

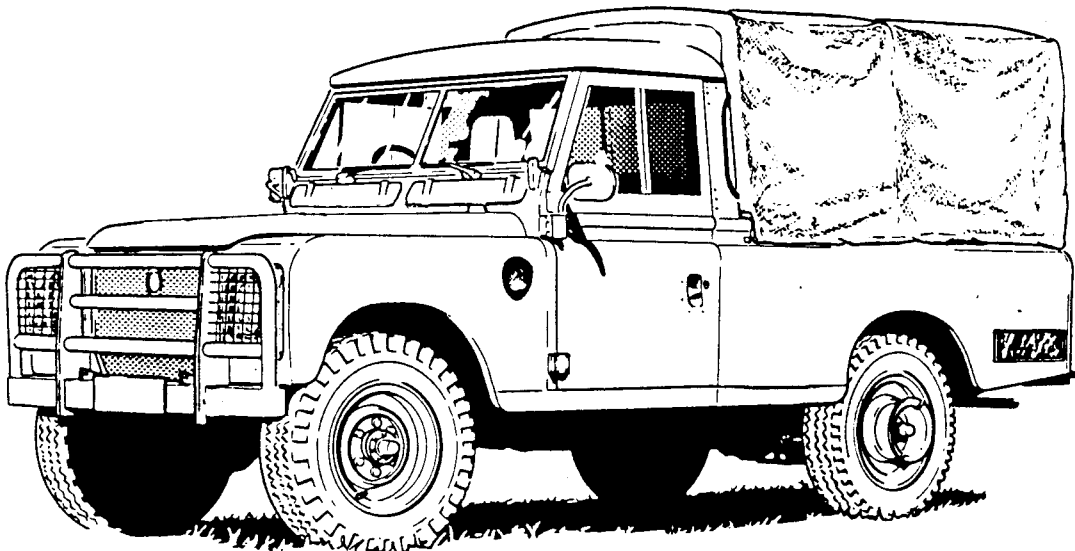
**ALLIED AUTO ELECTRICAL**  
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**4051 DURBAN**  
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# **WORKSHOP REPAIR MANUAL**

FOR

## **LAND ROVER SERIES III S**

**ALLIED AUTO ELEC. c.c.**  
REG. No. CK 87/06137/23



### **VOLUME 1 : SECTIONS**

**A - GENERAL INFORMATION AND SPECIFICATIONS**  
**B - MAIN POWER UNIT**  
**C - FUEL SYSTEM**  
**D - IGNITION SYSTEM**  
**E - COOLING SYSTEM**  
**F - EXHAUST SYSTEM**  
**G - AIR CLEANING SYSTEM**

DATA INFORMATION SHEET

Make ..... Land Rover 109"

Model ..... PUPR6 Series IIIS

Engine Type ..... R6

Gearbox/Transfer Box Type ..... M S A

Front Differential Type ..... Salisbury

Rear Differential Type ..... Salisbury 8HA

Fuel Pump Type ..... Facit - Electrical

WORKSHOP REPAIR MANUAL SET PART NO.



## PREFACE

### GENERAL

1. The manual is intended to provide guidance to workshop personnel carrying out minor and major adjustments and repairs to the Land Rover Series IIIS. The instructions contained herein are set out in a step-by-step format and should enable workshop personnel unfamiliar with the vehicle to carry out all adjustments and repairs necessary to maintain the vehicle in good working order.

2. All necessary information and the correct sequence for carrying out replacement and repair work are detailed in this manual and are in accordance with the correct repair procedures as considered necessary by the manufacturers. It is not advisable to deviate from these instructions.

### ARRANGEMENT AND LAYOUT OF THE MANUAL

3. The manual is divided into three volumes. The content of each volume is shown in the main contents page at the front of each volume. The division between volumes is selected so that allied subjects are contained in one complete volume. Typically, the arrangement is as follows:

- a. VOLUME 1: Engine and associated systems such as fuel, cooling, ignition and exhaust systems.
- b. VOLUME 2: Transmission system from the gearbox through to and including the front and rear axles and hubs.
- c. VOLUME 3: All other systems such as brakes, steering, body, electrical etc not covered in Volumes 1 and 2.

### INSTRUCTIONS CONTAINED IN THE MANUAL

4. All instructions contained in this manual are arranged in a logical step-by-step format. Where necessary to support the description, an illustration is provided. This illustration is positioned above the relevant steps explaining that part of the procedure.

5. Although in certain instances it is possible to vary the order of removal and replacement, workshop personnel are strongly advised to carry out the procedures in the order given. This will ensure that all components are correctly fitted and that all fasteners are tight.

6. For most removal and replacement procedures it is recommended that these are carried out on a hard surface such as concrete. Where this is not possible due to operational considerations it is essential that whatever improvisation is used, first consideration is given to the safety of personnel and the protection of the vehicle.

### DIVISION OF SUBJECTS

7. The manual as a whole is divided into Sections, each Section covering one main subject. For example, Section B deals with the power unit and Section C with the fuel system. Where necessary, each Section is further sub-divided into Sub-sections, Sub-sub-sections or Chapters.

8. Where applicable the content of each Section is arranged in the following sequence:

- a. Brief description and specifications including tightening specifications for assembly or component fixings.
- b. Fault finding and corrective procedures.
- c. Testing procedures.
- d. Adjustments.
- e. Removal and replacement procedures.
- f. Repair, cleaning or overhaul instructions.
- g. Maintenance.
- h. Special workshop tools.

### USE AND PRESENTATION OF THE MANUAL

9. Each sub-division deals with one particular aspect or major component directly related to the main subject. Typically, checks and adjustments, removal and replacement, overhaul and repairs, etc are contained separately in individual sub-divisions. Therefore, to locate instructions for removing the engine for example, the user should refer to the Contents page which precedes Section B (Power Unit). Then, on the page given for removal and replacement procedures, the reader will find that Chapter 1 of Sub-section B4 deals with this subject.

## MAIN CONTENTS LIST

| SECTION | DESCRIPTION                            | VOLUME |
|---------|----------------------------------------|--------|
| A       | GENERAL INFORMATION AND SPECIFICATIONS | 1      |
| B       | POWER UNIT                             | 1      |
| C       | FUEL SYSTEM                            | 1      |
| D       | IGNITION SYSTEM                        | 1      |
| E       | COOLING SYSTEM                         | 1      |
| F       | EXHAUST SYSTEM                         | 1      |
| G       | AIR CLEANING SYSTEM                    | 1      |
| H       | TRANSMISSION SYSTEM                    | 2      |
| I       | SUSPENSION SYSTEM                      | 2      |
| J       | AXLES AND HUBS                         | 2      |
| K       | BRAKING SYSTEM                         | 3      |
| L       | STEERING SYSTEM                        | 3      |
| M       | BODY                                   | 3      |
| N       | HEATING AND VENTILATION                | 3      |
| O       | ELECTRICAL SYSTEM                      | 3      |
| P       | WHEELS AND TYRES                       | 3      |
| Q       | <i>Not Applicable</i>                  |        |
| R       | <i>Not Applicable</i>                  |        |
| S       | <i>Not Applicable</i>                  |        |
| T       | <i>Not Applicable</i>                  |        |
| U       | <i>Not Applicable</i>                  |        |
| V       | WINDSCREEN WIPER AND WASHER SYSTEM     | 3      |
| W       | <i>Not Applicable</i>                  |        |
| X       | <i>Not Applicable</i>                  |        |
| Y       | GENERAL FAULT FINDING                  | 3      |
| Z       | SUMMARY OF SPECIAL WORKSHOP TOOLS      | 3      |



SECTION CONTENTS LIST

SECTION A

GENERAL INFORMATION AND SPECIFICATIONS

| CHAPTER | DESCRIPTION                                                    | PAGE |
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| 2       | GENERAL INFORMATION                                            | A5   |
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| 4       | DEFINITIONS                                                    | A9   |
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SECTION A

CHAPTER 1

LOCATION OF IDENTIFICATION PLATES

INTRODUCTION

1. The identification plates fitted to this vehicle are described below:

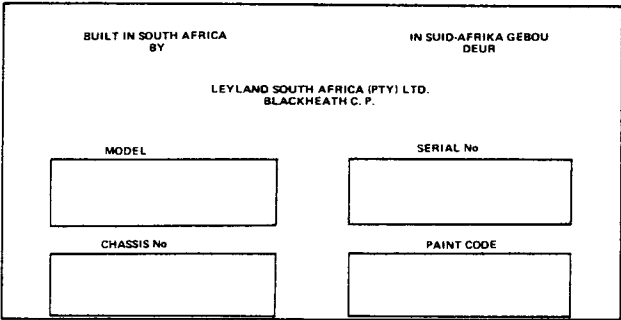


Fig A1

2. Refer to Fig A1. The plate on the right hand wing inside the engine compartment shows:

Model  
Serial number  
Chassis number  
Paint code

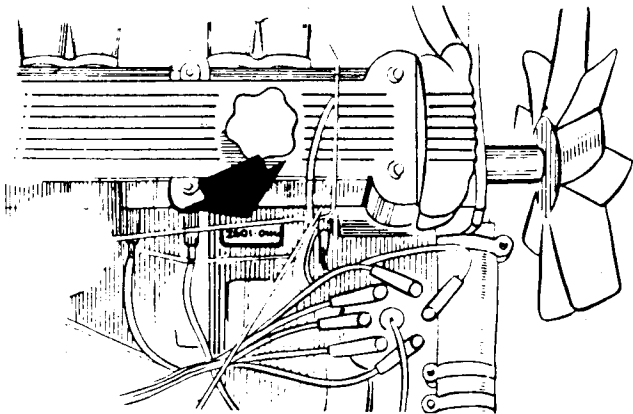


Fig A2

3. Refer to Fig A2. The engine number is stamped onto a machined surface at the right front of the engine.

|                                                      |                       |                                                         |              |   |
|------------------------------------------------------|-----------------------|---------------------------------------------------------|--------------|---|
| TITLE<br>TITEL                                       | 0,75 ton PERS<br>VRAG | CARGO<br>VRAG                                           | MARK<br>MERK | 1 |
| SERIAL<br>REEKS                                      | NO AJ 027             |                                                         |              |   |
| ORDER<br>BESTEL                                      | NO                    |                                                         |              |   |
| PRODUCTION SERIAL<br>PRODUKSIE REEKS                 | NO                    |                                                         |              |   |
| WAARBORG<br>20 000 km OF 12 MAANDE<br>VANAF<br>DATUM |                       | GUARANTEE<br>20 000 km OR 12 MONTHS<br>AS FROM<br>DATE: |              |   |

Fig A3

4. Refer to Fig A3. This plate is mounted on the passenger side seat support in the cab. It indicates:

Title of the vehicle and mark number

Production serial number  
Guarantee period

|    |         |
|----|---------|
| T  | 1640 kg |
| V  | 2681 kg |
| DT | 6748 kg |

Fig A4

5. Refer to Fig A4. Vehicle masses are shown on a plate behind the left rear wheel arch. They are:

Vehicle mass (T) : 1640 kg  
Maximum mass of vehicle and load (V) : 2681 kg  
Maximum mass of vehicle, trailer and loads (DT) : 6748 kg

## SECTION A

### CHAPTER 2

#### GENERAL INFORMATION

##### INTRODUCTION

1. The Land Rover is a two or four-wheel drive, general purpose vehicle designed for both on- and off-road use. The power unit is a water cooled, type R6, petrol engine which is coupled via a gearbox and a transfer box, to both the front and rear wheels.
2. The vehicle has a high performance under normal driving conditions. The suspension and overall construction enables the vehicle to reliably traverse rugged terrain with minimum driver discomfort.

##### POWER UNIT AND TRANSMISSION

3. The power unit is a water cooled, six cylinder petrol engine rated at 82.0 kW at 4750 r/min.
4. Drive is transmitted via a single plate, diaphragm spring clutch to the gearbox. The clutch is hydraulically operated and enclosed within a bell-shaped housing, which is bolted to the front of the gearbox.
5. The gearbox is manually operated and has four forward gears and reverse. All forward gears are of the synchromesh type.
6. The transfer box provides a high and a low range which are selected manually.

##### AXLES

7. The rear axle and differential assembly is of the spiral bevel type, with fully floating shafts. The ratio to the rear wheels is 4,7:1.
8. The front axle and differential assembly is of the spiral bevel type, with fully encased constant velocity joints transmitting the drive from the differential to the front wheels. The ratio to the front wheels is 4,7:1.

##### SUSPENSION

9. Leaf springs are fitted longitudinally between the axles and the underside of the chassis. Hydraulic, telescopic shock absorbers are fitted to both axles.

##### BRAKES

10. The hydraulic braking system is dual line, servo assisted, operating on front and rear wheels. The lockable handbrake acts mechanically on the rear wheels, via a mechanical brake unit mounted on the output shaft from the transfer box.

##### BODY

11. The body is of solid unitary construction and is mounted on a chassis. The aluminium alloy body panels will not rust or corrode under normal circumstances. Inside the driver's cab, the controls are placed conveniently within reach and vision of the driver.

##### STEERING

12. The recirculating ball type steering only requires three comma five (3,5) turns from lock to lock. A steering lock is combined with the ignition switch.

##### ELECTRICAL SYSTEM

13. The electrical system is negative earth, and energised by a 12 V battery. The battery is maintained in a charged state by an alternator. A pre-engaged type starter is fitted for engine starting.

##### FUEL

14. Twin SU type carburettors fed by an electrically operated fuel pump. A fuel filter unit is fitted to provide additional filtration. The air cleaner is a single element, dry type, fitted with a removable dust cup.

##### MAINTENANCE REQUIREMENTS

15. The vehicle is designed to minimise maintenance. However, to maintain the vehicle at peak performance, periodic checks and adjustments are necessary. Typically, regular inspections must be made to check oil levels, tightness of fasteners, drive belt tensions, clutch fluid levels, operation of the vehicle, etc. At less frequent intervals it is necessary to repack hubs with grease, check tappet clearances, condition of brake linings, clutch pedal adjustments, specific gravity of battery electrolyte and so on.
16. Maintenance requirements for each assembly or component are detailed at the end of the appropriate Section. It is essential that the maintenance instructions are strictly observed and carried out at the periods indicated.

##### WORKSHOP REPAIRS TO THE VEHICLE - GENERAL NOTES

17. Many assemblies and components fitted to the vehicles are large and heavy. It is essential, therefore to observe all safety measures when working on the vehicle. Stands and supports should be underrated so that a considerable safety margin is available and to allow for miscalculations of the mass to be supported.
18. Due to the large mass of many assemblies and components, removal and replacement of heavy items should be carried out on a firm surface. Preference should be given to thick concrete floors laid on a well prepared and compact base. If doubt exists or the surface is known to be soft, strong planks should be used if replacement under dangerous conditions cannot be avoided.
19. When recovery vehicles are used in operational areas for removing the engine (for example) it is important that the capacity of the gantry in the extended position is correctly calculated. Once again it is stressed that capacity should be underrated. Preference

should be given to recovery vehicles which are fitted with a gantry which can be extended its length smoothly with the load attached. Recovery vehicles with short gantrys and the need to move the recovery vehicle or the vehicle under repair are not recommended.

20. Dirt, grit, sand, metal filings, etc, cause moving parts to wear quickly. Working areas and parts being repaired must, therefore, be kept clean. Components which are to be refitted must not be placed on

dirty surfaces or into dirty containers. Floors and working surfaces should be kept free of oil. When draining oils or disconnecting fuel lines use a suitable container with sufficient size and capacity to avoid spillage. Tools and hands should be kept as clean as is practical and frequent cleaning is recommended. A plentiful supply of clean rags for frequent cleaning of hands and tools is essential. Dirty and oily hands and tools are not only detrimental to good repairs but also prevent safe handling.

## SECTION A

### CHAPTER 3

#### VEHICLE SPECIFICATIONS

##### INTRODUCTION

1. The specifications contained in this Chapter are only intended to provide an overall description of the basic vehicle's content. Detailed specifications of each major component are contained in each Section or Sub-section as appropriate.

##### ENGINE

2. The main power unit is a normally aspirated, water cooled, petrol engine. The six cylinders are arranged in line, with valve operation via an overhead camshaft.
3. A forced feed lubrication system is employed and a replaceable oil filter filters the oil in the main lubrication circuit.
4. The engine type is as follows:
  - a. Type R6
  - b. Cylinder capacity 2623 cm<sup>3</sup>

##### FUEL SYSTEM

5. Twin SU type, semi-downdraught carburettors fed by a Facit electric fuel pump. A renewable element type fuel filter is fitted.
6. Petrol is contained in a 90 litre tank under the chassis frame at the rear of the vehicle.

##### GEARBOX

7. The gearbox is a single helical constant mesh type with synchromesh on all forward gears and the following input/output ratios:
  - a. Forward gears: First 3,65:1; Second 2,22:1; Third 1,497:1, Fourth direct
  - b. Reverse gear 4,06:1

##### TRANSFER GEARBOX

8. The transfer gearbox provides a two-speed reduction on the main gearbox output and allows selection of two- or four-wheel drive. The following are the input/output ratios for the transfer box:
  - a. High transfer 1,148:1
  - b. Low transfer 2,346:1

##### FRONT AXLE

9. The front axle uses a spiral bevel differential and has enclosed universal joints. Reduction ratio to the wheels is 4,7:1.

##### REAR AXLE

10. Spiral bevel type with floating shafts. Reduction ratio is 4,7:1.

##### SUSPENSION

11. Semi-elliptical springs are used for both front and rear suspension and are damped by hydraulic, double acting telescopic shock absorbers.
12. The front of each spring is bolted to brackets fixed to the chassis while the rear is bolted to shackle plates.

##### WHEELS AND TYRES

13. The wheel size is 550F x 16 and takes cross ply 7.50 x 16 tyres.

##### BRAKES

14. The following braking systems are fitted to the vehicle:
  - a. Footbrake: Hydraulic, dual line, servo assisted system operating drums front and rear.
  - b. Handbrake: Drum type, cable operated onto the rear propellor shaft.

##### HEATING AND VENTILATION

15. Hot engine coolant is switched to a heat exchanger. Fresh air is drawn over the heat exchanger and can be switched to demist the windscreen or through foot level vents to warm the cab. With the coolant switched off, fresh air can be drawn into the cab.
16. Two hand-operated vents below the windscreen can be opened to allow fresh air into the cab.

##### ELECTRICAL SYSTEM

17. The main components of the electrical system are:
  - a. Alternator, 12 V nominal.
  - b. Battery, 12 V, 58 Ah.
  - c. Starter motor, 12 V, pre-engaged.

##### STEERING SYSTEM

18. A recirculating ball type operating on the front wheels through a steering relay, track rod and drag link.

**DIMENSIONS AND PERMISSIBLE LOADS**

19. Principal vehicle dimensions are:

- Wheelbase - 109 mm
- Overall length - 4450 mm
- Maximum width - 1690 mm
- Ground clearance - 209 mm
- Track - 1395 mm

20. Maximum permissible loads are:

- Gross vehicle load - 2681 kg

- Gross front axle load - 970 kg
- Gross rear axle load - 1905 kg
- Maximum trailer load - 4080 kg using trailer with four wheels and independent power brakes

**MAXIMUM SPEED**

21. Maximum speed for the vehicle is 130 km/h.

## SECTION A

### CHAPTER 4

#### DEFINITIONS

##### INTRODUCTION

1. Terminology in the motor trade varies sometimes from area to area, manufacturer to manufacturer and, therefore, it was decided to include a few definitions of what is meant by certain terms used in this Workshop Repair Manual. It must be borne in mind that the compilers of the list contained herein do not purport that these definitions are the final authority, or in any way exhaustive. This is the work of other bodies and not the purpose of these definitions.

##### DEFINITIONS

2. The following list of definitions is bounded by the conditions stated in Paragraph 1 :

##### **AXIAL**

Forming or belonging to an axis (refer axis).

##### **AXIAL MOVEMENT**

Axial movement is a movement of a shaft (or other object) along the line of its axis. Sometimes this is known as end-to-end movement or end play.

##### **AXIS**

The axis is an imaginary line about which a body revolves.

##### **BOLT**

A bolt is defined in several different ways, one of which includes the length of thread contained on a headed metal pin. However, for the purposes of this manual, a bolt is defined as being a metal pin threaded at one end and a head of any shape at the other end, and used in conjunction with a nut or similar fastener.

##### **BOLTED (-TOGETHER)**

The term 'bolted together' is used in this manual to indicate that two or more items are secured to each other by a headed metal pin which is threaded at one end. Nuts may be used to fasten the metal pin or used in conjunction with studs. The actual metal pin may also be a screw (studs and screws are also defined).

##### **BORE (Noun Usage)**

The noun bore is used in this manual to indicate that a hole is open at both ends and is circular in shape.

##### **CIRCLIP**

A circlip is a small flat strip of springy steel, usually having an oblong-shaped cross section, bent circular but not a complete circle. Some circlips have a hole drilled at each end to facilitate fitment. A circlip may be fitted in a groove around the inside of a bore (hole) or a groove around a shaft or spindle. Little or no side-thrust should be imposed against the circlip.

##### **CLEVIS**

A clevis is a U-shaped piece of metal at the end of a metal rod or bar, and used as a linkage. It is not unlike a short-pronged tuning fork in appearance. A hole is drilled near the ends of the two prongs, inside which a clevis pin is fitted. A clevis might be drilled and threaded internally at that part of the U or fork, opposite to the open end, so that a threaded rod can be screwed in. This type of clevis enables the length of the linkage to be adjusted by screwing the threaded rod further in or out.

##### **CLEVIS PIN**

A clevis pin fits inside the holes at the end of the two prongs and is used to couple the clevis to its associated linkage. A clevis pin may be headed at one end with a hole drilled through the shank at right angles at the other. In most instances, a split pin is fitted in the hole drilled in the shank.

##### **COTTER**

Normally consists of two half moon shaped semi-circular tapered wedges used to hold a spring retainer in position on a stem. eg A valve spring retainer.

##### **DURLOCK BOLTS**

Durlock bolts and nuts are a patented design self locking fastener. A locking action is achieved by a specially designed head, which in cross-section is serrated on the gripping face. The Durlock nut is similar in construction. When the nut or bolt is turned in the tightening direction, the sloping edges of the serrations pass normally over the material being fastened together. The peak of the serration bites deep into the material. Movement in the opposite direction (unscrewing) causes the peak of the serration to bite even deeper. Washers of any description must not be used with Durlock bolts and nuts, otherwise the self-locking action will be nullified. All types of self-locking nuts and bolts should not be re-used.

## FASTENER

A fastener is a device which is used to secure two or more items together and includes, nuts, bolts, studs, screws, rivets etc. Although in its widest classification, a fastener is often used to describe split pins, circlips etc., it must be remembered that these items are truly retainers, since their inherent strength or method of fitting prohibits significant side thrust or pressure.

## LIFTING TACKLE

The term 'lifting tackle' is used in this Workshop Repair Manual, and embraces any device, of sufficient capacity, which raises the item vertically from an overhead position. Block and tackle, handy-billy, endless chain, etc are typical examples of a lifting tackle.

## NUTS (Self-locking)

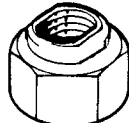
There are several types of self-locking nuts. Usually, the design of the nut is patented.

Nyloc nuts resemble standard type nuts in appearance, except that one end does not have a flat face (rounded). This end is specially designed so that Nyloc material can be inserted during manufacture. Since the hole in the Nyloc is smaller than the bolt diameter, the Nyloc grips the threads and prevents the nut from falling off.

Crimp type nuts resemble standard type nuts in appearance, except that one end does not have a flat face. The shape of this end varies according to design and several types are available. During manufacture, the non-flat face is crimped slightly, and when screwed onto a bolt, it grips the thread and prevents the nut from loosening.



NYLOC NUT



CRIMPED NUT

Durlock nuts are discussed under the heading of Durlock Bolts.

Although design requirements vary from designer to designer and in respect of application, it is not unusual for washers to be omitted when self-locking nuts are used. It is not recommended to re-use self-locking type nuts.

## SPLIT PINS

A split pin is a universally accepted shape, design and application. Its appearance in this list of definitions is only to stress that split pins should not be replaced with pieces of wire, etc. Once used, split pins should be discarded. The application of a split pin should be such that little or no side thrust is exerted against the split pin.

## SPRINGS

Springs have a multitude of shapes and applications. Two types are discussed here : compression and tension springs of the coiled variety.

Compression springs are manufactured from coils of spring steel and vary in cross-section shape. The coils may be tighter wound at one end. Usually, the ends are flat and parallel. In its application, the coils of the spring are compressed thus exerting a force in an outwards direction. Springs which are tightly wound at one end should be fitted so that the loosely wound end faces in the direction of movement, ie a poppet valve spring (if tightly wound at one end) is fitted so that the loosely wound end is nearest the cotter (end of valve stem) and at the tightly wound end is nearest the cylinder head (valve seat end).

Tension (return) springs are manufactured from coils of spring steel and vary in cross-section shape. The coils are tightly wound along its entire length. Each end is hooked to enable attachment to the anchoring point and to the component which it is required to return to a desired position. The shape and arrangement of the hooks vary according to application and to suit attachment.

Springs should be replaced when they become unserviceable, such as badly rusted, pitted, cracked, etc. The length of the spring also indicates its serviceability. A weakened compression becomes shorter and a tension spring becomes longer. Comparison with a new spring will assist in determining original length if this is not known. It should be borne in mind, however, that although of the correct length, the springiness may be insufficient for its application. If this is suspected, the doubtful spring should be compressed or stretched (depending on spring type) using a known force and its length measured. The procedure is repeated with a new spring and the results compared. If a known force is not available, both springs can be fitted end-to-end, then compressed or stretched, as appropriate, and both lengths measured while the force (must be constant) is still applied. It is important to note that whichever method is used, the spring used for comparison purposes must be known to be serviceable. The fact that it is a new spring does not necessarily mean that it is serviceable.



**STUDS**

The type of stud referred to in this Workshop Repair Manual is threaded at both ends and has a shank similar to a bolt (without a head). In most applications, only one end is secured by a nut, the other end screwed into a threaded hole in one of the items being secured together.

**SWIVEL PINS**

On a front wheel drive vehicle, drive is imparted from the front axle differential to the front road wheels. The drive is transmitted via a shaft and a constant velocity universal joint. This arrangement prevents the use of a king pin, normally fitted to a standard free-wheeling type front axle, since the king pin would have to pass through the rotating components. Therefore, to overcome this, the pin is manufactured in two halves. One half fits at the top and the other at the bottom of the universal joint housing. These halves are known as swivel pins. The manner in which swivel pins are fitted varies from manufacturer to manufacturer and application to application.

SECTION A

CHAPTER 5

CONVERSION TABLES

INTRODUCTION

1. Throughout the workshop manual, SI (International Metric System) units as approved by the South African Bureau of Standards (SABS) are used. However, since not all countries have adopted the system and others are still in the process of converting to SI units, Workshop personnel will, from time-to-time, encounter measuring devices which are not graduated in SI units.
2. SABS have published a number of very useful booklets which give guidance in these matters, including a comprehensive list of conversions to SI units. However, since these may not be readily to hand

at all times, it was considered worthwhile to include a short list of conversion factors covering units of measurement that workshop personnel are likely to meet, when servicing the vehicle.

3. In this respect, two tables are provided. The first, Table A5.1, gives definitions of derived SI units which have special names. The second, Table A5.2, is a short list of useful conversion factors, arranged in alphabetical order. It should be noted that although every reasonable effort has been made to ensure accuracy, the user shall be responsible for verifying that the data given herein is correct, before applying the conversion tables contained in this Sub-section.

TABLE A5.1 DEFINITIONS OF DERIVED UNITS HAVING SPECIAL NAMES

| Quantity                                            | SI unit and symbol | Definition                                                                                                                                                                                                                                 |
|-----------------------------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Force                                               | Newton, N          | The newton is that force which when applied to a body having a mass of 1 kg, gives it an acceleration of 1 m/s <sup>2</sup> .                                                                                                              |
| Pressure, stress                                    | Pascal, Pa         | The pascal is the pressure which results when a force of 1 N is applied evenly and perpendicularly to an area of 1 m <sup>2</sup> .                                                                                                        |
| Power                                               | Watt, W            | The watt is the power which results in the production of energy at the rate of 1 J/s (joule per second).                                                                                                                                   |
| Electric potential difference (electromotive force) | Volt, V            | The volt is the potential difference between two points of a conducting wire carrying a constant current of 1 A, when the power dissipated between these points is equal to 1 W.                                                           |
| Capacitance                                         | Farad, F           | The farad is the capacitance of a capacitor between the plates of which there appears a potential difference of 1 V when it is charged with an electric charge equal to 1 C (Coulomb).                                                     |
| Electric resistance                                 | Ohm (Ω)            | The ohm is the electric resistance between two points of a conductor when a constant potential difference of 1 V, applied between these two points, produces a current of 1 A, the conductor not being the source of any electronic force. |

TABLE A5.2 LIST OF CONVERSION FACTORS TO SI UNITS  
(SI SYMBOLS ARE GIVEN IN BRACKETS)

| To convert from                                    | To                                            | Multiply by                      |
|----------------------------------------------------|-----------------------------------------------|----------------------------------|
| Abampere (biot)                                    | Ampere (A)                                    | * $1 \times 10$                  |
| Abohm                                              | Ohm ( $\Omega$ )                              | * $1 \times 10^{-9}$             |
| Abvolt                                             | Volt (V)                                      | * $1 \times 10^{-8}$             |
| Ampere (International, 1948)                       | Ampere (A)                                    | 0,9998 35                        |
| Astronomical unit                                  | Metre (m)                                     | $1,496 \times 10^{11}$           |
| Atmosphere (standard)                              | Pascal (Pa)                                   | * $1,013\ 25 \times 10^5$        |
| Atmosphere (technical)<br>(1 kgf/cm <sup>2</sup> ) | Pascal (Pa)                                   | $9,806\ 65 \times 10^4$          |
| Atomic mass unit (unified)                         | Kilogram (kg)                                 | $1,660\ 531 \times 10^{-27}$     |
| Bar                                                | Pascal (Pa)                                   | * $1 \times 10^5$                |
| Biot (abampere)                                    | Ampere (A)                                    | * $1 \times 10$                  |
| Cheval vapeur or metric<br>horsepower              | Watt (W)                                      | $7,354\ 99 \times 10^2$          |
| Cubic foot                                         | Cubic metre (m <sup>3</sup> )                 | $2,831\ 685 \times 10^{-2}$      |
| Cubic foot per minute                              | Cubic metre per second (m <sup>3</sup> /s)    | $4,719\ 474 \times 10^{-4}$      |
| Cubic foot per second                              | Cubic metre per second (m <sup>3</sup> /s)    | $2,831\ 685 \times 10^{-2}$      |
| Cubic inch                                         | Cubic metre (m <sup>3</sup> )                 | * $1,638\ 706\ 4 \times 10^{-5}$ |
| Cubic inch per minute                              | Cubic metre per second (m <sup>3</sup> /s)    | $2,731\ 177 \times 10^{-7}$      |
| Cubic inch per pound                               | Cubic metre per kilogram (m <sup>3</sup> /kg) | $3,612\ 729 \times 10^{-5}$      |
| Cubic yard                                         | Cubic metre (m <sup>3</sup> )                 | 0,7645 549                       |
| Cubic yard per minute                              | Cubic metre per second (m <sup>3</sup> /s)    | $1,274\ 258 \times 10^{-2}$      |
| Degree Celsius<br>(particular temperature)         | Kelvin (K)                                    | use $T = t_c + 273,15$           |
| Degree Celsius<br>(temperature interval)           | Kelvin (K)                                    | * 1                              |
| Degree Fahrenheit<br>(particular temperature)      | Kelvin (K)                                    | use $T = (t_F + 459,67)$         |
| Degree Fahrenheit<br>(temperature interval)        | Kelvin (K)                                    | $\frac{1,8}{0,555\ 556}$         |
| Electrostatic unit of potential                    | Volt (V)                                      | $2,997\ 925 \times 10^2$         |
| Electrostatic unit of resistance                   | Ohm ( $\Omega$ )                              | $8,987\ 554\ 31 \times 10^{11}$  |
| Foot pound-force (torque)                          | Newton metre (N.m)                            | 1,355 818                        |
| Foot pound-force per second                        | Watt (W)                                      | 1,355 818                        |
| Horsepower (electrical)                            | Watt (W)                                      | * $7,46 \times 10^2$             |
| Horsepower (550 foot<br>pounds-force per second)   | Watt (W)                                      | $7,456\ 999 \times 10^2$         |
| Horsepower (metric or<br>cheval vapeur)            | Watt (W)                                      | $7,345\ 99 \times 10^2$          |
| Inch                                               | Metre (m)                                     | * $2,54 \times 10^{-2}$          |
| Inch of mercury (32 °F)                            | Pascal (Pa)                                   | $3,386\ 389 \times 10^3$         |
| Inch of mercury (60 °F)                            | Pascal (Pa)                                   | $3,376\ 85 \times 10^3$          |
| Inch of water (39,2 °F)                            | Pascal (Pa)                                   | $2,490\ 82 \times 10^2$          |
| Inch of water (60 °F)                              | Pascal (Pa)                                   | $2,488\ 4 \times 10^2$           |
| Inch per minute                                    | Metre per second (m/s)                        | $4,233\ 333 \times 10^{-4}$      |
| Kilogram-force                                     | Newton (N)                                    | * 9,806 65                       |
| Kilogram-force metre (torque)                      | Newton metre (N.m)                            | * 9,806 65                       |
| Kilogram-force per square<br>centimetre            | Pascal (Pa)                                   | * $9,806\ 65 \times 10^4$        |
| Ohm (international, 1948)                          | Ohm ( $\Omega$ )                              | 1,000 495                        |
| Ounce-force                                        | Newton (N)                                    | 0,2780 139                       |
| Ounce-force inch (torque)                          | Newton metre (N.m)                            | $7,061\ 552 \times 10^{-3}$      |
| Torr                                               | Pascal (Pa)                                   | $1,333\ 223\ 7 \times 10^2$      |

\* Exact values

**SUB-SECTION A6**

**MISCELLANEOUS TIGHTENING RECOMMENDATIONS FOR METRIC THREADS**

TABLE A6.1 STANDARD TIGHTENING TORQUE FOR NUTS AND BOLTS

| CLASS OF FASTENERS |              | 6,9          | 8,8     | 10,9    | 12,9    |
|--------------------|--------------|--------------|---------|---------|---------|
| NUTS AND BOLTS     |              | TORQUE (N.m) |         |         |         |
| Diameter           | Thread Pitch |              |         |         |         |
| M4                 |              | 2,4          | 2,9     | 4,1     | 4,9     |
| M5                 |              | 5,0          | 6,0     | 8,5     | 10,0    |
| M6                 |              | 8,5          | 10,0    | 14,0    | 17,0    |
| M8                 | 1            | 23,0         | 27,0    | 38,0    | 45,0    |
| M8                 |              | 21,0         | 25,0    | 35,0    | 41,0    |
| M10                | 1            | 46,0         | 55,0    | 77,0    | 92,0    |
| M10                | 1,25         | 44,0         | 52,0    | 73,0    | 88,0    |
| M10                |              | 41,0         | 49,0    | 69,0    | 83,0    |
| M12                | 1,25         | 80,0         | 95,0    | 135,0   | 160,0   |
| M12                | 1,5          | 76,0         | 90,0    | 125,0   | 150,0   |
| M12                |              | 72,0         | 86,0    | 120,0   | 145,0   |
| M14                | 1,5          | 125,0        | 150,0   | 210,0   | 250,0   |
| M14                |              | 115,0        | 135,0   | 190,0   | 230,0   |
| M16                | 1,5          | 190,0        | 225,0   | 315,0   | 380,0   |
| M16                |              | 185,0        | 210,0   | 295,0   | 355,0   |
| M18                | 1,5          | 295,0        | 325,0   | 460,0   | 550,0   |
| M18                | 2            | 265,0        | 310,0   | 440,0   | 530,0   |
| M18                |              | 245,0        | 290,0   | 405,0   | 485,0   |
| M20                | 1,5          | 385,0        | 460,0   | 640,0   | 770,0   |
| M20                | 2            | 370,0        | 440,0   | 620,0   | 740,0   |
| M20                |              | 345,0        | 410,0   | 580,0   | 690,0   |
| M22                | 1,5          | 520,0        | 610,0   | 860,0   | 1 050,0 |
| M22                | 2            | 500,0        | 600,0   | 840,0   | 1 000,0 |
| M22                |              | 465,0        | 550,0   | 780,0   | 930,0   |
| M24                | 1,5          | 690,0        | 820,0   | 1 150,0 | 1 400,0 |
| M24                | 2            | 650,0        | 780,0   | 1 100,0 | 1 300,0 |
| M24                |              | 600,0        | 710,0   | 1 000,0 | 1 200,0 |
| M26                | 1,5          | 880,0        | 1 050,0 | 1 470,0 | 1 760,0 |
| M27                | 2            | 970,0        | 1 150,0 | 1 600,0 | 1 950,0 |
| M27                |              | 890,0        | 1 050,0 | 1 500,0 | 1 800,0 |
| M28                | 1,5          | 1 070,0      | 1 270,0 | 1810,0  | 2 170,0 |
| M30                | 1,5          | 1 400,0      | 1 650,0 | 2 300,0 | 2 750,0 |
| M30                | 2            | 1 350,0      | 1 600,0 | 2 250,0 | 2 700,0 |
| M30                |              | 1 300,0      | 1 450,0 | 2 000,0 | 2 400,0 |

**NOTES**

1. Before using the torque specifications given in Table A6.1 above, the user should verify that special methods of tightening are not applicable. Therefore, refer in the first instance to the tightening tables and instructions in the relevant section.

2. The values given in Table A6.1 apply only to untreated or phosphated bolts (unlubricated) and to instances where the same grade of material is used for both bolt and nut, ie. bolt 8,8, nut 8.

3. Special values based on the waist cross section apply to necked-down bolts (refer Table A6.4).

4. In instances where gaskets, packing, softer grade materials, unclassified fasteners, etc are used, the torque applied should not exceed 75 percent of the specifications given in Table A6.1, left column (Class 6,9). If doubt exists, the manufacturer of the fasteners should be consulted.

TABLE A6.2 TORQUE VALUES FOR PIPE CONNECTIONS

| CONNECTION |              |              |
|------------|--------------|--------------|
| Diameter   | Thread Pitch | Torque (N.m) |
| M10        | 1,0          | 16           |
| M12        | 1,5          | 28           |
| M14        | 1,5          | 33           |
| M16        | 1,5          | 38           |
| M18        | 1,5          | 46           |
| M20        | 1,5          | 56           |
| M22        | 1,5          | 68           |
| M24        | 1,5          | 87           |
| M26        | 1,5          | 91           |
| M27        | 2,0          | 102          |
| M30        | 1,5          | 105          |
| M32        | 1,5          | 110          |
| M35        | 1,5          | 125          |
| M38        | 1,5          | 130          |
| M40        | 1,5          | 160          |
| M42        | 1,5          | 175          |
| M45        | 1,5          | 175          |
| M48        | 1,5          | 190          |

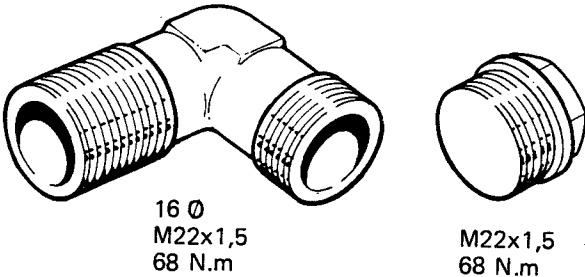
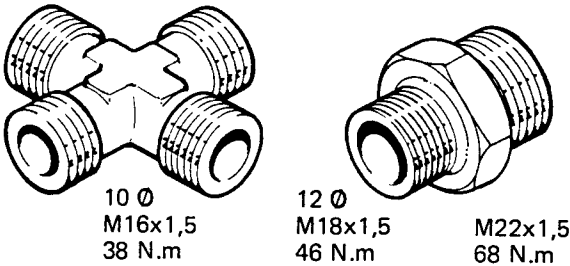
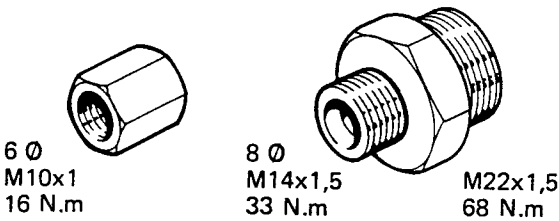
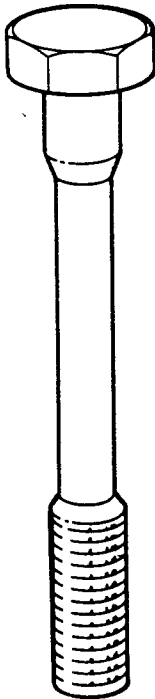


TABLE A6.3 TORQUE VALUES FOR CASTLENUTS ON BALL JOINTS

| CASTLE NUT |              |              |
|------------|--------------|--------------|
| Diameter   | Thread Pitch | Torque (N.m) |
| M16        | 1,5          | 100          |
| M18        | 1,5          | 150          |
| M20        | 1,5          | 200          |
| M24        | 1,5          | 250          |

TABLE A6.4 TORQUE VALUES FOR WAISTED SHANK  
(NECKED-DOWN) BOLTS

| CLASS OF FASTENERS |              | 6,9          | 8,8     | 10,9    | 12,9    |
|--------------------|--------------|--------------|---------|---------|---------|
| Diameter           | Thread Pitch | TORQUE (N.m) |         |         |         |
| M4                 |              | 1,2          | 1,5     | 2,1     | 2,6     |
| M5                 |              | 2,7          | 3,2     | 4,5     | 5,4     |
| M6                 |              | 4,6          | 5,4     | 7,8     | 9,3     |
| M8                 |              | 11,7         | 13,7    | 19,6    | 23,5    |
| M8                 | 1            | 13,7         | 16,6    | 22,5    | 27,4    |
| M10                |              | 24,5         | 28,4    | 40,2    | 48,0    |
| M10                | 1,25         | 26,4         | 32,3    | 45,1    | 53,9    |
| M12                |              | 43,1         | 51,0    | 72,5    | 86,3    |
| M12                | 1,25         | 51,0         | 59,8    | 84,3    | 103,0   |
| M12                | 1,5          | 47,0         | 55,9    | 78,4    | 94,1    |
| M14                |              | 69,6         | 82,4    | 117,7   | 137,3   |
| M14                | 1,5          | 79,4         | 94,1    | 132,4   | 156,9   |
| M16                |              | 112,8        | 132,4   | 186,3   | 220,7   |
| M16                | 1,5          | 122,6        | 147,1   | 206,0   | 250,1   |
| M18                |              | 152,0        | 176,5   | 250,1   | 299,2   |
| M18                | 1,5          | 186,3        | 220,7   | 300,0   | 372,7   |
| M20                |              | 220,7        | 259,9   | 367,8   | 441,4   |
| M20                | 1,5          | 259,9        | 309,0   | 436,5   | 519,9   |
| M22                |              | 304,0        | 358,0   | 510,1   | 508,2   |
| M22                | 1,5          | 358,0        | 421,8   | 598,4   | 716,1   |
| M24                |              | 382,5        | 451,2   | 637,6   | 765,1   |
| M24                | 2            | 441,4        | 519,9   | 735,7   | 882,9   |
| M27                |              | 588,6        | 686,7   | 971,1   | 1 177,2 |
| M27                | 2            | 657,2        | 774,9   | 1 079,1 | 1 324,3 |
| M30                |              | 784,8        | 931,9   | 1 324,4 | 1 569,6 |
| M30                | 2            | 931,9        | 1 128,2 | 1 569,6 | 1 863,9 |



NOTES

1. Before using the torque specifications given in Table A6.4 above, the user should verify that special methods of tightening are not applicable. Therefore, refer in the first instance to the tightening tables and instructions in the relevant section.
2. The values given in Table A6.4 apply only to untreated or phosphated bolts (unlubricated) and to instances where the same grade of material is used for both bolt and nut, ie. bolt 8,8 nut 8.

## SECTION A

### CHAPTER 7

#### LOCTITE USAGE INSTRUCTIONS

##### PRE-TREATMENT

1. All parts must be free of oil and water; using trichloroethylene, perchloroethylene, chloroethene for cleaning etc would be best, or similar grease solvents. Be sure that the solvents have completely dissipated before applying Loctite. Non-metals, parts with natural or synthetic oxide films, as well as electroplated surface layers must be pretreated with an activator to ensure normal curing. Always use activator for repairs, since this will considerably shorten the curing period. 'Activator T' is recommended.

##### APPLICATION

2. Apply a few drops on parts or dip parts, then assemble. When using Loctite for blind holes, the tapped hole should also be coated and not only the screw, so that the escaping air will not force the Loctite out.

##### CURING

3. Curing time is approximately 24 hours; 40 percent of the final hardness is already obtained after 2 to 4 hours. Heating the parts to approximately 120 °C will provide full shear strength already after approximately 15 minutes.

##### DISASSEMBLY

4. Connections secured with Loctite can be released again with standard tools. If strongly attached, heat parts to approximately 250 °C and dismount immediately. The lock will become tight again after cooling down.

##### REASSEMBLY

5. Parts previously assembled with Loctite may be used again after applying a few drops of Loctite. It is not necessary to remove hardened Loctite, but parts should be dry and free of grease. Remove loose Loctite remainders with a wire brush or compressed air.

##### SURFACE ROUGHNESS

6. Fixing forces increase with rising surface roughness. The most favourable result is obtained at an average peak-to-valley height of 12 microns ( $\mu$ ) or more.

##### TEMPERATURE RANGE

7. Loctite products are applicable from -80 °C to 200 °C. At temperatures of approximately 260 °C to 320 °C Loctite will begin to dissolve. Brittleness will start when temperatures are very low.

##### STRENGTH

8. Upon curing, Loctite has a shear strength of between 490 kPa to 34 MPa depending on type. Compression strength varies, depending on type, between 340 MPa to 490 MPa without any permanent deformation worth mentioning.

##### STORAGE

9. Loctite taken from its container should never be poured back, since any contamination entering the container will cure or pre-harden its content. Protect against sunshine and heat. Never store Loctite in metal containers or excluded from air. Loctite products are completely non-toxic.

SECTION A

CHAPTER 8

RECOMMENDED LUBRICANTS AND FLUIDS

INTRODUCTION

These recommendations apply to temperate climates where operation temperatures are above –10°C (14°F). Information on recommended lubricants for under extreme winter conditions can be obtained from Leyland S.A. (Pty.) Limited, Technical Department. Lubricants marked with an asterisk (\*) are multi-grade oils suitable for all temperature ranges.

TABLE A8.1 - RECOMMENDED LUBRICANTS AND FLUIDS

| COMPONENTS                                                                                                                                                                                                                                                                                                                 | SAE                                                                                                                                                                    | BP                                    | CASTROL                    | DUCKHAM'S                        | ESSO                                  | MOBIL                                                 | CALTEX                               | SHELL                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|----------------------------|----------------------------------|---------------------------------------|-------------------------------------------------------|--------------------------------------|----------------------------|
| Engine<br>Carburettor<br>Dash Pots                                                                                                                                                                                                                                                                                         | **<br>20W                                                                                                                                                              | *BP Super<br>Visco-Static<br>20-500** | *Castrol<br>GTx            | Duckham's<br>Q20-50<br>Motor Oil | Extra<br>20W-50                       | Mobiloil<br>Super or<br>Mobiloil<br>Special<br>20W-50 | Supreme<br>5-Star<br>20W-50          | *Shell<br>Super<br>Oil     |
| Main gearbox<br>Transfer box                                                                                                                                                                                                                                                                                               | 90EP<br>GL5                                                                                                                                                            | BP Hypo<br>GL 5 EP 90                 | Castrol<br>Hypoy<br>B90 EP | Duckham's<br>Hypoid 90<br>GL5    | GX 85W<br>90                          | HD<br>80W/90                                          | Multi-<br>purpose<br>Thuban<br>90 EP | Spirax<br>HD<br>80W/90     |
| Front differential<br>Rear differential<br>Swivel housing, R.H.<br><br>Swivel housing, L.H.<br>Steering box<br>Steering relay                                                                                                                                                                                              | 90EP                                                                                                                                                                   | BP Hypo-<br>gear<br>SAE 90EP          | Castrol<br>Hypoy<br>B90 EP | Duckham's<br>Hypoid 90           | GX 85W<br>90                          | Mobilube<br>HD<br>80W/90                              | Multi-<br>purpose<br>Thuban<br>EP 90 | Spirax<br>HD<br>80W/90     |
| Drag link ball joint, R.H.<br>Drag link ball joint, L.H.<br>Track rod ball joint, R.H.<br>Track rod ball joint, L.H.<br>Longitudinal arm ball joint, front<br>Longitudinal arm ball joint, rear<br>Front hub, R.H.<br>Front hub, L.H.<br>Rear hub, R.H.<br>Rear hub, L.H.<br>Front propeller shaft<br>Rear propeller shaft |                                                                                                                                                                        | BP<br>Energrease<br>L2                | Castrol<br>LM<br>Grease    | LB10 Grease                      | Esso<br>Multi-<br>purpose<br>grease H | Mobil-<br>grease MP<br>or Mobil-<br>grease<br>Super   | Marfak<br>All<br>purpose             | Retinax<br>or Darina<br>AX |
| Radiator (anti-freeze solution)<br>Any anti-freeze solution conforming to S.A.B.S.                                                                                                                                                                                                                                         |                                                                                                                                                                        | BP<br>Anti-frost                      | Castrol<br>Anti-<br>freeze | 'Standard'<br>Anti-<br>freeze    | Esso<br>Anti-<br>freeze               | Mobil<br>Per-<br>mazone                               | P.I.<br>Anti-<br>freeze              | Shell<br>Anti-<br>freeze   |
| Clutch fluid reservoir<br>Brake fluid reservoir                                                                                                                                                                                                                                                                            | Castrol Girling Brake and Clutch Fluid 'Crimson'. Specification J.1703D or Unipart<br>Brake and Clutch Fluid type 410 (coloured crimson) or type 550 (coloured green). |                                       |                            |                                  |                                       |                                                       |                                      |                            |

NOTE  
If SAE 20 grade oil is not available, SAE 30 may be used.



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SECTION B

POWER UNIT

| SUB-SECTION | DESCRIPTION                           | PAGE |
|-------------|---------------------------------------|------|
| B1          | DESCRIPTION AND SPECIFICATIONS        | B1.1 |
| B2          | FAULT DIAGNOSIS AND CORRECTIVE ACTION | B2.1 |
| B3          | VALVE CLEARANCE - CHECK AND ADJUST    | B3.1 |
| B4          | REMOVAL AND REPLACEMENT PROCEDURES    | B4.1 |
| B5          | ENGINE OVERHAUL PROCEDURES            | B5.1 |
| B6          | MAINTENANCE                           | B6.1 |
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SUB-SECTION B1

DESCRIPTION AND SPECIFICATIONS

| CHAPTER | DESCRIPTION               | PAGE |
|---------|---------------------------|------|
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| 2       | ENGINE SPECIFICATIONS     | B1.4 |

## SUB-SECTION B1

### CHAPTER 1

#### DESCRIPTION OF THE ENGINE

##### INTRODUCTION

1. The power unit fitted to the Land Rover is a type R6 petrol engine. The six in-line cylinders are water cooled and are fed by twin carburettors bolted to the inlet manifold on the left hand side of the engine.

##### CRANKSHAFT

2. The crankshaft is secured to the underside of the crankcase by seven journal bearings. Bearing shells (two halves per bearing) are fitted between the crankshaft journals and piston connecting rod big end. A timing gear and harmonic balancer/vibration damper are fitted at the front of the crankshaft and a flywheel is fitted at the rear end.

##### CAMSHAFT

3. An overhead camshaft is used and is chain driven from the crankshaft gear giving a 2:1 reduction. The chain runs over guides, one of which is adjustable, to give initial tension. A spring loaded tensioner is also fitted to take up wear stretch in the chain.

##### IGNITION

4. The spark plugs are fed from a distributor fitted to the right hand side of the engine. The distributor is driven by a worm gear on the crankshaft through a hollow shaft which also provides the drive for the oil pump.

##### LUBRICATION

5. The oil pump is fitted in the front of the sump and is driven by a shaft fitted inside the hollow distributor drive shaft. Oil from the pump is circulated through a cooler mounted directly under the radiator and also to various parts of the engine.

##### COOLING

6. A water pump, belt driven from a pulley on the crankshaft, circulates coolant through the engine and radiator. Cooling is assisted by a viscous drive fan mounted behind the radiator.

SUB-SECTION B1

CHAPTER 2

ENGINE SPECIFICATIONS

INTRODUCTION

1. General data for the engine is given in Table B1.1 and engine torque specifications are shown in Table B1.2.

TABLE B1.1 - GENERAL DATA

| ITEM                                                       | DESCRIPTION                                            |
|------------------------------------------------------------|--------------------------------------------------------|
| <b>ENGINE</b>                                              |                                                        |
| Type .....                                                 | R6                                                     |
| Number of cylinders and valve operation .....              | 6 cylinder overhead camshaft                           |
| Bore .....                                                 | 76,2 mm                                                |
| Stroke .....                                               | 95,76 mm                                               |
| Cubic capacity .....                                       | 2,623 litre                                            |
| Firing order .....                                         | 1 - 5 - 3 - 6 - 2 - 4                                  |
| Compression ratio .....                                    | 8,75 : 1                                               |
| Torque .....                                               | 201 Nm at 2200 r/min                                   |
| Maximum output .....                                       | 82 kW at 4750 r/min                                    |
| Engine idle speed .....                                    | 650 r/min                                              |
| Fast idle .....                                            | 1200 r/min                                             |
| Compression pressure - Cranking (hot) .....                | 1240 kPa                                               |
| Oversize bore - first .....                                | ±0,254 mm                                              |
| - maximum .....                                            | ±0,508 mm                                              |
| <b>CRANKSHAFT</b>                                          |                                                        |
| Type .....                                                 | 7 main bearing journals                                |
| Material .....                                             | Forged steel, counter balanced                         |
| Main journal diameter - standard .....                     | 60,353 - 60,371 mm                                     |
| Minimum permissible regrind diameter .....                 | 59,337 mm                                              |
| Crankpin journal diameter - standard .....                 | 47,643 - 47,661 mm                                     |
| Minimum permissible regrind diameter .....                 | 47,135 - 47,153 mm                                     |
| Crankshaft end float .....                                 | 0,1524 mm                                              |
| Crankpin width .....                                       | 22,50 - 22,55 mm                                       |
| <b>MAIN BEARINGS</b>                                       |                                                        |
| Type .....                                                 | Replaceable thin wall shell type                       |
| Bearing material .....                                     | Steel backed reticular tin aluminium                   |
| Bearing width .....                                        | 20,60 - 20,85 mm                                       |
| Undersize bearings available .....                         | 0,254 mm - 0,508 mm -0,7622 mm -1,016 mm               |
| Thrust washer thickness - standard .....                   | 2,31 - 2,36 mm                                         |
| Side clearance between thrust washers and crankshaft ..... | 0,1524 mm                                              |
| Thrust taken at .....                                      | Centre main bearing                                    |
| Diametral clearance .....                                  | 0,023 - 0,069 mm                                       |
| Tunnel bore diameter .....                                 | 64,008 - 64,021 mm                                     |
| <b>BIG END BEARINGS</b>                                    |                                                        |
| Type .....                                                 | Replaceable thin wall shell type                       |
| Bearing material .....                                     | Steel backed reticular tin aluminium                   |
| Bearing width .....                                        | 16,8 mm                                                |
| Diametral clearance .....                                  | 0,025 - 0,063 mm                                       |
| Undersize bearings .....                                   | -0,254 mm -0,508 mm                                    |
| <b>CONNECTING RODS</b>                                     |                                                        |
| Type .....                                                 | Horizontally split big end. Interference fit small end |
| Length between centres .....                               | 148,03 - 148,13 mm                                     |
| Side clearance - rod to crankshaft .....                   | 0,152 - 0,254 mm                                       |
| Small end bore diameter .....                              | 20,60 - 20,612 mm                                      |
| Big end bore diameter .....                                | 51,33 - 51,34 mm                                       |
| Width .....                                                | 22,33 mm                                               |

|                                                            |                                       |
|------------------------------------------------------------|---------------------------------------|
| <b>PISTONS</b>                                             |                                       |
| Type .....                                                 | Aluminium alloy-solid skirt - slotted |
| Clearance bottom of skirt .....                            | 0,203 - 0,033 mm                      |
| Ovality-top of skirt .....                                 | 0,33 - 0,38 mm                        |
| Piston head capacity .....                                 | 10 cc ± 0,25 cc                       |
| Gudgeon pin bore diameter .....                            | 20,645 - 20,650 mm                    |
| Pistons-oversize available .....                           | + 0,254 mm + 0,508 mm                 |
| Compression height - centre of gudgeon to top of piston .. | 35,63 - 35,84 mm                      |
| <b>PISTON RINGS</b>                                        |                                       |
| Number per piston .....                                    | 3                                     |
| Top ring type .....                                        | Cast iron-chrome faced                |
| Second ring type .....                                     | Cast iron torsional scraper           |
| Oil control ring type .....                                | Slotted segmental                     |
| Width - top ring .....                                     | 1,588 - 1,562 mm                      |
| - second ring .....                                        | 1,588 - 1,562 mm                      |
| Groove clearance - top ring .....                          | 0,038 mm                              |
| - second ring .....                                        | 0,038 mm                              |
| Ring gap fitted - top ring .....                           | 0,203 - 0,43 mm                       |
| - second ring .....                                        | 0,203 - 0,43 mm                       |
| <b>GUDGEON PINS</b>                                        |                                       |
| Type .....                                                 | Interference fit in connecting rod    |
| Fit in connecting rod (interference) .....                 | 0,023 - 0,038 mm                      |
| Fit in piston (clearance) .....                            | 0,0076 - 0,0152 mm                    |
| Outside diameter .....                                     | 20,635 - 20,638 mm                    |
| <b>CAMSHAFT</b>                                            |                                       |
| Material .....                                             | Cast iron - 4 bearings                |
| Journal diameter - first .....                             | 49,185 - 49,197 mm                    |
| - second .....                                             | 49,975 - 49,987 mm                    |
| - third .....                                              | 50,762 - 50,775 mm                    |
| - fourth .....                                             | 51,534 - 51,569 mm                    |
| Diametrical bearing clearance .....                        | 0,0254 - 0,0508 mm                    |
| End float (maximum) .....                                  | 0,05 - 0,17 mm                        |
| Chain pitch and number of pitches .....                    | 9,50 mm x 108                         |
| Timing marks .....                                         | Sprocket and carrier marks            |
| <b>TAPPETS</b>                                             |                                       |
| Material .....                                             | Forged steel - hardened               |
| Type .....                                                 | Inverted bucket                       |
| Outside diameter .....                                     | 30,129 - 30,145 mm                    |
| Clearance between tappet and bore .....                    | 0,018 - 0,053 mm                      |
| Shim adjustment .....                                      | 2,03 - 2,59 mm                        |
| <b>VALVES</b>                                              |                                       |
| Head diameter - inlet (nominal) .....                      | 38,10 mm                              |
| - exhaust (nominal) .....                                  | 30,91 mm                              |
| Stem diameter - inlet and exhaust (standard .....          | 7,912 - 7,925 mm                      |
| - inlet and exhaust (oversize) .....                       | 8,039 - 8,052 mm (Service only)       |
| Stem to guide clearance - inlet and exhaust .....          | 0,025 - 0,050 mm                      |
| Seat angle - inlet and exhaust .....                       | 45,5° (cylinder head 45°)             |
| Valve seat width - inlet (nominal) .....                   | 1,72 mm                               |
| - exhaust (nominal) .....                                  | 2,69 mm                               |
| Valve clearance - inlet .....                              | 0,40 - 0,46 mm                        |
| - exhaust .....                                            | 0,51 - 0,56 mm                        |
| Valve timing - inlet opens .....                           | 9°4' B.T.D.C.                         |
| - inlet closes .....                                       | 50°56' A.B.D.C.                       |
| - exhaust opens .....                                      | 48°56' B.B.D.C.                       |
| - exhaust closes .....                                     | 11°4' A.T.D.C.                        |
| Valve lift - inlet and exhaust .....                       | 9,14 mm                               |
| <b>VALVE SPRINGS</b>                                       |                                       |
| Type .....                                                 | Left hand-single wound                |
| Free length - inlet and exhaust .....                      | 45,64 mm                              |
| Number of working coils - inlet and exhaust .....          | 5,5                                   |
| Fitted length - inlet and exhaust .....                    | 34,92 mm                              |
| Load at fitted length .....                                | 231 N                                 |
| Length at full lift - inlet and exhaust .....              | 25,78 mm                              |
| Load at full lift .....                                    | 427 N                                 |

|                                                    |                                  |
|----------------------------------------------------|----------------------------------|
| <b>VALVE GUIDES</b>                                |                                  |
| Type .....                                         | Integral with cylinder head      |
| Inside diameter .....                              | 7,950 - 7,962 mm                 |
| Distance spring seat to top of guide - inlet ..... | 28,20 mm                         |
| - exhaust .....                                    | 25,40 mm                         |
| <b>FLYWHEEL</b>                                    |                                  |
| Number of teeth - ring gear .....                  | 156                              |
| Outside Diameter .....                             | 296,275 - 295,199 mm             |
| Ring gear - inside diameter .....                  | 294,141 - 294,168 mm             |
| Flywheel - Run-out (assembled to crank) .....      | 0,203 mm maximum                 |
| Flywheel thickness .....                           | 50 mm                            |
| <b>ENGINE LUBRICATION SYSTEM</b>                   |                                  |
| Oil pump - make .....                              | Concentric                       |
| - type .....                                       | Eccentric rotor                  |
| - relief valve .....                               | Sealed unit                      |
| - relief valve opens .....                         | 425 kPa                          |
| Oil filter - make .....                            | G.U.D.Z120                       |
| - type .....                                       | Full flow sealed unit            |
| - by-pass valve opens .....                        | 48,2-68,8 kPa                    |
| Oil pressure - normal running .....                | 276-475 kPa at 4000 engine r/min |
| - minimum idling .....                             | 138 kPa at 650 engine r/min      |

TABLE B1.2 - TORQUE SPECIFICATIONS

| ITEM                                      | TORQUE<br>(N.m) |
|-------------------------------------------|-----------------|
| Cylinder head bolts .....                 | 90              |
| Cam carrier to cylinder head .....        | 27              |
| Camshaft sprocket .....                   | 47              |
| Camshaft cover .....                      | 8               |
| Thermostat housing to cylinder head ..... | 10-13           |
| Manifold to cylinder head .....           | 24-27           |
| Carburetter studs .....                   | 8-10            |
| Water pump set screws .....               | 24-27           |
| Water pump pulley .....                   | 24              |
| Crankshaft pulley bolt .....              | 81-95           |
| Timing chain guide strips .....           | 24-27           |
| Timing cover .....                        | 24-27           |
| Pivot pin .....                           | 24-27           |
| Front cover bolts .....                   | 27              |
| Big end nuts .....                        | 42-47           |
| Main bearing bolts .....                  | 95              |
| Flywheel bolts .....                      | 81-88           |
| Oil pump mounting bolt 1/4 in. UNC .....  | 8-10            |
| Oil pump mounting bolt 3/8 in. UNC .....  | 27-33           |
| Oil reservoir 1/4 in. UNF bolts .....     | 34              |
| Oil reservoir no. 10 screws .....         | 17              |
| Oil reservoir drain plug .....            | 16-20           |

## SUB-SECTION B2

### FAULT DIAGNOSIS AND CORRECTIVE ACTION

#### INTRODUCTION

1. This sub-section deals with fault diagnosis and suggested action to cure a fault. Table B2.1 gives a list of symptoms, the probable cause and necessary remedial action. The Table is not exhaustive and faults may occur which are not listed. In this case the suspected components should be removed for closer inspection and/or overhaul.

TABLE B2.1 - ENGINE FAULT DIAGNOSIS CHART

| SYMPTON                              | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                | REMEDY                                                                                                                                                                                                                                                                                                  |
|--------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Engine fails to start                | Incorrect starting procedure.<br>Starter motor speed too slow.<br>Faulty ignition system.<br>Water or dirt in fuel system.<br>Carburetter(s) flooding.<br>Defective fuel pump system.<br>Defective starter motor.<br>Starter pinion not engaging.                                                                                                                                                             | See instruction manual.<br>Check battery and connections.<br>Rectify or renew.<br>Rectify.<br>Rectify.<br>Rectify or renew.<br>Rectify or renew.<br>Remove starter motor and investigate.                                                                                                               |
| Engine stalls                        | Low idling speed.<br>Faulty sparking plugs.<br><br>Faulty coil or condenser.<br>Faulty distributor points.<br>Incorrect mixture.<br>Foreign matter in fuel system.                                                                                                                                                                                                                                            | Adjust carburetter.<br>Clean and test, renew if necessary.<br>Renew.<br>Rectify or renew.<br>Adjust carburetter.<br>Rectify.                                                                                                                                                                            |
| Lack of power                        | Poor compression.<br><br><br>Badly seating valves.<br>Faulty exhaust silencer.<br>Incorrect ignition timing.<br>Leaks or restrictions in fuel system.<br>Faulty sparking plugs.<br>Excessive carbon deposit.<br>Brakes binding.<br>Faulty coil, condenser or battery.                                                                                                                                         | If the compression is appreciably less than the correct figure, the piston rings or valves are faulty. Low pressure in adjoining cylinders indicates a faulty cylinder head gasket.<br>Rectify or renew.<br>Renew.<br>Rectify.<br>Rectify.<br>Rectify.<br>Decarbonise.<br>Rectify.<br>Rectify or renew. |
| Engine runs erratically              | Faulty electrical connections.<br>Defective sparking plugs. ><br>Low battery charge.<br>Defective distributor.<br>Foreign matter in fuel system.<br>Faulty fuel pump.<br>Sticking valves.<br>Defective valve springs.<br>Incorrect ignition timing.<br>Worn valve guides or valves.<br>Faulty cylinder head gasket.<br>Damaged exhaust system.<br>Vacuum pipes disconnected at inlet manifold or distributor. | Rectify.<br>Rectify or renew.<br>Recharge battery.<br>Rectify.<br>Rectify.<br>Renew.<br>Rectify or renew.<br>Renew.<br>Rectify.<br>Renew.<br>Renew.<br>Rectify or renew.<br><br>Refit pipes.                                                                                                            |
| Engine starts, but stops immediately | Faulty electrical connections.                                                                                                                                                                                                                                                                                                                                                                                | Check HT leads for cracked insulation: check low tension circuit.                                                                                                                                                                                                                                       |

|                                                            |                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                            |
|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                            | Foreign matter in fuel system.<br>Faulty fuel pump.<br>Low fuel level in tank.                                                                                                                                                                                                                                                                                    | Rectify.<br>Renew.<br>Replenish.                                                                                                                                                                           |
| Engine fails to idle                                       | Incorrect carburettor setting.<br>Faulty fuel pump.<br>Sticking valves.<br>Faulty cylinder head gasket(s).                                                                                                                                                                                                                                                        | Rectify.<br>Renew.<br>Rectify or renew.<br>Renew.                                                                                                                                                          |
| Engine misfires on acceleration                            | Distributor points incorrectly set.<br><br>Faulty coil or condenser.<br>Faulty sparking plugs.<br>Faulty carburettor.<br>Vacuum pipes disconnected at inlet manifold.                                                                                                                                                                                             | Rectify.<br><br>Renew.<br>Rectify.<br>Rectify or renew.<br><br>Check all vacuum connections.                                                                                                               |
| Engine back fires                                          | Ignition defect.<br>Carburettor defect.<br>Sticking valve.<br>Weak valve spring.<br>Badly seating valves.<br>Excessively worn valve stems and guides.<br>Excessive carbon deposit.<br>Incorrect sparking plug gap.<br>Air leak in induction or exhaust systems.                                                                                                   | Rectify.<br>Rectify.<br>Rectify.<br>Renew.<br>Rectify or renew.<br><br>Renew.<br>Decarbonise.<br>Reset.<br>Renew faulty gaskets or components.                                                             |
| Burned valves                                              | Sticking valves.<br>Weak valve springs.<br>Excessive deposit on valve seats.<br>Distorted valves.<br>Excessive mileage between overhauls.                                                                                                                                                                                                                         | Rectify.<br>Renew.<br>Recut.<br>Renew.<br>Decarbonise.                                                                                                                                                     |
| Noisy valve mechanism                                      | Worn or scored parts in valve operating mechanism.<br>Valves and seats cut down excessively, raising end of valve stem 1,27 mm (0.50 in) above normal position.<br>Sticking valves.<br>Weak valve springs.<br>Worn timing chain or chain-wheels.                                                                                                                  | Replace faulty parts.<br>Grind off end of valve stem or replace parts.<br><br>Rectify.<br>Renew.<br>Renew worn parts.                                                                                      |
| Main bearing rattle                                        | Low oil level.<br>Low oil pressure.<br>Excessive bearing clearance.<br><br>Burnt-out bearings.<br>Loose bearing caps.                                                                                                                                                                                                                                             | Replenish as necessary.<br>See next symptom.<br>Renew bearings; grind crankshaft.<br>Renew.<br>Tighten.                                                                                                    |
| Low oil pressure warning light remains on, engine running. | Thin or diluted oil.<br><br>Low oil level.<br>Choked pump strainer.<br>Faulty release valve.<br>Excessive bearing clearance.<br>Oil pressure switch unserviceable.<br>Electrical fault.<br>Relief valve plunger sticking.<br>Weak relief valve spring.<br>Pump rotors excessively worn.<br>Excessively worn bearings; main connecting rod, big end, camshaft etc. | Drain and refill with correct oil.<br>Replenish.<br>Clean.<br>Rectify.<br>Rectify.<br>Renew.<br>Check circuit.<br>Remove and ascertain cause.<br>Renew.<br>Renew.<br>Ascertain which bearings and rectify. |
| Rattle in lubrication system                               | Oil pressure relief valve plunger sticking.                                                                                                                                                                                                                                                                                                                       | Remove and clean.                                                                                                                                                                                          |
| Engine overheating                                         | Low coolant level.<br>Faulty cooling system.<br>Faulty thermostat.<br>Incorrect timing.<br>Defective lubrication system.                                                                                                                                                                                                                                          | Check for leaks.<br>Rectify.<br>Renew.<br>Rectify.<br>Rectify.                                                                                                                                             |



SUB-SECTION B3

VALVE CLEARANCE - CHECK AND ADJUST

PRELIMINARIES

- 1. Before the valve clearance can be checked the following should be carried out:
  - (1) Remove the cam cover (see Sub-section B4, Chapter 11).
  - (2) Remove the spark plugs ((4) on Fig B3.1).

