

Chapter 7 Part B:

Automatic transmission

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Degrees of difficulty

Easy, suitable for novice with little experience



Fairly easy, suitable for beginner with some experience



Fairly difficult, suitable for competent DIY mechanic



Difficult, suitable for experienced DIY mechanic



Very difficult, suitable for expert DIY or professional



Specifications

General

Type	ECVT (Electronic Continuously Variable Transmission)	
Ratios (at transmission):		
Lowest	2.503	
Highest	0.497	
Final drive	4.647:1	

Torque wrench settings

	Nm	lbf ft
Earth cable	14	10
Control unit	5	4
Electro-magnetic clutch to flywheel	34	25
Transmission-to-engine bolt/nut	85	63

1 General information

1 The automatic transmission fitted is designated ECVT (Electronic Continuously Variable Transmission). The main components of the transmission are an electro-magnetic clutch, a variable-ratio coupling, a final drive/differential unit, and the associated control mechanisms (see illustrations overleaf).

2 The variable-ratio coupling consists of two pulleys and a flexible metal drivebelt. The effective diameter of the two pulleys can be varied to provide different transmission ratios between them.

3 During normal driving, the transmission automatically selects the ratio giving the best

compromise between economy and speed. When the driver depresses the accelerator pedal to the floor, a kickdown effect is provided, and the transmission selects a lower ratio for improved acceleration.

4 The gear selector control resembles that fitted to conventional automatic transmissions. The control positions are as follows:

P (Parking) The transmission is mechanically locked by the engagement of a pawl with a toothed segment on the driven pulley.

R (Reverse) Reverse gear is engaged.

N (Neutral) The transmission is in neutral.

D (Drive) Normal driving position. Transmission ratio is varied automatically to suit prevailing speed and load.

L (Low) Prevents the transmission

moving into high ratios.

Provides maximum acceleration and maximum engine braking.

5 The engine can only be started in positions P and N. A warning buzzer sounds if the selector is in any position other than P when the ignition is switched off or when the driver's door is opened.

6 The electro-magnetic clutch consists of a driving element bolted to the engine flywheel, and a driven element splined to the transmission input shaft. The degree of coupling between the two elements is determined by the intensity of a magnetic field generated by a current passing through windings in the driven element. The magnetic field acts on a layer of metallic powder between the driving and driven elements. When no magnetic field is present, the powder is loose and the two elements are effectively

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disconnected. As the magnetic field increases, the powder sticks together, and the coupling between the elements becomes increasingly rigid.

7 Selection of reverse, neutral and forward gears is by the movement of a sliding sleeve on a hub keyed to the drive pulley shaft. In forward gear, the sleeve engages with the gear on the end of the input shaft, which is then locked to the drive pulley shaft. When reverse is selected, the sleeve engages with reverse driven gear, which is in constant mesh with an idler gear driven by transfer gears from the input shaft gear. In neutral, the sleeve is in an intermediate position, and the

