

Chapter 5

Ignition 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

General information

Cylinder numbering	
Left	1
Right	2
Spark plugs	see Chapter 1

Ignition timing

At idle	10° BTDC
Full advance	
1991 to 1995 TDM models	42° BTDC @ 5000 rpm
XTZ models	43° BTDC @ 6000 rpm
1996-on TDM models and TRX models	not available

Pick-up coil

Resistance	
1991 to 1995 TDM models and XTZ models	184 to 276 ohms @ 20°C
1996-on TDM models and TRX models	192 to 288 ohms @ 20°C

Ignition HT coils

Primary winding resistance	
1991 to 1995 TDM models and all XTZ models	2.38 to 3.22 ohms @ 20°C
1996-on TDM models and all TRX models	3.10 to 4.60 ohms @ 20°C
Secondary winding resistance (without plug cap)	
1991 to 1995 TDM models and all XTZ models	12.0 to 18.0 K-ohms @ 20°C
1996-on TDM models and all TRX models	10.4 to 15.6 K-ohms @ 20°C
Spark plug cap resistance	10 K-ohms @ 20°C
Minimum spark gap (see Section 2)	6 mm

1 General information

All models are fitted with a fully transistorised electronic ignition system, which due to its lack of mechanical parts is totally maintenance free. The system comprises a rotor, pick-up coil, ignitor unit and ignition HT coil(s) (refer to the wiring diagrams at the end of Chapter 9 for details). All TRX models and 1996-on TDM models are fitted with two HT coils, while all other models have one coil supplying both cylinders. The TRX models and 1996-on TDM models are also fitted with a throttle position sensor.

The ignition triggers, which are on the alternator rotor on the left-hand end of the crankshaft, magnetically operate the pick-up coil as the crankshaft rotates. The pick-up coil sends a signal to the ignitor unit which then supplies the ignition HT coil(s) with the power necessary to produce a spark at the plugs. The ignitor incorporates an electronic advance system controlled by signals generated by the ignition triggers and the pick-up coil.

The ignitor is linked to the clutch and sidestand cut-off switches. This safety circuit prevents the bike being started in gear unless the clutch lever is pulled in, and prevents the bike being ridden with the sidestand down.

Because of their nature, the individual ignition system components can be checked but not repaired. If ignition system troubles occur, and the faulty component can be isolated, the only cure for the problem is to renew the part. Keep in mind that most electrical parts, once purchased, cannot be returned. To avoid unnecessary expense, make very sure the faulty component has been positively identified before buying a new part.

Note that there is no provision for adjusting the ignition timing on these models.

2 Ignition system – check



Warning: The energy levels in electronic systems can be very high. On no account should the ignition be switched on whilst the plugs or plug caps are being held. Shocks from the HT circuit can be most unpleasant. Secondly, it is vital that the engine is not turned over or run with either of the plug caps removed, and that the plugs are soundly earthed (grounded) when the system is checked for sparking. The ignition system components can be seriously damaged if the HT circuit becomes isolated.

1 As no means of adjustment is available, any failure of the system can be traced to failure of a system component or a simple wiring fault. Of the two possibilities, the latter is by far the most likely. In the event of failure, check the system in a logical fashion, as described below.

2 Disconnect the HT leads from the spark plugs. Connect each lead to a spare spark plug and lay each plug on the engine with the threads contacting the engine (see illustration). If necessary, hold each spark plug with an insulated tool.



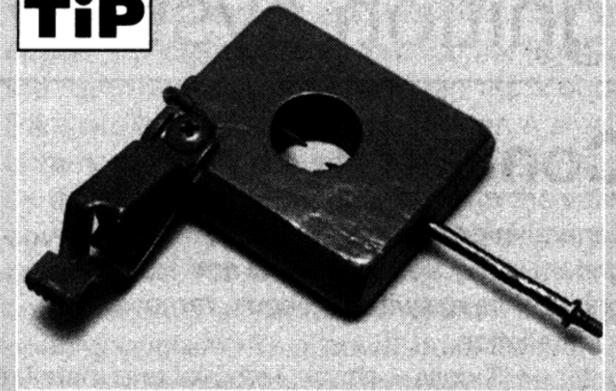
Warning: Do not remove the spark plugs from the engine to perform this check – atomised fuel being pumped out of an open spark plug hole could ignite, causing severe injury!

3 Having observed the above precautions, check that the kill switch is in the RUN position and the transmission is in neutral, then turn the ignition switch ON and turn the engine over on the starter motor. If the system is in good condition a regular, fat blue spark should be evident at each plug electrode. If the spark appears thin or yellowish, or is non-

existent, further investigation will be necessary. Before proceeding further, turn the ignition OFF.

4 The ignition system must be able to produce a spark which is capable of jumping a particular size gap. A healthy system should produce a spark capable of jumping at least 6 mm. A simple testing tool can be made to test the minimum gap across which the spark will jump (see **Tool Tip**) or alternatively it is possible to buy an ignition spark gap tester tool and some of these tools are adjustable to alter the spark gap.

