

Chapter 4 Part A:

Fuel system - carburettor models

Contents

| | | | |
|---|----------------|---|----------------|
| Accelerator cable - removal, refitting and adjustment | 3 | Fuel filter - renewal | See Chapter 1A |
| Accelerator pedal - removal and refitting | 4 | Fuel pump and gauge sender unit - removal and refitting | 11 |
| Air cleaner - removal and refitting | 2 | Fuel system - depressurisation | 6 |
| Air cleaner elements - renewal | See Chapter 1A | Fuel tank - removal and refitting | 12 |
| Carburettors - overhaul | 8 | General information and precautions | 1 |
| Carburettors - removal and refitting | 7 | Idle speed and mixture adjustment | See Chapter 1A |
| Carburettors - tuning and adjustment | 9 | Inlet manifold - removal and refitting | 10 |
| Choke cable - removal and refitting | 5 | Unleaded petrol - general information and usage | 13 |
| Fast idle adjustment | See Chapter 1A | | |

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 | | |
|------------------------------------|---|--------|
| System type | Twin SU carburettors, manual choke operation. Electric fuel pump, mounted in tank | |
| Minimum octane rating (all models) | 95 RON unleaded | |
| Carburettors | | |
| Type | 2 x SU HIF44 | |
| Jet size | 2.5 mm | |
| Needle | BGV | |
| Idle speed | 700 ± 50 rpm | |
| Fast idle speed | 1100 ± 50 rpm | |
| CO content (at idle) | 1.0 to 2.0 % | |
| Torque wrench settings | | |
| Fuel pump/sender unit locking ring | Nm | lbf ft |
| Inlet manifold bolts | 50 | 37 |
| Inlet manifold gasket clamp bolts | 50 | 37 |
| | 20 | 15 |

1 General information and precautions

Early Discovery models are fitted with twin SU carburettors, with manual choke operation for cold starting.

The fuel system comprises a fuel tank with a submerged low-pressure electric fuel pump, a fuel filter, fuel supply and return lines, and the twin carburettors.

The fuel pump delivers a constant supply of fuel through a cartridge filter to the carburettors. A spill pipe returns excess fuel from the carburettors back to the fuel tank.

Inlet air is drawn into the engine through the air cleaner, which contains two renewable paper filter elements.

For information on the exhaust and emission control systems, refer to part D of this Chapter.

SU HIF carburettor - description

The SU HIF (Horizontal Integral Float chamber) carburettor is the last significant development of the SU design which has been around since the 1960s. Each carburettor is of the variable-choke, constant-depression type, incorporating a sliding piston which automatically controls the mixture of air and fuel supplied to the engine with respect to the throttle valve position and engine speed.

The carburettor functions as follows. When the engine is started and is allowed to idle, the throttle valve passes a small amount of air. Because the piston is in a low position, it offers a large restriction, and the resultant pressure reduction draws fuel from the jet, and atomisation occurs to provide a combustible mixture. Since the inside section of the tapered needle is across the mouth of the jet, a relatively small amount of fuel is passed.

When the throttle valve is opened, the amount of air passing through the carburettor is increased, which causes a greater depression beneath the sliding piston. An internal passageway connects this depression with the suction chamber above the piston, which now rises. The piston offers less of a restriction and the depression is reduced, with the result that a point is reached where the forces of depression, gravity, and spring tension balance out. The tapered needle has now been raised, and more fuel passes from the jet.

If the throttle is opened suddenly, the natural tendency of the air valve piston to rise - causing a weak mixture when it is least required (ie during acceleration) - is prevented by a hydraulic damper which delays the piston in its upward travel. The air intake is thus restricted and a proportionately larger quantity of fuel to air is drawn through.

Incorporated in the jet adjusting (mixture) screw mechanism is a bi-metal strip which alters the position of the jet to compensate for

varying fuel densities resulting from varying fuel temperatures.

For cold starting, the carburettor incorporates a disc valve which allows additional fuel to flow into the mixture stream. The disc valve itself incorporates several orifices which are progressively uncovered as the disc is moved when the choke control is pulled. The throttle butterfly is also opened a small amount. Also included is a temperature-controlled valve which weakens the mixture under light load and idling conditions when the engine is hot.

The overall effect of this type of carburettor is that it will remain in tune during the lengthy service intervals and also under varying operating conditions and temperature changes. The design of the unit and its related systems ensures a fine degree of mixture control over the complete throttle range, coupled with enhanced engine fuel economy.

Precautions



Warning: Many of the procedures in this Chapter require the removal of fuel lines and connections, which may result in some fuel spillage. Before carrying out any operation on the fuel system, refer to the precautions given in Safety first! at the beginning of this manual, and follow them implicitly. Petrol is a highly-dangerous and volatile liquid, and the precautions necessary when handling it cannot be overstressed.

Do not smoke, or allow any naked flames or uncovered light bulbs near the work area. Note that gas-powered domestic appliances with pilot flames, such as heaters boilers and tumble-dryers, also present a fire hazard - bear this in mind if you are working in an area where such appliances are present. Always keep a suitable fire extinguisher close to the work area, and familiarise yourself with its operation before starting work. Wear eye protection when working on fuel systems, and wash off any fuel spilt on bare skin immediately with soap and water. Note that fuel vapour is just as dangerous as liquid fuel - possibly more so; a vessel (such as the fuel tank) that has been emptied of liquid fuel will still contain vapour, and can be potentially explosive.

Although a low-pressure electric fuel pump is used, some residual fuel pressure may still remain in the fuel system, long after the engine has been switched off. This pressure must be relieved in a controlled manner before disconnecting any part of the fuel system - refer to Section 6 for details.

When working with fuel system components, pay particular attention to cleanliness - dirt entering the fuel system may cause blockages, which will lead to poor running.

In the interests of personal safety, many of the procedures in this Chapter suggest

that the negative lead be removed from the battery terminal. This eliminates the possibility of accidental short-circuits being caused as the vehicle is being worked upon, which would be particularly dangerous if the fuel system is open.

2 Air cleaner - removal and refitting

1 The air cleaner is an oval metal cylinder. A paper disposable air filter is fitted into each end and alloy elbows feed the air to the twin carburettors. The air cleaner is located on mounting pegs attached to the rear of the inlet manifold, and the air intake protrudes forward between the carburettors.

Removal

2 Slacken the hose clips on either end of the air cleaner and pull the elbows from the carburettors and air cleaner assembly.

3 Using two open-ended spanners, disconnect the one-way valve hose from the flame trap.

4 Remove the air cleaner assembly from the retaining posts by lifting it and pulling it forwards. As the assembly is withdrawn, disconnect the crankcase breather hose from its base.

Refitting

5 Refit the air cleaner into position, making sure that the breather hoses are reconnected. Reconnect the flame trap to the one-way valve, then refit the elbows and secure the hose clips.

3 Accelerator cable - removal, refitting and adjustment

Removal

Note: New split-pins should be used to secure the cable end clevis pins on refitting.

1 Remove the air cleaner as described in Section 2.

2 Remove the split pin and clevis pin, and disconnect the cable end from the operating linkage.

3 Slide back the rubber cover, and loosen the locknut and adjuster nut so that the adjuster can be removed from the bracket.

4 Where applicable, release the accelerator cable from the bracket on the engine compartment bulkhead, noting the cable routing.

5 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. This will allow access to the accelerator pedal assembly.

6 Remove the split-pin, and withdraw the clevis pin securing the end of the cable to the accelerator pedal.

7 Release the cable grommet from the bulkhead, then withdraw the cable through the bulkhead into the engine compartment.

Refitting

8 Refitting is a reversal of removal, bearing in mind the following points:

- a) Ensure that the cable is routed as noted before removal.
- b) Use new split-pins to secure the cable end clevis pins.
- c) On completion, check the cable adjustment, as described in the following paragraphs.

Adjustment

9 Ensure the throttle lever is in the fully-closed position, by pressing the lever fully against its stop.

10 Loosen the locknut, then turn the adjuster nut to give a small amount of freeplay in the inner cable, so that the throttle lever is free to return to the closed (idle) position, but without undue slack. If there is any reluctance to return to idle, lubricate the throttle linkages with a few drops of light oil.

11 With the aid of an assistant, check that the accelerator lever moves to the full-throttle position when the accelerator pedal is fully depressed.

12 With the handbrake applied and the transmission in neutral, start the engine. Press and release the accelerator pedal several times, and ensure the engine returns to idle promptly. On completion, check and if necessary adjust the idle speed as described in Chapter 1A.

4 Accelerator pedal - removal and refitting

Removal

1 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. This will allow access to the accelerator pedal assembly.

2 Remove the split-pin, and withdraw the clevis pin securing the end of the cable to the accelerator pedal.

3 Using a suitable pair of circlip pliers, remove the circlip from one end of the pedal pivot pin.

4 Withdraw the pivot pin from the pedal bracket, and recover the bushes, noting their locations. Withdraw the pedal and return spring, noting the orientation of the spring.

Refitting

5 Refitting is a reversal of removal, bearing in mind the following points:

- a) Ensure that the pedal return spring and the pivot bushes are located as noted during removal. Lubricate the pivot pin with a little light oil or grease.
- b) On completion, check the accelerator cable adjustment, as described in Section 3.

5 Choke cable - removal and refitting

Removal

1 The choke cable is attached to the trunion at the front of the left-hand carburettor (left and right are as seen from the driver's seat). Undo the screw to release it. If the cable is to be refitted, note how far the inner cable protrudes from the trunion.

2 Disconnect the outer cable from the cable clamp by the carburettor and the clip on the air cleaner housing. Again, note the fitted position of the outer cable if it is to be refitted.

3 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. Disconnect the choke warning light switch cables from the choke control assembly.

4 Pull out the outer cable retaining clip, then release the bulkhead grommet and withdraw the choke control knob and cable complete.

Refitting

5 Refitting is a reversal of removal, bearing in mind the following points:

- a) If the old cable is being refitted, position the inner and outer cables as noted on removal.
- b) On completion, check the cable adjustment, as described below.

Adjustment

6 Before starting the adjustment, make sure that the fast idle adjustment procedure has been carried out, as described in Chapter 1A, Section 12.

7 Pull out the choke control to the full choke position.

8 At the left-hand carburettor, check to see whether the choke lever has been pulled against its stop. Now push the choke control fully home, and ensure the choke lever has returned to the off position. If not, proceed as follows.

9 There are two ways to adjust the choke cable - neither way is uniquely right, and some trial-and-error may be required.

10 To adjust the outer cable, loosen the cable clamp and move the cable as necessary. If the choke is not operating enough, pull the cable out of the clamp slightly, and tighten the clamp. If the choke is not returning, push the cable through the clamp before retightening it. Push the choke control fully in, then pull it fully out again, and re-check the adjustment.

11 Adjusting the inner cable is similar to the outer cable - on an older car, it is likely that the inner cable will have stretched, causing the choke not to operate sufficiently. Holding the choke lever in the full-choke position, loosen the inner cable screw and pull the cable through taut, tightening the screw when in the right position. Push the choke control fully in, then pull it fully out again, and re-check the adjustment.

6 Fuel system - depressurisation

Note 1: Observe the precautions in Section 1 before working on any component in the fuel system.

Note 2: The fuel pressure on carburettor models is lower than that found in those with fuel injection, but there is still a risk of uncontrolled fuel spray if the procedures below are not followed.



Warning: The following procedure will merely relieve the pressure in the fuel system - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

1 The fuel system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, and the metal pipes and flexible hoses of the fuel lines between these components. All these contain fuel, which will be under pressure while the engine is running and/or while the ignition is switched on. The pressure will remain for some time after the ignition has been switched off, and must be relieved before any of these components are disturbed for servicing work. Ideally, the engine should be allowed to cool completely before work commences.

2 Identify and remove the fuel pump fuse from the fusebox (see Chapter 13).

3 With the fuel pump disabled, crank the engine for about ten seconds. The engine may fire and run for a while, but let it continue running until it stops. This will lower the line fuel pressure, and reduce the risk of fuel spraying out when a fuel line is disturbed.

4 Switch off the ignition, disconnect the battery negative terminal, then refit the fuel pump fuse.

5 Place a suitable container beneath the relevant connection/union to be disconnected, and have a large rag ready to soak up any escaping fuel not being caught by the container.

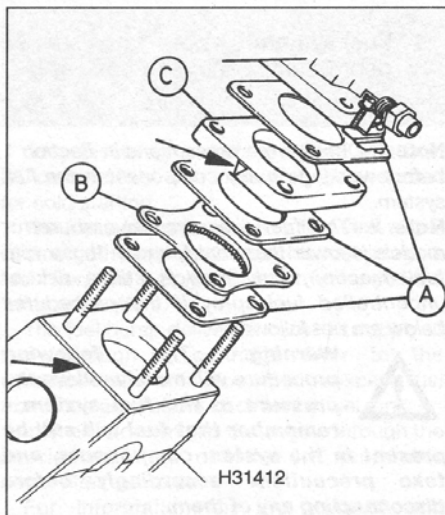
6 Slowly loosen the connection to avoid a sudden release of pressure, and position the rag around the connection to catch any fuel spray which may be expelled. Once the pressure has been released, disconnect the fuel line. Insert plugs to minimise fuel loss and prevent the entry of dirt into the fuel system.

7 Carburettors - removal and refitting

Removal

1 Depressurise the fuel system as described in Section 6.

2 Remove the air cleaner as described in Section 2.



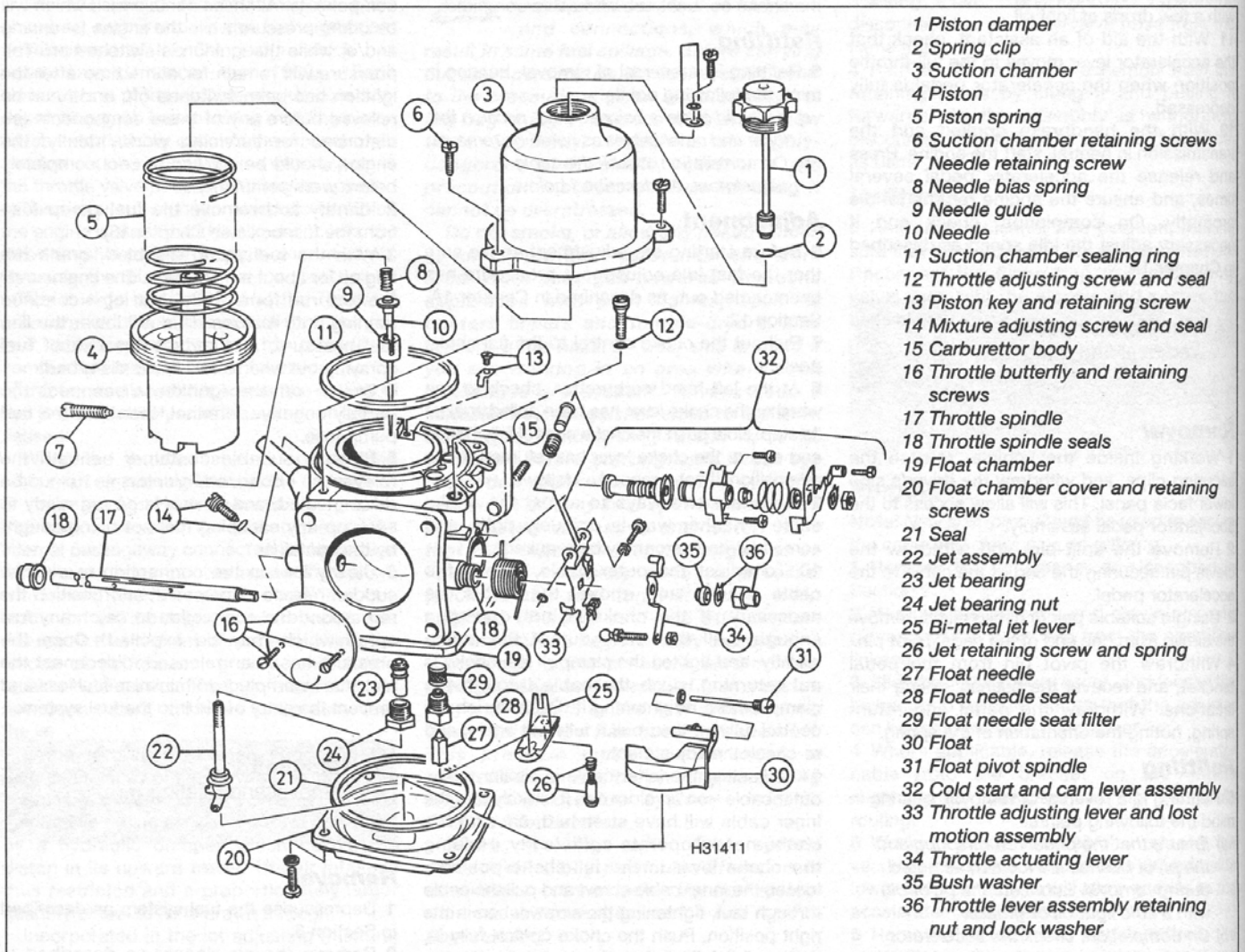
7.9 Correct fitted order of the carburettor gaskets (A), liner (B) and insulator (C)
Arrows indicate insulator alignment markings

- 3 Disconnect the rocker cover breather pipes from the carburettors, as applicable.
- 4 Disconnect the main fuel and choke fuel supply pipes which run between the carburettors.
- 5 To remove the left-hand carburettor (left as seen from the driver's seat), disconnect the following:
 - a) Accelerator cable (Section 3).
 - b) Choke cable (Section 5).
 - c) Fuel supply pipe at the front of the carburettor.
 - d) Throttle linkage between the carburettors.
 - e) Vacuum pipe to the distributor.
- 6 To remove the right-hand carburettor, disconnect the following:
 - a) Fuel return pipe from the union in front of the carburettor.
 - b) Throttle linkage between the carburettors.
 - c) Brake vacuum servo hose from inlet manifold (for convenience).
- 7 Undo the four retaining nuts and spring washers for each carburettor, and lift it away.
- 8 The gaskets and insulator can then be

removed if necessary. Note that there is a liner fitted inside the insulator on some models.

Refitting

- 9 Refitting of the carburettors is the reverse of the removal procedure, but the following points should be noted:
 - a) Clean the mating faces of the carburettors and the inlet manifold.
 - b) Fit the inner gasket, followed by the liner (where applicable), taking care to ensure that the lugs locate properly in the insulator recesses and do not stand proud. **Note:** The liner can only be fitted one way round, that is with the teeth engaged in the slots.
 - c) Fit the next gasket and the insulator, making sure that the arrow is uppermost and pointing towards the centre of the manifold. Fit the final gasket, then the carburettor can be mounted in place (see illustration).
 - d) Refit the retaining nuts and spring washers, and tighten evenly.



8.4 Exploded view of the SU HIF carburettor

- 1 Piston damper
- 2 Spring clip
- 3 Suction chamber
- 4 Piston
- 5 Piston spring
- 6 Suction chamber retaining screws
- 7 Needle retaining screw
- 8 Needle bias spring
- 9 Needle guide
- 10 Needle
- 11 Suction chamber sealing ring
- 12 Throttle adjusting screw and seal
- 13 Piston key and retaining screw
- 14 Mixture adjusting screw and seal
- 15 Carburettor body
- 16 Throttle butterfly and retaining screws
- 17 Throttle spindle
- 18 Throttle spindle seals
- 19 Float chamber
- 20 Float chamber cover and retaining screws
- 21 Seal
- 22 Jet assembly
- 23 Jet bearing
- 24 Jet bearing nut
- 25 Bi-metal jet lever
- 26 Jet retaining screw and spring
- 27 Float needle
- 28 Float needle seat
- 29 Float needle seat filter
- 30 Float
- 31 Float pivot spindle
- 32 Cold start and cam lever assembly
- 33 Throttle adjusting lever and lost motion assembly
- 34 Throttle actuating lever
- 35 Bush washer
- 36 Throttle lever assembly retaining nut and lock washer

10 The remainder of the fitting procedure is a direct reversal of the removal sequence. On completion, adjust the carburettors as described in Chapter 1A, Section 12.

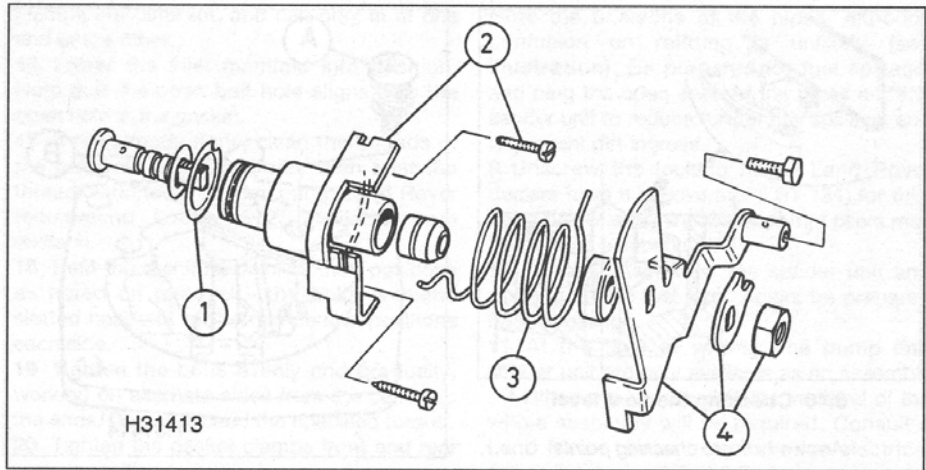
8 Carburettors - overhaul



Note: The following procedure is for the right-hand carburettor. The left-hand carburettor procedure is similar.

Dismantling

- 1 Remove the carburettor from the engine as described in Section 7, and clean it with fuel or paraffin.
- 2 Remove the nuts and spring washers, and remove the air inlet adaptor and the gasket.
- 3 Unscrew the piston damper and drain the oil into a suitable container.
- 4 Mark the suction chamber and piston body in relation to each other with a pencil. Remove the screws and withdraw the suction chamber, together with the piston and spring (see illustration opposite).
- 5 Extract the circlip from the top of the piston rod, and remove the piston and spring.
- 6 Unscrew the metering needle guide locking screw and remove the needle, guide and spring assembly from the piston. If difficulty is experienced, carefully grip the needle in a soft-jawed vice close to the piston, and give the piston a sharp pull. Take care not to bend the needle.
- 7 Invert the carburettor, then loosen the screws and remove the float chamber cover plate and sealing ring from the bottom of the carburettor.
- 8 Unscrew the jet adjusting lever mounting screw, and remove the spring.
- 9 Remove the jet, together with the bi-metal lever, and separate the lever from the jet.
- 10 Hold the float, then unscrew and remove the pivot spindle and remove the washer. Withdraw the float.
- 11 Remove the needle valve from its seat.
- 12 Unscrew and remove the needle valve seat, and remove the filter.
- 13 Unscrew the jet bearing nut, then invert the carburettor and extract the jet bearing. If necessary, tap the carburettor to release the bearing.
- 14 Loosen the screw and remove the piston guide key. Remove the suction chamber sealing ring.
- 15 Unscrew and remove the mixture adjusting screw and seal, using thin-nosed pliers to withdraw the screw.
- 16 Bend back the tabs and remove the cam lever nut and lockwasher. Remove the cam lever and spring.
- 17 Remove the end seal cover and seal.
- 18 Remove the screws and withdraw the cold start valve body and seal, together with the valve spindle (see illustration). Remove the gasket.



8.18 Cold start valve components

- 1 Washer with half-moon cut-out
- 2 Body and screws

- 3 Return spring
- 4 Cam lever, lock washer and nut

- 19 Note the positions of the throttle levers and the return spring, then bend back the tab and remove the throttle lever nut. Withdraw the lockwasher, bush washer and the throttle actuating lever.
- 20 Release the throttle return spring, and remove the throttle adjusting lever from the throttle butterfly spindle. Remove the return spring.
- 21 With the butterfly shut, mark the butterfly in relation to the carburettor flange. Unscrew the remaining screws and withdraw the butterfly from the spindle.
- 22 Remove the throttle butterfly spindle from the carburettor body, together with the two seals.

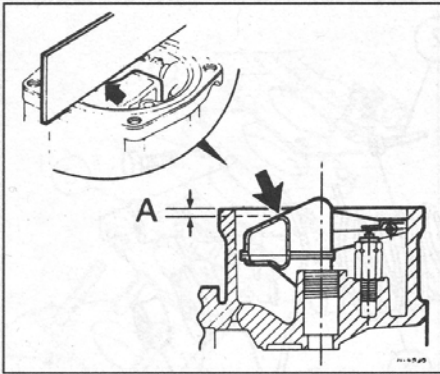
Inspection

- 23 Wash all components in fuel or paraffin, and examine them for wear and damage.
- 24 In particular, check the throttle spindle and bearing for excessive play, the float needle and seating for wear, the float for punctures, the carburettor body for cracks, the metering needle for wear and scoring, and the bi-metal jet for cracks.
- 25 Check all springs and renew all seals.
- 26 Clean the inside of the suction chamber and the piston, then locate the piston in the chamber without the spring. Hold the assembly horizontal and spin the piston - it should spin freely in all positions. If there is any tendency to stick, check for any foreign matter or for distortion, and renew the components as necessary.

Reassembly

- 27 Commence reassembly by inserting the throttle spindle into the carburettor body, then insert the butterfly into the spindle in its correct position as noted on removal. Insert the screws but before tightening them, close the throttle firmly to ensure that the butterfly is centred correctly. After tightening the screws, carefully splay the inner ends to lock them.

- 28 Locate the new seals on both ends of the throttle spindle, making sure that they are the correct way round.
- 29 Locate a new O-ring to the cold start valve body, and assemble the valve spindle to the valve body. Fit the new gasket to the valve, noting that the half-moon cut-out in the washer is positioned for the top retaining screw.
- 30 Refit the cold start assembly to the carburettor body, and fit and tighten the screws.
- 31 Fit the end seal and cover, followed by the spring.
- 32 Refit the cam lever and tension the spring, then fit a new lockwasher and secure with the nut. Bend over the locktab to secure. Check that the spring is located correctly and reposition the coils if necessary.
- 33 Refit the throttle lever return spring so that the longest leg rests against the throttle adjusting screw housing.
- 34 Refit the throttle adjusting lever and lost motion assembly, and tension the return spring.
- 35 Fit the throttle actuating lever, then refit the bush washer and lockwasher. Refit the special nut and bend over the locktabs to lock.
- 36 Refit the jet bearing with its long end towards the float, then refit the bearing nut.
- 37 Clean the filter and refit it followed by the float seat. Tighten securely.
- 38 Locate the needle valve in the seat, with its spring-loaded pin uppermost.
- 39 Locate the float in the carburettor body, then insert the pivot pin with the washer and tighten.
- 40 With the carburettor inverted and the needle valve closed by the weight of the float only, use a straight-edge and check that the ridge on the float is 0.5 to 1.5 mm below the level of the float chamber face. If not, adjust the position by bending the brass pad until the correct dimension is achieved (see



8.40 Checking the float level

Arrows indicate checking points
A 0.5 to 1.5 mm

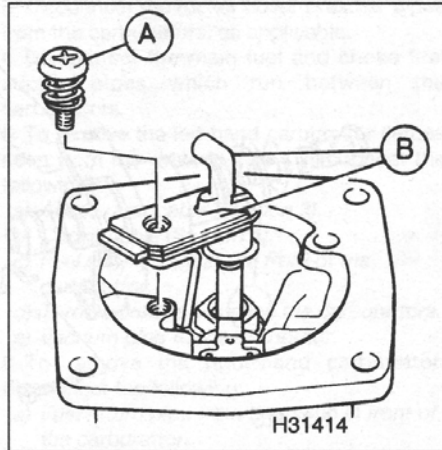
illustration). Make sure that the float pivots correctly on the spindle.

41 Assemble the jet to the bi-metal jet lever, and make sure that the jet head moves freely in the cut-out.

42 Refit the jet and bi-metal jet lever to the carburettor, and secure with the spring-loaded jet retaining screw (see illustration).

43 Refit the mixture adjusting screw and adjust until the jet is flush with the carburettor bridge, then turn the screw 3 1/2 turns clockwise (see illustration).

44 Refit the float chamber cover together with a new gasket. Insert the screw and washer, and tighten securely.

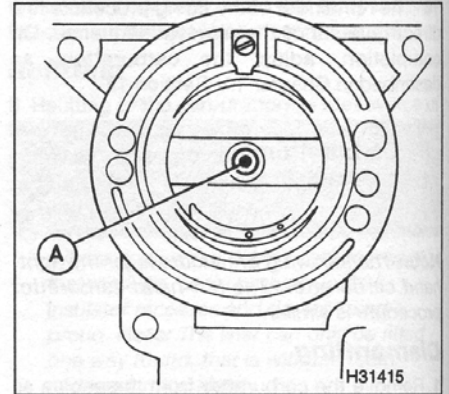


8.42 Spring-loaded screw (A) secures bi-metal jet assembly (B)

45 Locate the needle, spring and guide assembly to the piston, making sure that the etched arrow head on the needle locating guide is aligned between the piston transfer holes. Insert and tighten the screw, making sure that the guide is flush with the piston and that the screw locates in the guide slot (see illustration).

46 Locate the piston key on the body and tighten the screw. Splay the end of the screw to lock it.

47 Locate a new sealing ring in the groove in the carburettor body.



8.43 Adjust the jet (A) flush with the carburettor bridge - use a straight edge to check

48 Locate the piston and needle assembly in the carburettor body, followed by the spring.

49 Hold the suction chamber over the spring in its correct position in relation to the body, then lower the chamber onto the spring and onto the body, taking care not to rotate the chamber. Failure to observe this may result in the spring being 'wound up'. Insert and tighten the screws, then check that the piston moves up and down freely.

50 With the piston held at the top of its stroke, refit the circlip.

51 Top-up the piston with the correct quantity of oil, then insert the piston damper and tighten.

52 Refit the air inlet adaptor together with a new gasket, and refit the carburettor as described in Section 7.

9 Carburettors - tuning and adjustment

Refer to Chapter 1A, Section 12.

10 Inlet manifold - removal and refitting

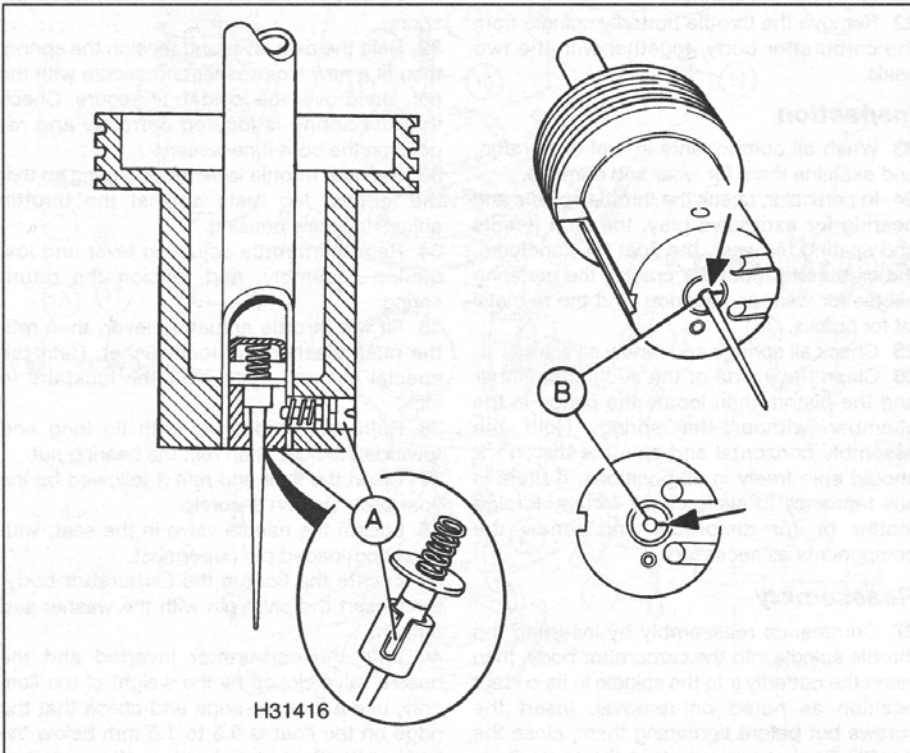
Removal

1 Disconnect the battery negative lead.
2 Drain the cooling system as described in Chapter 1A.

3 Remove the air cleaner assembly as described in Section 2. If the manifold is being removed as part of an engine overhaul procedure, the carburettors need not be removed separately, and can be removed with the manifold as an assembly.

4 Disconnect the following items first, if they have not already been removed:

- a) *Distributor advance/retard vacuum pipe.*
This can be disconnected from the left-hand carburettor and its retaining bracket from the inlet manifold, or from the distributor.



8.45 Correct alignment of the needle, spring and guide assembly in the piston

A Guide location B Etched arrow location

- b) The engine breather hoses and flame traps from between the carburettors and rocker covers.
- c) The bypass hoses from the front of the inlet manifold to the water pump, and the heater hoses.
- d) The brake servo vacuum pipe.

5 There are twelve bolts securing the inlet manifold to the cylinder heads. These should be loosened progressively in a diagonal sequence, starting with the outermost bolts and working inwards. The bolts are of differing lengths, so take note of their exact locations as they are removed.

6 Any bolts removed from the cylinder heads or block should have their threads cleaned with a wire brush dipped in paraffin or clean petrol. If this cleaning cannot be carried out immediately, it is vital that they are stored in petrol or paraffin, as the sealant used when the bolts were originally fitted will tend to harden on exposure to the air, making its removal difficult.

7 Move aside the heater hoses and the hose from the water pump, and ease the manifold away from the cylinder head.

8 Before removing the gasket clamps, ensure that there is no coolant lying on top of the gasket. Remove the clamps and lift away the gasket, followed by the rubber gasket seals. Discard the gasket and seals - new items must be fitted on assembly.

Refitting

9 As the inlet manifold also serves to cover the pushrod cavities of the cylinder block, a single manifold gasket is fitted. Made from sheet metal, this gasket extends downwards over the inlet port face of each cylinder head, and over each of the respective pushrod cavities. Rubber seals are fitted at each end, to seal the manifold to the timing chest and rear flange. It is important that the gasket and seals are carefully fitted, or oil leaks may develop.

10 Clean all the mating surfaces of the manifold, and the cylinder heads and block.

11 Apply a blob of suitable sealant (Land Rover recommend Loctite Superflex) to the four outer notches formed between the cylinder heads and block, where the new seals will be fitted.

12 Locate the new seals to the front and rear walls of the engine. The seals must be smeared on both sides with silicone grease and their ends must locate in the notches between the cylinder head and cylinder block joints.

13 Apply gasket sealing compound to the joints between the seals and cylinder heads, and around the manifold gasket cylinder head and inlet manifold water passages.

14 Fit the new gasket with the word FRONT at the front. The open notch should be at the right-hand side front (right as seen from the driver's seat).

15 Refit the two gasket clamps, but do not tighten the bolts fully. Note that the two

clamps are different, and can only fit at one end or the other.

16 Lower the inlet manifold into position. Note that the open bolt hole aligns with the open hole in the gasket.

17 If not already done, clean the threads of the manifold securing bolts, then coat the threads with locking compound (Land Rover recommend Loctite 572, available from dealers).

18 Refit the manifold bolts to their positions as noted on removal - the bolts with the slotted heads fit to the two central positions each side.

19 Tighten the bolts evenly and gradually, working on alternate sides from the centre to the ends. Do not exceed the specified torque.

20 Tighten the gasket clamps front and rear to the specified torque.

21 The remainder of refitting is a reversal of removal. On completion, start the engine and check for oil and water leaks.

