Triple Maintenance Manual

Section 7 - Electrical System Service

Index

Chapter 7
Electrical System Service

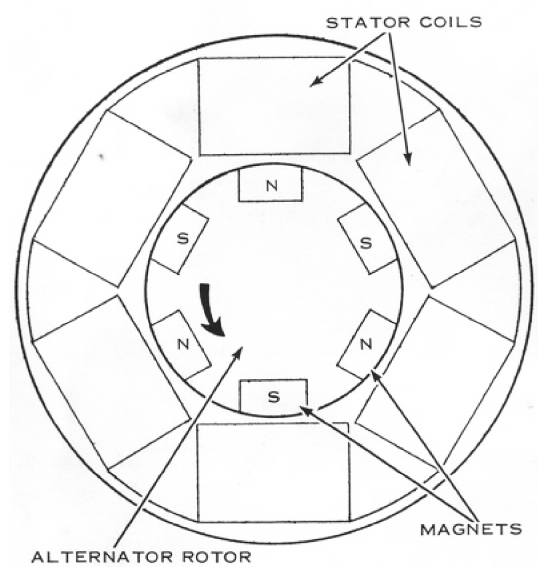
This chapter describes the construction, operation, and service procedures for the motorcycle's electrical equipment, including the charging, ignition, and lighting systems as well as the warning devices. First, charging-system service is covered for each of the three basic systems used on the different models, in chronological order of their development. Then the various ignition systems are covered in order of increasing sophistication. Finally, the lighting and warning devices used on these machines are covered. In the end of the chapter is a specifications table for the electrical systems of all Kawasaki triples.

CHARGING SYSTEMS

The charging system on any motorcycle must perform one basic task; supply enough electrical power to satisfy the needs of the other electrical systems on the motorcycle. To do this, the heart of the charging system, the alternator, is driven by the engine. Some of the engine horsepower is absorbed by the alternator and converted to electrical energy. Some of this energy goes to the battery, some to the lighting system, and some to supply current for ignition.

Operation of the alternator is made possible by movement; if a wire is moved through a magnetic field, or if a magnetic field is moved past a wire, an electrical current is generated in the wire. All that happens in the alternator is that a magnetic field, formed by the alternator rotor, is rotated inside several interconnected coils of wire. These, known as the charging coils, are wrapped around core pieces of laminated steel plates. The core pieces help direct the spinning magnetic field to make it more effective.

Every magnet has a north and a south pole. If the magnetic field around a magnet could be seen, it would look like lines of force moving out of the north end, curving around the length of the magnet, and entering the south end. As the alternator rotor turns, it sweeps its north and south poles alternately past each charging coil. When a north pole passes a given coil, it induces a current in one direction. When a south pole passes the same coil, it induces a current in the opposite direction.



A generator and alternator operate on the principle that if a wire is moved through a magnetic field, or vice versa, an electrical current will flow through the wire. All models use a spinning magnetic field in the form of the alternator rotor and surround it with coils of wire in the form of the alternator stator assembly.

Electrical current flows from a "negative" to a "positive" area. That is, electrical current is the flow of electrons with a negative charge from an area of high electron concentration (therefore a "negative" area) to one of low concentration (therefore a more "positive" area, relatively speaking). Thus, because the current in the charging coils flows in two directions alternately, the ends of the wires coming from the charging coils are said to change polarity, from negative to positive.

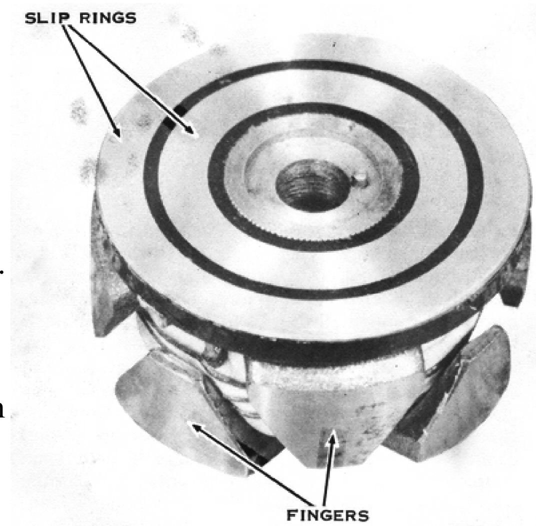
This "alternating current" or AC from the alternator raises a problem. The battery to be charged by the alternator is a "direct current" or DC device. It has a negative lead and a positive lead, making it incompatible with the alternating current produced by the alternator. This compatibility problem is solved by a rectifier. On Kawasaki triples, the rectifier is a solid-state device, made up of four, six, or nine silicon diodes arranged in such a manner as to change AC into DC. It does this by electronically switching the connections from the charging coils to the battery so that they are always connected in the right direction to charge the battery, no matter which way the alternating current in the charging coils is flowing. The rectifier's individual diodes accomplish this by allowing current flow in one direction only. Current will not flow through a diode in a reverse direction.

The voltage regulator, working with the alternator and rectifier, controls the output of the charging system.

Because the alternator must be designed to put out enough power to satisfy the whole electrical system's needs at low engine speeds, its output at high speeds must be controlled by a regulator or it would overcharge the battery and burn out the lights. The regulators on these motorcycles are of only two basic designs, though they all look different.

The battery itself is a 12-volt. lead-acid type of battery. It has 6 cells, each rated at 2 volts, wired in series. That is, the positive lead of one goes to the negative lead of the next, and so on, so that the total cumulative voltage is 12. The amperage capacity of the battery depends on the physical size of each cell. The H1 models have the largest battery, with a rating of 9 amp-hours. This is an arbitrary rating that gives us an idea of its relative endurance under a given electrical load. The other Kawasaki triples have a 5.5 amp-hour battery because their ignition systems do not require as much current as do those of the H1 models. When replacing a battery, be sure it has an adequate amp-hour rating or it will soon be exhausted.

H1, H1A. H1B, H1C MODEL CHARGING SYSTEM

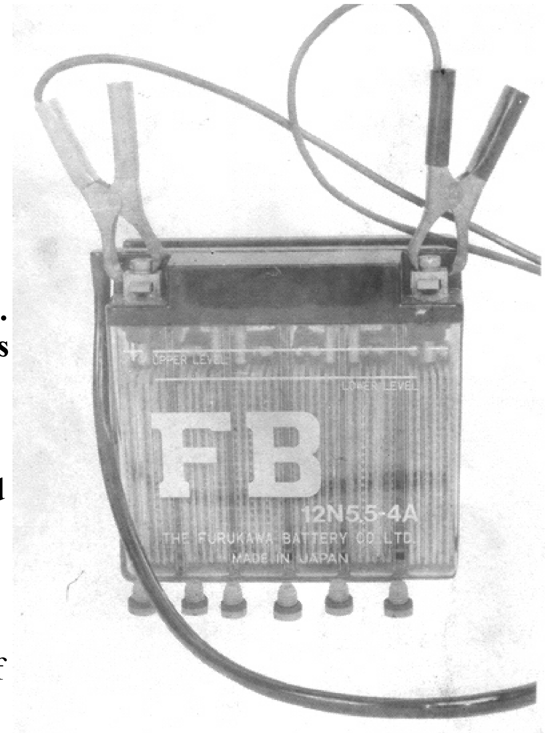


This is the alternator rotor from an early H1 model with an excited-field alternator. The slip rings receive current from two brushes on the stator plate and activate the electromagnetic "field" coil in the center of the rotor. The alternating "fingers" from either side of the rotor are north and south poles magnetically.

The charging system of these models has an excited-field type of alternator; the alternator rotor is not a permanent magnet. This rotor has two pole pieces, one on the front and one on the back. whose "fingers" curve over the edge of the rotor. As the rotor turns. the coils around it on the stator are exposed first to a finger of the north pole piece, then one of the south pole piece, and so on. A large electromagnetic field coil is wound around inside the pole pieces. The field coil is powered by the rest of the electrical system via two brushes that ride on slip rings in the outer face of the rotor.

The alternator brushes are connected by a green and a black wire to the voltage regulator. The voltage regulator has a solenoid-operated switch that controls the source of power to the rotor. Less power to the rotor lowers its magnetism, thus lowering the output of the alternator. Increasing the power to the rotor increases its magnetic field strength and the alternator output rises. The regulator connects the battery to the field coil at low engine speeds to keep the alternator's output high enough to sustain the ignition system. At higher engine speeds, some of the alternator's output is siphoned off at the rectifier to power the field coil. As engine speed rises. the alternator's output increases to 14.5 volts. The voltage regulator then turns off the current to the field coil. Therefore, the alternator output drops immediately, and then the field coil is "turned on" again. The voltage regulator turns the field coil on and off rapidly to hold the alternator's maximum output at 14.5 volts. Because the field coil is initially excited by the battery, this system will not charge a battery whose voltage has dropped too low.

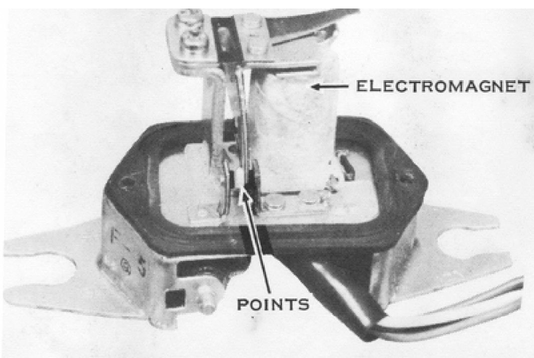
If the battery's voltage is less than 10, remove it from the motorcycle. then check the electrolyte level. Fill the battery to the upper level line with distilled water only. **CAUTION: If nondistilled water is used, the battery's life will be reduced by sedimentation shorting the plates.** Charge the battery at a 1/2 amp-hour rate for 15 to 20 hours, with the caps removed. **CAUTION: The caps must be removed during charging to prevent a dangerous buildup of hydrogen gas inside the battery. Charge the battery only in a well-ventilated area. Hydrogen gas is very flammable.**



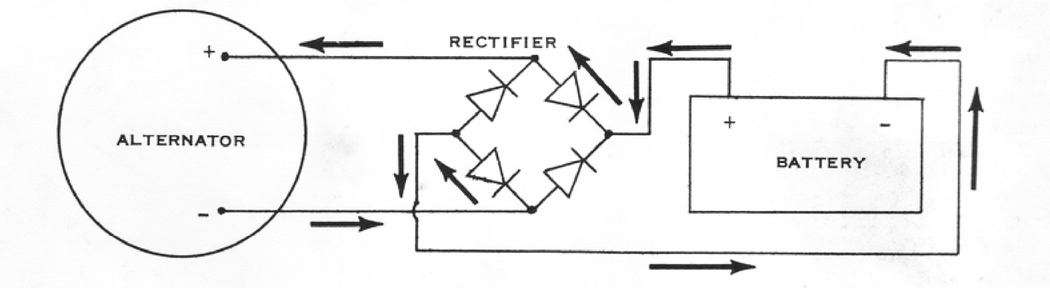
Charge a battery about twice the number of hours as its amperage/hour rating at a ½-amp/hour rate. CAUTION: Remove the caps for charging to prevent a possible battery explosion. Keep open flames and sparks away from a charging battery, as explosive hydrogen gas is given off. Turn the charger on or off only with the charger leads connected to the battery.

The alternator has three charging coils wound on laminations around the stator and wired together in a "wye." Each coil is joined on one end to a center (or neutral) connection. The other end of each coil is connected to a yellow wire. All three yellow wires go to the rectifier.

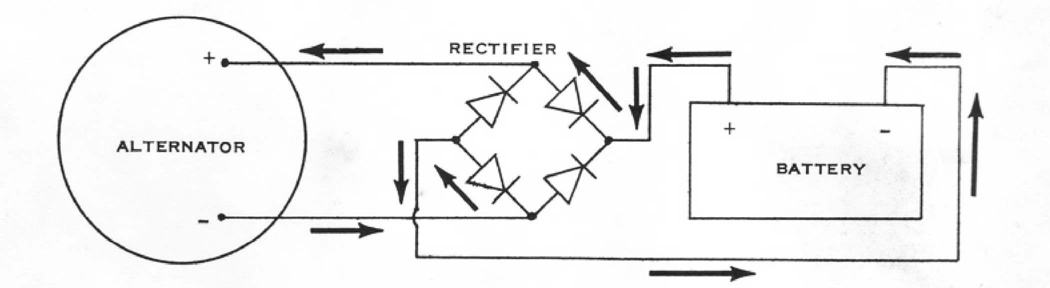
The rectifier has nine individual diodes arranged in three groups of three. The rectifier is a nonserviceable unit; the diodes cannot be replaced. Besides the three yellow wires, there are three other leads on the rectifier. The black (negative) wire is a ground lead. The blue lead goes to the voltage regulator to supply current to the field coil. The red (positive) lead goes to the battery to charge it.



The excited-field alternator uses a mechanical voltage regulator, shown here with the cover removed. The electromagnet is activated by the alternator output and switches the field coil input by moving the points.



A full-wave rectifier, as used on these models, must have at least four diodes. Each diode will not allow current to flow in the direction of the blocked arrow. All four work together to let the current flow to the battery.



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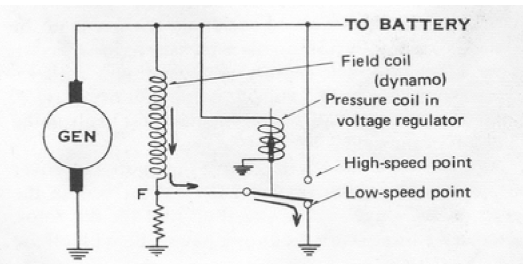
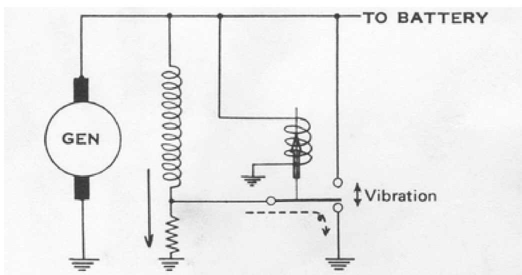
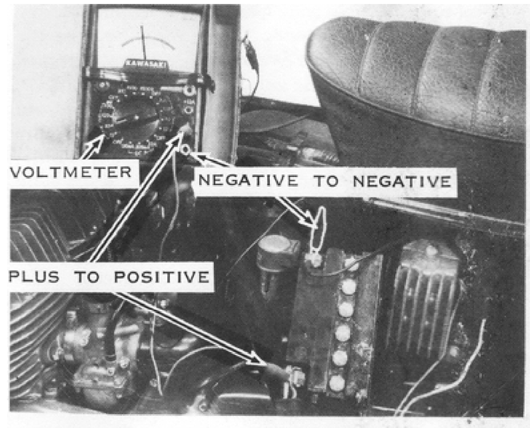


In this diagram the engine is turning slowly and the alternator is not producing enough voltage to support itself. The battery is used to activate the field coil.



At medium engine speeds, the alternator output is switched to the field coil and the battery is now being charged.

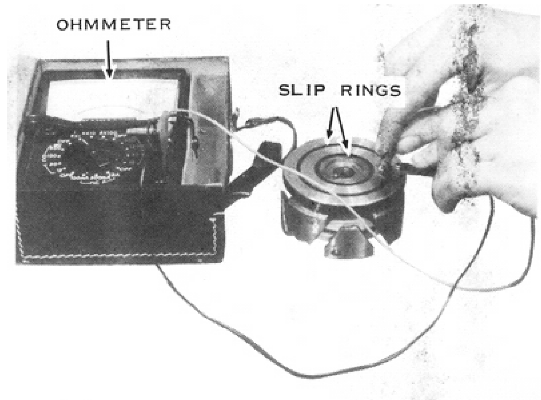
TESTING THE ALTERNATOR



Testing H1 battery voltage with a 30-volt DC voltmeter. It should be 12.5 volts with no load, and should not drop below 11.5 volts with the ignition and lights turned on.

If you suspect that the alternator is not charging the battery, the first test is a voltage check of the battery with the englne running. Connect a DC voltmeter across the terminals of the battery without disconnectlng the battery leads. The meter must have a range of at least 15 volts. The battery voltage with the main switch OFF should be at least 12 volts. A fully charged battery will be about 12.5 volts. If the voltage is less than 12 volts, remove the battery, fill it with distilled water, and then charge it at a rate not exceeding 1 amp for several hours. If the voltage is less than 10 volts. charge the battery at a 1/2 amp-hour rate for 15 hours before continuing the test. With a fully charged battery, start the engine. The voltage with the engine at idle speed should be about 11.5 volts. This is because the alternator does not supply enough power at this speed to supply the needs of the ignition system fully. Gradually increase engine speed to about 4.000 rpm. The battery voltage should with increased speed rise to 14.5 volts. If it does not rise that far, or if it does not rise at all, the problem is most likely in the windings of the field coil.

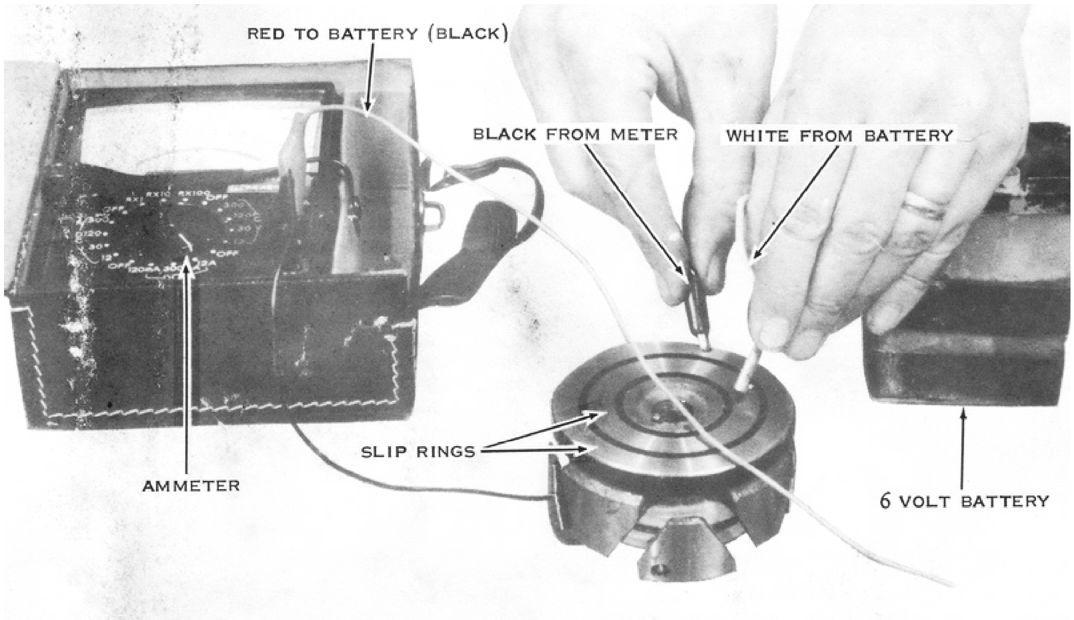
To check the field coil, remove the alternator cover on the left side of the engine. Take out the bolt in the center of the signal rotor, and then pull off the rotor. Remove the three stator mounting screws, then lift off the stator. Hook the stator over the shift pedal. Check the slip rings on the face of the rotor for oil or dirt that could prevent the brushes from making good contact.



The resistance between the slip rings of the early H1 rotor (1969-72) should be 3.5 to 5.5 ohms.

The most common cause of rotor failure is overrevving the engine. At high engine speeds, centrifugal force on the rotor's field coil windings is considerable. The result is failure of the rotor because the winding is stretched and either shorted or snapped by the tremendous force. Use an ohmmeter to measure the resistance between the two slip rings, which should be 3.5 to 5.5 ohms. If the resistance is infinite, the windings have snapped. If the reading is zero, the windings are shorted. The resistance between either slip ring and the pole pieces, or the core of the rotor, should be infinite.

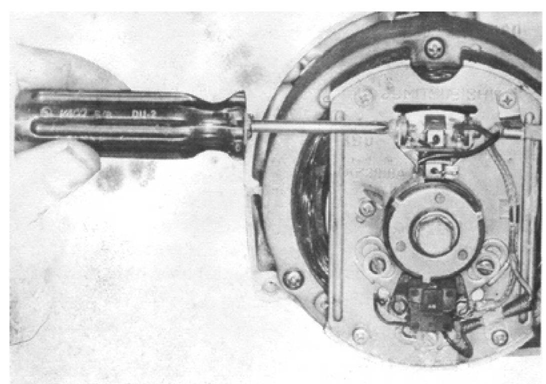
Sometimes a defect will occur only under load. To test for this, hook a 6-volt battery in series with an ammeter; that is, connect the positive lead from the battery to the positive lead of the ammeter. Hold the negative lead from the battery against one slip ring. **CAUTION: Use only a 6-volt battery. A 12-volt battery will ruin the field coil windings.** Momentarily tap the negative lead from the ammeter against the other slip ring. If the needle swings wildly across the face of the meter, the field coil is shorted. **CAUTION: Do not hold the meter lead to the slip ring under these conditions, or the meter will be damaged.** If the needle moves slowly, hold the connection until the needle stabilizes. It should read 1.1 to 1.7 amps. A lower reading indicates an open circuit.



This test of the field coil windings uses a 6-volt battery. Hook it in series with the ammeter, which should read 1.1 to 1.7 amps. CAUTION: Tap the meter lead to the slip ring momentarily at first to see if the amperage draw is going to be too high for the meter.

Another load test also uses a 6-volt battery. Hold the leads of the battery across the slip rings, one to each ring, for 30 seconds. Remove the battery, then measure the resistance across the slip rings. It must be 3.5 to 5.5 ohms. This test heats the rotor windings to near their normal operating temperature for more realistic results.

Other rotor problems do not occur very often, but they can be hard to find if they do. Check that the slip rings are not loose or dented. The wires from the slip rings to the coil can also come loose. They must be soldered in place, or the alternator will not charge. Dirty slip rings should be cleaned with trichloroethylene and #000 steel wool. Very rarely, one of the pole pieces will twist on the core and touch the other. This will cause a magnetic short. **CAUTION: Never insert a screwdriver or a bar into the rotor pole pieces to keep the crankshaft from turning. You could twist the pole pieces.** When they are twisted, the field coil windings will be broken, and the rotor will have to be replaced.



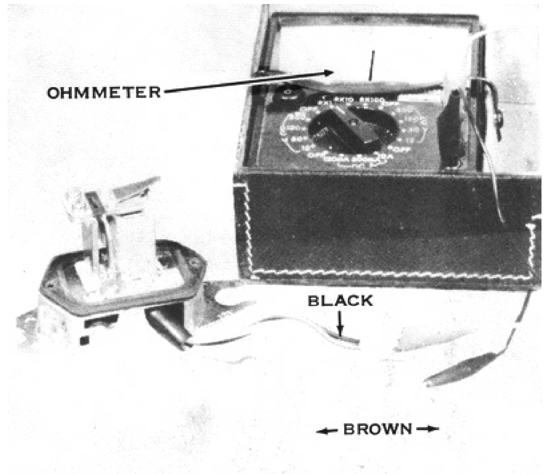
To remove the field coil brushes on the early H1 (1969-72), take out the two small screws on each side of the brushes. The brushes should be at least ⅜" long or they must be replaced.

To check the brushes, remove the two screws holding the brush assembly to the stator plate. The brushes are 14mm (9/16') long when new. The service limit is 9mm (3/8"). If either brush is shorter than this, the brush assembly must be replaced as a unit.

In order to generate electricity, the three charging coils must be connected together. Use an ohmmeter to check for continuity between all three coils. Remove the left-side cover under the seat, then disconnect the large plastic plug with the three yellow wires, which are the ones from the charging coils. Test the continuity between each of the yellow wires and the other two. The ohmmeter should read zero. If the reading is greater than that between any two of the leads, the stator assembly must be replaced.

TESTING THE REGULATOR

If the alternator passes the checks described above, you must test the regulator next, because it is the next most likely component to break down. The basic regulator check is to test the resistance of the coil in the solenoid that controls the current flow to the field coil.



To test the regulator coil, check the resistance between the brown and black leads. It should be 53 to 55 ohms. A lower reading indicates a short in the coil; a higher reading, an open circuit.

Remove the left-side cover under the seat. The regulator is fastened to the rear of the battery box. Disconnect the three-prong plastic plug and the single connector. Use an ohmmeter to measure the resistance between the brown wire and the black one to check the solenoid coil. The meter should register 53 to 55 ohms. If it is greater than this, the coil has an open circuit. If it is lower than this, the coil has a short circuit. In either case, the regulator must be replaced.

