohm.

2. Measure resistance between either primary terminal and the secondary high voltage terminal. Resistance should be in the range of 5,000-11,000 ohms.

If a coil tester is available, connect the coil to the tester and use a 6-volt battery as a power source. Use the 3-prong gap to test coil performance. The coil should produce a ¼-inch spark. If there is reason to suspect that the coil may be breaking down under load, continue the test for 5 minutes.

STARTER/GENERATOR

Some models are equipped with a combination starter/generator instead of a flywheel magneto. The unit operates as a generator when the engine is running, and as a starting motor when it is stopped. Associated with the starter/generator are a cutout relay, voltage regulator, and starter relay. **Figure 133** is a schematic diagram of the associated circuitry. Refer to that diagram during the following discussion.

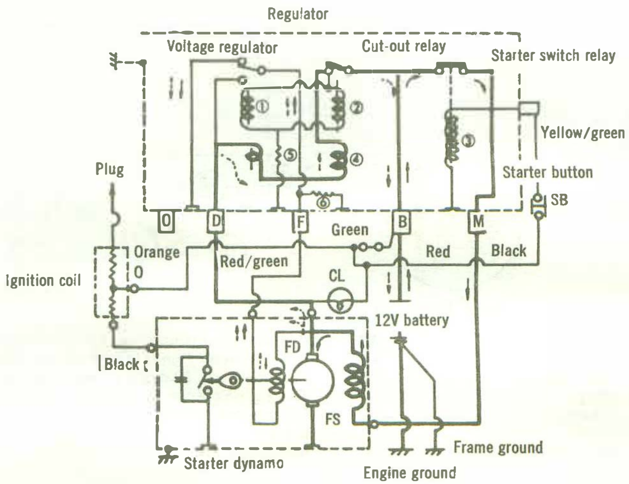
Starter Relay

The starter relay is enclosed within the voltage regulator unit. When the stator switch is pressed, the relay coil is energized, and closes the relay contacts. Current then flows from the battery, through the relay contacts, and finally through the series field winding of the starter/generator.

Cutout Relay

When the engine is off or running at low speed, the battery must be disconnected from the generator to prevent it from discharging. The cutout relay performs this function. As engine speed increases, generator output voltage increases to a value sufficient to charge the battery. When this occurs, a voltage sensing coil in the cutout relay causes the cutout relay contacts to close, and thus permit current to flow from the

133



generator to the battery and external loads. As the engine slows down, generator output decreases, and current tends to flow from the battery to the generator. A second coil in the cutout relay senses this reverse current and opens the contacts, thereby disconnecting the battery and generator.

Voltage Regulator

Varying engine speeds and electrical loads affect generator output. The voltage regulator maintains output voltage at a constant level by controlling generator field current.

Starter/Generator Troubleshooting

Malfunctions within the starter/generator system can be diveded into 3 main categories:

a. Starter does not work properly.

b. Generator output is too low, resulting in an undercharged battery.

c. Generator output is too high, resulting in an overcharged battery.

Starter Troubleshooting

Table 26 lists symptoms, probable causes, and remedies for starter malfunctions.

Generator Troubleshooting

In the case of charging system malfunctions, it is necessary to determine whether the generator or the regulator is at fault. To determine which, refer to **Figure 134**, then proceed as follows:

1. Disconnect the wires from terminals D and F of the regulator.

2. Connect the wire which you removed from terminal F to a good ground. Connect an accurate 0-20 DC voltmeter between the wire removed from terminal D and ground.

3. Start the engine and run it at 2,500 rpm. If the voltmeter indicates more than 15.1 volts, it can be assumed that the generator is OK.

If the meter indication is not as specified, the starter/generator is faulty.

Table 26 STARTER TROUBLESHOOTING

Symptom	Probable Cause	Remedy
Starter does not work	Low battery	Recharge battery
	Worn brushes	Replace brushes
	Internal short	Repair or replace defective component
	Relay inoperative	Replace voltage regulator
	Defective wiring or connections	Repair wire or clean and tighten connections
	Defective switch	Replace switch
Starter action is weak	Low battery	Recharge battery
	Pitted relay contacts	Clean contacts or replace voltage regulator
	Brushes worn	Replace brushes
	Defective wiring or connections	Repair wire or clean and tighten connections
	Short in commutator	Replace armature
Starter runs continuously	Stuck relay	Dress contacts or replace voltage regulator

Checking the Stator

Remove the yoke and clean it of all foreign material.

1. Use an ohmmeter to measure insulation resistance between the positive brush and ground. If the meter indicates continuity, check for a short circuit at the brush holder or terminal D. Note that negative brush holder is not insulated.

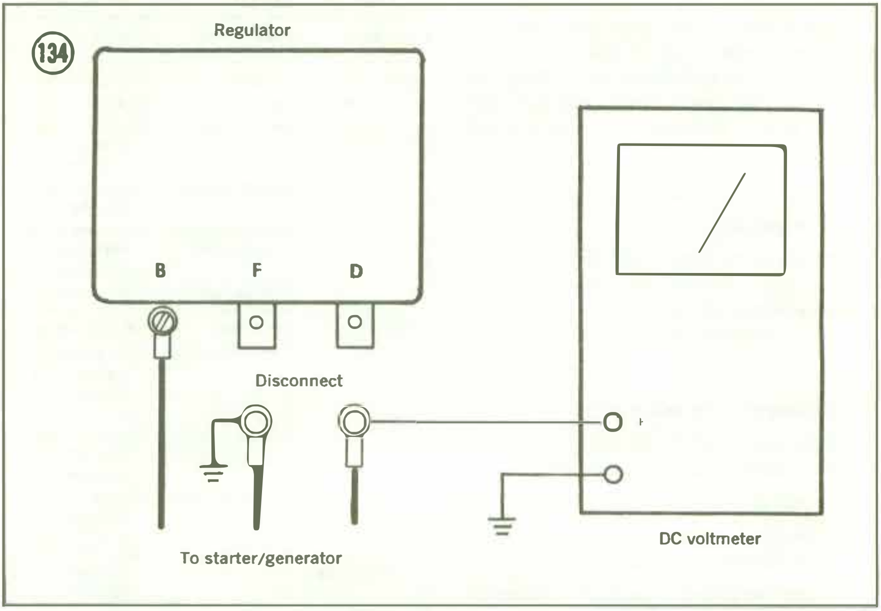
2. Measure resistance between terminals F and D. Field coil resistance should be 5-8 ohms.

3. Set ohmmeter to its highest range. Measure insulation resistance between terminal F and a good ground. Insulation resistance should be essentially infinite.

If indications obtained in Steps 2 or 3 are not as specified, replace the stator. If the stator assembly is good, check the brushes and the armature.

Checking Brushes

Poor brush condition is one of the most frequent causes of low generator output. Remove



the brushes and examine them carefully. Each brush must contact the commutator with at least ¾ of its contact surface. If either brush is worn excessively, replace both.

If the brushes and the commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if there are any burrs.

When you replace the brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure that the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

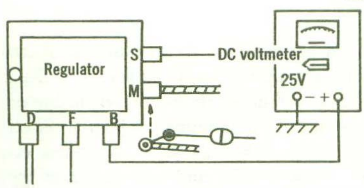
1. Clean commutator of oil, dust, and foreign material.
2. If the commutator is rough or covered with carbon dust, polish it with fine sandpaper. If a light polishing does not clean up the surface, remove the armature and turn the commutator in a lathe. Do not reduce commutator diameter by more than 0.08 in. (2mm). Be sure to remove all traces of emery dust.
3. Undercut the mica segments between the commutator segments with a hacksaw blade to a depth of 0.02-0.04 in. (0.5-1.0mm). Remove all dust from between segments.
4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If any short exists, replace the armature.

Checking the Regulator

Varying engine speeds and electrical loads affect generator output. The regulator controls generator output, and also disconnects the battery from the generator whenever the generator output voltage is less than that of the battery, thereby preventing battery discharge through the generator.

Disconnect the wire from terminal B at the regulator. Be careful that you don't allow this wire to become grounded. Connect the voltmeter between terminal B on the regulator and ground, as shown in **Figure 135**. Start the engine and run it at 2,500 rpm. The voltmeter should indicate 15.1-16.3 volts.

135



Observe the contacts on the cutout relay as you slowly increase engine speed. The contacts should close when the voltmeter indicates 12.5-13.5 volts.

Adjusting the Voltage Regulator

CAUTION

Disconnect the battery before removing the regulator cover. Do not make any adjustment with battery in place.

Remove the regulator cover and adjust by bending the adjustment spring. Bending the spring downward raises the voltage setting. The voltage regulator can be identified by its 2 contact points.

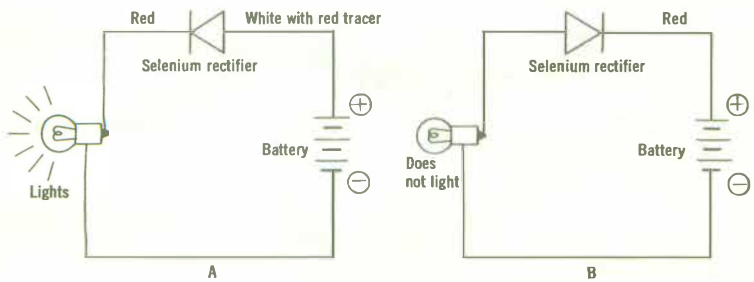
The cutout relay can be identified by a single set of contacts which are normally open. The relay rarely, if ever, needs adjustment. Usually all that is required is to dress the contacts lightly to remove any corrosion or light pitting. Should adjustment be required, bend the spring retainer up or down as required. Lowering the spring retainer raises the voltage setting.

RECTIFIER

The rectifier serves 2 purposes. First, it converts alternating current generated by the magneto into direct current used for battery charging. It also prevents the battery from discharging through the charging coil in the magneto when the engine isn't turning fast enough to charge the battery.

To test the rectifier, refer to **Figure 136**. Connect the test circuit shown, using the motorcycle battery and a small lamp, such as one from the speedometer. If the lamp lights when the rectifier is connected one way, but not when the rectifier connections are reversed, the rectifier is OK. If the lamp lights when the rectifier is connected either way, the rectifier is shorted. If the lamp does not light at all the rectifier is open. Replace the rectifier if it is shorted or open.

136



SUZUKI TWINS

This section discusses troubleshooting and service procedures for major electrical system components on Suzuki twin-cylinder models.

IGNITION SYSTEM

All models have a conventional battery and coil ignition system using one set of points and one coil for each cylinder. Operation and troubleshooting procedures for battery ignition systems are discussed elsewhere in this chapter.

ALTERNATOR

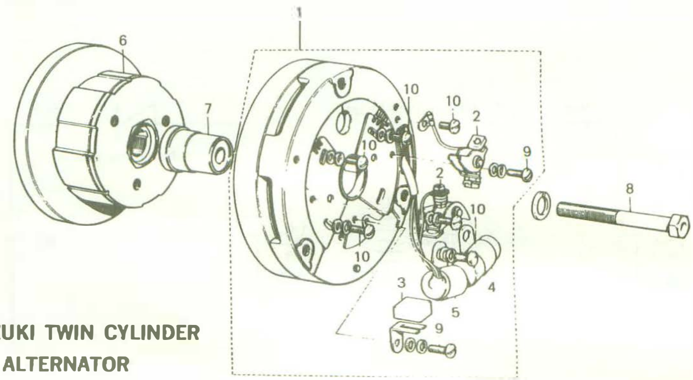
An exploded view of a typical alternator is shown in **Figure 137**. An alternator is a form of electric generator in which a magnetized field called a rotor revolves within a set of stationary coils called a stator. As the rotor turns, alternating current is induced in the stator. The current is then rectified and used to operate some of the electrical accessories on the motorcycle, and for charging the battery. Suzuki alternator rotors are permanently magnetized. Separate windings within the stator are switched in or out as required to accommodate different electrical loads imposed by day and night riding conditions. **Figures 138 and 139** illustrate typical circuits during day and night operation.

Some machines are equipped with solid state voltage regulators to control alternator output. Such regulators have no moving parts and require no service.

If alternator problems are suspected, as in the case of a chronically undercharged battery or dim headlights, check alternator output voltage.

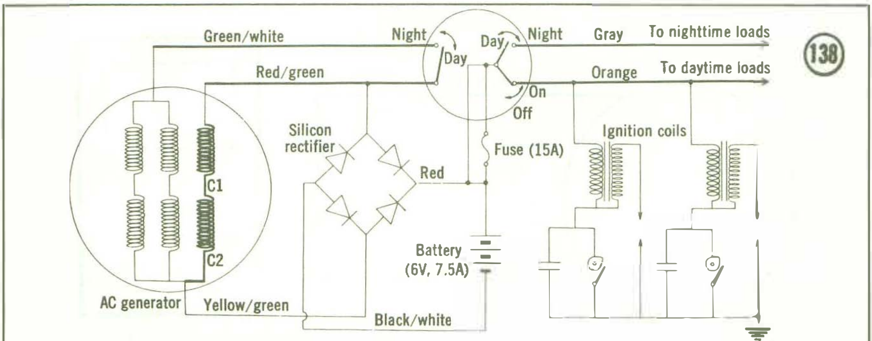
1. Connect an accurate 0-20 DC voltmeter across the battery terminals. Be sure to connect the positive voltmeter lead to the positive battery terminal, and the negative voltmeter lead to the negative battery terminal. Do not start engine.
2. Observe the voltmeter indication and record it for reference during the next step. The voltmeter will indicate battery voltage.
3. Start the engine and run it at 5,000 rpm. Turn on the headlights.

(137)

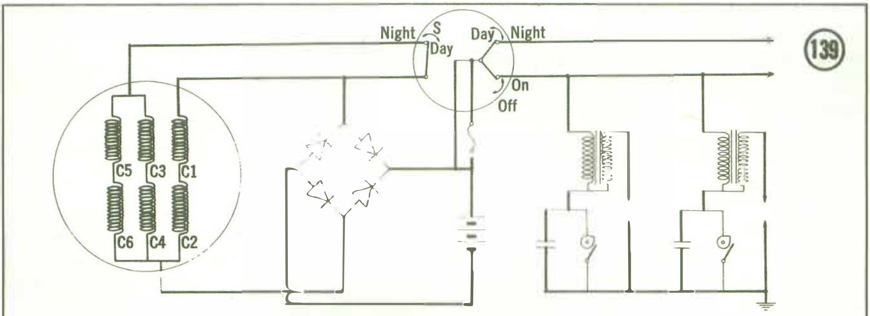


SUZUKI TWIN CYLINDER ALTERNATOR

1. Stator assembly
2. Contact point assembly
3. Contact breaker cam oil felt.
4. Right condenser
5. Left condenser
6. Rotor
7. Contact breaker cam
8. Rotor fixing bolt
9. Slotted pan head screw
10. Slotted pan head screw



ALTERNATOR WIRING DIAGRAM – DAY POSITION



ALTERNATOR WIRING DIAGRAM – NIGHT POSITION

4. Again observe the voltmeter. If the voltmeter indication is now approximately 1-1½ volts higher than the meter indication obtained in Step 2, the alternator is OK, and no further checks are required.

5. If the indication obtained in Step 4 was less than one volt greater than battery voltage obtained in Step 2, further checking will be required.

If further testing is required, perform the following steps:

1. Stop the engine, then disconnect the alternator wiring.

2. On models with 6-volt electrical systems, measure resistance between the yellow/green and red/green leads from the alternator. It should be approximately 2 ohms.

