

LAND-ROVER 101”  
FORWARD CONTROL  
1 TONNE 4 x 4  
REPAIR OPERATION  
MANUAL

IF YOU PAYED PTC 9120 FOR THIS FILE,  
YOU HAVE BEEN RIPPED OFF.

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YOU HAVE BEEN RIPPED OFF.**

**EMER  
WHEELED VEHICLES  
Q052**

**AIR PUBLICATION  
5046A  
Volume 1 and Volume 6**

**TRUCK, GENERAL SERVICE  
1 TONNE, 4 x 4, ROVER**

**TRUCK, GENERAL SERVICE, FFR  
1 TONNE, 4 x 4, ROVER**

**TECHNICAL HANDBOOK –  
TECHNICAL DESCRIPTION,  
UNIT AND FIELD REPAIRS**

## AMENDMENT RECORD

AL number	Date of incorporation	Signature	AL number	Date of incorporation	Signature
1			31		
2			32		
3			33		
4			34		
5			35		
6			36		
7			37		
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## INTRODUCTION

The purpose of this Handbook is to assist in the efficient repair and maintenance of Rover 101 1 Tonne 4 × 4 vehicles.

### **Indexing**

For convenience, this Handbook is divided into a number of divisions. A contents page listing the titles and reference numbers of the various divisions is provided.

A list of the operations within each of the divisions appears in alphabetical order on the contents page preceding each of the divisions.

### **Operation Numbering**

Each operation is followed by the number allocated to it in a master index. The number consists of six digits arranged in three pairs.

The master index of operations has been compiled for universal application and therefore continuity of the numbering sequence is not maintained throughout the Handbook. To assist with locating information, each division of the Handbook is preceded by a contents page listing the operations in alphabetical order.

Each instruction within an operation has a sequence number and, to complete the operation in the minimum time it is essential that these instructions are performed in numerical sequence commencing at 1 unless otherwise stated. Where applicable the sequence numbers identify the components in the appropriate illustration.

Where performance of an operation requires the use of a service tool, the tool number is quoted under the operation heading and is repeated in, or following the instruction involving its use.

An illustrated list of all service tools necessary to complete the operations described in the Handbook is also included.

### **References**

References to the left or right hand side in the Handbook are made when viewing the vehicle from the rear. With the engine and gearbox assembly removed, the water pump end of the engine is referred to as the front.

### **Amendments**

Revised and additional procedures resulting from changes in the vehicle specification will be issued as revised or additional pages.

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**NOTES TO READERS**

1. The subject matter of this publication may be affected by Defence Council instructions, EMER Modifications, Miscellaneous Instructions or General Orders and Modification Leaflets. If possible, amendments are issued to correct this publication accordingly. When an Instruction or Leaflet contradicts any portion of this publication, the Instruction or Leaflet must be taken as the overriding authority.
2. The lubricants and lubrication periods to be used will be those quoted in the Servicing Schedule or Air Diagram.
3. Torque wrench setting figures given in the Technical Handbook must be strictly adhered to. Locking devices, where specified, must be fitted. If the efficiency of a locking device is impaired during removal it must be renewed.

**ASSOCIATED PUBLICATIONS**

	Code No.
<b>ARMY</b>	
Servicing Schedule . . . . .	61287
Complete Equipment Schedule, Cargo and FFR vehicles . . . . .	34219
Cargo and FFR w/winch vehicles . . . . .	34244
User Handbook . . . . .	22260
Parts List . . . . .	22726
<b>RAF</b>	AP No.
Data Book of RAF Vehicles . . . . .	2782E
Manual for Mech. Trans Servicing . . . . .	3260 Series
RAF Engineering — Mech. Trans . . . . .	1464E
User Handbook . . . . .	5046A (UH)
General Orders and Modifications . . . . .	4545 Series
Lubrication Air Diagram (Daily and Weekly Servicing) . . . . .	AD 8287/1
Lubrication Air Diagram (Minor and Major Servicing) . . . . .	AD 8290

**DESCRIPTION OF VEHICLE**

The 101 inch wheelbase forward control Land Rover is designed to meet military requirements for a 1 ton payload 4 × 4 vehicle with added capacity of towing a 1½ ton trailer. In order to provide a multi-role capability, there are alternative vehicle specifications in use, these include right-hand steering or left-hand steering, 12 volt electrical system or 24 volt electrical system and the option of a side mounted powered winch.

The vehicle is designed around an all steel, welded box-section chassis, to which the major units are secured. The engine and gearbox unit, secured to the chassis by four rubber mountings, comprises a 3.5 litre, V8 petrol engine coupled directly to a main and transfer gearbox with output shafts to the front and rear axles. The main gearbox has four forward speeds and a reverse that are transmitted through a two speed transfer box to give either high or low ratio. The vehicle drive is to all four wheels through an intermediate differential that is fitted in the transfer gearbox. When operating under exceptionally adverse conditions, the gearbox differential can be locked to provide maximum traction.

The front and rear axles are under-slung on semi-elliptic taper leaf springs, that are themselves secured to flexible bushes incorporated in the chassis side members. Front wheel drive is transmitted through hypoid bevel gearing and a normal type differential to the half-shafts and then via enclosed constant velocity joints to the front hubs. The rear axle is of the 'fully-floating' type, the drive being transmitted by hypoid bevel gearing and normal type differential to the axle shafts.

Suspension is by semi-elliptic taper leaf springs, as already described, with double acting hydraulic telescopic dampers and rubber buffers. An anti-roll bar is fitted between the front axle case and No. 2 chassis cross-member to provide partial control of movement between the front axle and the chassis, in order to reduce vehicle body roll.

The steering equipment consists of a recirculating ball type steering box, secured to an outrigger on the chassis side member, and a relay unit located in No. 2 chassis cross-member. A tube, incorporating a ball joint at each end, connects the steering box to the relay unit and a conventional drag link and track rod transmits the steering wheel movement from the relay unit to the road wheels.

The road wheel brakes are drum and shoe type, operated by a vacuum servo assisted, dual line hydraulic system. The hydraulic system is divided between the front and rear brakes with an apportioning valve in the rear system. A hand operated transmission brake, mounted at the rear of the transmission gearbox, is all mechanical in operation and acts on the gearbox output drive to the rear axle.

The vehicle body is composed of two main, prefabricated units, the driving cab and the cargo section. Both units are constructed from light alloy sheet metal with steel cappings and corners and are secured to the chassis with bolts and nuts. A special feature of the body is its adaptability for air transport by helicopter. The complete hood, body sides, windscreen, bumpers and spare wheel can be removed to reduce the weight of the vehicle and give access to built-in lifting eyes.

There are 12 volt and 24 volt electrical systems in use, depending on the particular vehicle's specification. 12 volt models employ a negative earth system with a 34 amp alternator incorporating a rectifier and voltage regulator. 24 volt models have a negative earth system and employ a 90 amp AC generator incorporating a rectifier, but with a separate generator panel containing a voltage regulator and split charge facility for radio batteries. Vehicles are prepared to receive a radio station and are completely suppressed to prevent interference to radio.

**NOTE:** Detailed descriptions of major units are included at the beginning of the applicable Divisions of this Manual.

## VEHICLE TYPES AND IDENTIFICATION

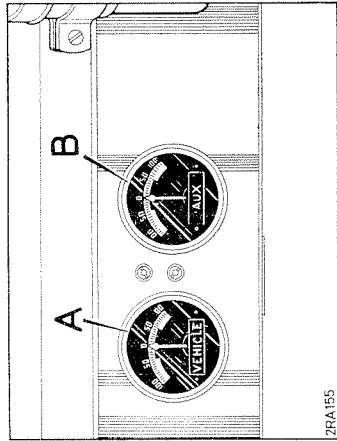
This book covers the following Rover vehicles:

### Rover 1 tonne FC, 101 in wheelbase, 24 volt models

Identification: Inclusion of ammeters adjacent to inspection light sockets.

### Rover 1 tonne FC, 101 in wheelbase, 12 volt models

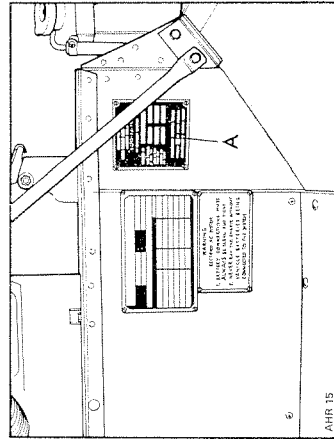
Identification: Ammeters not fitted.



Ammeters, 24 volt models  
A—Vehicle ammeter  
B—Auxiliary ammeter

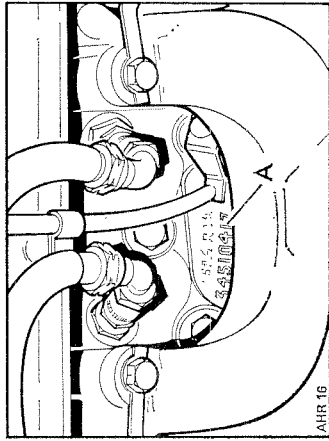
## VEHICLE SERIAL NUMBERS

The vehicle serial number, comprising eight digits and a suffix letter, will be found on a plate on the radiator ducting, passenger side.



Vehicle Serial Number  
A—Vehicle Serial Number

The engine serial number is stamped on the cylinder block on a cast pad between numbers 3 and 5 cylinders adjacent to the engine oil level dipstick.



Engine Serial Number  
A—Engine Serial Number

Other units bear serial numbers as detailed below, but they should not be quoted unless specifically requested:  
Gearbox number: On top of the gearbox spacer between the main gearbox casing and bell housing.  
Rear axle: On top of axle casing on left-hand side.  
Front axle: On top of axle casing on left-hand side.

## ABBREVIATIONS AND SYMBOLS IN THIS MANUAL

Across flats (bolt size) ..	AF	Miniature edison screw ..	MES
After bottom dead centre ..	ABDC	Millimetre ..	mm
After top dead centre ..	ATDC	Miles per gallon ..	mpg
Alternating current ..	a.c.	Miles per hour ..	mph
Ampere ..	amp	Minimum ..	min
Ampere-hour ..	amp hr	minute (of angle) ..	'
Atmospheres ..	Atm	Minus (of tolerance) ..	-
Before bottom dead centre ..	BBDC	Negative (electrical) ..	-
Before top dead centre ..	BTDC	Number ..	No.
Bottom dead centre ..	BDC	Ohms ..	ohm
Brake mean effective pressure ..	BMEP	Ounces (force) ..	ozf
Brake horse power ..	bhp	Ounces (mass) ..	oz
British Standards ..	BS	Ounce inch (torque) ..	ozf.in.
Carbon monoxide ..	CO	Outside diameter ..	o.dia.
Centimetre ..	cm	Paragraphs ..	para.
Centigrade (Celsius) ..	C	Part number ..	Part No.
Cubic centimetre ..	cm <sup>3</sup>	Percentage ..	%
Cubic inch ..	in <sup>3</sup>	Pints ..	pt
Degree (angle) ..	deg or °	Pints (US) ..	US pt
Degree (temperature) ..	deg or °	Plus (tolerance) ..	+
Diameter ..	dia.	Positive (electrical) ..	+
Direct current ..	d.c.	Pound (force) ..	lbf
Fahrenheit ..	F	Pounds feet (torque) ..	lbf.ft.
Feet ..	ft	Pounds inches (torque) ..	lbf.in.
Feet per minute ..	ft/min	Pound (mass) ..	lb
Fifth ..	5th	Pounds per square inch ..	lb/in <sup>2</sup>
Figure (illustration) ..	Fig.	Radius ..	r
First ..	1st	Rate (frequency) ..	c/min
Fourth ..	4th	Ratio ..	:
Gramme (force) ..	gf	Reference ..	ref.
Gramme (mass) ..	g	Revolution per minute ..	rev/min
Gallons ..	gal	Right-hand ..	RH
Gallons (US) ..	US gal	Right-hand steering ..	RHSig
High compression ..	h.c.	Second (angle) ..	°
High tension (electrical) ..	H.T.	Second (numerical order) ..	2nd
Hundredweight ..	cwt	Single carburetter ..	SC
Independent front suspension ..	i.f.s.	Specific gravity ..	sp.gr.
Internal diameter ..	i.dia.	Square centimetres ..	cm <sup>2</sup>
Inches of mercury ..	in.Hg	Square inches ..	in <sup>2</sup>
Inches ..	in	Standard ..	std.
Kilogramme (force) ..	kgf	Standard wire gauge ..	s.w.g.
Kilogramme (mass) ..	kg	Synchroniser/synchromesh ..	synchro.
Kilogramme centimetre (torque) ..	kgf.cm	Third ..	3rd
Kilogramme per square centimetre ..	kgf/cm <sup>2</sup>	Top dead centre ..	TDC
Kilogramme metre (torque) ..	kgf.m	Twin carburetters ..	TC
Kilometres ..	km	United Kingdom ..	UK
Kilometres per hour ..	km/h	Volts ..	V
Kilovolts ..	kV	Watts ..	W
King pin inclination ..	k.p.i.		
Left-hand steering ..	LHSig	<b>SCREW THREADS</b>	
Left-hand thread ..	LHThd	American Standard Taper Pipe ..	NPTF
Litres ..	litre	British Association ..	BA
Low compression ..	l.c.	British Standard Fine ..	BSF
Low tension ..	l.t.	British Standard Pipe ..	BSP
Maximum ..	max.	British Standard Whitworth ..	Whit.
Metre ..	m	Unified Coarse ..	UNC
Microfarad ..	mfd	Unified Fine ..	UNF

## Wheeled Vehicles Q052 SEALANTS & JOINTING COMPOUNDS CONVERSION CHART

TRADE NAME	EQUIVALENT ARMY CODE
Bostik 771	Sealing compound H1/8030-99-913-0065
Hermetite (Flexible) Sealant	Sealing compound H1/8030-99-220-1299 (Provisional Number)
Holdite 88 Cement	Sealing compound H1/2830-99-999-0898
Hylomar P132M	Joining compound H1/8030-99-220-2370
Kelseal Glasticord	Sealing strip
Loctite Primer Grade 'T'	Primer sealing compound H1/8030-99-224-0353
(Not required with Loctite 245, 270, 542)	
Loctite 245 (was Studlock CVX)	Sealing compound H1/8030-99-224-1998
Loctite 270 (was Grade AVV)	Sealant locking H1/8030-99-224-8707
Loctite 542	Sealing compound H1/8030-99-220-2572
Molybdenum Disulphate Grease	Grease ZX-35
Prestik Sealing Strip	Sealing strip
Ragosine Listate Grease	Grease XG271
Shell Turbo Oil	Oil OM100

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**ENGINE**

Type	Rover 2158 V8
Number of cylinders	Eight — Two banks of 4
Bore	88,90 mm (3.50 in)
Stroke	71,12 mm (2.80 in)
Capacity	3528 cm <sup>3</sup> (215 in <sup>3</sup> )
Valve operation	Overhead by pushrod
Compression ratio	8.5:1
<b>Crankshaft</b>	
Number of main journals	5
End — thrust	Taken on Number 3
End — play	0,10 to 0,20 mm (0.004 to 0.008 in)
Crankpin diameter (Standard)	50,800 to 50,812 mm (2.0000 to 2.0005 in)
Main bearing:	
Clearance	0,023 to 0,065 mm (0.0009 to 0.0025 in)
Journal diameter (Standard)	58,399 to 58,412 mm (2.2992 to 2.2997 in)
Bearing overall length	Nos. 1, 2, 4 & 5 20,24 to 20,49 mm (0.797 to 0.807 in) No. 3 26,82 to 26,87 mm (1.056 to 1.058 in)
<b>Connecting rods</b>	
Type	Horizontally split big end, solid small end
Length between centres	143,71 to 143,81 mm (5.658 to 5.662 in)
Bearing:	
Clearance on crankshaft	0,015 to 0,055 mm (0.0006 to 0.0022 in)
End float on crankshaft	0,15 to 0,37 mm (0.006 to 0.014 in)
<b>Gudgeon pin</b>	
Length	72,67 to 72,79 mm (2.861 to 2.866 in)
Diameter	22,112 to 22,219 mm (0.8745 to 0.8748 in)
Fit in con rod	Press fit
Clearance in piston	0,005 to 0,007 mm (0.0002 to 0.0003 in)

<b>Pistons</b>		
Type	Aluminium alloy, concave topped	
Clearance at skirt bottom	0,018 to 0,033 mm (0,0007 to 0,0013 in)	
<b>Piston rings</b>		
No. 1 compression ring	Chrome faced and marked 'TOP'	
No. 2 compression ring	Stepped to 'L' shape and marked 'TOP'	
Depth of compression rings	1,98 to 2,01 mm (0,078 to 0,079 in)	
Compression ring clearance in piston groove	0,05 to 0,10 mm (0,002 to 0,004 in)	
Compression ring gap	0,44 to 0,57 mm (0,017 to 0,022 in)	
Oil control ring	Two oil ring rails with separate expander	
Rail oil rings	Perfect circle 110 -15	
Expander ring	Perfect circle 110 -37	
<b>Cylinder heads</b>		
Material	Aluminium alloy	
Type	Two heads with separate alloy inlet manifold	
Inlet and exhaust valve seat material	Piston ring iron	
Inlet and exhaust valve seat angle	46 + 4 degrees	
<b>Valves</b>		
Opens	Inlet Exhaust	
Closes	30 degrees BTDC 68 degrees BBDC	
Duration	75 degrees ABDC 37 degrees ATDC	
Valve open overlap	285 degrees 285 degrees	
	67 degrees	
<b>Valves, inlet</b>		
Overall length	116,58 to 117,34 mm (4,590 to 4,620 in)	
Actual overall head diameter	37,97 to 38,22 mm (1,495 to 1,505 in)	
Angle of face	45 degrees	
Stem diameter	8,640 to 8,666 mm (0,3402 to 0,3412 in) at the head and increasing to 8,653 to 8,679 mm (0,3407 to 0,3417 in)	
Stem clearance in guide	Top 0,02 to 0,07 mm (0,001 to 0,003 in) Bottom 0,013 to 0,0635 mm (0,0005 to 0,0025 in)	
<b>Valves, exhaust</b>		
Overall length	116,58 to 117,34 mm (4,590 to 4,620 in)	
Actual overall head diameter	33,215 to 33,466 mm (1,3075 to 1,3175 in)	
Angle of face	45 degrees	
Stem diameter	8,628 to 8,654 mm (0,3397 to 0,3407 in) at the head and increasing to 8,640 to 8,666 mm (0,3402 to 0,3412 in)	
Stem clearance in guide	Top 0,038 to 0,088 mm (0,0015 to 0,0035 in) Bottom 0,05 to 0,10 mm (0,002 to 0,004 in) 9,9 mm (0,39 in) both valves	
Valve lift	9,9 mm (0,39 in) both valves	
<b>Valve spring length</b>		
Outer	40,6 mm (1,6 in) at pressure of 17,69 to 20,41 kg (39 to 45 lb)	
Inner	41,4 mm (1,63 in) at pressure of 9,75 to 12,02 kg (21.5 to 26.5 lb)	
<b>Camshaft</b>		
Drive	Chain and sprocket from crankshaft	
Timing chain	Inverted tooth type 9,52 mm (0,375 in) pitch x 54 pitches	
<b>Tappets</b>		
	Hydraulic non-adjustable	
<b>Lubrication</b>		
System type	Wet sump, pressure fed	
Oil filter — internal	Gauze pump intake strainer in sump	
Oil filter — external	Full-flow filter, A.C. Delco; PF2	
Oil pump	Gear type, camshaft operated	
Oil pressure	2,1 to 2,8 kg/cm <sup>2</sup> (30 - 40 lb/in <sup>2</sup> ) at 2400 r.p.m. — warm engine	
Pressure relief valve	0,56 - 0,84 kg/cm <sup>2</sup> (8 - 12 lb/in <sup>2</sup> )	
Oil cooler	Marston Still tube, full flow	
<b>COOLING SYSTEM</b>		
Type	Pressurised 1,05 kg/cm <sup>2</sup> (15 lb/in <sup>2</sup> ) spill return system with thermostat control, pump and fan assisted 4 row, 11 fins per inch tube type with overflow bottle. 7 bladed, cowed, 406 mm (16 in) viscous coupled. Belt driven from crankshaft	
Fan	By centrifugal impeller type pump	
Circulation	Wax type. Start opening at 79,4° — 82,2°C (175° — 180°F). Fully open at 93°C (195°F)	
Thermostat		

**FUEL SYSTEM**

Fuel pump  
Carburettors  
Carburettor metering needle  
Air cleaner  
Filter

Electric, AC 6440793  
Two Zenith Stromberg 175 CD 2S (internally vented)  
2 AY  
AC Cyclone paper element 228.6 mm (9 in)  
Sediment bowl type and element type

**CLUTCH**

Make/type  
Driven plate  
Operation

Borg & Beck diaphragm type  
266 mm (10.5 in) diameter  
Hydraulic

**MAIN GEARBOX**

Type  
Speeds  
Synchronesh  
Ratios: Fourth (Top)  
Third  
Second  
First  
Reverse

Single helical, constant mesh  
4 forward, 1 reverse  
All forward speeds  
1.00:1  
1.505:1  
2.448:1  
4.069:1  
3.665:1

**TRANSFER GEARBOX**

Type  
Controls

Two-speed reduction on main gearbox output  
High/Low lever, cable operated. Differential lock switch  
vacuum control, mounted on the radiator ducting

Ratios:

High transfer  
Low transfer

1.174:1  
3.321:1

**FRONT AXLE**

Differential  
Front wheel drive  
Ratio

Hypoid bevel; Salisbury 8 HS  
Enclosed constant velocity joints  
5.57:1

**REAR AXLE**

Type  
Ratio  
Overall ratio including final drive  
Top  
Third  
Second  
First  
Reverse

Hypoid bevel; Salisbury 8 HA fully floating shafts  
5.57:1  
High transfer  
6.54:1  
9.85:1  
27.8:1  
16.01:1  
45.3:1  
26.60:1  
75.0:1  
24.00:1  
67.0:1

**SUSPENSION**

Road springs  
Hydraulic dampers  
Anti-roll bar

76 mm (3 in) wide-semi-elliptic taper leaf.  
44.5 mm (1½ in) bore, telescopic hydraulic dampers.  
Make: Woodhead  
Fitted on front

**STEERING**

Type  
Gear ratio-variable  
Steering damper  
Steering wheel diameter  
Front wheel toe-out  
Camber angle  
Castor angle  
Swivel pin inclination  
Steering wheel free movement

Burman re-circulating ball  
Straight ahead 23.3:1  
Full lock 25.7:1  
Woodhead S 11 A  
406 mm (16 in)  
1.2 — 2.4 mm ( $\frac{3}{8}$  —  $\frac{3}{4}$  in)  
 $1\frac{1}{4}^{\circ}$   
 $1^{\circ}$   
 $7^{\circ}$   
16 mm ( $\frac{5}{8}$  in)

**BRAKES**

Type

Drum, Girling hydraulic through split (front and rear) circuits by leading and trailing shoes on the rears and twin leading shoes on the fronts

Total lining area-front  
Total lining area-rear  
Brake drum diameter  
Brake apportioning valve clearance

775 cm<sup>2</sup> (120 in<sup>2</sup>)  
640 cm<sup>2</sup> (99.5 in<sup>2</sup>)  
280 mm (11 in)  
0,050 mm (0.002 in)

**HANDBRAKE**

Type Lockheed Duo — Servo drum brake on transfer box output shaft  
 Total lining area 195 cm<sup>2</sup> (30.2 in<sup>2</sup>)  
 Drum diameter 184 mm (7.25 in)

**WHEELS**

Size/type 6½L × 16 Steel well base. Six stud fixing

**TYRES**

Size/type 9.00 × 16 tubed Cross country tread, (18.6 in Terra Tires special wheels, available as an extra)  
 Pressures See Servicing Schedule

**ELECTRICAL EQUIPMENT**

12 Volt Models  
 System  
 Battery:—  
 Type  
 Voltage  
 Capacity  
 Control box  
 Fuse box inside front panel  
 Generator

24 Volt Models  
 System

**Batteries:—**

Type Oldham UK 2HN  
 Voltage 24 volt 2 + 12 volt in series  
 Capacity 57 a/h  
 Generator No. 10 Mk 2 (FV 546125) 90 amp  
 Generator panel CAV 396/3 No. 9 MK 3. FV 546131  
 Regulator CAV N66  
 Fuses — inside front panel

24 volt negative earth with rectified AC generating system

35 amp cartridge type

**ALTERNATOR — 12 Volt****Alternator Data**

Type Lucas 16 ACR No. 23793A  
 Polarity Negative earth  
 Nominal voltage 12  
 Nominal d.c. output (Hot, at 14V and 6,000 rev/min) 34 amps  
 Alternator controlled voltage (measured across battery terminals with alternator current stabilised below 10 amps) 13.6 to 14.4 V  
 Max. permissible speed 15,000  
 Rotor field winding resistance (approx) 4.3 ohms (Rotors with Pink windings)  
 3.3 ohms (Rotors with Purple windings)  
 Brush spring pressure (measured with brush depressed and flush with brushbox moulding) 9 to 13 oz (255 to 368 g)  
 New brush length 0.5 in (12 mm)  
 Renew when worn to: 0.3 in ( 8 mm)

**ALTERNATOR — 24 Volt****Data**

Type CAV AC 90/2 No. 10 Mk 2  
 Voltage 24 nominal  
 Current 90 amps maximum  
 Field resistance 15 ohms  
 Cutting-in speed 900 rev/min cold  
 Main full load speed 1,900 rev/min cold  
 Maximum safe speed 10,000 rev/min  
 Weight 40 lbs  
 Maximum input torque 12 lbf in at 1,900 rev/min  
 Horse-power input 6 at 4,500 rev/min  
 Maximum ambient temperature 80°C  
 Direction of rotation Reversible  
 Cooling Internal fan  
 Number of poles 12  
 Number of brushes 2  
 Brush grade EG 12  
 Spring pressure 8 — 10 oz  
 Type of diode DD 716, DD 716A, DD 3026A  
 Number of diodes 3, 3, 3,

STARTER MOTOR 12V & 24V Models

**Data**  
 Manufacturer Lucas  
 Type 3M100 PE  
 Lucas part number 25701  
 Rover part number 586638 589816

**Motor**  
 Yoke diameter 4 in (101,60 mm)  
 Light running-speed 6,000 rev/min  
 Current 65 amp  
 Torque Not stated  
 Load running-speed 1,000 rev/min  
 Current 365 amp  
 Torque 9.0 lbf ft (12.2 Nm)  
 Locked — speed Nil  
 Current 545 amp  
 Torque 16.5 lbf ft (22.4 Nm)

Commutator minimum skimming diameter 0.140 in (3,56 mm)  
 Brush length — new 0.710 in (18,03 mm)  
 Renew if less than: 0.375 in (9,53 mm)  
 Brush spring pressure 36 ozf (1000 gf)

Shaft end-float; maximum between bush and spire retaining ring 0.010 in (0,25 mm)  
 Bearing renewal mandrel diameter commutator end 0.4377 in (11,118 mm)  
 Drive end bracket bearing 0.4729 in (12,012 mm)

**Solenoid**

Pull-in winding resistance — measured between un-marked 'WN wire' connector and 'STA' terminal 0.25 to 0.27 ohm  
 Hold-in winding resistance — measured between un-marked 'WN wire' connector and unit body 0.76 to 0.80 ohm

**SHUNT BOX 24V Models CAV 466/3**

**Radio/Auxiliaries fuse (Shunt box)**  
 650 — 150A Tested to 300 volt peak 200 RMS

**Radio Interference Capacitors (Shunt box)**  
 7727 FLM/73 1.8 m.f.d. 200VDC Wkg (a) 70°C

**BULB CHARTS**

**12 VOLT**

POSITION	TYPE	VOLTAGE	WATTAGE
Headlight	Lucas SP 367	12	50/40
Sidelight	Lucas SP 207	12	5
Stop/tail	Lucas SP 380	12	21/5
Flasher	Lucas SP 382	12	21
Number plate	Lucas SP 989	12	2.2
Convoy	Lucas SP 223	12	12/14-7
Instrument panel	Lucas SP 987	12	2.2
Ignition light	Lucas SP 281	12	2
Flasher — indicator			
Hazard — indicator			
Differential lock			
Brake — warning			
Trailer — warning			
Winch — warning			

**24 VOLT**

POSITION	TYPE	VOLTAGE	WATTAGE
Headlight	Lucas SP 368	26	50/50
Sidelight	Lucas SP 149	24	5
Flasher	Lucas SP 241	24	21
Stop/tail	Lucas SP 380	24	4
Number plate	Lucas SP 227	24	6
Convoy	Lucas SP 149	24	5
Instrument panel	Lucas SP 650	24	2.8
Ignition light	Lucas SP 283	24	3
Flasher — indicator			
Hazard — indicator			
Differential lock			
Trailer — warning			
Winch — warning			
Ammeter			
Brake — warning	Lucas SP 650	24	2.8
	Lucas SP 687	24	Liliput 1.1

**DIMENSIONS**

Overall length, fully equipped 4330 mm 170.5 in  
 Overall length, basic, stripped 4217 mm 166 in  
 Overall width 1842 mm 72.5 in  
 Overall height:  
 Over hood 2283 mm 90 in  
 To top of windscreen 2138 mm 84 in  
 Wheel base 2565 mm 101 in  
 Track, front 1524 mm 60 in  
 Track, rear 1549 mm 61 in  
 Internal body dimension:  
 Length 2491 mm 98 in  
 Width 1720 mm 67.75 in  
 Width between wheel boxes 991 mm 39 in  
 Height, floor to underside of hoop sticks 1334 mm 52.5 in  
 Height of wheel boxes 282 mm 11 in  
 Turning circle 11.3 m 37 ft  
 Minimum ground clearance under axles 254 mm 10 in

**WEIGHTS**

Unladen:  
 Total:  
 Running with coolant, oil, 24 galls fuel 1924 kg 4242 lb  
 Front axle 1138 kg 2504 lb  
 Rear axle 723 kg 1589 lb  
 Stripped: 5½ galls and without spare wheel 1580 kg 3500 lb  
 Front axle 1012 kg 2225 lb  
 Rear axle 552 kg 1212 lb

12V models 24V models

Laden:  
 Total, max. approved gross loaded 3143 kg 6930 lb  
 Maximum front axle 1654 kg 3618 lb  
 Maximum rear axle 1580 kg 3475 lb

\*( ) — Without modular radio kit fitted

**ENGINE**

Type Gasoline 90° V8  
 Capacity 3528 cm³ (215 in³)  
 Compression ratio 8.5:1  
 Firing order 1.8.4.3.6.5.7.2  
 Number one cylinder At front L.H. bank  
 Valve timing:  
 Exhaust valve peak 105.5° B.T.D.C.  
 Inlet valve peak 112.5° A.T.D.C.

