






Chapter 3

Cooling 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	
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Specifications

Coolant

Mixture type and capacity see Chapter 1

Radiator

Cap valve opening pressure 11 to 15 psi (0.75 to 1.05 Bar)

Fan switch

Cooling fan cut-in temperature 102 to 108°C
Cooling fan cut-out temperature 98°C

Coolant temperature sensor

Resistance – 1991 to 1995 TDM models and all XTZ models

@ 50°C	154 ohms
@ 80°C	47 to 53 ohms
@ 100°C	26 to 29 ohms
@ 120°C	16 ohms

Resistance – 1996-on TDM models and all TRX models

@ 80°C	47 to 53 ohms
@ 100°C	26 to 30 ohms

Thermostat

Opening temperature 80 to 84°C
Valve lift 8 mm (min) @ 95°C

Torque settings

Cooling fan switch 28 Nm

Coolant temperature sensor

1991 to 1995 TDM models and all XTZ models	13 Nm
1996-on TDM models and all TRX models	15 Nm

Thermostat cover bolts 10 Nm

Thermostat mounting bolt 10 Nm

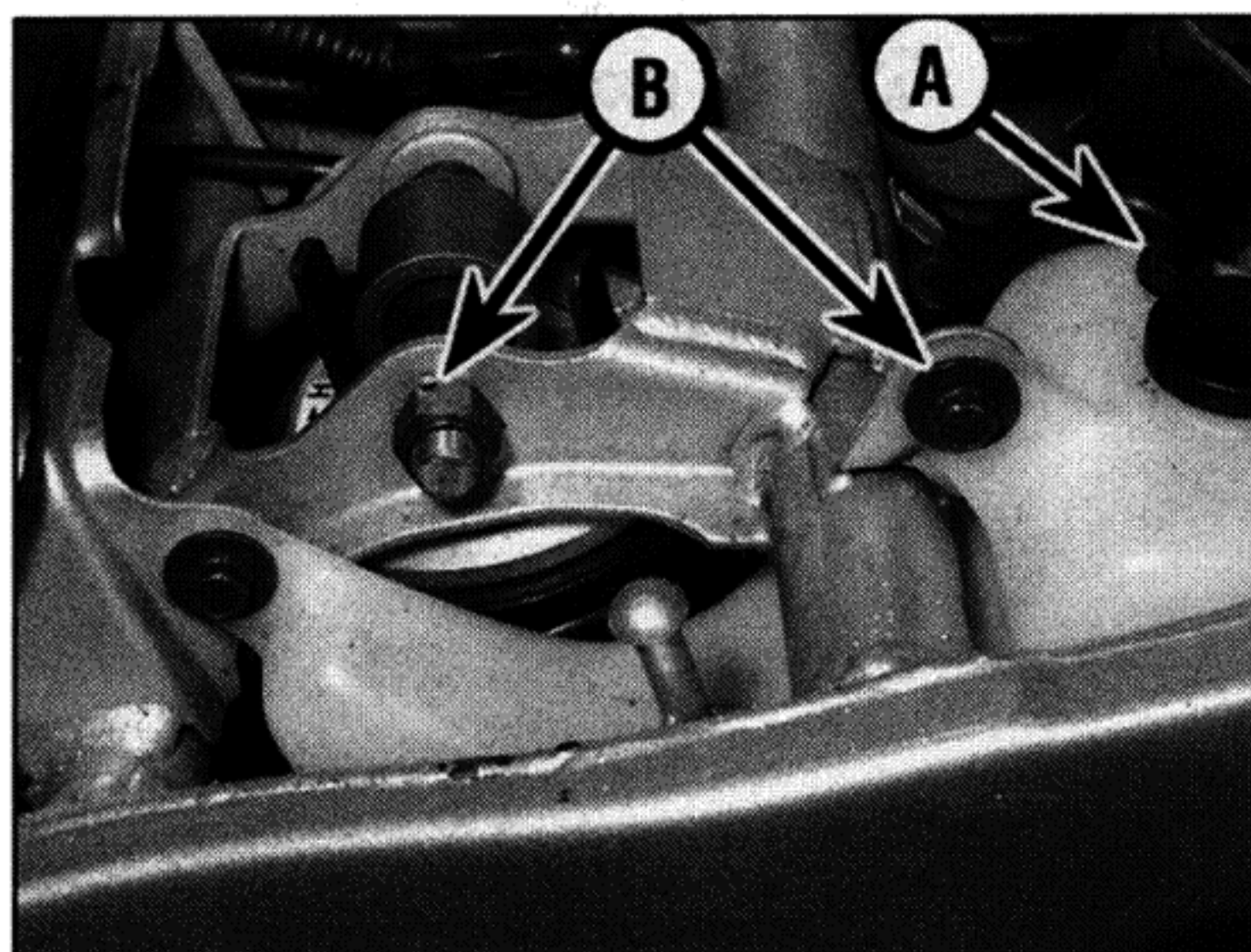
Water pump bolts 10 Nm

Frame downtube bolts/nuts (XTZ models) 32 Nm

1 General information

The cooling system uses a water/antifreeze coolant to carry away excess energy in the form of heat. The cylinders are surrounded by a water jacket from which the heated coolant is circulated by thermo-syphonic action in conjunction with a water pump, driven by the front balancer shaft. The hot coolant passes upwards to the thermostat and through to the radiator. The coolant then flows across the radiator core, where it is cooled by the passing air, to the water pump and back to the engine where the cycle is repeated.

A thermostat is fitted in the system to prevent the coolant flowing through the radiator when the engine is cold, therefore accelerating the speed at which the engine reaches normal operating temperature. A coolant temperature sensor mounted in the thermostat housing transmits to the temperature gauge on the instrument panel. A thermostatically-controlled cooling fan is also fitted to aid cooling in extreme conditions. The fan switch is mounted in the thermostat housing.



3.2a Breather hose (A), mounting bolts (B) – TDM models

The complete cooling system is partially sealed and pressurised, the pressure being controlled by a valve contained in the spring-loaded radiator cap. By pressurising the coolant the boiling point is raised, preventing premature boiling in adverse conditions. The overflow pipe from the system is connected to a reservoir into which excess coolant is expelled under pressure. The discharged coolant automatically returns to the radiator when the engine cools.



Warning: Do not remove the pressure cap from the radiator when the engine is hot. Scalding hot coolant and steam may be blown out under pressure, which could cause serious injury. When the engine has cooled, place a thick rag, like a towel over the pressure cap; slowly rotate the cap anti-clockwise to the first stop. This procedure allows any residual pressure to escape. When the steam has stopped escaping, press down on the cap while turning it anti-clockwise and remove it. Do not allow antifreeze to come in contact with your skin or painted surfaces of the motorcycle. Rinse off any spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by its sweet smell and may drink it. Check with the local authorities about disposing of used antifreeze. Many communities will have collection centres which will see that antifreeze is disposed of safely. Caution: At all times use the specified type of antifreeze, and always mix it with distilled water in the correct proportion. The antifreeze contains corrosion inhibitors which are essential to avoid damage to the cooling system. A lack of these inhibitors could lead to a build-up of corrosion which would block the coolant passages,

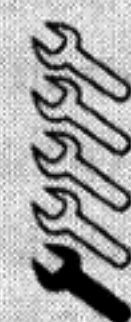
resulting in overheating and severe engine damage. Distilled water must be used as opposed to tap water to avoid a build-up of scale which would also block the passages.

2 Radiator pressure cap – check



1 If problems such as overheating or loss of coolant occur, check the entire system as described in Chapter 1. The radiator cap opening pressure should be checked by a Yamaha dealer with the special tester required to do the job. If the cap is defective, renew it.

3 Coolant reservoir – removal and installation

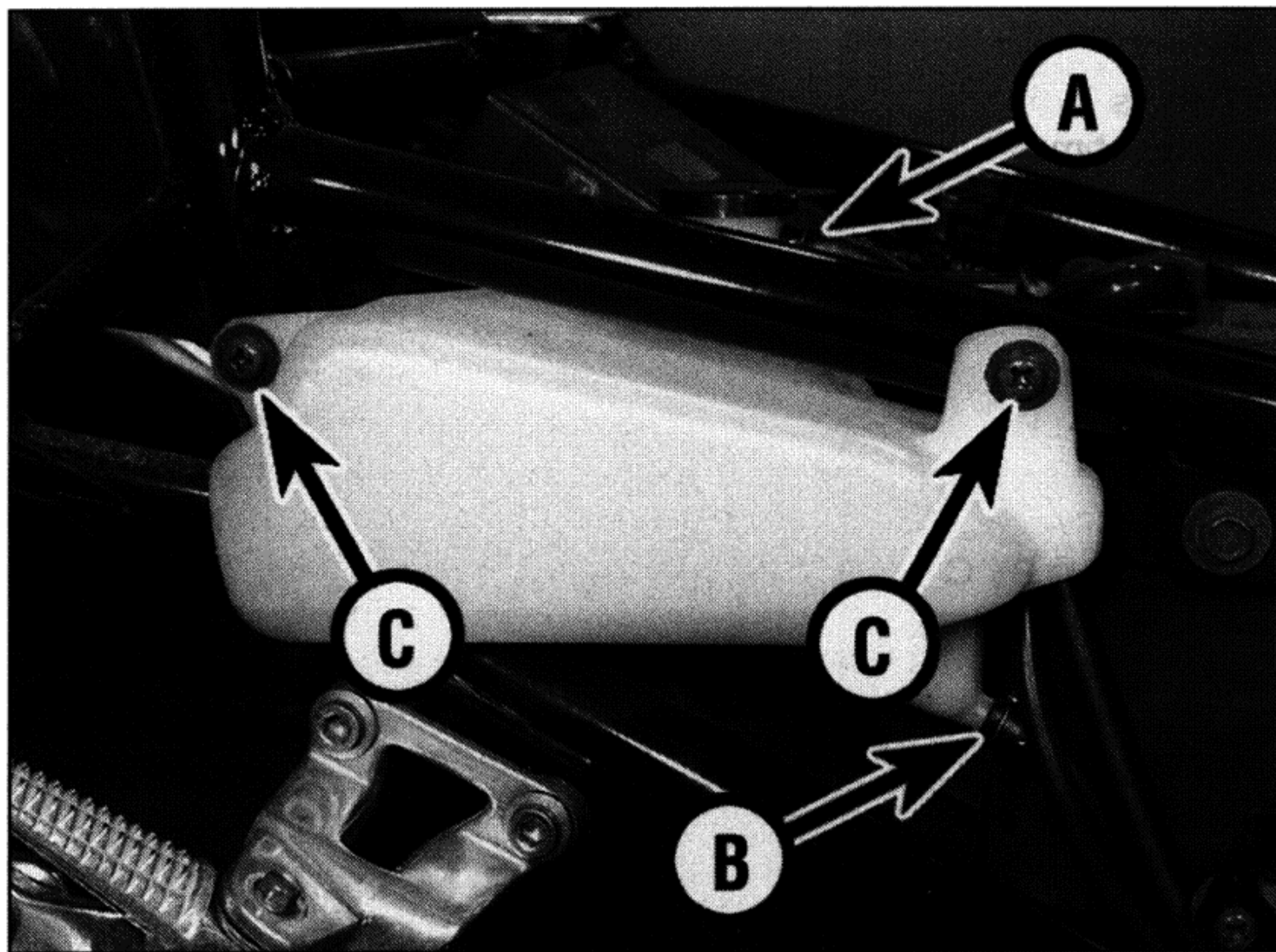


Removal

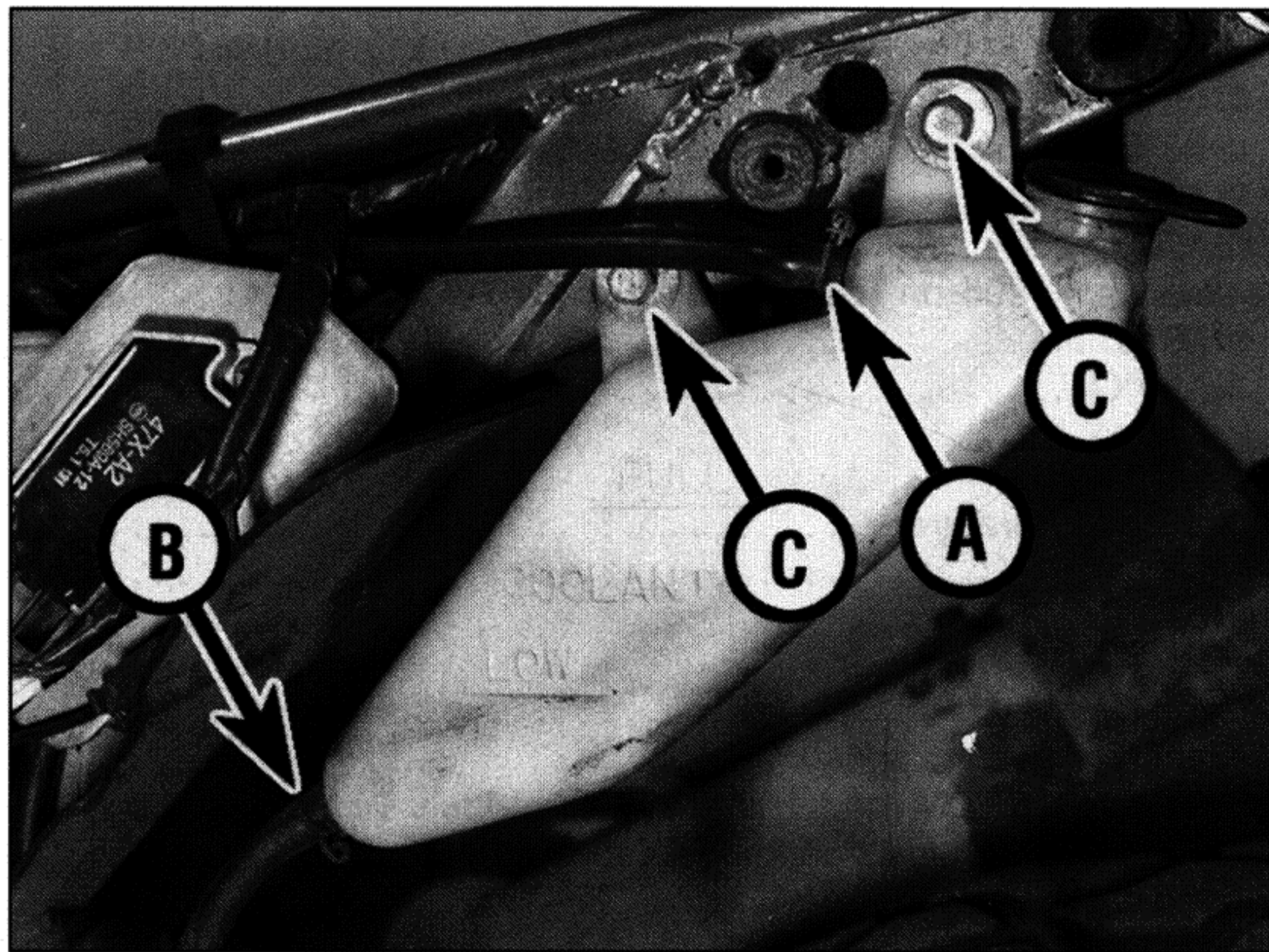
- 1 On TDM models, remove the seat (see Chapter 8). On TRX models, remove the seat and the side covers (see Chapter 8). On XTZ models remove the left-hand side cover (see Chapter 8).
- 2 Release the clamp securing the breather hose (coming out of the top of the reservoir) and detach the hose (see illustrations).
- 3 Place a suitable container underneath the reservoir, then release the clamp securing the radiator overflow hose to the base of the reservoir. Detach the hose and allow the coolant to drain into the container.
- 4 Unscrew the reservoir mounting bolts or screws and remove the reservoir, noting how it fits (see illustrations 3.2a, b and c).

