

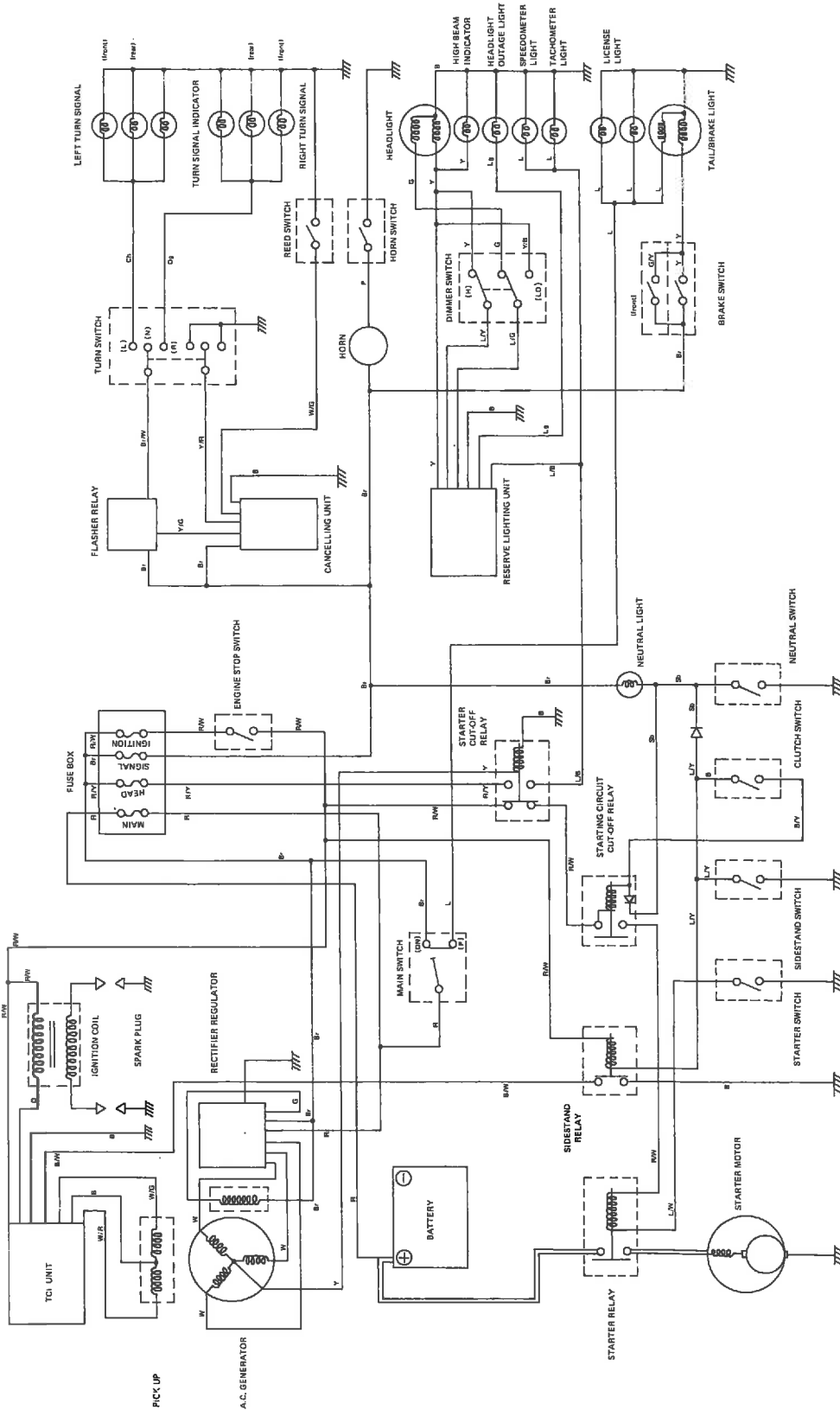
CHAPTER 6. ELECTRICAL

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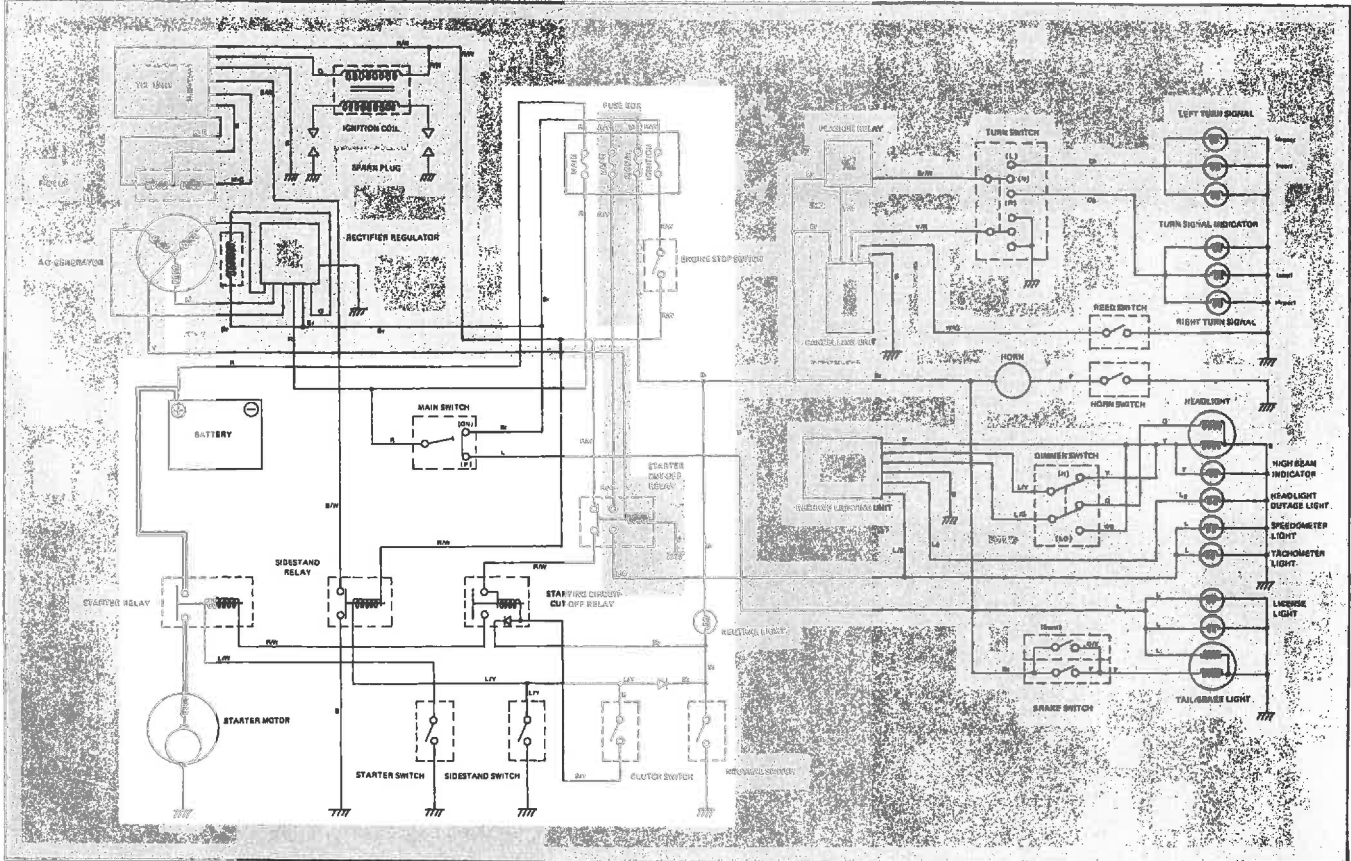


ELECTRICAL

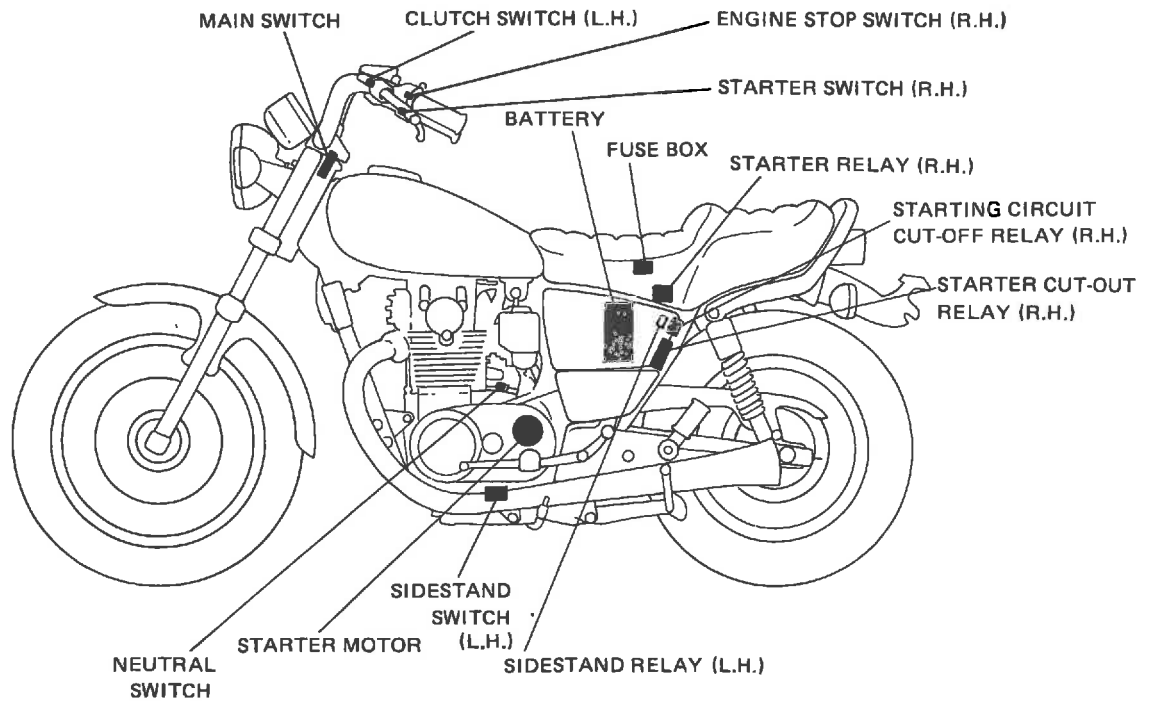
XS650SJ WIRING DIAGRAM



ELECTRIC STARTING SYSTEM



ELECTRIC STARTER SYSTEM



STARTING CIRCUIT OPERATION

The starting circuit on this model consists of the starter motor, starter relay, starter cut-out relay, and the starting-circuit cut-off relay. If the engine stop switch and the main switch are both on, the starter motor can operate only if:

- a. The transmission is in neutral (the neutral switch is on).