CHECKING CLEARANCES

- 2. Check as follows:

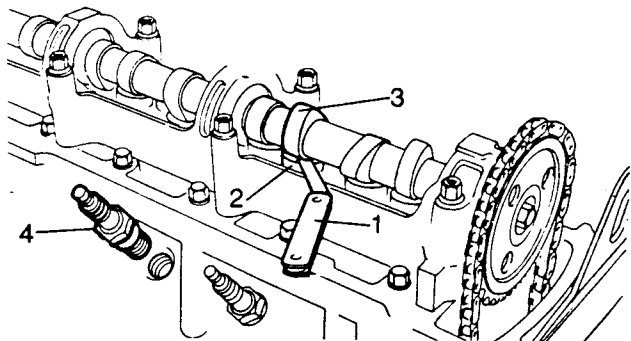


Fig B3.1

- (1) Refer to Fig B3.1. To check the clearance use a feeler gauge (1) between the cam lobe (2) and cam follower (3) of each valve and record the clearance measured.

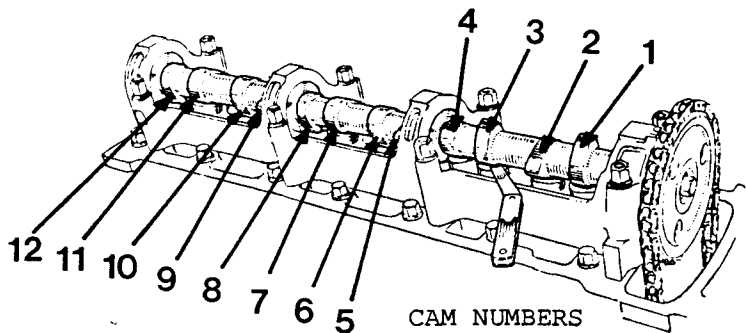


Fig B3.2

- (2) Refer to Fig B3.2. Turn the camshaft against the normal direction of rotation and measure the clearance in the following order:

| Check cam No | With cam No fully open |
|--------------|------------------------|
| 1            | 12                     |
| 7            | 6                      |
| 9            | 4                      |
| 2            | 11                     |
| 5            | 8                      |
| 10           | 3                      |
| 12           | 1                      |
| 6            | 7                      |
| 4            | 9                      |
| 11           | 2                      |
| 8            | 5                      |
| 3            | 10                     |

- 3. Under a normal service check, adjustment is only necessary if the clearance (inlet and exhaust) is less than 0,31 mm. When new components have been fitted or valves have been reground, adjust the tappet clearances to the standard settings given in Sub-section B1, Chapter 2.

ADJUSTING

- 4. All cams which have recorded measurements outside the recommended tolerances should be adjusted at the same time. Make sure which cams are to be adjusted, then:

- (1) Remove the cam followers (see Sub-section B4, Chapter 4, steps (1) to (8)).
- (2) On the bench, remove the cam followers of the valves to be adjusted, keeping them separate and referring them to their respective guides.
- (3) Calculate the shim thickness required for each follower in turn by:
  - i. Remove the shim from the cam follower and make a note of its thickness.

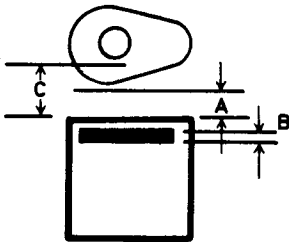


Fig B3.3

- ii. Refer to Fig B3.3. Call the measured clearance A, the shim thickness B and the required clearance C.  
Note that C= 0,40 to 0,46 mm for inlet valves and 0,51 to 0,56 mm for exhaust valves.

- iii. Calculate for each follower the shim thickness required, in the following manner:

$A + B - C = \text{shim thickness.}$

Example:  
 Measured clearance A = 0,24 mm  
 Shim thickness B = 2,72 mm  
 Inlet valve clearance C = 0,40 to 0,46 mm  
 Shim thickness required:  $A + B - C$   
 $= 0,24 + 2,72 - 0,40 \text{ to } 0,46 \text{ mm}$   
 $= 2,50 \text{ to } 2,56 \text{ mm}$

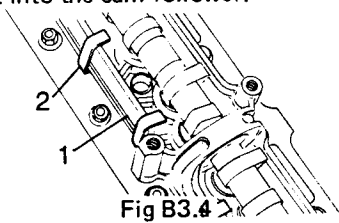
- (4) Shims available are shown in the table below:

TABLE B3.1 - SHIMS AVAILABLE

| REF | THICKNESS | REF | THICKNESS |
|-----|-----------|-----|-----------|
| 97  | 2,47 mm   | 13  | 2,87 mm   |
| 99  | 2,52 mm   | 15  | 2,93 mm   |
| 01  | 2,56 mm   | 17  | 2,98 mm   |
| 03  | 2,62 mm   | 19  | 3,03 mm   |
| 05  | 2,67 mm   | 21  | 3,08 mm   |
| 07  | 2,72 mm   | 23  | 3,13 mm   |
| 09  | 2,77 mm   | 25  | 3,18 mm   |
| 11  | 2,83 mm   | 27  | 3,23 mm   |

- (5) In the example above it can be calculated that using a shim of 2,52 mm will give a thickness which is between the required limits.
- (6) The old shim may be discarded.

- (7) Smear the new shim with petroleum jelly and fit it into the cam follower.



- (8) Refer to Fig B3.4. Fit the followers (1) into their respective guides and hold them in place with the retaining clips (2) (special tool 18G 1218).
- (9) Refit the camshaft carrier (see Sub-section B4, Chapter 4, Para 2, steps (4) to (15)) and re-check valve clearances.

## SUB-SECTION CONTENTS LIST

### SUB-SECTION B4

#### REMOVAL AND REPLACEMENT PROCEDURES

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| 2       | OIL PUMP DRIVE SHAFT - REMOVAL AND REPLACEMENT                                     | B4.9  |
| 3       | DISTRIBUTOR DRIVE SHAFT - REMOVAL AND REPLACEMENT                                  | B4.10 |
| 4       | CAMSHAFT AND FOLLOWERS - REMOVAL AND REPLACEMENT                                   | B4.12 |
| 5       | CONNECTING RODS AND PISTONS - REMOVAL AND REPLACEMENT                              | B4.14 |
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## SUB-SECTION B4

### CHAPTER 1

#### ENGINE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove the engine as detailed below:

- (1) Drain the engine oil.
- (2) Remove the bonnet (see Sub-section M3, Chapter 1).
- (3) Disconnect the battery earth lead (see Sub-section O5, Chapter 3).
- (4) Remove the radiator (see Sub-section E4, Chapter 1) and grille panel (see Sub-section M3, Chapter 6).
- (5) Remove the gearbox tunnel cover (see Sub-section M3, Chapter 5).
- (6) Disconnect the two exhaust pipes from the manifold (see Sub-section F3, Chapter 2).
- (7) Disconnect the oil cooler pipes from the filter (see Sub-section B4, Chapter 22).

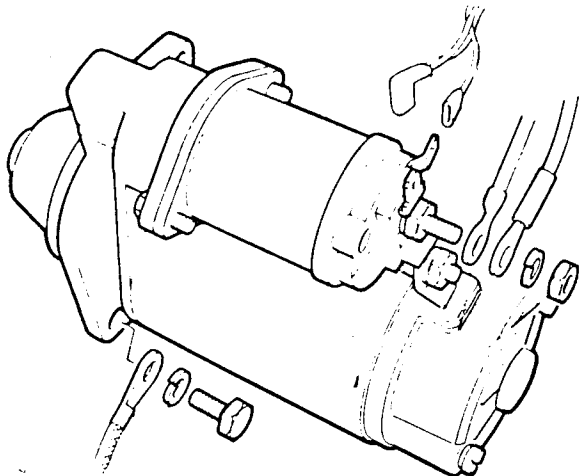


Fig B4.1

- (8) Refer to Fig B4.1. Disconnect five electrical leads from the starter motor.

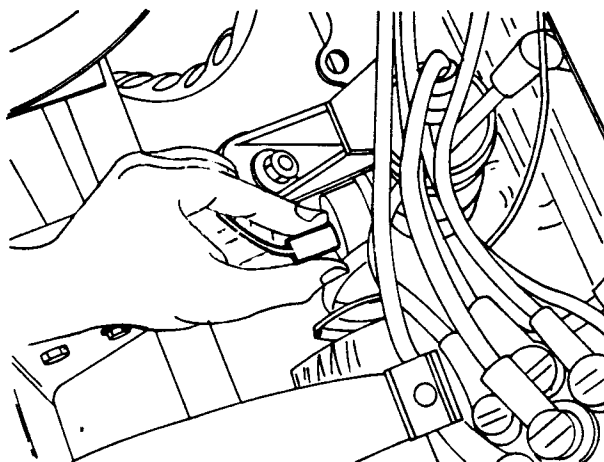


Fig B4.2

- (9) Refer to Fig B4.2. Disconnect the oil pressure switch lead.

- (10) Disconnect the engine earth cable at the chassis.

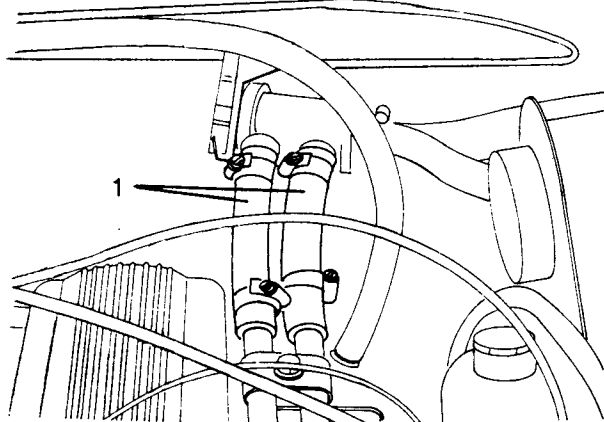


Fig B4.3

- (11) Refer to Fig B4.3. Disconnect the heater hoses (1) from the heater water valve.

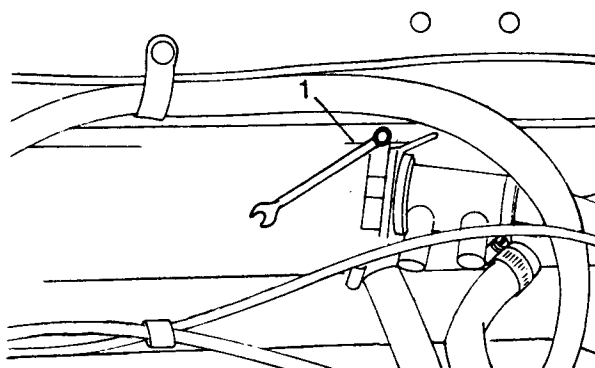


Fig B4.4

- (12) Refer to Fig B4.4. Disconnect the control cable (1) at the heater water valve.

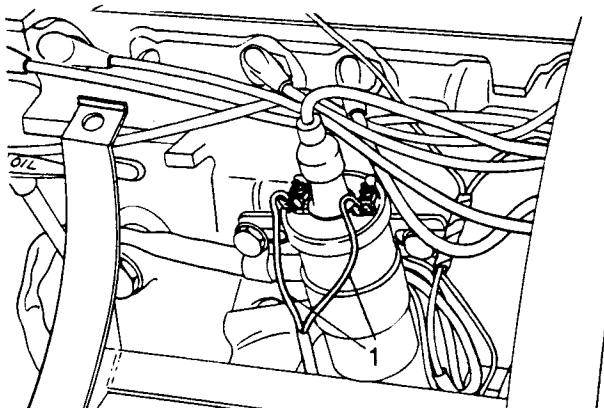


Fig B4.5

- (13) Refer to Fig B4.5. Disconnect the switch leads (1) at the ignition coil.

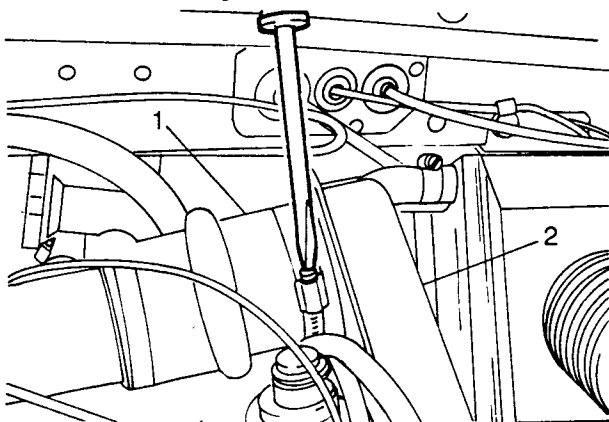


Fig B4.6

- (14) Refer to Fig B4.6. Remove the hose (1) between the air cleaner and the air intake box (2) over the carburetors.

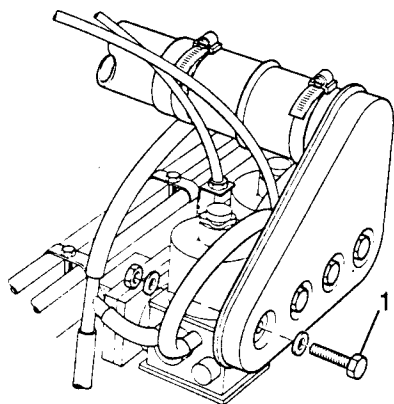


Fig B4.7

- (15) Refer to Fig B4.7. Remove the air intake box by removing the four bolts (1) holding the box to the carburettor. Note that the bolts have loose nuts and washers behind the box.

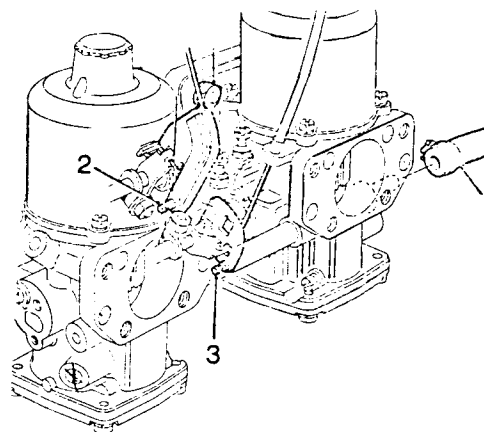


Fig B4.8

- (16) Refer to Fig B4.8. Disconnect the fuel feed (1) at the carburettor.

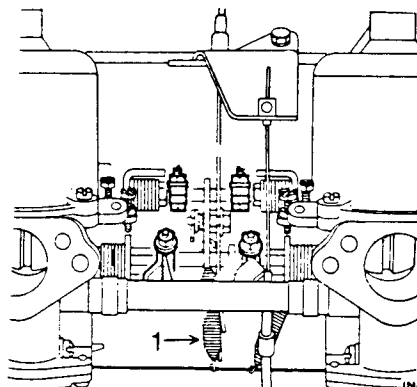


Fig B4.9

- (17) Refer to Fig B4.9. Release the accelerator return spring (1).

- (18) Disconnect the accelerator cable at the carburettor. (The fixing is (2) on Fig B4.8).

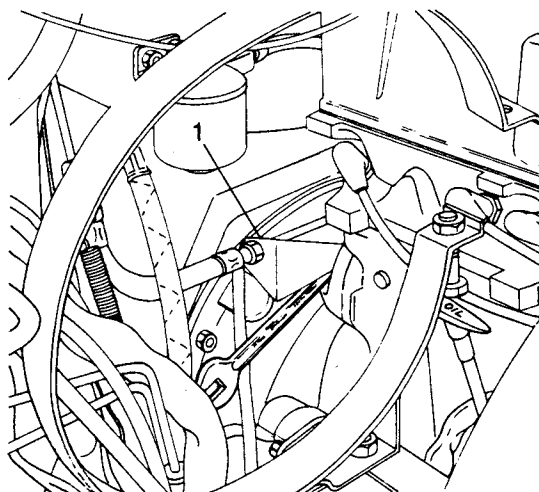


Fig B4.10

- (19) Refer to Fig B4.10. Remove the fixings securing the clutch hose and speedometer cable bracket (1) at the flywheel housing.

- (20) Disconnect the cold start control cable at the carburettor. (The fixing is (3) on Fig B4.8).

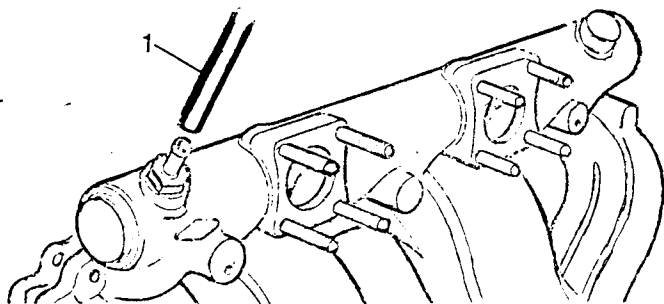


Fig B4.11

- (21) Refer to Fig B4.11. Detach the servo hose (1) at the manifold pipe.

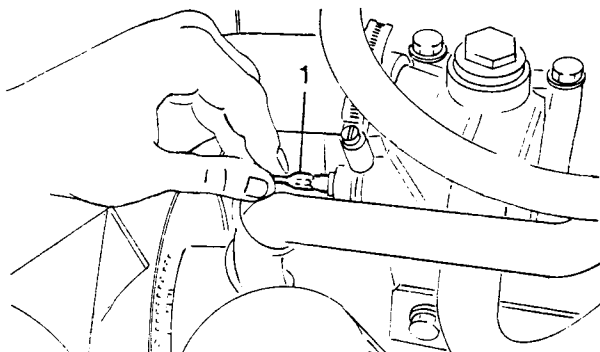


Fig B4.12

- (22) Refer to Fig B4.12. Disconnect the electrical lead (1) at the coolant temperature transmitter.

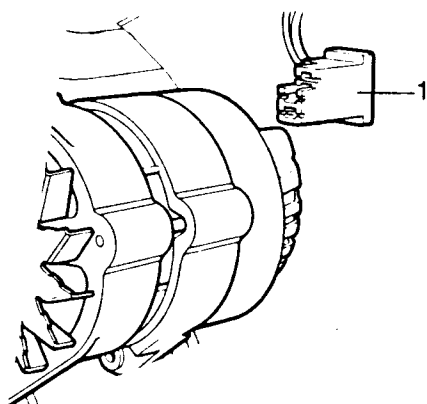


Fig B4.13

- (23) Refer to Fig B4.13. Disconnect the electrical leads (1) at the alternator.

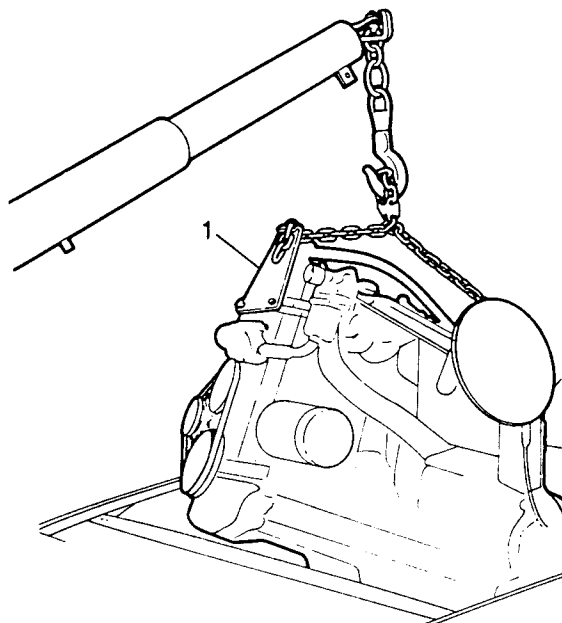


Fig B4.14

- (24) Refer to Fig B4.14. Support the engine weight using suitable lifting tackle with engine lifting brackets 18GA041 (1). Note that the figure is only to illustrate the fixings for the lifting brackets. The engine is not lifted clear of the vehicle at this stage.

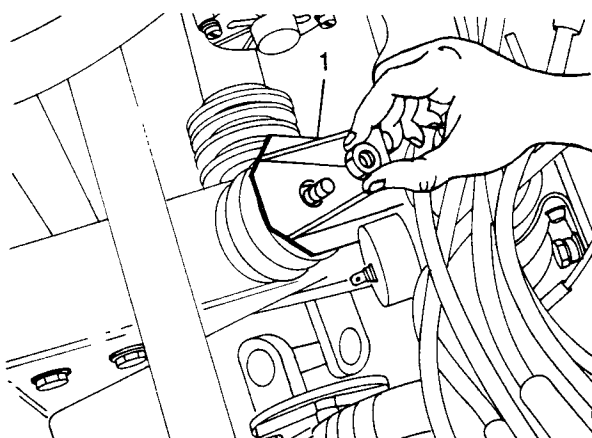


Fig B4.15

- (25) Refer to Fig B4.15. Remove the engine front mountings upper (1) and lower fixings.

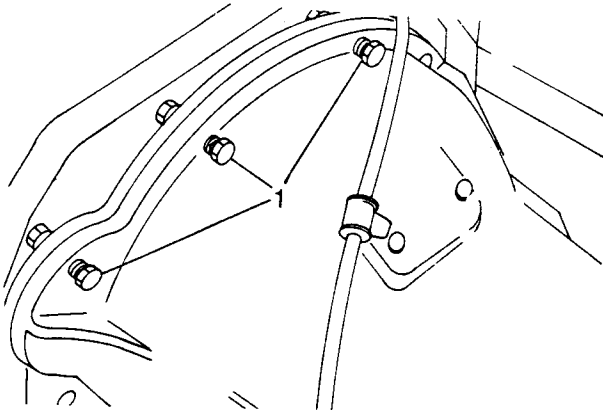


Fig B4.16

(26) Refer to Fig B4.16. Support the gearbox, using suitable packing blocks or a jack, and remove the bell housing to flywheel housing fixings (1).

(27) Pull the engine forward sufficiently to disengage the drive from the gearbox.

(28) Ensure that all cables, pipes etc. are clear then hoist the engine from the vehicle.

## REPLACEMENT

2. To replace the engine:

(1) Engage a gear to prevent gearshaft rotation and offer up the engine to the gearbox. If necessary, rotate the engine sufficient to align the gearbox primary pinion with the clutch plate splines.

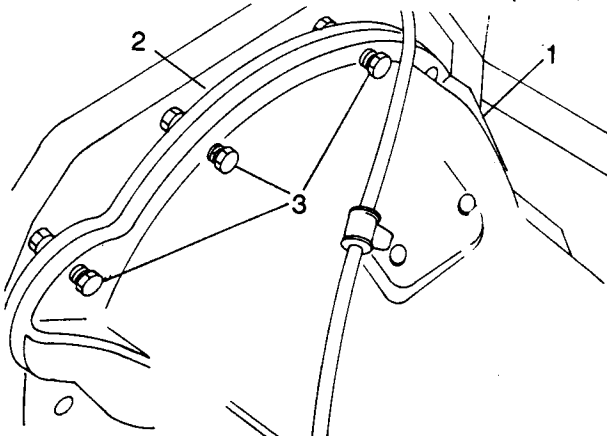


Fig B4.17

(2) Refer to Fig B4.17. When aligned, push the engine fully to the rear and secure the bell housing (1) to the flywheel housing (2), tightening the fixings (3) evenly.

(3) Lift the engine sufficiently to remove the packing or jack from beneath the gearbox.

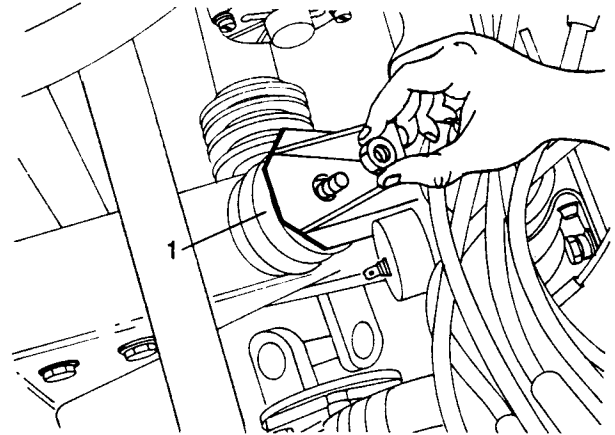


Fig B4.18

(4) Refer to Fig B4.18. Insert and secure the engine front mounting rubbers (1).

(5) Remove the sling and engine lifting brackets.

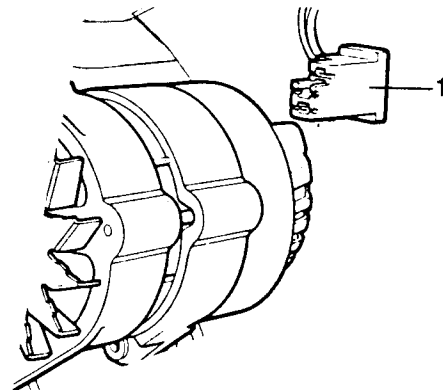
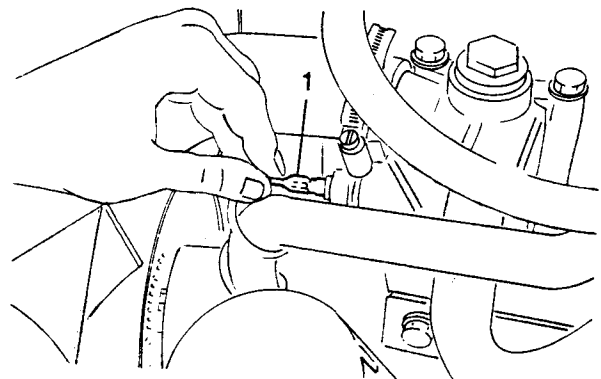


Fig B4.19

(6) Refer to Fig B4.19. Reconnect the electrical plug (1) to the alternator.



(7) Refer to Fig B4.20. Connect the leads (1) to the coolant temperature indicator.

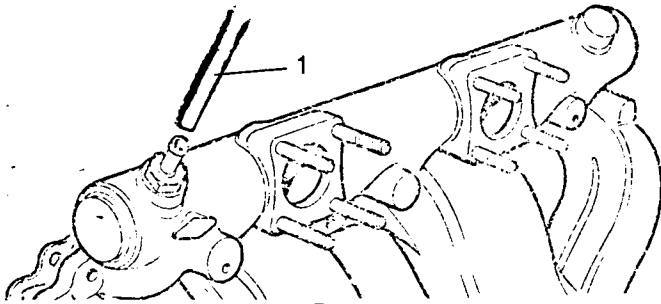


Fig B4.21

- (8) Refer to Fig B4.21. Fit the servo hose (1) to the manifold pipe.

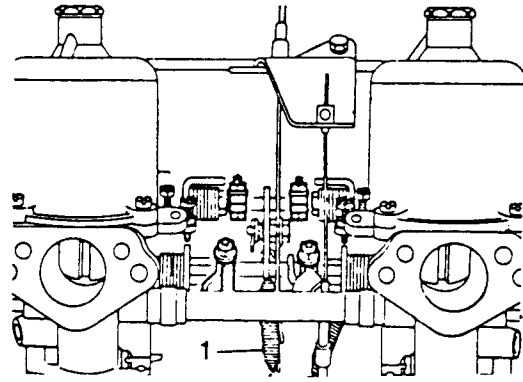


Fig B4.24

- (13) Refer to Fig B4.24. Replace the accelerator return spring (1).

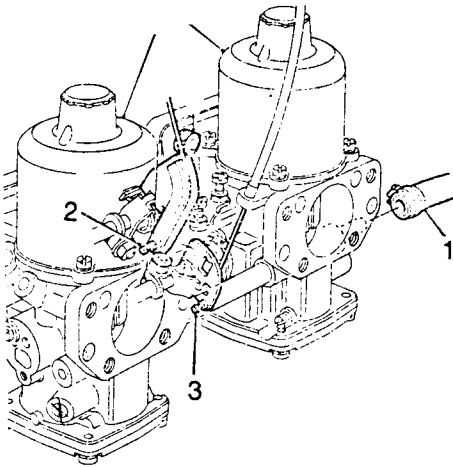


Fig B4.22

- (9) Refer to Fig B4.22. Connect the cold start control cable at the carburettor fixing (3).
- (10) Refit the accelerator cable to the carburettor fixing (2).
- (11) Reconnect the fuel feed pipe (1) to the carburettor.

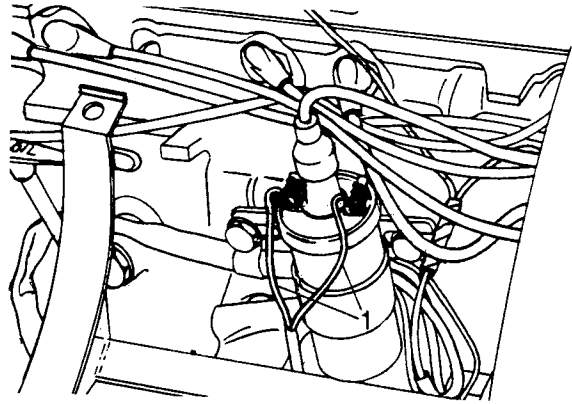


Fig B4.25

- (14) Refer to Fig B4.25. Connect the switch lead (1) at the ignition coil.

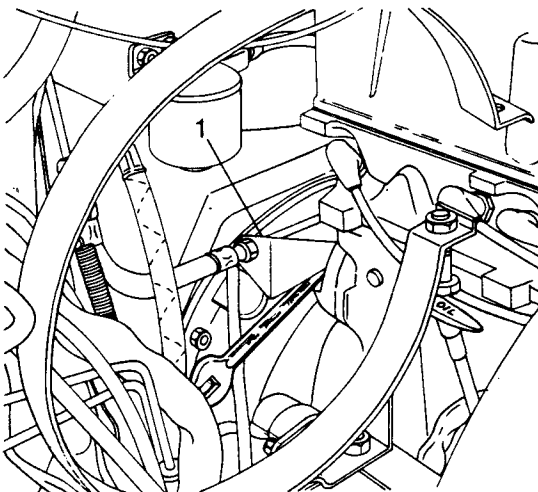


Fig B4.23

- (12) Refer to Fig B4.23. Refit the clutch hose and speedometer cable bracket (1) at the flywheel housing.

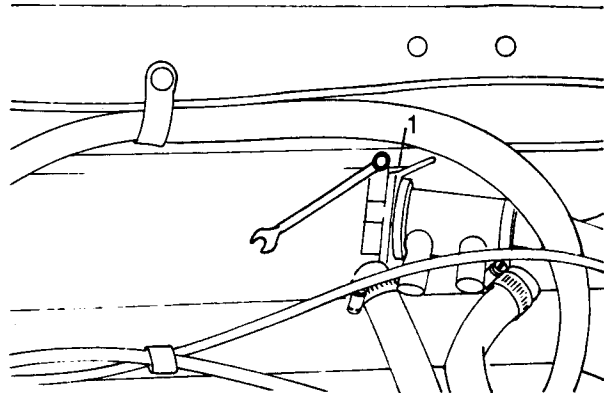


Fig B4.26

- (15) Refer to Fig B4.26. Connect the control cable (1) at the heater water valve.



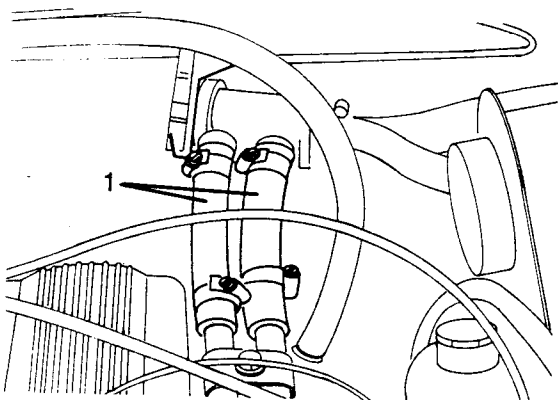


Fig B4.27

(16) Refer to Fig B4.27. Connect the heater hoses (1).

(17) Reconnect the engine earth cable to the chassis side member.

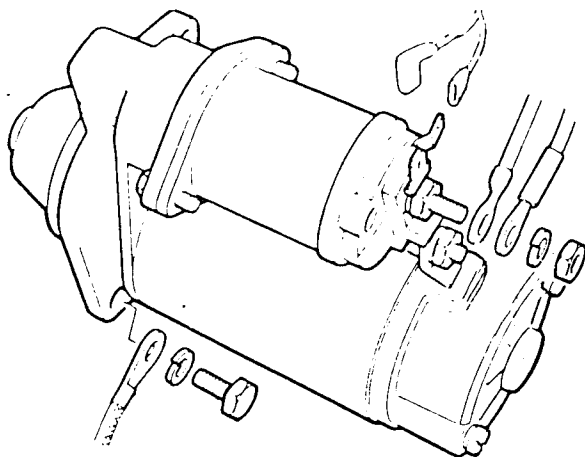


Fig B4.28

(18) Refer to Fig B4.28. Reconnect the five electrical leads to the starter motor and where applicable secure with nuts or bolt and lock washers.

(19) Reconnect the oil cooler pipes to the filter (see Sub-section B4, Chapter 22).

(20) Refit and secure the two exhaust pipes (see Sub-section F3, Chapter 2).

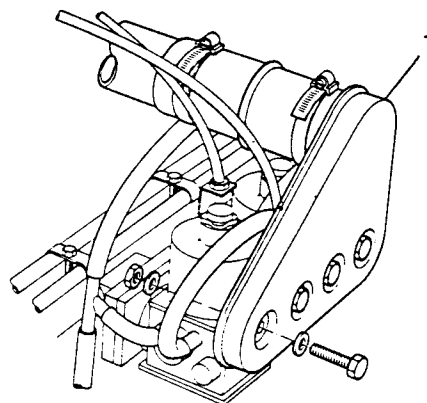


Fig B4.29

(21) Refer to Fig B4.29. Fit the air intake box (1) over the carburetors.

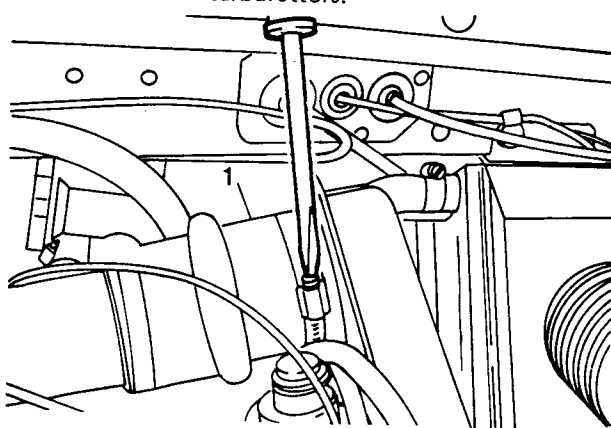


Fig B4.30

(22) Refer to Fig B4.30. Reconnect the hose (1) between the air cleaner and the air intake box.

(23) Refit the gearbox tunnel cover (see Sub-section M3, Chapter 5).

(24) Replace the grille panel (see Sub-section M3, Chapter 6) and radiator (see Sub-section E4, Chapter 1).

(25) Reconnect the battery earth lead (see Sub-section O5, Chapter 3).

(26) Refill the engine with the correct grade of oil.

(27) Replace the bonnet (see Sub-section M3, Chapter 1).

## SUB-SECTION B4

### CHAPTER 2

#### OIL PUMP DRIVE SHAFT - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The drive shaft is in the tube forming the distributor drive shaft. To remove:

- (1) Remove the distributor (see Sub-section D4, Chapter 2).

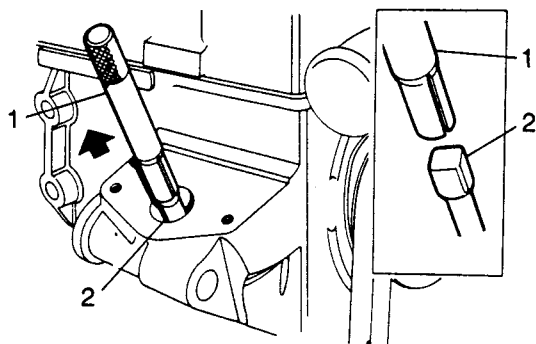


Fig B4.31

- (2) Refer to Fig B4.31. Position tool 18G1147 (1) with the slots diagonally across the square end of the oil pump drive shaft (2).
- (3) Press down on the tool and then withdraw the drive shaft upwards.

##### REPLACEMENT

2. To replace the oil pump drive shaft:
  - (1) Fit the shaft into the distributor drive shaft tube.
  - (2) Ensure full engagement. If necessary use the special tool to turn the shaft until it fits into the square hole in the distributor shaft.
  - (3) Replace the distributor (see Sub-section D4, Chapter 2).

## SUB-SECTION B4

### CHAPTER 3

#### DISTRIBUTOR DRIVE SHAFT - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the drive shaft:

- (1) Raise the vehicle on a hoist or stands.

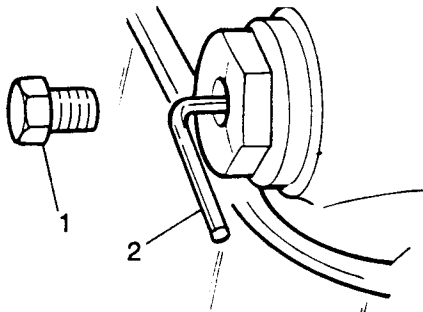


Fig B4.32

- (2) Refer to Fig B4.32. Retract the timing chain tensioner by removing the chain tensioner adaptor screw (1), fitting a 3,17 mm allen key (2) and turning the key 90° clockwise.

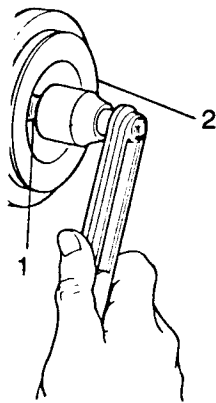


Fig B4.33

- (3) Refer to Fig B4.33. Loosen the harmonic balancer bolt (1) using special tool 18G98A (2).

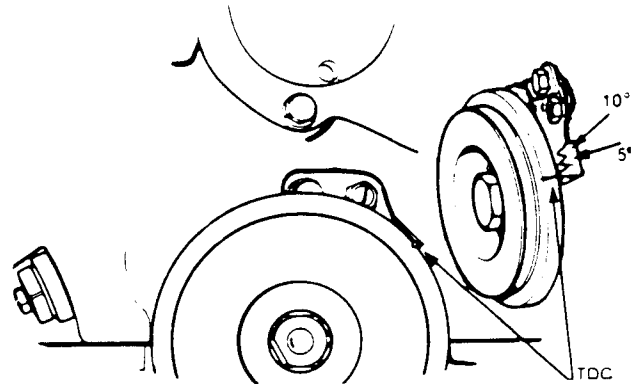


Fig B4.34

- (4) Refer to Fig B4.34. Set the timing marks to TDC with No 1 cylinder firing. See Fig B4.35.

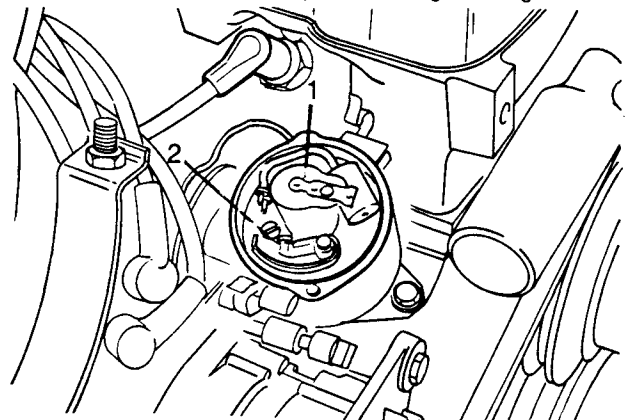


Fig B4.35

- (5) Refer to Fig B4.35. The No 1 cylinder firing position is with the distributor rotor (1) pointing to No 1 cylinder take-off (as shown) and the points (2) opening.
- (6) Remove the distributor (see Sub-section D4, Chapter 2).
- (7) Remove the harmonic balancer ((2) on Fig B4.14).
- (8) Remove the crankshaft oil seal (see Sub-section B4, Chapter 7).
- (9) Remove the oil pump (see Sub-section B4, Chapter 16) and oil pump drive shaft. Note that this shaft will come out from the bottom of the engine block once the pump is removed.

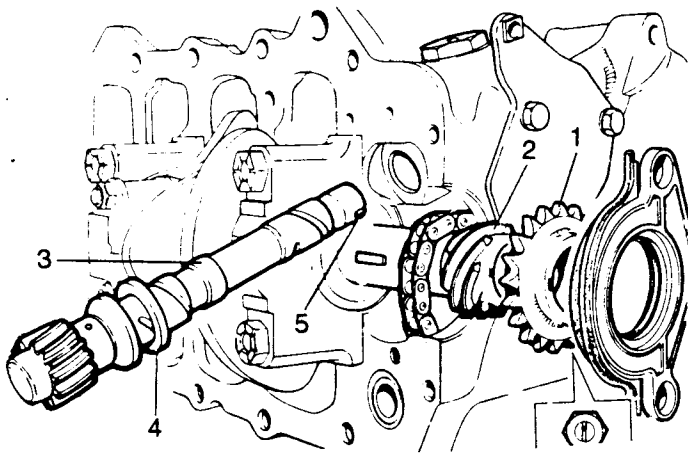


Fig B4.36

(10) Refer to Fig B4.36. Move the sprocket (1) and drive gear (2) forwards.

(11) Pull out the distributor drive shaft (3).

#### REPLACEMENT

2. Fig B4.36 still refers. Replace the distributor drive shaft as follows:

(1) Fit the thrust washer (4) to the drive shaft.

(2) Check that No 1 piston is at TDC.

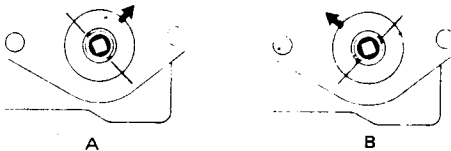


Fig B4.37

(3) Refer to Fig B4.37. Fit the drive shaft into the housing with the large slot ((5) on Fig B4.36) running in the 10 o'clock/4 o'clock position (Fig B4.37A, shown looking from the top).

(4) Push the driver gear into position. As the teeth mesh the drive shaft will turn through 90° bring the slot into the 2 o'clock/8 o'clock position (Fig B4.37B). This is the correct position for No 1 cylinder firing.

(5) Refit the distributor (see Sub-section D4, Chapter 2) and check that the rotor arm is set for No 1 cylinder firing with the contact breaker points just opening.

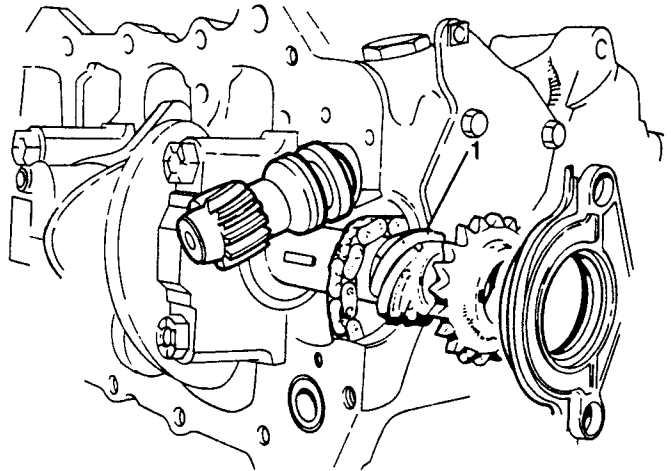


Fig B4.38

(6) Refer to Fig B4.38. Position the sprocket (1) over its woodruff key and replace the chain.

(7) Refit the oil pump drive shaft ensuring that it fits into the square hole at the top of the distributor drive shaft.

(8) Replace the oil pump (see Sub-section B4, Chapter 16).

(9) Replace the crankshaft oil seal (see Sub-section B4, Chapter 7).

(10) Replace the sump (see Sub-section B4, Chapter 17).

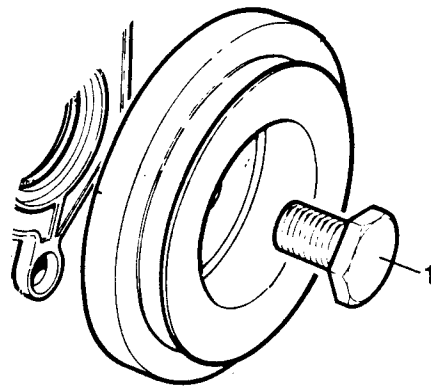


Fig B4.39

(11) Refer to Fig B4.39. Fit the harmonic balancer and pulley and secure with the harmonic balancer bolt (1). Torque the bolt 81 to 92 N.m.

(12) Release the chain tensioner by turning the allen key ((2) on Fig B4.32) 90° counterclockwise.

(13) Remove the allen key and replace the screw ((1) on Fig B4.32).

## SUB-SECTION B4

### CHAPTER 4

#### CAMSHAFT AND FOLLOWERS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the camshaft and followers:

- (1) Remove the camshaft cover and gasket (see Sub-section B4, Chapter 11).

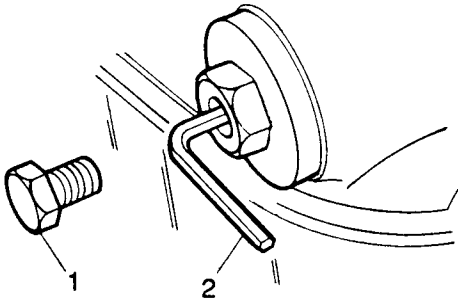


Fig B4.40

- (2) Refer to Fig B4.40. Retract the timing chain tensioner by removing the chain tensioner adaptor screw (1), fitting a 3,17 mm allen key (2) and turning the key 90° clockwise.

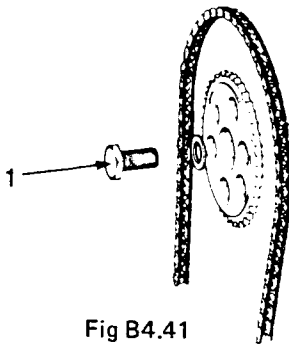


Fig B4.41

- (3) Refer to Fig B4.41. Remove the fixing (1) for the camshaft sprocket and remove the sprocket.

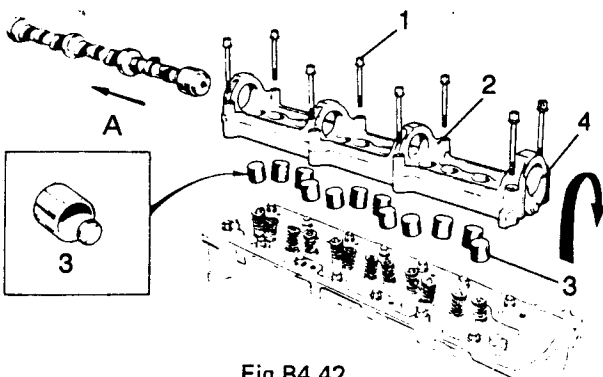


Fig B4.42

- (4) Refer to Fig B4.42. Evenly slacken the camshaft carrier bolts (1) in a diagonal sequence until the valve spring pressure is released.

- (5) Remove the camshaft carrier bolts.

- (6) Raise the camshaft carrier (2) sufficiently to allow the followers (3) to clear the engine valves.

- (7) Push the followers into the camshaft carrier until they contact the camshaft.

- (8) Continue to remove the carrier assembly by easing it away from the cylinder head and quickly revolve it to prevent the followers from falling out.

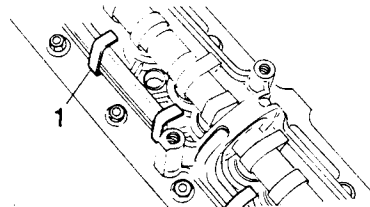


Fig B4.43

##### NOTE

Refer to Fig B4.43. Special tool 18G1218 (tappet retaining clips) (1) may be used to prevent the followers falling out during this operation.

- (9) On the bench remove the cam followers with their adjusting shims, maintaining them in the order in which they were removed.

- (10) Remove the camshaft locating plate (4).

- (11) Remove the camshaft in the direction of arrow A.

##### REPLACEMENT

2. Replace the camshaft as detailed below:

- (1) Lubricate the cam bearings and fit the camshaft in the opposite direction to arrow A.

- (2) Fit and secure the camshaft locating plate.

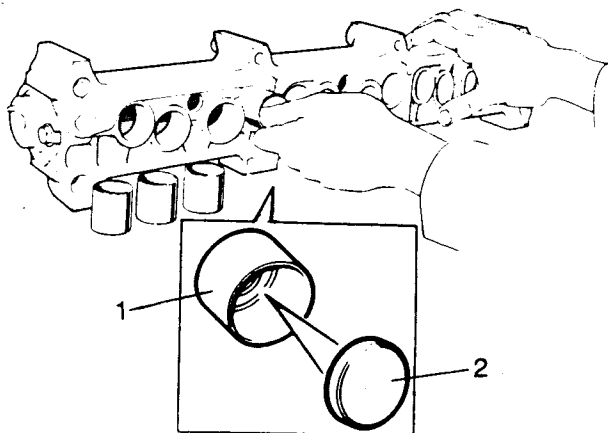


Fig B4.44

- (3) Refer to Fig B4.44. Lay the carrier on its side, lubricate the followers (1) and fit them into their respective housings. Smear the shims (2) with grease and replace them.
- (4) Check the bottom face of carrier for burrs or damage, as any protrusions will affect valve clearance. Also check that the carrier bolt thread and the respective threads in the cylinder head are free of foreign material.
- (5) Position the carrier over the two locating dowels in the cylinder head, taking care not to dislodge the adjusting shims.

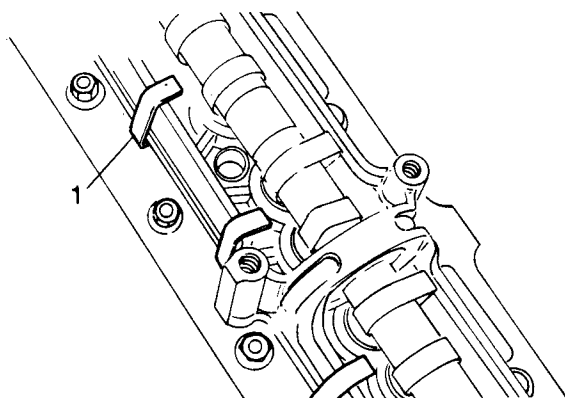


Fig B4.45

- (6) Refer to Fig B4.45. If the tappet retaining clips (1) are fitted, remove them at this stage.

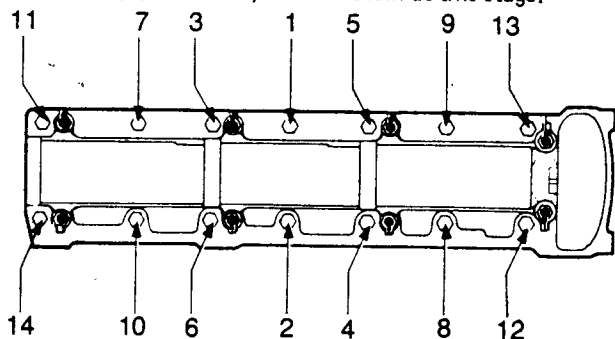


Fig B4.46

- (7) Refer to Fig B4.46. Fit the carrier bolts (1 to 14) and gradually tighten them in a diagonal sequence to 27 Nm.
- (8) Revolve the camshaft several times.

- (9) Check valve clearances and reset if required (see Sub-section B3).

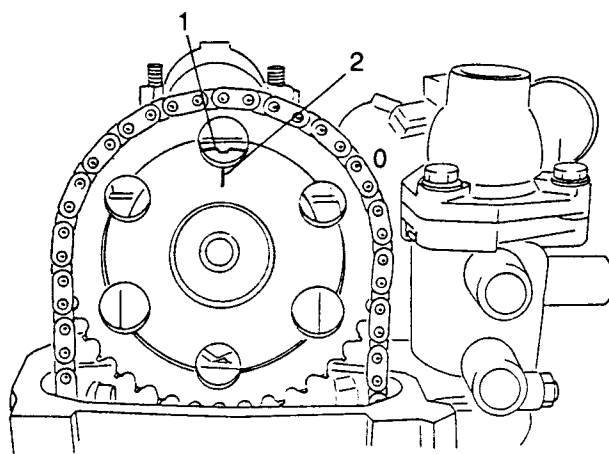


Fig B4.47

- (10) Refer to Fig B4.47. Temporarily fit the sprocket to the camshaft and turn the sprocket until the timing mark (1) on the sprocket aligns with the mark (2) on the carrier. Remove the sprocket.

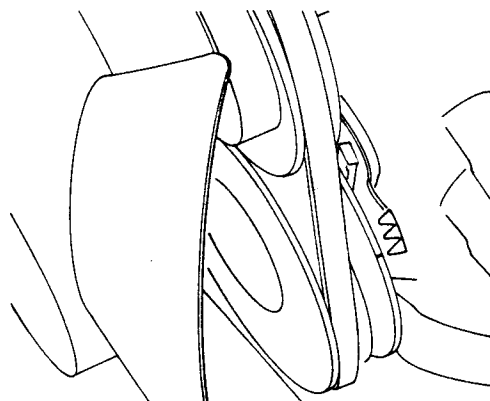


Fig B4.48

- (11) Refer to Fig B4.48. Set the crankshaft pulley timing mark to the TDC position with No 1 cylinder firing (rotor pointing to No 1 cylinder take-off and points opening).
- (12) Fit the timing chain over the (loose) camshaft sprocket, maintaining the aligning marks.
- (13) Fit the camshaft sprocket with the chain, onto the camshaft.
- (14) Fit and tighten the securing bolt to 37 N.m.
- (15) Release the chain tensioner by turning the Allen key (Fig B4.40) 90° counterclockwise.
- (16) Replace the camshaft cover and gasket (see Sub-section B4, Chapter 11).

## SUB-SECTION B4

### CHAPTER 5

## CONNECTING RODS AND PISTONS - REMOVAL AND REPLACEMENT

### REMOVAL

1. First remove the engine from the vehicle (see Sub-section B4, Chapter 1).
2. Remove the connecting rods and pistons as follows:
  - (1) Remove the cylinder head (see Sub-section B4, Chapter 10).
  - (2) Remove the oil pump (see Sub-section B4, Chapter 16).
  - (3) Remove any traces of carbon from around the top of the cylinder bores.
  - (4) Check the top of the bores for wear. If a ridge is present it should be removed prior to withdrawing the piston assemblies or damage to the piston could result.
  - (5) Carefully remove carbon from the top of the piston.

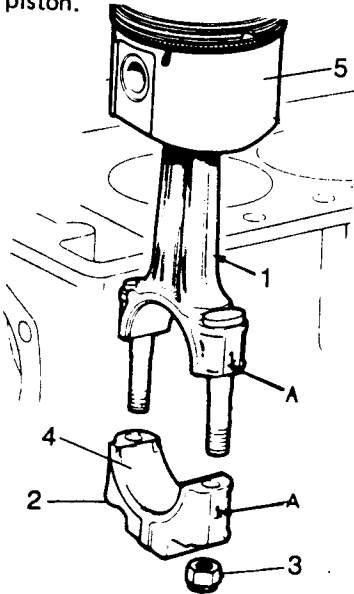


Fig B4.49

- (6) Refer to Fig B4.49. Mark each piston by number in its forward position.

### NOTE

The pistons have offset gudgeon pin bosses and can only be fitted one way: The mark "FRONT" or  $\Delta$  faces the front of the engine.

- (7) Mark the connecting rods (1) and caps (2) so that they may be assembled in their correct order ('A' in Fig B4.49).
- (8) Remove nuts (3).
- (9) Remove the connecting rod caps (2) and bearings (4).

- (10) Remove the pistons (5) and connecting rods (1) out through top.

- (11) Temporarily refit the connecting rod caps and bearing shells to their respective rods.

### REPLACEMENT

### CAUTION

*It is essential that the piston is fitted the correct way round on the connecting rod. The mark "FRONT" or  $\Delta$  on the piston crown faces the front of the engine and the cylinder number stamped on the connecting rod and cap faces the distributor side of the engine.*

2. To replace the connecting rods and pistons:
  - (1) Ensure that the connecting rod big end bores are clean and free from burrs or marks.
  - (2) Clean the bearing shells and fit them to the connecting rods and caps. The shells are notched to fit the recesses machined in the rods and caps.

### NOTE

Any foreign material between the bearing shells and connecting rod or cap will affect clearance and result in bearing failure.

- (3) Liberally lubricate the cylinder bores, pistons and connecting rod bearings with engine oil.

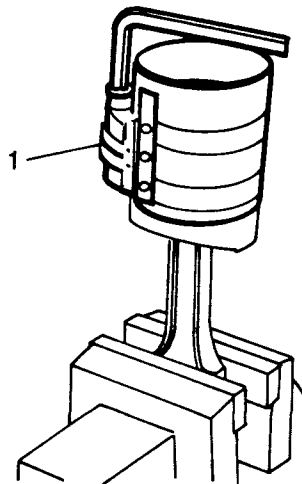


Fig B4.50

- (4) Refer to Fig B4.50. Compress the piston rings using a suitable ring compressor (1).

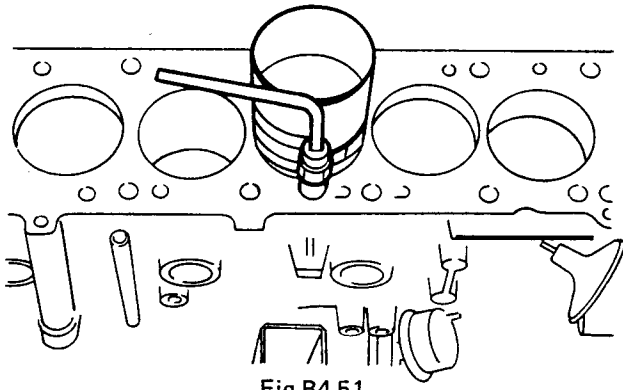


Fig B4.51

- (5) Refer to Fig B4.51. Enter the piston and connecting rod assembly to the cylinder bores from the top, ensuring that the oil jet holes in the connecting rods are facing the distributor side of the engine.
- (6) Gently tap the piston into the cylinder, at the same time checking that the connecting rods are facing the distributor side of the engine.

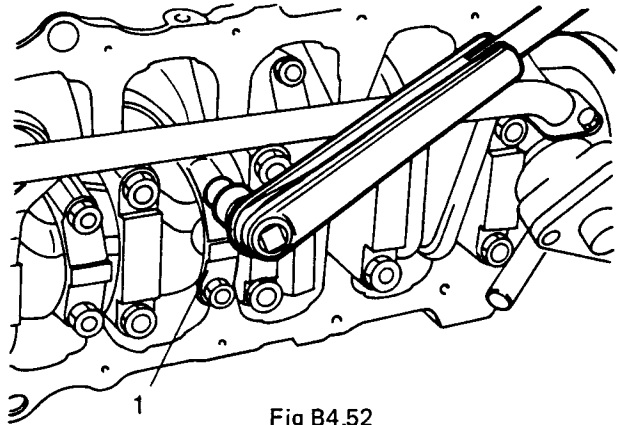


Fig B4.52

- (7) Refer to Fig B4.52. With the connecting rod positioned on the crankshaft, fit the connecting rod cap (1) and lower half bearing.
  - (8) Fit the connecting rod bolts and tighten the nuts to 42 to 47 N.m.
3. Replace the oil pump (see Sub-section B4, Chapter 16), the sump (see Sub-section B4, Chapter 17), the cylinder head (see Sub-section B4, Chapter 10).



## SUB-SECTION B4

### CHAPTER 6

#### CRANKSHAFT PULLEY AND VIBRATION DAMPER ASSEMBLY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the crankshaft pulley and vibration damper assembly:
  - (1) Remove fan cowling assembly.
  - (2) Slacken alternator drive belt and remove (see Sub-section O5, Chapter 1).

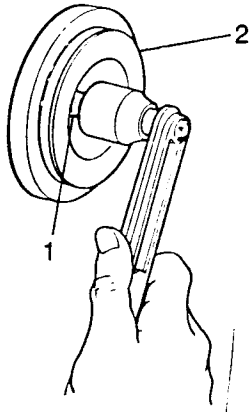


Fig B4.53

- (3) Refer to Fig B4.53. Loosen the retaining bolt (1) with special tool 18G98A and remove bolt.
- (4) Remove the assembly (2) from the shaft using suitable levers.

##### REPLACEMENT

2. Replace the crankshaft pulley and vibration damper as follows: (Fig B4.53 still applies).
  - (1) Lubricate the seal surface with engine oil.
  - (2) Replace crankshaft pulley and vibration damper assembly (2).
  - (3) Refit retaining bolt (1) and torque to 81 to 95 N.m.
  - (4) Replace the alternator drive belt (see Sub-section O5, Chapter 1).
  - (5) Replace fan cowl assembly.

## SUB-SECTION B4

### CHAPTER 7

#### SUMP FRONT SEAL, SEAL HOUSING AND CRANKSHAFT OIL SEAL - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the components:

- (1) Remove the sump and gaskets (see Sub-section B4, Chapter 17).
- (2) Remove the crankshaft pulley and vibration damper assembly (see Sub-section B4, Chapter 6).

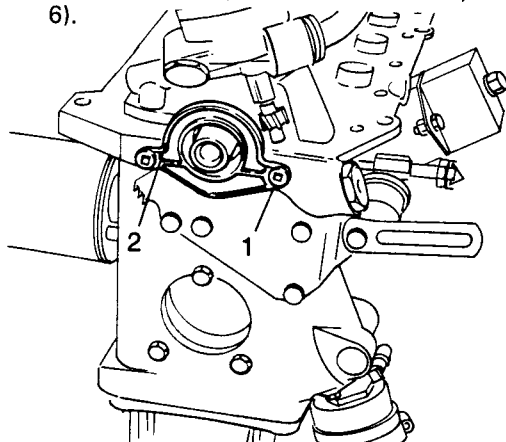


Fig B4.54

- (3) Refer to Fig B4.54. Remove the two counter sunk head screws (1) and washers securing the seal housing (2) to the crankcase and detach the housing.
- (4) Detach the reservoir seal from its groove in the housing.



Fig B4.55

- (5) Refer to Fig B4.55. Carefully drift out the crankshaft oil seal (1) as necessary or alternatively replace the seal and housing as a unit.

##### REPLACEMENT

2. Refit the seals and housings as detailed below:

- (1) Carefully press a new crankshaft oil seal into the housing as necessary.
- (2) Install the seals and housing assembly over the crankshaft, maintaining fitted horizontal alignment of the countersunk holes and the threaded holes in the crankcase.

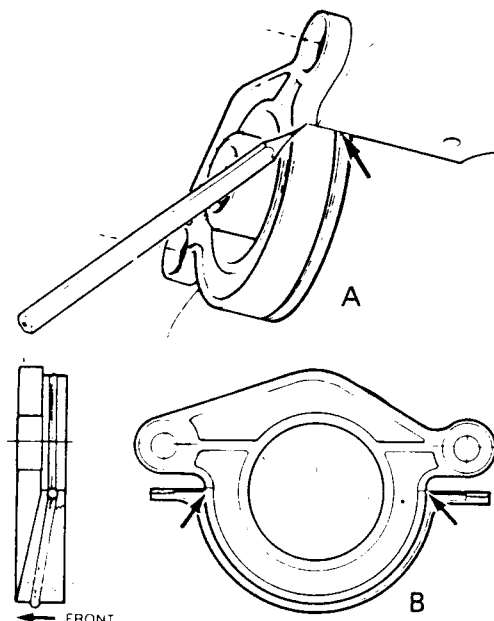


Fig B4.56

- (3) Refer to Fig B4.56. Using a lead pencil mark the position of the crankcase rails on the housing. (Fig B4.56A).
- (4) Remove the housing.
- (5) Fit the seal in the groove in the housing, so that the under side of the lugs align with the pencil lines on the housing, and the hooded part of the seal faces to the front and away from the engine. (Fig B4.56B).

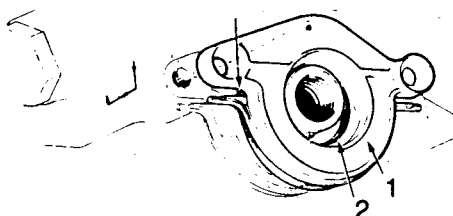


Fig B4.57

- (6) Refer to Fig B4.57. Locate the housing (1) in position on the crankcase and align the attaching screw holes.
- (7) Keeping the housing assembly in the same horizontal alignment, position the whole assembly vertically away from the engine so that the crankshaft oil seal (2) lips are resting on the crankshaft.

# CRANKSHAFT REAR OIL SEAL - REMOVAL AND REPLACEMENT

## REMOVAL

1. To remove the rear oil seal:

- (1) Remove the flywheel (see Sub-section B4, Chapter 13).

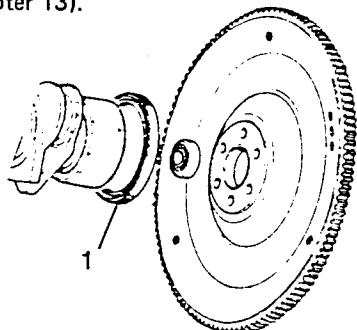


Fig B4.59

- (2) Refer to Fig B4.59. Extract the seal (1) from the cylinder block.

- (4) Lubricate the inside of the seal replacer sleeve (3) 18GA044 and fit it over the crankshaft against the seal (4).

- (5) Fit the nut to the adaptor and wind up till the seal enters its housing. Continue to wind in until the seal is flush or just clear of the crankcase face.

## NOTE

Clearance must exist between the seal and the flywheel mounting face on the crankshaft.

- (6) Refit the flywheel (see Sub-section B4, Chapter 13).

## REPLACEMENT

2. Replace the seal as follows:

- (1) Liberally lubricate the seal lip and the surface of the crankshaft with engine oil.

## NOTE

The direction of crankshaft rotation is indicated on the seal by an arrow.

- (2) Carefully fit the seal to the crankshaft journal, turning it in the opposite direction to the arrow (clockwise).

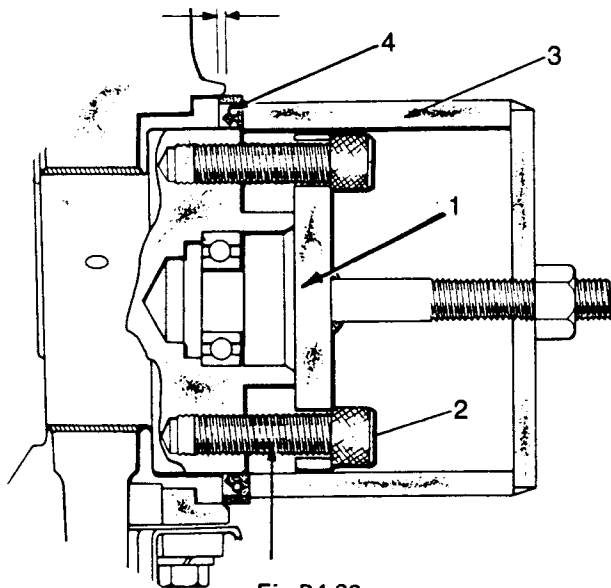


Fig B4.60

- (3) Refer to Fig B4.60. Secure the seal replacer adaptor 18GA044 (1) to the end of the crankshaft with the screws (2) as shown.

## SUB-SECTION B4

### CHAPTER 9

## CRANKSHAFT - REMOVAL AND REPLACEMENT

### REMOVAL

1. For this operation, first carry out the following procedure:
  - (1) Remove the engine (see Sub-section B4, Chapter 1).
  - (2) Remove the clutch (see Sub-section H3.4, Chapter 1).
  - (3) Remove the flywheel (see Sub-section B4, Chapter 13).
  - (4) Turn the engine over and remove the sump (see Sub-section B4, Chapter 17).
  - (5) Remove the engine back plate and adaptor plate.
  - (6) Remove the oil pump (see Sub-section B4, Chapter 16).
  - (7) Remove the oil pump drive shaft (see Sub-section B4, Chapter 2).
  - (8) Remove the crankshaft pulley and vibration damper assembly (see Sub-section B4, Chapter 6).
  - (9) Remove the oil reservoir front seal, seal housing and crankshaft oil seal (see Sub-section B4, Chapter 7).
  - (10) Remove the crankshaft rear oil seal (see Sub-section B4, Chapter 8).
  - (11) Remove the distributor drive shaft assembly (see Sub-section B4, Chapter 3).

2. To remove the crankshaft:

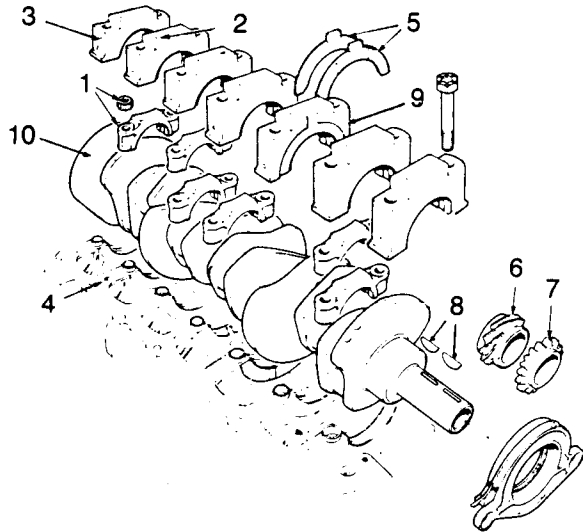


Fig B4.61

- (1) Refer to Fig B4.61. Remove the connecting rod caps (1) maintaining them in their correct order for replacement.
- (2) Remove the main bearing caps (2) noting the location stamping. The caps are number stamped on the LH side (3) and corresponding numbers are stamped on the LH side main bearing webs adjacent to the cap joint (4) to ensure correct replacement.
- (3) Lift the crankshaft from the engine and recover the thrust washers (5) from both sides of No 3 main bearing housing (9).
- (4) Remove the gear (6), sprocket (7) and keys (8) as necessary.

### INSPECTING

3. Inspect the crankshaft as follows:
  - (1) Thoroughly clean the crankshaft ensuring that there is no foreign material remaining in the oilway.
  - (2) Check the main and connecting rod journals for size and wear.
  - (3) Check the condition of the thrust faces at No. 3 main journal.
  - (4) Check the condition of the spigot bearing (10).

## REPLACEMENT

4. Note that Fig B4.61 still applies. To replace the crankshaft:

- (1) Replace the keys (8), gear (6) and sprocket (7) if these have been removed.
- (2) Fit bearing shells to their respective housings.
- (3) Lubricate the crank shaft journals and install shaft in the crankcase.
- (4) Fit the upper half thrust washers in position in the crankcase at No 3 main bearing.
- (5) Install No 3 main bearing cap (9) with its thrust washers (5).

### NOTE

The oil grooves in the thrust washers face the crankshaft.

- (6) Install the remainder of the main bearing caps (2) and check the bearing clearances.
- (7) Torque the main bearing bolts to 95 N.m.
- (8) Ensure that the crankshaft turns freely.
- (9) Check and adjust as necessary the crankshaft end float.
- (10) Fit the connecting rod bearing shells and assemble the connecting rods to their shaft journals using new self-locking nuts on the bolts. Tighten the nuts to 42 to 47 N.m.
- (11) Ensure that the crankshaft turns freely.

5. Having now replaced the crankshaft, continue:

- (1) Replace the distributor drive shaft assembly (see Sub-section B4, Chapter 3).
- (2) Fit the crankshaft rear oil seal (see Sub-section B4, Chapter 8).
- (3) Replace the oil reservoir front seal, seal housing and crankshaft oil seal (see Sub-section B4, Chapter 7).