3. Measure resistance between the yellow/green and green/white leads. It should be approximately 0.5 ohm.

4. Measure insulation resistance between each lead and the stator body. It should be at least 5 megohms.

5. Connect a 0-100 AC voltmeter to the alternator, as shown in **Figure 140**. Start the engine and measure alternator output voltage under each of the conditions specified in **Table 27**.

Table 27 ALTERNATOR OPEN CIRCUIT VOLTAGE

Engine Speed	Voltage Limits
2,000 rpm	17-33
5,000 rpm	40-59
8,000 rpm	70-92

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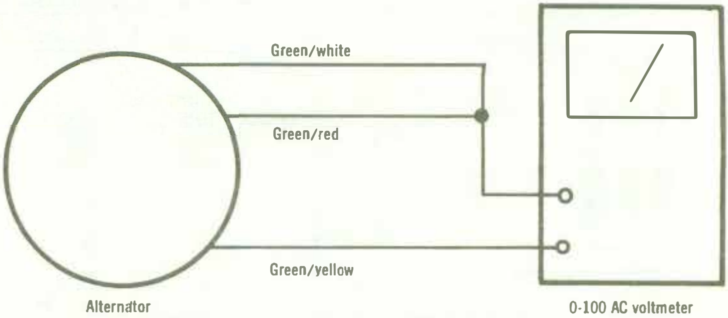


6. Connect a 0-5 DC ammeter into the battery circuit as shown in **Figure 141**. Start the engine, and set the ignition switch to day riding position. The ammeter should indicate as specified in **Table 28**.

Table 28

Engine Speed	Indication
2,000 rpm	Charging begins
8,000 rpm	Less than 3 amperes

7. Set the ignition switch to the night riding position. The ammeter should indicate as specified in **Table 29**.

Table 29

Engine Speed	Indication
2,300 rpm	Charging begins
8,000 rpm	Less than 3 amperes

Checking the alternator on machines with 12-volt electrical systems is similar to the procedure for 6-volt systems. With the ammeter connected as shown in Figure 141 and the ignition switch in the day position, charging current should be as in **Table 30**.

With the switch in the night position, the ammeter should indicate as specified in **Table 31**.

141

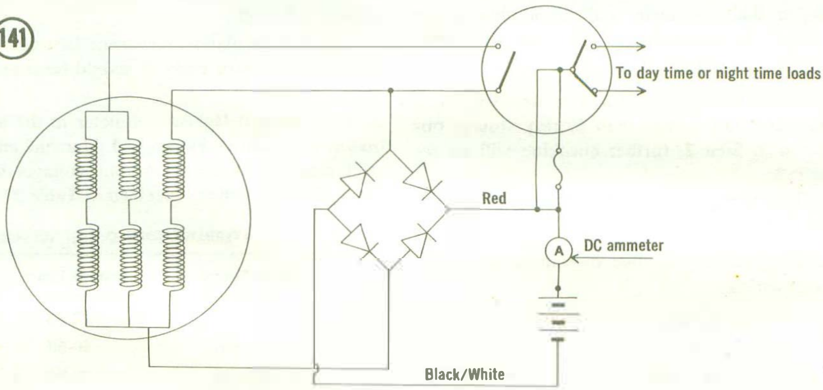


Table 30

Engine Speed	Indication
2,000 rpm	Charging begins
8,000 rpm	1.5 to 2.5 amperes

Table 31

Engine Speed	Indication
2,000 rpm	Charging begins
8,000 rpm	2 to 3 amperes

RECTIFIER

The rectifier serves 2 purposes. It converts alternating current produced by the alternator into direct current which is used to charge the battery. It also prevents discharge of the battery through the alternator when the engine isn't running, or at times when output voltage of the alternator is less than battery voltage.

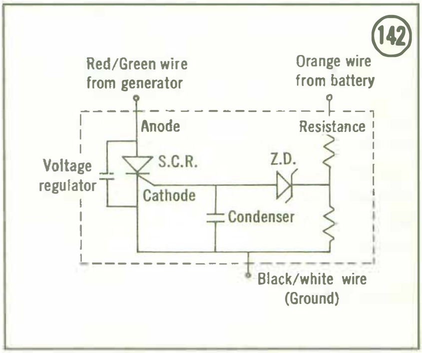
Check the rectifier with an ohmmeter if its condition is doubtful. Measure and record resistance between each pair of listed leads, and record the ohmmeter indications. Then repeat the measurements with the ohmmeter leads reversed.

Yellow/green and red
Red/green and black/white (or ground)
Red/green and red
Yellow/green and black/white (or ground)

If resistance between each pair of leads was high with the ohmmeter leads connected one way and low with the ohmmeter leads reversed, the rectifier is OK. Replace the unit if any measurement was either high or low with the ohmmeter leads connected both ways.

SOLID STATE VOLTAGE REGULATOR

Some machines are equipped with a solid state voltage regulator. This unit consists of a zener diode (ZD), a silicon controlled rectifier (SCR), and 2 resistors, as shown in (**Figure 142**). Refer to that illustration during the following discussion.



Operation

Assume that the main switch is closed. As engine speed increases, output voltage from the alternator tends to increase. If the battery is fully charged, voltage at the junction of the 2 resistors will tend to rise. If it reaches zener voltage, approximately 16 volts, the zener diode conducts in the reverse direction thereby triggering the silicon controlled rectifier. When the silicon controlled rectifier conducts, alternator output is grounded, thereby reducing its output voltage to near zero. As voltage at the junction of the resistors drops, the zener diode ceases to conduct, and removes the trigger signal to the silicon controlled rectifier, allowing the alternator output voltage to increase.

Inspection

1. Measure resistance between the orange and black/white wires. It should be about 1,000 ohms.

2. There shouldn't be any continuity between the red/green and black/white wires with the ohmmeter leads connected either way.

Handling Precautions

Do not remove the rubber insulating cap from the regulator. Be sure that the hex nut in the cap is tight. Failure of the engine to run may result if this nut is loose. Be sure that the regulator is connected properly. Improper connections could result in damage to the regulator or battery.

STARTER/GENERATOR

Some machines are equipped with a combination starter/generator. This unit operates as a generator when the engine is running, and as a starter motor when it's stopped. Associated with the starter/generator are a cutout relay, voltage regulator, and starter relay. **Figure 143** is a schematic diagram of the associated circuitry. Refer to that diagram during the following discussion.

Starter Relay

The starter relay is enclosed within the voltage regulator unit. When the starter switch is pressed, the relay coil is energized, and closes the relay contacts. Current then flows from the battery, through the relay contacts, and finally through the series field winding and armature of the starter/generator.

Cutout Relay

When the engine is off, or running at low speed, the battery must be disconnected from the generator to prevent it from discharging. The cutout relay performs this function. As engine speed increases, output voltage of the generator increases to a value sufficient to charge the battery. When this occurs, a voltage sensing coil in the cutout relay causes its contacts to close, permitting current to flow from the generator to the battery and external loads. As the engine slows down, generator output decreases, and current tends to flow from the battery to the generator. A second coil in the cutout relay senses this reverse current and allows the contacts to again open, thereby disconnecting the battery and generator.

Starter/Generator Troubleshooting

Malfunctions in the starter/generator system can be divided into 3 main categories:

a. Starter does not work properly.
b. Generator output is too low, resulting in an undercharged battery.
c. Generator output is too high, resulting in an overcharged battery.

Starter Troubleshooting

Table 32 lists symptoms, probable causes, and remedies for starter malfunctions.

143

SUZUKI TWIN CYLINDER STARTER/GENERATOR CIRCUIT

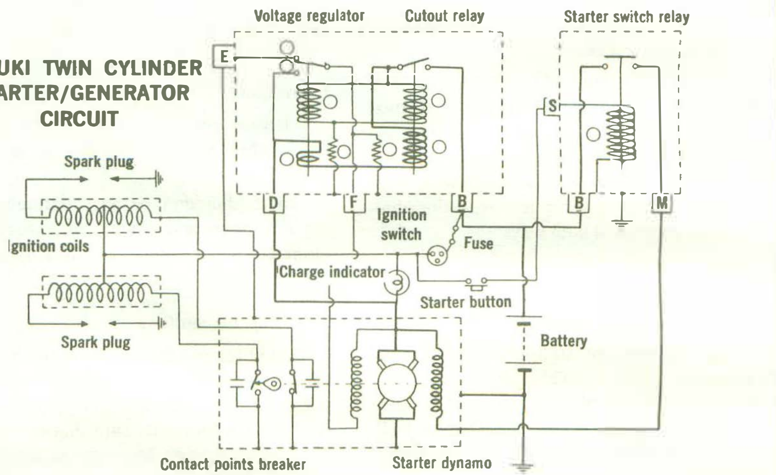


Table 32 STARTER TROUBLESHOOTING

Symptom	Probable Cause	Remedy
Starter does not work	Low battery	Recharge battery
	Worn brushes	Replace brushes
	Internal short	Repair or replace defective component
	Defective wiring or connections	Repair wire or clean and tighten connections
	Defective switch	Replace switch
Starter action is weak	Low battery	Recharge battery
	Pitted relay contacts	Clean contacts or replace voltage regulator
	Brushes worn	Replace brushes
	Defective wiring or connections	Repair wire or clean and tighten connections
	Short in commutator	Replace armature
Starter runs continuously	Stuck relay	Dress contacts or replace voltage regulator

Generator Troubleshooting

In the case of charging system malfunctions, it is necessary to determine whether the generator or the regulator is at fault. To do this, refer to **Figure 144**, then proceed as follows:

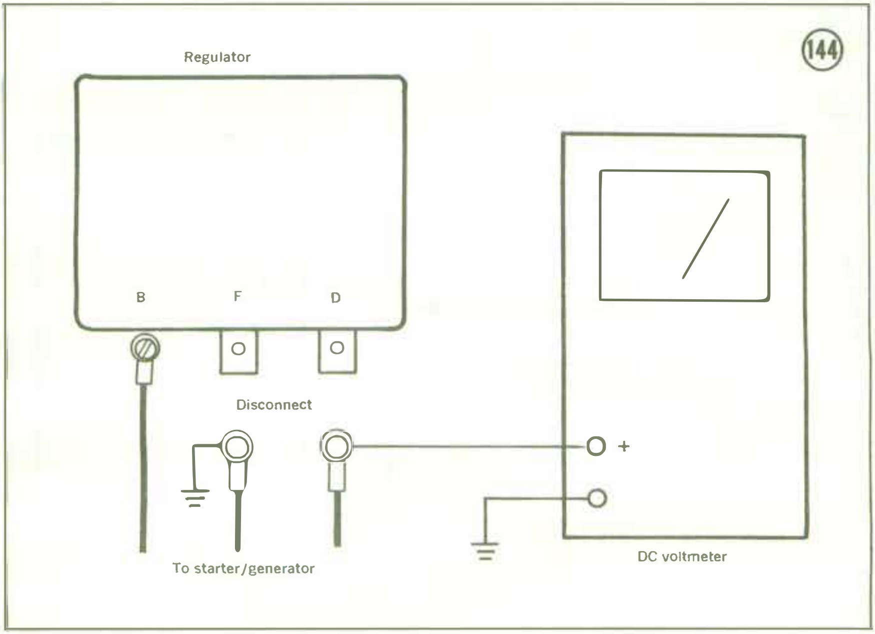
1. Disconnect the wires from terminals D and F of the regulator.
2. Connect the wire which you removed from terminal F to a good ground. Connect an accurate 0-20 DC voltmeter between the wire removed from terminal D and ground.
3. Start the engine and run it at 2,500 rpm. If the voltmeter indicates more than 15.1 volts, assume that the generator is OK.

If the meter indications were not as specified, the starter/generator is faulty.

Checking the Stator

Clean the stator assembly of all foreign material, then remove it from the machine.

1. Use an ohmmeter to measure insulation resistance between the positive brush and ground.



If the meter indicates continuity, check for a short circuit at the brush holder or terminal D. Note that the negative brush holder is not insulated.

2. Check for field coil continuity. The ohmmeter should indicate approximately 5-8 ohms between the yellow and red/green wires, and between the green and red/green wires (**Figure 145**).

3. Set the ohmmeter to its highest range. Measure insulation resistance between the green wire and a good ground. Insulation resistance should be essentially infinite (**Figure 146**).

If the measurements obtained in Steps 2 and 3 are not as specified, replace the yoke. If the yoke assembly is good, check brushes and armature.

Checking Brushes

Poor brush condition is a frequent cause of low generator output. Remove the brushes and examine them carefully. Each must contact the commutator with at least ¾ of its contact surface. If either brush is worn excessively replace both.

If the brushes and the commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if there are any burrs.

When you replace the brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure that the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

1. Clean the commutator of oil, dust, and foreign material.

2. If the commutator is rough or covered with carbon dust, polish it with fine sandpaper. If a light polishing does not clean the surface, remove the armature and turn the commutator in a lathe. Do not reduce commutator diameter by more than 0.08 in. (2mm).

3. Undercut the mica (**Figure 147**) between the commutator segments with a hacksaw blade to a depth of 0.02-0.04 in. (0.5-1.0mm). Remove the dust from between the segments.

4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If a short exists, replace the armature.

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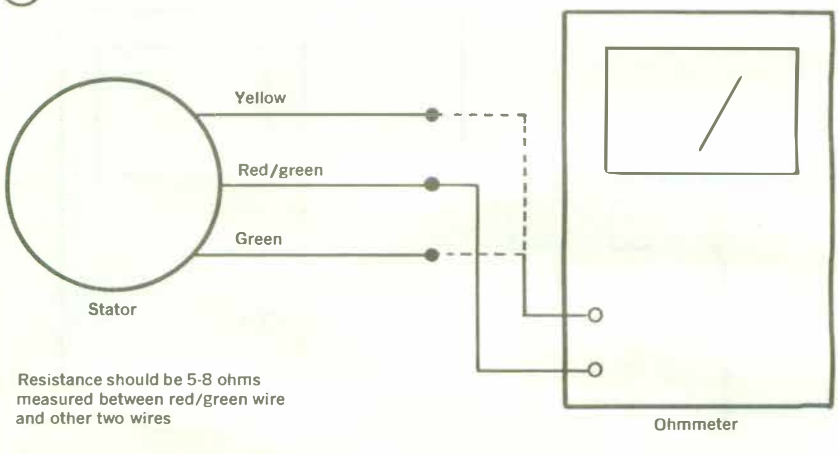
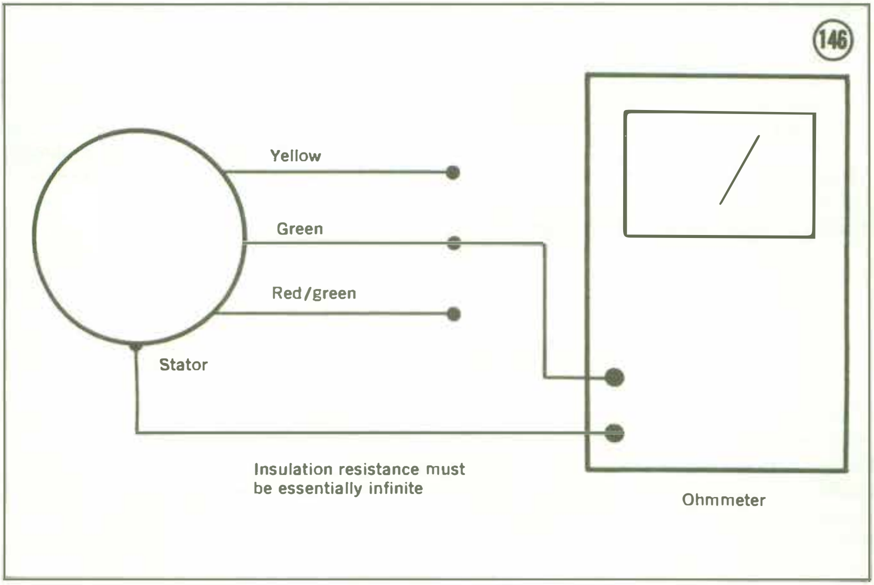
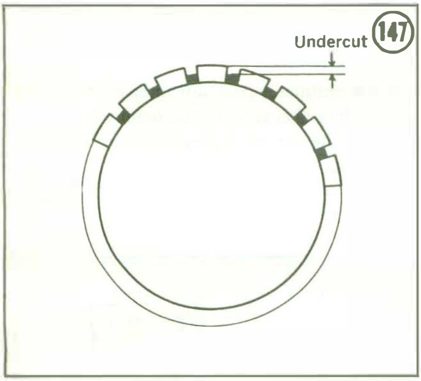


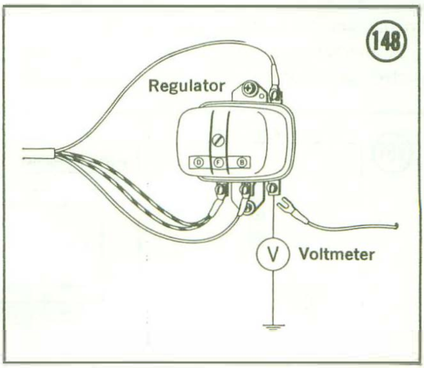




Checking the Regulator

Varying engine speeds and electrical loads affect generator output. The regulator controls this, and also disconnects the battery from the generator whenever generator output voltage is below that of the battery, thereby preventing battery discharge through the generator.