TOOL TIP

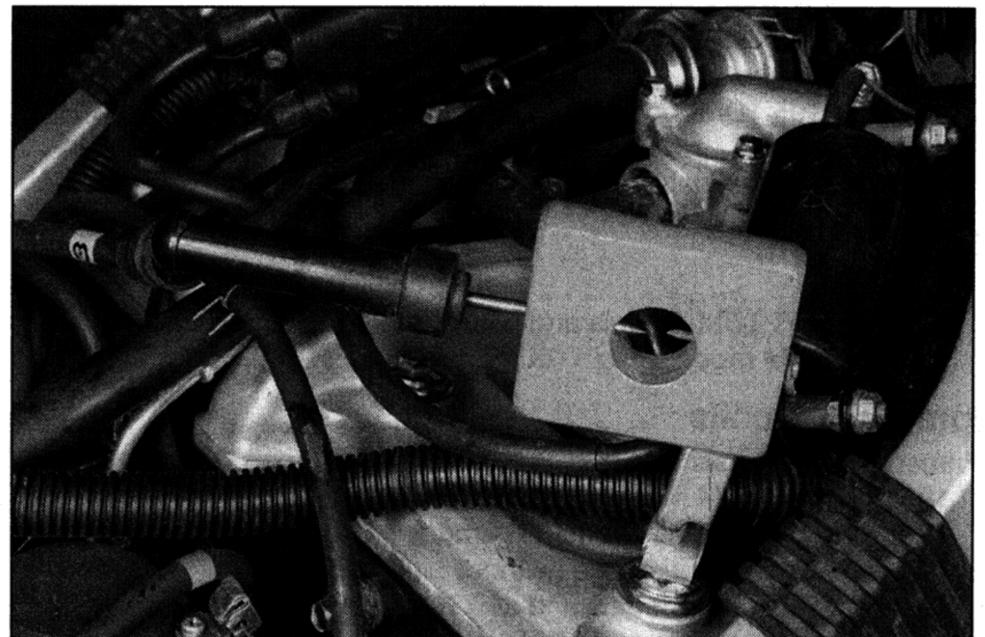


A simple spark gap testing tool can be made from a block of wood, a large alligator clip and two nails, one of which is fashioned so that a spark plug cap or bare HT lead end can be connected to its end. Make sure the gap between the two nail ends is the same as specified.

5 Connect one of the spark plug HT leads to the protruding electrode on the test tool, and clip the tool to a good earth (ground) on the engine or frame (see illustration). Check that the kill switch is in the RUN position, turn the ignition switch ON and turn the engine over on the starter motor. If the system is in good condition a regular, fat blue spark should be seen to jump the gap between the nail ends. On 1996-on TDM models and TRX models,



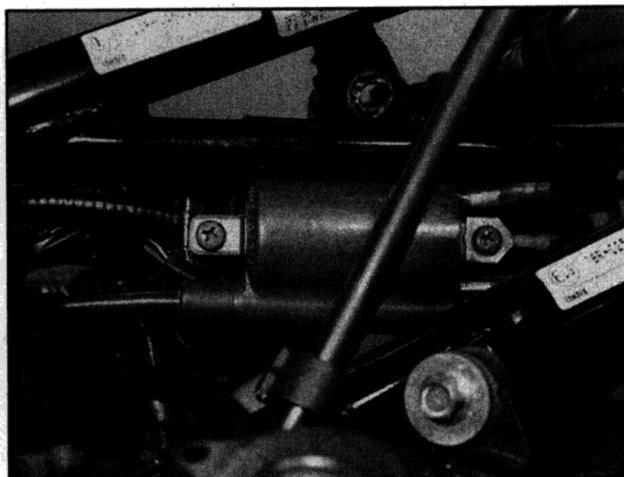
2.2 Earth the spark plug and operate the starter – bright blue sparks should be visible



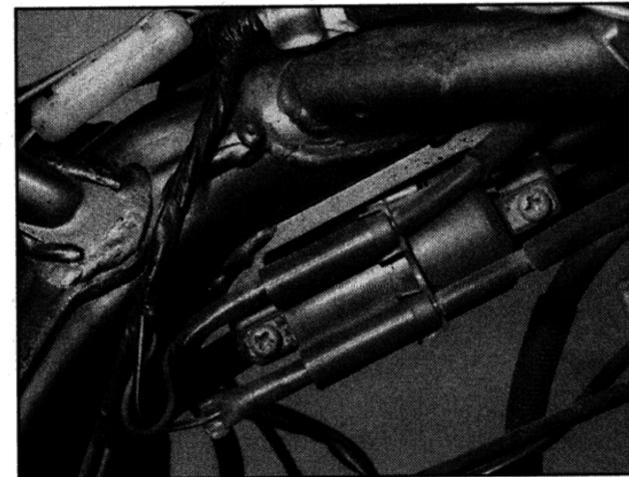
2.5 Connect the tester as shown – when the starter is operated sparks should jump between the nails



3.4a Ignition coil – 1991 to 1995 TDM models



3.4b Ignition coil – TRX models



3.4c Ignition coil – XTZ models

repeat the test for the other coil. If the test results are good the entire ignition system can be considered good. If the spark appears thin or yellowish, or is non-existent, further investigation will be necessary.

