Chapter 9
Electrical system

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Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

Battery

Capacity	12V, 16Ah
Type	YB16AL-A2
Charge condition	
Fully charged	12.8V
Half-charged	12.4V
Discharged	12V or less
Specific gravity	1.280 @ 20°C
Charging time	10 hrs @ 1.4 amps, or until fully charged (12.8V) (see Text)

Charging system

Current leakage	1 mA (max)
Alternator nominal output	14V, 25A @ 5000 rpm
Alternator stator coil resistance	0.33 to 0.48 ohms @ 20°C
Regulated voltage output (no load)	14.0 to 15.0 V @ 5000 rpm

Starter circuit cut-off relay

Resistance (1985 to 1989 models)	202 to 248 ohms @ 20°C

Starter relay

Resistance	
1985 to 1989 models	3.15 to 3.85 ohms @ 20°C
1990 to 2003 models	3.85 to 4.75 ohms @ 20°C

Starter motor

Brush length – 2-brush starter motor	
Standard	12.5 mm
Service limit (min)	5.5 mm
Brush length – 4-brush starter motor	
Standard	10 mm
Service limit (min)	5 mm
Commutator diameter	
Standard	28 mm
Service limit (min)	27 mm
Mica depth	0.7 mm

Fuses

Main	30A
Headlight	15A
Signal (turn signals, horn, brake light, warning lights etc)	10A
Ignition	10A
Fan	10A
Spares	30A, 15A, 10A

Bulbs

Headlight	60/55W
Sidelight	
UK models	3.4W
Other European markets	4W
Brake/tail light	
European models	21/5W x 2
US models	27/8W x 2
Turn signals	
European models	21W x 4
US models – front turn signals/running lights	27/8W x 2
US models – rear turn signals	27W x 2
Instrument illumination	3W
High beam indicator light	3W
Neutral indicator light	3W
Oil level warning light	3W
Fuel level warning light	3W
Turn signal warning light	3W

Torque wrench settings

Alternator cover bolts	10 Nm
Alternator rotor bolt	130 Nm
Alternator stator screws	7 Nm
Oil level sensor bolts	10 Nm
Starter motor bolts	10 Nm

1 General information

All models have a 12-volt electrical system charged by a three-phase alternator with a separate regulator/rectifier.

The regulator maintains the charging system output within the specified range to prevent overcharging, and the rectifier converts the ac (alternating current) output of the alternator to dc (direct current) to power the lights and other components and to charge the battery. The alternator rotor is mounted on the left-hand end of the crankshaft.

The starter motor is mounted on the front of the crankcase. The starting system includes the battery, the starter relay, the starter motor, and the various switches and wires. Some of the switches (sidestand switch, clutch switch and neutral switch) are part of the starter interlock circuit, which allows the starter motor to operate only if the transmission is in neutral (neutral switch on) or, if the transmission is in gear, if the clutch lever is pulled into the handlebar and the sidestand is up. The circuit is controlled by the starter circuit cut-off relay.

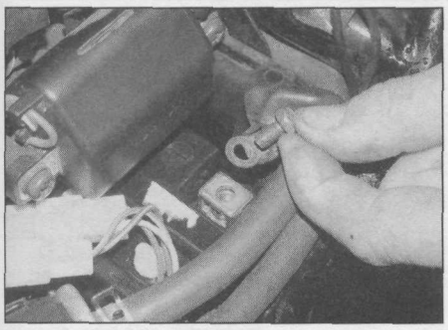
Note: *Keep in mind that electrical parts, once purchased, cannot be returned. To avoid unnecessary expense, make very sure the faulty component has been positively identified before buying a replacement part.*

2 Electrical system – fault finding

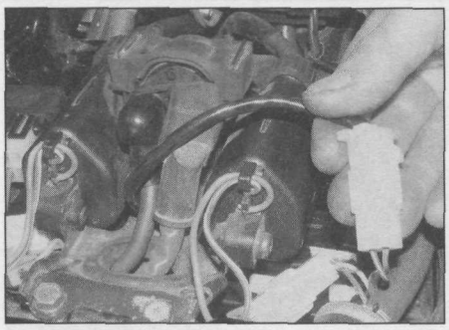
Warning: To prevent the risk of short circuits, the ignition (main) switch must always be OFF and the battery negative (–ve) terminal should be disconnected before any of the bike's other electrical components are disturbed. Don't forget to reconnect the terminal securely once work is finished or if battery power is needed for circuit testing.

1 A typical electrical circuit consists of an electrical component, the switches, relays, etc. related to that component and the wiring and connectors that link the component to the battery and the frame. To aid in locating a problem in any electrical circuit, and to guide you with the wiring colour codes and connectors, refer to the *Wiring Diagrams* at the end of this Chapter.

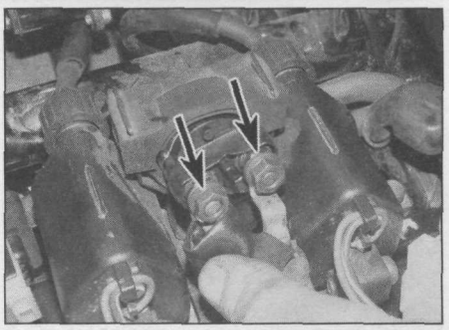
2 Before tackling any troublesome electrical circuit, first study the wiring diagram (see end of Chapter) thoroughly to get a complete picture of what makes up that individual circuit. Trouble spots, for instance, can often be narrowed down by noting if other components related to that circuit are



3.2 Unscrew the terminal bolt and disconnect the negative lead



3.3a Disconnect the relay's wiring connector . . .



3.3b . . . then unscrew the nuts (arrowed) and detach the leads from it

operating properly or not. If several components or circuits fail at one time, chances are the fault lies in the fuse or earth (ground) connection, as several circuits often are routed through the same fuse and earth (ground) connections.

3 Electrical problems often stem from simple causes, such as loose or corroded connections or a blown fuse. Prior to any electrical fault finding, always visually check the condition of the fuse, wires and connections in the problem circuit. Intermittent failures can be especially frustrating, since you can't always duplicate the failure when it's convenient to test. In such situations, a good practice is to clean all connections in the affected circuit, whether or not they appear to be good. All of the connections and wires should also be wiggled to check for looseness which can cause intermittent failure.

4 If testing instruments are going to be utilised, use the wiring diagram to plan where you will make the necessary connections in order to accurately pinpoint the trouble spot.

5 The basic tools needed for electrical fault finding include a battery and bulb test circuit or a continuity tester, a test light, and a jumper wire. A multimeter capable of reading volts, ohms and amps is a very useful alternative and performs the functions of all of the above, and is necessary for performing more extensive tests and checks where specific voltage, current or resistance values are needed.

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Refer to Fault Finding Equipment in the Reference section for details of how to use electrical test equipment.

3 Battery – removal, installation, inspection and maintenance

Caution: Be extremely careful when handling or working around the battery. The electrolyte is very caustic and an explosive gas (hydrogen) is given off when the battery is charging.

Removal and installation

1 Remove the rider's seat (see Chapter 8).

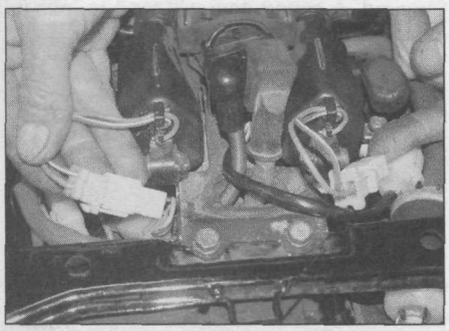
2 Unscrew the negative (–ve) terminal bolt and disconnect the lead from the battery **(see illustration)**.

3 Disconnect the starter relay wiring connector **(see illustration)**. Pull the rubber insulating covers off the starter relay terminals, then unscrew the nuts and detach the battery and starter motor leads, noting which fits where **(see illustration)**.

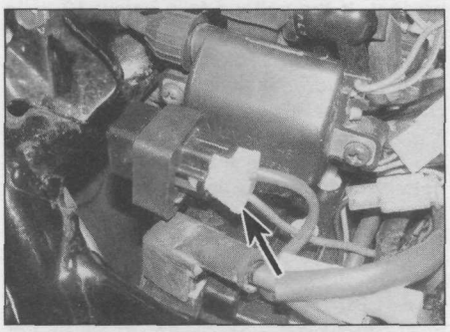
4 Disconnect the ignition coil primary circuit wiring connectors **(see illustration)**. Disconnect the main fuse holder wiring connector **(see illustration)**.

5 Unscrew the ignition coil/starter relay mounting plate bolts **(see illustration)**. Unscrew the HT lead retaining rings on the coils and detach the leads **(see illustration)**. Lift the plate and draw the battery and starter motor leads through the hole, and remove the plate **(see illustration)**.

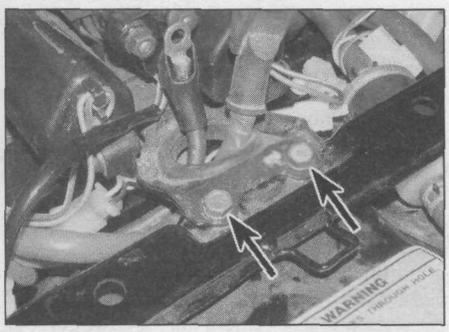
6 If you are removing the battery to check the levels, disconnect the positive sub-lead wiring connector – you can leave the main lead



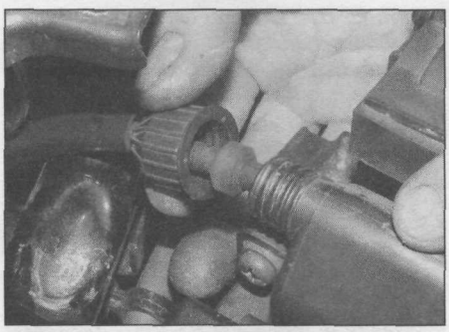
3.4a Disconnect the coil wiring connectors . . .



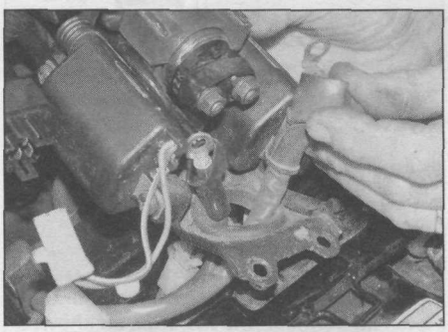
3.4b . . . and the main fuse wiring connector (arrowed)



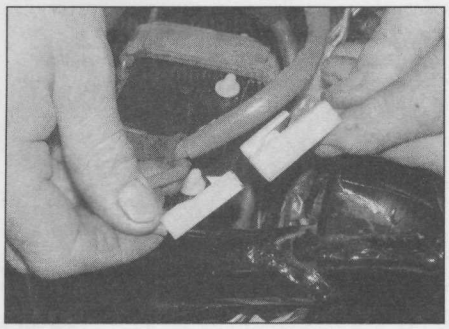
3.5a Unscrew the bolts (arrowed) . . .



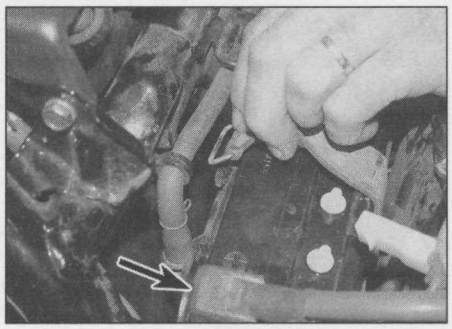
3.5b . . . then detach the leads from the coils . . .



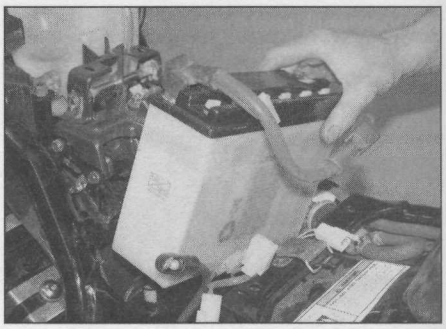
3.5c . . . and remove the plate, drawing the leads through the hole



3.6a Either disconnect the wiring connector . . .



3.6b . . . or detach the positive lead (arrowed), then release the strap . . .



3.6c . . . and remove the battery

attached to the terminal on the battery **(see illustration)**. If a new battery is being installed, unscrew the positive (+ve) terminal bolt and disconnect the lead **(see illustration)**. Release the battery strap and remove the battery from the bike **(see illustration)**.

7 Before installing the battery, clean the battery terminals and lead ends with a wire brush or knife, and emery paper. Reconnect the leads, connecting the positive (+ve) terminal first.

8 Installation is the reverse of removal.

> **HAYNES HiNT** ***Battery corrosion can be kept to a minimum by applying a layer of petroleum jelly or battery terminal (dielectric) grease to the terminals after the cables have been connected.***

Inspection and maintenance

9 Refer to Chapter 1 for scheduled maintenance. The following checks should also be regularly performed – remove the battery first (see above).

10 Check the battery terminals and leads for corrosion. If corrosion is evident, clean the terminals and lead ends with a wire brush or knife, and emery paper. On installation apply a thin coat of petroleum jelly or dielectric grease to the connections to slow further corrosion.

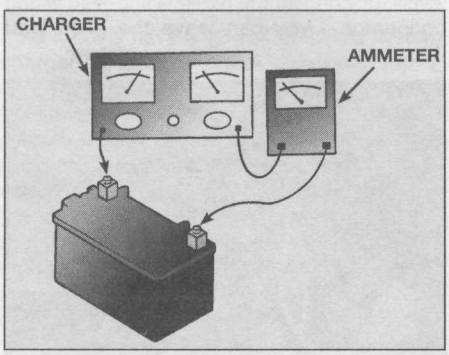
11 Keep the battery case clean to prevent current leakage, which can discharge the battery over a period of time (especially when it sits unused). Wash the outside of the case with a solution of baking soda and water. Rinse the battery thoroughly, then dry it.

12 Look for cracks in the case and replace the battery with a new one if any are found. If acid has been spilled on the frame or battery box, neutralise it with a baking soda and water solution, dry it thoroughly, then touch up any damaged paint.

13 If the motorcycle sits unused for long periods of time, refer to Section 4 and charge the battery once every month to six weeks.

14 Assess the condition of the battery by measuring the voltage across the battery terminals – connect the voltmeter positive (+ve) probe to the battery positive (+ve) terminal, and the negative (–ve) probe to the battery negative (–ve) terminal. When fully charged there should be 12.8 volts (or more) present. If the voltage falls below 12 volts remove the battery (see above) and recharge it as described in Section 4.

15 If an hydrometer is available, use it to check the specific gravity of the electrolyte – if it is below that specified at the beginning of the Chapter charge the battery. Dedicated battery hydrometers usually have a charge scale marked on them which will indicate the exact level of charge.



4.2 If the charger doesn't have ammeter built in, connect one in series as shown. DO NOT connect the ammeter between the battery terminals or it will be ruined

4 Battery – charging

Caution: Be extremely careful when handling or working around the battery. The electrolyte is very caustic and an explosive gas (hydrogen) is given off when the battery is charging.

1 Remove the battery (see Section 3). If not already done, refer to Section 3, Step 14, and check the open circuit voltage of the battery.

2 Connect the charger to the battery, making sure that the positive (+ve) lead on the charger is connected to the positive (+ve) terminal on the battery, and the negative (–ve) lead is connected to the negative (–ve) terminal. The battery should be charged for the specified time, or until the voltage across the terminals reaches 12.8V (allow the battery to stabilise for 30 minutes after charging before taking a voltage reading). Exceeding this can cause the battery to overheat, buckling the plates and rendering it useless. Few owners will have access to an expensive current controlled charger, so if a normal domestic charger is used check that after a possible initial peak, the charge rate falls to a level **(see illustration)**. If the battery becomes hot during charging **stop**. Further charging will cause damage. **Note:** *In emergencies the battery can be charged at a higher rate of around 3.0 amps for a period of 1 hour. However, this is not recommended and the low amp charge is by far the safer method of charging the battery.*

3 If the recharged battery discharges rapidly when left disconnected it is likely that an internal short caused by physical damage or sulphation has occurred. A new battery will be required. A sound item will tend to lose its charge at about 1% per day.

4 Install the battery (see Section 3).

5 If the motorcycle sits unused for long periods of time, charge the battery once every month to six weeks and leave it disconnected.

5 Fuses – check and renewal

1 The electrical system is protected by fuses of different ratings. All the fuses except the main fuse are housed in the fusebox, which is located on the left-hand end of the coolant reservoir – remove the top cover for access (see Chapter 8), then unclip the fusebox lid **(see illustrations)**. The main fuse is housed in its own holder on the left-hand side of the rear cylinder ignition coils – remove the rider's seat for access (see Chapter 8), then displace the fuseholder and unclip the lid **(see illustrations)**.

2 The fuses can be removed and checked visually. If you can't pull the fuse out with your fingertips, use a suitable pair of pliers **(see illustration)**. A blown fuse is easily identified by a break in the element **(see illustration)**, or can be tested for continuity using an ohmmeter or continuity tester – if there is no

continuity, it has blown. Each fuse is clearly marked with its rating and must only be replaced by a fuse of the same rating. There is a spare fuse of each rating. If a spare is used, always replace it with a new one so that a spare of each rating is carried on the bike at all times.

Warning: Never put in a fuse of a higher rating or bridge the terminals with any other substitute, however temporary it may be. Serious damage may be done to the circuit, or a fire may start.

3 If a fuse blows, be sure to check the wiring circuit very carefully for evidence of a short-circuit. Look for bare wires and chafed, melted or burned insulation. If the fuse is renewed before the cause is located, the new fuse will blow immediately.

4 Occasionally a fuse will blow or cause an open-circuit for no obvious reason. Corrosion of the fuse ends and fusebox terminals may occur and cause poor fuse contact. If this happens, remove the corrosion with a wire brush or emery paper, then spray the fuse end and terminals with electrical contact cleaner.

6 Lighting system – check

1 The battery provides power for operation of the headlight, tail light, brake light, turn signals and instrument cluster lights. If none of the lights operate, always check battery voltage before proceeding. Low battery voltage indicates either a faulty battery or a defective charging system. Refer to Section 3 for battery checks and Sections 31 and 32 for charging system tests. Also check the condition of the fuses (see Section 5). When checking for a blown filament in a bulb, it is advisable to back up a visual check with a continuity test of the filament as it is not always apparent that a bulb has blown. When testing for continuity, remember that on tail light and turn signal bulbs it is often the metal body of the bulb which is the ground or earth, and make sure when testing a dual filament tail light bulb that you are testing the correct filament, and if in doubt test them both. A definitive way of testing a bulb is to connect it directly to a fully charged 12 volt battery using suitable jumper wires, and to see whether it comes on or not. Note that if there is more than one problem at the same time, it is likely to be a fault relating to a multi-function component, such as one of the fuses governing more than one circuit, or the ignition switch.

Headlight

2 If the headlight fails to work, check the bulb first and the bulb terminals and wiring connector first (see Section 7), then the headlight circuit fuse (see Section 5), then check for battery voltage at the yellow (HI beam) and/or green (LO beam) wire terminal on the supply side of the headlight wiring connector, with the ignition switch ON, and on European models the lighting switch ON. If voltage is present, check for continuity between the black wire terminal and earth (ground). If there is no continuity, check the earth (ground) circuit for an open or poor connection.

3 If no voltage is indicated, check the wiring and connectors between the headlight, dimmer switch, lighting switch (European models) and the ignition switch, then check the switches themselves.

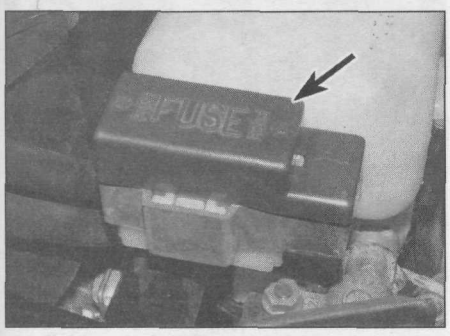
Sidelight

4 On models equipped with a sidelight, if it fails to work, check the bulb and the bulb terminals and wiring connector first (see Section 7), then check for battery voltage at the blue/red wire terminal on the supply side of the sidelight wiring connector, with the ignition switch and lighting switch ON. If voltage is present, check for continuity between the wiring connector terminals on the sidelight side of the wiring connector and the corresponding terminals in the bulbholder. If voltage and continuity are present, check for continuity between the black wire terminal on the supply side of the sidelight wiring connector and earth (ground). If there is no continuity, check the earth (ground) circuit for an open or poor connection.

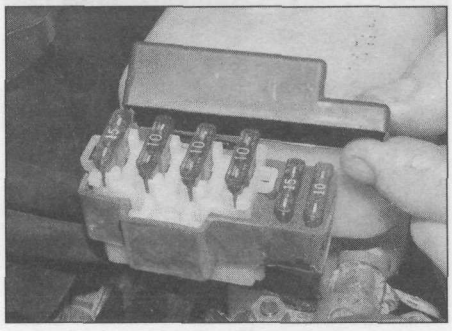
5 If no voltage is indicated, check the wiring and connectors between the sidelight, the lighting switch and the ignition switch, then check the switches themselves.

Tail light

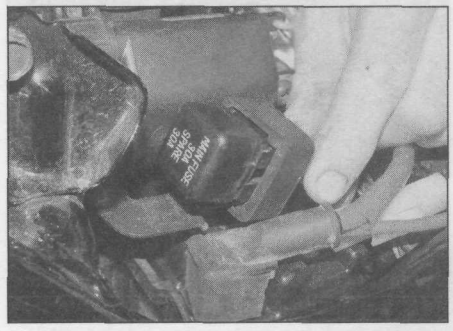
6 If one or both of the tail lights fail to work,



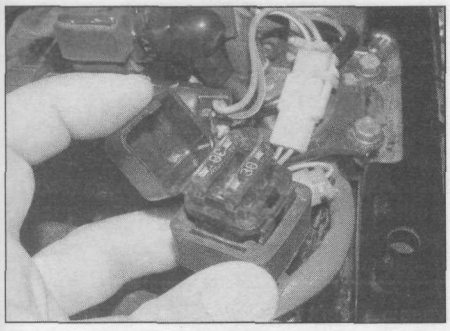
5.1a The fusebox (arrowed) is next to the coolant reservoir



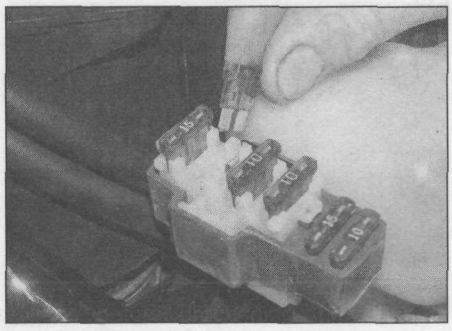
5.1b Unclip the lid to access the fuses



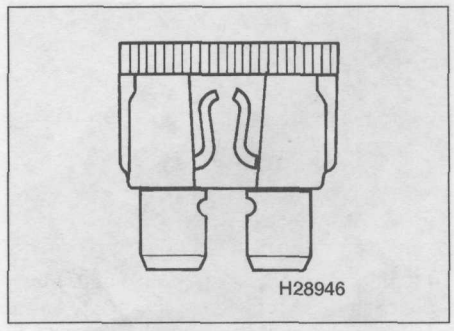
5.1c Displace the main fuse holder from its mount . . .