Installation

- 5 Installation is the reverse of removal. Make sure the hoses are correctly installed and secured with their clamps. On completion refill the reservoir as described in Chapter 1.



3.2b Breather hose (A), radiator overflow hose (B), mounting screws (C) – TRX models



3.2c Breather hose (A), radiator overflow hose (B), mounting screws (C) – XTZ models



4.3a Fan motor wiring connector (arrowed) – TDM models



4.3b Fan motor wiring connector (arrowed) – XTZ models

4 Cooling fan and cooling fan switch – check and renewal



Cooling fan

Check

1 If the engine is overheating and the cooling fan isn't coming on, first check the fan circuit fuse (see Chapter 9) and then the fan switch as described in Steps 9 to 13 below.

2 If the fan does not come on, (and the fan switch is good), the fault lies in either the cooling fan motor or the relevant wiring. Test all the wiring and connections as described in Chapter 9.

3 To test the cooling fan motor, trace the fan motor wiring and disconnect it at the connector (see illustrations). Remove the fuel tank and on TDM and TRX the air filter housing for best access. Using a 12 volt battery and two jumper wires, connect the battery leads to the fan wiring connector. Once connected the fan should operate. If it

does not, and the wiring is all good, then the fan is faulty.

Renewal



Warning: The engine must be completely cool before carrying out this procedure.

4 Remove the radiator (see Section 7).

5 Unscrew the three bolts securing the fan shroud and fan assembly to the radiator (see illustration). On TDM and TRX models, unscrew the bolts on the front of the fan securing it to the shroud and remove the shroud. Separate the fan blade from the motor and renew the motor. On XTZ models, individual components are not available and the entire fan assembly must be renewed.

6 Installation is the reverse of removal.

7 Install the radiator (see Section 7).

Cooling fan switch

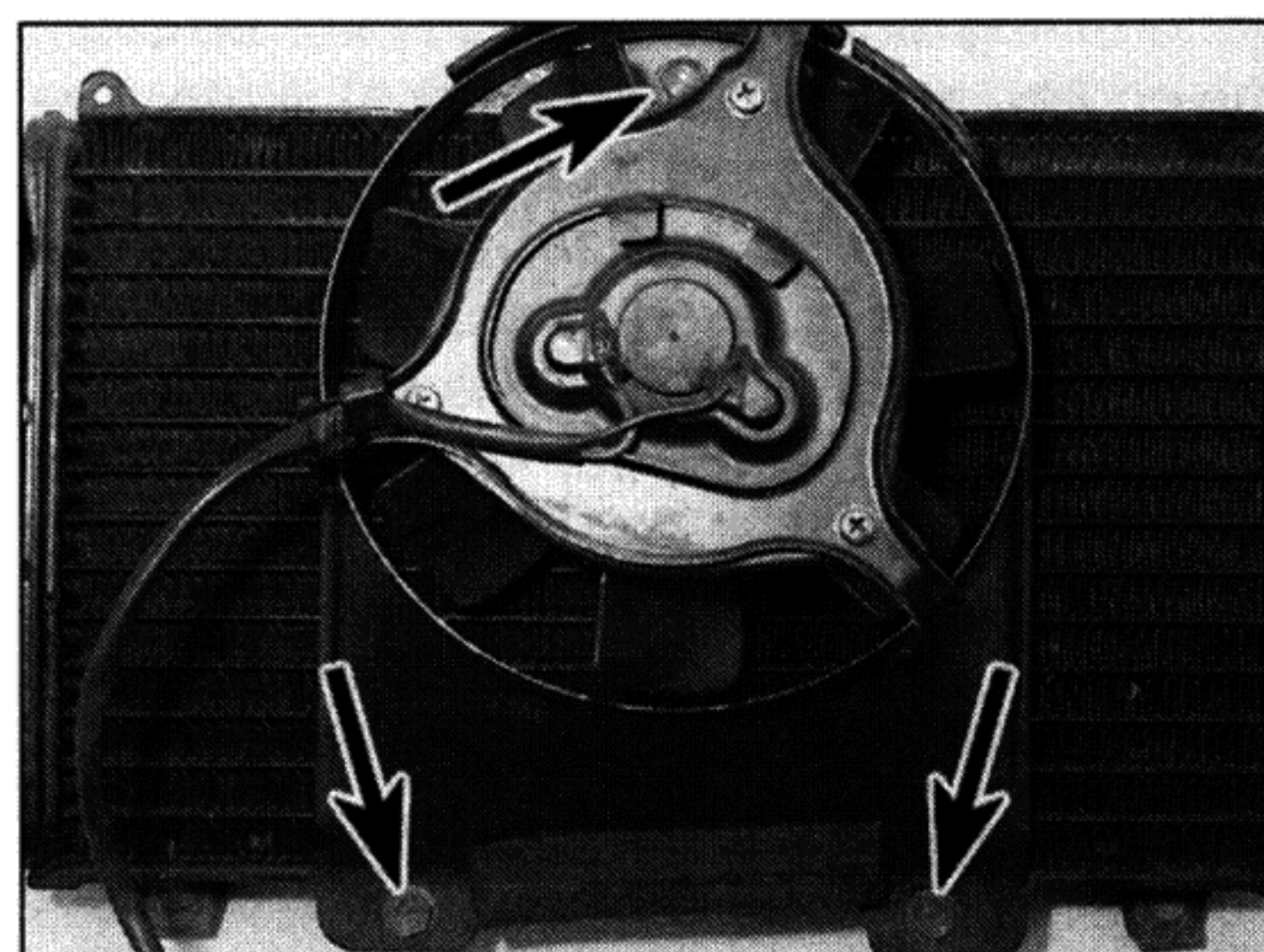
Check

8 If the engine is overheating and the cooling fan isn't coming on, first check the fan circuit fuse (see Chapter 9). If the fuse is blown, check the fan circuit for a short to earth (see the wiring diagrams at the end of this book).

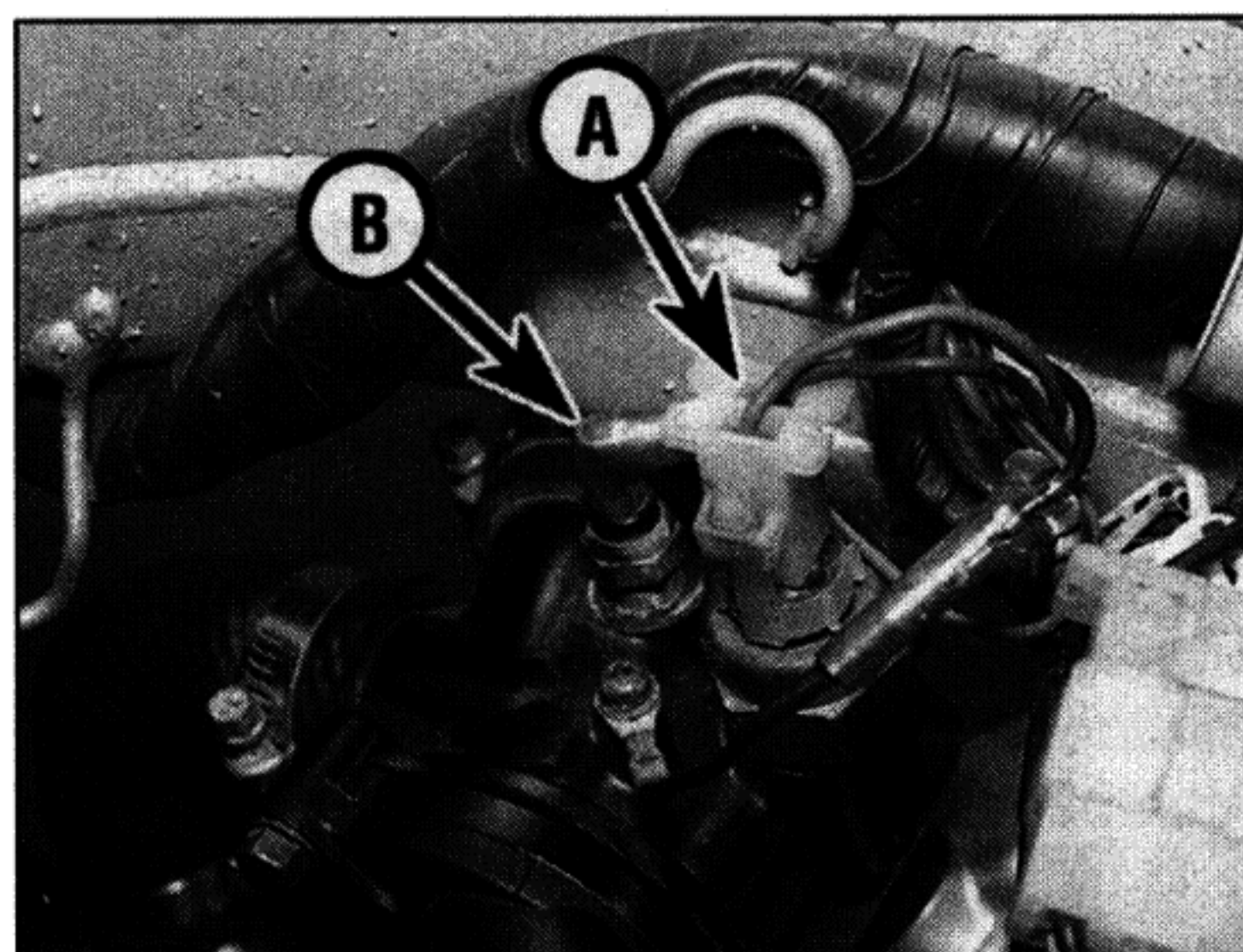
9 If the fuse is good, on TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8). Disconnect the wiring connector(s) from the fan switch, mounted in the thermostat housing (see illustrations). Using a jumper wire, connect between the terminals in the wiring connector(s). The fan should come on. If it does, the fan switch is defective and must be renewed. If it does not come on, the fan should be tested (see Step 3).

10 If the fan is on the whole time, disconnect the wiring connector. The fan should stop. If it does, the fan switch is defective and must be renewed. If it doesn't, check the wiring between the fan switch and the fan motor, and the fan itself.