11 Fuel pump and gauge sender unit - removal and refitting

Note: Refer to the precautions given in Section 1 before proceeding.

Removal

1 Depressurise the fuel system as described in Section 6.

2 Remove the securing screws, and withdraw the carpet retainer from the rear edge of the luggage compartment.

3 Manipulate the carpet from under the lower trim panels behind the rear seats.

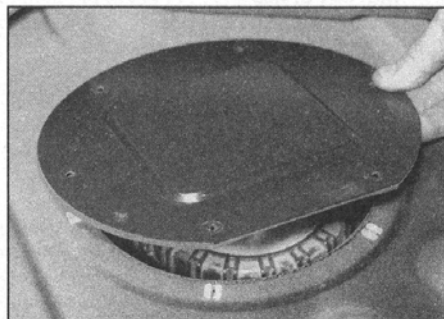
4 Lift the carpet to expose the sound insulation, then fold back the sound insulation to expose the fuel level sender cover.

5 Remove the securing screws, and recover the washers, then withdraw the cover from the floor (see illustration).

6 Disconnect the wiring plug from the sender unit, or separate the two halves of the wiring connector, as applicable.

7 Where applicable, remove the insulating sealant from the earth lead connection on the sender unit, then disconnect the earth lead.

8 Unscrew the union nuts, and disconnect the fuel pipes from the top of the sender unit.



11.5 Withdrawing the fuel gauge sender unit cover

Note the positions of the pipes, although confusion on refitting is unlikely (see illustration). Be prepared for fuel spillage, and plug the open ends of the pipes and the sender unit to reduce further fuel spillage, and to prevent dirt ingress.

9 Unscrew the locking ring - Land Rover dealers have a special tool (LST 131) for this, but a pair of slip-joint (water pump) pliers may be used as a substitute.

10 Carefully withdraw the sender unit and pump from the fuel tank. Again, be prepared for fuel spillage.

11 At the time of writing, the pump and sender unit are only available as an assembly - if either one is proved faulty, renewal of the whole assembly will be required. Consult a Land Rover dealer or automotive electrical specialist to see if repairs can be made, however.

Refitting

12 Refitting is a reversal of removal, noting the following points:

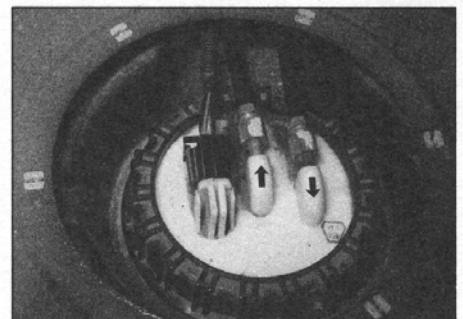
- a) There is a torque specified for the pump/sender unit locking ring (see Specifications). Without the special Land Rover tool, tightening to this torque is not possible, but make sure whatever method is used that the locking ring is secure.
- b) Make sure that all fuel line and electrical connections are securely made.
- c) Once the fuel lines have been reconnected, before refitting the cover, carpet and insulation, switch on the ignition and check that the pump can be heard working. Run the engine, and check carefully for any signs of fuel leakage from the disturbed fuel lines.

12 Fuel tank - removal and refitting

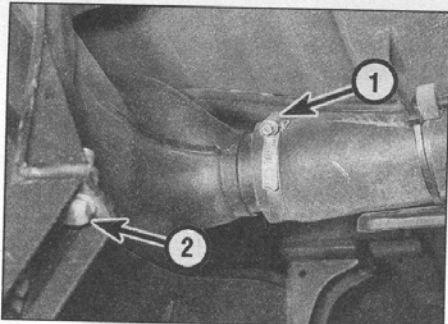
Note: Refer to the precautions given in Section 1 before proceeding.

Removal

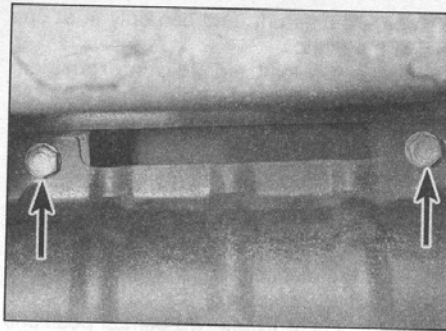
1 A drain plug is not provided on the fuel tank, and it is therefore preferable to carry out the removal operation when the tank is nearly



11.8 Flow direction arrows are stamped into the fuel gauge sender unit casing



12.5 Fuel tank filler hose clamp (1) and right-hand tank strap securing bolt (2)



12.8 Fuel tank cradle rear securing bolts (arrowed)

empty. Before proceeding, disconnect the battery negative lead, then syphon or hand-pump the remaining fuel from the tank.

2 To improve access, apply the handbrake, jack up the vehicle, and support securely on axle stands positioned under the axles, as described in *Jacking and vehicle support*.

3 Disconnect the fuel pipes and the wiring from the fuel gauge sender unit, as described in Section 11.

4 Working under the vehicle, where applicable, mark the positions of the anti-roll bar mounting rubbers on the bar. Unscrew the bolts, withdraw the mounting brackets, then allow the anti-roll bar to swing down clear of the fuel tank.

5 Loosen the securing clips, disconnect the fuel tank filler and, where applicable, the breather hoses from the tank, noting their routing (see illustration). Note that the tank may have to be lowered before the breather hose can be disconnected.

6 Remove the nut and bolt securing the right-

hand side of the fuel tank strap to the bracket on the chassis.

7 On certain models, it may be necessary to unbolt the towing hitch bracket from the chassis, to allow sufficient clearance to remove the fuel tank.

8 Remove the two bolts and plate-nuts securing the rear of the fuel tank cradle to the underbody (see illustration).

9 Remove the two front fuel tank cradle securing nuts and bolts, and recover the washers. Withdraw the fuel tank cradle.

10 Where applicable, manipulate the fuel tank for access to the breather hose connection, and disconnect the breather hose.

11 With the aid of an assistant, tilt the right-hand side of the tank upwards, then manipulate the tank around the chassis member, and withdraw the tank from under the vehicle.

12 If the tank is contaminated with sediment or water, remove the sender unit as described

in Section 11, and swirl the tank out with clean fuel. If the tank is damaged, or if leaks are apparent, it should be repaired by a specialist, or alternatively, renewed.

Refitting

13 Refitting is a reversal of removal, but note the following points:

- a) Ensure that the fuel filler and breather hoses are securely reconnected and correctly routed.
- b) Where applicable, align the anti-roll bar mounting rubbers with the marks made on the bar before removal, and tighten the mounting bolts to the specified torque (see Chapter 11).
- c) On completion, check very carefully for any sign of fuel leakage.

13 Unleaded petrol - general information and usage

Note: The information given in this Chapter is correct at the time of writing, and applies only to petrols currently available in the UK. Check with a Land Rover dealer as more up-to-date information may be available. If travelling abroad, consult one of the motoring organisations (or a similar authority) for advice on the petrols available and their suitability for your vehicle.

1 The fuel recommended by Land Rover is given in the Specifications of this Chapter.






2 RON and MON are different testing standards; RON stands for Research Octane Number (also written as RM), while MON stands for Motor Octane Number (also written as MM).

Chapter 4 Part B: Fuel system - petrol injection models

Contents

| | | | |
|---|-----------------|--|-----------------|
| Accelerator cable - removal, refitting and adjustment | 3 | Fuel injection system - testing | 11 |
| Accelerator pedal - removal and refitting | 4 | Fuel injection system components - removal and refitting | 6 |
| Air cleaner - removal and refitting | 2 | Fuel pump and gauge sender unit - removal and refitting | 7 |
| Air cleaner element - renewal | .See Chapter 1A | Fuel tank - removal and refitting | 8 |
| Base idle speed - adjustment | 10 | General information and precautions | 1 |
| Cruise control system - description and component renewal | 13 | Idle speed and mixture adjustment | .See Chapter 1A |
| Fuel filter - renewal | .See Chapter 1A | Inlet manifold - removal and refitting | 9 |
| Fuel injection system - depressurisation | 5 | Unleaded petrol - general information and usage | 12 |

Degrees of difficulty

| | | | | |
|--|---|---|--|---|
| <p>Easy, suitable for novice with little experience</p>  | <p>Fairly easy, suitable for beginner with some experience</p>  | <p>Fairly difficult, suitable for competent DIY mechanic</p>  | <p>Difficult, suitable for experienced DIY mechanic</p>  | <p>Very difficult, suitable for expert DIY or professional</p>  |
|--|---|---|--|---|

Specifications

General

| | |
|--------------------------------------|---|
| System type | Lucas Hot-Wire multiport fuel injection |
| ECU type | Lucas 14 CUX |
| Idle speed (non-adjustable) | 665 to 735 rpm |
| Base idle speed | 525 ± 25 rpm |
| Mixture/CO level (non-adjustable) | 0.5 to 1.0 % |
| Minimum octane rating: | |
| Low-compression, non-catalyst engine | 91 RON unleaded |
| All other engines | 95 RON unleaded |
| Fuel pump delivery pressure | 2.4 to 2.6 bar |

Torque wrench settings

| | Nm | lbf ft |
|-----------------------------------|----|--------|
| By-pass air valve | 20 | 15 |
| Fuel union to fuel rail | 22 | 16 |
| Inlet manifold bolts | 38 | 28 |
| Inlet manifold gasket clamp bolts | 18 | 13 |
| Lambda sensor | 20 | 15 |
| Plenum chamber to ram housing | 28 | 21 |
| Ram housing to inlet manifold | 27 | 20 |

1 General information and precautions

The fuel injection system comprises a fuel tank, an electric fuel pump, a fuel filter, fuel supply and return lines, a fuel rail, a fuel pressure regulator, eight electronic fuel injectors, and an Electronic Control Unit (ECU) together with its associated sensors, actuators and wiring.

For information on the exhaust and emission control systems, refer to part D of this Chapter.

Lucas Hot-Wire injection system - description

A Lucas Hot-wire electronic fuel injection system is fitted to all petrol Discovery models from 1991 model year. The system ensures that the correct air/fuel mixture is supplied to the engine under all engine operating conditions. This is achieved by using various sensors which send signals to the ECU, and this information is then computed and the injectors opened for the correct period. The injectors are operated on each bank separately (ie each set of four injectors is triggered together).

The ECU is located behind the kick panel in the driver's footwell, and is connected to the main harness by a 40-pin multi-plug.

The injectors are located on a common fuel rail, but electrically they are arranged in two banks of four.

A tune select resistor is located next to the ECU, which allows the system to be set up for different world markets (for example, a different value of resistor is fitted if the vehicle has a catalytic converter).

A coolant temperature thermistor is located by the front left-hand branch of the inlet manifold.

A fuel temperature thermistor is located on the front of the fuel distribution rail.

Engine idle speed is controlled by a by-pass air valve located on the rear of the air inlet plenum chamber. The by-pass air valve maintains the engine idle speed constant when differing loads are applied to the engine, such as when the air conditioning system or headlights are switched on. When the valve is energised by the ECU, extra air passes into the inlet manifold - this fools the system into supplying more fuel, raising the idle speed.

On engines fitted with catalytic converters, Lambda sensors are located just forward of the front converters to monitor the oxygen content of the exhaust gases. The sensors are heated by an internal element to improve their response time - see part D of this Chapter for more information.

The fuel pressure regulator located on the rear of the fuel rail maintains the fuel pressure at 2.5 bars above the inlet manifold pressure.

The high-pressure fuel pump is located in the top of the fuel tank.

The airflow sensor is of the hot-wire type. A proportion of air flowing through the sensor is

passed through a by-pass in which two wires are located. One wire is a sensing wire, and the other is a compensating wire. An electronic module mounted on the side of the airflow sensor passes a small current through the sensing wire to produce a heating effect. The air passing over the sensing wire has a cooling effect, which changes the wire's resistance, and this signal is passed back to the module. The compensating wire is not heated, but reacts to the temperature of the air passing through the meter. The electronic module monitors the reaction of the wires in proportion to the airflow, and sends output signals to the ECU.

A throttle potentiometer is mounted on the side of the plenum chamber inlet neck, and is attached to the throttle valve shaft. This device monitors the position of the throttle, and its rate of opening.

A vehicle speed sensor is located on the side of the transfer box, adjacent to the handbrake, and it sends signals to the ECU. It is also used to operate the electronic speedometer (and cruise control, on models so equipped).

An inertia switch is located either beneath the driver's side of the fascia, to the left of the steering wheel, or latterly at the rear of the engine compartment, next to the washer reservoir. In the event of a sudden impact, the switch opens and disconnects the fuel pump. The switch may be reset by pressing the top button.

Two fuel injection relays are fitted. The main relay supplies current to the fuel injection system, while the fuel pump relay energises the fuel pump - both relays are controlled by the ECU.

Should the fuel injection system develop a fault, a warning light on the instrument panel will illuminate, and the fuel injection system should then be investigated to find the fault. The system incorporates a 'limp-home' feature, enabling the vehicle to be driven carefully to a garage.

The fuel pump delivers a constant supply of fuel through a cartridge filter to the fuel rail. The return pipe from the pressure regulator returns excess fuel back to the fuel tank.

Inlet air is drawn into the engine through the air cleaner, which contains a renewable paper filter element.

For information on the exhaust and emission control systems, refer to part D of this Chapter.

Precautions



Warning: Many of the procedures in this Chapter require the removal of fuel lines and connections, which may result in some fuel spillage. Before carrying out any operation on the fuel system, refer to the precautions given in Safety first! at the beginning of this manual, and follow them implicitly. Petrol is a highly-dangerous and volatile liquid, and the precautions necessary when handling it cannot be overstressed.

Do not smoke, or allow any naked flames or uncovered light bulbs near the work area. Note that gas-powered domestic appliances

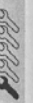
with pilot flames, such as heaters boilers and tumble-dryers, also present a fire hazard - bear this in mind if you are working in an area where such appliances are present. Always keep a suitable fire extinguisher close to the work area, and familiarise yourself with its operation before starting work. Wear eye protection when working on fuel systems, and wash off any fuel spilt on bare skin immediately with soap and water. Note that fuel vapour is just as dangerous as liquid fuel - possibly more so; a vessel (such as the fuel tank) that has been emptied of liquid fuel will still contain vapour, and can be potentially explosive.

Residual fuel pressure always remains in the fuel system, long after the engine has been switched off. This pressure must be relieved in a controlled manner before disconnecting any part of the fuel system - refer to Section 5 for details.

When working with fuel system components, pay particular attention to cleanliness - dirt entering the fuel system may cause blockages, which will lead to poor running.

In the interests of personal safety, many of the procedures in this Chapter suggest that the negative lead be removed from the battery terminal. This eliminates the possibility of accidental short-circuits being caused as the vehicle is being worked upon, which would be particularly dangerous if the fuel system is open.

2 Air cleaner - removal and refitting



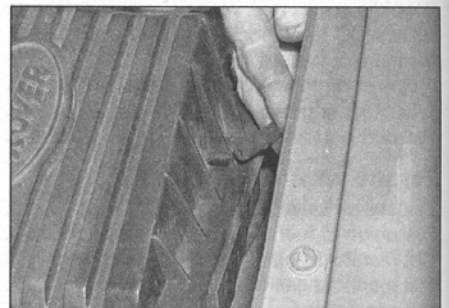
Canister-type air filter (early models)

1 Slacken the connecting hose retaining clip, then undo the two mounting bracket nuts and bolts, and remove the unit from the engine compartment.

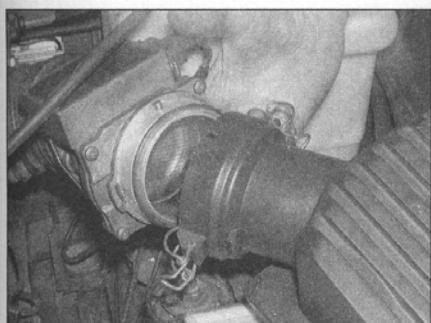
2 Refitting is a reversal of removal.

Square-type air filter (later models)

3 Release the clip and disconnect the small vacuum hose from the front of the air cleaner lid (see illustration).



2.3 Disconnect the breather hose from the side of the air cleaner lid



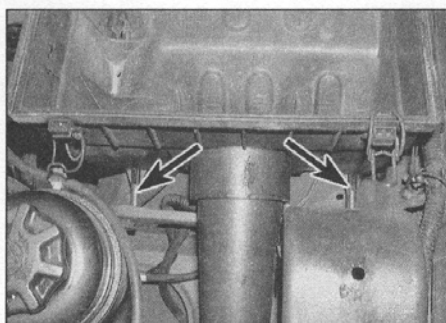
2.4 Release the two clips, then move the airflow sensor rearwards to release the lid

4 Release the four over-centre clips securing the lid to the air cleaner assembly, and the two clips securing the air cleaner to the airflow sensor (see illustration).

5 Lift the lid away, and lift out the filter element, noting which way up it fits.

6 Ease the air cleaner housing up to disengage the two rubber locating pegs from the inner wing. If difficulty is experienced, reach in under the wing, and push the rubber mountings up from below. As the housing is withdrawn, also disengage the front corner locating pegs (see illustration).

7 Refitting is a reversal of removal. When offering the housing into position, some trial-and-error may be required before all the locating pegs engage, and the air cleaner lid can be reconnected to the airflow sensor. The rubber pegs can be pulled down through the holes in the wing if this is easier.



2.6 Removing the air cleaner housing - disengage the locating pegs (arrowed)

withdraw the cable from the bracket (see illustrations).

3 Work back along the cable, releasing it from its retaining clips and cable-ties in the engine compartment (see illustration).

4 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. This will allow access to the accelerator pedal assembly.

5 Remove the split-pin, and withdraw the clevis pin securing the end of the cable to the accelerator pedal.

6 Release the cable grommet from the bulkhead, then withdraw the cable through the bulkhead into the engine compartment.

Refitting

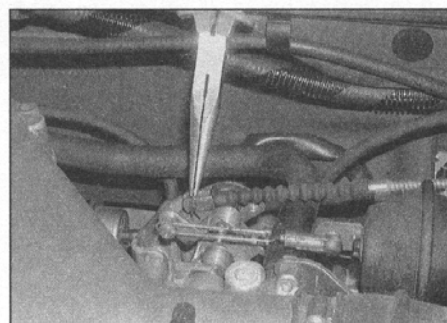
7 Refitting is a reversal of removal, bearing in mind the following points:

- a) Ensure that the cable is routed as noted before removal, and secured with new cable-ties where necessary.
- b) Use new split-pins to secure the cable end clevis pins.
- c) On completion, check the cable adjustment, as described in the following paragraphs.

Adjustment

8 Ensure the throttle lever is in the fully-closed position, by pressing the lever fully against its stop.

9 Turn the adjuster wheel to give a small amount (1.5 mm) of freeplay in the inner cable, so that the throttle lever is free to return to the closed (idle) position, but without undue slack.



3.1a Using pliers, take out the split-pin ...

If there is any reluctance to return to idle, lubricate the throttle linkages with a few drops of light oil.

10 With the aid of an assistant, check that the accelerator lever moves to the full-throttle position when the accelerator pedal is fully depressed.

11 With the handbrake applied and the transmission in neutral, start the engine. Press and release the accelerator pedal several times, and ensure the engine returns to idle promptly.

12 The idle speed is not adjustable. Any reluctance to return to idle may be due to mechanical resistance in the throttle linkage (which should be curable by cleaning and lubricating) or in the cable (which may be due to poor routing of the cable).

13 If poor idle quality is experienced, this may indicate a problem with another

3 Accelerator cable - removal, refitting and adjustment

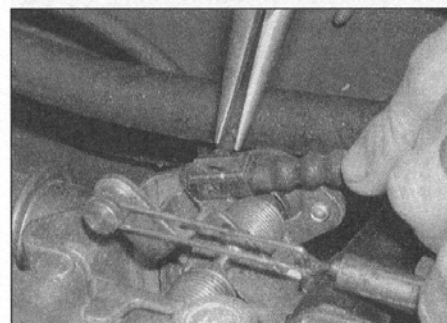


Removal

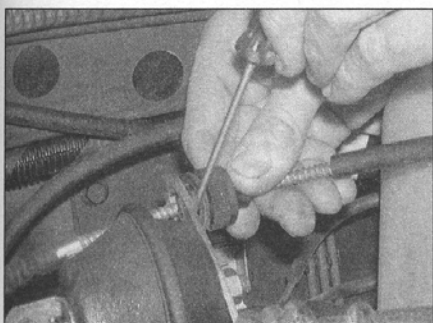
Note: New split-pins should be used to secure the cable end clevis pins on refitting.

1 Extract the split-pin and remove the washer and clevis pin securing the cable to the throttle linkage (see illustrations).

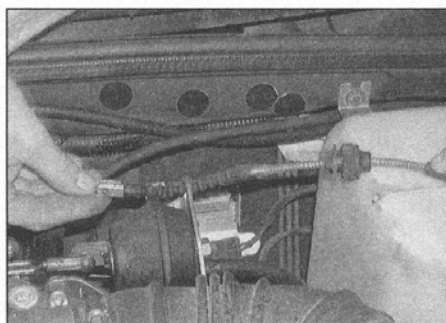
2 Carefully prise the cable adjuster assembly out of the linkage mounting bracket, and



3.1b ... then extract the clevis pin securing the cable end fitting



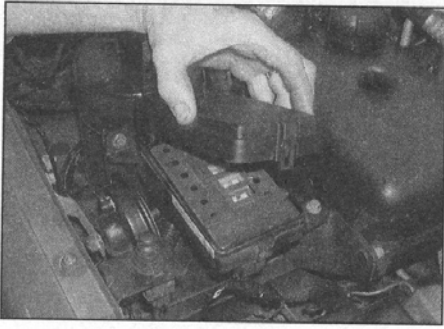
3.2a Prise the cable adjuster out of the mounting bracket ...



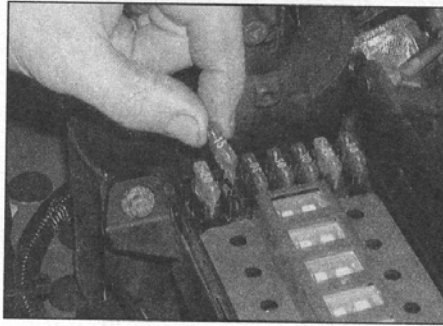
3.2b ... then feed the cable through it



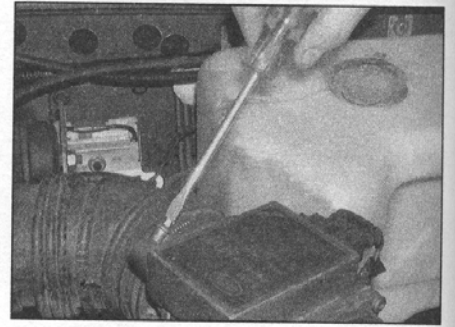
3.3 This cable-tie had to be cut to release the cable



5.2a Lift off the cover from the engine compartment fusebox ...



5.2b ... and remove the fuel pump fuse



6.2a Loosen the hose clip ...

component in the injection system - possibly an air leak or a partially-blocked injector (see Section 11). A faulty speed sensor (see Sections 1 and 6) could also give rise to idle problems, as the signal from the sensor (on whether the vehicle is moving) engages and disengages the idle air control mode.

4 Accelerator pedal - removal and refitting

Refer to part A of this Chapter. On completion, the cable should be adjusted as described in Section 3 above.

5 Fuel injection system - depressurisation

Note: Observe the precautions in Section 1 before working on any component in the fuel system.

Warning: The following procedure will merely relieve the pressure in the fuel system - remember that fuel will still be present in the system components, and take precautions accordingly before disconnecting any of them.

1 The fuel system referred to in this Section is defined as the tank-mounted fuel pump, the fuel filter, the fuel rail and injectors, the fuel pressure regulator, and the metal pipes and flexible hoses of the fuel lines between these components. All these contain fuel, which will be under pressure while the engine is running and/or while the ignition is switched on. The pressure will remain for some time after the ignition has been switched off, and must be relieved before any of these components are disturbed for servicing work. Ideally, the engine should be allowed to cool completely before work commences.

2 Referring to Section 6, remove the fuel pump relay. Alternatively (and more easily), identify and remove the fuel pump fuse from the fusebox (see illustrations). Refer to Chapter 13 if necessary to positively identify the fuse.

3 With the fuel pump disabled, crank the engine for about ten seconds. The engine may fire and run for a while, but let it continue running until it stops. The fuel injectors should have opened enough times during cranking to considerably reduce the line fuel pressure, and reduce the risk of fuel spraying out when a fuel line is disturbed.

4 Switch off the ignition, disconnect the battery negative terminal, then refit the fuel pump fuse or relay.

5 Place a suitable container beneath the relevant connection/union to be disconnected, and have a large rag ready to soak up any escaping fuel not being caught by the container.

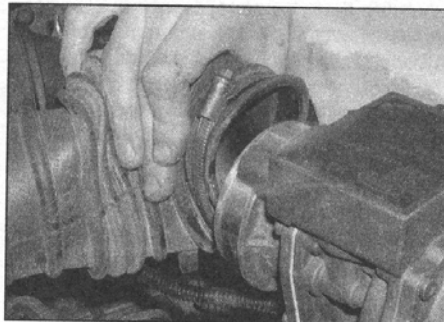
6 Slowly loosen the connection or union nut (as applicable) to avoid a sudden release of pressure, and position the rag around the connection to catch any fuel spray which may be expelled. Once the pressure has been

released, disconnect the fuel line. Insert plugs to minimise fuel loss and prevent the entry of dirt into the fuel system.

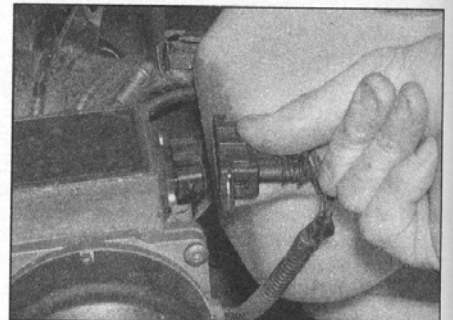
6 Fuel injection system components - removal and refitting

Airflow sensor

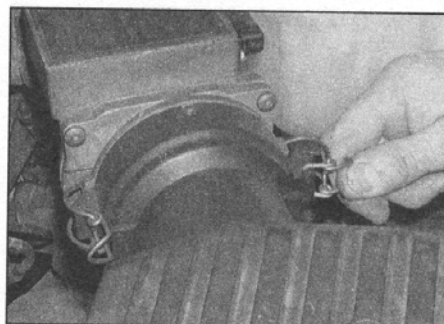
- 1 Disconnect the battery negative lead.
- 2 Loosen the hose clip and disconnect the air inlet hose from the rear of the airflow sensor (see illustrations).
- 3 Disconnect the multi-plug from the unit (see illustration).
- 4 Release the two clips securing the airflow sensor to the air cleaner, then withdraw it from the engine compartment (see illustrations).



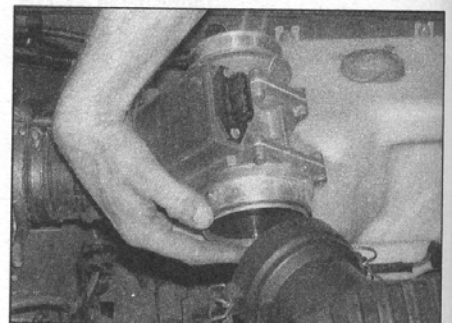
6.2b ... and disconnect the air inlet hose



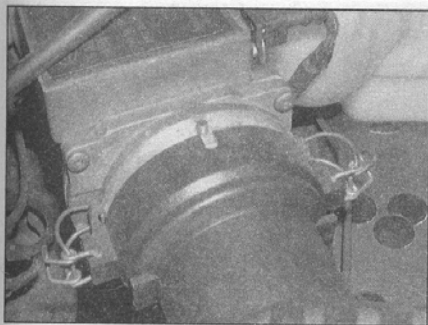
6.3 Disconnect the airflow sensor wiring plug



6.4a Release the two over-centre wire clips ...



6.4b ... and remove the airflow sensor



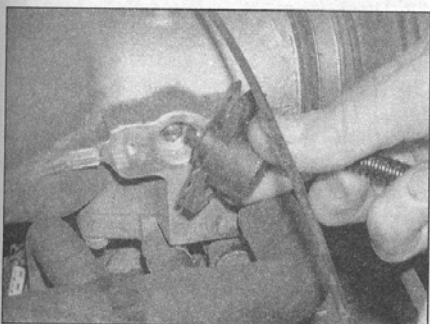
6.5 The pip in the airflow sensor engages with a notch in the air cleaner lid

5 Refitting is a reversal of the removal procedure, noting the following points:

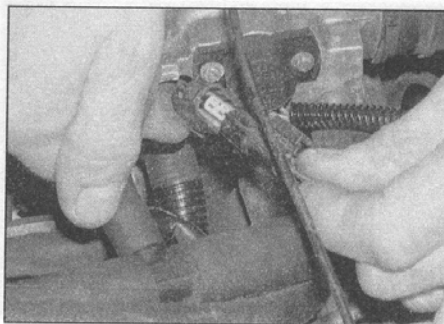
- a) Make sure that the multi-plug is securely reconnected.
- b) A large O-ring is fitted at each end of the airflow sensor - check that these have not been omitted, and that they are in good condition.
- c) Ensure that the pip on the airflow meter engages with the notch in the air cleaner lid (see illustration).
- d) The hoses and clips must be fitted correctly, to avoid air leaks.

Throttle potentiometer

- 6 Disconnect the battery negative terminal.
- 7 Trace the wiring from the potentiometer back to its wiring multi-plug, and disconnect it (see illustration).
- 8 Undo the two screws securing the throttle potentiometer to the side of the plenum



6.8b ... and withdraw the potentiometer and gasket



6.7 Disconnect the potentiometer wiring plug

chamber and carefully pull the switch from the throttle spindle. Remove the gasket (see illustrations).

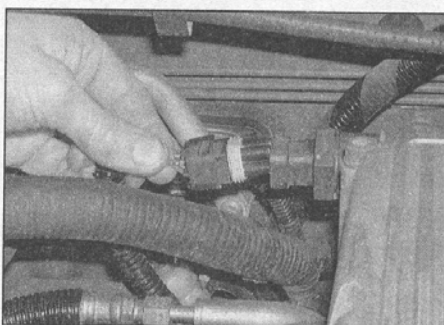
9 If the unit is to be removed for some time, note that the throttle must not be operated while the unit is removed.

10 Refitting is a reversal of removal, using a new gasket. Align the end of the potentiometer with the slot in the throttle shaft before inserting and tightening the screws.

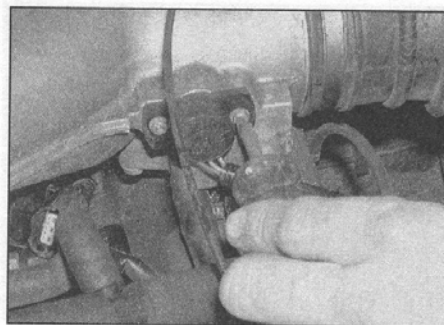
By-pass air valve

- 11 Disconnect the battery negative lead.
- 12 Disconnect the wiring multi-plug (see illustration).
- 13 There are two ways of removing the air valve, as follows:

- a) Disconnect the air hose from the valve, then unscrew the three Allen bolts securing the housing to the rear of the plenum chamber. Remove the housing,



6.12 Disconnect the wiring plug from the air valve



6.8a Loosen and remove the two securing screws ...

recover the gasket, and disconnect the air hose (see illustration). The valve can then be unscrewed on the bench.

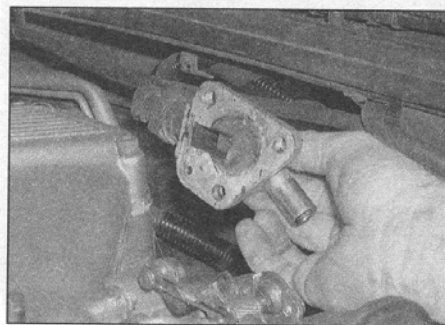
- b) Unscrew the valve from the rear of the plenum chamber (this requires a large spanner), and remove the fibre washer (see illustrations).

14 Refitting is a reversal of the removal procedure, but use a new fibre washer (and housing gasket, where removed). Clean the threads and apply locking fluid (such as Loctite 241) before tightening the valve to the specified torque.

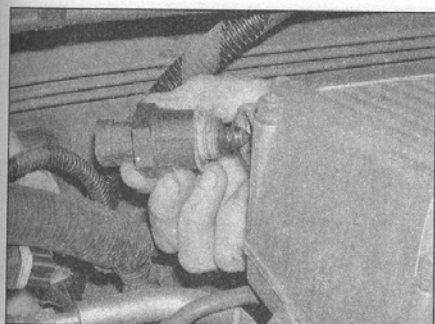
Vehicle speed sensor

Removal

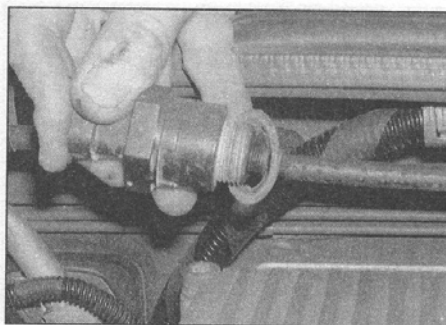
- 15 The sensor is located in the transfer gearbox casing, next to the handbrake (see illustration).
- 16 Disconnect the battery negative lead.



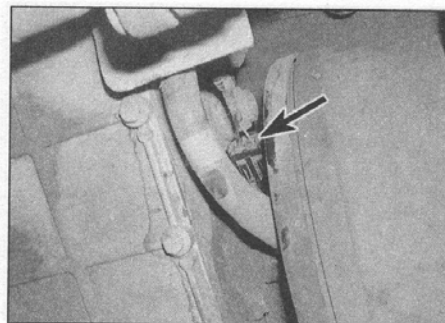
6.13a Removing the air valve housing



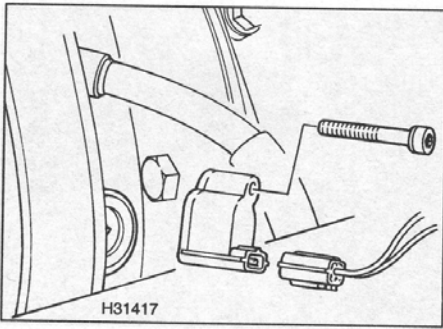
6.13b Unscrew and remove the valve from the housing ...



6.13c ... noting the fibre washer



6.15 Vehicle speed sensor (arrowed)



H31417

6.18 Speed sensor mounting details

17 Working under the vehicle, disconnect the sensor wiring plug.

18 Unscrew the sensor securing bolt, and recover the washer (see illustration).

19 Withdraw the sensor from the transfer gearbox.

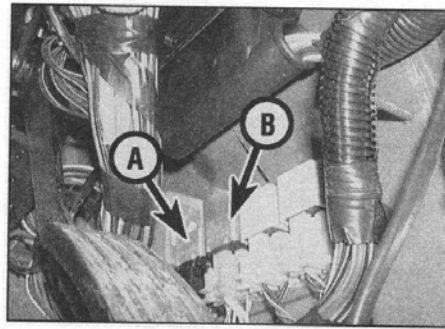
20 Check the condition of the wiring plug and terminals on the sensor, and clean as necessary.

Refitting

21 Refitting is a reversal of removal. The sensor drive peg must engage correctly with the hole in the drivegear - turn the drive peg as necessary until it fits.