5.1d . . . then unclip the lid to access the fuse



5.2a Remove the fuse to check it



5.2b A blown fuse can be identified by a break in its element

check the bulb(s) and the bulb terminals and wiring connectors first (see Section 9), then the headlight fuse (European models) or main fuse (US models) – see Section 5, then remove the passenger seat (see Chapter 8) and check for battery voltage at the blue wire terminal on the supply side of the tail light wiring connector, with the ignition switch ON, and on European models the lighting switch ON. If voltage is present, check for continuity between the wiring connector terminals on the tail light side of the wiring connector and the corresponding terminals in the bulbholder. If voltage and continuity are present, check for continuity between the black wire terminal on the supply side of the tail light wiring connector and earth (ground). If there is no continuity, check the earth (ground) circuit for an open or poor connection.

7 If no voltage is indicated, check the wiring and connectors between the tail light, the lighting switch (European models) and the ignition switch, then check the switches themselves.

Brake light

8 If a brake light fails to work, check the bulb(s) and the bulb terminals and wiring connector first (see Section 9), then the signal fuse, then remove the passenger seat (see Chapter 8) and check for battery voltage at the yellow wire terminal on the supply side of the tail light wiring connector, with the ignition switch ON and the brake lever or pedal applied. If voltage is present, check for continuity between the wiring connector terminals on the tail light side of the wiring connector and the corresponding terminals in the bulbholder. If voltage and continuity are present, check for continuity between the black wire terminal on the supply side of the tail light wiring connector and earth (ground). If there is no continuity, check the earth (ground) circuit for an open or poor connection.

9 If no voltage is indicated, check the brake light switches (see Section 14), then the wiring and connectors between the tail light and the switches.

Instrument and warning lights

10 See Section 17.

Turn signal lights

11 If one light fails to work, check the bulb and the bulb terminals first, then the wiring connectors (see Section 12). If none of the turn signals work, first check the signal fuse (see Section 5).

12 If the fuse is good, see Section 11 for the turn signal circuit check.

7 Headlight bulb and sidelight bulb – renewal



Note: *The headlight bulb is of the quartz-halogen type. Do not touch the bulb glass as skin acids will shorten the bulb's service life. If the bulb is accidentally touched, it should be wiped carefully when cold with a rag soaked in methylated spirit and dried before fitting.*



Warning: Allow the bulb time to cool before removing it if the headlight has just been on.

Headlight

1 Undo the screw on each side of the headlight rim **(see illustration)**. Pull the bottom of the rim out of the shell then release the tab at the top, noting how it locates **(see illustration)**.

2 Disconnect the headlight wiring connector and, where fitted, the sidelight wiring connector **(see illustration)**.

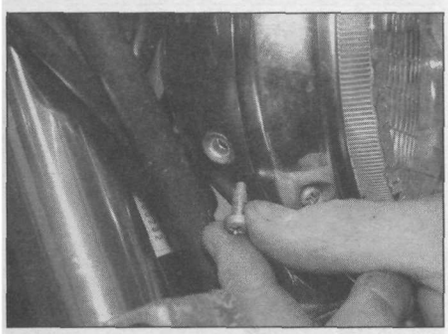
3 Remove the rubber dust cover, noting how it fits **(see illustration)**. Release the bulb retaining ring by turning it anti-clockwise, noting how it fits, then remove the bulb **(see illustrations)**.

4 Fit the new bulb, bearing in mind the information in the **Note** above. Make sure the tabs on the bulb fit correctly in the slots in the bulb housing, and secure it in position with the retaining ring.

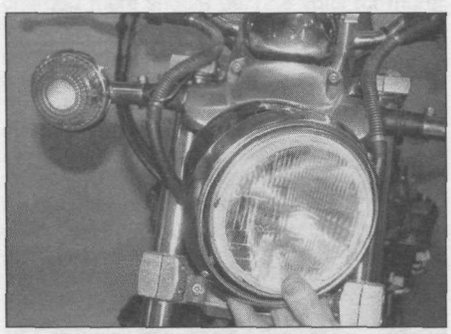
5 Install the dust cover, making sure it is correctly seated and with the 'TOP' mark at the top. Connect the headlight wiring connector and, where fitted, the sidelight wiring connector.

6 Check the operation of the headlight.

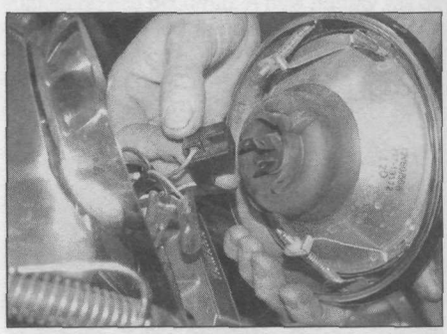
7 Locate the tab on the top of the headlight rim behind the protrusion on the shell, then push the bottom of the rim in **(see**



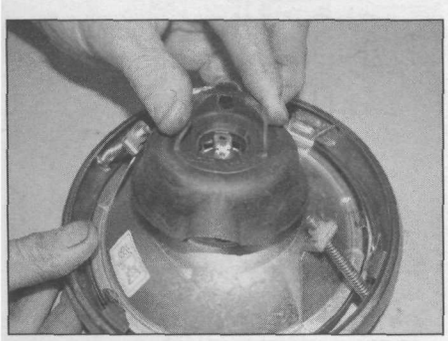
7.1a Undo the screw on each side . . .



7.1b . . . and draw the rim out of the shell as described



7.2 Disconnect the headlight wiring connector and, where fitted, the sidelight wiring connector



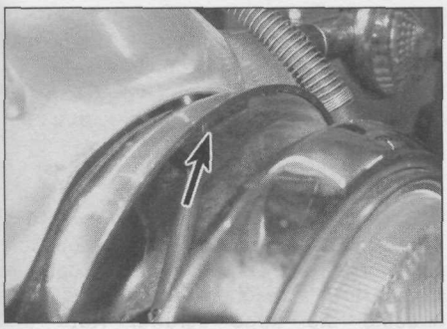
7.3a Remove the dust cover



7.3b Release the retaining ring . . .



7.3c . . . and remove the bulb



7.7 Locate the tab behind the protrusion (arrowed)

illustration). Make sure it is correctly seated all the way round then install the screws.

> **HAYNES HiNT** ***Always use a paper towel or dry cloth when handling new bulbs to prevent injury if the bulb should break and to increase bulb life.***

Sidelight

8 Undo the screw on each side of the headlight rim **(see illustration 7.1a)**. Pull the bottom of the rim out of the shell then release the tab at the top, noting how it locates **(see illustration 7.1b)**.

9 Disconnect the headlight and sidelight wiring connectors **(see illustration 7.2)**.

10 Pull the bulbholder out of the headlight, then remove the bulb. Fit the new bulb in the bulbholder, then fit the bulbholder into the headlight, making sure it correctly seated. Check the operation of the sidelight.

11 Connect the headlight and sidelight wiring connectors.

12 Locate the tab on the top of the headlight rim behind the protrusion on the shell, then push the bottom of the rim in. Make sure it is correctly seated all the way round then install the screws.

8 Headlight assembly – removal and installation

Removal

1 Undo the screw on each side of the headlight rim **(see illustration 7.1a)**. Pull the bottom of the rim out of the shell then release the tab at the top, noting how it locates **(see illustration 7.1b)**.

2 Disconnect the headlight wiring connector and, where fitted, the sidelight wiring connector, and remove the beam unit **(see illustrations 7.2)**.

3 Make a note of the routing of all the wiring into the headlight shell (i.e. which hole it enters via), and the location of the wiring connectors. Disconnect the connectors.

4 Unscrew the two bolts securing the headlight bracket to the bottom yoke **(see illustration)**. Support the shell, then unscrew the bolt in the shell and remove the shell from between the brackets, feeding the wiring out of the back **(see illustrations)**. If required unscrew the nut and withdraw the bolt securing the shell to the bottom bracket and separate them. Note the collars in the rubber mounts. Check the rubber mounts for damage, deformation and deterioration and replace them with new ones if necessary.

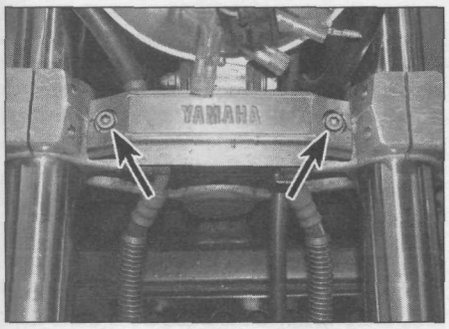
Installation

5 Installation is the reverse of removal. Locate the shell on the lug for the top bolt **(see illustration)**. Make sure all the wiring is correctly routed, connected and secured – feed the wiring from the speedometer through the top hole in the shell **(see illustration 8.4c)**; feed the headlight and turn signal wiring, and the wiring to the speedometer, through the bottom hole **(see illustration)**. Check the operation of the headlight and sidelight (where fitted), and of the turn signals. Check the headlight aim (see Chapter 1).

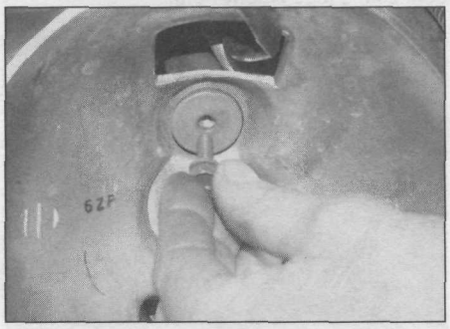
9 Brake/tail light bulb – renewal

1 Undo the two lens screws and remove the lens **(see illustration)**. Note the rubber seal between the lens and the tail light and replace it with a new one if it is damaged, deformed or deteriorated.

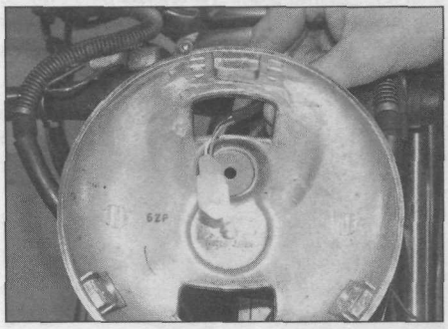
2 Push the bulb into the holder and twist it anti-clockwise to remove it **(see illustration)**.



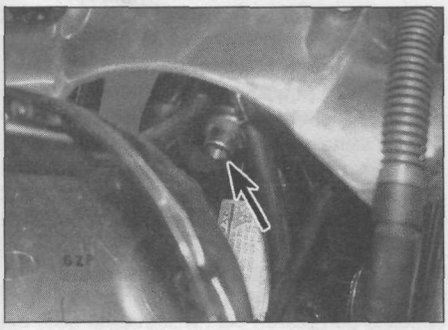
8.4a Unscrew the bracket bolts (arrowed)



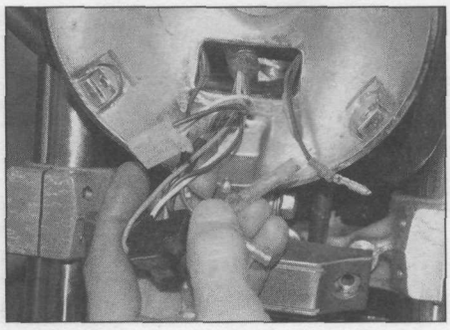
8.4b Unscrew the bolt in the shell . . .



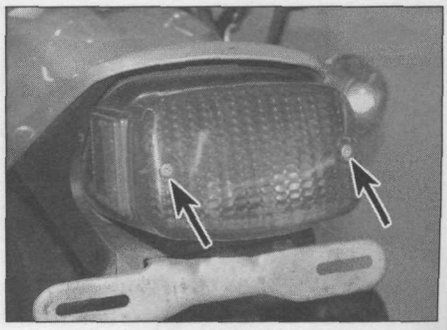
8.4c . . . then remove the shell and feed the wiring connectors out the back



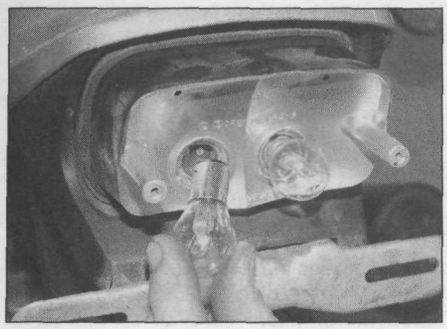
8.5a Locate the bolt hole in the shell over the bolt lug (arrowed)



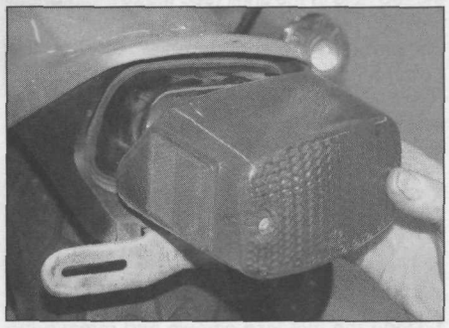
8.5b Make sure the wiring is correctly routed



9.1 Undo the screws (arrowed) and remove the lens

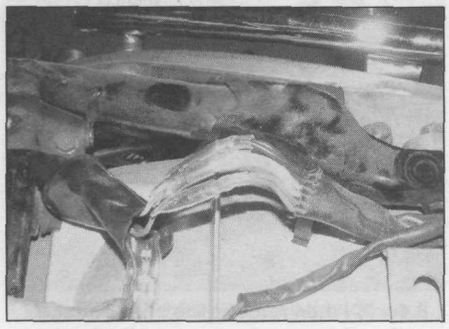


9.2 Release the bulb as described

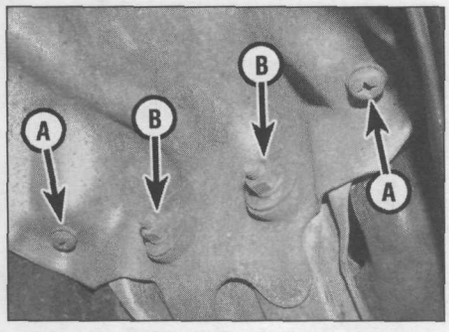


9.4b . . . before installing the lens

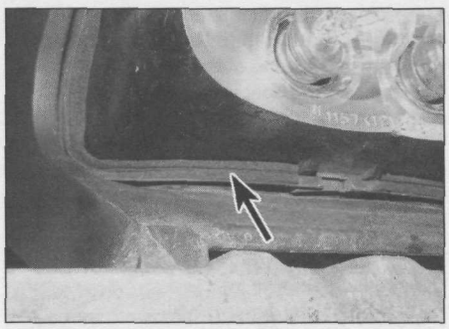
3 Check the socket terminals for corrosion and clean them if necessary. Line up the pins of the new bulb with the slots in the socket, then push the bulb in and turn it clockwise until it locks into place. **Note:** *The pins on the bulb are offset so it can only be installed one way. It is a good idea to use a paper towel or dry cloth when handling the new bulb to prevent injury if the bulb should break and to increase bulb life.*



10.1 Disconnect the wiring connectors



10.2b . . . and the screws (A) and remove the plate. Tail light nuts (B)



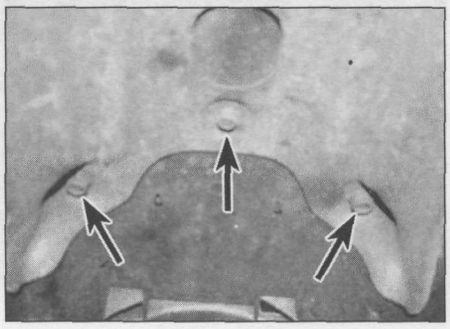
9.4a Make sure the seal (arrowed) is in good condition and correctly seated . . .

4 Make sure the rubber seal is correctly seated, then install the lens – do not overtighten the screws as it is easy to either strip the threads in the lugs or to crack the lens **(see illustrations)**.

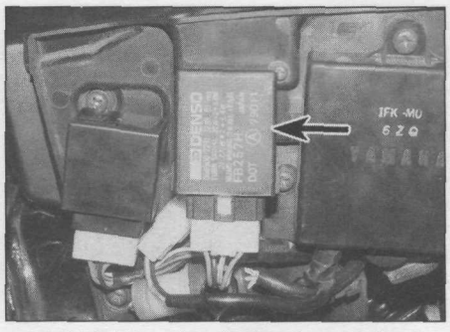
10 Tail light assembly – removal and installation

Removal

1 Remove the passenger seat (see Chapter 8). Disconnect the tail light and brake light wiring connectors **(see illustration)**.



10.2a Unscrew the bolts (arrowed) . . .



11.3 Turn signal relay (arrowed)

2 Undo the three bolts and the two screws securing the plate on the underside of the rear mudguard and remove the plate with the tail light and licence plate bracket, taking care not to snag the wiring as you draw it through the mudguard, and noting how the wiring channels between them **(see illustrations)**.

3 Undo the nuts securing the tail light and remove it, noting how the tail light holder and bracket and the licence plate bracket all fit together **(see illustration 10.2b)**. Separate the tail light from its holder and bracket by undoing the three screws. Note the arrangement of the washers, collars and rubber mounts. Check the rubber mounts for damage, deformation and deterioration and replace them with new ones if necessary.

Installation

4 Installation is the reverse of removal. Check the operation of the tail light and the brake light.

11 Turn signal circuit – check

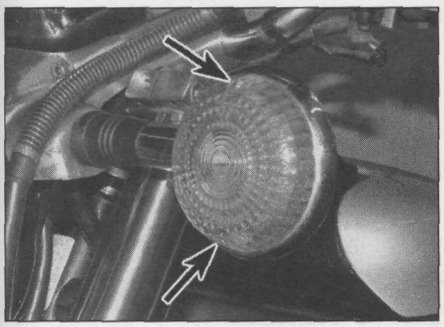
1 Most turn signal problems are the result of a burned out bulb or a corroded socket. This is especially true when the turn signals function properly in one direction, but fail to flash in the other direction. Check the bulbs and the sockets (see Section 12) and the wiring connectors. Also, check the signal circuit fuse (see Section 5) and the switch (see Section 19).

2 The battery provides power for operation of the turn signal lights, so if they do not operate, check the battery voltage. Low battery voltage indicates either a faulty battery or a defective charging system. Refer to Section 3 for battery checks and Sections 31 and 32 for charging system tests.

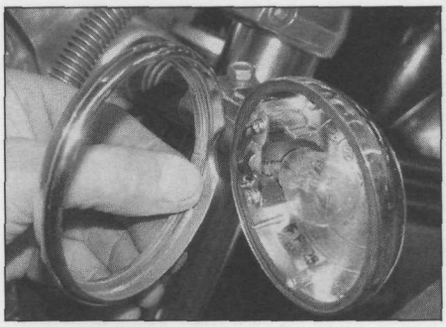
3 If the bulbs, sockets, connectors, fuse, switch and battery are good, check the turn signal relay (integrated with the starter circuit cut-off relay on 1985 to 1989 models into one relay unit), which is mounted behind the left-hand side cover **(see illustration)**. Remove the cover for access (see Chapter 8).

4 Check for voltage at the brown wire in the relay wiring connector with the ignition ON. If no voltage is present, using the appropriate wiring diagram at the end of this Chapter check the wiring between the relay, fuse and the ignition (main) switch. If voltage was present, check for voltage at the brown/white wire with the ignition ON, and with the switch turned to either LEFT or RIGHT. If no voltage is present, replace the relay with a new one. If voltage was present, check the wiring between the relay, turn signal switch and turn signal lights for continuity. Turn the ignition OFF when the check is complete.

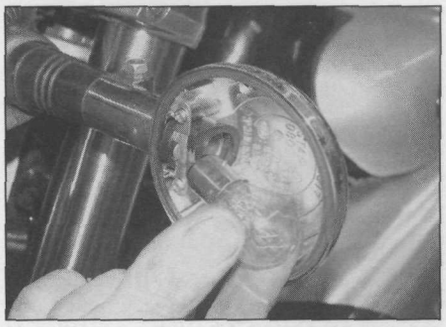
5 If the self-cancelling function of the turn signal circuit malfunctions, disconnect the



12.1a Remove the screws and detach the lens . . .



12.1b . . . and the rim . . .



12.2 . . . then remove the bulb as described

relay wiring connector. Remove the headlight beam unit from the shell (see Section 8, Steps 1 and 2). Place the bike on its centrestand, and raise the front wheel off the ground using a suitable jack or auxiliary stand – if using a jack place a block of wood between the head and the sump. Using an ohmmeter or multimeter set to the ohms x 10 scale, measure the resistance between the white/green and black wire terminals in the speedometer wiring connector in the headlight shell with the connector still connected and while spinning the front wheel – there should be about 7 ohms. When the wheel stops, check that the resistance returns to zero or infinity. If the readings are not as specified, first check the speedometer wiring and connectors, and check the speedometer cable. If they are good the reed switch in the speedometer is faulty, so the speedometer must be replaced with a new one. If the switch proves good, check the wiring and connectors between the speedometer and the turn signal relay, and if they are good replace the relay with a new one.

12 Turn signal bulbs – renewal



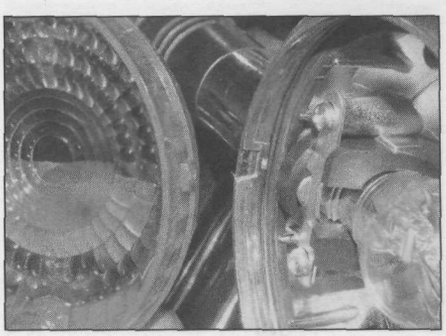
1 Remove the screws securing the turn signal lens and remove the lens and the rim, noting how they fit **(see illustrations)**. Note the rubber seal and replace it with a new one if it is damaged, deformed or deteriorated.

2 Push the bulb into the holder and twist it anti-clockwise to remove it **(see illustration)**. Check the socket terminals for corrosion and clean them if necessary. Line up the pins of the new bulb with the slots in the socket, then push the bulb in and turn it clockwise until it locks into place.

3 Make sure the rubber seal is correctly located **(see illustration)**. Fit the rim and the lens onto the holder, making sure the cut-out in the rim is around the stem, and the tab on the lens locates correctly in the notch in the rim **(see illustration)**. Do not overtighten the screws as the lens or threads could be damaged.