**IGNITION — 12 VOLT MODELS**

Distributor:  
 Dwell angle Lucas type 35 D8 — G No. 41487  
 26° — 28° at 600 r.p.m.  
 Contact breaker gap 0.35 — 0.40 mm (0.014 — 0.016 in)  
 Ignition timing. (Static and dynamic) 3° BTDC at 600 r.p.m., 91 — 93 octane fuel  
 TDC at 600 r.p.m. 85 octane fuel  
 Coil Lucas type 16C6  
 Sparking plugs: Champion L92Y, 14 mm with suppressors  
 Gap 0.60 mm (0.025 in)  
 Suppressor (sparking plug cables) 10,000 to 15,000 ohms  
 LY6/MT4/2920 — 99-803 — 5505

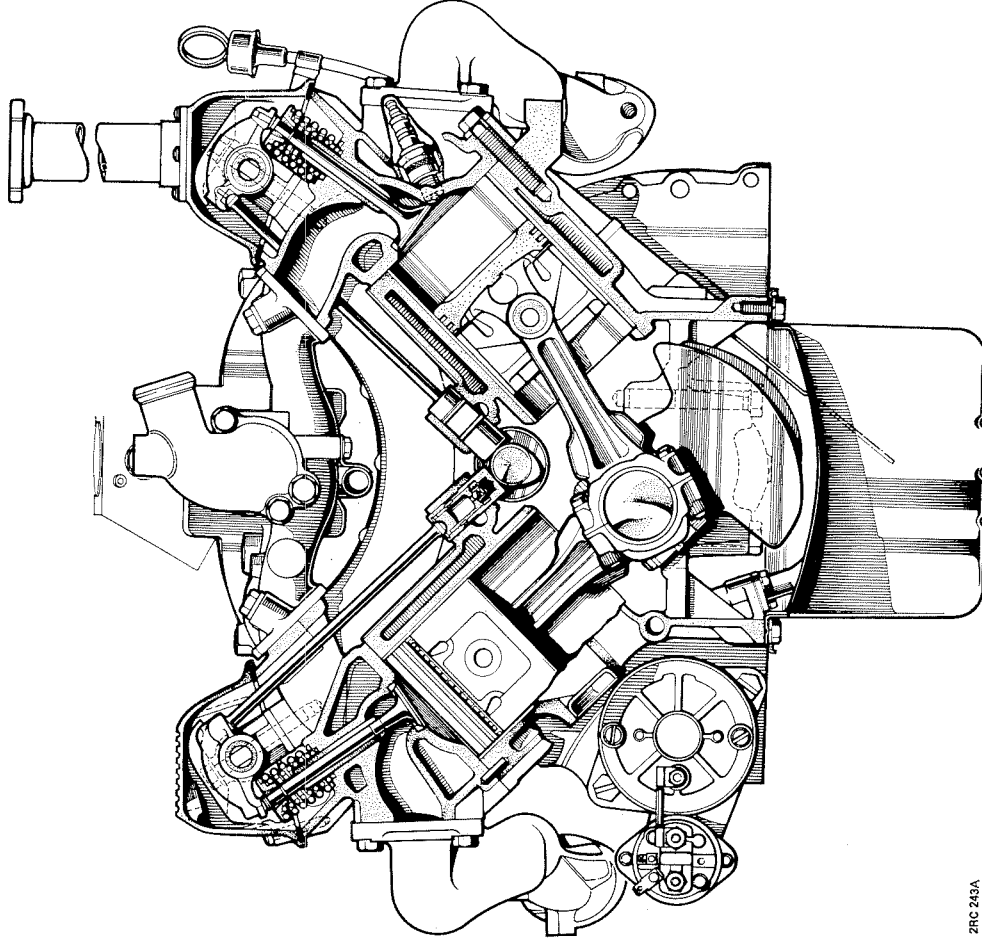
**IGNITION — 24 VOLT MODELS**

Distributor:  
 Contact breaker gap Lucas twin lever concentric contact breaker (screened)  
 Ignition timing. (Static and dynamic) 0.35 — 0.40 mm (0.014 — 0.016 in)  
 3° B.T.D.C. 91 — 93 octane fuel  
 T.D.C. at 600 rev/min 85 octane fuel  
 Coil Lucas type 5 C10  
 Sparking plugs: Screened and waterproofed type,  
 Champion RSL 92Y 14 mm  
 Gap 0.60 mm (0.025 in)

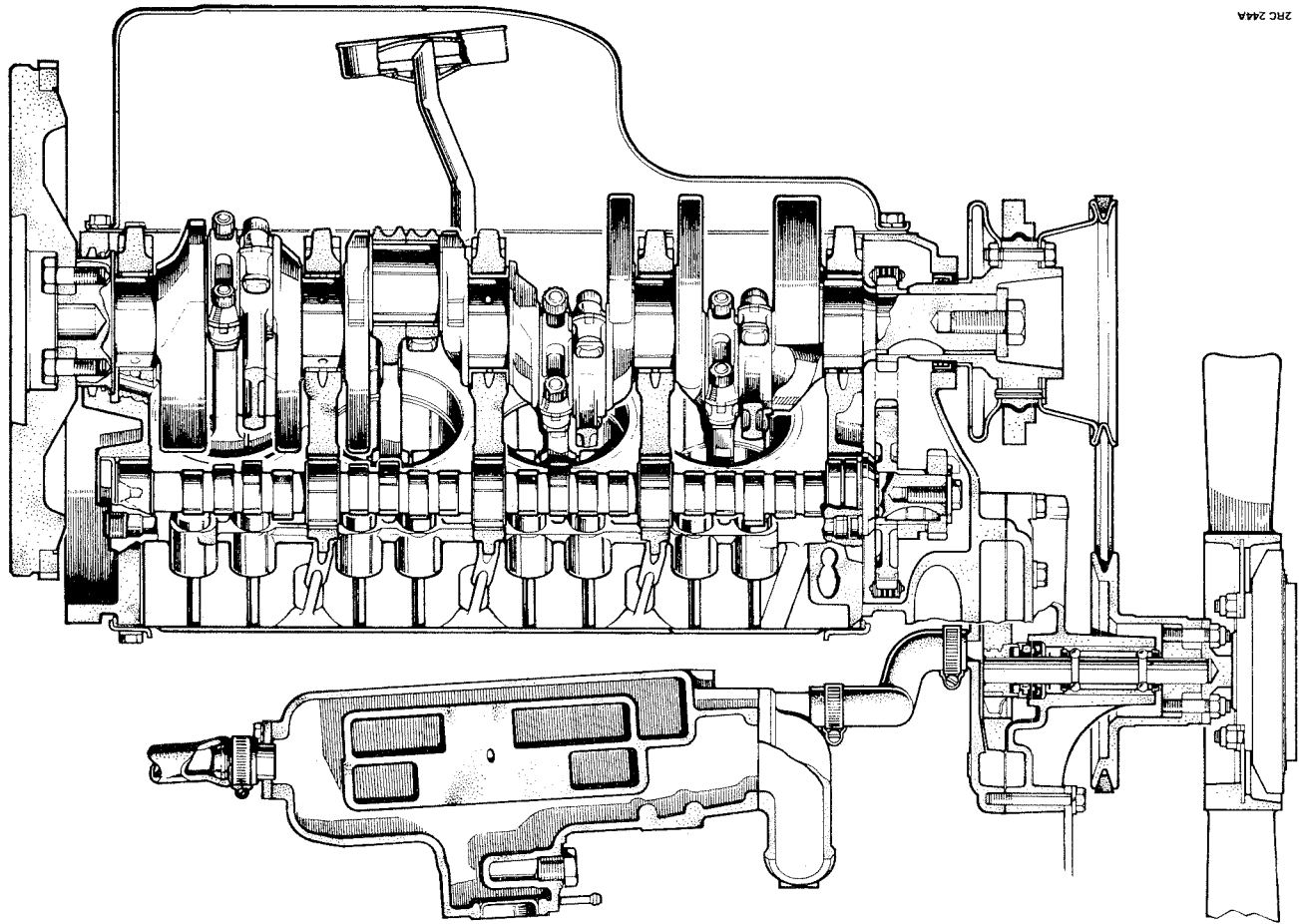
Operation	Specified Nm	Torque lbf ft
<b>ENGINE</b>		
Connecting rod cap nuts	49.0	36.2
Cover plate engine to bell housing	10.0	7.4
Cylinder head bolts — length	97.03 mm (3.80 in)	71.5
	66.55 mm (2.62 in)	
	54.86 mm (2.16 in)	45.7
Flywheel to crankshaft	62.0	45.7
Main bearing cap bolts Nos. 1 to 4	85.0	62.7
Main bearing-rear-cap bolts	76.0	56.1
Oil pump cover bolts	97.0	71.5
Oil pump relief valve plug	12	8.9
Rocker shaft bolts	49	36.1
Starter dog	40	29.5
Timing cover bolts	223	164.5
	35	25.8
<b>COOLING SYSTEM</b>		
Water pump housing bolts $\frac{7}{16}$ in AF	10	7.4
Water pump housing bolts $\frac{1}{2}$ in AF	35	25.8
<b>MANIFOLDS AND EXHAUST SYSTEM</b>		
Induction manifold bolts	40	29.5
Induction manifold gasket clamp bolts	20	14.7
Exhaust manifold bolts	20	14.7
<b>CLUTCH</b>		
Clutch cover bolts	15	11.1
Slave cylinder bolts	27	20.00
<b>GEARBOX</b>		
Bell housing to engine block	40.6	30.00
Casing to bell housing	162.7	120.00
Coupling flange retaining nut	94.9	70.00
Gearlever retaining plate bolt	15.0	11.1
Rear output shaft drive flange retaining nut	162.7	120.1
Transmission brake — screwscrew bolt	58.0	42.8
	47.0	34.7
	66.7	49.2
Gearbox switch		
Torques for bolts not specified — Bolt size	10.9	8.04
	M6	19.70
	M8	26.7
	M10	53.0
<b>PROPELLOR SHAFTS</b>		
Coupling flange bolts $\frac{3}{8}$ in UNF $\times$ $\frac{1}{2}$ in	46	33.9
<b>REAR AXLE AND FINAL DRIVE</b>		
Axle tubes to casing	38	28.0
Differential crown wheel bolts	142	104.7
Torques for bolts not specified — Bolt size		
	M8	21.7
	M10	58.3
	M12	98.1
		72.4

Operation	Specified Nm	Torque lbf ft	ENGINE	Wheeled Vehicles Q052
<b>FRONT AXLE AND FINAL DRIVE</b>				
Axle tubes to casing — bolt	38.0	28.0		12-3
Axle casing setscrew M8 × 16	29,4	21.7		12-6
Differential crown wheel bolts	142,0	104.7		12-8
<b>STEERING</b>				
Drag link to steering lever	39,2	29.0		
Longitudinal steering rod ball joints	12,2	9.0		
Steering box bolts	58,3	43.0		
Steering relay mounting bracket	29,8	22.0		
Steering relay — upper and lower — levers M10 × 30	58,3	43.0		
Swivel pin — upper — setscrew M12 × 35	98,1	72.4		
Swivel pin — lower — setscrew M10 × 20	58,3	43.0		
Swivel pin housing — setscrew M8 × 20	29,4	21.7		
Track rod end locknuts	98,0	72.3		
Track rod steering levers	39,2	29.0		
<b>SUSPENSION</b>				
Drive flange to hub M12 × 60	98,1	72.4		
Road springs, plates and 'U' bolts	88,0	65.0		
Shackle pins — all	92,0	68.0		
<b>BRAKES</b>				
Front brake assemblies to swivel pin housing M10 × 28	58,3	43.0		
Rear brake assemblies to axle tube flange M10 × 35	98,4	72.6		
<b>MISCELLANEOUS</b>				
Bumperette bolts	30,0	22.0		
Lifting rings: front	30,0	22.0		
helicopter	54,0	40.0		
rear	30,0	22.0		
No. 1 cross-member to chassis	30,0	22.0		
Radiator mounting bolts to frame	15,5	11.5		
Towing hook fixings	61,0	45.0		
<b>ENGINE OPERATIONS</b>				
Description of engine				
Description of engine lubrication system				
Fault diagnosis—engine				
Camshaft—remove and refit				12.13.01
Connecting rods and pistons				
—remove and refit				12.17.01
—overhaul				12.17.10
Crankshaft				
—remove and refit				12.21.33
—overhaul				12.21.46
—front oil seal—remove and refit				12.21.14
—rear oil seal—remove and refit				12.21.20
—spigot bearing—remove and refit				12.53.20
Cylinder				
—heads—remove and refit				12.29.10
—heads—overhaul				12.29.18
—pressures—check				12.25.01
Engine assembly—remove and refit				12.41.01
Engine and gearbox assembly—remove and refit				12.37.01
Flywheel				
—remove and refit				12.53.07
—overhaul				12.53.10
—starter ring gear—remove and refit				12.53.19
Oil				
—filter assembly, external—remove and refit				12.60.01
—pump—remove and refit				12.60.26
—pump—overhaul				12.60.32
—sump—remove and refit				12.60.44
—cooler—remove and refit				12.60.68
Rocker shafts				
—remove and refit				12.29.54
—overhaul				12.29.55
Timing				
—chain and gears—remove and refit				12.65.12
—gear cover—remove and refit				12.65.01
Valve gear—remove and refit				12.29.34





ZRC 243A



ZHC 244A

**ENGINE—DESCRIPTION**

The engine is a 3.5 litre, 90° Vee-eight-cylinder with overhead inlet and exhaust valves operated by a single central camshaft via push rods, and, is built-in unit construction with a dry single-plate clutch and with an integral main and transfer gearbox; the whole being carried on four flexible rubber mountings.

**Cylinder block**

The aluminium alloy cylinder block with inserted liners is cast integrally with a shallow crankcase. It has two banks of four cylinders that form a 90° angle.

**Crankshaft**

The crankshaft is supported by five bearings with thrust taken on the centre bearing. At the front of the crankshaft is a pulley that drives the coolant pump and alternator via a fan belt, while a spigot diameter at the rear, carries the flywheel.

**Connecting rods and pistons**

Forged steel connecting rods with shell bearings are located in V-pairs on the crankshaft journals, and are fitted with aluminium alloy pistons, each with two compression and one oil control ring above the gudgeon pin.

**Camshaft**

The camshaft is located between the two banks of cylinders, above the crankshaft and runs in fine white metal steel-backed bearings. It is driven at half the crankshaft speed by a duplex roller chain.

**Cylinder heads**

The two detachable, aluminium alloy, cylinder heads carry both the inlet and exhaust valves. Iron valve seat inserts and valve guides are used, and the valves are arranged in line and operate at an angle of 10° above the cylinder bore centre line. Hydraulic tappets maintain the correct valve clearance and ensure quiet engine running.

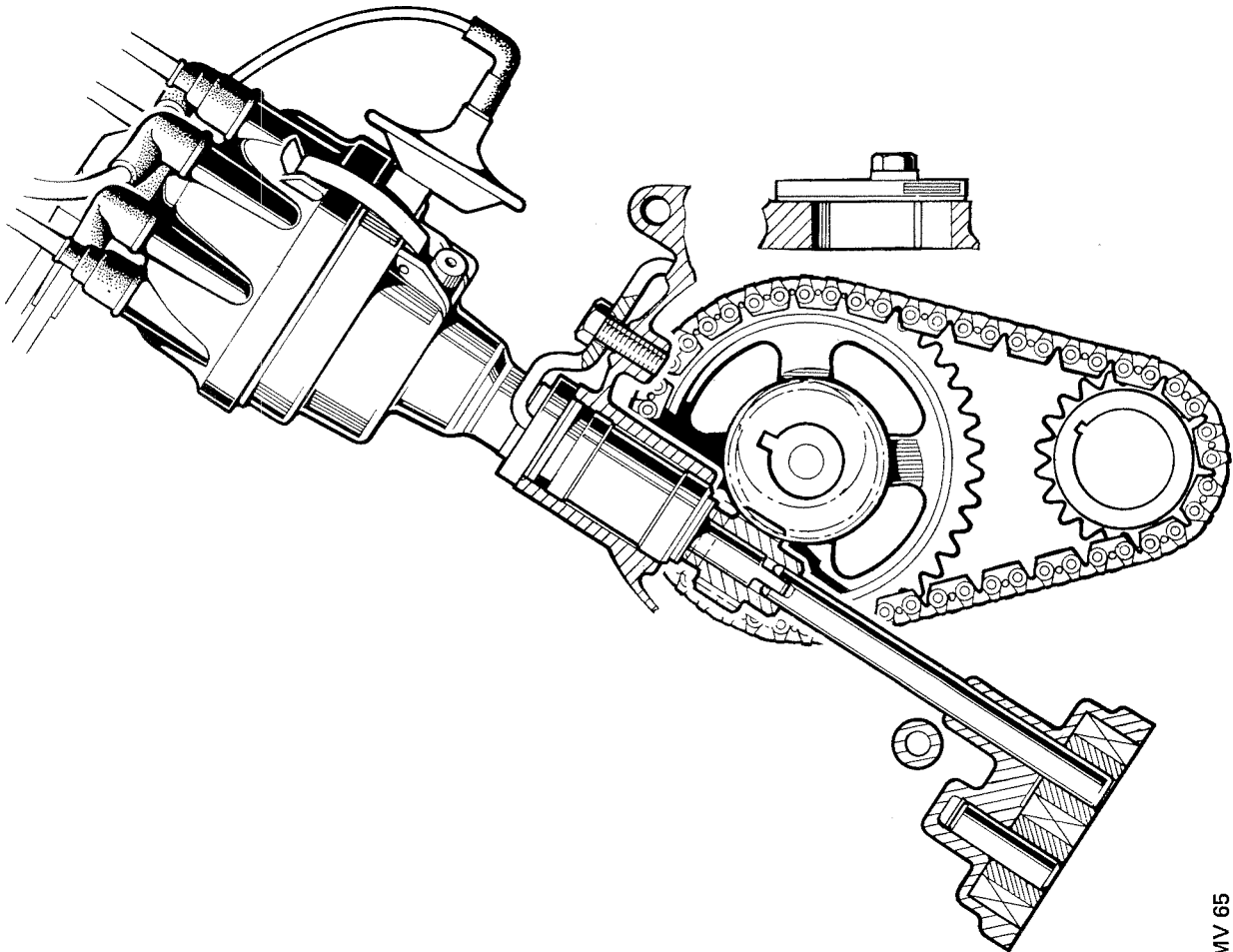
**Lubrication**

A removable pressed steel sump carries the bulk lubricating oil, which is circulated under pressure by a gear type oil pump located in the timing chain cover and driven from the camshaft through skew gearing. The oil is cleaned by means of a gauze strainer on the pump intake in the sump and by an external full flow filter. An oil cooler is fitted to maintain the correct running temperature when the engine is operated for long periods with the vehicle stationary.

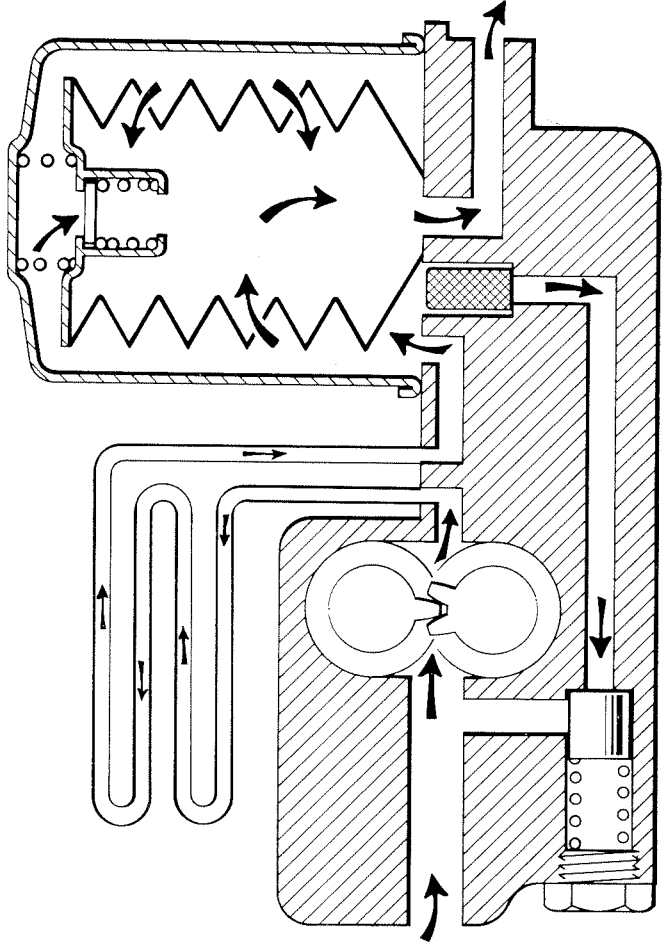
In operation, oil is drawn from the sump by the gear type pump and is fed under pressure through the oil cooler into the external oil filter. After passing through the filter element, the cooled and cleaned oil is fed to the main and connecting rod bearings, camshaft bearings and valve rocker shafts through a gallery pipe in the cylinder block. Oil released from the pressure fed components is directed to splash feed all other moving parts before finally draining back to the sump.

As already mentioned, the oil pump is driven from the engine camshaft and therefore, the pump speed varies with engine speeds. To prevent a resulting wide range in oil pressures, a relief valve is fitted in the high pressure side of the pump to constantly monitor and adjust the oil pressure. The relief valve remains closed to maintain normal oil pressure and opens under excess pressures, allowing oil to recirculate to the low pressure side of the pump.

If for any reason, oil flow through the filter element becomes restricted, the resulting increased pressure in the filter bowl causes the filter by-pass valve to open to provide an alternative route to the engine.



MV 65



MV 64

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>A—ENGINE FAILS TO START</b>	<ol style="list-style-type: none"> <li>Incorrect starting procedure</li> <li>Starter motor speed too slow</li> <li>Faulty ignition system</li> <li>Water or dirt in fuel system</li> <li>Carburettor(s) flooding</li> <li>Defective fuel pump system</li> <li>Defective starter motor</li> <li>Starter plunger not engaging</li> </ol>	<ol style="list-style-type: none"> <li>See <i>Instruction Manual Check battery and connections</i></li> <li>See <i>Group 86</i></li> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>See <i>Group 86</i></li> <li>Remove starter motor and investigate</li> </ol>
<b>B—ENGINE STALLS</b>	<ol style="list-style-type: none"> <li>Low idling speed</li> <li>Faulty spark plug</li> <li>Faulty distributor</li> <li>Faulty distributor points</li> <li>Incorrect mixture</li> <li>Foreign matter in fuel system</li> <li>Low oil pressure (fuel pump circuit is routed through engine oil pressure switch)</li> </ol>	<ol style="list-style-type: none"> <li>Adjust carburettor. See <i>Group 19</i></li> <li>Check and test, renew if necessary</li> <li>Renew</li> <li>Rectify or renew. See <i>Group 86</i></li> <li>Adjust carburettor. See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>Check engine oil pressure, if correct, fit new switch. See item P</li> </ol>
<b>C—LACK OF POWER</b>	<ol style="list-style-type: none"> <li>Poor compression</li> <li>Badly seating valves</li> <li>Excessive carbon deposit</li> <li>Incorrect ignition timing</li> <li>Leaks or restrictions in fuel system</li> <li>Faulty sparking plugs</li> <li>Excessive carbon deposit</li> <li>Brakes binding</li> <li>Faulty coil, condenser or battery</li> </ol>	<ol style="list-style-type: none"> <li>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</li> <li>Rectify or renew</li> <li>Rectify</li> <li>Rectify</li> <li>See <i>Group 19</i></li> <li>Rectify</li> <li>Decarbonise</li> <li>See <i>Group 70</i></li> <li>See <i>Group 86</i></li> </ol>
<b>D—ENGINE RUNS ERRATICALLY</b>	<ol style="list-style-type: none"> <li>Faulty electrical connections</li> <li>Defective sparking plugs</li> <li>Low battery charge</li> <li>Defective distributor</li> <li>Foreign matter in fuel system</li> <li>Faulty fuel pump</li> <li>Sticking valves springs</li> <li>Defective ignition timing</li> <li>Worn valve guides or valves</li> <li>Faulty cylinder head gaskets</li> <li>Damaged exhaust system</li> <li>Vacuum pipes disconnected at inlet manifold, distributor or gearbox</li> </ol>	<ol style="list-style-type: none"> <li>Rectify</li> <li>Renew or rectify</li> <li>Recharge battery</li> <li>Rectify</li> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>Rectify or renew</li> <li>Rectify</li> <li>Renew</li> <li>Rectify</li> <li>Renew</li> <li>Rectify or renew</li> <li>Refit pipes</li> </ol>
<b>E—ENGINE STARTS, BUT STOPS IMMEDIATELY</b>	<ol style="list-style-type: none"> <li>Faulty electrical connections</li> <li>Foreign matter in fuel system</li> <li>Faulty fuel pump</li> <li>Low fuel level in tank</li> <li>Low oil pressure (fuel pump circuit is routed through engine oil pressure switch)</li> </ol>	<ol style="list-style-type: none"> <li>Check HT leads for cracked insulation; check piston circuit</li> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>Replenish</li> <li>Check engine oil pressure, if correct, fit new switch. See item P</li> </ol>
<b>F—ENGINE FAILS TO IDLE</b>	<ol style="list-style-type: none"> <li>Incorrect carburettor setting</li> <li>Faulty fuel pump</li> <li>Sticking valves</li> <li>Faulty cylinder head gasket(s)</li> </ol>	<ol style="list-style-type: none"> <li>See <i>Group 19</i></li> <li>See <i>Group 19</i></li> <li>Rectify or renew</li> <li>Renew</li> </ol>
<b>G—ENGINE MISFIRES ON ACCELERATION</b>	<ol style="list-style-type: none"> <li>Distributor points incorrectly set</li> <li>Faulty coil or condenser</li> <li>Faulty sparking plugs</li> <li>Faulty carburettor</li> <li>Vacuum pipes disconnected at inlet manifold</li> </ol>	<ol style="list-style-type: none"> <li>Rectify. See <i>Group 86</i></li> <li>Renew</li> <li>Rectify</li> <li>See <i>Group 19</i></li> <li>Check all vacuum connections</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>H—ENGINE KNOCKS</b>	<ol style="list-style-type: none"> <li>Ignition timing advanced</li> <li>Excessive carbon deposit</li> <li>Incorrect carburettor setting</li> <li>Insuitable fuel</li> <li>Worn pistons or bearings</li> <li>Distributor advance mechanism faulty</li> <li>Defective sparking plugs</li> </ol>	<ol style="list-style-type: none"> <li>Adjust</li> <li>Decarbonise</li> <li>See <i>Group 19</i></li> <li>Adjust ignition timing. See <i>Group 86</i></li> <li>Renew</li> <li>Rectify. See <i>Group 86</i></li> <li>Rectify or renew</li> </ol>
<b>J—ENGINE BACKFIRES</b>	<ol style="list-style-type: none"> <li>Ignition defect</li> <li>Carburettor defect</li> <li>Sticking valve</li> <li>Weak valve springs</li> <li>Badly seating valves</li> <li>Excessively worn valve stems and guides</li> <li>Excessive carbon deposit</li> <li>Incorrect sparking plug gap</li> <li>Air leak in induction or exhaust systems</li> </ol>	<ol style="list-style-type: none"> <li>See <i>Group 86</i></li> <li>See <i>Group 19</i></li> <li>Rectify</li> <li>Renew</li> <li>Rectify or renew</li> <li>Renew</li> <li>Decarbonise</li> <li>Reset</li> <li>Renew faulty gaskets or components</li> </ol>
<b>K—BURNED VALVES</b>	<ol style="list-style-type: none"> <li>Sticking valves</li> <li>Weak valve springs</li> <li>Excessive deposit on valve seats</li> <li>Distorted valves</li> <li>Excessive mileage between overhauls</li> </ol>	<ol style="list-style-type: none"> <li>Rectify</li> <li>Renew</li> <li>Re-cut</li> <li>Renew</li> <li>Decarbonise</li> </ol>
<b>L—NOISY VALVE MECHANISM</b>	<ol style="list-style-type: none"> <li>Excessive oil in sump, causing air bubbles in hydraulic tappets</li> <li>Worn or scored parts in valve operating mechanism</li> <li>Valves and seats cut down excessively, raising end of valve stem 1,27 mm (0.050 in) above normal position</li> <li>Sticking valves</li> <li>Weak valve springs</li> <li>Worn timing chain or chainwheels</li> </ol>	<ol style="list-style-type: none"> <li>Drain and refill to correct level</li> <li>Replace faulty parts</li> <li>Grind off end of valve stem or replace parts</li> <li>Rectify</li> <li>Renew</li> <li>Renew worn parts</li> </ol>
<b>M—NOISE FROM HYDRAULIC TAPPETS</b>	<ol style="list-style-type: none"> <li>Oil too heavy for prevailing temperature. Excessive varnish in tappet</li> <li>Leakage at check ball</li> <li>Excessive leakdown</li> <li>High oil level in sump</li> <li>Leakage at check ball</li> <li>Worn tappet body</li> <li>Worn camshaft</li> <li>Excessive leak down rate or scored-lifter plunger</li> </ol>	<ol style="list-style-type: none"> <li>Drain and refill with correct grade</li> <li>Replace tappet</li> <li>Replace tappet</li> <li>Drain and refill to correct level</li> <li>Replace tappet</li> <li>Replace tappet</li> <li>Replace camshaft</li> <li>Replace tappet</li> </ol>
<b>N—MAIN BEARING RATTLE</b>	<ol style="list-style-type: none"> <li>Low oil level</li> <li>Low oil pressure</li> <li>Excessive bearing clearance</li> <li>Burnt-out bearings</li> <li>Loose bearing caps</li> </ol>	<ol style="list-style-type: none"> <li>Replenish as necessary</li> <li>See next symptom</li> <li>Renew bearings; grind crankshaft</li> <li>Renew</li> <li>Tighten</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
P—LOW OIL PRESSURE WARNING LIGHT REMAINS ON, ENGINE STARTS, BUT STOPS IMMEDIATELY (Fuel pump circuit is routed through engine oil pressure switch)	<ol style="list-style-type: none"> <li>Thin or diluted oil</li> <li>Low oil level</li> <li>Choked pump strainer</li> <li>Faulty release valve</li> <li>Excessive bearing clearance</li> <li>Oil pressure switch unserviceable</li> <li>Electrical fault</li> <li>Relief valve plunger sticking</li> <li>Weak relief valve spring</li> <li>Pump rotors excessively worn</li> <li>Excessively worn bearings: main, connecting rod, big end, camshaft, etc.</li> </ol>	<ol style="list-style-type: none"> <li>Drain and refill with correct oil</li> <li>Replenish</li> <li>Clean</li> <li>Rectify</li> <li>Renew</li> <li>Renew</li> <li>Check circuit</li> <li>Remove and ascertain cause</li> <li>Renew</li> <li>Renew</li> <li>Ascertain which bearings and rectify</li> </ol>
Q—RAATTLE IN LUBRICATION SYSTEM	<ol style="list-style-type: none"> <li>Oil pressure relief valve plunger sticking</li> </ol>	<ol style="list-style-type: none"> <li>Remove and clean</li> </ol>
R—ENGINE OVERHEATING	<ol style="list-style-type: none"> <li>Low coolant level</li> <li>Faulty cooling system</li> <li>Faulty thermostat</li> <li>Incorrect timing</li> <li>Defective lubrication system</li> </ol>	<ol style="list-style-type: none"> <li>Check for leaks</li> <li>See Group 26</li> <li>Renew</li> <li>Rectify</li> <li>See Group 12</li> </ol>

CAMSHAFT

—Remove and refit

12.13.01

Removing

1. Drain the cooling system. 26.10.01.
2. Remove the fan blades. 26.25.06.
3. Remove the radiator block. 26.40.04.
4. Remove the alternator. 86.10.02.
5. Remove the air intake. 19.70.01.
6. Remove the induction manifold. 30.15.02.
7. Remove the valve gear. 12.29.34.
8. Remove the timing gear cover. 12.65.01.
9. Remove the timing chain. 12.65.12.