- (4) Refit the crankshaft pulley and vibration damper assembly (see Sub-section B4, Chapter 6).

- (5) Replace the oil pump drive shaft (see Sub-section B4, Chapter 2).

- (6) Refit the oil pump, cleaning the oil pump pick-up strainer first (see Sub-section B4, Chapter 16).

- (7) Fit a new oil filter.

- (8) Replace the engine back plate and adaptor to plate.

- (9) Clean and replace the sump (see Sub-section B4, Chapter 17).

- (10) Replace the flywheel (see Sub-section B4, Chapter 13).

- (11) Refit the clutch (see Sub-section H3.4, Chapter 1).

- (12) Replace the engine (see Sub-section B4, Chapter 1).

- (13) Prime the lubrication system prior to starting the engine:

- a. Fill the engine with oil to the level indicated on the dipstick.
- b. Disconnect the main coil lead.
- c. Remove the spark plug.
- d. Crank the engine on the starter until the oil pressure warning light is extinguished.
- e. Replace the plugs and reconnect the main coil lead.

- (14) Start the engine and check for oil leaks.

- (15) Stop the engine and top up the engine oil as necessary.

- (16) Check engine tune.

## SUB-SECTION B4

### CHAPTER 10

#### CYLINDER HEAD AND GASKET - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the cylinder head:

- (1) Disconnect the battery.
- (2) Drain the cooling system (see Sub-section E6).
- (3) Remove the air intake box on the carburettors (see Sub-section C4, Chapter 1).

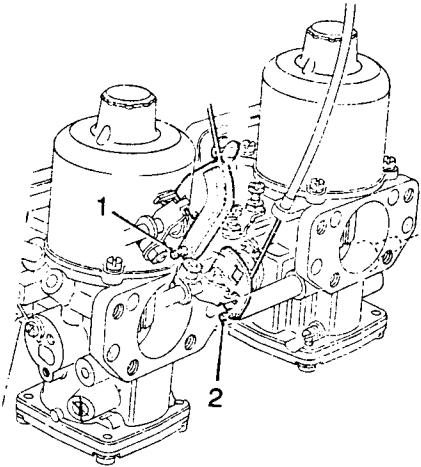


Fig B4.62

- (4) Refer to Fig B4.62. Loosen the fixing (1) and withdraw the accelerator control cable.
- (5) Loosen the fixing (2) and withdraw the mixture (choke) control cable.

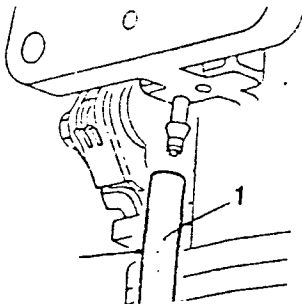


Fig B4.63

- (6) Refer to Fig B4.63. Disconnect the ignition vacuum pipe (1) from the manifold.

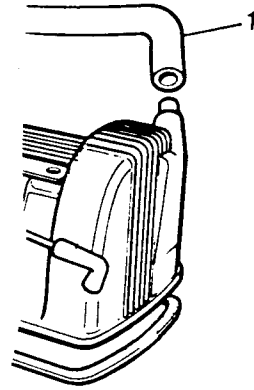


Fig B4.64

- (7) Refer to Fig B4.64. Disconnect the engine breather hose (1) from the cam cover.

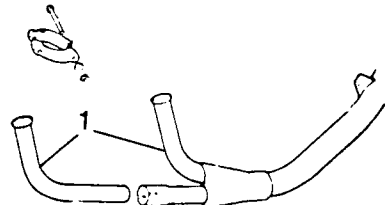
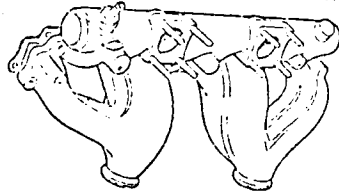


Fig B4.65

- (8) Refer to Fig B4.65. Disconnect the exhaust down pipes (1) from the manifold.
- (9) Disconnect the top radiator hose, the heater hoses and the bypass hose.
- (10) Undo the bolt holding the clamp for the heater hoses on the inlet manifold and lay the hoses to one side.

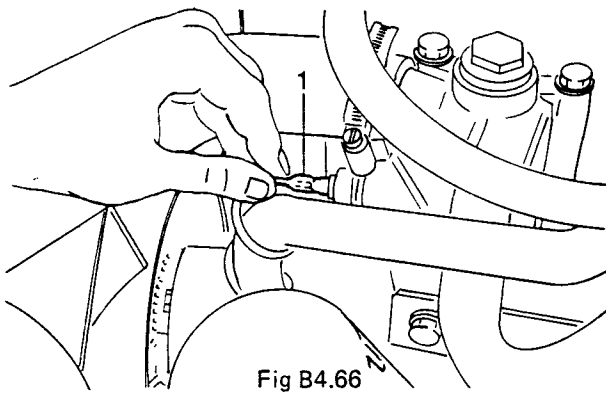


Fig B4.66

- (11) Refer to Fig B4.66. Disconnect the wire (1) from the coolant temperature transmitter. The transmitter is located in the thermostat housing on the left hand upper side of the engine just above the water pump and oil filter.

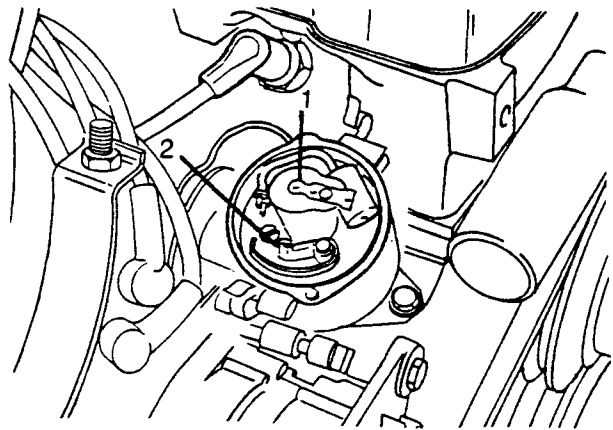


Fig B4.69

- (15) Refer to Fig B4.69. Check that No 1 cylinder is in the firing position (rotor (1) pointing to No 1 cylinder take-off and points (2) opening).

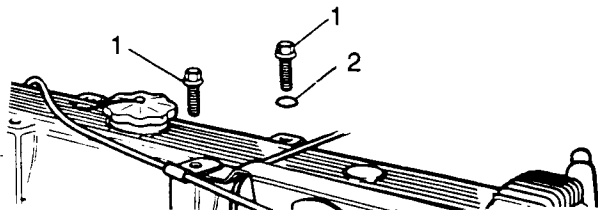


Fig B4.67

- (12) Refer to Fig B4.67. Remove the eight flanged bolts (1) and O-rings (2) securing the cam cover and remove the cover and gasket.
- (13) Remove the distributor cap and the leads from the spark plugs. It may be necessary to rotate the distributor slightly so that the cap does not foul the head when being removed.

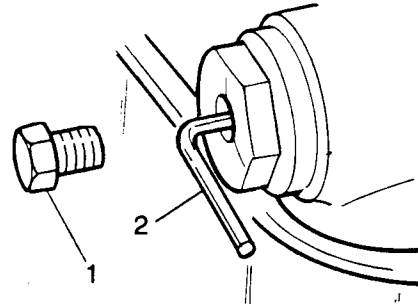


Fig B4.70

- (15) Refer to Fig B4.70. Remove the chain tensioner adaptor screw (1).
- (16) Insert a 3,17 mm allen key (2) and turn it 90° clockwise to retract the chain tensioner.

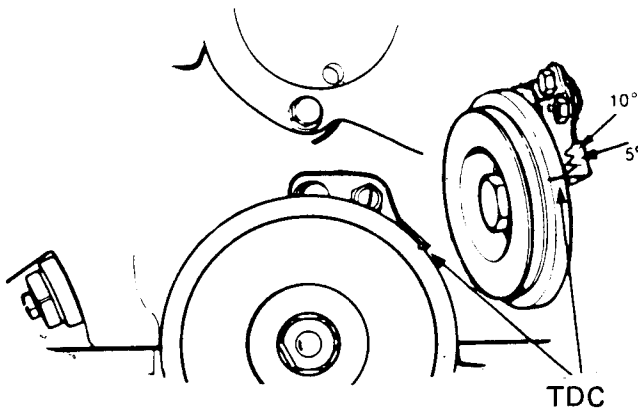


Fig B4.68

- (14) Refer to Fig B4.68. Turn the engine until the mark on crankshaft pulley lines up with the TDC mark on the engine block.

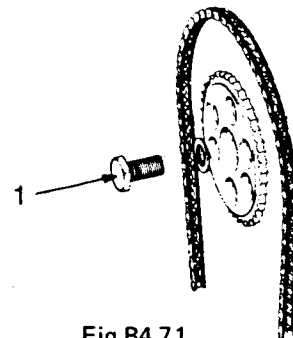


Fig B4.71

- (17) Refer to Fig B4.71. Unscrew the camshaft sprocket retaining screw (1), remove the sprocket and allow the chain to hang over the guides.

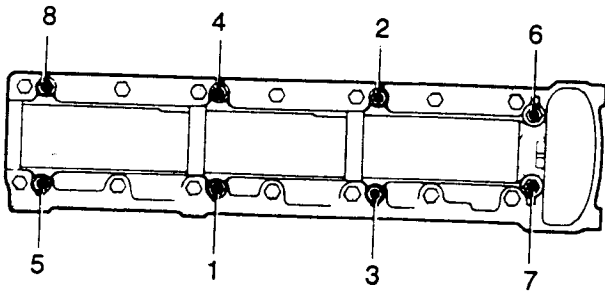


Fig B4.72

(18) Refer to Fig B4.72. Slacken the cylinder head bolts (1 to 8) gradually in a diagonal sequence starting with bolt (8) and ending with bolt (1) and remove the bolts.

(19) Lift off the cylinder head and remove the gasket.

## REPLACEMENT

2. Replace the cylinder head as detailed below:

(1) Fit a new cylinder head gasket.

(2) Replace the cylinder head and bolts. Tighten the bolts gradually in the sequence bolt (1) to bolt (8) (Fig B4.72). Final torque figure for the bolts is 90 N.m.

(3) Check that the crankshaft pulley mark is still at TDC.

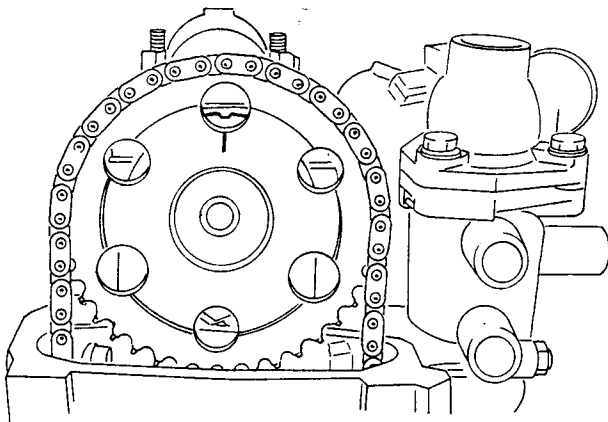


Fig B4.73

(4) Refer to Fig B4.73. Fit the camshaft sprocket and locating pin. Check that the timing marks on the sprocket and cam cover align, then replace the bolt and tighten to 47 N.m.

(5) Replace the chain over the sprocket.

(6) Release the chain tensioner by turning the allen key (Fig B4.70) 90° counterclockwise.

(7) Remove the allen key and replace the adaptor screw.

(8) Refit the distributor cap and the spark plug leads.

(9) Replace the cam cover, using a new gasket and secure with the eight flanged bolts and O-rings. Tighten the bolts to 8 N.m.

## NOTE

Do not overtighten the bolts. A bolt flange which touches the alloy cover will promote noise from the valve mechanism.

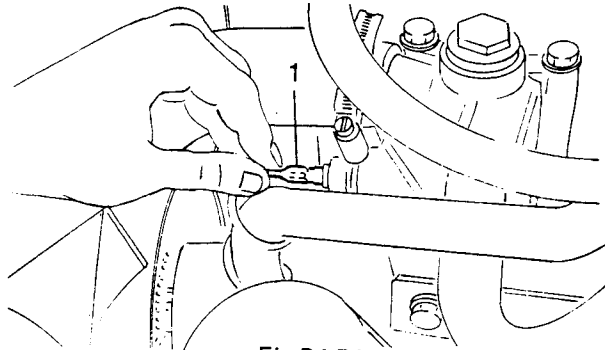


Fig B4.74

(10) Refer to Fig B4.74. Reconnect the wire to the coolant temperature transmitter (1).

(11) Position the heater hoses and secure with the clamp on the inlet manifold.

(12) Reconnect the bypass hose, the heater hoses and the top radiator hose.

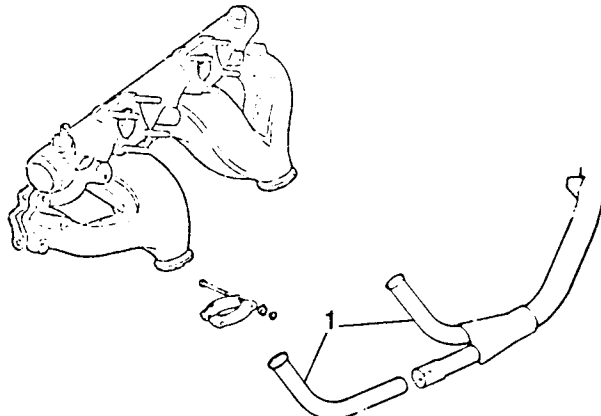


Fig B4.75

(13) Refer to Fig B4.75. Position and connect the exhaust downpipes (1) to the manifold.

(14) Connect the engine breather hose to the cam cover (Fig B4.64).

(15) Connect the ignition vacuum pipe to the manifold (Fig B4.63).



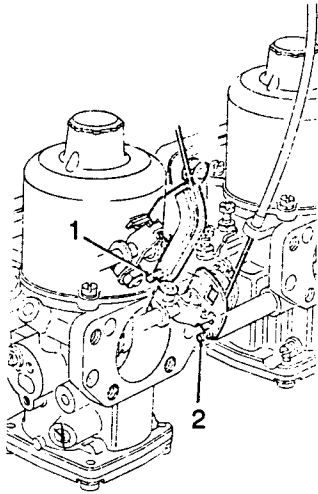


Fig B4.76

- (16) Refer to Fig B4.76. Refit the mixture cable and secure with the fixing (2).

- (17) Replace the accelerator cable and secure with the fixing (1).
- (18) Refit the air intake box over the carburetors (see Sub-section C4, Chapter 1).
- (19) Fill the cooling system (see Sub-section E6).
- (20) Reconnect the battery.
- (21) If the position of the distributor has been disturbed, reset the ignition timing (see Sub-section D3, Chapter 2).

## SUB-SECTION B4

### CHAPTER 11

#### CAMSHAFT COVER - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the camshaft cover:

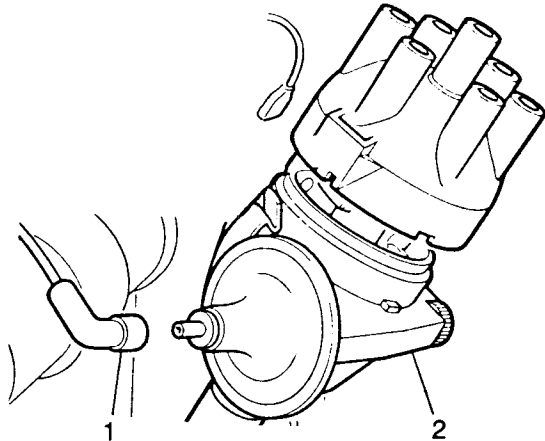


Fig B4.77

- (1) Refer to Fig B4.77. Disconnect the vacuum advance pipe (1) at the distributor (2).

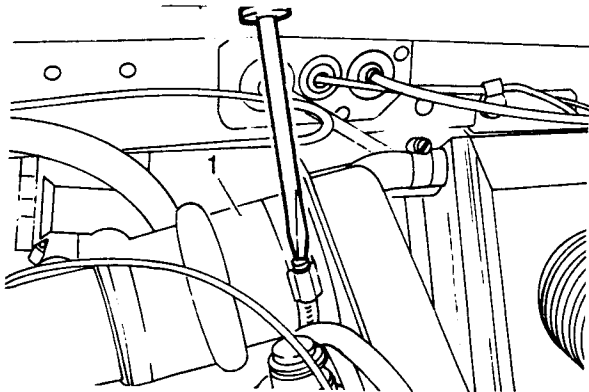


Fig B4.78

- (2) Refer to Fig B4.78. Remove the air intake hose (1) between the air cleaner and the air intake box.

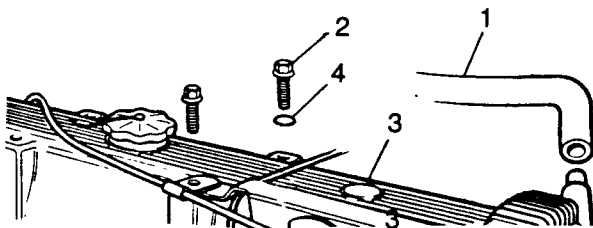


Fig B4.79

- (3) Refer to Fig B4.79. Disconnect the breather pipe (1) from the front of the cam cover (3).
- (4) Starting from the centre of the cover slacken the eight flanged bolts (2).

- (5) Remove the bolts and O-rings (4).
- (6) Move the choke and accelerator cables to one side and lift off the cover over the camshaft carrier.
- (7) Remove the gasket.

##### REPLACEMENT

2. Replace the cam cover as follows:

- (1) Fit a new cover gasket.
- (2) Replace the cam cover, fitting it under the choke and accelerator cables.
- (3) Fig B4.79 still applies. Examine the O-ring seals (4) for damage or wear. Replace if necessary.
- (4) Fit the flanged bolts (1) and O-rings (2). Tighten the bolts evenly to 8 N.m., working diagonally from the centre. Check that the O-rings (4) stand proud of the bolt flange when the bolts are tightened.

##### NOTE

Do not overtighten. A bolt flange which touches the alloy cover will promote noise from the valve mechanism.

- (5) Refit the air intake hose and tighten the hose clamps.
- (6) Reconnect the breather pipe to the front of the cam cover (Fig B4.79,(1)).
- (7) Reconnect the vacuum advance pipe to the distributor (Fig B4.77,(1)).

## SUB-SECTION B4

### CHAPTER 12

#### FRONT ENGINE MOUNTINGS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the front mountings:
  - (1) Support the engine with an engine sling.

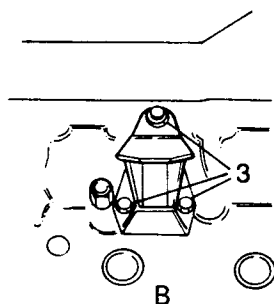
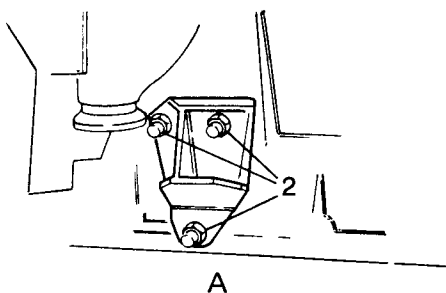
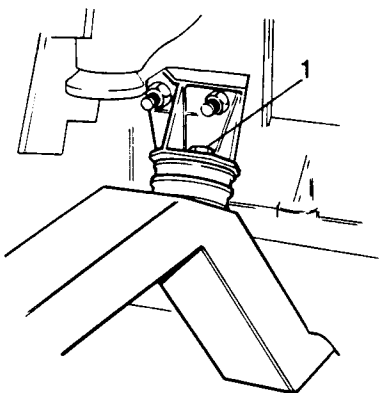


Fig B4.80

- (2) Refer to Fig B4.80. Remove the nuts (1) and spring washers securing the engine mountings to the rubber mountings.
- (3) Remove the nuts (2) and spring washers securing the mountings to the engine brackets (Fig B4.80A - left hand mounting, B4.80B - right hand mounting).
- (4) Remove the mountings.

##### REPLACEMENT

2. Replace the engine mountings as follows:
  - (1) Fit the mounting into position.
  - (2) Refit the nuts and spring washer securing the mountings of the engine brackets.
  - (3) Replace the spring washers and nuts securing the engine mountings to the rubber mountings.
  - (4) Remove the engine sling.

## SUB-SECTION B4

### CHAPTER 13

#### FLYWHEEL - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the flywheel:
  - (1) Remove the clutch assembly (see Sub-section H3.4, Chapter 1).

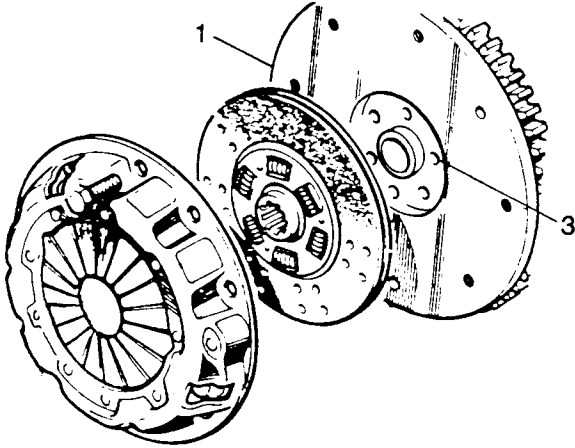


Fig B4.81

- (2) Refer to Fig B4.81. Mark the position of the flywheel (1) in relation of the crankshaft.
  - (3) Remove the six bolts (3) and withdraw the flywheel.

##### REPLACEMENT

2. Replace the flywheel as follows:
  - (1) Fit the flywheel to the crankshaft with the six securing bolts, ensuring the positioning marks are aligned.
  - (2) Torque the securing bolts to 81 to 88 N.m.
  - (3) Replace the clutch assembly (see Sub-section H3.4, Chapter 1).
  - (4) Replace the gearbox (see Sub-section H1.3, Chapter 1).

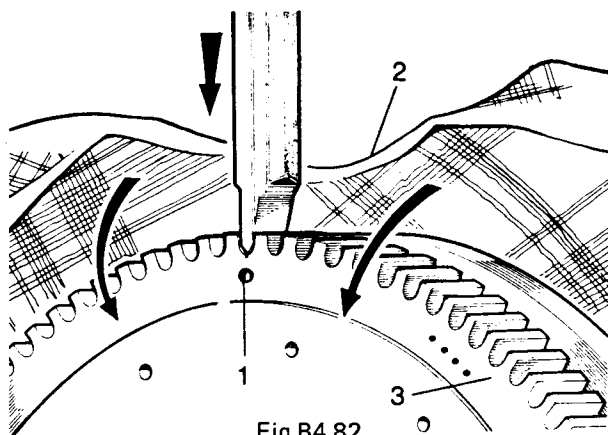
## SUB-SECTION B4

### CHAPTER 14

#### STARTER RING GEAR - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the starter ring gear:
  - (1) Remove the flywheel (see Sub-section B4, Chapter 13).



- (2) Refer to Fig B4.82. Drill a 10 mm diameter hole (1) axially between the root of any tooth and the inner diameter of the starter ring sufficiently deep to weaken the ring. DO NOT allow the drill to enter the flywheel.
- (3) Secure the flywheel in a vice fitted with soft jaws and place a cloth (2) over the flywheel as protection from flying fragments.

##### WARNING

*Take adequate precautions against flying fragments as the starter ring gear may fly to pieces when being split.*

- (4) Place a chisel immediately above the drilled hole and strike it sharply to split the starter ring gear (3).

##### REPLACEMENT

2. Replace the starter ring gear as detailed below:
  - (1) Place the flywheel, flanged side down, on a flat surface.
  - (2) Heat the starter ring gear uniformly to between 170 and 175 degrees centigrade but do not exceed the higher temperature.
  - (3) Locate the heated ring gear in position on the flywheel with the chamfered inner diameter towards the flywheel flange.
  - (4) Press the starter ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel.
  - (5) Allow the flywheel to cool gradually. DO NOT hasten the cooling in any way and thereby avoid the setting up of internal stresses in the ring gear which could lead to subsequent fracture or failure.
  - (6) Replace the flywheel (see Sub-section B4, Chapter 13).

## SUB-SECTION B4

### CHAPTER 15

#### OIL PICK-UP PIPE AND STRAINER ASSEMBLY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove this assembly:

- (1) Remove the sump (see Sub-section B4, Chapter 17).

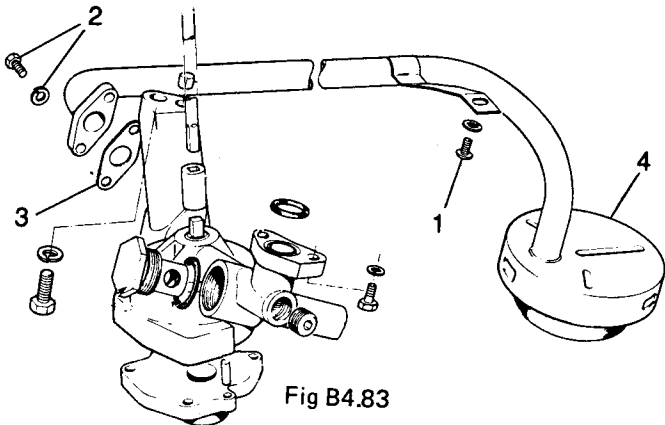


Fig B4.83

- (2) Refer to Fig B4.83. Remove the screw (1) spring, and flat washer securing the support bracket to the main bearing cap. Remove the two screws (2) and spring washers securing the pipe flange to the oil pump. Remove the assembly, detach and discard the flange gasket (3).

##### REPLACEMENT

2. Replace the assembly as follows:

- (1) Wash the oil strainer (4) in petrol.
- (2) Using a new flange gasket (3), fit the assembly to the oil pump. **DO NOT** tighten the screws at this stage.
- (3) Check for clearance between the support bracket and the mounting face on the main bearing cap and alignment of the holes. Should clearance or misalignment be present remove the assembly and adjust the bracket.
- (4) Tighten the flange screws and the bracket screw. Ensure that there is no strain on the flange when the three screws are tightened.
- (5) Replace the sump (see Sub-section B4, Chapter 17).

## SUB-SECTION B4

### CHAPTER 16

#### OIL PUMP - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the oil pump:
  - (1) Remove the oil pipe pick-up and strainer assembly (see Sub-section B4, Chapter 15).

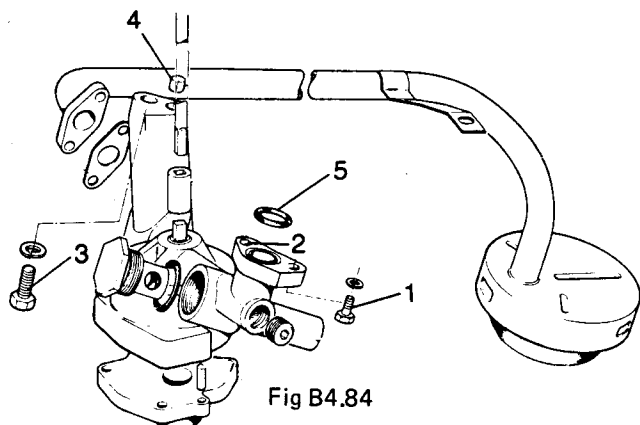


Fig B4.84

- (2) Refer to Fig B4.84. Remove the bolt (1) clamping the oil pump outlet sealing ring flange to the crankcase. Left-hand side of the engine. Note that hole (2) is an alternative mounting used in early models. It is not used on this model.
  - (3) Remove the bolt (3) securing the oil pump to the crankcase. Right-hand side of the engine.
  - (4) Lift the oil pump assembly off the locating dowels (4) and recover the outlet sealing ring (5).

##### NOTE

If the pump is removed with the engine in situ, the square ended oil pump drive shaft disengages from its driving square and drops out.

##### REPLACEMENT

2. To replace the oil pump: (Fig B4.84 still applies).
  - (1) Fit a new sealing ring (5) to the outlet flange.
  - (2) Ensure that the pump drive shaft is fitted.
  - (3) Fit the pump over the locating dowels (4). Should the pump assembly not sit evenly on both mounting faces due to zero end float between the drive square and the distributor drive shaft, check that the shaft has not disengaged from the distributor at the drive tang. Normal shaft end float should be approximately 2,54 mm.
  - (4) Secure the pump to the crankcase with the bolt (3) and lockwasher. Tighten to 27 to 33 N.m.
  - (5) Replace the bolt (1) and lockwasher holding the pump to the crankcase. Tighten to 8 to 10 N.m.
  - (6) Refit the oil pick-up pipe and strainer (see Sub-section B4, Chapter 15).
  - (7) Prime the engine before starting by cranking with the starter motor having first removed the coil lead and the spark plugs.

## SUB-SECTION B4

### CHAPTER 17

#### SUMP - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the sump:

- (1) Remove the engine oil dipstick.
- (2) Raise the vehicle to a suitable working height and support it with stands.

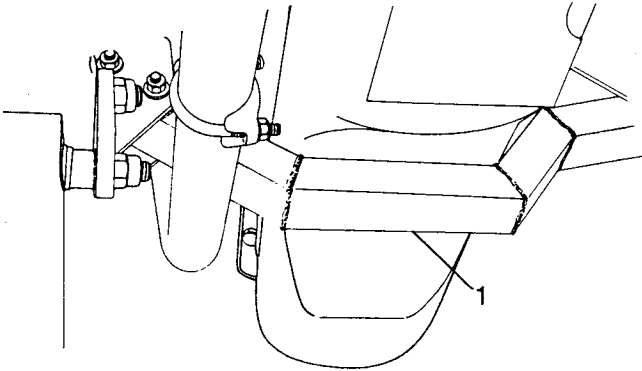


Fig B4.85

- (3) Refer to Fig B4.85. Remove the engine mounting member (1) across the sump (four bolts, washers and locknuts).
- (4) Drain the engine oil (see Sub-section B6).

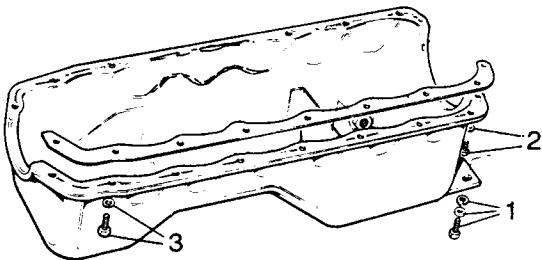


Fig B4.86

- (5) Refer to Fig B4.86. Remove the two bolts, plain and spring washers (1) securing the support plate to the adaptor plate.
- (6) Remove the two 4,76 mm UNC screws (2) and flat washers securing the sump, rear seal and gasket to the adaptor plate.
- (7) Remove the remaining 16 screws and spring washers (3) securing the sump to the cylinder block.
- (8) Lower and remove the sump.

##### REPLACEMENT

2. Replace the sump as detailed below:

- (1) Check the front and rear sump seals for damage or wear and replace if necessary.
- (2) Fit a new sump gasket as follows:
  - i. Apply a thin coat of Permatex No 3 jointing compound to the side rails of the crankcase and allow it to become tacky.
  - ii. Apply a thin coat of jointing compound to the underside of each gasket and allow it to become tacky.
  - iii. Position the gasket on the side rails so that all holes line up, and the end of the gasket at the front abuts with the lug on the front seal, while at the same time it is positioned on top of the sealing rib.

##### NOTE

It is not necessary to use jointing compound on the rubber seals.

- (3) Offer up the sump to the crankcase.
- (4) Fig B4.86 still applies. Fit the 16 screws and spring washers (3) and torque to 10 to 13 N.m.
- (5) Replace the two bolts, plain and spring washers (1) securing the support plate to the adaptor plate.
- (6) Refit the two 4,76 mm UNC screws and flat washers (2) securing the sump, rear seal and gasket to the adaptor plate.
- (7) Replace the engine cross mounting member.
- (8) Lower the vehicle to the ground.
- (9) Replace the dipstick and fill with the correct grade of oil.



## SUB-SECTION B4

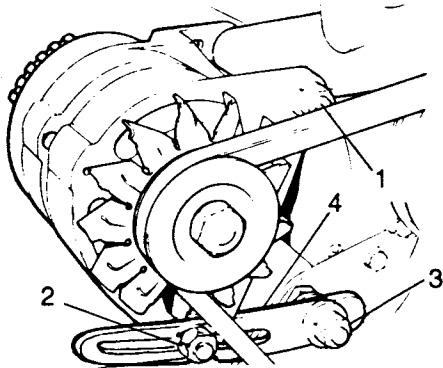
### CHAPTER 21

#### TIMING CHAIN GUIDES - REMOVAL AND REPLACEMENT

##### REMOVAL

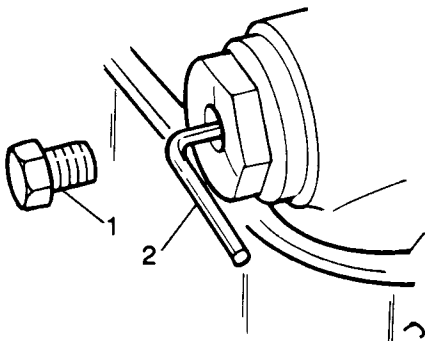
1. To remove the timing chain guides:

(1) Raise the vehicle on a hoist or stands.

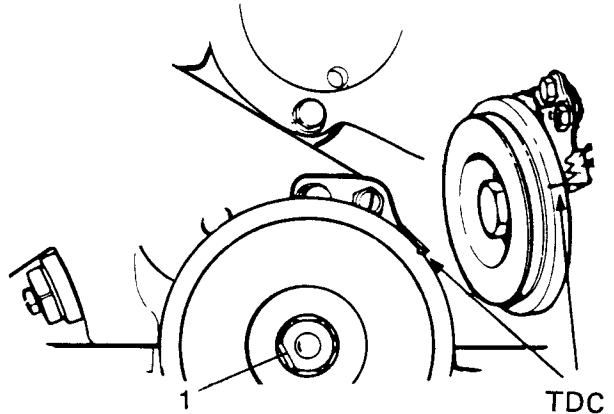


(2) Refer to Fig B4.104. Slacken the nuts (1) and (2) and remove the alternator belt.

(3) Remove the nut (3) and take off the alternator adjusting bracket (4).

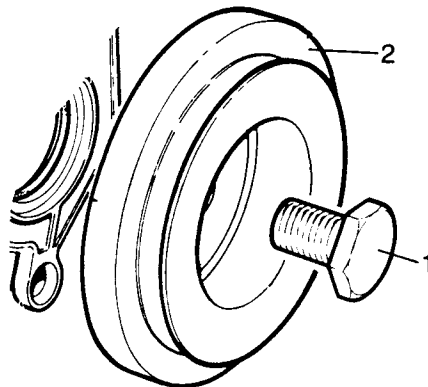


- (4) Refer to Fig B4.105. Retract the timing chain tensioner by removing the chain tensioner adaptor screw (1), fitting a 3,17 mm allen key (2) and turning the key 90° clockwise.



(5) Refer to Fig B4.106. Loosen the harmonic balancer bolt (1) using special tool 18G98A.

(6) Set the crankshaft pulley timing mark to the TDC position with No 1 cylinder firing.



(7) Refer to Fig B4.107. Remove the harmonic balancer bolt (1) and pull the crankshaft pulley (2) away.

(8) Remove the camshaft cover (see Sub-section B4, Chapter 11).

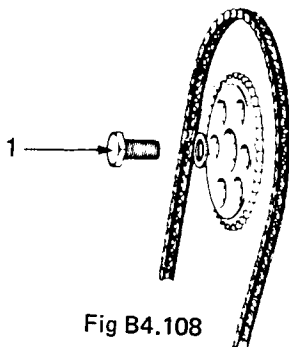


Fig B4.108

- (9) Refer to Fig B4.108. Remove the fixing (1) for the camshaft sprocket and remove the sprocket.

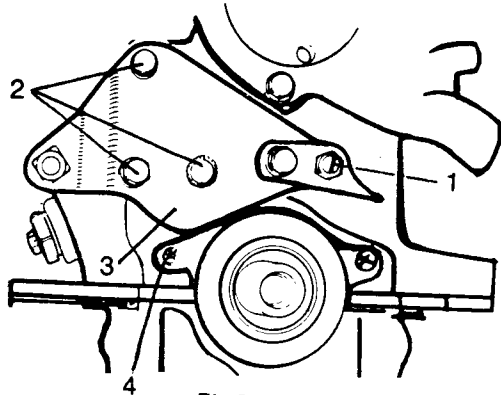


Fig B4.109

- (10) Refer to Fig B4.109. Remove the locknut (1) and three bolts (2) and lift away the timing cover (3).
- (11) Slacken the sump screws sufficiently to lower the sump by approximately 5 mm.
- (12) Remove the two seal housing screws (4). Carefully separate the housing gasket from the sump gasket with a suitable blade or knife and remove the housing.

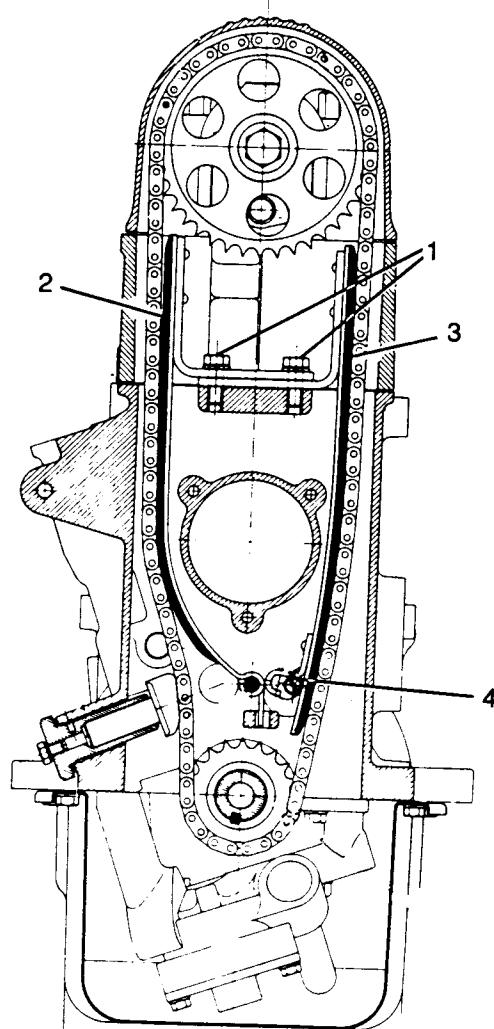


Fig B4.110

- (13) Refer to Fig B4.110. Remove the guide retaining bolts (1).
- (14) Release the RH guide (2) from the engine.
- (15) Release the LH guide (3) from the adjuster (4) at the bottom and remove the guide by lifting and turning through 90° anti-clockwise.

#### REPLACEMENT

2. Replace the chain guides as follows:
  - (1) Replace the LH guide first, turning the cam adjuster to ensure that the guide is vertical.
  - (2) Fit the RH guide.
  - (3) Replace the guide retaining bolts and tighten to 24 to 27 N.m.

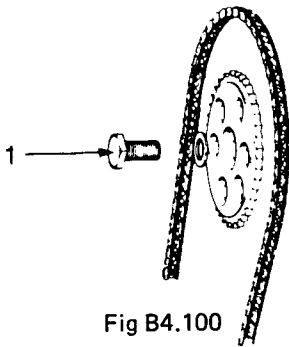


Fig B4.100

- (9) Refer to Fig B4.100. Remove the fixing (1) for the camshaft sprocket and remove the sprocket.

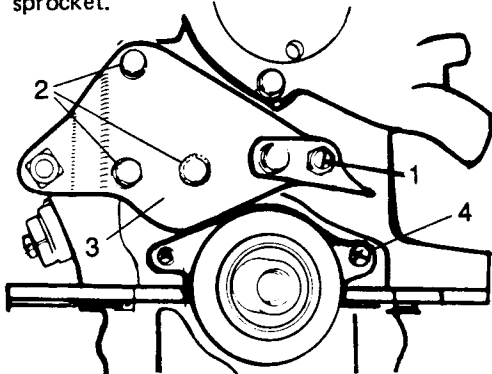


Fig B4.101

- (10) Refer to Fig B4.101. Remove the locknut (1) and three bolts (2) and lift away the timing cover (3).

- (11) Slacken the sump screws sufficiently to lower the sump by approximately 5 mm.

- (12) Remove the two seal housing screws (4). Carefully separate the housing gasket from the sump gasket with suitable blade or knife and remove the housing.

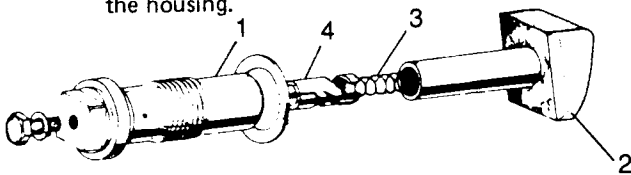


Fig B4.102

- (13) Refer to Fig B4.102. Unscrew the tensioner body (1) from the engine block.

- (14) Turn the cam adjuster stud ((1) on Fig B4.101) to obtain maximum slack in the chain.

- (15) Lever the chain away from the tensioner (2) and turn the tensioner through 180°. Finally push the chain inwards and remove the tensioner through the timing cover aperture.

#### NOTE

In some cases it may be necessary to remove the camshaft sprocket to obtain sufficient chain movement.

## REPLACEMENT

2. To replace the chain tensioner: (Fig B4.102 still applies).

- (1) Fit the spring (3) and plunger (4) into the tensioner and lock them in place by fitting the Allen key and turning it 90° clockwise. Remove the Allen key.

- (2) Fit the tensioner through the timing hole cover. Push the chain inwards and place the tensioner in position.

- (3) Screw in the tensioner body (1) while holding the tensioner against the chain.

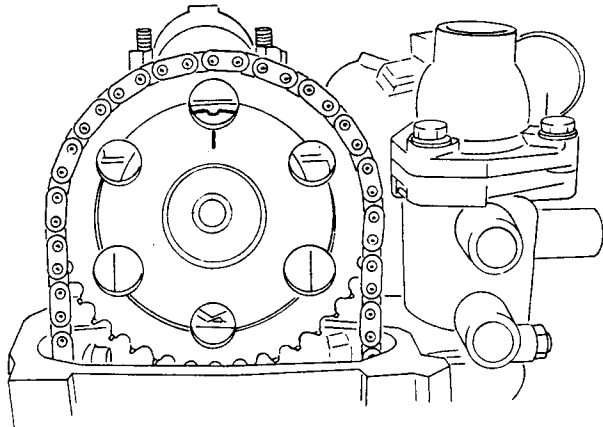


Fig B4.103

- (4) Refer to Fig B4.103. Replace the camshaft sprocket. Check that the timing marks on the sprocket and carrier are aligned.

- (5) Refit the chain over the sprocket.

- (6) Replace the camshaft cover (see Sub-section B4, Chapter 11).

- (7) If the crankshaft sprocket has been removed, replace it and refit the chain.

- (8) Turn the cam adjuster stud ((1) on Fig B4.101) to the point where the slack in the chain is just taken up. Do not overtighten the chain.

- (9) Fit the allen key into the chain tensioner and turn 90° counterclockwise to release the tensioner.

- (10) Replace the seal housing, securing it with the two screws.

- (11) Retighten the sump screws to 10 to 13 N.m.

- (12) Replace the timing cover noting that the dowel bolt goes through the eye at the bottom of the fixed (RH) chain guide. Tighten the other three bolts to 24 to 27 N.m.
- (13) Replace and tighten the locknut on the cam adjuster stud. Do not move the stud while tightening the nut.
- (14) Refit the crankshaft pulley and tighten the harmonic balancer bolt to 81 to 95 N.m. Check that the timing mark is still at TDC.
- (15) Replace the alternator adjusting bracket.
- (16) Replace and tension the alternator bolt. Tighten the three nuts (1), (2) and (3) on Fig B4.96.
- (17) Lower the vehicle to the ground.

## SUB-SECTION B4

### CHAPTER 18

#### OIL PRESSURE RELIEF VALVE - REMOVAL AND REPLACEMENT

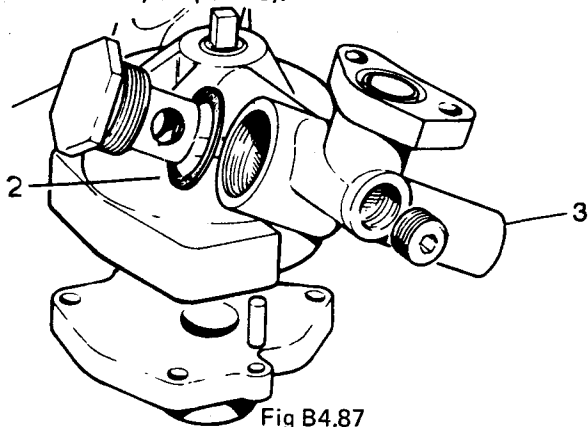
##### INTRODUCTION

1. The oil pressure relief valve is a sealed non-adjustable assembly pressed into the oil pump body. Should a valve be suspect it must be replaced.

##### REMOVAL

2. To remove the relief valve:

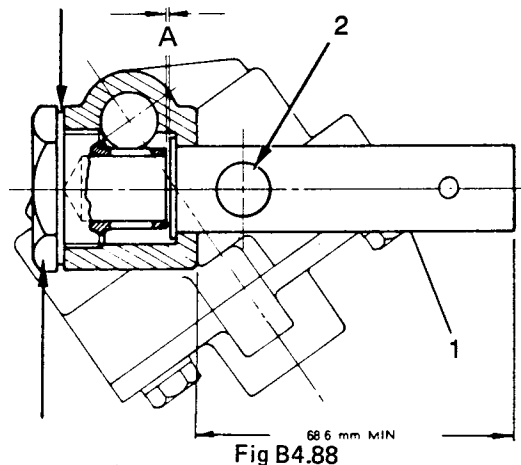
- (1) Remove the oil pump assembly (see Sub-section B4, Chapter 16).



- (2) Refer to Fig B4.87. Remove the relief valve screw plug (1) and copper washer (2).
- (3) Press the valve assembly (3) from the pump body.

##### REPLACEMENT

3. Replace the valve as follows:



- (1) Refer to Fig B4.88. Enter the valve (1) into its housing on the oil pump. This press fit valve must be positioned so that the discharge hole (2) is parallel to the pump mounting face.
- (2) Ensure the valve is square in the housing and press in until the locating flange bottoms in the housing.
- (3) Fit the copper washer and plug assembly and tighten the plug.
- (4) Check that a clearance of 0,05 to 0,5 mm exists at dimension A after the plug is tightened.
- (5) Replace the oil pump assembly (see Sub-section B4, Chapter 16).

## TIMING CHAIN - REMOVAL, FITTING NEW CHAIN AND REPLACEMENT

## REMOVAL

1. To remove the timing chain:

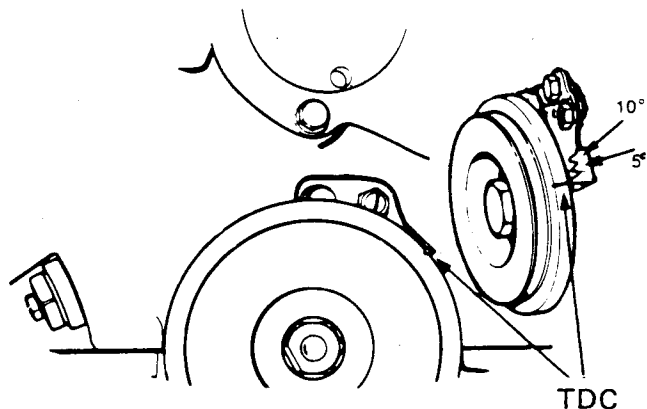


Fig B4.89

- (1) Refer to Fig B4.89. Set the timing marks to TDC. With No 1 cylinder firing (distributor rotor pointing to No 1 cylinder take-off and the points opening).
- (2) Remove the camshaft cover and gasket (see Sub-section B4, Chapter 11).

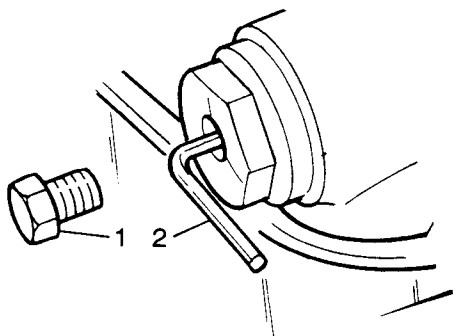


Fig B4.90

- (3) Refer to Fig B4.90. Retract the timing chain tensioner by removing the chain tensioner adaptor screw (1), fitting a 3,17 mm allen key (2) and turning the key 90° clockwise.

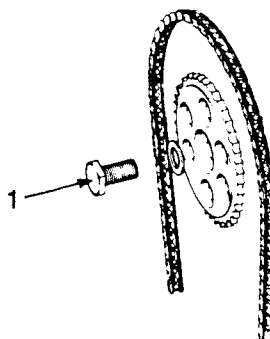


Fig B4.91

- (4) Refer to Fig B4.91. Remove the fixing (1) for the camshaft sprocket and remove the sprocket.

## FITTING NEW CHAIN

2. The following procedure continues from the removal procedure. To fit a new chain:

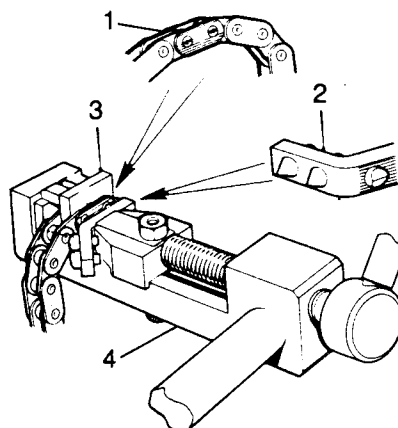


Fig B4.92

- (1) Refer to Fig B4.92. Locate the bright link of the chain (1) in special tool 18G1151 (4).
- (2) Fit the pointed extractor adaptor (2) into the head of the tool sliding press. Fit the bridge-piece of the tool (3) into the bright link.
- (3) Position the link in the front of the tool anvil with the rivet side of the link (link pin heads with horizontal depressions) towards the sliding press of the tool.
- (4) Tighten the press until the link pins shear through the link plate.
- (5) Retract the press and remove the chain.
- (6) Remove the extractor from the press.

- (7) Attach the replacement chain to the old chain with a piece of wire so the old chain will act as 'pull through' to locate the new chain around the guides, tensioner and crankshaft sprocket.

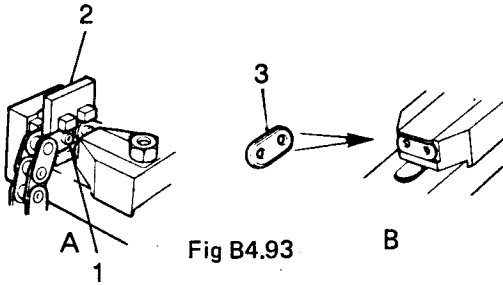


Fig B4.93

- (8) Refer to Fig B4.93. Join the ends of the chain with a new link and position the link in the anvil with the head of the pins towards the press.
- (9) Fit the locating bridge (2) with its legs centralising the link in the anvil.
- (10) Locate the plate of the link (3), chamfered side away from the chain, on the bed of the press.
- (11) Press the plate fully onto the link pins, ensuring that the holes and pins are aligned.
- (12) Retract the press.

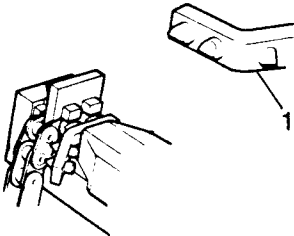


Fig B4.94

- (13) Refer to Fig B4.94. Fit the rivet adaptor (1) into the head of the press and tighten the press fully down onto the pins using hand pressure only on the press tommy-bar.
- (14) Check that a slight side-play exists on the link with no tight spots.

## REPLACEMENT

3. To replace the chain:

- (1) Fit the camshaft sprocket. Tighten the bolt to 47 N.m.

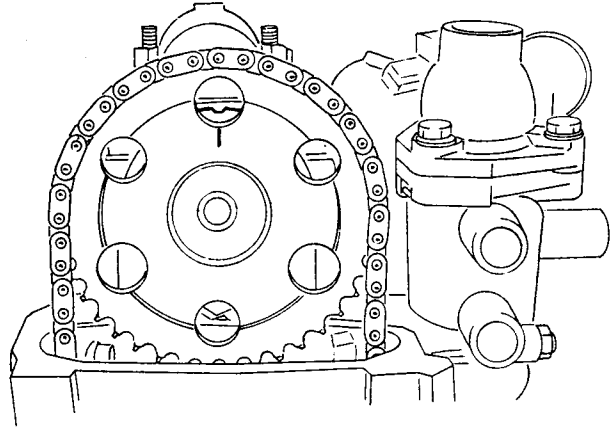


Fig B4.95

- (2) Refer to Fig B4.95. Align the timing marks on the camshaft sprocket and carrier.
- (3) Check that the crankshaft pulley mark is at the TDC position with No 1 cylinder firing.
- (4) Fit the chain over the sprocket, making sure that it is also over the bottom sprocket.
- (5) Release the timing chain tension by turning the allen key 90° counterclockwise. Remove the allen key and replace the adaptor screw (Fig B4.90).
- (6) Replace the camshaft cover (see Sub-section B4, Chapter 11).

## SUB-SECTION B4

### CHAPTER 20

#### TIMING CHAIN TENSIONER - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the timing chain tensioner:

- (1) Raise the vehicle on a hoist or stands.

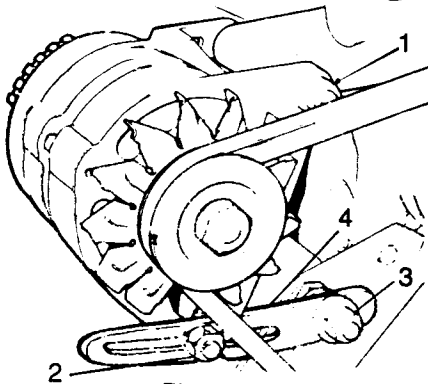


Fig B4.96

- (2) Refer to Fig B4.96. Slacken the nuts (1) and (2) and remove the alternator belt.

- (3) Remove the nut (3) and take off the alternator adjusting bracket (4).

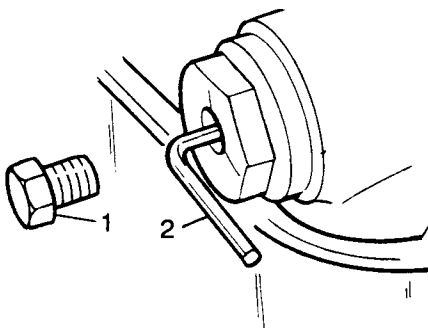


Fig B4.97

- (4) Refer to Fig B4.97. Retract the timing chain tensioner by removing the chain tensioner adaptor screw (1), fitting a 3,17 mm allen key (2) and turning key 90° clockwise. Remove the Allen key.

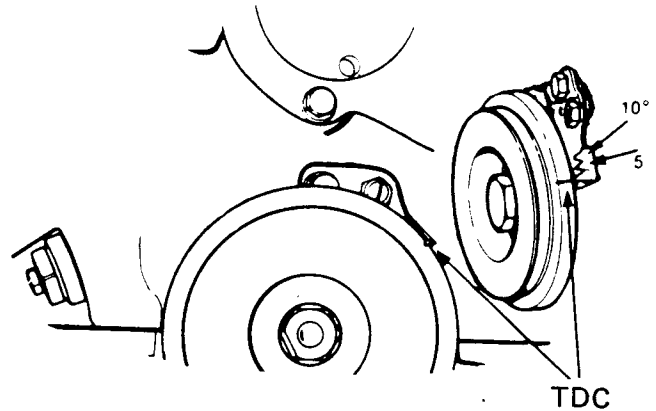


Fig B4.98

- (5) Refer to Fig B4.98. Loosen the harmonic balancer bolt (1) using special tool 18G98A.

- (6) Set the crankshaft pulley timing mark to the TDC position with No 1 cylinder firing.

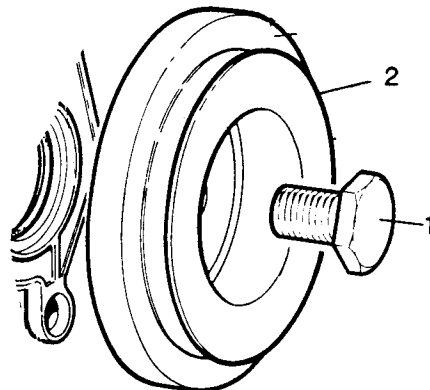


Fig B4.99

- (7) Refer to Fig B4.99. Remove the harmonic balancer bolt (1) and pull the crankshaft pulley (2) away.

- (8) Remove the camshaft cover (see Sub-section B4, Chapter 11).



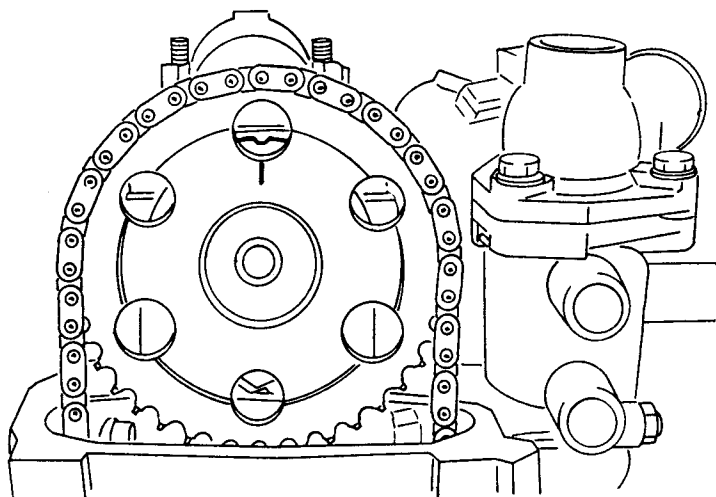


Fig B4.111

- (4) Refer to Fig B4.111. Replace the camshaft sprocket. Check that the timing marks on the sprocket and carrier are aligned.
- (5) Refit the chain over the sprocket.
- (6) Replace the camshaft cover (see Sub-section B4, Chapter 11).

- (7) Turn the cam adjuster stud ((4) on Fig B4.110) to the point where the slack in the chain is just taken up. Do not overtighten the chain.
- (8) Fit the allen key into the chain tensioner and turn 90° counterclockwise to release the tensioner.
- (9) Replace the seal housing, securing it with the two screws.
- (10) Retighten the sump screws to 10 to 13 N.m.
- (11) Refit the crankshaft pulley and tighten the harmonic balancer bolt to 81 to 95 N.m. Check that the timing mark is still at TDC.
- (12) Replace the timing cover noting that the dowel bolt goes through the eye at the bottom of the fixed (RH) chain guide. Tighten the other three bolts to 24 to 27 N.m.
- (13) Replace and tighten the locknut on the cam adjuster stud. Do not move the stud while tightening the nut.
- (14) Replace the alternator adjusting bracket.
- (15) Replace and tension the alternator. Tighten the three nuts (1), (2) and (3) on Fig B4.104.
- (16) Lower the vehicle to the ground.

## SUB-SECTION B4

### CHAPTER 22

#### OIL COOLER AND PIPES - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The oil cooler is located under the radiator. To remove:

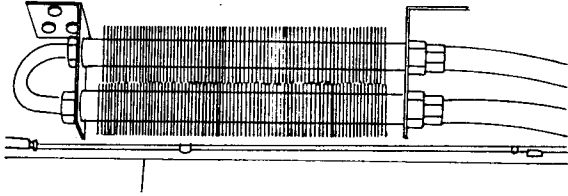


Fig B4.112

- (1) Refer to Fig B4.112. Remove the six nuts and bolts securing the oil cooler to the chassis.
- (2) Lower the oil cooler from the chassis.

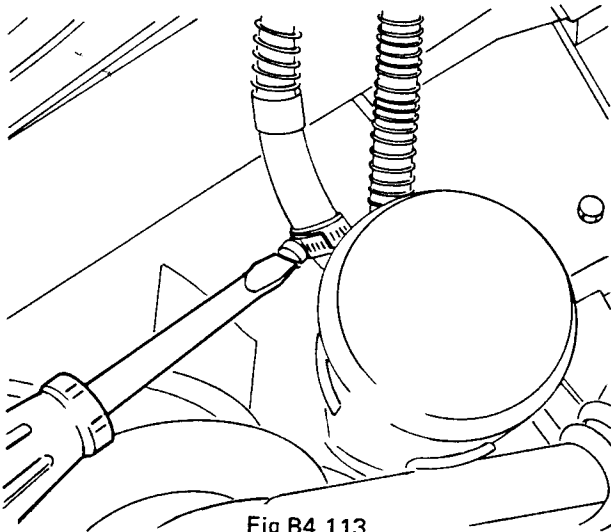
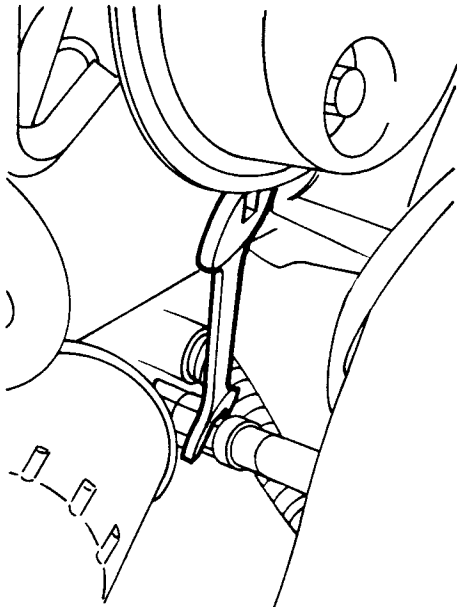


Fig B4.113

- (3) Refer to Fig B4.113. Using a suitable container to catch the oil, disconnect the oil cooler pipes from the oil filter adaptor housing and remove the pipes.

##### REPLACEMENT

2. To replace the oil cooler:

- (1) Fig B4.113 still applies. Reconnect the pipes to the oil filter adaptor housing.
- (2) Fig B4.112 still applies. Position the oil cooler on the chassis and secure with the six nuts and bolts.

**SUB-SECTION CONTENTS LIST**

**SUB-SECTION B5**

**ENGINE OVERHAUL PROCEDURES**

| <b>CHAPTER</b> | <b>DESCRIPTION</b>                                                  | <b>PAGE</b> |
|----------------|---------------------------------------------------------------------|-------------|
| <b>1</b>       | <b>CONNECTING RODS AND PISTONS - DISMANTLING<br/>AND REASSEMBLY</b> | <b>B5.3</b> |
| <b>2</b>       | <b>FLYWHEEL - OVERHAUL</b>                                          | <b>B5.5</b> |
| <b>3</b>       | <b>OIL PUMP - OVERHAUL</b>                                          | <b>B5.6</b> |

## SUB-SECTION B5

### CHAPTER 1

#### CONNECTING RODS AND PISTONS - DISMANTLING AND REASSEMBLY

##### DISMANTLING

1. Remove the connecting rod and piston (see Sub-section B4, Chapter 5) then proceed as follows:

- (1) Remove the piston rings over the crown of the piston.

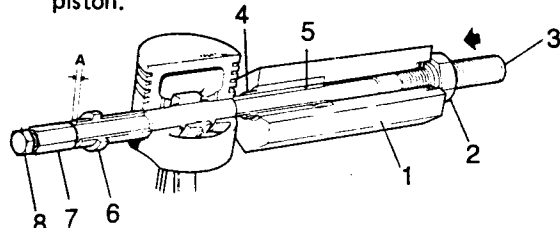


Fig B5.1

- (2) Refer to Fig B5.1. Retain the hexagon body (1) of special tool 18G1150 in a vice.
- (3) Screw the large nut (2) forward until the nut contacts the thrust race.
- (4) Push the screw (3) forward until the nut contacts the thrust race.
- (5) Locate the piston adaptor (4) of 18G1150D in the bore of the body with its spigot facing outwards.
- (6) Smear the outside diameter of the parallel sleeve (5) with oil and fit the sleeve onto the centre screw, groove end first.
- (7) Fit the piston, with the mark "FRONT" or  $\Delta$  etched on the piston crown towards the adaptor, and onto the centre screw of 18G1150.

##### CAUTION

*The gudgeon pin bore is offset towards the distributor side of the engine. A gudgeon pin counter bore is on the forward side of the piston only (marked "FRONT" or  $\Delta$  on the piston crown).*

- (8) Fit the remover/replacer bush (6) on the centre screw with the flanged end away from the gudgeon pin.
- (9) Screw the stop-nut (7) onto the centre screw and adjust it until approximately 1,0 mm end-play (dimension A) exists on the assembly.
- (10) Lock the stop-nut securely with the lock screw (8).
- (11) Check that the remover/replacer bush and parallel sleeve are correctly positioned in the bore on both sides of the piston.
- (12) Screw the large nut (2) up to the thrust race.

- (13) Hold the lock screw (8) and turn the large nut until the gudgeon pin is withdrawn from the piston.

##### REASSEMBLY

2. To reassemble the connecting rods and pistons:

- (1) Check the connecting rod alignment.
- (2) Remove the large nut of 18G1150 and pull the centre screw out of the body approximately 50 mm.

##### CAUTION

*Ensure that the threads of the large nut and screw are lubricated.*

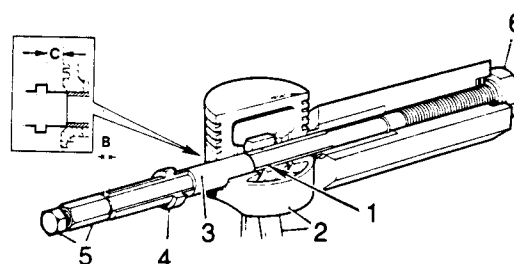


Fig B5.2

- (3) Refer to Fig B5.2. Slide the parallel sleeve (1), groove end last onto the centre screw, and up to the shoulder.
- (4) Lubricate the gudgeon pin and bores of the connecting rod and piston with graphited oil (Acheson's Colloids 'Oildag').
- (5) Fit the connecting rod and piston to the tool (2) with the connecting rod entered on the sleeve up to the groove.
- (6) Fit the gudgeon pin (3) into the piston bore up to the connecting rod.
- (7) Fit the remover/replacer bush (4) with the flanged end towards the gudgeon pin.
- (8) Screw the stop-nut onto the centre screw; adjust the nut to give a 1,0 mm end-play (dimension B) and lock the nut securely with the lock screw (5).
- (9) Screw the large nut up to the thrust race (6).
- (10) Set the torque wrench to 16 N.m (this represents the minimum load for an acceptable fit).
- (11) Using a torque wrench on the large nut, and holding the lock screw, pull the gudgeon pin in until assembly dimension (dimension C) is 8,5

mm. Under no circumstances must the flange of the remover/replacer bush be allowed to contact the piston.

#### CAUTION

*If the torque wrench has not broken through-out the pull, the fit of the gudgeon pin to the connecting rod is not acceptable and necessitates the renewal of components. The large nut and centre screw of the tool must be kept well oiled.*

(12) Remove the tool.

(13) Check that the piston pivots freely on the pin, also with sideways movement, and that the gudgeon pin will not foul the bore. If stiffness exists, wash the assembly in fuel or paraffin (kerosene), lubricate the gudgeon pin with Acheson's Colloids 'Oildag' and re-check for ingrained dirt or damage.

(14) Check the piston and connecting rod for alignment.

3. Refit the piston rings:

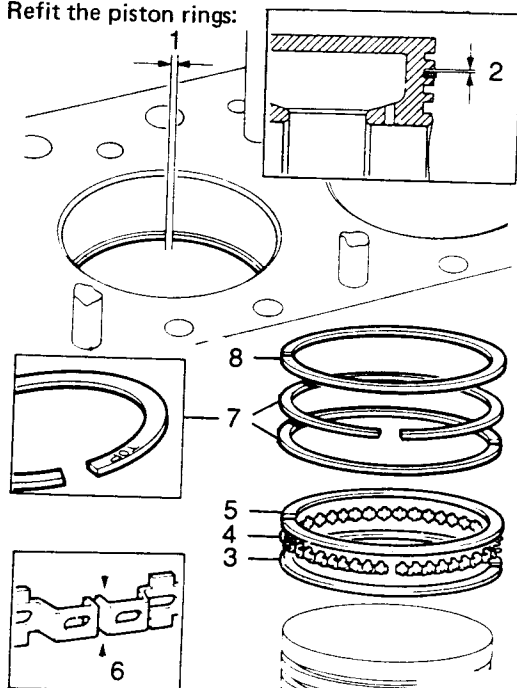


Fig B5.3

(1) Refer to Fig B5.3. Check the piston ring gap in the cylinder bore (1). To be 0,203 to 0,43 mm.

(2) Check the ring to groove clearance (2). To be 0,038 mm.

(3) Fit the bottom rail (3) to the oil control ring to the piston, and position it below the bottom groove.

(4) Fit the oil control expander (4) into the bottom groove.

(5) Move the bottom oil control ring into the bottom groove.

(6) Fit the top control ring rail (5) into the bottom groove.

(7) Check that the ends of the expanders are butting (6) but not overlapping and set the gaps of the rails and expander at 90 degrees to each other.

(8) Fit the tapered compression ring (7) with the face marked 'Top' towards the top of the piston; these rings are thinner than the top compression ring.

(9) Fit the plain compression ring (8) to the top groove.

(10) Position the ring gaps at 90 degrees to each other and away from the thrust side of the piston.

4. Replace the connecting rod and piston assembly (see Sub-section B4, Chapter 5).

mm. Under no circumstances must the flange of the remover/replacer bush be allowed to contact the piston.

# CAUTION

*If the torque wrench has not broken through-out the pull, the fit of the gudgeon pin to the connecting rod is not acceptable and necessitates the renewal of components. The large nut and centre screw of the tool must be kept well oiled.*

(12) Remove the tool.

(13) Check that the piston pivots freely on the pin, also with sideways movement, and that the gudgeon pin will not foul the bore. If stiffness exists, wash the assembly in fuel or paraffin (kerosene), lubricate the gudgeon pin with Acheson's Colloids 'Oildag' and re-check for ingrained dirt or damage.

(14) Check the piston and connecting rod for alignment.

3. Refit the piston rings:

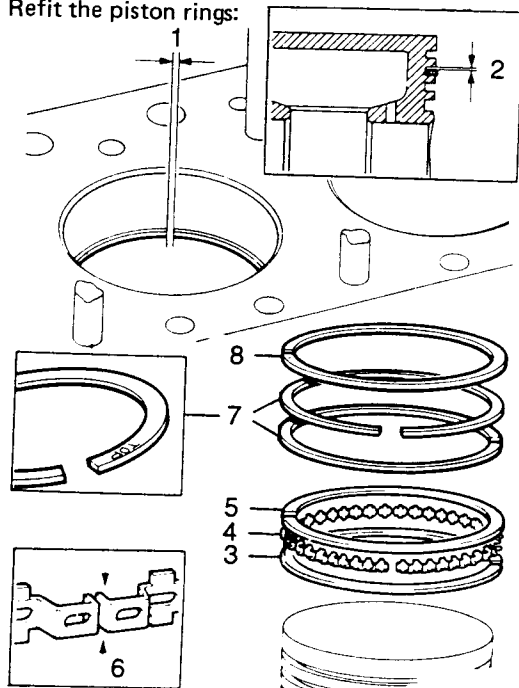


Fig B5.3

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(9) Fit the plain compression ring (8) to the top groove.

