ROVER LEARNING BUSINESS

ROVER

MG RV8

Familiarisation Course

mpi VERSION 3
SMD 4072/12 V3

MG 'R'

V8

Rover Cars are constantly seeking ways to improve the specification and design of its vehicles and alterations take place continually.

Whilst every effort is made to produce up to date literature, this training workbook should not be regarded as an infallible guide to current specification, nor does it constitute an offer for the fitment of any particular system or component.

ROVER LEARNING BUSINESS
PRODUCT TRAINING COLLEGE
COWLEY
OXFORD
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This training workbook is designed to support the Service Product Training courses and is issued as part of the training programme.

It may be used to compliment other literature available but the Repair Operations Manual should always be consulted prior to servicing or repair work.

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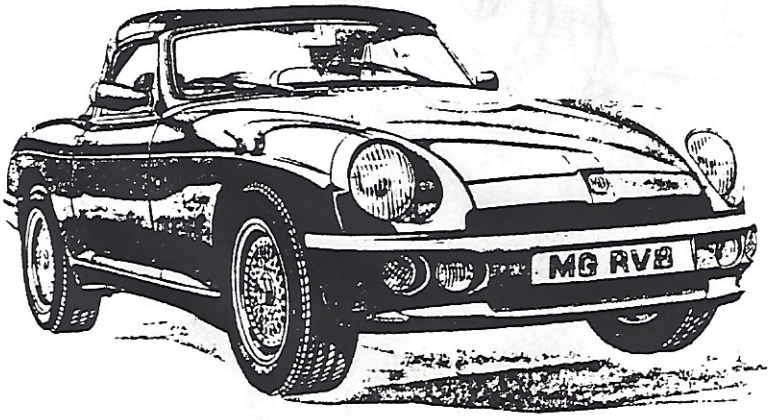


Thirty years after the birth of the Lengendary MGB, the MG marque lives again, reviving a golden history of track winners, record breakers and classic road cars. The MG RV8 is the most exclusive, luxurious and powerful MG ever built.....

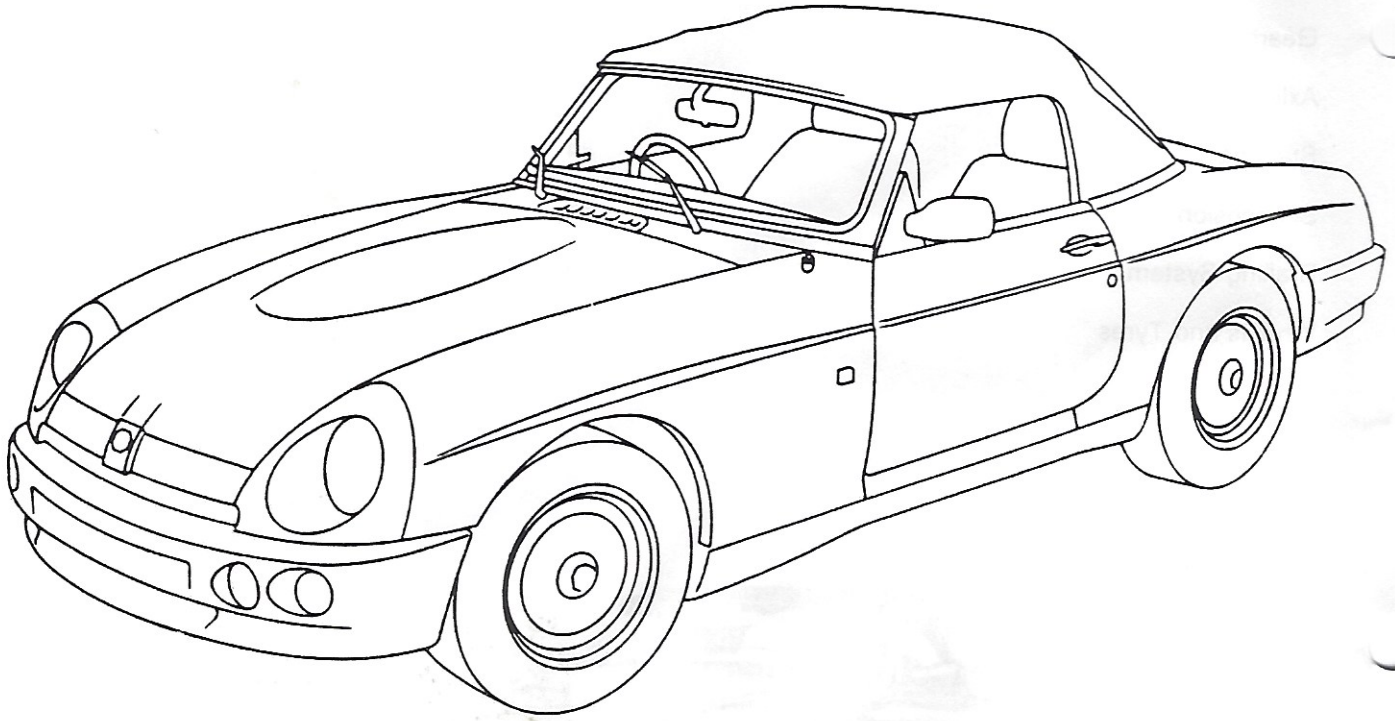


fig.1

The MG Story

The origins of the MG marque date back to 1904, when the young William Morris set up Morris Garages in Oxford. During the period of 1930 to 1935, the classic MG years, the MG factory found its home at Abingdon. Most of the cars built at that time were sports cars, some of them pure racing models, and they scored countless successes on race tracks and road circuits in Britain and abroad. The MG "EX" record breakers also helped to establish the lasting fame of the marque. The fastest being the tear drop shaped, mid-engined EX 181, which pushed the 1500 cc class record up to 245 mph.

The sleek styling of the EX181 exerted a strong influence on the eventual shape of the MGB, which was launched in 1962, as the successor to the highly successful MGA. It made its debut in roadster form, and was an instant success both at home and abroad.

The Aluminum V8 engine was fitted to the MGB GT in 1973. Although it has been enormously changed and developed to its current form - and now powers the MG RV8 for the very first time - The V8 had a number of classic strengths which ensured its subsequent success and popularity as a racing engine. It's combination of compactness, strength and light weight was ideal for performance and underbonnet packaging. The MGB GT V8 boasted a maximum speed of 125 mph and a 0-60 time of 7.7 seconds. Above all, the V8 was superbly smooth and refined - two more qualities which are very much in evidence in the highly developed power plant of the MG RV8.

In September 1979 came "Black Monday" - the announcement that B production would cease shortly, that the Abingdon plant would be closed down and the marque name discontinued. Eighteen months later it all seemed to be over. Sports car enthusiasts worldwide went into mourning. The MG name became frozen in time.

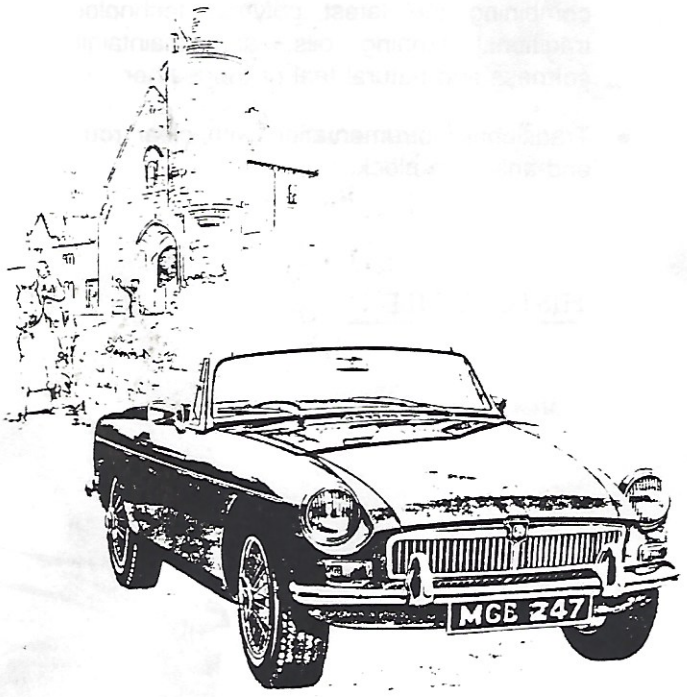
The total MG production was more than 1.1 million cars of which 920,000 were sports cars, MG was the most popular sports car make in the world.

Now, the marque has a future once again. The MG RV8 is far more than a unique celebration of the MG's thirtieth anniversary.

fig.2

HISTORY FILE

MGB



PRODUCT OVERVIEW

Exterior Style

- New front and rear wings, bonnet and sills. New front and rear bumpers, lights and screen surround. One-piece front door glass.

Interior Style

- Extensively trimmed in Connolly leather and elm burr veneer, with modern refinements including an anti-theft system and top line in car audio.
- Classic instrumentation layout.

Power Unit

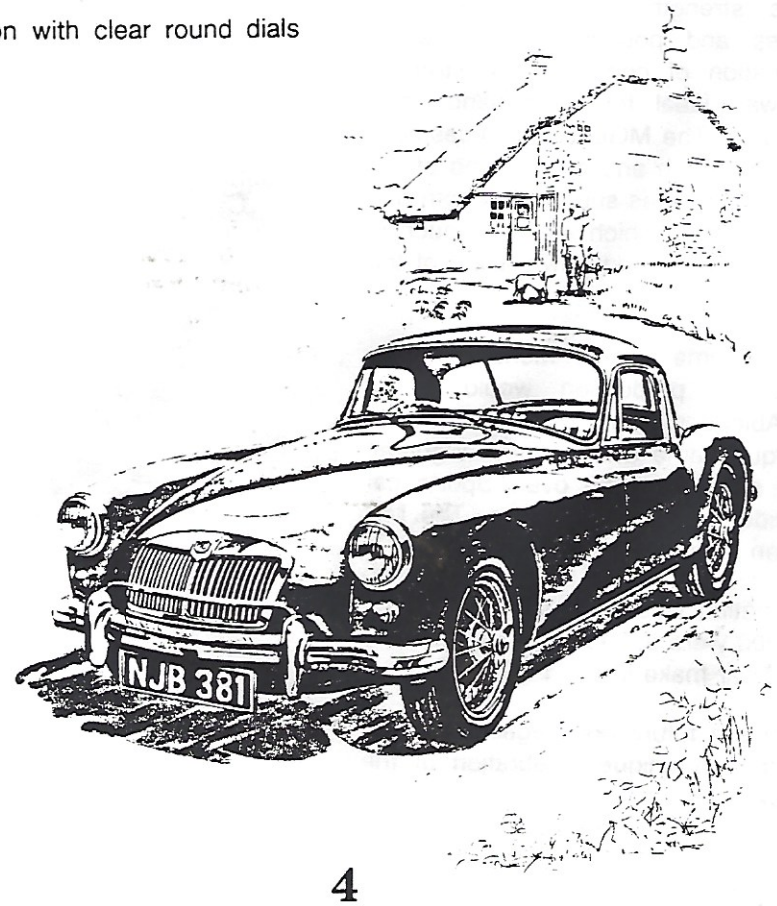
- 3.9 litre fuel injected V8 with catalysts.

Interior

- All leather seats, leather trimmed head restraints, steering wheel, gear lever and handbrake gaiters. Centre console armrest, door pulls and ruched leather panels in doors.
- Water and stain resistance leather, created by combining the latest polymer technology with traditional tanning oils, and maintaining the softness and natural feel of the leather.
- Traditional instrumentation with clear round dials and analogue clock.
- Twin column stalks for indicators, lights, windscreen wipers and washers.
- Sculptured seats with upper seat belt guide.
- Tickford hood on a steel frame with zip down rear window and hood cover.
- Anti-theft alarm with state-of-the-art Doppler engine immobilisation technology giving protection with the hood up or down, perimetric sensing of doors, bonnet and boot, Radio frequency remote control arming/disarming.
- Electric remote boot release, assisted by gas filled struts.
- Removable in-car entertainment system.
- ICE system, electronic stereo radio/cassette player with Radio Data System and optional, boot mounted 6 disc CD Autochanger. Coaxial speaker system, two 8" hi-power sub woofer units in the rear bulkhead driven by a boot-mounted power amp. Four high performance mid-range and top range units in doors and rear quarter panels.

HISTORY FILE

MGA



MG "R" V8 MAJOR FEATURES

- All steel construction, state-of-the-art anti-corrosion measures including zinc coated panels, wax injected box members, stainless steel exhaust system and advanced paint technology.
- Wiring harness routed through the inside of the car body, with sealed connectors; In the engine bay, latched to car body or components.
- Stringent quality control procedures; each car individually road tested for at least 20 miles.

SUSPENSION

Front

- Double wishbones, coil springs and telescopic dampers, anti-roll bar.
- Formula One-type spherical bearing for lower joints.

Rear

- Live axle with updated two-leaf taper springs, twin lower torque control arms, telescopic dampers, anti-roll bar.
- Quaife torque bias differential re-distributes torque to the wheels with the utmost traction.

ENGINE

- 3946cc aluminium alloy V8.
  Power: 188 bhp @ 4750 rev/min.
  Torque: 318 Nm @ 3200 rev/min.
  Speed: 135mph: 0-60mph: 5.9 seconds.
- Electronic engine management system controlling fuelling, ignition, engine diagnostics and twin three-way closed loop catalysts.
- Robust, well proven transmission with high final drive (28.1mph/1000 rpm in 5th).

GEARBOX

- 5 speed manual transmission
  (LT775 - 77mm gearbox)

FUEL CONSUMPTION

Model	Simulated/Urban Driving		Constant Speed 56 mph (90 km/h)		Constant Speed 75 mph (120 km/h)	
	mpg	litre/100 km	mpg	litre/100 km	mpg	litre/100 km
MG "R" V8	17.2	16.4	40.9	6.9	32.5	8.7

NOTE: All figures are shown in miles per gallon and litres per 100 kilometres, and are from officially approved tests under the Passenger Car Fuel Consumption Order 1983. These are intended to provide fuel economy information for model to model comparisons and are achieved in standard tests. They do not express or imply any guarantee of fuel consumption for the particular car with which this information is supplied.

Technical Data

Engine	
Capacity	3946 cm^3
Firing Order	1-8-4-3-6-5-7-2
Idle speed	700 ± 25 rev/min
Ignition System	
Type	Breakerless ignition
Spark plugs	Champion RN11YCC
Spark plug gap	0.9mm - 0.035in
Electrical	
Battery type	Sealed for life
Voltage and polarity	12v, negative (-) earth
Wheels and Tyres	
Wheel type and size	6J x 15 alloy
Tyre size	206/65 ZR 15
Tyre pressures:	
Front	1.5 bar - 22lbf/in^2
Rear	1.6 bar - 24 lbf/in^2
Road wheel nut torque	72 Nm
Dimensions	
Overall length	4.01mm - 15ft - 9.4in
Overall width (including mirrors)	1.69m - 5ft - 6.5in
Overall height *	1.32m - 4ft - 3.6in
Ground clearance *	130mm - 5.1in
Wheelbase	2.32m - 7ft 7.7in
Turning circle (kerb to kerb)	10.94m - 35ft 10.8in
Wheel alignment	
Front	5' toe-in ± 0-10'
* At unladen weight	
Weights	
Approx unladen ehicle weight (full fuel tank, excluding options)	1095kg - 2416lb
Max gross vehicle weight	1310 kg - 2890lb
Capacities	
Fuel tank	51 litre - 11 gallons
Engine oil refill and filter change	5.5 litre - 9.7 pints
Manual gearbox refill	2.7 litre - 4.8 pints
Cooling system refill	5.0 litre - 8.8 pints
Washer reservoir	3.8 litre - 6.7 pints

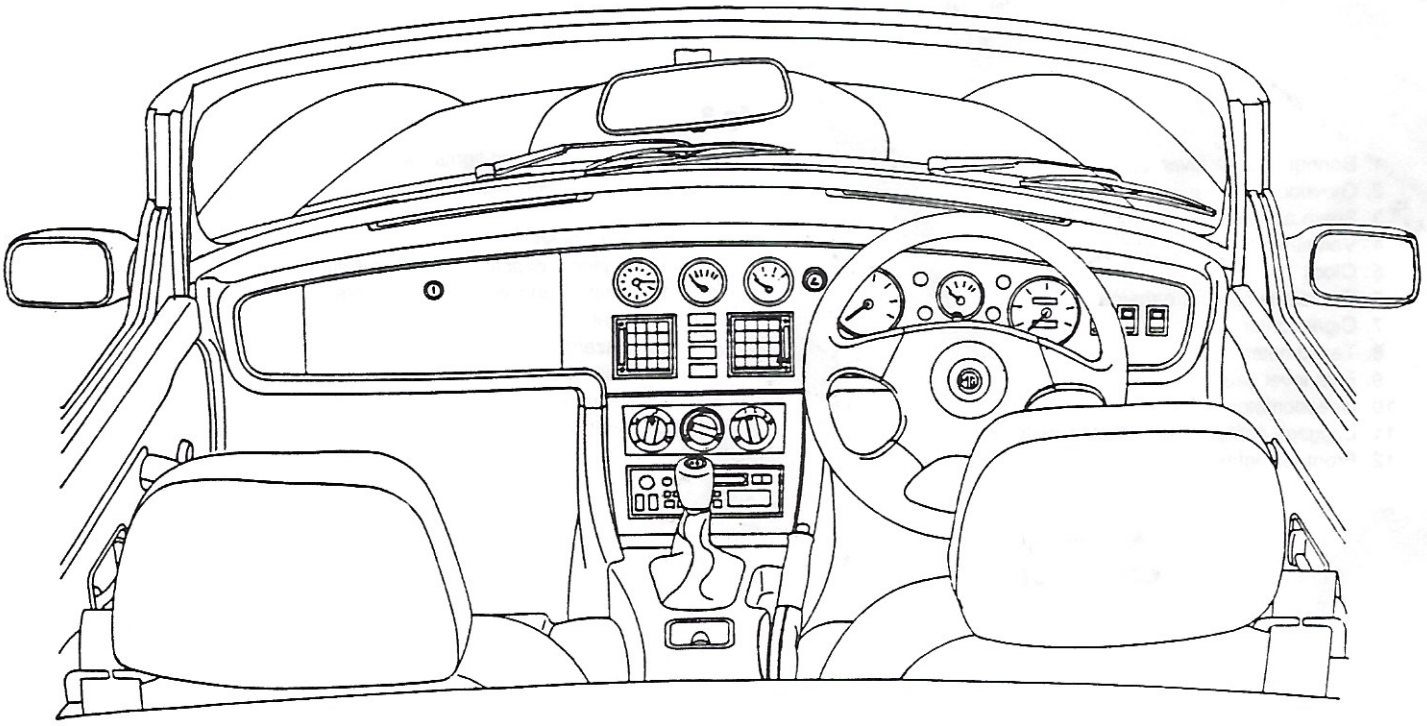
VEHICLE ELECTRICS

Introduction

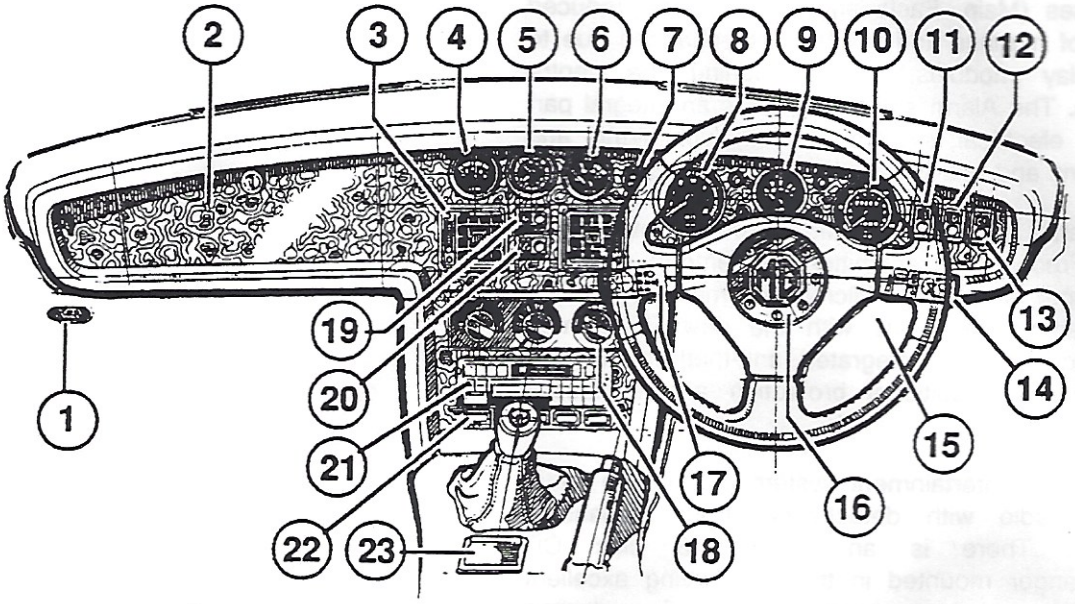
The MG "R" V8 - electrical system consists of three harnesses (Main, Facia and Engine). The reduced length of harness and reliability is enhanced due to two relay modules, located behind the centre console. The Alarm system which is an integral part of the electrical system is both volumetric and perimetric and operates with the hood up or down.

The alarm can be activated or de-activated by a Radio Frequency Transmitter (RF remote). If a new RF remote is required, Microcheck must be used to reprogramme the ECU with the new RF remote frequency. A new integrated anti-theft immobiliser unit provides additional protection against todays modern car thief.

The In-Car Entertainment system utilises the latest Phillips radio with detacheable front, enhancing security. There is an optional 6 disc CD auto-changer mounted in the boot giving excellent sound through a six speaker system. The chrome body mounted telescopic aerial restores character to this "tradiaitonal" sports car.



CONTROLS

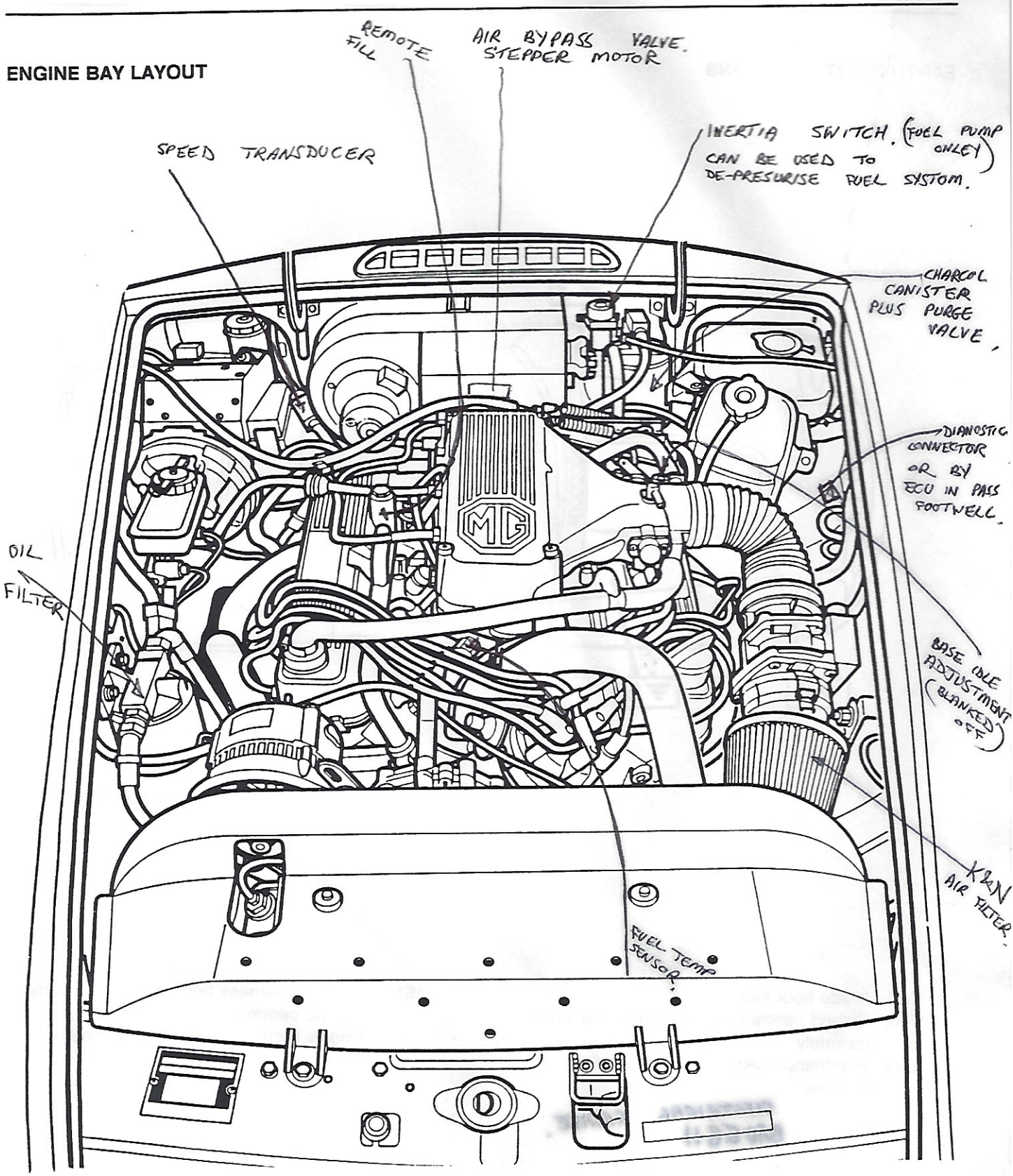


MG 0001

fig.3

1. Bonnet release lever
2. Glovebox
3. Fresh air vents
4. Voltmeter
5. Clock
6. Coolant temperature gauge
7. Cigar lighter
8. Tachometer
9. Fuel level gauge
10. Speedometer
11. Luggage compartment release switch
12. Front fog lights switch
13. Rear fog guard lights switch
14. Windscreen wiper/washer switch
15. Fusebox
16. Horn push
17. Lighting, direction indicators switch
18. Heating and ventilation controls
19. Interior light switch
20. Hazard warning light switch
21. Radio/cassette player
22. Warning lights
23. Ashtray

ENGINE BAY LAYOUT



EARTH POINT LOCATIONS

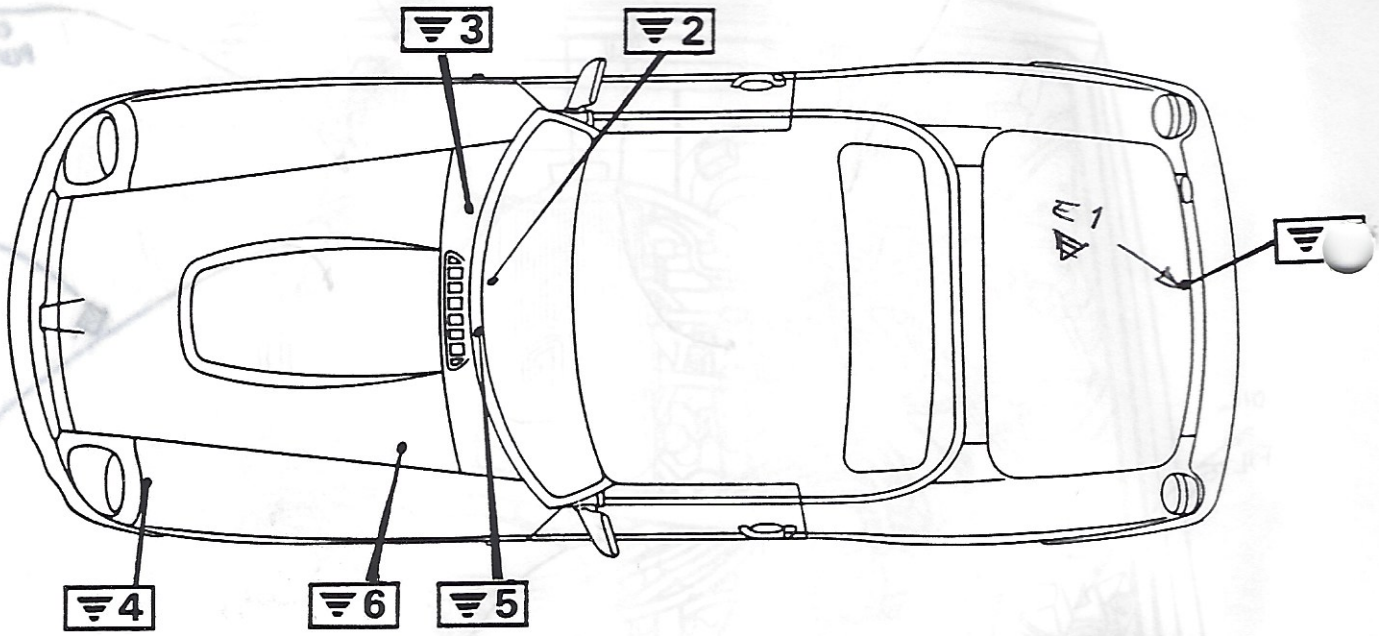


fig.4

EH1 Inside boot near striker
EH2 Behind centre console near heater switch assembly
EH3 Righthand bulkhead near brake fluid reservoir

ELECTRICAL GREASE.
BAU5811

EH4 On main harness behind lefthand headlight
E5 Behind centre console
E6 Engine harness earth lefthand inner wing

PASSENGER COMPARTMENT FUSEBOX

Front

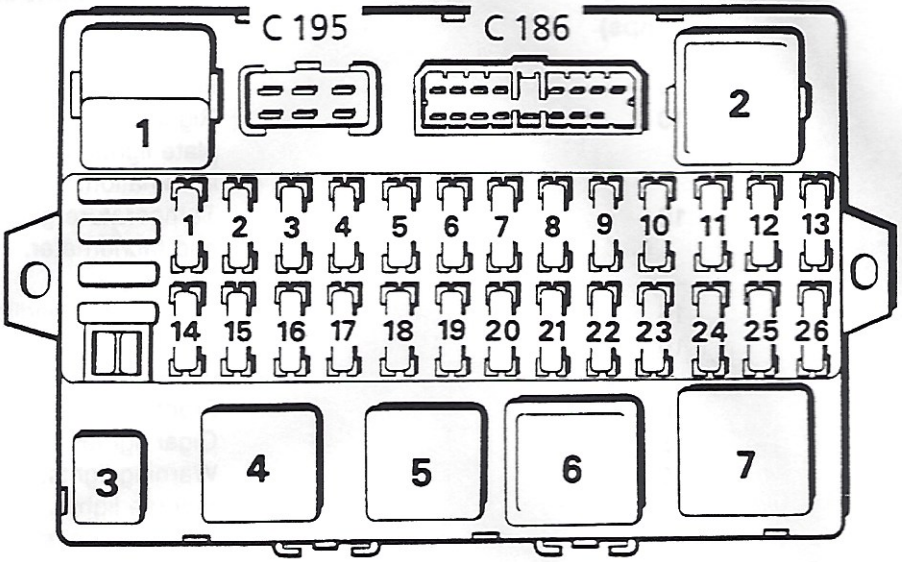


fig.5

Rear

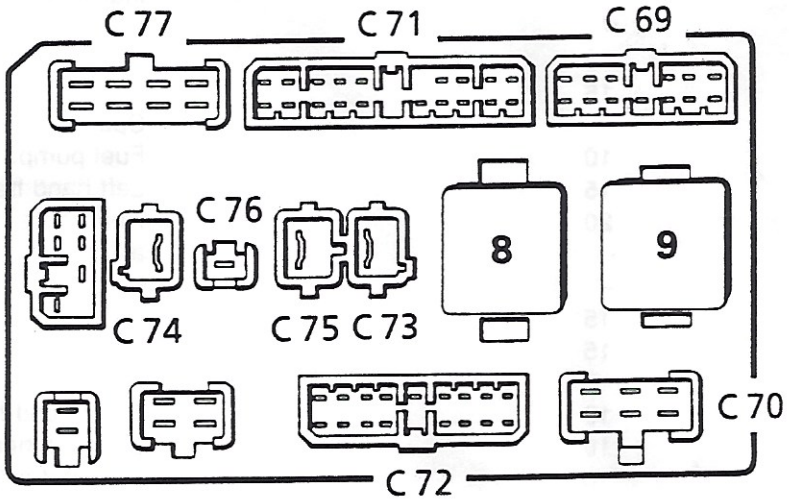


fig.6

1. Lights on alarm/interior light delay unit
2. Cooling fan relay
3. Headlamp relay
4. Ignition relay
5. NOT USED
6. Direction indicators/hazard warning unit
7. NOT USED
8. Wiper relay
9. NOT USED

FASCIA PANEL FUSE BOX

Fuse No	Rating (amps)	System's Controlled
1	10	Fuel, ignition coil, anti-theft alarm.
2	10	Right hand side tail and number plate lights, interior light, fascia illumination.
3	10	Temperature gauge, fuel gauge and tachometer.
4	-	Spare.
5	15	Right hand headlight - main beam.
6	10	Brake lights, warning lights and voltmeter.
7	10	Front fog lights.
8	15	Cigar lighter.
9	10	Warning lights, indicators and reverse lights.
10	10	Rear fog lights.
11	20	Cooling fan.
12	15	Radio cassette memory, electric boot switch warning light, clock, interior light, horn, engine management and anti-theft indicator.
13	-	Spare.
14	15	Heater blower motor.
15	15	Windscreen wiper/washer.
16	-	Spare.
17	10	Fuel pump.
18	15	Left hand headlight - main beam.
19	20	Headlights, sidelights, anti-theft alarm and boot release.
20	-	Spare.
21	15	Hazards.
22	15	Radio cassette and rear amplifier.
23	-	Spare.
24	10	Right hand headlight - dip beam.
25	10	Lefthand headlight - dip beam.
26	10	Lefthand side, tail and number plate lights, radio cassette illumination, fascia illumination.

COMPONENT LOCATION

Component	Location
Relay module 1	
a) Boot release relay b) Front fog light relay c) Rear fog light relay d) Horn relay	Behind centre console (LOWER)
Relay module 2	
a) Fuel pump relay b) Starter relay c) Main relay	Behind centre console Attached to the bulkhead (VERTICAL)
Anti-theft ECU	Between boot/cabin panel
Anti-theft diagnostic socket	Between boot/cabin panel
Anti-theft immobiliser unit	Behind centre control attached to bulkhead
Volumetric sensor	Under arm-rest assembly
EFI ECU	Above passenger's footwell
EFI diagnostic socket	Engine bay Lefthand side
Inertia switch	Bulkhead lefthand side
Battery	Behind drivers seat
CD Auto-changer (optional)	Boot lefthand side

ANTI-THEFT ALARM

Introduction

Anti-theft security precautions

The theft of motor vehicles or their contents accounts for a very large proportion of all known crime. It pays to take precautions !