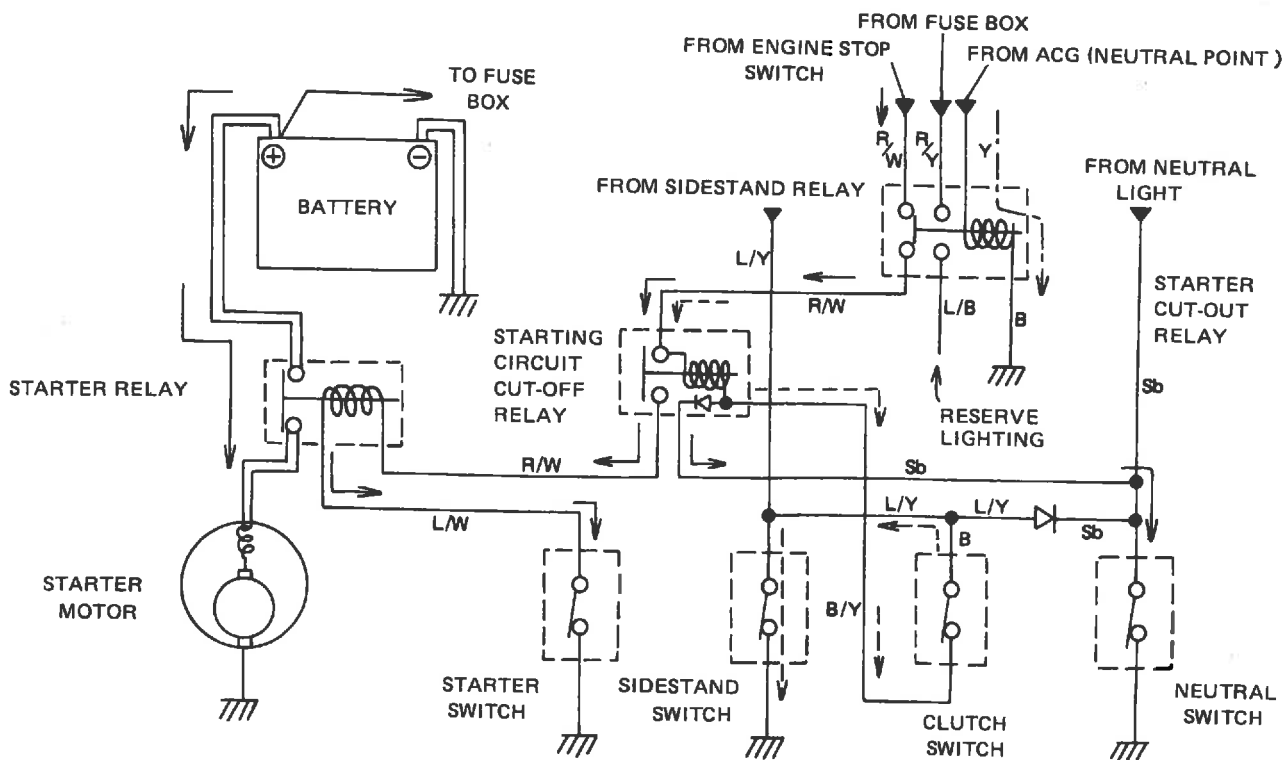
or if

- b. The clutch lever is pulled to the handlebar (the clutch switch is on) and the sidestand is up (the sidestand switch is on).

The starting-circuit cut-off relay prevents the starter from operating when neither of these conditions has been met. In this instance, the starting-circuit cut-off relay is off so current cannot reach the starter motor.

When one or both of the above conditions have been met, however, the starting-circuit cut-off relay is on, and the engine can be started by pressing the starter switch.

This starting system also has a starter cut-out relay which protects the starter motor during engine operation. After the engine has started, the tachometer control unit sends current to the starter cut-out relay. The relay switches off, interrupts the current flow to the starter motor, and the starter ceases to operate.

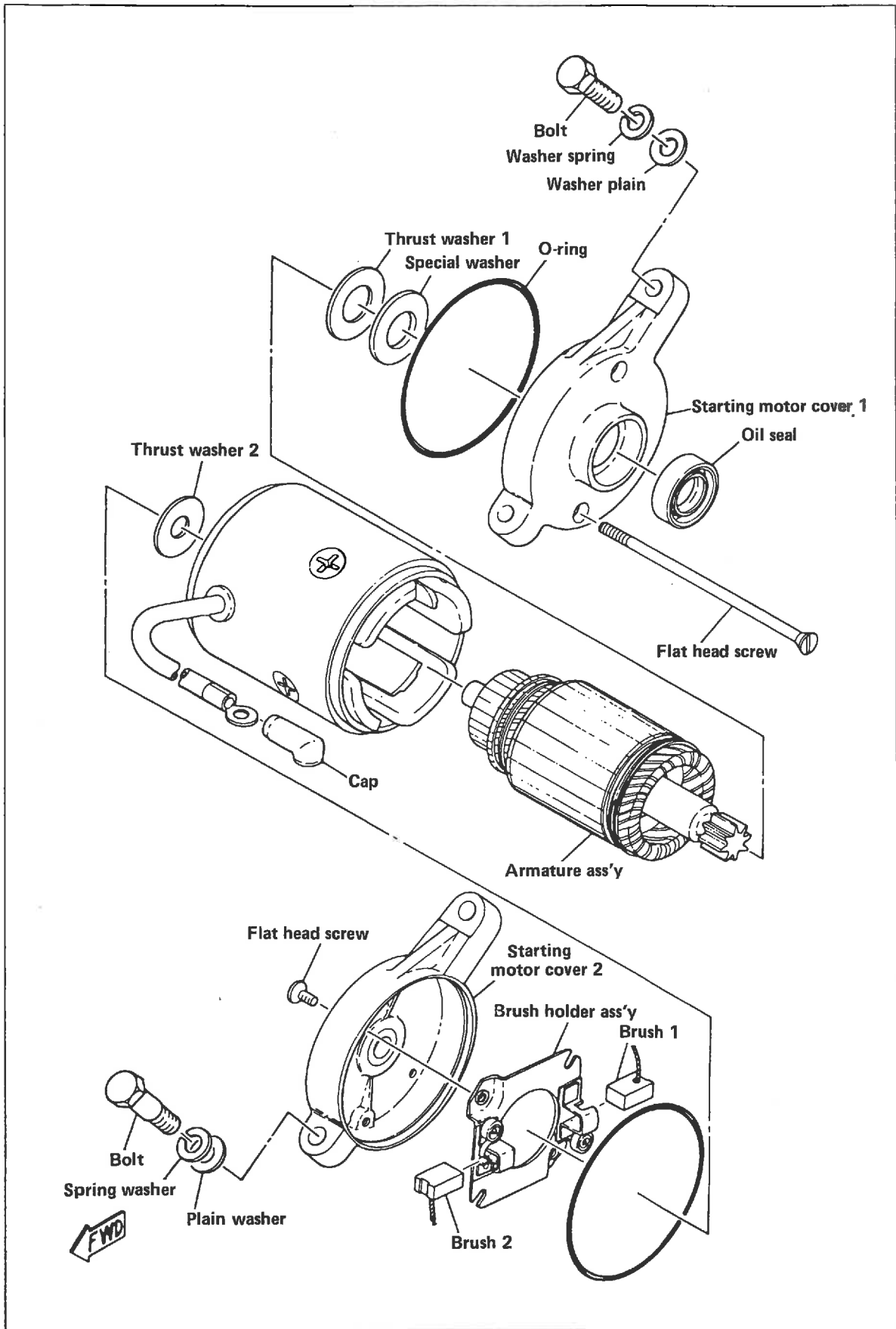


← WHEN THE TRANSMISSION IS IN NEUTRAL.

← - - - WHEN THE CLUTCH LEVER IS PULLED TO THE HANDLEBAR AND THE SIDESTAND IS UP.

← - - - WHEN THE ENGINE IS RUNNING.

STARTER MOTOR



A. Removal

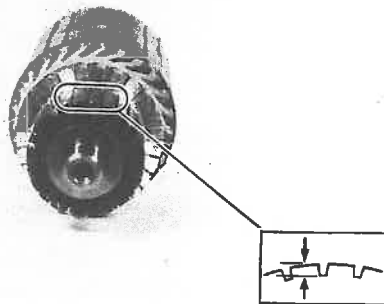
1. See Chapter 3. "ENGINE DISASSEMBLY."

B. Inspection And Repair

1. Check the outer surface of the commutator. If its surface is dirty, clean it with # 600 grit sandpaper.
2. The mica insulation between the commutator segments should be 0.4~0.8 mm (0.02 ~ 0.03 in) below the segment level. If not, scrape the mica to proper limits with an appropriately shaped tool. (A hacksaw blade can be ground to fit.)

NOTE:

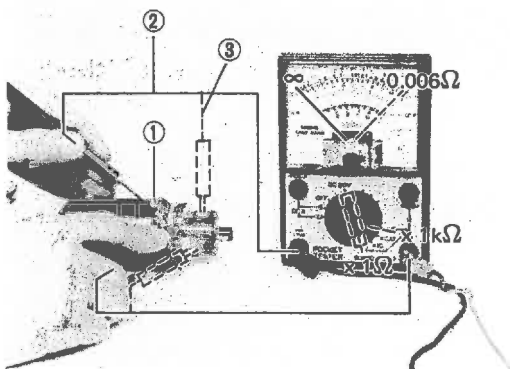
The mica insulation of the commutator must be under-cut to ensure proper operation of commutator.



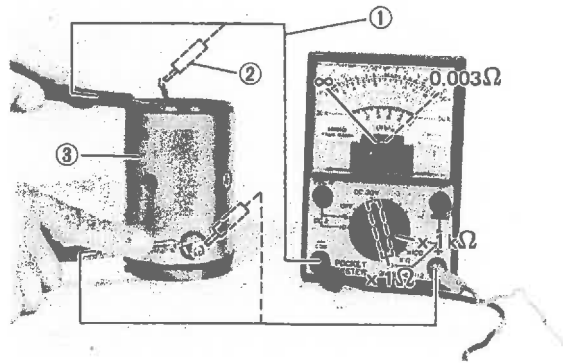
3. The field and armature coils should be checked for insulation breakdown (shorting to each other or to ground) and for continuity. Use a pocket tester.

Coil resistance:

Armature coil: 0.006Ω at 20°C (68°F)
 Field coil: 0.003Ω at 20°C (68°F)

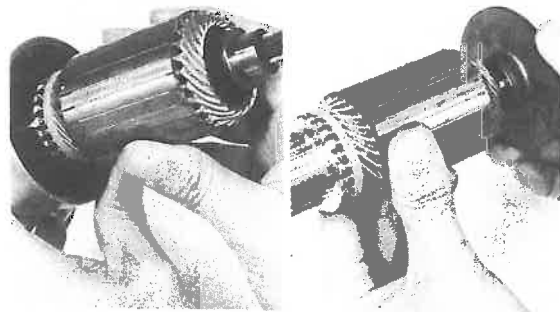


1. Armature coil
2. Insulation check
3. Continuity check



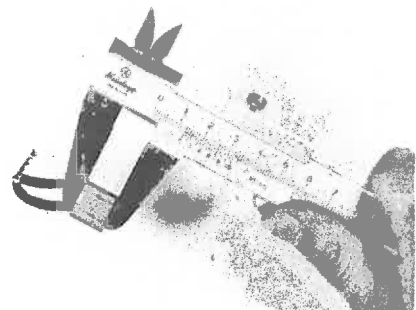
1. Insulation check
2. Continuity check
3. Field coil

4. Check the front and rear cover bearings for damage. If either is damaged, the starter motor must be replaced.



5. Check the brush length. Replace the brush if it's at or near its limits.

Minimum brush length: 4.0 mm (0.157 in)

