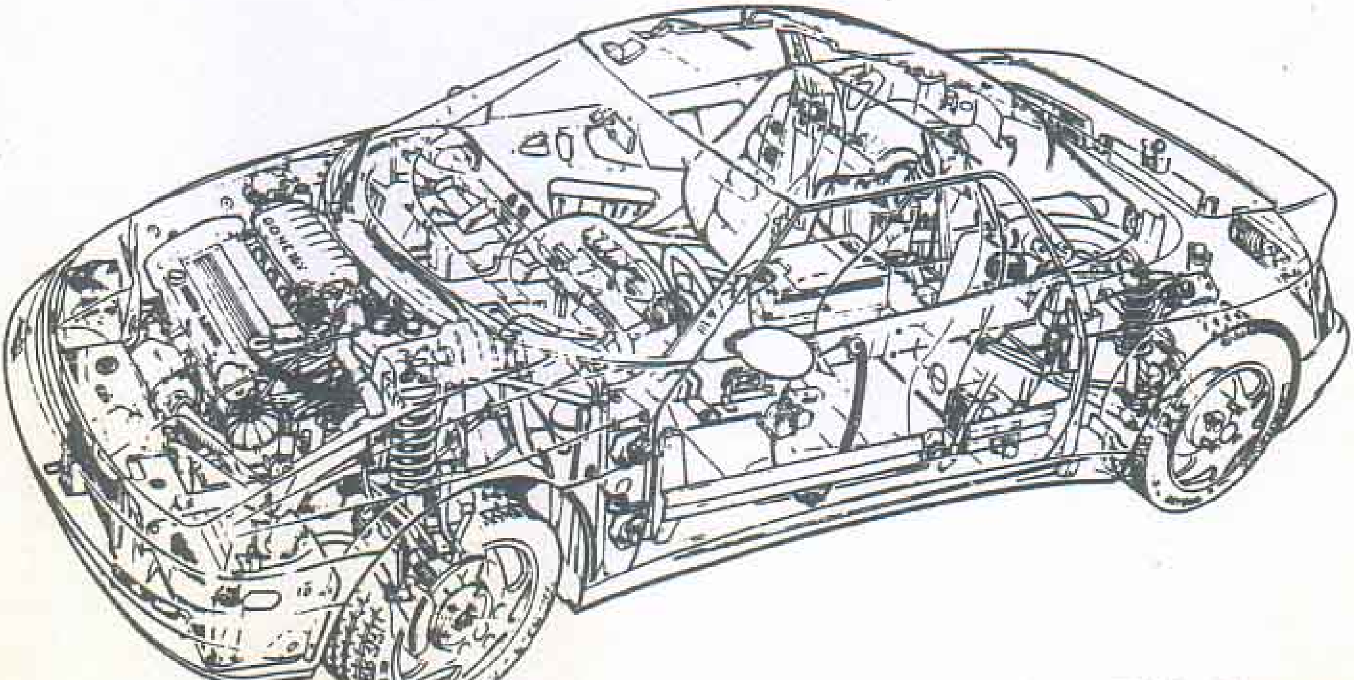
Training Centre

Course Notes

ELAN

OVERVIEW



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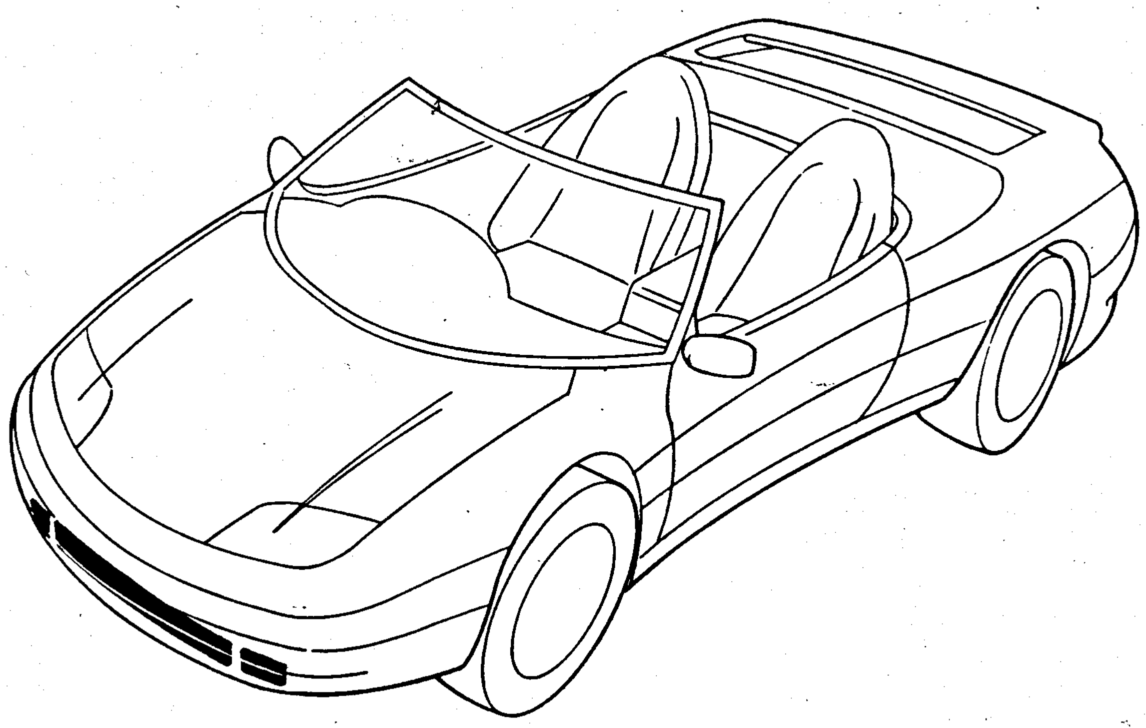
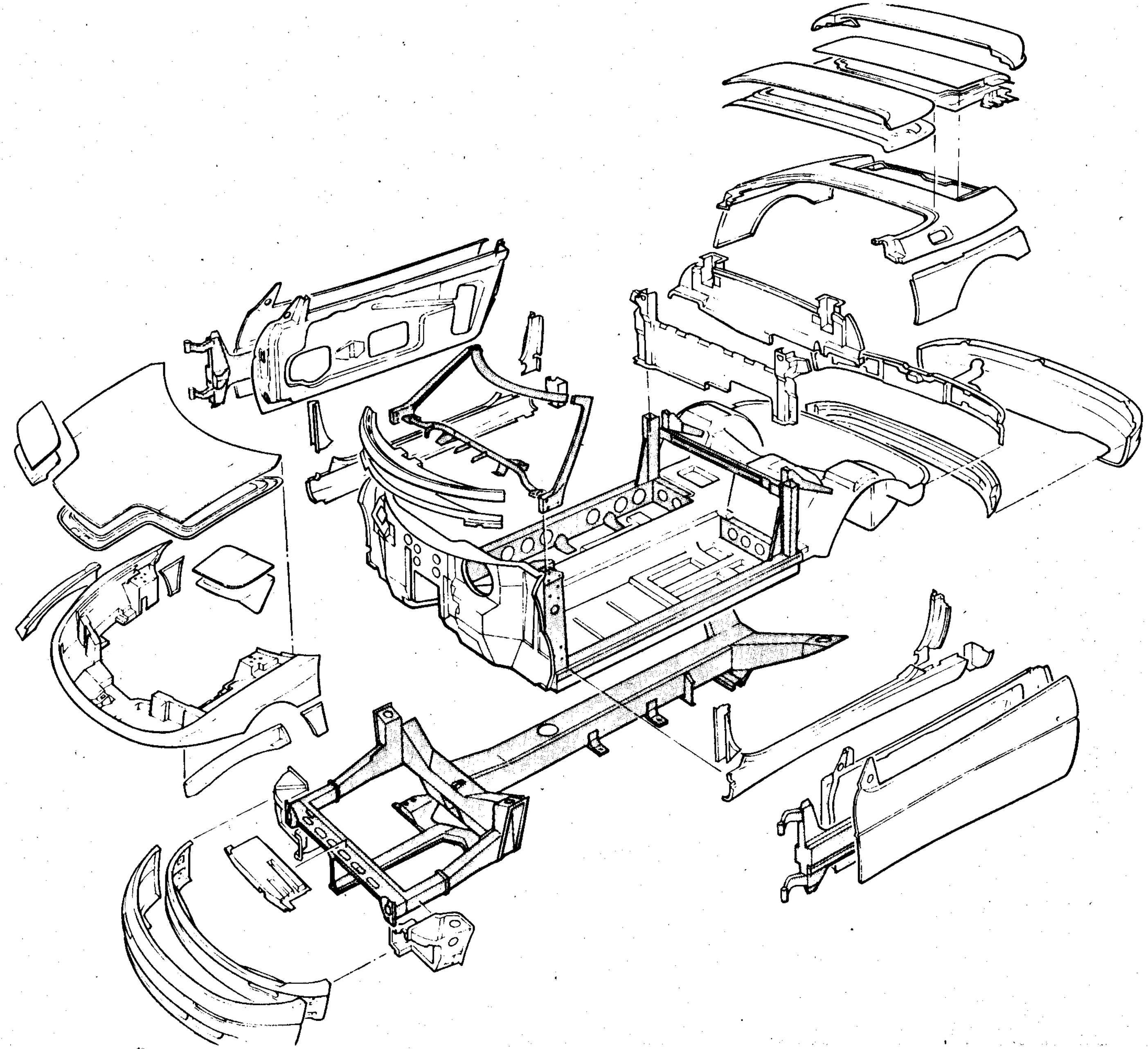
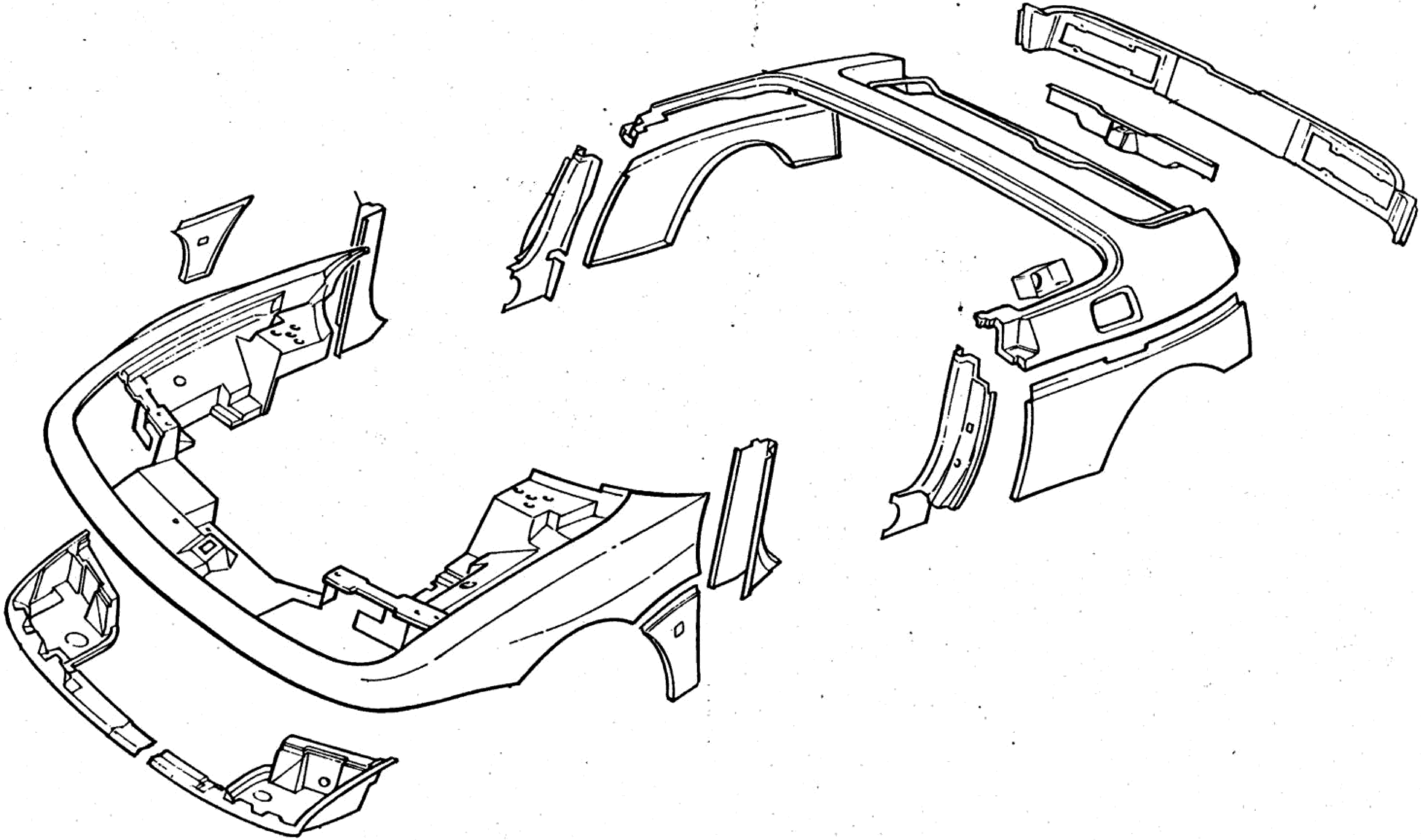
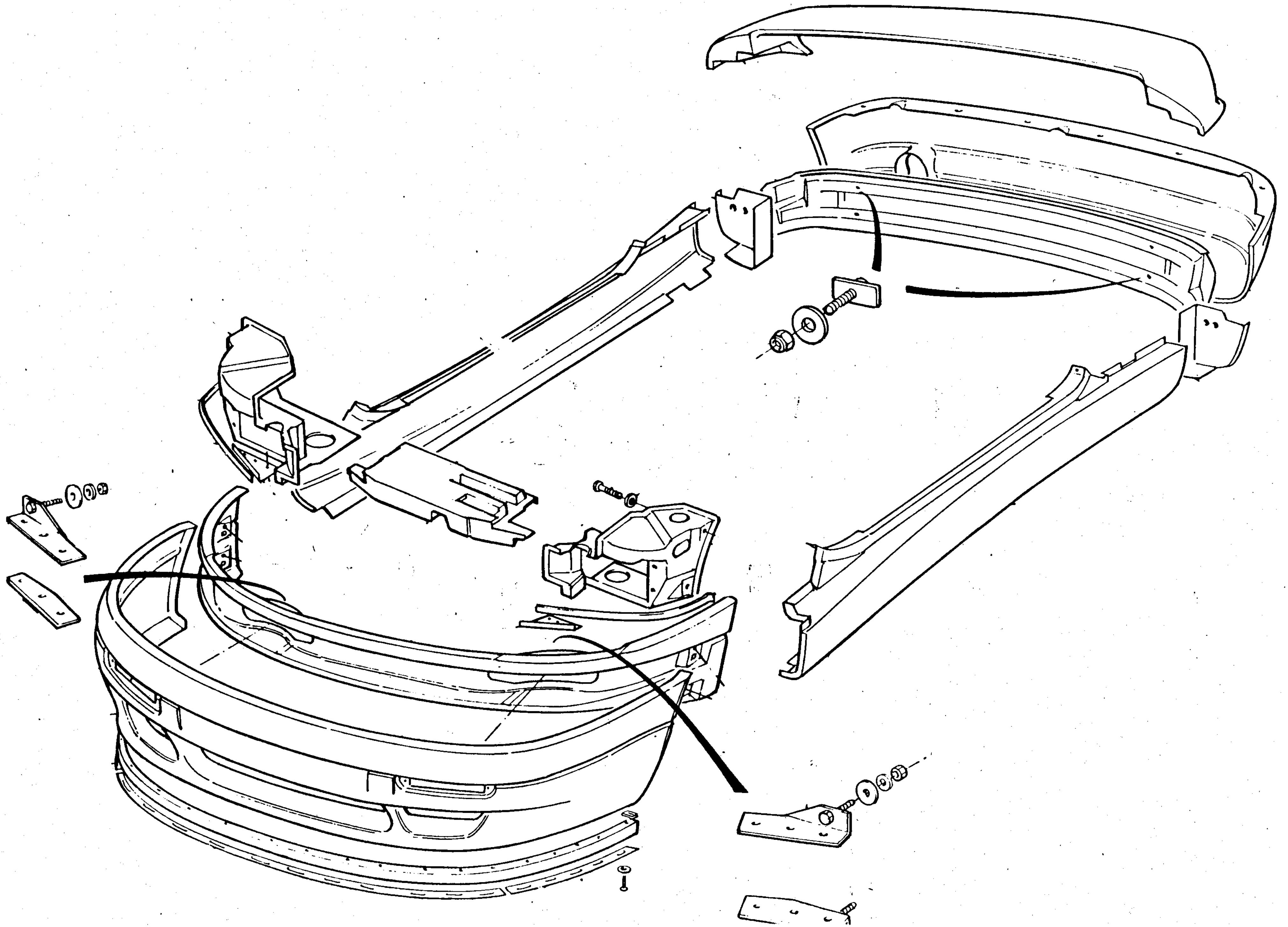
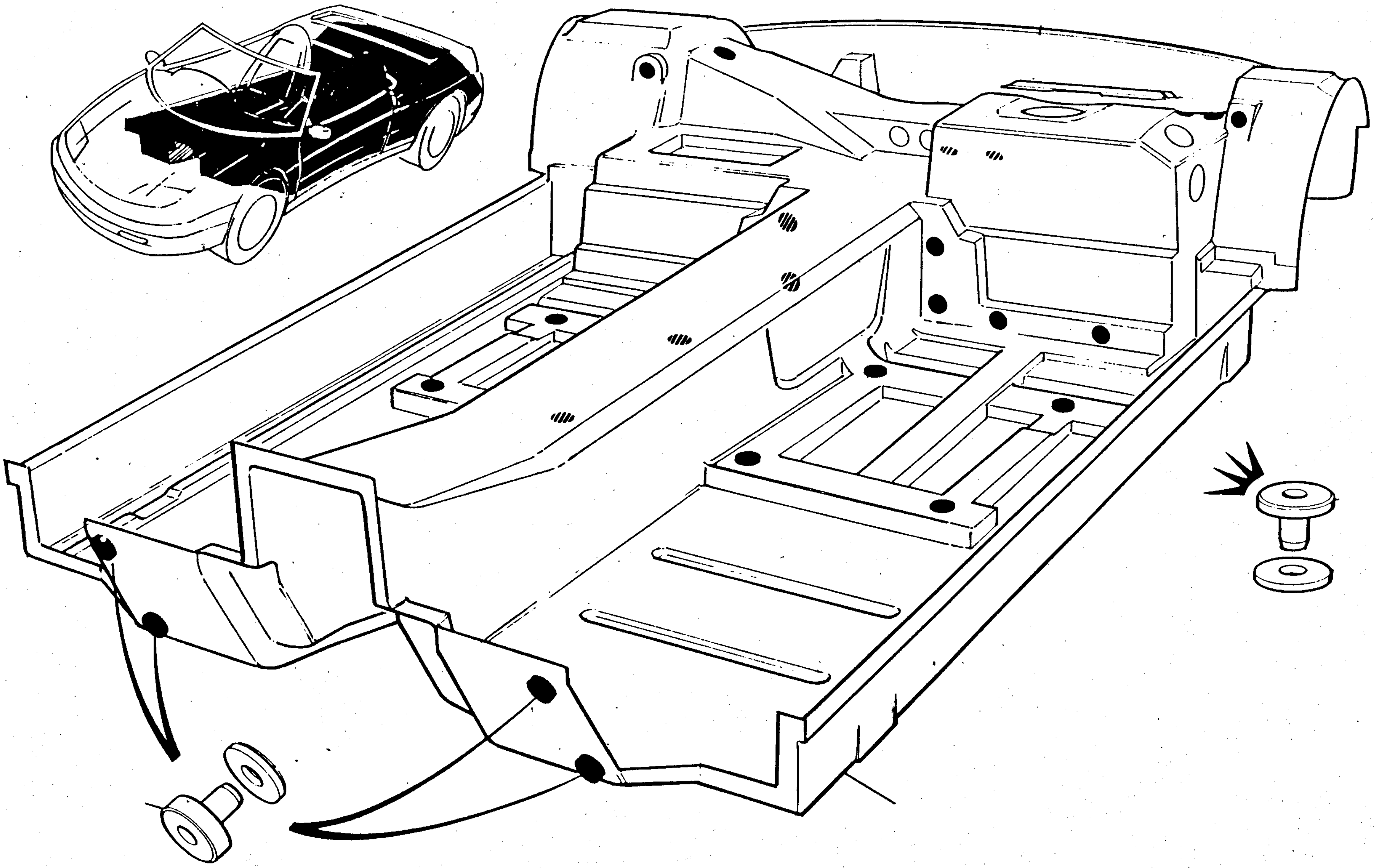
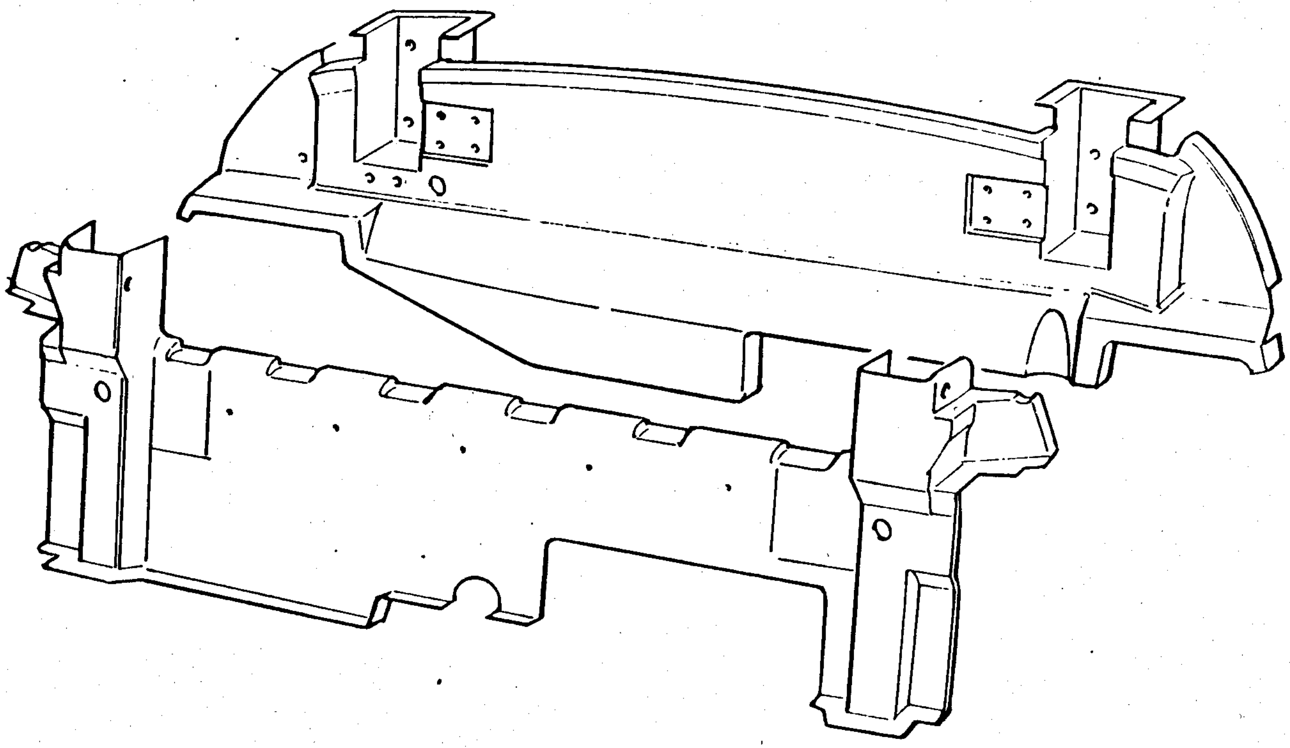


