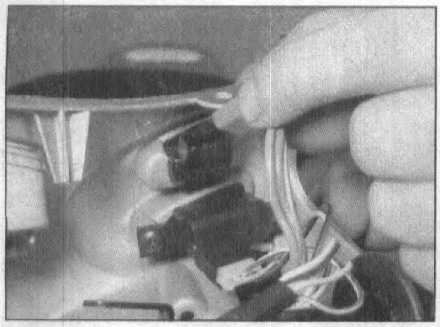
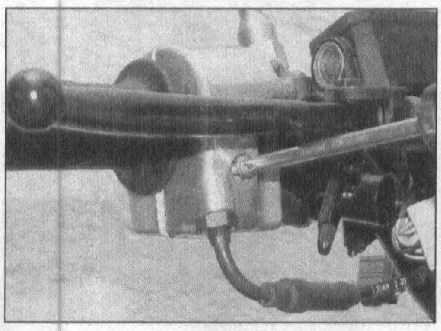


21.3 Disconnect the wiring connector from the switch



21.6a Undo the switch unit screw . . .

21.6b . . . and separate the two halves

21 Handlebar switches – check

Note: *B125 models are fitted with motorcycle-type handlebar switches – see Step 6.*

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 is a possibility that should not be overlooked. If breakage does occur, the switch will have to be renewed.

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

3 Remove the handlebar front cover (see Chapter 7). If required for improved access, also displace or remove the rear cover, in which the switches are housed. Disconnect the wiring connector from the switch being tested **(see illustration)**.

4 Check for continuity between the terminals of the switch harness 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 and use the wire colours to identify terminals where a switch has more than two terminals.

5 If the continuity check indicates a problem exists, spray the switch contacts with electrical contact cleaner (refer to Section 22 and remove the switch if required). 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 operated.

6 To check the switches on B125 models, first remove the rear handlebar cover and trace the wiring from the switch unit to be tested to the connector (see Chapter 7). Disconnect the wiring connector, then follow the procedure in Step 4 to check for continuity. To inspect the switch contacts, undo the screw securing the two halves and separate them, noting how they fit, then follow the procedure in Step 5 **(see illustrations)**.

22 Handlebar switches – removal and installation

Note: *B125 models are fitted with motorcycle-type handlebar switches – see Step 3.*

Removal

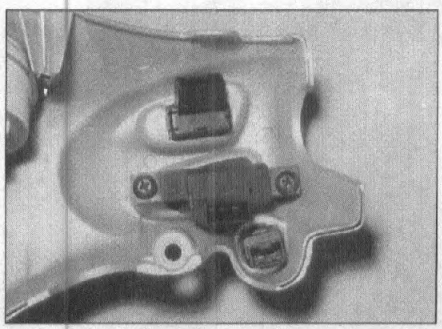
1 Remove the handlebar front cover (see Chapter 7). If required for improved access, also displace or remove the rear cover, in which the switches are housed.

2 Disconnect the wiring connector from the switch being removed **(see illustration 21.3)**, then remove the screws or release the clips securing the switch to the handlebar cover and remove the switch, noting how it fits **(see illustration)**.

3 On B125 models, first remove the rear handlebar cover and trace the wiring from the switch unit to the connector (see Chapter 7). Disconnect the wiring connector, then undo the screw securing the two halves of the unit and separate them **(see illustrations 21.6a and 21.6b)**. Note that to remove the front half of the right-hand switch unit the throttle cable must be disconnected from the twistgrip (see Chapter 4).

Installation

4 Installation is the reverse of removal. Make sure the wiring connectors are secure.



22.2 The switches are either a clip-fit or are screwed onto the cover

23 Diode (two-stroke engines) – check and renewal

Check

Note: *The following test applies to models fitted with two-stroke engines (see Model Specifications, Chapter 1). Refer to the Wiring diagrams at the end of this Chapter to confirm the location of the diode. On some models the warning light check function is controlled by the regulator/rectifier unit.*

1 The diode is part of the starter circuit which illuminates the oil level warning light, and on certain models the fuel level warning light, when the starter button is pressed. This serves as a check of the warning light bulb.

2 Locate the diode; if necessary trace the green/black wire from the starter relay to locate it. Disconnect the wires from the diode terminals.

3 Referring to the wiring diagrams at the end of this Chapter, note that the diode will only allow current to pass in the direction of the arrowhead.