Fuel injection relays

22 The two relays are located either on a small bracket beneath the facia, to the right of the centre console, or behind the right-hand



6.22 Fuel injection system relay (A) and fuel pump relay (B)

kick panel in the driver's footwell, below the main ECU. The fuel pump relay is mounted on a blue terminal block, and the main relay is mounted on a black terminal block (see illustration).

23 Disconnect the battery negative lead.

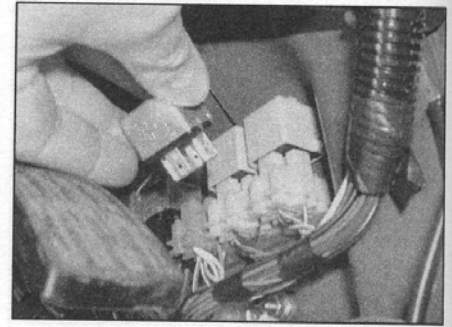
24 Pull the relevant relay directly from its socket (see illustration).

25 Refitting is a reversal of the removal procedure.

Electronic control unit (ECU)

26 It is essential that the ignition is switched off when the ECU multi-plug is disconnected, or the ECU could be irreparably damaged. Disconnect the battery negative lead.

27 Release the clips, and remove the driver's side lower facia panel, and the right-hand kick panel from the driver's footwell.



6.24 Removing the fuel pump relay

28 Release the multi-plug retaining clip from the front end, and pull the front edge of the multi-plug down (see illustration). Unhook the rear end of the multi-plug and disconnect it completely from the ECU.

29 Remove the two nuts/screws at the side of the unit, and release the ECU from the spring clip on the opposite side (see illustration).

30 Refitting is a reversal of the removal procedure. Ensure that the ECU multi-plug is fully and securely reconnected.

Fuel temperature thermistor

Note: It is not necessary to depressurise the fuel system, as the thermistor is not in direct contact with the fuel.

31 Disconnect the battery negative lead.

32 Disconnect the engine breather hoses as required for access to the thermistor.

33 Disconnect the multi-plug from the thermistor - prise the wire clip aside with a small screwdriver (see illustration).

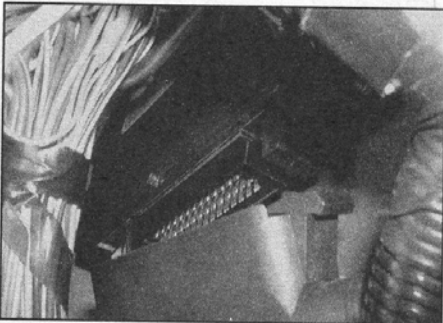
34 Unscrew the thermistor from the fuel rail (see illustrations).

35 Refitting is a reversal of the removal procedure. Ensure that the thermistor is securely screwed into the fuel rail.

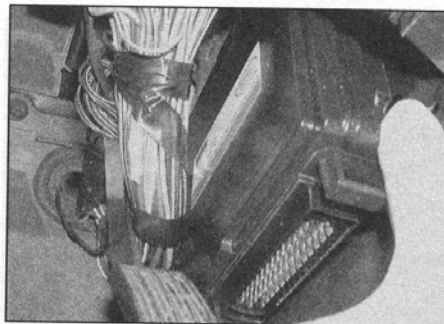
Coolant temperature sender

36 Partially drain the cooling system with reference to Chapter 1A.

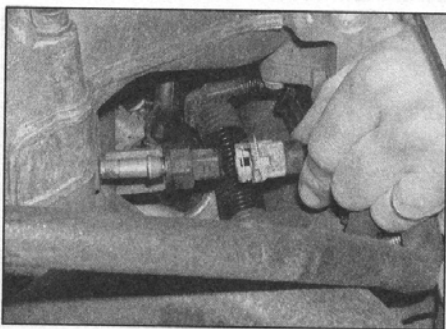
37 Remove the top hose from the thermostat housing.



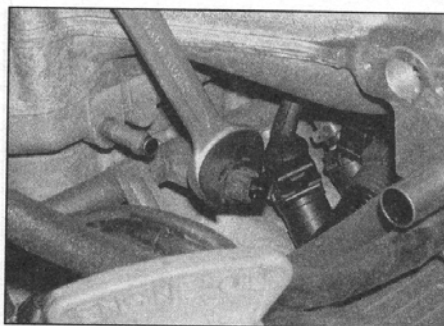
6.28 Release the front end of the ECU multi-plug



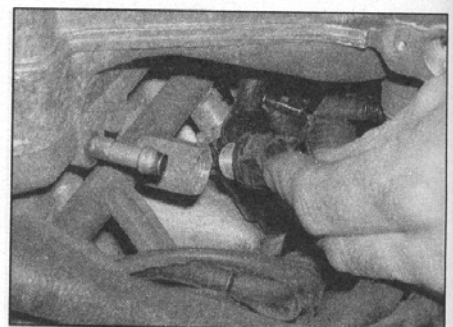
6.29 Removing the fuel injection ECU



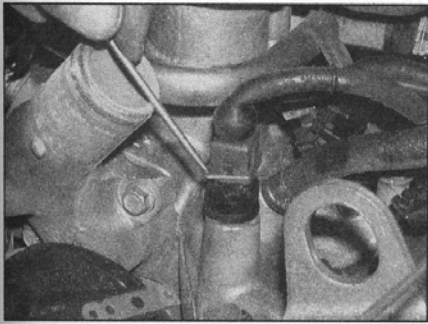
6.33 Disconnect the thermistor wiring plug



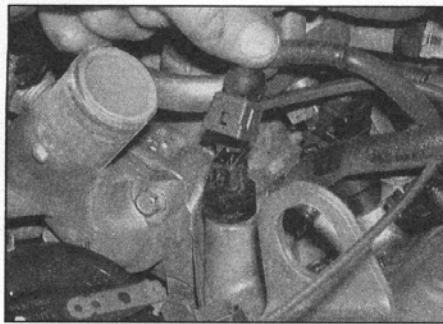
6.34a Loosen the thermistor ...



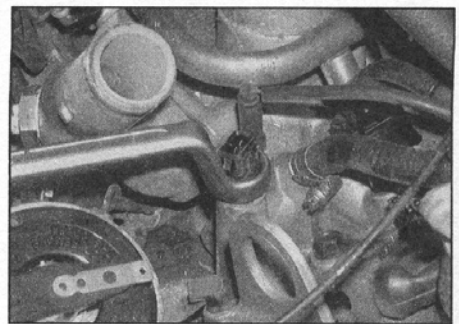
6.34b ... and remove it from the fuel rail



6.39a Ease out the wire clip with a small screwdriver ...



6.39b ... then disconnect the wiring plug



6.39c Unscrew the temperature sensor ...

38 Release the two clips securing the distributor cap, then lift off the cap complete with HT leads and place it to one side.

39 Disconnect the multi-plug, and unscrew the sender from the left-hand front branch of the inlet manifold (square wiring plug) (see illustrations). Remove the copper washer.

40 Refitting is a reversal of the removal procedure, but fit a new copper washer and refill the cooling system with reference to Chapter 1A. On completion, run the engine and check for coolant leaks.

Inertia switch

41 Disconnect the battery negative lead.

42 On models up to 1995 model year, the switch is under the driver's side of the fascia, to the left of the steering wheel. Release the

clips and remove the driver's side lower fascia panel for access.

43 From 1995 model year onwards, the inertia switch is at the rear of the engine compartment, behind the washer reservoir. Remove the reservoir as described in Chapter 13 for access.

44 Disconnect the multi-plug from the base of the switch (see illustration).

45 Remove the switch retaining screws, or unclip the switch from its mounting bracket, and remove it (see illustration).

46 Refitting is a reversal of removal.

Plenum chamber

47 Disconnect the battery negative lead.

48 Partially drain the cooling system with reference to Chapter 1A.

49 Loosen the clips and remove the air hose between the airflow sensor and plenum chamber.

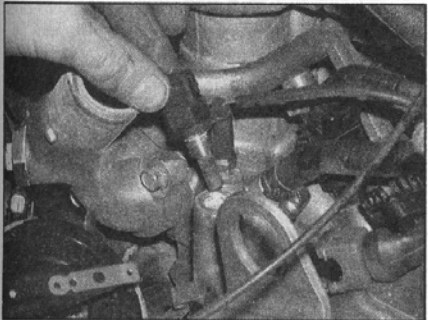
50 Disconnect the distributor vacuum hose, and the crankcase ventilation hose (see illustrations).

51 Identify their locations, then disconnect the coolant hoses from the bottom of the plenum chamber (see illustration).

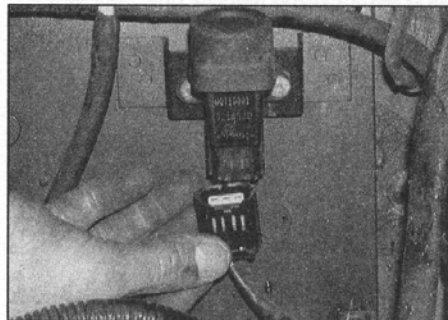
52 Disconnect the multi-plug from the air by-pass valve. To avoid damage to the throttle potentiometer wiring, remove the potentiometer completely as described previously in this Section.

53 Disconnect the small vacuum hose from the rear of the plenum chamber below the air by-pass valve location.

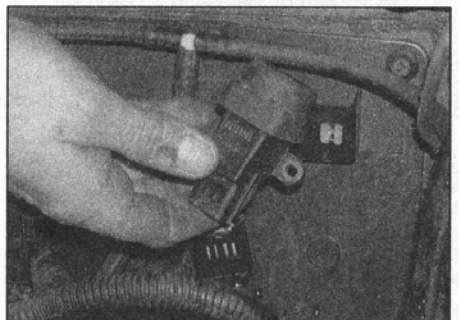
54 Disconnect the hose between the air by-



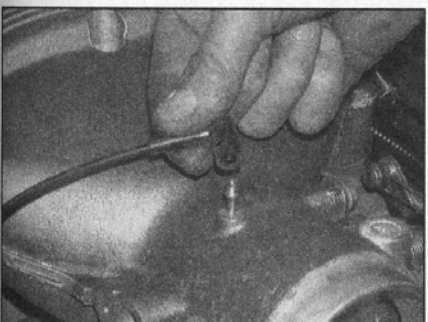
6.39d ... and remove it from the inlet manifold



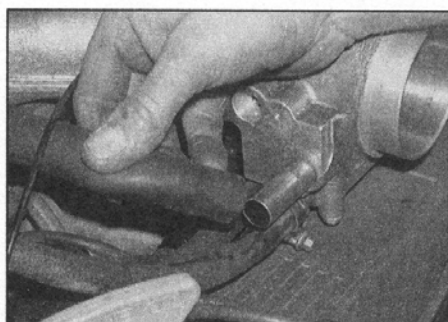
6.44 With the washer bottle removed, disconnect the wiring plug from the inertia switch



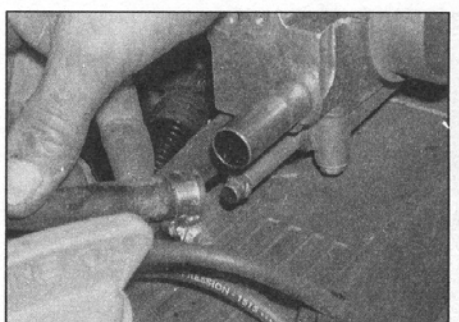
6.45 Remove the retaining screws, and take out the inertia switch



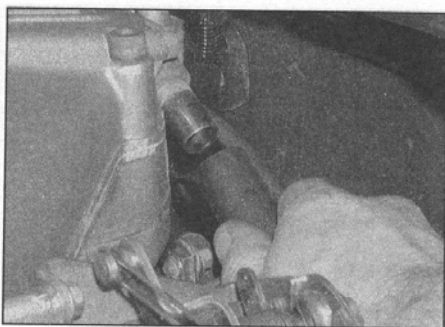
6.50a Disconnect the distributor vacuum hose ...



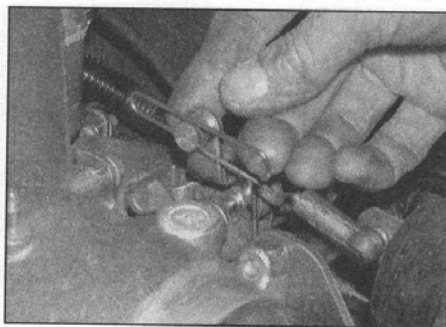
6.50b ... and the crankcase breather hose



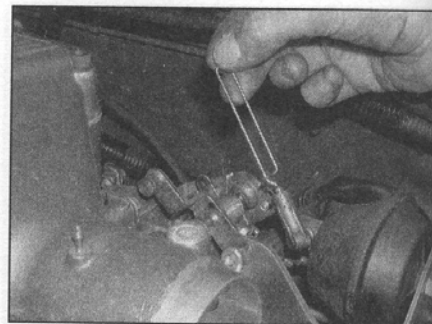
6.51 Disconnect the two coolant hoses at the base of the plenum chamber



6.54 Disconnecting the air hose from the by-pass valve



6.56a Unhook the control link . . .



6.56b . . . and lift it clear

pass valve and plenum chamber (see illustration).

55 On models without cruise control, remove

the three bolts (and recover the spring washers) securing the throttle linkage assembly bracket to the plenum chamber,

and lay the assembly to one side without disconnecting any cables.

56 On models with cruise control, dismantle the throttle linkage as follows:

a) Unhook the control link for the vacuum control unit, and lift the link out of the way (see illustrations).

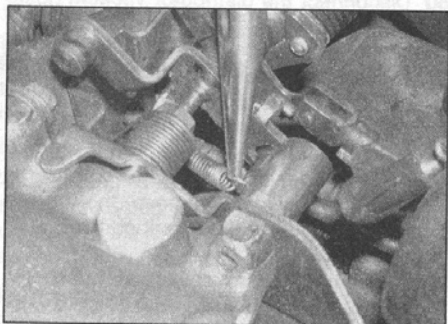
b) Unhook the small overtravel spring at the base of the throttle linkage (see illustration).

c) Hold the throttle plate open slightly for access, then loosen and remove the bolts securing the throttle linkage bracket (see illustration).

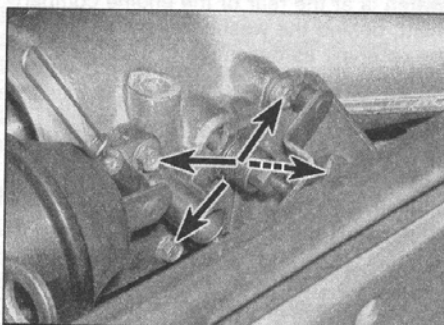
d) Press down the spring leg nearest the front of the linkage, and slide the leg out of the locating slot (see illustration).

e) Unhook the front throttle plate tab from the jaws in the rear throttle plate, and separate the two sections of the linkage.

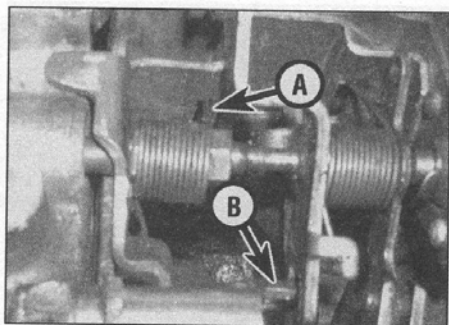
Move the throttle linkage assembly to one side (see illustration).



6.56c Unhook the overtravel spring



6.56d Remove the bolts (three of four arrowed) securing the throttle linkage bracket



6.56e Front spring leg slides down out of slot (A). Front throttle plate tab (B) disengages from the jaws in the rear plate



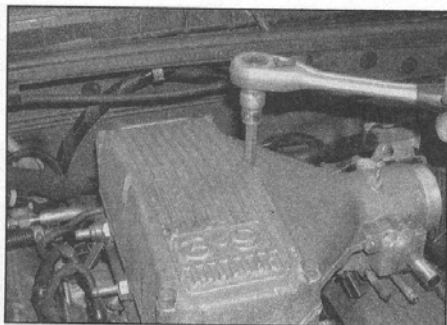
6.56f Remove the throttle linkage assembly, and place to one side

57 Unscrew the six socket-headed bolts and lift the plenum chamber from the ram housing (see illustrations). Cover the ram housing to prevent the ingress of foreign matter.

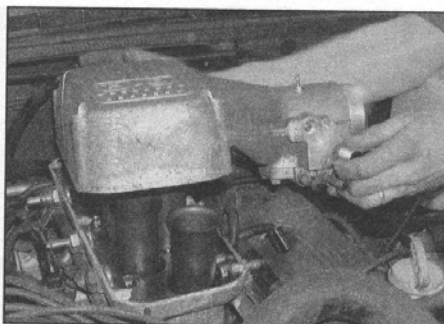
58 With the plenum chamber removed, the coolant supply elbow gasket can be renewed if necessary. The elbow is secured by four bolts. Clean the mating surfaces thoroughly before refitting the elbow using a new gasket (see illustrations).

59 Refitting is a reversal of the removal procedure, noting the following points:

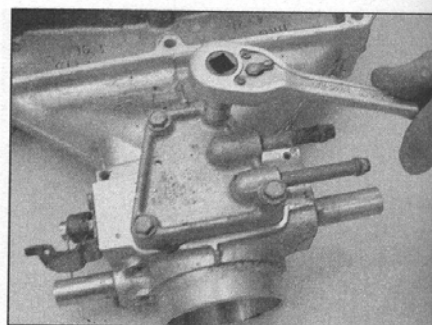
a) Clean the mating faces, and apply gasket sealant to the plenum chamber mating face.



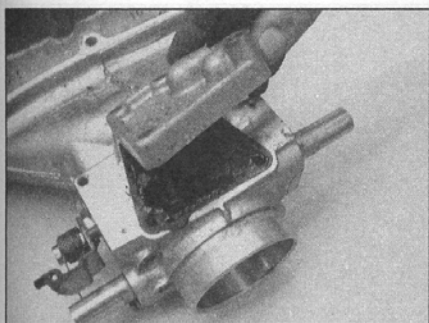
6.57a Remove the six bolts . . .



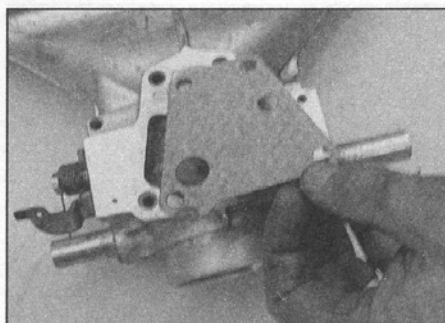
6.57b . . . and lift off the plenum chamber



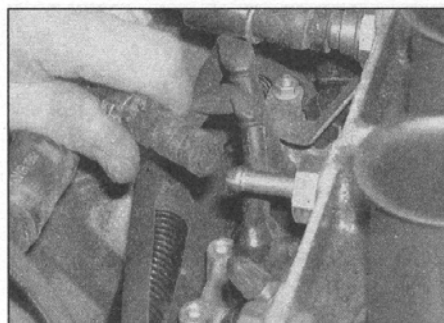
6.58a If necessary, remove the four bolts . . .



6.58b ... and take off the coolant supply elbow



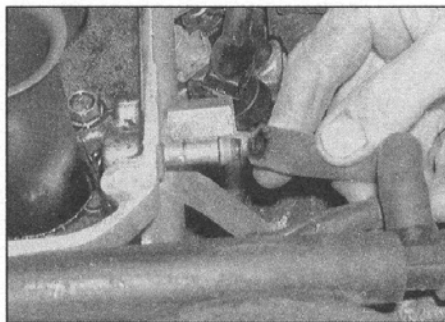
6.58c On refitting, use a new gasket



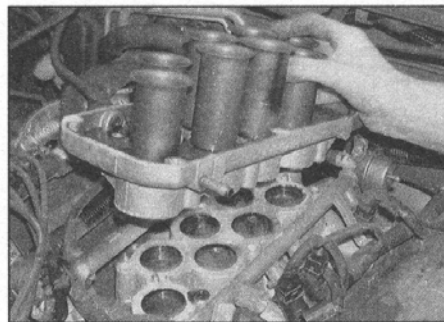
6.61a Disconnect the charcoal canister hose ...



6.61b ... the brake servo vacuum hose ...



6.61c ... and the crankcase breather hose

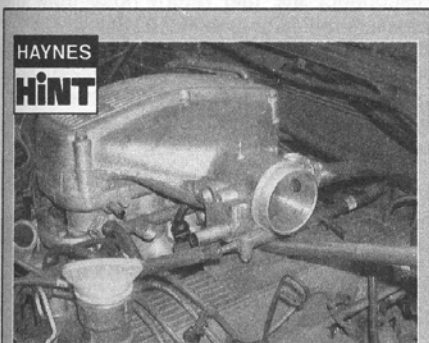


6.63 Removing the ram housing

- b) Tighten the plenum chamber bolts evenly to the specified torque.
- c) Make sure that all hoses are correctly and securely reconnected, to prevent air leaks.

Ram housing

- 60 Remove the plenum chamber as described previously.
- 61 Disconnect the hoses from the outer



If the housing is stuck, do not lever against the fuel rail, nor lever between the mating faces. Loosely fit two bolts to the ram housing, then temporarily refit the plenum chamber. Using a suitable piece of wood, lever gently between the plenum chamber and the rocker cover to release the ram housing joint

edges of the ram housing, noting their locations. Depending on model, these will include a small breather hose on the air cleaner side, and vacuum hoses for the brake servo and charcoal canister on the other side (see illustrations).

62 Unscrew and remove the six through-bolts and washers holding the ram housing to the inlet manifold.

63 Withdraw the ram housing from the inlet manifold, and cover the top of the inlet manifold to prevent the ingress of foreign matter (see illustration and Haynes Hint).

64 Refitting is a reversal of the removal procedure, noting the following points:

- a) Clean the mating faces, and apply gasket sealant to the inlet manifold mating face.
- b) Tighten the bolts progressively to the

specified torque, working diagonally outwards from the two centre bolts.

- c) Make sure that all hoses are correctly and securely reconnected, to prevent air leaks.

Fuel pressure regulator

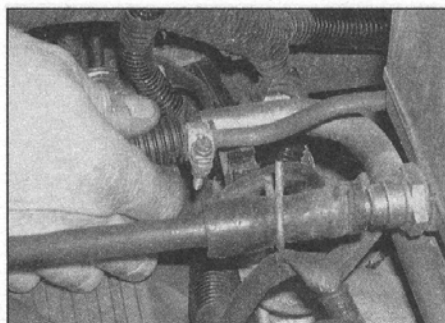
65 Depressurise the fuel system as described in Section 5.

66 Disconnect the battery negative terminal.

67 Release the fuel return hose from the clip to the inside of the right-hand rocker cover (see illustration).

68 To improve access, disconnect the air hose from the by-pass air valve, then pull off the vacuum hose from the fuel pressure regulator (see illustrations).

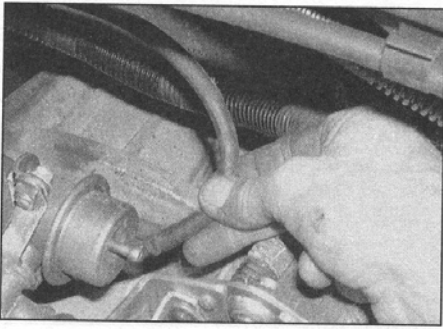
69 Undo the two nuts and bolts securing the regulator to its mounting bracket, then



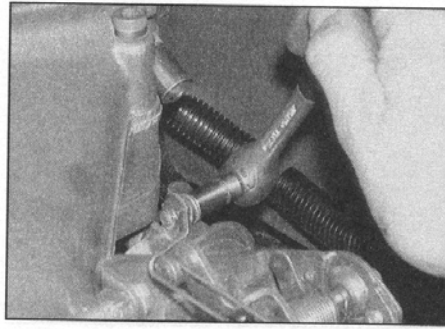
6.67 Unclip the fuel return hose by pulling upwards



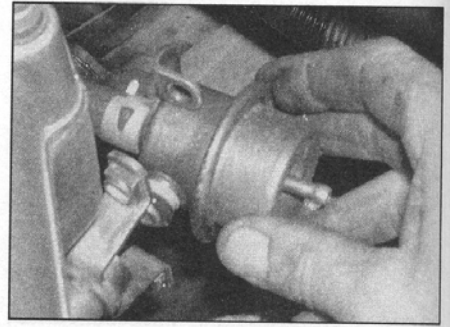
6.68a Disconnect the air by-pass valve hose for access ...



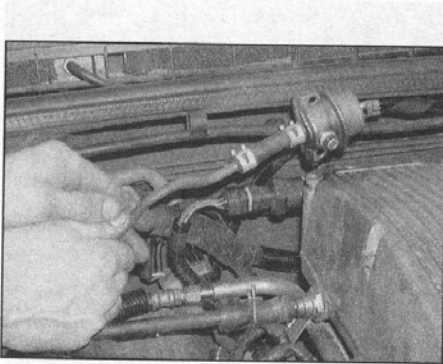
6.68b ... then pull off the pressure regulator vacuum hose



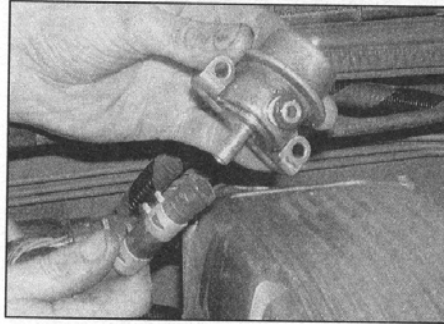
6.69a Unscrew the regulator mounting nuts and bolts ...



6.69b ... then pull the regulator to the rear to release its O-ring from the fuel rail



6.70a Move the pressure regulator around the back of the plenum chamber ...



6.70b ... then release the pipe clips and disconnect the regulator

carefully ease the regulator inlet pipe and O-ring rearwards out of the fuel rail (see illustrations).

70 Feed the regulator and hose behind the plenum chamber, then release the pipe clips securing the regulator to the hose, and remove the regulator (see illustrations).

71 Refitting is the reversal of removal, noting the following points:

- a) Use a new O-ring, and coat it with a little silicon grease before refitting the regulator to the fuel rail (see illustration).
- b) On completion, switch on the ignition to pressurise the system, and check for signs of fuel leakage.

Fuel rail and injectors

72 Depressurise the fuel system as described in Section 5.

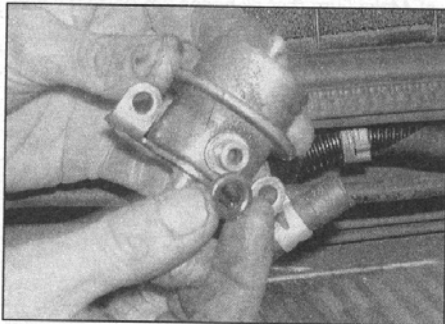
73 Disconnect the battery negative lead.

74 Remove the plenum chamber and ram housing as described previously. Place clean cloth rags in the inlet ports to prevent ingress of dirt.

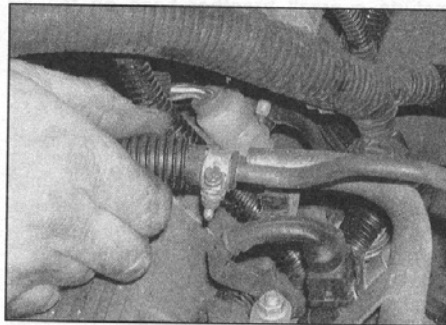
75 Unclip the fuel return hose from the right-hand rocker cover, then release the clips and disconnect the fuel return hose from the pressure regulator (see illustrations).

76 Loosen the union nuts and disconnect the fuel feed hose from the fuel rail (see illustrations).

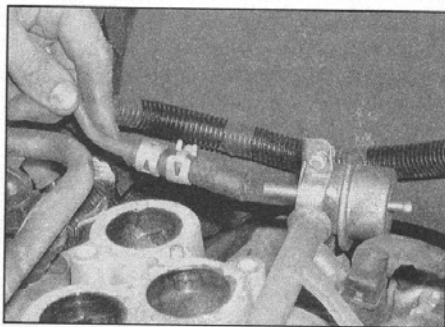
77 Disconnect the multi-plug from the fuel



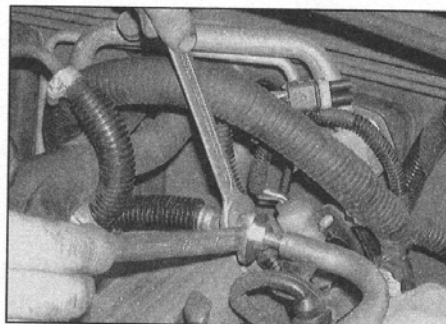
6.71 Use a new O-ring when refitting the regulator



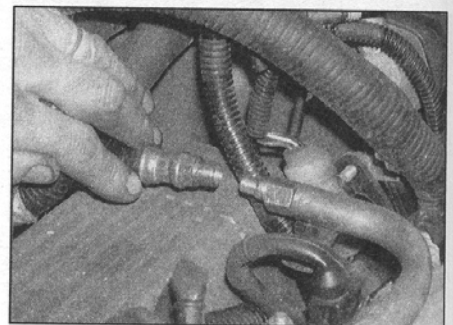
6.75a Unclip the fuel return hose from the right-hand rocker cover ...



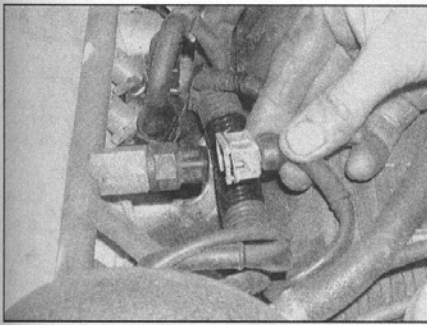
6.75b ... then release it from the fuel pressure regulator



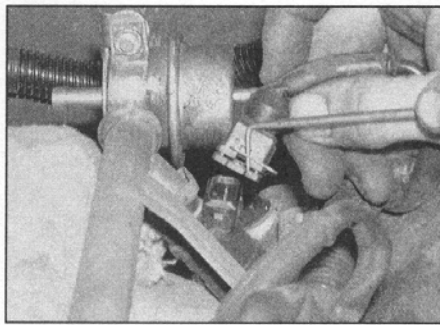
6.76a Loosen the union nuts ...



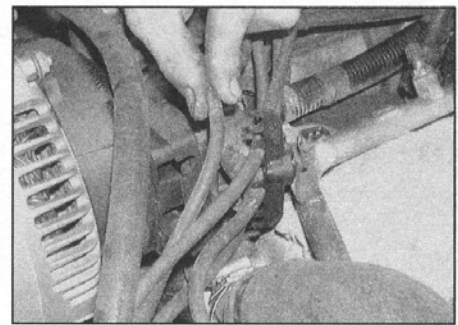
6.76b ... and disconnect the fuel feed hose from the fuel rail



6.77 Disconnecting the wiring plug from the fuel temperature thermistor



6.78 Use a suitable tool to release the clip securing the injector multi-plugs



6.79 Release the HT leads from the fuel rail clip

temperature thermistor on the front of the fuel rail (see illustration). Use a small screwdriver (or similar tool) to ease out the wire clip securing the plug before pulling the plug clear.

78 Disconnect the multi-plugs from the injectors, using the same method as for the fuel temperature thermistor plug (see illustration). Label the plugs if necessary, to prevent any confusion on refitting.

79 Release the HT leads from the clip attached to the fuel rail (see illustration).

80 Unscrew and remove the fuel rail mounting nuts (see illustration).

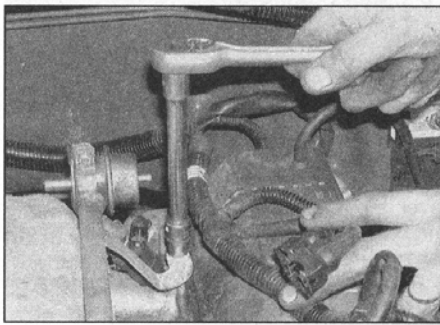
81 Remove the heater pipe clamp bolt from the top of the rocker cover, then disconnect the heater hose leading to the inlet manifold. Move the heater pipes and wiring to one side as necessary, so that the heater pipe bracket can be lifted off the stud which is also used to locate the front right-hand fuel rail mounting (see illustrations).

82 Carefully ease the fuel rail and injectors from the inlet manifold, and remove the assembly from the engine compartment (see illustration).

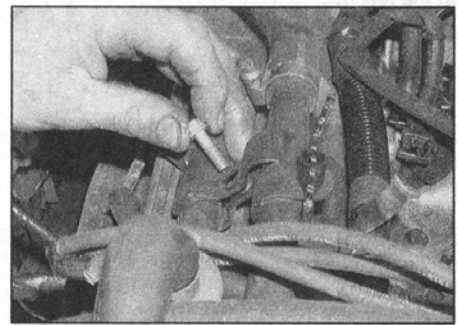
83 Pull out the clips securing the injectors to the fuel rail, and ease the injectors from the rail (see illustrations).

84 Unscrew the two nuts and bolts securing the pressure regulator to the fuel rail, and ease the regulator from the rail.

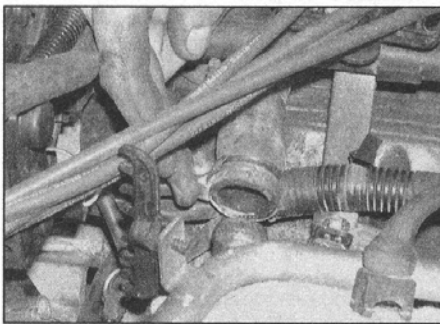
85 Prise the O-rings from the injectors, clean the grooves and fit new O-rings (see



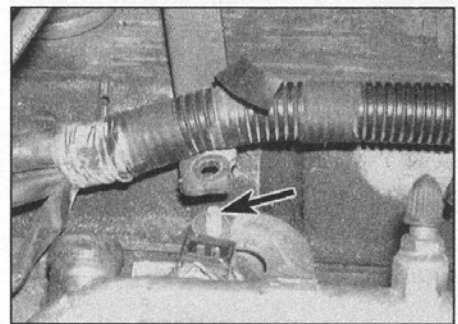
6.80 Unscrew the fuel rail mounting nuts



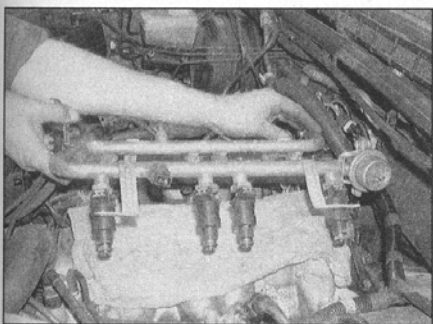
6.81a Remove the bolt and clamp from the heater pipework ...



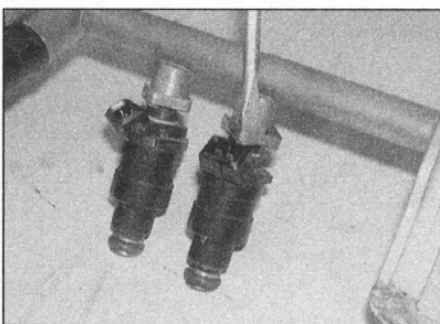
6.81b ... then unscrew the hose clip and disconnect the hose from the inlet manifold ...