Always adopt this simple "five point" drill whenever you leave your car - even for just a few minutes:

- Put the hood up and fully close all windows.
- Remove any valuables (or hide them in the luggage compartment).
- Remove the starter key.
- Engage the steering lock (by slightly turning the wheel until it locks).
- Lock all the doors and activate the alarm.

Even when you have done all these things, there is still much more you can do to make your car a less inviting target for the thief.

BE SAFE NOT SORRY !

- Try to park where your vehicle can be seen by householders or passers-by.
- At night, always park in well lit areas and try to avoid dimly lit side streets.
- Never leave vehicle documents or spare keys in the car - these are a real bonus for the thief.
- If you have a garage, use it and don't risk leaving the keys in the starter switch.

OPERATION

Before attempting to arm the alarm, ensure that the doors, luggage compartment and bonnet are properly closed and locked.

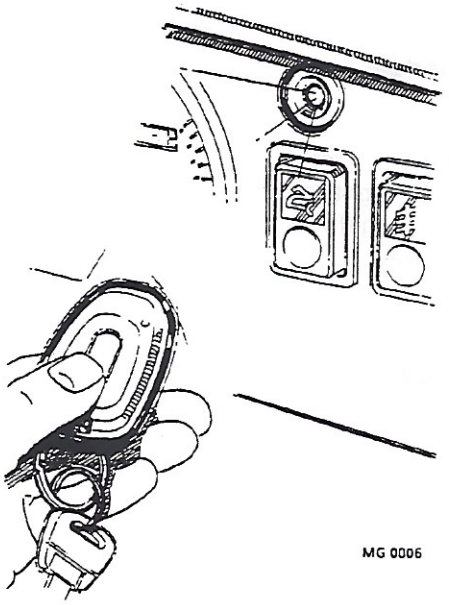


fig.7

Arming the Alarm:

- To arm the alarm, press the handset button once.
- The hazard warning lights flash 3 times.
- The alarm indicator light flashes rapidly, for approximately five seconds.

After five seconds the indicator light adjusts to a slower frequency and continues flashing on every second (as a visible theft deterrent) until the alarm is disarmed.

Once the alarm is armed, the horn will sound if any of the following occur:

- A door, the luggage compartment or bonnet is opened.
- The volumetric space protection sensor is activated.
- The vehicle immobilisation system is activated.

Vehicle immobilisation

The alarm system features vehicle immobilisation, this prevents the vehicle being started and the luggage compartment release switch operating.

The horn will sound if the starter switch is operated.

Volumetric space protection

A feature of the alarm system is a hidden volumetric sensor, which monitors interior space in the vehicle and automatically activates the alarm if an intrusion is detected. Volumetric space protection is activated automatically whenever the alarm system is armed.

However, if necessary, it can be inhibited without affecting the remainder of the alarm system by using the following procedure:

1. Open the driver's door.
2. Press the handset button to arm the alarm in the normal way - the alarm indicator light illuminates continuously.
3. Shut and lock the driver's door. The hazard lights flash three times and the alarm indicator light flashes rapidly for five seconds before reverting to a single pulse every second.

IMPORTANT: To prevent false alarms, it is ESSENTIAL that the volumetric space protection is inhibited if the car is to be left with people or animals inside.

Disarming the Alarm

To disarm the alarm, press the handset button once

- the hazard warning lights flash once.
- the alarm indicator light stops flashing.

IMPORTANT:

- The alarm can ONLY be armed and disarmed using the handset - if the doors are locked using the key, the alarm will NOT be armed !
- With the alarm armed, any attempt to open a door will activate the alarm !

Partial Failure to arm the alarm:

If a door, luggage compartment or bonnet is left open, the alarm will not fully arm. This will be indicated by the hazard warning lights failing to flash and the alarm indicator light not illuminating for the first 5 seconds after pressing the handset button. **The car should not be left in this condition !**

Close the open door, bonnet or luggage compartment, and the alarm will automatically re-arm itself (the hazard warning lights will flash 3 times and the alarm indicator light flashes rapidly to confirm that the alarm is fully armed).

WARNING: In the interests of security, ALWAYS arm the alarm whenever you leave the car - even for a short while - and try to NEVER leave the car with windows or hood open even if the alarm is armed !

In event of the car having to be left with the roof down, park it away from overhanging branches etc, as the volumetric alarm may be activated if the volumetric sensor detects movement above the vehicle.

Using the Handset

The handset transmits a coded radio signal, which changes every time the button is pressed. However, if the button is operated when the handset is out of range of the car, and the signal therefore fails to arm or disarm the alarm, the sequence of signals will be lost. It is then necessary to restore synchronisation of the sequence by moving closer to the car and pressing the button rapidly 3 times in one second.

Should the handset be accidentally soaked in water.it must be dried out as soon as possible. To do this, open the case and discard the batteries, then allow the handset to dry thoroughly before fitting new batteries and reassembling the case.

NOTE: An additional or replacement handset is available and can be reprogrammed using Microcheck.

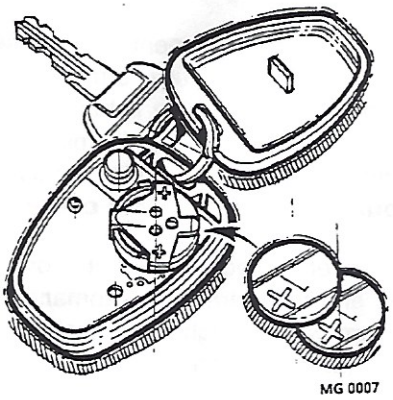


fig.8

Handset Batteries

Battery life will vary according to use. As an approximate guide, new batteries should last for a year in normal use (3072 transmissions is possible from one battery set).

The following conditions indicate that the batteries need to be replaced :-

- The L.E.D light on the handset flashes rapidly when the button is pressed.
- The hazard warning lights illuminate continuously for approximately three seconds (instead of flashing 3 times) when the alarm is armed.

Always fit **Unipart YWK 10004** batteries (available from a Rover dealer), and adopt the following replacement procedure:

1. Prise the handset apart (from the rear of the unit) using a small, flat bladed, screwdriver.
2. Push the side of the batteries (in the direction of the arrow in the illustration) to remove them from the retaining clip.
3. With the batteries removed, press and hold the button for at least 5 seconds. This will enable the handset circuits to be reset.
4. Fit the new batteries with the positive (" + ") side uppermost (as shown in illustration).

NOTE: *Finger marks will adversely affect battery life - avoid touching the flat surfaces and wipe clean before fitting.*

SYSTEM INPUTS

The following inputs are used to provide the alarm ECU with information:

Ignition Supply
This is used to trigger the alarm if armed. The alarm can **not** be armed while the ignition is switched "ON".

Engine Crank
This signal is used to trigger the alarm if armed. The alarm can **not** be armed while the engine is cranking.

Volumetric Alarm Signal
When the volumetric unit is activated it must have a clear period of at least 15 seconds before it is armed. If the interior of the vehicle were to be continually disturbed, in effect, the volumetric alarm would never actually arm.

Bonnet Switch
The bonnet switch is used to trigger the alarm and for mislock detection. The switch is made when the bonnet is lifted and open when the bonnet is closed.

Passengers door
The passenger's door is used to signal a mislock condition and to trigger the alarm system. If a door or the boot is not fully closed, any attempt to lock the vehicle will give a subsequent mislock signal and prevent the vehicle from being locked until the doors and boot are perceived by the unit as being closed.

NOTE: *The same switches are used to operate the interior light circuit.*

Boot switch
The boot switch operates in a similar manner to the passengers doors and as far as the ECU is concerned there is no distinction.

Drivers door switch
The drivers door switch is used for alarm triggering, mislock detection and volumetric disabling.

NOTE: *The drivers door switch is shared with the lights on alarm circuit.*

SYSTEM OUTPUTS

Volumetric power
This output powers the volumetric alarm. The output is activated when the alarm is armed using the RF remote as long as there is no mislock and the volumetric alarm has not been disabled.

The volumetric alarm is disabled by locking the vehicle with the RF remote while the drivers door is open. Subsequent closing of the drivers door will cause the perimetric alarm to arm after approx five seconds but the volumetric alarm will remain disabled.

Confidence/confirm Tell Tale L.E.D
The confidence confirm tell tale L.E.D is driven by the alarm module and is used to indicate mislock, tamper, volumetric arming/disarming.

- **Confidence**
  The tell tale L.E.D will provide a 1Hz confidence flash when the alarm system is correctly armed.

- **Confirm**
  Immediately after arming the alarm or after ending the partially armed state by closing any open panel the tell tale L.E.D will flash very rapidly for 5 seconds to show all the panels are closed.

- **Tamper**
  If the vehicle is attacked, the system will remember the type of attack. If the alarm is allowed to reset itself after the attack ie: 30 seconds of horn sounding then the type of attack will be signalled to the driver in one of the following ways:-

1. If the volumetric alarm was triggered then upon disarming the alarm the tell tale L.E.D will flash fast until the system is either rearmed or the ignition is switched on.

2. If the perimetric alarm was triggered i.e: a door, boot, bonnet or the ignition was switched either on or opened, then upon disarming the alarm the tell tale L.E.D will glow continuously on, to indicate the type of attack. The tell tale L.E.D will remain illuminated until the system is rearmed or the ignition is switched on.

Horn drive
The horn is driven when the alarm is triggered. The alarm will sound for approx 30 seconds (governed by legislation).

NOTE: Some markets will trigger the horn with a 50:50 mark space ie. the horn will pulse on and off 1 second on 1 second off.

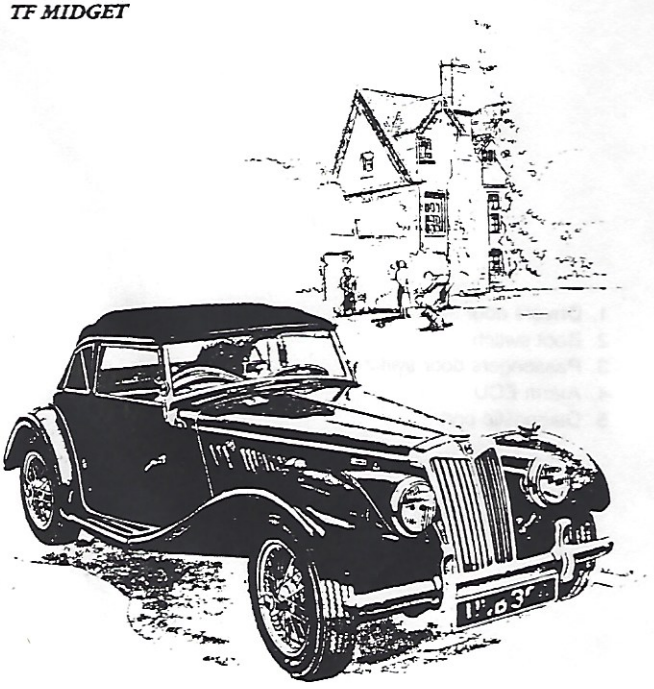
Hazards
This output provides a direct drive for both the LH and RH hazard lights. The hazard/flash unit is pulsed when the alarm is armed (300ms) and and when the alarm is disarmed (700ms). When the alarm is sounding the hazard warning lights will pulse on and off for as long as the horn is triggered.

Cranking relay

The cranking relay (starter relay) is enabled when the alarm system is disarmed and the ignition switch is moved to the crank position.

HISTORY FILE

TF MIDGET



INTRODUCTION

Microcheck Transmitter Reprogramming - SMD 4072/29 V2 has been designed to allow technicians to :-

1. Disarm the burglar alarm systems fitted to :-

   Mini, Metro, MG RV8

2. Reprogramme a new / additional* transmitter for the burglar alarm systems fitted to:-

   * Mini & Metro (from 93 MY)
     Rover 200 & 400 (from 93 MY)
     Rover 800 (from 91 MY)
   * MG RV8

3. Programme a MEMS ECU to accept a new security code from the burglar alarm / central control unit fitted to :-

   Rover 200 & 400 (from 94½ MY)
   Rover 600 (from 94½ MY)
   Rover 800 (from 94 MY)

4. Adjust the sensitivity of the volumetric alarm fitted to MG RV8.

5. Identify the Transmitter Serial Code* / Key Acecss Code (K.A.C) from the burglar alarm systems fitted to :-

   Rover 200 & 400 (from 94½ MY)
   * Rover 600 (from 94½ MY)
   Rover 800 (from 94 MY)

To avoid misuse, this Microcheck system incorporates the following security features:-

- A Supervisor password to control Microcheck Transmitter Reprogramming System usage, which is valid for 1 year from the initial date of use. After 1 year has elapsed a further password must be obtained. (See Supervisor Operation section of this booklet.)
- A User password, to implement additional security at a dealer level, which is entered by the technician and is set by the supervisor.
- Incremental 'time-out' prevents use of the Transmitter Reprogramming System should the incorrect password be entered.
- VIN and date of each reprogramming needs to be entered and is stored in the Microcheck security module.

CONNECTION DETAILS

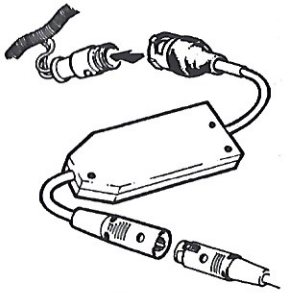
(Transmitter, Sensitivity & Codes)

A) Mini, Metro & MG RV8.

Connect Burglar Alarm / CDL serial harness adaptor (SMD 4072/36) to serial diagnostic connector located :-

Mini - Left hand side of engine compartment.
Metro - Right hand side of engine compartment.
MG RV8 - Behind speaker panel in boot.

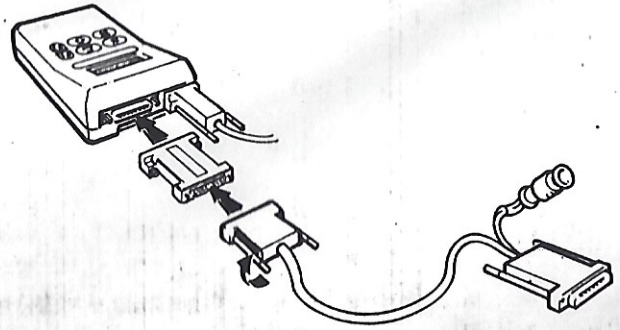
NOTE : The Burglar Alarm / CDL serial connector is green.



Connect serial harness (SMD 4072/3) to the Burglar Alarm / CDL serial harness adaptor (SMD 4072/36).
Microcheck is now ready to reprogramme a new transmitter / adjust the volumetric sensitivity. Follow the Microcheck screens carefully.

B1) Rover 200 & 400 (93 ⟶ 94½ MY).

Connect Microlink harness (SMD 4073/1) to Security module (SMD 4072/29) and tighten the thumb screws.



Connect Microlink harness (SMD 4073/1) to the Burglar Alarm / CDL harness (SMD 4072/35)

MG "R" V8 ALARM SYSTEM

Component Location

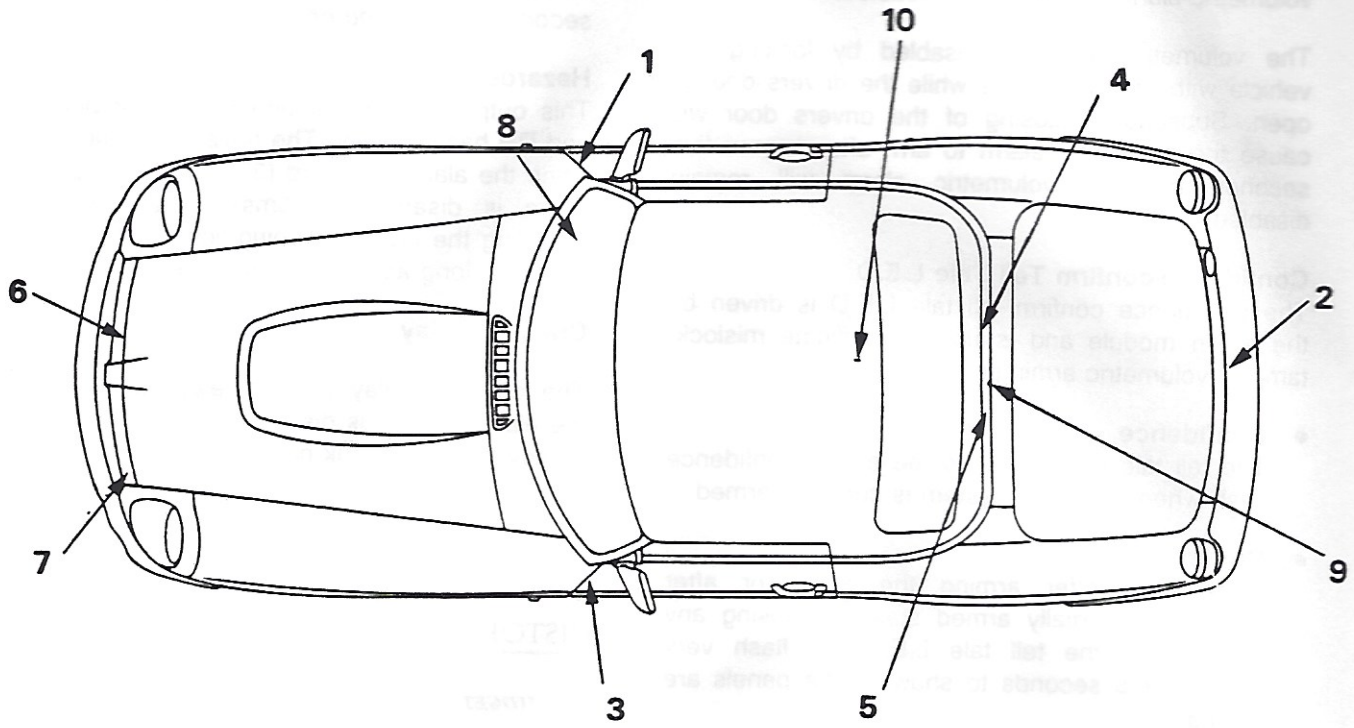


fig.9

1. Drivers door switch
2. Boot switch
3. Passengers door switch
4. Alarm ECU
5. Diagnostic port
6. Bonnet switch
7. Horn
8. Tell tale L.E.D
9. Immobiliser unit
10. Volumetric sensor

The Burglar Alarm

When the alarm is armed it will be triggered by one or more of the following events:-

- bonnet opening;
- boot opening;
- any door opening;
- ignition being switched on;
- any attempt to crank the engine;
- the volumetric sensor detecting an intruder.

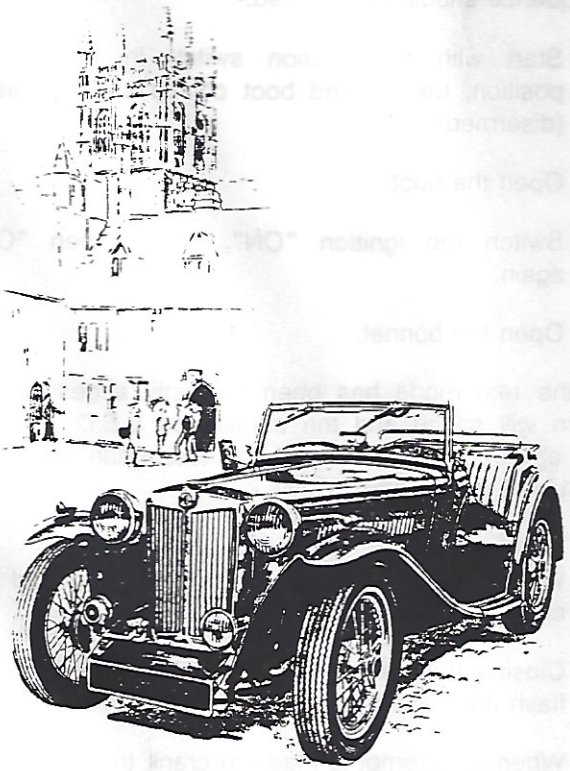
The alarm system can only be disarmed using one of the following methods:-

- with a valid request from the RF remote;
- using Microcheck.

NOTE: *The alarm system remembers the state of the alarm at battery disconnection i.e: if the battery is disconnected with the alarm armed but not sounding, when the battery is reconnected it will revert to the same. If the battery is disconnected while the alarm is sounding it will continue to sound when the battery is reconnected. If the battery is disconnected while the alarm is not armed it will revert to the same when the battery is reconnected.*

HISTORY FILE

TC MIDGET



SELF TEST

The following self test should only be performed if Microcheck is not available to carry out a full diagnostic check.

To access the built in test mode the following sequence should be followed:-

1. Start with the ignition switch in the "OFF" position, bonnet and boot closed and the alarm (disarmed).
2. Open the boot.
3. Switch the ignition "ON", "OFF" then "ON" again.
4. Open the bonnet.

If the test mode has been correctly accessed the horn will sound and the confidence L.E.D will light for approx 100ms. While in the test mode the alarm ECU will respond as follows:-

- When any door or the boot/tailgate is opened the confidence L.E.D will illuminate.
- Closing the bonnet will cause the alarm ECU to flash the Hazard lights.
- When an attempt is made to crank the engine the confidence L.E.D will illuminate.
- The drivers sill lock button will operate normally through the test.
- The test mode will automatically cease when the RF remote is operated.

NOTE: *When the perimetric test mode is terminated the ECU enters the volumetric test mode and the confirmation L.E.D will light for approx 5 seconds as confirmation. While in the volumetric test mode any valid volumetric input will cause the confirmation L.E.D to light. The volumetric test will be terminated when a signal is received from the RF remote. This will cause the horn to sound for approx 100ms then the system will return to normal operation. If the ignition is switched "OFF" during the test the horn will sound for approx 100ms then the system will revert to normal operation.*

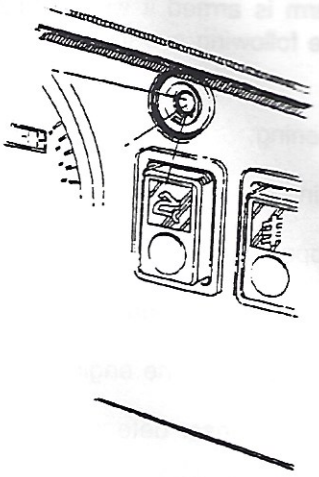
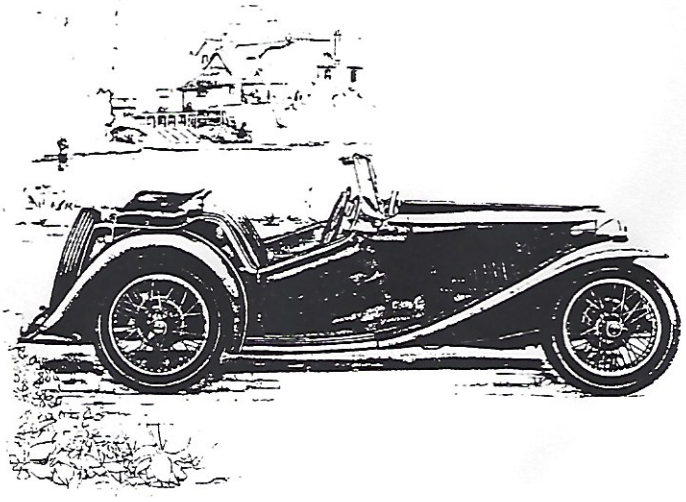


fig.10

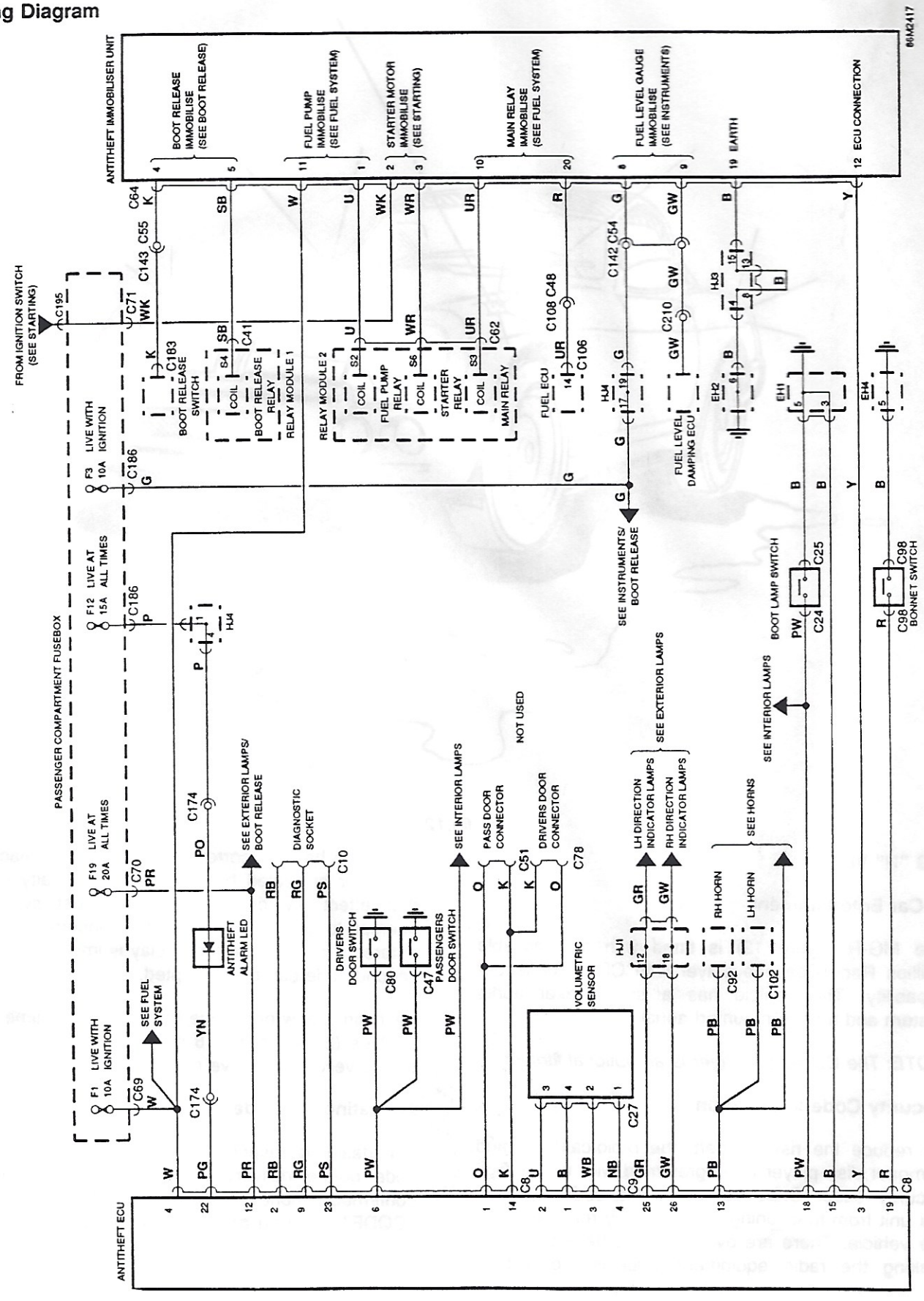
HISTORY FILE

TA MIDGET



MG "R" V8 ALARM SYSTEM

Wiring Diagram



MG "R" V8

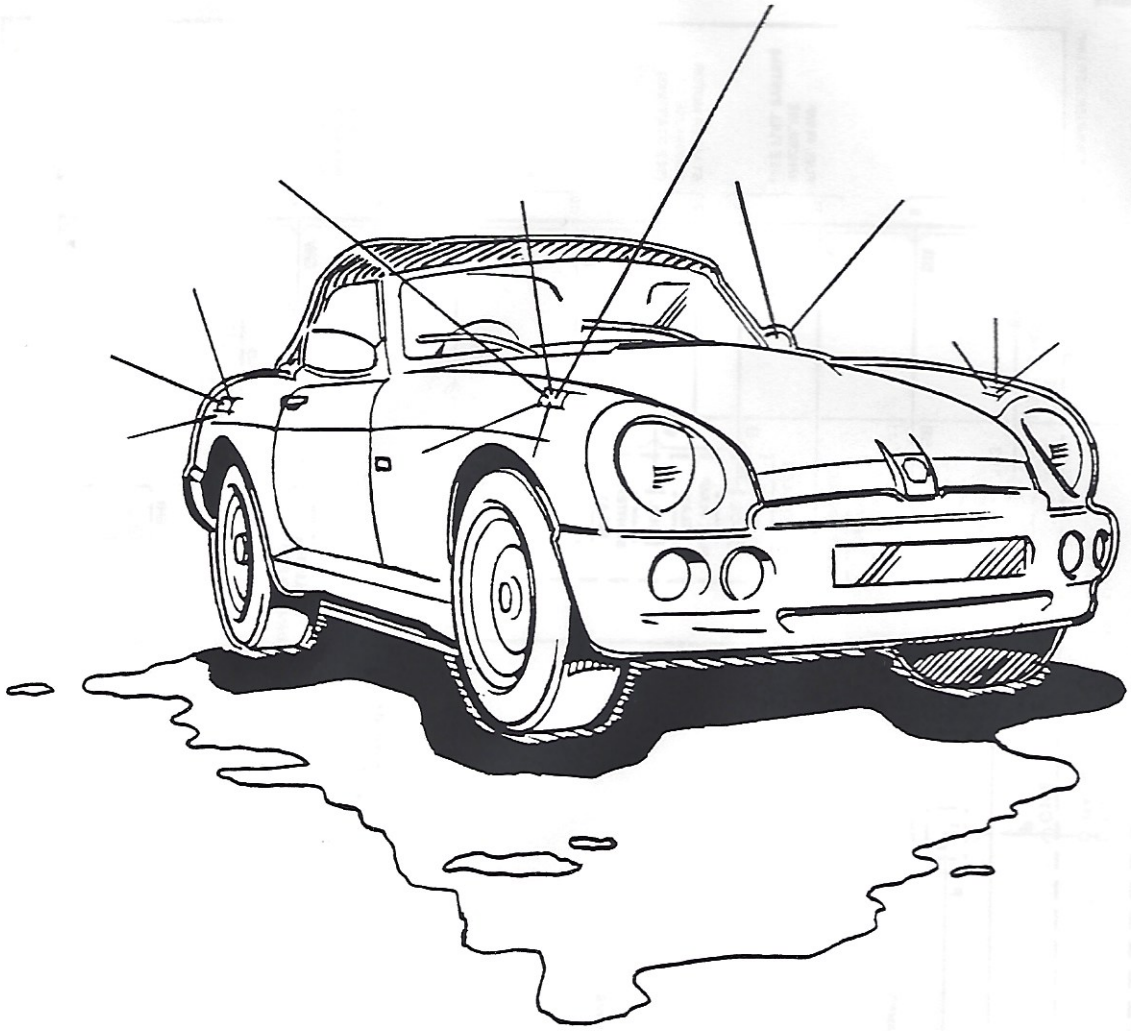


fig.12

MG "R" V8

In-Car Entertainment

The MG-R (figure 12) is fitted with a removable Phillips Radio/Cassette player with CD Autochanger capability. The vehicle has a six speaker audio system and a body mounted aerial.

NOTE: *The CD Autochanger is an optional fitment.*

Security Code Information

To reduce the risk of theft, the radio/cassette and compact disc player is programmed with a four digit security code. Once activated, this code prevents the unit from functioning if it is illegally removed from the vehicle. There are over 10,000 different codes - making the radio equipment valueless to a thief unless he has the correct one. In addition, each unit is further protected by a time delay penalty system that effectively defies even the most systematic attempt to break the code. If an incorrect code is entered a one minute time delay is imposed before a second code can be attempted.

Each time a wrong code is entered the time delay doubles (2 min, 4 min, 8 min, and so on ...) making theft a very unattractive proposition.

Activating the code

The dealer is responsible for activating the security code before delivery of the vehicle. This will be confirmed whenever you switch the radio on by "CODE", showing **briefly** in the display window.

IMPORTANT: *If this display is absent, the radio will still operate but is not protected by the security code. You should activate the code as follows:*

- Keeping the "UP" tuning button depressed, switch on the radio and wait until a two-tone beep sounds. The code is now activated !

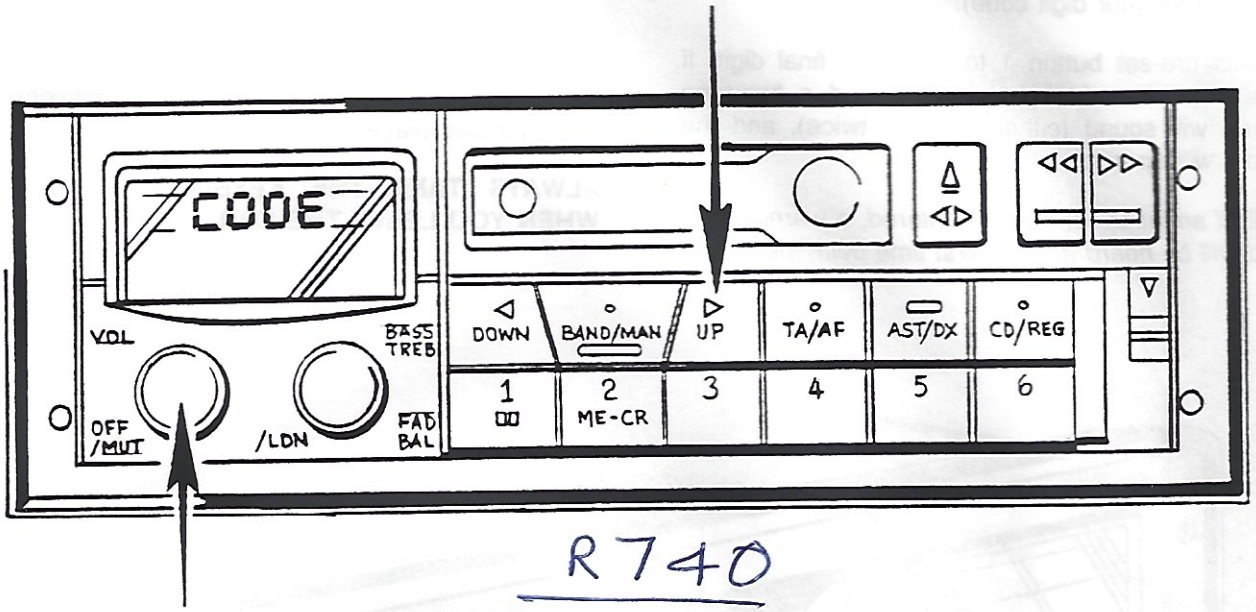


fig.13

Deactivating The Security Code

If the electrical supply to the radio is to be disconnected it is advisable to first deactivate the code as follows:

1. Depress the "UP" tuning button while you switch on the radio and keep it depressed until the display shows "CODE".
2. Enter the correct security code using the procedure explained in "Re- entering the Code". When the code is deactivated a two-tone beep will sound.