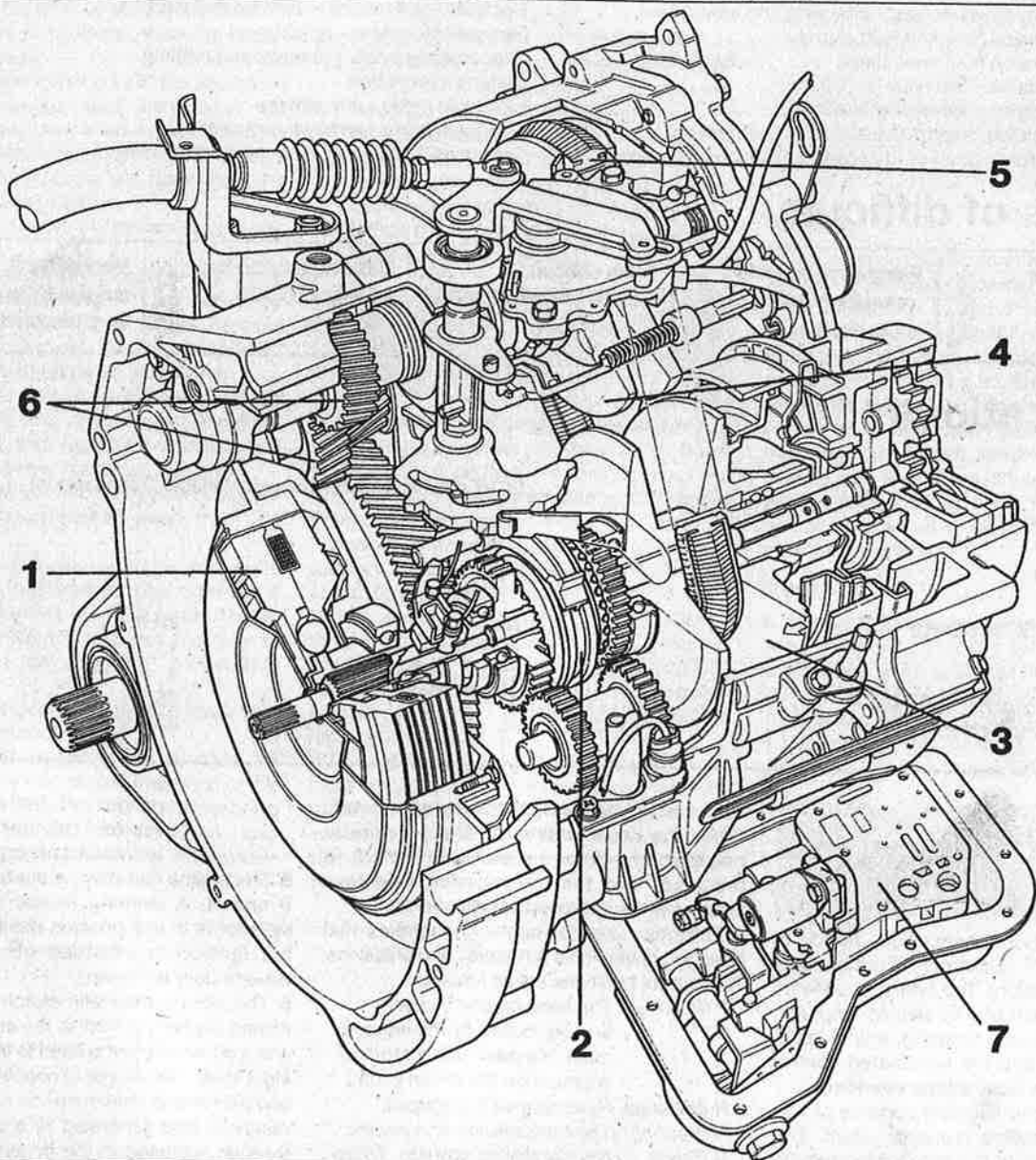
two shafts are not connected.

8 The drive pulley and driven pulley both consist of fixed and moving halves. The movement of the drive pulley halves is controlled hydraulically, while the driven pulley halves move under the influence of a spring and the tension exerted by the drivebelt. As the drive pulley opens, the driven pulley closes, and vice-versa. In this way, the transmission ratio between the two pulleys can be varied. The ratios are continuously variable between preset limits; the difference between the lowest and highest ratios available is approximately 5:1.

9 Hydraulic pressure is generated by a gear-

type pump inside the transmission. The pump driveshaft runs inside the input and drive pulley shafts, and is splined to the centre of the engine flywheel. This means that hydraulic pressure is only generated when the engine is running, which is why a car with this type of transmission cannot be push- or tow-started.

10 Application of hydraulic pressure to the pulley halves is via a control unit, which receives information on accelerator pedal position, transmission selector lever position, transmission ratio currently in use, and drive pulley speed. From this information, the control unit determines whether, and in which direction, to change the pulley ratios.



1.1a Cutaway view of the ECVT (electronic continuously variable transmission)

1 Electromagnetic clutch
2 Gear selector sleeve

3 Drive pulley
4 Driven pulley

5 Metal drivebelt
6 Final drive reduction gears

7 Hydraulic control unit

11 When reverse gear is selected, the control unit keeps the transmission in low ratio. If this were not the case, it would, in theory, be possible to drive as fast in reverse as in forward gear.

12 An electronic control unit supplies the current to energise the clutch. The control unit receives signals concerning engine speed, road speed, accelerator pedal position, and gear selector position. Sensors include the following.