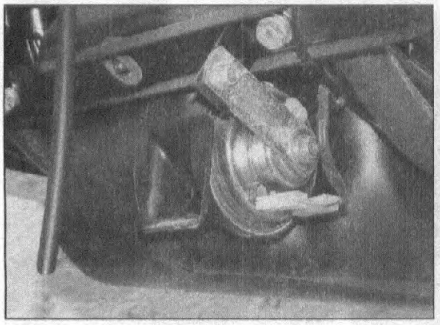
4 Using an ohmmeter or continuity tester, connect the positive (+ve) probe to the green/black wire terminal of the diode and the negative (-ve) probe to the other terminal – wire colour differs according to model. The diode should show continuity. Now reverse the probes. The diode should show no continuity. If it doesn't behave as stated, renew the diode.

5 Where two diodes are shown, connect the negative probe to the other terminal to test the other diode.

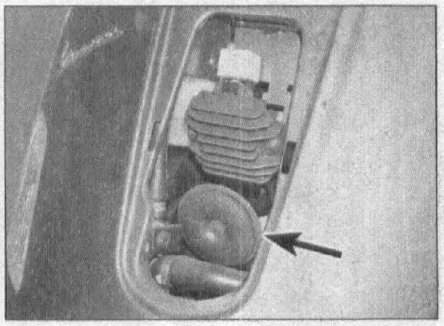
6 If the diode is good, check the other components in the circuit, and check the wiring between the various components (see the wiring diagrams at the end of this Chapter).

Renewal

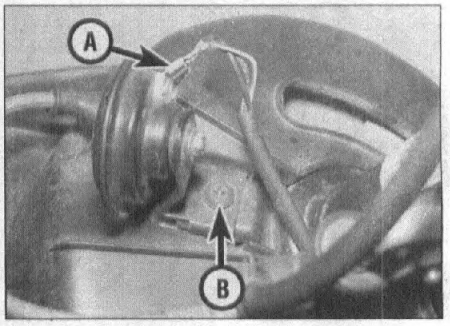
7 Trace the green/black wire from the starter relay to the diode, then disconnect the diode wiring connectors.



24.1a Location of horn on lower frame – X9



24.1b Location of horn (arrowed) behind front grille – GT models



24.5 Horn wiring connectors (A) and mounting screw (B)

24 Horn – check and renewal

Check

1 The horn is mounted behind the front panel or the belly panel **(see illustrations)**. Remove the panels as necessary, or on ET2, ET4, S and all LX and GT models, the front panel grille, to access the horn (see Chapter 7).
2 Unplug the wiring connectors from the horn **(see illustration 24.5)**. Using two jumper wires, apply battery voltage directly to the terminals on the horn. If the horn sounds, check the switch (see Section 21) and the wiring between the switch and the horn (see the *wiring diagrams* at the end of this Chapter).
3 If the horn doesn't sound, renew it.

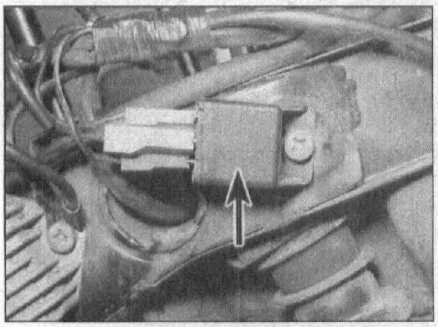
Renewal

4 Remove the panels as necessary to access the horn (see Step 1).
5 Unplug the wiring connectors from the horn, then remove the screw or bolt securing the horn and remove it **(see illustration)**.
6 Install the horn and securely tighten the screw or bolt. Connect the wiring connectors to the horn.