**CAUTION:** Do not damage the bearings when withdrawing the camshaft as the camshaft bearings are not serviceable.

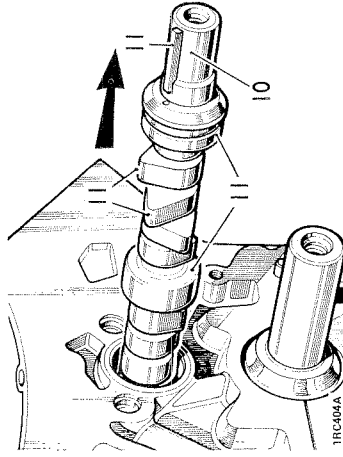
10. Withdraw the camshaft.

Inspecting

11. Check all bearing surfaces for wear and score marks. Also, check cam lobes for excessive wear. Check key and keyway.

Refitting

12. Reverse 1 to 10.



CONNECTING RODS AND PISTONS

—Remove and refit

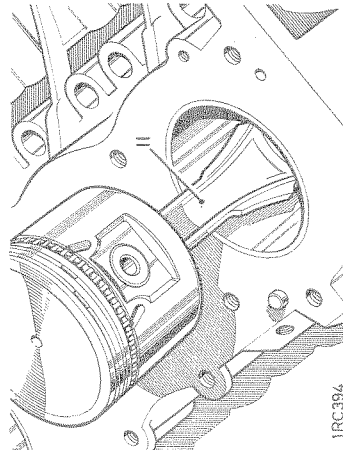
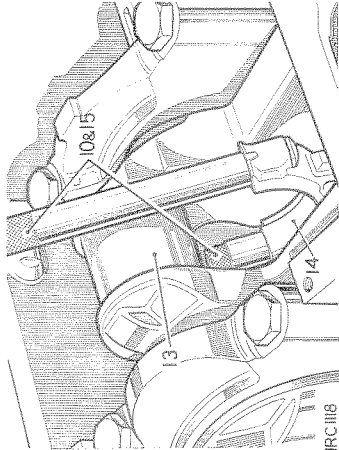
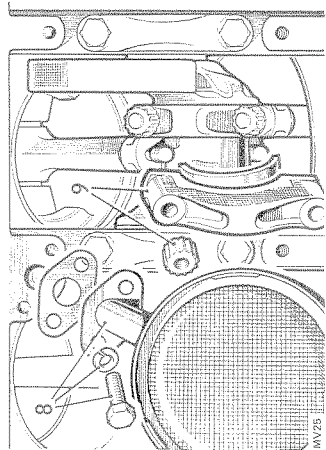
12.17.01

Service tool 605351—Guide bolts for connecting rods

Removing

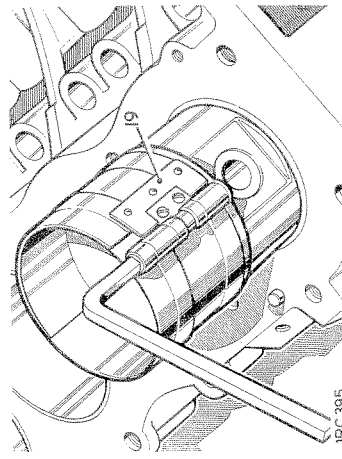
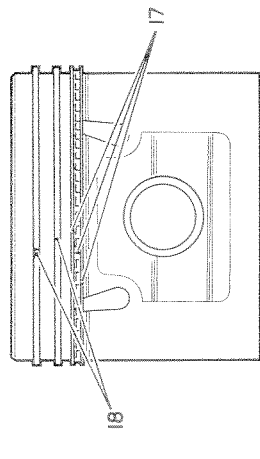
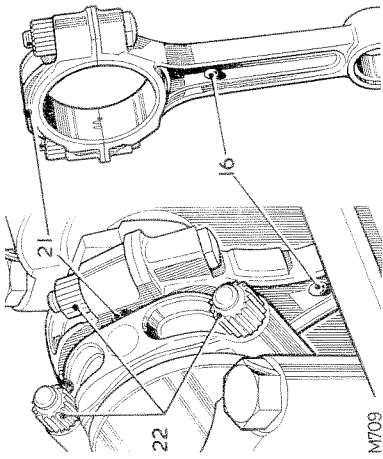
1. Drain the cooling system. 26.10.01.
2. Remove the air cleaner. 19.10.01.
3. Remove the alternator. 86.10.02.
4. Remove the induction manifold. 30.15.02.
5. Remove the valve gear. 12.29.34.
6. Remove the cylinder heads. 12.29.10.
7. Remove the oil sump. 12.60.44.
8. Remove the sump oil strainer.
9. Remove the connecting rod caps and retain them in sequence for reassembly.
10. Screw the guide bolts 605351, on to the connecting rods.
11. Push the connecting rod and piston assembly up the cylinder bore and withdraw it from the top. Retain the connecting rod and piston assemblies in sequence with their respective caps.
12. Remove the guide bolts 605351, from the connecting rod.

*continued*



Refitting

13. Locate the applicable crankshaft journal at BDC.
14. Place the bearing upper shell in the connecting rod.
15. Retain the upper shell by screwing the guide bolts 605351, on to the connecting rods.
16. Insert the connecting rod and piston assembly into its respective bore, noting that the domed shape boss on the connecting rod must face towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank. When both connecting rods are fitted, the bosses will face inwards towards each other.
17. Position the oil control piston rings so that the ring gaps are all at one side, between the gudgeon pin and piston thrust face. Space the gaps in the ring rails approximately 25 mm (1 in) each side of the expander ring joint.
18. Position the compression rings so that their gaps are on opposite sides of the piston between the gudgeon pin and piston thrust face.
19. Using a piston ring compressor, locate the piston into the cylinder bore.
20. Place the bearing lower shell in the connecting rod cap.
21. Locate the cap and shell on to the connecting rod, noting that the rib on the edge of the cap must be towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank.
22. Secure the connecting rod cap. Torque 4.0 to 4.9 kgf.m (30 to 35 lbf ft).
23. Reverse 1 to 8.



CONNECTING RODS AND PISTONS

—Overhaul

12.17.10

Service tools: 605350 Tool for removing and refitting gudgeon pin

Dismantling

1. Remove the connecting rods and pistons. 12.17.01.
2. If the same piston is to be refitted, add location marks to ensure reassembling in the same relative position.
3. Locate the piston and connecting rod assembly on tool 605350.
4. Locate the drift, part of tool 605350, on to the gudgeon pin.
5. Using a hydraulic press—8 tonne (8 ton) capacity—press out the gudgeon pin.

Overhauling pistons

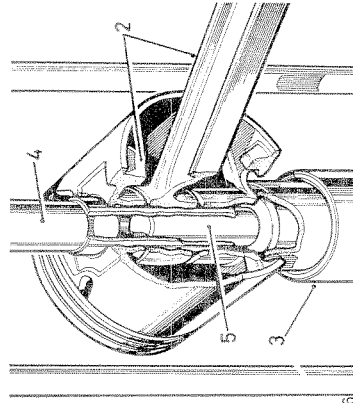
Original pistons

6. Remove carbon and deposits, particularly from the ring grooves.
7. Examine the pistons for damage or excess wear—see under 'New pistons' for clearance dimensions—fit new replacements as necessary.

New pistons

Pistons are available in service standard size and in oversizes of 0,25 mm (0.010 in) and 0,50 mm (0.020 in). Service standard size pistons are supplied in a 0,0254 mm (0.001 in) oversize condition, to accommodate production tolerances allowed on new engines. When fitting a new service standard size piston to a cylinder block, offer the new piston to the bore, check for correct piston to bore clearance, honing the bore if necessary.

*continued*



IRC3961

The clearance limits with new pistons and a new or rebored cylinder are 0,018 to 0,033 mm (0.0007 to 0.0013 in).

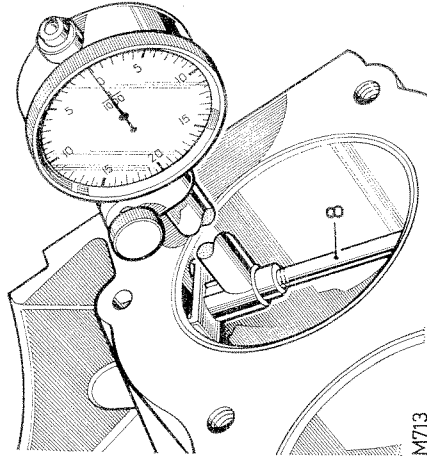
**NOTE:** The temperature of the piston and cylinder block must be the same to ensure accurate measurements. When reboring the cylinder block, the crankshaft main bearing caps must be fitted and tightened to the correct torque.

8. Check the cylinder bore dimension at right angles to the gudgeon pin, 90 to 100 mm (3.5 to 4.0 in) from the top.
9. Check the piston dimension at right angles to the gudgeon pin, at the bottom of the skirt.
10. The piston dimension must be 0,018 to 0,033 mm (0.0007 to 0.0013 in) smaller than the cylinder.
11. If new piston rings are to be fitted without reboring, deglaze the cylinder walls with a hone, without increasing the bore diameter.

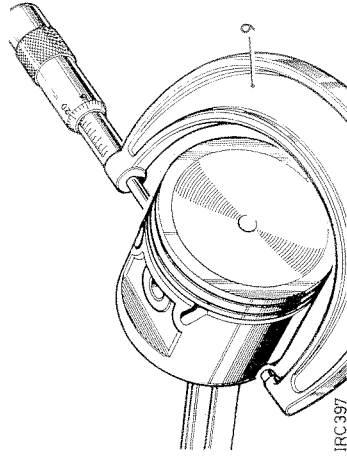
**NOTE:** A deglazed bore must have a cross-hatch finish.

12. Check the compression ring gaps in the applicable cylinder, held square to the bore with the piston. Gap limits: 0,44 to 0,57 mm (0.017 to 0.022 in). Use a fine-cut flat file to increase the gap if required. Select a new piston ring if the gap exceeds the limit.

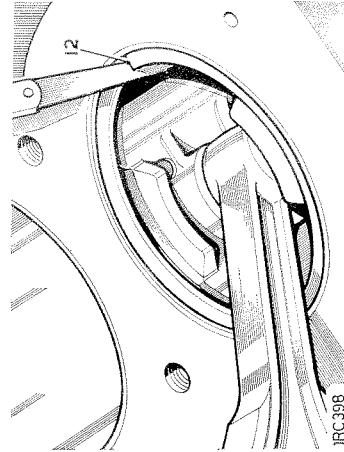
*continued*



M713



IRC397



IRC398

**NOTE:** It is not necessary to check or adjust the gap on oil control rings.

13. Temporarily fit the compression rings to the piston with the marking 'T' or 'TOP' uppermost and the chrome compression ring in the top groove.
14. Check the compression ring clearance in the piston groove. Clearance limits: 0,05 to 0,10 mm (0,002 to 0,004 in).

**Fitting piston rings**

15. Fit the expander ring into the bottom groove making sure that the ends abut and do not overlap.
16. Fit two ring rails to the bottom groove, one above and one below the expander ring.
17. Fit the compression rings with the marking 'T' or 'TOP' uppermost and the chrome compression ring in the top groove.

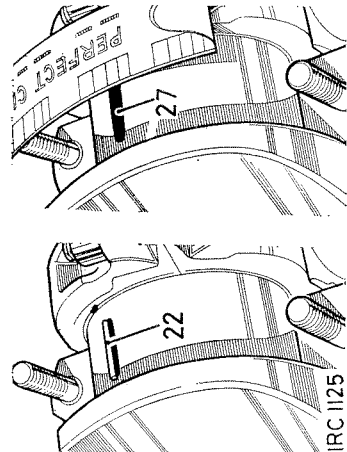
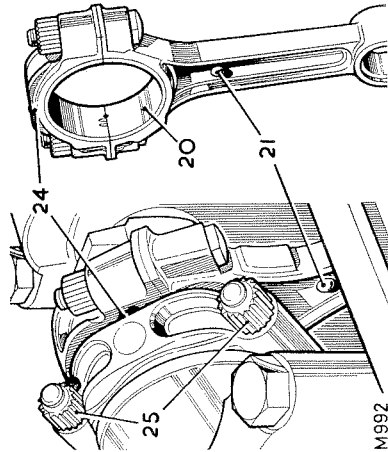
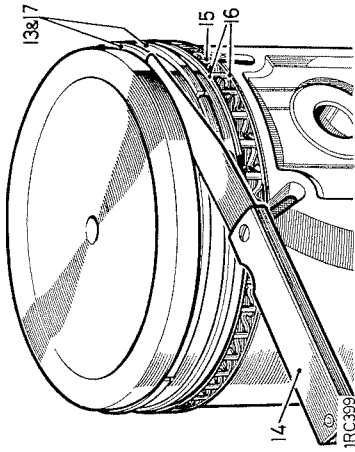
**Connecting rods**

18. Check the alignment of the connecting rod.
19. Check the connecting rod small end, the gudgeon pin must be an interference fit.

**Big-end bearings**

20. Locate the bearing upper shell into the connecting rod.
21. Locate the connecting rod and bearing on to the applicable crankshaft journal, noting that the domed shape boss on the connecting rod must face towards the front of the engine on the right-hand bank of cylinders and towards the rear on the left-hand bank. When both connecting rods are fitted, the bosses will face inwards towards each other.
22. Place a piece of Plastigage PG-1 (Green) across the lower half of the crankshaft journal approximately 6 mm (0,250 in) off centre.
23. Locate the bearing lower shell into the connecting rod cap.
24. Locate the cap and shell on to the connecting rod. Note that the rib on the edge of the cap must be the same side as the domed shape boss on the connecting rod.
25. Secure the connecting rod cap. Torque 4,0 to 4,9 kgf.m (30 to 35 lbf ft).

*continued*



**NOTE:** Do not rotate the crankshaft while the Plastigage is fitted.

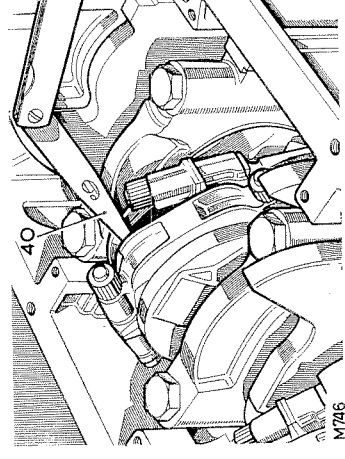
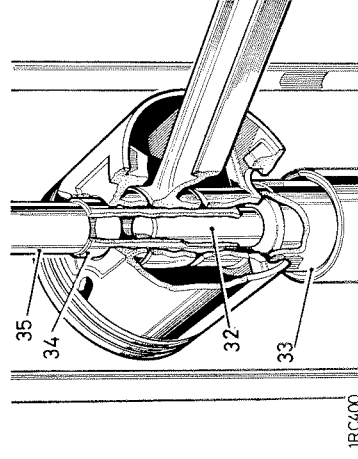
26. Remove the connecting rod cap and shell.
27. Using the scale printed on the Plastigage packet, measure the flattened Plastigage at its widest point. The graduation that mostly corresponds to the width of the Plastigage indicates the bearing clearance.
28. The correct bearing clearance with new or overhauled components is 0,013 to 0,06 mm (0,0006 to 0,0022 in).
29. If a bearing has been in service, it is advisable to fit a new bearing if the clearance exceeds 0,08 mm (0,003 in).
30. If a new bearing is being fitted, use selective assembly to obtain the correct clearance.
31. Wipe off the Plastigage with an oily rag. **DO NOT** scrape it off.

**NOTE:** The connecting rods, caps and bearing shells must be retained in sets, and in the correct sequence.

**Reassembling**

32. Locate the guide for the gudgeon pin on tool 605350.
33. Locate the piston and connecting rod on tool 605350.
34. Insert the gudgeon pin into the piston and locate it over the guide.
35. Locate the drift, part of 605350, on to the gudgeon pin.
36. Using a hydraulic press—8 tonne (8 ton) capacity—press in the gudgeon pin until it abuts the shoulder of the guide.
37. Check that the piston moves freely on the gudgeon pin and that no damage has occurred during pressing.
38. Fit the connecting rods and pistons, 12.17.01, carrying out the following checks during fitting.
39. Check that the connecting rods move freely sideways on the crankshaft. Tightness indicates insufficient bearing clearance or a mis-aligned connecting rod.
40. Check the end-float between the connecting rods on each crankshaft journal. Clearance limits: 0,15 to 0,37 mm (0,006 to 0,014 in).

*continued*





DATA

Standard size cylinder bore diameter	88,861 to 88,900 mm (3.4985 to 3.5000 in)
<b>Connecting rod:</b>	
Length between centres	143,71 to 143,81 mm (5.658 to 5.662 in)
Bearings:	
Clearance on crankshaft	0,015 to 0,055 mm (0,0006 to 0,0022 in)
End float on crankshaft	0,15 to 0,37 mm (0,006 to 0,014 in)
<b>Pistons and gudgeon pins</b>	
<b>Pistons</b>	
Type	Aluminium alloy, concave topped
Clearance at skirt bottom	0,018 to 0,033 mm (0,0007 to 0,0013 in)
<b>Piston rings</b>	
No. 1 compression ring	Chrome faced and marked 'TOP'
No. 2 compression ring	Stepped to 'L' shape and marked 'TOP'
Depth of compression rings	1,98 to 2,01 mm (0,078 to 0,079 in)
Compression ring clearance in piston groove	0,05 to 0,10 mm (0,002 to 0,004 in)
Compression ring gap	0,44 to 0,57 mm (0,017 to 0,022 in)
Oil control ring	Two oil rings with separate spacer
Rail oil rings	Perfect circle 110-15
Spacer	Perfect circle 110-37
<b>Gudgeon pins</b>	
Length	72,67 to 72,79 mm (2,861 to 2,866 in)
Diameter	22,112 to 22,219 mm (0,8745 to 0,8748 in)
Fit in con rod	Press fit
Clearance in piston	0,005 to 0,007 mm (0,0002 to 0,0003 in)

CRANKSHAFT FRONT OIL SEAL

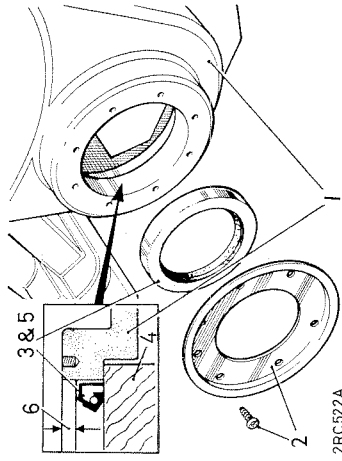
—Remove and refit 12.21.14

Removing

1. Remove the timing gear cover. 12.65.01.
2. Remove the screws and withdraw the mudshield.
3. Remove the oil seal.

Refitting

4. Position the gear cover with the front face uppermost and the underside supported across the oil seal housing bore.
5. Enter the oil seal, open side first, into the housing bore.
6. Press in the oil seal until the plain face is 1,5 mm (0,062 in) approximately, below the gear cover face.
7. Reverse 1 and 2 using sealing compound on the threads of the mudshield securing screws.



CRANKSHAFT REAR OIL SEAL

12.21.20

---Remove and refit

Service tool: RO 1014 Seal guide

Removing

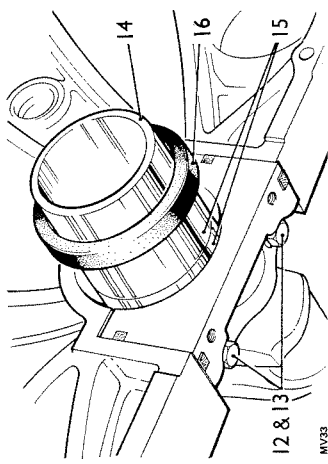
1. Remove the gearbox assembly. 37.20.01.
2. Remove the clutch assembly. 33.10.01.
3. Remove the flywheel. 12.53.07.
4. Remove the engine oil sump. 12.60.44.
5. Remove the rear main bearing cap and bearing half.
6. Remove and discard the rear main bearing cap side seals.
7. Remove and discard the crankshaft rear oil seal.

Refitting

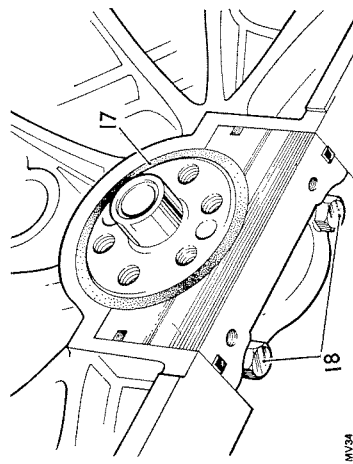
**CAUTION:** Do not handle the seal lip at any time, visually check that it is not damaged and ensure that the outside diameter remains clean and dry.

8. Fit the side seals to the grooves each side of the rear main bearing cap.
9. Do not cut the side seals to length; they must protrude approximately 1,5 mm (0,062 in) above the bearing cap parting face.
10. Apply Hylomar PL 32M jointing compound, Part No. 534244 (or Unipart No. GGC 102) to the rearmost half of the rear main bearing cap parting face or, if preferred, to the equivalent area on the cylinder block, as illustrated.
11. Lubricate the bearing half and bearing cap side seals with clean engine oil.
12. Fit the bearing cap assembly to the engine. Do not tighten the fixings at this stage but ensure that the cap is fully home and squarely seated on the cylinder block.

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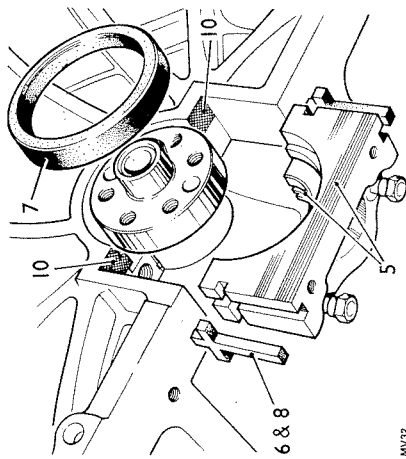


MV33



MV24

13. Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.
14. Position the seal guide RO.1014 on the crankshaft flange.
15. Ensure that the oil seal guide and the crankshaft journal are scrupulously clean then coat the seal guide and oil seal journal with clean engine oil.  
**NOTE:** The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly.
16. Position the oil seal, lipped side towards the engine on to the seal guide. The seal outside diameter must be clean and dry.
17. Push home the oil seal fully and squarely by hand into the recess formed in the cap and block until it abuts against the machined step in the recess. Withdraw the seal guide.
18. Tighten the rear main bearing cap fixings fully and evenly. Torque: 9,0 to 9,6 kgf.m (65 to 70 lbf ft).
19. Reverse 1 to 4.



MV22

## CRANKSHAFT

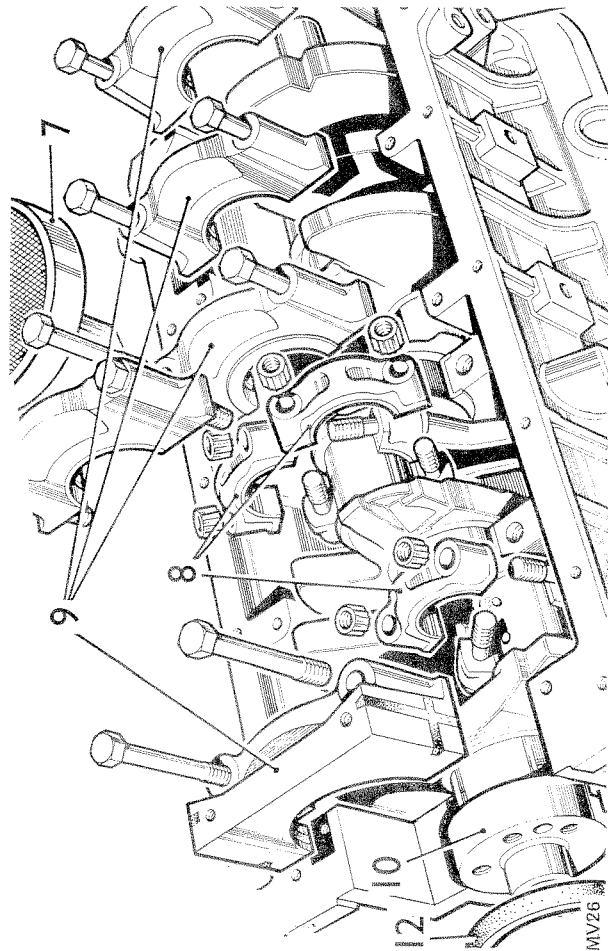
—Remove and refit 12.21.33

Service tool: 605351 Guide bolts for connecting rods  
RO 1014 Seal guide

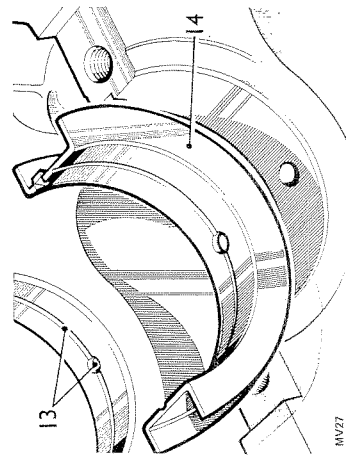
## Removing

1. Remove the gearbox assembly. 37.20.01.
  2. Remove the timing gear cover. 12.65.01.
  3. Remove the timing chain and gears. 12.65.12.
  4. Remove the clutch. 33.10.01.
  5. Remove the flywheel. 12.53.07.
  6. Remove the oil sump. 12.60.44.
  7. Remove the sump oil strainer.
  8. Remove the connecting rod caps and lower bearing shells and retain in sequence.
  9. Remove the main bearing caps and lower bearing shells and retain in sequence.
- NOTE:** If the same bearing shells are to be refitted, retain them in pairs and mark them with the number of the respective journal.
10. Withdraw the crankshaft.
  11. Remove and discard the side seals from the rear main bearing cap.
  12. Remove and discard the crankshaft rear oil seal.

*continued*



MV26



MV27

**Refitting**

13. Locate the upper main bearing shells into the cylinder block; these must be the shells with the oil drilling and the oil grooves.

14. Locate the flanged upper main bearing shell in the centre position.

15. Place suitable blocks, approximately 12,5 mm (0.500 in) thick on to each end of the cylinder block so that they cover the front and rear upper main bearing shells.

16. Lift the crankshaft into position with the ends supported on the blocks.

17. Lubricate the crankshaft journals and bearing shells with engine oil.

18. Holding the connecting rods in position, remove one of the blocks and lower the crankshaft on to the connecting rod bearings. Repeat for the opposite end.

19. Where necessary, use the guide bolts 605351 to draw the connecting rods up to the crankshaft journal.

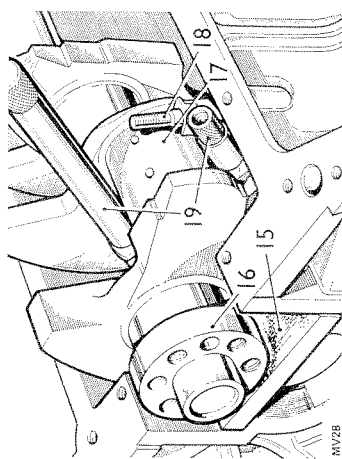
20. Locate the bearing caps and lower shells on to the connecting rods, noting that the rib on the edge of the cap must be towards the front of the engine on the right-hand bank of cylinders, and towards the rear on the left-hand bank.

21. Secure the connecting rod caps. Torque: 4,0 to 4,9 kgf.m (30 to 35 lbf ft).

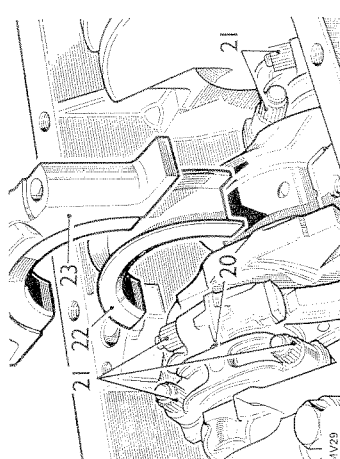
22. Lubricate the lower main bearing shells with engine oil.

23. Fit numbers one to four main bearing caps and shells, leaving the fixing bolts finger tight at this stage.

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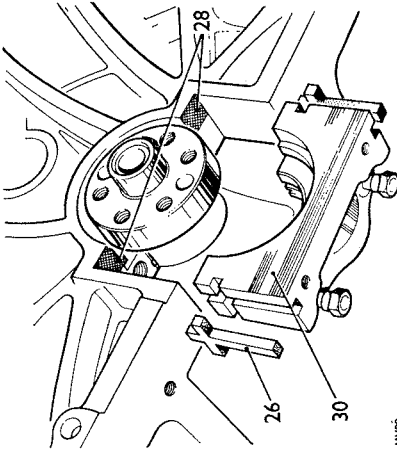
MV28



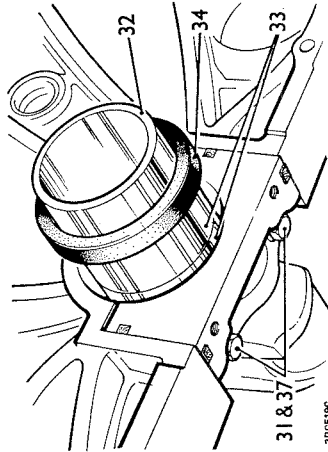
MV29

24. Align the thrust faces of the centre main bearing by tapping the crankshaft with a mallet, rearward and then forward to the limits of its travel.
25. Tighten numbers one to four main bearing cap bolts. Torque: 7,0 to 7,6 kgf.m (50 to 55 lbf.ft).
26. Fit the side seals to the grooves each side of the rear main bearing cap.
27. Do not cut the side seals to length; they must protrude approximately 1,5 mm (0,062 in) above the bearing cap parting face.
28. Apply 'Hylomar PL 32M' jointing compound, Rover Part No. 534244, to the rearmost half of the rear main bearing housing parting face, as illustrated.
29. Lubricate the lower bearing shell and side seals with light engine oil.
30. Fit the rear main bearing cap and shell. Do not tighten the fixings at this stage but ensure that the cap is fully home and squarely seated on the cylinder block.
31. Tension the cap bolts equally by one-quarter turn approximately, then back off one complete turn on each fixing bolt.
32. Position the seal guide RO.1014 on the crankshaft flange.
33. Ensure that the oil seal guide and the crankshaft journal are scrupulously clean, then coat the seal guide and oil seal journal with clean engine oil.  
**NOTE:** The lubricant coating must cover the seal guide outer surface completely to ensure that the oil seal lip is not turned back during assembly.  
**CAUTION:** Do not handle the seal lip at any time; visually check that it is not damaged and ensure that the outside diameter remains clean and dry.
34. Position the oil seal, lipped side towards the engine, on to the seal guide. The seal outside diameter must be clean and dry.
35. Push home the oil seal fully and squarely by hand into the recess formed in the cap and block until it abuts against the machined step in the recess.
36. Withdraw the seal guide.
37. Tighten the rear main bearing cap fixings fully and evenly. Torque: 9,0 to 9,6 kgf.m (65 to 70 lbf.ft).