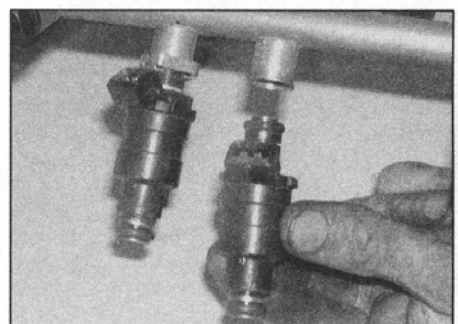
6.81c ... to allow the heater pipe bracket to be lifted off the stud also used by the fuel rail (arrowed)



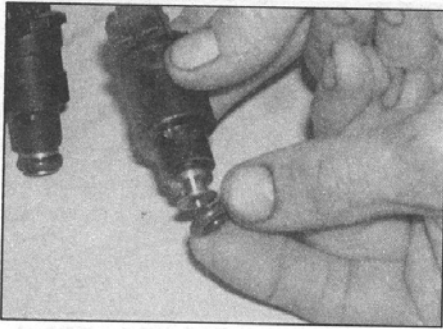
6.82 Removing the fuel rail and injectors



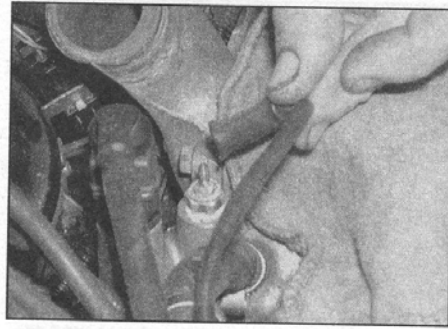
6.83a Prise out the injector securing clips ...



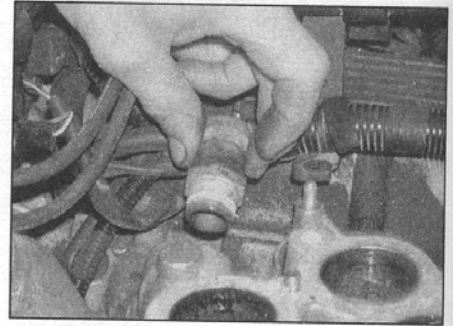
6.83b ... and remove the injectors from the fuel rail



6.85 Prise out the injector O-rings, and fit new ones



9.6 Disconnect the coolant temperature sensor wiring plugs



9.12 Unscrew the heater pipe stub from the inlet manifold

illustration). Also clean the injector locations in the fuel rail.

86 Apply a light coating of silicon grease to the O-rings then fit the injectors to the fuel rail with the multi-plug connections facing outwards. Secure with the clips.

87 Remove the O-ring from the pressure regulator, clean the location and fit a new O-ring. Apply a little silicon grease to the O-ring and press the regulator into the fuel rail. Refit and tighten the two nuts and bolts.

88 The remaining procedure is a reversal of removal. On completion switch on the ignition and check for leaks from the fuel rail.

7 Fuel pump and gauge sender unit - removal and refitting

1 Depressurise the fuel system as described in Section 5.

2 The procedure is now identical to that described in part A of this Chapter, Section 11.

8 Fuel tank - removal and refitting

1 Depressurise the fuel system as described in Section 5.

2 The procedure is now identical to that described in part A of this Chapter, Section 12.

9 Inlet manifold - removal and refitting

1 Depressurise the fuel system as described in Section 5.

2 Disconnect the radiator bottom hose and partially drain the cooling system until the level is below the thermostat housing. Refit the hose and tighten the clip. Refer to Chapter 1A if necessary.

3 Remove the plenum chamber with reference to Section 6.

4 Disconnect the wiring multi-plugs to the fuel temperature thermistor and fuel injectors. Label the injector plugs if necessary, to avoid confusion on refitting.

5 Release the injector harness from the rear of the fuel rail, and place it to one side.

6 Disconnect the two coolant temperature switches fitted to the inlet manifold, behind the distributor (see illustration). Remove the top hose from the thermostat housing, and on models with air conditioning, disconnect the wiring plug from the housing.

7 To improve access, unclip and lift off the distributor cap, complete with HT leads.

8 Release the HT leads from the clip attached to the fuel rail.

9 Unclip the fuel return hose from the rocker cover, and separate the hose from the rigid pipe.

10 Taking note of the precautions given in Section 5, loosen the union, and disconnect the fuel supply hose from the fuel rail. Plug the union to prevent further loss of fuel.

11 Disconnect the hoses from the outer edges of the ram housing, noting their locations. Depending on model, these will include a small breather hose on the air cleaner side, and vacuum hoses for the brake servo and charcoal canister on the other side.

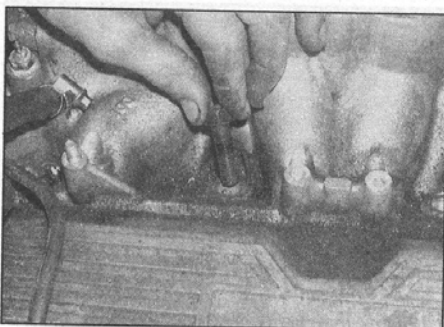
12 Unbolt the rigid heater pipes from the inlet manifold, disconnect the hose leading to the inlet manifold connection, and place the heater pipe assembly to one side. Unscrew the heater pipe stub from the inlet manifold (see illustration).

13 Starting with the outermost bolts, and working in a diagonal sequence, progressively loosen the twelve bolts securing the inlet manifold to the cylinder heads. Remove the bolts, noting their positions for refitting, as they are of different lengths (see illustration).

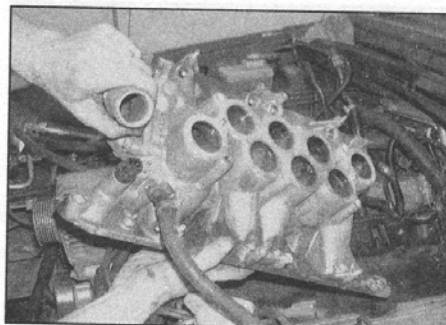
14 Any bolts removed from the cylinder heads or block should have their threads cleaned with a wire brush dipped in paraffin or clean petrol. If this cleaning cannot be carried out immediately, it is vital that they are stored in petrol or paraffin, as the sealant used when the bolts were originally fitted will tend to harden on exposure to the air, making its removal difficult.

15 Move aside the heater hoses, and ease the manifold assembly away from the engine (see illustration). Take care not to damage the alternator or distributor as the assembly is lifted out.

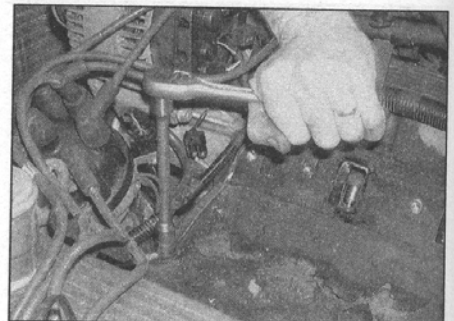
16 Before removing the gasket clamps, ensure that there is no coolant lying on top of the gasket. Remove the clamps and lift away the gasket, followed by the rubber gasket seals (see illustrations). Discard the



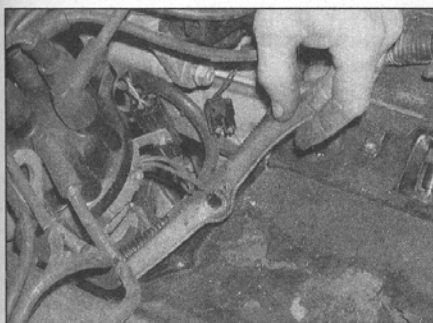
9.13 Removing an inlet manifold securing bolt



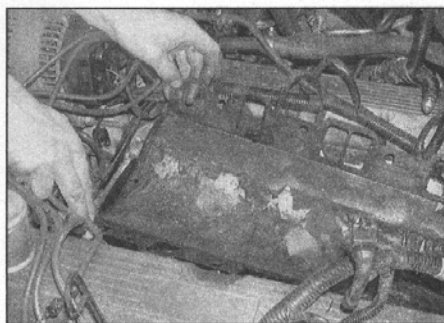
9.15 Removing the inlet manifold



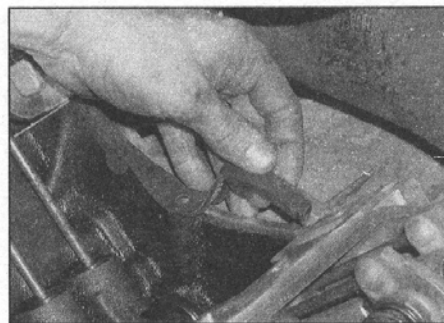
9.16a Unbolt the inlet manifold gasket clamps . . .



9.16b ... and remove the clamps and rubber seals



9.16c Removing the inlet manifold gasket



9.19 Place the rubber seals in position

gasket and seals - new items must be fitted on assembly.

Refitting

17 As the inlet manifold also serves to cover the pushrod cavities of the cylinder block, a single manifold gasket is fitted. Made from sheet metal, this gasket extends downwards over the inlet port face of each cylinder head, and over each of the respective pushrod cavities. Rubber seals are fitted at each end, to seal the manifold to the timing chest and rear flange. It is important that the gasket and seals are carefully fitted, or oil leaks may develop.

18 Clean the mating faces of the inlet manifold, and the cylinder heads and block.

Also clean the threads of the manifold securing bolts.

19 Commence refitting by locating the new rubber seals in position with their ends engaged in the notches formed between the cylinder heads and cylinder block (see illustration).

20 Apply a blob of suitable RTV sealant between the ends of the seals and the cylinder heads/block (see illustration).

21 Locate the new manifold gasket in position, with the word FRONT to the front, and the open bolt hole to the front right-hand side (right as seen from the driver's seat). Later gaskets have no markings, however, and appear to fit either way round.

22 Refit the two gasket clamps, but do not tighten the bolts fully (see illustration). Note

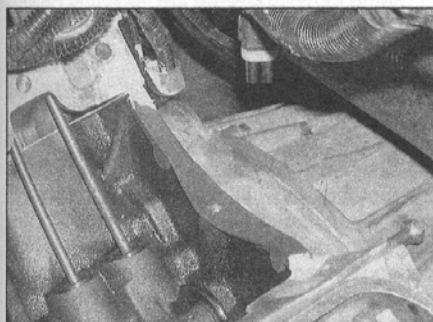
that the two clamps are different, and can only fit at one end or the other.

23 Lower the inlet manifold into position (see illustration). Note that, where applicable, the open bolt hole aligns with the open hole in the gasket.

24 Insert all the bolts to their positions as noted on removal - the two long bolts fit either side at the front of the manifold (see illustration).

25 Tighten all bolts progressively in a diagonal sequence from the centre outwards to the specified torque. Tighten the gasket clamps to the specified torque (see illustrations).

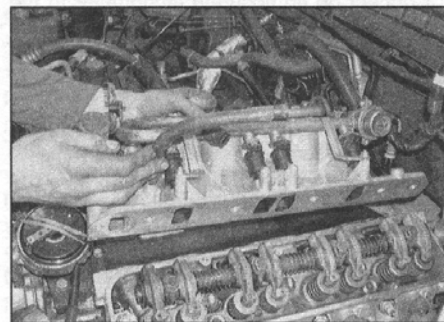
26 The remainder of refitting is a reversal of removal. On completion, start the engine and check for oil and water leaks.



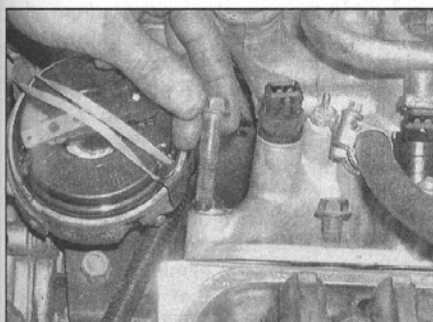
9.20 Apply sealant to the ends of the rubber seals



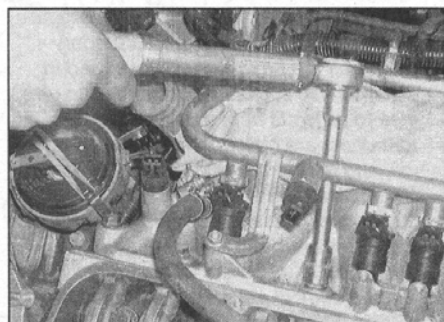
9.22 Gasket clamp in position



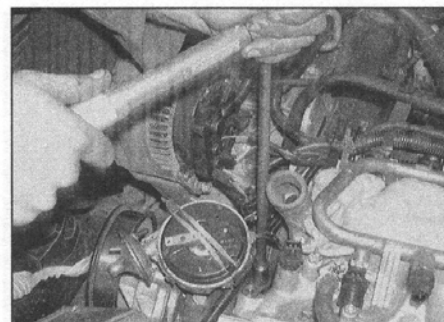
9.23 Lowering in the inlet manifold



9.24 Fitting one of the longer inlet manifold bolts



9.25a Tighten the manifold bolts ...

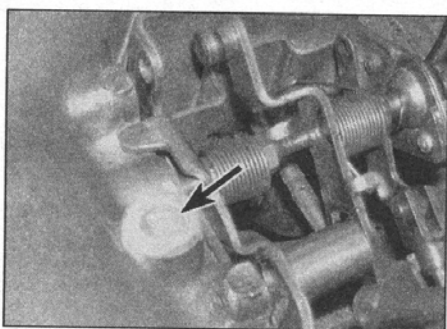


9.25b ... and the gasket clamp bolts

10 Base idle speed - adjustment



- 1 Routine adjustment of the idle speed and mixture settings is not required, as these settings are under the control of the Lucas engine management ECU.
- 2 Similarly, the base idle speed is set at the factory, and unless the plenum chamber is changed, it should not require adjustment. A tamperproof plug is fitted over the adjuster screw.
- 3 The ECU will normally compensate for factors such as engine wear, so poor idle quality should not be blamed on the base setting being too low. Consider the possibility of an air leak into the engine, a blocked breather, or general lack of maintenance, before tampering with the base idle setting (see Section 11). A fault with the speed sensor (see Section 6) may cause poor idle quality.
- 4 If adjustment is to be made, run the engine to operating temperature.
- 5 Check the ignition timing as described in Chapter 5B.
- 6 To enable an accurate setting to be made, the by-pass air valve at the rear of the plenum chamber must be effectively disabled. Land Rover dealers disconnect both ends of the by-pass air hose, then fit special blanked-off sections of hose to each connection. The same effect may be achievable by fitting and tightening a hose clamp halfway along the hose.
- 7 Connect up an accurate tachometer to the engine, using its manufacturer's instructions. The vehicle's own tachometer will only give a rough guide for adjustment, but will suffice if necessary.
- 8 Start the engine, and check the base idle speed achieved against the specified value.
- 9 If adjustment is required, hook out the tamperproof plug from the adjuster, which is fitted to the throttle housing in front of the main throttle linkage (see illustration).
- 10 Using a suitable Allen key inserted down the adjuster bore, turn the screw as necessary to bring the base idle speed into the specified range.



10.9 Base idle speed screw is located under tamperproof plug (arrowed)

11 Press and release the accelerator pedal a few times, then let the engine settle and re-check the adjustment. If there is any reluctance to return to idle, lubricate the throttle linkages with a few drops of light oil.

11 Fuel injection system - testing



- 1 If a fault appears in the fuel injection system, first ensure that all the system wiring connectors are securely connected and free of corrosion. Then ensure that the fault is not due to poor maintenance; ie, check that the air cleaner filter element is clean, the spark plugs are in good condition and correctly gapped, the cylinder compression pressures are correct, the ignition timing is correct and the engine breather hoses are clear and undamaged, referring to Chapter 1A, Chapter 2A and Chapter 5B.
- 2 One of the most common complaints with fuel injection systems is that of poor idle quality and frequent stalling. The reasons behind this are many and varied, but those listed below are the easiest to cure:
 - a) *Inlet air leaks, allowing 'unmetered' air into the engine. If the hose clips securing the various air inlet and engine breather hoses are not tight, or if the hoses themselves are damaged, air will leak into the engine, and this upsets the idle fuel/air mixture - if this is the problem, the engine will probably only run badly at idle, and no other speed.*
 - b) *Partially-blocked injectors, causing poor atomisation of the fuel. The fuel injected into the engine should be in the form of a fine spray, not a jet. Over time, if poor-quality petrol is used, the injectors may become partially blocked, and the fuel does not atomise. This leads not only to poor idle quality, but will adversely affect the idle mixture (emissions). Some improvement may be effected by adding a proprietary injector cleaning agent to the fuel in the tank. If this does not work, injector cleaning services may be available from local automotive specialists.*
 - c) *Blocked engine breathers. This really falls into the lack of maintenance category - check all the breathers as described in Chapter 1A. A blocked breather can give rise to all kinds of problems. Once the breathers are clear, consider changing the oil, and the quality of oil being used in the engine - the older the oil gets, or the lower quality it is to begin with, the more oil fumes are produced, and the more blocked the breathers will become.*
 - d) *Poor electrical connections and damaged wiring. This is a particularly good source of intermittent problems. Every visible wiring connection in the engine*

compartment should be checked, separated and cleaned. A light spray with a water-dispersant aerosol will often help restore a poor connection, but should not be used as a substitute for proper cleaning (using fine emery paper) if required. If appropriate, simpler connections may benefit from having the connector pins bent slightly, to achieve a better connection, but this should not be attempted on more complex connectors, or if there is a risk of damaging the plug. Wiring should be checked for insulation which has chafed through or been melted, or stretching (which may cause it to detach from a wiring plug, or to fracture internally). Wire also becomes brittle with age, particularly if it is exposed (as may be the case with some earth connections) - an apparently-sound connection may have fractured, and be anything but.

- e) *Ignition system problems, causing a partial misfire. Check all the ignition system components as described in Chapter 1A, paying special attention to the distributor cap, rotor arm and HT leads. Having eight cylinders may make one poor-condition or badly-fitting HT lead harder to pinpoint than on a four-cylinder engine. Pay particular attention to the routing of the leads, and arrange them so that they overlay each other as little as possible. Also check that they do not directly contact more metal surfaces than necessary, bearing in mind also that they might come into contact with the inside of the bonnet when it is closed. If any HT lead has damaged insulation, or cannot be made to connect securely, it should be renewed - if all the leads have seen long service, renew the leads as a set.*
- 3 If these checks fail to reveal the cause of the problem, the vehicle should be taken to a suitably-equipped Land Rover dealer for the system to be checked electronically for fault codes. A diagnostic plug (white) is located adjacent to the system ECU, into which a fault code reader can be plugged.
- 4 Fault codes can only be extracted from the ECU using a dedicated fault code reader. A Land Rover dealer will obviously have such a reader, but they are also available from other suppliers, including Haynes. It is unlikely to be cost-effective for the private owner to purchase a fault code reader, but a well-equipped local garage or auto electrical specialist will have one.
- 5 Using this equipment, faults can be pinpointed quickly and simply, even if their occurrence is intermittent. Testing all the system components individually in an attempt to locate the fault by elimination is a time-consuming operation that is unlikely to be fruitful (particularly if the fault occurs dynamically), and carries high risk of damage to the ECU's internal components.

12 Unleaded petrol -
general information and usage

Note: The information given in this Chapter is correct at the time of writing, and applies only to petrols currently available in the UK. Check with a Land Rover dealer as more up-to-date information may be available. If travelling abroad, consult one of the motoring organisations (or a similar authority) for advice on the petrols available and their suitability for your vehicle.

1 The fuel recommended by Land Rover is given in the Specifications of this Chapter.

2 RON and MON are different testing standards; RON stands for Research Octane Number (also written as RM), while MON stands for Motor Octane Number (also written as MM).

13 Cruise control system -
description and
component renewal

Cruise control system -
description

1 Cruise control may be fitted to later models as an option. The system incorporates the following components:

- a) *Electronic control unit located behind the driver's side lower fascia panel. The ECU receives information from the driver, brake pedal switch and vehicle speed sensor, and activates the throttle vacuum pump accordingly. On models with manual transmission, a further ECU in this location cuts the cruise control if the engine speed exceeds 5000 rpm.*
- b) *Cruise control switches are located in the auxiliary switch panel and on the steering wheel.*

wheel. The steering wheel switches provide set/accelerate and resume/decelerate functions.

- c) *The clutch and brake pedal switches are mounted on the pedal bracket and, when either pedal is pressed, the ECU disengages the cruise control system and releases the throttle levers to their idle position.*
- d) *The vehicle speed sensor is mounted on the side of the transfer box. Cruise control cannot be engaged at road speeds under 28 mph.*
- e) *The vacuum pump fitted at the front left-hand side of the engine compartment provides the vacuum source for the actuator. A control valve in the pump allows precise control to the throttle actuator, or a quick purge of the system when the system disengages.*
- f) *The actuator is located in the engine compartment and moves the throttle levers as required.*
- g) *The neutral lockout relay, fitted to automatic transmission models, is located behind the driver's side right-hand footwell trim panel. Its function is to disengage the cruise control if Neutral or Park is selected in the main gearbox when the system is engaged.*

2 If the cruise control system develops a fault, first check all of the associated wiring and fuses, and the vacuum hoses.

Cruise control system components - removal, refitting and adjustment

Brake or clutch switch/vent valve

- 3 Disconnect the battery negative lead.
- 4 Release the clips and pull down the lower fascia panel.
- 5 Disconnect the wiring and vacuum hose from the switch/vent valve.

6 Release the locking sleeve behind the switch, then release the locking tabs and remove the switch from the pedal bracket (see illustration).

7 Refitting is a reversal of the removal procedure, noting the following points:

- a) *The brake switch should be adjusted to provide a clearance of 1.0 mm between the switch/vent valve body and the inside shoulder of the contact button.*
- b) *The clutch switch should be set to a zero clearance between the switch/vent valve body and the inside shoulder of the contact button.*

Main control switch

8 See Chapter 13, Section 4.

Steering wheel switches - models with driver's airbag

9 Disconnect the battery negative lead. Remove the airbag unit as described in Chapter 13.

10 Disconnect the cruise control switch main multi-plug in the centre, and the two horn contact wiring plugs at the base.

11 At each side of the wheel, remove the two small screws securing the switches to the wheel.

12 Unscrew the three mounting bracket bolts from the centre of the wheel, and remove the cruise control switch assembly.

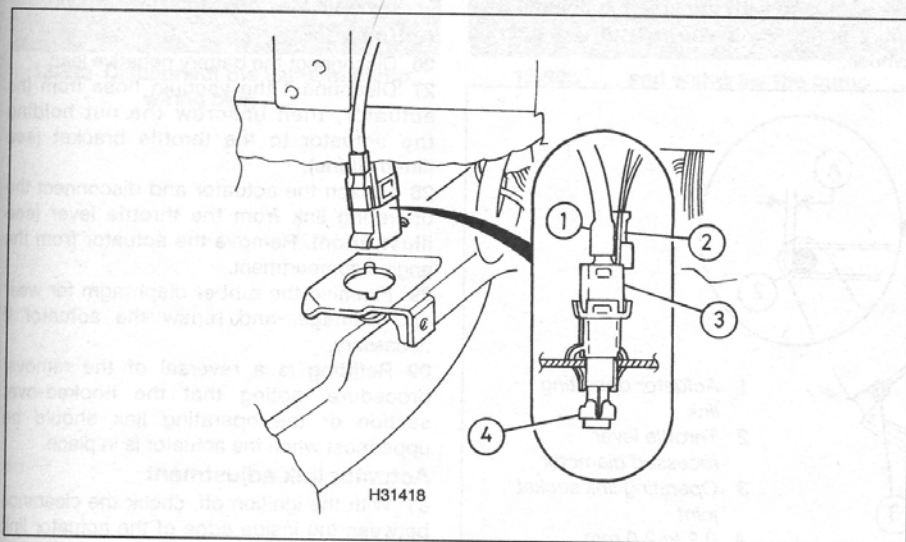
13 Refitting is a reversal of the removal procedure, ensuring that the cruise control wiring harness is routed correctly. Refit the airbag unit as described in Chapter 13.

Steering wheel switches - models without driver's airbag

14 Disconnect the battery negative lead.

15 The switches must be prised from their locations in the steering wheel, and this requires significant effort with a screwdriver. The first attempt when we tried in the workshop did no more than separate the top half of the switch from the switch body - the wheel padding has to be levered aside considerably to ease out the switch complete (see illustration). Take care to minimise the potential damage to the wheel padding as this is done - use stiff card behind the screwdriver shaft, for instance.

16 Once the switch has been removed,

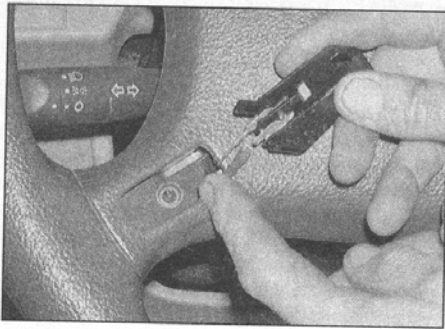


13.6 Cruise control pedal switch removal

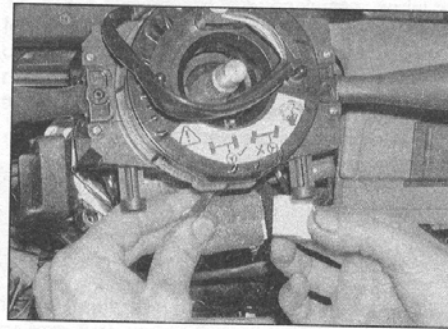
- 1 Vacuum hose
- 2 Wiring connector
- 3 Wiring plug
- 4 Locking sleeve



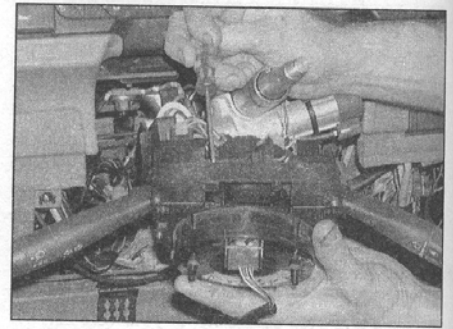
13.15 Prise out the cruise control switches from the steering wheel . . .



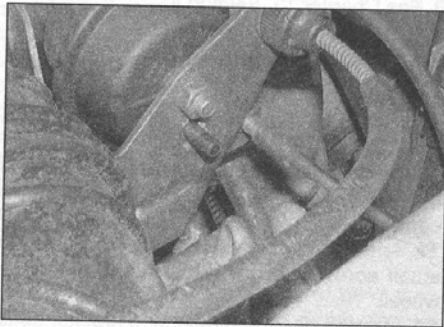
13.16 ... and disconnect the wiring



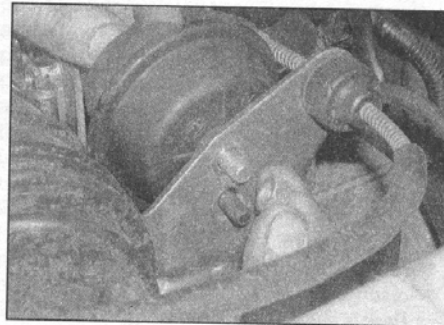
13.21 Disconnect the contact unit wiring plug



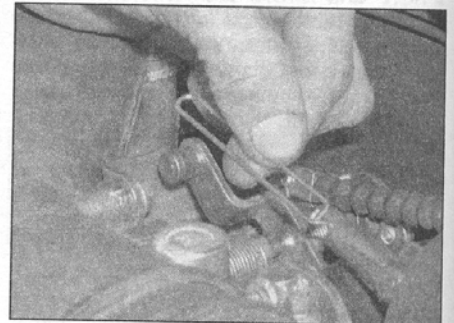
13.23 Using a small screwdriver to release the contact unit retaining lugs



13.27a Disconnect the vacuum hose ...



13.27b ... then unscrew the actuator mounting nut



13.28 Unhook the actuator operating link from the throttle linkage

disconnect the wiring from the switch base (see illustration).

17 Refitting is a reversal of removal.

Rotary contact unit

18 Disconnect the battery negative lead.

19 Set the front wheels pointing straight-ahead, then remove the steering wheel as described in Chapter 11.

20 Release the clips securing the driver's side lower trim panel, and remove the three screws securing the steering column lower shroud.

21 Disconnect the contact unit multi-plug from the steering column wiring harness (see

illustration), and release the harness from the ignition switch.

22 If the contact unit is to be re-used, apply adhesive tape to the upper and lower halves to prevent rotation. If this precaution is not taken, the wiring inside the unit will be damaged.

23 Pull the assembly rearwards off the steering column, then using a small screwdriver, release the upper and lower plastic lug which secures the unit to the column switches (see illustration). Remove the unit from the steering column, noting how the protruding pegs engage with the steering column (two more engage with the rear of the steering wheel).

24 While the contact unit is removed, keep it in a plastic bag, and make sure the mechanism is not rotated.

25 Refitting is a reversal of the removal procedure, noting the following points:

- a) Check that the front wheels are still in the straight-ahead position.
- b) Make sure that the pegs on the front and rear of the unit locate in the holes on the steering column and the underside of the steering wheel.
- c) Make sure that the wiring is not trapped between the upper and lower shroud.

Actuator

26 Disconnect the battery negative lead.

27 Disconnect the vacuum hose from the actuator, then unscrew the nut holding the actuator to the throttle bracket (see illustrations).

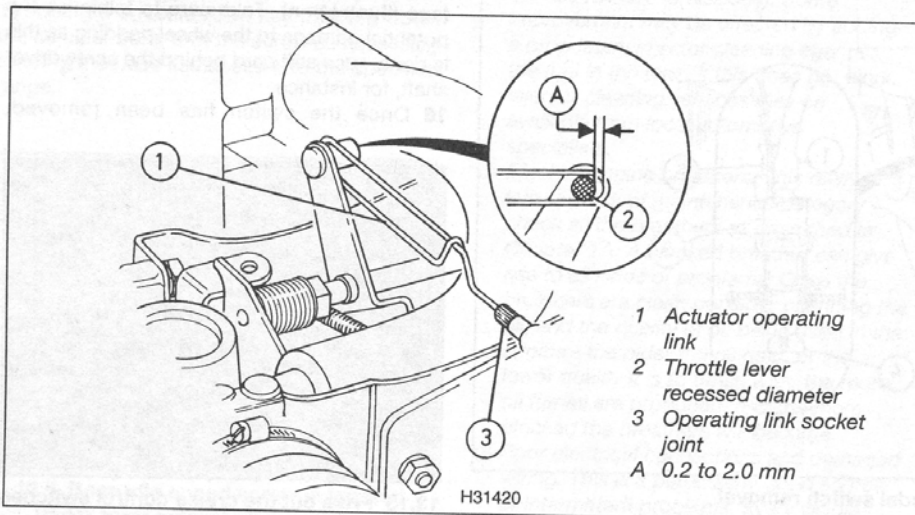
28 Detach the actuator and disconnect the operating link from the throttle lever (see illustration). Remove the actuator from the engine compartment.

29 Examine the rubber diaphragm for wear and damage, and renew the actuator if necessary.

30 Refitting is a reversal of the removal procedure, noting that the hooked-over section of the operating link should be uppermost when the actuator is in place.

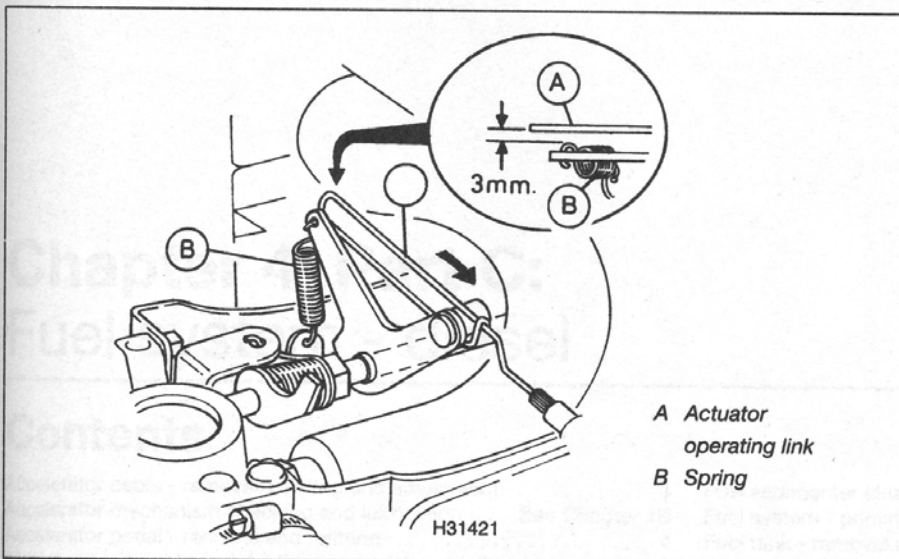
Actuator link adjustment

31 With the ignition off, check the clearance between the inside edge of the actuator link and the recessed diameter of the throttle lever. This should be between 0.2 and 2.0 mm (see illustration).



13.31 Actuator link adjustment

- 1 Actuator operating link
- 2 Throttle lever recessed diameter
- 3 Operating link socket joint
- A 0.2 to 2.0 mm



13.33 Actuator link adjustment

A Actuator operating link
B Spring

32 To adjust the setting, remove the link from the actuator and rotate the socket joint on the link as required to increase or decrease the length of the link. Refit the link to the actuator and recheck the adjustment.
33 Open the throttle fully and check that a gap of 3.0 mm minimum exists between the

side of the actuator link and the side of the small spring which connects the inner throttle lever to the outer throttle lever (see illustration).
34 Bend the link to achieve the correct gap if it is less than 3.0 mm.
35 Check the clearance again at closed

throttle and open throttle and check that the actuator link slides smoothly in the groove of the throttle lever.

Vacuum pump

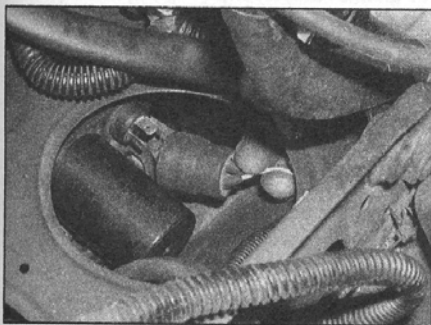
36 Disconnect the battery negative lead.
37 Remove the air cleaner as described in Section 2.
38 Release the wheel chock and jack from their mountings and remove them.
39 Disconnect the vacuum pump multi-plug, then release the pump's rubber mountings and withdraw the pump (see illustrations).
40 Disconnect the vacuum feed hose from the pump (see illustration).
41 Refitting is a reversal of the removal procedure.

Cruise control electronic control unit (ECU)

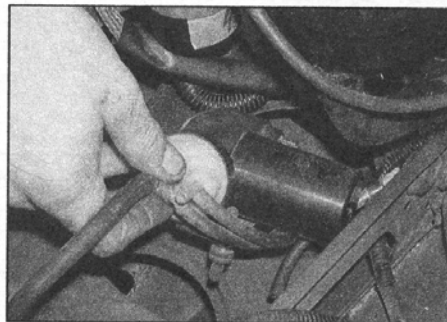
42 The ECU is located behind the fascia below the steering column. First disconnect the battery negative lead.
43 Release the clips and pull down the driver's side lower fascia panel.
44 Unscrew the mounting bolt and withdraw the cruise control ECU so that the wiring multi-plug can be disconnected.
45 Refitting is a reversal of the removal procedure.

Vehicle speed sensor

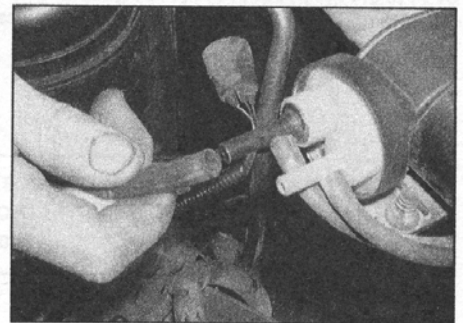
46 See Section 6.