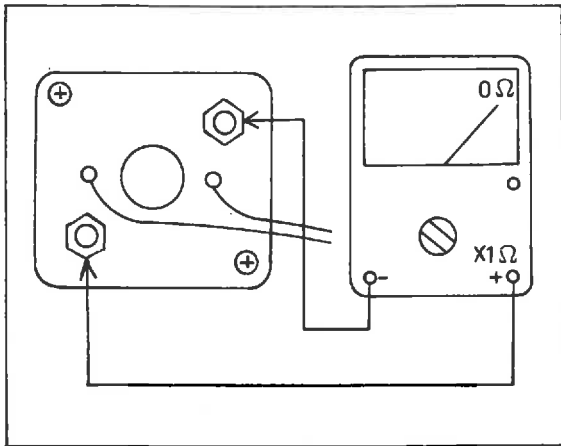


6. Check the brush spring pressure. Compare it with a new spring. Replace the old spring if it is weak.

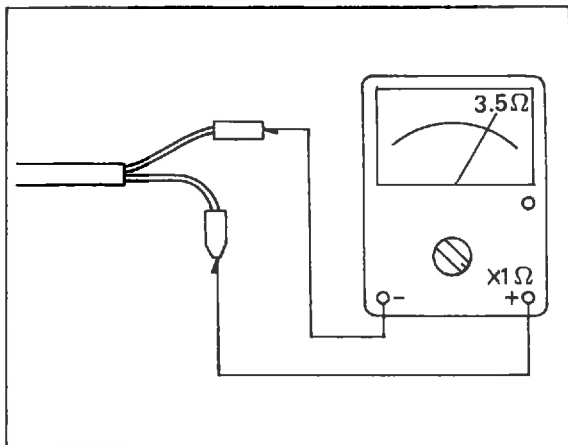
STARTER RELAY

A. Inspection

1. Disconnect the starter cable at the relay.
2. Connect the pocket tester leads to the relay terminals (ohms x 1 scale).
3. Turn the ignition to the "ON" position, the engine stop switch to "RUN", and the shift lever to "NEUTRAL".
4. Push the starter button. The starter relay should click once, and the scale on the tester should read zero. If it does not read zero, the relay must be replaced.



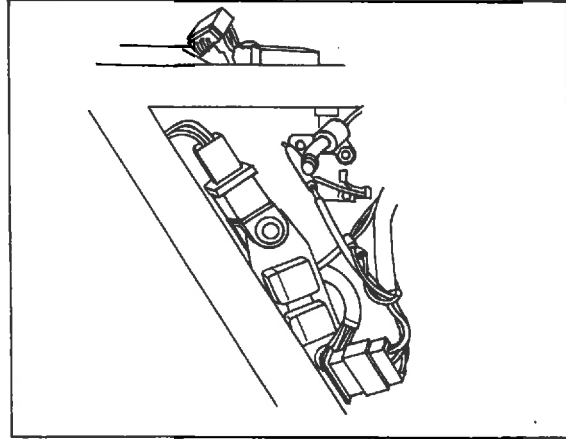
5. If the relay does not click, check the wires from the starter button and from the battery (red/white, blue/white). Turn the ignition off. Use the scale (ohms x 1) on the tester. The resistance between these wires should be no more than 3.5 ohms. If there is more resistance, the relay should be replaced.



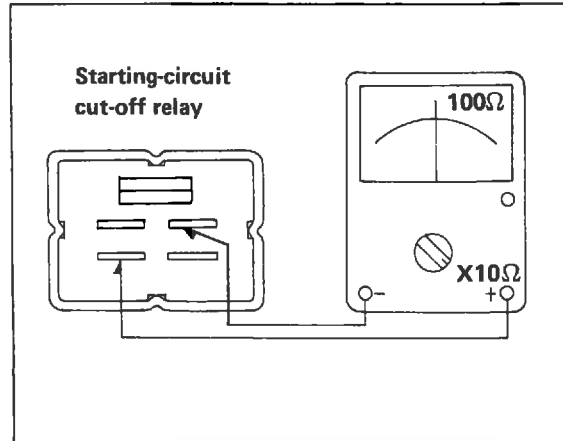
STARTING-CIRCUIT CUT-OFF RELAY

A. Inspection

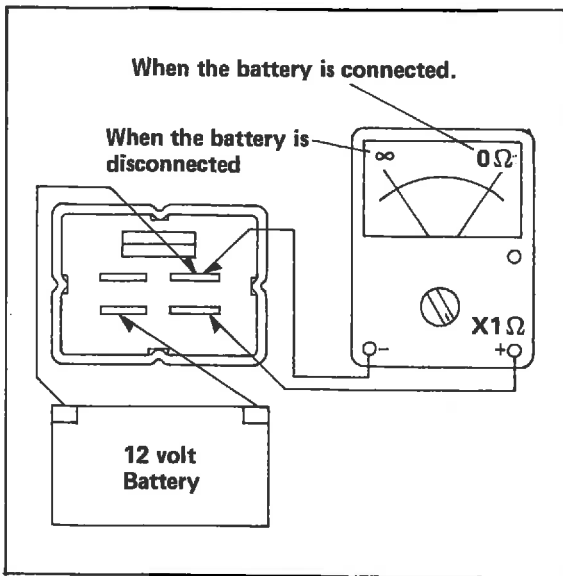
1. Remove the starting-circuit cut-off relay from the rear fender bracket, and disconnect the connector.



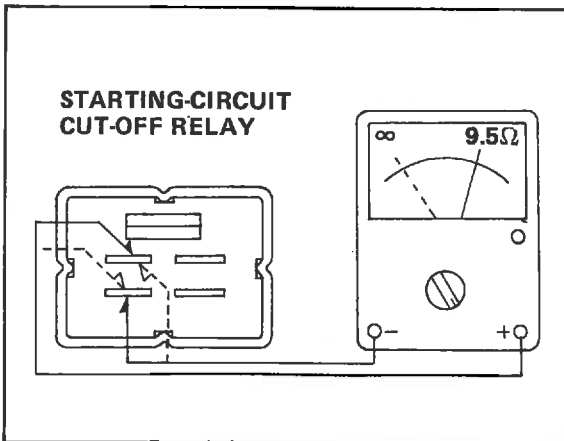
2. Check the resistance of the relay coil windings with the pocket tester. If the resistance is not within specification, replace the relay.



3. Check the relay function with a 12 volt battery and the pocket tester. Connect the leads as shown in the illustration. If the resistance readings do not equal those shown in the illustration, replace the relay.



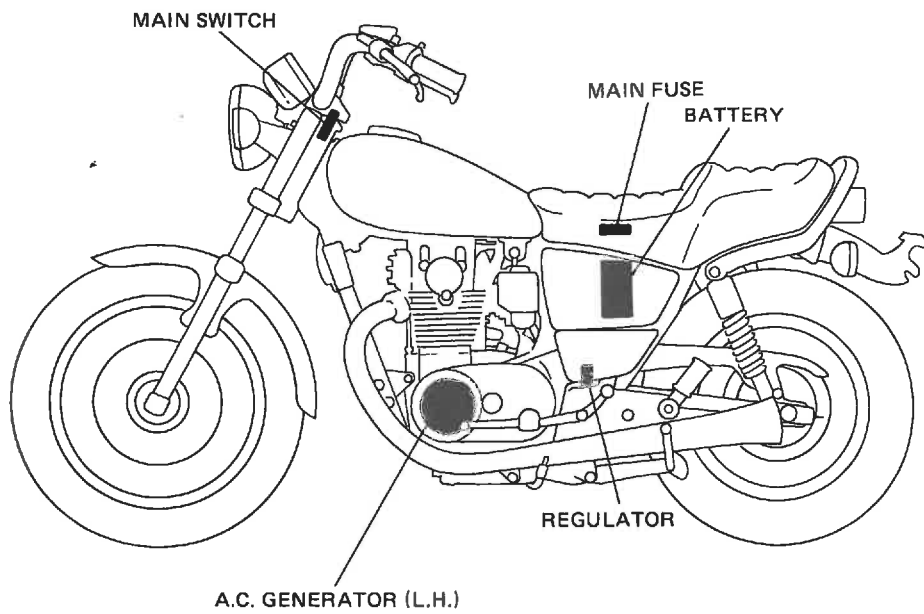
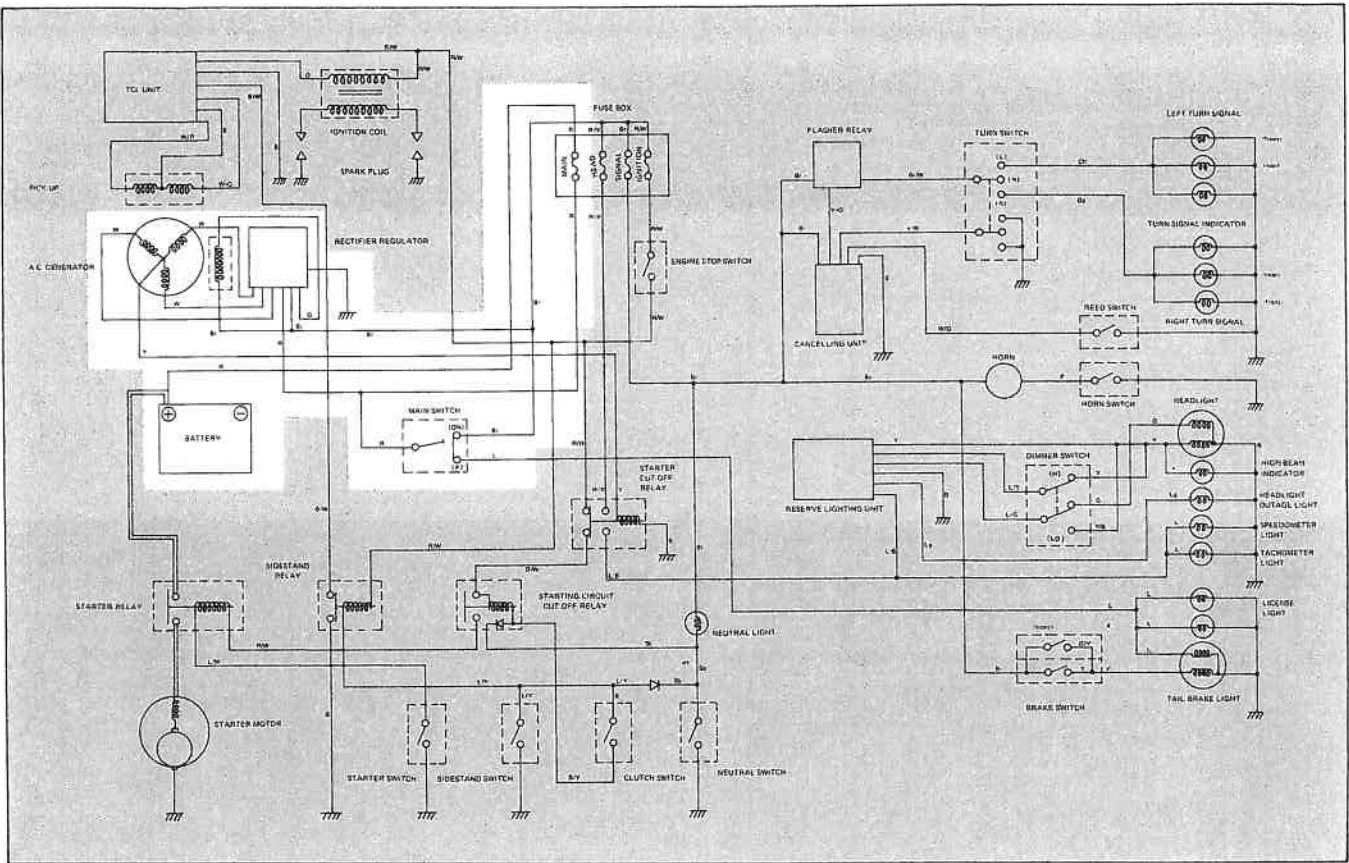
4. Check the diode in the starting circuit cut-off relay with the pocket tester as shown in the illustration. Replace the relay if the diode is damaged.