12.3a Make sure seal is in good condition and correctly seated . . .



12.3b . . . and the tab locates correctly when fitting the lens

13 Turn signal assemblies – removal and installation



Front

Removal

1 Refer to Section 8, Steps 1 and 2 and remove the headlight beam unit from the shell.

2 Trace the wiring from the turn signal and disconnect it at the connectors **(see illustration)**. Feed the wiring out the back of the headlight shell and through to the turn signal, noting its routing.

3 To remove the turn signal itself leaving the rubber stem in place, unscrew the nut and withdraw the clamp bolt, then draw the turn signal off, taking care not to snag the wiring as you draw it through **(see illustration 13.8)**.

4 To remove the assembly as one, or to remove the stem, unscrew the nut securing it on the inside of the bracket – depending on the tools available you may have to unscrew the bracket bolts and displace it to get to the nut **(see illustration 13.8)**.

Installation

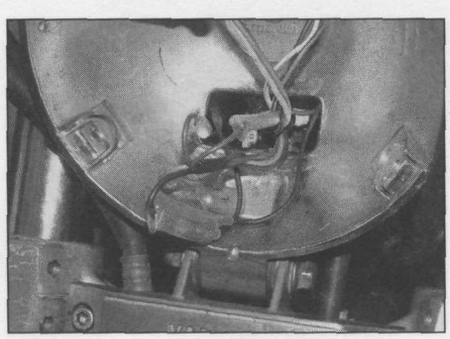
5 Installation is the reverse of removal. Make sure the wiring is correctly routed and securely connected. Check the operation of the turn signals.

Rear

Removal

6 Remove the passenger seat (see Chapter 8).

7 Trace the wiring back from the turn signal and disconnect it at the connectors **(see illustration)**.



13.2 Disconnect the front turn signal wiring connectors



13.7 Disconnect the rear turn signal wiring connectors

8 To remove the turn signal itself leaving the rubber stem in place, unscrew the nut and withdraw the clamp bolt, then draw the turn signal off, taking care not to snag the wiring as you draw it through **(see illustration)**.
9 To remove the assembly as one, or to remove the stem, unscrew the nut securing it on the inside of the bracket **(see illustration 13.8)**.

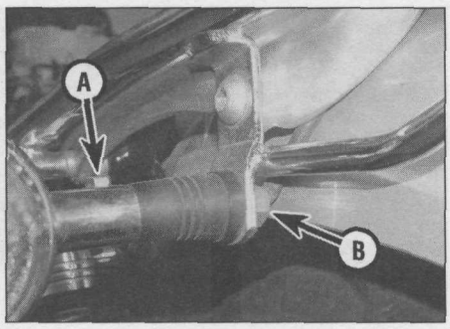
Installation

10 Installation is the reverse of removal. Make sure the wiring is correctly routed and securely connected. Check the operation of the turn signals.

14 Brake light switches – check and renewal

Circuit check

1 Before checking the switches, check the brake light circuit (see Section 6, Step 8).
2 The front brake light switch is mounted on the underside of the brake master cylinder. Disconnect the wiring connectors from the switch **(see illustration)**. Using a continuity tester, connect the probes to the terminals of the switch. With the brake lever at rest, there should be no continuity. With the brake lever applied, there should be continuity. If the switch does not behave as described, replace it with a new one.
3 The rear brake light switch is mounted on the clutch cover, above the brake pedal. Remove the right-hand side panel to access the wiring connector (see Chapter 8). Trace the wiring from the switch and disconnect it at the connector **(see illustration)**. Using a continuity tester, connect the probes to the terminals on the switch side of the wiring connector. With the brake pedal at rest, there should be no continuity. With the brake pedal applied, there should be continuity. If the switch does not behave as described, replace it with a new one, although check first that the switch is correctly adjusted (see Step 10).
4 If the switches are good, check for voltage at the brown wire terminal on the connector with the ignition switch ON – there should be battery voltage. If there's no voltage present, check the wiring between the switch, signal fuse and the ignition switch (see the *Wiring Diagrams* at the end of this Chapter). If there is voltage, check the wiring and connectors between the switch and the brake light bulbs.



13.8 Turn signal clamp bolt (A) and stem nut (B)

Switch renewal

Front brake light switch

5 The switch is mounted on the underside of the brake master cylinder. Disconnect the wiring connectors from the switch **(see illustration 14.2)**.
6 Remove the single screw and washer securing the switch to the bottom of the master cylinder and remove the switch **(see illustration)**.
7 Installation is the reverse of removal. The switch isn't adjustable.

Rear brake light switch

8 The switch is mounted on the clutch cover, above the brake pedal. Remove the right-hand side panel to access the wiring connector (see Chapter 8). Trace the wiring from the switch and disconnect it at the connector **(see illustration 14.3)**. Free the wiring from any clips or ties and feed it through to the switch.
9 Detach the lower end of the switch spring from the brake pedal, then unscrew and remove the switch, holding the adjuster nut to prevent it turning if required **(see illustration)**.
10 Installation is the reverse of removal. Make sure the brake light is activated just before the rear brake pedal takes effect. If adjustment is necessary, hold the switch and turn the adjuster nut on the switch body until the brake light is activated when required.

15 Instrument cluster and speedometer – removal and installation

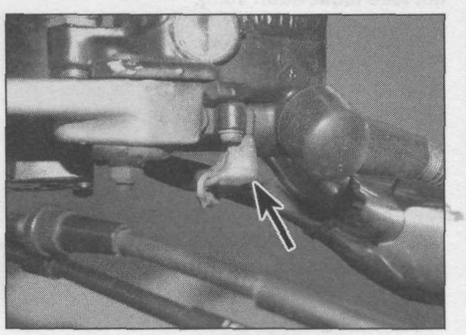
Instrument cluster

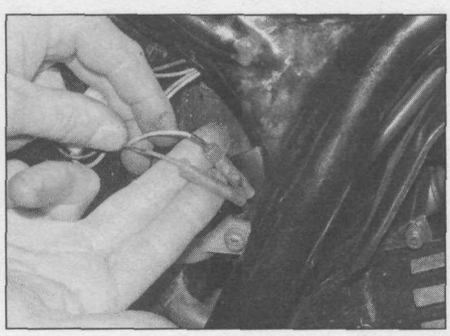
Removal

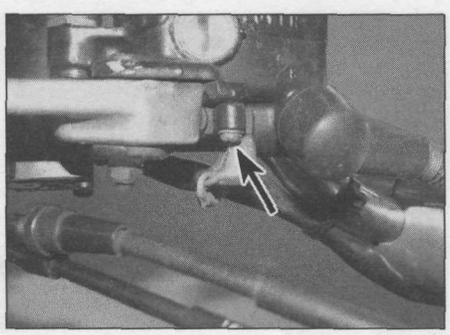
1 Remove the top cover (see Chapter 8). Remove the air filter cover (see Chapter 1).
2 Unscrew the two instrument cluster nuts, then displace the cluster, lay it aside and disconnect its wiring connectors **(see illustrations)**. Note the collars fitted in the rubber mounts.

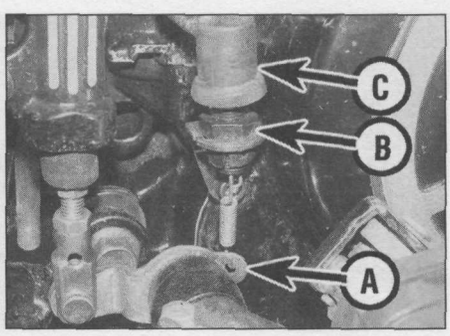
Installation

3 Installation is the reverse of removal. Check

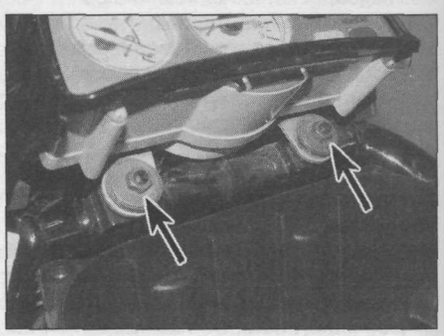

14.2 Front brake switch wiring connectors (arrowed)


14.3 Rear brake switch wiring connectors


14.6 Front brake switch mounting screw (arrowed)



14.9 Unhook the spring (A), then hold the adjuster nut (B) and unscrew the switch (C)


15.2a Unscrew the nuts (arrowed) . . .

the rubber mounting grommets for cracks and deterioration and replace them with new ones if necessary.

Speedometer

Removal

4 Remove the headlight assembly.

5 Unscrew the two speedometer bolts, accessing them using a socket extension, then lift the speedometer and unscrew the knurled ring securing the speedometer cable **(see illustrations)**.

Installation

6 Installation is the reverse of removal.

16 Instruments and speedometer cable – check and renewal

Speedometer

Check

1 Special instruments are required to properly check the operation of this meter. If it is believed to be faulty, take the motorcycle to a Yamaha dealer for assessment. Before doing this, make sure that the fault is not due to a faulty cable or drive gear, either at the front wheel or at the instruments.

Renewal

2 Remove the speedometer (see Section 15).

3 Undo the screw securing the shroud and lift it off the speedometer, feeding the wiring through **(see illustrations)**.

4 Unscrew the nuts securing the bracket and remove it **(see illustration)**.

5 Carefully draw the bulbholders out of the speedometer **(see illustration 17.1a and b)** and unplug the distance sensor reed switch.

6 Reassemble the speedometer in reverse order.

Speedometer cable

7 Unscrew the knurled ring securing the speedometer cable to the drive housing on the front wheel and detach it, noting how it locates **(see illustration)**.

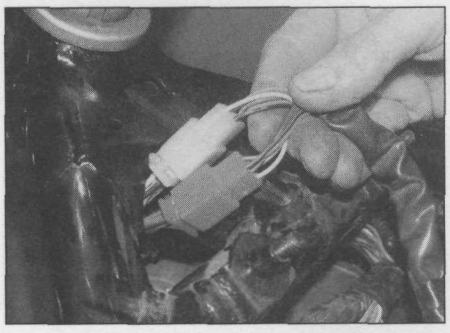
8 Remove the speedometer (see Section 15).

9 Slacken the two bolts securing the brake hose splitter to the bottom yoke and slip the cable out from behind it when there is enough clearance **(see illustration)**. Remove the cable, noting its routing.

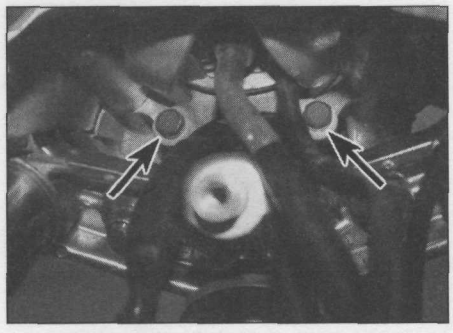
10 Installation is the reverse of removal. Unless a new cable is being fitted, refer to Chapter 1 and lubricate it before installation. Make sure the cable is correctly routed.



15.2b . . . then displace the instruments . . .



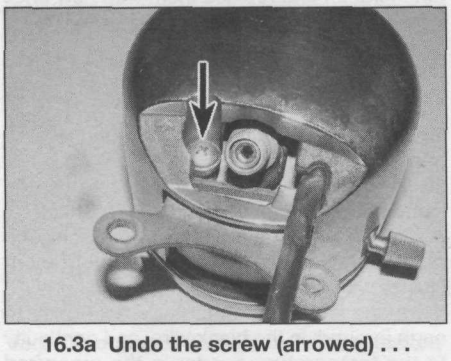
15.2c . . . and disconnect the wiring connectors



15.5a Unscrew the bolts (arrowed) . . .



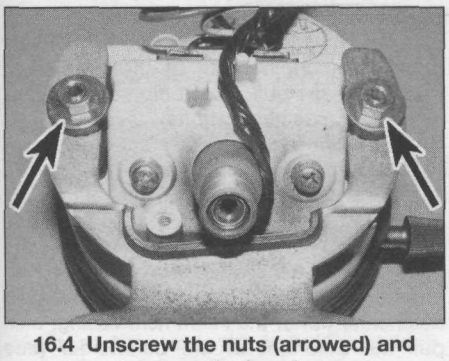
15.5b . . . then lift the speedometer and disconnect the cable by unscrewing the ring (arrowed)



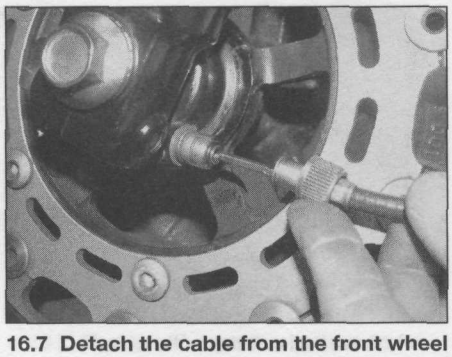
16.3a Undo the screw (arrowed) . . .



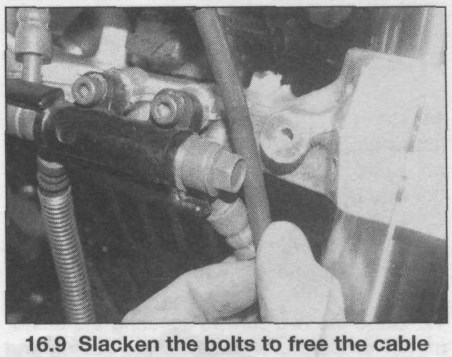
16.3b . . . and remove the shroud



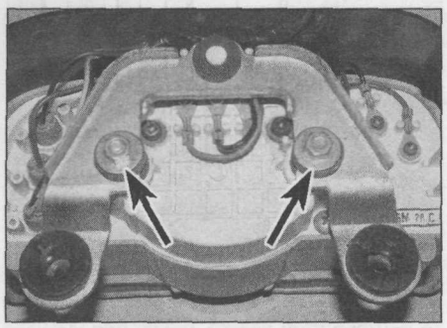
16.4 Unscrew the nuts (arrowed) and remove the bracket



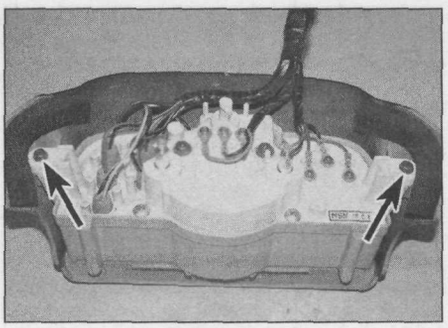
16.7 Detach the cable from the front wheel by unscrewing the ring



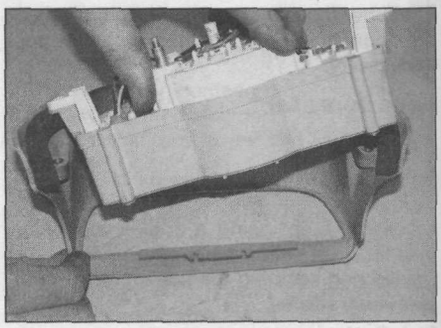
16.9 Slacken the bolts to free the cable from the splitter



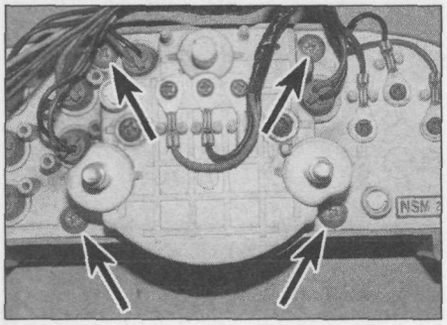
16.13 Unscrew the nuts (arrowed) and remove the bracket



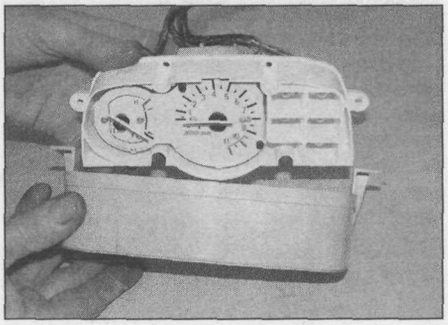
16.14a Undo the screws (arrowed) . . .



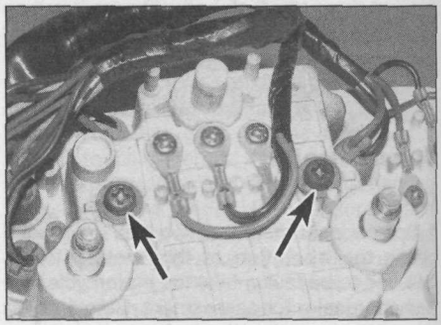
16.14b . . . and remove the housing



16.15a Undo the screws (arrowed) . . .



16.15b . . . and remove the front cover



16.16 Undo all the wiring screws, followed by the instrument screws (arrowed)

Tachometer

Check

11 No specific tests are available for the tachometer itself. If it is not working, remove the instrument cluster (see Section 15). First check for battery voltage at the brown wire terminal on the loom side of the relevant instrument cluster wiring connector with the ignition ON. If voltage is present, check for continuity to earth (ground) in the black wire, and continuity to the ignition control unit wiring connector in the grey wire. Also make sure that the wiring between the connectors and the instrument itself is good, and that there are no loose wires or terminals in the connectors. If all the wiring and connectors are good, replace the tachometer with a new one (see below).

Renewal

12 Remove the instrument cluster (see Section 15). The tachometer and temperature gauge are integrated into one component.

13 Unscrew the nuts securing the bracket and remove it **(see illustration)**.

14 Undo the two screws securing the housing and remove it **(see illustrations)**.

15 Undo the four screws securing the front cover and remove it **(see illustrations)**.

16 Undo the screws securing the tachometer and temperature gauge wiring connectors and detach them, noting which fits where **(see illustration)**.

17 Undo the two screws securing the tachometer/temperature gauge to the casing and carefully withdraw it **(see illustration 16.16)**.

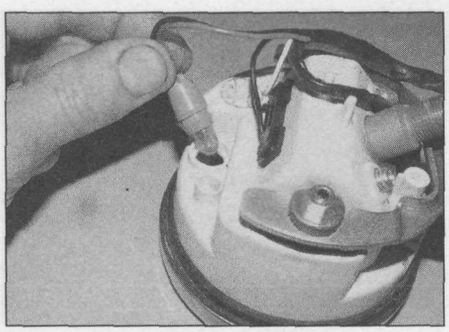
18 Installation is the reverse of removal. Make sure the wiring is correctly connected – colour code letters are stamped into the casing to remove any doubt. Check the rubber mounting grommets for cracks and deterioration and replace them with new ones if necessary.

Temperature gauge

Check

19 To check the function of the gauge itself refer to Chapter 3.

20 If the gauge is good, remove the instrument cluster (see Section 15). Check for battery voltage at the brown wire terminal on the loom side of the relevant instrument cluster wiring connector with the ignition ON. If voltage is present, check for continuity to earth (ground) in the black wire, and continuity to the temperature sender in the green/red wire. Also make sure that the wiring between the connectors and the instrument itself is good, and that there are no loose wires or terminals in the connectors. If all the wiring and connectors are good, replace the gauge with a new one.



17.1a Pull out the bulbholder . . .

Renewal

21 The temperature gauge and tachometer are integrated into one component – if the gauge is faulty, refer to the tachometer renewal procedure above and replace the combined instrument.

17 Instrument and warning light bulbs – renewal

1 If renewing a speedometer bulb, refer to Section 15 and remove the speedometer, then refer to Section 16 and remove the shroud, and if required (depending on which bulb has blown) the bracket. Carefully pull the relevant bulbholder out of the instrument casing, then pull the bulb out of the bulbholder **(see illustrations)**.

2 If renewing either a tachometer or temperature gauge bulb, or any of the warning light bulbs, refer to Section 15 and remove the instrument cluster. If required (depending on which bulb needs replacing), unscrew the nuts securing the bracket and remove it **(see illustration 16.13)**. Carefully pull the relevant bulbholder out of the instrument casing, then pull the bulb out of the bulbholder **(see illustrations)**.

3 If the socket contacts are dirty or corroded, scrape them clean and spray with electrical contact cleaner before a new bulb is installed.
4 Carefully push the new bulb into the holder and push the holder into the casing.
5 Reassemble and install the speedometer or instrument cluster as required.

18 Ignition (main) switch – check, removal and installation

Warning: To prevent the risk of short circuits, remove the rider's seat and disconnect the battery negative (–ve) lead before making any ignition (main) switch checks.

Check

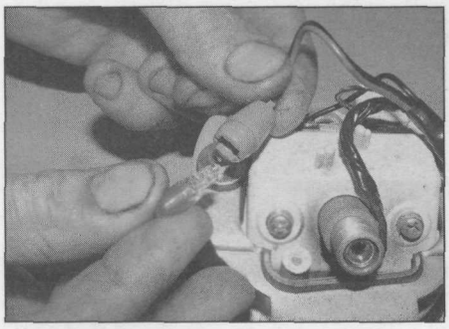
1 Remove the air filter housing (see Chapter 4).
2 Trace the wiring from the base of the ignition switch and disconnect it at the connector **(see illustration)**. Make the checks on the switch side of the connectors.
3 Using an ohmmeter or a continuity tester, check the continuity of the connector terminal pairs (see the *Wiring Diagrams* at the end of this Chapter). Continuity should exist between the terminals connected by a solid line on the diagram when the switch key is turned to the indicated position.
4 If the switch fails any of the tests, replace it with a new one.

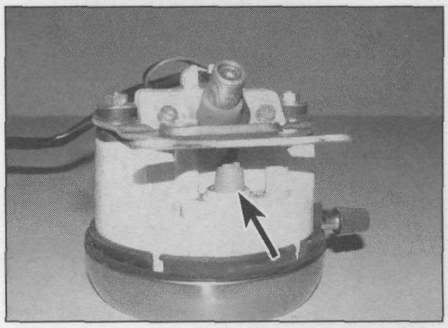
Removal

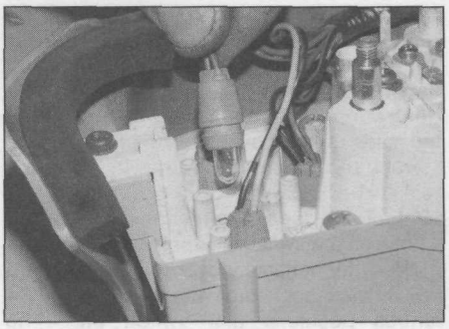
5 Remove the air filter housing (see Chapter 4).
6 Remove the cover from the radiator filler neck on the right-hand side of the frame **(see illustration)**. Undo the screws securing the radiator filler neck board and displace it – there is no need to drain the cooling system or detach any hoses, but watch the wiring and disconnect the connectors if necessary **(see illustration)**. Mark the locations of all wires and leads before disconnecting them.
7 Remove the ignition switch cover **(see illustration)**.
8 Trace the wiring from the base of the ignition switch and disconnect it at the connectors **(see illustration 18.2)**.
9 Unscrew the two ignition switch bracket bolts and remove the switch, noting the routing of the wiring **(see illustration)**.

