VEHICLE IDENTIFICATION 00

Index

GENERAL DESCRIPTION

The Ford Capri 2,8 'Injection' is a high performance luxury two door coupe with an opening rear tailgate.

The car can be identified by the unique bodyside coachlining; two-tone tape stripe and tailgate "2,8 Injection" decal.

The Capri 2,8 'Injection' is fitted with a 2,8 litre V6, fuel injected petrol engine. Power assisted steering is a standard fitment as is breakerless ignition.

A four speed manual gearbox is standard equipment on the Capri 2,8 'Injection' model. Automatic transmission is not available as the torque characteristics of the high performance engine are not suited to an automatic transmission.

The vehicle is fitted with a polyurethane tailgate air spoiler to improve the aerodynamics of the body. It does this by smoothing out the airflow and turbulence behind the car and thus giving improved fuel economy, roadholding, acceleration and top speed.

The exterior door mirrors fitted to this model are finished in the same colour as the rest of the car, with the option of electric control of the passenger side mirror.

The handling of the Capri 2,8 'Injection' is taken care of by the special alloy 7 x 13 wheels fitted with high speed, ultra low profile 205/60 VR x 13 tyres, complemented by uprated suspension and braking systems.

Note: Snow chains should not be used with the 205/60 VR x 13 tyres as these have reduced running clearances. Alternative wheels (185/70 VR x 13 tyres on 5,5 x 13 steel rims) are available if 'thin' snow chains are required.

The Capri 2,8 'Injection' has been specially engineered for its high performance and not specifically engineered for towing ability. Towing of either caravans or trailers is therefore not recommended.

GENERAL DESCRIPTION (cont'd)

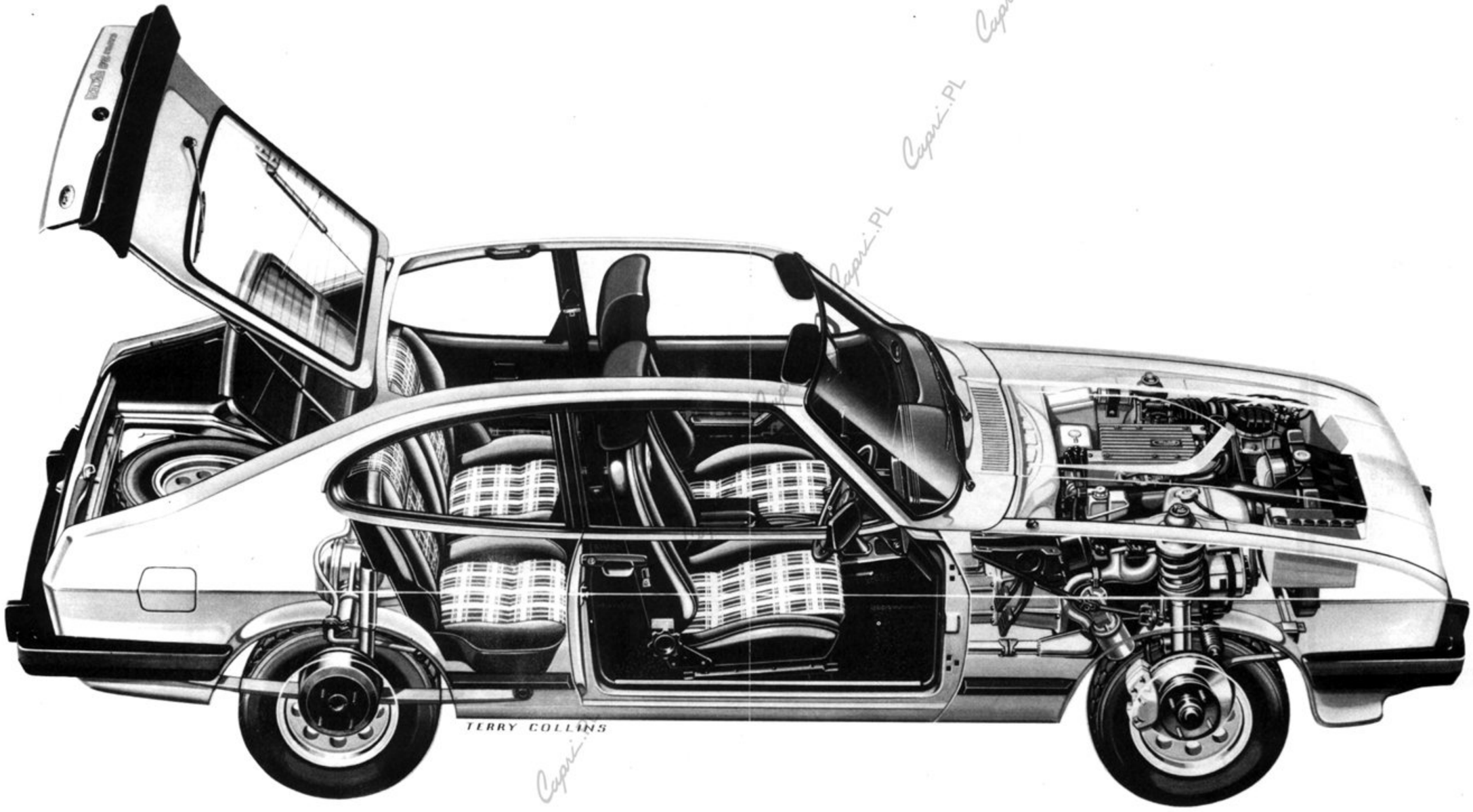
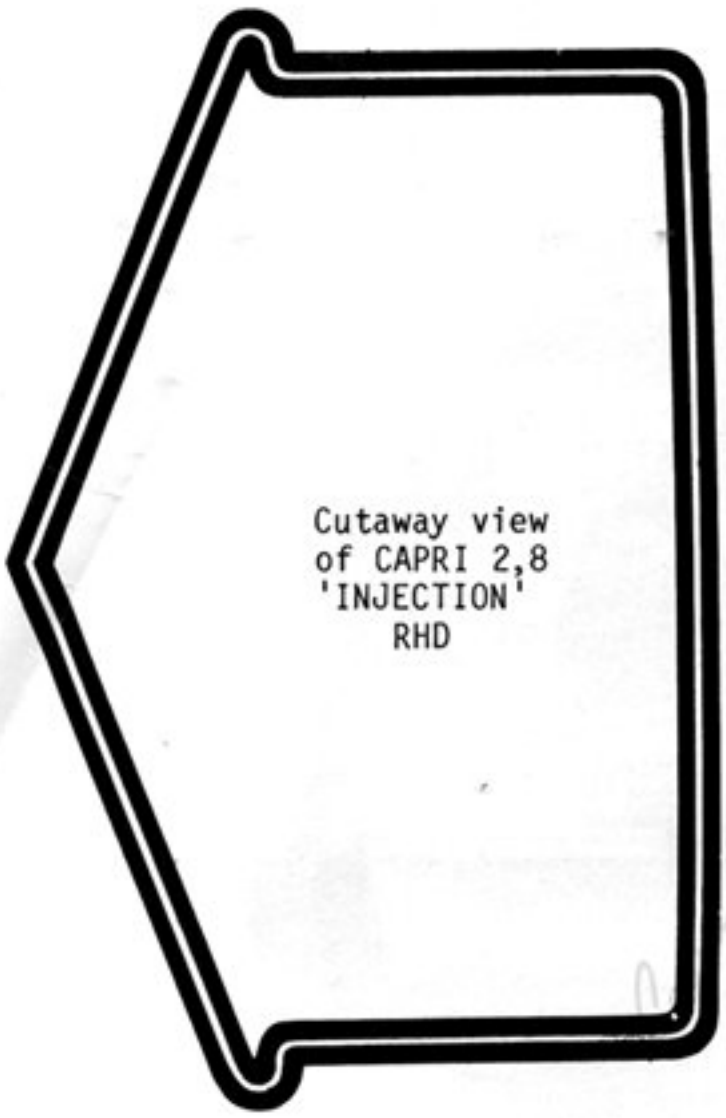


Fig.1. Cutaway of Capri 2,8 'Injection' RHD.



Cutaway view
of CAPRI 2,8
'INJECTION'
RHD

GENERAL DESCRIPTION (cont'd)

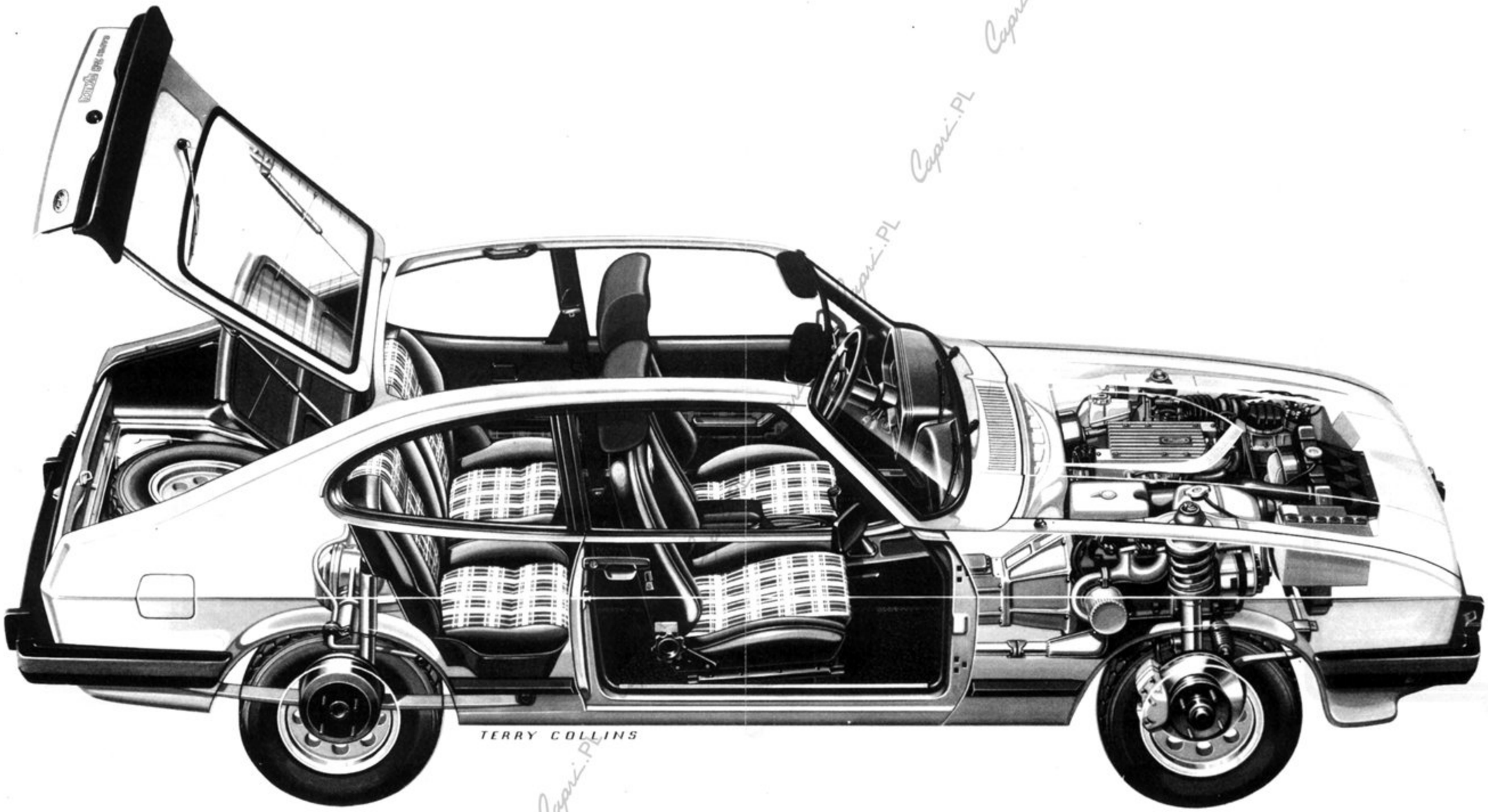
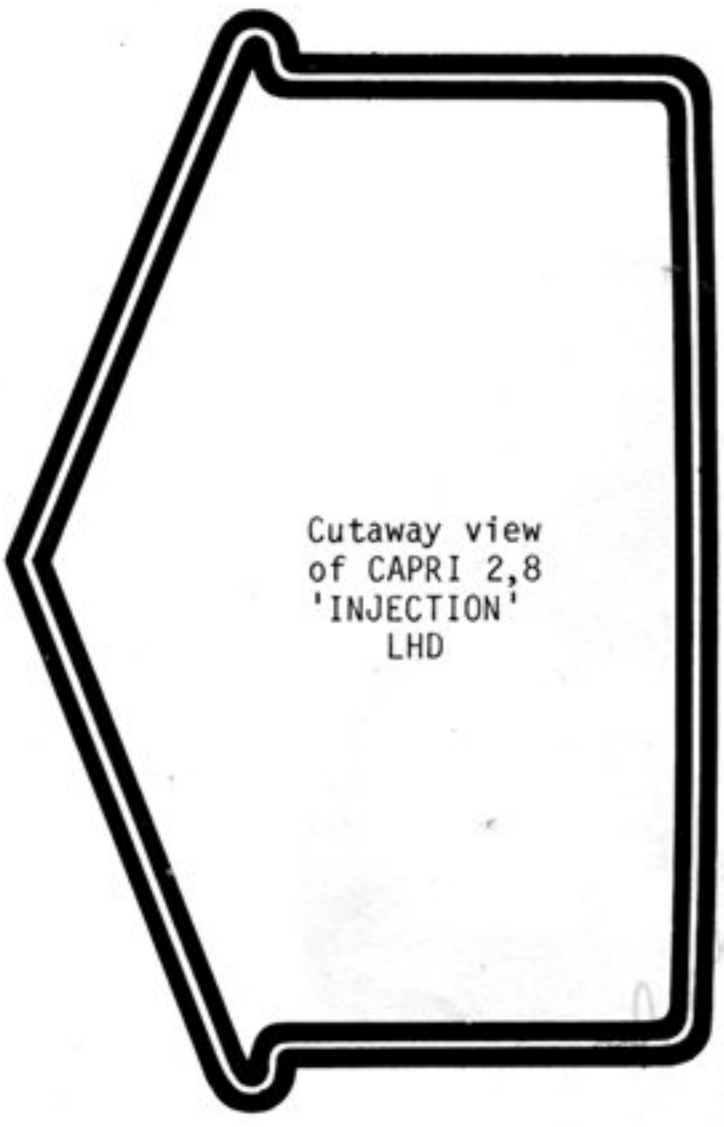
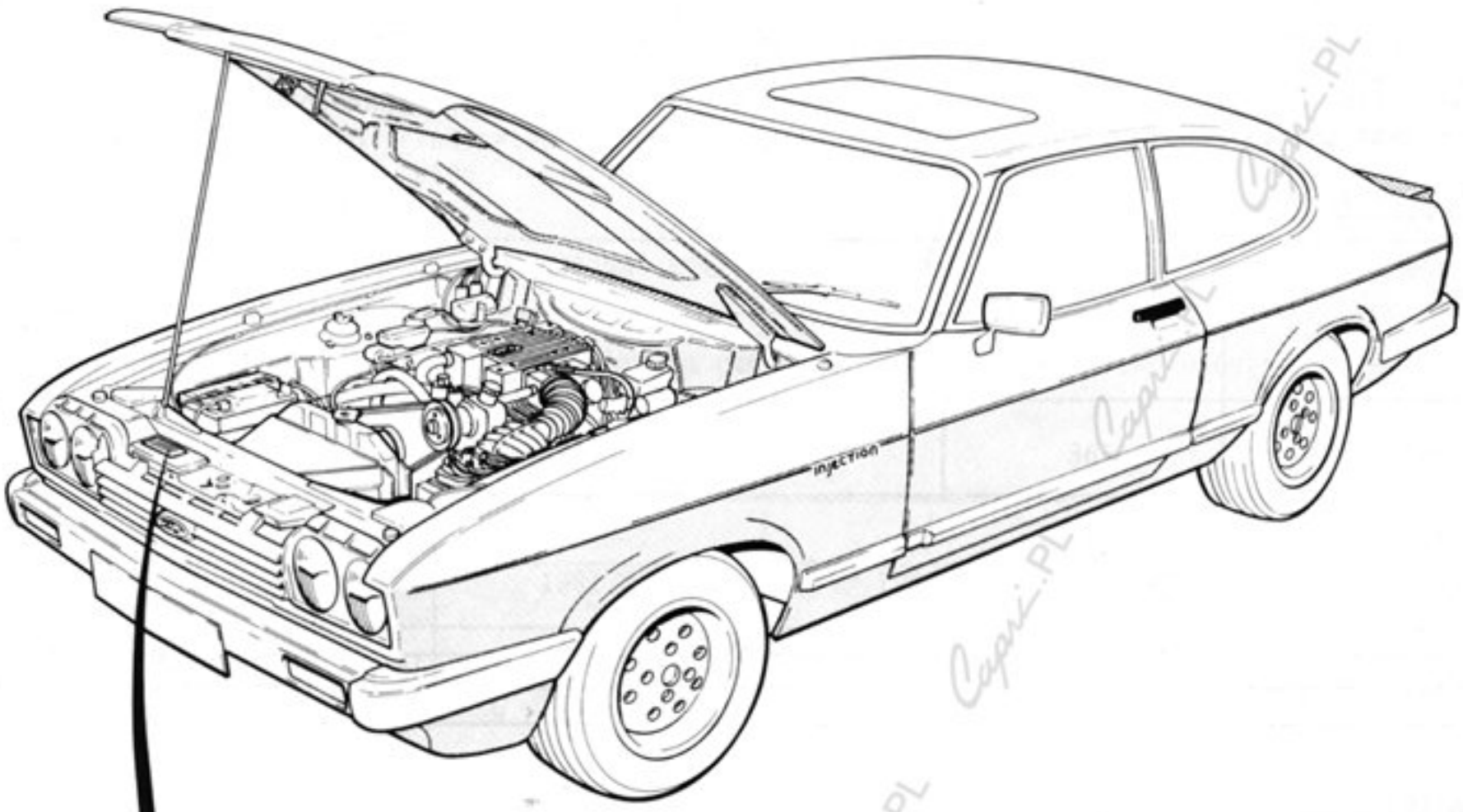


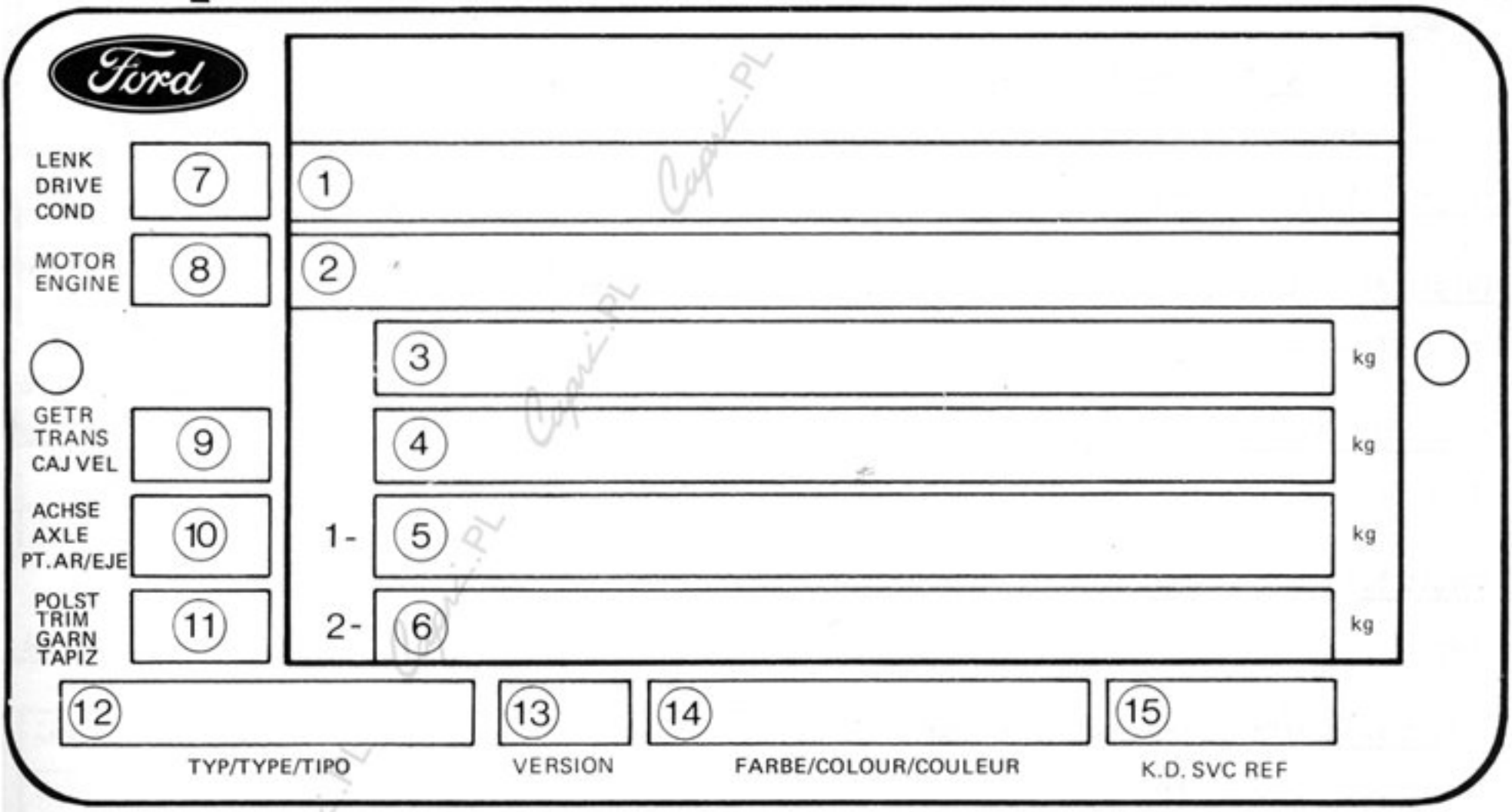
Fig.2. Cutaway of Capri 2,8 'Injection' LHD.



Cutaway view
of CAPRI 2,8
'INJECTION'
LHD

CODE DEFINITION





CAI/00/3

Fig.3. VIN Plate location.

CODE DEFINITION (cont'd)

The vehicle identification plate which is rivetted to the front upper cross-member of each vehicle - as shown in Fig.3, consists of alpha-numerical codes which are explained on the following pages. These codes indicate details of vehicle specifications in respect of type, permissible loading weights, engine, gear ratio, body paint colour, trim within the vehicle etc. and are therefore useful for spare parts procurement purposes.

(Box 1)TYPE APPROVAL NUMBER

Derivative	Type Approval Number			
	U.K.	Germany	Belgium & Luxemburg	Netherlands
2,8 V6 Injection	TBE	9052/3	41365	TBE

(Box 2) VEHICLE IDENTIFICATION NUMBER (VIN)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
*	A	A	A	B	C	C	D	E	F	G	H	I	J	J	J	J	J	*

(Digit 1 & 19): Constant asterisk - *

A) (Digit 2 - 4): World Manufacturer Indicator

Ford Werke A.G. - West Germany - WF0

B & G) (Digit 5 & 11): Model Variant

C - 2 door coupe

C) (Digit 6 & 7): Constant X

D) (Digit 8): Product Source Company

G - Ford of Germany - Own assembly

E) (Digit 9): Assembly Plant

A - Cologne

F) (Digit 10): Model Range

E - Capri

H) (Digit 12): Date of Manufacture - Year

B - 1981 C - 1982 D - 1983

I) (Digit 13): Date of Manufacture - Month

	JA	FE	MA	AP	MA	JU	JU	AU	SE	OC	NO	DE
1981	J	U	M	P	B	R	A	G	C	K	D	E
1982	L	Y	S	T	J	U	M	P	B	R	A	G
1983	C	K	D	E	L	Y	S	T	J	U	M	P

J) (Digit 14 - 18): Vehicle Sequence Number - Five digits

CODE DEFINITION (Cont'd)

(Box 3) GROSS VEHICLE MASS Indicates maximum legal laden mass, in territories where this is required.

(Box 4) GROSS TRAIN MASS Indicates the maximum combined mass of vehicle and trailer or caravan. (See page 00-2.)

(Box 5) PERMITTED FRONT AXLE LOADING Maximum permissible mass on the front wheels of the vehicle.

(Box 6) PERMITTED REAR AXLE LOADING Maximum permissible mass on the rear wheels of the vehicle.

(Box 7) STEERING

Code	1	A	2	B
Build year	1981/83	1980/82	1981/83	1980/82
Drive	Left-hand drive		Right-hand drive	

(Box 8) ENGINE:

Code	PR
Type	OHV/V6
Capacity, PS(kW)	2,8 HC 160(118)

(Box 9) TRANSMISSION

Code	B
Type	manual 4 speed

(Box 10) AXLE

1st code	L
Axle ratio	3,09:1

(Box 11) INTERIOR TRIM (1981 Model year only)

Code	T	G
Colour	Shark Grey	Blue

CODE DEFINITION (cont'd)

(Box 12) TYPE

1st letter	2nd letter	3rd letter	4th letter	5th-8th letter
Product Source	Model	Body type	Year of homologation	28 = 2,8 litre
G - Germany	E - Capri	C - 2 door coupe	P - 1974	Belgium & Luxemburg only

(Box 13) VERSION Provision for locally required codes by certain territories.

(Box 14) BODY COLOUR (1981 Model Year only)

Code	B1	R1	X1
Standard Colour	Diamond White	Venetian Red	Midnight Blue

Code	V1	41	31	61	91
Metallic Colour	Strato Silver	Forest Green	Cobalt Blue	Crystal Green	Graphite Grey

(Box 15) K.D. REFERENCE Usually blank, filled in by Export assembly country only.

LICENCE PLATE MOUNTING

The necessary parts required for fixing licence plates to unregistered vehicles will be found in a plastic bag placed in the vehicle glove box.

FITTING INSTRUCTIONS

U.K, GERMANY and territories not specified below

Drill or pierce licence plate with two holes at 230 mm between hole centres, each one 115 mm from the vertical centre line of the plate and on the horizontal centre line.

Front

Fit the grommet supplied to the hole in the centre of the bumper. Press the two expanding nuts supplied firmly into the square holes in the front bumper. Screw the licence plate to the expanding nuts with two screws.

Rear

Check that the sealing tape is in place over the panel holes. Failure to ensure a correct fit could lead to water leaks. Press the two blind anchor nuts into the holes then fit the plate to the body using two screws and four sealing washers.

ITALY ONLY

Front

Press the two expanding nuts supplied firmly into the square holes in the front bumper. Attach brackets to the expanding nuts using two screws. Place licence plate on brackets and align brackets so that the plastic rivets supplied can be inserted into the brackets through the licence plate. Insert all four rivets and fix in place by driving the centre stem into the rivet body.

Rear - As UK and others.

FRANCE ONLY

Front

Press the two expanding nuts supplied firmly into the square holes in the front bumper. Attach brackets to the expanding nuts using two screws. Drill licence plate with 4 holes, 4,85 mm diameter to line up with the two holes in each bracket, apply corrosion resistant paint. Push four 4,8 mm blind rivets through plate and brackets. Check horizontal alignment of plate and set rivets in place.

Rear

Check the sealing tape applied to the holes in the rear panel, ensuring a water tight fit. Align the plate with the mounting area and drill two 4,8 mm holes symmetrically along horizontal centre line 400 mm apart, into the body panel, avoiding licence numerals. Fix plate by passing 4,8mm blind rivets through plate into body panel and setting in place.

SWITZERLAND ONLY

Front - As UK and others.

Rear

Check that the sealing tape is in place over the panel holes. Failure to ensure a correct fit could lead to water leaks. Press the two blind anchor nuts into the holes, ensure that anti rattle tape is applied to body panel to prevent licence plate vibrating then fit the plate to the body using two screws and two sealing washers.

FUEL CONSUMPTION

Certain territories require that, for new petrol-engined passenger cars, official fuel consumption figures are included in service literature intended for presentation to the first purchaser of the vehicle.

The fuel consumption of each class of car is determined in accordance with specified test procedures and three sets of data are given.

a) Simulated Urban Driving (ECE 15 cycle, see below for details)

b) Constant Speed Driving at 90 km/h (56 mph)

c) Constant Speed Driving at 120 km/h (75 mph)

A passenger car prepared for testing shall have been run-in and driven for at least 3000 km (1850 miles), it shall be clean, have its windows and air intakes closed, have any manually controlled device on the carburettor inlet in the "Summer" position, have in use only the equipment necessary for normal operation, have its heating system or air conditioner system switched off and have any temperature controlled radiator fan or any supercharger in the normal operation condition. The tyres shall be a type normally fitted and inflated to the manufacturer's recommended pressures.

In addition to the above, the driving weight of the car, the type of fuel used, the lubricants used and the ambient air conditions during the test are controlled by the Regulations.

SIMULATED URBAN DRIVING

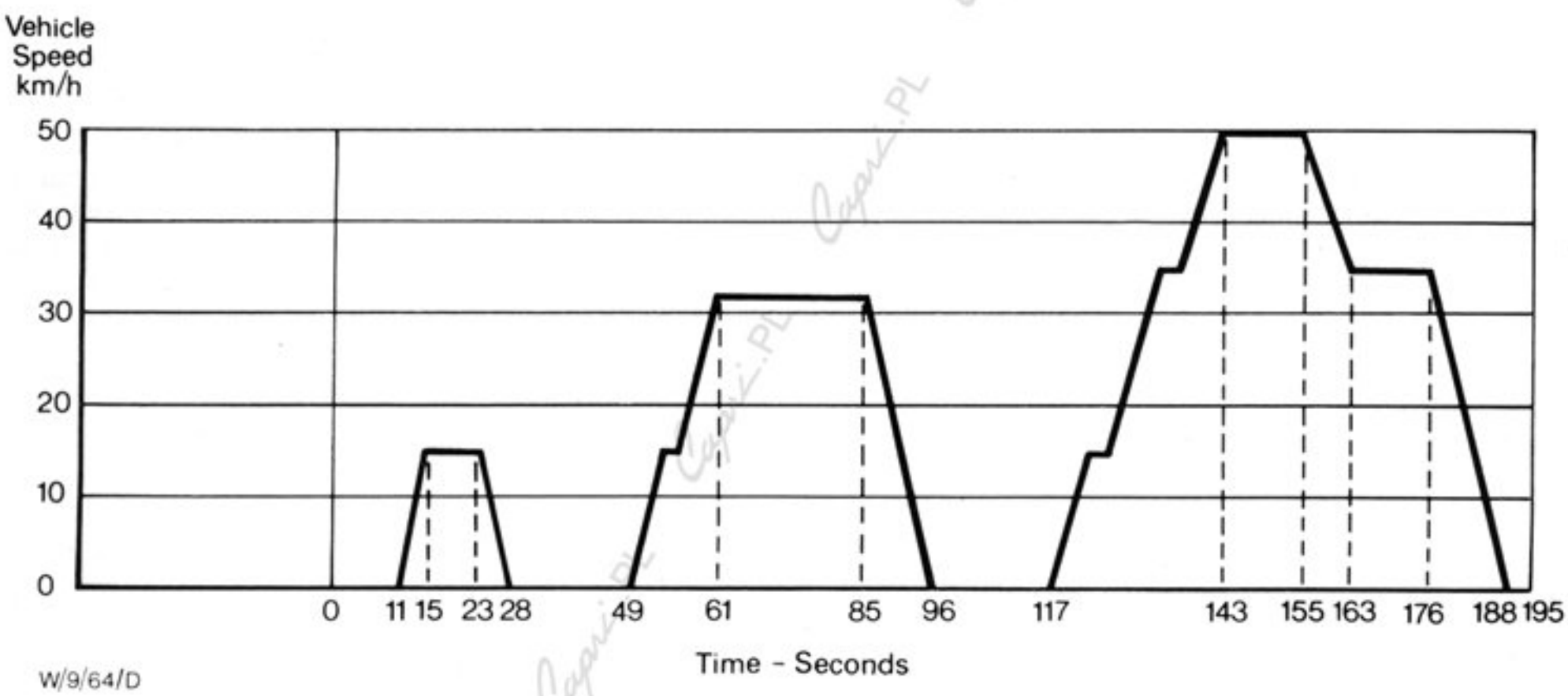


Fig.4. Simulated Urban Driving (ECE 15 Cycle)

Prior to starting, the vehicle must not be used for 6 hours (cold soak). After cold start it is allowed to idle for 40 seconds before the test commences. The test cycle shown in Fig.4. can be described below:
Idle for 11 seconds, accelerate in 1st gear to 15 km/h (9,4 mph) in 4 seconds, maintain this speed for 8 seconds, decelerate to rest in 5 seconds. Idle for 21 seconds, accelerate to 32 km/h (20 mph) in 12 seconds (changing from 1st to 2nd gear at 15 km/h) hold this speed for 24 seconds, decelerate to rest in 11 seconds. Idle for 21 seconds, accelerate to 50 km/h (31,2 mph) in 26 seconds (changing from 1st to 2nd at 15 km/h and 2nd to 3rd at 35 km/h), hold this speed for 12 seconds, decelerate to 35 km/h (21,9 mph) in 8 seconds and hold this speed for a further 13 seconds, change to 2nd gear and decelerate to rest in 12 seconds. Idle for a final 7 seconds. To complete the cycle, the test is repeated a further three times without interruption. The total test cycle time is 13 minutes, the average speed is 19 km/h (11,9 mph) and the distance covered is 4,052 km (2,5 miles).

FUEL CONSUMPTION (cont'd)

OWNER LITERATURE

To comply with the requirements of the Regulations, for certain territories, as required by the Regulations, Ford Car Owner Handbooks contain official fuel consumption figures.

The results recorded in the approved tests for determining fuel consumption carried out on the range of models to which this manual is applicable are as follows:

The results do not express or imply any guarantee of the fuel consumption of any particular car. Individual vehicles are not tested and there are inevitablydifferences between different cars of the sam model. In addition, any car may incorporate particular modifications. Furthermore the driver's style and road and traffic conditions as well as the extent to which the car has been driven and the standard of maintenance will all affect its fuel consumption.

MODEL/ ENGINE	BODY STYLE	DERIV-ATIVE	TRANS-MISSION	FINAL DRIVE	TYRE SIZE
2800 HC	Coupe	'Injection'	Man	3,09:1	205/60VRx13

FUEL CONSUMPTION					
Miles per Gallon			Litres per 100 km		
A	B	C	A	B	C
19,1	34,9	27,4	14,8	8,1	10,3

A = Simulated Urban Driving (ECE 15 cycle)
B = Constant Speed Driving at 56 mph (90 km/h)
C = Constant Speed Driving at 75 mph (120 km/h)

ENGINE 21B

(2,8 litre V6 Injection Engine)

Index

GENERAL DESCRIPTION

From January 1981, the CAPRI vehicles can also be equipped with a 2,8 litre OHV/V6 engine with Bosch K-Jetronic fuel injection system.

OHV = Overhead valves.

This section only describes those service and repair operations which differ because of the installation of the injection system, from those for the V6 engines (Type 'C') already dealt with in Section 21 of the Capri '74 Onwards Workshop Manual. In addition, the special tools needed and the Technical Data for this engine are listed.

For simplicity, the engine will be referred to in the following descriptions, as is the case in other workshop manuals, briefly by a one-letter engine code.

The table below shows which engine is installed.

Engine Summary.

Cubic capacity, litres	Compression ratio	Type	kW (HP)	Engine code, Vehicle plate	Engine code Workshop Manual
2,8 FI	HC	OHV/V6	118 (160)	PRN	C

HC = High compression = (only suitable for super grade fuel) (97 Octane - 4 star)

GENERAL DESCRIPTION (cont'd)

The "C" engine is a water-cooled, 6-cylinder, 4 stroke petrol engine in 60° V-formation. The overhead valves are operated by tappets, push-rods and rocker arms.

The camshaft, running in bronze bushes, is located centrally in the cylinder block and is driven by spur gears.

The camshaft drive gear-wheel for the ignition distributor and oil pump is located in front of the rear bearing of the camshaft.

The cylinder heads, which incorporate the combustion chambers, are of cross-flow design, i.e. fresh fuel-air mixture is drawn from one the side and burned gas is passed to the exhaust system on the other side.

The end-float of the four-bearing crankshaft is determined by flanged bearing shells on the third bearing (guide bearing).

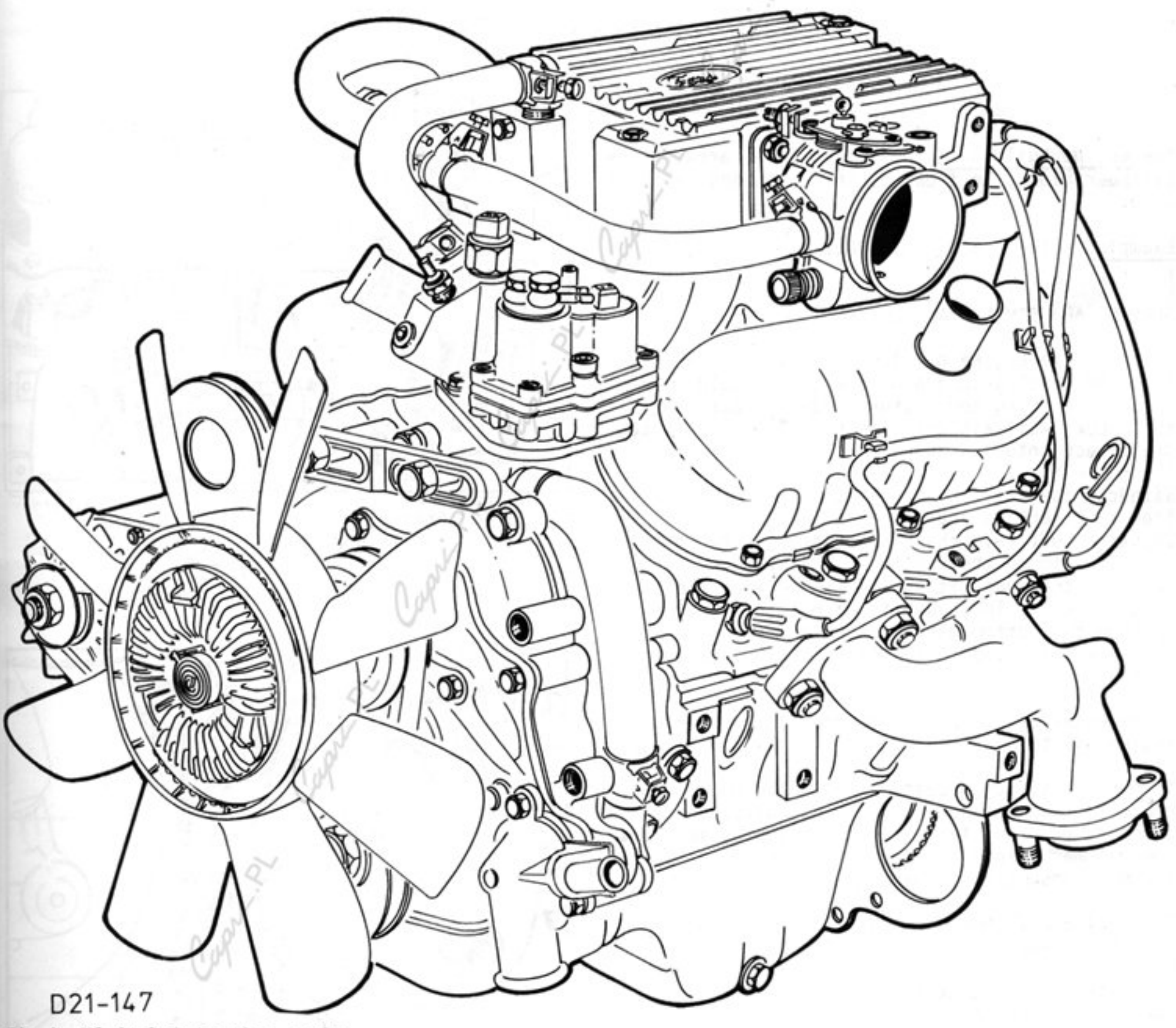


Fig.1. V6 fuel-injection engine.

GENERAL DESCRIPTION (cont'd)

Engine identification code and engine serial numbers

Regulations in force in certain countries demand that engines be marked with identification codes and serial numbers. Fig.2. shows where this data should be marked on the engine. Minimum height of letters and numbers is 6 mm and both codes and serial numbers (e.g. on replacement engines) should be marked in such a manner that they can be clearly recognised by the appropriate testing authorities, thereby preventing rejection of engines.

The engine number consists of a two-digit build year/build month code and a 5-digit serial number (see Section 00 - Vehicle Identification). A five-point star is stamped before and after the complete seven-digit engine number.

The engine code comprises capacity and compression ratio data and also indicates the vehicle type to which engines are fitted.

Example: P = 2,8 litre
R = high compression
N = Capri

The engine build date is stamped on an area of the cylinder block, in front of the left-hand cylinder head.

Example: = 1B4 = 4th Feb. 1981.

SERVICE ADJUSTMENTS AND CHECKS

To check the engine oil level the vehicle should stand on level ground and te engine should be at normal operating temperature. Before carrying out the check, wait a short time to allow all oil to drain back into the sump.

Withdraw the dipstick, wipe it clean with a lint-free rag, replace and withdraw it again. (The dipstick must have the ring pointing outwards). The oil film on the dipstick indicates the oil level in the sump; it should lie between the two marks, Fig.3. The quantity of oil required on top up from the bottom mark to the top mark is approximately 0,75 to 1,0 litres (1,3 to 1,75 pints).

If necessary, top up through the filler neck with engine oil to FORD specification.

Topping up is not necessary until the oil level drops to the bottom marks. Do not allow the oil level to drop any further. Never top up to above the top mark since the excess oil is wasted, i.e. the oil consumption is increased.

The engine oil should be changed and the oil filter renewed at least every 10,000 Km (6000 miles). If conditions of use are severe, e.g. short trips, frequent starts from cold, dusty roads etc., the oil should be changed and the oil filter renewed at shorter intervals.

If the specified engine oil is not used the inevitable consequence will be excessive wear or damage to the engine. The oil film becomes discontinuous and engine components under high thermal stresses are subject to increased wear. Residues collect in the sump and block the oil passages. In addition, poor quality oil does not protect against corrosion so that rust forms on the cylinder walls. After a relatively short time the efficiency of the engine will decrease and there will be increasing fuel and oil consumption.

Always use a branded oil complying with FORD specification (Refer to Technical Data).

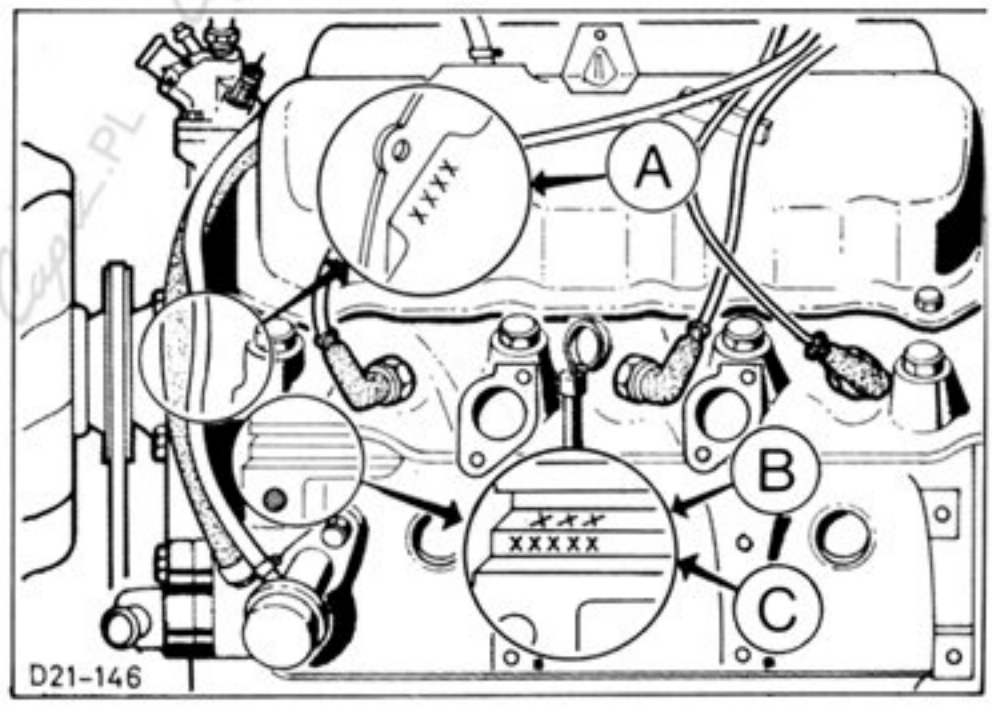


Fig.2. 'C' Engine.
A - Build code
B - Engine code
C - Engine number

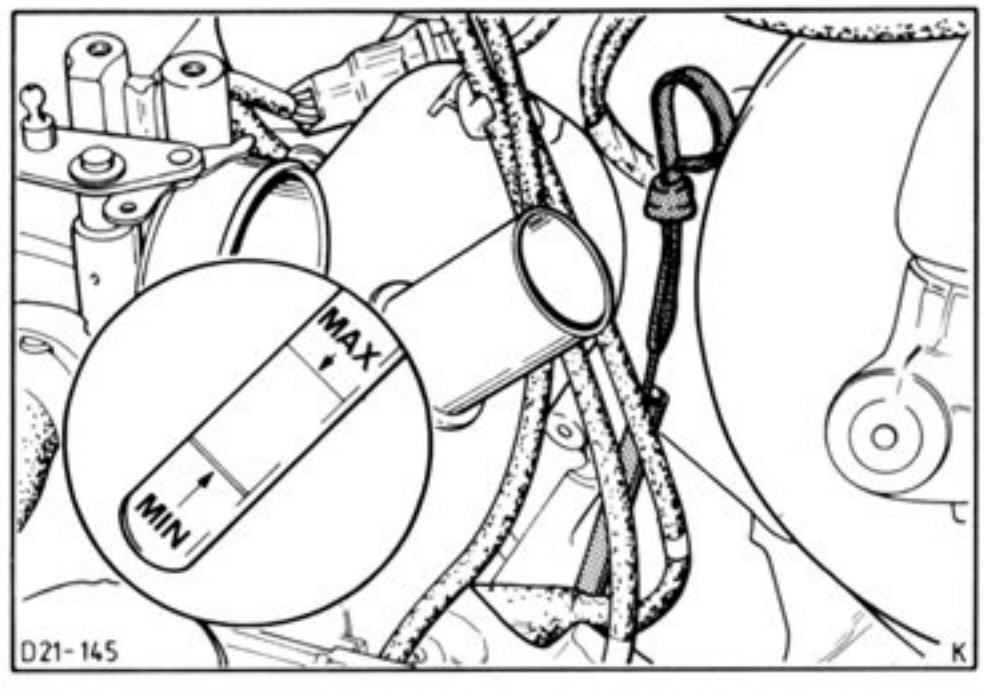
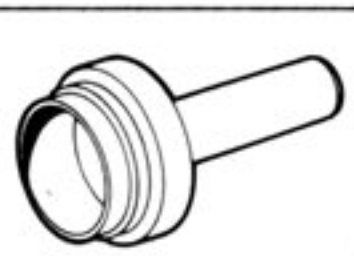
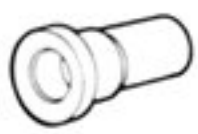
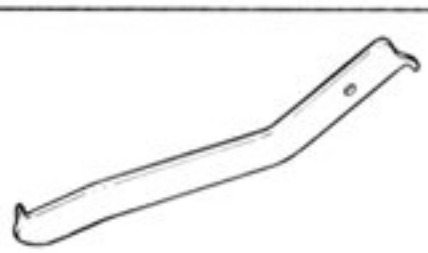


Fig.3. Dipstick.

SPECIAL SERVICE TOOL RECOGNITION

	21-014	Piston pin installer
	21-023	Universal spindle (only in conjunction with engine stands)
	21-037-A	Flywheel bearing remover
	21-056	Valve spring compressor
	21-057	Valve retainer
	21-059	Crankshaft rear oil seal replacer
	21-063	Crankshaft front oil seal replacer
	21-064	Engine mounting bracket (only in conjunction with 21-023)
	21-067-A	Flywheel bearing replacer and clutch disc locator
	21-068	Engine lifting bracket

SPECIAL SERVICE TOOL RECOGNITION (cont'd)

	21-069	Front cover oil seal replace and aligning ring
	21-070	Front cover oil seal extractor and aligner
	21-071 - 21-074	Valve guide reamers, 0,2 to 0,8 mm oversize
	21-092-A	Intake manifold wrench
	21-096	Crankshaft front oil seal extractor

SERVICE AND REPAIR OPERATIONS CONTENT

ENGINE		Described in this Publication	Contained in operation	Also applicable to certain variants in the following model range:				
				FIESTA	ESCORT '81	CAPRI '78	TAUNUS / CORTINA '80	GRANADA '78
21 134	Engine assembly - remove and install	X						
21 134 ö	Engine assembly - dismantle and reassemble (engine removed)	X						X
21 154	Sump - remove and install	X						X
21 164	Cylinder heads - remove and install	X						X
21 213	Valve clearances - adjust	X						X
21 238	Seals - valve stem - replace (all)	X						X

SERVICE AND REPAIR OPERATIONS

21 134 ENGINE ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

To Remove

1. Disconnect earth cables from battery and engine, remove hood (4 bolts).

2. Drain coolant by disconnecting lower radiator hose from water-pump neck and upper hose from radiator, Fig.4.

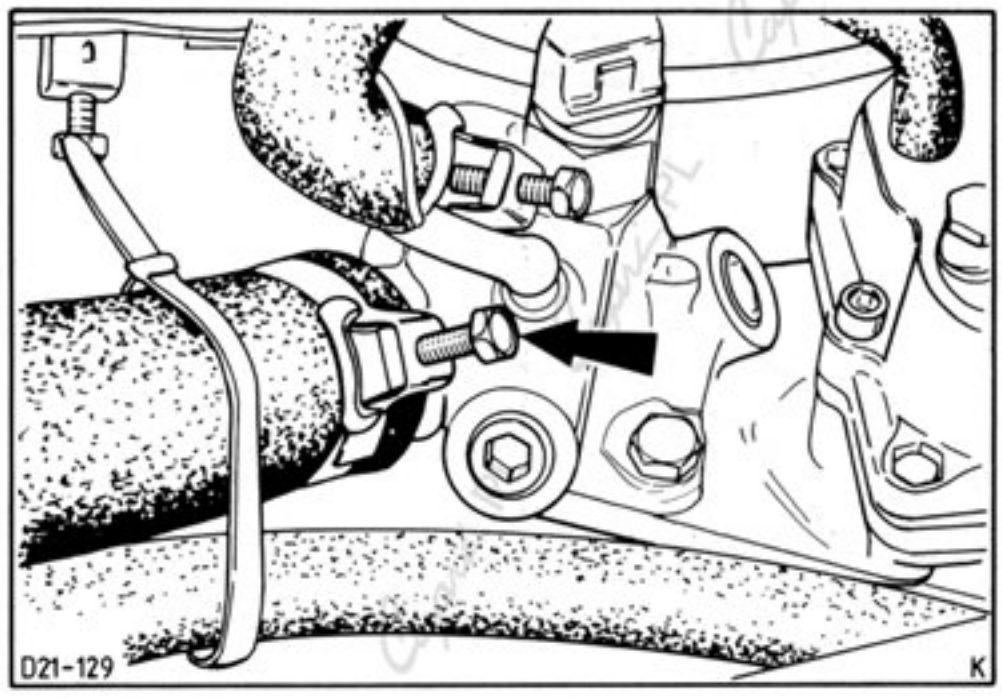


Fig.4. Disconnect upper radiator hose.

3. Disconnect expansion tank coolant hoses from the radiator and from the intermediate section of the auxiliary air device. Remove from bracket.

4. Unscrew splash shields, Fig.5. and fan shroud (5 and 4 bolts respectively). Unbolt radiator (4 bolts) and lift out with shroud.

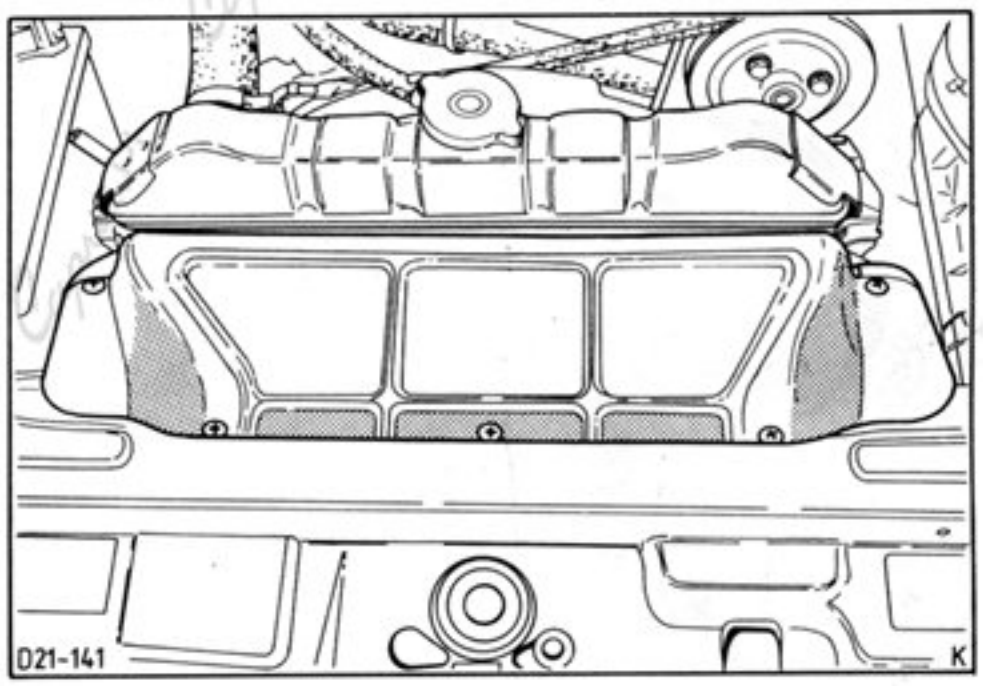


Fig.5. Remove splash shield.

5. Disconnect hot-water hose from the intermediate section of the auxiliary air valve and from the thermostat housing, Fig.6.

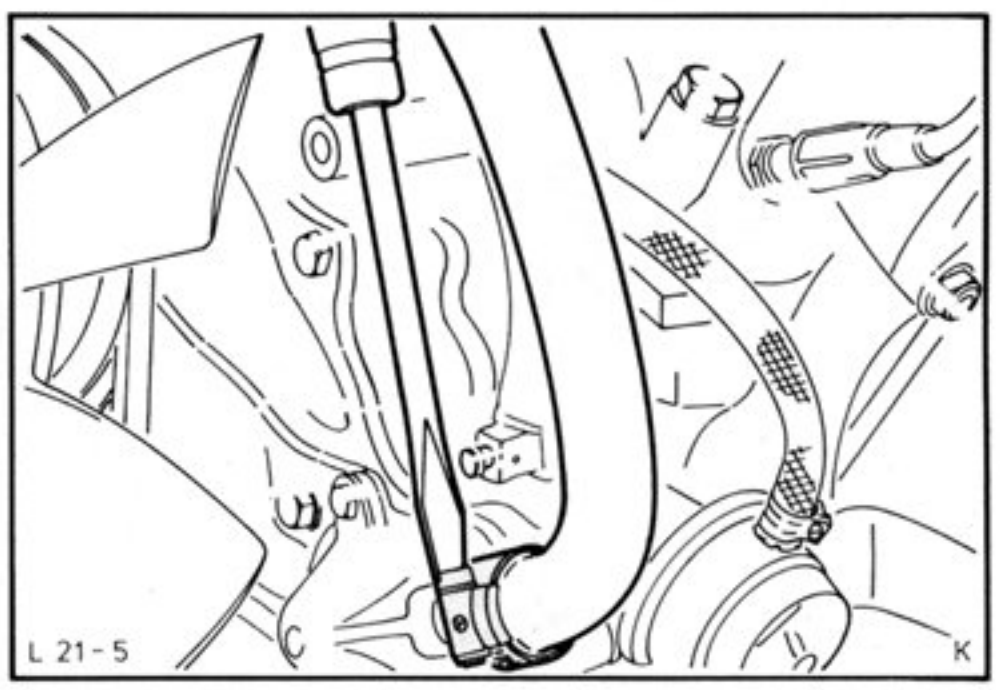


Fig.6. Disconnect hot-water hose from thermostat housing.

6. Disconnect the brake servo vacuum hose from the air chamber connection, Fig.7.

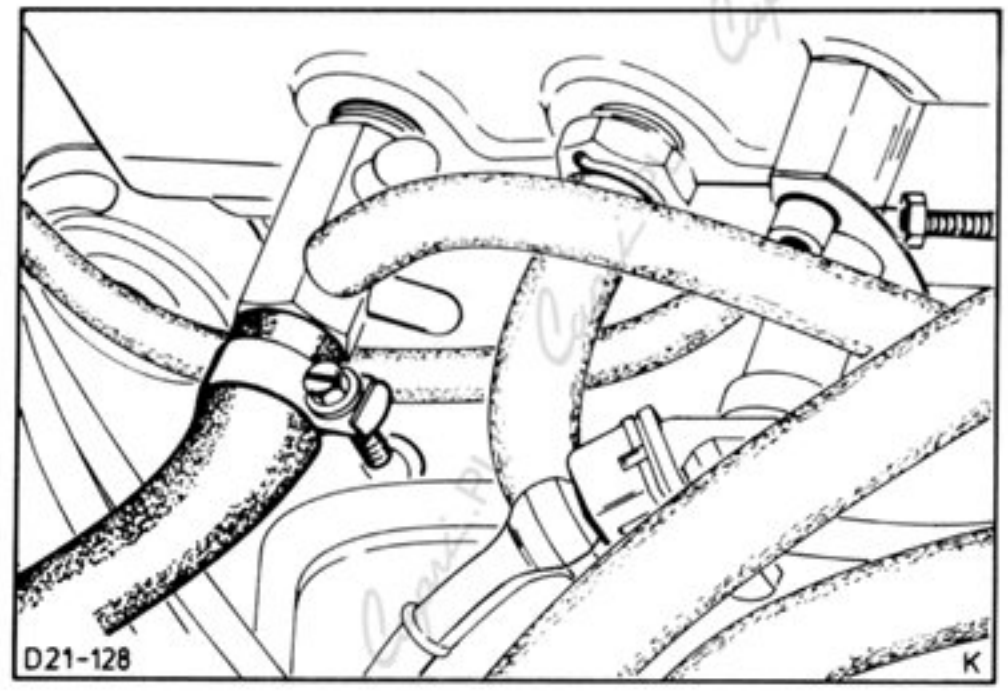


Fig.7. Brake servo vacuum hose.

7. Disconnect connecting hose from intake silencer. Disconnect throttle cable at throttle lever and remove with bracket (2 screws), Fig.8.

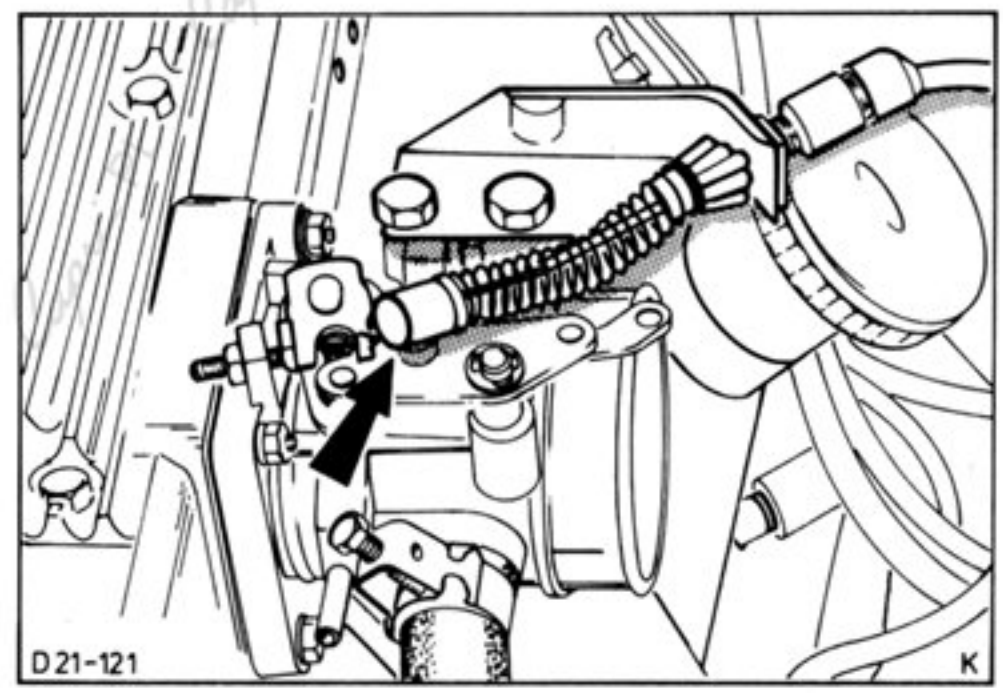


Fig.8. Disconnect throttle cable.

8. Disconnect fuel lines from fuel distributor unit and close ends, Fig.9.

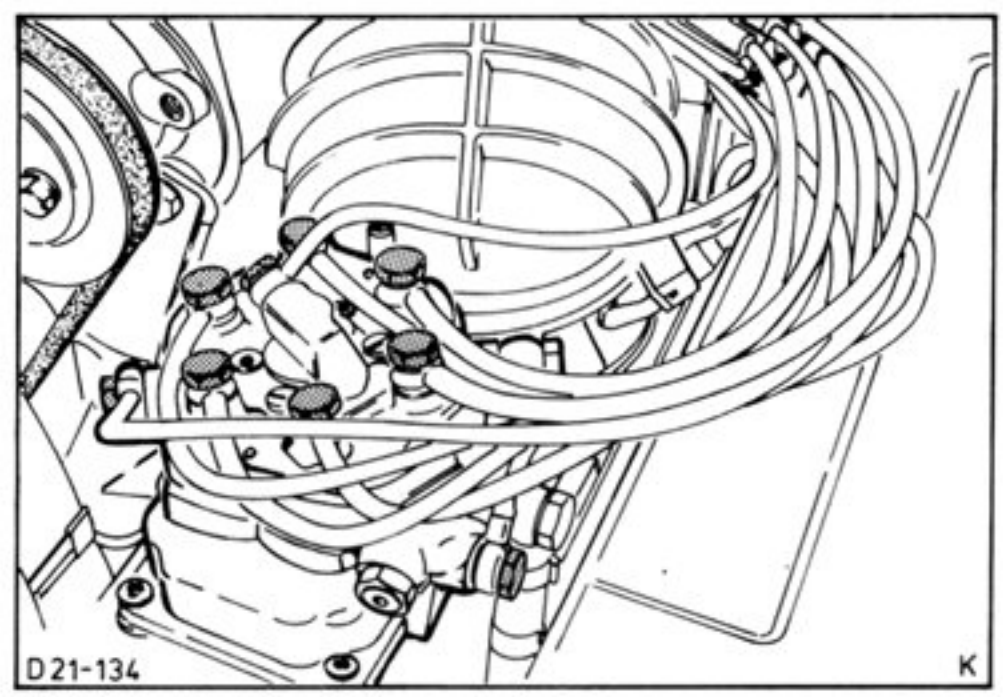


Fig.9. Fuel lines on fuel distributor unit.

9. Disconnect ignition cable from coil and disconnect multi plug on distributor.

21 134

10. Disconnect electrical leads from temperature gauge sender, thermo time switch, warm-up device regulator, auxiliary air device and start valve, Fig.10.

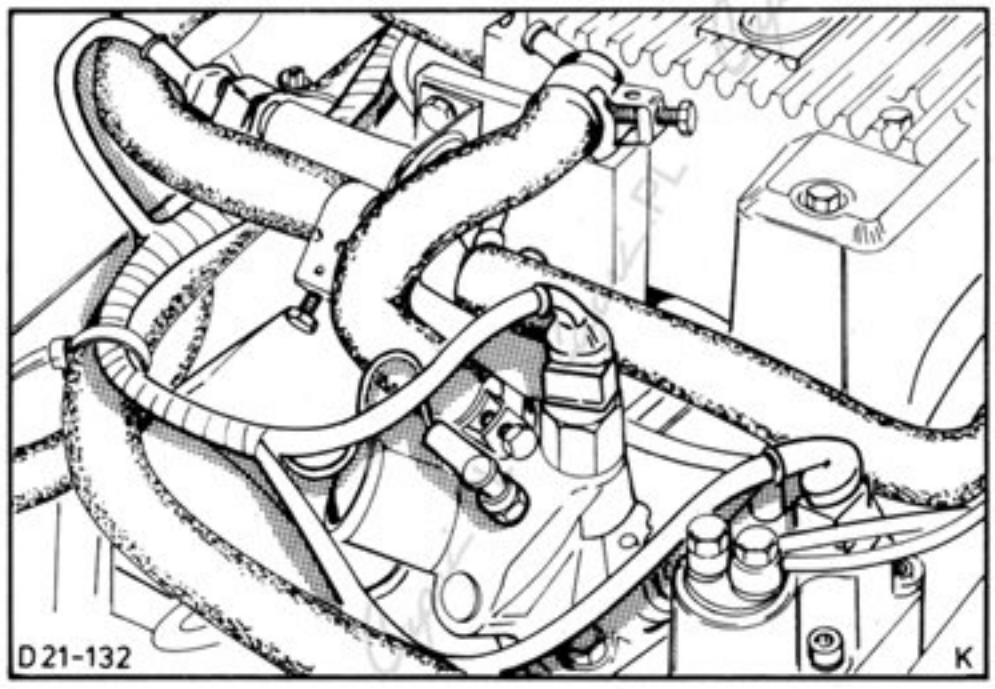


Fig.10. Disconnect electrical leads.

11. Disconnect oil pressure line from oil pressure connector.

12. Loosen tensioner pulley fixing screws and remove belt. Remove power-steering oil pump with bracket from the engine (3 bolts), Fig.11, place aside and secure with wire.

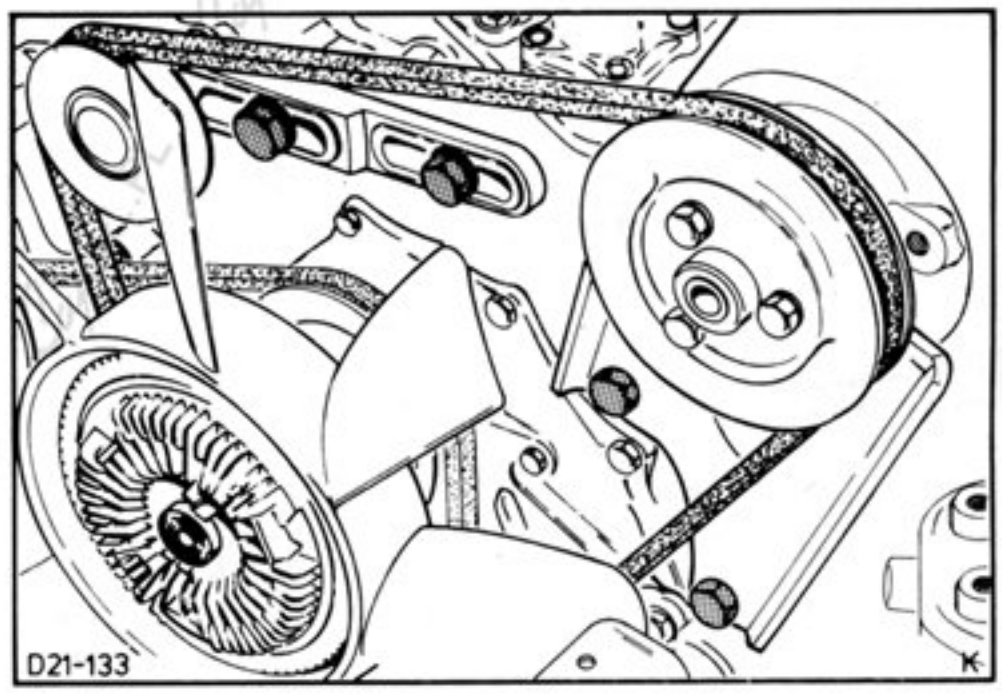


Fig.11. Remove power-steering oil pump.

13. Disconnect cable from the alternator, unscrew alternator complete with bracket and take off fan belt.

14. Disconnect starter cable and remove starter motor (2 bolts), Fig.12.

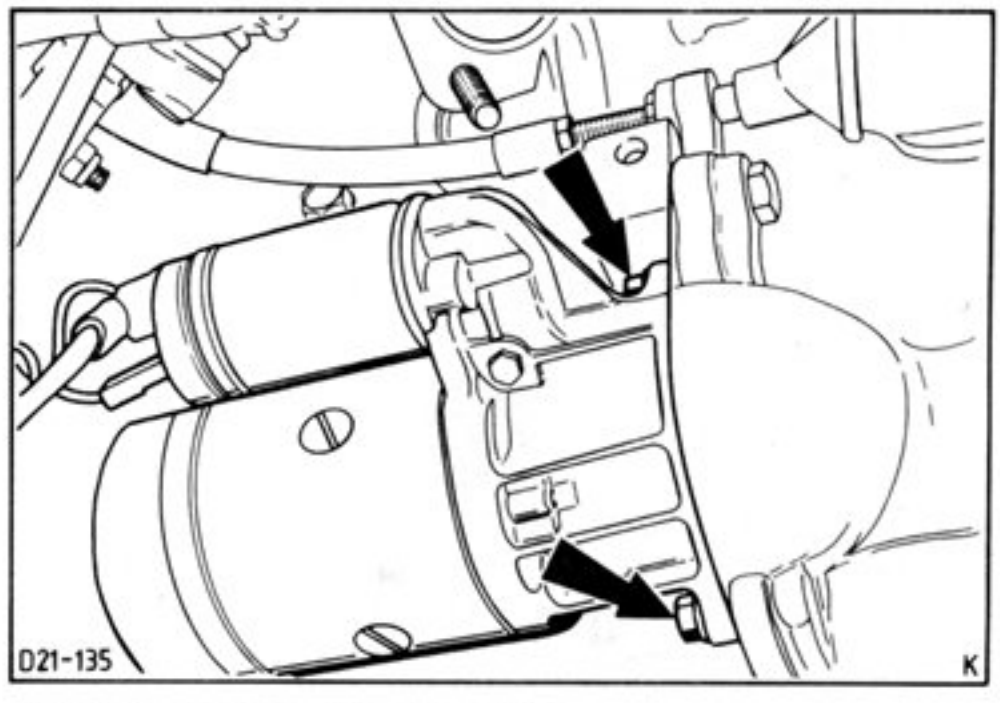


Fig.12. Remove starter motor.

15. Push back clutch cable and unhook from the clutch lever.

21 134

16. Disconnect coolant hoses from oil cooler, Fig.13, and unbolt exhaust pipes from the exhaust manifolds.

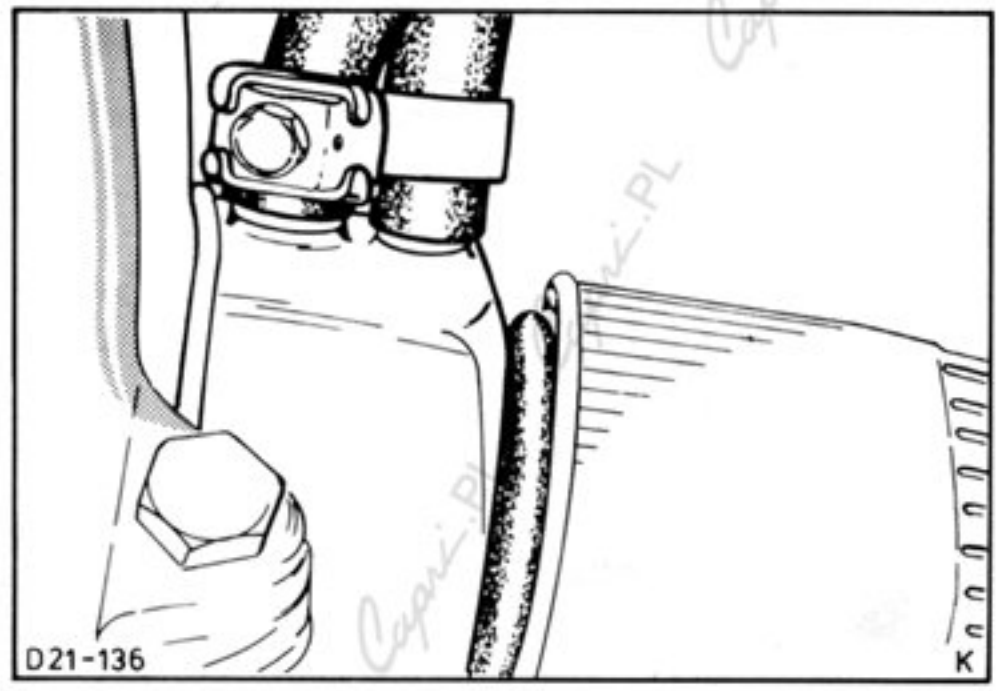


Fig.13. Coolant water hoses on the oil cooler.

17. Unbolt the two engine mounting insulators from the crossmember (2 nuts), Fig.14.

18. Fit engine lifting bracket 21-068 to the engine, Fig.15.

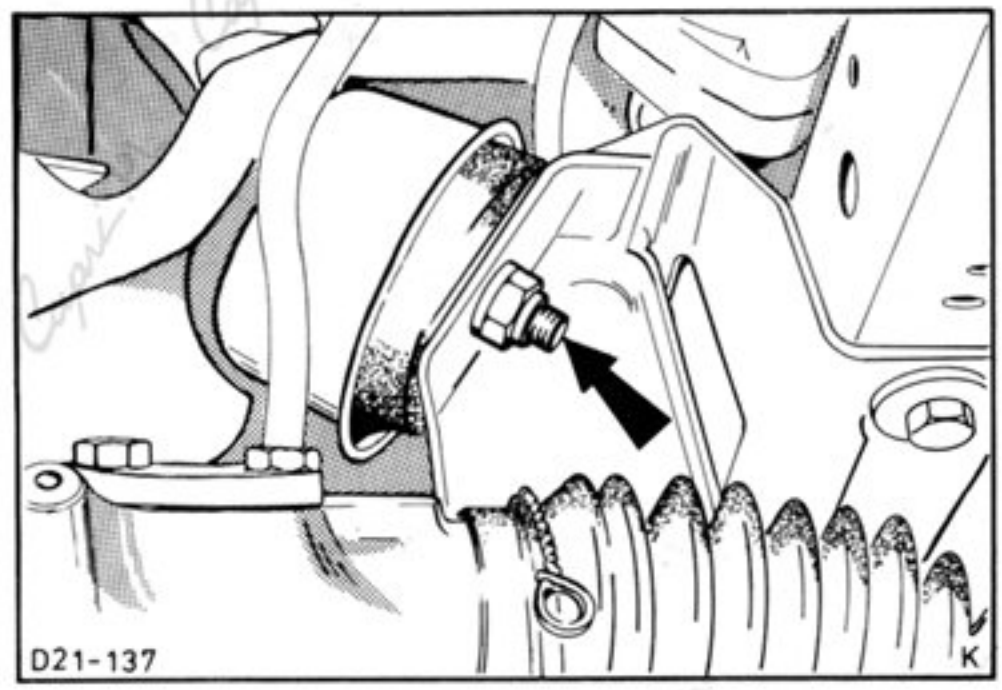


Fig.14. Insulators - Engine mountings.

19. Remove clutch housing cover (1 bolt with nut) and disconnect engine from clutch housing flange (6 bolts)

20. Support transmission, raise engine with lifting bracket and pull forward. Remove right-hand rubber mounting and carefully lift out the engine.

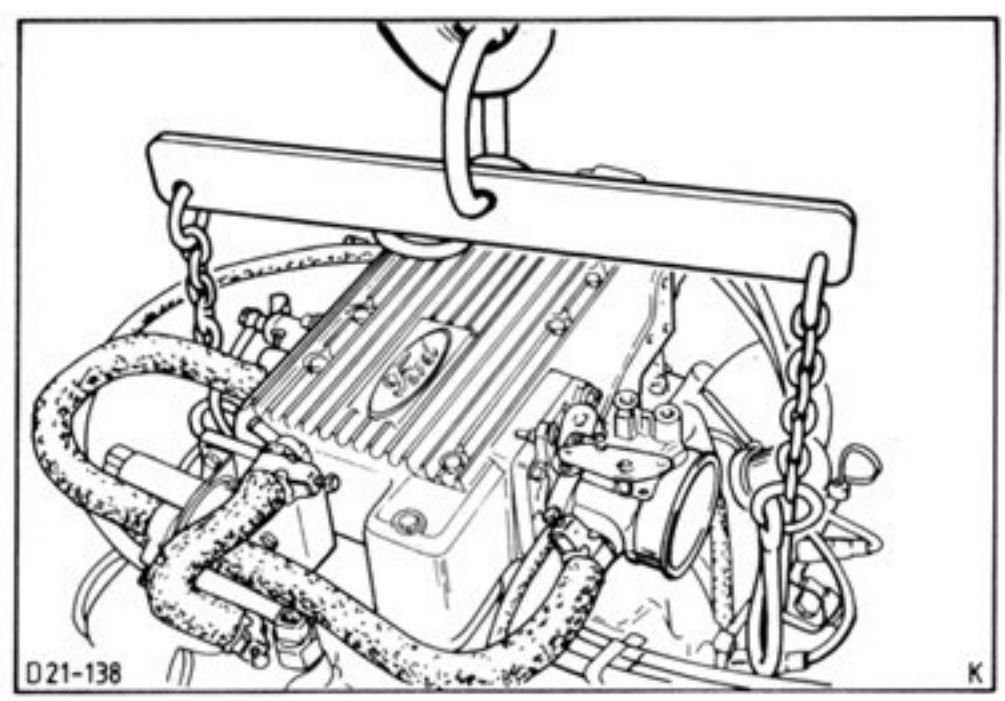


Fig.15. Fit engine lifting bracket 21-068.

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To Install

21. If necessary, transfer dowel bushes from the clutch housing to the engine block and fit adapter plate, Fig.16.

NOTE: Ensure that clutch release lever is correctly located.

22. Lower engine into the vehicle with the engine lifting bracket 21-068 and bolt right-hand engine mounting insulator to the engine block. Push engine onto the lightly greased gearbox input shaft and pull home uniformly onto the clutch housing flange, with bolts.

23. Insert all flange bolts, and tighten to the specified torque. Fit the clutch housing cover.

24. Bolt the engine mounting insulators to the crossmember and remove engine lifting bracket.

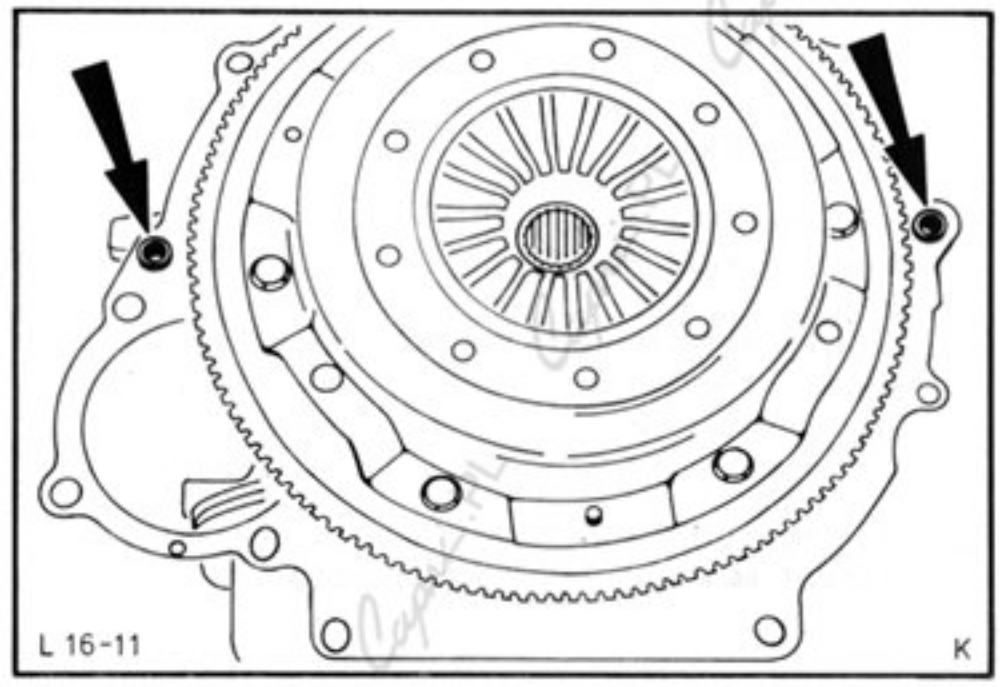

Fig.16. Dowel bushes - clutch housing.

25. Bolt exhaust pipes to the exhaust manifolds, Fig.17, and fit cooling-water hoses to the oil cooler.

26. Attach clutch cable to the clutch lever and adjust.

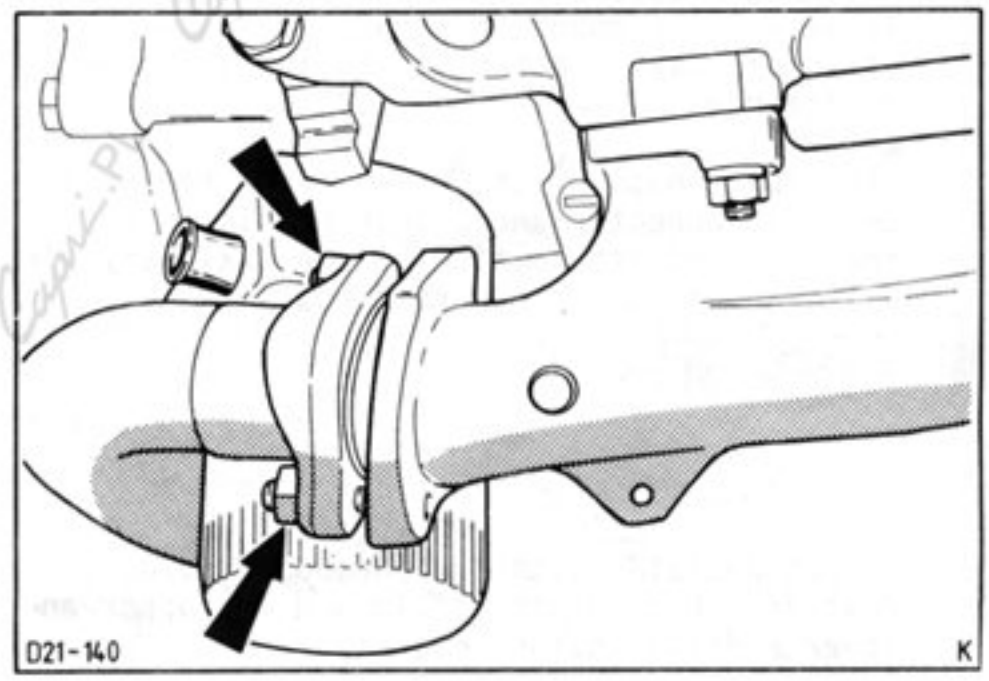

Fig.17. Bolt on exhaust pipe.

27. Install starter motor and connect starter cable.

28. Install alternator with bracket and connect cable.

29. Fit V-belt and adjust tension, Fig.18.

NOTE: The belt tension should be measured with a belt tension gauge tool (if available), see Technical Data.

Otherwise the necessary V-belt tension can be measured with normal finger pressure in the middle of the longest span of the belt. Total play - 13 mm (0,5 in.).

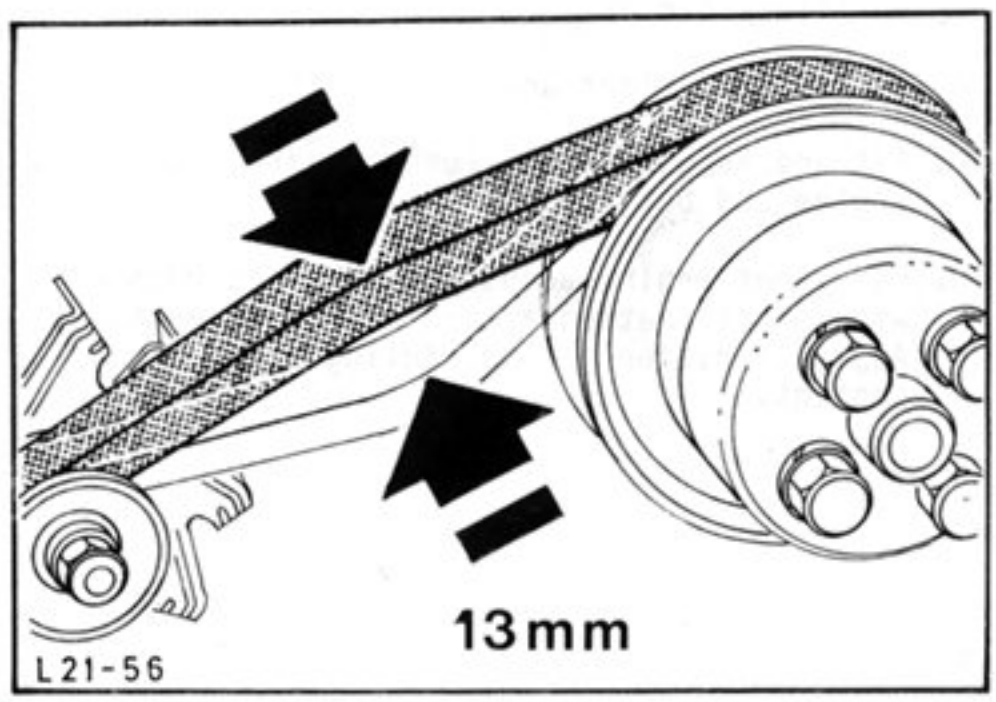

Fig.18. Tension alternator V-belt.

30. Mount oil-pump for power-assisted steering on engine. Fit V-belt and adjust tension (see also Section 13B, FORD CAPRI '74 Onward Workshop Manual).

31. Connect oil pressure line and attach fuel lines to fuel distributor.

32. Connect electrical leads to temperature sender thermo time switch, warm-up regulator, auxiliry air device and start valve.

33. Plug ignition cable onto ignition coil and connect multi plug to distributor.

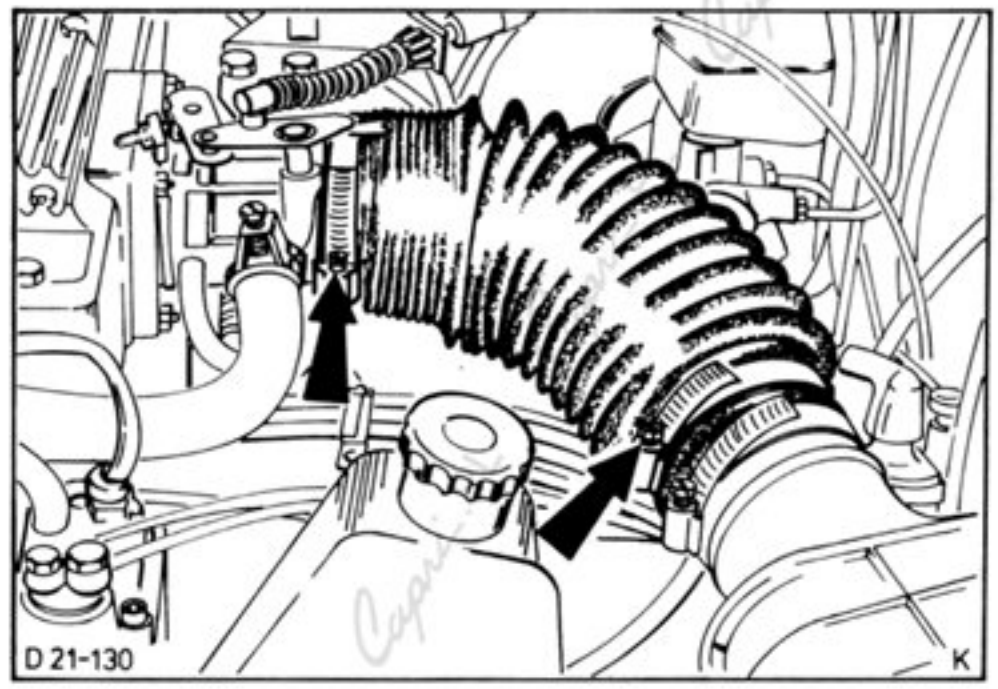

Fig.19. Connecting hose to intake silencer in installation position.

34. Attach throttle cable with bracket to throttle lever and fit connecting hose to intake silencer, paying attention to installation position as shown in Fig.19.

35. Fit vacuum hose of the brake servo to the air-chamber connector and attach heating hoses to the intermediate section of the auxiliary air valve and to the thermostat housing.

36. Insert radiator with fan shroud, Fig.20, and bolt in. Fit splash shield and fix upper and lower radiator hoses, Fig.21.

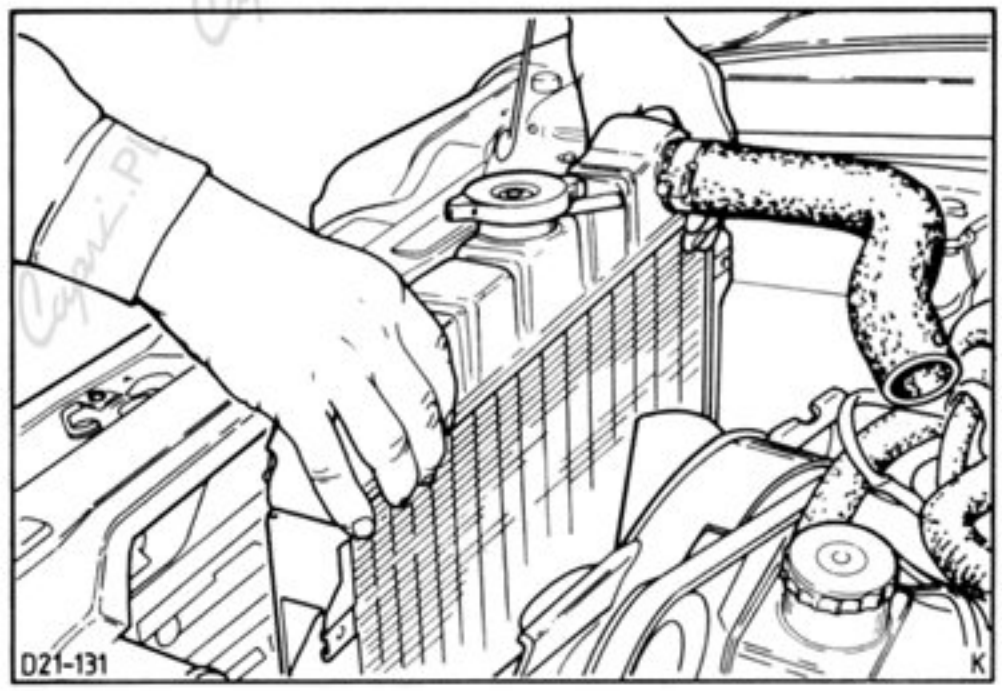

Fig.20. Insert radiator.

37. Fit expansion tank and attach coolant hoses to radiator and intermediate section of the auxiliary air valve.

38. Fill with coolant and engine oil.

39. Fit and adjust hood. Connect earth cables to engine and battery.

40. Carry out engine adjustments in accordance with specification at operating temperature. Adjust ignition timing, idling speed and CO content.

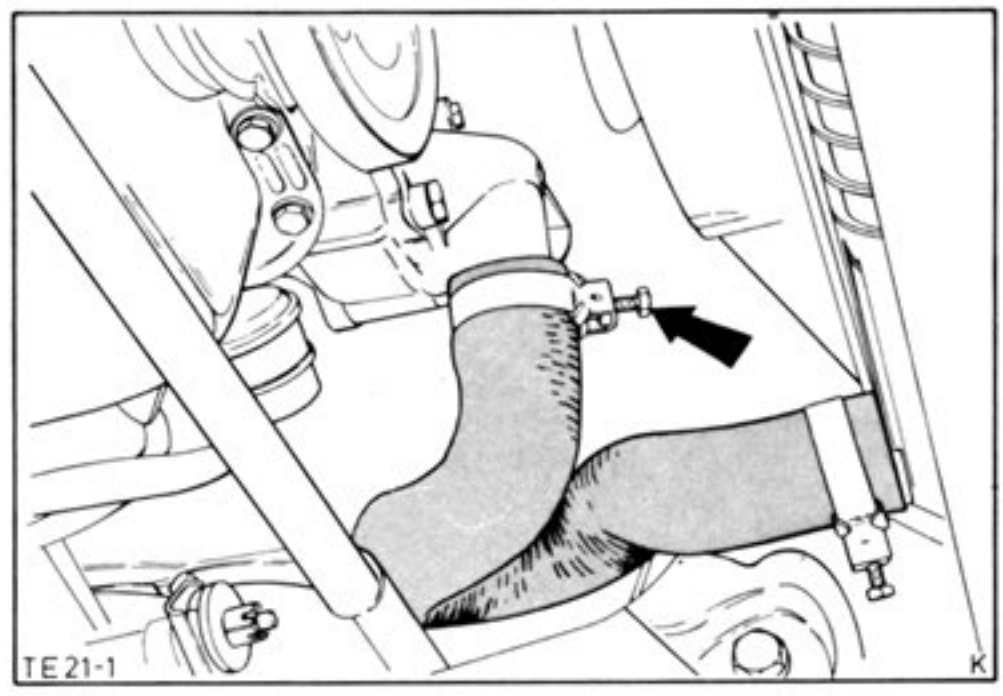

Fig.21. Fit radiator hose to water pump neck.

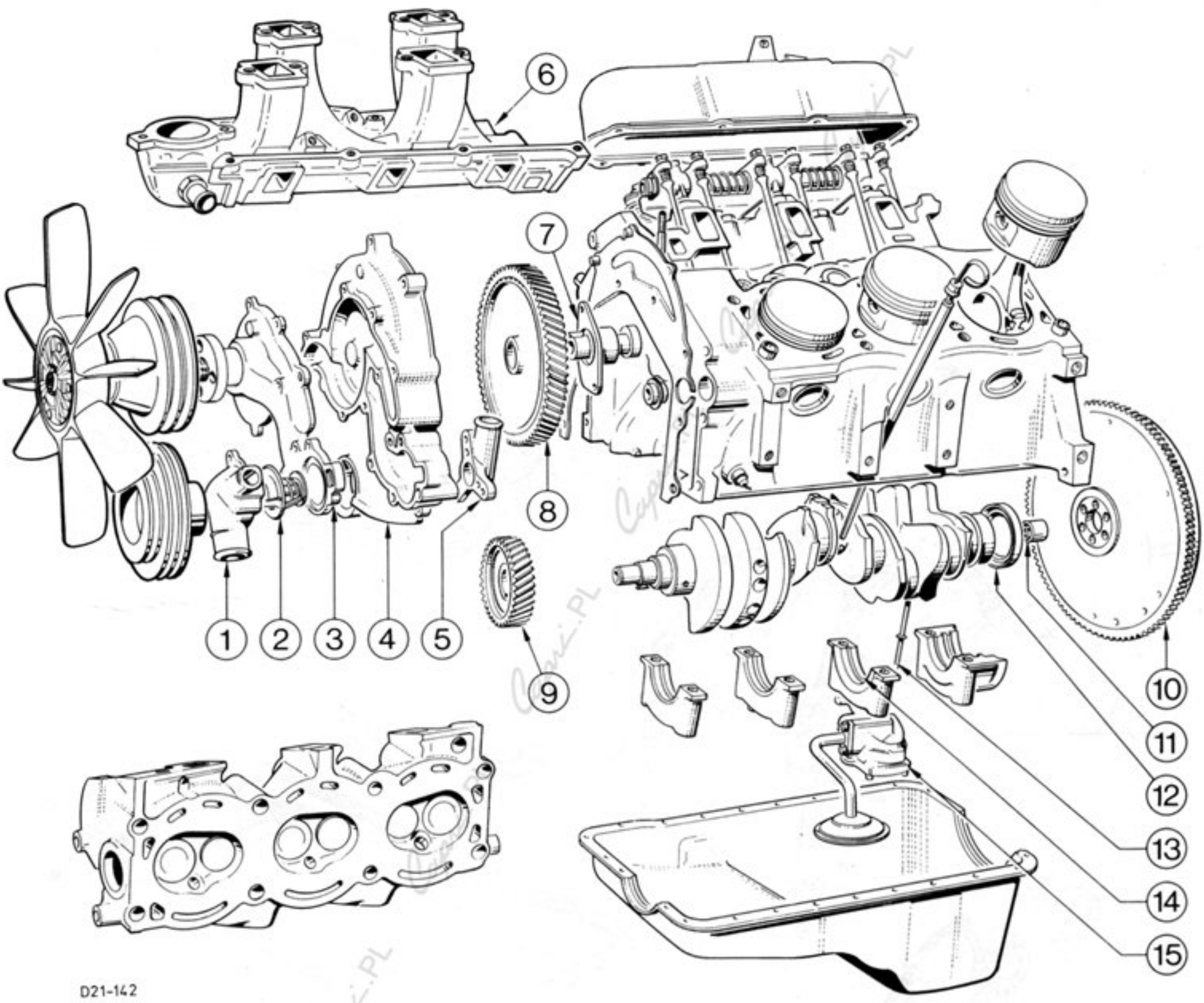

Fig.22. 'C' engine, exploded view.

1. Water inlet connection
2. Thermostat
3. Water pump
4. Timing cover
5. By-pass hose flange
6. Inlet manifold
7. Camshaft thrust plate
8. Camshaft gear
9. Crankshaft timing gear
10. Flywheel ring gear
11. Crankshaft pilot bearing
12. Oil seal
13. Oil pump drive shaft
14. Crankshaft main bearing
15. Oil pump

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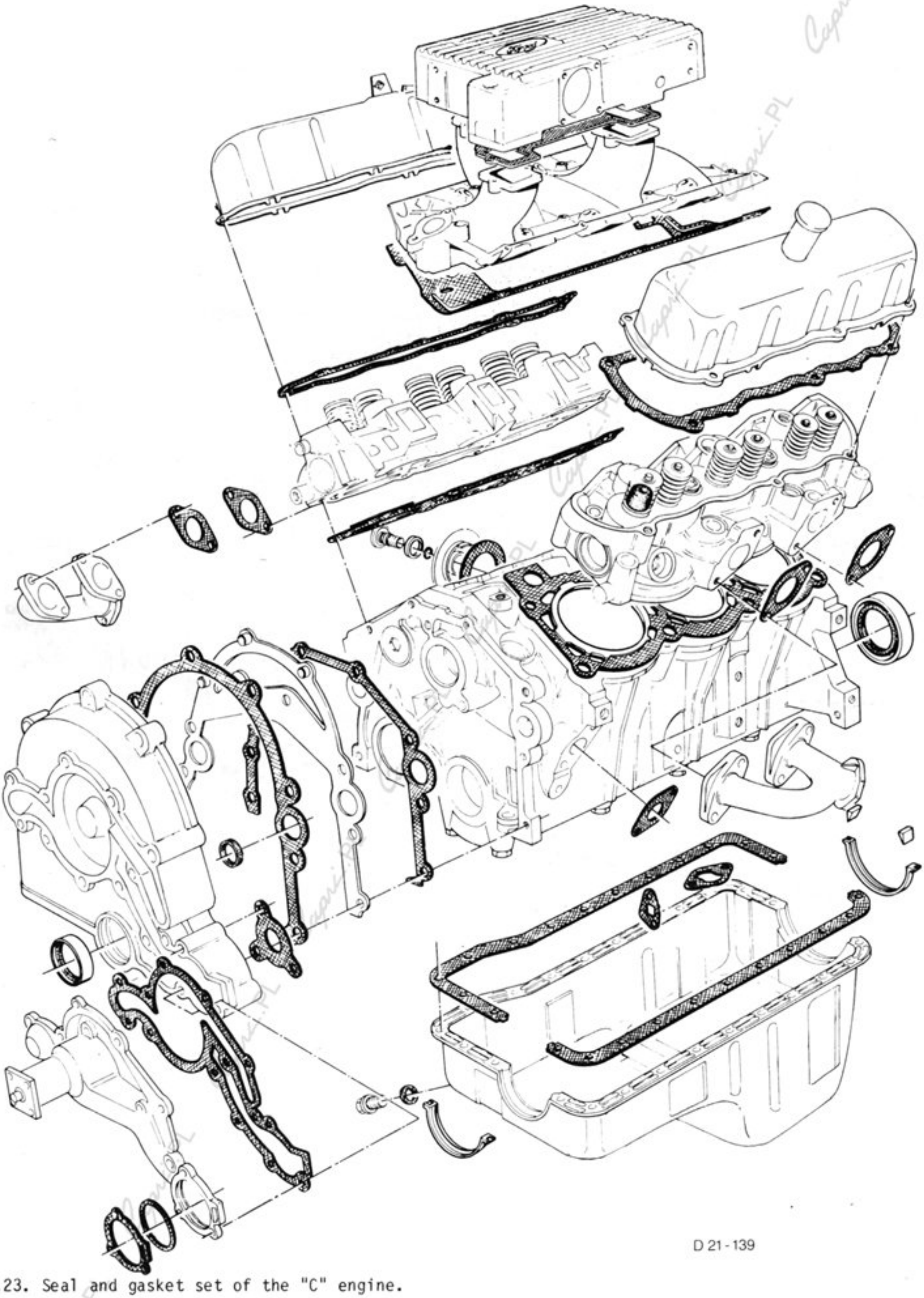

Fig.23. Seal and gasket set of the "C" engine.

21 134 8 ENGINE ASSEMBLY - DISMANTLE AND REASSEMBLE (Engine removed)

SPECIAL SERVICE TOOLS REQUIRED:

Universal spindle	21-023
Flywheel bearing remover	21-037-A
Crankshaft rear oil seal installer	21-059
Crankshaft front oil seal installer ring	21-063
Engine mounting bracket	21-064
Flywheel bearing installer and clutch disc locator	21-067-A
Front cover oil seal installer and aligner	21-069
Front cover oil seal extractor and aligner	21-070
Intake manifold wrench	21-192-A

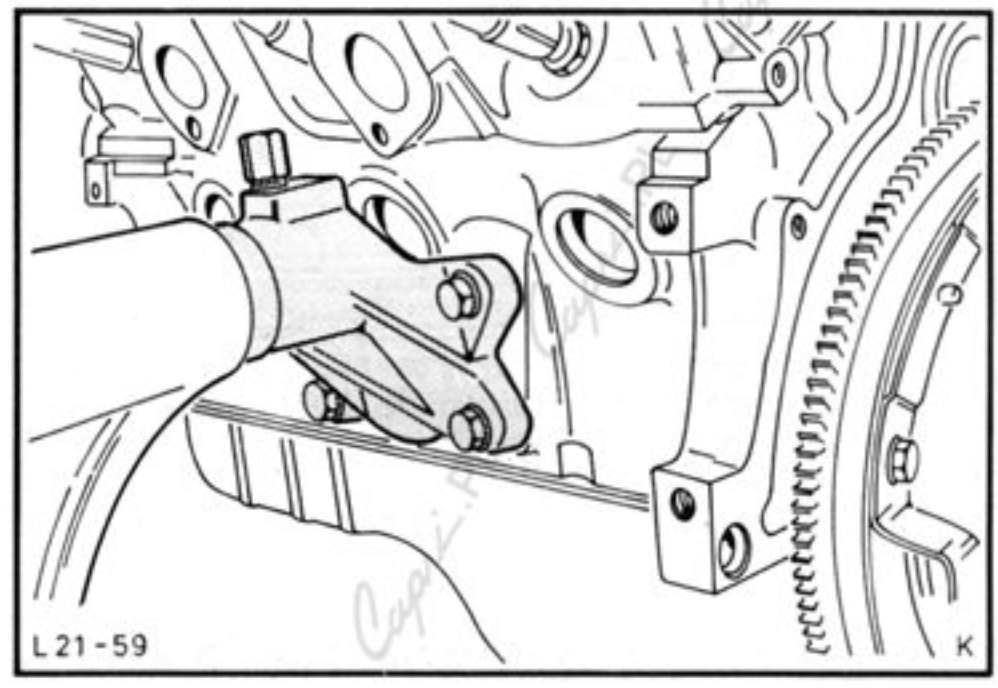

Fig.24. Fix engine on engine stand with engine mounting bracket 21-064.

To Dismantle

1. Remove left-hand exhaust manifold. Fix engine, with engine mounting bracket 21-064 and universal spindle 21-023, to the engine stand, Fig.24.

2. Drain engine oil and remove dipstick. Unscrew oil filter grip, Fig.25. Remove oil cooler.

3. Remove clutch pressure plate (6 bolts) and clutch disc from flywheel. Remove adapter plate from rear of engine.

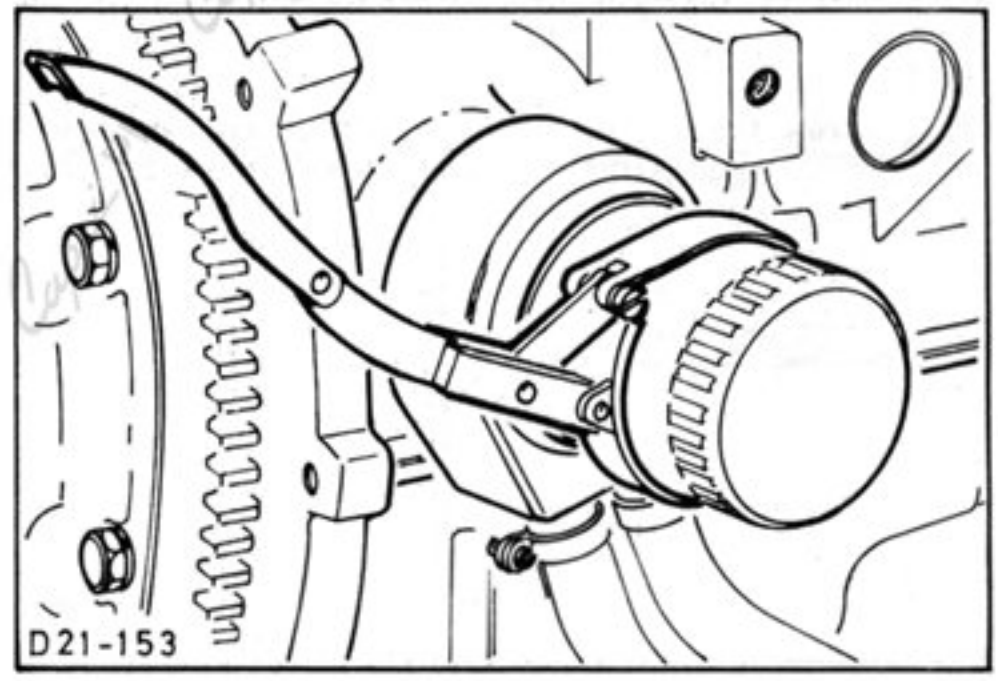

Fig.25. Unscrew oil filter.

4. Pull off spark plug connectors and remove distributor cap with HT leads. Remove spark plugs and distributor.

5. Remove fan (with 32 mm open-ended spanner) and belt pulley (4 bolts) from the water pump, Fig.26.

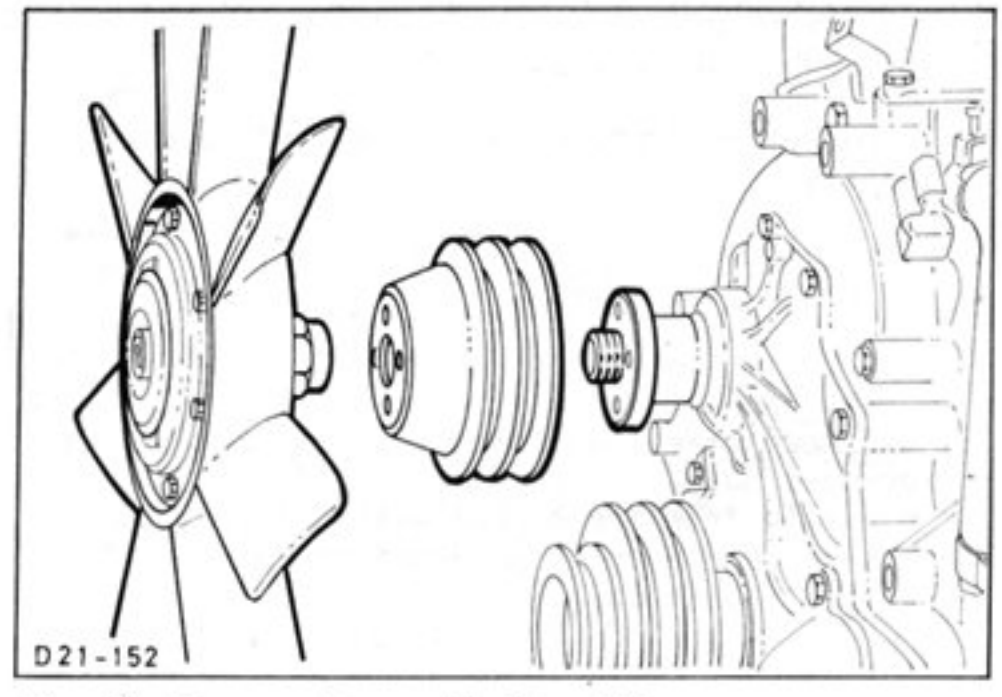

Fig.26. Remove fan and belt pulley.

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6. Remove coolant hose from the intermediate section of the auxiliary air device and fuel line from the start valve.

7. Pull off breather hose from the rocker cover and dismantle air chamber (8 bolts) from the intake manifold. Fig.27.

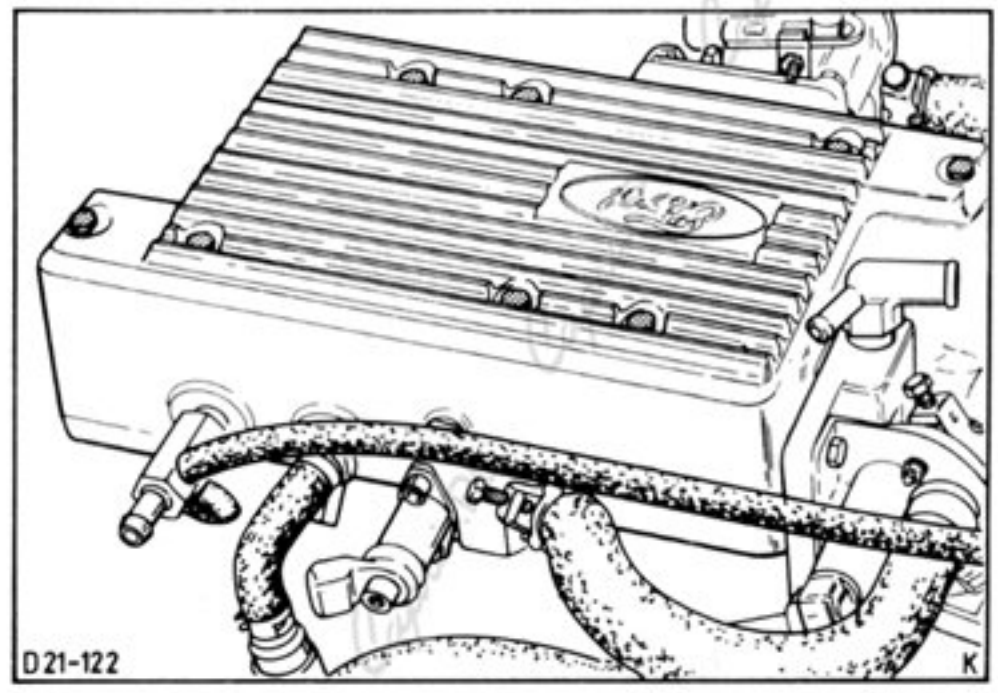

Fig.27. Remove air box.

8. Remove by-pass hose from the thermostat housing.

9. Unscrew fuel lines from injection nozzles and warm-up regulator. Remove injection nozzles, Fig.28.

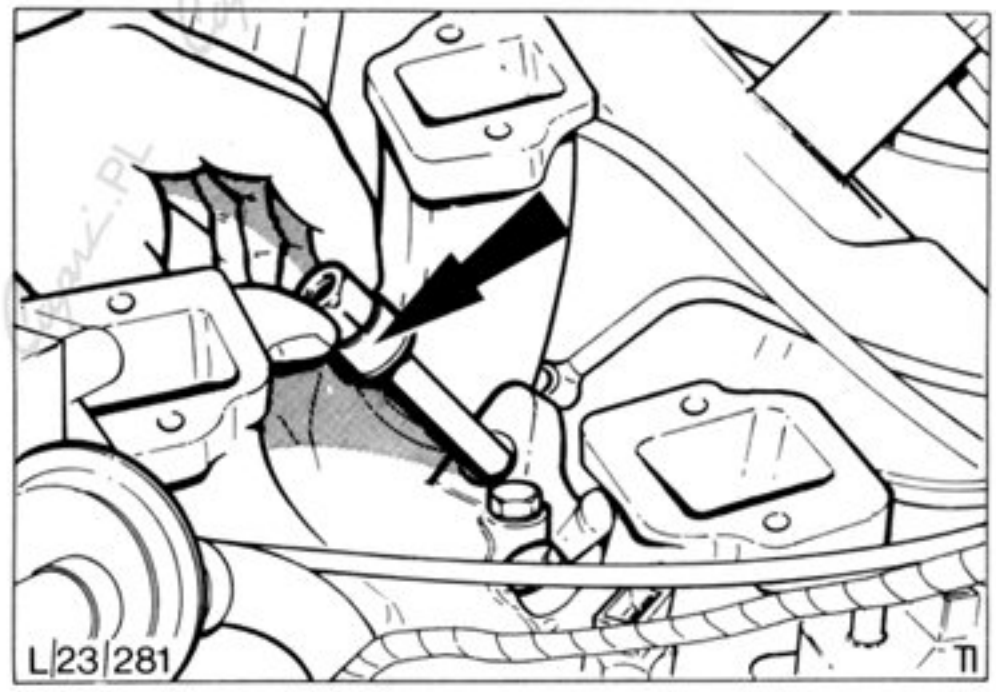

Fig.28. Remove injection nozzles.

10. Remove tension roller and water drain connection with warm-up regulator.

11. Remove rocker covers (14 bolts) and rocker shafts (6 bolts) with oil splash shields, Fig.29. Take out push rods.

NOTE: Do not interchange push-rods and rocker shafts.

12. Unscrew intake manifold (6 bolts, 2 nuts) with by-pass hose. If necessary, prise inlet manifold from the gasket with a lever, Fig.30, but do not insert a screwdriver between the sealing surfaces.