If the regulator has checked "good" so far, remove the two screws holding the cover on the regulator. Visually check the point set for pitting, burning, dirt, or oil. File the points carefully on both sides with a clean flexstone or small ignition file. Clean the points thoroughly with a business card soaked in trichloroethylene. Pull a dry card through the points until it comes out clean. Now reassemble the regulator and the alternator, then retest the battery voltage at 4,000 rpm. If there is still no voltage increase as speed rises, you must test the rectifier.

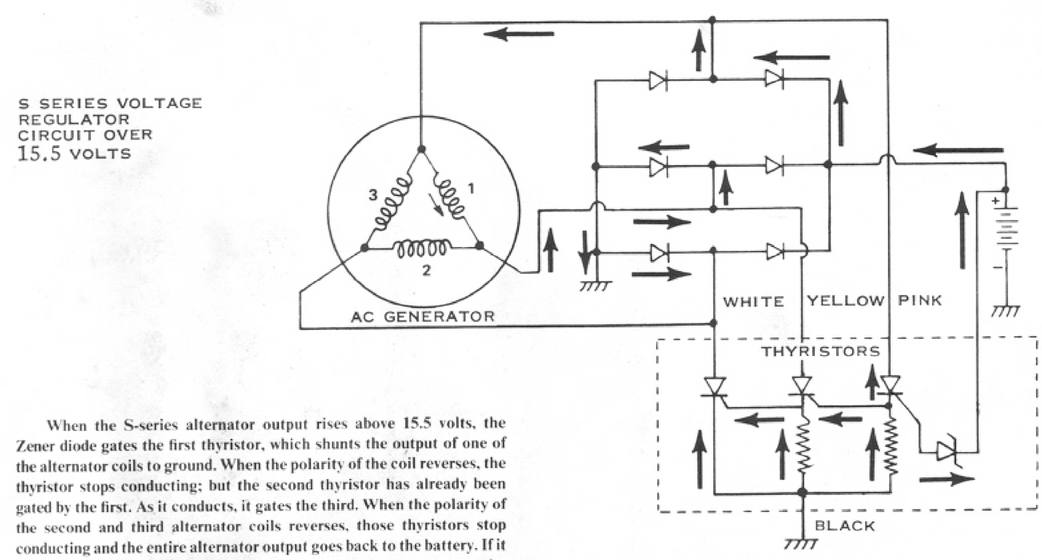
TESTING THE RECTIFIER

The rectifier is checked by testing the conductivity of the individual diodes. Remove the left-side cover beneath the seat. The rectifier is near the regulator on the back of the battery case. Disconnect the leads and use an ohmmeter to test the continuity between them. The meter should show infinite resistance in one direction and no resistance in the other. Connect the negative lead to the black wire and the positive lead in turn to each of the three yellow wires, the blue wire, and the red one. The meter should read zero each time. Now connect the positive lead to the blue wire and the negative lead, in turn, to each of the yellow wires; connect the positive lead to the red wire and the negative lead to each of the yellow wires, in turn. Again, all the readings should be zero. If all these tests register infinite resistance, the batteries in the meter may be reversed. Try the tests again with the meter leads switched. If all the readings are now zero, the rectifier is good. However, if any readings are different from the others, the rectifier is defective and must be replaced.

The checks described so far test the major components of the charging system. If you still have trouble check every wire for continuity along its entire length. Make sure every soldered connection is solid and that the multiple connections aren't missing any pins. Check that the engine is well grounded to the frame. Clean any corrosion off the battery terminals, and be sure the battery leads are making a good connection to the battery terminals.

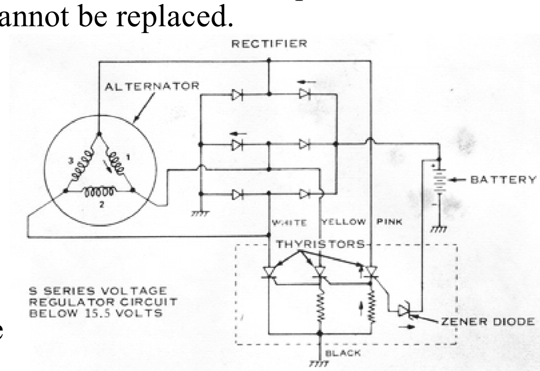
S-SERIES MODEL CHARGING SYSTEM

The charging system of the S-series features a permanent-magnet type rotor and a solid-state voltage regulator. The alternator's stator has three charging coils arranged in a "delta" circuit. That is, they are all connected together end-to-end in a triangle. The leads to the rectifier are connected to the corners of the triangle. This alternator has no field coil and no brushes. The field is fully sustained by the permanent magnets in the rotor which makes the S-series alternator very reliable and inexpensive, but it is not capable of as much output as the excited-field alternator of the early H1 models. This is not a handicap, however, because the S-series ignition system does not require as much power.



When the S-series alternator output rises above 15.5 volts, the Zener diode gates the first thyristor, which shunts the output of one of the alternator coils to ground. When the polarity of the coil reverses, the thyristor stops conducting; but the second thyristor has already been gated by the first. As it conducts, it gates the third. When the polarity of the second and third alternator coils reverses, those thyristors stop conducting and the entire alternator output goes back to the battery. If it is still above 15.5 volts, the whole regulation process happens over again. Because the voltage regulator is all-electronic with no moving parts, it can never wear out, though it can be damaged by heat.

The rectifier has 6 diodes. It does not need 9 like the early H1 models, because there is no power takeoff for the field. The rectifier is a nonserviceable unit; individual diodes cannot be replaced.



This is a simplified diagram of the S-series solid-state voltage regulator. The current flows from the alternator to the rectifier and the battery because the alternator's output is below 15.5 volts.

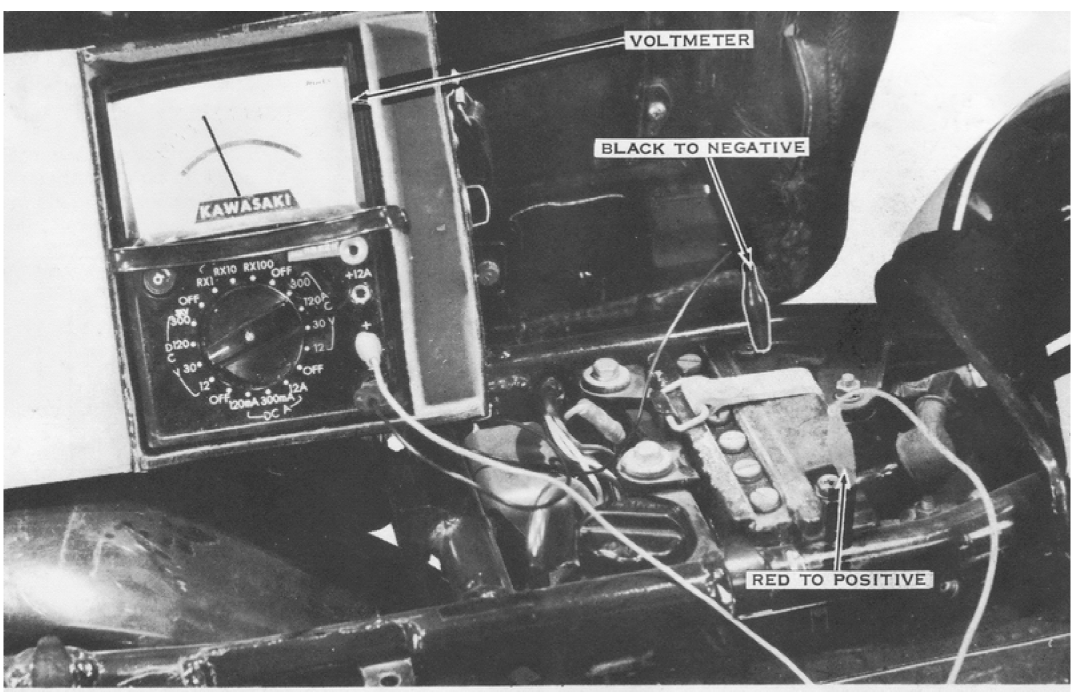
The voltage regulator is a solid-state unit. It has no moving parts and cannot be disassembled. The basis of this voltage regulator is the combination of two semiconductor devices, a Zener diode and a thyristor (or silicon-controlled rectifier, SCR). The Zener diode, like all diodes, wants to pass current in one direction only. But a standard diode will pass current in the other direction if the voltage is high enough. Unfortunately, this will destroy it. The Zener diode, however, is capable of passing a current in the "wrong" direction without being damaged when the voltage reaches a certain point. Thus, a Zener diode with a "breakdown voltage" of 15.5 volts is used to sense when the alternator, output reaches this predetermined maximum. The thvristor (SCR) is a diode that won't conduct at all until a small voltage is applied to its "gate" lead. When the thyristor has been "gated" or activated by a voltage to its gate lead, it will pass a current only in the forward direction, and then only until the current tries to change direction. Then it will become nonconductive until it is gated again. The gate signal need only be momentary. The thyristor is simply an electronic switch.

The Zener diode and thyristor work together in the voltage regulator like this; When the voltage across the battery reaches 15.5 volts, the Zener breaks down and conducts in a reverse direction. But it is connected to the gate of a thyristor. The thyristor is connected to one of the three outputs from the alternator, and it sends that output to ground instead of through the rectifier for charging the battery. As soon as alternator current begins to flow through it, two things happen in quick succession; first, the current gates a second thyristor, then the output from the alternator reverses (its output is AC) and the first thyristor stops conducting. The second thyristor grounds another of three outputs from the alternator. At the same time, it gates a third thyristor, and then turns off as the current direction reverses. The third thyristor grounds the third output of the alternator, and when that output reverses direction, it too stops conducting. Now the entire alternator output can go through the rectifier to charge the battery. But as soon as its output voltage rises to 15.5 volts again, the Zener diode breaks down, gating the first thyristor and starting the whole process over again. Thus, the maximum output voltage is regulated at 15.5 volts.

TESTING THE ALTERNATOR

The basic alternator test is to check the voltage across the battery with the engine running. Lift the seat and connect the negative lead of a voltmeter, with a range of at least 20 volts DC, to the negative terminal of the battery. Connect the positive lead to the positive terminal. With the main switch OFF, the battery voltage should be 12 to 12.5 volts.

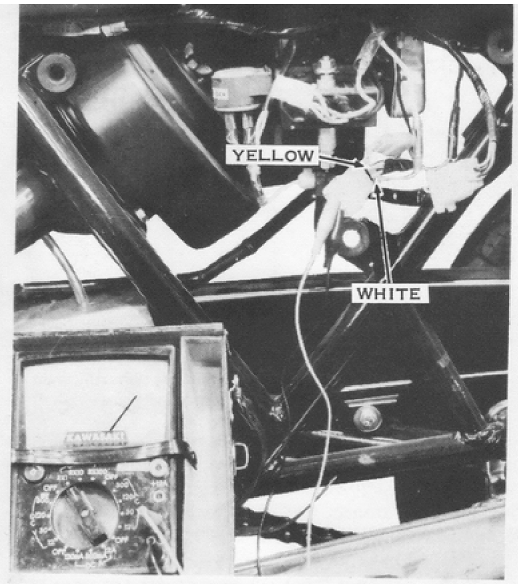
If the voltage is less than 12 volts (but greater than 10), remove the battery, fill it with distilled water, and then charge it at no more than a 1 amp-hour rate for 1 to 2 hours. If the voltage is less than 10 volts, charge the battery at a 1/2 amp-hour rate or less for about 10 hours before continuing the test. **CAUTION: Remove the battery caps and charge the battery only in a well-ventilated place. Charging the battery releases explosive hydrogen gas which must be dispersed into the air for safety. Never allow an open flame or sparks near a charging battery; this includes the slight spark that occurs when the charger leads are removed. Therefore, always unplug the charger before disconnecting the leads.**



Testing the S-series battery voltage with a 30-volt DC capacity voltmeter. The battery should show at least 12.5 volts with no load and 11.5 volts with the lights and ignition turned on.

With a fully charged battery, start the engine. The voltage at an idle should be about 11.5 volts. This is because the alternator cannot supply enough power for the ignition system at idle speeds. Gradually increase engine speed to 4,000 rpm. The battery voltage should rise to 15.5 volts. If it does not rise that far, or if it drops, the charging system components must be checked separately as follows.

The alternator rotor is a permanent magnet. There is no simple test of its magnetic field intensity, but only extreme heat, on the order of 500° to 600° Fahrenheit, will cause it to weaken.



Test the resistance between the yellow lead and the white lead from the alternator stator, then between the pink lead and the white lead. The reading must be around 1 ohm; if it is greater than 10 ohms, the stator must be replaced.

The stator is checked by testing the continuity of the charging coils. To do this, remove the left-side cover below the seat and disconnect the two large plastic plugs, each with a yellow, pink, and white wire. Connect one lead of an ohmmeter to the yellow wire from the female side of one of the plugs (the side connected to the alternator), and then touch the other lead to the pink wire and then the white wire. There should be very little resistance, less than one ohm. Now connect one lead to the pink wire and touch the other to the white. There should be very little resistance here also. If either of these tests shows a resistance of over 10 ohms. the stator assembly must be replaced. Now remove the alternator cover on the left side of the engine. Hook one lead of the ohmmeter to the stator frame. Touch each of the three wires (blue, pink and white) from the charging coil with the other lead There should be infinite resistance. Any lower resistance indicates a short circuit to ground; the stator assembly must be replaced.

If the stator assembly fails any of the above tests, it is defective. However, even if it passes them all, it still can be defective. You must test the other components of the system to check the stator by the process of elimination.

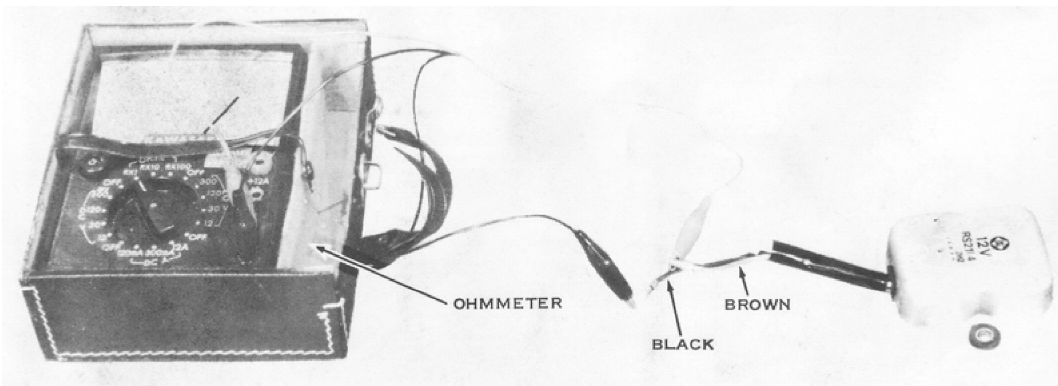
INSPECTING THE RECTIFIER

The rectifier is mounted on a tab on the frame behind the left-side cover. Disconnect the single red wire that goes to the battery, the single black wire connected to ground, and the large plastic plug that goes to the alternator. Connect the positive lead of an ohmmeter to the black wire and the negative lead to each of the three yellow wires and the red wire, in turn. In each case, the meter should register zero. Now connect the negative lead to the red wire and the positive lead to each of the yellow wires, in turn. In each case, the meter should register zero. If the meter registers infinite resistance it all the tests above, its batteries may be reversed. Switch the meter leads and go through the tests again. If the meter now registers zero on each test, the rectifier is good. However, if the meter does not read zero consistently or all the tests, but zero on some and infinity on others, the rectifier is defective and must be replaced.

INSPECTING THE VOLTAGE REGULATOR

Because the voltage regulator is a solid-state device it must not be disassembled and cannot be adjusted **CAUTION: Do not turn the screws on the regulator case They are not adjustments; they are heat sinks (heat-dissipation points) for some of the internal components. If they are loosened, the components will overheat and the regulator will fail.**

The regulator is fastened to a frame tab near the rectifier behind the left-side cover. Disconnect the large plastic plug (with the yellow, pink, and white wires), the single brown wire. and the single black wire. Using short lengths of small-diameter, bare copper wire, connect the yellow, pink, and white wires in the regulator side of the plastic plug; these will be treated as one lead in these tests. Connect the negative lead of an ohmmeter to the brown wire and the positive lead to the black wire. The meter should register 1,000 ohms or more. If the resistance is less than this, there is an internal short and the regulator must be replaced.

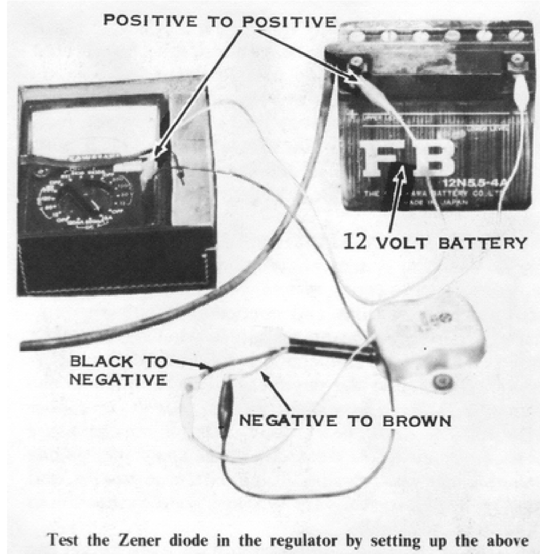


Check the regulator with an ohmmeter as described in the accompanying text. CAUTION: Do not loosen the screws on the regulator case. They are heat sinks for the internal parts.

Now connect the negative lead of an ohmmeter to the interconnected wires of the plastic plug and the positive lead to the black wire. The resistance should be infinite. Now switch the two leads; the resistance should still be infinite. If it is any less in either test, one of the thyristors is defective and the regulator must be replaced. To test the Zener diode, connect the negative lead of a 12-volt battery to the brown wire and the positive lead of the battery to the negative lead of an ammeter. Now touch the positive lead of the ammeter to the black wire. If the ammeter needle is deflected at all from its rest position, the Zener diode is defective and the regulator must be replaced.

The tests described so far will detect problems in the major charging-system components. If there are still troubles in the charging system, you must also check the continuity of all wires and connections with an ohmmeter. There must be no resistance whatsoever. Make sure every soldered connection is solid and clean of corrosion. Check that the engine is well grounded to the frame. *NOTE; The engine in S3 models is rubber mounted. There must be a ground wire from the chain case cover top screw to the frame lug at the upper rear engine mount.* Clean all corrosion off the battery terminals, and be sure the battery leads are making a good connection to the battery terminals.

If your charging system continually overcharges the battery, boiling the water out of it, the Zener diode breakdown voltage may be too high. The alternator is supplying too much voltage to the system. This can also burn out the lights in a short time. Before replacing the voltage regulator, check the continuity of all wiring and connections with an ohmmeter. There must be no resistance at all. Test the battery voltage at 4,000 rpm. If it is over 16 volts, the Zener diode is bad and the voltage regulator must be replaced.



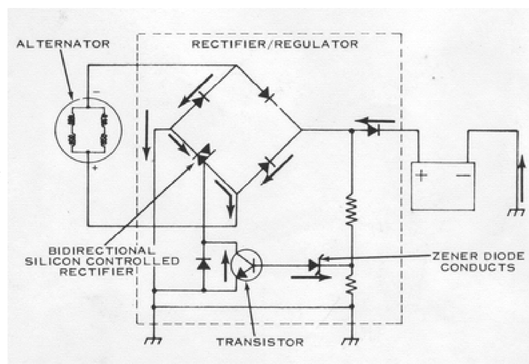
Test the Zener diode in the regulator by setting up the above circuit. The ammeter needle must not move or the regulator is defective.

H1D, H1E, H1F, H2, H2A, H2B, H2C MODEL CHARGING SYSTEMS

In this section two charging systems will be covered together. The H1D and the H2 models have identical systems. The H1E and H1F models share a slightly different system. Most of the differences between the H1D/H2 system and the H1E/H1F system are in the part numbers of the components, many of which look exactly like their counterparts in the other system

The alternator has a permanent-magnet rotor that needs no external power source to activate it. There are four charging coils in the stator, connected in pairs in series. The two series-connected pairs are connected in parallel. Thus, the charging coils only have two yellow wires leading to the rectifier.

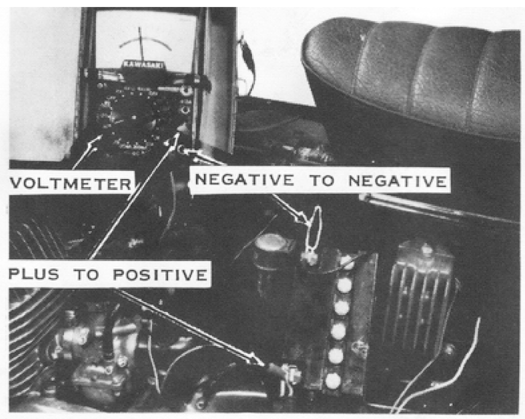
The rectifier and voltage regulator are built into one unit in these charging systems. The rectifier/regulator unit is a solid-state type and cannot be disassembled or adjusted. **CAUTION: Do not turn the bolts and nuts between the cooling fins in this unit. They are not adjustments. They are heat-dissipation points for the internal components. If they are loosened, the components will overheat and the rectifier/regulator unit will fail.** Although there are several semiconductor components in the rectifier/regulator unit, the special components that make up the regulator circuit are a feature of this unit. One is the Zener diode, which like any diode will conduct only in the "forward" direction unless a "reverse"' voltage great enough is applied. (Any diode will conduct in reverse if a great enough voltage is present. but the Zener diode will not be damaged by this kind of treatment.) The other unique component is the bidirectional-controlled rectifier, or BCR, a type of electronic switch. It has a third lead called a "gate" lead. Ordinarily, the BCR will allow current to flow through it in one direction only. However, when the BCR is "gated" (when it has had a voltage applied to the gate lead), it will conduct in either direction until the gate voltage is removed.



This is the current flow in the H2 or H1E regulator/rectifier unit during regulation. The process is described in detail in the text.

To combine these two special components into a voltage-regulated circuit, a Zener diode is chosen with a breakdown voltage of 15.5 volts. The Zener diode senses when the output of the alternator reaches the desired maximum charging voltage of 15.5. It then breaks down and gates the BCR. The BCR is used in place of an ordinary diode in the rectifier circuit. The other three diodes in the circuit are conventional. But the BCR, when it is gated, will conduct in both directions. and the rectifier circuit can only send half as much current to the battery as a result. The other half is sent back to the charging coils through the BCR, conducting in a reverse direction. As soon as the BCR is gated and the rectifier can send only half the alternator output to the battery, the battery voltage drops and the Zener diode stops conducting. The no-longer-gated BCR returns to normal diode function, and the rectifier again sends the full alternator output to the battery. The cycle starts all over again. By combining the rectifier and voltage-regulator functions in a single unit, Kawasaki has made the system less expensive to manufacture and more reliable.

TESTING THE ALTERNATOR

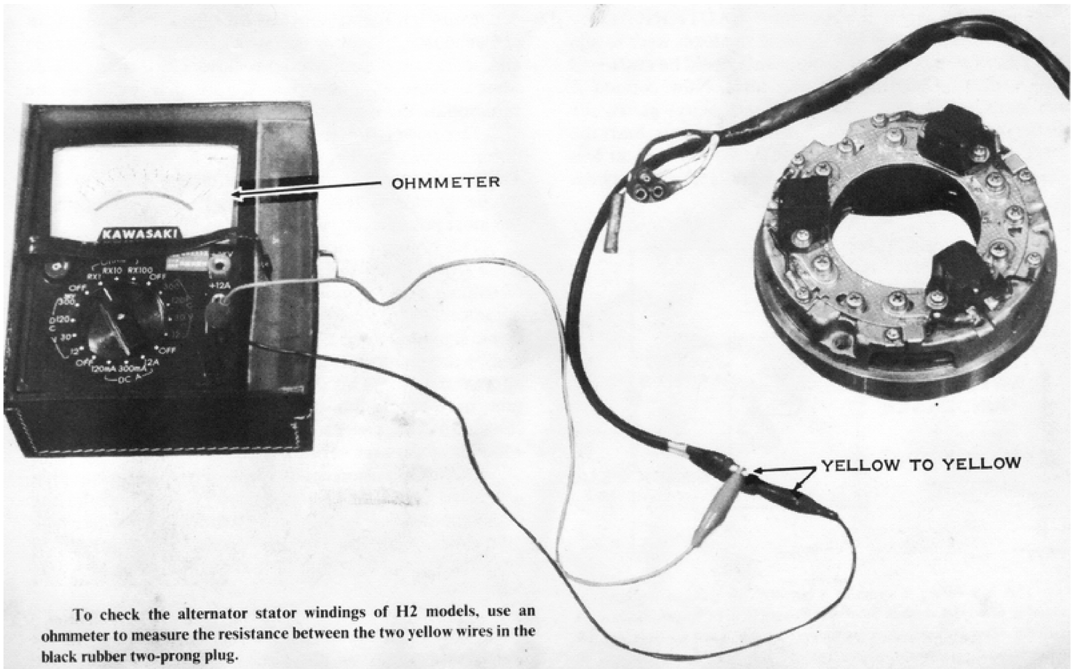


Testing the H1 battery voltage with a 30-volt DC voltmeter. It should be 12.5 volts with no load, and should not drop below 11.5 volts with the ignition and lights turned on.