- a) Engine rpm sensor (from the injection/ignition control unit)
- b) Accelerator pedal switch

- c) Throttle valve position sensor
- d) Selector lever position sensor
- e) Vehicle speed sensor
- f) Coolant temperature sensor
- g) Air conditioning sensor
- h) Brake switch
- i) Torque signal

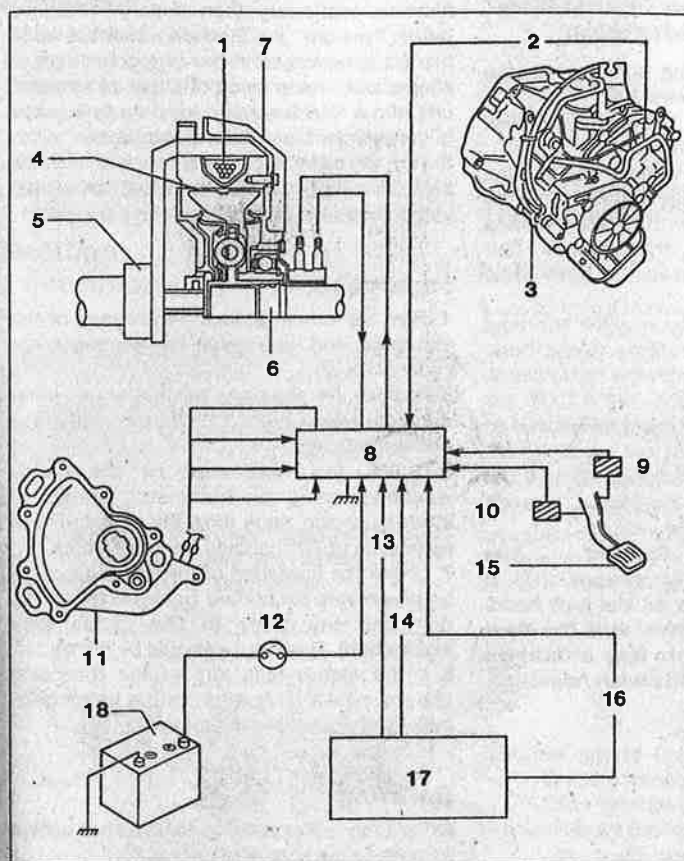
13 The final drive/differential unit is conventional. Drive from the driven pulley is transmitted to the differential by an intermediate reduction gear.

14 The ECVT incorporates a warning light which illuminates when a fault occurs.

Precautions

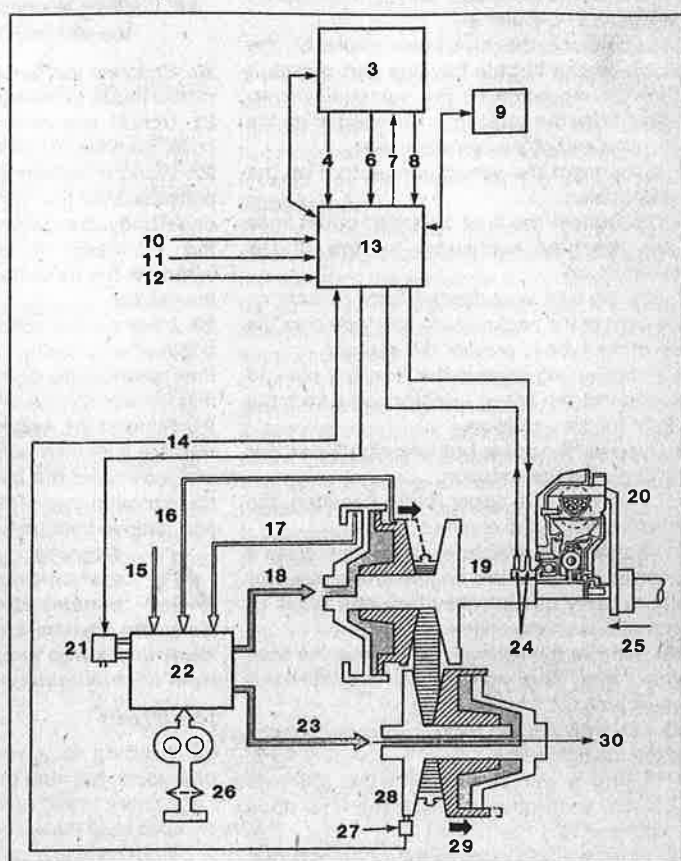
15 Observe the following precautions to avoid damage to the automatic transmission:

- a) Do not attempt to start the engine by pushing or towing the car.
- b) If the car has to be towed for recovery, the distance must not exceed 12 miles (20 km), and the speed must not exceed 19 mph (30 kph). If these conditions cannot be met, or if transmission damage is suspected, only tow the car with the front wheels clear of the ground.
- c) Only engage P or R when the vehicle is stationary.



1.1b Electromagnetic clutch control system

- | | |
|--------------------------------------|--|
| 1 Coil | 9 Accelerator pedal micro switch |
| 2 Signal from vehicle speed sensor | 10 Throttle valve opening position potentiometer |
| 3 Transmission | 11 Multifunction switch |
| 4 Electromagnetic powder | 12 Ignition switch |
| 5 Drive shaft (driven by crankshaft) | 13 Air conditioning signal |
| 6 Transmission input shaft | 14 Engine RPM signal |
| 7 Electromagnetic clutch housing | 15 Accelerator pedal |
| 8 ECVT control unit | 16 Coolant temperature signal |
| | 17 Injection/ignition control unit |
| | 18 Battery |



1.1c Hydraulic control system

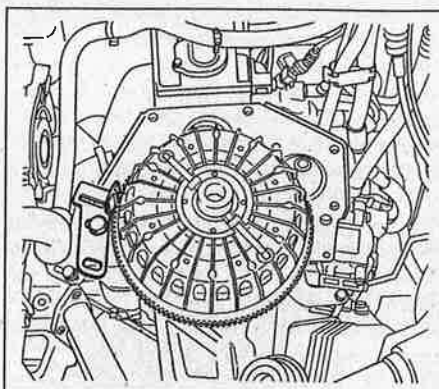
- | | |
|--|---------------------------------------|
| 3 Injection/ignition control unit | 16 Pulley ratio |
| 4 Air conditioner sensor signal | 17 Input shaft RPM |
| 6 Coolant temperature signal | 18 Primary oil pressure |
| 7 Clutch signal | 19 Primary pulley |
| 8 Engine RPM signal | 20 Electromagnetic clutch |
| 9 ECVT warning light | 21 Pressure regulating solenoid valve |
| 10 Selector lever position | 22 Oil pressure control valve |
| 11 Accelerator pedal switch/throttle valve potentiometer/torque signal | 23 Secondary oil pressure |
| 12 Brake switch | 24 Slip ring |
| 13 ECVT control unit | 25 Drive from engine |
| 14 Signal from vehicle speed sensor | 26 Oil pump |
| 15 Accelerator pedal position switch | 27 Vehicle speed sensor |
| | 28 Secondary pulley |
| | 29 Belt and pulley |
| | 30 Drive to driveshafts |

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2 Automatic transmission - removal and refitting

Removal

- 1 Select a solid, level surface to park the vehicle upon. Give yourself enough space to move around it easily. Apply the handbrake then jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove both front wheels.
- 2 Remove the battery and mounting tray as described in Chapter 5A.
- 3 Remove the air cleaner and air inlet duct as described in Chapter 4A.
- 4 Disconnect the kickdown cable at the sector on the throttle housing and detach it from the mounting on the camshaft cover. Also release the cable from the support on the left-hand end of the cylinder head.
- 5 Disconnect the wiring connectors on the transmission.
- 6 Disconnect the fluid inlet and outlet lines from the heat exchanger on top of the transmission.
- 7 Pull the fluid level dipstick from its tube on the front of the transmission and tape over the top of the tube to prevent dirt entry.
- 8 Unscrew and remove the retaining pin and disconnect the speed selector cable from the top of the transmission.
- 9 Unscrew the upper bolt securing the starter motor to the transmission.
- 10 Unscrew the upper bolts securing the transmission to the engine.
- 11 Support the weight of the engine using a hoist attached to the engine lifting eyes, or alternatively use a trolley jack and block of wood beneath the engine.
- 12 Remove the screws and remove the front wheel arch liner from under the left-hand wheel arch.
- 13 Unscrew the nut securing the earth cable to the transmission.
- 14 Using a punch drive out the roll pins securing both driveshafts to the final drive output shafts.
- 15 Unscrew and remove the bolts securing the left-hand swivel hub assembly to the front suspension strut, then separate the components and support the swivel hub on an axle stand.
- 16 Move the swivel hub assembly outwards and slide the inner end of the driveshaft from the splines on the transmission output shaft. Support the shaft away from the transmission to prevent damage to the gaiters.
- 17 Unscrew the Lambda/oxygen sensor from the exhaust downpipe and position it in a safe place to prevent damage.
- 18 Unscrew the nuts securing the downpipe to the exhaust manifold, then lower it and support on an axle stand. Recover the gasket.
- 19 Unscrew the knurled nut and disconnect the speedometer cable from the top of the final drive housing.