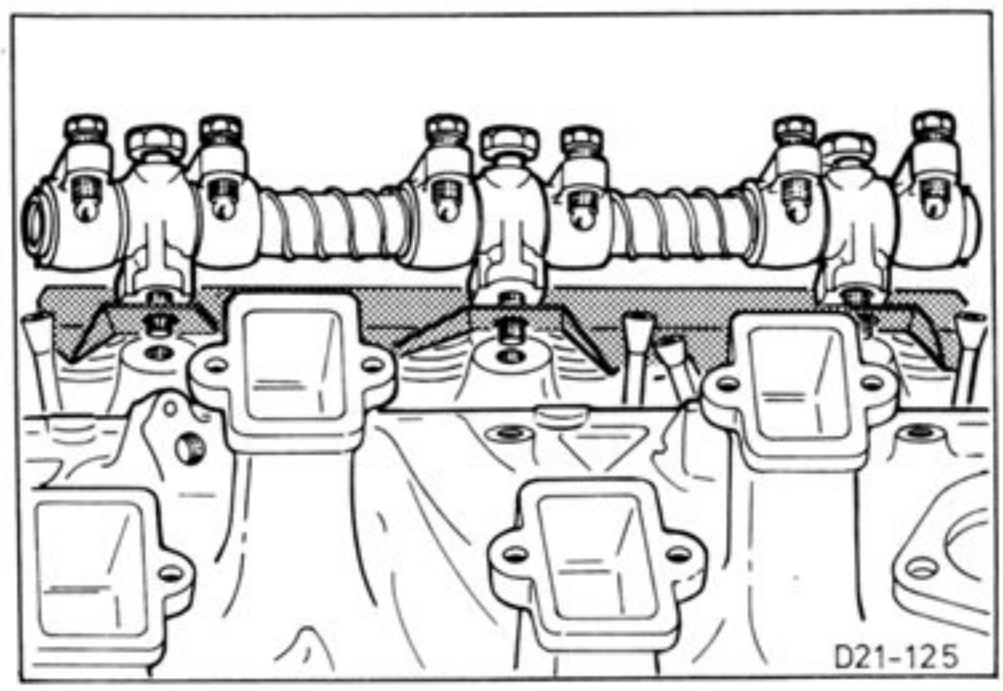

Fig.29. Remove rocker shaft and oil splash shield.

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13. Remove cylinder heads, unscrewing bolts in reverse sequence to when tightening. (For tightening sequence, see Fig.68).

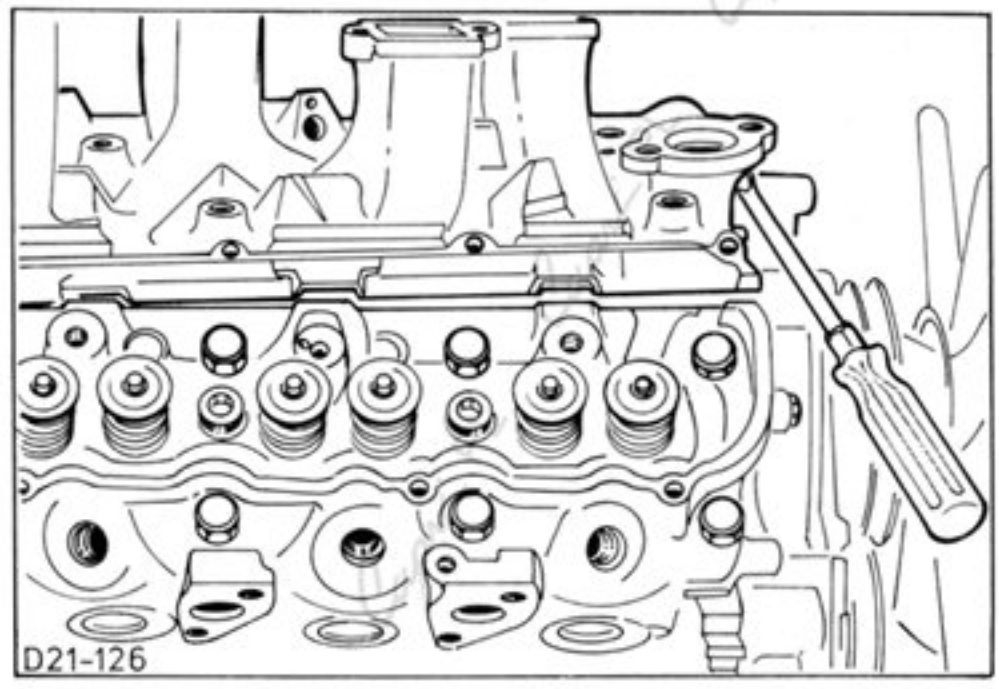

Fig.30. Release inlet manifold with a lever.

14. Unscrew oil pressure connection and remove crankshaft pulley (1 bolt).

15. Remove sump downwards to prevent oil sludge or swarf from getting into the engine, Fig.31.

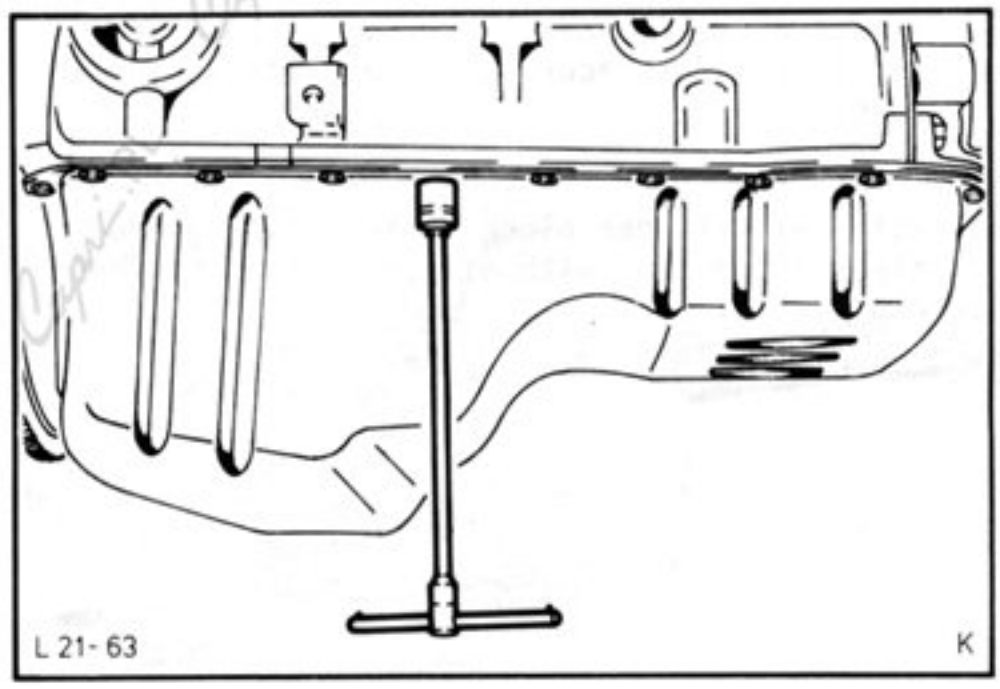

Fig.31. Detach sump.

16. Remove the ring of carbon at the upper edge of the cylinder with a scraper, without touching the cylinder bore.

17. Mount engine upright. Place a large oil drip tray under the engine and prise out the valve tappets with a bent brass wire, Fig.32.

NOTE: Do not interchange tappets when removing and installing.

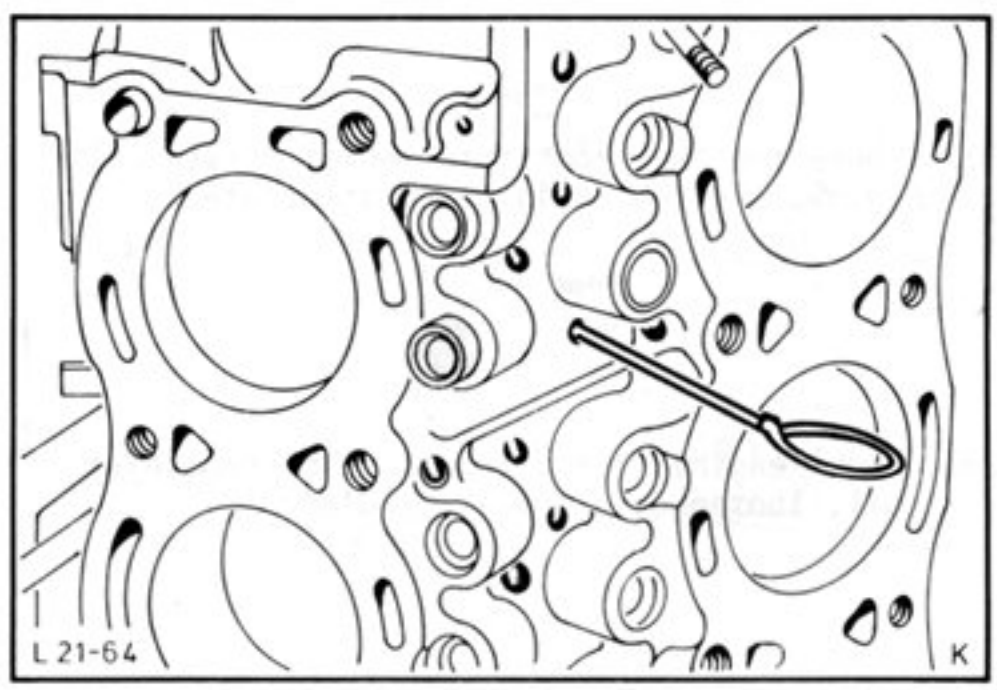

Fig.32. Prise out valve tappets by means of brass wire.

18. Remove water pump (13 bolts), Fig.33, unscrew thermostat housing (3 bolts) and remove thermostat. Detach rear water elbow.

19. Remove timing cover (9 bolts).

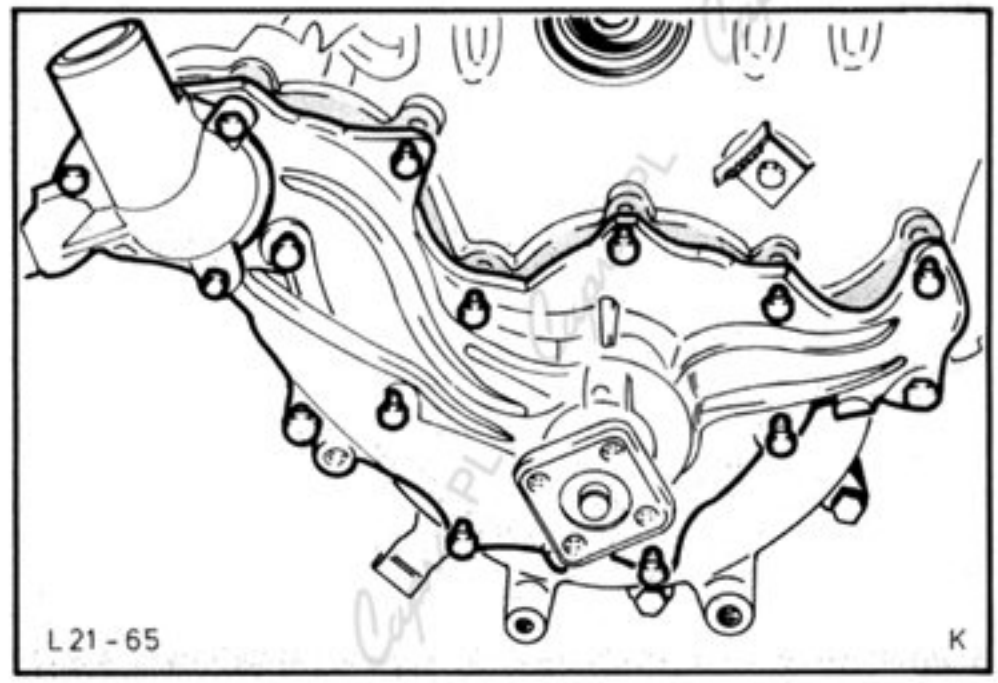

Fig.33. Remove water pump.

20. Remove camshaft gear (1 bolt) and camshaft thrust plate (2 bolts). Withdraw camshaft together with spacer. Remove plate spring an spacer.

21. Withdraw cylinder block timing cover guide sleeves together with oil seals from cylinder block, Fig.34.

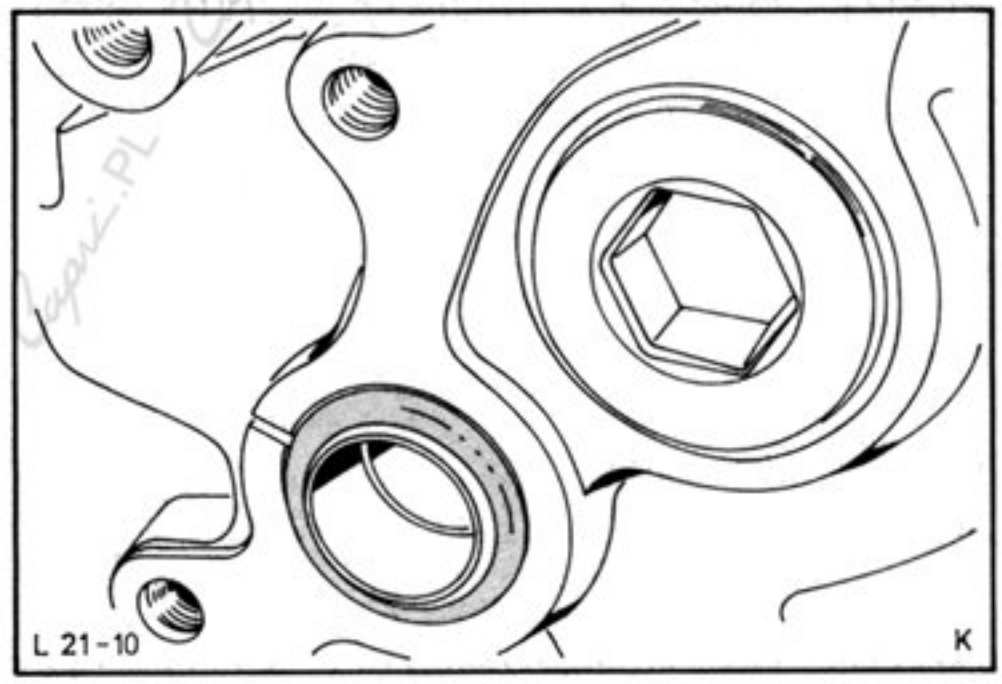

Fig.34. Cylinder block timing cover guide sleeve.

22. Remove the two front intermediate plate bolts, Fig.35, and remove intermediate plate.

23. 'Rock' engine to and fro to catch remaining oil, loosened carbon and coolant.

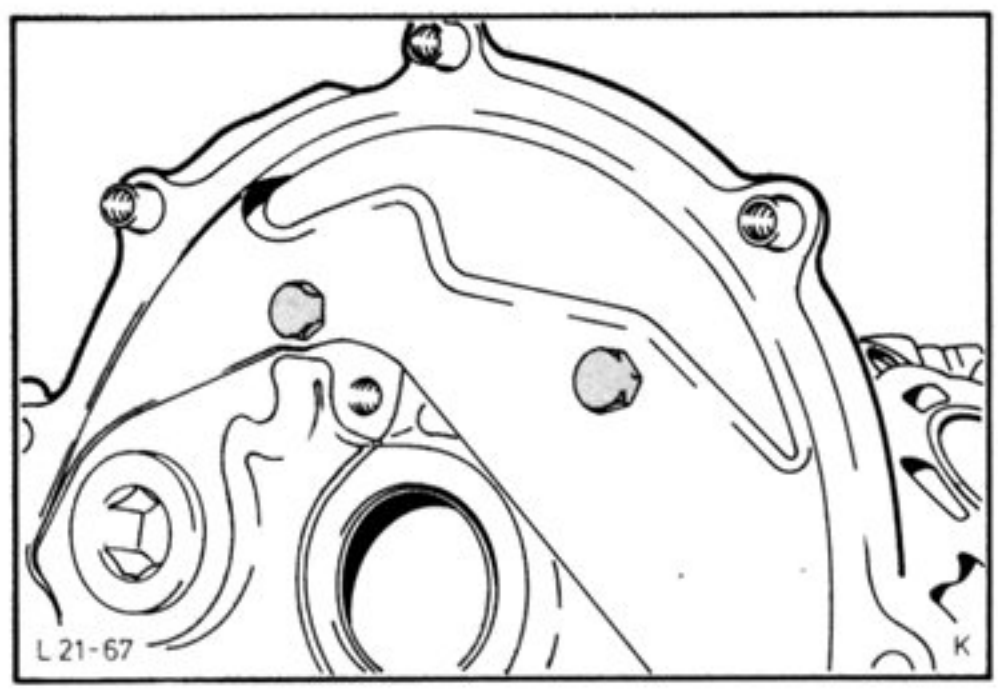

Fig.35. Unscrew intermediate plate.

24. Remove oil pump and suction pipe (2 bolts), Fig.36, and withdraw drive shaft.

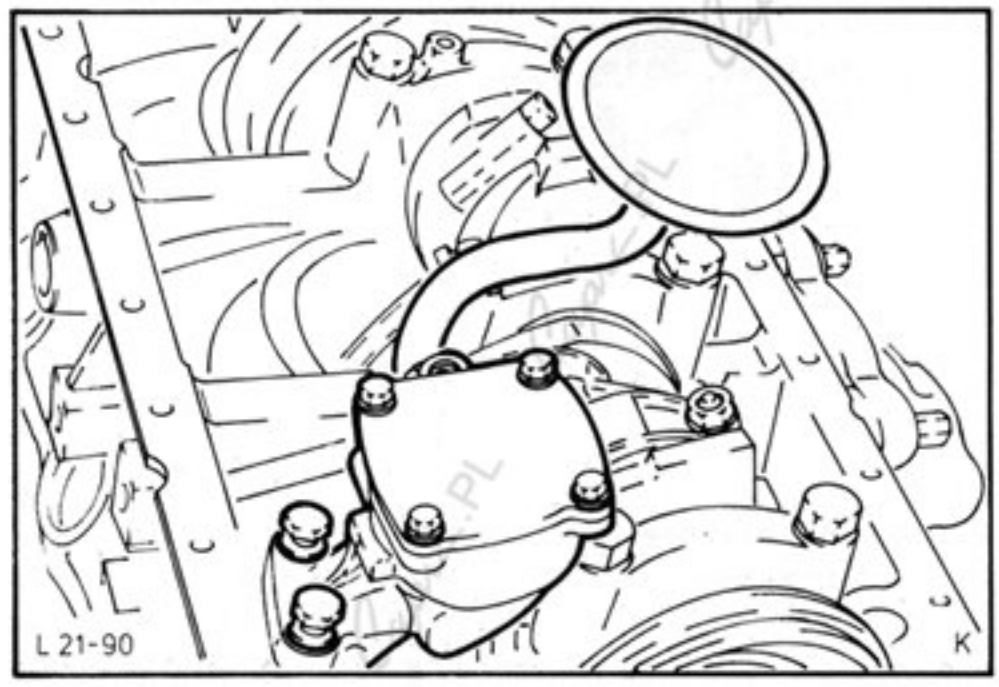

Fig.36. Remove oil pump and suction pipe.

25. Pull off crankshaft gear using standard puller Fig.37.

26. Check markings of big end and main bearing caps for subsequent reassembly, Fig.38.

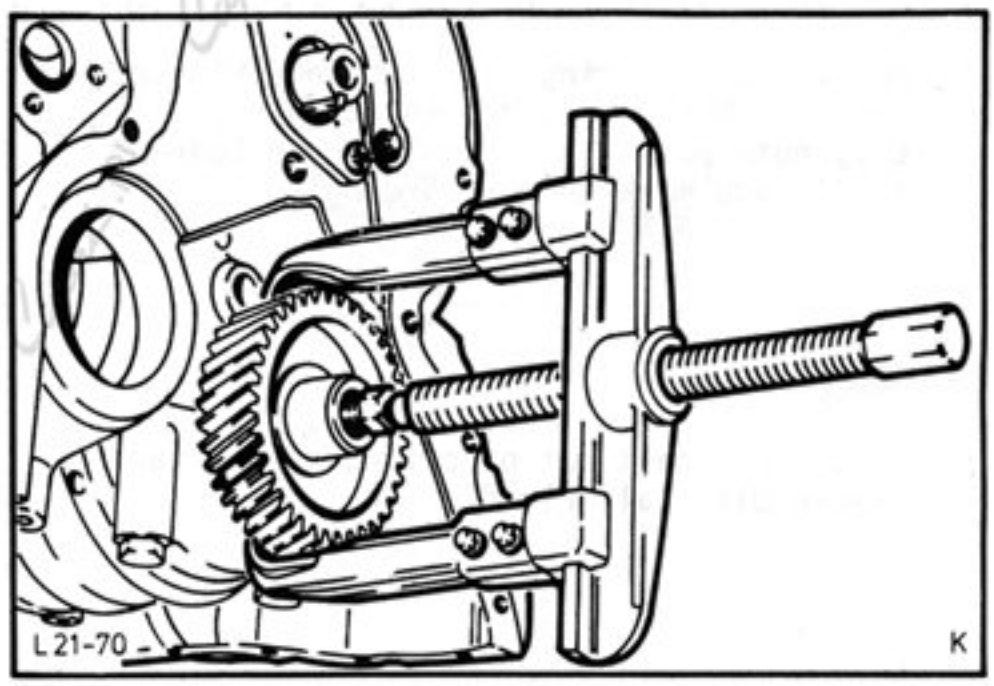

Fig.37. Remove crankshaft gear.

27. Remove big end bearing caps one by one, together with bearing shells. Push pistons complete with connecting rods and bearing shells out of engine. If big end bearing shells are removed before pistons are taken out, mark shells to correspond with connecting rods, for purposes of subsequent reassembly.

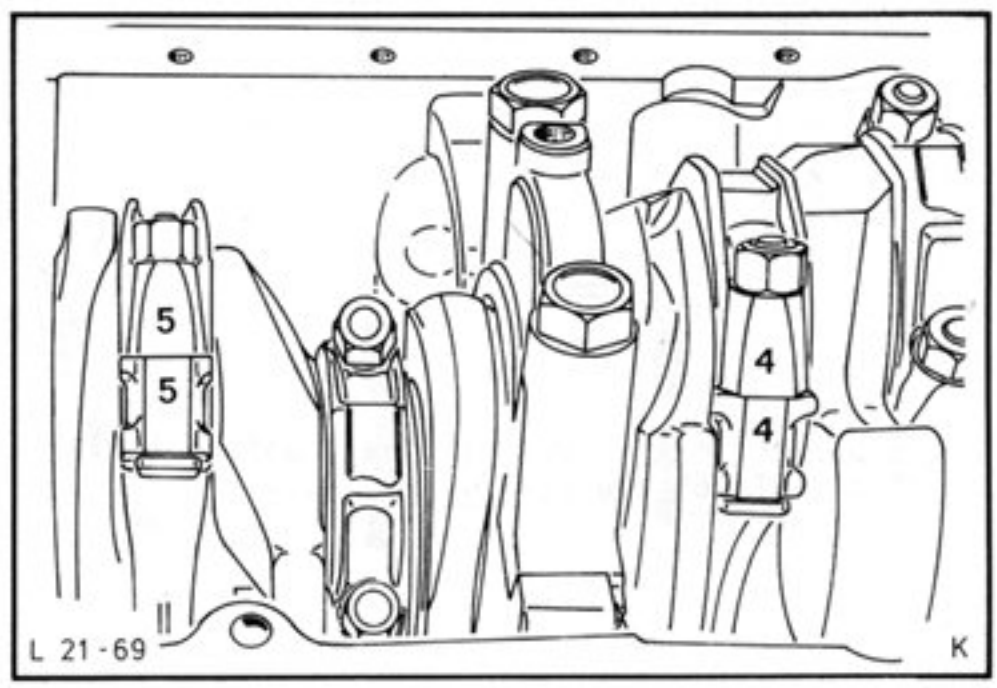

Fig.38. Big end cap markings.

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28. Withdraw crankshaft pilot bearing from crankshaft, using Special Tool 21-037-A, Fig.3.

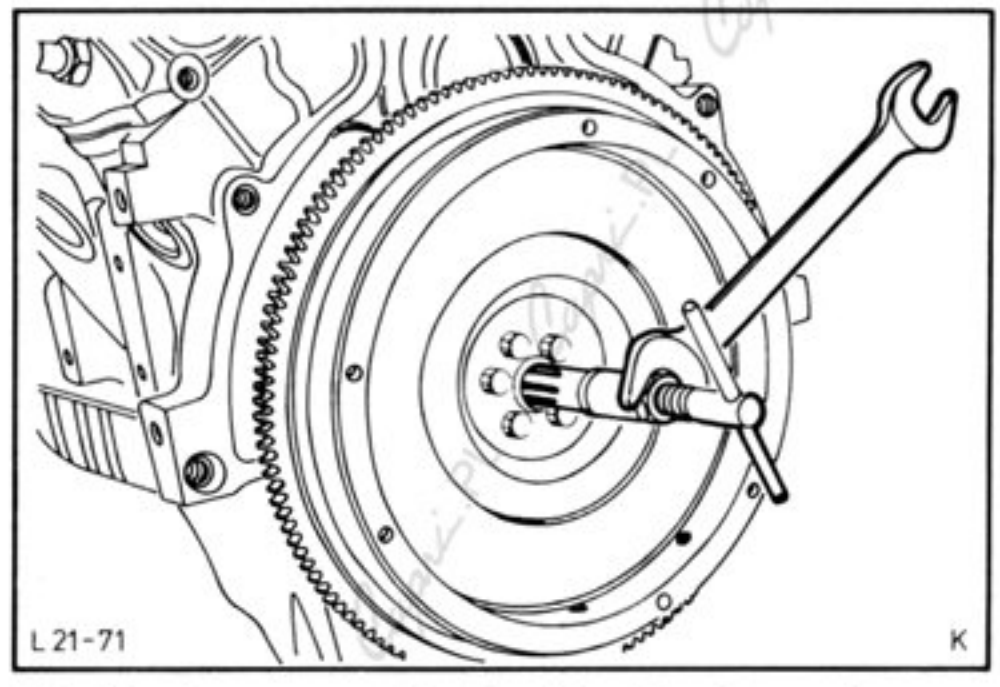

Fig.39. Remove crankshaft pilot bearing using Special Tool 21-037-A.

29. Detach flywheel (6 bolts).

30. Remove main bearing caps together with bearing shells. When removing centre main bearing cap, note position of two flanged bearing shells and mark them accordingly.

31. Lift crankshaft out of cylinder block and remove oil seal, Fig.40.

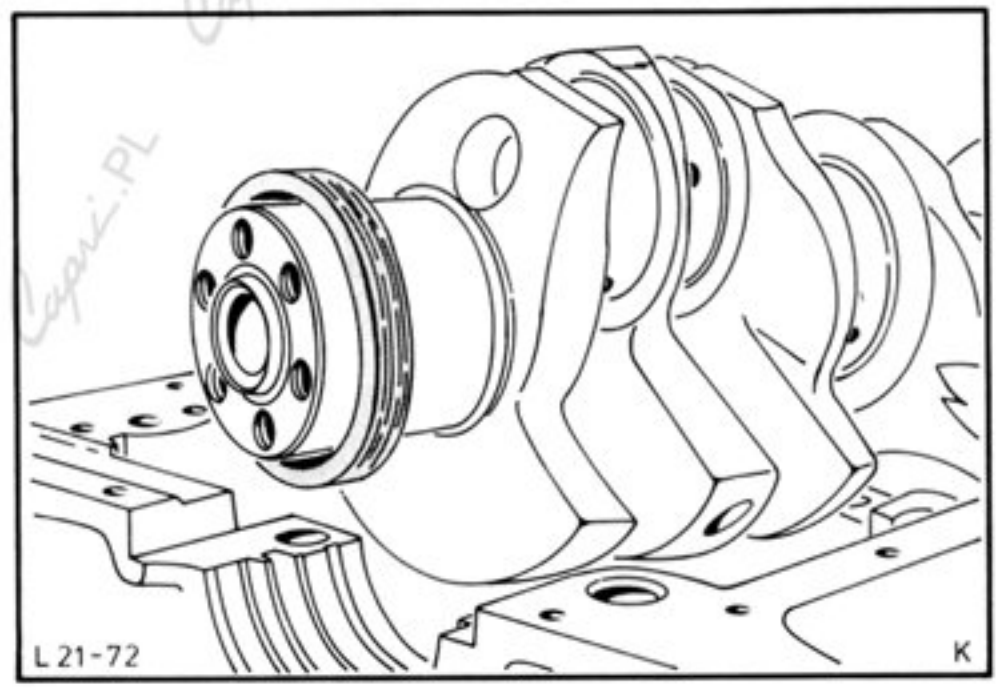

Fig.40. Lift crankshaft out of cylinder block.

32. Take bearing shells out of cylinder block and mark them for subsequent reassembly.

33. Replace timing cover oil seal, using Special Tools 21-069 and 21-070, Fig.41.

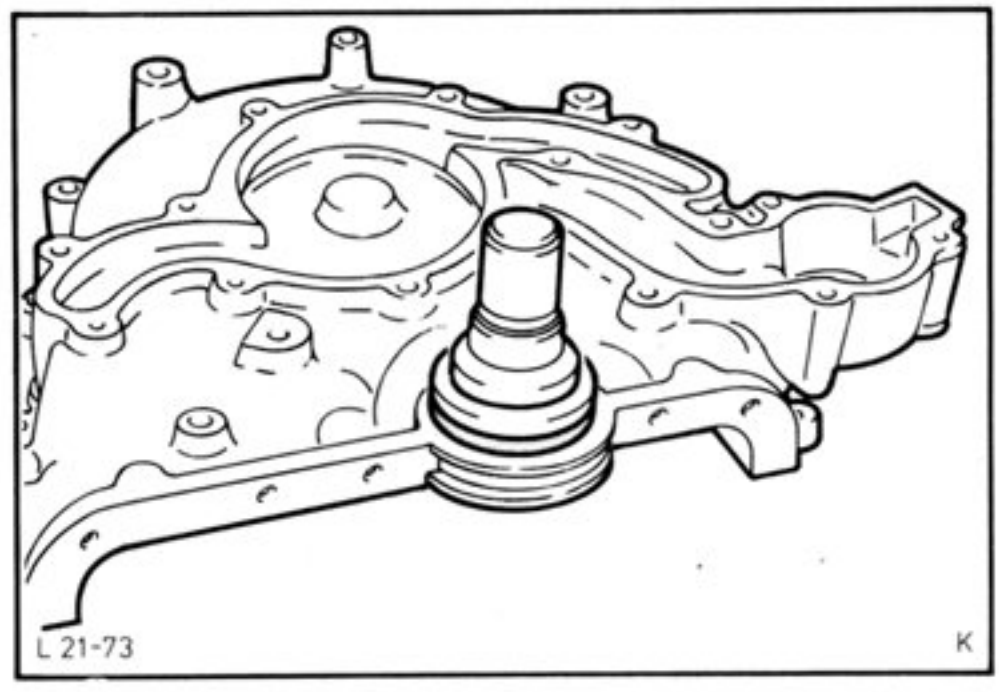

Fig.41. Replace oil seal.

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To Reassemble

The type and degree of cleaning of a given part before reassembly must depend on the hours the engine has run, the extent of any damage and its possible re-use. This applies particularly to the cylinder block with its corners, angles and bores. If necessary, remove all plugs and covers and clean their seats, using suitable cleaning agents and tools (brushes, scrapers). The oil galleries in particular, e.g. in the cylinder block, cylinder head, etc. should be free from dirt and abrasive particles, Fig.42. If press-fit plugs and screw plugs are removed, they, like all seals and gaskets, should be renewed.

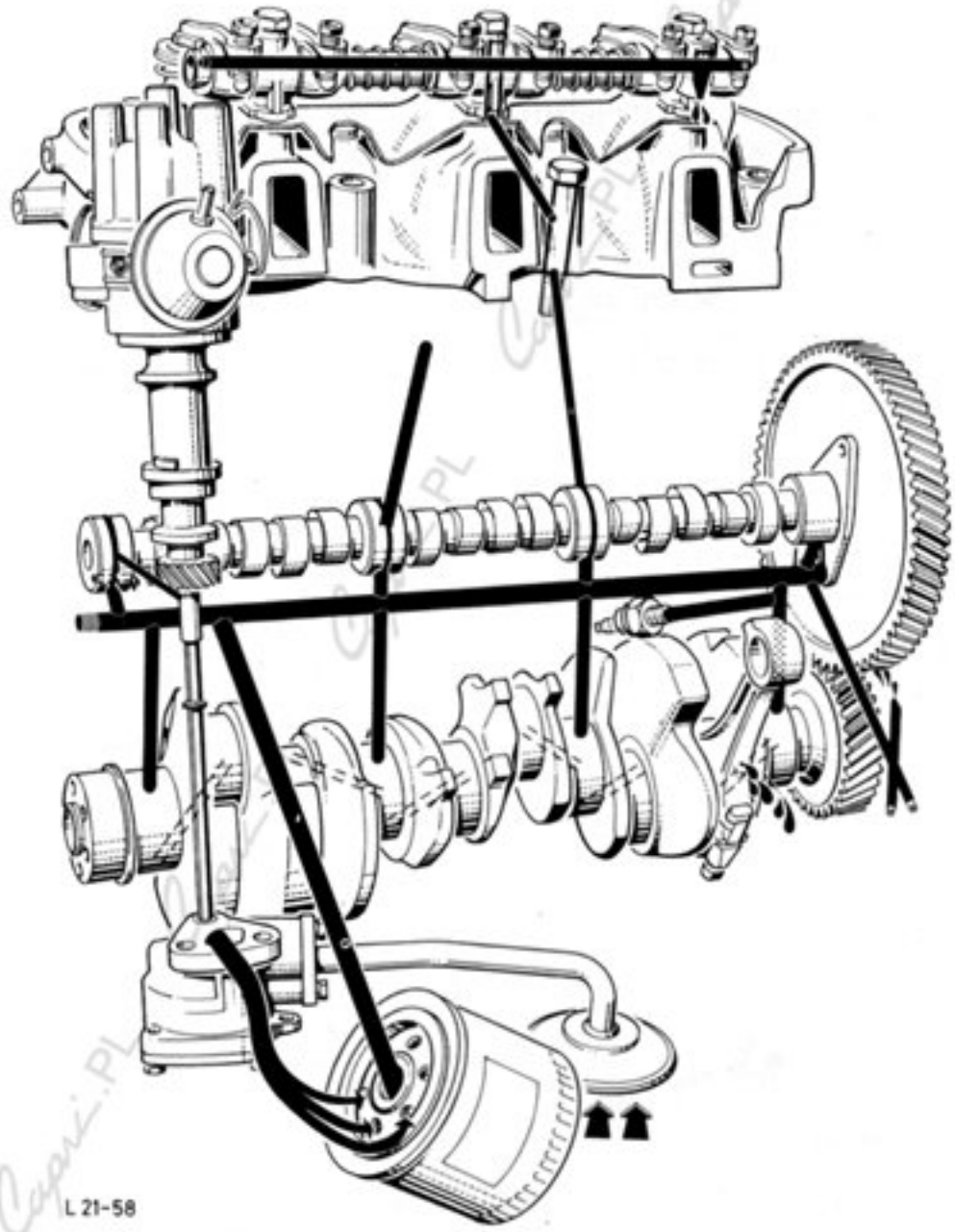

Fig.42. Oil circuit.

MAIN BEARINGS

Parent bore in cylinder block

The parent bore in the cylinder block may be either standard or 0,38 mm (0,015 in.) oversize. There is no marking for the standard parent bore, but with an oversize bore the bearing caps are marked with white paint, Fig.43.

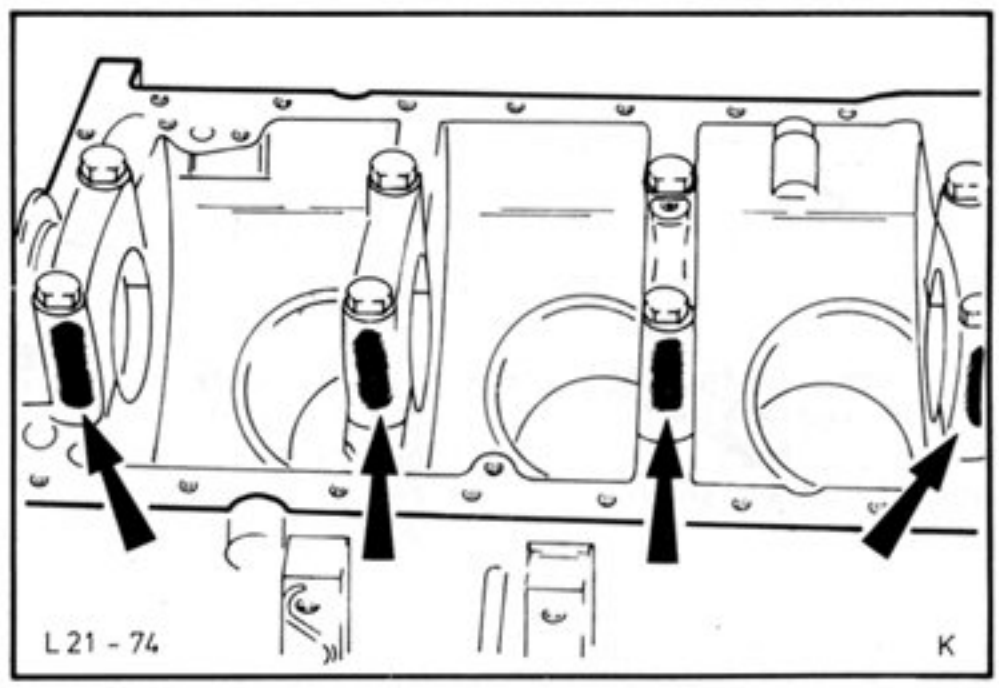

Fig.43. Colour marking of main bearing caps.

Crankshaft main bearing journals

The crankshaft main bearing journals may be standard or 0,25 mm (0,01 in.) undersize. Standard main bearing journals are not marked, while the crankshaft undersize main journal is marked with a green stripe on front balance weight.

NOTE: Only crankshafts with rolled blending radii at main and big end journals may be used on the Capri 2,8 Injection.

Thes rolled crankshafts may only be ground down to a maximum of 0,254 mm (0,01 in.) undersize at main and big end journals.

Crankshaft big end bearing journals

Standard big end bearing journals are not marked. Journals which are 0,25 mm (0,01 in.) undersize are marked with a green paint spot on web next to the journal, Fig.44.

Crankshafts with undersize main and big end bearing journals are marked with both stripe and spot on the front of the web adjacent to journals, Fig.45.

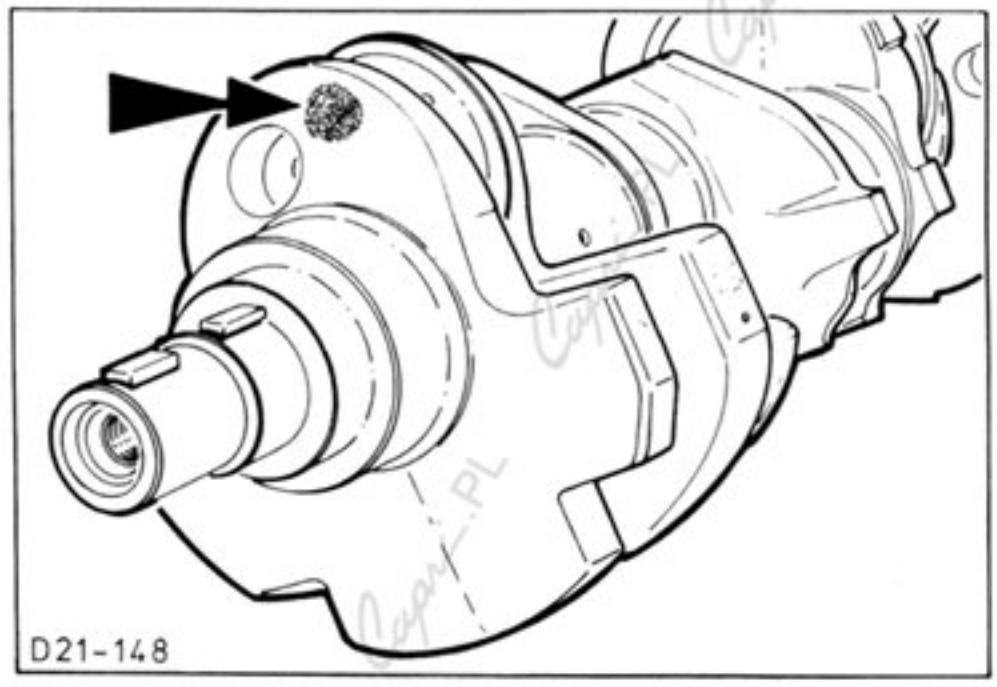

Fig.44. Colour markings, big end bearing journals.

Bearing caps

Standard main bearing and big end bearing shells are not marked. Bearing shells for undersize crankshafts or oversize cylinder blocks have an appropriate inscription on the back (see Parts Catalogue Microfilm) while colour markings on production repair sizes are on the outer edge at the side, Fig.46. The Service main and big end bearing shells (0,5, 0,75, and 1,00 mm (0,02, 0,03, 0,04 in.) must not be used.

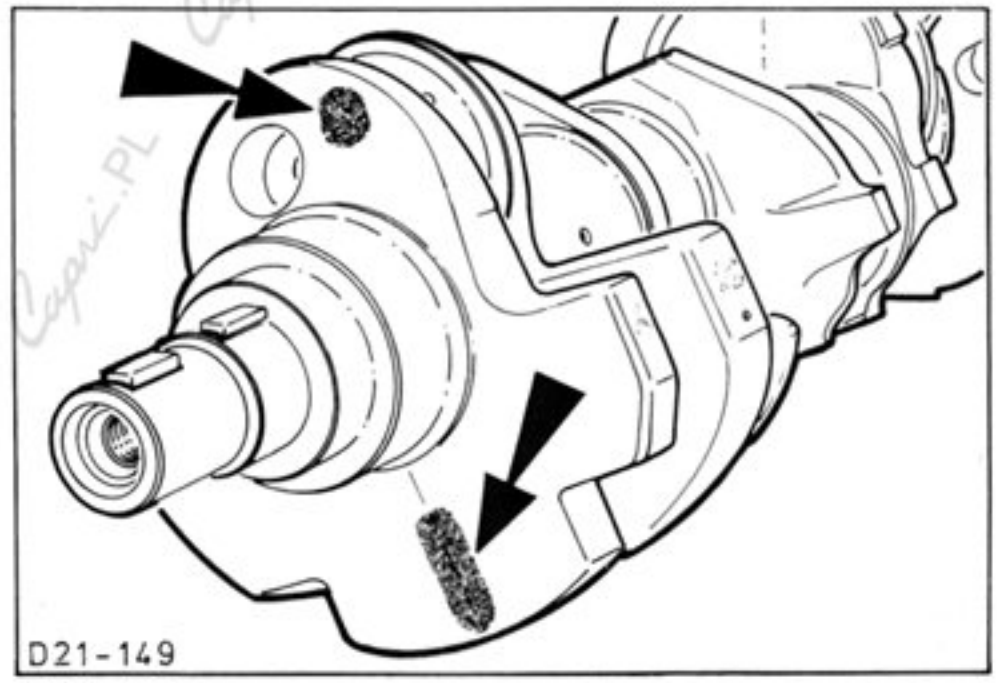

Fig.45. Connecting rod colour markings.

When new bearing shells are selected they should be checked against the Parts Catalogue Microfilm to ensure that they are appropriate ones and in addition they should be measured.

In order to remain within the specified tolerances (see Technical Data) journals, parent bores and bearing shells should be measured individually.

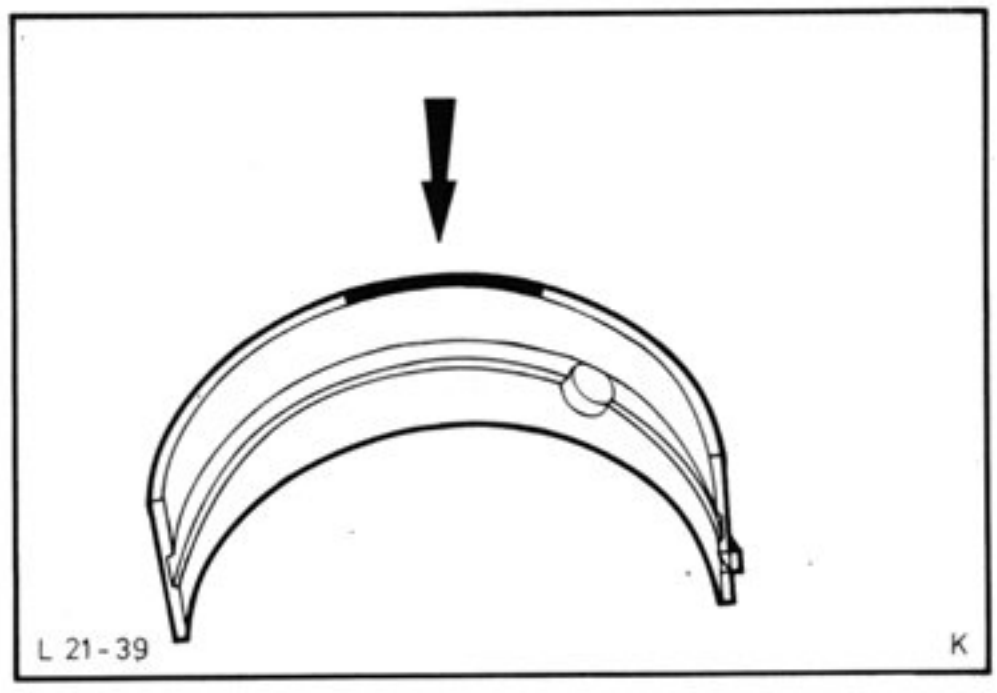

Fig.46. Bearing shell colour marking (Production repair size).

Measuring bearing clearance

Measuring bearings (even with undersize crankshafts) can be eliminated and determination of required bearing shells can be considerably simplified by use of:

'PLASTIGAGE' (type PG 1) made by:
PERFECT CIRCLE CORPORATION
HAGERSTOWN, INDIANA, USA.

UK Supplier:
NORMAN GAYDON (International Ltd.,
68, London Road,
Southend-on-Sea,
Essex.

West German Supplier:
K.H. ERN/MOTORENTEILE CmbH.
SCHINKELSTRASSE 46-48,
D-4000 DUSSELDORF.

'PLASTIGAGE' is the name of an accurately calibrated plastic filament.

Requirements for use of 'Plastigage'

1. Bearing should be dry and clean.
2. Crankshaft should not be turned during measuring operation.
3. Points of measurements should be close to top and bottom dead centre position.
4. Bearing caps should not be seated with hammer blows.

Procedure

Place length of Plastigage across width of bearing on crankshaft or big end journal, Fig.47. Fit main or big end bearing cap together with bearing shells and torque as specified. The plastic filament will be compressed more or less depending on bearing clearance. Remove bearing cap.

Each main bearing should be measured separately without other bearing caps being fitted.

Width of compressed plastic filament can be measured by means of scale printed on PLASTIGAGE pack, Fig.47, reading shows bearing clearance.

Only bolts in good condition should be used for securing bearing caps on crankshaft and they should not be tightened in excess of specified torque.

Measuring piston clearance

1. Fit main bearing caps without bearing shells and tighten to specified torque.
2. Turn the run-in engine block through 180° and measure cylinder bores with standard measuring instruments.
3. If the measured diameter of the cylinder bore is too large by comparison with the piston classification of the piston in use, the engine block must be overhauled or replaced. Fit the engine block with new pistons of corresponding cylinder bore classifications.
4. Before installing the pistons, check the piston ring gaps, Fig.48. The stated dimensions (see Technical Data) relate to the gauge ring used in production and can be exceeded by up to 0,15 mm (0,006 in.) when measured in the cylinder.

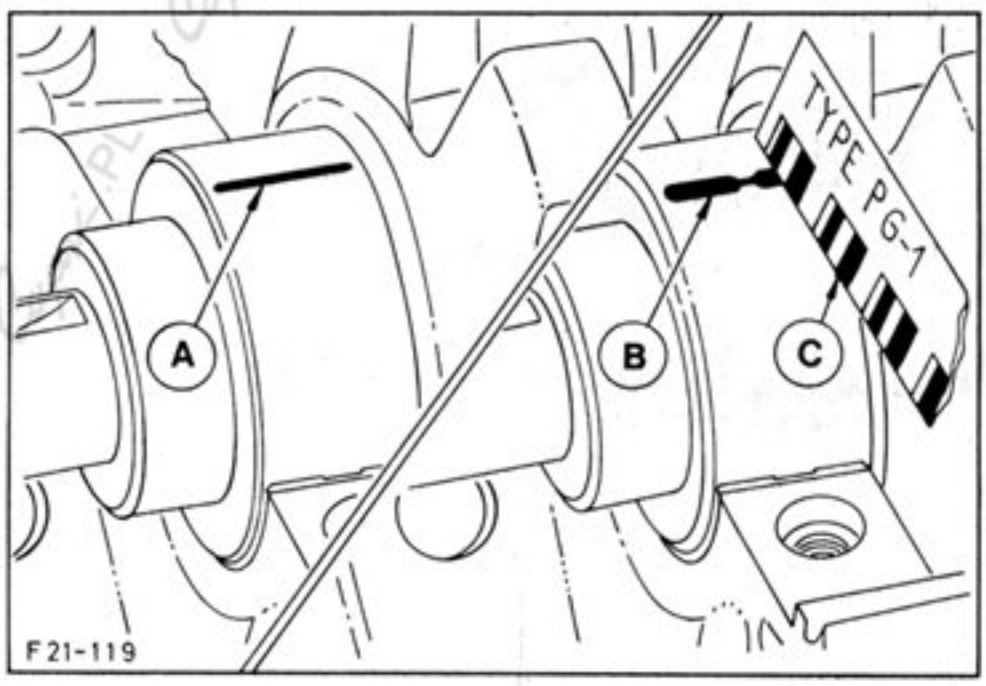

Fig.47. Measuring bearing clearance.
A - Calibrated plastic filament
B - Compressed filament
C - Scale

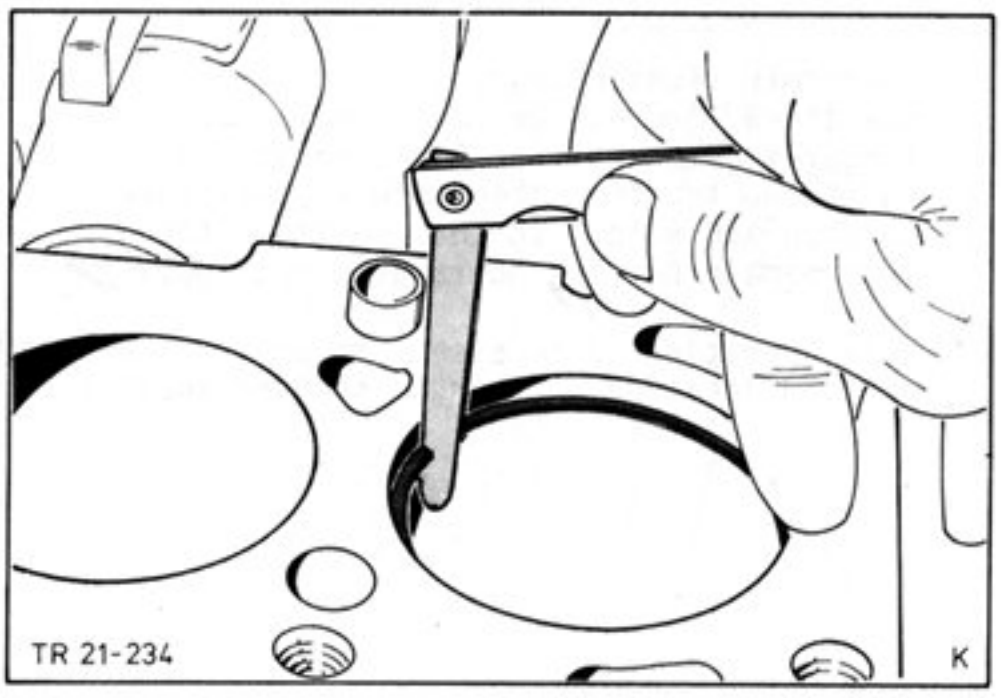

Fig.48. Check piston ring gaps.

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34. Press new pilot bearing into crankshaft, using Special Tool 21-067-A, Fig.49. Place timing gear in position and pull on with the belt pulley.

35. Insert main bearing shells dry into cylinder block, apply engine oil and place crankshaft in position.

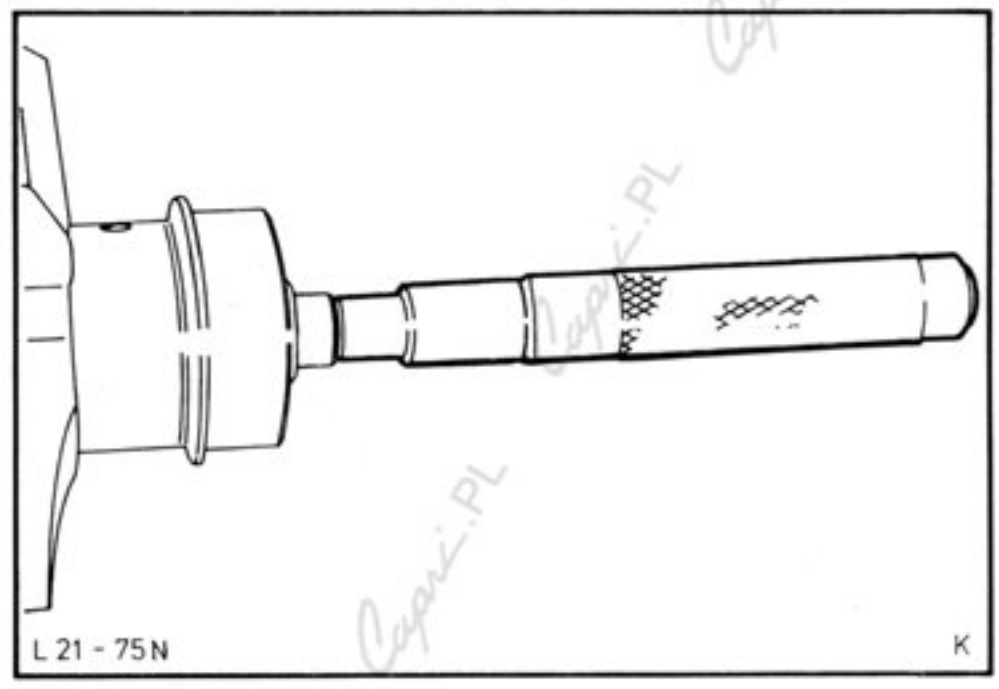

Fig.49. Fitting crankshaft pilot bearing using Special Tool 21-067-A.

36. Apply thin coat of sealing compound (Part No. A 70SX-19554-BA) to rear main bearing cap on rear part of contact face, Fig.51. Position main bearing caps complete with oiled bearing shells. Ensure flanged bearing shells are fitted to centre main bearing, Fig.50.

NOTE: Arrows on main bearing caps should point to front of engine.

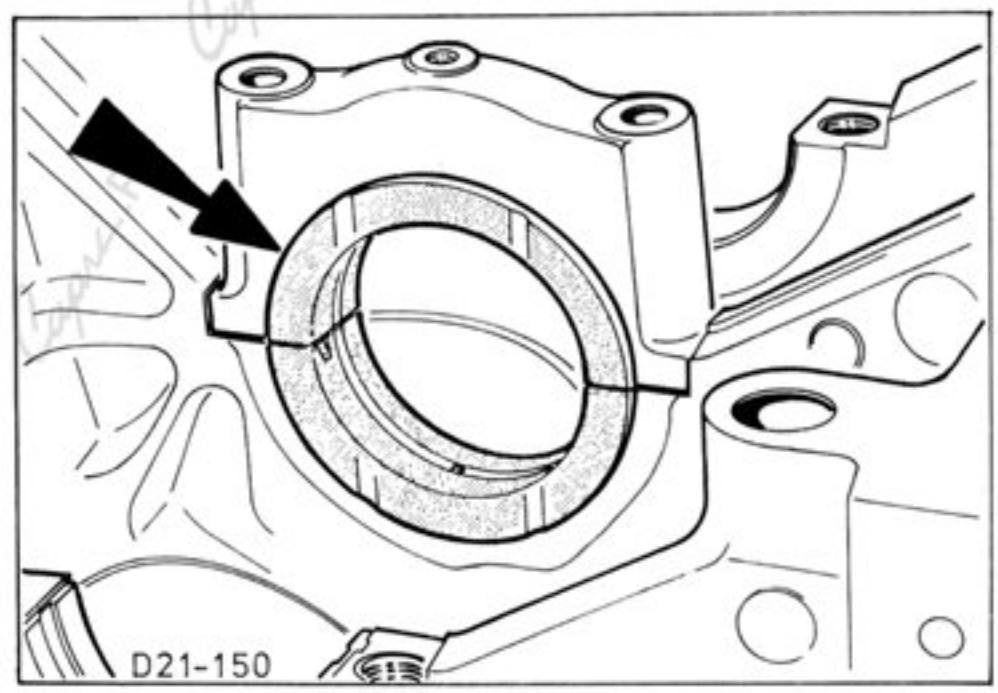

Fig.50. Centre main bearing flanged bearing shells.

37. Uniformly tighten bearing cap bolts to specified torque. On centre main bearing only finger-tighten bolts. First press crankshaft to ear up to stop, then slowly press forward to stop and hold. In this position torque centre main bearing bolts as specified.

This operation is necessary in order to ensure uniform location of flanged bearing shells).

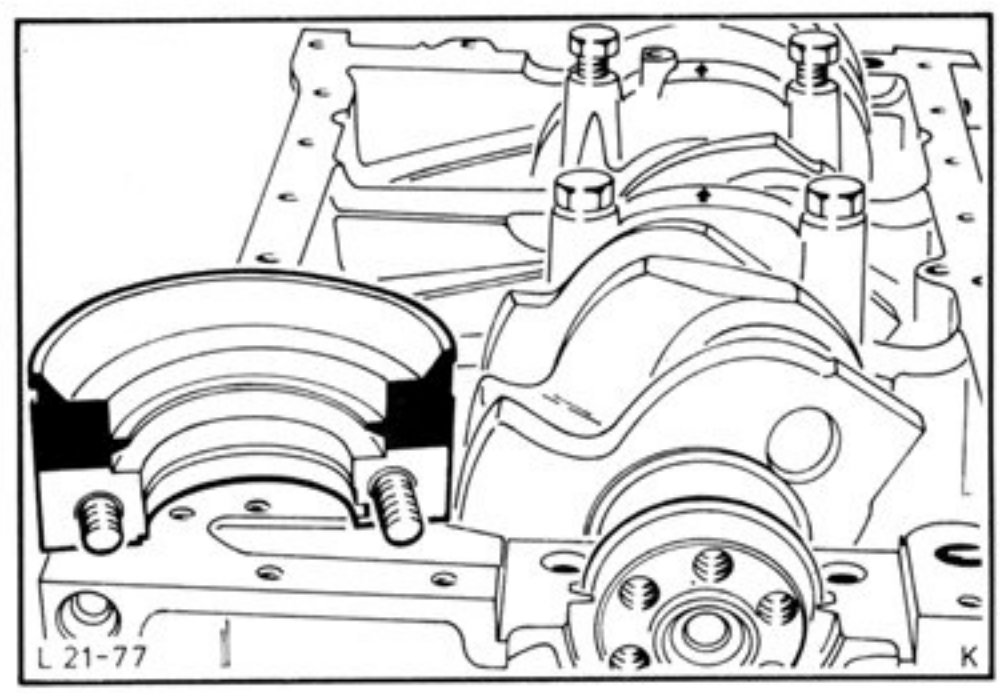

Fig.51. Apply sealing compound to rear main bearing cap contact face.

38. Check crankshaft end-float (see Technical Data) with a dial gauge, Fig.52, and correct if necessary with flanged bearing shells.

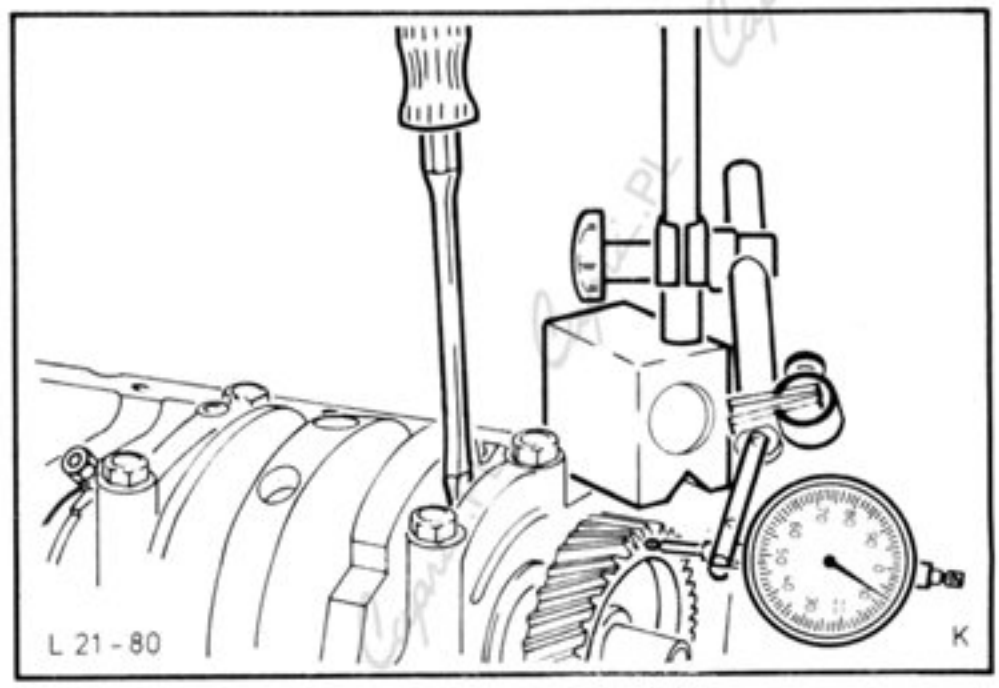

Fig.52. Check crankshaft end-float.

39. Apply engine oil to sealing lip of new rear oil seal, slide seal onto the Special Tool 21-059 and drive home against the rear main bearing, Fig.53.

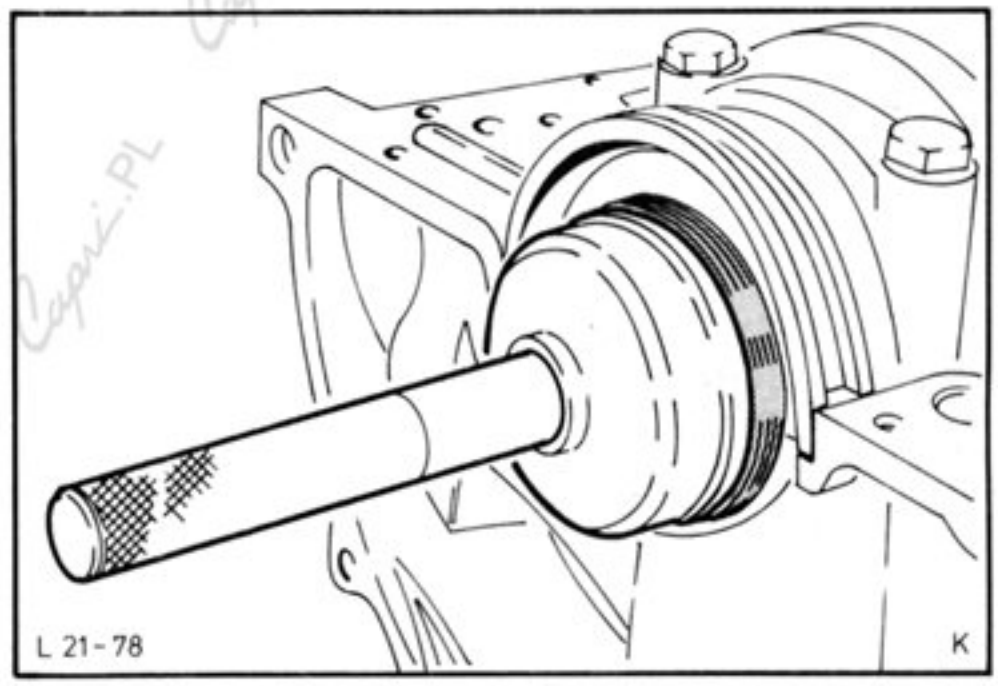

Fig.53. Fit oil seal with Special Tool 21-059.

40. Coat rear main bearing cap dowel bushes with sealing compound (Part No.A 70SX-19554-BA and drive in with a blunt screwdriver, Fig.54. (The rounded face of the dowel bush has a red mark and must be fitted pointing towards the bearing cap).

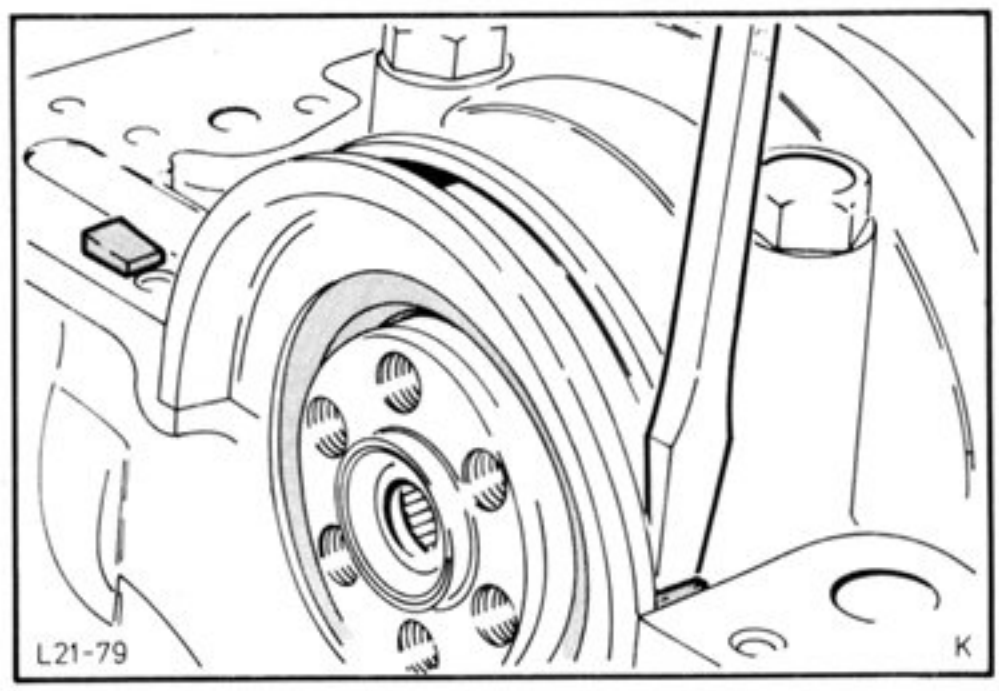

Fig.54. Fit rear main bearing dowel bushes.

41. Invert engine and lubricate camshaft bearings, camshaft and thrust plate.

42. Carefully fit camshaft from front, Fig.55. Prior to installation slide spacer onto camshaft, chamfered side first, and fit plate spring. Torque self-locking thrust bolts as specified in Technical Data.

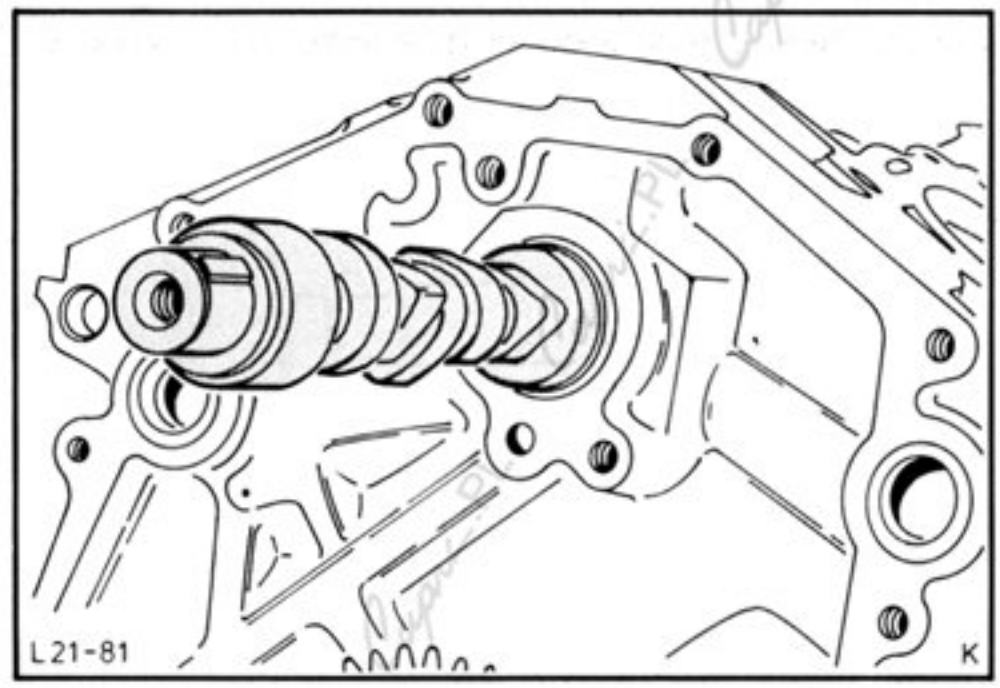

Fig.55. Fit camshaft.

43. Apply sealing compound to cylinder block front outer diameter and to rear of front intermediate plate. Position gasket and fit intermediate plate to cylinder block, initially only finger-tightening bolts, Fig.56. Fit two further bolts into lower intermediate plate bores for locating purposes and remove bolts after torquing intermediate plate.

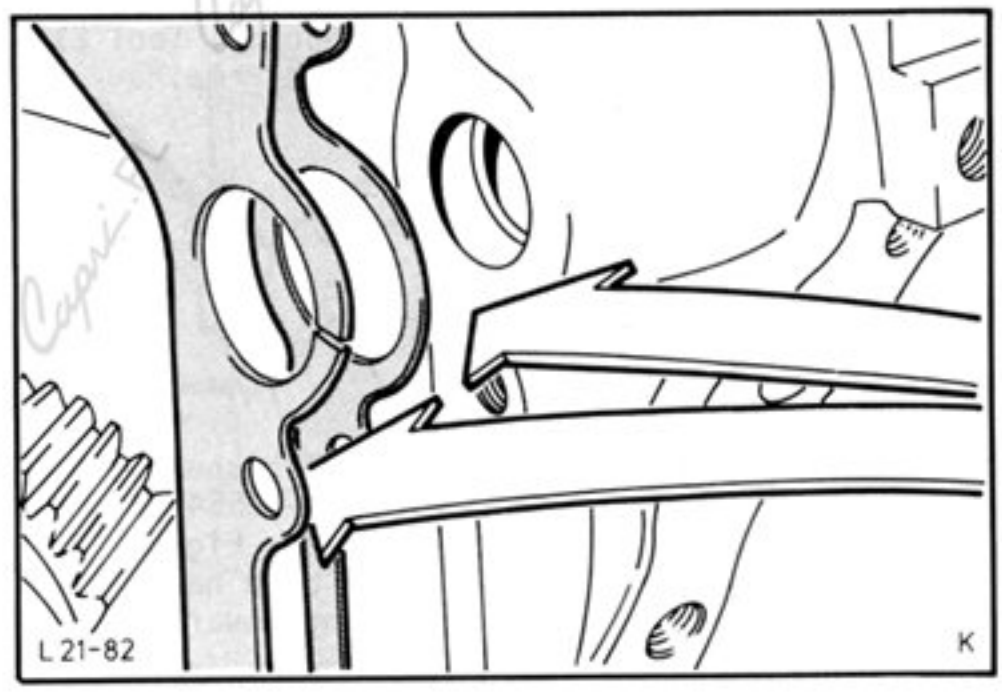

Fig.56. Fit intermediate plate with gasket.

44. Insert both guide sleeves with sealing rings fitted, without sealing compound, into cylinder block. Chamfered side of guide sleeve should face timing cover, Fig.57.

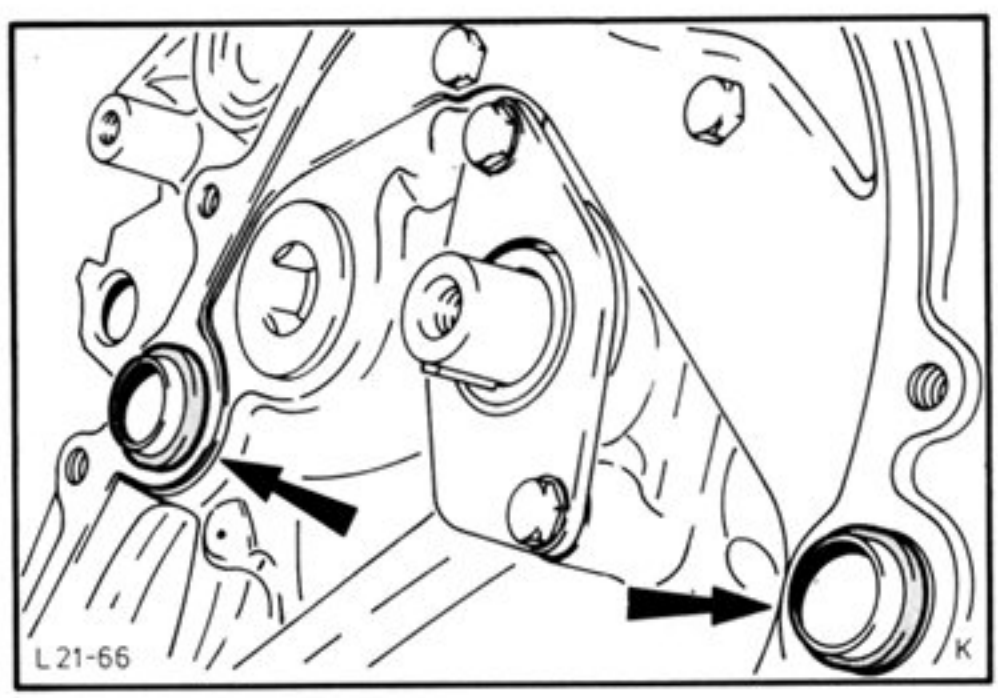

Fig.57. Guide sleeves with sealing rings.

45. Slide camshaft gear into position with spot mark aligned on crankshaft gear mark. (Plate spring grooves should face each other). While doing so slightly turn crankshaft to and fro to facilitate positioning of camshaft gear. Fit plate with bolt and tighten to specified torque.

NOTE: Crankshaft gear has two markings and camshaft gear should therefore be fitted as shown in Fig.58. only.

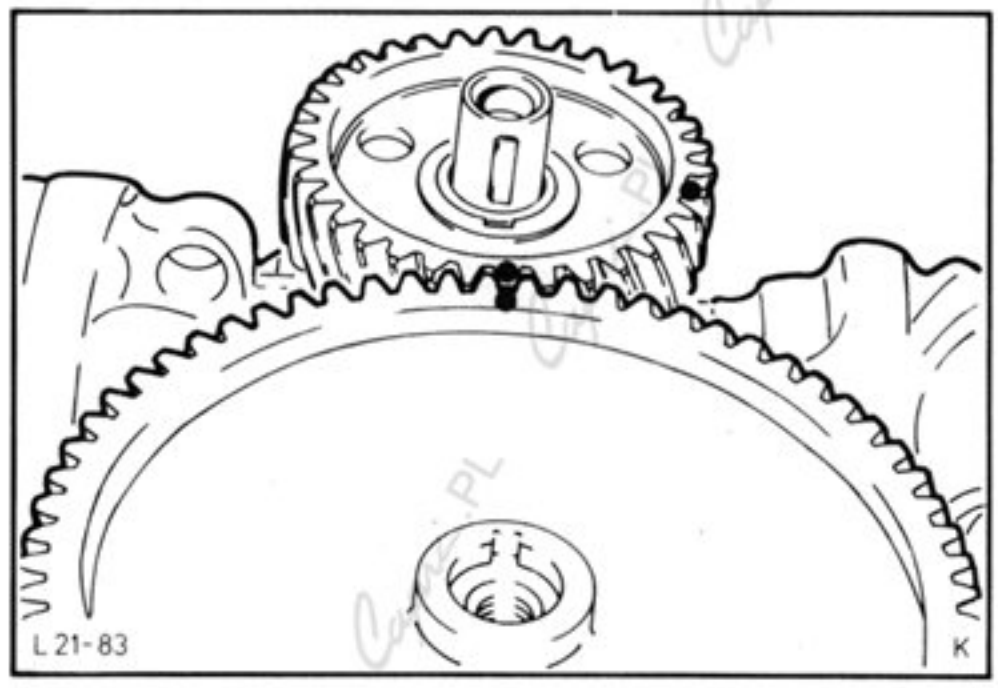

Fig.58. Camshaft gear and crankshaft gear spot markings.

46. Check camshaft end-float, using dial indicator, Fig.46, then check backlash at four points of gear (see Technical Data).

47. Apply sealing compound to timing cover outer diameter as well as to front of intermediate plate.

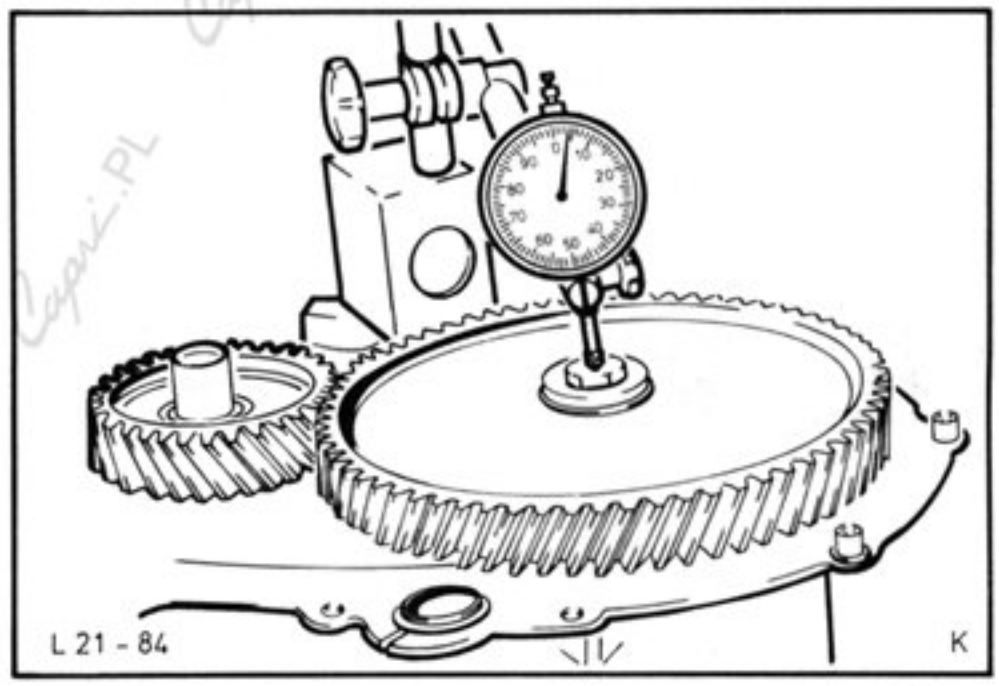

Fig.59. Check camshaft end-float.

48. Position gasket and fit assembled timing cover, centering cover by means of Special Tool 21-069 and crankshaft pulley, Fig.60. Tighten bolts to specified torque.

49. Fit crankshaft pulley and tighten bolt to specified torque.

NOTE: Apply sealing compound to one side of pulley washer.

50. Mount water-pump with gasket and insert thermostat. Fit thermostat housing and by-pass elbow with gasket.

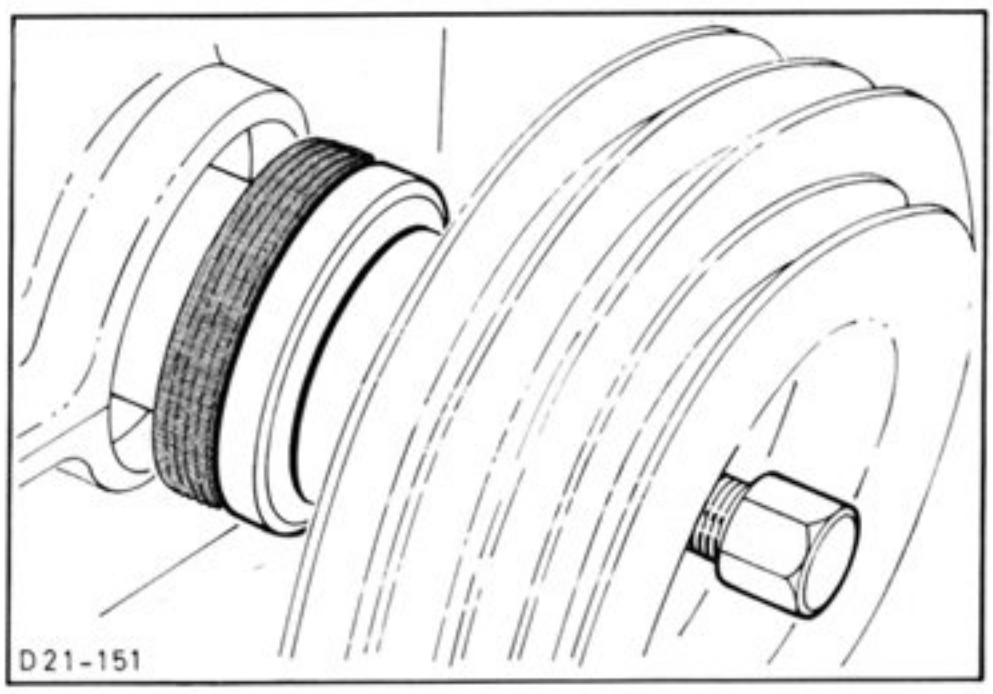

Fig.60. Centre timing cover by means of Special Tool 21-069 and crankshaft pulley.

51. Invert engine, position adaptor plate, fit flywheel and tighten bolts to specification, Fig.61.

NOTE: Re-use only bolts which are in good condition and lubricated.

52. Apply engine oil to pistons and cylinder bores. Offset piston rings with specified gaps. (Refer to Technical Data).

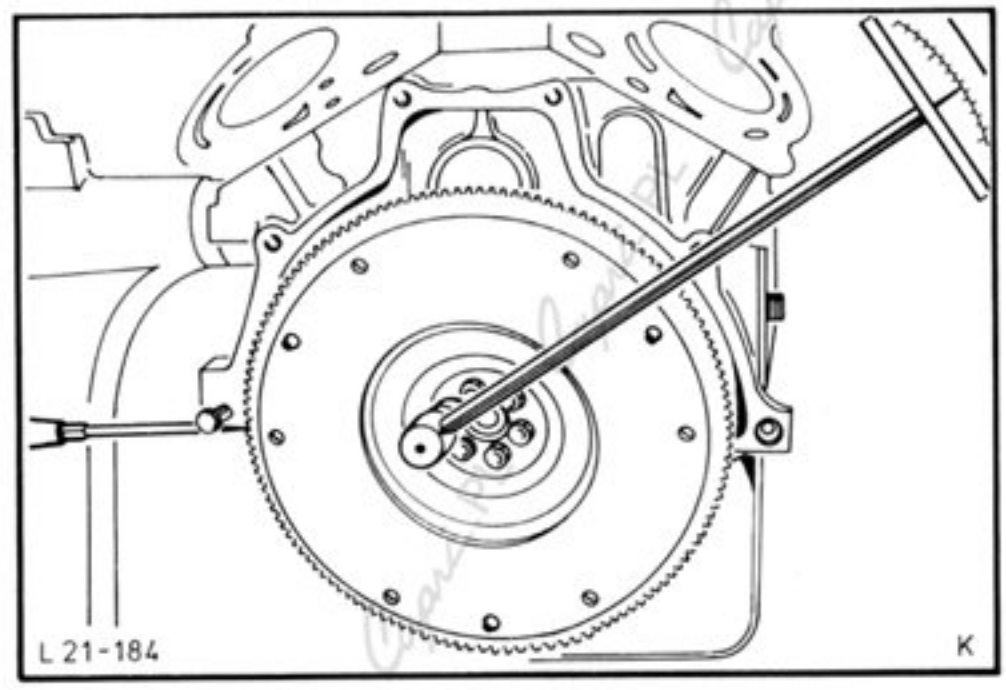

Fig.61. Refit flywheel.

53. Compress piston rings with a standard tool (ring compressor). Press piston into cylinder using a hammer handle, guiding connecting rod onto big end journal, Fig.62.

NOTE: The 'front' marking on piston (arrow, notches, etc.) should point to front of engine.

54. Invert engine.
Place big end bearing shell in position, apply oil and press firmly against big end bearing journal.

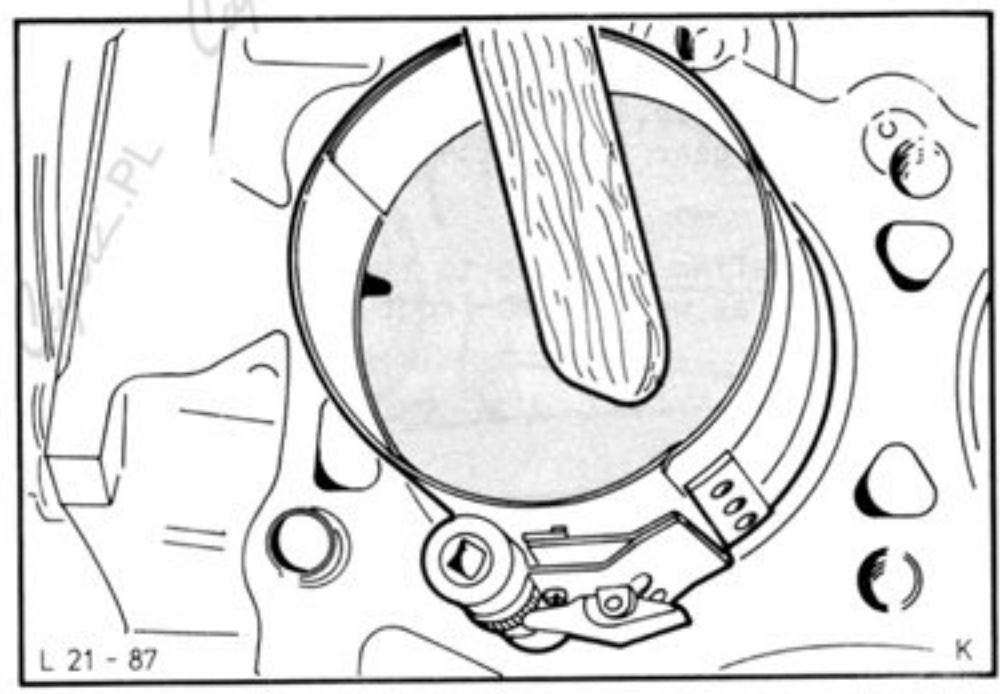

Fig.62. Fit piston ring using ring compressor.

55. Fit big end bearing cap complete with oiled bearing shell. Torque connecting rod bolts as specified in Technical Data, Fig.63.

NOTE: Check whether connecting rods have enough end-float on journals.

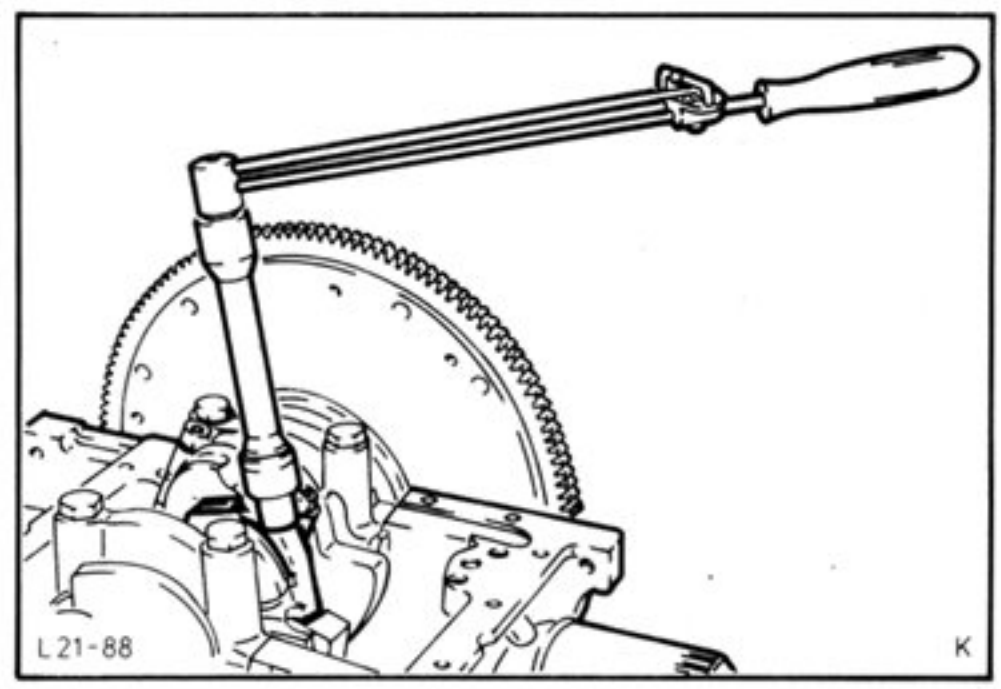

Fig.63. Torque connecting rod bolts as specified in Technical Data.

56. Insert oil pump drive shaft with retaining plate fitted (note direction and spacing) with pointed end towards distributor, Fig.64.

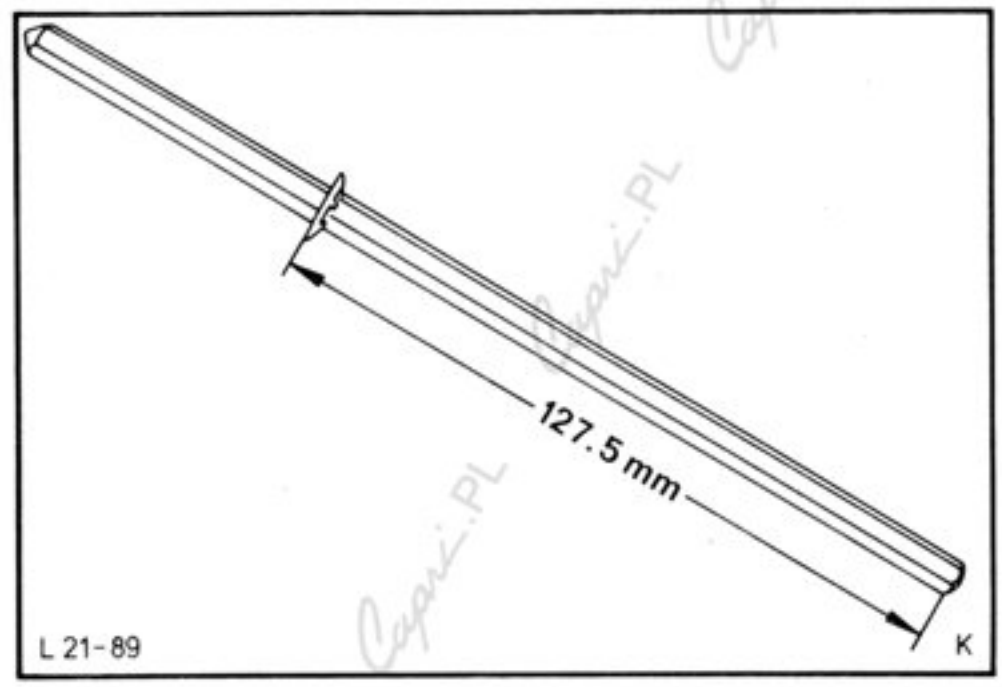

Fig.64. Oil pump drive shaft. (127,5 mm = 5,02 in.)

57. Fit oil pump complete with suction pipe and torque bolts as specified in Technical Data, Fig.65.

NOTE: When a new or overhauled oil pump is used, it should be turned by hand through a complete rotation and filled with engine oil prior to installation.

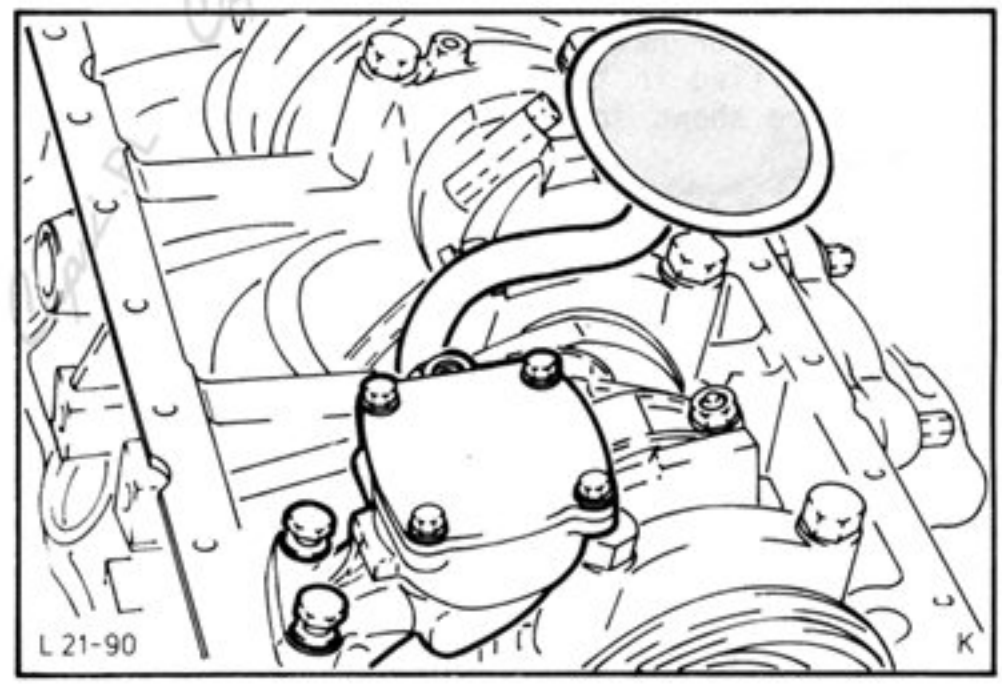

Fig.65. Fit oil pump.

58. Insert rubber seal in groove of rear seal carrier. Apply sealing compound to cylinder block mating surface at joint of cover and rear seal carrier. Place sump gasket in position and slide projections on cork gasket under cut-outs in rubber gasket, Fig.66.

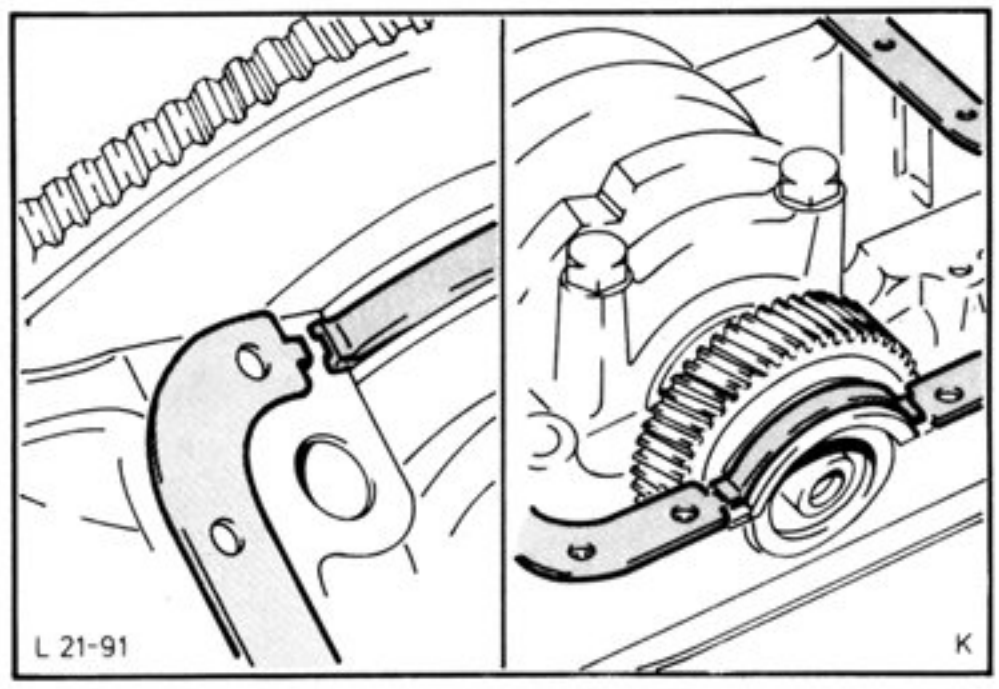

Fig.66. Fit sump gasket.

59. Fit sump. Torque bolts in two stages as specified in Technical Data.

60. Fit oil drain plug complete with new washer and torque as specified in Technical Data.

NOTE: Every time oil is changed and oil drain plug is removed, a new sealing ring should be fitted.

61. Invert engine, lubricate valve tappets with oil and install in cylinder block.

62. Position cylinder head gaskets over guide bushes on cylinder block, Fig.67. Left-hand and right-hand cylinder head gaskets are different.

NOTE: Gaskets are marked 'OBEN VORN' (top front). Note Spare Parts number.

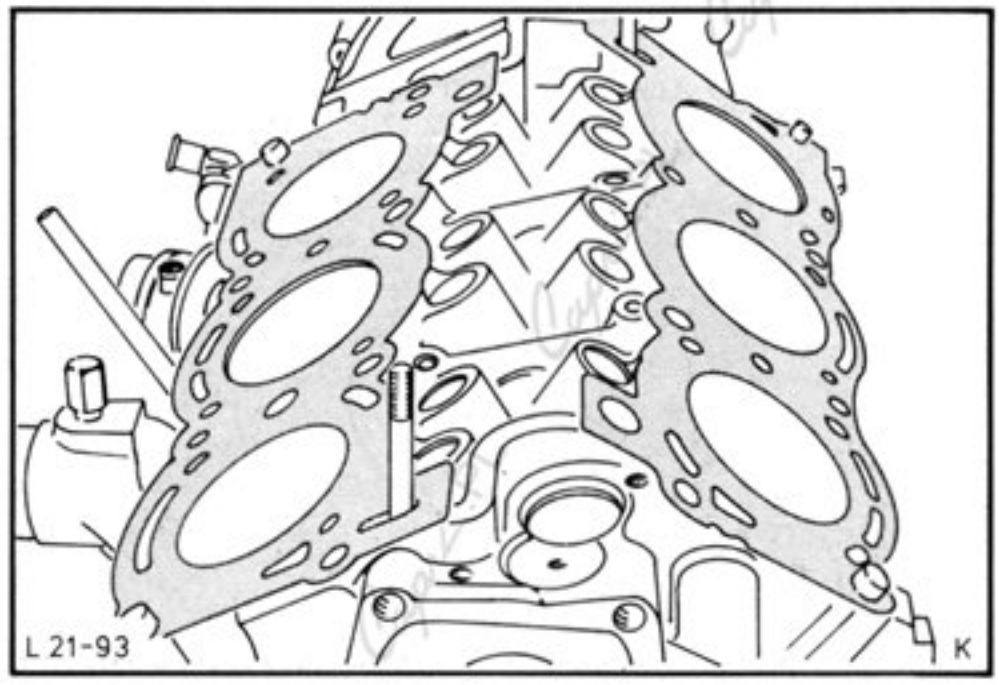

Fig.67. Position cylinder head gaskets.

63. Fit cylinder heads. Insert bolts and torque as specified in three stages proceeding in sequence shown in Fig.68 (see Technical Data).

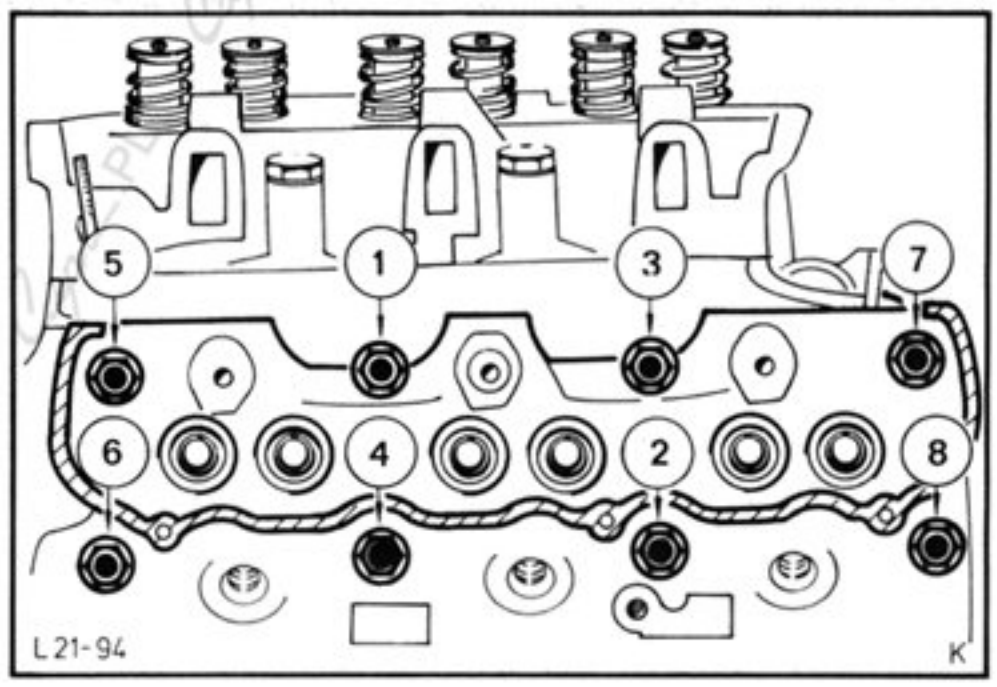

Fig.68. Cylinder head bolt tightening sequence.

64. Apply sealing compound to two cylinder head and two cylinder block faces, and inlet manifold, Fig.69. Fit new inlet manifold gasket.

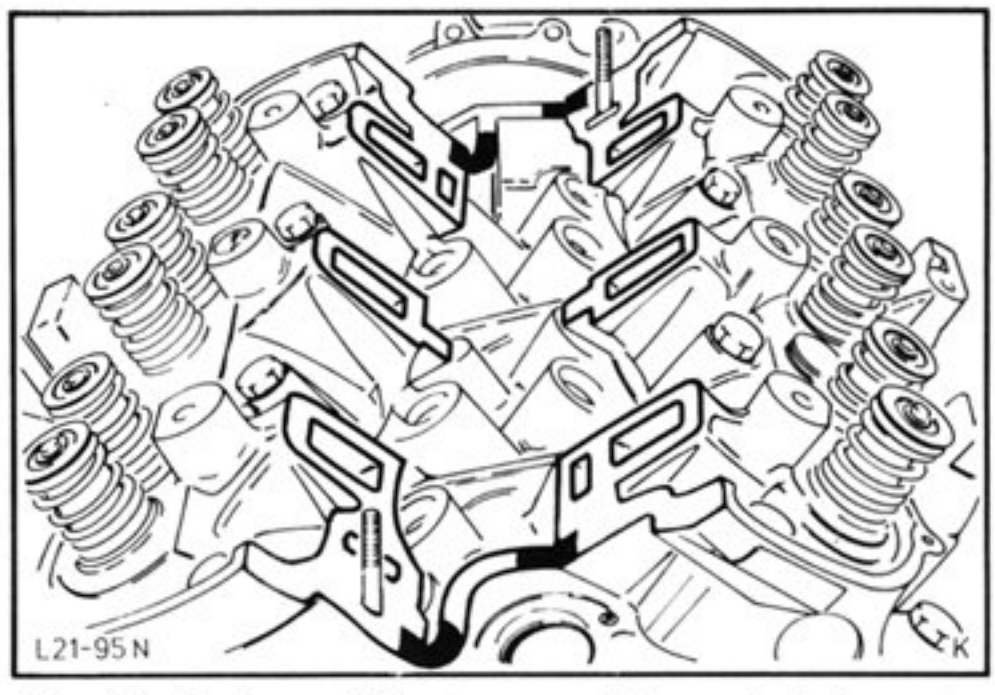

Fig.69. Apply sealing compound to gasket faces.

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65. Fit inlet manifold, insert bolts and tighten with specified torque (see Technical Data) in four stages as shown in Fig.70.

66. Apply engine oil to both ends of push rods and place them in the valve tappet sockets. Fit oil throwers and rocker shafts, Fig.71, guiding the adjusting screws of the rockers into the push-rod sockets. Tighten rocker shaft bolts by hand, then torque them as specified.

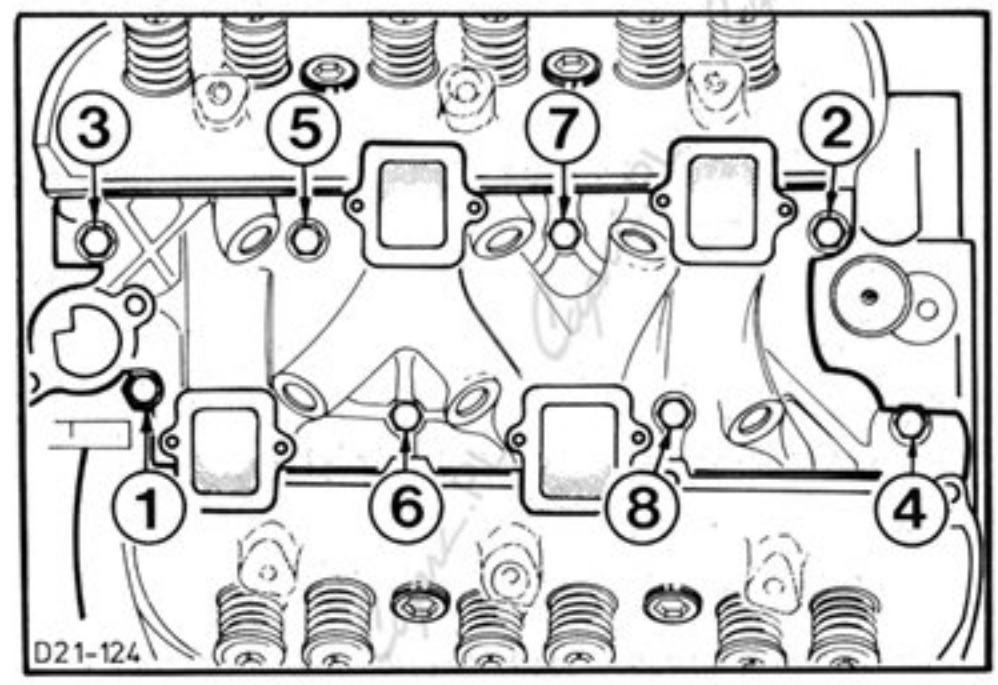


Fig.70. Inlet manifold bolt tightening sequence.

67. Fix by-pass hose to thermostat housing.

68. Crank engine to bring cylinder No.1 to TDC and install distributor.

69. Adjust valve clearance (see Operation No.21 213)

70. Fit rocker covers as specified. Fit tension pulley and water outlet connection with new gasket.

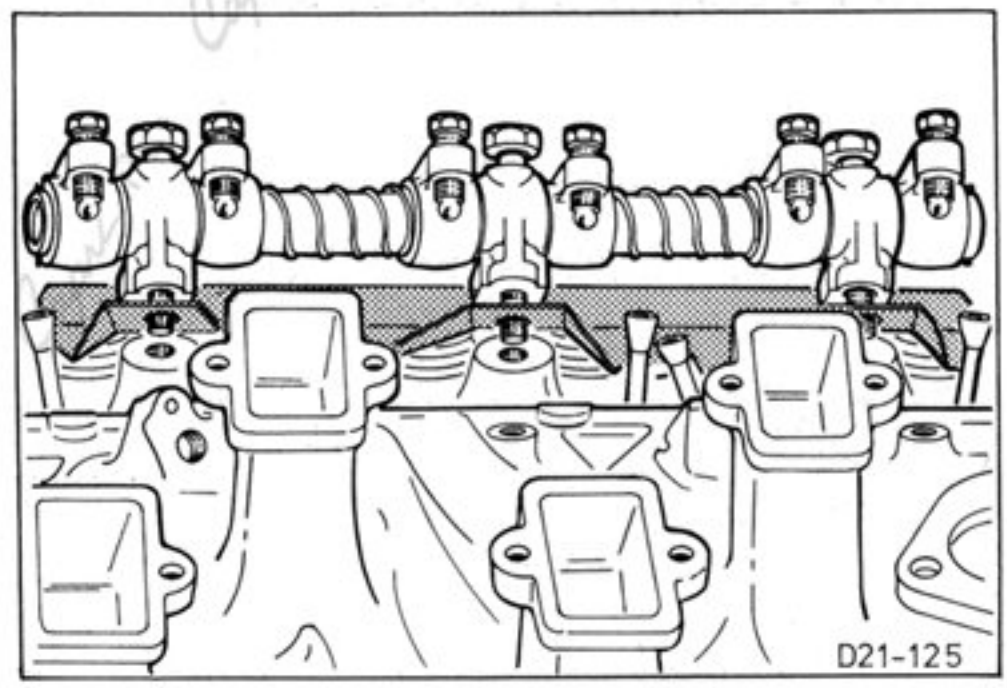


Fig. Fit rocker shaft with oil splash shield.

71. Install injection nozzles and attach fuel lines to nozzles and warm-up regulator.

72. Install oil cooler as follows:

a) Screw new threaded bush, 'A' in Fig.72, into the cylinder block.

b) Apply Omnifit Activator, 'Rapid', as per Ford specification SSM-4G-9003-AA, to the threads of the bush 'A' in Fig.72 and inside the new threaded sleeve 'D' in Fig.72.

c) Apply Omnifit Sealant, '300 Rapid', as per Ford specification SSM-4G-9003-AA, to the front threads only of the threaded bush projecting from the cylinder block.

NOTE: Only apply one drop of sealant, to prevent sealant finding its way into the oil circuit.

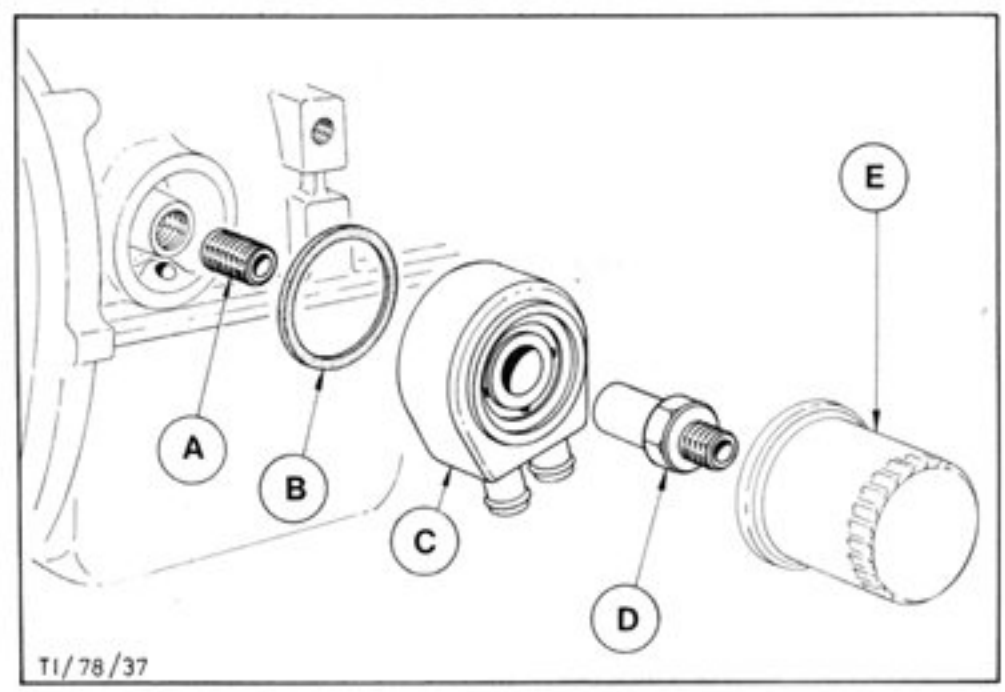


Fig.72. Component parts of oil cooler and main oil filter.

A - Threaded bush
B - Seal ring
C - Oil cooler
D - Threaded sleeve
E - Main oil filter

d) Fit new seal ring "B" in Fig.72 and oil cooler "C" in Fig.72, and fasten with threaded sleeve "D in Fig.72. When tightening the sleeve with the specified torque, ensure that the oil cooler is correctly positioned in relation to the vertical rear edge of the cylinder block, Fig.73.

73. Screw on new oil filter cartridge until rubber gasket makes contact with housing, then tighten a further 3/4 turns. Apply engine oil to rubber gasket before assembly.

74. Screw in oil pressure connection and tighten with specified torque.

75. Fit air chamber with new gasket to the intake manifold and attach engine breather hose to rocker cover.

76. Attach fuel line to cold-start valve and coolant hose to the intermediate section of the auxiliary air valve.

77. Fit fan and belt pulley to the water pump.

78. Fit spark plugs and tighten to specified torque. Fit distributor cap and attach HT leads to the spark plugs in the order shown, Fig.74.

79. Centre clutch disc with special tool 21-067-A, Fig.75. Place pressure plate on the dowels and tighten to specified torque.

80. Insert dipstick and remove engine from stand.

81. Fit left-hand exhaust manifold with new gaskets.

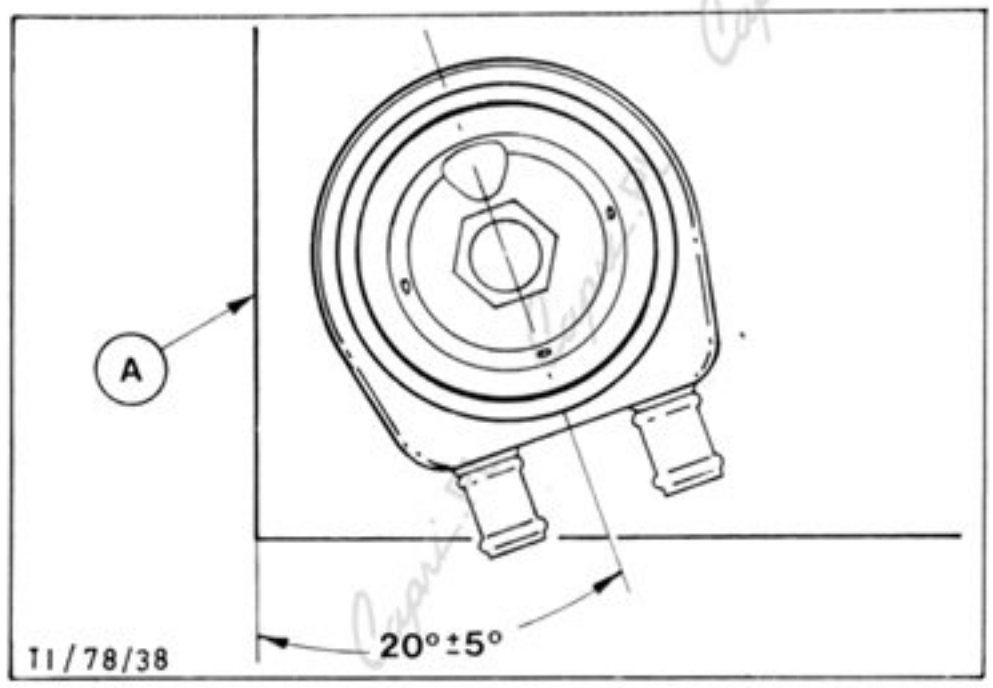


Fig. 73 Mounting position of the oil cooler.
A - Rear edge of cylinder block

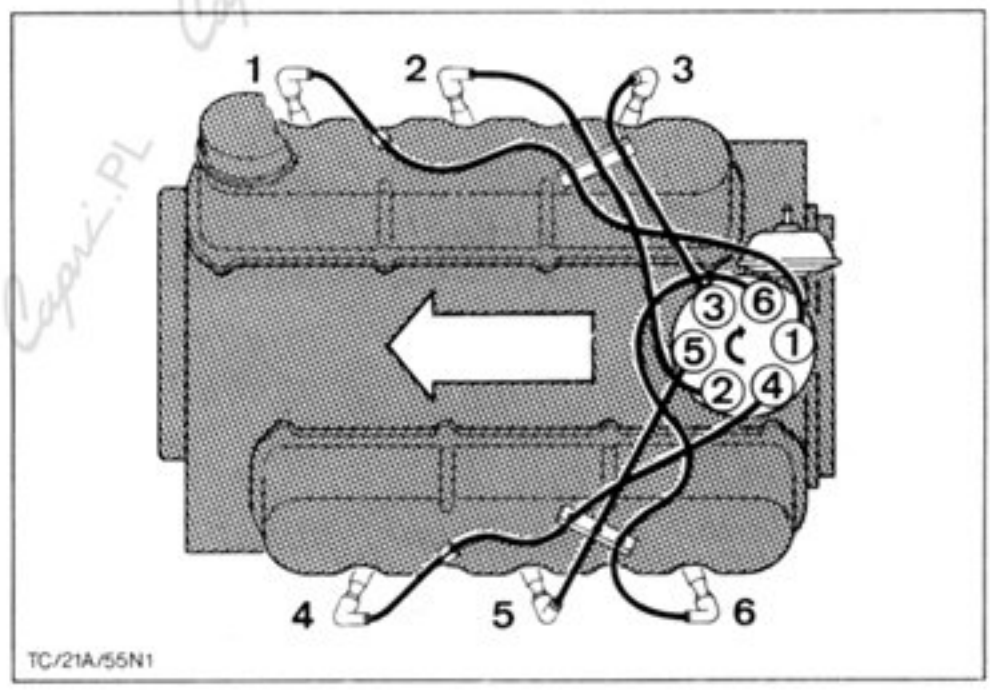


Fig.74. Arrangement of HT leads (firing order).