NOTE: *Failure to enter the correct code first time is automatically penalised - requiring you to first RE-ENTER the correct code before continuing.*

Code Explained

- A **permanent** display of **"CODE"** indicates that the code is "lost". You must re-enter the code as shown below before the radio will work !
- A **brief** display of **"CODE"** means that the code has been activated. The radio will work normally.
- A blank display indicates that the security code has been deactivated and is therefore inoperative. You should activate the code as previously explained.

Re-Entering the Code

If the electrical supply has been disconnected without the code first being deactivated, the display will permanently show "CODE". The code must be re-entered as follows before the radio will work.

1. Switch on the radio - the code symbol will appear on the display. Press pre-set button 1.
2. Press one of the tuning buttons to enter the first digit of the security code.
3. Press pre-set button 1 to store the first digit in the unit's memory.
4. Use a tuning button to enter the second digit of the code.
5. Press the pre-set button 1 to store the second digit.

6. Enter the third digit, again using the tuning buttons.

7. Press pre-set button 1 to store the third digit.

8. Select and enter the final digit (display will now show a full four digit code).

9. Press pre-set button 1 to store the final digit. If the correct code has been entered a two-tone beep will sound (either once or twice), and the radio will operate.

NOTE: *If an incorrect code is entered, a warning sound will be heard and the first time delay period commences. During the delay period, the display will show the word "WAIT". DO NOT switch off. At the end of the delay period the word "CODE" will return and you can then enter another code. Remember, the time delay doubles each time an incorrect code is entered.*

Detachable Keyboard

For added anti theft protection the radio/cassette and compact disc player has a detachable keyboard.

ALWAYS TAKE THE KEYBOARD WITH YOU WHEN YOU LEAVE THE CAR.

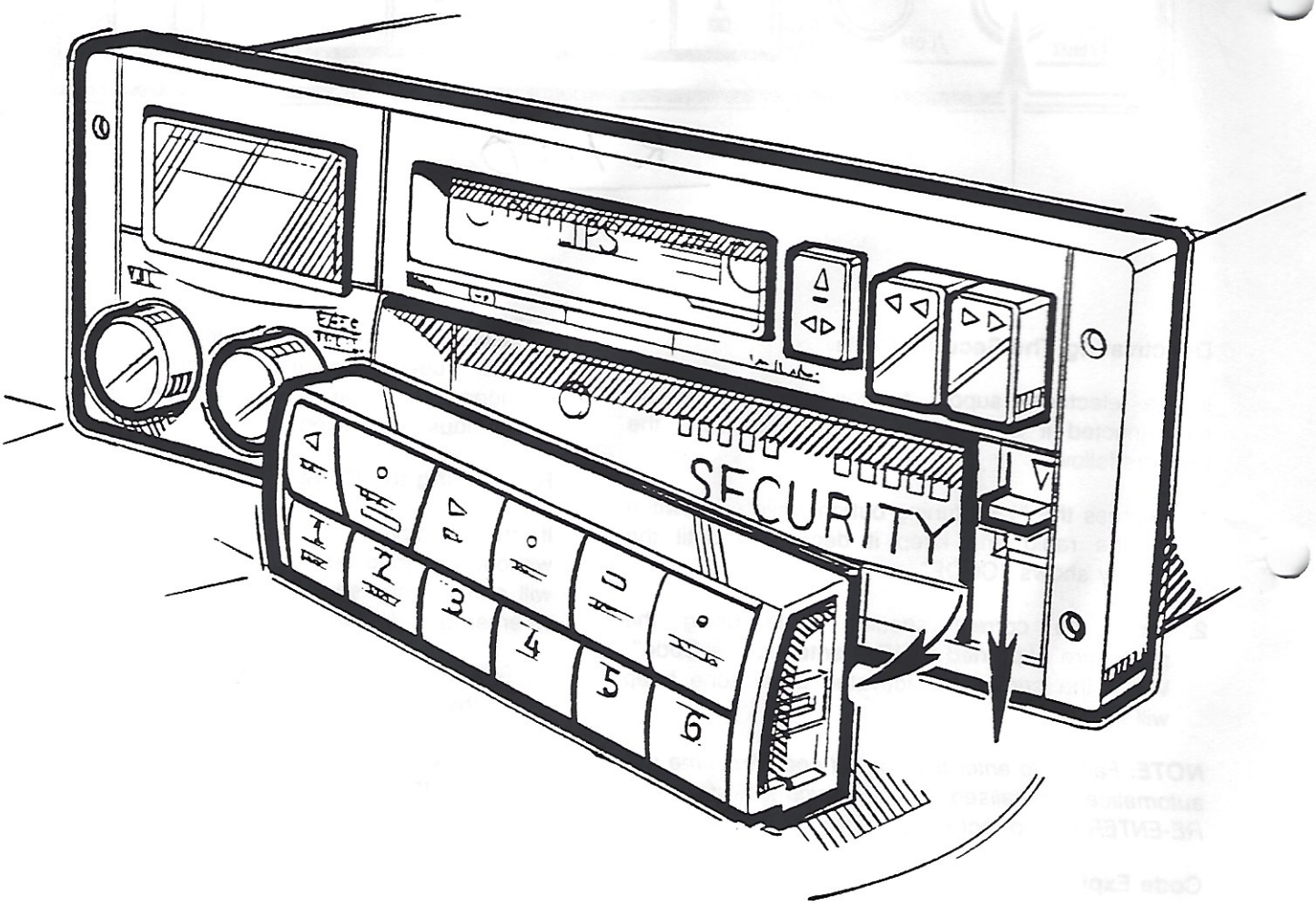


fig.14

Removing the keyboard

1. Slide release key downwards.
2. Remove keyboard from player.
3. **ALWAYS** keep the keyboard in its protective case.

Replacing the keyboard

4. Position keyboard and slide to the left.
5. Press the right hand side fully home. *Ensure that the keyboard is locked fully in position.*
6. Press the ON/OFF control to switch on.

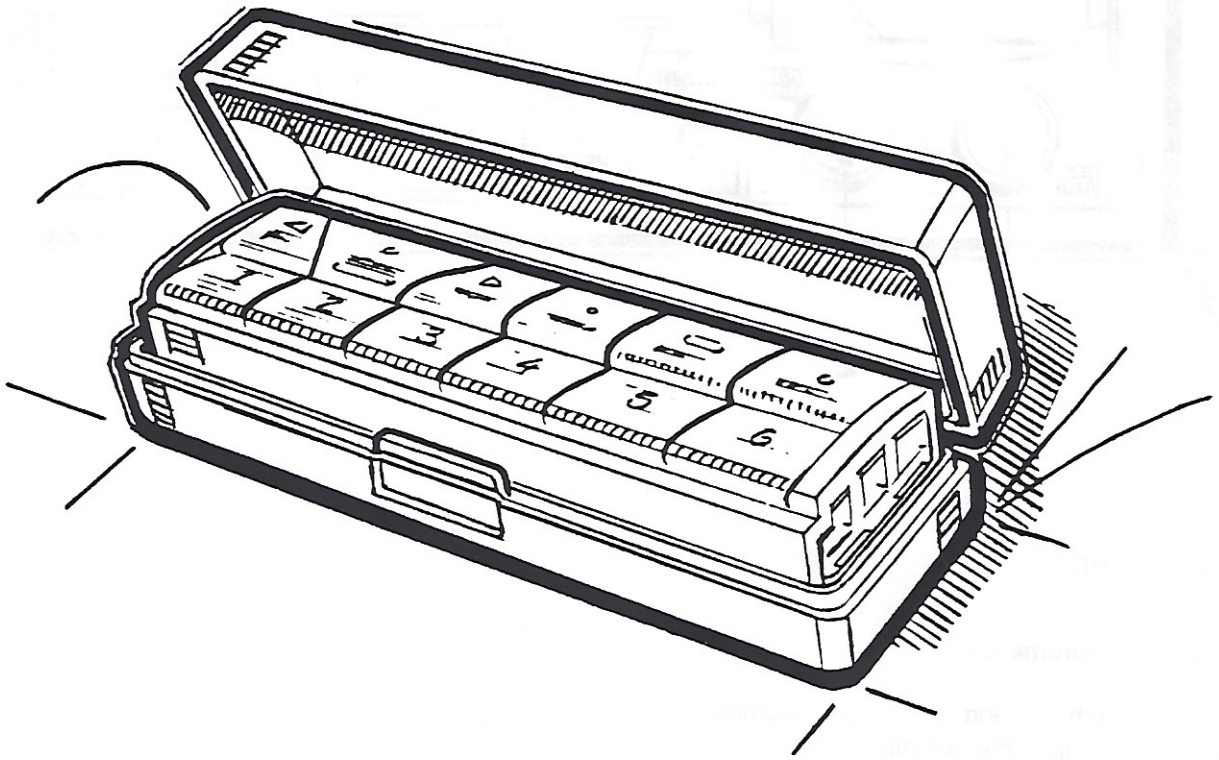


fig.15

SOUND CONTROLS

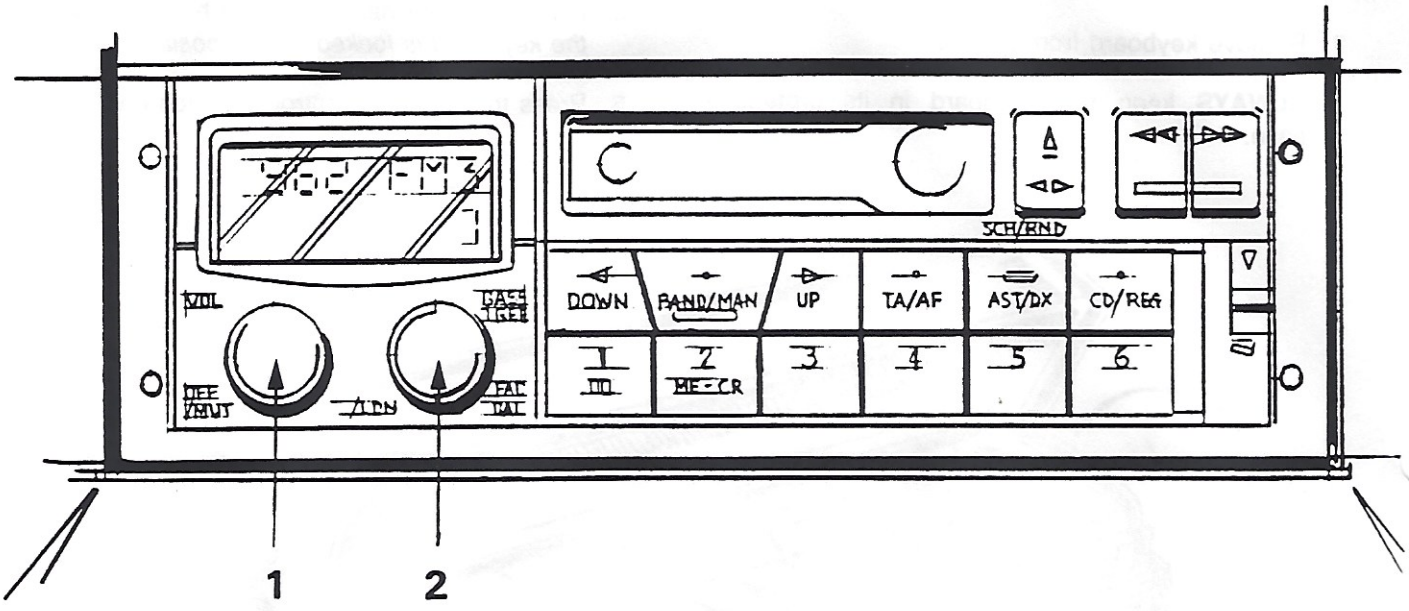


fig.16

SOUND CONTROLS

1. **On/Off and Volume Control**

   Push to switch on and off (display illuminates), and rotate to adjust the volume.

   Mute: Press and hold for 2 seconds. A two-tone beep sounds and the display shows "MUTE" (or "PAUSE" in CD player mode). All sound is muted apart from the special traffic information broadcasts. Press and hold for a further 2 seconds to cancel the mute facility.

NOTE: If you have a car telephone with a mute signal output connected to the radio, the radio will automatically mute when the telephone is in use.

2. **Bass, Treble, Fader and Balance Control**

   Bass: Press the control once and rotate to left or right to increase or reduce the bass response. The display shows:
   "BASS - 4" = minimum bass
   "BASS 0" = normal bass
   "BASS + 4" = maximum bass

   Treble: Press the control twice and rotate to left or right to increase or reduce the treble response. The display shows:
   "TREB - 4" = minimum treble
   "TREB 0" = normal treble
   "TREB + 4" = maximum treble

   Fader: Press the control three times. Rotate to the left or right to adjust the balance between front and rear speakers. The display shows:
   "FAD 0-9" = max sound from FRONT
   "FAD 9-9" = mid point of equal balance
   "FAD 9-0" = max sound from REAR

   Balance: Press the control four times and rotate to left or right to adjust the balance between left and right speakers. The display shows:
   "BAL 0-9" = max sound from RIGHT
   "BAL 9-9" = mid point of equal balance
   "BAL 9-0" = max sound from LEFT

   Loudness: Press the control for a minimum of two seconds. This can be used to increase the high and low notes at low volume settings. The display briefly shows:
   "LOUD ON" **or** "LOUD OFF"

RADIO CONTROLS

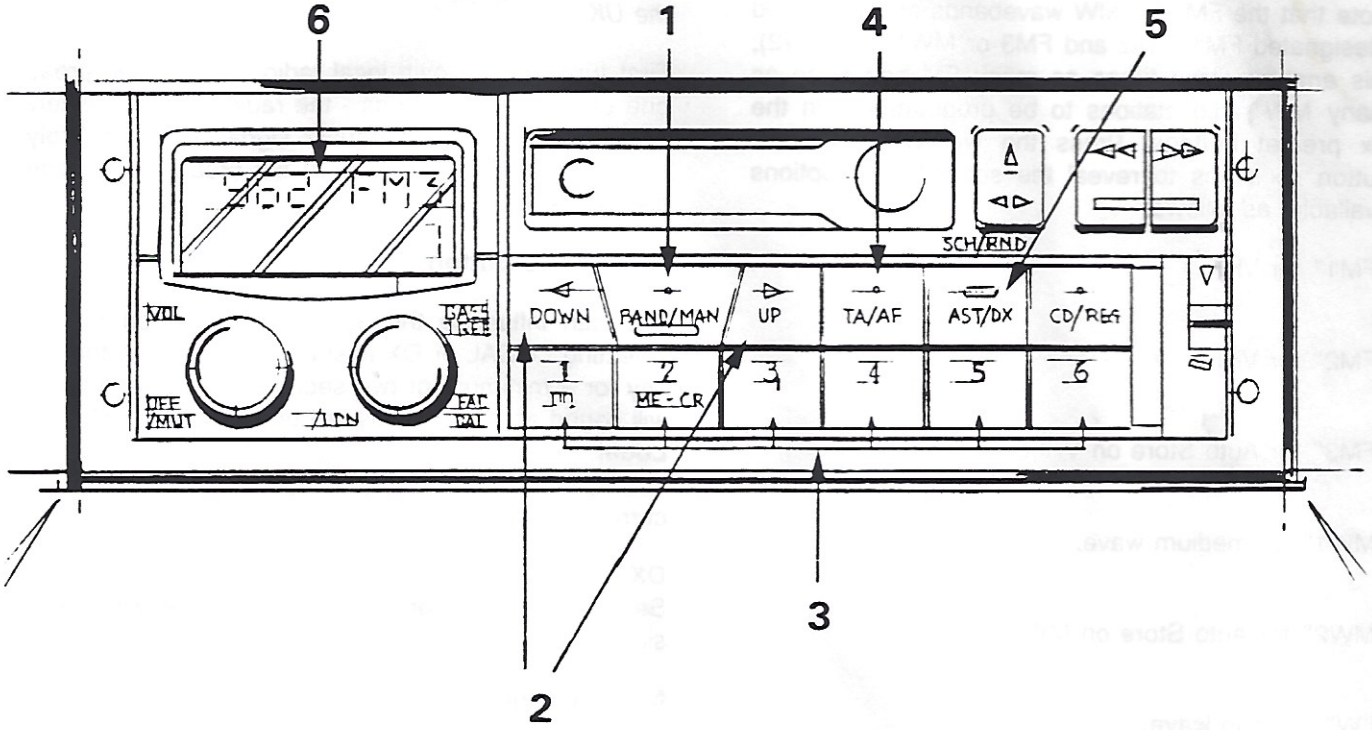


fig.17

RADIO CONTROLS

1. **Waveband Selector**
   Press to select frequencies, FM1, FM2 or FM3, MW1 or MW2, LW.

   NOTE: *FM3 and MW2 can use AUTO STORE.*

   Press for at least two seconds to convert to manual tuning.

2. **Tuning Buttons**
   Press either button for tuning (up or down the frequency range).

3. **Radio Pre-set Buttons (1-6)**
   Use to store up to 18 radio stations on FM, 12 on MW and 6 on LW.

4. **Traffic Announcements (TA)**
   Press briefly to obtain traffic information broadcasts -FM waveband only.

5. **RDS Alternative Frequencies (AF)**
   Press and hold for a minimum of two seconds to activate Radio Data System - FM waveband only.

6. **Automatic Stowage (AST)**
   Press briefly to start rapid tune operation.

7. **Digital Display**

RADIO TUNING

The radio is equipped with six pre-set frequency selection buttons (3). These can be programmed to store six radio stations on each waveband. In addition, the special auto store (AST) facility enables you to automatically store the strongest transmission signals in your locality in a single operation.

The radio is equipped with RDS (Radio Data System). When the radio is tuned to the FM waveband the RDS feature ensures that you will always receive the strongest possible radio signals wherever you are. In addition, the Traffic Information facility on the FM waveband enables you to automatically receive any available traffic information broadcasts, whether you are listening to radio, cassette tape or compact disc.

These facilities are fully described on the pages that follow.

WAVEBAND SELECTION

Waveband Selector Button (1)

Press to select FM (VHF), MW or LW frequencies. Note that the FM and MW wavebands are duplicated (designated FM1, FM2 and FM3 or MW1 and MW2); this enables three times as many FM and twice as many MW radio stations to be programmed on the six pre-set buttons. Press the waveband selector button six times to reveal the sequence of options available, as follows:

"FM1" for VHF.

"FM2" for VHF.

"FM3" for Auto Store on VHF.

"MW1" for medium wave.

"MW2" for Auto Store on MW.

"LW" for long wave.

Automatic Tuning

Select the required waveband, then press one of the tuning buttons (2).

The radio will automatically search through the frequency range (either up or down depending upon which button is pressed) until a radio station is located. The search then stops unless you elect to continue by pressing the tuning button again.

Automatic tuning occurs at different sensitivity levels. Initially the radio searches for strong signals only, but after the whole waveband has been examined, the search automatically switches to a higher level of sensitivity, whereby weaker signals are sought as well. After a delay of approximately 60 seconds, the radio will automatically revert to searching for strong signals once more.

NOTE: Because of the close grouping of local radio stations on the FM waveband, automatic search tuning enables you to quickly tune to the strongest local radio frequency when travelling in any part of the UK.

First tune to your own local radio station, then press one of the tuning buttons - the radio will immediately tune to the nearest adequate signal, which is likely to be the local radio station in the area in which you are travelling.

Seek Mode Button

You can influence the automatic tuning on FM by selecting LOCAL or DX (distant) mode. Press the DX key for a minimum of two seconds (a two-tone bleep will sound and the display will briefly show "DX".

Local
Searches of strong signals in the area you are currently in.

DX
Searches for all stations including those with weak signals, which can be received in the area.

Manual Tuning

Use manual tuning when you know the frequency of the radio station you are seeking or for selecting stations that are too weak to be found by automatic tuning. To select manual tuning, press and hold the BAND/MAN button (1) for a minimum of two seconds (a two-tone beep sounds). Then, by briefly pressing either tuning button, the frequency will change (either up or down) in steps of 0.05 MHz for FM, or 1 kHz for MW and LW.

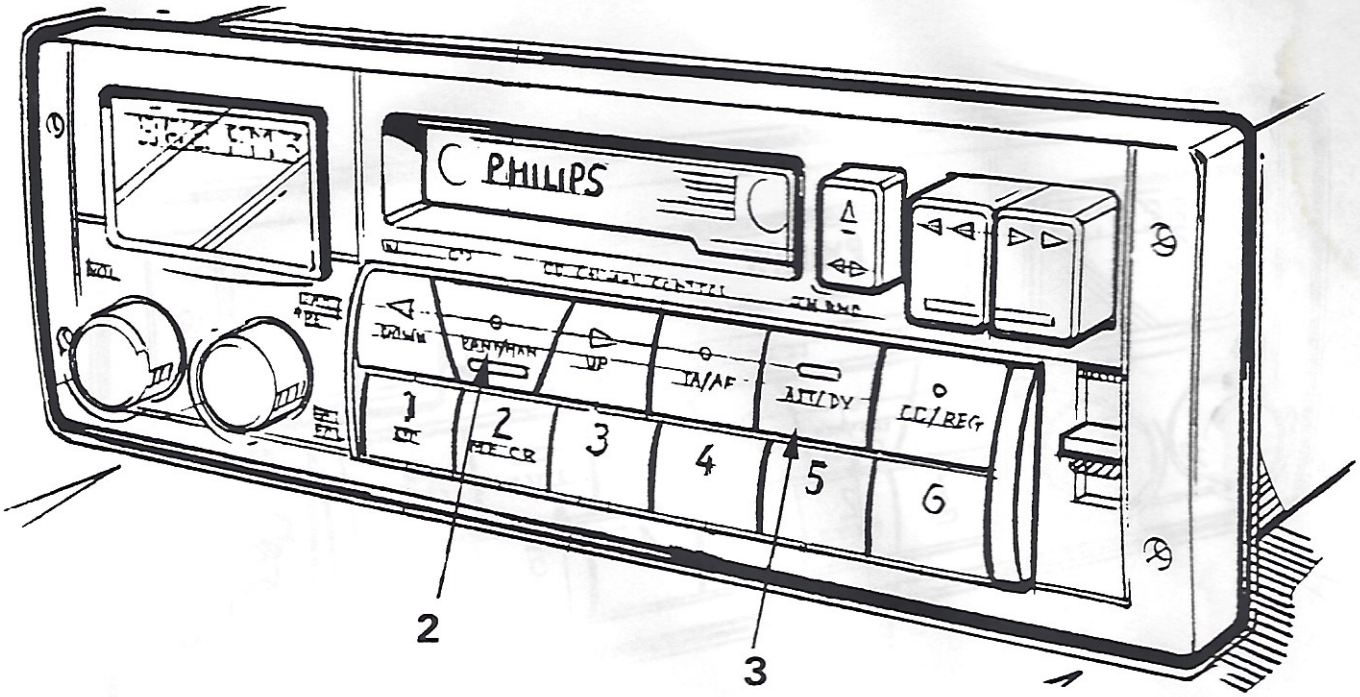


fig.18

Fast Manual Tuning

By keeping either tuning button depressed, the waveband will be scanned rapidly (up or down) until the button is released.

Automatic tuning will return if:

- the BAND/MAN button is pressed for a minimum of two seconds (a two-tone beep sounds).
- the tuning buttons are not used for 60 seconds.
- the radio is switched off and on again.
- one of the waveband selector or pre-set buttons is pressed.

Mono/Stereo

Whenever the FM waveband is selected, the radio will automatically reproduce stereo sound provided a suitable signal is available. However, if a stereo signal becomes too weak for good reception, the radio will automatically change to mono, and the stereo indicator will disappear from the display. As soon as the stereo signal strengthens, the radio will return to the stereo mode.

Radio Pre-set Buttons

The six pre-set buttons (3) can be used to manually store upto 18 radio stations on FM (six on each of FM1, FM2 and FM3) and six each on MW1, MW2 or LW. The pre-sets are programmed as follows:

1. Select the required waveband (FM1, FM2, FM3, MW1, MW2 or LW).
2. Tune to the desired frequency using either automatic or manual tuning.
3. Press and hold one of the pre-set buttons until a two-tone beep sounds (this indicates that the frequency has been stored). The display will show the pre-set number, together with the waveband and frequency (or name) of the radio station you have tuned.

Repeat this procedure to store radio stations on the remaining pre-set buttons on this and the other wavebands.

Operation of the Pre-sets

Once the pre-set buttons have been programmed, operation is simple, select the desired waveband and then press the pre-set button of your choice.

NOTE: *The pre-set frequencies will be retained when the starter switch is turned off but will be lost if the battery is disconnected for any length of time.*

Auto store

Auto store enables you to rapidly tune and store the strongest FM or MW radio signals in a single operation. This facility is particularly useful if you are in an unfamiliar area and have little knowledge of local transmitter frequencies.

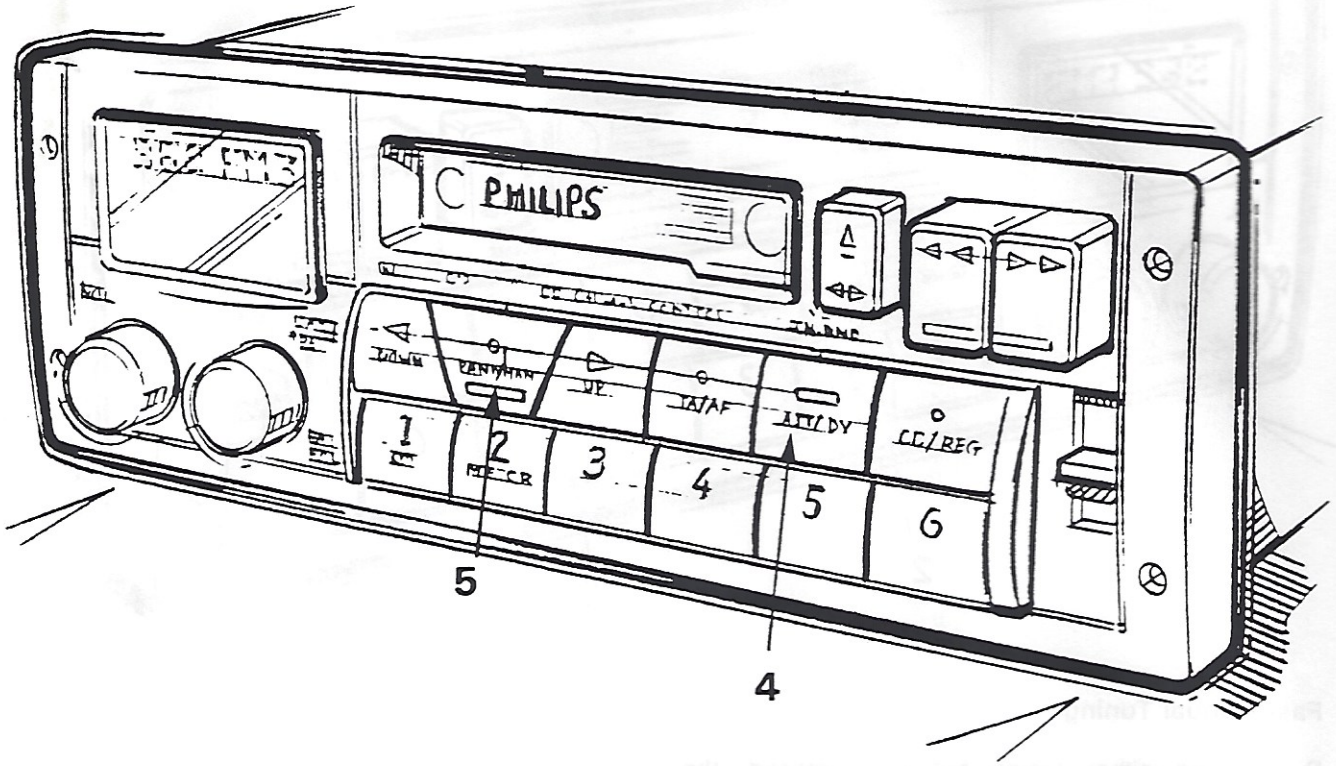


fig.19

Programming Auto-Store

Briefly press the "AST" button (4) the waveband will automatically revert to the "AST" station (FM3 or MW2. LW is not available on auto store and attempted selection will provoke an error bleep).

Auto store then quickly scans the waveband to find the six strongest frequencies and automatically stores them on the pre-set buttons in order of signal strength (each time a station is stored the display shows the frequency and relevant pre-set number).

A second two-tone beep indicates that the auto store operation is complete. All "Auto store" frequencies remain stored on the pre-sets until the process is repeated.

NOTE: *If auto store is unable to find five strong stations, the remaining pre-set buttons will remain blank (the display showing: "0000 AST").*

NOTE: *The traffic information facility cannot be stored on the auto store pre-set buttons.*

Repeat the auto store procedure to store the strongest stations on the remaining waveband.

Operating Auto Store

To tune to one of the auto store frequencies, select the appropriate waveband selector (FM3, or MW2) (5) then press the pre-set button of your choice, the frequency to radio station name and pre-set number will appear on the display.

To leave the auto store mode press the waveband selector button.

Radio Data System (RDS)

The radio is equipped with RDS (Radio Data System). RDS is progressively being introduced in a number of European countries and operates on the FM waveband only. The system enables the radio to receive other information in addition to radio signals, including:

- the programme service name (this enables the set to display the radio station name instead of the frequency).
- alternative frequencies for the FM radio station being received (this enables the set to automatically select the strongest signal, there maintaining the best possible reception).

- a traffic information system (this enables the set to give priority to traffic information broadcasts).
- information from other radio networks.

Receiving RDS Stations

Whenever an RDS radio station is received, the "AF" indicator and radio station name illuminate in the display. The set constantly scans all alternative frequencies on which that station can be received, and automatically switches to the strongest signal it can find.

This is particularly useful on long journeys when the car may travel through several different transmitter areas which serve the same radio station.

Switching RDS "ON" and "OFF"

The radio is automatically in the RDS mode whenever the FM waveband is selected.

To cancel RDS and prevent the radio from automatically retuning to the strongest alternative frequency, press the TA/AF button (6) for a minimum of two seconds (the display briefly shows the radio station frequency, and the "AF" indicator disappears from the display). To restore automatic retuning, press the TA/AF button for a minimum of two seconds a second time (the "AF" indicator returns to the display).

If the "AF" indicator starts to flash when a radio station name is displayed

This indicates that the RDS signal is weak.

If the "AF" indicator starts to flash when a frequency is displayed

This indicates that the station received is not linked to the RDS network (After 2 minutes the "AF" indicator will stop flashing).

If the display shows "SEARCH" alternately with the radio station name

This indicates that the vehicle is outside the reception area for that station. The set will search for the last tuned station, or the last tuned frequency.

NOTE: The RDS facility will automatically be included when FM stations are programmed onto the pre-set buttons. If RDS is not required, it must be switched off (by pressing the TA/AF button) immediately prior to each pre- set being programmed.

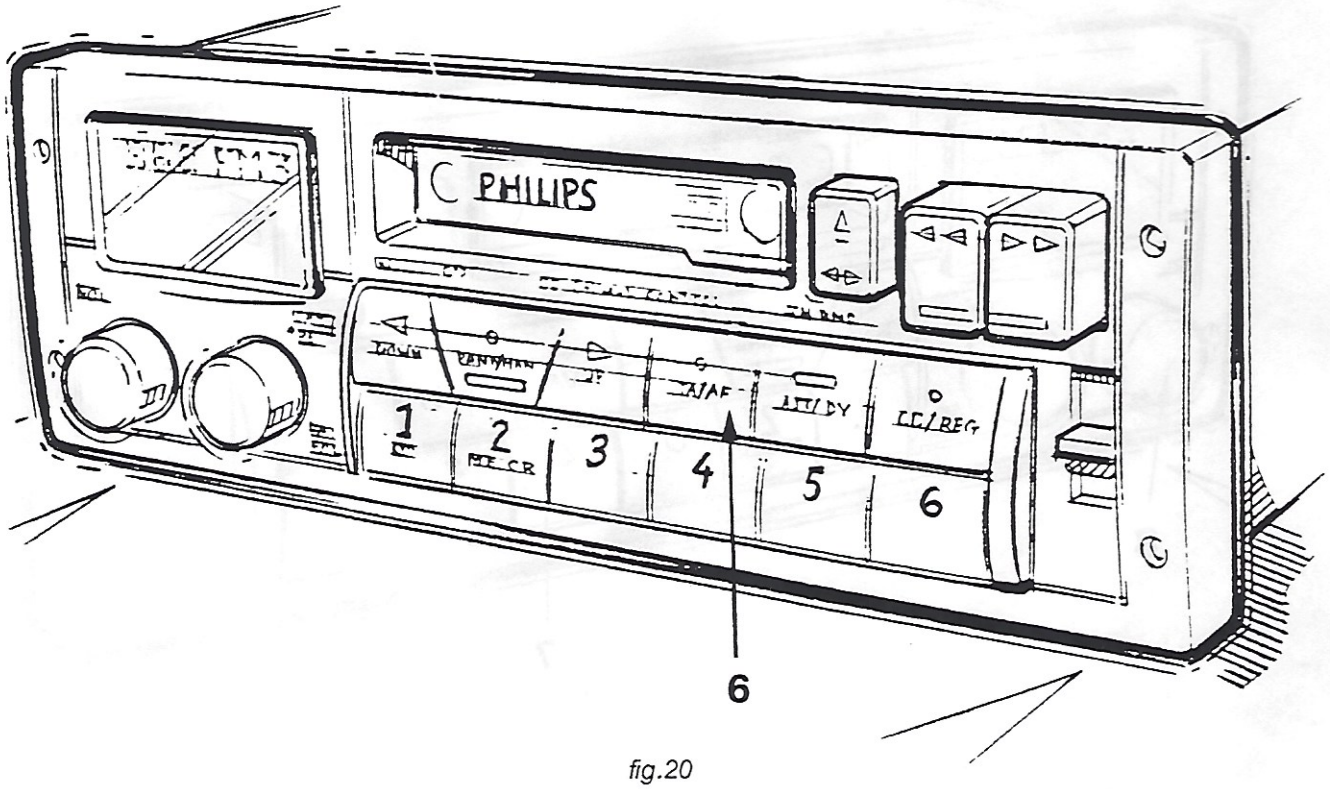


fig.20

Local Radio Stations

Reception of most local radio stations is intentionally limited to a comparatively small area around the transmitter.

Once the limit of the reception range is reached, it is unlikely that the RDS facility on your radio will be able to locate an alternative frequency for the local radio station being received. Instead RDS is able to automatically locate, and tune to, the nearest alternative local radio station.

You have the option to enable or inhibit this process, as follows:

"REG ON"

Press and HOLD the CD/REG button for at least two seconds (a two-tone beep sounds and the display briefly shows "REG ON"). This effectively overrides the RDS facility and prevents the radio from automatically tuning to a different local radio station (enabling you to continue listening to the existing local radio station even though reception is poor).