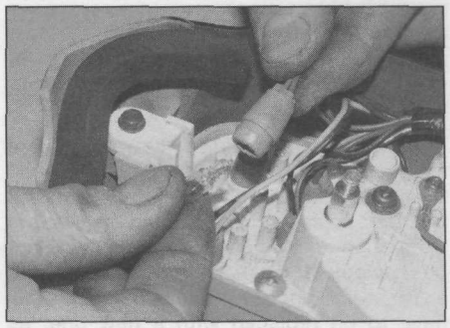
Installation

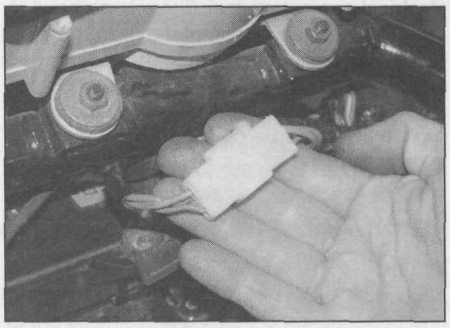
10 Installation is the reverse of removal. Make sure wiring is correctly routed and securely connected.

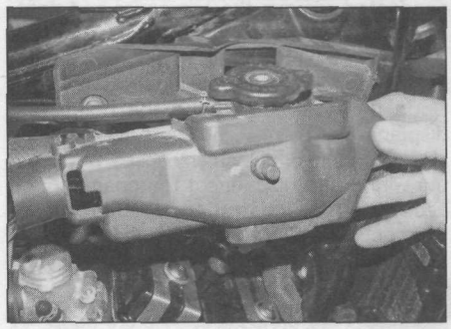

17.1b . . . and remove the bulb

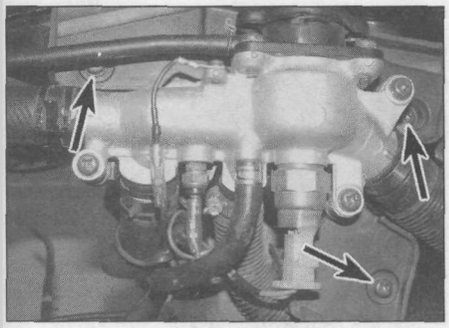

17.1c The other bulbholder (arrowed) is under the bracket

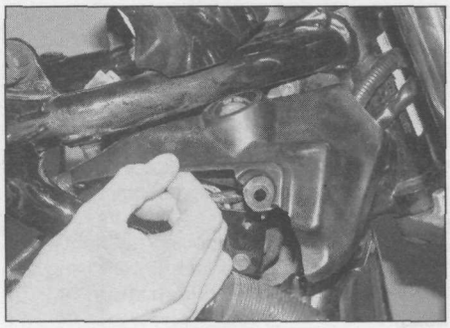

17.2a Pull out the bulbholder . . .

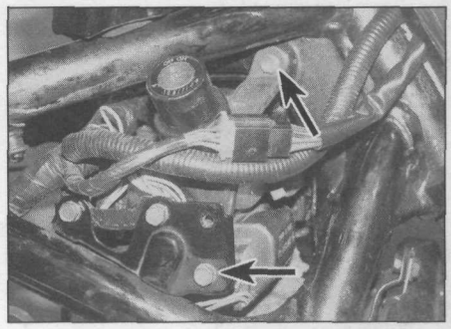

17.2b . . . and remove the bulb

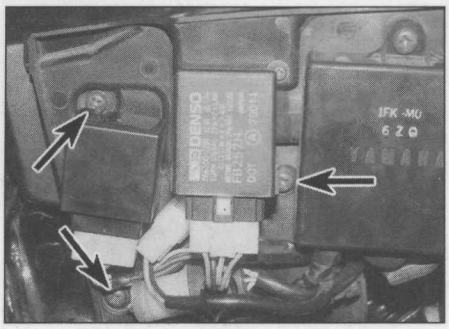

18.2 Disconnect the ignition (main) switch wiring connector


18.6a Remove the filler neck cover . . .

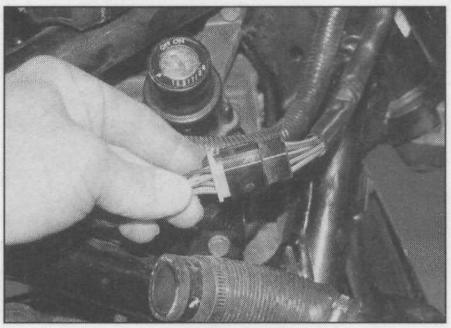

18.6b . . . then undo the screws (arrowed) and displace the board


18.7 Remove the ignition switch cover

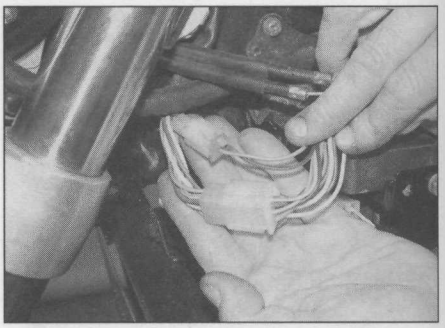

18.9 Ignition switch bolts (arrowed)



19.4 Undo the screws (arrowed) and displace the board



19.5a Right-hand switch connector



19.5b Left-hand switch connectors

19 Handlebar switches – check

1 Generally speaking, the switches are reliable and trouble-free. Most troubles, when they do occur, are caused by dirty or corroded contacts, but wear and breakage of internal parts is a possibility that should not be overlooked. If breakage does occur, the entire switch and related wiring harness will have to be replaced with a new one, as individual parts are not available.

2 The switches can be checked for continuity using an ohmmeter or a continuity test light. Always disconnect the battery negative (–ve) lead, which will prevent the possibility of a short circuit, before making the checks (see Section 3).

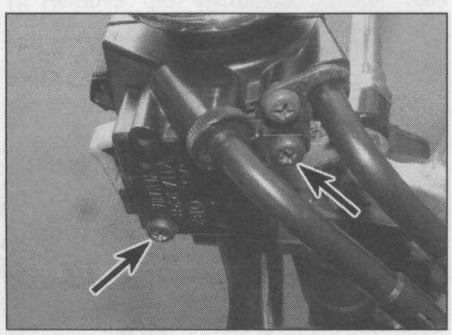
3 To access the right-hand switch wiring connector, remove the top cover and right-hand side cover (see Chapter 8). Remove the cover from the radiator filler neck on the right-hand side of the frame **(see illustration 18.6a)**. Undo the screws securing the board and displace it – there is no need to drain the cooling system or detach any hoses, but watch the wiring and disconnect the connectors if necessary **(see illustration 18.6b)**. Mark the locations of all wires and leads before disconnecting them. Remove the ignition switch cover **(see illustration 18.7)**.

4 To access the left-hand switch wiring connectors, remove the top cover and left-hand side cover (see Chapter 8). Undo the screws securing the board and displace it – there is no need to disconnect any connectors, but watch the wiring and disconnect them if necessary **(see illustration)**. Mark the locations of all wires and leads before disconnecting them.

5 Trace the wiring from the switch housing being checked and disconnect it at the connector(s) **(see illustrations)**. Make the checks on the switch side of the connectors.

6 Check for continuity between the terminals of the switch connector with the switch in the various positions (i.e. switch off – no continuity, switch on – continuity) – see the *wiring diagrams* at the end of this Chapter. Continuity should exist between the terminals connected by a solid line on the diagram when the switch is in the indicated position.

7 If the continuity check indicates a problem exists, refer to Section 20, displace the switch housing and spray the switch contacts with electrical contact cleaner (there is no need to remove the switch completely). If they are accessible, the contacts can be scraped clean with a knife or polished with crocus cloth. If switch components are damaged or broken, it should be obvious when the switch is disassembled.



20.3a Right-hand switch housing screws (arrowed)

20 Handlebar switches – removal and installation

Removal

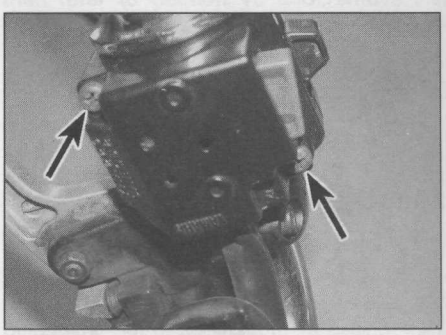
1 If the switch is to be removed from the bike, rather than just displaced from the handlebar, refer to Section 19, Step 3 or 4 for details on accessing the switch wiring connectors. Trace the wiring from the switch housing and disconnect it at the connector(s) **(see illustration 19.5a or b)**. Work back along the harness, freeing it from all clips and ties, and feed it to the switch, noting its routing.

2 Disconnect the wiring connectors from the brake light switch (if removing the right-hand switch) or the clutch switch (if removing the left-hand switch) **(see illustration 14.2 or 23.2)**.

3 Note the alignment of the switch housing mating halves with the handlebar by making a mark with a felt pen so they are installed in the same place – there is no locating pin or manufacturer's mark. Unscrew the handlebar switch screws and free the switch from the handlebar by separating the halves **(see illustrations)**. When working on the right-hand switch, refer to Chapter 4 for removal of the throttle cables, which involves detaching the switch housing from the handlebars. Free the throttle cables from the twistgrip and remove them from the housing.

Installation

4 Installation is the reverse of removal. Make sure the wiring connectors are correctly routed and securely connected. Refer to Chapter 4 for installation of the throttle cables and right-hand switch housing.



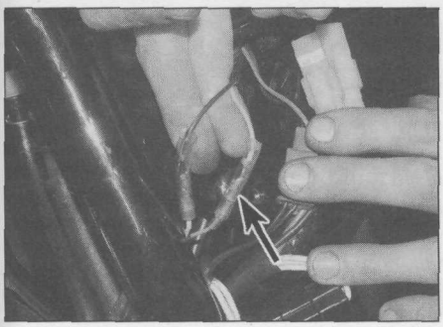
20.3b Left-hand switch housing screws (arrowed)

21 Neutral switch – check, removal and installation

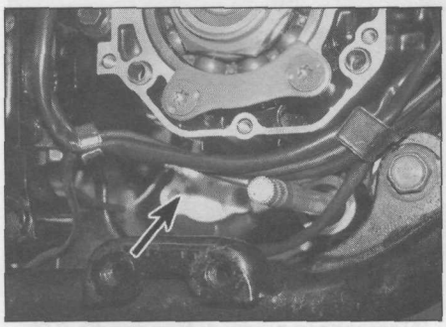
Check

1 The switch is located on the left-hand side of the engine. The switch is part of the safety circuit which prevents or stops the engine running if the transmission is in gear whilst the sidestand is down, and prevents the engine from starting if the transmission is in gear unless the sidestand is up, and unless the clutch is pulled in.

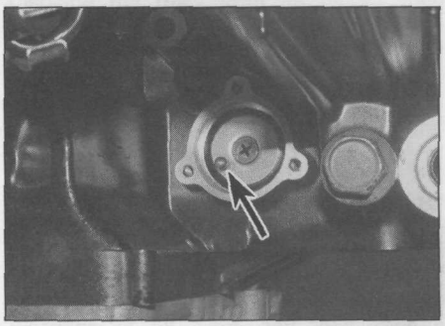
2 Before checking the electrical circuit, check the bulb (see Section 17) and ignition circuit fuse (see Section 5). Make sure the



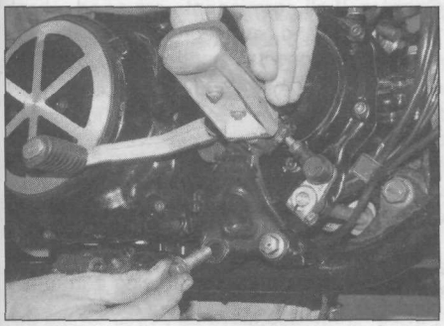
21.2 Disconnect the neutral switch wiring connector (light blue wire, arrowed)



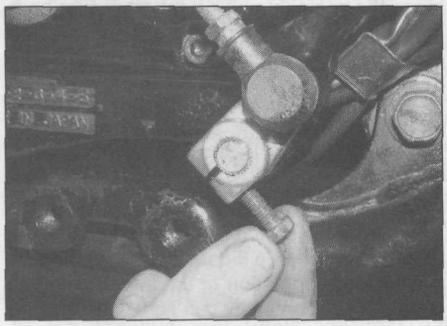
21.4 Slacken the screw (arrowed) and detach the connector



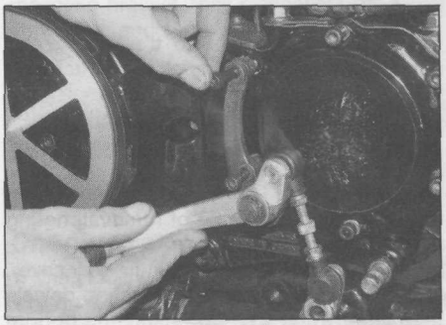
21.5 Check the contact (arrowed) in the end of the drum (see Chapter 2)



21.7 Unscrew the bolts and remove the footrest assembly



21.8a Unscrew the bolt and slide the arm off the shaft . . .



21.8b . . . then unscrew the bracket bolts and remove the lever assembly

transmission is in neutral. To access the wiring connector, remove the left-hand side panel (see Chapter 8). Trace the wiring from the switch and disconnect it at the connector **(see illustration)**.

3 With the connector disconnected and the ignition switched ON, the neutral light should be out. If not, the wire between the instrument cluster and connector must be earthed (grounded) at some point.

4 Check for continuity between the light blue wire terminal on the switch side of the wiring connector and the crankcase. With the transmission in neutral, there should be continuity. With the transmission in gear, there should be no continuity. If the tests prove otherwise, refer to Steps 7 to 9 below to access the switch, then slacken the screw securing the wiring terminal to the switch and detach it **(see illustration)**. Check for continuity in the wiring between the connector and the terminal. If the wiring is good, check for continuity between the terminal screw on the switch side and the crankcase. With the transmission in neutral, there should be continuity. With the transmission in gear, there should be no continuity. If the tests prove otherwise, remove the switch and check its contact on the inner face, and also check the contact plunger and spring in the end of the selector drum, and renew whichever is faulty.

5 If the continuity tests prove the switch is good, refer to Section 15 and disconnect the instrument cluster wiring connectors. Check for voltage (with the ignition ON) at the brown wire terminal on the wiring loom side of the connector. If there's no voltage present, check the wire between the connector and signal fuse (see the *Wiring Diagrams* at the end of this Chapter). If the voltage is good, check the wiring between the connector and the bulbholder, then check the starter circuit cut-off relay and other components in the starter circuit as described in the relevant sections of this Chapter. If all components are good, check the wiring and connectors between the various components (see the *Wiring Diagrams* at the end of this Chapter). Note that if there is still a problem with the switch, it could lie in the contact in the end of the selector drum **(see illustration)**. Check it as described in Chapter 2, Section 32, Step 10.

Removal

6 The switch is located on the left-hand side of the engine. Make sure the transmission is in neutral.

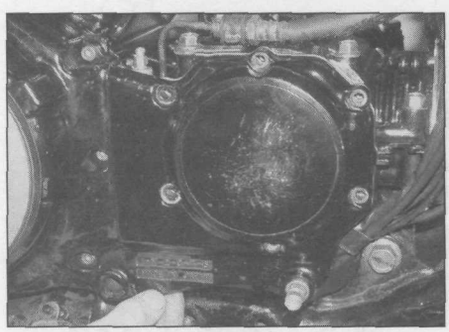
7 Unscrew the two bolts securing the rider's left-hand footrest bracket and remove the footrest assembly **(see illustration)**.

8 Unscrew the gearchange linkage arm pinch bolt and slide the arm off the shaft, noting how the slot in the arm aligns with the punch mark on the shaft **(see illustration)**. Unscrew the two bolts securing the gearchange lever pivot bracket and remove the lever assembly **(see illustration)**.

9 Unscrew the remaining middle gear assembly cover bolts and remove the cover, being prepared with some rag to catch any oil **(see illustration)**. Discard the gasket as a new one must be used. Note the two locating dowels and remove them for safekeeping if they are loose.

10 Undo the single screw securing the wiring connector to the switch.

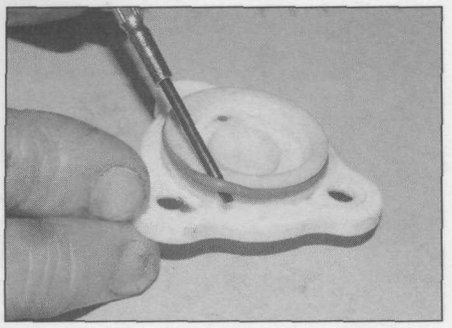
11 Undo the screws securing the switch and withdraw it from the casing **(see illustration)**. Discard the O-ring, as a new one must be used.



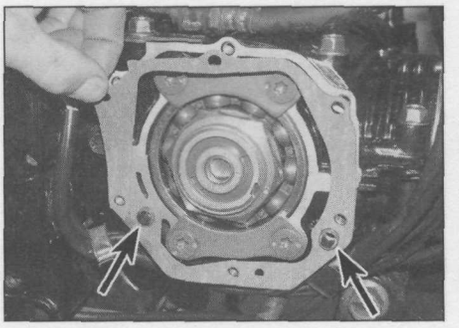
21.9 Unscrew the bolts and remove the cover



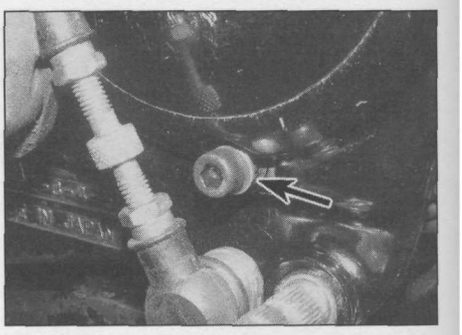
21.11 Undo the screws and remove the switch



21.12 Fit a new O-ring onto the switch



21.14a Locate the new gasket onto the dowels (arrowed) . . .



21.14b . . . and use a new sealing washer on the bottom bolt

Installation

12 Fit a new O-ring onto the switch and smear it with oil, then install the switch and tighten its screws **(see illustration)**.

13 Attach the wiring connector and secure it with the screw. Check the operation of the neutral light.

14 The remainder of the installation procedure is the reverse of removal, noting the following points:

- Use a new gasket on the middle gear cover, and do not forget the cover locating dowels **(see illustration 21.14a)**. Install the bottom bolt using a new sealing washer **(see illustration 21.14b)**.
- When installing the middle gear assembly cover, make sure the rubber fillet locates around the clutch pipe and over the bleed valve.
- When fitting the gearchange linkage arm onto the gearchange shaft, align the slit in the arm with punch mark on the shaft **(see illustration 21.8a)**.

22 Sidestand switch and relay – check and renewal

Note: *The side stand switch is fitted to all US market models and 1990-on European market models. The side stand relay is only fitted on 1985 to 1989 US market models.*

Check

1 The sidestand switch is mounted on the frame just ahead of the sidestand. The switch is part of the safety circuit which prevents or stops the engine running if the transmission is in gear whilst the sidestand is down, and prevents the engine from starting if the transmission is in gear unless the sidestand is up and the clutch lever is pulled in. Before checking the electrical circuit, check the ignition circuit fuse (see Section 5).

2 To access the wiring connector, remove the left-hand side panel (see Chapter 8). Trace the wiring from the switch and disconnect it at the blue connector **(see illustration)**.

3 Check the operation of the switch using an ohmmeter or continuity test light. Connect the meter probes to the terminals on the switch side of the connector. With the sidestand up there should be continuity (zero resistance) between the terminals, and with the stand down there should be no continuity (infinite resistance).

4 If the switch does not perform as expected, it is defective and must be replaced with a new one.

5 On 1985 to 1989 models to check the relay, first remove it (see below). Connect a meter set to the ohms x 100 range, or a continuity tester, between the black/white (+ve) and black (–ve) wire terminals. No continuity should be shown. Using jumper wires now connect a fully charged 12V battery to the relay's blue/yellow and red/white wire terminals (positive (+ve) lead to blue/yellow and negative (–ve) lead to red/white). The meter should show continuity with battery voltage applied.

6 If the switch and relay (where fitted) are good, check the starter circuit cut-off relay and other components in the starter circuit as described in the relevant sections of this Chapter. If all components are good, check the wiring and connectors between the various components (see the *Wiring Diagrams* at the end of this Chapter).

Renewal

7 The sidestand switch is mounted on the frame just ahead of the sidestand. Remove the left-hand side panel (see Chapter 8). Trace the wiring from the switch and disconnect it at the connector **(see illustration 22.2)**. Feed the wiring down to the switch, freeing it from any clips and ties, noting its correct routing.

8 Undo the screws securing the switch and remove it, noting how it fits **(see illustration)**.

9 Fit the new switch, making sure the plunger locates correctly, and tighten the screws.

10 Make sure the wiring is correctly routed up to the connector and retained by the clips and ties.

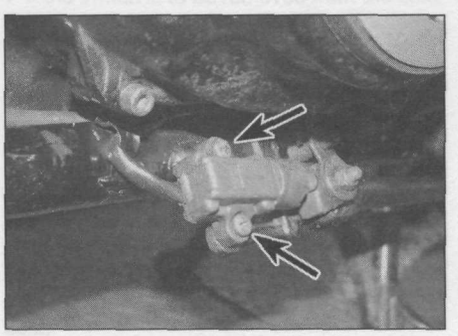
11 Reconnect the wiring connector and check the operation of the switch.

12 Install the left-hand side panel (see Chapter 8).

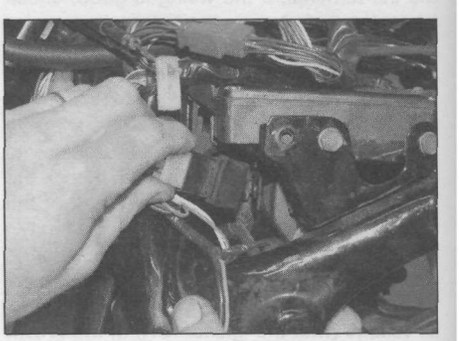
13 On 1985 to 1989 models to remove the relay, remove the top cover and left-hand side cover (see Chapter 8). Undo the screws securing the board and displace it – there is no need to disconnect any connectors, but watch the wiring and disconnect them if necessary **(see illustration 19.4)**. Mark the locations of all wires and leads before disconnecting them. Free the relay from its mount on the ignition coil and control unit mounting bracket, then disconnect the wiring connector and remove it **(see illustration)**. Installation is the reverse of removal.