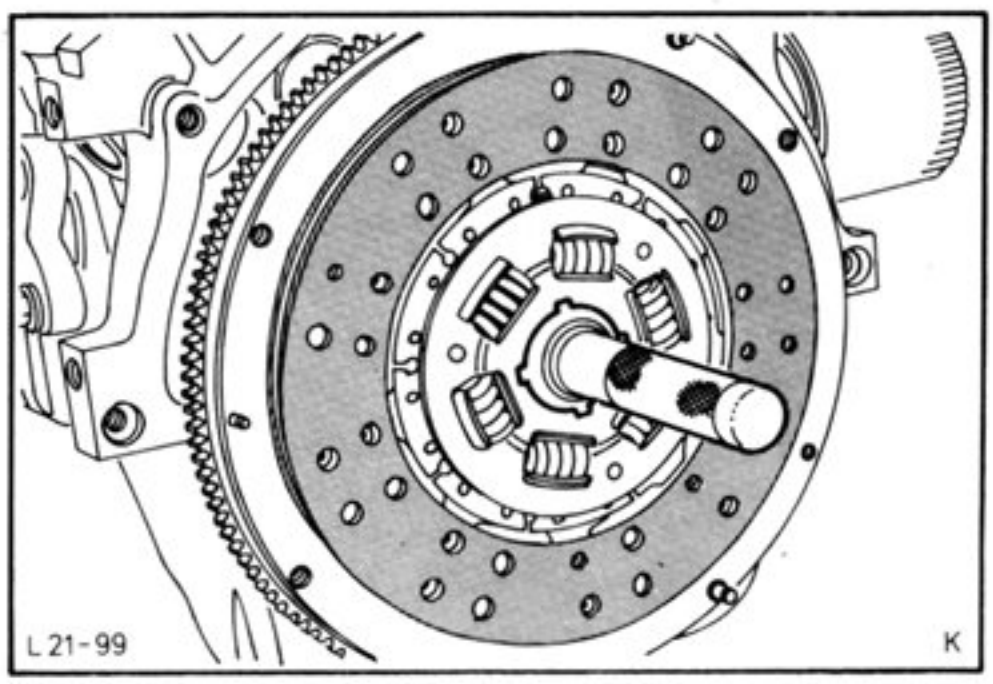


Fig.75. Centre clutch disc with special tool 21-067-A.

21 154 SUMP - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED - NONE

To Remove

1. Disconnect earth cable from battery. Remove distributor cap and unscrew shroud from radiator.

2. Drain engine oil, disconnect starter cable and remove starter motor (2 bolts).

3. Unbolt both engine mounting insulators from the crossmember (2 nuts), Fig. 76, and remove clutch housing cover.

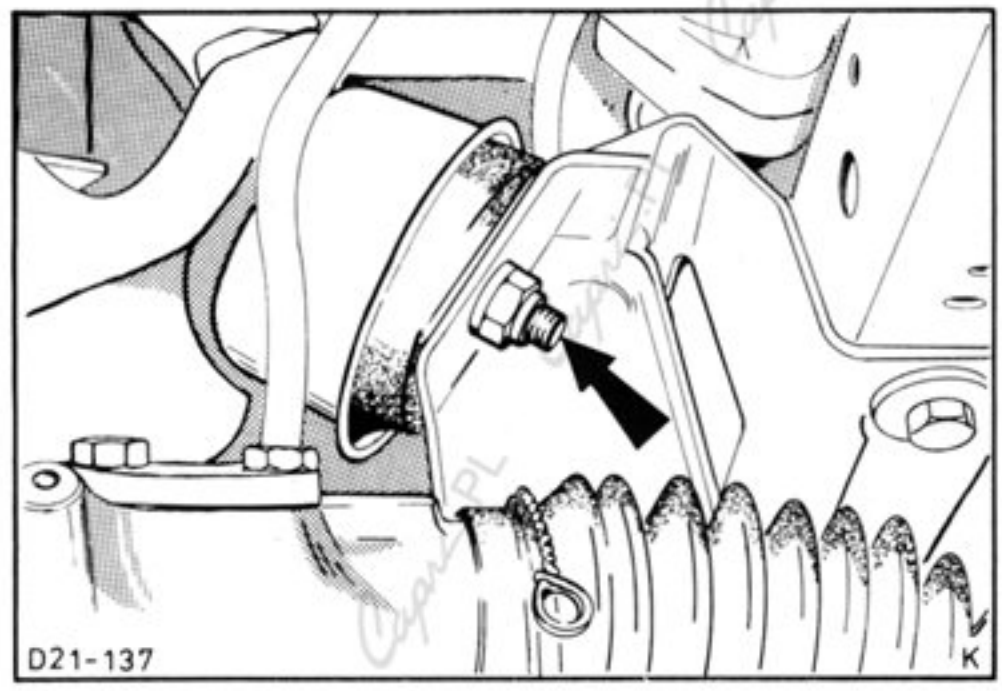


Fig.76. Unbolt insulators - engine mountings.

4. Remove sump bolts (24) and release sump from cylinder block. If sump sticks, prise off to one side with a screwdriver.

5. Jack up engine and support by gearbox. Remove sump.

NOTE: Only raise engine sufficiently for sump to be removed.

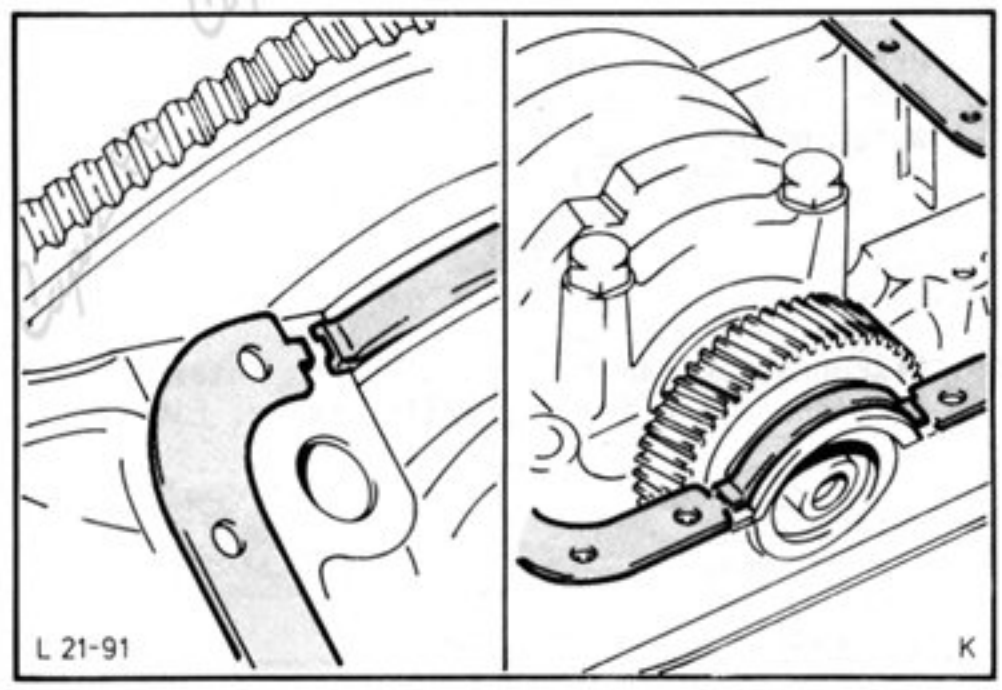


Fig.77. Fit sump gasket.

To Install

6. Remove traces of old gasket from sealing faces of cylinder block and sump. Straighten sump gasket face, if distorted. Stick new set of gaskets to the cylinder block, using grease, taking care that the sump gasket is correctly located, fig.77.

7. Insert sump bolts and tighten to specified torque (see Technical Data). Screw in oil drain plug with new sealing ring and tighten with specified torque.

8. Remove support under the gearbox and lower engine.

9. Fit clutch housing cover and bolt engine mounting insulators to crossmember to specified torque.

10. Install starter motor and connect starter cable, Fig.78.

11. Fit distributor cap and bolt fan shroud onto radiator.

12. Fill with engine oil and connect battery earth cable. Start engine and check sump for leaks.

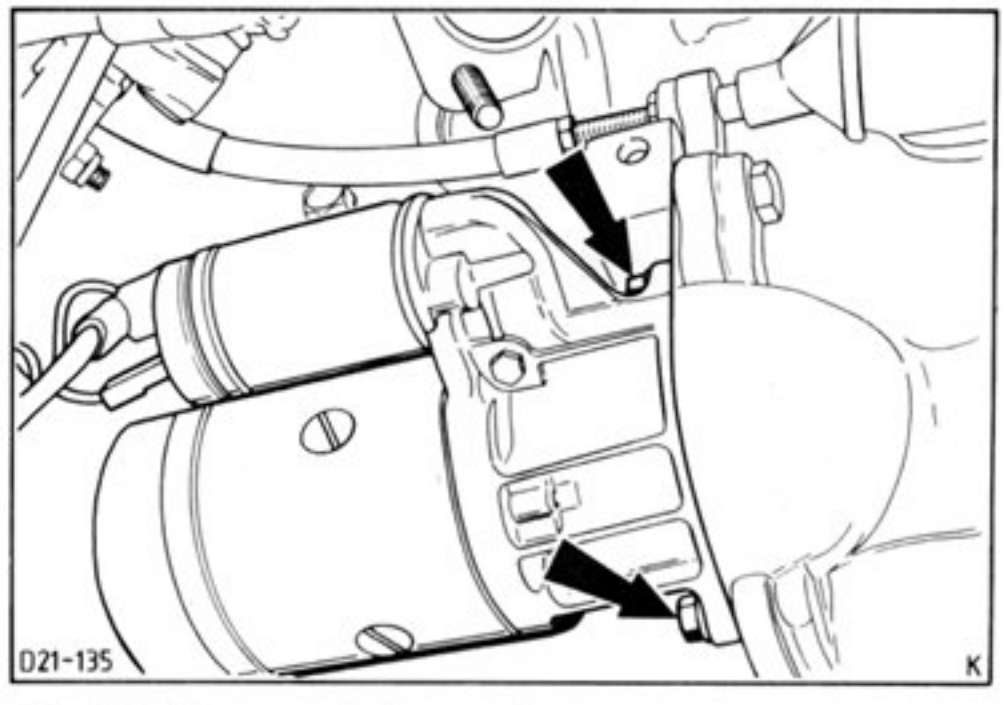


Fig.78. Remove starter motor.

21 164 CYLINDER HEADS - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED:

Inlet manifold wrench 21-092A

To Remove

1. Disconnect earth cable from battery.

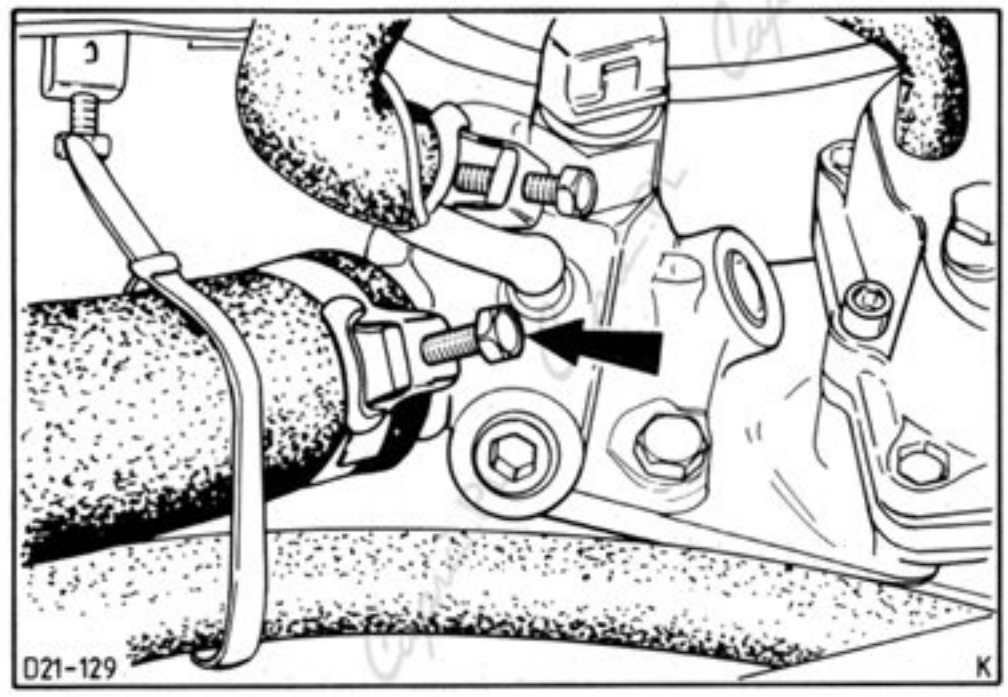


Fig.79. Detach upper radiator hose.

2. Drain coolant by disconnecting lower radiator hose from radiator and upper hose from engine water outlet, Fig.79.

3. Disconnect coolant hoses (3) from intermediate section of the auxiliary air device, Fig.80.

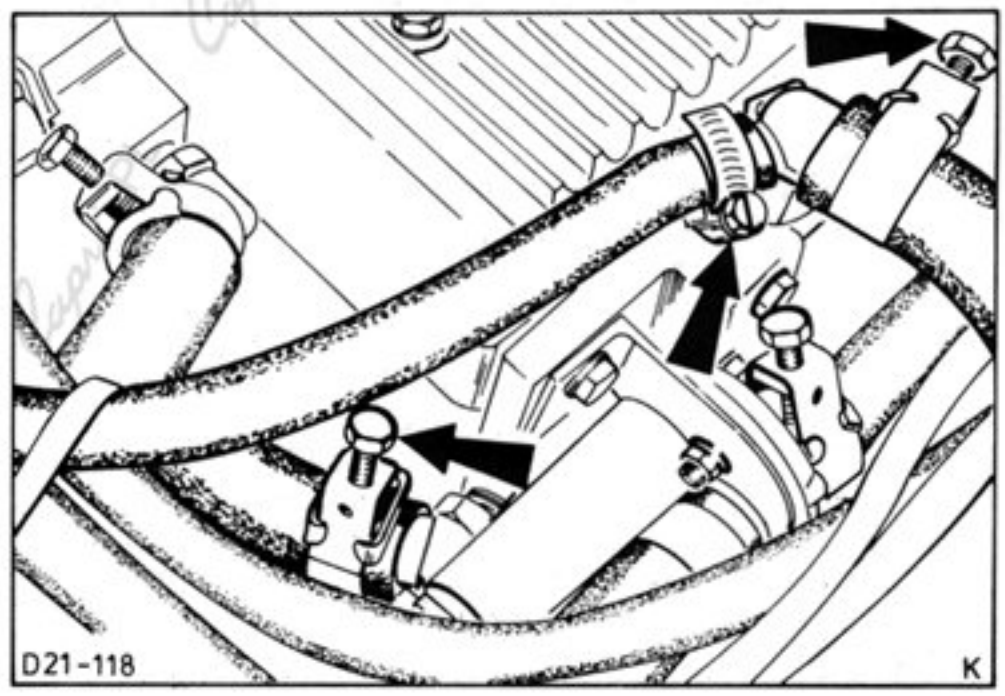


Fig.80. Coolant hoses on the auxiliary air device.

4. Disconnect brake servo vacuum hose from the air box connection.

5. Pull off vacuum hoses from warm-up regulator and from the throttle plate, Fig.81.

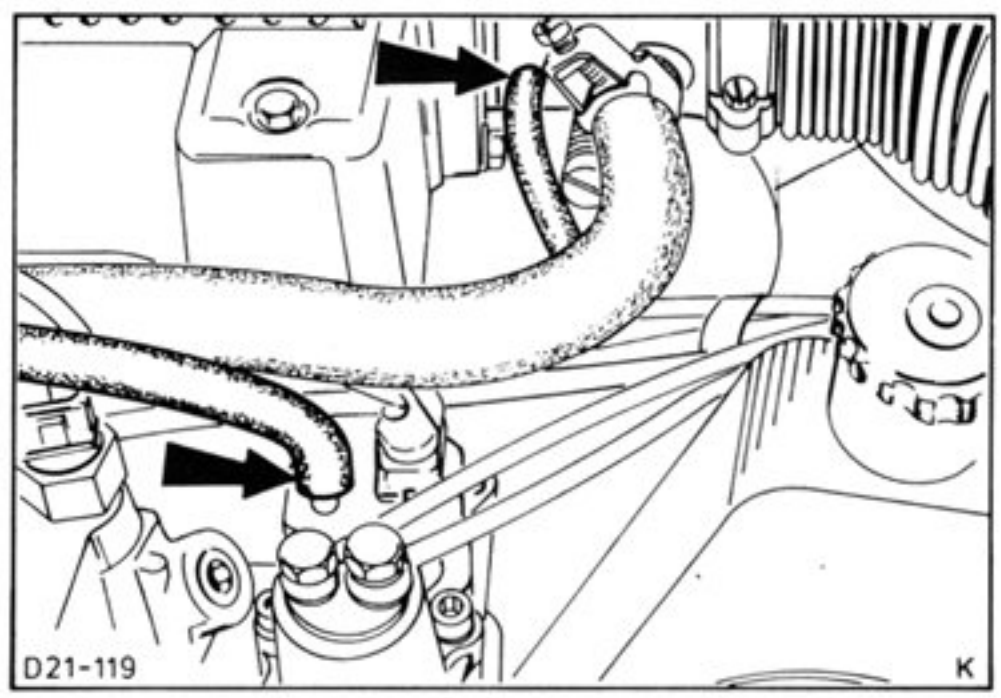


Fig.81. Pull off vacuum hoses.

6. Disconnect leads from thermometer sensor, thermo time switch, warm-up regulator, auxiliary air device and valve Fig.82.

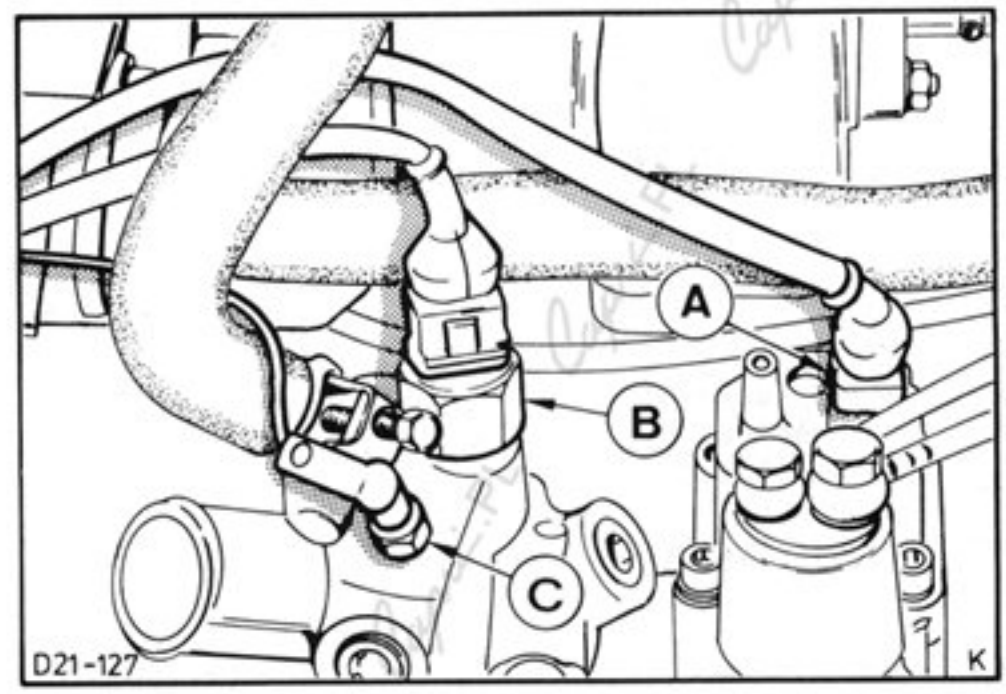


Fig.82. Disconnect electrical leads.
A - Warm-up regulator plug
B - Thermal time switch
C - Thermometer sensor

7. Disconnect fuel line from cold-starting valve, Fig.83 and connecting hose from intake silencer.

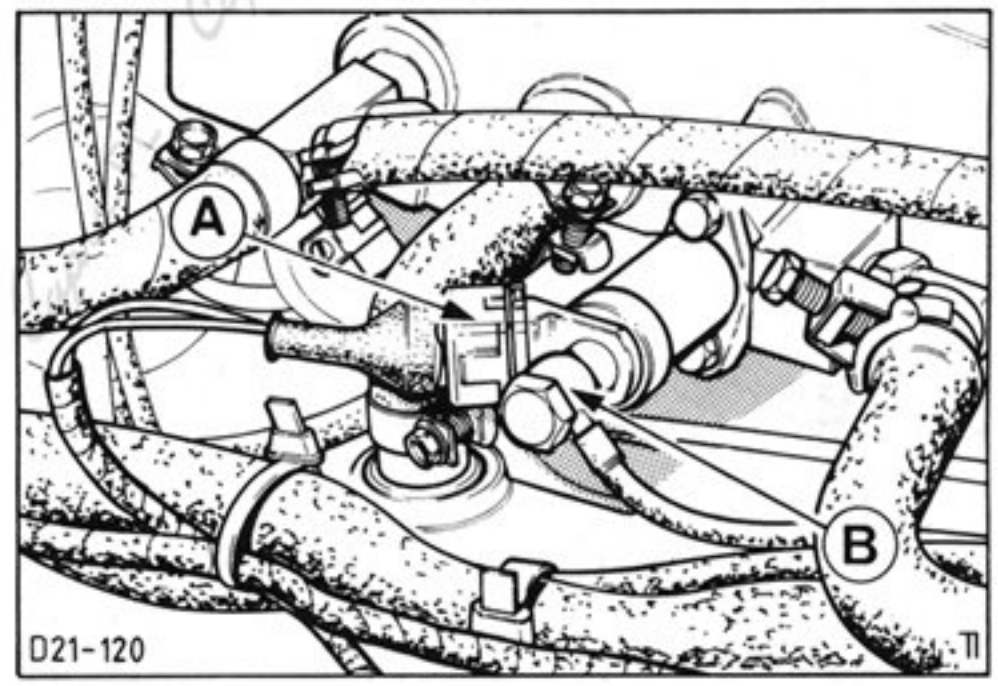


Fig.83. Installation position of start valve.
A - Multi plug
B - Fuel line

8. Detach throttle cable from throttle lever and remove complete with bracket (2 bolts), Fig.84.

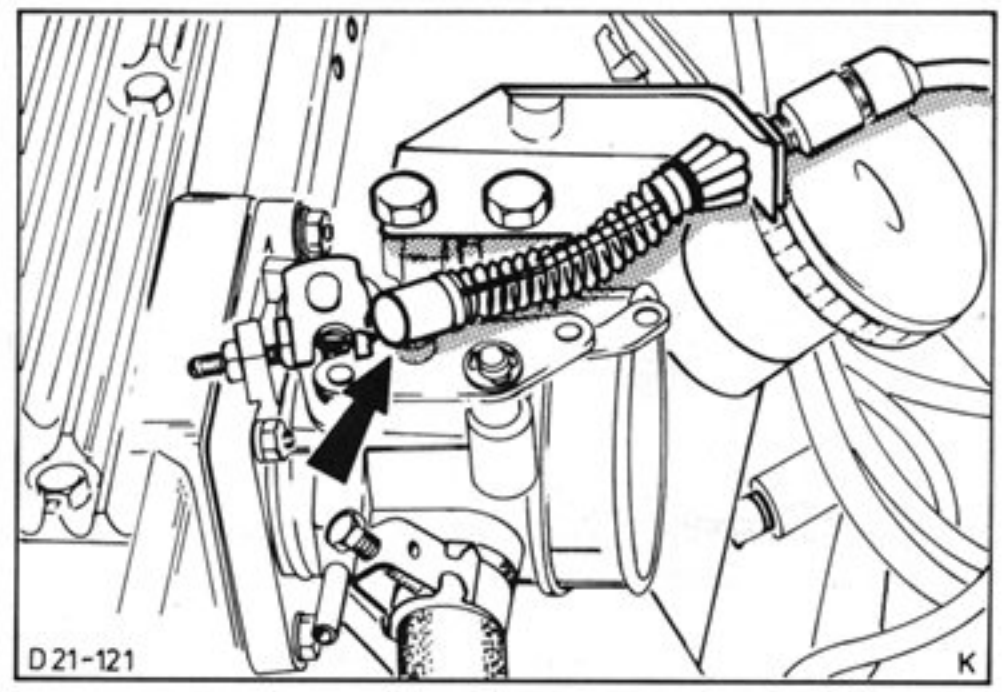


Fig.84. Detach throttle cable.

21 164

9. Disconnect engine breather hose with valve from rocker cover and remove air box from intake manifold (8 bolts), Fig.85.

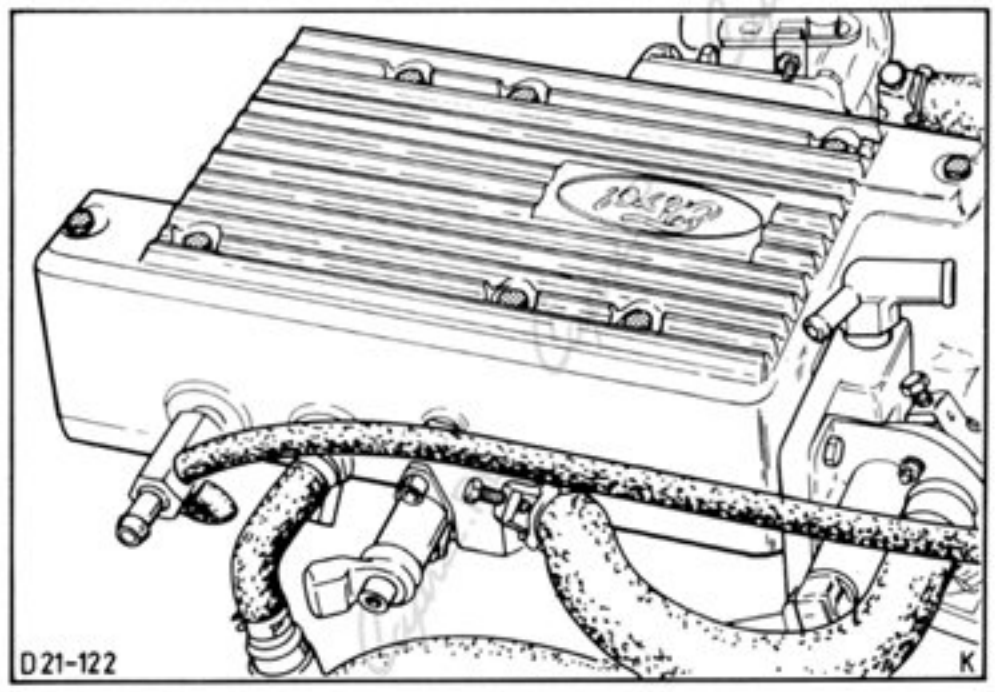


Fig.85. Remove air box.

10. Remove fuel lines from injection nozzles and from warm-up regulator and set aside, Fig.86. Remove injection nozzles.

NOTE: Place nozzles and pipes in a secure area.

11. Disconnect HT leads from coil and spark plugs and disconnect multi plug at distributor. Rotate crankshaft belt pulley until Cylinder No.1 is at TDC. release clamping screw below distributor and remove distributor.

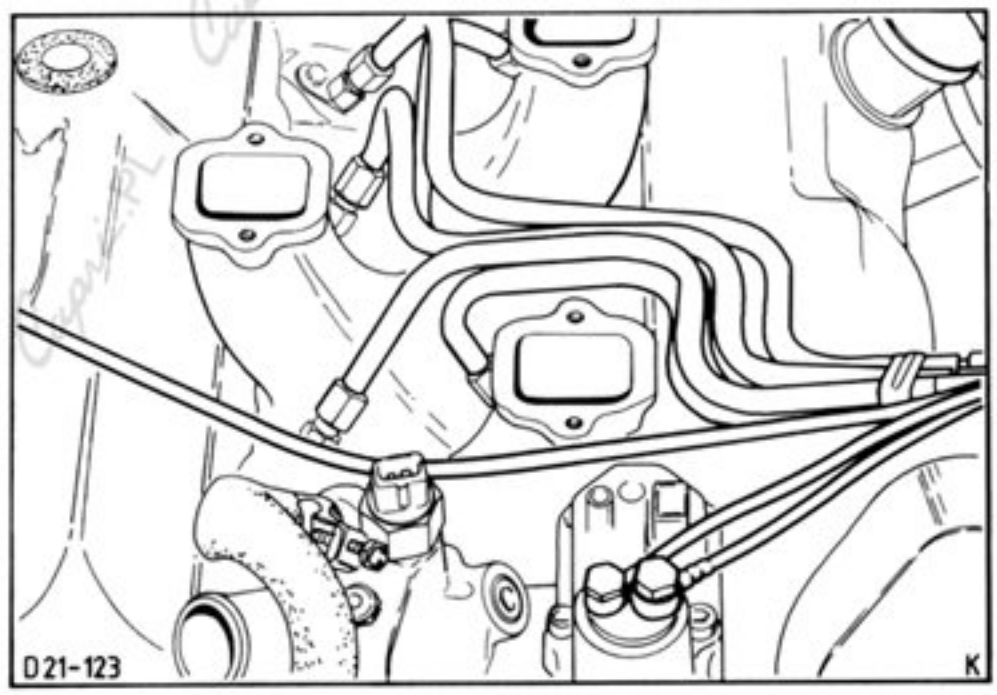


Fig.86. Disconnect fuel lines.

12. Disconnect leads from alternator. Unbolt alternator complete with bracket and take off V-belt.

13. Remove rocker shafts and oil throwers, Fig.87. Remove push-rods.

NOTE: Do not interchange push-rods and rocker shafts.

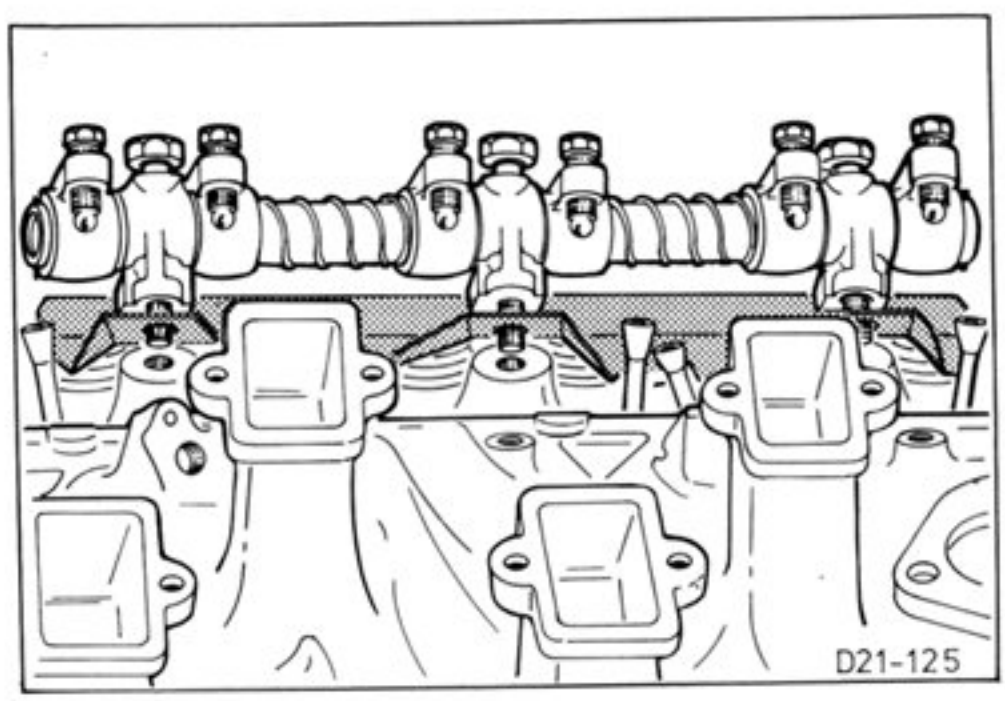


Fig.87. Remove rocker shaft and oil thrower.

14. Remove spark plugs and rocker covers. Remove by-pass hose and unbolt inlet manifold. If necessary, prise inlet manifold loose from the gasket with a lever, Fig.88. Do not insert a screwdriver between the sealing faces.

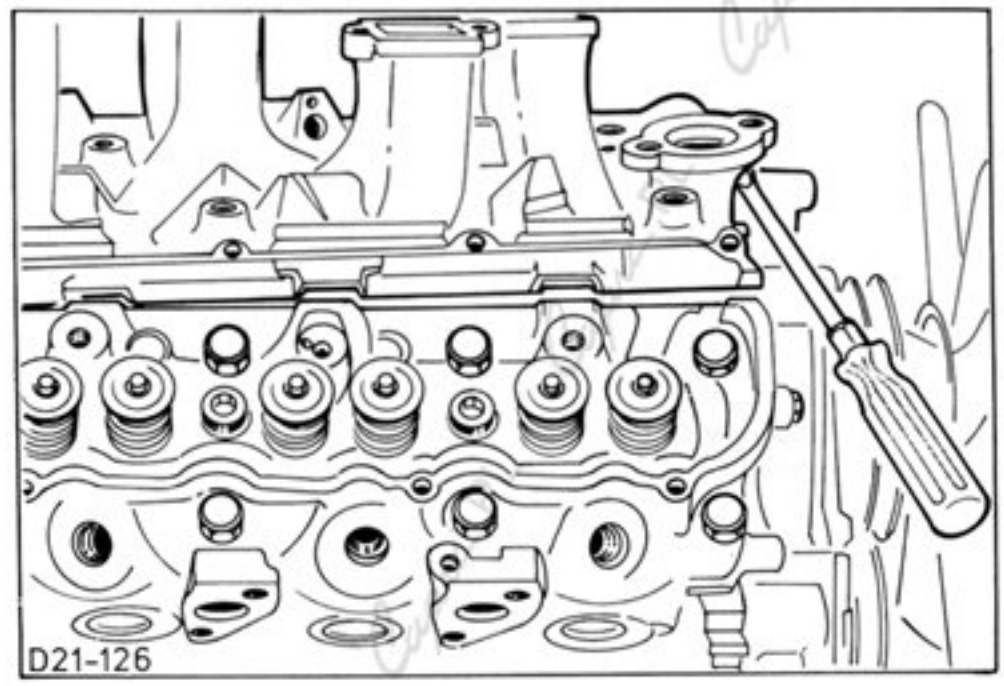


Fig.88. Remove inlet manifold.

15. Unbolt exhaust pipes from exhaust manifolds (4 nuts).

16. Remove cylinder heads, loosening the bolts in the reverse sequence to that used in tightening (see tightening sequence, Fig.90).

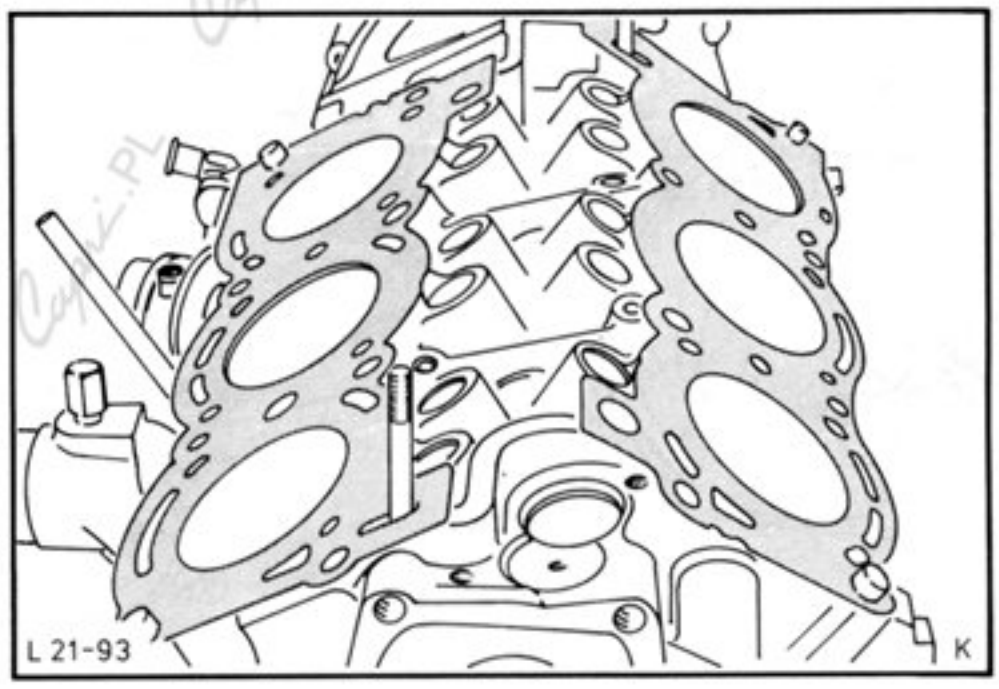


Fig.89. Position cylinder-head gaskets.

To Install

17. After cleaning the sealing faces (cylinder head - cylinder heads - inlet manifold), place new cylinder head gasket over the cylinder head guide sleeves, Fig.89.

NOTE: Cylinder head gaskets are marked 'OBEN VORN' (Top front).

18. Put on cylinder heads and tighten bolts with specified torque in three stages as per Fig. 90. (see Technical Data).

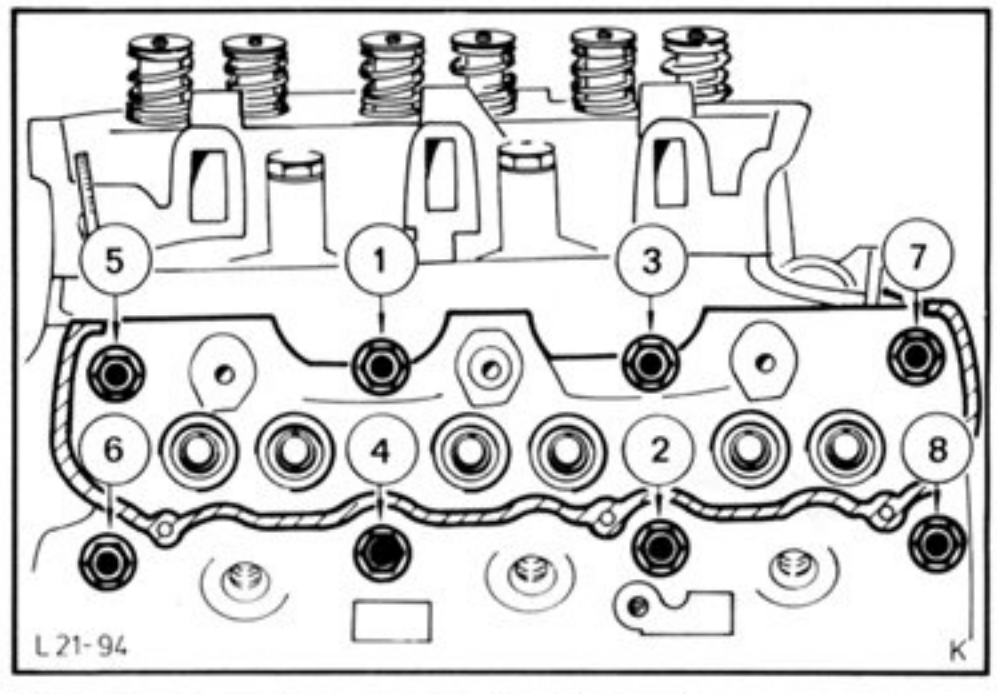


Fig.90. Cylinder head bolt tightening sequence.

21 164

19. Apply sealing compound to the four sealing faces of the cylinder block, cylinder heads and inlet manifold, Fig.91, and fit new inlet manifold gasket.

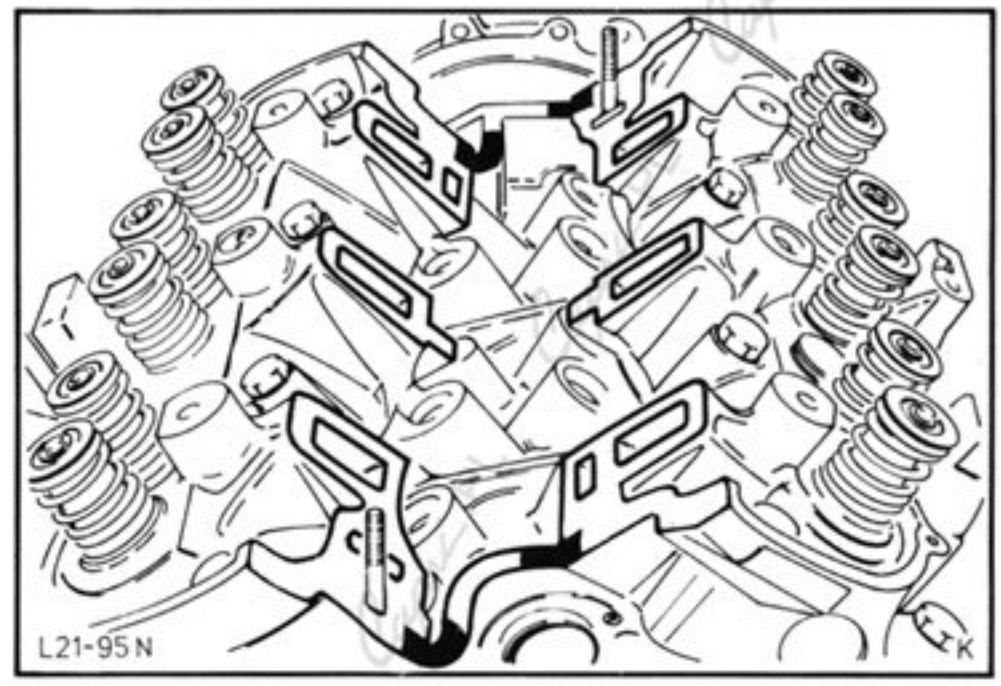


Fig.91. Apply sealing compound to joint faces.

20. Fit inlet manifold and tighten bolts and nuts with specified torque in four stages, as per Fig.92. Fit by-pass hose.

21. Fit exhaust pipes to exhaust manifolds.

22. Apply engine oil to both ends of push rods and place them in the tappet sockets. Fit oil throwers and rocker shafts, Fig.93, guiding the adjusting screws of the rockers into the push-rod sockets. Screw in rocker shaft bolts and tighten to specified torque.

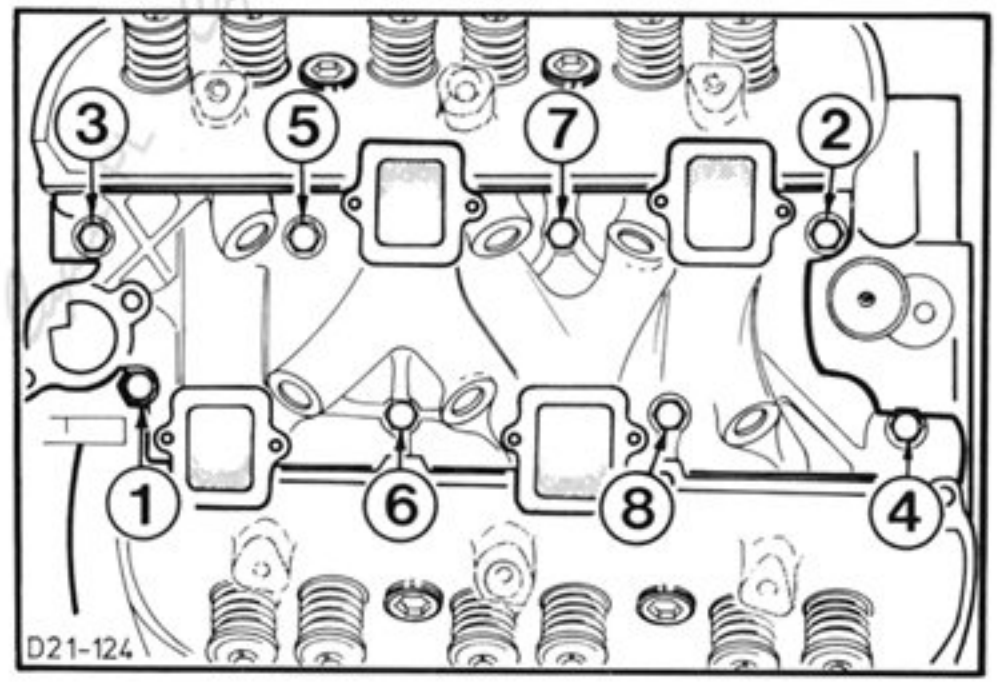


Fig.92. Inlet manifold bolt tightening sequence.

23. Set cylinder No.1 to TDC and install distributor.

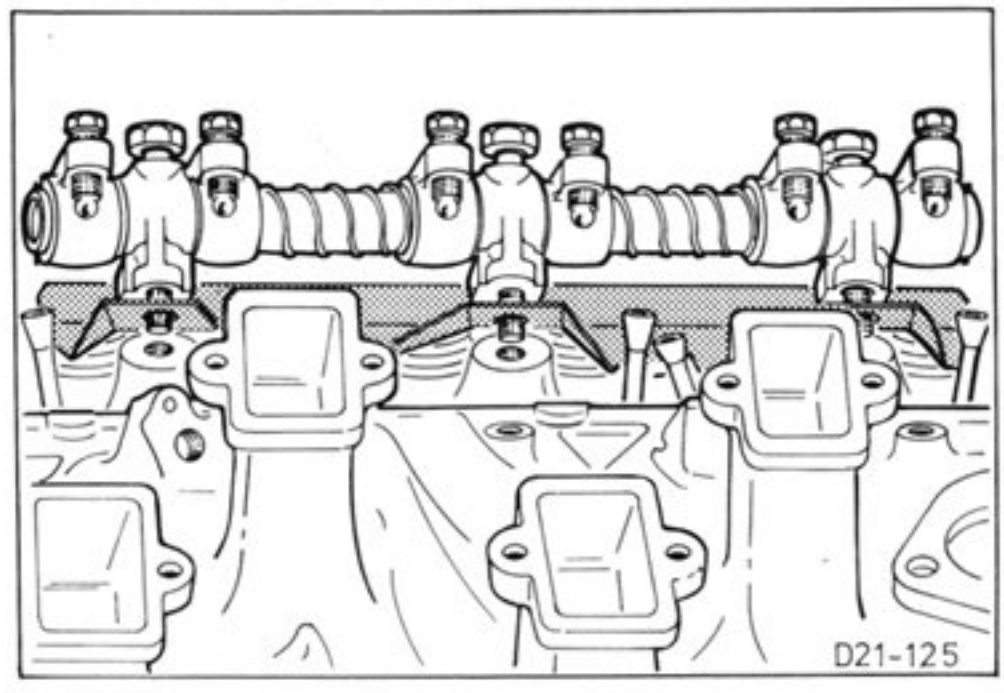


Fig.93. Fit rocker shaft with oil splash plate.

24. Adjust valve clearance (see Operation 21 213).

21 164

25. Fit rocker covers and spark plugs. Connect HT leads to spark plugs and coil, Fig.94. Connect multi plug to distributor.

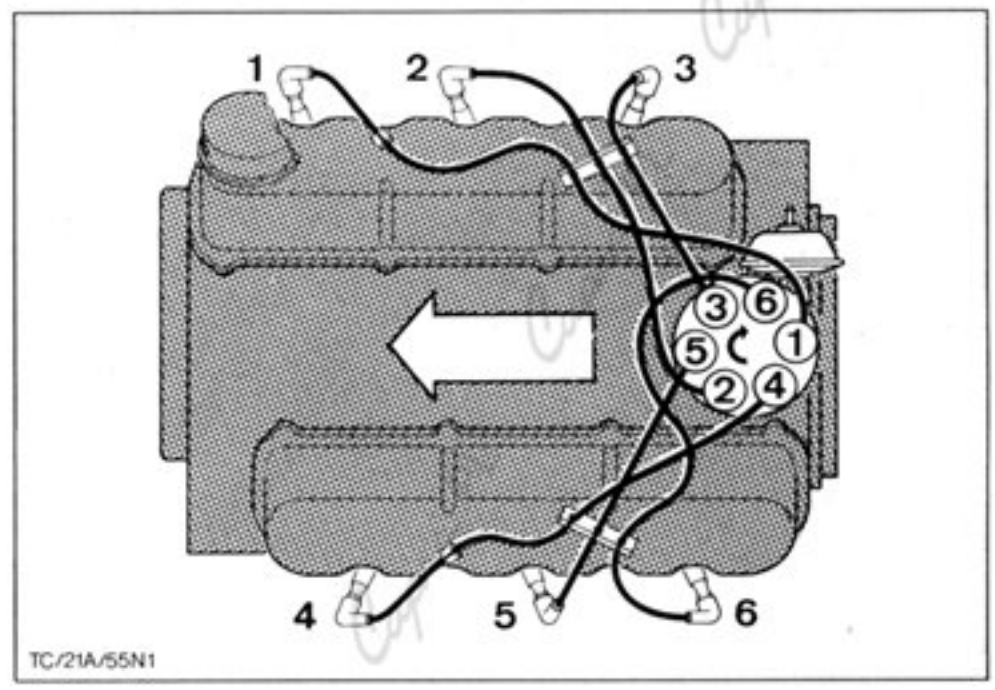


Fig.94. Arrangement of HT leads (firing order).

26. Fit alternator complete with bracket and connect multi plug.

27. Fit V-belt and adjust tension, Fig.95.

NOTE: The belt tension should be measured with a tension gauge (if available), see Technical Data. Otherwise, the necessary belt tension will be measured with normal finger pressure in the middle of the longest span of the belt. Total play - 13 mm (0,5 in.)

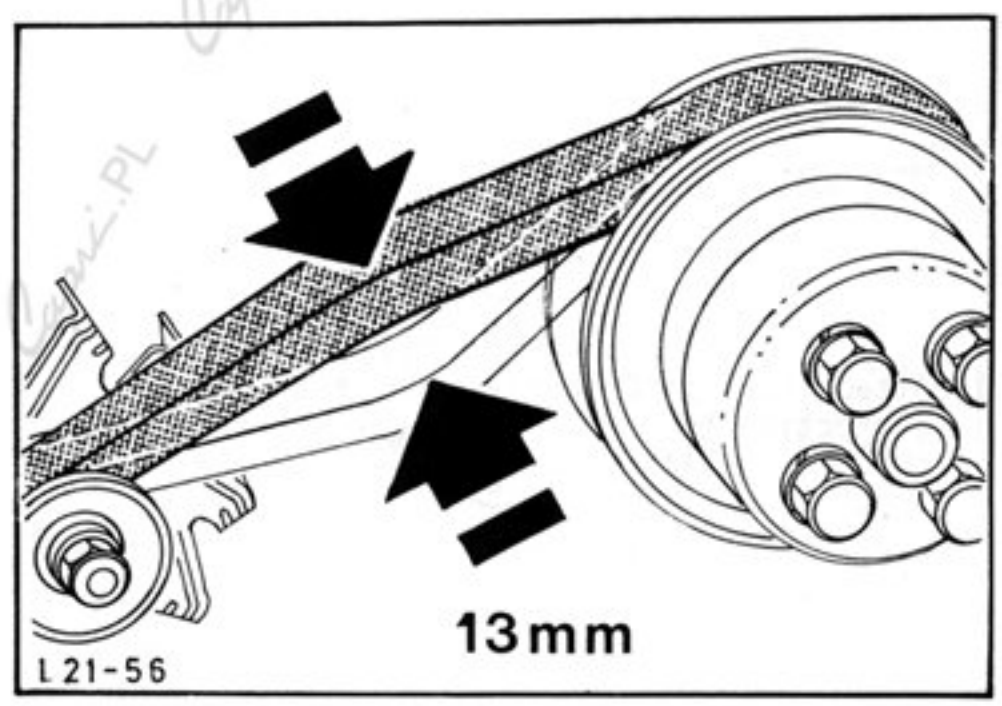


Fig.95. Adjust alternator V-belt tension.

28. Screw in injection nozzles and attach fuel lines to nozzles and warm-up regulator, Fig.96.

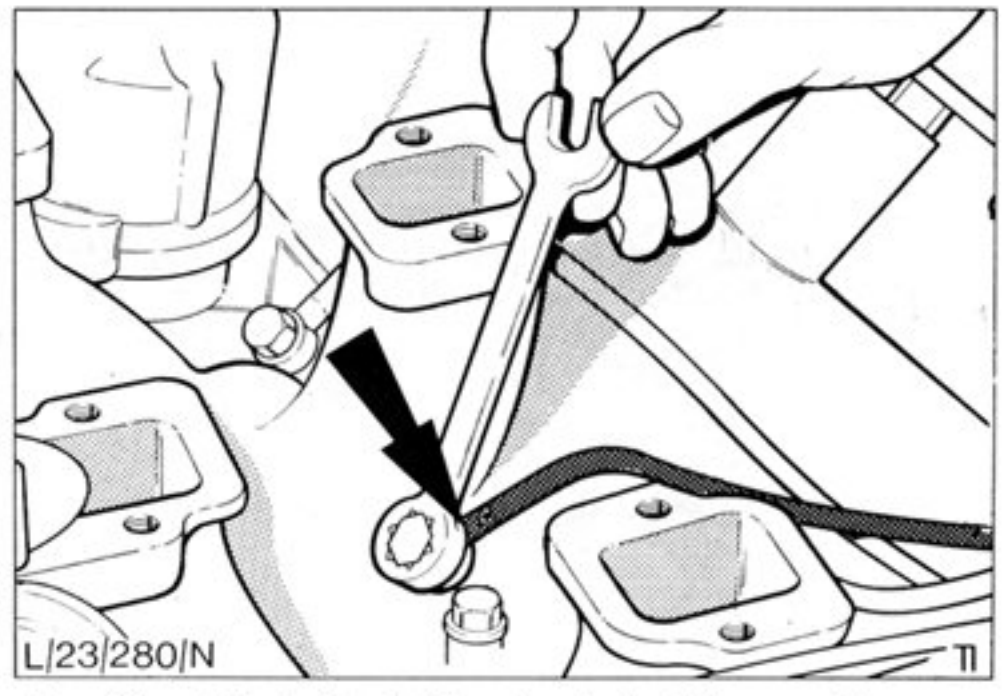


Fig.96. Attach fuel line to injection nozzle.

29. Fit air chamber with new gasket to inlet manifold and fit engine breather hose to rocker cover.

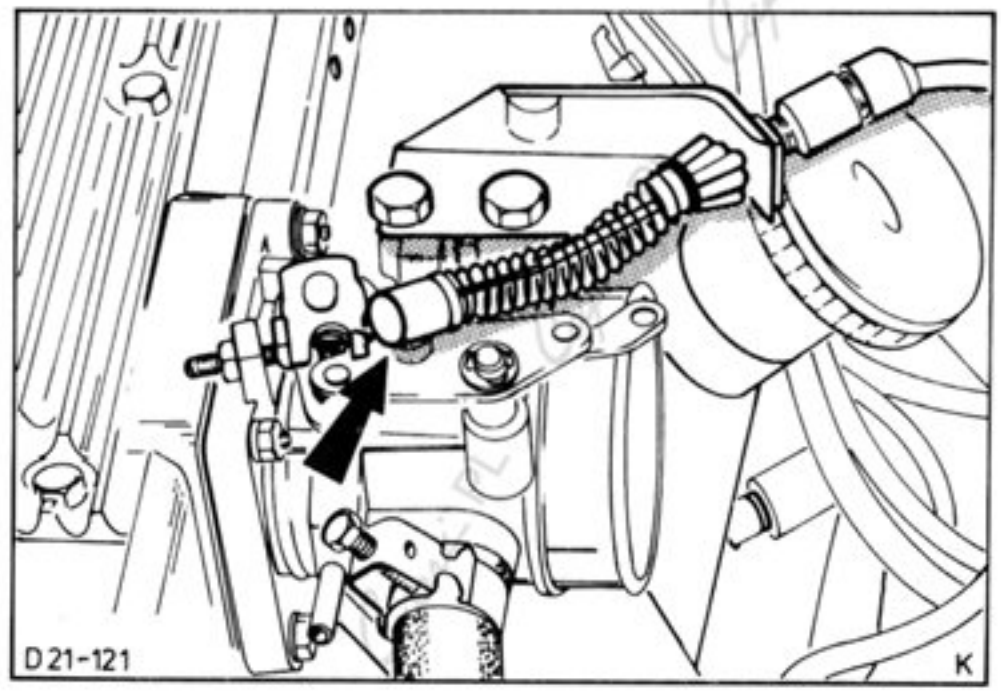


Fig.97. Install throttle cable.

30. Fit throttle cable and bracket and hook onto throttle lever, Fig.97.

31. Attach fuel line to start valve and fit connecting hose to inlet silencer, ensuring that installation position is as shown in Fig.102.

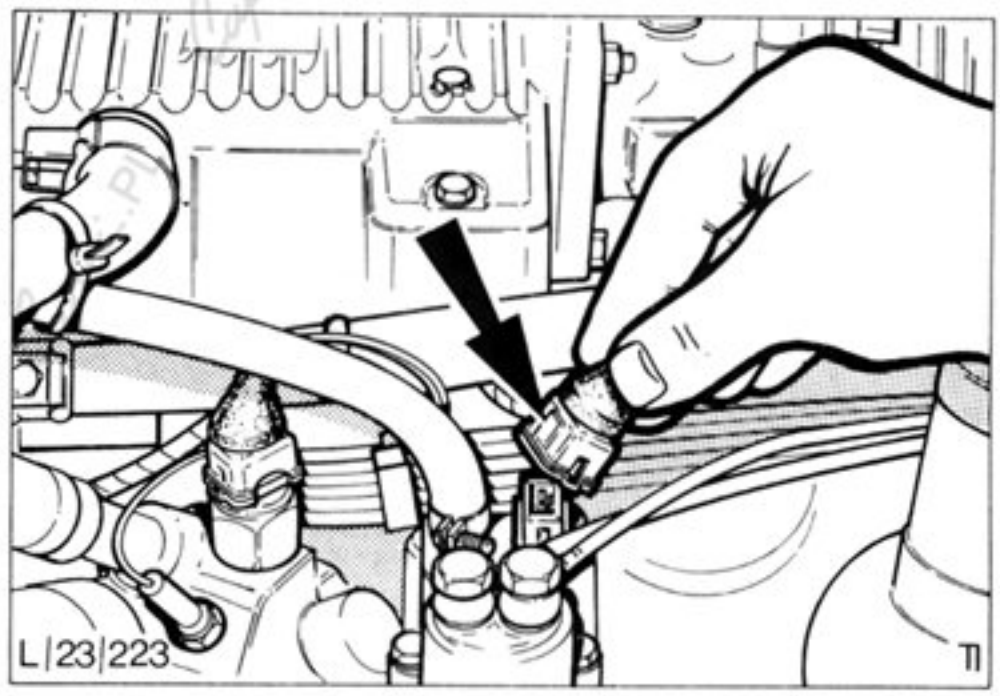


Fig.98. Fit plug to warm-up regulator.

32. Connect leads to temperature sensor, thermo time switch, warm-up regulator, auxiliary air device cold-start valve, Fig.98. Connect vacuum hoses to throttle plate connection and warm-up regulator, Fig.99.

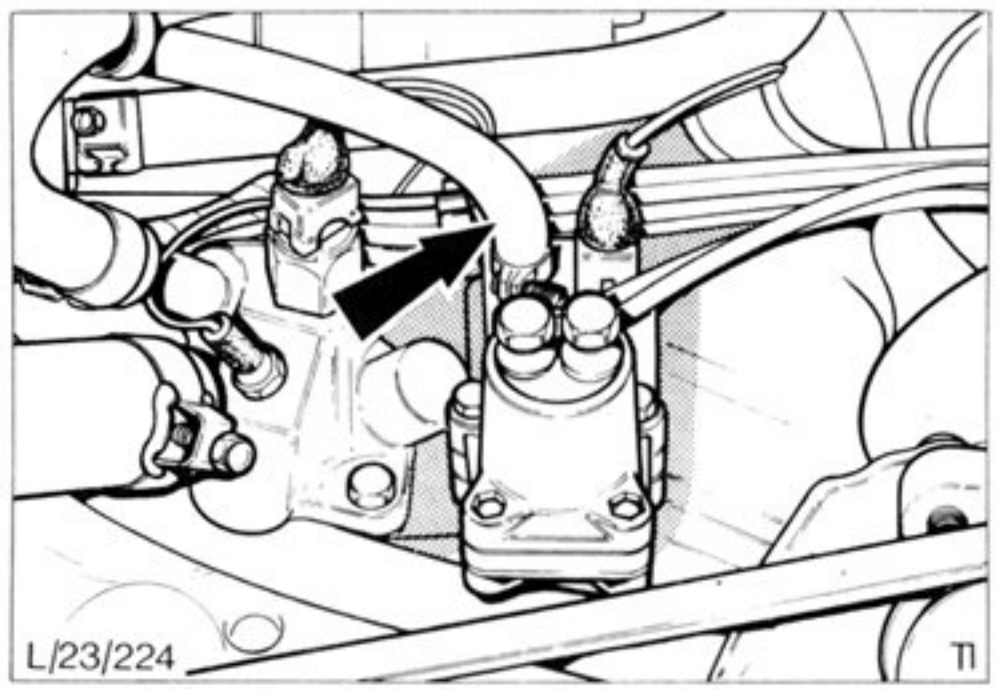


Fig.99. Vacuum hose to warm-up regulator.

21 164

33. Fit brake servo vacuum hose to the air box connection, Fig.100, and attach coolant hoses to the intermediate section of the auxiliary air valve.

34. Fix upper and lower radiator hoses, Fig.101, and fill with coolant.

35. Connect earth cable to battery. Start engine and check for leaks.

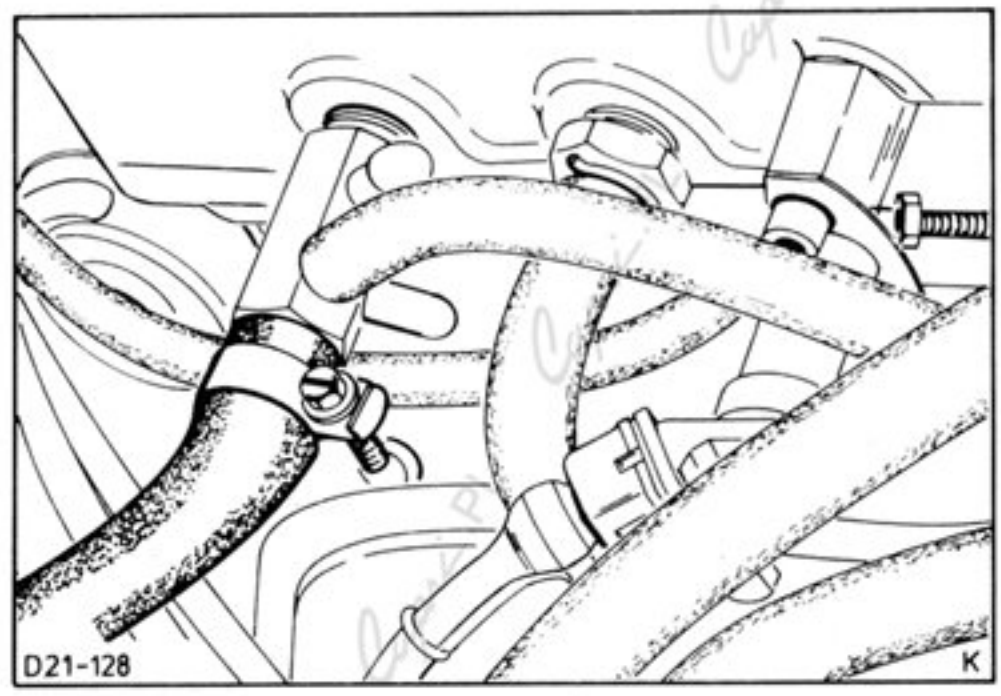


Fig.100. Brake servo vacuum hose.

After engine has warmed up:

36. Remove connecting hose from inlet silencer and expansion tank from bracket.

37. Disconnect HT leads from spark plugs and remove rocker covers.

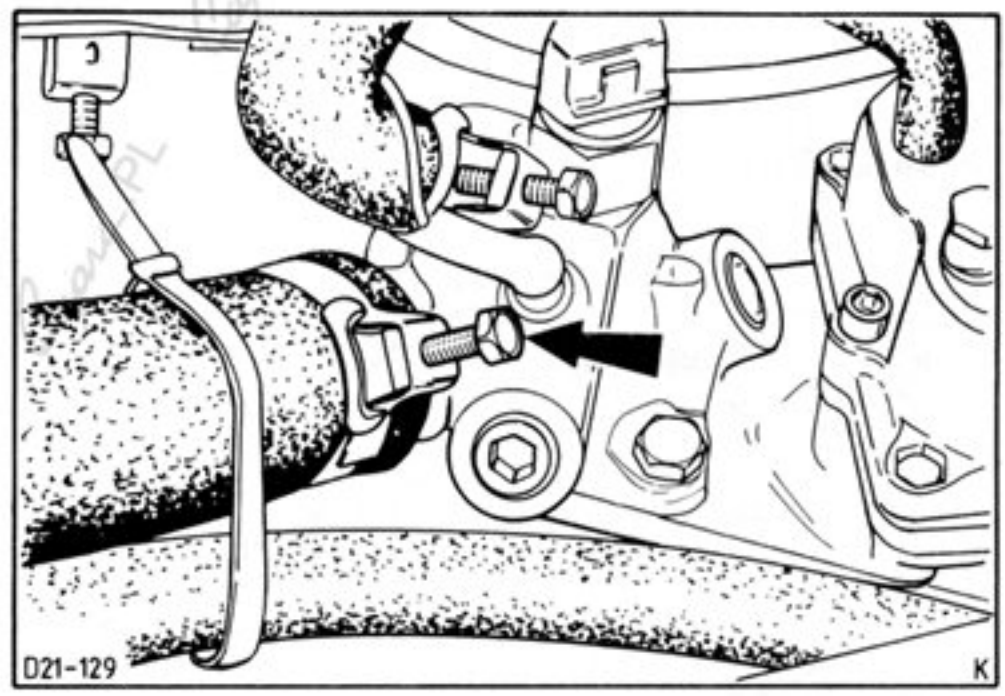


Fig.101. Fix upper radiator hose.

38. Re-tighten cylinder head and inlet manifold bolts (Special Tool 21-092A) to specified torque as per figures 90 and 92.

39. Check valve clearance. Fit rocker covers and connect HT leads.

40. Install connecting hose to inlet silencer (note installation position in Fig.102) and fix expansion tank.

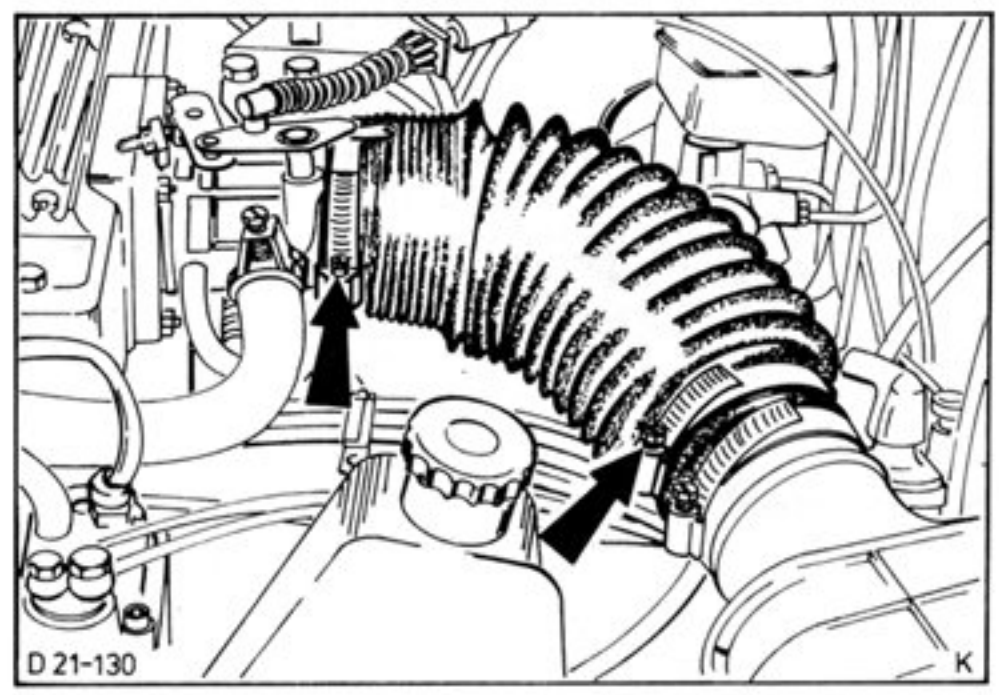


Fig.102. Connecting hose to inlet silencer.

41. Adjust ignition timing, idle speed and CO content.

21 213 VALVE CLEARANCES - ADJUST

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Disconnect earth cable from battery.

2. Remove connecting hose from inlet silencer, Fig.103, and remove expansion tank from bracket.

3. Disconnect HT leads from spark plugs and remove rocker covers.

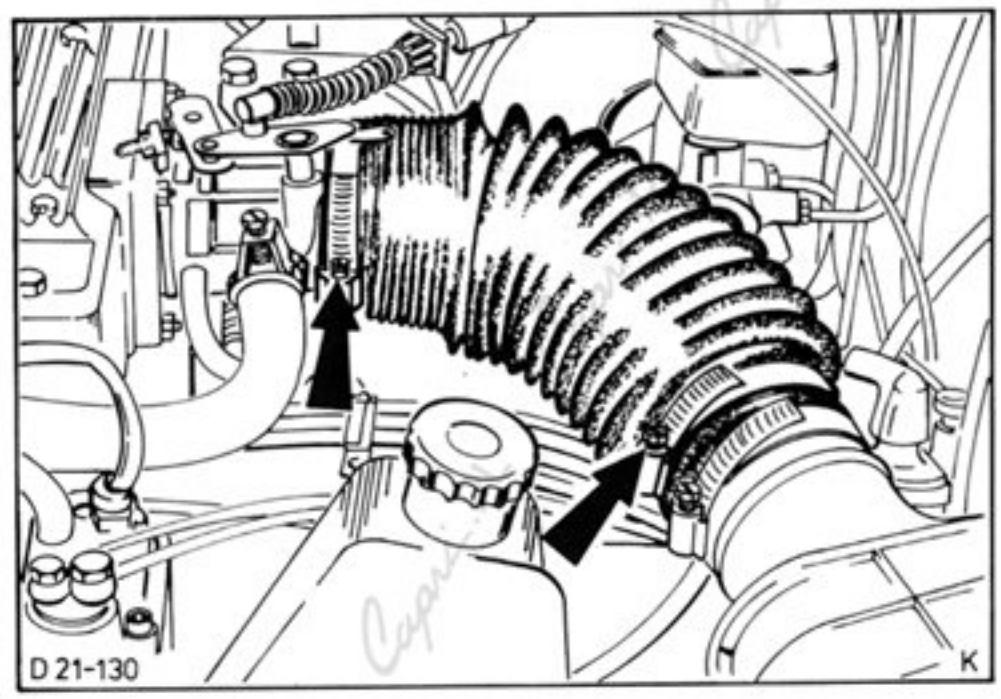


Fig.103. Connecting hose of inlet silencer in installation position.

4. Adjust valve clearances, Fig.104. proceeding as follows:

   During adjustment of valve clearances, crank engine only in direction of normal rotation. First set crankshaft pulley with its mark on the '0' mark on the timing cover.

   To facilitate matters when commencing the adjustment, make three chalk marks on the belt pulley, spaced apart by 120°.

   If the pulley is now turned to and fro a little, the valves of cylinder No.1 or No.5 will be on overlap, i.e. both rockers and push-rods will be moving in opposite directions. If the valves of cylinder No.5 are rocking in this way, the valve clearances of cylinder No.1 should be adjusted. If the pulley is turned through a further 120°, the valves of cylinder No.3 will be rocking and the valve clearances of cylinder No.4 can be adjusted, and so on in accordance with the firing order, Fig.105. For setting values, see Technical Data.

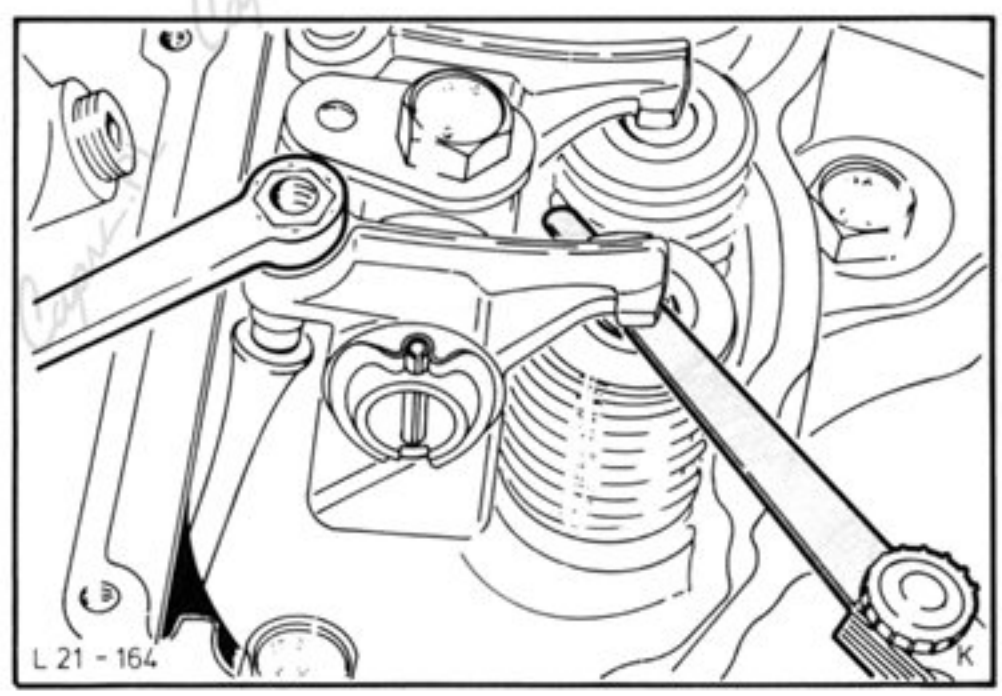


Fig.104. Adjust valve clearances.

   Cylinder No.5 rocking - adjust cylinder No.1
   Cylinder No.3 rocking - adjust cylinder No.4
   Cylinder No.6 rocking - adjust cylinder No.2
   Cylinder No.1 rocking - adjust cylinder No.5
   Cylinder No.4 rocking - adjust cylinder No.3
   Cylinder No.2 rocking - adjust cylinder No.6

5. Fit rocker covers with new gaskets and tighten. Connect HT leads, Fig.105.

6. Fix expansion tank, install connecting hose to inlet silencer (note installation position in Fig.103) and connect battery earth lead. lead.

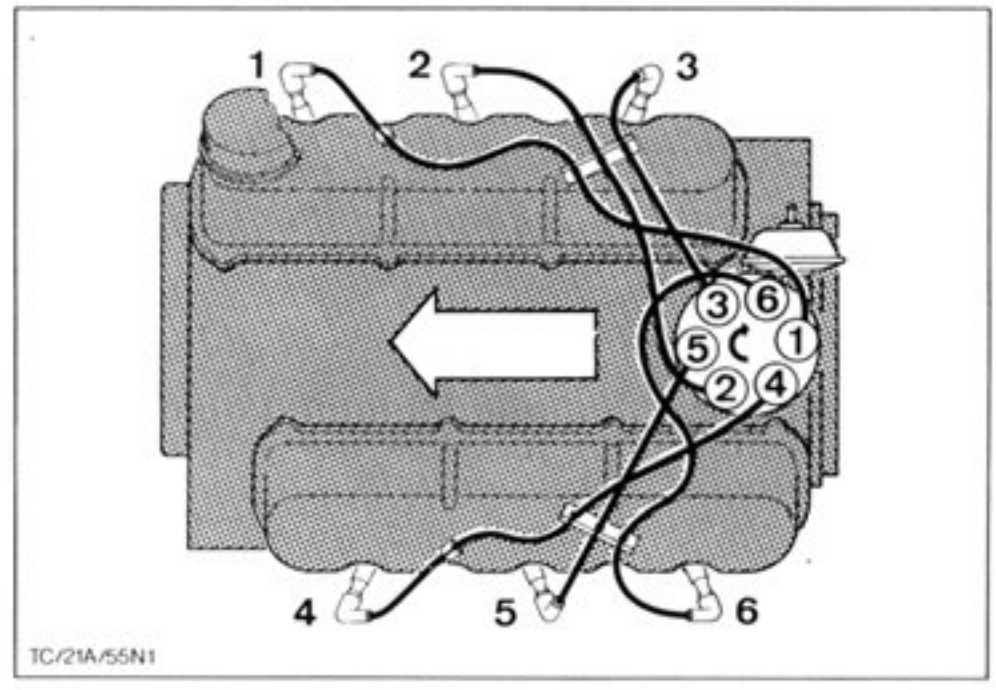


Fig.105. Arrangement of HT leads (firing order).

21 238 SEALS - VALVE STEM - REPLACE (ALL)

SPECIAL SERVICE TOOLS REQUIRED:

Valve spring compressor	21-056
Valve retainer	21-057

To Remove

1. Disconnect earth cable from battery.

2. Remove connecting hose from inlet silencer and expansion tank from bracket, ket, Fig.106.

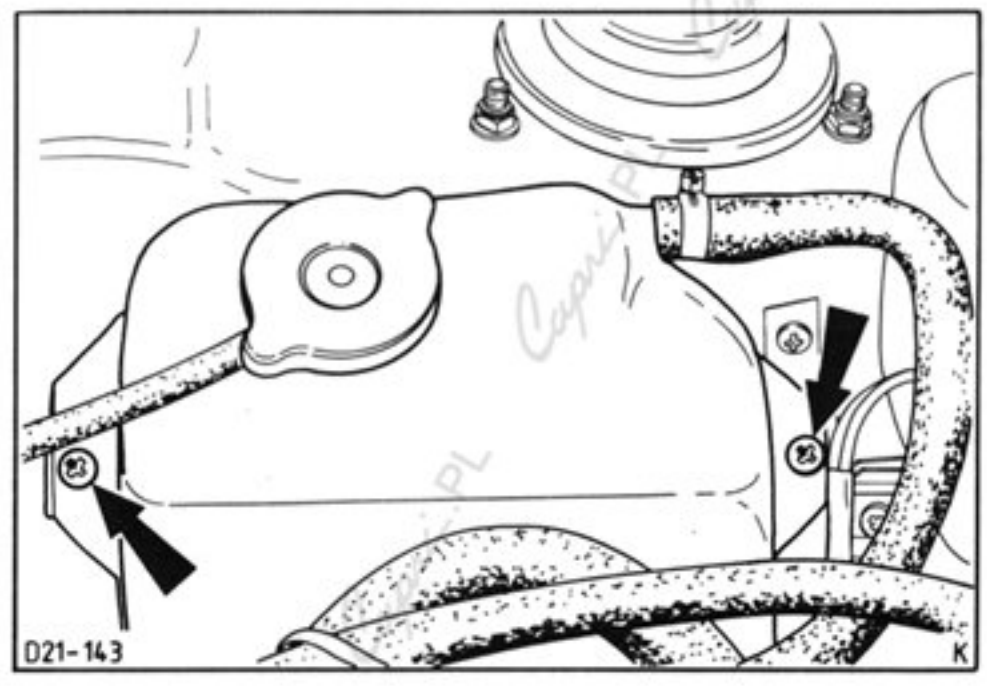


Fig.106. Remove expansion tank.

3. Remove hoses and leads from the screen-washer reservoir and take out reservoir. Unscrew bracket from the bodywork (1 bolt).

4. Disconnect HT leads from spark plugs and unbolt rocker covers.

5. Unscrew spark plugs, remove rocker shafts (6 bolts) with oil splash plates, Fig.107, and remove push rods.

NOTE: Do not interchange push rods and rocker shafts.

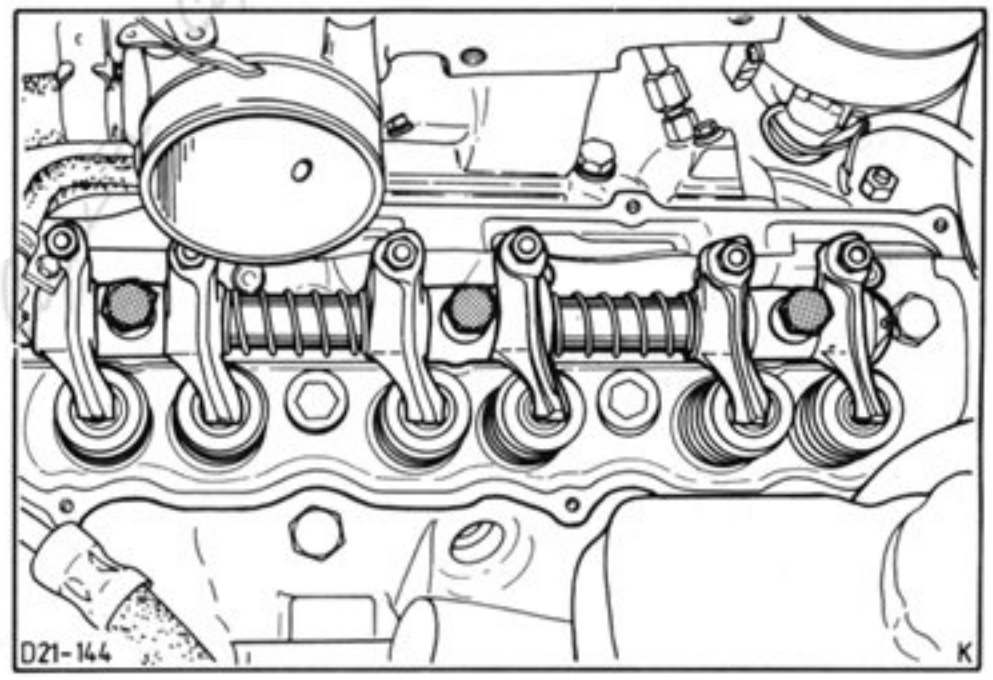


Fig.107. Remove rocker shaft with oil splash plate.

6. Screw valve retainer 21-057 into spark plug hole, position against valve head and lock. Fit valve spring compressor 21-056 to cylinder head, Fig.108.

7. Press valve spring down, using Special Tool 21-056, remove collets, Fig.109, and release valve spring. Remove valve spring plate and valve spring. Remove oil seal.

NOTE: When removing and refitting valve springs, it is essential to ensure that the valve stem is not damaged by the valve spring plate when the latter is pressed down. If the stem is damaged, there is no guarantee of adequate sealing. The result will be increased oil consumption and wear in the valve guide.

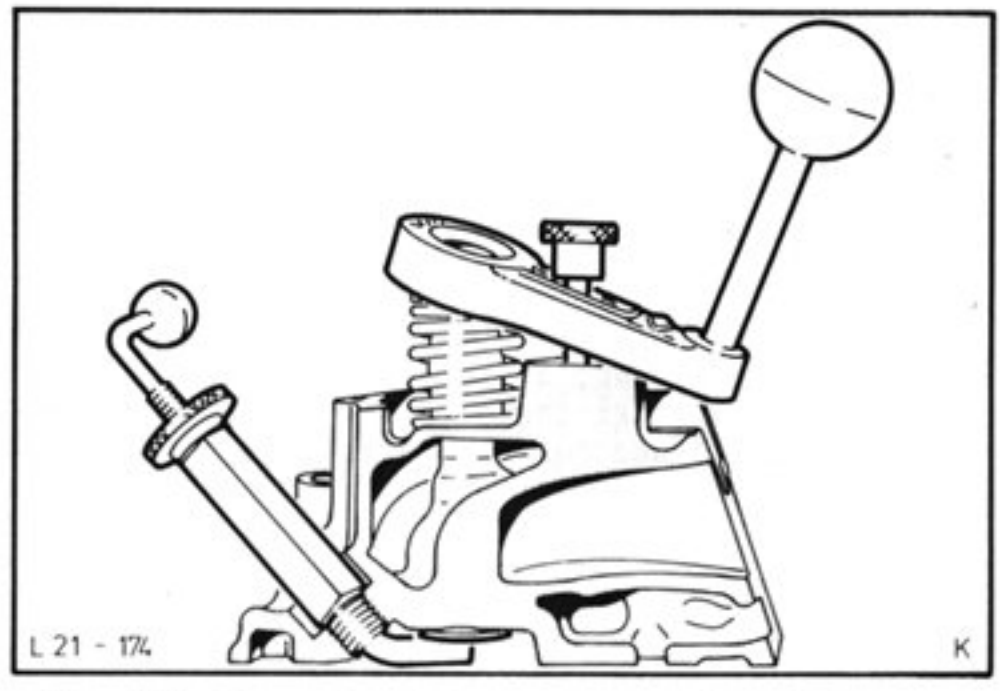


Fig.108. Removal of the valve spring with Special Tools 21-056 and 21-057.

21 238

To Install

8. Cover valve collet groove with adhesive tape, slide new valve stem seal onto the valve stem, Fig.110, and push down against the stop. Remove adhesive tape from valve stem. Fit valve spring and valve spring plate, compress with Special Tool and fit collets. Pay attention to correct seating of collets. Release pressure on valve spring and remove Special Tools.

NOTE: Use a new valve stem seal whenever a valve is removed and installed. Cover valve collet grooves with adhesive tape to prevent damage to the valve stem seals.

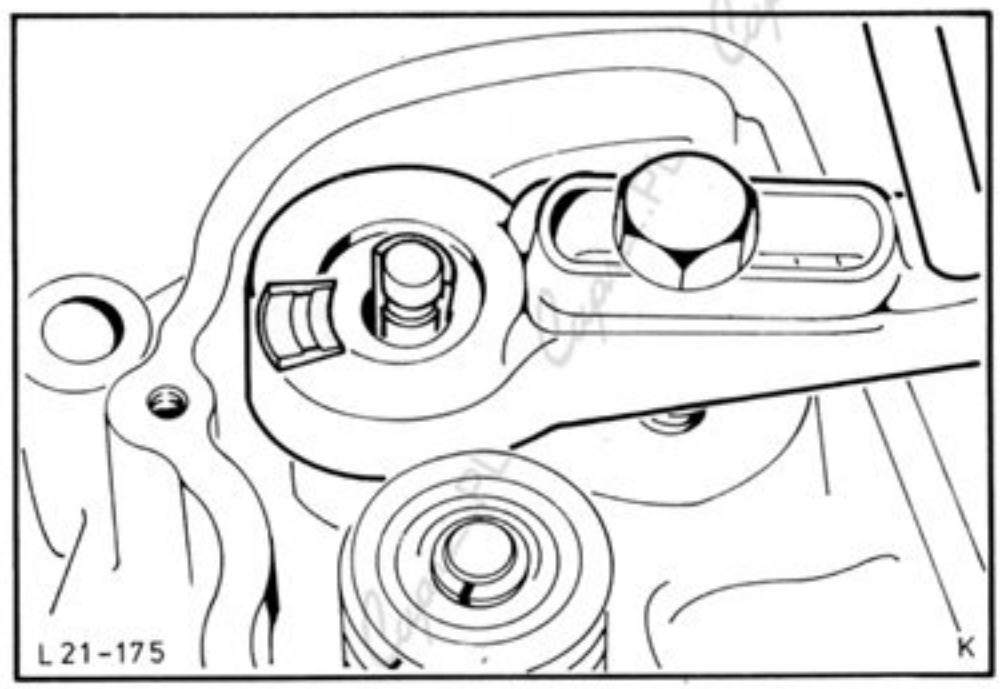


Fig.109. Remove collets.

9. Insert push rods into tappet sockets. Position rocker shafts and oil throwers, guiding rocker arm adjusting screws into push rod sockets. Replace rocker shaft bolts and tighten to specified torque.

10. Adjust valve clearances (see Operation No.21 213). Screw in spark plugs and fit rocker covers.

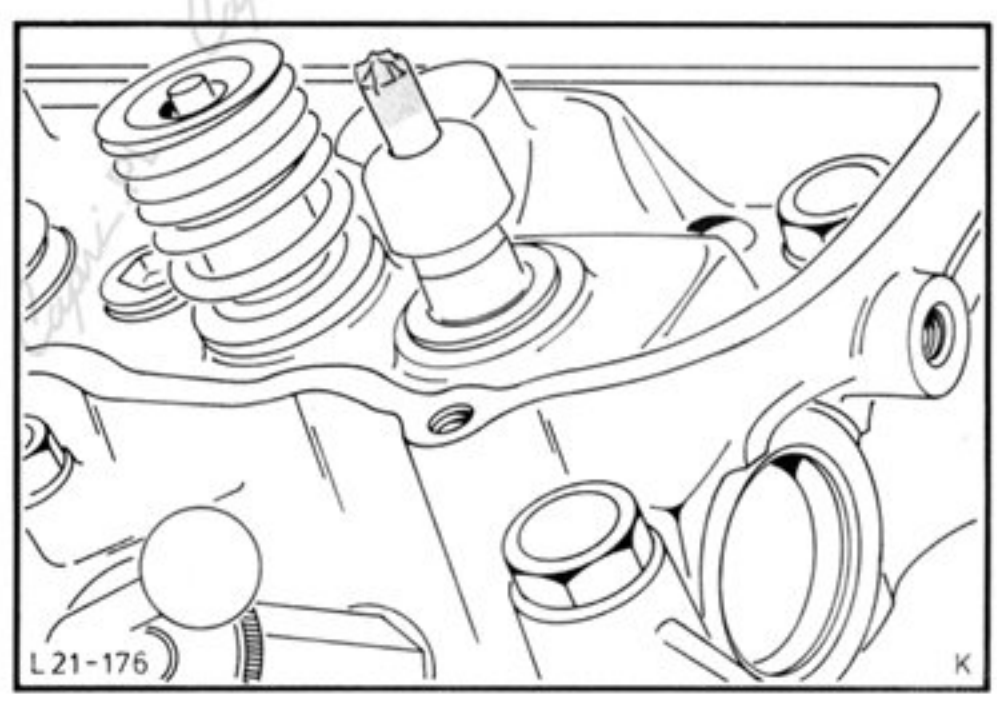


Fig.110. Slide seal onto valve stem.

11. Connect HT leads and install screen-washer reservoir. Connect hoses and leads.

12. Fix overflow tank, install connecting hose of inlet silencer (note installation position in Fig.111.) and connect battery earth cable.

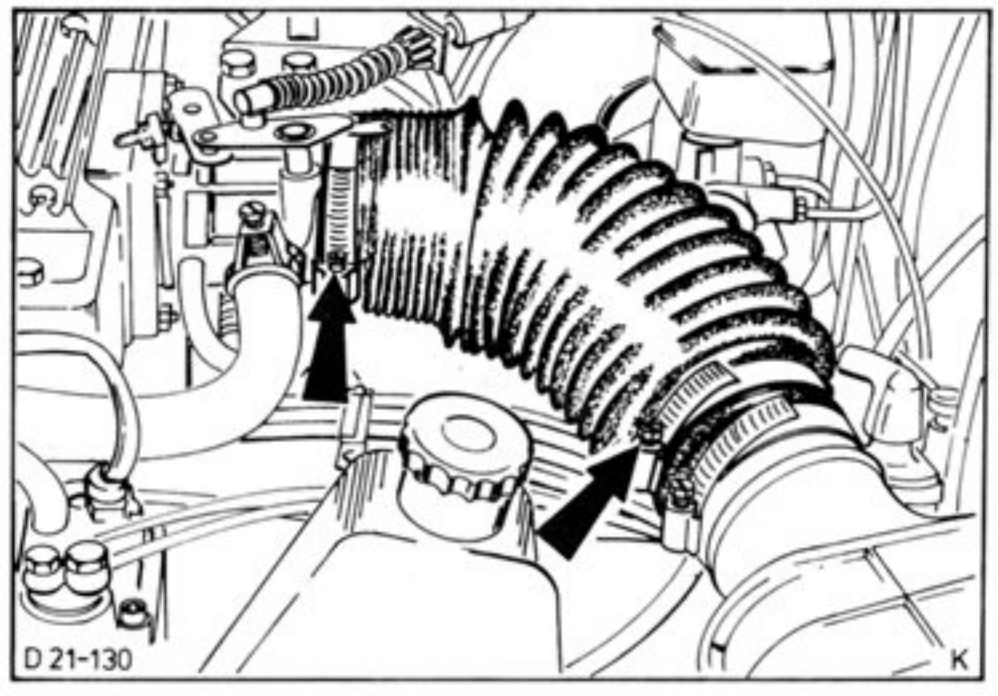


Fig.111. Connecting hose of inlet silencer in installation position.

TECHNICAL DATA — 'C' Engine (OHV/V6)

Engine - General

Engine code	PRB
Firing order	1-4-2-5-3-6
Bore - mm	93,03
Stroke - mm	68,50
Cubic capacity - effective cc	2792
- fiscal cc	2772
Compression ratio - E	9,2 : 1
Compression pressure at starter speed - Bar	11,5 - 12,5
Mean working pressure - Bar	10,2
Idle speed - rev/min	900
Max. engine speed - continuous - rev/min	6100 (speed limiter)
Engine power (DIN) - kW (HP)	118 (160)
at rev/min	5700
Torque (DIN) - Nm (kpm)	221 (22,5)
at rev/min	4300

Cylinder Block

Casting mark				E
Number of main bearings				4
Bore diameter Standard grade	1	mm		93,010 to 93,020
	2	mm		93,020 to 93,030
	3	mm		93,030 to 93,040
	4	mm		93,040 to 93,050
Oversize Grade	A	mm		93,520 to 93,530
	B	mm		93,530 to 93,540
	C	mm		93,540 to 93,550
Service Standard		mm		93,040 to 93,050
Oversize	0,5	mm		93,540 to 93,550
	1,0	mm		94,540 to 93,050
Centre main bearing width		mm		22,610 to 22,660
Main bearing shell internal diameter (fitted)				
Standard		mm		57,018 to 57,052
Undersize	0,254	mm		56,764 to 56,798
	0,508	mm		56,510 to 56,544
	0,762	mm		56,256 to 56,290
	1,020	mm		56,002 to 56,036
Main bearing parent bore	Standard	mm		60,620 to 60,640
	Oversize 0,38	mm		61,000 to 61,020
Camshaft parent bore	Front	mm		45,025 to 45,060
	Centre 1	mm		44,645 to 44,680
	Centre 2	mm		44,265 to 44,300
	Rear	mm		43,885 to 43,920

Crankshaft

End float		mm		0,080 to 0,280
Backlash		mm		0,17 to 0,27
Main bearing journal diameter	Standard	mm		56,980 to 56,000
	Undersize 0,254	mm		56,726 to 56,746
	0,508	mm		56,482 to 56,492
	0,762	mm		56,228 to 56,238
	1,020	mm		55,974 to 55,984
Centre main bearing - shoulder width	Standard	mm		26,390 to 26,440
	Oversize	mm		26,871 to 26,821
Half thrust washer thickness	Standard	mm		2,300 to 2,350
	Oversize	mm		2,500 to 2,550
Main bearing shell/journal clearance		mm		0,018 to 50,072
Big end journal diameter	Standard	mm		53,980 to 54,000
	Undersize 0,254	mm		53,726 to 53,746

TECHNICAL DATA — 'C' Engine (OHV/V6)

2,8 HC Injection

Camshaft

Number of bearings		4
Drive		Via gears
Thrust plate thickness - red	mm	3,960 to 3,985
- blue	mm	3,986 to 4,011
Backlash	mm	0,17 to 0,27
Spacer thickness - red	mm	4,075 to 4,100
- blue	mm	4,101 to 4,125
Camlift - Inlet	mm	6,700
- Exhaust	mm	6,600
Cam length (heel to toe) - Inlet	mm	33,695 to 33,865
- Exhaust	mm	33,595 to 33,765
Camshaft journal diameter Front	mm	41,903 to 41,923
Centre 1	mm	41,522 to 41,542
Centre 2	mm	41,141 to 41,161
Rear	mm	40,760 to 40,780
Bearing inside diameter - Front	mm	41,948 to 41,968
Centre 1	mm	41,567 to 41,587
Centre 2	mm	41,186 to 41,206
Rear	mm	40,805 to 40,825
Endfloat	mm	0,02 to 0,10

Pistons

Diameter	Standard 1	mm	92,972 to 92,982
	2	mm	92,982 to 92,992
	3	mm	92,992 to 93,002
	4	mm	93,002 to 93,012
Service	Standard	mm	92,978 to 93,002
Service	Oversize 0,5	mm	93,478 to 93,502
	1,0	mm	93,978 to 94,002
Clearance in bore		mm	0,028 to 0,048
Ring gap (fitted) - top		mm	0,38 to 0,58
- centre		mm	0,38 to 0,58
- bottom		mm	0,38 to 1,40
Ring gap position - top			Displaced 150° from spreader ring gap
- centre			Displaced 150° on other side of spreader ring gap

3-part oil Scraper ring:

Top intermediate ring:	Displaced 25 mm from spreader ring gap
Spreader ring	Opposite the marked side of the piston
Bottom intermediate ring	Displaced 25 mm on other side of spreader ring gap.

Piston Pins

Diameter - red	mm	23,994 to 23,997
- blue	mm	23,997 to 24,000
Clearance in piston (floating)	mm	0,008 to 0,014
Interference in con-rod	mm	0,018 to 0,042

Connecting rod

Bore diameter (without bearing shells	Big end mm	56,820 to 56,840
	Small end mm	23,958 to 23,976
Vertical inside diameter (bearing shells fitted)		
	Standard mm	54,006 to 54,046
	Undersize 0,254 mm	5,752 to 53,792
Clearance, journal to bearing shell	mm	0,006 to 0,064

TECHNICAL DATA — 'C' Engine (OHV/V6)

2,8 HC Injection

Cylinder Head

Casting mark			EN
Valve seat angle			45°
Valve seat width	Inlet/Exhaust	mm	1,61 to 2,33
Upper correction angle (Prod.)	Inlet/Exhaust		18°
	Correction cutter for service		15°
Lower correction angle (Prod.)	Inlet/Exhaust		60°
	Correction cutter for service		70°
Stem bore, inlet and exhaust valves	Standard	mm	8,063 to 8,088
	Oversize 0,2	mm	8,263 to 8,288
	0,4	mm	8,463 to 8,488

Valves

Valve operation			via push-rods and rockers
Valve clearance (cold)	Inlet	mm	0,35 (0,014 in.)
	Exhaust	mm	0,40 (0,016 in.)
Inlet valve opens			24° BTDC
closes			72° ABDC
Exhaust valve opens			73° BBDC
closes			25° ATDC
Tapper diameter		mm	22,190 to 22,202
Tappet clearance in housing		mm	0,023 to 0,060

Inlet Valve

Length		mm	105,0 to 106,2
Head diameter		mm	41,850 to 42,240
Stem diameter	Standard	mm	8,025 to 8,043
	Oversize 0,2	mm	8,225 to 8,243
	0,4	mm	8,425 to 8,443
	0,6	mm	8,625 to 8,643
	0,8	mm	8,825 to 8,843
Stem/guide clearance		mm	0,020 to 0,063
Lift (0.35 mm valve clearance)		mm	9,388 to 9,463
Free spring length		mm	52,5
Valve spring force	Valve open	kg	72,2 to 77,8
	Valve closed	kg	38,2 to 42,0
Valve spring length	Valve open	mm	31,04
	Valve closed	mm	40,26

Exhaust Valve

Length		mm	105,2 to 106,2
Head diameter		mm	35,830 to 36,210
Stem diameter	Standard	mm	7,999 to 8,017
	Oversize 0,2	mm	8,199 to 8,217
	0,4	mm	8,399 to 8,417
	0,6	mm	8,599 to 8,617
	0,8	mm	8,799 to 8,817
Stem/guide clearance		mm	0,046 to 0,089
Lift (0,40 mm valve clearance)		mm	9,192 to 9,267
Free spring length		mm	52,5
Valve spring force	Valve open	kg	72,2 to 77,8
	Valve closed	kg	38,2 to 42,0
Valve spring length	Valve open	mm	31,04
	Valve closed	mm	40,26

TECHNICAL DATA

'C' Engine (OHV/V6)

2,8 HC Injection

Engine Lubrication

Oil grade		HD Oil (FORD Super Engine Oil)
Ford Specification		SSM-2C9001-AA
Viscosity	below -12°C	SAE 5W - 20
	below 0°C	SAE 5W - 30
	-23°C to +32°C	SAE 20W-40/50
	above -12°C	SAE 20W-40/50
Initial fill capacity including filter	Ltr.	4,7
Oil change including filter change	Ltr.	4,25
without filter change	Ltr.	4,0
Minimum oil pressure at	750 rpm (80°C) Bar	1,0
	2000 rpm (80°C) Bar	2,8
Pressure relief valve opens at	(1000 rpm/80°C) Bar	4,0 to 4,7
Oil pressure warning light operates at	Bar	0,3 to 0,5
Oil pump - rotor/casing clearance	mm	0,150 to 0,301
inner/outer rotor clearance	mm	0,05 to 0,20
End-float, rotor/sealing face	mm	0,028 to 0,014

Tightening Torques

		Nm	(kgfm)
Main bearing caps		90 to 104	(9,0 to 10,4)
Big end caps		29 to 34	(1,9 to 3,4)
Crankshaft pulley		42 to 50	(4,2 to 5,0)
Camshaft gear		42 to 50	(4,2 to 5,0)
Camshaft thrust plate		17 to 21	(1,7 to 2,1)
Flywheel		65 to 71	(6,5 to 7,1)
Timing cover - to cylinder block		17 to 21	(1,7 to 2,1)
Timing cover - to adaptor plate		13 to 17	(1,3 to 1,7)
Adaptor plate to cylinder block		17 to 21	(1,7 to 2,1)
Oil pump		14 to 17	(1,4 to 1,7)
Oil pump cover		9 to 13	(0,9 to 1,3)
Rocker shaft		59 to 67	(5,9 to 6,7)
Sump	1)	4 to 7	(0,4 to 0,7)
	2)	7 to 10	(0,7 to 1,0)
Oil drain plug		21 to 28	(2,1 to 2,8)
Oil pressure switch		12 to 15	(1,2 to 1,5)
Threaded sleeve - oil cooler		20 to 40	(2,0 to 4,0)
Cylinder head	1)	39 to 54	(3,9 to 5,4)
	2)	54 to 69	(5,4 to 6,9)
after 10 to 20 minutes wait	3)	88 to 108	(8,8 to 10,8)
after engine warm-up (15 minutes at 1000 rpm) retighten to	4)	88 to 108	(8,8 to 10,8)
Rocker cover		4 to 7	(0,4 to 0,7)
Inlet manifold	1)	4 to 8	(0,4 to 0,8)
	2)	8 to 15	(0,8 to 1,5)
	3)	15 to 21	(1,5 to 2,1)
	4)	21 to 25	(2,1 to 2,5)
after engine warm-up (15 minutes at 1000 rpm) retighten to	5)	21 to 25	(2,1 to 2,5)
Air chamber on inlet manifold		7 to 10	(0,7 to 1,0)
Spark plugs		30 to 40	(3,0 to 4,0)
Clutch pressure plate to flywheel		17 to 21	(1,7 to 2,1)
Water pump		7 to 10	(0,7 to 1,0)
Water connection to thermostat housing		7 to 10	(0,7 to 1,0)
Belt pulley to water-pump hub		9 to 12	(0,9 to 1,2)
Fan clutch to water-pump hub		20 to 50	(2,0 to 5,0)
Fan to fan clutch		8 to 10	(0,8 to 1,0)
Clutch housing to engine		30 to 27	(3,0 to 3,7)

IGNITION SYSTEM 22B

Index

GENERAL DESCRIPTION

The ignition system used on the Capri Petrol Injection variant is of the breakerless distributor type, utilising conventional high tension leads, a high output coil and conventional spark plugs.

An additional component used in this system is an electronic module which is connected in the low tension circuit between the distributor and coil.

The basic items that require periodic checks and adjustments are spark plugs and ignition timing. Dwell angle is totally governed by the electronic module and is continually changing with engine rpm and therefore can not be adjusted.

Alterations to ignition timing can be achieved by rotating the complete distributor assembly and to enable the distributor locking bolt to be loosened easily use the special tool specified on page 12.

As with conventional ignition systems the breakerless system plays an important part in engine performance, fuel economy and the control of exhaust emission levels.

It is therefore essential that the correct service repair and setting procedures are used in conjunction with the relevant specifications contained in the technical data section.

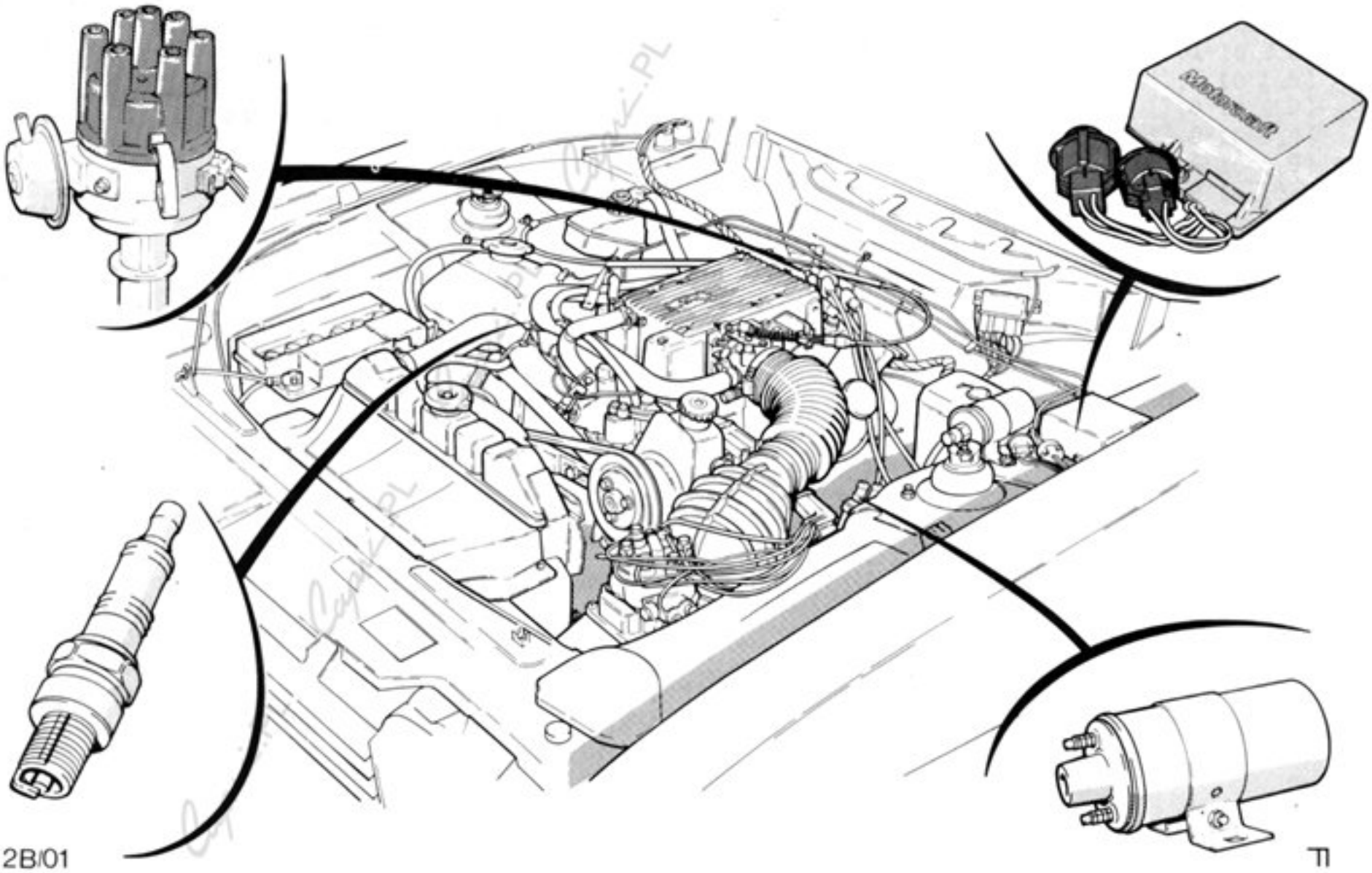


Fig.1. V6 Petrol Injection ignition system.

Components that make up the ignition system are described individually on the following pages.

GENERAL DESCRIPTION (cont'd)

(a) Breakerless Ignition Coil

The ignition coil is mounted on the left hand inner fender panel, refer Fig,2, and has a higher output than that used on contact breaker ignition systems.

The coil is of a conventional design utilising two concentrically wound copper wire coils immersed in wax to prevent over-heating. It is designed to operate under normal running conditions with a 5.5 amp primary current which is boosted to a secondary output of approximately 30,000 volts.

To ensure that the high output coils are readily identified, all production and service replacement units will have a RED label.

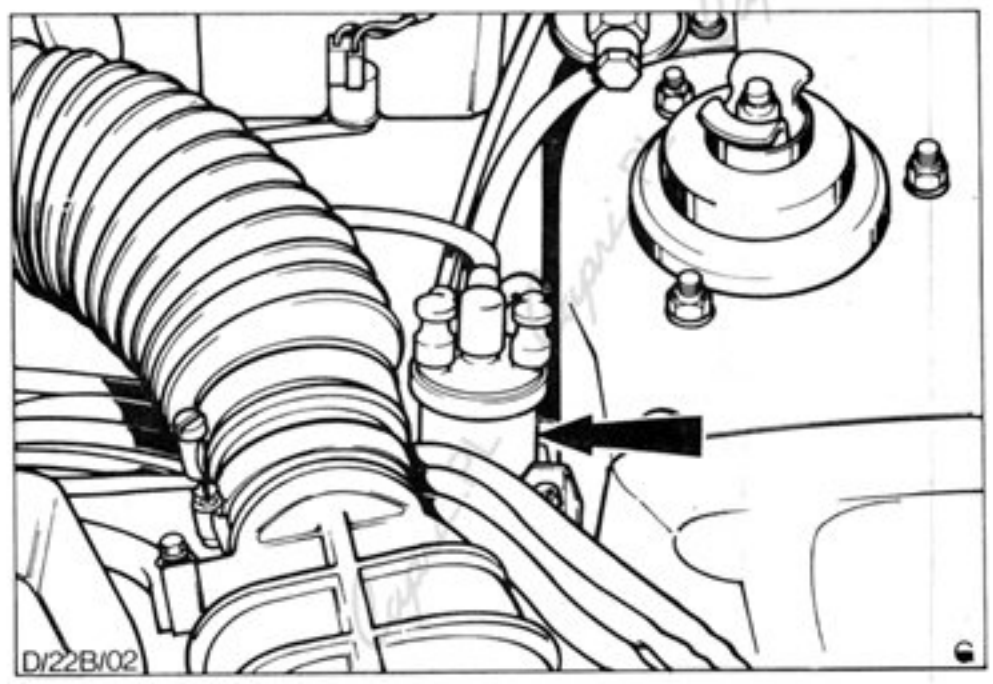


Fig.2. Ignition coil location.

(b) Distributor

The distributor, Fig.3, is of the breakerless type using a shaft mounted trigger plate and associated pick-up coil to replace the contact breaker and capacitor. (Refer to page 5 for detailed Principle of Operation).

The distributor is driven at half engine speed by a skew gear from the camshaft, and rotates in a clockwise direction when viewed from the top.

Ignition advance is achieved by the same method as used on the conventional system, utilising governed weights and a vacuum advance / retard diaphragm. (Refer to Section 22A of the Capri Workshop Manual for full details of advance units).

The breakerless distributor can be easily identified by the colour of the cap, which will be BRICK RED and the signal wires with a multi-plug. The only components of the distributor that can be serviced are the cap and rotor arm.

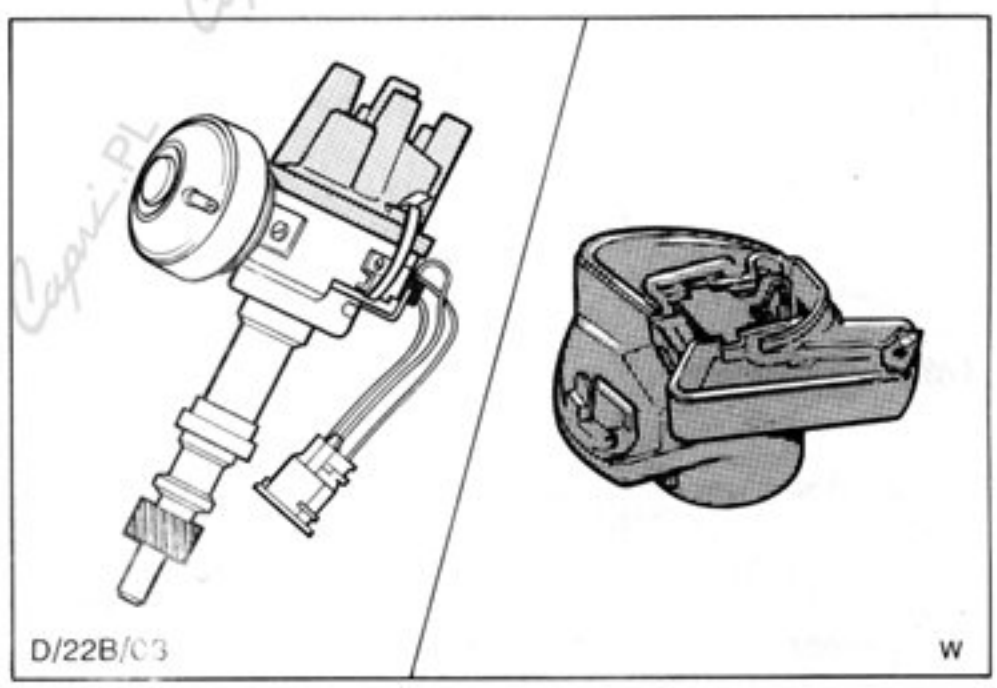


Fig.3. Breakerless distributor and rotor arm with built in rev limiter.