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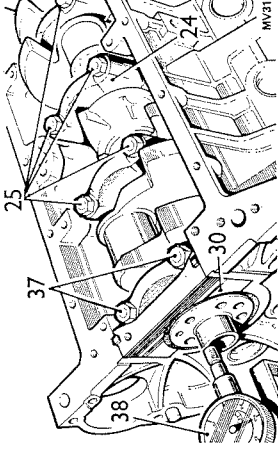


MV30



31837  
216519C

38. Check the crankshaft end float. Limits: 0,10 to 0,20 mm (0,004 to 0,008 in). If not correct, check the components and assembly procedure for faults.
39. Reverse 1 to 7.



MV31

**DATA**

Main bearing:

Journal diameter (standard)

Clearance on crankshaft

Crankshaft end thrust

Crankshaft end float

58,400 to 58,413 mm (2,2992 to 2,2997 in).  
0,023 to 0,061 mm (0,0009 to 0,0024 in)  
Taken on Number 3 main bearing  
0,10 to 0,20 mm (0,004 to 0,008 in)

CRANKSHAFT

12.21.46

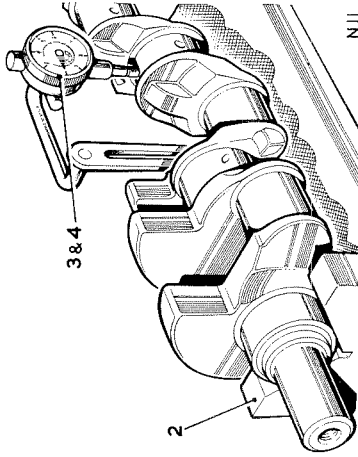
—Overhaul

- Procedure**
1. Remove the crankshaft. 12.21.33.

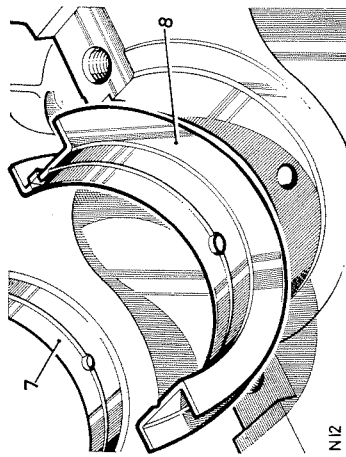
**Inspecting**

2. Rest the crankshaft on vee-blocks at numbers one and five main bearing journals.
3. Using a dial test indicator, check the run-out at numbers two, three and four main bearing journals. The total indicator readings at each journal should not exceed 0.08 mm (0.003 in).
4. While checking the run-out at each journal, note the relation of maximum eccentricity on each journal to the others. The maximum on all journals should come at very near the same angular location.
5. If the crankshaft fails to meet the foregoing checks it is bent and is unsatisfactory for service.
6. Check each crankshaft journal for ovality. If ovality exceeds 0.040 mm (0.0015 in), a reground or new crankshaft should be fitted.
7. Bearings for the crankshaft main journals and the connecting rod journals are available in the following undersizes:
  - 0.25 mm (0.010 in)
  - 0.50 mm (0.020 in)
8. The centre main bearing shell, which controls crankshaft thrust, has the thrust faces increased in thickness when more than 0.25 mm (0.010 in) undersize, as shown on the following chart.

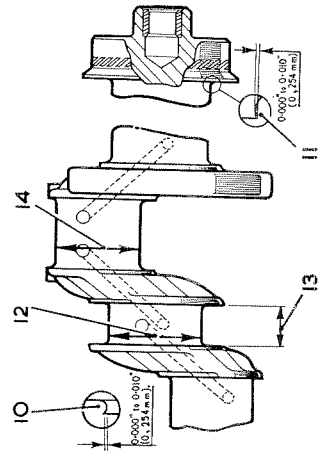
*continued*



N11



N12



M727

9. When a crankshaft is to be reground, the thrust faces on either side of the centre main journal must be machined in accordance with the dimensions on the following charts.

Main bearing journal size		Thrust face width	
Standard	0.25 mm (0.010 in) undersize	Standard	0.25 mm (0.010 in) oversize
0.50 mm (0.020 in) undersize		Standard	0.25 mm (0.010 in) oversize

For example: If a 0.50 mm (0.020 in) undersize bearing is to be fitted, then 0.12 mm (0.005 in) must be machined off each thrust face of the centre journal, maintaining the correct radius.

**Crankshaft dimensions 10 to 14**

10. The radius for all journals except the rear main bearings is 1.90 to 2.28 mm (0.075 to 0.090 in).
11. The radius for the rear main bearing journal is 3.04 mm (0.120 in).
12. Main bearing journal diameter, see the following charts.
13. Thrust face width, see the following charts.
14. Connecting rod journal diameter, see the following charts.

**Crankshaft dimensions, metric sizes**

Crankshaft Grade	Diameter <sup>12</sup>	Width <sup>13</sup>	Diameter <sup>14</sup>
Standard	58,398-58,412 mm	26,975-27,026 mm	50,800-50,812 mm
0.254 mm U/S	58,146-58,158 mm	26,975-27,026 mm	50,546-50,558 mm
0.508 mm U/S	57,892-57,904 mm	27,229-27,280 mm	50,292-50,303 mm

**Crankshaft dimensions, British sizes**

Crankshaft Grade	Diameter <sup>12</sup>	Width <sup>13</sup>	Diameter <sup>14</sup>
Standard	2.2992-2.2997 in	1.062-1.064 in	2.0000-2.0005 in
0.010 in U/S	2.2892-2.2897 in	1.062-1.064 in	1.9900-1.9905 in
0.020 in U/S	2.2792-2.2797 in	1.072-1.074 in	1.9800-1.9805 in

*continued*

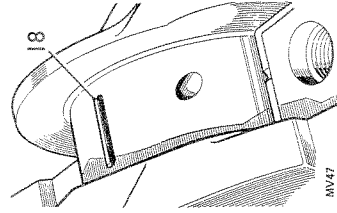
Checking the main bearing clearance

15. Locate the upper main bearing shells into the cylinder block. These must be the shells with the oil drilling and oil grooves.
16. Locate the flanged upper main bearing shell in the centre position.
17. Place the crankshaft in position on the bearings.

*continued*



MV46



MV47

18. Place a piece of 'Plastigage' PG-1 (Green) across the crankshaft main bearing journals approximately 6 mm (0.250 in) off centre.
19. Locate the bearing lower shell into the main bearing cap.
20. Fit numbers one to four main bearing caps and shells. Torque: 7.0 to 7.6 kgf.m (50 to 55 lbf ft).
21. Fit the rear main bearing cap and shell. Torque: 9.0 to 9.6 kgf.m (65 to 70 lbf ft).

**NOTE:** Do not rotate the crankshaft while the 'Plastigage' is fitted.

22. Remove the main bearing caps and shells.
23. Using the scale printed on the 'Plastigage' packet, measure the flattened 'Plastigage' at its widest point. The graduation that most closely corresponds to the width of the 'Plastigage' indicates the bearing clearance.

24. The correct bearing clearance with new or overhauled components is 0.023 to 0.065 mm (0.0009 to 0.0025 in).

25. If the correct clearance is not obtained initially, use selective bearing assembly.

26. Wipe off the 'Plastigage' with an oily rag. Do NOT scrape it off.

**NOTE:** The bearing shells must be retained in sets and in the correct sequence.

27. If required, check the connecting rod big-end bearing clearance. 12.17.10.

28. Refit the crankshaft. 12.21.33.

**DATA**

**Crankshaft**

No. of main journals	5
End-thrust	Taken on Number 3
End-play	0.10 to 0.20 mm (0.004 to 0.008 in)
Crankpin journal diameter (standard)	50,800 to 50,812 mm (2.0000 to 2.0005 in)
Main bearing:	
Clearance	0.023 to 0.065 mm (0.0009 to 0.0025 in)
Journal diameter (standard)	58,399 to 58,412 mm (2.2992 to 2.2997 in)
Bearing overall length	20,24 to 20,49 mm (0.797 to 0.807 in). Nos. 1, 2, 4 and 5
	26,82 to 26,87 mm (1.056 to 1.058 in) Number 3

## CYLINDER PRESSURES

12.25.01

—Check

## Checking

1. Run the engine until it attains normal operating temperature.
2. Slacken the three, quarter turn fasteners and remove the side cover plate from each front wheel arch.
3. Remove all the sparking plugs.
4. Secure the throttle in the fully open position.
5. Check each cylinder in turn as follows:
6. Insert a suitable pressure gauge into the sparking plug hole.
7. Crank the engine with the starter motor for several revolutions and note the highest pressure reading obtainable.
8. If the compression is appreciably less than the correct figure, the piston rings or valves may be faulty.
9. Low pressure in adjoining cylinders may be due to a faulty cylinder head gasket.

## DATA

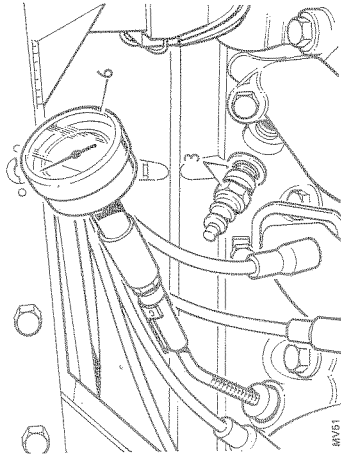
Cranking speed at 15°C (60°F) approximate ambient temperature

150 to 200 rev/min

8.25:1

10.9 kgf/cm<sup>2</sup> (155 lbf/in<sup>2</sup>)0.7 kgf/cm<sup>2</sup> (10 lbf/in<sup>2</sup>)

Maximum variation between cylinders

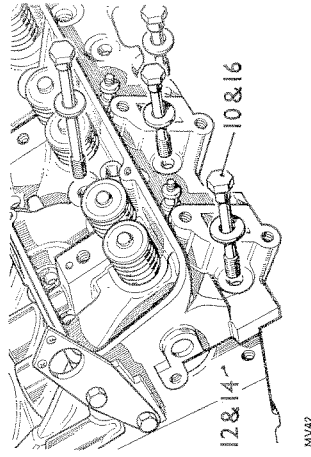


## CYLINDER HEADS

—Remove and refit  
 Left-hand cylinder head 12.29.10  
 Right-hand cylinder head 12.29.11  
 12.29.12

## Removing

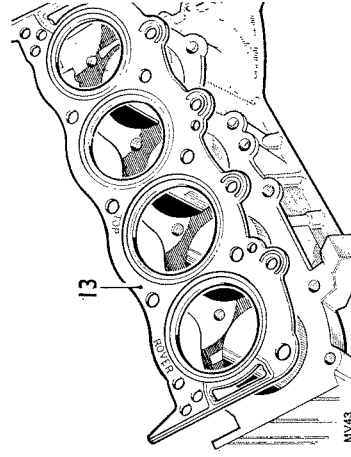
1. Drain the cooling system. 26.10.01.
  2. Remove the carburetter air intake duct. 19.70.01.
  3. 12 volt models—If removing the right-hand cylinder head, remove the alternator. 86.10.02.  
 24 volt models—If removing either cylinder head, remove the alternator. 86.10.02.
  4. Remove the induction manifold. 30.15.02.
  5. Remove the valve gear. 12.29.34.
  6. Slacken the three, quarter-turn fasteners and remove the side cover plate from each front wheel arch.
  7. Disconnect the leads from the sparking plugs.
  8. Remove the exhaust manifolds. 30.15.10-11.
  9. Release the dipstick tube clip from the left-hand cylinder head.
  10. Slacken the cylinder head bolts evenly.
  11. If both cylinder heads are being removed, mark them relative to L.H. and R.H. sides of the engine.
  12. Remove the cylinder heads and discard the gaskets.
- NOTE:** On stripping an engine, the cylinder head bolts should be immediately wire brush washed in 3M Solvent No. 2, manufactured by The 3M Company Ltd., 3M House, Wigmore Street, London W1A 1ET and available through normal trade channels in the British Isles and overseas. It is not available from Rover Parts Dept.
- If the bolts cannot be cleaned immediately, it is essential that they be stored in a bath of trichloroethylene, petrol or paraffin etc., which may also be used as a cleaner if 3M Solvent No. 2 is not available, otherwise the sealant used on previous assembly will tend to air harden, making subsequent removal very difficult.
- After four re-assembly operations renew all bolts. When re-assembling at any time, renew all bolts if more than two bolts exhibit evidence of elongation. If one or two bolts are elongated, they must be replaced.

*continued*

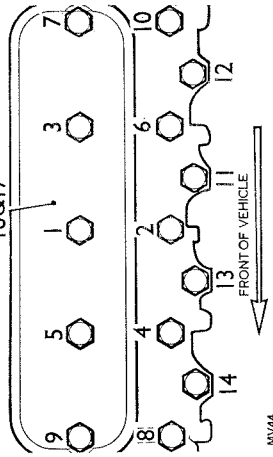
**Refitting**

13. Fit new cylinder head gaskets with the word 'TOP' uppermost. DO NOT use any sealant.
14. Locate the cylinder heads on the block dowel pins.
15. Clean the threads of the cylinder head bolts then coat them with Thread Lubricant Sealant 3M EC776, Rover Part No. 605764.
16. Locate the cylinder head bolts in position:  
 Long bolts—1, 3 and 5.  
 Medium bolts—2, 4, 6, 7, 8, 9 and 10.  
 Short bolts—11, 12, 13 and 14.
17. Tighten the cylinder head bolts a little at a time in the sequence shown. Final torque:  
 Bolts 1 to 10, 9.0 to 9.6 kgf.m (65 to 70 lbf ft).  
 Bolts 11 to 14, 5.6 to 6.2 kgf.m (40 to 45 lbf ft).
18. When all bolts have been tightened, recheck the torque settings.
19. Reverse 1 to 9.

*continued*



**L.H. HEAD ILLUSTRATED**  
16&17

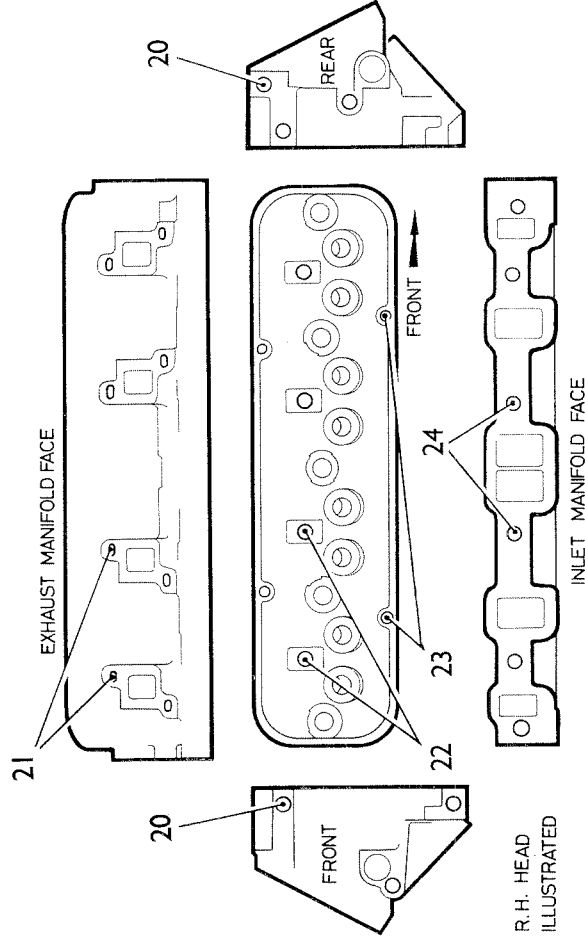


MV44

**Cylinder head thread insert salvage instructions**

20. These three holes may be drilled 0.3906 in dia. × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min.) deep (§ UNC 1½D insert).
21. These eight holes may be drilled 0.3906 in dia × 0.812 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CBB 0.749 in (min) deep (§ UNC 1½D insert).
22. These four holes may be drilled 0.3906 in dia × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min) deep (§ UNC 1½D insert).
23. These four holes may be drilled 0.261 in dia × 0.675 + 0.040 in deep. Tapped with Helicoil Tap No. 4CPB or 4CS × 0.625 in (min) deep (§ UNC 1½D insert).
24. These six holes may be drilled 0.3906 in dia × 0.937 + 0.040 in deep. Tapped with Helicoil Tap No. 6 CPB or 6CS × 0.875 in (min) deep (§ UNC 1½D insert).

**CAUTION:** Any attempt to salvage the sparking plug threads in the cylinder head may result in breaking into the water jacket, rendering the head scrap.



**R.H. HEAD ILLUSTRATED**

MV45



CYLINDER HEADS

- 12.29.18 —Overhaul
- 12.29.19 Left-hand cylinder head
- 12.29.30 Right-hand cylinder head

Service tools: 276102—Valve spring compressor  
 274401—Valve guide remover  
 600959—Valve guide drift  
 605774—Distance piece for valve guide drift

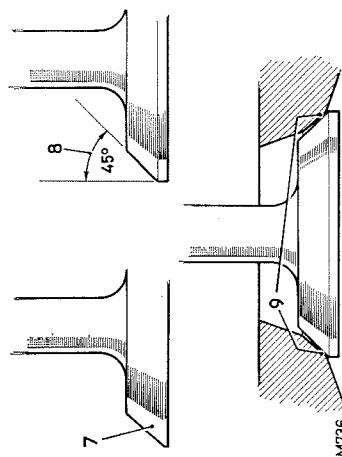
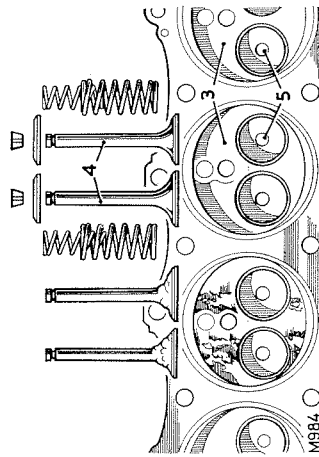
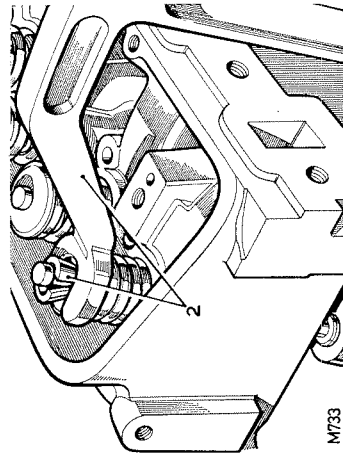
Dismantling

1. Remove the cylinder heads. 12.29.10.
2. Remove the valves and retain in sequence for refitting. Spring compressor 276102.

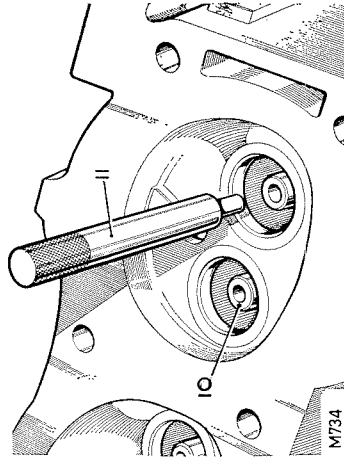
Inspecting

3. Clean the combustion chambers with a soft wire brush.
4. Clean the valve guides.
5. Clean the valve guide bores.
6. Regrind or fit new valves as necessary.
7. If a valve must be ground to a knife-edge to obtain a true seat, fit a new valve.
8. The correct angle for the valve face is 45 degrees.
9. The correct angle for the seat is  $46 \pm \frac{1}{4}$  degrees, and the seat witness should be towards the outer edge.

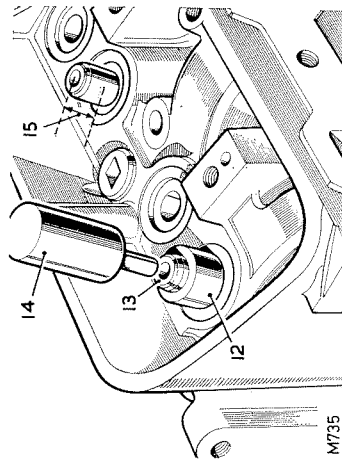
*continued*



10. Check the valve guides and fit replacements as necessary. 11 to 15.
11. Using the valve guide remover 274401, drive out the old guides from the combustion chamber side.
12. Locate the distance piece for the valve guide drift 605774 on the valve spring seat in the top of the cylinder head.
13. Lubricate the new valve guide and insert it into the distance piece.
14. Using the valve guide drift 600959, drive the valve guide into the cylinder head until the drift bottoms on the distance piece.
15. The fitted guide should stand 19 mm (0.750 in) above the step surrounding the valve guide boss in the cylinder head.

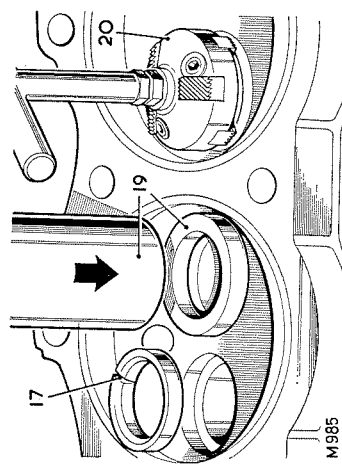


16. Check the valve seats and fit replacements as necessary. 17 to 19.
17. Remove the old seat inserts by grinding them away until they are thin enough to be cracked and prised out.
18. Heat the cylinder head evenly to approximately 65 degrees C (150 degrees F).
19. Press the new insert into the recess in the cylinder head.



**NOTE:** The outside diameter of standard size valve seat inserts is as follows:  
 Inlet: 41,465 mm to 41,490 mm (1.6325 in to 1.6335 in).  
 Exhaust: 36,918 mm to 36,944 mm (1.4535 in to 1.4545 in).

- Service valve seat inserts are available in two oversizes 0,25 mm and 0,50 mm (0,010 in and 0,20 in) larger on the outside diameter than standard in order to obtain a good press fit in the cylinder head.
20. If necessary, cut the valve seats to  $46 \pm \frac{1}{4}$  degrees.



*continued*

21. The nominal seat width is 0,8 mm (0,031 in). If the seat exceeds 2,0 mm (0,078 in) it should be reduced to the specified width by the use of 20 and 70 degree stones.
22. The inlet valve seat is 35,25 mm (1,388 in) diameter and the exhaust seat is 30,48 mm (1,200 in) diameter.
23. Check the height of the valve stems above the outer valve spring seat surface of the cylinder head. This MUST NOT exceed 47,63 mm (1,875 in). If necessary grind the end of the valve stem or fit new parts.

**Reassembling**

24. Lubricate the valve stems and guides with engine oil and fit each valve as follows:
  25. Insert the valve into its guide.
  26. Place the valve springs in position.
  27. Locate the cap on the springs.
  28. Using the valve spring compressor 276102, fit the valve collets.
  29. Refit the cylinder heads. 12.29.10.

*continued*

**DATA**

**Cylinder heads**

**Material**

**Type**

Inlet and exhaust valve seat material

Inlet and exhaust valve seat angle

**Valves**

**Opens**

30 degrees BTDC

**Closes**

75 degrees ABDC

**Duration**

285 degrees

**Valve open overlap**

67 degrees

**Valves, inlet**

Overall length

116,58 to 117,34 mm (4,590 to 4,620 in)

Actual overall head diameter

37,97 to 38,22 mm (1,495 to 1,505 in)

Angle of face

45 degrees

Stem diameter

8,640 to 8,666 mm (0,3402 to 0,3412 in) at the head and increasing to 8,653 to 8,679 mm (0,3407 to 0,3417 in)

Stem clearance in guide

Top 0,02 to 0,07 mm (0,001 to 0,003 in)

Bottom 0,013 to 0,0635 mm (0,0005 to 0,0025 in)

**Valves, exhaust**

Overall length

116,58 to 117,34 mm (4,590 to 4,620 in)

Actual overall head diameter

33,215 to 33,466 mm (1,3075 to 1,3175 in)

Angle of face

45 degrees

Stem diameter

8,628 to 8,654 mm (0,3397 to 0,3407 in) at the head and increasing to 8,640 to 8,666 mm (0,3402 to 0,3412 in)

Stem clearance in guide

Top 0,038 to 0,088 mm (0,0015 to 0,0035 in)

Bottom 0,05 to 0,10 mm (0,002 to 0,004 in)

9,9 mm (0,39 in) both valves

**Valve lift**

40,6 mm (1,6 in) at pressure of 17,69 to 20,41 kg (39 to 45 lb)

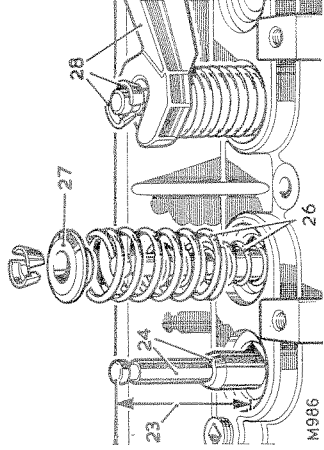
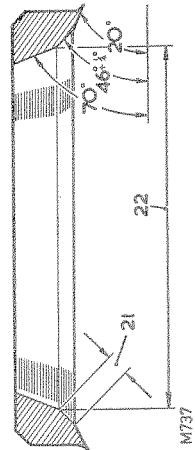
**Valve spring length:**

Outer

41,4 mm (1,63 in) at pressure of 9,75 to 12,02 kg (21,5 to 26,5 lb)

Inner

40,6 mm (1,6 in) at pressure of 17,69 to 20,41 kg (39 to 45 lb)



**Aluminum alloy**

Two heads with separate alloy inlet manifold

Piston ring iron

46 + 4 degrees

**Inlet**

30 degrees BTDC

75 degrees ABDC

285 degrees

67 degrees

**Exhaust**

68 degrees BBDC

37 degrees ATDC

285 degrees

67 degrees

116,58 to 117,34 mm (4,590 to 4,620 in)

37,97 to 38,22 mm (1,495 to 1,505 in)

45 degrees

8,640 to 8,666 mm (0,3402 to 0,3412 in) at the head and increasing to 8,653 to 8,679 mm (0,3407 to 0,3417 in)

Top 0,02 to 0,07 mm (0,001 to 0,003 in)

Bottom 0,013 to 0,0635 mm (0,0005 to 0,0025 in)

116,58 to 117,34 mm (4,590 to 4,620 in)

33,215 to 33,466 mm (1,3075 to 1,3175 in)

45 degrees

8,628 to 8,654 mm (0,3397 to 0,3407 in) at the head and increasing to 8,640 to 8,666 mm (0,3402 to 0,3412 in)

Top 0,038 to 0,088 mm (0,0015 to 0,0035 in)

Bottom 0,05 to 0,10 mm (0,002 to 0,004 in)

9,9 mm (0,39 in) both valves

40,6 mm (1,6 in) at pressure of 17,69 to 20,41 kg (39 to 45 lb)

41,4 mm (1,63 in) at pressure of 9,75 to 12,02 kg (21,5 to 26,5 lb)

**VALVE GEAR**

—Remove and refit 1 to 7, 15 to 21 and 29 to 37

12.29.34

**ROCKER SHAFTS**

—Remove and refit 2, 4, 5 and 30 to 37

12.29.54

—Overhaul 2, 4, 5, 8 to 13, 22 to 28 and 30 to 37

12.29.55

**Removing**

1. Drain the cooling system. 26.10.01.
2. Remove the air intake. 19.70.01.
3. Remove the induction manifold. 30.15.02.
4. Remove the rocker covers.

5. Remove the rocker shaft assemblies.
6. Withdraw the pushrods and retain in the sequence removed.
7. Withdraw the tappets and retain with respective pushrods.

**NOTE:** If a tappet cannot be withdrawn, remove the camshaft and withdraw the tappet from the bottom.

**Dismantling rocker shafts**

8. Remove the split pin from one end of the rocker shaft.

Withdraw the following components and retain them in the correct sequence for reassembly:

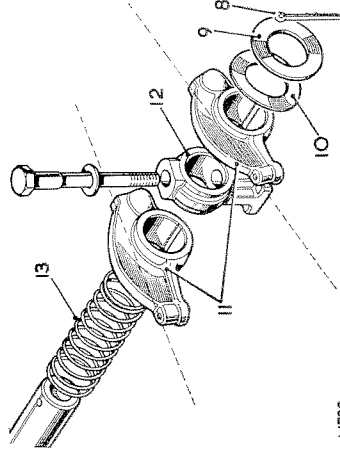
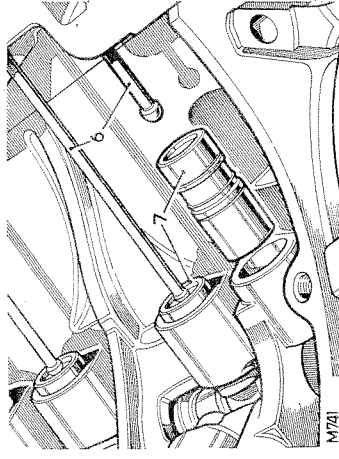
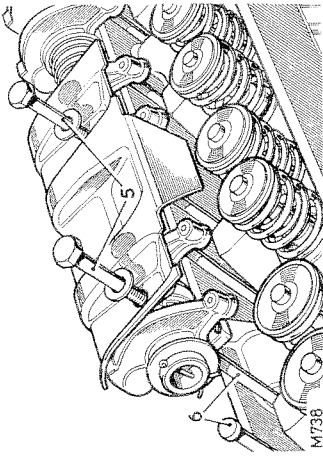
9. A plain washer.
10. A wave washer.
11. Rocker arms.
12. Brackets.
13. Springs.

**Inspection of hydraulic tappets and pushrods**

14. Hydraulic tappet; inspect inner and outer surfaces of body for blow holes and scoring. Replace hydraulic tappet if body is roughly scored or grooved, or has a blow hole extending through the wall in a position to permit oil leakage from lower chamber.

15. The prominent wear pattern just above lower end of body should not be considered a defect unless it is definitely grooved or scored; it is caused by side thrust of cam against body while the tappet is moving vertically in its guide.

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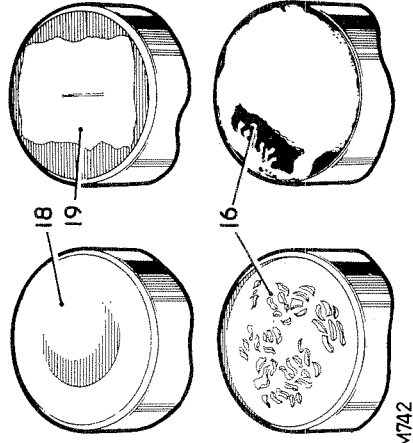
16. Inspect the cam contact surface of the tappets. Fit new tappets if the surface is excessively worn or damaged.
17. A hydraulic tappet body that has been rotating will have a round wear pattern and a non-rotating tappet body will have a square wear pattern with a very slight depression near the centre.
18. Tappets MUST rotate and a circular wear condition is normal, and such bodies may be continued in use if the surface is free of defects.
19. In the case of a non-rotating tappet, fit a new replacement and check camshaft lobes for wear; also ensure new tappet rotates freely in the cylinder block.
20. Fit a new hydraulic tappet if the area where the pushrod contacts is rough or otherwise damaged.
21. Pushrod. Replace with new, any pushrod having a rough or damaged ball end or seat.