Disconnect the wire from terminal B at the regulator. Be careful you don't allow this wire to become grounded. Connect the voltmeter between terminal B on the regulator and ground, as shown in **Figure 148**. Start the engine and run it at 2,500 rpm. The voltmeter should indicate 14.4-15.6 volts.



Observe the contacts on the cutout relay as you slowly increase engine speed. The contacts should close when voltmeter indicates 12.0-13.5 volts.

Adjusting the Voltage Regulator

CAUTION

Disconnect the battery before you remove the regulator cover. Do not make any adjustments with the battery in place.

Remove the regulator cover and adjust the regulator by bending the adjustment spring. Bending it downward raises the voltage setting. The voltage regulator can be identified by its 2 contact points.

The cutout relay can be identified by a single set of contacts which are normally open. The relay rarely, if ever, needs adjustment. Usually all that's required is to dress the contacts lightly to remove any corrosion or light pitting. Should adjustment be required, bend the spring retainer up or down as needed. Lowering the spring retainer raises the voltage setting.

SUZUKI TRIPLES

This part covers operating principles and troubleshooting procedures for Suzuki charging, starting, signal, and lighting systems. All Suzuki 3-cylinder machines are equipped with alternators as the source of electrical system power. Conventional battery and coil ignition systems are on all models.

ALTERNATOR

Suzuki triples are equipped with either Denso (**Figure 149**) or Kokusan (**Figure 150**) alternators. Service procedures for the 2 types are similar. Differences are pointed out where they exist. Charging system connections (**Figure 151**) are the same for both systems.

If alternator or regulator problems are suspected, as in the case of a chronically undercharged battery or dim headlights, first check alternator output voltage.

1. Connect an accurate 0-20 DC voltmeter across the battery terminals (**Figure 152**). Be sure to connect the positive voltmeter lead to the positive battery terminal, and the negative voltmeter lead to the negative battery terminal.
2. Start the engine and run it at 2,000-3,000 rpm. If the voltmeter indicates 13.5-14.5 volts, you may assume that the alternator and regulator are OK.
3. If the voltmeter does not indicate 13.5-14.5 volts, further checking will be required. Trouble may lie in the alternator, regulator, or wiring.
4. Measure field winding resistance between the slip rings. If the resistance is not approximately as specified, replace the rotor.

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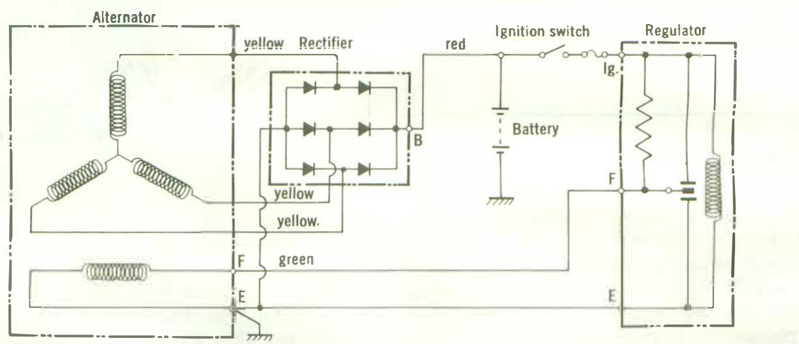
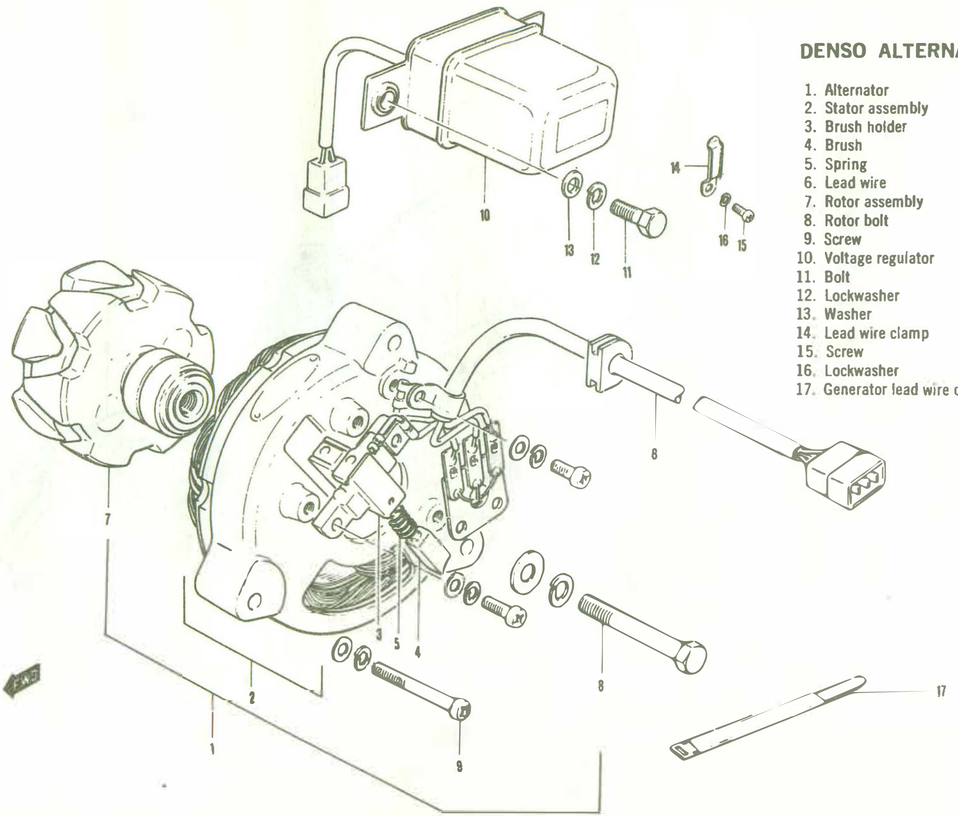
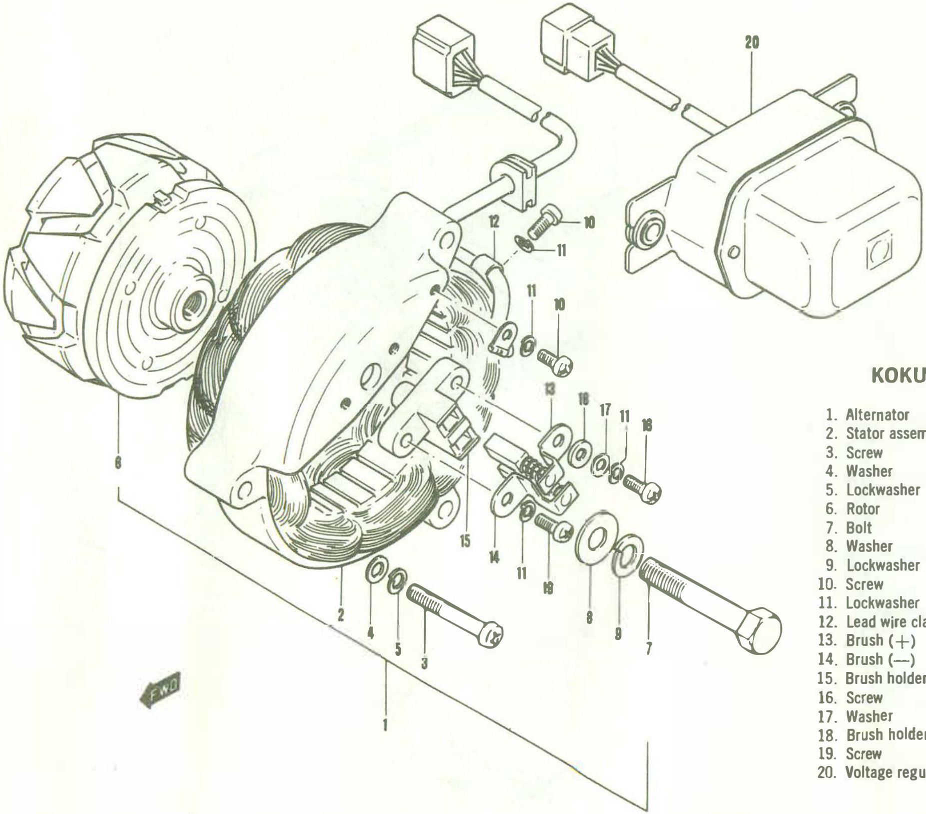




DENSO ALTERNATOR

1. Alternator
2. Stator assembly
3. Brush holder
4. Brush
5. Spring
6. Lead wire
7. Rotor assembly
8. Rotor bolt
9. Screw
10. Voltage regulator
11. Bolt
12. Lockwasher
13. Washer
14. Lead wire clamp
15. Screw
16. Lockwasher
17. Generator lead wire clamp

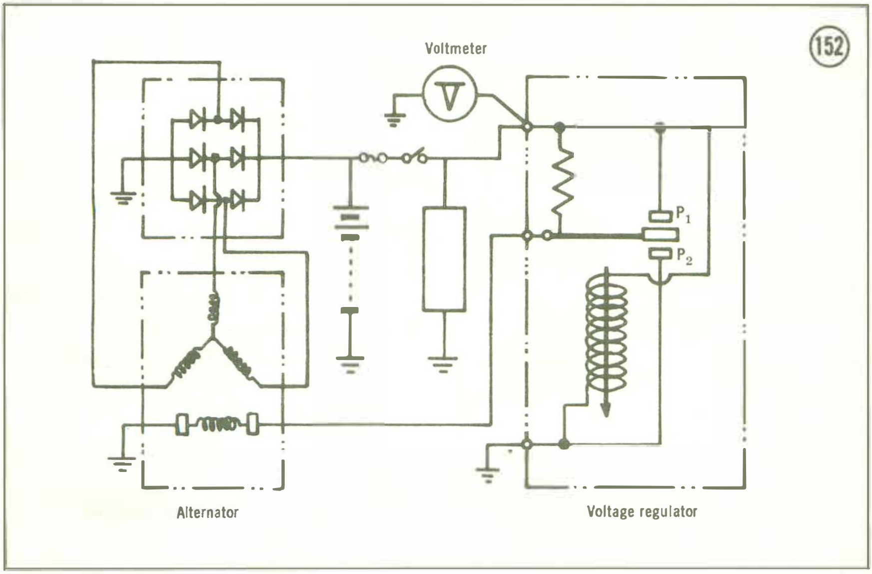
149



KOKUSAN ALTERNATOR

1. Alternator
2. Stator assembly
3. Screw
4. Washer
5. Lockwasher
6. Rotor
7. Bolt
8. Washer
9. Lockwasher
10. Screw
11. Lockwasher
12. Lead wire clamp
13. Brush (+)
14. Brush (—)
15. Brush holder
16. Screw
17. Washer
18. Brush holder insulator
19. Screw
20. Voltage regulator assembly

150



Denso rotor	10-12 ohms
Kokusan rotor	4-5 ohms

5. Measure insulation resistance of the field winding. Set the ohmmeter to its highest range, then measure resistance between either slip ring and the rotor shaft. Insulation resistance must be essentially infinite.

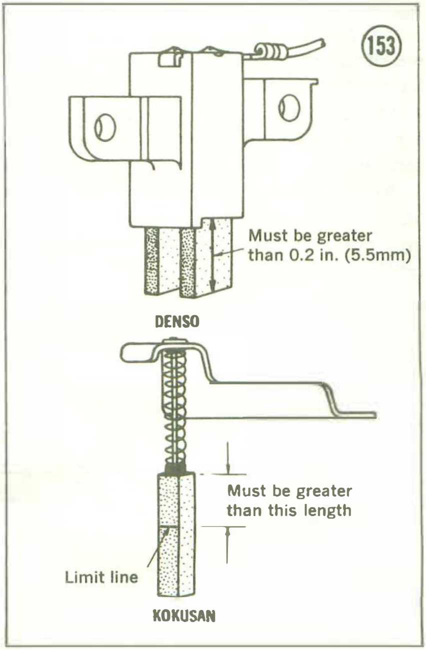
6. Check the alternator brushes (**Figure 153**) for wear. Replace Denso brushes when they are worn to 0.28 in. (7mm). Kokusan brushes should be replaced when they are worn to the limit mark on the brush. On GT750 models, replace brushes when they are worn to 0.22 in. (5.5mm).

7. Check for continuity between each pair of yellow wires coming from the alternator stator.

8. Set the ohmmeter to its highest range, then measure insulation resistance between the stator housing and any of the 3 yellow leads. Insulation resistance must be essentially infinite.

RECTIFIER

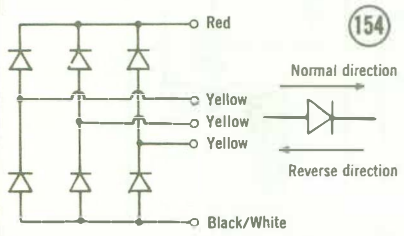
The rectifier assembly serves 2 purposes. It converts alternating current produced by the alternator into direct current which is used to charge the battery. It also prevents discharge of



the battery through the alternator when the engine isn't running, or at other times when the output voltage of the alternator is less than battery voltage.

The rectifier assembly has 3 yellow leads, one red lead, and one black/white lead (**Figure 154**).

154



1. Measure resistance between each yellow lead and the red lead. Record each measurement.
2. Reverse ohmmeter leads and repeat Step 1.
3. If each pair of measurements was high in one direction and low in the reverse direction, proceed with Step 4. If any pair of measurements was either high or low in both directions, replace the rectifier assembly.
4. Measure resistance between each yellow lead and the black/white lead. Record each measurement.
5. Reverse the meter connections and repeat Step 4. If any pair of measurements was either high or low in both directions, replace the rectifier assembly.