Rev Limiter

Built into the rotor arm on Petrol Injection variants is a rev limiter, refer Fig,3, which restricts the engine speed to a maximum of 6,100 rev/min ± 100.

(c) Electronic Amplifier Module

The electronic module is a sealed unit located on the left hand inner fender panel. Refer Fig.4. It is of a solid state construction consisting of transistors, various resisters and printed circuits. The electronics are bedded in sand and sealed with an epoxy resin sealer to ensure that vibrations and knocks do not damage the circuits.

For information on the module's operating function refer to the Principle of Operation section.

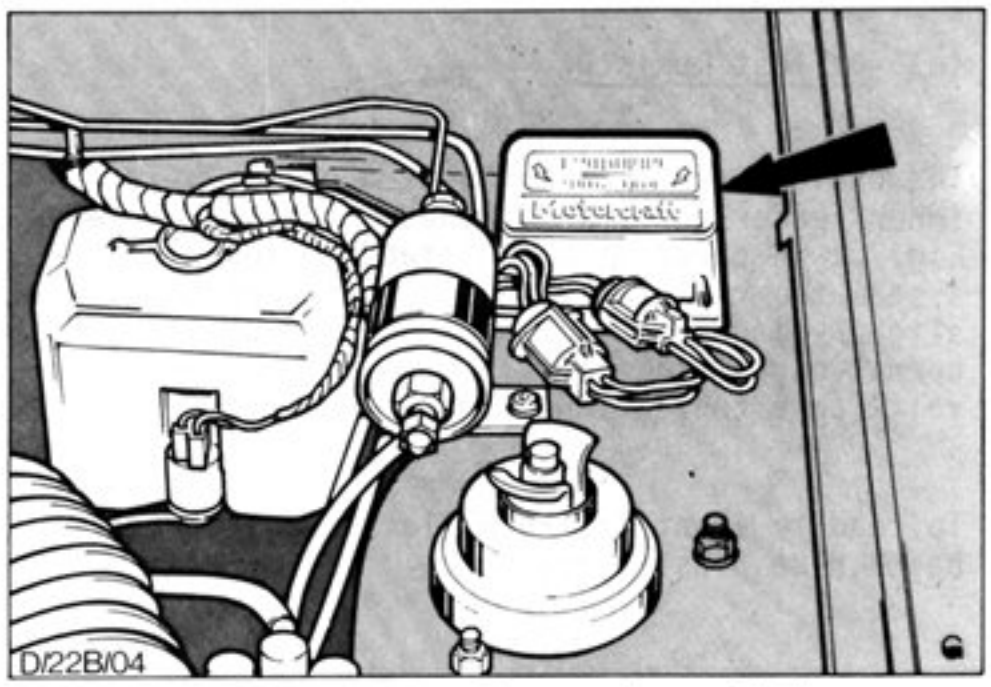


Fig.4. Location of the electronic amplifier module.

GENERAL DESCRIPTION (cont'd)

(c) Electronic Amplifier Module (Cont'd)

The module is connected into the main loom by two special multiplug connections, refer Fig.5, which require a different method of disconnecting compared with a conventional multiplug.

A neoprene seal is fitted between the two halves of the plug and to ensure the plugs are water tight they are filled with grease. When reconnecting plugs it will be found that a high mechanical resistance will have to be overcome before the electrical connection is made.

The module is earthed directly to the distributor to minimise the effects of electrical interference which could result in damage to the module circuits.

It is important to note that if poor driveability is experienced on this engine, apart from checking its connections, the module should NOT be changed until all other possible causes have been exhausted.

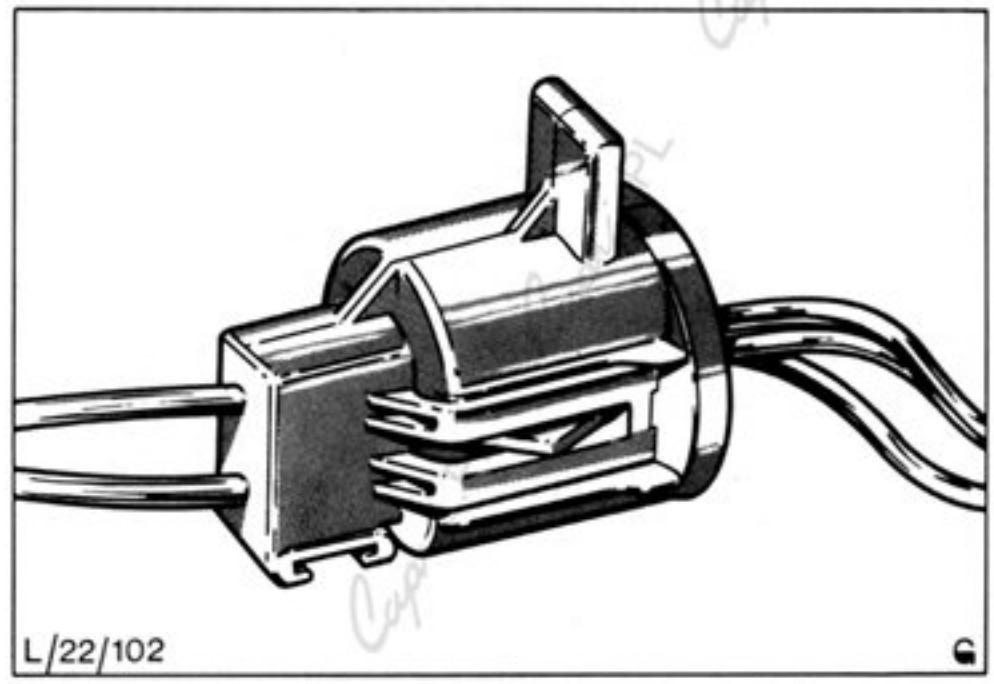


Fig.5. Module multiplug connector.

(d) High Tension Leads (HT)

The HT lead material used on breakerless ignition systems is identical to that used on the OHC and Kent variants, but with improved insulation at the distributor cap. It will be found that the leads fit deeper in the cap terminals.

Cylinder numbering sequence is shown in Fig.6.

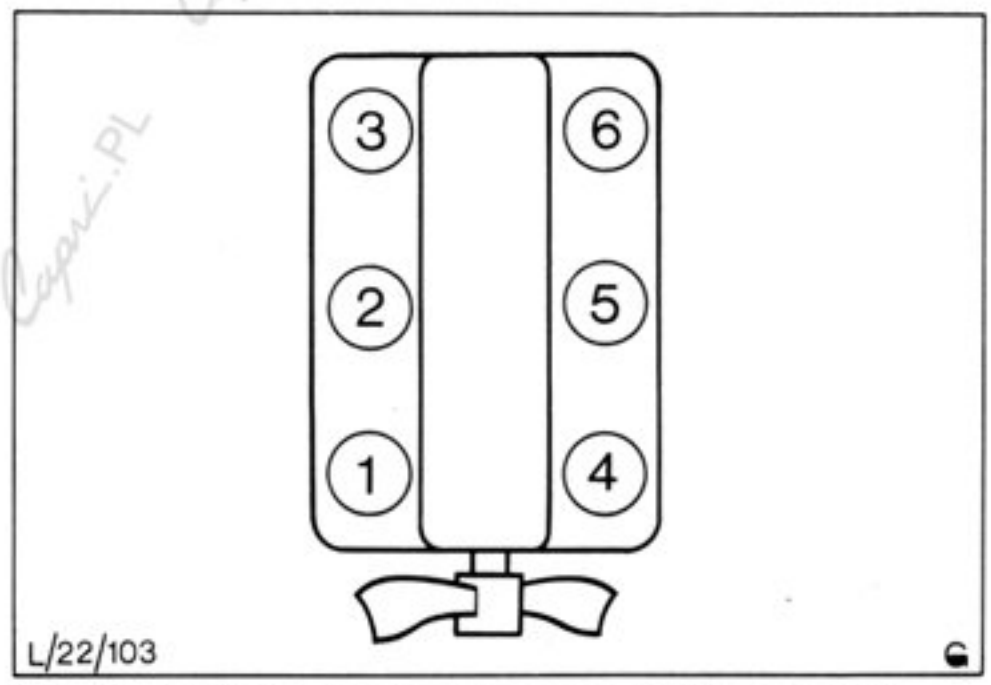


Fig.6. Cylinder numbering sequence for all V6 engines.

(e) Ballast Resistor

The ballast resistor is located on the left hand inner fender panel just beneath the coil. Refer Fig.7. Compared with the standard ignition system the resistance has been reduced to give a slightly increased voltage, during normal operation, at the coil. (8 volts compared with 7 volts on a conventional ignition system)

To readily identify the ballast resistor the wire has a blue plastic coating.

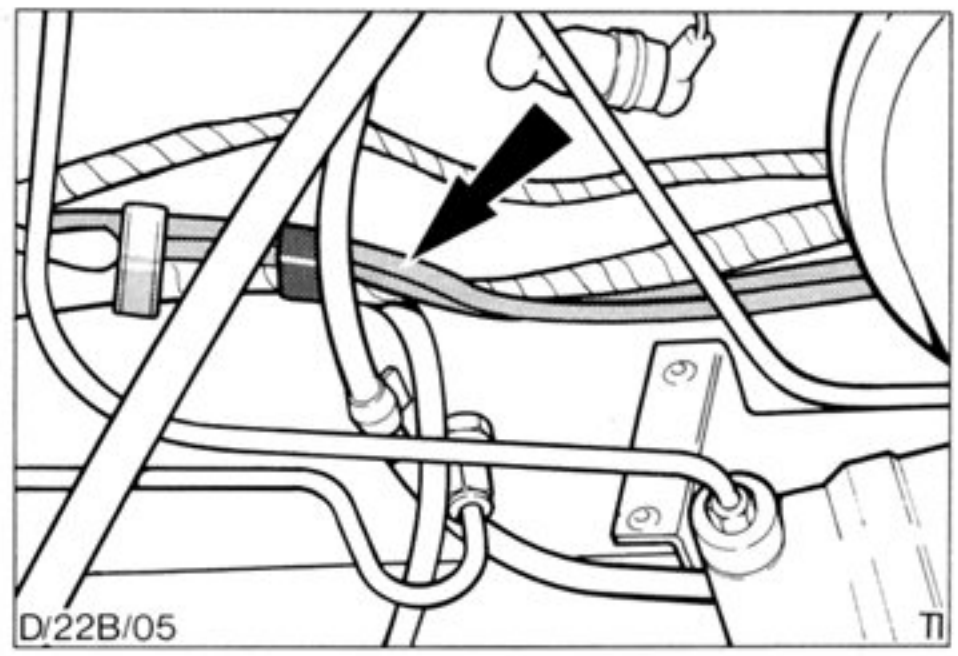


Fig.7. Location of ballast resistor on left hand inner fender panel.

PRINCIPLE OF OPERATION

Distributor

The distributor fulfils three functions:

(a) To provide a pulse to the electronic amplifier module which in turn will trigger the ignition firing process.

The electrical pulse transmitted to the module is created by a magnetic signal generating system which produces an electrical pulse at exactly the correct point in the engine operating cycle. The pulse is generated when the arms of the trigger wheel are lined up with the corresponding parts of the stator, Fig.8. A more detailed operating function of the signal generating system is described on the following page.

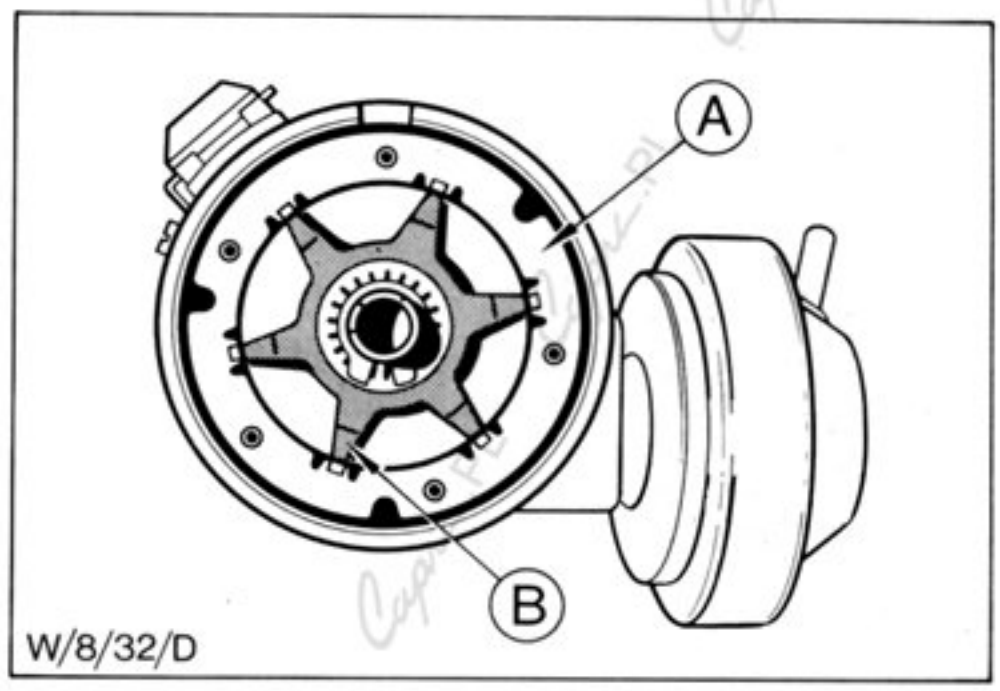


Fig.8. Distributor pulse triggering device.
A - Stator
B - Trigger wheel arm

(b) To vary the timing of the electrical pulse according to engine speed and load.

Spark advance is achieved by using exactly the same method as that adopted on contact breaker systems. Refer Fig.9. For the Principle of Operation reference should be made to Section 22 of the Capri Workshop Manual which shows in detail both the mechanical and vacuum spark advance systems.

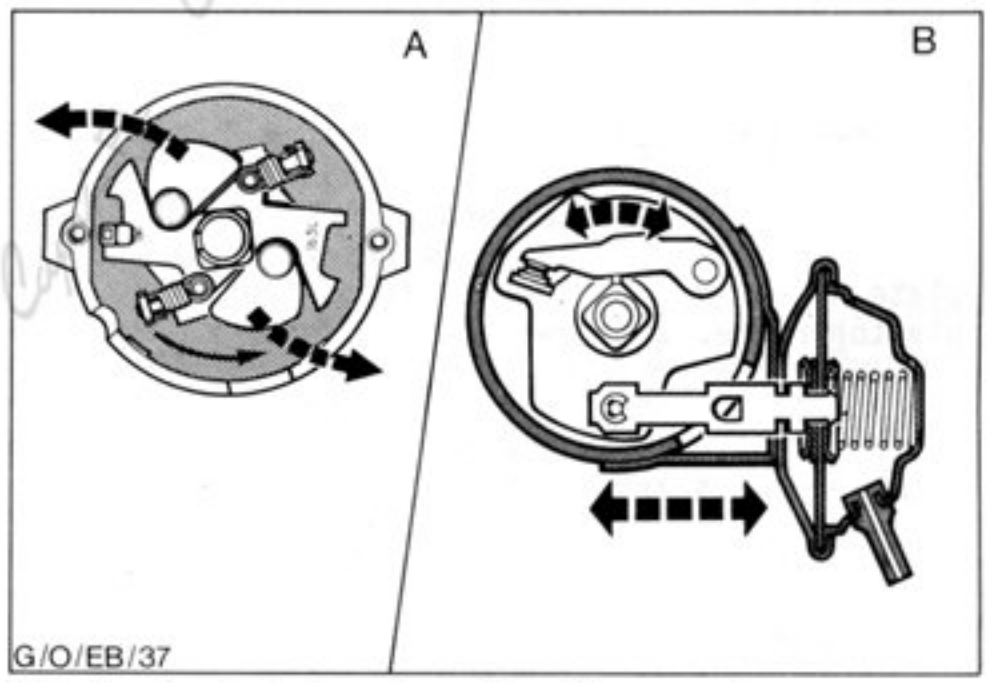


Fig.9. Contact breaker distributor advance systems.
A - Mechanical advance system
B - Vacuum advance system

(c) To distribute the high tension voltage produced by the coil to the appropriate cylinder, Fig.10.

High tension voltage from the coil is fed into the distributor through the centre terminal of the cap, which is connected to a spring loaded carbon electrode fitted inside the cap. The voltage is then applied through the rotor arm to the output terminals and leads which supply the individual spark plugs.

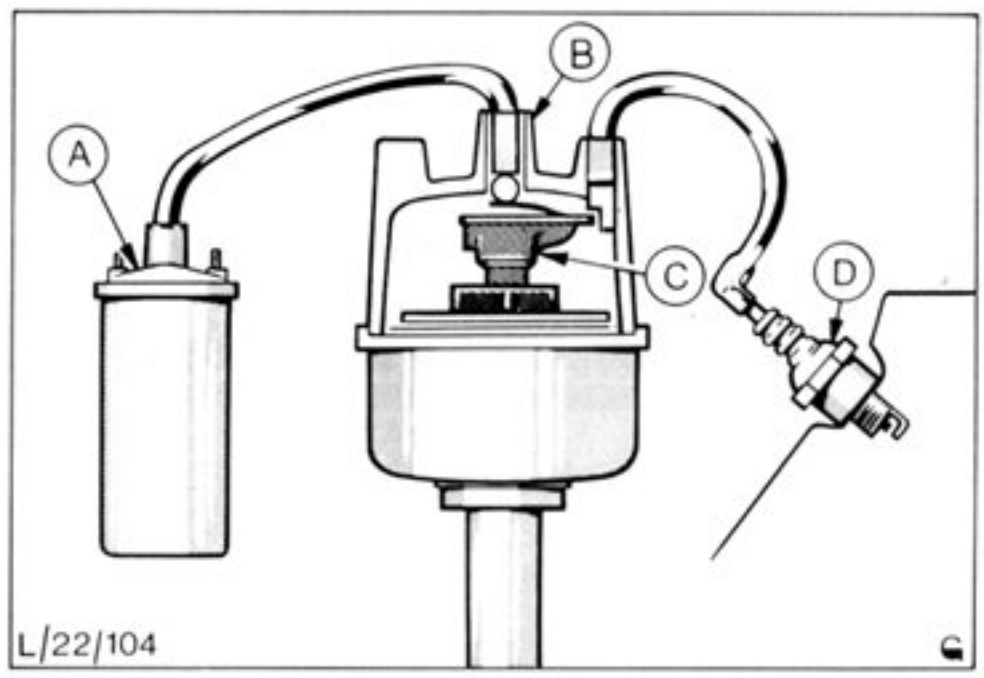


Fig.10. Schematic view of HT circuit.
A - Coil
B - Centre terminal of cap
C - Rotor arm
D - Spark plug

PRINCIPLE OF OPERATION (cont'd)

Distributor Signal Generating System

The signal generating system consists of three main components:

(a) Trigger Wheel

The trigger wheel, Fig.11, is aligned onto the shaft sleeve by a pin and secured in the vertical plane by a circlip. It has six segments, one for each cylinder, and is driven at half engine speed by a skew gear on the engine camshaft.

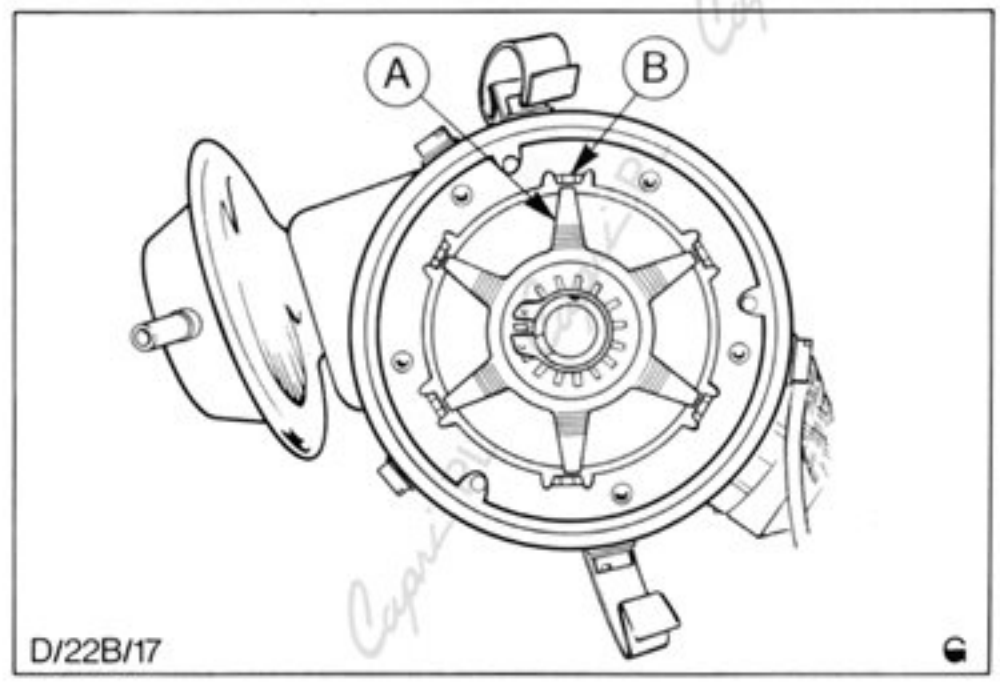


Fig.11. Trigger wheel location on driveshaft.
A - Trigger wheel
B - Stator arm

(b) Permanent Magnet

The magnet, annular in form, is riveted beneath the stator, Fig.12, and forms part of the upper plate assembly. The magnet is made of plastoferrite.

The magnet has an unusual characteristic in that instead of the North and South poles being at each end, the poles are on the top and bottom faces.

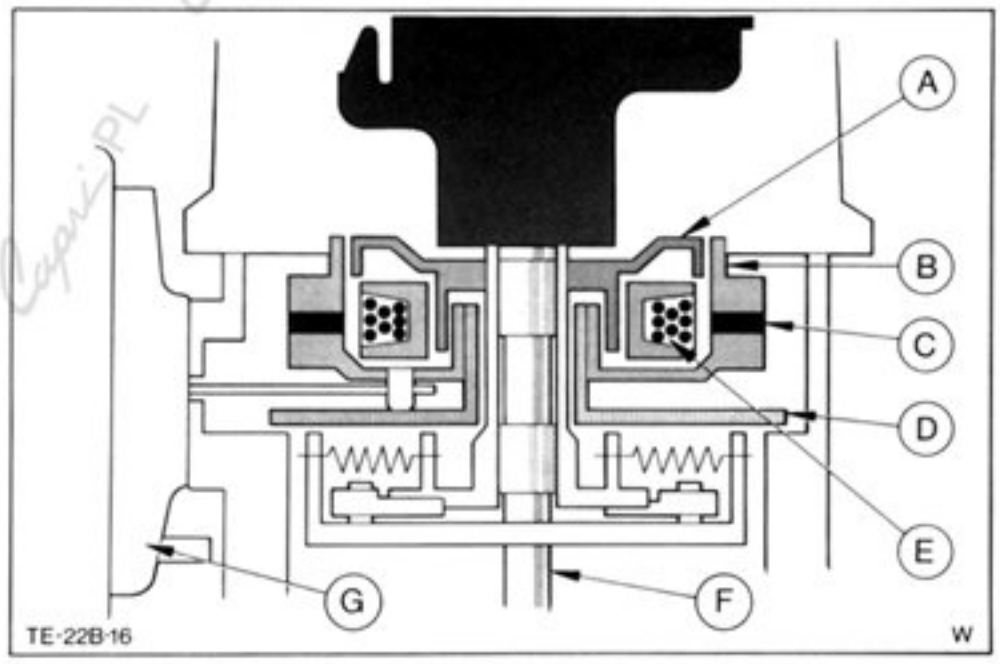


Fig.12. Section view of signal generating system.
A - Trigger wheel
B - Stator arm
C - Magnet
D - Lower plate
E - Trigger coil
F - Distributor shaft
G - Vacuum diaphragm

Fig.13, shows the pole positions of a conventional magnet and the pole positions of a breakerless distributor magnet. Fig.13, also shows how the magnetic force field or flux is altered.

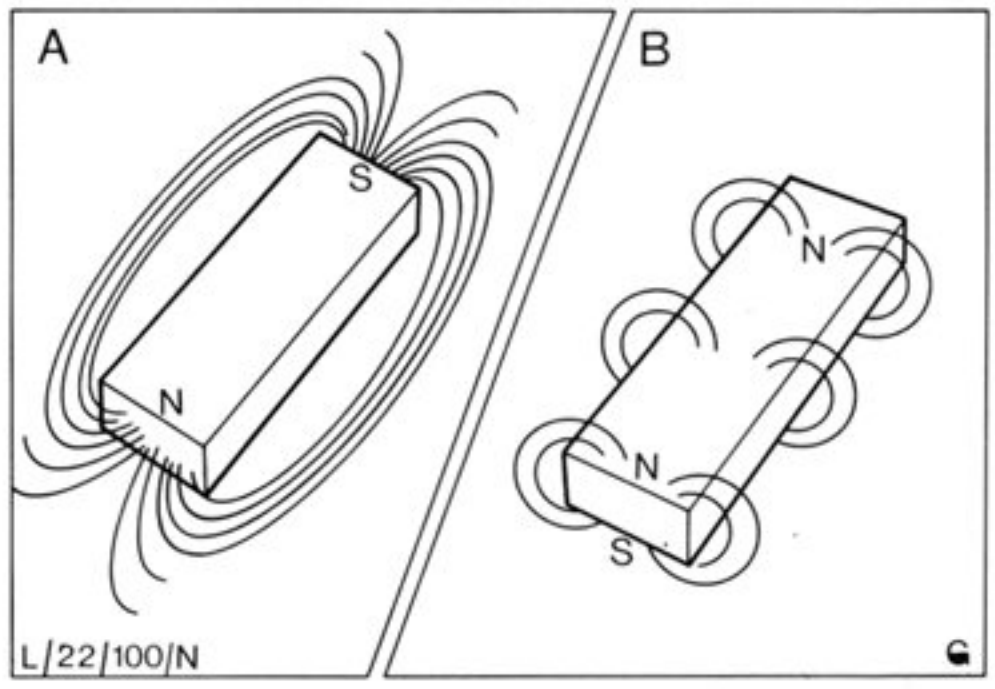


Fig.13. Simple magnets with force field or flux.
A - Conventional magnet with poles at either end
B - Breakerless ignition system magnet with poles on top and bottom faces

PRINCIPLE OF OPERATION (cont'd)

(c) Magnetic trigger coil

The trigger coil, Fig.14, is mounted onto the lower plate and secured by three screws. The lower plate is secured to the base casting. The coil consists of a continuous winding, each end of which is connected through the wiring loom to the module. Any change in the magnetic field force (flux) created by the magnet induces a current flow in the coil.

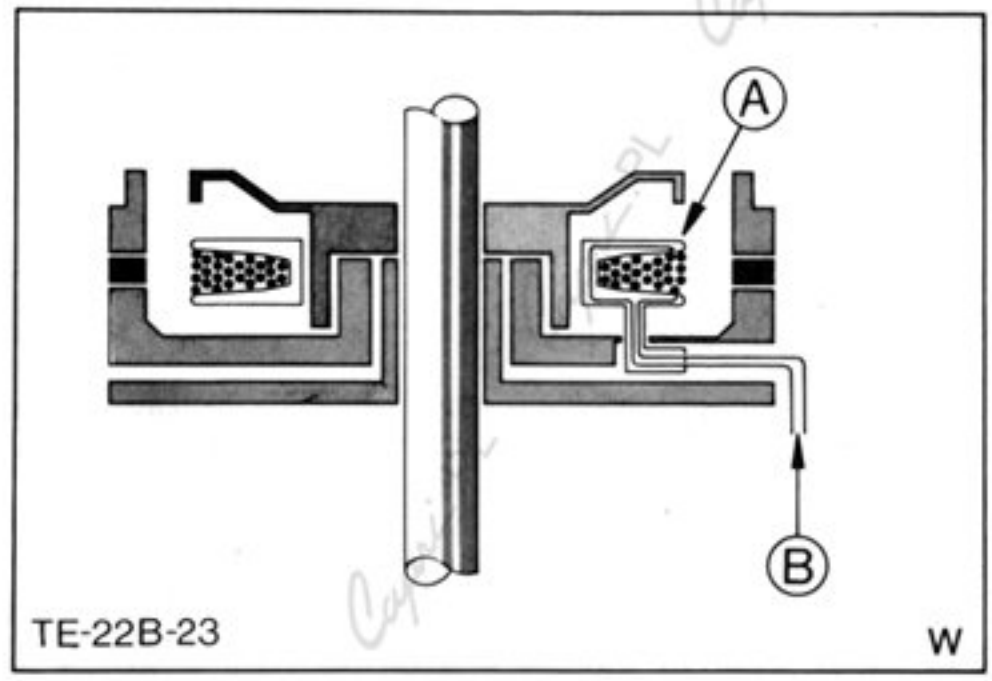


Fig.14. Schematic view of magnetic trigger coil.
A - Magnetic trigger coil
B - Connecting wires to module

Operation Function

The three components fitted together operate as follows:

The magnet, lower plate, stator and trigger wheel form a magnetic circuit.

Due to the magnet pole positions (refer to Fig.13) the stator arm will become the north pole and the trigger wheel which is magnetically coupled to the lower plate will become the south pole, Fig.15.

To simplify the situation the unit will act like a series of 'U' magnets, as shown in Fig.15, with the flux (magnetic field force) acting across the north and south poles.

The flux strength across the two poles is dependant on two factors. These are the strength of the magnet, which in this case is permanent and stable, and more importantly the air gap between the two poles. The smaller the air gap between the poles the stronger the flux of the magnetic field force. In the case of breakerless distributors the trigger wheel is revolving, resulting in the air gap between the poles varying from approximately 1,0 mm (0,04 in) when the trigger wheel arm is directly opposite the stator arm, up to 10,0 mm (0,4 in) when the trigger wheel arm is midway between the stator segments. This results in the magnetic flux or field force varying to give a peak (maximum field force) when the trigger wheel arm is directly opposite the stator arm. THIS IS THE TRIGGER POINT.

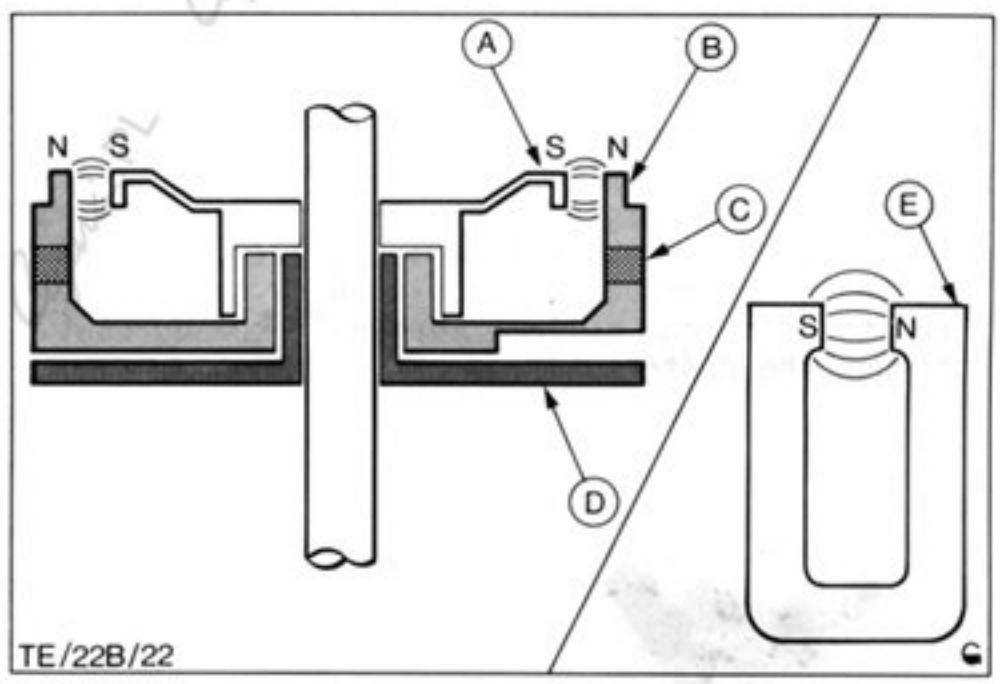


Fig.15. Creation of magnetic field force.
A - Trigger wheel
B - Stator arm
C - Magnet
D - Lower plate
E - Simple 'U' magnet

Having established that the field strength of the magnet varies, this must now be converted to an electrical pulse.

This is achieved by using a simple coil winding which senses the variation in the magnetic field force, Fig.16. The variations in field force causes an alternating voltage to be generated at the coil terminals.

This alternating voltage is sensed by the module and results in the firing sequence.

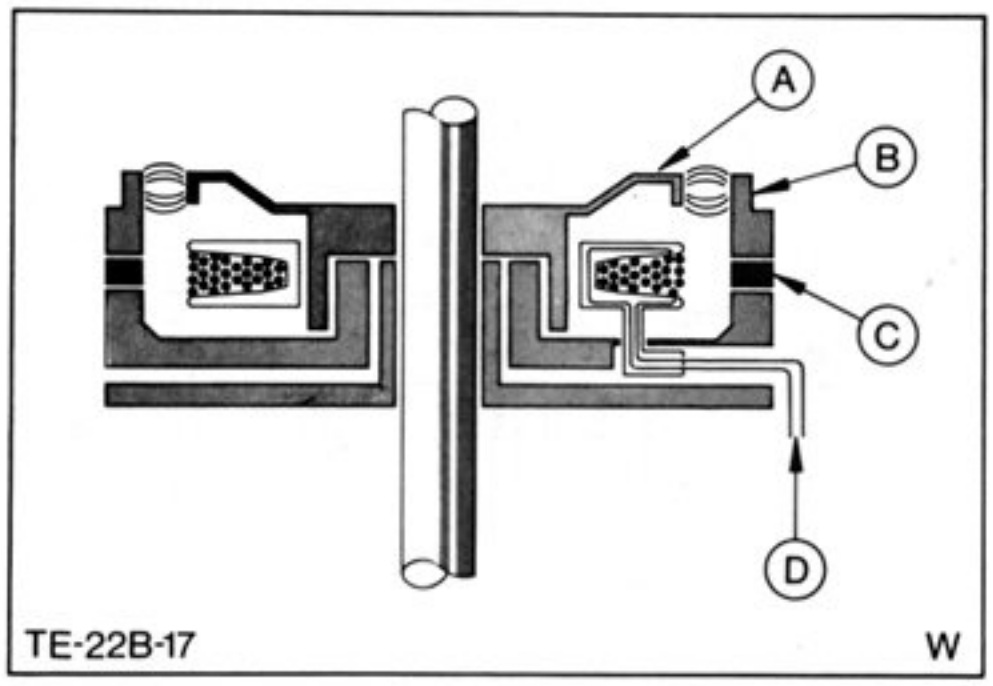


Fig.16. Module sensing alternating voltage from trigger coil due to flux variations.
A - Trigger wheel
B - Stator arm
C - Magnet
D - Two wires to module

PRINCIPLE OF OPERATION (Cont'd)

Electronic Amplified Module ('B' in Fig.17.)

The module, performs the following functions;

(a) To sense the trigger pulse from the distributor and amplify its voltage.
The voltage of the pulse transmitted by the distributor is not, at all times, high enough to operate the out-put transistor built into the module and therefore requires boosting.

(b) To switch off the coil primary circuit on receipt of the amplified trigger pulse from the distributor.
With the primary circuit cut, HT voltage will build up within the coil and be directed to the spark plugs via the distributor cap. This part of the firing sequence is identical to the conventional breaker ignition system.

(c) To switch the primary circuit back 'on' at precisely the correct point in the engine firing cycle.
With the primary circuit 'on', the coil current will stabilise. Due to this factor the dwell angle of the engine is determined. The module has the facility to constantly vary the dwell angle to suit varying engine rpm which is a major advantage compared with the conventional system.

(d) To increase sensitivity during cranking to cater for the lower available trigger voltages.
During cranking when the engine speed is relatively low the voltage induced in the distributor trigger windings is proportionally lower compared with normal engine running speeds. To ensure good starting characteristics are maintained a separate circuit is built into the module to increase its sensitivity during cranking only. The sensitivity of the main running circuit has to be of a lower level to ensure electrical interference does not trigger the module.

Operating Function

The module is energised by a feed wire connected to the ignition switch. When the stator arm is between the trigger wheel arms, Fig.17, the module will switch on. This allows current to flow from the battery, through the ignition switch to the primary winding of the ignition coil (+ terminal). From the ignition coil (- terminal) the current flows through the amplifier module circuits to earth through the distributor.

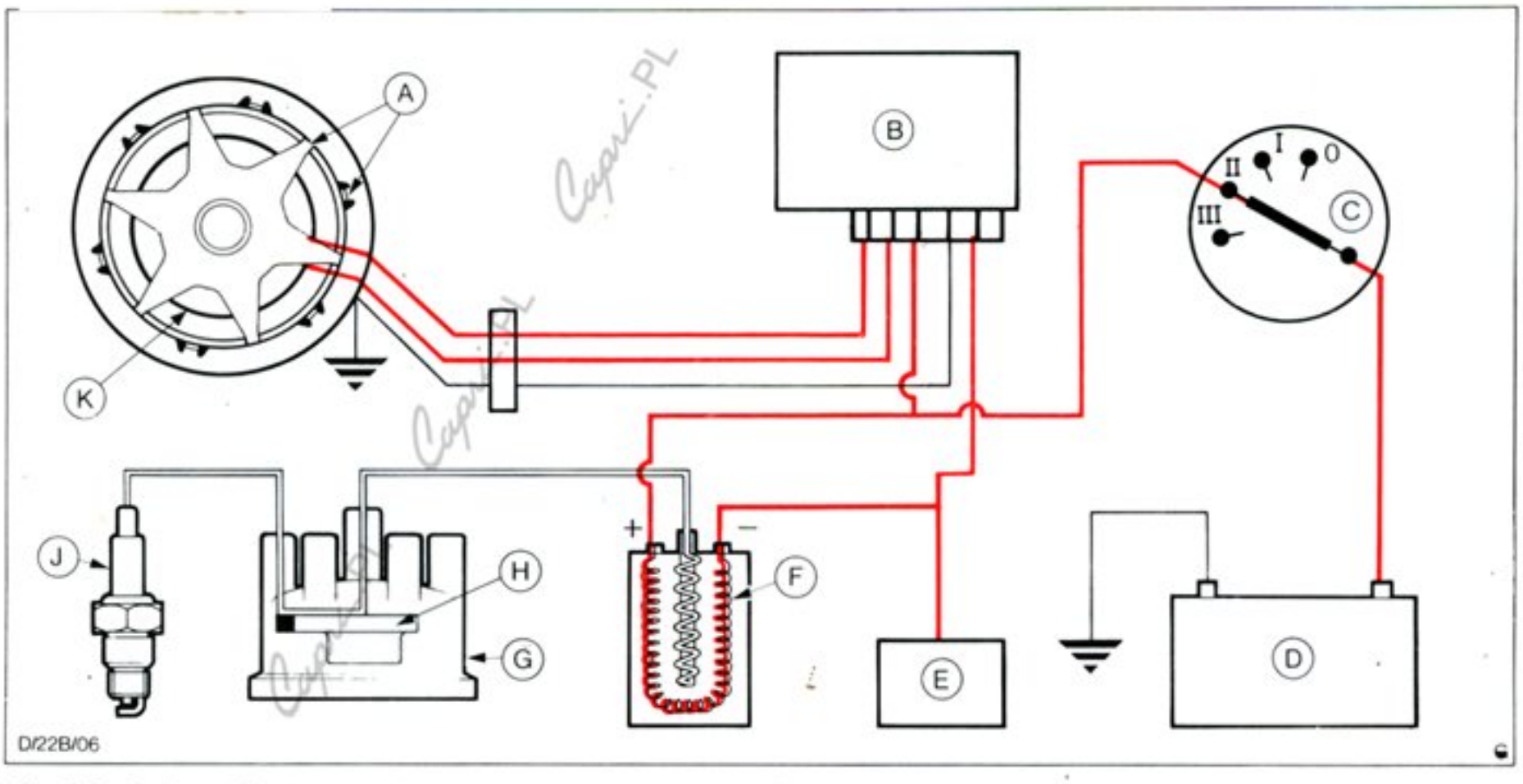


Fig.17. Schematic breakerless ignition system. (Current flow between firing pulses)
A - Trigger wheel between stator arm segments
B - Amplifier module
C - Ignition key in running position
D - Battery
E - Tachometer
F - Coil primary circuit in operation
G - Distributor cap
H - Rotor arm
J - Spark plug
K - Distributor trigger coil

PRINCIPLE OF OPERATION (cont'd)

When a trigger wheel arm is directly opposite a stator arm the voltage induced in the trigger coil will change from a positive to a negative voltage. This change over will trigger a transistor in the module, which switches OFF the ignition coil primary circuit. This results in the collapse of the ignition coil magnetic field which generates the high voltage required to fire the plugs.

After a given time dependant upon the frequency of the trigger pulses (i.e. engine speed) the module switches 'ON', and the primary current is again switched 'ON' enabling the coil to recharge for the next cycle.

At zero rpm no current will flow through the coil.

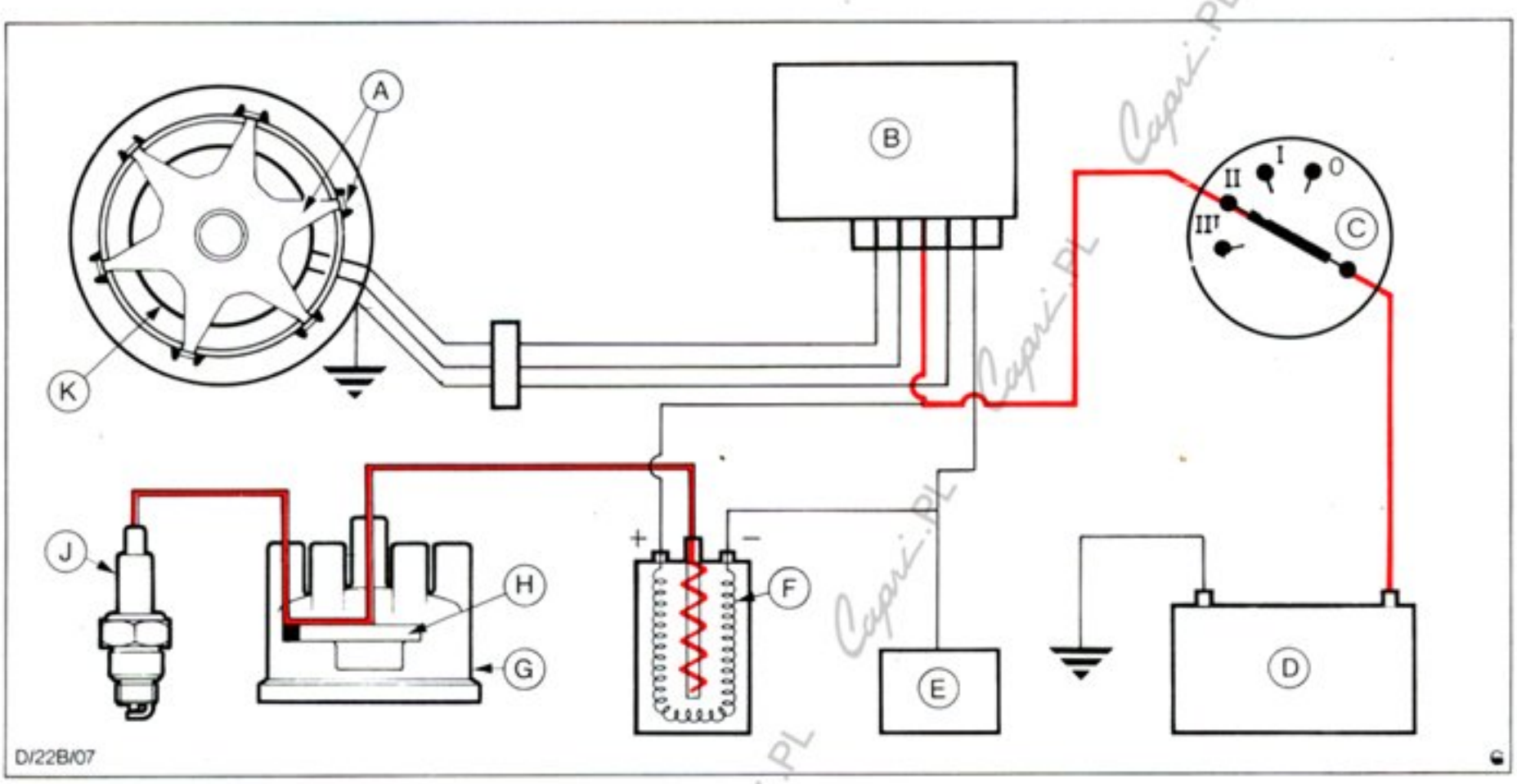


Fig.18. Schematic breakerless ignition system. (Current flow at start of the firing pulse)

A - Trigger wheel aligned to stator arm
B - Module switched OFF
C - Ignition key in running position
D - Battery
E - Tachometer
F - Coil primary circuit cut with resultant HT voltage
G - Distributor cap
H - Rotor arm
J - Spark plug
K - Coil with no current flow (change over point)

Module Terminal and Wiring Identification

Colour Code	Routing
A - Red	Ignition switch 'run' terminal
B - White	Ignition switch 'start' terminal
C - Black	Distributor to module earth lead
D - Green	Negative terminal to coil
E - Violet	Distributor pick up coil
F - Orange	Distributor pick up coil

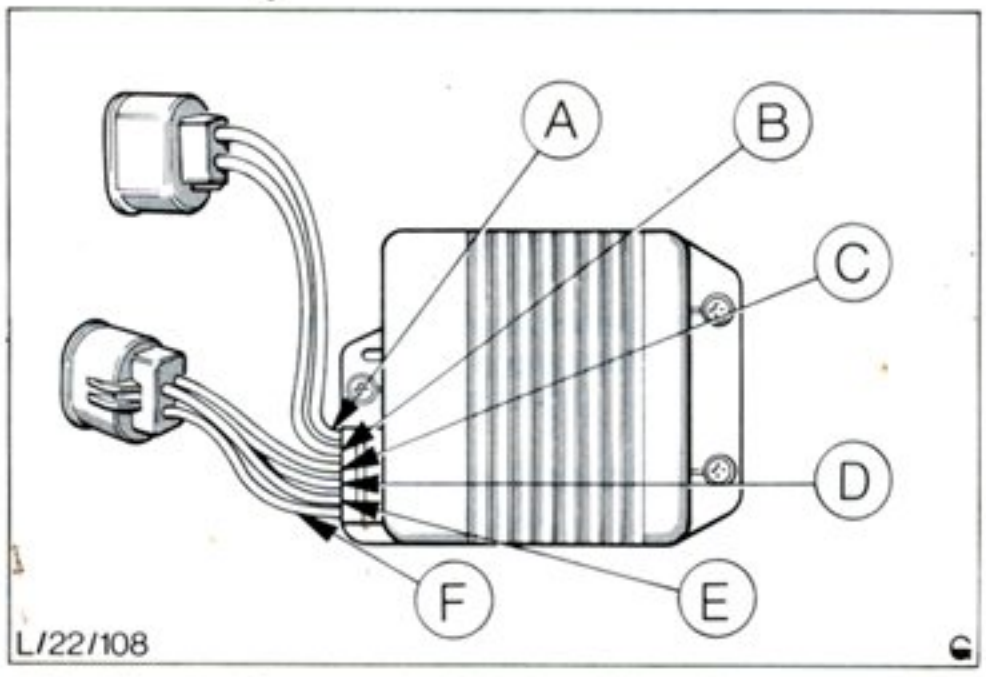


Fig.19. Module terminal identification.

PRINCIPLE OF OPERATION (Cont'd)

Rev Limiter

The rev limiter is built into the distributor rotor arm, refer Fig.20, and consists of a spring loaded contact and earth tag. As the engine R.P.M. approaches the calibrated cut out speed the contact moves outwards, due to centrifugal force, against the load of the return spring. At 6,100 r.p.m. + 100 the moving contact will connect with the earth tag and short out the H.T. voltage being passed through the rotor arm.

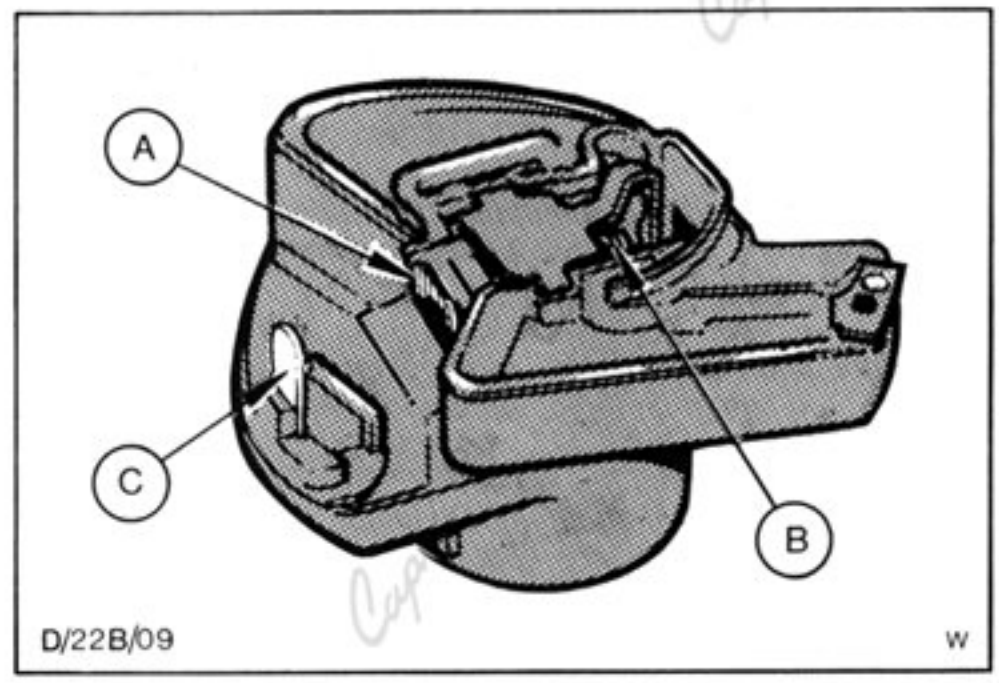


Fig.20. Rev limiter built into rotor arm.
A - Moving contact
B - Return spring
C - Earth tag

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals or where required, the following items should be checked.

1. Clean spark plugs and adjust gaps, or renew if necessary.

   After cleaning adjust electrode gap to specified clearance.

   Ensure that all abrasive is removed from plug and clean ceramic insulator. Check general condition of plug.

   Oily or wet plugs should be dried before cleaning.

   Ensure that the sealing ring is in good condition.

   Replace plugs in cylinder head and tighten to 25-38 Nm (18-28 lbf.ft).

2. Clean high tension leads and check for security.

3. Clean and check distributor cap and rotor arm. Fig.21.

   Cap and rotor arm should be checked for hair-line cracks, damage, or excessive arcing between rotor arm and connections inside cap.

4. Clean and check coil tower and HT leads for secure fit.

5. Lubricate cam spindle wick with two drops of engine oil, Fig.22.

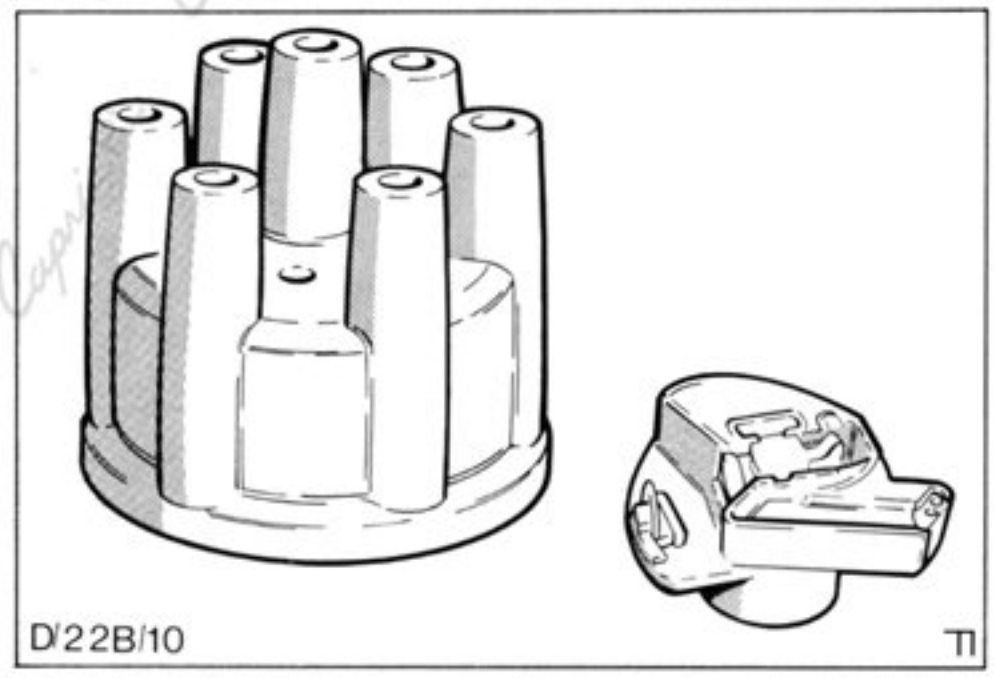


Fig.21. Distributor cap and rotor arm checked for hairline cracks, damage or excessive arcing.

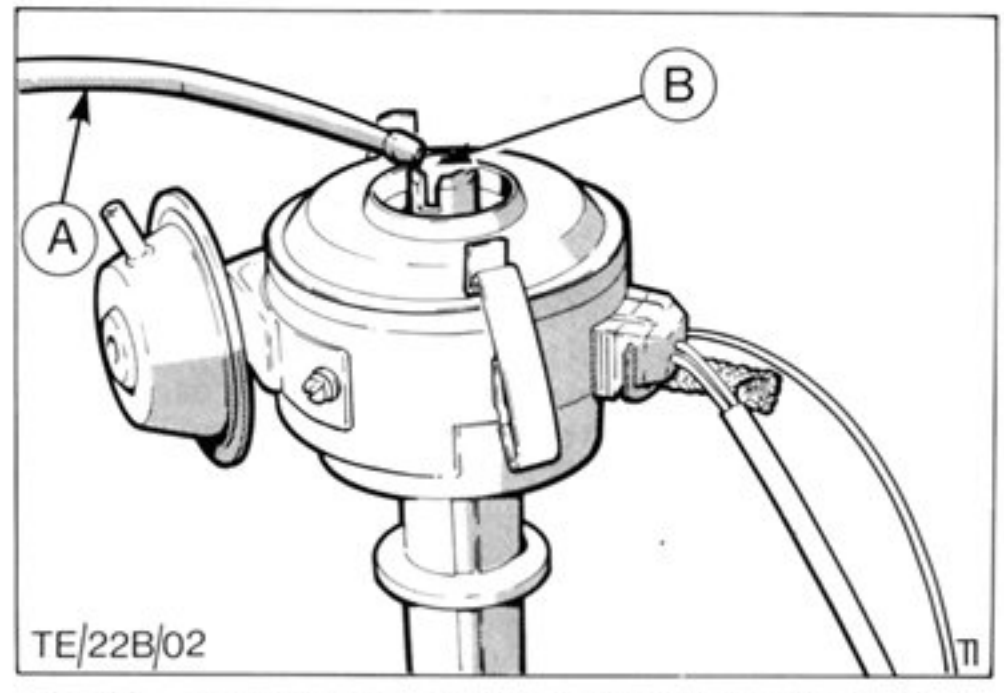


Fig.22. Lubricating distributor cam spindle wick.
A - Oil can nozzle
B - Distributor cam spindle

SERVICE ADJUSTMENTS AND CHECKS (cont'd)

6. Check ignition timing, and adjust if necessary, as described below, Fig.23.

   Disconnect and plug vacuum pipe(s). Manually turn engine to locate timing marks on crankshaft pulley and using a piece of chalk 'highlight' TDC mark. Connect timing light to engine and allow to idle at specified speed. Check ignition timing. Refer Technical Data.

   To adjust timing, stop engine, loosen distributor clamp bolt using Tool No. 21-079, and rotate complete assembly. Tighten clamp and recheck timing.

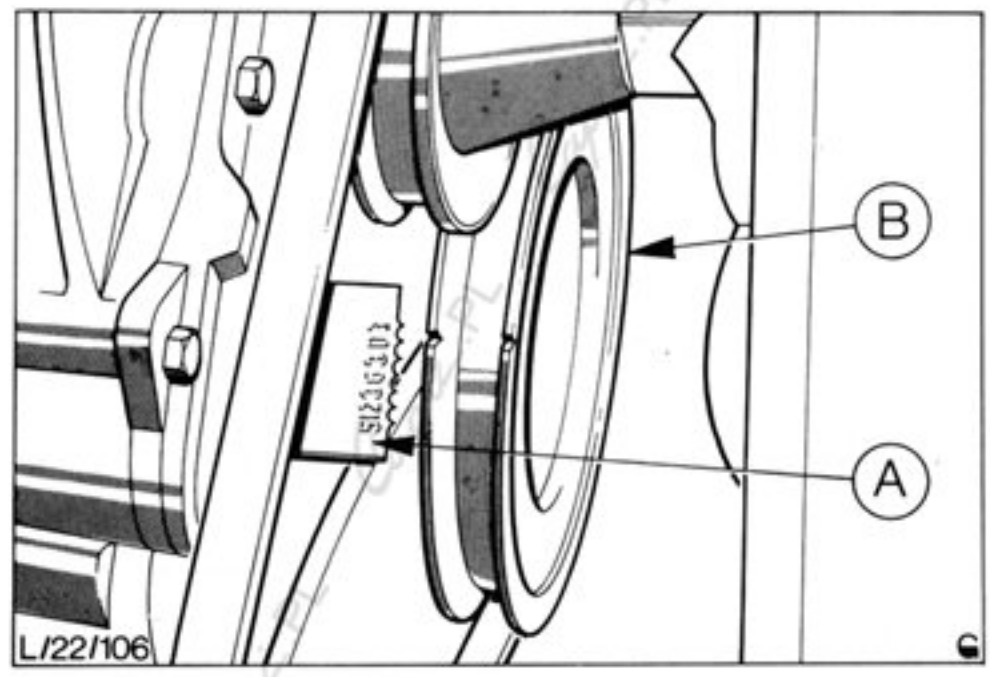


Fig.23. Engine set on TDC.
A - Timing pointer
B - Crankshaft pulley

7. Check ignition mechanical and vacuum advance.

NOTE: To carry out ignition advance check, the timing light must be of the type that includes an advance meter.

   With the timing lamp still connected, restart engine and hold at 2000 rpm, adjust timing lamp and note mechanical advance, reconnect vacuum advance pipe and measure total advance. To obtain a vacuum advance figure subtract mechanical advance figure from total. Refer Technical Data.

   Remove vacuum pump and reconnect distributor vacuum pipes.

IMPORTANT NOTE: Dwell angle is totally governed by the electronic module and is continually changing with engine rpm and can not be adjusted. Therefore there is no necessity to check dwell angle.

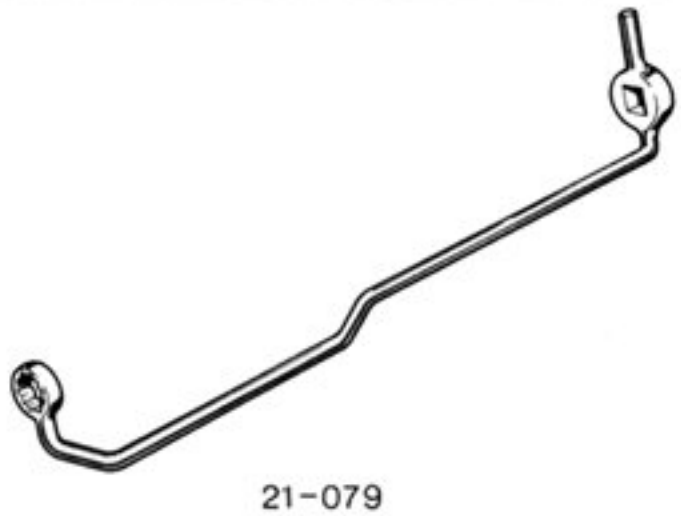
SAFETY PRECAUTIONS TO BE OBSERVED WHEN CARRYING OUT SERVICE OPERATIONS ON BREAKERLESS IGNITION VEHICLES

When carrying out service operations on a vehicle equipped with breakerless ignition which involve the engine running or the ignition switched on, additional precautions to those normally taken on vehicles with a conventional ignition system should be observed for the following reasons.

1. The high tension voltage is approximately 25% higher than on a vehicle with a conventional ignition system. Any electric shock that may be received from the breakerless ignition will be therefore more severe.

2. It is possible for an electric shock to be received from the breakerless ignition system in circumstances which would not result in a shock from a conventional system.
   As the ignition is switched off, or if the distributor is knocked with the ignition switched on, a single high tension pulse will be generated to one spark plug. This may result in an electric shock if the spark plug is being held or touched at that moment.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 21-079	Distributor clamp bolt wrench

L/22/136

SERVICE AND REPAIR OPERATIONS CONTENT

IGNITION SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range:				
				FIESTA	ESCORT '81	CAPRI '78	TAUNUS / CORTINA '76/'77	GRANADA '78
22 111	Ignition system - test	X						X
22 213	Distribution timing - adjust	X				X	X	X
22 214	Distributor - remove and install	X						X
22 284	Cap - distributor - replace	X						X
22 292	Ignition amplifier module - remove and install	X						X
22 411	Ignition coil - test	X		X	X	X	X	X
22 414	Ignition coil - remove and install	X		X	X	X	X	X
22 451	High tension leads resistance - check (all)	X		X	X	X	X	X
22 454	Leads - high tension - replace (all)		22 284					
22 481 1	Spark plugs - check and adjust (spark plugs removed)	X		X	X	X	X	X
22 484	Spark plugs - remove and install	X		X	X	X	X	X

General test information

For full ignition system test procedure refer to Operation 22 111 on page 22B-15.

If an engine is not running, a quick check can be carried out on the ignition system to determine whether or not HT voltage is available at the plugs.

HT output check

1. Obtain an old plug, break away insulation and cut away centre electrode and screw cap, Fig.24. Discard threaded section of plug.

2. Disconnect No.1. plug lead and fit plug adaptor ensuring that the electrode extends beyond the lead insulation.

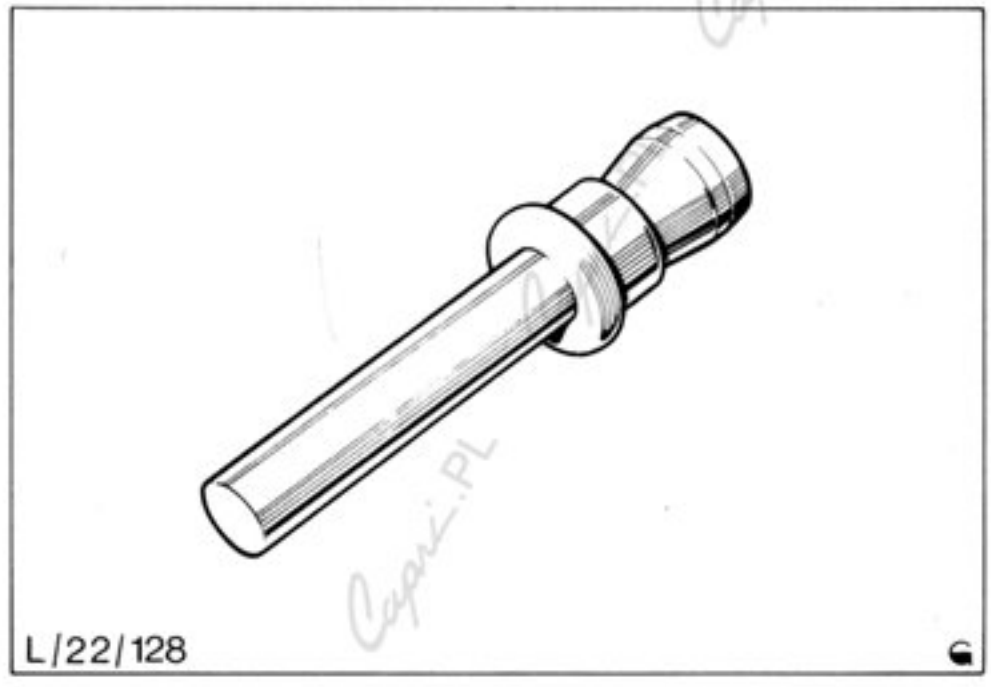


Fig.24. Spark plug centre electrode and cap.

3. Using insulated pliers hold lead approximately 5 mm (0,2 in) away from the cylinder block and using ignition switch crank engine. HT voltage will spark between electrode and block, Fig.25.

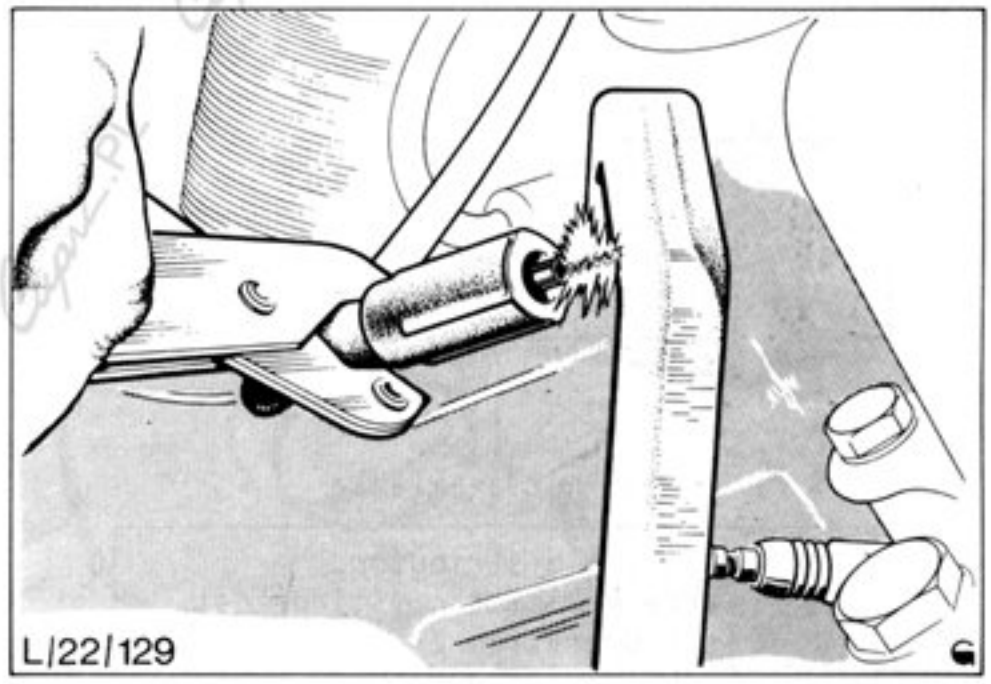


Fig.25. HT output test of No.1 plug lead using insulated pliers.

4. If no HT voltage is achieved disconnect plug lead at the distributor cap and reconnect to coil centre terminal, Fig.26.

5. Repeat HT output test.

6. If HT voltage is still not achieved refer to fault finding chart on the following page.

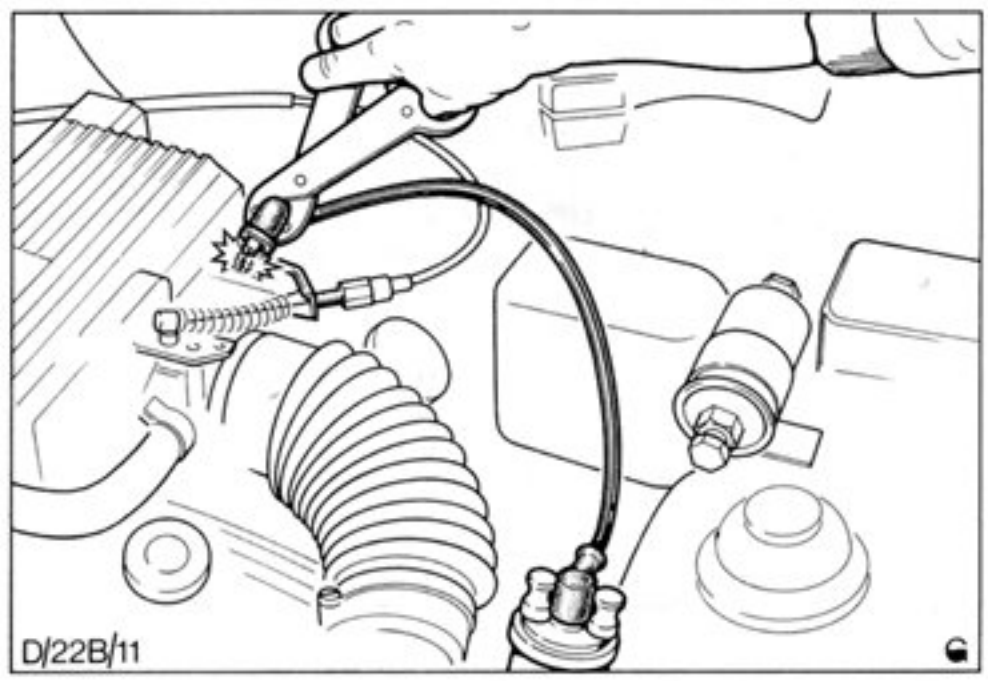


Fig.26. HT output test with test lead connected to coil centre terminal. Use insulated pliers for this test.

FAULT FINDING CHART

IGNITION SYSTEM - TEST

Engine will not start.

Check starter motor, battery condition and all starting circuit connections.

Carry out HT output test at the spark plug lead. Refer page 13.

HT not available

Disconnect HT lead at centre terminal on distributor cap and hold lead close to block. Repeat HT output test.

HT available

Check spark plugs.
Check plugs for wear and correct gap.
Check fuel and remaining engine systems.
Repair or renew as necessary.

Fault still evident

(a) Check coil connections.
(b) Check coil primary resistance.
(c) Check coil secondary resistance.
(Refer sub-operation 6 on page 15.)

HT available

Check distributor cap, rotor arm and HT leads. Repair or renew as required.

HT not available

Check distributor.
(a) Carry out static timing test. (sub-operation 2 on page 18)
(b) Crank engine and check drive.
(c) Check for wear or damage.
(d) Check distributor connections.
Repair or renew as required.

Fault still evident

Fault rectified

Check amplifier module.
Module should be checked by substitution and if engine starts the old unit should be re-checked to ensure that a bad connection was not the fault.

Fault still evident

Fault rectified

Carry out wiring loom continuity check.

22 111 IGNITION SYSTEM - TEST

SPECIAL EQUIPMENT REQUIRED:

Electronic test equipment which includes an ohm meter, oscilloscope and timing light.

NOTE: If the technician is unfamiliar with the use of electronic test equipment then it is essential that reference be made to existing training material before attempting the following operation.

IMPORTANT: As dwell angle is totally governed by the module and is continually changing there is no requirement to check it.

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Disconnect two LT (low tension) leads and one HT (high tension) lead at coil.

   To disconnect leads pull on end of terminal not cable, Fig.27.

4. Disconnect HT leads at spark plugs and detach cap and lead assembly.

5. Test HT leads resistance as follows:

   Connect ohm meter to HT lead terminal and to distributor cap at rotor arm connection, record resistance, Fig.28. If resistance is high, HT lead to cap connection should be cleaned and resistance rechecked before lead is replaced.
   Refer Technical Data.

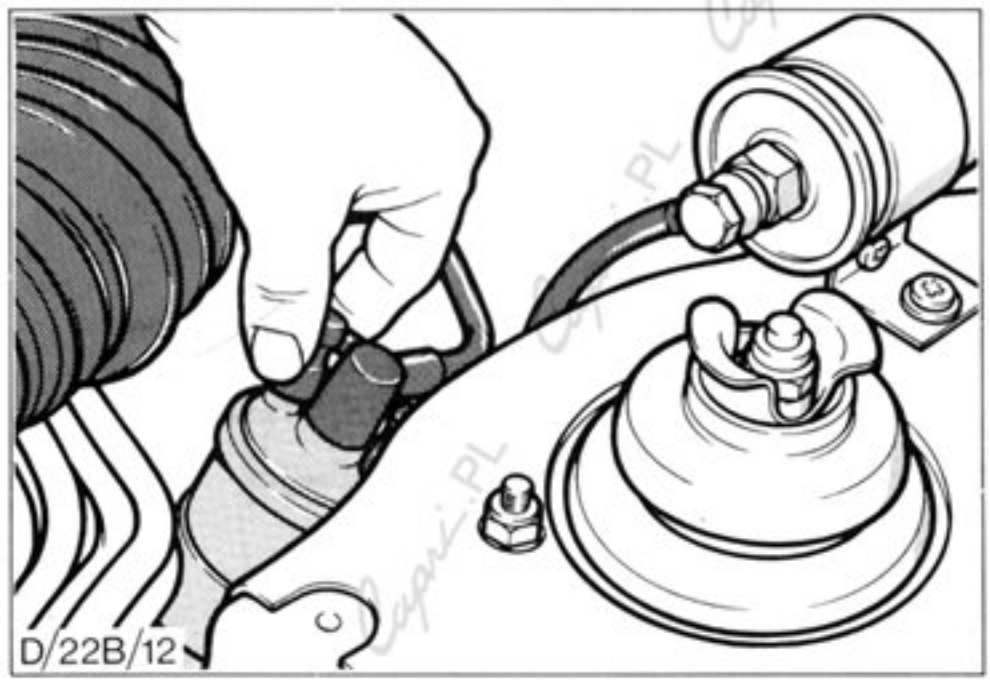


Fig.27. Disconnecting coil LT lead. (Hold terminal NOT lead)

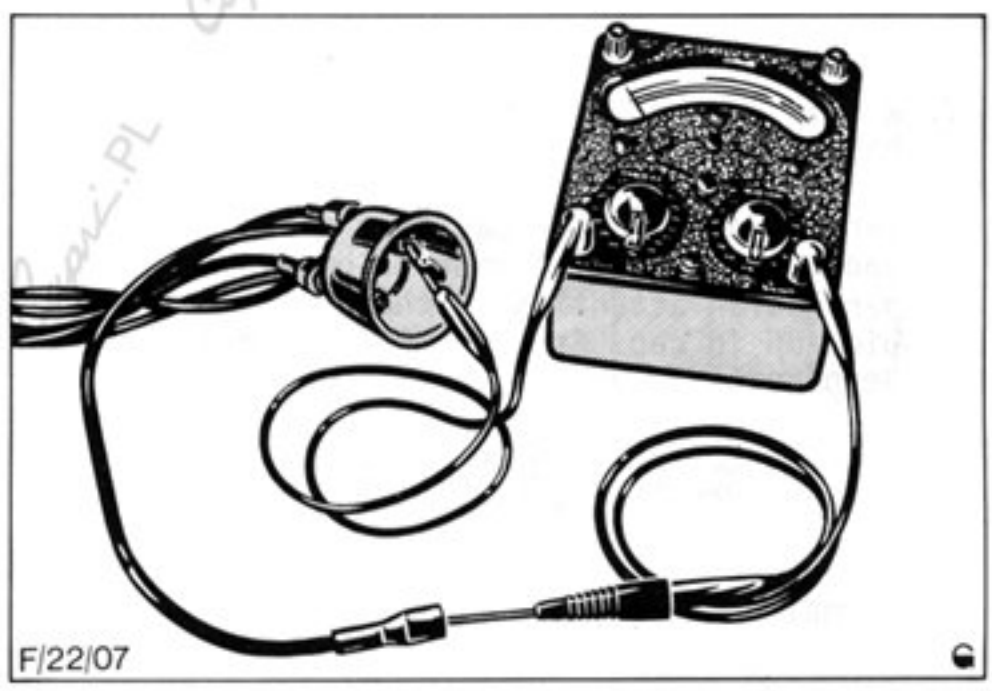


Fig.28. HT lead resistance being checked. (Ohm meter shown).

6. Test coil resistance as follows:

   (a) Primary Circuit, Fig.29.

   Connect ohm meter between two LT connections on coil, select appropriate scale and record resistance. Refer Technical Data.

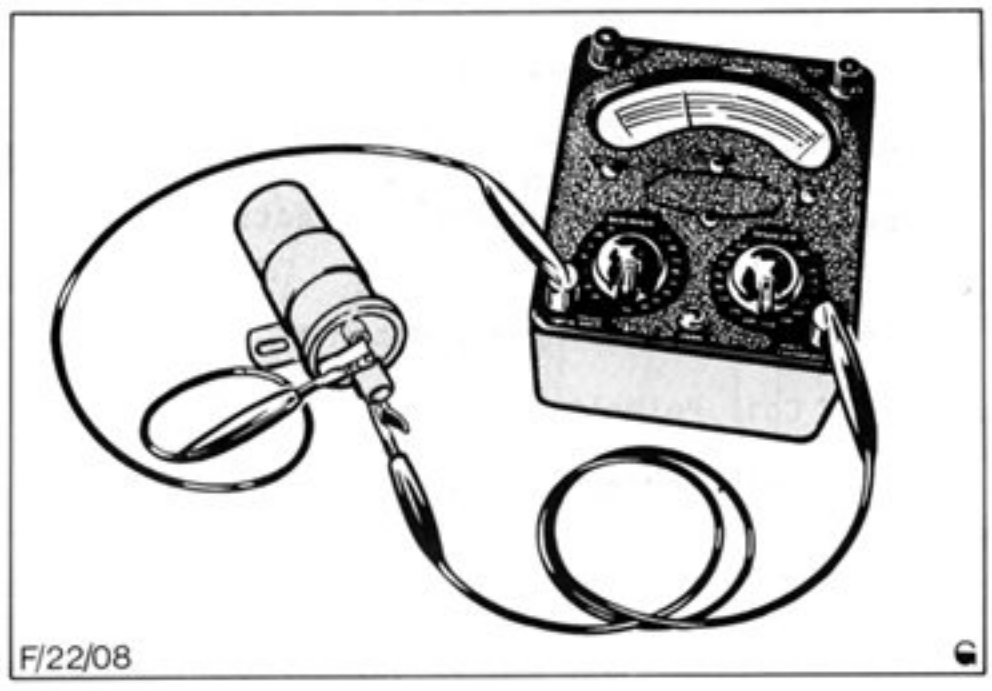


Fig.29. Primary circuit resistance test. Note: Coil shown off vehicle for clarity

(b) Secondary Circuit, Fig.30.

Reconnect ohm meter to coil HT lead and either one of the two LT connections, select scale and record resistance. Refer Technical Data.

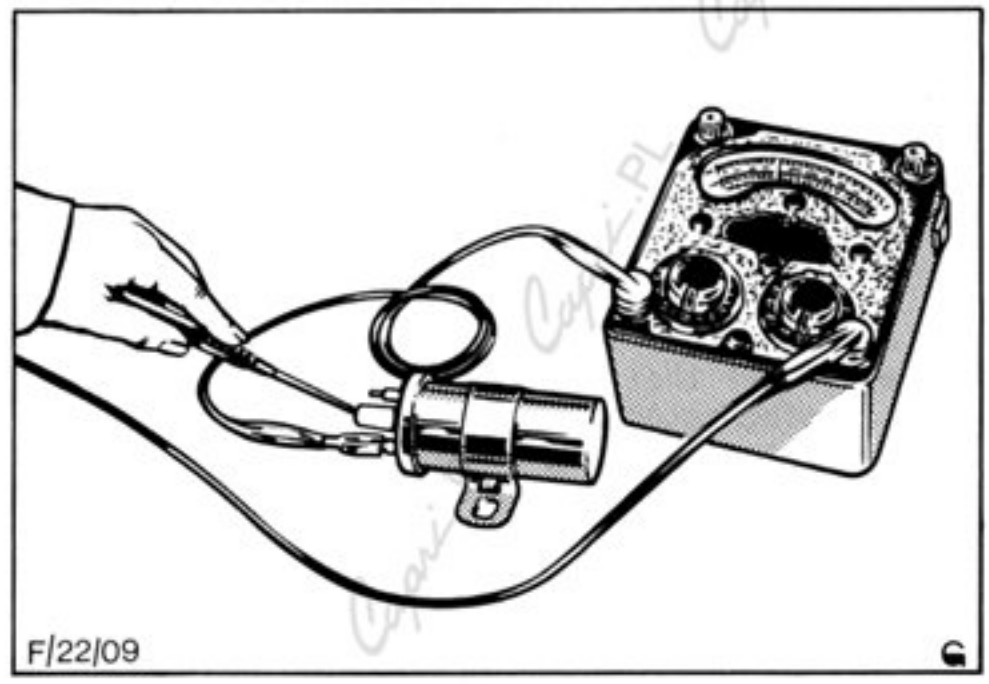


Fig.30. Coil secondary circuit resistance test. NOTE: Coil shown off vehicle for clarity.

7. Remove rotor arm, clean and inspect for wear, hairline cracks and burning then refit.

8. Inspect distributor cap for hairline cracks and connections for wear or burning, paying particular attention to the centre carbon pick-up in cap, Fig.31. Clean cap and refit. Reconnect HT leads to spark plugs.

9. Connect test set to engine in accordance with manufacturer's instructions.

10. Reconnect battery, start engine and warm up to normal operating temperature.

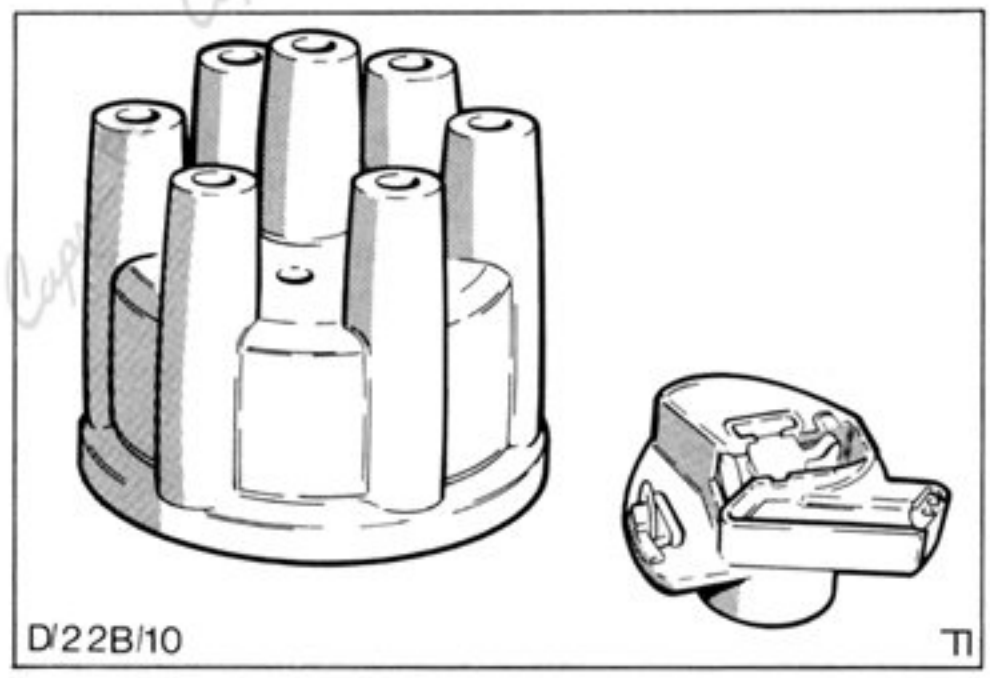


Fig.31. Check distributor cap and rotor arm for hairline cracks, damage or excessive arcing.

NOTE: Some equipment used in Dealerships does not include an oscilloscope but still has the facility to carry out the following operations. In these cases, for detailed procedures reference should be made to the equipment manufacturer's instructions.

11. Check coil polarity and maximum coil output.

(a) Coil Polarity.

With engine idling, display secondary circuit on oscilloscope and check polarity.
Refer to Fig.32:
A is correct
B is incorrect

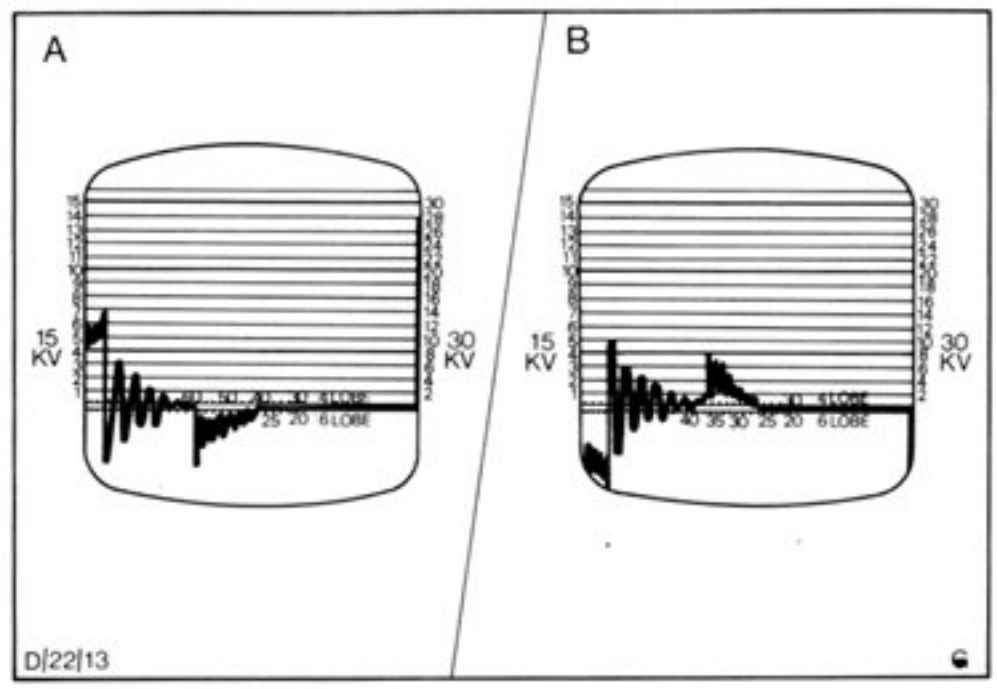


Fig.32. Coil polarity check.
A - Correct polarity
B - Incorrect polarity

(b) Maximum coil output.

With engine at 1000 rpm adjust secondary oscilloscope pattern to show all six spark lines. Using insulated pliers, disconnect one HT lead at spark plug. Maximum coil voltage measured in kilo volts will be recorded on scope as shown in Fig.33. Refer Technical Data.

Reconnect HT lead to spark plug.

NOTE: Special care should be taken not to damage HT terminal insulation when removing with insulated pliers.

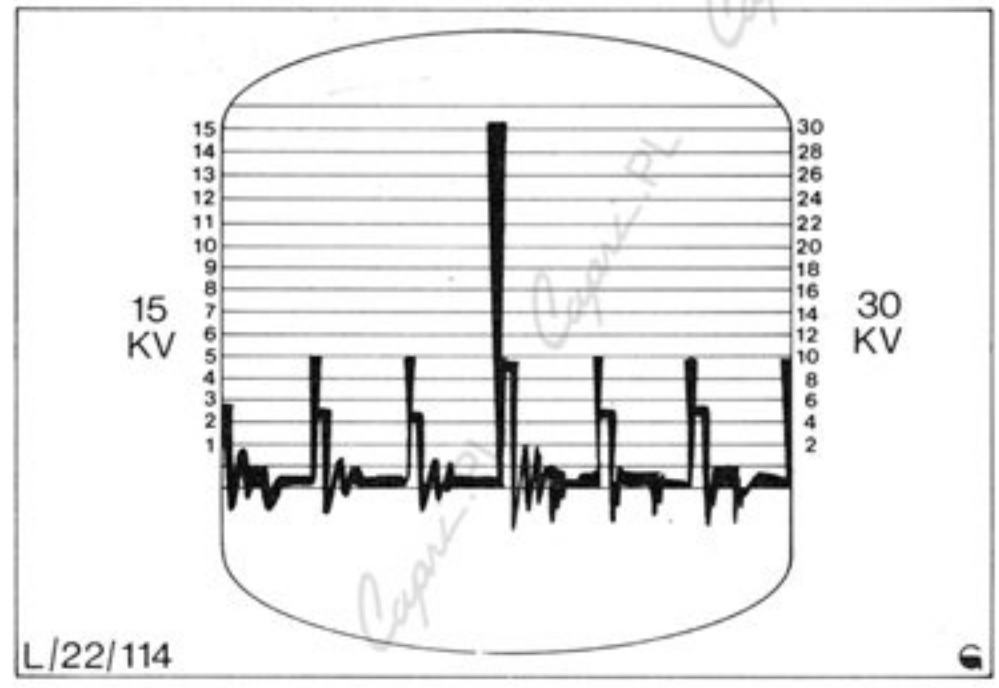


Fig.33. Maximum coil voltage, using 30 KV scale.

12. Check spark plug voltage at idle and under acceleration.

(a) At idle.

Fig.34 shows pattern that would be expected if all plugs are in good condition e.g. a voltage of between 9 and 10 KV and all of an equal length. If observations reveal an incorrect reading, reference should be made to existing training material to ascertain correct diagnosis.

(b) Under acceleration.

Snap open throttle to increase engine speed to approximately 3000 rpm, note plug KV readings and release throttle. On initial acceleration the plug voltage will rise to a peak, this peak should not be in excess of two-thirds of maximum coil output, sub-operation 11b.

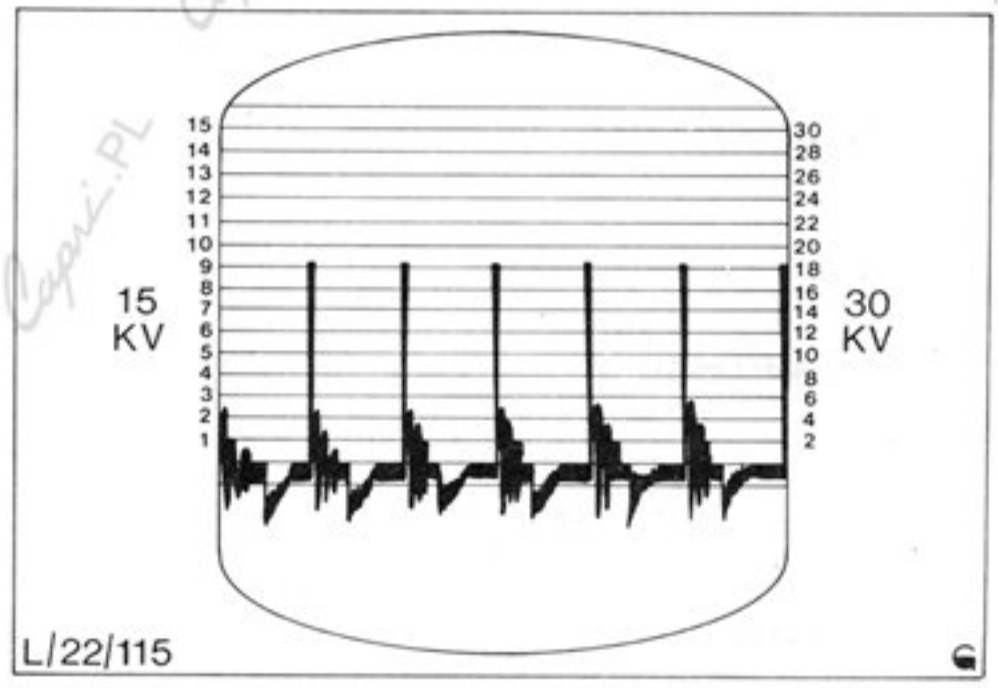


Fig.34. Secondary scope pattern showing six cylinders.

13. Check timing and timing advance characteristic, as detailed in Operation No. 22 213, Fig.35.

14. Disconnect test set.

15. Remove fender covers and close hood.

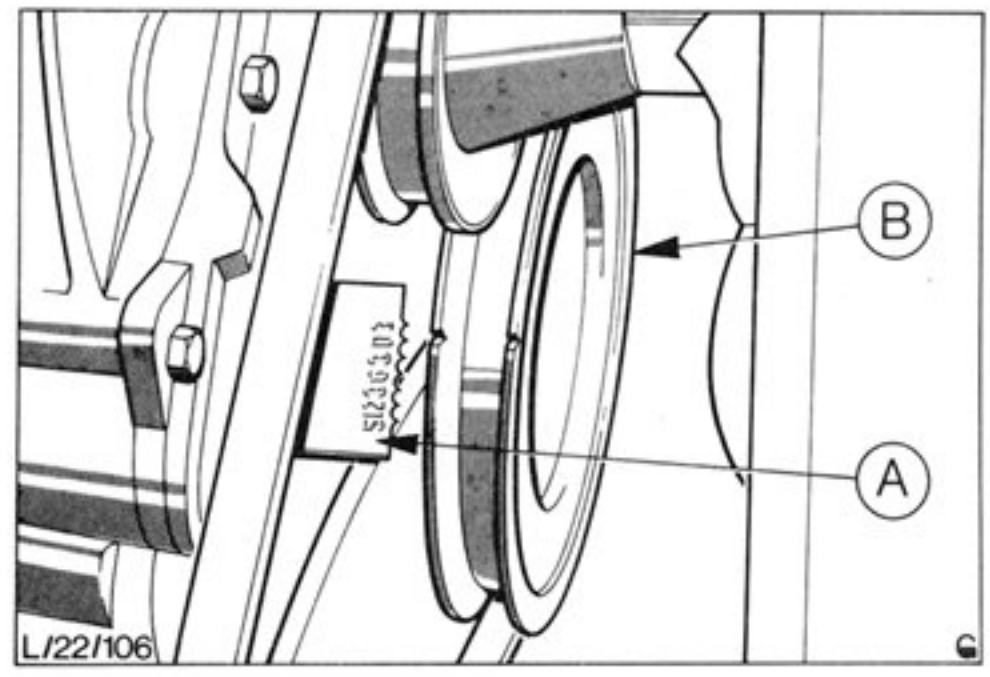


Fig.35. Engine set on TDC.
A - Timing pointer
B - Crankshaft pulley

22 213 DISTRIBUTOR TIMING - ADJUST

SPECIAL SERVICE TOOLS AND EQUIPMENT REQUIRED:

Distributor clamp bolt wrench 21-079
Timing Lamp

1. Open hood and fit fender covers.

2. If distributor has been removed for any reason the timing should be initially adjusted as follows, to enable the engine to be started.

   (a) Unclip distributor cap and position cap clear of distributor assembly.

   (b) Turn engine to 12° BTDC on No.1. cylinder, Fig.36.

   i.e. Timing pointer at 12° BTDC and rotor arm pointing to the slot cut in distributor housing.

   (c) Remove rotor arm.

   (d) Using Tool No. 21-079 loosen distributor clamp bolt and rotate complete distributor assembly so that the trigger wheel arms and stator arms line up correctly, Fig.37.

   (e) Secure distributor clamp bolt.

NOTE: Angle 'Z' in Fig.37, between rear face of block (line XX) and distributor diaphragm axis (line YY), should be 0° to 14° in an anti-clockwise direction.

   (f) Refit rotor arm and cap.

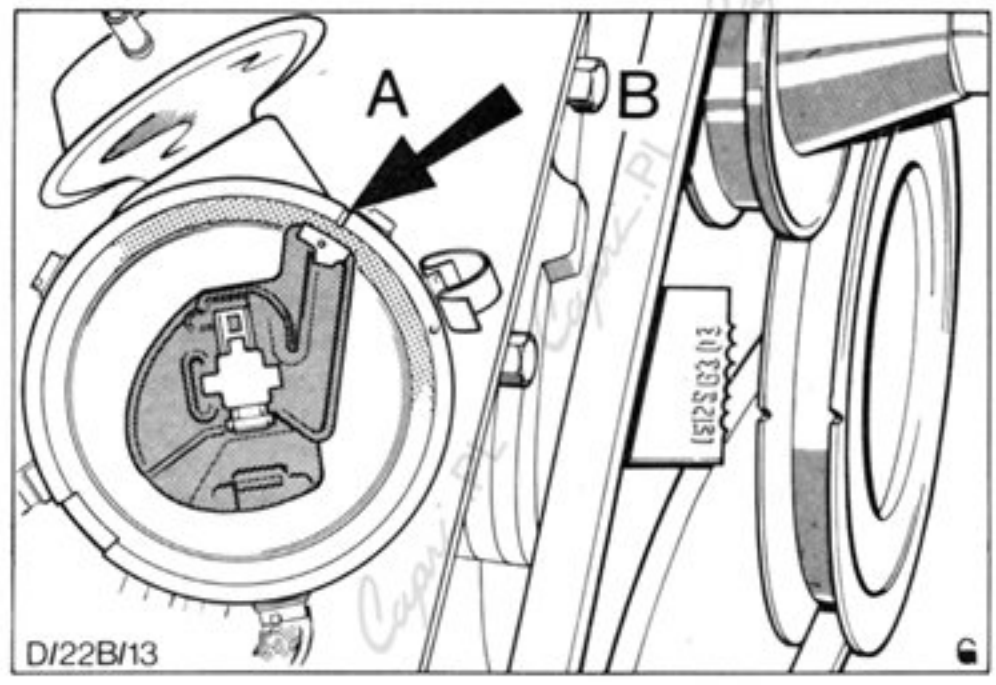


Fig.36. Engine set at 12° BTDC.
A - Rotor arm pointing to slot cut in distributor housing
B - Timing pointer at 12° BTDC

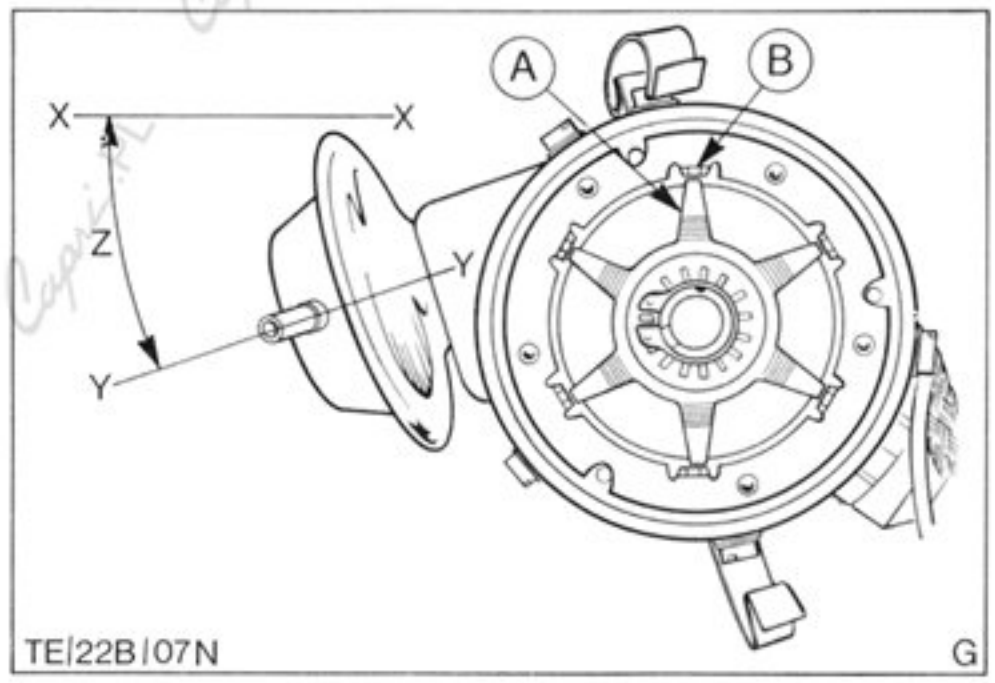


Fig.37. Trigger wheel arms lined up with stator arms.
A - Trigger wheel arm
B - Stator arm

3. Check and adjust ignition timing as follows:

   Manually turn engine to locate timing notch on crankshaft pulley and using a piece of chalk 'highlight' notch. Connect timing light to engine as per manufacturer's instructions, start engine and allow to idle at specified idle speed. Disconnect and plug vacuum pipes and check ignition timing. Refer Technical Data.

   To adjust timing, stop engine, using Tool No. 21-079 loosen distributor clamp and rotate complete assembly, Fig.38.

   Tighten clamp bolt and recheck timing.

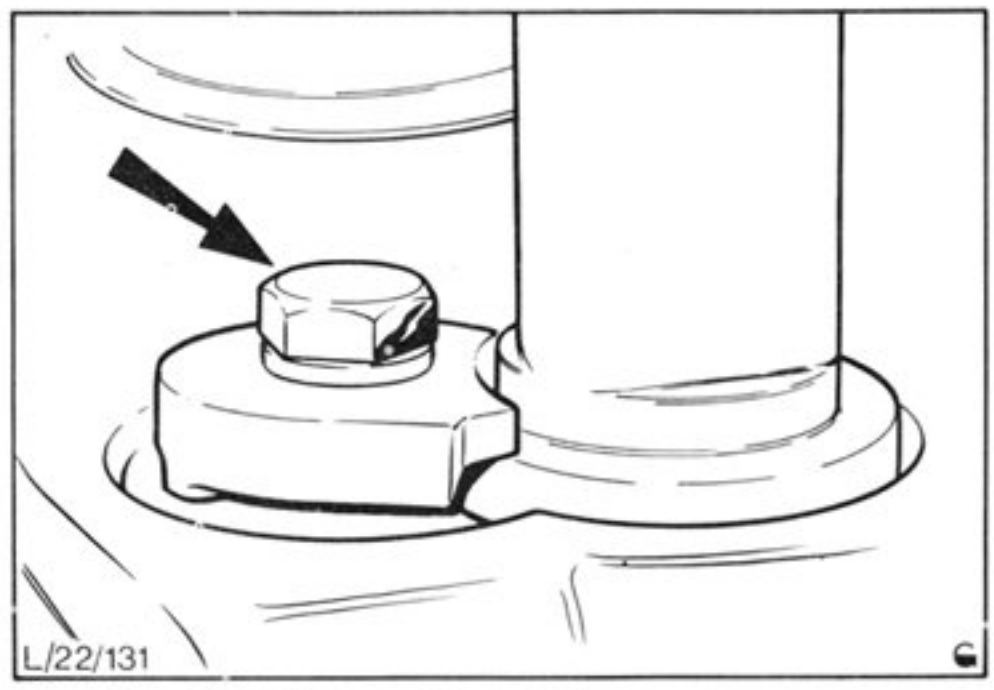


Fig.38. Distributor clamp bolt.

4. Check ignition mechanical and vacuum advance as follows;

NOTE: To carry out ignition advance checks, the timing light must be of the type that includes an advance meter. Refer Fig.39.

With timing light still connected and vacuum pipe plugged, restart engine and hold at 2000 rpm. Adjust timing lamp and note mechanical advance, reconnect vacuum advance pipe and measure total advance. To obtain a vacuum advance figure subtract mechanical advance figure from total. Refer Technical Data.

When investigating ignition problems more detailed checks of the advance characteristic may be required i.e. at varying engine rpm and vacuums. This can be done in two ways:

Fig.39. Typical timing light which includes an advance meter.

(A) Using distributor test equipment.

There are many different types of equipment and in all cases a test procedure will be supplied by the manufacturer.

IMPORTANT NOTE: The Technical Data section shows advance figures in crankshaft degrees and to obtain distributor degrees, figures quoted should be divided by two.

(B) An alternative method of checking advance characteristics is by using a vacuum pump, Fig.40.

(a) Connect pump directly to distributor, Fig.41.

(b) Start engine and adjust idle to 1,000 rpm.

(c) Adjust timing light to bring crankshaft notch back to TDC and note mechanical advance.

(d) Pump vacuum to required figure (Refer Technical Data) readjust timing light and note advance.

NOTE: To calculate vacuum advance subtract mechnical advance obtained in element (c) from total advance obtained in element (d).

(e) Repeat element (d) at varying vacuum figures.

(f) Remove vacuum pump and check mechanical advance at varying engine rpm.

NOTE: Figures quoted in the Technical Data section do not include the initial static advance.

(g) Reconnect vacuum advance pipe.

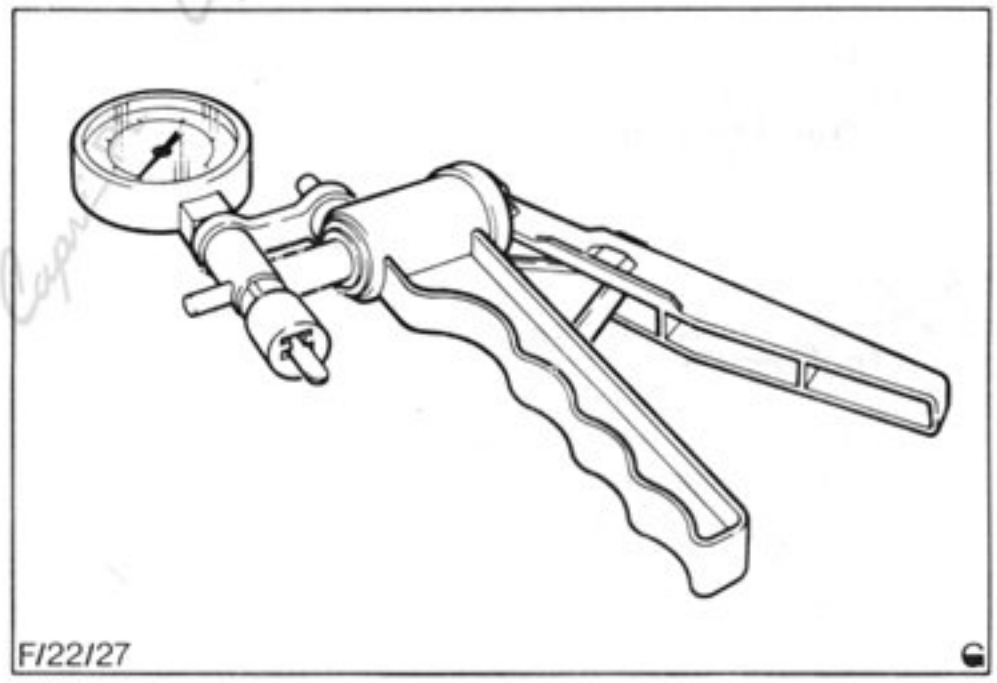


Fig.40. Typical vacuum pump.

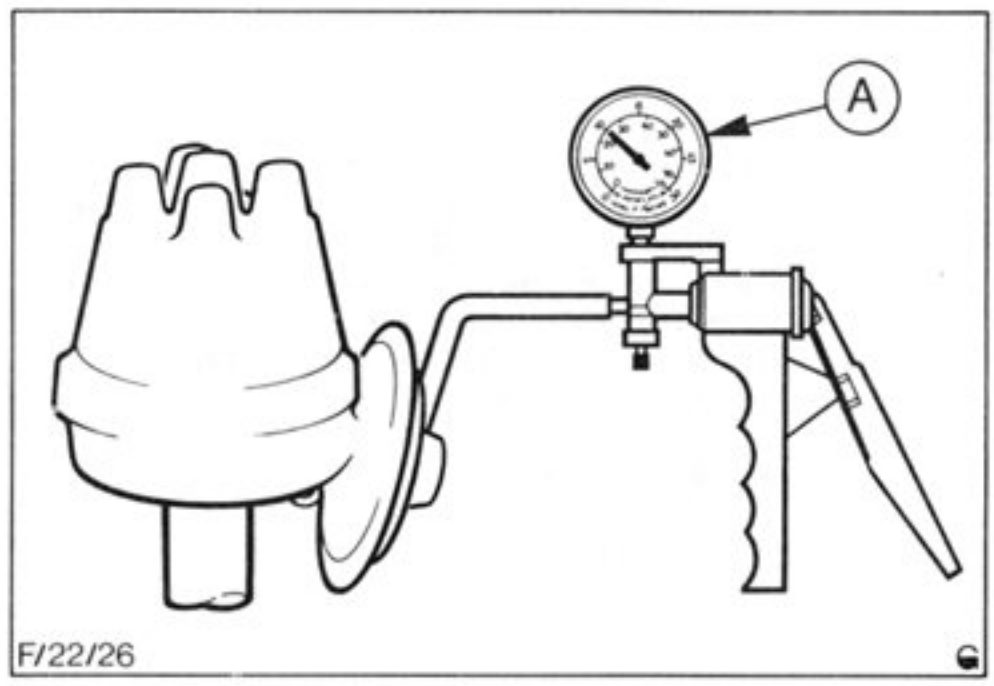


Fig.41. Vacuum pump connected to distributor.
A - Vacuum pump

5. Remove fender covers and close hood.

22 214 DISTRIBUTOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS AND EQUIPMENT REQUIRED:

Distributor clamp bolt wrench 21-079
Timing light

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery earth lead.

3. Disconnect plug leads, remove distributor cap and position clear of distributor assembly.

4. Position engine at 12° BTDC on No.1. cylinder by manually turning engine to a point where rotor arm lines up with slot cut in distributor housing and 12° mark on crankshaft pulley lines up with timing mark, Fig.42.

5. Disconnect loom multi-plug.
To disconnect plug, pull wires as shown in Fig.43.

NOTE: Multi-plug is of a special construction which cannot be disconnected if housing is held. Also plug wire connections have been strenghened to ensure they are not damaged on removal.

6. Using special Tool No. 21-079 remove single bolt located at base of distributor and slide out assembly.

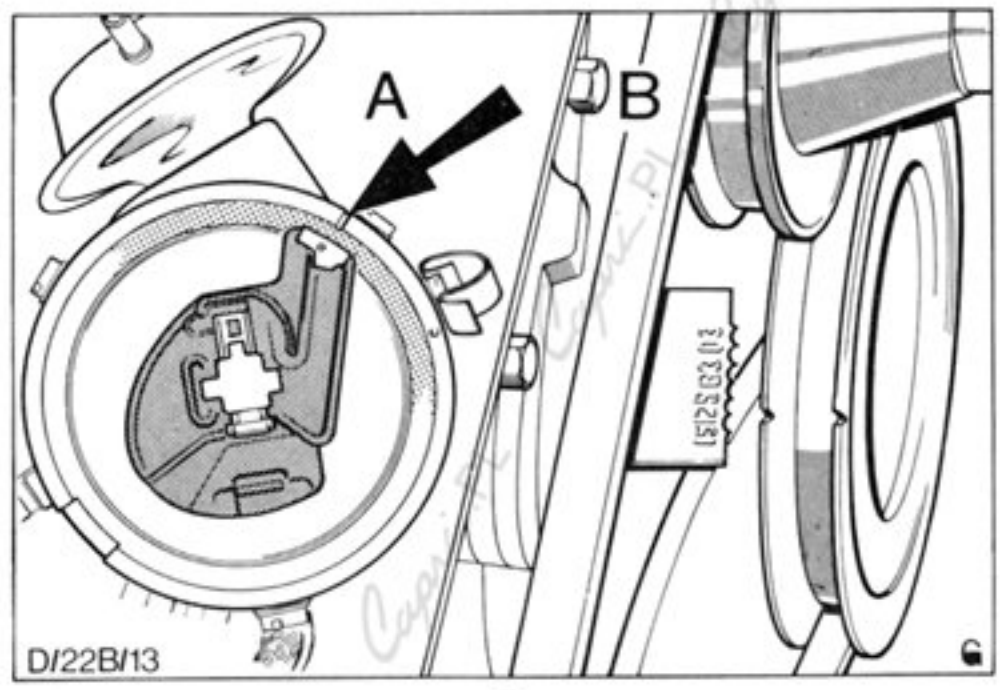


Fig.42. Engine set at 12° BTDC on No.1. cylinder.
A - Rotor arm pointing to slot cut in distributor housing
B - Crankshaft pulley lined up at 12° BTDC

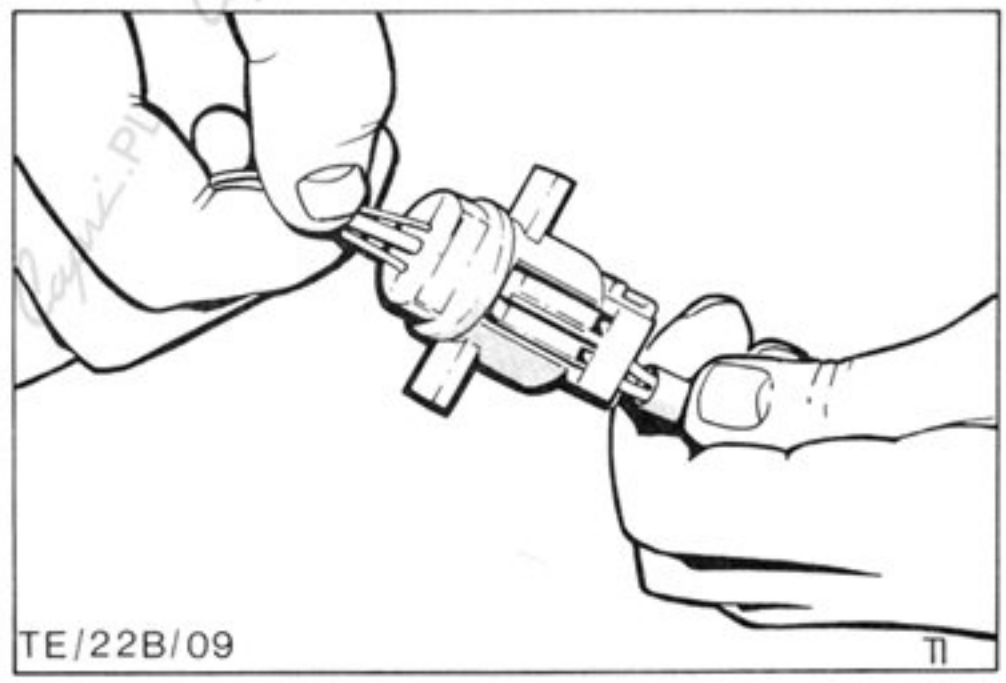


Fig.43. Disconnecting distributor loom multi-pug.
NOTE: Pull wires not multi-plug

To Install

7. Ensure engine is at 12° BTDC on No.1. cylinder. Fit rotor arm to new distributor and turn shaft until rotor arm lines up with dot punch mark on casing. Refer Fig.44.
Slide assembly into position.
Angle 'Z' in Fig.44, between rear face of block (line XX) and distributor diaphragm axis (line YY), should be 0° to 14° in an anti-clockwise direction.

NOTE: Once distributor has been installed rotor arm should point to slot cut into distributor housing.