13.39a Disconnect the vacuum pump wiring plug ...



13.39b ... and withdraw the pump



13.40 Disconnecting the vacuum feed hose

Chapter 4 Part C:

Fuel system - diesel

Contents

| | | | |
|--|----------------|--|----------------|
| Accelerator cable - removal, refitting and adjustment | 3 | Fuel sedimenter cleaning | See Chapter 1B |
| Accelerator mechanism checking and lubrication | See Chapter 1B | Fuel system - priming and bleeding | 5 |
| Accelerator pedal - removal and refitting | 4 | Fuel tank - removal and refitting | 7 |
| Air cleaner assembly and ducting - removal and refitting | 2 | Fuel tank security check | See Chapter 1B |
| Air cleaner dump valve check - 200 TDi engine models | See Chapter 1B | General information and precautions | 1 |
| Air cleaner element renewal | See Chapter 1B | Idle speed - checking and adjustment | 10 |
| Cruise control system - description and component renewal | 22 | Injection timing - checking and adjustment | 13 |
| Electronic Diesel Control (EDC) system - general description and precautions | 20 | Injection timing - checking methods and adjustment | 12 |
| Electronic Diesel Control (EDC) system components - removal and refitting | 21 | Inlet manifold - removal and refitting | 19 |
| Fuel filter element renewal | See Chapter 1B | Intercooler - removal and refitting | 18 |
| Fuel gauge sender unit - removal and refitting | 6 | Intercooler element cleaning | See Chapter 1B |
| Fuel injection pump - removal and refitting | 11 | Maximum speed - checking and adjustment | 9 |
| Fuel injectors - testing, removal and refitting | 14 | Turbocharger - description and precautions | 15 |
| Fuel lift pump - removal and refitting | 8 | Turbocharger - examination and overhaul | 17 |
| | | Turbocharger - removal and refitting | 16 |
| | | Turbocharger boost pressure check | See Chapter 1B |

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 | |
| System type | Rear-mounted fuel tank, distributor fuel injection pump with camshaft-driven mechanical lift pump, indirect injection. Turbocharger and intercooler |
| Injection pump type: | Bosch VE4/11F |
| 200 TDi engine | Bosch R509 (non-EDC) or R500 (EDC) |
| 300 TDi engine | 1-3-4-2 (No 1 at timing belt end) |
| Firing order | Clockwise (viewed from timing belt end) |
| Direction of injection pump rotation | |
| Accelerator cable | |
| Freeplay | 1.5 mm |
| Injection timing | |
| <i>Note: For reference only - see text for adjustment procedure</i> | |
| 200 TDi engine | 1.54 mm lift at TDC |
| 300 TDi engine: | |
| Engines without EDC (Electronic Diesel Control) or electronic EGR (Exhaust Gas Recirculation) | 1.54 mm lift at TDC |
| With EDC | 0.45 mm lift at TDC |
| With electronic EGR | 1.40 mm lift at TDC |

4C•2 Fuel system - diesel

Maximum speed

| | |
|--|---------------------|
| No-load (all engines) | 4600 + 40 - 120 rpm |
| Full load (cut-off begins - all engines) | 4000 rpm |

Idle speed

| | |
|-------------------|--------------|
| All engines | 720 ± 20 rpm |
|-------------------|--------------|

Fast idle speed

Determined by idle speed - no adjustment possible

Injectors

| | |
|----------------------|----------|
| Type | Pintle |
| Opening pressure: | |
| Initial | 200 bars |
| Secondary: | |
| 200 TDi engine | 280 bars |
| 300 TDi engine | 300 bars |

Turbocharger

| | |
|-------------------------|---------------------------|
| Type: | |
| 200 TDi engine | Garrett T25 |
| 300 TDi engine | Allied signal |
| Maximum boost pressure: | |
| 200 TDi engine | 0.78 bars |
| 300 TDi engine | 0.83 to 1.04 bars |
| Speed of rotation | Approximately 150 000 rpm |

Torque wrench settings

| | Nm | lbf ft |
|---|----|--------|
| Air temperature sensor/blanking plug-to-inlet manifold | 14 | 10 |
| Boost pressure pipe-to-fuel injection pump union | 10 | 7 |
| Fuel hose-to-fuel filter unions: | | |
| 200 TDi engine | 15 | 11 |
| 300 TDi engine | 33 | 24 |
| Fuel hose-to-fuel lift pump unions: | | |
| 200 TDi engine | 12 | 9 |
| 300 TDi engine | 33 | 24 |
| Fuel injection pump front securing nuts | 25 | 18 |
| Fuel injection pump hub cover plate screws | 25 | 18 |
| Fuel injection pump rear bracket fixings | 25 | 18 |
| Fuel injection pump sprocket-to-hub bolts | 25 | 18 |
| Fuel injector clamp plate nuts | 25 | 18 |
| Fuel injector pipe unions | 25 | 18 |
| Fuel injector spill rail banjo bolt: | | |
| 200 TDi engine | 2 | 1 |
| 300 TDi engine | 10 | 7 |
| Fuel leak-off pipe-to-fuel injection pump union | 25 | 18 |
| Fuel leak-off pipe-to-injector unions: | | |
| Fuel lift pump securing bolts | 25 | 18 |
| Fuel supply hose-to-fuel injection pump union: | | |
| 200 TDi engine | 12 | 9 |
| 300 TDi engine | 25 | 18 |
| Inlet manifold heat shield | 6 | 4 |
| Inlet manifold securing nuts and bolts | 25 | 18 |
| Turbocharger oil drain pipe-to-cylinder block adapter union | 38 | 28 |
| Turbocharger oil drain pipe-to-turbocharger union: | | |
| 200 TDi engine | 45 | 33 |
| 300 TDi engine | 25 | 18 |
| Turbocharger oil feed pipe-to-cylinder block adapter union | 25 | 18 |
| Turbocharger oil feed pipe-to-turbocharger union | 19 | 14 |
| Turbocharger outlet elbow nuts (200 TDi engine) | 25 | 18 |
| Turbocharger-to-manifold nuts (200 TDi engine) | 25 | 18 |
| Turbocharger-to-manifold bolts (300 TDi engine) | 45 | 33 |

1 General information and precautions

General information

The fuel system consists of a rear-mounted fuel tank, a fuel sedimenter (which removes large droplets of water and particles of contamination), a fuel filter (incorporating a secondary water separator), a fuel lift pump, a fuel injection pump, injectors and associated components (see illustration). On some models, as the fuel passes through the filter, it is heated by a coolant supply flowing through the filter bowl. A turbocharger and intercooler are fitted to all engines.

For information on the exhaust and emission control systems, refer to part D of this Chapter.

Fuel is drawn from the fuel tank to the fuel injection pump by a camshaft-driven mechanical lift pump. Before reaching the fuel injection pump, the fuel passes through the fuel sedimenter and the fuel filter, where foreign matter and water are removed. Excess fuel lubricates the moving components of the pump, and is then returned to the tank.

The fuel injection pump is driven at half-crankshaft speed by the timing belt. The high pressure required to inject the fuel is achieved by a cam plate acting on a piston. The fuel passes through a central rotor with a single outlet drilling which aligns with ports leading to the injector pipes.

All 200 TDi engines, and early UK 300 TDi engines, are equipped with a conventional diesel injection system. Certain export models and later UK models may have an Electronic Diesel Control (EDC) system.

On models with a conventional fuel

injection system, fuel metering is controlled by a centrifugal governor which reacts to accelerator pedal position and engine speed. The governor is linked to a metering valve which increases or decreases the amount of fuel delivered at each pumping stroke. A separate device also increases fuel delivery with increasing turbocharger boost pressure. Basic injection timing is determined when the pump is first fitted. When the engine is running, it is varied automatically to suit the prevailing engine speed, by a mechanism which turns the cam plate or ring.

On models with Electronic Diesel Control (EDC), fuel metering, injection timing and cold start control is under the control of the EDC electronic control unit. The fuel injection pump operates in fundamentally the same way as a conventional pump, but instead of using mechanical mechanisms, fuel metering is controlled by an electronically-controlled actuator, and injection timing is controlled by a solenoid. The actuator and solenoid are controlled by the EDC electronic control unit according to information provided by various sensors. The most notable feature of the EDC system is that a 'drive-by-wire' accelerator control system is used, with no mechanical link (accelerator cable) between the accelerator pedal and the fuel injection pump. Further details of the EDC system are given in Section 20.

The four fuel injectors produce a homogeneous spray of fuel into the combustion chambers. The injectors are calibrated to open and close at critical pressures to provide efficient and even combustion. Each injector needle is lubricated by fuel, which accumulates in the spring chamber and is channelled to the injection pump return hose by leak-off pipes.

Cold starting is assisted by preheater or

glow plugs - one for each cylinder (see Chapter 5C for further details).

A stop solenoid cuts the fuel supply to the injection pump rotor when the engine is switched off.

Provided that the specified maintenance is carried out, the fuel injection equipment will give long and trouble-free service. The injection pump itself may well outlast the engine. The main potential cause of damage to the injection pump and injectors is dirt or water in the fuel.

Servicing of the injection pump and injectors is very limited for the home mechanic, and any dismantling or adjustment other than that described in this Chapter must be entrusted to a Land Rover dealer or fuel injection specialist.

Precautions

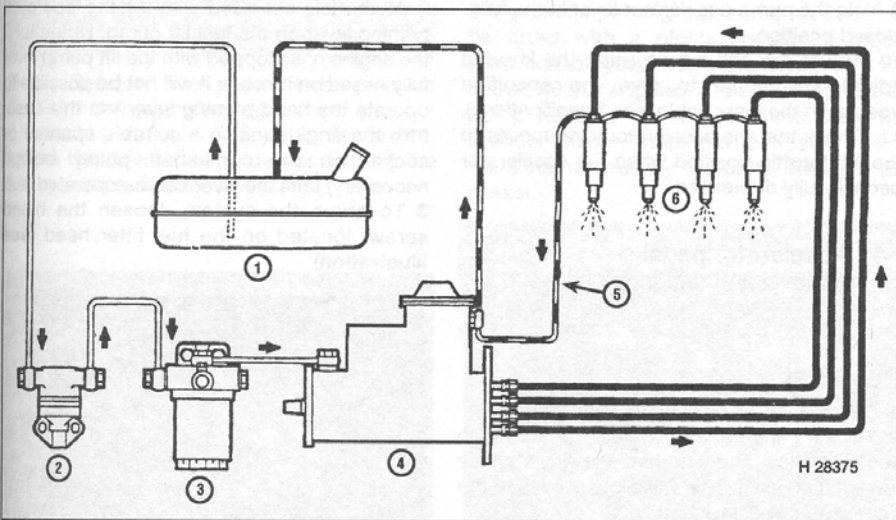


Warning: It is necessary to take certain precautions when working on the fuel system components, particularly the fuel injectors. Before carrying out any operations on the fuel system, refer to the precautions given in Safety first! at the beginning of this manual, and to any additional warning notes at the start of the relevant Sections.

When working on any part of the fuel system, avoid direct contact skin contact with diesel fuel - wear protective clothing and gloves when handling fuel system components. Ensure that the work area is well-ventilated, to prevent the build-up of diesel fuel vapour.

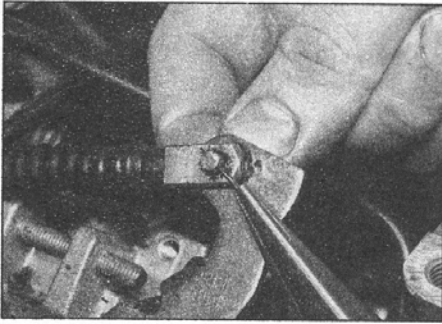
Fuel injectors operate at extremely high pressures, and the jet of fuel produced at the nozzle is capable of piercing skin, with potentially fatal results. When working with pressurised injectors, take great care to avoid exposing any part of the body to the fuel spray. It is recommended that any pressure testing of the fuel system components should be carried out by a diesel fuel systems specialist.

Under no circumstances should diesel fuel be allowed to come into contact with coolant hoses - wipe off accidental spillage immediately. Hoses that have been contaminated with fuel for an extended period should be renewed. Diesel fuel systems are particularly sensitive to contamination from dirt, air and water. Pay particular attention to cleanliness when working on any part of the fuel system, to prevent the ingress of dirt. Thoroughly clean the area around fuel unions before disconnecting them. Store dismantled components in sealed containers, to prevent contamination and the formation of condensation. Only use lint-free cloths and clean fuel for component cleansing. Avoid using compressed air when cleaning components in situ.

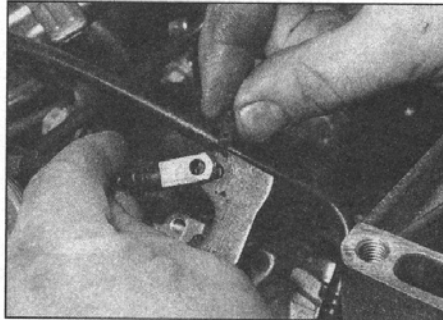


1.1 Schematic layout of diesel fuel system

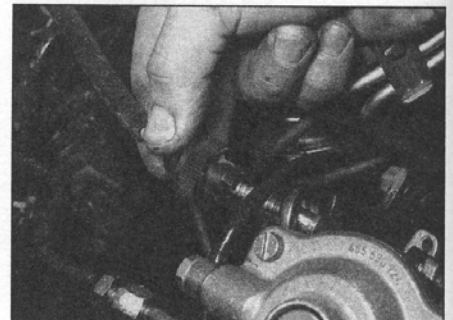
- | | | |
|------------------|-----------------------------|------------------------------------|
| 1 Fuel tank | 4 Fuel injection pump | Arrows show direction of fuel flow |
| 2 Fuel lift pump | 5 Fuel leak-off return line | |
| 3 Fuel filter | 6 Fuel injectors | |



3.2a Remove the split-pin . . .



3.2b . . . and withdraw the accelerator clevis pin at the fuel injection pump



3.3 Unclip the cable adjuster ferrule from the bracket on the injection pump

2 Air cleaner assembly and ducting - removal and refitting

200 TDi engine

- 1 Removal of the air cleaner assembly is described in Chapter 1B as part of the air cleaner element renewal procedure.
- 2 Removal and refitting of the ducting is self-evident, but note the locations of any wiring or hose clips attached to the ducting, and ensure that they are refitted in the same locations.

300 TDi engine

Removal

- 3 Working in the engine compartment, loosen the securing clamp, and disconnect the air outlet hose from the air cleaner cover.
- 4 Unclip the air cleaner cover, and withdraw the filter element.
- 5 Remove the wheel chock from the corner of the engine compartment.
- 6 Carefully pull the air cleaner up to release the mounting rubbers from the holes in the bottom of the air cleaner casing. Note that the rubbers remain in place in the body panel.
- 7 Release the plastic clips securing the air inlet tube to the body side panel, then lift the air cleaner assembly from the engine compartment.

Refitting

- 8 Refitting is a reversal of removal, but ensure that the mounting rubbers engage securely in the air cleaner holes.

3 Accelerator cable - removal, refitting and adjustment

Note: Does not apply to EDC-equipped models.

Removal

Note: New split-pins should be used to secure the cable end clevis pins on refitting.

- 1 Disconnect the battery negative lead.
- 2 Working in the engine compartment, remove the split-pin, and withdraw the clevis pin securing the end of the accelerator cable to the accelerator lever on the fuel injection pump (see illustrations).

- 3 Unclip the cable adjuster from the bracket on the fuel injection pump (see illustration).
- 4 Where applicable, release the accelerator cable from the bracket on the engine compartment bulkhead, noting the cable routing.
- 5 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. This will allow access to the accelerator pedal assembly.
- 6 Remove the split-pin, and withdraw the clevis pin securing the end of the cable to the accelerator pedal.
- 7 Release the cable grommet from the bulkhead, then withdraw the cable through the bulkhead into the engine compartment.

Refitting

- 8 Refitting is a reversal of removal, bearing in mind the following points:
 - a) Ensure that the cable is routed as noted before removal.
 - b) Use new split-pins to secure the cable end clevis pins.
 - c) On completion, check the cable adjustment, as described in the following paragraphs.

Adjustment

- 9 Hold the pump accelerator lever in the fully-closed position.
- 10 Adjust the cable by turning the knurled adjustment wheel to give the specified freeplay in the inner cable (see Specifications).
- 11 Check that the accelerator lever moves to the full-throttle position when the accelerator pedal is fully depressed.

4 Accelerator pedal - removal and refitting

Removal

- 1 Disconnect the battery negative lead.
- 2 Working inside the vehicle, release the securing clips, and withdraw the driver's side lower fascia panel. This will allow access to the accelerator pedal assembly.
- 3 Where applicable, remove the split-pin, and withdraw the clevis pin securing the end of the cable to the accelerator pedal.
- 4 Using a suitable pair of circlip pliers, remove the circlip from one end of the pedal pivot pin.

- 5 Withdraw the pivot pin from the pedal bracket, and recover the bushes, noting their locations. Withdraw the pedal and return spring, noting the orientation of the spring.

Refitting

- 6 Refitting is a reversal of removal, bearing in mind the following points:
 - a) Ensure that the pedal return spring and the pivot bushes are located as noted during removal.
 - b) On completion, check the accelerator cable adjustment, as described in Section 3, where applicable.

5 Fuel system - priming and bleeding

Note: Refer to the precautions given in Section 1 before proceeding.

- 1 After disconnecting part of the fuel supply system (or after running out of fuel), it is necessary to prime the system and bleed off any air which may have entered the system components.
- 2 All models are fitted with a hand-operated priming lever on the fuel lift pump. Note that if the engine has stopped with the lift pump lever fully raised on its cam, it will not be possible to operate the hand priming lever - in this case, turn the engine (using a suitable spanner or socket on the crankshaft pulley bolt if necessary) until the lever can be operated.
- 3 To prime the system, loosen the bleed screw, located on the fuel filter head (see illustration).



5.3 Fuel filter head bleed screw (arrowed)

4 Operate the priming lever until fuel free from air bubbles emerges from the bleed screw, then retighten the screw. To operate the lever, push the lever down to release it from the catch, then pump the lever up and down.

5 Switch on the 'ignition' (to activate the stop solenoid) and continue operating the priming lever until firm resistance is felt, then pump a few more times.

6 If a large amount of air has entered the fuel injection pump, place a wad of rag around the fuel return union on the fuel injection pump (to absorb spilt fuel), then slacken the union. Operate the priming lever (with the 'ignition' switched on to activate the stop solenoid), or crank the engine on the starter motor in 10-second bursts, until fuel free from air bubbles emerges from the fuel union. Tighten the union, and mop up any split fuel.



Warning: Be prepared to stop the engine if it should fire, to avoid excessive fuel spray and spillage.

7 If air has entered the injector pipes, place wads of rag around the injector pipe unions at the injectors (to absorb spilt fuel), then slacken the unions. Crank the engine on the starter motor until fuel emerges from the unions, then stop cranking the engine and retighten the unions. Mop up spilt fuel.



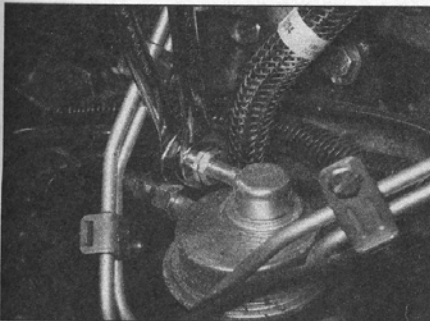
Warning: Be prepared to stop the engine if it should fire, to avoid excessive fuel spray and spillage.

8 Start the engine with the accelerator pedal fully depressed. Additional cranking may be necessary to finally bleed the system before the engine starts.

6 Fuel gauge sender unit - removal and refitting

Note: Refer to the precautions given in Section 1 before proceeding.

Refer to part A of this Chapter, Section 11. Ignore the references to depressurising the fuel system, and to the fuel pump.



8.3 Disconnecting a fuel hose from the fuel lift pump

7 Fuel tank - removal and refitting

Note: Refer to the precautions given in Section 1 before proceeding.

Refer to part A of this Chapter, Section 12. Ignore the references to depressurising the fuel system, and to the fuel pump.

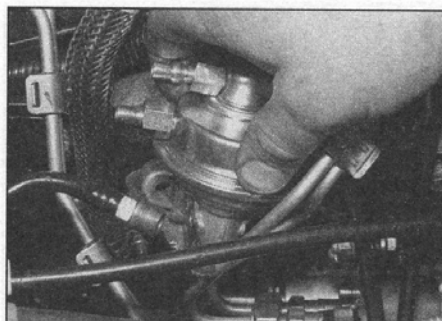
8 Fuel lift pump - removal and refitting

Note: Refer to the precautions given in Section 1 before proceeding.

Removal

Note: A new gasket must be used when refitting the pump.

- 1 Disconnect the battery negative lead.
- 2 Unscrew the union nuts, and disconnect the upper two fuel pipes connecting the fuel injectors to the fuel injection pump, from the fuel injectors. Be prepared for fuel spillage, and plug or cover the open ends of the injectors and the pipes, to prevent dirt ingress. Loosen the pipe unions at the fuel injection pump (counterhold the unions on the pump), and manipulate the pipes to allow sufficient access to remove the fuel lift pump.
- 3 Unscrew the unions (again, counterhold the unions on the pump), and disconnect the fuel supply and feed hoses from the fuel lift pump (see illustration). Again, plug or cover the open ends of the hoses and pump.
- 4 Unscrew the two bolts securing the pump to the cylinder block, then withdraw the pump and the gasket(s) (see illustrations). Discard the gasket(s), noting that some models may be fitted with a plastic insulating block, sandwiched between two gaskets..
- 5 On 200 TDi engines, if desired, the fuel lift pump housing can be unbolted from the cylinder block - note the locations of any brackets secured by the bolts. Recover the gasket.



8.4a Remove the fuel lift pump ...

Refitting

6 Commence refitting by cleaning all traces of old gasket from the mating faces of the pump and the cylinder block (and the insulating block, where applicable).

7 Similarly, where applicable on 200 TDi engines, clean the mating faces of the fuel pump housing, and refit the housing using a new gasket.

8 Refit the pump, and the insulating block where applicable, using new gasket(s). Ensure that the pump operating lever engages correctly with the camshaft as the pump is refitted.

9 Refit the pump securing bolts, and tighten them to the specified torque.

10 Reconnect the fuel hoses to the lift pump, and reconnect the injector pipes to the injectors. Ensure that all unions are securely tightened.

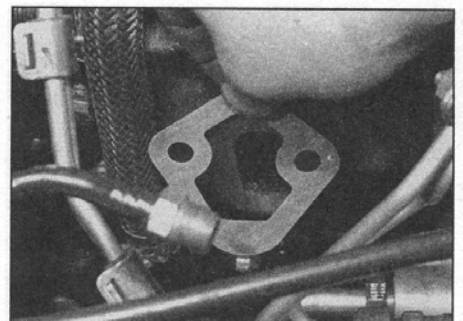
11 Start the engine. If difficulty is experienced, bleed the fuel system as described in Section 5.

9 Maximum speed - checking and adjustment

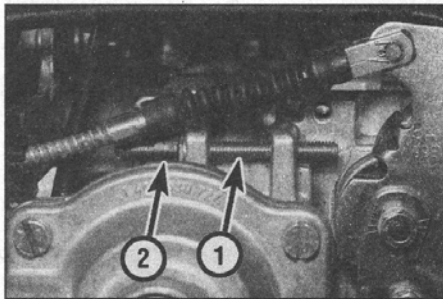
Models with conventional fuel injection system

Caution: The maximum speed adjustment screw is sealed by the manufacturers at the factory, using paint or a locking wire and a lead seal. There is no reason why it should require adjustment. Do not disturb the screw if the vehicle is still within the warranty period, otherwise the warranty will be invalidated. This adjustment requires the use of a tachometer - refer to Section 10 for alternative methods.

- 1 Run the engine to normal operating temperature.
- 2 Have an assistant fully depress the accelerator pedal, and check that the maximum engine speed is as given in the Specifications. Do not keep the engine at maximum speed for more than two or three seconds.



8.4b ... and recover the gasket - 300 TDi engine



9.3 Maximum speed adjustment screw (1) and locknut cover (2) - viewed from rear of pump

3 If adjustment is necessary, stop the engine then loosen the locknut, turn the maximum speed adjustment screw as necessary, and retighten the locknut. Note that the locknut may be sealed using a plastic cover (see illustration).

4 Repeat the procedure in paragraph 2 to check the adjustment.

5 Stop the engine and disconnect the tachometer.

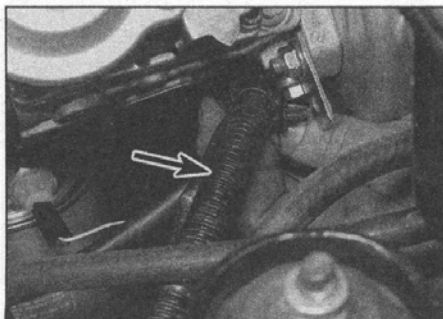
Models with Electronic Diesel Control (EDC) system

6 The maximum speed is controlled by the EDC system, as a built-in safety feature, and no adjustment is possible.

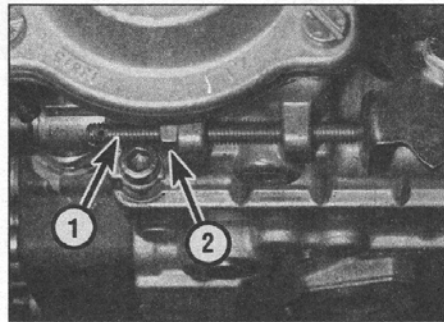
10 Idle speed - checking and adjustment

Note: The fast idle speed is automatically set with the idle speed, and cannot be adjusted independently. Adjustment of the idle speed is permitted in service, but the manufacturers recommend that any other fuel injection pump adjustments are entrusted to authorised Bosch agents. For information purposes, details of maximum engine speed adjustment are given in Section 9.

1 The usual type of tachometer (rev counter), which works from ignition system pulses, cannot be used on diesel engines. If it is not felt that adjusting the idle speed by ear is satisfactory, one of the following alternatives may be used:



11.4a Unclip the wiring harness (arrowed) from the bracket on the pump . . .



10.4 Idle speed adjustment screw (1) and locknut (2)

- a) Purchase or hire of an appropriate tachometer.
- b) Delegation of the job to a Land Rover dealer or other specialist.
- c) Timing light (strobe) operated by a petrol engine running at the desired speed. If the timing light is pointed at a mark on the camshaft or injection pump sprocket, the mark will appear stationary when the two engines are running at the same speed (or multiples of that speed). The sprocket will be rotating at half the crankshaft speed, but this will not affect the adjustment. (In practice, it was found impossible to use this method on the crankshaft pulley, due to the acute viewing angle.)

2 Before making adjustments, warm-up the engine to normal operating temperature. Make sure that the accelerator cable is correctly adjusted, where applicable (see Section 3).

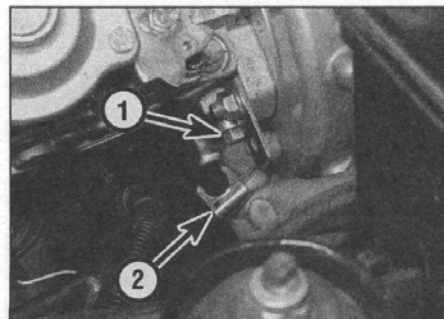
3 With the accelerator lever resting against the idle stop, check that the engine idles at the specified speed. If necessary, adjust as follows.

4 If adjustment is necessary, loosen the idle speed adjustment screw locknut, and turn the screw as necessary to give the desired engine speed (see illustration). Turn the screw clockwise to increase the engine speed, or anti-clockwise to decrease the engine speed.

5 Operate the accelerator lever to increase the engine speed for a few seconds, then re-check the idle speed.

6 When the adjustment is correct, hold the adjustment screw steady, as the locknut is tightened.

7 On completion, stop the engine and, where applicable, disconnect the tachometer.



11.4b . . . then loosen the screw (1) and remove the keeper plate (2) - 300 TDI engine

11 Fuel injection pump - removal and refitting

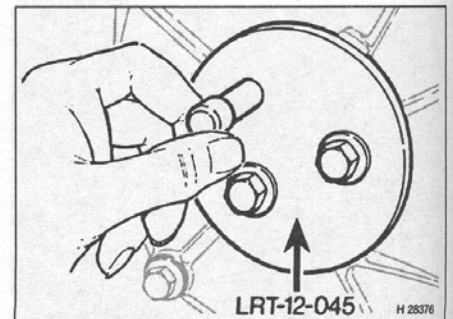
Note 1: Refer to the precautions given in Section 1 before proceeding. On 300 TDI engines, also refer to the note in Chapter 2B, Section 7.

Note 2: To remove the pump without disturbing the timing belt, Land Rover special tool LRT-12-045 will be required to retain the pump sprocket in position. If a suitable tool is not available, remove the timing belt as described in Chapter 2B. A new pump front gasket and a new pump hub cover plate gasket must be used on refitting.

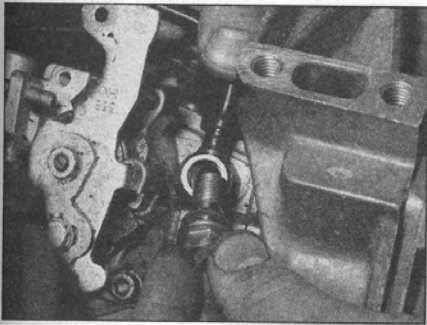
Conventional fuel injection system - using special tool LRT-12-045

Removal

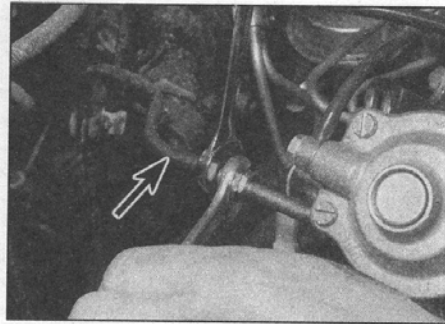
- 1 Disconnect the battery negative lead.
- 2 Turn the crankshaft to bring No 1 piston to TDC on the compression stroke, and fit the tools to lock the crankshaft and injection pump spindle in position, as described in Chapter 2B, Section 3.
- 3 With the engine locked in the TDC position, proceed as follows.
- 4 Loosen the pump locking screw, and remove the keeper plate (located at the front of the pump, behind the timing belt housing). Tighten the locking screw to lock the pump in position (see illustrations).
- 5 Remove the three pump sprocket-to-hub bolts, and withdraw the sprocket retaining plate. If necessary, counterhold the injection pump hub using a socket on the hub nut - do not rely on the pump spindle locking screw to hold the sprocket in position whilst loosening the pump sprocket-to-hub bolts.
- 6 Withdraw the pump timing pin.
- 7 Fit the sprocket retaining tool (LRT-12-045), with an 8.0 mm washer, 1.5 to 2.0 mm thick, under each bolt head, in addition to the washers supplied with the tool. Tighten the two retaining tool bolts, then re-insert the timing pin through the hole provided in the retaining tool plate (see illustration).
- 8 Disconnect the wiring from the stop solenoid.



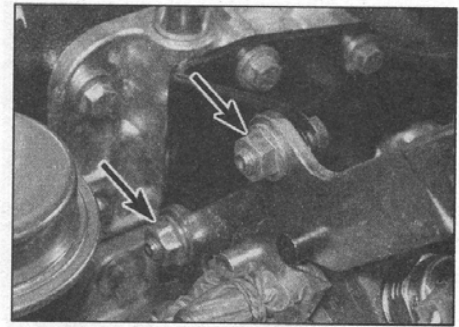
11.7 Special tool LRT-12-045 fitted to retain fuel injection pump sprocket



11.10a Disconnecting the fuel supply pipe from the pump



11.10b Counterhold the union on the pump when unscrewing the fuel return pipe union nut



11.13 Unscrew the two nuts and bolts (arrowed) securing the pump to the rear support bracket

9 Disconnect the accelerator cable from the pump, with reference to Section 3. On models with automatic transmission, also disconnect the kickdown cable from the pump.

10 Unscrew the banjo bolt and the union nut, and disconnect the fuel supply and return pipes from the pump (see illustrations). Be prepared for fuel spillage. Recover the sealing washers from the banjo union. Cover the open ends of the pipes, and plug the openings in the injection pump to keep dirt out (the banjo bolt can be refitted to the pump and covered).

11 Similarly, disconnect the boost pressure pipe from the pump.

12 Unscrew the union nuts, and disconnect the injector pipes from the rear of the pump, and from the injectors. Remove the pipes. Plug or cover the open ends of the pump, pipes, and injectors, to prevent dirt ingress.

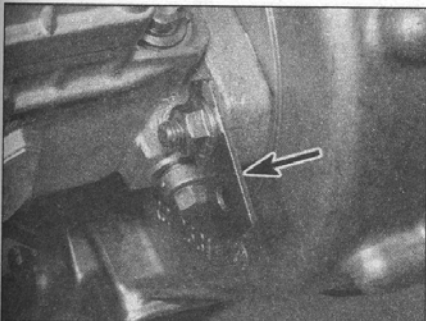
13 Working at the rear of the pump, counterhold the bolts, and unscrew the two nuts securing the pump to the rear support bracket (see illustration).

14 Unscrew the three nuts securing the pump to the studs at the rear of the timing belt housing, then withdraw the pump and recover the gasket. Where applicable, note the location of any brackets on the studs (see illustrations).

Refitting

15 Commence refitting by thoroughly cleaning the mating faces of the pump flange and the timing belt housing.

16 Place the new gasket in position over the pump mounting studs.



11.14a Note the location of any brackets (arrowed) on the timing belt housing studs

17 If a new pump is being fitted, proceed as follows:

a) Fit the timing pin to the pump. If necessary, rotate the pump spindle to allow the pin to locate fully.

b) Slacken the pump locking screw, remove the keeper plate, then tighten the screw to lock the pump.

c) Remove the timing pin from the pump.

18 Place the pump in position on the mounting studs, ensuring that the gasket is correctly located, and tighten the mounting nuts to the specified torque.

19 Refit the pump rear mounting bracket to the cylinder block, but do not fully tighten the bolts at this stage.

20 Refit the nuts and bolts securing the pump to the rear mounting bracket, but again do not fully tighten at this stage.

21 Tighten the rear mounting bracket-to-cylinder block bolts, followed by the pump-to-mounting bracket bolts.

22 Refit and reconnect the injector pipes, and tighten the union nuts.

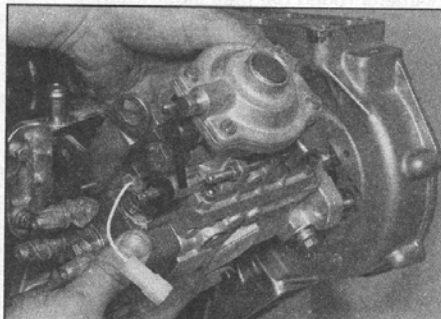
23 Reconnect the boost pressure pipe to the pump.

24 Reconnect the fuel supply and return pipes to the pump.

25 Reconnect the accelerator cable to the pump, and adjust the cable as described in Section 3. On models with automatic transmission, also reconnect and adjust the kickdown cable, with reference to Chapter 7B.

26 Reconnect the stop solenoid wiring.

27 Unscrew the securing bolts, and remove the injection pump sprocket retaining tool.



11.14b Withdrawing the fuel injection pump

28 Refit the sprocket retaining plate, then refit the pump timing pin through the pump hub into the pump body.

29 Refit and tighten the pump sprocket-to-hub bolts.

30 Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.