If you suspect that the alternator is not charging the battery, the first test is a voltage check of the battery with the engine running. Connect a voltmeter across the terminals of the battery without disconnecting the battery leads. The meter must have a range of at least 20 volts DC. The battery voltage, with the main. switch OFF, should be at least 12 volts. A fully charged battery will be about 12.5 volts. If the voltage is between 10 and 12 volts, remove the battery, fill it with distilled water, then charge it at no more than a 1 amp-hour rate for 1 to 2 hours for H2 models, and 2 to 3 hours for H1 models. **CAUTION: Remove all the caps to charge the battery. During charging, the battery gives off explosive hydrogen gas, which must be dispersed by adequate ventilation. Keep all open flame or sparks away from the battery. Do not remove the charger leads while the charger is plugged in; they will spark and can ignite the hydrogen.** If the voltage is less than 10 volts, charge the battery at no more than a 1/2 amp-hour rate for 10 hours for H2 models, and 15 hours for H1 models before continuing the test. With a fully charged battery, start the engine. The voltage with the engine at an idle should be 12 volts. Gradually increase the engine speed to 4,000 rpm. The battery voltage should rise with the engine speed to 15.5 volts. If it does not rise that far, or if it does not rise at all, you must inspect each of the components of the charging system separately as follows.

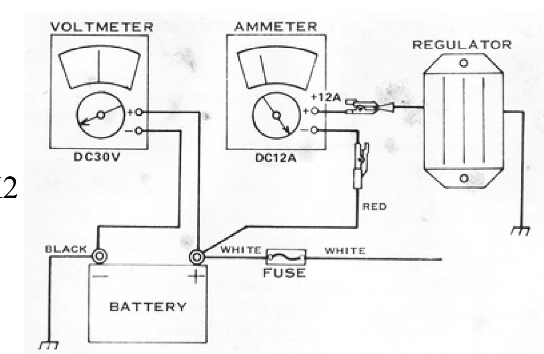
The alternator rotor has permanent magnets. The brushes and slip rings on the H1E/H1F alternator rotor are part of the ignition system. The alternator rotor will not lose its magnetic field intensity unless it is heated to 400° to 500° Fahrenheit.

To test the charging coils, remove the left-side cover and unplug the two-prong rubber connector with the yellow wires. Connect one lead of an ohmmeter to one yellow wire from the alternator and the other lead to the other yellow wire. The meter should register 0.4 ohms on HID/H2 systems, and 0.22 to 0.26 ohms on H1E/H1F systems. If the resistance is higher than this, there is an open circuit in the charging coils. If it is lower, there is a short within one of the four charging coils. In either case, the stator must be replaced. Measure the resistance between the ground and both yellow wires to the alternator. If the reading is less than infinite, the charging coils are shorted to ground. Again, the stator must be replaced.



To check the alternator stator windings of H2 models, use an ohmmeter to measure the resistance between the two yellow wires in the black rubber two-prong plug.

This diagram shows how to check the rectifier/regulator unit on H2 or H1E/H1F models with a voltmeter and an ammeter. Make the connections as shown and described in the accompanying text, then start the engine. CAUTION: Do not let any leads come loose while the engine is running or the charging system components will be destroyed.



This diagram shows how to check the rectifier/regulator unit on H2 or H1E/H1F models with a voltmeter and an ammeter. Make the connections as shown and described in the accompanying text, then start the engine. CAUTION: Do not let any leads come loose while the engine is running or the charging system components will be destroyed.

TESTING THE RECTIFIER/ REGULATOR UNIT

The design of the rectifier/regulator makes simple resistance checks of its internal components impossible. The only possible test is to check the alternator amperage output under various load conditions (lighting, etc.) after having determined that the charging coils are in good condition.

Remove the left-side cover for access to the rectifier/regulator unit. Disconnect the red wire to the unit. Fasten the positive lead of an ammeter (of at least 10 amps range) to the red wire to the unit and the negative lead to the red wire to the alternator. **CAUTION: Be sure they are fastened securely, if one of the leads were to slip free, the charging system components could be destroyed in seconds during the following tests.** Now connect a voltmeter (of at least 20 volts DC capacity) across the battery terminals-plus to plus, minus to minus. Start the engine and let it idle. The ammeter should register less than 2 amps and the voltmeter 14.5 to 15.5 volts. These readings should be the same with the engine speeded up to 3,000 rpm. With the engine at idle again, turn on the headlight low beam. The ammeter should read less than 5 amps; the voltmeter 12 to 13 volts. At 3,000 rpm the readings should be less than 5 amps and 14.5 to 15.5 volts. If these readings are not obtained, the rectifier/regulator unit is not functioning properly and must be replaced. *NOTE: Remember to follow all the charging system tests given here, in the order in which they are given, before deciding to replace any component.*

IGNITION SYSTEM

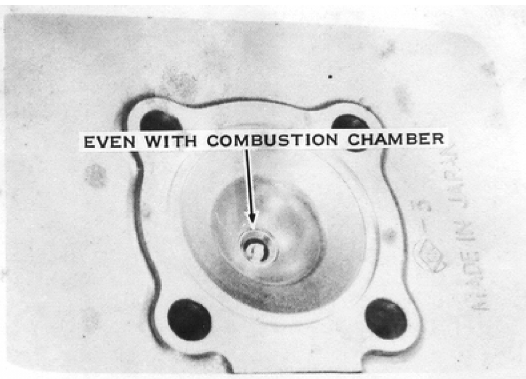
The motorcycle's ignition system has only one job -to ignite the mixture in the cylinders at exactly the right instant to produce smooth, economical power. This may sound like a simple job, but it's not. The spark plugs must operate under difficult conditions. One end is exposed to the atmosphere at a pressure of around 14 psi and at a temperature of 50° to 100° Fahrenheit. The other end is in the combustion chamber exposed to pressures in excess of 500 psi and temperatures around 1500° Fahrenheit. The electrodes must not burn off after delivering millions of sparks; the insulator must not break down even though it must hold back 10,000 to 30.000 volts. The ignition coils must amplify the voltage of the rest of the system to the over-10,000-volt levels required by the spark plugs. The timing devices, points or signal coils of the different models must work at precisely the right instant, thousands of times every minute, to make the engine run properly.

Every ignition system has four basic components: a power source, trigger or timing source. high-tension coil, and spark plug. Some systems have more than one of some of these basic components, but that is only to accommodate the number of cylinders that must be fired. The power source on three-cylinder Kawasaki ignition systems is either the battery or a special alternator. The power source supplies all the electrical power used by the ignition system, which may be over 100 watts in the most power-hungry system.

The timing devices on these systems come in two basic types. The S-series models and the H1B have sets of contact breaker points very much like those used in automobile ignitions. The other models have an electronic signaling device consisting of a signal rotor on the end of the crankshaft and a signal coil (or coils) on the alternator stator. This device sends a small pulse of current to the ignition unit, which allows a capacitor charged by the power source to discharge to the primary winding of the high-tension coil.

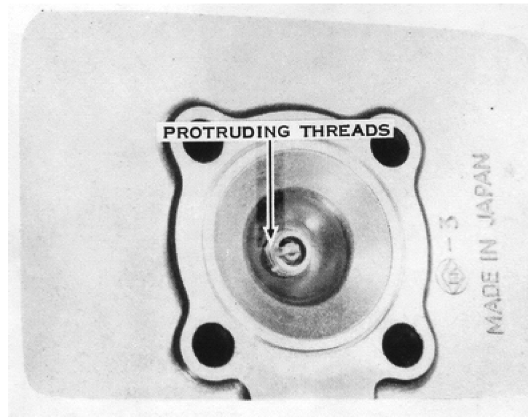
The high-tension coil is similar on all models in that it consists of a pair of concentrically wound coils, one with few turns (called a primary winding), the other with many turns (called a secondary winding). The primary has a lead to the CDI unit or to the points; the secondary has a high-voltage lead to the spark plug.

The spark plugs on all models are essentially the same, differing only in heat range and electrode configuration, except for the surface-gap plugs that were supplied originally in the H1, H1A, and H1C models. All these models use 1/2"-reach spark plugs. **CAUTION: Do not use 3/4"- or 3/8"-reach or extended-nose spark plugs. Some plugs may hit the top of the piston near TDC with disastrous results.** The exposed threads of others can preignite the mixture, causing major engine damage. Spark plug recommendations are made at the end of this chapter



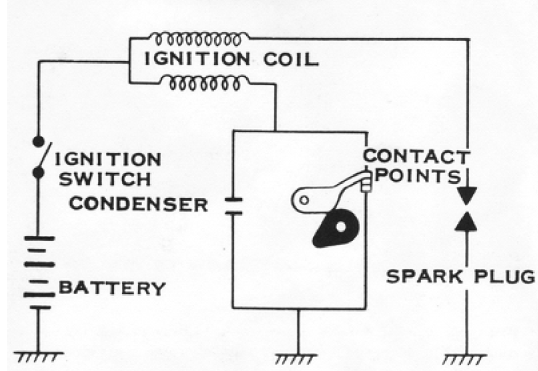
This shows the correct plug reach. All models use a ½" plug reach. Be sure to use the right plugs.

Plug reach is the length of the threaded portion of the spark plug shell. If the plug reach is too short for the hole in the cylinder head, as shown, the spark plug will become carbon-fouled and the correct spark plug will no longer fit. It is also possible for the bottom threads of the plug hole to be heated red hot by the combustion process, inviting detonation and preignition.



This spark plug has too long a reach. The last few threads on the plug shell protrude into the combustion chamber where they will glow red from the heat of the combustion process, inviting detonation and preignition. Carbon will build up on the exposed threads also, and soon it will be impossible to remove the plug. CAUTION: If you need to remove a plug in this condition, be sure to clean all the carbon off the threads first, or you will destroy the threads in the cylinder head.

S-SERIES AND H1B MODEL IGNITION SYSTEM



This is a wiring diagram of a battery/coil ignition system. The S-series and H1B models have three systems like this, one for each cylinder. The only components shared by the three systems are the battery and the point cam.

These models use a so-called battery/coil or battery/point ignition system similar to that used in automobiles for the past fifty years. Actually, these models have three separate systems, one for each cylinder. A distributor is not used, nor is there any provision for automatic timing advance or retard under changed speed or load conditions.

A single-lobe point cam is mounted on the left end of the crankshaft. On the stator, located around the cam at 120° intervals, are three sets of contact breaker points. As the crankshaft turns, the cam opens and closes each set of points in turn. Each set of points is opened and closed once per crankshaft revolution. One side of each set of points is grounded; the other side has a wire to the ground wire of one of the high-tension coils. On the S-series models, the point set wires are color coded as follows: left cylinder, green wire; center cylinder, black wire; right cylinder, blue wire. On the H1B. the color code is: left cylinder, green wire; center cylinder, red/white wire; right cylinder, black wire.

The three high-tension coils are mounted on frame tabs under the front end of the fuel tank, which must be taken off to remove, replace, or inspect the coils. Each coil has a brown wire from its primary winding to a common brown wire which goes to the main switch, where it is connected to the battery. The secondary winding of each coil has a large black high-tension lead to one spark plug.|

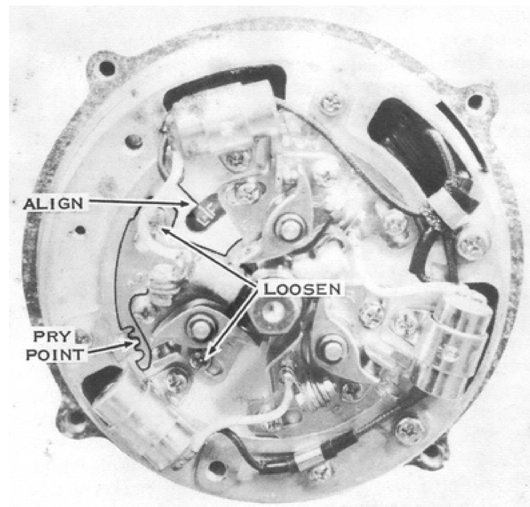
The spark plug is fired, as in any battery/coil system, by the opening of the points. As long as the points are closed, the battery is supplying current to the primary windings of the high-tension coil to develop a strong magnetic field around both windings. When the points open, the current stops flowing in the primary windings and the magnetic field collapses. The field collapses rapidly past the thousands of turns of wire in the secondary winding to the soft iron core, and extremely high voltage is generated, which jumps the spark plug gap. As the field collapses, it also moves past the primary winding, generating a smaller voltage in it that tries to jump the point gap, as if it were a spark plug. If this were allowed, to happen, the points would soon become burned and pitted by the arcing. To prevent this a condenser is connected across the points. It "soaks up" this surge of electricity and helps preserve the points. When the points close again, current from the battery starts to flow in the primary, rebuilding the magnetic field around the high-tension coil in preparation for the next spark.

TIMING THE S-SERIES AND H1B IGNITION

There are two methods of checking the static ignition timing; matching the timing marks or measuring the piston movement from TDC with a dial indicator. Matching the timing marks is the simplest method, but it may not be completely accurate because of production tolerances in stamping the marks and machining the keyways in the crankshaft and rotor. A bent timing pointer (or shifted stator plate) can also result in incorrect positioning of the stationary timing mark. Using the dial indicator eliminates these inaccuracies because the points are adjusted to open at the exact piston position and, therefore, at the specified crankshaft angle. The dial indicator can also be used to verify the accuracy of the timing marks, after which they can be used with confidence.

MATCHING THE TIMING MARKS

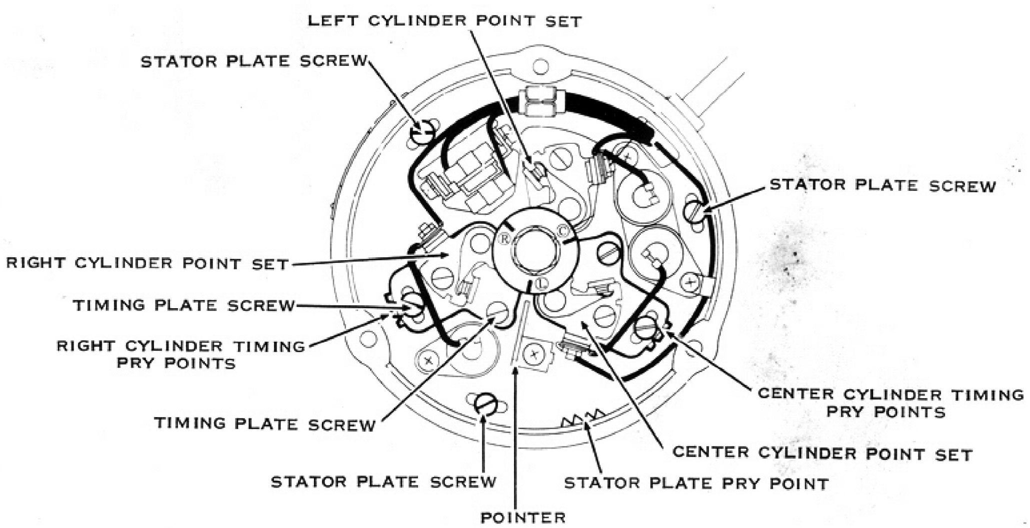
Adjust the ignition timing only after having cleaned the points and adjusted their gap. Attach a self-powered continuity lamp across one set of points by connecting one lead to any metal part of the engine (ground) and the other lead to the breaker-arm spring. **CAUTION: Make sure the main siwitch is in the OFF position, or else the lamp will be energized by the motorcycle's battery.** Slowly turn the crankshaft in the normal direction of rotation (counterclockwise) and watch the continuity lamp, which will go out when the points open.



On S-series models, look through the hole in the stator plate for the timing marks on the alternator rotor. Each set of points must be adjusted separately. Loosen the two screws holding the timing plate to the stator, then move the timing plate by inserting a screwdriver between the pry points as shown.

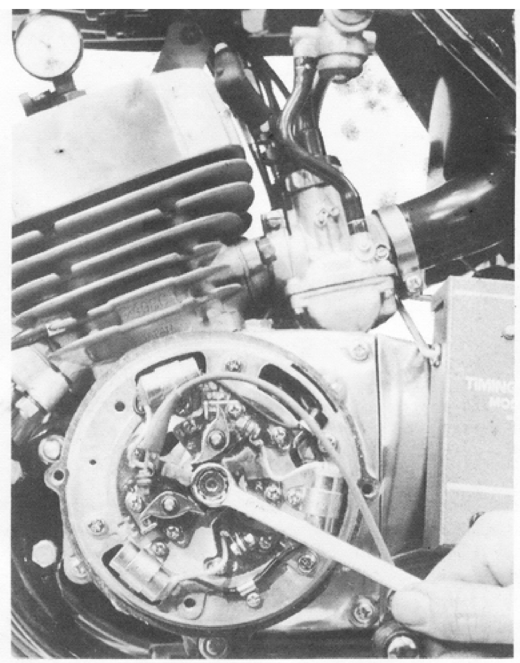
If the timing is correct, the points will open just as, the timing mark on the edge of the rotor coincides with the pointer's mark. If the points open before the marks coincide, the ignition timing is advanced; if they open after the marks coincide, the timing is retarded.

To adjust the ignition timing, loosen the two screws securing the timing plate by 1/2 turn. Wedge a screwdriver blade between the timing plate notch and the stator plate dimples. If the timing is advanced, turn the screwdriver clockwise to retard it; if retarded, turn the screwdriver counterclockwise to advance it. Tighten the timing plate screws, recheck the point gap. and then recheck the ignition timing. Repeat the procedure for the other two sets of points. Burnish the closed point surfaces by drawing strips of lintless paper through until no trace of dirt or oil is left, and then install the left engine cover.



The timing marks on the H1B appear on the small rotor on the end of the point cam. The pointer is just below it, fastened to the stator plate. Remember to time the left cylinder first (the top point set) by loosening the stator plate screws. Then time the other two sets of points by loosening only the screws holding their timing plates to the stator plate. The various sets of notches in the drawing are pry points for moving the stator plate and the two timing plates.

CHECKING THE S-SERIES IGNITION TIMING WITH A DIAL GAUGE



Timing the S-series ignition with a dial gauge is more accurate than using the marks on the alternator rotor. Remember to turn the crankshaft in its normal direction of rotation (counterclockwise) to find the firing point when the ignition contacts should open.

Remove all spark plugs, then screw a dial gauge adaptor into the left-hand spark plug hole, leaving the clamp screw loose. Turn the crankshaft with a wrench until TDC is indicated by the needle's reversing direction. Push the dial gauge into the adaptor until the small pointer registers 5mm. **CAUTION: If the dial gauge is forced past 5mm, the delicate internal mechanism will be jammed.** Tighten the adaptor clamp screw to secure the dial gauge in this position. Turn the crankshaft back and forth past TDC while rotating the dial bezel so that the needle registers zero just as it reverses.

Starting with the crankshaft and piston at TDC (needle at zero), slowly rotate the crankshaft clockwise. Count the number of rotations of the needle and stop when the needle indicates a piston drop of 2.60mm. This is exactly 23° before TDC. The mark on the stator plate near the window (located at 10 o'clock) should align with the mark near the **L** on the face of the alternator rotor. If it does not, make a small scratch mark on the stator plate that does align. Move the dial gauge to the other two cylinders and repeat the procedure. The ignition should now be timed (using the corrected timing marks) as described in the previous section.

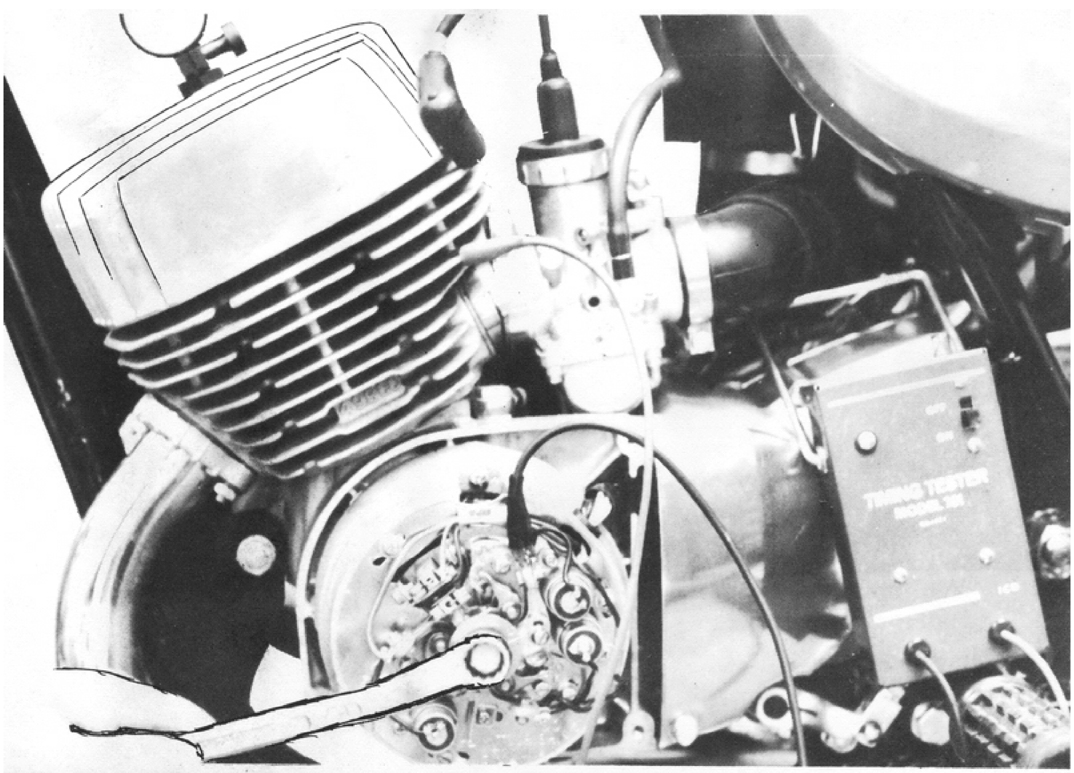
Alternatively, you can use the self powered continuity lamp with the dial gauge instead of marking the stator. When the crankshaft is rotated counterclockwise, the continuity lamp should light just as the dial gauge indicates 2.60mm. Turn the crankshaft counterclockwise to about 2.70mm, then turn it slowly clockwise; the light must go out as the needle registers 2.60mm. Be sure to move the dial gauge to the other two cylinders to be sure all three are timed properly.

After timing all three sets of points, replace the spark plugs, the spark plug wires, and the ignition cover. Be sure to get the right wires on the right spark plugs.

CHECKING THE H1B IGNITION TIMING WITH A DIAL GAUGE

The procedure for timing the H1B with a dial gauge is very similar to the S-series procedure described above. Remove all three spark plugs, and then screw the dial gauge adaptor into the left-hand spark plug hole. **CAUTION: Do not tighten the clamp.** Turn the crankshaft with a wrench until the needle's reversing direction signals TDC. Push the dial gauge into the adaptor until the small pointer registers 5mm. **CAUTION: If the dial gauge is forced past 5mm, the delicate internal mechanism will be damaged.** Tighten the clamp screw to secure the dial gauge in this position. Turn the crankshaft back and forth past TDC while rotating the bezel on the dial gauge so that the needle registers zero just as it reverses.

Connect one lead of a self powered continuity lamp to the arm of the movable point and the other to a good ground such as a cylinder fin. **CAUTION: Be sure the main switch is turned OFF or the motorcycle's battery will light the lamp.**



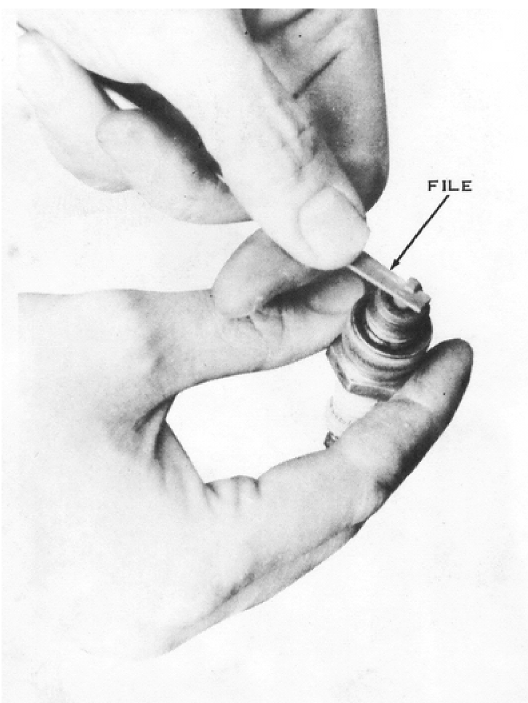
When the timing the H1B ignition with a dial gauge, be sure to time the top point set first. It is mounted directly on the stator plate. Therefore, changing its timing also changes the timing of the other two sets.