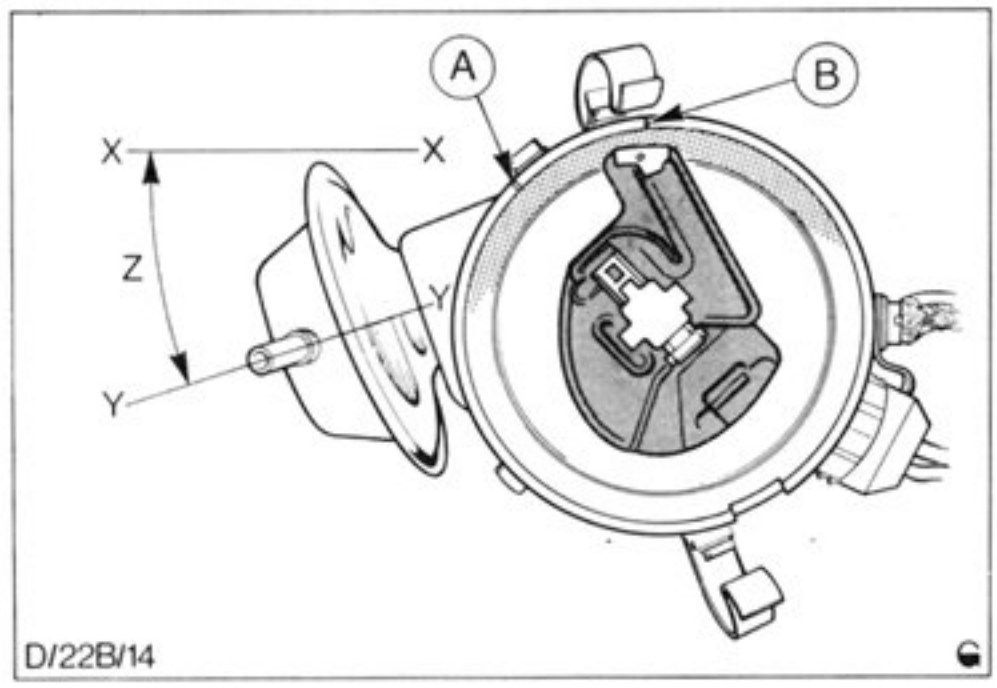


Fig.44. Distributor ready to be installed with rotor arm lined up with dot on housing.
A - Slot to be used once distributor has been fitted
B - Dot punch mark on housing

8. Rotate complete distributor until arms of trigger wheel and stator line up correctly, Fig.45.

9. Tighten distributor clamp bolt.

10. Clean distributor cap and refit.

11. Reconnect HT leads.

12. Fill multi-plug with specified grease, refer to Technical Data, and reconnect.

13. Reconnect battery earth lead.

14. Check and adjust ignition timing, as detailed in Operation No. 22 213, and tighten securing bolt.

15. Remove fender covers and close hood.

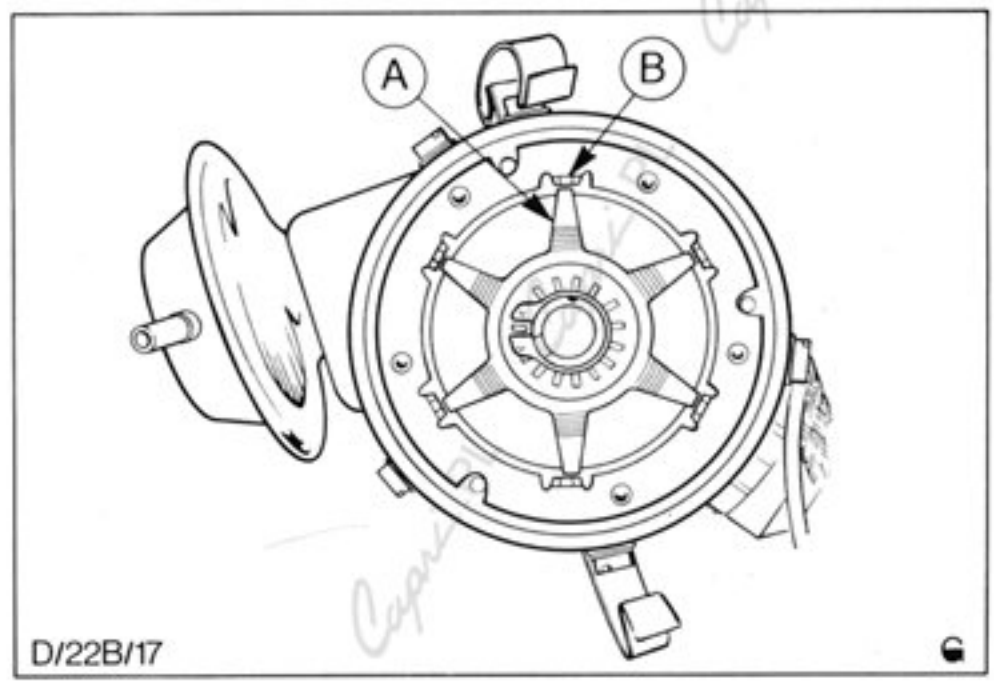


Fig.45. Distributor installed with trigger wheel and stator arms correctly lined up.
A - Trigger wheel arm
B - Stator arm

22 284 CAP - DISTRIBUTOR - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery earth lead.

3. Disconnect HT leads from spark plugs and coil. Detach cap and leads.

4. Disconnect HT leads from cap.

NOTE: When disconnecting leads pull on terminal, not lead, Fig.46.

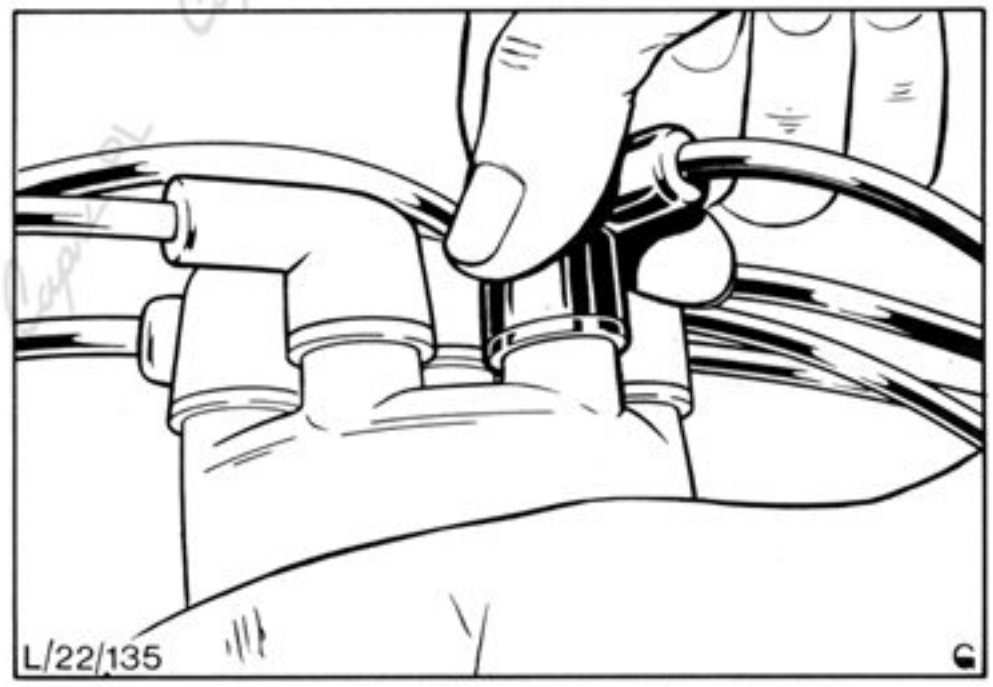


Fig.46. HT lead removal pulling terminal NOT lead.

To Install

5. Reconnect HT leads in correct order as shown in Fig.47. (Firing order 142536)

6. Position cap, secure clips and reconnect HT leads to spark plugs and coil.

7. Reconnect battery earth lead.

8. Remove fender covers and close hood.

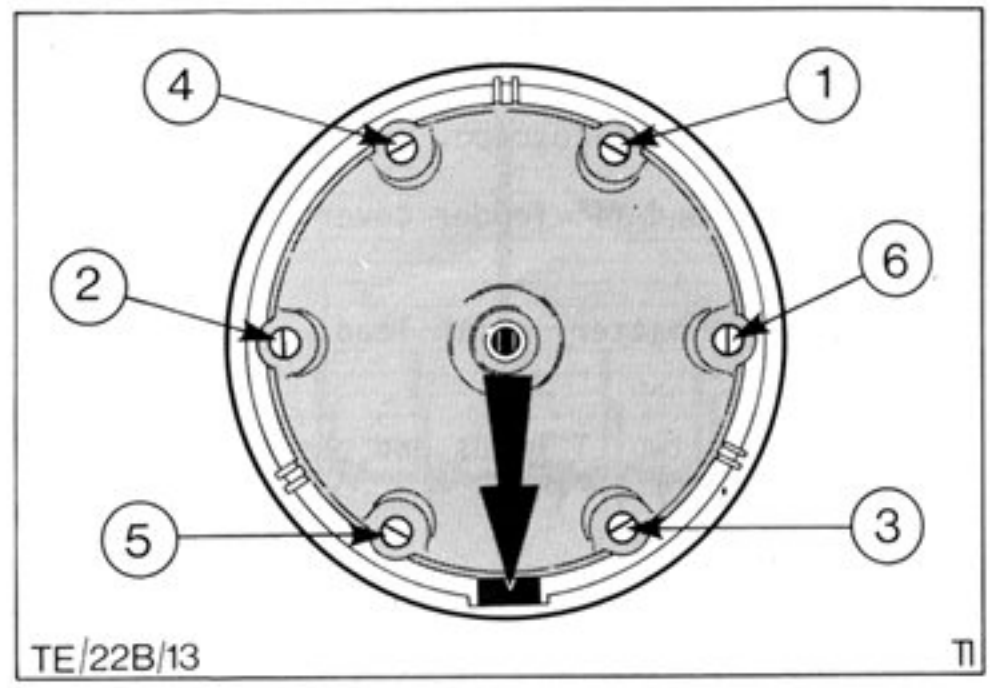


Fig.47. Breakerless distributor cap showing HT lead connections as viewed inside cap. Locating lug arrowed.

22 292 IGNITION AMPLIFIER MODULE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery earth lead.

3. Disconnect two loom multi-plugs. To disconnect plugs, wires must be held. Refer Fig.48.

NOTE: Multi-plugs are of a special construction which cannot be disconnected if housing is held. Also wire connections have been strengthened to ensure they are not damaged on removal.

4. Remove three screws and detach module from left hand inner fender panel. Refer Fig.49.

To Install

5. Place module in position and secure.

6. Fill two multi-plugs with specified grease and reconnect.

7. Reconnect battery earth lead.

8. Remove fender covers and close hood.

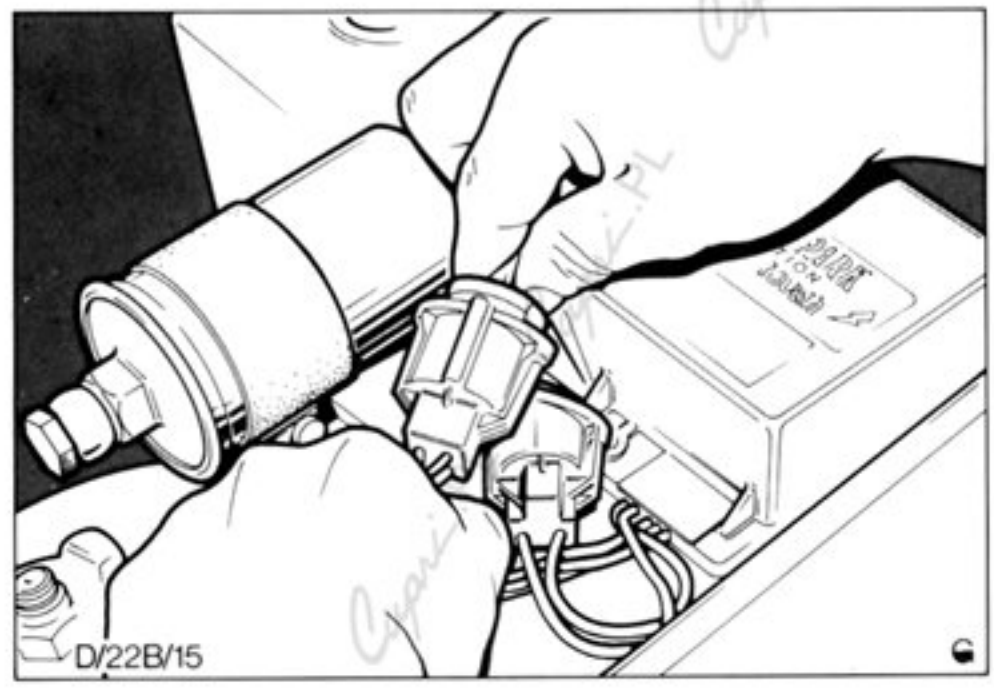


Fig.48. Disconnecting module loom multi-plug.

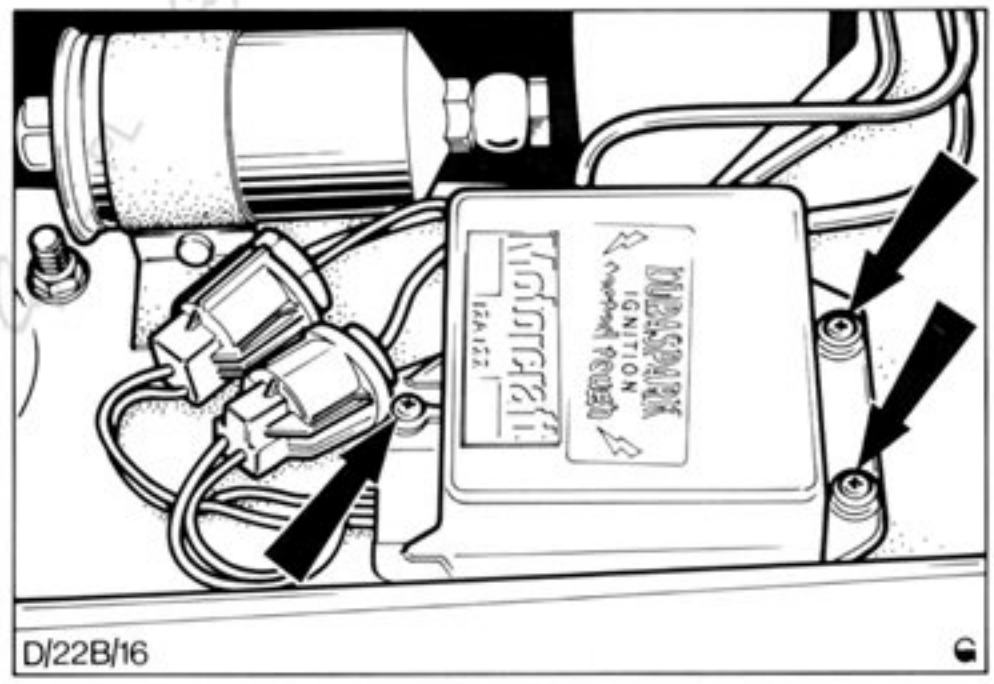


Fig.49. Ignition module securing screws.

22 411 IGNITION COIL - TEST

SPECIAL EQUIPMENT REQUIRED:

Ohm meter, Oscilloscope.

1. Open hood and fit fender covers.

2. Disconnect battery earth lead.

3. Disconnect two LT leads and one HT lead at coil.

4. Test coil resistance. Refer Technical Data.

   (a) Primary circuit.

   Connect ohm meter between two LT connections on coil. Select appropriate scale and record resistance, Fig.50.

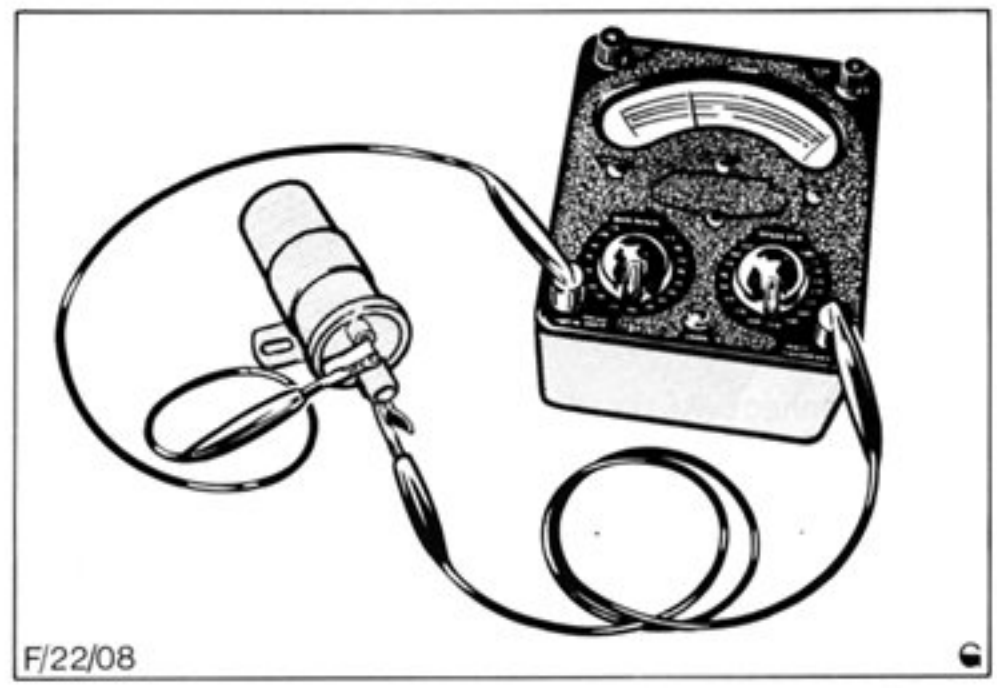


Fig.50. Coil primary circuit resistance check. (Coil removed for clarity)

(b) Secondary circuit.

Reconnect ohm meter between HT lead connection and either LT connection, select scale and record resistance, Fig.51.

5. Remove test equipment and reconnect loom to coil.

6. Reconnect battery earth lead.

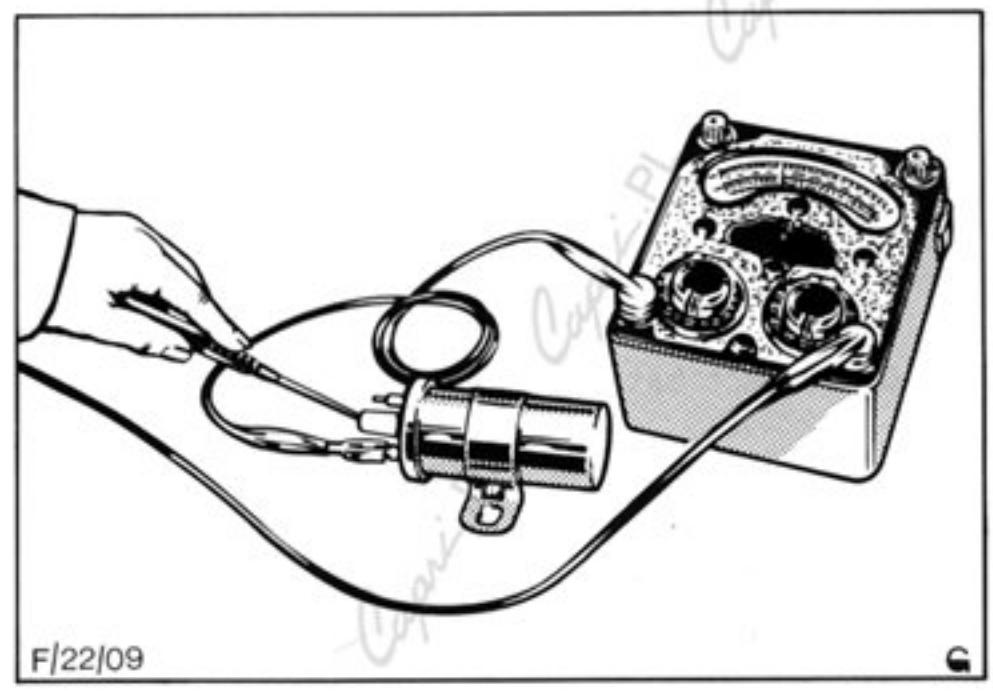


Fig.51. Coil secondary circuit resistance check. (Coil removed for clarity)

7. Test coil polarity and maximum output.

(a) Coil polarity.

Connect a test set oscilloscope to engine as per manufacturer's instructions. Select primary circuit and display on oscilloscope, start engine and check coil polarity, Fig.52.

A is correct
B is incorrect

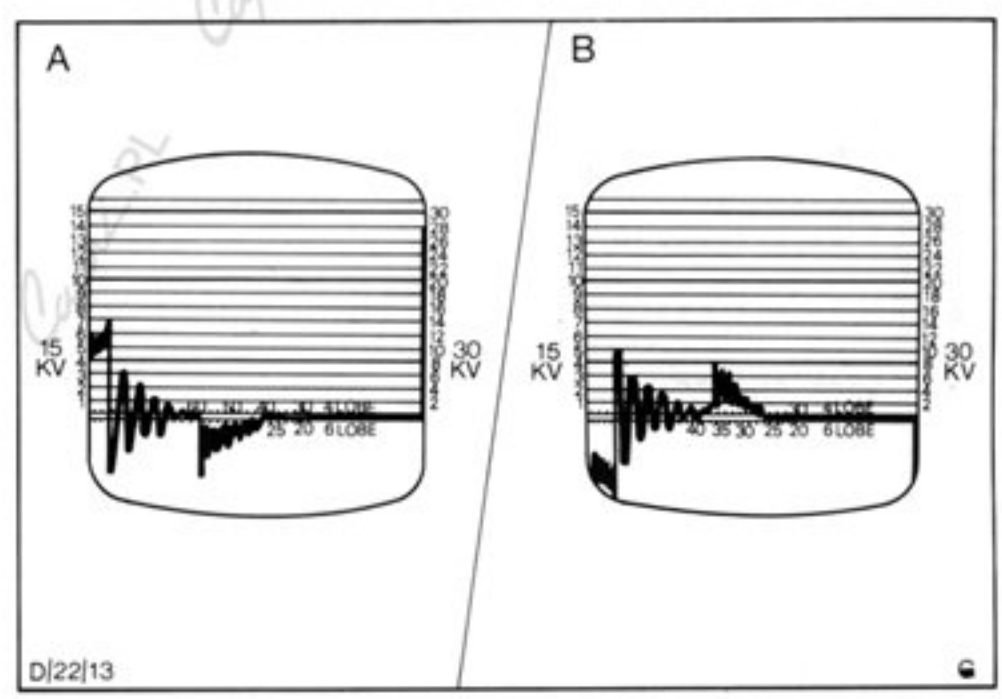


Fig.52. Coil polarity check.
A - Correct
B - Incorrect

(b) Maximum coil output.

With engine at 1000 rpm, select secondary oscilloscope pattern and using insulated pliers disconnect one of the HT leads at a spark plug. Maximum voltage measured in kilo volts, will be recorded on scope as shown in Fig.53. Refer Technical Data.

NOTE: Special care should be taken not to damage HT terminal insulation when removing with pliers.

8. Reconnect HT leads and disconnect test set.

9. Remove fender covers and close hood.

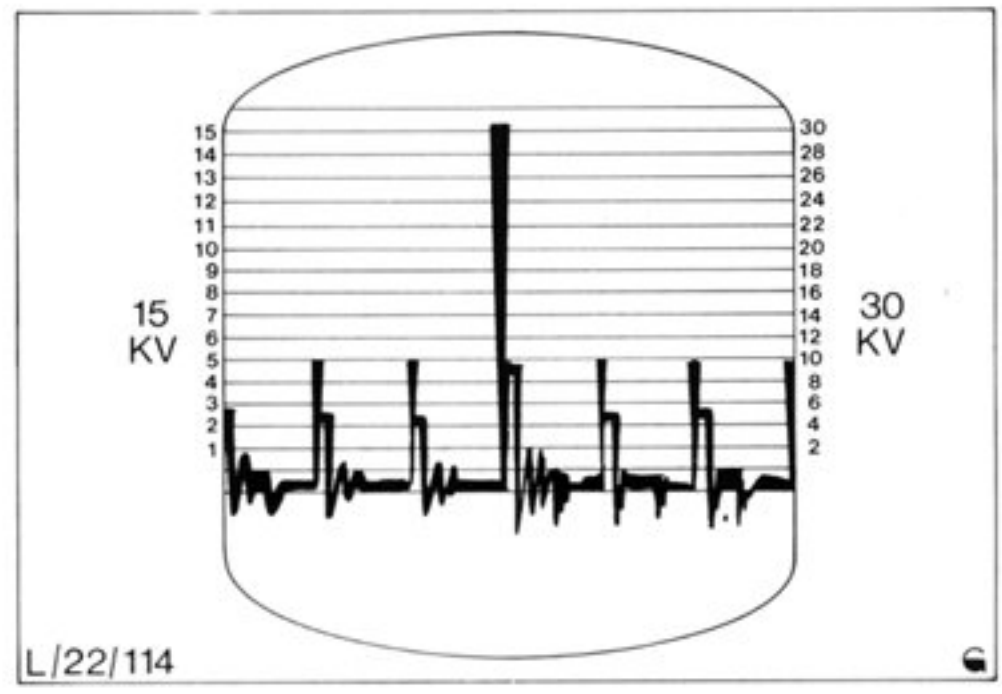


Fig.53. Maximum coil voltage, using 30 KV scale.

22 414 IGNITION COIL - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery earth lead.
3. Disconnect HT and LT connections at coil.

NOTE: When disconnecting HT lead pull on terminal not lead. Refer Fig.54.

4. Remove two screws and detach coil and clamp assembly.
5. Remove clamp from coil.

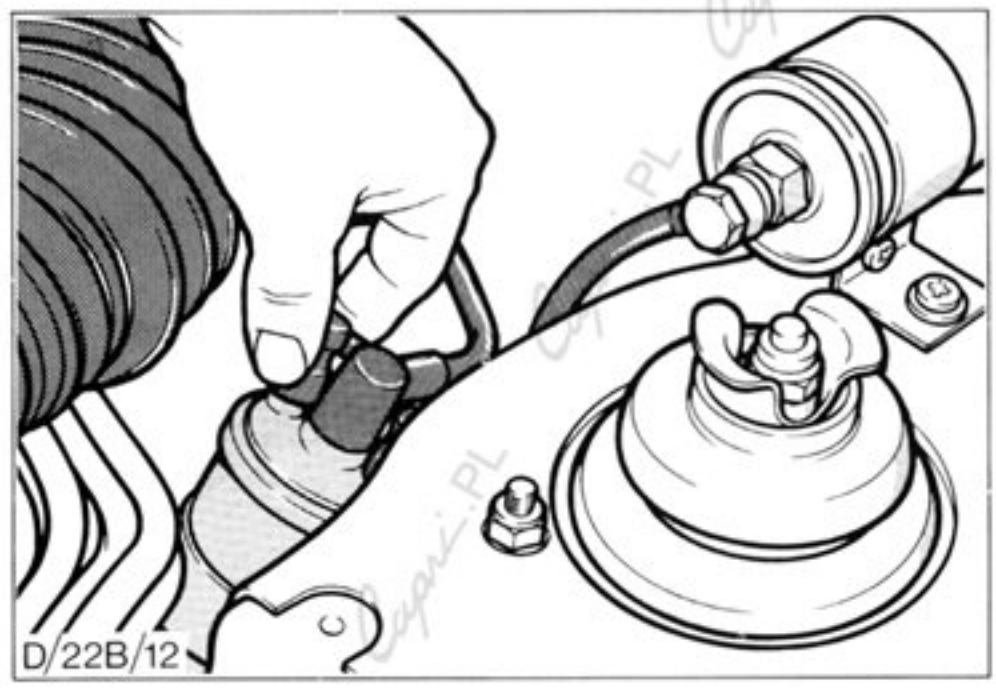


Fig.54. LT lead removal from coil pulling terminal NOT lead.

To Install

6. Refit clamp to coil.
7. Position coil assembly, secure with two screws. Reconnect HT and LT connections. Positive terminal to loom, negative terminal to distributor.
8. Reconnect battery earth lead.
9. Start engine and check operation.
10. Remove fender covers and close hood.

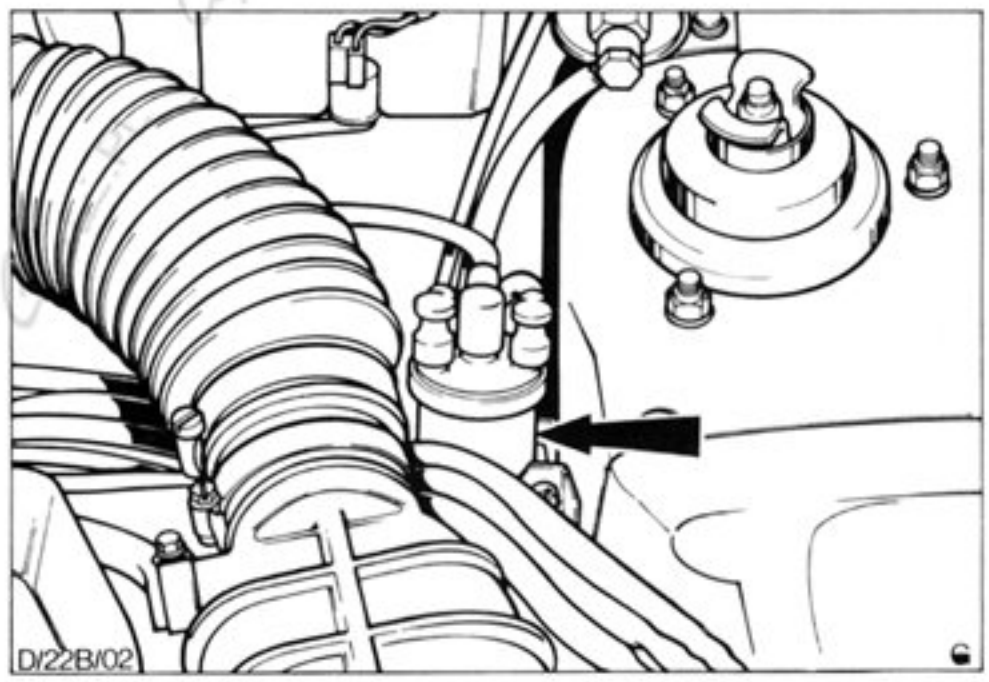


Fig.55. Coil installation.

22 451 HIGH TENSION LEADS - RESISTANCE CHECK (ALL)

SPECIAL EQUIPMENT REQUIRED:

Ohm meter

1. Open hood and fit fender covers.
2. Disconnect battery earth lead.
3. Disconnect HT leads at spark plugs and coil.
4. Detach distributor cap and lead assembly.
5. Connect ohm meter to HT terminal lead and to distributor cap to rotor arm connection, record resistance, Fig.56. Refer Technical Data. If resistance is high, lead to cap connection should be cleaned and resistance rechecked before lead is replaced.
6. Clean distributor cap and refit assembly, reconnect HT leads.
7. Reconnect battery earth lead.
8. Remove fender covers and close hood.

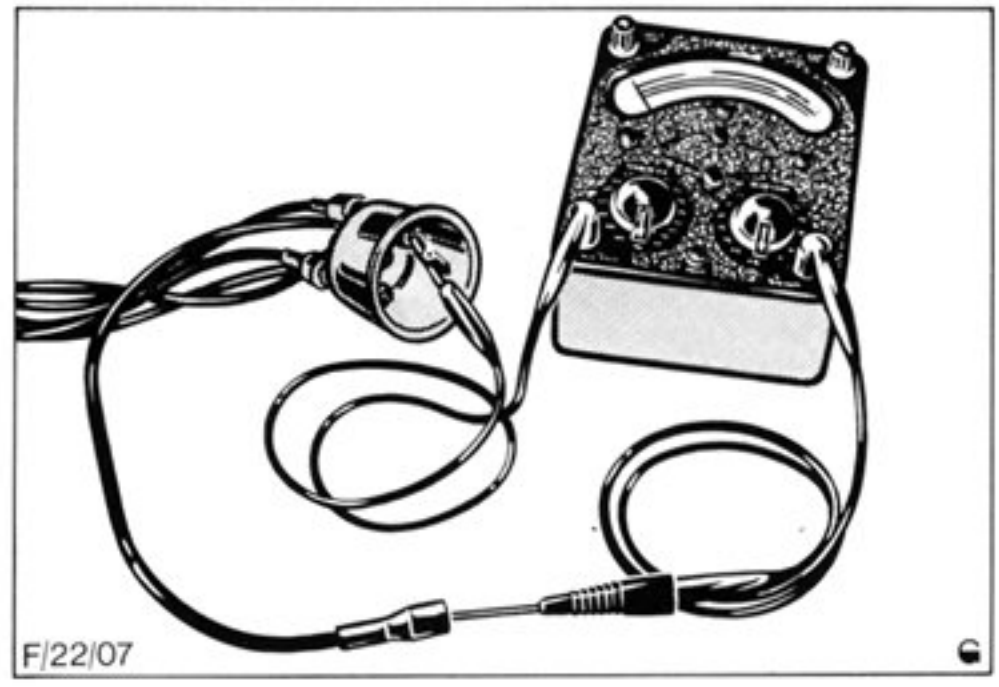


Fig.56. HT lead resistance check.

22 481 1 SPARK PLUGS - CHECK AND ADJUST (SPARK PLUGS REMOVED)

SPECIAL SERVICE TOOLS REQUIRED: NONE

When required by service intervals or by suspected malfunction, plugs should be removed and examined for wear, damage, fouling etc.

Clean and check general condition of plug in the normal way. After cleaning, adjust electrode gap to specified clearance.

Ensure that all abrasive is removed from plug, clean ceramic insulator if necessary to remove all traces of dirt.

Oily or wet plugs should be dried before cleaning.

22 484 SPARK PLUGS - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery earth lead.
3. Disconnect HT leads at spark plugs and unscrew plugs from cylinder head.

   When disconnecting HT leads pull on terminal not lead, Fig.57.

To Install

4. Ensure sealing rings are in good condition, fit plugs and tighten to 25-38 Nm (18-28 lbf.ft).
5. Reconnect HT leads.
6. Reconnect battery earth lead.
7. Remove fender covers and close hood.

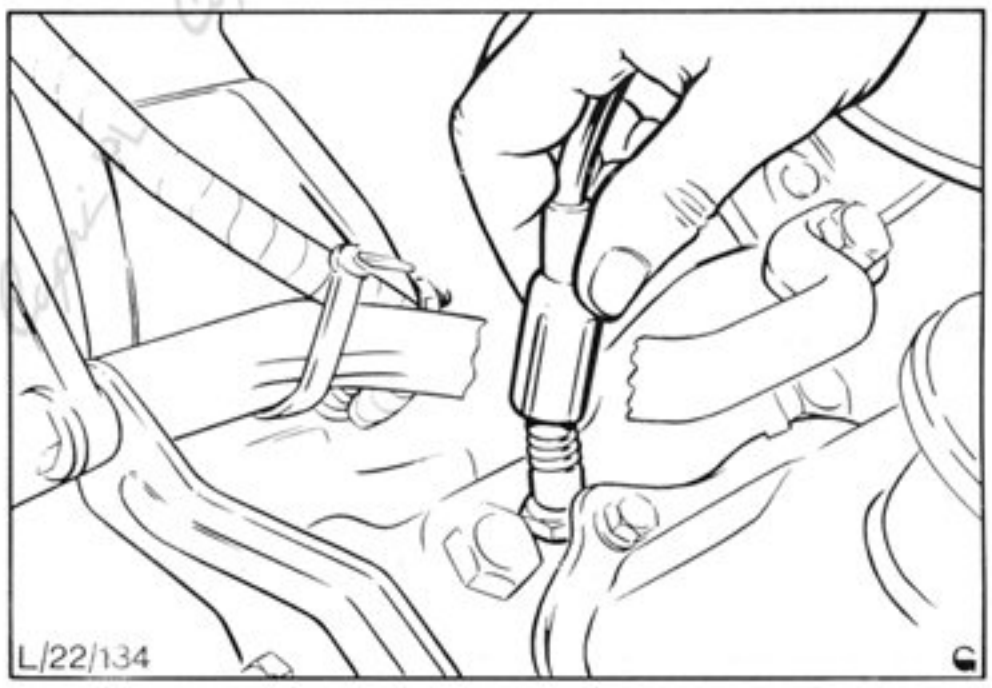


Fig.57. HT lead removal from spark plug pulling terminal NOT lead.

TECHNICAL DATA

Coil

Type	High output breakerless ignition coil
Output	40,0 kilovolt (minimum) - Open circuit condition on test rig
.. ..	28,0 kilovolt (minimum) - Open circuit condition in vehicle
Primary resistance	0,75 to 0,85 ohms
Secondary resistance	5000 to 6000 ohms

Spark Plugs

All territories

Type All V6	Motorcraft AGR 22 C
Electrode gap	0,60 mm (0,025 in)

Distributor

Type	Breakerless
Automatic advance	Mechanical and vacuum control
Drive	Skew gear from camshaft
Rotation (viewed from top)	Clockwise

Static advance (initial)	
All territories	12° BTDC

Dwell angle	It is totally governed by the module and there is no requirement to check it.
Distributor shaft end float	0,6 to 1,05 mm
Distributor multi-plug grease specification ..	ESBM-1C158-A (Lithium grease)

HT Leads

Resistance	30,000 ohms maximum per lead

TECHNICAL DATA (Cont'd)

Advance Characteristics

NOTE: All figures quoted below are spark advance in degrees crankshaft and do not include initial advance setting.

BOSCH

Advance at 2000 rpm (Engine speed with no load)	Mechanical	Vacuum	Total
2,8 Litre V6 PI Manual Trans. only (78TF-12100-GA)	13,0° to 17,0°	8,0° to 12,0°	21,0° to 29,0°

Detailed Service Advance Characteristics

BOSCH

2,8 Litre V6 (Petrol Injection) Manual Trans. COLOUR CODE: BLUE / RED 78TF - 12100 - GA

MECHANICAL		VACUUM	
Engine rpm	Advance Degrees (Crankshaft)	Vacuum mm Hg (in Hg)	Degrees Advancement (Crankshaft)
500 and below	0°	76 (3,0)	0°
600	- 1,0° to + 1,0°	102 (4,0)	- 1,0° to + 1,5°
1000	- 2,0° to + 1,0°	127 (5,0)	- 0,5° to + 4,5°
1200	1,0° to + 5,0°	152 (6,0)	+ 3,0° to + 8,5°
1500	7,5° to 11,5°	178 (7,0)	6,5° to 12,0°
2000	13,0° to 17,0°	190 (7,5) and above	8,0° to 12,0°
2500	15,0° to 19,0°		
3000	16,5° to 20,5°		
4000	20,0° to 24,0°		
4400	19,5° to 25,5°		

PETROL INJECTION SYSTEM 23B

Index

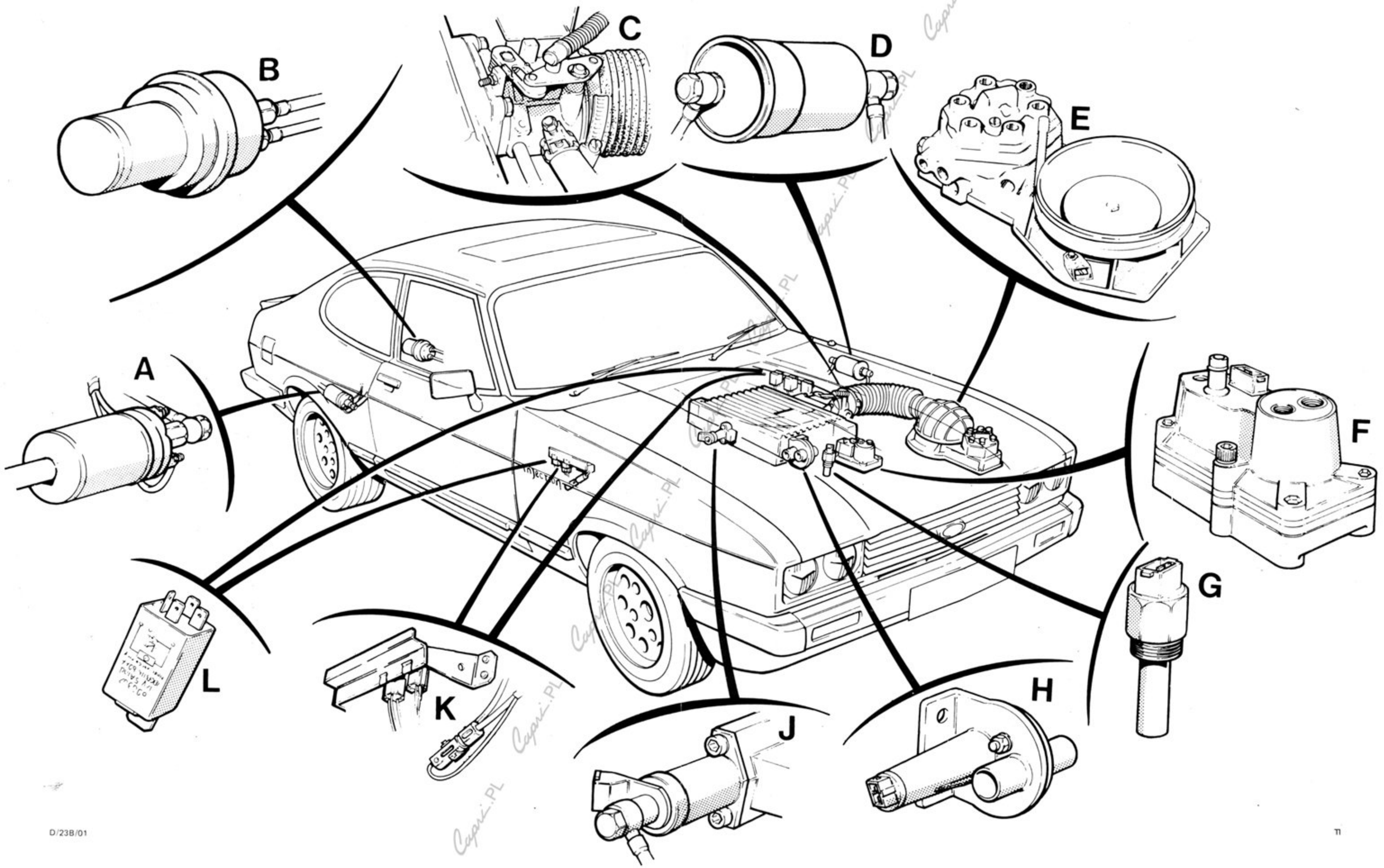


Fig.1. Capri Petrol Injection System.

A - Fuel pump
B - Fuel accumulator
C - Throttle plate
D - Fuel filter
E - Mixture control unit
F - Warm-up regulator
G - Thermo time switch
H - Auxiliary air device
J - Start valve
K - Relays and line fuse
L - Impulse module

GENERAL DESCRIPTION

The Ford petrol injection system fitted on the 2.8 litre V6 Capri, is of the continuous injection type which will supply a precisely controlled amount of atomized fuel to each cylinder. The system when compared with conventional carburettors achieves a greater control of the air/fuel mixture under all driving conditions, resulting in reduced emission levels, improved performance and petrol economy.

To ensure that optimum performance, economy and exhaust emission levels are maintained it is essential that the correct service repair and setting procedures are used in conjunction with the relevant specifications contained in the Technical Data Section.

The only components on the petrol injection system that require periodic checks or adjustments are the fuel and air filters, which should be changed at the specified service intervals and the idle speed and mixture setting which should be checked and if required adjusted during normal routine servicing.

The fuel mixture control is tamperproofed by a plastic plug, Fig.2, which has to be destroyed in order to gain access to the adjusting screw. The objective is to prevent unqualified persons from adjusting the injection idle mixture (and hence alter the CO reading) whilst still retaining the adjustment capability for authorised persons in service. Mixture adjustment procedure is detailed in Operation No. 23-213.

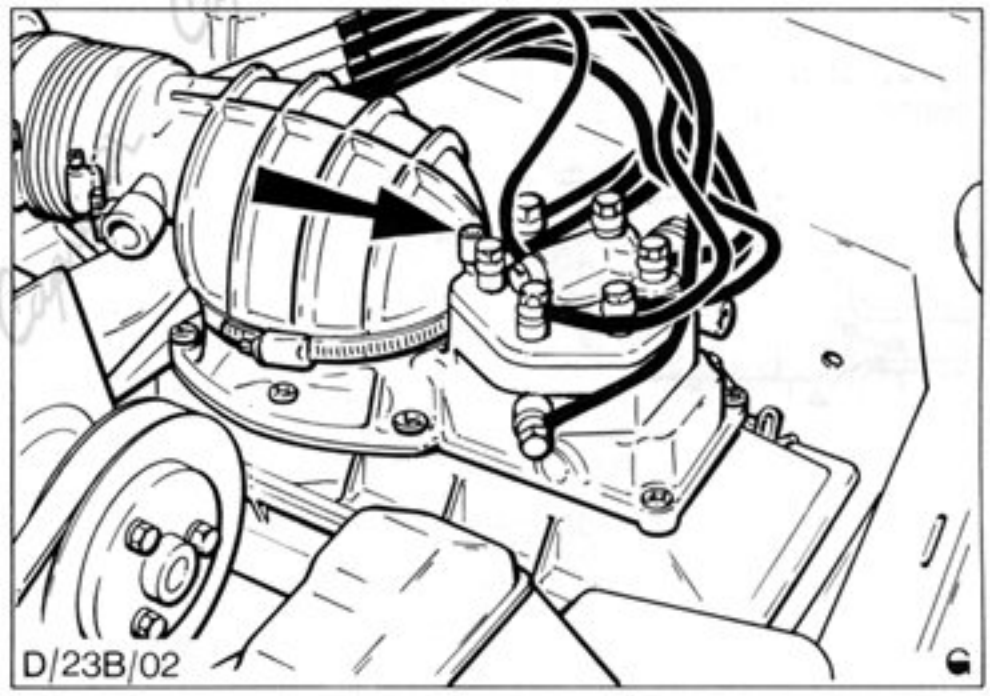


Fig.2. Mixture control tamperproof plug.

One other component on the petrol injection system can be adjusted if driveability problems are experienced, this is the system pressure regulator, Fig.3. The regulator is mounted in the main mixture control unit, refer 'F' in Fig.1, and is adjusted by removing or replacing shims. Full check and adjustment procedure for the regulator is detailed on page 24.

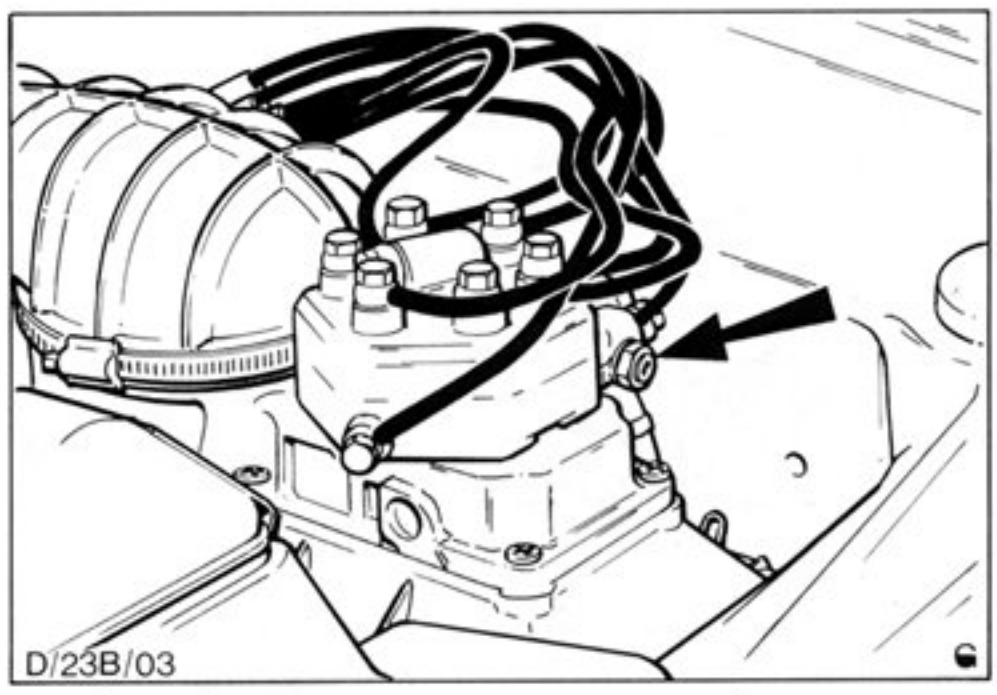


Fig.3. Injection system pressure regulator.

GENERAL DESCRIPTION (Cont'd)

The components that make up the petrol injection system fall into three main categories:

(a) Fuel tank, Electric fuel pump, Fuel accumulator, Fuel filter, Mixture control and fuel distributor assembly, Throttle plate assembly, Injector valve, Air box

The above components are in operation at all times when the engine is running and make up the basic injection system.

(b) Warm-up regulator, Auxiliary air device, Start valve, Thermo time switch, Impulse module

These components modify the air/fuel ratio under specific driving conditions, mainly when an engine is first started from cold and during the warm up period

(c) Wiring Loom, Electric relays

The loom and relays supply the electrical feed to the warm up regulator, auxiliary air device and fuel pump. Included in the loom is a safety switch which will cut the feed to the pump when the engine stops, even if the ignition is still on. Refer to page 19 for details of the relays and safety switch.

Fig.1, shows the location of the individual components, whereas Fig.4, shown below, details the components in schematic form which will be an aid in understanding the injection system.

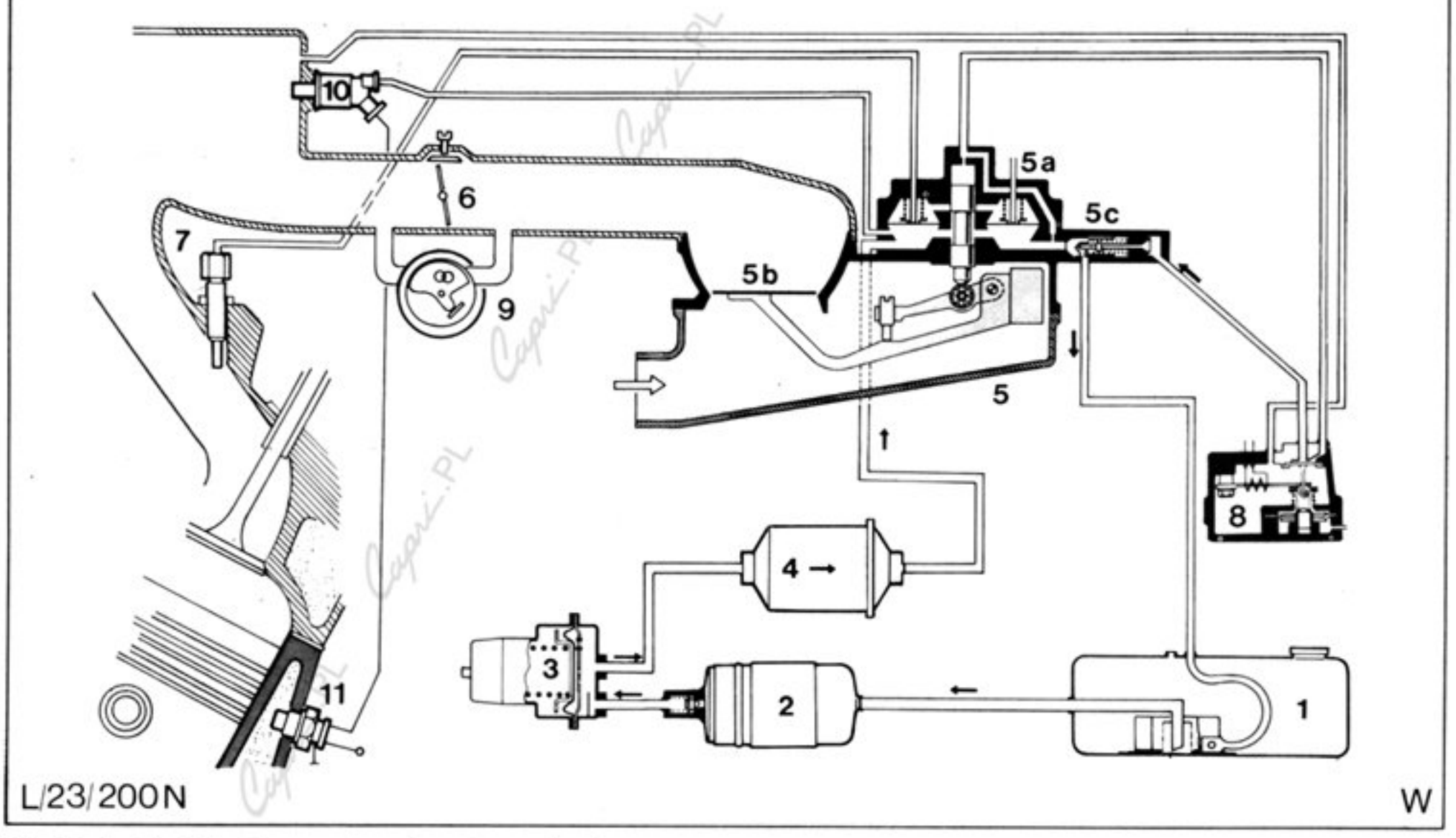


Fig.4. Fuel injection system in schematic form.

1 - Fuel tank
2 - Fuel pump
3 - Accumulator
4 - Fuel filter
5 - Mixture control unit
5a - Fuel distributor
5b - Air sensor
5c - Pressure regulator
6 - Throttle plate assembly
7 - Injector valve
8 - Warm-up regulator
9 - Auxiliary air device
10 - Start valve
11 - Thermo time switch

PRINCIPLE OF OPERATION

FUEL PUMP

The components that make up the injection system are explained individually on this and the following pages.

a) Fuel Pump Fig.5.

The fuel pump is mounted in rubber and strapped on the right hand side of the fuel tank assembly. The pump is of a roller cell type, which is driven by an electric motor and includes a non-return valve and safety valve. The pump has the ability to deliver several times the quantity of fuel actually required. This ensures that the system operating pressure is maintained under all driving conditions.

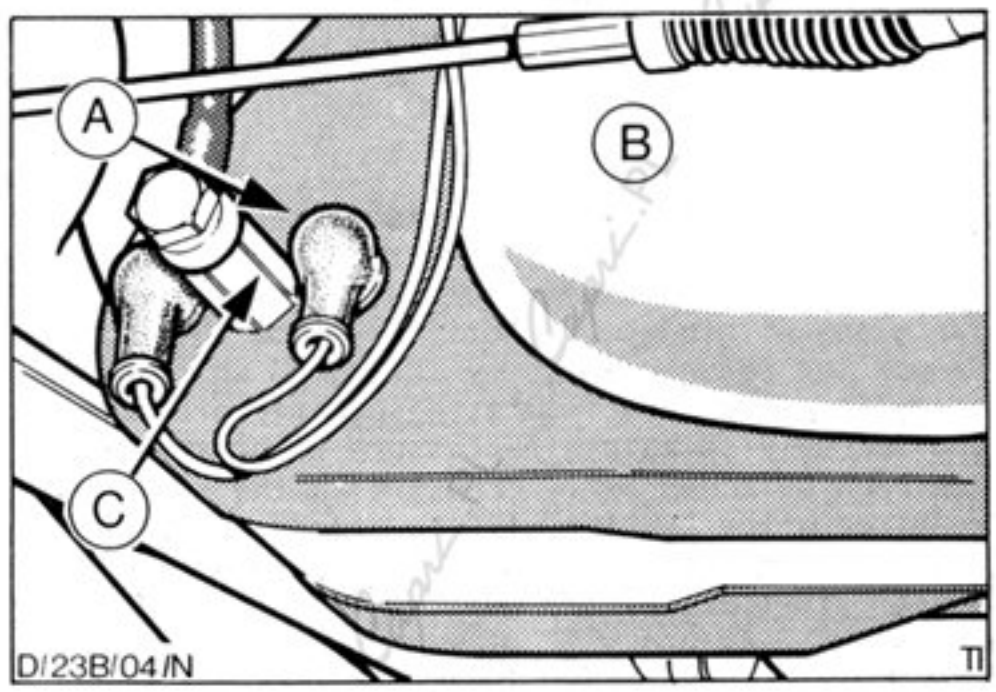


Fig.5. Fuel pump location.
A - Rubber casing
B - Fuel tank
C - Fuel pump outlet

Operating Principle

Fuel is drawn in through the roller cells, flows around the electric motor and out through a one-way valve, Fig.6.

The fuel although in direct contact with the electric motor, will not ignite because there is never a combustable mixture in the pump housing.

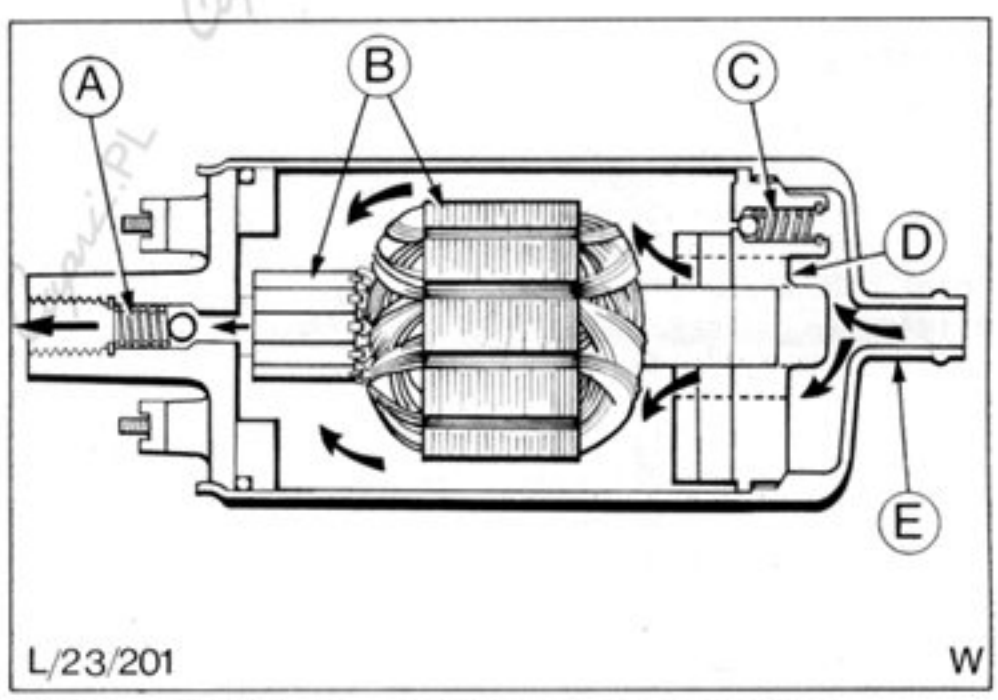


Fig.6. Fuel flow - during normal operation.
A - Fuel outlet and one-way valve
B - Electric motor
C - Safety valve
D - Roller cell pump
E - Fuel inlet

The safety valve is designed to ensure that if for example one of the fuel pipes becomes kinked and blocked, the pump will not create an excessive pressure. The valve works by allowing the fuel, supplied from the roller cells, to be fed back into the inlet chamber, Fig.7.

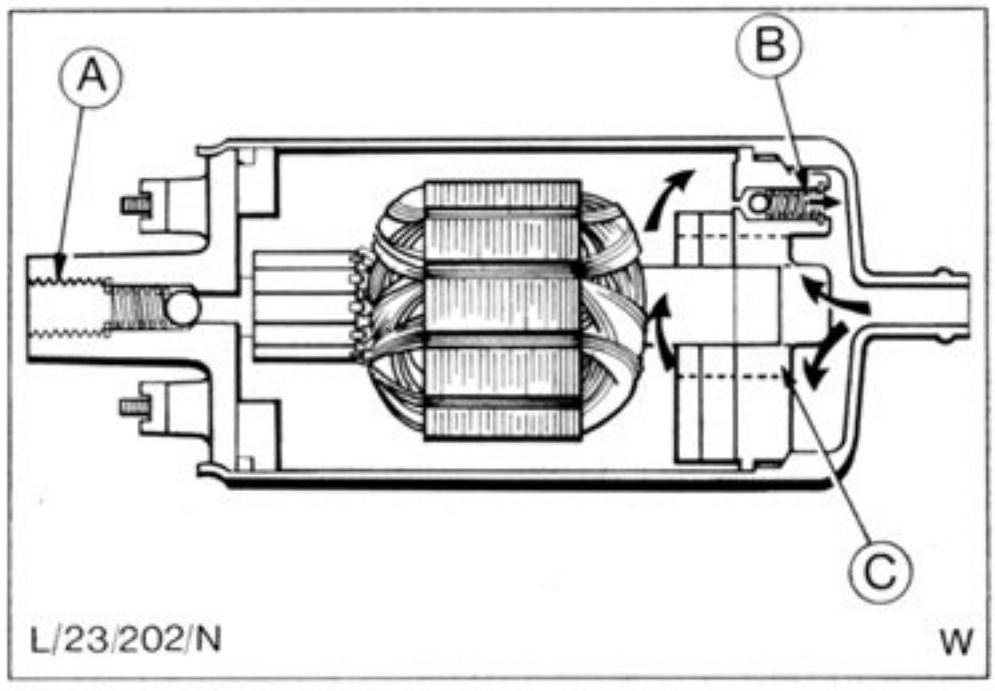


Fig.7. Fuel flow when outlet is blocked.
A - Outlet pipe blocked
B - Safety valve open
C - Roller cell pump

PRINCIPLE OF OPERATION (Cont'd)

FUEL ACCUMULATOR

b) Fuel Accumulator

The accumulator or reservoir is bolted onto the underside of the floor pan just in front of the fuel tank, Fig.8. The accumulator carries out two functions within the injection system. Firstly to dampen the pulse created by the pump, which stabilises the fuel flow at a specific pressure and secondly to maintain pressure after the engine has been switched off. Pressure in the system is required after 'switch off' to eliminate vapour and therefore vapour lock, which could cause 'hot start' difficulties.

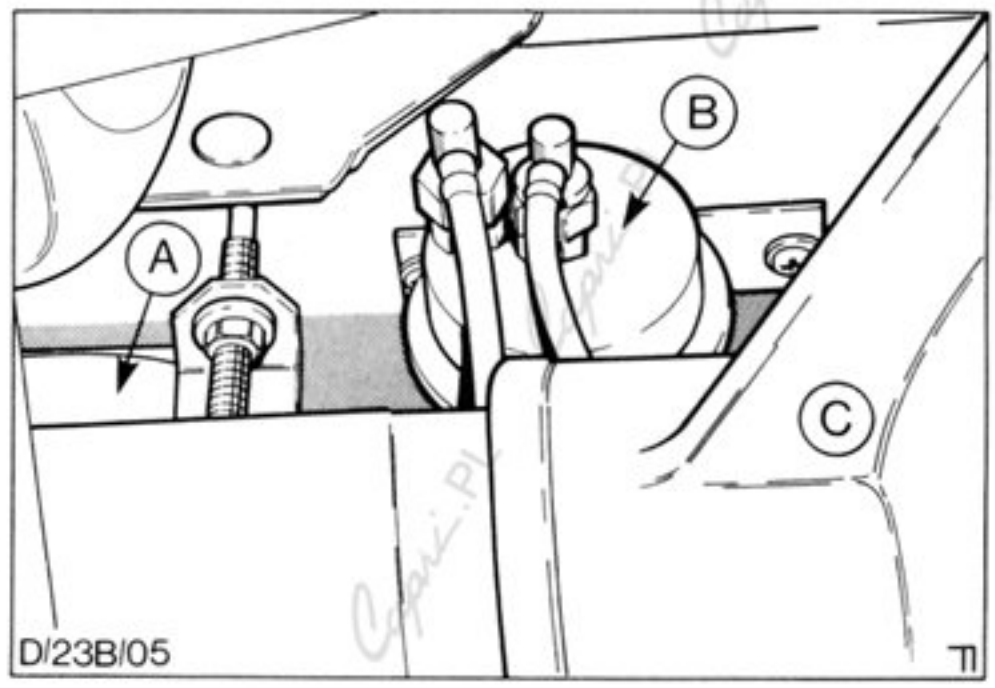


Fig.8. Fuel accumulator.
A - Fuel tank
B - Fuel accumulator
C - Rear axle

Operating Principle

When an engine is started from cold, fuel flows into the accumulator, opens the plate valve and presses the diaphragm downwards against a spring load. A baffle plate positioned over the intake, eliminates pulses created by the fuel pump.

After the engine is switched off, fuel pressure is maintained by the operation of the diaphragm and spring, which will feed the reserve fuel into the system as required, Fig.9.

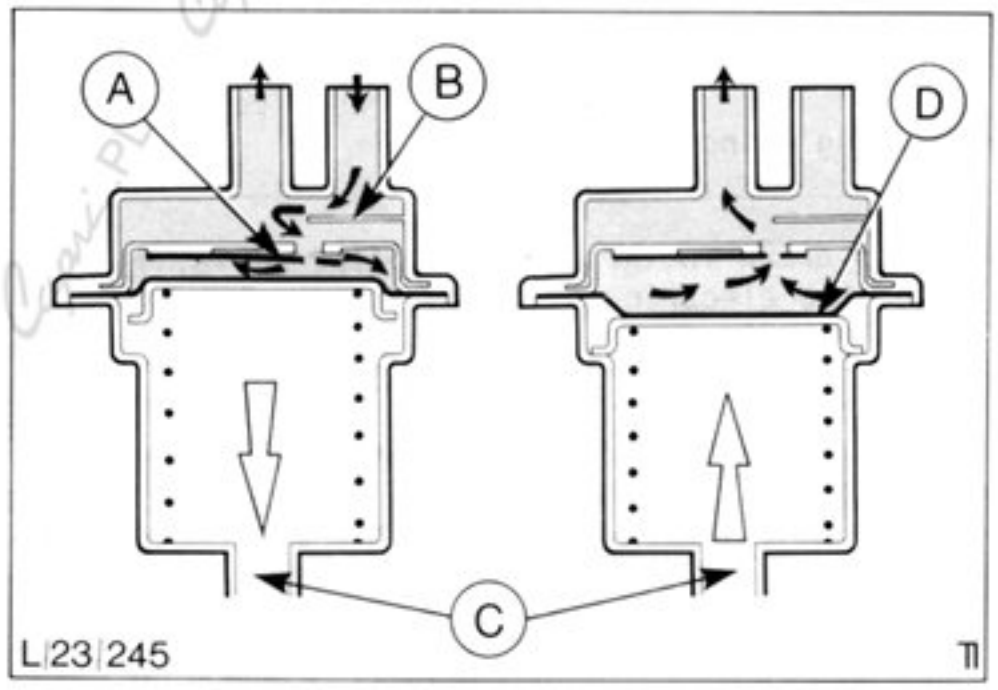


Fig.9. Fuel accumulator. (Schematic)
A - Plate valve
B - Baffle plate
C - Vent
D - Diaphragm

c) Fuel Filter

The filter is located in the engine compartment on top of the inner fender panel. Refer Fig.10. The unit contains two filter elements one of which has a very fine mesh. This is to ensure that the fuel supplied to the injection system is totally free from dirt. Because the filter has two different elements it is essential that the unit is fitted the correct way round and for this reason the input and output connections are of a different size.

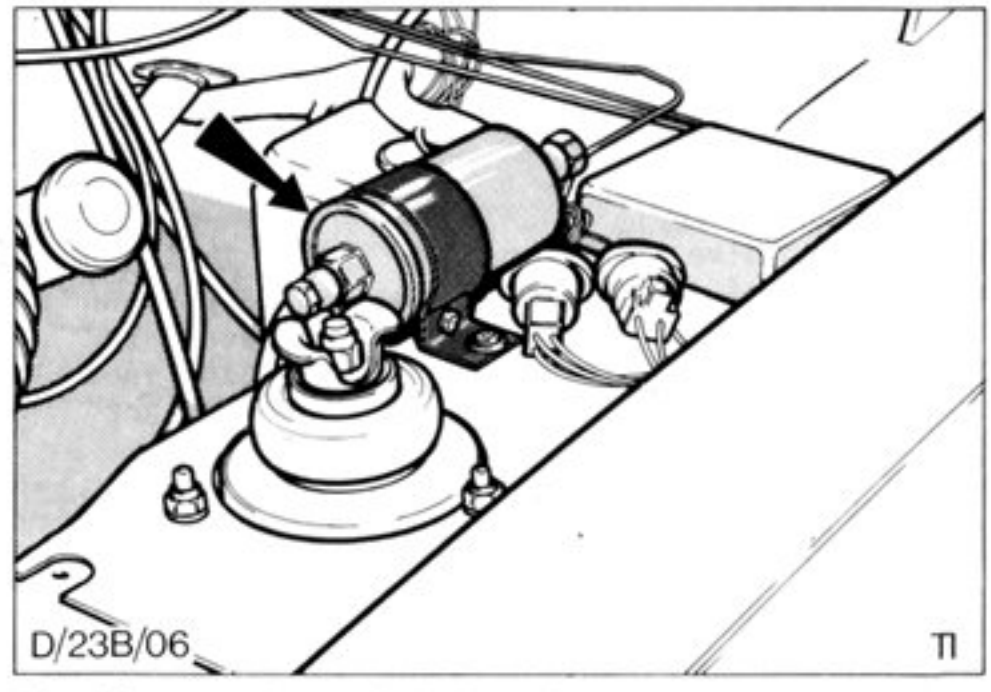


Fig.10. Location of fuel filter assembly on the left hand inner fender panel.

PRINCIPLE OF OPERATION (Cont'd)

MIXTURE CONTROL UNIT

d) Mixture Control and Fuel Distributor Assembly.

The mixture control unit is the heart of the injection system and is its most complicated component. For this reason the principle of operation of this unit is split into four parts;

1. Air sensor plate and control plunger.
2. Fuel distributor.
3. Main system pressure regulator.
4. Safety switch.

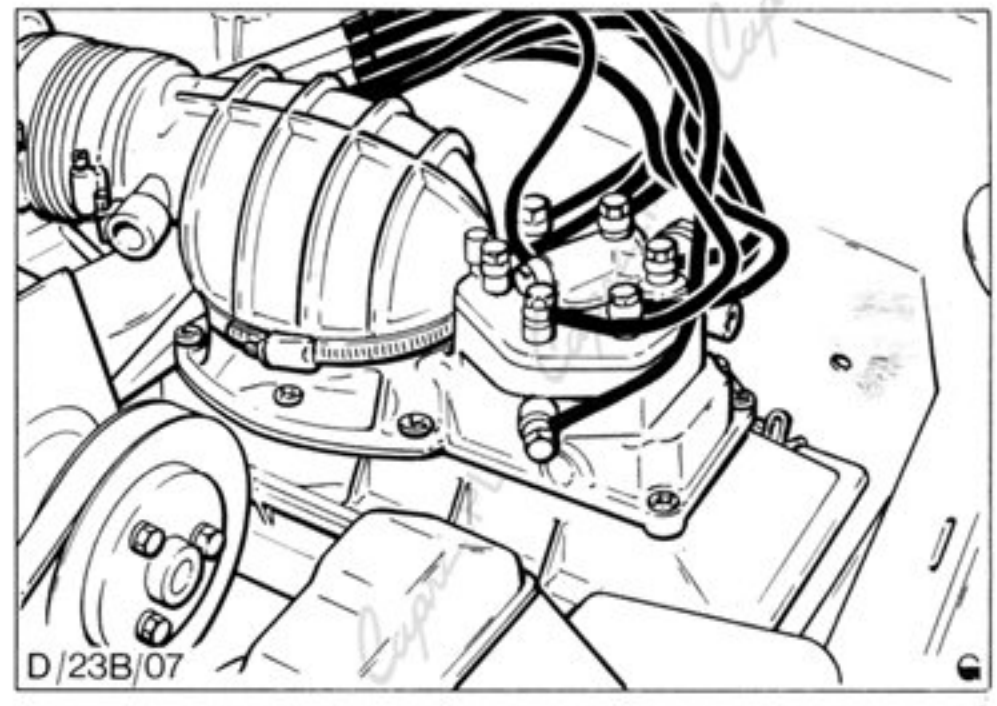


Fig.11. Mixture control and fuel distributor assembly.

1. Air Sensor Plate and Control Plunger. Fig.12.

The air sensor plate is located in the main air stream between the air cleaner and throttle butterfly. The sensor plate is mounted in an air funnel and attached to a lever which can pivot about a fulcrum. The weight of the sensor plate and lever is balanced by a counterweight to ensure that the plate is 'free floating' in the air funnel. The fuel control plunger sits on top of the sensor lever and will rise or fall according to the sensor plate position.

To ensure that the air sensor plate does not 'pulse' or 'bounce' in the air funnel, fuel, fed from the main system acts on the top face of the plunger. This dampens the operation of the plunger and stabilises the air sensor plate under all operating conditions. Refer Fig.12.

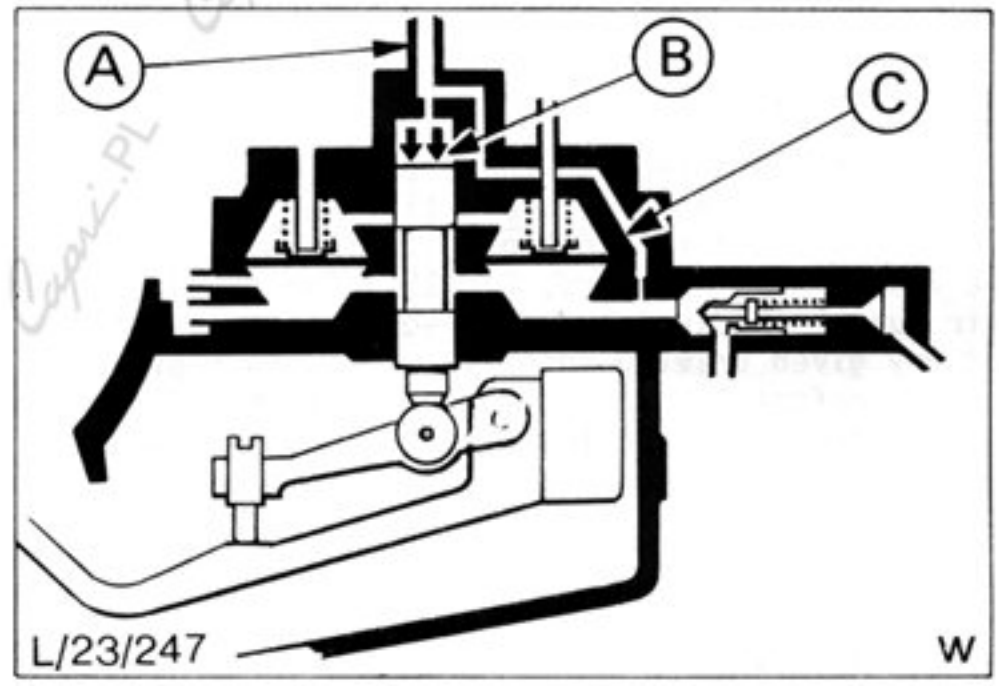


Fig.12. Fuel distributor assembly.
A - Outlet to warm up regulator
B - Control pressure on plunger
C - Control pressure feed

Operating Principle.

When an engine is stationary the sensor plate is in its rest position, 'B' in Fig.13, and the control plunger is in its lower position cutting off fuel supply to the injectors.

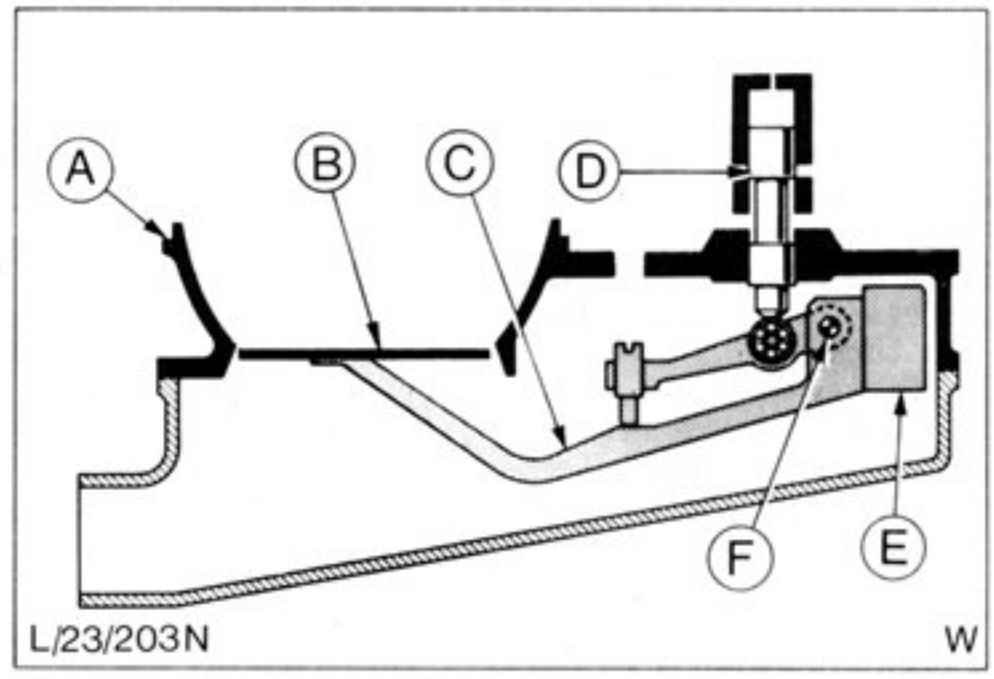


Fig.13. Air sensor plate and control plunger. (Engine stationary)
A - Air funnel
B - Sensor plate
C - Operating lever
D - Operating plunger blocking fuel outlet
E - Counterweight
F - Fulcrum point

Air sensor Plate and Control Plunger. (Cont'd)

During idle the air flowing through the air funnel will lift the sensor plate which in turn will lift the control plunger. Fuel will then flow past the plunger and out to the injector valves as shown in Fig.14.

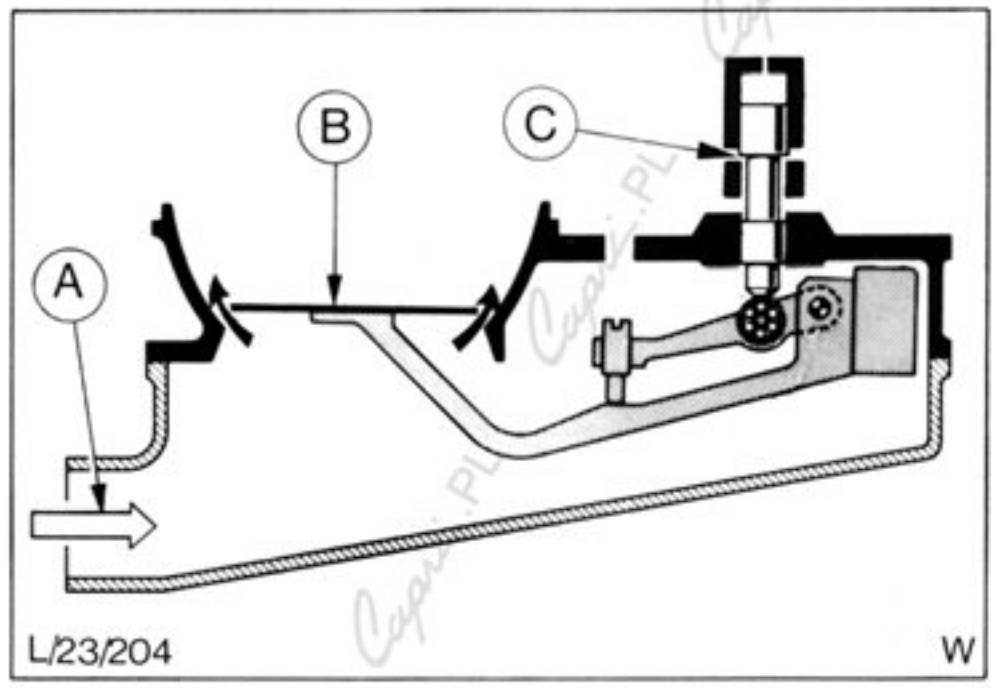


Fig.14. Air sensor plate and control plunger. (Engine idling)
A - Air intake (Low)
B - Sensor plate (Partially open)
C - Control plunger (Partially open)

As the engine speed and therefore airflow increases the sensor plate will rise, pushing the control plunger further up, allowing more fuel to be fed to the injectors, Fig.15. The shape of the air funnel is carefully engineered to ensure that at any given driving condition the sensor plate and therefore the control plunger is in exactly the correct position to give the required quantity of fuel.

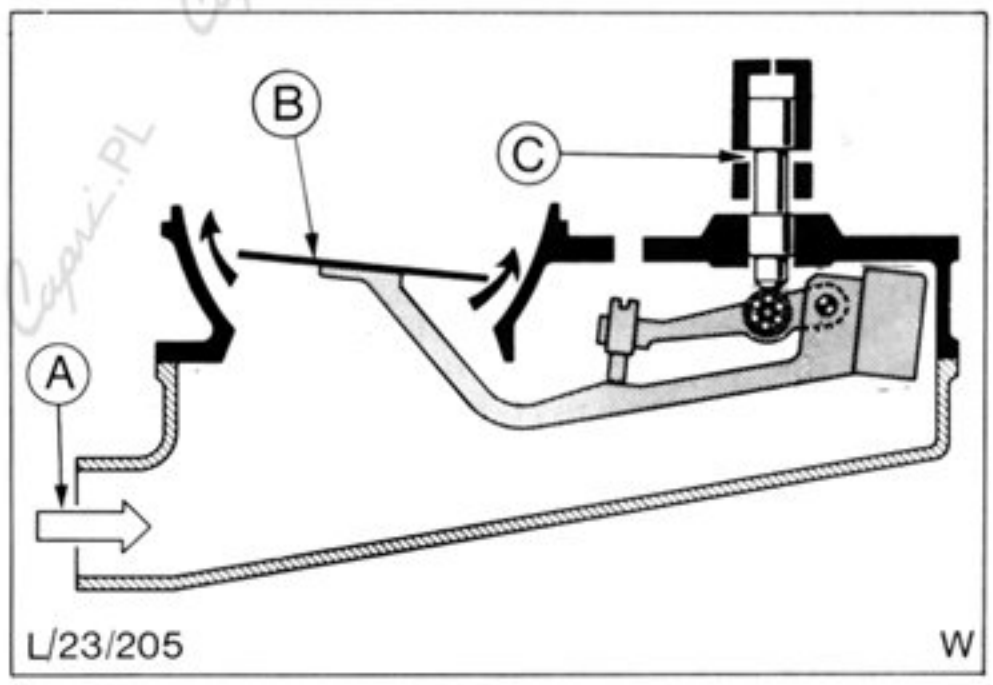


Fig.15. Air sensor plate and control plunger. (Engine full load)
A - Air intake (High)
B - Sensor plate (Fully open)
C - Control plunger (Fully open)

2. Fuel Distributor. Fig.16.

The fuel distributor controls the amount of fuel being delivered to the engine and ensures distribution to each of the six cylinders is exactly equal. The casing of the fuel distributor is in two parts, divided by a thin steel diaphragm. Cast into the top half are the fuel outlets which supply fuel directly to the injectors.
Components included in the fuel distributor are the main pressure regulator, (described on page 10) control plunger, (described on the previous page) plunger barrel and pressure regulator valve. The control plunger barrel has six metering slits machined into the upper section (one for each cylinder) and it is these slits working in conjunction with the plunger, that control the amount of fuel supplied to the injectors. Also fitted into the barrel are two 'O' ring seals and a fine mesh filter.

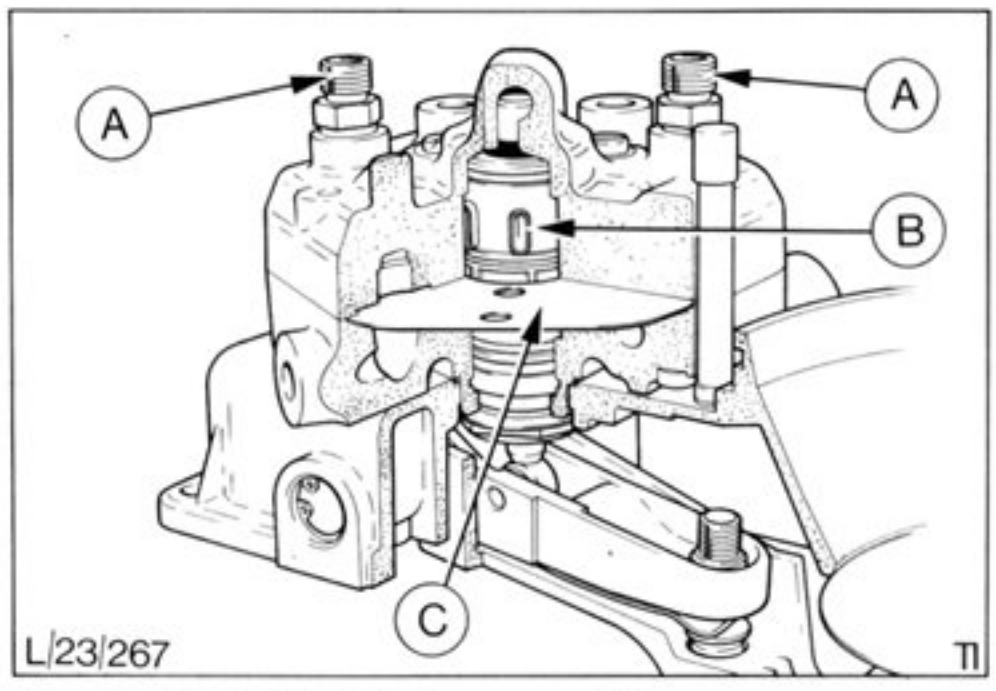


Fig.16. Fuel distributor assembly.
A - Fuel outlet connections
B - Control plunger and barrel
C - Steel diaphragm

PRINCIPLE OF OPERATION (Cont'd) MIXTURE CONTROL UNIT

Fuel Distributor (Cont'd)

As already stated it is absolutely essential that an equal amount of fuel is supplied to each cylinder, which means that a constant pressure at the distributor outlets must be achieved.

If fuel was fed to the injectors directly after passing round the control plunger the pressure changes that would occur at the metering slits, would not be acceptable. For example, if the plunger were to be suddenly lifted from the idle to full throttle position the pressure at the metering slits would rise dramatically. To overcome this condition a pressure regulator valve, one for each cylinder, is fitted between the metering slits and distributor outlets.

The differential pressure valve consists of an upper and lower chamber, thin steel diaphragm and control spring. The regulators operate as follows;

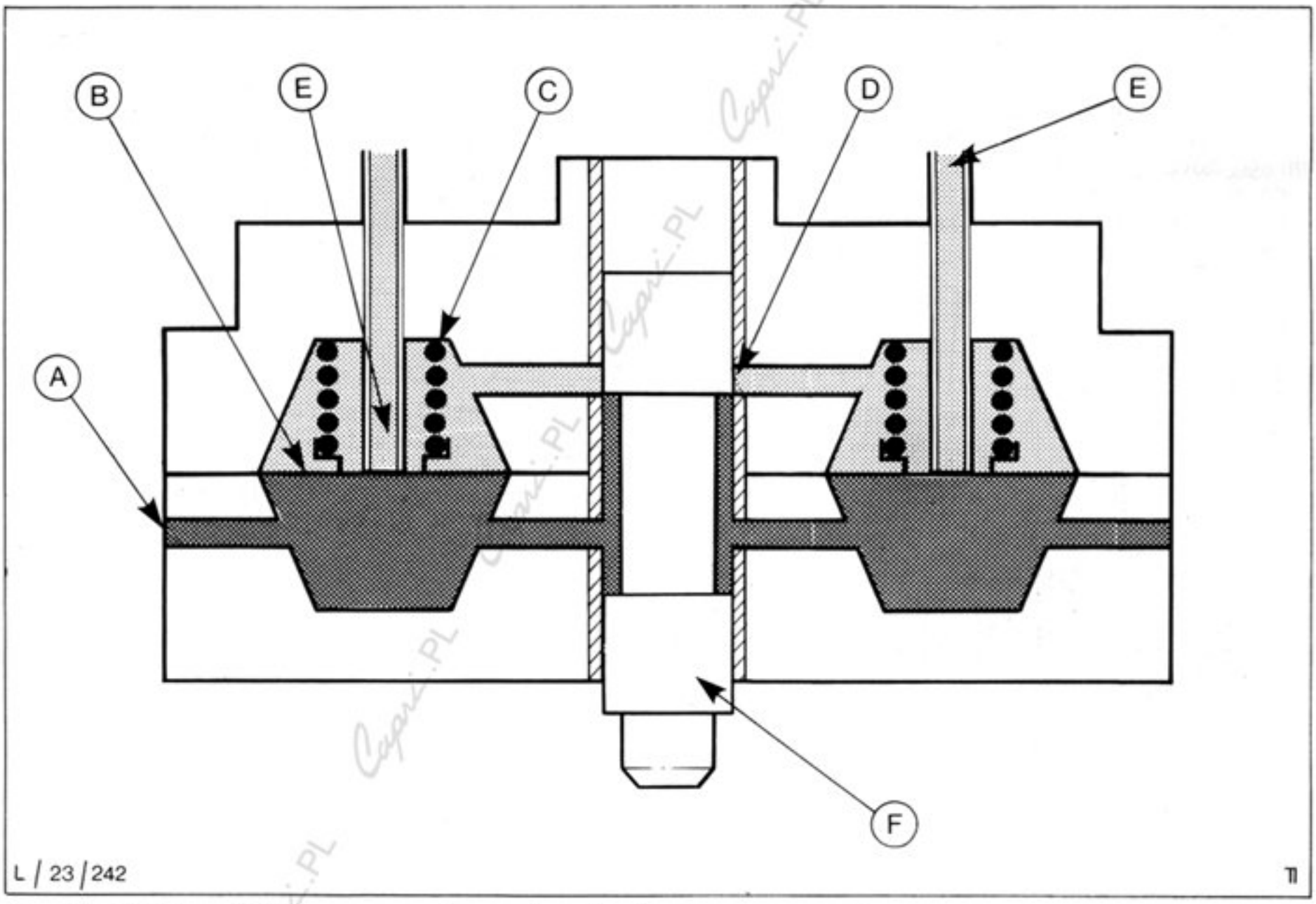


Fig.17. Differential pressure valve and control plunger assembly.
(Two valves illustrated - the full system has six)
A - Fuel inlet
B - Steel diaphragm
C - Control spring
D - Metering slit
E - Injector supply pipe
F - Control plunger

Fuel Distributor (Cont'd)

During normal operation the pressure in the upper chamber is maintained at 0,1 bar less than the pressure in the lower chamber, i.e. 4,6 bar. This pressure difference is created by the control spring which is acting on the diaphragm.

When the engine is started and allowed to idle the plunger is pushed upwards by the air sensor plate allowing fuel to enter the upper chamber through the metering slits. As pressure in the upper chamber rises the diaphragm is pushed downwards opening the injector supply pipe and allowing fuel to be passed to the injectors. The movement of the diaphragm will stabilise when a differential pressure of 0,1 bar prevails. Refer Fig.18.

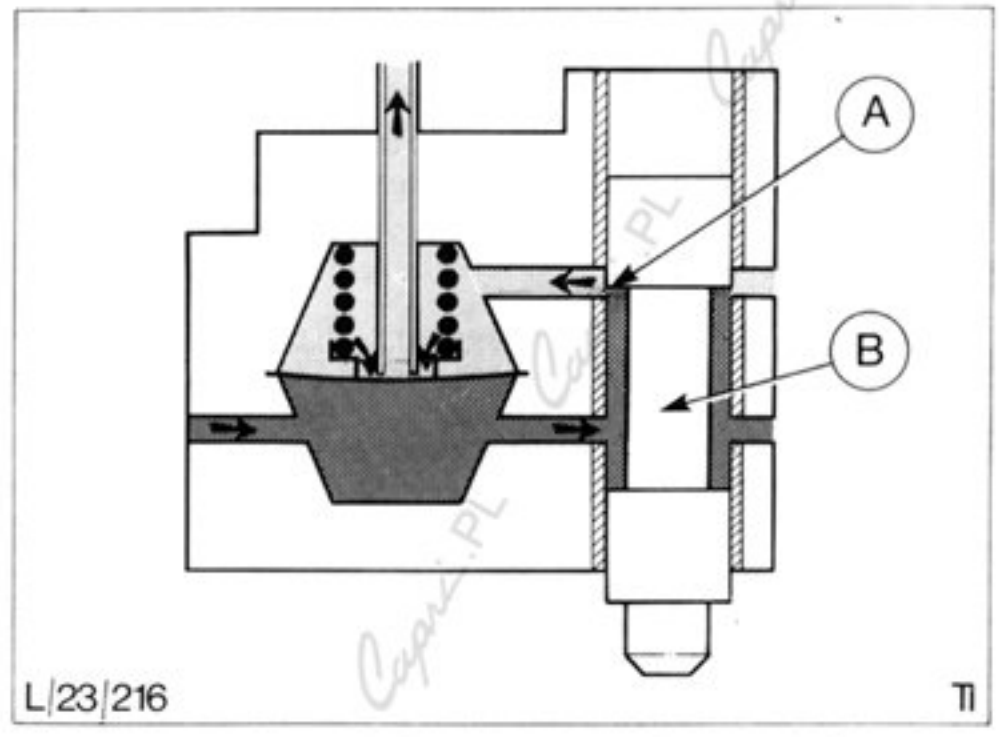


Fig.18. Differential pressure valve and plunger during engine idling. (Arrows denote fuel flow)
A - Metering slit
B - Control plunger

During acceleration the plunger moves upwards allowing more fuel to enter the upper chamber. The diaphragm moves further downwards until the 0,1 bar pressure difference prevails, resulting in a larger opening of the injector feed pipe. Fig.19.

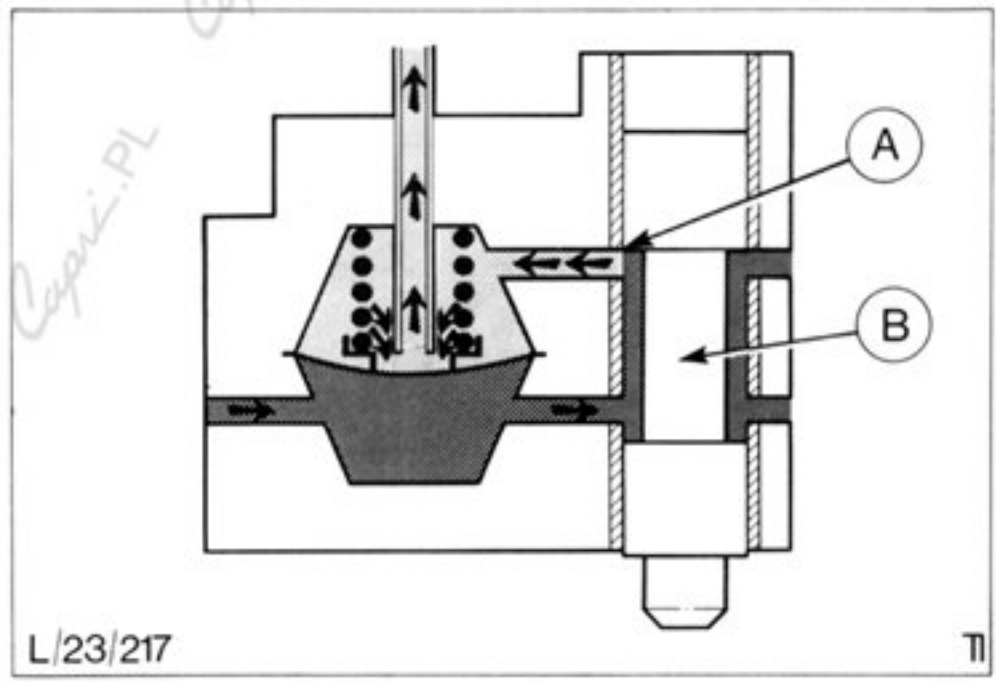


Fig.19. Differential pressure valve and plunger during acceleration. (Arrows denote fuel flow)
A - Metering slit (Fully open)
B - Control plunger

3. Main System Pressure Regulator

The main system pressure regulator is located in the main housing of the fuel distributor and consists of a plunger, valve, control spring and adjusting shims.

NOTE: Full adjustment procedure is detailed on page 25.

The regulator operates in the fuel return system allowing more or less fuel to be passed back to the tank and so maintaining the main system pressure at a predetermined figure.

Operating Principle

Fuel is pumped from the tank to the lower pressure chamber in the distributor, from here fuel is fed to the regulator and back to the tank, completing the main system pressure circuit. Refer Fig.20.

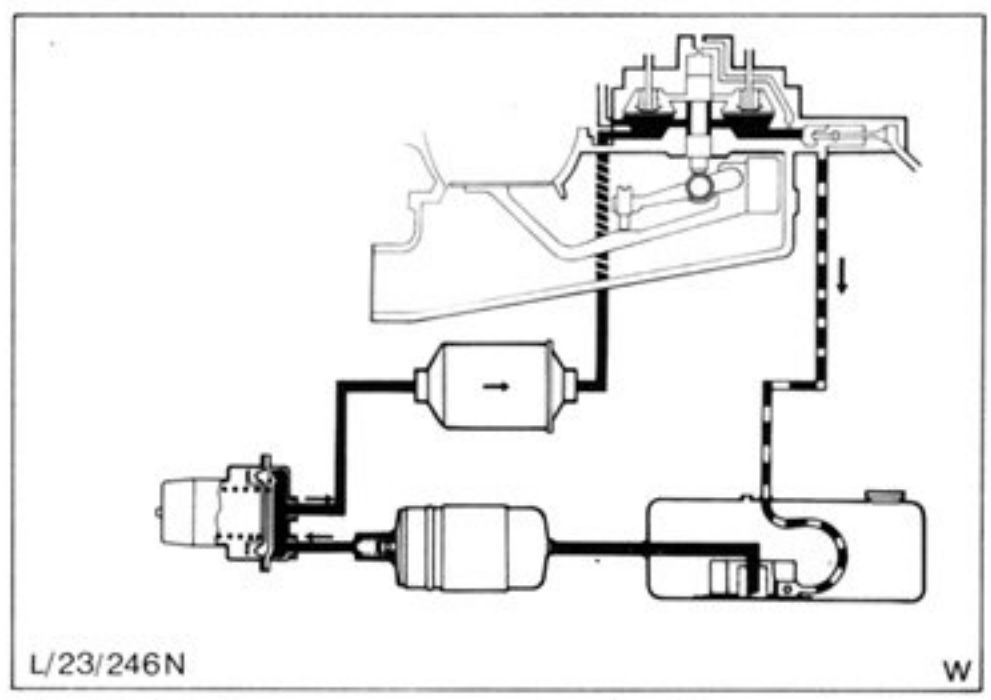


Fig.20. Main system pressure circuit.

4. Safety Switch. Fig.21.

The fuel safety switch is designed to cut off all power to the injection system when the air sensor plate is in the rest position, even if the ignition switch is in the 'ON' position. For example, if the vehicle was involved in an accident which damaged a fuel line, the safety switch would cut power to the fuel pump, and so stop fuel flowing through the system.

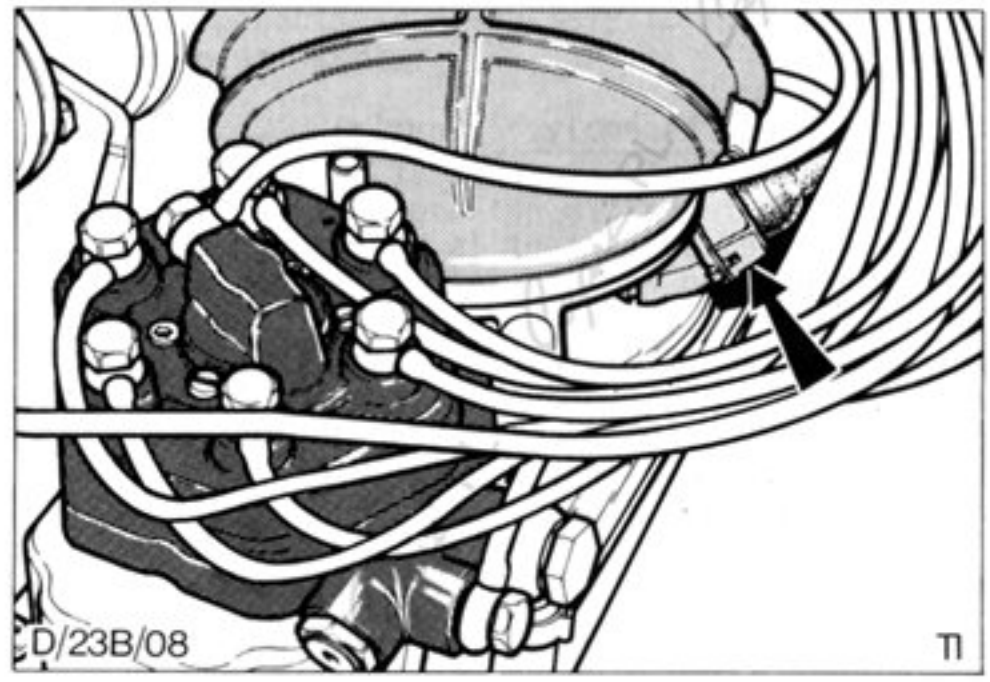


Fig.21. Location of Safety switch.

Operating Principle

The switch is located beneath the air sensor plate, Fig.22, and connected to one of the two relays. The electrical circuits that make up the injection system are explained on page 19.

When the engine stalls the sensor plate returns to the rest position and completes an electrical circuit which energises the relay. The relay in turn cuts off power to the complete system including the fuel pump, and so stops any further flow of fuel through the system.

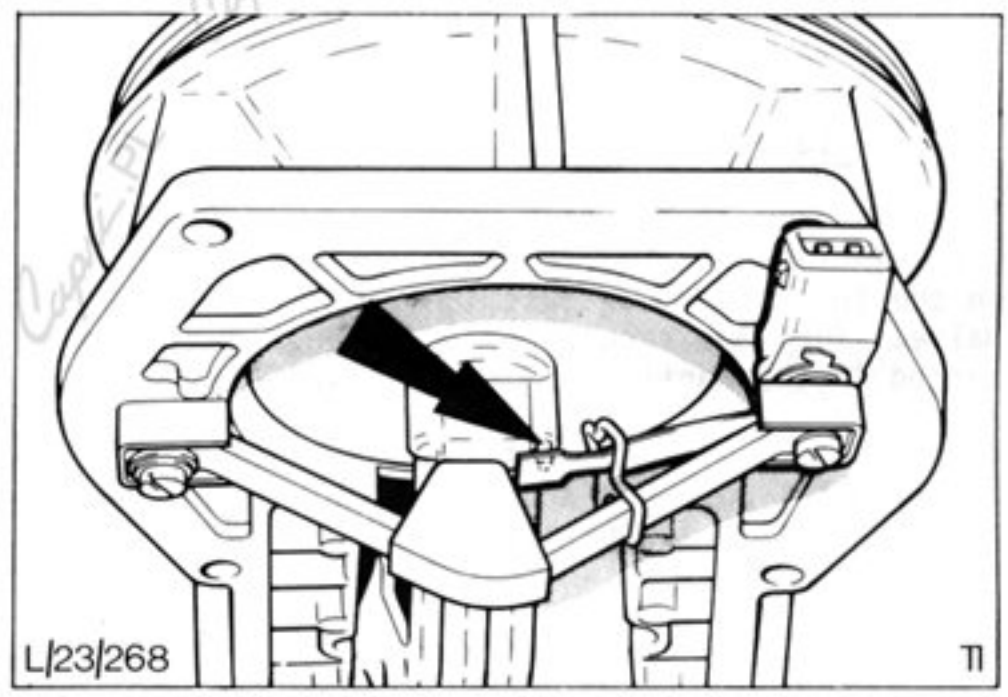


Fig.22. Safety switch fitted in the mixture control unit.

e) Throttle Plate Assembly. Fig.23.

The throttle plate assembly is mounted in the main air stream between the mixture control unit and air box, Fig.23. The unit consists of a simple plate mounted in an air funnel, and is operated by a cable connected to the throttle pedal. The plate is held slightly open to ensure that it does not bind in the air funnel when the housing contracts as the engine cools.

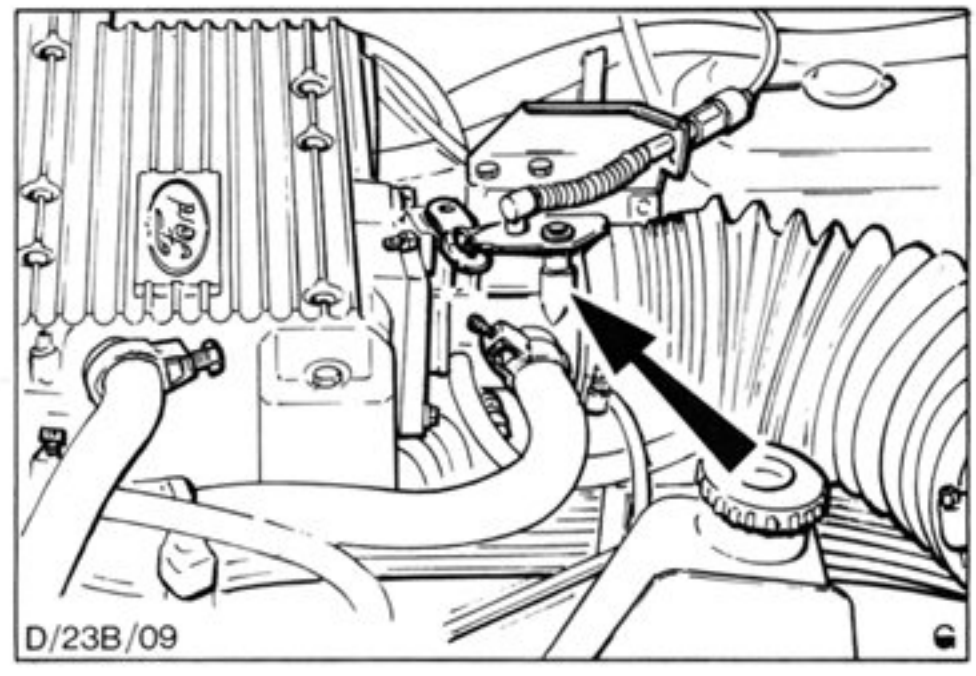


Fig.23. Location of throttle plate assembly.

PRINCIPLE OF OPERATION (Cont'd)

Throttle Plate Assembly. (Cont'd)

The idle speed adjustment is mounted in the throttle housing and consists of a simple plunger fitted into an air channel. The air channel by-passes the throttle plate and idle speed adjustment is achieved, by unscrewing the plunger, which increases the air flow and therefore engine speed, or by screwing in the plunger which restricts the air flow, Fig.24.

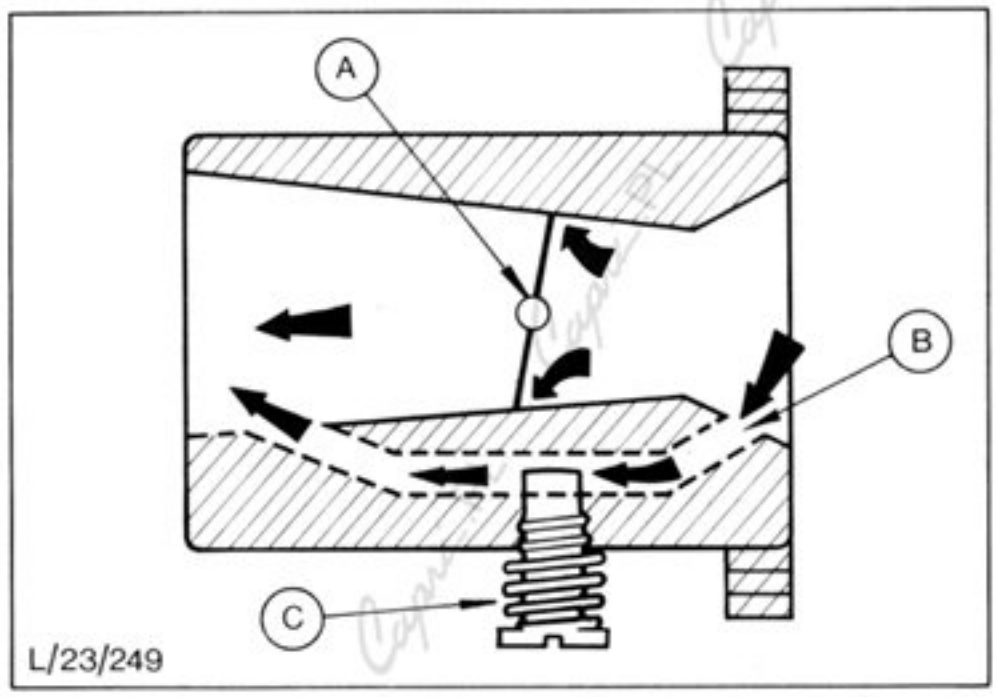


Fig.24. Throttle plate assembly showing by-pass idle speed adjustment.
A - Throttle plate
B - By-pass air channel
C - Idle speed adjusting screw

Injector Valves. Fig.25.

The injectors, one for each cylinder, are located in the inlet manifold just in front of each inlet valve. They are secured by a forked clamp and sealed in the manifold by an '0' ring.

The injectors will open at a pressure of approximately 3,3 bar and stay open at all times when the engine is operating.

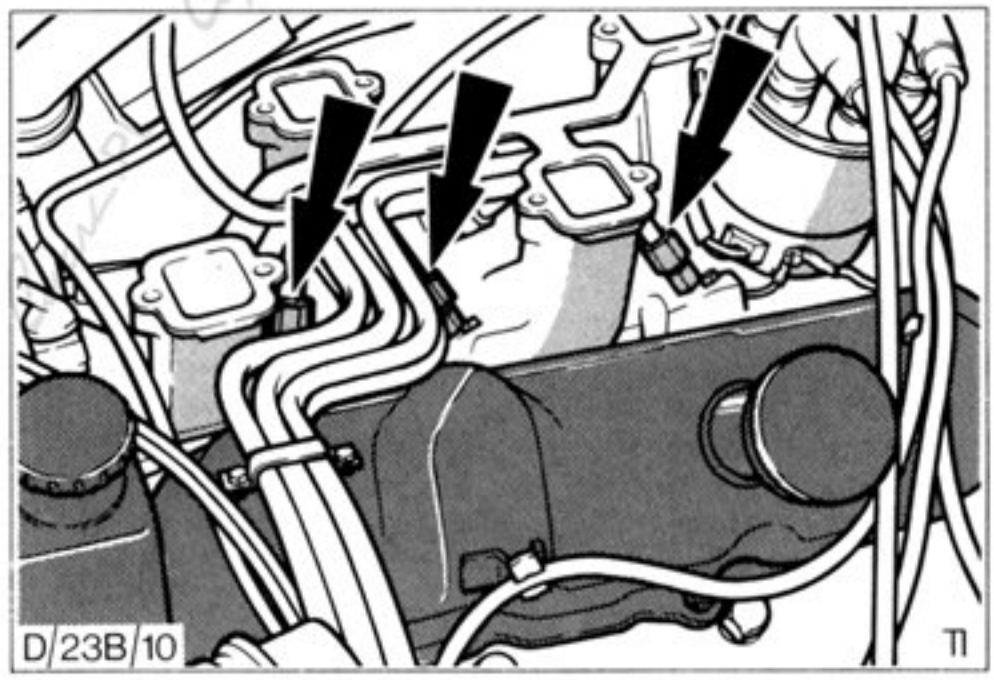


Fig.25. Injector valve assemblies. (Three shown in illustration)

Air Box. Fig.26

The air box is bolted on to the top of the engine and acts as an auxiliary inlet manifold directing air, fed from the sensor plate, to the individual cylinders.

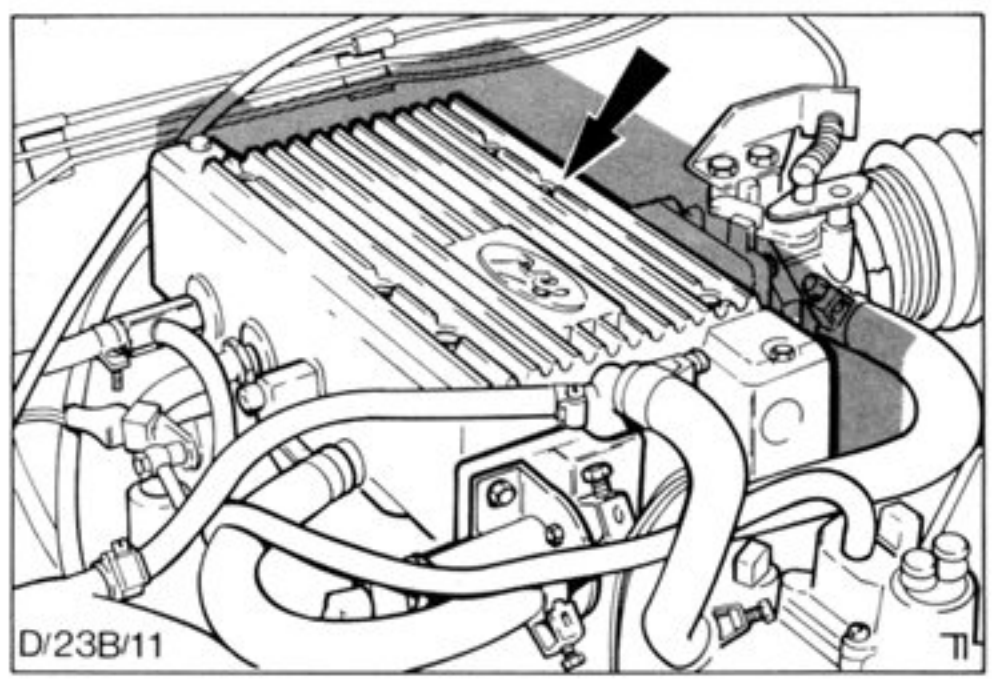


Fig.26. Air box assembly.

PRINCIPLE OF OPERATION (Cont'd)

This completes the basic injection system and all remaining components are used only to modify the air fuel ratio under specific driving conditions such as during engine warm-up.

To summarise fuel flows from the tank through the pump, accumulator and filter up to the mixture control unit. Fuel then flows past the control plunger metering slits, into the differential pressure valve, and out to the individual injectors.

Air is taken in through the air cleaner, flows past the air sensor and throttle plates into the air box. From here air is directed to the individual cylinder past the injectors which are continuously spraying fuel.

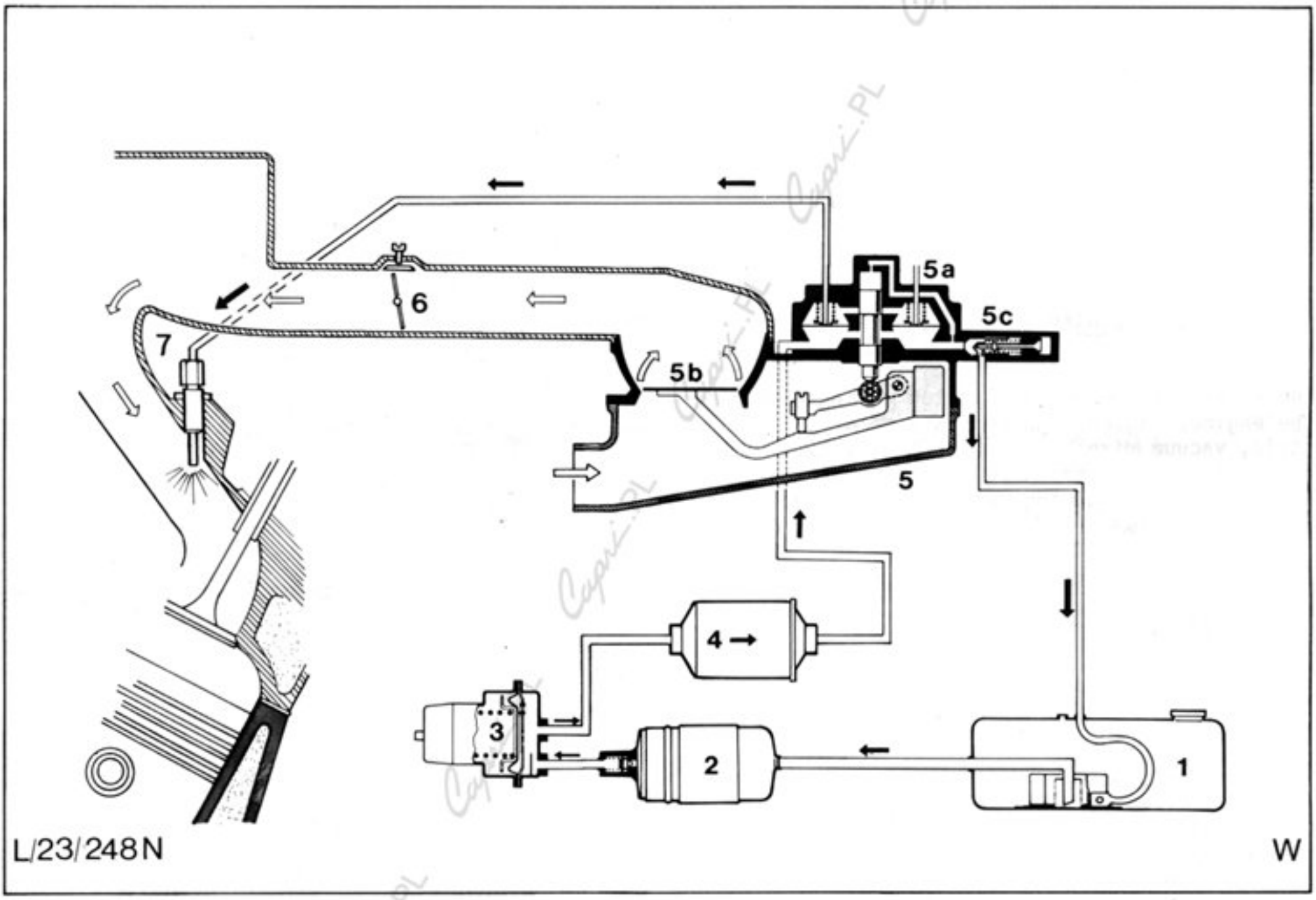


Fig.27. Petrol Injection - fuel and air supply systems.