"REG OFF"

Press and HOLD the CD/REG button (the display briefly shows "REG OFF" accompanied by a two-one beep). This enables the RDS facility to operate as normal and retune to a different local radio station (with a stronger signal).

NOTE: Either state can be included or inhibited when RDS stations are programmed onto the pre-set buttons.

Traffic Information

On the FM waveband, your radio is able to identify radio stations that broadcasts traffic information on the RDS network, as follows:

- The "TP" (Traffic Programme) indicator automatically illuminates on the display whenever the radio is tuned to a station that broadcast traffic information.
- The "TP-EON" (Traffic Programme - enhanced other networks) indicator automatically illuminates on the display when the radio is tuned to a station that, while not necessarily broadcasting traffic information itself, is linked to a network of other radio stations that do.

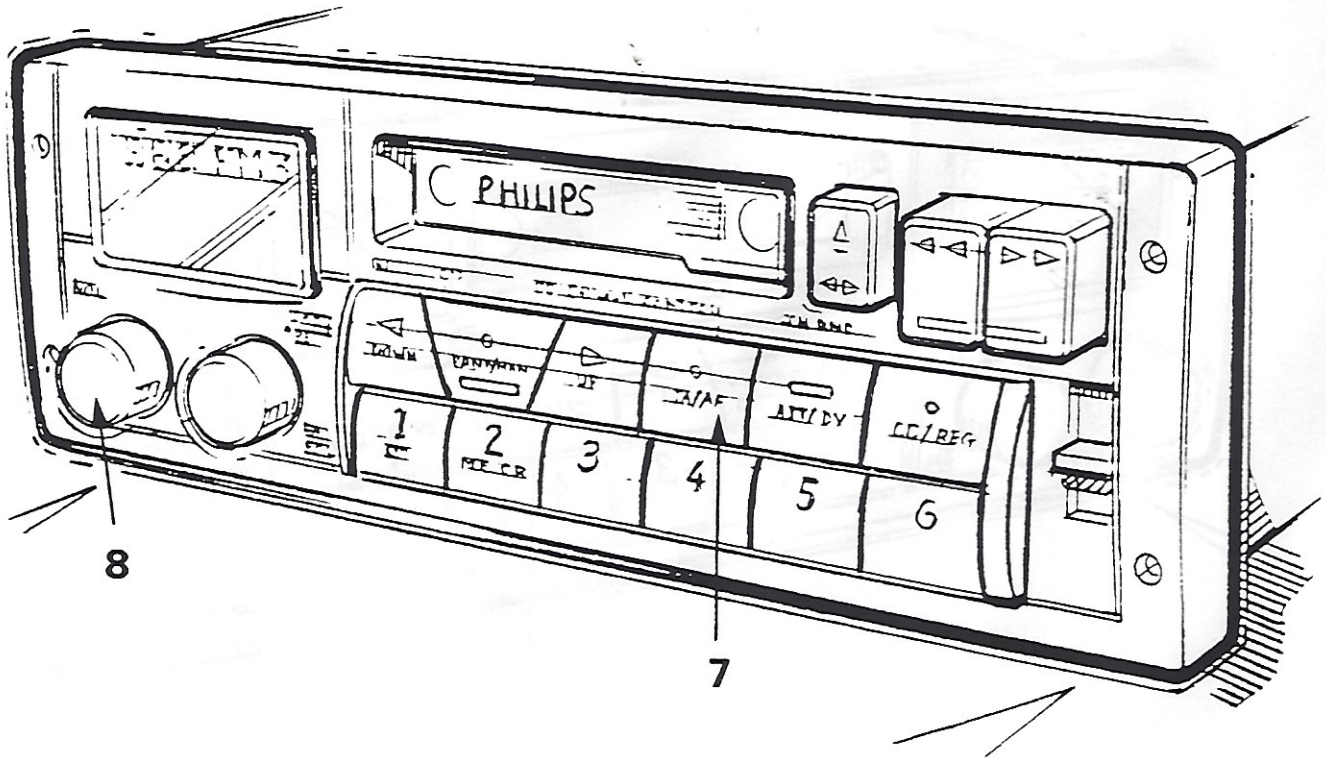


fig.21

Tuning in to Traffic Information

1. Select an FM waveband and BRIEFLY press the TA/AF button (7) the "TA" indicator illuminates.

2. If the radio is already tuned to a station that broadcasts traffic information, the "TP" or "TP-EON" indicators also illuminate. Any available traffic information will then automatically be broadcast as and when it occurs (even if you are listening to cassette tapes or compact discs).

If the radio is NOT already tuned to a traffic information station, a warning tone sounds, the radio mutes and immediately searches for a station that does broadcast traffic information.

NOTE: *When the traffic information mode is active, automatic tuning will search only for radio stations that broadcast traffic information.*

In more remote areas of the UK, it may be impossible to locate a traffic information station. However, your radio will continue searching for one (interrupted by warning bleeps), and if this occurs, you are advised to switch off the traffic information mode.

When "traffic information: is switched on (TA indicator illuminated), occasional, and very brief, muting of the radio programme may occur while the radio searches for traffic information broadcasts. For this reason, it is recommended that the traffic information is switched off when not required.

NOTE: *It is also recommended that you ensure the traffic information mode is switched off when the FM pre-set buttons are programmed.*

Switching OFF Traffic Information

To switch off the traffic information mode, briefly press the TA/AF button (the "TA" indicator disappears from the display).

Receiving ONLY Traffic Information

With the radio tuned to a traffic information station ("TA" and "TP" indicators illuminated), press and hold the VOL button (8) until a two-tone beep sounds. The display shows "MUTE" and the radio remains silent until a traffic information broadcast is received. During traffic information broadcasts the display will indicate which radio station the set has tuned to.

To restore normal radio reception, cancel the MUTE facility by pressing the button a second time until the display changes.

Receiving Traffic Information During Tape or Compact Display Play

When the radio is in the traffic information mode ("TA" and "TP" or "TP-EON" indicators illuminated), tape or compact disc play will be interrupted by traffic information broadcasts as and when they occur.

During traffic announcements the display will alternatively indicate the radio station name with the word "INFO".

Enhanced Other Networks (EON)

EON is a service whereby a number of different radio stations are linked together in a single network. If your radio is tuned to a station in the network that does not broadcast traffic information, then once the TA button is pressed, the set will broadcast any available traffic information from other transmitters in the network.

NOTE: *If any of the radio stations stored in the pre-set buttons are in the EON network then, provided the set is tuned to an EON station, the radio automatically updated their frequencies during the journey.*

Radio Wavebands and Frequencies

In the past it was unusual for MW and LW wavelengths to be identified in metres, eg. Radio 4, 1500 metres. However identification by frequency is now normal. The frequencies on the radio are indicated in kilo-Hertz (kHz) and under this system Radio 4 is found at 200 kHz.

This simple formula approximately converts wavelengths in metres into frequencies in kHz:

kHz = 300.000 metres

Reception Quality

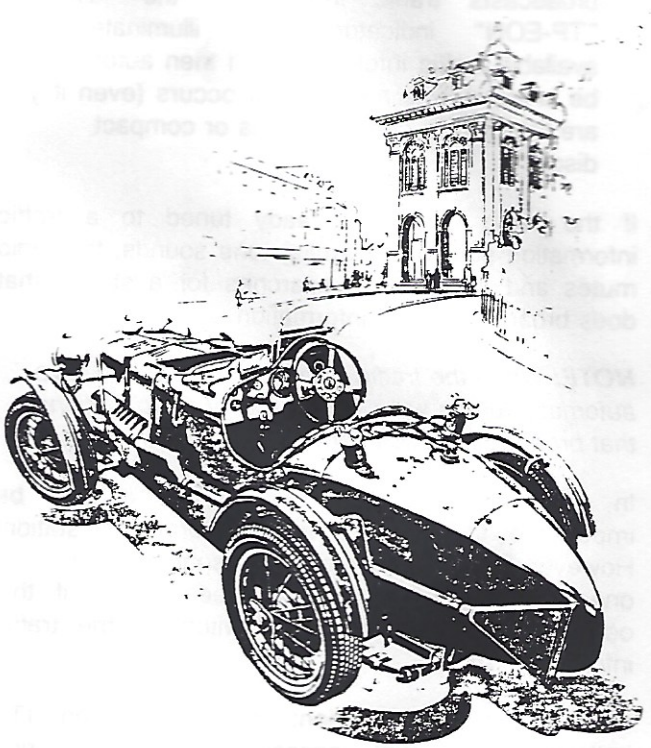
Weak or distorted reception is often attributed to a fault in the radio. This is rarely the case!

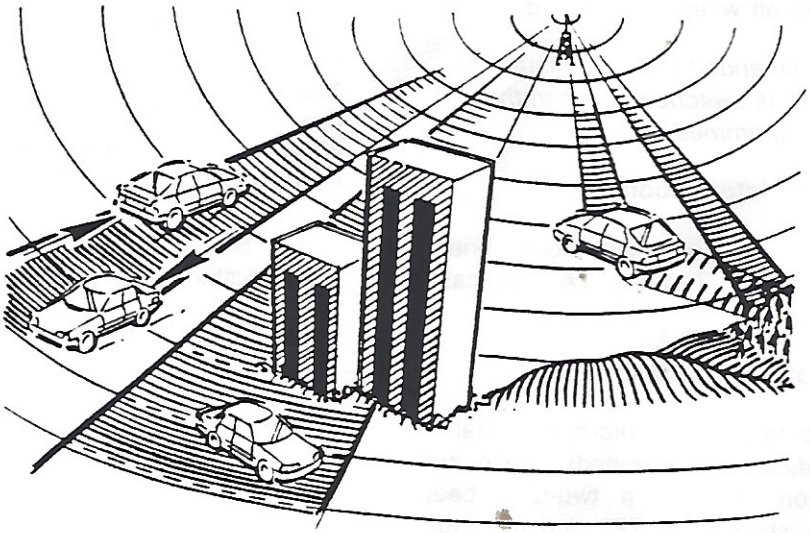
Please Remember: A car radio receives signals while the vehicle is in motion - constantly changing direction and moving further away from, or nearer to, the transmitter and also negotiating terrain with widely differing reception characteristics.

- When travelling it may be necessary to re-tune the radio from time to time to offset the effects of moving from one transmitter area to another. (Note: sets with RDS do this automatically).
- FM transmitters broadcast over a limited range, and good signals will only be received in the immediate area of the transmitter.
- The broadcast range for good stereo reception usually within a 30 to 40 mile radius of the transmitter - is noticeably less than for mono.
- FM signals behave like light waves and travel in a nearly straight line. Obstacles such as tall buildings can sometimes shield a vehicle from the signal causing distortion or even complete loss of reception.
- Distortion can also occur if FM signals received directly from the transmitter mix with signals reflected by mountains or buildings.
- Use of the mono/stereo switch can sometimes reduce excessive background noise.
- The quality of LW and MW reception is usually better during daylight hours.

HISTORY FILE

1933 K3 MAGNETTE





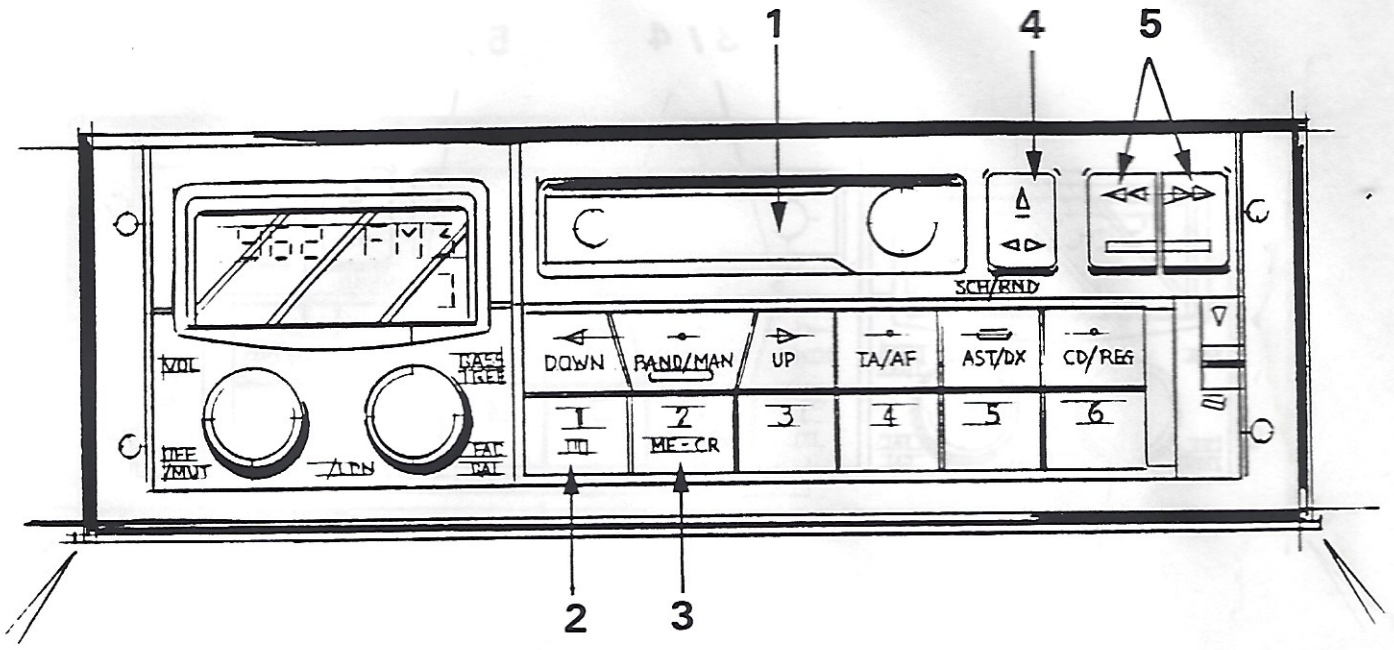


fig.22

CASSETTE PLAYER CONTROLS

1. **Cassette Compartment**
   Insert the tape with the open side to the right and push fully in until the eject button springs out. The radio mutes and tape play starts immediately the word "TAPE" and an arrow (indicating the direction of play) appear in the display.

NOTE: *At the end of either side of the tape, play will automatically continue in the opposite direction (an arrow shows in the digital display to indicate direction of play).*

2. **Dolby B Noise Reduction Switch***
   Press when playing tapes recorded using the Dolby BNR system (the display shows the Dolby "DD" symbol).

3. **Metal/Chromium Cassette Selector**
   Press when playing a Metal or Chromium cassette tape (the display shows "ME CR"). Press again to change back to a Ferro cassette tape.

4. **Cassette Eject and Reverse Button**
   Push the button fully in to eject the tape, or half way in to reverse the direction of play.

5. **Rewind and Fast Forward Wind Buttons**
   To rewind press the button opposite to the direction of the arrow appearing in the display during tape play. To forward wind, press the button corresponding to the direction of the arrow in the display during tape play .

During tape winding, the radio operates and "FAST" shows in the display. To stop tape winding, half press the remaining (unlocked) button. Tape play will automatically resume.

NOTE: *Whenever the end of a tape is reached, the cassette player will automatically stop winding, reverse direction and start playing in the opposite direction (on the other side of the tape).*

* Noise reduction manufactured under license. "Dolby" and the "DD" symbol are trade marks of Dolby Laboratories Licensing Corporation.

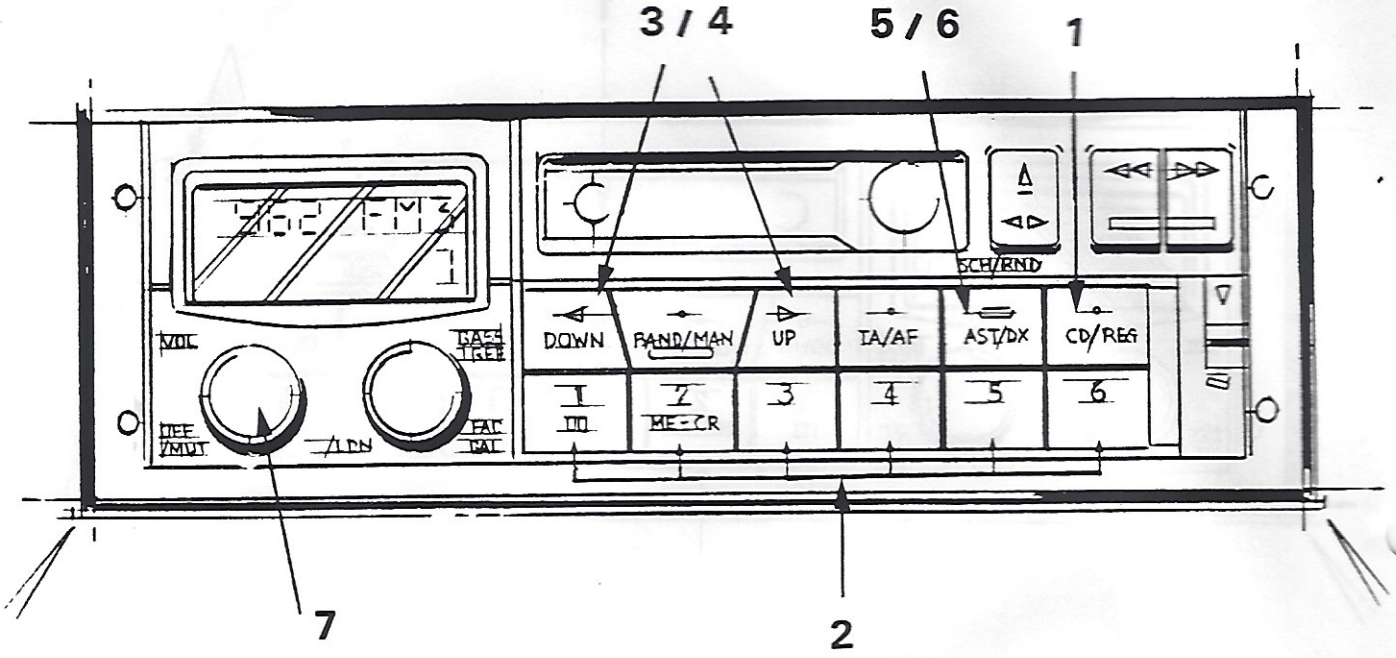


fig.23

COMPACT DISC PLAYER CONTROLS

1. **CD Selector**
   Press briefly to select CD player mode (the display reads "CD CHANGE").

Once the CD mode is selected, playback starts from the point on the disc at which you last stopped, or from the beginning of the first disc if the magazine is newly inserted. The display shows the track number ("TR 01") and the disc number ("CD 1").

At the end of each disc, playback automatically continues with the next disc (skipping any missing discs if less than six have been loaded in the magazine).

2. **Disc Selection Buttons 1-6**
   Press one of the pre-set keys 1-6 to select the desired disc. If an empty compartment is inadvertently requested, the display shows "NO DISC" and the CD player automatically locates the next available disc.

3. **Track Selection Buttons**
   Briefly press the "up" or "down" button to either advance to the next track , or return to the start of the current track.
   Press either button repeatedly to move forward or back through several tracks at a time (also see "Random Play Button").

4. **Fast forward/backward**
   To quickly move to another part of the disc during playback, press the "UP" key or "DOWN" key for a minimum of two seconds. Playback resumes when the key is released.

5. **Scanning Button**
   Briefly press the (SCN/RND) button, each track is played for 10 seconds (the display shows "SC"). When all the tracks have been scanned, scan continues from the first disc until the function is switched off by pressing the SCN/RND button for a second time.

6. **Random play Button**
   Press the (SCN RND) button for at least two seconds, each track on the selected disc will be played in a random order (the display shows"RD"). When all the tracks have been played, random selection continues on the remaining discs until the function is switched off by pressing the RND button for a second time. With random play selected, the functions of the track selection buttons operate as follows:

Press the "up" button to advance to the next randomly chosen track and press the "down" button to return to the start of the current track.

7. **Mute Button**
   Press and hold for 2 seconds. A two-tone beep sounds and the display shows "CD PAUSE". All sound is muted apart from the special traffic information radio broadcasts. Press briefly a second time to cancel the mute facility.

Digital Display Information

"NO MAG" indicates that the magazine is empty or that the magazine has not been inserted in the CD changer.

"NO DISC" indicates that a disc has been inserted the wrong way up.

"CD ERROR" indicates that either a damaged disc has been inserted in the magazine or that a disc has been inserted the wrong way up. If the message persists, switch the set off and then on again

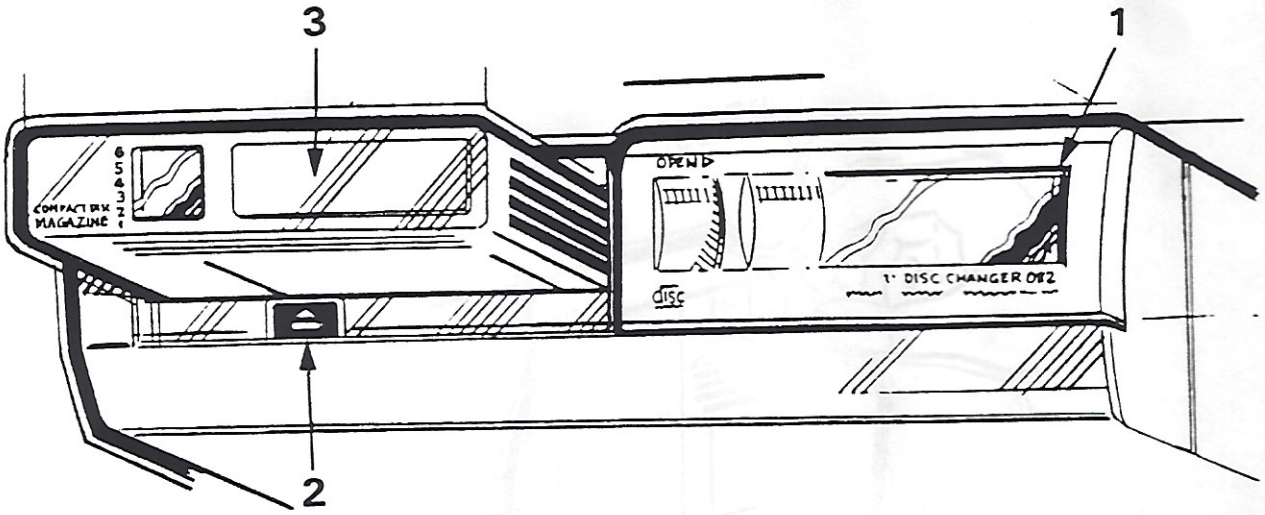


fig.24

1. **Sliding Cover**
   Open cover to insert or remove the magazine. Keep closed at all other times to prevent dust and dirt from entering the changer unit.

2. **Eject Button**
   Press to eject the magazine.

3. **Magazine**
   Insert the magazine in the direction of the arrow marked on the magazine cover (with the white disc levers towards the bottom of the changer) and push the magazine fully into the changer unit.

Loading the magazines with discs

Holding the magazine with the arrow pointing upwards (as shown), insert each disc into the magazine with the label side facing you. Be sure to hold ONLY the edge or centre hole of the disc, and only insert one disc in each compartment.

If you require to play 8 cm singles, use a CD single adapter. Ensure the disc fits securely into the adapter to avoid any possibility of it coming loose and blocking the auto changer.

NOTE: *Additional magazines can be obtained from a dealer.*

Unloading

Again, holding the magazine as shown, press down the appropriate white disc lever. The disc in that compartment will partially eject and can then be pulled out by hand. Unload one disc at a time and handle ONLY the edge or centre of the disc.

WARNING: The CD changer should not be used in temperatures outside the range -10°C to +60°C.
The CD changer should be used in the manner described - any other application or method or use could result in the user being exposed to invisible laser radiation exceeding the limit of laser class 1.

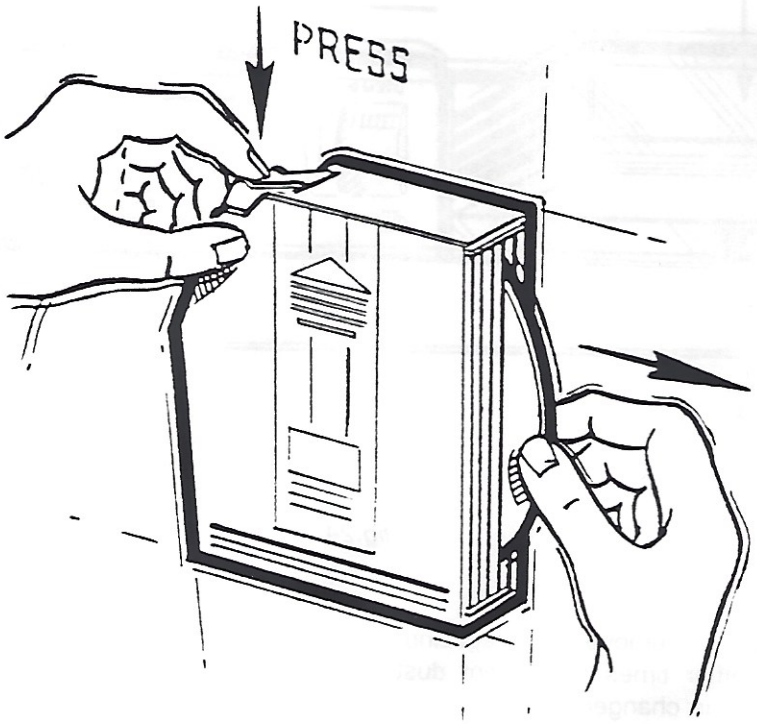


fig.25

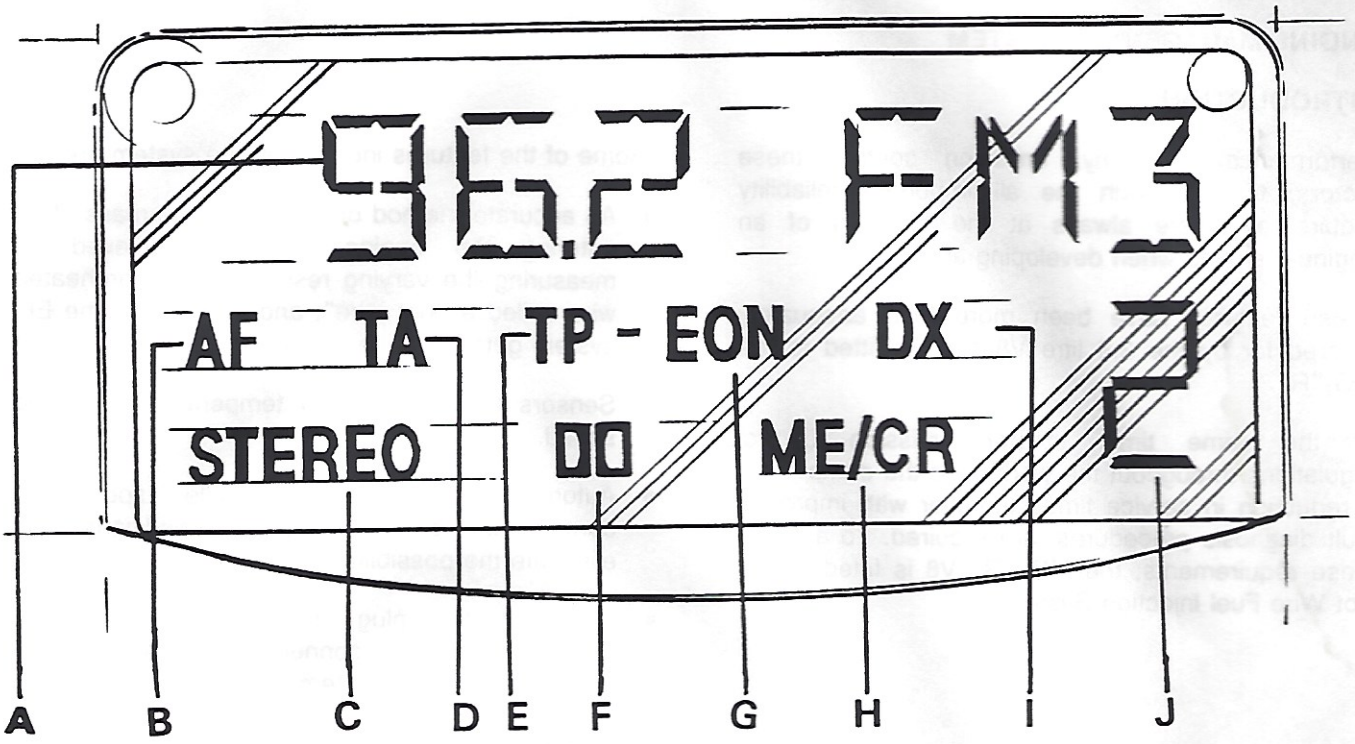


fig.26

Digital Display

The digital display highlights the function of the radio and cassette player during use:

(a) The main display area indicated the following:
During radio reception:
The frequency, waveband (FM1, FM2, FM3, MW1, MW2, LW) or radio station name.

During tape play
The word "TAPE" to indicate tape play or "FAST" to indicate tape winding , together with an arrow showing the direction of play.

During compact disc play:
The track number ("TR 01") and compact disc number ("CD 1"). In addition, any of the following words may be displayed to indicate the status of the CD changer.
"CD MODE". "CD CHANGE", "CD PAUSE"
"NO DISC", "NO MAG", or "CD ERROR".

(b) RDS alternative frequency (AF) indicator (illuminates when the traffic information mode is selected - FM waveband only).

(c) Stereo indicator (FM waveband only).

(d) Traffic announcement (TA) indicator (illuminates when the traffic information mode is selected - FM waveband only).

(e) Traffic programme (TP) indicator (illuminates when the radio is tuned to a station or a network of stations, that broadcast traffic information).

(f) Dolby B noise reduction indicator (cassette play only).

(g) Enhanced other networks (EON) indicator (illuminates when the radio is tuned to a station that is included in a network of radio stations).

(h) Metal/chromium tape indicator (cassette playback only).

(i) Seek mode indicator (illuminates when AUTO STORE searches for weaker signals).

(j) Radio pre-set number (1-6).

IMPORTANT: *If the words "WAIT" or "CODE" appear in the display, an incorrect security code has been entered or the power supply has been interrupted.*

WARNING: DO NOT push or rub the window. This will damage the display!

ENGINE MANAGEMENT SYSTEM

INTRODUCTION

Performance, economy, emission control; these factors, together with the all important reliability requirements, are always at the forefront of an engineer's mind when developing an engine.

These features have been more than adequately catered for by the 3.9 litre V8 engine, fitted to the MG "R".

At the same time, stricter emission control regulations throughout the world, and the demand for a reduction in service times together with improved fault diagnosis procedures, are required. To achieve these requirements, the MG "R" V8 is fitted with a Hot Wire Fuel Injection System.

This Training Manual contains a full description of the Hot Wire EFI System and its components parts in the following sections:

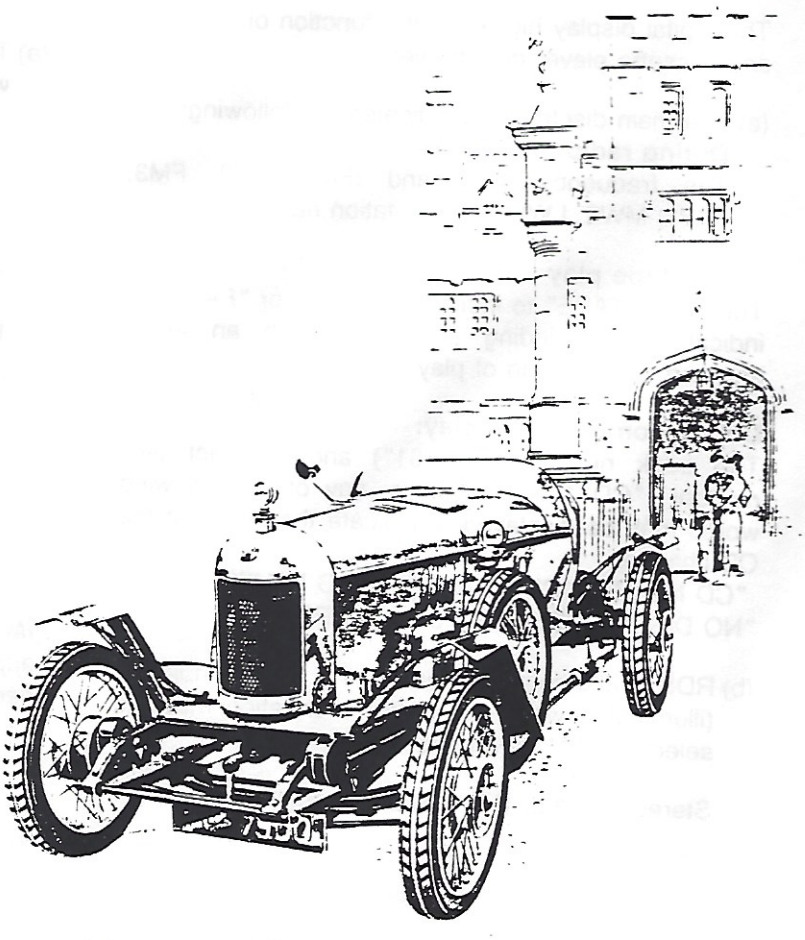
Fuel System
Air Intake System
Electronics
Fault Diagnosis

Some of the features included in the system are:-

- An accurate method of measuring the mass of air entering the engine. This is achieved by measuring the varying resistance of a preheated wire called a "hot wire", and from which the EFI system gets its name.
- Sensors to measure fuel temperature and road speed.
- Automatic adjustment of idle speed to compensate for changing load conditions, and eliminate the possibility of engine stall.
- A diagnostic plug to enable Microcheck equipment to be connected for a thorough examination of the system.