Starting at TDC, slowly rotate the crankshaft clockwise. Count the number of rotations of the needle and stop when the needle indicates a piston drop of 2.23mm. This is exactly 20° before TDC. The lamp should light. Turn the crank past this point to about 2.40mm. Now turn it counterclockwise until the dial gauge indicates 2.23mm. The light should go out at exactly this point. If it does not, loosen the three stator plate screws and move the entire stator plate until the light goes out at exactly 2.23mm. Tighten the stator plate screws securely, and then check the timing again. Now move the dial gauge to the other two cylinders and repeat the procedure with the following difference: When setting the timing of the center and right-hand cylinders, do not loosen the stator plate screws; loosen only the two screws holding that one set of points. After timing all three sets of points, check that the point gaps are still between 0.012" and 0.016" Replace the spark plugs, spark plug wires. and ignition cover. Be sure to get the right wires on the correct spark plugs.

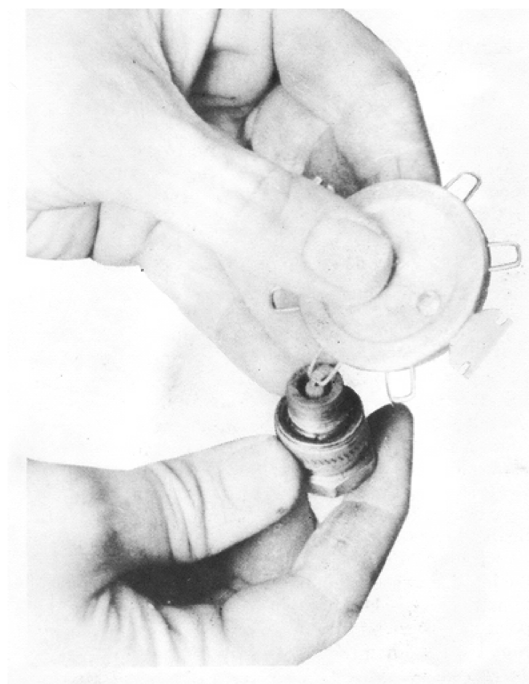
TROUBLESHOOTING THE IGNITION SYSTEM-S-SERIES AND H1B MODELS

If the engine does not run at all, check for a spark at the plug electrodes by laying the spark plug, with its high-tension wire attached, on the cylinder head, and then try to kickstart the engine. If there is a spark, you must inspect the other systems of the engine as described in Chapter 1, Troubleshooting. If there is no spark or if the engine misses at high engine speeds or under load, you must inspect the components of the ignition system as described here.

A common part to fail in any ignition system is the spark plug, because of the extreme conditions of heat and pressure under which it functions. Remove the spark plugs. The electrodes will be burned and rounded unless the plugs are new. File the electrodes square, then regap the plugs to 0.020" (0.5mm). Clean the carbon deposits from inside the plug shell and from around the center electrode. **CAUTION: Never bend or stress the center electrode or its insulator will break.** If the spark plugs have over 2,000 miles on them, you should discard them. Spark plugs do not last long in these high-output engines.

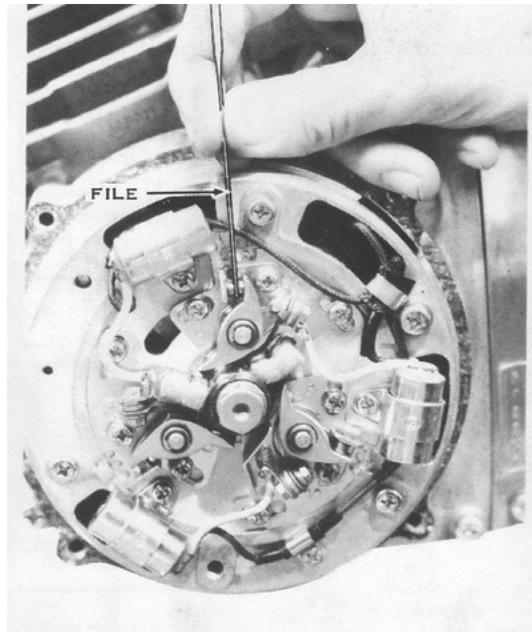


Use a small file to dress the spark plug electrodes flat, which will lower the plug's firing voltage requirement to make it more efficient.



Measure the spark plug gap with only a wire-type gauge. A flat feeler gauge will give an inaccurate reading because the inside of the side electrode is not flat.

To inspect the points, remove the ignition cover on the left side of the engine. Remove all three spark plugs to make the crankshaft easier to rotate. Pry each of the point sets open with your fingers so you can see the contact points themselves. The surfaces of the points are flat and smooth when they are new. After being used for a while they become burned and pitted. If one side is deeply pitted and the other has a mound built up on it, the condenser is bad and must be replaced. If the points are not severely pitted, dress them flat with a clean flexstone or a small ignition file. Clean the points with a business card soaked in trichloroethylene, then pull a dry card between the points until it comes out clean. Gap the points and adjust the ignition timing as described previously. Replace the ignition cover, spark plugs, and wires.



Use a clean flexstone or ignition point file to remove pitting and roughness from the point surfaces. CAUTION: Oil on the ignition file can be deposited on the points, to oxidize and cause problems later.

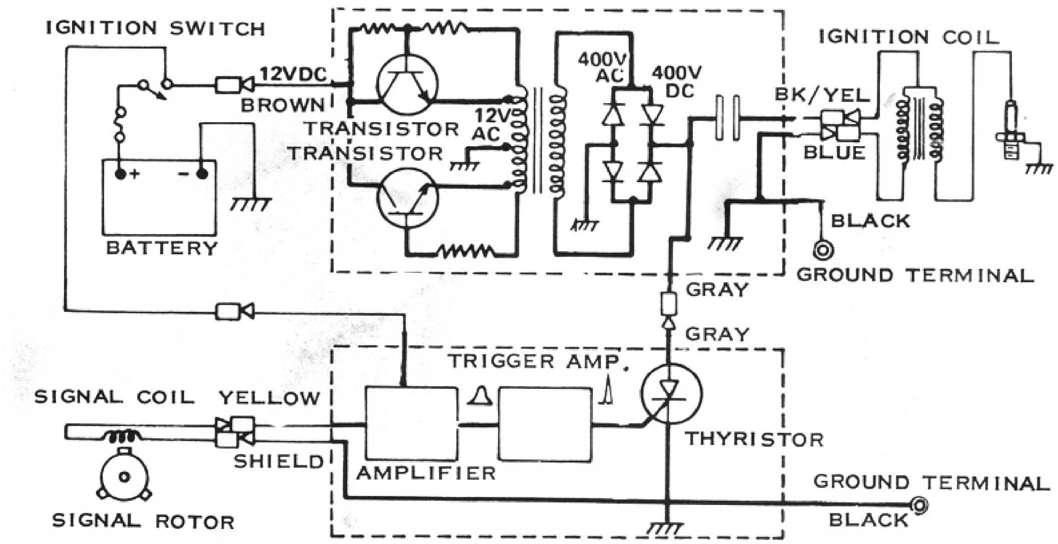
If there is still no spark at the spark plugs, check the high-tension coils and the spark plug wires. To test the coils, you must first remove the fuel tank. **CAUTION: Make sure the fuel cock is turned to S (for stop), before disconnecting the fuel hoses.** Pull the brown wires and the black wires free of the coils. Hook one lead of an ohmmeter to the black wire for one of the sets of points and the other lead to a good ground. Kick the engine over. The ohmmeter should swing from infinity to zero and back as the points open and close and open again. Test each black wire this way.

Now connect the positive lead of a DC voltmeter (with a range of at least 15 volts) to the brown wire going into the wiring loom. Hook the other lead to a good ground. Turn the main switch ON; the meter should read 12.5 volts. If it does not, check the battery voltage. If the battery voltage is low, you may have a charging system problem. If the battery voltage is 12 or more, the problem is in the wiring or the main switch. Use the ohmmeter to isolate the problem.

Check for continuity between all connections and across the main switch in all positions. Checking the main switch is described in detail later in this chapter. Finally, connect one lead of an ohmmeter to the black lead from the coil and touch the other lead to the brown wire and the spark plug wire in turn. Both should show some resistance but less than infinity.

H1, H1A, H1C MODEL IGNITION SYSTEM

The ignition system of the H1, H1A, and H1C models was the first CDI (Capacitor Discharge Ignition) system used by Kawasaki. A capacitor is charged by the battery indirectly, then discharged to fire the spark plug.



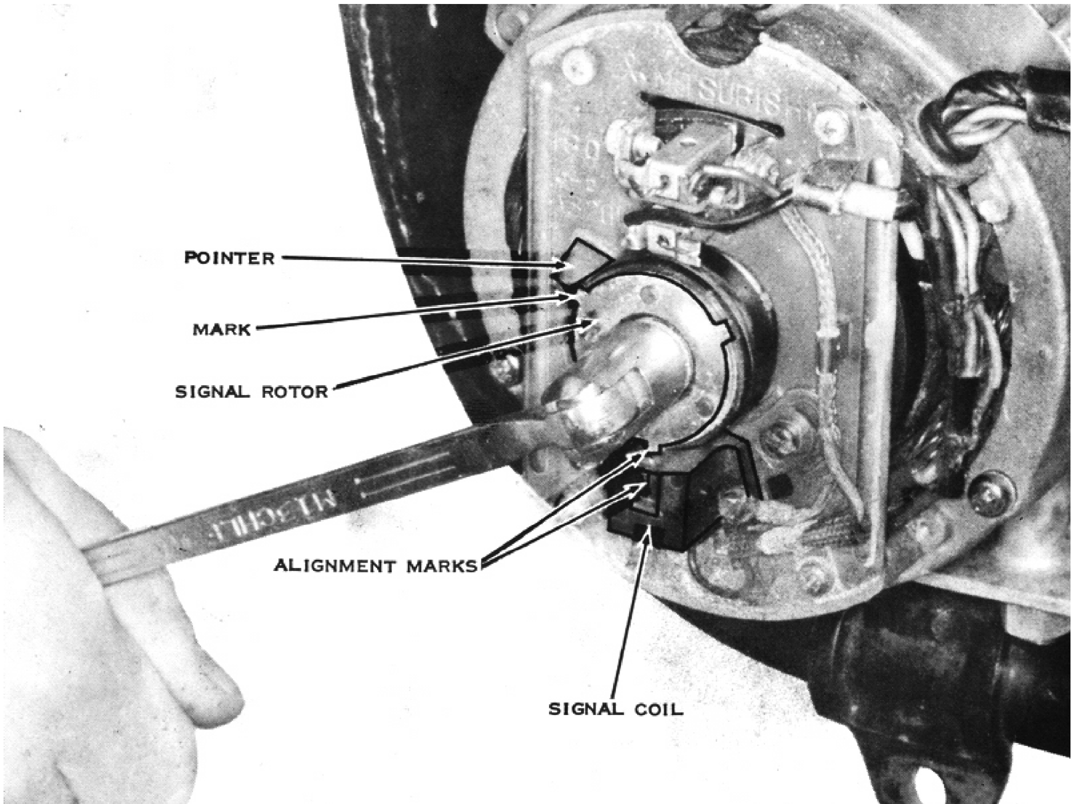
This simplified wiring diagram shows how the battery CDI of early H1 (1969-71) models works. Correct battery voltage is necessary to the efficient operation of this system, which uses over 100 watts of electrical power at high engine speeds.

This is how it works: Battery voltage is fed to a transistor oscillator circuit. In simple terms, this is a circuit that automatically switches the battery direct current back and forth so that alternating current comes out the other side. This alternating current, still at 12 volts, is fed to a special step-up transformer which is very similar to a high-tension coil. The 12 volts AC goes through the primary winding of the special transformer, and the magnetic field that rises and falls with every alternation of the current flow direction induces a current in the secondary winding of the transformer. The secondary winding, however, has many more turns of wire than the primary winding, so the voltage is much higher, around 380 to 400 volts AC. This current goes through a rectifier, and the resulting 380-400 volts DC is used to charge the capacitor, which will be discharged into the primary lead of the high-tension coil.

A small signal rotor with three magnets in it is located on the left end of the crankshaft, outboard of the alternator rotor. Mounted on the stator near the signal rotor is a small black plastic component called a signal coil. As each of the three magnets in the rotor moves past it, a tiny pulse of current is generated in the signal coil. The pulse travels through two solid-state electronic amplifiers which shape its wave-form and increase its strength to make the timing more precise and reliable at all speeds. The pulse now goes to a solid-state electronic switch called a thyristor. It will not allow any current to flow through itself unless it is given a signal in the form of a small pulse of current. The thyristor then is triggered by the pulse from the signal coil. When the thyristor conducts, it connects the highly charged capacitor to the primary winding of the high-tension coil. As the capacitor discharges its stored energy through the primary winding, a strong magnetic field quickly builds around the core of the high-tension coil. This rising magnetic field cuts across the secondary winding, inducing in it a tremendous voltage (up to 30,000 volts) which arcs across the plug gap. A distributor much like an automotive one switches the output of the high-tension coil to each of the three spark plugs in turn.

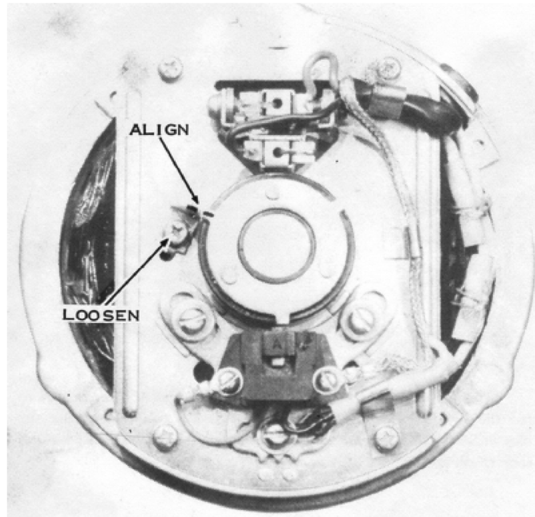
TIMING THE IGNITION SYSTEM-H1. H1A, AND H1C MODELS

MATCHING THE TIMING MARKS



To time the ignition on an H1, H1A, or H1C by the marks, align the mark on one signal rotor tang with the pointer. The raised line molded on the signal coil must align with the mark in the other tang. Move the signal coil by loosening the two screws holding the signal coil base plate to the stator plate. CAUTION: Do not pry on the signal coil with any kind of tool or it will break.

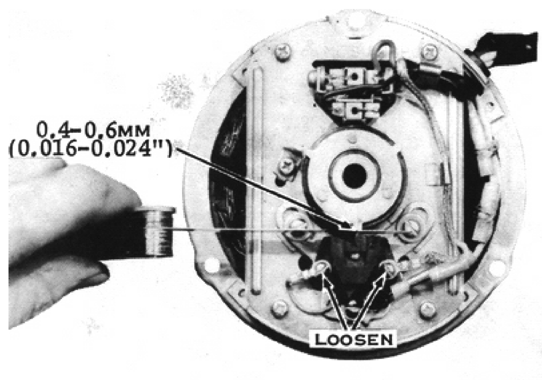
Adjust the ignition timing only after having set the air gap. Turn the crankshaft until the mark on one of the signal rotor tangs aligns with the pointer on the stator plate (located at about 10 o'clock). One signal rotor tang will point straight toward the signal coil. The mark on that tang should align with the raised line molded on top of the signal coil. If it does not, loosen the two screws holding the signal coil mounting plate to the stator and move it accordingly. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** Tighten the screws, recheck the timing, and then replace the ignition cover.



Using a dial gauge in the H1, H1A, or H1C ignition allows one to position the pointer accurately for future ignition timing. Be sure to check the specifications for the proper piston position; not all H1 models have the same ignition timing.

TIMING THE IGNITION SYSTEM WITH A DIAL GAUGE

Remove all three spark plugs and the ignition cover on the left side of the engine. Screw a dial gauge adaptor into the left cylinder spark plug hole, leaving the clamp loose. Turn the crankshaft with a wrench until TDC is indicated by the needle's changing direction. Push the dial gauge into the adaptor until the small pointer registers 5mm. **CAUTION: If the dial gauge is forced past 5mm, the delicate internal mechanism will be damaged.** Tighten the adaptor clamp screw to hold the dial gauge in this position. Turn the crankshaft back and forth past TDC while turning the dial bezel so that the needle registers zero just as it reverses.



When adjusting the air gap on the H1, H1A, and H1C, be sure to use the signal rotor tang closest to the signal coil to measure the clearance. CAUTION: Do not pry on the signal coil with any kind of tool. It will break.

Starting with the crankshaft at TDC, slowly rotate it clockwise. Count the number of rotations of the needle and stop when the needle indicates 3.45mm. This is exactly 25° before TDC. The raised line molded into the top of the signal coil should align with the mark on the signal rotor tang. If it does not. loosen the three screws that hold the signal coil base plate to the stator plate, then move the signal coil as required. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** Tighten the signal coil base plate mounting screws. then check the air gap which must be from 0.016" to 0.024". Now loosen the screw that holds the pointer (located at about 10 o'clock) to the stator plate. Move the pointer so it aligns with the mark on the closest signal rotor tang, and then retighten the screw. The ignition can be timed from now on (without the use of the dial gauge) by just matching the pointer with the mark as described in the previous section

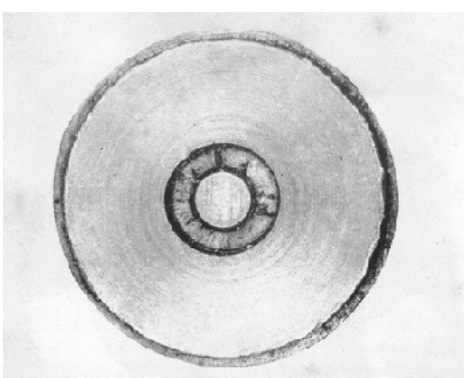
Replace the spark plugs, spark plug wires, and ignition cover. Be sure to get the right spark plug wires on the correct plugs.

TROUBLESHOOTING THE IGNITION SYSTEM-H1, H1A AND H1C MODELS

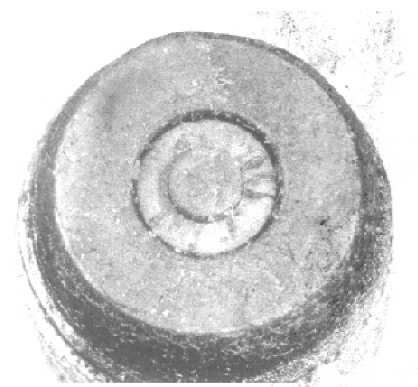
If the engine does not run at all, check for a spark at the spark plug electrodes by laying each of the spark plugs, with its high-tension wire attached, on the cylinder and trying to kickstart the engine. If there is a spark, you must inspect the other systems of the engine as described in Chapter 1, Troubleshooting. If there is no spark. or if the engine misses at high speeds or under load, you must inspect the components of the ignition system as described here.

A common part to fail in any ignition System is the spark plug. because of the extreme conditions of heat and pressure under which it functions. Remove the spark plugs. The electrodes will be burned and rounded unless the plugs are new. File the electrodes square. then regap them to 0.040" (1.0mm). Clean the carbon deposits f: from around the center electrode. **CAUTION: Never bend or stress the center electrode or its insulator will break.**

If the spark plugs are the surface gap type, they do not need to be cleaned or gapped. Check the surface of the insulator around the center electrode for signs of tracking, which looks like shiny, radial lines from the center electrode to the spark plug shell. If the insulator surface is tracked, the high voltage from the ignition coil will "leak" across the track before it has risen high enough to jump the gap. *NOTE: The two surface gap spark plugs recommended for this engine are the Champion UL-17V and the NGK BUHX. Generally, the UL-17V will make the engine run more smoothly at small throttle openings because it has an extended nose. However, it tends to foul or track more easily than the BUHX because it has only a 0.200" booster gap (series gap). The BUHX has a 0.250" booster gap so that the voltage seen at the spark plug electrodes is higher.*



Channeling. This is sometimes incorrectly diagnosed as cracking. It is generally caused by extreme heat. When the deposits cover the shallow channels, the rate of insulation erosion is aggravated, the spark plug is masked, and misfiring can occur.

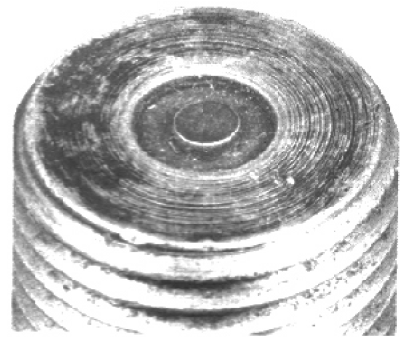


Carbon tracking. The electrically conductive deposits on the firing end provide a low-resistance path for the high voltage. Carbon tracks are formed and misfiring generally occurs.

Aluminum throw-off. This is an indication of preignition. Check the engine to determine the extent of damage. Replace the plugs.

Concentrated arc. The multicolored appearance is a normal condition, caused by electrical energy consistently following the same firing path. The arc path will generally change with deposit conductivity and gap erosion. This spark plug does not need to be replaced.

Normal spark plug. The deposits are light tan or gray, indicating good engine and ignition system conditions. The electrode wear indicates normal spark rotation.



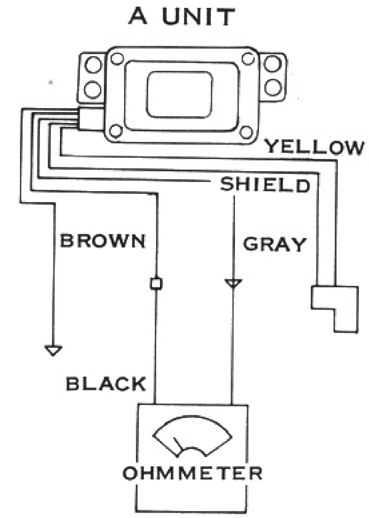
Low-temperature fouling. The soft, sooty deposits indicate incomplete combustion. Possible causes are rich carburetion, weak ignition, retarded timing, or low compression.

Cold-foul spark plug. These wet fuel/oil deposits can be caused by "drowning" the spark plug with raw fuel during cranking, an excessively rich fuel/air mixture, or a weak ignition system.

Worn-out spark plug. This amount of electrode wear can cause misfiring during acceleration or hard starting.

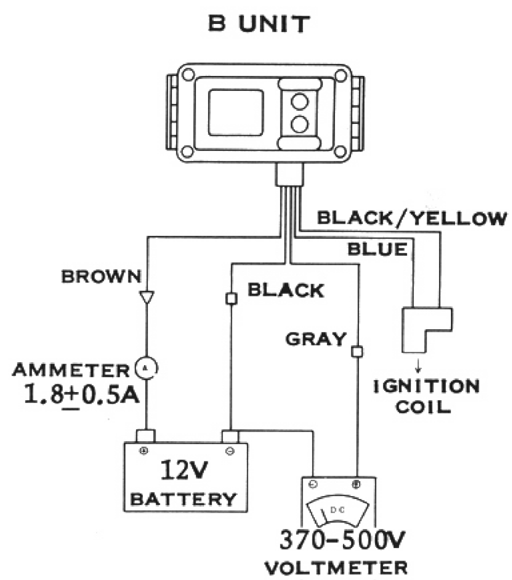
After checking the spark plugs, go to the "top" of the system and work down. To check the CDI units, lift the seat and turn on the ignition switch. You should be able to hear a high-pitched hum, which is the oscillator in the "B" unit. If you do not hear the hum, or if it is very faint, check the battery voltage, which must be at least 10 volts or the engine will not run. If the voltage is less than 12, the engine may miss at high speeds (if the charging system is not operating perfectly).

To check the "A" unit with an ohmmeter, first disconnect all the wires to the "A" unit. *NOTE: The "A" unit is the box directly behind the fuel tank under the seat.* Connect the red lead from the ohmmeter to the black wire from the "A" unit and the black meter lead to the gray wire from the unit. The meter should read infinity. Switch the leads and try again. There should still be infinite resistance between the black and gray wires. These tests are not conclusive; therefore, if the unit fails either one, it must be replaced. If it passes both tests, it may still be bad. The only way to test it further is by the process of elimination: if there is nothing else wrong, the "A" unit must be bad.