22.2 Sidestand switch wiring connector



22.8 The sidestand switch is secured by two screws (arrowed)



22.13 Free the relay from its mount

23 Clutch switch – check and renewal

Check

1 The clutch switch is mounted on the underside of the clutch lever bracket. The switch is part of the safety circuit which prevents or stops the engine running if the transmission is in gear whilst the sidestand is down, and prevents the engine from starting if the transmission is in gear unless the sidestand is up and the clutch lever is pulled in. Note that the 1985 to 1989 European market models are not fitted with a sidestand switch. The clutch switch isn't adjustable.

2 To check the switch, disconnect the wiring connectors **(see illustration)**. Connect the probes of an ohmmeter or a continuity test light to the two switch terminals. With the clutch lever pulled in, continuity should be indicated. With the clutch lever out, no continuity (infinite resistance) should be indicated.

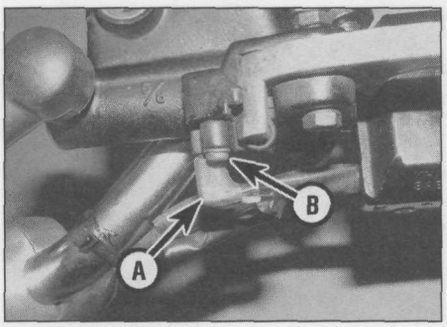
3 If the switch is good, check the starter circuit cut-off relay and other components in the starter circuit as described in the relevant sections of this Chapter. If all components are good, check the wiring between the various components (see the *Wiring Diagrams* at the end of this Chapter).

Renewal

4 The clutch switch is mounted on the underside of the clutch lever bracket.

5 Disconnect the wiring connectors **(see illustration 23.2)**, then remove the screw and washer and detach the switch.

6 Installation is the reverse of removal.



23.2 Clutch switch wiring connector (A) and mounting screw (B)

24 Starter circuit cut-off relay – check and renewal

Check

1 The starter circuit cut-off relay is part of the safety circuit which prevents or stops the engine running if the transmission is in gear whilst the sidestand is down, and prevents the engine from starting if the transmission is in gear unless the sidestand is up and the clutch lever is pulled in.

2 On 1985 to 1989 models the starter circuit cut-off relay (integrated with the turn signal relay), is mounted on the board behind the left-hand side cover – remove the cover for access (see Chapter 8).

3 On 1990 to 2003 models the starter circuit cut-off relay is mounted on the front left side of the ignition coil and ignition control unit mounting bracket **(see illustration 24.9)**.

4 Remove the relay (see below).

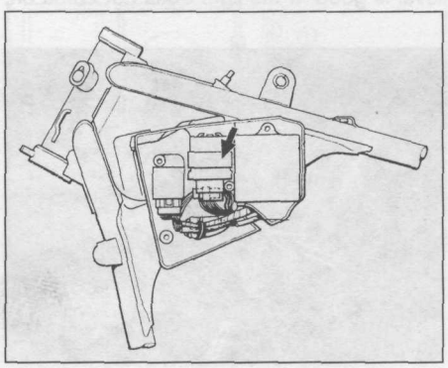
5 To check the operation of the relay, connect a meter set to the ohms x 100 range, or a continuity tester, between the two blue/white wire terminals of the relay on 1985 to 1989 models, and between the red/black and red/white wire terminals on 1990 to 2003 models. No continuity should be shown. Using jumper wires now connect a fully charged 12V battery to the relay's red/black and black/yellow wire terminals (positive (+ve) lead to red/black and negative (–ve) lead to black/yellow). The meter should show continuity with battery voltage applied.

6 On 1985 to 1989 models to check the cut-off relay coil resistance, connect a meter set to the ohms x 100 range between the red/black (+ve) and black/yellow (–ve) wire terminals of the relay. The figure given in the Specifications at the beginning of this chapter should be obtained.

7 If the cut-off relay is good, yet the starting system fault still exists, check all other components in the starting circuit (i.e. the neutral switch, side stand switch, clutch switch, starter button and kill switch, diode block and starter relay) as described in the relevant sections of this Chapter. If all components are good, check the wiring between the various components (see *Wiring Diagrams* at the end of this Chapter).

Renewal

8 On 1985 to 1989 models the starter circuit cut-off relay (integrated with the turn signal relay into one relay unit), is mounted on the board behind the left-hand side cover – remove the cover for access (see Chapter 8).



24.8 Starter circuit cut-off relay – 1985 to 1989 models

Displace the relay from its mount then disconnect the relay wiring connector **(see illustration)**. Installation is the reverse of removal.

9 On 1990 to 2003 models the starter circuit cut-off relay is mounted on the front left side of the ignition coil and ignition control unit mounting bracket. Remove the top cover and left-hand side cover (see Chapter 8). Undo the screws securing the board and displace it – there is no need to disconnect any connectors, but watch the wiring and disconnect them if necessary **(see illustration 19.4)**. Mark the locations of all wires and leads before disconnecting them. Free the relay from its mount on the ignition coil and control unit mounting bracket, then disconnect the wiring connector and remove it **(see illustration)**. Installation is the reverse of removal.

25 Diode block – check and renewal

Check

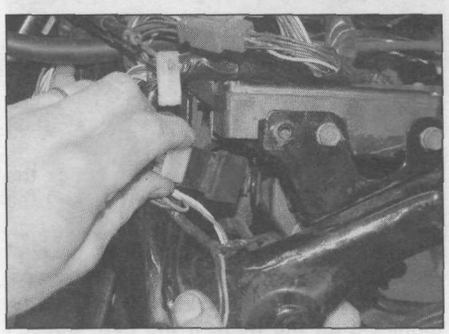
1 The diode block is part of the safety circuit which prevents or stops the engine running if the transmission is in gear whilst the sidestand is down, and prevents the engine from starting if the transmission is in gear unless the sidestand is up and the clutch lever is pulled in. Note that 1985 to 1989 European market models are not fitted with a sidestand switch.

2 Remove the diode block (see below). The diodes contained within the relay assembly can be checked by performing continuity tests.

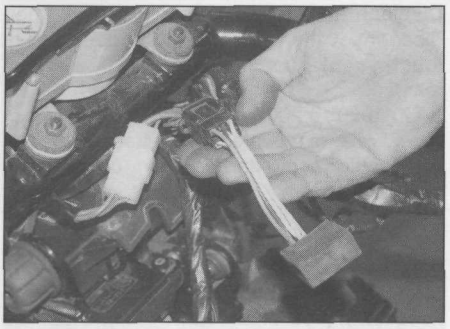
3 Connect the meter (set to the ohms function) or continuity tester between the specified wire terminals on the diode connector. The diode should show continuity in one direction and no continuity when the meter or tester probes are reversed. If the diode shows the same condition in both directions it should be considered faulty. Perform the test between the following pairs:

1985 to 1989 models

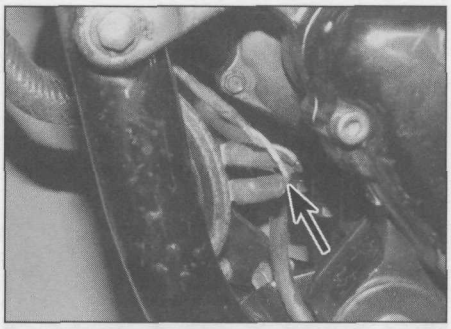
green (+ve) and blue/white (–ve) – continuity
blue/white (+ve) and green (–ve) – no continuity



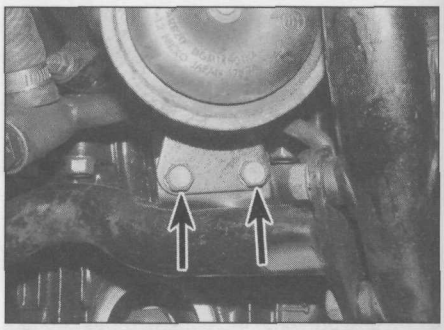
24.9 Starter circuit cut-off relay – 1990 to 2003 models



25.7 Disconnect the diode block and remove it



26.3 Horn wiring connectors (arrowed)



26.7 Horn mounting bolts (arrowed)

yellow (+ve) and light blue (–ve) – continuity
light blue (+ve) and yellow (–ve) – no continuity
white/green (+ve) and white (–ve) – continuity
white (+ve) and white/green (–ve) – no continuity

1990 to 2003 models

light blue (+ve) and yellow (–ve) – continuity
yellow (+ve) and light blue (–ve) – no continuity

4 To check the oil level sensor resistor housed within the diode block, connect an ohmmeter or multimeter set to the ohms x 1 scale and measure the resistance between the green (+ve) and black/red (–ve) terminals – there should be 8.2 ohms. If any test result differs from that stated, replace the diode block with a new one.

5 If the diode is good, yet the starting system fault still exists check all other components in the starting circuit (i.e. the neutral switch, side stand switch, clutch switch, starter circuit cut-off relay, starter button and kill switch, and starter relay) as described in the relevant sections of this Chapter. If all components are good, check the wiring between the various components (see *Wiring Diagrams* at the end of this Chapter).

Renewal

6 Remove the air filter housing (see Chapter 4).
7 Locate the diode block and disconnect it from the wiring loom **(see illustration)**.
8 Installation is the reverse of removal.

26 Horn – check and renewal

Check

1 The horn is mounted on the frame cross-piece at the front of the engine.
2 If the horn doesn't work, first check the signal circuit fuse (see Section 5) and the battery (see Section 3).
3 Unplug the wiring connectors from the horn **(see illustration)**. Using two jumper wires, apply battery voltage (12 volts) directly to the terminals on the horn. If the horn doesn't sound, replace it with a new one.
4 If the horn sounds, check for battery voltage at the brown wire terminal with the ignition ON. If there is voltage check the pink wire between the horn and the horn switch for continuity, then if the wiring is good check the switch (see Section 19). If the switch is good check for continuity to earth in the black wire from the switch (see *Wiring Diagrams* at the end of this Chapter).
5 If there was no voltage at the brown wire terminal check the wiring and connectors between the ignition (main) switch and the horn and repair it as necessary (see *Wiring Diagrams* at the end of this Chapter).

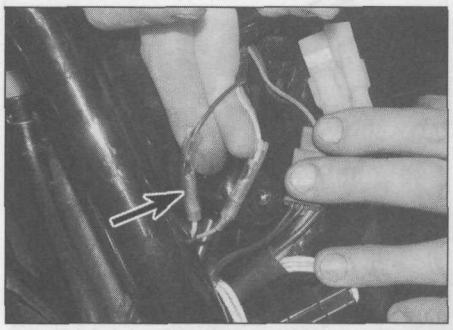
Renewal

6 The horn is mounted on the frame cross-piece at the front of the engine.
7 Unplug the wiring connectors from the horn **(see illustration 26.3)**. Unscrew the bolts securing the horn and remove it from the bike **(see illustration)**.
8 Install the horn and tighten the bolts. Connect the wiring connectors.

27 Oil level sensor – check, removal and installation

Check

1 With the ignition switch ON and the kill switch in the RUN position, the oil level warning light should come on for a few seconds, then go out, indicating that the oil level is good. If the light does not come on, check the bulb (see Section 17) and the fuse (see Section 5). If the light stays on, check the oil level (see *Daily (pre-ride) checks*). If the oil level is good, check the sensor and relay (see Steps 3 and 4).
2 Start the engine. The oil level warning light should come on briefly, and then go out. If the light stays on, stop the engine immediately and check the oil level. If the light does not come on, check the bulb (see Section 17).
3 To check the sensor, remove it from the sump (see below). Connect one probe of an ohmmeter or continuity tester to the sensor wire and the other probe to its base. With the sensor in its normal installed position (wiring at the bottom), there should be continuity. Turn the sensor upside down. There should be no continuity. If either condition does not occur, replace the sensor with a new one.
4 If the sensor is good, check the wiring and connectors between the sensor and the warning light, referring to the wiring diagram at the end of this Chapter for your model.
5 A resistor is fitted inside the diode block to stabilise the signals to the oil level warning light, thus preventing it flickering when cornering or braking hard. If there is a fault in the warning light operation which is not due to a faulty bulb or relay, refer to Section 25, Step 4 and check the resistor value.



27.7 Disconnect the sensor wiring connector (black/blue wire – arrowed)

Removal

6 Drain the engine oil (see Chapter 1).
7 Remove the left-hand side panel (see Chapter 8). Trace the wiring back from the sensor and disconnect it at the single bullet connector **(see illustration)**. Free the wiring from its clamps and feed it down to the sensor, noting its routing.
8 Unscrew the two bolts securing the sensor to the bottom of the sump and withdraw it, being prepared to catch any residual oil **(see illustration)**. Do not discard the O-ring – new ones are not available separately from the sensor itself **(see illustration)**. If the O-ring is damaged, deformed or deteriorated, take it to an automotive parts supplier and match it to a new one – a lot cheaper than a new sensor.

Installation

9 Smear the O-ring with oil. Fit the sensor into the sump and push on it to seat the O-ring

(see illustration). Tighten its bolts to the torque setting specified at the beginning of the Chapter.

10 Feed the wiring to the connector, making sure it is correctly routed and secured in its clamps, and connect it **(see illustration 27.7)**. Check the operation of the sensor (see Steps above). Install the left-hand side panel (see Chapter 8).

11 Fill the engine with oil (see Chapter 1).

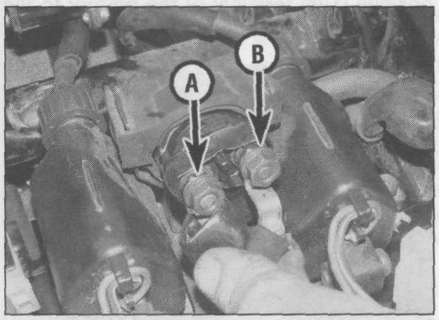
28 Starter relay – check and renewal

Check

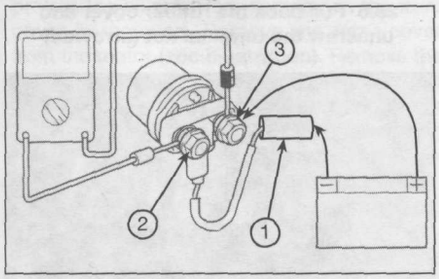
1 If the starter circuit is faulty, first check the main fuse (see Section 5).

2 Remove the rider's seat (see Chapter 8). The starter relay is located between the rear cylinder ignition coils. Lift the rubber terminal cover on the black lead to the starter motor, then unscrew the nut and detach the lead **(see illustration)**; position the lead away from the relay terminal. With the ignition switch ON, the engine kill switch in the RUN position, and the transmission in neutral, press the starter switch. The relay should be heard to click.

3 If the relay doesn't click, switch off the ignition and remove the relay as described below; test it as follows.

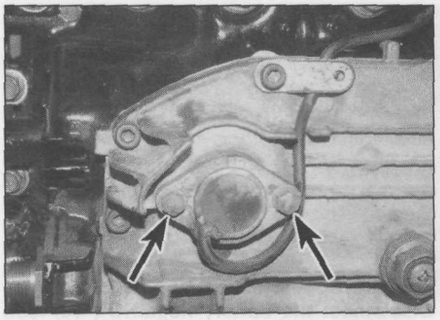


28.2 Starter motor lead (A), battery lead (B)



28.4a Starter relay operation test – 1985 to 1989 models

1 Blue/white wire terminal
2 Starter motor lead terminal
3 Battery lead terminal



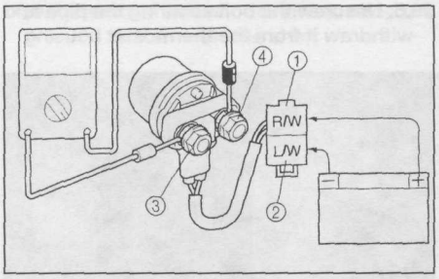
27.8a Unscrew the bolts (arrowed) and remove the sensor

4 Set a multimeter to the ohms x 1 scale and connect it across the relay's starter motor and battery lead terminals. Using a fully-charged 12 volt battery and two insulated jumper wires, connect the positive (+ve) terminal of the battery to the relay's battery lead terminal (1985 to 1989 models) or the red/white wire terminal on the relay wiring connector (1990 to 2003 models), and the negative (–ve) terminal to the blue/white wire terminal on the connector **(see illustrations)**. At this point the relay should be heard to click and the multimeter read zero ohms (continuity). If this is the case the relay is proved good. If the relay does not click when battery voltage is applied and indicates no continuity (infinite resistance) across its terminals, it is faulty and must be replaced with a new one.

5 The relay's internal resistance can be checked by connecting the multimeter, set to the ohms x 1 scale, between the relay's battery lead terminal and the blue/white lead on 1985 to 1989 models, and between the relay's red/white and blue/white leads on 1990 to 2003 models. Compare the reading obtained with that specified at the beginning of this Chapter.

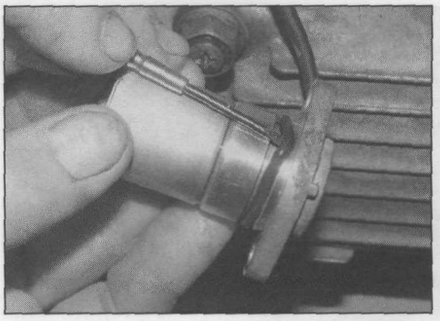
6 On 1985 to 1989 models, if the relay is good check the other components in the starter circuit and the wiring between them.

7 On 1990 to 2003 models, if the relay is good check for battery voltage at the red/white wire terminal on the loom side of the relay wiring connector when the starter button is pressed. If voltage is present, check the other components after the relay in the starter circuit and the wiring between them as described in the relevant sections of this Chapter. If no voltage was present, check the wiring between the various components before the relay in the circuit (see *Wiring Diagrams* at the end of this Chapter).

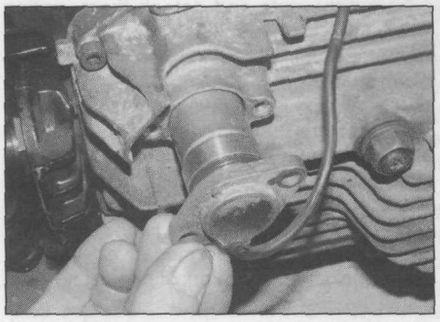


28.4b Starter relay operation test – 1990 to 2003 models

1 Red/white wire terminal
2 Blue/white wire terminal
3 Starter motor lead terminal
4 Battery lead terminal



27.8b Check the O-ring as described

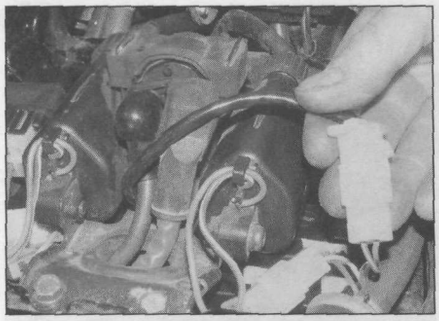


27.9 Push the sensor in to seat the O-ring

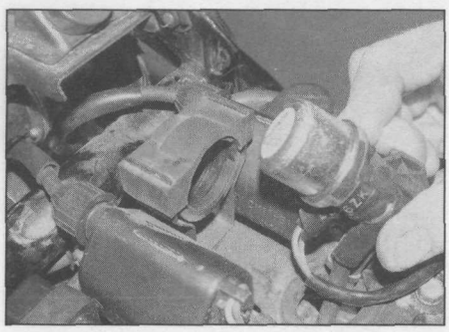
Renewal

8 Remove the rider's seat (see Chapter 8). The starter relay is located between the rear cylinder ignition coils. Disconnect the battery negative (–ve) lead before removing the starter relay **(see illustration 3.2)**.

9 Disconnect the relay wiring connector **(see illustration)**. Lift the rubber terminal covers on the starter motor and battery leads, then



28.9a Disconnect the relay wiring connector



28.9b Withdraw the relay from its sleeve

unscrew the nuts and detach them, noting which fits where **(see illustration 28.2)**. Draw the relay out of its rubber sleeve **(see illustration)**.

10 Installation is the reverse of removal. The red lead from the battery goes to the right-hand terminal, and the black lead to the starter motor goes on the left-hand terminal. Make sure the terminal nuts are securely tightened and the covers are in place.

11 Connect the battery negative (–ve) lead and check the operation of the relay, then install the rider's seat.

29 Starter motor – removal and installation

Note: *If you have a 2-brush starter motor (identifiable by the screws that hold the magnets in the main housing), and are experiencing problems with it (i.e. it is sluggish, even with a fully charged battery), it is worth considering getting hold of a newer 4-brush motor (it doesn't have screws in the main housing). If the motor is sluggish, disassemble it, clean all components (particularly the brushes and the commutator bars) and check them as described in Section 30.*

Removal

1 Remove the rider's seat (see Chapter 8). Disconnect the battery negative (–ve) lead **(see illustration 3.2)**. The starter motor is mounted on the front of the engine.

2 Drain the coolant (see Chapter 1).

3 Remove the horn (see Section 26).

4 Slacken the clamp securing the coolant hose to the thermostat cover and detach the hose **(see illustration)**.

5 Unscrew the coolant by-pass pipe bolt, then draw the pipe out of the thermostat housing and secure it out of the way (cable-tie to the exhaust downpipe for example – if required, slacken the clamps and detach the pipe from the hoses) **(see illustration)**. Discard the O-ring as a new one must be used.

6 Peel back the rubber terminal cover and unscrew the nut securing the lead to the starter motor **(see illustration)**. Detach the lead.

7 Unscrew the two bolts securing the starter motor **(see illustration)**. Draw the starter motor out of the crankcase and remove it from the machine **(see illustration)**.

8 Remove the O-ring on the end of the starter motor and discard it as a new one must be used.

Installation

9 Fit a new O-ring onto the end of the starter motor, making sure it is seated in its groove, and smear it with grease **(see illustration)**.

10 Manoeuvre the motor into position and slide it into the crankcase. Ensure that the starter motor teeth mesh correctly with those of the starter reduction gear. Install the mounting bolts and tighten them to the torque setting specified at the beginning of the Chapter.

11 Connect the lead to the starter motor and secure it with the nut. Make sure the rubber cover is correctly seated over the terminal.

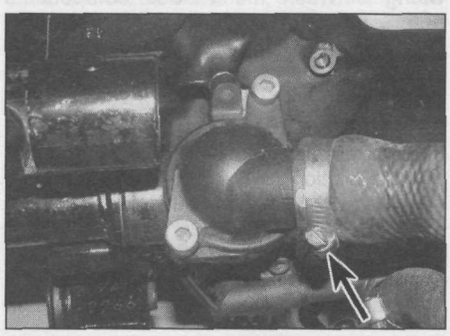
12 Connect the battery negative (–ve) lead and install the seat.