6 Ignition faults can be divided into two categories, namely those where the ignition system has failed completely, and those which are due to a partial failure. The likely faults are listed below, starting with the most probable source of failure. Work through the list systematically, referring to the subsequent sections for full details of the necessary checks and tests. **Note:** Before checking the following items ensure that the battery is fully charged and that all fuses are in good condition.

- a) Loose, corroded or damaged wiring connections, broken or shorted wiring

between any of the component parts of the ignition system (see Chapter 9).

- b) Faulty HT lead or spark plug cap, faulty spark plug, dirty, worn or corroded plug electrodes, or incorrect gap between electrodes.
- c) Faulty ignition (main) switch or engine kill switch (see Chapter 9).
- d) Faulty neutral, clutch or sidestand switch, and on XTZ models, diode (see Chapter 9).
- e) Faulty pick-up coil or damaged rotor triggers.
- f) Faulty ignition HT coil(s).
- g) Faulty ignitor unit.

7 If the above checks don't reveal the cause of the problem, have the ignition system tested by a Yamaha dealer equipped with diagnostic testing equipment.

3 Ignition HT coils – check, removal and installation



Check

1 The ignition HT coil(s) can be checked visually (for cracks and other damage) and the primary and secondary coil resistance can be measured with a multimeter. If the coil is undamaged, and if the resistance readings are as specified at the beginning of the Chapter, it is probably capable of proper operation, although note that sometimes a fault is only evident when the coil is under load and the engine running at high speed.

2 Remove the left-hand side cover (XTZ models) or the seat (all other models) (see Chapter 8).

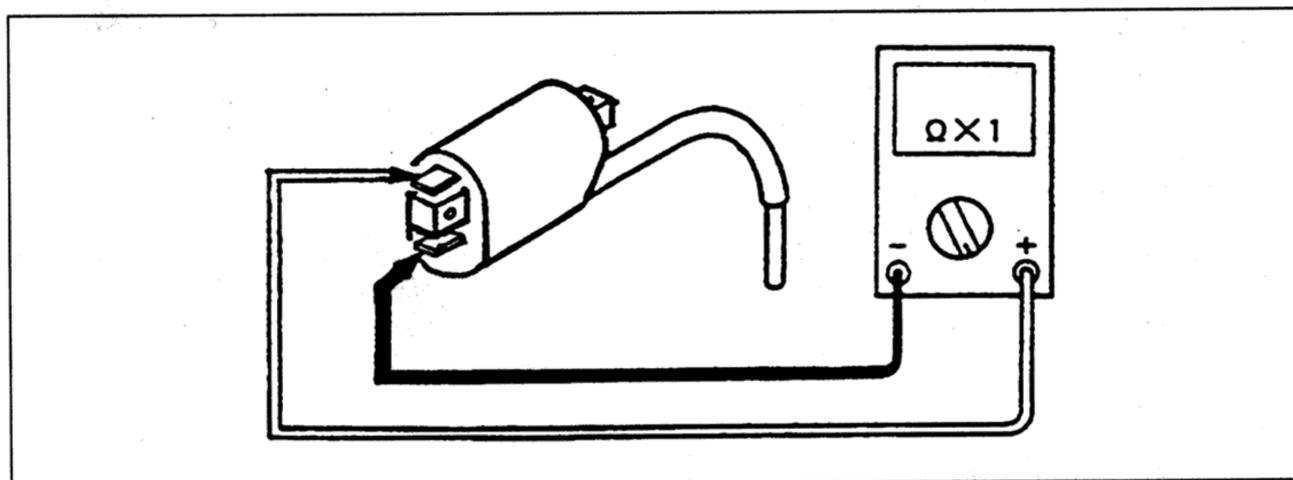
3 Disconnect the battery negative (-ve) lead.

4 On TDM and TRX models, the coil(s) is/are mounted on the inside of the frame behind the steering head – remove the fuel tank and the air filter housing for access (see Chapter 4) (see illustrations). On XTZ models, the coil is mounted underneath the rear of the fuel tank – remove the tank for access (see Chapter 4) (see illustration).