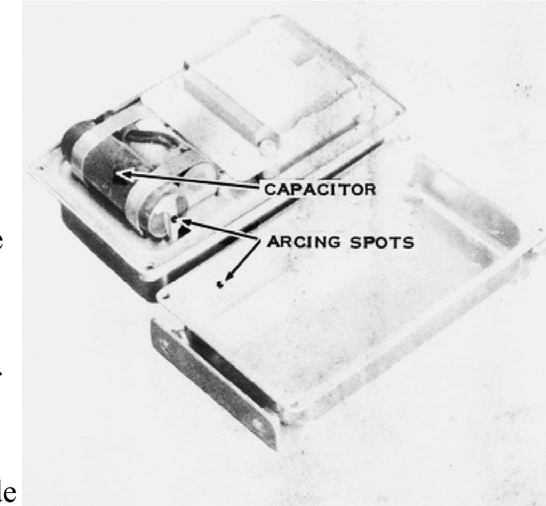


This diagram shows how to test the H1 battery CDI A-unit with an ohmmeter. There should be infinite resistance no matter which way the leads are connected.

To test the "B" unit with an ammeter and a voltmeter, first disconnect the brown wire from the "B" unit and the gray wire and the black wire to the "A" unit. Hook a voltmeter with a capacity of at least 500 volts DC between the gray wire from the "B" unit and a good ground. Fasten the positive lead of an ammeter to the brown wire from the "B" unit and the negative lead to the brown wire from the main wiring harness. **CAUTION: When the ignition switch is turned on, the gray wire will be carrying from 370 to 500 volts; do not touch it. Keep all tools away from it.** Turn on the ignition switch. The "B" unit should hum, the ammeter should give a steady reading of 1.3 to 2.3 amps; and the voltmeter should indicate 370 to 500 volts DC. If you do not get these readings with a fully charged battery, or if the unit does not hum, the "B" unit is defective and must be replaced.

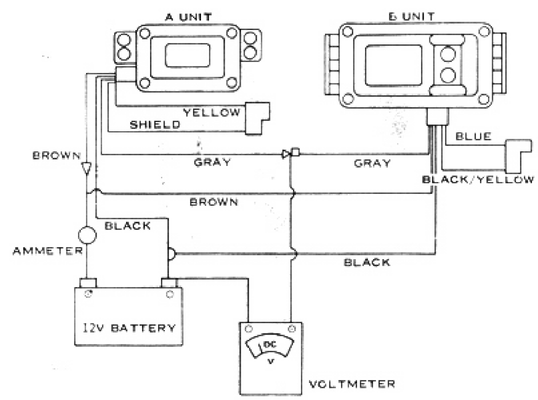


This diagram shows how to test the H1 battery CDI B-unit with a 500-volt DC voltmeter and an ammeter. CAUTION: When the main switch is turned on, the gray wire will be carrying 370 to 500 volts. Don't touch it, and keep all tools away from it.



The capacitor inside the B-unit sometimes shorts against the cover as shown. Glue a piece of rubber cut from an old innertube inside the cover to prevent the short circuit.

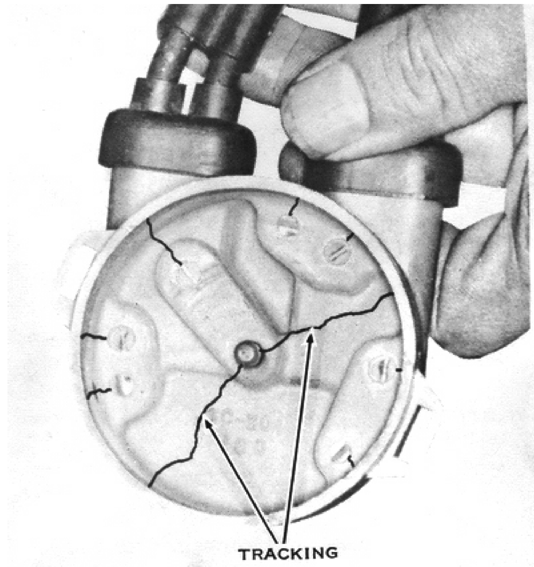
Before discarding a "B" unit that does not pass these tests, remove it from the motorcycle and take off the cover. Four small Phillips-head screws hold it in place. Check inside the cover to see if the capacitor (the large light-colored cylindrical component that is placed across one end of the unit) has shorted against the cover. If the cover is blackened near the end of the capacitor, shorting has occurred. The unit is probably salvageable if this is all that has gone wrong. Glue a piece of rubber from an innertube on the inside of the cover so that the end of the capacitor cannot touch the cover. Now reassemble the unit and retest it. If it now checks good, remount the "B" unit. If it still does not pass the voltmeter/ ammeter test, it must be replaced.



This diagram shows how to test the A- and B-units of the H1 battery CDI together with an ammeter and a voltmeter of at least 500 volts DC capacity. CAUTION: When the main switch is turned on, the gray wire carries 370 to 500 volts. Don't touch it, or let any tools get near it.

If both units check good separately. but the engine still won't run, check the two units together. To do this, hook all the wires together properly. Disconnect the white wire from the battery to the fuse and insert an ammeter as follows: Connect the negative ammeter lead to the battery side and the positive lead to the fuse end of the white wire. Now attach one lead of a voltmeter with a capacity of at least 500 volts DC to the connector in the gray wire from the "A" unit to the "B" unit. Connect the other lead to a good ground. **CAUTION: When the ignition switch is turned on, the gray wire carries 370 to 500 volts; do not touch it. Keep all tools away from it.** Turn on the ignition switch. The "B" unit should hum, the ammeter should give a steady reading of 1.5 to 2.5 amps, and the voltmeter should indicate 370 to 500 volts DC. If the units together do not pass these tests they are defective.

The distributor is located on the right end of the engine under the aluminum cover. To inspect the distributor, remove the cover. The grommet that goes around the high-tension wires where they leave the cover should be free of cracks and should seal well against the cover to keep moisture out of the distributor. Remove the two screw clamps holding the distributor cap to the end of the engine. Check the inside of the cap for carbon tracks caused by internal arcing, which mean that the insulating strength of the material of the cap has diminished and the distributor cap must be replaced.

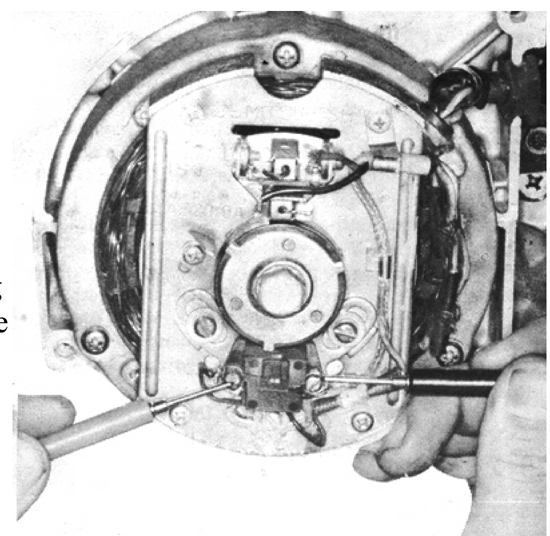


Inspect the inside of the distributor cap for "tracking." Arcing inside the distributor reduces ignition efficiency and leaves the carbon "tracks" seen here.

Pull the distributor rotor straight off to check it. The brass end will be burned but will work properly unless both it and the contacts inside the cap are severely burned. Take off the gasket and the distributor insulator. Check the insulator for carbon tracks. The gasket must fit the insulator and cap properly without buckling or stretching. If it has shrunk or shriveled, it must be replaced.

Inspect the insulation of the high-tension wires carefully for cracks or breaks that might let the high-voltage electricity leak before the plug is fired. Broken or frayed insulation will cause high-speed misfiring, and one of the spark plugs will seem to foul very quickly. If one wire needs to be replaced, the others should be replaced too. **CAUTION: When reassembling the distributor, be sure to include the gasket and the insulator under the rotor. If either is left out, the rotor will hit the distributor cap and be damaged.**

Probably the least likely part of this ignition system to fail is the signal generator. To check the signal coil, lift the seat, then unplug the black rubber two-prong plug with the shielded yellow wire. Use an ohmmeter to check the resistance between the prong and the socket on the engine side of the connector. There should be 300 to 400 ohms. If there is less, the turns of wire in the coil are shorted together and the signal coil will not put out a strong enough signal pulse to trigger the ignition system. If there is excessive resistance, the signal coil pulse will be reduced before it can trigger the ignition system. In either case it must be replaced



Check the resistance of the signal coil with an ohmmeter. The reading should be 300 to 400 ohms.

To check for a reversed magnet in the signal rotor, hold a compass near the rotor, then move it around the face of the rotor. If the needle swings around end-for-end, it indicates a reversed magnet.

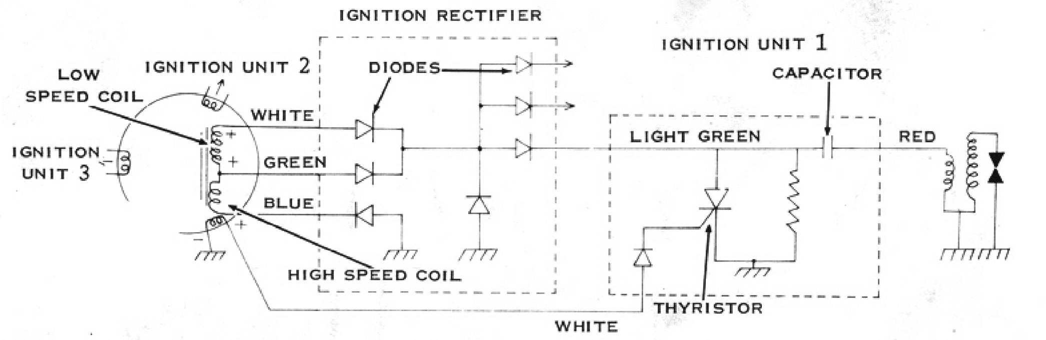
The magnets in the signal rotor are a permanent type and only very high temperatures, as in a gasoline fire, can cause them to lose their magnetism. There have been cases, however, where the magnets have been installed in a rotor improperly. This is not a problem that develops over a period of time, but you might experience it when the rotor is replaced with a new one that has never been used before. To test for a reversed magnet, check the polarity of each of the three magnets in the rotor with a compass. Hold the compass near the outer face of the rotor near the edge, and then turn the rotor slowly. One end of the needle must point to the rotor at all times, provided that all three magnets are installed the same way. If the compass needle reverses itself as you turn the rotor, one of the magnets is reversed and the rotor must be replaced.

If you have installed a rotor with a reversed magnet, your engine will not run properly because one spark plug will fire about 40° too soon. This will make the engine run irregularly, and it may kick back very strongly when you try to kick start it. *NOTE: Before inspecting the rotor when these symptoms occur, first be sure that the ignition is properly timed with a dial gauge.*

There is no test for the ignition high-tension coil that will tell you if it is absolutely good or bad. Use an ohmmeter to measure the resistance between the high-tension terminal and the negative terminal and between the positive and negative terminals. If either resistance is less than one ohm, the coil can be internally shorted. If either resistance is greater than 10 ohms, there can be a partially open winding. If all the previous tests show the other ignition components to be in good condition, replace the high-tension coil with a new one or one from a motorcycle that runs.

H1D AND H2 MODEL IGNITION SYSTEMS

The ignition system used on all H2 models and on the H1D is actually three separate ignition systems, one for each cylinder, that share only a few common parts The power source for this CDI system is an alternator on the left end of the crankshaft. It uses the same permanent magnet rotor as the alternator for the charging system and has two coils on the same stator as the main alternator. These two coils are one of the advantages of this ignition system. One coil, called a low-speed coil, has a great many turns of wire so that it feeds, the ignition system high voltage even at low engine speeds. The high-speed coil has fewer turns of wire but less resistance than the low-speed coil. At high engine speeds, when the voltage from the low-speed coil drops, the voltage from the high-speed coil is high enough to operate the ignition system. There is no change-over switch; the high-speed coil takes over from the low-speed coil automatically.

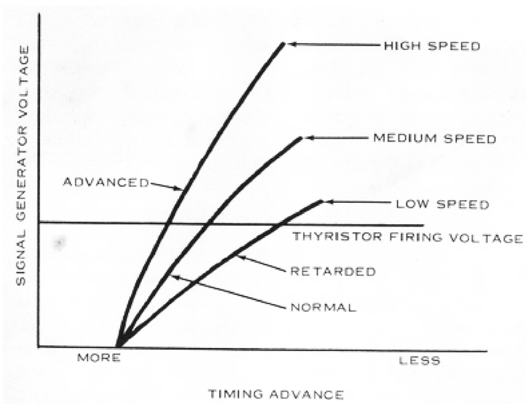


The simplified diagram shows how the H2/H1D ignition system works. Note that the power source is two special coils on the alternator stator.

The two coils put out 300 to 400 volts AC to the rectifier unit. This is a long, narrow box mounted under the seat with the three ignition units. The rectifier changes the AC voltage to DC voltage and sends it to each of the three ignition units through the three light green wires. Each ignition unit has a capacitor in it (among other things), charged to 300 to 400 volts by the rectifier.

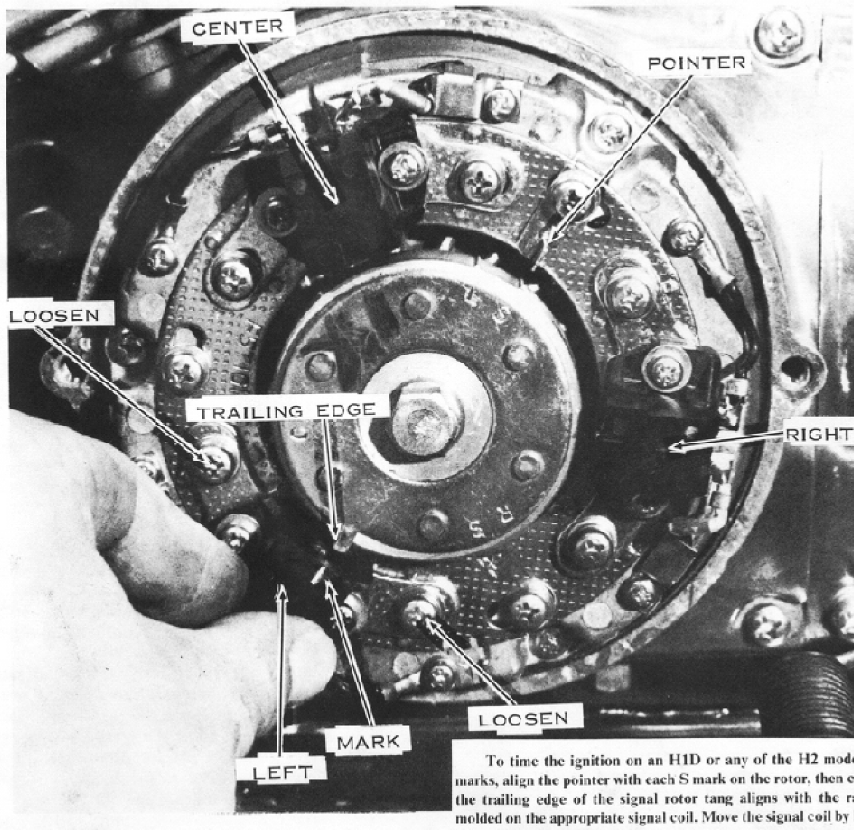
There is a signal generator on the left end of the crankshaft. It consists of three signal coils on the stator plate and a signal rotor on the crankshaft, outboard of the alternator rotor. The signal rotor has one magnet in it. As the magnet passes one of the signal coils, a current is generated in the coil. A white wire (all three signal coils have white wires) carries the pulse back to the ignition unit. Inside the unit, the pulse goes to a thyristor (a kind of solid-state electronic switch) which "turns on" and conducts the charge in the capacitor to the primary winding of a high-tension coil, one of three under the fuel tank. The current flowing through the primary winding of the high-tension coil creates a rapidly expanding magnetic field. As the magnetic field expands, its lines of force cut through the secondary winding of the high tension coil, inducing a current in it. Because of the great number of turns on the secondary winding, the induced current has a very high voltage, as high as 36,000 volts. The secondary winding is attached to the spark plug via a high-tension wire. When the voltage in the secondary winding gets high enough, it jumps the plug gap and fires the mixture. This usually happens at no more than 13,000 volts and, because the system is capable of a minimum of 20,000 volts under the worst conditions, the spark plugs almost never misfire.

This system also has an automatic timing advance feature. The thyristors (in the ignition units that conduct the charge in the capacitor to the primary winding of the high-tension coil) always "turn on" when the voltage from the signal coil reaches a certain level. As the engine speed rises from idle, the now-faster-moving magnet in the signal rotor generates a higher voltage in the signal coil. The voltage in the coil, because it must rise higher in the same amount of time, rises more quickly. This means that the firing voltage of the thyristor is reached sooner and the ignition timing is advanced.



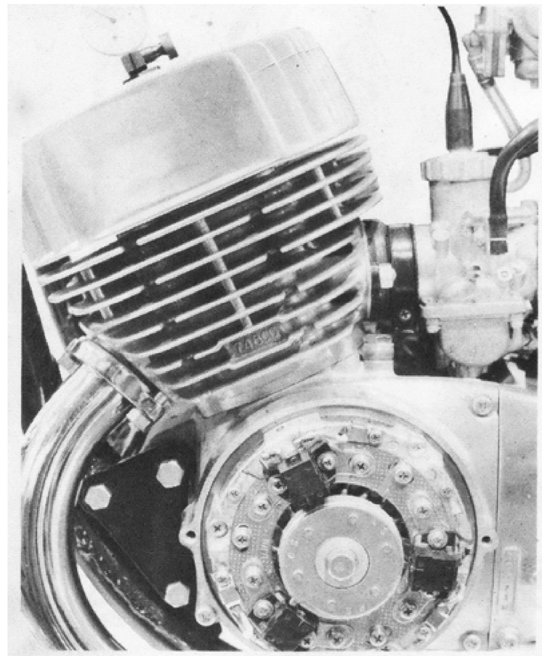
The H2/H1E CDI systems have an automatic electronic ignition advance feature based on the triggering voltage of the thyristor. As the engine spins faster, the triggering voltage is reached sooner, advancing the timing.

TIMING THE HID/H2 IGNITION SYSTEM MATCHING THE TIMING MARKS



To time the ignition on an H1D or any of the H2 models by the marks, align the pointer with each S mark on the rotor, then check that the trailing edge of the signal rotor tang aligns with the raised line molded on the appropriate signal coil. Move the signal coil by loosening the two screws holding the signal coil base plate to the stator plate. CAUTION: Do not pry on the signal coils with any kind of tool or they will break.

Adjust the ignition timing only after having set the air gap. Turn the crankshaft until the **S** mark on the signal rotor nearest the **L** mark aligns with the pointer on the stator (located at about 2 o'clock). The trailing edge of the rotor tang should align with the raised line molded onto the top of the left cylinder signal coil (located at about 7 o'clock). If it does not align. loosen the two screws holding the signal coil mounting plate to the stator, then move the signal coil as required. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** When the marks align, tighten the screws and recheck the alignment. Now rotate the crank till the **S** mark nearest the **R** mark aligns with the pointer and repeat the procedure for the signal coil at 4 o'clock. Rotate the crank again to align the **S** mark nearest the **C** mark with the pointer, and then repeat the procedure for the top signal coil.



Use a dial gauge on an H1D or H2 model ignition system to align the pointer with the L mark for the left cylinder, the C mark for the center cylinder, and the R mark for the right cylinder. Then align the pointer with each of the S marks to position the signal coils. Be sure to go through the entire timing procedure for each signal coil before doing another.

TIMING THE IGNITION SYSTEM WITH A DIAL GAUGE

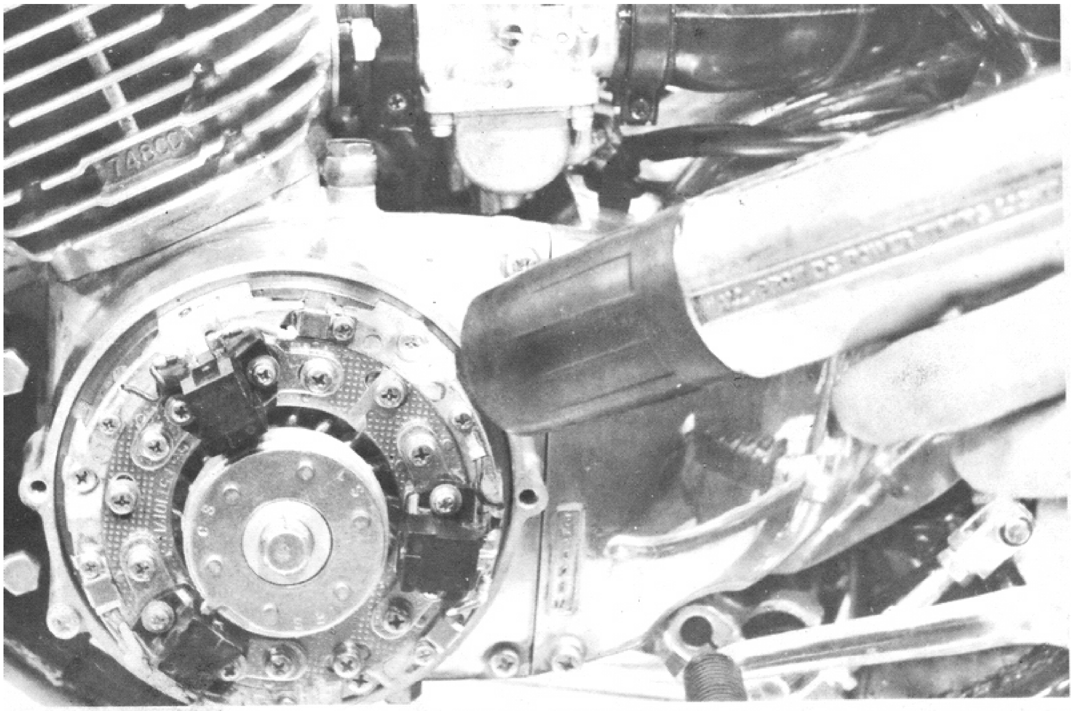
Remove all spark plugs, then screw a dial gauge adaptor into the left spark plug hole. leaving the clamp screw loose. Turn the crankshaft back and forth until TDC is indicated by the needle's reversing direction. Push the dial gauge into the adaptor until the small pointer indicates 5mm. **CAUTION: If the dial gauge is forced past 5mm, the delicate internal mechanism will be jammed.** Tighten the clamp screw to secure the dial gauge in this position. Turn the crankshaft back and forth past TDC while rotating the dial bezel so that the needle registers zero just as it reverses.

Starting with the crankshaft at TDC, slowly turn it clockwise. Count the number of rotations of the needle and stop when it indicates a piston drop of 3.45mm (25° BTDC) for the H1D and 3.13mm (23° BTDC) for the H2 models. At this point, the pointer on the stator plate (located at about 2 o'clock) should align with the **L** mark on the edge of the signal rotor. If it does not, bend it carefully as required. Now turn the crankshaft so that the pointer aligns with the **S** mark nearest the **L** mark. The trailing edge of the signal rotor tang should now align with the raised line molded onto the signal coil. If it does not. loosen the two signal coil base plate mounting screws and move the signal coil as required. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** Move the dial gauge to the other two cylinders and repeat the procedure with the other two signal coils. When the ignition is timed properly, the air gap must be between 0.020" and 0.031". Replace the spark plugs, spark plug wires, and ignition cover. Be sure to put the right wire on each of the spark plugs.

IGNITION TIMING WITH A STROBOSCOPIC TIMING LIGHT

Warm the engine to normal operating temperature. Shut it off, remove the ignition cover, and attach a stroboscopic timing light to the left cylinder spark plug wire.

Start the engine and have a helper hold it at 4,000 rpm. The pointer should align with the **L** mark. If it does not, loosen the lower left signal coil base plate mounting screws and change the ignition timing as required. The center and right cylinders must be timed separately. Move the timing light leads to each of the other two spark plug wires and check the timing again. The top signal coil times the center cylinder; the right-hand signal coil. the right cylinder. When the timing is properly set. remove the timing light, check that all screws are secure, and replace the ignition cover.



Using a stroboscopic timing light on the H1D and H2 models allows the ignition timing advance to be checked. The pointer must align with the L, R, and C marks when the light is connected to the left, right, and center plug wires respectively, with the engine running at 4,000 rpm.