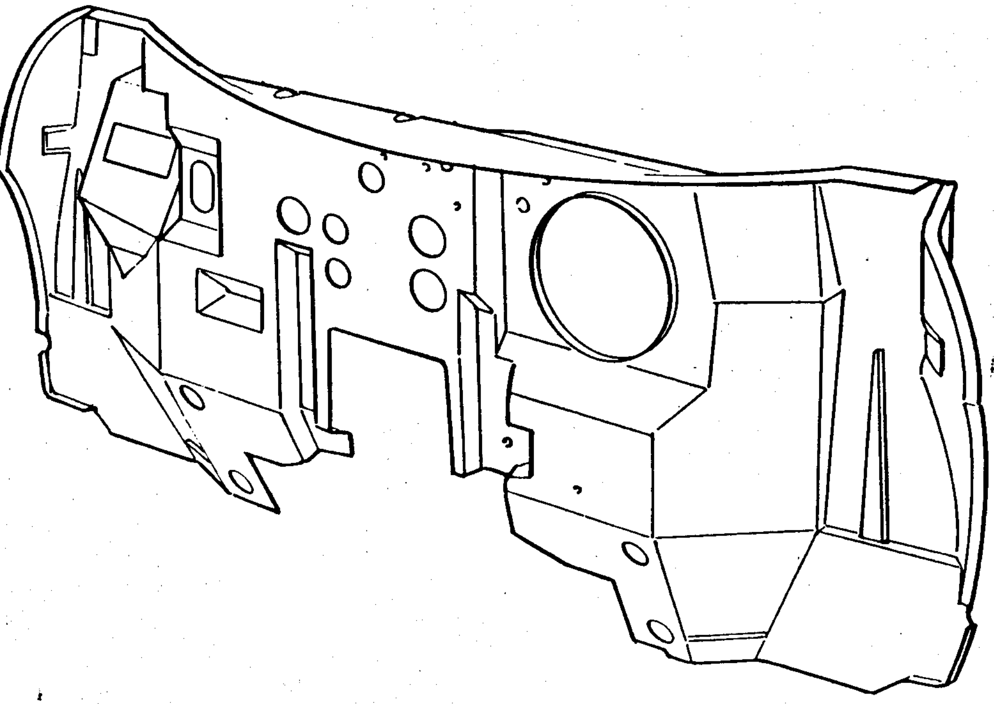


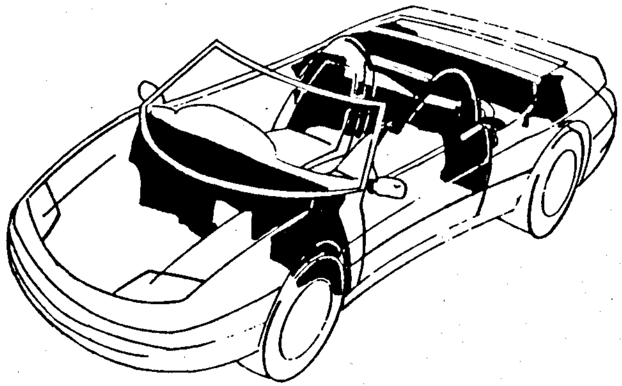


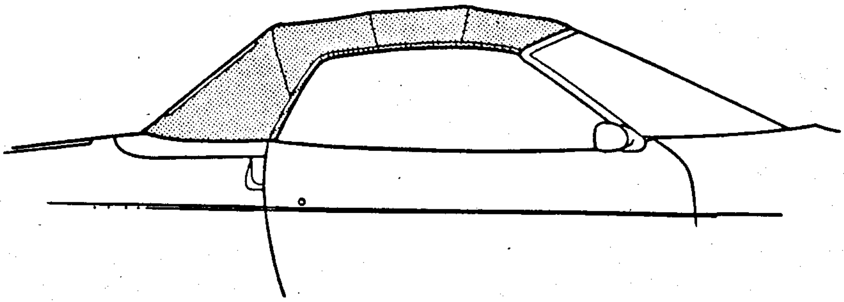


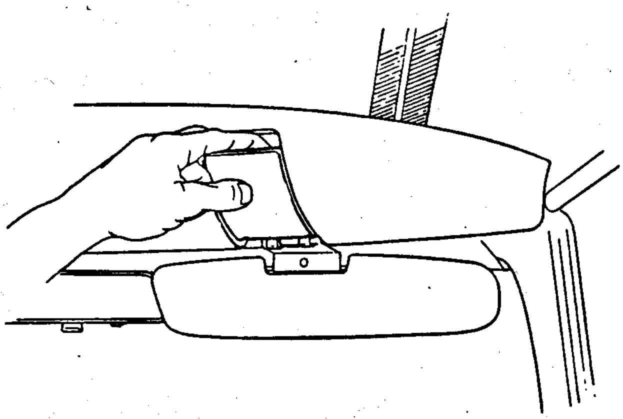


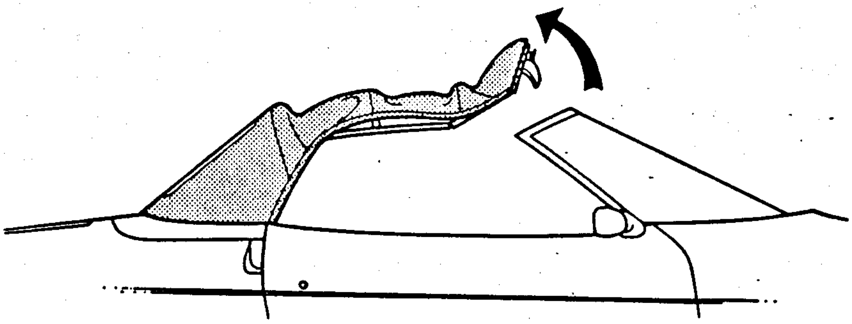


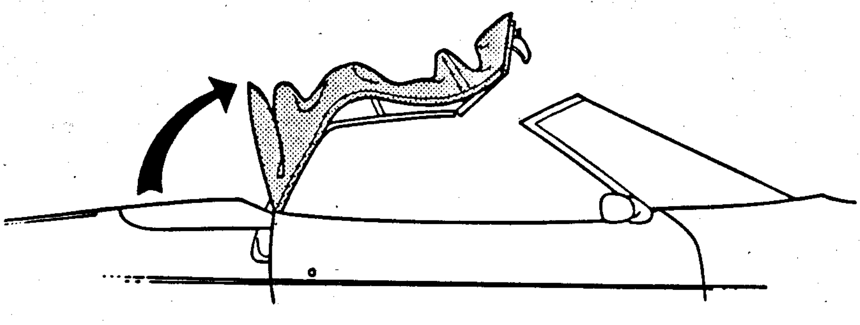


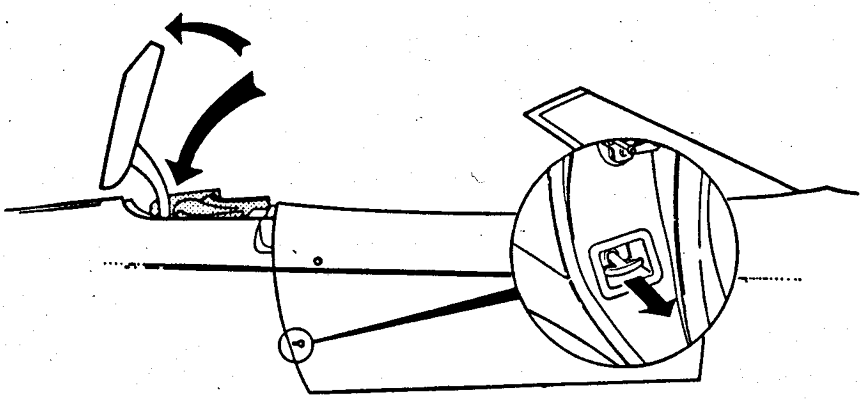




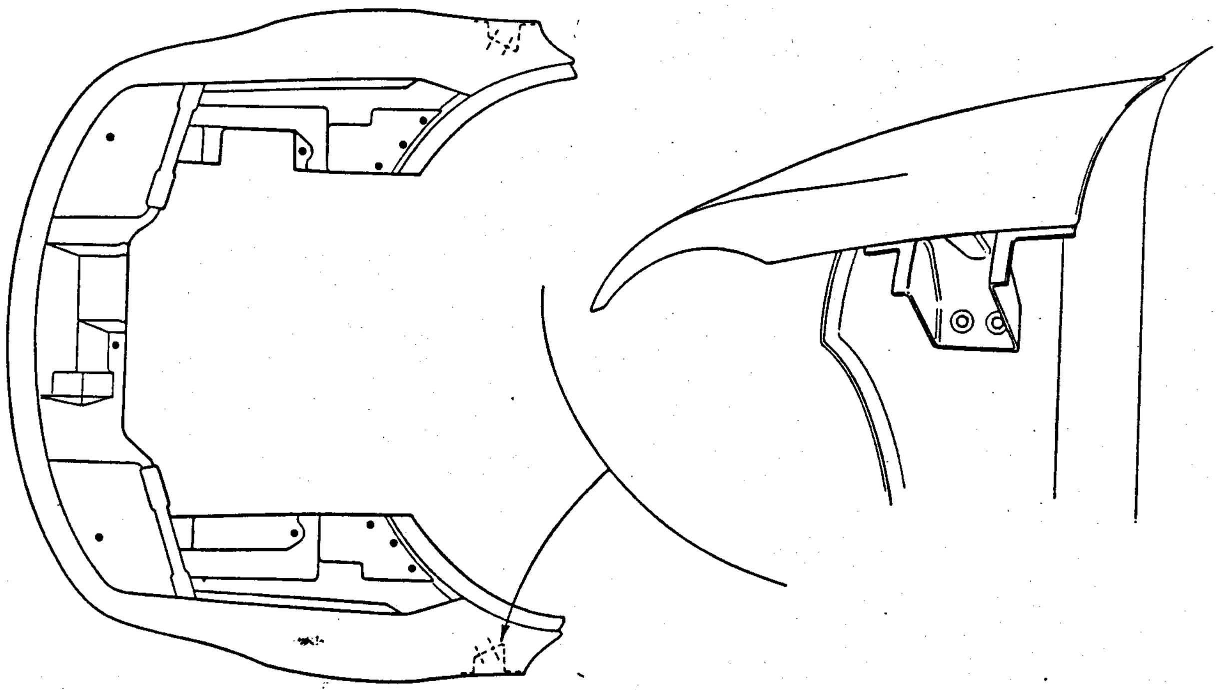


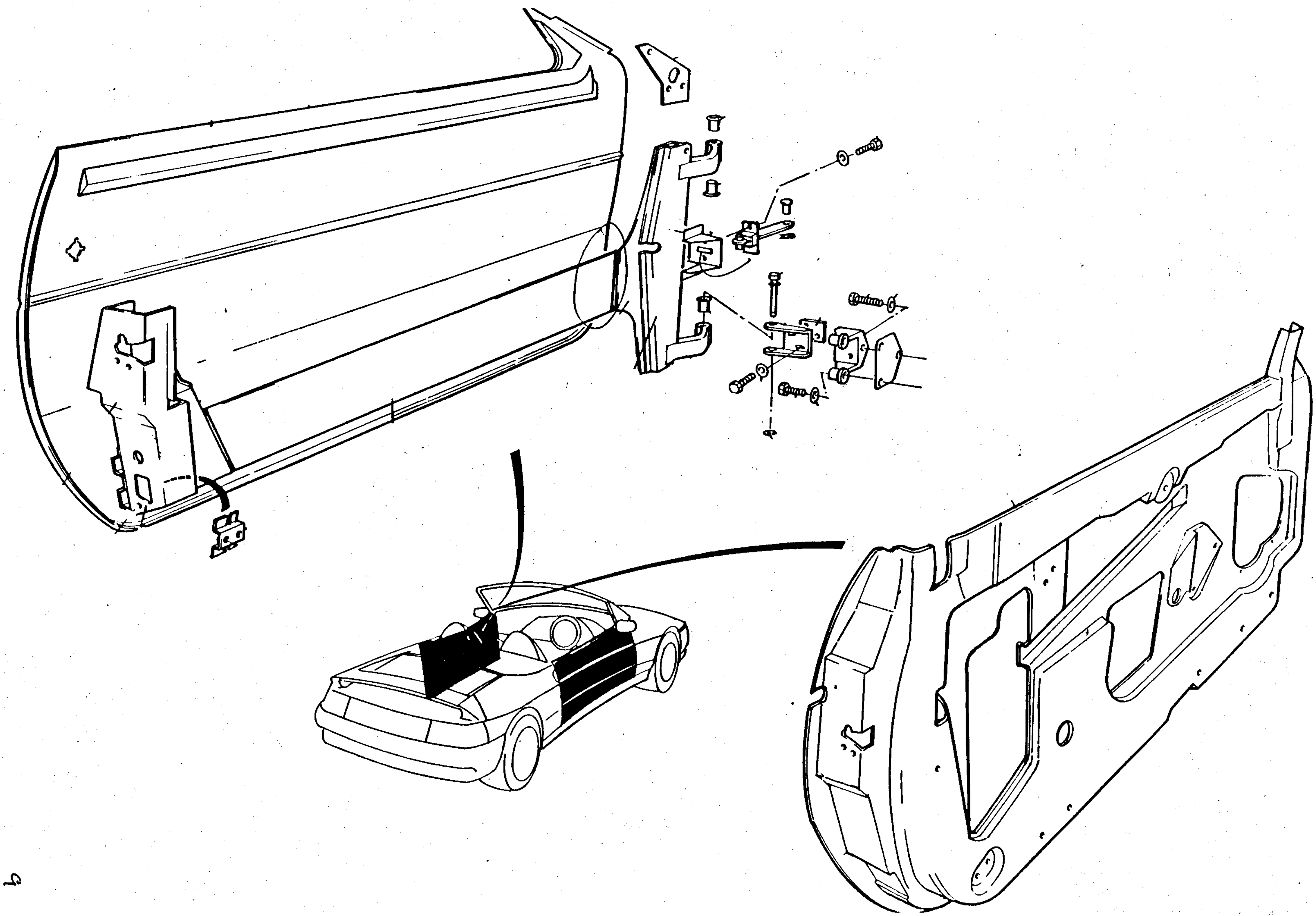


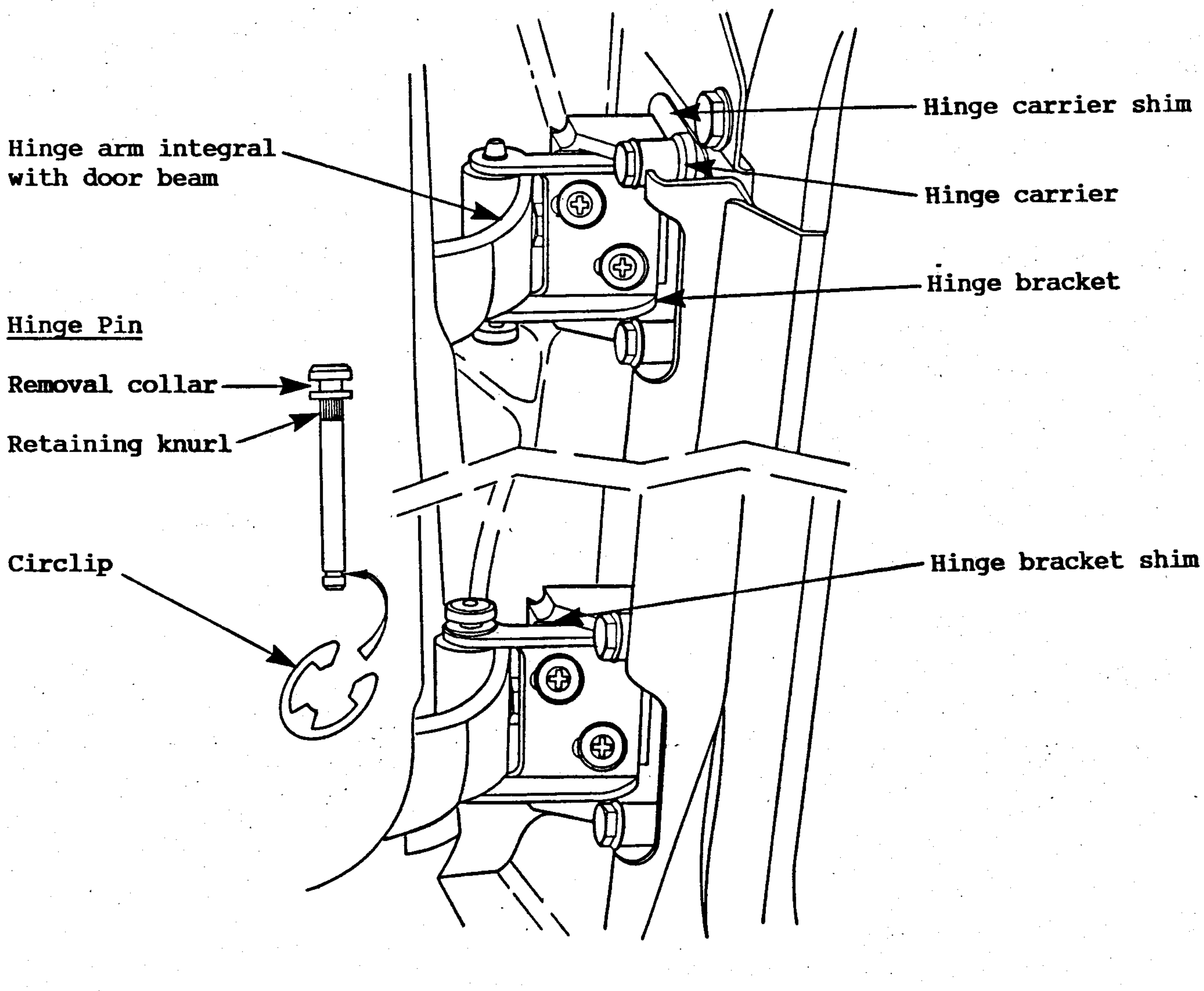


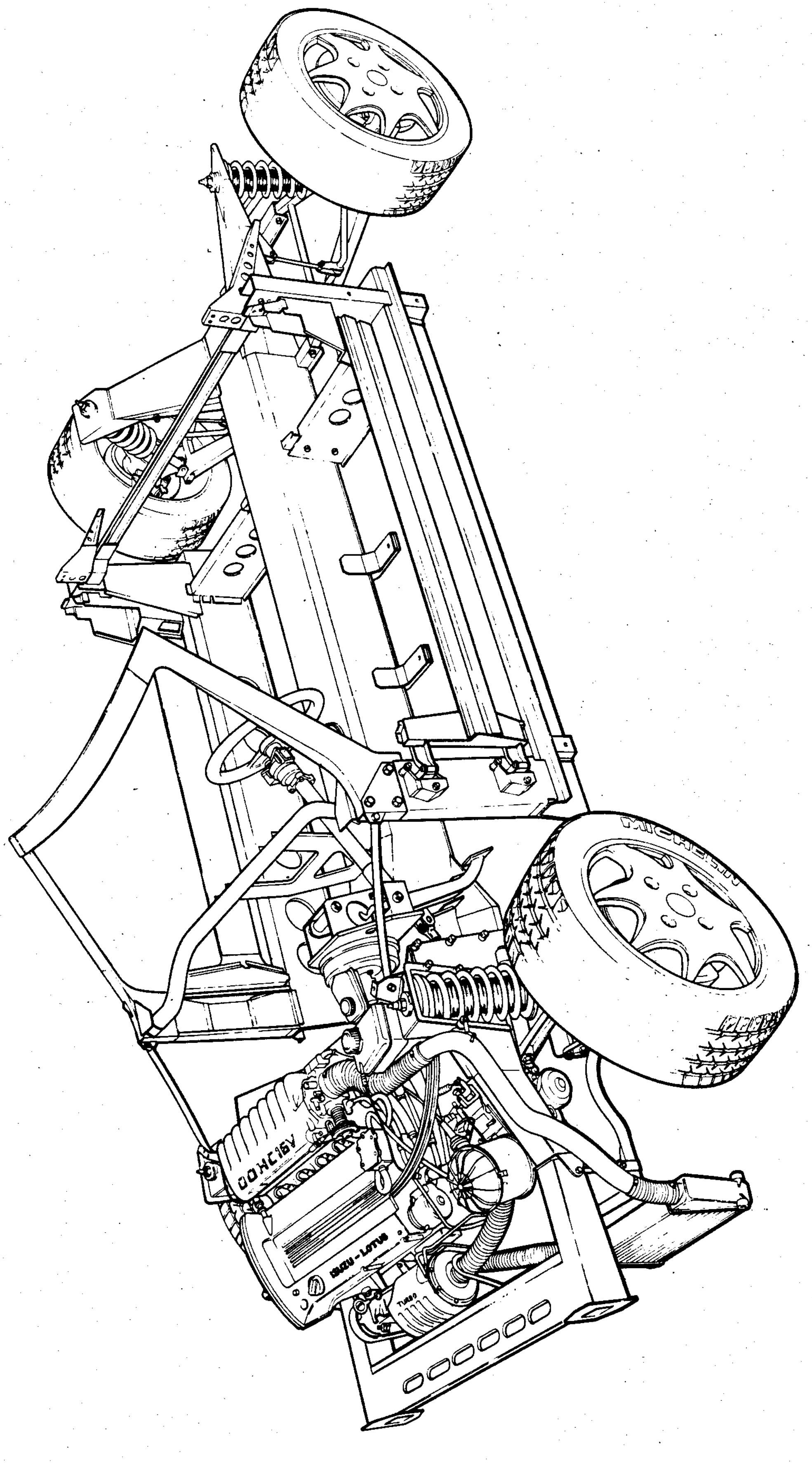


Topshell Fixings



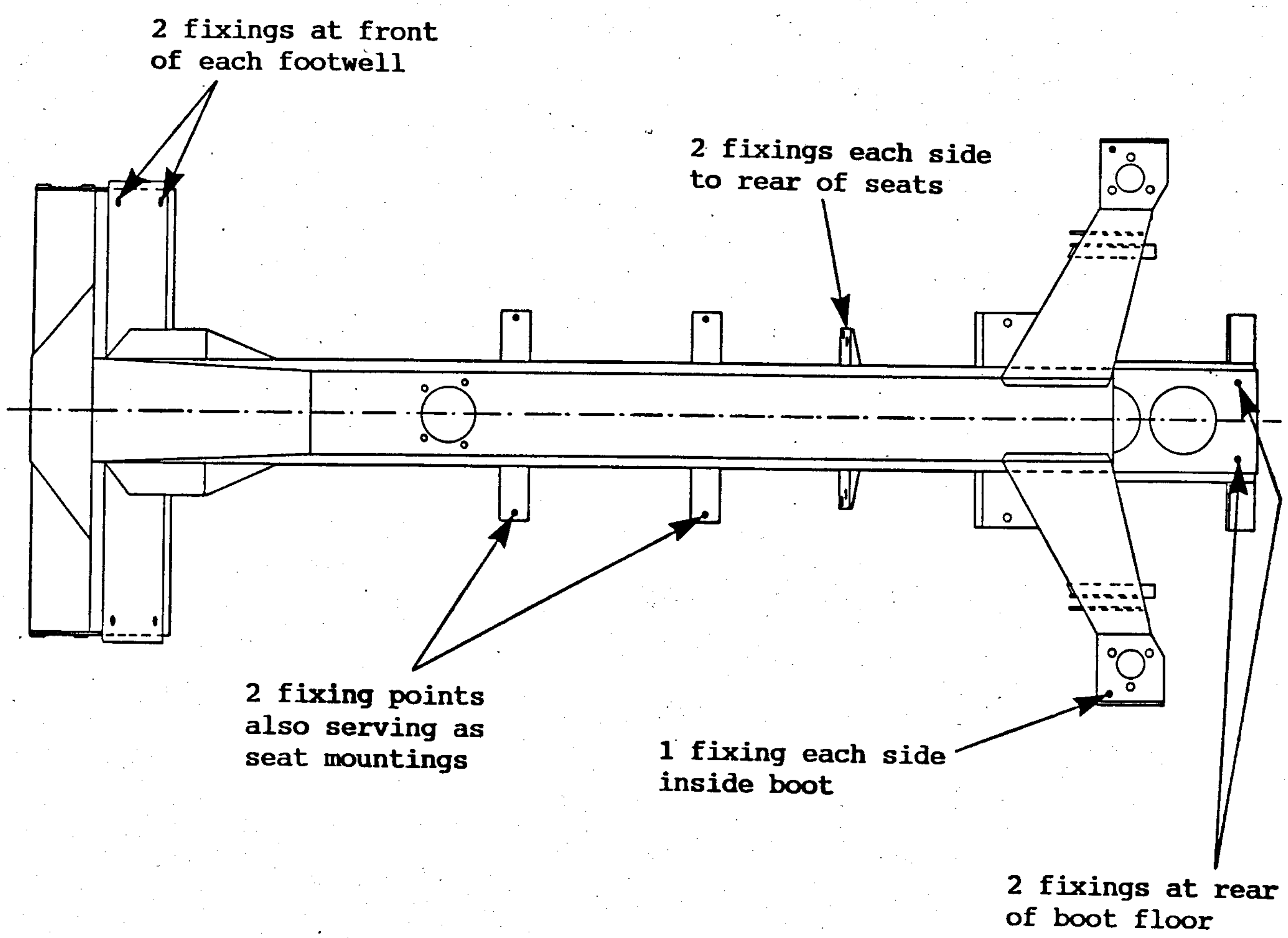


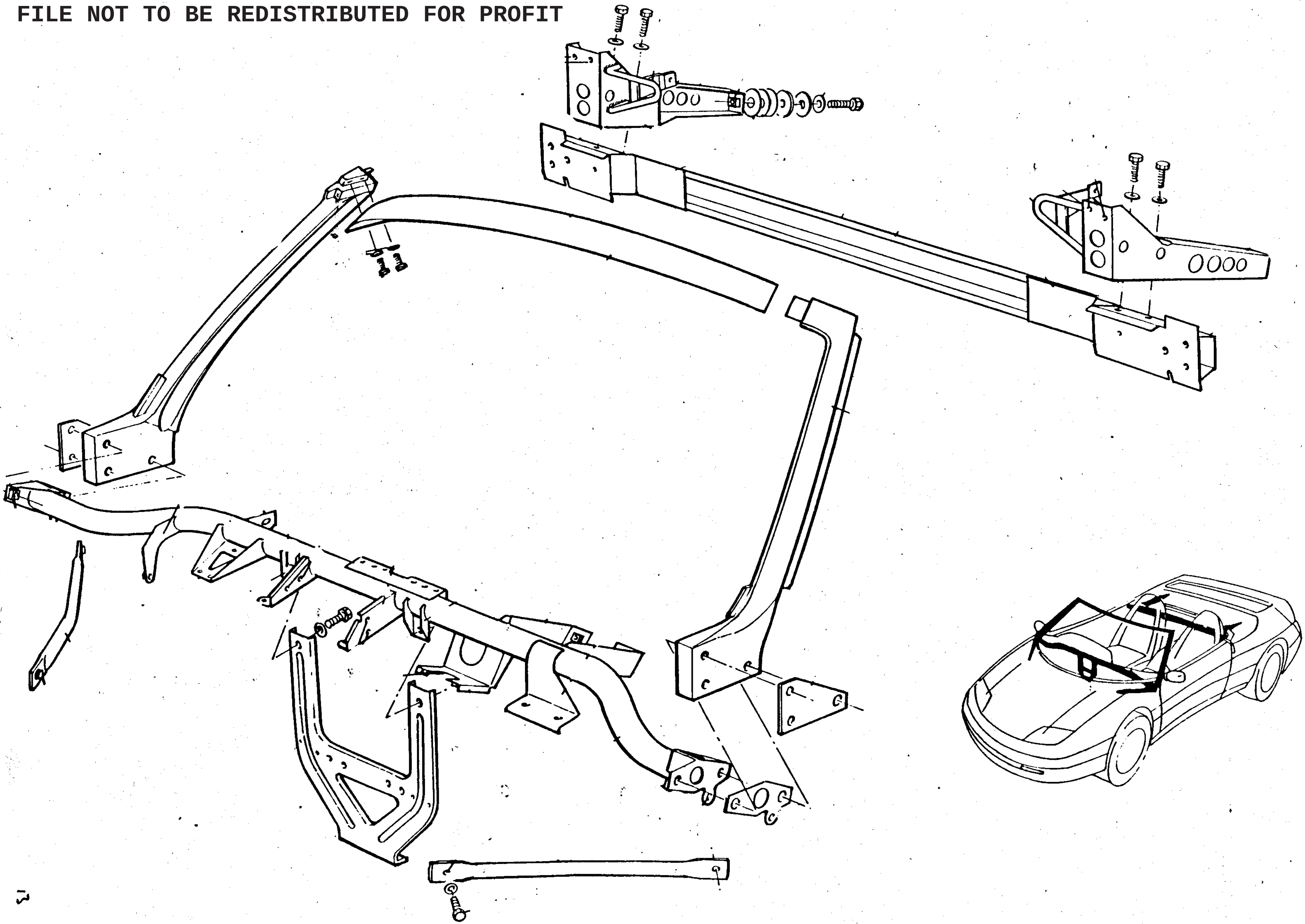

Hinge arm integral with door beam
Hinge Pin
Removal collar
Retaining knurl
Circlip
Hinge carrier shim
Hinge carrier
Hinge bracket
Hinge bracket shim



Chassis, powertrain and suspension layout

Body/Chassis Fixings





Front suspension

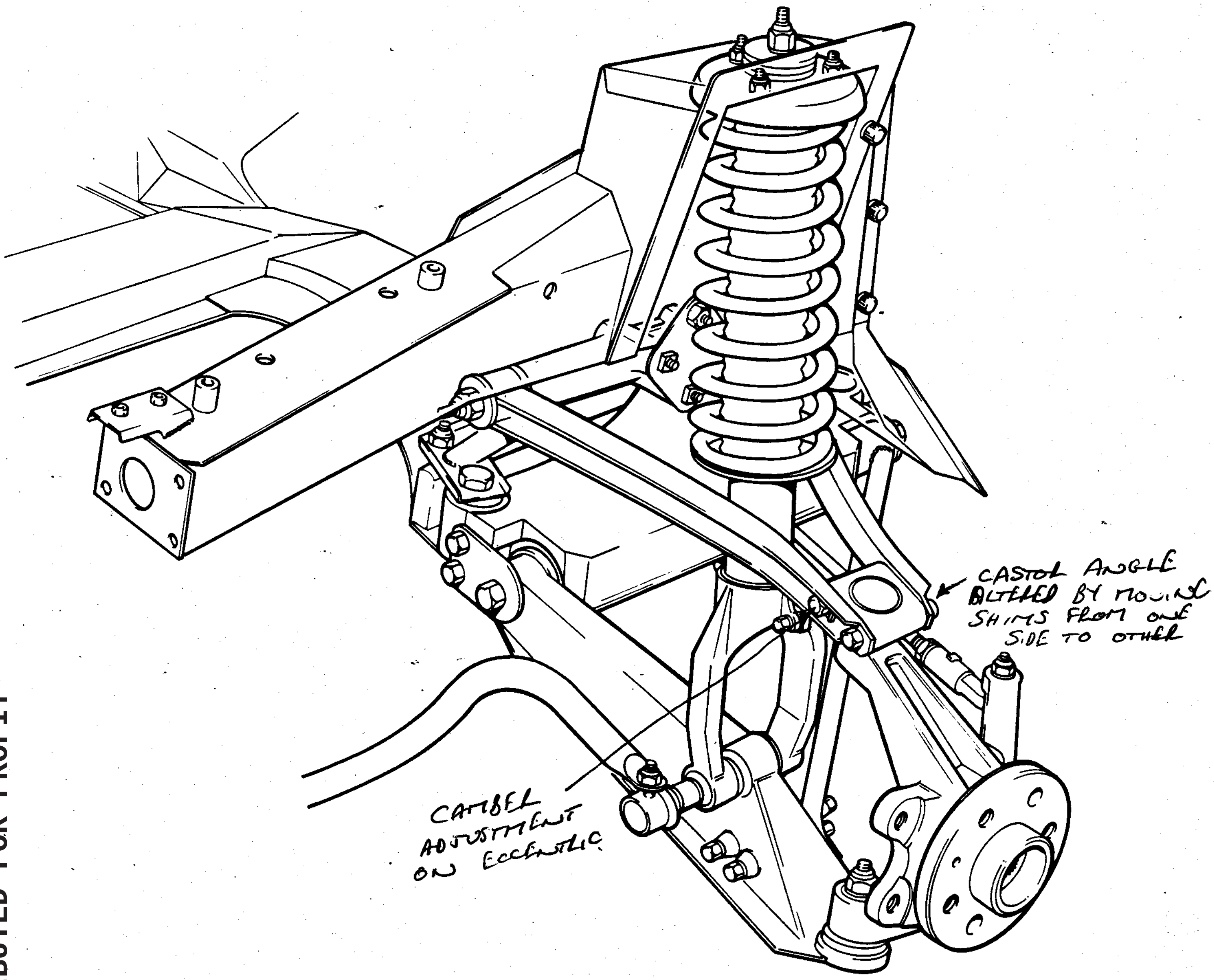
CE.1 - GENERAL DESCRIPTION

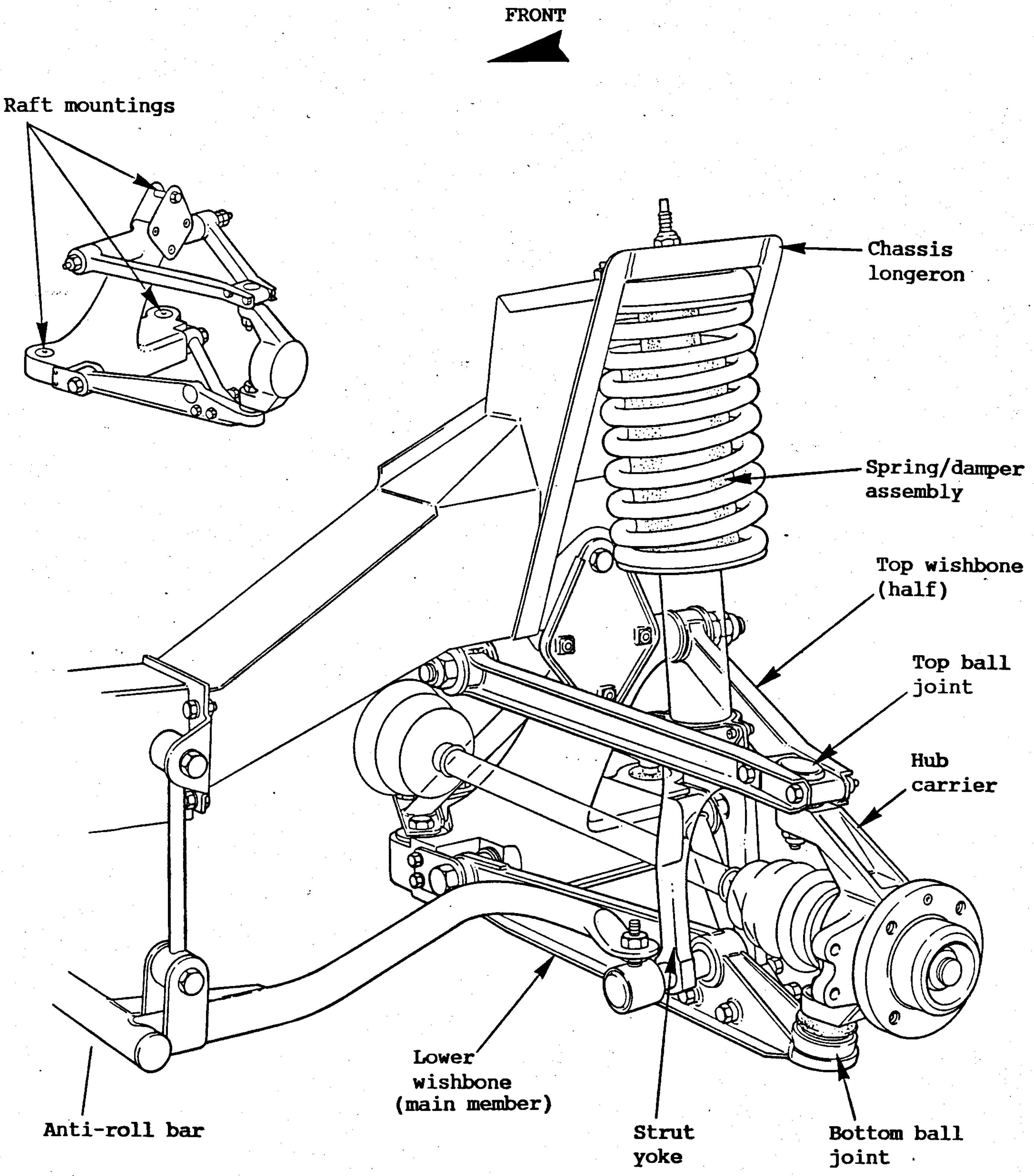
The front suspension comprises of upper and lower wishbones with concentric coil spring/telescopic damper unit and an anti-roll bar. The upper and lower wishbones on each side of the car are mounted on a separate cast alloy 'raft' (subframe) which is itself mounted to the chassis on three bonded rubber bushes, and helps to isolate the body from suspension noise and harshness, whilst maintaining accurate wheel control.

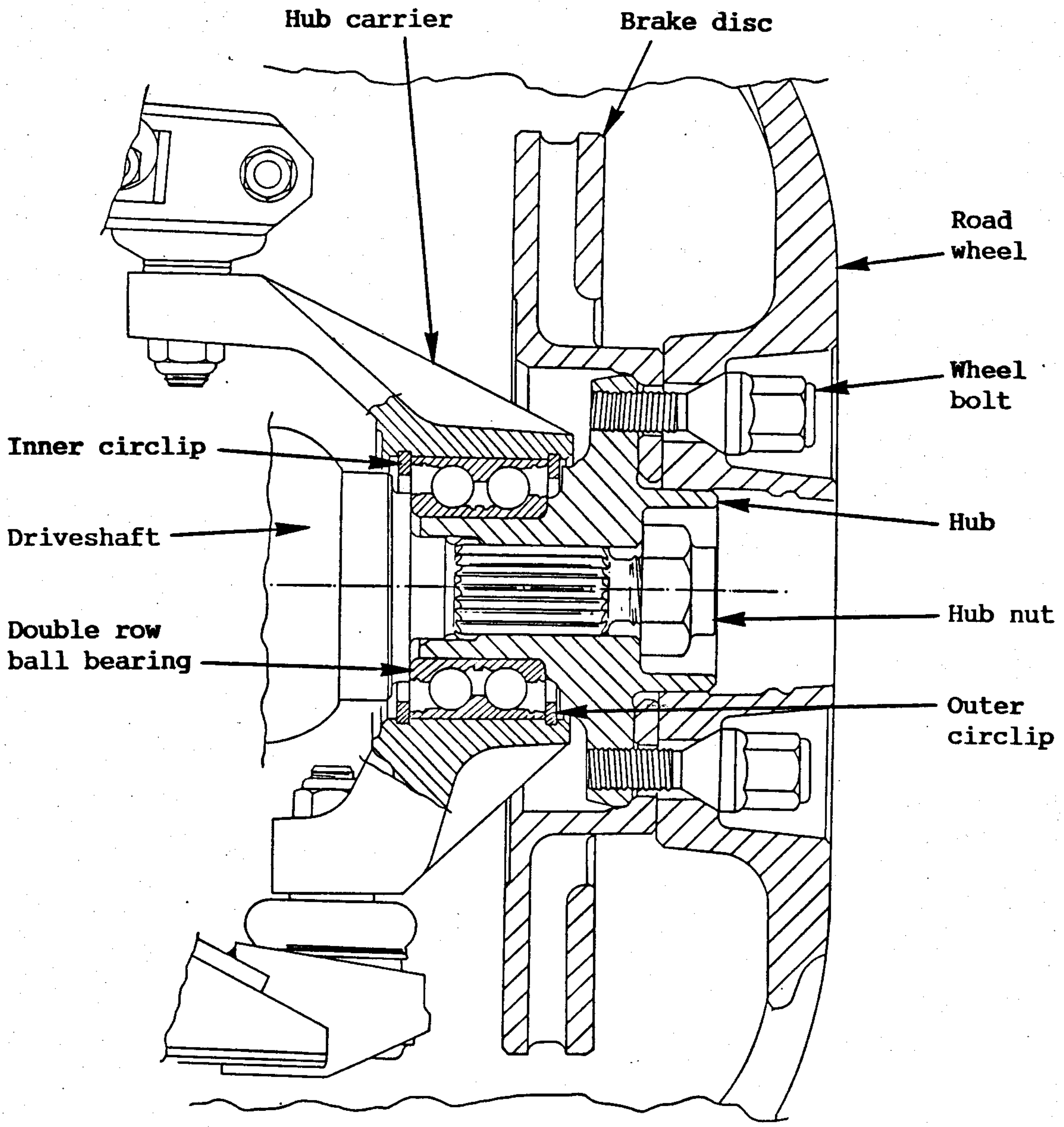
The lower wishbone uses a main fabricated steel track control arm to carry the spring/damper unit, and, at its outboard end, the lower steering swivel ball joint. A separate tubular steel strut is bolted to this member, and leads rearwards to form a wishbone. The upper wishbone comprises two similar pressed steel links, bolted together at their outboard end where they sandwich the top steering swivel ball joint. Both upper and lower ball joints are secured to a cast iron hub carrier with integral rearward facing steering arm. The co-axial coil spring/damper unit uses a two piece yoke at its lower end to straddle the driveshaft. A forward mounted tubular anti-roll bar, picks up off the damper lower mount, and is supported by two hanging links. The coil spring/ damper unit is secured at its upper end, to the chassis longeron.