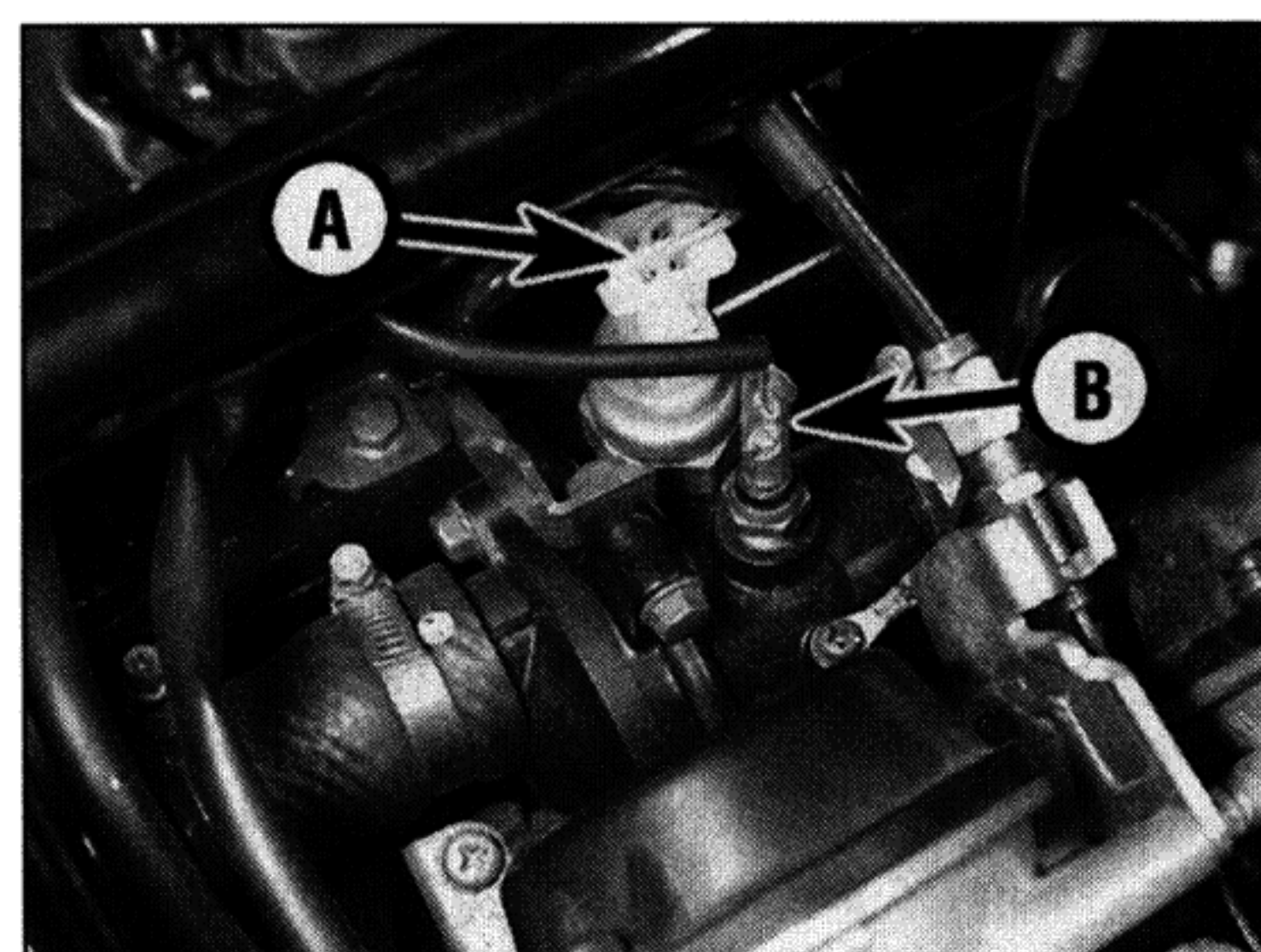
11 If the fan works but is suspected of



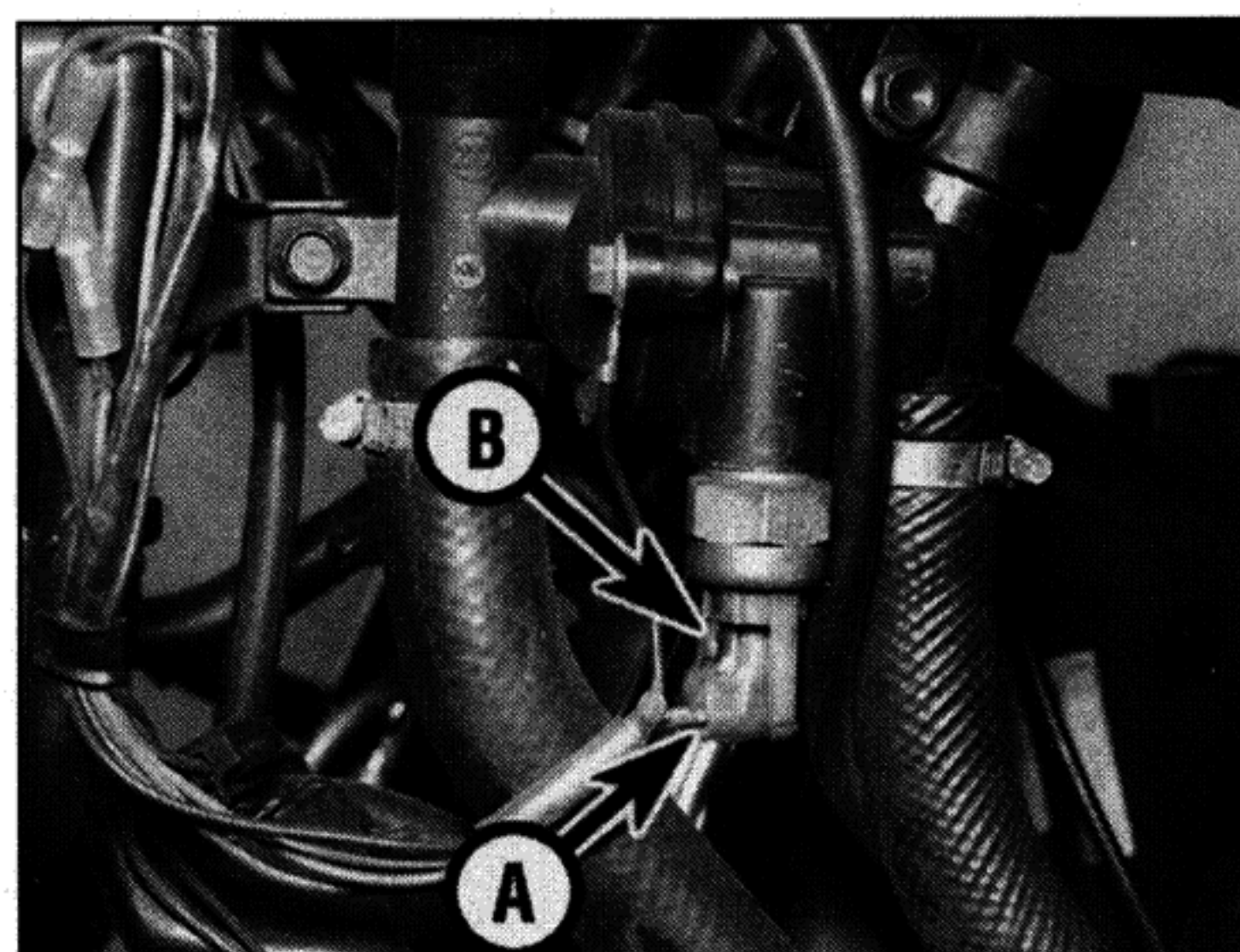
4.5 Fan assembly mounting bolts (arrowed)



4.9a Fan switch wiring connector (A), temperature sender wiring connector (B) – TDM models



4.9b Fan switch wiring connector (A), temperature sender wiring connector (B) – TRX models



4.9c Fan switch wiring connector (A), temperature sender wiring connector (B) – XTZ models

cutting in at the wrong temperature, a more comprehensive test of the switch can be made as follows.

12 Remove the switch (see Steps 14 to 17). Fill a small heatproof container with coolant and place it on a stove. Connect the probes of an ohmmeter to the terminals of the switch, and using some wire or other support suspend the switch in the coolant so that just the sensing portion and switch body are submerged (see illustration). Also place a thermometer capable of reading temperatures up to 110°C in the coolant so that its bulb is close to the switch.

Note: None of the components should be allowed to directly touch the container.

13 Initially the ohmmeter reading should be very high indicating that the switch is open (OFF). Heat the coolant, stirring it gently.



Warning: This must be done very carefully to avoid the risk of personal injury.

When the temperature reaches around 102 to 108°C the meter reading should drop to around zero ohms, indicating that the switch has closed (ON). Now turn the heat off. As the temperature falls below 98°C the meter reading should show infinite (very high) resistance, indicating that the switch has opened (OFF). If the meter readings obtained are different, or they are obtained at different temperatures, then the switch is faulty and must be renewed.

Removal and installation



Warning: The engine must be completely cool before carrying out this procedure.

14 Drain the cooling system (see Chapter 1). **Note:** The fan switch is positioned near the top of the cooling system so coolant draining can be avoided if care is taken to catch any coolant which escapes as the switch is removed.

15 On TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8). Disconnect the wiring

connector(s) from the fan switch, mounted in the thermostat housing (see illustrations 4.9a, b and c). Unscrew the switch and withdraw it from the housing.

16 Apply a suitable thread locking and sealing compound to the switch threads, then install the switch and tighten it to the torque setting specified at the beginning of the Chapter. Take care not to overtighten the switch as the housing could be damaged.

17 Reconnect the switch wiring and refill or top up the cooling system (see Chapter 1).

5 Coolant temperature gauge/warning light and sender – check and renewal



Warning: The engine must be completely cool before carrying out work on the temperature sender.

Coolant temperature gauge (XTZ, TRX and 1991-98 TDM models)

Check

1 The circuit consists of the sender mounted in the thermostat housing and the gauge assembly mounted in the instrument panel. If the system malfunctions check first that the battery is fully charged and that the fuses are all good. If they are, on TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8).

2 Disconnect the wire from the sender and turn the ignition switch ON (see illustrations 4.9a, b and c). The temperature gauge needle should be on the C on the gauge. Now earth the sender wire on the engine. The needle should swing immediately over to the H on the gauge.

Caution: Do not earth the wire for any longer than is necessary to take the reading, or the gauge may be damaged.

If the needle moves as described above, the sender is proven defective and must be renewed.

3 If the needle movement is still faulty, or if it does not move at all, the fault lies in the wiring or the gauge itself. Check all the relevant wiring and wiring connectors (see Chapter 9). If all appears to be well, the gauge is defective and must be renewed.

Removal and installation

4 See Chapter 9, Section 16.

Coolant temperature warning light (1999 TDM models)

5 The circuit consists of the sender mounted in the thermostat housing and the coolant temperature warning light in the instrument panel. The warning light should illuminate briefly when the ignition is first turned on as a check of the warning light bulb; the light should then extinguish. If the bulb doesn't light, it is probably blown and should be renewed as described in Chapter 9. Less likely is a wiring fault, but referring to the wiring diagram at the end of this manual, check the coolant temperature warning light circuit wiring for continuity.

6 The bulb should illuminate if the engine coolant ever reaches too high a temperature. If you suspect that the bulb is failing to come on check the sender as described below.

Sender check (all models)

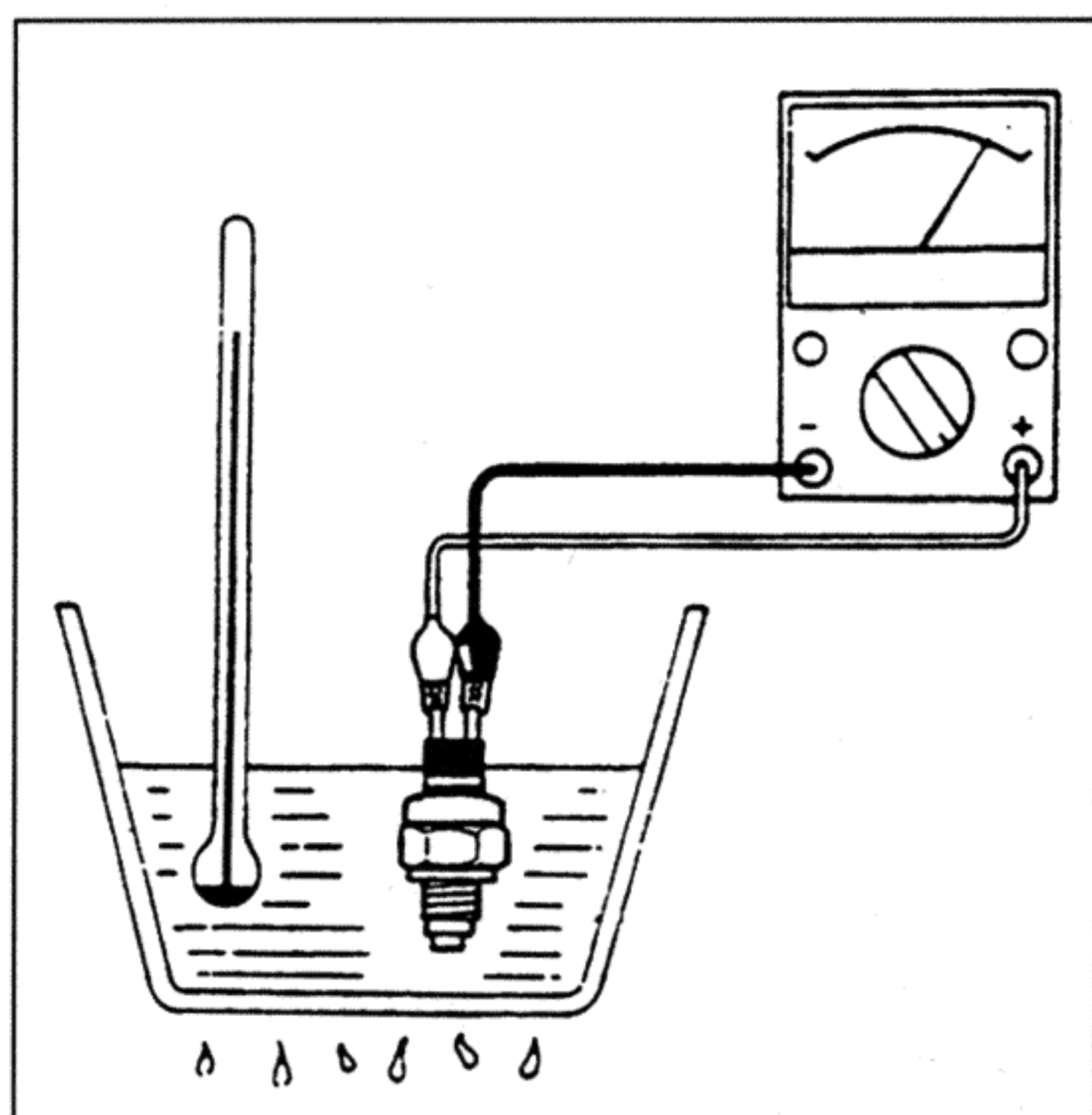
7 The sender is mounted in the thermostat housing. On TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8). Drain the cooling system (see Chapter 1). **Note:** The sender is positioned near the top of the cooling system so coolant draining can be avoided if care is taken to catch any coolant which escapes as the sender is removed.

8 Disconnect the sender wiring connector (see illustrations 4.9a, b and c). Using a continuity tester, check for continuity between the sender body and earth on the motorcycle's frame. There should be continuity. If there is no continuity, check that the thermostat mounting is secure, and where fitted, that the thermostat housing earth wire is securely connected.

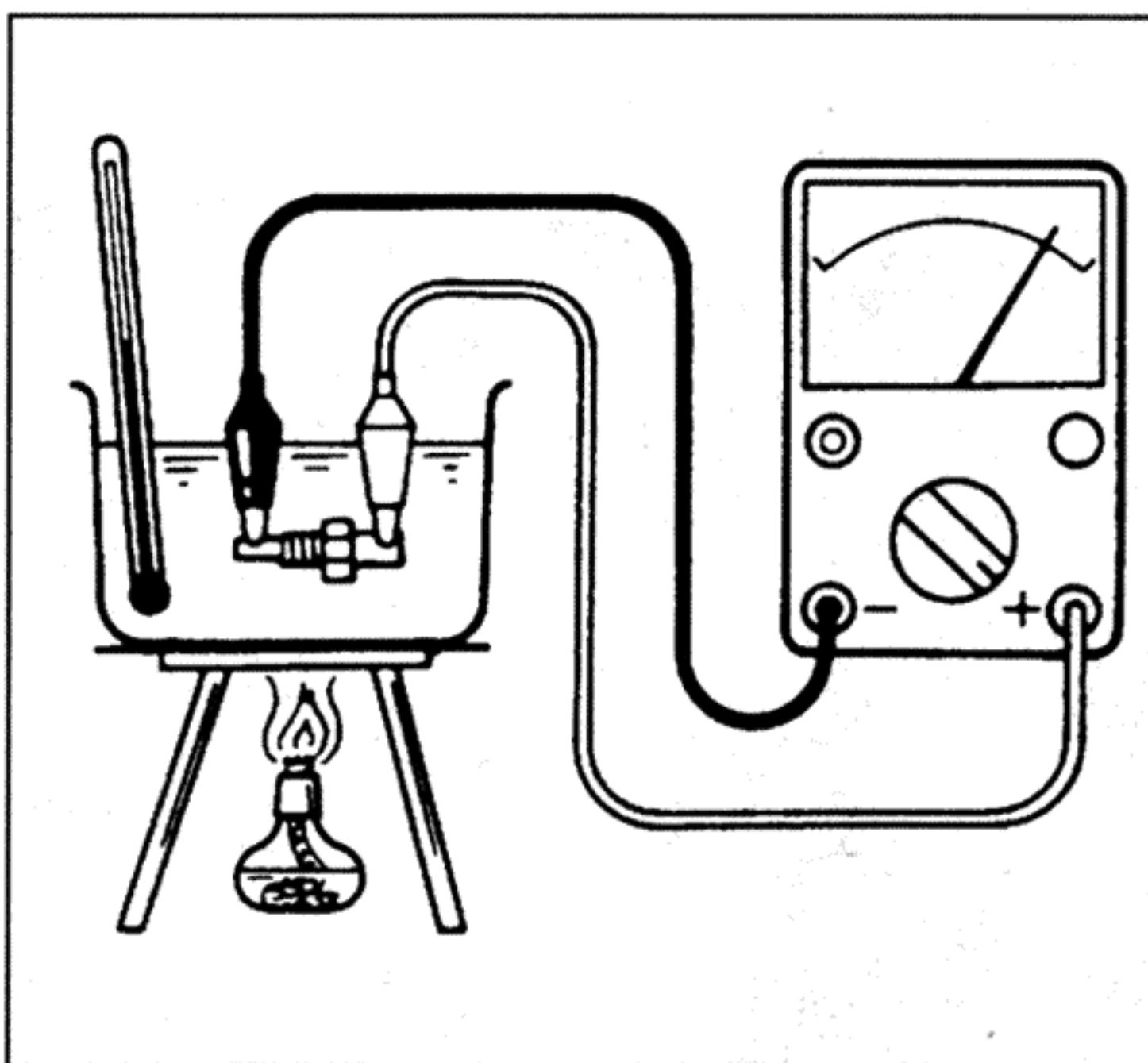
9 Unscrew the sender and remove it from the thermostat housing (see below). Test the sender according to the appropriate sub-section.