HISTORY FILE

OLD NUMBER ONE



Engine Harness - Component location

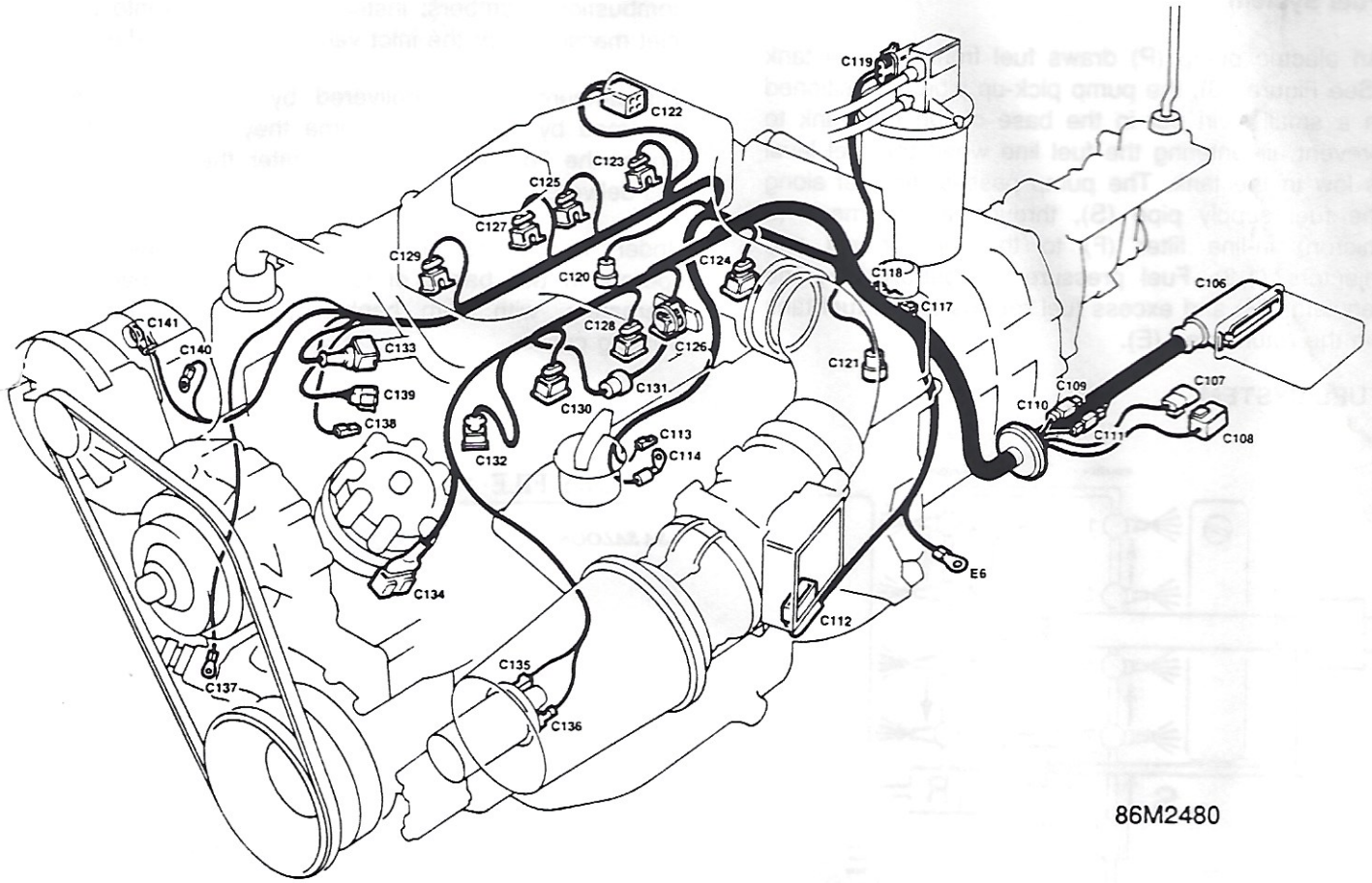


fig.27

E6 Earth point 6
C106 Fuel ECU
C107 Engine to main harness
C108 Engine to main harness
C109 Diagnostic connector link
C110 Diagnostic connector link (EFI)
C111 Tune select resistor
C112 Air-flow meter
C113 Starter solenoid
C114 Starter motor
C117 Ignition resistor
C118 Ignition resistor
C119 Purge valve
C120 Oxygen sensor
C121 Oxygen sensor
C122 Stepper Motor
C123 Injector N°8
C124 Injector N°7
C125 Injector N°6
C126 Injector N°5
C127 Injector N°4
C128 Injector N°3
C129 Injector N°2
C130 Injector N°1
C131 Throttle Potentiometer
C132 Coolant temperature sensor (ECU)
C133 Fuel temperature sensor
C134 Ignition amplifier module
C135 Ignition coil
C136 Ignition coil
C137 Oil pressure switch
C138 Coolant temperature sensor (INST)
C139 Radiator fan switch
C140 Alternator (INST)
C141 Alternator

DESCRIPTION

Fuel System

An electric pump (P) draws fuel from the fuel tank (See Figure 28); the pump pick-up pipe is positioned in a small swirl pot in the base of the fuel tank to prevent air entering the fuel line when the fuel level is low in the tank. The pump passes the fuel along the fuel supply pipe (S), through a fine mesh (2 micron) in-line filter (F) to the injector rail and injectors (1-8). Fuel pressure is controlled by the regulator (R) and excess fuel returns to the fuel tank via the return pipe (E).

FUEL SYSTEM

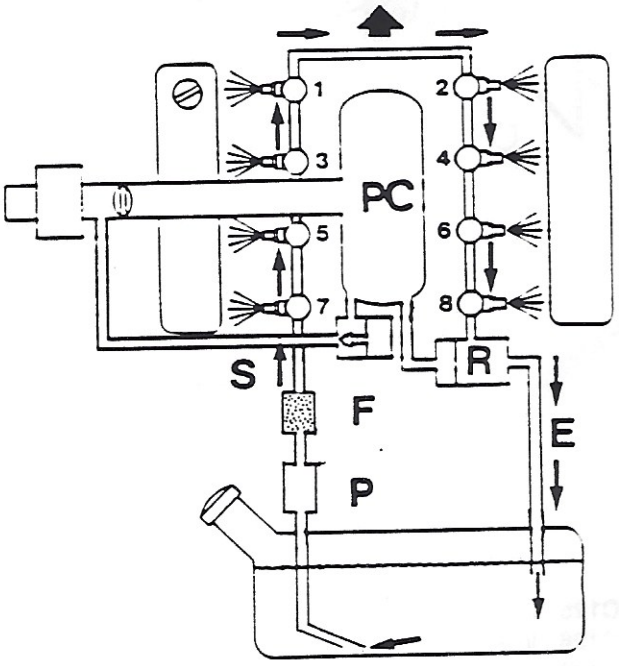


fig.28

P Fuel pump
F Filter
S Fuel supply pipe
E Excess fuel return pipe
R Fuel pressure regulator
PC Plenum chamber
1-8 Injectors

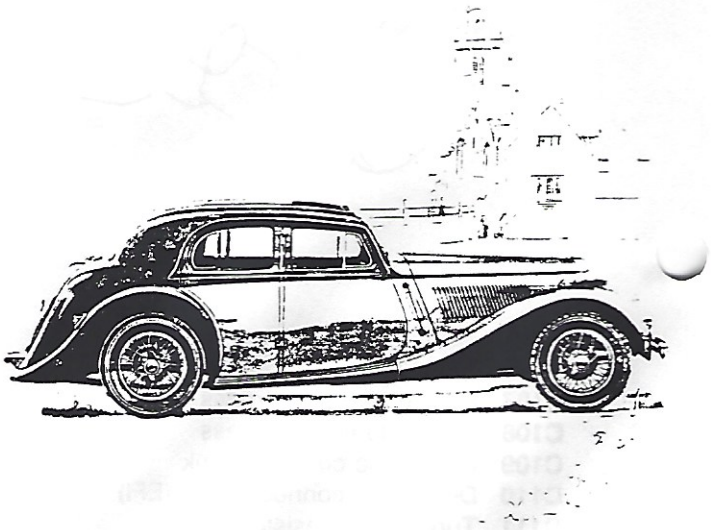
Fuel enters the engine via eight injectors, one for each cylinder, and the fuel is injected indirectly. This means that fuel is not injected directly into the combustion chambers; instead it is injected into the inlet manifold near the inlet valve of each cylinder.

The amount of fuel delivered by the injectors is governed by the period of time they are open, the longer the "open" time, the greater the amount of fuel delivered.

Under normal running conditions, the injectors operate in two banks of four, each bank operates alternately, with both banks operating twice per working cycle.

HISTORY FILE

SA SALOON



INTAKE AIR SYSTEM

Without the correct volume of air the fuel will not burn efficiently; therefore a sophisticated intake air control system is necessary.

INTAKE AIR SYSTEM

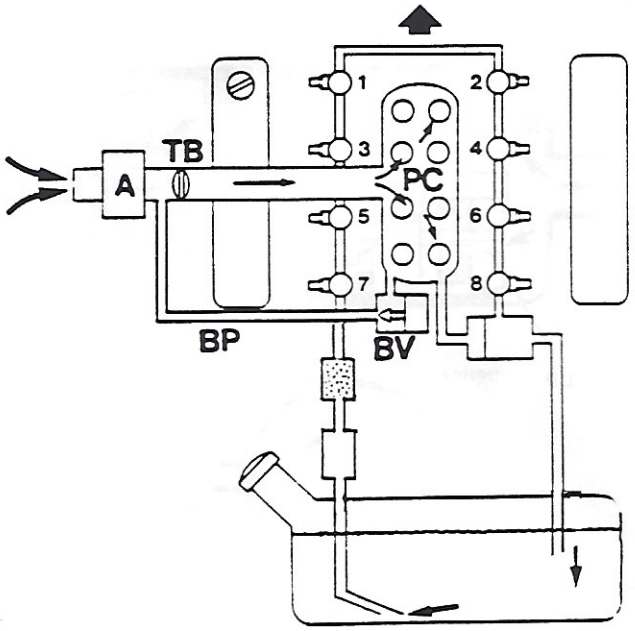


fig.29

A Air flow meter
TB Throttle butterfly
PC Plenum chamber
BP By-pass pipe
BV By-pass valve

The accelerator pedal operates a throttle butterfly (TB) (See Figure 29), located in the air intake tract. From there air passes to a plenum chamber (PC) located centrally over the engine and from which the air is drawn through its ram pipes into the inlet manifold.

However, before the air reaches the throttle butterfly it is drawn through the air flow meter (A). The air flow meter is a vital part of the EFI system; it measures the temperature and volume of the air entering, which enables the ECU to calculate its weight and mass.

When the engine is idling, the throttle butterfly is closed, and air reaches the engine via an external pipe (BP) and the by-pass valve (BV) attached to the rear of the plenum chamber. The position of the valve is adjusted electronically to maintain the correct idle speed, at all times.

ELECTRONICS SYSTEM

The injector "open" time (duration) is controlled by the Electronic Control Unit (ECU) (See Figure 30).

The ECU contains a solid state computer which receives information from a number of sensors i.e. road speed, engine speed, engine temperature, ambient temperature, fuel temperature, throttle position, air flow, etc. It compares this information with data stored in its memory and injects the correct amount of fuel by controlling the injector "open" time.

Electronics System

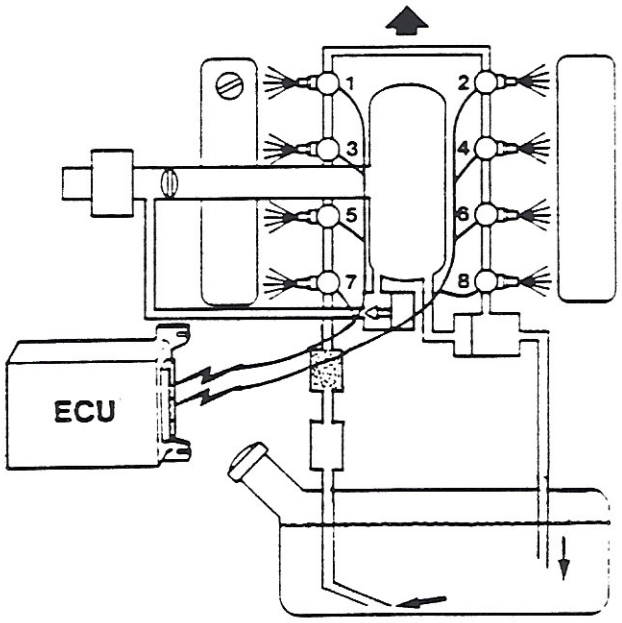


fig.30

In addition to controlling injector opening, the ECU signals the stepper motor in the by-pass valve to control the idle speed.

The ECU is also responsible for opening the purge valve in the fuel evaporative loss system.

FUEL SYSTEM OPERATION

Fuel Pump

The electric fuel pump is located below the RH rear wing.

Fuel Pump

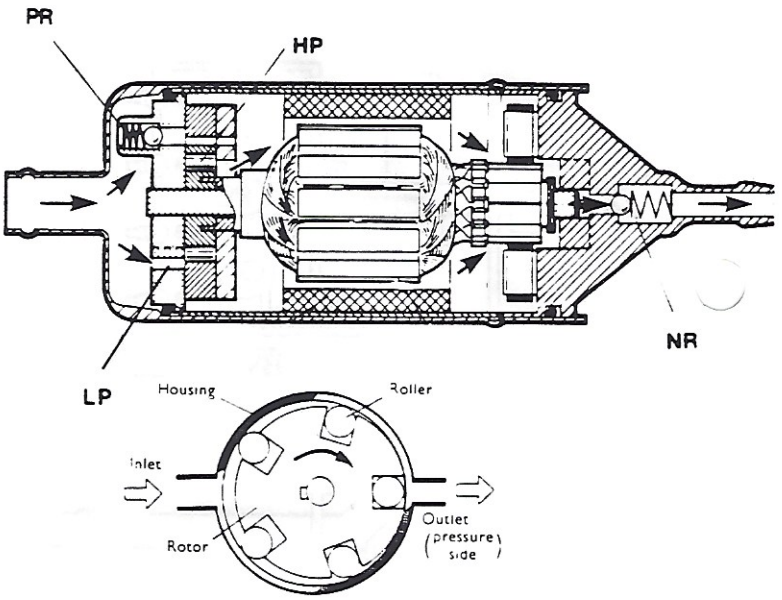


fig.31

LP Low pressure vane pump
HP High pressure roller pump
PR Pressure relief valve
NR Non-return valve

An excess pressure relief valve (PR) is located on the outlet side of the armature and protects the pump from over-pressurising. A non-return valve (NR) is located in the pump outlet to the filter and injectors; it prevents fuel draining from the injector supply pipe.

Fuel is drawn through a filter at the pump inlet and into the vane pump (LP). The vane pump delivers pressure, thus ensuring that the system is primed. The roller pump boosts the fuel pressure to feed the injection system; excess pressure opens the relief valve allowing fuel circulation through the pump to ensure lubrication and cooling of the motor.

Fuel Filter

Injector components are machined to extremely close tolerances, and therefore thorough fuel filtering is essential for efficient operation and long life.

The fuel filter is mounted, forward of the fuel tank, and is accessed under the right rear wheel arch. It is a 2 micron, fine mesh unit which must be changed at stipulated service intervals. When the filter is replaced it must be fitted the correct way round, an arrow on the filter body shows the direction of fuel flow when it is installed.

Fuel Pressure Regulator

The fuel pressure regulator is fitted to control the pressure of fuel delivered at the injectors by sensing variations in manifold depression, this ensures that the actual quantity of fuel released by the injectors is governed by one factor only - injector "open time".

The pressure regulator is fitted in the excess fuel return pipe (E), close to the injector fuel rail with its fuel supply (F). It has two chambers separated by a diaphragm (R1), one chamber contains fuel from the supply line (F), the other is linked by a pipe to the engine side of the throttle butterfly to sense manifold depression.

In the rest position the spring (R2) holds the diaphragm valve against the fuel return pipe.

Under conditions of low manifold depression, e.g. full throttle (Figure 32), the spring continues to hold the diaphragm on its fuel return pipe seat. In these circumstances, pump pressure must reach approximately 2.5 kgf/cm², (36 lbf/in²) to move the diaphragm valve against spring pressure and allow excess fuel to return to the tank.

When manifold depression is high, e.g. idle and overrun (Figure 33), the diaphragm valve is drawn against the spring pressure and the pressure in the fuel line falls to 1.8 kgf/cm² (26 lbf/in²). Any intermediate depression will regulate fuel pressure between the minimum and maximum.

In this way fuel pressure varies according to manifold depression and ensures the amount of fuel delivered by the injectors is governed only by the injector "open time".

Fuel Pressure Regulator

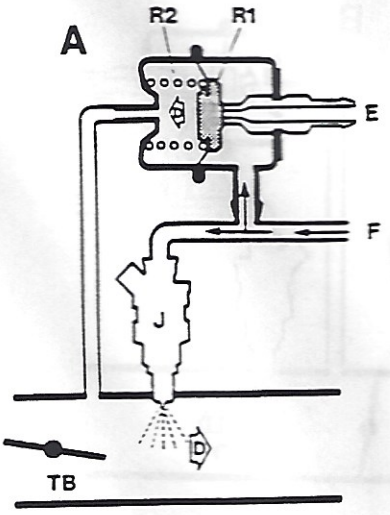


fig.32

TB Throttle butterfly
D Manifold depression
E Excess fuel return
J Injector
R1 Regulator diaphragm valve
R2 Regulator spring
F Fuel rail (pump supply)

Fuel Pressure Regulator

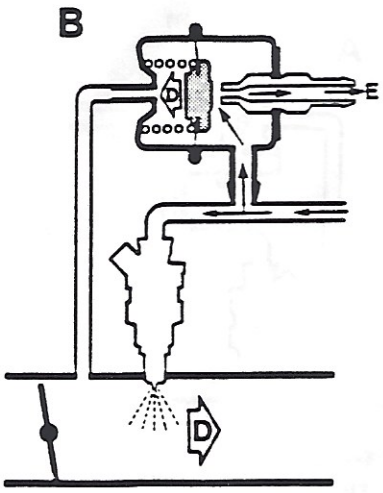


fig.33

When manifold depression is low (Figure 32), fuel pressure needs to be high to ensure sufficient fuel is forced through the injector for a given injector "open time", say 0.003 cc of fuel per 10 millisecond period.

When manifold depression is high (Figure 33), the depression will try to "suck" fuel from the injector nozzle. Therefore the fuel pressure needs to be reduced by the action of the regulator to ensure the same 0.003 cc of fuel, will pass through the injector, in the same 10 millisecond period.

INJECTORS

Although the injectors are non-serviceable items, it is useful to have some working knowledge of how they operate for diagnostic purposes.

Injector

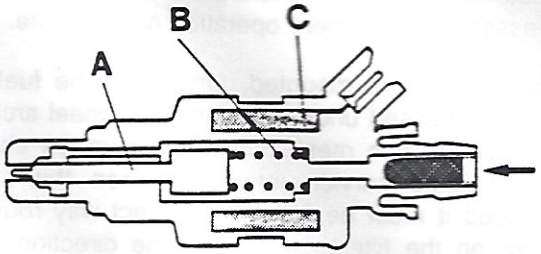


fig.34

Each injector contains a needle valve (A) as seen in Figure 34, which is held closed in the rest position by a coil spring (B). When the electrical solenoid (C) is energised, it lifts the needle valve to allow the fuel to pass; and when the solenoid is de-energised, the spring snaps the needle valve closed to cut-off the fuel flow. The tip of the needle is ground to a pintle shape to ensure efficient atomisation of the fuel spray into the inlet manifold.

The injector needle valve is opened when signalled by the ignition system via the ECU.

The signal to inject comes from the ignition distributor reluctor as shown in Figure 35. Only four of the reluctor gaps are used to signal "inject"; the ECU ignores every other signal. It is the ECU which dictates the injector "open time" and therefore the amount of fuel that is injected.

As can be seen in Figure 8, the injectors are linked in two banks of four, 1, 3, 5, 7 and 2, 4, 6, 8. Under most driving conditions the two banks inject alternately, twice per engine cycle. However, under cold start conditions, all eight injectors open simultaneously until the engine speed reaches approximately 250 rpm.

As has been already stated, fuel pressure is controlled initially by the pressure relief valve in the fuel pump; "fine tuning" of the pressure to the injectors is provided by the pressure regulator.

Injector Opening Sequence

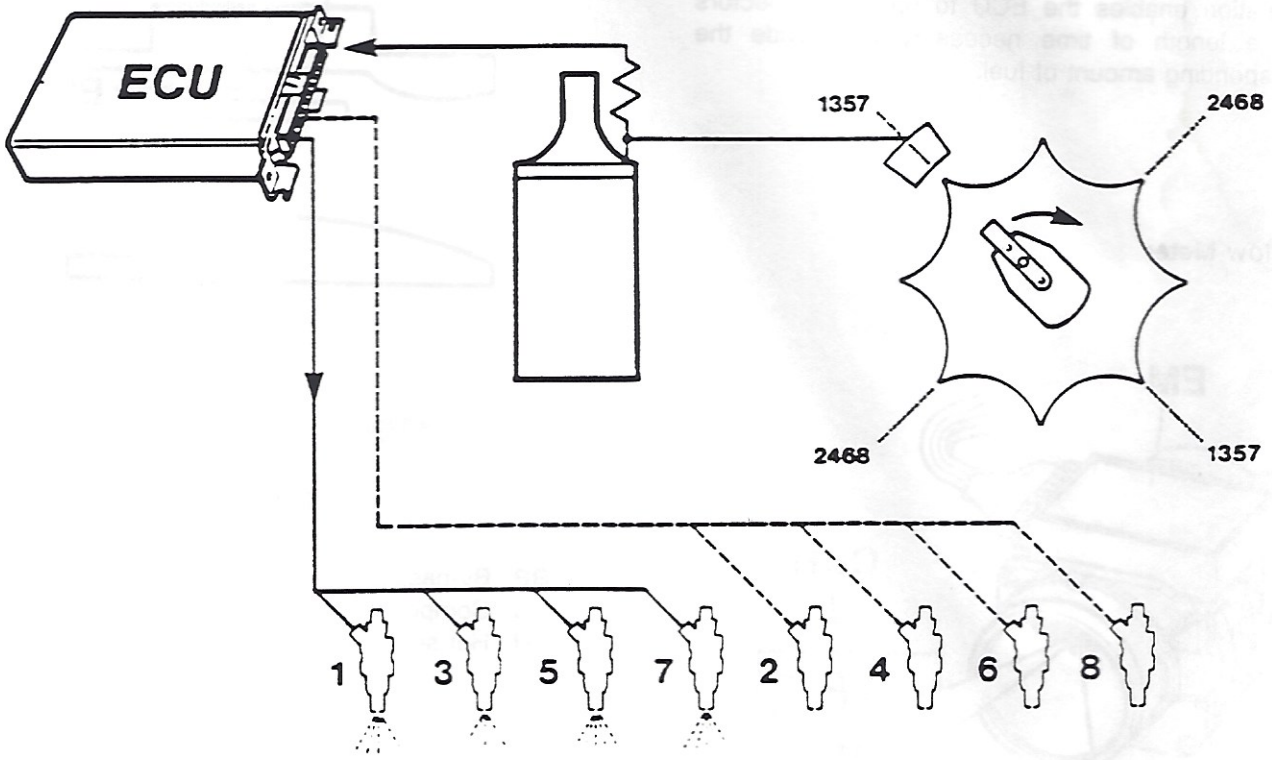


fig.35

AIR SYSTEM OPERATION

Air Flow Meter

The air flow meter is located between the air filter and the throttle butterfly housing. It is the key sensing component of the EFI system, providing the ECU with details about the quantity and temperature of the air being drawn into the engine. This information enables the ECU to open the injectors for the length of time necessary to provide the corresponding amount of fuel.

Air Flow Meter

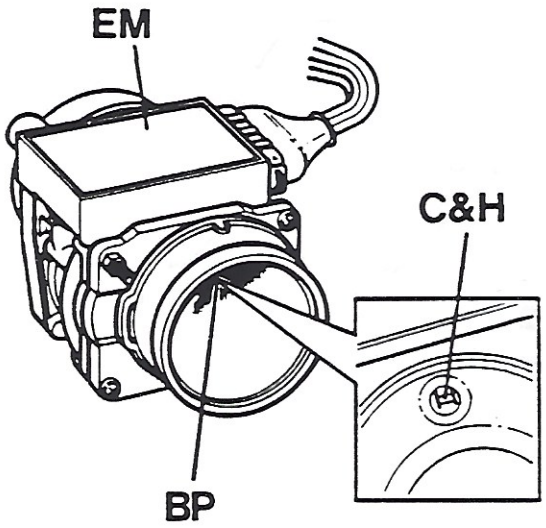


fig.36

EM Electronic module
BP Bypass port
C/H Sensing wires

The air flow meter has a cast alloy body with an electronic module (EM) mounted on top (See Figure 36). A small by-pass port (BP) in the top of the air intake contains two sensing wires (C & H) which are connected to the electronic module which, in turn, is connected to the ECU.

Air Flow Meter (Bypass port)

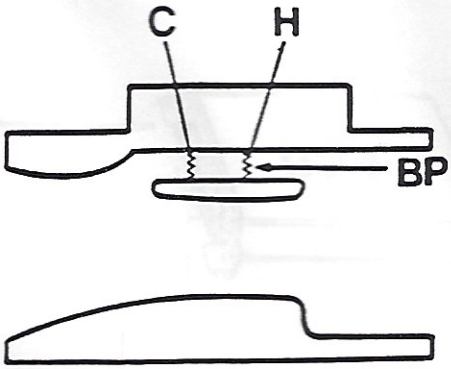


fig.37

BP By-pass port
C Compensating sensing wire
H Hot sensing wire

Referring to the schematic cross-section of the air flow meter (Figure 37), you can see the bypass port (BP) through which a small portion of the total air entering the engine has to pass.

Located in this by-pass are the two sensing wires C and H; both are connected to the ECU and have current passing through them. The compensating wire is unheated: it reacts to the intake air temperature and signals this information to the ECU.

As its name suggests, the hot sensing wire has a heating current passing through it; the intake air has a cooling effect on this wire which altered its resistance. The amount the resistance altered is proportional to the volume of air entering, and the ECU uses this information to compute the necessary "open time" of the injectors.

Throttle Butterfly

The throttle butterfly (See Figure 38) is mounted between the plenum chamber and the air flow meter; it is linked directly to the driver's accelerator pedal and controls the volume of air entering the engine.

A potentiometer is connected to the butterfly spindle and senses all movements of the throttle butterfly and signals this information back to the ECU.

Plenum Assembly

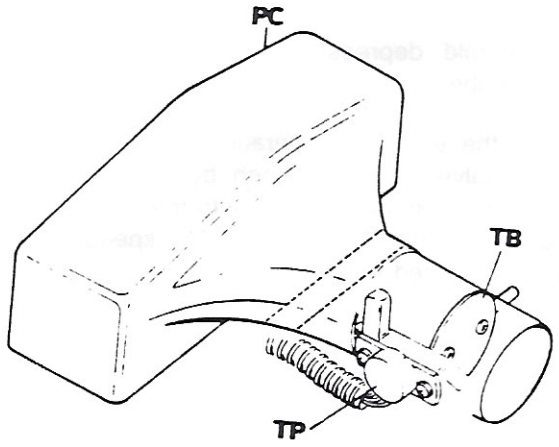


fig.38

PC Plenum chamber
TP Throttle potentiometer
TB Throttle butterfly

This information, along with the air flow information provided by the air flow meter, is signalled to the ECU for analysis and therefore calculation of the injector "open time", providing the engine with a very accurate air/fuel ratio. The required ratio's vary, depending on a number of factors; therefore, additional sensors are fitted to ensure the correct air/fuel ratio is achieved under all driving conditions.

By-pass Air Valve

When the engine is running at idle speed (i.e: the drivers foot is off the accelerator pedal), the throttle butterfly is closed, and air is supplied via the by-pass air valve (See Figure 39).

The by-pass air valve and stepper motor assembly is fitted directly onto the rear of the plenum chamber. The valve position is adjusted by the stepper motor which is controlled by the ECU.

Air By-pass Valve

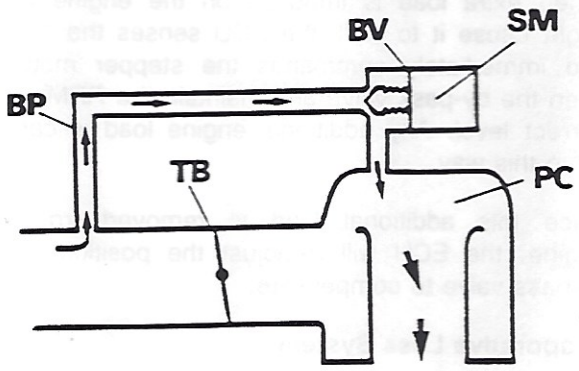


fig.39

PC Plenum chamber
TB Throttle butterfly
BP Throttle by-pass
BV By-pass air valve
SM Stepper motor

The purpose of the by-pass air valve assembly is to enable the idle speed to be automatically maintained at a constant speed.

As can be seen in Figure 39, whenever the throttle butterfly (TB) is closed, air is drawn from the atmospheric side of the butterfly into the plenum chamber (PC) via the by-pass pipe (BP) and valve (BV).

The stepper motor (SM), which is controlled by the ECU, moves the by-pass valve in or out to adjust the volume of air entering the plenum chamber, thereby increasing or decreasing the engine speed. The ECU not only monitors engine speed but also engine temperature, as well as receiving information from many other sources. The information received by the ECU enables it to adjust the stepper motor and by-pass valve to suit any variation in engine load.

When the engine is being started from cold for example, the ECU will command the stepper motor to open the by-pass port sufficiently to provide fast idle warm-up; then, as the engine temperature rises, the idle speed will automatically be reduced by the ECU and stepper motor to the specified idle RPM.

When extra load is imposed on the engine which might cause it to stall, the ECU senses the change and immediately commands the stepper motor to open the by-pass valve and maintain the RPM at the correct level. Any additional engine load is catered for in this way.

Once this additional load is removed from the engine, the ECU will re-adjust the position of the by-pass valve to compensate.

Evaporative Loss System

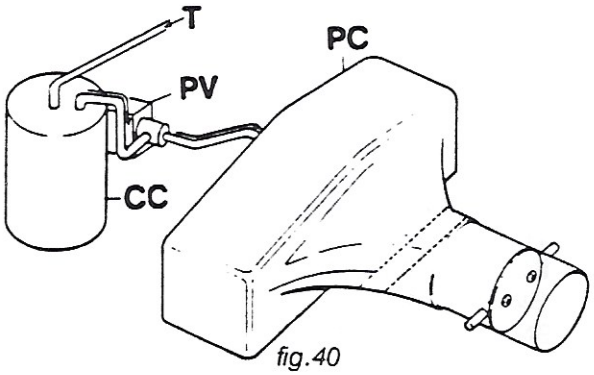


fig.40

CC Charcoal canister
T Fuel tank connection
PV Purge valve
PC Plenum chamber

FUEL EVAPORATIVE LOSS SYSTEM

Todays specification of fuel systems requires for the recycling of fuel vapour escaping from the fuel tank. A charcoal canister and purge valve are mounted on the lefthand engine bay bulkhead to deal with this.

The purpose of the charcoal canister (CC) is to absorb any fuel vapour released from the fuel tank via the fuel tank connection (T) in Figure 40 when the engine is not running.

The opening of the Purge Valve is controlled by the ECU, and only occurs when the following conditions prevail:

- Engine temperature is above approx 54°C (130°F).
- Manifold depression is present in the plenum chamber.

When the engine is operating below 1700 rpm the purge valve is pulsed open by the ECU, ensuring that stored vapour is drawn into the plenum chamber (PC) and burnt. At higher engine speeds the purge valve is opened for longer periods.

COOLANT CONNECTIONS

To ensure a quick warm-up time a manifold "hot spot" (MH), see Figure 41, is fitted under the plenum chamber intake in the area of the throttle butterfly; the hot spot is heated by coolant passing through hoses (CH) from the engine.

It is important to ensure that the "hot spot" gasket and bolt threads are smeared with silicone sealant during assembly to ensure coolant cannot leak to the outside, or indeed past the bolt hole threads which could break though into the plenum chamber throat.

Throttle Butterfly Housing

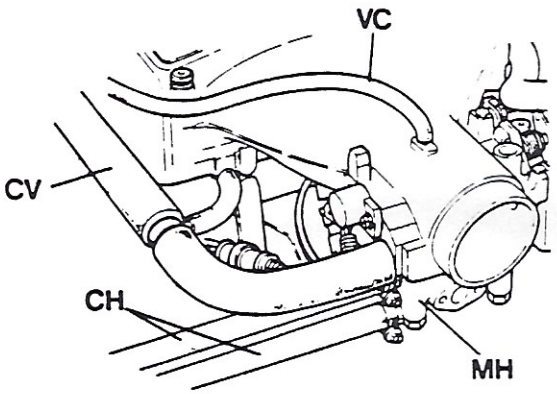


fig.41

VC Vacuum advance pipe
CV Crankcase vent pipe
MH Manifold hot spot
CH Coolant hoses

The illustration also shows the vacuum advance pipe connection (VC) on the manifold side of the butterfly and the crankcase vent pipe (CV).

CRANKCASE VENTILATION

The crankcase ventilation system (see figure 42) is an integral part of the air supply system to the engine, but it is often overlooked when diagnosing problems. An air leak or a blocked pipe in the ventilation system will both noticeably affect engine performance.

Crankcase Ventilation System

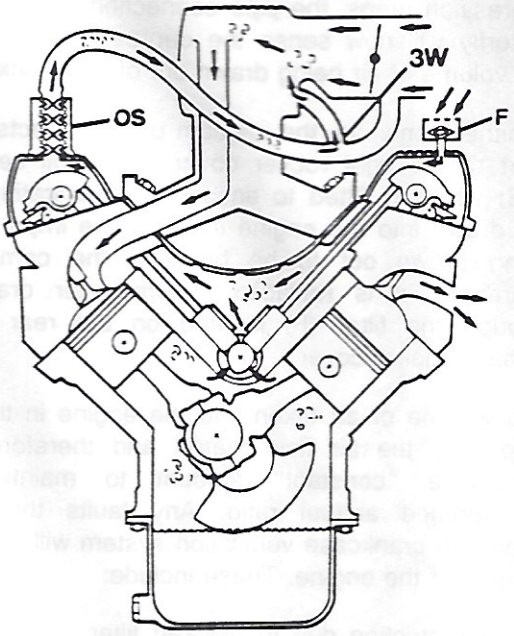


fig.42

OS Oil separator
F Filter
3W Three way connector

It can be seen that the vacuum pipe from the oil separator (OS) is split at a three way connector (3W), one pipe going to the atmospheric side of the throttle butterfly housing and the other direct to the plenum chamber. The latter pipe is connected via a restrictor built into the 3 way connector.

The system works as follows:

When the engine is idling, the throttle butterfly is closed and air is drawn out of the crankcase by depression felt at the pipe connected directly to the plenum chamber. In this condition (closed throttle) plenum chamber depression is very high, and to ensure excess air is not drawn out of the crankcase the pipe connection to the atmospheric side of the butterfly provides a convenient air bleed in.

When the throttle is opened and plenum chamber depression drops, the pipe connection at the throttle butterfly will now sense the depression, and assist the volume of air being drawn out of the crankcase.

In either condition, the vacuum pipe connects to the front of the right rocker cover via an oil separator (OS) which is fitted to ensure that lubricating oil is not drawn into the engine inlet. As the impure air is being drawn out to be burnt in the combustion chambers, it is replaced by fresh air drawn in, through the filter (F) located on the rear of the lefthand rocker cover.