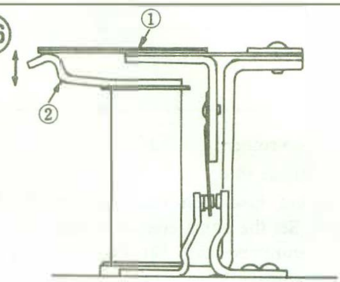
Testing the Regulator

The most common causes of voltage regulator trouble are open wires or short circuits. To check the regulator, proceed as follows:

1. Remove the regulator.
2. Check for continuity between the green and orange wires, and also between the black/white and orange wires (**Figure 155**). Reconnect the ohmmeter between the green and orange leads. Remove the regulator cover, then gently press the armature (1, **Figure 156**) so that the movable contact touches the other fixed contact. The ohmmeter should indicate about 10 ohms.

NOTE: *The regulator cover is sealed to prevent entry of dirt and moisture. Do not remove the regulator cover unless it is necessary to do so.*

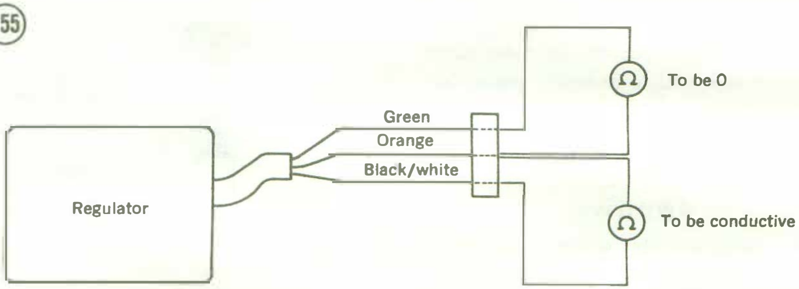
156



1. Regulator lever
2. Lever

3. Connect a voltmeter across the battery terminals. Reconnect the regulator.

155



4. Start the engine and run it at 3,000 rpm. If measured voltage is 14.0 ± 0.5, the regulator is OK. Adjust or replace the regulator if regulated voltage is not within those limits.

NOTE: *Denso and Kokusan regulators are interchangeable.*

Voltage Regulator Adjustment

Do not attempt to adjust the regulator unless it has first been determined that all other parts of the charging system are in good condition.

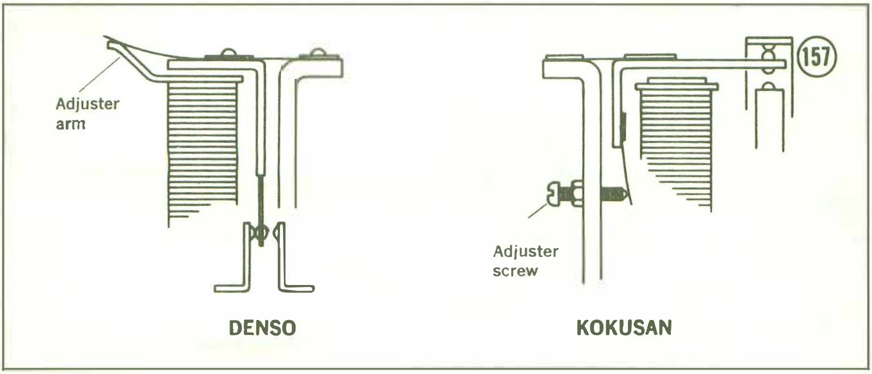
1. With the engine not running, and the ignition switch off, remove the regulator cover.
2. Connect a voltmeter of known accuracy to measure system voltage (Figure 152).
3. Start the engine and run it at approximately 3,000 rpm. Note the voltmeter indication.
4. Bend the adjustment arm on Denso regulators, or turn the screw on Kokusan regulators (**Figure 157**) until the voltmeter indicates 14.0 ± 0.5 volts.
5. Turn off the ignition and replace the cover.
6. Check adjustment with the cover installed.

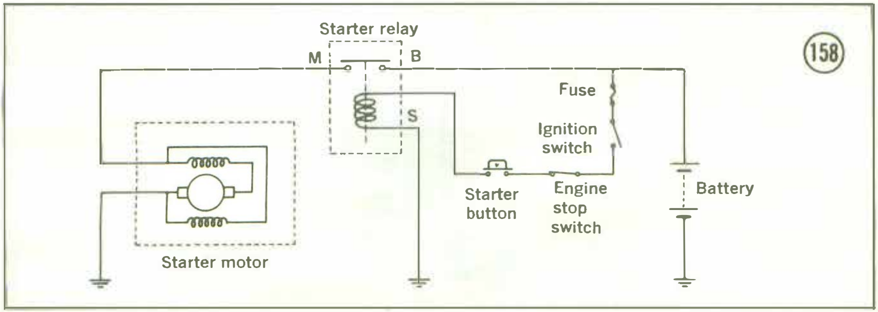
ELECTRIC STARTER

Models GT550 and GT750 are equipped with electric starters. Starter motors are supplied by 2 different manufacturers, Denso and Kokusan, so it is important to specify the type and model motor when ordering replacement parts. Service procedures are similar; differences are pointed out where they exist.

Starter Operation

Figure 158 illustrates a typical starter motor circuit. When the rider presses the engine starter button, current flows from the battery through the coil of the starter relay, causing the relay





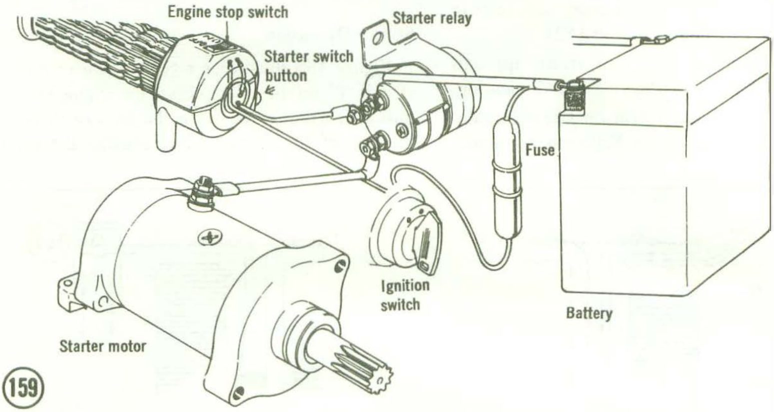
armature to connect terminals **M** and **B**. Current then flows directly from the battery to the starter motor. **Figure 159** is a pictorial diagram of the system connections.

Figure 160 illustrates a typical starter drive train. When the starter turns, torque is transmitted through, and multiplied by, the idler gear and starter clutch gear. The starter clutch will transmit torque in only one direction. When the engine starts, the outer race, connected to the clutch housing, overruns the inner race and disconnects the drive. Note that since the starter drives the clutch housing, the engine may be started with the transmission in gear if the clutch is released.

Starter Disassembly

Figures 161 and 162 are exploded views, respectively, of Denso and Kokusan starter motors. Refer to the applicable illustration during disassembly and reassembly. To disassemble the starter motor, proceed as follows:

1. Remove both thru-bolts, commutator end frame, bolts, brushes, shims, and thrust washers.



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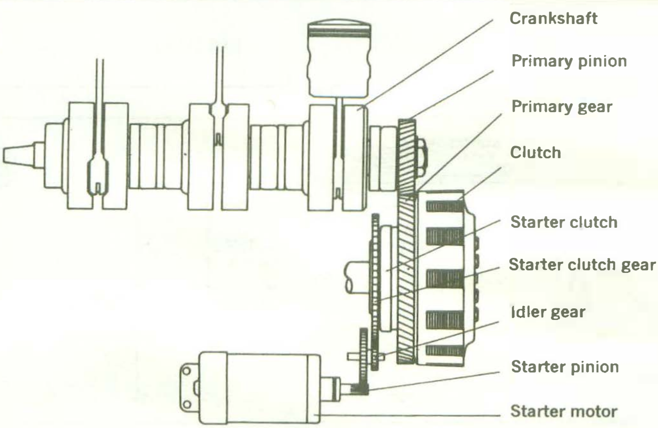
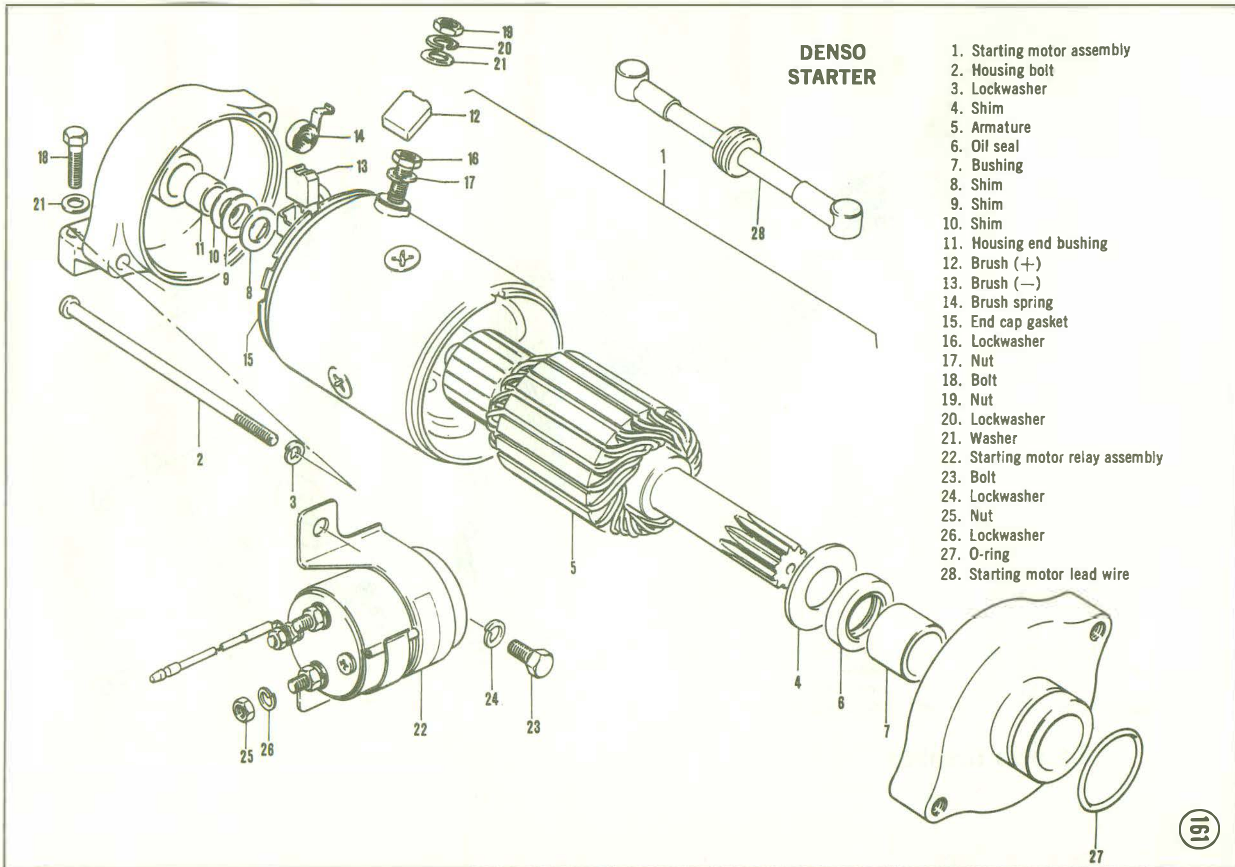




DENSO STARTER

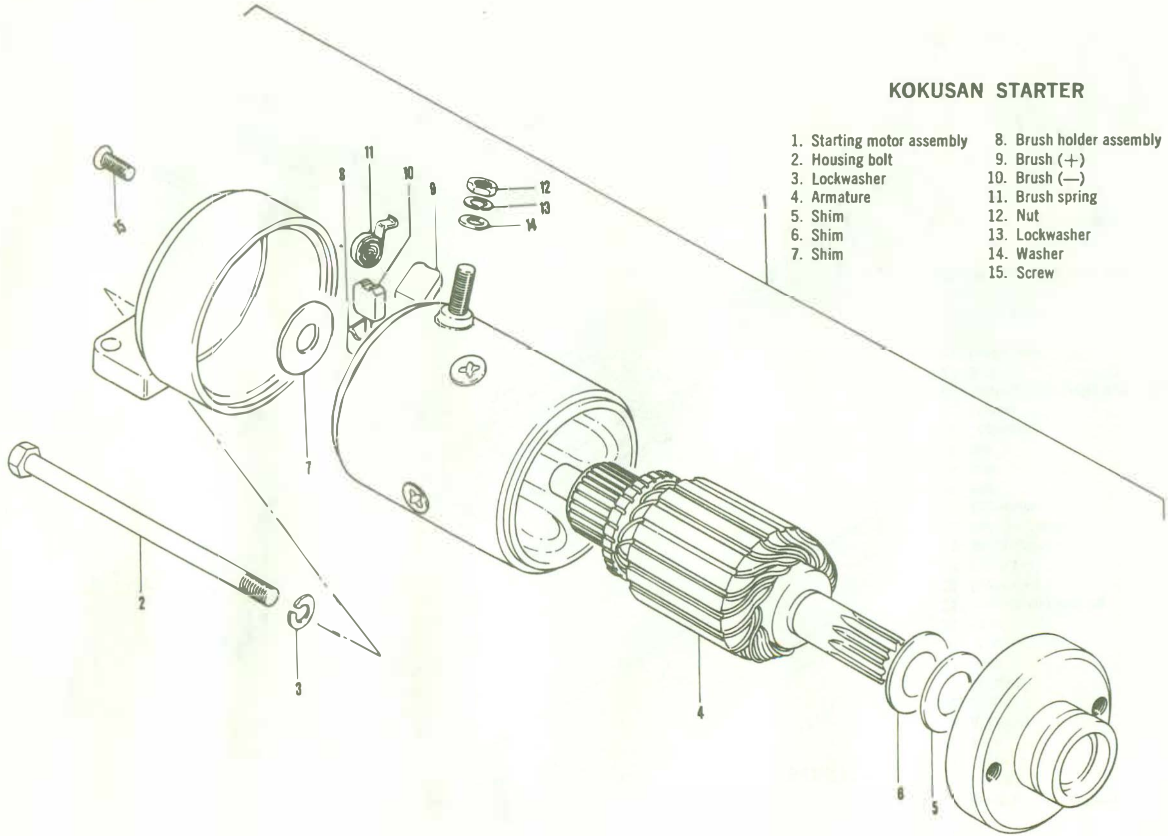
1. Starting motor assembly
2. Housing bolt
3. Lockwasher
4. Shim
5. Armature
6. Oil seal
7. Bushing
8. Shim
9. Shim
10. Shim
11. Housing end bushing
12. Brush (+)
13. Brush (—)
14. Brush spring
15. End cap gasket
16. Lockwasher
17. Nut
18. Bolt
19. Nut
20. Lockwasher
21. Washer
22. Starting motor relay assembly
23. Bolt
24. Lockwasher
25. Nut
26. Lockwasher
27. O-ring
28. Starting motor lead wire

161

(162)

KOKUSAN STARTER

1. Starting motor assembly
2. Housing bolt
3. Lockwasher
4. Armature
5. Shim
6. Shim
7. Shim
8. Brush holder assembly
9. Brush (+)
10. Brush (—)
11. Brush spring
12. Nut
13. Lockwasher
14. Washer
15. Screw



Note locations of all small parts as they are removed.

2. Press out the bushings from both end frames.

3. Reverse the disassembly procedure to reassemble the starter motor. Pay particular attention to the following points:

   a. Apply a small amount of multipurpose grease to both armature bushings.

   b. Install armature brushes into the brush holders after the armature is installed.

   c. Be sure that all shims and thrust washers are positioned correctly.

   d. Be sure that the shaft turns freely.