1991 to 1995 TDM models and all XTZ models

10 Fill a small heatproof container with coolant mixture and place it on a stove. Using an ohmmeter, connect the positive (+ve) probe of the meter to the terminal on the sender, and the negative (-ve) probe to the tip of the sender. Using some wire or other support suspend the sender in the coolant so that it is submerged. Also place a thermometer capable of reading temperatures up to 120°C in the coolant so that its bulb is close to the sender (see illustration). **Note:** None of the components should be allowed to directly touch the container.



4.12 Fan switch testing set-up



5.10 Temperature sender testing set-up – 1991 to 1995 TDM models and all XTZ models

11 Heat the coolant, stirring it gently. When the temperature reaches around 50°C the meter should read 154 ohms. When the temperature reaches around 80°C the meter should read between 47 and 53 ohms. When the temperature reaches around 100°C the meter should read between 26 and 29 ohms. When the temperature reaches around 120°C the meter should read 16 ohms. If the meter readings obtained are different, or they are obtained at different temperatures, then the sender is faulty and must be renewed.

1996-on TDM models and all TRX models

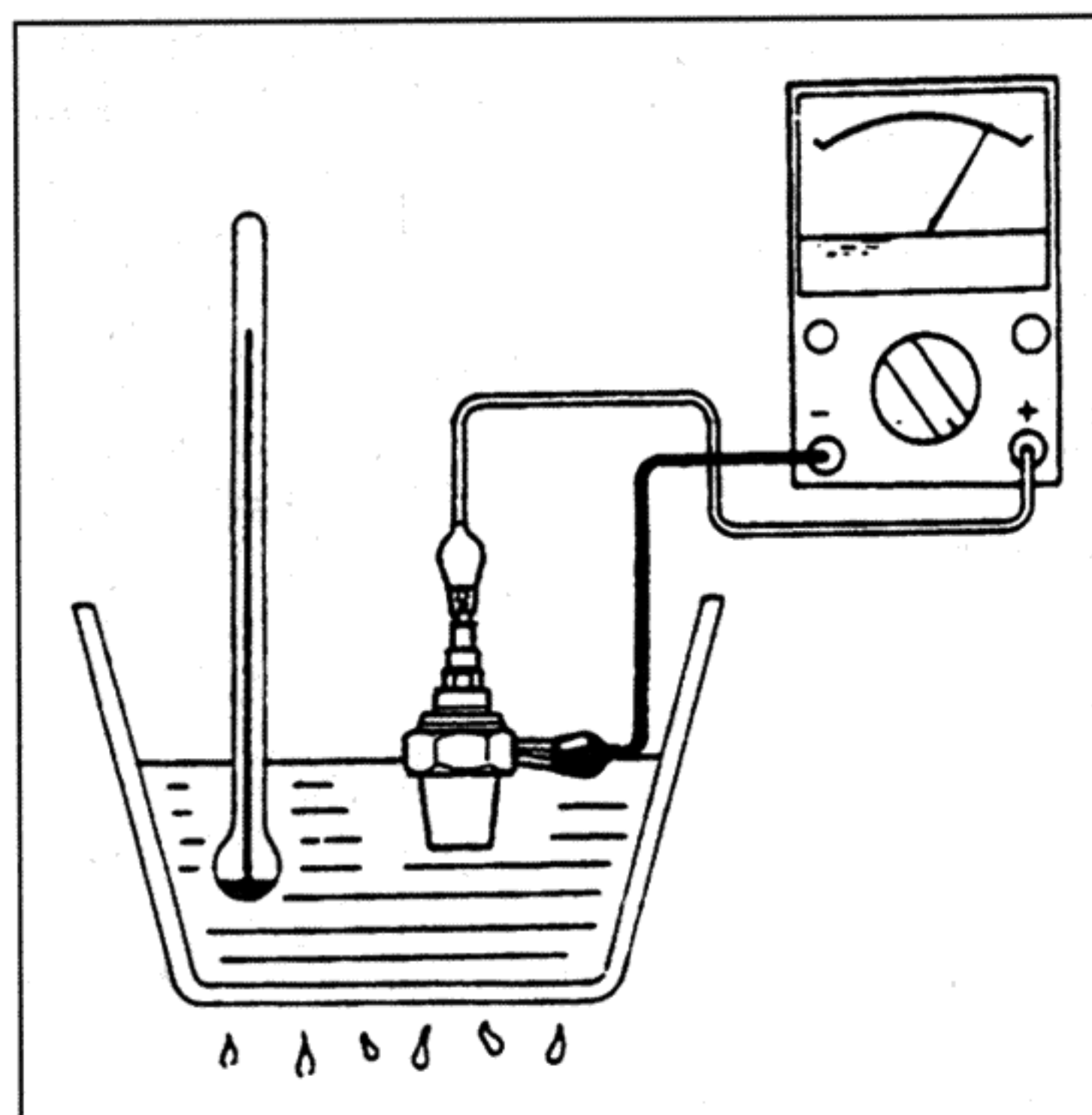
12 Fill a small heatproof container with water and place it on a stove. Using an ohmmeter, connect the positive (+ve) probe of the meter to the terminal on the sender, and the negative (-ve) probe to the body of the sender. Using some wire or other support suspend the sender in the water so that just the sensing portion and the threads are submerged. Also place a thermometer capable of reading temperatures up to 110°C in the water so that its bulb is close to the sender (*see illustration*). **Note:** None of the components should be allowed to directly touch the container.

13 Heat the water, stirring it gently. When the temperature reaches around 80°C the meter should read 47 to 53 ohms. When the temperature reaches around 100°C the meter should read 26 to 30 ohms. If the meter readings obtained are different, or they are obtained at different temperatures, then the sender is faulty and must be renewed.

Sender removal and installation (all models)

14 Drain the cooling system (see Chapter 1). On TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8).

15 Disconnect the sender wiring connector



5.12 Temperature sender testing set-up – 1996-on TDM models and all TRX models

(*see illustrations 4.9a, b and c*). Unscrew the sender and remove it from the thermostat housing.

16 Apply a suitable thread locking and sealing compound to the sender threads, then install the sender and tighten it to the torque setting specified at the beginning of the Chapter. Take care not to overtighten the sender as the housing could be damaged.

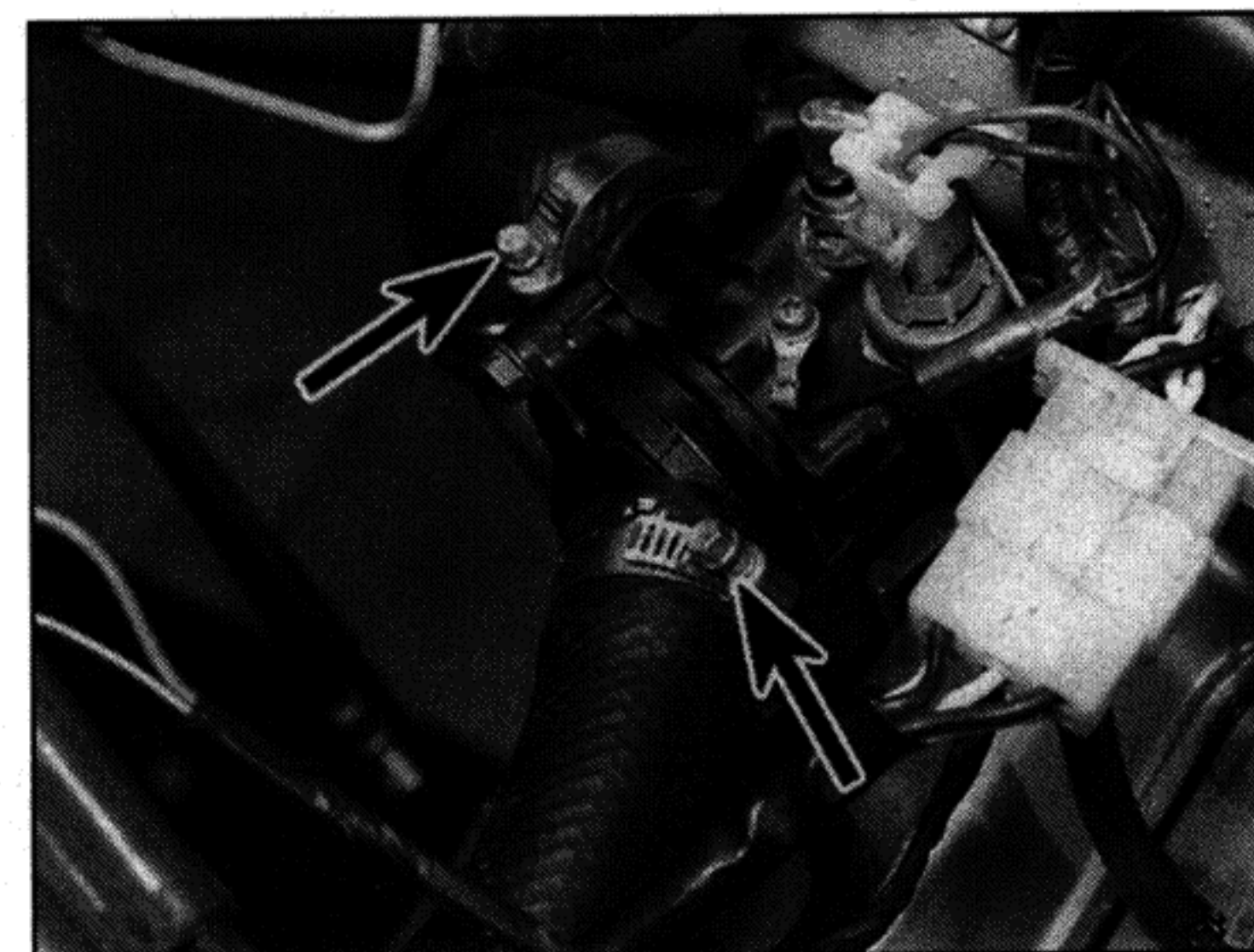
17 Reconnect the sender wiring and top up the cooling system (see Chapter 1).

6 Thermostat housing and thermostat – removal, check and installation

Removal

Warning: The engine must be completely cool before carrying out this procedure.

1 The thermostat is automatic in operation and should give many years of service without requiring attention. In the event of a failure, the valve will probably jam open, in which



6.3 Slacken the clamp screws and pull off the hoses

case the engine will take much longer than normal to warm up. Conversely, if the valve jams shut, the coolant will be unable to circulate and the engine will overheat. Neither condition is acceptable, and the fault must be investigated promptly.

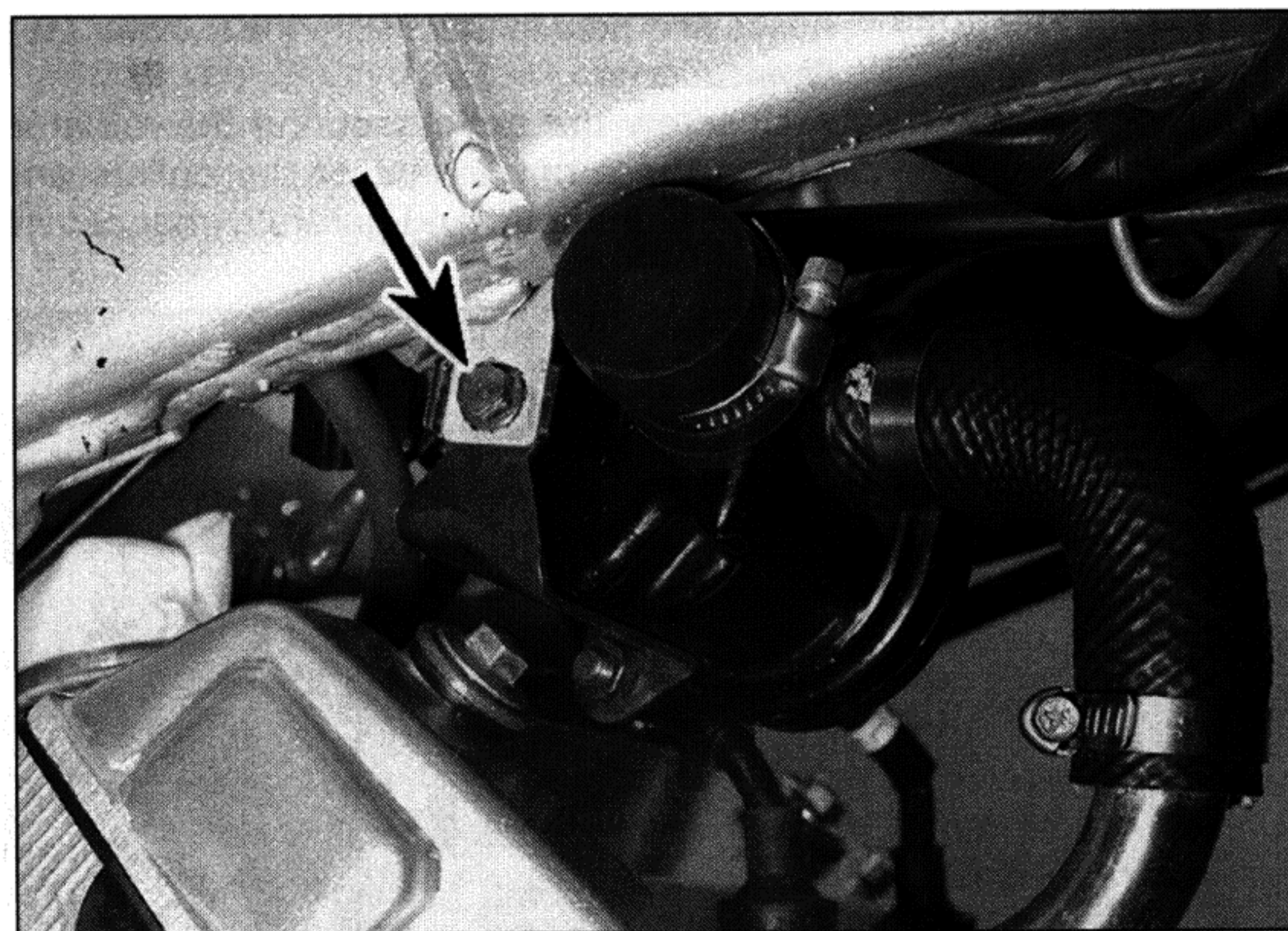
2 Drain the cooling system (see Chapter 1).

3 The thermostat is located in the thermostat housing. On TDM and TRX models, remove the fuel tank and air filter housing (see Chapter 4). On XTZ models, remove the left-hand fairing side panel (see Chapter 8). Slacken the clamps securing the hoses to the housing and detach the hoses, noting which fits where (*see illustration and 4.9b and c*). On XTZ models, release the clamp securing the overflow hose to the filler neck and detach the hose.

4 Disconnect the fan switch and temperature sensor wiring connectors (*see illustrations 4.9a, b and c*). Where fitted, also slacken the screw securing the earth lead and detach the lead.

5 Unscrew the bolt securing the thermostat housing and remove the housing, noting how it fits (*see illustration and 4.9b and c*).