#### Refitting

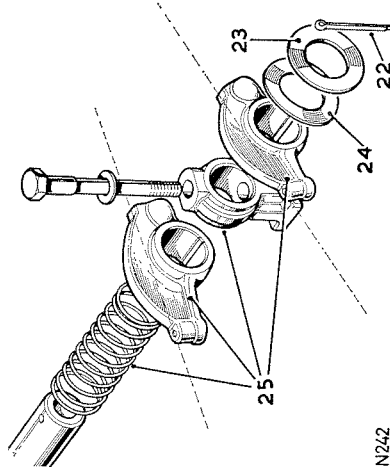
##### Reassembling rocker shafts 22 to 28

- NOTE:** If new rocker arms are being fitted, ensure that the protective coating is removed from the oil feed hole and push rod seat.
22. Fit a split pin to one end of the rocker shaft.
  23. Slide a plain washer over the long end of the shaft to abut the split pin.
  24. Fit a wave washer to abut the plain washer.
  - NOTE:** Two different rocker arms are used and must be fitted so that the valve ends of the arms slope away from the brackets.
  25. Assemble the rocker arms, brackets and springs to the rocker shaft.
  26. Compress the springs, brackets and rockers, and fit a wave washer, plain washer and split pin to the end of the rocker shaft.
  27. Locate the oil baffle plates in place over the rockers furthest from the notched end of the rocker shaft.
  28. Fit the bolts through the brackets and shaft so that the notch on the one end of the shaft is uppermost and towards the front of the engine on the right-hand side, and towards the rear on the left-hand side.
  29. Fit the tappets and pushrods in the original sequence.

*continued*



M742



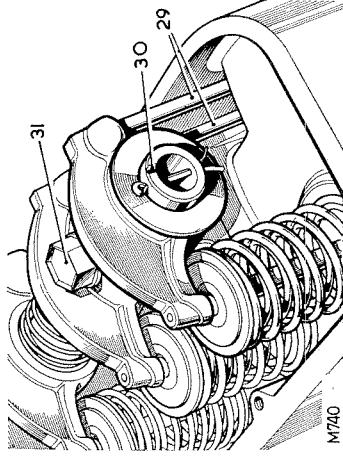
N242

**NOTE:** The rocker shafts are handed and must be fitted correctly to align the oilways.

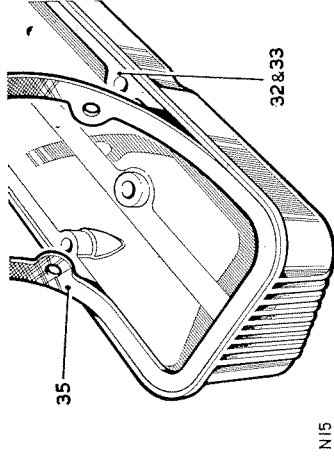
30. Each rocker shaft is notched at one end and on one side only. The notch must be uppermost and towards the front of the engine on the right-hand side, and towards the rear on the left-hand side.
31. Fit the rocker shaft assemblies. Ensure that the pushrods engage the rocker cups and that the baffle plates are fitted to the front on the left-hand side, and to the rear on the right-hand side. Tighten the bolts evenly. Torque: 3.5 to 4.0 kgf.m (2.5 to 3.0 lbf. ft).
- If it is necessary to fit a new rocker cover gasket, proceed as follows. 32 to 36.
32. Clean and dry the gasket mounting surface, using Bostik cleaner 6001.
33. Apply Bostik 1775 impact adhesive, Rover Part No. 601736 to the seal face and the gasket, using a brush to ensure an even film.
34. Allow the adhesive to become touch-dry, approximately fifteen minutes.
- NOTE:** The gasket fits one way round only and must be fitted accurately first time, any subsequent movement would destroy the bond.
35. Place one end of the gasket into the cover recess with the edge firmly against the recess wall; at the same time hold the remainder of the gasket clear; then work around the cover, pressing the gasket into place ensuring that the outer edge firmly abuts the recess wall.
36. Allow the cover to stand for thirty minutes before fitting it to the engine.
37. Reverse 1 to 4.

#### **NOTE: Tappet noise**

It should be noted that tappet noise can be expected on initial starting up after an overhaul due to oil drainage from the tappet assemblies or indeed if the vehicle has been standing over a very long period. If excessive noise should be apparent after an overhaul, the engine should be run at approximately 2,500 rev/min for a few minutes, when the noise should be eliminated.



M740



N15

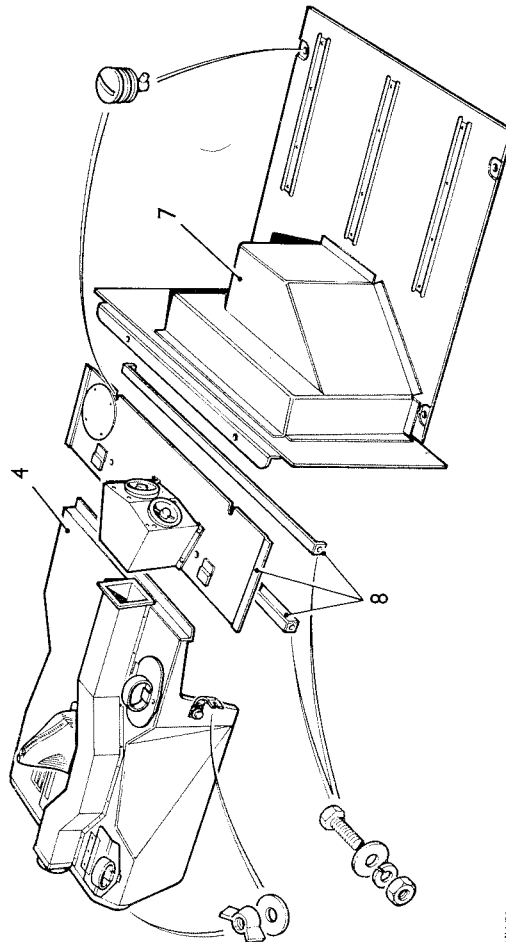
ENGINE AND GEARBOX ASSEMBLY

—Remove and refit (Downwards) 12.37.01

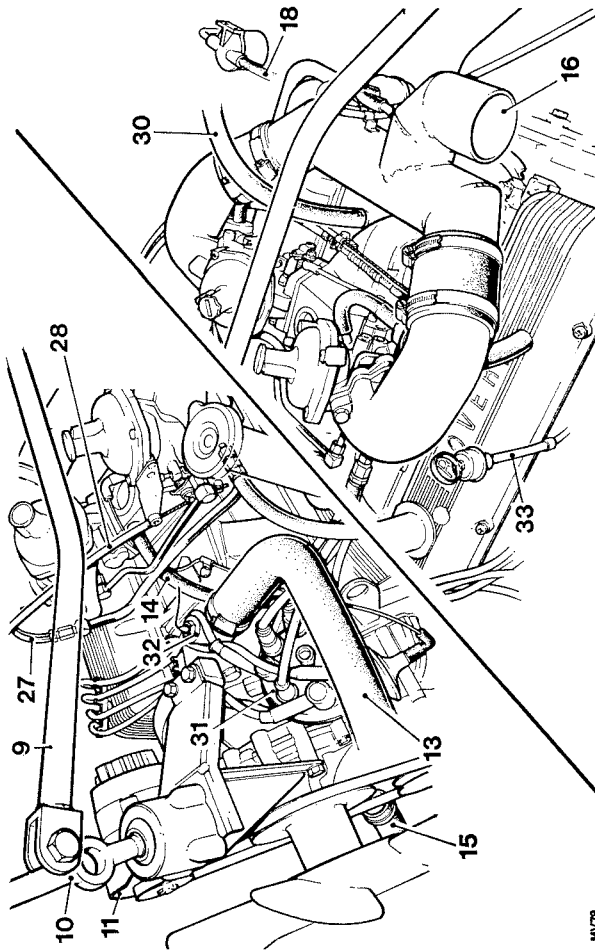
Service tool: RO8459 Engine and gearbox sling

Removing

1. If fitted, remove the vehicle hood and hood sticks.
2. If the vehicle is fitted with a winch, remove the winch. 90.10.10 and disconnect the winch drive selector cable from the gearbox.
3. Disconnect the earth lead from the vehicle battery.
4. Remove the engine compartment lid.
5. Drain the cooling system. 26.10.01.
6. Remove the drain plug from the engine oil sump, allow all the oil to drain, then refit the drain plug and washer.
7. Remove the rear compartment gearbox lid.
8. Remove the engine compartment centre panel and stays.



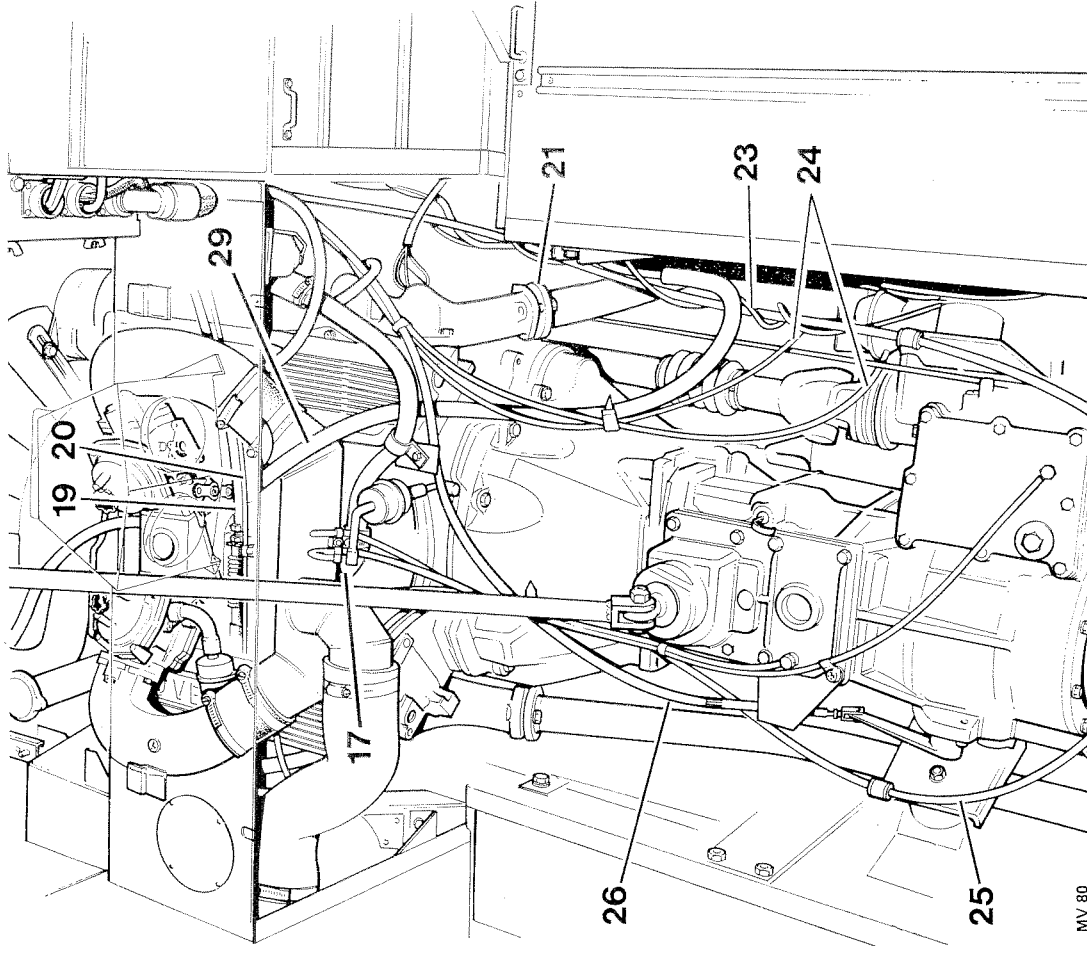
MV 78



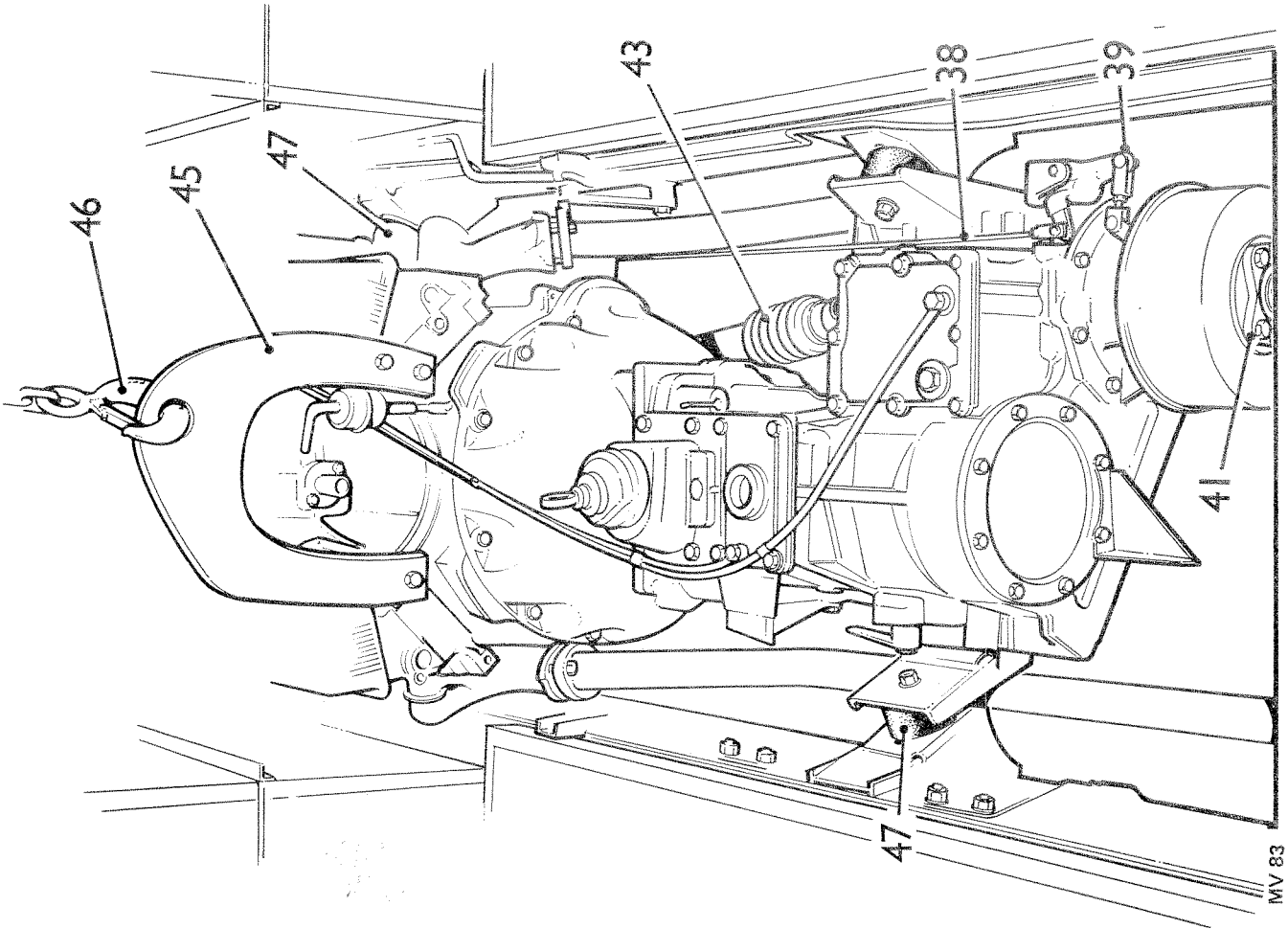
MV 79

9. Remove the remote control gearchange shaft.
10. Remove the main gearchange lever.
11. Remove the alternator. 86.10.02.
12. Remove the fan blades.
13. Disconnect the hose from the water outlet elbow.
14. Disconnect the hose from the top of the induction manifold.
15. Disconnect the hose from the water pump inlet.
16. Disconnect the hose from the carburettor air intake duct.
17. Disconnect the heater hose from the rear of the induction manifold.
18. Disconnect the outlet pipe from the fuel filter.

19. Disconnect the throttle cable from the carburetter linkage and manifold.
20. If fitted, disconnect the hand throttle cable from the carburetter linkage and manifold.
21. Disconnect the front exhaust pipes from the manifolds.
22. Release the speedometer cable and gearbox High/Low ratio cable from the clamp at the rear of the engine.
23. Disconnect the electrical leads from the gearbox differential indicator switch.
24. Disconnect the vacuum pipes from the gearbox differential actuator.
25. Disconnect the speedometer cable and clip.
26. Disconnect the High/Low ratio cable at the gearbox.
27. Disconnect the fuel spill return pipe from the right-hand carburetter.
28. Disconnect the choke cable from the carburetter.
29. Disconnect the vacuum pipe for the brake servo.
30. Disconnect the vacuum pipe for the gearbox.
31. Remove the distributor cap and cables, including the low tension lead.
32. Disconnect the capillary tube from the top of the water outlet elbow.
33. Remove the dipstick tube clip from the left-hand cylinder head.

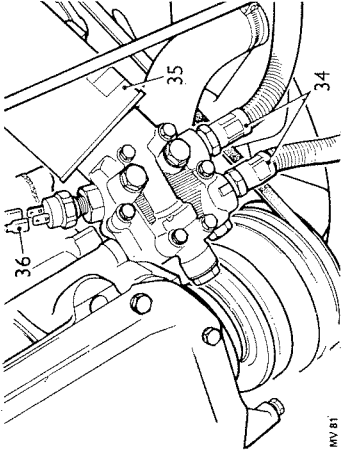


MV 80

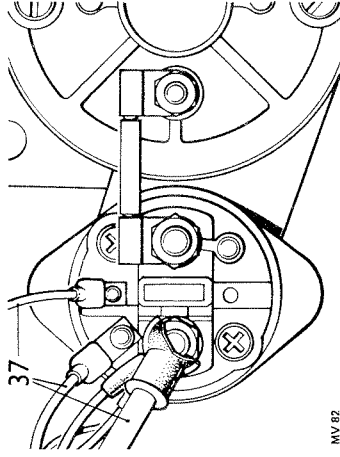


MV 83

34. Disconnect the oil cooler pipes from the oil pump.  
Cap the disconnected pipes and apertures.
35. Remove the oil filter.
36. Disconnect the leads from the oil pressure switch.
37. Disconnect the leads and earth strap from the starter motor.
38. Disconnect the handbrake rod front connection at the relay.
39. Disconnect the handbrake rod at the gearbox.
40. Remove the front exhaust pipes.
41. Disconnect the rear propeller shaft from the transmission brake drum.
42. If fitted, disconnect the trailer drive selector cable and propeller shaft from the gearbox.
43. Disconnect the front propeller shaft from the gearbox.
44. Remove the clutch slave cylinder.
45. Securely bolt engine and gearbox lifting sling RO8459 to the tapped holes provided in the rear face of the cylinder heads.
46. Attach a hoist to the lifting sling.
47. Remove the four, engine and gearbox mounting rubbers.
48. Position a suitable trolley beneath the engine and gearbox.
49. Roll the vehicle slightly forward.
50. Lower the engine and gearbox through the chassis and on to the trolley.
51. Detach the hoist from the engine lifting sling.
52. Jack up the left-hand side of the vehicle sufficient to withdraw the engine and gearbox.
53. Withdraw the engine and gearbox assembly on the trolley.
54. If required, remove the engine lifting sling.



MV 81

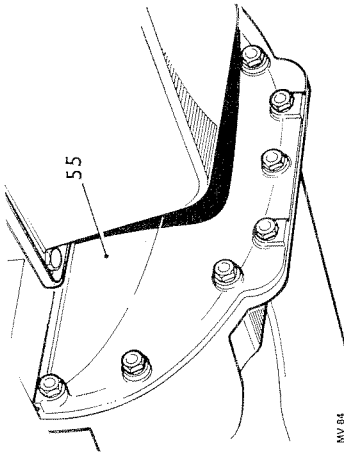


MV 82

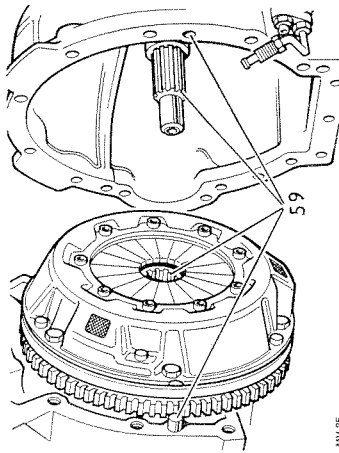
- If required, separate the engine and gearbox, 55 to 57.  
 55. Remove the cover plate from the bell housing.  
 56. Remove the fixings securing the bell housing to the engine.  
 57. Withdraw the gearbox from the engine.

**Refitting**

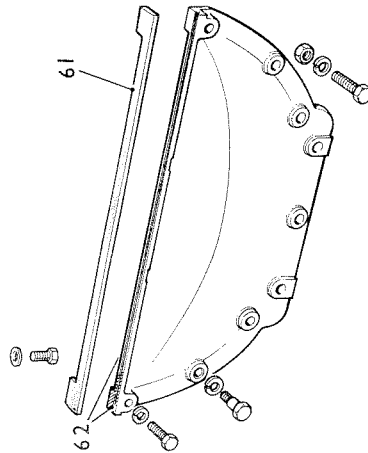
- If separated, assemble the engine to the gearbox, 58 to 63.  
 58. Spray the splines of the primary pinion, the clutch centre and the withdrawal unit abutment faces with a dry-film lubricant followed by a smear of molybdenum disulphide grease.  
 59. Offer the gearbox to the engine, locating the primary pinion into the clutch and engage the bell housing dowels.  
 60. Secure the bell housing to the engine. Torque: 3,5 kgf.m (25 lbf ft).  
 61. If necessary, fit a new seal to the bell housing cover plate, using a cement such as 'Holdite 88'.  
 62. Apply 'Hylomar PL32 M' jointing compound to the cover plate and seal, for the joints between the bell housing, cylinder block and rear main bearing cap.  
 63. Secure the cover plate to the engine and bell housing. Torque: 1,0 kgf.m (8 lbf ft).  
 64. Reverse 8 to 54.  
 65. If the vehicle is fitted with a winch, refit the winch, 90,10,10, and reconnect the winch drive selector cable to the gearbox lever.  
 66. Replenish the engine oil sump.  
 67. Replenish the cooling system, using the correct anti-freeze mixture.  
 68. Check, and if necessary replenish, the gearbox and transfer box oil level.  
 69. Reconnect the battery earth lead.  
 70. Start the engine and check that the oil pressure warning light goes out. If the light remains on, the engine must be stopped and the oil pump dismantled and primed. 12.60.26.  
 71. Check for oil and coolant leaks and rectify as necessary.  
 72. Check, and if necessary adjust, the engine idle speed.  
 73. Check, and if necessary adjust, the distributor dwell angle and ignition timing.  
 74. Reverse 1, 4 and 7.  
 75. When the engine is cold, check the oil level in the engine sump and top up if necessary.  
 76. Check the coolant level in the radiator and top up if necessary.



MV 84



MV 85



MV 86

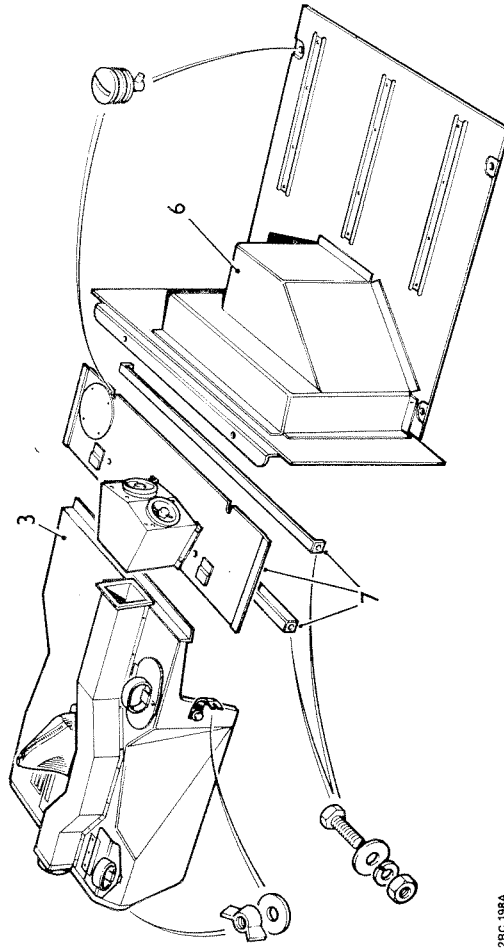
**ENGINE ASSEMBLY**

—Remove and refit (through top) 12.41.01

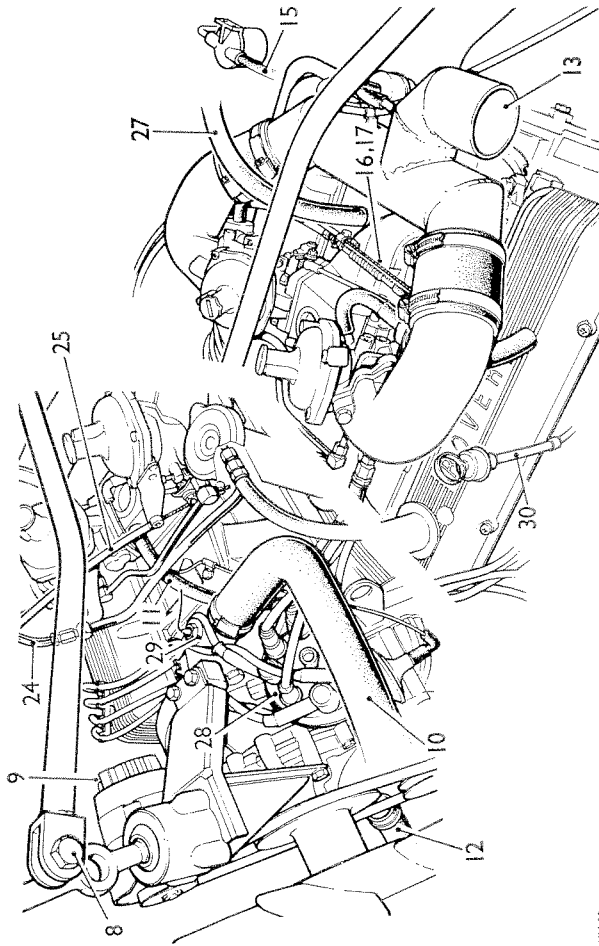
Service tool: FV817336 Engine lifting eye.

**Removing**

1. If fitted, remove the vehicle hood and hood sticks.
2. Disconnect the earth lead from the vehicle batteries.
3. Remove the engine compartment lid.
4. Drain the cooling system. 26.10.01.
5. Remove the drain plug from the engine oil sump, allow all the oil to drain, then refit the drain plug and washer.
6. Remove the rear compartment gearbox lid.
7. Remove the engine compartment centre panel and stays.

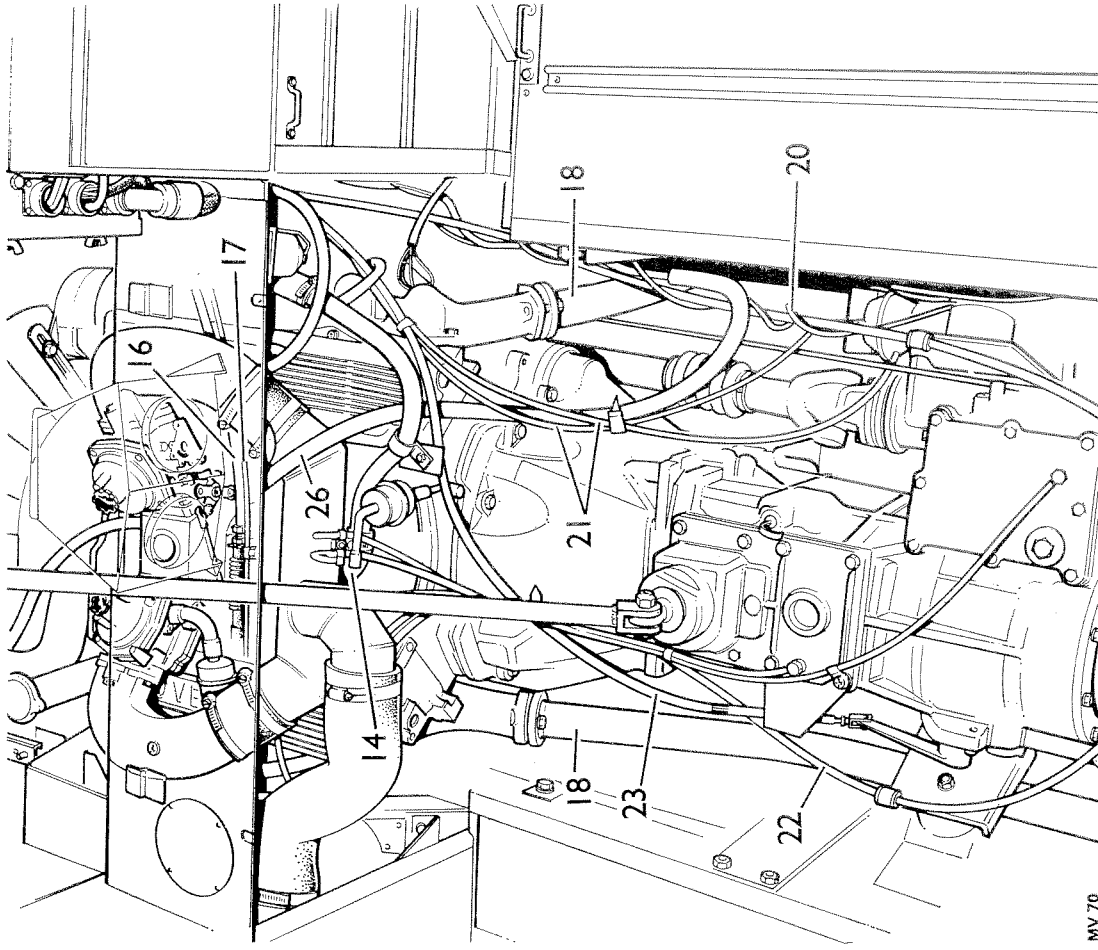


2RC 198A



MV 60

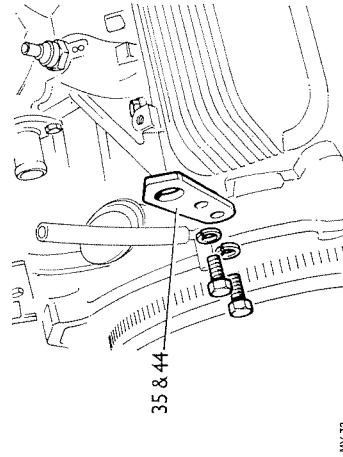
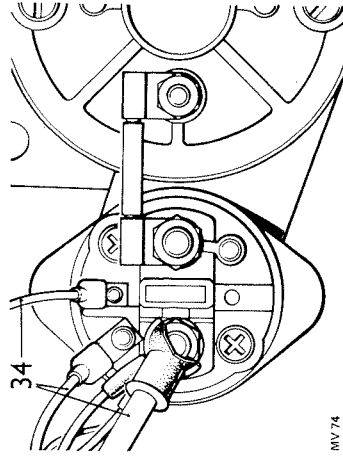
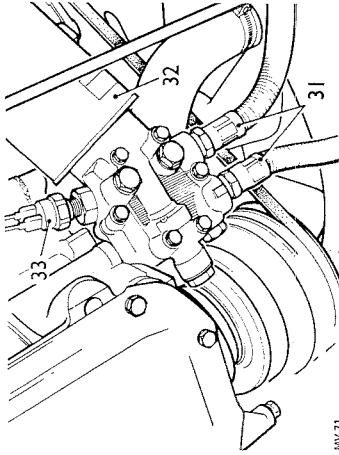
8. Remove the remote control gearchange shaft.
9. Remove the alternator. 86.10.02.
10. Disconnect the hose from the water outlet elbow.
11. Disconnect the hose from the top of the induction manifold.
12. Disconnect the hose from the water pump inlet.
13. Disconnect the hose from the carburettor air intake duct.
14. Disconnect the heater hose from the rear of the induction manifold.
15. Disconnect the fuel supply pipe from the filter.
16. Disconnect the throttle cable from the carburettor linkage and manifold.
17. If fitted, disconnect the hand throttle cable from the carburettor linkage and manifold.
18. Disconnect the front exhaust pipes from the manifolds.
19. Release the speedometer cable and gearbox High/Low ratio cable from the clamp at the rear of the engine.
20. Disconnect the electrical leads from the gearbox differential indicator switch.
21. Disconnect the vacuum pipes from the gearbox differential actuator.
22. Disconnect the speedometer cable and clip.
23. Disconnect the High/Low ratio cable at the gearbox.
24. Disconnect the fuel spill return pipe from the right-hand carburettor.
25. Disconnect the choke cable from the carburettor.
26. Disconnect the vacuum pipe for the brake servo.
27. Disconnect the vacuum pipe for the gearbox.
28. Remove the distributor cap and cables, including the low tension lead.
29. Disconnect the capillary tube from the top of the water outlet elbow.
30. Remove the dipstick tube clip from the left-hand cylinder head.