Starter Motor Overhaul

1. Measure clearance between each bushing and the armature shaft. Replace the bushings if clearance exceeds 0.008 in. (0.2mm).

2. Examine the commutator for rough, burned, or scored segments, and for possible signs of overheating or thrown solder.

3. Mount the armature in a lathe, V-blocks, or other suitable centering device, then measure the commutator for runout. If runout exceeds 0.012 in. (0.3mm), turn it down, but do not take off so much that overall commutator diameter is less than 1.045 in. (26.5mm).

4. After turning, undercut the mica insulators between commutator segments to 0.020-0.030 in. (0.5-0.8mm). If commutator turning was not required, be sure that the mica insulators are undercut at least 0.012 in. (0.3mm). A broken hacksaw blade is a suitable tool for undercutting mica. Be sure to clean each slot thoroughly.

5. Using an ohmmeter or armature growler, test each commutator segment to be sure that it is not shorted to ground. Replace the armature if any short exists. Do not connect either test prod to the bearing surfaces of the shaft.

6. Using an armature growler, test for armature coil shorts. Follow the manufacturer's instructions on the test equipment.

7. Using an ohmmeter or armature tester, check for open windings in the armature.

8. With the armature removed, test the shunt field coils by connecting the motorcycle battery between the starter terminal and the stator housing as shown in **Figure 163**. Insert a screwdriver into the motor housing. If the screwdriver is

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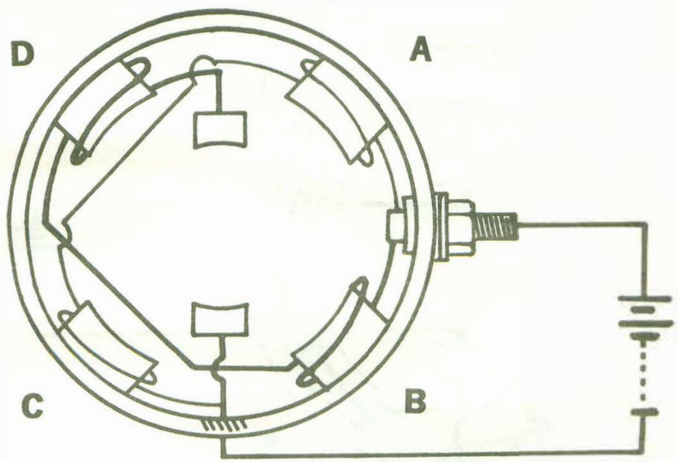

drawn to coils A and C, the shunt field coils are not open. Do not leave the battery connected any longer than is necessary to make this test.

9. Disconnect the shunt field coil wire at the ground brush. Then with an ohmmeter set to its highest range, check for continuity between the starter terminal and ground. If the ohmmeter shows continuity, replace the shunt field coils. Shunt field coil resistance, measured between the stator terminal and the grounded brush, should be approximately 2.5 ohms.

10. Check the series field coils by connecting the motorcycle battery between both brushes as shown in **Figure 164**. Then again insert a screwdriver into the motor housing. The screwdriver should be attracted to the *shunt coils*, A and C. Do not leave the battery connected any longer than is required to make this test.

11. Disconnect the shunt coil wire at the starter terminal. With an ohmmeter set to its highest range, check for continuity between the starter terminal and the motor housing. If the ohmmeter shows continuity, replace the series field coil.

12. With the ohmmeter set to its highest range, check for any short circuit between the insulated starter brush and ground. Repair or replace the brush holder if any short circuit exists.

13. Examine both starter brushes. Replace them when they are worn to the limits shown in **Figure 165**.

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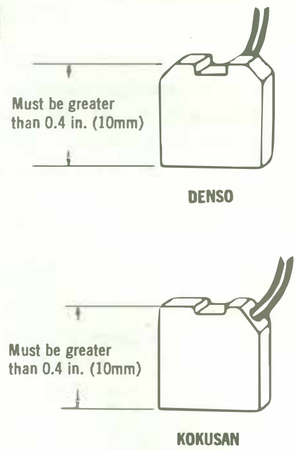
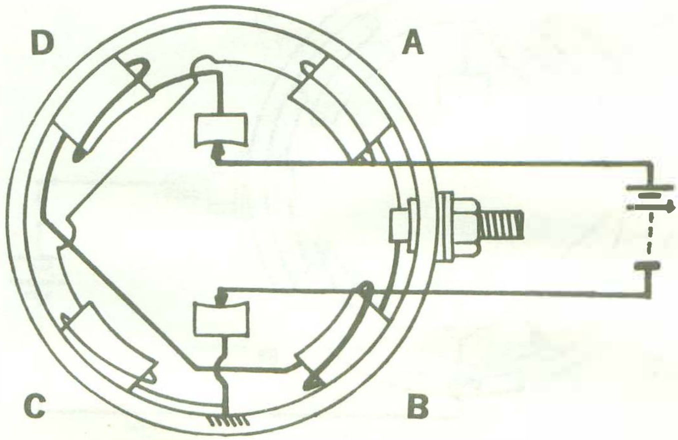


14. Upon reassembly, check brush spring tension. If tension is less than 0.85 lb. (600 g), replace the springs.

164



STARTER RELAY

The starter relay controls operating current to the starter motor. When the starter button is pressed, the relay coil is energized, closing the relay contacts. Current then flows from the battery, through the relay contacts, and finally thorough the starter motor.

To check the starter relay, connect the battery as shown in **Figure 166**. The relay should click as the battery is connected. Then remove the relay cover and check its contacts for burrs or roughness. Dress the contacts, if necessary, with a fine file.

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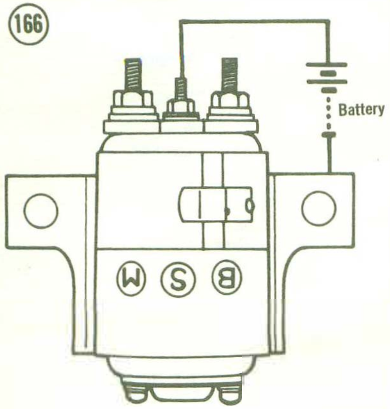

STARTER CLUTCH

The starter clutch transmits torque from the starter to the engine, but releases whenever the engine overruns the starter. **Figure 167** is a simplified drawing of starter clutch mechanism.

Figures 168 and 169 are exploded views of starter clutches for models GT550 and GT750, respectively. Refer to the appropriate illustration during disassembly and reassembly.

During reassembly, observe following notes:

1. Apply thread lock cement to each assembly bolt or screw.
2. On GT750 models, be sure that the punch mark aligns with pin on the water pump drive gear.
3. Tighten the retaining nut on model GT750 to 33-40 ft.-lb. (450-550 cm-kg). A starter clutch holder will make the job easier (**Figure 170**).
4. On model GT750, turn the breaker cam shaft by hand to align its cutaway with the pin on the water pump drive gear (**Figure 171**).

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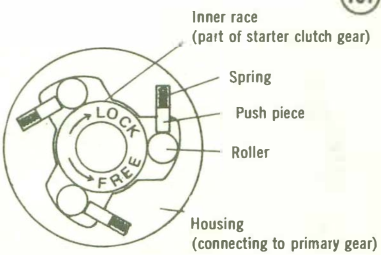

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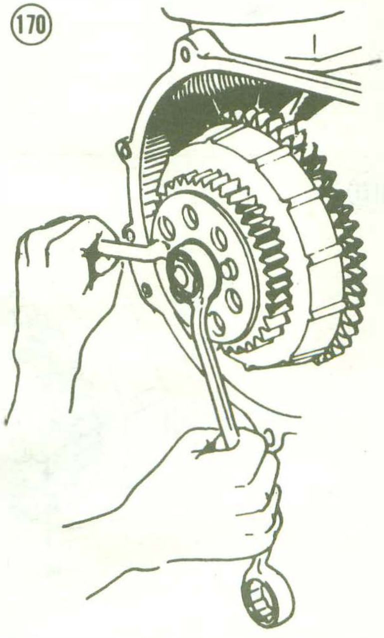
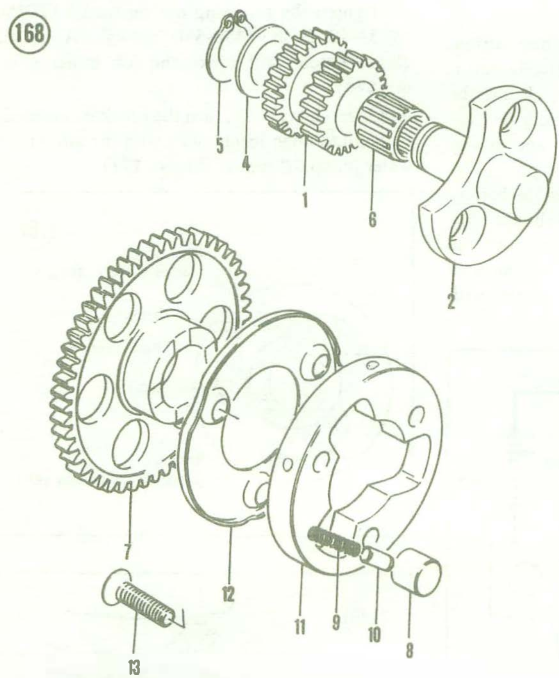
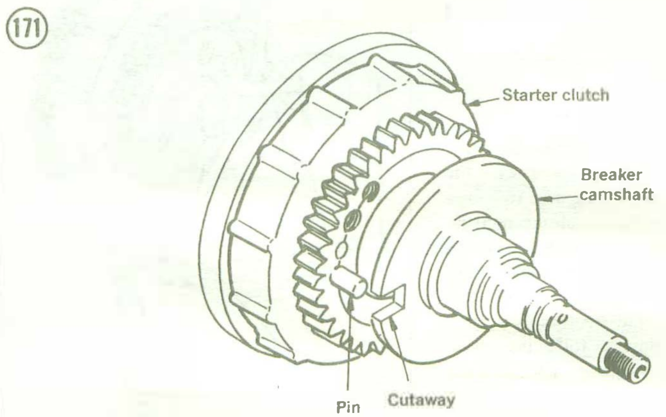




GT550 STARTER CLUTCH

1. Starter idler gear
2. Starter idle gear shaft
3. Screw
4. Thrust washer
5. Snap ring
6. Needle bearing
7. Starter clutch gear
8. Roller
9. Spring
10. Roller push piece
11. Starter clutch hub
12. Starter clutch plate
13. Screw



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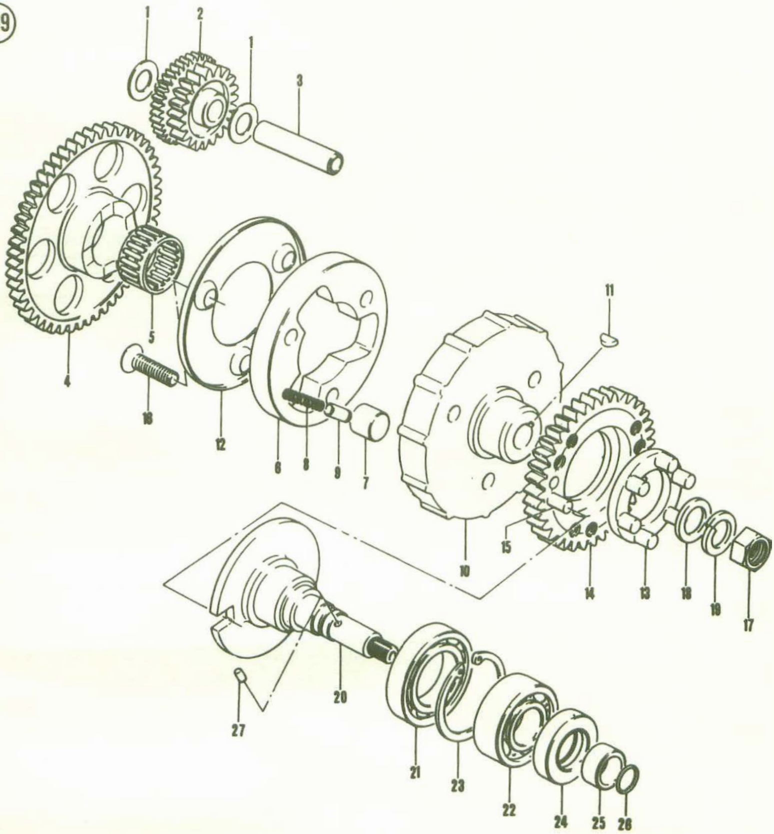


GT750 STARTER CLUTCH

1. Starter idle gear washer
2. Starter idle gear
3. Idle gear pin
4. Starter clutch gear
5. Starter clutch bearing
6. Starter clutch hub
7. Roller
8. Starter clutch spring
9. Push piece
10. Starter clutch housing
11. Key
12. Starter clutch plate
13. Breaker cam shaft rubber
14. Water pump drive gear
15. Breaker cam shaft drive pin
16. Screw
17. Nut
18. Washer
19. Lockwasher
20. Breaker cam shaft
21. Breaker cam shaft bearing
22. Bearing
23. Circlip
24. Oil seal
25. Spacer
26. O-ring
27. Dowel pin

TRIUMPH TWINS

Triumph 500-750cc twins are variously equipped with battery or magneto ignition systems, and 6-volt or 12-volt charging systems. Alternators supply electrical system power for all models. Battery and magneto ignition systems are discussed in *Battery Ignition* and *Magneto Ignition*, found earlier in this chapter.

CHARGING SYSTEM

The charging system consists of an alternator, rectifier, zener diode for voltage control, battery, and interconnecting wiring. Some models do not have batteries.

If charging system problems are suspected, first be sure that the battery is in good condition and fully charged, then perform the following test:

1. Disconnect the brown/blue wire at the negative battery terminal.

2. Connect the wire which was removed to the negative terminal of a 0-5 DC ammeter.

3. Connect the positive ammeter terminal to the negative battery terminal.

4. On models so equipped, disconnect the wire or wires from the zener diode. When 2 wires are removed, they should remain connected together. Start the engine and run it at 3,000 rpm. **Table 33** lists approximate ammeter indications to be obtained with headlights off and with high beam on.

Table 33 CHARGING CURRENT

		Charging Current (Amperes)	
Stator Number	System Voltage	Lights Off	High Beams On
47162	6	2.7	2.0
47162	12	4.8	1.8
47164	6	2.7	1.6

If charging system output is not approximately as specified, test the alternator and rectifier separately.

Alternator Test

1. With the engine off, unplug the alternator output leads. Connect a one-ohm, 50-watt resistor across each pair of leads listed in **Table 34**, and also connect a 0-20 AC voltmeter across the same pair of leads.

Table 34 ALTERNATOR OUTPUT VOLTAGE

Stator Number	Leads	Voltage
47162	Green/white-green/black	4.0
	Black/yellow-black/white	6.5
	Green/white-green/black and green/yellow connected	8.5
47164	Green/white-green/black	4.5
	Green/white-green/yellow	7.0
	Green/white-green/black and green/yellow connected	9.5
Magneto ignition	Brown/blue-red	5.0
	Black/yellow-black/white	1.5
	Black/yellow-brown	3.5

2. Start the engine and run it at 3,000 rpm. For battery ignition models, alternator output voltage must be at least so high as specified.

If output from any one pair of coils is low, the coil is probably shorted. Zero output from any pair of leads indicates an open coil. Output between any lead and ground indicates a coil shorted to ground. Replace the stator if any of these conditions exist.

If output from all coils is low, the rotor is probably demagnetized, and must be replaced.