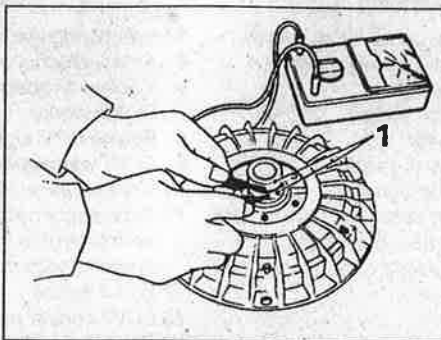
3.2 Locking the flywheel when removing the electromagnetic clutch

- 20 Unscrew the remaining bolt securing the starter motor to the transmission
- 21 Unbolt and remove the lower flywheel cover from the transmission.
- 22 Working beneath the vehicle, unscrew the bolts securing the rear engine mounting to the underbody then unscrew the bolts securing the mounting to the transmission and withdraw the mounting assembly from under the vehicle.
- 23 Unscrew the bolts securing the left-hand engine/transmission mounting to the body then unscrew the bolts from the transmission and remove the mounting.
- 24 Support the weight of the transmission on a trolley jack then unscrew the remaining nut and bolt from the bellhousing and pull the transmission away from the engine. Lower it and remove from under the vehicle.

Warning: Support the transmission to ensure that it remains steady on the jack head. Keep the transmission level until the input shaft and pump shaft are fully withdrawn from the electromagnetic clutch housing.

Refitting

- 25 Refitting is a reversal of the removal procedure, but note the following points.
 - a) Apply a smear of high-melting-point grease to the splines of the transmission input shaft and oil pump driveshaft.



3.6 Checking the resistance of the clutch windings

1 Slip rings

- b) Tighten all nuts and bolts to the specified torque, where given.
- c) Renew both driveshaft roll pins.

3 Electro-magnetic clutch - removal, inspection and refitting

Removal

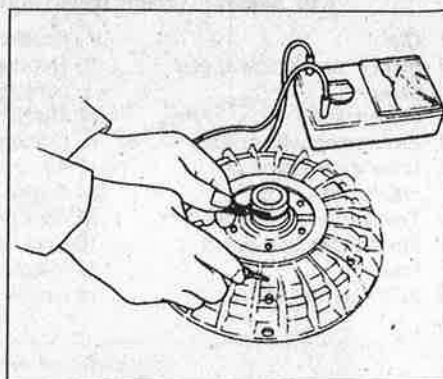
- 1 Remove the transmission as described in Section 2.
- 2 Turn the flywheel so that two of the four mounting bolts are accessible. Hold the flywheel stationary then unscrew the two bolts. To hold the flywheel, insert a wide bladed screwdriver in the ring gear teeth or alternatively use a piece of angle iron against one of the retaining bolts temporarily inserted in the cylinder block (see illustration).
- 3 Turn the crankshaft half a turn and unscrew the remaining bolts, then withdraw the electromagnetic clutch.

Inspection

- 4 Turn the driven element by means of the slip rings, and check that the bearing is not noisy or rough.
- 5 Inspect the slip rings for burning or other damage. Clean them if necessary using fuel and a clean rag.
- 6 Check the resistance of the clutch windings, using an ohmmeter connected across the slip rings (see illustration). The resistance at 20°C should be 2 to 4 ohms.
- 7 Check the insulation of the windings, using an ohmmeter connected between either slip ring and the body of the clutch (see illustration). Resistance should be infinity.
- 8 If the clutch fails any of the foregoing checks, renew it. Apart from the brush gear, individual spares are not available.