(10) Position the ring gaps at 90 degrees to each other and away from the thrust side of the piston.

4. Replace the connecting rod and piston assembly (see Sub-section B4, Chapter 5).

## SUB-SECTION B5

### CHAPTER 2

#### FLYWHEEL - OVERHAUL

##### PROCEDURE

1. Overhaul the flywheel as follows:

- (1) Remove the flywheel (see Sub-section B4, Chapter 13).
- (2) Measure the overall thickness of the flywheel. Fit a new flywheel if it is more than 2 mm below the specified thickness of 50 mm.
- (3) If the flywheel is above the minimum thickness, the clutch face may be refaced as follows:

(4) Remove the dowels.

(5) Reface the flywheel over the complete surface.

(6) Check the overall thickness of the flywheel to ensure that it is still above the minimum thickness.

(7) Refit the dowels.

(8) Replace the flywheel (see Sub-section B4, Chapter 13).

## SUB-SECTION B5

### CHAPTER 3

#### OIL PUMP - OVERHAUL

##### DISMANTLING

1. First dismantle the pump as follows:

- (1) Remove the pump (see Sub-section B4, Chapter 16).

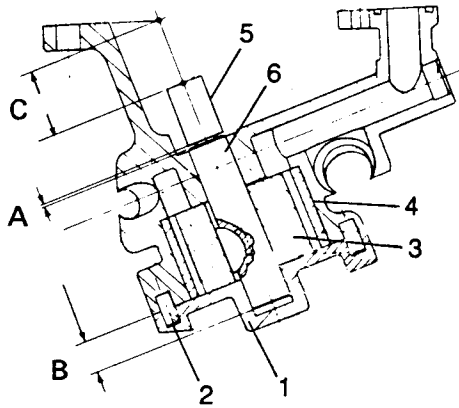


Fig B5.4

- (2) Refer to Fig B5.4. Remove the two screws, spring washers and Allen screw securing the pump cover (1) to the body.
- (3) Remove the cover with O-ring by tapping with a suitable drift on the area adjacent to the dowel bosses (2).
- (4) Identify the rotor lobe (3) with its mating cavity in the outer ring (4) to facilitate correct assembly.
- (5) Remove the outer ring, clean and dry all components.
- (6) Only remove the drive square (5) if it is to be replaced. Grip the square at the driving end and drift out the rotor shaft (6).

##### INSPECTING

2. Inspect the components as follows:

##### NOTE

The only serviceable components of the oil pump are the drive square and relief valve assembly. The oil pump must be renewed as an assembly if the rotor lobe clearance is in excess of 0,14 mm.

- (1) Check the drive square for looseness and position on the shaft. A clearance of 0,76 mm must exist between the bottom of the square and the shoulder of the shaft (dimension A).
- (2) Check for indication of flaring or splitting of the square at the drive end.

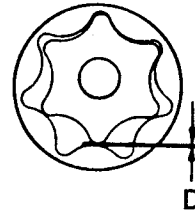


Fig B5.5

- (3) Refer to Fig B5.5. Fit the outer ring in its original running position and check rotor lobe clearance using feeler gauges (dimension D). Clearance to be 0,089 to 0,127 mm.

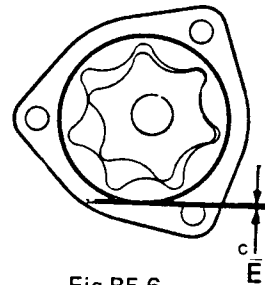


Fig B5.6

- (4) Refer to Fig B5.6. Check outer ring to body clearance (dimension E). Clearance to be 0,28 mm maximum.

##### NOTE

The outer ring to body clearance (dimension E) will be nil when checking rotor lobe clearance.

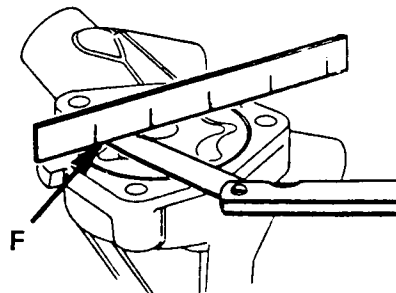


Fig B5.7

- (5) Refer to Fig B5.7. Check the outer ring end float (dimension F). Float to be 0,11 to 0,12 mm.
- (6) Check rotor end float. To be 0,11 to 0,14 mm.

##### REASSEMBLY

3. To reassemble the pump:

- (1) Lubricate the rotor and shaft assembly if removed.



- (2) Mount the pump vertically under a press ram with the rotor shaft end on the press bed.
- (3) Locate the square drive and press on until it is 0,6 mm from the shoulder.

**NOTE**

The chamfer on the shaft at the shoulder should be visible when the rotor assembly is seated in the body. If the chamfer is not visible check the fitted dimensions of the rotor and shaft as shown in Fig B5.4.

These dimensions are:

Dimension A : 0,76 mm

Dimension B : 12,32 to 12,57 mm

Dimension C : 25,65 to 25,90 mm

- (4) Refit the outer ring with the chamfer toward the pump body and the correct cavity with its mating rotor lobe.
- (5) Fit the bottom cover with O-ring, spring washers, screws and Allen screw.
- (6) Tighten the screws and check that the pump shaft turns freely.

## SUB-SECTION B6

### MAINTENANCE

#### INTRODUCTION

1. General maintenance on the engine requires a regular inspection for obvious defects including oil and coolant leaks from pipes, hoses and connections.
2. At the intervals specified the sump should be drained and replenished with fresh clean oil of the correct grade. Under severe conditions of mud or dust, the first and subsequent oil changes must be more frequent, even to the extent of a daily change. Under deep wading conditions through water carrying mud and grit, a daily oil change is essential.

#### ACCELERATOR CABLE

3. At first service (1 500 km) and thereafter every 10 000 km or 6 months:
  - (1) Lubricate the accelerator cable using clean engine oil paying particular attention to accelerator cross shaft bearings.
  - (2) Check the cable for correct operation and ensure that there is no tendency to stick.

#### CHECKING ENGINE OIL LEVEL

##### NOTE

Whenever the oil level is checked, whether the engine is hot or cold, the vehicle must be parked on a level surface.

4. Check engine oil level daily or weekly depending on operating conditions.

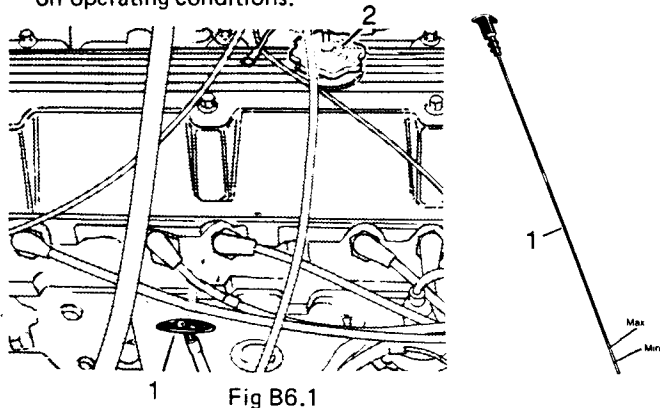


Fig B6.1

- (1) Refer to Fig B6.1. Withdraw the dipstick (1), wipe it with a lint free cloth and reinsert it to its full depth.
- (2) Withdraw the dipstick again and check that the oil level is between the maximum and minimum marks on the dipstick. Reinsert the dipstick.
- (3) If necessary, remove the filler cap (2) and add sufficient oil to take the level close to but not above the maximum mark on the dipstick. Replace the filler cap.

- (4) Under normal circumstances the oil level must never be allowed to fall below the minimum mark on the dipstick.

#### CHANGING ENGINE OIL

##### NOTE

Adhere strictly to the oil qualities and grades specified in the service schedule and Technical Specifications.

##### CAUTION

*The engine must be at operating temperature before the oil is drained. Draining must be carried out soon after the engine has stopped so that suspended pollutants do not settle out.*

5. Drain and refill the sump at first service (1 500 km) and thereafter every 10 000 km or 6 months.

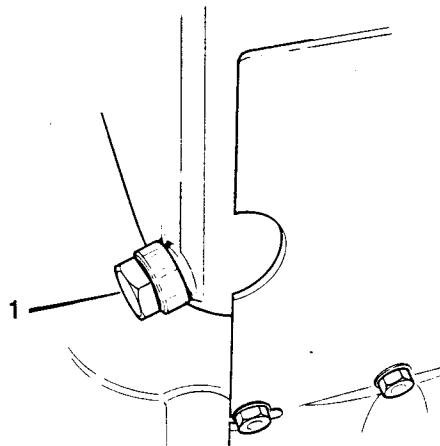


Fig B6.2

- (1) Refer to Fig B6.2. Place a container under the sump drain plug (1). The container must be capable of holding five litres of old oil.
- (2) Remove the oil filter cap ((2) on Fig B6.1).
- (3) Remove the drain plug (1) and allow all oil to drain from the engine.
- (4) Replace the drain plug, using a new copper gasket.
- (5) Change the oil filter (see paragraph below).
- (6) Refill with fresh oil and check the level as described in paragraph 4.
- (7) Run the engine and check for oil leaks at the filter and drain plug.

## CHANGING THE FILTER

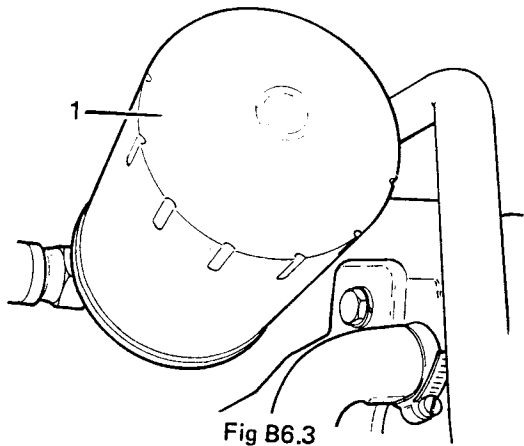


Fig B6.3

6. Refer to Fig B6.3. The filter (1) is located on the left hand side of the engine. Change the filter every 10 000 km or 6 months.

- (1) With the sump drained, unscrew the filter cannister.
- (2) Remove and discard the used filter.
- (3) Thoroughly clean the canister.
- (4) Lubricate the sealing washer of the new filter with engine oil.
- (5) Fit the new filter into the canister and screw the canister onto the engine.

## CARBURETTER HYDRAULIC DAMPERS

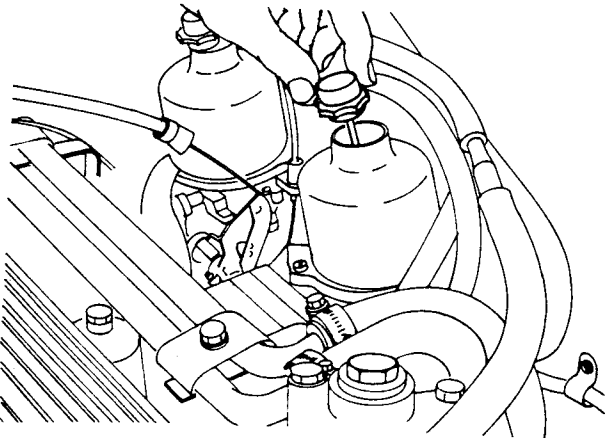


Fig B6.4

7. Refer to Fig B6.4. At first service (1 500 km) and every 10 000 km or 6 months thereafter unscrew the cap on top of the suction chamber and withdraw the hydraulic damper. Replenish the damper reservoir as necessary with SAE 20 oil to within about 12 mm from the top of the tube. Replace the cap and damper.

## CLEANING THE ENGINE

8. It is essential that the external parts of the engine are kept clean. Several methods of cleaning can be used and the choice of method depends on the facilities available and the condition of the engine. Dust can be removed with compressed air. The best method of cleaning, especially if oil or grease are present is using a steam jet.

9. Oil and grease can also be removed using a commercial detergent. Allow time for the detergent to loosen the oil and grease and then wash off with water.

### NOTE

When washing the engine with water take care to protect the starter motor, alternator and all other electrical devices from water splash.

## FLYWHEEL HOUSING DRAIN PLUG

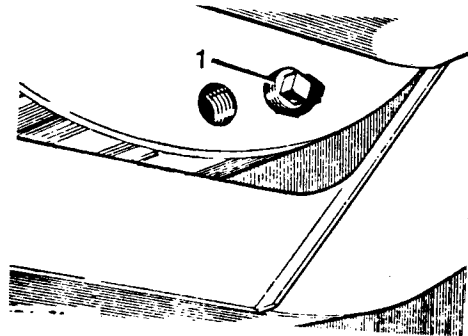


Fig B6.5

10. Refer to Fig B6.5. The flywheel housing can be completely sealed to exclude mud and water under severe wading conditions, by means of a plug (1) fitted in the bottom of the housing. The plug (1) is screwed into a hole adjacent to the drain hole and should only be fitted when the vehicle is expected to do wading or very muddy work.

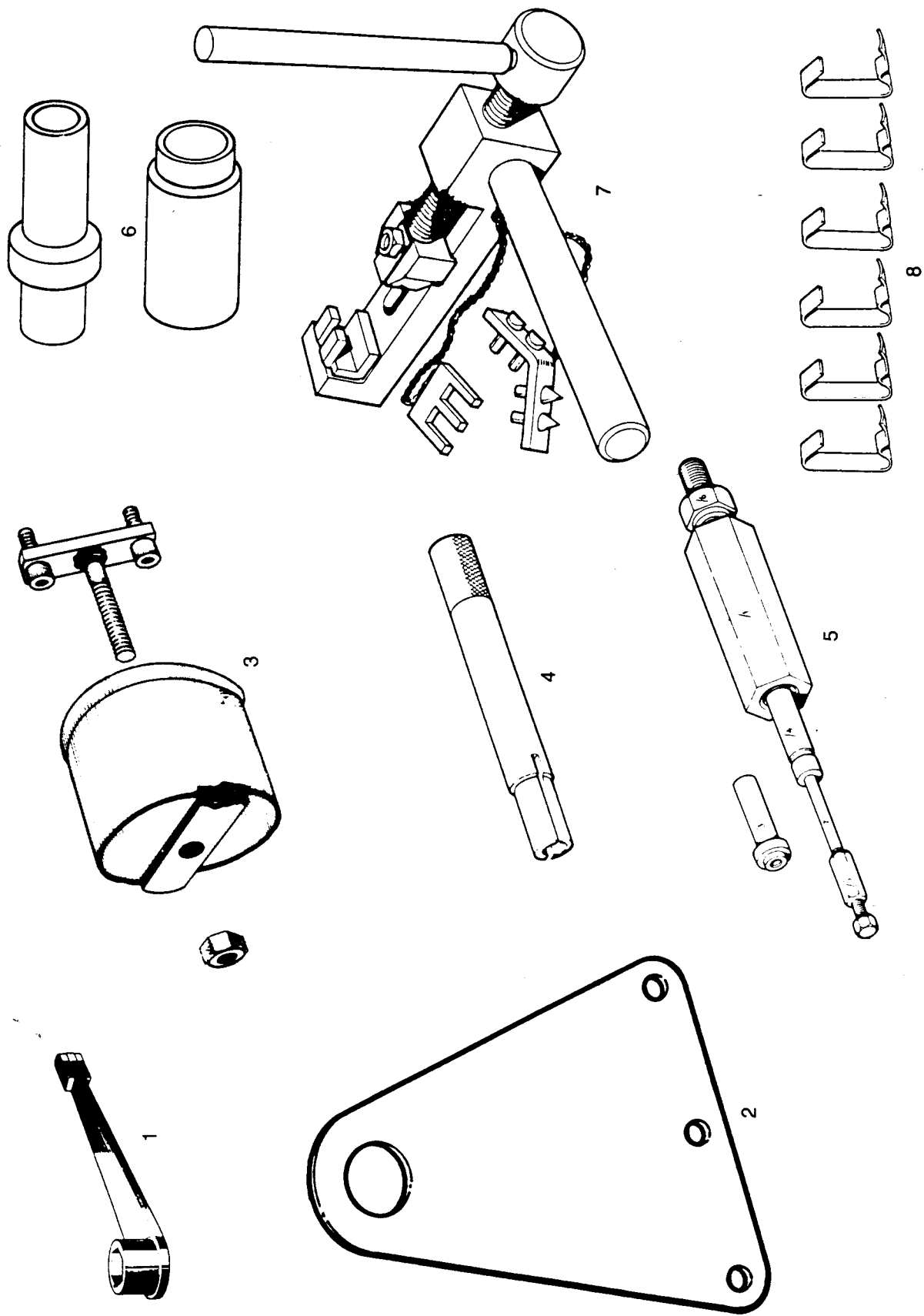
11. When the plug is in use it must be removed every 5 000 km or 3 months and all oil allowed to drain off before the plug is replaced.

**SUB - SECTION B7**

**SPECIAL WORKSHOP TOOLS**

**B7.1**

SPECIAL WORKSHOP TOOLS FOR SECTION B - POWER UNIT



SPECIAL WORKSHOP TOOLS FOR SECTION B - POWER UNIT

| Item Ref   | Mfr. Part No. & / or Drg.No. &/or Spec. No. | I. C. N. | Item Name and Description                                                                                                                                                                                                                                                                                                                                                                          | Items/ Unit   | Repair Lines       |
|------------|---------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|
| Item Verw. | Verv. Ond. Nr. & / of Tek.Nr. &/of Spes.Nr. | I. B. N. | Itemnaam en Beskrywing                                                                                                                                                                                                                                                                                                                                                                             | Items/ Eenhd. | Herstel Lyne 1 2 4 |
| 1          | 18G98A                                      |          | CRANKSHAFT NUT SPANNER for removing cranshaft nut<br>ENGINE LIFTING BRACKETS for use with double ended chain<br>REAR CRANKSHAFT OIL SEAL REPLACER for fitting oil seal<br>OIL PUMP DRIVE SHAFT remover and replacer<br>GUDGEON PIN remover and replacer<br>ADAPTOR for use with 18G1150<br>TIMING CHAIN LINK remover and replacer<br>TAPPET RETAINING CLIPS for use when removing camshaft carrier |               |                    |
| 2          | 18GA041                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 3          | 18GA044                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 4          | 18G1147                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 5          | 18G1150                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 6          | 18G1150D                                    |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 7          | 18G1151                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |
| 8          | 18G1218                                     |          |                                                                                                                                                                                                                                                                                                                                                                                                    |               |                    |

**SECTION CONTENTS LIST**

**SECTION C**

**FUEL SYSTEM**

| <b>SUB-SECTION</b> | <b>DESCRIPTION</b>                    | <b>PAGE</b> |
|--------------------|---------------------------------------|-------------|
| C1                 | DESCRIPTION AND SPECIFICATIONS        | C1.1        |
| C2                 | FAULT DIAGNOSIS AND CORRECTIVE ACTION | C2.1        |
| C3                 | CARBURETTERS - TUNE AND ADJUST        | C3.1        |
| C4                 | REMOVAL AND REPLACEMENT PROCEDURES    | C4.1        |
| C5                 | OVERHAUL PROCEDURES                   | C5.1        |
| C6                 | MAINTENANCE                           | C6.1        |

SUB-SECTION CONTENTS LIST

SUB-SECTION C1

DESCRIPTION AND SPECIFICATIONS

| CHAPTER | DESCRIPTION                    | PAGE |
|---------|--------------------------------|------|
| 1       | DESCRIPTION OF THE FUEL SYSTEM | C1.3 |
| 2       | SPECIFICATIONS                 | C1.4 |



## SUB-SECTION C1

### CHAPTER 1

#### DESCRIPTION OF THE FUEL SYSTEM

##### INTRODUCTION

1. The fuel system consists of a fuel tank, an electric fuel pump, a separate filter and the carburetters. The recommended fuel for the system is Premium grade (coast 93 octane, high altitude 98 octane).

##### TANK

2. The 90 litre fuel tank is mounted at the rear of the vehicle underneath the load area. It incorporates an electrically operated gauge unit connected to an instrument panel meter. The meter gives a constant indication of the amount of fuel in the tank.
3. The filler tube has an anti theft device which prevents removal of fuel by syphoning.

##### PUMP AND FILTER

4. The tank feeds fuel to a vertically mounted Facit fuel pump. This is an electrically operated type which runs immediately the ignition is switched on.

5. The outlet pipe feeds fuel to a separate filter mounted on the rear wall of the engine compartment. The filter has a reusable element which is accessible when the filter body is removed.

##### CARBURETTERS

6. Twin SU HIF6 carburetters are fitted to the inlet manifold, each carburetter feeding three cylinders. The carburetters are of the semi downdraught type. They receive fuel from the filter and air from the air cleaner via an intake box.
7. As the throttle is opened, progressively greater amounts of fuel and air are metered into the engine, thereby increasing engine speed. A manually operated choke is fitted which greatly increases the fuel supply to provide a richer mixture for cold starting.
8. The two carburetters must be balanced to ensure an even metering of fuel to all cylinders and optimum performance of the engine.

SUB-SECTION C1

CHAPTER 2

SPECIFICATIONS

INTRODUCTION

1. General data for the fuel system is given in Table C1.1. These are no torque specifications for the fuel system other than for the carburetter fixings to the inlet manifold studs. This specification is given in Table B1.2.

TABLE C1.1 - GENERAL DATA

| ITEM                            | DESCRIPTION                      |
|---------------------------------|----------------------------------|
| Carburetter — make .....        | S.U. Twin HIF 6                  |
| — type .....                    | 10 <sup>0</sup> semi-downdraught |
| — choke size .....              | 44,45 mm                         |
| — needle .....                  | BCP                              |
| — spring colour .....           | Red                              |
| — jet size .....                | 2,54 mm                          |
| — damper oil .....              | SAE 20 or 20/30 Multigrade       |
| Carburetter — float level ..... | 0,5—1,5 mm                       |
| Air cleaner-type .....          | Donaldson Cyclopac               |
| Fuel pump-type .....            | Electric-Facit                   |
| Recommended octane rating ..... | 93 (coast), 98 (highveld)        |
| Maximum C.O. at idle .....      | 3-4%                             |

SUB-SECTION C2

FAULT DIAGNOSIS AND CORRECTIVE ACTION

INTRODUCTION

1. This Sub-section deals with fault diagnosis and corrective action for the fuel system. In Table C2.1, a list of symptoms, the probable cause and the necessary action is given. It should be noted that the Table is not exhaustive and faults may occur which are not listed. Should the Table fail to give an indication of a fault, the suspected components should be removed for closer inspection and/or overhaul.

TABLE C2.1 - FUEL SYSTEM FAULT DIAGNOSIS CHART

| SYMPTOM                      | POSSIBLE CAUSE                                                                                                                                                           | REMEDY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Difficult starting when cold | Insufficient choke action.<br><br>Fast idle adjustment incorrect.<br><br>Float chamber level too low.<br><br>Carburettor flooding.<br><br>No fuel supply to carburettor. | Check action of cold start unit to ensure that the choke is being applied fully - adjust choke cable.<br>Check and adjust fast idle setting. Check linkage between choke and throttle for distortion.<br>Check needle valve for sticking - (closed). Check float level setting. Check inlet connection filter for blockage. Check external fuel system in accordance with fuel system fault diagnosis.<br>Check needle valve for sticking - (open).<br>Float punctured.<br>Fuel pump pressure too high.<br>Float level too high.<br>Check filters and pump for blockage.<br>Check fuel tank breather and fuel lines for blockage.<br>Remove fuel pump and check operation.<br>Overhaul or fit new pump. |
| Difficult starting when hot  | Choke sticking 'on'.<br><br>Blocked air cleaner.<br><br>Float chamber level too high.                                                                                    | Check to ensure choke is returning to fully 'off' position, reset as necessary.<br>Fit new air cleaner elements, (check indicator).<br>Check float level setting.<br>Check float arms for distortion. Check needle valve for sticking. Punctured float, fuel pump pressure too high.                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Lack of engine power         | Piston sticking.<br><br>Water in fuel.                                                                                                                                   | Check piston assembly moves freely and returns under spring load - centre jet assembly.<br>Check diaphragm for cracks or porosity.<br>If water is present in float chamber, the complete fuel system should be drained, fuel components should be                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

|                                   |                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |                                                                                                                                                                                                           | dismantled, inspected for contamination, paying particular attention to filters.                                                                                                                                                                                                                                                                                                                            |
| Erractic slow-running or stalling | Float level too low.<br><br>Incorrect jet setting.<br><br>Carburettor air leaks.<br><br>Manifold air leaks.                                                                                               | Check float chamber level. Check for needle valve sticking. Check and reset jet settings in accordance with carburettor overhaul instructions. Check throttle spindle and bearings for wear. Check inlet manifold gasket for leakage. Check inlet manifold for cracks and distortion of mating faces. Check gasket between carburettor and manifold. Check condition of vacuum servo pipes and connections. |
| Excessive fuel consumption        | Blocked air cleaner.<br><br>Damper oil too thick. Incorrectly adjusted carburettor.<br><br>Float level too high. Worn jets and needle.<br><br>Incorrect needle. Choke sticking 'on'.<br><br>Engine fault. | Fit new air cleaner elements.<br><br>Replace with correct grade. Check and reset slow running in accordance with carburettor tune and adjust instructions. Check and reset float level. Check and replace as necessary. Check needle type. Check to ensure choke is returning to fully 'off' position, reset as necessary. See engine fault diagnosis.                                                      |

## SUB-SECTION C3

### CARBURETTERS - TUNE AND ADJUST

#### NOTE

Before servicing or tuning a carburettor in an endeavour to rectify poor engine performance, make sure that the maladjustment or fault is not from another source by first checking:

Valve clearance  
Spark plug condition  
Contact breaker (dwell angle)  
Ignition timing and advance  
Presence of air leaks into the induction system

#### 1. To tune the carburetters:

- (1) Remove the bonnet (see Sub-section M3, Chapter 1).

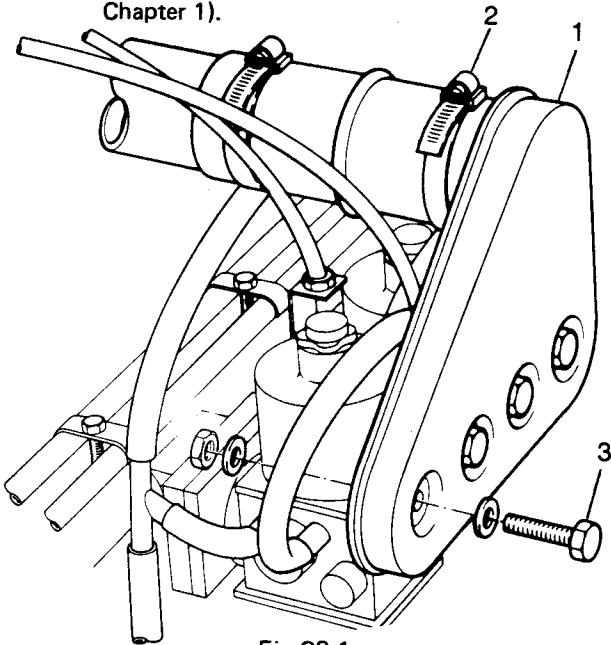


Fig C3.1

- (2) Refer to Fig C3.1. Remove the air intake box (1) by disconnecting the air inlet hose (2) and removing the four bolts (3) holding the box to the carburetters. (The bolts have loose nuts and washers behind the box).
- (3) Check the throttle for correct operation and free movement with no signs of sticking.

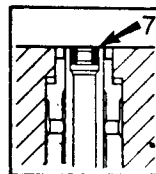
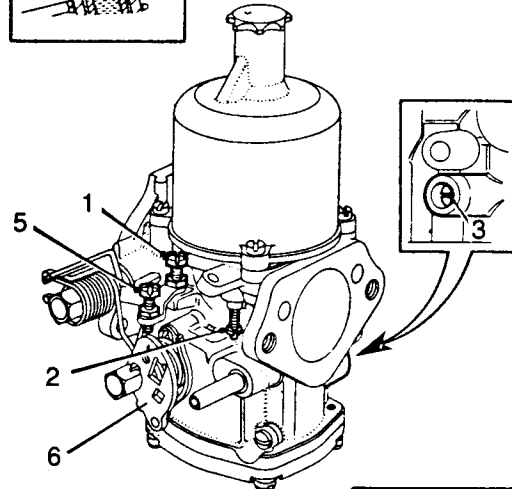
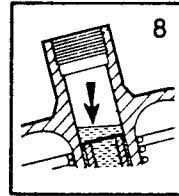
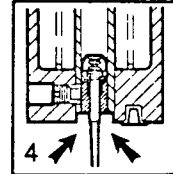


Fig C3.2



- (4) Refer to Fig C3.2. Unscrew the throttle adjusting screws (1) until they are just clear of the throttle lever with the throttle closed, then turn the screws (1) clockwise one turn on each.
- (5) Raise the piston of each carburettor with the lifting pin (2) and check that it falls freely onto the bridge when the pin is released. If the piston shows any tendency to stick, the carburettor must be serviced.
- (6) Lift and support the piston clear of the bridge so that the jet is visible; if this is not possible due to the installed position of the carburettor, remove the suction chamber assembly.
- (7) Turn the jet adjusting screw (3) anti-clockwise until the jet (7) is flush with the bridge without exceeding the bridge height. Ensure that the jets on multi-carburetters are in the same relative position to the bridge of their respective carburetters.
- (8) Check that the needle shank is flush with the underside of the piston (4).
- (9) Turn the jet adjusting screws (3) clockwise until jet is 2,5 mm below bridge (2 1/4 to 2 1/2 turns).
- (10) Turn the fast idle adjusting screws (5) anti-clockwise until they are well clear of the cam.

## SUB-SUB-SECTION K1.4

### CHAPTER 9

#### REAR WHEEL BRAKE CYLINDER - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove the rear brake cylinder:
  - (1) Remove the brake shoes (see Sub-sub-section K1.4, Chapter 6).
  - (2) Disconnect and seal off the brake fluid pipe.
  - (3) Remove the fixings and pull the cylinder away from the back plate.

##### REPLACEMENT

2. To replace the rear brake cylinder:
  - (1) Position the cylinder on the back plate and secure with the fixings.
  - (2) Reconnect the brake fluid pipe.
  - (3) Refit the brake shoes (see Sub-sub-section K1.4, Chapter 6).
  - (4) Bleed the brakes (see Sub-sub-section K1.6).

## **SUB-SUB-SECTION CONTENTS LIST**

### **SUB-SUB-SECTION K1.5**

#### **REPAIR, CLEANING AND OVERHAUL**

| <b>CHAPTER</b> | <b>DESCRIPTION</b>                     | <b>PAGE</b> |
|----------------|----------------------------------------|-------------|
| 1              | BRAKE FAILURE SWITCH - OVERHAUL        | K1.27       |
| 2              | MASTER CYLINDER - OVERHAUL             | K1.29       |
| 3              | BRAKE LININGS - REFITTING              | K1.31       |
| 4              | SERVO ASSEMBLY - OVERHAUL              | K1.32       |
| 5              | FRONT WHEEL BRAKE CYLINDERS - OVERHAUL | K1.33       |
| 6              | REAR WHEEL BRAKE CYLINDERS - OVERHAUL  | K1.34       |

## SUB-SUB-SECTION K1.5

### CHAPTER 1

#### BRAKE FAILURE SWITCH - OVERHAUL

##### DISMANTLING

1. Remove the brake failure switch (see Sub-sub-section K1.4, Chapter 1).
2. Dismantle the unit as follows:

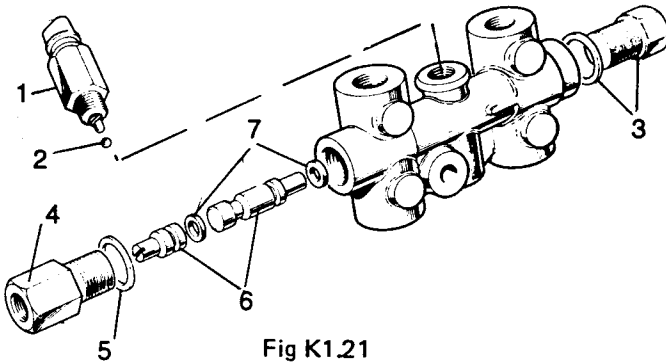


Fig K1.21

- (1) Refer to Fig K1.21. Remove the switch unit (1) from the housing.
- (2) Withdraw the plunger ball (2).
- (3) Remove the end plug and sealing washer (3).
- (4) Remove the pipe connector union (4) and sealing washer (5).
- (5) Push out the two-part shuttle valve (6) using a soft drift.
- (6) Remove and discard the shuttle valve oil seals (7).

##### INSPECTING

3. Carry out the following inspection on the components:
  - (1) Clean the shuttle valve, end plug, pipe union and five-way connector, using new brake fluid or ethyl alcohol.
  - (2) Examine the shuttle valve and its bore in the five-way connector. They must be in perfect condition with no signs of scratches or corrosion, otherwise fit a new switch complete.
  - (3) To test the electrical switch, reconnect the leads and actuate the switch plunger by pressing it against an earthing point on the vehicle. The BRAKE light should go out.

##### REASSEMBLY

4. To reassemble the brake failure switch:



Fig K1.22

- (1) Refer to Fig K1.22. If the plunger spring (1) is dislodged, refit with the small coil of the spring toward the switch unit threads.
- (2) Position the plunger spring 4 mm approximately from the plunger end (2).

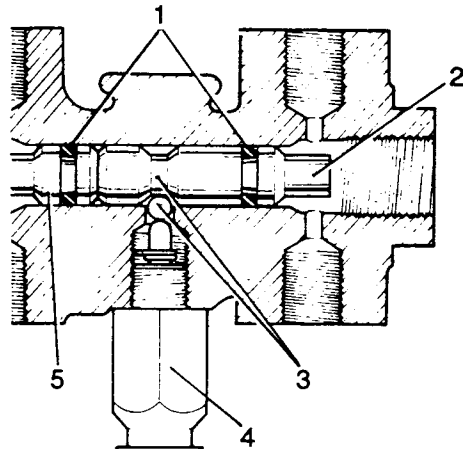


Fig K1.23

- (3) Refer to Fig K1.23. Fit new shuttle valve seals (1).
- (4) Coat the seals with Girling brake lubricant or clean brake fluid.
- (5) Fit the longer shuttle valve (2), slotted end last, to the end plug end of the housing bore.
- (6) Position the shuttle valve to align the groove for the plunger ball with the drilling for the ball (3).
- (7) Fit the ball and switch unit (4). Torque loading 1,728 N.m.
- (8) Fit the shorter shuttle valve (5) slotted end last to the pipe connector end of the housing bore.
- (9) Replace the pipe connector union ((4) on Fig K1.21) using a new sealing washer ((5) on Fig K1.21). Torque to 22 N.m.



(10) Replace end plug ((3) on Fig K1.21) using a new sealing washer. Torque to 22 N.m.

5. Replace the switch assembly (see Sub-sub-section K1.4, Chapter 1).

## SUB-SUB-SECTION K1.5

### CHAPTER 2

#### MASTER CYLINDER - OVERHAUL

##### DISMANTLING

1. Remove the master cylinder (see Sub-sub-section K1.4, Chapter 3).
2. Dismantle as follows:
  - (1) Withdraw retaining pins and withdraw the fluid reservoir.

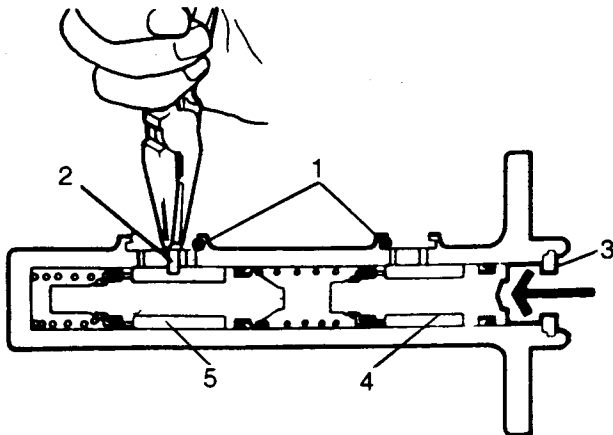


Fig K1.24

- (2) Refer to Fig K1.24. Lever out seals (1).
- (3) Push the plunger fully down the cylinder bore and withdraw secondary plunger stop pin (2).
- (4) Remove the circlip (3) and withdraw the primary plunger assembly (4).
- (5) Tap the cylinder on a soft or wooden surface to remove the secondary plunger assembly (5).
- (6) Remove the secondary plunger spring seal retainer, recuperating seal and washer. Keep the plunger and its spring together at all times.
- (7) Remove seal from the plunger.
- (8) Remove the primary plunger spring, seal retainer, recuperating seal and washer. Keep the plunger and its spring together at all times.
- (9) Remove the seal from the plunger.

##### INSPECTING

3. Inspect as follows:
  - (1) Clean all components in Girling cleaning fluid and allow to dry.

- (2) Examine the cylinder bore and pistons; ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is doubt, fit new replacements.

- (3) The seals should be replaced. These items are included in the master cylinder overhaul kit.

##### REASSEMBLY - (USING SERVICE KIT)

4. To reassemble the master cylinder:

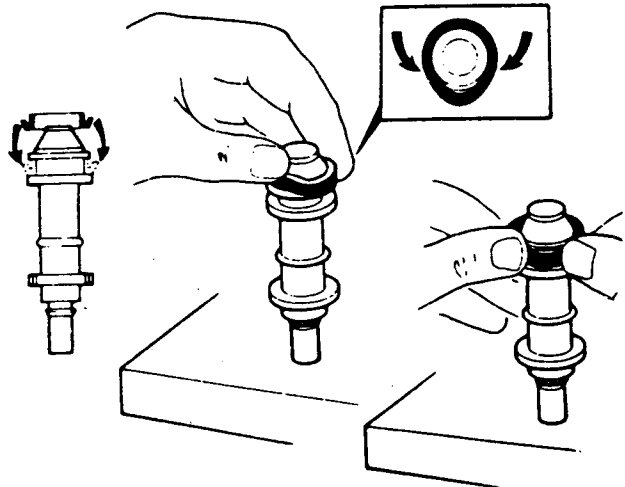


Fig K1.25

- (1) Refer to Fig K1.25. Fit a new seal (1) into the groove in the secondary plunger, as follows: Squeeze the seal into an ellipse then press the raised point of the seal over the flange.

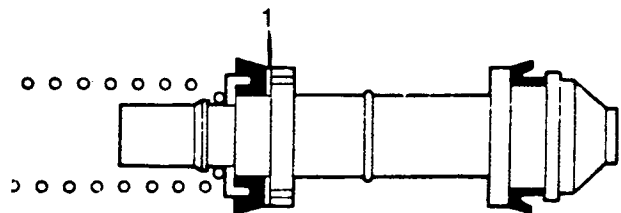


Fig K1.26

- (2) Refer to Fig K1.26. Fit the washer (1), new recuperating seal and spring to the secondary plunger.

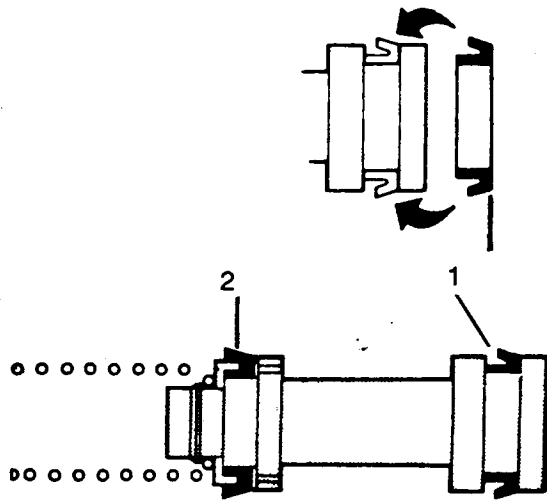


Fig K1.27

- (3) Refer to Fig K1.27. Fit the seal into the groove (1) in the primary plunger as described previously.
- (4) Fit the washer (2) new recuperating seal, seal retainer and primary spring. Ensure that the seals are fitted as illustrated.

**NOTE**

It is vital that the following instructions are carried out precisely and that generous amounts of unused brake fluid are used to lubricate the cylinder bore and plunger seals to prevent damage to the seals during assembly.

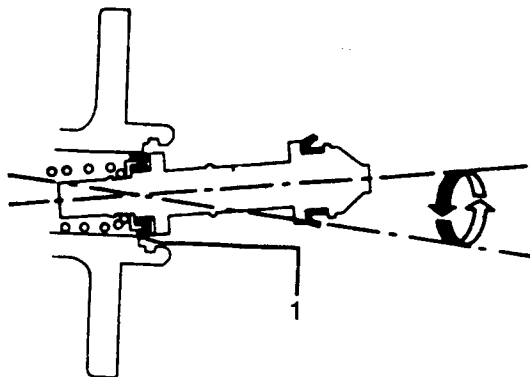


Fig K1.28

- (5) Refer to Fig K1.28. Clamp the cylinder in a bench vice, lubricate the secondary plunger seals (1) and the cylinder bore.
- (6) Offer the plunger assembly to the cylinder until the recuperation seal is resting centrally in the mouth of the bore. Then, ensuring that the seal does not become trapped, gently introduce the plunger with a circular rocking motion as illustrated to ease in the seal, then slowly push the plunger down the bore in one continuous movement.

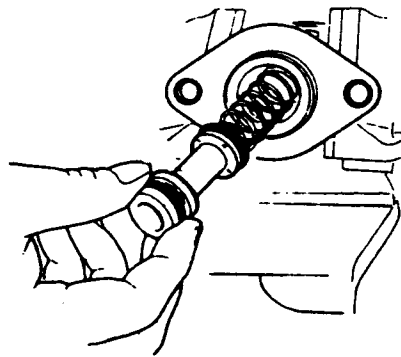


Fig K1.29

- (7) Refer to Fig K1.29. Repeat the lubricating and fitting procedure for the primary plunger assembly and fit the retaining circlip.

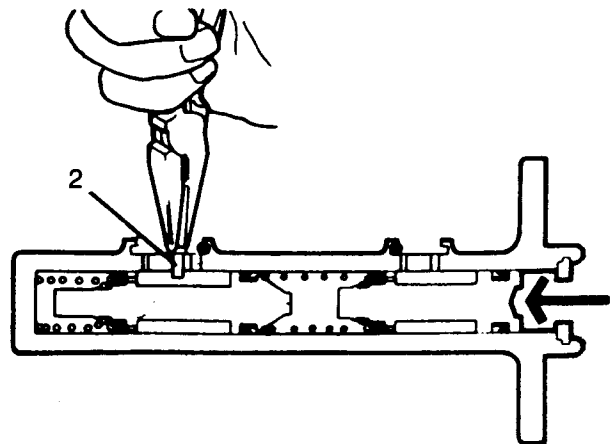


Fig K1.30

- (8) Refer to Fig K1.30. Using a clean screw driver, slowly press the plunger (arrowed) fully down the bore to enable the secondary plunger stop-pin (2) to be fitted in its correct position.
- (9) Lubricate new seals with unused brake fluid and fit one in each inlet port.
- (10) Lubricate the seals and press the fluid reservoir into position on the cylinder and secure with the retaining pins.
- (11) Refit the master cylinder (see Sub-section K1.4, Chapter 3).

## SUB-SUB-SECTION K1.5

### CHAPTER 3

#### BRAKE LININGS - REFITTING

##### REMOVAL

1. Remove the old brake linings:

- (1) Remove the brake shoes (see Sub-sub-section K1.4, Chapter 5 or 6).
- (2) Remove the old linings from the shoes by shearing the rivets.

(2) Then with all the rivets loosely fitted, fully secure, start peening from the centre again.

(3) Chamfer both ends of each lining (2).

(4) Replace the brake shoes (see Sub-sub-section K1.4, Chapter 5 or 6).

##### REFITTING

2. To refit new linings:

##### NOTE

Brake shoes fitting with bonded linings: If the shoes incorporate rivet holes, the bonded linings can be removed and rivetted linings can be fitted in their place. If the shoes are not pre-drilled, replacement shoe and lining assemblies must be fitted.

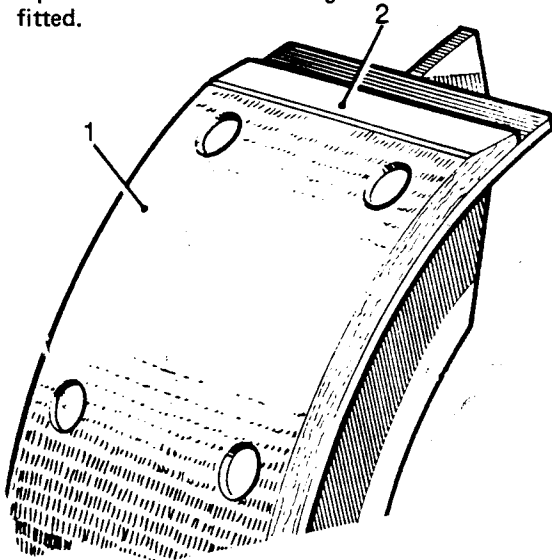


Fig K1.31

- (1) Refer to Fig K1.31. Attach the new linings to the shoes (1) commencing at the centre and working outwards, but only peen the rivets sufficiently to locate the linings.

## SUB-SUB-SECTION K1.5

### CHAPTER 4

#### SERVO ASSEMBLY - OVERHAUL

##### NOTE

The Supervac servo unit can be serviced with a kit that is available without completely dismantling the servo. In the event of the servo developing a major fault, the unit must be renewed.

##### DISMANTLING

1. First remove the servo assembly (see Sub-sub-section K1.4, Chapter 7).
2. Dismantle as follows:

##### CAUTION

*Do not attempt to remove or adjust the operating rod which is pre-set and locked at the manufacturers (see (6) on Fig K1.32).*

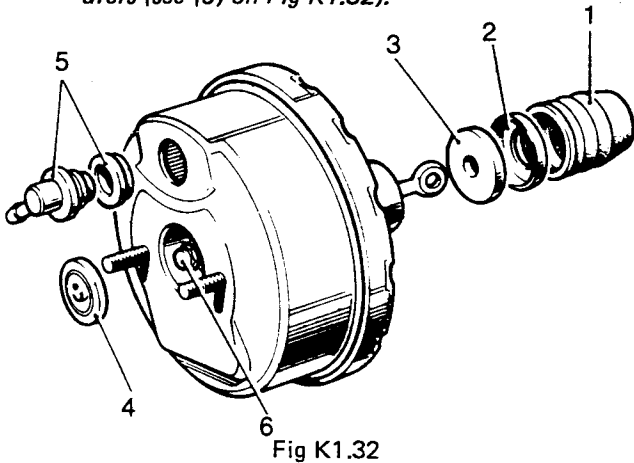


Fig K1.32

##### REASSEMBLY - (USING SERVICE KIT)

3. To reassemble the servo assembly:
  - (1) Lubricate the non-return valve grommet (5) with Girling Grease (64949009) and fit to the front shell.
  - (2) Fit the new non-return valve into the grommet.
  - (3) Smear the new seal and plate assembly (4) with Girling Grease (64949009) and press into the front shell, ensuring the plate faces inwards.
  - (4) Fit the new filter (3) into the neck of the diaphragm plate.
  - (5) Fit the new end cap (2).
  - (6) Locate the new dust cover (1) over the lugs of the rear shell.

- (1) Refer to Fig K1.32. Pull back the dust cover (1).
- (2) Remove the end cap (2).
- (3) Withdraw the filter (3).
- (4) Remove the seal plate assembly (4) from the front shell recess.
- (5) Remove the non-return valve and grommet (5).

## SUB-SUB-SECTION K1.5

### CHAPTER 5

#### FRONT WHEEL BRAKE CYLINDERS - OVERHAUL

##### NOTE

A wheel cylinder overhaul kit is available and the components in the kit must be used to replace the old components on overhaul.

##### DISMANTLING

##### 1. To dismantle the cylinder:

- (1) Remove the brake cylinder (see Sub-sub-section K1.4, Chapter 8).

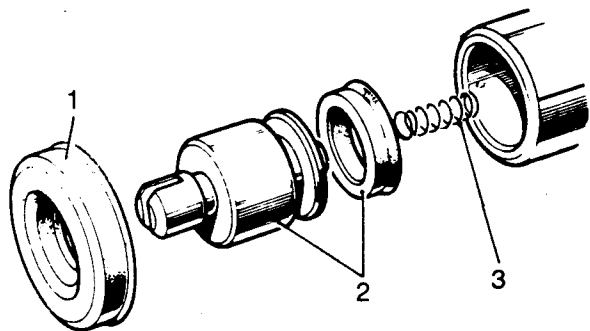


Fig K1.33

- (2) Refer to Fig K1.33. Withdraw the dust cover (1).
- (3) Withdraw the piston and seal (2).
- (4) Withdraw the spring (3).

##### INSPECTING

##### 2. Inspect as follows:

- (1) Clean all components using Girling cleaning fluid and allow to dry.
- (2) Inspect the cylinder bore and piston for corrosion, scores and wear. If any component is unsatisfactory, replace the wheel cylinder assembly complete.

##### REASSEMBLY

##### 3. Reassemble the cylinder as follows:

##### NOTE

Use new seals and dust covers from the wheel cylinder overhaul kit.

- (1) Lubricate the components using the recommended Girling brake fluid.

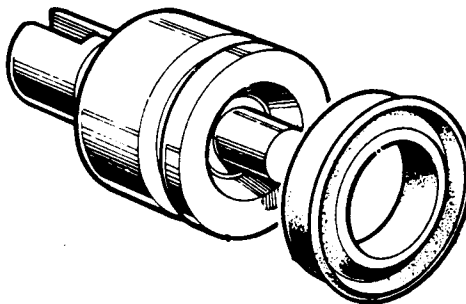


Fig K1.34

- (2) Refer to Fig K1.34. Refit the spring, seal and piston. Fit the piston seal with the lipped side away from the slotted end.
- (3) Fit a new dust cover.
- (4) Replace the brake cylinder (see Sub-sub-section K1.4, Chapter 8).

## SUB-SUB-SECTION K1.5

### CHAPTER 6

#### REAR WHEEL BRAKE CYLINDER - OVERHAUL

##### NOTE

A wheel cylinder overhaul kit is available and the new seals and dust covers contained in the kit must be used in place of the old ones.

##### DISMANTLING

1. To dismantle a rear wheel brake cylinder:

- (1) Remove the cylinder (see Sub-sub-section K1.4, Chapter 9).

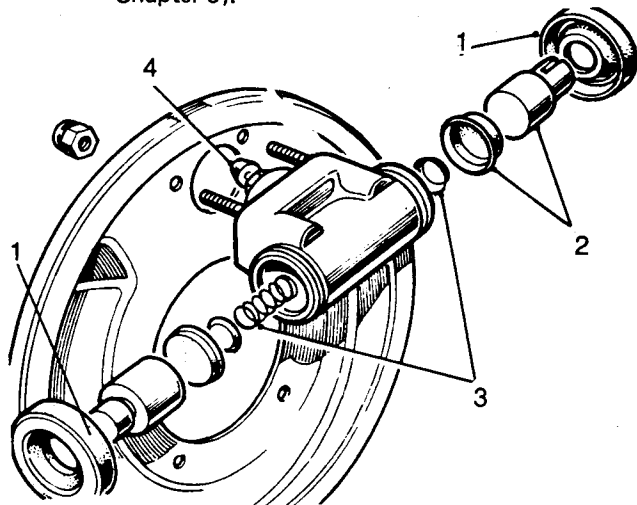


Fig K1.35

- (2) Refer to Fig K1.35. Withdraw the dust covers (1).
- (3) Withdraw the pistons and seals (2).
- (4) Withdraw the spring and seal supports (3).
- (5) Remove the bleed screw (4).

##### INSPECTING

2. Inspect the components:

- (1) Clean all components using Girling cleaning fluid and allow to dry.
- (2) Inspect the cylinder bore and piston for corrosion, scores and wear. If any components are unsatisfactory, replace the wheel cylinder assembly complete.

##### REASSEMBLY

3. Reassemble the cylinder as follows:

- (1) Lubricate the components, using the recommended Girling brake fluid.

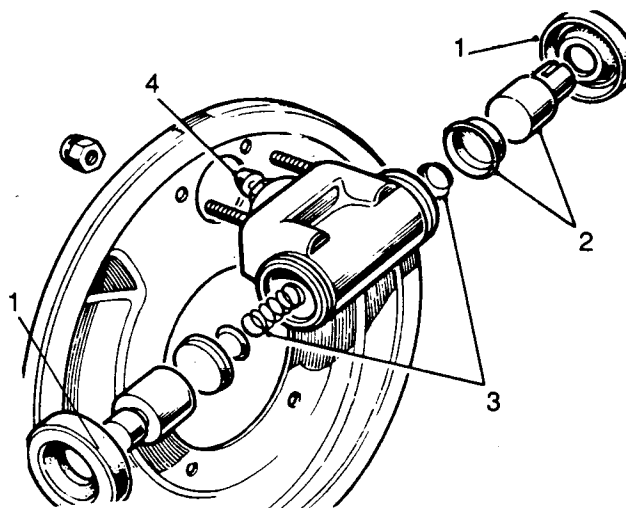


Fig K1.36

- (2) Refer to Fig K1.36. Replace the spring and seal supports (3).
- (3) Refit the pistons and new seals (2). Fit the piston seal with the lipped side away from the slotted end.
- (4) Replace the dust covers (1).
- (5) Fit the bleed screw and tighten to 5 to 8 N.m. Do not overtighten.
- (6) Replace the cylinder (see Sub-sub-section K1.4, Chapter 9).

## SUB-SUB-SECTION K1.6

### MAINTENANCE

#### INTRODUCTION

1. Maintenance of the road wheel brakes is only required when operation of the brakes indicates a fault such as spongy action, long pedal travel before the brakes are applied, etc. Periodic checks on the efficiency of the brakes should be made and the brakes adjusted (see Sub-sub-section K1.3) or bled (see below).
2. The back plate should be cleaned and examined at regular intervals for oil leaks which may indicate oil on the brake linings and impair brake efficiency.

#### BLEEDING THE BRAKE SYSTEM

##### NOTES

1. Use only new supplies of the recommended brake hydraulic fluid.
2. Keep the fluid reservoir topped up during bleeding.
3. Where the complete hydraulic system is to be filled, it is advantageous to first charge the system, to each bleed point in turn, before attempting to expel all air from the system.
4. Observe strict cleanliness precautions to prevent foreign matter from entering the hydraulic system.

##### Isolating Local Air Pockets

3. Use of Girling Brake Service Hose Clamp considerably facilitates the location of air in the system, therefore saving time by locating the hydraulic fault, and saving fluid when servicing the wheel cylinders. To isolate an air pocket:

##### CAUTION

*Providing the brake hose is in reasonable condition, damage cannot be caused using the hose clamp, but the use of other tools to clamp the hoses is not recommended as damage may be caused internally to the hose without it being noticed externally.*

- (1) With clamps fitted on the two front and one rear hose the pedal action should be perfect with no indication of 'sponginess'. If under these circumstances a spongy pedal is apparent, a new or overhauled master cylinder assembly must be fitted and bled and the test repeated.
- (2) If perfect pedal action is obtained with the three hose clamps in position, remove the rear clamp and if the pedal is spongy, the air must be in the rear cylinders. However, if the pedal action is good remove first one then the other of the two front clamps, repeating the test until the air is located.

#### Bleeding Procedure

4. For wheel cylinder servicing, only the appropriate hose need be clamped. This keeps the loss of fluid to a minimum and after the service is satisfactorily completed, only the affected parts require bleeding. To bleed the brake system:

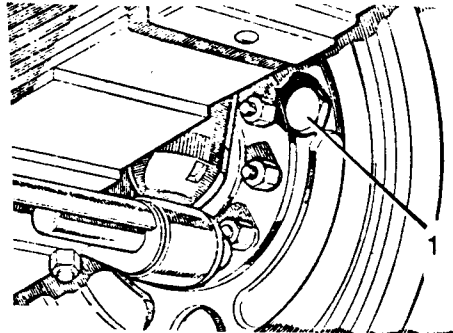


Fig K1.37

- (1) Refer to Fig K1.37. Slacken off the brake shoe adjusters (1) on each wheel to minimise wheel cylinder volume.

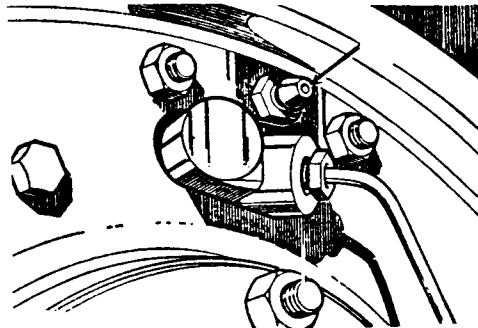


Fig K1.38

- (2) Refer to Fig K1.38. Attach a bleed tube to the bleed nipple farthest from the master cylinder. Submerge the tube free end in brake fluid in a transparent container.
- (3) Slacken the bleed nipple a half-turn.

##### NOTE

On dual braking systems only, do not use full pedal travel as this may decentralise the shuttle valve plunger in the brake failure switch. Operate the pedal slowly. If during the bleeding procedure the plunger operates the switch and the warning light is on, the bleedscrew must be closed and the bleedscrew at the other end of the vehicle opened (if bleeding the front brakes, open a bleedscrew on a rear brake and vice versa).



- (4) A steady pressure must then be applied to the pedal until the light goes out, then the pressure must be released immediately and the bleed-screw closed, otherwise the piston will move too far in the opposite direction and require resetting again.
- (5) Repeat the procedure until fluid discharged from the bleed tube is free of air, then tighten the bleed nipple during a pedal downstroke.
- (6) Repeat the procedure on the remaining wheels, commencing and continuing at the next wheel farthest from the master cylinder.
- (7) Adjust the brakes (see Sub-sub-section K1.3).
- (8) If the system is fitted with servo assistance: hold foot pressure on the brake pedal and start the engine. If the vacuum system is functioning correctly, the pedal will move towards the board. If no movement is felt, the vacuum system is not operating.

**SUB-SECTION CONTENTS LIST**

**SUB-SECTION K.2**

**TRANSMISSION BRAKE**

| <b>SUB-SUB-SECTION</b> | <b>DESCRIPTION</b>                       | <b>PAGE</b> |
|------------------------|------------------------------------------|-------------|
| K2.1                   | DESCRIPTION AND SPECIFICATIONS           | K2.3        |
| K2.2                   | FAULT DIAGNOSIS AND CORRECTIVE ACTION    | K2.9        |
| K2.3                   | TRANSMISSION BRAKE - ADJUSTING           | K2.11       |
| K2.4                   | REMOVAL AND REPLACEMENT PROCEDURES       | K2.13       |
| K2.5                   | TRANSMISSION BRAKE - CLEANING AND REPAIR | K2.23       |
| K2.6                   | MAINTENANCE                              | K2.25       |

**SUB-SUB-SECTION CONTENTS LIST**

**SUB-SUB-SECTION K2.1**

**DESCRIPTION AND SPECIFICATIONS**

| <b>CHAPTER</b> | <b>DESCRIPTION</b>                           | <b>PAGE</b> |
|----------------|----------------------------------------------|-------------|
| <b>1</b>       | <b>DESCRIPTION OF THE TRANSMISSION BRAKE</b> | <b>K2.5</b> |
| <b>2</b>       | <b>TRANSMISSION BRAKE SPECIFICATIONS</b>     | <b>K2.6</b> |

## **SUB-SUB-SECTION K2.1**

### **CHAPTER 1**

#### **DESCRIPTION OF THE TRANSMISSION BRAKE**

##### **INTRODUCTION**

1. The transmission brake is a normal type of drum brake operated only by mechanical linkage between the brake itself and the hand lever in the cab.
2. The brake drum is attached to the rear propeller shaft while the shoes are mounted on a back plate secured to the gearbox housing.

##### **OPERATION**

3. The drive from the gearbox passes coaxially through the brake shoes and turns not only the rear propeller shaft but the transmission brake drum as well. When the shoes are expanded by pulling the hand lever, the brake action prevents the propeller shaft and thus the rear wheels from turning. If four wheel drive is engaged the front propeller shaft is indirectly connected to the rear propeller shaft and in effect all four wheels are braked.

SUB-SUB-SECTION K2.1

CHAPTER 2

TRANSMISSION BRAKE SPECIFICATIONS

INTRODUCTION

1. The general data for the transmission brake are given in Table K2.1 below. No torque specifications are available for the transmission brake.

TABLE K2.1 - GENERAL DATA

| ITEM                        | DESCRIPTION                    |
|-----------------------------|--------------------------------|
| Drum diameter . . . . .     | 228,6 mm                       |
| Lining dimensions . . . . . | 209,55 mm x 44,45 mm x 4,74 mm |

**SUB-SUB-SECTION K2.2**

**FAULT DIAGNOSIS AND CORRECTIVE ACTION**

**INTRODUCTION**

1. This Sub-sub-section covers fault diagnosis and corrective action for the transmission brake. In Table K2.2 a list of symptoms, the probable cause and the recommended remedial action is given. The Table is not exhaustive and faults may occur which are not listed. Should the Table not indicate the fault, the suspected components should be removed for closer inspection and/or overhaul.

**TABLE K2.2 - TRANSMISSION BRAKE FAULT DIAGNOSIS CHART**

| <b>SYMPTOM</b>                                                        | <b>POSSIBLE CAUSE</b>                                                                                                    | <b>REMEDY</b>                                                                                   |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Brake not holding                                                     | Water soaked linings.<br>Incorrect or glazed linings.<br>Incorrect shoe adjustment.<br>Incorrect brake lever adjustment. | Dry out.<br>Replace linings.<br>Adjust brake.<br>Adjust lever.                                  |
| Brake drags                                                           | Incorrect shoe adjustment.<br>Seized shoe.<br>Weak pull-off springs.<br>Distorted drum.<br>Scored or cracked drum.       | Readjust shoes.<br>Overhaul brake.<br>Overhaul brake.<br>Skim or replace drum.<br>Replace drum. |
| NOTE: The brake drum may be skimmed to a maximum of 0,75 mm oversize. |                                                                                                                          |                                                                                                 |

## **SUB-SUB-SECTION K2.3**

### **TRANSMISSION BRAKE - ADJUSTING**

1. To adjust the brake: .
  - (1) Turn the adjuster cone fully in and tighten the fixings.
  - (2) Slacken off the adjuster cone two 'clicks'; give the brake a firm application to ensure that the shoes have centralised at the expander end. The brake drum should now be free to rotate.
  - (3) Set the hand brake linkage so that the hand brake has one or two clicks free movement in the off position.

**SUB-SUB-SECTION CONTENTS LIST**

**SUB-SUB-SECTION K2.4**

**REMOVAL AND REPLACEMENT PROCEDURES**

| <b>CHAPTER</b> | <b>DESCRIPTION</b>                                                         | <b>PAGE</b>  |
|----------------|----------------------------------------------------------------------------|--------------|
| <b>1</b>       | <b>TRANSMISSION BRAKE HAND LEVER AND LINKAGE - REMOVAL AND REPLACEMENT</b> | <b>K2.13</b> |
| <b>2</b>       | <b>TRANSMISSION BRAKE ASSEMBLY - REMOVAL AND REPLACEMENT</b>               | <b>K2.15</b> |



CHAPTER 1

TRANSMISSION BRAKE HAND LEVER AND LINKAGE -  
REMOVAL AND REPLACEMENT

REMOVAL

1. To remove the lever and linkage:

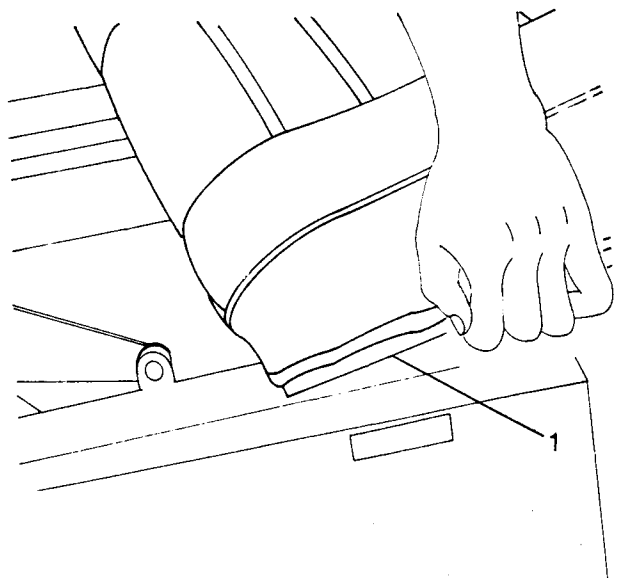


Fig K2.1

- (1) Refer to Fig K2.1. Remove the seat cushion and lid panel (1) from the seat base.

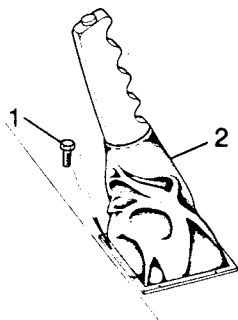


Fig K2.2

- (2) Refer to Fig K2.2. Remove the eight screws (1) retaining the leather dust cover (2) on the handbrake lever and remove the cover.

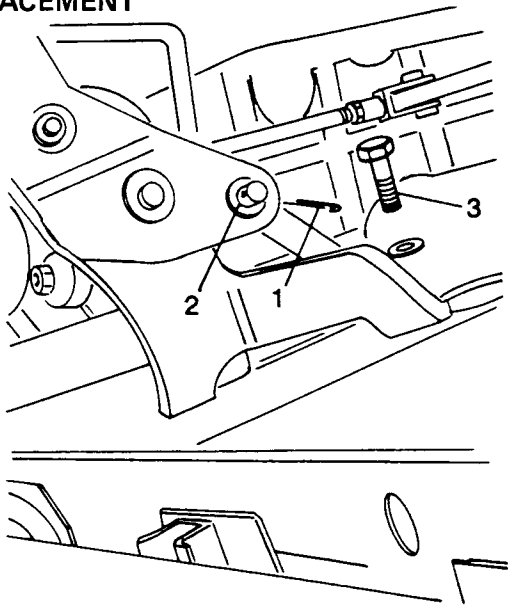


Fig K2.3

- (3) Refer to Fig K2.3. Disconnect the cable from the handbrake lever by removing the split pin (1) and clevis pin (2).
- (4) Remove the two (3) nuts and bolts holding the handbrake lever mounting to the seat base and remove the handbrake lever.

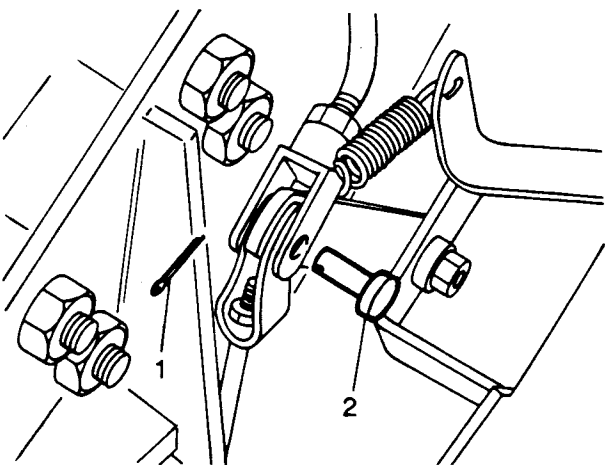


Fig K2.4

- (5) Refer to Fig K2.4. From underneath the vehicle disconnect the cable from the relay lever by removing the split pin (1) and clevis pin (2).
- (6) Remove the cable.

## REPLACEMENT

2. Replace the lever and linkage as follows:

- (1) Fig K2.4 still applies. Under the vehicle, connect the cable to the relay lever and secure with the clevis pin and a new split pin.
- (2) Fig K2.3 still applies. Replace the handbrake lever and secure the lever mounting to the seat base with the two bolts and nuts.
- (3) Connect the cable to the handbrake lever with the clevis pin and a new split pin.

(4) Adjust the cable to give two clicks on the ratchet when applying the handbrake.

(5) Fig K2.2 still applies. Replace the leather dust cover and the eight retaining screws.

(6) Replace the lid panel and the seat cushion.

## SUB-SUB-SECTION K2.4

### CHAPTER 2

#### TRANSMISSION BRAKE ASSEMBLY - REMOVAL AND REPLACEMENT

##### NOTE

To adjust the assembly or to fit new linings, it is not essential to remove the transmission brake from the vehicle. The brake shoe components are accessible after removing the brake drum which can be detached from the gearbox output flange and pushed back over the propeller shaft.

##### REMOVAL

1. To remove the transmission brake assembly:

- (1) Chock the road wheels.
- (2) Disconnect the rear propeller shaft from the transmission brake (see Sub-sub-section H4.3) and move the shaft aside.

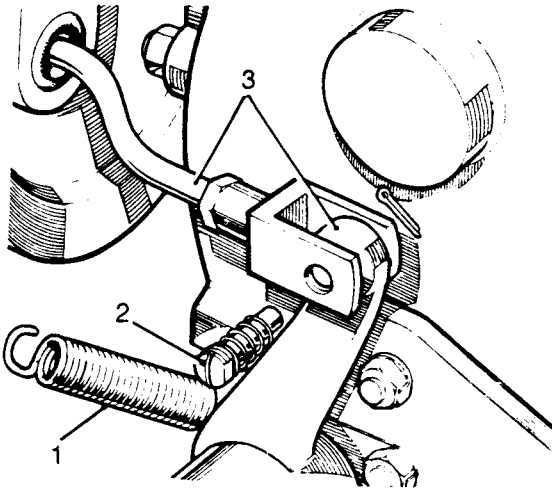


Fig K2.5

- (3) Refer to Fig K2.5. Disconnect the brake return spring (1).
- (4) Remove the expander rod fork fixings (2).
- (5) Disconnect the expander rod from the relay lever (3).

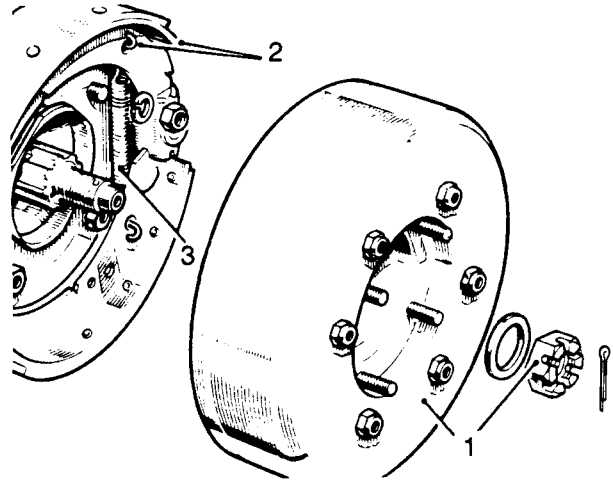


Fig K2.6

- (6) Refer to Fig K2.6. Remove the fixings and withdraw the brake drum (1).
- (7) Remove the brake shoes together with the pull-off springs (2).
- (8) Separate the shoes by detaching the springs (3).