31 Remove the timing pin from the pump, and withdraw the flywheel locking tool centre pin from the slot in the flywheel.

32 Turn the crankshaft through two complete revolutions, then re-engage the flywheel locking tool centre pin with the slot in the flywheel, and check that the pump timing pin can still be inserted easily.

33 If the pump timing pin cannot be easily inserted into position, proceed as follows.

34 Withdraw the flywheel locking tool centre pin from the slot in the flywheel, then turn the crankshaft as necessary, until the timing pin can be inserted easily into the injection pump.

35 Loosen the pump locking screw, and remove the keeper plate, then tighten the locking screw to lock the pump in position.

36 Loosen the three pump sprocket-to-hub bolts.

37 Turn the crankshaft back to TDC, and engage the flywheel locking tool centre pin with the timing slot in the flywheel.

38 Re-check to ensure that the pump timing pin is an easy sliding fit in the pump.

39 Tighten the pump sprocket-to-hub bolts to the specified torque.

40 Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.

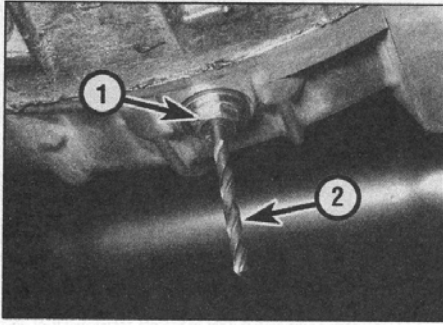
41 Remove the timing pin from the pump, and withdraw the flywheel locking tool centre pin from the slot in the flywheel.

42 Refit the blanking plug, or the cover plate bolt, as applicable, to the flywheel locking tool aperture (on models with a blanking plug, coat the threads of the plug with thread-locking compound before refitting).

43 Refit the injection pump hub cover plate, using a new gasket.

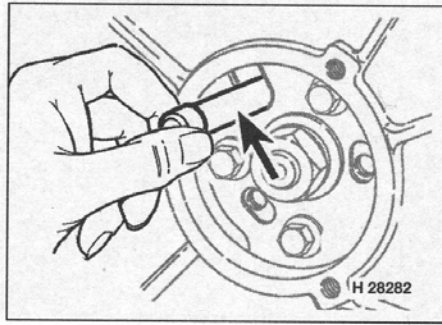
44 Where applicable, refit the air conditioning compressor, and refit the drivebelt as described in Chapter 1B.

45 Reconnect the battery negative lead.

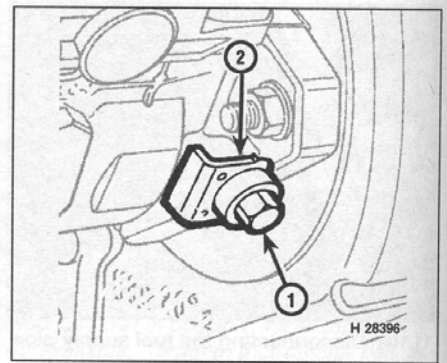


12.6a Improvised flywheel locking tool in position on manual gearbox model

1 Blanking plug 2 3/16 in twist drill



12.6b Injection pump timing pin (arrowed) can be improvised using a length of 9.5 mm diameter bar



13.5 Pump locking screw (1) and keeper plate (2)

Conventional fuel injection system - without special tool LRT-12-045

Removal

- 46** Remove the timing belt as described in Chapter 2B.
- 47** Loosen the pump locking screw, and remove the keeper plate (located at the front of the pump, behind the timing belt housing). Tighten the locking screw to lock the pump spindle in position.
- 48** Withdraw the pump timing pin from the pump sprocket.
- 49** Remove the pump sprocket-to-hub securing bolts, then withdraw the sprocket retaining plate and the sprocket.
- 50** Proceed as described in paragraphs 8 to 14 inclusive.

Refitting

- 51** Proceed as described in paragraphs 15 to 26 inclusive.
- 52** Refit the pump sprocket and retaining plate (noting that the U-shaped slot in the retaining plate should align with the slot in the pump hub), then refit the sprocket-to-hub bolts. Do not fully tighten the bolts at this stage.
- 53** Refit the pump timing pin through the sprocket into the pump body.
- 54** Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.
- 55** Refit the timing belt as described in Chapter 2B.

Electronic Diesel Control (EDC) system

56 The removal and refitting procedure is as described previously for models with a conventional fuel injection system, bearing in mind the following points:

- a) Ignore all references to the accelerator cable.
- b) Disconnect all relevant wiring from the pump, noting the routing of the harnesses.

12 Injection timing - checking methods and adjustment

Checking the injection timing is not a routine operation. It is only necessary after the injection pump has been disturbed.

Dynamic timing equipment does exist, but it is unlikely to be available to the home mechanic, and there should be no need to carry out dynamic timing on the engines fitted to the Discovery. The equipment works by converting pressure pulses in an injector pipe into electrical signals. If such equipment is available, use it in accordance with its maker's instructions.

Static timing can be carried out very accurately, provided that the appropriate flywheel and injection pump spindle locking tools are available.

The Land Rover special tool available to lock the flywheel is LRT-12-044 for models with a conventional fuel injection system, or LRT-12-085 for models with EDC.

Special flywheel locking tool LRT-12-044 can be improvised by obtaining a spare flywheel housing blanking plug, and accurately drilling a hole through its centre to accept a 3/16 in twist drill.

To lock the fuel injection pump sprocket, special tool LRT-12-045 will be required - this tool can be improvised using a short length (approximately 50.0 mm) of 3/8 in (9.5 mm) diameter round bar (see illustrations).

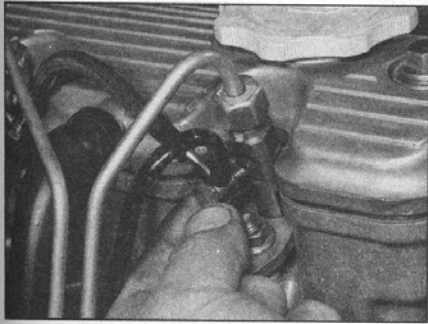
13 Injection timing - checking and adjustment

Caution: The maximum engine speed and transfer pressure settings, together with timing access plugs, are sealed by the manufacturers at the factory, using locking wire and lead seals. Do not disturb the wire if the vehicle is still within the warranty period, otherwise the warranty will be invalidated. Also do not attempt the timing procedure unless accurate locking tools

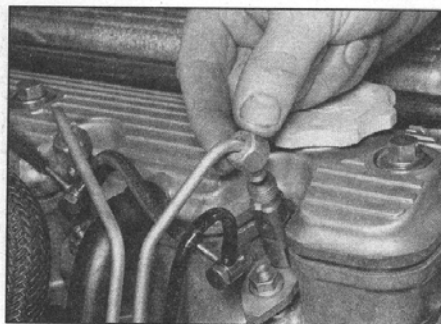
(see Section 12) are available. Refer to the precautions given in Section 1 of this Chapter before proceeding.

Note: A new injection pump hub cover plate gasket must be used on refitting.

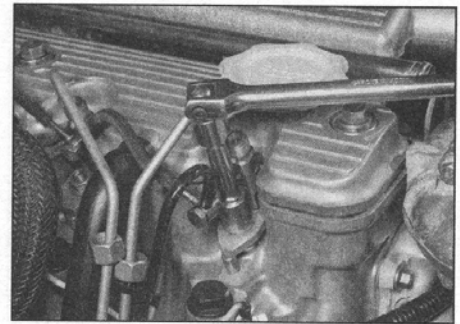
- 1** Disconnect the battery negative lead.
- 2** Turn the crankshaft to bring No 1 piston to TDC on the compression stroke, and fit the tools to lock the flywheel and the injection pump sprocket in position, as described in Chapter 2B, Section 3. If the flywheel and injection pump sprocket can be locked using the tools as described, the injection pump timing is correct.
- 3** If the flywheel locking tool centre pin cannot be engaged easily with the timing slot in the flywheel, proceed as follows.
- 4** Withdraw the flywheel locking tool centre pin from the slot in the flywheel, then turn the crankshaft as necessary, until the timing pin can be inserted easily into the injection pump.
- 5** Loosen the pump locking screw, and remove the keeper plate (located at the front of the pump, behind the timing belt housing). Tighten the locking screw to lock the pump in position (see illustration).
- 6** Loosen the three pump sprocket-to-hub bolts.
- 7** Turn the crankshaft back the small amount to TDC, and engage the flywheel locking tool centre pin with the timing slot in the flywheel.
- 8** Re-check to ensure that the pump timing pin is an easy sliding fit in the pump.
- 9** Tighten the pump sprocket-to-hub bolts to the specified torque.
- 10** Loosen the pump locking screw, then refit the keeper plate, and tighten the locking screw.
- 11** Remove the timing pin from the pump, and withdraw the flywheel locking tool centre pin from the slot in the flywheel.
- 12** Turn the crankshaft through two complete revolutions, and check that the flywheel locking tool and the pump timing pin can still be inserted easily, both at the same time.
- 13** Withdraw the timing pin and the flywheel locking tool.
- 14** Refit the blanking plug (or the cover plate bolt, as applicable) to the flywheel locking tool aperture (on models with a blanking plug, coat



14.5 Disconnecting the leak-off pipes . . .



14.6 . . . and the injector pipe from a fuel injector



14.9 Unscrew the securing nut . . .

the threads of the plug with thread-locking compound before refitting).

15 Refit the injection pump hub cover plate, using a new gasket.

16 Where applicable, refit the air conditioning compressor, and refit the drivebelt as described in Chapter 1B.

14 Fuel injectors - testing, removal and refitting



Warning: Exercise extreme caution when working on the fuel injectors. Never expose the hands or any part of the body to injector spray, as the high working pressure can cause the fuel to penetrate the skin, with possibly fatal results. You are strongly advised to have any work which involves testing the injectors under pressure carried out by a Land Rover dealer or fuel injection specialist. Refer to the precautions given in Section 1 of this Chapter before proceeding.

Testing

1 Injectors do deteriorate with prolonged use, and it is reasonable to expect them to need reconditioning or renewal after 60 000 miles (100 000 km) or so. Accurate testing, overhaul and calibration of the injectors must be left to a specialist. A defective injector which is causing knocking or smoking can be located without dismantling as follows.

2 Run the engine at a fast idle. Slacken each

injector union in turn, placing rag around the union to catch spilt fuel, and being careful not to expose the skin to any spray. When the union on the defective injector is slackened, the knocking or smoking will stop.

Removal

Note: Take great care not to allow dirt into the injectors or fuel pipes during this procedure. New sealing washers must be used when refitting the injectors.

3 Where applicable, remove the engine oil filler cap, and unclip the plastic cover from the top of the valve cover.

4 Carefully clean around the relevant injector and injector pipe union nuts.

5 Unscrew the banjo bolt, and disconnect the leak-off pipe(s) from the injector (see illustration).

6 Unscrew the union nut securing the injector pipe to the fuel injector (see illustration). Cover the open ends of the injector and the pipe, using small plastic bags or fingers cut from discarded (but clean!) rubber gloves.

7 Counterhold the union on the pump, and slacken the union nut securing the relevant injector pipe to the injection pump. There is no need to disconnect the pipe from the pump.

8 If working on No 4 fuel injector on engines fitted with EDC (see Section 20), separate the two halves of the fuel injector wiring connector (the injector incorporates the EDC injection timing sensor).

9 Unscrew the nut securing the injector clamp plate to the cylinder head (see illustration).

10 Withdraw the clamp plate and the injector from the cylinder head (see illustrations).

11 Recover the copper washer from the cylinder head.

12 Take care not to drop the injectors, nor allow the needles at their tips to become damaged. The injectors are precision-made to fine limits, and must not be handled roughly. In particular, do not mount them in a bench vice.

Refitting

13 Fit a new copper washer to the cylinder head, with the concave side towards the injector (see Tool Tip).

14 Place the injector in position, with the hole for the leak-off pipe union facing away from the cylinder head, then refit the clamp plate, locating it over the cylinder head stud.

15 Refit the clamp nut, and tighten to the specified torque.

16 Reconnect the injector pipe to the fuel injector, and tighten the union.

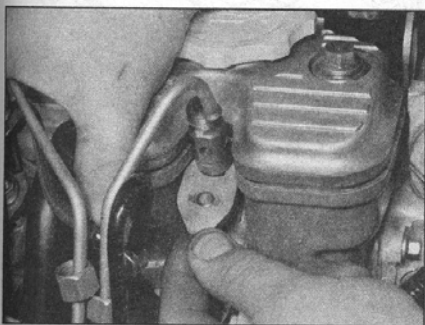
17 Tighten the injector pipe union at the injection pump.

18 Reconnect the leak-off pipe to the injector, and tighten the banjo bolt.

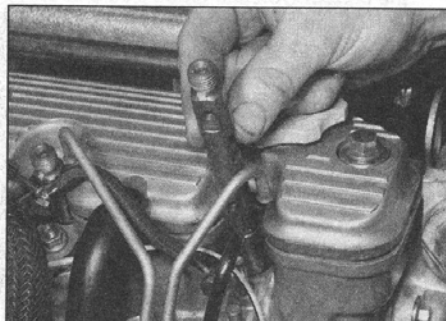
19 Where applicable, reconnect the two halves of the fuel injector wiring connector.

20 Start the engine. If difficulty is experienced, bleed the fuel system as described in Section 5.

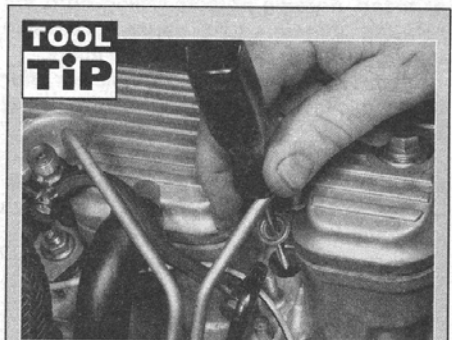
21 On completion, where applicable, refit the plastic cover and the oil filler cap to the valve cover.



14.10a . . . then withdraw the clamp plate . . .



14.10b . . . and the injector



TOOL TIP
The washer can be guided into position by sliding it down the shaft of a screwdriver positioned over the injector hole in the cylinder head

15 Turbocharger - description and precautions

Description

A turbocharger is fitted to all engines. It increases engine efficiency by raising the pressure in the inlet manifold above atmospheric pressure. Instead of the air simply being sucked into the cylinders, it is forced in. Additional fuel is supplied by the injection pump, in proportion to the increased amount of air.

Energy for the operation of the turbocharger comes from the exhaust gas. The gas flows through a specially-shaped housing (the turbine housing) and in so doing, spins the turbine wheel. The turbine wheel is attached to a shaft, at the end of which is another vaned wheel, known as the compressor wheel. The compressor wheel spins in its own housing, and compresses the inducted air on the way to the inlet manifold.

Between the turbocharger and the inlet manifold, the compressed air passes through an intercooler. This is an air-to-air heat exchanger, mounted at the front of the vehicle, next to the radiator, and supplied with air through the front grille. The purpose of the intercooler is to remove from the inducted air some of the heat gained in being compressed. Because cooler air is denser, removal of this heat further increases engine efficiency.

Boost pressure (the pressure in the inlet manifold) is limited by a wastegate, which diverts the exhaust gas away from the turbine wheel in response to a pressure-sensitive actuator.

The turbo shaft is pressure-lubricated by an oil feed pipe from the main oil gallery. The shaft 'floats' on a cushion of oil. A drain pipe returns the oil to the sump.

Precautions

The turbocharger operates at extremely high speeds and temperatures. Certain precautions must be observed to avoid premature failure of the turbo, or injury to the operator.

Do not operate the turbo with any parts exposed. Foreign objects falling onto the rotating vanes could cause excessive damage and (if ejected) personal injury.

Do not race the engine immediately after start-up, especially if it is cold. Give the oil a few seconds to circulate.

Always allow the engine to return to idle speed before switching it off - do not blip the throttle and switch off, as this will leave the turbo spinning without lubrication.

Allow the engine to idle for several minutes before switching off after a high-speed run.

Observe the recommended intervals for oil and filter changing, and use a reputable oil of the specified quality. Neglect of oil changing, or use of inferior oil, can cause carbon formation on the turbo shaft and subsequent failure.

16 Turbocharger - removal and refitting

200 TDi engine

Removal

Note: A new gasket will be required when refitting the turbocharger.

- 1 Disconnect the battery negative lead.
- 2 To improve access, remove the air cleaner assembly with reference to Section 2.
- 3 Disconnect the exhaust front section from the turbocharger, with reference to part D of this Chapter.
- 4 Loosen the securing clips, and disconnect the air trunking from the turbocharger. If desired, to improve access, remove the air trunking.
- 5 Place a suitable container beneath the engine to catch escaping oil, then unscrew the union nuts, and disconnect the turbocharger oil feed and return hoses from the cylinder block. Plug the open ends of the hoses and the cylinder block, to prevent dirt ingress.
- 6 Disconnect the turbocharger boost pressure pipe from the turbocharger.
- 7 Unscrew the four securing nuts, and withdraw the turbocharger from the exhaust manifold. Recover the gasket.

Refitting

8 Refitting is a reversal of removal, bearing in mind the following points:

- a) Refit the turbocharger to the manifold using a new gasket, and tighten the securing nuts to the specified torque.
- b) Ensure that the oil pipes are securely reconnected.
- c) Reconnect the exhaust front section to the turbocharger with reference to part D of this Chapter.

9 Before starting the engine, the turbocharger must be primed with oil as follows. Failure to carry out this procedure may result in serious (and expensive) damage to the turbocharger:

- a) Unscrew the oil feed pipe banjo bolt from the top of the turbocharger housing. Recover the two sealing washers, and move the feed pipe away from the oil hole in the housing.
- b) Fill the housing with clean engine oil of the correct type and grade (see end of Weekly checks), from a freshly-opened sealed container.
- c) Reconnect the oil feed pipe, and refit the banjo bolt, ensuring that one sealing washer is positioned on each side of the pipe. Tighten the banjo bolt to the specified torque.

300 TDi engine

10 On 300 TDi engines, the turbocharger is integral with the exhaust manifold. Although the turbocharger and manifold can be separated once the manifold assembly has been removed, at the time of writing, it was unclear whether the turbocharger can be

renewed independently of the manifold - check with a Land Rover dealer for details.

11 Removal and refitting of the turbocharger is described as part of the exhaust manifold removal and refitting procedure in part D of this Chapter.

17 Turbocharger - examination and overhaul

1 With the turbocharger removed, inspect the housing for cracks or other visible damage.

2 Spin the turbine or the compressor wheel to verify that the shaft is intact, and to feel for excessive shake or roughness. Some play is normal, since in use the shaft is 'floating' on a film of oil. Check that the wheel vanes are undamaged.

3 The wastegate actuator is a separate unit, and can be renewed independently of the turbocharger. Testing of the wastegate actuator (boost pressure check) is described in Chapter 1B.

4 If the exhaust or inlet passages are oil-contaminated, the turbo shaft oil seals have probably failed. (On the inlet side, this will also have contaminated the intercooler, which if necessary should be flushed with a suitable solvent.)

5 Check the oil feed and return pipes for contamination or blockage, and clean if necessary.

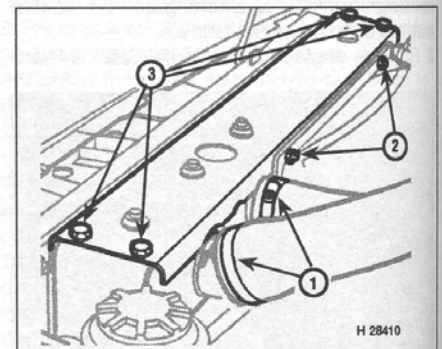
6 No DIY repair of the turbocharger is possible. A new unit may be available on an exchange basis.

18 Intercooler - removal and refitting

200 TDi engine

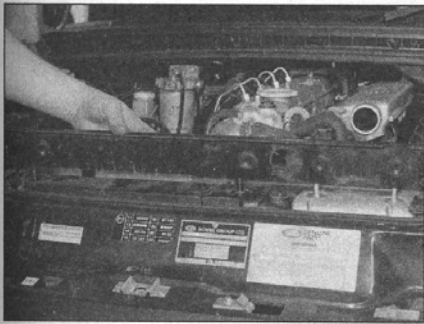
Removal

- 1 Disconnect the battery negative lead.
- 2 Loosen the clips securing the two hoses to the intercooler, and carefully pull the hoses from the intercooler stubs (see illustration).

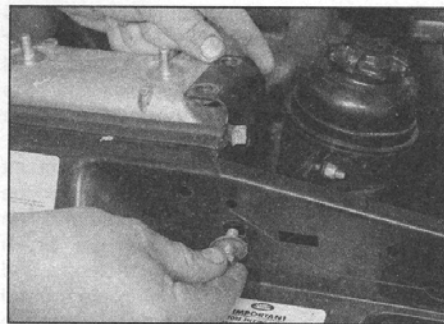


18.2 Intercooler mounting details

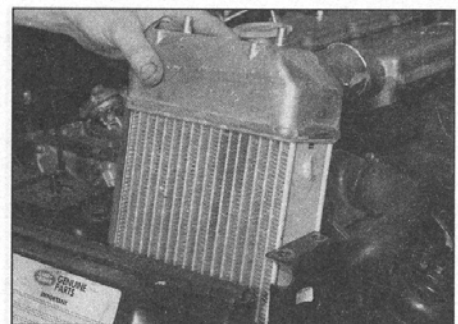
- 1 Intercooler hose clips
- 2 Cooling fan cowl-to-radiator nuts
- 3 Radiator top cover bolts



18.11 Withdrawing the radiator top cover



18.12 Remove the nut and bolt securing the power steering pump bracket



18.17 Lift the intercooler upwards and remove it from the vehicle

3 Unscrew the two nuts and washers securing the upper cooling fan cowl to the radiator.

4 Ease the fan cowl upwards to disengage the lower section from the securing clips, then move the cowl towards the rear of the vehicle, over the fan blades.

5 Remove the four bolts (two at each side) securing the radiator top cover, and withdraw the cover.

6 Lift the intercooler upwards from the support frame.

Refitting

7 Before refitting, check the condition of the intercooler locating lug grommets in the lower body panel and the radiator top cover, and renew if necessary. Also check the condition of the foam insulating pad, and ensure that it is securely attached to the intercooler.

8 Refitting is a reversal of removal, ensuring that the hose sleeves are securely reconnected.

300 TDi engine

Removal

9 Disconnect the battery negative lead.

10 Release the two clips securing the cooling fan cowl to the radiator top cover.

11 Remove the four bolts (two at each side) securing the radiator top cover, and withdraw the cover (see illustration).

12 Unscrew the nut and bolt securing the power steering pump bracket to the body

front panel (see illustration). Recover the washer.

13 Release the power steering pump bracket from the locating lug, then position the bracket and power steering fluid reservoir assembly to one side.

14 Pull the side bracket away from the intercooler.

15 Loosen the two securing clips, and disconnect the sleeve connecting the top hose to the intercooler.

16 Similarly, disconnect the sleeve connecting the bottom hose to the intercooler.

17 Lift the intercooler upwards clear of the cooling fan shroud (see illustration).

Refitting

18 Proceed as described in paragraphs 7 and 8.

19 Inlet manifold - removal and refitting

Removal

Note: A new manifold gasket, and a new dipstick tube O-ring, may be required on refitting.

1 Disconnect the battery negative lead.

2 Where applicable, remove the engine oil filler cap, and unclip the plastic cover from the top of the valve cover.

3 On 200 TDi engines, remove the two securing bolts, and release the dipstick tube bracket from the inlet manifold. Pull the dipstick tube from the cylinder block.

4 Where applicable, remove the securing screws, and withdraw the heat shield from the rear of the manifold.

5 On 300 TDi engines, unbolt the dipstick tube from the cylinder block, and withdraw the assembly (see illustration).

6 Loosen the securing clip, and disconnect the air inlet hose from the manifold.

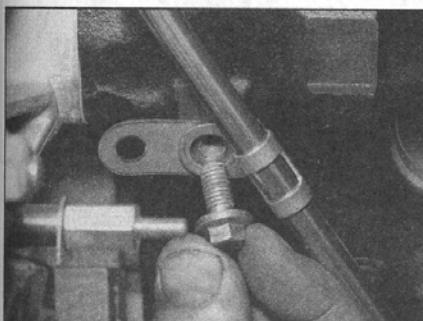
7 Where applicable, unbolt the EGR pipe which connects the inlet manifold to the EGR valve, and recover the gaskets.

8 Remove the two upper bolts, and the two lower nuts securing the manifold to the cylinder head, then withdraw the manifold (see illustrations).

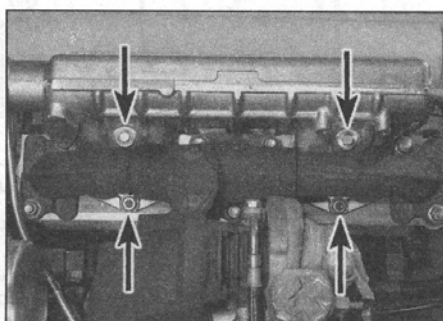
Refitting

9 Refitting is a reversal of removal, bearing in mind the following points:

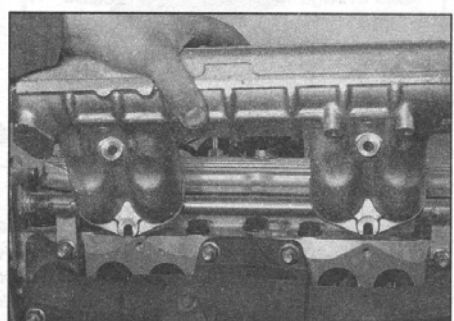
- a) Check the condition of the manifold gasket, and renew if necessary (in which case, the exhaust manifold will have to be removed) - if the original gasket has deteriorated, clean all traces of old gasket from the mating faces of the cylinder head and manifold before fitting a new gasket.
- b) Tighten the manifold securing nuts and bolts to the specified torque.
- c) Check the condition of the lower dipstick



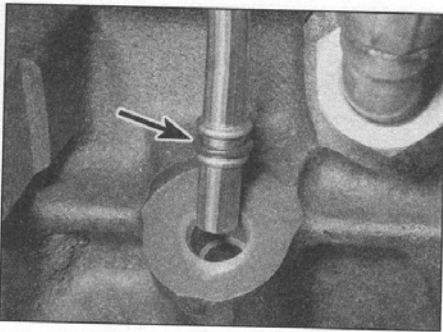
19.5 Unbolt the dipstick tube from the cylinder block - 300 TDi engine



19.8a Remove the bolts and nuts (arrowed) . . .



19.8b . . . and withdraw the inlet manifold - 300 TDi engine



19.9 Use a new O-ring (arrowed) when refitting the dipstick tube - 300 TDI engine

tube O-ring, and renew if necessary (see illustration).

d) Where applicable, use new gaskets when refitting the EGR pipe.

20 Electronic Diesel Control (EDC) system - general description and precautions

General description

The Electronic Diesel Control (EDC) 'drive-by-wire' system replaces certain mechanical systems used to control a conventional diesel fuel injection system with electronic controls (see illustration).

The most notable feature of the EDC system is that a 'drive-by-wire' accelerator control system is used, with no mechanical link (accelerator cable) between the accelerator pedal and the fuel injection pump.

The EDC system supplies the exact amount of fuel required by the engine, according to the prevailing engine operating conditions. The engine is fitted with various sensors, which monitor the engine operating conditions, and transmit data to the EDC electronic control unit. The electronic control unit processes the data from the various sensors, and determines the optimum amount of fuel required, and the injection timing for the prevailing running conditions. Additionally, the electronic control unit activates the fuel injection pump stop solenoid, and on models fitted with EGR (see part D of this Chapter) the electronic control unit also determines the degree of exhaust gas recirculation.

The system uses the following sensors:

- a) Injection timing sensor - an inductive sensor incorporated in No 4 fuel injector.
- b) Airflow sensor - positioned in the air inlet trunking between the air cleaner and the turbocharger.
- c) Engine speed sensor - an inductive sensor mounted on the flywheel housing, activated by slots in the flywheel.
- d) Vehicle speed sensor - located in the

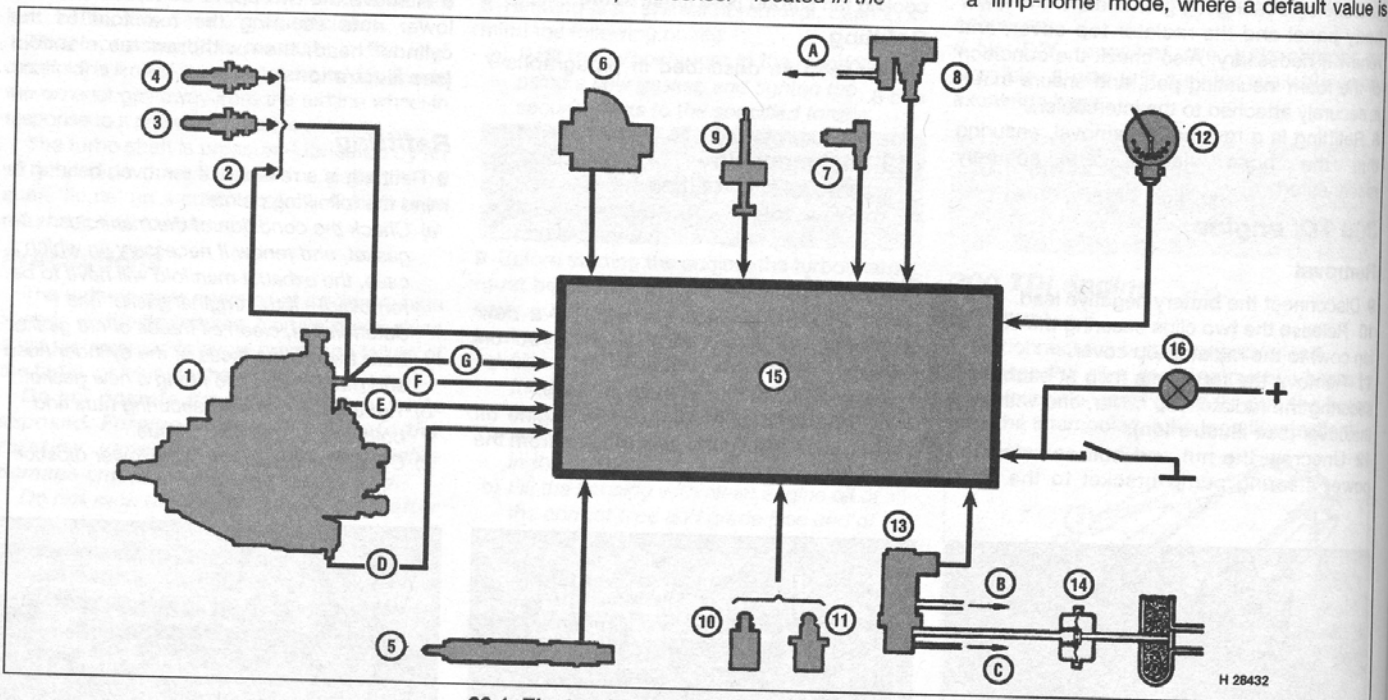
transfer gearbox, and also acts as a speedometer sender unit.

- e) Brake and clutch switches - located in the pedal box.
- f) Throttle position sensor - located in the pedal box.
- g) Turbocharger boost pressure sensor - located on the engine compartment bulkhead.
- h) Coolant temperature sensor - located in the cylinder head.
- i) Air temperature sensor.
- j) Fuel temperature sensor - located in the fuel injection pump.

To control the fuelling of the engine, the system uses the following actuators:

- a) Fuel delivery actuator - incorporated in the fuel injection pump.
- b) Injection timing solenoid - incorporated in the fuel injection pump.
- c) EGR control solenoid - mounted at the front left-hand corner of the engine compartment.
- d) Engine stop solenoid, or on models from 1997 onwards, the digital diesel shut-off valve (DDS) - located in the fuel injection pump.

Safety features are built into the system to protect the engine against overspeed and overheating damage. If a component in the system fails, the electronic control unit activates a 'limp-home' mode, where a default value is



20.1 Electronic Diesel Control system layout

- | | | | |
|--|--------------------------------------|----------------------------|--------------------------------------|
| 1 Fuel injection pump | 7 Engine speed sensor | 13 EGR control solenoid | C To brake servo vacuum hose T-piece |
| 2 Fuel temperature sensor | 8 Turbocharger boost pressure sensor | 14 EGR valve | D Injection timing solenoid |
| 3 Air temperature sensor | 9 Vehicle speed sensor | 15 Electronic control unit | E Engine stop solenoid |
| 4 Coolant temperature sensor | 10 Clutch switch | 16 Diagnostic indicator | F Actuator current |
| 5 Injection timing sensor (No 4 fuel injector) | 11 Brake switch | | G Fuel delivery actuator |
| 6 Airflow sensor | 12 Throttle position sensor | A To turbocharger | |
| | | B To air cleaner | |

substituted for the failed component - this will allow the engine to start and run, but a noticeable loss in engine performance may occur.

Precautions

Electronic control units are very sensitive components, and certain precautions must be taken, to avoid damage to the EDC control unit when working on the vehicle.

When carrying out welding operations on the vehicle using electric welding equipment, the battery and alternator should be disconnected.

Although the underbonnet-mounted modules will tolerate normal underbonnet conditions, they can be adversely affected by excess heat or moisture. If using welding equipment or pressure-washing equipment in the vicinity of an electronic module, take care not to direct heat, or jets of water or steam, at the module. If this cannot be avoided, remove the module from the vehicle, and protect its wiring plug with a plastic bag.

Before disconnecting any wiring, or removing components, always ensure that the 'ignition' is switched off.

Do not attempt to improvise fault diagnosis procedures using a test light or multi-meter, as irreparable damage could be caused to the module.

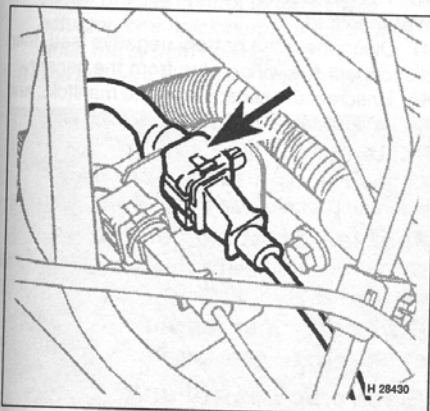
After working on any of the EDC system components, ensure that all wiring is correctly reconnected before reconnecting the battery or operating the 'ignition' switch.

21 Electronic Diesel Control (EDC) system components - removal and refitting

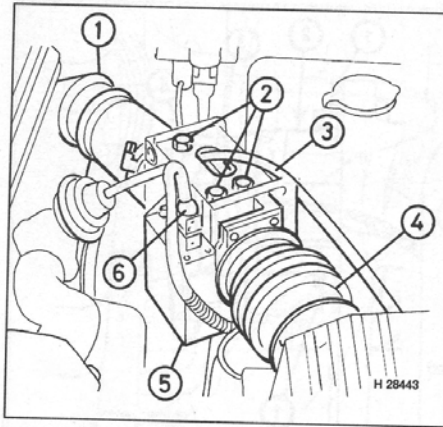


Injection timing sensor

- 1 The sensor is incorporated in No 4 fuel injector.
- 2 The removal and refitting procedure for the fuel injectors is given in Section 14.