Rectifier

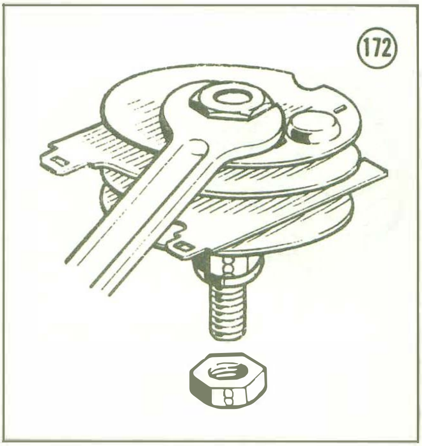
Alternator output is converted to direct current by the rectifier. Failure of this unit can be determined readily by use of a test light or ohmmeter.

1. With the rectifier removed from the motorcycle, connect the test light or ohmmeter across the following pairs of terminals, then reverse the test connections. Replace the rectifier if measured resistance is either high or low for any pair of measurements.

Red and green/yellow or green/black
Red and green/white
Brown/white and green/yellow
or green/black
Brown/white and green/white

If the motorcycle has a rectifier which does not follow the color code listed, measure resistance between each input terminal (from the alternator) to each output terminal (to battery and ground) in both directions.

When handling the rectifier, be very careful not to twist the plates in relation to one another. Such twisting will break internal connections, rendering the unit useless. Be sure to hold the retaining nut (**Figure 172**) when removing or replacing the rectifier assembly.



Zener Diode

On models so equipped, the zener diode controls alternator output voltage. To test it, proceed as follows:

> NOTE: *The battery must be in good condition and fully charged before performing this test. If its condition is doubtful, temporarily replace it with one known to be good.*

1. Connect the positive terminal of a 0-5 DC ammeter to the Lucar blade terminal on the zener diode. Connect the negative ammeter terminal to the wire or wires which normally connect to the zener diode.
2. Connect the negative terminal of a 0-20 DC voltmeter to the Lucar terminal on the zener diode. Connect the voltmeter positive terminal to ground.
3. With all lights and other electrical loads off, except for ignition, start the engine.
4. Slowly increase engine speed and observe both meters. The ammeter must indicate little or no current flow until the voltmeter indicates at least 12.7 volts. The ammeter must indicate at least 2 amperes before the voltmeter indicates 15.5 volts. Replace the zener diode if these conditions are not met.

YAMAHA SINGLES

Flywheel magnetos supply ignition current for most models; a few models, such as AT1, are equipped with battery ignition systems. *Battery Ignition,* found earlier in this chapter, discusses troubleshooting and operating principles of battery ignition systems; *Magneto Ignition* contains similar treatment of the magneto systems.

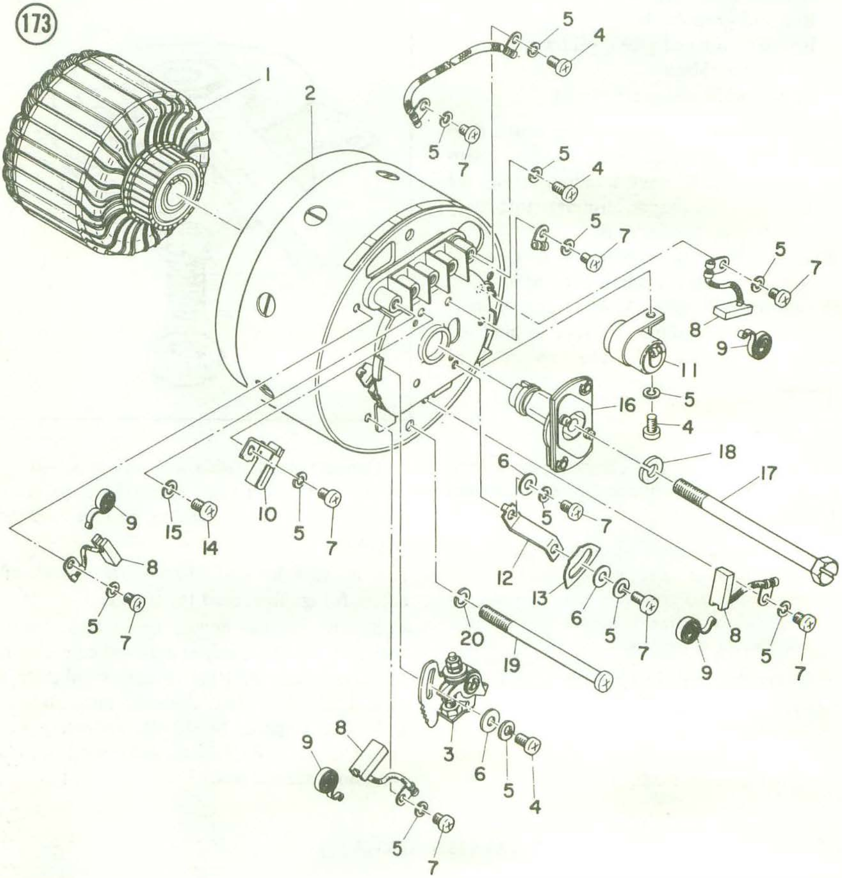
AT1-TYPE CHARGING SYSTEM

This type system is equipped with a combination starter/generator (**Figure 173**). This unit functions as a motor for engine starting, and as a generator when the engine is running. **Figure 174** is a circuit diagram of a typical starter/generator system.

Checking Generator Output

To check generator output, proceed as follows:

1. Disconnect white wire from terminal A.
2. Disconnect green wire from terminal F.
3. Connect terminal E to terminal F with a jumper.



AT1-TYPE STARTER/GENERATOR

1. Armature
2. Stator assembly
3. Contact breaker assembly
4. Pan head screw
5. Spring washer
6. Washer
7. Pan head screw
8. Brush
9. Brush spring
10. Lubricator
11. Condenser
12. Timing plate fixture
13. Timing plate
14. Pan head screw
15. Spring washer
16. Governor assembly
17. Bolt
18. Spring washer
19. Stator screw
20. Spring washer

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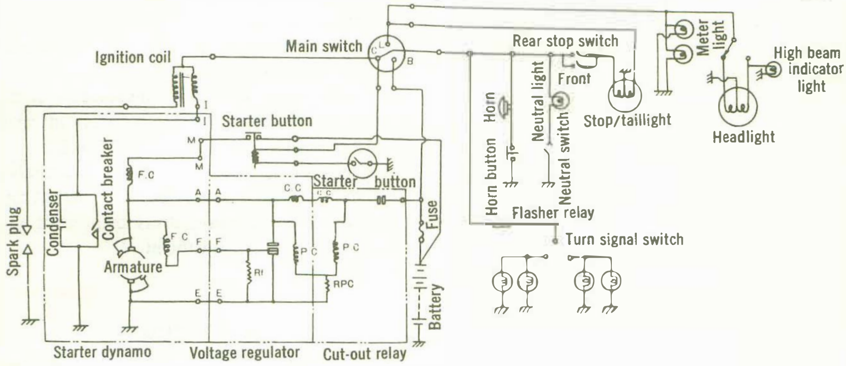

AT1-TYPE CHARGING SYSTEM CIRCUIT

4. Connect the positive lead of a voltmeter to terminal A; connect the negative lead to ground.
5. Start the engine and run it at 1,800 rpm. Do not run the engine at a higher speed, as this will damage the coil and other electrical components.
6. If the voltmeter indicates 10 volts or more, the generator is in good condition.

Checking the Yoke

Before checking the yoke, clean it with a rag to remove carbon dust, oil, and other foreign material.

1. With the yoke removed, use an ohmmeter to be sure the positive brush is not shorted to ground.
2. Use the ohmmeter to determine that there is continuity between terminals M and A, and between terminals A and F. If there is no continuity, and coil connections are good, replace the coil.
3. Poor brush condition is one of the most frequent causes of generator trouble. Remove the brushes and check them carefully. Each brush must contact the commutator with at least ¾ of its contact surface.

If brushes and commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if any burrs are found. If either brush is worn beyond the minimum length mark, replace both brushes. When replacing brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

1. Clean the armature of oil, dust, and foreign material.
2. If the commutator is only slightly rough, it may be polished with fine sandpaper.

If the commutator is out-of-round, burned, or too rough to polish, remove it and turn it on a lathe. Do not turn it to a diameter less than 1.5 in. (38mm).

3. If the commutator has high mica, undercut the mica segments with a broken hacksaw blade or mica undercutting tool. Be sure that there is no thin mica edge next to the commutator seg-

ments. The mica should be undercut 0.02-0.03 in. (0.5-0.8mm).

4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If any short circuit exists, replace the armature.

Checking the Voltage Regulator

Varying engine speeds and electrical loads affect generator output voltage. The regulator controls generator output voltage, and also disconnects the battery from the generator whenever generator voltage is less than that of the battery, thereby preventing discharge of the battery through the generator.

NOTE: *Do not attempt to make the following adjustments unless you have a voltmeter of known accuracy.*

To measure no-load voltage, disconnect the red wire from the regulator, then connect the positive lead to that wire. Ground the negative lead of the voltmeter. Start the engine and run it at 2,500 rpm. **Figure 175** illustrates test connections. If the voltmeter does not indicate 15.8 to 16.5 volts, adjust regulator output voltage with the adjustment screw on the regulator.

To measure cut-in voltage of the cutout relay, disconnect the wire from terminal A on the generator. Connect the positive lead of the voltmeter to terminal A; ground the negative lead. Start the engine, and slowly increase its speed as you observe the voltmeter. The cutout relay should close between 12.5 and 13.5 volts.

Under normal circumstances, the cutout relay will rarely, if ever, need adjustment. If the contacts are pitted or worn, dress them with fine emery cloth before adjustment.

CHOKE COIL

Some models are equipped with a choke coil in the night lighting circuit. As engine rpm increases, so does output frequency of the lighting coils in the magneto. Inductance of the choke coil tends to maintain current to the lights at a more constant level.

No maintenance on the choke coil is required. If its condition is doubtful, check it for continuity and insulation from ground with an ohmmeter.

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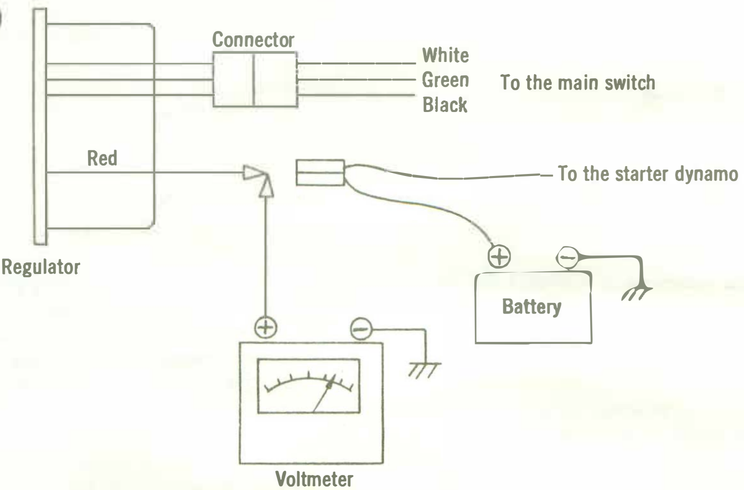


YAMAHA 2-STROKE TWINS

All Yamaha 2-stroke twins are equipped with battery and coil ignition systems. Refer to *Battery Ignition*, found earlier in this chapter, for troubleshooting and operating principles.

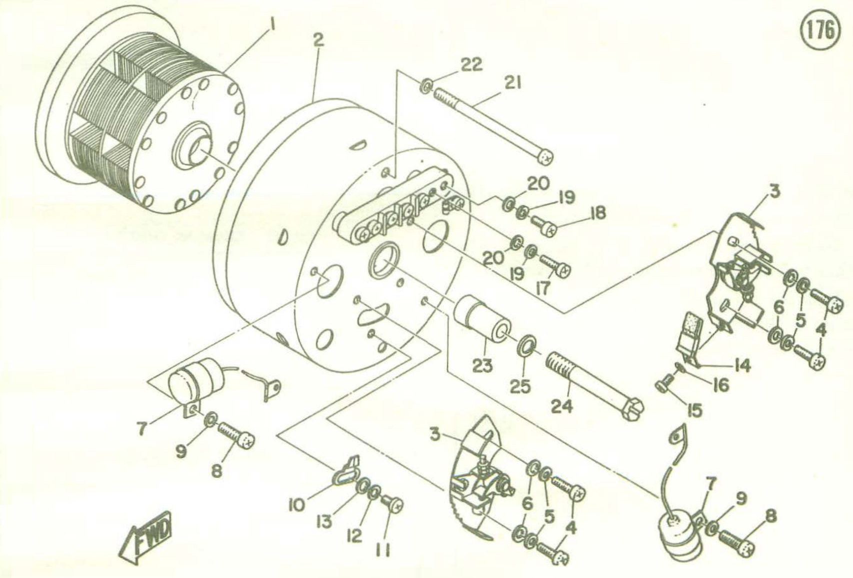
All models are equipped with either an alternator or DC generator as the source of electrical power. Some models are equipped with electric starters.

CHARGING SYSTEM

The charging system consists of an electrical generator, voltage regulator, battery, and connecting wiring. Generators on these machines are either alternator, direct current generators, or combination starter/generators.

Hitachi 108-08 Alternator

This alternator, the simplest, consists of a 6-pole permanently magnetized rotor that revolves within a stator. Rotation of the rotor induces alternating current in the stator, which is then rectified and used to charge the battery and operate the electrical accessories. This alternator does not require a regulator. **Figure 176** is an exploded view of the alternator.

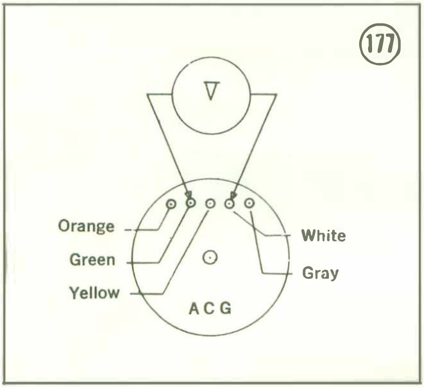


HITACHI 108-08 ALTERNATOR

1. Rotor
2. Stator
3. Breaker points
4. Screw
5. Lockwasher
6. Flat washer
7. Condenser
8. Screw
9. Lockwasher
10. Timing plate
11. Screw
12. Lockwasher
13. Flat washer
14. Lubricator
15. Screw
16. Lockwasher
17. Screw
18. Screw
19. Lockwasher
20. Flat washer
21. Screw
22. Lockwasher
23. Cam
24. Bolt
25. Lockwasher

When alternator problems are suspected, as in the case of dim headlights or a chronically low battery, check alternator day and night output voltages.

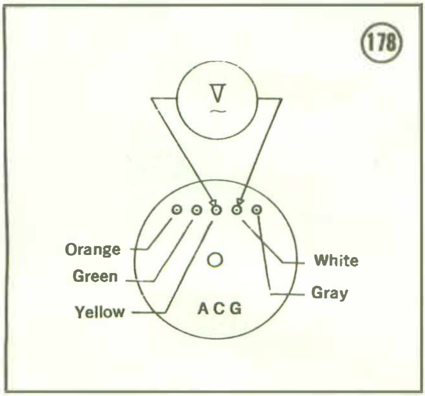
1. Disconnect the yellow, green, and white wires from the alternator. Connect a 0-100 AC voltmeter as shown in **Figure 177**, to measure daytime charging voltage.



2. Start the engine and run it at 3,000 rpm. Set the main switch to the day riding position. The voltmeter should indicate 48-58 volts.