The volume of air taken into the engine in this way by-passes the air flow meter, and therefore must remain a "constant" amount to maintain the programmed air/fuel ratio. Any faults that occur within the crankcase ventilation system will affect the running of the engine. These include:

- Air restriction due to blocked filter, oil separator, external pipe, restrictor in 3 way connector, etc.
- Excess air due to leaking gaskets etc.

Having explained the fuel, air and crankcase ventilation system, we will now look at the operation of the electrical sensors which provide the information by which components carry out the commands of the ECU.

HOT WIRE EFi - Circuit Diagram

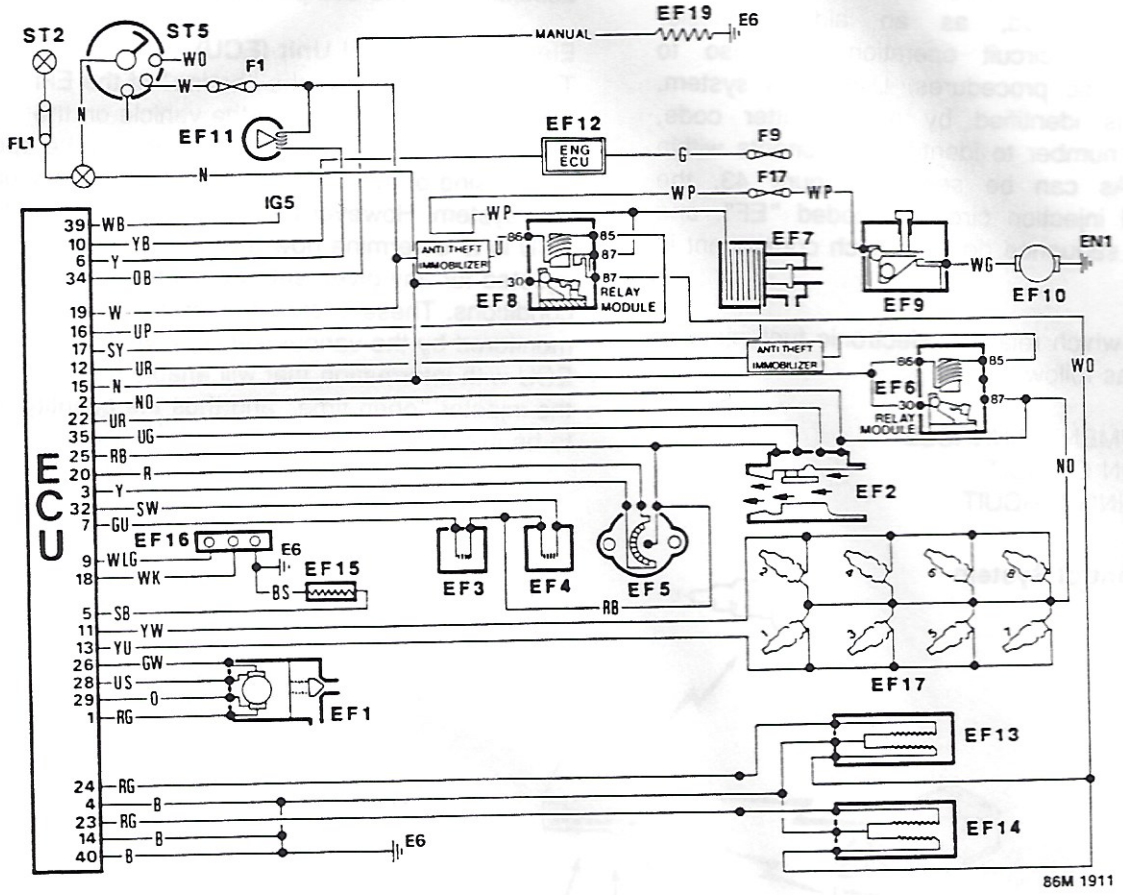


fig.43

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF5 Throttle Potentiometer
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
EF18 Anti-theft Immobiliser
EF19 Resistor
EIB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch
RM Inside relay module

Colour Code
B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

ELECTRICAL INTRODUCTION

A system of circuit and electrical component identification is used, as an aid to easier understanding of circuit operation and also to improve diagnostic procedures. Using this system, each circuit is identified by a two letter code, followed by a number to identify components within that circuit. As can be seen in Figure 43, the electronic fuel injection circuit is coded "EF", and the numerical sequence denotes each component in the circuit.

Other circuits which relate to electronic fuel injection are identified as follows:

IB = INSTRUMENT BINNACLE
IG = IGNITION CIRCUIT
ST = STARTING CIRCUIT

Electronic Control System

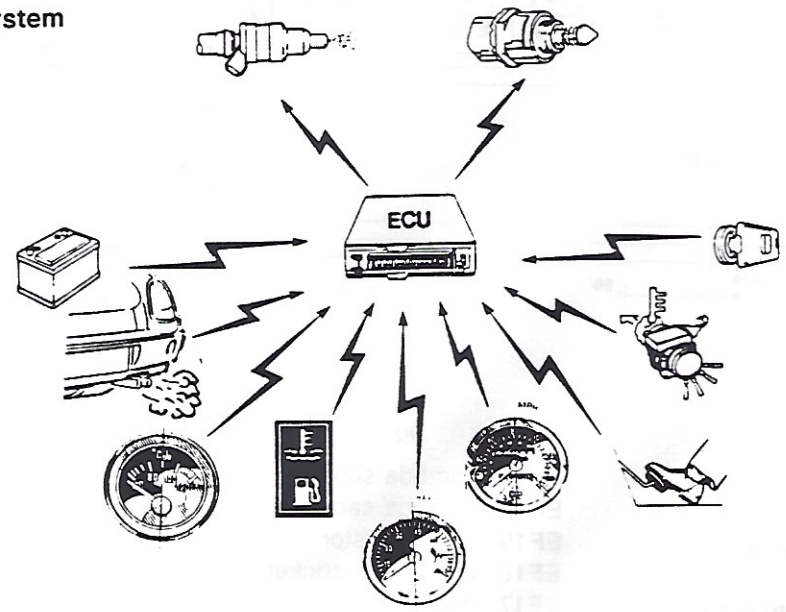


fig.44

Information is supplied to the ECU from:

- Ignition key position - to detect engine cranking duration.
- Air temperature sensor - signalled by the compensating wire in the air flow meter.
- Volume of intake air - signalled by the "hot wire" in air flow meter.
- Throttle potentiometer - to interpret the driver's accelerator movement.
- Ignition coil - to give engine speed.
- Speedometer cable transducer - to give road speed.
- Coolant temperature sensor - to calculate cold start and warm up fuelling requirements.
- Fuel temperature sensor - to give the fuel viscosity/flow information.
- Lambda sensors - to analyse exhaust gas content and mixture strength.
- Battery - to provide its state of charge condition.

Electrical Component Function and Operation

Before examining the operation of the electrical system in the various modes, the following is a brief description of the components.

Electronic Control Unit (ECU)

The ECU is of course the "brains" of the EFI system, it is located inside the vehicle on the lefthand lower A post. The ECU controls the opening and closing of the purge valve in the fuel evaporative loss system. However the principal function of the ECU is to determine how much fuel should be injected for any given set of circumstances and conditions. These circumstances and conditions are monitored by the various sensors, which provide the ECU with information that will enable it to compute the injector "open time" and thus the quantity of fuel to be injected.

Relay Module

The relay module houses the main relay and the fuel pump relay both are the electro-magnetic type of relay and work in a similar way.

The relay module is located behind the centre consul attached to the bulkhead.

Fuel Pump Relay Circuit

The fuel pump relay supplies current to the fuel pump, purge valve and lambda sensors if fitted.

When the ignition switch (ST5) is turned on, current flows to terminal 86 of the relay, around the core to magnetise it and close the contacts, out through terminal 85 and the blue/purple wire (UP) to the ECU pin 16.

With the contacts in the relay closed, this allows current direct from the battery supply (ST2) to terminal 30 of the relay to pass through the closed contacts to terminal 87. There are two connections to terminal 87 one is the white/orange wire (WO) to the lambda sensors, and the other is the white/purple wire (WP) to supply the purge valve (EF7) and the fuel pump (EF1).

Fuel Pump (EF1)

The fuel pump is supplied via the WP wire (See Figure 45) to the inertia switch (EF9) and to the fuel pump (EF1) which will start to operate.

If the ignition switch has only been turned to position II (i.e: not to the cranking position) the pump will only run for one second to prime the fuel system. After that time the ECU switches off the earth for the relay at pin 16 and the pump will stop. As soon as the ignition switch is turned to the "crank" and "run" positions, pin 16 becomes a permanent earth and the pump will operate continuously.

Fuel Pump Relay Circuit

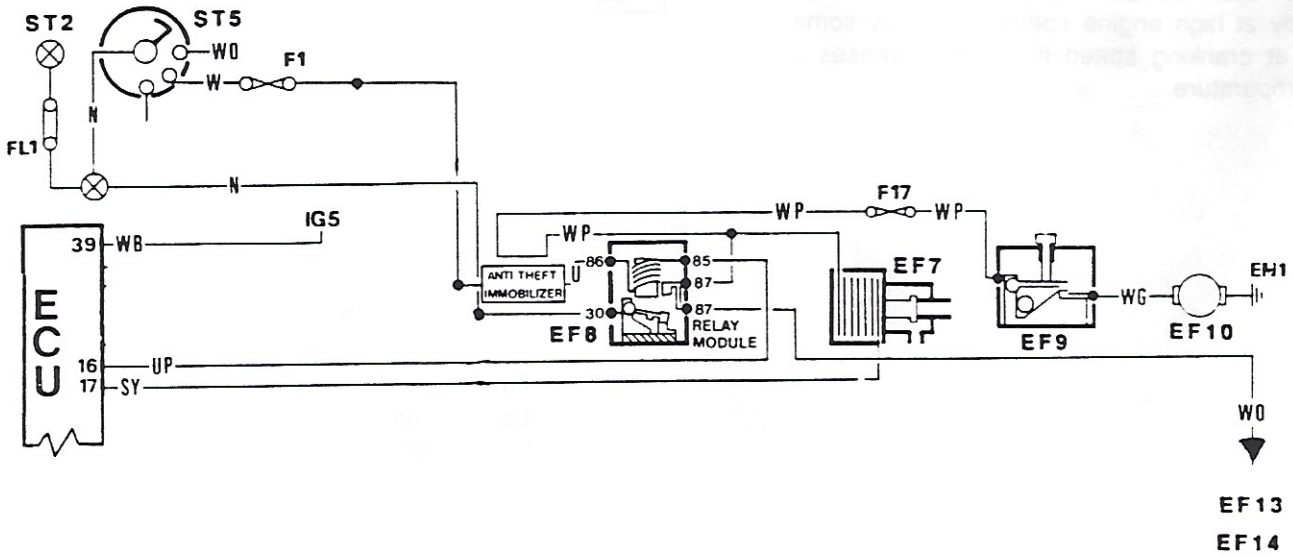


fig.45

IG5 Coil
ST2 Battery supply
ST5 Ignition switch
EF8 Fuel pump relay
EF7 Purge valve
EF9 Inertia switch
EF1 Fuel pump
EF13 Lambda sensor
EF14 Lambda sensor

Inertia Switch (EF9)

The inertia switch (See EF9 Figure 45) is located in the engine bay on the lefthand bulkhead. If the vehicle is subjected to a sudden impact, the inertia switch will open circuit the current supply to the fuel pump, which will stop it immediately.

To make the circuit operational again, the top of the inertia switch must be depressed manually.

Purge Valve (EF7)

The purge valve (See EF7 Figure 43) comprises an electromagnetic coil to open a valve in the fuel tank purge line.

The purge valve is connected via a white/purple wire (WP) to terminal 87 on the fuel pump relay EF8 and therefore can only be energised when the ignition is on.

Opening and closing of the valve is controlled by the ECU pin 16 via the blue/purple wire (UP). This does not occur at a specific time, but only when the ECU senses that certain conditions prevail. This is normally at high engine speeds, but may sometimes occur at cranking speed if the ECU senses a high fuel temperature.

Lambda (Oxygen) Sensors (EF13, EF14)

The lambda sensors are located in each exhaust pipe where they are able to "measure" the oxygen content of the exhaust and signal this information to the ECU. They operate independently, and therefore, if the exhaust content differs between the two exhausts, this information is used by the ECU to adjust the injector "open time" on one bank or the other and improve the mixture balance.

Lambda Sensors

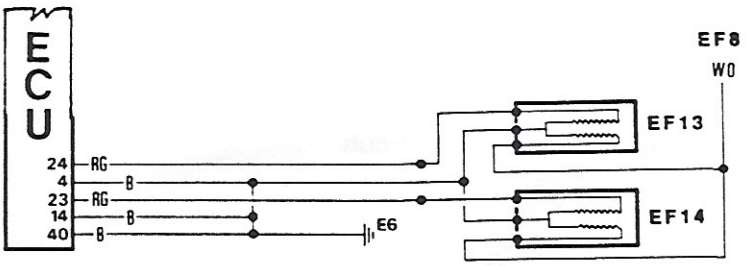


fig.46

EF8 Fuel pump relay
EF13 Lambda sensor
EF14 Lambda sensor

Current to the lambda sensors (EF13 & EF14) (See Figure 46) is supplied from terminal 87 of the fuel pump relay (EF8) via the White/Orange wire (WO).

Each sensor contains two elements, a heating element and a sensing element. The heating element is fitted between the supply wire (WO) and the black earth wire (B) to the ECU pin 4. As soon as the ignition is turned on, this element heats the oxygen sensor in order to enable it to operate even when the engine is cold. The ECU uses a feedback signals on the Red/Green (RG) wires into pins 23 and 24 from the oxygen sensors to control exhaust emissions. This system controls the air fuel ratio to 14.7:1 (ideal air/fuel ratio) at idle and cruise conditions. Therefore this type of system is called "closed loop".

The output voltage from the oxygen sensor is in relation to the amount of oxygen in the exhaust manifold. It is therefore possible for the ECU to increase or decrease the injector "open" time in order to adjust the air/ fuel ratio as necessary.

The main relay supplies current to the air flow meter and to the injectors.

Main Relay Circuit

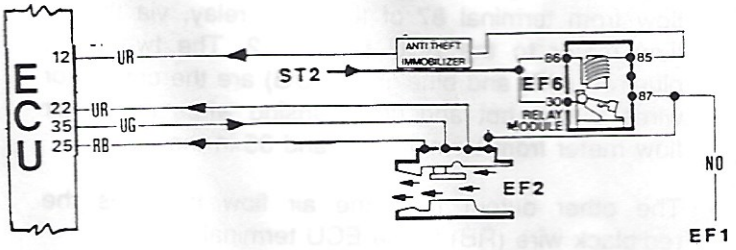


fig.47

ST2 Battery supply
EF6 Main relay
EF2 Air flow meter
EF17 Injectors

The main relay (See Figure 47) works in a similar way to the fuel pump relay, the only difference being that terminals 86 and 30 are both connected directly to the battery supply (ST2) via the brown wire (N) and are therefore "live" at all times. Relay terminal 85 is connected to the ECU terminal 12 via a blue/red wire (UR), through the alarm immobiliser unit.

When the ignition is turned on, the ECU allows current to pass between relay terminals 86 and 85; the electromagnet closes the relay contacts and current can now flow between terminals 30 and 87. There are two connections to terminal 87 a brown/orange wire (NO) to the injectors (EF17), and a second brown/orange wire to the air flow meter (EF2).

Air Flow Meter (EF2)

The air flow meter contains two separate sensing elements, a hot sensing wire and a cold, compensating sensing wire. The hot wire measures the volume of intake air, and the cold wire measures its temperature.

As stated previously, when the ignition is turned on, the main relay contacts close and current can now flow from terminal 87 of the main relay, via the air flow meter to the ECU terminal 2. The two wires blue/red (UR) and blue/green (UG) are the connector wires to the hot and cold sensing wires in the air flow meter from terminals 22 and 35 in the ECU.

The other output from the air flow meter is the red/black wire (RB) to the ECU terminal 25.

Injectors (EF17)

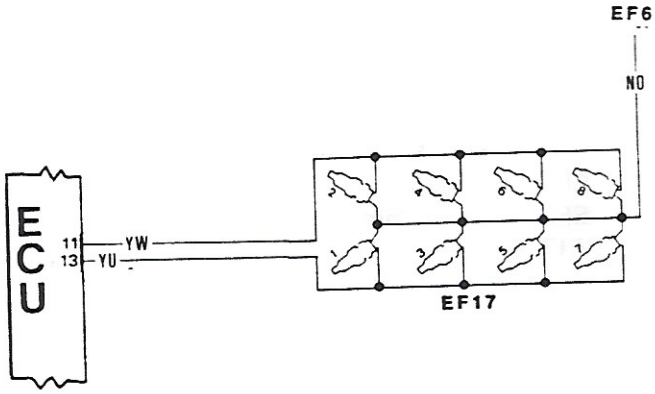


fig.48

EF6 Main relay
EF17 Injectors

The injectors are supplied via a brown/orange wire (NO) from terminal 87 of the main relay. Referring to Figure 47 it can be seen that this will only happen after the contacts in the relay have closed; i.e. after the ignition has been turned on to create an earth return via the ECU terminal 12.

The two banks of injectors (See Figure 48) are connected independently to the ECU. The left bank 1, 3, 5, and 7 are connected to terminal 13 via a yellow/blue wire (YU), and the right bank 2, 4, 6, and 8 to terminal 11 via a yellow/white wire (YW). These two wires provide the earth return for the injector which therefore can only open, and remain open, for the length of time dictated by the ECU.

This "open-time" (pulse width) is decided by the ECU upon receipt of information from a number of sources as listed at the start of this electrical section.

Throttle Potentiometer (EF5)

As has already been discussed in the air system operation section, the throttle potentiometer is attached to the throttle butterfly spindle. It senses the butterfly movement and signals this information to the ECU.

Throttle Potentiometer

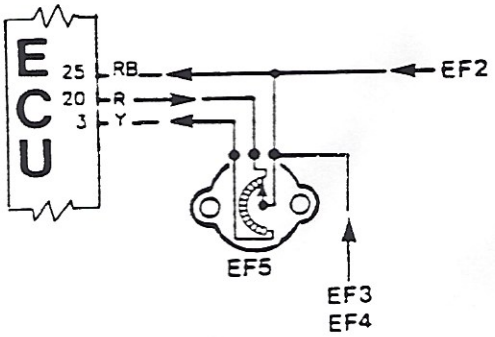


fig.49

EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF5 Throttle potentiometer

The throttle potentiometer (See Figure 49) has three connections to the ECU, a yellow wire (Y) to pin 3, a red wire (R) to pin 20 and red/black wire (RB) to pin 25. Pin 25 is a shared earth return from the air flow meter (EF2) and the coolant and fuel temperature sensors (EF3) and (EF4).

The ECU detects the changing voltage between pins 3 and 20 when the driver moves the accelerator pedal, and adjusts the injector "open" time to suit.

COOLANT TEMPERATURE SENSOR (EF3)

FUEL TEMPERATURE SENSOR (EF4)

Both sensors are located near the front of the engine. The fuel temperature sensor is fitted directly into the fuel rail so that it can sense the temperature of the fuel in the area where it is being injected. It will, for example, signal to the ECU a high fuel temperature being experienced during hot starts, and increase injector "open" time to avoid the possibility of fuel vapourisation which could cause difficult starting.

The coolant temperature sensor serves the important function of signalling engine temperature to the ECU. This enables the ECU to establish the fuelling required for cold starts, and increases in temperature possibly due to traffic hold-ups, etc. and adjust injector "open" time to suit.

Coolant Temperature Sensor

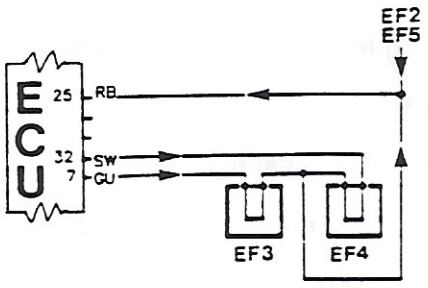


fig.50

EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF5 Throttle potentiometer

The coolant temperature sensor (EF3) (See Figure 50) is supplied via a green/ blue wire (GU) from the ECU pin 7, and the fuel temperature sensor via a slate/white wire (SW) from pin 32. The earth return red/black wire (RB) is to pin 25, and is common with the air flow meter (EF2) and throttle potentiometer (EF5) returns.

The sensors work in the same way. Both contain a resistance through which the current has to pass and temperature changes will affect their resistance values. The resultant voltage changes are measured by the ECU which relates to temperature.

Stepper Motor (EF1)

As already discussed in the "Air System Operation" section, the stepper motor is an integral part of the air by-pass valve. Upon receipt of signals from the ECU, it opens or closes the valve to adjust the engine idle speed.

Stepper Motor

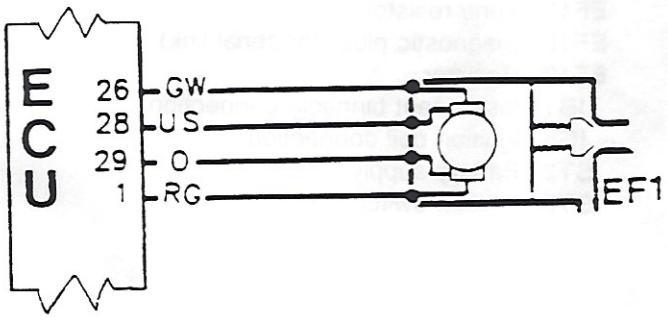


fig.51

The stepper motor (see figure 51) has two pairs of wires to it from the ECU, one pair is necessary to turn the motor in one direction, then stop it, and the other pair to turn and stop it in the opposite direction.

The stepper motor operates in a series of pulses or "steps". The ECU determines the number of "steps" required in either direction to achieve the desired idle speed.

Other Wiring Diagram Symbols - *Figure 52*

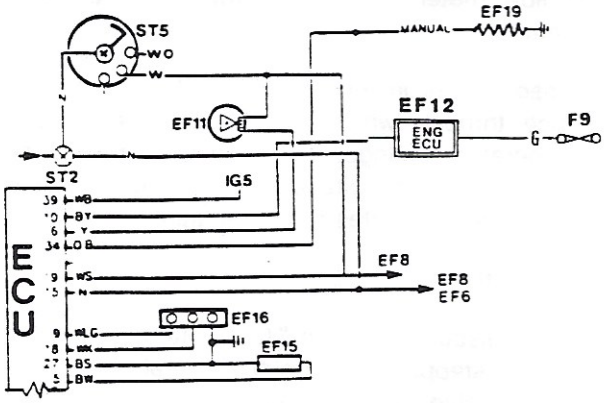


fig.52

EF6 Main relay
EF8 Fuel pump relay
EF11 Road speed transducer
EF12 Instrument panel warning light
EF15 Tune resistor
EF16 Diagnostic plug (for serial link)
EF19 Resistor
IB1 Instrument binnacle connection
IG5 Ignition coil connection
ST2 Battery supply
ST5 Ignition switch

EFI Warning Light (EF12)

The EFI warning light (EF12) is connected to the ECU pin 10 via a Yellow/Black wire (YB) and to the instrument binnacle (IB1).

The EFI warning light is fitted to tell the driver that an electrical fault has occurred in the system, and that any such fault should be corrected without delay.

Road Speed Transducer (EF11)

The road speed transducer operates in a similar manner to an ignition distributor, but uses only a three point reluctor to generate the road speed signal which is passed to the ECU for calculation of engine load.

Resistor (EF19)

The resistor (EF19) is fitted to make the ECU aware of engine idle speed requirements specific to a manual transmission vehicle. The resistor is located on the LH inner wing and has a resistance value of 510 ohms.

Diagnostic Plug (EF16) Tune Resistor (EF15)

The diagnostic plug (EF16) enables Microcheck to be plugged into the system.

The white 3K9 ohms (0.5 watt) tune resistor (EF15) informs the ECU of the engine specification and its fuelling requirements.

The tune resistor is encapsulated in a clear plastic sleeve attached to a coloured connector. The resistor is located in the EFI cable adjacent to the LH inner wing.

ELECTRICAL CIRCUIT OPERATION

IGNITION OFF *(See Figure 53)*

In the mode shown in Figure 53 the ignition is turned off and the engine is cold. The following terminals are live:

Brown wire (N) from the battery connection (ST2) to:

- ECU pin 15
- Fuel pump relay (EF8) terminal 30
- Main relay (EF6) terminals 86 and 30

At this stage the ECU earth connection is via pins 14 and 40.

ELECTRICAL CIRCUIT OPERATION

Ignition OFF

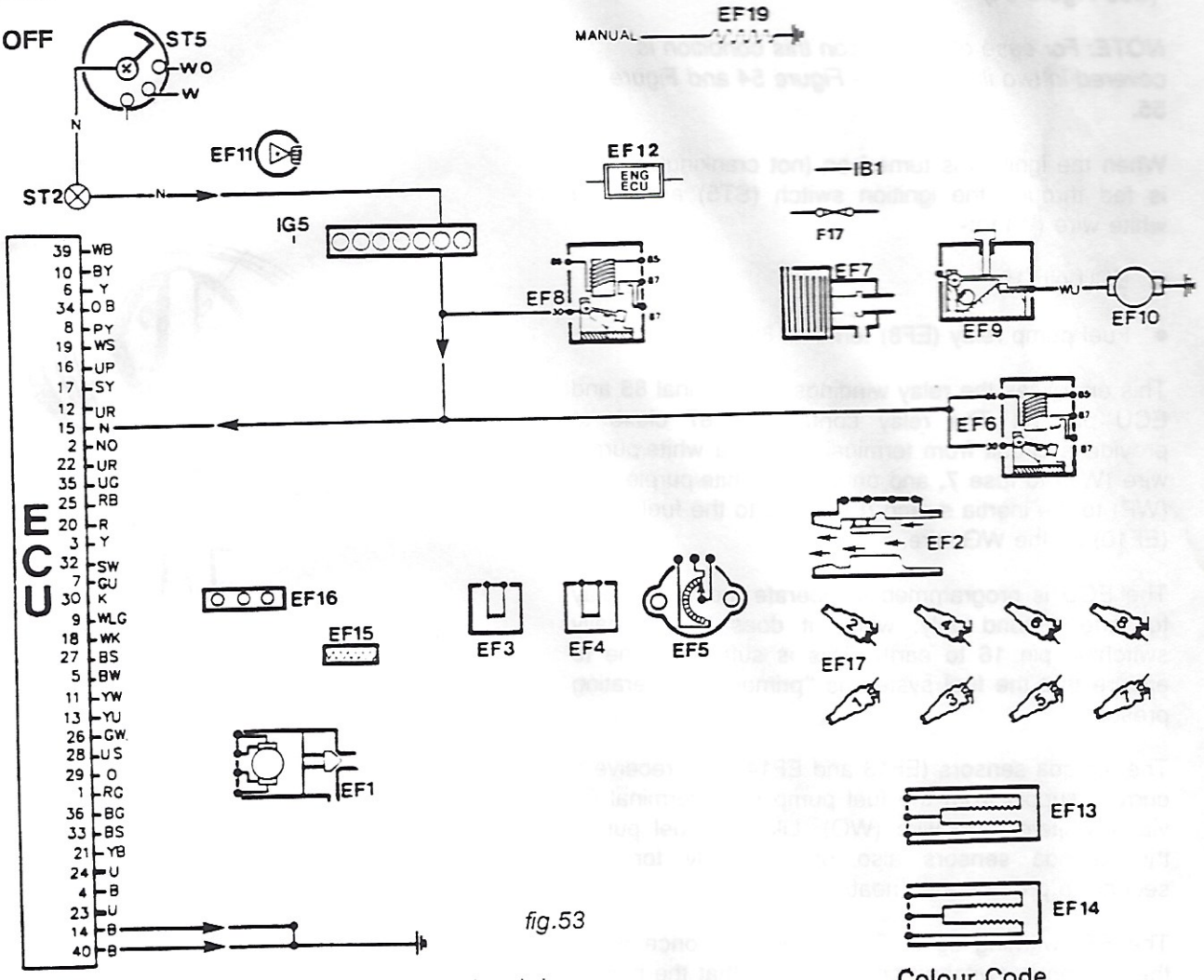


fig.53

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
EF19 Resistor
IB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch

Colour Code

B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

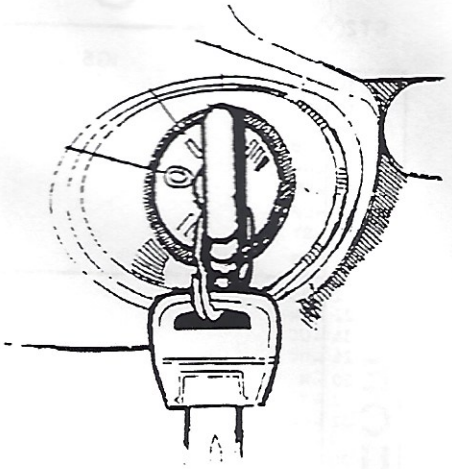
IGNITION ON (Not cranking or running)
(See Figure 54)

***NOTE:** For ease of explanation this condition is covered in two illustrations - Figure 54 and Figure 55.*

When the ignition is turned on (not cranking) current is fed through the ignition switch (ST5) and via a white wire (W) to:-

- ECU pin 19
- Fuel pump relay (EF8) terminal 86

This energises the relay windings via terminal 85 and ECU pin 16. The relay contacts 30/87 close to provide a circuit from terminal 87, via a white/purple wire (WP) to fuse 7, and on via the white/purple wire (WP) to the inertia switch (EF9) and to the fuel pump (EF10) by the WG wire.



The ECU is programmed to operate the pump relay for one second only, which it does by internally switching pin 16 to earth. This is sufficient time to ensure that the fuel system is "primed" to operating pressure.

The lambda sensors (EF13 and EF14) also receive a current supply from the fuel pump relay terminal 87 via a white/orange wire (WO). Like the fuel pump, the lambda sensors also operate only for one second to preheat their heating elements.

The EFI warning light (EF12) will flash once when the ignition is switched on to indicate that the bulb is working.

The ECU will only repeat this programme if the ignition is switched off and on again.

The tune resistor (EF15) and the diagnostic socket (EF16) are also now "live". The tune resistor tells the ECU the engine/vehicle specification.

The road speed transducer (EF11) is now in circuit, via a yellow wire (Y) to the ECU pin 6. As the vehicle is stationary, no signal will be generated.

IGNITION "ON" (not cranking or running)

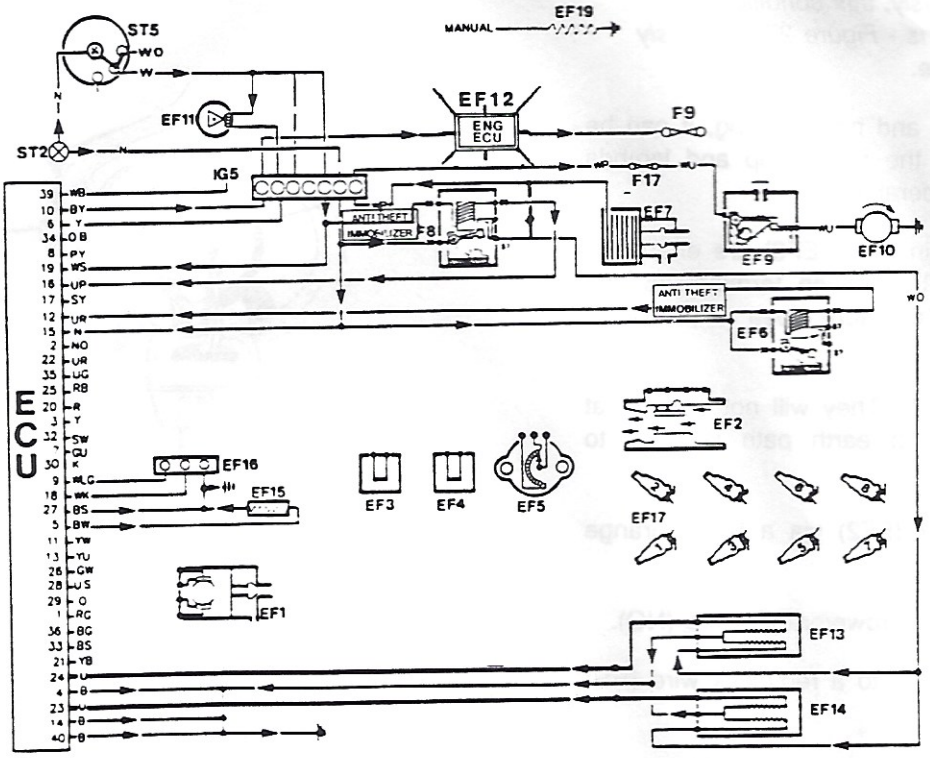


fig.54

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
IB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch

Colour Code

B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

IGNITION "ON" (not cranking or running)
(See Figure 55)

***NOTE:** As stated previously, this condition is covered in two illustrations - Figure 27 previously and also Figure 55 above.*

With the ignition still on and not cranking, it can be seen in Figure 54 that the fuel pump and lambda sensors are no longer operating.

The windings of the main relay (EF6) are energised via a blue/red wire (UR) between terminal 85 and ECU pin 12. The relay contacts close to provide a supply from terminal 87:-

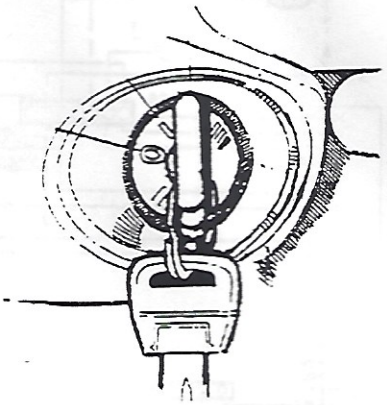
- to the injectors (EF17). They will not operate at this stage because no earth path is open to them.
- to the air flow meter (EF2) via a brown/orange wire (NO).
- to the ECU pin 2 via a brown/orange wire (NO).

This same supply switches to a red/black wire (RB) from the ECU pin 25.

- A second supply to the air flow meter (EF2)
- The coolant temperature sensor (EF3)
- The fuel temperature sensor (EF4)
- The throttle potentiometer (EF5)

The ECU analyses the information received from various sensors and, assuming that the engine is about to be started from cold, will signal the stepper motor to open the by-pass valve to a "fast idle" position as shown.

At this stage, all the circuits are live and ready for cranking.