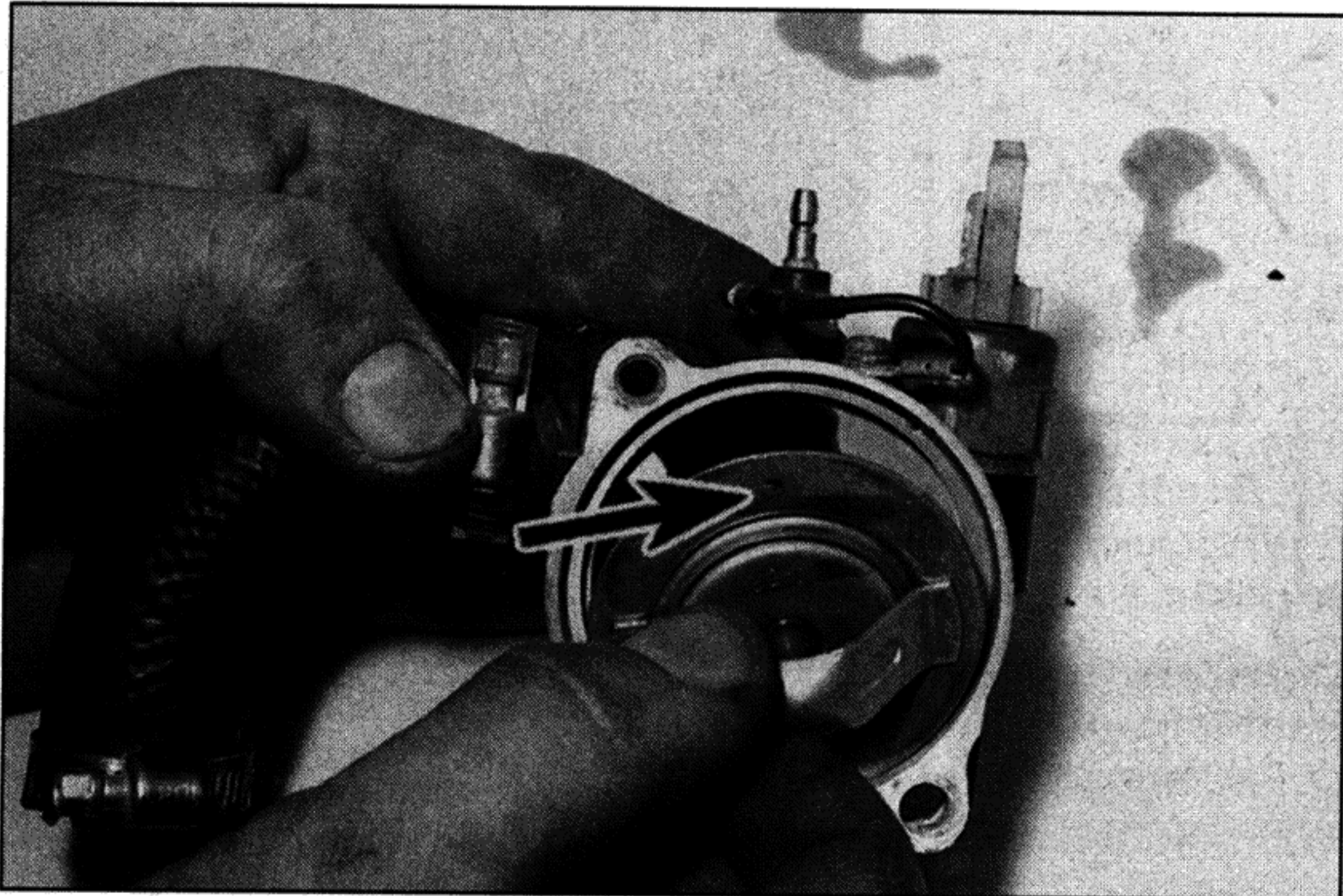
6 Unscrew the two bolts securing the cover and separate it from the housing (*see illustration*). Withdraw the thermostat, noting



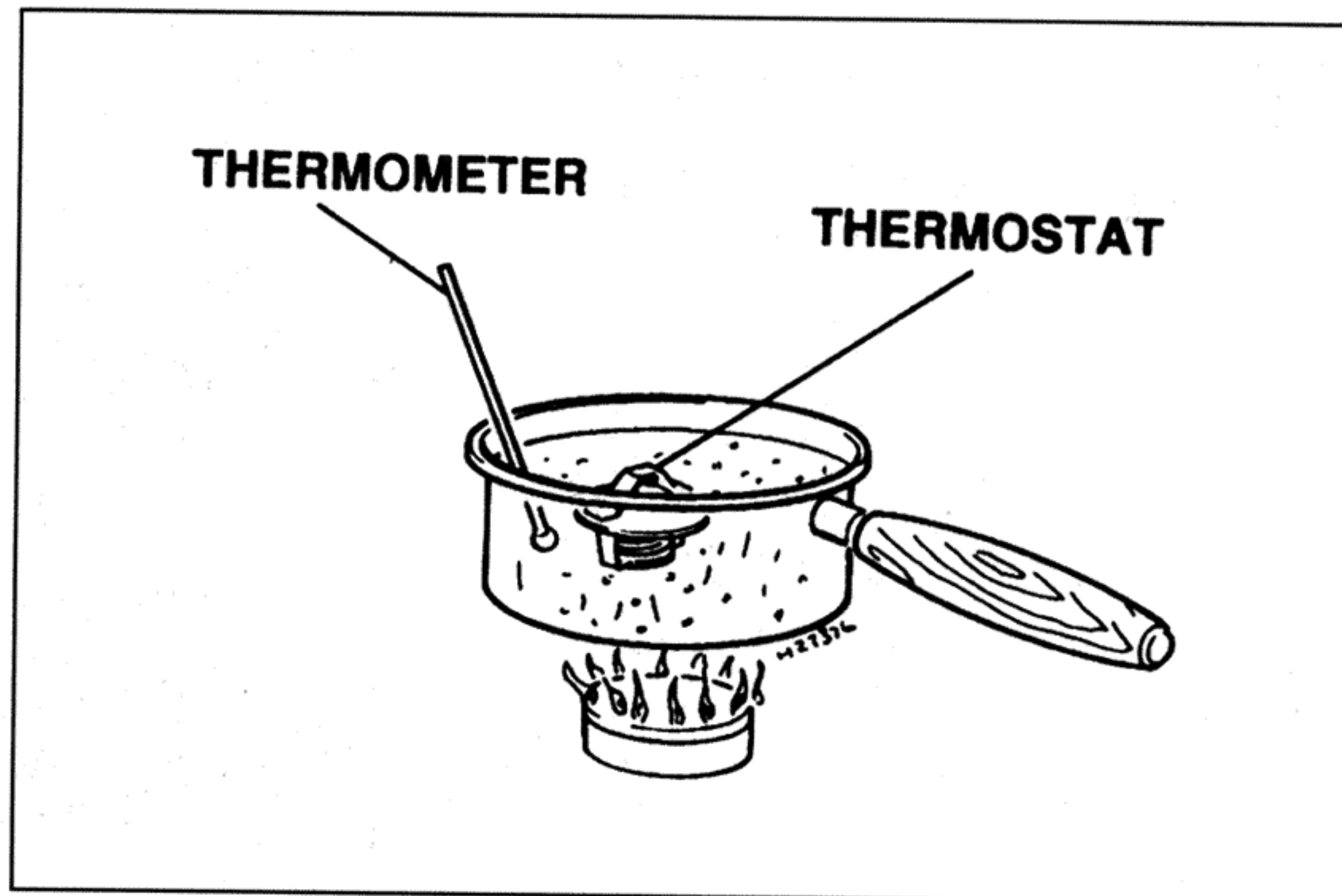
6.5 Thermostat housing mounting bolt (arrowed) – TDM models



6.6a Unscrew the bolts and remove the cover . . .



6.6b ... and withdraw the thermostat



6.8 Thermostat testing set-up

how it fits (see illustration). Discard the cover O-ring as a new one must be used.

Check

7 Examine the thermostat visually before carrying out the test. If it remains in the open position at room temperature, it should be renewed.

8 Suspend the thermostat by a piece of wire in a container of cold water. Place a thermometer in the water so that the bulb is close to the thermostat (see illustration). Heat the water, noting the temperature when the thermostat opens, and compare the result

with the specifications given at the beginning of the Chapter. Also check the amount the valve opens after it has been heated at 95°C for a few minutes and compare the measurement to the specifications. If the readings obtained differ from those given, the thermostat is faulty and must be renewed.

9 In the event of thermostat failure, as an emergency measure only, it can be removed and the machine used without it. **Note:** Take care when starting the engine from cold as it will take much longer than usual to warm up. Ensure that a new unit is installed as soon as possible.

Installation

10 Fit the thermostat into the housing, making sure that it seats correctly and that the hole is at the top (see illustration 6.6b).

11 Fit a new O-ring onto the cover, using a dab of grease to keep it in place if required (see illustration). Fit the cover onto the housing, then install the two bolts and tighten them to the torque setting specified at the beginning of the Chapter (see illustrations 6.6a).

12 Install the thermostat housing and tighten the bolt to the specified torque setting (see illustrations 4.9b and c). Connect the hoses

and tighten the clamps securely. Also connect the wiring connectors, not forgetting the earth lead, where fitted.

13 Refill the cooling system (see Chapter 1).

7 Radiator – removal and installation



Removal



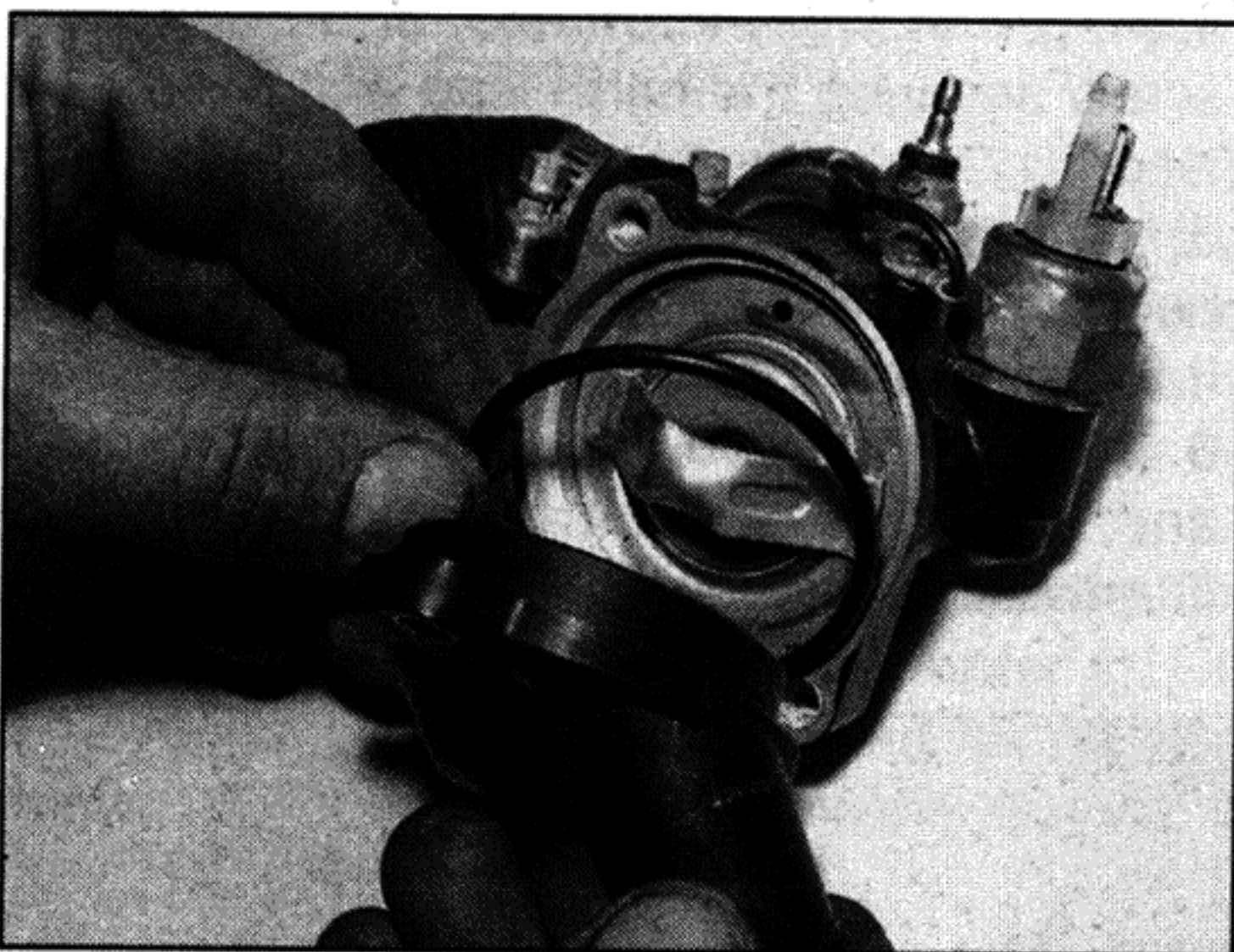
Warning: The engine must be completely cool before carrying out this procedure.

1 Remove the fairing side panels on TDM and XTZ models, and the fairing on TRX models (see Chapter 8). Remove the fuel tank, and on TDM and TRX models, the air filter housing (see Chapter 4). Drain the cooling system (see Chapter 1).

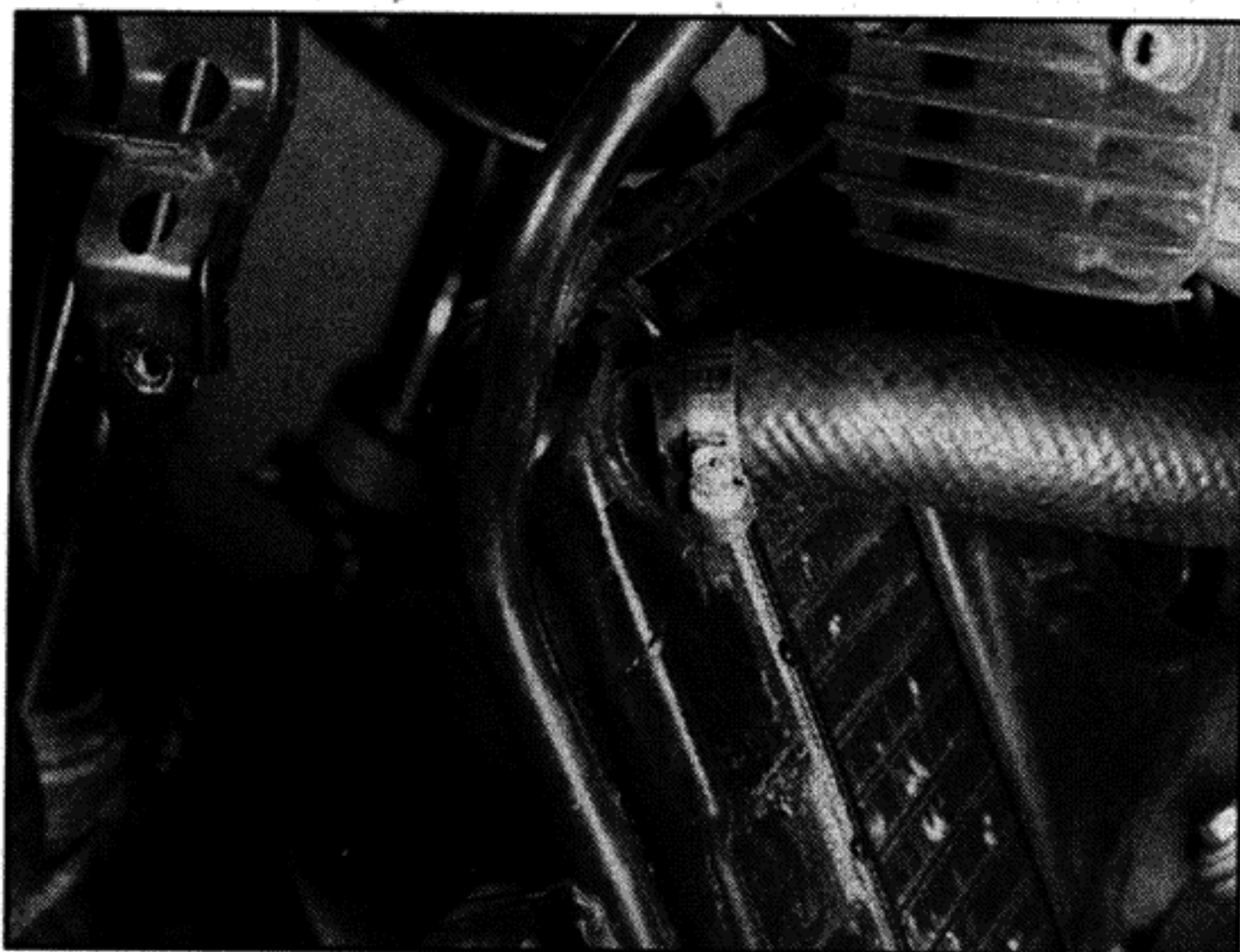
2 Trace the fan motor wiring and disconnect it at the connector (see illustrations 4.3a and b).