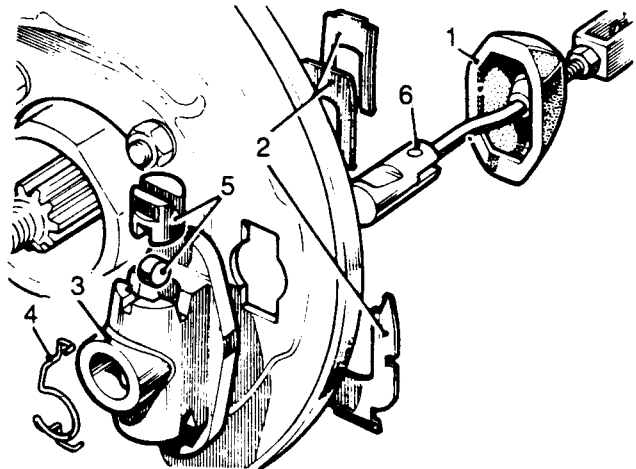


Fig K2.7

- (9) Refer to Fig K2.7. Withdraw the dust excluder (1).
- (10) Remove the expander unit fixing plates (2).
- (11) Withdraw the expander unit (3).
- (12) Remove the spring clip from the expander unit (4).
- (13) Withdraw the plungers and rollers (5).
- (14) Withdraw the operating rod (6).

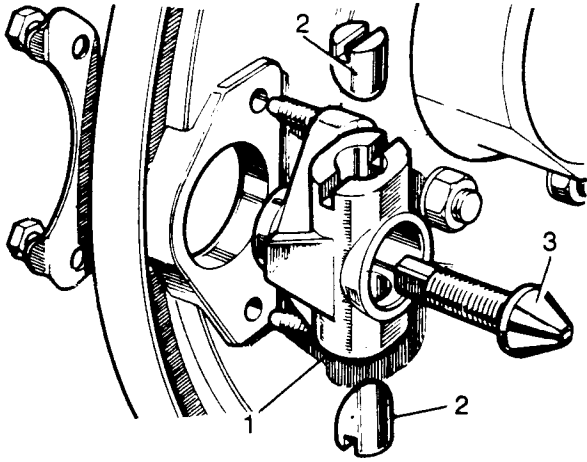


Fig K2.8

- (15) Refer to Fig K2.8. Remove the adjuster unit assembly (1).
- (16) Pull out the adjuster plungers (2).
- (17) Unscrew the adjuster cone (3).

#### REPLACEMENT

- 2. To replace the transmission brake assembly:

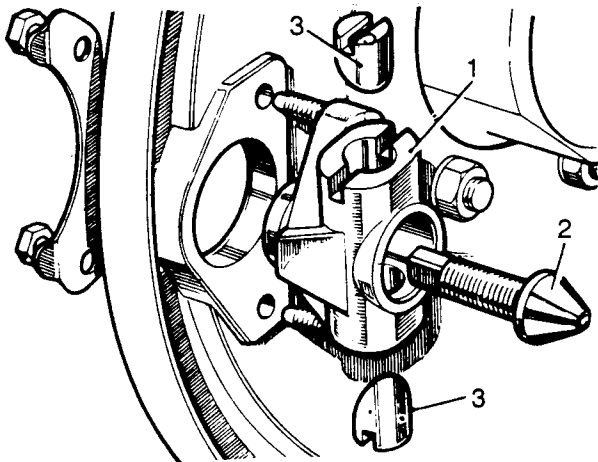


Fig K2.9

- (1) Refer to Fig K2.9. Fit the adjuster unit housing (1). Do not tighten the fixings at this stage.
- (2) Screw in the adjuster cone (2).
- (3) Grease and refit the adjuster plungers (3).

#### NOTE

The two plungers are identical and may be fitted to either bore. Align the chamfered ends of the plungers with the cone on the adjuster.

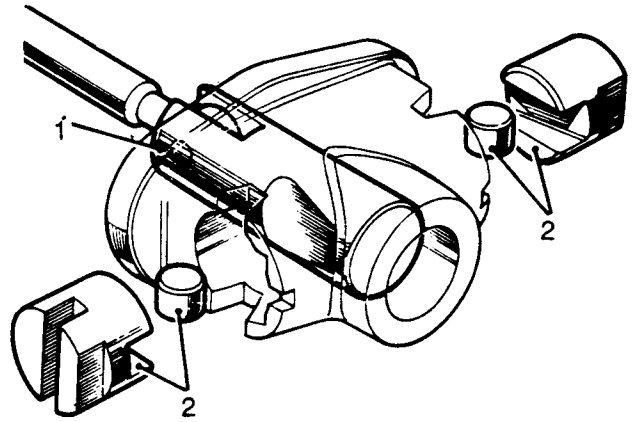


Fig K2.10

- (4) Refer to Fig K2.10. Grease and fit the expander rod (1).
- (5) Grease and fit the plungers and rollers (2).

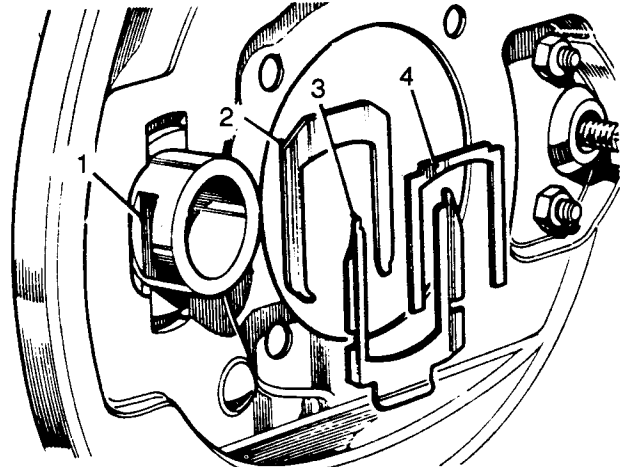


Fig K2.11

- (6) Refer to Fig K2.11. Position the adjuster housing (1) on the back plate.
- (7) Fit the packing piece (2).
- (8) Fit the locking plate (3).
- (9) Fit the retainer spring (4).

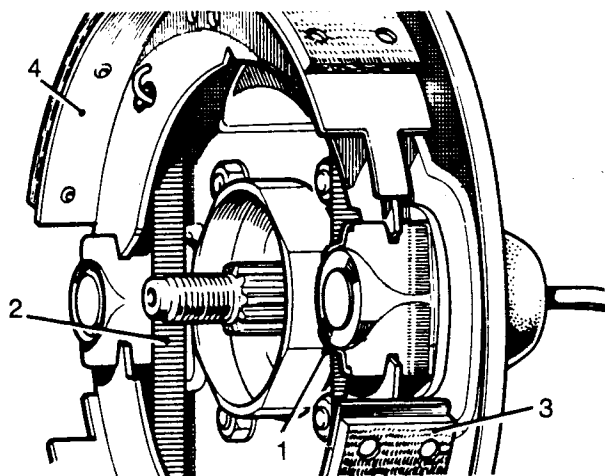


Fig K2.12

- (10) Refer to Fig K2.12. Fit the spring clip (1) to the expander unit.
- (11) Fit the brake shoes and pull-off springs together (2).
- (12) The fully lined end of the lower shoe (3) must be towards the expander housing.
- (13) The fully lined end of the upper shoe (4) must be towards the adjuster housing.
- (14) Replace the brake drum and secure with the washer and castellated nut. Fit a new split pin and spread the ends.

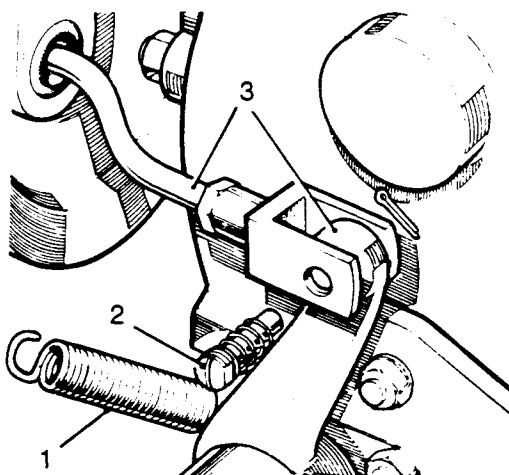


Fig K2.13

- (15) Refer to Fig K2.13. Fit the expander rod (3) to the relay lever.
- (16) Replace the expander rod fork fixings (2).
- (17) Connect the brake return spring (1).
- (18) Adjust the brake (see Sub-sub-section K2.3).
- (19) Remove the chocks under the road wheels.

## SUB-SUB-SECTION K2.5

### TRANSMISSION BRAKE - CLEANING AND REPAIR

1. Remove the brake assembly (see Sub-sub-section K2.4, Chapter 2).
2. Clean and inspect as follows:
  - (1) Clean all components in Girling cleaning fluid and allow to dry.
  - (2) Examine all items for obvious wear and replace as necessary.
  - (3) Examine the brake for scoring and ovality and skim if required. Standard diameter is 228,6 mm; reclamation limit is 0,75 mm oversize.
  - (4) If the brake linings are oily, check and if necessary replace the output shaft oil seal.
  - (5) If required, reline the brake shoes (see Sub-sub-section K1.5, Chapter 3).

## SUB-SUB-SECTION K2.6

### MAINTENANCE

#### INTRODUCTION

1. The transmission brake has been designed to give maintenance free operation, requiring only periodic inspection for obvious defects. At the specified intervals check the brake operation and adjust the shoes and linkage if necessary.
2. At frequent intervals, depending on operating conditions, the brake assembly should be cleaned to prevent the accumulation of mud, dirt, oil, etc. Oil should be wiped off with a clean cloth and a check made for oil leaks which may indicate a faulty output shaft oil seal.

SECTION CONTENTS LIST

SECTION L

STEERING SYSTEM

| SUB-SECTION | DESCRIPTION                           | PAGE |
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| L2          | FAULT DIAGNOSIS AND CORRECTIVE ACTION | L2.1 |
| L3          | ADJUSTMENTS                           | L3.1 |
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SUB-SECTION L1

DESCRIPTION AND SPECIFICATIONS

| CHAPTER | DESCRIPTION                        | PAGE |
|---------|------------------------------------|------|
| 1       | DESCRIPTION OF THE STEERING SYSTEM | L1.3 |
| 2       | STEERING SYSTEM SPECIFICATIONS     | L1.4 |

## SUB-SECTION L1

### CHAPTER 1

#### DESCRIPTION

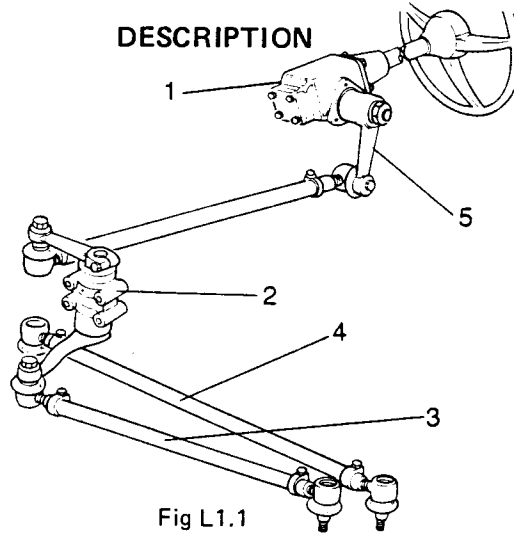


Fig L1.1

1. The steering system is a recirculating ball type operating through the steering box (1), a drop arm (5) and a relay unit (2) to a drag link (3). A track rod (4) connects the two front wheels through ball joints.
2. The steering requires 3,5 turns of the steering wheel from lock to lock.

SUB-SECTION L1

CHAPTER 2

STEERING SYSTEM SPECIFICATIONS

INTRODUCTION

1. The specifications are given in the following Tables:

TABLE L1.1 - GENERAL DATA  
TABLE L1.2 - TORQUE SPECIFICATIONS

The specifications in Table L1.1 apply with the vehicle in the static, unladen condition with coolant, oils and 22,7 litres of fuel and with the tyres at the recommended pressures:

TABLE L1.1 - GENERAL DATA

| ITEM                             | DESCRIPTION        |
|----------------------------------|--------------------|
| Type . . . . .                   | Recirculating ball |
| Ratio: Straight ahead . . . . .  | 15,6:1             |
| Full lock . . . . .              | 23,8:1             |
| Front wheel toe-in . . . . .     | 1,2 to 2,4 mm      |
| Camber angle . . . . .           | 1,5° positive      |
| Castor angle . . . . .           | 3°                 |
| Swivel pin inclination . . . . . | 7°                 |

TABLE L1.2 - TORQUE SPECIFICATIONS

| ITEM                                                    | TORQUE<br>(N.m) |
|---------------------------------------------------------|-----------------|
| Steering wheel nut . . . . .                            | 54              |
| Ball joint nuts . . . . .                               | 40              |
| Relay lever pinch bolts . . . . .                       | 76              |
| Steering box support bracket bolts . . . . .            | 70 to 85        |
| Steering box support bracket to chassis bolts . . . . . | 20              |
| Steering box drop arm nut . . . . .                     | 85 to 110       |

SUB-SUB-SECTION L2

FAULT DIAGNOSIS AND CORRECTIVE ACTION

INTRODUCTION

1. This Sub-sub-section deals with fault diagnosis and corrective action required for the steering system. In Table L2.1 a list of symptoms, the probable cause and the necessary remedies are given. If a fault is suspected, the faults listed in the Table should be consulted. It should be remembered that the Table is not exhaustive and faults may occur which are not listed. Should the Table fail to reveal the fault the suspected component(s) should be removed for a closer inspection and/or over-haul.

TABLE L2.1 - STEERING SYSTEM FAULT DIAGNOSIS CHART

| SYMPTOM                   | POSSIBLE CAUSE                                                                                                                                                                             | REMEDY                                                                                                                                                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Backlash in steering      | Worn or badly adjusted rocker shaft.<br>Worn or loose linkage.<br>Worn swivel hub assembly.<br>Worn or loose front wheel bearings.<br>Steering box loose on chassis.                       | Replace rocker shaft.<br>Tighten or replace.<br>Overhaul swivel pin housing.<br>Tighten or replace bearings.<br>Tighten box.                                                 |
| Tight steering            | Low or unequal tyre pressures.<br>Steering box oil level low.<br>Rocker shaft adjusted too tightly.<br>Inner column binding.<br>Seized ball joint.<br>Relay unit damaged or oil level low. | Check pressures and adjust.<br>Replenish to correct level.<br>Readjust rocker shaft.<br>Clean and lubricate.<br>Replace ball joint.<br>Replenish oil or overhaul relay unit. |
| Rattle in steering column | Rocker shaft worn or badly adjusted.                                                                                                                                                       | Check rocker shaft and replace or readjust.                                                                                                                                  |

SUB-SECTION CONTENTS LIST

SUB-SECTION L3

ADJUSTMENTS

| CHAPTER | DESCRIPTION              | PAGE |
|---------|--------------------------|------|
| 1       | STEERING BOX ADJUSTMENTS | L3.3 |
| 2       | STEERING GEOMETRY        | L3.4 |
| 3       | LOCKSTOPS                | L3.5 |
| 4       | FRONT WHEEL ALIGNMENT    | L3.6 |

## SUB-SECTION L3

### CHAPTER 1

#### STEERING BOX ADJUSTMENTS

1. To adjust for steering wheel backlash:

(1) Set the steering in the straight ahead position.

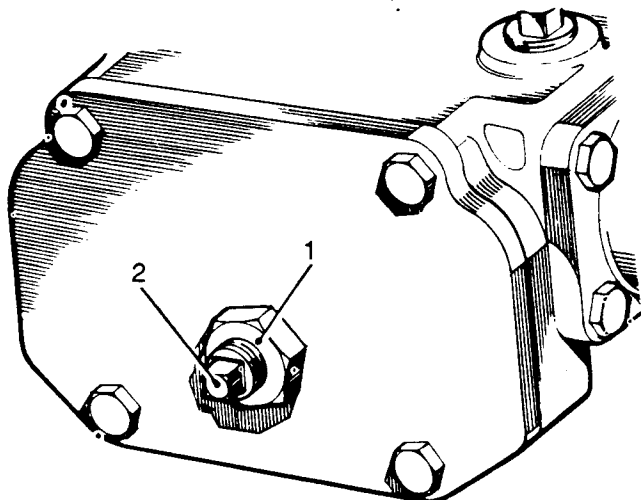


Fig L3.1

(2) Refer to Fig L3.1. Slacken the lock nut (1) and adjuster (2).

(3) Screw in the adjuster (2) until steering wheel backlash is taken up.

(4) Screw in a further one-half flat (maximum) to allow for lock nut (1) tightening.

(5) Tighten the lock nut without disturbing the adjuster (2).

## SUB-SECTION L3

### CHAPTER 2

#### STEERING GEOMETRY

1. No adjustment is provided for castor, camber or swivel pin inclination. However, the following applies to the steering system:
  - a. It is essential that there is equal thread engagement of all steering tube ends (ball joints).
  - b. With the road wheel in the straight-ahead position and the steering wheel centralised, the steering column lock (if fitted) should engage within  $\pm 20$  degrees.
  - c. Steering box movement exceeds that required to obtain full lock to lock steering movement. This excess movement must be evenly divided between right-hand and left-hand locks and must not be less than 90 degrees steering wheel movement before the stops in the steering box are operative. This adjustment must be made in the drag link only.

## SUB-SECTION L3

### CHAPTER 3

#### LOCKSTOPS

1. To set the lockstops:

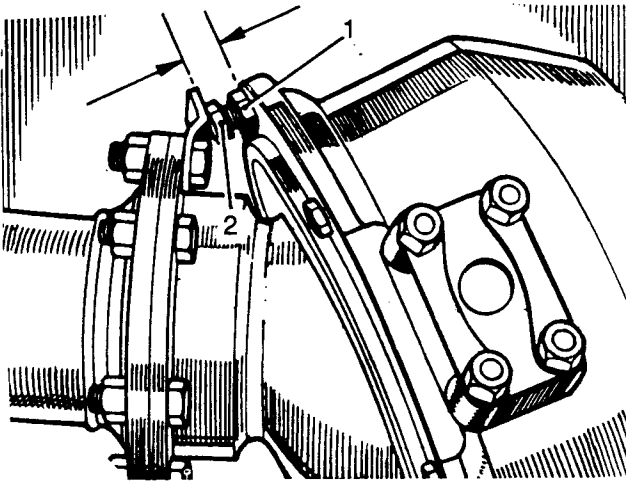


Fig L3.2

(1) Refer to Fig L3.2. Slacken the locknuts (1).

(2) Adjust the stop bolts (2) to obtain 12,5 mm between the bolt head top face and the oil seal retainer face.

(3) Tighten the locknuts (1).

(4) Check the steering at full lock and ensure clearance between the tyres and chassis components.



## SUB-SECTION L3

### CHAPTER 4

#### FRONT WHEEL ALIGNMENT

##### CHECKING TOE-IN

1. To check toe-in:

- (1) Set the vehicle on level ground with the road wheels in the straight-ahead position, and push it forward a short distance.

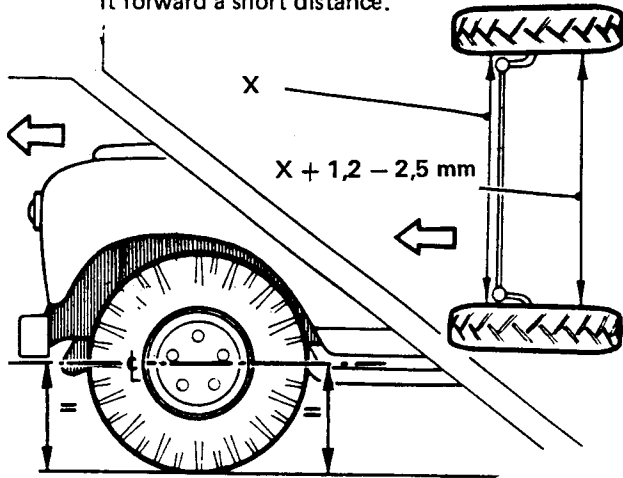


Fig L3.3

- (2) Refer to Fig L3.3. Measure the toe-in, with the aid of a tracking stick or suitable proprietary equipment; it should be 1,2 to 2,5 mm measured at the horizontal centre-line of the road wheels.

- (3) If necessary, adjust the toe-in as detailed below.

##### ADJUSTMENT

2. To set toe-in:

- (1) Slacken the clamps securing the ball joint at each end of the track rod.
- (2) Turn the track rod to decrease or increase its effective length as necessary, until the toe-in is correct.
- (3) Push the vehicle rearwards turning the steering wheel from side to side to settle the ball joints. Then, with the road wheels in the straight ahead position, push the vehicle forward a short distance. Re-check the toe-in. If necessary carry out further adjustment.

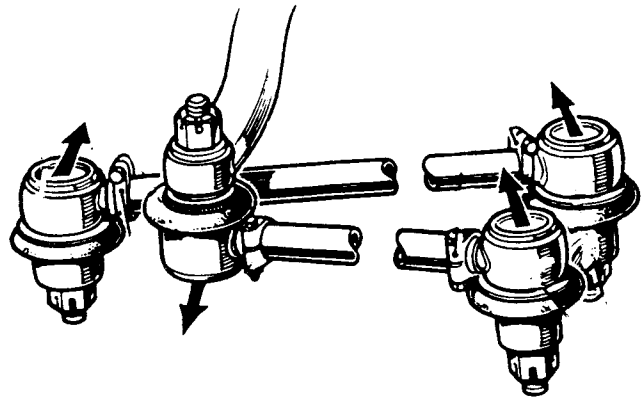


Fig L3.4

- (4) Refer to Fig L3.4. When the toe-in is correct, lightly tap the track rod ball joints in the direction indicated to the maximum of their travel, to ensure full unrestricted movement of the track rod.

- (5) Secure the ball joint clamps. Torque load 11 to 15 N.m.

SUB-SECTION CONTENTS LIST

SUB-SECTION L4

REMOVAL AND REPLACEMENT PROCEDURES

| CHAPTER | DESCRIPTION                                                                | PAGE  |
|---------|----------------------------------------------------------------------------|-------|
| 1       | STEERING COLUMN TOP BEARING - REMOVAL AND REPLACEMENT                      | L4.3  |
| 2       | STEERING COLUMN LOCK AND IGNITION/STARTER SWITCH - REMOVAL AND REPLACEMENT | L4.5  |
| 3       | STEERING COLUMN AND BOX ASSEMBLY - REMOVAL AND REPLACEMENT                 | L4.6  |
| 4       | STEERING RELAY - REMOVAL AND REPLACEMENT                                   | L4.9  |
| 5       | TRACK ROD AND BALL JOINTS - REMOVAL AND REPLACEMENT                        | L4.10 |
| 6       | LONGITUDINAL STEERING TUBE AND BALL JOINTS - REMOVAL AND REPLACEMENT       | L4.11 |
| 7       | DRAG LINK AND BALL JOINTS - REMOVAL AND REPLACEMENT                        | L4.12 |
| 8       | STEERING WHEEL - REMOVAL AND REPLACEMENT                                   | L4.14 |

## SUB-SECTION L4

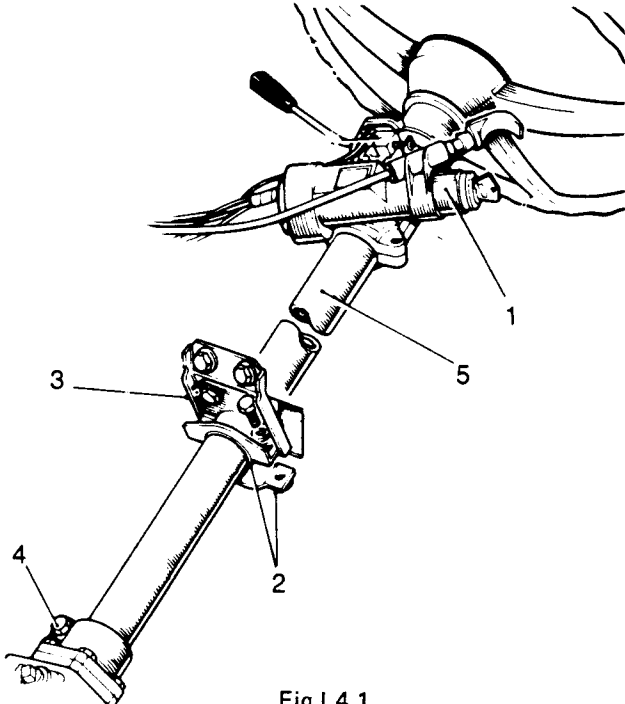
### CHAPTER 1

#### STEERING COLUMN TOP BEARING - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove the steering column top bearing as follows:

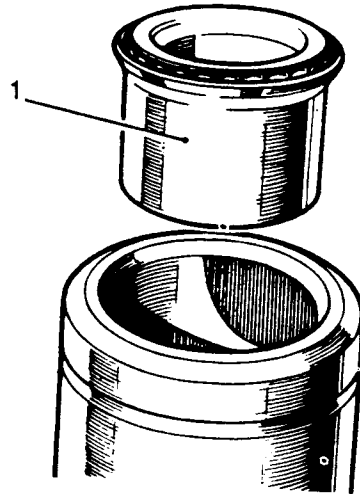
- (1) Disconnect the battery earth lead.
- (2) Remove the steering wheel (see Sub-section L4, Chapter 8).
- (3) Release the combined switch from the steering column (see Sub-section L4, Chapter 2).



- (4) Refer to Fig L4.1. On vehicles without a steering column lock, unscrew the lock ring (1) and move aside the ignition/starter switch from the mounting bracket.
- (5) Remove the column clamp bracket and seal (2).
- (6) Remove the column support bracket (3).
- (7) Slacken the pinch bolt (4) outer column to steering box.
- (8) Withdraw the outer column (5) from the inner column and steering box.

##### NOTE

On vehicles fitted with a steering column lock disconnect the cold start control in the engine compartment and disconnect the leads from the ignition/starter switch (see Sub-section L4, Chapter 2), turn the ignition/starter key to unlock steering.

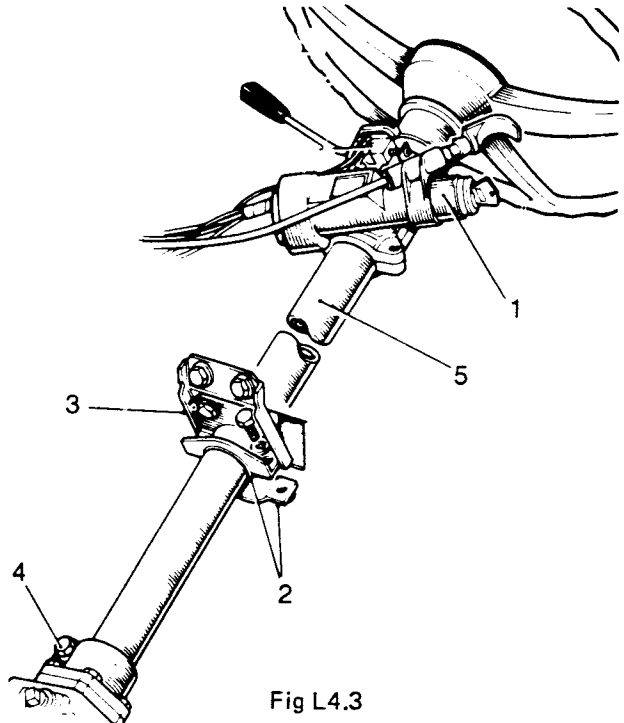


- (9) Refer to Fig L4.2. Remove the column top bearing (1).

##### REPLACEMENT

2. To replace the steering column top bearing:

- (1) Refit the top bearing (1) to the steering column.



- (2) Refer to Fig L4.3. Replace the outer column (5) over the inner column.
- (3) Tighten the pinch bolt (4), outer column to steering box.

- (4) Refit the column support bracket (3).
- (5) Replace the column clamp bracket and seal (2).
- (6) Replace the ignition/starter switch on the mounting bracket and screw the locking ring (1) tight.
- (7) Replace the combined switch onto the steering column (see Sub-section L4, Chapter 2).
- (8) Replace the steering wheel (see Sub-section L4, Chapter 8).
- (9) Refit the battery negative lead.

## SUB-SECTION L4

### CHAPTER 2

#### STEERING COLUMN LOCK AND IGNITION/STARTER SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the lock and switch:

- (1) Disconnect the battery earth lead.
- (2) Disconnect the cold start control in the engine compartment.

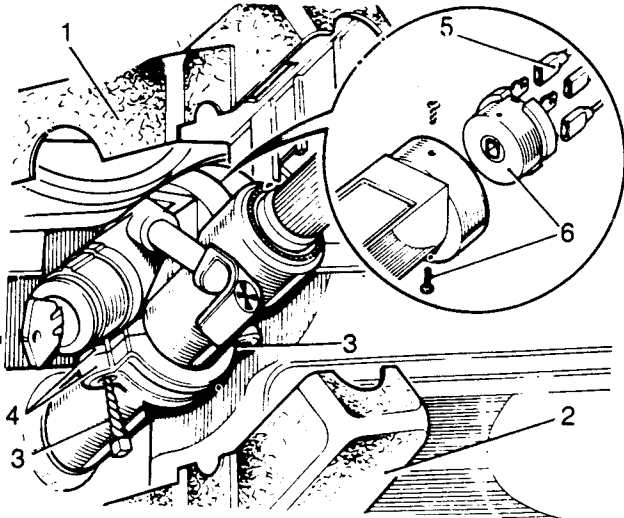


Fig L4.4

- (3) Refer to Fig L4.4. Remove the fixings and withdraw the steering column upper shroud (1).
- (4) Remove the fixings and move aside the lower shroud (2).
- (5) Centre punch and drill a hole in each sheared bolt to accept an extractor (3).
- (6) Remove the sheared bolts using a suitable 'Easy-out' extractor.
- (7) Withdraw the steering column lock and retainer saddle (4).
- (8) Disconnect the electrical leads (5) at the ignition/starter switch.
- (9) If required, remove the fixing screws (6) and withdraw the switch and the cold start control.

##### REPLACEMENT

2. Replace the lock and switch as detailed below:

- (1) If the switch has been withdrawn, replace it and tighten the fixing screws.

##### LEAD COLOUR CODE:

N—Brown  
R—Red  
W—White  
O—Orange

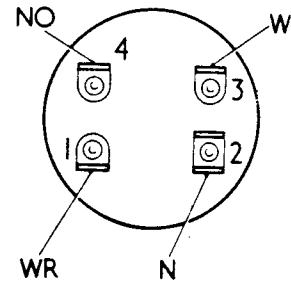


Fig L4.5

- (2) Refer to Fig L4.5. Reconnect the electrical leads to the ignition/starter switch.

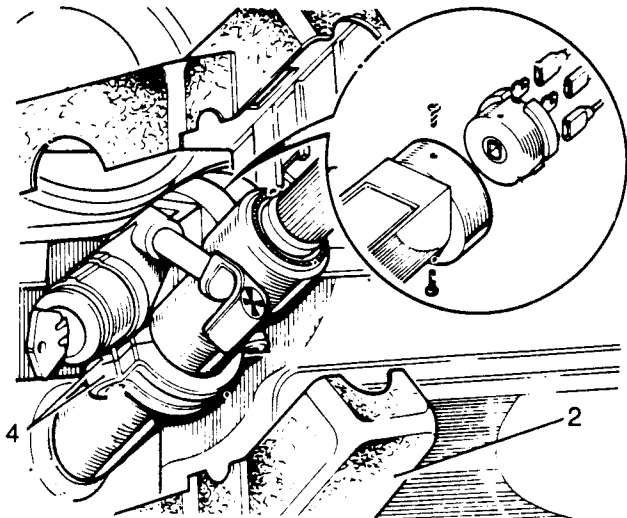


Fig L4.6

- (3) Refer to Fig L4.6. Replace the steering column lock and retainer saddle (4) and secure with new bolts.
- (4) Replace the lower shroud (2).
- (5) Replace the upper shroud (1).
- (6) Reconnect the cold start control in the engine compartment.
- (7) Refit the battery negative lead.

## SUB-SECTION L4

### CHAPTER 3

#### STEERING COLUMN AND BOX ASSEMBLY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the column and box:

- (1) Remove the bonnet (see Sub-section M3, Chapter 1).
- (2) Disconnect the battery earth lead.
- (3) Remove the air cleaner (see Sub-section G3).
- (4) Remove the steering wheel (see Sub-section L4, Chapter 8).
- (5) Remove the lock and starter switch (see Sub-section L4, Chapter 2).

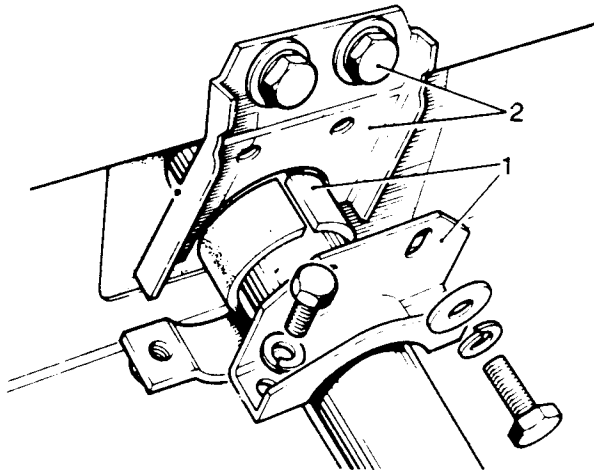


Fig L4.7

- (6) Refer to Fig L4.7. Remove the lower clamp bracket and rubber sleeve (1) from the outer column.
- (7) Remove the upper clamp bracket and support bracket (2) from the bulkhead.

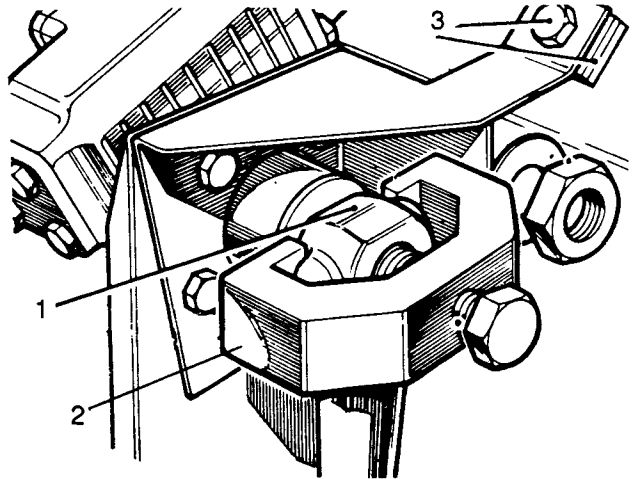


Fig L4.8

- (8) Refer to Fig L4.8. Disconnect the steering drop arm and the attached longitudinal steering tube (1) from the steering box, using special tool 600000 (2).
- (9) Remove the fixings steering box stiffener bracket (3) to the box.
- (10) Raise the front of the vehicle and support on stands.
- (11) Remove the driver's side front road wheel.

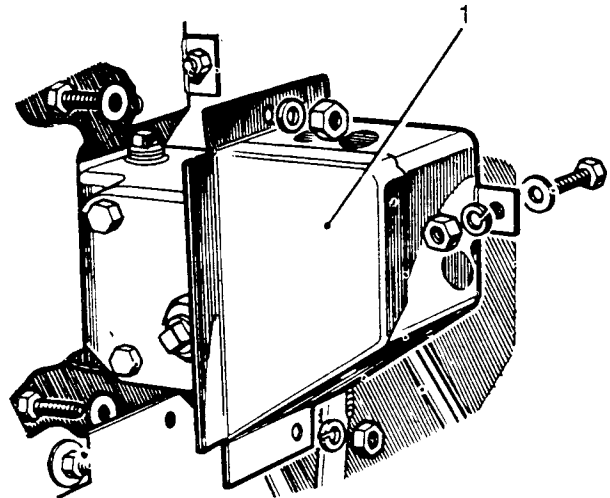


Fig L4.9

- (12) Refer to Fig L4.9. Remove the steering unit box (1) from the wheel arch.

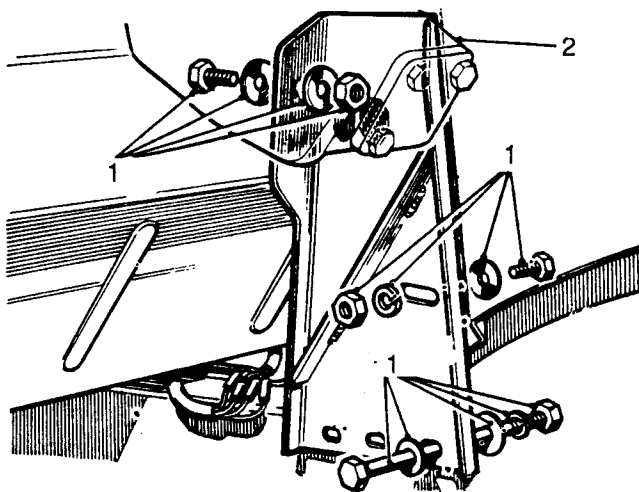


Fig L4.10

(13) Refer to Fig L4.10. Remove the fixings (1), steering box support bracket to toe box, wing valance and chassis.

(14) Withdraw the steering column and box assembly (2) complete with attached brackets from beneath the front wing.

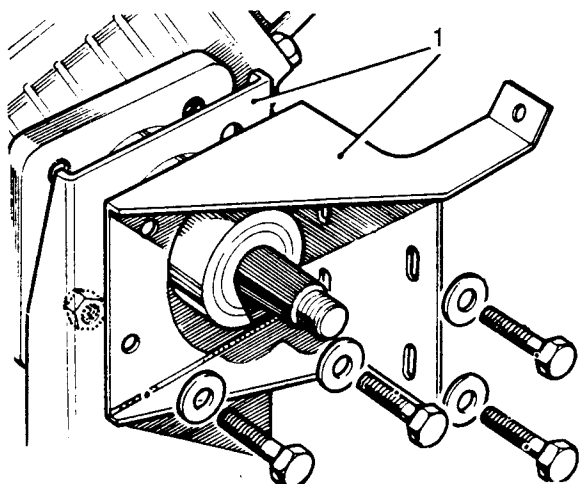


Fig L4.11

(15) Refer to Fig L4.11. If required, remove the stiffener bracket and support bracket (1) from the steering box.

#### NOTE

The steering box can be overhauled without removing the brackets.

## REPLACEMENT

2. Replace the column and box as follows:

(1) If removed, fit the support bracket and stiffener brackets to the steering box. Torque 70 to 85 N.m.

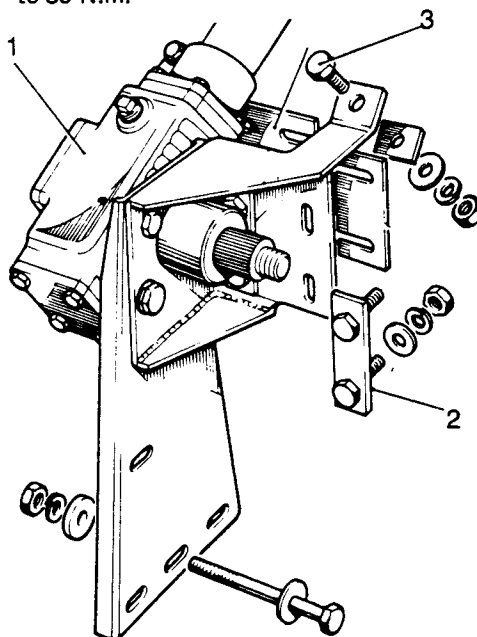


Fig L4.12

(2) Refer to Fig L4.12. Locate the steering box and bracket assembly (1) less drop arm, in position on the vehicle.

(3) Retain the support bracket to the chassis, wing valance and toe box, but do not fully tighten the fixings (2) at this stage.

(4) Retain the steering box stiffener bracket (3) to the toe box, but do not fully tighten the fixings at this stage. If necessary, fit shim washers between the stiffener bracket and the toe box to prevent distorting the toe box or bracket.

#### CAUTION

*During the next steps, do not strain the steering column. If necessary, adjust the steering box position, using the slotted fixing holes in the support and stiffener brackets, to obtain a snug fit between the clamp upper half and the steering column, before securing the clamp halves.*

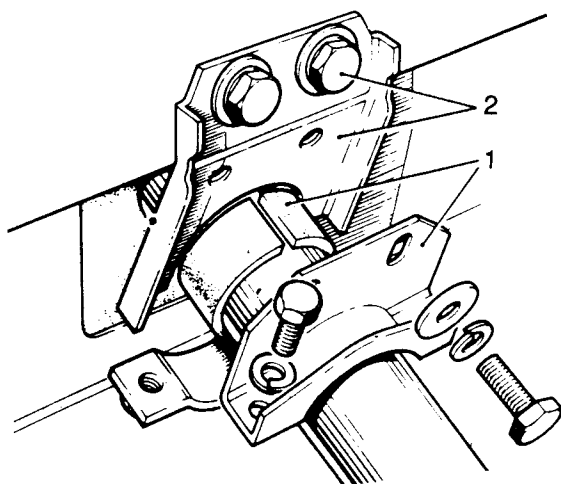


Fig L4.13

- (5) Refer to Fig L4.13. Refit the upper clamp bracket and support bracket (2) to the bulk-head.
- (6) Fit the rubber sleeve and lower clamp bracket (1) to the outer column.
- (7) Insert slotted packing pieces as required to take up clearance between the support bracket, stiffener bracket and toe box.
- (8) Secure the support bracket and stiffener bracket fixings. Torque load for support bracket to chassis fixings is 20 N.m.
- (9) Lower the front of the vehicle to the ground.

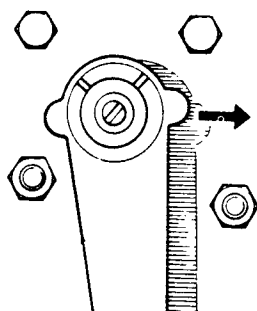


Fig L4.14

- (10) Refer to Fig L4.14. Replace the fixings (3), steering box stiffener bracket to the box.

- (11) Fit the drop arm to the steering box, aligning the mark on the steering rocker arm with the forward mark of the two on the drop arm.

#### NOTE

Where a replacement steering box and drop arm complete is being fitted, remove and discard the original drop arm from the longitudinal steering tube, using special tool 601763 (see Fig L4.15), and fit the new drop arm. Torque load for ball joint fixings is 40 N.m.

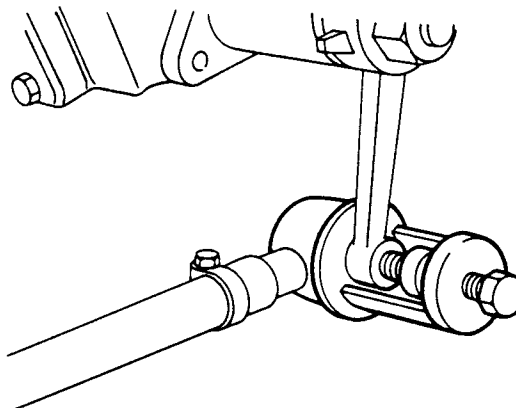


Fig L4.15

- (12) Tighten the drop arm fixing to 85 to 110 N.m.
- (13) Replace the lock and starter switch (see Sub-section L4, Chapter 2).
- (14) Replace the steering wheel (see Sub-section L4, Chapter 8).
- (15) Replace the air cleaner (see Sub-section G3).
- (16) Reconnect the battery earth lead.
- (17) Refit the bonnet (see Sub-section M3, Chapter 1).



## SUB-SECTION L4

### CHAPTER 4

#### STEERING RELAY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the steering relay:

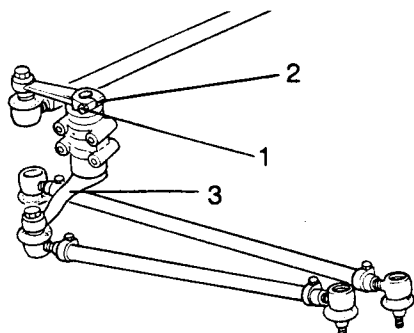


Fig L4.16

- (1) Refer to Fig L4.16. From under the bonnet, remove the pinch bolt (1) and withdraw the upper lever (2) from the relay shaft.
- (2) Remove the two upper nuts and bolts securing the relay to the chassis.
- (3) From under the vehicle, remove the pinch bolt and withdraw the lower lever (3) from the relay shaft.
- (4) Support the relay and remove the two lower nuts and bolts securing the relay to the chassis.
- (5) Withdraw the steering relay.

##### REPLACEMENT

2. Replace the steering relay as follows:

- (1) Ensure that the relay unit is filled with the correct oil.
- (2) Locate the relay in position on the chassis and secure the assembly with the four nuts and bolts.
- (3) Fit the upper and lower relay levers and their respective securing bolts and nuts.

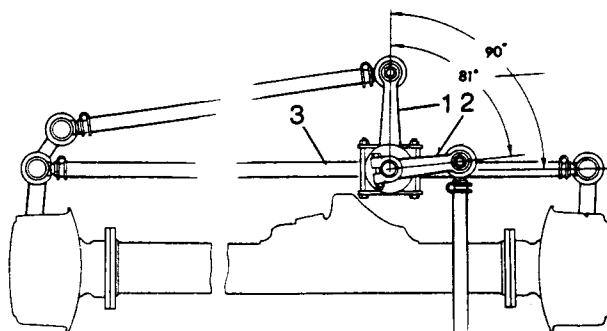


Fig L4.17

- (4) Refer to Fig L4.17. The angular relationship of the upper and lower relay levers should be 81 degrees. Check by setting the road wheels in the straight ahead position, at which point the relay lower lever (1) should be at 90 degrees to the track rod. The relay upper lever (2) should be inclined forward of the track rod, 9 degrees out of alignment with the track rod (3).
3. Refit the ball joints to the track rod as follows:
    - (1) Screw the ball joints equally until the overall dimension between the ball joint centres is 1157 to 1160 mm (dimension A on Fig L4.19).
    - (2) Position the ball joint clamps 1,6 to 3,2 mm from the track rod ends (dimension B). Do not tighten the clamp bolts at this stage.
  4. Refit the track rod:
    - (1) Fit the ball joints into their housings and secure with the washer and castellated nut. Torque to 40 N.m. Fit new split pins.
    - (2) Replace the front road wheels.
    - (3) Lower the front end of the vehicle to the ground.
    - (4) Check and if necessary adjust wheel alignment leaving the clamp fixings slackened.
    - (5) Tighten the ball joint clamps. Torque to 11 to 15 N.m.

## SUB-SECTION L4

### CHAPTER 5

#### TRACK ROD BALL AND JOINTS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. First remove the track rod:
  - (1) Jack up the vehicle front end and support on stands.
  - (2) Remove the front road wheels.

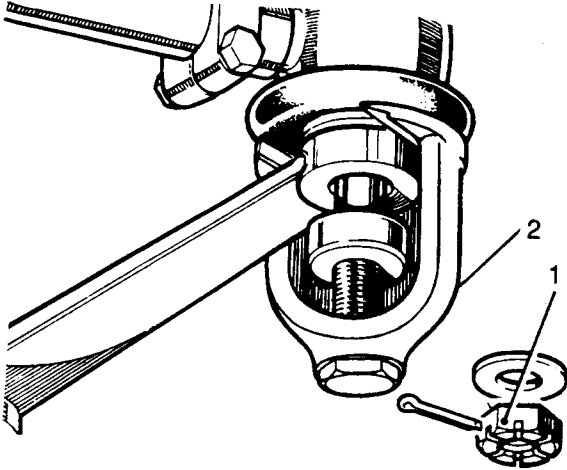


Fig L4.18

- (3) Refer to Fig L4.18. Remove the fixings (1) from both ball joints.
  - (4) Extract the ball joint, using special tool 601763 (2).
  - (5) Withdraw the track rod and ball joints.
2. Now remove the ball joints from the track rod:

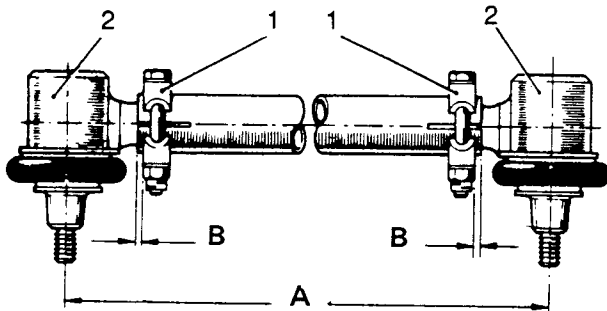


Fig L4.19

- (1) Refer to Fig L4.19. Slacken the ball joints clamp fixings (1).
  - (2) Unscrew the ball joints (2) (LH and RH thread).

##### REPLACEMENT

3. Refit the ball joints to the track rods as follows:
  - (1) Screw on the ball joints equally until the overall dimension between the ball joint centres is 1157 to 1160 mm (dimension A on Fig L4.19).
  - (2) Position the ball joint clamps 1,6 to 3,2 mm from the track rod ends (dimension B). Do not tighten the clamp bolts at this stage.
4. Refit the track rod:
  - (1) Fit the ball joints into their housings and secure with the washer and castellated nut. Torque to 40 N.m. Fit new split pins.
  - (2) Replace the front road wheels.
  - (3) Lower the front end of the vehicle to the ground.
  - (4) Check, and if necessary adjust, wheel alignment, leaving the clamp fixings slackened.
  - (5) Tighten the ball joint clamps. Torque to 11 to 15 N.m.

## SUB-SECTION L4

### CHAPTER 6

#### LONGITUDINAL STEERING TUBE AND BALL JOINTS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. First remove the longitudinal steering tube as detailed below:
  - (1) Prop open the bonnet.
  - (2) Remove the fixings (split pin, castellated nut and washer) from the ball joint connecting the longitudinal tube to the steering box drop arm.
  - (3) Using special tool 601763 extract the ball joint from the steering box drop arm (see Fig L4.18 for use of special tool).
  - (4) Remove the fixings from the ball joint connecting the longitudinal tube to the relay lever.
  - (5) Using special tool 601763 (see Fig L4.18) extract the ball joint from the relay lever and withdraw the longitudinal steering tube from the vehicle.

2. The ball joints may now be removed as follows:

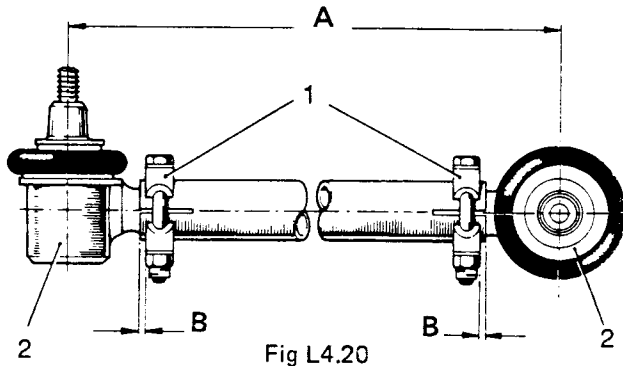


Fig L4.20

- (1) Refer to Fig L4.20. Slacken the ball joint clamp fixings (1).
- (2) Unscrew the ball joints (2) (LH and RH thread).

##### REPLACEMENT

3. To replace the ball joints onto the longitudinal steering tube:
  - (1) Screw in the ball joint equally until the overall dimension between ball joint centres is 621,4 to 624,6 mm (dimension A). Position the clamps 1,58 to 3,17 mm from the longitudinal tube ends (dimension B). Do not tighten the clamp fixings at this stage.
4. To refit the longitudinal steering tube:
  - (1) Insert the ball joint ends into their housings on the steering relay lever and the steering box arm.

- (2) Secure the ball joints with washers and castellated nuts. Torque the ball joint fixings to 40 N.m and fit new split pins.

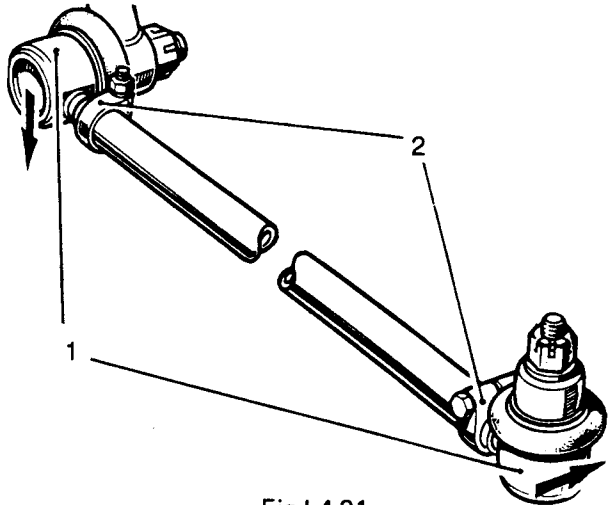


Fig L4.21

- (3) Refer to Fig L4.21. Using a mallet, lightly tap the ball joint cups (1) in the direction indicated to the maximum of their travel, to ensure full unrestricted movement of the longitudinal arm.
- (4) Tighten both ball joint clamps (2) to 11 to 15 N.m.
- (5) Check the steering lockstops setting (see Sub-section L3, Chapter 3).
- (6) Check the steering, lock to lock, for correct functioning. If necessary, adjust the overall length of the longitudinal arm by slackening the ball joint clamps and screwing the arm in or out, as required, then resecure the clamps.

## DRAG LINK AND BALL JOINTS - REMOVAL AND REPLACEMENT

## REMOVAL

1. Remove the drag link first as detailed below:

- (1) Jack up the vehicle front end.
- (2) Remove the front road wheel from the side where the drag link is connected to the swivel pin steering lever.

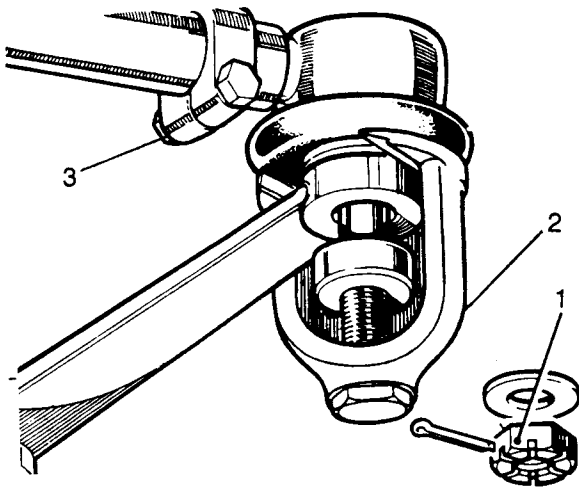


Fig L4.22

- (3) Refer to Fig L4.22. Remove both ball joint fixings (1).
  - (4) Extract the ball joints, using special tool 601763 (2).
  - (5) Withdraw the drag link.
2. Now remove the ball joints:
    - (1) Slacken the clamp fixings (3) on Fig L4.2 .
    - (2) Unscrew the ball joints, LH and RH thread.

## REPLACEMENT

3. Replace the ball joints as follows:

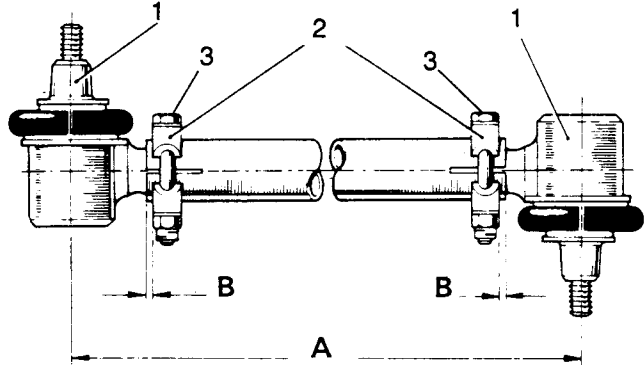


Fig L4.23

- (1) Refer to Fig L4.23. Screw in the ball joints (1) equally until the overall dimension between ball joint centres is 782,62 to 785,79 mm (dimension A).
  - (2) Position the clamps (2) 1,58 to 3,17 mm from the drag link ends (dimension B) with the clamp jaws situated over the slot in the tube; the relay lever ball joint is in the pendant position when fitted. Do not tighten the clamp fixings (3) at this stage.
4. Now refit the drag link:
    - (1) Fit the drag link ball joints into their housings and secure with a washer and castellated nut. Tighten the nuts to 40 N.m. Fit new split pins.

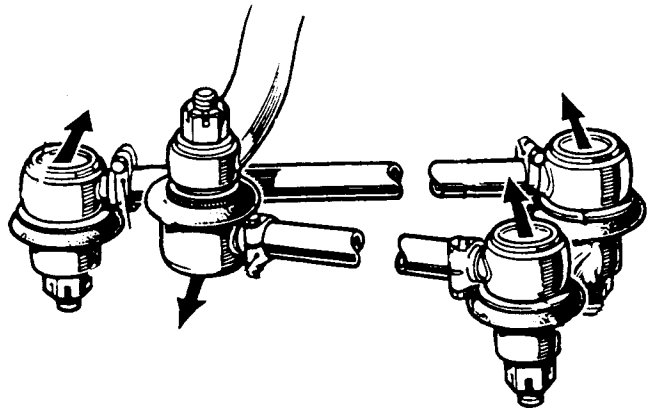


Fig L4.24

- (2) Refer to Fig L4.24. If the clamps were previously slackened, lightly tap the ball joint cups with a mallet in the direction indicated to the maximum of their travel, to ensure full unrestricted movement of the drag link.

(3) Tighten the ball joint clamps to 11 to 15 N.m.

(5) Lower the vehicle front end to the ground.

(4) Replace the front road wheel.

## SUB-SECTION L4

### CHAPTER 8

#### STEERING WHEEL - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the steering wheel:

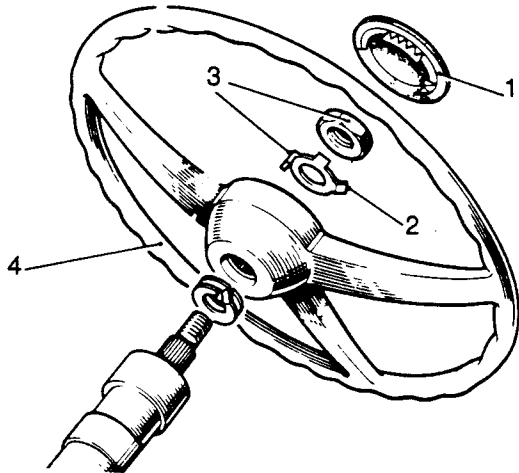


Fig L4.25

- (1) Refer to Fig L4.25. Prise off the wheel centre cover (1).
- (2) Release the locking tab (2).
- (3) Remove the tab washer and fixing nut (3).
- (4) Withdraw the steering wheel (4). Take care not to lose the spring washer below the wheel.

##### REPLACEMENT

2. To replace the steering wheel:

- (1) Position the road wheels in the straight ahead position.
- (2) Fit the steering wheel with the centre spoke pointing downwards.
- (3) Fit the tab washer and fixing nut. Torque the nut to 54 N.m.
- (4) Tap the locking tab into position against the nut.
- (5) Refit the wheel centre cover.

## **SUB-SECTION CONTENTS LIST**

### **SUB-SECTION L5**

#### **OVERHAUL AND CLEANING PROCEDURES**

| <b>CHAPTER</b> | <b>DESCRIPTION</b>                             | <b>PAGE</b> |
|----------------|------------------------------------------------|-------------|
| 1              | STEERING COLUMN AND BOX ASSEMBLY - OVERHAUL    | L5.3        |
| 2              | STEERING RELAY - OVERHAUL                      | L5.7        |
| 3              | STEERING BALL JOINTS - CLEANING AND REGREASING | L5.10       |

## SUB-SECTION L6

### MAINTENANCE

#### INTRODUCTION

1. The steering system is relatively trouble free and requires little regular maintenance other than periodic cleaning and checking the connecting links for wear and damage.
2. The ball joints should be examined periodically to see that the rubber covers are undamaged. If cuts or abrasions are noted the covers should be replaced immediately.

#### CHECKING OIL LEVEL IN THE STEERING RELAY

3. At the specified intervals, check the oil level as follows:

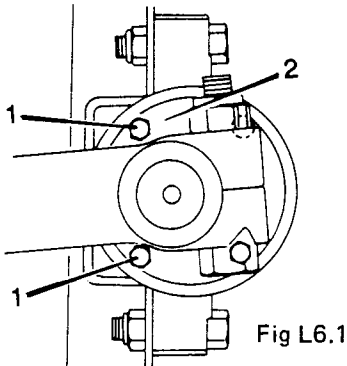


Fig L6.1

- (1) Refer to Fig L6.1. Remove two of the bolts (1) securing the relay top cover (2).

- (2) Check that the oil level is up to the bottom of the holes.

- (3) If it is not, pour oil into one of the holes (the other acts as a breather) until the oil is at the correct level.

#### NOTE

1. While filling, it is probable that oil will eject from the breather hole. If this occurs do not assume that the relay unit is full. Allow time for the oil to find its way to the main chamber. Wait a few moments until the breather hole is clear of oil, then continue pouring.

2. As the unit fills up, air is forced out of the breather hole in the form of an air bubble again giving the impression that the unit is full. Wait until the bubble subsides and then continue filling until the oil is clearly visible at the base of the filler and breather holes.

- (4) Replace the two top cover bolts.



## SUB-SECTION L5

### CHAPTER 1

#### STEERING COLUMN AND BOX ASSEMBLY - OVERHAUL

##### DISMANTLING

1. To dismantle the assembly:

(1) Remove the steering column and box assembly (see Sub-section L4, Chapter 3).

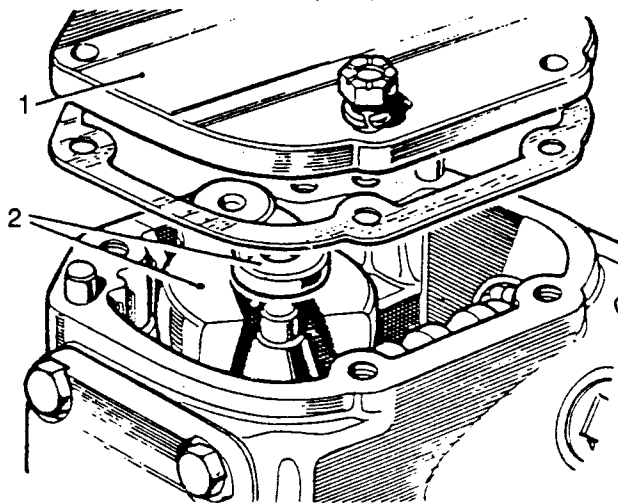


Fig L5.1

(2) Refer to Fig L5.1. Remove the side cover (1) and drain the oil from the steering box.

(3) Lift out the roller for the main nut and withdraw the rocker shaft (2).

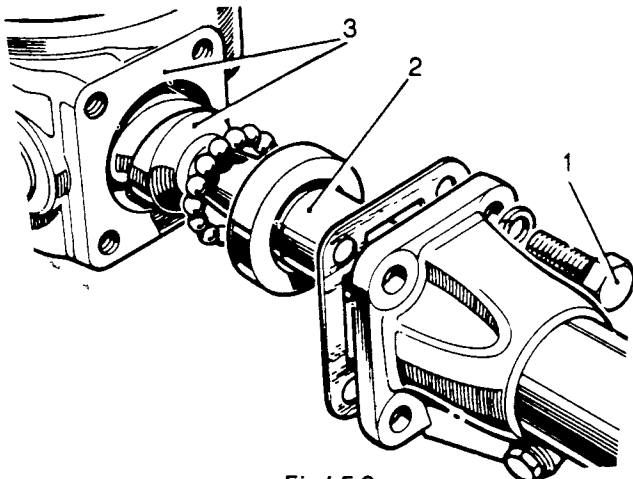


Fig L5.2

(4) Refer to Fig L5.2. Hold the outer column in a vice and remove the fixings (1) securing the steering box.

(5) Using a mallet, tap the inner column (2) at the steering wheel end to partially remove the box.

(6) Withdraw the box and inner column (3) complete. Take care not to lose any of the steel balls from the steering box bearings.

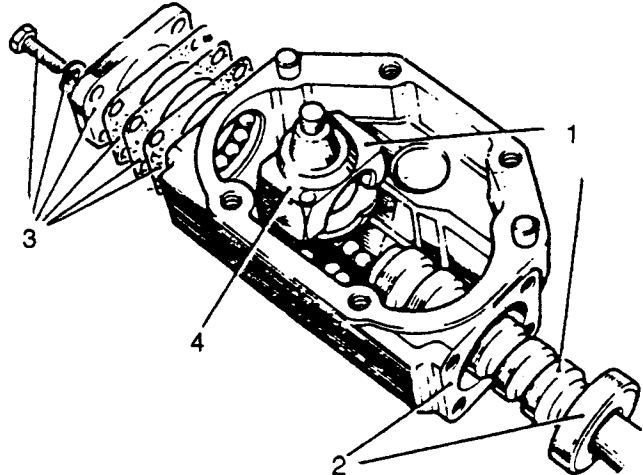


Fig L5.3

(7) Refer to Fig L5.3. Rotate the inner column to locate the main nut in the mid-way position on the worm shaft (1).

(8) Using a mallet, gently tap the box away from the inner column sufficient to remove the upper ball race (2). Take care not to lose the steel balls which will be released from the bearings.

(9) Wind the worm shaft through the main nut and remove the shaft, main nut and any loose steel balls.

(10) Remove the end cover, shims and lower ball race (3).

(11) Dislodge and remove the twelve 9,52 mm diameter ball bearings from the main nut and recirculating tube (4).

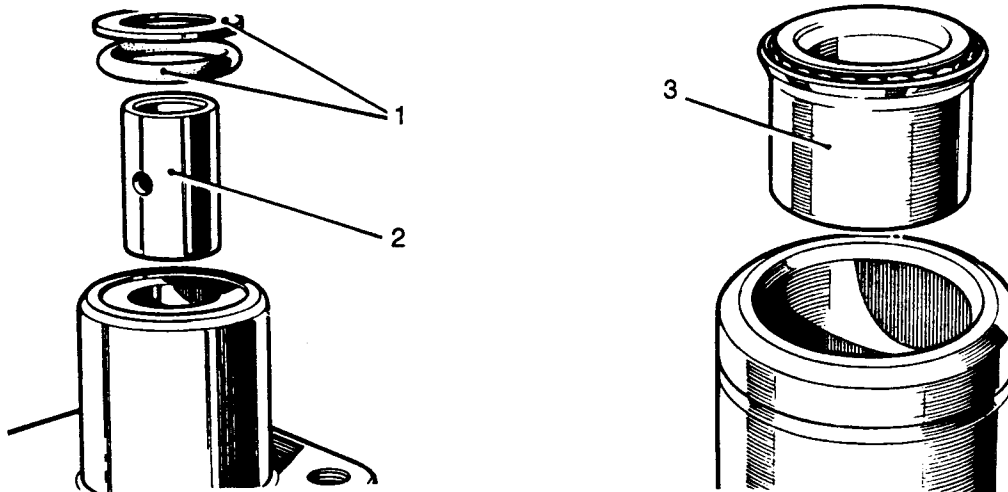


Fig L5.4

(12) Refer to Fig L5.4. Remove the retaining washer and oil seal (1).

(13) If required, press out the rocker shaft bush (2).

(14) If required, remove the outer column top bearing (3).

(3) Examine the main nut ball bearing track for evidence of indentations or scaling.

(4) Examine the worm shaft for similar markings. Slight indentations at the extreme end of the shaft can be disregarded as this is a normal wear condition, but if indentations have spread to the middle of the shaft, a replacement must be fitted.

#### INSPECTING

2. Carry out the following inspection:

(1) Clean all components in a grease solvent and dry out.

(2) Examine all components for obvious signs of wear or damage.

## REASSEMBLING

3. Reassemble the steering box and column as follows:

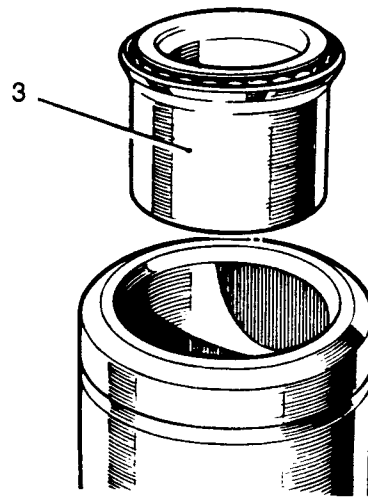
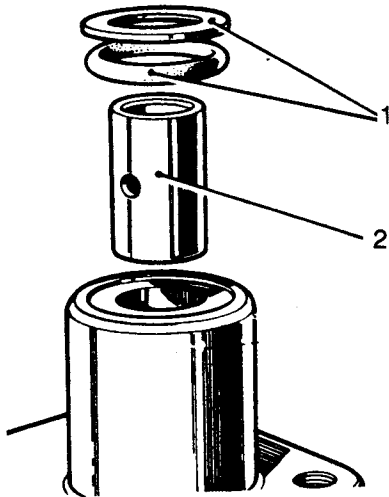


Fig L5.5

- (1) Refer to Fig L5.5. If it has been removed, replace the outer column top bearing (3).
- (2) If necessary, refit the rocker shaft bush (2). Use a press if required.
- (3) Replace the retaining washer and oil seal (1).

### NOTE

In the following procedures use a general purpose grease to retain ball bearings and to coat all joint washers while assembling.

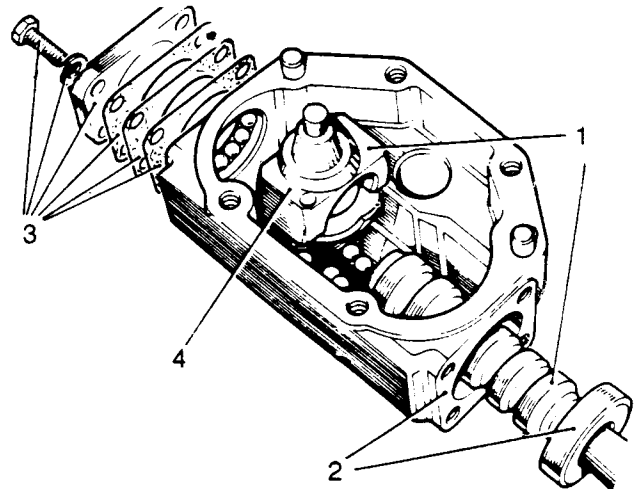


Fig L5.6

- (4) Refer to Fig L5.6. Fit the twelve 9,52 mm diameter ball bearings to the main nut and recirculating tube (4).
- (5) Replace the lower ball race, shims and end cover (3).
- (6) Wind the worm shaft through the main nut.

(7) Refit the upper ball race and fit the box to the inner column (2).

(8) Rotate the inner column to locate the main nut in the midway position on the worm shaft (1).