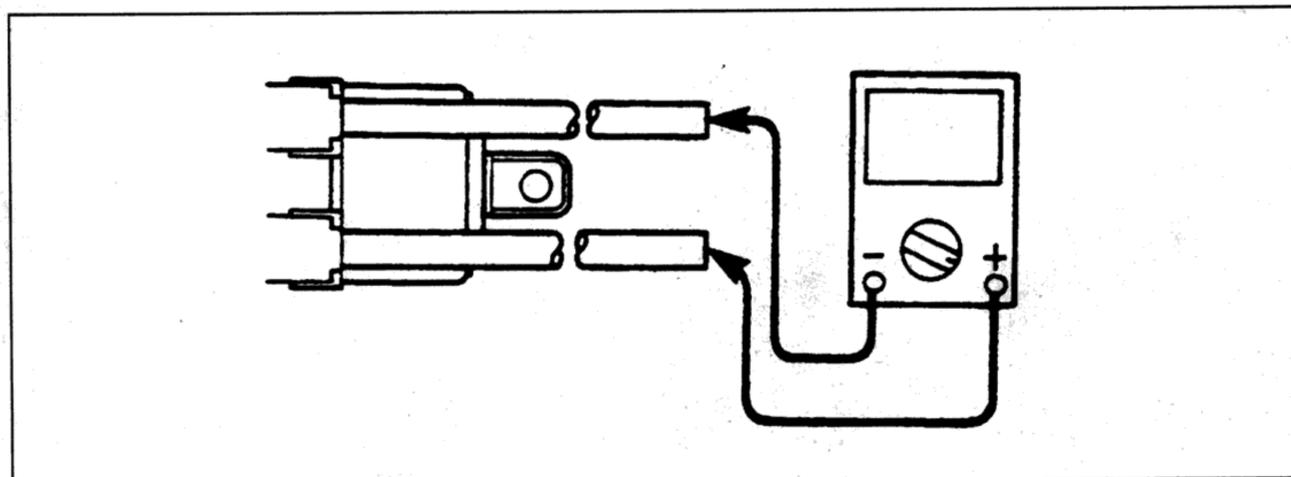
5 Disconnect the primary circuit electrical connectors from the coil and the HT leads from the spark plugs. Mark the locations of all wires and leads before disconnecting them.

6 Set the meter to the ohms x 1 scale and measure the resistance between the primary circuit terminals on the coil (see illustration). This will give a resistance reading of the primary windings of the coil and should be consistent with the value given in the Specifications at the beginning of the Chapter.

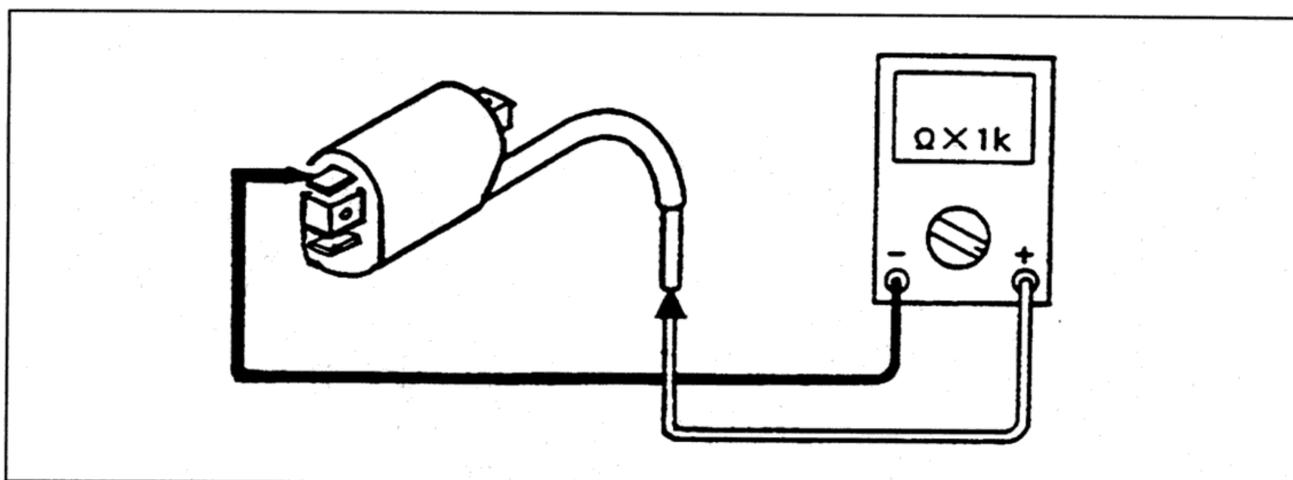
7 To check the condition of the secondary windings, unscrew the spark plug caps from the HT leads and set the meter to the K ohm scale. On 1991 to 1995 TDM models and XTZ models, connect one meter probe to one HT lead end and the other probe to the other HT lead end (see illustration). On 1996-on TDM models and TRX models, connect the positive (+ve) meter probe to the HT lead end and the negative (-ve) probe to the red/black wire



3.6 To test the coil primary resistance, connect the multimeter leads between the primary circuit terminals on the coil



3.7a Coil secondary resistance test – 1991 to 1995 TDM and all XTZ models



3.7b Coil secondary resistance test – 1996-on TDM and all TRX models



3.8 Measure the resistance of the spark plug cap

primary circuit terminal (see illustration). If the reading obtained is not within the range shown in the Specifications, it is likely that the coil is defective.

8 If the reading is as specified, measure the resistance of the spark plug cap by connecting the meter probes between the HT lead socket in the cap and the spark plug contact in the cap (see illustration). If the reading obtained is not as specified, renew the spark plug caps.