3 Slacken the clamps securing the radiator hoses and detach them from the radiator (see illustrations).

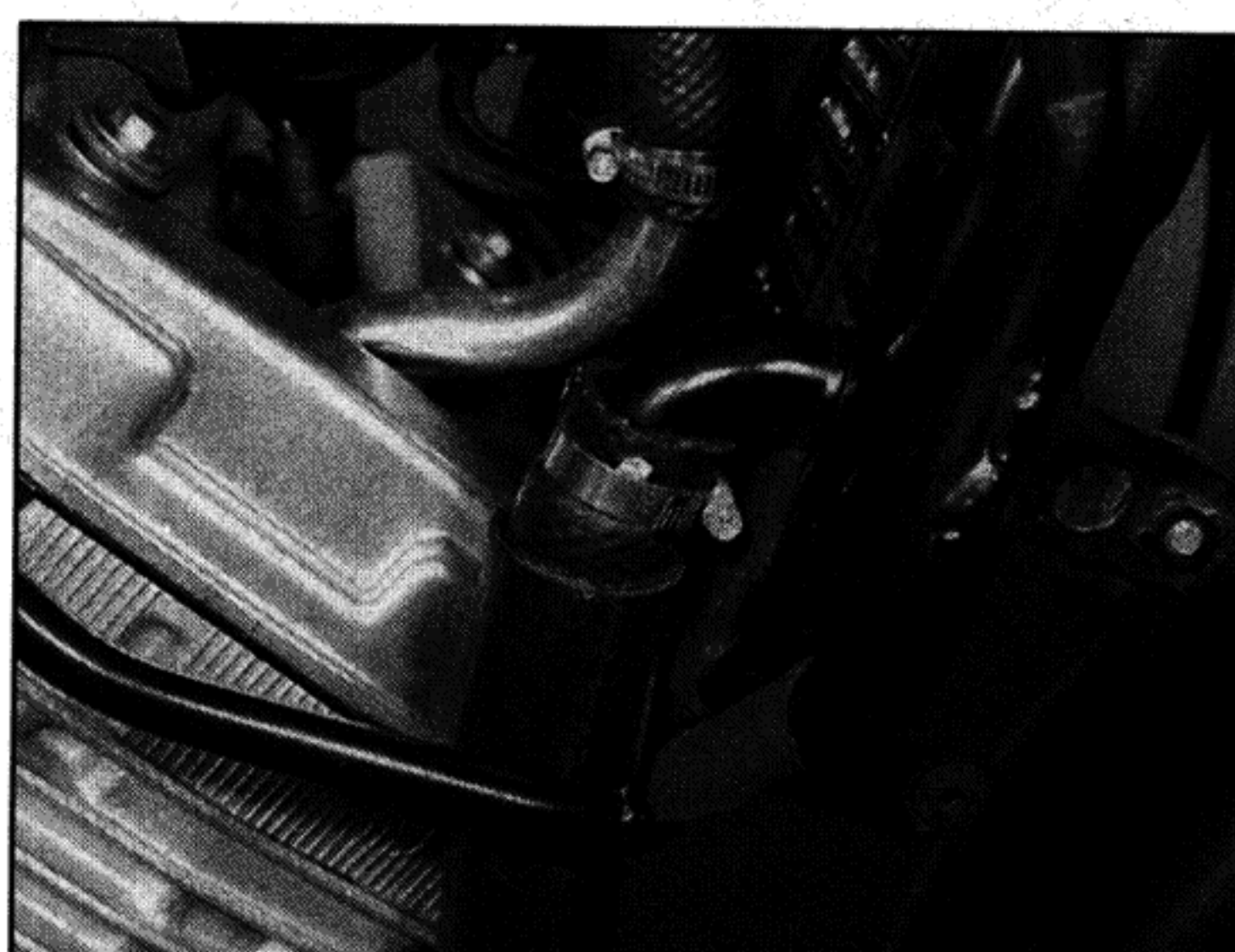
4 Unscrew the bolts securing the radiator, noting the arrangement of the collars and rubber grommets, and carefully manoeuvre



6.11 Fit the cover using a new O-ring



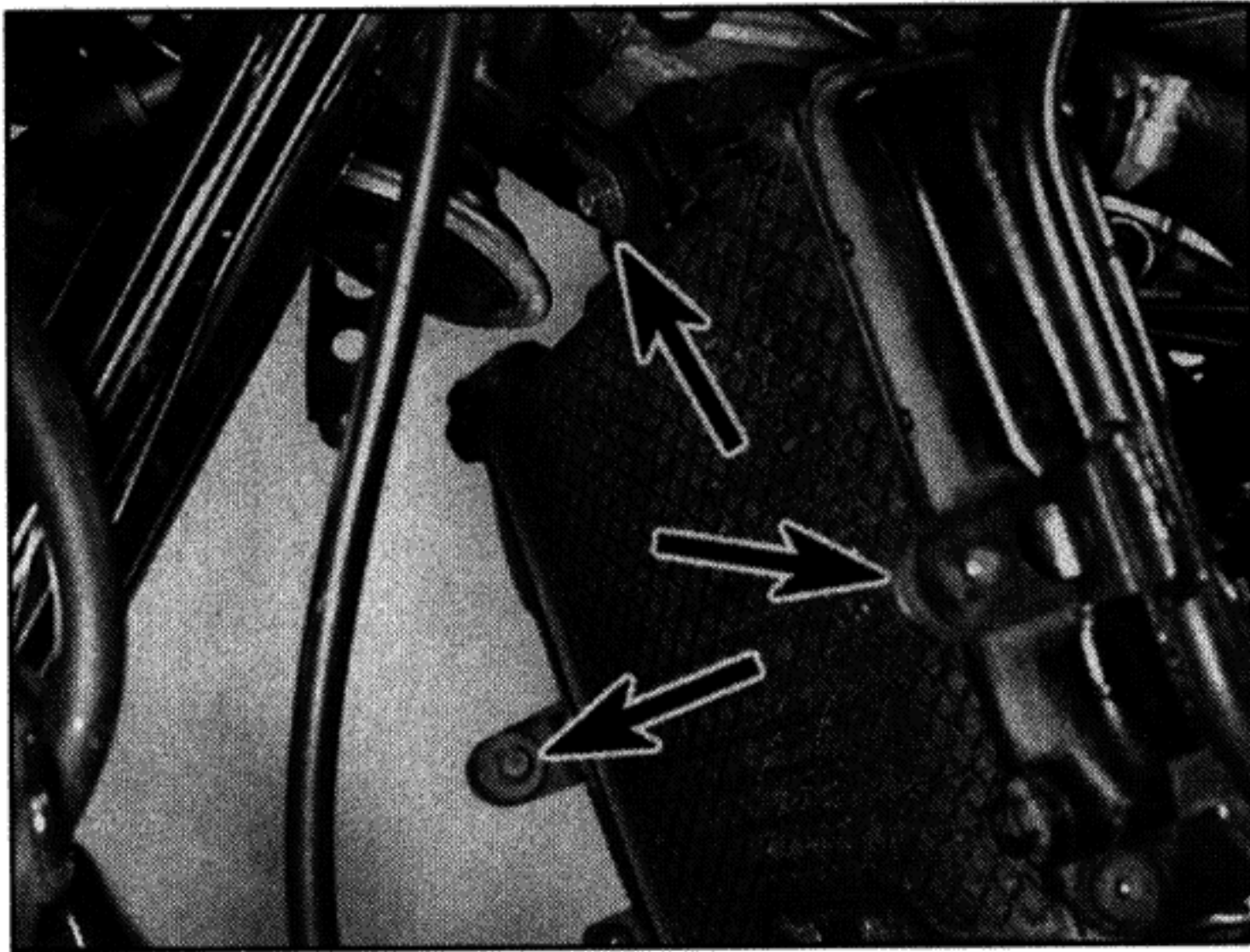
7.3a Detach the upper ...



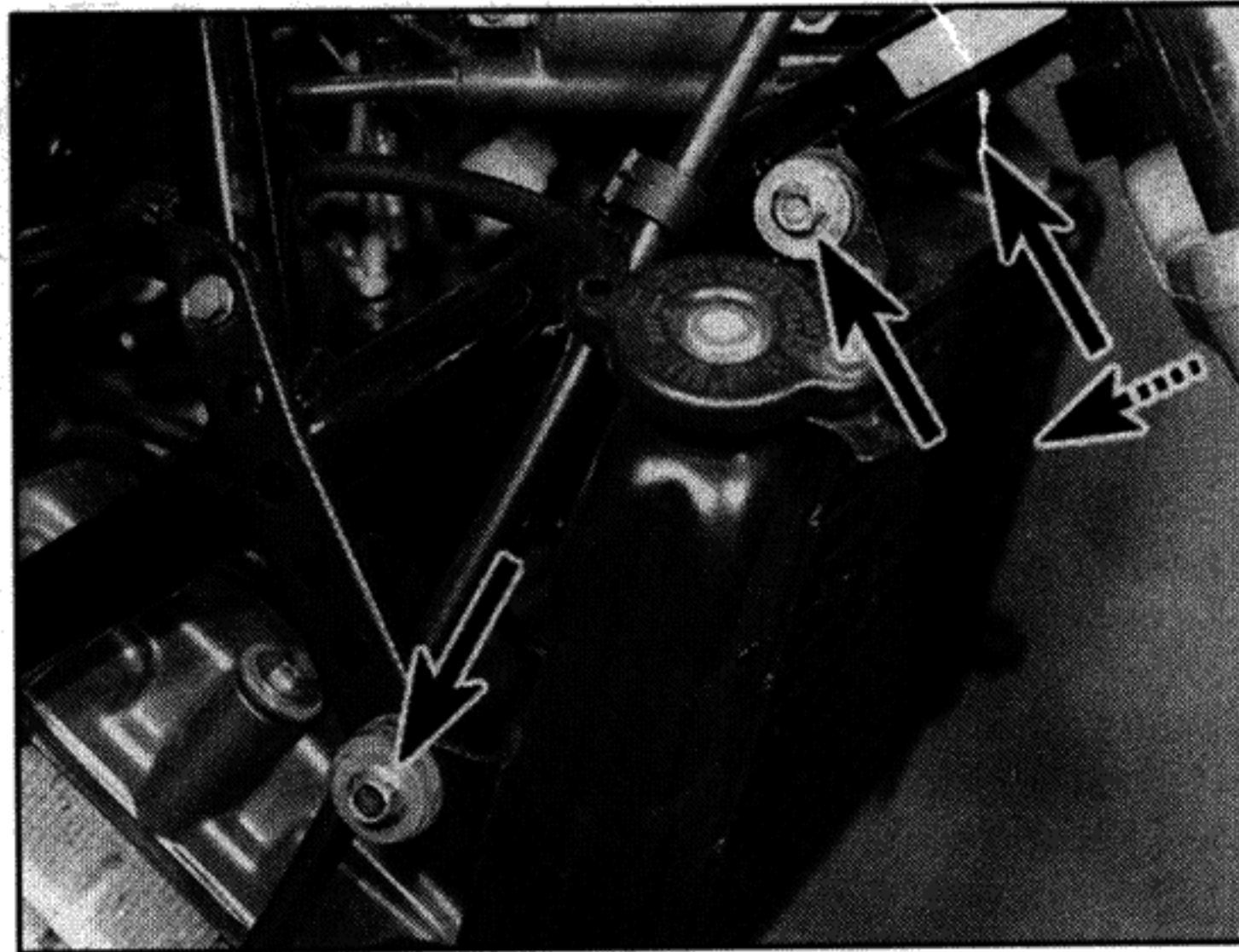
7.3b ... and lower radiator hoses (early TDM shown) ...