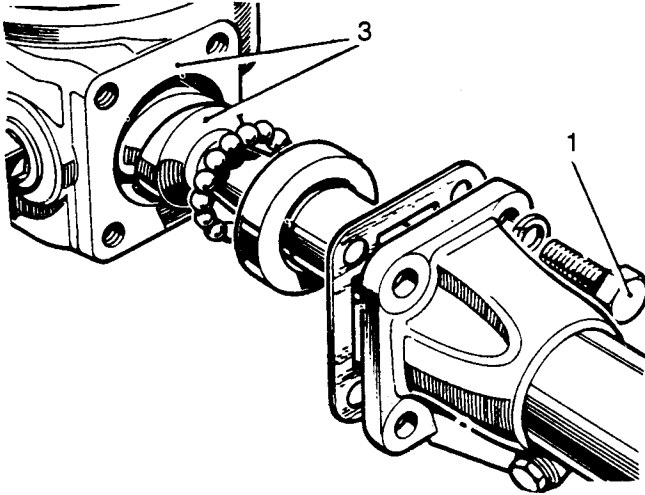


Fig L5.7

(9) Refer to Fig L5.7. Refit the box and inner column (3) complete to the outer column.

(10) With the outer column held in a vice, replace the fixings (1) securing the steering box.

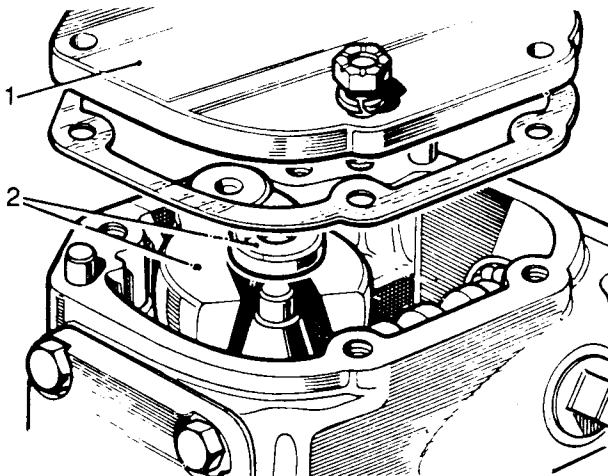


Fig L5.8

(11) Refer to Fig L5.8. Replace the rocker shaft (2) and refit the roller for the main nut.

(12) Replace the side cover (1). Coat all cover plate fixing nuts with 'Wellseal' or suitable equivalent sealing compound and tighten to 23 to 28 N.m.

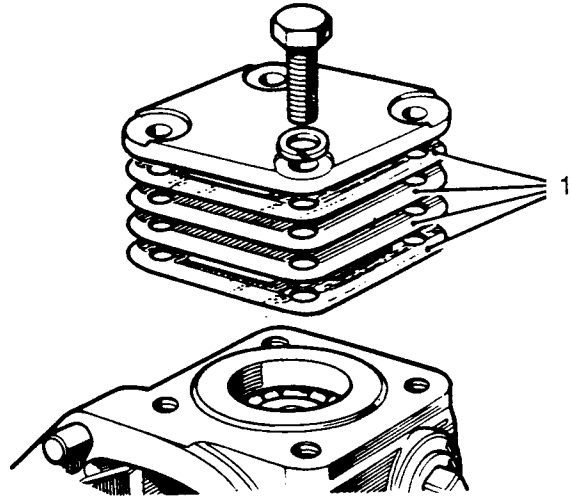


Fig L5.9

(13) Refer to Fig L5.9. Check for end-float on the steering column. Adjust the shim washer (1) thickness between the end cover and the steering box to obtain a 'free to rotate but no end-float' condition on the inner column.

(14) Set the steering in the straight ahead position (midway lock to lock).

(15) Screw the steering box adjuster by hand until there is no end-float between the adjuster and the rocker shaft. Screw in a further one half flat (maximum) to allow for locknut tightening.

(16) Tighten the adjuster locknut ensuring that the adjuster does not move.

(17) Fill the steering box with the correct grade of lubricating oil.

(18) Replace the steering column and box assembly (see Sub-section L4, Chapter 3).

## SUB-SECTION L5

### CHAPTER 2

#### STEERING RELAY - OVERHAUL

##### DISMANTLING

1. Dismantling the relay assembly as follows:

- (1) Remove the relay assembly (see Sub-section L4, Chapter 4).

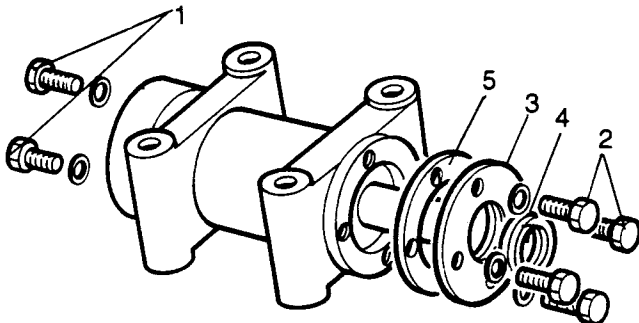


Fig L5.10

- (2) Refer to Fig L5.10. Remove the two of the securing bolts (1) from the relay top cover. Invert the relay and allow the oil to drain.
- (3) Locate the relay assembly horizontally in a vice.
- (4) Remove the four bolts (2) securing the relay lower cover (3).
- (5) Remove the lower cover complete with oil seal (4) gasket (5) and thrust washer. Discard the gasket.

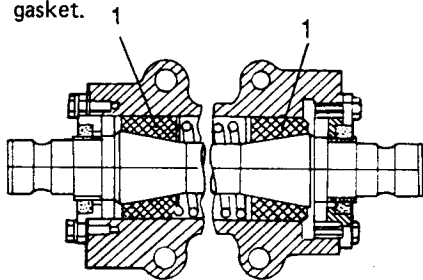


Fig L5.11

- (6) Refer to Fig L5.11. The relay shaft now has to be drifted through the lower end of the relay housing. In the sectioned illustration of the relay assembly, note that items (1) are split bushes with internal tapered faces, against which they are held by a compression spring.

##### WARNING

*The relay split bushes and spring will fly apart when released from the housing. Protection must be provided to prevent injury.*

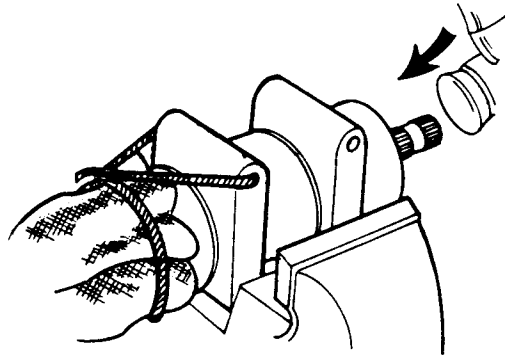


Fig L5.12

- (7) Refer to Fig L5.12. Enclose the lower end of the relay assembly with stout material, leaving within the material sufficient space to accommodate the relay shaft. Secure the material to the relay housing to form a safety sheath.
- (8) Gently tap the relay shaft into the safety sheath.
- (9) Remove the safety sheath and collect the relay shaft, split bushes, spring and washers.
- (10) Remove the bolts securing the relay upper cover and remove the upper cover complete with oil seal, gasket and thrust washer. Discard the gasket, remove the oil seal.
- (11) Remove the oil seal from the relay lower cover.

##### INSPECTING

2. Thoroughly clean all components and examine for wear and damage. Renew components as necessary.

##### REASSEMBLY

3. To reassemble the relay:

- (1) Apply jointing compound to the outer periphery of the new oil seals. Fit the oil seals to the relay upper and lower covers (seal lips towards the relay housing).

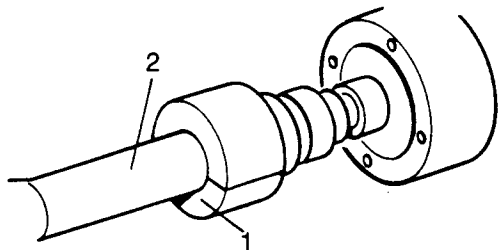


Fig L5.13

- (2) Refer to Fig L5.13. Locate the two halves of the split bush (1) on the top cone of the shaft (2).
- (3) Insert the assembly of shaft and bush into the housing from the bottom.

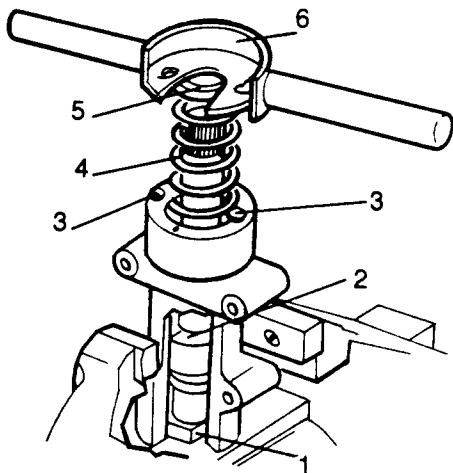


Fig L5.14

- (4) Refer to Fig L5.14. Secure the housing and shaft assembly, bottom end uppermost, in a vice with a 19 mm support block (1) under the bottom end of the shaft.
- (5) Insert the washer (2) for the spring into the housing and fit two of the oil seal retainer fixing bolts (3) into the housing diametrically opposite each other.
- (6) Fit the spring (4) and washer (5).
- (7) Using special tool 600536 (6) carefully compress the spring.
- (8) Turn the tool to lock in position with the key-hole slots under the heads of the bolts.

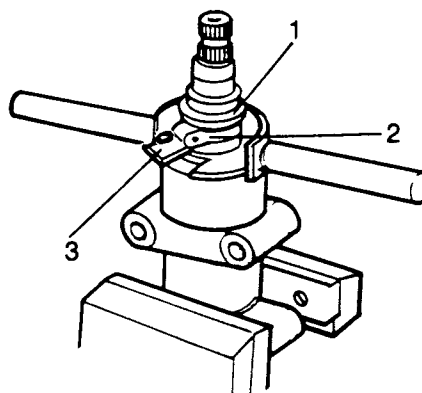


Fig L5.15

- (9) Refer to Fig L5.15. Locate the other split bush (1) in position on the bottom cone of the shaft and secure with a 50 mm hose clip (2).
- (10) Remove the special tool and the seal retainer fixing bolts (3).
- (11) Remove the assembly from the vice and gently tap the shaft into position until the split bush has entered the housing for at least half its length.
- (12) Remove the hose clip and continue to tap the shaft into the housing until the bushes are correctly located in the housing.

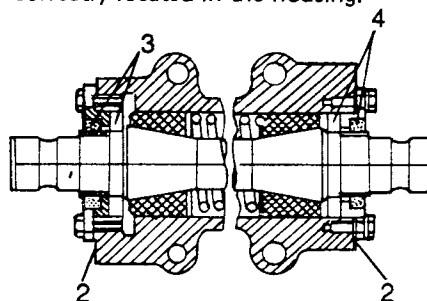


Fig L5.16

- (13) Refer to Fig L5.16. Smear general purpose grease on both sides of the joint washers (2) and fit one to each end of the housing.
- (14) Fit the thrust washer and end cover (3) complete with seal to the bottom end of the housing only. Use 'Wellseal' or a suitable equivalent sealing compound on the threads of the bolt fitted to the breather hole.
- (15) Fill the housing with the correct grade of oil.
- (16) Fit the thrust washer and end cover (4), complete with seal to the top of the housing, using sealing compound on the threads of the four securing bolts.

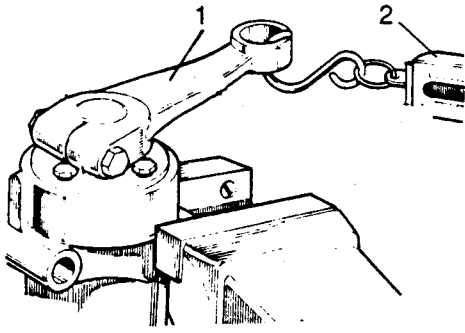


Fig L5.17

(17) Refer to Fig L5.17. Hold the relay in a vice.

(18) Temporarily attach the upper relay lever (1) and use a suitable spring balance (2) to check resistance to rotation of the relay shaft. The resistance, measured on the spring balance, must not be less than 5,4 kg and should not exceed 7,3 kg.

(19) If the resistance is less than 5,4 kg, fit a new spring.

(20) If the resistance is excessive, remove the oil seal retainers and thrust washers, then use a suitable piece of tube to push each split bush in turn clear of its cone and inject lubricating oil. Reassemble and recheck.

(21) Fit the assembly to the vehicle (see Sub-section L4, Chapter 4).

## SUB-SECTION L5

### CHAPTER 3

#### STEERING BALL JOINTS - CLEANING AND REGREASING

##### GENERAL

1. The steering ball joints have been designed in such a way as to retain the initial filling of grease for the normal life of the ball joint; however, this applies only if the rubber boot remains in position on the joint. The rubber boots should be checked at the maintenance intervals to ensure that they have not become dislodged or the joint damaged. Should any of the rubber boots be dislodged, proceed as follows:

##### DISMANTLING

2. To dismantle a ball joint:

- (1) Remove the ball joint from the longitudinal arm, track rod or drag link (see Sub-section L4, Chapter 5, 6 or 7).

##### NOTE

If only one ball joint requires attention, it is only necessary to disconnect the applicable end of the steering arm.

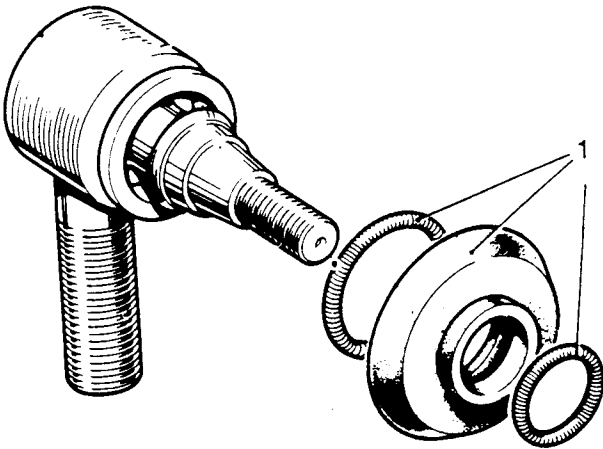


Fig L5.18

- (2) Refer to Fig L5.18. Remove the rubber cover and spring rings (1).
- (3) Thoroughly clean all parts.

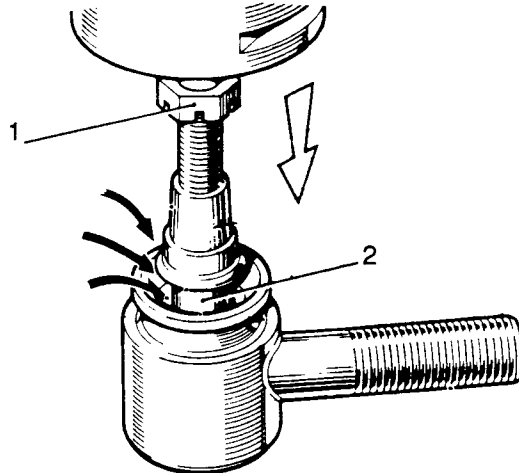


Fig L5.19

- (4) Refer to Fig L5.19. Place the castle nut (1) upside down on the pin and screw on a few threads.
- (5) Place the ball joint under a press or between the jaws of a vice and carefully force the pin and ball down against the spring. In this position the interior of the ball joint can be cleaned and lubricated.
- (6) Apply grease around the taper (2) and fill the replacement rubber boot.

##### REASSEMBLY

3. Reassemble the ball joint:

- (1) Discard the spring rings and fit new rings.
- (2) Take off the castle nut.
- (3) Replace the ball joint onto the longitudinal arm, track rod or drag link (see Sub-section L4, Chapter 5, 6 or 7).



## SUB-SECTION M1

### DESCRIPTION OF THE BODY

1. The Land Rover bodywork, with the exception of a steel radiator grille and tailboard frames is made from 'Birmabright' alloy. This is a magnesium-aluminium alloy which will not rust or corrode under normal circumstances. It is work hardening and so becomes brittle when hammered. It is, however, easily annealed.
2. Birmabright has the property of forming a hard oxide skin when exposed to air so care and special preparation is necessary when painting is undertaken.

## SUB-SECTION M2

### CHASSIS FRAME ALIGNMENT

#### PROCEDURE

1. With the vehicle assembled, a check for chassis 'squareness' can be made as follows:

- (1) Place the vehicle on a level floor.

#### NOTE

The measuring points referred to below are the fixed spring shackle locations.

- (2) Hold a plumb line against one of the measuring points.
- (3) Mark the floor directly beneath the plum bob.
- (4) Carry out steps (2) and (3) for the three other measuring points.
- (5) Move the vehicle and measure diagonally between the front and rear marks. The chassis is square if the two measurements agree to within 9,5 mm.

- (6) Using a suitable trammel, make comparative side-to-side checks between the front suspension front shackle pin and the rear wheel hub centre.

- (7) With the vehicle upper structure removed, comparative side-to-side checks for chassis frame malalignment can be made, using as datums the 9,5 mm diameter holes provided in the No. 2 and in the rearmost cross-members.

#### NOTE

The vehicle front bumper is regarded as the No. 1 cross-member.

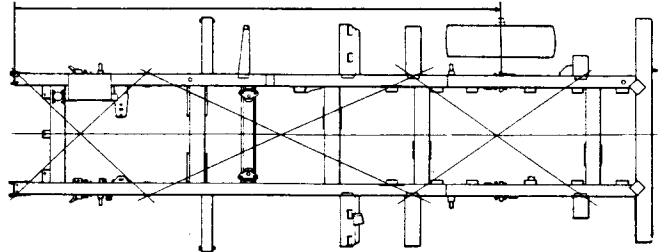


Fig M2.1

SUB-SECTION CONTENTS LIST

SUB-SECTION M3

REMOVAL AND REPLACEMENT PROCEDURES

| CHAPTER | DESCRIPTION                                                | PAGE  |
|---------|------------------------------------------------------------|-------|
| 1       | BONNET - REMOVAL AND REPLACEMENT                           | M3.3  |
| 2       | DOORS - REMOVAL AND REPLACEMENT                            | M3.4  |
| 3       | DOOR GLASS - REMOVAL AND REPLACEMENT                       | M3.5  |
| 4       | DOOR LOCK - REMOVAL AND REPLACEMENT                        | M3.6  |
| 5       | FRONT FLOOR - REMOVAL AND REPLACEMENT                      | M3.7  |
| 6       | RADIATOR GRILLE AND GRILLE PANEL - REMOVAL AND REPLACEMENT | M3.8  |
| 7       | WINDSCREEN - REMOVAL AND REPLACEMENT                       | M3.9  |
| 8       | WINDSCREEN GLASS - REMOVAL AND REPLACEMENT                 | M3.10 |

## SUB-SECTION M3

### CHAPTER 1

#### BONNET - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the bonnet:
  - (1) Remove the spare wheel if this is fitted to the bonnet.

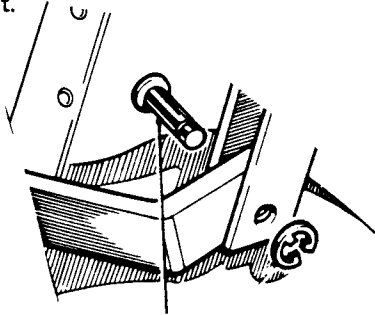


Fig M3.1

- (2) Refer to Fig M3.1. Disconnect the prop rod.
  - (3) Raise the bonnet to the vertical position.

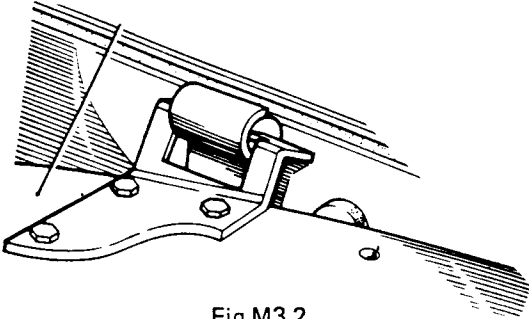


Fig M3.2

- (4) Refer to Fig M3.2. Lift the bonnet clear from the hinges.

##### REPLACEMENT

2. Replace the bonnet as follows:
  - (1) With the bonnet in the vertical position engage it with the hinges.
  - (2) Lower the bonnet sufficiently to reconnect the prop rod.
  - (3) Lower the bonnet fully and ensure that it engages with the lock.

## SUB-SECTION M3

### CHAPTER 2

#### DOORS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove a side door as follows:

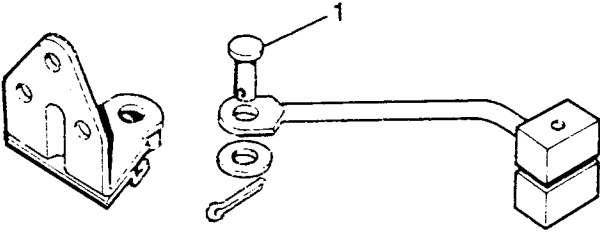


Fig M3.3

- (1) Refer to Fig M3.3. Disconnect the door check strap (1).

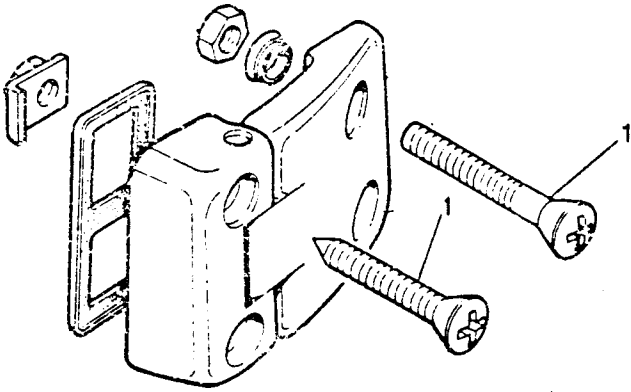


Fig M3.4

- (2) Refer to Fig M3.4. Remove the fixings (1) securing the hinges.
- (3) Withdraw the door.

##### REPLACEMENT

2. To replace the door:

- (1) Examine the weather seals for deterioration or damage. Replace if necessary.
- (2) Place the door into position. Swing the hinges into position and secure with the fixings.
- (3) Reconnect the door check strap.

## SUB-SECTION M3

### CHAPTER 3

#### DOOR GLASS - REMOVAL AND REPLACEMENT

##### REMOVAL

###### Sliding Glass

1. The sliding glass must be removed before the fixed glass can be taken out. Proceed as follows:
  - (1) Move the sliding window to allow access to the screws securing glass run channel, top and bottom.
  - (2) Remove the screws from inside the channel.
  - (3) Withdraw the top run channel and sliding window.
  - (4) Remove the bottom run channel if necessary.

###### Fixed Glass

2. Once the sliding glass is removed the fixed glass may be taken out as follows:
  - (1) Remove the screws securing the front retainer.
  - (2) Ease the fixed glass clear of the frame.

##### REPLACEMENT

3. First replace the fixed glass:
  - (1) Apply new Prestik sealing strip to the window frame.
  - (2) Fit the glass into the frame.
  - (3) Replace the screw securing the front retainer.
4. The sliding glass may now be replaced:
  - (1) Replace the bottom run channel if this has been removed.
  - (2) Place the top run channel onto the sliding glass top and fit both into the frame.
  - (3) Replace and tighten the securing screws inside the channel.
  - (4) Check that the sliding glass moves freely in the channels.

## SUB-SECTION M3

### CHAPTER 4

#### DOOR LOCK - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove a door lock:

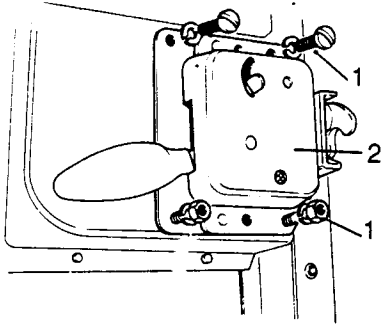


Fig M3.5

- (1) Refer to Fig M3.5. Remove the fixings (1).
- (2) Withdraw the door lock (2).
- (3) If required, remove the striker plate from its support bracket (2 screws).

##### REPLACEMENT

2. Replace the door lock as follows:

- (1) Fit the lock into position, engaging the square rod of the outer door handle into the square hole in the lock.
- (2) Secure the lock with the fixings.
- (3) Check movement of the catch.
- (4) Replace the striker plate if this has been removed.
- (5) Adjust the striker plate so that the door draught excluders are slightly compressed with the door closed.

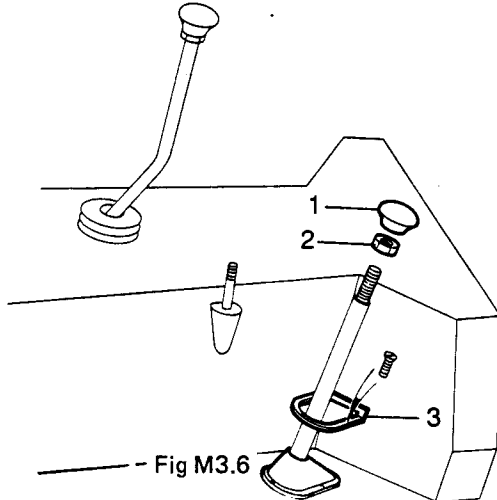
## SUB-SECTION M3

### CHAPTER 5

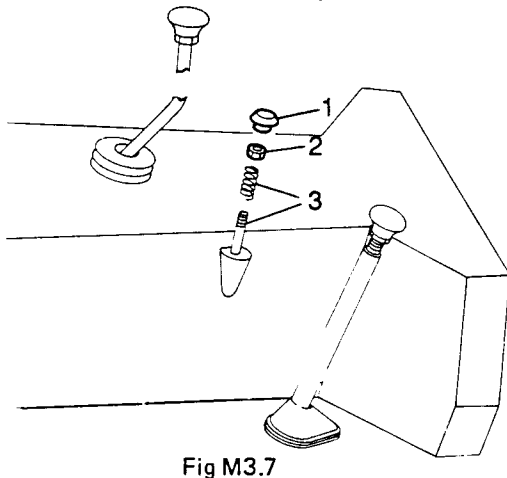
#### FRONT FLOOR - REMOVAL AND REPLACEMENT

##### REMOVAL

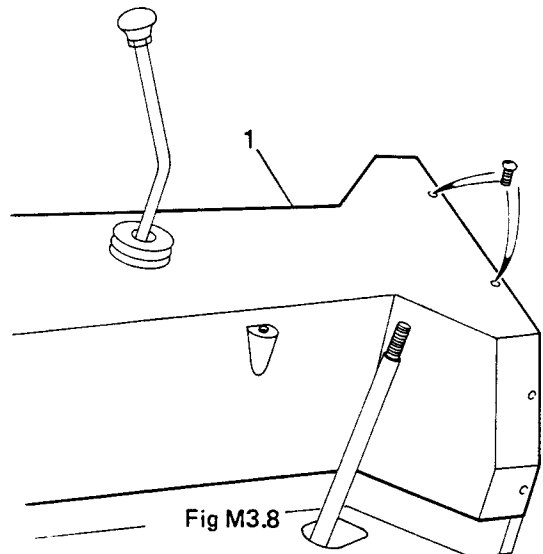
1. To remove the front floor:



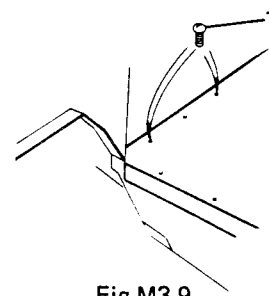
- (1) Refer to Fig M3.6. Unscrew the knob (1) and locknut (2) from the transfer gear lever.
- (2) Remove the fixings and withdraw the dust cover (3) from the transfer gear lever.



- (3) Refer to Fig M3.7. Unscrew the knob (1) and locknut (2) from the four-wheel drive lever.
- (4) Withdraw the spring and ferrule (3).
- (5) Remove the floor mats.



- (6) Refer to Fig M3.8. Unscrew the 17 speed screws and remove the gearbox tunnel cover (1).



- (7) Refer to Fig M3.9. Remove the securing bolts in the floor (1) and remove both halves of the floor.

##### REPLACEMENT

2. To replace the floor:

- (1) Using a waterproof sealant between the joint flanges (a suitable sealant is Sealastrip), fit the floor halves and secure with the fixing bolts.
- (2) Replace the gearbox tunnel cover, again using a waterproof sealant, and secure with the 17 speed screws.
- (3) Fit the ferrule, spring and locknut to the four-wheel drive lever. Depress the lever and adjust the locknut until the compressed spring length is 58 mm. Fit the knob and tighten the locknut.
- (4) Replace the dust cover over the transfer gear lever.
- (5) Replace the knob and locknut on the lever.



## SUB-SECTION M3

### CHAPTER 6

#### RADIATOR GRILLE AND GRILLE PANEL - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Two grilles are fitted to the Land Rover: a fine mesh grille at the front secured by wing nuts and behind this, a coarse mesh grille. To remove both grilles and the grille panel:

- (1) Remove the bonnet (see Sub-section M3, Chapter 1).
- (2) Disconnect the battery earth lead.
- (3) Unscrew the wing nuts and lift off the fine mesh grille.

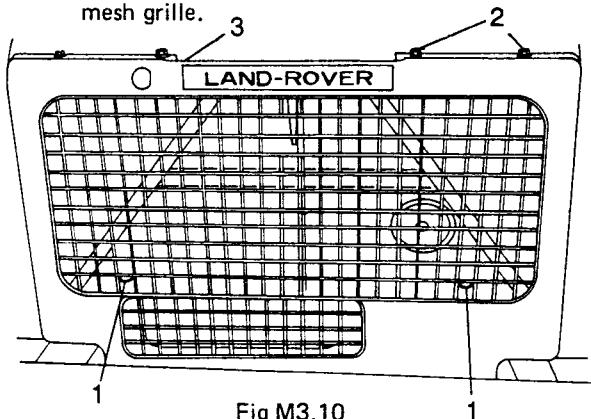


Fig M3.10

- (4) Refer to Fig M3.10. Remove the two screws (1) securing the coarse mesh grille and lift off the grille.
- (5) Remove the four screws (2) holding the grille panel (3) and lift off the panel.

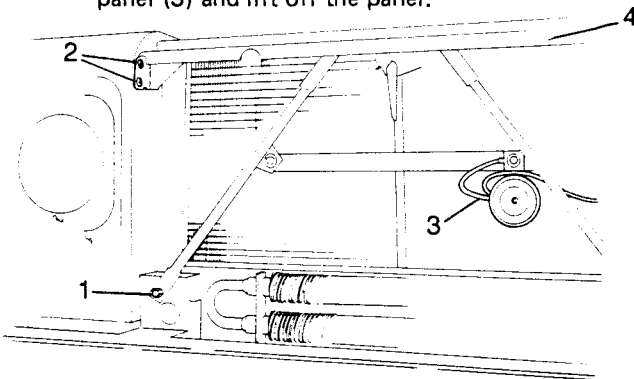


Fig M3.11

- (6) Refer to Fig M3.11. Remove the two bolts (1) at the bottom of the support tubes.
- (7) Remove the four screws (2) securing the grill panel frame to the wings. These screws have loose nuts inside the wings.
- (8) Disconnect the electrical connector (3) from the horn.

- (9) Lift off the complete grille panel framework (4).

##### REPLACEMENT

2. To replace the grille and grille panel:

- (1) Fig M3.11 still applies. Fit the grille panel framework into position and secure with the screws (2), nuts and washers through the wings.
- (2) Refit the two bolts (1) to the bottom of the support tubes.
- (3) Remake the electrical connection to the horn.

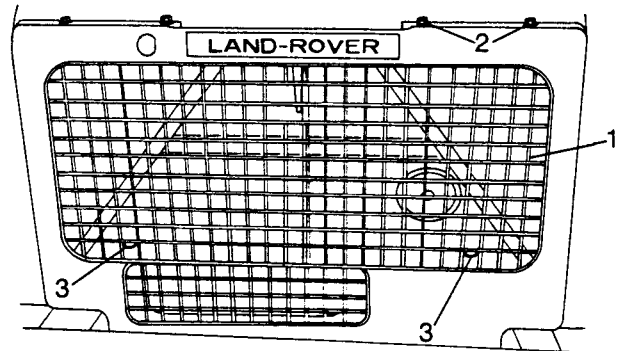


Fig M3.12

- (4) Refer to Fig M3.12. Place the grille panel (1) into position and secure with the four screws (2) at the top.
- (5) Fit the coarse mesh grille and replace the two screws (3) securing this to the grille panel.
- (6) Replace the fine mesh grille and secure with the wing nuts.

## SUB-SECTION M3

### CHAPTER 7

#### WINDSCREEN - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the windscreen:
  - (1) Remove the bolts securing the roof to the windscreen.
  - (2) Slacken or remove the remaining roof fixings.
  - (3) Remove the windscreen wiper arms and blades.

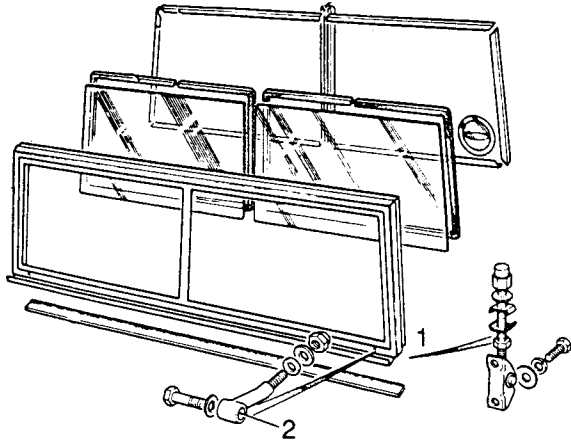


Fig M3.13

- (4) Refer to Fig M3.13. Slacken the nuts on the windscreen clamp bolts (1). Swing the clamp bolts clear of the windscreen.
- (5) Disconnect the wiper motor earth lead from the windscreen frame.
- (6) Remove the bolts securing the windscreen to the hinges (2).
- (7) Remove the windscreen.

##### REPLACEMENT

2. Replace the windscreen as follows:
  - (1) Refit the windscreen.
  - (2) Replace the bolts securing the windscreen to the hinges.
  - (3) Reconnect the wiper motor earth lead to the windscreen frame.
  - (4) Refit the clamp bolts to the windscreen and tighten the nuts.
  - (5) Replace the windscreen wiper arms.
  - (6) Ensure that the windscreen top and bottom sealing strips are in good condition. Replace and tighten the roof fixings.

## SUB-SECTION M3

### CHAPTER 8

#### WINDSCREEN GLASS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the windscreen glass:
  - (1) Remove the windscreen wiper arms and blades.
  - (2) Remove the sun visors and the rear view mirror from the interior of the cab.
  - (3) Remove the headlining strip from above the windscreen.
  - (4) Remove the fascia top rail.

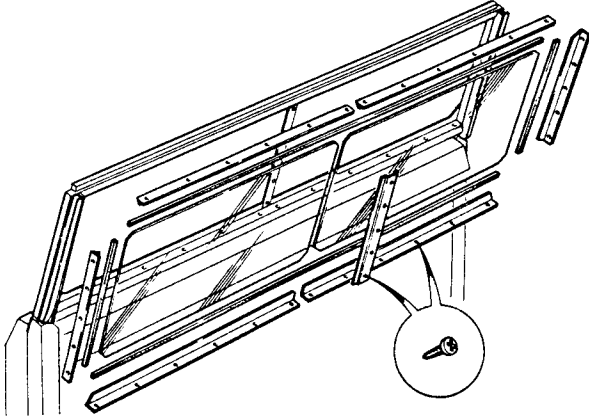


Fig M3.14

- (5) Refer to Fig M3.14. Remove the screws securing the glass retaining angle strips.
- (6) Carefully ease the glass clear of the screen.
- (7) Remove all traces of sealant from the windscreen frame and glass retaining strips.

##### REPLACEMENT

2. To replace the glass:
  - (1) Line the interior of the windscreen frame with 'Sealastrip'.
  - (2) Locate the glass in the windscreen frame and press firmly into the Sealastrip.
  - (3) Place Sealastrip round the edges of the glass to seal the angle strips when fitted.
  - (4) Fit the angle strips to retain the glass and secure with the retaining screws.
  - (5) Remove surplus Sealastrip.
  - (6) Fit the fascia top rail.
  - (7) Fit the headlining strip.
  - (8) Fit the sun visors and rear view mirror.
  - (9) Refit windscreen wiper arms and blades.

## SUB-SECTION M4

### BODY REPAIRS

#### INTRODUCTION

1. Land Rover body panels are manufactured from a special aluminium alloy known as 'Birmabright'.
2. 'Birmabright' melts at a slightly lower temperature than pure aluminium and will not rust nor corrode under normal circumstances. It is work-hardening, but is easily annealed. Exposed to the atmosphere, a hard oxide skin forms on the surface.
3. 'Birmabright' panels and wings can be beaten out after accidental damage, then must be annealed by the application of heat, followed by slow air-cooling. As the melting point is low, heat must be applied slowly and carefully.
4. A practical temperature control is to apply oil to the cleaned surface to be annealed. Play the welding torch on the underside of the cleaned surface and watch for the oil to clear, leaving the surface clean and unmarked; then allow to cool naturally in the air when the area so treated will again be soft and workable. Do not quench with oil or water.
5. Another method is to clean the surface to be annealed and then rub it with a piece of soap. Apply heat beneath the area, as described above, and watch for the soap stain to clear. Then allow to cool, as for the oil method.
6. When applying the heat for annealing, always hold the torch some little distance from the metal, and move it about, so as to avoid any risk of melting it locally.

#### GAS WELDING BIRMABRIGHT

##### General

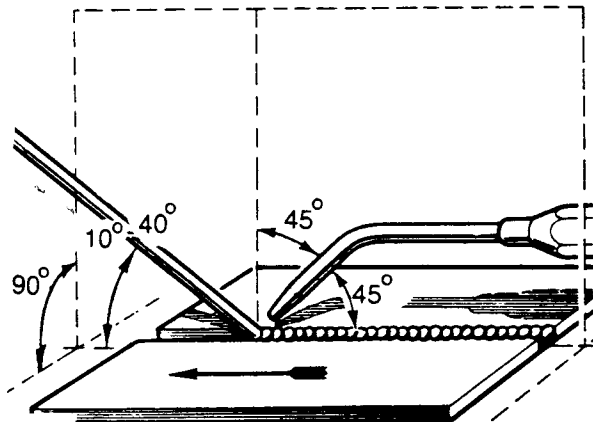


Fig M4.1

7. Refer to Fig M4.1. A small jet must be used, one or two sizes smaller than would be used for welding sheet steel of comparable thickness. For instance, use a No. 2 nozzle for welding 18 SWG sheet, and a No. 3 for 16 SWG sheet.

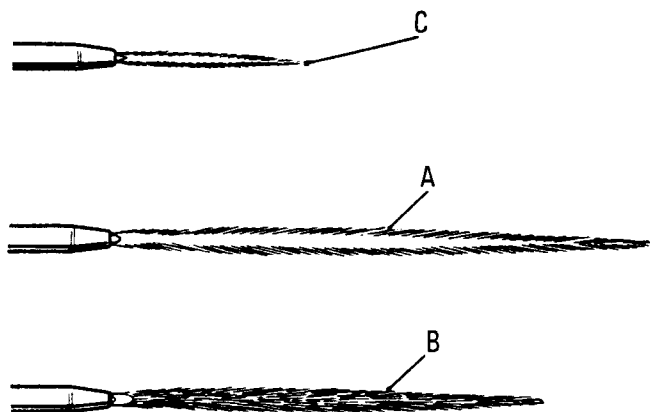


Fig M4.2

8. The flame should be smooth, quiet and neutral and have a brilliant inner core with a well-defined, rounded end as in (A). The hottest point of the flame is close to the jet, and the flame should have a blue to orange envelope becoming nearly colourless at the end.
9. A slightly reducing flame (B) may also be used, that is, there may be a slight excess of acetylene. Such a flame will have a brilliant inner core with a feathery white flame and a blue or orange envelope.
10. Do not use an oxydising flame (C) which has a short pointed inner core bluish white with a bluish envelope.
11. Use only 5 percent magnesium/aluminium welding rod (5Mg/A). Sifalumin No. 27 (MG.5 Alloy) (Use Sifbronze Special flux with this rod) or a 'Birmabright' offcut sheet. Do not use too wide or thick an offcut or trouble may be experienced in making it melt before the material which is being welded.
12. Clean off all grease and paint, dry thoroughly then clean the edges to be welded and an area at least 12,5 mm on either side of the weld with a stiff wire scratch brush or wire wool. Cleanliness is essential. Also clean the welding rod or strip with wire wool.
13. A special acid flux must be used, and we recommend 'Hari-Kari' which is obtainable from Afrox (South Africa).
14. A small quantity of 'Hari-Kari' may be made into a paste with water, following the directions on the tin, and the paste must be applied to both surfaces to be welded and also to the rod. In case of Sifbronze Special Flux, use in powder form as directed.

15. Remember that aluminium and its alloys do not show 'red-hot' before melting, and so there is nothing about the appearance of the metal to indicate that it has reached welding temperature. A little experience will enable the operator to gauge this point, but a useful guide is to sprinkle a little sawdust over the work; this will sparkle and char when the right temperature is approached; a piece of dry wood rubbed over the hot metal will sparkle at the point of contact.

16. As the flux used is highly acid, it is essential to wash it off thoroughly immediately after a weld is completed. The hottest possible water should be used, with wire wool or a scratch brush. Very hot soapy water is good, because of the alkaline nature of the soap, which will tend to 'kill' the acid.

17. It is strongly recommended that a few welds are made on scrap metal before the actual repair is undertaken if the operator is not already experienced in welding aluminium and its alloys.

18. The heat of welding will have softened the metal in the area of the repair, and it may be hardened again by peening with a light hammer. Many light blows are preferable to fewer heavy ones. Use a 'dolly' or anvil behind the work to avoid denting and deformation, and to make the hammering more effective. Filing of surplus metal from the weld will also help to harden the work again.

#### **Welding Tears and Patches**

19. If a tear extends to the edge of a panel, start the weld from the end away from the edge and also at this point drill a small hole to prevent the crack spreading, then work towards the edge.

20. When welding a long tear, or making a long welded joint, tack the edges to be welded at intervals of from 50 to 100 mm with spots. This is done by melting the metal at the starting end and fusing into it a small amount of the filler rod, repeating the process at the suggested intervals. After this, weld continuously along the joint from right to left, increasing the speed of the weld as the material heats up.

21. After the work has cooled, wash off all traces of flux as described previously, and file off any excess of build-up metal.

22. When patching, cut the patch to the correct shape for the hole to be filled, but of such size as to leave a gap of 0.8 mm between it and the panel, and then weld as described above. Never apply an 'overlay' patch.

23. For all body repairs work the gas welding method is sufficient and quite satisfactory.

#### **ELECTRIC WELDING**

##### **CAUTION**

*The battery earth lead must be disconnected before commencing electric welding, otherwise the alternator will be damaged.*

24. At the Rover factory the 'Argon-Arc' process is used, all atmospheric oxygen being excluded from the weld by the Argon gas shield.

#### **SPOT WELDING**

25. Spot-welding is largely used in the manufacture of Land Rover bodies, but this is a process which can only be carried out satisfactorily by the use of the proper apparatus.

26. Aluminium and its alloys are very good conductors of heat and electricity, and thus it is most important to maintain the right conditions for successful spot-welding. The correct current density must be maintained, and so must the 'dwell' of the electrodes. Special spot-welding machines have been developed, but they are expensive, and though the actual work can be carried out by comparatively unskilled labour, supervision and machine maintenance must be in the hands of properly qualified persons.

#### **RIVETING**

27. Where both sides of the metal are accessible and it is possible to use an anvil or dolly, solid aluminium rivets may be used, with a suitable punch or pop to ensure clean, rounded heads on the work. For riveting blind holes, pop-rivets must be used. These are inserted and closed by special 'Lazy-Tong' pop-rivet pliers.

## SUB-SECTION M5

### PAINTING THE BODY

#### GENERAL

1. Land Rover body panels are manufactured from a special aluminium-alloy known as 'Birmabright' and the following paintwork procedure should be followed on these panels.

#### PREPARATION

2. The area to be painted must be flatted to remove the hard oxide skin which forms on the surface of the alloy when exposed to the atmosphere. Degrease and dry the area, then apply a suitable etch-primer.
3. Unless an etch-primer is used, paint is liable to come away as it cannot 'key' into the hard oxide of an untreated alloy surface. The use of AECI Dulux Corrocote Twin Pack base and catalyst (reference 193-0821 and 115-0895) is recommended. It is quick and easy to apply, and it prolongs the life of the paint film by ensuring excellent adhesion.
4. The activated Etching Primer has a limited pot-life of about 8 hours at normal temperatures and should not be used after this time, as it may have inferior adhesion and corrosion resistance. Any Etching Primer which has been mixed for more than 8 hours must be thrown away, and not returned to the can.

#### APPLICATION

5. Apply Etching Primer as soon as possible after cleaning, and paint as soon as the pre-treatment is completed. Undue delay may cause the surface to be contaminated again and thus nullify the treatment. Do not leave pre-treated work overnight before it is painted.

6. Etching Primer, when followed by a suitable paint system, gives a film which is very resistant to moisture, but the Etching Primer itself is water sensitive. It should therefore be coated with paint as soon as possible when it is dry.
7. Activate the Etching Primer by mixing it with an equal volume of Activator P273-5021 and allow to stand for 10 minutes.
8. Adjust the spraying viscosity of the mixture if necessary to 22-25 sec. BSB4 Cup by adding small quantities of Thinner 851-565; never add more Activator.
9. Apply by spray to clean, dry surface in a thin uniform coat, rather than a thick heavy one which may impair adhesion.
10. Air dry for at least 15 minutes before applying undercoat by spray or for 2 hours before brush application. If required, these times can be shortened by force drying, this also gives increased hardness to the film.
11. Subsequent painting follows normal paintshop practice.
12. When wet flatting the subsequent paint layers take care not to rub through to the Etching Primer. If this does occur allow to dry out thoroughly, dry flat the area and spot in with Etching Primer.

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SECTION N

HEATING AND VENTILATION

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| N2          | FAULT DIAGNOSIS AND CORRECTIVE ACTION | N2.1 |
| N3          | REMOVAL AND REPLACEMENT PROCEDURES    | N3.1 |
| N4          | MAINTENANCE                           | N4.1 |

## SUB-SECTION N1

### DESCRIPTION OF THE HEATING AND VENTILATION SYSTEM

1. Fresh air is drawn through a grille on the left hand wing by an electrically driven fan. The fan feeds a heat exchanger through which engine coolant is fed when heating is required or is shut off when heating is not selected.
2. The air from the heat exchanger is ducted to the cab for demisting purposes or to foot level vents under the control of a selector lever in the cab.
3. A separate lever in the cab controls a valve in the engine coolant system. Progressively opening the valve regulates the quantity of hot coolant fed to the heat exchanger.
4. Two hand operated vents under the windscreen are provided. Either or both of these may be opened to allow a direct flow of air into the cab.



SUB-SECTION N2

FAULT DIAGNOSIS AND CORRECTIVE ACTION

INTRODUCTION

1. This Sub-section deals with fault diagnosis and corrective action for the heating and ventilation system. Table N2.1 lists symptoms, probable causes and suggested remedial action in the event of a system fault developing. The Table is not exhaustive and should a fault occur which is not listed, the suspected component should be removed for closer examination.

TABLE N2.1 - HEATING AND VENTILATION FAULT DIAGNOSIS CHART

| SYMPTOM                                | POSSIBLE CAUSE                                                                    | REMEDY                                             |
|----------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------|
| Inefficient or no heating or demisting | Water valve cable broken.<br>Water valve inoperative.<br>Hot water pipes blocked. | Replace cable.<br>Replace valve.<br>Replace pipes. |
| Fan not turning                        | Electrical fault.<br>Fan faulty.                                                  | Check circuit and repair.<br>Replace fan.          |
| System will not switch on (or off)     | Cable disconnected or broken.                                                     | Reconnect or replace cable.                        |

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SUB-SECTION N3

REMOVAL AND REPLACEMENT PROCEDURES

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| 3       | HEATER WATER VALVE CONTROL CABLE - REMOVAL AND REPLACEMENT              | N3.5  |
| 4       | HEATER WATER VALVE - REMOVAL AND REPLACEMENT                            | N3.6  |
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| 8       | VENTILATOR GRILLE PANEL AND QUADRANT ASSEMBLY - REMOVAL AND REPLACEMENT | N3.11 |
| 9       | FRESH AIR INTAKE - REMOVAL AND REPLACEMENT                              | N3.12 |
| 10      | HEATER BOX, COMPLETE - REMOVAL AND REPLACEMENT                          | N3.13 |
| 11      | HEATER/BLOWER FAN MOTOR - REMOVAL AND REPLACEMENT                       | N3.14 |

## SUB-SECTION N3

### CHAPTER 1

#### HEATER CONTROLS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the heater controls in the cab:

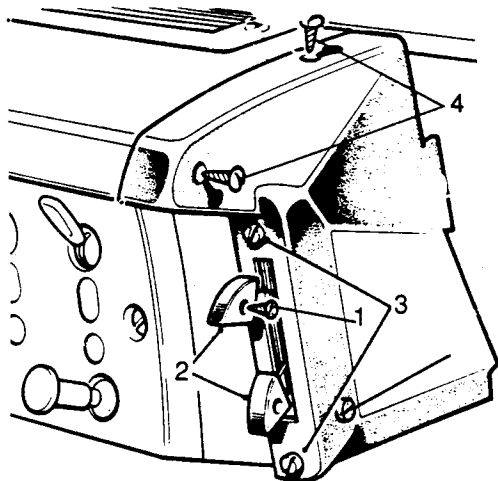


Fig N3.1

- (1) Refer to Fig N3.1. Remove the fixings (1) and withdraw the finger grips (2).
- (2) Remove the fixings, control lever assembly to end panel (3).
- (3) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).
- (4) Remove the end panel fixings (4). The lower screw at the side has a loose nut behind the instrument panel.

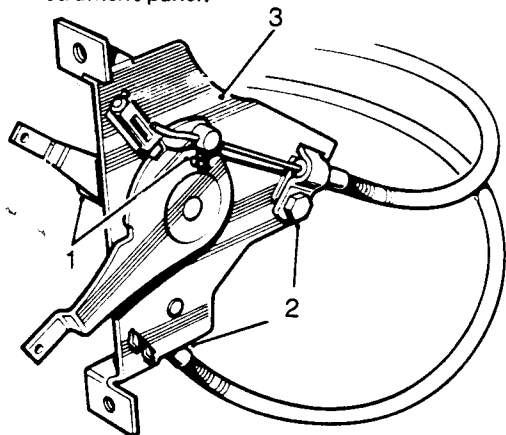


Fig N3.2

- (5) Refer to Fig N3.2. Slacken the inner cables grub screws (1).
- (6) Slacken the outer cables clamp screws (2).
- (7) Withdraw the heater control assembly (3).

##### REPLACEMENT

2. To replace the heater controls:

- (1) Refit the control cables outers under the clamps and tighten the clamp screws. Note that the cable from the left hand lever is connected to the water valve in the engine compartment.
- (2) Fit the cable inners to the levers and temporarily tighten the grub screws.
- (3) Operate each lever and check that the left hand lever causes the water valve push rod to operate over the full range. The right hand lever should operate the air distribution flaps from fully open to fully closed.

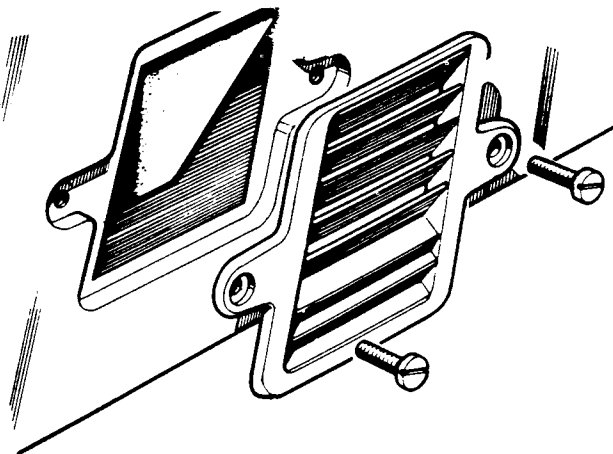


Fig N3.3

##### NOTE

Refer to Fig N3.3. The operation of the flaps can be checked by removing the air outlet grilles in the lower fascia.

- (4) Slacken the grub screws and adjust the cable inners if necessary until the water valve and flaps operate over the correct range. Tighten the grub screws.
- (5) Offer up the control assembly to the end plate and secure with the two fixing screws ((3) on Fig N3.1).
- (6) Replace the end panel and secure with the three screws. The lower screw has a loose nut behind the dash.
- (7) Replace the finger grips: HOT/COLD to the left hand lever and DEF/CAR to the right hand lever.
- (8) Refit the instrument panel into the dash.

## SUB-SECTION N3

### CHAPTER 2

#### AIRFLOW CONTROL CABLE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the heater/ventilator air flow control cable:
  - (1) Remove the heater controls up to step (4) in Sub-section N3, Chapter 1.
  - (2) Remove the lower facia.

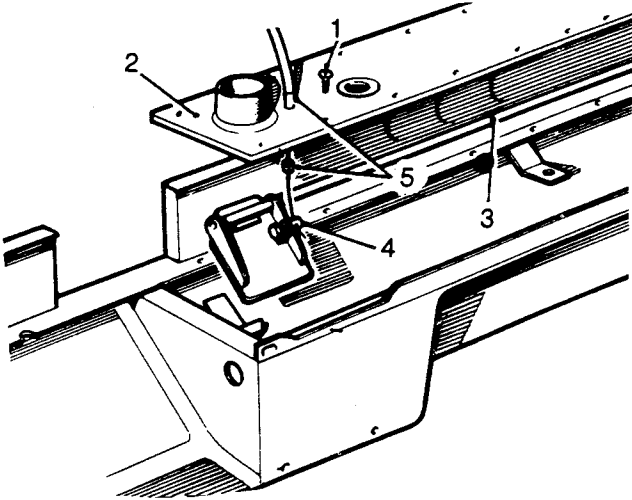


Fig N3.4

- (3) Refer to Fig N3.4. Remove the heater ducting cover fixings (1).
  - (4) Withdraw the ducting cover (2) to gain access to the air distribution flaps.

- (5) Withdraw the distribution flaps from the facia (3).
  - (6) Disconnect the inner cable at the flaps (4).
  - (7) Withdraw the outer cable (5) retained at the ducting cover by a tubular clip.

##### REPLACEMENT

2. Replace the air flow control cable as follows:
  - (1) Refit the outer cable (5) and secure.
  - (2) Connect the inner cable to the flaps (4).
  - (3) Fit the distribution flaps to the facia (3).
  - (4) Replace the ducting cover (2) and secure with the fixings (1).
  - (5) Replace the lower facia.
  - (6) Refit the heater controls (see Sub-section N3, Chapter 1).

## SUB-SECTION N3

### CHAPTER 3

#### HEATER WATER VALVE CONTROL CABLES - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the cable:
  - (1) Remove the heater controls (see Sub-section N3, Chapter 1).

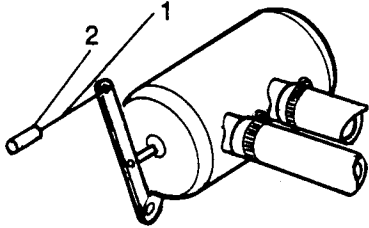


Fig N3.5

- (2) Refer to Fig N3.5. Disconnect the inner (1) and outer (2) cables at the water valve control lever (3).
  - (3) Withdraw the cable through the dash grommet.

##### REPLACEMENT

2. Replace the cable as follows:
  - (1) Feed the cable end through the grommet in the dash.
  - (2) Connect the inner and outer of the cable to the water valve control lever. Do not tighten the inner fixing at this stage.
  - (3) Replace the heater controls (see Sub-section N3, Chapter 1).
  - (4) Set the water valve in the closed position (push rod fully in).
  - (5) Set the cable control lever in the fully up 'cold' position.
  - (6) Take up all slack in the inner cable then tighten the inner cable fixing at the water control valve lever.

## SUB-SECTION N3

### CHAPTER 4

#### HEATER WATER VALVE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the water valve:

- (1) Partially drain the coolant from the radiator.

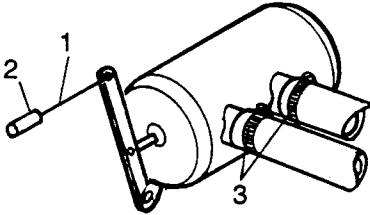


Fig N3.6

- (2) Refer to Fig N3.6. Slacken the inner (1) and outer (2) cable fixings.
- (3) Free the inner cable and withdraw from the valve.
- (4) Release the heater hose clips (3) and slide the hoses away from the valve.
- (5) Remove the fixings and lift out the valve.

##### REPLACEMENT

2. Replace the valve as follows:

- (1) Fit the valve into position and secure with the fixings.
- (2) Slide the heater hose out the valve and tighten the hose clips.
- (3) Replace the inner and outer cables and tighten the outer cable clamp. Do not tighten the inner cable fixing at this stage.
- (4) Set the water valve in the closed position (push rod fully in).
- (5) Set the control lever in the cab to cold (up).
- (6) Take up all the slack in the inner cable and tighten the fixing.
- (7) Refill the radiator.

## SUB-SECTION N3

### CHAPTER 5

#### HEATER FAN SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove the switch as follows:

- (1) Disconnect the battery earth lead.

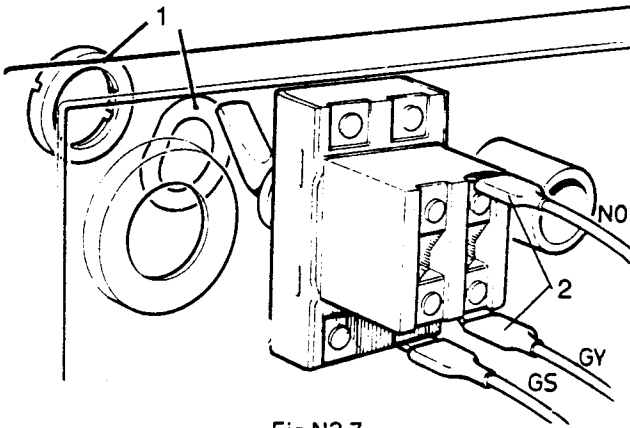


Fig N3.7

- (2) Refer to Fig N3.7. Unscrew the lockring (1) and withdraw the wave washer from the switch knob.
- (3) Withdraw the instrument panel from the dash (see Sub-section O5, Chapter 27).
- (4) Disconnect the leads from the switch.
- (5) Withdraw the switch.

##### REPLACEMENT

2. To replace the switch:

- (1) Fit the switch into the instrument panel. Orientate with the two inner terminals (2) on the right looking at the back of the switch.
- (2) Secure the switch with the wave washer and lockring.
- (3) Reconnect the leads to the switch terminals as shown in the illustration above.
- (4) Replace the instrument panel into the dash.
- (5) Reconnect the battery earth lead.

##### Lead colours:

N - Brown  
O - Orange  
G - Green  
Y - Yellow  
S - Slate

CHAPTER 6

DEMISTER HOSE - REMOVAL AND REPLACEMENT

REMOVAL

Passenger's Side Hose

1. To remove the hose on the passenger side:

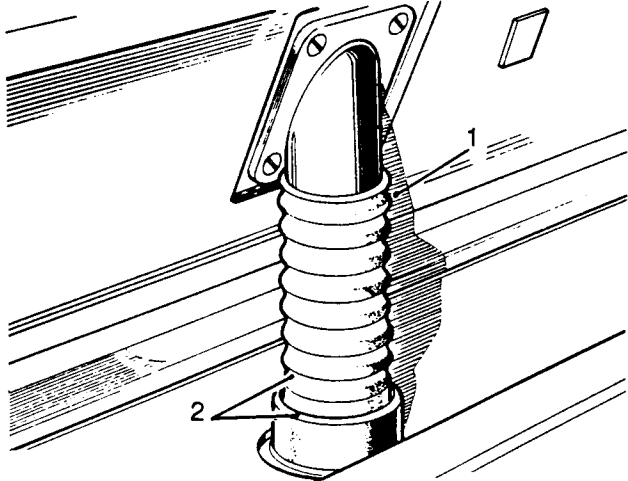


Fig N3.8

- (1) Refer to Fig N3.8. Pull the hose upper end (1) off the nozzle adaptor.
- (2) Withdraw the hose from the rubber connector (2).

Driver's Side Hose

2. To remove the hose on the driver's side:

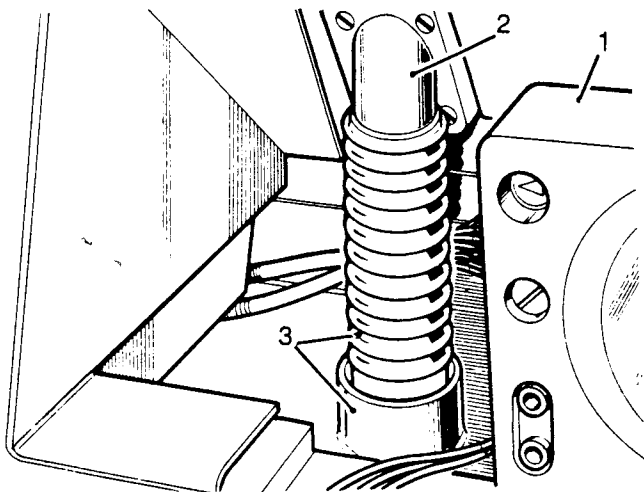


Fig N3.9

- (1) Refer to Fig N3.9. Withdraw the instrument panel (1) sufficiently to gain access to the hose (see Sub-section O5, Chapter 27).
- (2) Pull the upper end of the hose downwards off the nozzle adaptor (2).

- (3) Withdraw the hose from the rubber connector (3).

REPLACEMENT

Passenger Side Hose

3. To replace the passenger side hose:

- (1) Fit the hose, either way up, into the rubber connector.
- (2) Slide the upper end of the hose over the nozzle adaptor.

Driver's Side Hose

4. Replace the hose as follows:

- (1) Fit the hose, either way up, into the rubber connector.
- (2) Slide the upper end of the hose over the nozzle adaptor.
- (3) Replace the instrument panel.



## SUB-SECTION N3

### CHAPTER 7

#### DEMISTER NOZZLES - REMOVAL AND REPLACEMENT

##### REMOVAL

###### Passenger's Side Nozzle

1. To remove the nozzle:

- (1) Remove the demister hose (see Sub-section N3, Chapter 6).

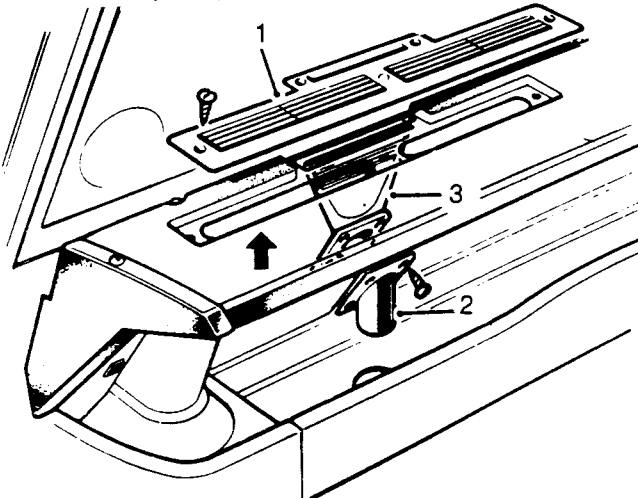


Fig N3.10

- (2) Refer to Fig N3.10. Remove the fresh air grille (1) (two screws).
- (3) Remove the nozzle adaptor fixings and withdraw the adaptor (2).
- (4) Manoeuvre the nozzle (3) out through the fresh air grille aperture.

###### Driver's Side Nozzle

2. Remove the nozzle as follows:

- (1) Disconnect the battery earth lead.
- (2) Remove the upper and lower shrouds from the steering column (6 screws). Note that the large screws in the bottom shroud holds the fuse box. Do not remove these screws.

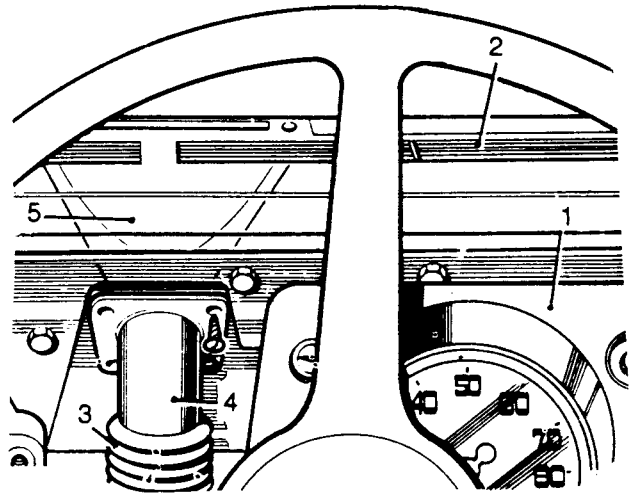


Fig N3.11

- (3) Refer to Fig N3.11. Withdraw the instrument panel (1) clear of the dash (see Sub-section O5, Chapter 27).
- (4) Remove the fresh air grille (2) (two screws).
- (5) Withdraw the demister hose (3) (see Sub-section N3, Chapter 6).
- (6) Remove the fixings from the nozzle adaptor (4) and remove the adaptor.
- (7) Manoeuvre the nozzle (5) out through the fresh air grille aperture.

##### REPLACEMENT

###### Passenger's Side Nozzle

3. To replace the nozzle:

- (1) Manoeuvre the nozzle in through the fresh air grille aperture.
- (2) Fit the nozzle adaptor and secure with the four screws.
- (3) Replace the fresh air grille.
- (4) Replace the demister hose (see Sub-section N3, Chapter 6).

#### **Driver's Side Nozzle**

4. Replace the driver's side nozzle as follows:

- (1) Manoeuvre the nozzle into position through the fresh air grille aperture.
- (2) Fit the nozzle adaptor and secure with the four screws.
- (3) Replace the demister hose (see Sub-section N3, Chapter 6).
- (4) Refit the fresh air grille (two screws).
- (5) Replace the instrument panel in the dash.
- (6) Refit the upper and lower shrouds to the steering column.
- (7) Reconnect the battery earth lead.

## SUB-SECTION N3

### CHAPTER 8

#### VENTILATOR GRILLE PANEL AND QUADRANT ASSEMBLY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the grille panel and quadrant assembly:

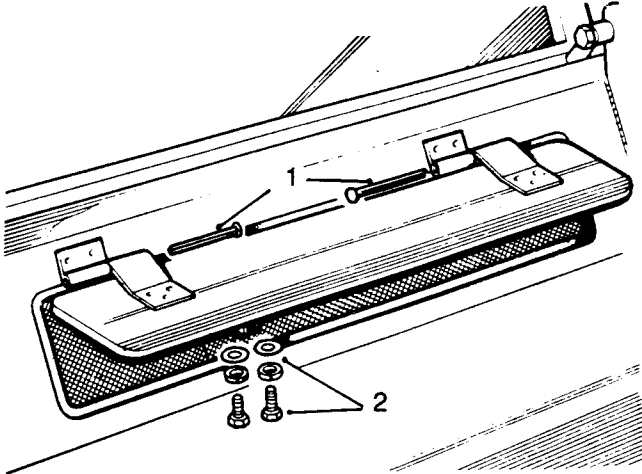


Fig N3.12

- (1) Refer to Fig N3.12. Remove the hinge pins (1) and grille panel.
- (2) Remove the control lever fixings (2).

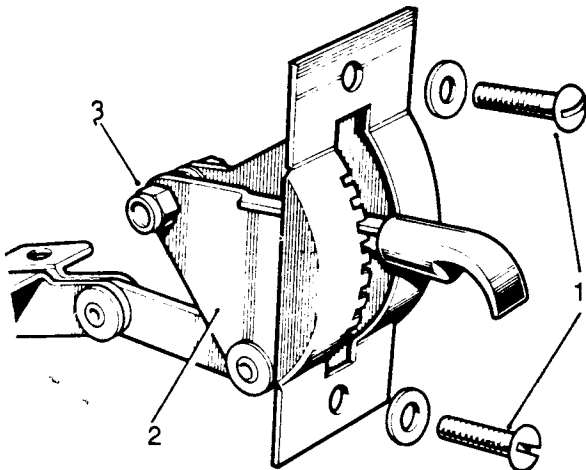


Fig N3.13

- (3) Refer to Fig N3.13. Remove the ventilator to dash fixings (1) and withdraw the ventilator control and quadrant assembly (2).

##### REPLACEMENT

2. Replace the grille panel and quadrant as follows:
  - (1) Check lever operation in the quadrant. If required adjust the special locknut (3) to alter the spring loading on the lever.
  - (2) Replace the ventilator control and quadrant assembly and secure with the ventilator to dash fixings.
  - (3) Refit the control lever fixings.
  - (4) Replace the grille and hinge pins.

## SUB-SECTION N3

### CHAPTER 9

#### FRESH AIR INTAKE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. Remove the fresh air intake on the left hand side fender just in front of the passenger door as follows:

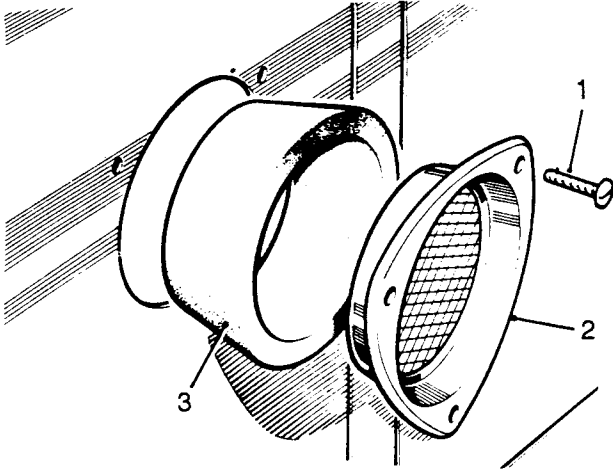


Fig N3.14

- (1) Refer to Fig N3.14. Remove the fixings (1).

- (2) Withdraw the intake grille assembly (2).

- (3) If required, withdraw the air inlet seal (3).

##### REPLACEMENT

2. To replace the fresh air intake:

- (1) Refit the air inlet seal (3).

- (2) Replace the intake grille assembly (2) and secure with the fixings (1).

## SUB-SECTION N3

### CHAPTER 10

#### HEATER BOX COMPLETE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the heater box:

(1) From inside the cab remove the trim stuck to the bulkhead panel.

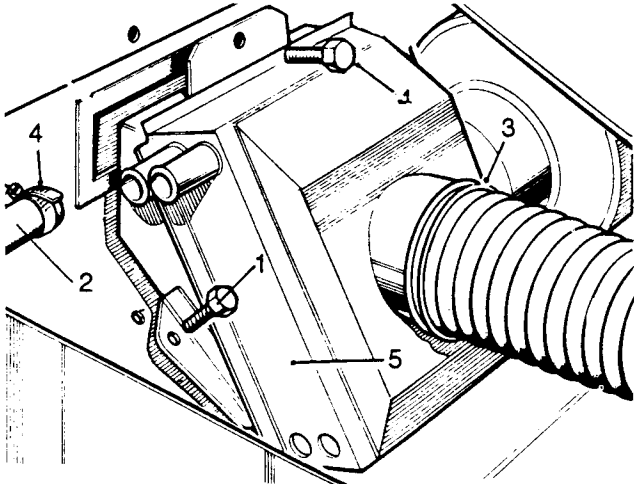


Fig N3.15

- (2) Refer to Fig N3.15. Open the bonnet and remove the heater box lower fixings (1).
- (3) Disconnect the heater water hoses (2).
- (4) Disconnect the air inlet hose (3).
- (5) Remove the heater box upper fixing (4).
- (6) Withdraw the heater box (5).