TROUBLESHOOTING THE H1D/H2 IGNITION SYSTEM

As in any ignition system. the most likely part to fail is the spark plug. Remove the plugs to check them. The electrodes should be burned and rounded unless they are new. Clean the carbon off the electrodes and the center insulator. **CAUTION: Do not stress the center electrode or insulator, as the insulator can break.** If a plug has a broken or cracked insulator, it must be replaced. File the electrodes square on the ends with a small file. Set the gap by bending the outer electrode, only, to 1.0mm (0.040"). This wide a gap is used because of the extremely high voltage potential of the ignition system.

After cleaning and gapping the spark plugs. check for spark at the plugs by removing the plugs one by one and laying them on the cylinder head with the high-tension lead attached. Now kick start the engine. If there is a spark at the spark plug electrodes, repeat the test with the other two plugs. If all three plugs spark when the engine is kicked over, check the ignition timing, and then try to start the engine again. If it still won't run, follow the instructions in Chapter 1, Troubleshooting, to test the other systems of the motorcycle. If one or more of the plugs does not have a spark at its electrodes, pull the plug from the high-tension wire and try to jump a spark from a screwdriver inserted in the spark plug cap to the cylinder head while kicking over the engine. If there is a spark now, the spark plugs are faulty and must be replaced. If there is no spark, the other components of the ignition system must be checked.

The wiring of this ignition system is very complex. It can easily be hooked together incorrectly. Be sure that the white wires from the signal coils go to the right CDI units. Each wire is marked R, C, or L, for Right, Center, or Left cylinder. The markings on both parts of each white wire must match or they are hooked up incorrectly. Be sure that the red wires from the units to the high-tension coils are also properly connected. They are marked R, C, or L, too. Check that the white wire and the red wire from each ignition unit are marked with the same letter. If they are not, correct them before proceeding further by referring to the wiring diagram.

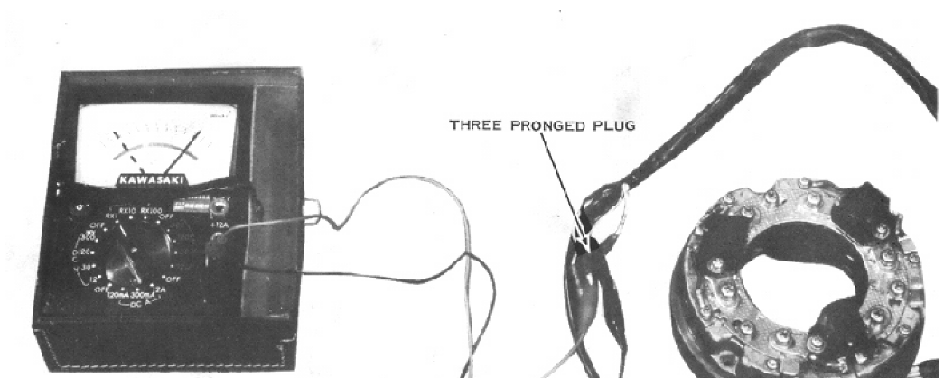
The ignition units can be checked by substituting them for each other, as the possibility of all three units and the rectifier going bad all at the same time is extremely remote. Sometimes one bad CDI unit can prevent the others from sparking too. To test for this, disconnect all three green wires from the rectifier to the ignition units. Connect one wire at a time and check that cylinder for spark. If two of the units now work and one doesn't, that one is bad and must be replaced.

If at least one cylinder has spark while all three ignition units are connected to the rectifier, the CDI unit(s) for the nonsparking cylinder(s) may not be at fault. The substitution test must be used, as follows.

First, switch the light green wire for a sparking cylinder and a nonsparking cylinder. If the bad cylinder now sparks and the good one doesn't, the ignition rectifier is defective and must be replaced. If the nonsparking and sparking cylinders stay that way, go on to the second step.

Second, reverse the high-tension leads for a sparking cylinder and a nonsparking cylinder. Switch the red wires (from the CDI units to the high-tension coils) between the same two cylinders. Check again for spark while trying to kick start the engine. If the problem has switched to the good cylinder. and the nonsparking cylinder now works, the ignition coil for the nonsparking cylinder is defective and must be replaced. If the locations of sparking and nonsparking conditions do not change places, go on to the third step.

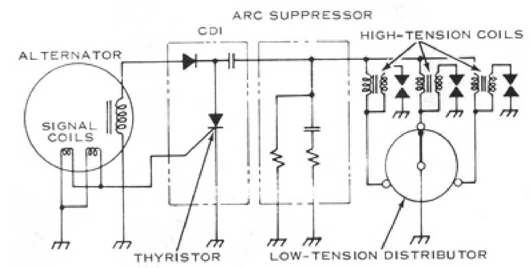
Third, reconnect the high-tension leads as they are supposed to be, but leave the red wires connected as in the second step. Switch the white wires for the sparking and nonsparking cylinders. If the good cylinder now has no spark, the CDI unit for the nonsparking cylinder is defective and must be replaced. If the problem stays with the nonsparking cylinder, then the signal coil for that cylinder is defective and must be replaced. **CAUTION: Once you have located the defective part, be sure to reconnect the wiring properly. Failure to do so can cause mechanical damage to the engine when it is run.**



This diagram shows how to check the resistance of the low- and high-speed ignition stator coils on the H1D/H2 ignition. The high-speed coil should have 5 ohms of resistance; the low-speed coil. 200 ohms.

To check the low- and high-speed coils in the stator of the alternator, first unplug the three-pronged plug with the blue, green. and white wires. Using an ohmmeter, measure the resistance between the blue and green wires, which should be 5 ohms. If it is less than 5 ohms, the high-speed coil is shorted internally; if it is more, the coil has an open circuit in its winding. In either case, the entire stator unit will have to be replaced. Now check the resistance between the white and green wires, which should be 200 ohms. If it is less than 200 ohms, the low-speed coil is shorted internally; if it is more, the coil has an open circuit in its windings. In either case. the entire stator unit must be replaced.

H1E AND H1F MODEL IGNITION SYSTEM



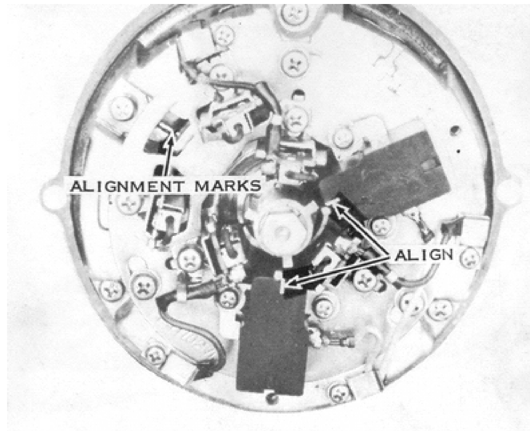
This simplified diagram shows how the H1E/H1F CDI works. The low-tension distributor is mounted on the alternator stator plate and uses the slip rings on the alternator rotor.

This ignition system is the latest in a long line of CDI systems. It combines the reliability and high output of the H1D/H2 type of system with the simplicity of a distributor system. The power for the H1E/H1F ignition system comes from a special alternator that uses the regular alternator rotor (with its permanent magnets) and has a single coil on the alternator stator. When the engine is kick started. the magnets of the spinning rotor induce a high-voltage alternating current in the winding of the ignition's alternator coil. The current is fed to the single CDI unit through the orange and brown wires. A diode in the unit rectifies the alternating current to direct current, which charges the capacitor in the unit. As the engine turns, the signal rotor (outboard of the alternator rotor) turns past the two signal coils. The two signal coils are placed in such a manner that when the signal rotor is positioned with one of its three projections between the two coils, they will send a small pulse to the CDI unit via the single white wire. When the pulse gets to the CDI unit. it gates a thyristor: that is. it "turns on" the thyristor like an electronic switch. The thyristor now connects the capacitor to the primary windings of the three high-tension ignition coils.

On the outer face of the alternator rotor is a set of grounded and insulated slip rings that are contacted by a set of five brushes; two brushes ground portions of the slip ring arrangement and the others are connected each to the primary winding of one of the three high-tension coils. The slip rings and brushes are arranged so that only one high-tension coil will be grounded at any one time. So, as the thyristor conducts the charge from the CDI capacitor to the high-tension coils, only one of the coils' primary windings is grounded. The others are open circuited so they do not conduct. The charge from the capacitor builds a powerful magnetic field around the core of the grounded high-tension coil and, as the rising lines of force cut across the secondary winding of the coil, a very high voltage is induced in it. This voltage fires the spark plug.

The slip ring/brush arrangement used to direct the capacitor's discharge to only one of the three high-tension coils is called a low-tension distributor because it operates on the low-voltage side of the high-tension coil. This is why there must be one high-tension coil for each cylinder in spite of the presence of a distributor.

There is a second "black box" in this ignition system, which is connected to the CDI unit by a yellow wire and is grounded. This is the arc suppressor. Its job is to prevent the brushes from arcing to the slip ring when the capacitor discharges.



To time the ignition on an H1E or H1F by the marks, align the pointer with the second mark on the alternator rotor (when rotating the crankshaft counterclockwise). The trailing edges of two of the signal rotor tangs should now align with the raised lines molded on the signal coils. Move the lower coil first by loosening the three stator plate screws. Move the other coil by loosening the two coil-mounting screws. CAUTION: Do not pry on the signal coils with any kind of tool or they will break. Be sure the air gaps are 0.020" to 0.030".

TIMING THE H1E/H1F IGNITION SYSTEM MATCHING THE TIMING MARKS

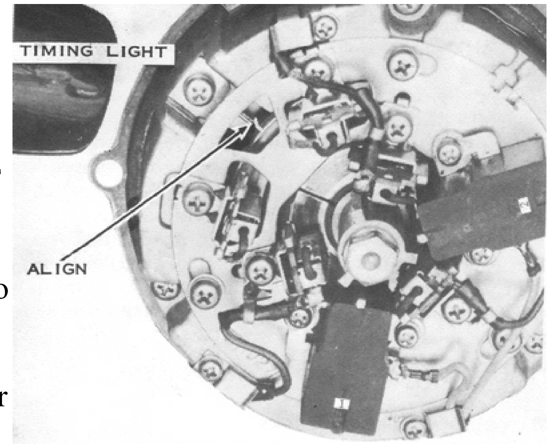
Adjust the ignition timing only after having set the air gap. Turn the crankshaft counterclockwise until the second notch on the edge of the alternator rotor aligns with the pointer (located at 10 o'clock). The trailing edges of two of the signal rotor tangs should align with the raised lines molded onto the tops of the signal coils. If the lower signal coil does not align, loosen the three base plate screws, then rotate the entire base plate as required. Tighten the base plate screws securely and recheck the alignment. If the upper signal coil does not align, loosen the signal coil mounting screws, then move the signal coil as required. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** Tighten the screws, then recheck the alignment and the air gaps.

On the H1E and H1F models, use a dial gauge in the left cylinder only to align the pointer with the first mark on the alternator rotor. Turn the crankshaft counterclockwise until the second mark on the alternator rotor aligns with the now accurately positioned pointer to set the signal coils. Move the lower coil with the stator plate and the upper one by itself. CAUTION: Do not pry on the signal coils with any kind of tool or they will break. Be sure the air gap remains at 0.020" to 0.030".

TIMING THE IGNITION WITH A DIAL GAUGE

Remove all spark plugs, then screw a dial gauge adaptor into the left cylinder spark plug hole, leaving the clamp screw loose. Turn the crankshaft with a wrench until TDC is indicated by the needle's reversing direction. Push the dial gauge into the adaptor until the small pointer registers 5mm. **CAUTION: If the dial gauge is forced past 5mm, the delicate internal mechanism will be jammed.** Tighten the clamp screw to hold the dial gauge in this position. Turn the crankshaft back and forth past TDC while turning the dial bezel so that the needle registers zero just as it reverses.

Starting with the crankshaft at TDC, slowly rotate it clockwise until the dial gauge indicates a piston drop of 2.94mm, which is exactly 23° BTDC. If the pointer (located at 10 o'clock) does not align with the mark on the alternator rotor, loosen the screw and move the pointer as required. Now turn the crankshaft counterclockwise until the pointer aligns with the second mark on the alternator rotor. At this point. the trailing edges of one signal rotor tang should align with the raised line molded onto the signal coil, located at 6 o'clock. If it does not, loosen the three stator plate screws and move the entire stator plate as required. After tightening the screws. check that the trailing edge of the right signal rotor tang aligns with the mark on the other signal coil. If it does not, loosen the two signal coil mounting screws and move it as required. **CAUTION: Do not pry on the signal coil with any kind of tool. It is very delicate and will break easily. Move it only with your fingers.** Tighten the screws carefully, then check the air gap, which must be 0.020" to 0.030". Replace the spark plugs. spark plug wires, and ignition cover. Be sure to put the right wires on the spark plugs.



On the H1E and H1F models, the pointer and the first mark on the alternator rotor must align when the stroboscopic timing light is connected to the left plug wire and the engine is running at 4,000 rpm. This checks the maximum ignition timing advance.

IGNITION TIMING WITH A STROBOSCOPIC TIMING LIGHT

Warm the engine to normal operating temperature. Shut it off, remove the ignition cover, and attach a stroboscopic timing light to the left cylinder spark plug wire.

Start the engine and have a helper hold it at 4,000 rpm. The pointer should align with the notch on the alternator rotor on the H1E and H1F models. If it does not, loosen the stator plate screws and change the ignition timing as required. The other two cylinders are now timed properly as well. When the timing is properly set, remove the timing light, check that all screws are secure, and replace the ignition cover.

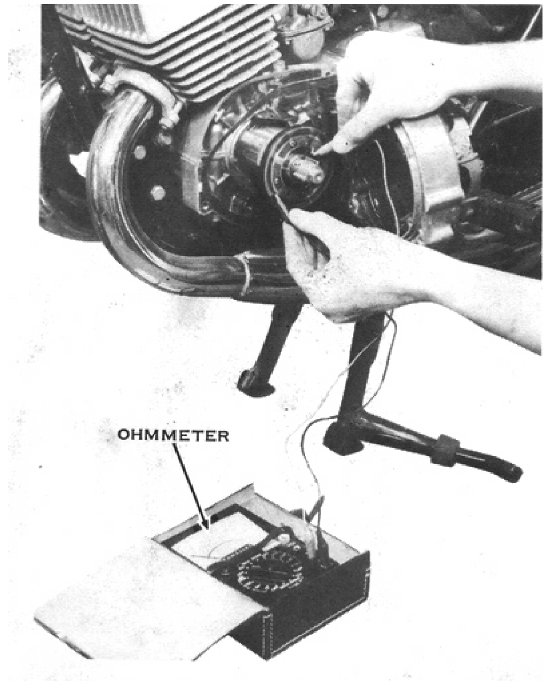
TROUBLESHOOTING THE H1E/H1F IGNITION SYSTEM

If the engine will not run, you must first check for spark at the spark plugs. To do this, remove the plugs one at a time, lay them on the cylinder head with their high-tension leads attached, and try to kick start the engine. There should be a spark across the electrodes of the spark plugs. If there is none, pull the plug off the high-tension lead and put a screwdriver into the spark plug cap, holding it near the cylinder head. Now kick start the engine. If a 1/16" spark jumps from the screwdriver blade to the head, the spark plug is defective.

Clean the carbon off the electrodes and out from around the center electrode insulator. **CAUTION: Do not stress the center electrode (or its insulator) or the insulator will break.** Inspect the insulator for cracks. Discard any plugs with a cracked or broken insulator. File the electrodes square and gap the plugs to 1.0mm (0.040"). If they now spark properly, check the timing and then the other systems of the engine as described in Chapter 1, Troubleshooting.

After the spark plug, the next most likely trouble spot is the low-tension distributor. To check it, unplug the three black wires from the high-tension coils to the brushes. Use alligator clips or something similar to ground all three coils. Now try to kick start the engine. *NOTE: The engine will operate almost as well with all three coils grounded at once as with the distributor working, but all three coils fire all three plugs at the same time. One cylinder is ready to fire and does; one cylinder is near the end of the exhaust stroke and cannot fire; the third is halfway through the transfer portion of the cycle and cannot fire either.* **CAUTION: Do not run the engine any longer than necessary with the distributor bypassed in this manner, because it puts an extra strain on the rest of the system. One hundred miles is a safe upper limit.** If the engine runs, the distributor is at fault, and its components must be checked individually.

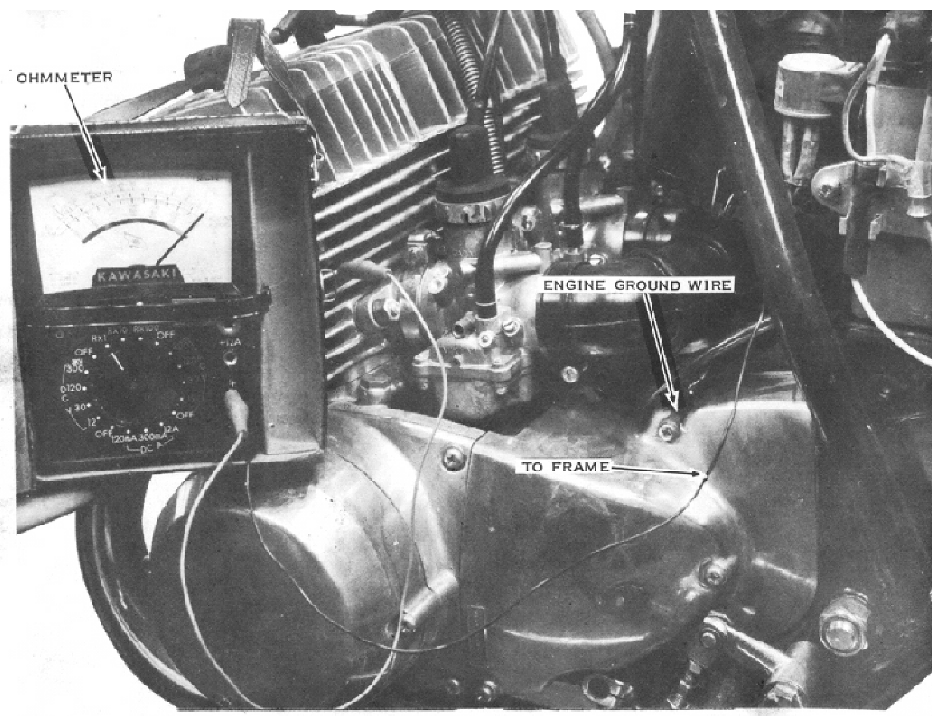
To check the distributor further, remove the alternator cover on the left end of the engine. Take out the screw holding each of the inner brushes to the stator plate. These brushes are connected to the high-tension coils. Make an alignment mark on the stator plate and on the stator (so that you can put the stator plate back in the position for proper ignition timing), and then remove the stator plate. Clean the surface of the slip rings with electrical contact cleaner and a soft cloth. Clean any foreign matter out of the slits that separate the parts of the inner slip ring.



Test the resistance between the segments of the rotor slip rings with an ohmmeter. It must be infinite.

Now measure the resistance between the two segments of the inner slip ring, and then from between the independent segment of the inner slip ring and the signal rotor (or the center of the alternator rotor). The resistance should be infinite in both cases. If it is anything less, the slip ring plate is defective and the entire alternator rotor must be replaced. If the surface of the slip rings is pitted or scratched. you may be able to salvage it by polishing it with # 600 or finer emery paper. The slip ring surface must be very smooth or it will cause accelerated brush wear.

Brush wear is easily checked by looking for the red line scribed around the brush, which marks the service limit. Brushes generally last for more than 20,000 miles unless the slip rings are dirty, pitted. or scratched. Reassemble the stator plate and remount the alternator cover.

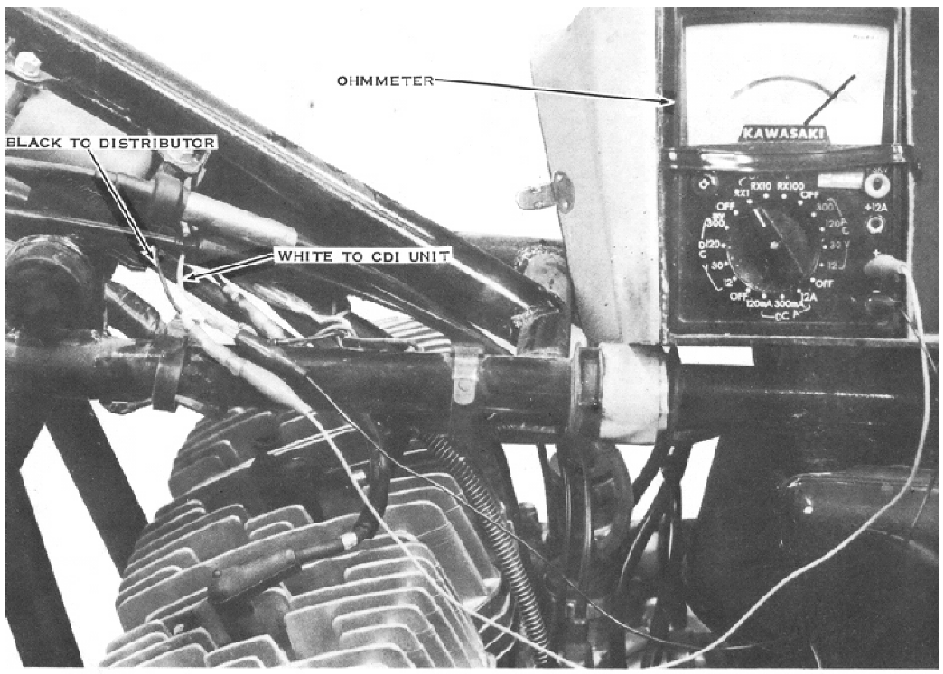


Test the resistance between the engine and the frame. If it is not zero, the engine will not run properly. The trouble is probably a poor ground wire connection.

A badly pitted slip ring and burned brushes can mean one of two things: either the arc suppressor is defective or the engine is not well grounded. Of these two conditions. it is far more likely that a poorly grounded engine has caused the problem. This model has a rubber-mounted engine (for less vibration) and a separate ground wire from the top screw of the chain case cover to the upper rear engine mount bolt. Check to see that it is in good condition. Use an ohmmeter to check the resistance between the frame and the engine, which should be zero. If it is any higher, the ground wire is at fault. Disconnect the ground wire and clean the contact areas on both ends of the wire, on the engine, and on the frame with an oilless solvent such as trichloroethylene or an electrical contact cleaner. Install the wire and retest the resistance. If it is still greater than zero, replace the wire and try again.

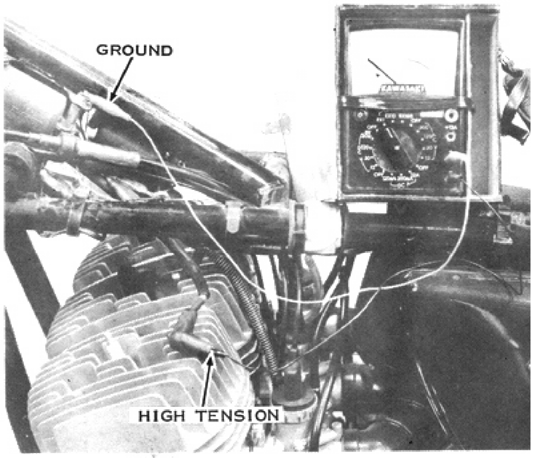
To test the arc suppressor, first remove it from the motorcycle. Measure the resistance between its yellow and black wires, which should be 300 ohms. If it is more or less than this, the arc suppressor is defective and must be replaced. *NOTE: The engine may be run briefly without the arc suppressor, but not more than one hundred miles.*

The signal generator coils should be checked next. Remove the alternator cover, then disconnect the ground terminal screw (black wire) for each signal coil. With an ohmmeter, test the resistance between the ground wire and the white wire for both signal coils, which should be 260 ohms. If it is not, the signal coil is defective and must be replaced.

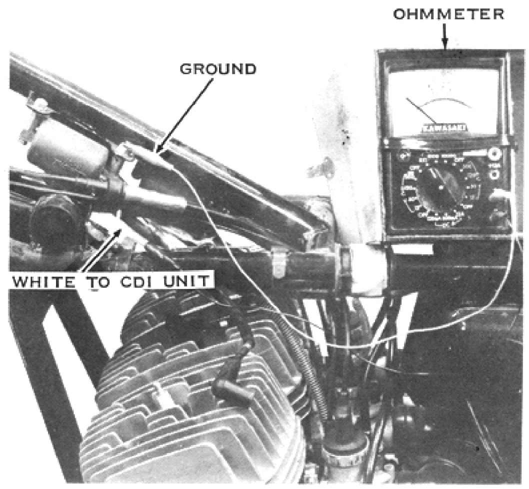


It is important to test the coil thoroughly. For the first test, connect the leads of the ohmmeter to the white wire and to the black wire that normally goes to the distributor. There should be about 1 ohm of resistance.