NOTE:

Only the Yamaha Pocket Tester will give a 9.5Ω reading when testing continuity. The particular characteristics of other testers will vary the continuity test readings.

CHARGING SYSTEM

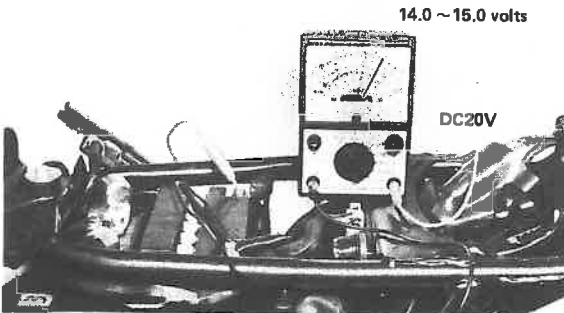


AC GENERATOR AND VOLTAGE REGULATOR

A. Inspection

1. Connect the pocket tester to the battery terminals.
2. Start the engine.
3. Accelerate the engine to approximately 2,000 rpm or more, and check the generator voltage.

Generator voltage: 14.5 ± 0.5 V



4. If the indicated voltage cannot be reached, check all connections. If the connections are all good, check the battery, stator coil, and the regulator/rectifier. If both the battery and stator coil are in working order, the regulator is defective and should be replaced.

CAUTION:

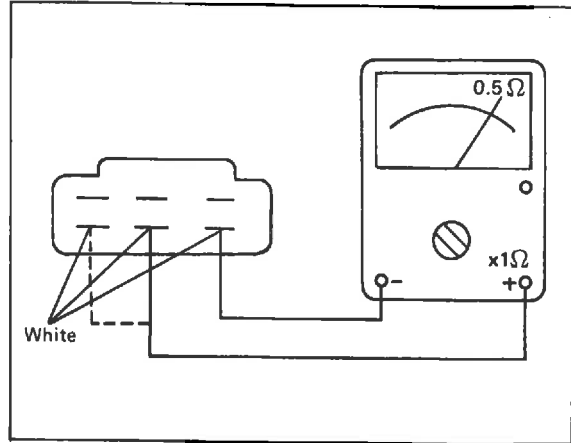
Never disconnect the wires from the battery while the generator is operating. If the battery is disconnected, the voltage across the generator terminals will increase and damage the semi-conductors.

B. Battery Inspection

1. Check the battery terminals and couplers. They should be tight.
2. Measure the specific gravity of the battery. If it is less than 1.260, remove and charge the battery until the specific gravity is greater than 1.260.

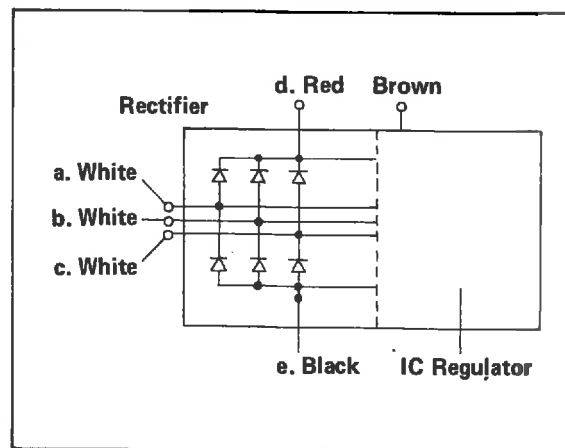
C. Stator Coil Inspection

1. Remove the side cover.
2. Disconnect the stator coil leads from the voltage regulator, and connect the pocket tester as shown. If the resistance does not equal the specified value, the stator coil is defective and should be replaced.



D. Checking The Silicon Rectifier

1. Check the silicon rectifier as specified using the pocket tester.



| Checking element | Pocket tester connecting point | | Good | Replace (element shorted) | Replace (element opened) |
|------------------|--------------------------------|-------------|------|---------------------------|--------------------------|
| | (+) (red) | (-) (black) | | | |
| D1 | d | a | ○ | ○ | x |
| | a | d | x | ○ | x |
| D2 | d | b | ○ | ○ | x |
| | b | d | x | ○ | x |
| D3 | d | c | ○ | ○ | x |
| | c | d | x | ○ | x |
| D4 | a | e | ○ | ○ | x |
| | e | a | x | ○ | x |
| D5 | b | e | ○ | ○ | x |
| | e | b | x | ○ | x |
| D6 | c | e | ○ | ○ | x |
| | e | c | x | ○ | x |

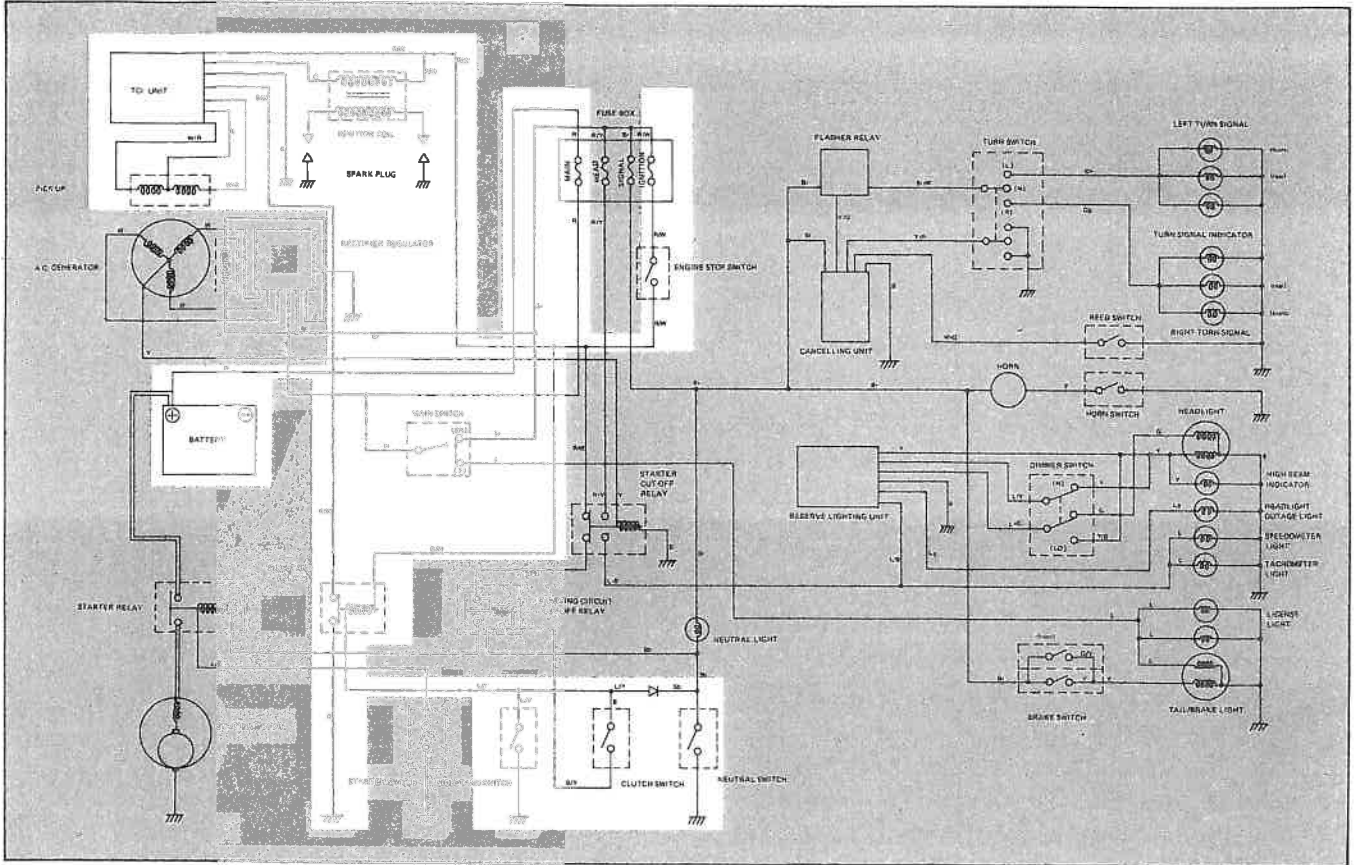
○ : Continuity
x : Discontinuity (∞)

2. If any element is broken, replace the entire unit.

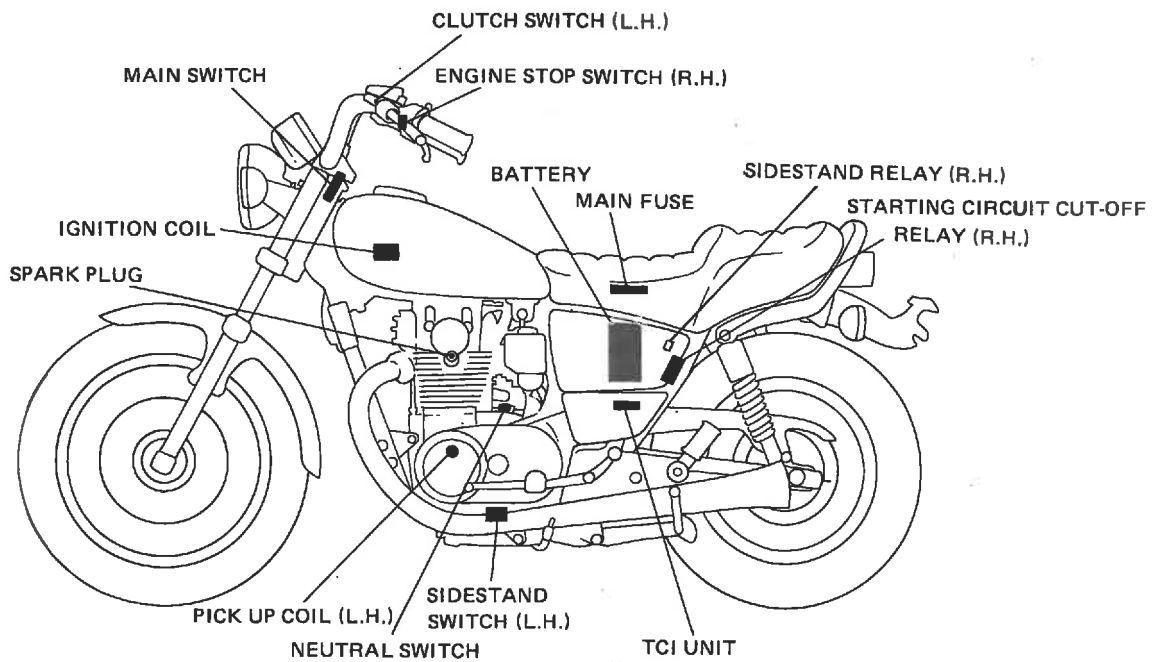
CAUTION:

The silicon rectifier can be damaged if subjected to overcharging. Special care should be taken to avoid a short circuit and/or incorrect connection of the positive and negative leads at the battery. Never connect the rectifier directly to the battery to make a continuity check.

IGNITION SYSTEM



IGNITION SYSTEM



A. Description

This model is equipped with a battery operated, fully transistorized, breakerless ignition system. By using magnetic pickup coils, the need for contact breaker points is eliminated. This adds to the dependability of the system by eliminating frequent cleaning and adjustment of points and ignition timing. The TCI (Transistor Control Ignition) unit incorporates an automatic advance circuit controlled by signals generated by the pickup coil. This adds to the dependability of the system by eliminating the mechanical advancer. This TCI system consists of two units; a pickup unit and an ignitor unit.