9 Should any of the above checks not produce the expected result, have your findings confirmed by a Yamaha dealer. If the coil is confirmed to be faulty, it must be renewed; the coil is a sealed unit and cannot therefore be repaired.

Removal

10 Remove the left-hand side cover (XTZ models) or the seat (all other models) (see Chapter 8). Disconnect the battery negative (-ve) lead.

11 On TDM and TRX models, the coil/s is/are mounted on the inside of the frame behind the steering head – remove the fuel tank and the air filter housing for access (see Chapter 4) (see illustrations 3.4a and b). On XTZ models, the coil is mounted underneath the rear of the fuel tank – remove the tank for access (see Chapter 4) (see illustration 3.4c).

12 Disconnect the primary circuit electrical connectors from the coil and disconnect the HT lead(s) from the spark plug(s). Mark the

locations of all wires and leads before disconnecting them.

13 Unscrew the two bolts or screws securing each coil, noting any spacers, and on TRX models the earth wire secured by one of the screws, and remove the coils (see illustrations 3.4a, b and c). Note the routing of the HT leads.

Installation

14 Installation is the reverse of removal. Make sure the wiring connectors and HT leads are securely connected.

4 Pick-up coil – check and replacement

Check

1 On TDM and TRX models remove the seat, and on XTZ models remove the left-hand side cover (see Chapter 8). Disconnect the battery negative (-ve) lead.

2 On TRX models, remove the side covers (see Chapter 8).

3 Trace the pick-up coil/alternator wiring from the top of the alternator cover and disconnect it at the connector with the white/green and white/red (early TDM models) or green/white and blue/yellow (all other models) wires (see illustrations). Using a multimeter set to the ohms x100 scale, measure the resistance between the terminals on the pick-up coil side of the connector.

4 Compare the reading obtained with that given in the Specifications at the beginning of this Chapter. The pick-up coil must be renewed if the reading obtained differs greatly from that given, particularly if the meter indicates a short circuit (no measurable resistance) or an open circuit (infinite, or very high resistance).

5 If the pick-up coil is thought to be faulty, first check that this is not due to a damaged or broken wire from the coil to the connector; pinched or broken wires can usually be repaired.

Replacement

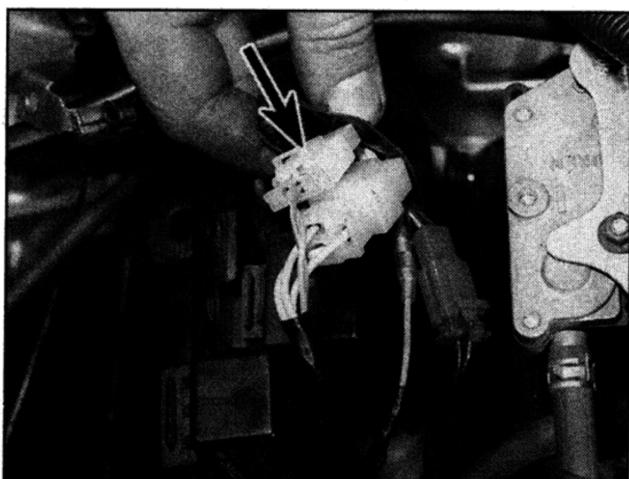
6 The pick-up coil is wired integrally with the alternator stator, which means that the stator must be removed and renewed along with the coil if the coil is faulty. However it is worth checking with a Yamaha dealer to see if the coil can be obtained separately and wired into the loom to avoid the extra expense of paying for a stator as well.

7 Refer to Chapter 9 for details of alternator stator/pick-up coil assembly removal.

5 Ignitor unit – check, removal and installation

Check

1 If the tests shown in the preceding or following Sections have failed to isolate the



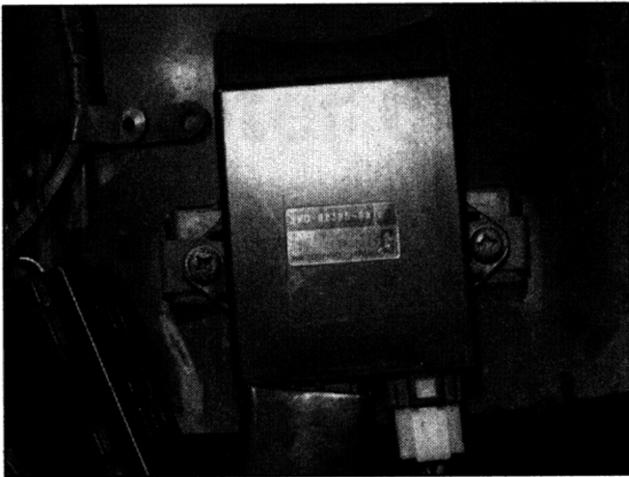
4.3a Pick-up coil wiring connector (arrowed) – TDM models