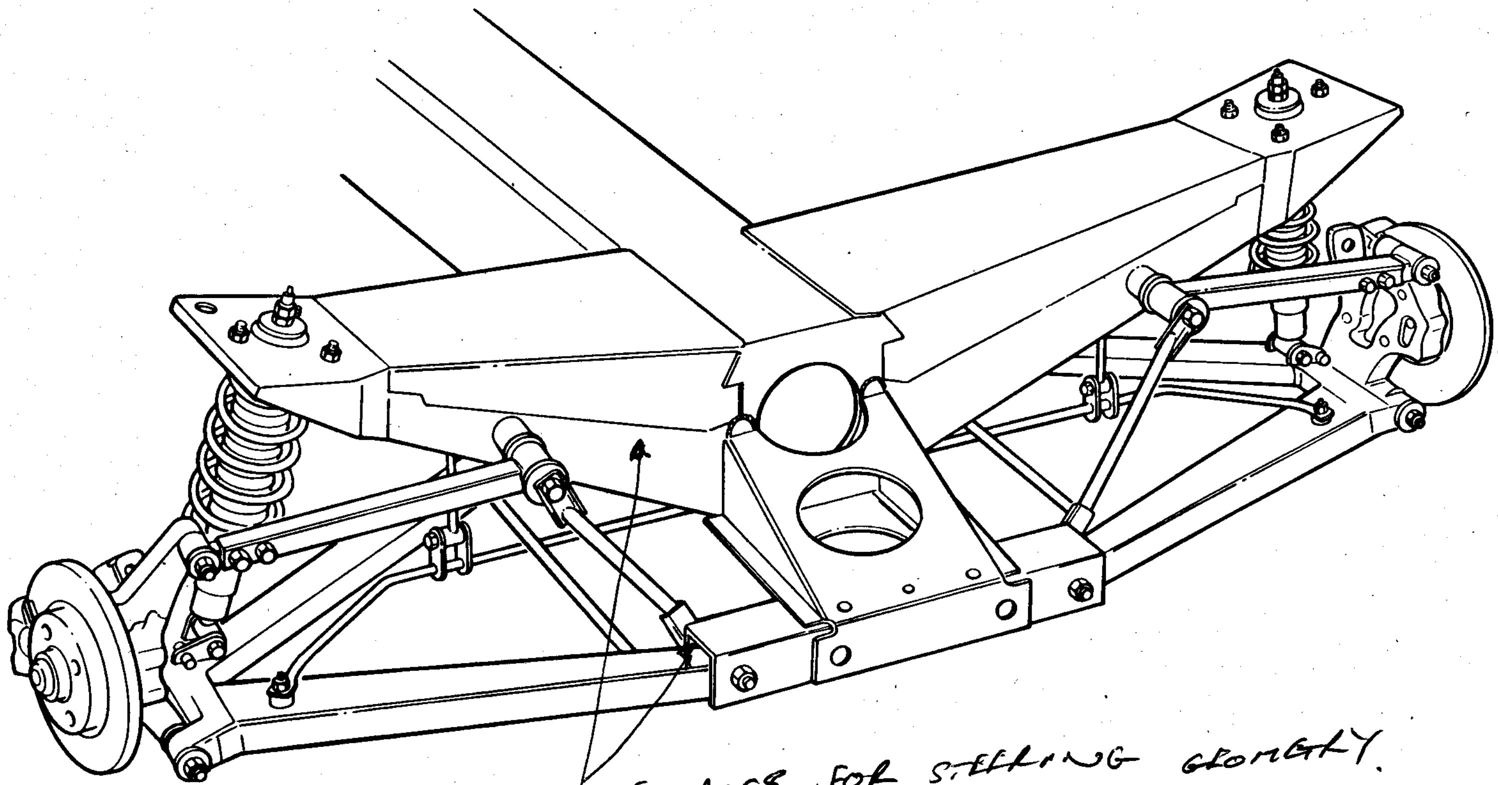
The inboard pivots of the upper and lower wishbones, take the form of bonded rubber bushes with longitudinal pivot axes. These bushes are anchored to separate cast aluminium alloy 'rafts' on each side of the car which serve to transfer all the longitudinal, lateral and torque loadings from the front suspension, into the chassis. Each raft is mounted to the chassis by three bonded rubber bushes, the lower two having vertical axes, and the single top bush having a transverse axis. The lower rear bush is bolted to directly to the chassis front crossmember, the lower front bush to the detachable underframe, and the top bush, via sandwich plates, to the chassis longeron. The compliance of the raft rear bush is sufficiently soft in order that on meeting a sharp bump, the front wheel is allowed to move back slightly as the raft pivots about its upper and front lower bushes. This movement has only a minimal effect on the steering, but significantly reduces the noise and harshness transmitted to the cabin. This feature allows for stiffer wishbone bushes to be used, in order to maintain accurate wheel control for optimum handling.

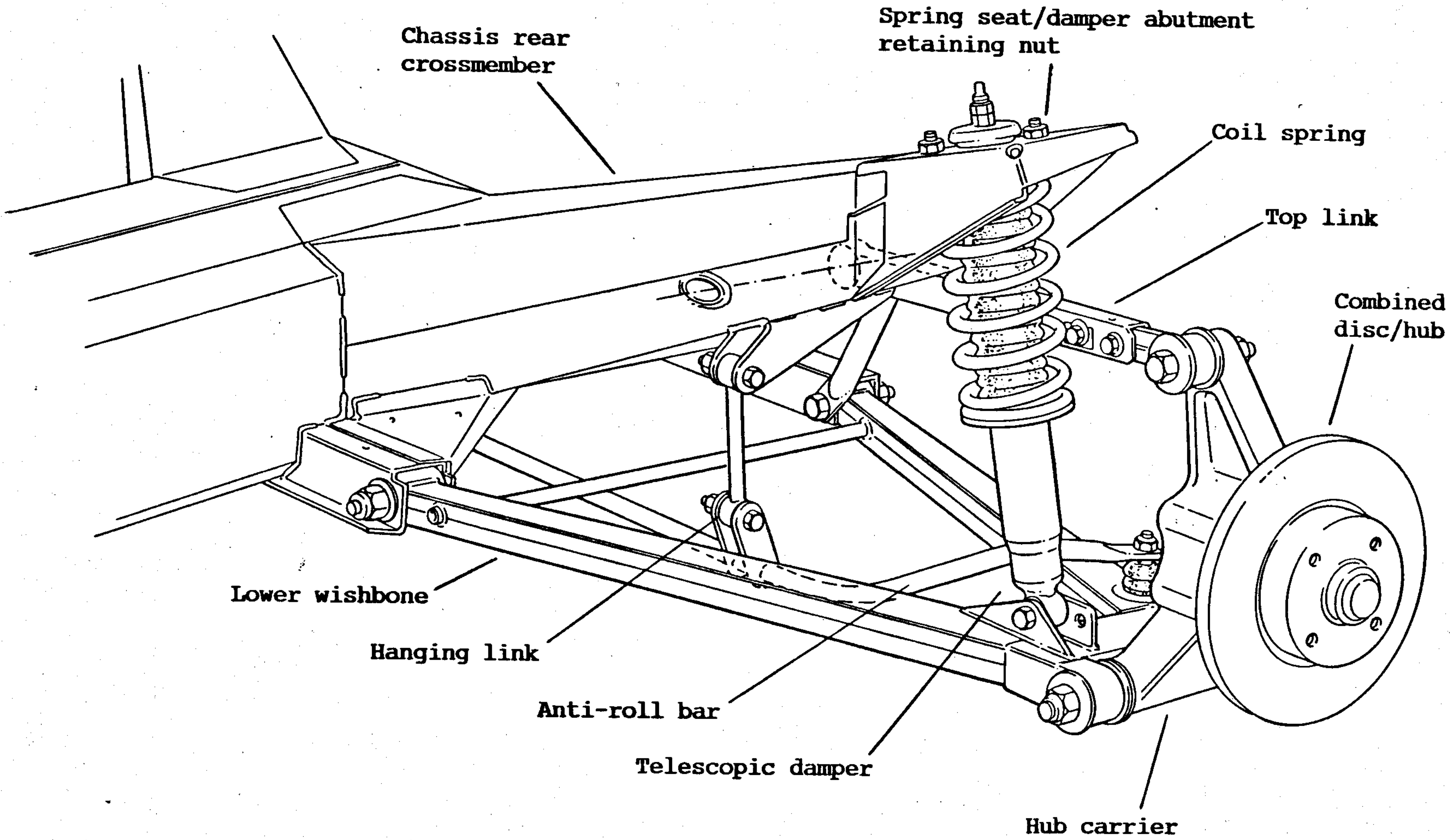
The hub carrier uses a single, double row ball bearing to support the wheel hub, into which is fitted the driveshaft.

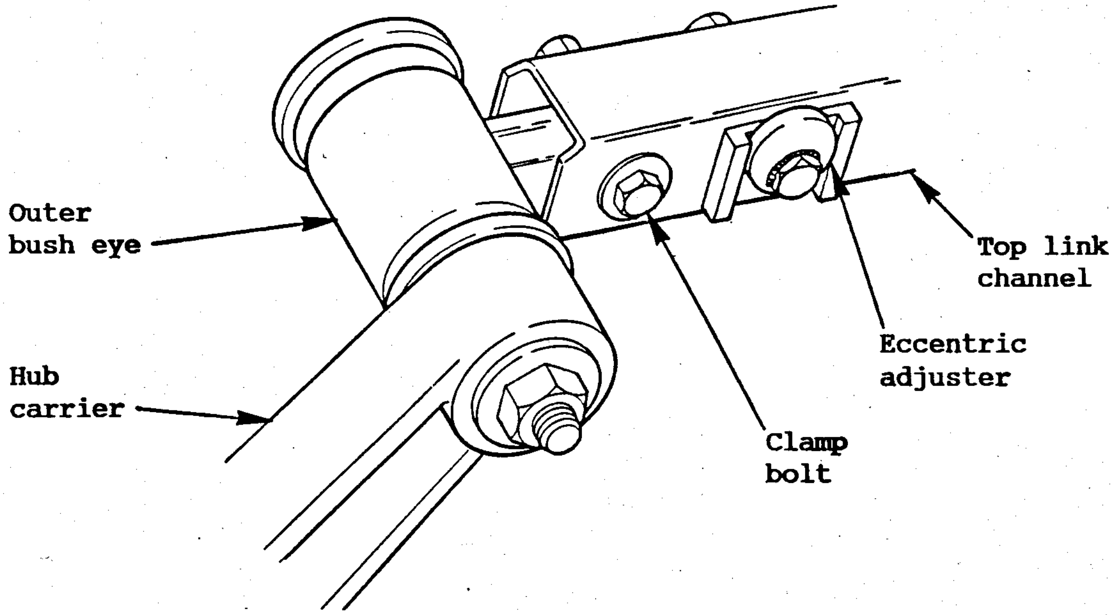

CASTOR ANGLE ALTERED BY MOVING SHIMS FROM ONE SIDE TO OTHER
CAMBER ADJUSTMENT ON ECCENTRIC

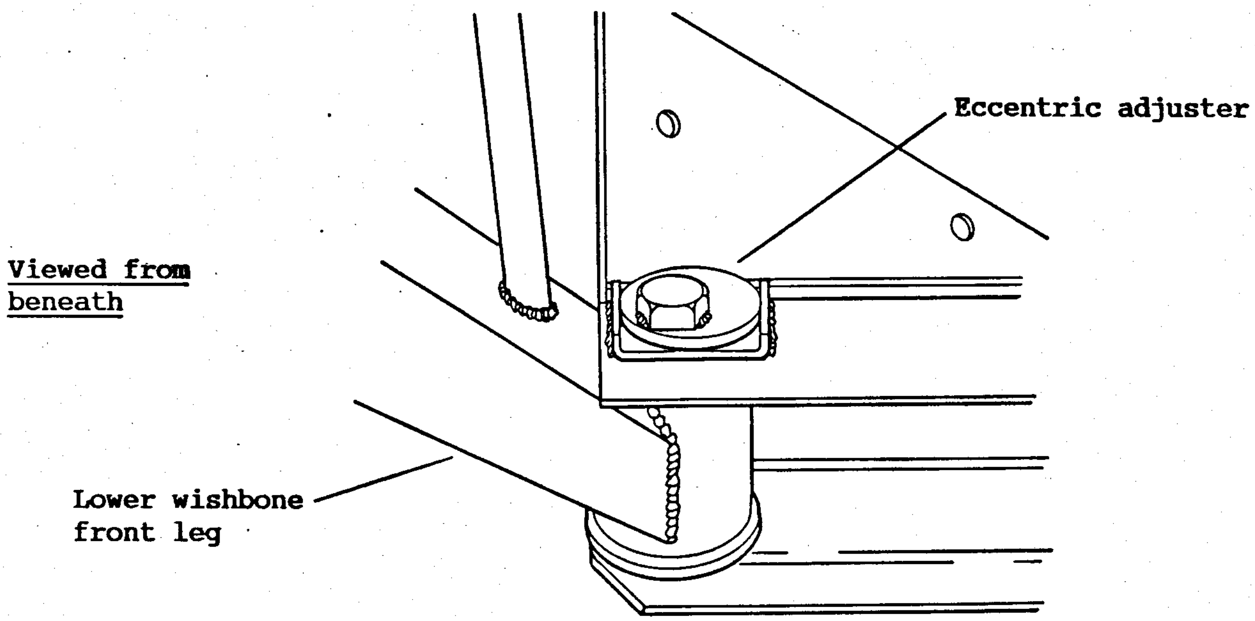

FRONT
Raft mountings
Chassis longeron
Spring/damper assembly
Top wishbone (half)
Top ball joint
Hub carrier
Anti-roll bar
Lower wishbone (main member)
Strut yoke
Bottom ball joint

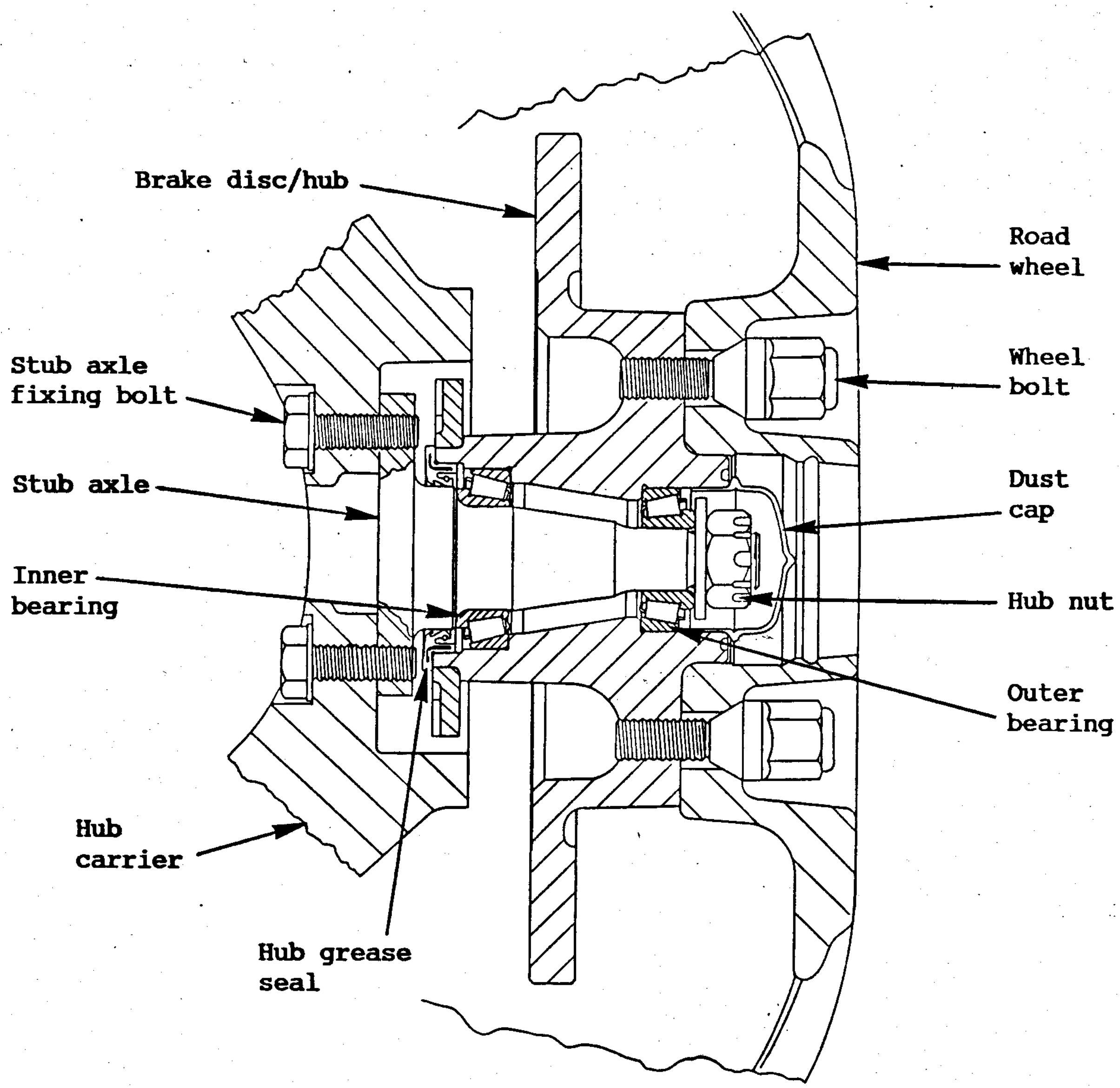

Hub carrier
Brake disc
Road wheel
Wheel bolt
Inner circlip
Driveshaft
Hub
Hub nut
Double row ball bearing
Outer circlip


ECCENTRICS FOR STEERING GEOMETRY.


Chassis rear crossmember
Spring seat/damper abutment retaining nut
Coil spring
Top link
Combined disc/hub
Lower wishbone
Hanging link
Anti-roll bar
Telescopic damper
Hub carrier


Outer
bush eye
Hub
carrier
Top link
channel
Eccentric
adjuster
Clamp
bolt


Eccentric adjuster
Viewed from
beneath
Lower wishbone
front leg


Brake disc/hub
Road wheel
Stub axle fixing bolt
Wheel bolt
Stub axle
Dust cap
Inner bearing
Hub nut
Outer bearing
Hub carrier
Hub grease seal

GENERAL DESCRIPTION

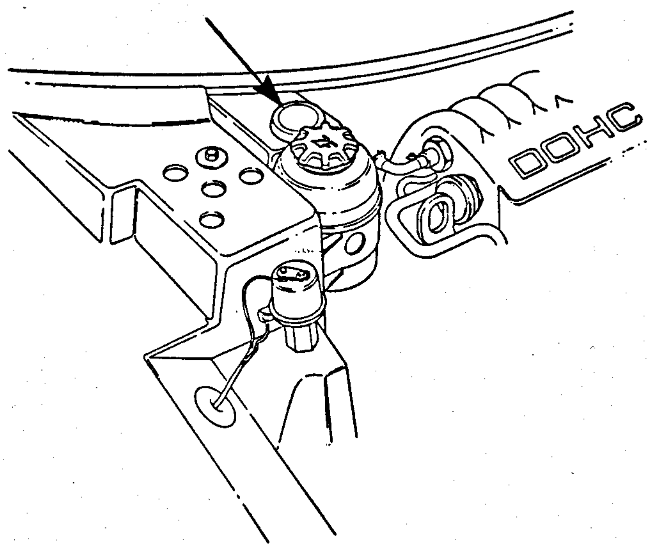
The braking system comprises a tandem master cylinder and direct acting vacuum servo unit operating single piston sliding calipers for each wheel, with ventilated front, and solid rear discs.

The hydraulic circuit is diagonally split (LH front/RH rear, and RH front/LH rear) for independent operation from the separate compartments of the tandem master cylinder, with separate hydraulic lines feeding each caliper. A brake pressure proportioning valve is incorporated into each of the rear brake lines in order to control rear brake line pressure under heavy braking, and reduce the likelihood of rear wheel lock up. A single divided reservoir serves both compartments of the tandem master cylinder, and is provided with a low fluid level warning switch, which operates a fascia mounted tell tale lamp.

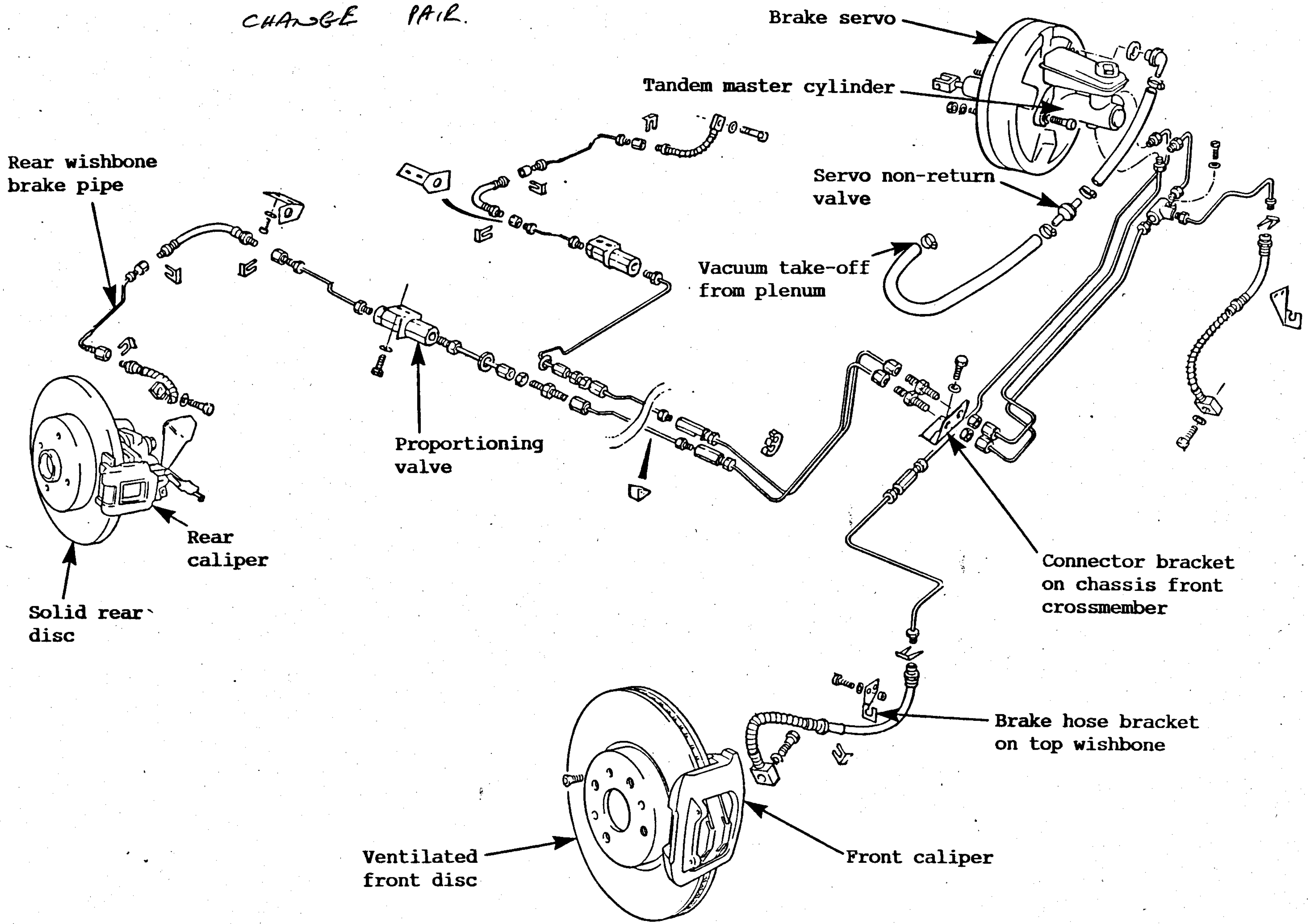
Single piston sliding calipers are used at each wheel. The caliper body is supported on two hardened steel sleeves, which allow the caliper free lateral movement. When the brakes are applied, hydraulic pressure in the caliper cylinder, forces the piston outwards and the caliper body inwards, resulting in the brake pads being clamped to the disc, producing the required friction.

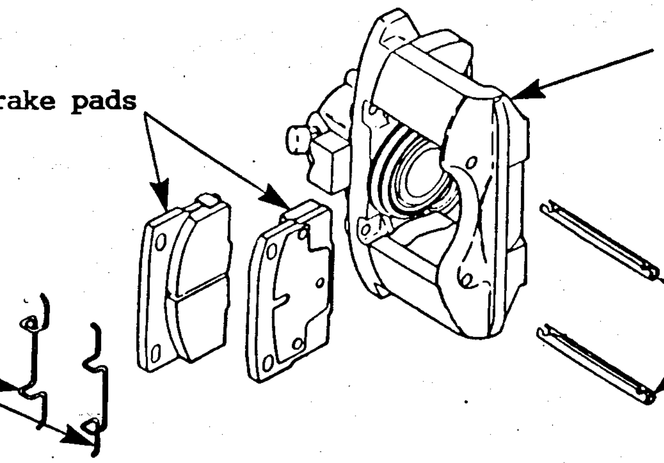
The parking brake lever connects, via a compensating link (to equalise the pull applied to each cable), to two cables, one leading to each rear caliper. Each cable operates a lever on the caliper which turns an actuating screw (quick thread) inside the caliper cylinder, forcing the piston against the pad and disc and applying the brake. A self adjusting mechanism within the cylinder, takes the form of a spring clutch wrapped around the piston 'nut' in which the parking brake actuator screw operates. On application, the one way spring clutch locks the nut to the piston, so that the piston is forced to move axially when the actuating screw is turned. On release, a 'piston retainer' outboard of the piston hydraulic seal, exerts sufficient grip on the piston to prevent it being drawn back by the mechanism. This compels the spring clutch to release the nut, so that the actuator screw and nut turn as one, as the screw returns to its start position. This results in any free play being automatically taken up, with the nut starting from a position further along the thread the next time the parking brake is applied. Operating the piston hydraulically, via the footbrake, has a similar effect, with the piston moving outwards and the nut being allowed to turn within it by the spring clutch. This automatically adjusts the parking brake mechanism ready for the next application.

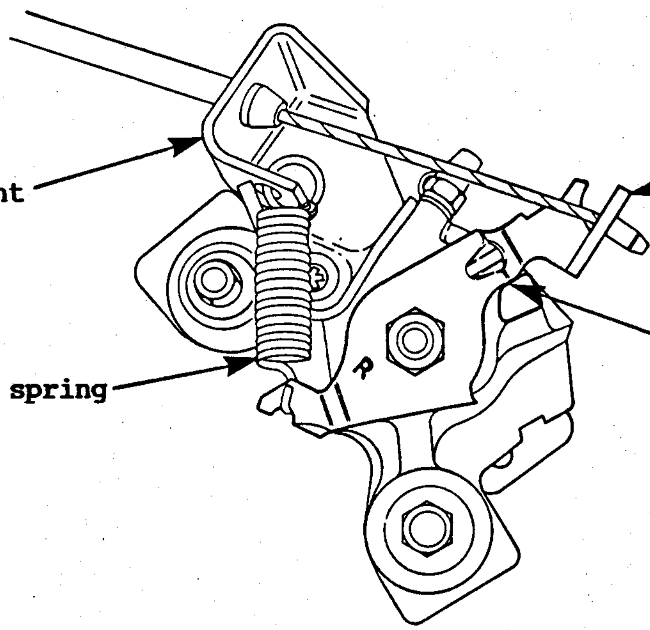
Brake fluid reservoir

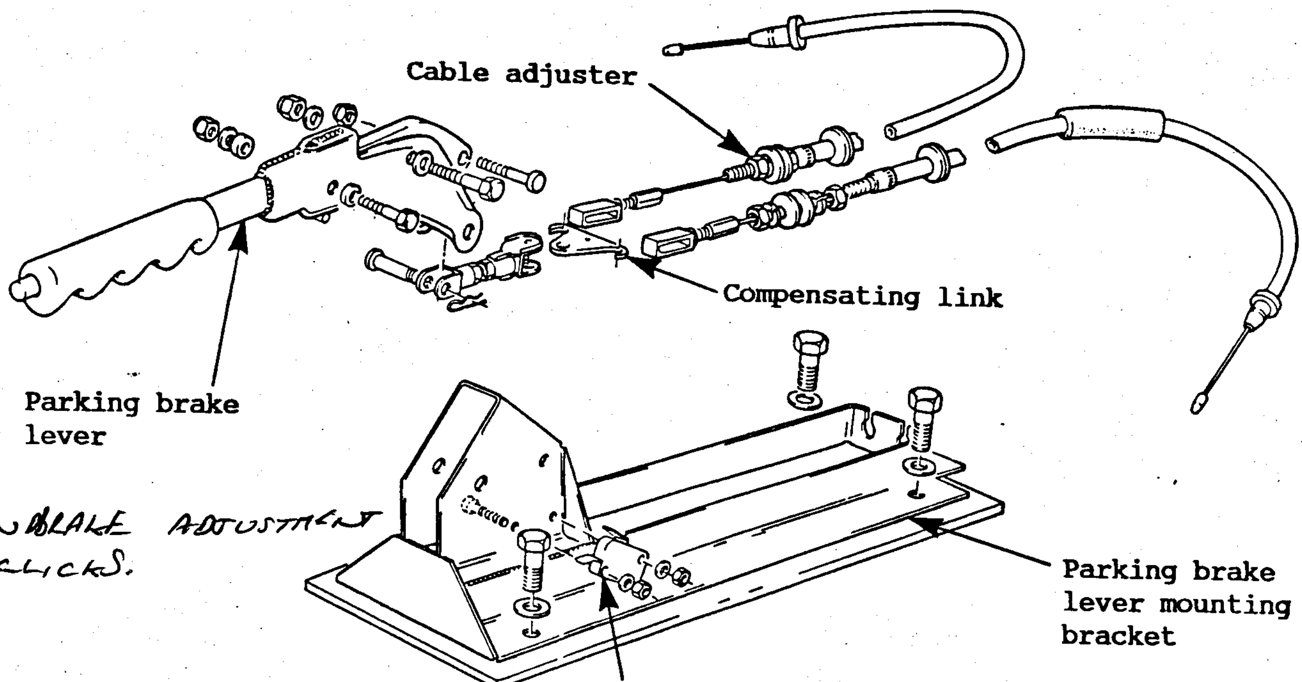


IF ONE PROPORTIONING VALVE FAILS.
CHANGE PAIR.