3. Increase engine speed to 5,000 rpm. The voltmeter should now indicate 83-97 volts.

4. Stop the engine. Reconnect the voltmeter as shown in **Figure 178** and set the main switch to the night riding position.



5. Start the engine and run it at 3,000 rpm. The voltmeter should indicate 48-58 volts.

6. Increase engine speed to 5,000 rpm. The voltmeter should now indicate 83-97 volts.

7. Reconnect the leads.

If output voltages were found to be within limits, the alternator is probably OK. To be sure, connect a 0-10 DC ammeter as shown in **Figure 179**. Start the engine and operate it at 3,000 and 5,000 rpm with the switch in both day and night positions. Output current should be as specified in **Table 35**, ± 0.5 ampere.

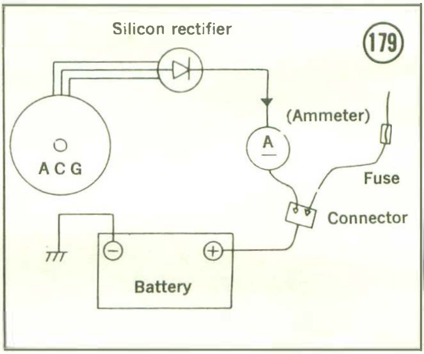
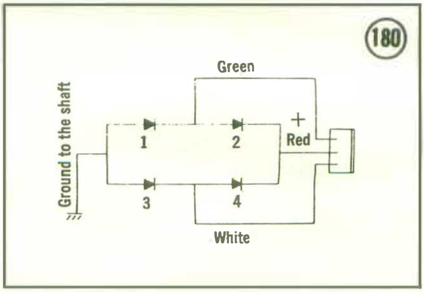


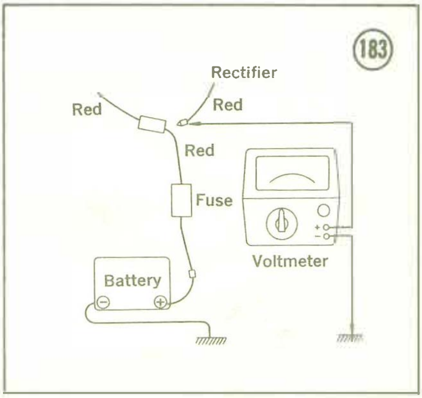
Table 35 CHARGING CURRENT

RPM	Amperes Day	Night
3,000	2.8	6.7
5,000	3.2	7.1

If output current is low, check the rectifier. Refer to **Figure 180** for this procedure.



1. Check diode 1 by measuring resistance between the green lead and the shaft. Then reverse the ohmmeter leads and again measure the resistance. If resistance is approximately 10 ohms in one direction, and essentially infinite in the other direction, the diode is good. If resistance is high in both directions, the diode is open.
2. Check diode 2 by measuring resistance between the red and green leads, in both directions.
3. Measure resistance between the white lead and shaft, in both directions, to check diode 3.
4. Check diode 4 by repeating the measurements between the white and red leads. Replace the diode assembly if any diode is open or shorted.



Mitsubishi AZ2010N Alternator

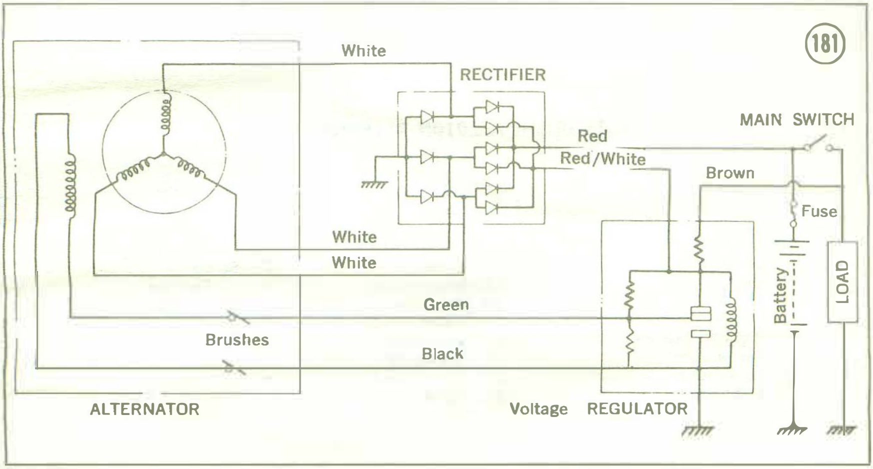
This alternator is excited by a separate field winding (**Figure 181**). The voltage regulator controls alternator output by varying its field current. **Figure 182** is an exploded view of this alternator.

To check alternator output, disconnect the red wire at the rectifier, and connect a 0-20 DC voltmeter as shown in **Figure 183**. Start the engine, then run it at approximately 2,500 rpm. The meter should indicate 15.5-16.5 volts.

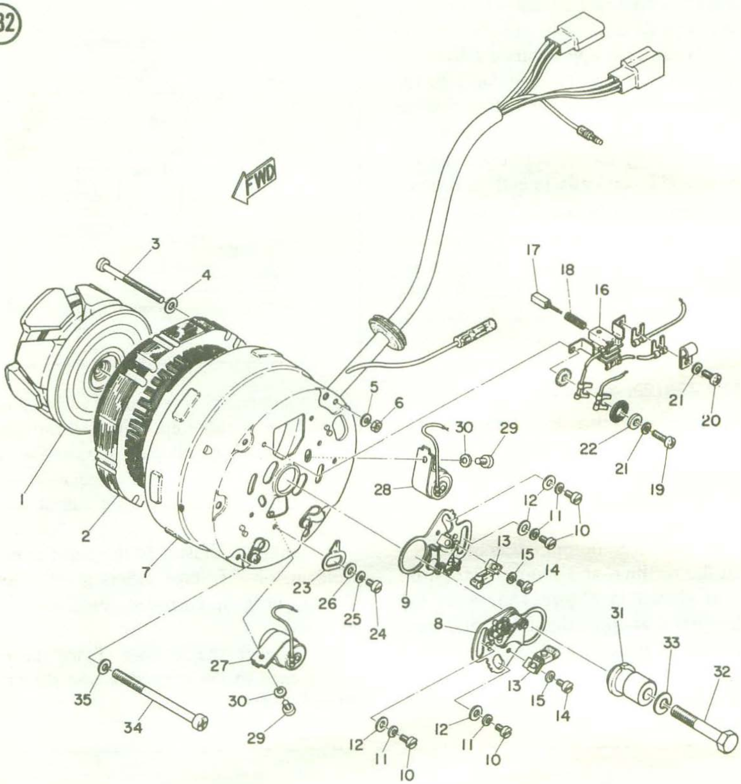
If measured voltage differs only slightly from the specified value, adjust the regulator by bending the adjusting arm. Make each adjustment carefully, in small steps. Upward movement of the arm raises regulated voltage. The voltage regulator can be easily distinguished from the cutout relay. Contacts on the cutout relay will be open.

If regulator adjustment does not remedy the problem, or if voltage differs greatly, look for obvious broken, corroded, or loose wires or terminals.

Next, check the rectifier. Trace the rectifier wiring back to the connector and disconnect it (**Figure 184**).

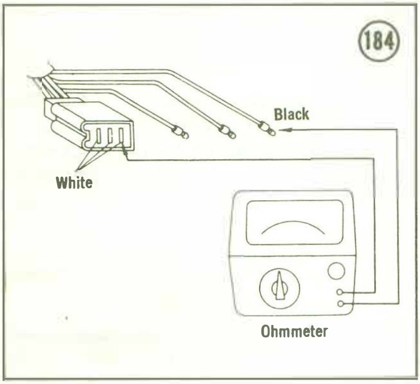


(182)



MITSUBISHI AZ2010N ALTERNATOR

1. Rotor
2. Armature
3. Screw
4. Flat washer
5. Lockwasher
6. Nut
7. Stator
8. Left breaker assembly
9. Right breaker assembly
10. Screw
11. Lockwasher
12. Flat washer
13. Lubricator
14. Screw
15. Flat washer
16. Brush holder
17. Brush
18. Brush spring
19. Screw
20. Screw
21. Lockwasher
22. Flat washer
23. Timing plate
24. Screw
25. Lockwasher
26. Flat washer
27. Left condenser
28. Right condenser
29. Screw
30. Lockwasher
31. Cam
32. Bolt
33. Lockwasher
34. Screw
35. Lockwasher



1. Connect one ohmmeter lead to the black wire, and the other lead to each of the 3 white wires in turn. Then repeat the measurements with the ohmmeter leads reversed. All measurements should be 20-30 ohms in one direction, and essentially infinite in the other direction.

2. Repeat Step 1, except make measurements between the red wire and each white wire. Meter indications should be as in Step 1.

3. Repeat Step 1, except make measurements between the red/white wire and the 3 white wires. Resistance readings should be the same as before.

4. If any reading differs greatly from the specified value, replace the rectifier unit.

5. Reconnect the leads if the rectifier reads OK.

To check for a defective alternator rotor or stator, proceed as follows:

1. Trace the wiring from the alternator to the connector. Disconnect the connector.

2. Measure resistance between each pair of white wires (3 possible combinations). Each combination should indicate 0.30-0.35 ohm.

3. Ground one ohmmeter lead to the stator housing. Set the ohmmeter to its highest resistance range.

4. Measure insulation resistance between each white lead and the stator housing. Resistance should be essentially infinite.

5. If the readings are not as specified in Steps 2 through 4, the windings are open, shorted, or shorted to the housing. Replace the entire unit.

Also check the rotor and the brushes.

1. Inspect the brushes for obvious damage or wear. Standard brush length is 0.43 in. (11mm). Wear limit is 0.23 in. (6mm).

2. Measure resistance between each of the rotor slip rings. Resistance should be 4.0-4.5 ohms.

3. Measure insulation resistance between each slip ring and the rotor core, with the ohmmeter on the highest range. Insulation resistance should be essentially infinite.

4. Replace the rotor if measurements differ greatly from those specified.

DC GENERATORS

Several different models of generators are installed on Yamaha machines, but they are all similar in construction and service procedures. **Figure 185** is a wiring diagram for a typical machine equipped with a DC generator. **Figure 186** is an exploded view of a typical DC generator.

Troubleshooting

If all wiring and connectors are in good condition, trouble in the system must be either in the generator or the regulator. To determine which, first check the generator.

1. Disconnect the wire (usually green) from terminal F on the generator.

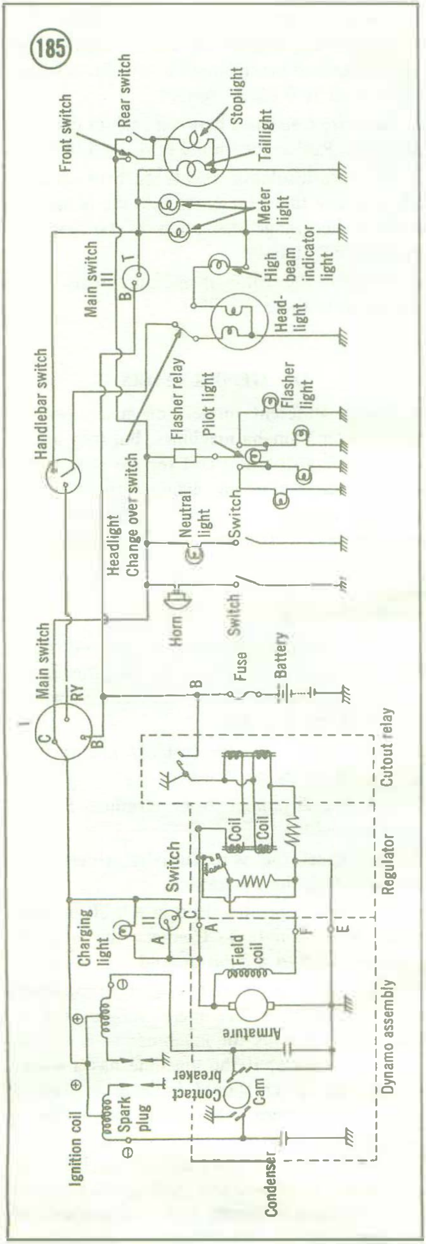
2. Connect a jumper from terminal F to a good ground.

3. Disconnect the wire (usually white) from terminal A on the generator.

4. Connect the positive lead of a 0-20 DC voltmeter to terminal A. Connect the negative voltmeter lead to a good ground.

5. Start the engine and run it at approximately 2,000 rpm. The meter should indicate more than 14 volts for machines with 12-volt electrical systems. If the machine has a 6-volt system, the meter should indicate at least 7 volts. Do not operate the engine longer than is necessary to make this measurement.

If the meter indication was as specified, the generator is good, and any trouble will be found in the regulator or wiring. If the meter indicated less than specified, the generator is at fault.



Checking the Yoke

Clean the yoke assembly of all foreign material and remove it from the machine.

1. Use an ohmmeter to measure insulation resistance between the positive brush and ground. If the meter indicates continuity, check for a short circuit at the brush holder or terminal A. Note that the negative brush holder is not insulated.

2. Measure resistance between terminals F and A. Field coil resistance should be 5-8 ohms.

3. Set the ohmmeter to its highest range. Measure insulation resistance between terminal F and a good ground. Insulation resistance must be essentially infinite.

If measurements obtained in Steps 2 or 3 are not as specified, replace the yoke. If the yoke assembly is good, check the brushes and armature.

Checking the Brushes

Poor brush condition is one of the most frequent causes of low generator output. Remove the brushes and examine them carefully. Each brush must contact the commutator with at least ¾ of its contact surface. If either brush is worn past the limit line, replace both brushes.

If the brushes and the commutator are rough, misalignment of the armature and crankshaft may be the cause. Check the tapered bore of the armature and smooth it if there are any burrs.

When replacing the brushes, be sure that the positive brush lead doesn't touch the brush holder or the edge of the breaker plate. Also be sure that the negative brush lead doesn't touch the positive brush spring.

Checking the Armature

1. Clean the commutator of oil, dust, and foreign material.

2. If the commutator is rough or covered with carbon dust, polish it, using fine sandpaper. If light polishing does not clean up the surface, remove the armature and turn the commutator in a lathe. Do not reduce commutator diameter by more than 0.08 in. (2.0mm).

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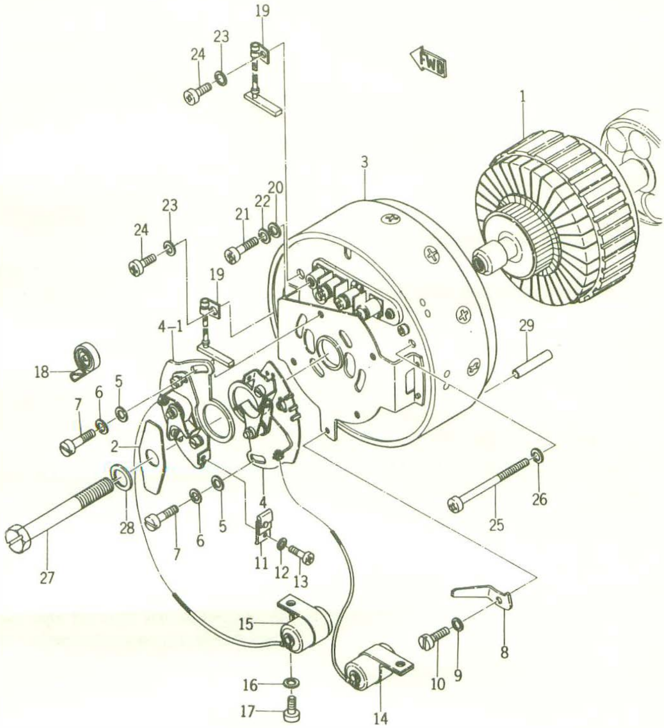

TYPICAL GENERATOR

1. Armature
2. Cam plate
3. Stator
4. Breaker points
5. Flat washer
6. Lockwasher
7. Screw
8. Timing plate
9. Lockwasher
10. Screw
11. Lubricator
12. Lockwasher
13. Screw
14. Right condenser
15. Left condenser
16. Lockwasher
17. Screw
18. Brush spring
19. Brush
20. Flat washer
21. Screw
22. Lockwasher
23. Lockwasher
24. Screw
25. Screw
26. Lockwasher
27. Bolt
28. Lockwasher
29. Dowel pin

3. Undercut the mica segments between the commutator segments, using a hacksaw blade, to a depth of 0.02-0.04 in. (0.5-1.0mm). Remove all dust from between the segments.