Refitting

- 9 Refitting is a reversal of removal but tighten all bolts to the specified torque.



3.7 Checking the insulation of the clutch windings

4 Electro-magnetic clutch brushes - removal, inspection and refitting

Removal

- 1 Remove the battery and battery tray as described in Chapter 5A.
- 2 Disconnect the wiring connector for the brushes. The brush holder is located near the dipstick tube.
- 3 Unscrew the mounting screws and withdraw the brush holder from the transmission (see illustration).

Inspection

- 4 Inspect the brushes. If they are worn down to the limit lines, or if they do not move smoothly in their holders, renew the brush carrier assembly (see illustration). **Note:** Be careful not to damage the brush supply leads when checking the brushes for free movement. It is not possible to renew the brushes separately.

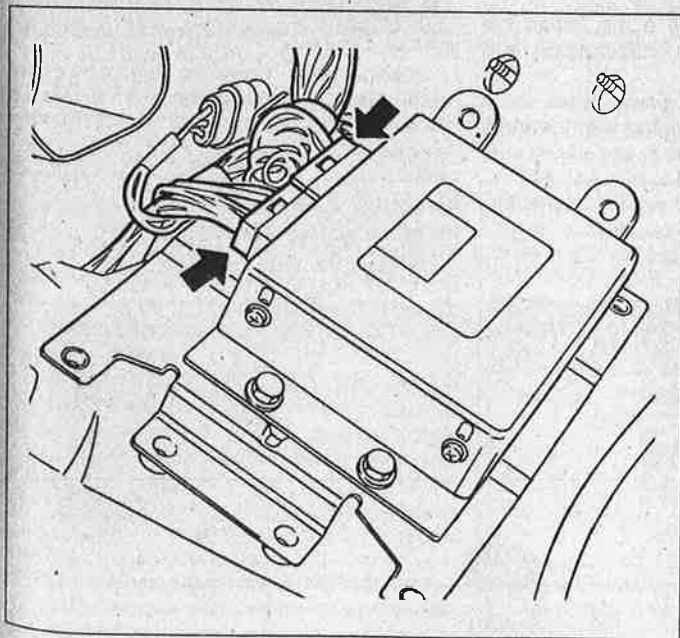
Refitting

- 5 Refitting is a reversal of removal.

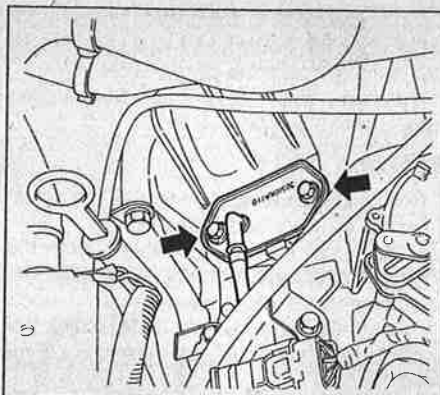
5 Electronic control unit - removal and refitting

Removal

- 1 Disconnect the battery negative terminal (refer to *Disconnecting the battery* in the Reference Section of this manual).



5.3 Wiring connectors on the electronic control unit



4.3 Brush holder mounting screws on top of the transmission

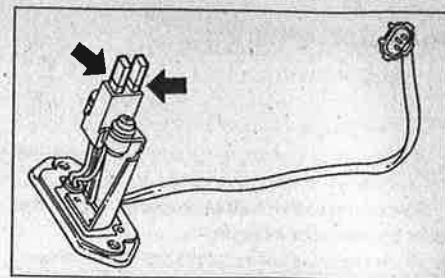
- 2 Unscrew the mounting screws and remove the centre console.
- 3 Unscrew the mounting bracket screws, lower the control unit then disconnect the two wiring connectors (see illustration). Withdraw the unit from inside the vehicle.

Refitting

- 4 Refitting is a reversal of removal.