21.13 Engine speed sensor wiring connector location (arrowed) - EDC system



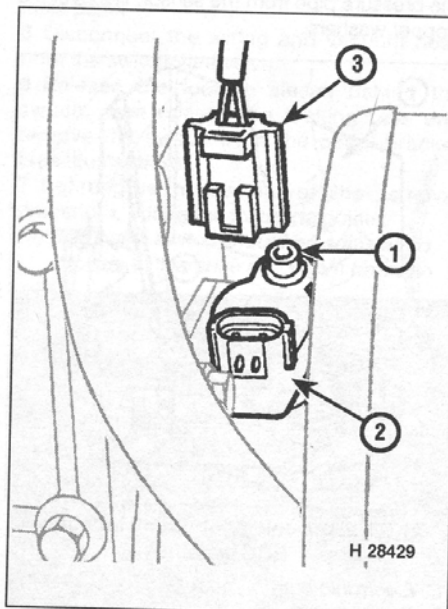
21.3 Airflow sensor location - EDC system

- 1 Air outlet hose
- 2 Airflow sensor mounting bolts
- 3 EGR valve vacuum pipe
- 4 Air inlet hose
- 5 Airflow sensor
- 6 Wiring plug

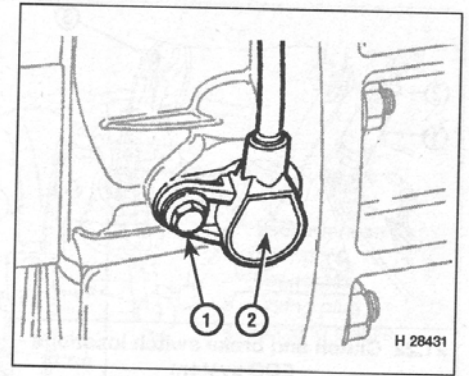
Airflow sensor

Removal

- 3 The sensor is located in the air trunking between the air cleaner and the turbocharger (see illustration).
- 4 Disconnect the battery negative lead.
- 5 Where applicable, disconnect the vacuum pipe from the EGR valve.
- 6 Disconnect the airflow sensor wiring plug.
- 7 Loosen the securing clips, and disconnect the air trunking from the airflow sensor.
- 8 Unscrew the three bolts securing the airflow sensor to the mounting bracket, and withdraw the airflow sensor.



21.16 Vehicle speed sensor location
1 Securing bolt 2 Sensor 3 Wiring plug



21.10 Engine speed sensor location - EDC system

- 1 Securing bolt
- 2 Sensor

Refitting

9 Refitting is a reversal of removal, but ensure that the wiring plug is securely reconnected, and make sure that the air trunking clips are securely tightened, to prevent air leaks.

Engine speed sensor

Removal

- 10 The sensor is located in the gearbox bellhousing, and access is obtained from under the vehicle (see illustration).
- 11 Disconnect the battery negative lead.
- 12 Jack up the vehicle, and support securely on axle stands positioned under the front and rear axles (see *Jacking and vehicle support*).
- 13 Unclip the sensor wiring connector from the top of the transfer gearbox, then separate the two halves of the connector (see illustration).
- 14 Unscrew the securing bolt, and withdraw the sensor from the bellhousing.

Refitting

- 15 Refitting is a reversal of removal.

Vehicle speed sensor

Removal

- 16 The sensor is located in the transfer gearbox casing (see illustration).
- 17 Disconnect the battery negative lead.
- 18 Disconnect the sensor wiring plug.
- 19 Unscrew the sensor securing bolt, and recover the washer.
- 20 Withdraw the sensor from the transfer gearbox.

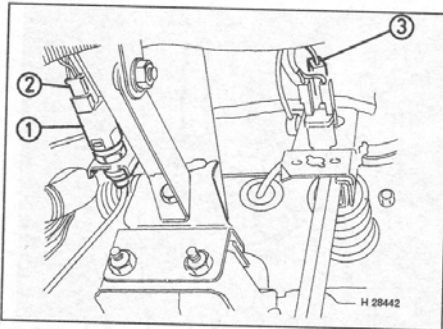
Refitting

- 21 Refitting is a reversal of removal.

Brake and clutch pedal switches

Removal

- 22 The brake pedal switch is mounted in the pedal box, above the stop-light switch, and



21.22 Clutch and brake switch locations - EDC system

- 1 Clutch pedal switch
- 2 Clutch pedal switch wiring plug
- 3 Brake pedal switch wiring plug

the clutch pedal switch is mounted at the top of the clutch pedal (see illustration).

- 23 Disconnect the battery negative lead.
- 24 Release the securing clips, and withdraw the driver's side lower facia panel for access to the pedals.
- 25 Disconnect the wiring from the switch.
- 26 Loosen the locknut at the rear of the switch, then unscrew the front securing nut, and withdraw the switch from the bracket.

Refitting

- 27 Refitting is a reversal of removal.

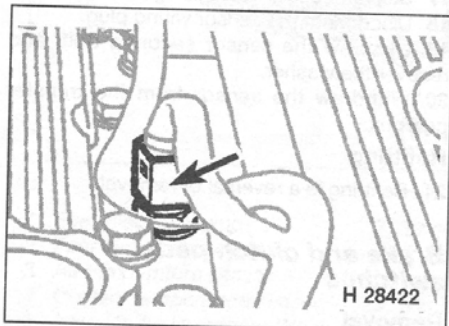
Throttle position sensor

Removal

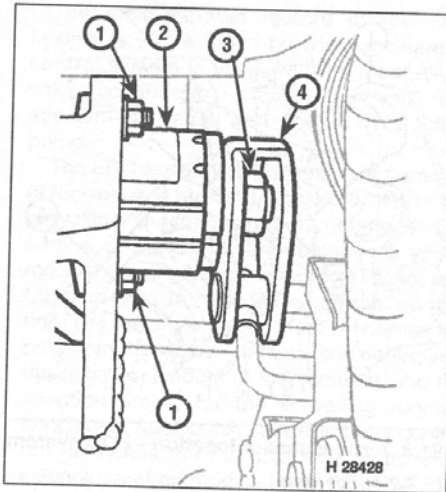


Warning: Do not operate the accelerator pedal if the sensor is loosely fitted, as damage to the sensor may result.

- 28 The sensor is located in the pedal box (see illustration).
- 29 Disconnect the battery negative lead.
- 30 Release the securing clips, and withdraw the driver's side lower facia panel for access to the pedals.
- 31 Working in the driver's footwell, disconnect the wiring plug from the sensor.
- 32 Unscrew the nut securing the accelerator pedal quadrant to the sensor, and disconnect the quadrant.
- 33 Unscrew the two nuts securing the sensor to the pedal box, and withdraw the sensor.



21.41 Coolant temperature sensor location (arrowed) - EDC system



21.28 Throttle position sensor location - EDC system

- 1 Sensor securing nuts
- 2 Sensor
- 3 Pedal quadrant-to-sensor nut
- 4 Pedal quadrant

Refitting

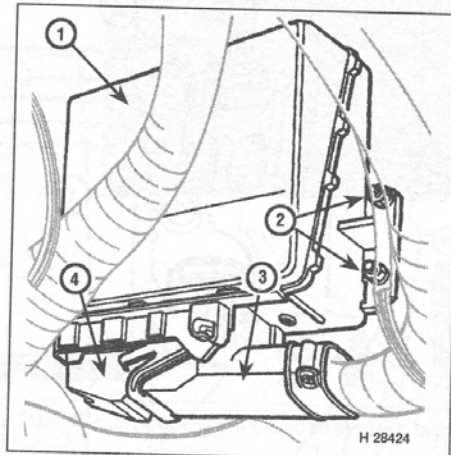
- 34 Refitting is a reversal of removal.

Turbocharger boost pressure sensor

Removal

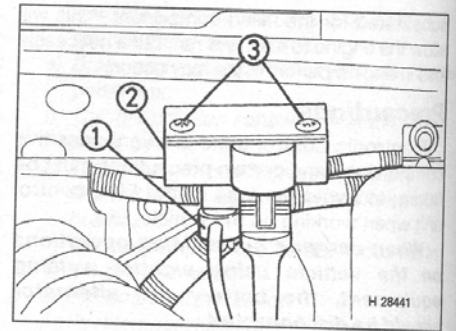
Note: New pressure pipe union copper washers will be required on refitting.

- 35 The sensor is located on a bracket attached to the engine compartment bulkhead (see illustration).
- 36 Disconnect the battery negative lead.
- 37 Disconnect the sensor wiring plug.
- 38 Unscrew the banjo bolt, and disconnect the pressure pipe from the sensor. Recover the copper washers.



21.52 Electronic control unit location - EDC system

- 1 Electronic control module
- 2 Securing nuts
- 3 Wiring plug
- 4 Wiring plug securing screw



21.35 Turbocharger boost pressure sensor - EDC system

- 1 Banjo union
- 2 Sensor
- 3 Sensor securing screws

- 39 Remove the two screws securing the sensor to the mounting bracket, and withdraw the sensor.

Refitting

- 40 Refitting is a reversal of removal, but use new copper washers when reconnecting the pressure pipe.

Coolant temperature sensor

Removal

Note: A new copper washer must be used on refitting.

- 41 The sensor is located in the top left-hand side of the cylinder head (see illustration).
- 42 Disconnect the battery negative lead.
- 43 Disconnect the sensor wiring plug.
- 44 Unscrew the sensor from the cylinder head, and recover the copper washer. Be prepared for coolant spillage.

Refitting

- 45 Refitting is a reversal of removal, but use a new copper washer, and on completion, check the coolant level as described in *Weekly checks*.

Air temperature sensor

Removal

Note: A new sealing ring may be required on refitting.

- 46 The sensor is located in the rear of the inlet manifold.
- 47 Disconnect the battery negative lead, then disconnect the wiring plug from the sensor.
- 48 Unscrew the sensor from the manifold, and where applicable, recover the sealing ring.

Refitting

- 49 Refitting is a reversal of removal, but where applicable, use a new sealing ring.

Fuel temperature sensor

- 50 The fuel temperature sensor is integral with the fuel injection pump.

EGR control solenoid

- 51 See part D of this Chapter.

Electronic control unit

Removal

- 52 The unit is located behind the right-hand A-pillar trim panel (see illustration).

- 53 Remove the A-pillar trim panel.
- 54 Disconnect the battery negative lead.
- 55 Loosen the control unit wiring plug securing screw, and disconnect the wiring plug. Move the wiring plug and the harness to one side.
- 56 Unscrew the securing nuts, and withdraw the control unit.

Refitting

- 57 Refitting is a reversal of removal.

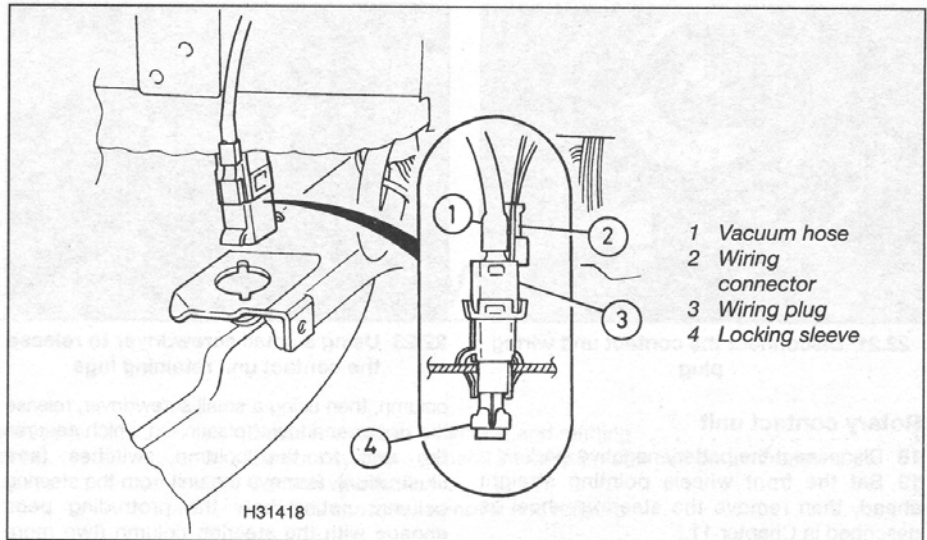
22 Cruise control system - description and component renewal



Cruise control system - description

1 Cruise control may be fitted to later models with automatic transmission as an option. The system incorporates the following components:

- a) Electronic control unit located behind the passenger's side lower facia panel. The ECU receives information from the driver, brake pedal switch and vehicle speed sensor, and activates the throttle vacuum pump accordingly.
- b) Cruise control switches are located in the auxiliary switch panel and on the steering wheel. The steering wheel switches provide **set/accelerate** and **resume/decelerate** functions.
- c) The clutch and brake pedal switches are mounted on the pedal bracket and, when either pedal is pressed, the ECU disengages the cruise control system and releases the throttle levers to their idle position.
- d) The vehicle speed sensor is mounted on the side of the transfer box. Cruise control cannot be engaged at road speeds under 28 mph.
- e) The vacuum pump fitted at the front left-hand side of the engine compartment provides the vacuum source for the actuator. A control valve in the pump allows precise control to the throttle actuator, or a quick purge of the system when the system disengages.
- f) The actuator is located in the engine



22.6 Cruise control pedal switch removal

- g) The neutral lockout relay is located behind the driver's side right-hand footwell trim panel. Its function is to disengage the cruise control if Neutral or Park is selected in the main gearbox when the system is engaged.
- 2 If the cruise control system develops a fault, first check all of the associated wiring and fuses, and the vacuum hoses.

Cruise control system components - removal, refitting and adjustment

Brake or clutch switch/vent valve

- 3 Disconnect the battery negative lead.
- 4 Release the clips and pull down the lower facia panel.
- 5 Disconnect the wiring and vacuum hose from the switch/vent valve.
- 6 Release the locking sleeve behind the switch, then release the locking tabs and remove the switch from the pedal bracket (see illustration).
- 7 Refitting is a reversal of the removal procedure, noting the following points:
 - a) The brake switch should be adjusted to provide a clearance of 1.0 mm between

- the switch/vent valve body and the inside shoulder of the contact button.
- b) The clutch switch should be set to a zero clearance between the switch/vent valve body and the inside shoulder of the contact button.

Main control switch

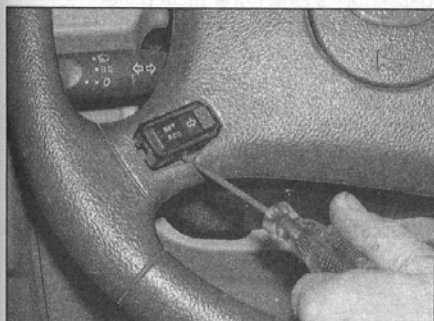
- 8 See Chapter 13, Section 4.

Steering wheel switches - models with driver's airbag

- 9 Disconnect the battery negative lead. Remove the airbag unit as described in Chapter 13.
- 10 Disconnect the cruise control switch main multi-plug in the centre, and the two horn contact wiring plugs at the base.
- 11 At each side of the wheel, remove the two small screws securing the switches to the wheel.
- 12 Unscrew the three mounting bracket bolts from the centre of the wheel, and remove the cruise control switch assembly.
- 13 Refitting is a reversal of the removal procedure, ensuring that the cruise control wiring harness is routed correctly. Refit the airbag unit as described in Chapter 13.

Steering wheel switches - models without driver's airbag

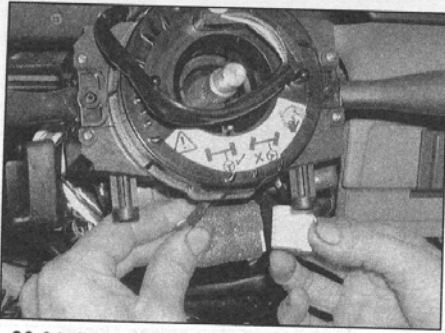
- 14 Disconnect the battery negative lead.
- 15 The switches must be prised from their locations in the steering wheel, and this requires significant effort with a screwdriver. The first attempt when we tried in the workshop did no more than separate the top half of the switch from the switch body - the wheel padding has to be levered aside considerably to ease out the switch complete (see illustration). Take care to minimise the potential damage to the wheel padding as this is done - use stiff card behind the screwdriver shaft, for instance.
- 16 Once the switch has been removed, disconnect the wiring from the switch base (see illustration).
- 17 Refitting is a reversal of removal.



22.15 Prise out the cruise control switches from the steering wheel ...



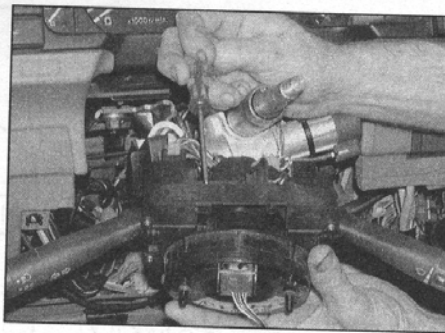
22.16 ... and disconnect the wiring



22.21 Disconnect the contact unit wiring plug

Rotary contact unit

- 18 Disconnect the battery negative lead.
- 19 Set the front wheels pointing straight ahead, then remove the steering wheel as described in Chapter 11.
- 20 Release the clips securing the driver's side lower trim panel, and remove the three screws securing the steering column lower shroud.
- 21 Disconnect the contact unit multi-plug from the steering column wiring harness (see illustration), and release the harness from the ignition switch.
- 22 If the contact unit is to be re-used, apply adhesive tape to the upper and lower halves to prevent rotation. If this precaution is not taken, the wiring inside the unit will be damaged.
- 23 Pull the assembly rearwards off the steering



22.23 Using a small screwdriver to release the contact unit retaining lugs

- column, then using a small screwdriver, release the upper and lower plastic lug which secures the unit to the column switches (see illustration). Remove the unit from the steering column, noting how the protruding pegs engage with the steering column (two more engage with the rear of the steering wheel).
- 24 While the contact unit is removed, keep it in a plastic bag, and make sure the mechanism is not rotated.
- 25 Refitting is a reversal of the removal procedure, noting the following points:
 - a) Check that the front wheels are still in the straight-ahead position.
 - b) Make sure that the pegs on the front and rear of the unit locate in the holes on the steering column and the underside of the steering wheel.
 - c) Make sure that the wiring is not trapped between the upper and lower shroud.

Actuator

- 26 Disconnect the battery negative lead.
- 27 Remove the split pin, then withdraw the clevis pin and disconnect the cable from the actuator lever.
- 28 Carefully prise off the ball end fitting from the actuator lever.
- 29 Disconnect the vacuum hose, then unscrew the mounting nut and remove the actuator from its bracket.
- 30 Examine the rubber diaphragm for wear and damage, and renew the actuator if necessary.
- 31 Refitting is a reversal of the removal procedure, but check the link and cable adjustment as described below.

Actuator link adjustment

- 32 With the ignition off, check that the link setting distance (A) is correct, and that the retainer is locked in position (see illustration).
- 33 If adjustment is required, measure the specified distance from the diaphragm collar, and mark this position. Set the link and retainer to the mark just made, and turn the retainer half a turn to secure. Check that the distance is still correct, then turn the retainer a further quarter-turn to lock it.
- 34 Remove any freeplay in the cable using the adjuster clip in the actuator mounting bracket. Check also that dimension (B) is correct (see illustration 22.32).

Vacuum pump

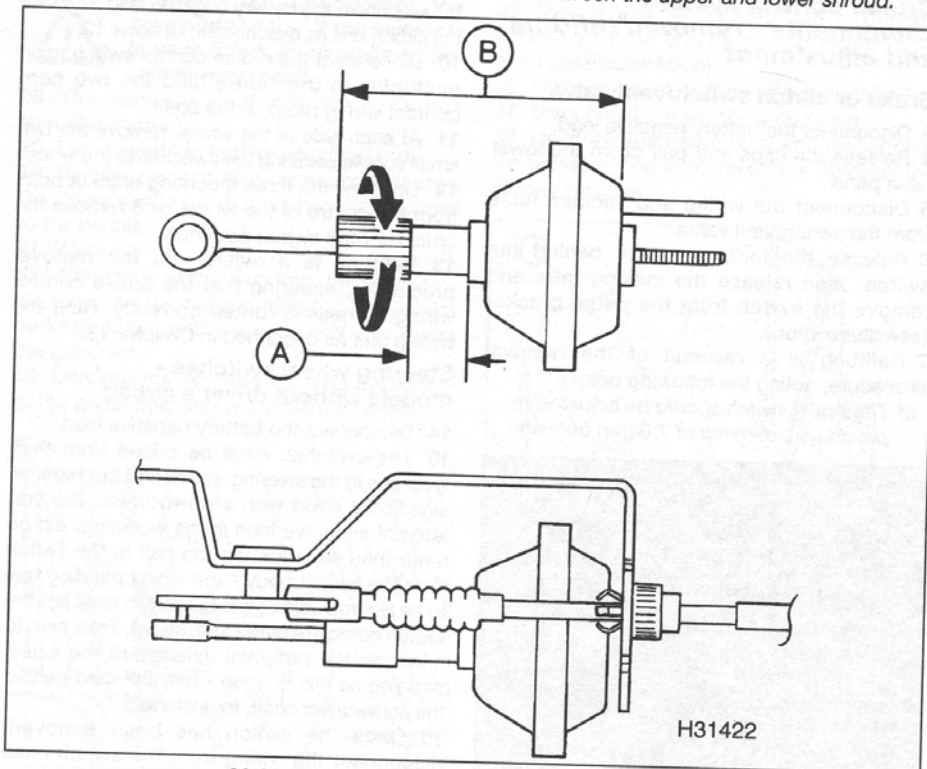
- 35 Disconnect the battery negative lead.
- 36 Release the wheel chock and the jack from their locations, and remove them.
- 37 Release the three pump mounting rubbers from the body, then manoeuvre the pump out of its location.
- 38 Release the cover from the pump multi-plug, and disconnect the plug.
- 39 Disconnect the vacuum pipe, then withdraw the pump.
- 40 Refitting is a reversal of the removal procedure.

Cruise control electronic control unit (ECU)

- 41 The ECU is located behind the passenger's side of the facia. First disconnect the battery negative lead.
- 42 Release the four clips and pull down the passenger's side lower facia panel.
- 43 Unscrew the nut securing the ECU/relay bracket, and lower the bracket for access. Unscrew the ECU lower securing nut.
- 44 Open the glovebox lid, align the lid stops with the cut-outs in the facia panel, and lower the lid out of position.
- 45 Move the airbag harness to one side, then unscrew the ECU upper securing nut. Disconnect the ECU multi-plug, and remove the ECU from its location.
- 46 Refitting is a reversal of the removal procedure.

Vehicle speed sensor

- 47 See Section 21.



22.32 Cruise control actuator link adjustment

A 16 mm B 103 mm

Chapter 4 Part D:

Exhaust and emission control systems

Contents

| | | | |
|---|---|---|---|
| Catalytic converter - general information and precautions | 8 | Exhaust manifold - removal and refitting | 6 |
| Crankcase emission system - general information | 3 | Exhaust system - general information and component renewal | 7 |
| Evaporative loss emission control system | 2 | General information | 1 |
| Exhaust gas recirculation (EGR) system - general information and component renewal | 5 | Lambda sensors - removal and refitting | 4 |

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

EGR throttle position sensor

| | |
|---|-------------------|
| Resistance across terminals 1 and 3 | 1000 to 1050 ohms |
| Resistance across terminals 1 and 2 | 850 to 900 ohms |

Torque wrench settings

| | Nm | lbf ft |
|---------------------------------|----|--------|
| EGR delivery pipe bolts | 25 | 18 |
| EGR valve securing bolts | 25 | 18 |
| Exhaust manifold securing nuts: | | |
| Petrol engines | 20 | 15 |
| 200 TDi engine | 25 | 18 |
| 300 TDi engine | 45 | 33 |

1 General information

Emission control systems

All petrol-engined models can use unleaded fuel, and fuel injection models are controlled by an engine management system 'tuned' to give the best compromise between driveability, fuel consumption and exhaust emission production. In addition, a number of systems are fitted that help to minimise other harmful emissions. All models are fitted with a crankcase emission-control system that reduces the release of pollutants from the engine's lubrication system. Models from 1993 onwards have a catalytic converter that reduces exhaust gas pollutants. Models with

a catalytic converter also have an evaporative loss emission control system that reduces the release of gaseous hydrocarbons from the fuel tank.

All diesel-engined models also have a crankcase emission control system. Later models are fitted with an Exhaust Gas Recirculation (EGR) system and a catalytic converter to reduce exhaust emissions.

Crankcase emission control

To reduce the emission of unburned hydrocarbons from the crankcase into the atmosphere, the engine is sealed, and the blow-by gases and oil vapour are drawn from inside the crankcase, through an oil separator, into the air cleaner, to be burned by the engine during normal combustion.

Under conditions of high manifold depression (idling, deceleration) the gases will be sucked positively out of the crankcase.

Under conditions of low manifold depression (acceleration, full-throttle running) the gases are forced out of the crankcase by the (relatively) higher crankcase pressure; if the engine is worn, the raised crankcase pressure (due to increased blow-by) will cause some of the flow to return under all manifold conditions.

Exhaust emission control - petrol models

To minimise the amount of pollutants which escape into the atmosphere, later models are fitted with twin catalytic converters in the exhaust system. The fuelling system is of the closed-loop type, in which twin lambda sensors in the exhaust system provide the engine management system ECU with constant feedback, enabling the ECU to adjust the air/fuel mixture to optimise combustion.

The lambda sensor has a built-in heating element that is controlled by the ECU through the lambda sensor relay, to quickly bring the sensor's tip to its optimum operating temperature. The sensor's tip is sensitive to oxygen, and relays a voltage signal to the ECU that varies according to the amount of oxygen in the exhaust gas. If the inlet air/fuel mixture is too rich, the exhaust gases are low in oxygen, so the sensor sends a low-voltage signal, the voltage rising as the mixture weakens and the amount of oxygen rises in the exhaust gases. Peak conversion efficiency of all major pollutants occurs if the inlet air/fuel mixture is maintained at the chemically-correct ratio for the complete combustion of petrol of 14.7 parts (by weight) of air to 1 part of fuel (the stoichiometric ratio). The sensor output voltage alters in a large step at this point, the ECU using the signal change as a reference point, and correcting the inlet air/fuel mixture accordingly by altering the fuel injector pulse width. Details of the lambda sensor removal and refitting are given in Section 4.

Exhaust emission control - diesel models

An oxidation catalyst is fitted in the line with the exhaust system of all diesel-engined models. The catalytic converter consists of a canister containing a fine mesh impregnated with a catalyst material, over which the exhaust gases pass. The catalyst speeds up the oxidation of harmful carbon monoxide, unburnt hydrocarbons and soot, effectively reducing the quantity of harmful products reaching the atmosphere.

An Exhaust Gas Recirculation (EGR) system is fitted to later models. This reduces the level of nitrogen oxides produced during combustion, by introducing a proportion of the exhaust gas back into the inlet manifold, under certain engine operating conditions, via a solenoid valve. The solenoid valve is controlled by a fuel injection pump-mounted sensor on models with a conventional fuel injection system, or by the EDC electronic control unit on models with EDC.

Evaporative emission control - petrol models

To minimise the escape of unburned

hydrocarbons into the atmosphere, an evaporative loss emission control system is fitted to all petrol models with a catalytic converter (1993 onwards). The fuel tank filler cap is sealed, and a charcoal canister is mounted on the right-hand inner wing to collect the petrol vapours released from the fuel contained in the fuel tank. It stores them until they can be drawn from the canister (under the control of the fuel injection system ECU) via the purge valve into the plenum chamber, where they are then burned by the engine during normal combustion.

To ensure that the engine runs correctly when it is cold and/or idling, and to protect the catalytic converter from the effects of an over-rich mixture, the purge control valve is not opened by the ECU until the engine has warmed up, and the engine is under load; the valve solenoid is then modulated on and off to allow the stored vapour to pass into the inlet tract.

Exhaust system

The exhaust system comprises the exhaust manifold(s), catalytic converter(s), two silencer units, a number of mounting brackets, and a series of connecting pipes.

2 Evaporative loss emission control system

General information

1 The evaporative loss emission control system fitted to petrol models consists of the purge valve, the activated charcoal filter canister, and a series of connecting hoses.

2 The purge valve is mounted on top of the charcoal canister, itself mounted on the right-hand inner wing (right as seen from the driver's seat) (see illustration).

Component renewal

3 The charcoal canister assembly can be renewed as described in Chapter 1A, Section 54. The purge valve is only available as part of the canister assembly

3 Crankcase emission system - general information

1 The crankcase emission control system consists of a series of hoses and filters that connect the crankcase vent to the rocker cover vent (where applicable) and the air cleaner.

2 The system requires no maintenance beyond that given in the relevant part of Chapter 1. Bear in mind, however, that using low-quality engine oil (or not changing the oil regularly) will result in more oil fumes passing into the system, and a greater chance of the pipes and filters being prematurely blocked.

4 Lambda sensors - removal and refitting

Removal

1 Each lambda sensor is threaded into the exhaust pipe, ahead of the catalytic converter. Removal details are much the same for either sensor.

2 Disconnect the battery negative lead and position it away from the terminal.

3 Access to the sensors may be gained from above or below, according to preference (see illustration). In either case, wait for the system to cool down completely before attempting removal.

4 Trace the wiring back from the sensor, releasing it from any securing clips. Unplug the wiring harness at the connector, located in the engine compartment, at the rear of each cylinder head (see illustration).

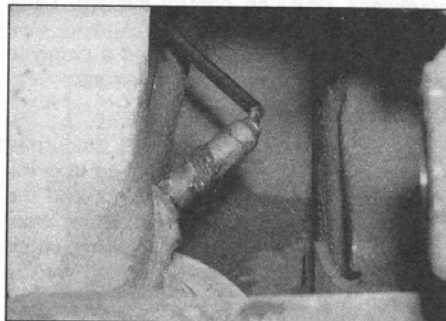
5 Slacken and withdraw the sensor, taking care to avoid damaging the sensor probe as it is removed. **Note:** As a flying lead remains connected to the sensor after it has been disconnected, if the correct-size spanner is not available, a slotted socket will be required to remove the sensor.

Refitting

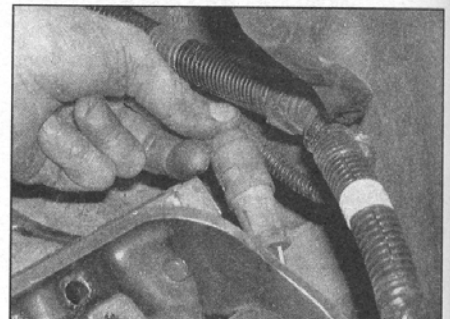
6 Apply a little anti-seize grease to the sensor threads only - keep the probe tip clean.



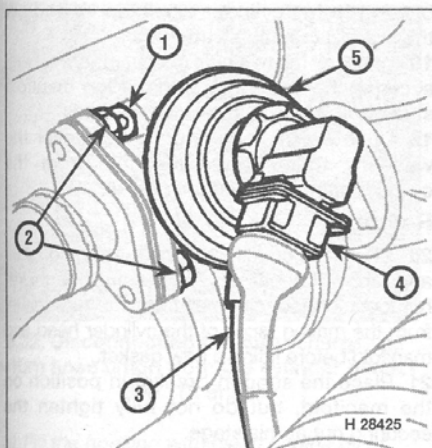
2.2 Charcoal canister - purge valve arrowed



4.3 Lambda sensor (seen from below)



4.4 The lambda sensor wiring connectors are clipped to the rear of each cylinder head



5.7 EGR valve location

- 1 Valve securing bolts
- 2 EGR delivery pipe securing bolts
- 3 Vacuum hose
- 4 Wiring plug
- 5 Valve

7 Refit the sensor to its location, tightening it securely. Restore the harness connection. Note that the type of lambda sensor fitted depends on vehicle specification - the sensor may not be interchangeable with one obtained from another model.

5 Exhaust gas recirculation (EGR) system - general information and component renewal

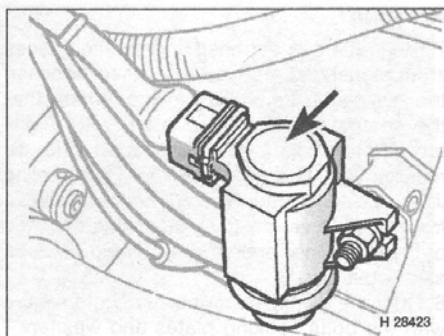
1 This system is fitted to certain models with a conventional diesel injection system, and to all models with Electronic Diesel Control (see part C of this Chapter).

2 The system is designed to recirculate small quantities of exhaust gas into the inlet tract, and therefore into the combustion process. This process reduces the level of oxides of nitrogen present in the final exhaust gas which is released into the atmosphere, and also lowers the combustion temperature.

3 The volume of exhaust gas recirculated is controlled by vacuum, via a solenoid valve. The solenoid valve is controlled by a fuel injection pump-mounted sensor on models with a conventional fuel injection system, or by the Electronic Diesel Control electronic control unit on models with EDC.

4 A vacuum-operated recirculation valve is fitted to the exhaust manifold, to regulate the quantity of exhaust gas recirculated. The valve is operated by the vacuum supplied via the solenoid valve.

5 Between idle speed and a pre-determined engine load, power is supplied to the solenoid valve, which allows the recirculation valve to open. Under full-load conditions, the exhaust gas recirculation is cut off. Additional control is provided by the engine temperature sensor, which cuts off the vacuum supply until the coolant temperature reaches 40°C, preventing



5.12 EGR control solenoid location (arrowed) - EDC system

the recirculation valve - from opening during the engine warm-up phase.

EGR valve

Removal

Note: New EGR valve-to-manifold, and delivery pipe-to-EGR valve, gaskets must be used on refitting.

6 Disconnect the battery negative lead then, where applicable, disconnect the wiring plug from the valve.

7 Disconnect the vacuum hose from the valve (see illustration).

8 Unscrew the two bolts securing the valve to the exhaust manifold.

9 Remove the two securing bolts, and disconnect the EGR delivery pipe from the valve.

10 Withdraw the valve, and recover the gaskets.

Refitting

11 Refitting is a reversal of removal, but use new gaskets when refitting the valve and reconnecting the delivery pipe.

EGR control solenoid

Removal

12 The solenoid is located at the front left-hand corner of the engine compartment (see illustration).

13 Disconnect the battery negative lead.

14 Disconnect the wiring plug from the solenoid.

15 Disconnect the three vacuum hoses from the modulator, noting their locations to ensure correct refitting.

16 Unscrew the securing nut, and withdraw the solenoid from the body panel.

Refitting

17 Refitting is a reversal of removal.

Coolant temperature sensor

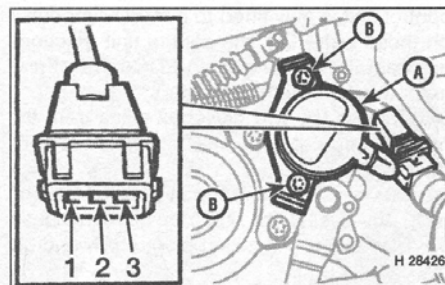
18 The system uses the coolant temperature gauge sender unit. Details of removal and refitting are given in Chapter 3, Section 6.

Throttle position sensor

19 This sensor is only used on models with a conventional fuel injection system, and is located on the fuel injection pump.

Testing

20 Start the engine, and run it until normal operating temperature is reached.



5.22 EGR throttle position sensor location - note plug terminal numbers (inset)

A Sensor B Securing screws

21 Stop the engine, and disconnect the throttle position sensor wiring plug.

22 Connect an ohmmeter across pins 1 and 3 of the wiring plug. The reading on the ohmmeter should be as given in the Specifications (see illustration).