NOTE:

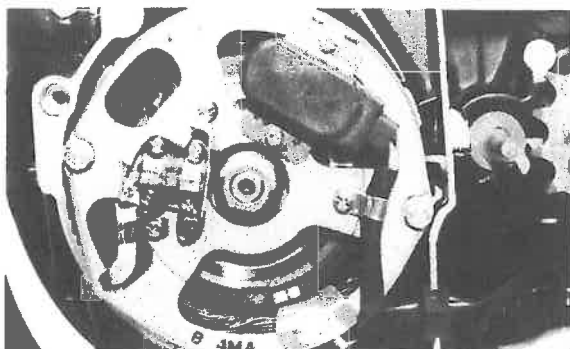
The ignition circuit can be operated only when the sidestand is up (the sidestand switch is on) or the transmission is in neutral.

B. Operation

The TCI functions on the same principle as a conventional DC ignition system with the exception of using magnetic pickup coils and a transistor control box (TCI) in place of contact breaker points.

1. Pickup unit

The pickup unit consists of two pickup coils and a flywheel mounted onto the crankshaft. When the projection on the flywheel passes a pickup coil, a signal is generated and transmitted to the ignitor unit. The width of the projection on the flywheel determines the ignition advance.

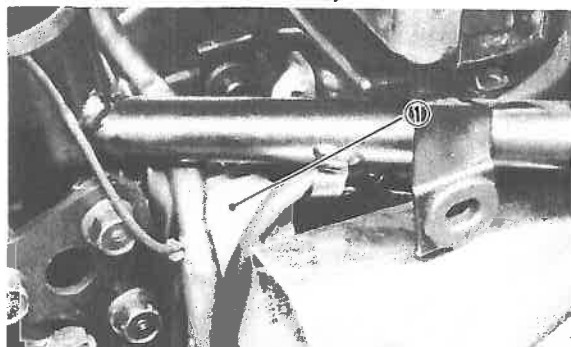


2. Ignitor unit

This unit controls wave form, duty control, switching, electronic ignition

advance, etc. The duty control circuit reduces electrical consumption by controlling the duration of the primary ignition current.

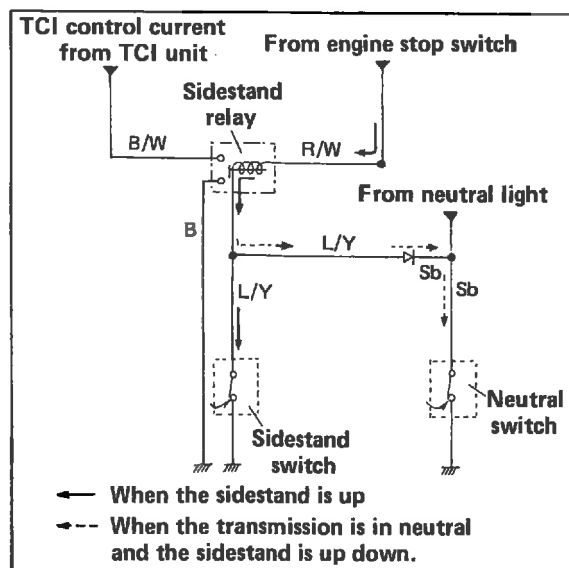
The ignitor unit also has a protective circuit for the ignition coil. If the ignition switch is on and the crankshaft is not turning, the protective circuit interrupts the current flow to the primary coil after a few seconds. When the crankshaft is turning, however, the ignitor unit sends current to the primary coil.



1. Transistor control ignitor unit (TCI unit)

3. Sidestand relay

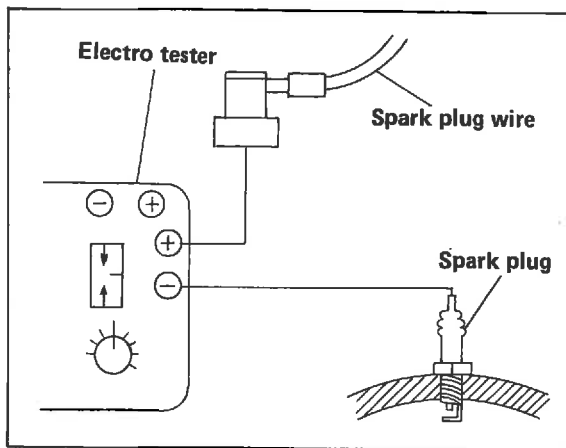
The sidestand relay operates by shorting the TCI control current. When the sidestand is down, the sidestand relay is closed, and the TCI control current is grounded through the sidestand relay. Thus, the engine will not run with the sidestand down unless the transmission is in neutral.



C. Troubleshooting

The entire ignition system can be checked for misfire and weak spark by using the Electro Tester. If the ignition system will fire across a specified gap, the entire ignition system is good. If it will not fire across the gap, proceed with the individual component tests until the source of the problem is located.

1. Warm up the engine thoroughly so all electrical components are at operating temperature.
2. Stop the engine, and connect the tester as shown.



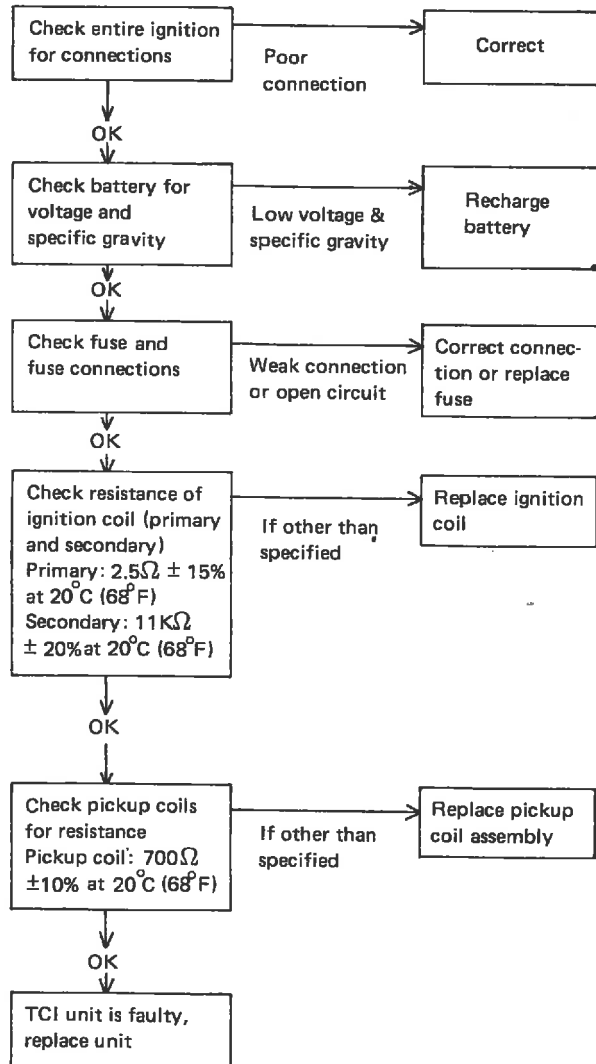
3. Start the engine, and increase the spark gap until misfire occurs. (Test at various rpm between idle and red line.)

Minimum spark gap: 7 mm (0.28 in)

CAUTION:

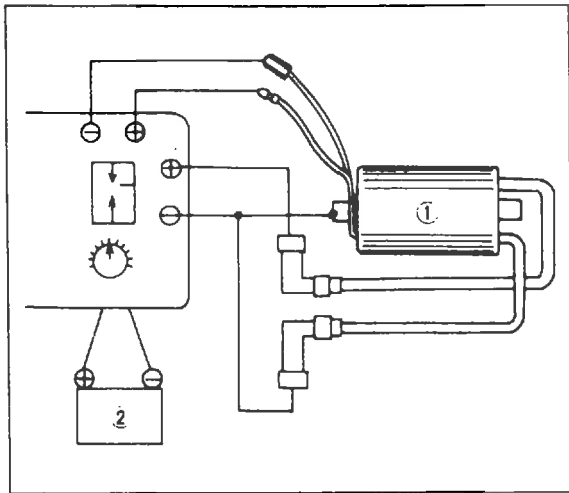
Do not run the engine in neutral above 6,000 rpm for more than 1 or 2 seconds.

If the ignition system becomes inoperative or if the engine misfires at the minimum spark gap or at a smaller gap, there is a problem in the ignition system. Follow the troubleshooting chart until the source of the problem is located.



Ignition spark gap test

1. Remove the seat, fuel tank, and disconnect the ignition coil wires from the wiring harness and from the spark plugs.
2. Connect the Electro Tester as shown.



1. Ignition coil
2. Battery

3. Connect a fully charged battery to the tester.
4. Turn on the spark gap switch, and increase the gap to maximum unless misfire occurs first.

Minimum spark gap: 7 mm (0.276 in)

Direct current resistance test.

Use the pocket tester to determine resistance and continuity of primary and secondary coil windings.

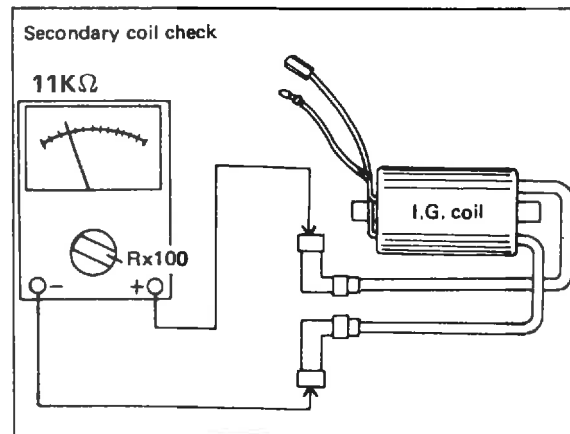
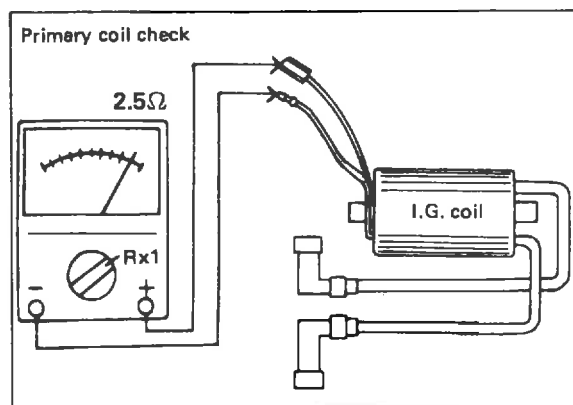
Standard value:

Primary coil resistance:

$2.5\ \Omega \pm 10\%$ at 20°C (68°F)

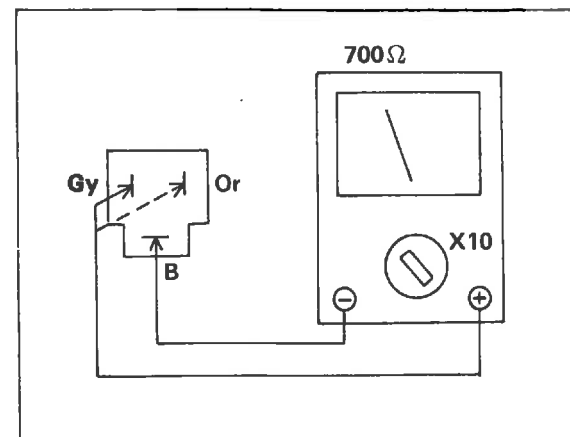
Secondary coil resistance:

$11\text{K}\ \Omega \pm 20\%$ at 20°C (68°F)



Pickup coil

1. Remove the left-side cover.
2. Disconnect the pickup coil wires from the TCI unit wires.
3. Check the resistance of the pickup coil windings with the pocket tester. If the resistance is not within specification, replace the pickup coil assembly.