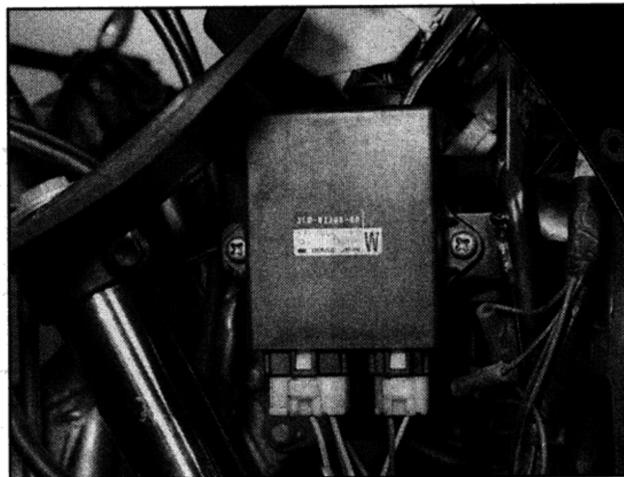
4.3b Pick-up coil wiring connector (arrowed) – TRX models



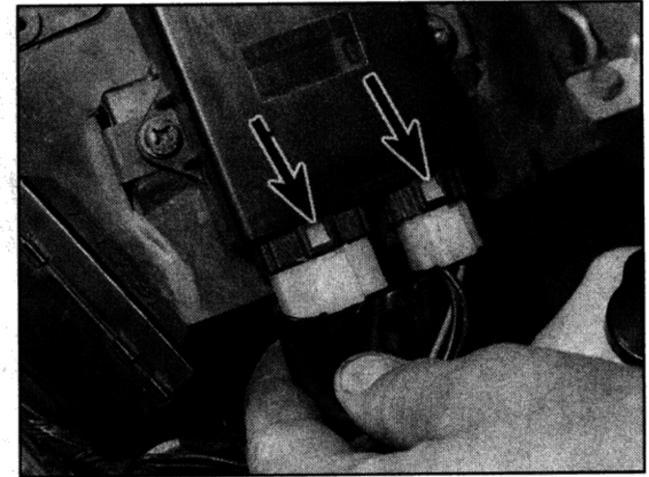
4.3c Pick-up coil wiring connector (arrowed) – XTZ models



5.3a Ignitor unit – TDM and TRX models



5.3b Ignitor unit – XTZ models



5.4 Disconnect the wiring connectors (arrowed)

cause of an ignition fault, it is possible that the ignitor unit itself is faulty. No test details are available with which the unit can be tested on home workshop equipment. Take the machine to a Yamaha dealer for testing.

Removal

2 On TDM and TRX models remove the seat, and on XTZ models remove the left-hand side cover and right-hand fairing side panel (see Chapter 8). Disconnect the battery negative (-ve) lead.

3 On TDM and TRX models the ignitor is mounted under the seat, and on XTZ models it is mounted in the fairing (see illustrations).

4 Disconnect the wiring connectors from the ignitor unit (see illustration).

5 Remove the screws securing the ignitor unit and remove the unit.

Installation

6 Installation is the reverse of removal. Make sure the wiring connectors are correctly and securely connected.

6 Ignition timing – general information and check

General information

1 Since no provision exists for adjusting the ignition timing and since no component is subject to mechanical wear, there is no need for regular checks; only if investigating a fault such as a loss of power or a misfire, should the ignition timing be checked.

2 The ignition timing is checked dynamically (engine running) using a stroboscopic lamp. The inexpensive neon lamps should be adequate in theory, but in practice may produce a pulse of such low intensity that the timing mark remains indistinct. If possible, one of the more precise xenon tube lamps should be used, powered by an external source of the appropriate voltage. **Note:** Do not use the machine's own battery as an incorrect reading may result from stray impulses within the machine's electrical system.

Check

3 Warm the engine up to normal operating temperature then stop it.

4 Unscrew the timing inspection plug from the alternator cover (see illustration). Discard the cover O-ring as a new one must be used.

5 The timing mark on the alternator rotor which indicates the firing point at idle speed for the no. 1 cylinder is a 'I' mark. The static timing mark with which this should align is the notch in the threads for the inspection plug on the alternator cover (see illustration).

6 Connect the timing light to the no. 1 cylinder HT lead as described in the manufacturer's instructions.

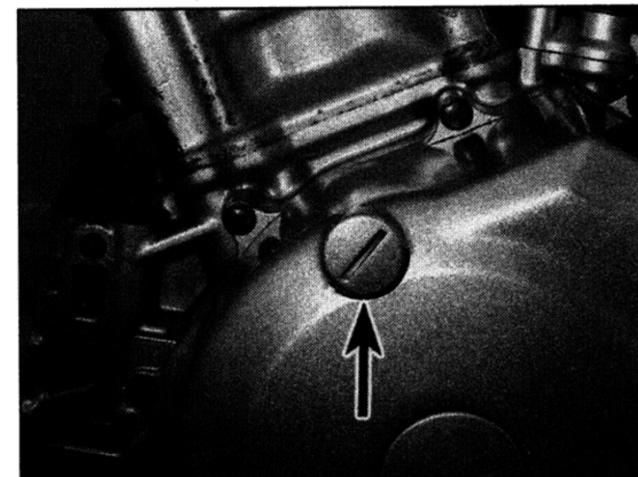
HAYNES HINT The timing marks can be highlighted with white paint to make them more visible under the stroboscope light.