1. Fuel tank
2. Fuel pump
3. Accumulator
4. Fuel filter
5. Mixture control unit
5a. Fuel distributor
5b. Air sensor plate
5c. Pressure regulator
6. Throttle plate
7. Injector

PRINCIPLE OF OPERATION (Cont'd) WARM UP-REGULATOR

Fuel Injection Auxiliary Equipment

The components listed below do not form part of the basic injection system, but are essential to ensure good starting characteristics, good driveability during engine warm-up and peak performance at full throttle.

(a) Warm up regulator
(b) Auxiliary air device
(c) Start valve
(d) Thermo time switch
(e) Impulse module

Operation of these components are described on this and the following pages.

(a) Warm-up Regulator

The warm-up regulator is located at the front of the engine, Fig.28, and consists of a bi-metal strip, vacuum diaphragm and control valve. The function of the regulator is to richen the air/fuel mixture during engine warm-up and during normal operation relative to manifold depression.

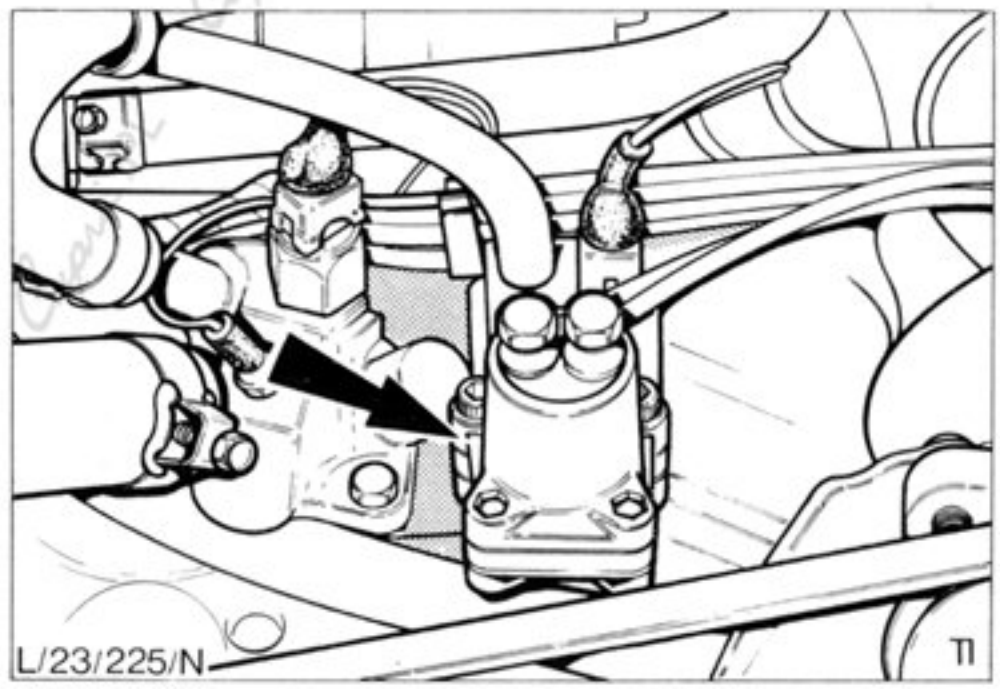


Fig.28. Location of warm-up regulator.

Operating Principle

As already shown on page 7 control pressure acts on the top face of the control plunger to stabilise the air sensor plate. When the engine is cold or operating under full load condition the warm-up regulator reduces the control pressure allowing the sensor plate to rise higher in the air funnel. This results in the plunger being lifted allowing more fuel to be fed to the injectors thus creating a rich air/fuel mixture. The regulator reduces the control pressure by allowing the fuel that is acting on the plunger to be fed back to the tank via the main system pressure regulator.

Fig.29, shows the situation when the engine is cold with the warm-up regulator valve open allowing fuel to be fed back to the tank via the main system pressure regulator.

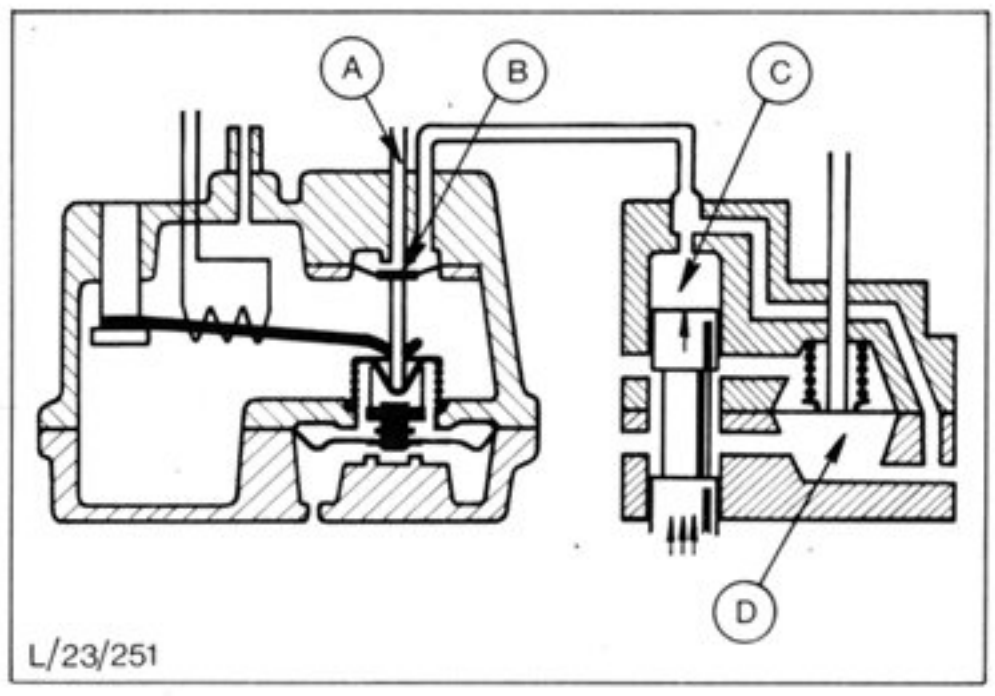


Fig.29. Warm up regulator and fuel distributor.
A - Regulator outlet to tank
B - Valve open
C - Reduced control pressure
D - Main system pressure

Warm-up Regulator (Cont'd)

The warm-up regulator reduces the control pressure by partially or fully opening a valve located in the upper housing. This valve is controlled by two separate systems, firstly a bi-metal strip, which controls the valve during engine warm-up and secondly by a vacuum diaphragm which operates when the engine is at full throttle.

1. Bi-metal Strip System

The bi-metal strip is heated from two sources, firstly by the actual temperature of the engine which is transmitted through the housing and secondly by an electrical element wound around the strip.

The bi-metal strip when cold, forces the valve operating rod downwards, against a spring tension, allowing fuel to flow back to the tank, Fig.30.

As the engine reaches normal operating temperature the bi-metal strip releases the operating rod allowing the return spring to close the valve, Fig.31.

2. Vacuum Diaphragm System

During normal operation manifold vacuum is fed to the regulator and acts on the upper side of a diaphragm. A small hole through the housing beneath the diaphragm ensures that the lower side is always at atmospheric pressure.

The diaphragm reacts by pushing the valve operating rod upwards, against a spring tension ensuring normal control pressure is available at the control plunger, Fig.31.

At full throttle the vacuum in the manifold, and therefore the regulator drops to almost zero which allows the return spring to push the diaphragm downwards. This releases the valve, the control pressure acting on the sensor plate drops and results in a richer air/fuel ratio being passed to the engine.

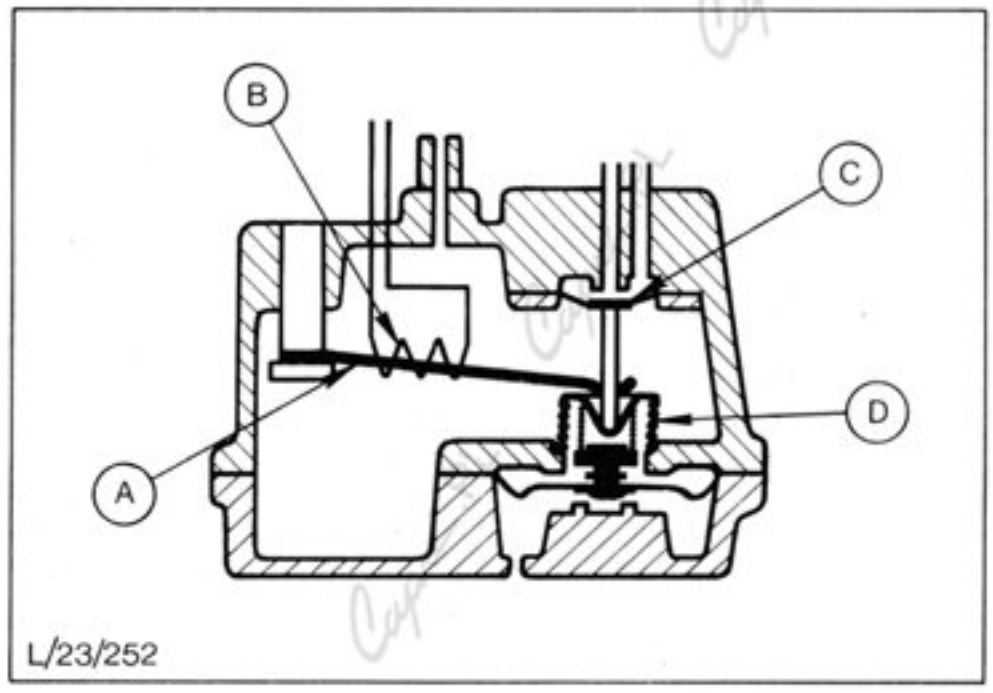


Fig.30. Warm-up regulator. (Engine Cold)
A - Bi-metal strip
B - Heater element
C - Control valve (Open)
D - Bi-metal return spring

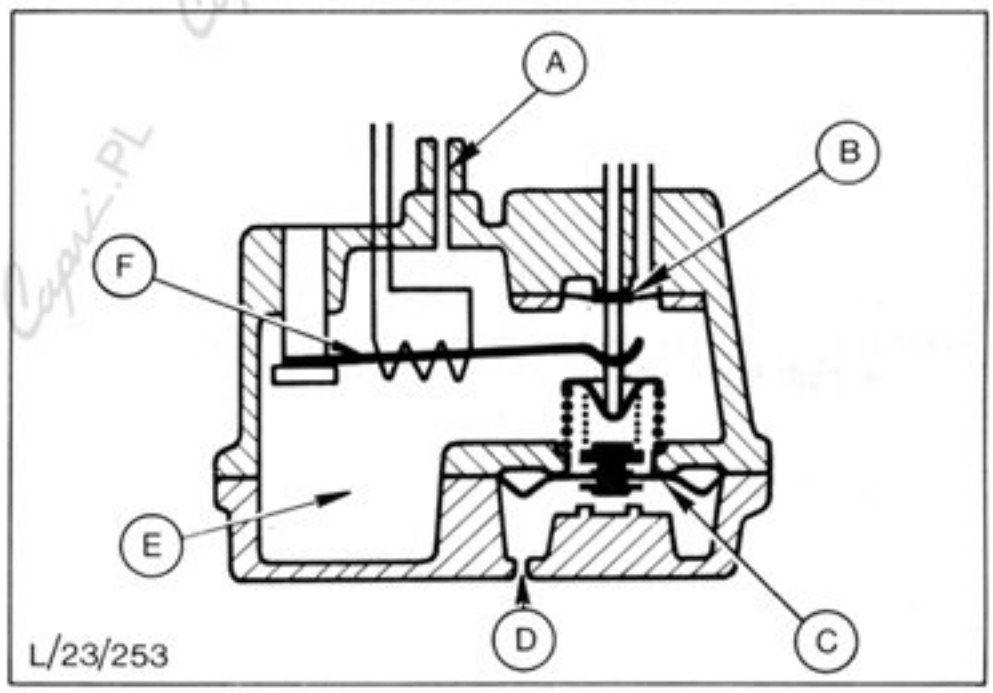


Fig.31. Warm-up regulator. (Engine hot)
A - Vacuum connection
B - Control valve (Closed)
C - Diaphragm
D - Hole open to atmosphere
E - High manifold vacuum
F - Bi-metal strip

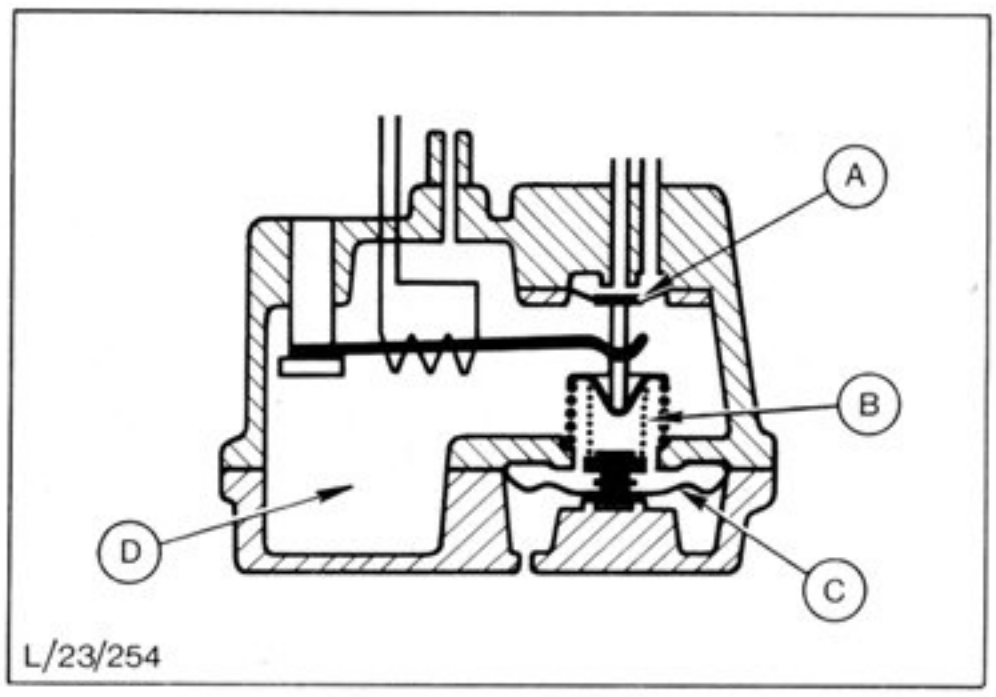


Fig.32. Warm-up regulator. (Engine hot and at full throttle)
A - Control valve open
B - Diaphragm return spring
C - Diaphragm pushed down
D - Low vacuum

PRINCIPLE OF OPERATION (Cont'd)

AUXILIARY AIR DEVICE

(b) Auxiliary Air Device

The auxiliary air device is located on the front face of the air box, refer Fig.33, and consists of a pivoted blocking plate and bi-metal strip with heater coil. As already explained on the previous page the warm up regulator richens the air/fuel mixture when the engine is cold. However, richening the mixture does not alter the idle speed which, if left would create a stall problem on cold engines. The function of the air device is to supply an increased amount of air/fuel mixture to the engine during cold idling conditions. The unit's function is similar to that achieved by the fast idle system on conventional carburettors.

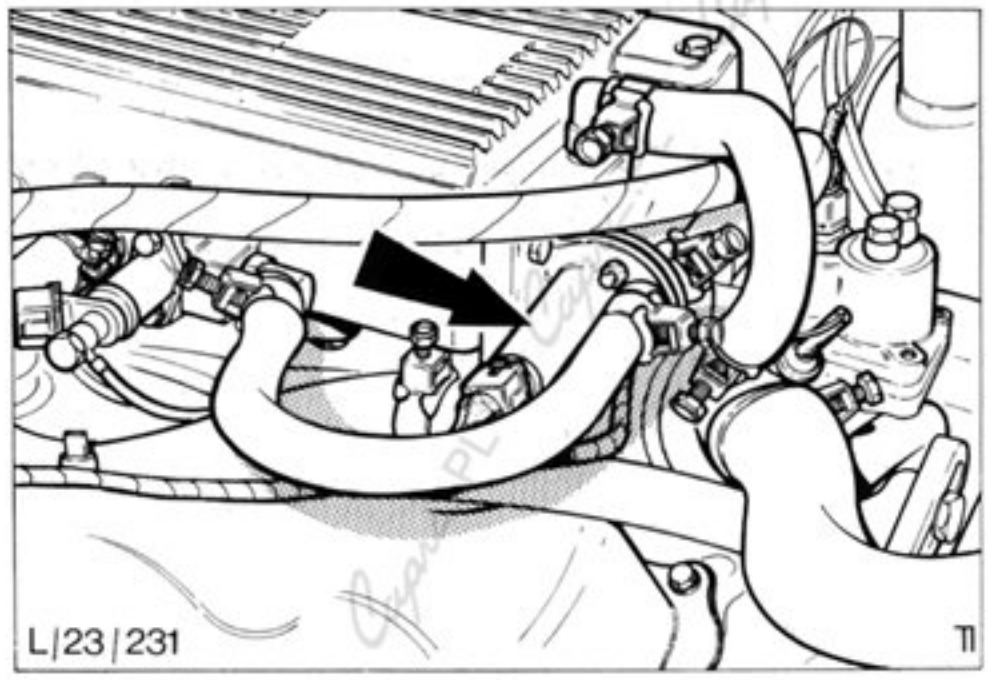


Fig.33. Auxiliary air device.

Operating Principle

When an engine is first started from cold, air is drawn from the main air stream just in front of the throttle plate, Fig.34. The air supply bypasses the throttle plate, passes through the air device and fed into the air box at the start valve. As the engine warms up the bi-metal spring expands and closes the air device, blocking any further flow of air.

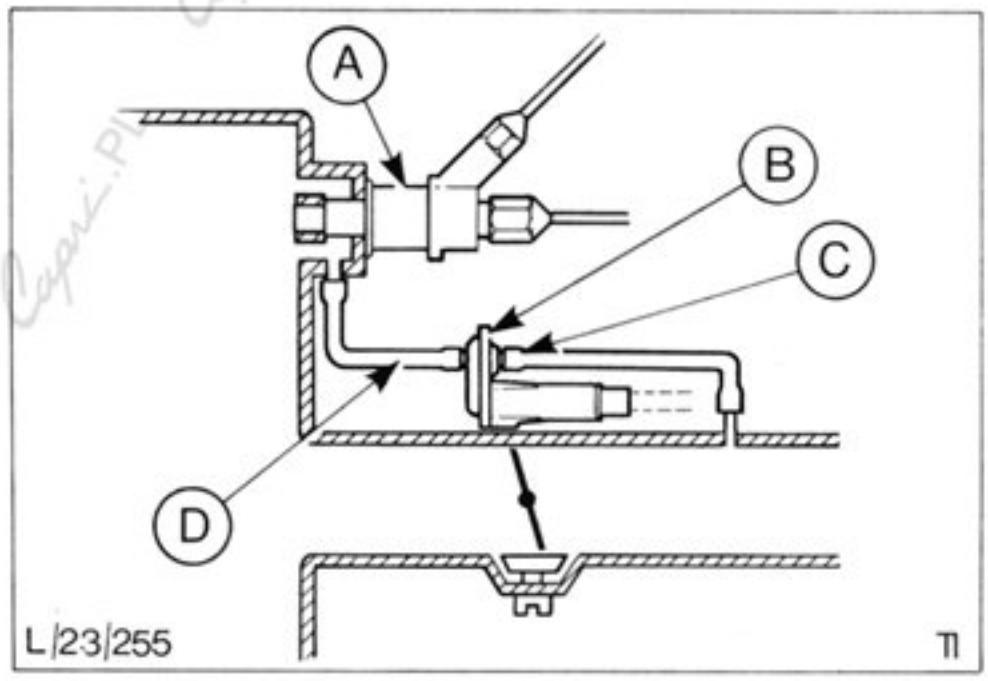


Fig.34. Auxiliary air device. (Schematic)
A - Start valve
B - Pivoted blocking plate
C - Air inlet
D - Air outlet

Fig.35 shows the pivoted blocking plate in cold and hot engine situations. On cold engines the bi-metal strip pushes the plate open against a spring load. As the bi-metal expands the return spring closes the blocking plate.

The bi-metal strip is heated from two sources, firstly by the actual temperature of the engine which is transmitted through the housing and secondly by an electrical element wound around the strip.

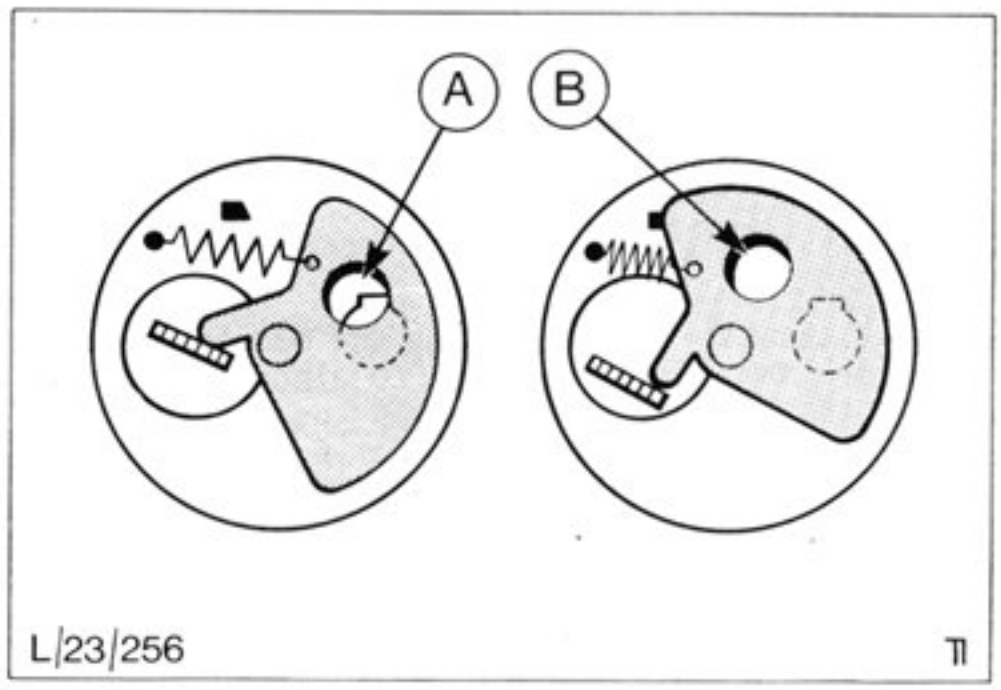


Fig.35. Pivoted blocking plate.
A - Engine cold (Plate open)
B - Engine hot (Plate closed)

PRINCIPLE OF OPERATION (Cont'd)

START VALVE SYSTEM

Fuel Start Valve System

The start valve system consists of three main components, an electrically operated injector, thermo time switch and an impulse module. The function of the system is to richen the air/fuel ratio during initial starting on both hot and cold engines. This is achieved by the injector which on a cold engine sprays fuel continuously into the air box for a pre-determined time interval, controlled by the thermo time switch.

On a hot engine the injector spray operation is controlled by the impulse module which pulses the injector in a regular cycle.

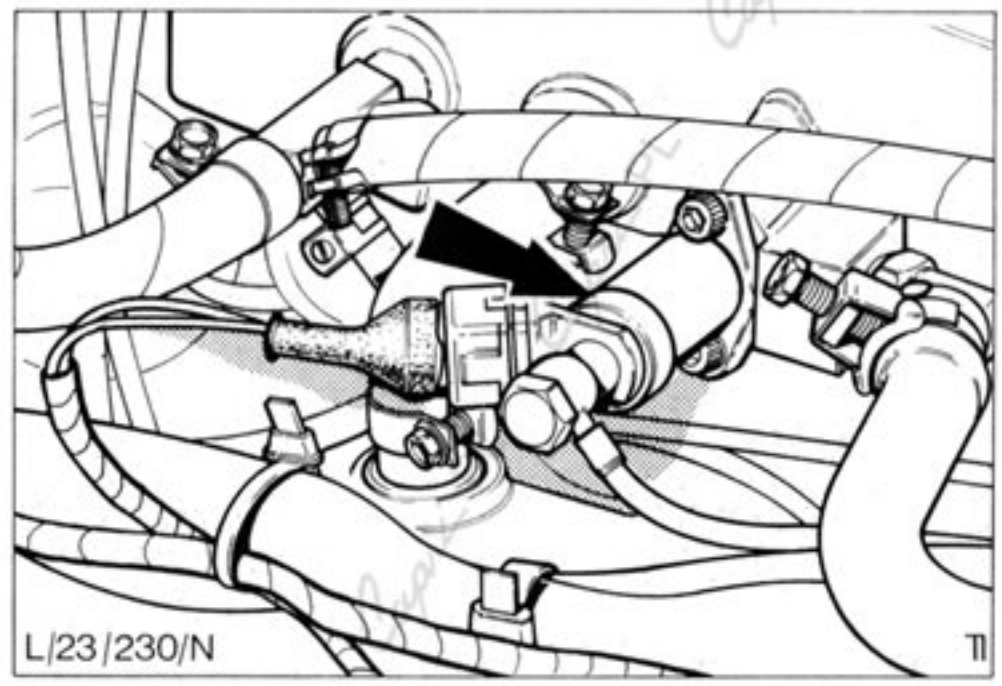


Fig.36. Location of fuel start valve.

(c) Start Valve Injector

The injector is located on the air box, refer Fig.36, and consists of a magnetic coil and armature, fuel valve assembly and a swirl nozzle. During normal operation of the vehicle the valve return spring holds the movable armature, together with the fuel valve, against the valve seat which closes the injector. During starting, power supplied to the coil will pull the armature back against a spring load and open the fuel valve. Fuel is then allowed to flow past the armature and down to the swirl nozzle where it is injected into the air box in a finely atomized form. Refer Fig.37.

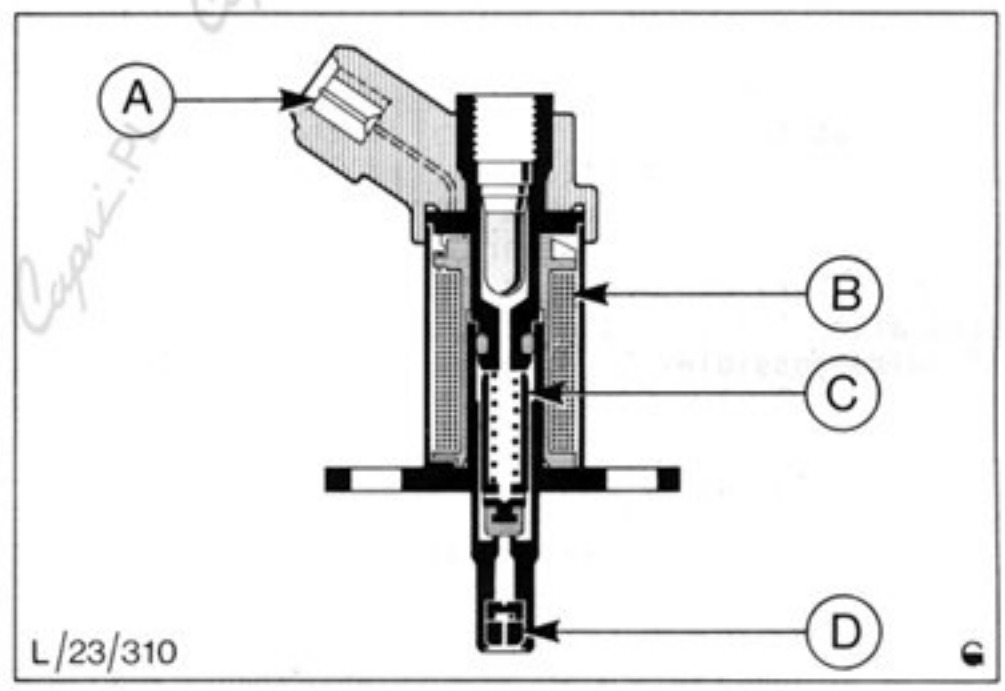


Fig.37. Fuel start valve assembly.
A - Fuel Inlet
B - Magnetic coil
C - Armature
D - Swirl nozzle

(d) Thermo Time Switch

The thermo time switch is located in the cooling system adjacent to the warm up regulator, refer Fig.38, and consists of a bi-metal strip, contact points and a double heater element. The switch controls the injector, when the engine is cold, by either earthing the circuit (points closed) and so allowing the injector to operate or by breaking the circuit (points open) and so cutting the current flow. The bi-metal strip is heated by a double heater element, one of the elements being earthed through the points and the second element earthed through the casing.

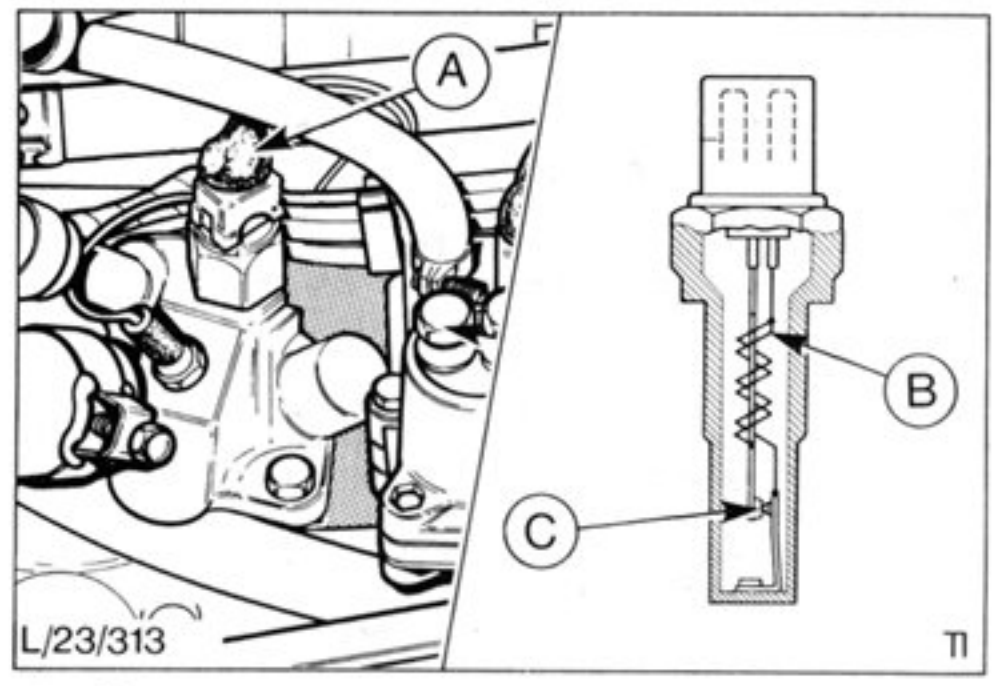


Fig.38. Thermo time switch.
A - Switch location
B - Double heater elements
C - Contact points

PRINCIPLE OF OPERATION (Cont'd)

START VALVE SYSTEM

Fuel Start Valve System - Engine Cold

Power, supplied from the starter solenoid, is fed through the injector to the connection marked 'B' in Fig.39, on the thermo time switch. When initially starting a cold engine the contact points within the switch will be closed so the current can flow to earth. With the points closed the circuit will be complete and the injector will operate.

NOTE: The power supply for the circuit is sourced from the starter solenoid to ensure that the injector can only function when the starter motor is in operation.

At the same time power is also fed to the heater elements at point 'C' in Fig.39, and these start to heat the bi-metal strip. After a pre-determined time interval the elements will have heated the bi-metal strip sufficiently so that the points will open. This breaks the injector circuit and cuts out its operation.

Under normal circumstances the engine would have started at this point, however if the starter is continued to be operated power will still be fed through the heater element that by-passes the points and is earthed separately through the casing. This ensures that the points are held open after the injection cycle is complete to minimise possible flooding.

Once the engine has reached normal operating temperature the cooling system heats the bi-metal strip holding the contact points open.

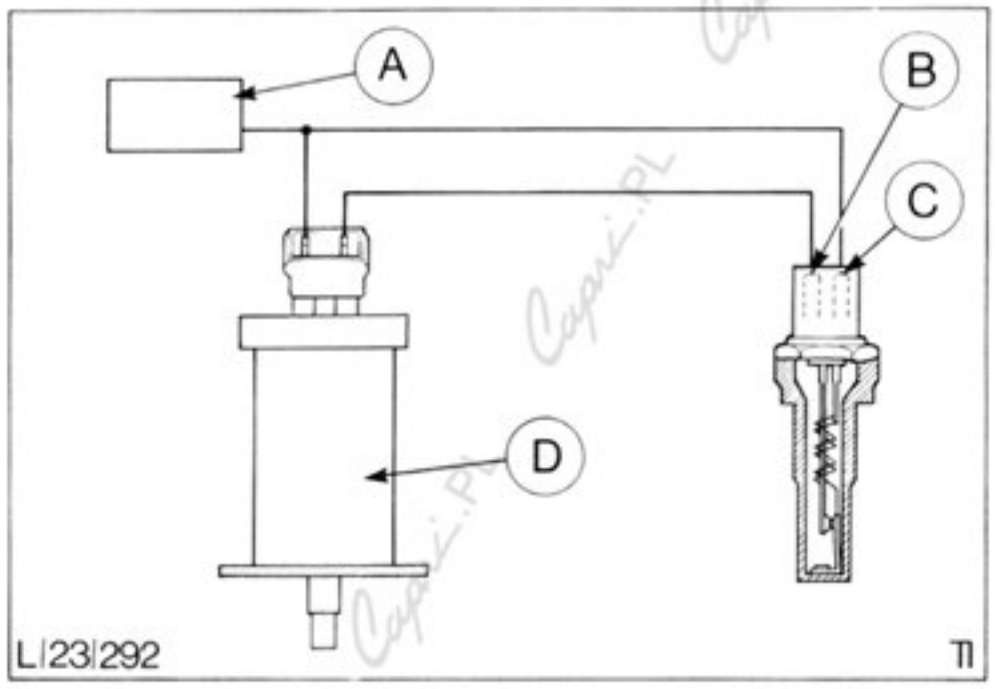


Fig.39. Fuel start valve system.
A - Starter solenoid
B - Switch connection to valve
C - Switch connection to starter
D - Start valve

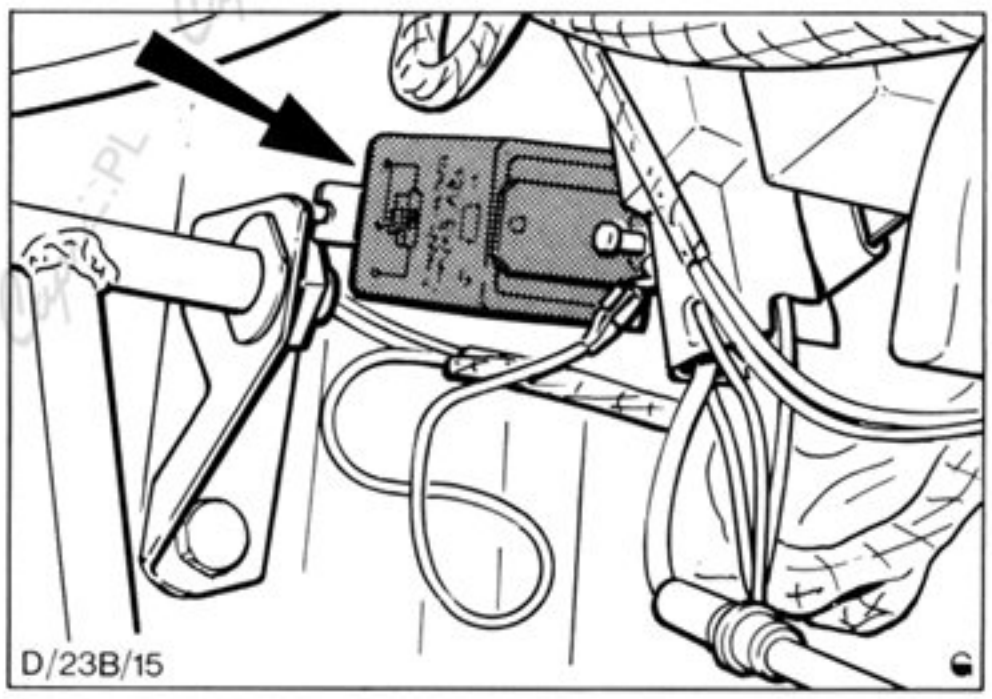


Fig.40. Location of impulse module on drivers side cowl panel.
(R.H.D. illustrated, L.H.D. module is located on left hand cowl panel)

(e) Impulse Module

To improve starting charactoristics on a hot engine an impulse module is included into the start valve system, designed to pulse the injector when the starter is in operation. The module is located on the drivers side cowl panel, refer Fig.40, and wired into the system as shown in Fig.41. As with the thermo time switch the power supply for the module is sourced from the starter solenoid thus ensuring that the system only functions when the starter motor is in operation.

Once energised the module has the ability to make and break an earth connection within itself which provides the electrical pulse for the injector.

NOTE: As stated earlier once the engine is at normal operation temperature the points within the time switch will be open which breaks the injector earth connection. The module provides a second earthing point for the injector and is capable of making and breaking this connection in a regular cycle.

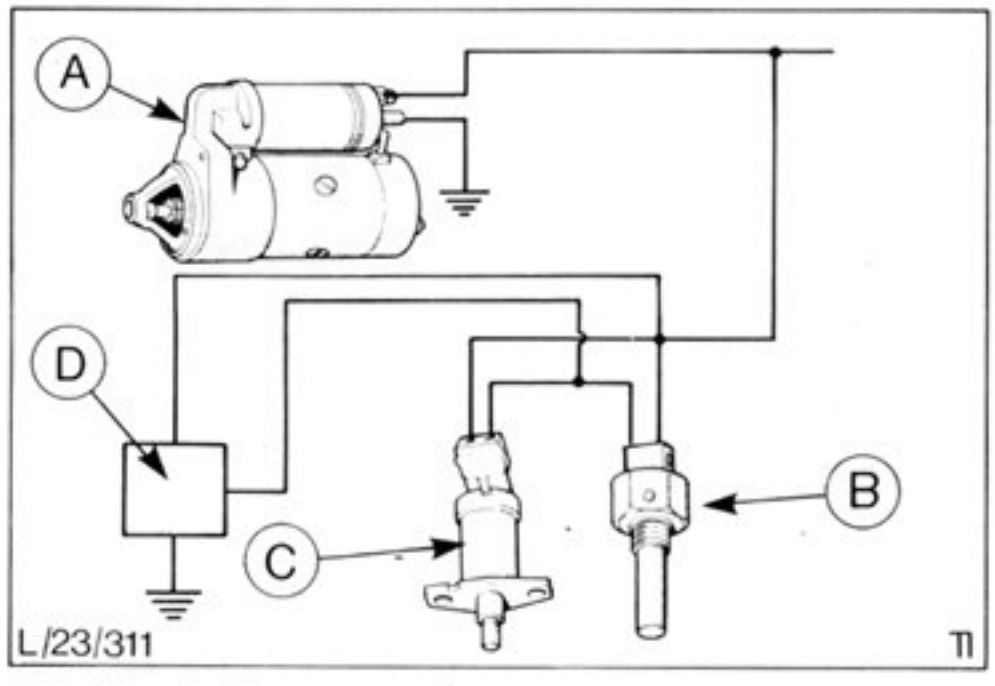


Fig.41. Fuel start valve system.
A - Starter motor
B - Thermo time switch
C - Start valve
D - Impulse module

PRINCIPLE OF OPERATION (Cont'd)

ELECTRICAL CIRCUITS AND RELAYS

Wiring Circuits and Relays

In addition to the actual wiring loom, two relays and a line fuse are included in the system. The two relays and line fuse are located on the drivers side cowl panel beneath the dash panel, refer Fig.42.

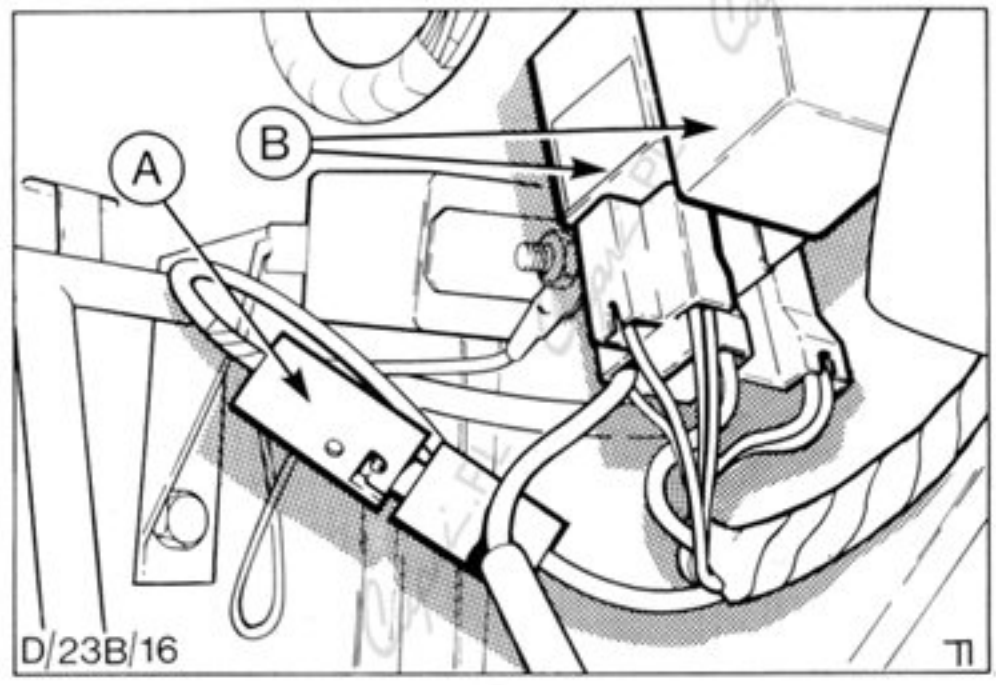


Fig.42. Location of injector relays and line fuse. (R.H.D. variant illustrated, L.H.D. module located on left hand cowl panel)
A - Line fuse
B - Relays

Fig.43, shown below details the complete electrical system in a pictorial form which will help in undersanding the operation of the individual circuits. The following Fig. Nos, 44, 45, 46 and 47 show the circuit in schematic form detailing which circuits are operational under four different operating conditions.

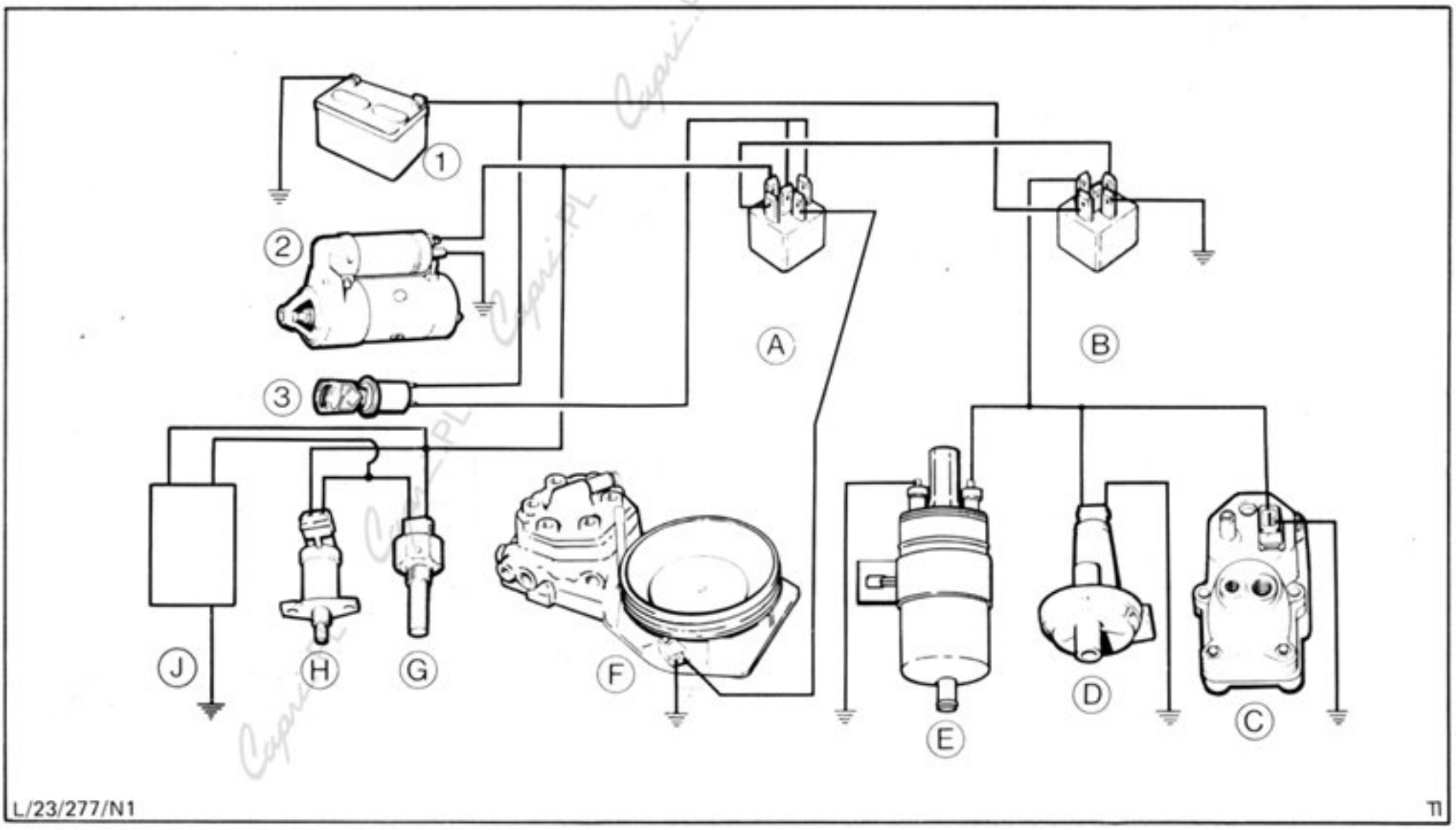


Fig.43. Petrol Injection Electrical System.

1 - Battery	B - Power supply relay	F - Safety switch at sensor plate
2 - Starter motor	C - Warm up regulator	G - Thermo time switch
3 - Ignition switch	D - Auxiliary air device	H - Start valve
A - Main control relay	E - Fuel pump	J - Impulse module

PRINCIPLE OF OPERATION (Cont'd)

ELECTRICAL CIRCUITS AND RELAYS

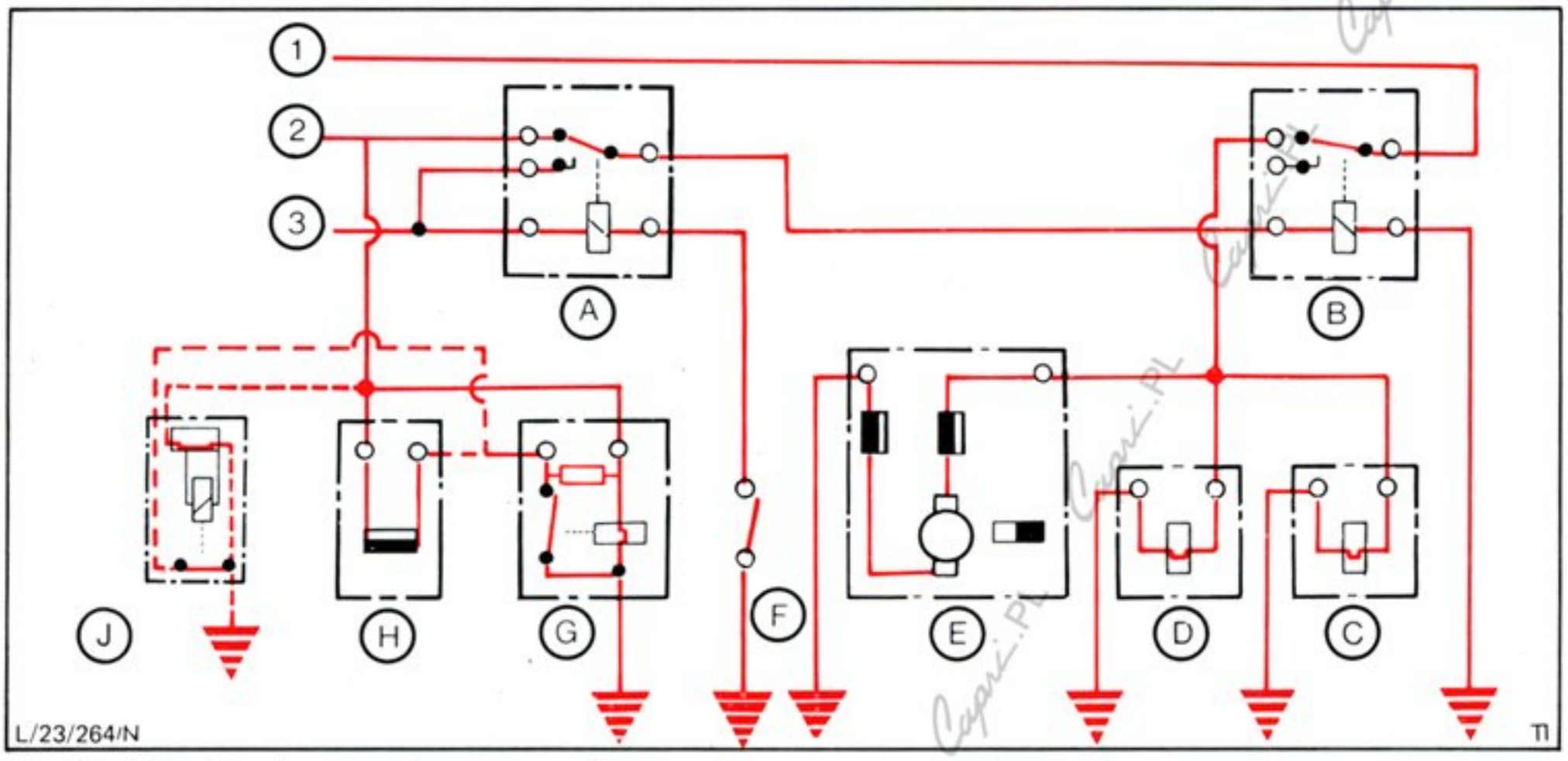


Fig.44. Circuits in operation when engine is being started - ENGINE COLD

A - Main control relay (Energised)
B - Power supply relay (Energised)
C - Warm up regulator
D - Auxiliary air device
E - Fuel pump (In operation)
F - Safety switch (Closed)
G - Thermo time switch
H - Start valve
J - Impulse module

Power flows from the ignition switch (Terminal 3) through the control relay 'A' to the safety switch 'F' and to earth. With the safety switch closed the circuit is complete and the control relay 'A' is energised. During cranking the solenoid terminal '2' will be live and power will now flow through the control relay 'A' to the power relay 'B' which becomes energised. With the supply relay 'B' energised power can flow from the battery terminal through the relay and out to the warm up regulator (C) auxiliary air device 'D' and fuel pump 'E'.
Power is also supplied to the thermo time switch 'G' and start valve 'H' from the starter solenoid.

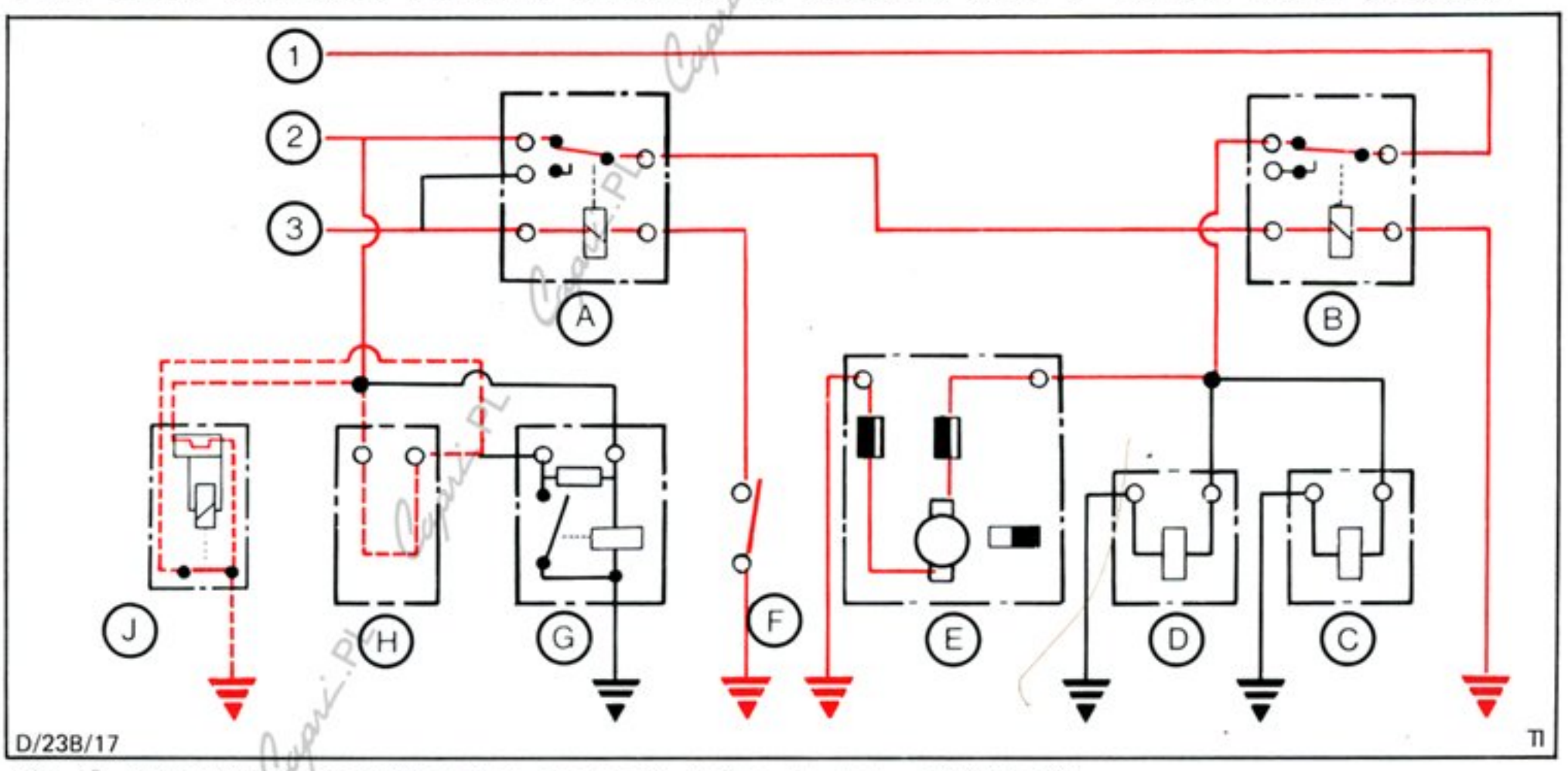


Fig.45. Circuits in operation when engine is being started - ENGINE HOT.

A - Main control relay (Energised)
B - Power supply relay (Energised)
C - Fuel pump
D - Safety switch
E - Start valve (Being pulsed)
F - Impulse module (Energised)

When starting a hot engine, the bi-metal strip built into the warm-up regulator, auxiliary air device, and thermo time switch are all open and these circuits are cut, thus ensuring that an over-rich mixture is not fed into the engine. However to ensure good starting characteristics are achieved the impulse module is energised to pulse the start valve during initial starting only. Power from the starter solenoid is fed through the start valve 'E' and earthed intermittently through the impulse module.

PRINCIPLE OF OPERATION (Cont'd)

ELECTRICAL CIRCUITS AND RELAYS

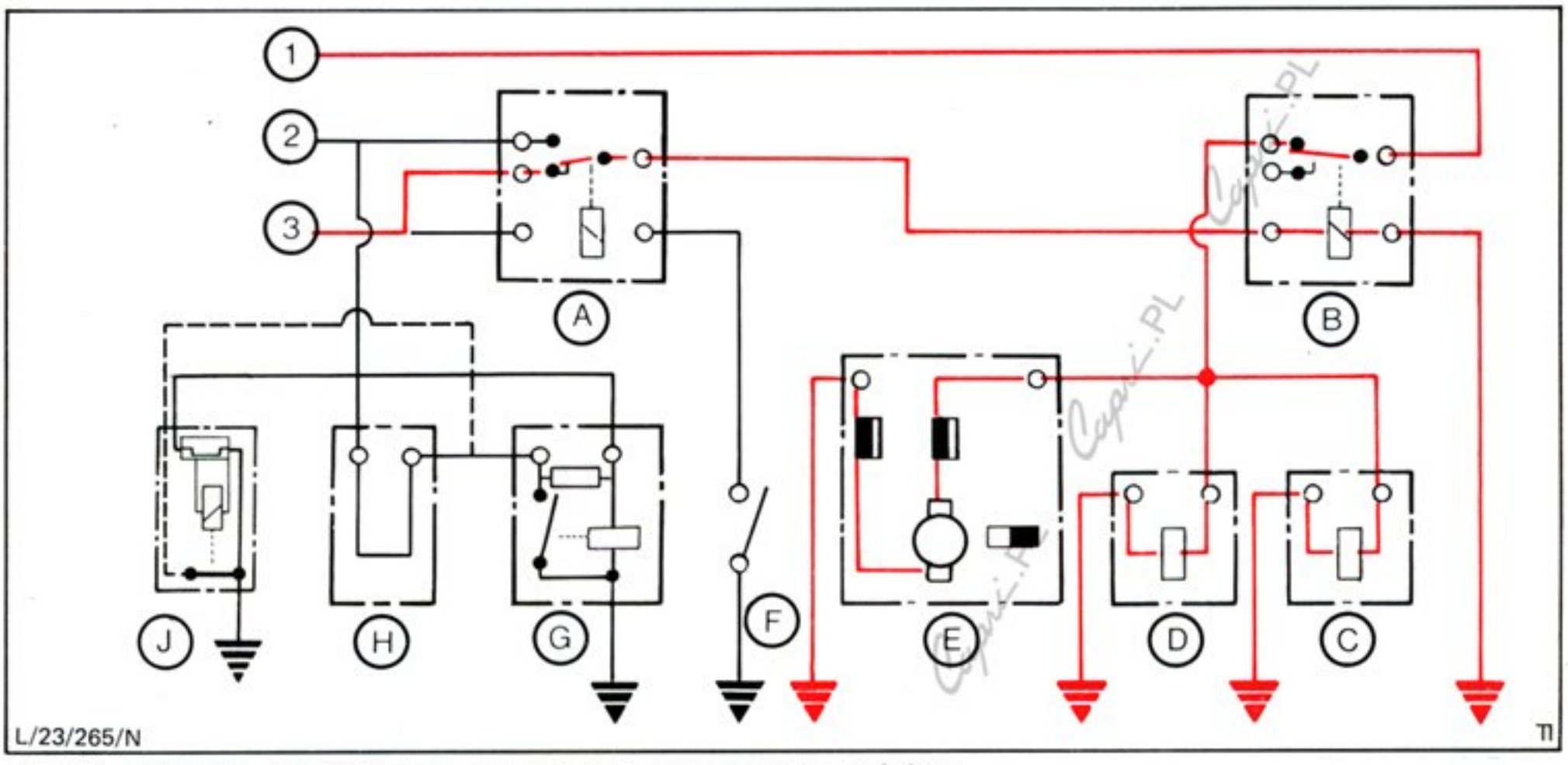


Fig.46. Circuits in operation during normal operation of engine.

1 - Battery	A - Control relay (De-energised)	D - Auxiliary air device
2 - Starter solenoid	B - Supply relay (Energised)	E - Fuel pump
3 - Ignition switch	C - Warm up regulator	F - Safety switch (Open)

When an engine is operating the air sensor plate is lifted from its seat which disconnects the safety switch 'F' and therefore cuts the circuit through the control relay 'A'. With the control relay de-energised power from the ignition switch will flow to the supply relay 'B' and to earth which energises the power relay. This then allows power from the battery to energise the warm-up regulator 'C', auxiliary air device 'D' and fuel pump 'E'.

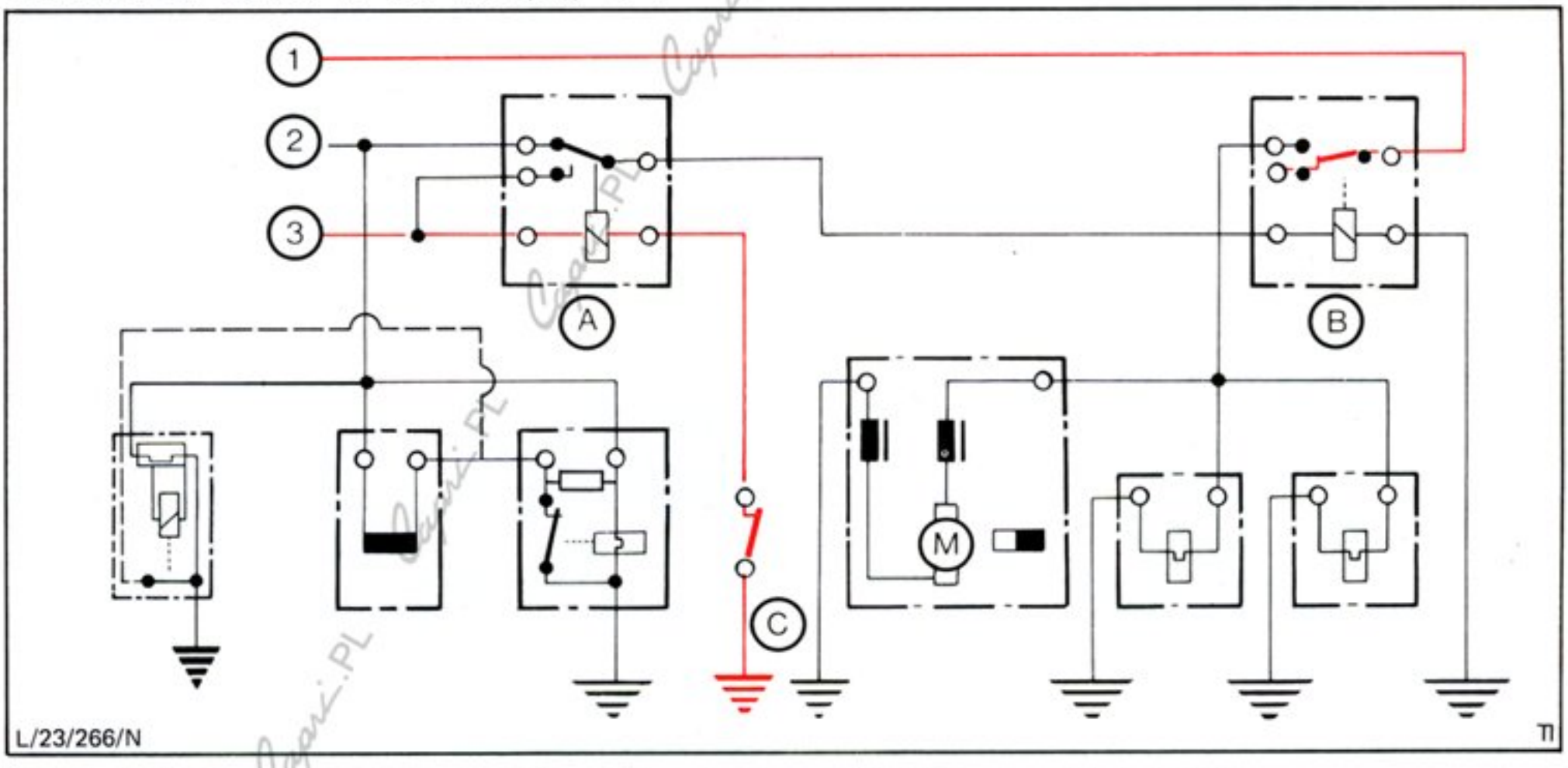


Fig.47. Circuit in operation when the engine stalls and ignition is switched 'ON'.

1 - Battery	A - Control relay (Energised)
2 - Starter solenoid	B - Supply relay (De-energised)
3 - Ignition switch	C - Safety switch (Closed)

When the engine stalls the air sensor plate will drop to its rest position and complete the circuit from the ignition switch. This energises the control relay 'A' cutting power to the supply relay 'B' which in turn cuts out the complete injection system including the fuel pump.

INJECTION SYSTEM CHECK AND ADJUST

Before attempting any detailed checks on the petrol injection system, it is essential that the basic engine is in a sound condition and that the ignition system is adjusted and operating correctly.

The test procedure described below covers all the tests and is therefore complete in itself. However, in practise the extent of the tests and the sequence to be followed will depend very much on the complaint to be handled.

When working on the petrol injection system, cleanliness is of a major importance. It is for this reason that fuel connections are to be cleaned before they are disconnected. Also always use new seals when refitting the fuel connections.

If the customer complaint occurs under all driving conditions, that is during the warm up period and when the engine is at normal operating temperature the basic injection system should be checked first as detailed below. However, if the complaint is poor starting or poor driveability during engine warm-up the injection auxiliary equipment should be checked first.

SPECIAL SERVICE TOOLS REQUIRED:

Pressure gauge - 23-011

1. Open hood and fit fender covers.

2. Ensure fuel filter has been changed at the specified maintenance intervals. If not replace fuel filter as described in Operation 23 545.

3. Ensure air cleaner filter element has been replaced at the specified service intervals.

4. Visually check the following items;

   (a) Check fuel pipes are not twisted or kinked and that connections are not leaking.

   (b) Check all air hoses for splits and connection for secure fit, Fig.48.

   (c) Check all electrical connections for secure fit.

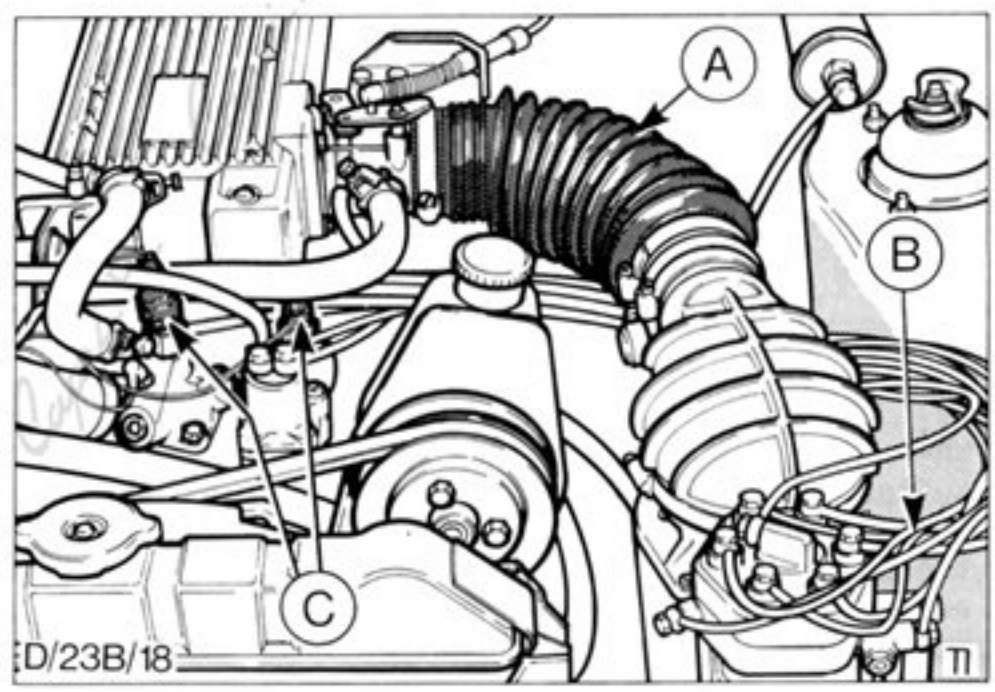


Fig.48. Injection system visual check.
A - Main air supply hose to be checked for splits and secure fit
B - Pipes to be checked for twists or kinks
C - Electrical connections checked for secure fit

5. Disconnect main hose at the mixture control unit, Fig.49.

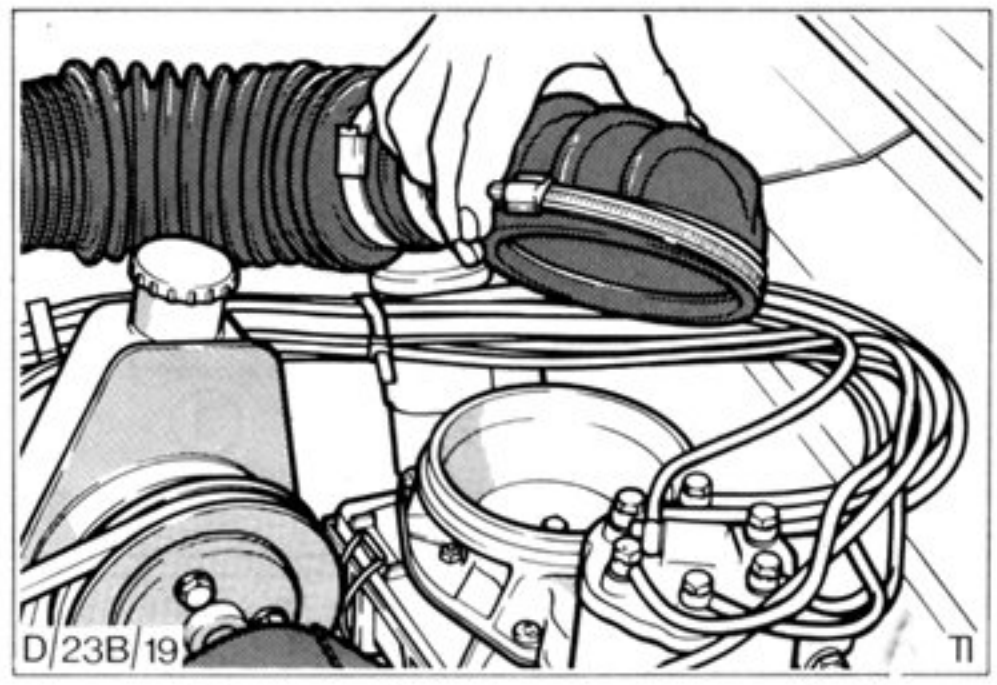


Fig.49. Disconnecting main air hose at air flow sensor.

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

6. Disconnect safety switch at air sensor unit.

7. Turn ignition 'ON' for approximately 5 seconds.

   The fuel pump will now operate and pressurise the system. Pump operation can be confirmed by listening at the rear of the vehicle.

8. Using a pair of pliers operate sensor plate and plunger assembly checking unit does not bind or stick, Fig.50.

NOTE: Due to control pressure acting on top of control plunger, sensor plate movement will feel sluggish and this should not be confused with binding or sticking.

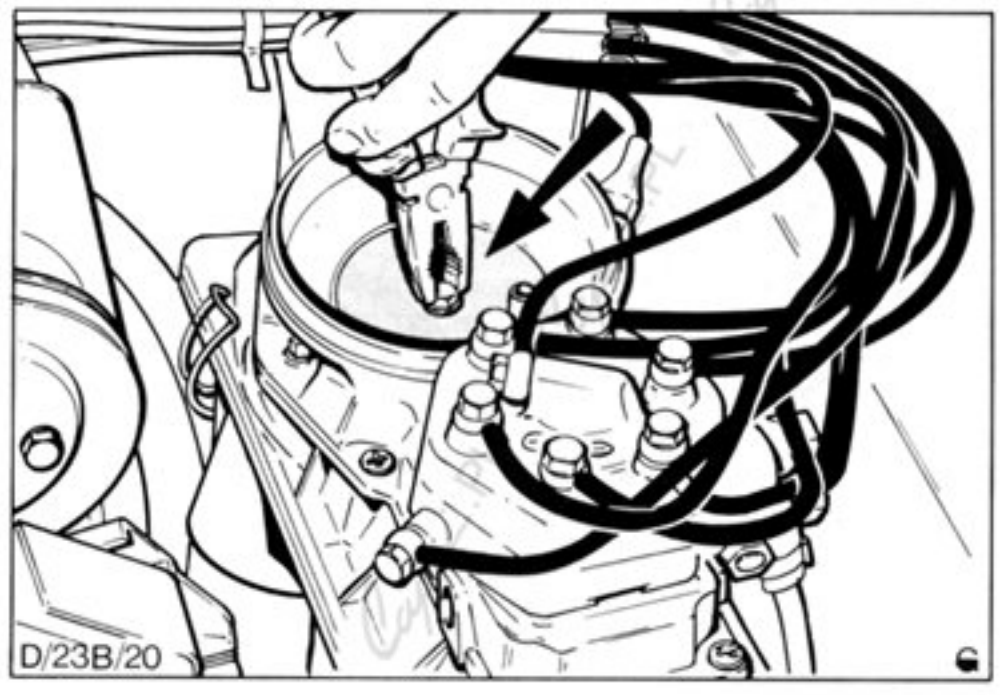


Fig.50. Checking air sensor plate movement.

9. Check sensor plate rest position. With plate in rest position upper edge should be level with start of cone or up to a maximum of 0,5 mm (0,02 in) below this point. Refer Fig.51.

   To adjust fully open sensor plate and using a pair of pliers bend clamp spring.

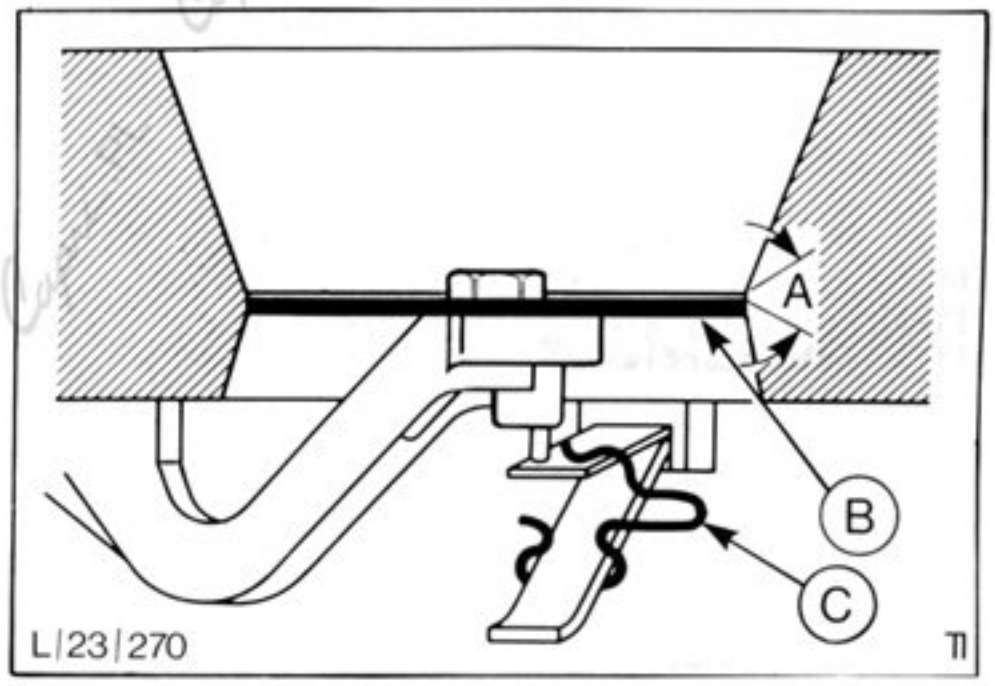


Fig.51. Air sensor plate.
Dimension 'A' maximum of 0,5 mm (0,02 in)
B - Sensor plate
C - Clamp spring

10. Check fuel pump output as follows:

NOTE: Ensure fuel handling safety precaution as detailed on page 30 are strictly adhered to.

(a) Disconnect fuel return pipe from main system pressure regulator.

(b) Make up a separate hose of aproximately 700 mm (28 in) in length and connect to regulator outlet.

(c) Position hose into a measuring jar graduated up to approximately 1500 cm^3.

(d) Turn ignition 'ON' for exactly 30 seconds and measure quantity of fuel delivered by pump. (Refer specification) If minimum specified quantity of fuel is not delivered check voltage at pump electrical connection and check fuel filter for clogging before pump is replaced.

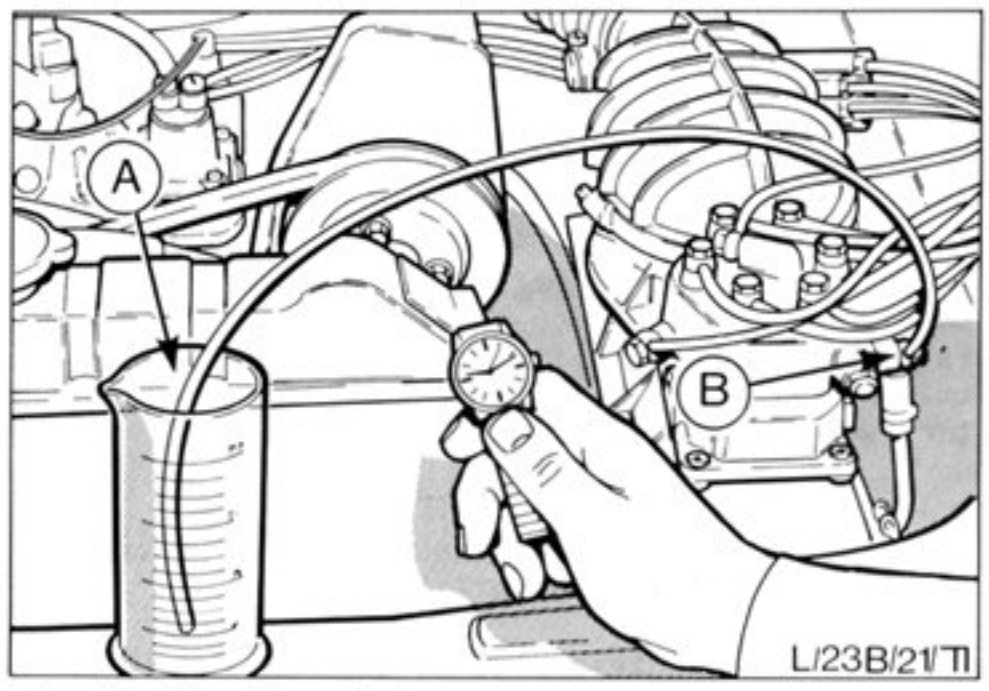


Fig.52. Checking fuel pump output.
A - Measuring jar
B - Regulator output connection

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

11. Carry out a complete system pressure check.

NOTE: Four separate pressure readings taken under differing operating conditions are required to fully check the two injection pressure systems. These are:

(a) Control pressure engine cold
(b) Control pressure engine warm
(c) Control pressure engine idling
(d) Main system pressure

(a) Place a piece of absorbent cloth beneath warm-up regulator output pipe at the fuel distributor and disconnect pipe.

NOTE: The cloth is required to soak up the small amount of fuel that may drain from system. Dispose of cloth in accordance with fuel handling safety precautions.

(b) Connect pressure gauge (Tool No 23-011) into warm-up regulator output pipe circuit, Fig.53.

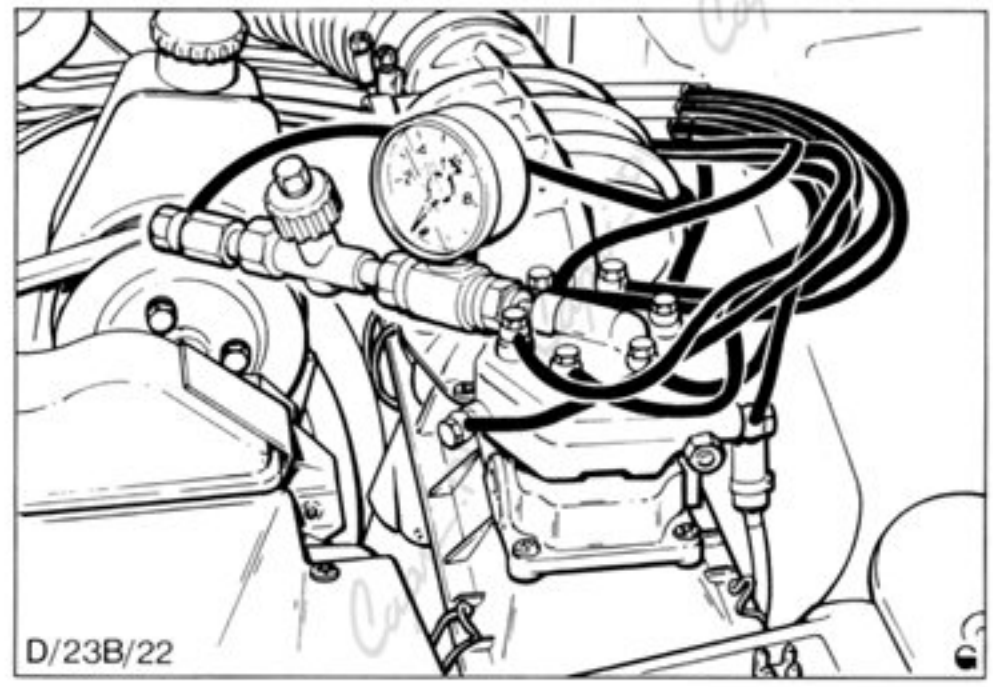


Fig.53. Pressure gauge connected into the warm-up regulator feed pipe.
A - Pressure gauge (23-011)
B - Fuel distributor

(c) Disconnect electric plugs from following components:

(i) Mixture control unit safety switch, Fig.54.
(ii) Thermo time switch
(iii) Auxiliary air device
(iv) Cold start valve
(v) Warm-up regulator

NOTE: If in doubt as to where the above mentioned components are reference should be made to Fig.1.

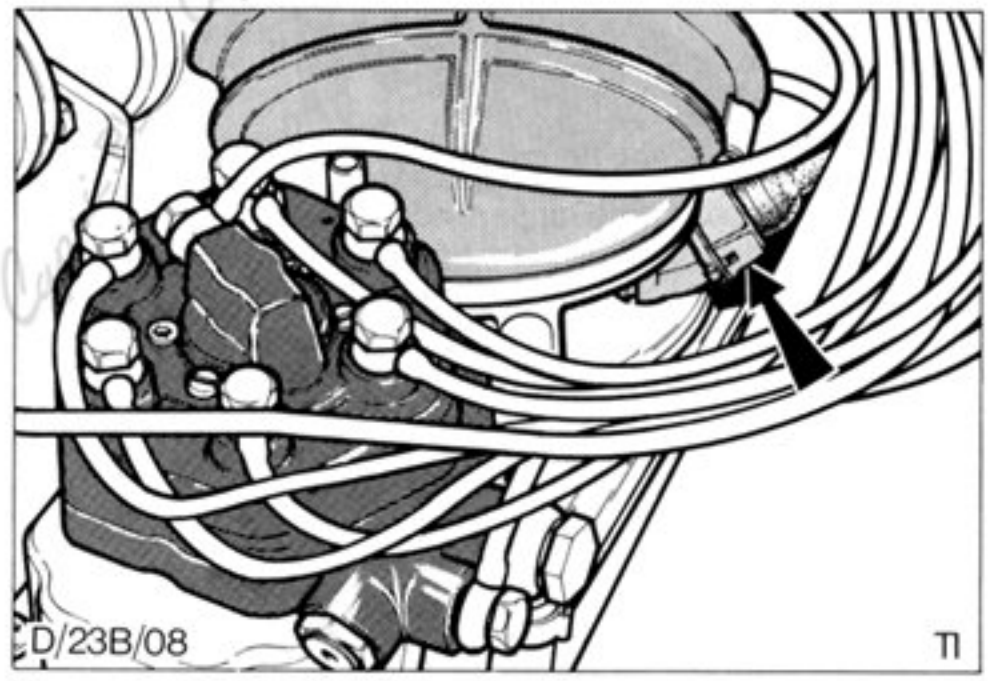


Fig.54 Mixture control unit safety switch plug.

(d) Carry out control pressure check with engine cold as follows:

(i) Open shut off valve on pressure tester.
(ii) Switch on ignition. (Do not start engine)

NOTE: With mixture control unit safety switch disconnected pump will operate normally.

(iii) Record ambient temperature and pressure reading on gauge. Compare figures recorded with graph shown in the Technical Data Section.

Example - Ambient temperature 20°C pressure gauge should read between 0,6 and 1,0 bars. If pressure is outside specification and all visual and preliminary checks as detailed on page 22 are satisfactory warm-up regulator should be replaced.

(e) Carry out control pressure check with warm-up regulator fully operational.

(i) Connect electric plug to warm-up regulator, Fig.55.

With ignition switched 'on' the bi-metal strip in the regulator will heat and increase control pressure recorded on gauge.

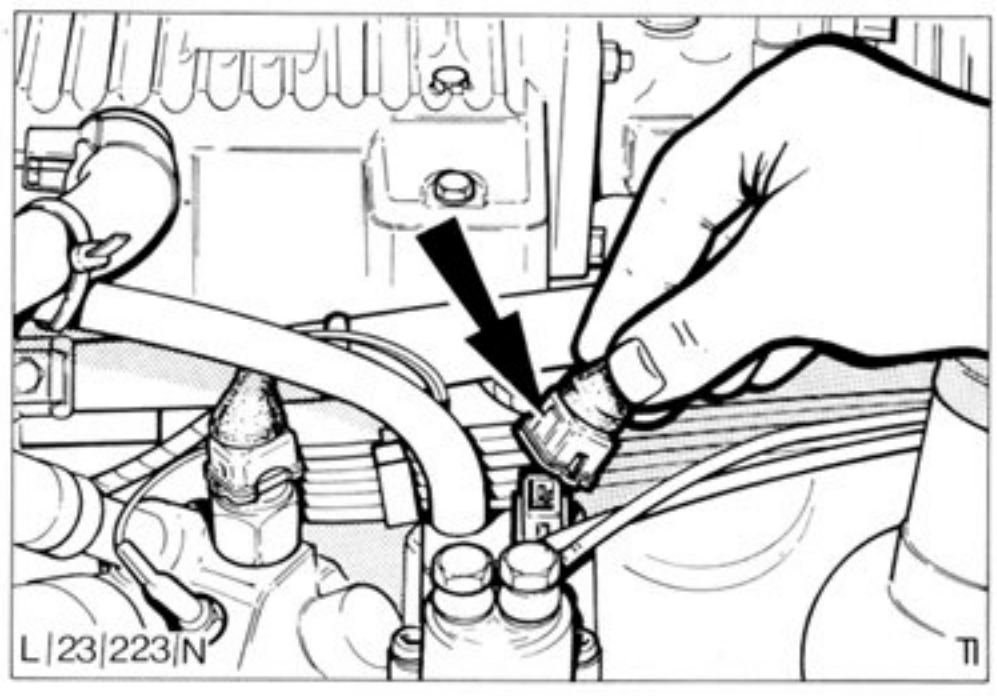


Fig.55. Reconnecting warm-up regulator electric plug.

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

(ii) Wait for bi-metal strip to fully heat up which will take approximately 6 mins and record pressure. (Refer Technical Data)

12. Carry out control pressure check with engine idling.

(i) Reconnect electric plug to safety switch on air sensor, Fig.56.

(ii) Start engine and allow to idle.

NOTE: The control pressure should rise due to manifold vacuum operating warm-up regulator.

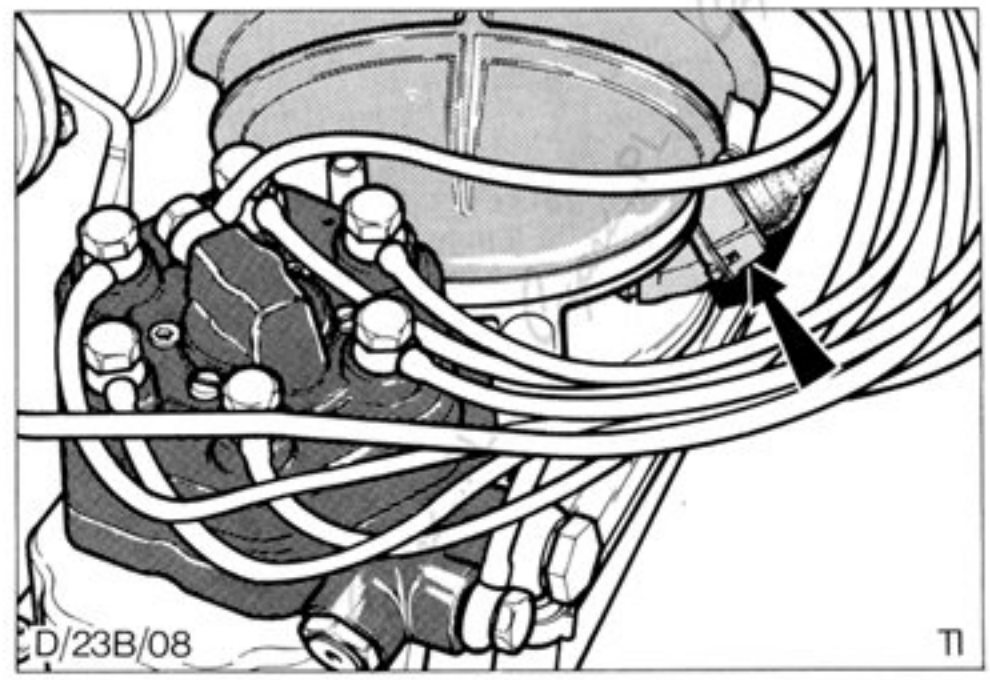


Fig.56. Air sensor plate safety switch reconnected.

If at this stage vacuum connection at regulator, Fig.57, is disconnected, pressure will drop to figure obtained in Sub-Operation 11.
Stop engine.

13. Carry out main system pressure check as follows:

NOTE: This check ensures that pressure regulator is operating to specification.

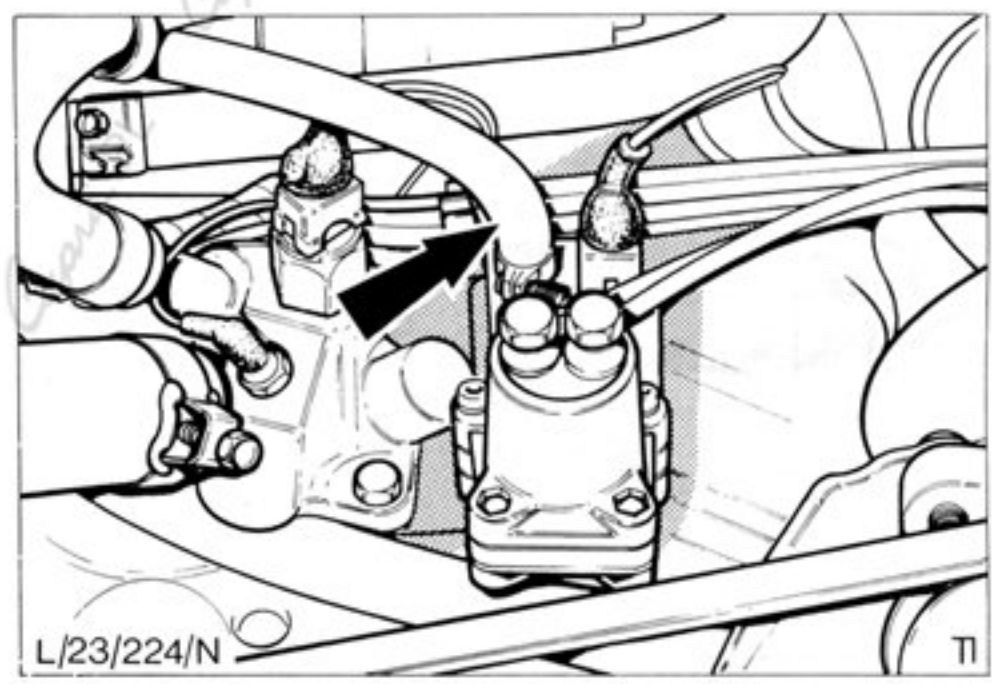


Fig.57. Vacuum connection at warm-up regulator.

Fig.58, shows in schematic form the system that is being checked.

NOTE: Engine temperature has no effect on main system pressure.

(i) Disconnect electric plug from air sensor safety switch, Fig.56, and switch ignition 'ON'. The fuel pump should now be operating.

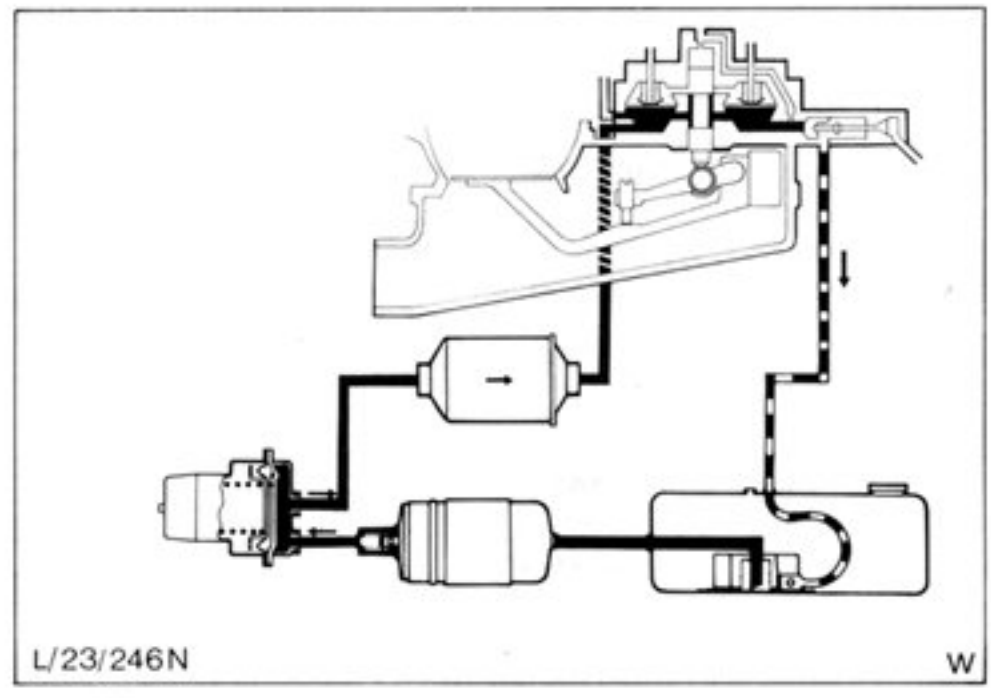


Fig.58. Main system pressure circuit.

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

(ii) Close shut off valve at pressure gauge and record pressure. Gauge will now indicate main system pressure which should be compared with specification. (Refer Technical Data) If pressure is outside specification the regulator, Fig.59, can be removed and adjusted as follows.

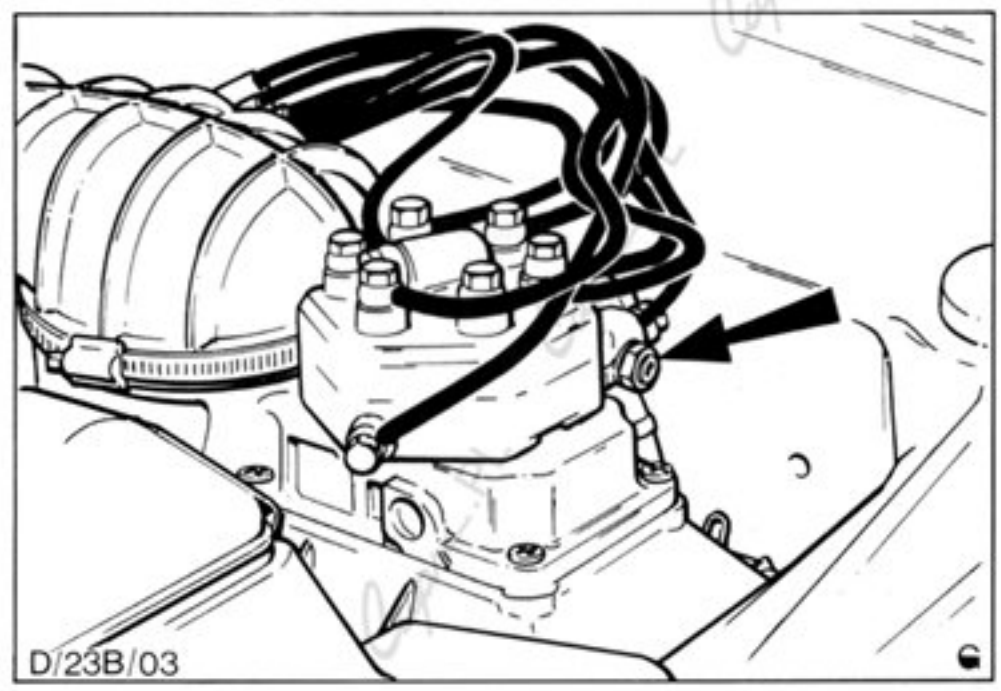


Fig.59. Main system pressure regulator.

14. Remove pressure regulator from fuel distributor and remove spacer shims (to reduce pressure) or add shims (to increase presure), Fig.60.

15. Refit regulator and re-check main system presure (Sub-operation 13).

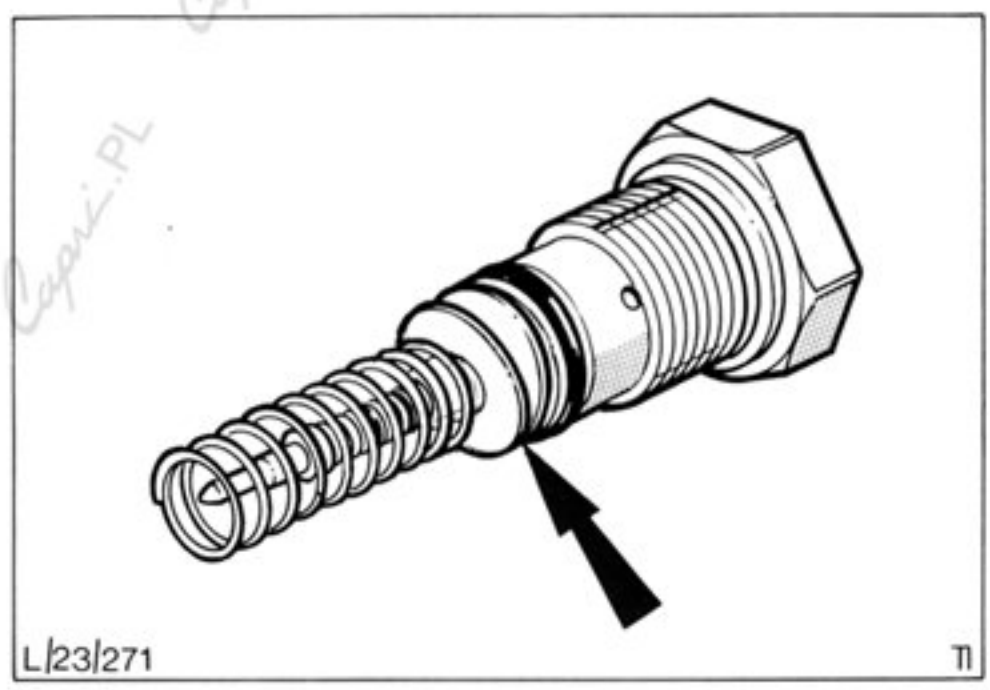


Fig.60. Main system pressure regulator. Adjusting shims arrowed.

16. Check operation of auxiliary air device. (Ensure safety switch at mixture control unit is disconnected).

(i) Disconnect both air hoses at the air device.

(ii) Using a mirror and lamp look through air device. On a cold engine device will be open as shown in Fig.61.

(iii) Connect electric plug to air device, turn ignition 'ON' and note operation of air device. As bi-metal strip warms up, pivot plate inside unit will fully block air outlet.

(iv) Reconnect air hoses.

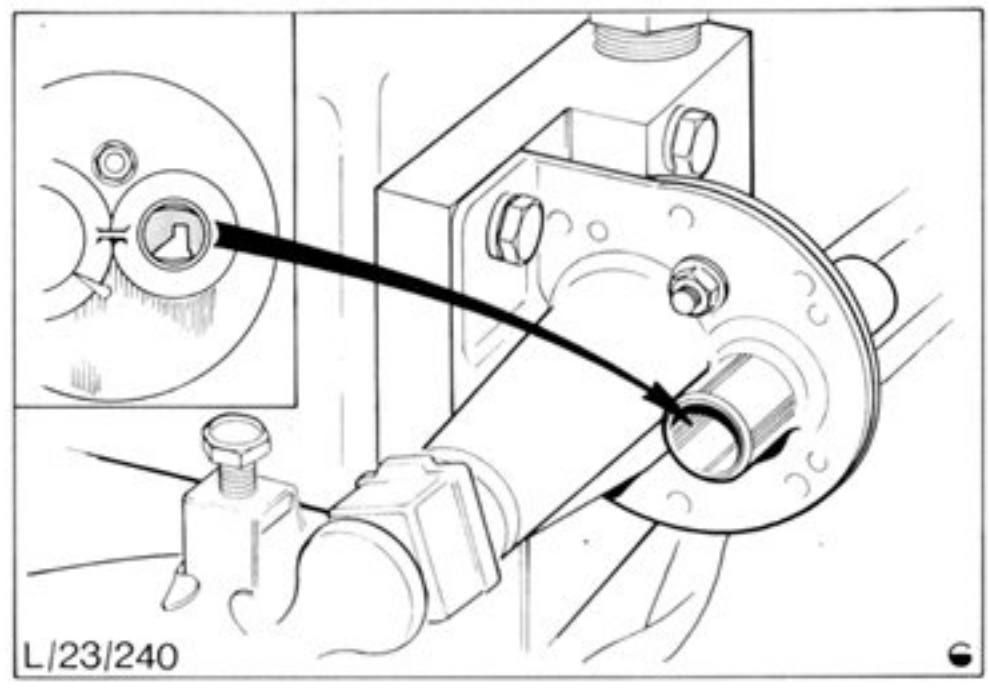


Fig.61. Auxiliary air device check. (Engine cold and device open)

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

17. Check operation of warm-up regulator.

NOTE: The following check is in addition to the control pressure check as detailed in Sub-operation 11 and 12.

(i) Reconnect electric plug to warm-up regulator and switch ignition 'On'.

(ii) Peel back plug insulation and check voltage at the two connections, Fig.62. (Minimum voltage 11,5V).

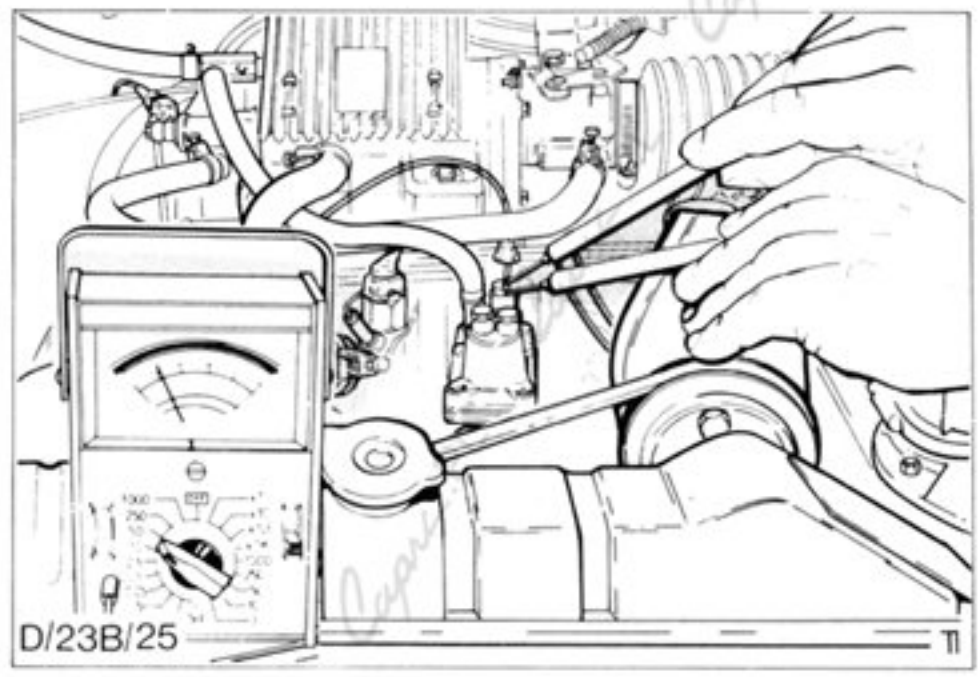


Fig.62. Voltage check at regulator plug.

(iii) Disconnect plug and using an ohm meter check resistance between the two regulator connections, Fig.63.

If an open circuit is recorded the bi-metal heater coil will be broken, and a new regulator will be required.

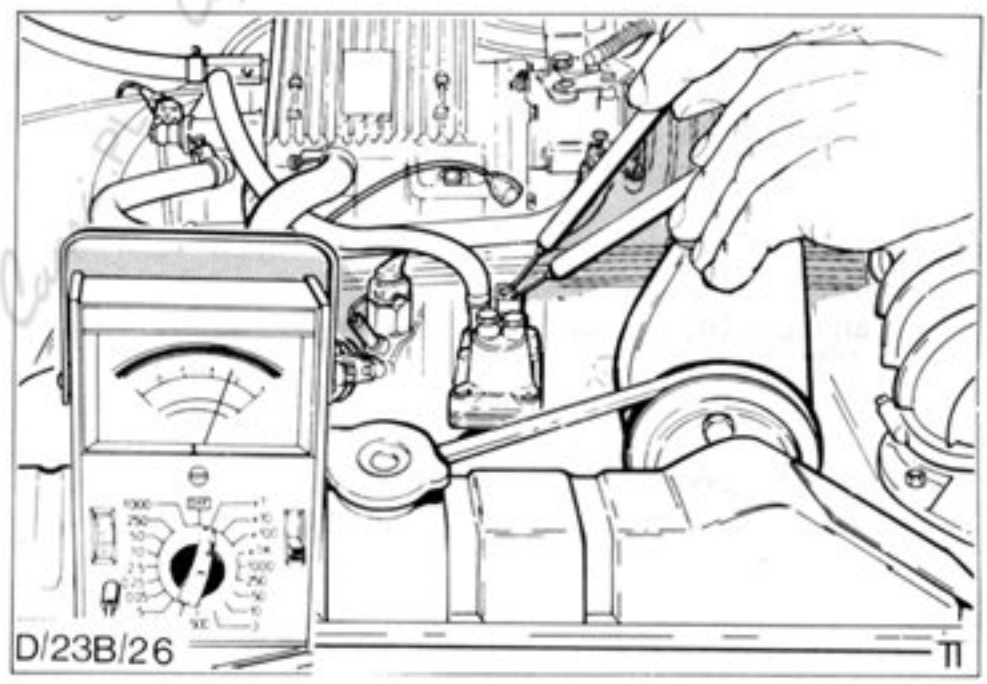


Fig.63. Resistance check at regulator socket.

18. Cneck operation of cold start valve. (Spray and leak test)

NOTE: Before carrying out test refer to fuel handling safety precaution as detailed on page 30.

(i) Remove two bolts securing start valve to air box.

(ii) Connect electric plug from auxiliary air device to start valve.

(iii) Hold valve in a glass jar and turn ignition 'ON' for two to three seconds, Fig.64. Fuel should now spray from valve.

(iv) Disconnect plug from start valve and re-connect to auxiliary air device.

(v) Turn on ignition to operate fuel pump.

(vi) After 10 seconds wipe valve clean and hold for a further 60 seconds. During this 60 second period no fuel should seep from valve.

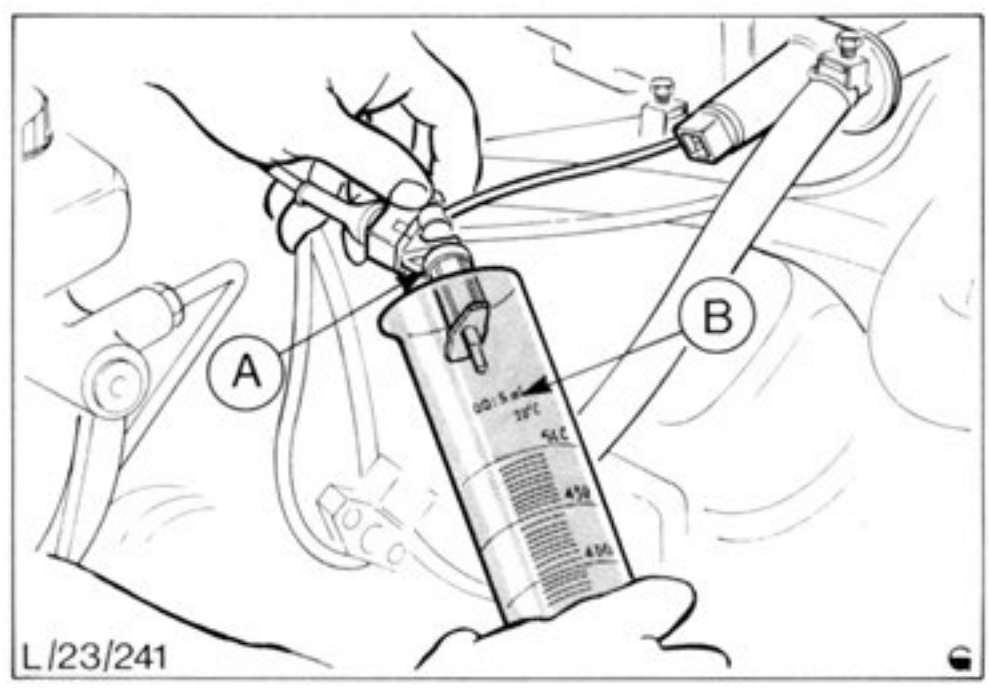


Fig.64. Cold start valve spray check operation.

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

19. Check operation of thermo time switch.

(i) Ensure engine temperature is below 30°C.

(ii) Disconnect one of the coil L.T. leads. (To stop engine firing)

(iii) Ensure thermo switch plug is connected and safety switch plug disconnected.

(iv) Peel back insulation at switch plug and with engine cranking measure voltage at plug, Fig.65.

(v) Disconnect plug.

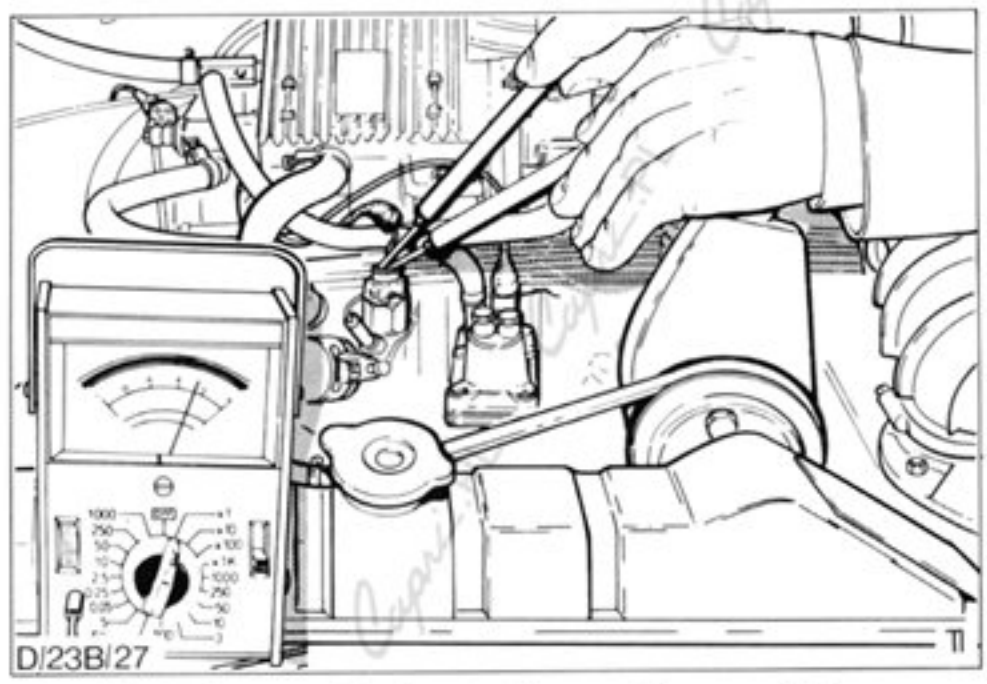


Fig.65. Voltage check at thermo time switch.

(vi) Connect an ohm meter between one of the switch terminals and earth, record resistance.

Reconnect ohm meter between second terminal and earth, record resistance, Fig.66.

On a cold engine the heater terminal A in Fig.66, will record a resistance and the bi-metal terminal 'D', will record a zero resistance.

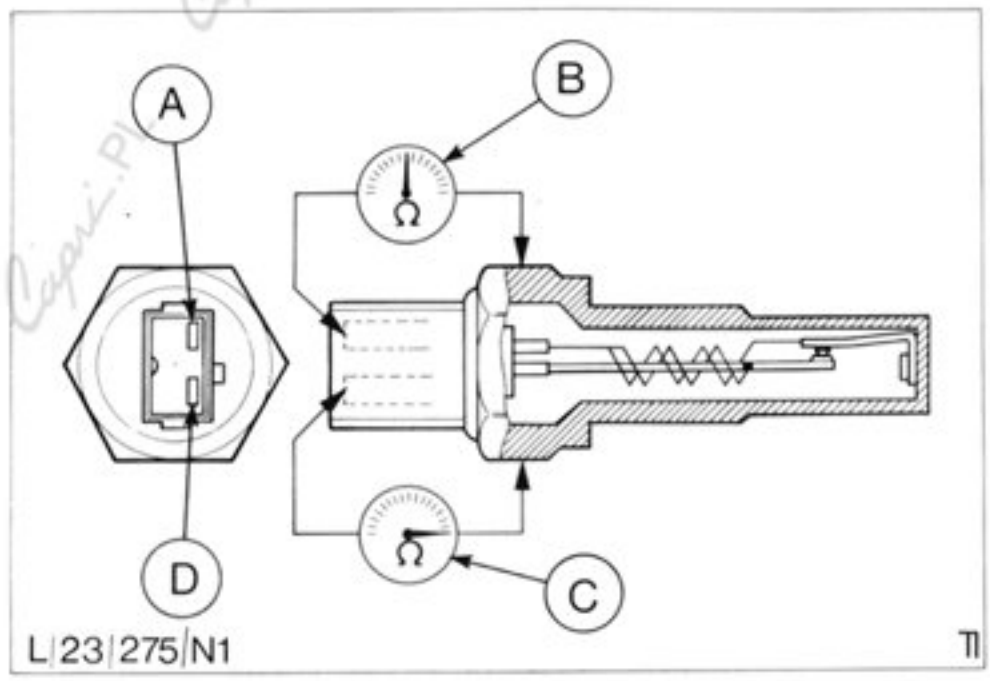


Fig.66. Resistance check with engine cold.
A - Heater terminal
B - Resistance reading at heater terminal
C - Zero reading at bi-metal terminal
D - Bi-metal terminal

(vii) Reconnect L.T. lead at coil.