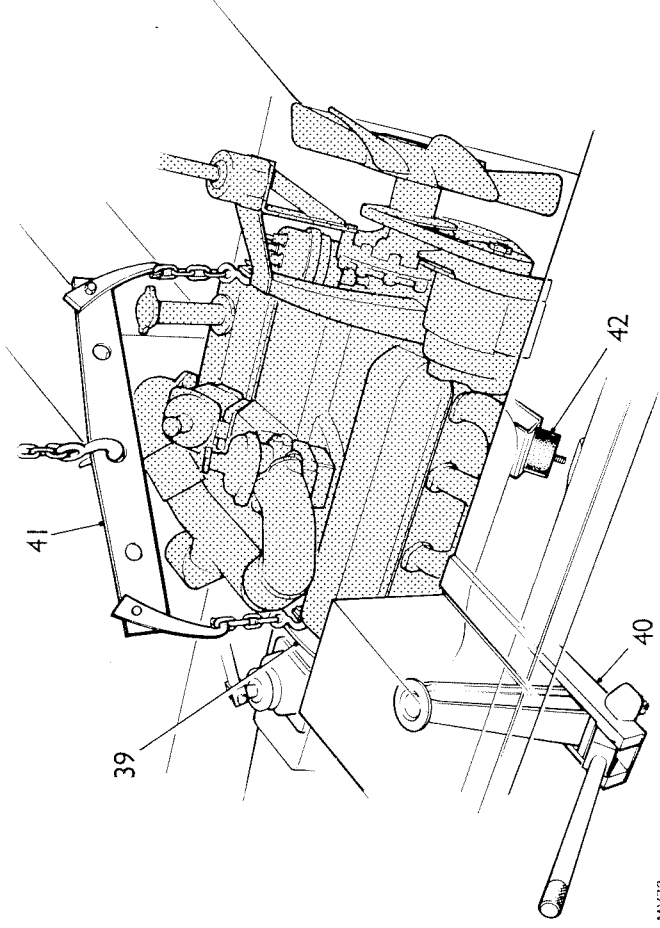
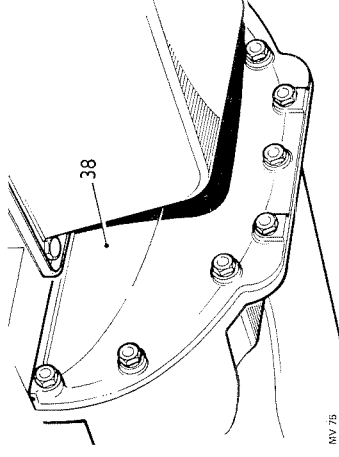
MV 70



31. Disconnect the oil cooler pipes from the oil pump. Cap the disconnected pipes and apertures.
32. Remove the oil filter.
33. Disconnect the leads from the oil pressure switch.
34. Disconnect the leads and earth strap from the starter motor.
35. Securely bolt engine lifting eye (FV817336) to the tapped holes provided in the rear face of the right-hand cylinder head.
36. Remove the fan blades.
37. Remove the radiator.

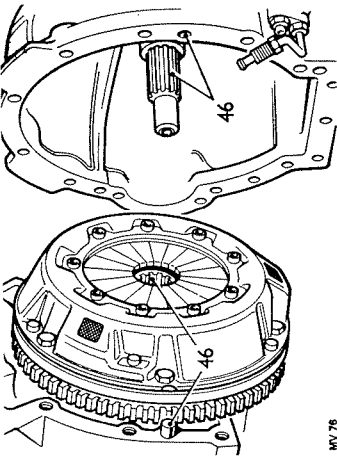


38. Remove the cover plate from the front of the bell housing.
39. Remove the fixings securing the bell housing to the engine.
40. Support the gearbox.
41. Attach a sling and hoist to the engine lifting eyes and tension the hoist.
42. Remove the engine mounting rubbers.
43. Push the engine forward to disengage it from the gearbox, then raise the engine and swing it clear.

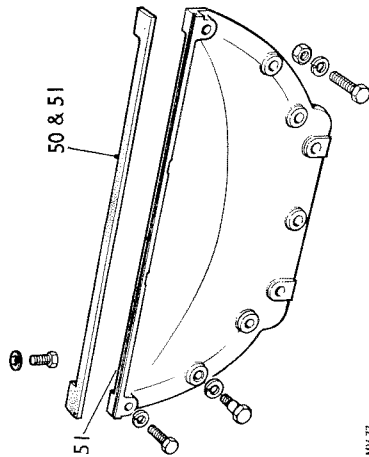


**Refitting**

44. If not already fitted, securely bolt engine lifting eye (FV817336) to the tapped holes provided in the rear face of the right-hand cylinder head.
45. Spray the splines of the primary pinion, the clutch centre and the withdrawal unit abutment faces with a dry-film lubricant, followed by a smear of molybdenum disulphide grease.
46. Attach a sling to the engine lifting eyes and lower the engine into position, locating the primary pinion into the clutch and engage the bell housing dowels.
47. Secure the bell housing to the engine. Torque: 3,5 kgf.m (25 lbf ft).
48. Raise the engine slightly and refit the engine mounting rubbers.
49. Remove the engine sling and lifting eye.
50. If necessary, fit a new seal to the bell housing cover plate, using a cement such as 'Holdite 88.'
51. Apply 'Hylomar PL32M' jointing compound to the cover plate and seal, for the joints between the bell housing, cylinder block and rear main bearing cap.
52. Secure the cover plate to the engine and bell housing. Torque 1,0 kgf.m (8 lbf ft).
53. Reverse 36 and 37.
54. Reverse 6 to 34.
55. Replenish the engine oil sump.
56. Replenish the cooling system, using the correct anti-freeze mixture.
57. Reconnect the battery earth lead.
58. Start the engine and check that the oil pressure warning light goes out. If the light remains on, the engine must be stopped and the oil pump dismantled and primed. 12.60.26.
59. Check for oil and coolant leaks and rectify as necessary.
60. Check, and if necessary adjust, the engine idle speed.
61. Check, and if necessary adjust, the distributor dwell angle and ignition timing. 86.35.20.
62. Reverse 1 and 3.
63. When the engine is cold, check the oil level in the engine sump and top up if necessary.
64. Check the coolant level in the radiator and top up if necessary.



MV 76



MV 77

**FLYWHEEL**

---Remove and refit

12.53.07

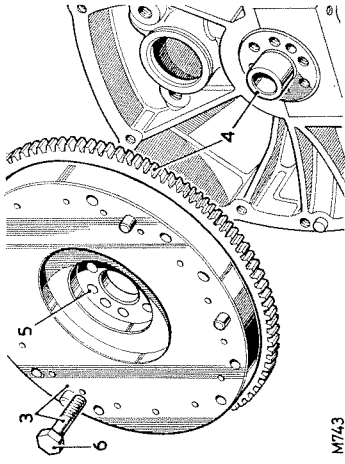
**Removing**

1. Remove the gearbox assembly. 37.20.01.
2. Remove the clutch assembly. 33.10.01
3. Remove the flywheel.

**Refitting**

4. Locate the flywheel in position on the crankshaft spigot, with the ring gear towards the engine.
5. Align the flywheel fixing bolt holes which are off-set to prevent incorrect assembly.
6. Fit the flywheel fixing bolts and before finally tightening, take up any clearance by rotating the flywheel against the direction of engine rotation. Torque: 7,0 to 8,5 kgf.m (50 to 60 lbf ft).
7. Reverse 1 and 2.

M743



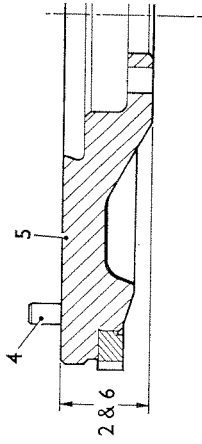
FLYWHEEL

—Overhaul

12.53.10

Procedure

1. Remove the flywheel. 12.53.07.
2. Measure the overall thickness of the flywheel. Fit a new flywheel if it is less than 39,93 mm (1.572 in).
3. If the flywheel is above the minimum thickness, the clutch face can be relaced 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. If the starter ring gear is worn or damaged, refer to 12.53.19.
8. Refit the flywheel. 12.53.07.



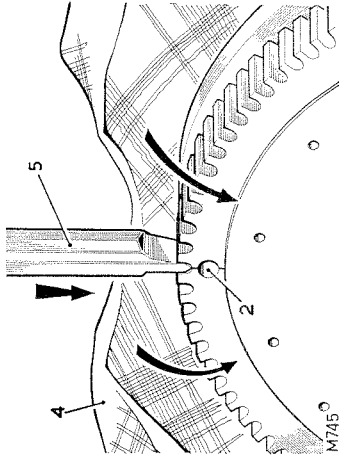
MV66

STARTER RING GEAR

—Remove and refit 12.53.19

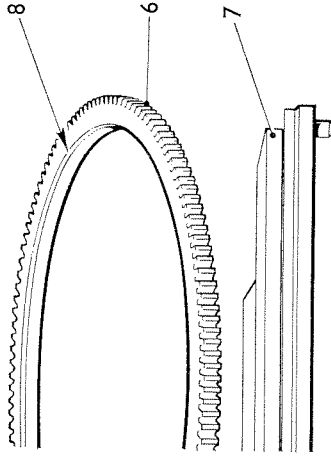
Removing

1. Remove the flywheel. 12.53.07.
  2. Drill a 10 mm (0.375 in) diameter hole 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.
  4. Place a cloth over the flywheel to protect the operator from flying fragments.
- WARNING: Take adequate precautions against flying fragments, as the starter ring gear may fly asunder when being split.**
5. Place a chisel immediately above the drilled hole and strike it sharply to split the starter ring gear.



Refitting

6. Heat the starter ring gear uniformly to between 170 degrees and 175 degrees C (338 degrees to 347 degrees F) but do not exceed the higher temperature.
7. Place the flywheel, flanged side down, on a flat surface.
8. Locate the heated starter ring gear in position on the flywheel, with the recessed inner diameter away from the flywheel flange.
9. Press the starter ring gear firmly against the flange until the ring contracts sufficiently to grip the flywheel.
10. Allow the flywheel to cool gradually. Do NOT hasten cooling in any way and thereby avoid the setting up of internal stresses in the ring gear which may cause fracture or failure in some respect.
11. Fit the flywheel. 12.53.07.



**SPIGOT BEARING**

12.53.20

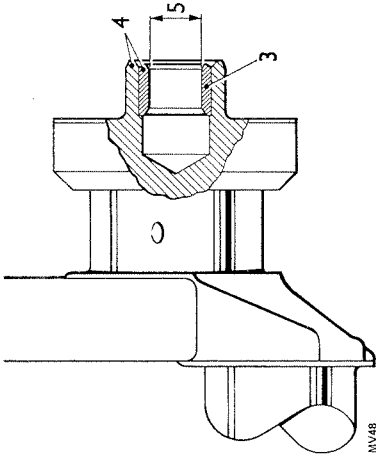
—Remove and refit

**Removing**

1. Remove the gearbox assembly. 37.20.01.
2. Remove the clutch assembly. 33.10.01.
3. Remove the spigot bearing.

**Refitting**

4. Fit the spigot bearing flush with, or to a maximum of 1,6 mm (0,063 in) below the end face of the crankshaft.
5. Reamer the spigot bearing to 19,06 + 0,02 mm (0,7505 + 0,001 in).
6. Reverse 1 and 2.



**OIL FILTER ASSEMBLY—EXTERNAL**

12.60.01

—Remove and refit

**NOTE:** The engine oil pump is located above the oil level in the engine sump and contains a primary charge of oil. Under normal circumstances, this primary charge is maintained by the functioning of the lubrication system. However, if the oil filter is removed while the oil sump is drained, the charge may be lost and the pump will require re-priming (12.60.26). Therefore, if possible, avoid removing the oil filter while the sump is drained.

**Removing**

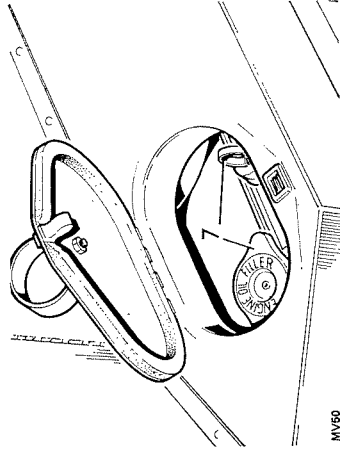
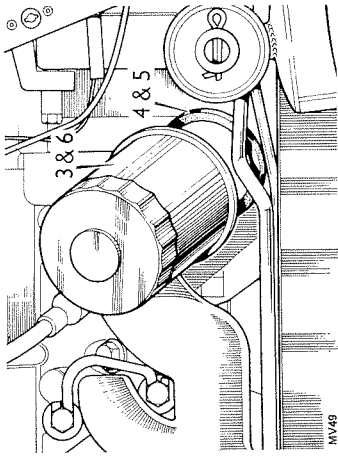
1. Slacken the three, quarter-turn fasteners and remove the side cover plate from the right-hand front wheel arch.
2. Place an oil drip tray under the filter.
3. Unscrew the filter anti-clockwise and discard.

**NOTE:** If the filter is difficult to remove, use a strap spanner.

4. Withdraw the sealing ring and discard.

**Refitting**

5. Smear a little clean engine oil on the sealing ring for the new filter.
6. Screw the filter on clockwise until the sealing ring touches the oil pump cover face, then tighten a further half-turn by hand only. Do not overtighten.
7. Using the oil filler tube on the left-hand front rocker cover, replenish with oil of the correct grade to the 'High' mark on the dipstick.
8. Start the engine and check that the oil pressure warning light goes out. If the light remains on, the engine must be stopped and the oil pump dismantled and primed. 12.60.26.
9. Run the engine and check the filter joint for leaks.
10. Check the sump oil level after the engine has been stopped for a few minutes and replenish if necessary.



## OIL PUMP

## —Remove and refit

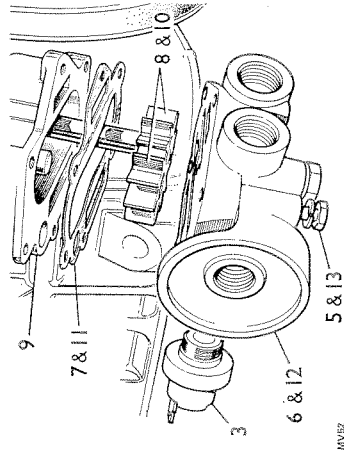
12.60.26

## Removing

1. Slacken the three, quarter-turn fasteners and remove the side cover plate from the right-hand front wheel arch.
2. Remove the oil filter assembly. 12.60.01.
3. Disconnect the electrical leads from the oil pressure switch.
4. Disconnect the oil cooler pipes from the oil pump. Cap the disconnected pipes and apertures.
5. Remove the bolts from the oil pump cover.
6. Withdraw the oil pump cover.
7. Lift off the cover gasket.
8. Withdraw the oil pump gears.

## Refitting

9. Fully pack the oil pump gear housing with petroleum jelly. Use only petroleum jelly; no other grease is suitable.
10. Fit the oil pump gears so that the petroleum jelly is forced into every cavity between the teeth of the gears.  
**NOTE:** Unless the pump is fully packed with petroleum jelly it may not prime itself when the engine is started.
11. Place a new gasket on the oil pump cover.
12. Locate the oil pump cover in position.
13. Fit the special fixing bolts and tighten alternatively and evenly. Torque: 1,2 kgf.m (9 lbf.ft).
14. Reverse 1 to 4.
15. Check the oil level in the engine sump and replenish as necessary.



## OIL PUMP

12.60.32

## —Overhaul

## Dismantling

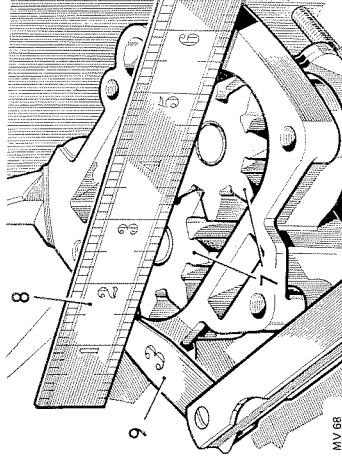
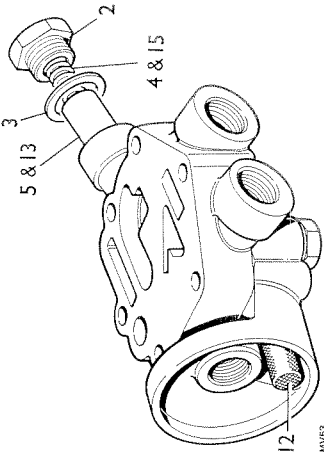
1. Remove the oil pump. 12.60.26.
2. Unscrew the plug from the pressure relief valve.
3. Lift off the joint washer for the plug.
4. Withdraw the spring from the relief valve.
5. Withdraw the pressure relief valve.

## Inspecting

6. Check the oil pump gears for wear or scores.
7. Fit the oil pump gears and shaft into the front cover.
8. Place a straight-edge across the gears.
9. Check the clearance between the straight-edge and the front cover. If less than 0,05 mm (0,0018 in) check the front cover gear pocket for wear.
10. Check the oil pressure relief valve for wear or scores.
11. Check the relief valve spring for wear at the sides or signs of collapse.
12. Clean the gauze filter for the relief valve.
13. Check the fit of the relief valve in its bore. The valve must be an easy slide fit with no perceptible side movement.

## Reassembling

14. Lubricate the oil pressure relief valve and fit it into its bore.
15. Insert the relief valve spring.
16. Locate the sealing washer on to the relief valve plug.
17. Fit the relief valve plug. Torque: 4,0 to 4,9 kgf.m (30 to 35 lbf.ft).
18. Refit the oil pump. 12.60.26.



OIL SUMP

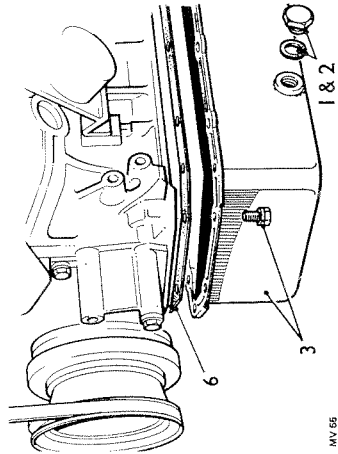
—Remove and refit 12.60.44

Removing

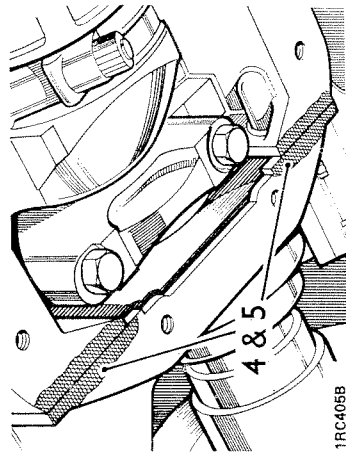
1. Remove the sump drain plug.
2. Allow all the oil to drain, then refit the plug and sealing washer.
3. Remove the sump.

Refitting

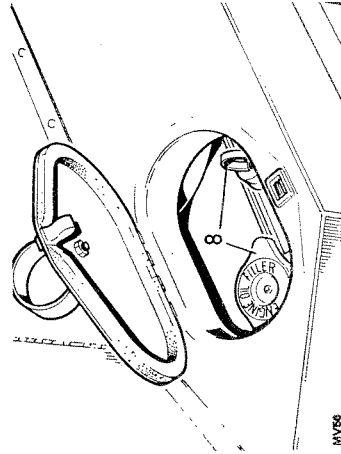
4. Clean the sump mating surfaces at the join between the timing chain cover and the cylinder block.
5. Apply a coating of 'Hylomar PL 32/M' sealing compound, Rover Part No. 534244, across the join.
6. Place the sump gasket in position.
7. Fit the sump.
8. Using the oil filler tube on the left-hand front rocker cover, replenish with oil of the correct grade to the 'High' mark on the dipstick.
9. Start the engine and check that the oil pressure warning light goes out. If the light remains on, the engine must be stopped and the oil pump dismantled and primed. 12.60.26.
10. Run the engine and check the sump joint for leaks.
11. Check the sump oil level after the engine has been stopped for a few minutes and replenish if necessary.



MV56



1RC405B



MV56

OIL COOLER

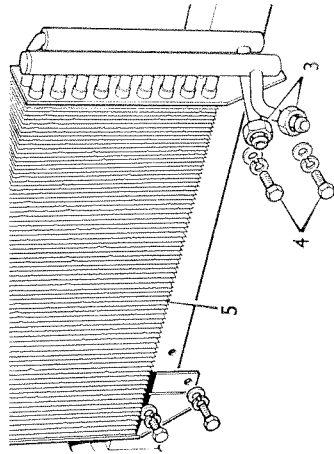
—Remove and refit 12.60.68

Removing

1. Remove the engine compartment lid.
2. Take precautions against oil spillage.
3. Disconnect the oil cooler inlet and outlet pipes. Cap the disconnected pipes and apertures.
4. Remove the fixings securing the oil cooler to the chassis cross-member.
5. Withdraw the oil cooler.

Refitting

6. Reverse 2 to 5.
7. Check the engine sump oil level and if necessary top up to the 'High' mark on the dipstick.
8. Run the engine and check the oil cooler and connections for leaks.
9. Check the sump oil level after the engine has been stopped for a few minutes and replenish if necessary.



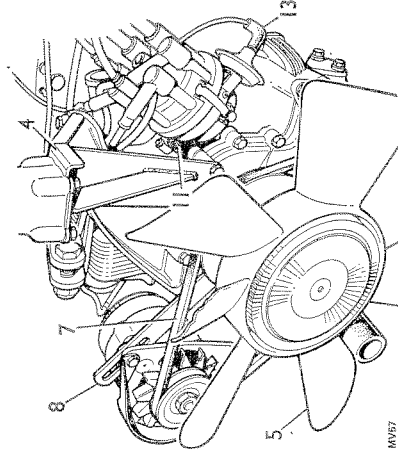
MV63

**TIMING GEAR COVER**

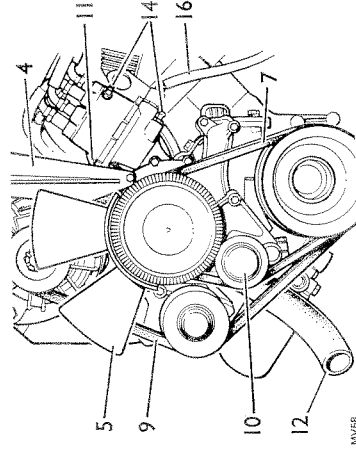
- Remove and refit 12.65.01  
 12 volt models 1 to 8, 11 to 13, 15 to 35 and 37 to 42  
 24 volt models 1 to 7, 9 to 12, 14 to 34 and 36 to 42

**Removing**

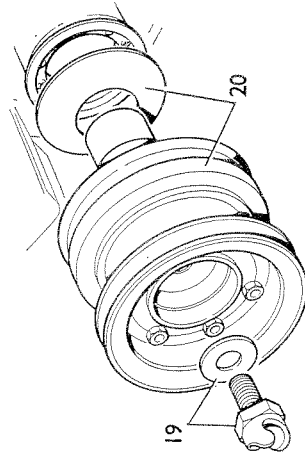
1. Disconnect the battery earth lead.
2. Remove the engine compartment lid.
3. Drain the coolant. 26.10.01.
4. Remove the four bolts securing the gear lever bracket to the engine, and move the bracket aside.
5. Remove the fan blades. 26.25.06.
6. Remove the radiator block. 26.40.04.
7. Remove the fan belt. 26.20.01.
8. Release the alternator adjusting link from the water pump.
9. Remove the alternator drive belts. 86.10.03.
10. Remove the jockey pulley and mounting bracket.
11. Disconnect the by-pass hose from the thermostat.
12. Disconnect the inlet hose from the water pump.
13. Disconnect the vacuum pipe from the distributor.
14. Disconnect the two ventilation hoses from the distributor.
15. Release the distributor cap, unclip the leads and move the cap to one side.
16. Disconnect the low tension lead from the ignition coil.
17. Disconnect the lead from the oil pressure switch.
18. Disconnect the oil cooler pipes from the oil pump. Cap the disconnected pipes and apertures.
19. Remove the starter dog.
20. Withdraw the crankshaft pulley and mud deflector.
21. Mark the distributor body relative to the centre line of the rotor arm.



MV57



MV58

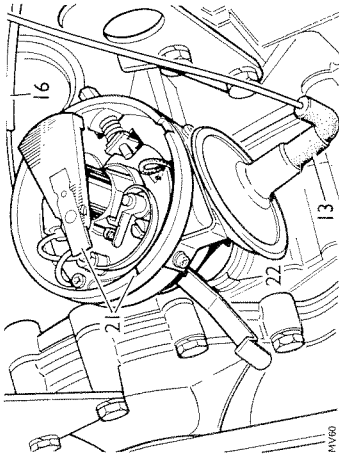


MV59

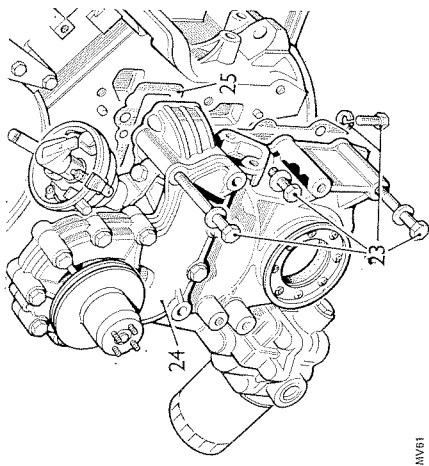
22. If the distributor is to be removed, make corresponding marks on the distributor and timing cover.
23. Remove the timing cover fixings, including two from the sump.
24. Withdraw the timing cover complete.
25. Remove the joint washer.

**Refitting**

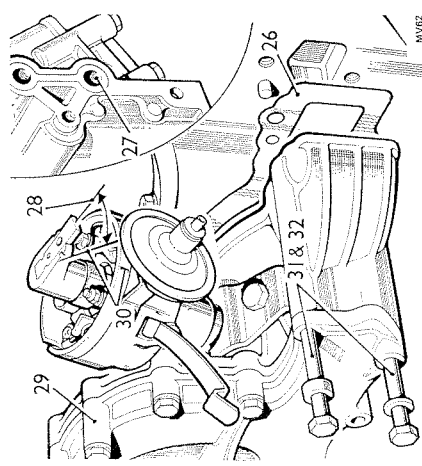
26. Place a new timing cover joint washer in position.
27. Prime the oil pump by injecting engine oil through the suction port.
28. Set the distributor rotor arm approximately 30 degrees before the final positioning mark, to compensate for the skew gear engagement.
29. Locate the timing cover in position.
30. Check that the distributor marking alignment is correct.
31. Clean the threads of the timing cover securing bolts, then coat them with Thread Lubricant-Sealant 3M EC776, Rover Part No. 605764.
32. Fit the timing cover securing bolts. Torque: 2.8 to 3.5 kgf.m (20 to 25 lbf ft).
33. Fit the crankshaft pulley together with the mud deflector.
34. Fit the starter dog. Torque: 19.3 to 22.3 kgf.m (140 to 160 lbf ft).
35. Reverse 15 to 18, 11 to 13 and 3 to 8.
36. Reverse 14 to 18, 9 to 12 and 3 to 7.
37. Reconnect the battery earth lead.
38. Start the engine and check that the oil pressure warning light goes out. If the light remains on, the engine must be stopped and the oil pump dismantled and primed. 12.60.26.
39. Check the cooling system for leaks.
40. Check, and if necessary adjust, the distributor dwell angle and ignition timing. 86.35.20.
41. Refit the engine compartment lid.
42. When the engine is cold, check the coolant level in the radiator and top up if necessary.



MV60



MV61



MV62

**TIMING CHAIN AND GEARS**

12.65.12

—Remove and refit

**Removing**

1. Set the engine—number one piston at TDC.
  2. Remove the timing chain cover. 12.65.01.
  3. Check that number one piston is still at TDC.
  4. Withdraw the oil thrower.
  5. Remove the distributor drive gear.
  6. Withdraw the spacer.
  7. Withdraw the chain complete with the chainwheels.
- CAUTION:** DO NOT rotate the engine if the rocker shafts are fitted, otherwise the valve gear and pistons will be damaged.

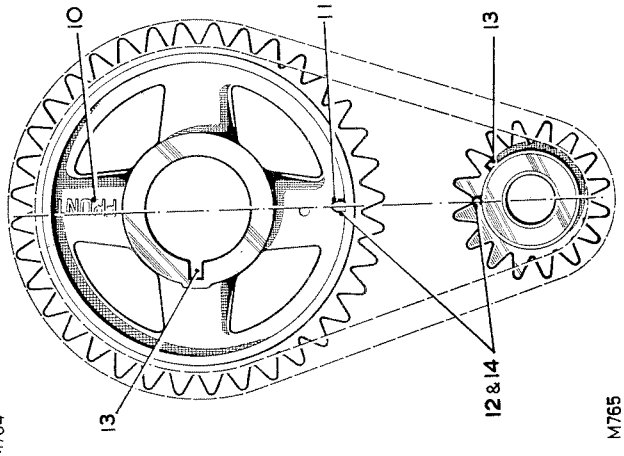
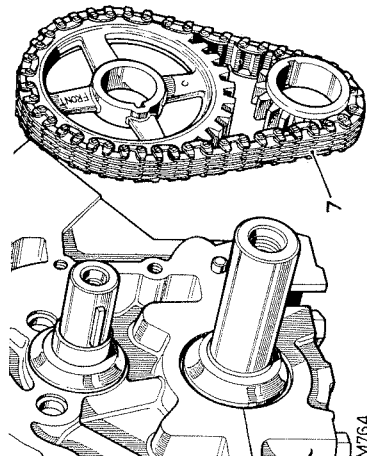
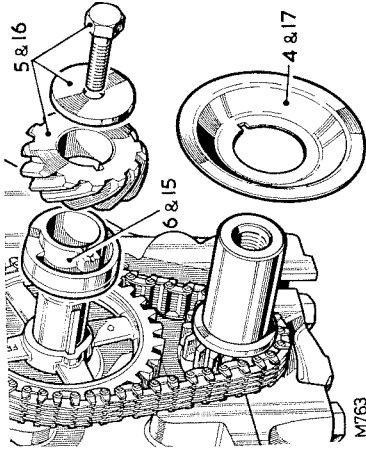
**Refitting**

**NOTE:** If the crankshaft and/or camshaft have not been rotated, commence at item 12. If they have been rotated, commence at item 8.