6 Kickdown cable - removal and refitting

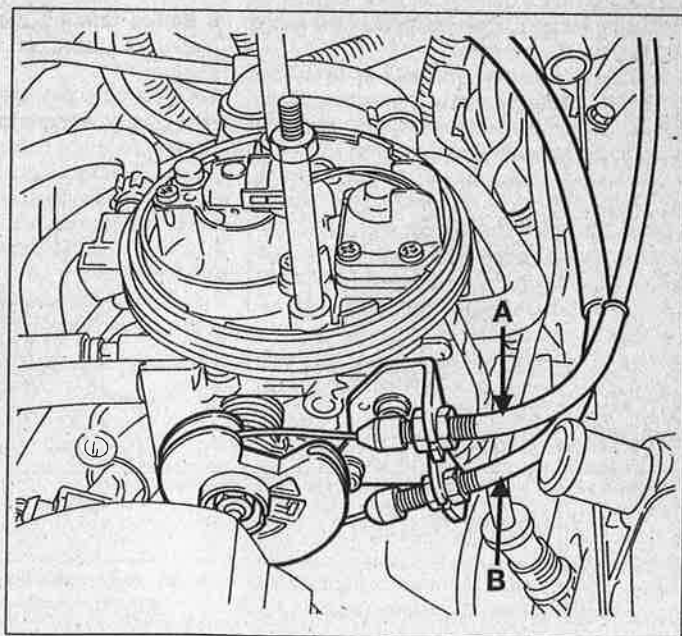
This operation involves the removal of the hydraulic control unit from inside the transmission. It should therefore be left to a Fiat dealer or other specialist.



4.4 Wear limit lines on the brushes

7 Kickdown cable - adjustment

- 1 Remove the air cleaner and air inlet duct assembly as described in Chapter 4A. The throttle cable is located on top of the throttle housing sector and the kickdown cable is located on the bottom of the sector (see illustration).
- 2 Turn the throttle housing sector fully clockwise so that the throttle is wide open, then position the kickdown outer cable so that its inner cable is slightly tensioned. Make the adjustment at the two adjustment nuts on the support bracket.
- 3 Check and if necessary adjust the accelerator cable as described in Chapter 4A.
- 4 Fully depress the accelerator pedal then check that there is approximately 0.5 to 1.0 mm free travel available on the kickdown cable. If necessary re-adjust the kickdown cable until it is set correctly.
- 5 Road test the vehicle and check for correct operation.



7.1 The throttle cable (A) is located on top of the throttle housing sector and the kickdown cable (B) on the bottom

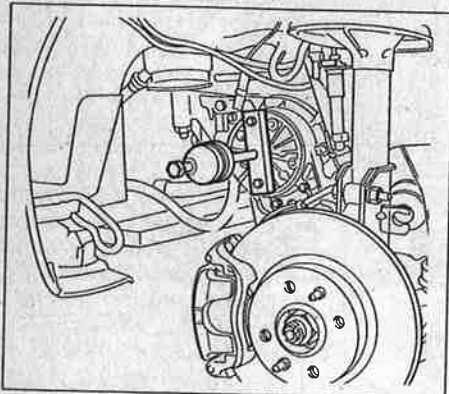
8 Gear selector cable - adjustment

- 1 Remove the battery and tray as described in Chapter 5A for access to the transmission.
- 2 Disconnect the selector cable from the lever on the transmission.
- 3 Move the selector lever inside the vehicle to the N (Neutral) position, then move the lever on the transmission to its central (Neutral) position. Locate the cable end over the lever. If the cable end fitting does not line up exactly with the hole in the lever, loosen the adjustment nut and reposition the end fitting.
- 4 With the adjustment correct reconnect the cable to the lever, then move the selector lever to the P (Park) position. Check that the lever on the transmission has also moved to the P position.
- 5 Refit the battery and tray as described in Chapter 5A.
- 6 Road test the vehicle, and check for correct operation in all selector lever positions.

9 Gear selector cable - removal and refitting

Removal

- 1 Using an Allen key, unscrew the screw and remove the selector lever knob from the lever.
- 2 Remove the oddment tray and the ashtray.
- 3 Remove the screws and withdraw the centre console and selector mechanism cover.
- 4 Unscrew the mounting screws, slightly lift the centre console, then disconnect the wiring and remove the console.
- 5 Remove the battery and tray as described in Chapter 5A for access to the transmission.
- 6 Disconnect the selector cable from the lever on the transmission.