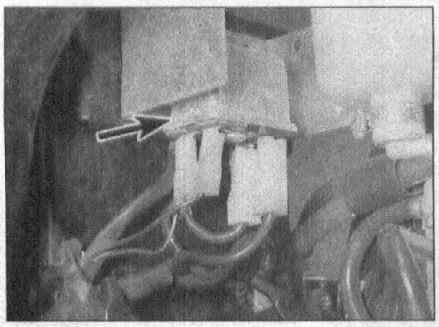
25 Starter relay – check and renewal

Check

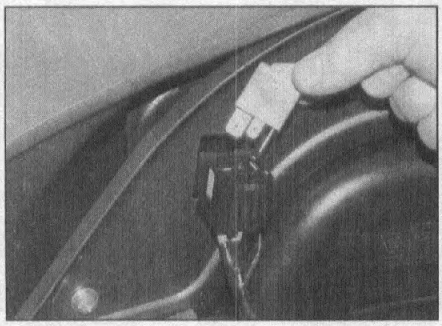
1 If the starter circuit is faulty, first check the fuse (see Section 5). Also check that the battery is fully-charged (see Section 3). If the brake switches are part of the starting system, check the operation of the switches and the switch wiring (see Section 14). If a side stand switch is fitted, check the operation of the switch (see Section 32).
2 To locate the starter relay, trace the lead from the positive terminal of the battery that connects to the relay (the other one connects to the ignition switch). Alternatively, trace the lead back from the starter motor to the relay **(see illustrations)**.
3 On scooters where the wires are connected to the relay terminals with individual connectors, disconnect the battery lead (terminal No. 30) and starter motor lead (terminal No. 87) from the relay **(see illustrations 25.2a 2b)**. With the ignition switch ON, press the starter switch. The relay should be heard to click. If the relay doesn't click, switch off the ignition and test it as follows.
4 On scooters where the relay plugs into a multi-pin connector **(see illustration 25.2c)**, or as a further check of the relay, disconnect the relay wiring/connector and test it as follows on the bench.
5 Set a multi-meter to the ohms x 1 scale and connect it across the relay's battery lead and starter motor lead terminals. Using a fully-charged 12 volt battery and two insulated jumper wires, connect across the starter switch and earth (ground) terminals of the relay **(see illustration)**. At this point the relay should be heard to click and the multi-meter read 0 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 renewed.
6 If the relay is good, check for battery voltage across the green/black (starter switch) wire



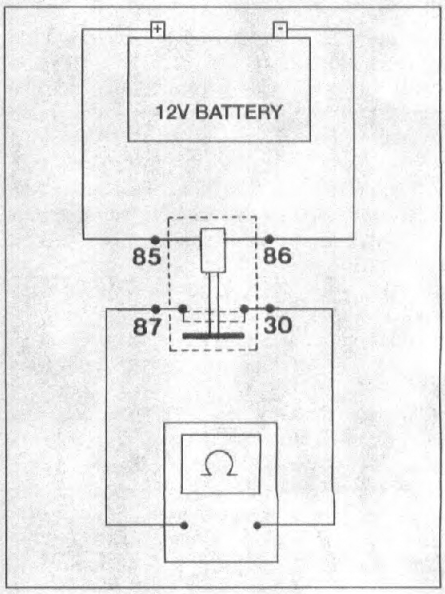
25.2a Starter relay – Typhoon



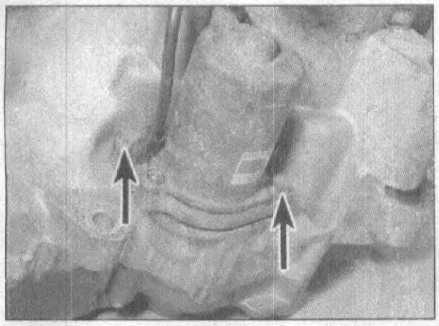
25.2b Starter relay – Hexagon



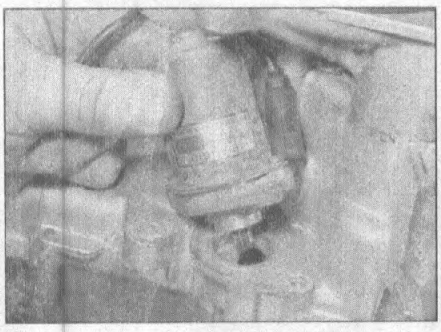
25.2c Starter relay with multi-pin connector – GT model shown



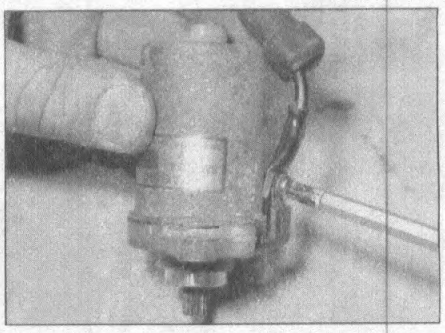
25.5 Starter relay test



26.2a Remove the two bolts (arrowed), noting the earth cable . . .



26.2b . . . then remove the starter motor . . .



26.2c . . . and detach the lead

and the white/black (earth) wire on the loom side of the relay connectors when the starter button is pressed. **Note:** *Wire colour codes may vary according to model – check the* wiring diagrams *at the end of this Chapter.* Check the 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).

Renewal

7 Disconnect the battery terminals, remembering to disconnect the negative (-ve) terminal first.

8 To locate the starter relay, trace the lead from the positive terminal of the battery that connects to the relay (the other one connects to the ignition switch). Alternatively, trace the lead back from the starter motor to the relay.

9 If applicable, make a careful note of which wire fits on which terminal (the terminals are numbered), then disconnect the relay wiring connectors and remove the relay **(see illustrations 25.2a, 2b and 2c)**.