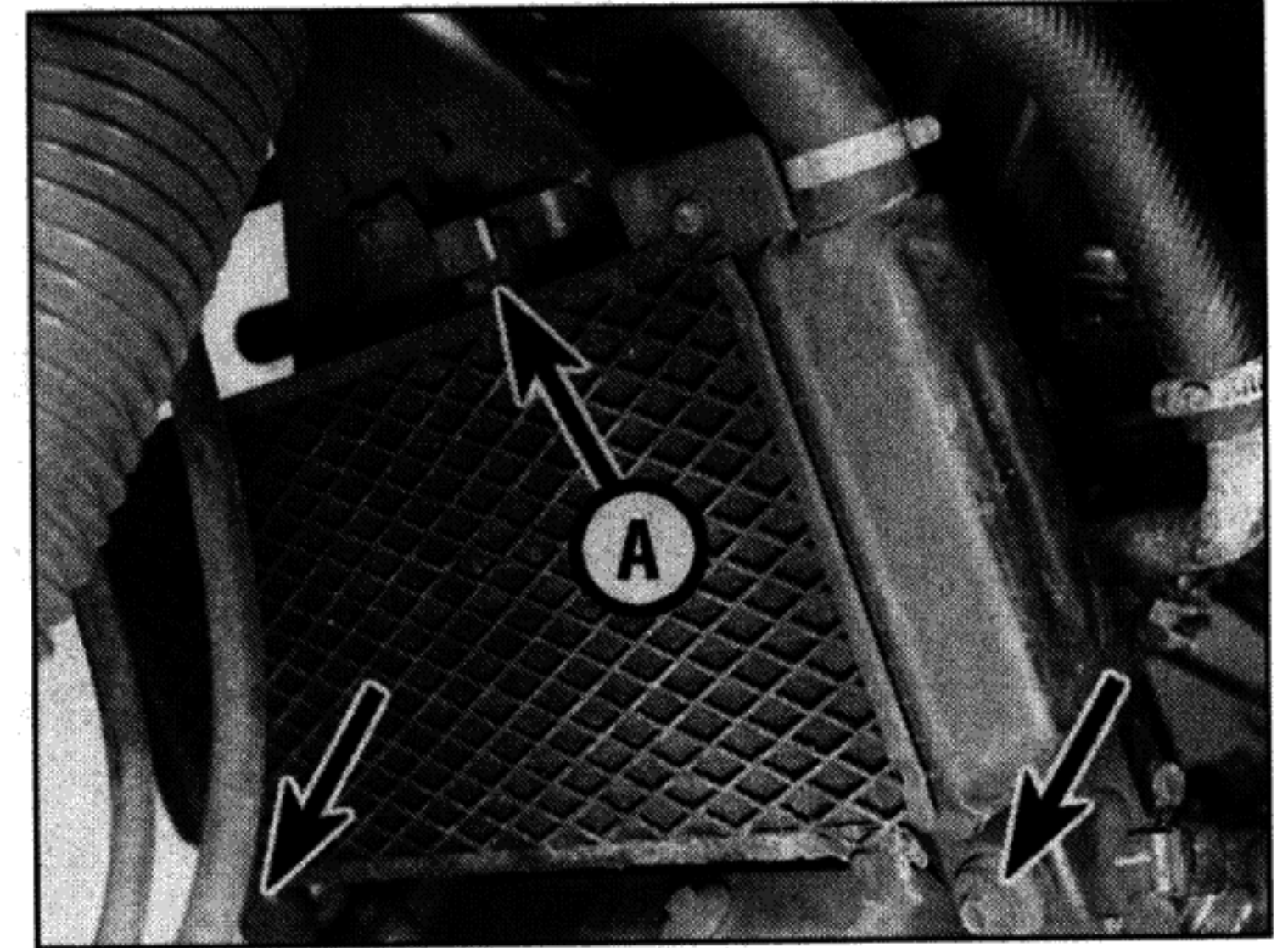
7.3c ... and on TDM and TRX models the overflow hose (arrowed)



7.4a Radiator mounting bolts (arrowed) – 1991 to 1995 TDM models



7.4b Radiator mounting bolts (arrowed) – 1996-on TDM models and all TRX models (TRX shown)



7.4c Radiator mounting bolts (arrowed) – XTZ models. Note how the rubber damper locates in the bracket (A)

the radiator away from the machine, noting how it fits (**see illustrations**).

5 On TDM models, if required, unscrew the bolts securing the radiator stay to the frame and remove the stay.

6 If necessary, remove the cooling fan (see Section 4) from the radiator.

7 If required, remove the stone guard from the radiator. Check the stone guard and the radiator for signs of damage and clear any dirt or debris that might obstruct air flow and inhibit cooling. If the radiator fins are badly damaged or broken the radiator must be renewed. Also check the rubber mounting grommets, and renew them if necessary.

Installation

8 Installation is the reverse of removal, noting the following.

- Make sure the various collars and grommets are correctly installed with the mounting bolts.*
- Make sure that the fan wiring is correctly connected.*
- Ensure the coolant hoses are in good condition (see Chapter 1), and are securely retained by their clamps, using new ones if necessary.*
- On completion refill the cooling system as described in Chapter 1.*

8 Water pump – check, removal, and installation

Check

1 The water pump is located on the right-hand side of the engine. Visually check the area around the pump for signs of leakage.

2 To prevent leakage of water from the cooling system into the lubrication system and vice versa, two seals are fitted on the pump shaft. On the underside of the pump body there is a drainage hole (**see illustration 8.12a**). If either seal fails, this hole should allow the coolant or oil to escape and prevent the oil and coolant mixing.

3 If there is any leakage from the drainage hole, remove the pump and renew it – individual components (except O-rings and bolts) are not available.

Removal

4 Drain the coolant (see Chapter 1). Place a suitable container below the water pump to catch any residue as the water pump is removed. On XTZ models, remove the exhaust system (see Chapter 4). Also unscrew the bolts securing the right-hand frame downtube section and remove it.

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

6 Unscrew the bolts securing the pump to the crankcase (**see illustration**). Carefully draw the pump from the crankcase, noting how it fits. It may be necessary to lever it out to overcome the O-rings on the pump body and on the joint pipe between the top of the pump housing and the union on the cylinder block.

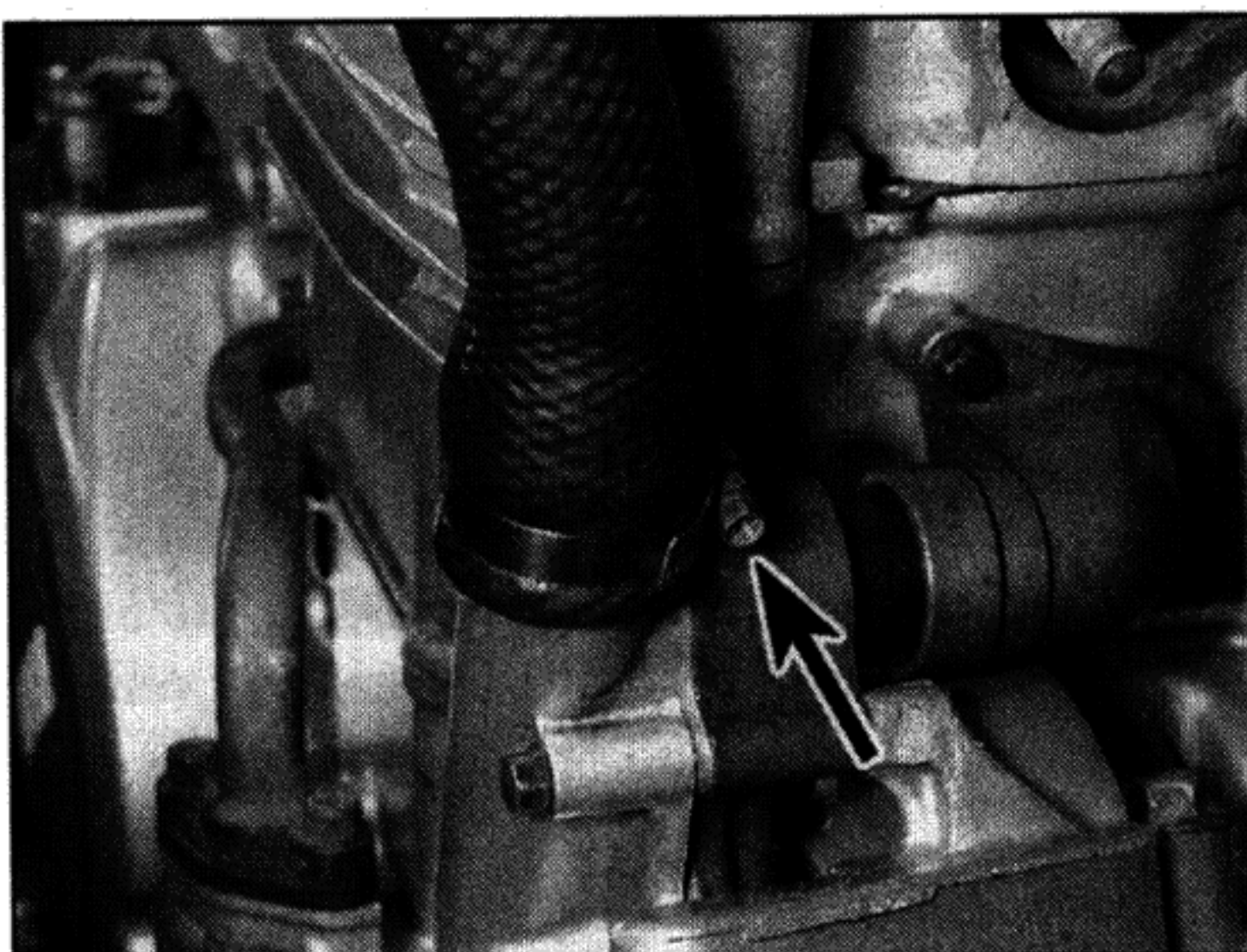
Caution: A shim is fitted on the pump shaft between the circlip and the drive gear. The shim will probably stick to the gear, however great care must be taken as it is possible for the shim to slip down into the engine as the shaft is withdrawn from the gear.

Remove the O-ring from the rear of the pump body and from the joint pipe and discard them as new ones must be used. Note the position of each bolt as their lengths differ.

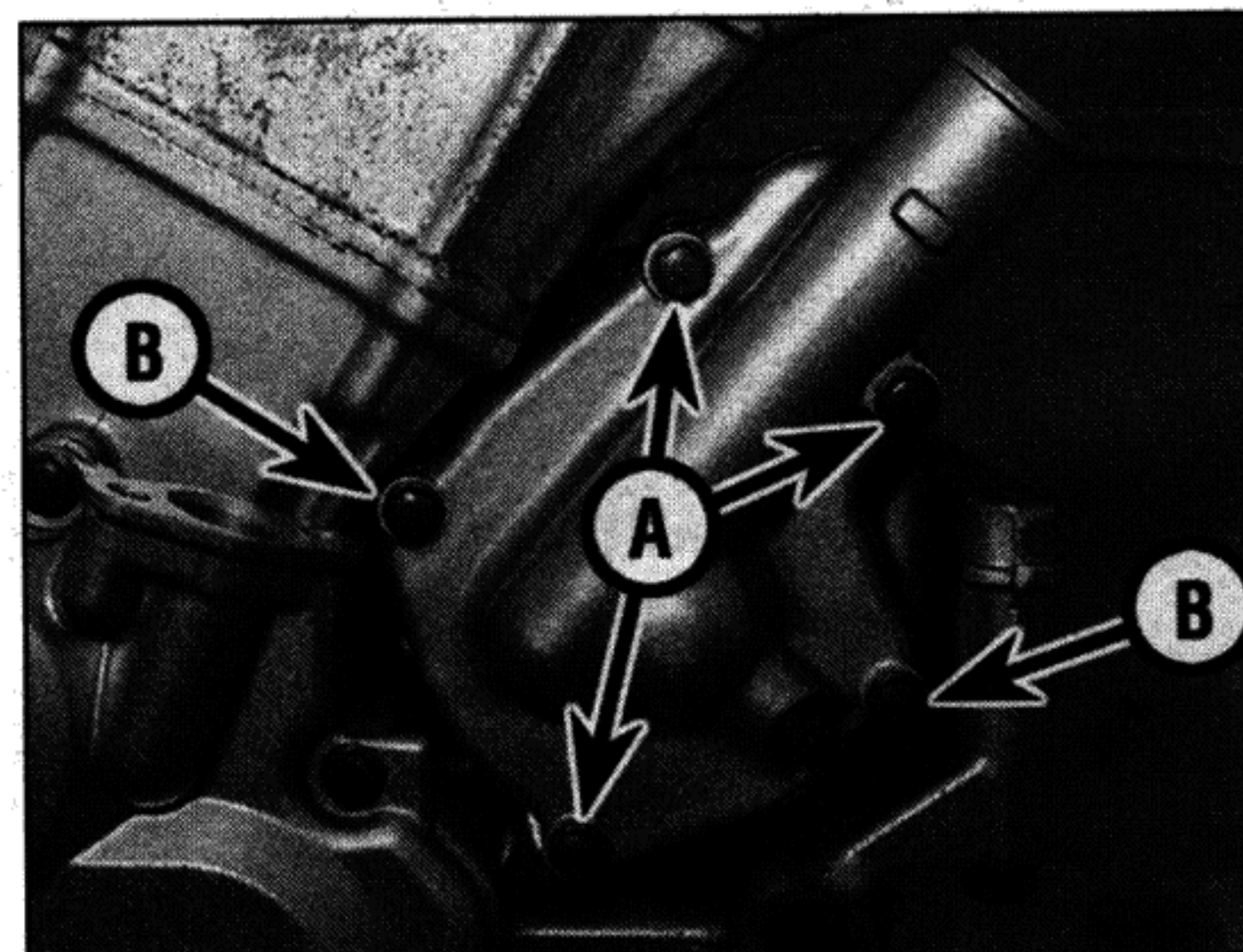
7 Unscrew the remaining bolts securing the pump cover and remove the cover (**see illustration 8.6**). Discard the cover O-ring as a new one must be used.

8 Wiggle the water pump impeller back-and-forth and in-and-out. If there is excessive movement the pump must be renewed. Rotate the impeller and check that it turns smoothly and freely. Also check for corrosion or a build-up of scale in the pump body and clean or renew the pump as necessary.

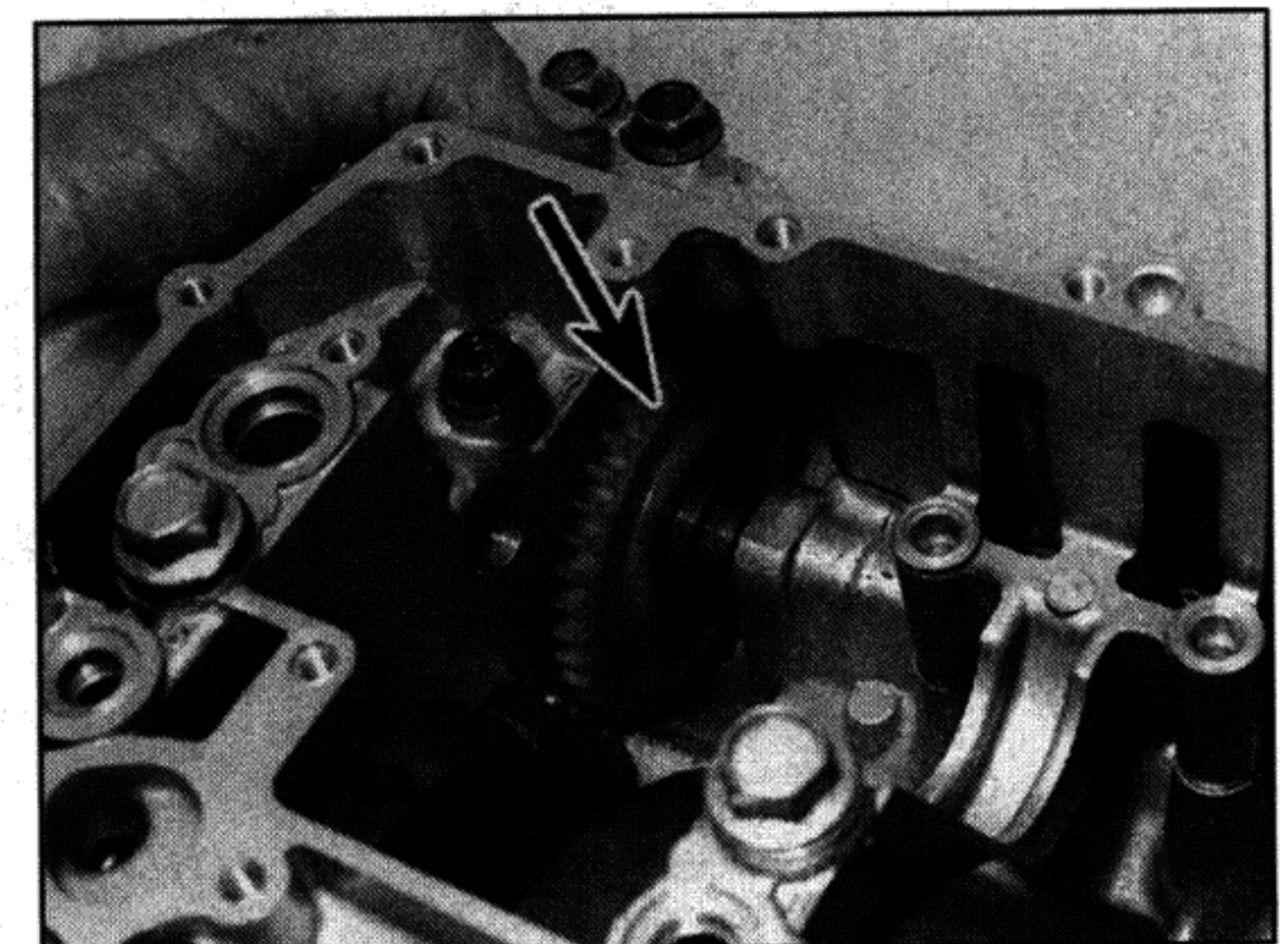
9 To remove the pump drive gear, first remove the front balancer shaft (see Chapter 2). Slide the gear out of its bore in the crankcase and lift it out, noting how it fits (**see illustration**).