30 Starter motor – overhaul

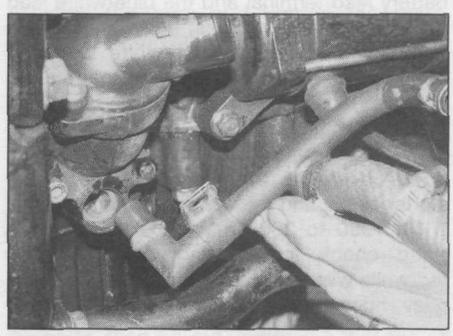
Check

1 Remove the starter motor (see Section 29). Cover the starter motor body in some rag and clamp the motor in a soft-jawed vice – do not overtighten it.

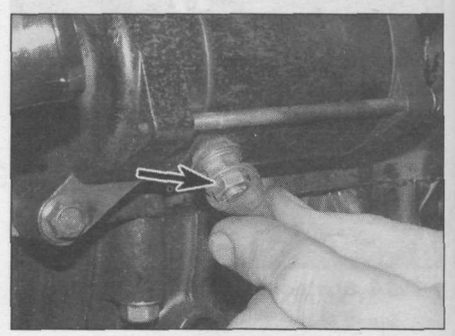
2 Using a fully-charged 12 volt battery and two insulated jumper wires, connect the positive (+ve) terminal of the battery to the protruding terminal on the starter motor, and



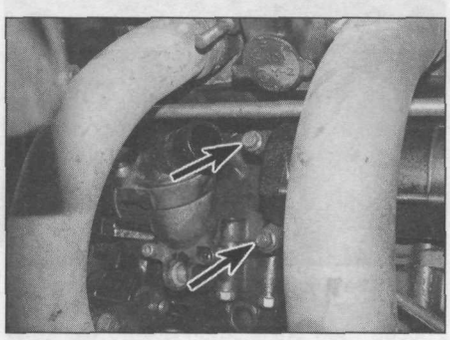
29.4 Slacken the clamp screw (arrowed) and detach the hose



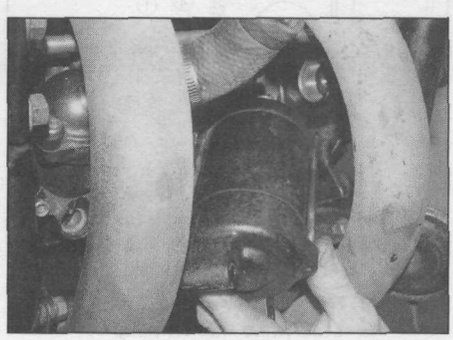
29.5 Unscrew the bolt securing the pipe and withdraw it from the thermostat housing



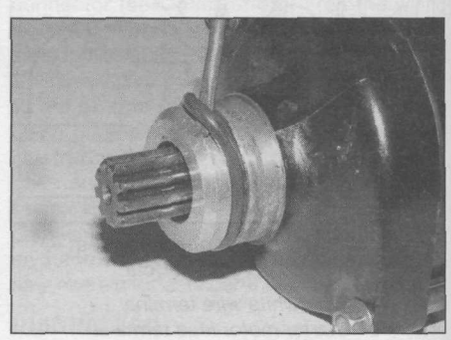
29.6 Pull back the rubber cover and unscrew the terminal nut (arrowed)



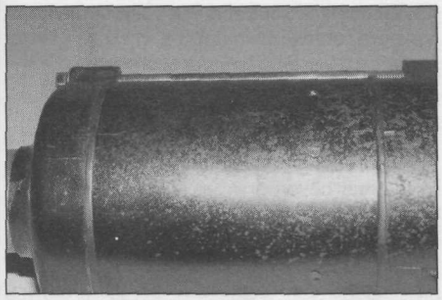
29.7a Unscrew the bolts (arrowed) . . .



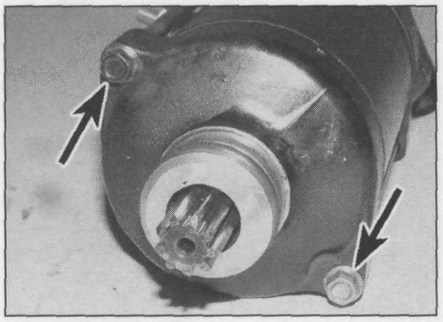
29.7b . . . and remove the starter motor



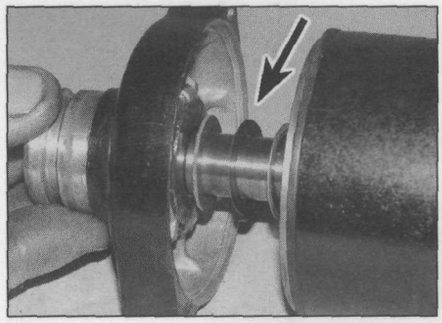
29.9 Fit a new O-ring



30.4 Note any alignment markings between the main housing and end covers, or make your own if necessary



30.5 Unscrew and remove the two long bolts (arrowed)



30.6 Remove the front cover and slide the shims (arrowed) off the shaft

the negative (–ve) terminal to one of the motor's mounting lugs. At this point the starter motor should spin. If this is the case the motor is proved good, though it is worth disassembling it and checking it if you suspect it of not working properly under load. If the motor does not spin, disassemble it for inspection.

Caution: Operate the starter motor for a few seconds only, otherwise it will overheat.

Disassembly

Note 1: *Before disassembling the motor, spray some penetrating fluid around the end cover screw or bolt threads and holes – due to the position of the motor on the front of the engine it is likely that the threads will be seized in the cover, especially on older engines.*

Note 2: *The illustrations in this procedure depict the 4-brush motor – the 2-brush motor is essentially the same in layout, though there may not be any shims fitted on the shaft ends, and the brush layout and terminal bolt assembly differs.*

3 Remove the starter motor (see Section 29).

4 Note the alignment marks between the main housing and the front and rear covers, or make your own if they aren't clear **(see illustration)**.

5 Unscrew the two long bolts and withdraw them from the starter motor **(see illustration)**.

6 Wrap some insulating tape around the teeth on the end of the starter motor shaft – this will protect the oil seal from damage as the front cover is removed. Remove the front cover from the motor **(see illustration)**. Remove the shims from the front end of the armature shaft or the inside of the front cover, noting their correct fitted order. Remove the sealing ring from the main housing and discard it as a new one must be used **(see illustration 30.25a)**. Also remove the tabbed washer from the front cover **(see illustration 30.25c)**.

7 Remove the rear cover from the motor **(see illustration)**. Remove the shims from the rear end of the armature shaft or from inside the rear cover **(see illustration 30.24b)**. Remove the sealing ring from the main housing and discard it as a new one must be used **(see illustration 30.24a)**.

8 Withdraw the armature from the main housing, noting that you will have to pull it out against the attraction of the magnets **(see illustration)**.

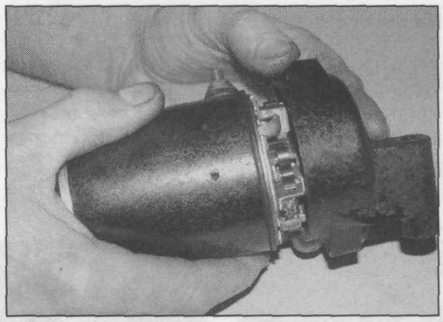
9 At this stage check for continuity between the terminal bolt and the main housing – there should be no continuity (infinite resistance). Also check for continuity between the insulated brushes and the terminal bolt – there should be continuity. Also check for continuity between the un-insulated brushes and the brushplate – there should be continuity (zero resistance). If there is no continuity when there should be, or vice versa, identify the faulty component and replace it with a new one.

10 Slide the brushes with the yellow insulated wires out of their housings **(see illustration 30.22a)**. Remove the brushplate assembly from the main housing, noting how it locates **(see illustration 30.20)**.

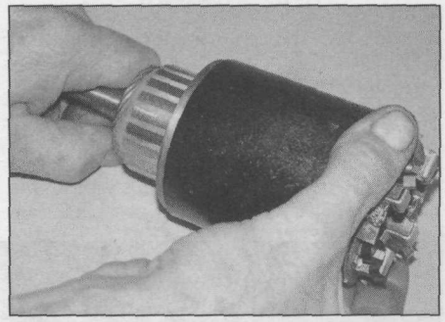
11 Noting the correct fitted location of each component, unscrew the terminal nut and remove it along with its washer, the one large and two small insulating washers and the O-ring, which you may have to carefully dig out from around the base of the terminal bolt **(see illustrations)**. Withdraw the terminal bolt, then remove the insulated brush assembly from the brushplate seat, noting how it fits **(see illustrations 30.19d and c)**. Remove the insulator and the brushplate seat **(see illustrations 30.19b and a)**. Check the condition of the O-ring and replace it with a new one it if it is damaged, deformed or deteriorated.

Inspection

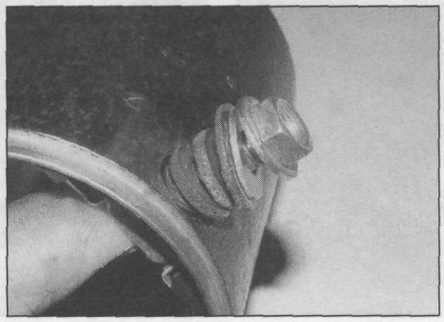
12 The parts of the starter motor that are most likely to require attention are the brushes. Measure the length of each brush and compare the results to the length listed in this Chapter's Specifications **(see**



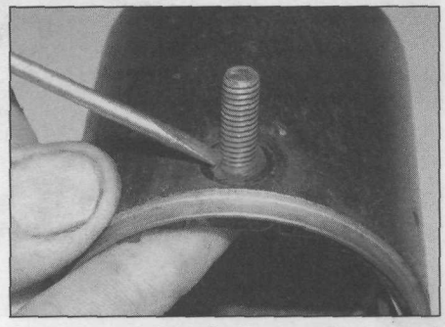
30.7 Remove the rear cover and slide the shims off the shaft



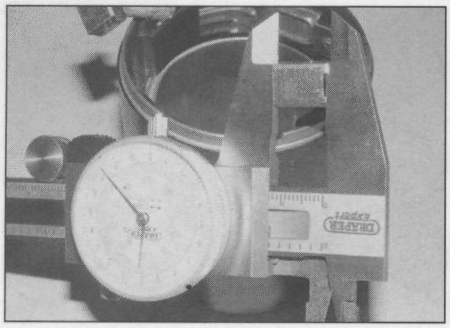
30.8 Withdraw the armature from the housing



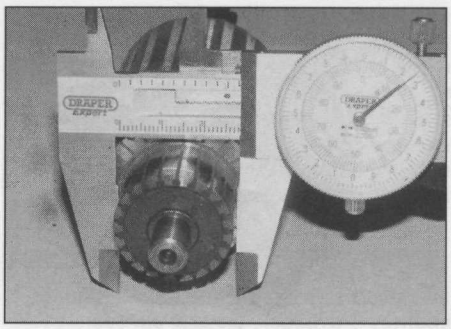
30.11a Unscrew the nut and remove the washers . . .



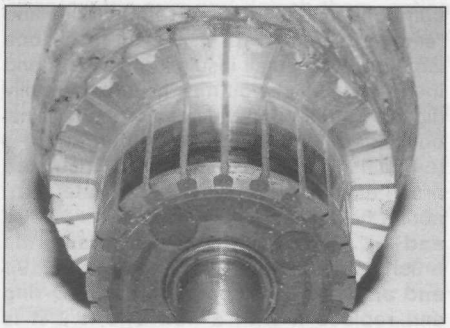
30.11b . . . and the O-ring from the base of the bolt



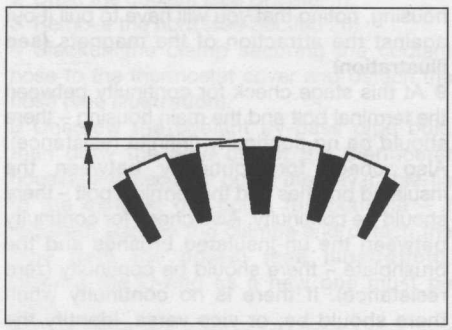
30.12 Measure the length of each brush



30.13a Measure the diameter of the commutator . . .



30.13b . . . and check the depth of the Mica below the bars . . .



30.13c . . . measuring it as shown

illustration). If any of the brushes are worn beyond the service limit, renew the brush assemblies. If the brushes are not worn excessively, nor cracked, chipped, or otherwise damaged, they may be re-used.

13 Inspect the commutator bars on the armature for scoring, scratches and discoloration. The commutator can be cleaned and polished with crocus cloth, but do not use sandpaper or emery paper. After cleaning, wipe away any residue with a cloth soaked in electrical system cleaner or denatured alcohol. Measure the diameter of the commutator and compare it to the specifications **(see illustration)**. If it has worn below the wear limit, replace the starter motor. Measure the depth of the insulating Mica below the surface of the commutator bars **(see illustrations)**. If the Mica is less than the depth specified, scrape it away until the specified depth is reached.

14 Using an ohmmeter or a continuity test light, check for continuity between the commutator bars **(see illustration)**. Continuity should exist between each bar and all of the others. Also, check for continuity between the commutator bars and the armature shaft **(see illustration)**. There should be no continuity (infinite resistance) between the commutator and the shaft. If the checks indicate otherwise, the armature is defective.

15 Check the front end of the armature shaft for worn, cracked, chipped and broken teeth. If the shaft is damaged or worn, replace the armature.

16 Inspect the front and rear covers for signs of cracks or wear. Check the oil seal and the needle bearing in the front cover and the bush in the rear cover for wear and damage – they are not listed as being available separately so if any is found new covers must be fitted **(see illustrations)**.

17 Inspect the magnets in the main housing and the housing itself for cracks.

18 Inspect the insulating washers, O-ring, and sealing rings for signs of damage, deformation and deterioration and replace them with new ones if necessary.

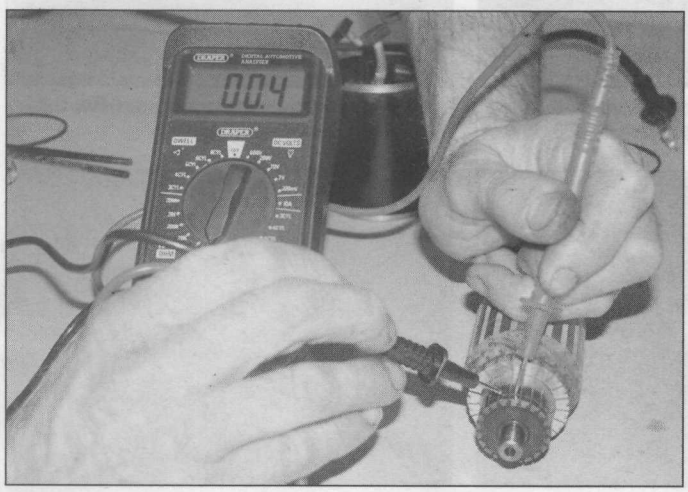
Reassembly

19 Fit the brushplate seat and insulator into the main housing **(see illustrations)**. Fit the insulated brush assembly, locating the arms into the brushplate seat **(see illustration)**. Insert the terminal bolt, then fit the O-ring, small and large insulating washers, plain washer and nut onto the bolt and tighten the nut **(see illustration and 30.11b and a)**. Use a new O-ring if necessary.

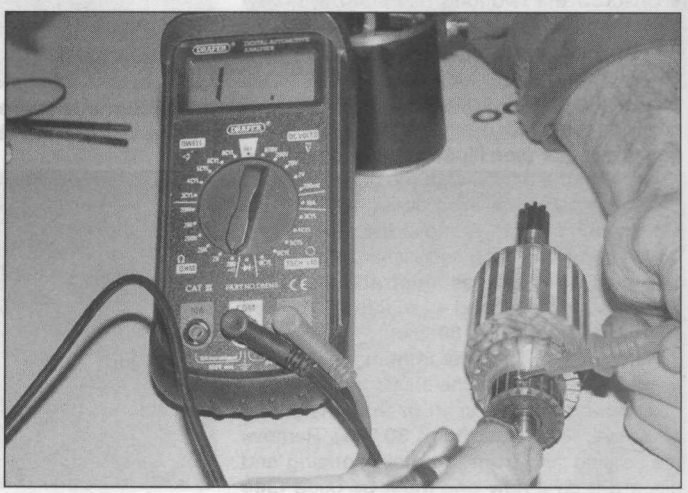
20 Fit the brushplate assembly onto the main housing, locating the insulated brush wires in the cut-outs and making sure the tab on the plate locates in the cut-out in the housing **(see illustration)**.

21 At this stage check again for continuity between the terminal bolt and the housing – there should be no continuity (infinite resistance). Also check for continuity between the insulated brushes and the terminal bolt – there should be continuity. Also check for continuity between the un-insulated brush and the brushplate – there should be continuity (zero resistance). If there is no continuity when there should be, or vice versa, identify the faulty component and replace it with a new one.

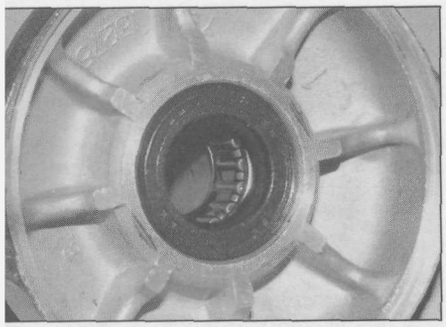
22 Fit each insulated brush into its housing and slide them fully in **(see illustration)**. Place



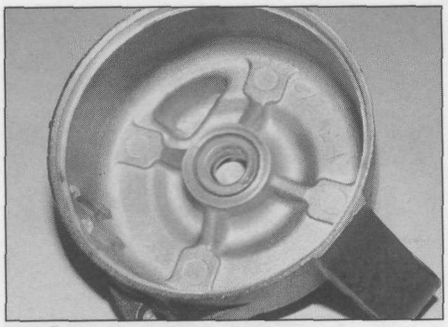
30.14a Continuity should exist between the commutator bars



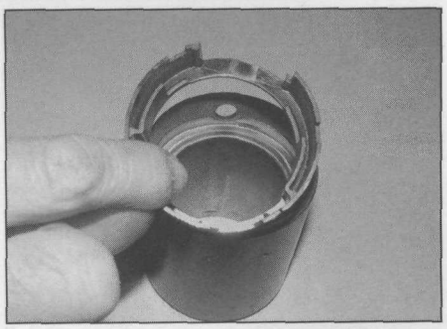
30.14b There should be no continuity between the commutator bars and the armature shaft



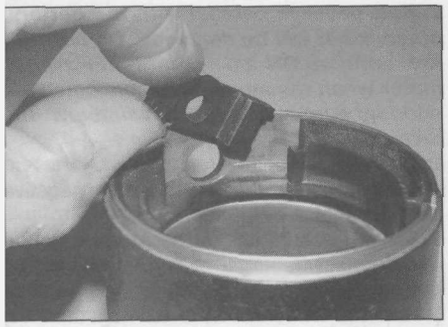
30.16a Check the seal and bearing in the front cover . . .



30.16b . . . and the bush in the rear cover



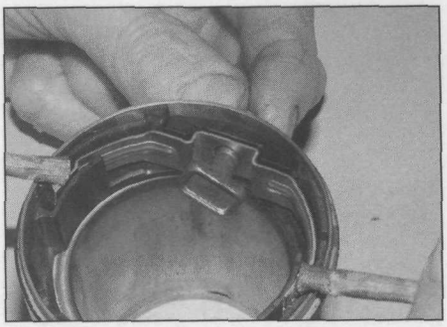
30.19a Fit the brushplate seat . . .



30.19b . . . and the insulator



30.19c Locate the insulated brush assembly . . .

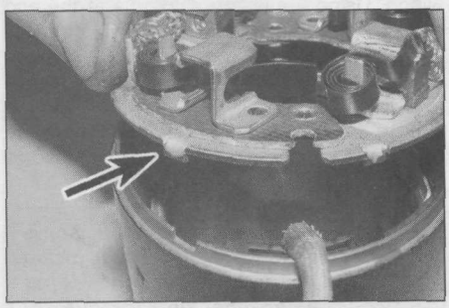


30.19d . . . then insert the terminal bolt

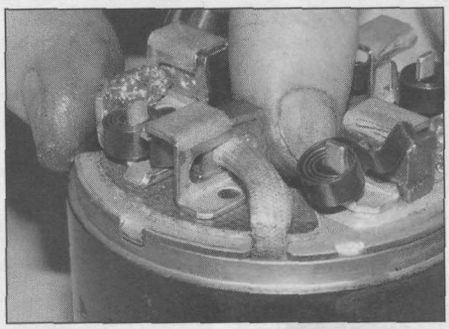
each brush spring end onto the top of the outer end of its brush – this keeps the brushes held right in so they do not foul the commutator bars when the armature is installed **(see illustrations)**.

23 Insert the armature into the main housing, noting that it will be forcibly drawn in by the attraction of the magnets **(see illustration 30.8)**. Locate each brush spring end onto its brush. Check that each brush is securely pressed against the commutator and is free to move in its housing.

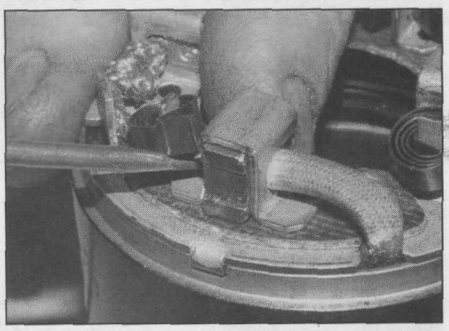
24 Fit a new rear cover sealing ring, then slide the shims onto the rear end of the armature **(see illustrations)**. Fit the rear cover



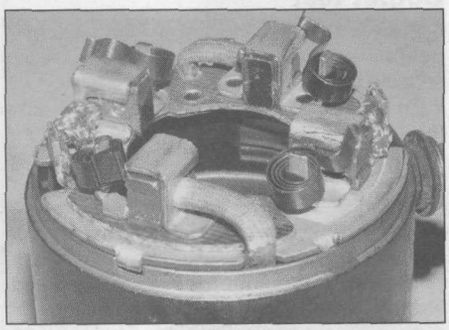
30.20 Fit the brushplate, locating the insulated wires and the tab (arrowed) correctly



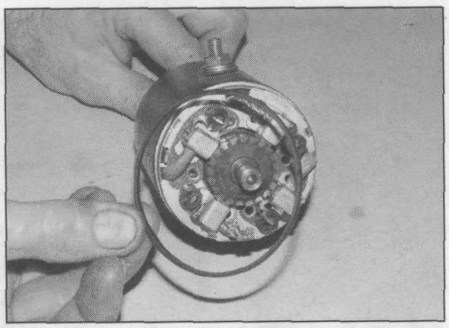
30.22a Slide the brushes into their housings . . .