7 Start the engine and aim the light at the static timing mark.

8 With the machine idling at the specified speed, the static timing mark should lie between the two vertical lines 'I'.

9 Slowly increase the engine speed whilst observing the 'I' mark. The mark should move clockwise, increasing in relation to the engine speed until it reaches full advance (no identification mark).

10 As already stated, there is no means of adjustment of the ignition timing on these machines. If the ignition timing is incorrect, or suspected of being incorrect, one of the



6.4 Unscrew the timing inspection plug (arrowed)

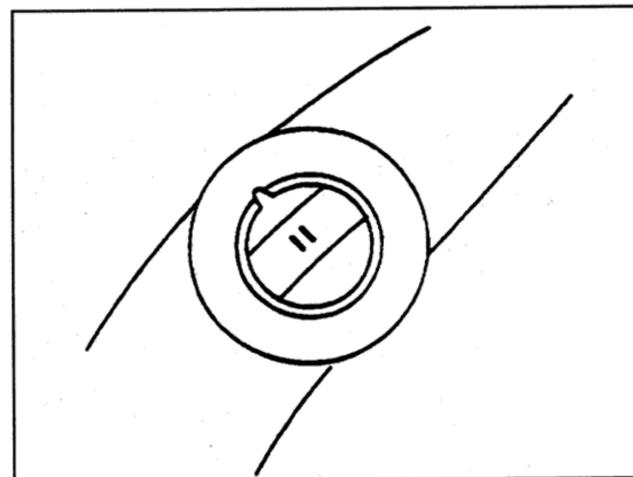
ignition system components is at fault, and the system must be tested as described in the preceding Sections of this Chapter.

11 When the check is complete, install the timing inspection plug using a new O-ring and tighten it securely.

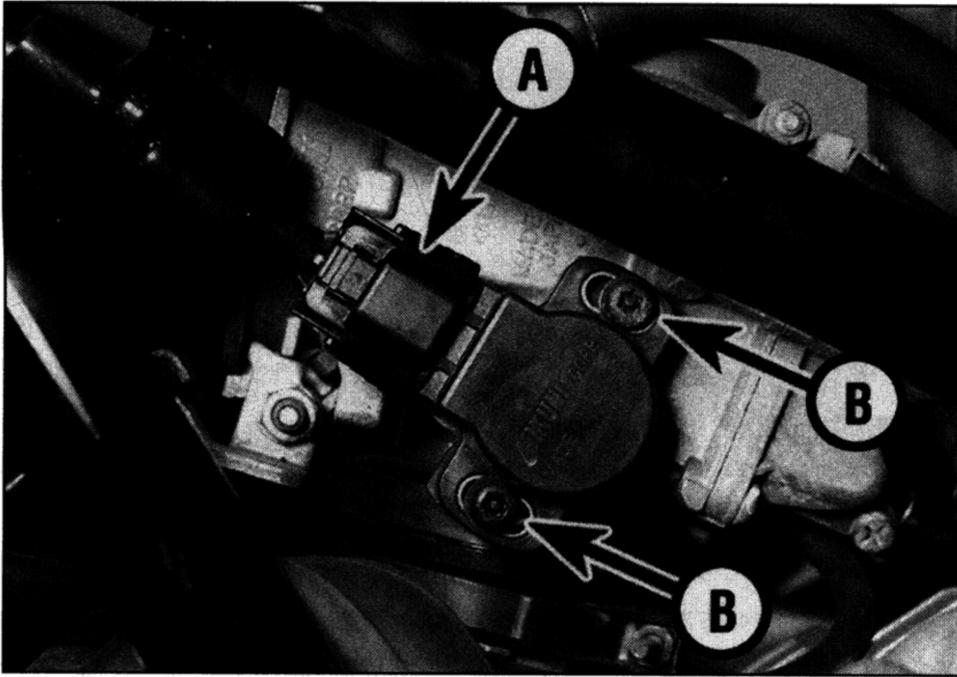
7 Throttle position sensor (1996-on TDM and TRX) – check, adjustment and replacement

1 The throttle position sensor is located on the side of the left-hand carburettor and is keyed to the end of the throttle operating shaft. The sensor provides the ignitor unit with information relating to throttle opening and the ignitor is thus able to set the ignition timing accordingly to produce the best running conditions and cleaner exhaust emissions. Not surprisingly it is essential that the throttle position sensor should be set up correctly. Do not tamper with the sensor's position unless it has been disturbed during carburettor overhaul or poor running problems have been experienced.