(viii) Reconnect plug and refit insulation.

(ix) Warm-up engine to normal operating temperature and recheck resistance, Fig.67. The heater terminal 'A' should now record a higher resistance whereas the bi-metal terminal 'D' should record an open circuit.

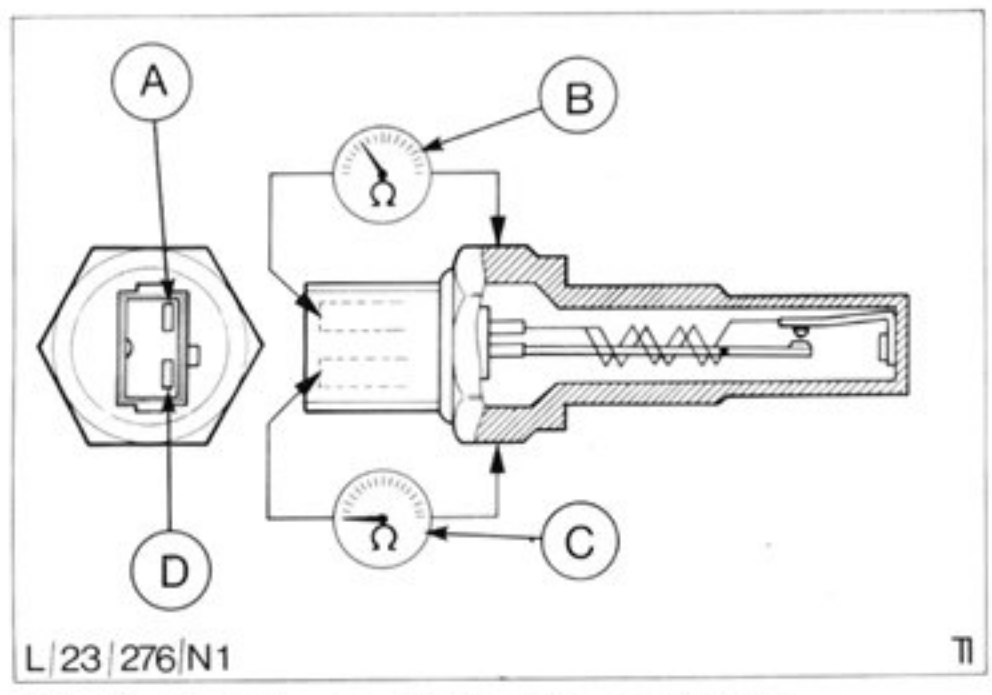


Fig.67. Resistance check with engine hot.
A - Heater terminal D - Bi-metal terminal
B - Increased resistance reading at heater terminal
C - Open circuit reading at bi-metal terminal

INJECTION SYSTEM CHECK AND ADJUST (Cont'd)

20. Check and adjust engine idle speed and fuel mixture setting.

    Detailed in Operation No. 23 213.

21. Check entire system for internal leaks.

    This test takes a considerable amount of time, since the drainage time for fuel accumulator has to be taken into account. The test should detect slight leakages in the internal system which could lead to hot start difficulties.

    Therefore this test should only be applied in cases where hot start difficulties have been reported. The pressure tester should be installed as for previous tests.

    NOTE: It is important that engine and warm-up regulator have cooled down when starting test. This means that engine should have been allowed to cool for approximately 60 minutes with hood open.

    (a) Open shut-off valve on pressure tester.

    (b) With electric plug disconnected from safety switch and correct plug connected to warm-up regulator, switch on ignition so that electric fuel pump starts priming system.

    (c) Observe increase in control pressure and wait for pressure to indicate control pressure 'warm'.

    (d) Switch off ignition (and therefore the electric fuel pump) and watch pressure drop to residual level of 2,3 bar. This residual pressure is created by fuel accumulator.

    (e) After 10 minutes, check drop in residual pressure and compare with specification.

NOTE: If residual pressure drops below minimum level, test should be repeated but with shut-off valve on pressure tester closed. This will determine whether area of internal leak lies after or before the pressure tester.

    It is recommended to check components in the following order and replace those found defective.

    (i) O-seal in the system's pressure regulator.

    (ii) Non-return valve fitted to output side of electric fuel pump. Replace pump external valve if required.

    (iii) Cold start valve. Refer component tests.

    (iv) Injector valves.

22. Check all plugs are fitted to the individual injection system components.

23. Remove fender cover and close hood.

FUEL (PETROLEUM SPIRIT) HANDLING SAFETY PRECAUTIONS

When carrying out repairs to vehicle fuel systems it is easy to become complacent about handling fuel, particularly in relation to draining fuel tanks. The risks involved should not be under estimated. The following information provides the basic precautions which must be taken if fuel is to be handled safely and also points out some other areas of risk that must not be overlooked.

1. Disconnect the battery when carrying out any work on fuel systems, except when a test requires ignition to be turned 'on'.

2. Always empty fuel tanks in the open, preferably in a designated no-smoking area. If this is not possible, portable warning notices should be positioned around the vehicle when carrying out the draining operation.

3. Always have a suitable fire extinguisher close at hand.

4. Empty tank using suitable pumping equipment, not by disconnecting fuel line from sender unit.

5. Ensure there are no naked lights or other ignition sources (i.e. welding equipment) within 7 metres (20 feet) of the vehicle, before commencing the emptying process.

6. Do not empty the tank over an inspection pit. Petrol vapour is heavier than air and will remain in a pit for several hours. This also applies when cleaning carburettor float bowls or fuel pumps as small amounts of petrol can produce sufficient vapour to constitute a possible source of risk.

7. Empty the fuel into a closed, clearly marked container. There are containers on the market which are specifically suited to this purpose incorporating such devices as a flame arrestor and a pressure vented cap.

8. Having removed the fuel, do not leave it standing in the workshop. Petrol should only be kept in a store which meets with the approval of local by-laws.

9. When the fuel has been drained from the tank, the tank will still contain petrol vapour. In this state it is in an even more hazardous condition, and the precautions regarding naked lights and other ignition sources should be maintained with the utmost care.

10. On many vehicles the fuel line is connected to the fuel tank outlet pipe by spring steel band clips to ensure a leak proof joint. These clips should be released before the fuel line is disconnected or the tank sender unit is removed. By observing this procedure, any sparks which may be generated when removing the clips cannot ignite residual petrol fumes in the fuel tank.

11. In no circumstances should any repair involving the application of heat be attempted on any fuel tank, without first rendering the tank safe. There are two main methods of rendering the tank safe:

    (a) Steaming Out.
    The filler cap and the tank sender unit must be removed and the tank emptied as completely as possible before steaming out. The tank should then be steamed for at least two hours with low pressure steam. Position the tank so that the condensate can drain away freely, thus ensuring that sediment and sludge, not volatilised by the steam, are washed out during the steaming process.

    (b) Boiling Out
    Again the filler cap and the tank sender unit must be removed and the tank emptied. Immerse the tank completely in boiling water containing an effective alkaline degreasing agent or a detergent, with the water filling as well as surrounding the tank. Boil the tank for at least two hours.

    In addition, no person should be allowed to work on petrol or any fuel tank repairs without having the special training necessary.

12. As an added precaution fuel tanks should have a PETROL (GASOLINE) VAPOUR warning label attached to them as soon as they are removed from the vehicle. After steaming or boiling out a signed and dated label to this effect should be attached to the tank.

DIAGNOSIS CHART

NOTE:
- When using this chart it is assumed that general engine condition is satisfactory and ignition system is adjusted correctly.
- It is also assumed that the electrical system, including the safety cut-out circuit for the petrol injection system, has been checked and repaired if necessary.
- For accurate diagnosis it is most important that tests identified on pages 22 to 29 are performed prior to replacement of any suspected faulty component.

Symptoms

1. Engine does not start in cold condition	2. Engine does not start in warm condition	3. Engine starts poorly in cold condition	4. Engine starts poorly in warm condition	5. Irregular idling during warm-up phase (shakes)	6. Irregular idling with warm engine (shakes)	7. Engine backfires into intake manifold	8. Engine backfires into exhaust system	9. Engine misfires when operating on the road	10. Driving performance unsatisfactory	11. Engine runs 'on'	12. High petrol consumption	13. CO level during idling too high	14. CO level during idling too low	15. Idle-speed cannot be adjusted (too high)	Possible Problem
X	X														1. Electric fuel pump not operating
									X						2. Loose contact at electric fuel pump
X		X		X											3. 'Cold' control pressure outside tolerances
	X		X		X	X			X				X		4. 'Warm' control pressure out of adjustment, too high (after warm-up)
	X		X		X		X		X		X	X			5. 'Warm' control pressure out of adjustment, too low (after warm-up)
			X	X	X									X	6. Auxiliary-air device does not close
X		X		X											7. Auxiliary-air device does not open
X		X													8. Start valve does not operate
X		X		X	X		X		X			X	X		9. Start valve leaking
									X						10. System's pressure outside tolerances
X	X	X	X												11. Air-flow sensor plate stop set incorrectly (too deep in air funnel)
X	X	X	X		X				X	X		X			12. Air-flow sensor plate and/or control plunger not moving freely
X	X	X	X	X	X	X			X				X		13. Vacuum system leaking
X	X	X	X	X	X		X	X			X	X			14. Overall fuel system leaking
	X		X	X	X					X					15. Injection valve(s) leaking, opening pressure too low
	X		X		X		X		X		X	X			16. Basic mixture adjustment (idle adj.) too rich
	X		X		X		X		X				X		17. Basic mixture adjustment (idle adj.) too lean
									X						18. Throttle does not open completely
X		X													19. Thermo-time switch does not close
	X		X												20. Impulse module does not operate

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals the following items should be checked and adjusted or replaced as necessary.

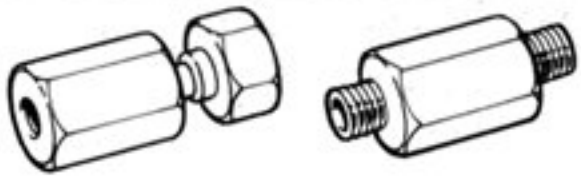
1. Check and if necessary adjust engine idle speed and fuel mixture setting as detailed in Operation No. 23 213.

   NOTE: At pre-delivery inspection adjustment should be confined to idle speed only.

2. Replace air cleaner element as detailed in operation 23 174.

3. Replace fuel filter as detailed in operation 23 545.

SPECIAL SERVICE TOOL RECOGNITION

Tool	Tool Name
 23-011	Pressure Gauge
 23-011-01	Pressure Gauge Adaptors

SERVICE AND REPAIR OPERATIONS - CONTENT

PETROL INJECTION SYSTEM	Description in this Publication	Contained in Operation
23 184 Element - air cleaner - Replace	X	
23 213 Engine idle speed and fuel mixture - Adjust	X	
23 421 Fuel system - pressure check	X	
23 422 Fuel distributor - Remove and Install	X	
23 424 Warm up regulator - Remove and Install	X	
23 426 Fuel start valve - Remove and Install	X	
23 428 Auxiliary air device - Remove and Install	X	
23 454 Injector - Remove and Install (One)		23 455
23 455 Injectors - Remove and Install (All)	X	
23 482 Pipe - injector delivery - Remove and Install (One)		23 483
23 483 Pipes - injector delivery - Remove and Install (All)	X	
23 534 Fuel pump - Remove and Install	X	
23 538 Fuel accumulator - Remove and Install	X	
23 545 Fuel filter - Remove and Install	X	

23 184 ELEMENT - AIR CLEANER - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Detach four cleaner retaining clips. Three shown in Fig.68.
4. Carefully raise fuel distributor assembly and detach air cleaner element. Refer Fig.69.

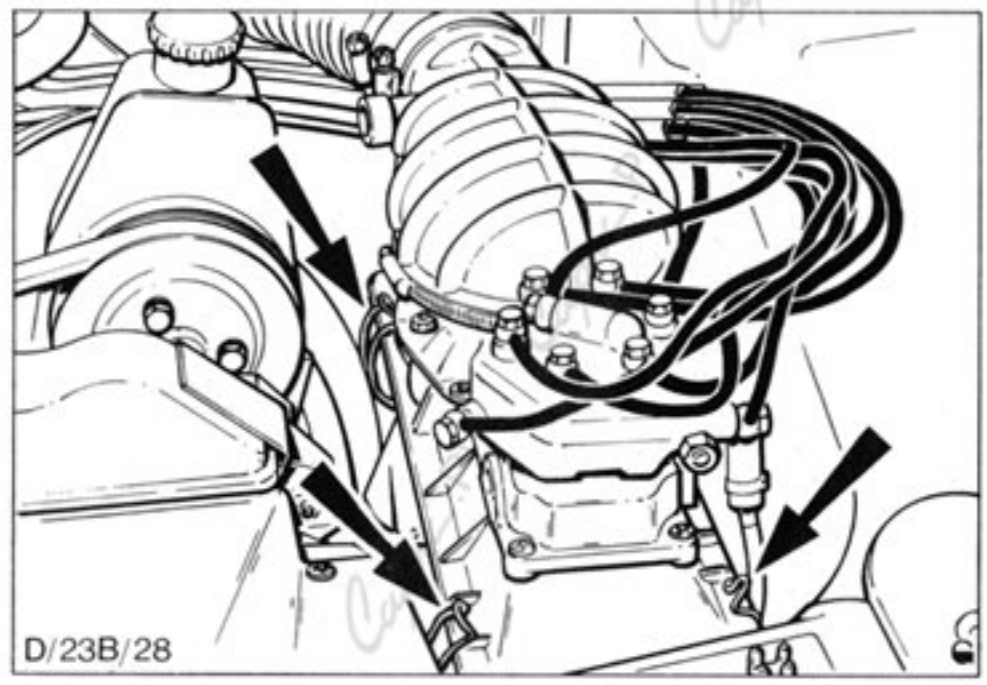


Fig.68. Air cleaner securing clips.

To Install

5. Place filter in position and refit cleaner upper casing and fuel distributor assembly.
6. Ensure filter and cleaner are correctly located and secure four clips.
7. Reconnect battery.
8. Remove fender covers and close hood.

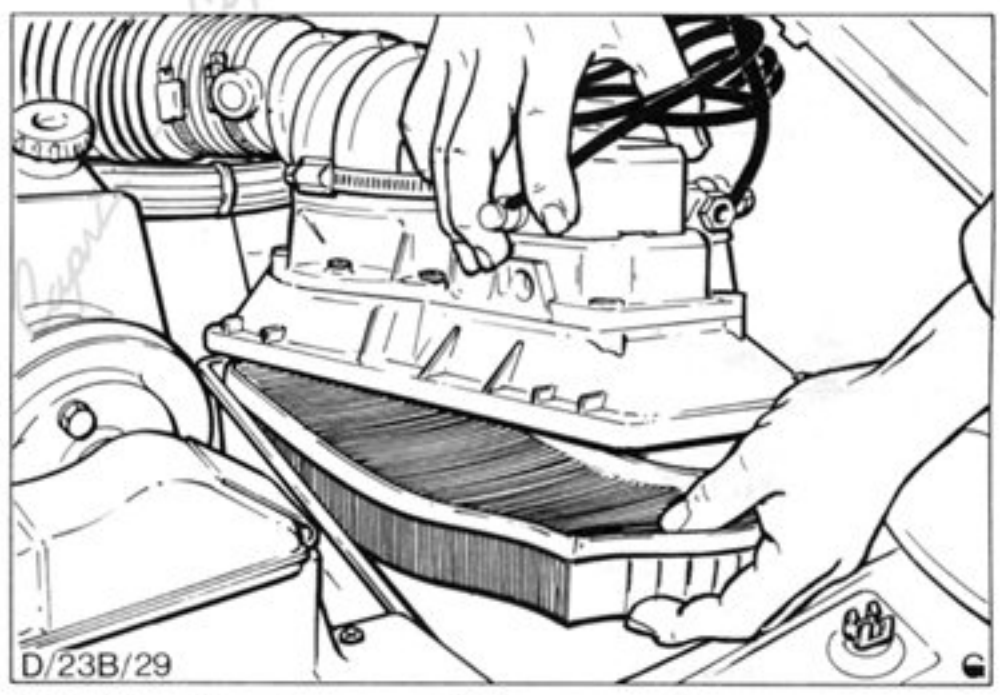


Fig.69. Air cleaner filter removal.

23 213 ENGINE IDLE SPEED AND FUEL MIXTURE - ADJUST

SPECIAL SERVICE EQUIPMENT REQUIRED:

RPM Meter
CO Meter
3 mm allan key - minimum length 100 mm (4,0 in)

1. Open hood and fit fender covers.
2. Warm up engine to normal operating temperature.
3. Connect CO and RPM meters to engine as per manufacturers instructions.
4. Stabilise engine by running at 3000 rpm for approximately 30 seconds and allow engine to idle.
5. Wait for meters to stabilise and record % CO and idle speed.
6. Adjust idle speed screw to achieve correct idle RPM, Fig.70. (Refer Technical Data section)

NOTE: It will be found that during normal routine maintenance servicing, normally no adjustment of the mixture (CO level) will be required. However, if CO level is found to be incorrect the following procedure should be adopted.

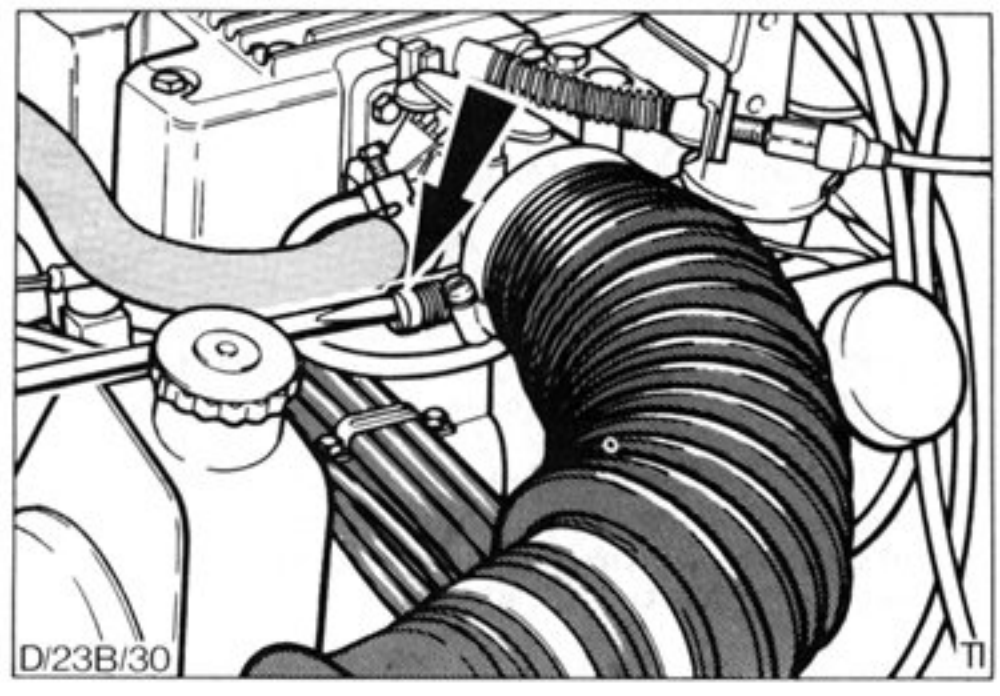


Fig.70. Engine idle speed adjusting screw.

23 213

7. Remove tamperproof cap from mixture screw tube, Fig.71.

8. Stabilise engine as shown in Sub-op. 4. and record % CO and idle speed.

9. Using the 3mm allan key adjust mixture screw and idle speed screw to achieve correct % CO at the specified idle speed, Fig.72.

NOTE: Adjustment must be carried out within 10 to 30 seconds from time meters stabilise. If time taken is longer than 30 seconds, run engine again at 3000 rpm for 30 seconds and recheck.

10. Renew tamperproof cap.

11. Remove fender covers and close hood.

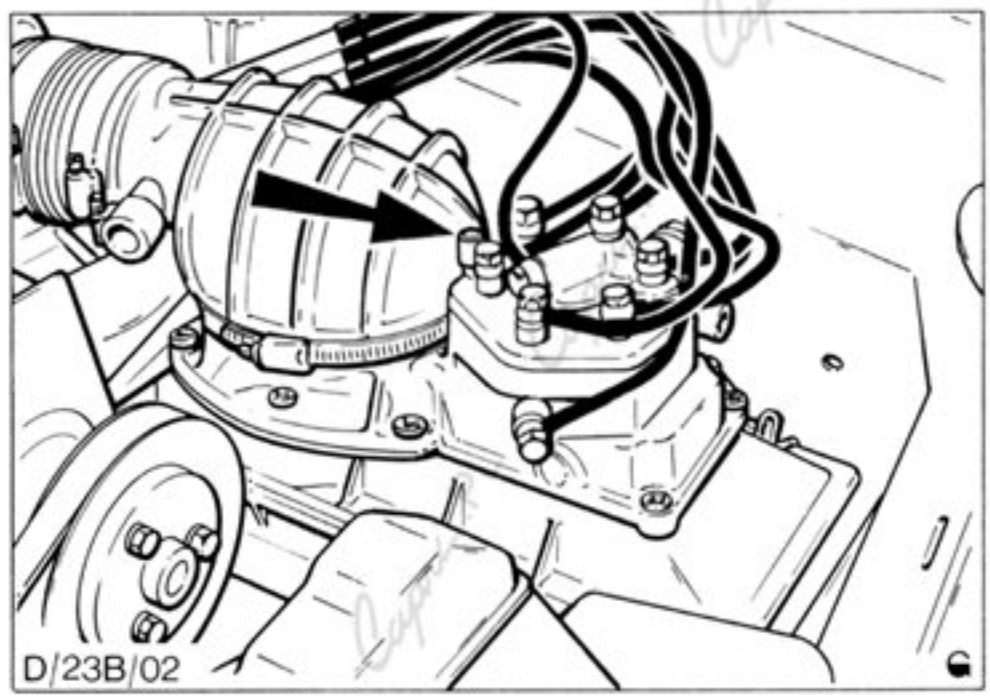


Fig.71. Mixture screw tamper-proof cap.

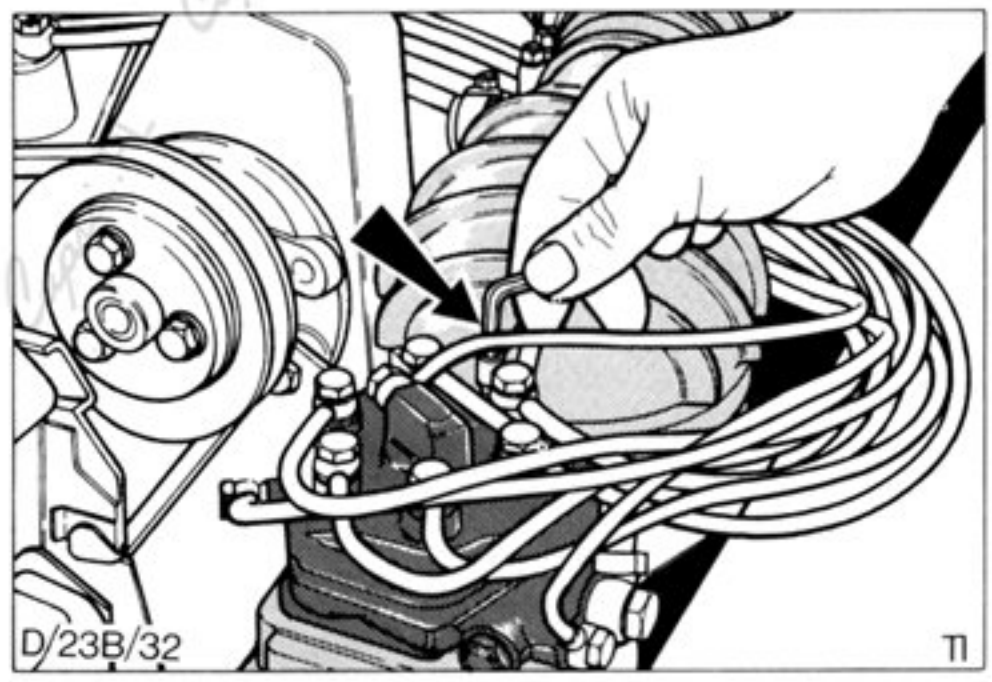


Fig.72. Idle mixture adjustment using allan key.

23 421 FUEL SYSTEM - PRESSURE CHECK

SPECIAL SERVICE TOOLS REQUIRED:

Pressure gauge No. 23 011
Thermometer

NOTE: Four separate pressure readings taken under differing operating conditions are required to fully check the two injection pressure systems. These are;

(a) Control pressure engine cold
(b) Control pressure engine warm
(c) Control pressure engine idling
(d) Main system pressure

1. Open hood and fit fender covers.

2. Place a piece of absorbent cloth beneath the warm-up regulator output pipe at the fuel distributor and disconnect pipe.

NOTE: The cloth is required to soak up the small amount of fuel that may drain from system. Dispose of cloth in accordance with fuel handling safety precautions.

3. Connect pressure gauge (Tool No. 23 011) into warm-up regulator supply pipe circuit, Fig.73.

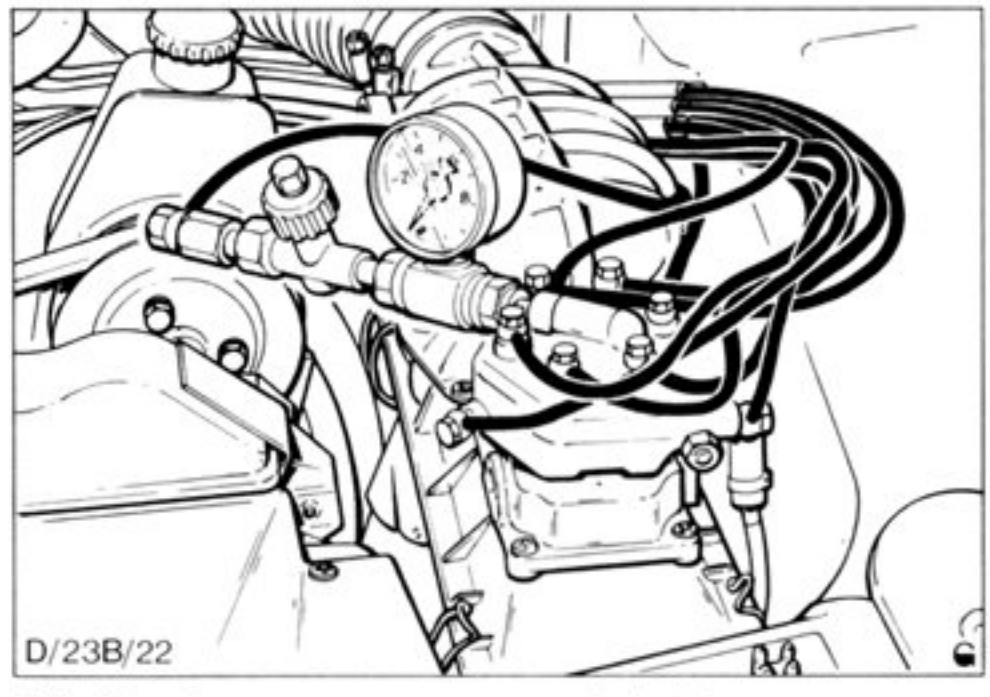


Fig.73. Pressure gauge connected into warm-up regulator feed pipe.
A - Pressure gauge (23 011)
B - Fuel distributor

4. Disconnect electric plugs from the following components:

   (a) Mixture control unit safety switch, Fig.74.

   (b) Thermo time switch

   (c) Auxiliary air device

   (d) Cold start valve

   (e) Warm-up regulator.

NOTE: If in doubt as to where the above mentioned components are located, reference should be made to Fig.1.

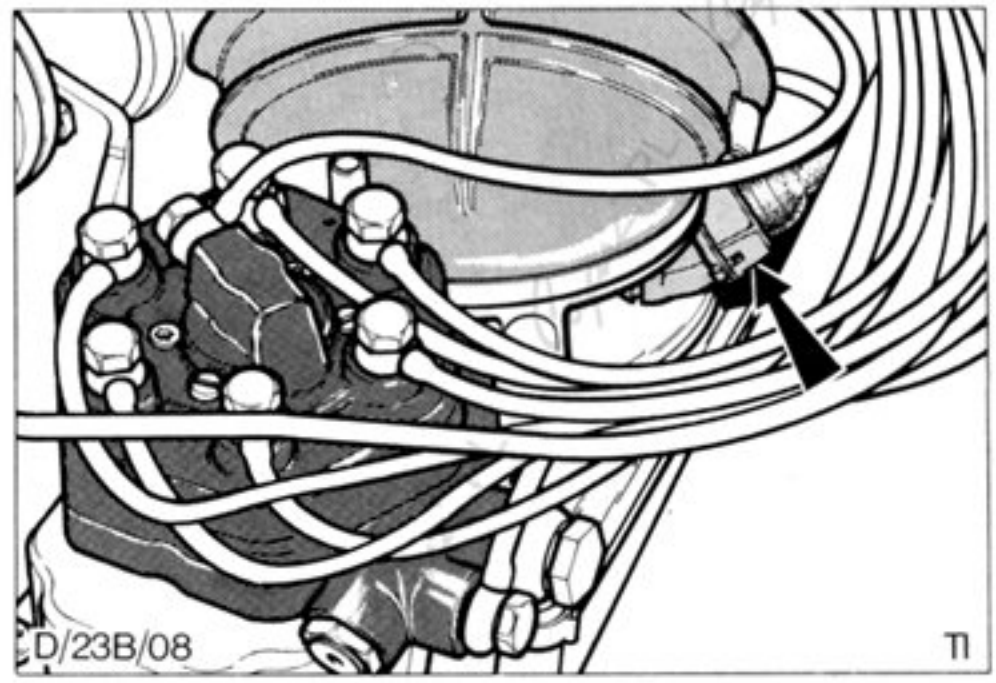


Fig.74. Mixture control unit safety switch plug.

5. Carry out control pressure check, with engine cold, as follows;

(i) Open shut off valve on pressure tester.

(ii) Switch on ignition. (Do not start engine)

NOTE: With mixture control unit safety switch disconnected pump will operate normally.

(iii) Record pressure reading on gauge and ambient temperature. Compare figures recorded with graph shown in Fig.75.

EXAMPLE: Ambient temperature 20°C, pressure gauge should read between 0,6 and 1,0 bars.

If pressure is outside specification and all visual and preliminary checks as detailed on page 22 are satisfactory, warm up regulator should be replaced.

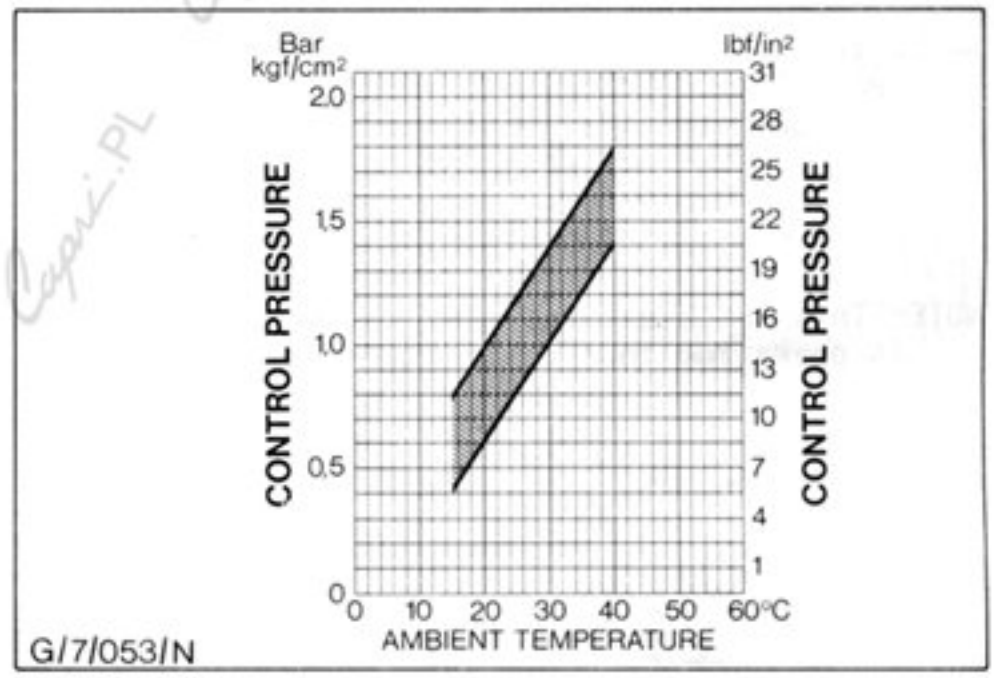


Fig.75. Control pressure specifications graph. (Engine cold)

(b) Carry out control pressure check, with warm-up regulator fully operational, as follows;

(i) Connect electric plug to warm-up regulator Fig.76.

NOTE: With ignition switched 'on' bi-metal strip in regulator will heat up and increase control pressure recorded on gauge.

(ii) Wait for bi-metal strip to fully heat up which will take approximately 6 mins and record pressure. (Refer Technical Data)

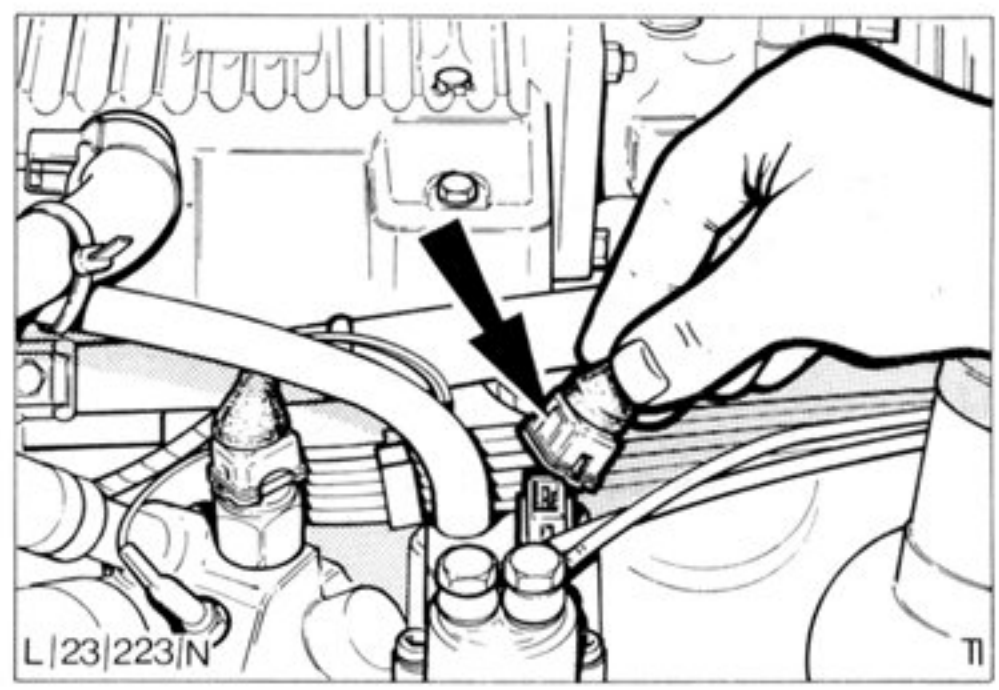


Fig.76. Reconnecting warm-up regulator electric plug.

6. Carry out control pressure, check with engine idling, as follows;

(i) Reconnect electric plug to safety switch on air sensor, Fig.77.

(ii) Start engine and allow to idle.

NOTE: Control pressure should rise due to manifold vacuum operating warm up regulator.

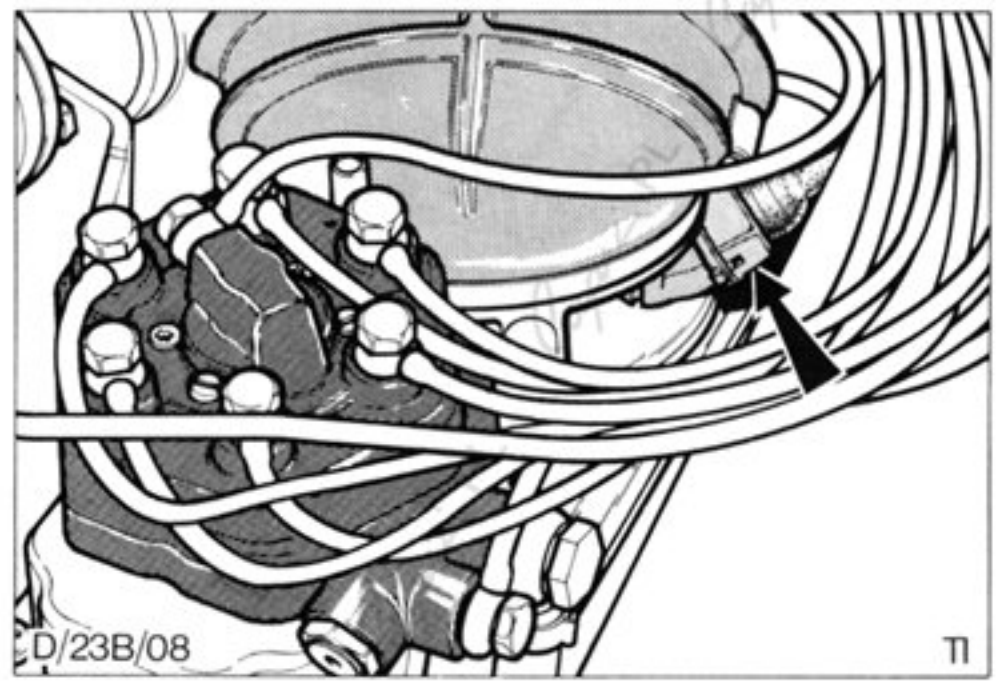


Fig.77. Air sensor plate safety switch reconnected.

NOTE: If at this stage vacuum connection at regulator, Fig.78, was disconnected pressure will drop to figure obtained in Sup-operation 5.

7. Carry out system pressure check, as follows;

NOTE: This check ensures that pressure regulator is operating to specifications.

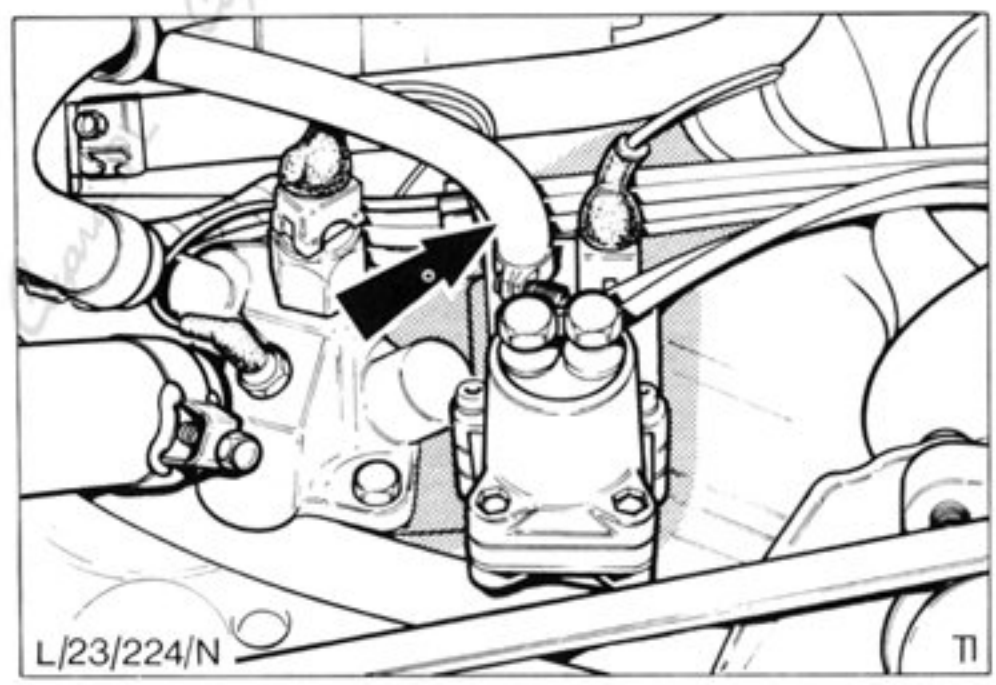


Fig.78. Vacuum connection at warm-up regulator.

Fig.79, shows in schematic form the system that is being checked.

NOTE: Engine temperature has no effect on main system pressure.

(i) Disconnect electric plug from air sensor safety switch, Fig.77, and switch ignition 'on'. Fuel pump should now be operating.

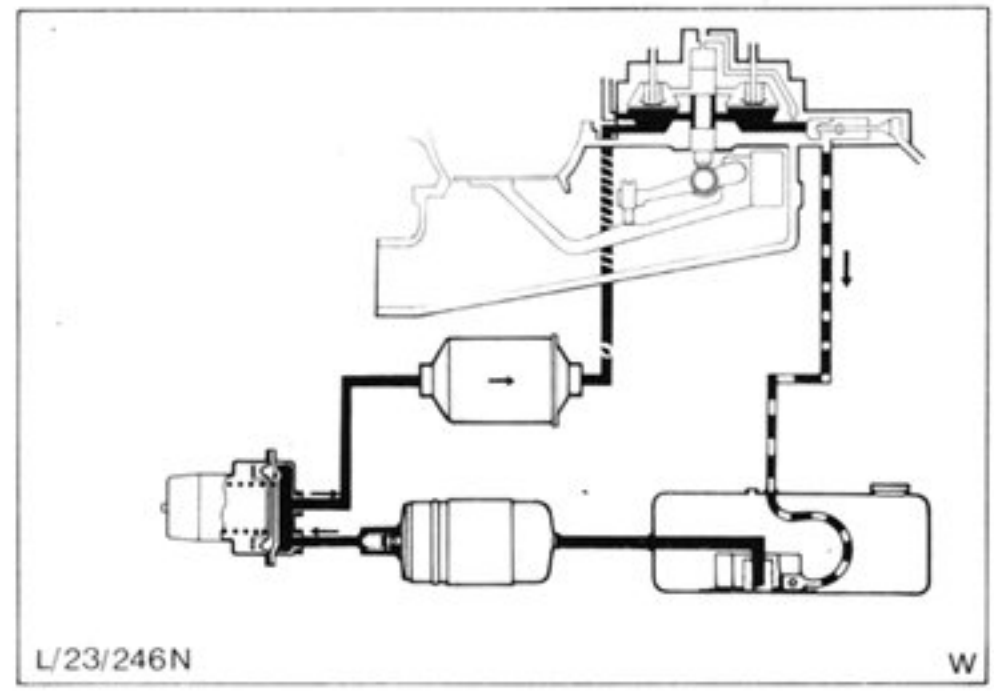


Fig.79. Main system pressure circuit.

(ii) Close shut off valve at pressure gauge and record pressure.

NOTE: Gauge will now indicate main system pressure. Refer Technical Data. If pressure is outside specification regulator, Fig.80, should be removed and adjusted. Full adjustment procedure is detailed on page 26.

8. Turn ignition off and reconnect all electric plugs to components listed in Sub-op. 4.

9. Position a piece of absorbent cloth beneath gauge and disconnect gauge.

10. Reconnect distributor outlet pipe.

11. Remove fender covers and close hood.

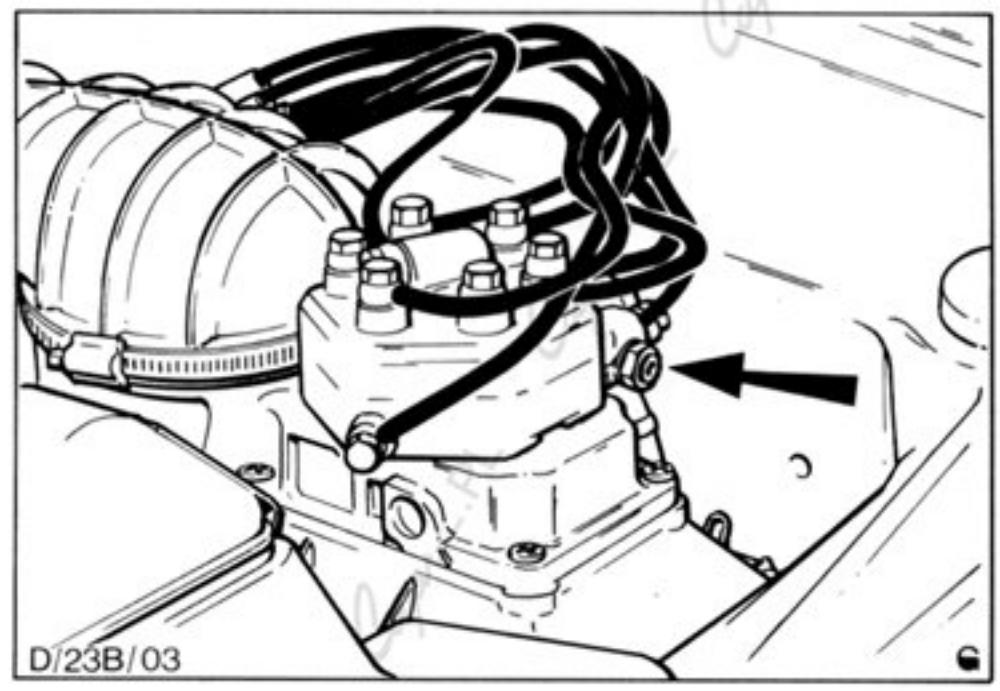


Fig.80. Main system pressure regulator.

23 422 FUEL DISTRIBUTOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Position a piece of absorbent cloth beneath warm up regulator feed pipe and disconnect pipe at distributor.

NOTE: Cloth is required to soak up a small amount of fuel that may drain from system. Dispose of cloth in accordance with fuel handling safety precautions.

4. Disconnect all outlet pipes at distributor.

5. Remove three screws and detach distributor assembly, Fig.81.

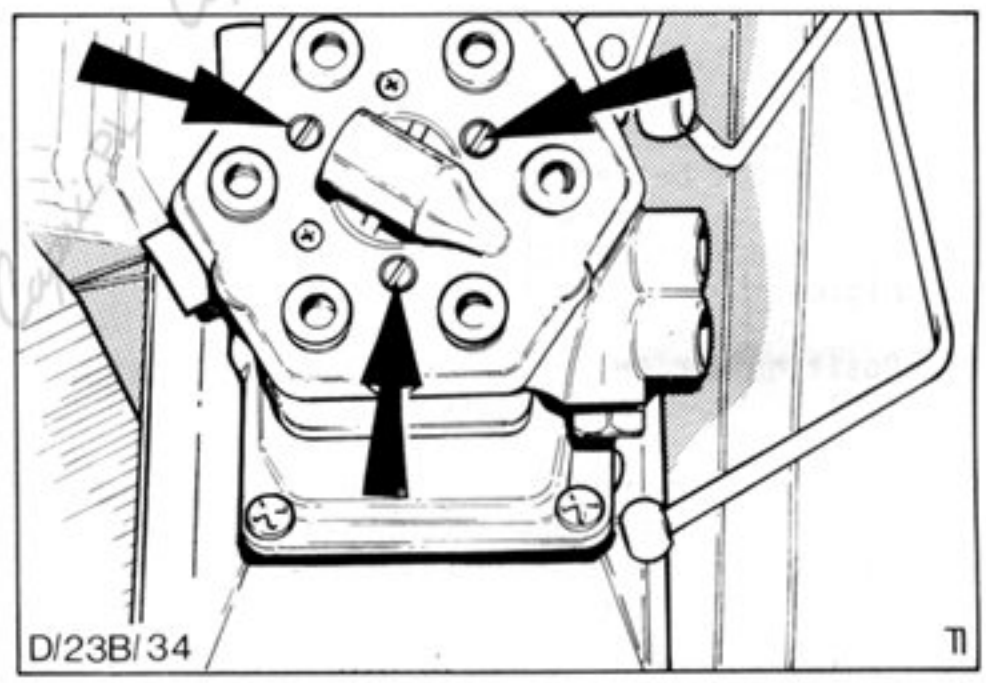


Fig.81. Distributor assembly securing screws.

To Install

6. Clean distributor mounting faces and pipe connections.

7. Using a new 'O' ring seal place assembly in position and secure with three screws.

8. Reconnect outlet pipes.

NOTE: Ensure two new copper washers are fitted on each union, one beneath union and one on top, Fig.82. Also ensure unions are not over-tightened as they can easily be broken.

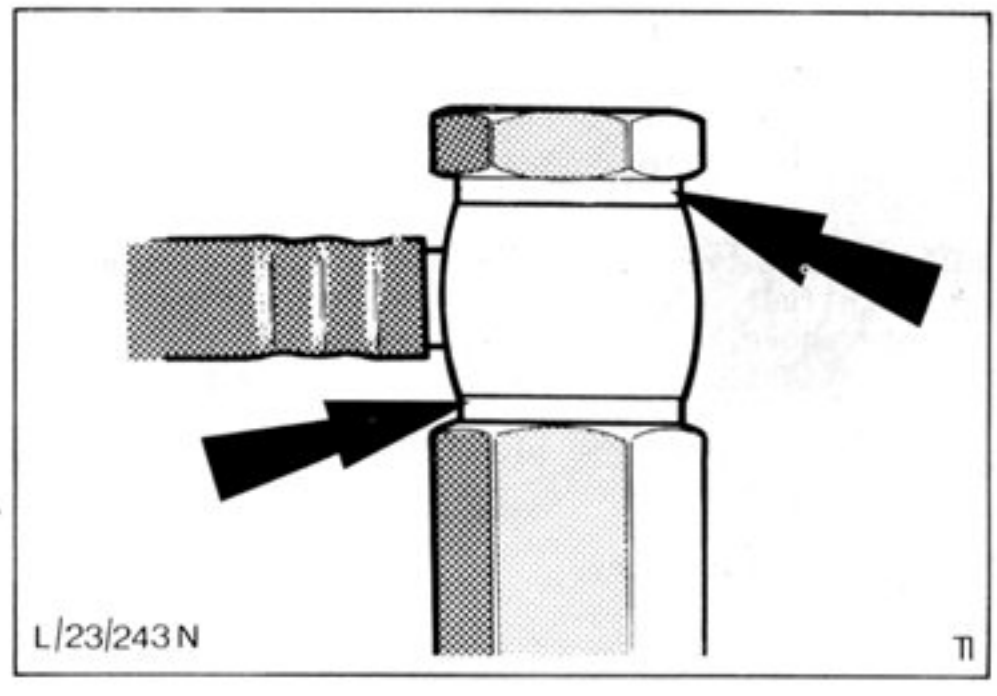


Fig.82. Distributor outlet union showing position of copper washers.

9. Reconnect battery.

10. Disconnect electric plug at air sensor safety switch, Fig.83.

11. Carry out a system pressure check as detailed in Operation No. 23 421 Sub-operation 7.

12. Check and adjust engine idle speed and fuel mixture setting as detailed in Operation No. 23-213.

13. Remove fender covers and close hood.

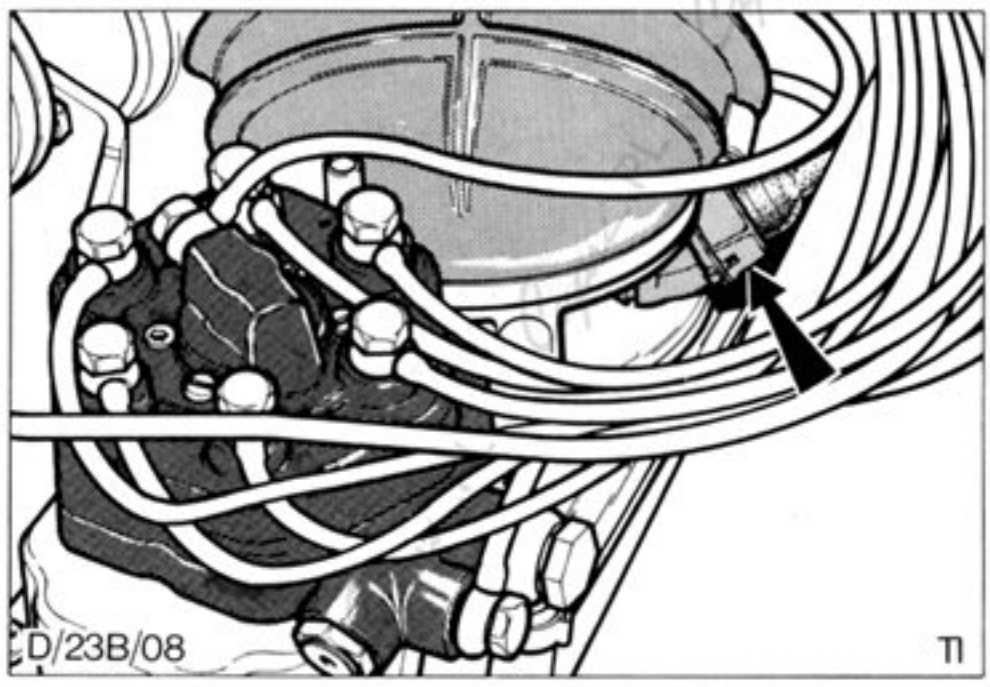


Fig.83. Air sensor safety switch.

23 424 WARM-UP REGULATOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Disconnect electric plug and vacuum hose, Fig.84.

4. Position a piece of absorbent cloth beneath fuel connections and disconnect pipes.

NOTE: Cloth is required to soak up a small amount of fuel that may drain from system. Dispose of cloth in accordance with fuel handling safety precautions.

5. Remove two allen screws and detach regulator, Fig.85.

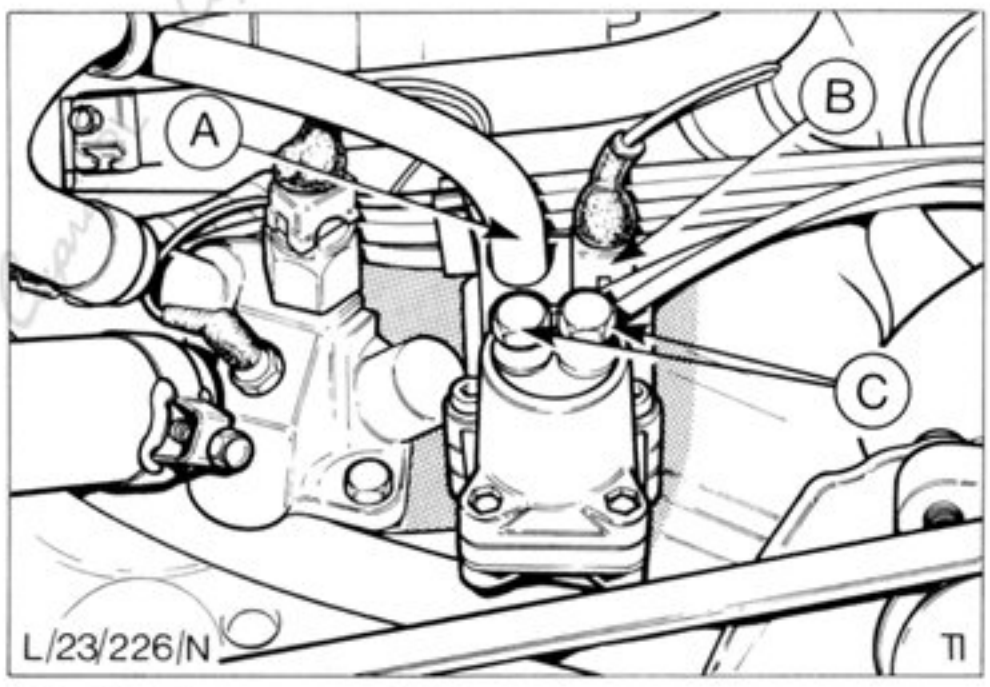


Fig.84. Warm-up regulator.
A - Vacuum hose connection
B - Electric plug
C - Fuel connections

To Install

6. Clean mounting faces and union connections.

7. Place regulator in position and secure two allen screws.

8. Reconnect fuel inlet and outlet pipes.

NOTE: Ensure two new copper washers are fitted on each fuel connection, one beneath union and one above. Also ensure that unions are not overtightened as they can be easily broken.

9. Reconnect electric plug and vacuum hose connections.

10. Reconnect battery.

11. Remove fender covers and close hood.

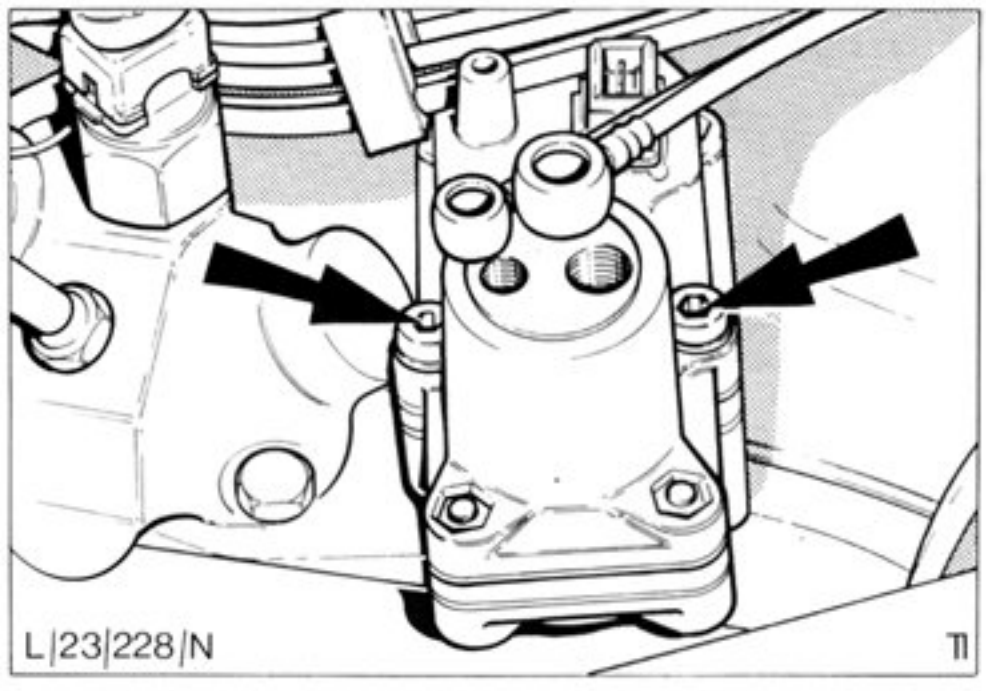


Fig.85. Warm-up regulator securing bolts.

23 426 FUEL START VALVE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

Test procedure detailed on page 27.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect electric plug.
4. Disconnect fuel supply pipe.
5. Remove two allan screws and detach valve, Fig.86.

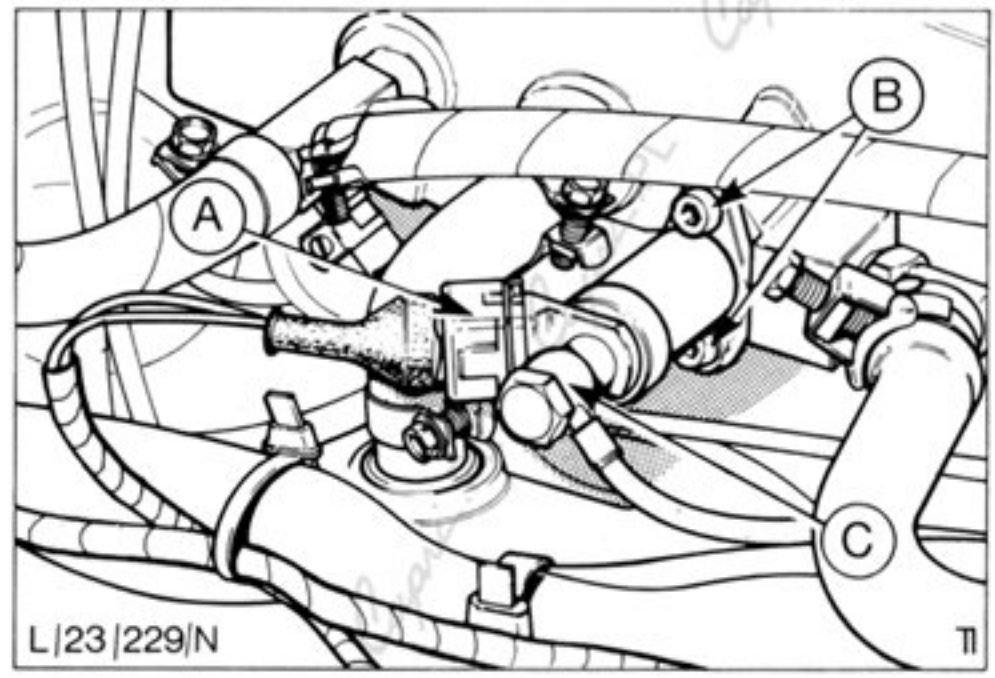


Fig.86. Fuel start valve.
A - Electric plug
B - Securing allan screws
C - Fuel supply pipe

To Install

6. Clean gasket faces.
7. Using a new gasket place valve in position and secure screws.
8. Reconnect electric plug.
9. Reconnect fuel supply pipe, Fig.87.

NOTE: Ensure two copper washers are fitted to unions, one beneath union and one above. Also do not overtighten unions as they can be easily broken.

10. Reconnect battery.
11. Remove fender covers and close hood.

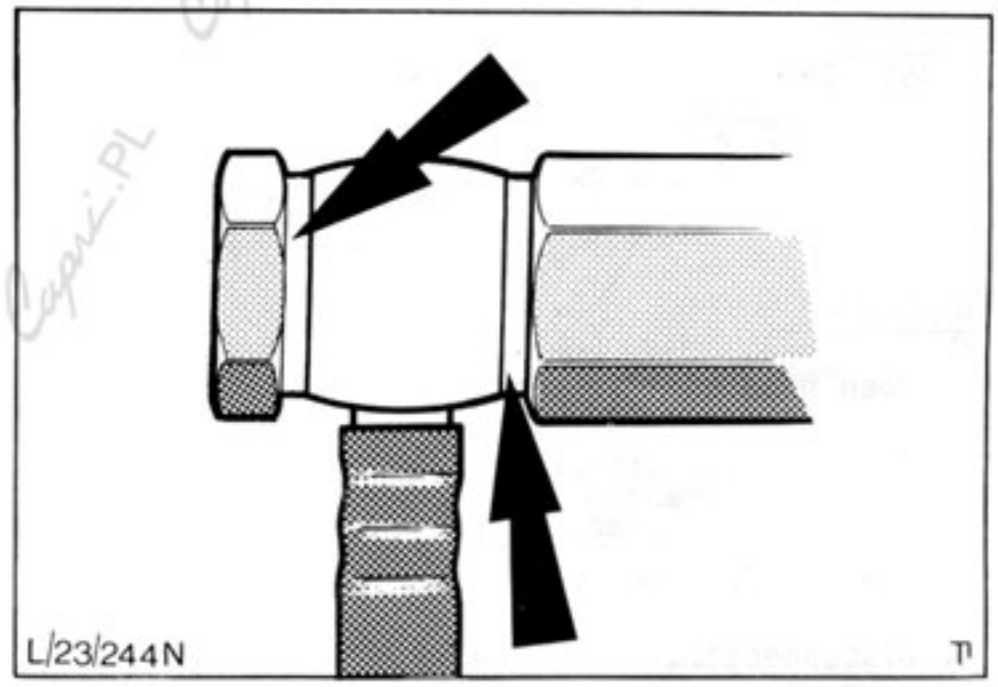


Fig.87. Start valve union connection with copper washers in position.

23 428 AUXILIARY AIR DEVICE - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

Test procedure detailed on page 26.

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Disconnect electric plug and two air hoses, Fig.88.

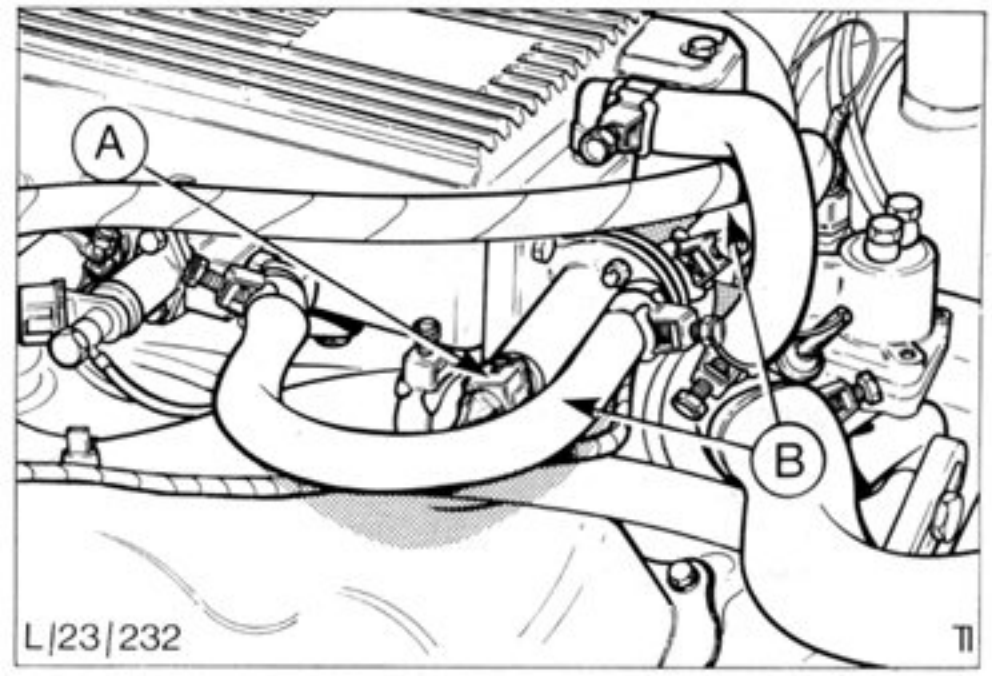


Fig.88. Auxiliary air device.
A - Electric feed plug
B - Air hoses

4. Remove two bolts securing air device to engine, Fig.89.

To Install

5. Place air device in position and secure two bolts.

6. Reconnect air hoses and electric plug.

7. Reconnect battery.

8. Remove fender covers and close hood.

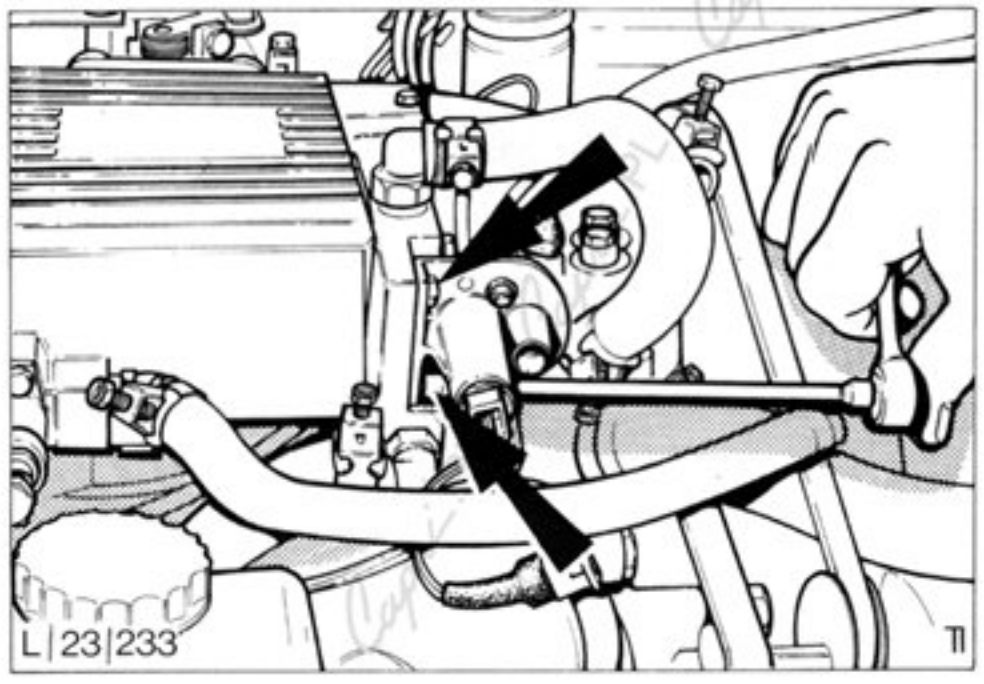


Fig.89. Auxiliary air device securing bolts.

23 455 INJECTORS - REMOVE AND INSTALL (ALL)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Detach accelerator cable and bracket from throttle assembly.

4. Disconnect main air supply hose at mixture control unit, Fig.90.

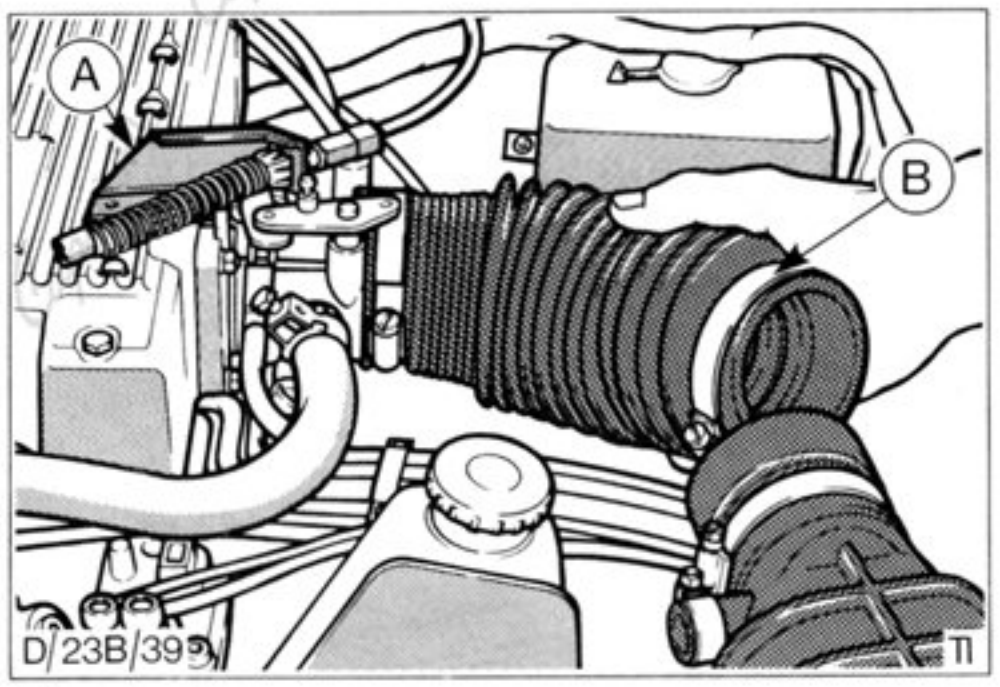


Fig.90. Disconnecting main air supply hose.
A - Throttle bracket
B - Main air supply hose

5. Disconnect supply plugs from
(a) Warm-up regulator, Fig.91.
(b) Thermo time switch
(c) Auxiliary air device, Fig.92.
(d) Fuel start valve

6. Disconnect fuel supply pipe at the start valve, Fig.91.

7. Disconnect vacuum pipe at the warm-up regulator, Fig.91.

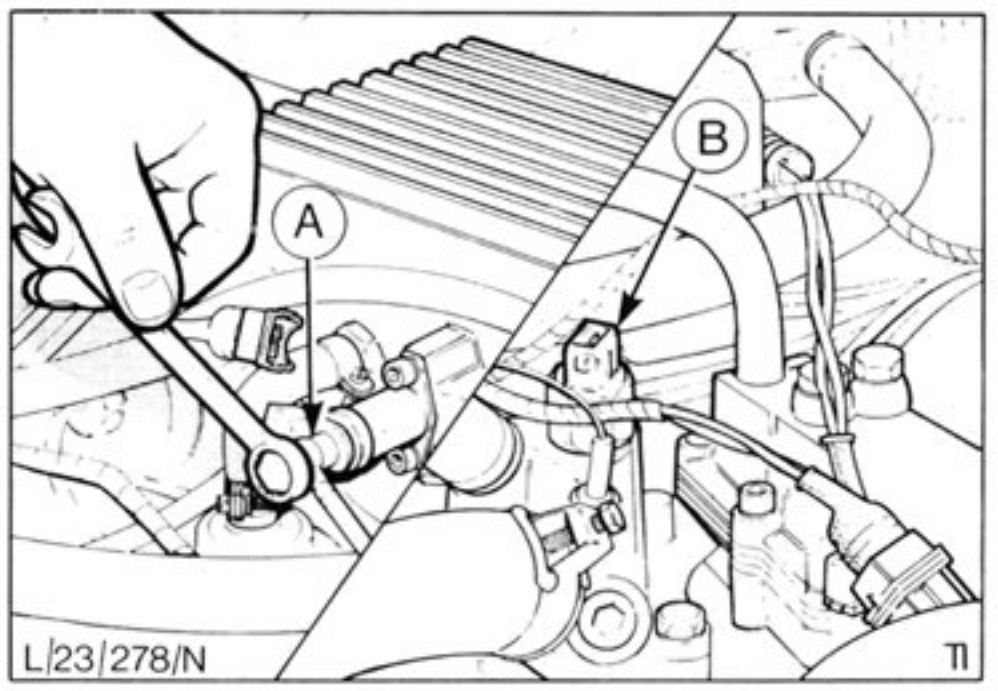


Fig.91. Items to be disconnected.
A - Fuel start valve
B - Thermo-time switch
C - Warm-up regulator

8. Remove eight bolts, detach air box and position clear of inlet manifold, Fig.92.

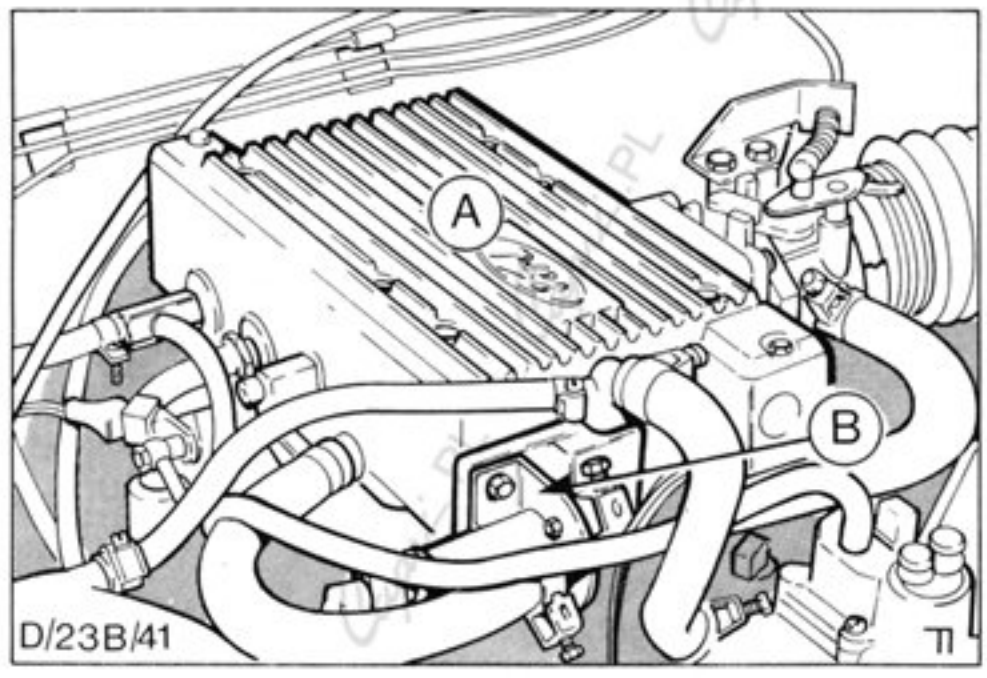


Fig.92. Air box assembly.
A - Air box
B - Auxiliary air device

9. Disconnect injector supply pipes, Fig.93.

NOTE: To disconnect supply pipe it is necessary to use two open ended spanners.

10. Remove a single bolt and detach bracket and injectors, Fig.94.

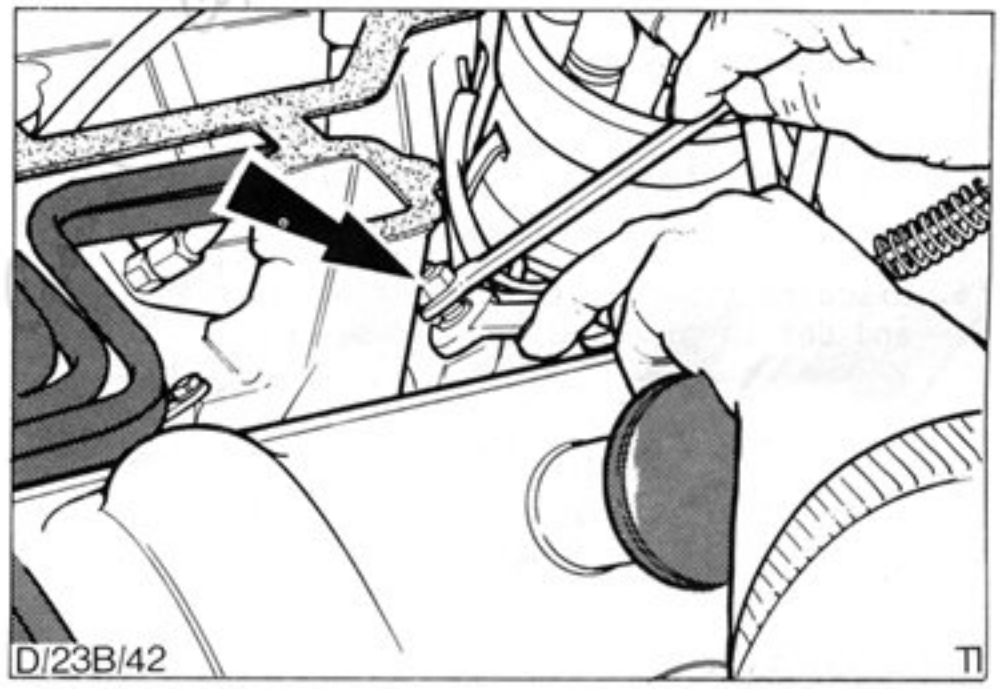


Fig.93. Injector supply pipe removal.

To Install

11. Clean connections, ensure 'O' seals are fitted to injectors and refit units, fully securing cross head screws.

12. Reconnect injector supply pipes and secure using two spanners.

13. Place air box in position and secure.

NOTE: Ensure cables and hoses are not twisted or kinked.

14. Reconnect vacuum pipe to warm up regulator and fuel pipe to start valve, Fig.91.

15. Reconnect electric supply plugs. Refer Sub-operation 5.

16. Reconnect main air supply hose.

NOTE: Ensure hose is fitted correctly with longer 'lead in' (55 mm) connected to throttle housing.

17. Refit accelerator cable and bracket.

18. Reconnect battery.

19. Remove fender covers and close hood.

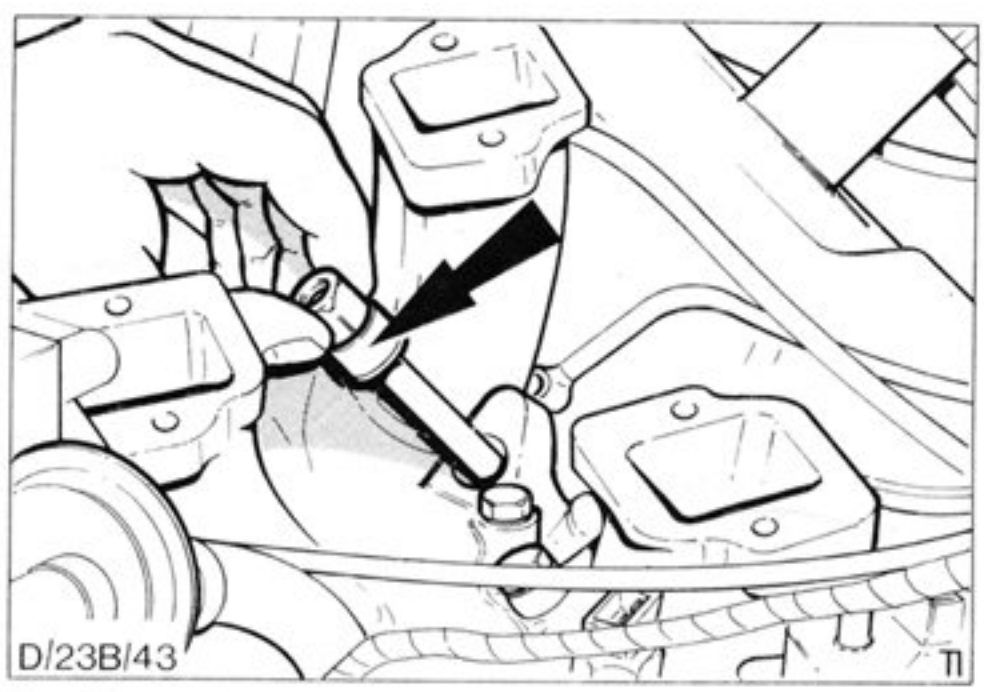


Fig.94. Injector removal.

25 483 PIPES - INJECTOR DELIVERY - REMOVE AND INSTALL (ALL)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Disconnect electric feed plugs from;
   a) Warm up regulator
   b) Thermo time switch
   c) Auxiliary air device
   d) Cold start valve
   Refer Fig.95.

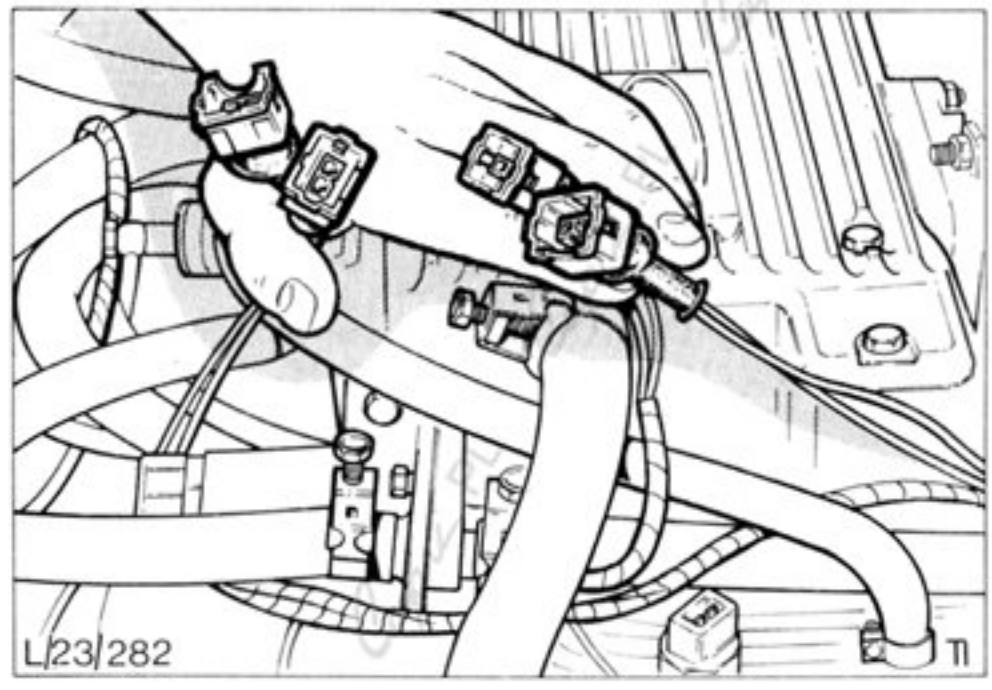


Fig.95. Electric plugs disconnected.

4. Detach air box assembly and position clear of inlet manifold. (Refer Operation 23 455 shown on previous two pages).

5. Disconnect injector supply pipes, Fig.96.

6. Disconnect supply pipes at fuel distributor and detach pipes as an assembly, Fig.97.

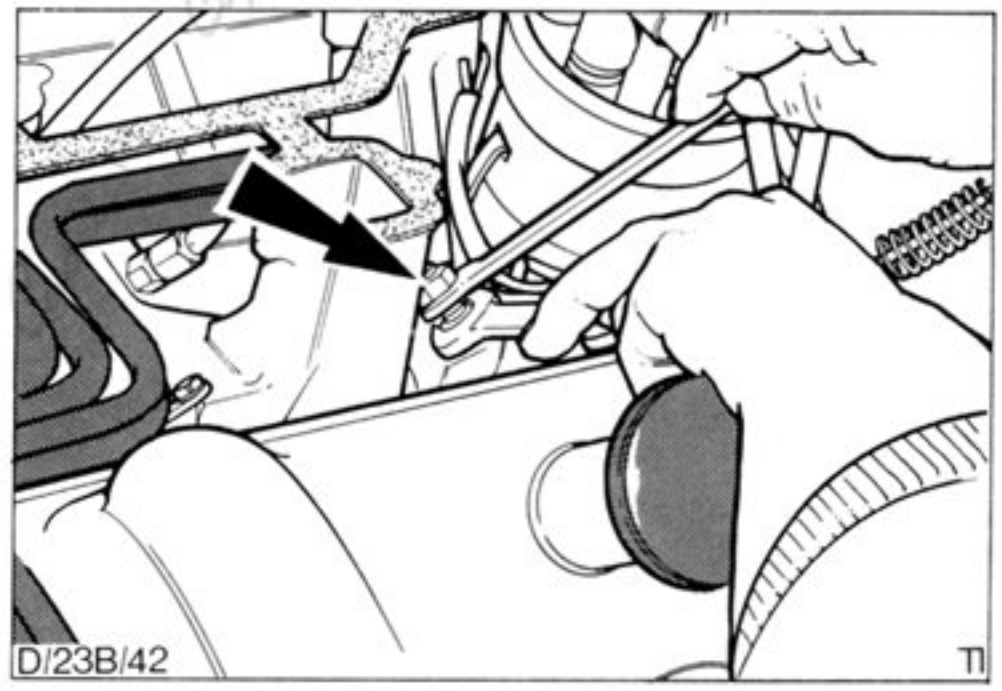


Fig.96. Injector supply pipe removal.

To Install

7. Thoroughly clean all pipes connections.

8. Place pipes in position and reconnect to injectors and fuel distributor.

NOTE: Ensure pipes are not kinked or twisted.

9. Refit air box assembly and secure.

NOTE: Ensure cables and hoses are not kinked or twisted. (Refer Operation No. 23 455)

10. Reconnect electric plugs. (Refer Sub-Operation 3)

11. Reconnect battery.

12. Remove fender covers and close hood.

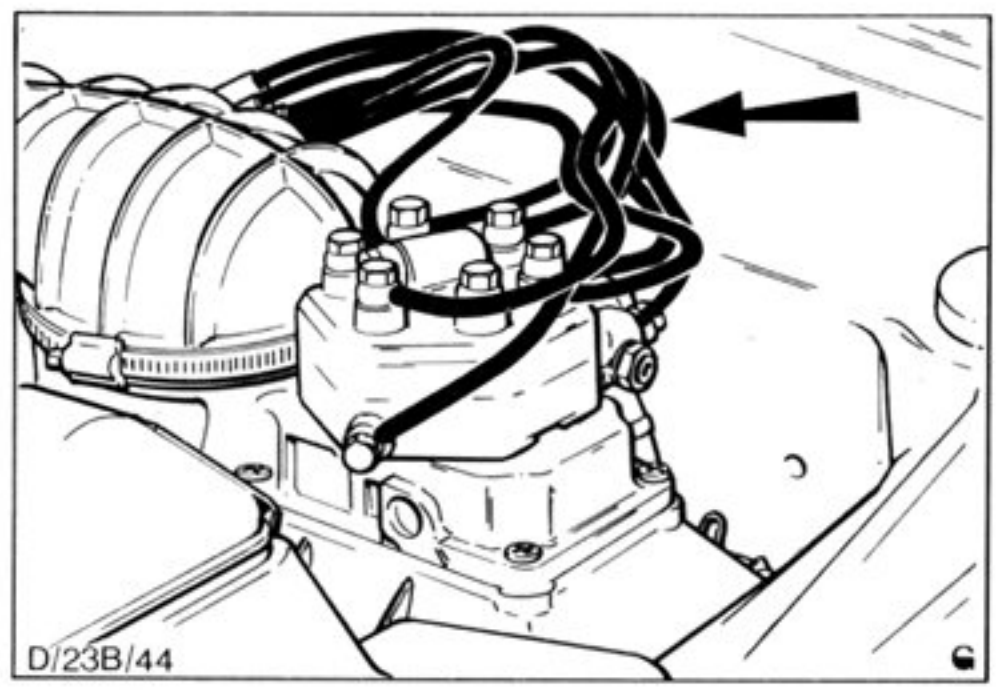


Fig.97. Injector supply pipes at fuel distributor.

25 534 FUEL PUMP REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Position a piece of absorbent cloth beneath warm up regulator feed pipe at distributor, refer Fig.98. Release pressure in system by loosening union at distributor and then tightening.

NOTE: Cloth is required to soak up any fuel which may come from system. Dispose of cloth in accordance with fuel handling safety precautions.

4. Pump fuel into a closed container.

NOTE: Ensure fuel handling safety precautions as detailed on page 30 are strictly adhered to.

5. Raise vehicle on ramp.
6. Hold a container beneath fuel connections and disconnect pump inlet and outlet pipes, Figs. 99 and 100.

NOTE: A small quantity of fuel will drain from system when pipes are disconnected. Dispose of fuel in accordance with fuel handling safety precautions.

7. Disconnect loom at pump.
8. Loosen tank supporting strap, remove three bolts and detach rubber mounting and pump assembly.
9. Push out pump assembly from its rubber mounting.

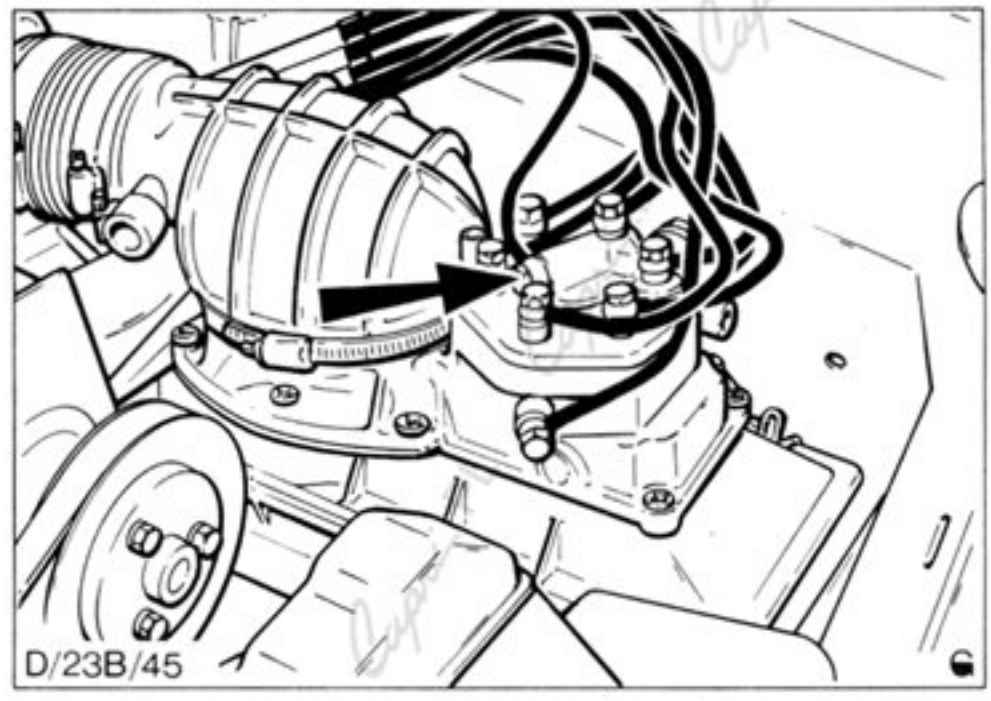


Fig.98. Warm-up regulator feed pipe at fuel distributor.

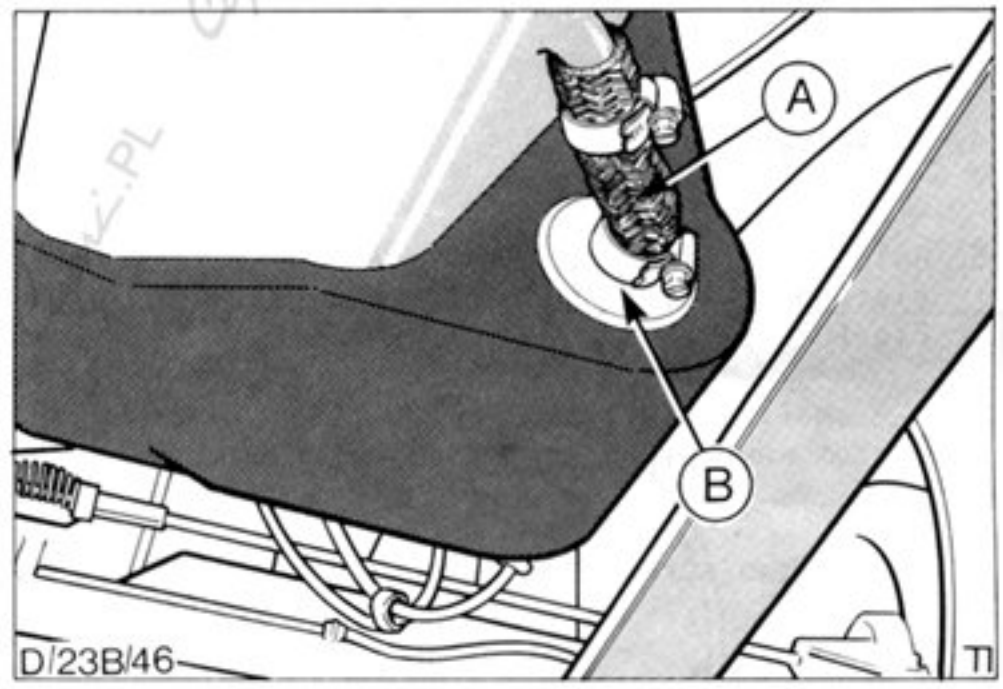


Fig.99. Fuel pump assembly viewed from rear.
A - Fuel inlet pipe
B - Fuel pump assembly

To Install

10. Clean fuel connections.
11. Slide pump into position ensuring unit locates fully into its rubber mounting.
12. Position and secure assembly.
13. Reconnect fuel pipes and loom wire.
14. Remove hose clamp.
15. Reconnect battery.
16. Start engine and check for leaks.
17. Lower vehicle to ground.
18. Refill tank.
19. Remove fender covers and close hood.

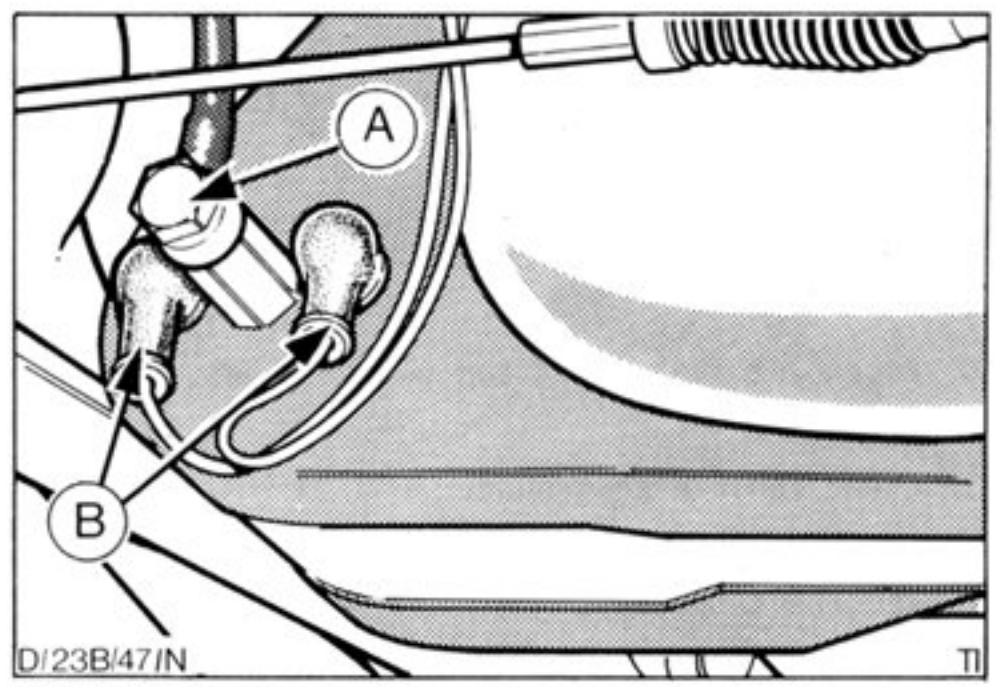


Fig.100. Fuel pump assembly viewed from front.
A - Pump outlet connection
B - Pump loom

23 538 FUEL ACCUMULATOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.

2. Disconnect battery.

3. Position a piece of absorbent cloth beneath warm up regulator feed pipe at distributor, refer Fig.101. Release pressure in system by loosening union at distributor and then tightening.

NOTE: Cloth is required to soak up any fuel which may come from system. Dispose of cloth in accordance with fuel handling safety precautions.

4. Raise vehicle on ramp.

5. Hold a container beneath fuel connections and disconnect inlet and outlet connections, Fig.102.

NOTE: A small quantity of fuel will drain from system when pipes are disconnected.

6. Remove two screws and detach assembly.

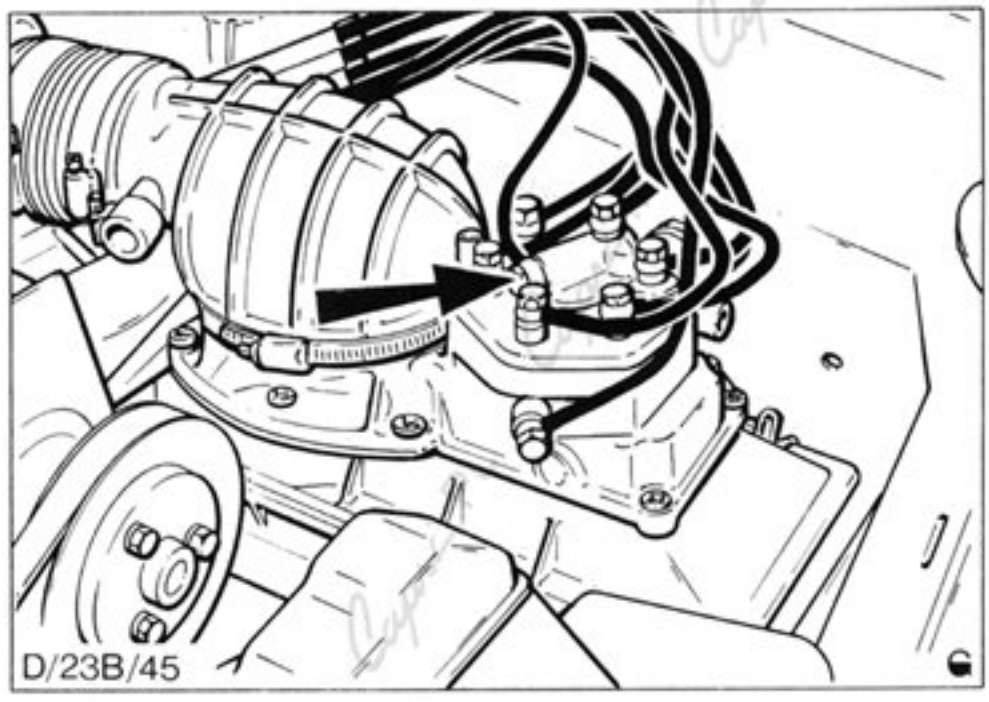


Fig.101. Warm up regulator feed pipe at fuel distributor.

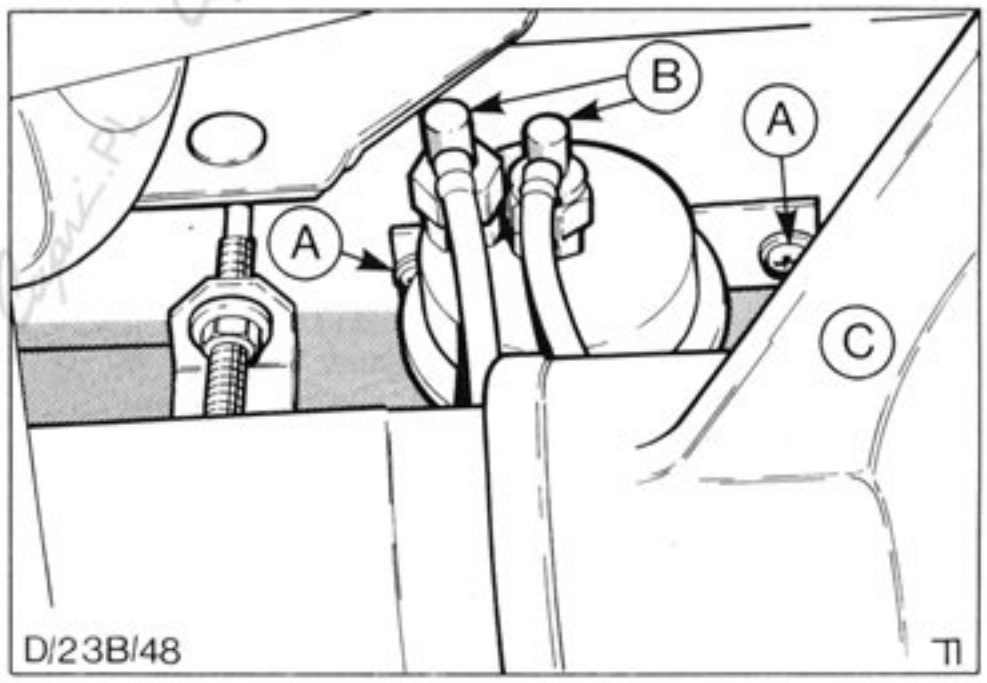


Fig.102. Fuel accumulator.
A - Securing screws
B - Inlet and outlet connections
C - Rear axle assembly

To Install

7. Clean fuel line connections.

8. Position accumulator, and secure two screws.

9. From inside luggage compartment remove floor panel and install protective caps over screw threads.

10. Reconnect fuel inlet and outlet pipes.

11. Lower vehicle to ground.

12. Reconnect battery.

13. Remove fender covers and close hood.

23 545 FUEL FILTER - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood and fit fender covers.
2. Disconnect battery.
3. Position a piece of absorbent cloth beneath warm up regulator feed pipe at distributor, refer Fig.101. Release pressure in system by loosening union at distributor and then tightening.

NOTE: Cloth is required to soak up any fuel which may come from system. Dispose of cloth in accordance with fuel handling safety precautions.

4. Position a piece of absorbent cloth beneath filter fuel connections and disconnect pipes. Refer Fig.103.

NOTE: A small quantity of fuel will drain from system when pipes are disconnected. Dispose of fuel in accordance with fuel handling safety precautions.

5. Remove two screws and detach filter and clamp assembly.
6. Remove clamp from filter.

To Install

7. Secure clamp to new filter.

NOTE: Ensure clamp is fitted correct way round. Refer Fig.103, which shows fuel inlet and outlet connections.

8. Position assembly and secure screw.
9. Reconnect fuel pipes.

IMPORTANT NOTE: When reconnecting pipes ensure outlet pipe is routed parallel with the apron panel as shown in Fig.104.

10. Reconnect battery.
11. Remove fender covers and close hood.

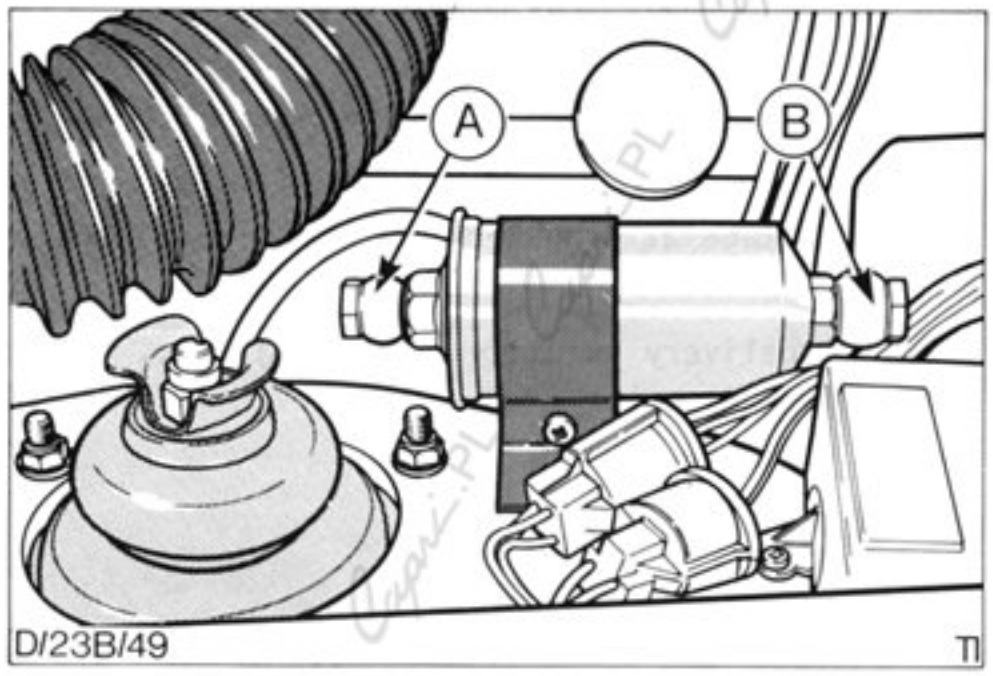


Fig.103. Fuel filter assembly.
A - Fuel outlet connection
B - Inlet connection

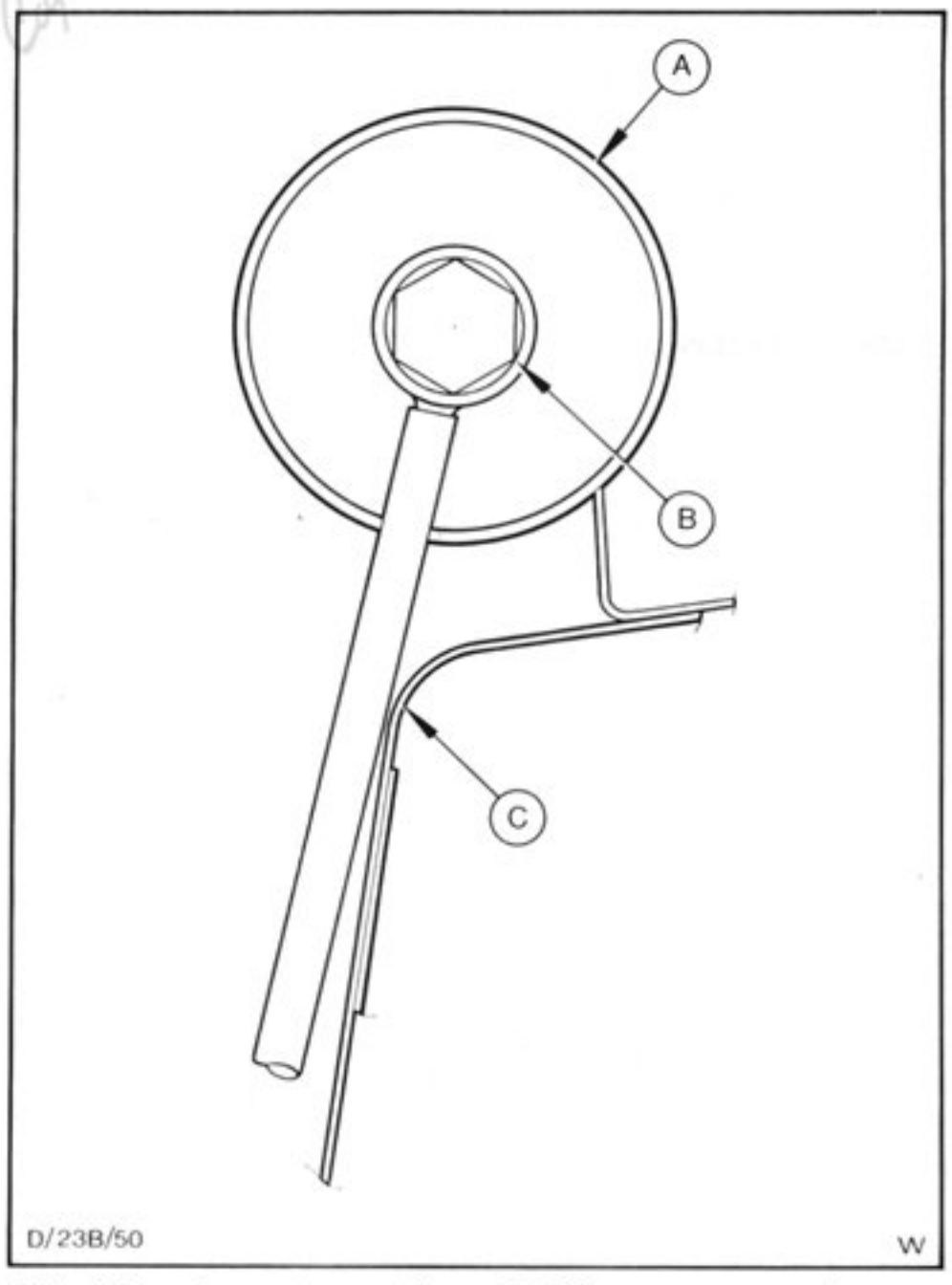


Fig.104. Correct routing of filter output pipe.
A - Fuel pump
B - Output connection
C - Apron panel

TECHNICAL DATA

Idle speed - Manual Transmission	900 ± 25 RPM
Mixture CO at idle	1,25 ±),2%
Minimum voltage at plug terminals	11,5 volts
Fuel pump delivery quantity (Minimum)	930cm^3 in 30 seconds.

Control Pressure 'Cold'

Refer Fig.105.

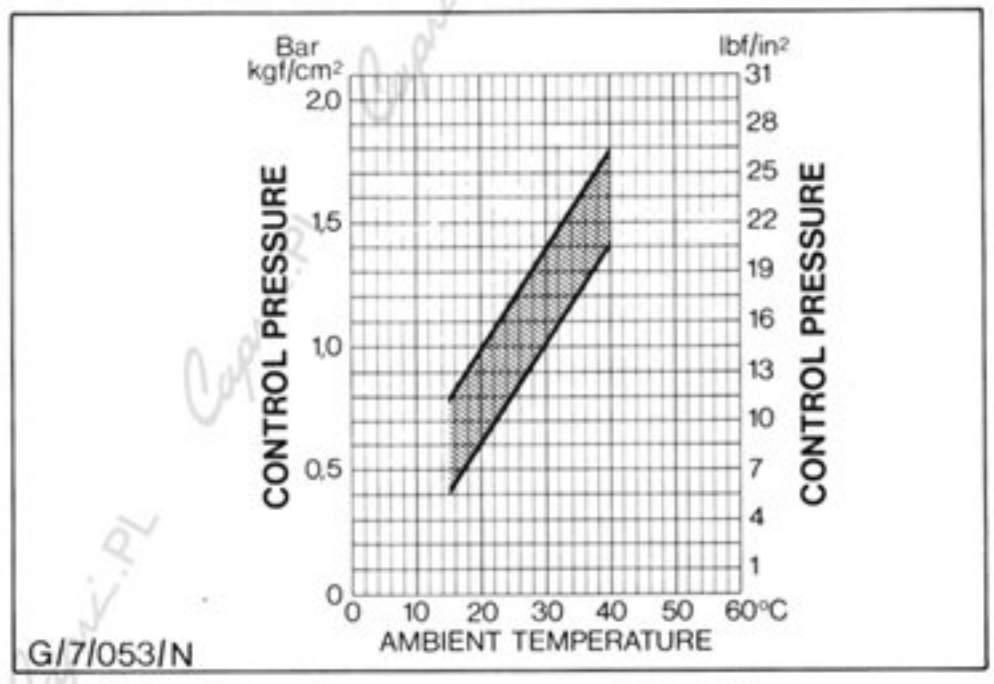


Fig.105. Control pressure specification graph (Engine cold).

Control Pressure 'Warm'

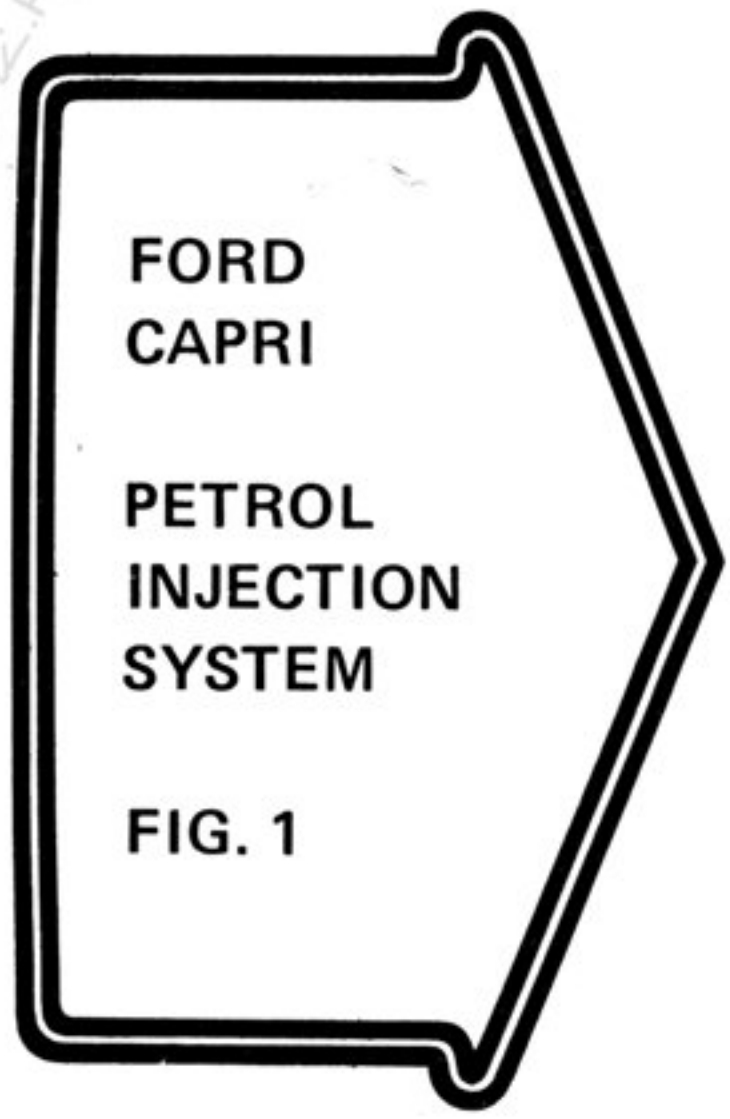
Without vacuum	2,9 ± 0,2 bar (42 ± 3 lbf.in^2)
With vacuum	3,6 ± 0,2 bar (52 ± 3 lbf.in^2)
System Pressure	5,55 ± 0,25 bar (79,8 ± 3,6 lbf.in^2)

Leak Test - Minimum residual pressure

After 10 mins	1,7 bar (24,7 lbf.in^2)
After 20 mins	1,5 bar (21,8 lbf.in^2)
Injector Valve - Opening Pressure	2,5 to 4,0 bar (36,5 to 51,5 lbf.in^2)

Tightening Torques

	Nm	(Kpm)	(lbf.ft)
Fuel distributor securing screws	32 - 38	(3,2 - 3,8)	(23,6 - 28,0)
Main system pressure regulator	20 - 25	(2,0 - 2,5)	(14,7 - 18,4)
Warm up regulator securing bolts	7 - 10	(0,7 - 1,0)	(5,2 - 7,4)
Cold start valve securing bolts	7 - 10	(0,7 - 1,0)	(5,2 - 7,4)
Auxiliary air device securing bolts	7 - 10	(0,7 - 1,0)	(5,2 - 7,4)
Air box retaining bolts	7 - 9	(0,7 - 0,9)	(5,2 - 6,6)
Banjo bolts - mixture control inlet and outlet	18 - 20	(1,8 - 2,0)	(13,3 - 14,7)
Banjo bolts - warm up regulator - inlet (M10)	11 - 15	(1,1 - 1,5)	(8,1 - 11,1)
Banjo bolts - warm up regulator - outlet (M8)	5 - 8	(0,5 - 0,8)	(3,7 - 5,9)
Banjo bolts - injection pipes, cold start valve and mixture control unit other than inlet and outlet connections. ..	5 - 8	(0,5 - 0,8)	(3,7 - 5,9)
Banjo bolts - fuel pump, filter and accumulator	18 - 20	(1,8 - 2,0)	(13,3 - 14,7)



COOLING SYSTEM 24B

Index

GENERAL DESCRIPTION

The cooling system basically comprises a radiator, circulating pump, thermostat and thermo viscous fan clutch. In addition, a plastic degas tank (expansion tank) is used to ensure that the system is maintained with the correct volume of coolant. The degas tank is fitted to a bracket adjacent to the right inner fender panel, behind the battery.