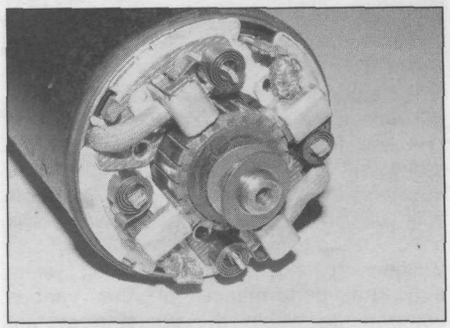
30.22b . . . then locate the spring ends onto the brushes . . .



30.22c . . . so they are held retracted in their housings



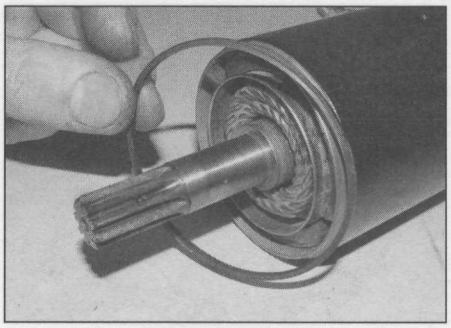
30.24a Fit a new sealing ring . . .



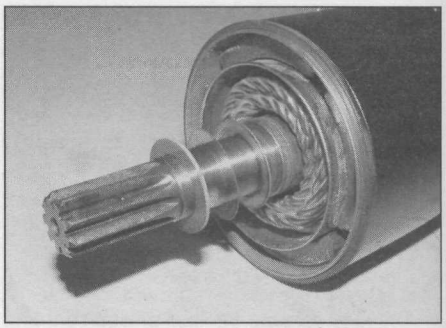
30.24b . . . then slide the shims onto the shaft



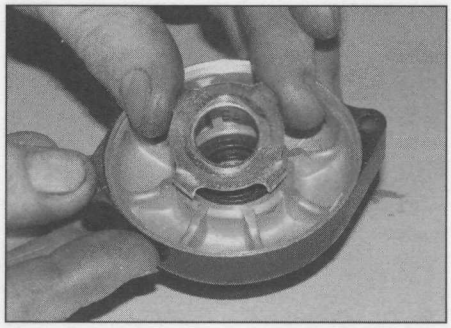
30.24c Fit the rear cover, locating the tab in the slot in the cover



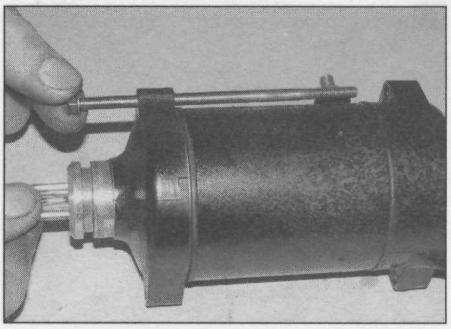
30.25a Fit a new sealing ring . . .



30.25b . . . then slide the shims and washer onto the shaft



30.25c Fit the tabbed washer into the cover



30.26 Install the two long bolts and tighten them

onto the housing, aligning the marks noted or made earlier, and locating the tab on the housing in the slot in the cover **(see illustration)**.

25 Fit a new front cover sealing ring **(see illustration)**. Slide the shims and insulating washer onto the front of the armature **(see illustration)**. Apply a smear of grease to the lips of the front cover oil seal. Fit the tabbed washer onto the cover **(see illustration)**, making sure the tabs locate correctly, then install the cover, aligning the marks made on removal **(see illustration 30.6)**. Remove the protective tape from the shaft end.

26 Check the alignment marks made on removal are correctly aligned, then install the long bolts and tighten them **(see illustration)**.

27 Install the starter motor (see Section 29).

31 Charging system testing – general information and precautions

1 If the performance of the charging system is suspect, the system as a whole should be checked first, followed by testing of the individual components. **Note:** *Before beginning the checks, make sure the battery is fully charged and that all system connections are clean and tight.*

2 Checking the output of the charging system and the performance of the various components within the charging system requires the use of a multimeter (with voltage, current and resistance checking facilities).

3 When making the checks, follow the procedures carefully to prevent incorrect connections or short circuits, as irreparable damage to electrical system components may result if short circuits occur.

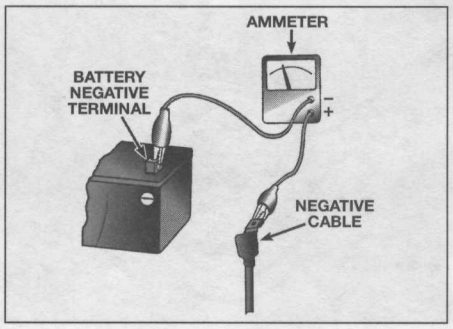
4 If a multimeter is not available, the job of checking the charging system should be left to a Yamaha dealer or automotive electrician.

32 Charging system – leakage and output test

1 If the charging system of the machine is thought to be faulty, remove the rider's seat (see Chapter 8) and perform the following checks.

Leakage test

Caution: Always connect an ammeter in series, never in parallel with the battery, otherwise it will be damaged. Do not turn the ignition ON or operate the starter motor when the ammeter is connected – a sudden surge in current will blow the meter's fuse.



32.3 Checking the charging system leakage rate – connect the meter as shown

2 Turn the ignition switch OFF and disconnect the lead from the battery negative (–ve) terminal.

3 Set the multimeter to the Amps function and connect its negative (–ve) probe to the battery negative (–ve) terminal, and positive (+ve) probe to the disconnected negative (–ve) lead **(see illustration)**. Always set the meter to a high amps range initially and then bring it down to the mA (milli Amps) range; if there is a high current flow in the circuit it may blow the meter's fuse.

4 No current flow should be indicated. If current leakage is indicated (generally greater than 0.1 mA), there is a short circuit in the wiring. Using the wiring diagrams at the end of this Chapter, systematically disconnect individual electrical components, checking the meter each time until the source is identified.

5 If no leakage is indicated, disconnect the meter and connect the negative (–ve) lead to the battery, tightening it securely.

HAYNES HiNT ***If an alarm or immobiliser is fitted, its current drain should be taken into account when checking for current leakage.***

Output test

6 Start the engine and warm it up to normal operating temperature. Remove the rider's seat (see Chapter 8).

7 To check the regulated voltage output, allow the engine to idle and connect a multimeter set to the 0 to 20 volts DC scale (voltmeter) across the terminals of the battery (positive (+ve) lead to battery positive (+ve) terminal, negative (–ve) lead to battery negative (–ve) terminal) (see Section 3). Slowly increase the engine speed to 5000 rpm and note the reading obtained. The regulated voltage output should be as specified at the beginning of the Chapter. If the voltage is outside these limits, check the

alternator and the regulator/rectifier (see Sections 33 and 34).

> **HAYNES HiNT** *Clues to a faulty regulator are constantly blowing bulbs, with brightness varying considerably with engine speed, and battery overheating.*

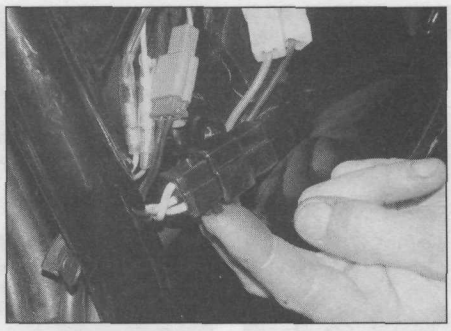
33 Alternator rotor and stator – check, removal and installation

Check

1 *Remove the left-hand side panel* (see Chapter 8).

2 Trace the alternator wiring back from the cover on the left-hand side of the engine and disconnect it at the black connector containing the three white wires **(see illustration)**.

3 Using a multimeter set to the ohms x 1 (ohmmeter) scale measure the resistance between each of the white wires on the alternator side of the connector, taking a total of three readings, then check for continuity between each terminal and ground (earth). If the stator coil windings are in good condition the three readings should be within the range shown in the Specifications at the start of this Chapter and there should be no continuity (infinite resistance) between any of the terminals and ground (earth). If not, check the fault is not due to damaged wiring between the connector and coils. If the wiring and connectors are good, the alternator stator coil *assembly is at fault and must be replaced with* a new one.



33.2 Disconnect the alternator wiring connector

Removal

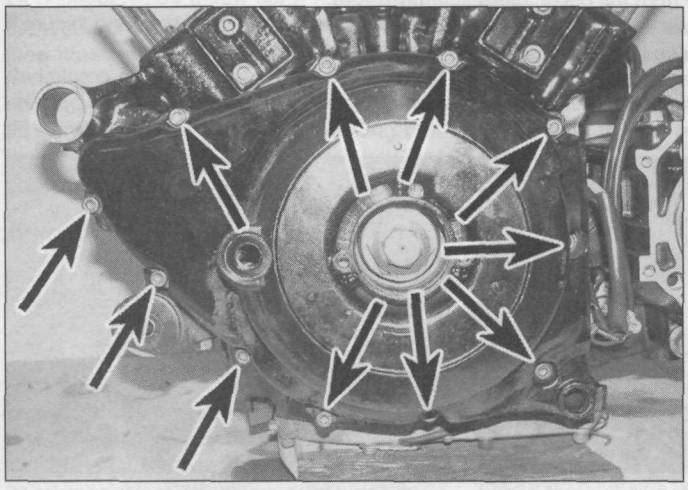
4 Remove the rider's seat and the left-hand side panel (see Chapter 8).

5 Trace the alternator and pick-up coil wiring back from the cover on the left-hand side of the engine and disconnect it at the connectors **(see illustration 33.2)**. Free the wiring from its ties and guides and feed it through to the alternator cover, noting its routing.

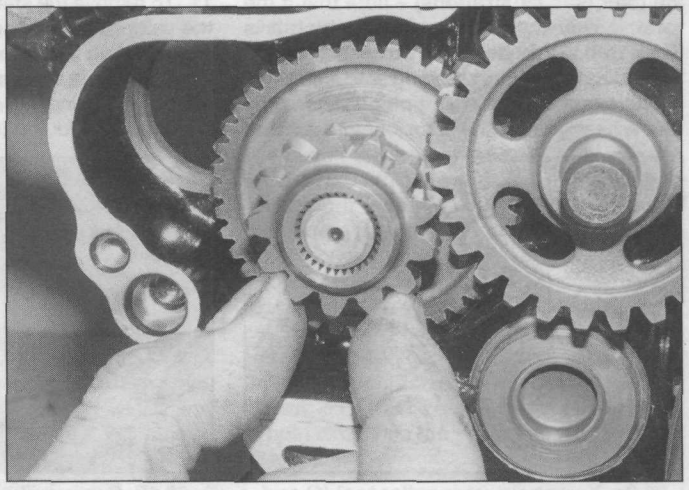
6 Working in a criss-cross pattern, unscrew the alternator cover bolts and remove the cover **(see illustration)**. Discard the gasket as *a new one must be used. Remove the dowels* for safekeeping if they are loose.

7 Remove the outer starter reduction gear, then withdraw the shaft and remove the inner gear **(see illustrations)**. Withdraw the idle gear shaft and remove the gear **(see illustration)**.

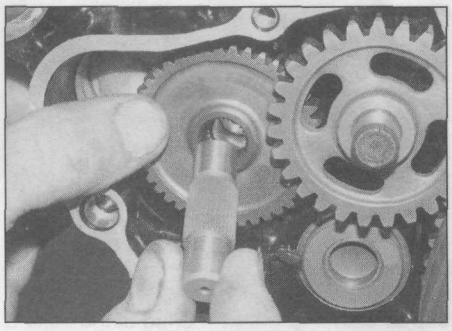
8 To remove the rotor bolt it is necessary to stop the rotor from turning. The best way to do this is to use a ring spanner on the hex on the rotor boss as shown to counter-hold while unscrewing the bolt **(see illustration)**. Alternatively use a rotor holding strap, but note that it must not contact the pick-up trigger on the outside of the rotor. If the engine is still in the frame, you can place the transmission in gear and have an assistant apply the rear brake, then unscrew the bolt. Note the oil passage pin in the bolt. Remove it and check the passage is not blocked by flushing it through with solvent.



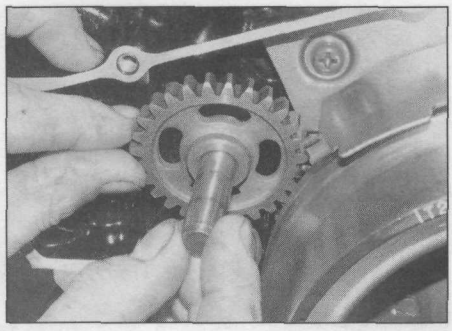
33.6 Alternator cover bolts (arrowed)



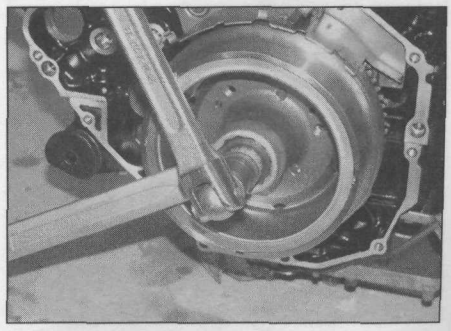
33.7a Remove the outer gear . . .



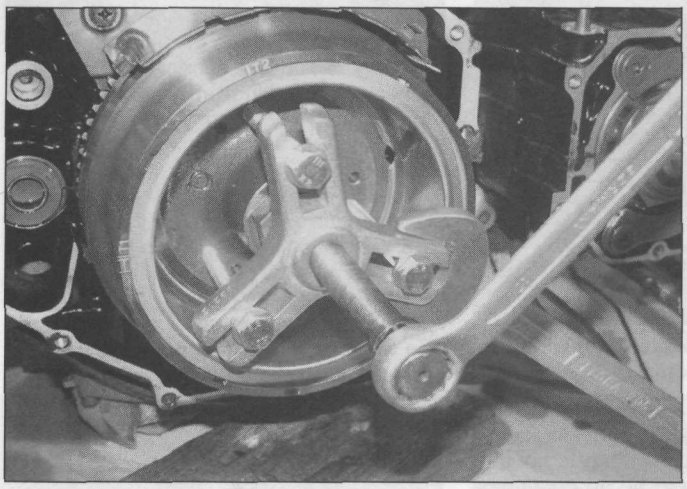
33.7b . . . then withdraw the shaft and remove the inner gear



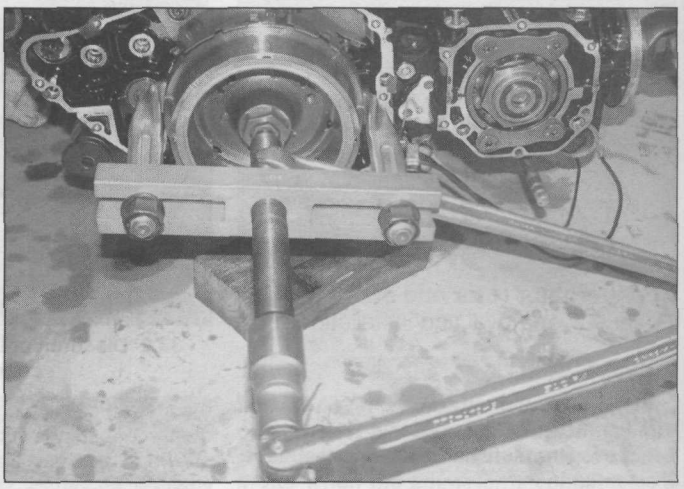
33.7c Withdraw the shaft and remove the idle gear



33.8 Unscrew the rotor bolt, counter-holding the rotor with a ring spanner as shown



33.9a You can use a puller that threads into the holes in the rotor . . .



33.9b . . . or one that locates behind the rotor

9 To remove the rotor from the shaft it is necessary to use a rotor puller. Yamaha provide a special tool (Pt. Nos. 90890-01362 and 04089 – European models, and Pt. Nos. YU-33270 and YM-33282 US models), or alternatively similar commercially available mechanical pullers can be set up as shown, either using the threaded holes in the rotor, or using a legged puller that locates behind the rotor **(see illustrations)** – note that if the rotor is very tight on the shaft, which it is likely to be, it is better not to use the type that relies on bolts threading into the holes as there is a danger of stripping the threads. Use a heat gun on the rotor boss to expand it, and or an hydraulic puller if necessary. When tightening the puller bolt, counter-hold the rotor using a suitable spanner or bar located as shown, according to the puller type.

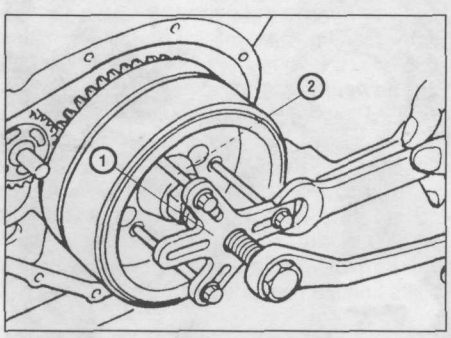
10 After the rotor has been removed, remove the Woodruff key from the slot in the crankshaft for safekeeping if loose **(see illustration)**.

11 To remove the stator from the cover, undo the wiring guide screws and remove the guide, noting how it locates **(see illustration)**. Undo the three screws securing the stator and remove it, freeing the wiring grommet from the crankcase as you do **(see illustration)**.

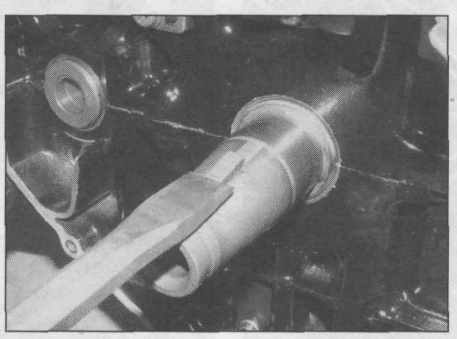
Installation

12 Install the stator in the cover, aligning the rubber wiring grommet with the groove, then install the screws and tighten them to the torque setting specified at the beginning of the Chapter **(see illustration 33.11b)**. Apply a suitable sealant to the wiring grommet, then press it into the cut-out in the cover **(see illustration)**. Fit the wiring guide, locating its holes over the pegs in the cover, and secure it with its screws **(see illustration)**.

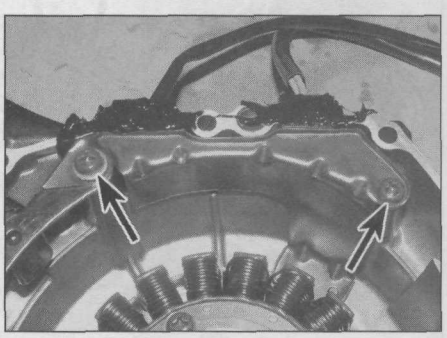
13 Clean the tapered end of the crankshaft and the corresponding mating surface on the inside of the rotor with a suitable solvent. Fit



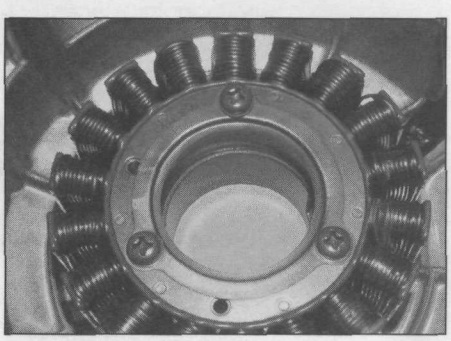
33.9c Yamaha's rotor puller tool (1) and adaptor (2) in use



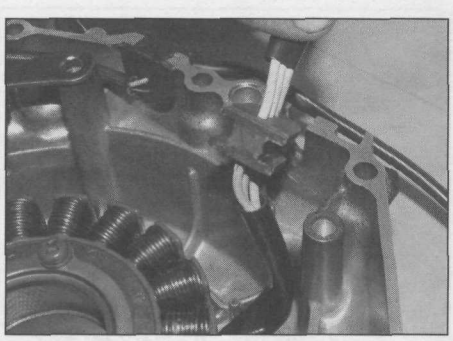
33.10 Remove the Woodruff key if it is loose



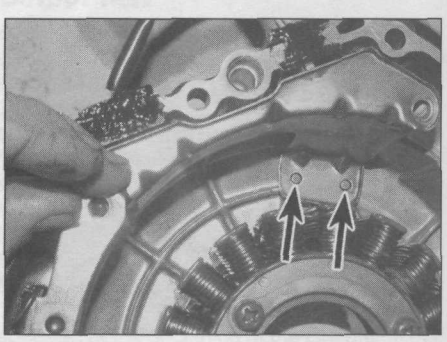
33.11a Undo the wiring guide screws (arrowed) and remove the guide . . .



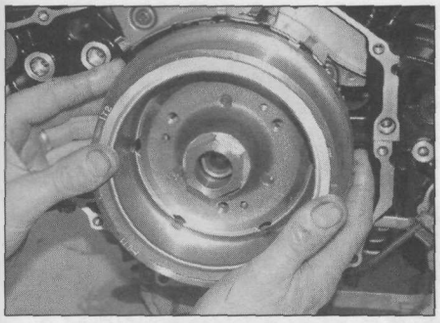
33.11b . . . then undo the stator screws



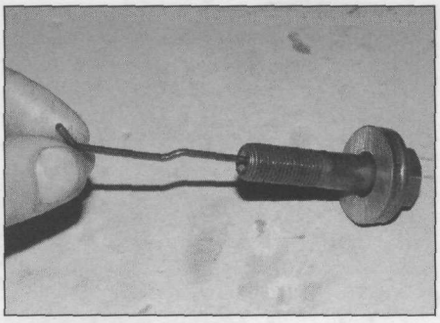
33.12a Fit the grommet into its cut-out



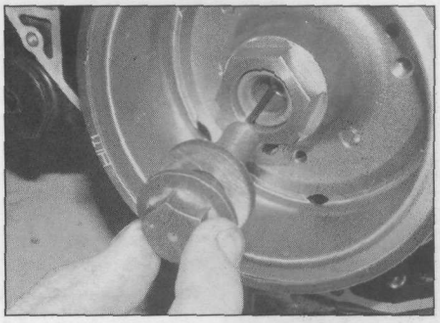
33.12b Locate the holes in the guide over the pegs in the cover (arrowed)



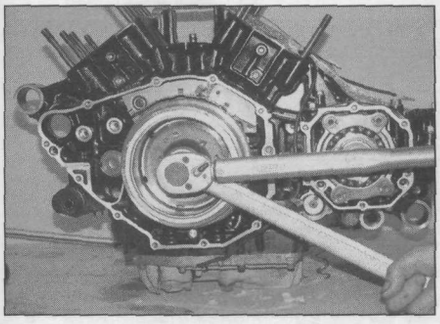
33.13 Slide the rotor onto the shaft, aligning the cut-out with the Woodruff key



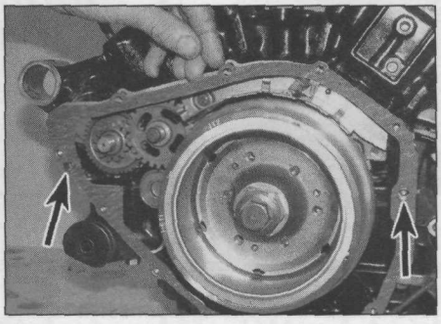
33.14a Fit the pin into the bolt . . .