IGNITION "ON"

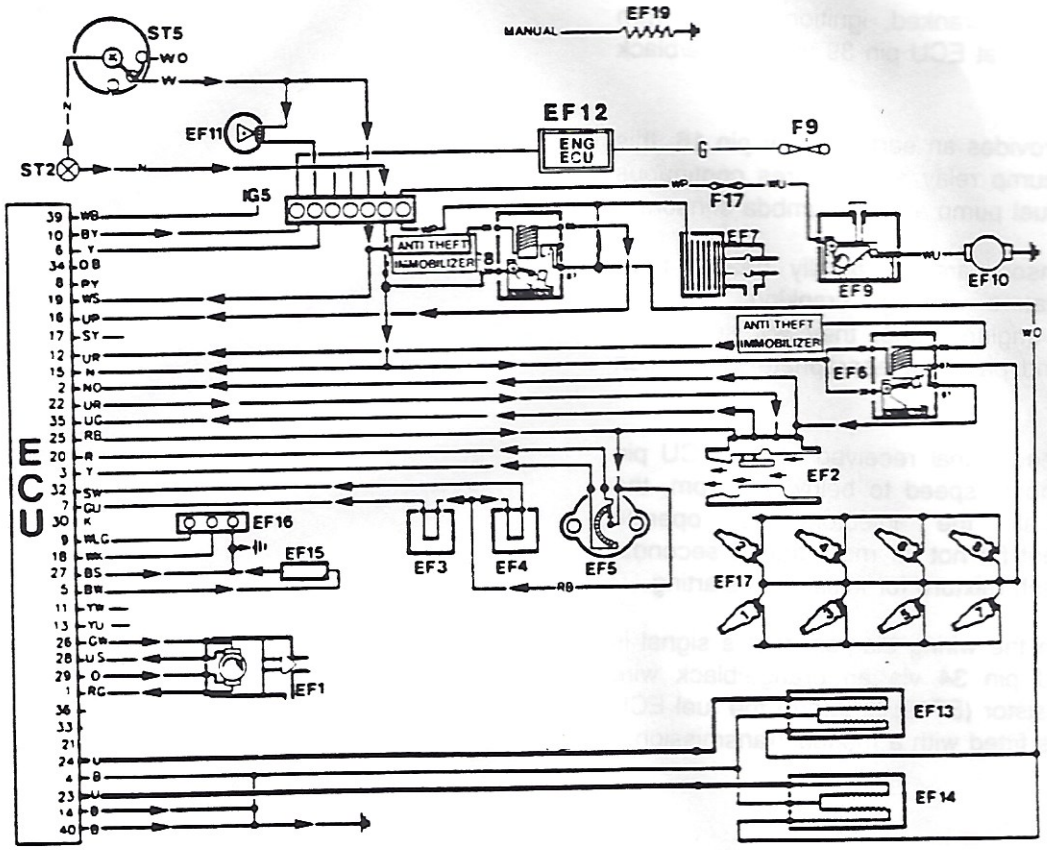


fig.55

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
EF19 Resistor
IB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch

Colour Code
B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

ENGINE CRANKING *(See Figure 56)*

When the engine is cranked, ignition signals from the coil are received at ECU pin 39 via a white/black wire (WB).

The ECU then provides an earth path at pin 16, this closes the fuel pump relay and ensures continuous operation of the fuel pump and the lambda sensors.

The lambda sensors are electrically heated to a nominal temperature during cranking so that immediately the engine starts, they will sense the exhaust gases and pass the appropriate information back to the ECU.

Provided the speed signal received at the ECU pin 39 shows the engine speed to below 250 rpm, the ECU signals all the injectors to operate simultaneously, but for not for more than 8 seconds. This provides a rich mixture for initial cold starting.

It can be seen in the wiring diagram that a signal is received at ECU pin 34 via an orange/black wire (OB) from the resistor (EF19) to inform the fuel ECU that the vehicle is fitted with a manual transmission.

ENGINE CRANKING

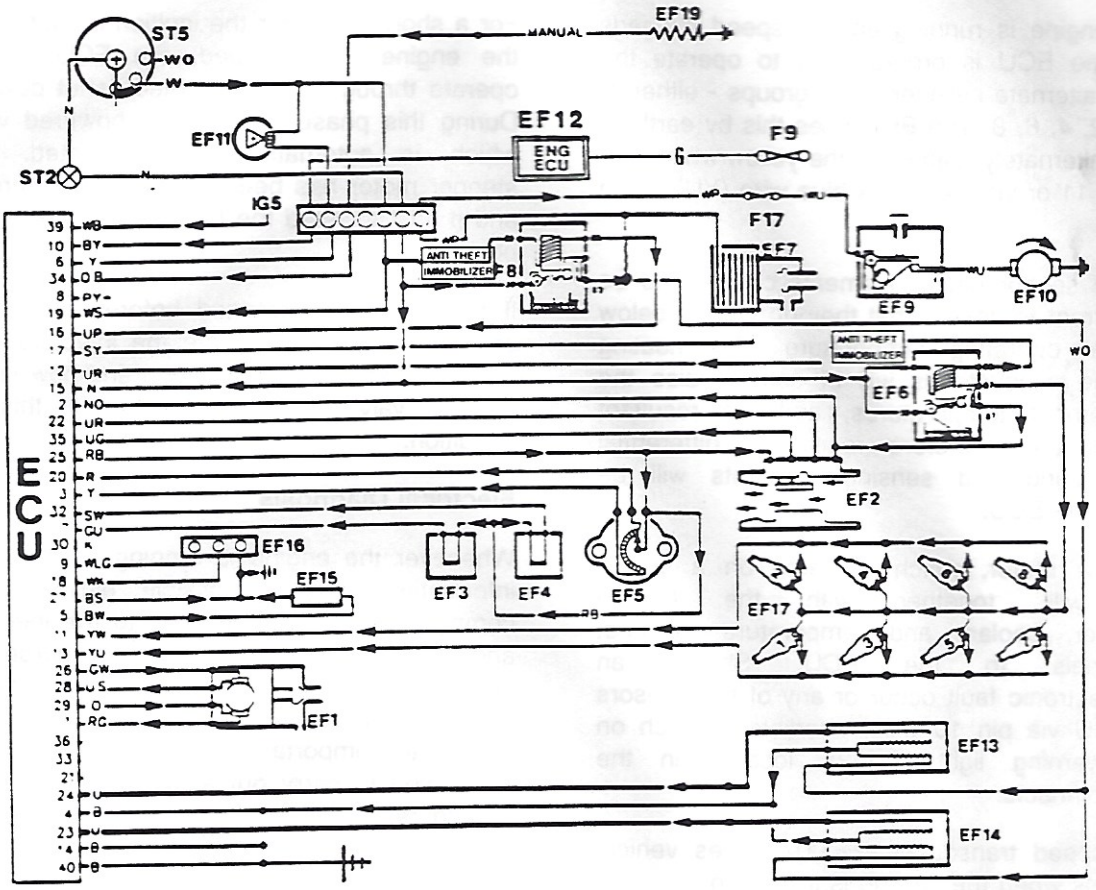


fig.56

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
EF19 Resistor
IB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch

Colour Code

B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

ENGINE RUNNING *(See Figure 57)*

Once the engine is running and its speed exceeds 250 rpm, the ECU is programmed to operate the injectors in alternate cylinder block groups - either 1, 3, 5, 7, or 2, 4, 6, 8. The ECU does this by earthing each bank alternately, either via the yellow/white wire (YW) to pin 11 or via the yellow/blue wire (YU) to pin 13.

The lambda sensor heater elements continue to be fed with current to ensure that they do not fall below the nominal operating temperature. The heating effect of the exhaust gas will of course raise the sensing element temperatures, and the resultant temperature, and therefore resistance differential between heating and sensing elements will be signalled to the ECU.

The air flow meter, which operates on a similar principle, will, together with the throttle potentiometer, coolant and temperature sensors, send signals to the ECU. Should an electrical/electronic fault occur or any of the sensors fail, the ECU via pin 10 will immediately switch on the EFI warning light (EF12), located in the instrument binnacle.

The road speed transducer (EF11) passes vehicle speed signals when the vehicle is in motion.

The fuel tank purge valve (EF7) is operated automatically when the ECU detects that the extra air to be admitted by the purge valve into the inlet manifold will least disturb the exhaust emissions.

IGNITION SWITCH - OFF

For a short time after the ignition is switched off and the engine has stopped, the ECU continues to operate through a programmed "shut down" phase. During this phase the ECU is powered via pin 15, which is automatically disconnected, after the stepper motor has been driven to its reference point and it has adjusted the by-pass port to its fully open position.

If the engine is restarted before returning back to cold, the ECU will operate the injectors alternately, compute the period of injection and how far open the by-pass valve needs to be to suit this particular condition.

Electrical Diagnosis

Whenever the engine is running, the ECU receives information from a possible eleven inputs and computes seven outputs, two to the injector banks, and one each to the stepper motor, purge valve, fuel pump and EFI warning light. When attempting to diagnose a problem it is obvious that the inputs are of primary importance; the following section will assist you to carry out a systematic fault diagnosis procedure.

ENGINE RUNNING

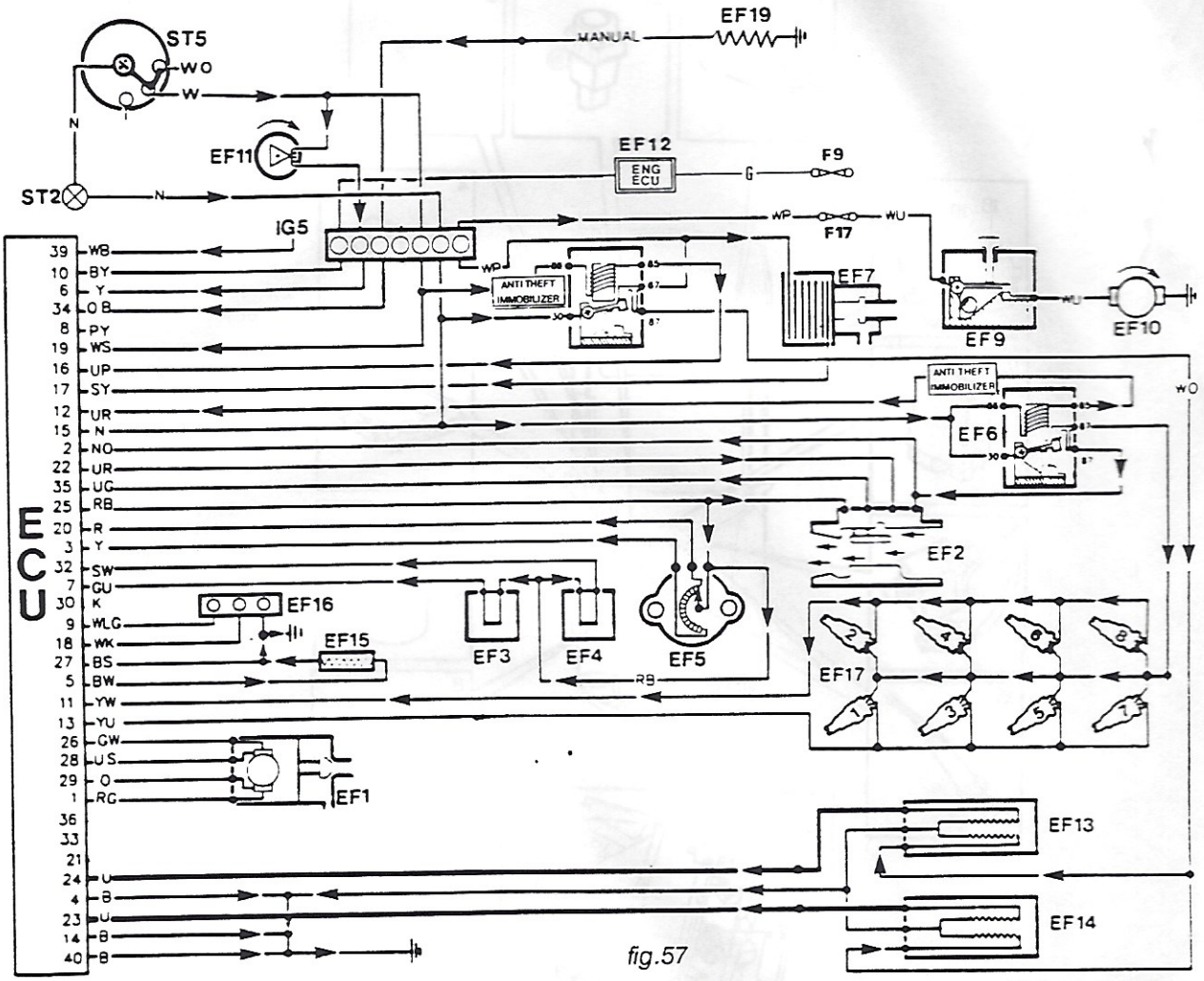


fig.57

EF1 Stepper motor
EF2 Air flow meter
EF3 Coolant temperature sensor
EF4 Fuel temperature sensor
EF6 Main relay
EF7 Purge valve
EF8 Fuel pump relay
EF9 Inertia switch
EF10 Fuel pump
EF11 Road speed transducer
EF12 EFI warning light
EF13 Lambda sensor
EF14 Lambda sensor
EF15 Tune resistor
EF16 Diagnostic socket
EF17 Injectors
EF19 Resistor
IB1 Instrument binnacle
IG5 Coil
ST2 Battery connection
ST5 Ignition switch

Colour Code

B Black
U Blue
N Brown
G Green
O Orange
P Purple
R Red
W White
Y Yellow
S Slate
K Pink
LG Light Green

COMPONENT LOCATION

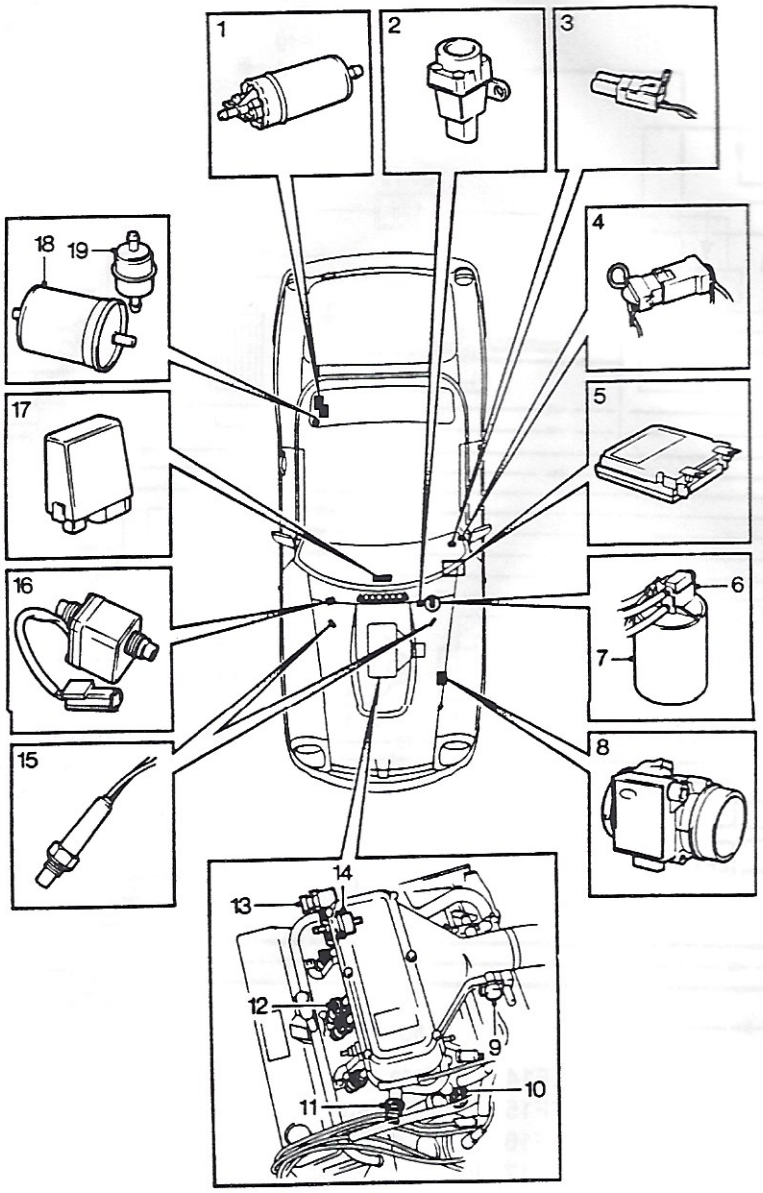


fig.58

1. Fuel pump
2. Inertia switch
3. Diagnostic socket
4. Tune resistor
5. ECU
6. Purge valve
7. Charcoal cannister
8. Air flow meter
9. Throttle potentiometer
10. Coolant temperature sensor
11. Fuel temperature sensor
12. Injector
13. Stepper motor
14. Fuel pressure regulator
15. Oxygen (Lambda) sensor
16. Road speed transducer
17. Relay module 2
18. Main fuel filter
19. Auxiliary filter

FAULT DIAGNOSIS

The need for problem solving usually arises when the owner complains that the engine will not start, is a poor starter or performance is down.

Having established that the complaint is justified, the main obstacle is to pin point the actual fault.

If the engine fails to crank, then obviously the battery state and the starting system must be checked. If the engine cranks but there is no attempt at combustion in any cylinder, check that the inertia switch has not been tripped inadvertently, as this will prevent operation of the fuel pump.

Next check the EFI warning light bulb by switching on the ignition; the warning light will be seen to flash once, proving that the bulb is working.

If the light remains illuminated, this indicates that the ECU has recognised a fault in the system.

The EFI electronics and ECU fault detection systems are very reliable. However, regardless of whether the warning light indicates a fault or not, if a problem still exists then a check on the system using the Microcheck is the quickest and simplest course of action.

Microcheck communicates with the ECU and is capable of directly pin pointing an electronic fault. In addition, if the fault is in one of the EFI associated circuits, the tester will interrogate the ECU memory.

All too often, a system employing sophisticated electronics can blind the technician to obvious basic faults which develop, for example, restricted throttle pedal movement due to thicker carpets being fitted, or faulty non- standard auxiliaries causing extra air to enter the inlet manifold.

Preliminary Checks/Basic Settings

The first checks are so obvious they are often overlooked; the following questions should be asked.

A. Is there pure "petrol" in the tank of the correct type and grade, or is it diesel perhaps ?

B. Has the inertia switch been tripped ?

C. Is the fuel tank ventilation system working properly ?

D. Is the inlet air or fuel filters blocked ?

Incidentally the above presupposes that the engine will crank; if it will not crank refer to the section of the Workshop Manual which deals with the starter motor and associated circuitry.

Assuming the engine attempts to start or run

- Is the battery fully charged (slow cranking speed)?
- Do all cylinders have good compressions? (Refer to the workshop manual for data).
- Is the distributor timing set correctly ?
- Are the distributor leads connected in the correct sequence. and are they correctly routed? Check No's 5 and 7 cylinders in particular as these will cause cross firing if incorrectly routed.

Plug Lead Routing

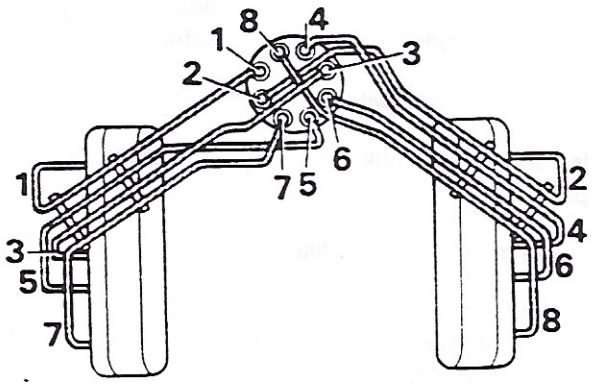


fig.59

- Is the crankcase ventilation system in good order? (See section on crankcase ventilation).
- Are all the inlet manifold joints and pipe connections to the plenum chamber secure?
- What is the condition of the spark plugs? If in doubt proceed as follows:

Spark Plug Condition

Remove the plugs keeping them in strict cylinder order i.e left bank 1357, right bank 2468. You will recall that the injectors operate in banks, so the colour of each cylinder bank of plugs should now be compared with the following chart.

Condition	Plug Colours	
	Left bank	Right bank
A	Grey	Grey
B	White	White
C	Black	Black
D	Black	Grey
	Grey	Black

A = No obvious problem with air or fuel systems
B = Excessive air or insufficient fuel
C = Excessive fuel, insufficient air
D = Excessive fuelling one bank only

Analysis

Condition A
Indicate a possible fault in the ignition system, plug lead condition or routing, timing, centrifugal or vacuum advance.

Condition B
Suggests that air is leaking into the inlet system due to a faulty stepper motor/by-pass air valve or by way of one of the connections to the manifold. Less likely is a fault with the air flow meter.

Condition C
Given that the air filter and hose connections are sound, the obvious choice is the fuel regulator (high fuel pressure), or it may be the coolant temperature sensor signalling engine cold, when the engine is in fact hot. The final possibility is that the air flow meter is faulty, giving the ECU incorrect information.

Condition D
Over-fuelling on one bank of cylinders is most certainly an electrical fault. This could simply be due to a poor connection, or chafing of the grey earth wires in the loom to one injector bank causing intermittent injection; or it might be a faulty lambda sensor or a more serious problem within the ECU.

NOTE: *Spark Plug gap = 0.84mm.*

DIAGNOSIS AND RECTIFICATION

Condition A (Ignition System)
Diagnosis and rectification should be possible by reference to the full Workshop Manual.

Condition B, C & D (EFI System)
Diagnosis and rectification is given in the air leak and fuel pressure checks detailed later in this workbook.

The spark plugs should be renewed if their condition is in any doubt.

The next item to check is the throttle butterfly and cable adjustment.

Throttle cable adjustment

Release the air intake trunking to allow visual inspection of the throttle butterfly operating, then, with the engine stationary, obtain the services of a colleague to press the accelerator pedal to the floor and check that the throttle butterfly opens fully.

If not, slowly turn the throttle cable adjuster until the throttle butterfly is fully open, but without going over-centre, and check that it closes fully when the pedal is released.

If the throttle butterfly does not fully close it may be necessary to release the two butterfly securing screws to allow it to centralise in the throttle body. Tighten both screws and recheck the butterfly operation. Refit the trunking and check that the potentiometer (which is not adjustable) is secure, before continuing with the ignition timing check.

NOTE: Throttle cable freeplay = 1.50mm

Check and Adjust Ignition Timing

To check the timing, run the engine until it reaches normal running temperature. Then connect a stroboscopic timing lamp and an accurate tachometer to the engine, and disconnect the vacuum pipe from the distributor.

Start the engine and check the timing on the crankshaft pulley damper at idle. For timing purposes the idle speed must not exceed 800 RPM.

If the ignition timing is outside the tolerance given in the workshop manual tuning data section, slacken the distributor clamp bolt and rotate clockwise to retard or anti-clockwise to advance to the correct setting. Tighten the clamp bolt and recheck.

NOTE: Ignition timing at 800 rpm, vacuum pipe disconnected = 5° ± 1° B.T.D.C.

Reconnect the vacuum advance pipe and the air conditioning compressor (if fitted).

Engine Tuning

On closed loop catalyst cars, the fuel ECU monitors air/fuel ration through oxygen (Lambda) sensors in the exhaust pipes. Consequently no manual adjustment of the idle mixture is possible.

Before tuning of any kind can take place the following must be checked:

- Spark plug gaps are correct.
- Ignition timing is correct.
- Air cleaner element is clean and all ducting has no leaks.
- Ensure throttle cable free-play is correct.
- Attain normal operating temperature (4 mile road test).

NOTE: Tuning should be completed within 2 minutes of return without stopping the engine. If tuning cannot be completed within 2 minutes or the cooling fans operate, wait for the fans to stop and increase the engine speed to 2000 rpm for 30 seconds and continue tuning.

1. Ensure all electrical loads are switched off.
2. Switch off ignition and connect a tachometer.
3. Disconnect the stepper motor multiplug and connect stepper motor fastcheck SMD 4057/2.
4. Remove the tamperproof seal by drilling the plug and inserting a self tapping screw. This should enable the plug to be removed.
5. Using a suitable Allen Key adjust the Base Idle screw to obtain the specified base idle speed. Turn the screw clockwise to decrease, anti-clockwise to increase.

   BASE IDLE SPEED - 500 ± 50 rev/min.
6. Increase engine speed to 2000 rev/min for 10 seconds.
7. Check base idle speed and adjust if necessary.

8. Switch the ignition off.

9. Remove fastcheck and reconnect harness plug.

10. Fit a new tamperproof seal.

Oxygen Sensor Check

1. Disconnect the oxygen sensor multiplug and connect 18G 1564 to the oxygen sensor harness.

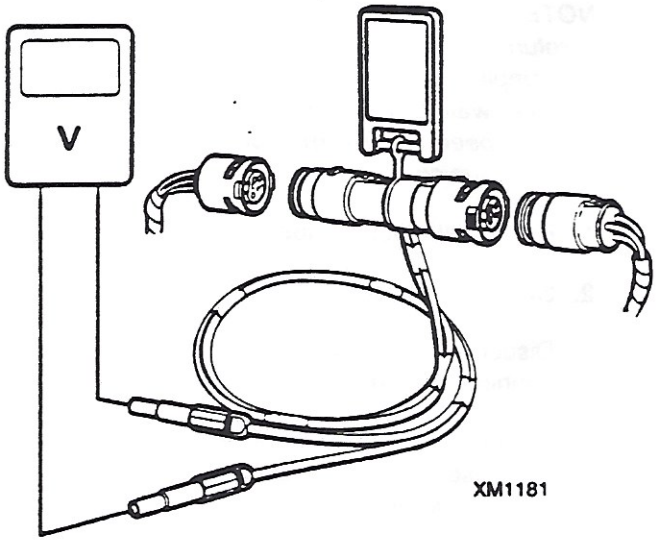
2. Connect a Multimeter to the Red and Black wires from the test harness.

3. Run the engine and hold at 3000 rpm for 30 seconds.

4. Check for a "swinging" on the meter between 0.4V and 0.6V at the controlled idle speed.

NOTE: If the multimeter remains at a constant 0.4V or 0.6V, ensure that the engine is hot. If there is still no change, a fuel pressure test must be carried out.

5. Disconnect the multimeter and harness and repeat the process for the other oxygen sensor.



XM1181

Air Leak Checking Procedure

The following procedure eliminates the corrective action of the stepper motor while tracing an air leak, but allows the lambda sensors to perform normally.

Begin by carrying out a vacuum check on the fuel pressure regulator, if this has not been done previously.

Disconnect the pressure regulator vacuum pipe at the plenum chamber and fit the vacuum pump to the pipe.

Operate the pump to read approximately 380mm Hg (15in Hg); if the vacuum does not hold, this will indicate an air leak in either the regulator diaphragm or the pipe connection.

Rectify as necessary and reconnect the regulator to the plenum chamber.

Before proceeding further, ensure that the throttle butterfly is fully closed.

It should be noted that in the following sequence, diagnosis of air leaks into the inlet system relies on comparing the engine idle speed before and after the leak point is located.

Start the engine, bring to normal running temperature and note the idle speed using an accurate tachometer.

Next, disconnect and seal the following connections to the plenum chamber using linen tape or tight fitting plastic plugs.

On the right side of the engine, disconnect the brake servo hose and seal the connection at the plenum chamber.

Disconnect the purge valve hose and seal the connection at the plenum chamber.

Disconnect the ventilation system vacuum hose, and seal the connection at the plenum chamber.

On the left side of the engine, completely remove the hose between the air by-pass valve housing and the throttle butterfly housing. Seal both connections at the air bypass valve housing and at the butterfly housing.

Remove the crankcase ventilation hoses between the oil separator on the right rocker cover and the plenum chamber and butterfly housing connections. Disconnect the three way connection and check that it is not blocked, paying particular attention to the restrictor in the port to the plenum chamber. Examine the three hoses for splits and general condition.

Refit the appropriate hoses to the plenum chamber and to the butterfly housing, ensuring the restrictor is correctly locked.

Seal the remaining three way connector port.

Refit the remaining hose to the oil separator end only.

Plenum Chamber Connections

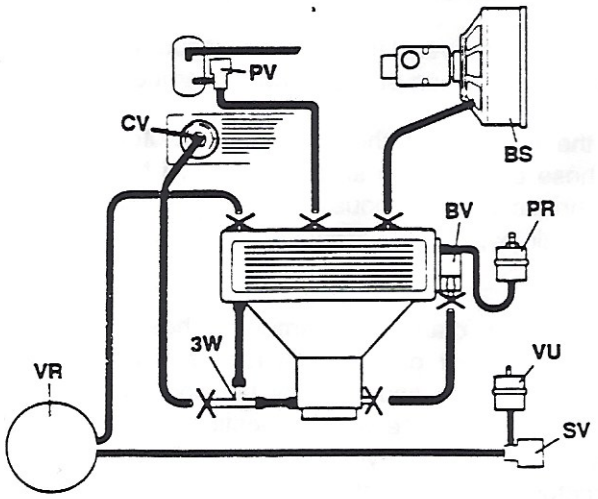


fig.60

PV Purge valve
CV Crankcase ventilation
BS Brake servo
PR Pressure regulator
BV By-pass air valve/stepper motor
VU Vacuum servo unit
SV Solenoid valve
VR Vacuum reservoir
3W Three way connector

With the ports sealed as shown in Figure 60, most parts of the system and the hoses which are liable to deterioration and therefore to air leakage have been isolated.

These include:

- Brake servo and hose.
- Purge valve, charcoal canister and hoses.
- Air ventilation hoses and controls.
- Crankcase ventilation system, and any possible engine gasket leaks, including tappet cover/gasket, front cover gasket and rocker cover gaskets.

At this stage, the by-pass air valve ports and the above connections are sealed. Therefore, because the throttle butterfly is closed, the only air which **should** enter the plenum chamber to maintain engine idle, is any which may leak past the throttle butterfly, and that which by-passes the butterfly, via the three way connector.

With air entering as described, the engine idle speed will be in the region of 450 - 600 rpm, unless air is leaking into the plenum chamber and inlet manifold from some other source e.g: gaskets.

For example, if an air leak is suspected at the inlet manifold plenum chamber joint, squirt engine oil around the suspect area; it can then usually be heard as it is drawn in at the leak point.

After rectifying any leak noted so far, restart the engine and note the idle speed which should now be between 450 - 500 rpm.

Now we can start to check out all the disconnected components and hoses one by one as follows:

Reconnecting Purge Valve

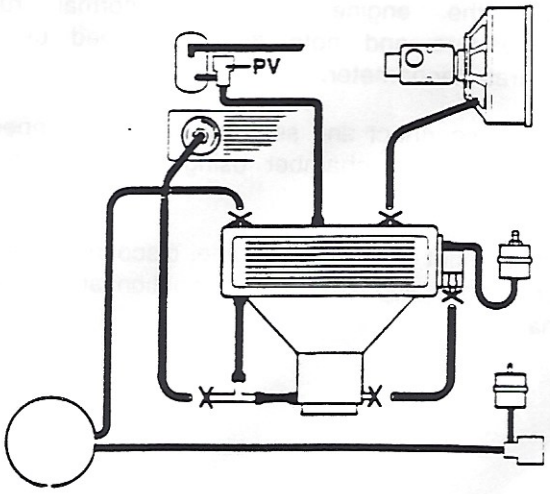


fig.61

Begin by unsealing and reconnecting the purge valve hose as indicated in Figure 61, then start the engine. If the purge valve hoses and system are leak proof the idle speed will remain stable at 450 - 600 rpm.

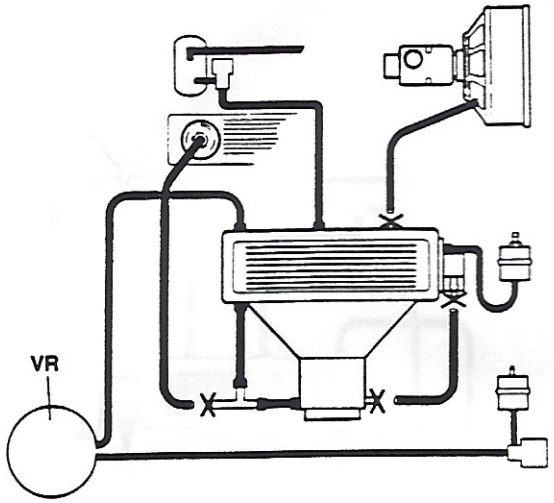


fig.62

Next unseal and refit the hose from the vacuum reservoir (VR) as indicated in Figure 62.

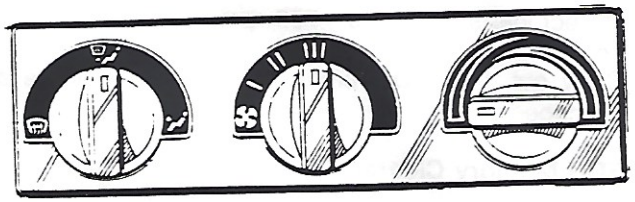


fig.63

Move the ventilation controls to "fresh Air" and "Fan On" as shown in Figure 63.

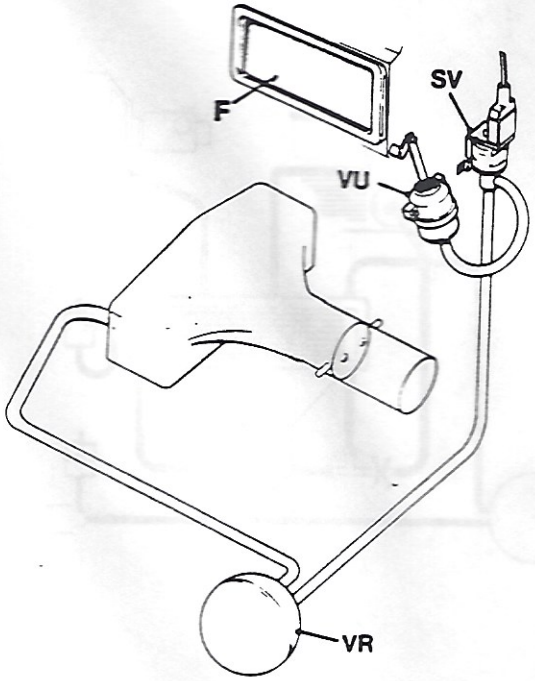


fig.64

VR Vacuum reservoir
SV Solenoid valve
VU Vacuum servo unit
F Fresh air flap

Start the engine and check that is continues to idle at 450 - 600 rpm. If the idle is connect, inspect the hoses and vacuum components shown in Figure 64 for leakage.