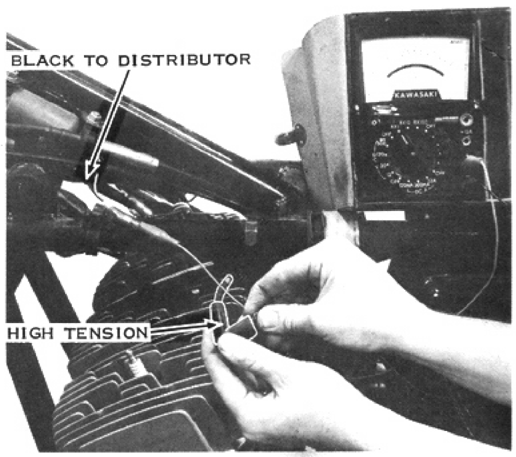
If only one or two spark plugs will not spark, the trouble can be a defective high-tension coil. To test the high-tension coils, first determine that the distributor is in good condition, as described previously, and then disconnect all wires to the nonsparking coil. With an ohmmeter, check the resistance between the white wire and the black wire that runs from the coil to the distributor. The meter should read approximately one ohm. If it is higher than 10 ohms or less than 1/2 ohm. the coil is defective and must be replaced. Now check the resistance between the high-tension lead and the black wire to the distributor and between the white wire and ground. In both cases the resistance should be infinite. If it is any less. the coil is internally shorted and must be replaced. *NOTE: This high-tension coil is different from any other motorcycle or automobile high-tension coil because the primary and secondary windings are separately grounded.* **CAUTION: Do not use anything but a genuine Kawasaki replacement part, or damage to the distributor will result.**



For the second coil test, connect the ohmmeter leads to the high-tension lead and to the black ground wire. There should be about 1 ohm of resistance.



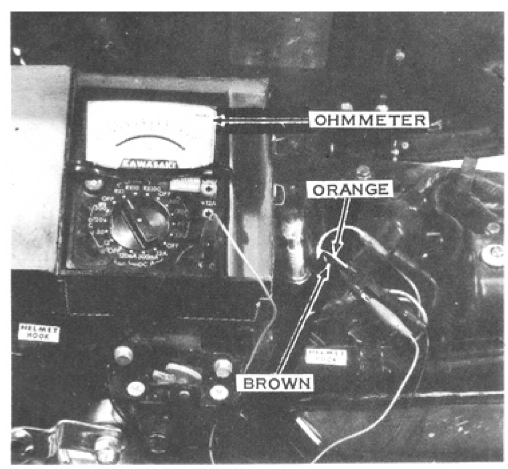
For the third coil test, connect the ohmmeter leads to the white lead and to the black ground lead. There should be infinite resistance.



For the fourth coil test, connect the ohmmeter leads to the high-tension lead and to the black wire that normally goes to the distributor. There should be infinite resistance.

Finally, test the special alternator coil on the stator. To do this, raise the seat and unplug the two-prong rubber connector with the brown and orange wires. With an ohmmeter, test the resistance between the brown and orange wires to the alternator, which should be 115 ohms. If it is not, the coil is defective and the entire stator assembly must be replaced.

There is no way to test the CDI unit without special testers that are not generally available. If the system passes all the previously described tests and still won't spark any of the plugs, by process of elimination the CDI unit is defective and must be replaced.



To test the stator ignition coil, check the resistance between the brown and orange wires from the stator. There should be 115 ohms of resistance.

LIGHTING SYSTEM AND WARNING DEVICES

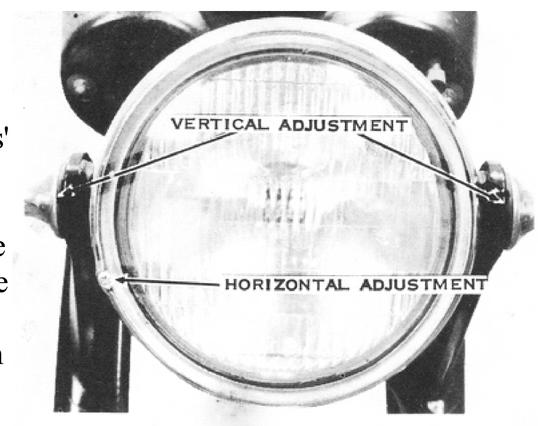
All Kawasaki triples have essentially the same lighting system with only minor differences in switch type and placement. The lighting system is run directly by the battery. The ignition switch controls the power available to the lights and horn even on those models that have separate light switches (besides the Hi-Lo beam switch for the headlight). The headlights all are dual-filament, sealed-beam types (except for 1969 and 1970 H1's which were available with bulb-type headlights). The taillights all use the same dual-filament bulb for both the taillight and brake light. The turn signals differ slightly from model to model (1972 models and later) but all use the same bulb and flasher unit.

HEADLIGHT

All model headlights are dual-filament types for high and low beams. The beam switch is in the left-hand switch case. On 1975 models the beam switch is pushed up for high beam and down for low. On all previous models it was the opposite. The headlight switch is incorporated into the ignition switch on H1's from 1969 through 1971. All models from 1972 onward have a separate headlight switch. On the 1972 H1B, H1C, and H2, the headlight switch is in the left-hand switch case. On all models from 1973 onward, the headlight switch is in the right-hand switch case. On any model. the headlight will work only with the ignition switch turned on.

ADJUSTING THE HEADLIGHT

Headlight aiming laws vary from state to state, but generally speaking the low beam should be aimed slightly to the right, and should drop about 2" in 25 feet to avoid dazzling oncoming drivers' eyes. The vertical adjustment of the headlight is extremely simple. Loosen the two large mounting bolts, one on either side of the headlight shell, and then push the light up or down as needed while sitting on the motorcycle. To make this more accurate, measure the distance from the center of your motorcycle's headlight to the ground, and then make a cross-mark on a wall at that height. Sit on your motorcycle at night, 25 feet from the wall on level ground, and adjust the headlight so that the center of the bright spot of the light is 2" below the cross-mark. Tighten the headlight mounting bolts.

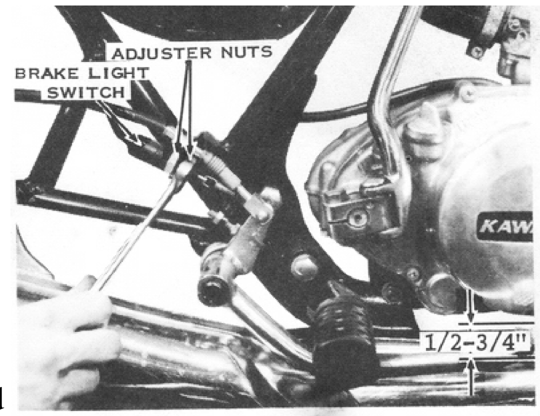


To change the vertical adjustment of the headlight, loosen the mounting bolts, one on each side, and push the headlight as required. To change the horizontal aim, turn the small screw in the headlight rim.

To adjust the side-to-side aim. turn the small screw on the left side of the headlight rim when viewed from the front. Turn the screw clockwise to aim the headlight more to the rider's left and counterclockwise to aim the headlight more to the rider's right. Now sit on your motorcycle at the same place, 25 feet from the wall with the front wheel aimed directly at the cross-mark on the wall. The center of the bright spot of the headlight should be about one inch to the right of the cross-mark on the wall. *NOTE: Check your local law enforcement agency for exact headlight-aiming specifications.*

TAILLIGHT

The headlight switch also activates the taillight on all models. One filament of the bulb is used for the taillight, the other for the brake light. The bulb used is a number 1034 or 1157 (either will work in any model) which is used in the taillights of almost all American automobiles. It can be purchased at any service station. The brake light has two independent switches; one is operated via a spring from the rear brake pedal; the other is a hydraulic switch in the front brake hydraulic system on disc-brake models, and a built-in switch in the cable of drum-brake models. The taillight and brake light will work only with the ignition switch turned on.

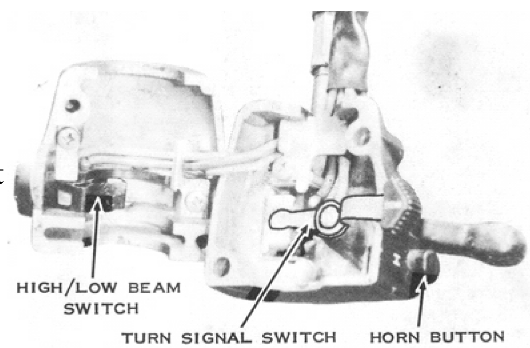


To adjust the rear brake-lamp switch, loosen the nuts on the body of the switch. The lamp should light when the pedal is depressed ½" to ¾". CAUTION: Do not overtighten the adjuster nuts, or you may break the switch body.

ADJUSTING THE BRAKE LIGHT SWITCH

The front brake light is not adjustable on any model, but the rear brake light switch is, and the adjustment is the same on all models. After adjusting the rear brake and brake pedal height (as described in Chapter 6, Frame and Running Gear Service), you will have to adjust the rear brake light switch so that the brake light is activated when the pedal is depressed 3/4". Loosen the adjuster nuts on the body of the switch. If the pedal must be depressed more than 3/4" to turn on the light, tighten the upper adjuster nut to move the switch upward. If the lamp lights before the pedal is moved far enough, tighten the lower adjuster nut to move the switch down. Tighten both nuts, then test the adjustment. **CAUTION: Do not overtighten the brake light switch adjuster nuts or you will break the body of the switch.**

TURN SIGNALS



The typical handlebar switch is held in with tiny Phillips-head screws. CAUTION: The switches have spring-loaded detent balls. Don't lose the ball or spring during disassembly.

The turn signals on all models have a switch in the left-hand switch case. It has three positions: center for off, left to signal a left turn, and right for a right turn. The switch must be manually returned to the center position after a turn has been completed. All models use the same flasher unit and the same turn signal bulbs, though the units and the lenses are different on different models. The only models that did not have stock turn signals were the 1969 to 1971 H1 and H1A. Later model turn signals can be modified to fit; only the mounting is a problem. (The switch and wiring are already there. The alternator and the battery are more than capable of supporting the extra load.) The turn signal units from the 1972 H2 or S2 are the most easily adapted to the earlier H1's. and the increased safety makes the work and expense worthwhile.

HORN

All models are equipped with a horn mounted underneath the steering stem on the frame. The horn button is in the left-hand switch case. The horn works only with the ignition switch turned on. The horn is not adjustable for either tone or volume.

TROUBLESHOOTING THE LIGHTING SYSTEM BULBS

The most common problem in any lighting system is burned-out bulbs. If a lamp won't light, check the bulb first. Remember that the headlight and taillight bulbs must have two filaments each. If there is only one left, then one function of the light will not be fulfilled. **CAUTION: When replacing the taillight and turn signal lenses, do not overtighten the screws. The plastic lenses will break.**

SWITCHES

If a bulb is not burned out, check the wiring and the switches for continuity. To do this, use an ohmmeter. First disconnect the battery leads. Now measure the resistance from the center contact of the socket of the bulb that won't light to the nearest connector on the wire that goes to the switch. *NOTE: Check the wiring diagram at the end of this chapter for the color of the wire.* The resistance along the length of the wire should be zero. If it is higher, the wire must be replaced. Test the resistance of the switch by connecting the ohmmeter to the incoming and outgoing wires of the switch. Again, the wiring diagram will tell you what color wires to look for. There should not be any resistance here either. If there is, there may be corrosion in the switch. To clean the switch, remove the switch case screws, then split the switch case off the handlebars. Before disassembling the switch itself, try cleaning it with an electrical contact cleaner. Squirt the cleaner into the contacts of the switch and work the switch back and forth rapidly for 10 or 15 seconds. Now try the resistance test again. If the problem has disappeared, assemble the switch case onto the handlebars; if it hasn't, you must disassemble the switch for cleaning.

To disassemble a handlebar switch, remove the tiny screw holding the switch parts to the inside of the case. **CAUTION: Most of the switches have spring-and-ball detents. Do not lose the ball, as the spring may suddenly throw it out of the switch case.** Carefully lift out the switch contact plates. Clean the copper contact spots with trichloroethylene or other oilless solvent and a soft cloth. When the contacts are clean, reassemble the switch. Be careful to include all the springs and other small parts that came out. If parts of a switch are broken, the entire switch case must be replaced, as parts for the switches are not available separately.

MAIN SWITCH

Ignition Switch Internal Connection

Lead	Ignition	Ground	H.L.	Tail	Battery	Coil
Color	Bk/W	Bk/Y	Bl	R/W	W	Br
OFF	●	●				
ON			●	●	●	●
PARK	●	●		●	●	

This is a main-switch diagram of the H1E. It tells us that when the main switch is turned off, the black/white wire is connected to the black/yellow wire; the others are all disconnected. When the main switch is turned on, the blue wire is connected to the red/white wire and the white wire to the brown wire. When the main switch is turned to the PARK position, the black/white wire is connected to the black/yellow wire and the red/white wire is connected to the white wire.

To test the resistance across the main switch, first decide which wires are electrically connected in the different switch positions. Each wiring diagram has a block diagram of the switch positions. Across the top of the diagram are the wires listed by their function and color (at the switch). Down the side of the diagram are the switch positions. To the right of each position are black bars connecting heavy dots under different wires. In that switch position, the wires that are dotted are connected the same as the dots. Some wires are the same from model to model. The main "hot" wire from the battery to the main switch is always white. With the switch in the ON position, the white wire will be connected with the brown wire. If there is any resistance at all across any connected wires, with the switch in the ON, DAYTIME, or NIGHTTIME positions, the switch must be replaced.

REAR BRAKE LAMP SWITCH

The rear brake lamp switch is located on the right side of the motorcycle on the vertical frame tube above the footpeg. If the brake lamp does not light when the brake pedal is depressed, check the switch by pulling down on the spring connecting the switch to the brake pedal. If the lamp now lights, the switch needs to be adjusted as described earlier in this chapter. If the brake lamp still doesn't light, disconnect the wires to the switch and connect them with a short piece of wire. If the brake lamp still doesn't light, the problem is a burned-out bulb or an open circuit in the wiring to the brake lamp. Check with an ohmmeter all the connectors and the wires going to the lamp for continuity. If the lamp lights, the switch is defective and must be replaced. *NOTE: Sometimes a broken brake lamp switch can cause the fuse to blow out. This happens when the switch adjustment nuts are over-tightened, which breaks the switch body, causing an internal short circuit.*

FRONT BRAKE LAMP SWITCH

The front brake lamp switch is located either on the front brake cable (on drum brake models) or in the hydraulic system on the lower triple clamp of the forks (on disc brake models). Neither is adjustable. but either can fail. If the brake lamp does not light when the brake lever is squeezed, pull the two wires off the switch. Use a short length of wire to connect the two wires. The brake lamp should now light. If it doesn't, the problem is either a burned-out bulb or an open circuit in the wiring. Check with an ohmmeter all connectors and the wires going to the brake lamp for continuity. If the brake lamp does light, the front brake lamp switch is defective and must be replaced. On drum brake models, this means you must replace the entire front brake cable. On disc brake models, you must bleed the hydraulic system after replacing the switch. (For instructions on bleeding the hydraulic system, see Chapter 6. Frame and Running Gear Service.)

TURN SIGNALS

The turn signal circuits are simple and easy to troubleshoot if you know how to interpret the symptoms of failure. If the indicator lamp lights but does not blink when the signals are activated, then one of the bulbs is burned out or one of the signal lamp housings is not grounded. To check for a good ground, measure with an ohmmeter the resistance between the wall of the bulb socket and the frame. The resistance should be zero. Any higher reading means that the ground connection is bad. To repair it, clean the areas where the black ground wires attach to the frame. If there are no ground wires, clean the area where the turn signal stalk attaches to the frame.

If the turn signals will not light at all, check the switch and the flasher unit. To test the switch, disconnect the wires to the switch inside the headlight shell. Use an ohmmeter to test the resistance between the gray wire and the brown wire with the switch in the right-turn position. Then test the resistance between the green wire and the brown wire with the switch in the left-turn position. The resistance should be zero in both cases. If it is any greater in either or both positions, the switch contacts are dirty. To clean the switch contacts, first remove the two screws holding the switch case to the handlebars. Split the case halves. In one half, the switch handle is pivoted on a small Phillips-head screw. Remove the screw and then lift out the switch handle. The switch block is held in by the wiring. Pull up the wiring to remove the switch block. Spread the sides of the block to disassemble it. **CAUTION: The detent mechanism is a spring-loaded ball, which will fly out when the block is disassembled. The spring and ball are not available separately.** Clean the brass contact surfaces with trlchloroethylene or an electrical contact cleaner and a soft cloth. When the contacts are clean, reassemble the switch. then retest its resistance as described previously.

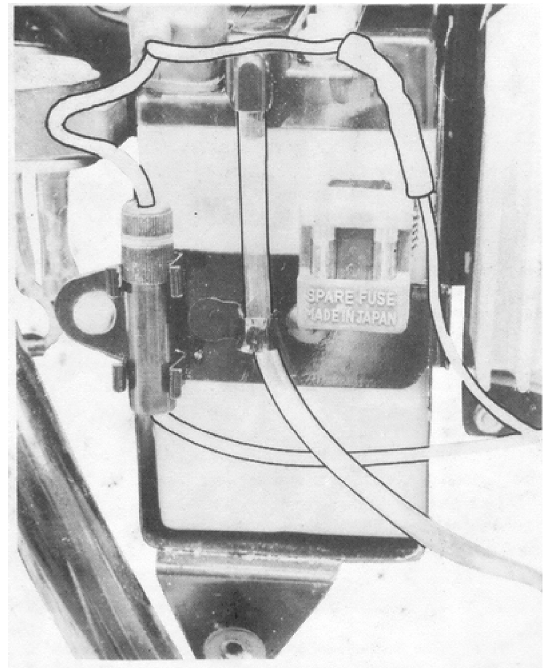
If the indicator lamp on the instrument panel (or on the speedometer face) will not light, remove it and check the bulb. If the bulb's filament is in good condition, the socket or the wiring is faulty. Neither wire to the indicator lamp is a ground wire. The gray wire goes to the right-turn signal circuit and the green wire to the left-turn signal circuit. Check that these wires go where they should and that neither is shorted to ground. Check the continuity from the wall of the indicator lamp socket through the two wires. The resistance should be zero through one wire and infinite through the other. Check the center contact of the socket as well. The resistance readings should be opposite the readings taken on the wall of the socket. Finally, check to be sure the wires are all connected properly according to the color codes in the wiring diagram at the end of this chapter.

The flasher unit is very reliable. but if it does become defective, the whole system (both left-turn and right-turn circuits) will share the problem. If both the front and rear lamps light but do not flash, the flasher unit is defective and must be replaced. **NOTE: The battery must put out at least 12 volts to make these tests valid.** If none of the signal lamps light, bypass the flasher with a short piece of wire. If they light now, the flasher is defective and must be replaced. However, if they still do not light, measure the battery voltage, and then check the main fuse, main switch, and turn signal switch and wiring for open circuits.

MAIN FUSE

The main fuse is located behind the left side-cover under the seat on all models. If the fuse blows, it is because of an electrical overload caused by a short circuit.

When the fuse blows. think back to what happened immediately before the fuse blew. On many models. the engine will stop when the fuse blows. but not on the H1D, H1E, H1F, and H2 models, because they have a magneto-powered ignition system. If the fuse blows just after the turn signals are switched on, then one of the turn signal wires is short-circuited to ground and must be repaired. If the fuse blows as the headlight is turned on, the headlight or taillight circuits must be short-circuited to ground. If the fuse blows as the brake is applied, the short is in the brake light circuit. This kind of logic can often tell you where the problem is even before you start looking for it.

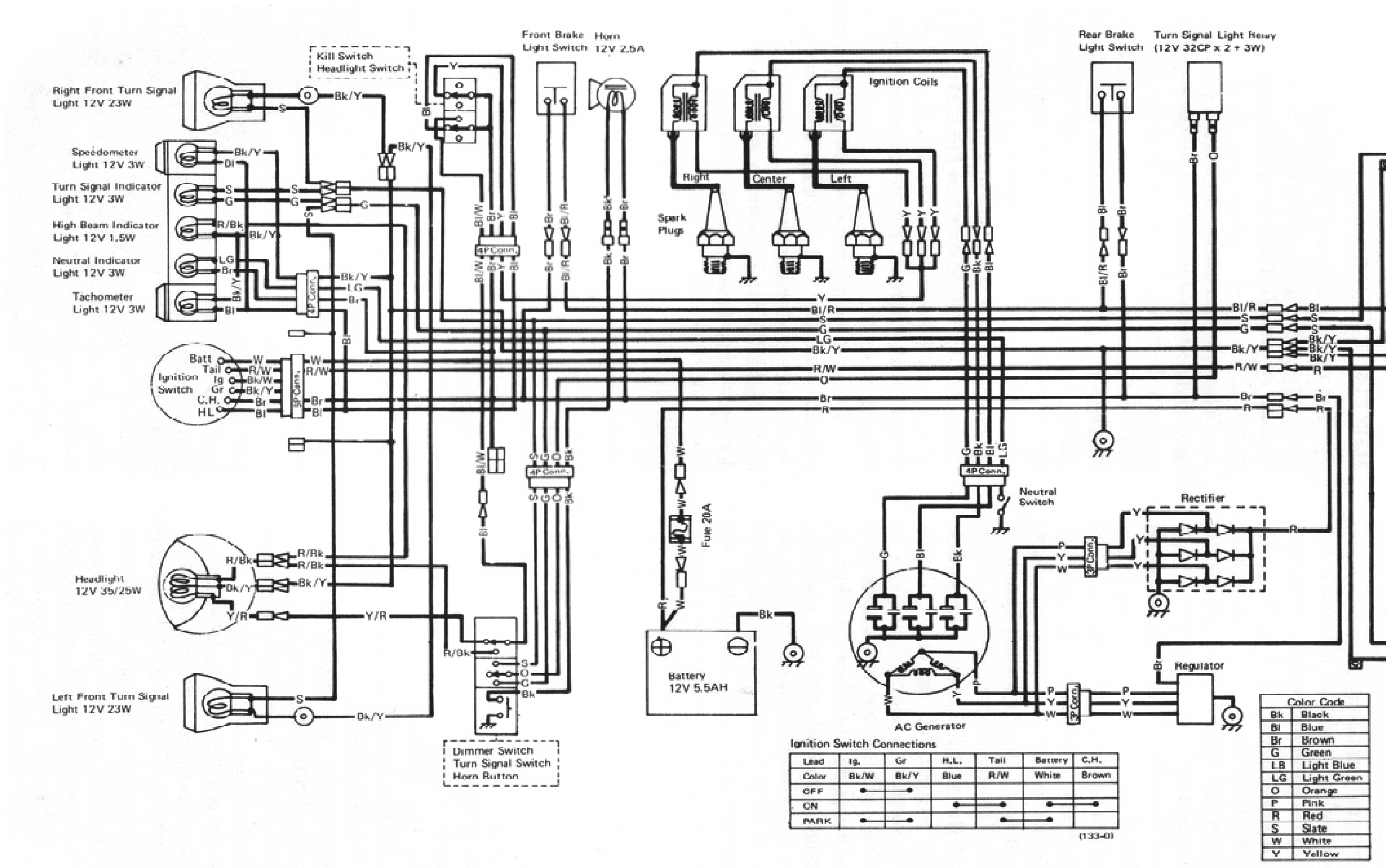


On all models, the main fuse is behind the left-hand cover under the seat.

If the problem is not obvious, start from the battery with an ohmmeter and check the resistance between the "hot" wires (red, white, brown, green, or gray) and the frame. **CAUTION: Be sure to disconnect the battery during these tests or the ohmmeter will be damaged.** As long as the resistance between the hot wire and the frame is zero, you have not isolated the problem. As an example, the first wire to check is the wire to the fuse from the positive terminal of the battery. Replace the fuse. then hold one probe of the meter against the frame and the other against the end of the wire that is normally connected to the positive terminal of the battery. Check the resistance before turning on the main switch. If it is zero. the short is between the battery and the main switch. If it is infinite. turn on the main switch. The resistance will now drop to zero. indicating that the short is beyond the main switch somewhere.