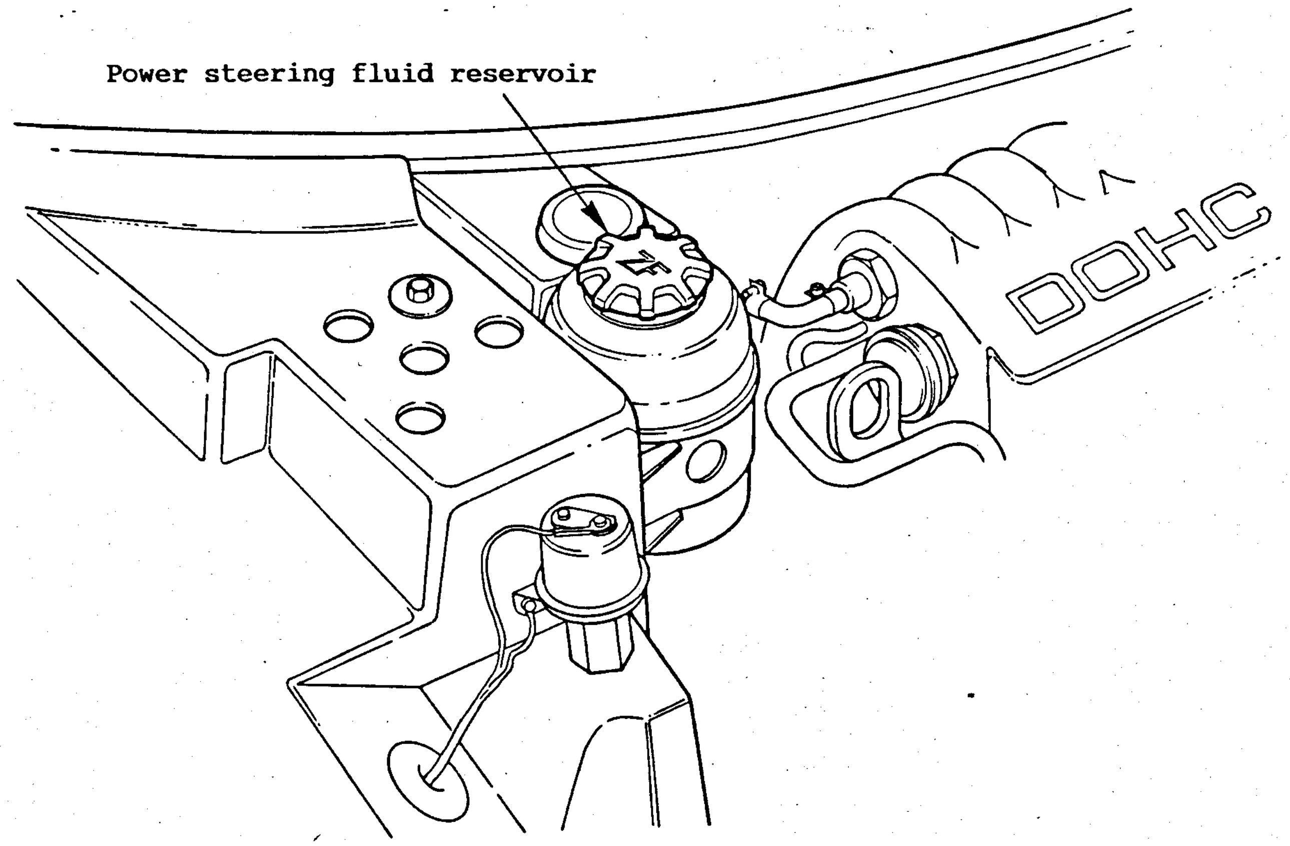








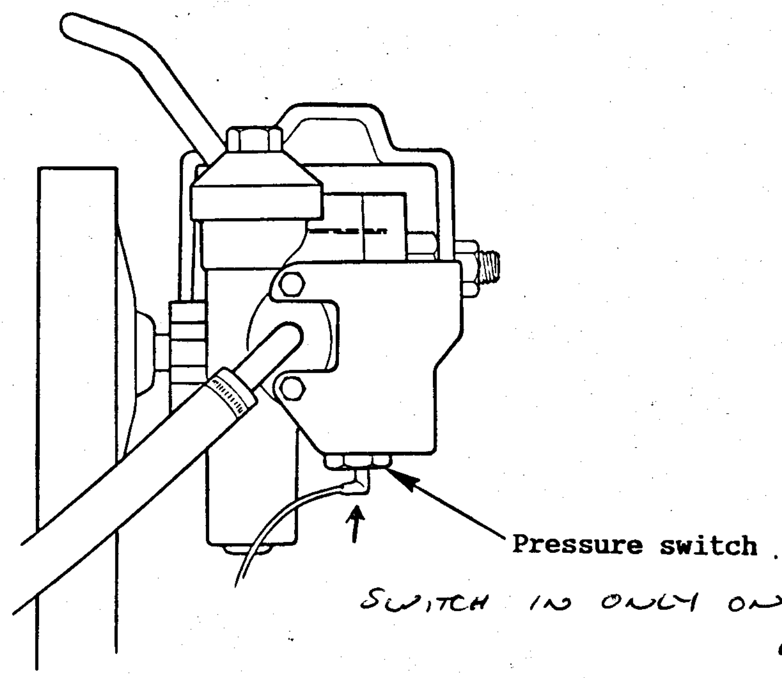
HANDBRAKE ADJUSTMENT
8 CLICKS.



Power Steering Pressure Switch (PSPS)

When a high torque is applied to the steering wheel, and a heavy load placed on the pump, a pressure switch in the outlet side of the pump, closes at about 40 kgf/cm^2 (570 lb/in^2) and signals the engine management ECM to open the idle air control valve and raise idle speed to prevent stalling. The air conditioning compressor (on cars so equipped) is also switched off when the power steering pressure switch (PSPS) closes.

PAS pump viewed from front side



SWITCH IN ONLY ON FULL LOCK.

IF TRACK ROD ENDS CHANGED. CENTRALIZE STEERING LOCKS FIRST. BEFORE GEOMETRY CHECK.

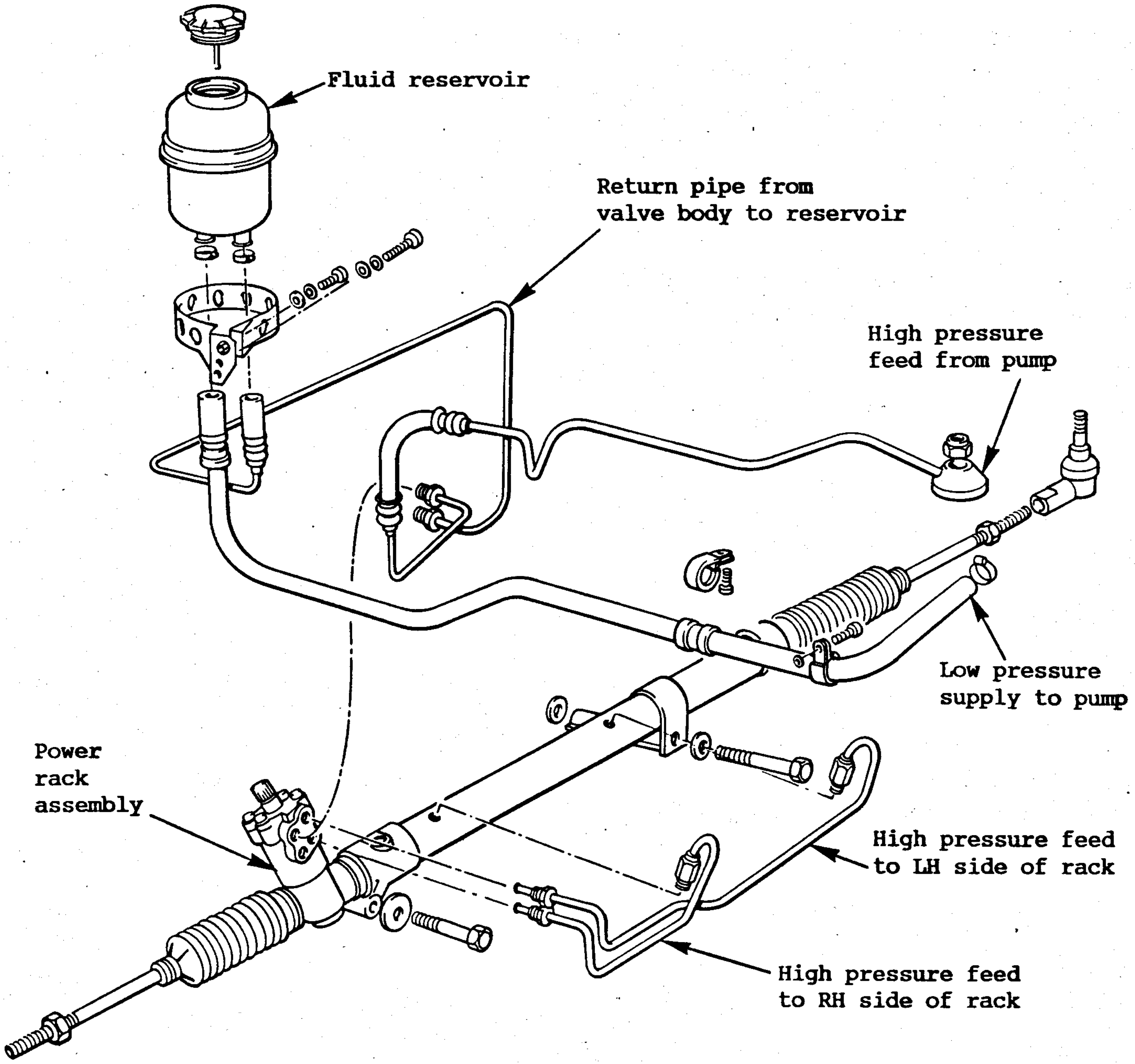
GENERAL DESCRIPTION

The steering system comprises an upper column assembly, fixed on cars with S.I.R., and tilt adjustable on cars without, both types being collapsible in the event of vehicle frontal collision, and a manual or power assisted rack and pinion assembly.

The rack and pinion assembly is secured rigidly to the chassis front crossmember by two fixing bolts, and connects with each front hub steering arm via ball jointed track rods. The constant ratio steering rack assemblies are geared for 3.0 (manual) or 2.7 (power) turns lock to lock.

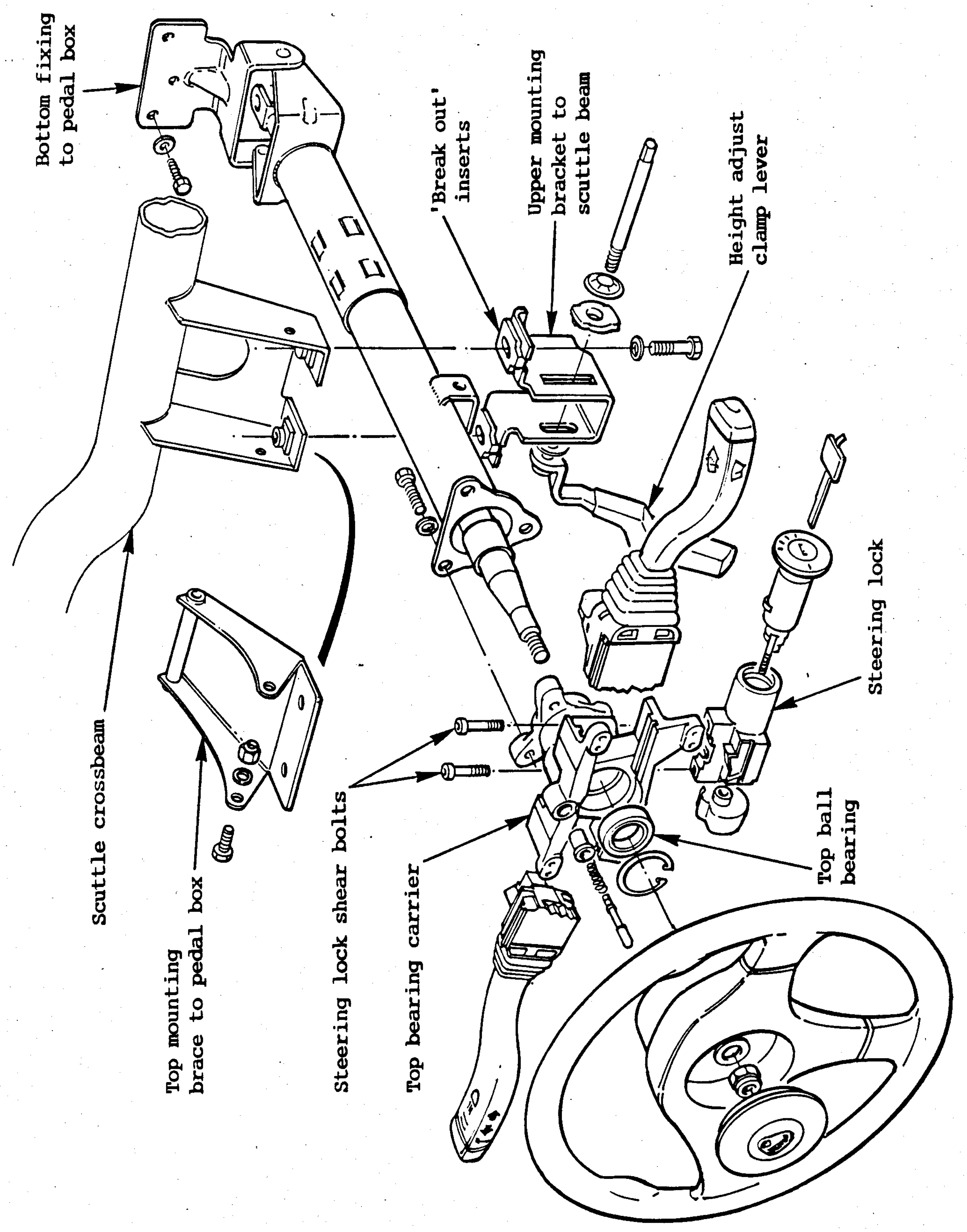
Power Assisted Steering (PAS)

The PAS system uses a hydraulic pump, mounted on the front side of the engine driven by multi-vee belt from the crankshaft, to supply oil to the valve body of the steering rack, which distributes hydraulic pressure to either side of a piston on the steering rack to lessen load at the steering wheel. A reservoir for the hydraulic fluid is mounted at the right hand rear of the engine bay.



UPPER COLUMN ASSEMBLY

Two types of upper steering column are used on the Elan; a tilt adjustable column for markets outside the USA, and a non-adjustable version with S.I.R. (Supplementary Inflatable Restraint) on USA vehicles.



GENERAL DESCRIPTION

Engine Cooling System

A centrifugal water pump is mounted on the front face of the cylinder block, and is driven by the toothed camshaft drive belt. Coolant is pumped by the impeller into the front of the block, around the cylinders, up into the cylinder head, and finally out of the back of the head (left hand end of engine), into the thermostat housing. When the thermostat is closed, water flow by-passes the radiator via a by-pass pipe which runs along the front side of the engine to an inlet spout at the left hand front of the block. In order for water on the engine side of the closed thermostat to reach the by-pass pipe, it must flow via one of three routes;

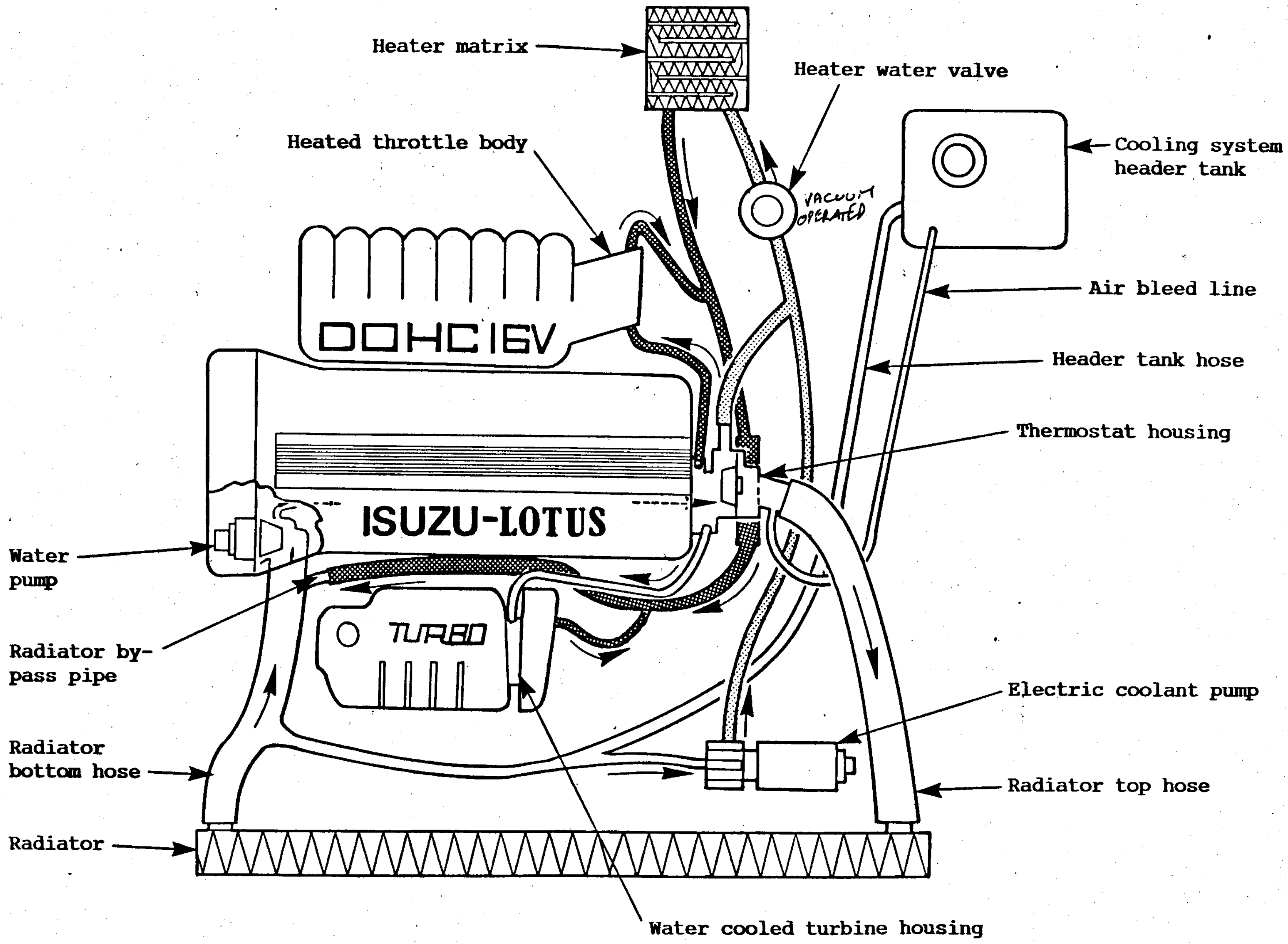
- the heater matrix (if the water valve is open)
- the primary throttle body water jacket
- the turbocharger water jacket

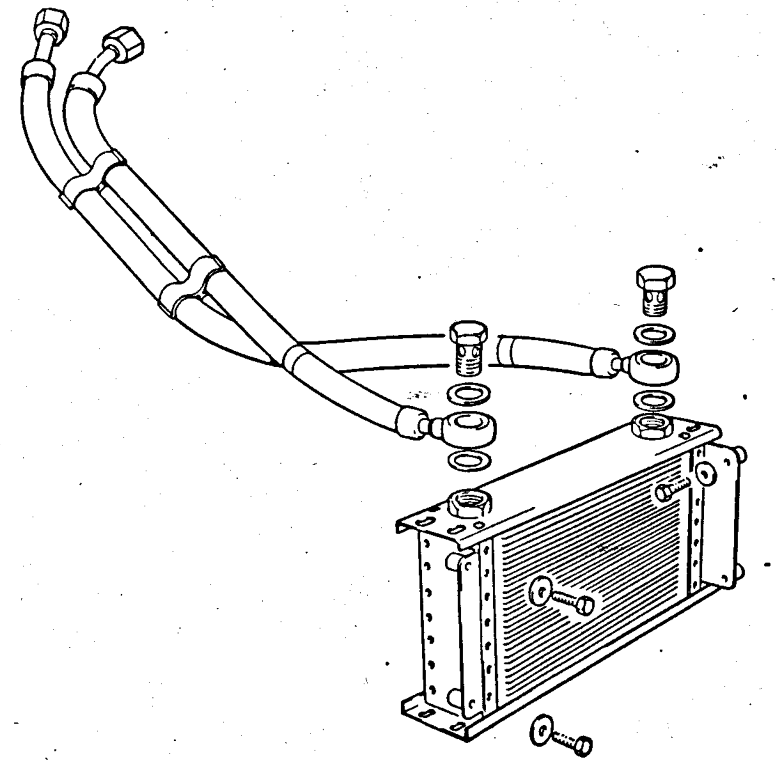
When the thermostat opens, a lesser volume of coolant will flow through these circuits, with the main flow passing through the thermostat into the radiator inlet hose, radiator, outlet hose, and finally back into the water pump via the inlet spout at the left hand front of the block.

A header tank is fitted at the left hand rear of the engine bay, and is connected into the radiator bottom hose, with an air bleed hose connecting the top of the tank with the top of the thermostat housing outlet spout. The tank is fitted with a 110kPa (15 lb/in^2) pressure cap to raise the boiling point of the coolant to 120°C.

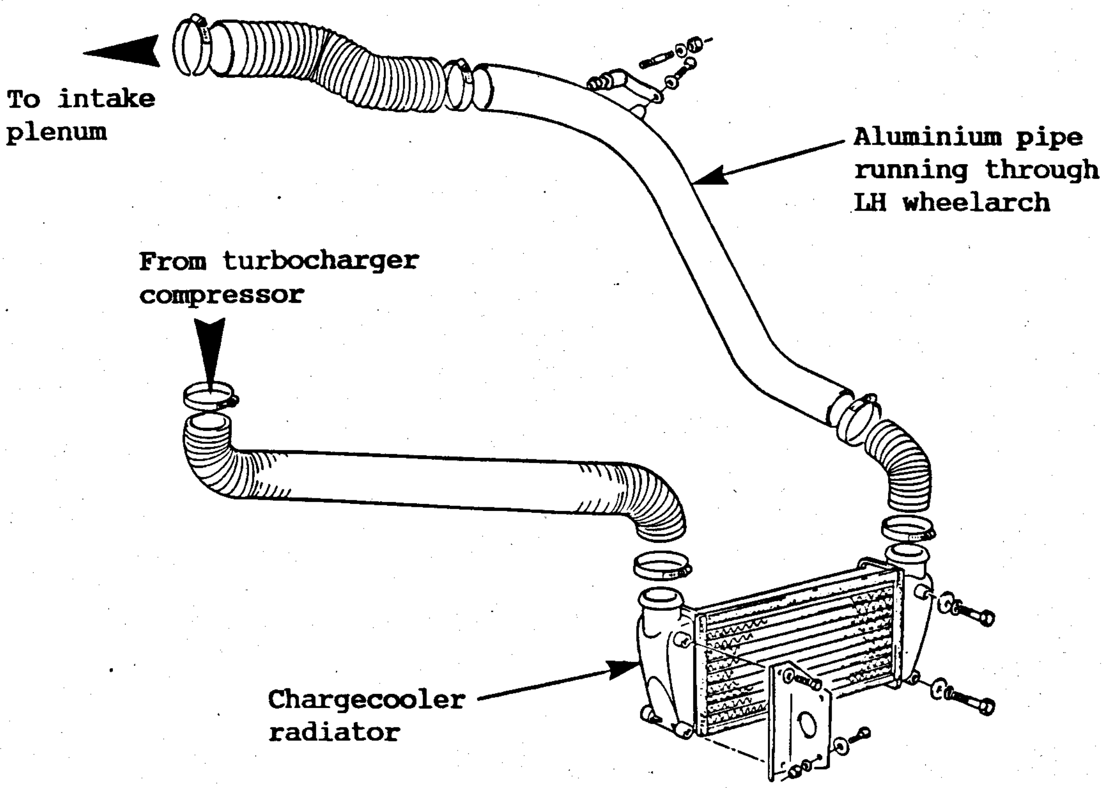
The radiator comprises an aluminium core sandwiched between plastic end tanks, and is flexibly mounted in a support frame by two spigots at the top, and two at the bottom. Two electric cooling fans are mounted on the rear of the radiator, and are controlled by a thermal switch in the thermostat housing outlet spout. The sensor for the water temperature gauge is fitted into the thermostat housing.

In extreme conditions of heat soak, in order to control water temperature after switching off the engine, an electric pump is used to maintain coolant circulation until the temperature drops to a safe level. The centrifugal pump is mounted at the front of the engine bay, and is connected between the radiator bottom hose, and the heater feed hose between the thermostat housing and the water valve. The pump is controlled by the radiator fans thermal switch, and operates only when the ignition is switched **OFF**. With ignition off and thermal switch closed (above 110°C), both the cooling fans and the pump will run until coolant temperature falls sufficiently for the thermal switch to open (approx 103°C). The electric pump operates to pump cool water from the bottom hose into the cylinder head via the thermostat housing; i.e. in the reverse direction to normal coolant flow.


Heater matrix
Heater water valve
VACUUM OPERATED
Cooling system header tank
Heated throttle body
DOHC 16V
Air bleed line
Header tank hose
Thermostat housing
ISUZU-LOTUS
Water pump
TURBO
Radiator by-pass pipe
Electric coolant pump
Radiator bottom hose
Radiator top hose
Radiator
Water cooled turbine housing



Charge Cooling System

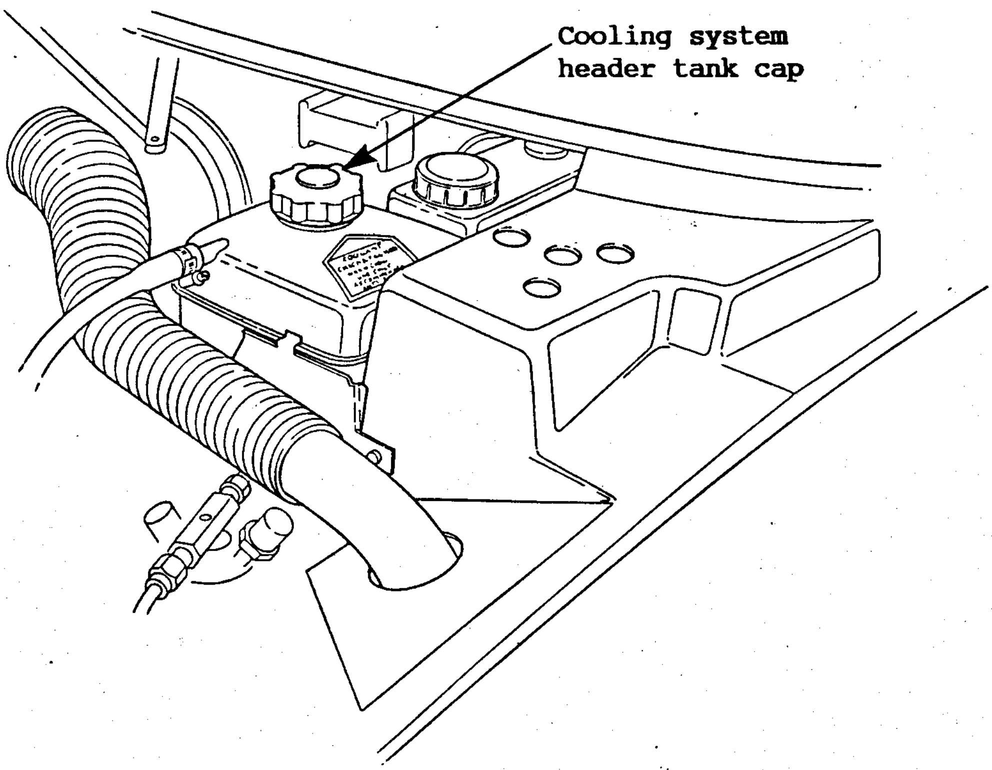


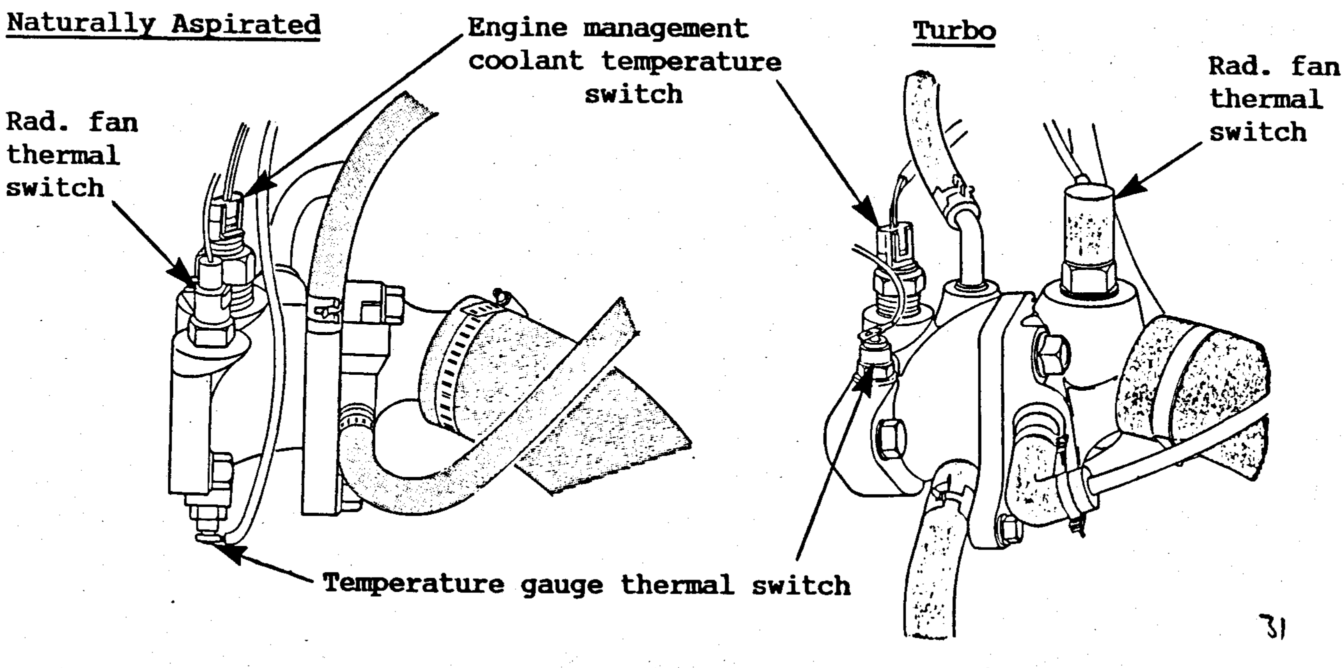
Oil Cooling System

A sandwich plate fitted between the oil filter canister (on the rear side of the cylinder block) and the block, diverts the pressurised oil supply from the oil filter input, via a steel pipe and high pressure hose, to an oil cooler radiator mounted in a separate duct to the right of the engine cooling radiator. Oil returns from the radiator via a hose and steel pipe to the sandwich plate, and then flows through the oil filter and into the engine.

Charge Air Cooling System

Turbocharged models use an air/air heat exchanger (chargecooler) to reduce the temperature and increase the density of air leaving the turbocharger compressor, before it enters the intake plenum chamber. The chargecooler is constructed of aluminium, and is located in a separate duct to the left of the engine cooling radiator. It is connected by moulded hose to the turbocharger compressor outlet, and uses an aluminium pipe routed through the left hand wheelarch to connect with the intake plenum hose.