2. If radiator removal is required for inspection purposes, continue as follows:

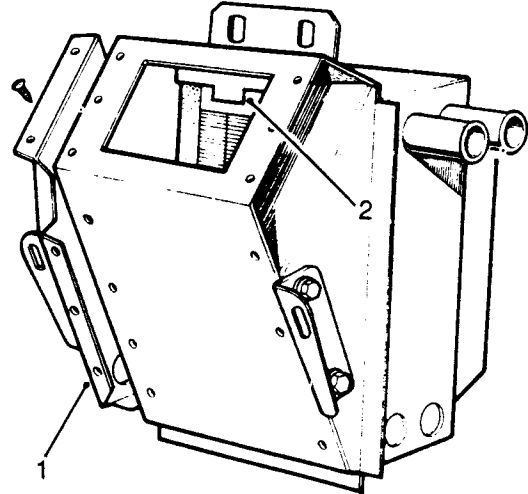


Fig N3.16

- (1) Refer to Fig N3.16. Remove the fixings and withdraw the detachable side panel (1).
- (2) Withdraw the radiator and pipes assembly. (2)

##### REPLACEMENT

3. Fit the radiator if it has been removed:

- (1) Replace the radiator and pipes assembly.
- (2) Refit the side panel and secure with the fixings.

4. Replace the heater box:

- (1) Fit the heater box into position and secure with the upper and lower fixings.
- (2) Refit the air inlet hose.
- (3) Restick the trim to the bulkhead panel.

CHAPTER 11

HEATER/BLOWER FAN MOTOR - REMOVAL AND REPLACEMENT

REMOVAL

1. To remove the motor:

- (1) Disconnect the battery earth lead.
- (2) Disconnect the blower motor leads ((1) on Fig N3.18).
- (3) From inside the cab, remove the trim stuck to the bulkhead panel.

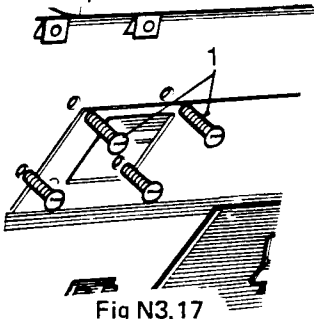


Fig N3.17

- (4) Refer to Fig N3.17. Still inside the cab, remove the blower motor fixings (1).

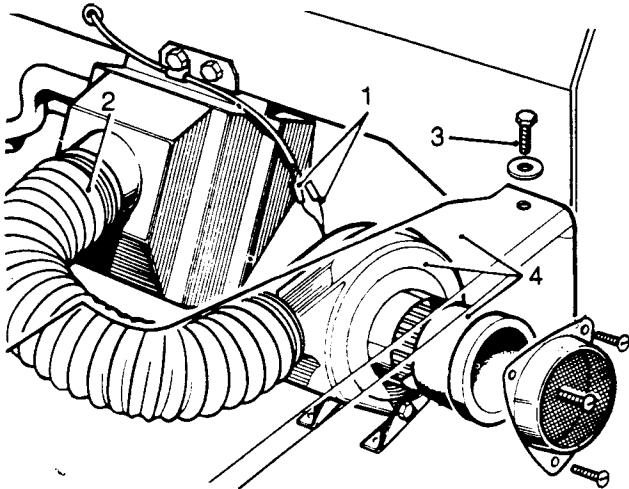


Fig N3.18

- (5) Refer to Fig N3.18. Lift the bonnet and disconnect the air hose at the matrix inlet (2).
- (6) Remove the wing panel rear top fixing bolt (3).

- (7) Manoeuvre the blower motor assembly clear, lifting the wing panel sufficiently to allow passage. (4)

- (8) Remove the air inlet seal (see Sub-section N3, Chapter 9).

REPLACEMENT

2. To replace the blower motor:

- (1) Place the motor in position.
- (2) Fit the air inlet seal and replace the intake grille (see Sub-section N3, Chapter 9).
- (3) Replace the wing panel rear top fixing bolt.
- (4) Reconnect the air hose to the matrix inlet.
- (5) In the cab, replace the blower motor fixings ((1) on Fig N3.17).
- (6) Restick the trim to the bulkhead panel.
- (7) Back in the engine compartment, reconnect the blower motor leads: The brown lead with the green marker band connects to the green/slate lead. The green lead connects to the green/yellow lead.
- (8) Reconnect the battery earth lead.

## **SUB-SECTION N4**

### **MAINTENANCE**

1. The heating and ventilating system is relatively trouble free, requiring only periodic inspection for obvious defects.
2. At intervals, check for water leaks from the joints in the hoses to the water valve. Check for smooth operation of the water valve rod and cable.
3. Keep the electrical leads to the blower motor clean and ensure that the connections are tight. Wipe off accumulated dust and dirt with a clean, dry cloth and clean the air inlet grille occasionally.

SECTION CONTENTS LIST

SECTION O

ELECTRICAL SYSTEM

| SUB-SECTION | DESCRIPTION                              | PAGE |
|-------------|------------------------------------------|------|
| O1          | DESCRIPTION AND SPECIFICATIONS           | O1.1 |
| O2          | FAULT DIAGNOSIS AND CORRECTIVE ACTION    | O2.1 |
| O3          | TESTING ALTERNATOR IN SITU               | O3.1 |
| O4          | ALTERNATOR DRIVE BELT - ADJUSTING        | O4.1 |
| O5          | REMOVAL AND REPLACEMENT                  | O5.1 |
| O6          | CLEANING, REPAIR AND OVERHAUL PROCEDURES | O6.1 |
| O7          | MAINTENANCE                              | O7.1 |
| O8          | WIRING DIAGRAMS                          | O8.1 |
| O9          | SPECIAL WORKSHOP TOOLS                   | O9.1 |

**CAUTION**  
Before working on the electrical system read the cautionary notes at the beginning of Sub-section O1, Chapter 1.



SUB-SECTION CONTENTS LIST

SUB-SECTION 01

DESCRIPTION AND SPECIFICATIONS

| CHAPTER | DESCRIPTION                          | PAGE |
|---------|--------------------------------------|------|
| 1       | DESCRIPTION OF THE ELECTRICAL SYSTEM | 01.3 |
| 2       | ELECTRICAL SYSTEM SPECIFICATIONS     | 01.7 |

## SUB-SECTION 01

### CHAPTER 1

#### DESCRIPTION OF THE ELECTRICAL SYSTEM

##### CAUTIONS

1. *Before carrying out any repairs or maintenance to an electrical component, always disconnect the battery.*
2. *The V-drive fan belt used with alternators is not the same as that used with d.c. machines. Use only the correct replacement fan belt. Occasionally check that the engine and alternator pulleys are accurately aligned.*
3. *It is essential that good electrical connections are maintained at all times. Of particular importance are those in the charging circuit (including those at the battery) which should be occasionally inspected to see that they are clean and tight. In this way any significant increase in circuit resistance can be prevented.*
4. *Do not disconnect battery cables while the engine is running or damage to the semiconductor devices may occur. It is also inadvisable to break or make any connections in the alternator charging and control circuits while the engine is running.*
5. *When using rapid charge equipment to recharge the battery, the battery must be disconnected from the vehicle.*
6. *When using electric arc welding equipment in the vicinity of the engine take the following precautions to avoid damage to the semiconductor devices used in the alternator and control unit and also to the ignition system:*
  - (1) *Disconnect battery earthed lead.*
  - (2) *Disconnect alternator output cables.*
7. *Alternator testing and repairs must only be undertaken by a qualified auto electrician or the local agents.*

##### INTRODUCTION

1. The main components of the electrical system are a 12 V battery charged by an engine-driven alternator. The battery drives the fuel pump, road and cab lights via switches, the ignition system, the starter motor and solenoid, and various warning and indicator lamps in the cab. Four fuses, rated at 17A continuous and 35A blow, are fitted to protect the battery from overloads in the low current circuits.
2. The electrical system is negative earth and it is most important to ensure correct polarity of all electrical connections. Incorrect connections made when reconnecting cables may cause irreparable damage to the semiconductor devices used in the alternator and regulator.

3. The electronic voltage regulator employs micro-circuit techniques resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink, ensuring complete protection against the adverse affects of temperature, dust, moisture, etc.

##### ALTERNATOR

4. The Lucas alternator type 21 ACR fitted to the vehicle is a high output three-phase machine which produces current at idling speed.
5. The heatsink-rectifier, terminal block assembly can be removed complete. There are six silicone diodes connected to form a full wave rectifier bridge circuit, and three silicone diodes which supply current to the rotor winding. Individual diodes cannot be removed from the heatsink assemblies. Regulation is by a Lucas type 8TRD control unit mounted in the slip-ring end bracket. There is no provision for adjustment in service.
6. Individual connectors are used to connect external wiring to the alternator. The alternator's main negative terminals are connected internally to the body of the machine. Provision is made for the connection of external negative wiring if required.

##### SURGE PROTECTION DEVICE

7. The surge protection device is a special avalanche-diode, fitted to the outer face of the slip-ring end bracket (not to be confused with a suppression capacitor, similarly fitted in the end bracket). The avalanche-diode is connected between terminal 'IND' and frame and its purpose is to protect the regulator from damage by absorbing high transient voltages which occur in the charging system due to faulty cable connections, or if the cables are temporarily disconnected at the battery whilst the engine is running. The surge protection device is intended to provide limited protection for the regulator under normal working conditions and therefore the service precaution not to disconnect any of the charging system cables, particularly those at the battery, whilst the engine is running, should still be observed.

##### STARTER MOTOR

###### General

8. The 2M100 pre-engaged starter motor is a four pole, four brush machine, 100 mm in diameter, with a series connected field, an armature with a face type commutator and a solenoid operated roller clutch drive.

**Commutator**

9. The face type commutator on the end face of the armature works in conjunction with a fully insulated brush-gear assembly comprising two pairs of wedge shaped brushes and coil type springs assembled into a brushbox moulding. The moulding is riveted to the inside of the commutator end cover. The brushes are provided with a keyway to ensure correct fitting and the springs are held captive in the brushbox moulding.

**Coil Connections**

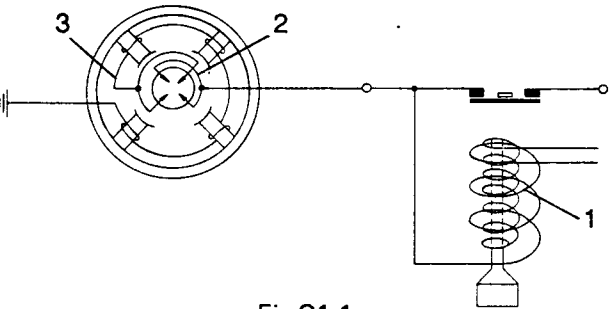


Fig O1.1

10. Refer to Fig O1.1. The field coils are of conventional design but the method of connection is different to that usually employed. The supply voltage to the starter motor is applied via the solenoid (1) direct to one pair of brushes (2). The start of the field winding (3) is connected to the other pair of brushes and the winding terminates at earth (the frame of the starter motor) via a riveted connection to the yoke.

**Armature Movement**

11. End float and axial movement of the armature is determined by the position in which a special type of 'Spire' retaining ring is fixed to the armature shaft, where it extends through the commutator end bracket.

**Drive Engagement Lever**

12. There is no need to set the drive pinion and therefore the operating position of the drive engagement lever is non-adjustable. The plain type pivot pin on which the lever swivels is retained in the fixing bracket by a small special type of 'Spire' retaining ring.

**Roller Clutch**

13. The roller clutch prevents the armature from rotating excessively if the drive remains in mesh after the engine has started.

SUB-SECTION 01

CHAPTER 2

SPECIFICATIONS

INTRODUCTION

1. The specifications for the electrical system are given in the following Tables:

TABLE 01.1 - GENERAL DATA  
TABLE 01.2 - TORQUE SPECIFICATIONS

TABLE 01.1 - GENERAL DATA

| ITEM                                                                                                  | DESCRIPTION                                                               |
|-------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|
| ALTERNATOR                                                                                            |                                                                           |
| Type                                                                                                  | Lucas 21 ACR battery sensed with transistorised current-voltage regulator |
| Nominal voltage                                                                                       | 12 volts                                                                  |
| Regulating voltage                                                                                    | 13,6 to 14,4 volts                                                        |
| Cut-in voltage                                                                                        | 13,5 volts at 2100 rev/min                                                |
| Polarity                                                                                              | Negative earth                                                            |
| Maximum output current                                                                                | 55 amperes at 6000 alternator rev/min                                     |
| Maximum output speed                                                                                  | 12400 rev/min                                                             |
| Rotor winding resistance                                                                              | 3,2 ohms at 20°C (68°F)                                                   |
| Brush spring pressure                                                                                 | 225 to 368 gf (9 to 13 ozf)                                               |
| Minimum brush length                                                                                  | 8 mm (0,312 in)                                                           |
| BATTERY                                                                                               |                                                                           |
| Type                                                                                                  | Lucas C9                                                                  |
| Capacity                                                                                              | 58 Ah at 20 hour rate                                                     |
| STARTER MOTOR                                                                                         |                                                                           |
| Type                                                                                                  | Lucas 2M100 pre-engaged                                                   |
| * Lock torque                                                                                         | 19,52 N.m with 463 A                                                      |
| * Torque at 1 000 r/min                                                                               | 9,9 N.m with 300 A                                                        |
| * Light running current                                                                               | 40 A at 6 000 r/min (approx)                                              |
| BULB AND SEALED BEAM                                                                                  |                                                                           |
| Headlamps with bulbs                                                                                  | Lucas 411, 12 V, 45/50 W, clear                                           |
| Headlamps with sealed beam units                                                                      | Lucas 54521872, 60/45 W                                                   |
| Sidelamps                                                                                             | Lucas 207, 12 V, 4 W                                                      |
| Stop/Tail lamps                                                                                       | Lucas 380, 12 V, 21/5 W                                                   |
| Flasher lamps                                                                                         | Lucas 382, 12 V, 21 W                                                     |
| Rear number plate lamp                                                                                | Lucas 233, 12 V, 4 W                                                      |
| Instrument panel lights                                                                               | Lucas 987, 12 V, 2,2 W MES                                                |
| Warning lights                                                                                        | Lucas 987, 12 V, 2,2 W MES                                                |
| Warning light, brakes                                                                                 | Lucas 280, 12 V, 1,5 W                                                    |
| Warning light, flashers                                                                               | Lucas 281, 12 V, 2 W                                                      |
| Interior light                                                                                        | Lucas 382, 12 V, 21 W                                                     |
| Hazard switch (on dash)                                                                               | Lucas 12 V, 2 W                                                           |
| All blackout lights                                                                                   | Lucas 12 V, 5 W                                                           |
| *Typical performance figures obtained with a 12 V, 60 Ah battery in a 70% charged condition at 20° C. |                                                                           |

TABLE 01.2 - TORQUE SPECIFICATIONS

| ITEM                 | TORQUE<br>(N.m) |
|----------------------|-----------------|
| Alternator shaft nut | 35 to 42        |

SUB-SECTION 02

FAULT DIAGNOSIS AND CORRECTIVE ACTION

INTRODUCTION

1. This Sub-section deals with fault diagnosis and the corrective action required for the electrical system. In the Table below a list of symptoms, the probable cause and the suggested remedies are shown. The Table is not exhaustive and does not indicate faulty bulbs. Should a fault occur in a circuit containing a bulb the first action should be to check the bulb by replacement. If the fault is still present, check wiring and connections between the lamp and the switch or battery.
2. Each of the four fuses protects several circuits, thus if more than one bulb fails, the fuses should be checked first.

TABLE 02.1 - ELECTRICAL SYSTEM FAULT DIAGNOSIS CHART

| SYMPTOM                                                                            | POSSIBLE CAUSE                                                                                                                                                                                   | REMEDY                                                                                                                                                                            |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Battery in low state of charge                                                     | Broken or loose connection in alternator circuit.<br><br>Current voltage regulator not functioning correctly.<br>Slip rings greasy or dirty.<br>Brushes worn not fitted correctly or wrong type. | Examine the charging and field circuit wiring. Tighten any loose connections and renew any broken leads. Examine the battery connection. Adjust or renew.<br><br>Clean.<br>Renew. |
| Battery over-charging, leading to burnt-out bulbs and frequent need for topping-up | Current voltage regulator not functioning correctly.                                                                                                                                             | Renew.                                                                                                                                                                            |
| Lamps giving insufficient lumination                                               | Battery discharged.<br><br>Bulbs discoloured through prolonged use.                                                                                                                              | Charge the battery from an independent supply or by a long period of daylight running.<br>Renew.                                                                                  |
| Lamps light when switched on but gradually fade out                                | Battery discharged.                                                                                                                                                                              | Charge the battery from an independent supply or by a long period of daylight runnings.                                                                                           |
| Lights flicker                                                                     | Loose connection.                                                                                                                                                                                | Tighten.                                                                                                                                                                          |
| Failure of lights                                                                  | Battery discharged.<br><br>Loose or broken connection.                                                                                                                                           | Charge the battery from an independent supply or by a long period of daylight running.<br>Locate and rectify.                                                                     |
| Starter motor lacks power or fails to turn engine                                  | Stiff engine.<br><br>Battery discharged.                                                                                                                                                         | Locate cause and rectify.<br><br>Charge the battery either by a long period of daytime running or from independent electrical supply.                                             |

TABLE O2.1 - ELECTRICAL SYSTEM FAULT DIAGNOSIS - Continued

| SYMPTOM                                                                        | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                                                                                                                                                                                              | REMEDY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                | Broken or loose connection in starter circuit.<br><br>Greasy or dirty slip rings.<br>Brushes worn, not fitted correctly or wrong type.<br>Brushes sticking in holders or incorrectly tensioned.<br>Starter pinion jammed in mesh with flywheel.                                                                                                                                                                                                                             | Check and tighten all battery, starter and switch connections and check the cables connecting these units for damage.<br>Clean.<br>Renew.<br><br>Rectify.<br><br>Remove starter motor and investigate.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Starter noisy                                                                  | Starter pinion or flywheel teeth chipped or damaged.<br>Starter motor loose on engine.<br><br>Armature shaft bearing.                                                                                                                                                                                                                                                                                                                                                       | Renew.<br><br>Rectify, checking pinion and the flywheel for damage.<br>Renew.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Starter operates but does not crank the engine                                 | Pinion of starter does not engage with the flywheel.                                                                                                                                                                                                                                                                                                                                                                                                                        | Check operation of starter solenoid. If correct, remove starter motor and investigate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Starter pinion will not disengage from the flywheel when the engine is running | Starter pinion jammed in mesh with the flywheel.                                                                                                                                                                                                                                                                                                                                                                                                                            | Remove starter motor and investigate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Engine will not fire                                                           | The starter will not turn the engine due to a discharged battery.<br><br>Sparking plugs faulty, dirty or incorrect plug gaps.<br>Defective coil or distributor.<br><br>A fault in the low tension wiring is indicated when no spark occurs between the contacts when separated quickly with an insulated screwdriver with the ignition on.<br>Dirty or pitted contacts.<br>Contact breaker out of adjustment.<br>Controls not set correctly or trouble other than ignition. | The battery should be recharged by running the car for a long period during daylight or from an independent electrical supply.<br>Rectify or renew.<br><br>Remove the lead from the centre distributor terminal and hold it approximately 6 mm from some metal part of the engine while the engine is being turned over. If the sparks jump the gap regularly, the coil and distributor are functioning correctly. Renew a defective coil or distributor.<br>Examine all the ignition cables and check that the bottom terminals are secure and not corroded.<br><br>Clean or renew.<br>Adjust.<br>See Starting Procedure in the OMM. |
| Engine misfires                                                                | Distributor points incorrectly set.<br>Faulty coil or condenser.<br>Faulty sparking plugs.<br>Faulty carburetter.                                                                                                                                                                                                                                                                                                                                                           | Adjust.<br>Renew.<br>Rectify.<br>Check and rectify.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

TABLE O2.1 - ELECTRICAL SYSTEM FAULT DIAGNOSIS - Continued

| SYMPTOM                                      | POSSIBLE CAUSE                                                                                                                                                                                                                                                                                       | REMEDY                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Frequent recharging of the battery necessary | Alternator inoperative.<br><br>Loose or corroded connections.<br><br>Slipping fan belt.<br>Voltage control out of adjustment.<br>Excessive use of the starter motor.<br>Vehicle operation confined largely to night driving.<br>Abnormal accessory load.<br><br>Internal discharge of the battery.   | Check the brushes, cables and connections or renew the alternator.<br>Examine all connections, especially the battery terminals and earthing straps.<br>Adjust.<br>Renew.<br>In the hands of the operator.<br>In the hands of the operator.<br><br>Superfluous electrical fittings such as extra lamps etc.<br>Renew. |
| Alternator not charging correctly            | Slipping fan belt.<br>Voltage control not operating correctly.<br>Greasy, charred or glazed slip rings.<br>Brushes worn, sticking or oily.<br>Shorted, open or burnt-out field coils.                                                                                                                | Adjust.<br>Rectify or renew.<br><br>Clean.<br>Rectify or renew.<br>Renew.                                                                                                                                                                                                                                             |
| Alternator noisy                             | Worn, damaged or defective bearings.<br>Cracked or damaged pulley.<br>Alternator out of alignment.<br>Alternator loose in mounting.<br>Excessive brush noise.                                                                                                                                        | Renew.<br><br>Renew.<br>Rectify.<br>Rectify.<br>Check for rough or dirty slip rings, badly seating brushes, incorrect brush tension, loose brushes and loose field magnets. Rectify or renew.                                                                                                                         |
| Defective distributor                        | Contact breaker gap incorrect or points burned and pitted.<br>Distributor cap cracked.<br>Weak or broken contact breaker spring.<br>Excessive wear in distributor shaft brushes, etc.<br>Rotor arm pitted or burned.<br>If the engine lacks power, or misfires, it may be due to a faulty condenser. | Clean and adjust.<br><br>Renew.<br>Renew.<br><br>Renew.<br><br>Clean or renew.<br>Renew the condenser.                                                                                                                                                                                                                |
| Poor performance of horns                    | Low voltage due to discharged battery.<br>Bad connections in wiring.<br><br>Loose fixing bolt.<br>A faulty horn.                                                                                                                                                                                     | Recharge.<br>Carefully inspect all connection and horn push.<br>Rectify.<br>Adjust or renew.                                                                                                                                                                                                                          |

## SUB-SECTION O3

### TESTING THE ALTERNATOR IN SITU

#### EQUIPMENT REQUIRED

1. The following test metres will be required for the tests:
  - a. A moving coil ammeter or multimeter with a range of 0-75 amps.
  - b. A moving coil voltmeter or multimeter with a range of 0-30 volts.

#### OUTPUT TEST

2. This test should be carried out with the alternator at normal temperatures. Run a cold engine at 3000 rev/min for three to four minutes before testing.

(1) Disconnect the battery earth lead.

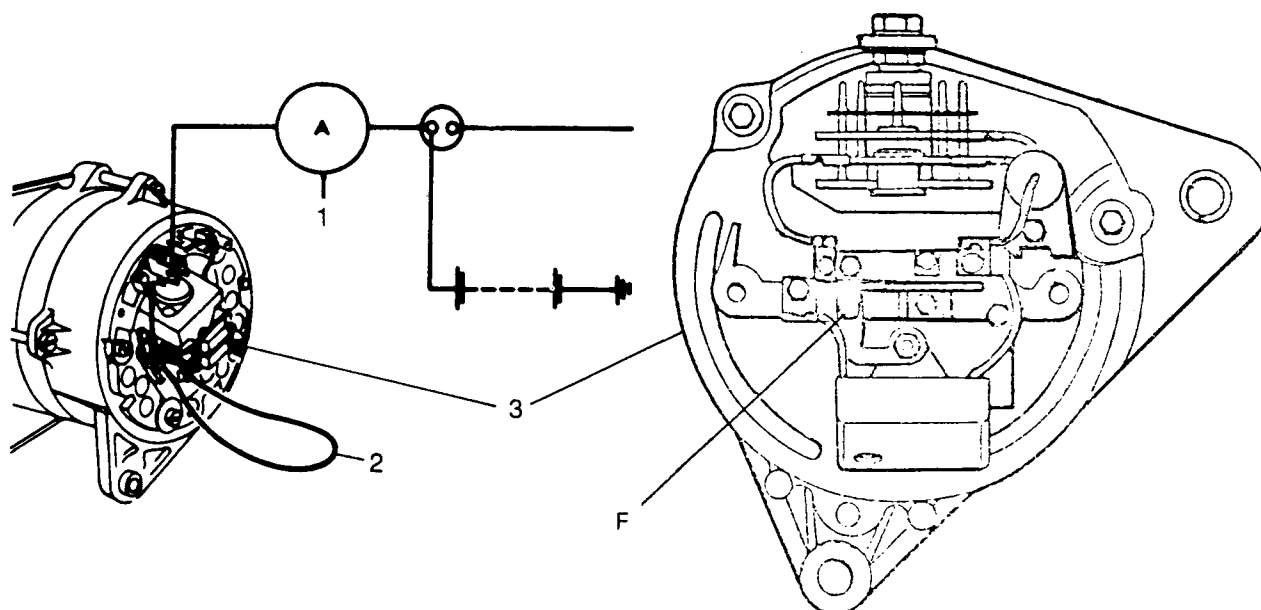


Fig O3.1

- (2) Refer to Fig O3.1. Connect ammeter (1) in series with alternator (3) main output cable and starter solenoid.
- (3) Remove connectors from alternator. Remove moulded end cover and re-make connectors.
- (4) Connect jumper lead (2) to short out the 'F' terminal to earth. (This makes regulator inoperative by effectively linking 'F' green lead to alternator frame).
- (5) Reconnect battery earth lead.



(6) Switch on all vehicle lighting, headlights on main beam. Switch on ignition and check warning light is on.

(7) Start engine, slowly increase speed to 3000 rev/min. Ammeter reading should equal maximum output of 55 amperes.

### VOLTAGE DROP TEST

3. This test checks for an unwanted high resistance in the charging circuit.

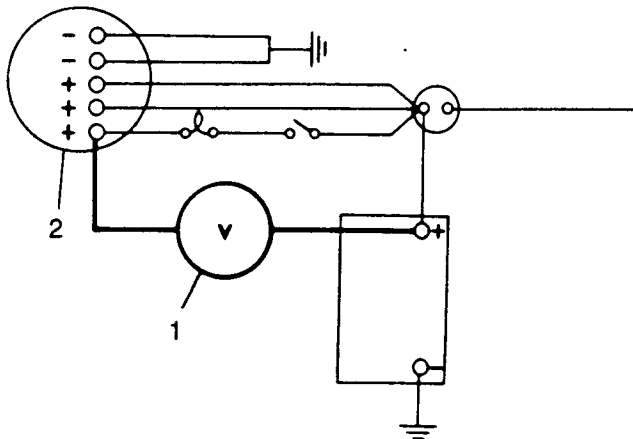


Fig O3.2

(1) Refer to Fig O3.2. Connect voltmeter (1) between battery +ve terminal and alternator main output terminal (2).

(2) Switch on all vehicle lighting, headlights on main beam.

(3) Start engine and run at 3000 rev/min. Note voltmeter reading. Stop engine and switch off the lights.

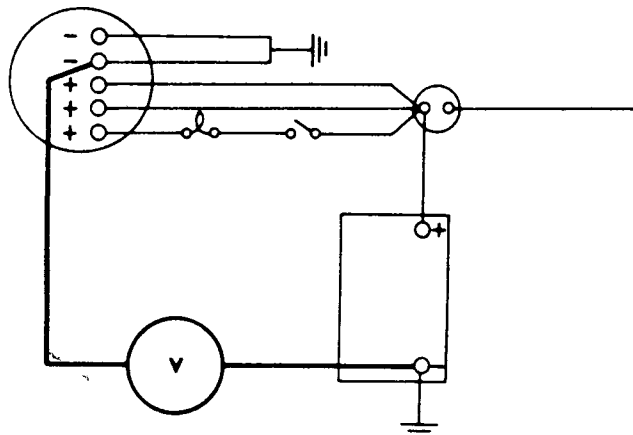


Fig O3.3

(4) Refer to Fig O3.3. Transfer voltmeter connections to battery earth and alternator negative terminal.

(5) Switch on all vehicle lighting, headlights on main beam.

(6) Start the engine and run at 3000 rev/min. Note the voltmeter reading. Stop the engine.

(7) The voltmeter readings in steps (3) and (6) should not be greater than 0,5 volts. Higher readings indicate an unwanted high resistance in the circuit.

### CONTROL UNIT TEST

4. Circuit wiring must be in good condition and all connections clean and secure. The battery must be in a well charged condition or be temporarily replaced by a charged unit. Test the control unit as follows:

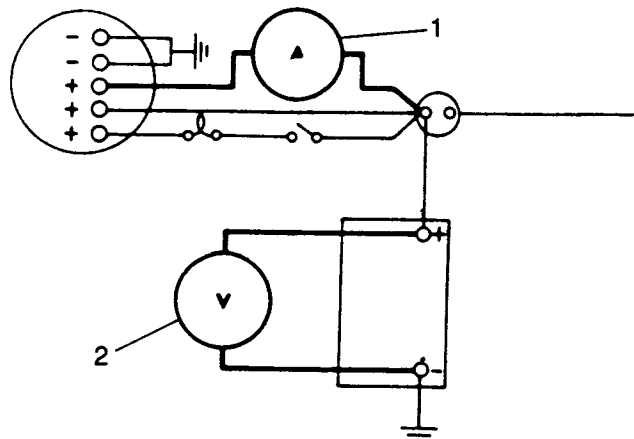


Fig O3.4

(1) Refer to Fig O3.4. Connect ammeter (1) in series with starter solenoid and alternator main output cable.

(2) Connect voltmeter (2) between battery terminals.

(3) Start engine and run at 3000 rev/min until the ammeter reads less than 10 amperes. Voltmeter reading should be between 13,6 volts and 14,4 volts.

(4) An unstable reading or a reading outside the specified limits indicates a faulty control unit.

## SUB-SECTION O4

### ALTERNATOR DRIVE BELT - ADJUSTING

#### CHECKING BELT TENSION

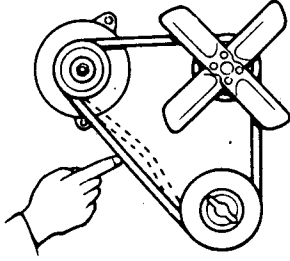


Fig O4.1

- (1) Refer to Fig O4.1. To check belt tension depress the belt at the midway point of its longest run with moderate finger pressure. Deflection is to be 12 mm. If it is more or less than this, retension the belt.

#### TENSIONING THE BELT

##### CAUTION

*Do not use leverage across the alternator body when tensioning the belt.*

2. To tension the belt:

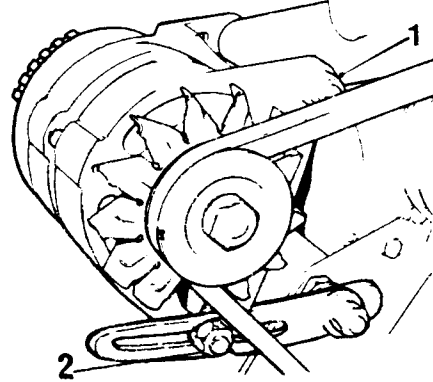


Fig O4.2

- (1) Refer to Fig O4.2. Slacken the nuts (1) securing the alternator to the mounting bracket.
- (2) Slacken the fixings (2) at the adjustment link.
- (3) Pivot the alternator inwards or outwards as necessary and adjust until the correct tension is obtained. Tighten the bolt on the top of the adjustment link.
- (4) Tighten the remaining fixings.
- (5) Recheck tension and readjust if necessary.

SUB-SECTION CONTENTS LIST

SUB-SECTION 05

REMOVAL AND REPLACEMENT

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| 2       | CONTROL UNIT - REMOVAL AND REPLACEMENT                                            | 05.4  |
| 3       | BATTERY - REMOVAL AND REPLACEMENT                                                 | 05.5  |
| 4       | HORN - REMOVAL AND REPLACEMENT                                                    | 05.6  |
| 5       | STARTER MOTOR - REMOVAL AND REPLACEMENT                                           | 05.7  |
| 6       | HEADLAMP ASSEMBLY - REMOVAL AND REPLACEMENT                                       | 05.8  |
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| 24      | BLACKOUT STOP LAMP - REMOVAL AND REPLACEMENT    | O5.27 |
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| 28      | HAZARD WARNING SWITCH - REMOVAL AND REPLACEMENT | O5.32 |

## SUB-SECTION O5

### CHAPTER 1

#### ALTERNATOR - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the alternator:
  - (1) Disconnect the battery earth lead.

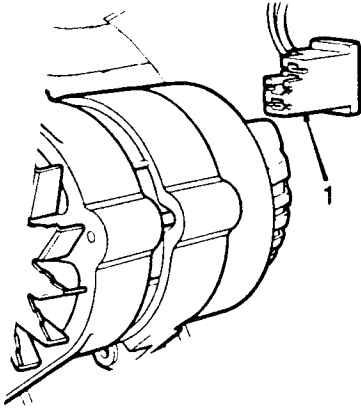


Fig O5.1

- (2) Refer to Fig O5.1. Disconnect the leads from the alternator.

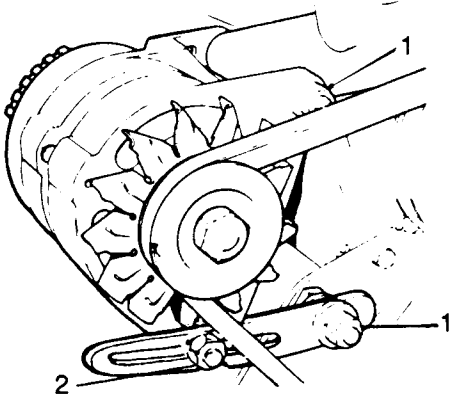


Fig O5.2

- (3) Refer to Fig O5.2. Slacken the alternator fixings (1) and (2). Pivot the alternator inwards towards the engine and remove the drive belt.
  - (4) Remove all fixings and lift out the alternator.

##### REPLACEMENT

2. To replace the alternator:
  - (1) Refer to Fig O5.2. Fit the alternator into position and secure with finger tight fixings (1) and (2).
  - (2) Fit the drive belt and adjust belt tension (see Sub-section O4, Chapter 3).
  - (3) Refer to Fig O5.1. Connect the leads (1) to the alternator.
  - (4) Reconnect the battery.

## SUB-SECTION O5

### CHAPTER 2

#### CONTROL UNIT - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the control unit:
  - (1) Disconnect the battery.
  - (2) Remove the alternator (see Sub-sub-section O5, Chapter 1).

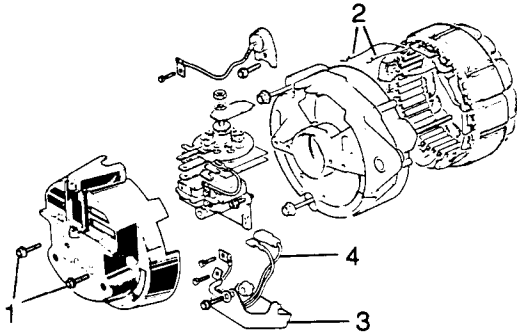


Fig O5.3

- (3) Refer to Fig O5.3. Remove alternator end cover by withdrawing two retaining screws (1).
- (4) Unsolder stator winding connections (2) at rectifier diodes.

##### CAUTION

*It is essential to use a thermal shunt and a light-weight soldering iron.*

- (5) Note position of cables (4) at rectifier plates and disconnect.

- (6) Remove three hexagon headed screws securing brush moulding and regulator (3) to slip-ring end bracket.

- (7) Remove brush gear and regulator from alternator.

##### REPLACEMENT

2. Replace the control unit as follows:

- (1) Refer to Fig O5.3. Replace the brush gear and regulator (3) and secure with the three screws.
- (2) Reconnect the cables (4) to the rectifier plate.
- (3) Solder the stator winding connections (2) to the rectifier diodes.
- (4) Replace the end cover (1) and secure with the two retaining screws.

## SUB-SECTION O5

### CHAPTER 3

#### BATTERY - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The battery is in the cab, under the driver's seat.  
To remove:

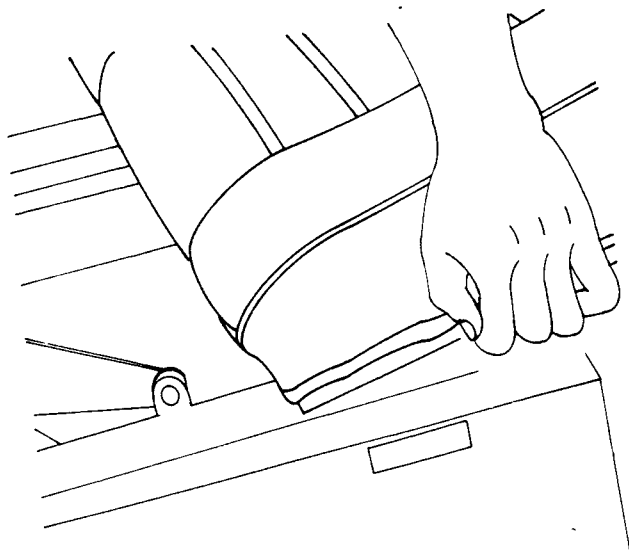


Fig O5.4

- (1) Refer to Fig O5.4. Lift off the seat.

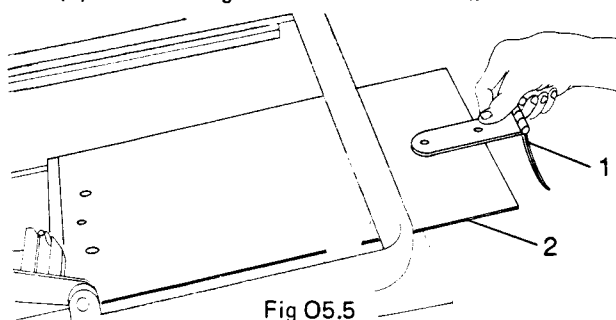


Fig O5.5

- (2) Refer to Fig O5.5. Undo the antiluce fastener (1) in front of the seat frame, lift the plate (2) slightly and pull forward to remove.

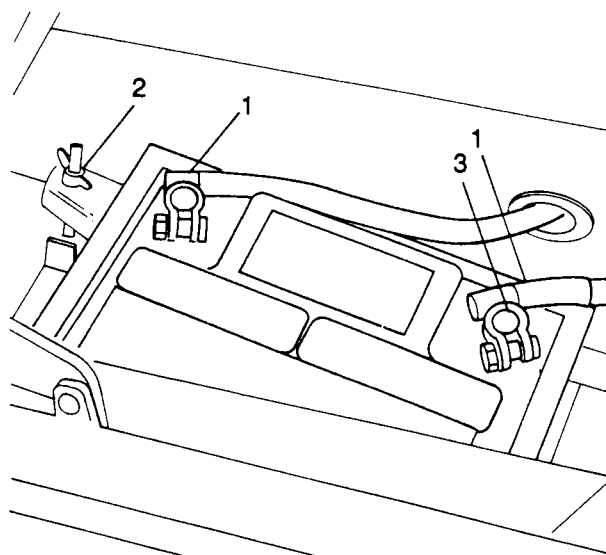


Fig O5.6

- (3) Refer to Fig O5.6. Disconnect the two battery leads (1).
- (4) Remove the two wing nuts (2) and lift off the battery retaining frame.
- (5) Lift out the battery.

##### REPLACEMENT

2. To replace the battery:

- (1) Fig O5.6 still applies. Place the battery into the box with the positive terminal (3) adjacent to the positive (red) lead.
- (2) Refit the battery frame, carefully avoiding contact with the terminals, and secure with the wing nuts (2).
- (3) Remove any oxydization from the leads and terminals with a clean cloth. Fit the leads and secure. Apply a smear of acid resistant grease around the terminals.
- (4) Fig O5.5 still applies. Replace the plate over the battery box and clip the antiluce device into position.
- (5) Replace the seat.

## SUB-SECTION O5

### CHAPTER 4

#### HORN - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the horn:
  - (1) Disconnect the battery earth lead.

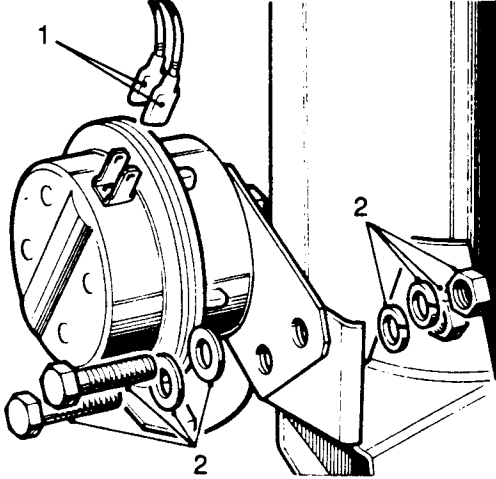


Fig O5.7

- (2) Refer to Fig O5.7. Disconnect the leads (1) from the horn.
  - (3) Remove the fixings (2) and lift the horn out.

##### REPLACEMENT

2. Replace the horn as follows:
  - (1) Offer up the horn to the bracket.
  - (2) Secure with the fixings (2).
  - (3) Replace the horn leads (1). It is immaterial which lead fits to each terminal.



## SUB-SECTION O5

### CHAPTER 5

#### STARTER MOTOR - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the starter motor:
  - (1) Drive the vehicle onto a ramp.
  - (2) Disconnect both battery leads.

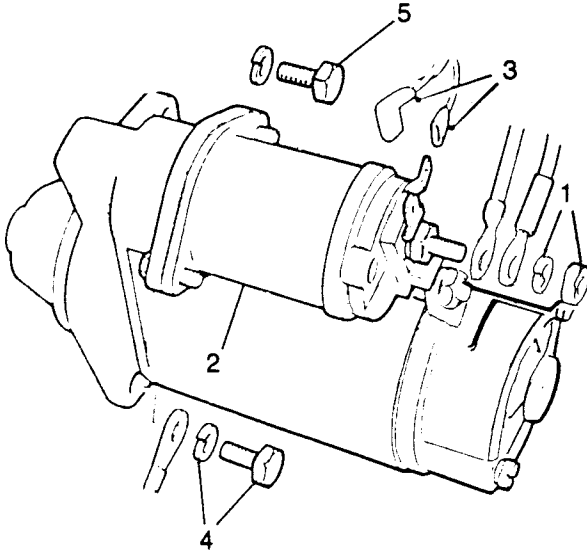


Fig O5.8

- (3) Refer to Fig O5.8. Remove the nut and spring washer (1) and remove the battery lead from the solenoid (2).
- (4) Disconnect the brown and the brown/red leads from their respective connections (3).

- (5) Remove the lower mounting bolt (4), nut and spring washer.
- (6) Remove the upper mounting bolt (5), nut and spring washer, and manoeuvre the starter motor downwards from the vehicle.

##### REPLACEMENT

2. Replace the starter motor as detailed below:
  - (1) Manoeuvre the starter motor upwards into the vehicle and secure with the upper mounting bolt (5) nut and spring washer.
  - (2) Refit the lower mounting bolt (4) nut and spring washer.
  - (3) Reconnect the brown and brown/red leads (3) to their respective connections.
  - (4) Reconnect the battery lead to the solenoid (2) and secure with the nut (1) and spring washer.
  - (5) Reconnect the battery leads.

## CHAPTER 6

## HEADLAMP ASSEMBLY - REMOVAL AND REPLACEMENT

## REMOVAL

1. To remove the headlamp assembly:

- (1) Disconnect the battery earth lead.

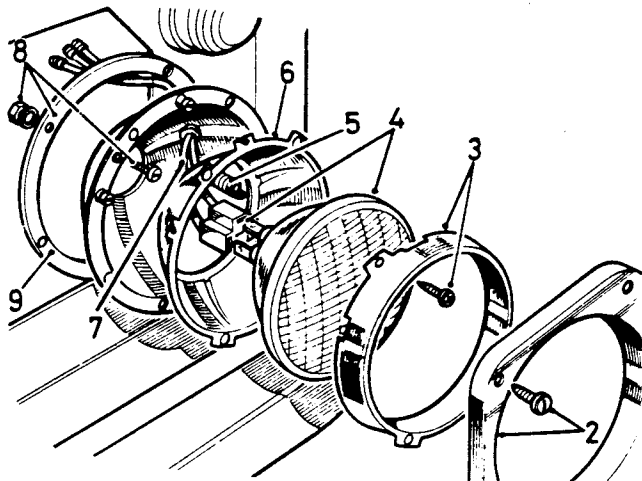


Fig O5.9

- (2) Refer to Fig O5.9. Remove the headlamp Bezel (2).
- (3) Remove the headlamp rim (3).
- (4) Disconnect the headlamp leads at the plug connector and withdraw the light unit (4).
- (5) Disconnect the spring from the headlamp shell (5).
- (6) Withdraw the headlamp shell (6) by rotating it clear of the slotted locations.
- (7) Disconnect the headlamp leads (7) at the snap connectors behind the radiator grille.
- (8) Remove the headlamp mounting shell (8).
- (9) Withdraw the gasket (9).

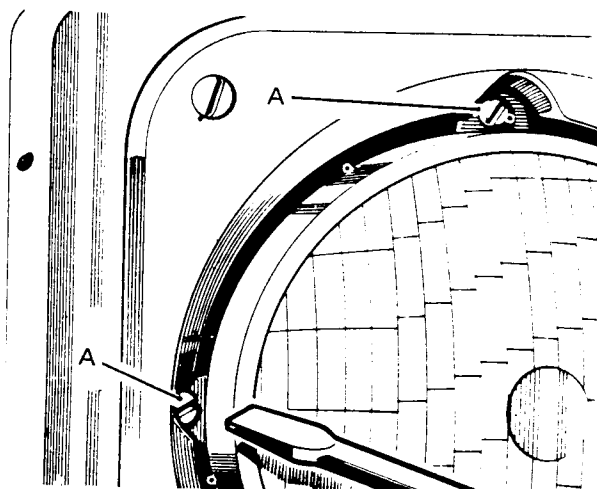
## REPLACEMENT

2. Replace the headlamp assembly as follows:

- (1) Replace the gasket (9).
- (2) Replace the headlamp mounting shell (8) and secure with the bolts, nuts and washers.
- (3) Reconnect the headlamp leads to the snap connectors behind the radiator grille. The connections are:

Blue/Red - dip beam positive.  
Blue/White - main beam positive.  
Black - earth.

- (4) Refit the headlamp shell (6) by rotating it into the slotted locations.
- (5) Reconnect the spring to the headlamp shell (5).
- (6) Refit the light unit (4) and connect the leads to the plug connector.
- (7) Replace the headlamp rim (3) and secure with the self tapping screws.
- (8) Refit the headlamp bezel (2) and secure with the fixing screws.
- (9) Reconnect the battery earth lead.
- (10) Check and if necessary adjust the headlamp using suitable beam setting equipment. The beam setting screws and beam position diagram are given in Fig O5.10 below:



BEAM SETTING SCREWS (A)

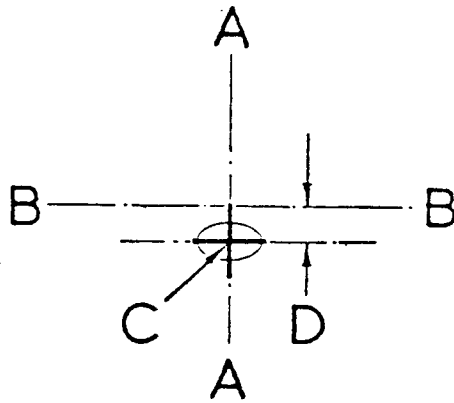


Fig O5.10

#### BEAM SETTING MARKS

- AA = Vertical centre line of headlamp
- BB = Horizontal centre line of headlamp  
measured from level floor
- C = Centre of concentrated area of light
- D = 50 mm  $\pm$  25 mm

FRONT FLASHER LAMP - REMOVAL AND REPLACEMENT

REMOVAL

1. To remove either the flasher or side lamp assembly:

(1) Disconnect the battery earth lead.

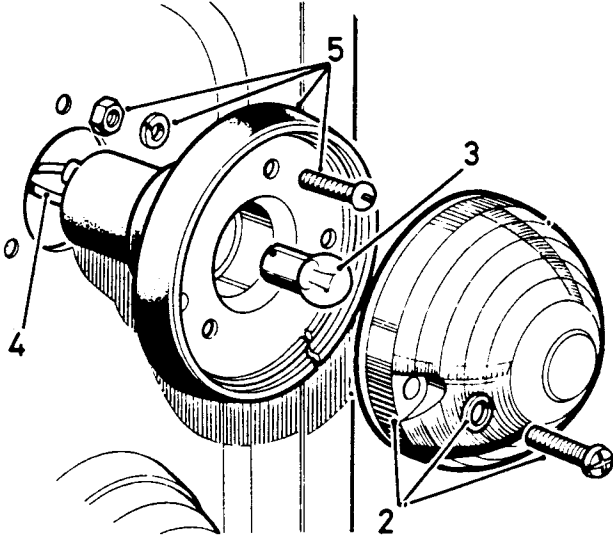


Fig O5.11

(2) Refer to Fig O5.11. Remove the lamp lens (2) after removing the two cross-head bolts and washers.

(3) If required, remove the bulb (3).

(4) Disconnect the lamp leads at the snap connectors (4) in the engine compartment.

(5) Remove the fixings (5) and pull out the lamp body.

REPLACEMENT

2. Replace the assembly as follows:

(1) Fit the lamp body into position and secure with the bolts, nuts and washers (5).

(2) Connect the lamp leads at the snap connectors in the engine compartment: Red lead - positive; Black lead - earth.

(3) Replace the bulb (3).

(4) Refit the lamp lens (2) and secure with the cross head bolts and washers.

(5) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 8

#### COMBINED REAR, FLASHER, STOP AND BL LAMPS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the lamp:

- (1) Disconnect the battery earth lead.

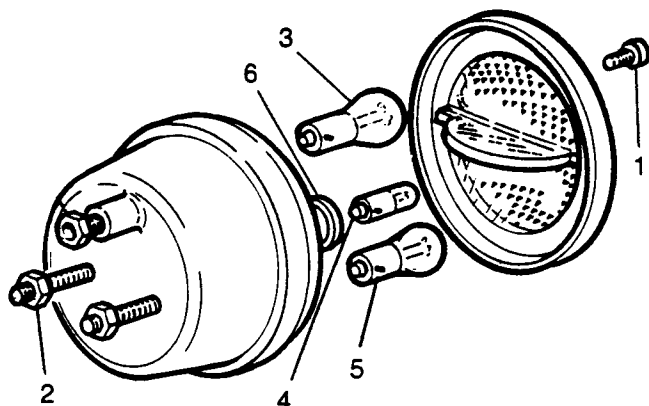


Fig O5.12

- (2) Refer to Fig O5.12. Remove the lens fixings (two screws) (1) and pull off the lens.
- (3) Remove the bulbs if required.
- (4) Remove the fixings for the cover in the rear of the load area behind the lamp (two self tapping screws and one nut) and lift the cover away.
- (5) Disconnect the lamp leads at the snap connectors, making a note of the socket each connector comes from.
- (6) Remove the two bolts (2) holding the lamp to the wall and pull the lamp body away.

##### REPLACEMENT

2. Replace the:

- (1) Position and secure the lens.
- (2) Reconnect the connectors.

- (3) Replace the bulbs:

18 W at the top (3).  
4 W in the centre (4).  
21/5 W at the bottom (5).

- (4) Replace the red tube (6) over the centre bulb.
- (5) Refit the lens with amber at the top and secure with the fixings.
- (6) Reconnect the battery earth lead and check that the bulbs operate correctly:
  - In the amber sector - flasher.
  - In the red sector - normal tail light.
  - normal stop light.
  - blackout tail light.
- (7) Replace the cover in the load area and secure with the two self tapping screws and the screw, two washers and nut.

## SUB-SECTION O5

### CHAPTER 9

#### INSPECTION SOCKETS - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the inspection sockets:

- (1) Disconnect the battery earth lead.
- (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

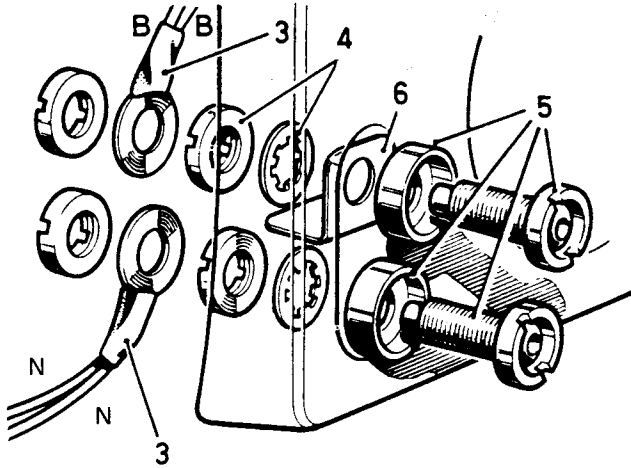


Fig O5.13

- (3) Refer to Fig O5.13. Disconnect the electrical leads (3) from the sockets.

- (4) Remove the screw lock rings, shakeproof washers (4) and insulation tab (6).

- (5) Withdraw the sockets (5).

##### REPLACEMENT

2. Replace the sockets as follows:

- (1) Fit the sockets into the holes (red on top) with the insulation tab (6) central between the two sockets. Secure with the shakeproof washers and lock rings (4).
- (2) Connect the leads to the sockets, black leads to the black socket and the remaining leads to the red socket, and secure with the screws.
- (3) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 10

#### PANEL ILLUMINATION OR WARNING LAMP BULB - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove a lamp bulb:
  - (1) Disconnect the battery earth lead.
  - (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

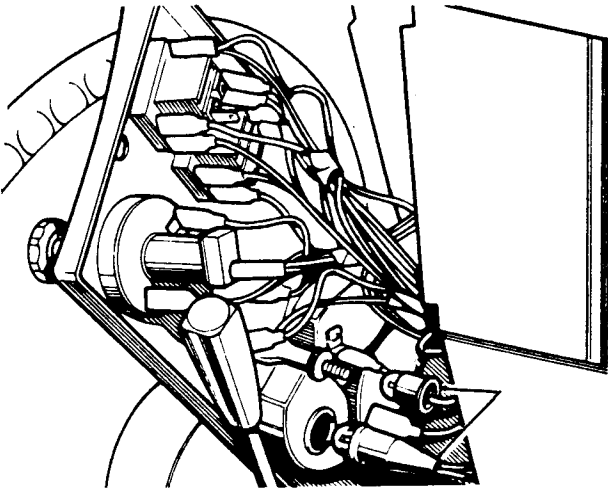


Fig O5.14

- (3) Refer to Fig O5.14. Withdraw the bulb holder and change the bulb as necessary.

##### REPLACEMENT

2. Replace the instrument panel as detailed in Sub-section O5, Chapter 27.

## SUB-SECTION O5

### CHAPTER 11

#### FLASHER UNIT - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The flasher unit is located on the bulkhead behind the instrument panel. To remove the unit:
  - (1) Disconnect the battery earth lead.
  - (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

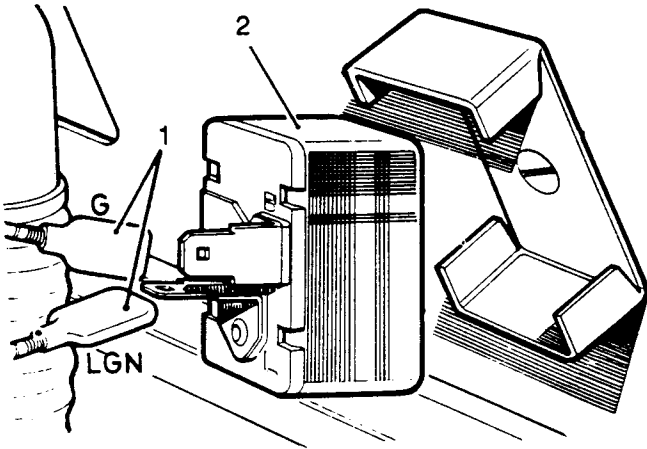


Fig O5.15

- (3) Refer to Fig O5.15. Disconnect the two leads (1) from the flasher unit.
  - (4) Pull the flasher unit (2) forward out of its clip.

##### REPLACEMENT

2. To replace the flasher unit:
  - (1) Fit the flasher unit into the clip.
  - (2) Connect the leads to the flasher unit terminals:

Green lead to the vertical terminal.  
Light green/brown lead to the horizontal terminal.
  - (3) Replace the instrument panel (see Sub-section O5, Chapter 27).

##### Lead colours:

G - Green  
L - Light  
N - Brown



## SUB-SECTION O5

### CHAPTER 12

#### LIGHTING SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the switch:
  - (1) Disconnect the battery earth lead.
  - (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

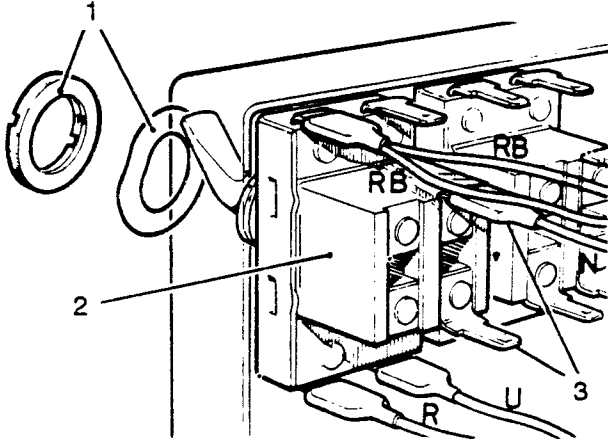


Fig O5.16

- (3) Refer to Fig O5.16. Unscrew the lock ring and wave washer (1) from the switch knob.
- (4) Disconnect the leads from the back of the switch.
- (5) Withdraw the switch (2).

##### REPLACEMENT

2. Replace the switch as follows:
  - (1) Orientate the switch by looking at the back and keeping the two inner terminals (3) to the right.
  - (2) Fit the switch this way up into its mounting hole and secure with the wave washer and lock ring.
  - (3) Connect the leads to the back of the switch in the positions shown on illustration above.
  - (4) Replace the instrument panel.
  - (5) Reconnect the battery earth lead.

##### Lead colours:

R - Red  
B - Black  
N - Brown  
U - Blue

PANEL LIGHT SWITCH - REMOVAL AND REPLACEMENT

REMOVAL

1. The following instructions apply to the panel light switch and to a combined panel and interior light switch. The latter has more leads to the back of the switch. To remove:

- (1) Disconnect the battery earth lead.
- (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

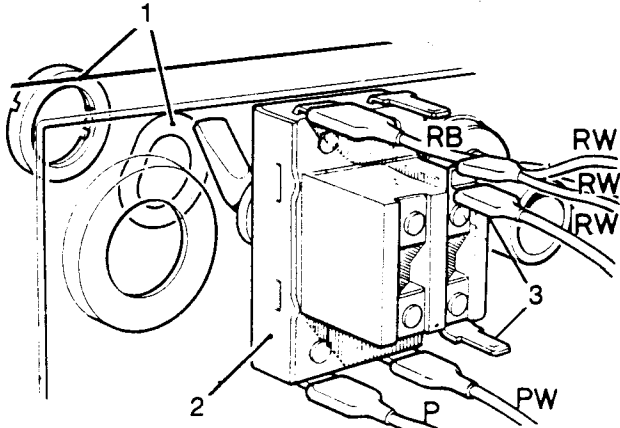


Fig O5.17

- (3) Refer to Fig O5.17. Unscrew the lock ring (1) and remove it and the wave washer (1) from the switch knob.

- (4) Disconnect the leads from the back of the switch.

- (5) Withdraw the switch (2).

REPLACEMENT

2. Replace the switch as follows:

- (1) Orientate the switch by looking at the back and keeping the two inner terminals (3) on the right.
- (2) Fit the switch this way up into the instrument panel mounting hole and secure with the wave washer and lock ring.
- (3) Connect the leads to the back of the switch as shown in the illustration above.
- (4) Replace the instrument panel.
- (5) Reconnect the battery earth lead.

Lead colours:

R - Red  
B - Black  
W - White  
P - Purple

## SUB-SECTION O5

### CHAPTER 14

#### WINDSCREEN WIPER/WASHER SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the switch:

(1) Disconnect the battery earth lead.

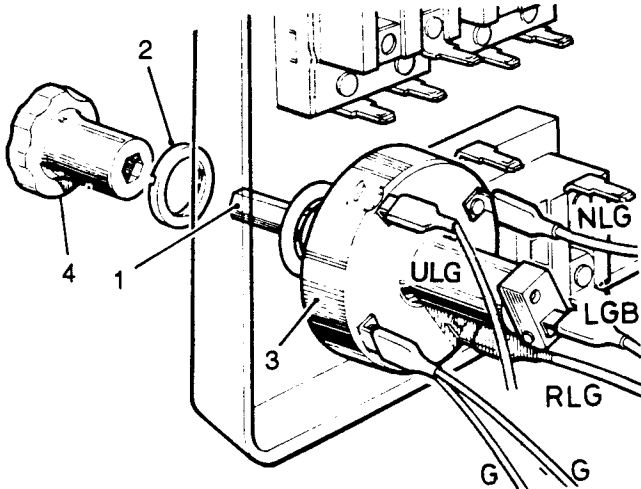


Fig O5.18

(2) Refer to Fig O5.18. Depress the plunger (use a matchstick or similar pointed instrument) and withdraw the switch knob (4).

(3) Unscrew the lock ring (2).

(4) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

(5) Disconnect the leads from the back of the switch and withdraw the switch (3).

##### REPLACEMENT

2. Replace the switch as follows:

(1) Fit the switch through the mounting hole with the centre terminal at the bottom of the block and secure with the lock ring.

(2) Connect the leads to the terminals on the back of the switch as shown in the above Figure.

(3) Refit the instrument panel to the dash.

(4) Push in the plunger and push the switch knob onto the hex rod (1).

(5) Reconnect the battery earth lead.

##### Lead colours:

N - Brown  
G - Green  
R - Red  
B - Black  
U - Blue  
L - Light

## SUB-SECTION O5

### CHAPTER 15

#### STOP LIGHT SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The stop light switch is mounted on a panel behind the servo unit. To remove the switch:

- (1) Disconnect the battery earth lead.
- (2) Raise the bonnet.

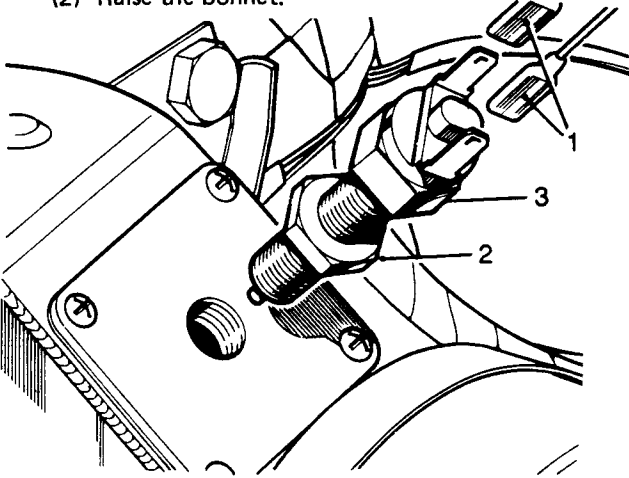


Fig O5.19

- (3) Refer to Fig O5.19. Disconnect the leads (1) from the stop switch.
- (4) Release the lock nut (2) and unscrew the switch (3) from the brake pedal bracket.

##### REPLACEMENT

2. To replace the stop switch:

- (1) Screw the switch into the brake pedal bracket but do not tighten the lock nut at this stage.
- (2) Connect the leads to the switch terminals. It is immaterial which lead goes to which terminal.
- (3) With the ignition on, check that the stop lamp lights at 19 to 25 mm brake pedal travel. If necessary, disconnect the leads and screw the stop switch into or out of the bracket. Reconnect the leads and recheck.
- (4) Carry out step (3) until the correct pedal travel is established.
- (5) Tighten the lock nut without moving the switch.
- (6) Lower the bonnet and reconnect the battery earth lead.

CHOKE WARNING LIGHT SWITCH - REMOVAL AND REPLACEMENT

REMOVAL

1. The choke warning light switch is clamped to the choke cable at the rear of the engine compartment. To remove the switch:

- (1) Disconnect the battery earth lead.

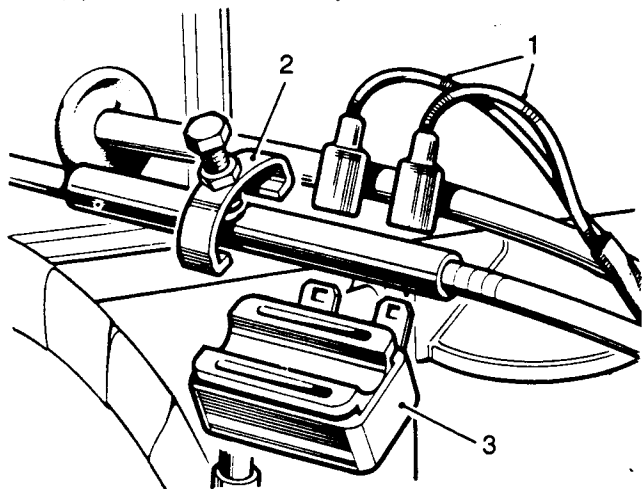


Fig O5.20.

- (2) Refer to Fig O5.20. Disconnect the leads (1) from the switch.
- (3) Remove the clip (2) securing the switch to the choke cable.
- (4) Remove the switch.

REPLACEMENT

2. Replace the switch as follows:

- (1) Offer up the switch to the choke cable.
- (2) Fit the clip and tighten the bolt and lock nut holding it to the choke cable.
- (3) Replace the leads. It is immaterial which lead goes to which terminal.
- (4) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 17

#### COMBINED DIRECTION INDICATOR, HEADLIGHT AND HORN SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the combined switch:

- (1) Disconnect the battery earth lead.
- (2) Remove both halves of the switch shroud from the steering column (six screws in all. The seventh (larger) screw is for the fuse box. Do not remove).

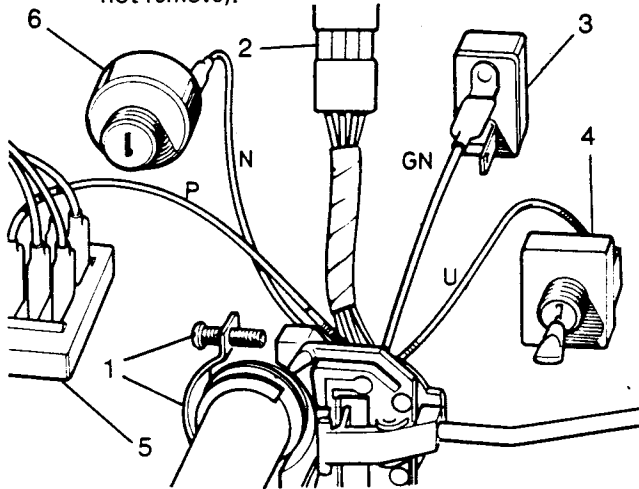


Fig O5.21

- (3) Refer to Fig O5.21. Unscrew the bolt (1) to release the switch from the steering column.
- (4) Withdraw the combined switch sufficient to disconnect the main harness (2) at the plug connector.

(5) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

(6) Disconnect the switch leads from the flasher unit (3), lighting switch (4), fuse box (5) and ignition switch (6). Note that only the leads connected to the switch unit are to be disconnected at the other units.

(7) Withdraw the combined switch.

##### REPLACEMENT

2. Replace the combined switch unit as follows:

(1) Connect the leads from the switch unit to the flasher unit (3), lighting switch (4), fuse box (5) and ignition switch (6) as shown in the illustration above.

(2) Fit the switch unit into position.

(3) Refit the instrument panel to the dash.

(4) Connect the main harness (2) to the plug connector.

(5) Secure the switch unit with the clamp and bolt (1).

(6) Replace the two halves of the shroud.

(7) Reconnect the battery earth lead.

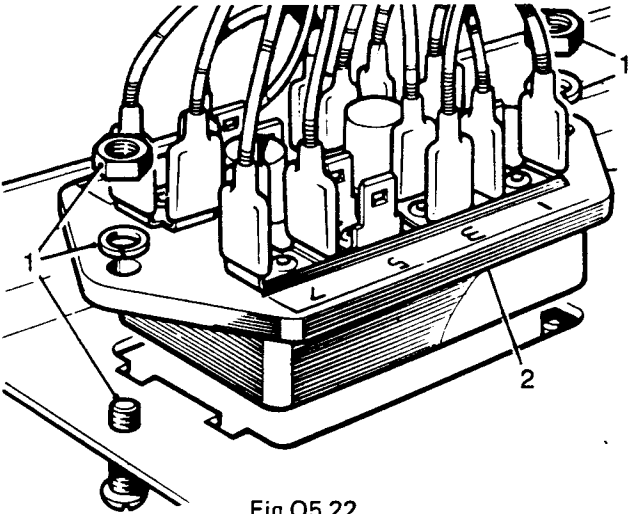
##### Lead colours:

G - Green  
N - Brown  
P - Purple  
U - Blue

FUSE BOX - REMOVAL AND REPLACEMENT

REMOVAL

- 1. To remove the fuse box:
  - (1) Disconnect the battery earth lead.
  - (2) Remove the upper half of the switch shroud from the steering column (four screws).



- (3) Refer to Fig O5.22. Disconnect all leads from the fuse box.
- (4) Remove the fuse box fixings (1) and (2) and lift the fuse box out of the lower shroud.

REPLACEMENT

- 2. To replace the fuse box:
  - (1) Fit the fuse box into the lower shroud and secure with the screws, lockwashers and nuts (1) and (2).
  - (2) Connect the leads to the fuse box:

| Terminal | Lead Colour |
|----------|-------------|
| 1        | Brown       |
| 2        | Purple      |
| 3        | Brown       |
| 4        | Brown*      |
| 5        | White       |
| 6        | 3 x Green   |
| 7        | White       |
| 8        | 2 x Green   |
  - (3) Replace the upper shroud.
  - (4) Check that the four fuses and two spares are all 17 amps with a 35 amp blow rate.
  - (5) Reconnect the battery earth lead.