10.4a Using a slide hammer to remove the oil pump from the transmission

- 7 Inside the vehicle disconnect the selector cable from the bottom of the selector lever then remove it from the support bracket.
- 8 Withdraw the cable into the engine compartment, and remove it.

Refitting

- 9 Refitting is a reversal of removal, but adjust the cable as described in Section 8.
- 10 Check that it is only possible to start the engine in positions P and N. Reposition the selector lever switch if necessary.
- 11 Road test the vehicle, and check for correct operation in all selector lever positions.

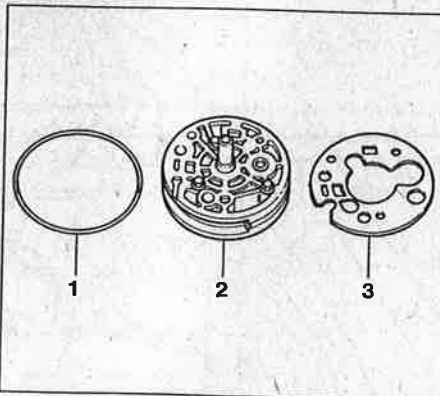
10 Transmission oil pump - removal and refitting

Removal

- 1 Apply the handbrake, then jack up the front of the vehicle and support on axle stands (see *Jacking and vehicle support*). Remove the left-hand wheel.
- 2 Unscrew the screws and remove the wheel arch liner.
- 3 Working through the left-hand wheel arch, remove the three bolts which secure the oil pump.
- 4 Attach a slide hammer to the oil pump, using the two tapped holes provided. Withdraw the pump using the slide hammer. Be prepared for some oil spillage. Recover the gasket and O-ring (see illustrations).
- 5 If the pump is defective, it must be renewed; no spares are available.

Refitting

- 6 Before refitting the oil pump, clean the mating surfaces of the transmission and pump.
- 7 Fit the oil pump, using a new gasket and a new O-ring. Secure the pump with the three bolts.



10.4b Automatic transmission oil pump O-ring (1), housing (2) and gasket (3)

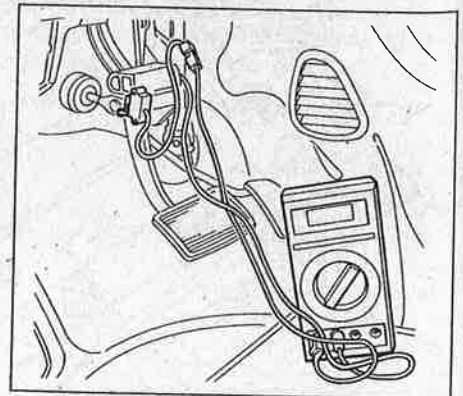
- 8 Refit the wheel arch liner, then refit the wheel and lower the vehicle to the ground.
- 9 Check the transmission fluid level as described earlier in this Section, and top-up if necessary.

11 Accelerator pedal micro-switch(es) - checking and adjustment

- 1 Correct adjustment of the micro-switch which senses the accelerator pedal position is essential for correct operation of the clutch. A quick check can be made by listening for the switch clicking as the accelerator is depressed. For an accurate check, proceed as follows.
- 2 Disconnect the microswitch wiring connector inside the vehicle. Connect a continuity tester across the terminals of the switch, located at the top of the pedal box (see illustration).
- 3 Remove the air cleaner and air ducting as described in Chapter 4A.
- 4 With the accelerator pedal released, the switch must be closed (zero resistance). Slowly depress the pedal, and check that the switch opens when the throttle valve on the throttle housing is 30° open. This will occur when the pedal has travelled between 3 and 7 mm. Adjust the switch position if necessary.
- 5 If the switch is permanently open or permanently closed, and adjustment makes no difference, renew it.
- 6 Remake the original wiring connections on completion.

12 Automatic transmission - overhaul

Apart from the operations described earlier in this Section, transmission overhaul should be entrusted to a Fiat dealer or transmission specialist.



11.2 Continuity tester connected across the accelerator pedal micro-switch