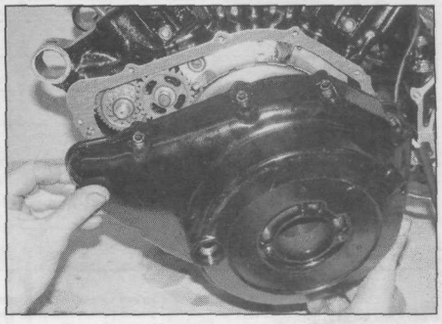
33.14b . . . then install the bolt with its washer . . .



33.14c . . . and tighten it to the specified torque



33.16a Locate the new gasket onto the dowels (arrowed) . . .



33.16b . . . then install the cover

the Woodruff key into its slot in the crankshaft **(see illustration 33.10)**. Make sure that no metal objects have attached themselves to the magnet on the inside of the rotor, then install the rotor onto the shaft, making sure the slot is correctly aligned with the key **(see illustration)**.

14 Install the rotor bolt with its washer, making sure the oil passage pin is in the bolt **(see illustrations)**. Tighten the bolt to the torque setting specified at the beginning of the Chapter, using the method employed on removal to prevent the rotor from turning **(see illustration)**.

15 Lubricate the idle gear shaft with oil, then locate the gear, meshing its teeth with those of the starter clutch driven gear, and install the shaft **(see illustration 33.7c)**. Lubricate the reduction gear shaft with oil, then locate the inner (large) gear, meshing its teeth with those of the starter motor, and install the shaft **(see illustration 33.7b)**. Slide the outer (small) reduction gear onto the shaft, engaging its teeth with those of the idle gear **(see illustration 33.7a)**.

16 Fit the cover dowels into the crankcase if removed **(see illustration)**. Fit a new gasket onto the dowels. Install the alternator cover, making sure the starter reduction and idle gear shafts locate in their bores, and the rubber fillet on the top of the baffle locates on the correct side of the wall in the cover **(see illustration)**. Tighten the cover bolts evenly in a criss-cross pattern to the specified torque setting **(see illustrations 33.6)**.

17 Feed the alternator and pick-up coil wiring up to their connectors, making sure they are correctly routed and secured by their ties and guides **(see illustration 33.2)**. Install the rider's seat (see Chapter 8).

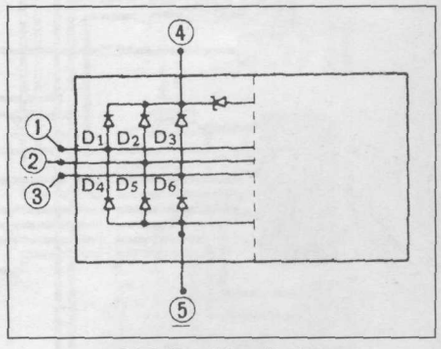
34 Regulator/rectifier – check and renewal

Check

1 Yamaha provide no test specifications for the regulator, apart from the output test in Section 32. If it is suspected of being faulty, first check all other components, wiring and connectors in the charging circuit, referring to the relevant Sections in this Chapter and to the wiring diagrams at the end. If the regulator side of the unit is suspect (for example if bulbs are constantly varying their brightness and/or blowing, and if fuses are blowing), remove the unit (see below) and take it to a Yamaha dealer for testing. Alternatively, substitute the suspect unit with a known good one and see if the fault is cured.

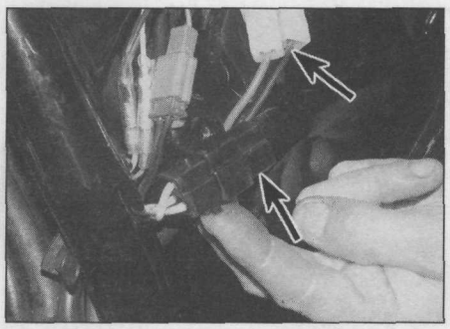
2 If the rectifier side of the unit is suspect (if the battery is not charging but the alternator is good), then it is possible to test the diodes within it. Remove the left-hand side panel (see Chapter 8). Trace the wiring from the regulator/rectifier and disconnect it at the wiring connectors **(see illustration 34.4)**.

3 A diode will pass current in one direction, but not in the other, i.e. only in the direction indicated by the arrowhead. Consequently when an ohmmeter or continuity tester is connected to it, the diode should show continuity with the meter or tester probes connected one way round and no continuity when the meter or tester probes are reversed. The circuit diagram of the rectifier shows the six diodes within it and the wires leading to and from it **(see illustration)**. When testing the diode marked D1, connect the meter positive (+ve) probe to the No. 1 white wire terminal and the negative (–ve) probe to the No. 4 red wire terminal, there should be continuity (zero resistance). Now reverse the meter probes – there should be no continuity (infinite resistance). Test all six diodes as follows. If the diode shows the same condition in both directions it is faulty.

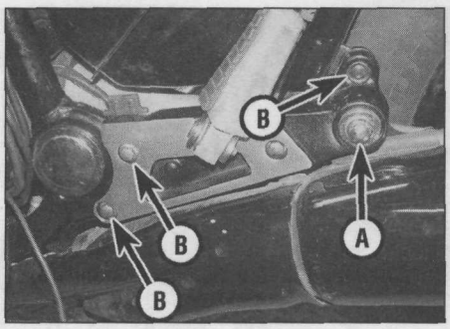


34.2 Rectifier diodes

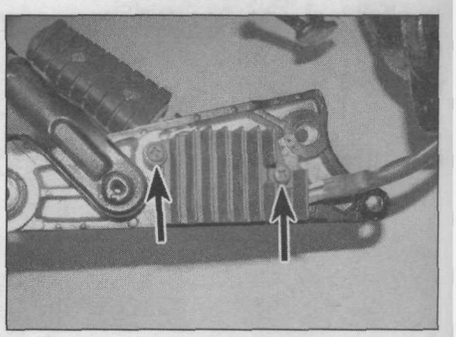
1 White wire
2 White wire
3 White wire
4 Red wire
5 Black wire



34.4 Disconnect the regulator/rectifier wiring connectors (arrowed)



34.5 Unscrew the silencer bolt (A), then the bracket bolts (B)



34.6 Regulator/rectifier screws (arrowed)

Diode no.	Continuity	No continuity
D1	1 (white) to 4 (red)	4 (red) to 1 (white)
D2	2 (white) to 4 (red)	4 (red) to 2 (white)
D3	3 (white) to 4 (red)	4 (red) to 3 (white)
D4	5 (black) to 1 (white)	1 (white) to 5 (black)
D5	5 (black) to 2 (white)	2 (white) to 5 (black)
D6	5 (black) to 3 (white)	3 (white) to 5 (black)

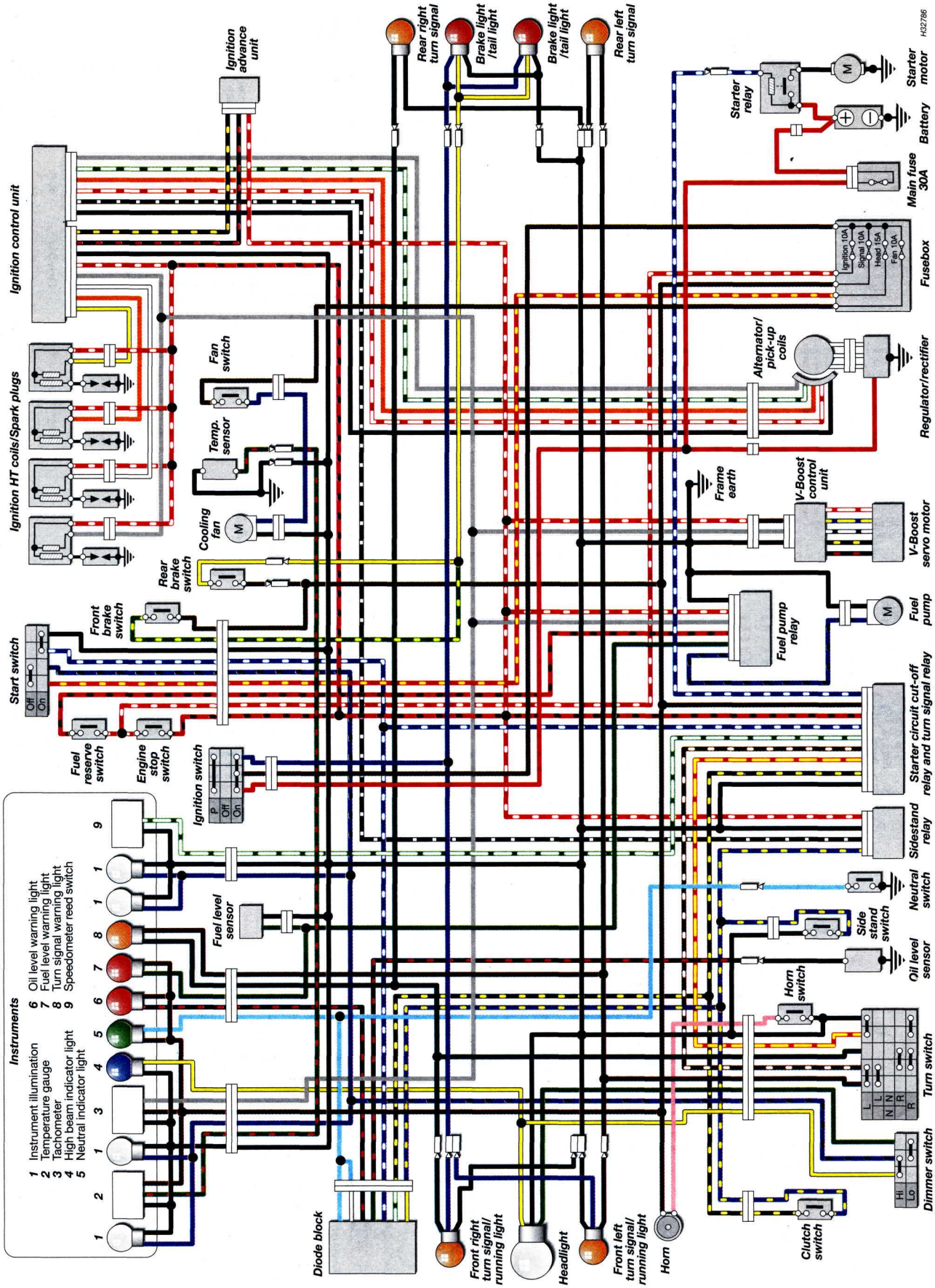
Renewal

4 The regulator/rectifier is mounted on the inside of the left-hand passenger footrest bracket. Remove the left-hand side panel (see Chapter 8). Trace the wiring from the regulator/rectifier and disconnect it at the wiring connectors **(see illustration)**. Free the wiring from any ties or guides and feed it down, noting its routing.

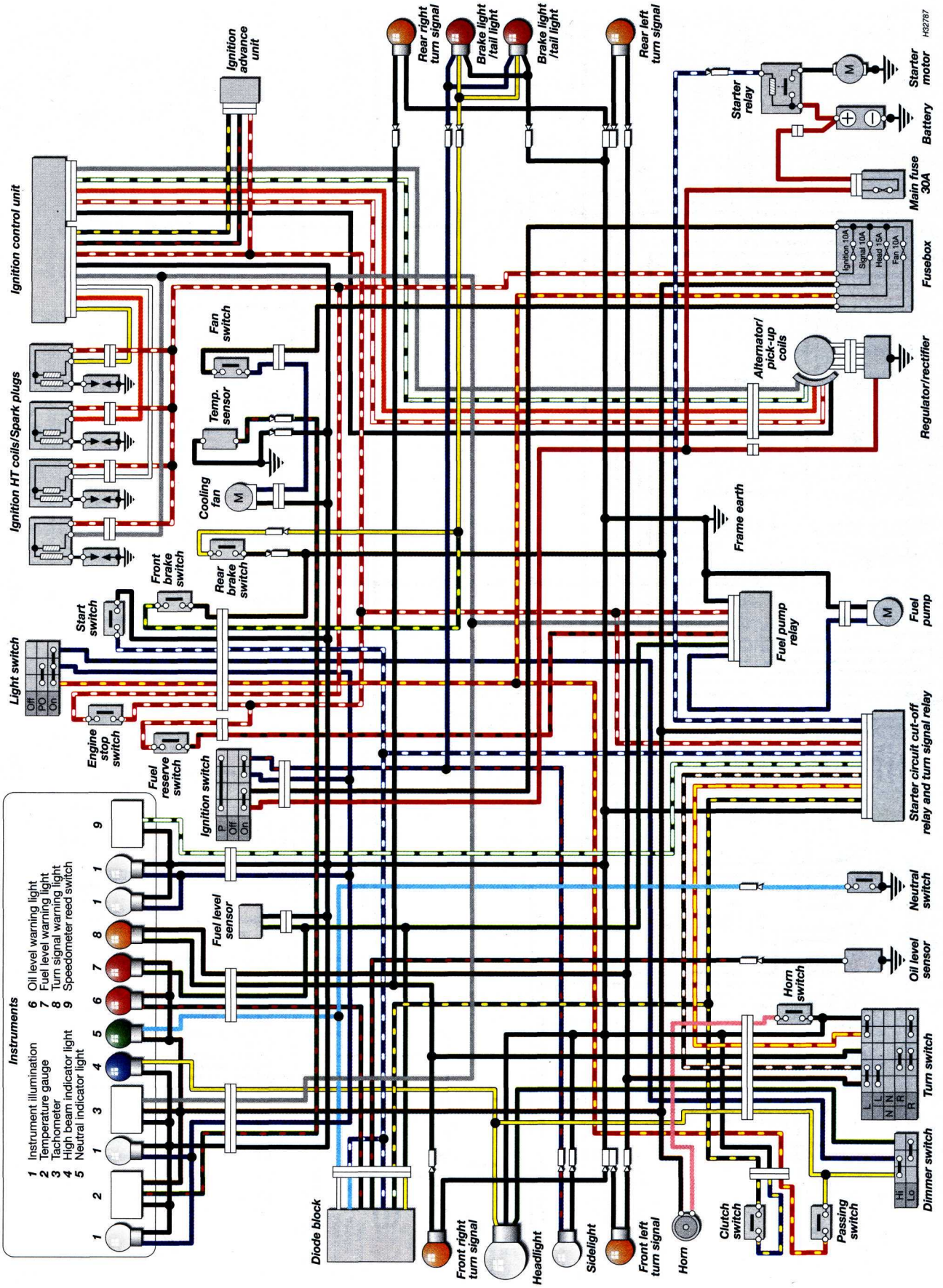
5 Unscrew the left-hand silencer mounting bolt, noting the washer **(see illustration)**. Unscrew the bolts securing the passenger footrest bracket and remove it.

6 Undo the two screws securing the regulator/rectifier and remove it **(see illustration)**.

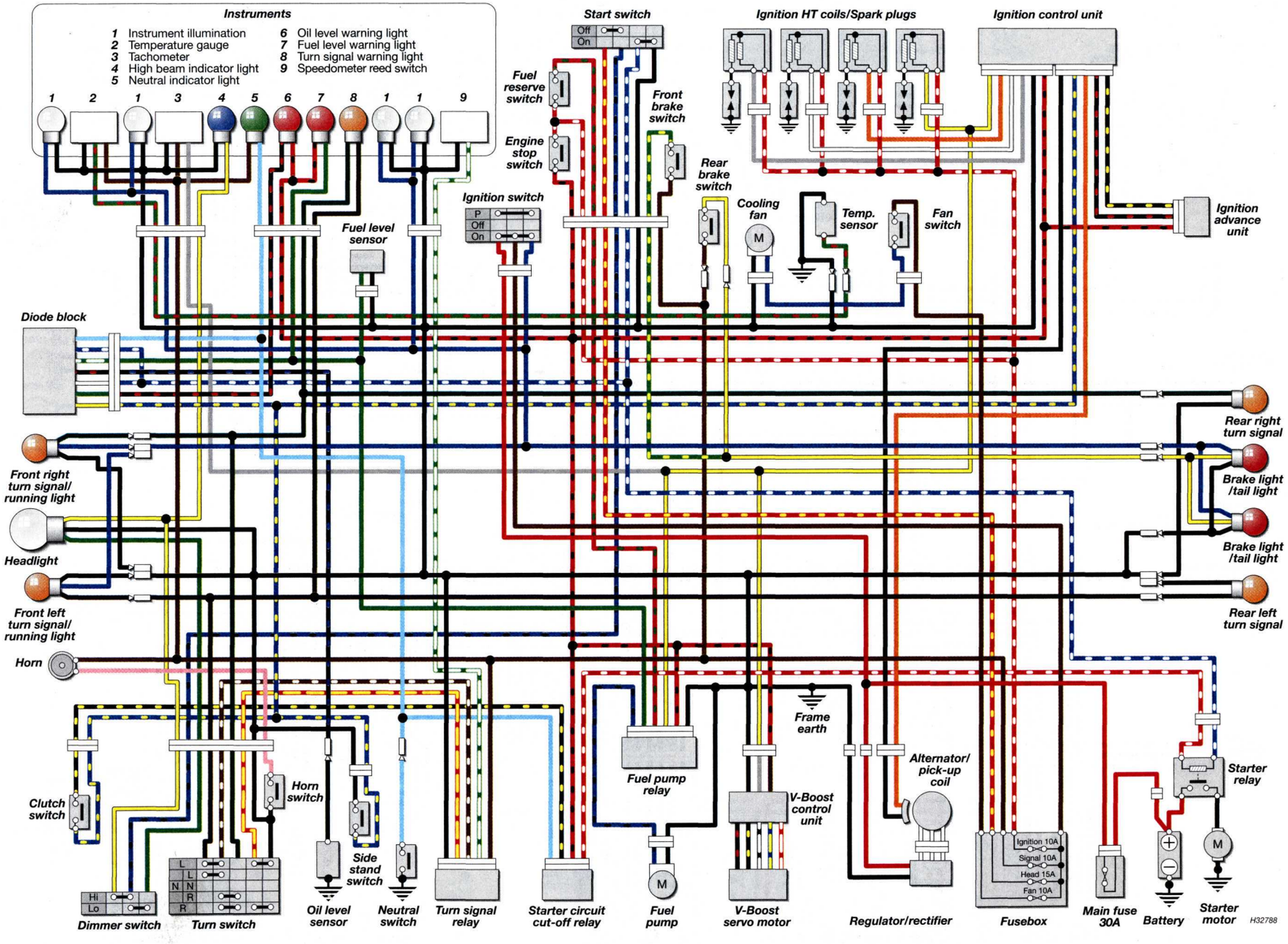
7 Installation is the reverse of removal.



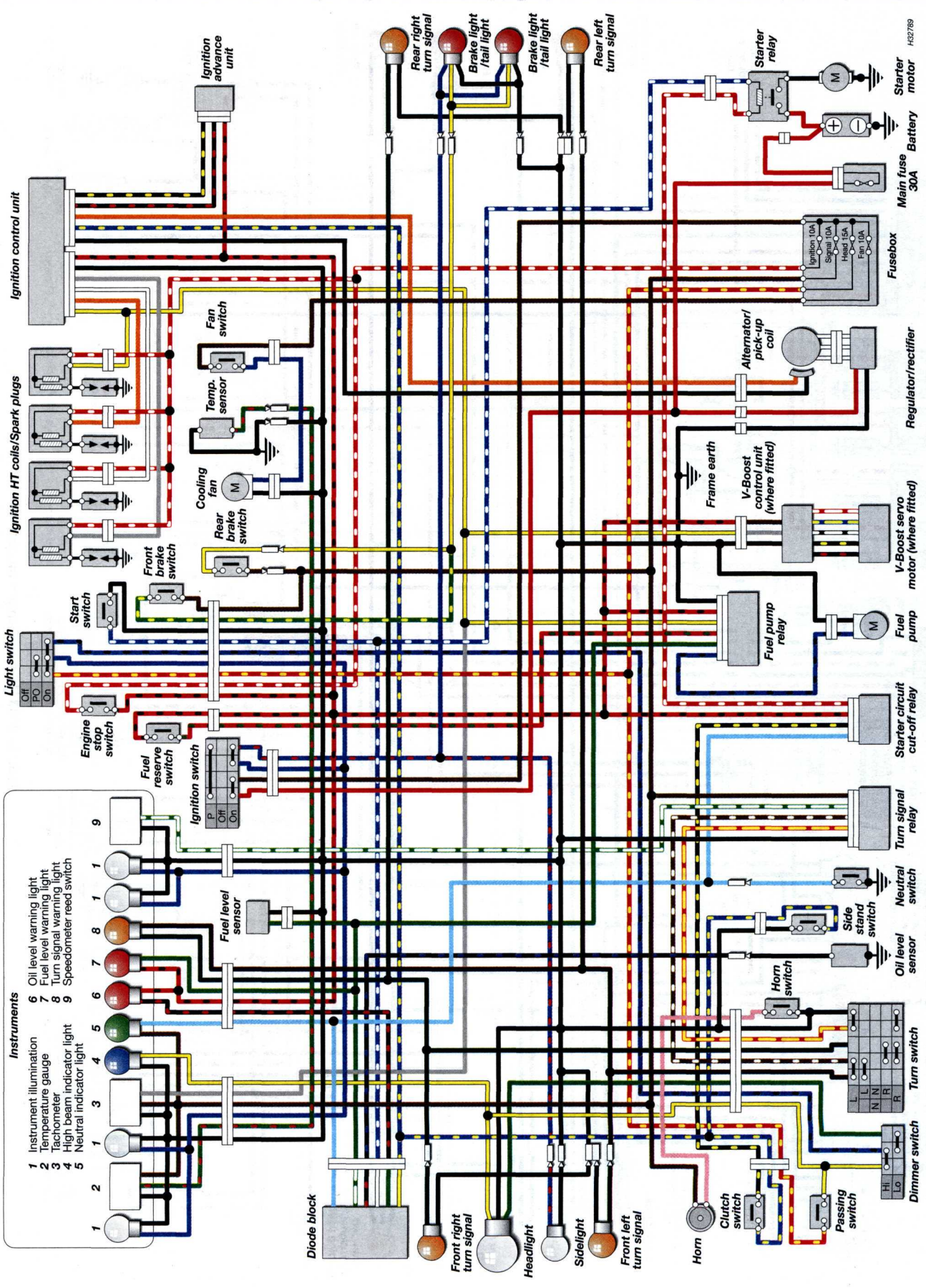
1985 to 1989 US and Canada models



1985 to 1989 Europe models



1990 to 2003 US and Canada models



1990 to 2003 Europe models