10 Installation is the reverse of removal. Connect the negative (-ve) lead last when reconnecting the battery.

26 Starter motor – removal and installation

Removal

Two-stroke engines

1 On two-stroke engines the starter motor is mounted underneath the engine. Disconnect the battery negative (-ve) lead.

2 Unscrew the two bolts securing the starter motor to the crankcase, noting the earth cable secured by the upper bolt **(see illustration)**. Slide the starter motor out from the crankcase, then peel back the rubber terminal cover and remove the screw securing the starter lead to the motor **(see illustrations)**. Detach the lead and remove the starter motor.

Four-stroke engines

3 On four-stroke engines the starter motor is mounted on top of the engine, behind the carburettor. Remove the body panels as required according to model (see Chapter 7). Disconnect the battery negative (-ve) lead.

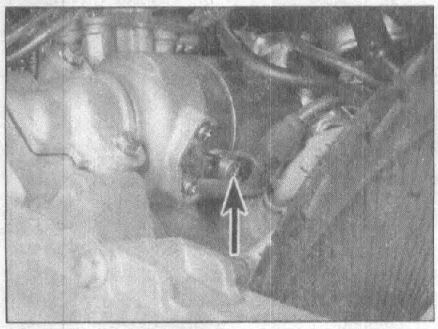
4 Peel back the rubber terminal cover, then remove the screw securing the starter lead to the motor and detach the lead **(see illustration)**.

5 Where fitted, unscrew the two bolts securing the starter motor pinion cover to the crankcase and remove the cover, noting the rubber pad on its inside **(see illustration)**. Unscrew the two bolts securing the starter motor to the crankcase, noting the earth lead and cable clip secured by them **(see illustration)**. Withdraw the bolts and remove the spacers, then lift the starter motor out of the crankcase **(see illustration)**.

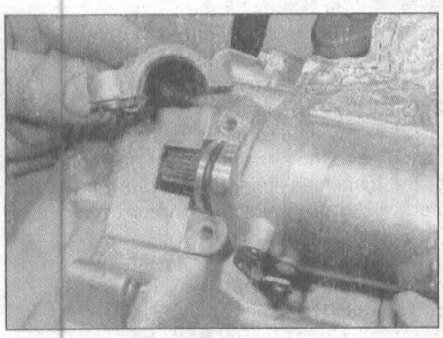
6 Remove the O-ring on the end of the starter motor and discard it, as a new one must be used.

Installation

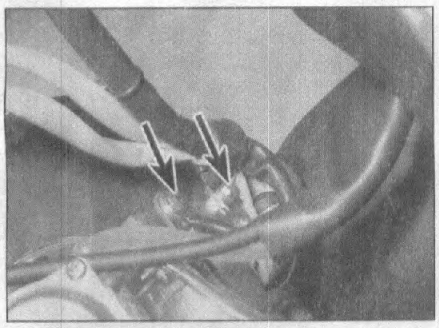
7 Installation is the reverse of removal. On four-stroke engines, fit a new O-ring on the end of the starter motor, making sure it is seated in its groove, and apply a smear of engine oil to it **(see illustration)**.



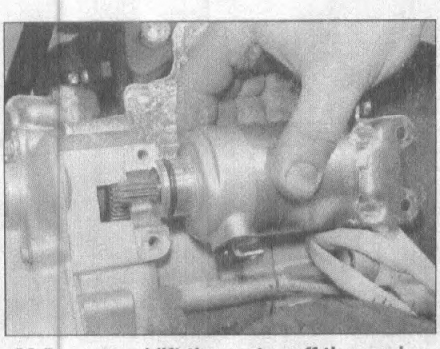
26.4 Pull back the rubber boot and remove the screw (arrowed) securing the lead



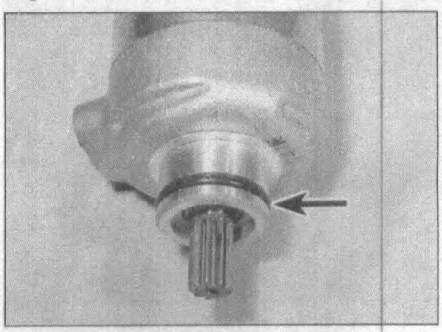
26.5a Remove the pinion cover where fitted . . .



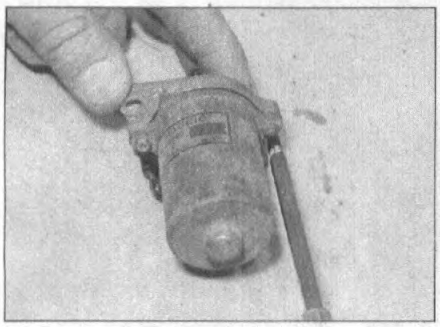
26.5b . . . then remove the two bolts (arrowed) . . .