23 Connect the ohmmeter between pins 1 and 2 of the wiring plug. Again, the reading should be as specified.

24 If the readings are not as specified, loosen the two sensor retaining screws, and rotate the sensor to achieve the correct readings. Tighten the retaining screws when the readings are correct.

25 If the correct readings cannot be obtained by rotating the sensor, then it is faulty and should be renewed.

26 Reconnect the wiring plug on completion.

Removal

27 Disconnect the battery negative lead, then disconnect the wiring plug from the sensor.

28 Unscrew the two securing screws, and withdraw the sensor.

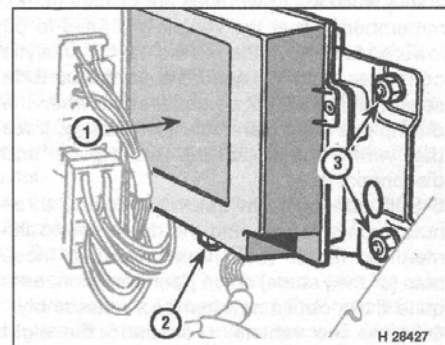
Refitting

29 Refitting is a reversal of removal, but before tightening the securing screws, adjust the position of the sensor as described previously in this Section (Testing).

EGR electronic control unit

Removal

30 The unit is located in the passenger compartment, behind the right-hand side of the fascia (see illustration). The separate



5.30 EGR electronic control unit location

- 1 Electronic control unit
- 2 Wiring plug
- 3 Securing nuts

control unit is only fitted to non-EDC models - on those with EDC, the control unit functions are contained in the main EDC control unit (refer to part C of this Chapter).

31 Release the two glovebox stays from the fascia, and pivot the glovebox fully downwards.

32 Unscrew the control unit plastic securing nuts, and release the unit from its mountings.

33 Disconnect the wiring plug, and withdraw the unit.

Refitting

34 Refitting is a reversal of removal.

6 Exhaust manifold - removal and refitting

Note: It would be well worth obtaining new manifold bolts (or studs and nuts on diesel engines) for reassembly - the same applies to the manifold-to-downpipe fasteners. Given the corrosion which will almost certainly be evident on the old fasteners, a new set will make reassembly much easier. It may be found that some of the fasteners cannot be re-used, in any case. Take care when loosening old fasteners that the socket does not slip on rounded-off/corroded nut or bolt heads, resulting in personal injury.

Petrol engines

Note: The exhaust manifolds are handed. Check that any replacement parts are correct.

Removal

1 Allow the exhaust system to cool down sufficiently if the engine has just been running.

2 Bend back the ends of the locking tabs on the eight manifold retaining bolts.

3 Make sure the handbrake is applied, then jack up the front of the vehicle and support on axle stands.

4 In order that no strain is placed on the rest of the system when the downpipes are released from the manifolds, loosen the front pipe fixings next to the transmission mounting bracket. Additionally, arrange to support the system (perhaps on a trolley jack, or an axle stand) while the downpipes are disconnected, remembering that the vehicle will have to be lowered to remove the manifolds. On catalytic converter models, ensure that the lambda sensor wiring will not be under strain when the downpipes are separated - if necessary, trace the wiring back to the multi-plug and disconnect it.

5 Still working from below, undo the three nuts each side securing the downpipe to the manifold flange (see illustration). If these nuts (or their studs) are in poor condition, as is quite likely, obtain new items for reassembly.

6 Lower the vehicle, then undo the eight manifold retaining bolts and lift the manifold away. Note the fitted order of the bolts, locking plates and washers, and obtain new items as necessary for reassembly.

Refitting

7 Clean the cylinder head and manifold faces scrupulously, as no gasket is used between the two parts. Land Rover recommend that the mating faces are coated with high-temperature anti-seize compound prior to reassembly - two mentioned are Rocal Foliac J166 and Moly Paul (which may be available from Land Rover dealers), but in the absence of these, copper brake grease could be used as a substitute.

8 Offer the manifold into position, and secure with the bolts, locking plates and washers - note that the washers fit between the manifold and locking plates, not under the bolt heads. Tighten the bolts to the specified torque, but do not bend over the locking tabs at this stage.

9 Raise the front of the vehicle once more, and support on axle stands. Apply a smear of exhaust jointing compound to the manifold-to-downpipe joint face.

10 Taking care not to impose any strain on the rest of the exhaust system, offer up the downpipe to the manifold, then fit and tighten the nuts evenly and securely.

11 Lower the front of the vehicle to the ground. Start the engine, allow it to warm up and check for exhaust gas leakage.

12 Stop the engine and allow the exhaust system to cool down for several hours.

13 Check the tightness of the exhaust manifold bolts and the downpipe flange nuts. Finally bend over the ends of the locking tabs on to the manifold bolt heads.

200 TDi diesel engine

Removal

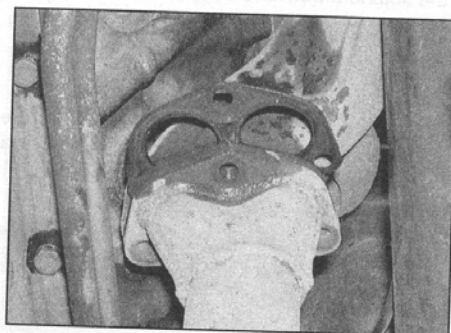
Note: A new manifold gasket should be used on refitting (a single gasket is used for both the inlet and exhaust manifolds).

14 Remove the inlet manifold and turbocharger as described in part C of this Chapter.

15 Where applicable, disconnect the wiring plug and the vacuum hose from the EGR valve.

16 Unscrew the nut securing the manifold support bracket to the manifold.

17 Slacken the nuts and bolts securing the two parts of the manifold support bracket together, then remove the bolts securing the



6.5 Separating the exhaust manifold-to-downpipe joint

bracket to the cylinder block, and withdraw the bracket (see illustration).

18 Unscrew the two nuts (recover the washers) securing the coolant pipe to the top manifold studs, and lift the pipe clear of the studs.

19 Unscrew the securing nuts, recover the washers, then lift the manifold from the cylinder head. Recover the gasket.

Refitting

20 Check the condition of the manifold gasket, and renew if necessary - if the original gasket has deteriorated, clean all traces of old gasket from the mating faces of the cylinder head and manifold before fitting a new gasket.

21 Place the support bracket in position on the manifold, but do not fully tighten the securing nut at this stage.

22 Fit the gasket and the manifold, then refit the securing nuts and washers, and tighten the nuts progressively to the specified torque.

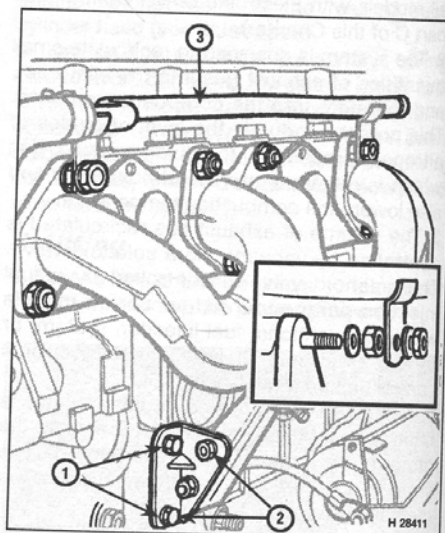
23 Refit the coolant pipe to the top manifold studs, and tighten the securing nuts. Ensure that the washers are in place.

24 Refit the bolts securing the manifold support bracket to the cylinder block, then tighten all the support bracket fixings.

25 Where applicable, reconnect the wiring plug and the vacuum pipe to the EGR valve.

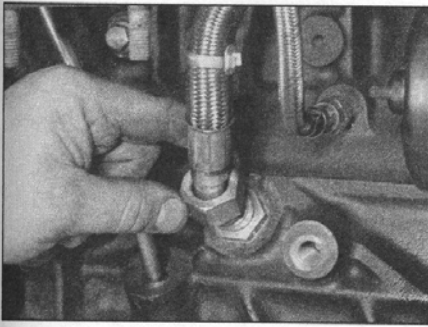
26 Refit the turbocharger and inlet manifold as described in part C of this Chapter. Before the engine is started, the turbocharger must be primed with oil. Failure to carry out this procedure may result in serious (and expensive) damage to the turbocharger.

a) Unscrew the oil feed pipe banjo bolt from the top of the turbocharger housing. Recover the two sealing washers, and move the feed pipe away from the oil hole in the housing.

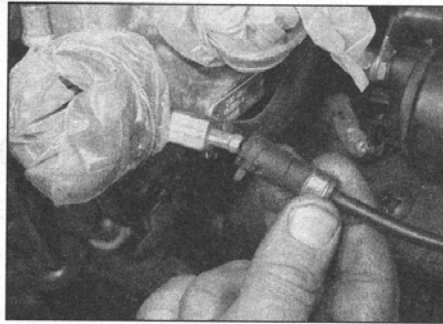


6.17 Exhaust manifold mounting details - 200 TDi engine

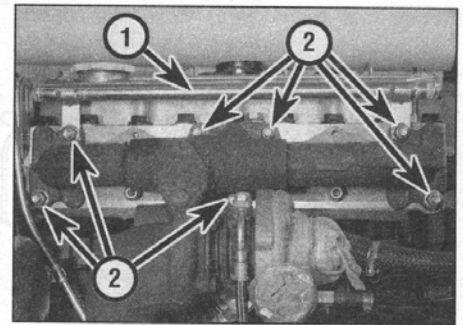
- 1 Support bracket-to-cylinder block bolts
- 2 Support bracket nuts and bolts (securing two parts of bracket together)
- 3 Coolant pipe



6.32 Disconnecting the turbocharger oil return hose union from the cylinder block - 300 TDi engine



6.33 Disconnecting the boost pressure pipe from the turbocharger - 300 TDi engine



6.34 Coolant pipe (1) and exhaust manifold securing nuts (2) - 300 TDi engine

- b) Fill the housing with clean engine oil of the correct type and grade from a freshly-opened sealed container.
- c) Reconnect the oil feed pipe, and refit the banjo bolt, ensuring that one sealing washer is positioned on each side of the pipe. Tighten the banjo bolt to the specified torque.

300 TDi diesel engine

Removal

Note: If the turbocharger is removed from the manifold, a new turbocharger-to-manifold gasket, and a new wastegate pushrod clip, will be required. On 300 TDi engines, the turbocharger is integral with the exhaust manifold. Although the turbocharger and manifold can be separated once the manifold assembly has been removed, at the time of writing, it was unclear whether the turbocharger can be renewed independently of the manifold - check with a Land Rover dealer for details. A new manifold gasket should be used on refitting (a single gasket is used for both the inlet and exhaust manifolds).

27 Remove the inlet manifold, as described in part C of this Chapter.

28 Loosen the securing clips, and remove the air cleaner-to-turbocharger inlet trunking, and the turbocharger outlet-to-intercooler trunking. Note the breather hose connected to the inlet trunking.

29 On models with EGR, unscrew the two securing bolts and disconnect the EGR

delivery pipe from the intercooler-to-inlet manifold trunking.

30 Where applicable, disconnect the wiring plug from the EGR valve.

31 Disconnect the exhaust front section from the turbocharger, with reference to Section 7.

32 Place a suitable container beneath the engine to catch escaping oil, then unscrew the union nuts, and disconnect the turbo-charger oil feed and return hoses from the cylinder block (counterhold the unions on the cylinder block) (see illustration). Plug the open ends of the hoses and the cylinder block, to prevent dirt ingress.

33 Disconnect the turbocharger boost pressure pipe from the turbocharger (see illustration).

34 Unscrew the two manifold nuts securing the coolant pipe to the top manifold studs, and lift the pipe clear of the studs (see illustration).

35 Unscrew the remaining manifold securing nuts, then lift the complete manifold/turbocharger assembly from the cylinder head. Recover the gasket.

36 It is possible that some of the manifold studs may be unscrewed from the cylinder head when the manifold securing nuts are unscrewed. In this event, the studs should be screwed back into the cylinder head once the manifolds have been removed, using two manifold nuts locked together.

37 If the turbocharger is to be removed from the manifold, refer to the note at the beginning of this sub-Section before proceeding.

38 To remove the turbocharger from the manifold, prise off the clip securing the operating lever to the wastegate pushrod, then remove the four bolts and the two clamp plates securing the turbocharger (see illustrations).

39 Withdraw the turbocharger, and recover the gasket.

Refitting

40 If the turbocharger has been removed from the manifold, thoroughly clean the mating faces of the turbocharger and the manifold, then refit the turbocharger using a new gasket.

41 Reconnect the operating lever to the wastegate pushrod, using a new clip.

42 Check the condition of the manifold gasket, and renew if necessary - if the original gasket has deteriorated, clean all traces of old gasket from the mating faces of the cylinder head and manifold before fitting a new gasket.

43 Fit the gasket and the manifold, and refit the coolant pipe to the top manifold studs. Refit the securing nuts and washers, and tighten the nuts progressively to the specified torque.

44 Reconnect the turbocharger boost pressure pipe.

45 Reconnect the turbocharger oil pipes, and securely tighten the union nuts.

46 Reconnect the exhaust front section to the turbocharger, with reference to Section 7.

47 Where applicable, reconnect the EGR valve wiring plug.

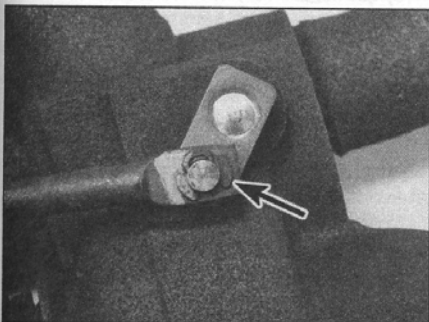
48 Refit the air trunking, and reconnect the breather hose to the inlet trunking.

49 On models with EGR, reconnect the EGR delivery pipe to the intercooler-to-inlet manifold trunking, and tighten the securing bolts.

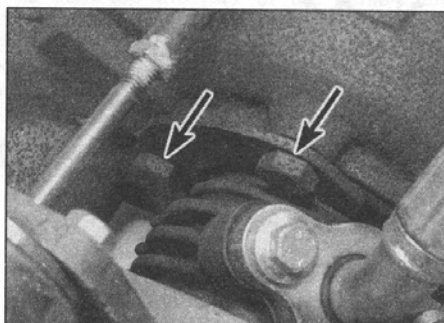
50 Refit the inlet manifold as described in Chapter 4C.

51 Before starting the engine, the turbocharger **must** be primed with oil as follows. Failure to carry out this procedure may result in serious (and expensive) damage to the turbocharger.

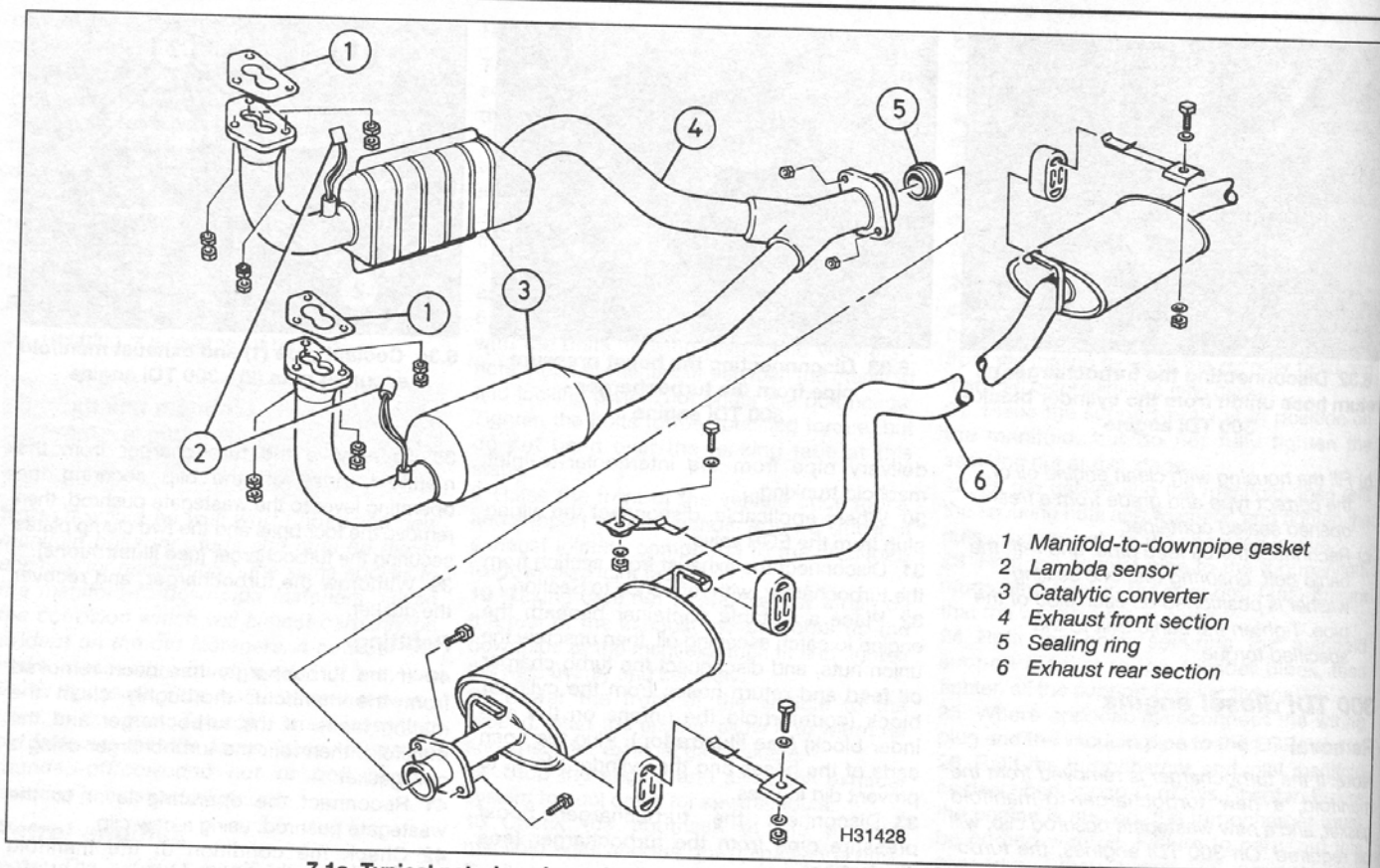
- a) Unscrew the oil feed pipe banjo bolt from the top of the turbocharger housing. Recover the two sealing washers, and



6.38a Turbocharger wastegate pushrod securing clip (arrowed)



6.38b Two of the turbocharger securing bolts (arrowed)



7.1a Typical petrol engine exhaust system - later model with catalytic shown

move the feed pipe away from the oil hole in the housing.

- b) Fill the housing with clean engine oil of the correct type and grade from a freshly-opened sealed container.
- c) Reconnect the oil feed pipe, and refit the banjo bolt, ensuring that one sealing washer is positioned on each side of the pipe. Tighten the banjo bolt to the specified torque (see Chapter 4C).

required on refitting, and a new sealing ring may be required.

- 3 Jack up the front of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so

that the suspension is not compressed, to give the best clearance between the axle and the exhaust.

- 4 Loosen the nuts and bolts securing the front section to the centre section, in front of

7 Exhaust system - general information and component renewal

General information

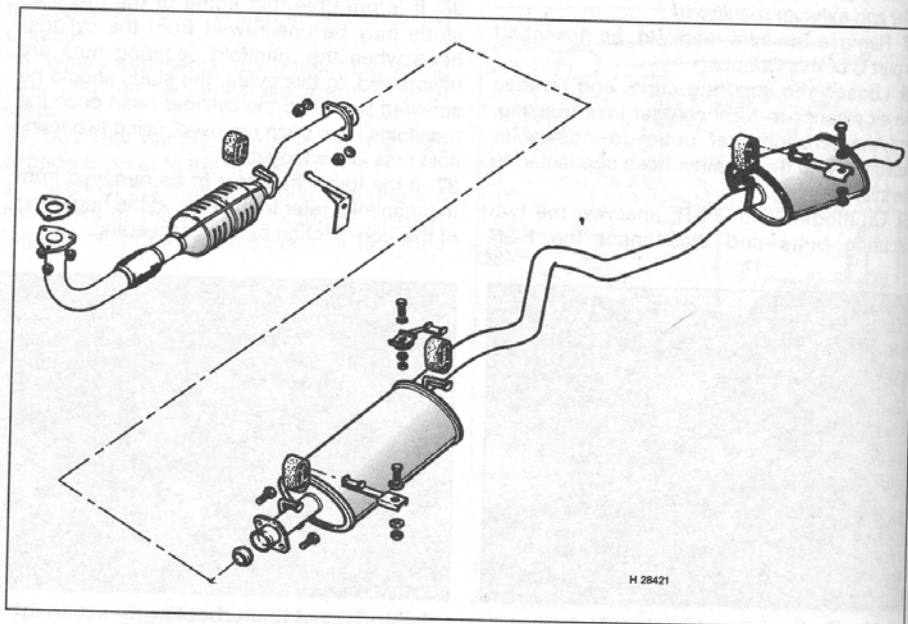
1 The exhaust system consists of two or three sections, the sections varying in detail depending on model (see **illustrations**). Each exhaust section can be renewed individually, leaving the remaining section(s) in place.

2 Where applicable, the catalytic converter(s) is/are located in the exhaust front (downpipe) section.

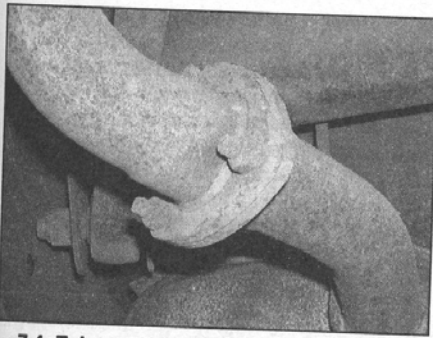
Component renewal - petrol models

Front section

Note: Suitable jointing compound will be



7.1b Typical diesel engine two-piece exhaust system components



7.4 Exhaust front-to-rear section joint

the centre silencer box (see illustration). Do not completely separate the joint at this stage.

5 Loosen the nuts securing the U-clamp support in front of the centre silencer, and remove the U-clamp.

6 On catalytic converter models, trace the lambda sensor wiring back to the multi-plugs (in the engine compartment, at the rear of the cylinder heads) and disconnect it.

7 Loosen the manifold-to-downpipe nuts, and separate the downpipes from the manifold flanges, supporting the front section so that it is not strained. Remove the nuts and bolts at the front silencer joint, and lower the front section out from under the vehicle. Recover the sealing ring used at the front silencer joint.

8 Refitting is a reversal of removal, bearing in mind the following points:

- Examine the condition of the silencer mounting rubbers, and renew if necessary.
- Apply a little exhaust jointing compound to the joints, especially the manifold joints, where no gasket is used.
- Examine the condition of the sealing ring, and renew if necessary. Ensure that the sealing ring is in place between the front section and the silencer.
- Do not fully tighten the clamp nuts and bolts until the completion of refitting.

Centre section - non-catalyst models

9 Jack up the front of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so that the suspension is not compressed, to give the best clearance between the axle and the exhaust.

10 Loosen the nuts and bolts securing the front section to the centre section, in front of the centre silencer box. Do not completely separate the joint at this stage.

11 Loosen the nuts securing the U-clamp at the rear of the centre silencer, and remove the U-clamp.

12 Support the front of the centre silencer, then remove the three nuts and bolts.

13 Twist the rear section of the exhaust to separate the sleeved joint behind the rear silencer. If this approach is not successful, the sleeved joint may have corroded together - try

carefully tapping the joint with a small hammer to free it.

14 To remove the centre silencer, it will have to be manipulated down or to the side, to clear the rest of the system - if necessary, loosen the U-clamp ahead of the rear silencer to give more movement.

15 Refitting is a reversal of removal, bearing in mind the following points:

- Examine the condition of the silencer mounting rubbers, and renew if necessary.
- Apply a little exhaust jointing compound to the joints.
- Examine the condition of the sealing ring, and renew if necessary. Ensure that the sealing ring is in place between the front section and the silencer.
- Do not fully tighten the clamp nuts and bolts until the completion of refitting.

Rear section - non-catalyst models

16 Jack up the rear of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so that the suspension is not compressed, to give the best clearance between the axle and the exhaust.

17 Loosen the nuts securing the U-clamp at the rear of the centre silencer, and remove the U-clamp.

18 Loosen the U-clamp ahead of the rear silencer, but do not remove it at this stage.

19 Twist the rear section of the exhaust to separate the sleeved joint behind the rear silencer. If this approach is not successful, the sleeved joint may have corroded together - try carefully tapping the joint with a small hammer to free it.

20 Remove the U-clamp from the rear silencer, then separate the sleeved joint and manipulate the exhaust carefully from under the vehicle.

21 Refitting is a reversal of removal, bearing in mind the following points:

- Examine the condition of the mounting rubbers, and renew if necessary.
- Apply a little exhaust jointing compound to the sleeved joint.
- Do not fully tighten the clamp nuts and bolts until the completion of refitting.

Rear section - catalyst models

22 Jack up the rear of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so that the suspension is not compressed, to give the best clearance between the axle and the exhaust.

23 Loosen and remove the nuts and bolts securing the front section to the centre section, in front of the centre silencer box. Separate the joint so that the system can be removed.

24 Working from the front, unhook the system from the mounting rubbers (three in total). Support the system as this is done. If preferred, the mountings can be unbolted from the underside of the vehicle - if this is

done, note which goes where, and also the fitted order of all components.

25 Manipulate the system from under the vehicle, and lower it to the floor. Recover the sealing ring fitted at the front joint.

26 Refitting is a reversal of removal, bearing in mind the following points:

- Examine the condition of the mounting rubbers, and renew if necessary.
- Apply a little exhaust jointing compound to the front joint.
- Examine the condition of the sealing ring, and renew if necessary. Ensure that the sealing ring is in place between the front section and the silencer.

Heatshields

27 The heatshields fitted to the downpipes and above the centre silencer are secured by a mixture of nuts, bolts and clips. Each shield can be removed once the relevant exhaust section has been removed. Note that if the shield is being removed to gain access to a component located behind it, in some cases it may prove sufficient to remove the retaining nuts and/or bolts and simply lower the shield, avoiding the need to disturb the exhaust system.

Component renewal - diesel models

Front section (three-piece exhaust system)

Note: Suitable jointing compound will be required on refitting, and a new sealing ring may be required.

28 Jack up the front of the vehicle and support securely on axle stands placed under the front axle (see *Jacking and vehicle support*).

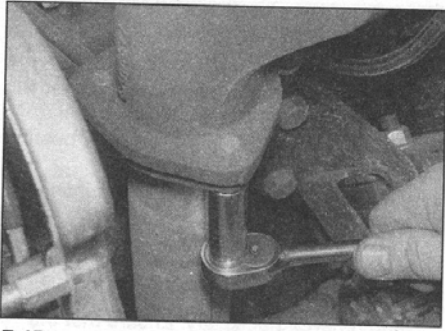
29 Working in the engine compartment, unscrew the clamp nut and bolt, and withdraw the clamp securing the exhaust front section to the turbocharger elbow.

30 Working under the vehicle, release the front exhaust silencer from the front and rear support brackets.

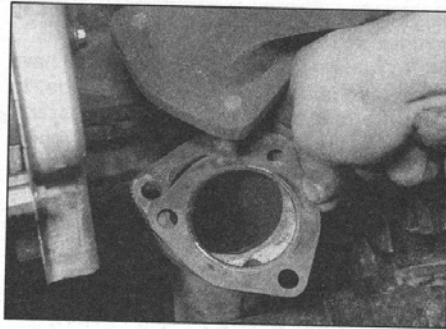
31 Unscrew the nuts and bolts securing the exhaust front section to the front silencer. Recover the washers, and the sealing ring, then withdraw the front section from under the vehicle.

32 Refitting is a reversal of removal, bearing in mind the following points:

- Examine the condition of the silencer mounting rubbers, and renew if necessary.
- Apply exhaust jointing compound to the joint between the exhaust front section and the turbocharger elbow.
- Examine the condition of the sealing ring, and renew if necessary. Ensure that the sealing ring is in place between the front section and the silencer.
- Do not fully tighten the clamp nuts and bolts until the completion of refitting.



7.45a Unscrew the three securing nuts . . .



7.45b . . . and disconnect the exhaust front section from the turbocharger

**Front silencer
(three-piece exhaust system)**

Note: New sealing rings may be required on refitting.

33 Jack up the front and rear of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so that the suspension is not compressed, to give the best clearance between the axles and the exhaust.

34 Remove the exhaust rear section as described later in this Section.

35 Unscrew the nuts and bolts securing the exhaust front section to the front silencer, and recover the washers, and the sealing ring.

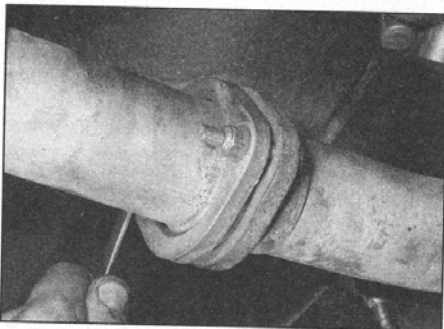
36 Release the silencer from the front and rear support brackets, then withdraw the silencer from under the vehicle.

37 Refitting is a reversal of removal, bearing in mind the following points:

- a) Examine the condition of the silencer mounting rubbers, and renew if necessary.
- b) Examine the condition of the sealing rings and renew if necessary. Ensure that the sealing rings are in place between the exhaust sections.
- c) Refit the exhaust rear section as described later in this Section.
- d) Do not fully tighten the clamp nuts and bolts until the completion of refitting.

**Rear section
(three-piece exhaust system)**

Note: New sealing rings may be required on refitting.



7.46 Unscrewing an exhaust clamp nut

38 Jack up the rear of the vehicle and support securely on axle stands (see *Jacking and vehicle support*). Arrange the axle stands so that the suspension is not compressed, to give the best clearance between the axle and the exhaust.

39 Working under the vehicle, unscrew the nuts and bolts securing the exhaust rear section to the front silencer. Recover the washers and the sealing ring.

40 Release the exhaust rear section from the rear support bracket, then manipulate the assembly from under the vehicle.

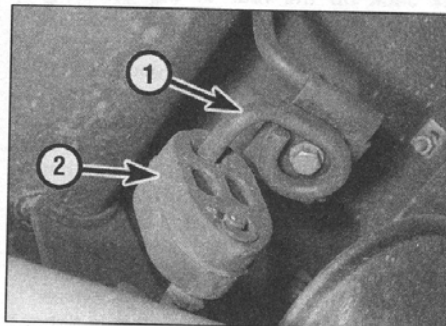
41 Refitting is a reversal of removal, bearing in mind the following points:

- a) Examine the condition of the exhaust mounting rubbers, and renew if necessary.
- b) Examine the condition of the sealing rings, and renew if necessary. Ensure that the sealing ring is in place between the exhaust sections.
- c) Do not fully tighten the clamp nuts and bolts until the completion of refitting.

**Front section
(two-piece exhaust system)**

Note: A new exhaust-to-turbocharger gasket must be used on refitting, and a new front section-to-rear section sealing ring may be required.

42 Jack up the vehicle, and support securely on axle stands positioned under the axles (see *Jacking and vehicle support*). Note that the axle stands must be of sufficient size to support the chassis of the vehicle with the suspension fully extended, with the wheels clear of the ground.



7.52 Rear exhaust mounting bracket (1) and rubber (2)

43 Working under the vehicle, where applicable, mark the positions of the front anti-roll bar mounting rubbers on the bar. Unscrew the bolts, withdraw the mounting brackets, then allow the anti-roll bar to swing down clear of the exhaust system.

44 Where applicable, disconnect the exhaust front section from its mounting bracket.

45 Unscrew the three securing nuts, and disconnect the exhaust front section from the turbocharger. Recover the gasket (see *illustrations*).

46 Unscrew the nuts and bolts securing the exhaust front section to the rear section (see *illustration*). Recover the washers and the sealing ring.

47 Place a suitable hydraulic jack under the centre of the front differential housing, then carefully jack up the front of the vehicle, and reposition the front axle stands under the chassis side-members.

48 Slowly lower the jack until the front suspension is fully extended.

49 Manipulate the exhaust front section out from under the vehicle.

50 Refitting is a reversal of removal, bearing in mind the following points:

- a) Examine the exhaust mounting rubbers, and renew if necessary.
- b) Use a new gasket when reconnecting the exhaust to the turbocharger.
- c) Examine the condition of the sealing ring, and renew if necessary. Ensure that the sealing ring is in place between the exhaust sections.
- d) Align the anti-roll bar mounting rubbers with the marks made on the bar before removal, and tighten the mounting bolts to the specified torque (see *Chapter 11*).
- e) Do not fully tighten the exhaust clamp nuts and bolts until the completion of refitting.

**Rear section
(two-piece exhaust system)**

Note: The aid of an assistant will greatly ease this operation.

51 Remove the exhaust front section, as described previously in this Section.

52 Unbolt the exhaust rear section brackets from the body, then carefully lower the exhaust onto the rear axle. Remove the mounting rubbers from the exhaust brackets (see *illustration*).

53 Ensure that the axle stands are securely positioned under the front of the chassis, then withdraw the jack from under the front axle, and reposition the jack under the rear axle.

54 Jack up the rear of the vehicle, then reposition the rear axle stands under the chassis side-members, in front of the rear towing brackets.

55 Slowly lower the jack until the rear suspension is fully extended.

56 Manipulate the exhaust diagonally across the underside of the vehicle, with the front silencer positioned to the right of the vehicle.

57 Facing towards the rear of the vehicle,

turn the exhaust assembly anti-clockwise to clear the rear axle, then manipulate the assembly out from under the vehicle.

58 Refitting is a reversal of removal, bearing in mind the following points:

- a) Examine the condition of the exhaust mounting rubbers, and renew if necessary.
- b) Refit the exhaust front section as described previously in this Section.

8 Catalytic converter - general information and precautions

The catalytic converter is a reliable and simple device which needs no maintenance in itself, but there are some facts of which an owner should be aware if the converter is to function properly for its full service life.

Petrol models

- a) DO NOT use leaded (UK 4-star) petrol in a

vehicle with a catalytic converter - the lead will coat the precious metals' reagents, reducing their converting efficiency, and will eventually destroy the converter.

- b) Always keep the ignition and fuel systems well-maintained in accordance with the manufacturer's schedule.
- c) If the engine develops a misfire, do not drive the vehicle at all (or at least as little as possible) until the fault is cured.
- d) DO NOT push- or tow-start the vehicle - this will soak the catalytic converter in unburned fuel, causing it to overheat when the engine does start.
- e) DO NOT switch off the ignition at high engine speeds, ie do not 'blip' the throttle immediately before switching off.
- f) In some cases a sulphurous smell (like that of rotten eggs) may be noticed from the exhaust. This is common to many catalytic converter-equipped vehicles and once the vehicle has covered a few

thousand miles the problem should disappear. Low-quality fuel with a high sulphur content will exacerbate this effect.

- g) The catalytic converter, used on a well-maintained and well-driven vehicle, should last between 50 000 and 100 000 miles - if the converter is no longer effective it must be renewed.

Petrol and diesel models

- h) DO NOT use fuel or engine oil additives - these may contain substances harmful to the catalytic converter.
- i) DO NOT continue to use the vehicle if the engine burns oil to the extent of leaving a visible trail of blue smoke.
- j) Remember that the catalytic converter operates at very high temperatures. DO NOT, therefore, park the vehicle in dry undergrowth, over long grass or piles of dead leaves after a long run.
- k) Remember that the catalytic converter is FRAGILE - do not strike it with tools during servicing work.