4. Use an ohmmeter or armature growler to determine that no commutator segment is shorted to the shaft. If any short exists, replace the armature.

Checking the Regulator

Varying engine speeds and electrical loads affect generator output. The regulator controls generator output, and also disconnects the battery from the generator whenever generator output voltage is less than that of the battery, thereby preventing battery discharge through the generator.

To check regulator voltage, make the connections shown in **Figure 187**. Remove the fuse or disconnect the battery. Start the engine and run it at 2,500 rpm. If the voltmeter does not indicate 15.0-15.8 volts (12-volt system) or 6.9-7.5 volts (6-volt system), adjust or replace regulator.

Observe the contacts on the cutout relay as you slowly increase engine speed. The contacts should close when the voltmeter indicates 12.5-13.5 volts (12-volt system) or 6.5-7.0 volts (6-volt system).

Adjusting the Voltage Regulator

CAUTION

Disconnect the battery before removing the regulator cover. Do not make any adjustments with the battery wiring in place.

Remove the regulator cover and adjust the regulator by bending the adjustment spring. Bending the spring downward raises the voltage setting. The voltage regulator can be identified by its 2 contact points.

The cutout relay can be identified by a single set of contacts which are normally open. The relay rarely, if ever, needs adjustment. Usually all that is required is to dress the contacts lightly to remove any corrosion or light pitting.

Should adjustment be required, bend the spring retainer up or down as required. Lowering the spring retainer raises the voltage setting.

STARTER/GENERATOR

The starter/generator and its associated voltage regulator function similarly to the shunt-wound DC generator and voltage regulator which were discussed in the foregoing paragraphs. When the engine is stopped, however, the starter/generator may be operated as a series-wound motor to start the engine. **Figure 188** is a

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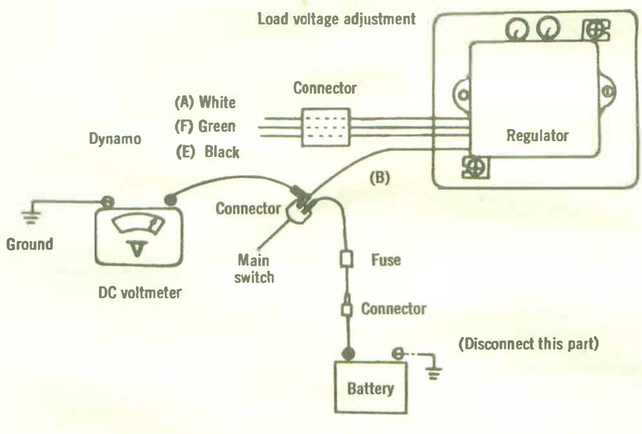

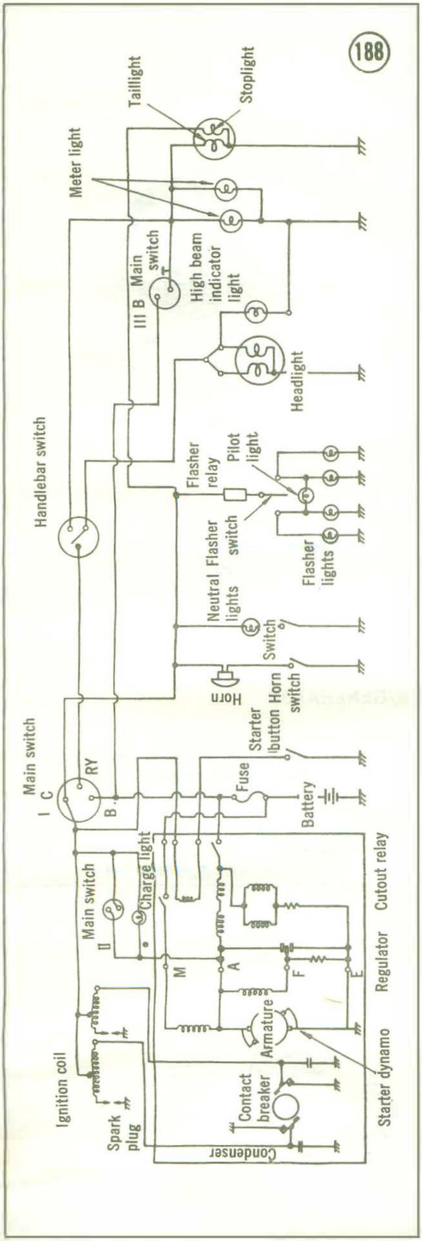

schematic diagram of a typical machine equipped with a starter/generator. **Figure 189** is an exploded view of a typical starter/generator.

In general, service procedures for these units are the same as for the corresponding units of the DC generator system. Those procedures which are different are described in the following paragraphs.

Checking the Generator

Test connections are the same. Do not run the engine at over 1,700 rpm for 12-volt systems, or 1,400 rpm for 6-volt systems. At these speeds, the voltmeter should indicate at least 10 volts for a 12-volt system, or 5 volts for a 6-volt system.

There are 3 field terminals to check on the starter/generator yoke instead of the 2 on the DC generator. Determine that there is continuity between terminals A and F, A and M, and F and M. Resistance should be as specified in **Table 36**.

Table 36 STARTER/GENERATOR RESISTANCE CHECKS

Terminals	Ohms
A to F	4.9
A to M	0
F to M	4.9

Starter Relay

There is an additional relay in the voltage regulator. This relay connects the battery to the starter/generator to operate it as a motor for engine starting.

When the rider presses the starter switch, current flows through the starter relay coil and closes the starter relay contacts (**Figure 190**). Current then flows from the battery, through the starter relay contacts, then through the series field winding and the armature of the starter/generator.

Starter Troubleshooting

Table 37 lists symptoms, probable causes, and remedies for starter malfunctions.

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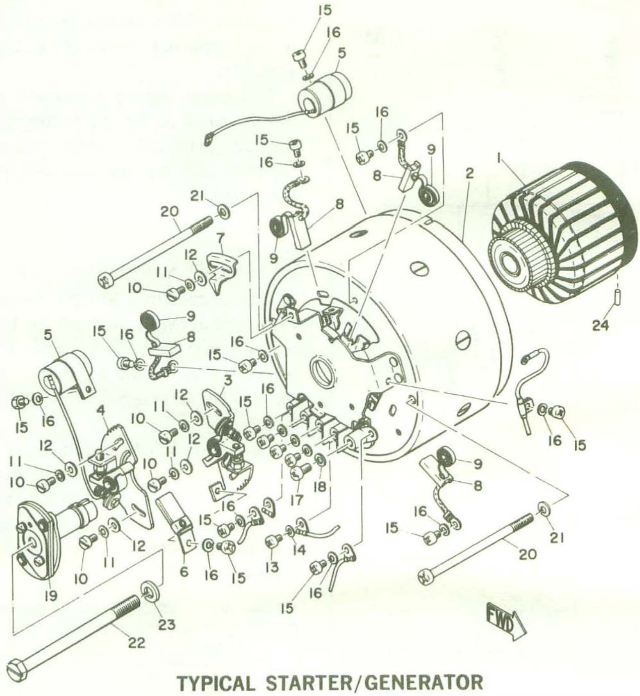

TYPICAL STARTER/GENERATOR

1. Armature
2. Stator
3. Left breaker assembly
4. Right breaker assembly
5. Condenser
6. Lubricator
7. Timing plate
8. Brush
9. Spring
10. Screw
11. Lockwasher
12. Flat washer
13. Screw
14. Lockwasher
15. Screw
16. Lockwasher
17. Screw
18. Lockwasher
19. Advance mechanism
20. Screw
21. Lockwasher
22. Bolt
23. Lockwasher
24. Dowel pin

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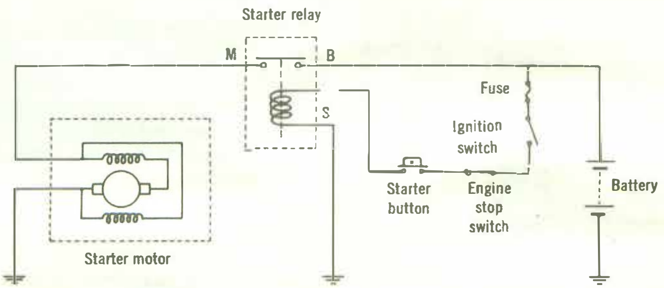

Table 37 STARTER TROUBLESHOOTING

Symptom	Probable Cause	Remedy
Starter does not work	Low battery	Recharge battery
	Worn brushes	Replace brushes
	Internal short	Repair or replace defective component
	Relay inoperative	Replace voltage regulator
	Defective wiring or connections	Repair wire or clean and tighten connections
	Defective switch	Replace switch
Starter action is weak	Low battery	Recharge battery
	Pitted relay contacts	Clean contacts or replace voltage regulator
	Brushes worn	Replace brushes
	Defective wiring or connections	Repair wire or clean and tighten connections
	Short in commutator	Replace armature
Starter runs continuously	Stuck relay	Dress contacts or replace voltage regulator

YAMAHA 4-STROKE TWINS

Yamaha 4-stroke twins are equipped with battery ignition systems, discussed in *Battery Ignition*. The charging system consists of an alternator, rectifier, voltage regulator, battery, and interconnecting wiring. **Figure 191** is a schematic diagram of the charging system.

CHARGING SYSTEM TEST

If charging system problems are suspected, first be sure that the battery is in good condition, and is at or near full charge. Then proceed as follows:

1. Connect a 0-20 DC voltmeter between the battery positive terminal or fuse and a good ground (**Figure 192**).

2. Start the engine and run it at about 2,500 rpm. If the voltmeter indicates approximately 14.5-15 volts, the charging system is OK, and no further tests need be made. Voltmeter indi-

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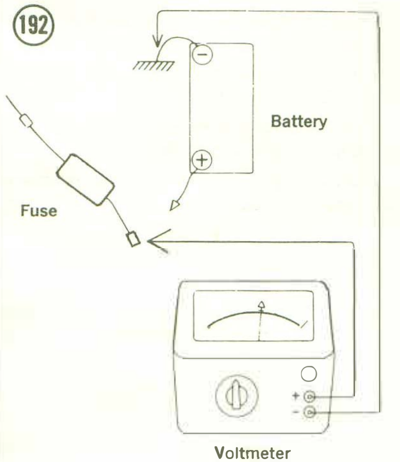

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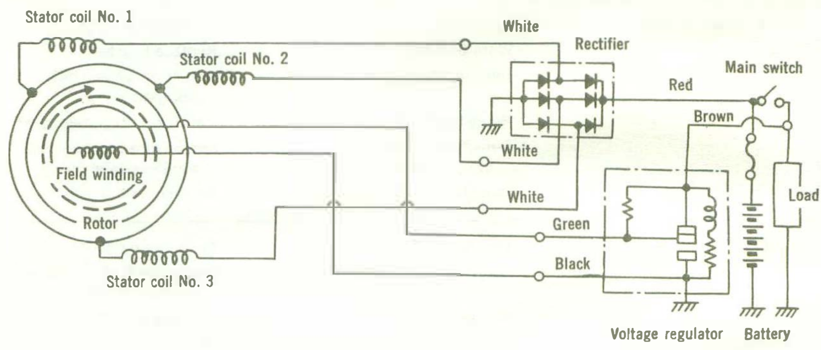

cations considerably less than specified indicate problems in the alternator, rectifier, or regulator.

ALTERNATOR

To test the alternator, proceed as follows:

1. With the engine off, unplug the alternator connector.
2. Using a low-range ohmmeter, measure resistance between each pair of white wires (3 measurements). Resistance between each pair must be 0.8-1.0 ohm.
3. Using the highest ohmmeter range, determine that there is no continuity between any white wire and ground. Replace the stator if it fails either Step 2 or Step 3.
4. Measure resistance between both slip rings. Resistance should be 5-7 ohms.
5. Using the highest ohmmeter range, determine that there is no continuity between either slip ring and ground.
6. Replace both brushes if they are worn to 0.28 in. (7.0mm).
7. Be sure that there is continuity between each brush and its associated connector terminal. Repair any broken wire if there is no continuity.

RECTIFIER

The rectifier converts alternating current from the alternator into direct current for use by electrical accessories, and for battery charging. To test the rectifier, proceed as follows:

1. Unplug the rectifier connector (**Figure 193**).

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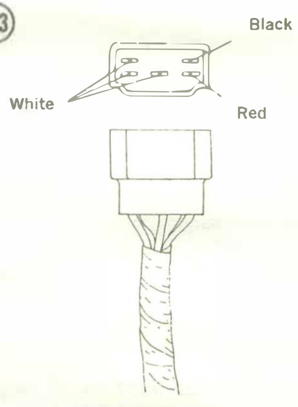


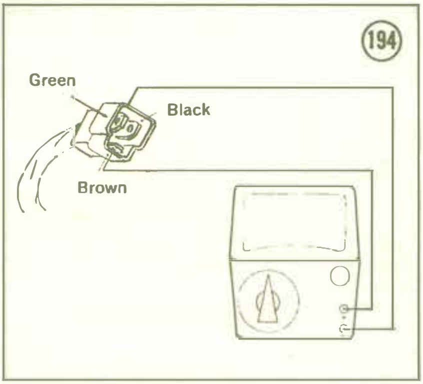
2. Using an ohmmeter, measure resistance between each white wire and the black wire, then repeat each measurement with the ohmmeter leads reversed. The ohmmeter should indicate low resistance in one direction, and almost infinite resistance in the other.
3. Repeat Step 2, but make measurements between each white wire and the red wire.

If any pair of measurements was either high or low in both directions, replace the rectifier.

VOLTAGE REGULATOR

It is usually better to replace the voltage regulator rather than repair it. However, some checks can be made with an ohmmeter.

1. Remove the cover. Examine it for dirty, pitted, or burned contacts. Sometimes the contacts become fused. Replace the unit if any of these conditions exist and cannot be corrected.
2. Connect an ohmmeter between the black wire and the regulator base. If the ohmmeter does not indicate zero, the black wire is broken.
3. Connect one ohmmeter lead to the brown wire and one to the green wire (**Figure 194**). Hold the armature so that it makes contact with the upper contact. The ohmmeter should indicate very close to zero. An indication as low as 2 ohms is cause to replace the regulator, although it may be possible to dress the contacts.
4. Move the armature so that it is midway between upper and lower contacts. The ohmmeter should indicate about 9-10 ohms.



5. Press the armature down until it contacts the lower contact. The ohmmeter should indicate about 7 or 8 ohms.
6. Connect the ohmmeter to the black and brown wires. Move the armature until it contacts the upper contact. The ohmmeter should indicate about 37 ohms.

Replace the regulator if any incorrect indication was not remedied by contact cleaning.

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