8. Remove the rocker shafts. 12.29.54.
  9. Set the engine—number one piston at TDC.
  10. Temporarily fit the camshaft chainwheel with the marking 'FRONT' outward.
  11. Turn the camshaft until the mark on the chainwheel is at the six o'clock position, then remove the chainwheel without disturbing the camshaft.
- NOTE:** The clearance between the top of the key and the keyway in the camshaft chainwheel is used as an oilway for lubricating the distributor drive gear. Therefore, ensure that the key is seated to the full depth of the keyway and that the top face is parallel with the shaft.
12. Locate the chainwheels to the chain with the timing marks aligned.
  13. Engage the chainwheel assembly on to the camshaft and crankshaft key locations.
  14. Check that the timing marks are in line.
  15. Fit the spacer.
  16. Fit the distributor drive gear, washer and bolt. Torque: 5.5 to 6.2 kgf.m (40 to 45 lbf ft).
  17. Fit the oil thrower, concave side outward.
  18. Fit the timing chain cover. 12.65.01.
  19. If removed, refit the rocker shafts. 12.29.54.

**DATA**

Valve timing	Inlet	Exhaust
Opens	30 degrees BTDC	68 degrees BBDC
Closes	75 degrees ABDC	37 degrees ATDC
Duration	285 degrees	285 degrees
Valve open overlap	67°	



Description of fuel system  
Fault diagnosis—fuel system

Air cleaner

—remove and refit  
—element—clean  
—element—renew

Air intake—remove and refit

Carburettors

—remove and refit  
—tune and adjust  
—overhaul and adjust

Choke control cable assembly—remove and refit

Fuel line sedimentor

—remove and refit  
—clean

Fuel main filter

—remove and refit  
—element—remove and refit

Fuel pump—remove and refit

Fuel tank—remove and refit

Hand control—engine speed—remove and refit

Petrol pipes—remove and refit

—main line—tank end section  
—main line—centre section  
—main line—engine end section  
—spill return

Throttle cable—remove and refit

Throttle linkage—remove and refit

Throttle pedal—remove and refit

19-2  
19-5

19.10.01  
19.10.07  
19.10.08

19.70.01

19.15.11  
19.15.02  
19.15.18

19.20.13

19.25.01  
19.25.04

19.25.02  
19.25.07

19.45.08

19.55.01

19.20.29

19.40.02  
19.40.03  
19.40.04  
19.40.08

19.20.06

19.20.07

19.20.01



**FUEL SYSTEM—DESCRIPTION**

The engine is fitted with twin Zenith-Stromberg CD2S carburetters fed by an AC Delco electrically operated pump located in the fuel tank. In order to maintain the operating temperature of the fuel within acceptable limits, a spill return system is used in which the fuel is constantly circulated during operation, providing adequate supply for all engine requirements and returning surplus fuel to the tank.

**Fuel tank and pump**

A 24 gallon (109 litre) capacity fuel tank is secured to outriggers on the right-hand side of the chassis. The top face of the tank is fitted with a transmitter unit for the contents gauge, an immersed type electrically operated fuel pump and connections for the spill return and breather pipes. A drain plug is fitted to the bottom of the tank. Access panels are provided in the vehicle floor for servicing the fuel pump and gauge unit.

**Filters**

The outlet pipe from the fuel pump leads to a two-stage filtering system, consisting of a sedimentor and a filter, mounted on the right-hand inner face of the engine compartment rear panel. The sedimentor is of the visual, glass bowl, type containing a gauze strainer. The filter has a cast alloy bowl containing a replaceable element. Both filters are accessible for servicing after removing the engine cover.

**Carburetters**

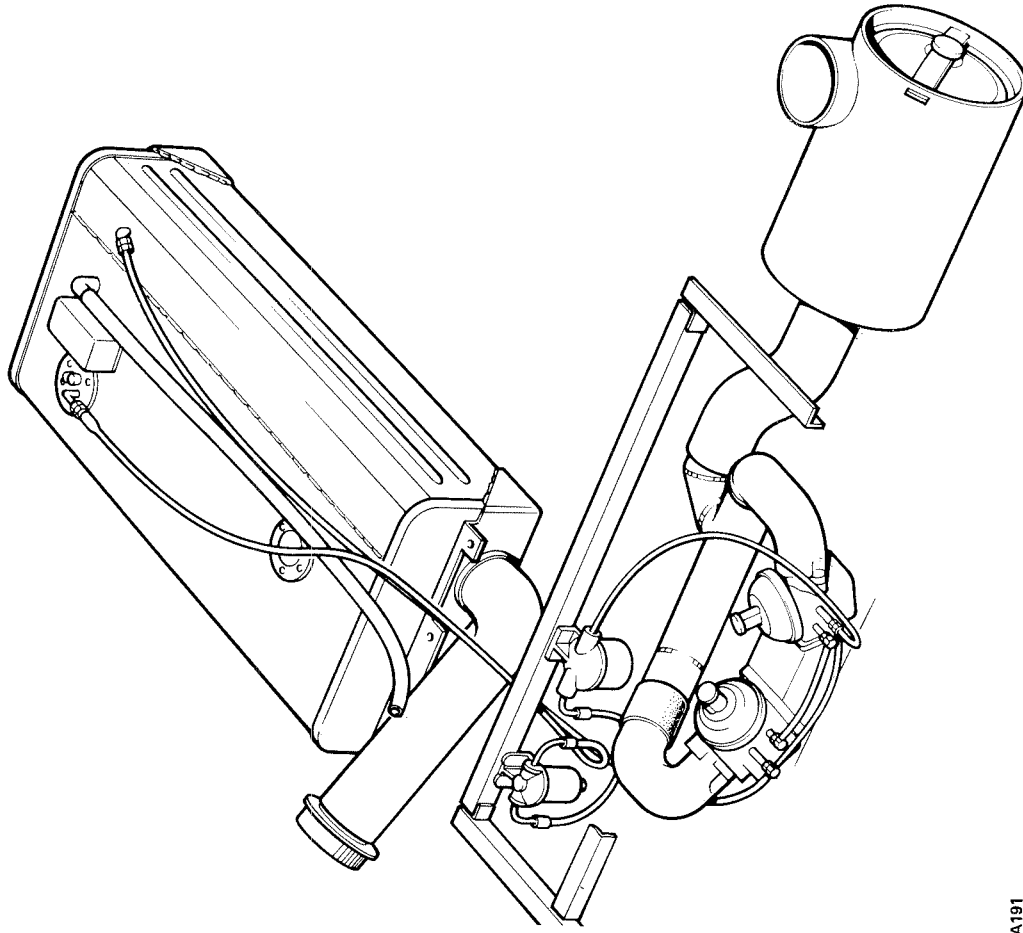
The outlet pipe from the filter leads to the left-hand carburettor float chamber, with a branch pipe supplying the right-hand carburettor.

The left-hand carburettor only, is fitted with a mixture enriching device for engine starting from cold. When operated, this device draws supplementary fuel from the float chamber and feeds it directly into the carburettor throttle body. An interconnecting pipe between the carburetters carries an enrichment supply to the right-hand carburettor.

A spill return pipe, connected to the right-hand carburettor main supply, leads back to the fuel tank, to return surplus fuel.

**Air cleaner**

An air cleaner, incorporating replaceable elements, is mounted in a separate compartment on the left-hand side of the vehicle and is connected by hoses and ducting to the carburetters. In addition to supplying combustion air, clean air is tapped off from the rear of the ducting for the crankcase ventilation system and, on 24 volt models, a second tapping is connected to the ignition distributor to ventilate the distributor.

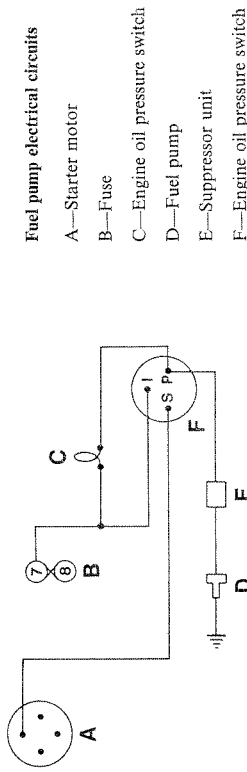


A191

General arrangement of fuel system

**Electrical circuits for fuel pump**

The electrical supply for the fuel pump is provided by one of two routes. For the purpose of engine starting only, current is taken from the starter solenoid and is fed to the fuel pump via contacts S and P on the engine oil pressure switch. Once the engine has started, the electrical supply from the starter solenoid is automatically disconnected and the fuel pump is then energised by a secondary electrical supply that is routed through contacts I and P on the engine oil pressure switch. This dual system is employed as a safety precaution to ensure that the fuel pump is only operative when engine start is selected or when the engine is running.



WV 87

An additional circuit is provided for the oil pressure warning light, so that, when the ignition is switched on, a circuit to the fuel pump is made through the oil pressure warning light and the oil pressure switch via contact P. This provides illumination of the oil pressure warning light, but due to the resistance of the bulb, insufficient current flows to permit the fuel pump to operate.

With the engine stationary, the fuel pump can only be brought into operation by turning the ignition-starter key to the start-position, this completes the circuits to the starter motor and the fuel pump, allowing engine start. Once the engine has started and the ignition-starter key returns to the ignition position, engine oil pressure will have risen and an alternative circuit to the fuel pump is completed, via the engine oil pressure switch, maintaining fuel pump operation. When the engine is stopped (regardless of ignition-starter key position) engine oil pressure falls, disconnecting the electrical supply to the fuel pump which ceases operation.

**FAULT DIAGNOSIS**

SYMPTOM	POSSIBLE CAUSE	CURE
<b>A—DIFFICULT STARTING WHEN COLD</b>	<ol style="list-style-type: none"> <li>Insufficient fuel in tank</li> <li>Insufficient choke action</li> <li>Incorrect choke setting</li> <li>Float chamber needle sticking</li> <li>Incorrect float level setting</li> <li>Float punctured</li> <li>Inoperative fuel pump</li> </ol>	<ol style="list-style-type: none"> <li>Replenish choke cable</li> <li>Check action of cold start unit to ensure that choke is being fully applied—adjust choke cable</li> <li>Check position of cold start adjuster—more outward</li> <li>Investigate and rectify</li> <li>Check and adjust as necessary</li> <li>Replace             <ol style="list-style-type: none"> <li>Disconnect lead with small Lucas connector from starter solenoid and, using extension, touch the positive terminal on battery. If pump operates, rectify faulty solenoid.</li> <li>Disconnect fuel pump lead from engine oil pressure switch and touch the lead on live positive terminal on battery. If pump operates replace oil pressure switch</li> <li>If tests a and b fail to locate fault, fit new fuel pump.</li> </ol> </li> <li>Check and rectify</li> <li>Check and rectify</li> <li>See Division 86 of this Manual</li> </ol>
<b>B—DIFFICULT STARTING WHEN HOT</b>	<ol style="list-style-type: none"> <li>Filters or fuel lines blocked</li> <li>Fuel tank breather blocked</li> <li>Ignition fault</li> <li>Choke sticking on</li> <li>Blocked air cleaner</li> <li>Float chamber needle not seating</li> <li>Incorrect float level setting</li> <li>Punctured float</li> </ol>	<ol style="list-style-type: none"> <li>Check that cold start unit returns to fully OFF position. Adjust as necessary</li> <li>Fit new elements</li> <li>Investigate and rectify</li> <li>Check and adjust as necessary</li> <li>Replace</li> </ol>

*continued*

## FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
C—ERRATIC SLOW-RUNNING OR STALLING ON DECELERATION	<ol style="list-style-type: none"> <li>No oil in carburetter damper</li> <li>Damper oil too thick</li> <li>Float chamber needle sticking</li> <li>Float level incorrect</li> <li>Carburetters require tuning</li> <li>Carburetter air leaks</li> <li>Manifold air leaks</li> </ol>	<ol style="list-style-type: none"> <li>Refill to correct level with recommended oil</li> <li>As 1 above</li> <li>Investigate and rectify</li> <li>Check and adjust as necessary</li> <li>See carburetter tuning operation</li> <li>Check throttle spindles and bearings for wear</li> <li>Rectify any of the following as necessary               <ol style="list-style-type: none"> <li>Check security and condition of vacuum pipes at manifold and operated units</li> <li>Check gaskets between carburetters and manifold</li> <li>Check manifold gasket for leaks</li> <li>Check inlet manifold for cracks and distortion</li> </ol> </li> </ol>
D—LACK OF ENGINE POWER	<ol style="list-style-type: none"> <li>No oil in carburetter damper</li> <li>Damper oil too thick</li> <li>Carburetter piston sticking</li> <li>Water in fuel</li> </ol>	<ol style="list-style-type: none"> <li>See C-1</li> <li>See C-1</li> <li>Check piston assembly moves freely and returns under spring load. If necessary, centralise jet assembly, see carburetter overhaul</li> <li>If water is present in float chamber, the complete fuel system should be drained, fuel components should be dismantled and inspected for contamination. Renew as necessary</li> </ol>

continued

## FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
E—EXCESSIVE FUEL CONSUMPTION	<ol style="list-style-type: none"> <li>Choke sticking on</li> <li>Damper oil too thick</li> <li>Blocked air cleaner</li> <li>Incorrectly adjusted carburetter</li> <li>Incorrect needle</li> <li>Float level too high</li> <li>Worn jets and needle</li> <li>Ignition fault</li> </ol>	<ol style="list-style-type: none"> <li>See B-1</li> <li>See C-1</li> <li>Fit new element</li> <li>Tune and adjust</li> <li>Check type, replace with correct needle as necessary</li> <li>Check and adjust as necessary</li> <li>Check and replace as necessary</li> <li>See Division 86 of this Manual</li> </ol>

**AIR CLEANER**

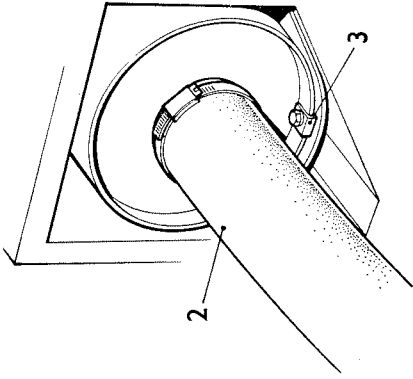
—Remove and refit 19.10.01

**Removing**

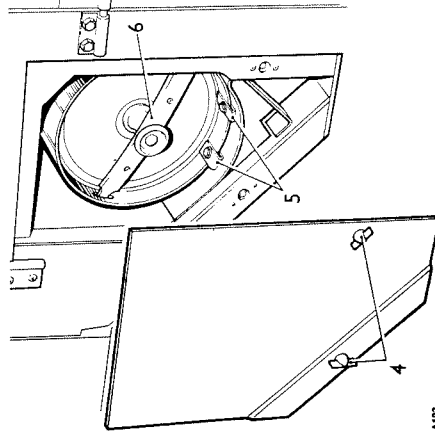
1. Remove the engine compartment lid.
2. Disconnect the hose from the air cleaner.
3. Slacken the retaining clip.
4. Remove the external panel from the air cleaner housing by slackening the two quarter turn fasteners and sliding the panel downwards.
5. Remove the retaining clips.
6. Withdraw the air cleaner.

**Refitting**

7. Reverse 1 to 6.



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A183

**AIR CLEANER**

—Clean element 1 to 6 19.10.07

—Renew element 1 to 4 and 6 19.10.08

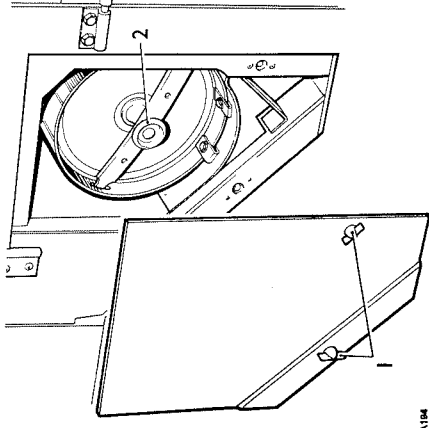
The air cleaner element can be cleaned a maximum of ten times before renewal is necessary. A new element must be fitted every 32,000 km (20,000 miles) or two years, whichever is first.

**Removing**

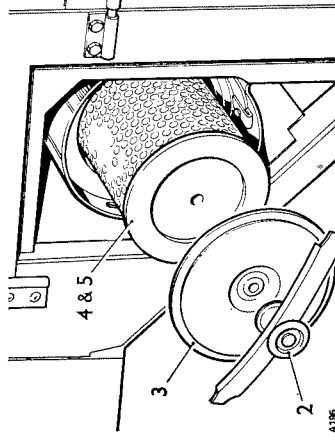
1. Remove the external panel from the air cleaner housing by slackening the two quarter turn fasteners and sliding the panel downwards.
2. Unscrew the stud and withdraw it together with the retaining clamp.
3. Withdraw the element end plate.
4. Withdraw the element.
5. Clean the element by washing thoroughly in warm soapy water, rinse in clean water and allow to dry.

**Refitting**

6. Reverse 1 to 4.



A184



A186

## CARBURETTERS

## —Tune and adjust

19.15.02

## Carburettor balancing device

A suitable carburettor balancer, similar to the one illustrated in this Operation, must be used when adjusting the carburettors. The balancer illustrated is a Crypton 'Synchro-check', manufactured by T.J. Transport Equipment Services Ltd., Bristol Road, Bridgewater, Somerset, England. NATO, use carburettor balancer Part No. LV6 MT2.4910.99.823.796.

## General requirements when setting carburettors

**Temperature:** Whenever possible the ambient air temperature of the setting environment should be between 15° to 26°C (60° to 80°F).

**Vehicle conditions.** Idling adjustments should be carried out on a fully warmed up engine, that is, at least 5 minutes after the thermostat has opened. This should be followed by a run of one minute duration at an engine speed of approximately 2,500 rev/min in neutral, after which three minutes may be taken in which to check and carry out adjustments; a further one minute run at 2,500 rev/min must be made before further checks or adjustments are carried out. This cycle may be repeated as often as required. It is important that the above cycle is adhered to, otherwise, overheating may result and settings may be incorrect.

Before any attempt is made to check settings a thorough check should be carried out to see that the throttle linkage between the pedal and carburettors is free and has no tendency to stick. Ensure that the choke control knob is pushed fully in. Any faults must be corrected before proceeding with the checks or settings.

## Procedure

1. Run the engine until it attains normal operating temperature. See preceding note concerning general requirements when setting carburettors.
2. Switch off the engine, remove the engine compartment lid and the hose connectors from the carburettor elbows by slackening the clips and pulling the hoses clear.

*continued*

3. Slacken the screws securing the throttle adjusting levers on both carburettors.
4. Start the engine and check the idling speed, using an accurate tachometer. If necessary, adjust the throttle stop screws to give an idle speed of 600 rev/min.
5. Using a suitable carburettor balancing device, (NATO Part No. LV6 MT2.4910.99.823.7976.) balance the carburettors as follows:
  6. Hold the carburettor balancing device on one of the carburettor elbows ensuring that there are no air leaks. Note the balancer gauge reading, then repeat the check on the other carburettor.
  7. An identical reading must be obtained for both carburettors at the correct engine idle speed of 600 rpm.

**NOTE:** The actual gauge reading is not important, only that it is the same on both carburettors.

8. If the gauge readings are identical and the engine idle speed is correct, no adjustment is required. Alternatively, if the carburettor balance or engine idle speeds are not correct, adjust the carburettors as follows. (Item 9).

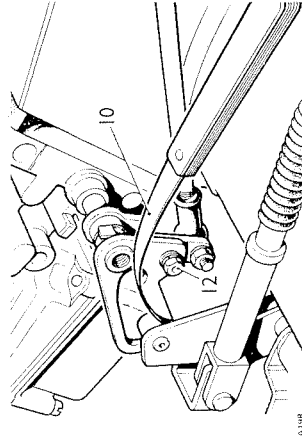
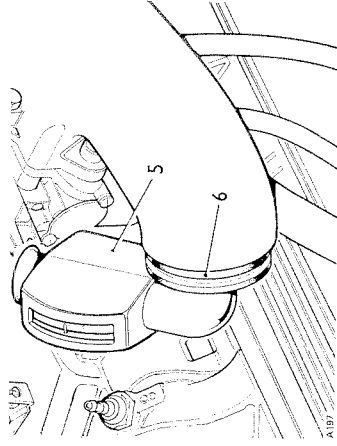
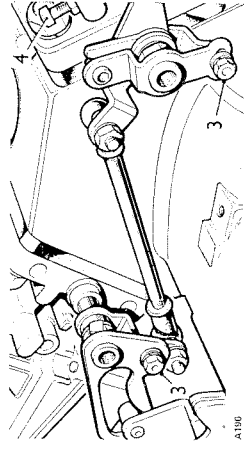
9. Balance both carburettors by screwing the idle adjustment screws in or out as required until an identical gauge reading is obtained on both carburettors. Should the idle speed rise too high or drop too low during balancing, adjust to the correct idle speed of 600 rpm, maintaining identical gauge readings.

10. On the left-hand carburettor place a 0,15 mm (0,006 in) feeler between the underside of the roller on the countershaft lever, and the throttle lever.

11. Apply light pressure to the throttle lever to hold the feeler.

12. Then tighten the throttle adjusting lever screw and withdraw feeler.

*continued*



13. On the right-hand carburetter place a 0,15 mm (0,006 in) feeler between the left leg of the fork on the adjusting lever and the pin on the throttle lever. Apply light pressure to the linkage to hold feeler.
14. Tighten the screw to secure the throttle adjusting lever, then withdraw the feeler.
15. Reconnect the hoses between the air inlet duct and the carburetter elbows.

**Mixture adjustment**

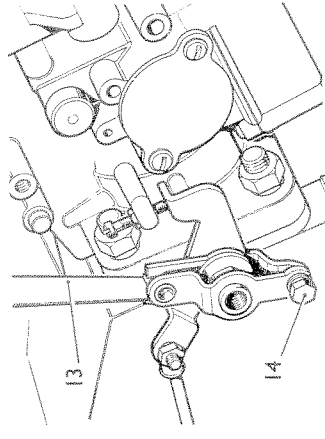
The carburetter mixture should not normally require adjustment and should not be unnecessarily disturbed. If the carburation is unsatisfactory, the mixture can be checked and adjusted as follows:

16. Carry out items 1 to 15 if not already done.
17. Remove the oil cap and damper from the carburetter suction chamber.
18. Hold the air valve down on to the bridge in the throttle bore.
19. Screw up the jet adjustment screw until the jet is felt to come into contact with the underside of the air valve. From this position, turn down the jet adjusting screw three turns. This establishes a datum position from which to commence.
20. Refit the oil caps and dampers.
21. Run the engine until it attains normal operating temperature.
22. Check the mixture with the engine idling. The engine beat should be smooth and regular, and by careful and gradual adjustment of the jet adjusting screw, the correct position will be determined.

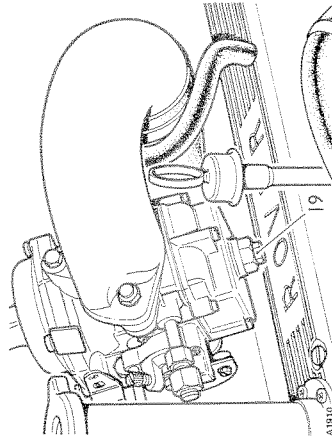
**Cold start unit—left-hand carburetter only**

23. For use in ambient temperatures down to  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) the pin should be pushed in and located as illustrated to reduce movement of the starter valve; this avoids over-richness on cold start. Below  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) the pin should be turned so that it is in the slot in the retaining lug.

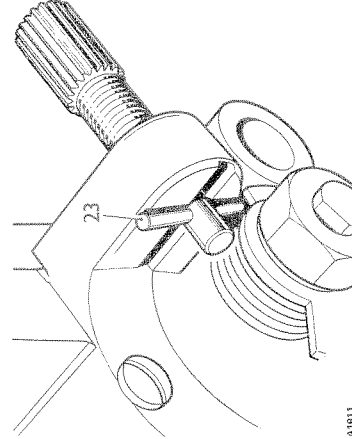
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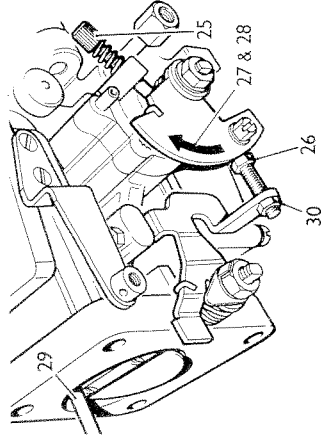
A188



A1810



A1811



A1827

**Fast idle adjustment**

The fast idle adjustment is pre-set on the left-hand carburetter to give an engine speed of 1,150 to 1,250 rev/min. If adjustment is necessary, proceed as follows:

24. Remove the left-hand carburetter. 19.15.11.
25. Set the cold start adjuster fully outward.
26. Slacken the fast idle adjusting screw.
27. Hold the cold start cam lever in the maximum position.
28. Adjust the fast idle adjusting screw against the cam lever until there is 0,61 to 0,66 mm (0,024 to 0,026 in) gap between the top edge of the throttle butterfly and the carburetter bore wall.
29. Use feeler gauges or a 0,65 mm diameter (No. 72) drill to measure the gap at the top edge of the throttle butterfly.
30. Secure the locknut on the fast idle adjusting screw without disturbing the adjustment.
31. Refit the left-hand carburetter. 19.15.11.
32. Repeat items 1 to 15.

**DATA**

Engine idle speed  
Engine fast idle speed

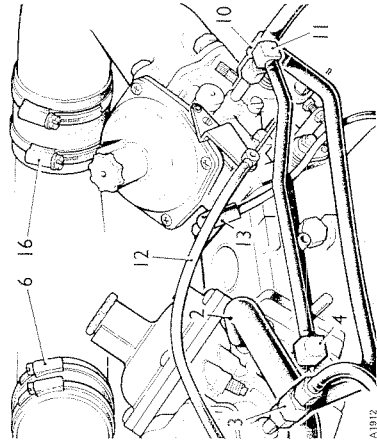
600 rev/min  
1,150 to 1,250 rev/min

**CARBURETTERS**

—Remove and refit 19.15.11

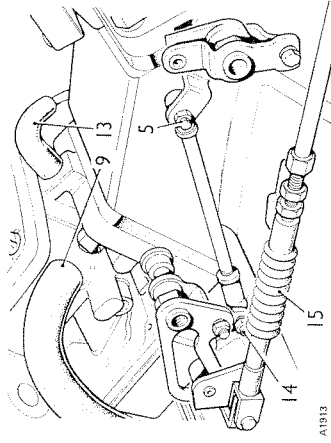
**Removing**

1. Remove the engine compartment lid.
- Right-hand carburettor**
2. Disconnect the crankcase emission hose.
  3. Disconnect the main fuel supply pipe.
  4. Disconnect the choke fuel supply pipe.
  5. Disconnect the throttle linkage.
  6. Release the clips securing the flexible connector for the carburettor elbow.
  7. Remove the carburettor.
  8. If required, withdraw the joint washers, insulator and liner.



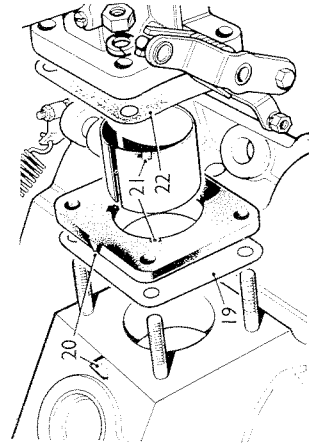
**Left-hand carburettor**

9. Disconnect the crankcase emission hose.
10. Disconnect the main fuel supply pipe.
11. Disconnect the choke fuel supply pipe.
12. Disconnect the choke cable.
13. 12 volt models only—disconnect the distributor vacuum pipe.
14. Disconnect the throttle linkage.
15. Disconnect the throttle cable.
16. Release the clips securing the flexible connector for the carburettor elbow.
17. Remove the carburettor.
18. If required, withdraw the joint washers, insulator and liner.



**Refitting**

19. Locate a joint washer on the induction manifold.
20. Fit the insulator, **aligning the arrows**.
21. Fit the liner fully into the insulator, engaging the three tabs into the recesses.
22. Locate a joint washer on the insulator.
23. Reverse 9 to 17 and 1 to 7, as applicable.



**CARBURETTERS**

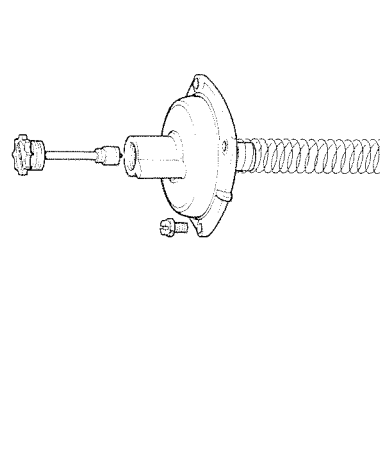
—Overhaul and adjust 19.15.18

**Dismantling**

1. Remove the carburetters. 19.15.11.

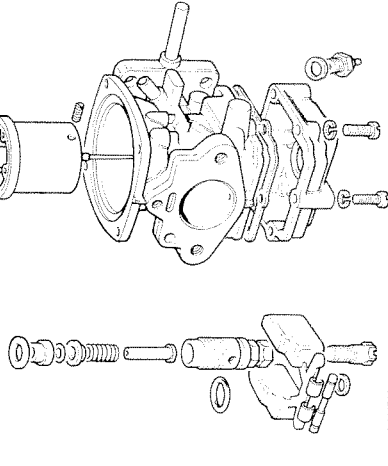
**Removing the piston assembly**

2. Remove the oil cap and damper.
3. Remove the top cover and spring.
4. Withdraw the air valve, shaft and diaphragm assembly.
5. Remove the metering needle, retained by a locking screw.
6. Remove the diaphragm from the air valve.



**Removing the float chamber**

7. Remove and dismantle the jet assembly.
8. Remove the float chamber and gasket.
9. Unclip the float and arm complete with the spindle.
10. Remove the needle valve and washer from the carburettor body.



**Dismantling the carburettor body**

11. Add location marks to the throttle butterfly and spindle.
12. Remove the throttle butterfly.
13. Left-hand carburettor. Remove the throttle levers.
14. Withdraw the throttle spindle.
15. If required, remove the throttle stop and fast idle lever.
16. Remove the cold start assembly.
17. Dismantle the cold start assembly, but **DO NOT** remove the discs from the spindle.