Spark plug

The life of a spark plug and its discoloring vary according to the habits of the rider. At each periodic inspection, replace burned or fouled plugs with new ones of the specified type. It is actually economical to install new plugs often since it will tend to keep the engine in good condition and prevent excessive fuel consumption.

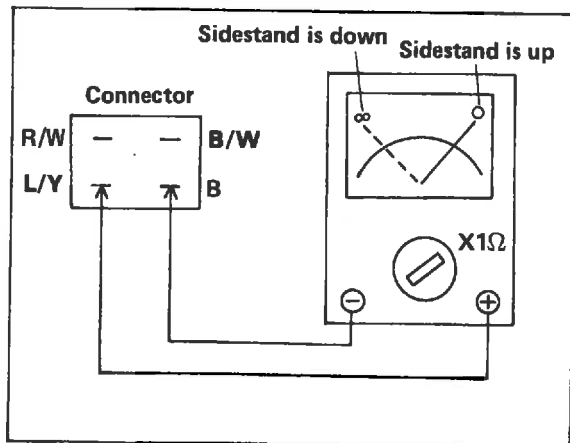
1. Inspect and clean the spark plug every 4,000 km (2,500 mi), and replace after initial 13,000 km (8,000 mi).
2. Clean the electrodes of carbon, and adjust the electrode gap to the specifica-

tion. Be sure to use the proper reach, type, and electrode gap plug(s) as a replacement to avoid overheating, fouling, or piston damage.

Type:
 BP7ES (NGK) or N-7Y (CHAMPION)
 Electrode gap:
 0.7 ~ 0.8 mm (0.028 ~ 0.031 in)
 Tightening torque:
 19.6 Nm (2.0 m-kg, 14.5 ft-lb)

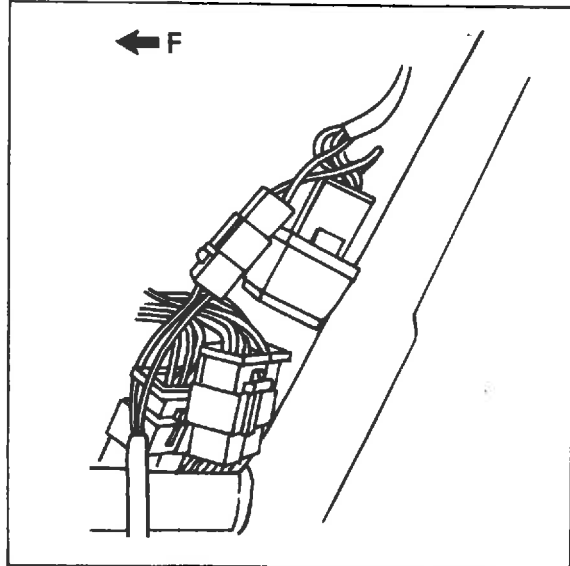
Sidestand switch

1. Remove the sidestand switch from the rear fender bracket, and disconnect the connector.
2. Connect the pocket tester leads as shown, and set the tester selector to ohm x 1. When the sidestand is up, the tester should read zero ohms. When the sidestand is down, the tester should read infinity.

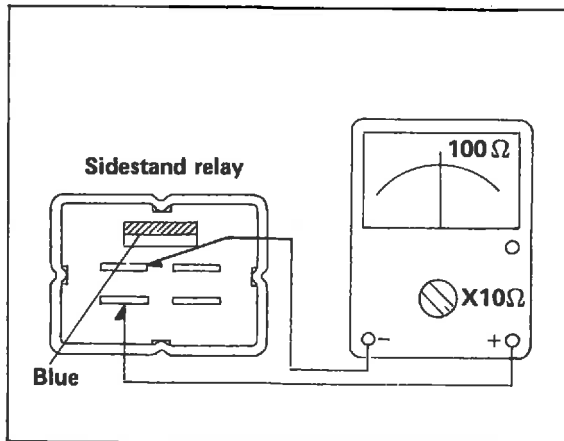


Sidestand relay

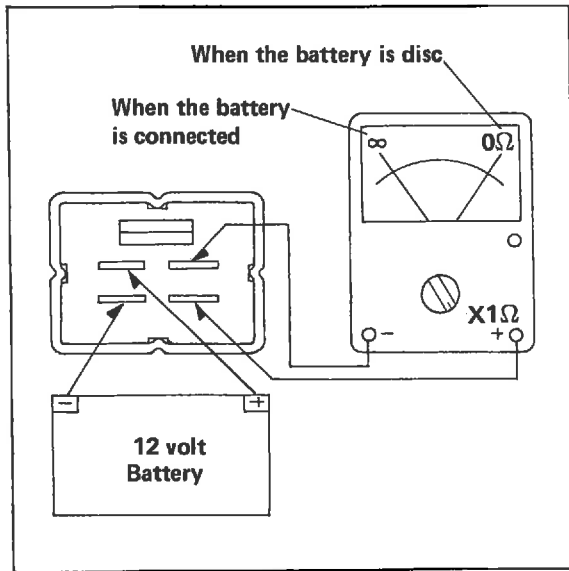
1. Remove the sidestand relay from the rear fender bracket, and disconnect the connector.



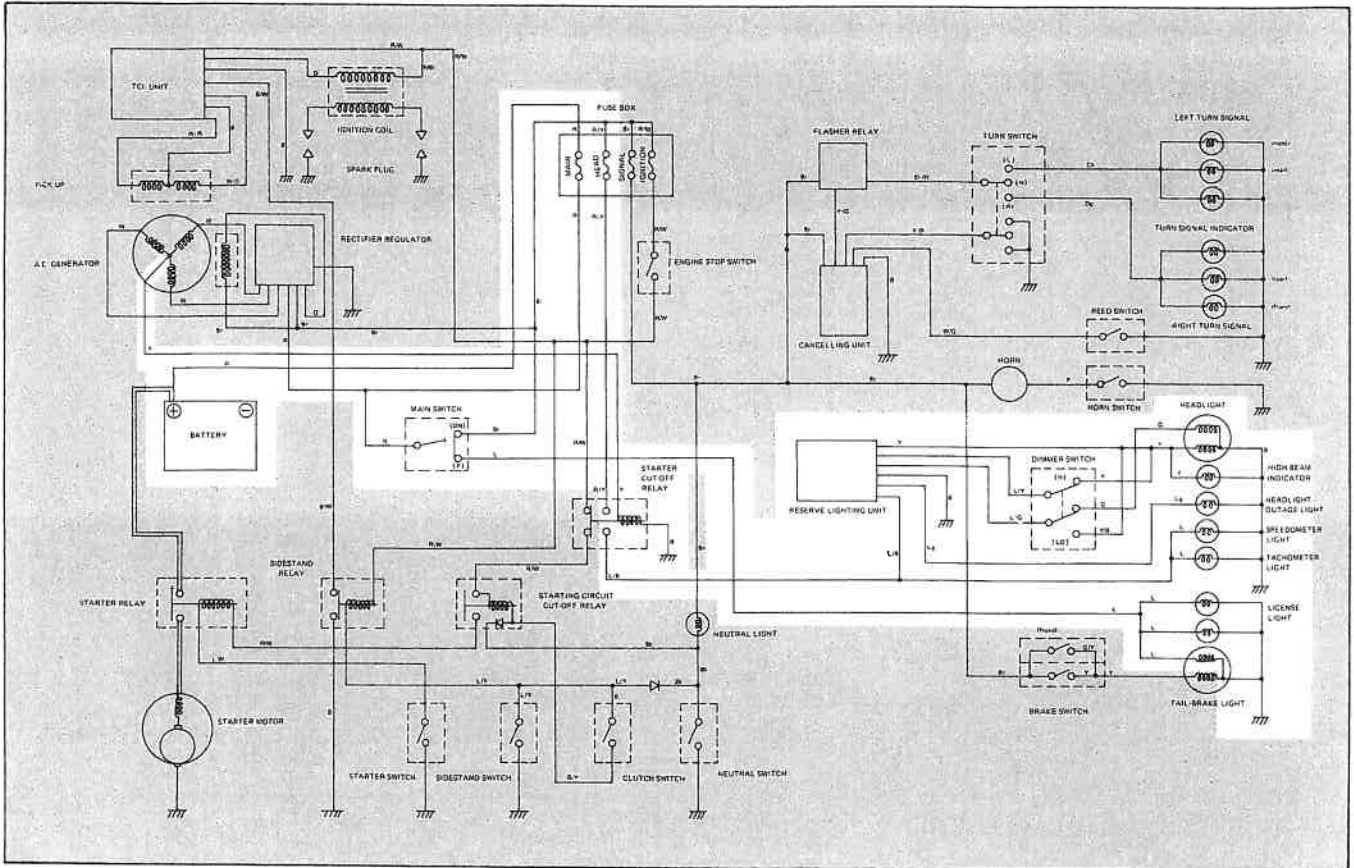
2. Check the resistance of the relay coil windings with the pocket tester. If the resistance is not within specification, replace the relay.



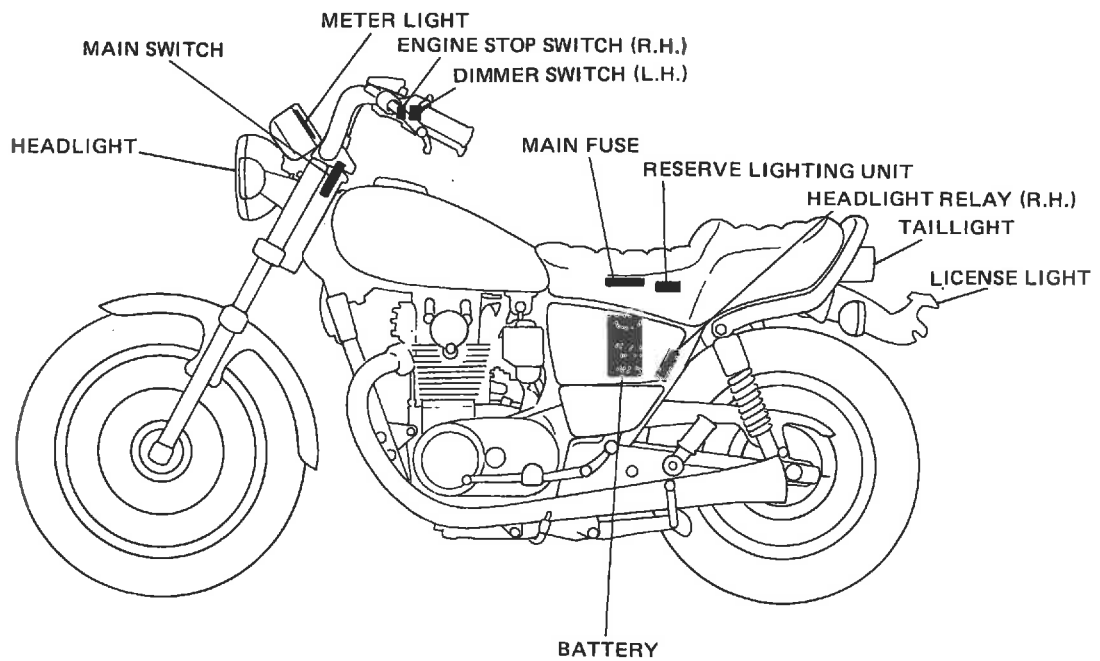
3. Check the relay contact breaker points with the pocket tester and a 12 volt battery. Connect the leads as shown in the illustration. If the resistance readings do not equal those shown in the illustration, replace the relay.