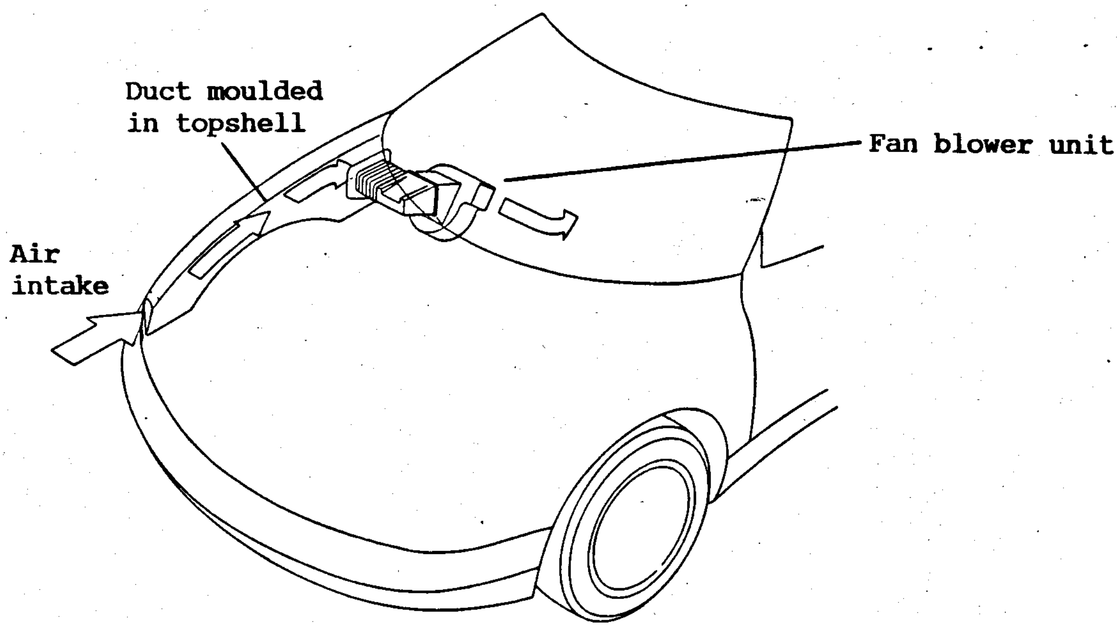




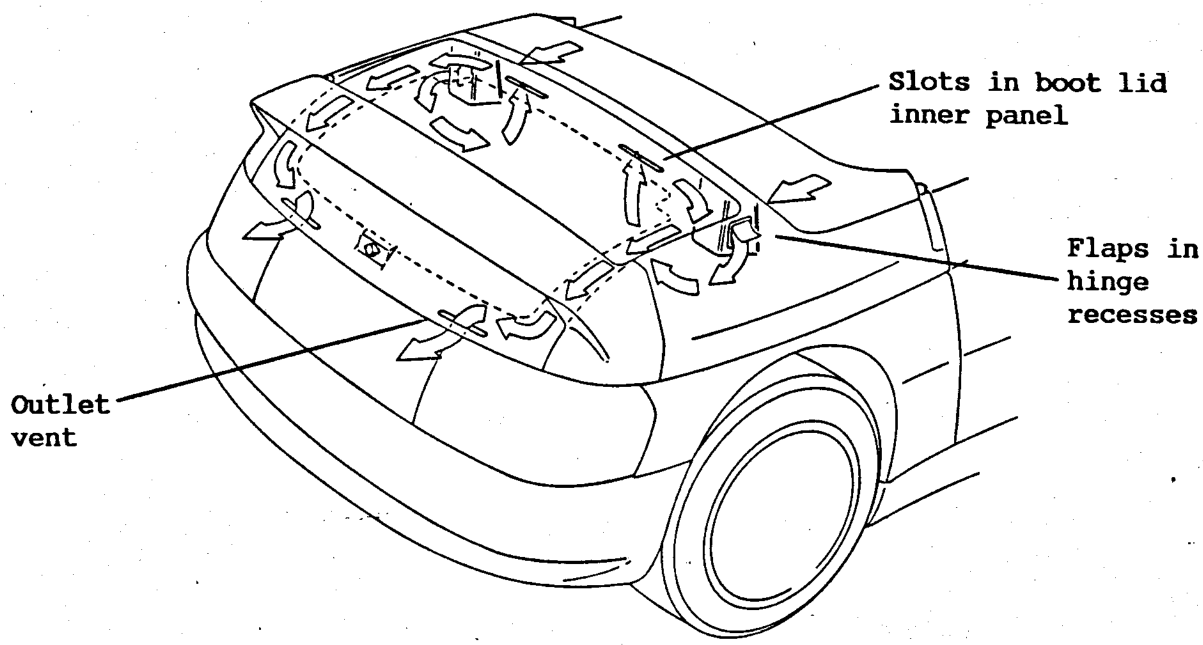
GENERAL DESCRIPTION

Ventilation

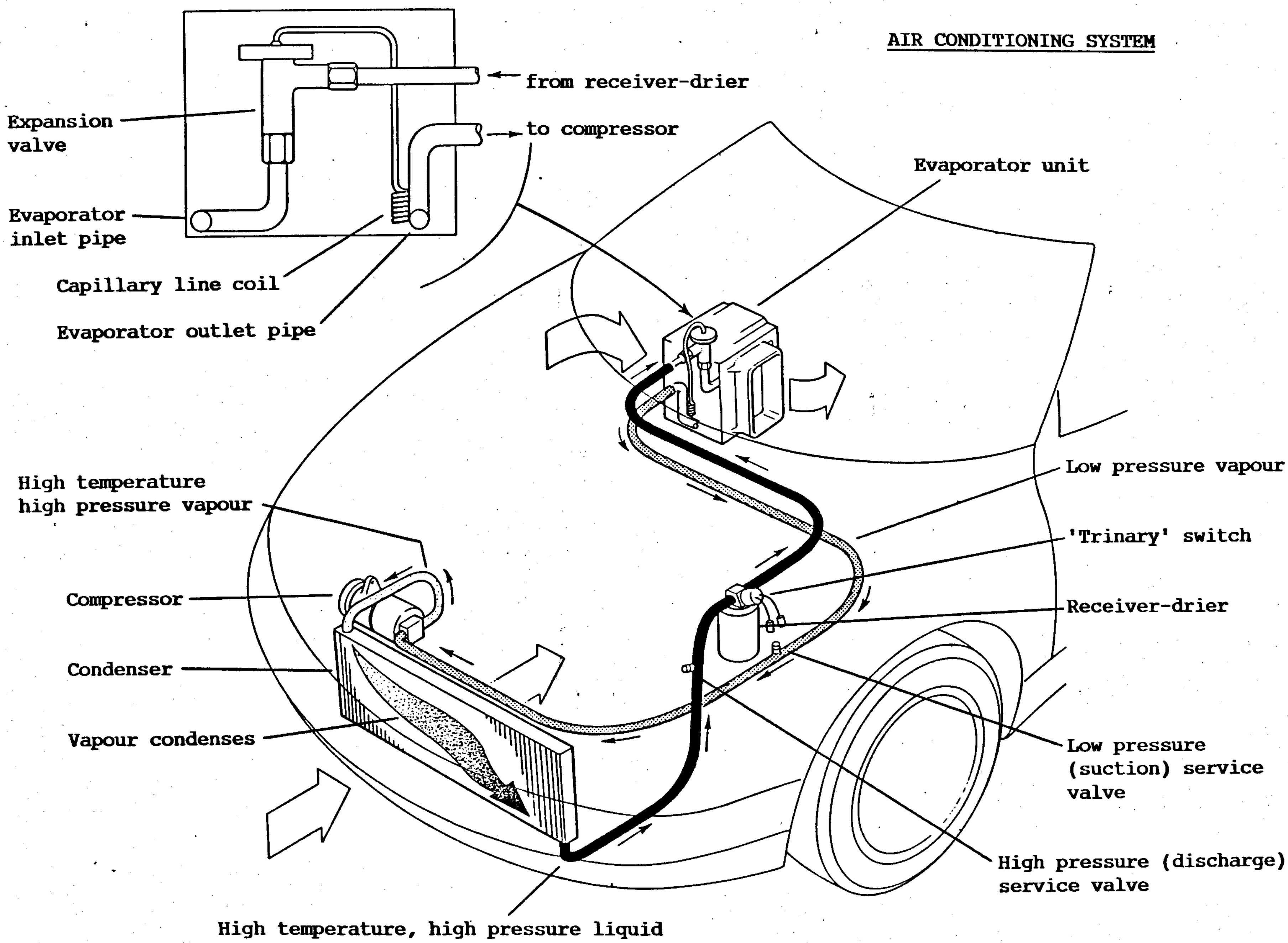
The ventilation system uses an air intake duct which collects air from the gap between the front bumper and front topshell, and runs inside the top of the passenger side front wheelarch before passing through the front bulkhead into the blower motor housing. On air conditioned cars, an air intake flap within this housing admits either fresh air from the intake duct, or 're-circulated' air from the cabin interior. The four speed blower fan forces air through the air conditioning evaporator (if fitted), and into an air blend heater unit which shares a housing with the distribution chamber. Two vacuum operated distribution flaps within this unit direct air to the various outlet vents.

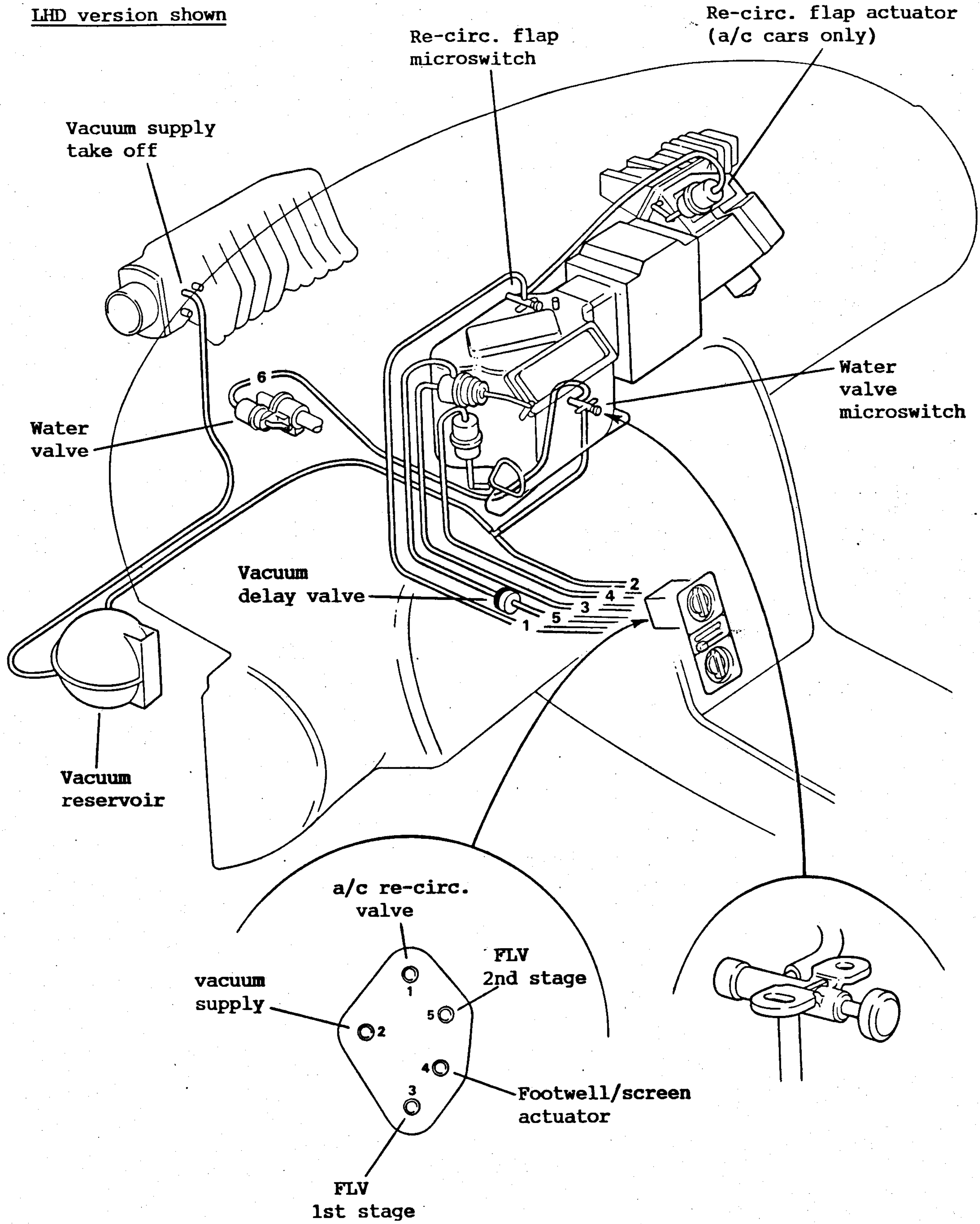


When the soft top roof is raised, air is able to vent from the cabin interior via one way flap valves in the rear bulkhead hinge recesses, into the boot. Ventilation of the boot is achieved by ducting air through the boot lid reinforcing channels to outlets over the rear number plate. Care should be taken not to obstruct the ventilation system with luggage or clothing.



AIR CONDITIONING SYSTEM





Vacuum Connection Diagram

FUEL SYSTEM

GENERAL DESCRIPTION

The single fuel tank is moulded from impact resistant blow moulded high density polyethylene for light weight and freedom from corrosion, and is mounted ahead of the left hand rear wheel by two stainless steel bands.

The fuel pump is a roller vane type, high pressure electric pump mounted submerged within the fuel tank. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel. A pulsator, fitted immediately above the fuel pump, reduces pressure pulsations in the supply line. The whole assembly of pump, strainer and pulsator is fixed (by the supply and return pipes), to a mounting plate secured by a threaded ring to the top face of the tank. Also incorporated into this assembly is the fuel level sender unit, which uses a nylon float and a rheostat to supply a signal to the fuel gauge.

The pump supplies fuel at a pressure of 211 - 379 kPa (30.5 - 55 psi) dependent on operating conditions, through an in line canister type filter located adjacent to the tank, to the fuel injector rail assembly on the engine. Nylon pipes are used to carry the fuel to and from the engine, and are routed alongside the chassis centre section. Compression joints are used on the high pressure supply side, and push on clamped joints, on the low pressure return. Special fittings are used on both lines at the connections to the fuel pump assembly and on the connector block in the supply line at the rear of the engine bay. This connector block is substituted with a pressure test adaptor when carrying out a fuel pump performance test.

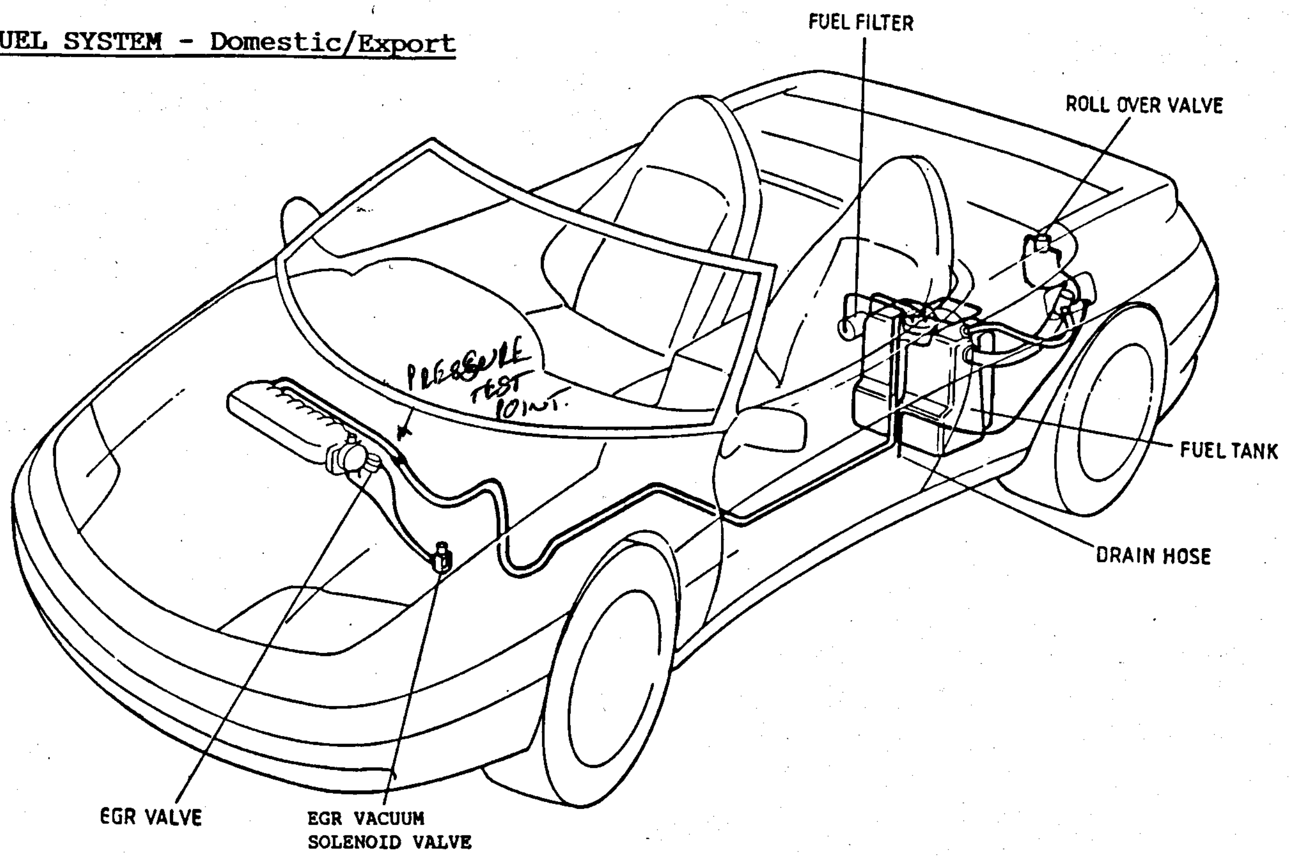
The pump is able to deliver 4 - 5 times the engine's maximum requirement, so that fuel is constantly circulated through the in-line fuel filter, fuel rail, and via the fuel pressure regulator, back to the tank. This fuel circulation helps avoid excessive fuel temperature with the consequent risk of vapour locks.

When the ignition is switched on, the engine management ECM energises the fuel pump which will continue to run for as long as the ECM receives ignition pulses from the ignition module (engine cranking or running). If no ignition pulses are received, the ECM switches off the pump either 2 seconds (approximately) after the ignition was switched on, or about 10 seconds after a stall.

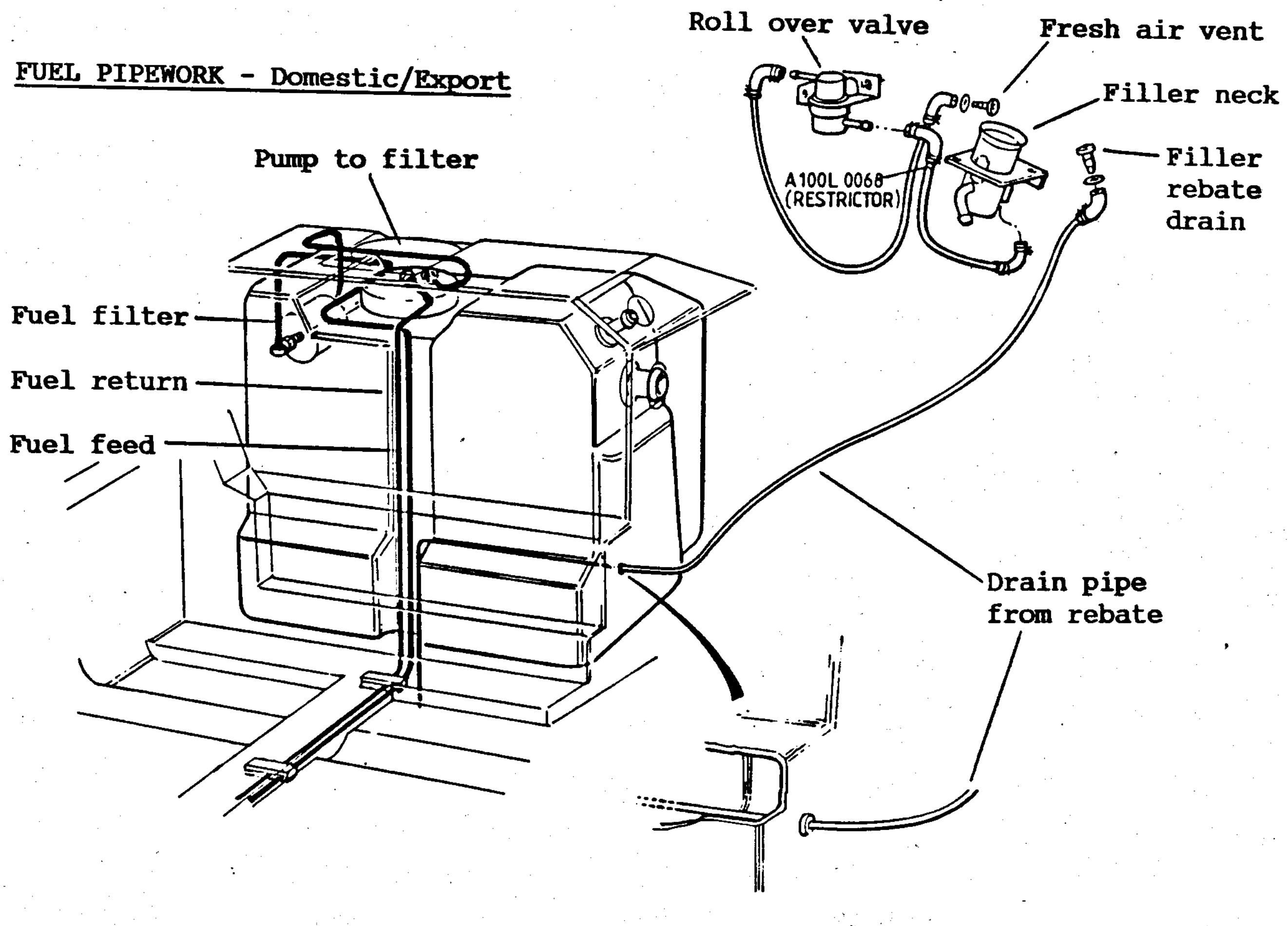
A roll over valve is mounted on the top left hand side of the rear bulkhead, and is connected between the breather spigot on the fuel filler neck, and the fresh air vent fitted at the top of the filler recess in the body. This valve allows venting of the tank under normal circumstances, but prevents fuel spillage if the vehicle is inverted during an accident.

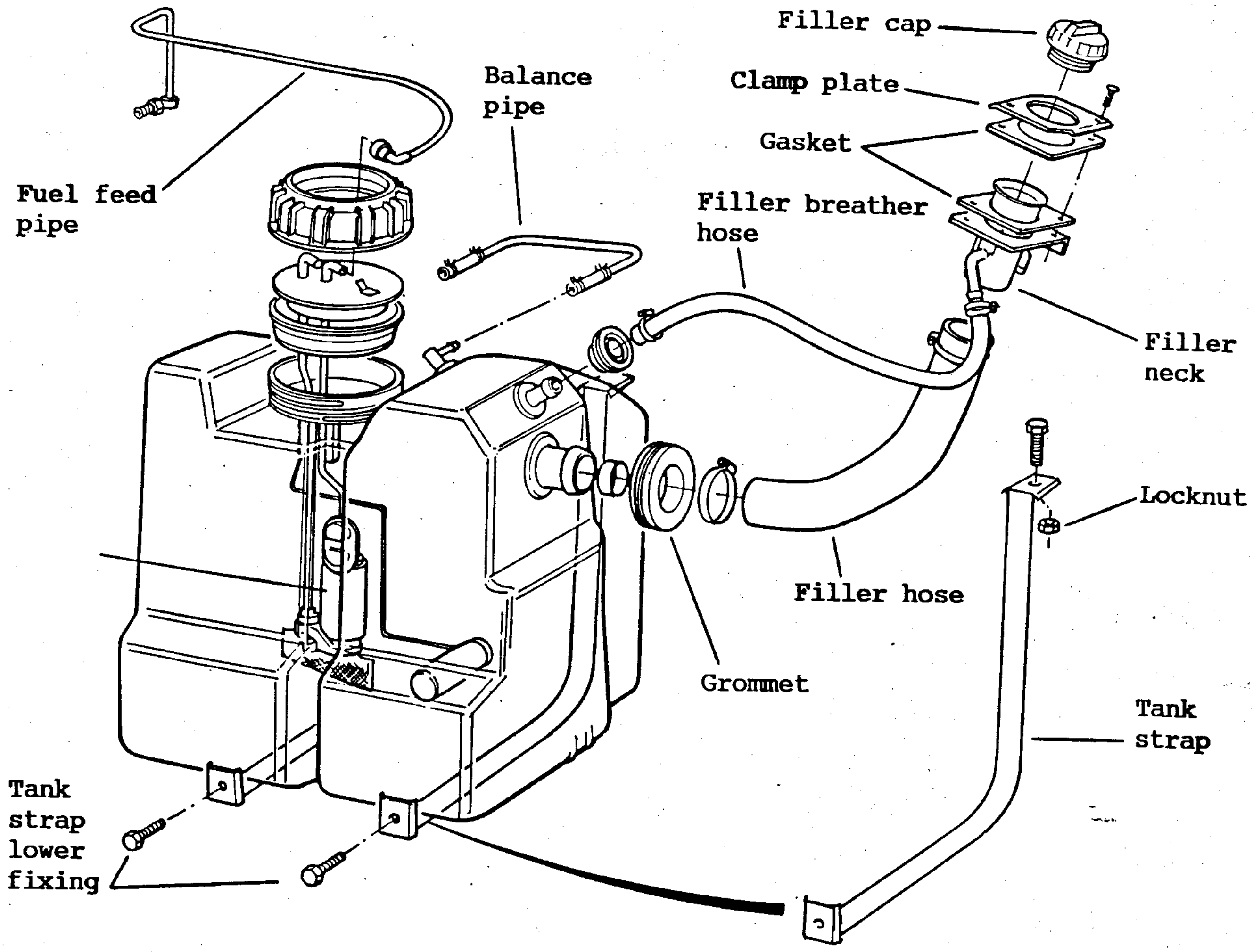
On USA specification vehicles, the vent side of the roll over valve is connected to a vapour storage charcoal canister mounted behind the LH 'B' post. When the engine is stopped, the fuel vapour from the tank is absorbed by charcoal in the canister. When the engine is running, the fuel vapour is purged from the charcoal by a flow of air through the unit, which is then consumed by the engine in the normal combustion process. This purging process is controlled by a diaphragm valve on the top of the canister, and a vacuum solenoid valve in the engine bay, which is itself controlled by the engine management ECM.

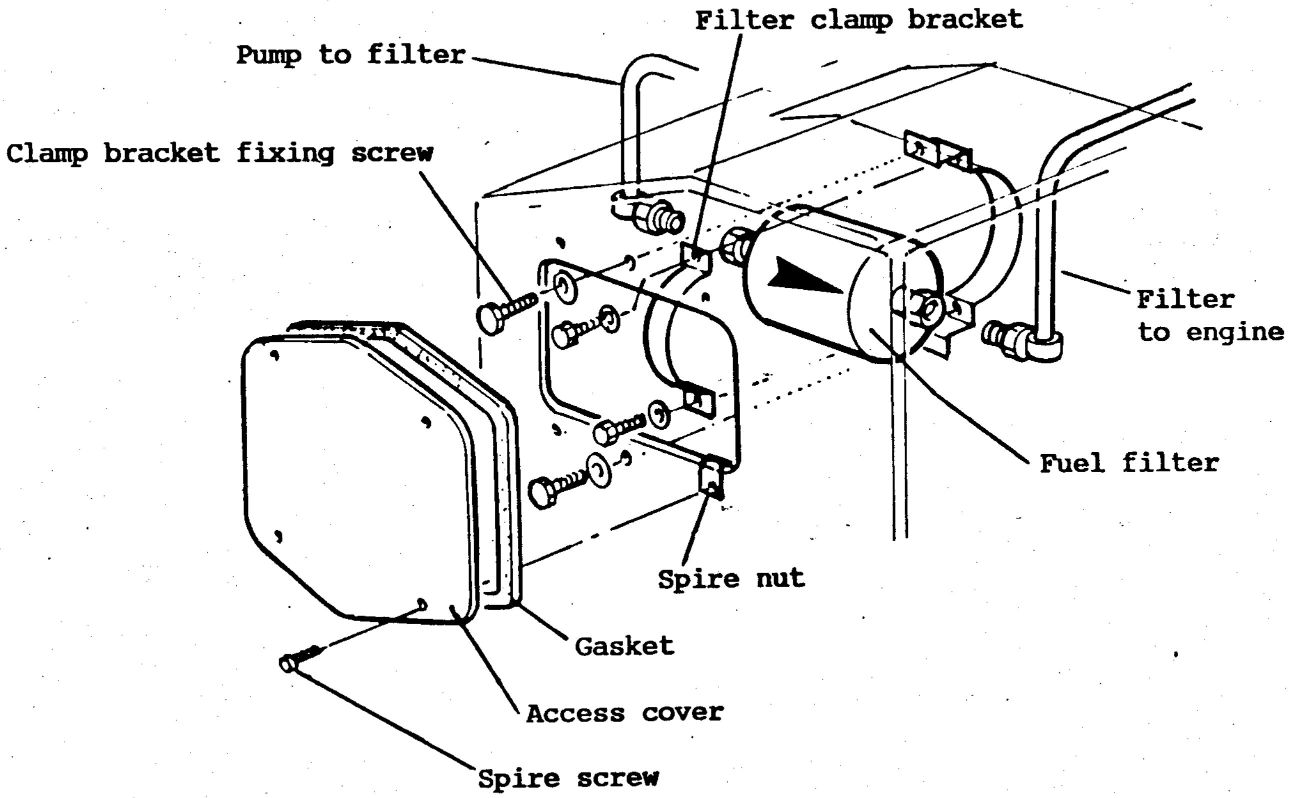
FUEL SYSTEM - Domestic/Export



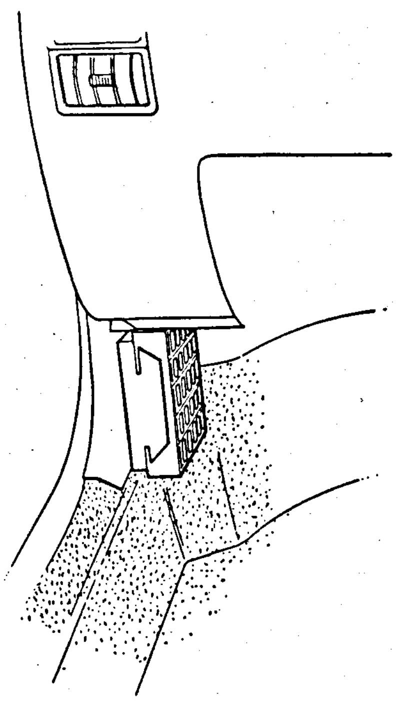
FUEL PIPEWORK - Domestic/Export




Fuel feed pipe
Balance pipe
Filler cap
Clamp plate
Gasket
Filler breather hose
Filler neck
Locknut
Filler hose
Grommet
Tank strap
Tank strap lower fixing

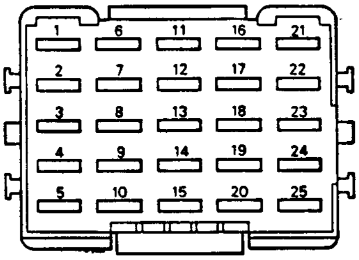

Filter clamp bracket
Pump to filter
Clamp bracket fixing screw
Filter to engine
Fuel filter
Spire nut
Gasket
Access cover
Spire screw

FUSES & RELAYS



Main Fusebox (A) - ahead of passenger door hingepost

Fuse	Rating	Circuit
1	15A	Horns
2	7.5A	Air Cond.
3	7.5A	Fuel Pump
4	10A	Lighting
5	10A	ECM
6	5A	RH Sidelamps
7	5A	LH Sidelamps
8	-	
9	-	
10	3A	VSV
11	10A	Hazard
12	3A	Batt Services
13	5A	Stoplamps
14	5A	Int. Lamps
15	15A	Rear Fog
16	10A	DI & Reverse
17	15A	Wash/wipe
18	3A	Ignition 1
19	3A	Mirror Heater
20	3A	Ign. Relay
21	5A	Mirrors
22	3A	Ignition 2
23	20A	Heater Blower
24	15A	Cigar Lighter
25	-	

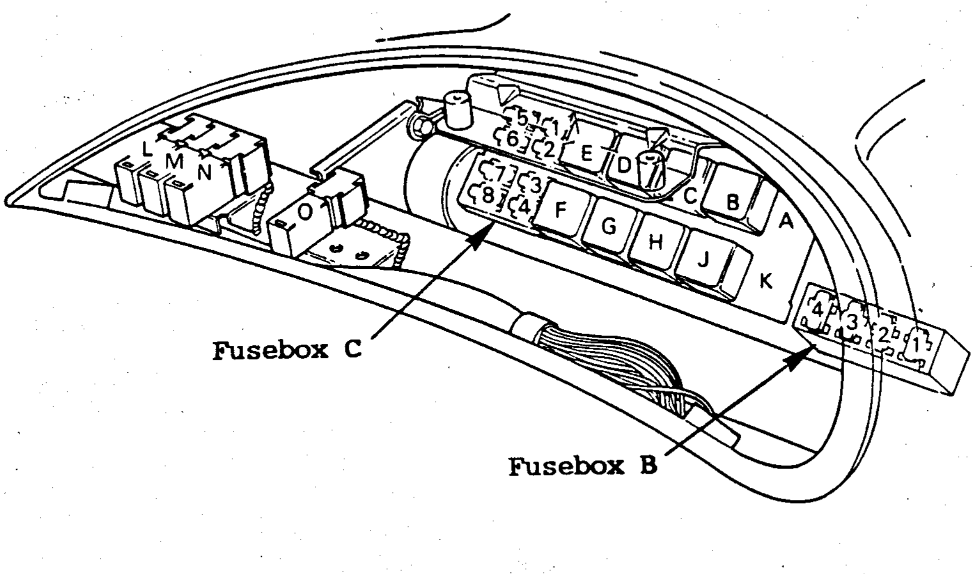


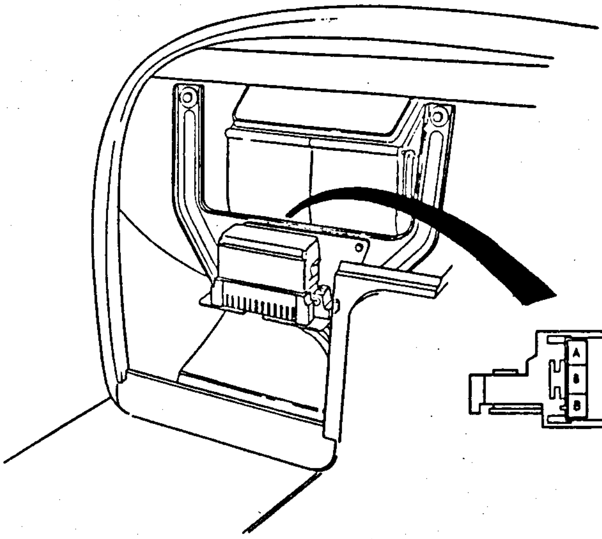
Relays Above Instrument Cluster

Relay	Circuit
A	-
B	Air Conditioning
C	Cooling Fans
D	Blower Fan Fast
E	Main Beam
F	Dip Beam
G	Electric Coolant Pump
H	Ignition
J	Start
K	-
L	Rear Fog Lamps
M	ECM
N	Blower Fan Slow (a/c cars only)
O	Horns

Fuses Above Instrument Cluster

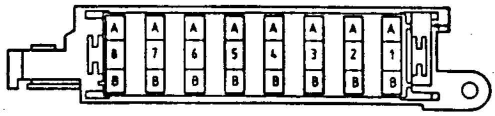
Fuse	Rating	Circuit
Fusebox B		
1	20A	RH Window Lift
2	20A	LH Window Lift
3	15A	RH Cooling Fan
4	15A	LH Cooling Fan
Fusebox C		
1	15A	LH H/L Motor
2	15A	RH H/L Motor
3	7.5A	CDL
4	5A	Elec Coolant Pump
5	7.5A	LH Dip Beam
6	7.5A	RH Dip Beam
7	7.5A	LH Main Beam
8	7.5A	RH Main Beam