The radiator is a down-flow design and is mounted on the front engine compartment body panel.

The water pump is the same as is fitted to all current Cologne V6 engines.

A wax type thermostat is located in a housing adjacent to the water pump assembly. The temperature rating of the thermostat is 82° compared to the 87° thermostat fitted to all other Cologne V6 engines. It ensures rapid engine warm up by restricting coolant flow at lower operating temperatures. It also assists in maintaining the engine operating temperature between pre-determined limits.

The vehicle has a temperature gauge mounted in the instrument facia which indicates the temperature of the coolant leaving the engine. The temperature sensor is fitted to the engine water outlet housing adjacent to the radiator top hose. As the vehicle is fitted with an 82° thermostat, the gauge reading is lower than normal for a warm engine (normal running temperature). The gauge needle will register just above the minimum of the segment outlined in white (normal running temperature segment).

The coolant used normally contains a 45% solution of Ford antifreeze, which also incorporates the required corrosion inhibitor. For certain territories, because of the climate, antifreeze is not required and the system is filled with a corrosion inhibitor in a concentration of 1 part inhibitor to 39 parts water.

The antifreeze is PINK in colour and to Ford Specification No. SSM-97B-9103-A. This antifreeze is now fitted to all Ford engines and supersedes the green antifreeze previously used.

NOTE: UNDER NO CIRCUMSTANCES SHOULD GREEN ANTIFREEZE BE USED ONLY PINK ANTIFREEZE TO FORD SPECIFICATION WHEN TOPPING UP OR REFILLING THE COOLING SYSTEM.

It is important that the system is maintained with the correct concentration of antifreeze or inhibitor as required.

A thermo viscous fan is fitted to the water pump hub adjacent to the hub pulley. This fan assembly incorporates a temperature actuating clutch and replaces the conventional permanently driven fan. This fan improves fuel economy and performance. As less power and torque is needed to drive the fan more power is available to drive the vehicle, thus reducing fan belt wear and fan noise.

NOTE: AS THE SYSTEM IS PRESSURISED, ALWAYS RELEASE THE PRESSURE WITHIN THE COOLING SYSTEM BY TURNING THE CAP ON THE EXPANSION TANK THROUGH 90°. PAUSE TO ALLOW DEPRESSURISATION AND THEN REMOVE THE EXPANSION TANK CAP COMPLETELY. NEVER REMOVE THE RADIATOR FILLER CAP PRIOR TO THE EXPANSION TANK CAP AND NEVER INTERCHANGE THE TWO CAPS.

GENERAL DESCRIPTION (cont'd)

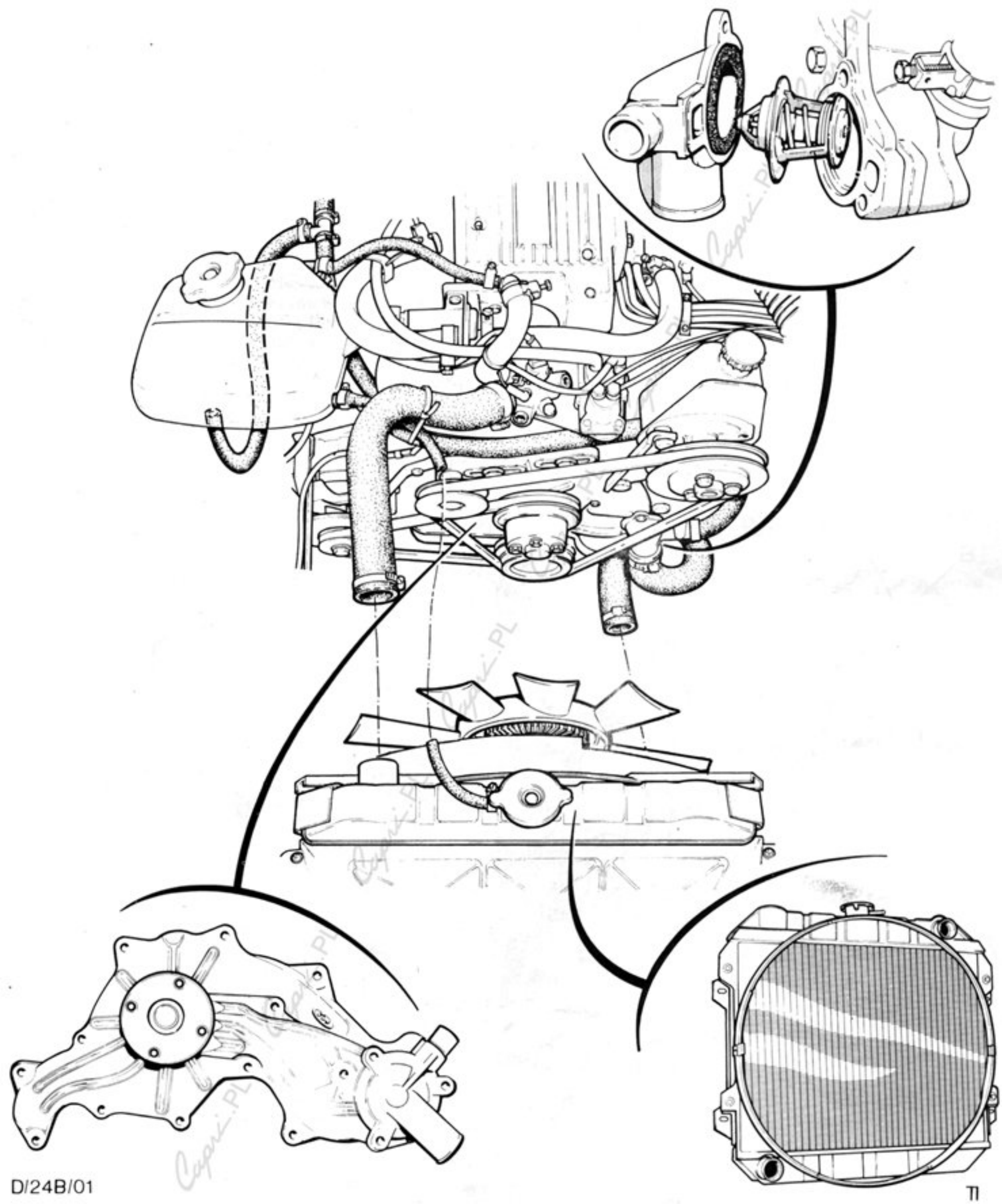


Fig.1. The cooling system.

PRINCIPLE OF OPERATION

Cooling System Flow

When the coolant is cold the thermostat is closed and flow is restricted to the cylinder block, heads, inlet manifold, by-pass hose from inlet manifold to water pump assembly, heater matrix and degas tank (via tank inlet from hot air box connector and outlet to heater return hose). Therefore the only part of the circuit that is isolated is the radiator.

At normal operating temperature, Fig.2, the coolant circulates from the base of the radiator into the thermostat housing, past the open thermostat to the water pump. From the pump, the coolant then circulates within the cylinder block and heads then into the inlet manifold. The main flow of coolant is then returned to the top of the radiator via the water outlet housing. Some coolant is fed back to the water pump assembly via the by-pass hose from the inlet manifold while some flows from the hot air box connector to the degas tank. Coolant entering the radiator top tank flows in a downward movement through the radiator to be cooled by air passing through the radiator cooling fins. Some coolant flows through a smaller hose from the radiator outlet to the top of the degas tank where separation of gas from coolant occurs. Tank coolant then flows back into the main circuit via the heater return hose.

As the coolant temperature rises the coolant expands into the degas tank. If the cooling system pressure exceeds that of the pressure relief valve in the tank cap, the valve lifts from its seat allowing the air to escape. As the coolant temperature returns to normal, coolant is drawn back from the tank into the main cooling system creating a vacuum at the top of the tank. This, in turn, opens the vacuum relief valve in the tank cap allowing air to be sucked into the tank until the pressure equalises. The vacuum valve will then close.

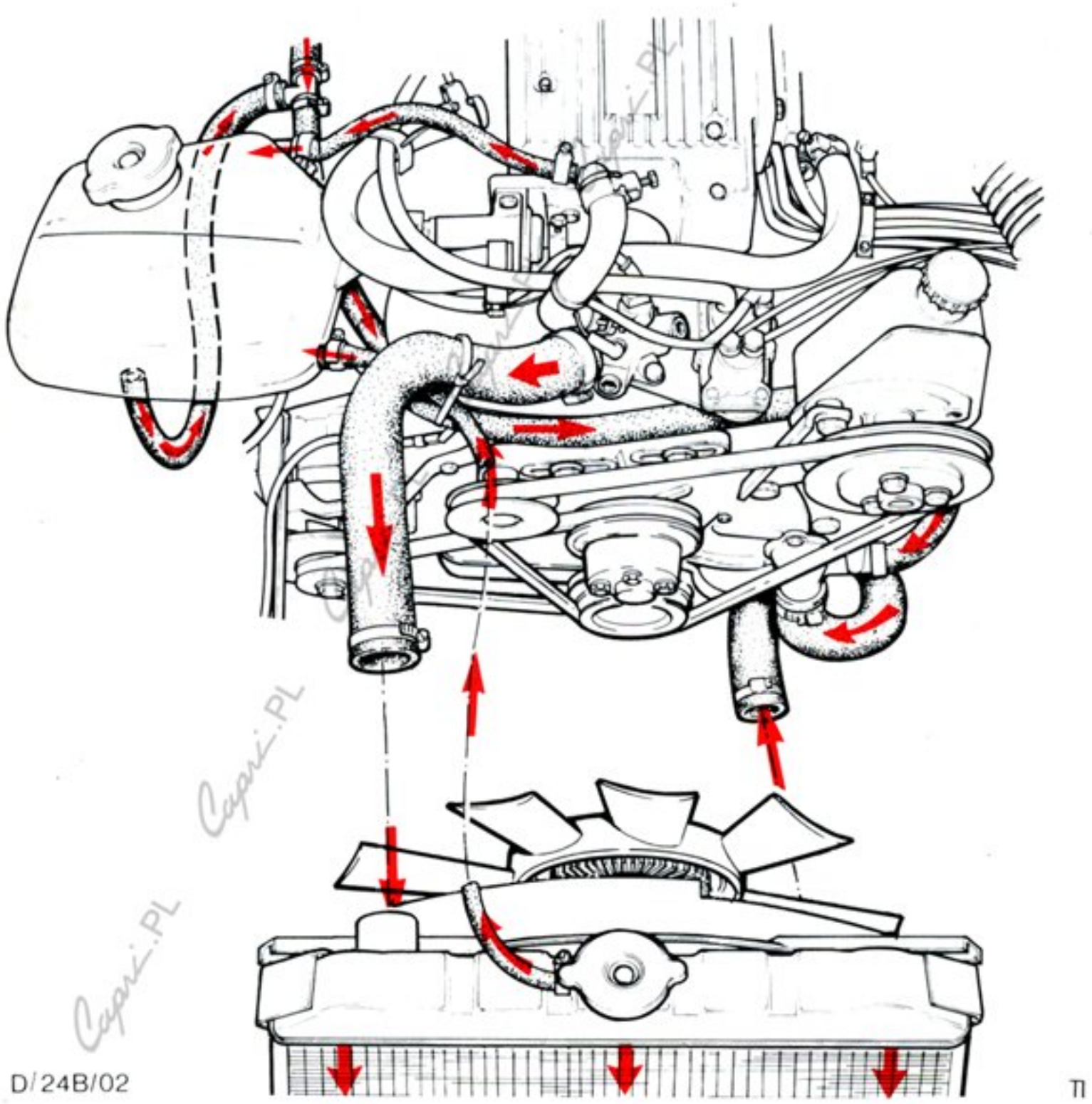


Fig.2. Coolant flow at normal operation temperature and pressure.

PRINCIPLE OF OPERATION (cont'd)

Temperature Sensing Viscous Fan

The temperature sensing fan drive operates a shear type fluid coupling which controls the fan speed by transmitting the drive through a film of silicone fluid and has the ability to idle the fan at all engine speeds, whenever the engine cooling requirements are low.

The interior of the drive is divided into two chambers. The rear chamber contains the rotor (K) whilst the front chamber forms the fluid reservoir (M). Fluid is pumped into the reservoir by the rotating action of the rotor and the use of a ram pump (C). This pump consists of a hole, called the discharge port (A) and a 'weir' (B), which is a depression in the pump plate designed to cause a pressure rise in the fluid. This has the effect of transferring the fluid from the rotor chamber to the reservoir while the engine is running. The ram pump is located near the circumference of the pump plate (P). The rotor is directly linked, via the drive shaft (L) to the engine and with the engine running the rotation of the rotor retains the fluid in the reservoir.

As the engine cooling demands increase, a bi-metallic element (E) senses the air temperature behind the radiator, and operates a control valve (G) which progressively (as demand increases), opens the intake port (H). This allows fluid re-entry into the rotor chamber, which in turn increases the torque capacity of the fan drives. Hence, as the engine coolant temperature increases the fan rotor chamber fills with more fluid, increasing the friction factor, which increases fan speed (within its design parameters), thereby increasing the air flow and cooling capabilities.

As the above description explains, the speed of the temperature sensing viscous fan is related to engine temperature and not engine rpm.

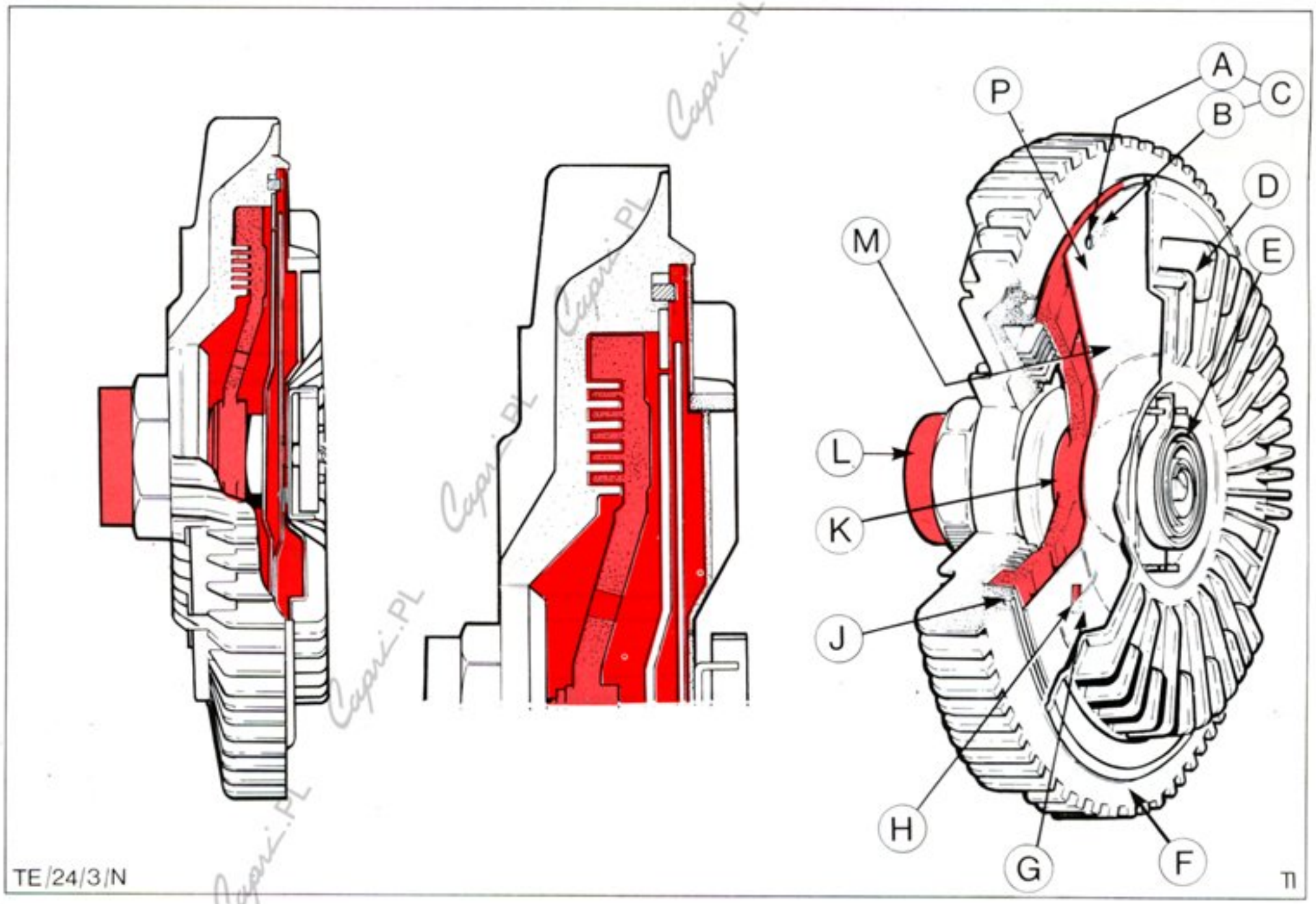


Fig.3. Tinted areas denote driving components. Solid colour shows fluid area.

A - Discharge port
B - Weir
C - Ram pump
D - Front casing
E - Bi-metallic element
F - Main casing (with integral cooling fins)
G - Control valve
H - Intake port
J - Seal
K - Rotor
L - Drive shaft
M - Fluid reservoir
P - Pump plate

SERVICE ADJUSTMENTS AND CHECKS

At specified service intervals or where required, the following items should be checked.

1. Check for evidence of coolant leaks.

   Examine all hoses, radiator, engine core plugs, cylinder head gaskets, water pump, thermostat housing and degas tank for any coolant leakage.

2. Check all hoses for cracks or deterioration by flexing by hand and visually checking condition.

3. Cooling antifreeze/inhibitor mixture content check.

   The quantity of coolant in the degas tank is a direct indication of the coolant level in the complete system. The acceptable level of coolant in the degas tank is to the top of the plastic indicator inside the tank (this is approximately half full).

NOTE: When topping up the coolant, only remove the degas tank cap, never the radiator cap. The radiator cap should only be removed in order to completely drain and refill the system.

   Antifreeze content should be checked through the degas tank filler neck with a hydrometer. The specific gravity of correctly balanced coolant is '1,069' which indicates an antifreeze concentration of 45%. If the concentration falls below 45% there is insufficient low temperature protection and the corrosion resistance is inadequate. In such cases, the concentration must be brought back to the specified 45%.

   If the owner/operator does not require antifreeze, inhibitor should be mixed with coolant in the ratio of 1 part inhibitor to 39 parts water.

4. Changing and flush out coolant.

   Motorcraft Antifreeze Plus, in the correct proportions, will protect the cooling system against frost damage for an indefinite period, but it's corrosion inhibitors lose their effectiveness after prolonged use. Therefore the cooling system should be drained by removing the bottom hose and back flushed. Refill using Motorcraft Antifreeze Plus, Ford Specification No. SSM-97B-9103-A (pink in colour) to the correct proportions (45% antifreeze).

5. Check that temperature gauge is functioning.

SAFETY PRECAUTIONS TO BE OBSERVED

Antifreeze

Antifreeze contains monoethylene glycol and other constituents which are toxic if taken internally and can be absorbed in toxic amounts on repeated or prolonged skin contact.

The following precautions must be taken to promote the safe handling of antifreeze

1. Antifreeze must never be taken internally. If antifreeze is swallowed accidentally, medical advice should be sought immediately.

2. Precautions should be taken to avoid skin contact with antifreeze. In the event of accidental spillage onto the skin, antifreeze should be washed off as soon as practicable. If clothing is splashed with antifreeze, it should be removed and washed before being worn again, to avoid prolonged skin contact.

3. For regular and frequent handling of antifreeze, protective clothing (plastic or rubber gloves, boots and impervious overalls or aprons) must be used to minimise skin contact.

SPECIAL SERVICE TOOL RECOGNITION

TOOL	TOOL NAME
	No Tools Required

A slightly modified 32 mm (1,25 in AF) spanner with jaw thickness of 5 mm or less must be used to remove the Viscous Fan Clutch from the water pump hub. The handle of the tool must be modified slightly by bending it parallel to the jaws as shown in the illustration below.

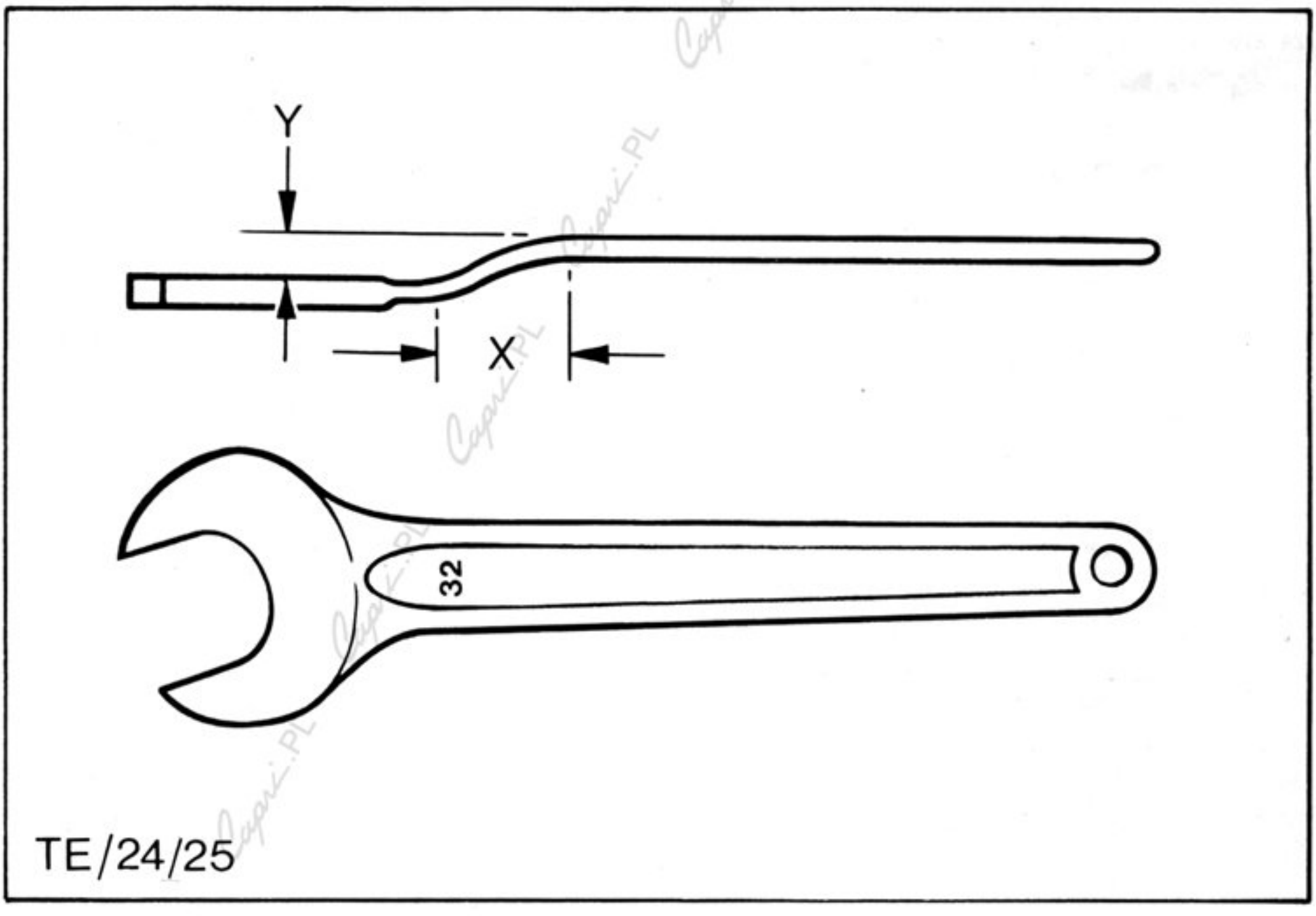


Fig.4. Dimensions showing modifications to be made to 32 mm (1,25 in AF) spanner.
X - 25 mm (1,0 in)
Y - 12 mm (0,5 in)

SERVICE AND REPAIR OPERATIONS CONTENT

COOLING SYSTEM		Described in this publication	Contained in operation	Also applicable to certain variants in the following model range:				
				FIESTA	ESCORT '81	CAPRI '78	TAUNUS / CORTINA '80	GRANADA '78
24 111	Cooling system - pressure test	X		X	X	X	X	X
24 122	Cooling system - drain and refill	X		X	X	X	X	X
24 203	Fan belt - adjust		24 205			X	X	X
24 205	Fan belt - replace	X				X	X	X
24 212	Fan - remove and install		24 215				X	
24 215	Clutch - viscous fan - remove and install	X					X	
24 216	Pulley - fan - remove and install	X					X	
24 254	Radiator - remove and install	X				X	X	X
24 284	Expansion tank - remove and install	X						
24 404	Water pump assembly - remove and install	X				X	X	X
24 454	Thermostat - remove and install		24 404			X	X	X
24 451 1	Thermostat - test (thermostat removed)	X		X	X	X	X	X
24 604	Hose - radiator top - replace		24 618	X	X	X	X	X
24 605	Hose - radiator bottom - replace		24 618	X	X	X	X	X
24 608	Hose - expansion tank to radiator - replace		24 618					
24 609	Hose - expansion tank to heater hose connector - replace	X						
24 610	Hose - expansion tank to air box connector - replace	X						
24 618	Hoses - radiator - replace (all)	X						

SERVICE AND REPAIR OPERATIONS

24 111 COOLING SYSTEM - PRESSURE TEST

SPECIAL SERVICE EQUIPMENT REQUIRED:

Cooling system pressure tester

1. Run engine to normal operating temperature, open hood, fit fender covers and disconnect battery.

2. Rotate degas tank pressure cap through 90° to allow system to depressurise then remove cap.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Using suitable pressure tester with correct adaptor, connect it to degas tank filler neck. Ensure tester creates good seal, Fig.5.

4. Pump up cooling system pressure to a maximum of 1,40 Bar (1,40 kg cm^2) (20 $lbf.in^2$) and hold for ten seconds. If pressure drops inspect for leaks. Release pressure.

5. Remove pressure tester and fit appropriate adaptor to test cap. Fit cap to tester, pump up pressure and note maximum steady pressure achieved. Pressure relief specification is stamped on cap top face. Remove tester.

6. Check condition of secondary seal on filler cap, Fig.6. Refit cap.

7. Reconnect battery.

8. Remove fender covers and close hood.

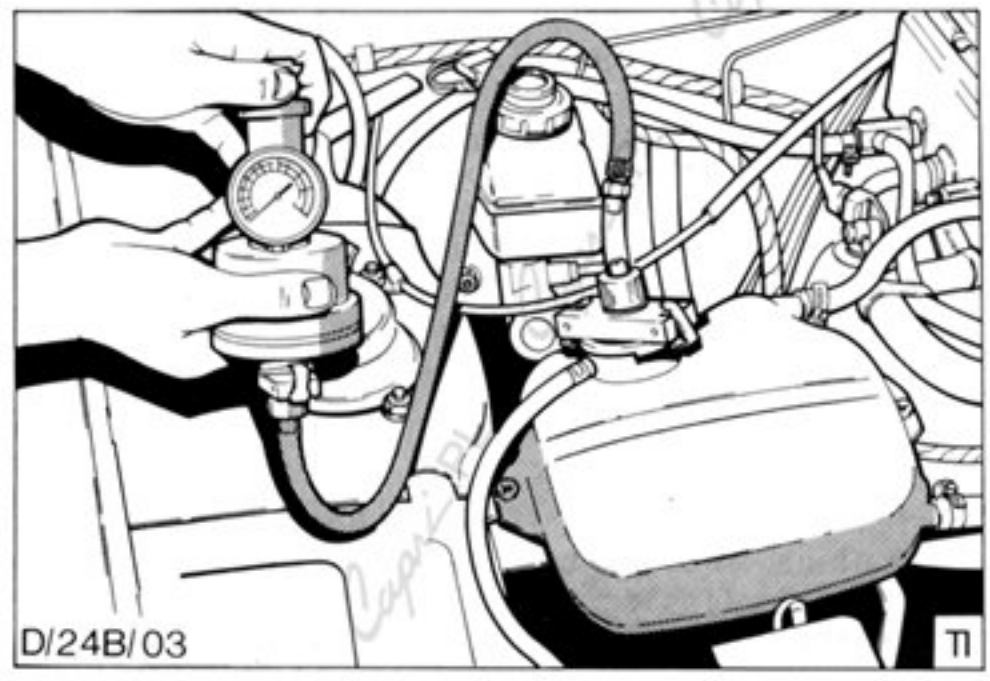


Fig.5. Pressure tester connected to degas filler neck.

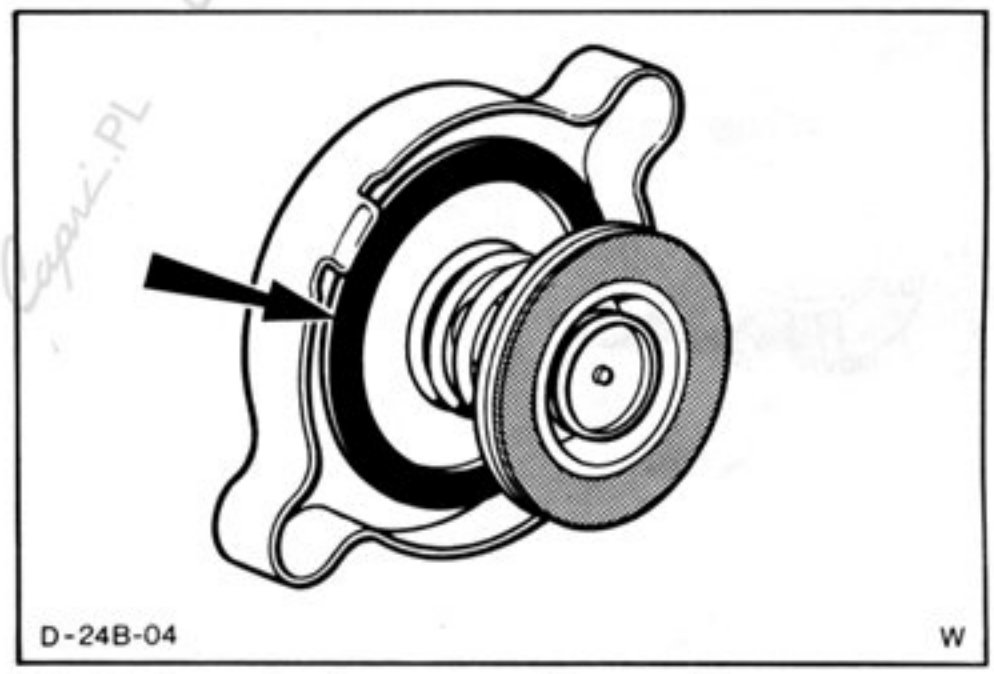


Fig.6. Degas tank cap secondary seal.

24 122 COOLING SYSTEM - DRAIN AND REFILL

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Open hood, fit fender covers and disconnect battery.

2. Relieve system pressure by rotating degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Position a clean drain tray below vehicle under radiator bottom hose.

4. Loosen radiator bottom hose clamp, Fig.7, remove hose from radiator and drain system. To assist draining remove radiator and degas tank caps.

5. Position a second drain tray under one cylinder block drain bolt, remove bolt and drain block.

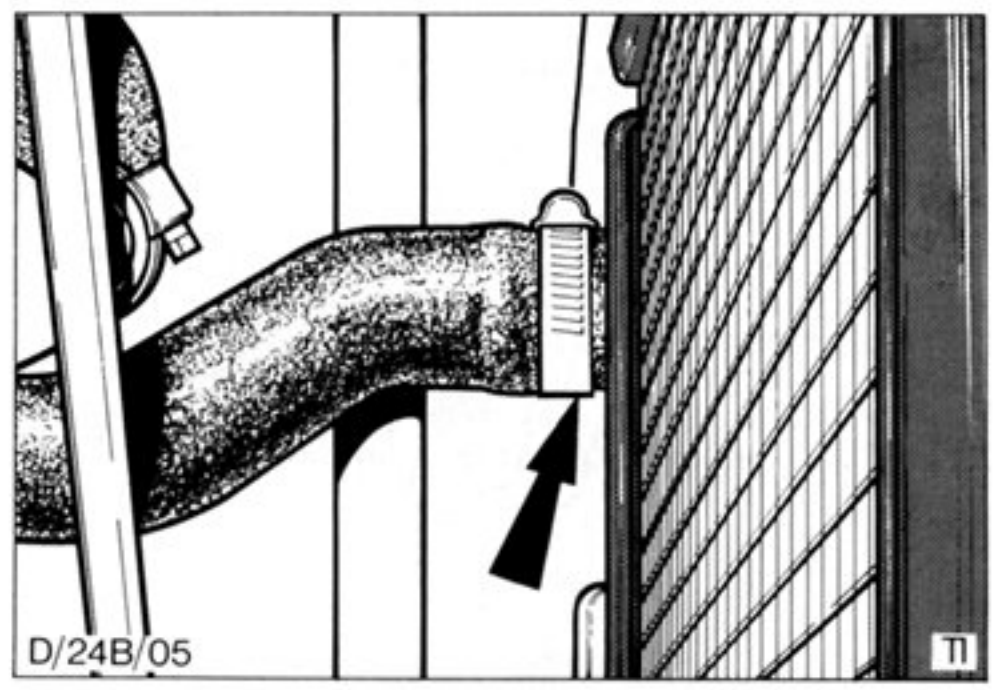


Fig.7. Radiator bottom hose clamp (fan shroud removed for clarity).

24 122

6. Refit cylinder block drain bolt and radiator bottom hose, tightening hose clamp.

7. Refill system through radiator filler neck with correct coolant solution. Fill until coolant level is nearly overflowing allowing time for air in system to bubble through. Refit radiator cap and top up degas tank to approximately half full. Refit tank cap.

8. Reconnect battery.

9. Run engine and check all hose connections for leaks. Check and, if necessary, top up coolant in degas tank to top of plastic indicator inside tank, Fig.8. Remove drain trays.

10. Remove fender covers and close hood.

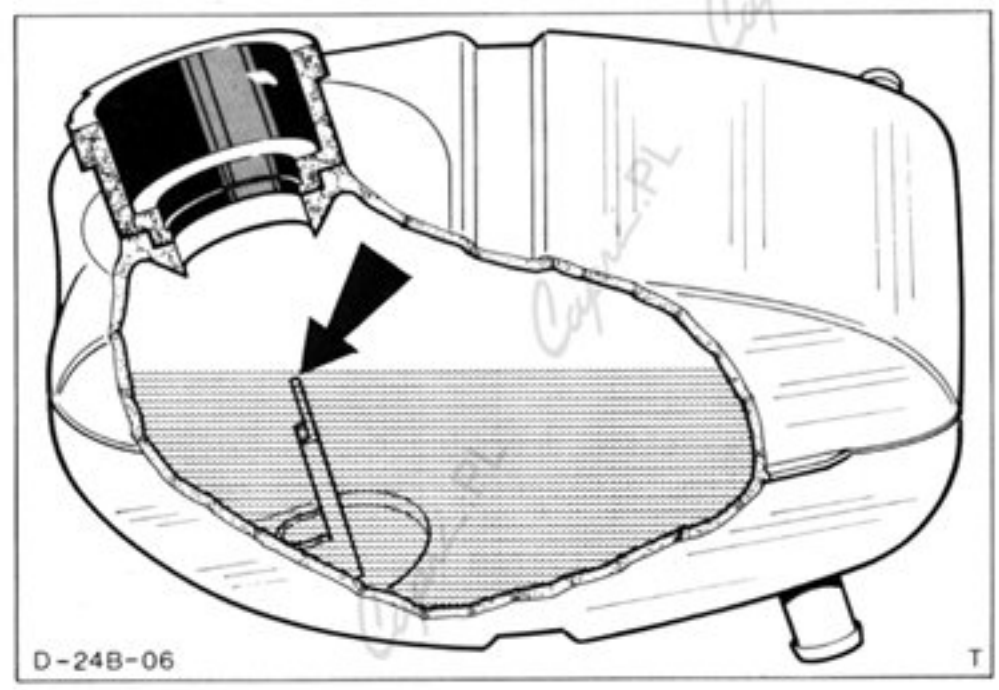


Fig.8. Plastic level indicator in degas tank, maximum coolant level is to top of indicator.

24 205 FAN BELT - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Open hood fit fender covers and disconnect battery.

2. Remove power steering drive belt by loosening belt tensioner two securing bolts, Fig.9.

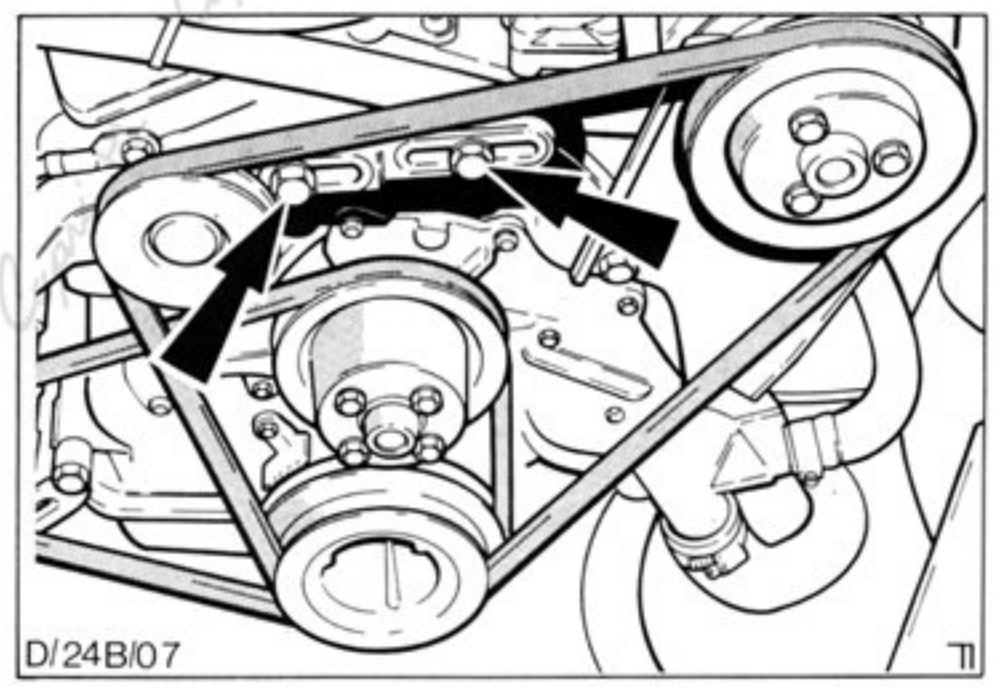


Fig.9. Power steering belt tensioner securing bolts.

3. Loosen three alternator mounting bolts, Fig.10, and remove fan belt.

NOTE: Certain vehicles may have a twin belt alternator drive.

4. Locate new fan belt on all three drive pulleys. This belt uses the rearward of the two crankshaft pulleys.

5. Pivot alternator away from engine to tighten belt. Tighten alternator mounting bolts.

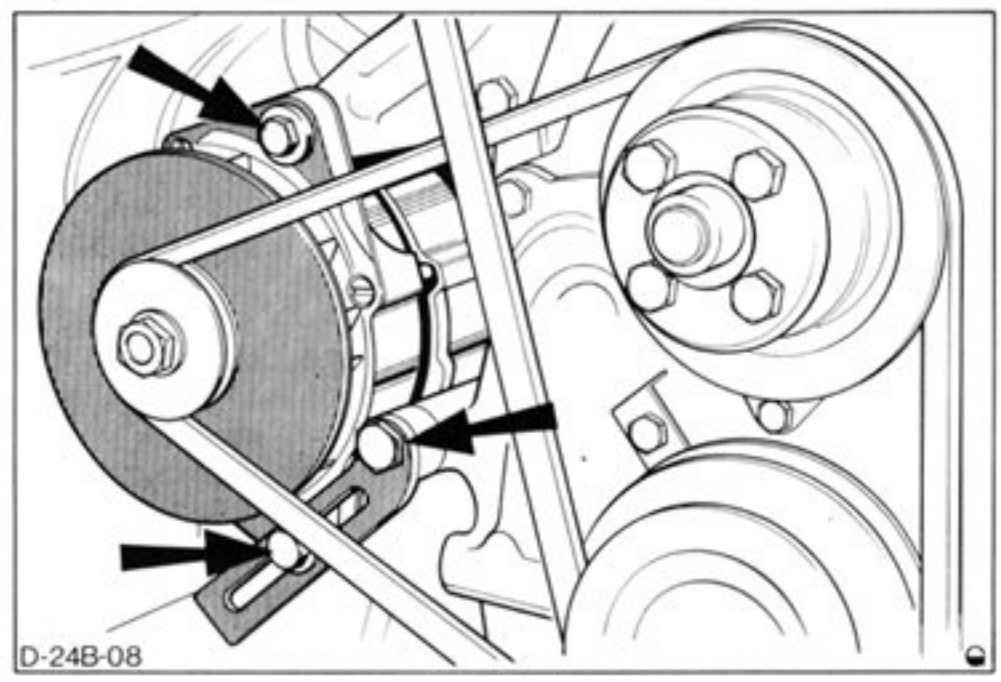


Fig.10. Alternator mounting bolts.

6. If available, use a belt tension gauge to check belt tension. For belt tensions refer to Technical Data (twin belt tensions are also quoted).

NOTE: Two tensions are quoted, one for new belts and one for belts which have run for ten minutes or more.

Alternatively, check that total free movement at mid point of the longest span of the belt is approximately 10 mm (0,4 in), when applying normal fingertip pressure, Fig.11.

7. Retighten alternator mounting bolts.

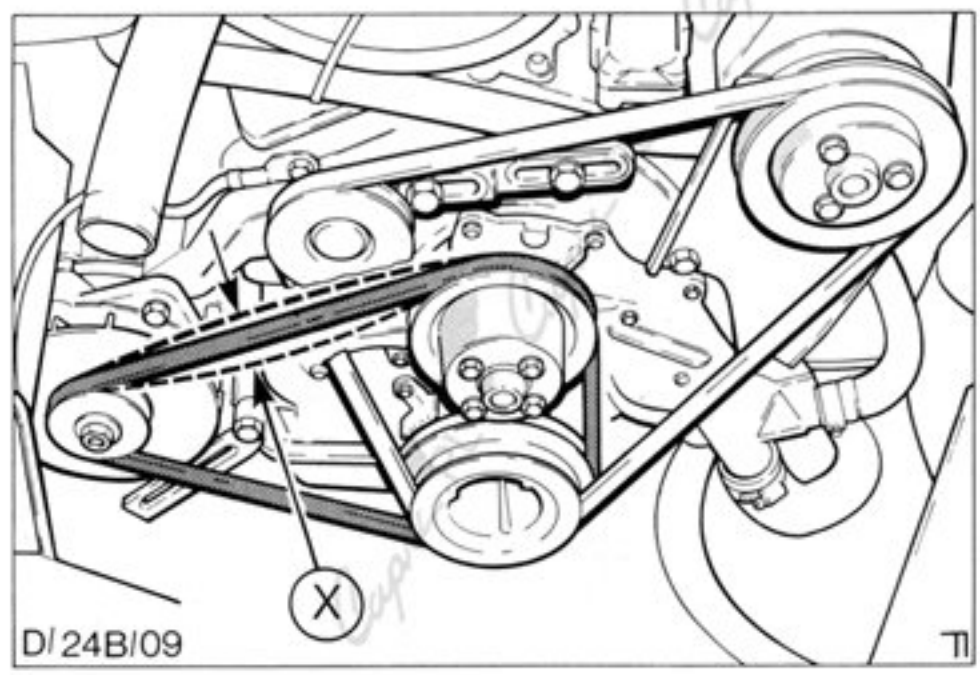


Fig.11. Fan belt maximum free movement.
X - 10 mm (0,4 in)

8. Refit power steering drive belt and adjust tension by moving tensioner. Tighten both tensioner securing bolts.

9. If available, use a belt tension gauge to check belt tension. For belt tensions refer to Technical Data.

Alternatively, check that total free movement at mid point of the longest span of the belt is approximately 13 mm (0,5 in), when applying normal fingertip pressure, Fig.12.

10. Retighten belt tensioner securing bolts.

11. Reconnect battery and if a new fan belt has been fitted, run engine for ten minutes then recheck and, if necessary, adjust belt tension.

12. Remove fender covers and close hood.

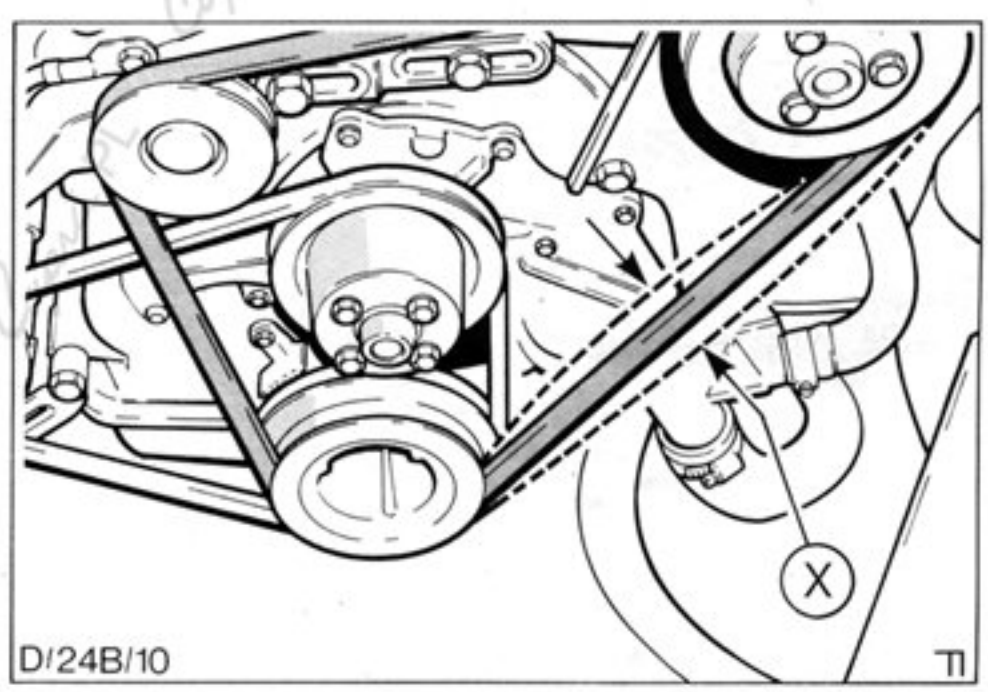


Fig.12. Power steering drive belt maximum free movement.
X - 13 mm (0,5 in)

24 215 CLUTCH - VISCOUS FAN - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.

2. Using modified 32 mm spanner, unlock and remove fan and clutch assembly from water pump hub, Fig.13.

NOTE: THIS HAS A LEFT HAND THREAD. It is necessary to hold the water pump pulley to prevent rotation. If the clutch is tight, a hide faced hammer may be used with the spanner.

3. Remove four bolts securing fan to clutch and separate clutch from fan.

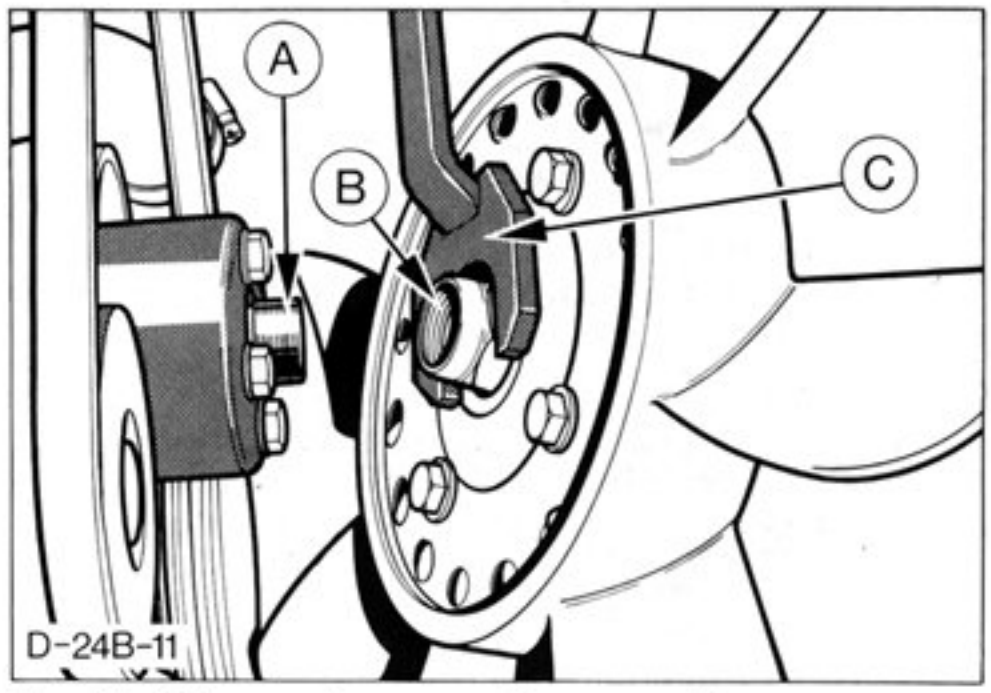


Fig.13. Viscous fan assembly removal.
A - Water pump hub
B - Clutch assembly retaining lock nut
C - Modified 32 mm spanner

24 215

To Install

4. Position fan blades on clutch and tighten all four retaining bolts, Fig.14, to specified torque, refer to Technical Data. Under no circumstances should specified torque figures be exceeded as fan clutch housing is an aluminium casting.

5. Screw fan and clutch assembly onto pump hub and tighten nut using 32 mm spanner. It is necessary to hold the water pump pulley to prevent rotation.

NOTE: Lock nut has a LEFT HAND thread.

6. Reconnect battery, remove fender covers and close hood.

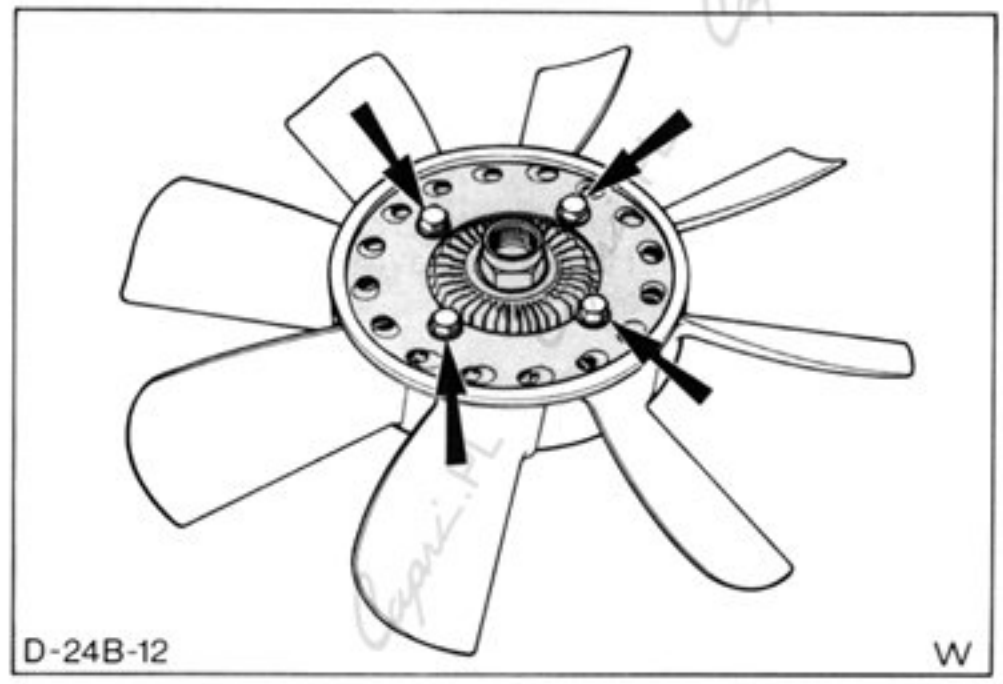


Fig.14. Fan to clutch assembly retaining bolts.

24 216 PULLEY - FAN - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.

2. Remove fan and clutch assembly as detailed in Operation No. 24 215.

3. Slacken alternator mounting bolts and slide fan belt off fan pulley.

4. Remove four pulley securing bolts, Fig.15, and remove pulley from hub.

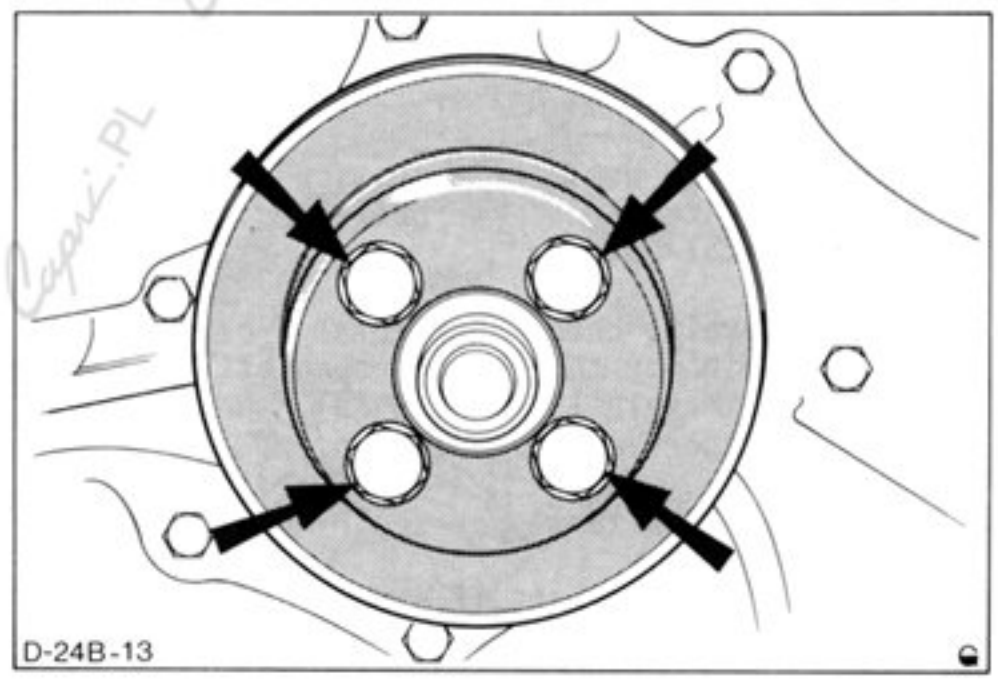


Fig.15. Fan pulley retaining bolts.

To Install

5. Refit pulley and secure with four bolts, tightening to specified torque, refer to Technical Data.

6. Slide fan belt onto pulley and tension belt. Tighten alternator mounting bolts.

7. If available, use a belt tension gauge to check belt tension. For belt tension refer to Technical Data.

   Alternatively, check that total free movement at mid point of the longest span of the belt is approximately 10 mm (0,4 in), when applying normal fingertip pressure, Fig.16. Retighten alternator mounting bolts.

8. Refit fan and clutch assembly as detailed in Operation No. 24 215.

9. Reconnect battery, remove fender covers and close hood.

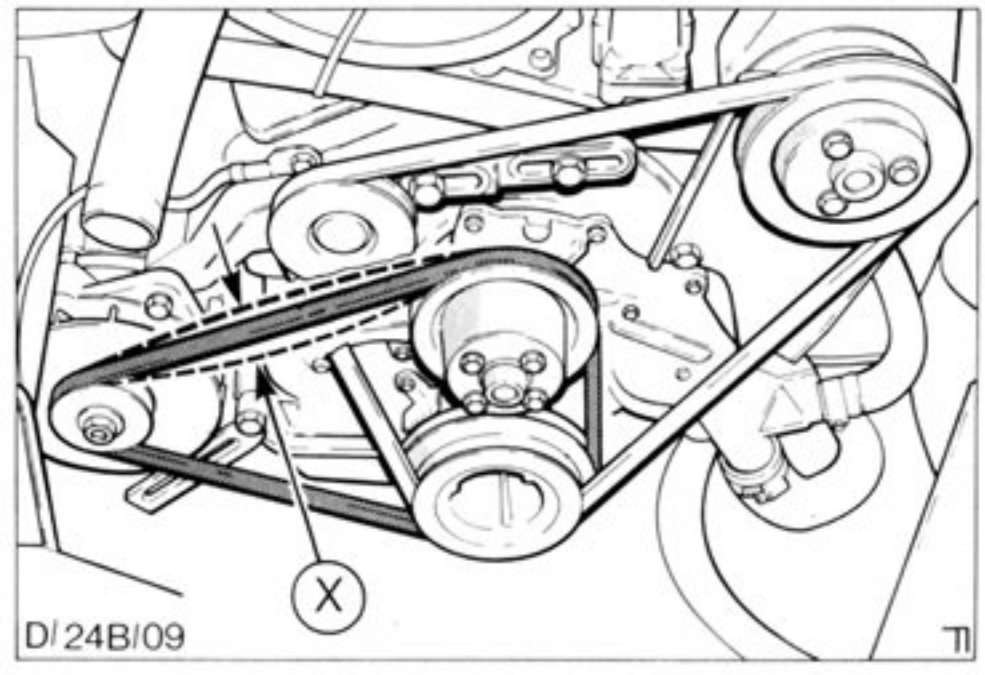


Fig.16. Fan belt maximum free movement.
X - 10 mm (0,4 in)

24 254 RADIATOR - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Position clean drain tray below radiator.
3. Relieve pressure of system by turning degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

4. Loosen radiator bottom hose retaining clip, Fig.17, slide hose from radiator and drain coolant. To assist draining remove radiator cap.

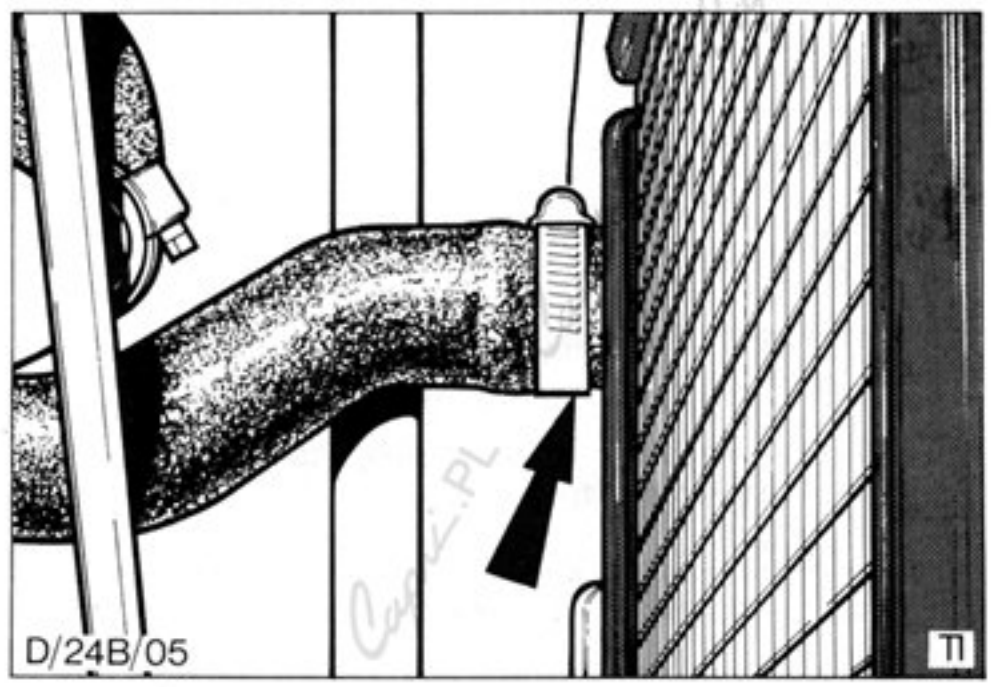


Fig.17. Radiator bottom hose retaining clip (fan shroud removed for clarity).

5. Loosen radiator top hose and degas tank hose retaining clips, Fig.18, and detach hoses.
6. Remove four screws securing fan shroud to radiator and slide shroud back over fan.
7. Remove four radiator retaining bolts and slide radiator from vehicle.

To Install

8. Check top and bottom radiator hoses for cuts, splits or deterioration, renew if required.
9. Locate radiator and secure with four retaining bolts, Fig.19.
10. Slide bottom hose onto radiator and secure.
11. Slide expansion tank hose onto radiator neck outlet and secure with clamp.
12. Slide top hose onto radiator and secure.
13. Position fan shroud against radiator and secure with four screws.
14. Refill system through radiator filler neck with correct coolant solution. Fill until coolant level is nearly overflowing allowing time for air in system to bubble through. Refit radiator cap and top up degas tank to approximately half full. Refit tank cap.
15. Reconnect battery.
16. Run engine and check all hose connections for leaks. Check and, if necessary, top up coolant in degas tank to top of plastic indicator inside tank. Remove drain tray.
17. Remove fender covers and close hood.

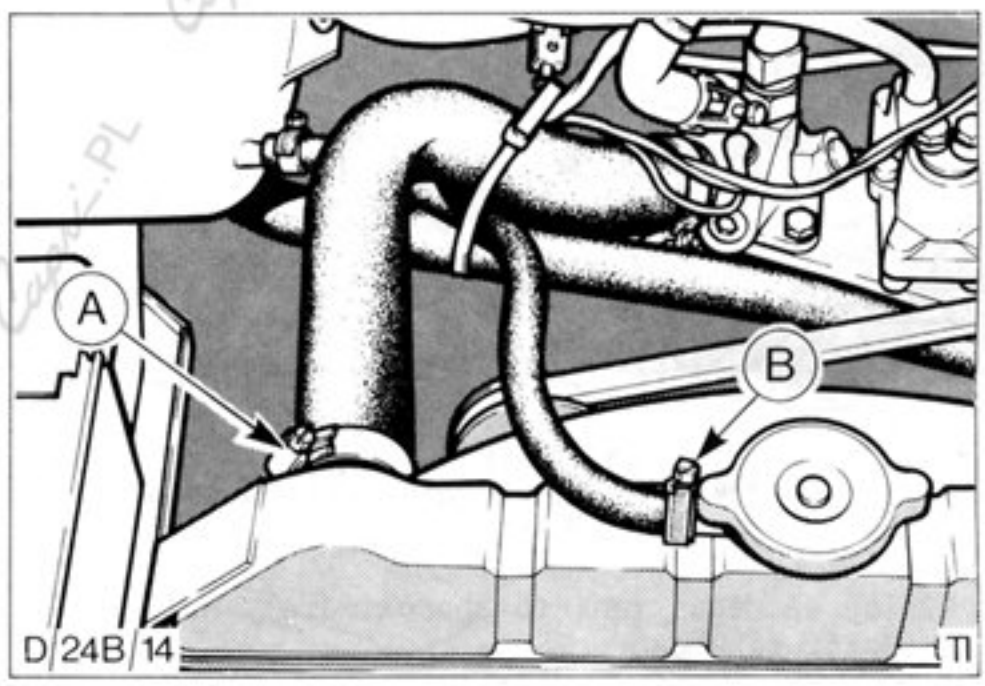


Fig.18. Radiator top hose and tank hose connections.
A - Top hose connection
B - Degas tank hose connection

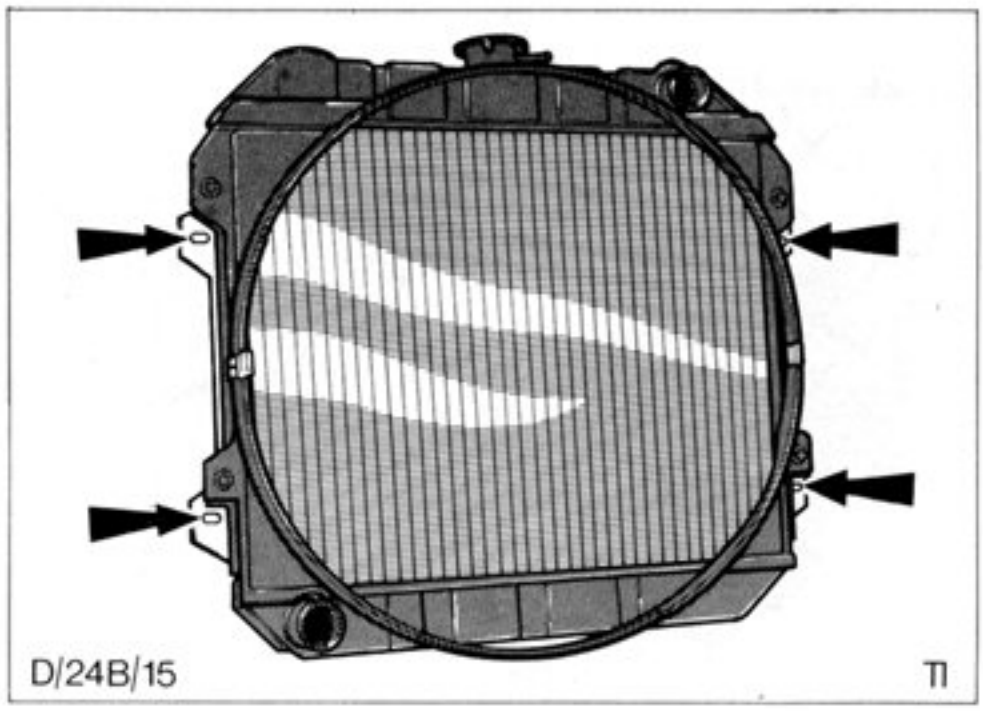


Fig.19. Radiator securing bolt holes (radiator removed from vehicle for clarity).

24 284

24 284 EXPANSION TANK - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Relieve pressure of system by turning degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Position clean drain tray under vehicle below degas tank.
4. Remove two tank securing screws, Fig.20, and lift tank from mounting bracket.
5. Disconnect three hoses from degas tank, Figs.21 and 22, and plug hose ends to prevent excessive coolant loss.
6. Remove tank from vehicle and drain coolant.

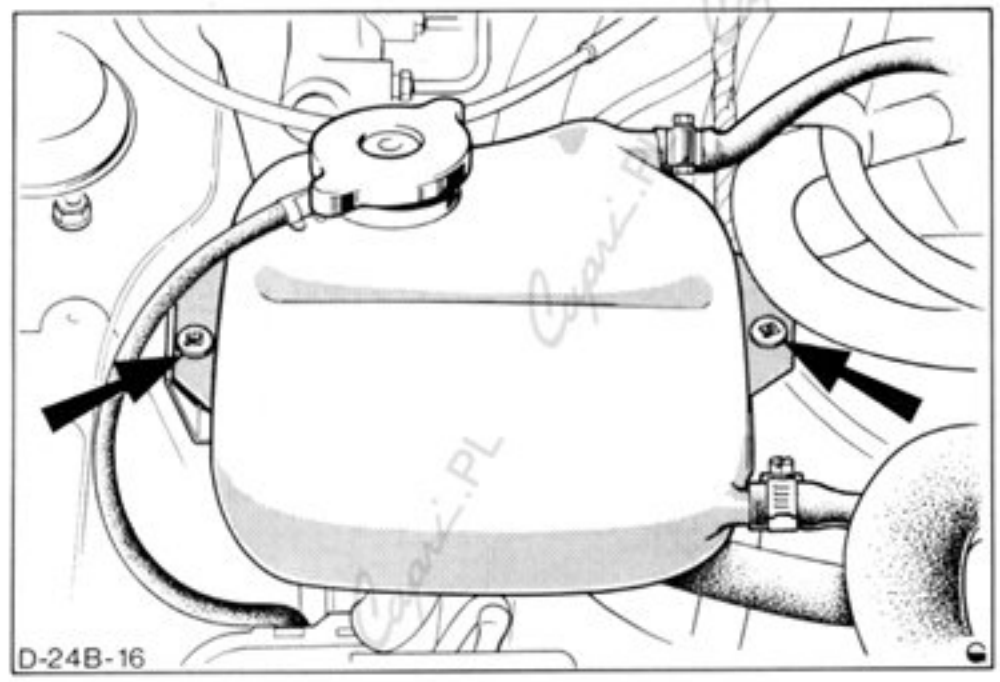


Fig.20. Degas tank securing screws.

To Install

7. Reconnect three tank hoses and secure with clamps.
8. Align tank to mounting bracket and secure with two screws.
9. Top up degas tank to approximately half full. Refit tank cap.
10. Reconnect battery.
11. Run engine and check all hose connections for leaks. Check and, if necessary, top up coolant in degas tank to top of plastic indicator inside tank. Remove drain tray.
12. Remove fender covers and close hood.

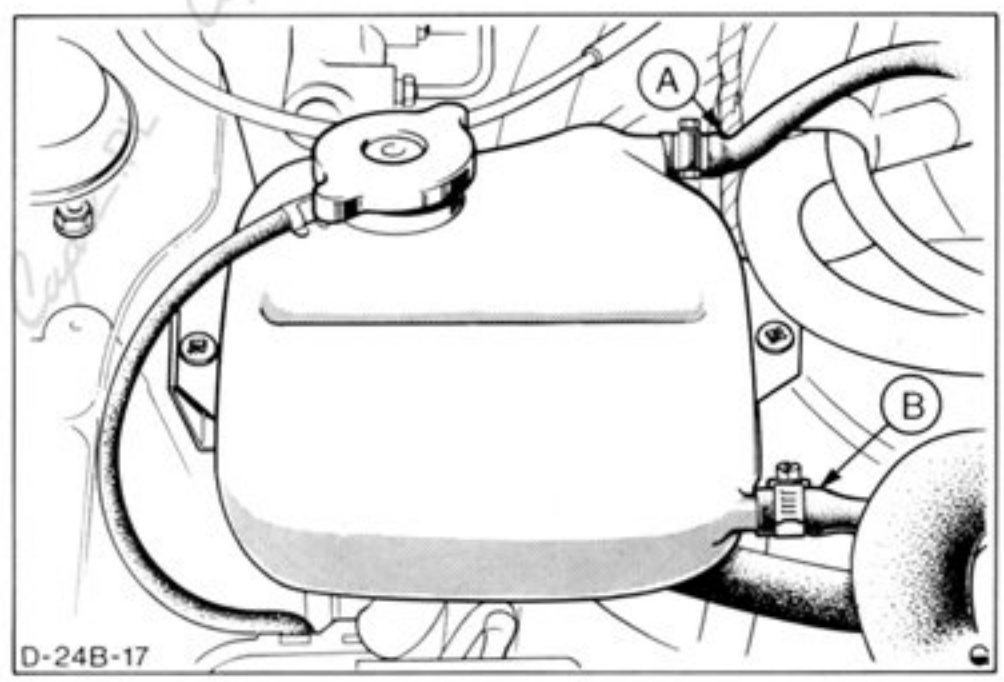


Fig.21. Upper two tank pipe connections.
A - Hose from hot air box connector
B - Hose from radiator filler neck

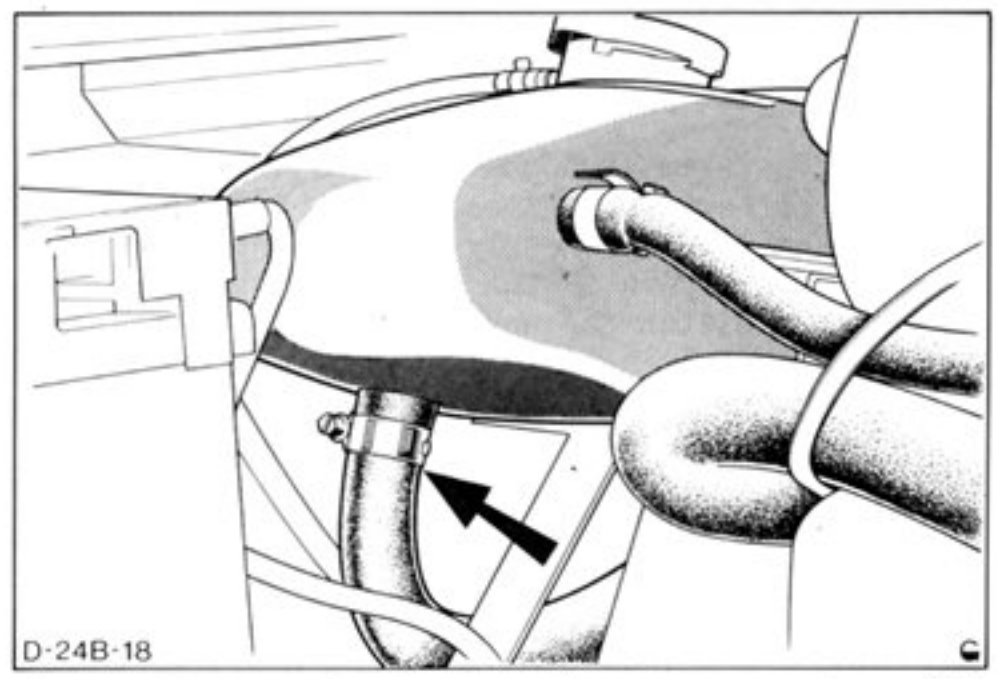


Fig.22. Tank outlet hose to heater return hose 'T' connector.

24 404 WATER PUMP ASSEMBLY - REMOVE AND INSTALL

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.

2. Relieve pressure of system by turning degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Position clean drain tray below vehicle, disconnect bottom hose and heater return hose from water pump, Fig.23, and allow system to drain.

4. Remove fan clutch assembly and fan pulley, as detailed in Operation No. 24 216.

5. Slacken power steering belt tensioner securing bolts, Fig.24, and remove belt.

6. With drain tray still in position remove three thermostat housing retaining bolts, Fig.23, remove housing and thermostat.

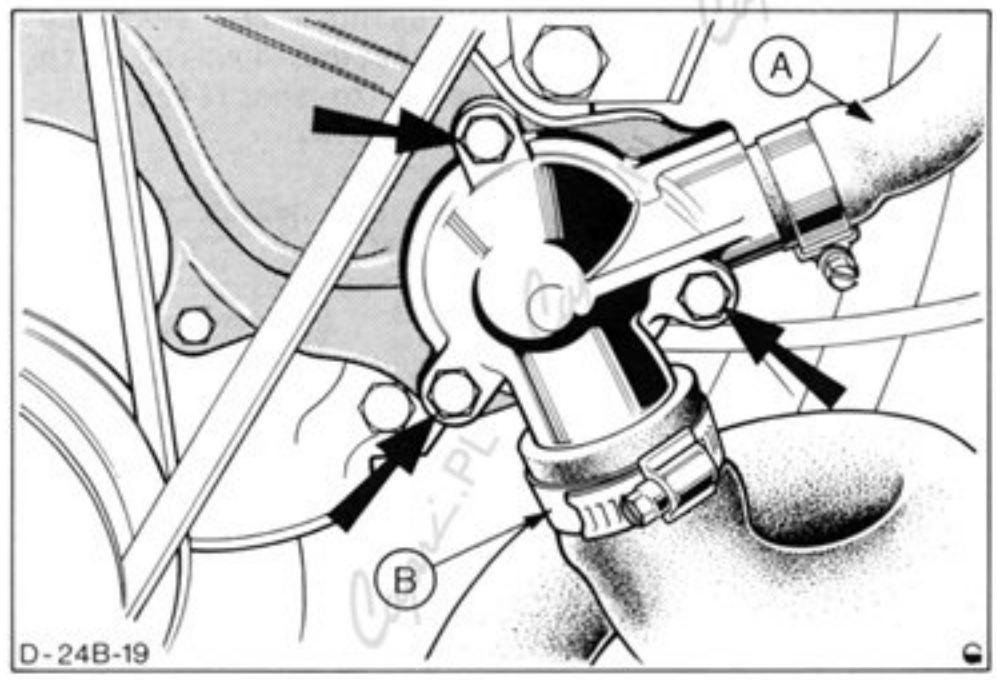


Fig.23. Thermostat housing hose connections (housing retaining bolts arrowed).
A - Heater return hose
B - Radiator bottom hose

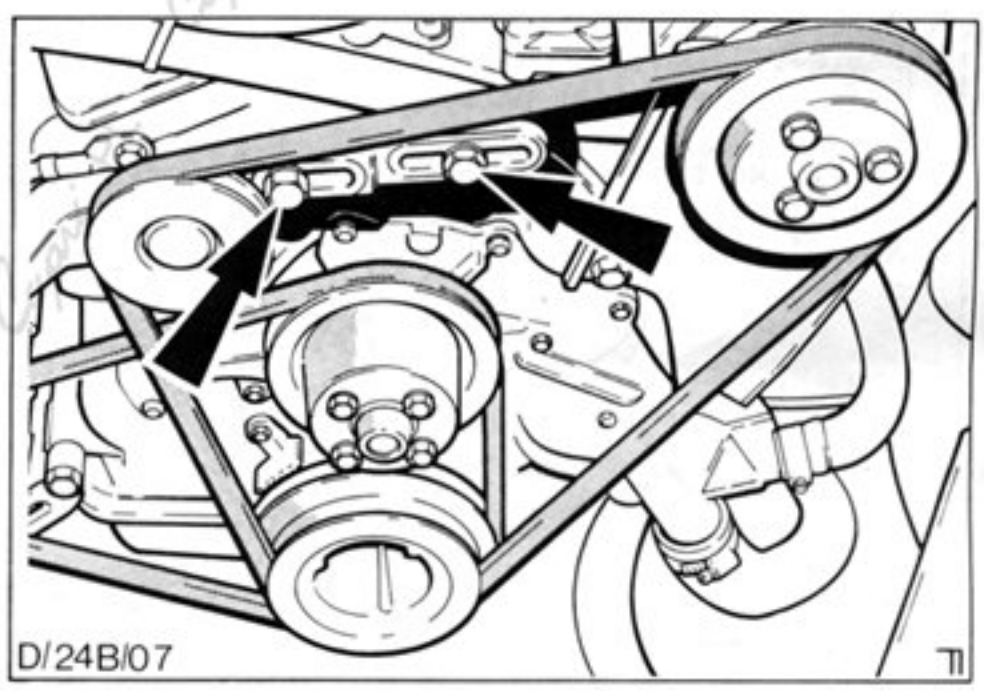


Fig.24. Power steering belt tensioner securing bolts.

7. Remove twelve bolts and detach water pump assembly, Fig.25.

To Install

8. Clean pump and block mating surfaces.

9. Using a new gasket, position and secure water pump assembly. Tighten bolts to specified torque, refer to Technical Data.

10. Clean thermostat housing and water pump mating surfaces.

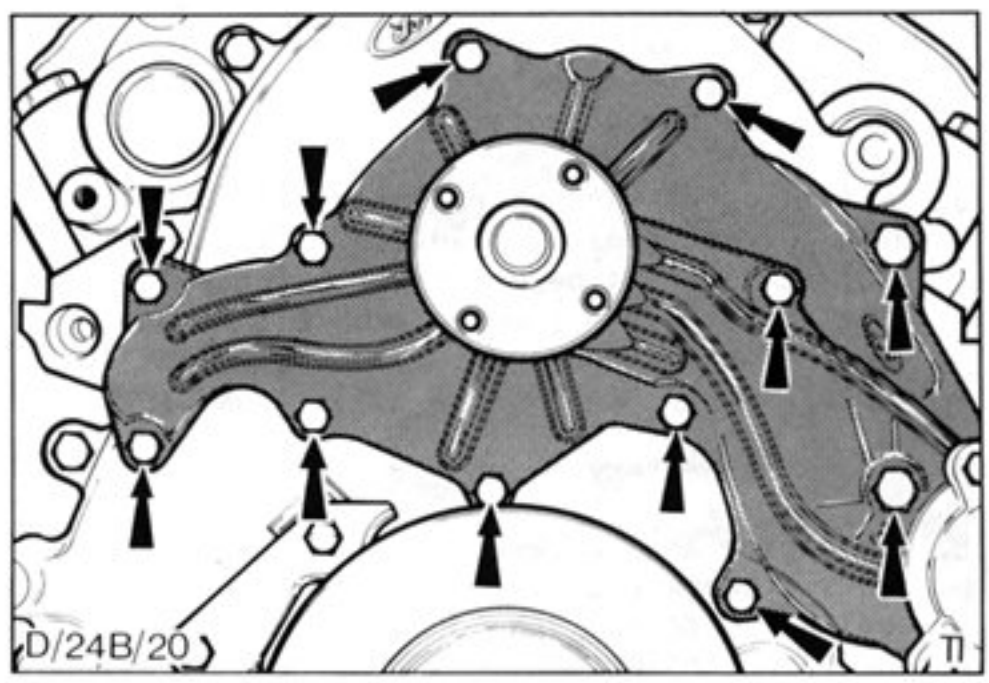


Fig.25. Water pump assembly retaining bolts.

24 404

11. Position thermostat, and using a new seal and gasket, Fig.26, refit and secure housing with three bolts. Tighten bolts to specified torque, refer to Technical Data.

12. Refit radiator bottom hose and heater hose to water pump.

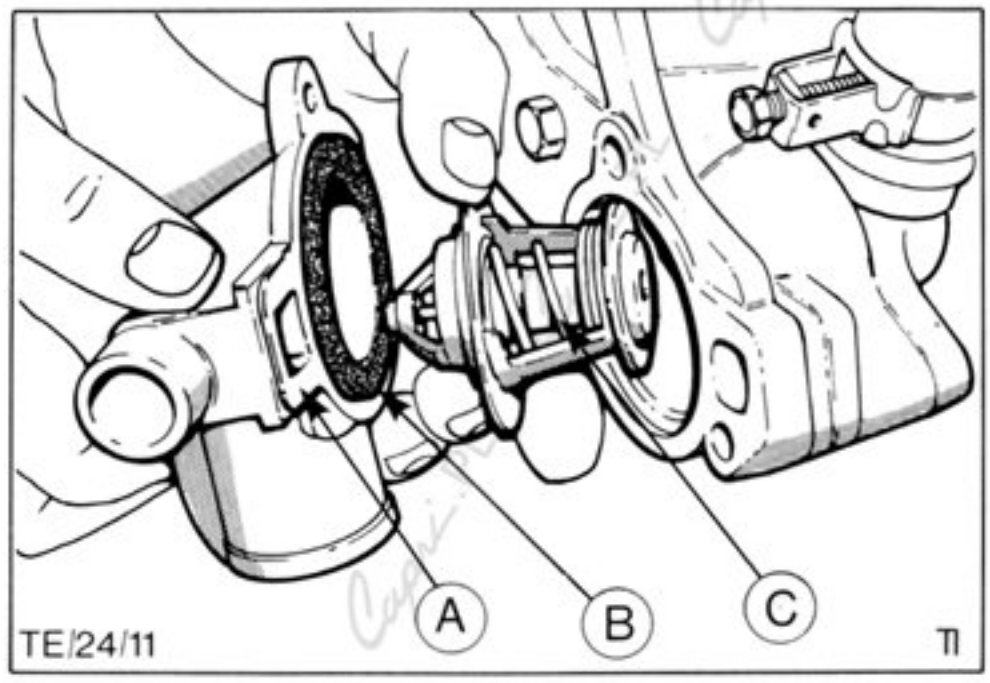


Fig.26. Thermostat installation.
A - Housing gasket
B - Sealing ring
C - Thermostat

13. Refit fan pulley and secure with four bolts, Fig.27. Tighten bolts to specified torque, refer to Technical Data.

14. Refit and tension fan belt and power steering drive belt as detailed in Operation No. 24 205.

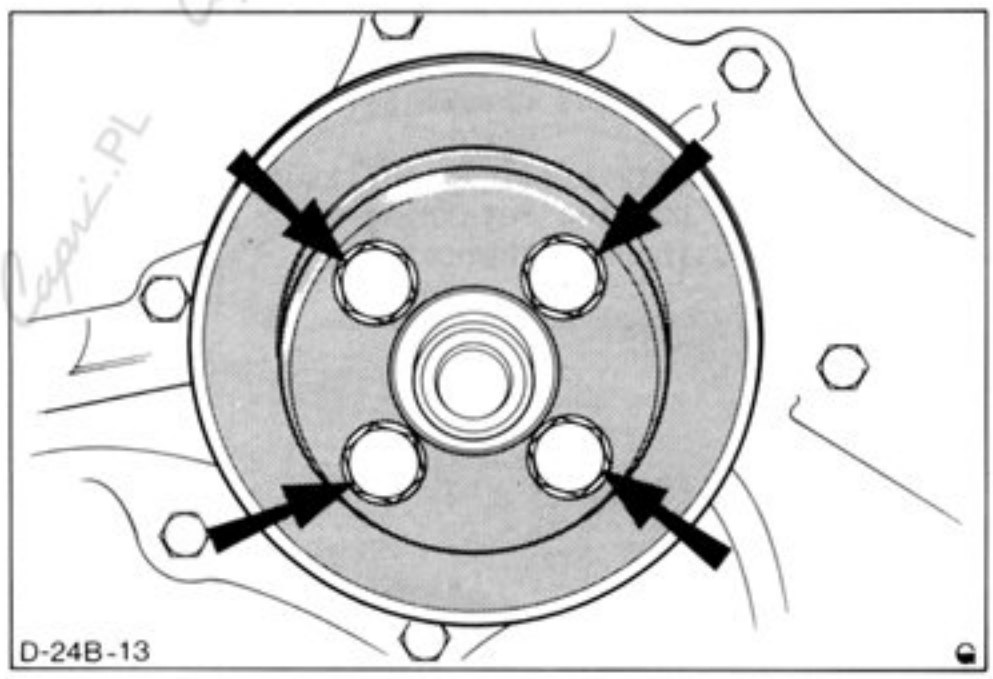


Fig.27. Fan pulley retaining bolts.

15. Screw fan and clutch assembly onto pump hub and tighten nut using modified 32 mm spanner, Fig.28. It is necessary to hold the fan pulley to prevent rotation.

16. Refill system through radiator filler neck with correct coolant solution. Fill until coolant level is nearly overflowing allowing time for air in system to bubble through. Refit radiator cap and top up degas tank to approximately half full. Refit tank cap.

17. Reconnect battery.

18. Run engine and check all hose connections for leaks. Check and, if necessary, top up coolant in degas tank to top of plastic indicator inside tank. Remove drain tray.

19. Remove fender covers and close hood.

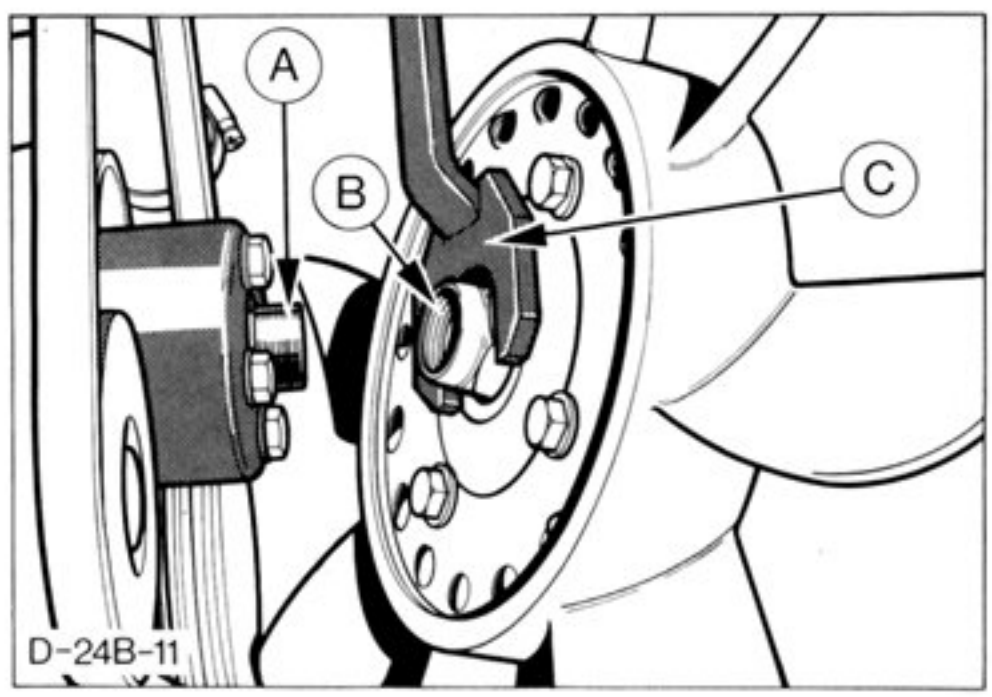


Fig.28. Viscous fan assembly installation.
A - Water pump hub
B - Clutch assembly retaining lock nut
C - Modified 32 mm spanner

24 451 1

24 451 1 THERMOSTAT - TEST (Thermostat removed)

SPECIAL SERVICE TOOLS REQUIRED: NONE

1. Measure and note dimension X in Fig.29.
2. Suspend thermostat in water in suitable container, ensuring thermostat does not touch the sides of the container.
3. Heat the water, checking temperature with an accurate thermometer. Thermostat should start to open at 79°C to 83°C (174°F to 181°F). Continue heating water to 97°C (206°F), then carefully remove thermostat. Remeasure dimension X and subtract original dimension. Difference between both readings should be a minimum of 7 mm (0,28 in).

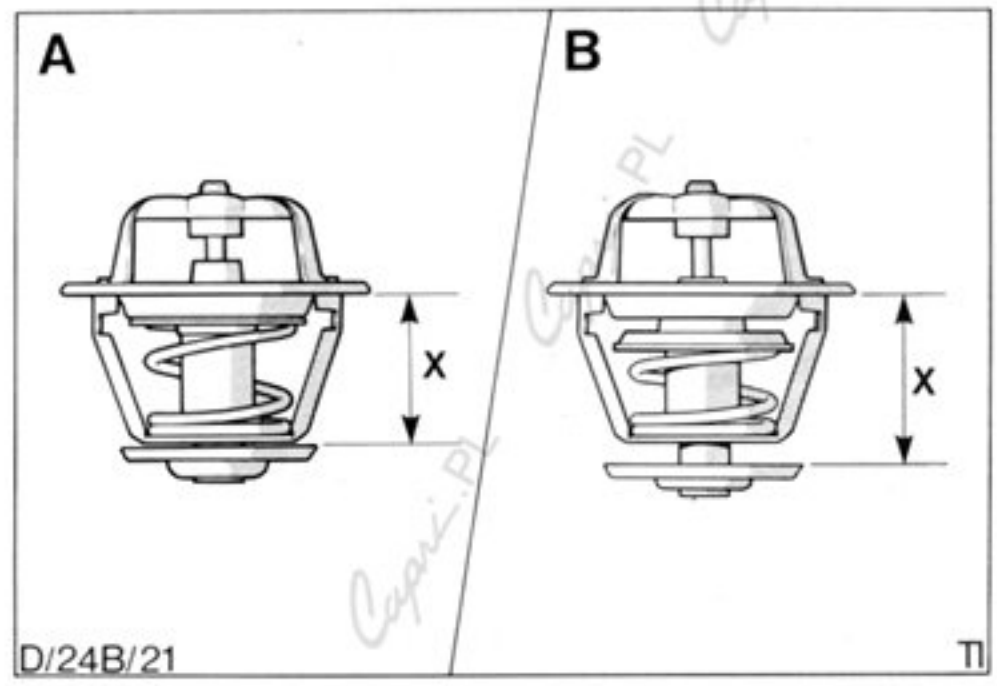


Fig.29. Thermostat testing dimension (X).
A - Before thermostat opens (cold)
B - After thermostat opens (hot)

24 609 HOSE - EXPANSION TANK TO HEATER HOSE CONNECTOR - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Relieve system pressure by turning degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Position clean drain tray below degas tank.
4. Remove tank two securing screws.
5. Tighten tank cap and tilt tank so that coolant is away from hose to be removed. Loosen tank hose clamp and detach hose.
6. Loosen 'T' connector hose clamp and remove hose, Fig.30.

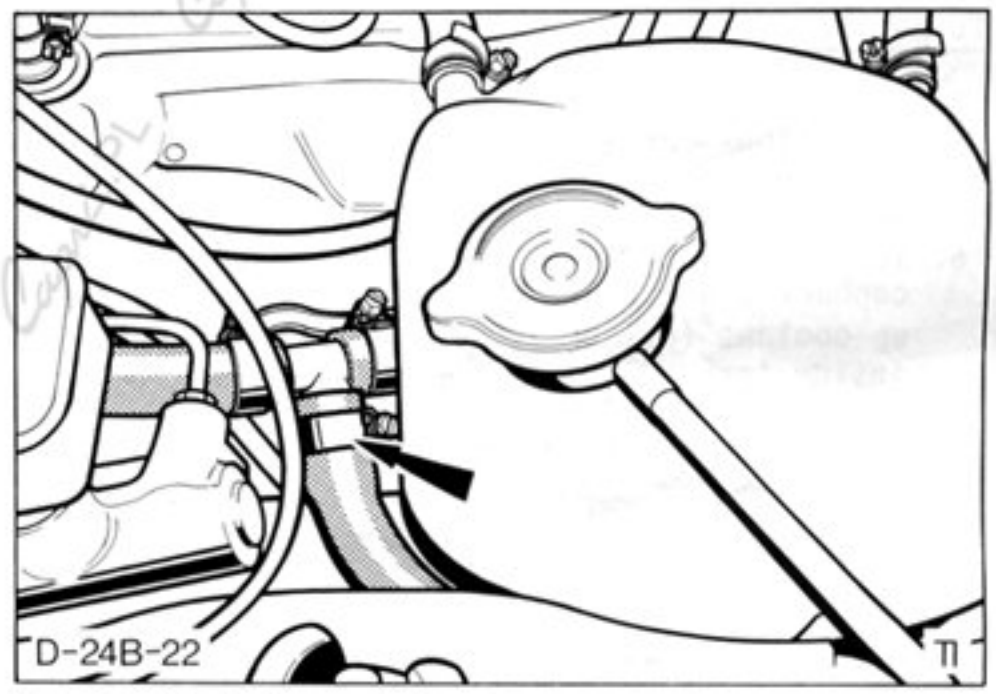


Fig.30. Tank hose to heater return hose connector.

To Replace

7. Assemble clamps to new hose and slide hose onto 'T' connector. Tighten hose clamp.
8. Fit hose onto tank and secure clamp, Fig.31.
9. Refit tank to its bracket with two screws.
10. Top up tank to approximately half full. Refit tank cap.
11. Reconnect battery. Run engine, check all hose connections for leaks and, if necessary, top up coolant in tank to top of plastic indicator inside tank. Remove drain tray.
12. Remove fender covers and close hood.

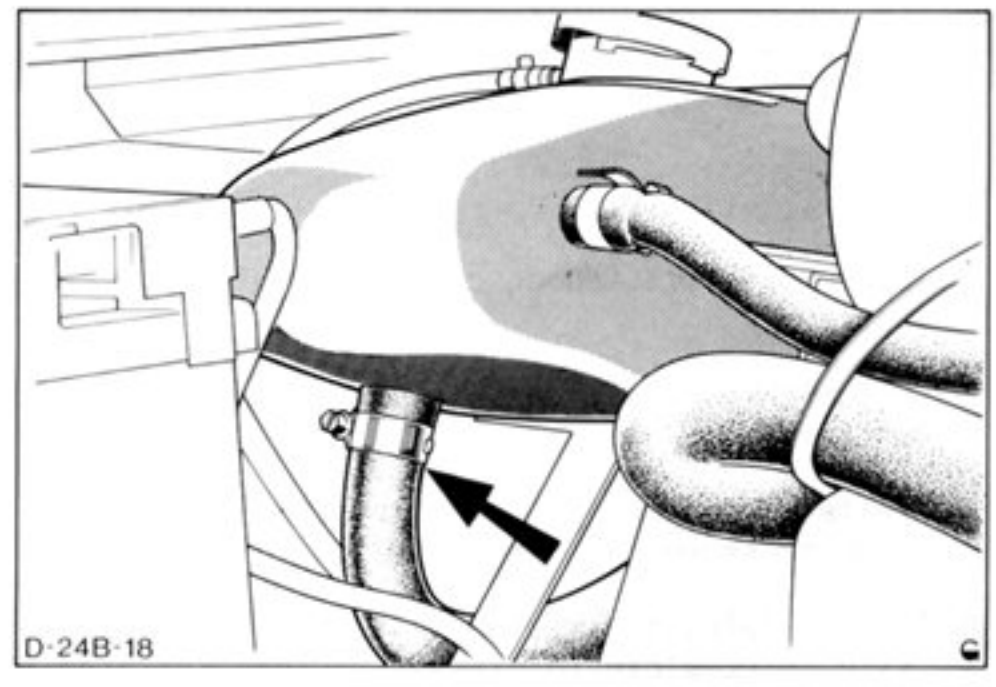


Fig.31. Hose to tank connection.

24 610

24 610 HOSE - EXPANSION TANK TO AIR BOX CONNECTOR - REPLACE

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Relieve system pressure by turning degas tank cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

3. Position clean drain tray below degas tank.
4. Loosen hose clamps and detach hose from degas tank and elbow connector, Fig.32.

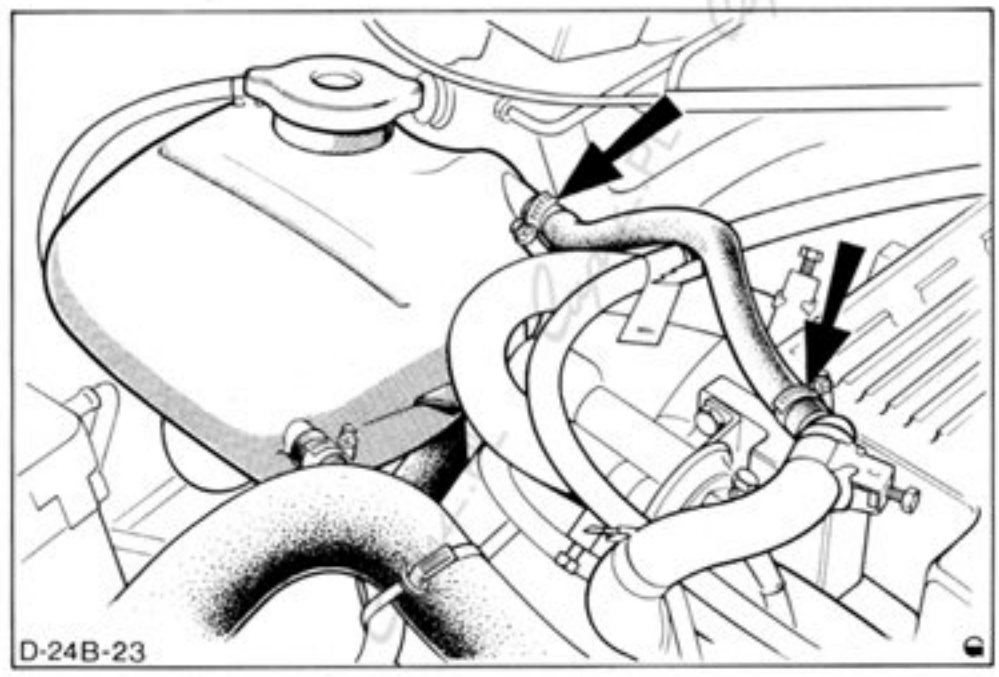


Fig.32. Degas tank to air box connector hose connections.

To Replace

5. Assemble clamps to new hose and slide hose onto elbow connector and tank connection. Tighten both hose clamps.
6. Reconnect battery. Run engine, check all hose connections for leaks and, if necessary, top up coolant in tank to top of plastic indicator inside tank, Fig.33. Remove drain tray.
7. Remove fender covers and close hood.

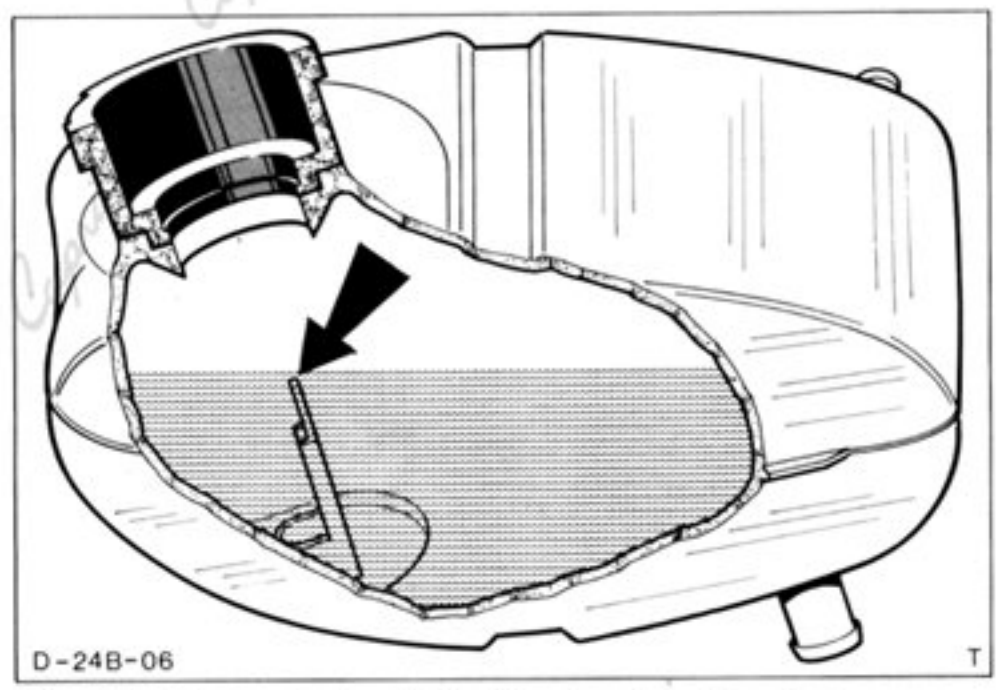


Fig.33. Coolant level indicator inside tank.

24 618 HOSES - RADIATOR - REPLACE (ALL)

SPECIAL SERVICE TOOLS REQUIRED: NONE

To Remove

1. Open hood, fit fender covers and disconnect battery.
2. Position clean drain tray below radiator bottom hose.
3. Relieve pressure of system by turning degas tank pressure cap through 90°.

NOTE: When releasing system pressure, cover cap with thick cloth to prevent coolant scalding.

4. Loosen radiator bottom hose clamp, Fig.34, slide hose from radiator and drain system. Remove radiator filler cap to assist draining.

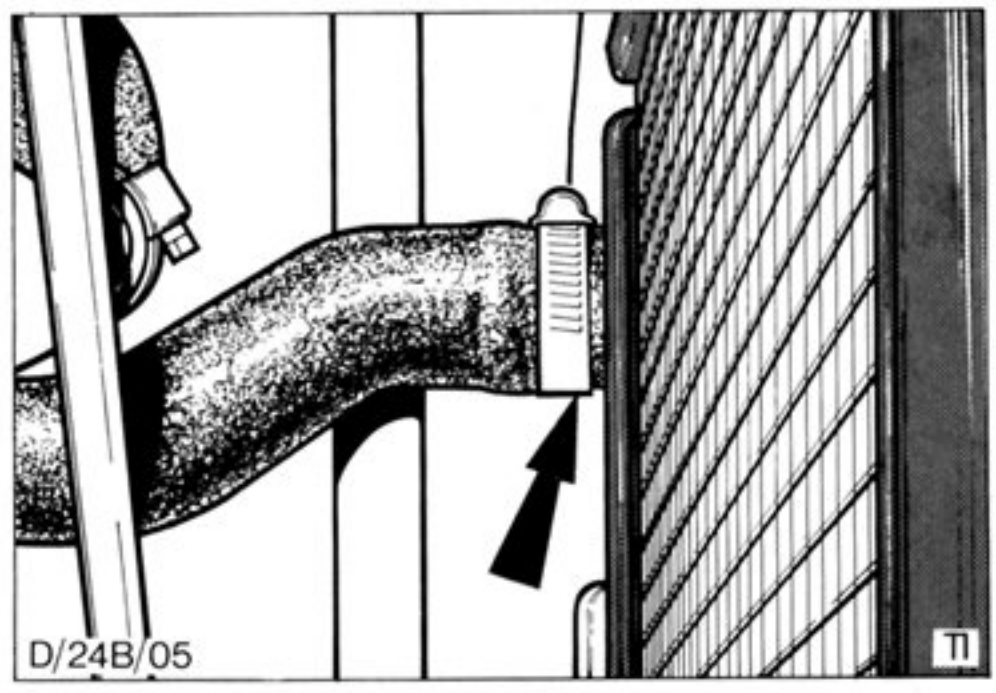


Fig.34. Radiator bottom hose connections (fan shroud removed for clarity).

24 618

5. Loosen both radiator top hose clamps and remove top hose, Fig.35.

6. Loosen both clamps of hose from degas tank to radiator, Fig.35, and remove hose.

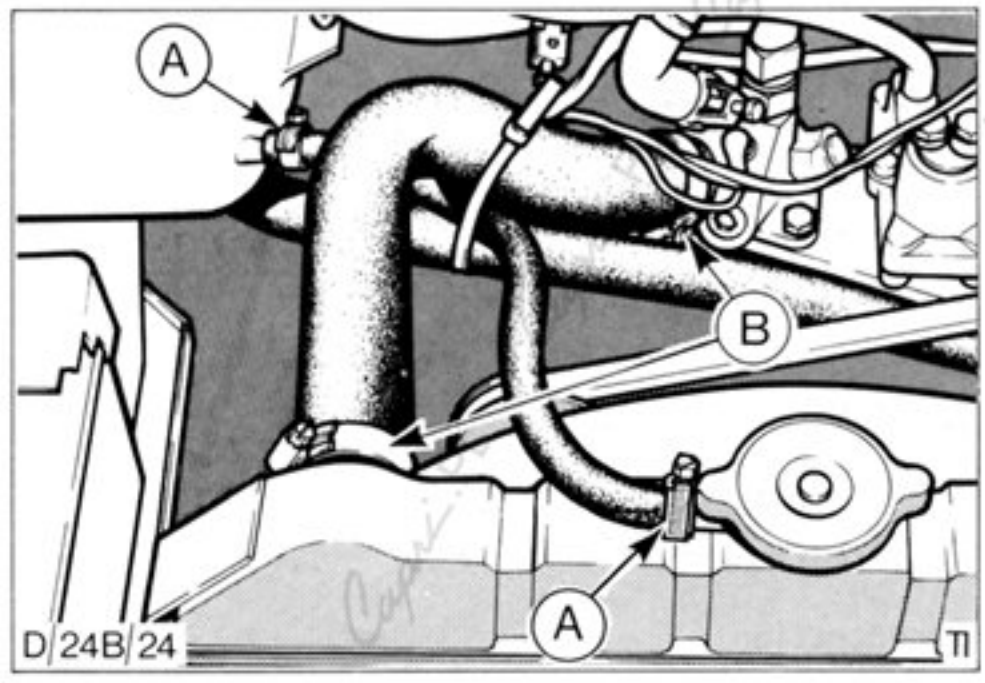


Fig.35. Radiator top hose and overflow hose connections.
A - Radiator to tank hose connections
B - Radiator top hose connections

7. Loosen radiator bottom hose clamp at thermostat housing, Fig.36, and remove hose.

8. Remove clamps from all hoses and discard hoses.

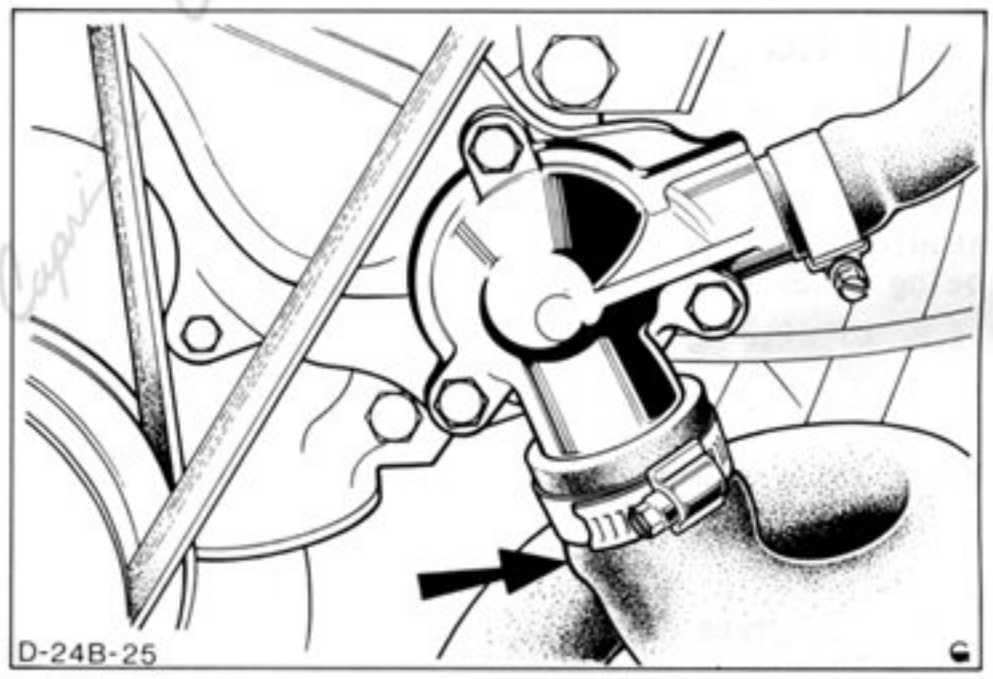


Fig.36. Radiator bottom hose connection to thermostat housing.

To Replace

9. Fit clamps to respective new hoses.

10. Fit radiator bottom hose to radiator and thermostat housing and tighten both clamps.

11. Fit radiator top hose to radiator and engine water outlet connector, tighten both clamps.

12. Fit hose from degas tank to radiator, clamping respective ends.

13. Refill system through radiator filler neck with correct coolant solution. Fill until coolant level is nearly overflowing allowing time for air in system to bubble through. Refit radiator cap and top up degas tank to approximately half full. Refit tank cap.

14. Reconnect battery.

15. Run engine and check all hose connections for leaks. Check and, if necessary, top up coolant in degas tank to top of plastic indicator inside tank. Remove drain tray.

16. Remove fender covers and close hood.

TECHNICAL DATA

System

Type	Fully pressurised using degas tank

Coolant Capacity

Including heater circuit and degas tank	8,7 litres (15,3 pints)

Antifreeze

Type	Ford Super Plus Antifreeze
Specification No.	SSM-97B-9103-A

Concentration

Specific Gravity (providing no other additive is in coolant)	Approximate Percentage of antifreeze (by volume)	Remains fluid to		Solidifies at	
		°C	°F	°C	°F
1,069	45	-30	-22	-38	-36

A 45% concentration of Ford Super Plus Antifreeze, which contains a powerful corrosion inhibitor, should remain in the cooling system for a maximum period of 2 years (regardless of climate) before being renewed. If water only is used as a coolant severe corrosion could result.

Corrosion Inhibitor

Ford Specification No.	SSM-97B-9100-A

Inhibitor to meet the above specification is manufactured by Ciba-Geigy Ltd., and is marketed as 'Inhibitor type 71C' which is available on a world wide basis through the Head Office of the Ciba-Geigy group in your area.

Inhibitor type 71C should be mixed with water in the ratio of 1 part inhibitor to 39 parts water.

Radiator

Type	Corrugated high efficiency fin on tube

Thermostat

Type	Wax
Nominal temperature rating	82°C
Opening temperature	79 to 83°C (174 to 181°F)
Minimum thermostat travel at 97°C (206°F) ..	7 mm (0,28 in) (Refer to Operation No. 24 451 1)

Water Pump

Type	Centrifugal

Pressure cap

Releasing pressure	0,85 to 1,10 Bar (0,85 to 1,10 kgf.cm^2) (12,0 to 15,7 lbf.in^2)

TECHNICAL DATA (cont'd)

Fan

Fan clutch	Thermo viscous temperature sensing type
Belt free play	10 mm (0,4 in) at mid-point of longest span of belt applying normal fingertip pressure

Single drive belt

	N	kgf	lbf
Belt tension - New belt *	400 to 600	40 to 60	90 to 135
- Used belt **	300 to 400	30 to 40	67 to 90

Twin drive belt

	N	kgf	lbf
Belt tension - New belt *	350 to 450	35 to 45	78 to 101
- Used belt **	280 to 330	28 to 33	63 to 74

* If a new belt is fitted, it will require readjustment after 1500 miles.
** A used belt is one that has run for more than 10 minutes.

Tightening Torques

	Nm	kgf.m	lbf.ft
Radiator to front body panel	8,0 to 11,0	0,8 to 1,1	5,9 to 8,1
Thermostat housing retaining bolts	16,6 to 20,4	1,7 to 2,1	12,2 to 15,1
Water pump retaining bolts	9,0 to 13,0	0,9 to 1,3	6,6 to 9,6
Fan shroud to radiator bolts	8,0 to 11,0	0,8 to 1,1	5,9 to 8,1
Fan pulley retaining bolts	20,0 to 25,0	2,0 to 2,6	14,8 to 18,4
Fan to fan clutch retaining bolts	20,0 to 25,0	2,0 to 2,6	14,8 to 18,4

Ford

Service

Service Publications, Ford Motor Company Limited, Brentwood, Essex.

FORD
CAPRI 2.8
injection

SUPPLEMENT TO
FORD CAPRI '74 ONWARDS
WORKSHOP MANUAL

FORD

CAPRI 2.8 injection

Supplementary Workshop Manual

To be used in conjunction with the Ford Capri '74 Onwards WORKSHOP MANUAL.

FOREWORD

This supplementary Manual has been prepared to cover the new features of the Ford Capri 2,8 Injection, and details repair operations for components which are not already described in publications previously distributed to Dealers. The information has been compiled for use by Ford Dealerships and gives repair and adjustment procedures applicable to the new features together with component illustrations, technical specifications and details of special tools or equipment that may be required.

FOR ALL OTHER REPAIR OPERATIONS, REFERENCE SHOULD BE MADE TO THE FORD CAPRI '74 ONWARDS WORKSHOP MANUAL

The repair operations numbering sequence used in all Sections corresponds with that used in the Ford Car Labour Time Schedule.

SPECIAL TOOLS

In addition to the two suppliers of Special Tools shown in the Ford Capri '74 Onwards Workshop Manual, European tools can also be ordered from:

OPTOM SA
Panama 3
Entreplanta b
Madrid 16
SPAIN

The illustrations and descriptive text in this issue were correct at the time of going to print. Ford policy is one of continuous improvement and the right to change prices, specifications and equipment at any time, without notice, is reserved.

Reference in this publication to 'optional', 'special equipment' and 'where fitted', refer to alternative specifications for certain parts.

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