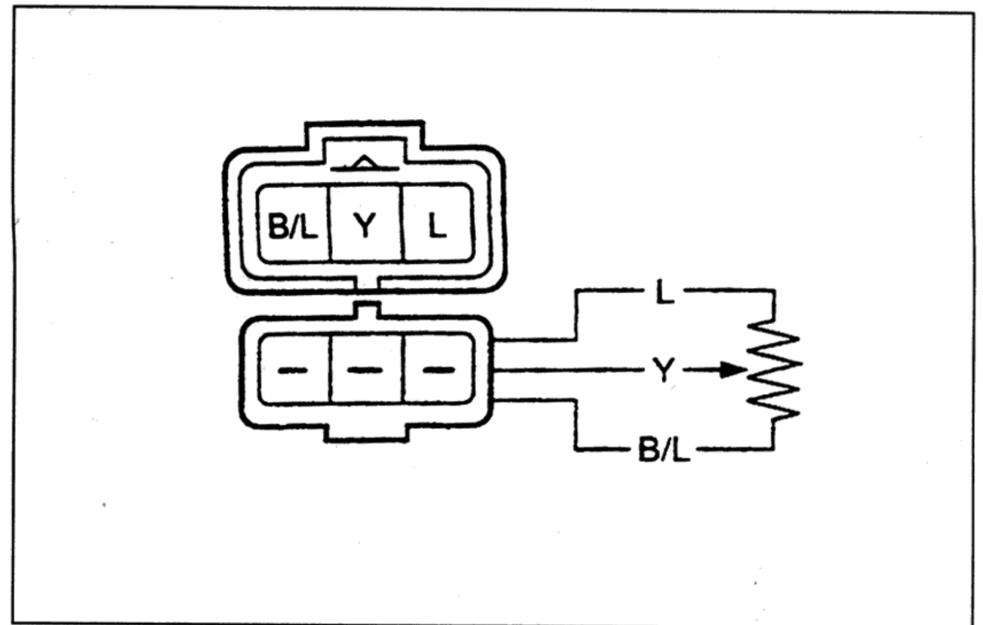
2 When the engine is running, the throttle position sensor performs its own self-diagnosis in the event of failure or faulty wiring. When this diagnosis occurs, the tachometer will be seen to display zero rpm for 3 seconds, then 3000 rpm for 2.5 seconds, then the actual engine speed for 3 seconds, whereupon it will repeat the cycle until the engine is switched off.



6.5 Ignition timing marks at idle speed



7.3 Throttle position sensor wiring connector (A) and mounting screws (B)



7.4 Throttle position sensor wiring connector terminals

B/L Black and blue
Y Yellow

L Blue

Check

3 Remove the fuel tank and the air filter housing (see Chapter 4). The throttle sensor is mounted on the outside of the left-hand carburettor (see illustration).

4 Make sure that the ignition is OFF, then disconnect the throttle sensor's wire connector. Using a multimeter set on the K-ohms range, measure the resistance between the blue and black/blue wire terminals on the throttle sensor half of the connector; 3.5 to 6.5 K-ohms should be shown (see illustration). Now measure the resistance between the yellow and black/blue wire terminals on the same half of the connector; whilst rotating the throttle grip slowly the resistance should vary between 0 to 5 K-ohms \pm 1.5 K-ohm. If either test does not produce the correct readings the throttle sensor should be renewed.

5 If the fault cannot be traced to the throttle sensor, check all three wires between the ignitor and throttle sensor for continuity. Check for continuity between one end to the

other on each wire. If no continuity is indicated, this is probably due to a damaged or broken wire between the connectors; pinched or broken wires can usually be repaired. If the wiring and connectors are good, check the adjustment of the sensor as described below.

6 If the sensor is suspected of being faulty, take it to a Yamaha dealer for further testing. If it is confirmed to be faulty, it must be renewed; the sensor is a sealed unit and cannot therefore be repaired. If the sensor is good, have the ignitor checked by the dealer.

Adjustment

7 Before adjusting the sensor, check the idle speed and carburettor synchronisation (see Chapter 1).

8 Turn the ignition switch ON, then disconnect and reconnect the sensor wiring connector. This sets the ignitor unit to sensor adjustment mode.

9 Slacken the sensor mounting screws and rotate the sensor until the tachometer needle

reads 4000 rpm. If the tachometer reads either 1000 rpm or 8000 rpm, the angle of the sensor is either too narrow or too wide. Adjust it as required until the reading is 4000 rpm, then tighten the screws.

10 To come out of the adjustment mode, start the engine or simply turn the ignition switch OFF.

Replacement

11 Remove the carburettors (see Chapter 4).
12 The throttle sensor is mounted on the outside of the left-hand carburettor (see illustration 7.3). Disconnect the wiring connector, then unscrew the sensor mounting screws and remove the sensor, noting how it fits. Retrieve the seal from behind the sensor as it is withdrawn. On TRX models and 1991 to 1998 TDM models the sensor mounts on a plate which is itself secured to the carburettor body by two screws.

13 Install the sensor and lightly tighten the screws. After installing the carburettors follow the adjustment procedure above to set the correct sensor position.