'Maxi' Fusebox (D) on Tunnel Top

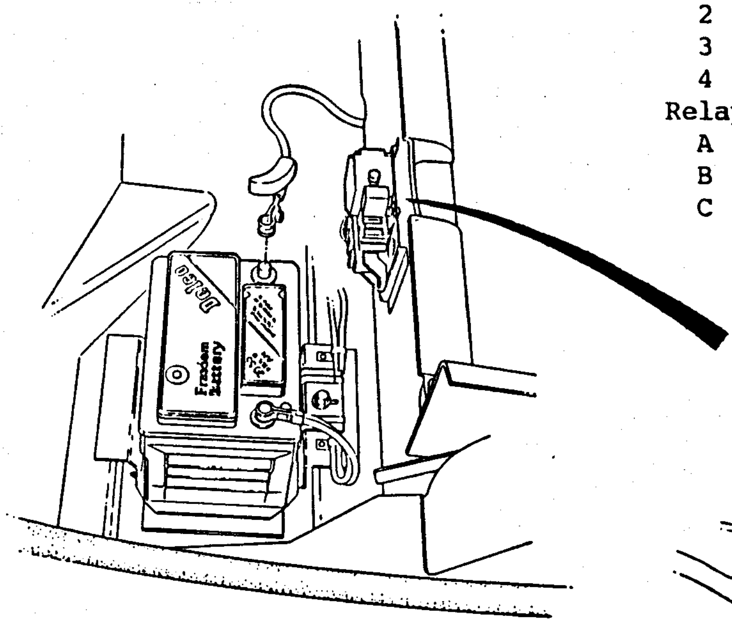
Fuse	Rating	Circuit
1	50A	Window Lift Motors
2	40A	Horn,A/C,Fuel Pump,Lights
3	40A	Haz,Batt Serv,Stop Lamps, Int Lamps,Rear Fog
4	40A	Ignition Switch
5	50A	Start Relay
6	40A	Headlamps,HL Motors
7	30A	Cooling Fans Relay
8	30A	ECM

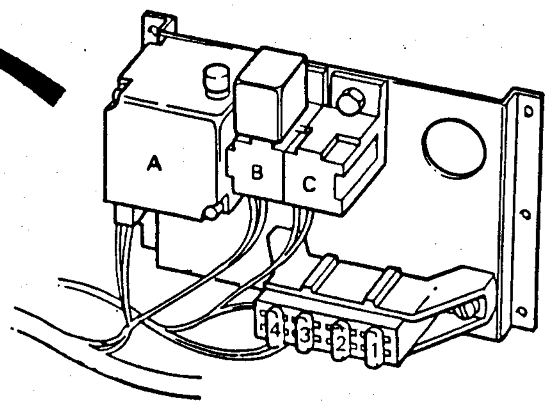


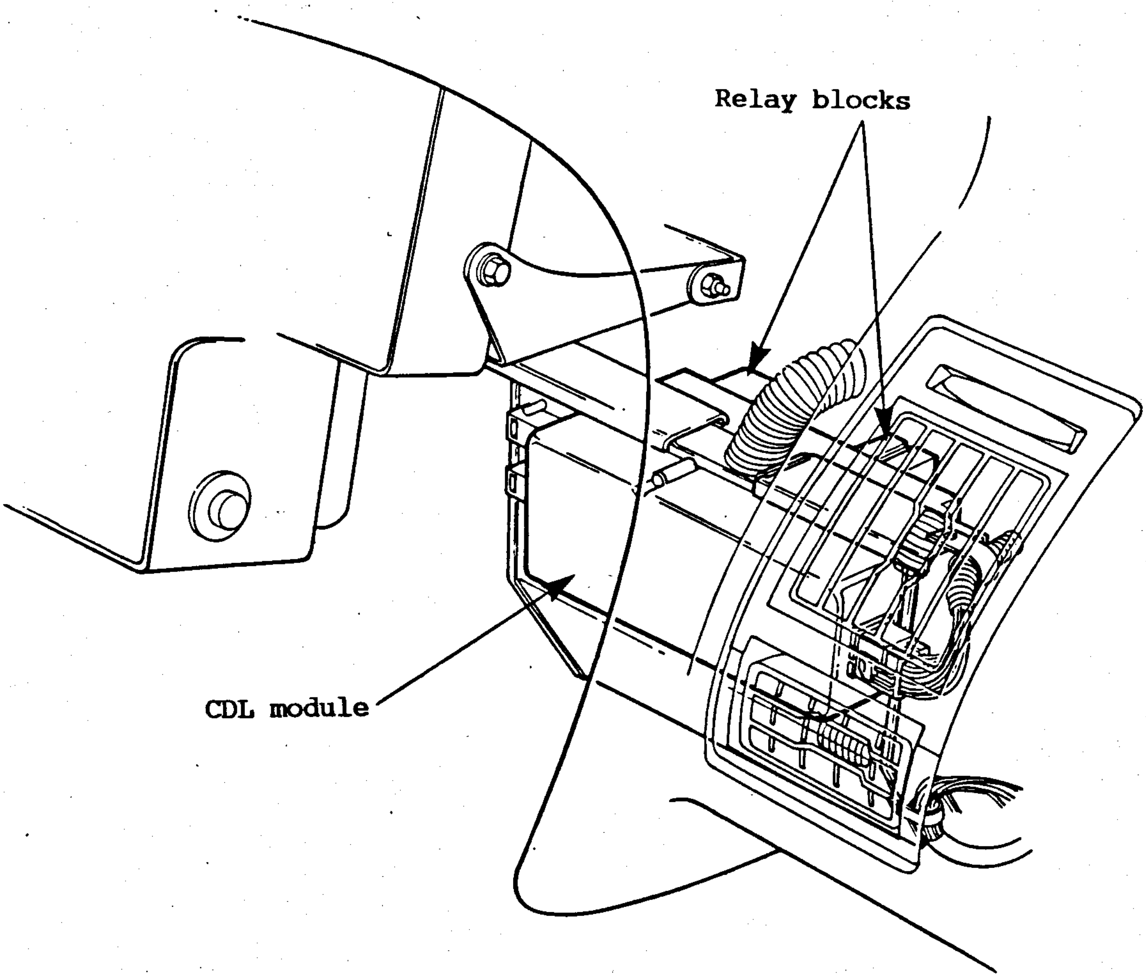
Fuses & Relays in Battery Compartment

Fuse	Rating	Circuit
1	5A	Radio
2	7.5A	Radio Antenna
3	-	'phone +12V Battery
4	-	'phone +12V Ignition

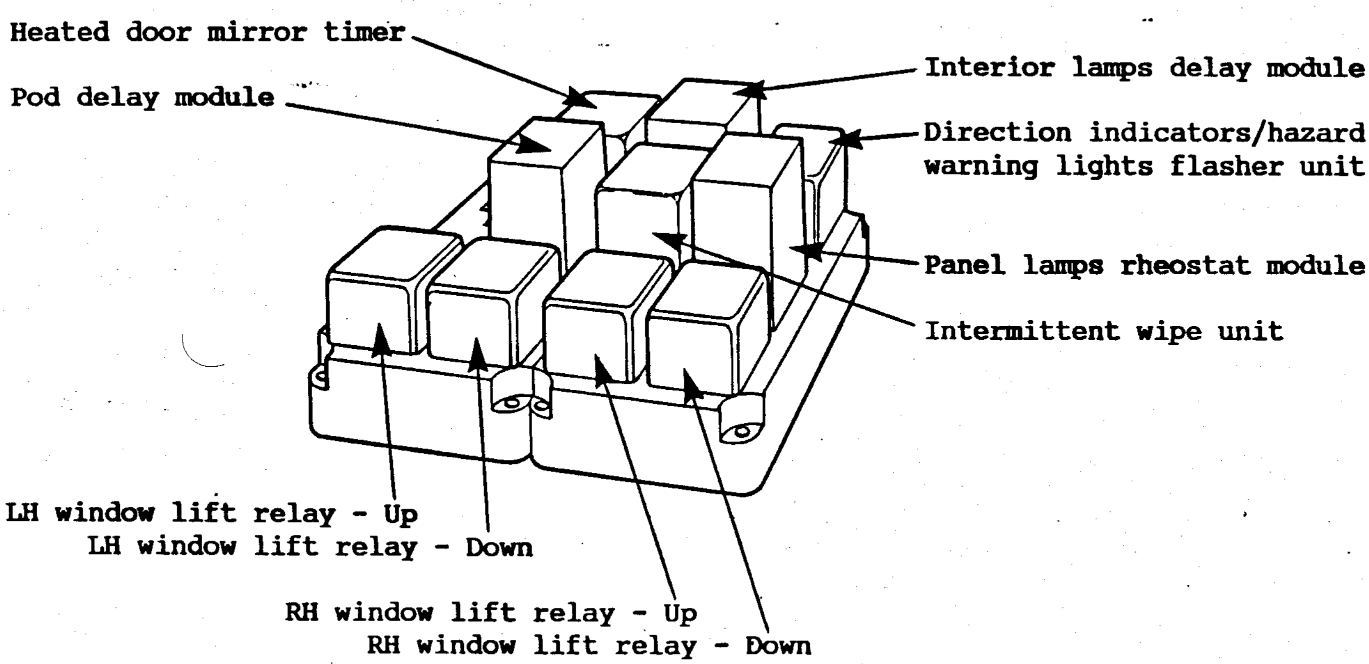
Relay	Circuit
A	Inertia Switch
B	Fuel Pump
C	Cellular 'Phone

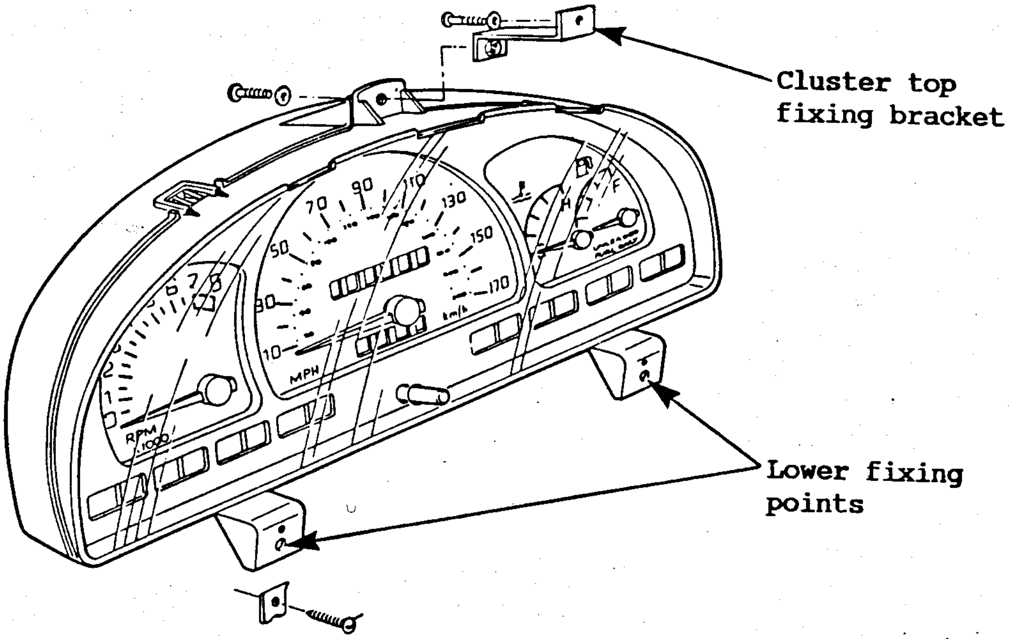


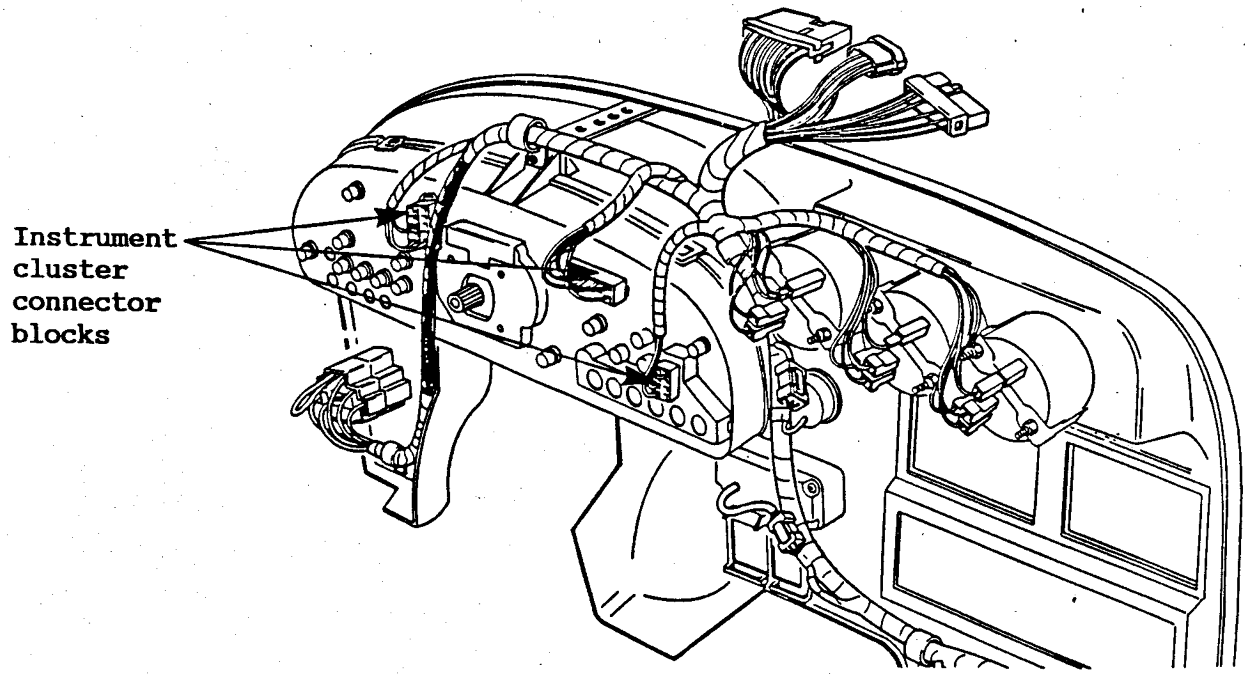


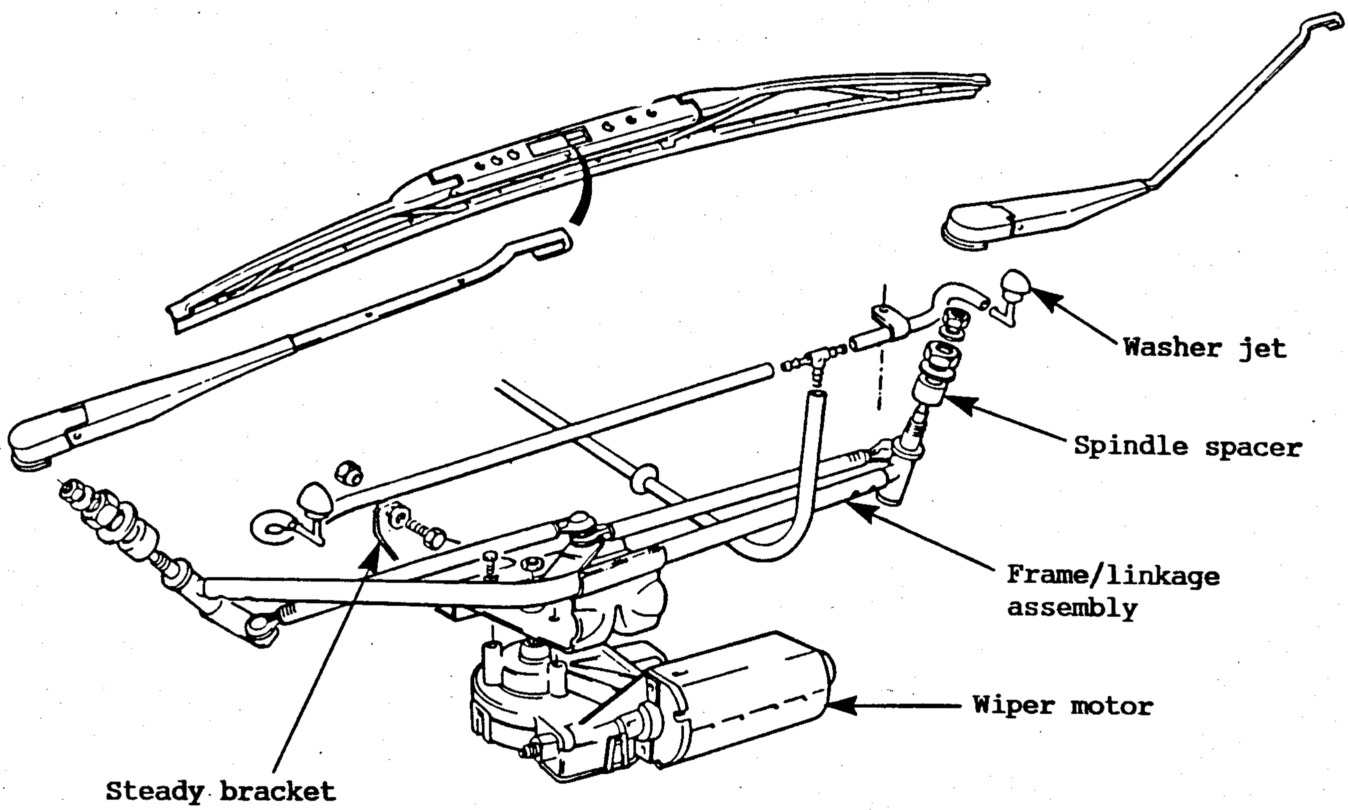


Relay Blocks Viewed From Beneath (RHD)




Cluster top fixing bracket
Lower fixing points
MPH
RPM


Instrument cluster connector blocks


Washer jet
Spindle spacer
Frame/linkage assembly
Wiper motor
Steady bracket

CRANK CANNOT BE RE-GROUND.

ENGINE

GENERAL DESCRIPTION

Note: The terms 'front', 'rear', 'right' and 'left' when used in connection with a transversely mounted engine can cause some confusion. Throughout this manual, when one of these terms is used in conjunction with the word 'engine', the description relates to the orientation in which the engine is fitted. i.e. 'the left hand end of the engine' refers to the flywheel end. However, when referring to individual components of the engine, e.g. cylinder head, block, crankshaft etc., the terms are used in accordance with the motor industry norm. whereby the flywheel end of the engine is regarded as the rear. Thus the 'rear end of the crankshaft' is at the 'left hand end of the engine'.

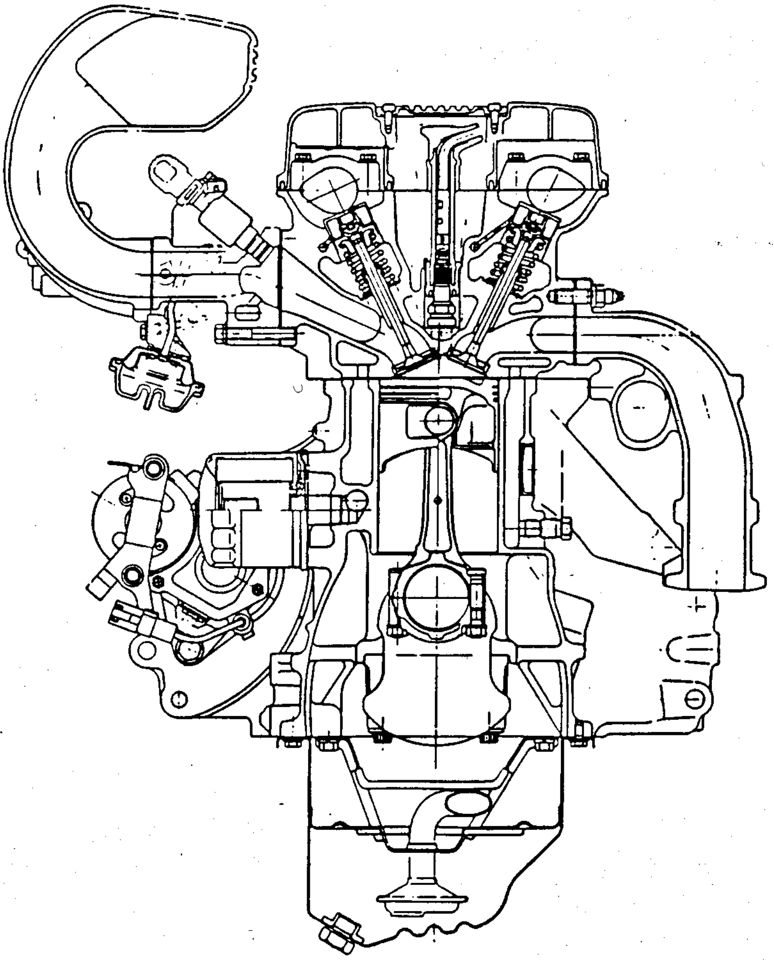
The transversely mounted '4XE1' engine used in the Lotus M100 model in both naturally aspirated and turbocharged forms, is an in-line four cylinder twin overhead camshaft unit, fitted with four valves per cylinder and electronic multi-point fuel injection. For details of the fuel injection and engine management system refer to Service Notes Section EMJ/EMK/EML (separate publication).

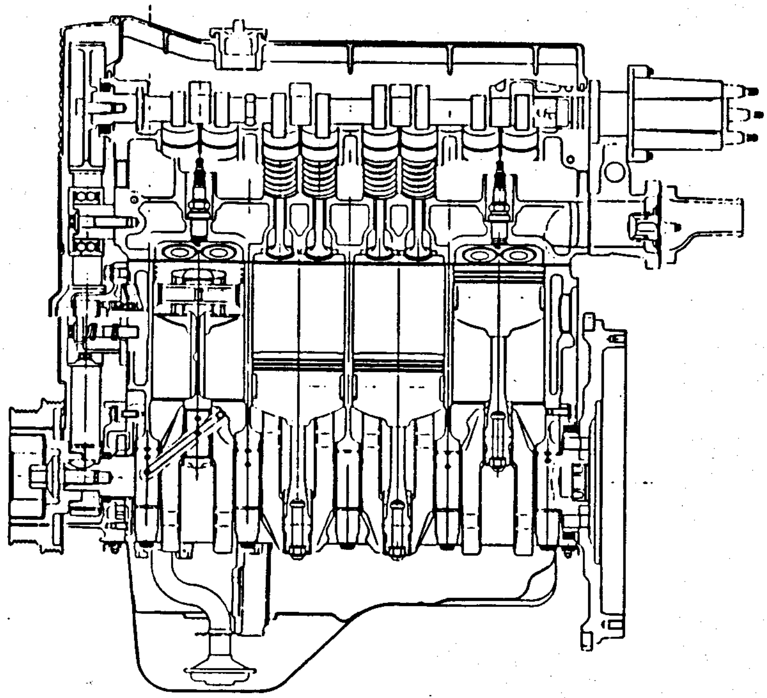
The cast iron cylinder block is surmounted by an aluminium alloy cylinder head containing four valves per cylinder in 'pent roof' combustion chambers. The inlet and exhaust valves are inclined at 50° to each other, and are operated by seperate overhead camshafts, driven from the front end of the crankshaft by a single toothed synthetic belt. The inverted bucket tappets incorporate hydraulic control of the valve clearances and eliminate the need for routine adjustment. The valves operate in replaceable cast iron valve guides and sintered steel valve seat inserts, and are fitted with single helical springs.

Forged aluminium alloy solid skirt pistons, are fitted with two compression and one oil control ring, all above the gudgeon pin. Two methods of gudgeon pin retention are used. On N.A. engines, the pin is an interference fit into the little end of the forged steel I-section connecting rod, whereas Turbo engines use a fully floating gudgeon pin retained by circlips in the piston. The five bearing cast iron crankshaft is tuftrided for wear resistance, and is controlled for end-float by thrust washers either side of no.2 main bearing. A trochoid type oil pump driven directly by the front end of the crankshaft, draws from an oil supply stored in the pressed steel sump.

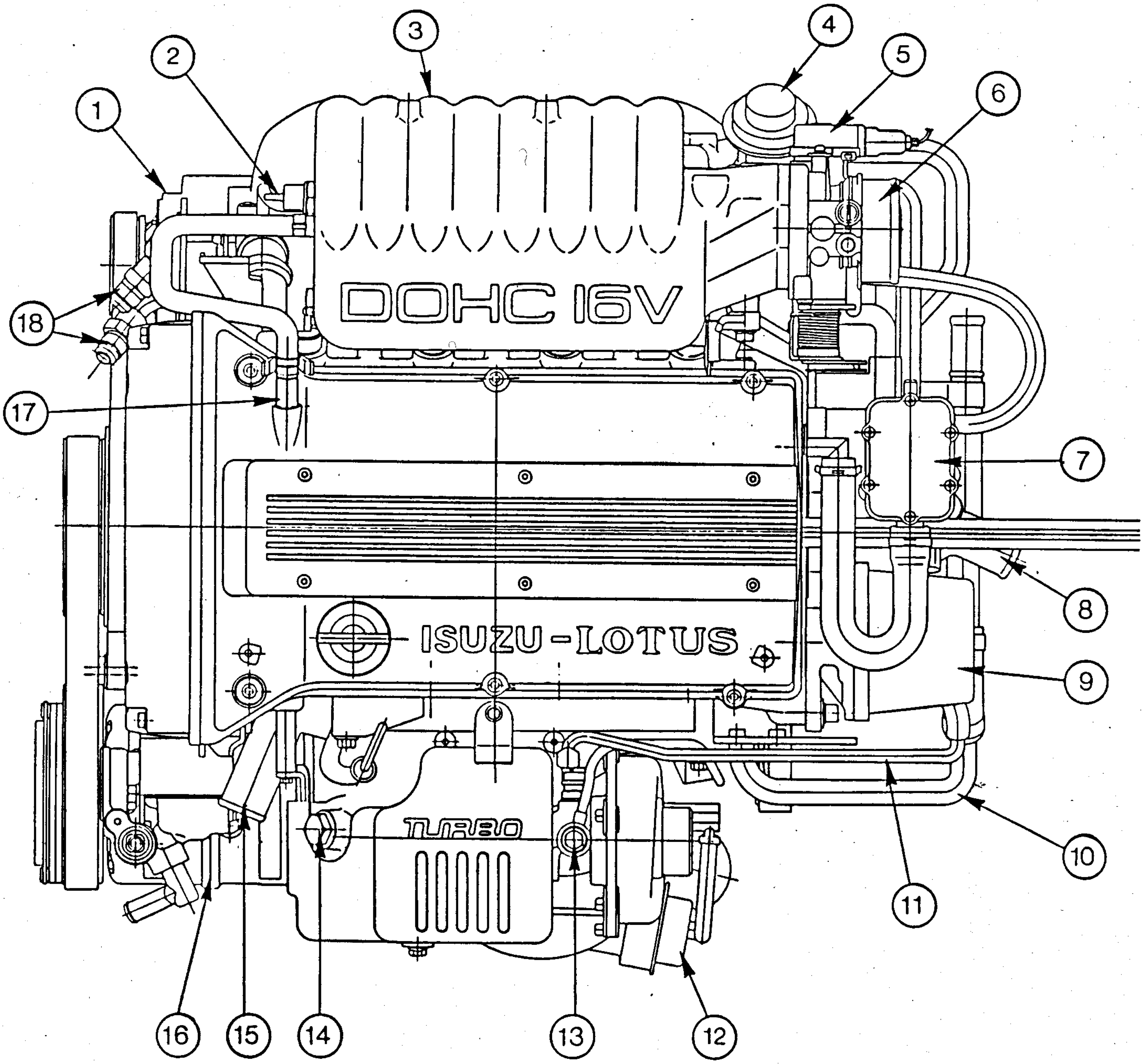
A centrifugal water pump mounted on the front face of the block, is driven by the toothed cam belt, and the ignition distributor (N.A.) or cam angle sensor (Turbo) is driven off the rear end of the exhaust camshaft.

The intake system incorporates a water heated throttle body containing a primary throttle valve; a plenum chamber integral with eight individual intake tracts; and a lower intake manifold feeding the four bifurcated cylinder head ports. The lower intake manifold contains a fuel injector for each of the four ports and a secondary throttle valve controlling one of the two tracts for each cylinder. These secondary throttle valves are operated by a single vacuum actuator whose vacuum supply is controlled by the engine management computor. At engine speeds below 5,200 rpm, the secondary throttles are closed to maintain a high gas speed in the intake air column for optimum low speed driveability and idle quality, but at higher engine speeds the secondary throttles are opened for maximum volumetric efficiency and performance.