Check the wiring diagram to see what color the wires are that are connected to the white battery wire when the main switch is turned on. These are the wires to check next. Disconnect them from the main switch and measure the resistance of each one to ground. The one with zero resistance has the short circuit in it. Now check the wiring diagram again to see where the problem wire goes. Disconnect each branching wire from the problem wire. Proceed this way until you find the last wire that exhibits the problem which is the wire with the short circuit. *NOTE: Remember to disconnect each wire as you test it to be sure you are checking a smaller piece of the total system each time.*

S-Series Wiring



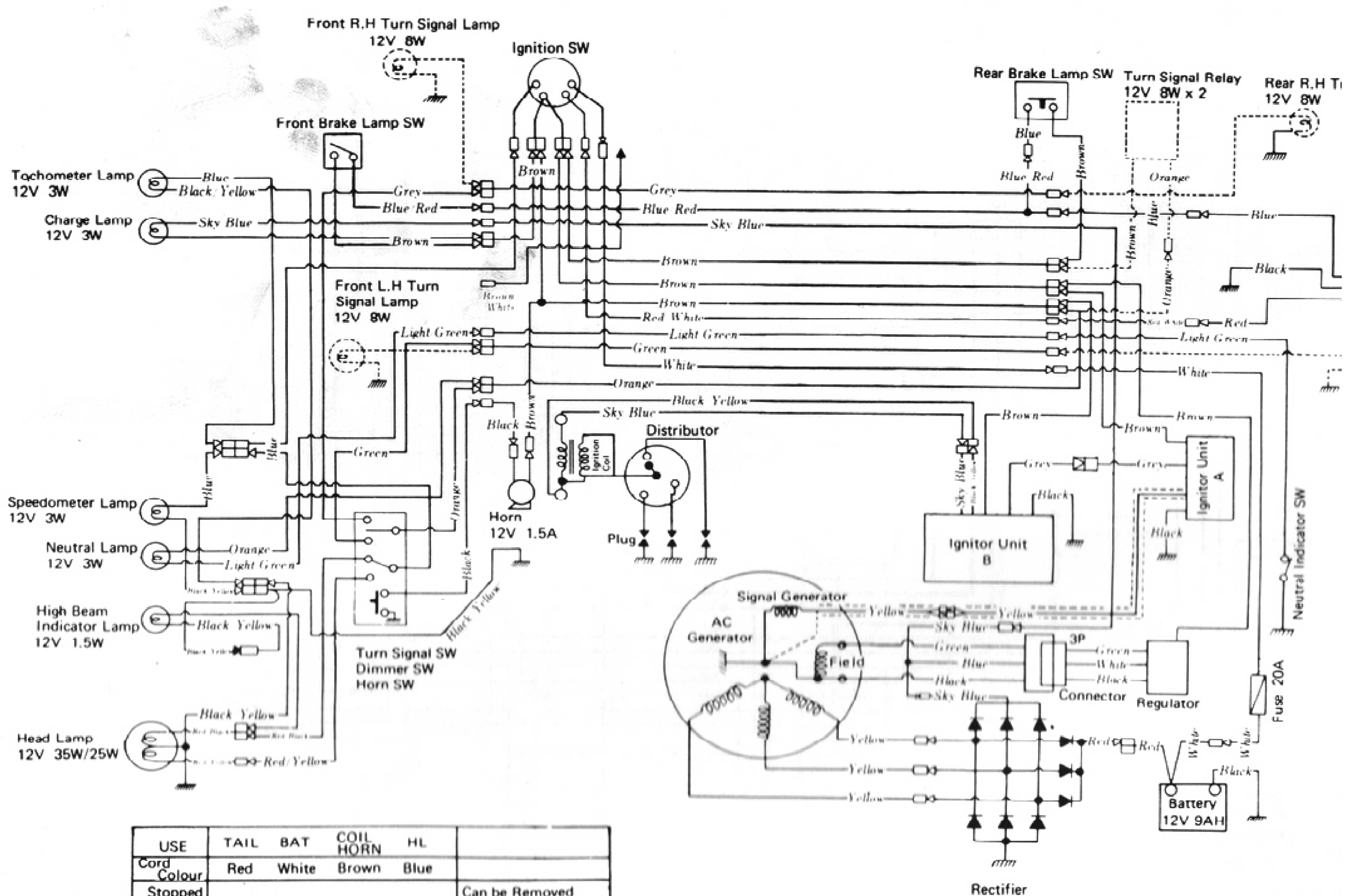
Ignition Switch Connections

Lead	Ig.	Gr	H.L.	Tail	Battery	C.H.
Color	Bk/W	Bk/Y	Blue	R/W	White	Brown
OFF	●—	—●				
ON			●—	—●	●—	—●
PARK	●—	—●		●—	—●	

Color Code

Bk	Black
Bl	Blue
Br	Brown
G	Green
LB	Light Blue
LG	Light Green
O	Orange
P	Pink
R	Red
S	Slate
W	White
Y	Yellow

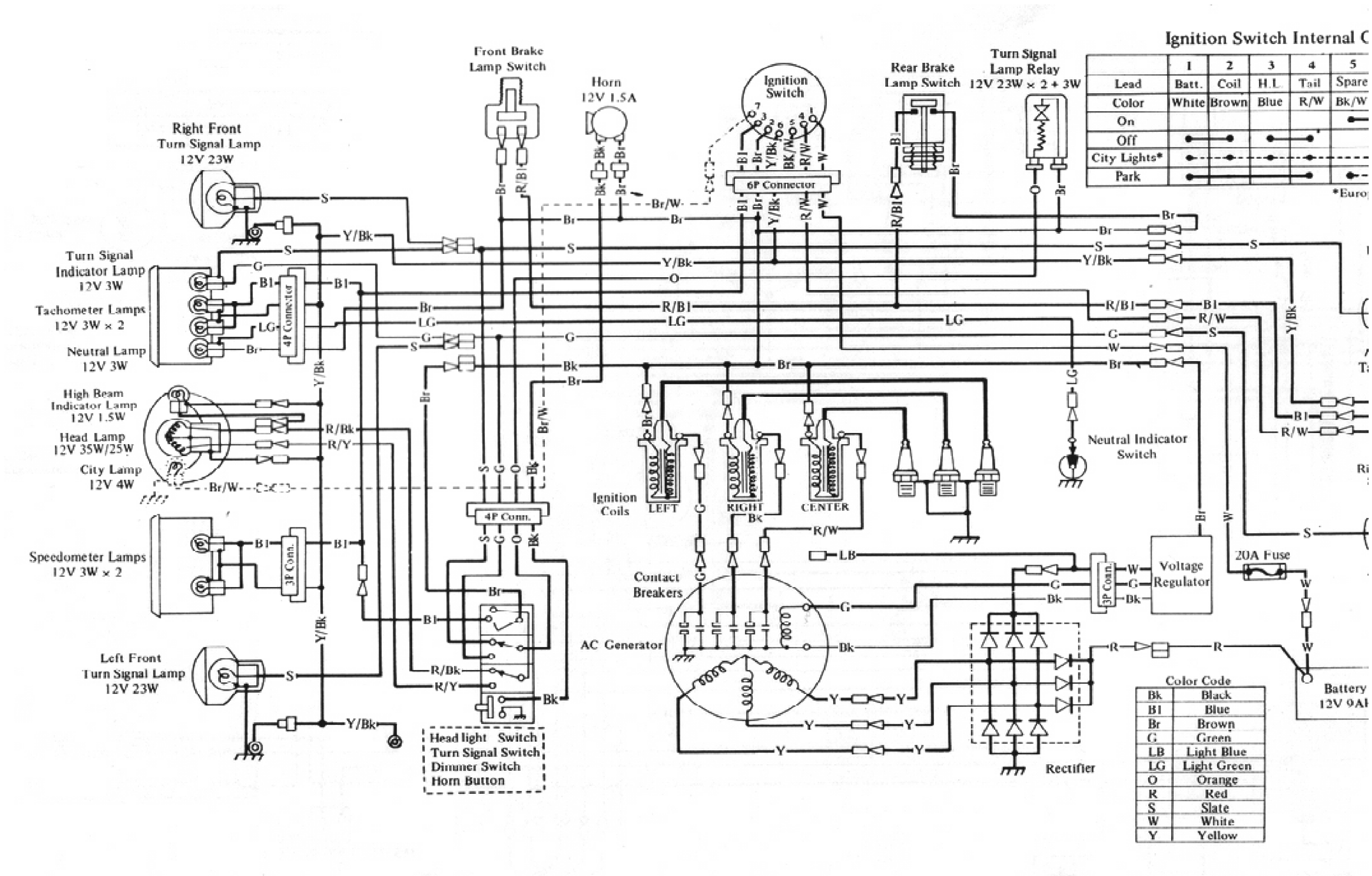
H1/A/C Wiring



USE	TAIL	BAT	COIL HORN	HL	
Cord Colour	Red	White	Brown	Blue	
Stopped					Can be Removed
Day		●	●		Can not be Removed
Night	●	●	●	●	Can not be Removed
Parking	●	●			Can be Removed

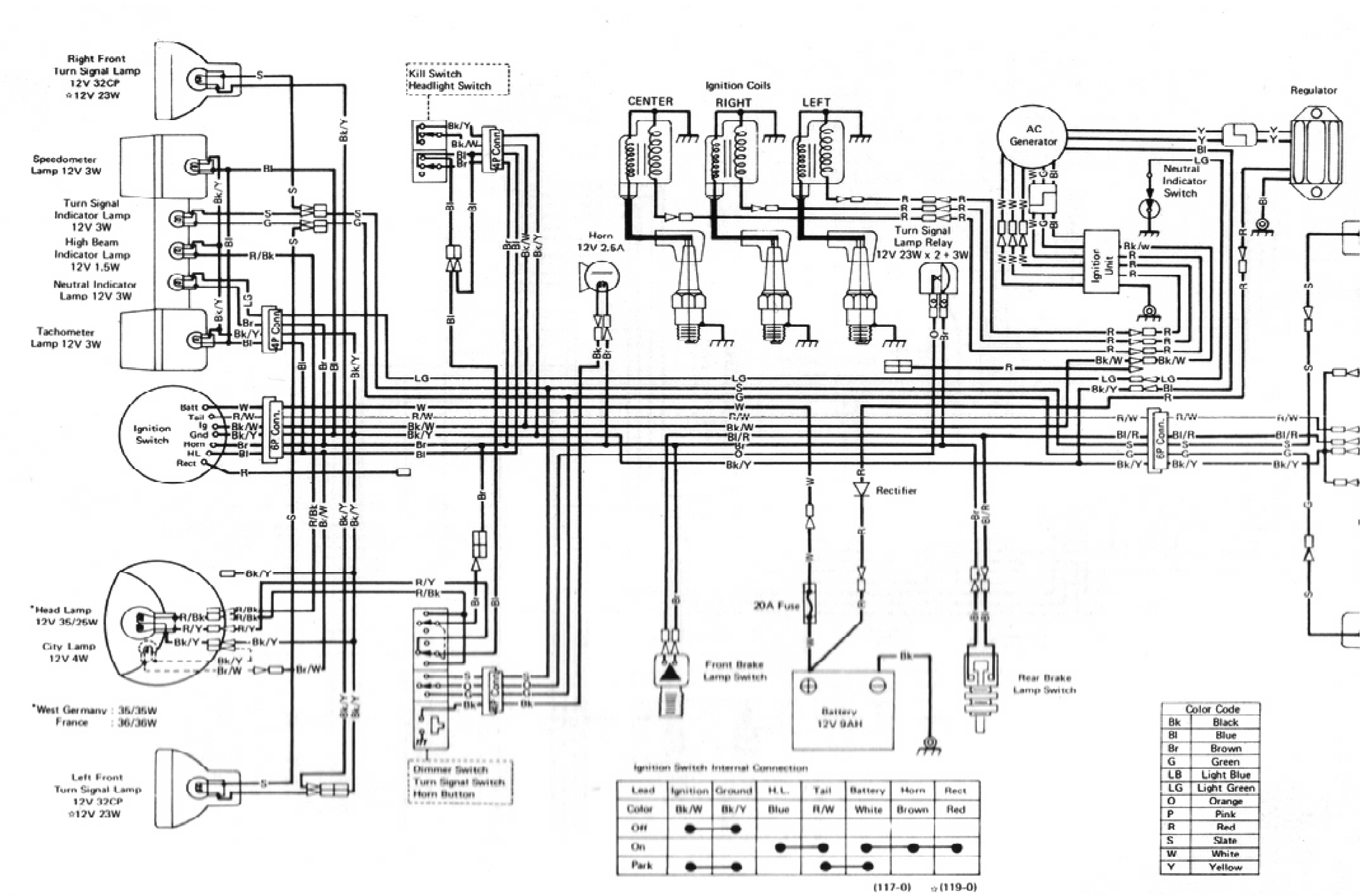
NOTE : Turn Signal Lamps and Lamp Relay are Optional P shown with dotted lines

H1B Wiring



Ignition Switch Internal C
Lead | 1 Batt. | 2 Coil | 3 H.L. | 4 Tail | 5 Spare
Color | White | Brown | Blue | R/W | Bk/W
On
Off
City Lights*
Park
*Euro
Front Brake Lamp Switch
Horn 12V 1.5A
Ignition Switch
6P Connector
Rear Brake Lamp Switch
Turn Signal Lamp Relay 12V 23W × 2 + 3W
Right Front Turn Signal Lamp 12V 23W
Turn Signal Indicator Lamp 12V 3W
Tachometer Lamps 12V 3W × 2
Neutral Lamp 12V 3W
4P Connector
High Beam Indicator Lamp 12V 1.5W
Head Lamp 12V 35W/25W
City Lamp 12V 4W
Speedometer Lamps 12V 3W × 2
3P Conn.
Left Front Turn Signal Lamp 12V 23W
4P Conn.
Head light Switch
Turn Signal Switch
Dimmer Switch
Horn Button
Ignition Coils
LEFT
RIGHT
CENTER
Contact Breakers
AC Generator
Neutral Indicator Switch
Voltage Regulator
3P Conn.
20A Fuse
Battery 12V 9AH
Rectifier
Color Code
Bk Black
Bl Blue
Br Brown
G Green
LB Light Blue
LG Light Green
O Orange
R Red
S Slate
W White
Y Yellow

H1D Wiring

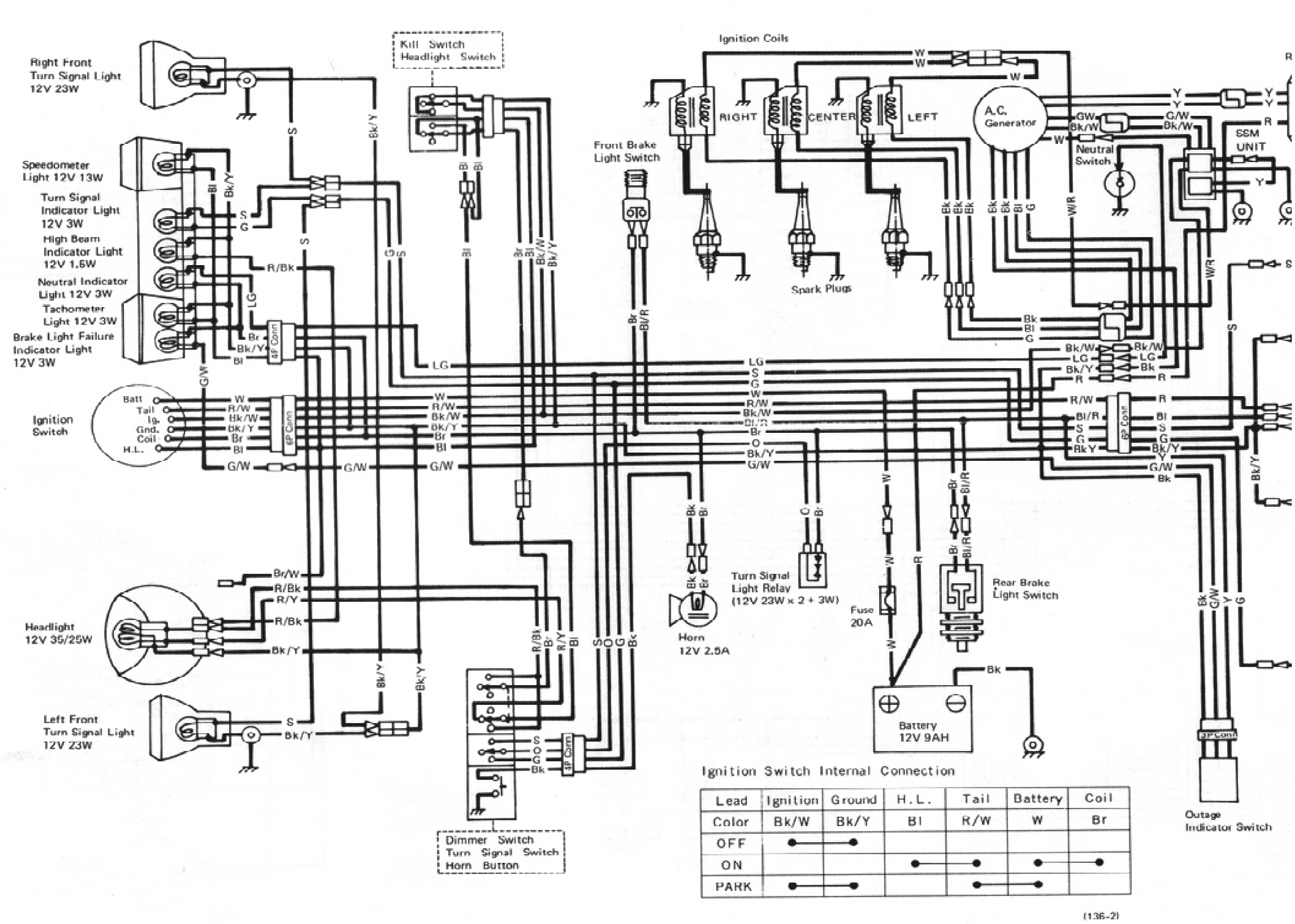


Ignition Switch Internal Connection

Lead	Ignition	Ground	H.L.	Tail	Battery	Horn	Rect
Color	Bk/W	Bk/Y	Blue	R/W	White	Brown	Red
Off	●	●					
On			●	●	●	●	●
Park	●	●		●	●		

Color Code	
Bk	Black
Bl	Blue
Br	Brown
G	Green
LB	Light Blue
LG	Light Green
O	Orange
P	Pink
R	Red
S	Slate
W	White
Y	Yellow

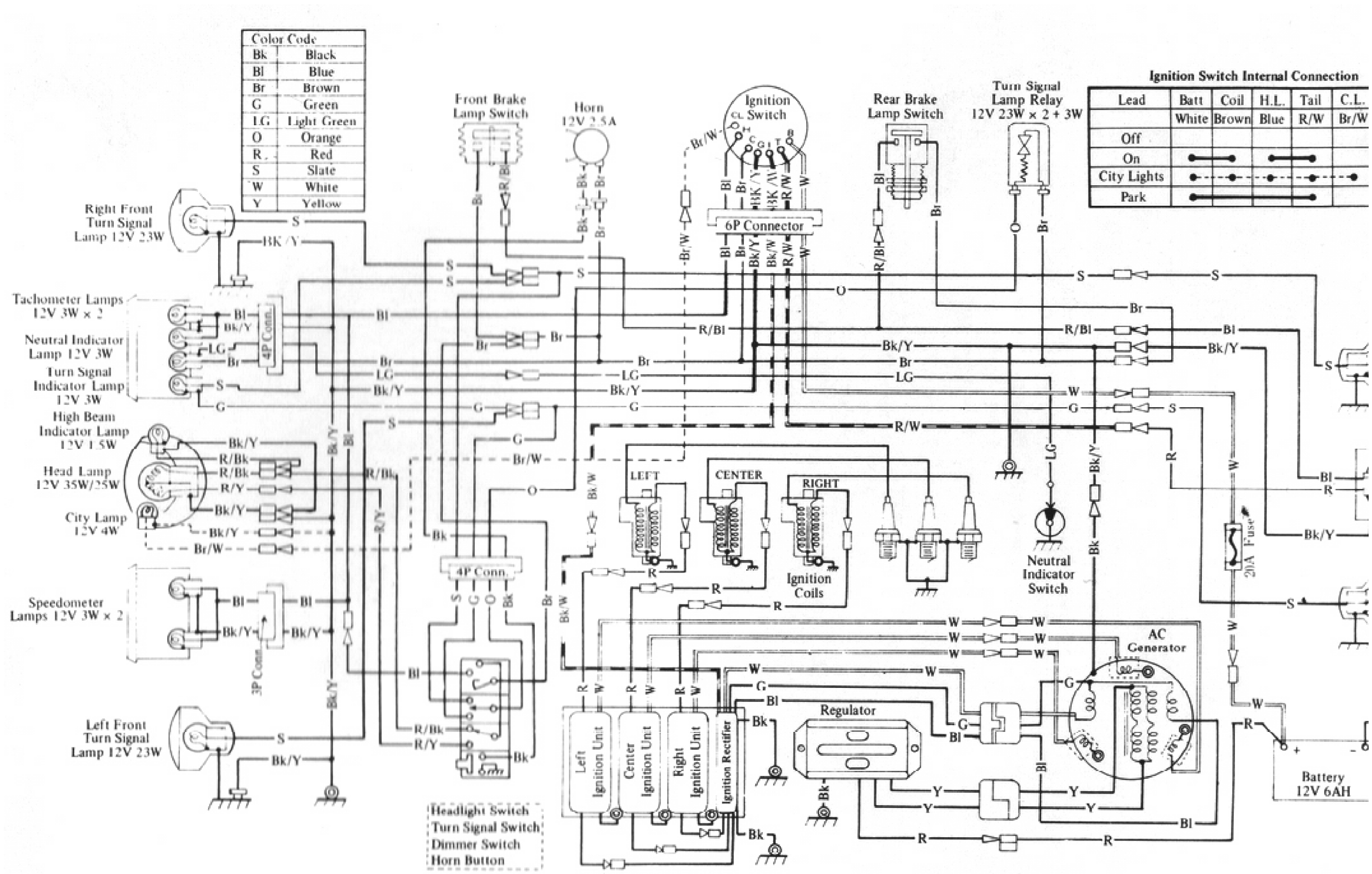
H1E/F Wiring



Ignition Switch Internal Connection

Lead	Ignition	Ground	H.L.	Tail	Battery	Coil
Color	Bk/W	Bk/Y	Bl	R/W	W	Br
OFF	●	●				
ON			●	●	●	●
PARK	●	●		●	●	

H2 Wiring



ELECTRICAL SYSTEM SPECIFICATIONS

S-SERIES MODELS

Battery	12V 6AH	
Ignition Timing	23° BTDC/2.60mm	
Ignition Point Gap	0.3-0.4mm (0.012-0.016")	
Spark Plug Gap	0.4-0.5mm (0.016-0.020")	
Spark Plug Type:		
Normal	NGK B9HCS	Champion L-78
Hot	NGK B8HC	Champion L-81
Cold	NGK B10HS	Champion L-57R
Spark Plug Reach	12.7mm (1/2")	

H1, H1A, H1C

Battery	12V 9AH	
Ignition Timing	25° BTDC/3.45mm	
Ignition Air Gap	0.4-0.6mm (0.016-0.024")	
Spark Plug Type	NGK BUHX	Champion UL17V
Spark Plug Reach	12.7mm (1/2")	

H1B

Battery	12V 9AH	
Ignition Timing	20° BTDC/2.23mm	
Ignition Point Gap	0.3-0.4mm (0.012-0.016")	
Spark Plug Gap	0.4-0.5mm (0.016-0.020")	
Spark Plug Type:		
Normal	NGK B9HCS	Champion L-78
Hot	NGK B8HC	Champion L-81
Cold	NGK B10HS	Champion L-57R
Spark Plug Reach	12.7mm (1/2")	

H1D

Battery	12V 9AH	
Ignition Timing	23° BTDC/2.94mm	
Ignition Air Gap	0.5-0.8mm (0.020-0.031")	
Spark Plug Gap	0.9-1.0mm (0.035-0.039")	
Spark Plug Type:		
Normal	NGK B9HCS	Champion L-78
Hot	NGK B8HC	Champion L-81
Cold	NGK B10HS	Champion L-57R
Spark Plug Reach	12.7mm (1/2")	

H1E, H1F

Battery	12V 9AH	
Ignition Timing	23° BTDC/2.94mm	
Ignition Air Gap	0.6mm (0.025")	
Spark Plug Gap	0.9-1.0mm (0.035-0.039")	
Spark Plug Type:		
Normal	NGK B9HCS	Champion L-78
Hot	NGK B8HC	Champion L-81
Cold	NGK B10HS	Champion L-57R
Spark Plug Reach	12.7mm (1/2")	

H2 MODELS

Battery	12V 6AH	
Ignition Timing	23° BTDC/3.13mm	
Ignition Air Gap	0.5-0.8mm (0.020-0.031")	
Spark Plug Gap	0.9-1.0mm (0.035-0.039")	
Spark Plug Type:		
Normal	NGK B9HCS	Champion L-78
Hot	NGK B8HC	Champion L-81
Cold	NGK B10HS	Champion L-57R
Spark Plug Reach	12.7mm (1/2")	