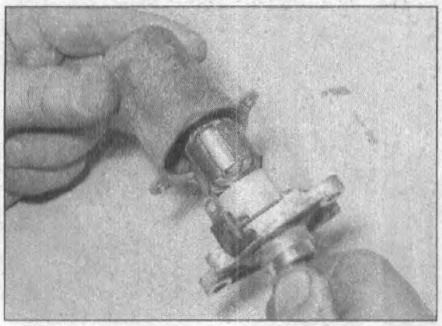
26.5c . . . and lift the motor off the engine



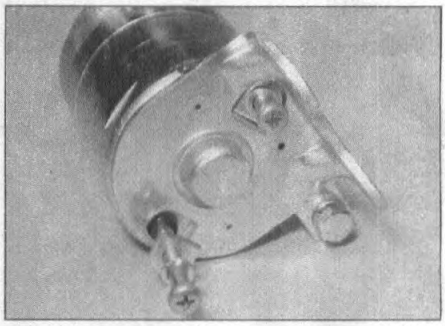
26.7 Fit a new O-ring on four-stroke models



27.3a Remove the starter motor housing screws . . .

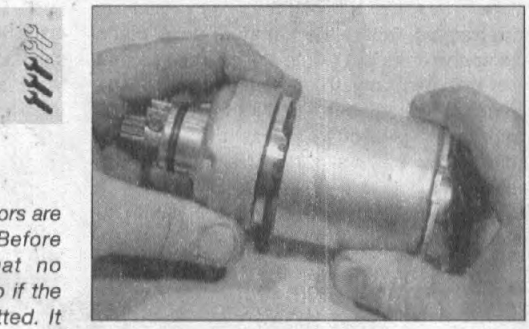


27.3b . . . and draw off the housing – Typhoon 50

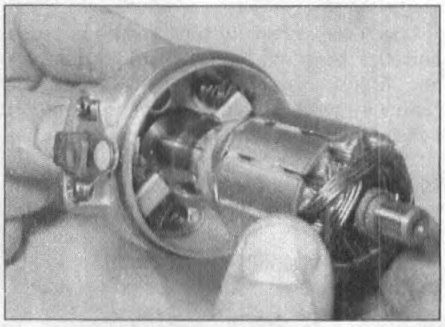


27.3c Remove the starter motor housing screws . . .

27 Starter motor – disassembly, inspection and reassembly



27.3d . . . and draw off the housing – ET4



27.4 Withdraw the armature, noting how it fits

Disassembly

Note: *A number of different starter motors are fitted across the range of models. Before disassembling the motor, note that no individual components are available, so if the motor is faulty, a new one must be fitted. It may be worthwhile consulting an auto-electrician before buying a new motor, as sometimes, depending on the nature of the fault, they can be repaired. When disassembling the motor, carefully note the correct fitted position of each component before removing it, as the procedure given below is general and does not cover the specific components of each type of motor.*

1 Remove the starter motor (see Section 26).

2 Note the alignment mark between the main housing and the cover, or make your own if it isn't clear.

3 Remove the screws or bolts securing the cover to the main housing and draw the housing off, leaving the armature in place in the cover **(see illustrations)**. It may be necessary to grasp the end of the starter motor shaft to prevent the magnets in the housing drawing the armature away with it – note that illustration 27.3d shows a clamp fitted around the shaft to prevent this.

4 Withdraw the armature from the cover, noting any shims or washers on either or both ends of the armature shaft, and noting how the brushes locate onto the commutator **(see illustration)**.

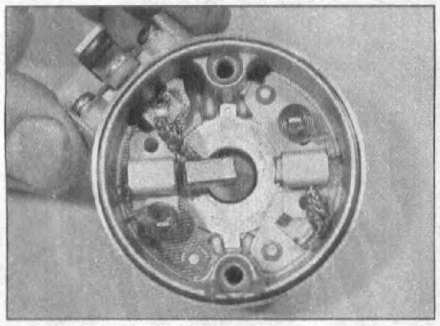
5 Slide the brushes out from their holders, noting how they locate against the brush springs **(see illustration)**.

Inspection

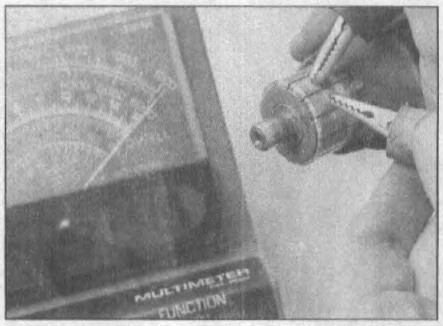
6 The parts of the starter motor that are most likely to wear and require attention are the brushes. Piaggio provide no specifications as to the minimum service length of the brushes, although those on the ET4 illustration measured 11 mm (new). If any of the brushes are excessively worn cracked, chipped, or otherwise damaged, they should be renewed. Check with a Piaggio dealer on the availability of new brushes – if none are available, a new starter motor must be fitted.