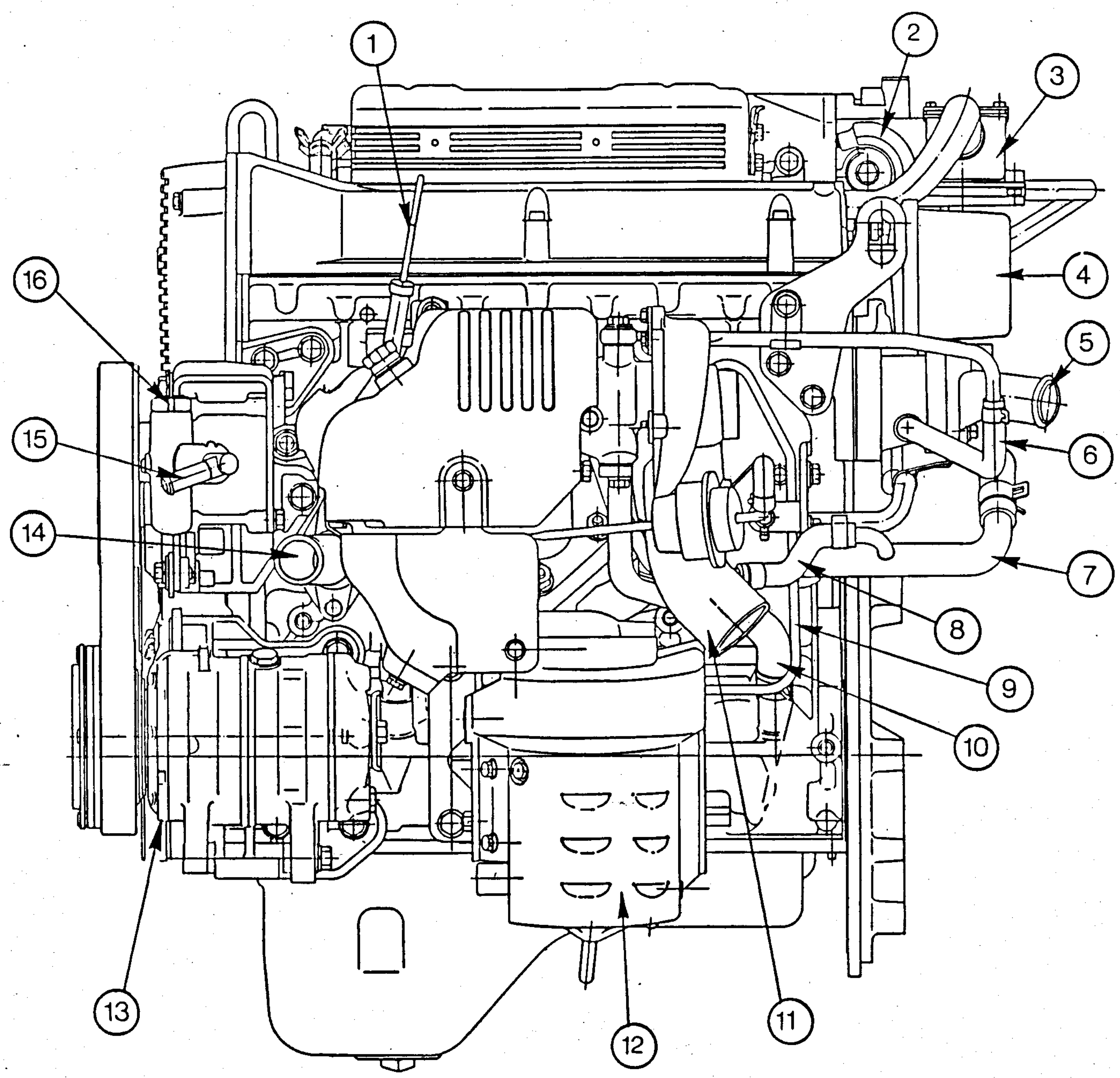


TURBO ENGINE PLAN VIEW



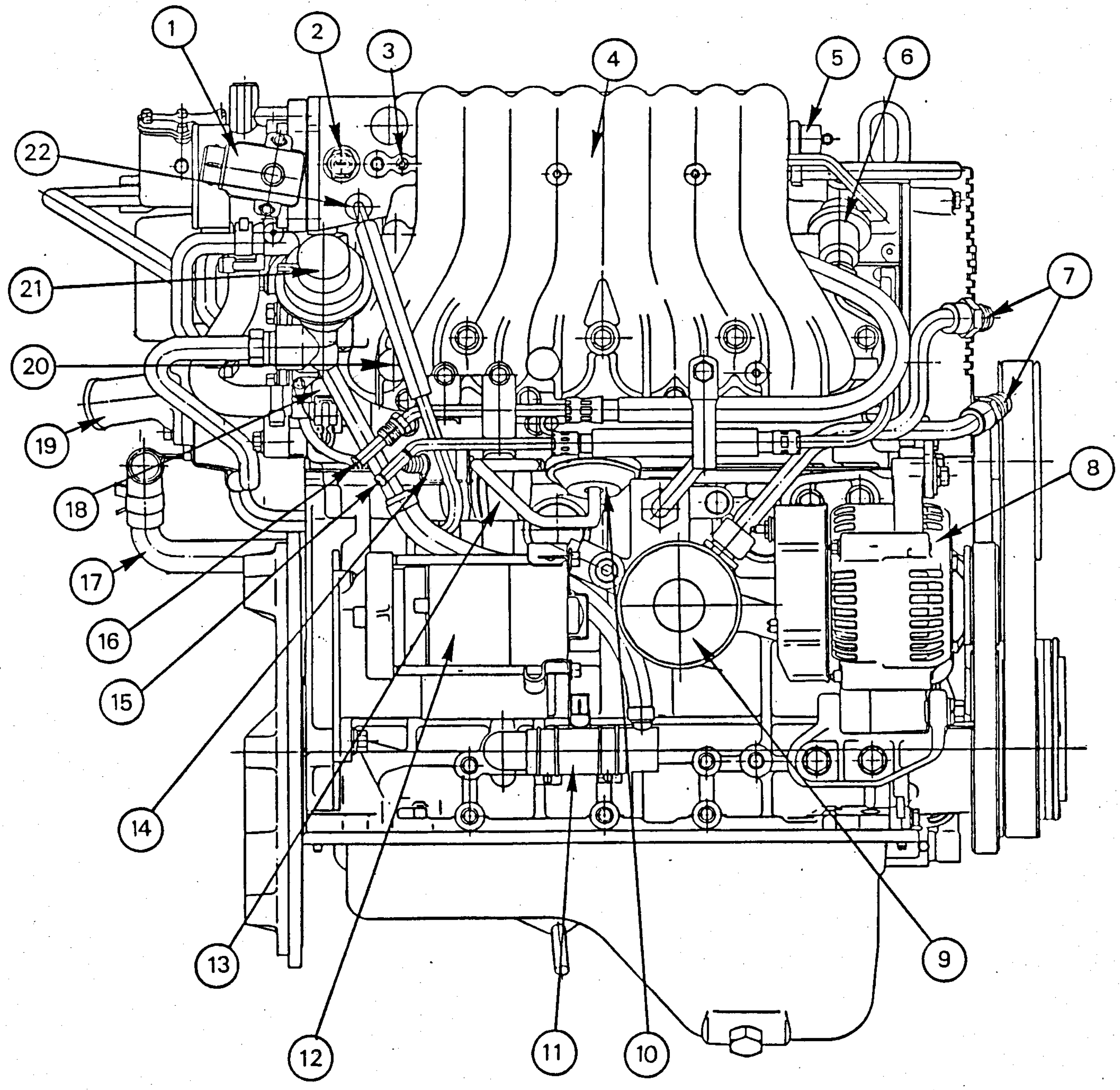
1. Alternator
2. MAP sensor filter/damper
3. Common chamber (intake plenum)
4. Exhaust Gas Recirculation (EGR) valve
5. Throttle Position Switch (TPS)
6. Primary throttle body
7. Oil seperator (Turbo only)
8. Thermostat housing outlet
9. Cam angle sensor (distributor on N.A.)
10. Radiator by-pass water pipe
11. Turbo water feed pipe
12. Wastegate capsule
13. Turbo oil feed
14. Oxygen sensor blanking plug
15. Water pump inlet spout
16. Air conditioning compressor
17. Positive Crankcase Ventilation (PCV) valve
18. Oil cooler hose connections

TURBO ENGINE FRONT SIDE



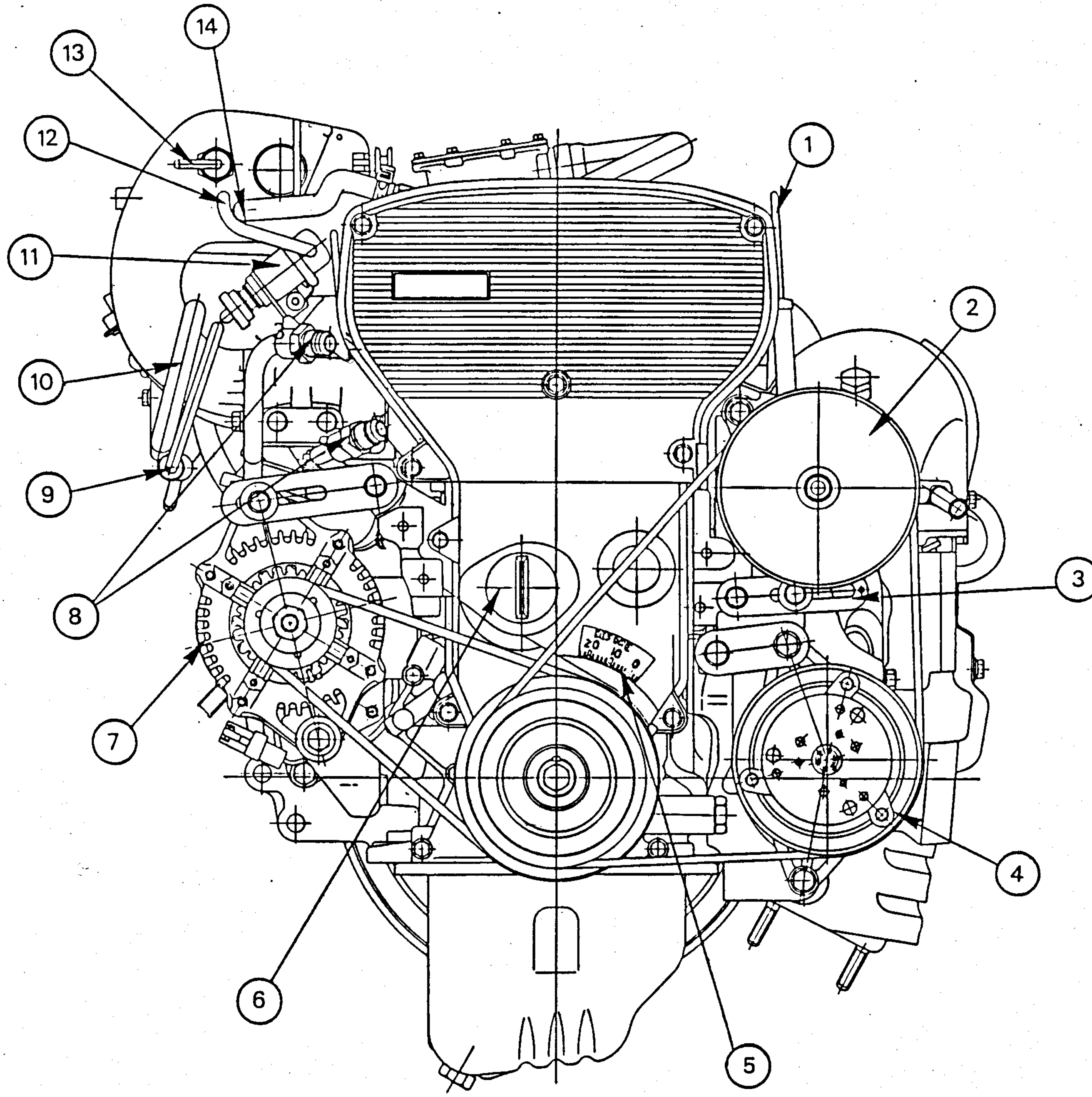
1. Dipstick
2. Primary throttle quadrant
3. Oil seperator (Turbo only)
4. Cam angle sensor (distributor on N.A.)
5. Thermostat housing outlet
6. Turbo water feed hose
7. Radiator by-pass water pipe
8. Turbo water return hose
9. Turbo oil feed pipe
10. Turbo oil drain hose
11. Turbo compressor outlet
12. Starter catalyst housing (Turbo only)
13. Air conditioning compressor
14. Water pump inlet spout
15. PAS pump inlet connection
16. PAS pump outlet connection

TURBO ENGINE REAR SIDE



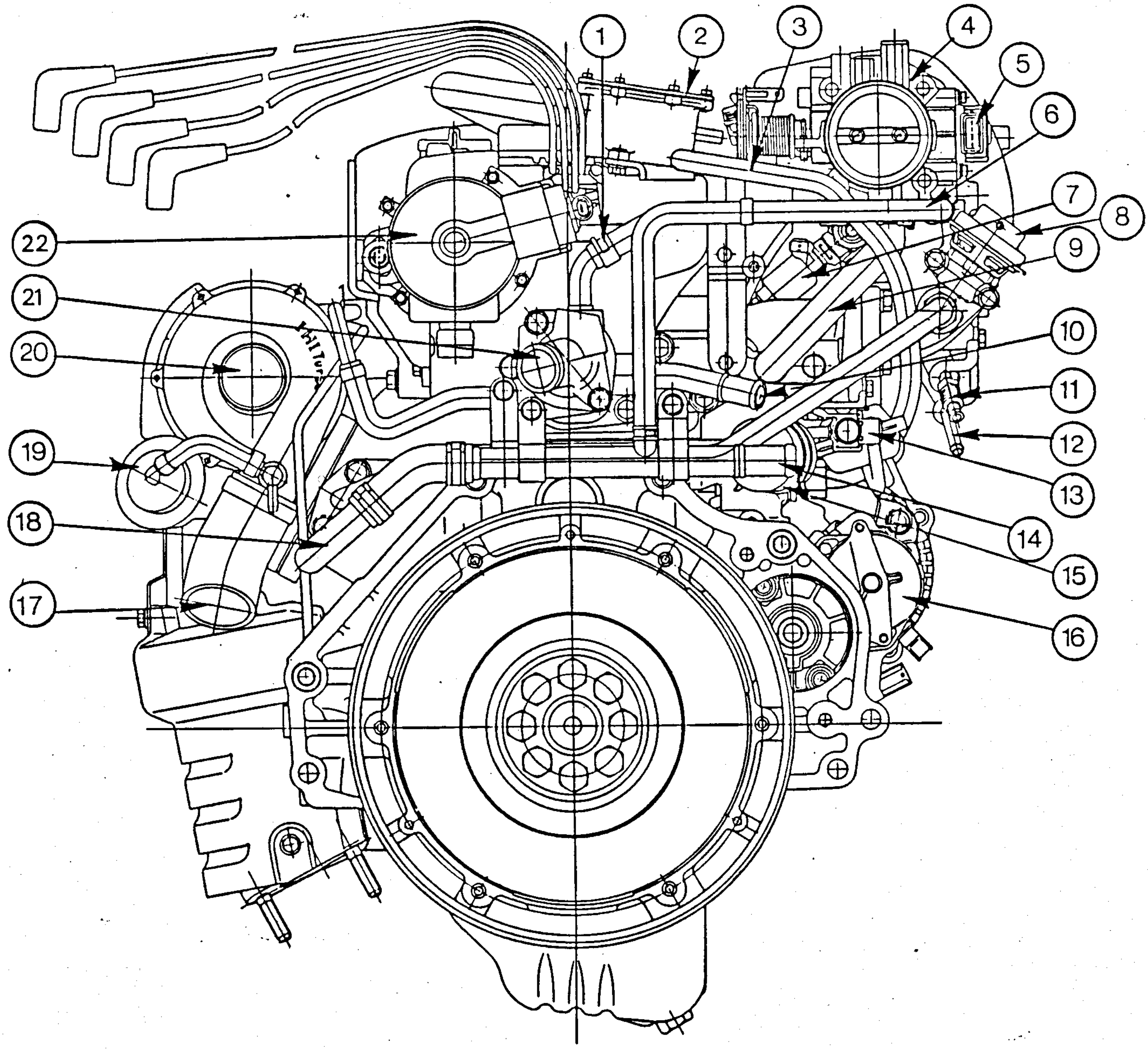
1. Throttle Position Switch (TPS)
2. Manifold Air Temperature (MAT) sensor
3. Evaporative emissions connection
4. Common chamber (intake plenum)
5. MAP sensor filter/damper
6. Fuel pressure regulator
7. Oil cooler hose connections
8. Alternator
9. Oil filter
10. Secondary throttle vacuum actuator
11. Oil seperator drain hose
12. Starter motor
13. Secondary throttle vac. reservoir
14. Secondary throttle vac. sol. valve
15. Fuel return connection
16. Fuel feed connection
17. Radiator by-pass water pipe
18. Idle Air Control (IAC) valve
19. Thermostat housing outlet
20. Brake servo vacuum take off
21. Exhaust Gas Recirculation (EGR) valve
22. Secondary throttle vacuum take-off

TURBO ENGINE RIGHT HAND END



1. Dipstick
2. PAS pump pulley
3. PAS pump adjuster strap
4. A.C. compressor clutch
5. Timing marks
6. Cam belt tensioner access grommet
7. Alternator
8. Oil cooler feed and return connections
9. Fuel return pipe
10. Fuel feed hose
11. Fuel pressure regulator valve
12. Regulator valve pressure take-off
13. MAP sensor filter/damper
14. PCV valve plenum connection

TURBO ENGINE LEFT HAND END



1. Throttle body water feed
2. Oil seperator (Turbo only)
3. Oil drain hose
4. Primary throttle body
5. Throttle Postion Switch (TPS)
6. Throttle body water return
7. Fuel injector
8. Exhaust Gas Recirculation (EGR) valve
9. Idle Air Control (IAC) hose
10. Heater feed connection
11. Fuel feed connection
12. Fuel return connection
13. Secondary throttle VSV
14. Heater return connection
15. Secondary throttle vacuum reservoir
16. Starter motor
17. Turbo compressor outlet
18. Radiator by-pass water pipe
19. Wastegate capsule
20. Turbo compressor inlet
21. Thermostat housing outlet
22. Cam angle sensor (distributor on N.A.)

HYDRAULIC VALVE LIFTERS

Description of Operation

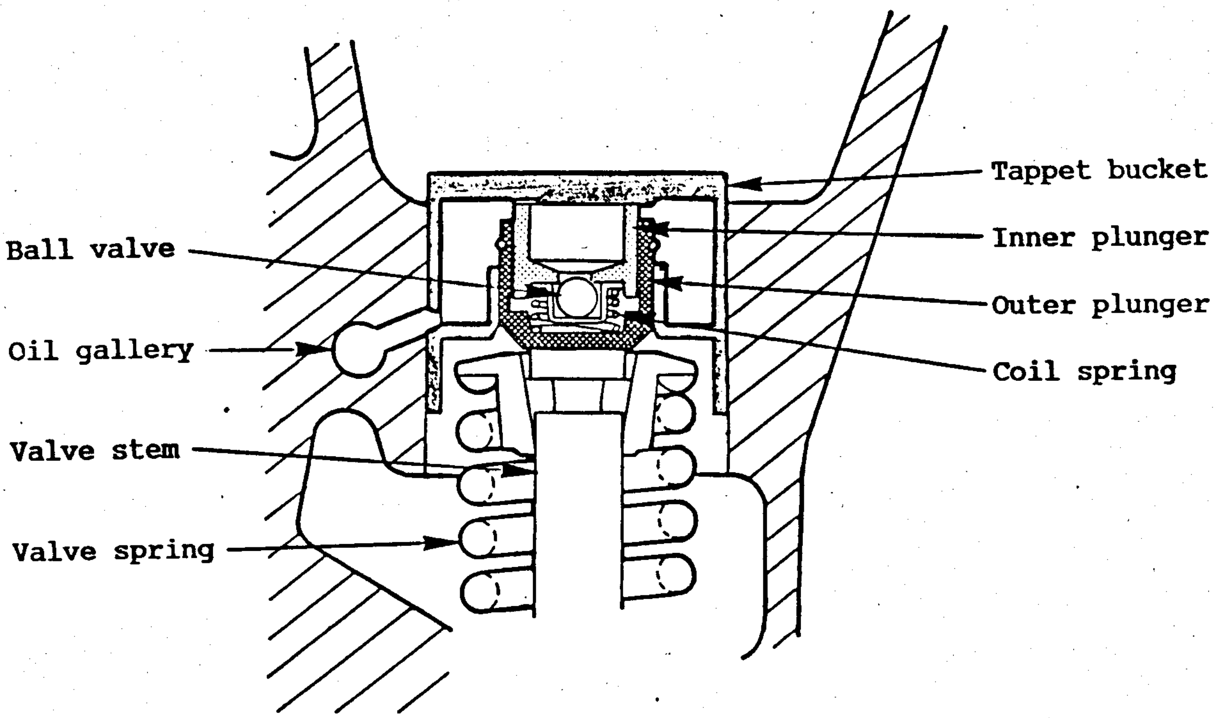
The hydraulic valve lifters (HVL) fitted on the 4XE1 engine, use the pressurised engine oil supply to control valve clearance and eliminate the necessity for periodic checking, and adjustment of tappet shimming.

The HVL consists of three main components; a tappet bucket, a two part (telescopic) plunger, and a ball valve. The plunger assembly slides inside the tappet bucket, with the inner and outer plungers held apart (extended) by a coil spring. In operation, with the engine valve closed, pressurised oil from an oil gallery running alongside the valves, is fed into the inside of the tappet bucket, and into the inner plunger. The oil flows past the ball valve, and enters the lower chamber where it extends the plunger assembly and takes up any clearance between the valve stem and the heel of the cam. When the cam lobe starts to depress the tappet bucket, and compress the plunger assembly, pressure in the lower chamber rapidly rises above supplied oil pressure so that the ball valve is forced against its seat in the inner plunger. The trapped incompressible fluid in the lower chamber acts to transfer the movement of the tappet bucket to the engine valve stem.

When the engine valve is returned to its seat, the compression force on the plunger assembly is relieved, and pressure in the lower chamber is reduced to that of the oil supply. Oil is again able to flow past the ball valve into the lower chamber to keep the plunger assembly fully extended and the tappet against the heel of the cam.

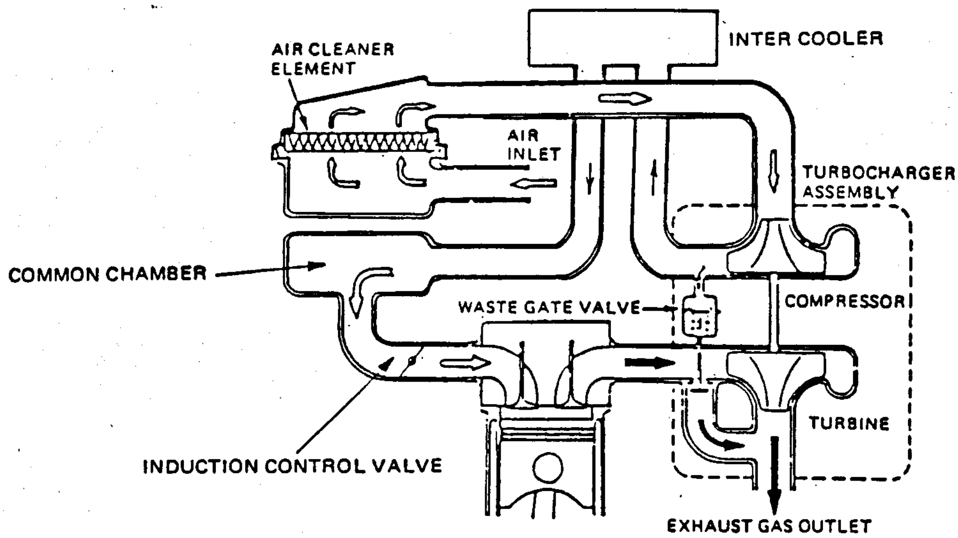
The purpose of the coil spring is to maintain full plunger extension when the engine is stopped and oil pressure is absent. The lower chamber thus remains filled with oil, and the tappet assembly operates satisfactorily for the short period before working oil pressure is attained following engine start up.

If any air should become trapped in the lower chamber of the HVL, the compressibility of this air will result in faulty valve operation, and mechanical noise as the inner plunger makes contact with the outer plunger.



TURBOCHARGER (if fitted)

An IHI turbocharger, type RHB 5 with a water cooled bearing housing and integral wastegate, is bolted to the cast iron exhaust manifold. The exhaust gases spin the turbine wheel at speeds up to 100,000 rpm, before exiting the turbocharger and flowing into the exhaust system. The turbine wheel is fixed to a short shaft supported by fully floating bearings, to the other end of which is fixed the compressor wheel. The compressor draws air from the air filter box and centrifuges the air out of the compressor housing, through the chargecooler radiator to reduce its temperature and increase its density, and into the intake plenum. The extent to which this air is compressed is dependent on throttle opening and engine speed, but is mechanically limited by the exhaust wastegate to a maximum boost pressure of 0.41 bar (6.0 lb/in²). However, an ECM controlled vacuum solenoid valve in the control pressure line to the wastegate capsule, is modulated under certain operating conditions, to vent the control line and allow boost pressures of up to 0.65 bar (9.6 lb/in²) to be developed. See engine management section EMK.2 - T for full details of the boost control strategy.

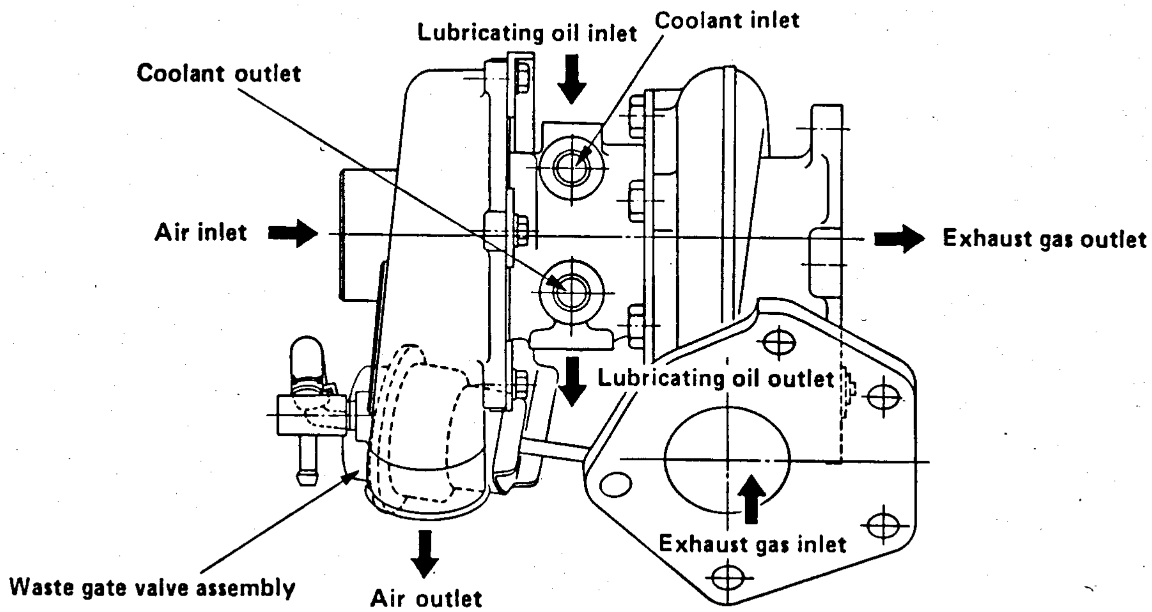


The wastegate consists of a coil spring/pneumatically operated flap valve fitted between the turbine housing inlet and outlet which, when opened, diverts a proportion of the exhaust gas away from the turbine to limit the boost pressure built up in the inlet. The flap valve is linked to an operating capsule which contains a spring to hold the valve shut, and a diaphragm pressure chamber connected by a short hose to the boost pressure at the compressor outlet. As boost pressure builds up, the force in the pressure chamber, opposing the spring pressure, builds up until the flap valve is opened.

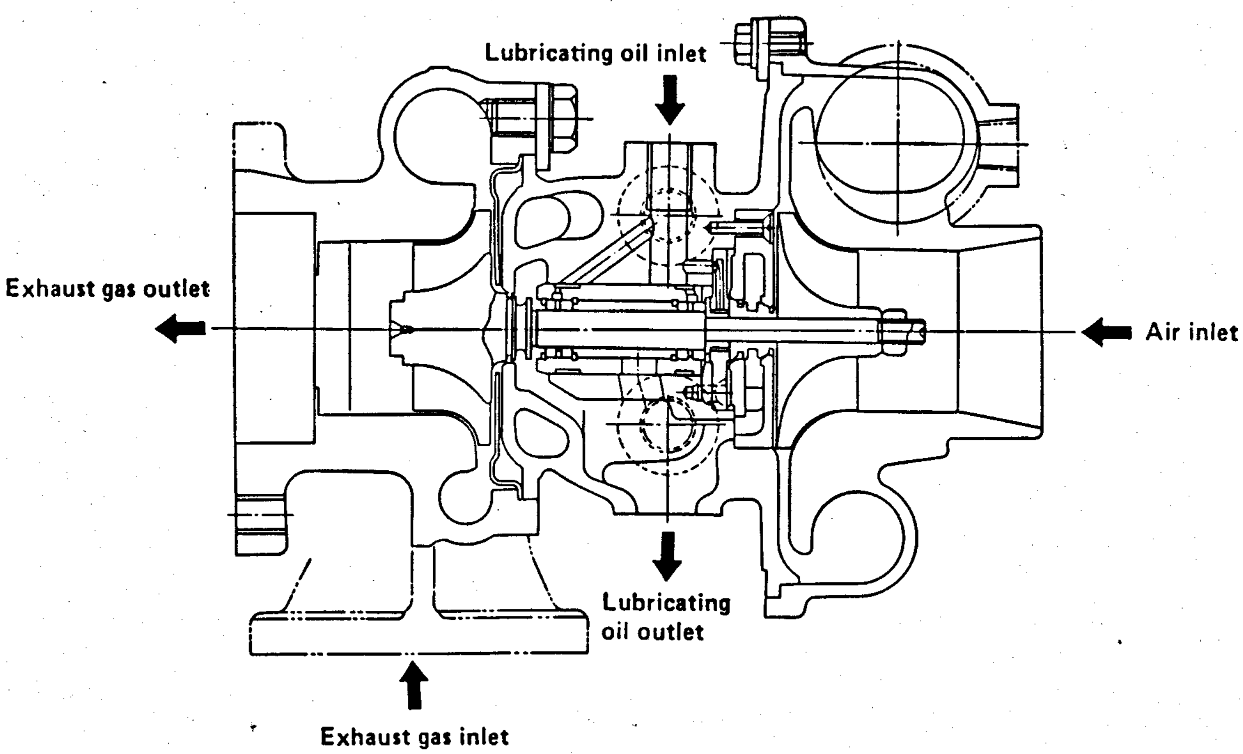
As an engine safeguard, in case of a boost control system failure, the ECM will switch off the fuel pump if boost pressure in excess of 0.92 bar (13.5 lb/in²) is detected for more than 0.5 second.

The turbocharger bearings are supplied with an oil feed from the oil gallery at the right hand side of the block, and an oil drain is provided to return oil to the right hand side of the crankcase. In order to help protect the lubricant in the turbocharger bearings from the effects of heat soak after the engine has been stopped, a water feed and return system is provided, and connected between the thermostat housing and the radiator by-pass water pipe. Water circulation around the bearings continues after engine switch off, by thermo-syphon action, and reduces the possibility of carbonisation of the oil in the turbocharger.

Turbocharger - External



Turbocharger - Cross Section



TURBO

GENERAL DESCRIPTION

The electronic multi-point fuel injection system used on the Lotus Elan is a General Motors fully electronic, processor controlled system, using a separate fuel injector in the intake tract of each cylinder.

The injectors are supplied with fuel at constant pressure (relative to intake manifold pressure) from a common fuel rail, with the quantity of fuel delivered to the engine being controlled by the length of time for which the solenoid operated injectors are opened. The injectors are 'pulsed' in two pairs (1/3 and 2/4) once every engine revolution, with half of the fuel requirement for each cylinder's combustion being supplied by each pulse. The injectors are controlled by a processor called an Electronic Control Module (E.C.M.) which calculates the amount of fuel required by the engine under the operating conditions at any particular time. This information is fed into the E.C.M. by a series of sensors measuring air and coolant temperature, inlet manifold pressure, throttle position and engine and vehicle speed. On the basis of these signals and others, the E.C.M. also controls the ignition timing, turbocharger boost pressure, engine idle speed, and air conditioning compressor clutch.

The Direct Ignition (D.I.) system does away with the conventional distributor and uses two separate ignition coils, a cam angle sensor, an ignition module and Electronic Spark Timing (E.S.T.) control circuitry incorporated into the E.C.M. This type of distributorless ignition system uses a 'waste spark' method of distribution wherein cylinder pairs 1/4 and 2/3 are provided with a spark every revolution, i.e. on both compression stroke and exhaust stroke. At engine cranking speed the ignition module (part of the ignition coil pack) alone controls the spark advance, but at speeds above 800 rpm, the E.C.M. takes over ignition timing control based on inlet manifold air pressure, air temperature, coolant temperature, engine speed and detection of the onset of detonation.

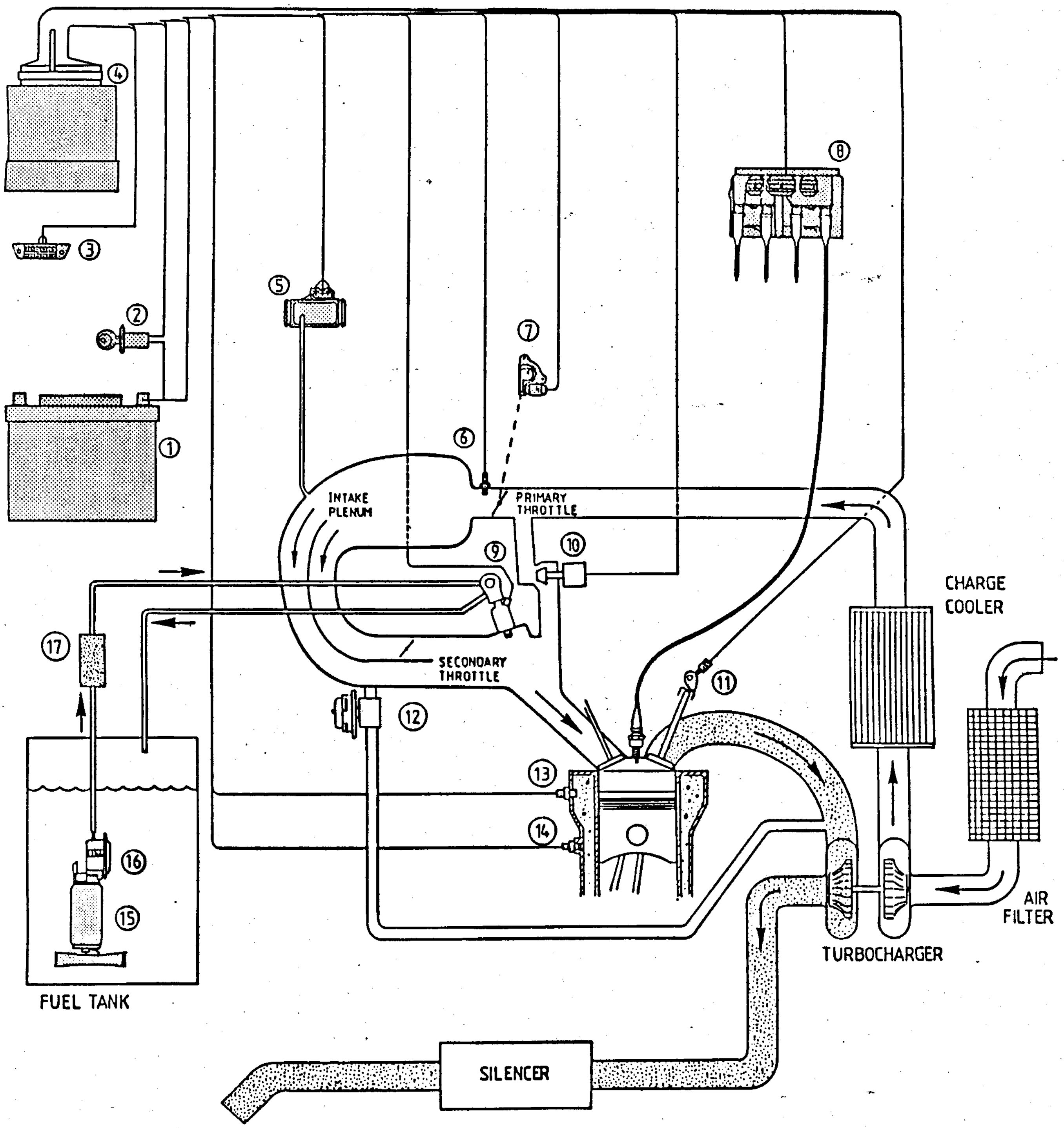
In addition to these functions, the E.C.M. monitors the signals received from the various sensors and compares them with pre-programmed tolerance bands to enable it to recognise 'faults' in the system and light a 'check engine' tell tale lamp on the fascia. This informs the driver that a fault has been detected and furthermore stores in its memory a 'trouble code' for the particular type of fault detected in order that a technician may access the code and be guided to the problem area.