LIGHTING SYSTEM



LIGHTING SYSTEM



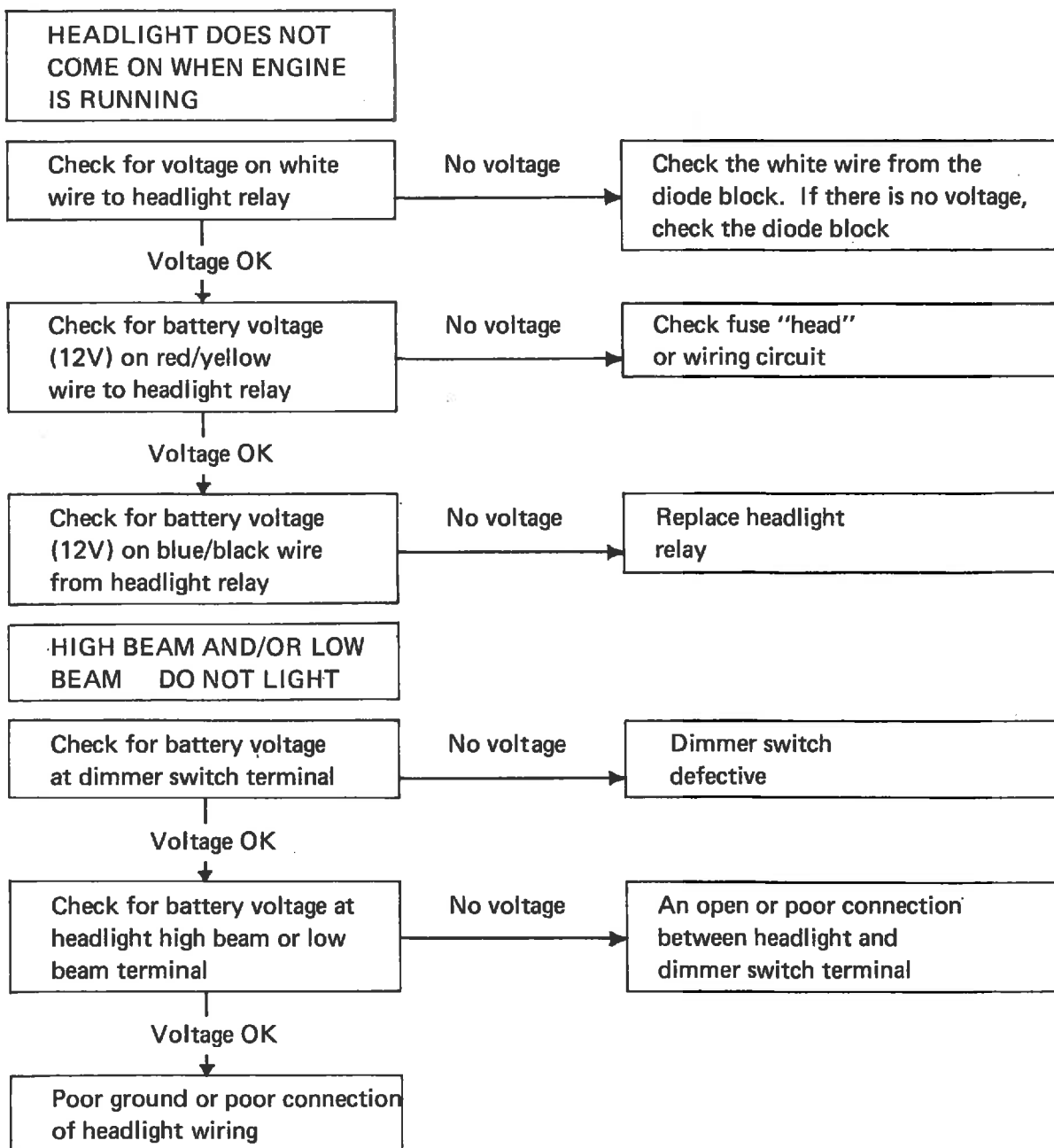
A. Lighting Tests and Checks

The battery provides power for operation of the headlight, taillight, and meter lights. If none of the above operates, always check battery voltage before proceeding further. Low battery voltage indicates either a faulty battery, low battery electrolyte, or a defective charging system. See page 6-8 "CHARGING SYSTEM" for checks of the battery and charging system. Also check fuse condition. Replace any "open" fuses. There are individual fuses for various circuits (see the complete circuit diagram).

NOTE: _____
 Check the headlight bulb first before performing the following check.

1. Headlight check.

NOTE: _____
 When the engine is started, the headlight and meter lights come on automatically and the lights stay on until the main switch is turned to "OFF" even if the engine stalls.



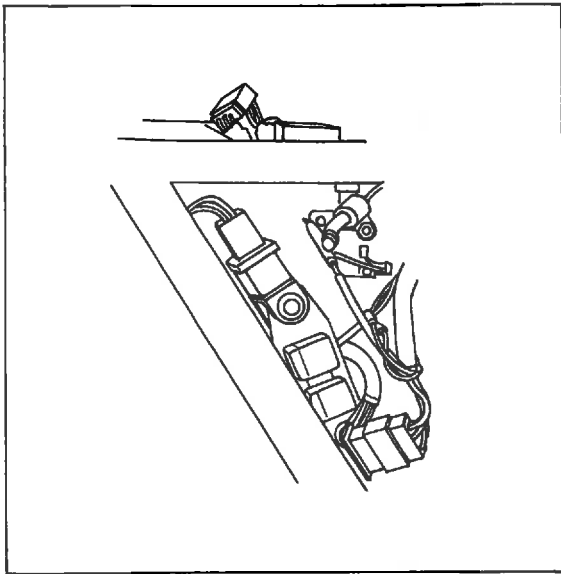
2. Taillight does not work:
- Check the bulb.
 - Check for 12V on the blue wire.
 - Check for ground on black wire to tail/brake light and/or license light assembly.

3. Check the relay contact breaker points with the pocket tester and a 12 volt battery. Connect the leads as shown in the illustration. If the resistance readings do not equal those shown in the illustration, replace the relay.

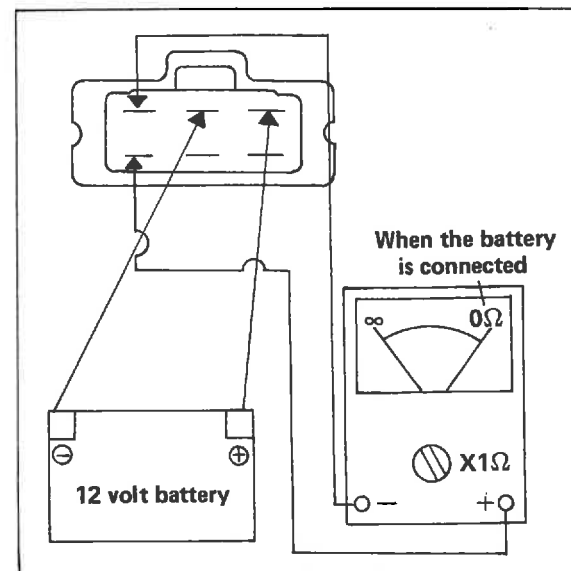
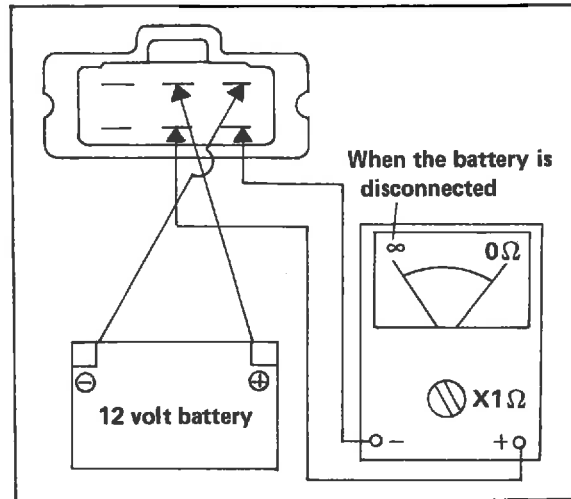
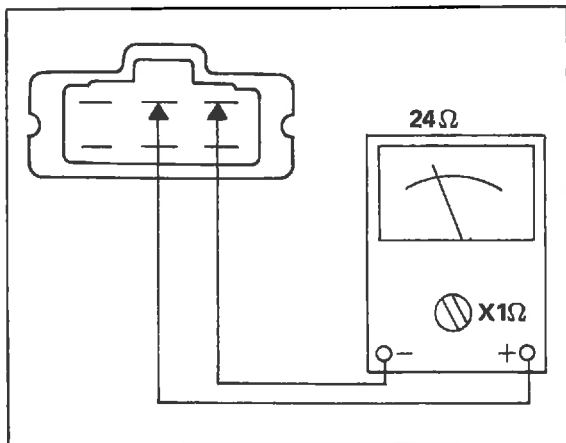
HEADLIGHT/STARTER CUT-OUT RELAY