7 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.

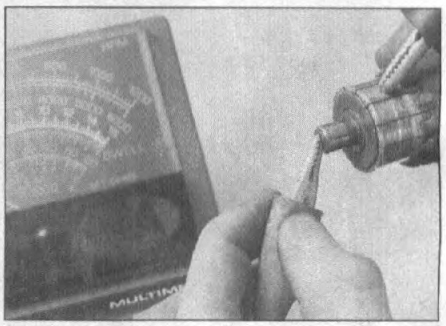
8 Using an ohmmeter or a continuity test light, check for continuity between the commutator bars **(see illustration)**. Continuity should exist between each bar and all of the others. Also, check for continuity between the commutator bars and the armature shaft **(see illustration)**. There should be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



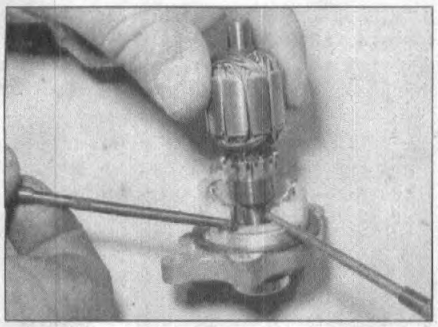
27.5 Slide the brushes out of their holders, noting how they fit



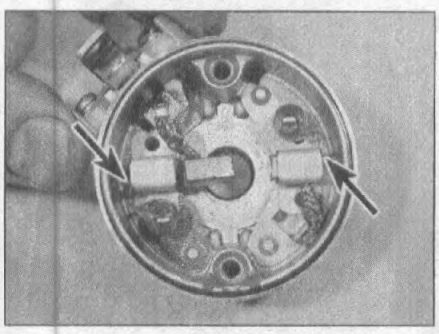
27.8a Continuity should exist between the commutator bars



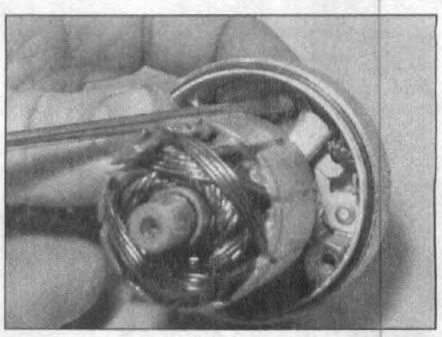
27.8b There should be no continuity between the commutator bars and the armature shaft



27.14a Hold the brushes back against the springs to allow the armature to be installed



27.14b Where possible, locate the spring ends (arrowed) onto the brush holders so that there is no pressure on the brushes . . .



27.14c . . . then locate them back onto the brushes after the armature has been installed

9 Check for continuity between each brush and the terminal bolt. There should be continuity (zero resistance). Check for continuity between the terminal bolt and the housing (when assembled). There should be no continuity (infinite resistance).

10 Check the front end of the armature shaft for worn, cracked, chipped and broken teeth. If the shaft is damaged or worn, renew the armature (or complete starter motor).

11 Inspect the end cover for signs of cracks or wear. Inspect the magnets in the main housing and the housing itself for cracks.

12 Inspect the armature shaft bearing surfaces in the cover and main housing and the cover seal.

Reassembly

13 Reassemble the starter motor in a reverse of the disassembly procedure.

14 When fitting the armature, note that it will be necessary to hold the brushes back against the pressure of their springs. There are a number of ways of doing this, all of which can be tricky, especially without the aid of an assistant. A pair of thin-ended angled scribes, or something similar, can be used **(see illustration)**. On some models it is possible to locate the spring ends onto the top of the brush holder so that there is no pressure on the brushes, which can be slid fully back into their holders as the armature is installed **(see illustration)**. Install the armature, then place the spring ends back onto the brushes so that the brushes are then pressed onto the commutator bars **(see illustration)**. Check that each brush is securely pressed against the commutator by its spring and is free to move easily in its holder.

15 Renew the cover O-ring if it is damaged **(see illustration)**.

28 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 multi-meter (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 multi-meter is not available, the job of checking the charging system should be left to a Piaggio dealer.