**\*NOTE**  
It is important that the brown lead to terminal 4 is the lead from the hazard unit (see wiring diagram).

## SUB-SECTION O5

### CHAPTER 19

#### SPEEDOMETER - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the speedometer from the instrument panel:
  - (1) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

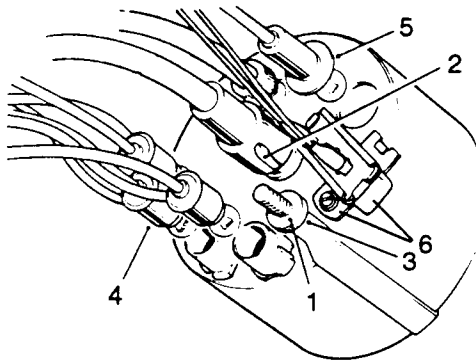


Fig O5.23

- (2) Refer to Fig O5.23. Remove the knurled nuts (1) at the speedometer clamp brackets.
- (3) Withdraw the earth lead eyelets (3) and shake-proof washers from the clamp studs.
- (4) Depress the spring clip and withdraw the speedometer cable (2).
- (5) Withdraw the speedometer clear of the instrument panel.
- (6) Withdraw the warning lamp (4) and illumination lamp (5) bulb holders.
- (7) Disconnect the leads from the instrument voltage stabiliser (6).
- (8) Remove the speedometer.

##### REPLACEMENT

2. To replace the speedometer:

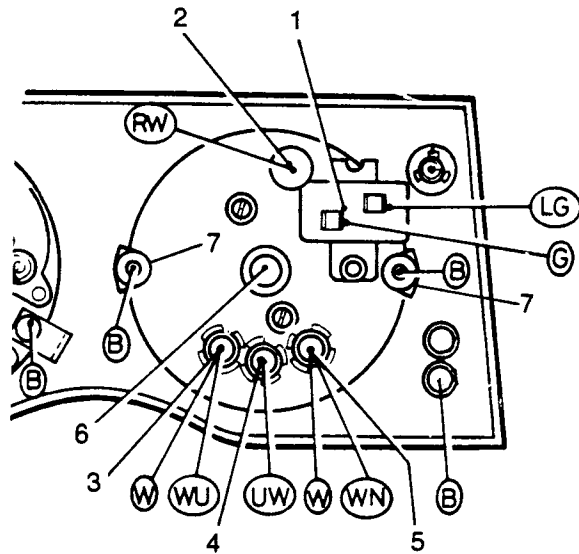


Fig O5.24

- (1) Refer to Fig O5.24. Hold the speedometer in front of the instrument panel, refit the warning and illumination lamp holders and leads to the following:
  - a. The voltage stabiliser (1).
  - b. The illumination hole (2).
  - c. The cold start warning lamp mounting (3).
  - d. The headlamp main beam warning lamp mounting (4).
  - e. The oil pressure warning lamp mounting (5).
- (2) Fit the speedometer into the instrument panel and reconnect the speedometer drive cable into its fitting (6).
- (3) Replace the earth lead eyelets, shakeproof washers and clamp brackets. Secure with the knurled nuts (7).
- (4) Refit the instrument panel to the dash.

##### Lead colours:

W - White  
B - Black  
U - Blue  
N - Brown  
G - Green  
R - Red  
L - Light



## SUB-SECTION O5

### CHAPTER 20

#### OIL PRESSURE WARNING SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The oil pressure warning switch is attached to the right hand lower side of the engine, below the ignition coil and adjacent to the engine mounting. Remove the switch as detailed below:

- (1) Disconnect the battery earth lead.
- (2) Disconnect the electrical lead from the switch.
- (3) Unscrew the switch.
- (4) Remove the switch and sealing washer.

##### REPLACEMENT

2. To replace the switch:

- (1) Fit the switch into position using a new sealing washer.
- (2) Screw the switch home.
- (3) Connect the electrical lead to the switch unit.
- (4) Reconnect the battery earth lead.

## SUB-SECTION 05

### CHAPTER 21

#### COOLANT TEMPERATURE TRANSMITTER - REMOVAL AND REPLACEMENT

##### REMOVAL

1. The coolant temperature transmitter is fitted to the thermostat housing on the left hand upper side of the engine just above the water pump and oil filter. To remove the transmitter:
  - (1) Drain the cooling system.
  - (2) Disconnect the electrical lead from the transmitter.
  - (3) Remove the transmitter from the thermostat housing.

##### REPLACEMENT

2. Replace the transmitter as follows:
  - (1) Fit the transmitter into position using a new sealing washer.
  - (2) Connect the electrical lead to the transmitter.
  - (3) Refill the cooling system with the correct water and inhibitor solution and add antifreeze if required.

## SUB-SECTION O5

### CHAPTER 22

#### FUEL CONTENTS GAUGE - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the fuel contents gauge:

- (1) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

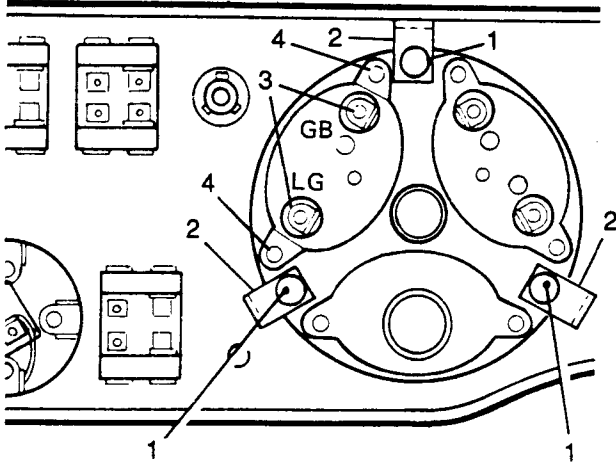


Fig O5.25

- (2) Refer to Fig O5.25. Remove the three knurled nuts (1) at the grouped instruments clamp brackets (2).
- (3) Withdraw the three earth lead eyelets and shakeproof washers.
- (4) Withdraw the grouped instrument clear of the instrument panel.

- (5) Disconnect the 'Lucar' connectors (3).

- (6) Remove the fixing screws (4) and withdraw the gauge.

##### REPLACEMENT

2. To replace the fuel contents gauge:

- (1) Fit the gauge into the grouped instrument and secure with the fixing screws (4).
- (2) Reconnect the Lucar connectors as illustrated.
- (3) Fit the grouped instrument into the instrument panel.
- (4) Refit the shakeproof washers and earth lead eyelets.
- (5) Replace the clamp brackets (2) and secure with the three knurled nuts (1).
- (6) Fit the instrument panel to the dash.

##### Lead colours:

- G - Green  
B - Black  
L - Light

# FUEL TANK GAUGE UNIT - REMOVAL AND REPLACEMENT

## REMOVAL

### 1. To remove the unit:

- (1) Disconnect the battery earth lead.
- (2) Remove the inspection cover in the rear floor.

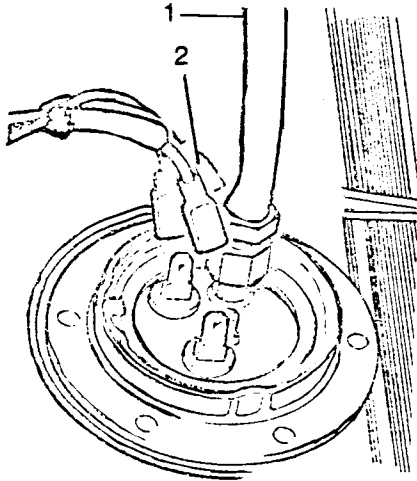
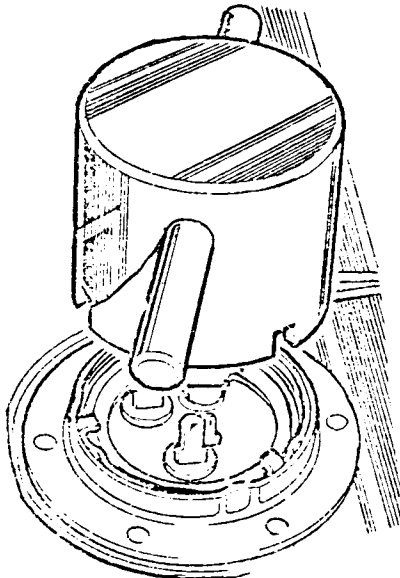


Fig O5.26

- (3) Refer to Fig O5.26. Disconnect the fuel pipe (1) at the fuel tank gauge unit.
- (4) Note the position of the electrical leads (2) and disconnect them from the unit.



- (5) Refer to Fig O5.27. Using special tool 600964 turn the gauge unit locking ring counterclockwise until the indents in the locking ring align with the lugs on the tank.

- (6) Withdraw the locking ring.
- (7) Withdraw the complete fuel gauge unit.
- (8) Remove the rubber seating ring.

## REPLACEMENT

### 2. Replace the gauge unit as follows:

- (1) Lightly smear the joint faces on the gauge unit, the sealing washer and the fuel tank with Bostik adhesive No 772 or a suitable alternative.
- (2) Insert the gauge unit and seating washer into the tank and engage the two lugs in the gauge unit base plate into the cutouts in the fuel tank flange.
- (3) Fit the locking ring and using special tool 600964 turn the ring clockwise until it is locked.
- (4) Connect the fuel pipe to the unit.
- (5) Reconnect the electrical leads.
- (6) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 24

#### BLACKOUT STOP LAMP - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the lamp:
  - (1) Disconnect the battery earth lead.

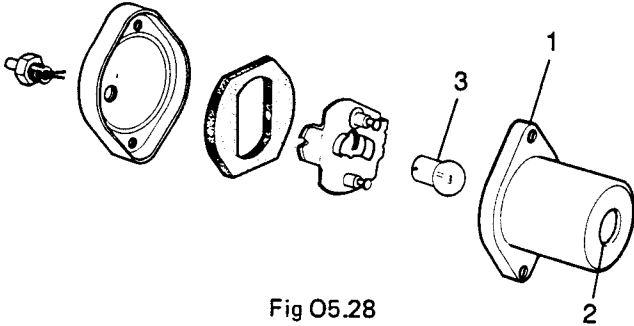


Fig O5.28

- (2) Refer to Fig O5.28. Remove the lens cover fixings (1) and pull off the lens.
- (3) Remove the bulb (3) if required.
- (4) Remove the fixings for the cover in the rear of the load area behind the lamp (two self tapping screws and one nut) and lift the cover away.
- (5) Disconnect the lamp leads at the snap connectors making a note of which socket each lead comes from.
- (6) Remove the two nuts holding the lamp to the wall and pull the lamp body away.

##### REPLACEMENT

2. Replace the lamp as follows:
  - (1) Position the lamp on the rear wall and secure with the two nuts and washers.
  - (2) Reconnect the lamp leads at the snap connectors.
  - (3) Replace the bulb.
  - (4) If removed, replace the lens (2) into the cover, locating the grooves in the lens over the protrusions inside the cover.
  - (5) Fit the lens cover and secure with the two screws (1).
  - (6) Replace the cover in the load area and secure with the two self tapping screws and the screw, washers and nut.
  - (7) Reconnect the battery earth lead.

# NUMBER PLATE LAMP - REMOVAL AND REPLACEMENT

## REMOVAL

1. To remove the lamp:

(1) Disconnect the battery earth lead.

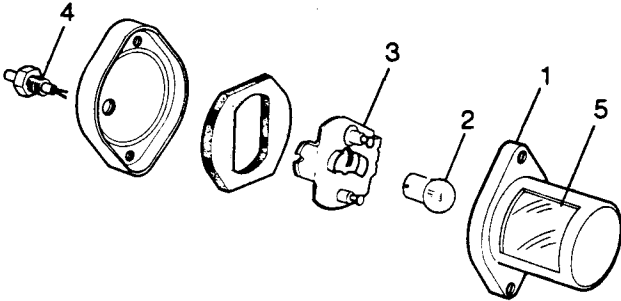


Fig O5.29

- (2) Refer to Fig O5.29. Remove the lens cover fixings (1).
- (3) Remove the bulb (2).
- (4) Disconnect the lamp leads at the connectors on the carrier (3) making a note of which connector each lead comes from.
- (5) Unscrew the hollow bolt (4) through which the leads are routed.
- (6) Remove the two nuts holding the lamp to the wall and pull the lamp body away.

## REPLACEMENT

2. Replace the lamp as follows:

- (1) Position the lamp on the rear wall and secure with the two nuts and washers.
- (2) Feed the leads through the rear body of the lamp and tighten the hollow bolt (4).
- (3) Reconnect the leads to their connectors on the carrier (3).
- (4) Replace the bulb (2).
- (5) If removed, replace the lens (5) into the cover, locating the grooves in the lens over the protrusions in the cover.
- (6) Fit the lens cover and secure with the two screws (1).
- (7) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 26

#### BLACKOUT SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the blackout switch:
  - (1) Disconnect the battery earth lead.
  - (2) Withdraw the instrument panel clear of the dash (see Sub-section O5, Chapter 27).

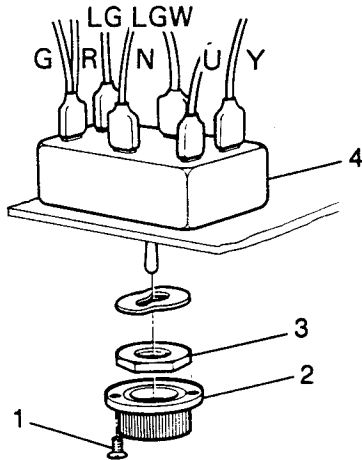


Fig O5.30

- (3) Refer to Fig O5.30. Remove the fixings (1) for the switch safety housing (2) and remove the housing.
  - (4) Remove the nut (3) and wave washer from the switch knob.
  - (5) Disconnect the leads from the back of the switch (4).
  - (6) Withdraw the switch.

##### REPLACEMENT

2. Replace the switch as follows:
  - (1) The switch is symmetrical and may be fitted either way round. Place the switch in position and secure with the wave washer and nut.
  - (2) Connect the leads to the switch as shown in Fig O5.28.
  - (3) Refit the switch safety housing (2) and secure with the two self tapping screws (1).
  - (4) Replace the instrument panel.
  - (5) Reconnect the battery earth lead.

##### Lead colours:

G - Green  
R - Red  
N - Brown  
W - White  
U - Blue  
Y - Yellow  
L - Light

INSTRUMENT PANEL - REMOVAL AND REPLACEMENT

REMOVAL

1. Remove the instrument panel as follows:

(1) Disconnect the battery earth lead.

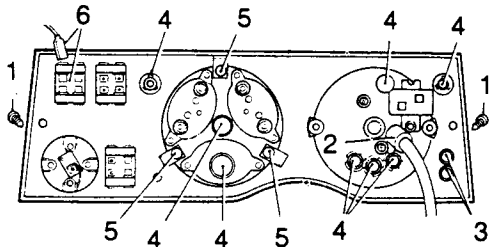
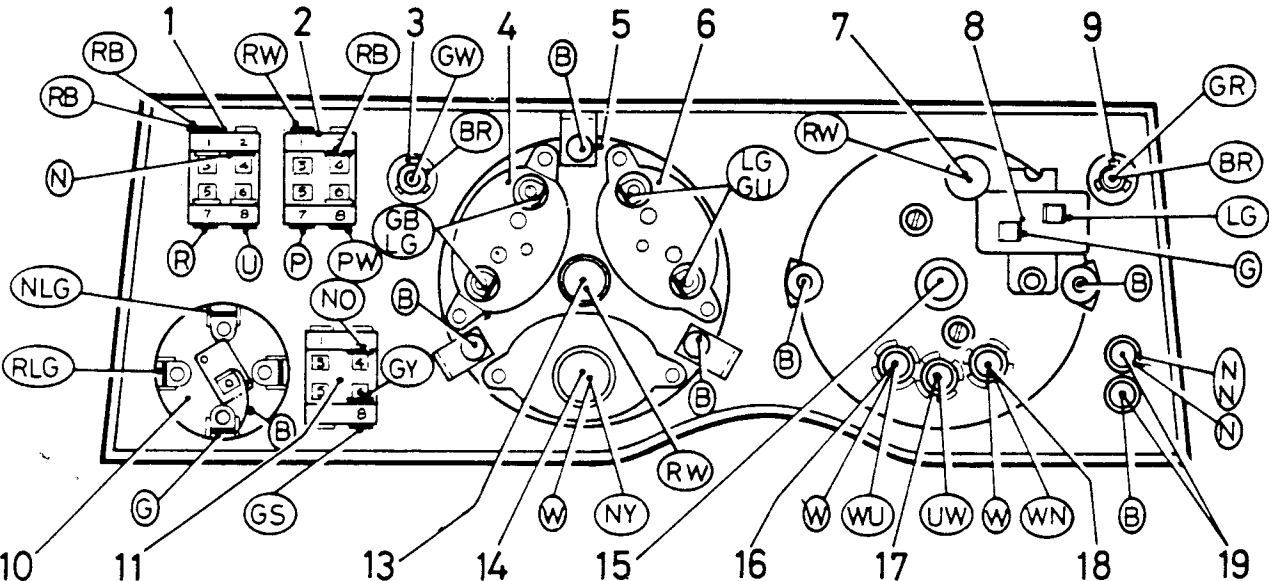


Fig O5.31

(2) Refer to Fig O5.31. Remove the instrument panel fixings (1).



Key to instrument panel and wiring

- 1. Lighting switch
- 2. Panel light switch
- 3. RH turn indicator warning light
- 4. Fuel contents gauge
- 5. Grouped instruments
- 6. Coolant temperature gauge
- 7. Panel illumination light
- 8. Instruments voltage stablizer
- 9. LH turn indicator warning light
- 10. Wiper/washer switch

- 11. Heater switch
- 13. Panel illumination light
- 14. Battery charge warning light
- 15. Speedometer drive head
- 16. Cold start warning light
- 17. Headlamp mainbeam warning light
- 18. Oil pressure warning light
- 19. Inspection lamp sockets

Lead colours:

- S - Slate
- B - Black
- G - Green
- N - Brown
- P - Purple
- R - Red
- U - Blue
- W - White
- Y - Yellow
- L - Light

(3) Withdraw the instrument panel clear of the dash. If necessary, remove the steering wheel. At this stage the panel is in a position where individual lamps, switches and instruments can be removed. Continue if the complete panel is to be withdrawn.

(4) Depress the spring clip and withdraw the cable assembly from the speedometer (2).

(5) Withdraw the instrument panel sufficient to gain access to the wiring connections.

(6) Remove the inspection lamp socket leads (3).

(7) Withdraw all warning and illumination lamp leads and bulbs complete with holders (4).

(8) Disconnect the earth lead terminals at the knurled nuts (5) on the grouped instrument.

(9) Disconnect all 'Lucar' connectors (6).

(10) Withdraw the instrument panel and instruments complete.



## REPLACEMENT

2. To replace the instrument panel:

- (1) Refer to Fig O5.32. Reconnect the Lucar connectors with the lead colours in the positions indicated.
- (2) Refit the warning and illumination lamps and holders. The positions and lamp lead colours are also shown in the illustration above.
- (3) Reconnect the inspection lamp socket leads.
- (4) Refit the speedometer cable assembly.
- (5) Replace the instrument panel in the dash and secure with the two fixing screws.
- (6) Reconnect the battery earth lead.

## SUB-SECTION O5

### CHAPTER 28

#### HAZARD WARNING SWITCH - REMOVAL AND REPLACEMENT

##### REMOVAL

1. To remove the switch:

(1) Disconnect the battery.

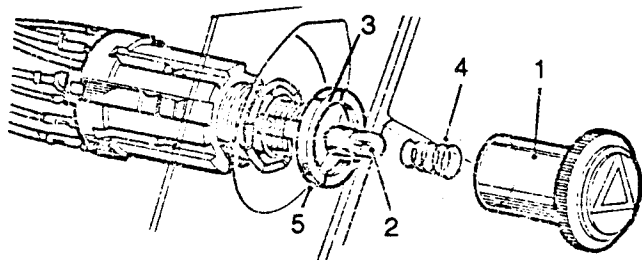


Fig O5.33

(2) Refer to Fig O5.33. Unscrew the hazard warning switch knob (1) taking care not to lose the bulb and spring (4).

(3) Pull out the warning lamp bulb (2).

(4) Remove the self tapping screws holding the panel on which the hazard warning lamp switch and test switch are mounted. Ease the panel forward away from the dash.

(5) Unscrew the locking ring (3) holding the switch to the panel and remove, together with the wave washer.

(6) Pull out the switch from the rear of the panel.

(7) Disconnect the electrical leads round the periphery of the switch.

(8) Disconnect the black centre lead.

##### REPLACEMENT

2. Replace the switch as follows:

(1) Connect the black lead through the centre of the switch.

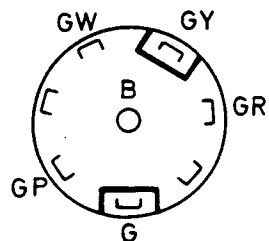


Fig O5.34

(2) Refer to Fig O5.34. Reconnect the electrical leads to the periphery of the switch.

(3) Fit the switch into the panel and secure with the wave washer and lock ring.

(4) Fit the hazard warning switch bulb and screw on the knob.

(5) Replace the panel and secure with the self tapping screws.

(6) Reconnect the battery.

##### Lead colours:

G - Green  
W - White  
Y - Yellow  
R - Red  
P - Purple

SUB-SECTION CONTENTS LIST

SUB-SECTION O6

CLEANING, REPAIR AND OVERHAUL PROCEDURES

| CHAPTER | DESCRIPTION                   | PAGE |
|---------|-------------------------------|------|
| 1       | OVERHAULING THE ALTERNATOR    | O6.1 |
| 2       | OVERHAULING THE STARTER MOTOR | O6.9 |

## SUB-SECTION O6

### CHAPTER 1

#### OVERHAULING THE ALTERNATOR

##### DISMANTLING

1. To dismantle the alternator:

(1) Remove the alternator (see Sub-section O5, Chapter 1).

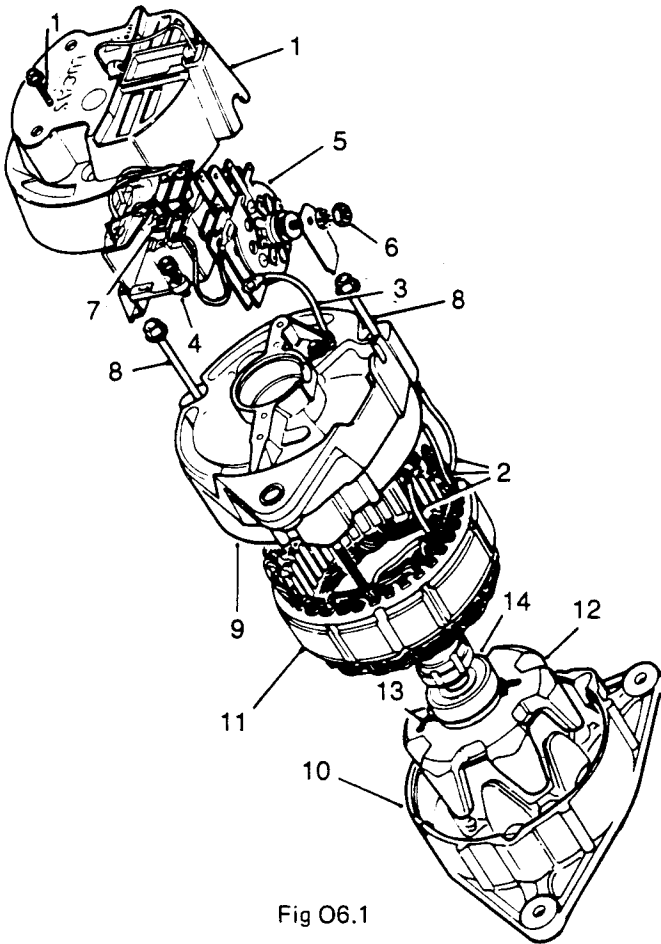


Fig O6.1

- (2) Refer to Fig O6.1. Withdraw two retaining screws and remove moulded slip-ring end cover (1).
- (3) Note positions of stator winding connections (2) to rectifier connecting pins.
- (4) Using thermal shunt and lightweight soldering iron (25 watt), unsolder the connections.
- (5) Note position of cable connectors to rectifier plates. Disconnect the cables (3).
- (6) Withdraw three hexagon headed screws (4) securing brushbox and regulator to slip-ring end bracket.
- (7) Remove brushbox moulding and regulator assembly (5).

(8) Slacken rectifier securing nut (6) and remove rectifier.

##### BRUSHGEAR INSPECTION

2. The serviceability of the brushes is gauged by the length protruding beyond the brush moulding in the free position. This amount should exceed (8 mm). If renewal is necessary care must be taken to replace the leaf spring at the side of the inner brush.
3. Renew brush and spring assemblies ((7) on Fig O6.1) if brushes are worn to 8 mm. To replace a brush:

- (1) Remove the small screws securing the brush retaining plates and regulator cables.
- (2) Replace brushes with new units and refit brush retaining plates and regulator cables.

4. Check brush spring pressure with push-type spring gauge to end of brush. Spring pressure should be 225 to 368 gf when brush is flush with moulding.

##### SLIP-RING INSPECTION

5. The surface of the slip-ring should be smooth and free from grease or dirt. Servicing is confined to cleaning with a petrol-moistened cloth or finest grade glass-paper.

##### CAUTIONS

1. Emery cloth or similar abrasive must not be used.
2. The slip-rings cannot be machined.

##### FURTHER DISMANTLING

6. Continue dismantling the alternator. Note that Fig O6.1 still applies.
  - (1) Withdraw three through-bolts (8).
  - (2) Separate the alternator into its major components:
    - a. Slip-ring and bracket (9).
    - b. Drive end bracket, rotor, fan and pulley (10).
    - c. Stator laminations and windings (11).
  - (3) Separate the rotor (12) from the drive end bracket by removing the pulley, fan and shaft key.
  - (4) Press the rotor shaft from the bearing.

7. Remove the slip-ring end bearing: (Fig O6.1 still applies).
  - (1) Unsolder the field wind rings (13) from the slip-ring moulding.
  - (2) Remove the slip-ring moulding (14).
  - (3) Press the bearing from the shaft.
8. Remove the drive end bearing:
  - (1) Remove the circlip and retaining slate from the drive end bearing.
  - (2) Press out the bearing.

#### BEARING INSPECTION

9. Inspect the bearings for wear, flat spots or other damage and replace if necessary.
10. Pack the bearing with Shell Alvania RA grease.

#### ROTOR TESTING

11. To test the rotor an ohmmeter, a 110 volt ac supply and a 15 watt test lamp are required. If an ohmmeter is not available a 12 volt battery and an ammeter may be used as an alternative. Test the rotor as follows:

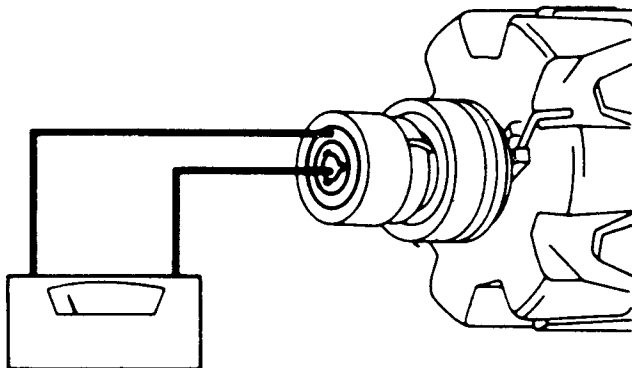


Fig O6.2

- (1) Refer to Fig O6.2. Connect the ohmmeter between the slip-rings.
- (2) Check that the resistance is 3,2 ohms at 20°C.

#### ALTERNATIVE METHOD

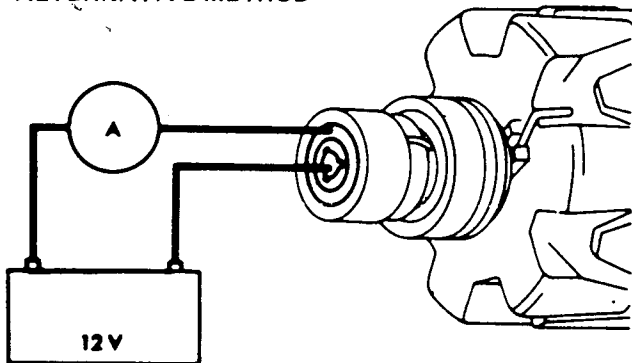


Fig O6.3

- (3) Refer to Fig O6.3. Connect an ammeter and battery between the slip-rings.

- (4) Check that the ammeter reads approximately 3 amps.

12. To test for defective insulation between the slip-rings and rotor poles:

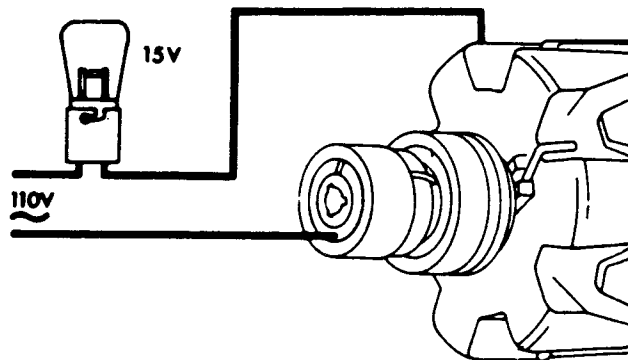


Fig O6.4

- (1) Refer to Fig O6.4. Connect a 110 volt ac supply between each slip-ring and the rotor poles in turn.
- (2) If the lamp lights, the coil is earthed to the rotor core and a replacement rotor and slip-ring assembly should be fitted.

#### STATOR TESTING

13. For this test, a 12 volt battery with a 36 watt test lamp and a 110 volt ac supply with a 15 watt test lamp are required.

To test the stator:

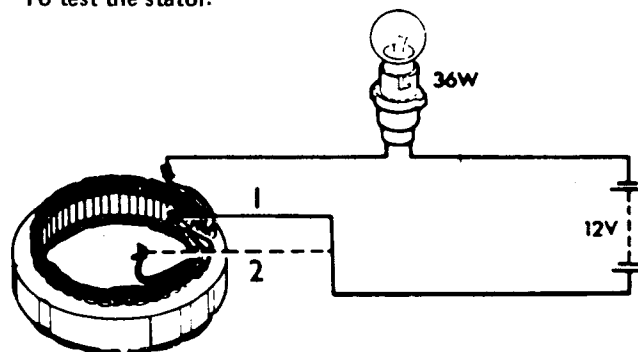


Fig O6.5

- (1) Refer to Fig O6.5. Check continuity of stator windings between any pair of wires by connecting in series a 12-volt battery and test lamp of not less than 36 watts. Failure of the test lamp to light means that part of the stator winding is open circuit and a replacement stator must be fitted.



Fig O6.6

- (2) Refer to Fig O6.6. Test stator insulation with 110-volt test lamp. Connect test leads to laminated yoke and any one of the three stator cables. If the lamp lights, the stator coils are earthed. A replacement stator must be fitted.

#### DIODE TESTING

14. To test the diodes a 12-volt battery and a 1.5 watt test lamp are required. Test as follows:

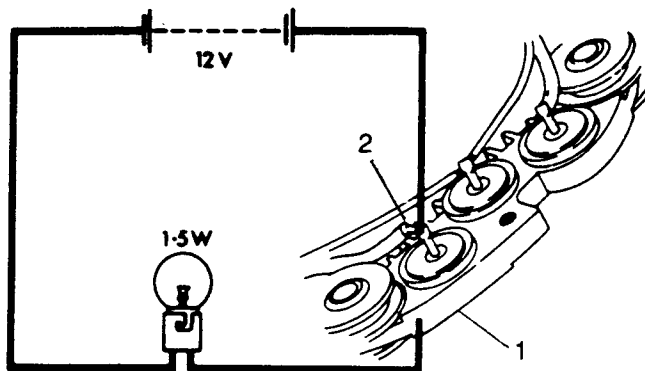


Fig O6.7

- (1) Refer to Fig O6.7. Connect one battery terminal to the heatsink under test (1).
- (2) Connect the other battery terminal in series with the test lamp and each diode pin (2) in turn.
- (3) Reverse connections to heatsink and diode pins. The lamp should light in one direction only. Should the lamp light in both tests, or not light at all the diode is defective and a new rectifier heatsink must be fitted.

#### NOTES

1. To prevent damage to diode assemblies during soldering operations it is important that a thermal shunt is used.
2. Only 'M' grade 45-55 tin-lead solder should be used.

#### REASSEMBLY

15. To reassemble the alternator:

- (1) Replace the drive end bearing, retaining plate and circlip.
- (2) Replace the slip-ring end bearing onto the shaft.

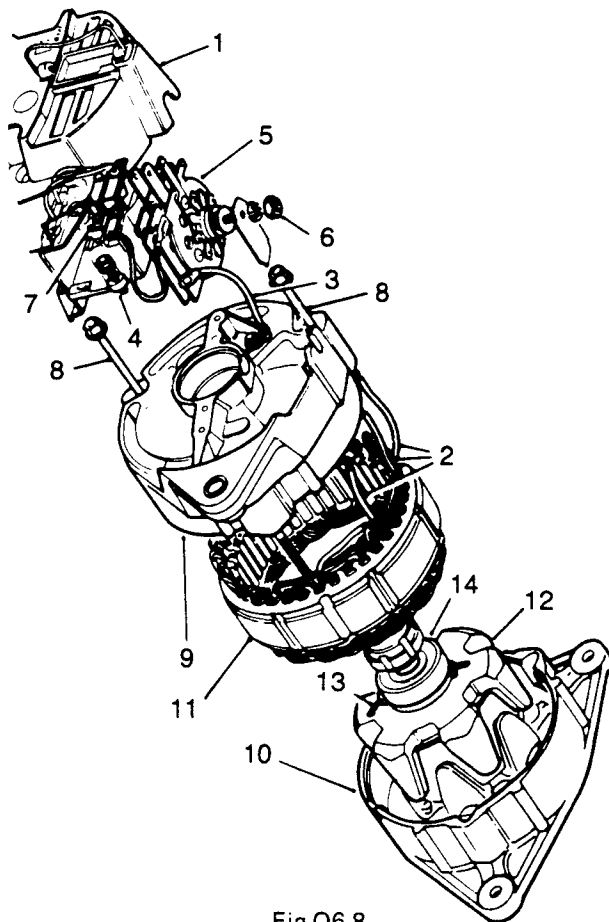


Fig O6.8

- (3) Refer to Fig O6.8. Replace the slip-ring moulding (14).
- (4) Resolder the field windings (13) to the slip-ring moulding.
- (5) Press the rotor shaft into the slip-ring end bearing.
- (6) Reconnect the rotor (12) to the drive end bracket, fitting the pulley, fan and shaft key.
- (7) Fit together the slip-ring end bracket (9), the drive end bracket (10) and the stator (11). Secure with the through bolts (8).
- (8) Replace the rectifier and tighten the securing nut (6).
- (9) Replace the brush box moulding and regulator assembly (5) and secure to the slip-ring end bracket with the three box head screws (4).
- (10) Reconnect the cables (3) to the rectifier plates in the position noted in paragraph 1, step (4).

(11) Using a thermal shunt and 25 watt soldering iron solder the stator winding connection (2) to the rectifier connecting pins. The positions of the connectors were noted in paragraph 1, step (2).

(12) Replace the moulded slip-ring end cover (1) and secure with the two retaining screws.

(13) Replace the alternator (see Sub-section O5, Chapter 1).

## CHAPTER 2

## OVERHAULING THE STARTER MOTOR

## DISMANTLING

1. First, remove the starter motor (see Sub-section O5, Chapter 5).
2. Remove the solenoid as follows:

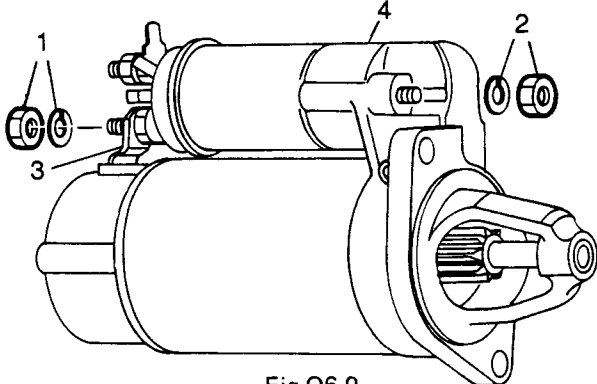


Fig O6.9

- (1) Refer to Fig O6.9. Remove the nut and washer (1) which secures the solenoid-to-starter connecting link to solenoid terminal STA.
- (2) Remove the two nuts (2) and washers securing the solenoid to the fixing bracket.
- (3) Pull back the connecting link (3) from the solenoid terminal and at the same time lift the terminal end of the solenoid clear of the connecting link and withdraw the major part of the solenoid from the fixing bracket (4).

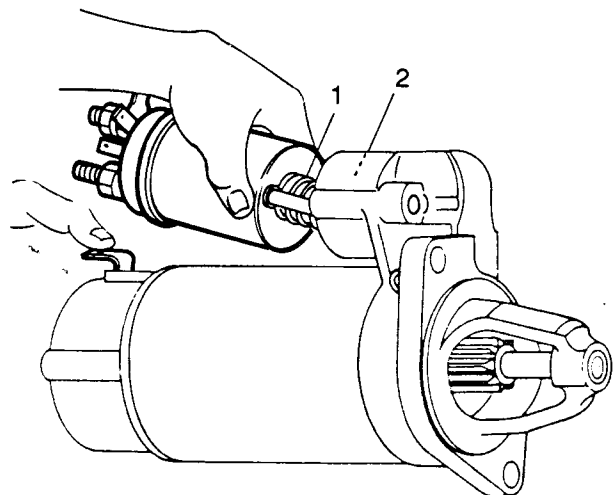


Fig O6.10

- (4) Refer to Fig O6.10. Remove the plunger (1) from the drive engagement lever (2) by gripping the plunger in the hand and applying an upward lift at the front of the plunger.

3. Remove the commutator end cover:

## NOTE

Before removing the end cover ensure that a replacement Spire retaining ring is available for use during reassembly. This is necessary because this type of retaining ring is a press fit on the armature shaft and if the original fitting of the ring is disturbed, it becomes unsatisfactory for further use.

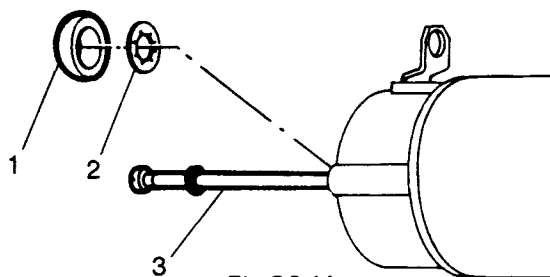


Fig O6.11

- (1) Refer to Fig O6.11. Remove the end cap (1) to gain access to the retaining ring (2).
- (2) Using an engineer's chisel cut through a number of the retaining ring claws until the grip on the armature shaft is sufficiently relieved to allow the ring to be removed. Remove the ring.
- (3) Remove the two through bolts (3).

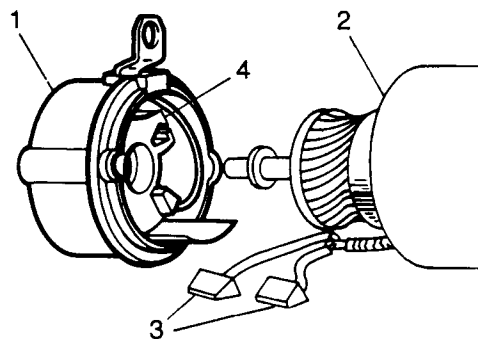


Fig O6.12

- (4) Refer to Fig O6.12. Partially withdraw the commutator end cover (1) from the yoke (2) and disengage the two field coil brushes (3) from the brush box moulding (4).
- (5) Withdraw the commutator end cover.



4. Remove the armature and roller clutch:

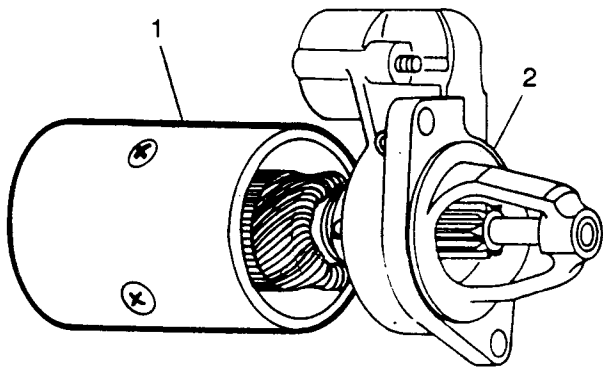


Fig O6.13

- (1) Refer to Fig O6.13. Withdraw the yoke (1) from the armature assembly (2).

**NOTE**

Do not disturb the field coil assembly in the yoke.

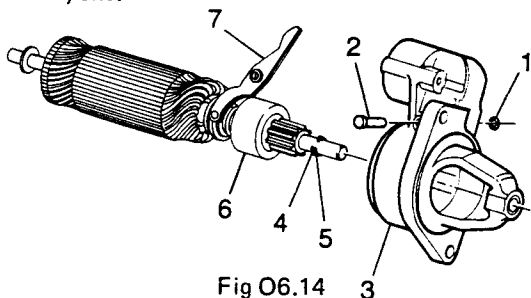


Fig O6.14

- (2) Refer to Fig O6.14. Remove the Spire retaining ring (1) from the drive engagement lever pivot pin (2).

**NOTE**

Ensure that a new Spire retaining ring is available for reassembly.

- (3) Withdraw the pivot pin (2).
- (4) Withdraw the fixing bracket (3) from the armature assembly.
- (5) Using a tubular tool (a box spanner for instance) drive the thrust collar (4) squarely off the jump ring (5).
- (6) Remove the jump ring from the groove in the armature shaft and slide the ring off the shaft.
- (7) Slide the thrust collar and the roller clutch drive (6) and lever assembly (7) off the shaft.

**INSPECTION - ARMATURE**

5. Check that the commutator face is clean and free from burn spots and grooving. If either or both of these are found, use a flat surface of very fine glass paper to remove the spots or grooving. Clean the commutator with a petrol moistened cloth.

6. If the burn spots or grooves are too deep to be removed with glass paper the commutator may be skimmed. The minimum thickness to which the commutator copper may be skimmed before the armature must be replaced is 3,5 mm. Terminate any skimming operation by polishing the commutator surface with a flat pad of very fine glass paper and then wiping it clean with a petrol moistened cloth.

**CAUTION**

Do not undercut the insulation slots.

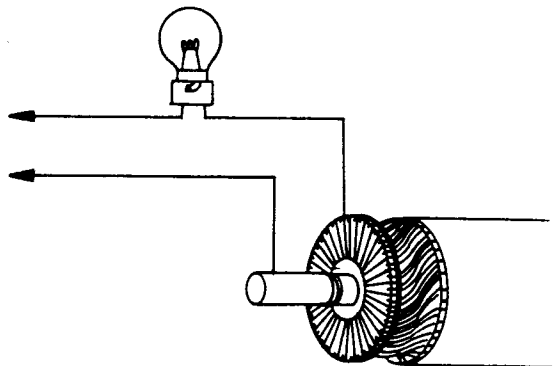


Fig O6.15

7. Refer to Fig O6.15. Check armature insulation by connecting a 110 V ac supply in series with a 15 W test lamp between the armature shaft and each commutator segment in turn. For satisfactory insulation the lamp should not light.
8. If the armature shows signs of 'thrown' solder or lifted conductors, overspeeding of the armature is indicated and the operation of the roller clutch drive should be checked (see para 19).
9. Short circuited armature windings (indicated by a high current consumption, low light running speed and low lock torque performance) can only be detected by the use of specialised armature testing 'Growler' equipment. If this equipment is not available, the only alternative is to check the armature by substitution.
10. If the armature laminations have been in contact with the pole shoes the armature bearings are probably excessively worn. First, check that the pole shoes are tight and that the armature runs true in a lathe. Then, check the inner diameter of the bearings. The bearings must be changed when the diameter exceeds 11,20 mm for the commutator end cover bearing, and 12,09 mm for the drive end fixing bracket bearing. (See para 26 for changing the bearings).

**INSPECTION - BRUSHGEAR**

11. Check that the brushes move freely in the brush box moulding. Sticking brushes should be cleaned with a petrol moistened cloth. Brushes which are worn down to approximately 9,5 mm in length must be renewed (See para 31).

12. Measure brush spring pressure:

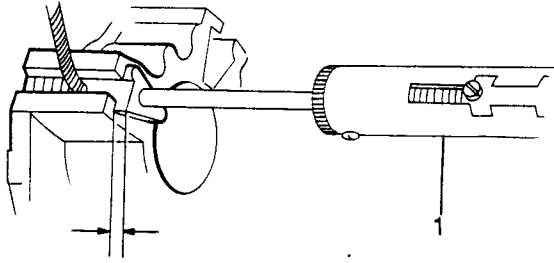


Fig O6.16

- (1) Refer to Fig O6.16. Position a new brush in each of the brush boxes in turn.
  - (2) Press on top of the brush with a push-type spring gauge (1) until the top of the brush protrudes by about 1,5 mm from the brush moulding (dimension A).
  - (3) Check that the spring gauge reading is 10,0 N.
13. Check the insulation of the brush springs by connecting a 110 V, 15 W test lamp between a clean part of the end cover and each of the springs in turn. The lamp should not light.
  14. Check that the connecting link grommet is in good condition.

#### INSPECTION - YOKE AND FIELD COIL ASSEMBLY

15. Inspect the field coils in situ for signs of obvious faults. Check the inter-connecting joints between coils, the earthed connection of the field winding where it is riveted to the yoke and look for discolouration (due to burning) of the winding insulation tape, which could indicate short-circuited windings or a short-circuit between the windings and the yoke. A visible fault will eliminate the need for testing and in such cases if necessary the field coil assembly should be removed from the yoke to enable it to be repaired or renewed.
16. If there are no obvious signs of a fault, the field coil continuity and the insulation between the field coils and yoke can be checked without removing the field coil assembly from the yoke.
17. Check field coil continuity by connecting a 12 V battery operated test lamp between either of the field coil brushes and a clean part of the yoke. The lamp should light.
18. **Field coil insulation:** Before being able to check the insulation between the field coils and yoke, it will first be necessary to disconnect the earthed end of the winding from the yoke. Before disconnecting the windings (See para 32) determine whether it is justified. Consider the light running and lock torque or alternatively consider the fault symptoms. If the speed and torque were low, and the current consumption high, or the fault symptom was low cranking speed, faulty field winding insulation could be the cause and this interpretation of the starting motor performance would justify disconnecting the earthed end of the field winding to enable a positive check to be carried out.

19. The field winding insulation can be checked (after disconnecting the winding at the yoke) by connecting a 110 V, 15 W test lamp between the disconnected end of the winding and a clean part of the yoke. **The lamp should not light.** Ensure that neither of the brushes, or bare parts of their flexible leads contact the yoke during the test.

20. **Field coil resistance:** Due to the very low resistance of the field coil conductors, the presence of a short-circuit between the field coil windings can only be determined by specialised equipment. If the results of all previous testing has been satisfactory, short-circuited field coil windings could be the cause of the fault and the field coil assembly should now be further proved by substitution. To change the field coils see para 32.

#### INSPECTION - ROLLER CLUTCH DRIVE ASSEMBLY

21. Check the clutch action. The pinion should have instantaneous take-up of the drive in one direction and be free to rotate in the other.
22. Check that the assembly moves freely along the armature shaft splines. The armature shaft splines and moving parts of the engagement lever should be liberally smeared with Shell SB.2628 (cold climates) or Retinax 'A' (hot climates). The roller clutch mechanism is a sealed unit, which is pre-packed with sufficient grease to last the life of the starter motor. In the unlikely event of the clutch action becoming faulty, it will not be possible to rectify the fault and the whole of the drive assembly will have to be renewed.

#### INSPECTION - SOLENOID

23. Check solenoid winding resistance by connecting a good quality ohmmeter between solenoid terminal STA and a good earth point on the solenoid body. A reading of 1,01 to 1,07 ohms indicates that the windings are in a satisfactory state.
24. An alternative method of carrying out the above test is to connect a 0 to 20 A moving coil ammeter in series with a 12 V battery, solenoid terminal STA and a good earth point on the solenoid body. A reading of 11,2 to 11,8 amps should be obtained.
25. Associated with the solenoid plunger are three springs: the plunger and drive return spring, the drive engagement spring which is incorporated inside the plunger to overcome the difficulty of engaging the pinion on occasions of tooth-to-tooth abutment, and the 'lost motion' spring which is assembled to the connecting part of the solenoid plunger to provide a measure of lost motion in the drive operating mechanism as the drive commences to disengage. It is sufficient to check only that the springs are not broken. In the case of the drive engagement spring (inside the plunger), to check the spring it will be necessary to ensure that a spring-loaded pull action exists between the plunger body and the connecting part of the plunger.
26. The solenoid incorporates a very small additional Lucar terminal blade (marked IGN), which is for use in conjunction with ballast ignition systems. It is sufficient to check that this terminal becomes electrically connected to the solenoid main input terminal, when the solenoid is energised.

27. Should the above tests give satisfactory results the only other fault would be the solenoid contacts and these should be changed (See para 33).

### REPLACING THE BEARINGS

28. The armature bearings, fitted in the commutator end cover and the drive end fixing bracket, are self-lubricating porous-bronze bushes.

29. New bushes must be completely immersed in Shell 'Turbo 41' oil, or in clean engine oil, for 24 hours at room temperature, before they are fitted. Alternatively, if the lubricant is heated to a temperature of 100°C, 2-hours immersion of the bushes is sufficient, providing the lubricant is allowed to cool before the bushes are removed.

30. The bushes must **not** be reamed after fitting otherwise the self-lubricating qualities will be impaired.

31. Worn bushes should be removed by using a wheel-operated press. Alternatively, support the bearing housing and then with a mandrel carefully tap the bush out of the cover or bracket.

32. New bushes should be pressed into position by means of a shouldered polished mandrel with dimensions as follows:- commutator end cover bush 11,117 mm, drive end fixing bracket bush 12,011 mm.

### RENEWING THE BRUSHES

33. Renew the brushes as follows:

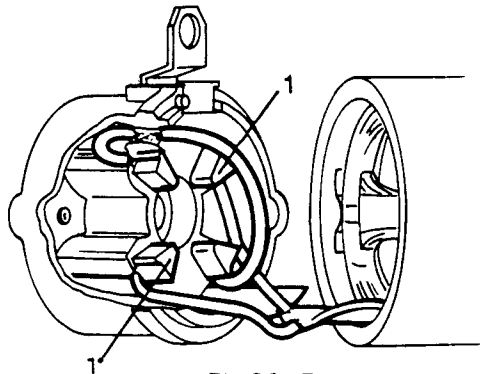


Fig O6.17

(1) Refer to Fig O6.17. For the field coil brushes (1) cut the brush flexible leads leaving approximately 6 mm of lead each side of the coil end.

(2) Solder the new brushes to the remaining ends of the old leads.

#### NOTE

Use only resin-cored type solder.

(3) For the other two brushes, replace them complete with terminal link and moulded rubber grommet.

(4) Check that the brushes are in the positions shown in the figure.

### RENEWING THE FIELD COILS

34. Fit new field coils as follows:

(1) Disconnect the end of the field winding where it is riveted to the yoke. To do so, file away the riveted-over end of the connecting eyelet securing rivet sufficiently to enable the rivet to be tapped out of the yoke.

(2) Remove the four pole shoe screws with a wheel-or-power-operated screwdriver.

(3) Withdraw the field coil from the yoke.

(4) Wipe clean the inside of the yoke and the insulating pieces through which the through-bolts locate.

(5) Loosely fit the new field coil assembly (with pole shoes) into the yoke, with the threads of the pole shoe fixing screws only partially engaged.

(6) Assemble the through bolt insulating pieces into the yoke by sliding the shoulders of the insulating pieces between the field coils and the yoke in a position 180° apart and 90° each side of the field coil brush connection point.

(7) Tighten the pole shoes progressively to a torque of 40 N.m.

(8) Make a good earth connection between the end of the field winding and the yoke.

### RENEWING THE SOLENOID CONTACTS

35. To renew the contacts:

(1) Remove the two screws securing the terminal and base assembly to the solenoid.

(2) Apply a hot soldering iron alternately to each of the two soldered terminal connections and wait for the solder to run free.

(3) Shake most of the melted solder out of the joints by tapping the solenoid terminal ends sharply down on the bench.

(4) Clamp the solenoid body in a vice (terminals uppermost) and while applying a constant pull on the moulded cover, apply the soldering iron alternately to the two soldered connections until the terminal and base assembly is freed.

(5) When remaking the soldered connections avoid dry-soldered joints by ensuring that the parts are clean and adequately heated before applying the solder.

(6) Tighten the terminal and base fixing screws to a torque of 2,44 N.m.

## REASSEMBLY

36. Reassemble the starter motor as follows:

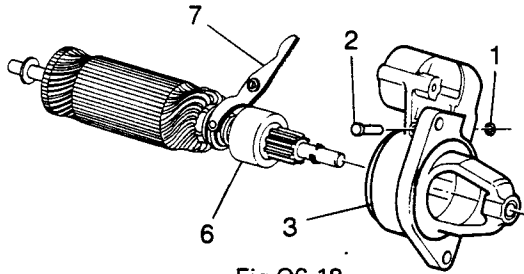


Fig O6.18

- (1) Refer to Fig O6.18. Slide the roller clutch drive (6) and lever assembly (7) and the thrust washer onto the armature shaft.
- (2) Fit the jump ring into the groove in the armature shaft and drive the thrust washer squarely onto the jump ring.
- (3) Refit the fixing bracket (3) to the armature assembly and secure with the pivot pin (2) through the bracket and the bore in the drive engagement lever.
- (4) Fit a new Spire retaining ring (1).

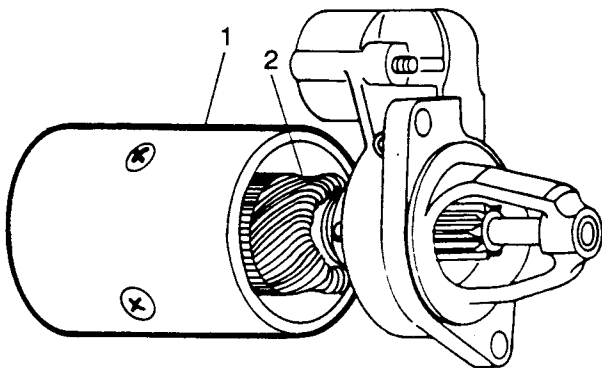


Fig O6.19

- (5) Refer to Fig O6.19. If it has been removed, fit the internal thrust washer (3) to the commutator end of the armature shaft.
- (6) Fit the yoke (1) over the armature assembly (2).

37. Fit the commutator end cover:

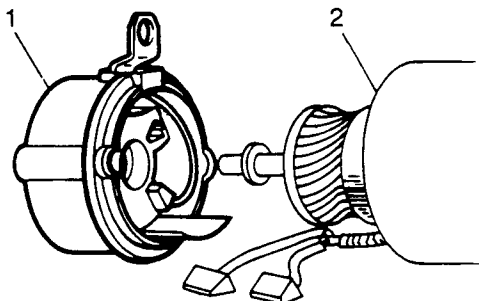


Fig O6.20

- (1) Refer to Fig O6.20. Hold the commutator end cover (1) close to the yoke (2) and fit the brushes into their correct housings in the brush box moulding.

- (2) Fit the commutator end cover to the yoke and align the holes for the through bolts.

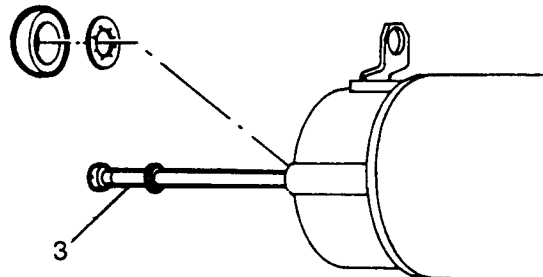


Fig O6.21

- (3) Refer to Fig O6.21. Fit the two through bolts (3) and tighten to a torque of 10,84 N.m.

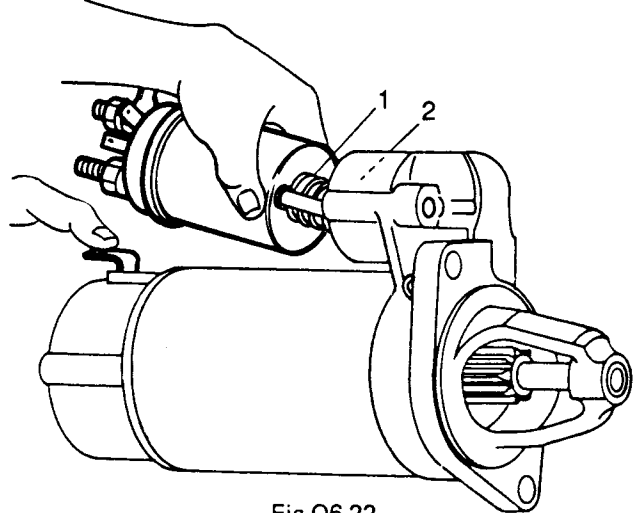


Fig O6.22

- (4) Refer to Fig O6.22. Fit the solenoid plunger into the fixing bracket. Hold the plunger (1) and use a downward push to engage the drive engagement lever (2).

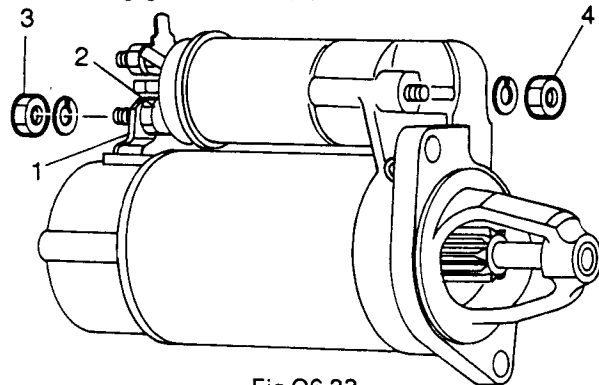


Fig O6.23

- (5) Refer to Fig O6.23. Pull back the connecting link (1) and lower the solenoid into position on top of the starter motor.
- (6) Engage the solenoid terminal STA over the connecting link (2).
- (7) Replace the nut and washer (3) on terminal STA.
- (8) Fit the two nuts and washers (4) securing the solenoid to the fixing bracket and tighten to 6,1 N.m.

(9) Drive a new Spire retaining ring onto the armature shaft into a position which provides a maximum of 0,25 mm clearance between the retaining ring and the bearing bush shoulder.

(10) Replace the end cap to the commutator end cover.

## SUB-SECTION 07

### MAINTENANCE

#### INTRODUCTION

1. The electrical system is relatively trouble free if maintained in good condition. However, regular inspections are needed to keep the system in this condition.

#### BATTERY

2. Check electrolyte level at least once per week and if necessary, top up with distilled water until the electrolyte is about 10 mm above the top of the plates.
3. The battery terminals should be kept free of oxidation products (a white powdery substance). Whenever this is found it should be wiped off with a clean, dry cloth and a smear of acid resistant grease (vaseline for example) should be applied to the terminals. Note that good contact must be maintained between the battery terminal and the connecting lead; grease must not be applied to the mating surfaces.

#### LIGHTS

4. Bulbs are liable to failure at any time without warning. Because of this, frequent checks of lamp operation should be made and faulty bulbs replaced immediately.
5. Lenses should at all times be kept free of mud and dirt. They should be wiped with a clean, damp cloth whenever practical.

#### WIRING

6. The leads between the various electrical circuits are an important part of the system. Where clips or grommets are used the wires should be firmly held in position. Wires trapped between metal parts, especially where they pass across sharp edges should be suitably protected against chafing. Mud or moisture on leads, especially close to terminals, can cause short circuits and failure of circuits.

7. The wiring should be checked for the points made above at regular intervals and immediate remedial action taken where required. Disconnect and reconnect terminals occasionally to ensure good contact is maintained between mating surfaces.

#### FUSE CHANGING

8. If more than one lamp or service fails at the same time the fuses should be examined and a blown fuse replaced. If the same fuse blows again immediately on switching on, check the circuits concerned for a short circuit to earth.
9. To change a fuse:

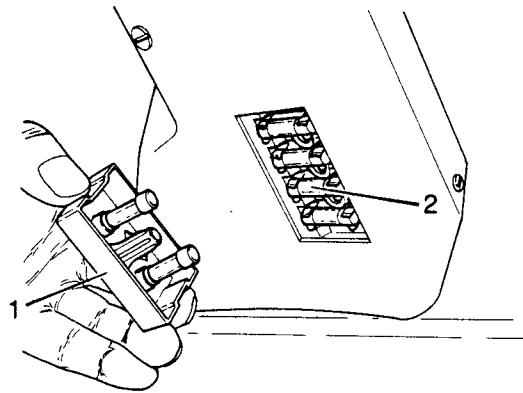
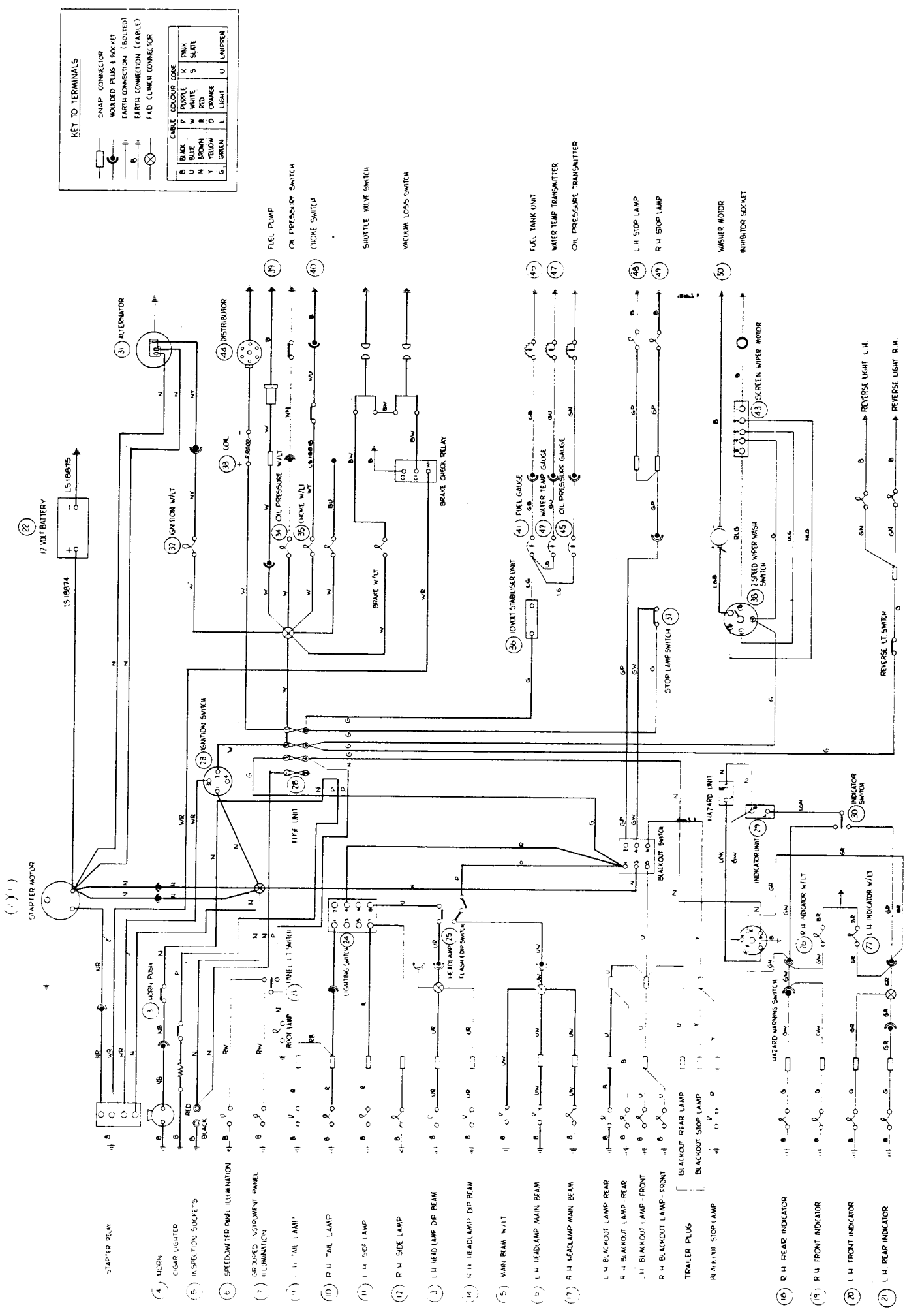


Fig 07.1

- (1) Refer to Fig 07.1. Pull off the fuse box cover (1).
- (2) Pull the ruptured fuse (2) out of its clips and discard.
- (3) Clip a fresh fuse into position.
- (4) Replace the fuse box cover.



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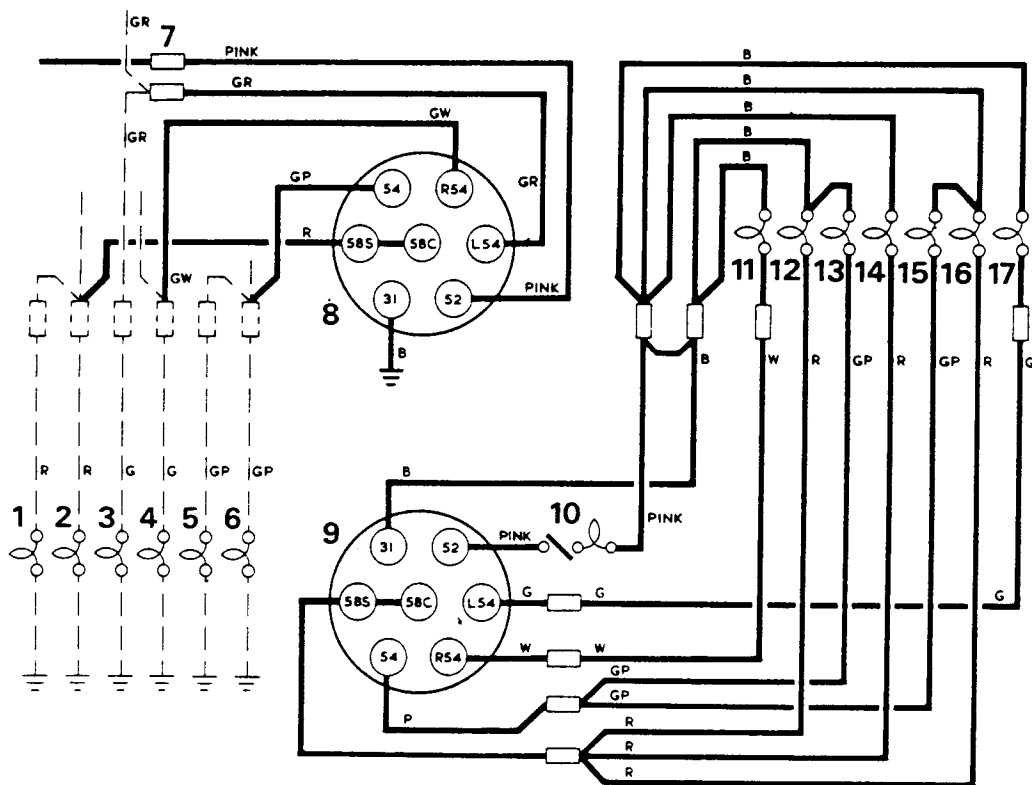
Starter motor  
Solenoid, Starter motor  
Switch for horns  
Horn  
Inspection sockets  
Speedometer panel illumination  
Grouped instrument panel illumination  
Switch panel, lights  
Tail lamp, LH  
Tail lamp, RH  
Side lamp, LH  
Side lamp, RH  
Headlamp, LH dipped beam  
Headlamp, RH dipped beam  
Warning light, headlamp main beam  
Headlamp, LH main beam  
Headlamp, RH main beam  
Direction indicator lamp, rear RH  
Direction indicator lamp, front RH  
Direction indicator lamp, front LH  
Direction indicator lamp, rear LH  
Battery  
Switch, ignition and starter  
Switch, lights  
Switch, headlamp flash and dip  
Warning light, indicator RH

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Warning light, indicator LH  
Fuses, 1 to 4, 35 amp, blow, 17 A normal working  
Indicator unit, flasher  
Switch, direction indicators  
Alternator, Lucas 16 ACR  
Warning light, ignition  
Ignition coil  
Warning light, oil pressure  
Warning light, choke  
Voltage stabiliser, fuel-, water-, and temperature gauge  
Switch, stop lamp  
Switch, windscreen wiper  
Fuel pump  
Switch, cold start, warning light  
Fuel gauge  
Water temperature gauge  
Screenwiper motor  
Distributor  
Switch, oil pressure  
Fuel tank unit  
Water temperature transmitter unit  
Stop lamp, LH  
Stop lamp, RH  
Screenwasher motor

KEY FOR VEHICLE WIRING DIAGRAM





**CIRCUIT DIAGRAM, TRAILER LIGHTING, NEGATIVE EARTH**

**Vehicle**

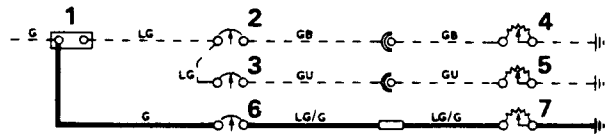
1. Tail lamp, R.H.
2. Tail lamp, L.H.
3. Flasher lamp, L.H.
4. Flasher lamp, R.H.
5. Stop lamp, R.H.
6. Stop lamp, L.H.
7. To fuse box
8. Socket on vehicle

**Trailer**

9. Socket on trailer
10. Interior lamp & switch
11. Flasher lamp, R.H.
12. Tail lamp, R.H.
13. Stop lamp, R.H.
14. Number-plate illumination
15. Stop lamp, L.H.
16. Tail lamp, L.H.
17. Flasher lamp, L.H.

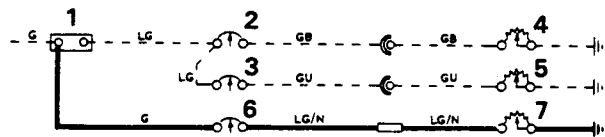
**KEY TO CABLE COLOURS**

|    |       |    |        |
|----|-------|----|--------|
| B. | Black | P. | Purple |
| N. | Brown | V. | Blue   |
| W. | White | R. | Red    |
| G. | Green | L. | Light  |



#### Oil Temperature Gauge

1. Stabilizer unit
2. Fuel gauge
3. Water temperature gauge
4. Fuel tank unit
5. Water temperature transmitter
6. Oil temperature gauge
7. Oil temperature transmitter



#### Oil Pressure Gauge

1. Stabilizer unit
2. Fuel gauge
3. Water temperature gauge
4. Fuel tank unit
5. Water temperature transmitter
6. Oil pressure gauge
7. Oil pressure transducer

#### KEY TO CABLE COLOURS

|    |       |    |        |
|----|-------|----|--------|
| B. | Black | P. | Purple |
| N. | Brown | U. | Blue   |
| W. | White | R. | Red    |
| G. | Green | L. | Light  |
| S. | Slate |    |        |

SECTION CONTENTS LIST

SECTION P

WHEELS AND TYRES

| SUB-SECTION | DESCRIPTION                    | PAGE |
|-------------|--------------------------------|------|
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| P2          | MAINTENANCE                    | P2.1 |