A. Inspection

1. Remove the headlight starter cut-out relay from the rear fender bracket, and disconnect the connector.

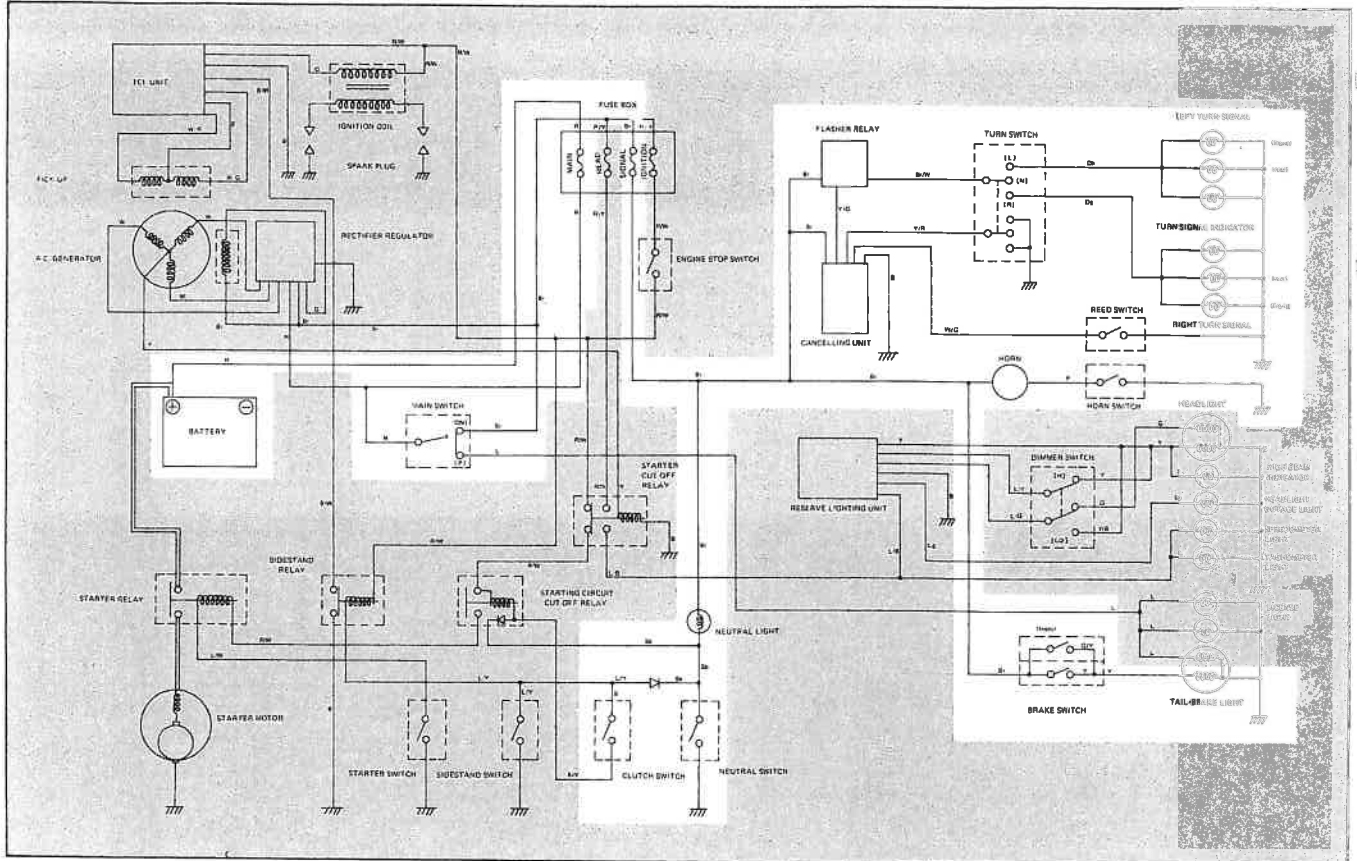


2. Check the resistance of the relay coil windings with the pocket tester. If the resistance is not within specification, replace the relay.

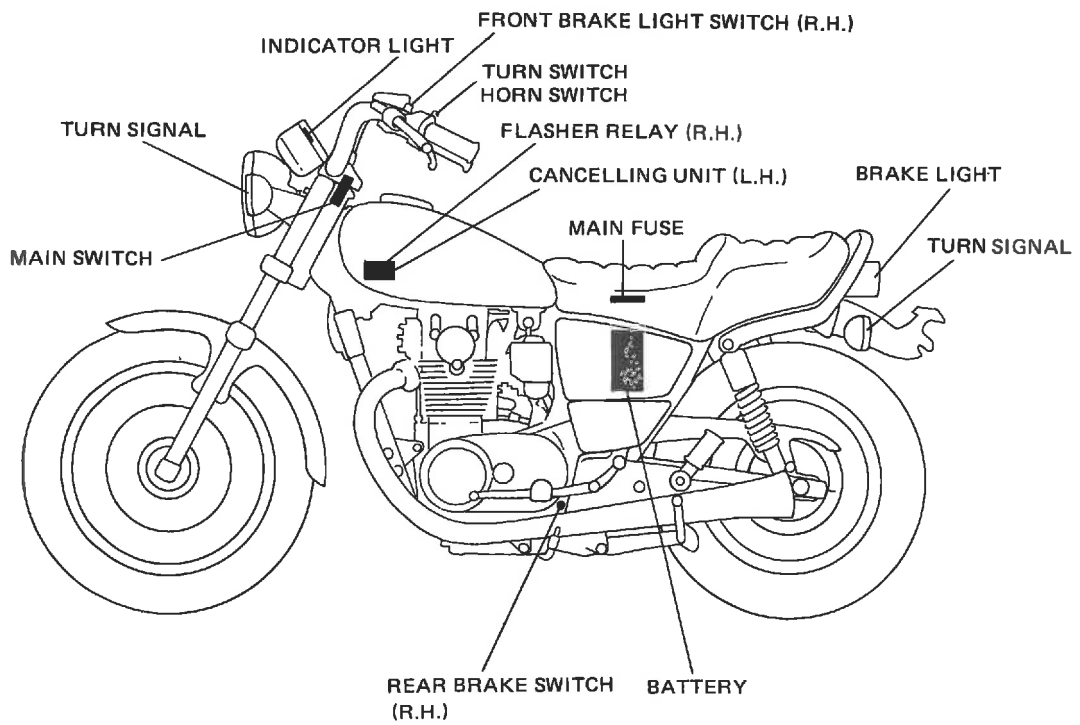


NOTE: Only the Yamaha Pocket Tester will give a 24Ω reading when testing continuity. The particular characteristics of other tests will vary the continuity test readings.

SIGNAL SYSTEM



SIGNAL SYSTEM



A. Signal System Tests and Checks

The battery provides power for operation of the horn, brake light, indicator lights, and flasher light. If none of the above operates, always check the battery voltage before proceeding further. Low battery voltage indicates either a faulty battery, low battery electrolyte, or a defective charging system. See page 6-8 "CHARGING SYSTEM" for checks of the battery and charging system. Also check the fuse condition. Replace any "open" fuses. There are individual fuses for various circuits (see the complete circuit diagram).

Horn does not work:

1. Check for 12V on the brown wire to the horn.
2. Check for good grounding of the horn (pink wire) when the horn button is pressed.

Brake light does not work:

1. Check the bulb.
2. Check for 12V on the yellow wire to the brake light with brake pedal depressed.
3. Check for 12V on the brown wire to each brake light switch (front brake and rear brake switches).

Flasher light(s) do not work:

1. Check the bulb.
2. Right circuit:
 - a. Check for 12V on the dark green wire to the light.
 - b. Check for ground on the black wire to the light assembly.
3. Left circuit:
 - a. Check for 12V on the dark brown wire to the light.
 - b. Check for ground on the black wire to the light assembly.
4. Right and left circuits do not work:
 - a. Check for 12V on the brown/white wire to the flasher switch on the left handlebar.
 - b. Check for 12V on the brown wire to the flasher relay.
 - c. Replace the flasher relay.
 - d. Replace the flasher switch.
5. Check the self-cancelling unit. (Refer to Flasher Self-Cancelling Unit.)

The neutral light does not work:

1. Check the bulb.
2. Check for 12V on the sky blue wire to the neutral switch.
3. Replace the neutral switch.

B. Flasher Self-Cancelling Unit

The self-cancelling unit turns off the flashers. Generally, the signal will cancel after either 10 seconds of operation or after the motorcycle has traveled 150 meters (490 feet), whichever is greater. At low speed, the cancelling is a function of distance; at high speeds, it's a function of both time and distance.

The self-cancelling mechanism only operates when the motorcycle is moving; thus the signal will not self-cancel while you are stopped at an intersection.

The handlebar switch has three positions: L (left), OFF, and R (right). The switch lever will return to the "OFF" position after being pushed to L or R, but the signal will function. By pushing the lever in, the signal may be cancelled manually.

Inspection

If the flasher self-cancelling unit should become inoperative, proceed as follows:

1. Pull off the 6-pin connector from the flasher self-cancelling unit, and operate the handlebar switch. If the signal operates normally in L, R, and OFF, the following are in good condition.
 - a. Flasher unit
 - b. Bulb
 - c. Lighting circuit
 - d. Handlebar switch light circuit

If (a) and (b) are in good condition, the following may be faulty:

- Flasher cancelling unit.
- Handlebar switch reset circuit.
- Speedometer sensor circuit.

- Pull off the 6-pin connector from the flasher self-cancelling unit, and connect a tester (ohms x 100 range) across the white/green and the black lead wires on the wiring harness side. Turn the speedometer shaft. If the tester needle swings back and forth between 0 and ∞ , the speedometer sensor circuit is in good condition. If not, the sensor to wiring harness may be inoperative.
- Pull the 6-pin connector from the flasher self-cancelling unit. Check if there is continuity between the yellow/red lead wire on the wiring harness side and the chassis.

| |
|---|
| Flasher switch OFF: ∞ Flasher switch L or R: 0 ohms |
|---|

If the tester needle does not swing as indicated above, check the handlebar switch circuit and wiring harness.

- If no defect is found with the above three checks and the flasher cancelling system is still inoperative, replace the flasher cancelling unit.
- If the signal flashes only when the handlebar switch lever is turned to L or R and it turns off immediately when the handlebar switch lever returns to center, replace the flasher cancelling unit.

C. Switches

Switches may be checked for continuity with a pocket tester on the "ohms x 1" scale.

- Main switch.

| Switch position | Wire Color | | |
|-----------------|------------|----|-----|
| | R | Br | L/Y |
| ON | | | |
| OFF | | | |
| LOCK | | | |
| P (parking) | | | |

- Engine stop switch

| Switch position | Wire color | |
|-----------------|------------|-----|
| | Br | R/W |
| RUN | | |
| OFF | | |

- Start switch

| Button position | Wire color | |
|-----------------|------------|--------|
| | L/W | Ground |
| PUSH | | |
| OFF | | |

- Lights (dimmer) switch

| Switch position | Wire Color | | | | |
|-----------------|------------|-----|---|-----|-----|
| | Y | L/Y | G | L/G | Y/B |
| HI | | | | | |
| LO | | | | | |

- Turn switch

| Switch position | Wire color | | | | |
|-----------------|------------|------|----|-----|--------|
| | Dg | Br/W | Ch | Y/R | Ground |
| R | | | | | |
| N | | | | | |
| L | | | | | |

- Horn switch

| Button position | Wire color | |
|-----------------|------------|--------|
| | P | Ground |
| PUSH | | |
| OFF | | |

D. Battery

If the battery shows the following defects, it should be replaced:

- The battery voltage will not rise to a specific value or no bubbles rise in any cell even after many hours of charging.
- Sulfation of one or more cells is indicated by the plates turning white or an

accumulation of material in the bottom of the cell.

3. Specific gravity readings after a long, slow charge indicate a cell to be lower than any others.
4. Warpage or buckling of plates or insulators is evident.

WARNING:

Battery fluid is poisonous and dangerous, causing severe burns, etc. It contains sulfuric acid. Avoid contact with the skin, eyes, or clothing.

Antidote: **EXTERNAL** – Flush with water. **INTERNAL** – Drink large quantities of water or milk. Follow with milk of magnesia, beaten eggs, or vegetable oil. Call physician immediately.

Eyes: Flush with water for 15 minutes, and get prompt medical attention. Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in an enclosed space. Always shield your eyes when working near batteries.

KEEP OUT OF REACH OF CHILDREN.

The service life of a battery is usually two to three years. Lack of care, as described below, will shorten the life of the battery.

- Negligence in keeping battery topped off with distilled water.
- Battery left discharged.
- Over-charging with heavy charge.
- Freezing.
- Filling with tap water or sulfuric acid containing impurities.
- Improper charging voltage or current on new battery.

If the motorcycle is not to be used for a long time, remove the battery and have it stored.

The following instructions should be observed:

1. Recharge the battery periodically.
2. Store the battery in a cool, dry place.
3. Recharge the battery before reinstallation.

| | |
|--------------------------|--|
| Battery | YB16AL |
| Electrolyte | Specific gravity: 1.280 |
| Initial charging current | 1.6 amp for 10 hours (new battery) |
| Recharging current | 10 hours (or until specific gravity reaches 1.280) |
| Refill fluid | Distilled water (to maximum level line) |
| Refill period | Check once per month (or more often, as required) |