29 Charging system – leakage and output test

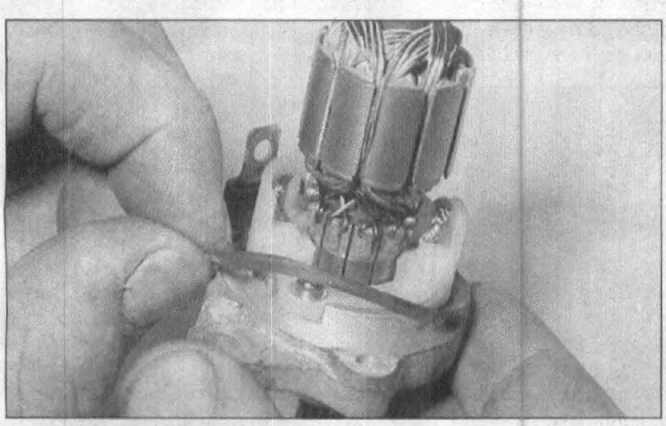
1 If the charging system of the machine is thought to be faulty, perform the following checks.

Leakage test

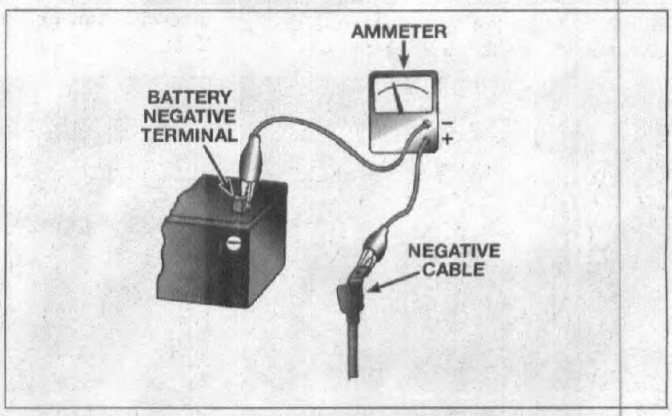
Caution: Always connect an ammeter in series, never in parallel with the battery, otherwise it will be damaged. Do not turn the ignition ON or operate the starter motor when the ammeter is connected – a sudden surge in current will blow the meter's fuse.

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

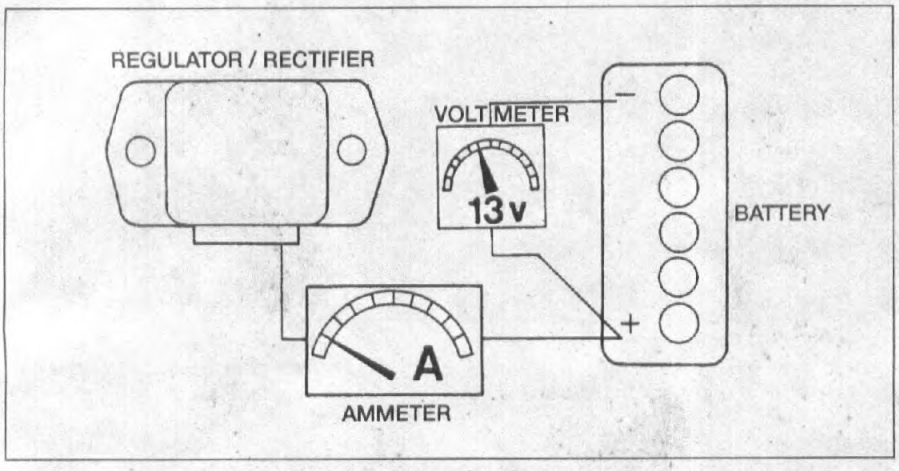
3 Set the multi-meter to the amps function and connect its negative (-ve) probe to the battery negative (-ve) terminal, and positive (+ve) probe to the disconnected negative (-ve) lead **(see illustration)**. Always set the meter to a high amps range initially and then bring it down to the mA (milli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



27.15 Renew the cover sealing O-ring if damaged



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



29.9 Checking the regulated current output

4 While Piaggio do not specify an amount, if the current leakage indicated exceeds 1 mA, there is probably a short circuit in the wiring. Disconnect the meter and connect the negative (-ve) lead to the battery, tightening it securely.

5 If leakage is indicated, use the wiring diagrams at the end of this book to systematically disconnect individual electrical components and repeat the test until the source is identified.