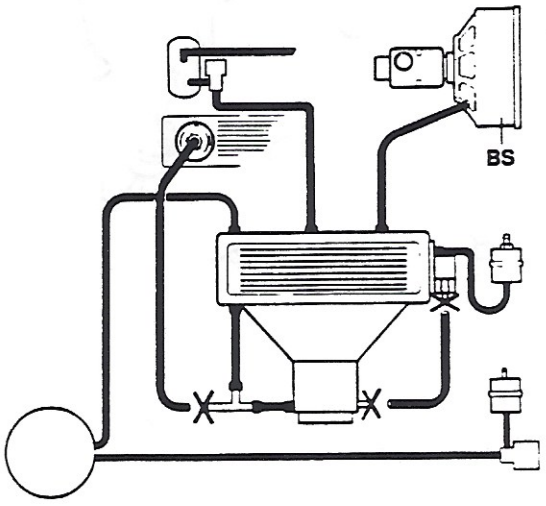


fig.65

Unseal and reconnect the brake servo hose as indicated in Figure 65 and start the engine. If the idle speed is higher than 450 - 600 rpm, check for air leakage into the hose and/or brake servo system.

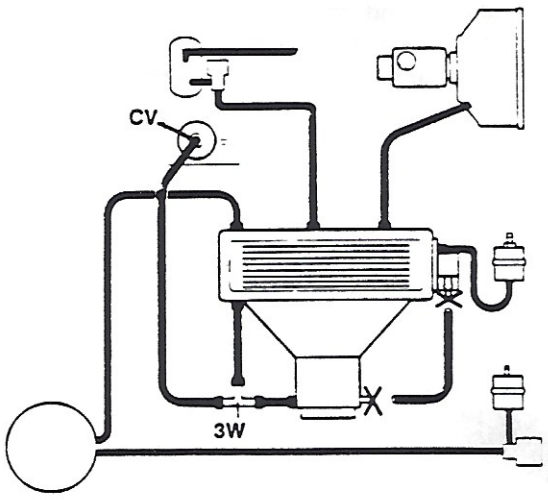


fig.66

Unseal the three way connector (3W) and reconnect the crankcase ventilation hose (CV) as indicated in Figure 66 and start the engine. The hoses and three way connector (3W) have already been checked and therefore, provided there are no gasket leaks or blockage in the oil separator on the right rocker cover, the idle speed should remain at 450 - 600 rpm.

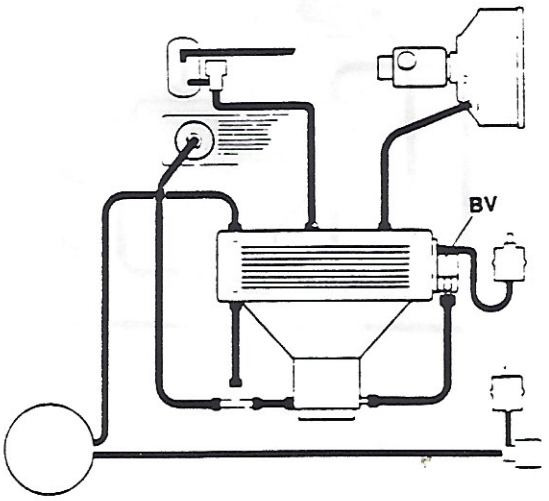


fig.67

Examine the by-pass hose for cracks and renew if in doubt. Unseal the hose connections at the butterfly housing and at the by-pass air valve housing (BV) and fit the hose as indicated in Figure 67.

Start the engine and allow to idle for one and a half minutes to give the ECU time to react and adjust the stepper motor. The engine should now run at its correct idle speed. 650 - 750 rpm.

Carry out the ECU memory clearance procedure as described below.

ECU Memory Clearance

After making the air leak tests in the way previously described way, the ECU will have memorised that the stepper motor/by-pass air valve had no effect on the idle speed: this will have therefore caused the ECU to record a fault.

If Microcheck is already connected into the system, it can now be used to clear the ECU memory.

NOTE: *The ECU memory can also be cleared by momentarily disconnecting the battery. This action will also clear any memory held in the vehicles audio system*

FUEL PRESSURE CHECKING

WARNING: Under operating conditions the fuel injection system is pressured by a high pressure fuel pump, operating at 2.4 - 2.6 kgf/cm² (34 - 38 lbf/in²). When the engine is stationary this pressure is maintained within the system.

To prevent pressurised fuel escaping and to avoid personal injury, it is necessary to depressurise the fuel injection system before connection of the test gauge or any service is carried out.

WARNING: The spilling of fuel in unavoidable during this operation. Ensure that all necessary precautions are taken to prevent fire and explosion.

To depressurise the fuel system proceed as follows:

1. Turn off the ignition and isolate the fuel pump by disconnecting the inertia switch.

2. Crank the engine for at least 10 seconds, if the engine starts, let it run until it stops. Turn off the ignition.

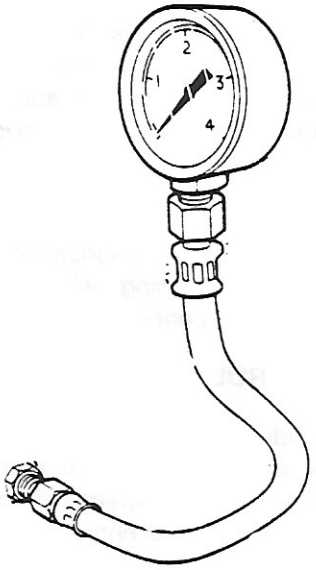


fig.68

Make the fuel pressure check as follows:

3. The pressure gauge is fitted between the rubber pipe and fuel rail casting on the supply side to the engine.
   First thoroughly clean the pipe connection, place some cloth around the connection to absorb any residual fuel then disconnect the pipe by removing the crimped clip. Always replace with a new hose clip.

4. Fit the pressure gauge 18G 1500 using adaptor 18G 1500/1. Reconnect the inertia switch, start the engine and then check for leaks.

5. Note the pressure gauge reading at idle; it should be approximately **1.8 kgf/cm² (26 lbf/in²)** .

6. Blip the throttle and at the same time note the gauge reading. If the system is operating correctly, there should be a momentary pressure increase to **2.4 - 2.6 kgf/cm² (34-38 lbf/in²)** , before the pressure falls back to the original reading of approximately **1.8 kgf/cm² (26 lbf/in²)** .

If the pressure does not increase, this indicates a fault with the fuel pressure regulator.

7. Stop the engine and observe the pressure gauge reading, it should remain at approximately **1.8 kgf/cm² (26 lbf/in²)** .

NOTE: The pressure reading may drop slowly, either through the pressure regulator or through the fuel pump non-return valve. A slow steady drop is permissible, but a rapid fall must be investigated.

8. If the pressure checks are satisfactory, the system must be depressurised as before prior to removal of the pressure gauge.

9. Reconnect the fuel pipe, run the engine and check for fuel leaks.

FUELLING

The basic fuelling requirement is stored in the electronic memory of the ECU in digital form of a three-dimensional map giving the correct injector pulse lengths for 16 different engine speeds and 8 different engine loads. From this basic fuelling requirement the ECU will take into consideration information from the other sensors, e.g. coolant temperature, throttle position etc. and make various corrections to ensure the engine is supplied with the correct amount of fuel by adjusting injector opening time as required.

OVERRUN CONDITIONS

During engine overrun the ECU will implement "fuel cut-off" provided the following conditions prevail:

(a) Coolant temperature above 30°C.

(b) Throttle in idle position, potentiometer output 0.3V.

(c) Engine speed above 1500 rev/min.

When the engine speed falls below 1500 rev/min or the accelerator pedal is actuated, fuel is gradually re-instated ensuring a smooth take-up.

FULL THROTTLE

During hard acceleration, extra injector pulses are generated to compensate for throttle movement. At full throttle, the ECU provides a full load enrichment independent of engine temperature. This is a fixed amount and is achieved by opening the injectors for a longer period. When the throttle is fully open the output voltage to the ECU is 3.5 volts and fully closed 0.3 volts.

OVERSPEED FUEL CUT-OFF

As an overspeed protection, the ECU will cut-off the injector pulses should the engine speed exceed 6700 rev/min. The injector pulses are then gradually reinstated when engine speed falls below 6300 rev/min.

IGNITION SWITCH OFF

When the ignition is switched off the following operations take place:

(a) Fuel pump relay is switched off by the ECU - fuel pump off.

(b) Main relay remains energised by the ECU for 5 seconds enabling the stepper motor to be driven to fast idle position.

(c) Main relay and the fuel system is now switched off by the ECU.

HOT START CONDITIONS

The ECU continuously monitors the signal from the fuel thermistor. When restarting an engine, with the fuel rail temperature above 60°C, the fuel thermistor signal causes the ECU to implement the same procedure it uses for cold starting. This increases the opening period for the injectors and provides extra fuelling to counteract the possible effects of fuel vapourisation and thus reduce the possibility of the engine stalling.

FUEL TEMPERATURE ~~SWITCH~~ SENSOR

The fuel temperature switch is a normally open bi-metallic switch. When the temperature in the fuel rail is above 90°C the switch closes and the engine coolant temperature thermistor signal is bypassed.

This is sensed by the ECU which increases the opening period of the injectors during a hot start to minimise the effects of fuel vapourisation. The ECU reduces the additional fuelling when the switch opens again after a short period.

IDLE SPEED CONTROL

If during engine idle, the load on the engine is increased, by for example additional electrical load on the alternator, the engine speed will drop (more than 45 rev/min), and the ECU energises the stepper motor and opens the air valve thus maintaining the idle speed. Constant engine idle speed is maintained by the ECU progressively opening or closing the air valve.

V8 - ENGINE

Introduction

The new MG "R" V8 sports car is powered by the well proven, all aluminium, Rover 3.9 litre V8 engine.

The engine produces an attractive 188PS @ 4750 rpm, with a maximum torque of 318 Nm @ 3,200 rpm.

The engine management system uses the "Hot Wire" fuel injection and electronic ignition systems. A tubular stainless steel exhaust system is employed with two catalysts which combine with the "Closed Loop" engine management system.

Due to the compactness of the engine in the chassis, certain modifications have had to be made, i.e: the oil filter is mounted on the RH inner wing and connected to the engine via two high pressure hoses.

The cooling system uses a cross flow radiator, expansion tank and ~~twin~~ SINGLE thermostatic electrically operated cooling fans, which are mounted in front of the radiator.

Engine Features

Type - V8
Capacity - 3950 cm^3
Bore x Stroke - 94 x 71.12mm
Compression Ratio - 9.35:1
Firing Order - 1-8-4-3-6-5-7-2
D.O.R. - Clockwise

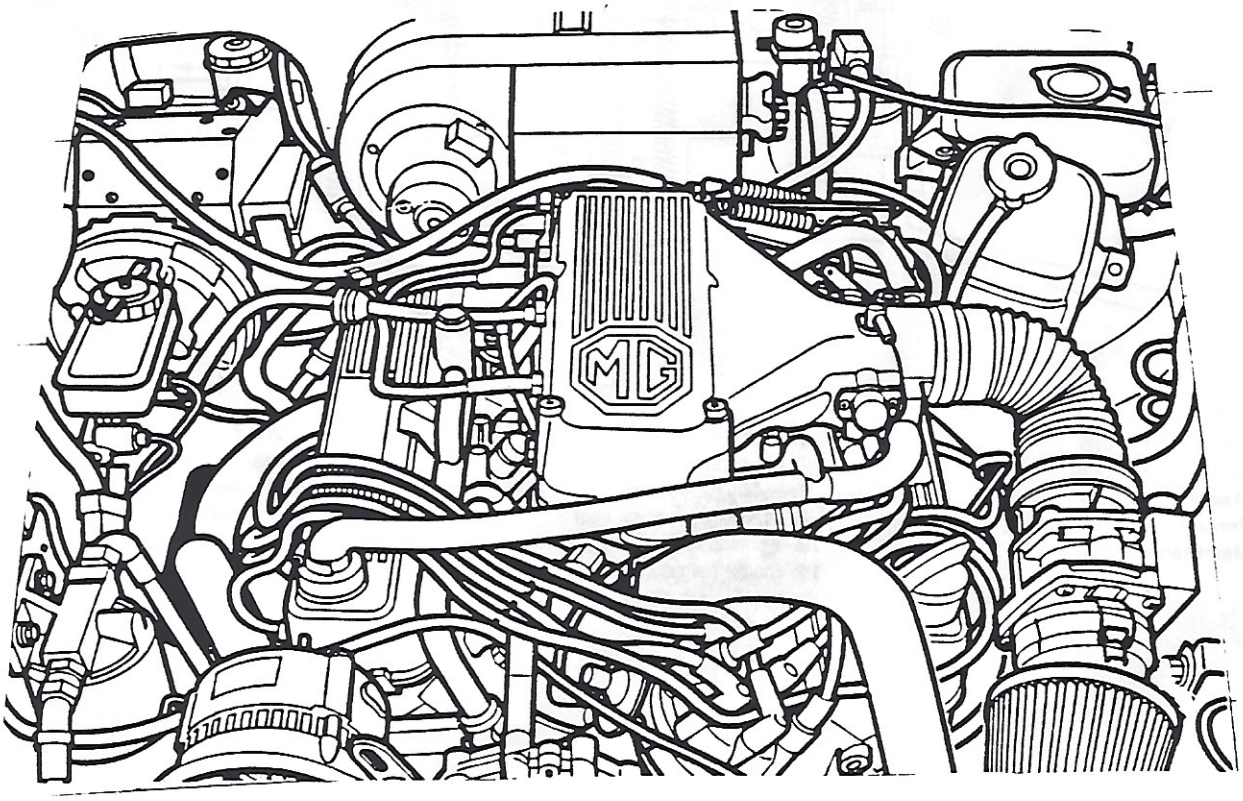
Cylinder Numbers

Left Bank - 1-3-5-7
Right Bank - 2-4-6-8

Number 1 cylinder - Pulley end of left bank.

Engine overhaul procedures fall in-line with existing Land Rover/Range Rover procedures.

BORE × STROKE 94 × 71.2
WAS 88.5 × 71.2



GEARBOX

Introduction

The MG "R" V8 employs the well proven five speed synchromesh gearbox, known as the 77mm gearbox with a identification code of LT77S.

All gears, including reverse gear run on needle roller bearings and the main, layshaft and primary shafts are supported by tapered roller bearings. Lubrication is achieved through drillings in the shafts, supplied by a low pressure oil pump driven from the rear of the layshaft.

For improved gear selection, 1st and 2nd gears use double synchro rings. If overhauling the gearbox, existing special tools are used, which were supplied for the earlier specification 77mm, gearboxes, i.e: (SD1 Rover).

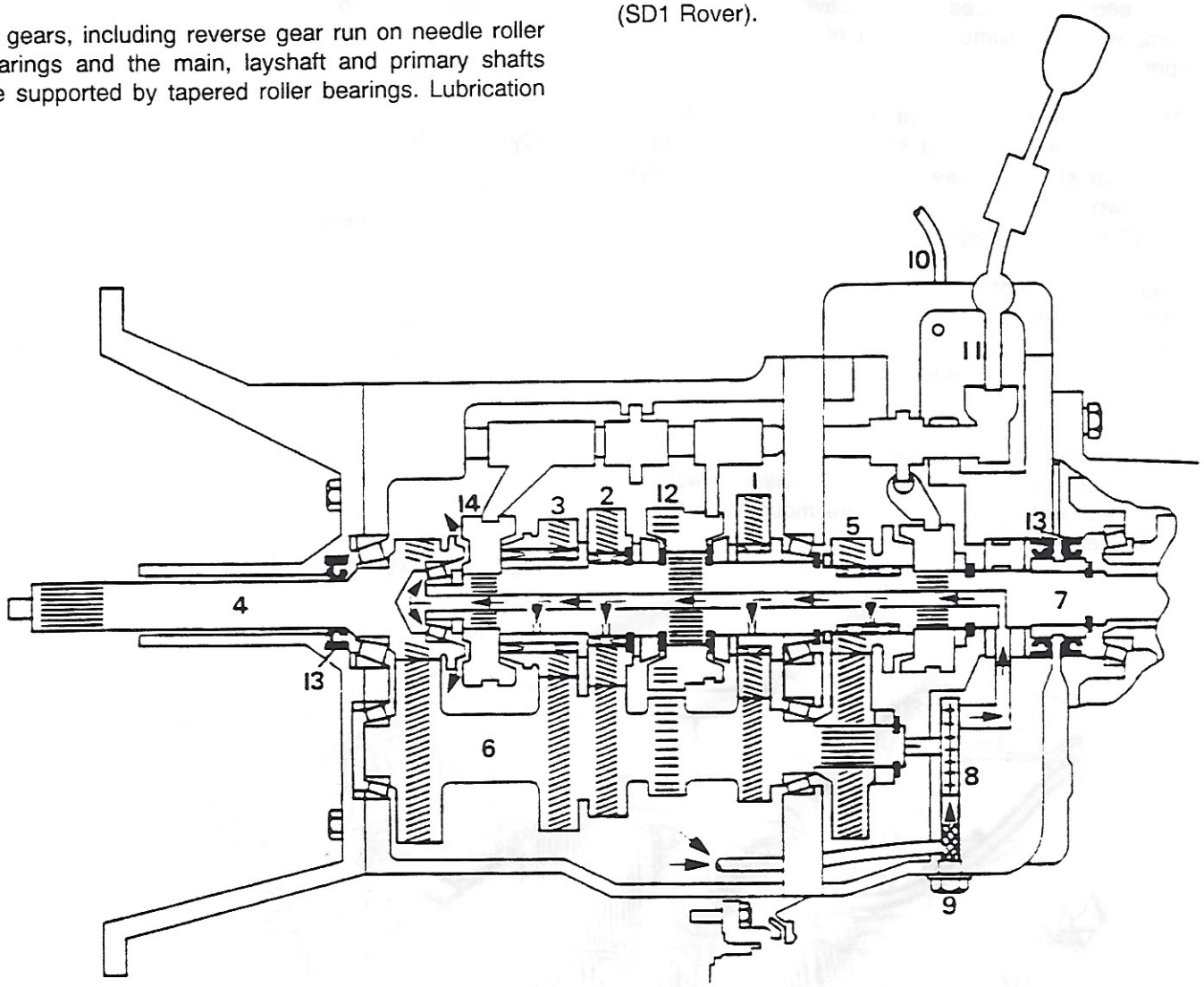


fig.69

1. Mainshaft 1st gear
2. Mainshaft 2nd gear
3. Mainshaft 1st gear
4. Primary input shaft
5. Mainshaft 5th gear
6. Layshaft
7. Mainshaft
8. Lubrication pump
9. Drain plug and oil filter
10. Ventilation pipe
11. Single rail gear shift
12. 1st/2nd synchromesh
13. Oil seals
14. 3rd/4th synchromesh
15. 5th gear synchromesh

AXLE

Introduction

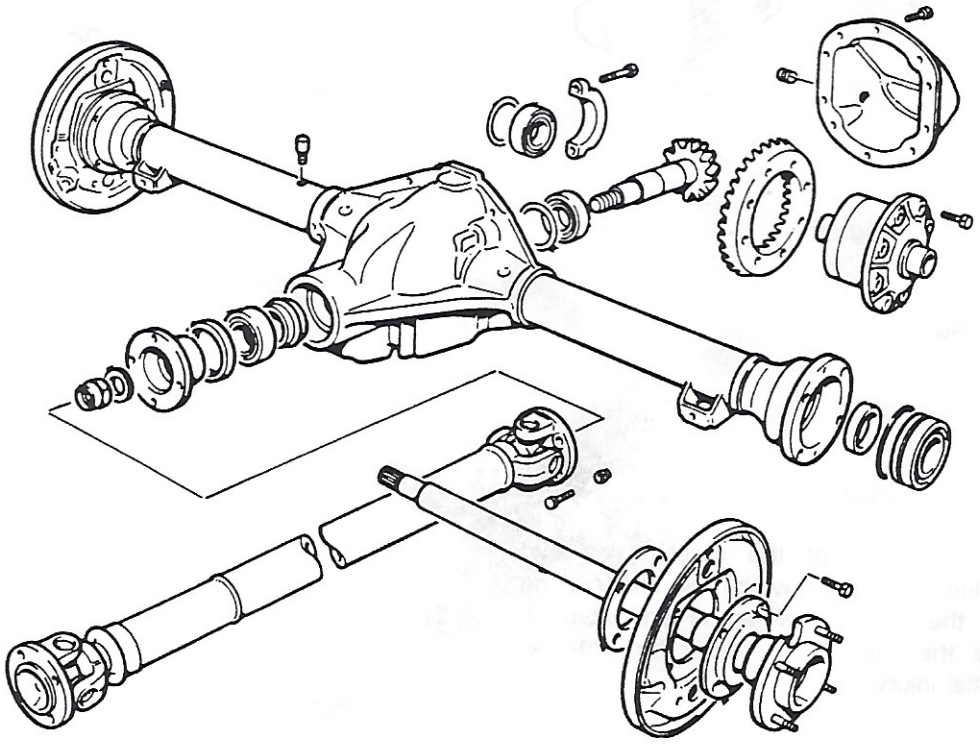
The final link in the power train is the rear axle. This is a semi- floating "Live Axle" and employs a "Quaife" torque bias differential assembly which re-distributes torque to the road wheels with utmost traction.

The "Quaife" torque sensing differential is used by other vehicle manufacturers including "Maserati" so it is a well proven unit.

Lubrication for the axle is by a high efficiency gear oil thus minimising the axle operating temperature under sustained high speed running. It is recommended that the axle oil is changed at the first 1,000 mile maintenance check in order to maximise the durability of the running components. Ensure that the correct grade of oil is used referring to the Recommended Service Lubricants list in the Repair Manual.

Overhaul procedures to the axle are limited to rear hub bearings and seals, and the pinion oil seal. For anything other than these faults, the complete axle assembly must be renewed.

Diff 3.77-1



STEERING

The steering system consists of a Motolita leather covered, soft feel steering wheel, a fixed column assembly and a manual steering rack mounted to the front of the suspension crossbeam.

The column is secured by three datum fixings at its lower end and three fixings at its upper end via a slotted bracket. Controls consist of column stalks as fitted to the new Rover 800 and a central horn push in the 3 spoke, 14in steering wheel.

Shims are used at either or both of the steering rack mountings to align the rack pinion to the inner column. Fit special tool 18G 1668 to the top of the rack pinion and to the inner column and then shim the rack mountings until the tool pointed ends are aligned. Remove tool and fit the universal joint.

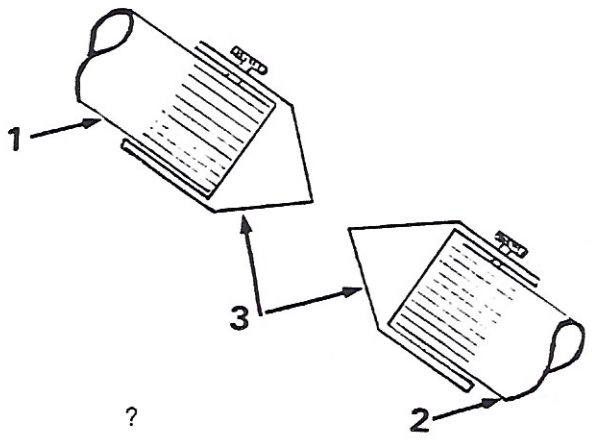


fig.70

1. Inner column
2. Rack pinion
3. 18G 1668 (2 parts)

Steering Wheel Removal

The steering column is of the safety type and incoporates nylon shear pins which will shear if the driver impacts the steering wheel in an accident. This will allow the column to move forwards so reducing potential injury.

Therefore, do not drift off the steering wheel or impart shock loads to the column or the shear pins may be affected necessitating column renewal.

Remove the centre logo and retaining nut, mark the wheel relative to the column to aid refitment and pull off the wheel using 18G 1014. Ensure the puller adaptor pins are screwed fully into the steering wheel upto the shoulder on the pins. Refit in the reverse order noting the alignment marks and tightenthe retaining nut to the correct torque.

Front Wheel:	
Alignment	5' toe-in
Camber	0.4° positive ± 0.5°
Caster	3.8° ± 0.9°
Kin pin inclination	7.2° ± 0.4°
Steering wheel turns lock to lock	3.3:1
Turning circle	
- between kerbs	10.95 metres
- between walls	11.22 metres

NOTE: *All steering and suspension settings are for a vehicle at unladen weight.*

ACKERMAN
INNER AT 20°.
OUTER 18° 25' +- 1°

FRONT SUSPENSION

The front suspension is a double wishbone type with all suspension components mounted on a crossbeam attached to the body via rubber insulated mountings.

Four individual arms make up the upper and lower arm assemblies with the outer ends of each pair carrying a steering swivel joint. The caster angle can be adjusted by adding or subtracting shims either side of the top swivel joint.

The top wishbone inner ends are secured to the crossbeam with Slipflex bushes which incorporates thrust washers in the bush outer face. During reassembly, liberally apply Castrol Red Rubber Grease N°2 to the outer face of the bushes and also to the inner face of the thrust washers.

A telescopic Koni damper, mounted within the coil spring, is secured to the lower arm and to an alloy housing, fitted to the top of the crossbeam, which also carries the inner ends of the upper arms. The damper is the adjustable type and is fitted new on the minimum damping setting. To check the damper setting, fully push the lower half inwards, slowly rotate lower half until it engages the valve and then wind the lower half anti- clockwise until it stops. At 48,000 miles, engage the valve and rotate the lower half one half of a turn clockwise (inwards).

A 23mm diameter anti-roll bar, incorporating metalastic bushes each end for the connecting links, is installed in front of the crossbeam. Fit the bar to body bushes with the slit facing forwards.

Nominal height - wheel arch to centre of hub:	355 ± 10mm
Trim height variation across each axle	10mm MAX.

TOP WISHBONE BUSH
GIRLING RED RUBBER
GREASE BETWEEN
SLIPFLEX BUSH AND THRUST WASHER.

REAR SUSPENSION

The rear suspension consists of a live axle, two single leaf springs, two torque control arms, telescopic dampers and an anti-roll bar. The leaf spring front eye carries a metalastic bush with the rear eye using rubber half bushes in a hanger assembly.

Conventional "U" bolts, rubber insulation pads and a top plate secure the spring to the axle. Each lower "plate" is a cast housing which also carries mounting points for the anti-roll bar, a torque control arm and a Koni, adjustable telescopic damper. Ensure the hexagonal spacer is fitted between the damper lower eye and its fixing point. Adjust the damper as detailed in "front suspension".

The front end of the torque control arms are secured to a bracket below each spring front eye.

A bump rubber screwed into each wheel arch is common to that fitted on the front suspension. A 15mm diameter anti-roll bar is installed behind the axle.

Nominal height (wheel arch to centre of hub):	375 ± 10mm
Trim height variation across each axle	10mm MAX
Rear wheel alignment:	Parallel
Rear wheel camber:	0°

BRAKING SYSTEM

Introduction

The braking system consists of a Tandem master cylinder, a direct acting servo, front wheel calipers/disc assemblies, rear wheels drums and a pressure reducing valve in the rear brake line.

The system is split front to rear with the primary system operation the rear drums and the secondary system for the front calipers. Use only DOT 4 brake fluid.

Master Cylinder

The dual circuit master cylinder provides two independent fluid circuits to ensure one circuit remains operational should a fluid leak occur. A fluid level warning switch is installed in the reservoir cap. The assembly can be overhauled using conventional procedures.

Servo

The type 38 DA is non-serviceable except for normal checks to the air filter and vacuum hose connector.

Testing the Servo

Press the brake pedal several times to fully exhaust the servo, hold the brake pedal hard on and start the engine. If the pedal sinks slightly the servo is serviceable.

Servo Boost Ratio: 2.56:1

Front Caliper Assembly

The four piston caliper is an existing type with a spacer fitted between the two housings to accommodate the ventilated brake disc. All four pistons are actuated from a single fluid input adjacent to the single bleed nipple.

A brake pad anti-rattle spring is secured by the pads retaining pins and all pads are fitted with an adhesive backing shim.

The ventilated brake disc is a unique fitment to the MG "R" V8 and is manufactured from the same material as the new Rover 800.

Disc diameter:	272mm
Disc thickness:	
- new	25.25mm
- minimum	24.00mm
Run Out - Maximum:	0.04 mm
Disc thickness variation (DTV) - maximum:	0.015 mm

Rear Drum Assembly

The rear drum assembly is a self-adjusting leading/trailing shoe design operated by a double acting wheel cylinder. A fixed abutment secures the shoes lower ends.

When the brakes are applied, pressure to the wheel cylinder pushes the top of both shoes outwards until they contact the drum. The primary shoe continues to be pulled on by the wrap round (self-servo) action of the rotating drum whilst the fluid pressure continues to push the secondary shoe against the drum.

The handbrake is actuated by a cable attached to the secondary (rear) shoe.

The brakes are self-adjusting by a linkage actuated by the hydraulic operation. Hand adjustment can be made via an access hole in the backplate opposite the adjusting mechanism, after removing a rubber sealing plug. The same mechanism can also be used to retract the shoes to remove a ridged brake drum.

The handbrake cable adjuster is situated in the right hand side of the propshaft tunnel.

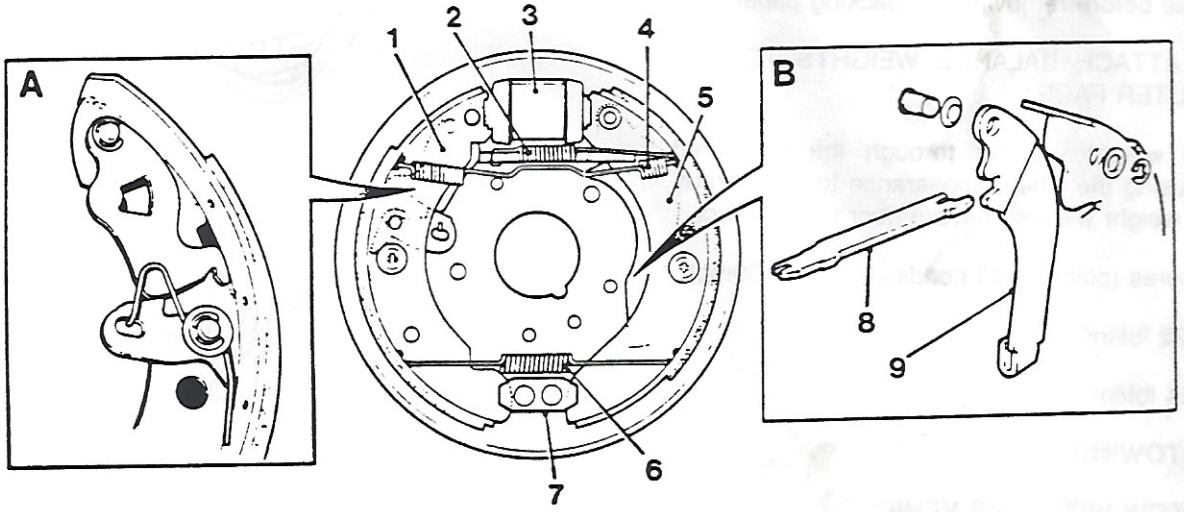


fig.71

1. Primary (leading) shoe
2. Cross lever spring
3. Wheel cylinder
4. Pull off spring
5. Secondary (trailing) shoe
6. Tension spring
7. Fixed abutment
8. Cross lever
9. Handbrake lever

A Automatic Adjusting mechanism (primary shoe)
B Handbrake mechanism (secondary shoe)

Pressure reducing valve

The valve is fitted into the rear brake pipe to regulate the fluid pressure proportionally to the front calipers. The valve is directional and the connections prevent incorrect fitment.

The pressure setting of 33/38 is stamped on the valve.

Bleeding Sequence

Use only new DOT4 fluid from sealed containers and bleed the brakes in the following order:

- LHR
- RHR
- LHF
- RHF

LININGS,
6·1m NEW 1·5m min

WHEELS AND TYRES

The 6J x 15in alloy wheels are fitted with 205/65 ZR 15 profile tyres and have a clear lacquered finish to the outer face.

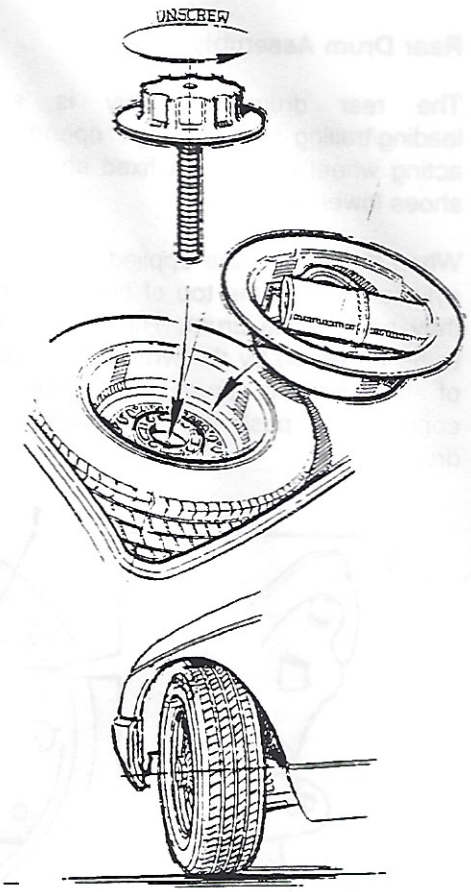
The wheels are blind balanced which means that ALL balance weights are fixed to the wheel inner face. One weight is clipped to the inner rim in the normal manner. If additional weights are necessary to correct dynamic imbalance, then they must be the stick-on type and attached to a properly cleaned surface as near to the hub mounting face as possible. ALWAYS "bend" the stick-on weight to the wheel profile before removing the backing paper.

DO NOT ATTACH BALANCE WEIGHTS TO THE WHEEL OUTER FACE.

A clip on weight will cut through the lacquered coating causing the wheel appearance to deteriorate. A stick-on weight will also have a poor visual effect.

Tyre pressures (cold) for all conditions upto 100mph

- front - 22 lbf/in^2
- rear - 24 lbf/in^2



VEHICLE TOWING

DO NOT TOW WITH THIS VEHICLE.

VEHICLE RECOVERY

The safest method of recovering your vehicle is on a flat-bed trailer where all four wheels are off the ground.

If the only method of moving the vehicle is by towing, it should be with the front wheels lifted off the ground. The propeller shaft linking the rear axle to the gearbox must first be disconnected or damage may occur.

The vehicle **MUST NOT** be towed using a rope or chain, the car's suspension, bodywork and gearbox will be seriously damaged.

MG·R COOLING SYSTEM.

ANTI-FREEZE CONTENT 50%.

1) REMOVE EXPANSION TANK CAP

2) REMOVE PLUG FROM COOLANT PIPE.

3) FILL SYSTEM THROUGH PLUG APERTURE. — UNTIL COOLANT REACHES CORRECT LEVEL IN EXPANSION TANK.

4) FIT PRESSURE CAP.

5) CARRY-ON FILLING THROUGH PLUG APERTURE UNTIL LEVEL.

6) FIT PLUG.

7) RUN ENGINE UNTIL NORMAL OPERATING TEMP. (COOLING FAN CUTS IN ONCE).

8) ALLOW TO COOL DOWN.

9) TOP-UP AS NECESSARY THROUGH EXPANSION TANK.