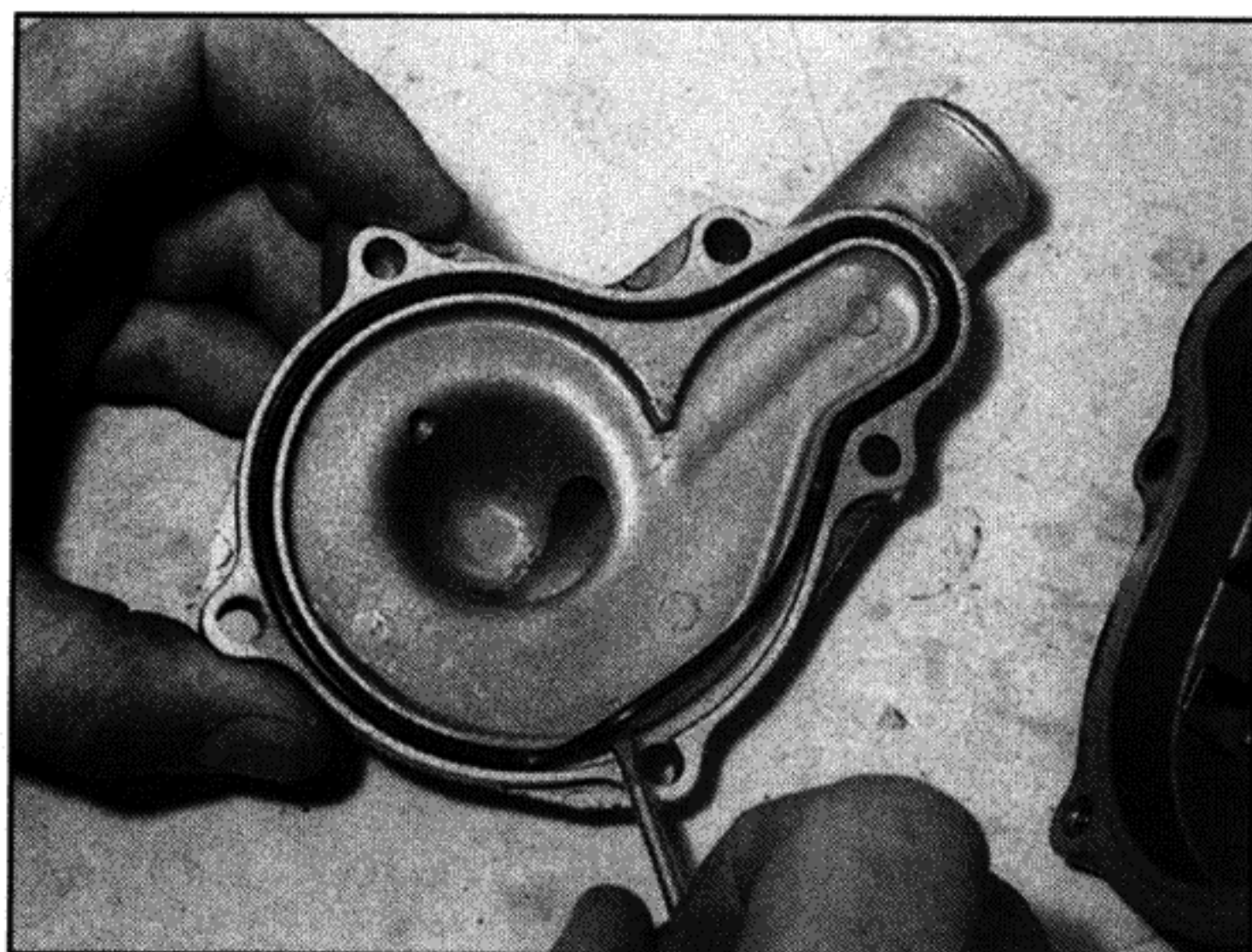
8.5 Slacken the clamp (arrowed) and detach the hose



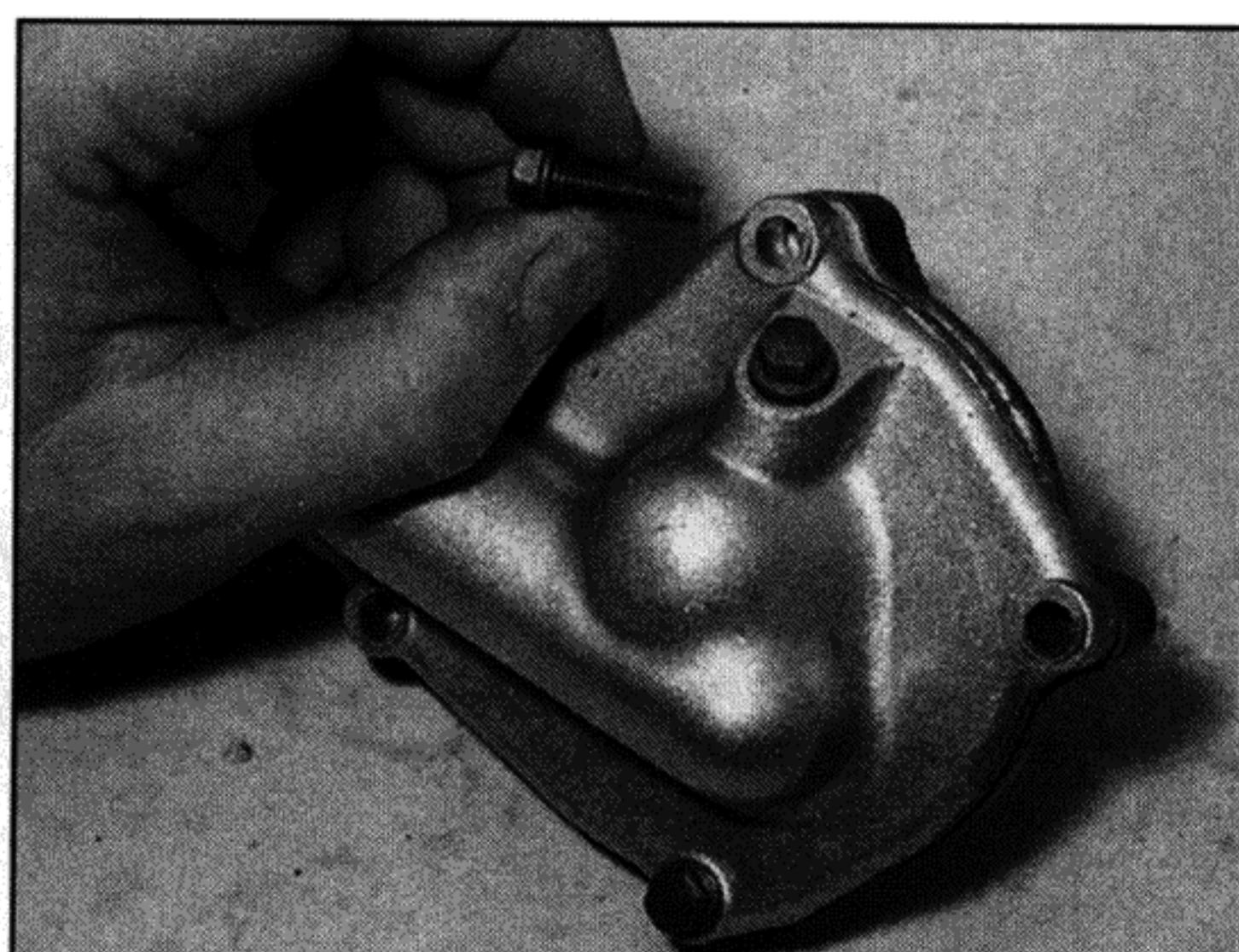
8.6 Water pump mounting bolts (A), cover bolts (A) and (B)



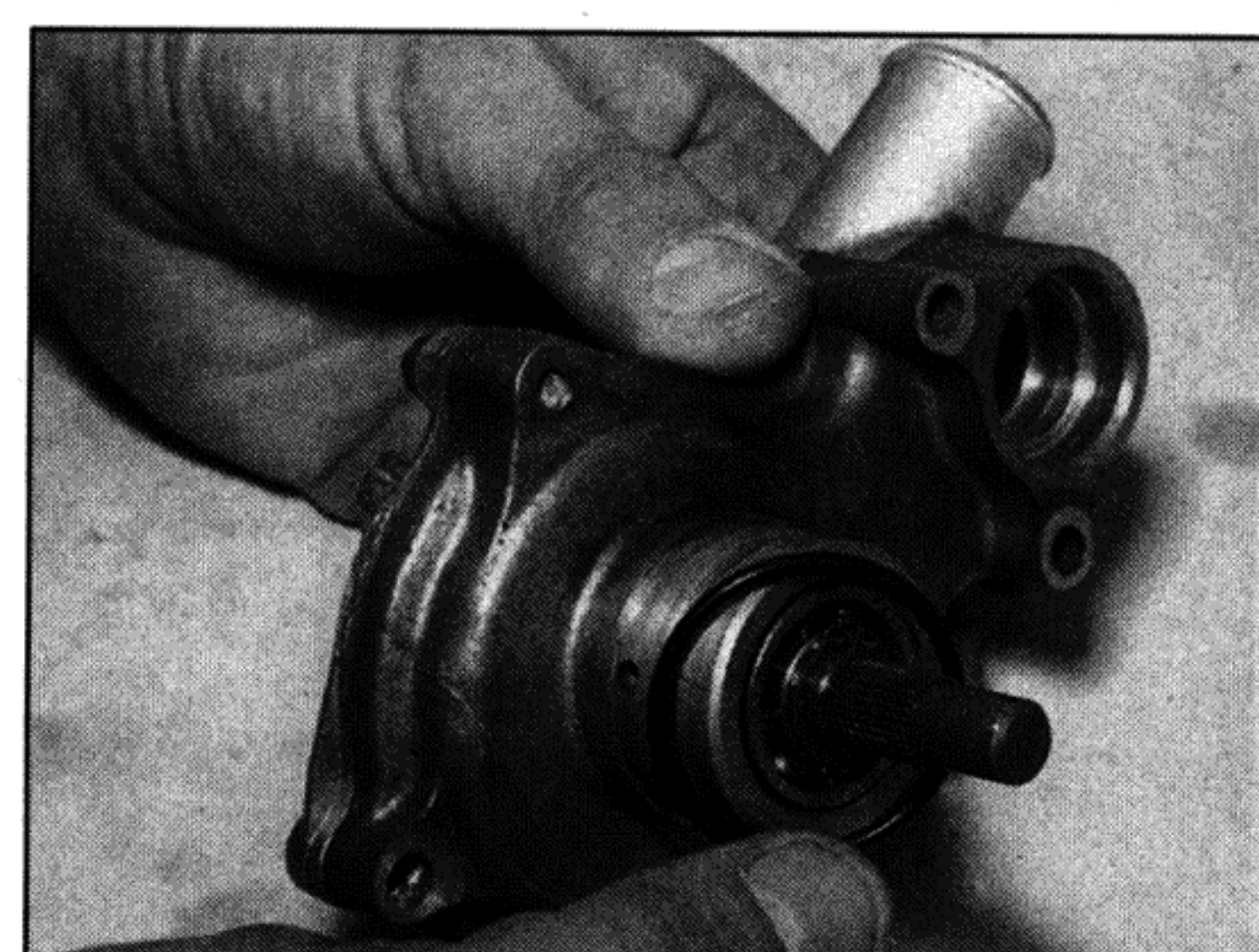
8.9 Water pump drive gear (arrowed)



8.11a Fit the O-ring into the groove in the cover ...



8.11b ... then fit the cover and its two bolts



8.12a Fit a new O-ring onto the body ...

Installation

10 If removed, slide the shouldered side of the pump drive gear into its bore in the crankcase (see illustration 8.9). Install the front balancer shaft (see Chapter 2).

11 Install the new cover O-ring into its groove in the pump (see illustration). Fit the cover and secure it with the two bolts (see illustration).

12 Fit the new pump body O-ring and joint pipe O-ring (see illustration). Apply some grease to the shim to stick it in place, then slide it onto the pump shaft (see illustrations). Install the pump into the crankcase, making sure it locates correctly into the driven gear (see illustration). Install the bolts and tighten them to the torque setting specified at the beginning of the Chapter (see illustration 8.6). Make sure the different length bolts are in their correct locations.

13 Attach the coolant hose to the pump cover and secure it with its clamp (see illustration 8.5).

14 On XTZ models, install the frame downtube and tighten its bolts to the specified torque setting (see Chapter 2).

Also install the exhaust system (see Chapter 4).

15 Refill the cooling system (see Chapter 1).

9 Coolant hoses – removal and installation

Removal

1 Before removing a hose, drain the coolant (see Chapter 1).

2 Use a screwdriver to slacken the larger-bore hose clamps, then slide them back along the hose and clear of the union spigot (see illustrations 6.3, 7.3a and b). The smaller-bore hoses are secured by spring clamps which can be expanded by squeezing their ears together with pliers (see illustration 7.3c).

Caution: The radiator unions are fragile.

Do not use excessive force when attempting to remove the hoses.

3 If a hose proves stubborn, release it by rotating it on its union before working it off. If all else fails, cut the hose with a sharp knife

then slit it at each union so that it can be peeled off in two pieces. Whilst this means replacing the hose, it is preferable to buying a new radiator.

4 The water pipe union on the front of the cylinder block can be removed by unscrewing the retaining bolts (see Chapter 2, Section 13). If it is removed, the O-rings must be renewed.

Installation

5 Slide the clamp onto the hose and then work it on to its respective union.

HAYNES
HINT *If the hose is difficult to push on its union, it can be softened by soaking it in very hot water, or alternatively a little soapy water can be used as a lubricant.*

6 Rotate the hose on its union to settle it in position before sliding the clamp into place and tightening it securely.

7 If the water pipe union on the engine has been removed, fit new O-rings, then install the union and tighten the mounting bolts to the specified torque setting (see Chapter 2, Section 13).



8.12b ... then grease the shim ...



8.12c ... and slide it onto the shaft



8.12d Install the pump, making sure it locates correctly into the drive gear