Alternator output test

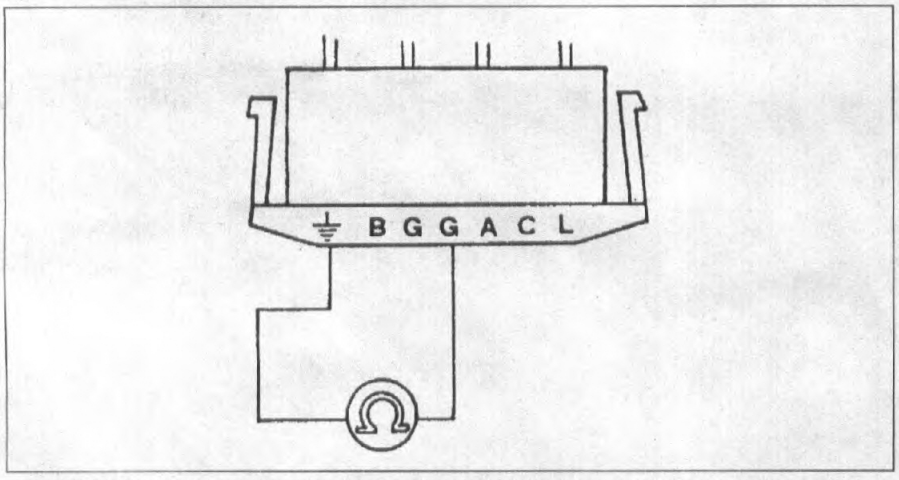
6 To check the unregulated voltage output, first start the engine and warm it up to normal operating temperature. Stop the engine and turn the ignition OFF. Support the scooter on its centre stand with the rear wheel clear of the ground.

7 Disconnect the regulator wiring connector (see Section 31). Connect a voltmeter set to the 0 – 50 volts ac scale between the wire with the violet cap and earth (Sfera 50/80, Typhoon 50/80, NRG MC2, Zip and Zip SP/RS models), or between the grey/blue terminal and earth (Sfera 125, Liberty 50, Liberty 50 4T, Zip 50, Zip 50/100 4T, ET2, ET4 50, ET4 125, LX 50, LX4 50, LXV50, S50, Fly 50, Fly 50/100 4T, NRG Power models), or between the yellow and black wire terminals (Typhoon 125, Zip 125, Hexagon and Skipper models).

8 Allow the engine to idle, then slowly increase the engine speed to 2000 or 3000 rpm according to model (see Specifications) and note the reading obtained. The unregulated voltage should be as specified at the beginning of the Chapter. Turn the ignition OFF, disconnect the voltmeter and reconnect the regulator connector. If the voltage is within the specified limits, follow the procedure in Step 9 and check the regulated current output. On all LEADER engined models also check the alternator coils (see Section 30).

9 To check the regulated current output, disconnect the battery positive (+ve) lead and connect a multi-meter set to the 0 to 20 amps DC scale (ammeter) in series between the lead and the battery positive (+ve) terminal **(see illustration)**. Connect another multi-meter set to the 0 to 20 volts DC scale (voltmeter) across the battery terminals (meter positive (+ve) probe to battery positive terminal, and meter negative (-ve) probe to battery negative terminal). Start the engine and allow it to idle, then slowly increase the engine speed to 2000 or 3000 rpm according to model (see Specifications) and note the reading obtained. The regulated current should be as specified at the beginning of the Chapter with battery voltage at 13 V.

10 If the regulated current is outside these limits, yet the unregulated voltage output from the alternator is as specified (see Steps 7 and 8), renew the regulator (see Section 31).



30.2 Checking the alternator coil insulation on Typhoon, Hexagon and Skipper

30 Alternator coils – check (Typhoon 125, Hexagon, Skipper and LEADER engines)

1 On ET2, ET4, LX, S and all GT models the regulator/ rectifier is mounted behind the grille in the front panel, though access is easier on all except the GT models if the kick panel is removed. On all other models, it is mounted on the frame behind the engine cover or side panels. Remove the body panels as required (see Chapter 7).

2 Using a multi-meter set to the ohms x 10 range, connect one probe to one of the yellow (G terminal) wires in the connector and the other probe to the black (earth) wire terminal in the connector **(see illustration)**. If the alternator stator insulation is in good condition, no continuity (high resistance) should be indicated. Repeat the test between the other yellow wire terminal and the black wire terminal.

3 Next connect the meter probes between the two yellow wire terminals of the connector. Continuity (zero resistance) should be shown.

4 If the test results indicate that the alternator coils are open circuit or that there is a short to earth, have your findings confirmed by a Piaggio dealer or auto-electrician before fitting a new alternator stator. Check that the fault is not due to broken or shorted wiring between the alternator and regulator/rectifier connector.

31 Regulator/rectifier – renewal

1 On ET2, ET4, LX, S and all GT models the regulator/rectifier is mounted behind the grille in the front panel, though access is easier on all except the GT models if the kick panel is removed **(see illustration)**. On NRG Power models, the regulator/rectifier is located to the right of the battery compartment **(see illustration)**. On all other models, it is mounted on the frame behind the engine cover or side panels **(see illustrations)**. Remove the body panels as required (see Chapter 7).