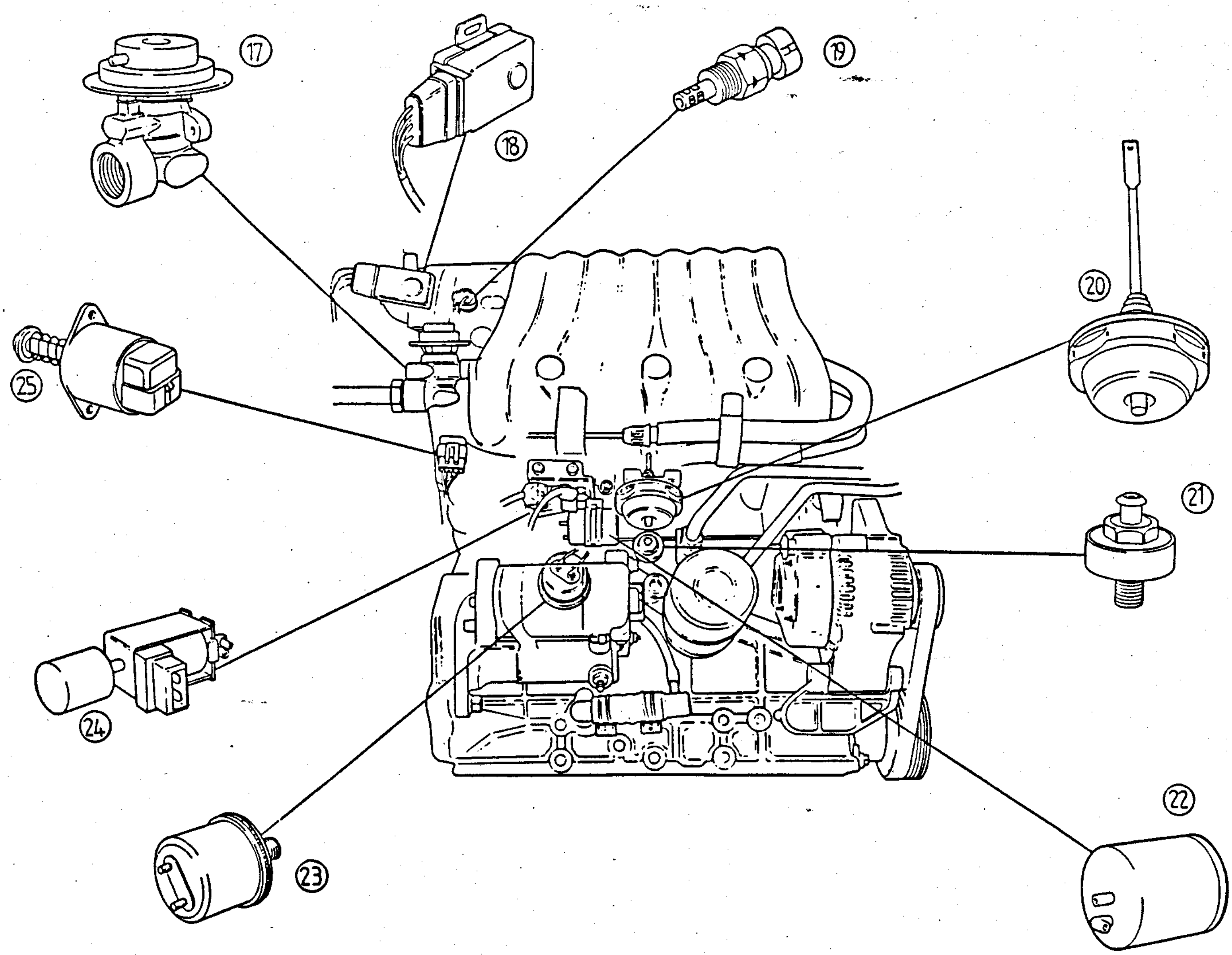
A facility is also provided for the data monitored by the E.C.M. to be tapped via a hand held electronic scanner (known as the 'Tech 1' tool) with an LCD display panel. This tool aids rapid fault diagnosis by displaying all sensor readings and trouble codes.

Key to Schematic Diagram

1. Battery
2. Ignition switch
3. Assembly Line Diagnostic Link (ALDL)
4. Electronic Control Module (ECM)
5. Manifold Air Pressure (MAP) sensor
6. Mass Air Temperature (MAT) sensor
7. Throttle Position Sensor (TPS)
8. Direct Ignition (DI) module and coils
9. Fuel injector (4 off)
10. Idle Air Control (IAC) valve
11. Cam angle sensor
12. Exhaust Gas Recirculation (EGR) valve
13. Coolant Temperature Sensor (CTS)
14. Knock sensor
15. Fuel pump
16. Pulsator
17. Fuel filter

Schematic Diagram

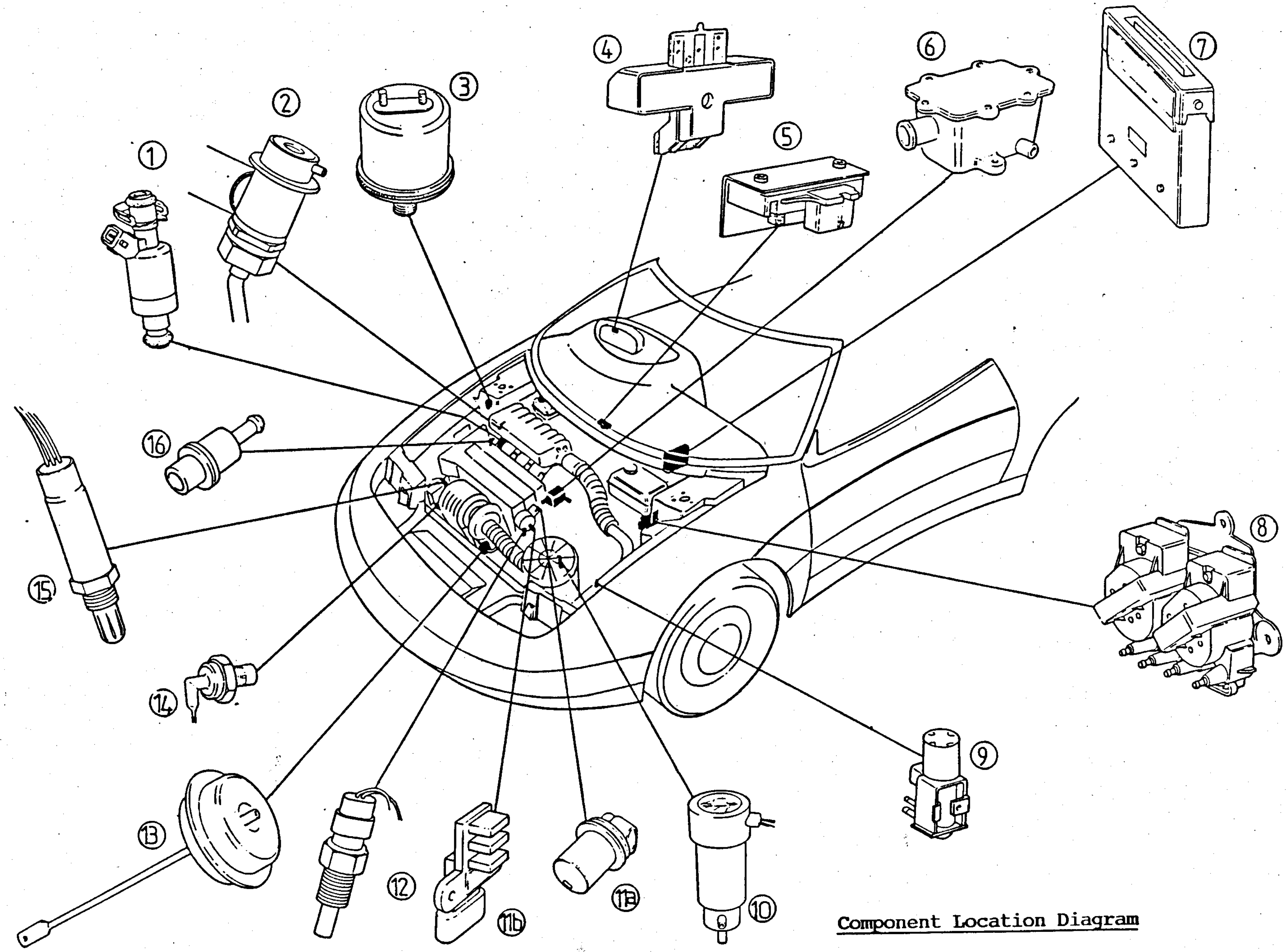




Component Location - Rear Side of Engine

Key to Component Location Diagram

1. Fuel injector
2. Fuel pressure regulator valve
3. Boost gauge transducer
4. Vehicle Speed Sensor (VSS)
5. Manifold Air Pressure (MAP) sensor
6. Crankcase breather oil seperator
7. Electronic Control Module (ECM)
8. Ignition module & H.T. coils
9. Exhaust Gas Recirculation (EGR) vacuum solenoid valve
10. Boost control frequency valve
11. Cam angle sensor:
    11A. Magnetic pick up
    11B. Hall effect sensor
12. Coolant Temperature Sensor (CTS)
13. Wastegate actuator capsule
14. Power Steering Pressure Switch (PSPS)
15. Oxygen (O_2) sensor
16. Positive Crankcase Ventilation (PCV) valve
17. Exhaust Gas Recirculation (EGR) valve
18. Throttle Position Switch (TPS)
19. Manifold Air Temperature (MAT) sensor
20. Secondary throttle vacuum actuator
21. Knock sensor
22. Secondary throttle vacuum reservoir
23. Oil pressure transducer
24. Secondary throttle vacuum solenoid valve
25. Idle Air Control (IAC) valve



Component Location Diagram

NATURALLY ASPIRATED

B GENERAL DESCRIPTION

The electronic multi-point fuel injection system used on the Lotus Elan is a General Motors fully electronic, processor controlled system using a separate fuel injector in the intake tract of each cylinder.

The injectors are supplied with fuel at constant pressure (relative to intake manifold pressure) from a common fuel rail, with the quantity of fuel delivered to the engine being controlled by the length of time for which the solenoid operated injectors are opened. All four injectors are 'pulsed' simultaneously once every engine revolution, with half of the fuel requirement for each cylinder's combustion being supplied by each pulse. The injectors are controlled by a processor called an Electronic Control Module (E.C.M.) which calculates the amount of fuel required by the engine under the operating conditions at any particular time. This information is fed into the E.C.M. by a series of sensors measuring air and coolant temperature, inlet manifold pressure, throttle position, and engine and vehicle speed. On the basis of these signals and others, the E.C.M. also controls the ignition timing, engine idle speed, and air conditioning compressor clutch.

The 'High Energy Ignition' system uses a variable reluctance trigger within a distributor driven off the end of the exhaust camshaft, an ignition coil, and control circuitry within the E.C.M. At cranking speed, the ignition timing is controlled by the distributor module, but at higher speeds the E.C.M. takes over control of electronic spark timing (EST).

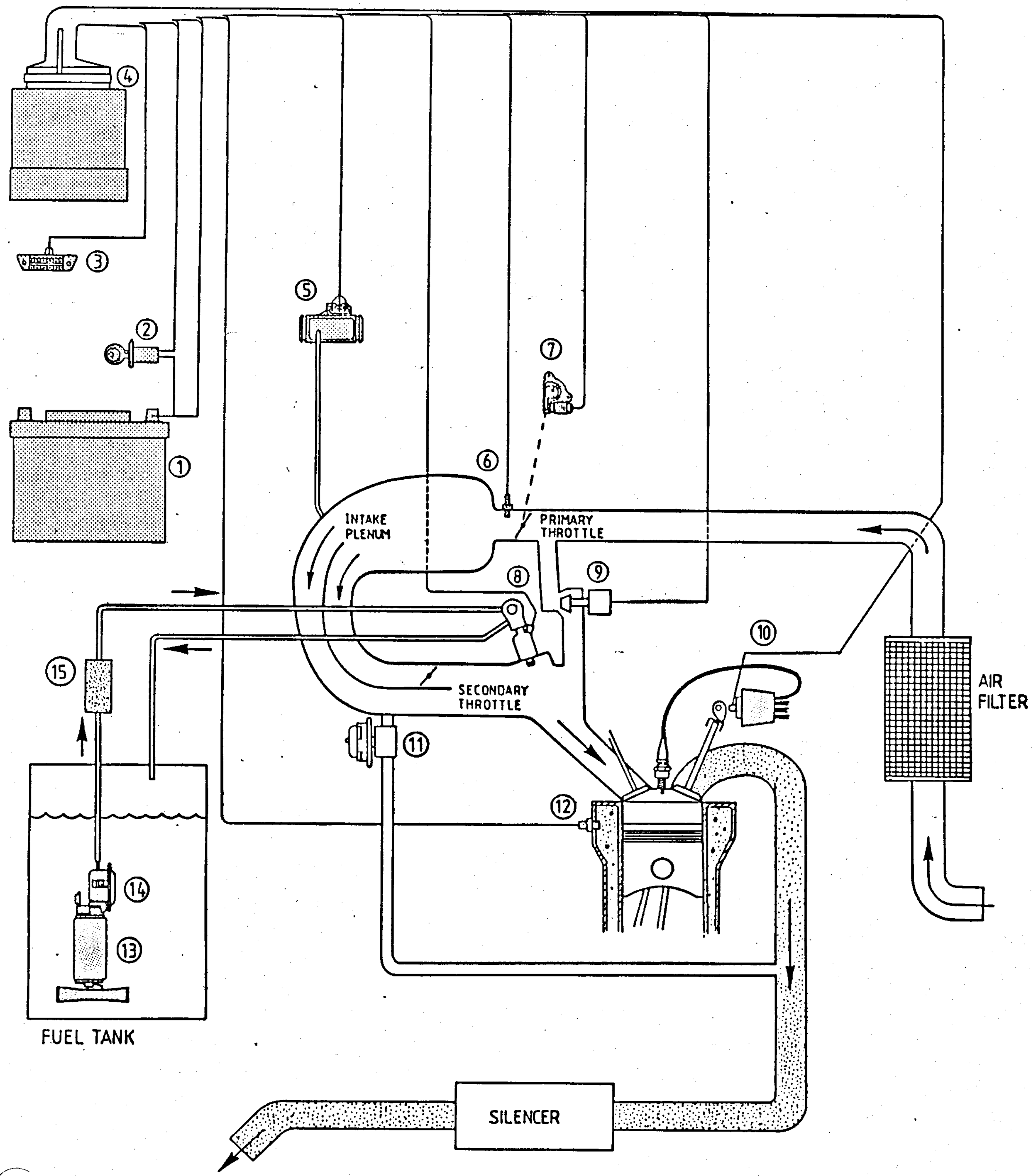
In addition to these functions, the E.C.M. monitors the signals received from the various sensors and compares them with pre-programmed tolerance bands to enable it to recognise 'faults' in the system and light a 'check engine' tell tale lamp on the fascia. This informs the driver that a fault has been detected and furthermore stores in its memory a 'trouble code' for the particular type of fault detected in order that a technician may access the code and be guided to the problem area.

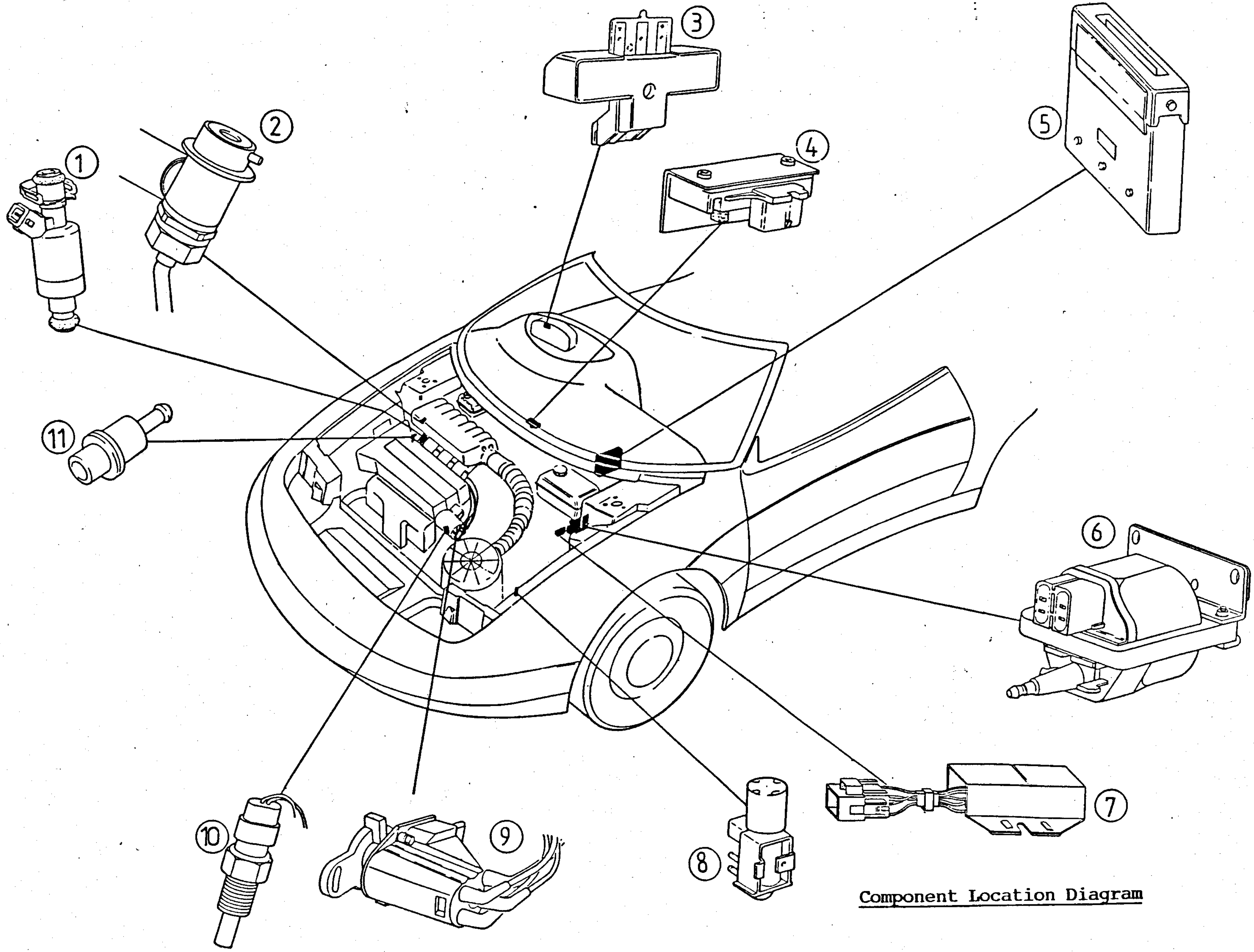
A facility is also provided for the data monitored by the E.C.M. to be tapped via a hand held electronic scanner (known as the 'Tech 1' tool) with an LCD display panel. This tool aids rapid fault diagnosis by displaying all sensor readings and trouble codes.

Key to Schematic Diagram

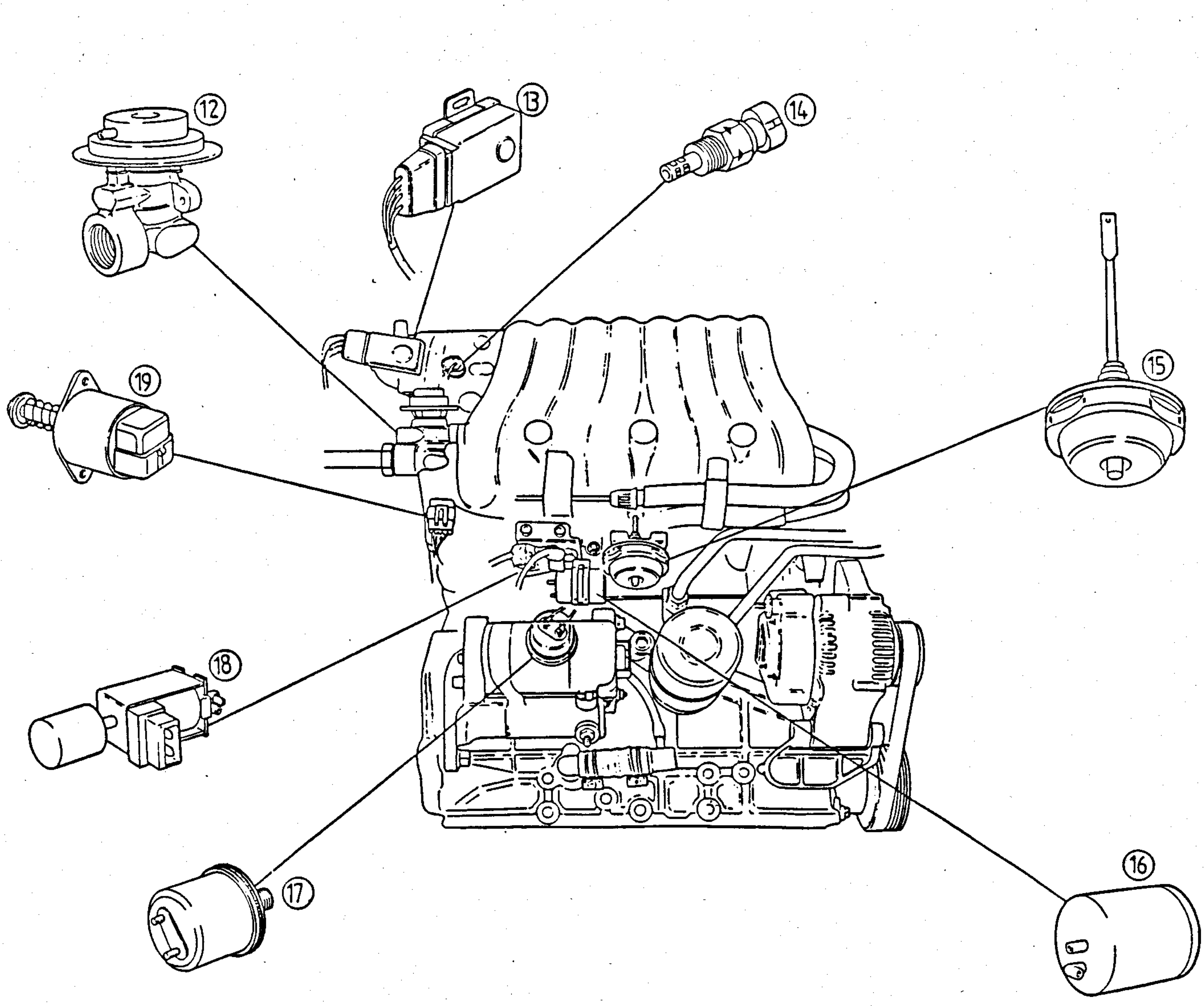
1. Battery
2. Ignition switch
3. Assembly Line Diagnostic Link (ALDL)
4. Electronic Control Module (ECM)
5. Manifold Air Pressure (MAP) sensor
6. Mass Air Temperature (MAT) sensor
7. Throttle Position Sensor (TPS)
8. Fuel injector (4 off)
9. Idle Air Control (IAC) valve
10. High Energy Ignition (HEI) module and distributor
11. Exhaust Gas Recirculation (EGR) valve
12. Coolant Temperature Sensor (CTS)
13. Fuel pump
14. Pulsator
15. Fuel filter

Schematic Diagram





Component Location Diagram



Component Location - Rear Side of Engine

Key to Component Location Diagram

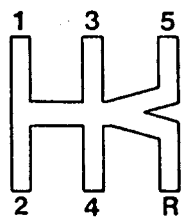
1. Fuel injector
2. Fuel pressure regulator valve
3. Vehicle Speed Sensor (VSS)
4. Manifold Air Pressure (MAP) sensor
5. Electronic Control Module (ECM)
6. Ignition coil
7. Injector dropping resistor
8. Exhaust Gas Recirculation (EGR) vacuum solenoid valve
9. Ignition module & distributor
10. Coolant temperature sensor (CTS)
11. Positive Crankcase Ventilation (PCV) valve
12. Exhaust Gas Recirculation (EGR) valve
13. Throttle Position Switch (TPS)
14. Manifold Air Temperature (MAT) sensor
15. Secondary throttle vacuum actuator
16. Secondary throttle vacuum reservoir
17. Oil pressure transducer
18. Secondary throttle vacuum solenoid valve
19. Idle Air Control (IAC) valve

TRANSMISSION

MAIN DATA

Total Length	348.5 mm
Weight	36.5 kg
Lubricant (5W-30)	Mobil 1 RTS 9775 Fully Synthetic
Lotus part number	A100F6036V
Capacity	1.9 litres
Gear ratio - 1st	3.333:1 (40/12)
2nd	1.917:1 (46/24)
3rd	1.333:1 (40/30)
4th	1.027:1 (38/37)
5th	0.829:1 (34/41)
Reverse	3.583:1 (43/12)
Final drive ratio - N.A.	4.118:1 (70/17)
- Turbo	3.833:1 (69/18)
Speedometer gear ratio	0.829:1 (29/35)
Identification on 'bar code' label - N.A.	LAA
- Turbo	LAB

Shift pattern



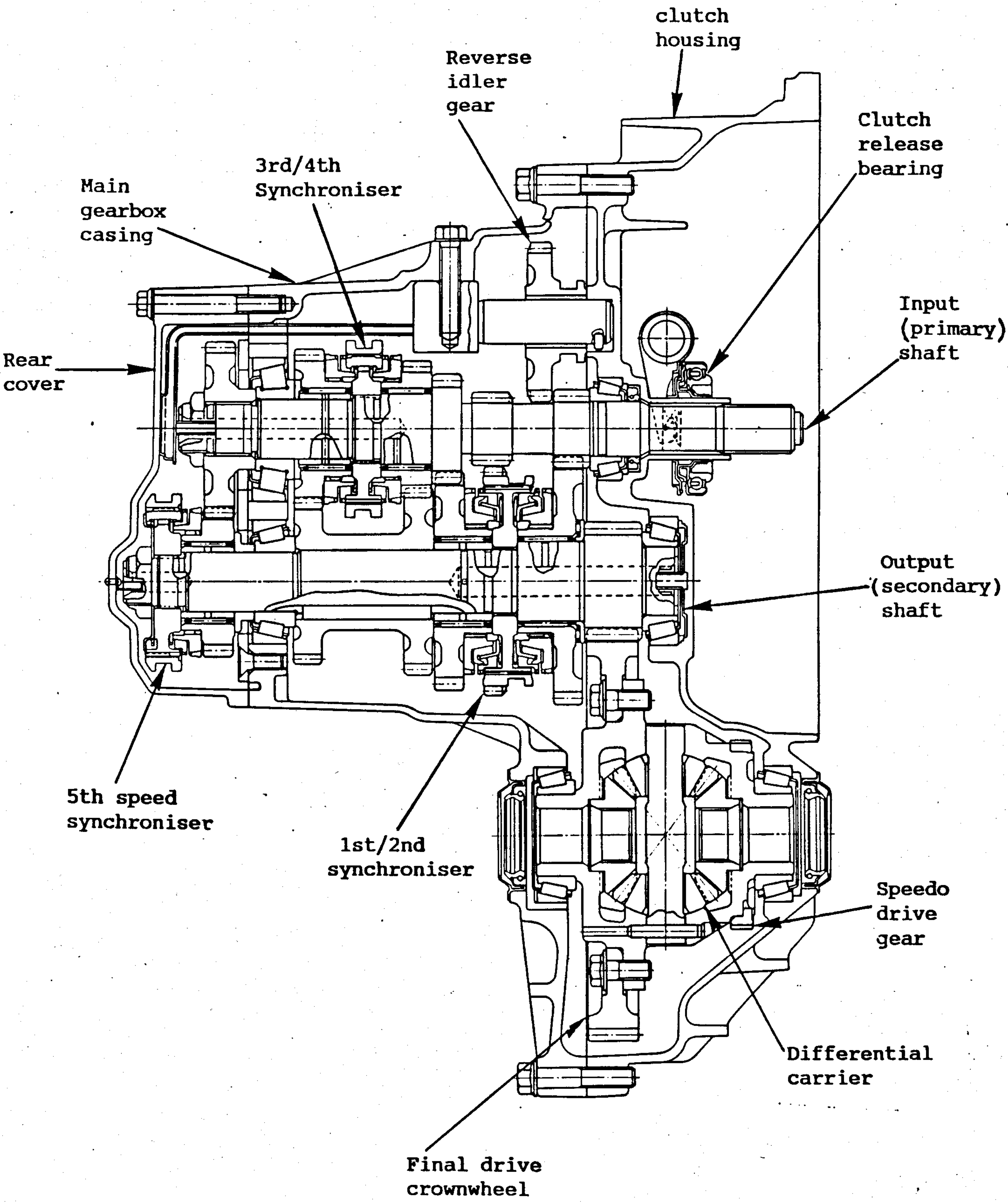
GENERAL DESCRIPTION

The transmission assembly is an 'end on' type, mounted on the left hand end of the engine unit, and comprises of the clutch housing, five speed gearbox, final drive gears, and differential.

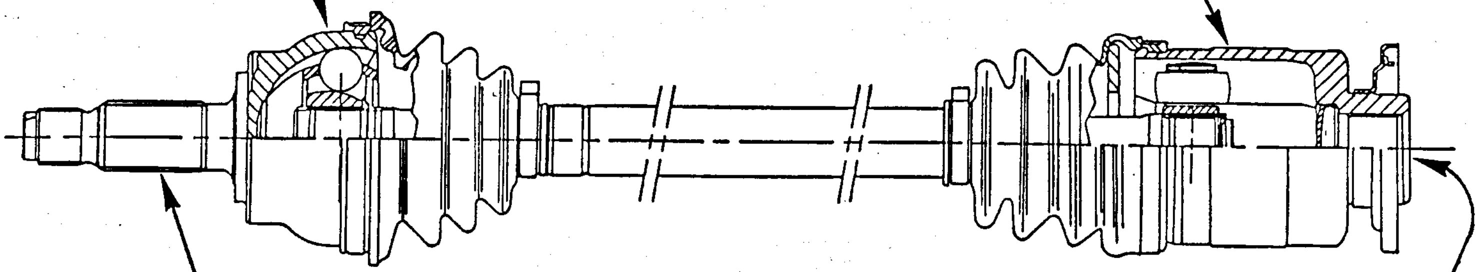
Gearbox

The gearbox is a two shaft all indirect five speed manual. Drive passes into the unit via the primary shaft which is co-axial with the engine crankshaft, and carries the clutch driven plate on its right hand end. A secondary shaft lying alongside and behind the primary shaft, outputs the drive via an integral final drive pinion on its right hand end. This pinion meshes with a crownwheel carried on a bevel gear differential assembly, which distributes drive to the front wheels via two C.V. jointed driveshafts. Use of an output shaft jackshaft on the right hand side, enables the two driveshafts to be of similar length to reduce the effects of torque steer.

Sychromesh is fitted to all forward speeds, with the 1st/2nd synchroniser mounted on the secondary shaft, the 3rd/4th synchroniser on the primary shaft, and the 5th synchroniser on the 'overhung' left hand end of the secondary shaft. Reverse gear is achieved by sliding an idler spur gear into engagement with both a drive gear integral with the primary shaft, and the spur gear teeth machined on the outside of the 1st/2nd synchroniser assembly. The primary shaft, secondary shaft and differential carrier are all supported on pairs of taper roller bearings adjusted by shims. The speedo drive gear is mounted on the differential carrier.


clutch
housing
Reverse
idler
gear
Clutch
release
bearing
3rd/4th
Synchroniser
Main
gearbox
casing
Input
(primary)
shaft
Rear
cover
Output
(secondary)
shaft
5th speed
synchroniser
1st/2nd
synchroniser
Speedo
drive
gear
Differential
carrier
Final drive
crownwheel

RH Driveshaft Assembly



LH Inboard Joint