11C1071A

**Cleaning and inspection**

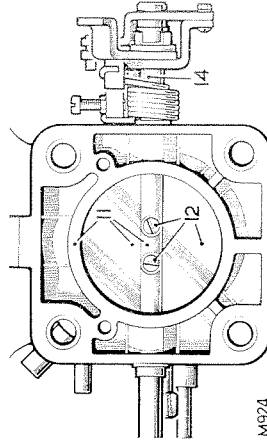
**Carburettor cleaning**

18. When cleaning fuel passages do not use metal tools (files, scrapers, drills, etc.) which could cause dimensional changes in the drillings or jets. Cleaning should be effected using clean fuel and where necessary a moisture-free air blast.

**Joint faces**

19. Examine the faces for deep scores which would lead to leakage taking place when assembled.

*continued*



M924

**Joint gasket and seals**

20. New gaskets and seals should be used throughout carburetter rebuild.
21. Inspect metering needle, it is machined to very close limits and should be handled with care. Examine for wear, bend and twist, renew if necessary.

**Diaphragm**

22. In common with other products made from rubber compounds, any contact of the diaphragm with volatile cleaners should be avoided, use only CLEAN RAG. Examine for damage and deterioration.
23. Examine float for puncture or damage and chamber for corrosion, retaining clips for wear.
24. Examine cold start bushes for wear, renew starter cover as necessary.
25. Examine clamping screw for two positions, renew as necessary.
26. Examine the retaining screws for the throttle butterfly, renew as necessary.

**Assembling**

**Assembling the cold start, LH carburetter**

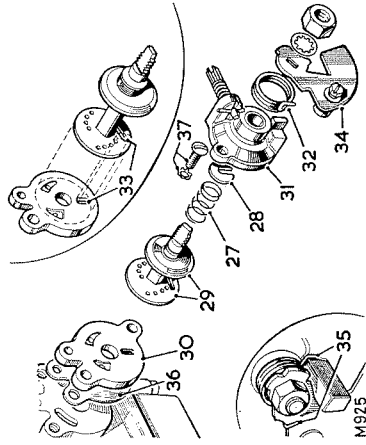
27. Place the spring on the cold start spindle.
28. Fit the spring retaining clip.
29. Check that the discs slide easily on the spindle.
30. Place the cold start spindle on the starter face.
31. Place the starter cover in position.
32. Fit the return spring over the spindle.
33. Rotate the spindle until the oval port in the end disc is aligned with the oval port in the starter face.
34. Fit the cold start lever.
35. Engage the return spring over the lug on the starter cover and the back of the cold start lever.
36. Place the cold start gasket on to the carburetter body.
37. Fit the cold start assembly to the carburetter body, then check for ease of operation.

**Assemble the throttle spindles**

**Left-hand carburetter 38 and 39**

38. Place the return spring over either end of the spindle.
39. Fit the throttle stop and fast idle lever.

*continued*



**Right-hand carburetter 40 to 44**

40. Place the return spring over the recessed end of the spindle.
41. Fit the throttle stop and fast idle lever.
42. Fit the throttle lever.
43. Secure the assembly with a bushed washer, tab washer and nut. Engage the tab washer.
44. Fit the throttle adjusting lever.
45. Insert the throttle spindle from the cold start side of the carburetter body (blank plate side on RH carburetter) fitting the throttle return spring on the fast idle adjustment holder, tension the spring half a turn.
46. Fit the throttle butterfly, maintaining the previously marked alignment. Leave the retaining screws loose.
47. Actuate the throttle several times to centralise the butterfly, then tighten the retaining screws and lock by peening ends.
48. Fit the throttle stop adjusting screw until it touches the stop, then turn a further one and a half turns and secure the locknut.

**Left-hand carburetters**

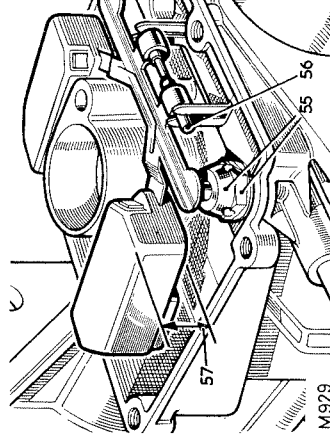
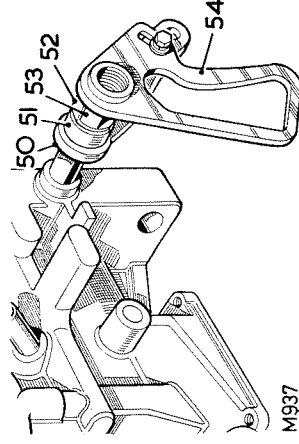
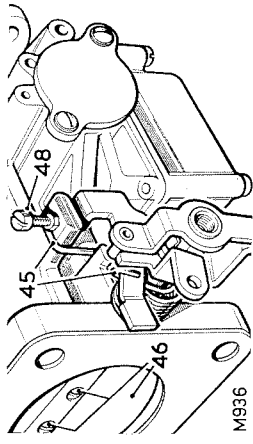
49. Fit the fast idle adjustment screw and adjust to give slight clearance from the cold start lever, then secure the locknut.
50. Fit the throttle lever to the spindle.
51. Place the spacer on the spindle.
52. Place the tab washer on the spindle.
53. Fit the sleeve nut, sleeve end last, and engage the tab washer.
54. Fit the throttle adjusting lever.

**Assembling the float chamber**

55. Fit the needle valve and washer.
56. Locate the spindle into the float arm and engage the assembly in the retaining clips.
57. With the needle valve on its seating and the tab on the float carrier contacting the needle valve, measure the distance between the carburetter flange face and the highest point on the floats.
58. The dimension required for correct float level is 16 to 17 mm (0.630 to 0.670 in). Adjust by bending the tab on the float carrier or fitting an additional washer under the needle seating.

**NOTE: The float carrier tab must be maintained at right angles to the needle in the closed position.**

*continued*

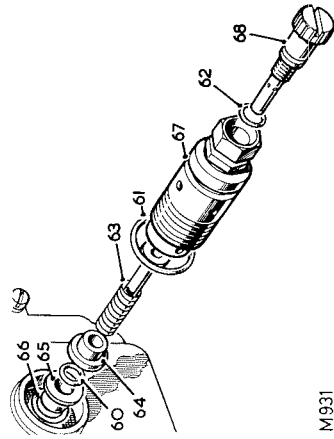




59. Fit the float chamber and gasket but do not fully tighten the screws at this stage.

**Assembling the jet assembly**

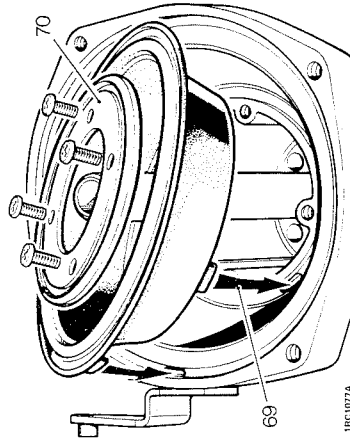
60. Fit the 'O' ring into the guide bush.
61. Fit the 'O' ring over the jet orifice carrier.
62. Fit the 'O' ring over the adjusting screw.
63. Place the spring over the jet orifice.
64. Fit the guide bush (thin flanged) on to the jet orifice.
65. Fit the top bush to the jet orifice.
66. Place a plain washer on to the top bush.
67. Place the jet orifice assembly into the carrier. Insert the assembly through the float chamber and fully tighten, then tighten the float chamber screws.
68. Fit the adjusting screw and adjust the jet orifice until it is in line with the top of the bushing.



M931

**Assembling air valve, shaft and diaphragm**

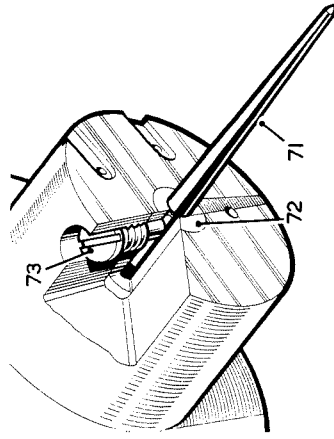
69. Locate the diaphragm on to the air valve with the tab engaged in the recess.
70. Fit the diaphragm retaining ring.
71. Locate the metering needle into the air valve.
72. Align the needle shoulder with the top surface of the air valve shaft.
73. Secure the needle in position.



1RC1077A

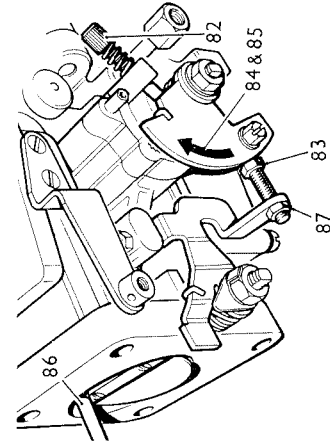
**Jet centralisation**

74. Locate the air valve and needle assembly into the carburettor and allow the air valve to bottom on the jet bridge. **DO NOT** push the valve down. If the valve does not bottom, unclamp the jet assembly sufficient to allow the valve to bottom. In this position, ensure that the locating tab on the diaphragm locates in the recess on the carburettor body.
75. Fit the air valve return spring and carburettor top cover.
76. Lift the air valve and tighten the jet assembly fully.
77. Slacken off the whole jet assembly approximately half a turn to release the orifice bush.
78. Allow the air valve to fall, if necessary assist by inserting a pencil in the dash pot. The needle will automatically centralise the jet orifice.
79. Slowly tighten the jet assembly, checking frequently that the needle remains free in the orifice. Check by raising the air valve approximately 6mm (¼ in) and allowing it to fall freely. The air valve should stop firmly on the bridge.
80. Fill the dashpot in the air valve to within 6mm (¼ in) of the top of the air valve shaft with OMD 75 (SAE 20) engine oil.
81. Fit the damper assembly.



M928

*continued*



A1937A

- Fast idle adjustment—Left-hand carburettor only**
82. Set the cold start adjuster fully outward.
  83. Slacken the fast idle adjusting screw.
  84. Hold the cold start cam lever in the maximum position.
  85. Adjust the fast idle adjusting screw against the cam lever until there is 0,61 to 0,66 mm (.0024 in to .0026 in) gap between the top edge of the throttle butterfly and the carburettor barrel wall.
  86. Use feeler gauges or a 0,65 mm diameter (No. 72) drill to measure the gap at the top edge of the throttle butterfly.
  87. Secure the locknut on the fast idle adjusting screw without disturbing the adjustment.
  88. Refit the carburettors. 19.15.11.
  89. Tune and adjust the carburettors. 19.15.02.

**DATA**

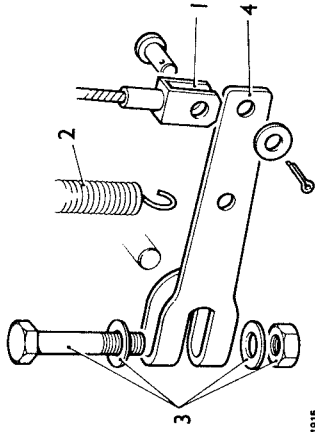
Carburettor make	Zenith-Stromberg
Type	175 CD2S
Metering needle	2AY
Air valve return spring	Red
Jet orifice	0.100 in diameter
Needle valve	1,75 mm diameter
Float height	16 mm to 17 mm (0.630 in to 0.670 in)

**THROTTLE PEDAL**

—Remove and Refit 19.20.01

**Removing**

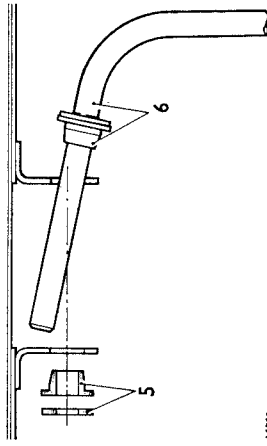
1. Disconnect the throttle cable from the throttle pedal lever.
2. Disconnect the return spring.
3. Remove the nut, plain washer and bolt from the throttle pedal lever.
4. Withdraw the throttle pedal lever.
5. Withdraw the plain washer and pivot bearing from the left-hand side of the pedal bracket.
6. Withdraw the throttle pedal together with the right-hand pivot bearing.



A1915

**Refitting**

7. Assemble the right-hand pivot bearing to the throttle pedal shaft.
8. Insert the throttle pedal into its housing, engaging the flats on the pivot bearing into the square locating hole.
9. Reverse 1 to 5, noting that the pedal lever securing bolt must engage the slot in the pedal shaft.



A1916

**THROTTLE CABLE**

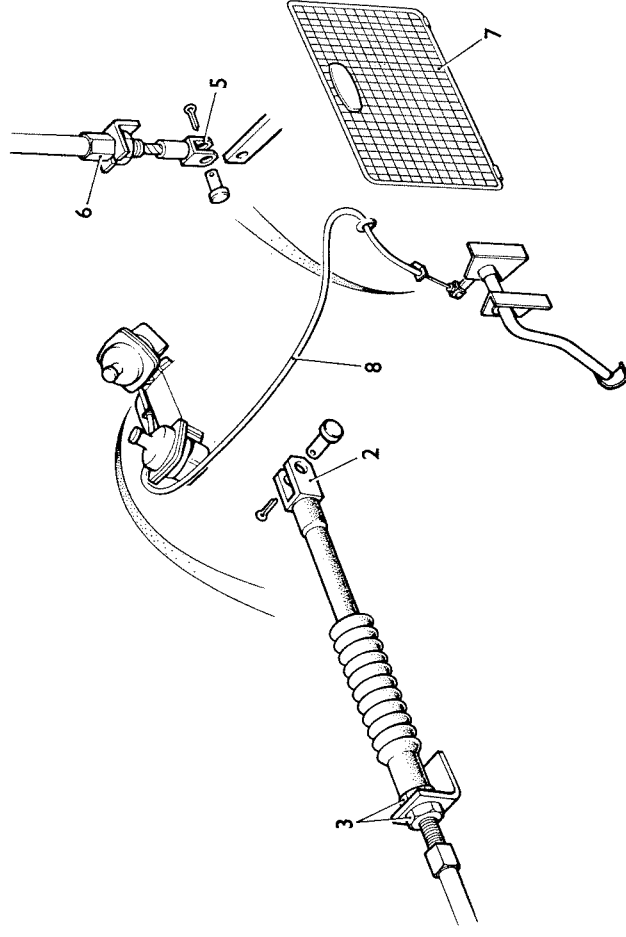
—Remove and refit 19.20.06

**Removing**

1. Remove the engine compartment lid.
2. Disconnect the throttle cable from the carburetter.
3. Unscrew the locknuts and withdraw the cable from the adjuster brackets.
4. Release the throttle cable from the clips in the engine compartment.
5. Disconnect the throttle cable from the throttle pedal lever.
6. Unscrew the locknut and withdraw the cable from the stop bracket on the side of the pedal housing.
7. Remove the radiator grille.
8. Withdraw the throttle cable from the front of the radiator housing.

**Refitting**

9. Reverse 2 to 8.
10. Adjust the throttle cable as necessary, using the cable adjuster at the carburetter end.
11. Refit the engine compartment lid.



A1917

THROTTLE LINKAGE

—Remove and refit 19.20.07

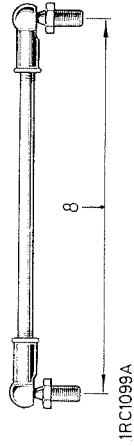
Removing

1. Remove the engine compartment lid, then, disconnect the throttle cable.
2. Remove the throttle adjusting lever.
3. Disconnect the throttle return spring.
4. Remove the return spring lever.
5. Remove the circlip and plain washer from the countershaft.
6. Withdraw the countershaft assembly.
7. Remove the throttle link from between the carburetters.

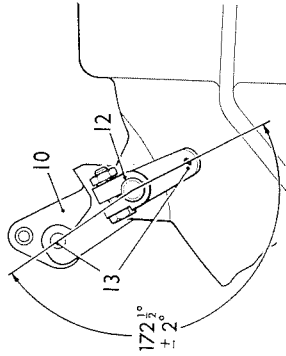
**NOTE:** For details of carburetter linkage 19.15.18 refers.

Refitting

8. If the throttle link ball joints have been disturbed, they should be set at  $122,55 \text{ mm} \pm 0,18 \text{ mm}$  (4,825 in  $\pm .007$  in) centres.
9. Fit the throttle link.
10. Fit the countershaft assembly.
11. Secure the countershaft with a plain washer and circlip.
12. Fit the lever for the throttle return spring to abut the circlip.
13. Position the lever and countershaft assembly so that the holes for the throttle cable and return spring connections are at  $172\frac{1}{2}^{\circ} \pm 2^{\circ}$ .
14. Reverse 1 to 3.
15. Adjust the carburetter linkage. 19.15.02.



1RC1099A



A1918

CHOKE CONTROL CABLE ASSEMBLY

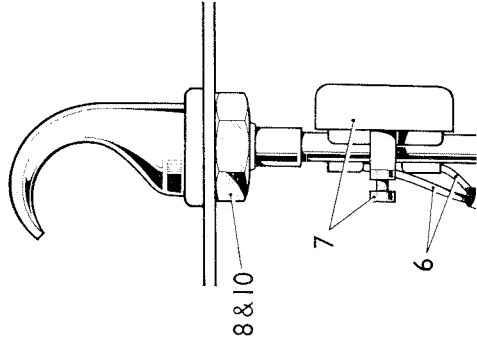
—Remove and refit 19.20.13

Removing

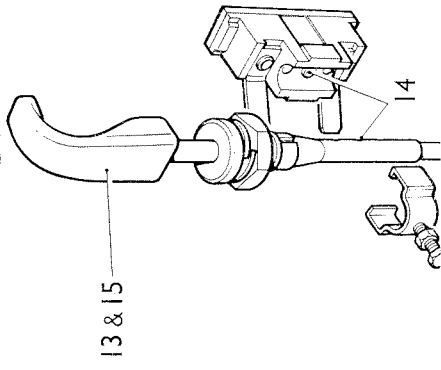
1. Disconnect the battery earth lead.
2. Remove the engine compartment lid.
3. Disconnect the choke cable from the carburetter.
4. Release the cable from the clips in the engine compartment.
5. Remove the radiator grille.
6. Disconnect the electrical leads from the choke warning light switch.
7. Release the clamping bolt and withdraw the switch.
8. Release the nut securing the cable.
9. Pass the cable into the driving compartment.
10. Retrieve the cable securing nut and washer.
11. Withdraw the cable assembly from the driving compartment.

Refitting

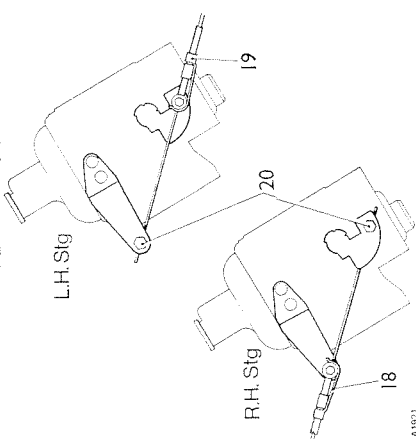
12. Reverse 8 to 11.
13. Pull the choke control out a short distance.
14. Fit the choke warning light switch with its operating plunger located in the centre hole in the choke cable outer sleeve.
15. Push in the choke control.
16. Reverse 4 to 6.
17. Connect the choke cable to the carburetter as follows.
18. RH Stg. Insert the inner cable through the hole in the swivel and the hole in the clip. Then position the clip as illustrated, ensuring that it is securely pressed over the cable outer cover.
19. LH Stg. Insert the inner cable through the hole in the swivel and the hole in the clip. Then position the clip as illustrated, ensuring that it is securely pressed over the cable outer cover.
20. Secure the end of the inner cable ensuring that the choke mechanism has not commenced operation.
21. Reverse 1 and 2.



A1919



A1920



A1921

**HAND CONTROL—Engine speed**

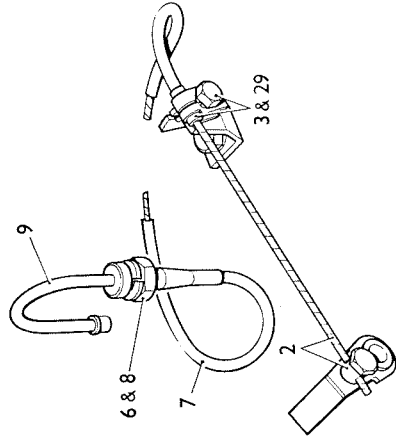
19.20.29

—Remove and refit

**Removing**

**Hand lever and cable**

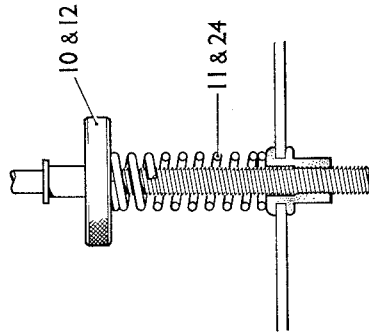
1. Remove the engine compartment lid.
2. Disconnect the hand control cable from the carburettor throttle linkage.
3. Remove the nut and bolt and release the cable from the clip at the anchor bracket.
4. Release the cable from the clips in the engine compartment.
5. Remove the radiator grille.
6. Release the nut securing the hand control cable.
7. Pass the cable into the driver's compartment.
8. Retrieve the cable securing nut and washer.
9. Withdraw the cable assembly from the driver's compartment.



A1922

**Hand control adjuster**

10. Use assistance to hold the adjuster wheel stationary while completing the following item.
11. From inside the radiator duct, remove the locknut washer and spring.
12. From the driver's compartment, unscrew the adjuster wheel.



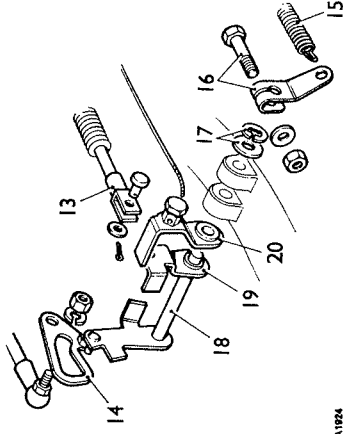
A1923

*continued*

**Throttle linkage**

13. Disconnect the throttle cable.
14. Remove the throttle adjusting lever.
15. Disconnect the throttle return spring.
16. Remove the return spring lever.
17. Remove the circlip and plain washer from the countershaft.
18. Withdraw the countershaft assembly.
19. Withdraw the hand throttle lever.
20. Withdraw the foot pedal throttle lever.

*continued*



A1924

## Refitting

## Throttle linkage

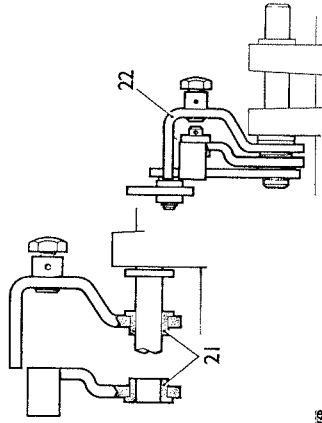
21. If new bushes are required in either of the throttle levers, press out the old bush, press the new bush into position with the flanged side as illustrated. Check the inside diameter of the fitted bush and if necessary, reamer 7,962 to 7,988 mm (0.3135 to 0.3145 in).
22. Reverse 17 to 20.
23. Fit the lever for the throttle return spring to abut the circlip.
24. Position the lever and countershaft assembly so that the holes for the foot operated throttle cable and return spring connection are at  $172^{\circ} \pm 2^{\circ}$ .
25. Reverse 13 to 15.

## Hand control adjuster

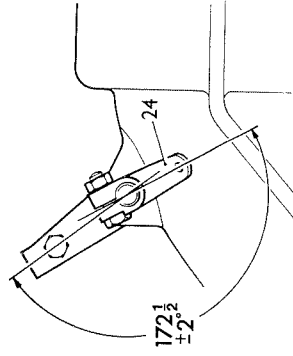
26. Reverse 10 to 12, ensuring that the threaded shaft of the adjuster wheel just protrudes through the locknut.

## Hand lever and cable

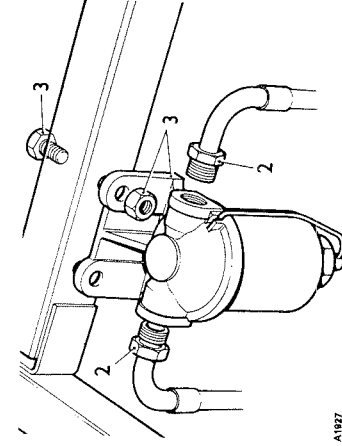
27. Ensure that the hand control adjuster in the driver's compartment is turned fully down.
28. Reverse 2 to 9.
29. Adjust the hand control cable as necessary, using the cable adjuster at the carburettor end.
30. Refit the engine compartment lid.



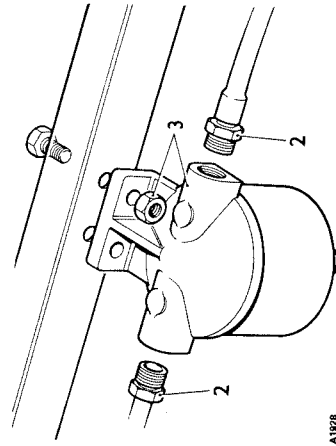
A1926



A1926



A1927



A1928

## FUEL LINE SEDIMENTOR

19.25.01

## Removing

1. Remove the engine compartment lid.
2. Disconnect the fuel pipes.
3. Remove the sedimentor complete.

## Refitting

4. Reverse 1 to 3.

## FUEL MAIN FILTER

19.25.02

## Removing

1. Remove the engine compartment lid.
2. Disconnect the fuel pipes.
3. Remove the filter complete.

## Refitting

4. Reverse 1 to 3.

FUEL LINE SEDIMENTOR

19.25.04

—Clean

Procedure

1. Remove the engine compartment lid.
2. Remove the bowl by slackening the thumb screw and swinging the retainer aside.
3. Remove and clean the filter gauze in petrol.
4. Ensure that the sealing washer is in good condition.
5. Refit the filter gauze and bowl.

FUEL MAIN FILTER ELEMENT

19.25.07

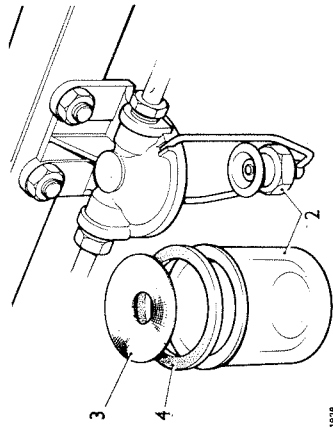
—Remove and refit

Removing

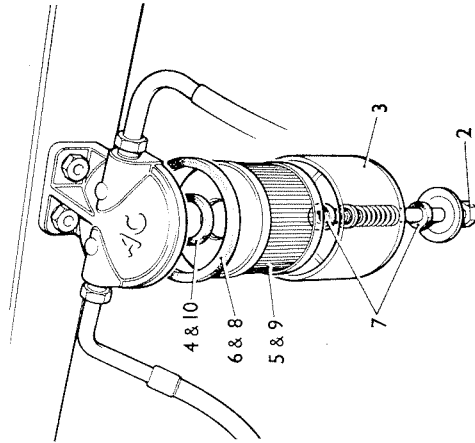
1. Remove the engine compartment lid.
2. Unscrew the centre bolt.
3. Withdraw the filter bowl.
4. Remove the small sealing ring.
5. Remove the element.
6. Withdraw the large sealing ring from the underside of the filter body.

Refitting

7. Fit new centre sealing rings as necessary.
8. Fit new top sealing ring.
9. Fit new element small hole downward.
10. Fit new small sealing ring.
11. Reverse 1 to 3.



A1920



A1920

PETROL PIPES

—Remove and refit

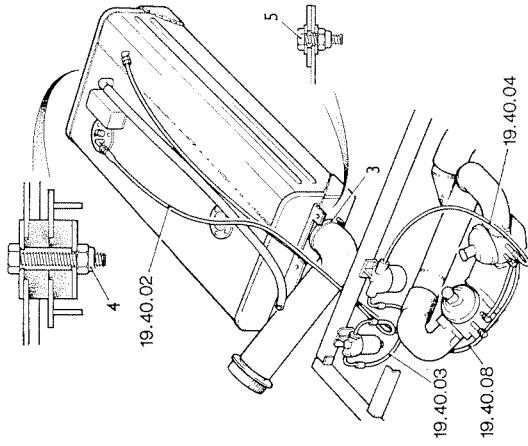
- Main line—tank end section, 1 to 11 19.40.02
- Main line—centre section, 7 to 10 and 12 19.40.03
- Main line—engine end section, 7 to 10 and 12 19.40.04
- Spill return, 1 to 11 19.40.08

Removing

1. Disconnect the battery earth lead.
2. Drain the fuel tank.
3. From underneath the vehicle, slacken the clip securing the fuel filler hose to the tank, and disconnect the hose from the tank.
4. Remove the fixing at the rear of the tank.
5. Support the tank and remove the front fixings then lower the tank to give access to the fuel pipes.
6. Disconnect the fuel pipe.
7. Remove the engine compartment lid.
8. Disconnect the fuel pipe unions.
9. Release the pipe from the retaining clips.
10. Withdraw the fuel pipe.

Refitting

11. Reverse 1 to 10.
12. Reverse 7 to 10.



A1921

## FUEL PUMP

—Remove and refit 19.45.08

## Removing

1. Disconnect the battery earth lead.
2. Remove the fuel pump access panel from the rear compartment floor.
3. Disconnect the electrical leads from the fuel pump.
4. Disconnect the outlet pipe.
5. Remove the fixings from the pump flange.
6. Withdraw the fuel pump and sealing washer.

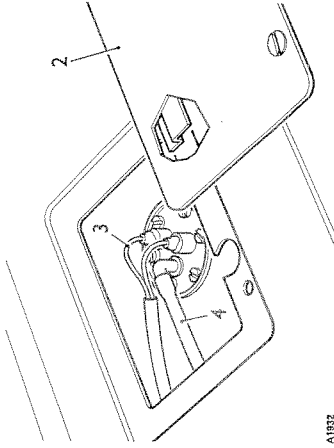
## Refitting

**NOTE:** Use care not to damage the pump filter within its mounting sleeve, otherwise fuel starvation could result.

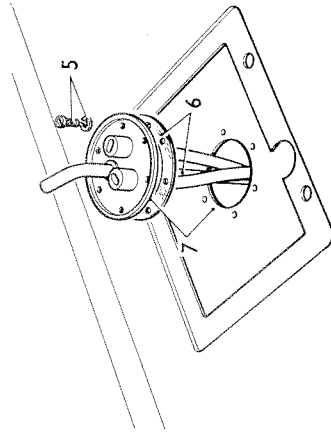
7. Ensure that the mating faces of the pump and fuel tank are clean, then, using a new sealing washer, secure the pump in position.
8. Using 'Bostik 772' sealant, apply a brushed coating completely over and around the fuel pump, as illustrated by the shaded area.
9. Reconnect the outlet pipe.
10. Reconnect the electrical leads and fill the terminal protection shrouds with a water repellent grease, such as XG315 (Silicone M.S.4).
11. Reconnect the battery earth lead.
12. Carry out a functional check of the fuel pump by starting the engine.

**NOTE:** The electrical supply to the fuel pump is taken from the starter motor solenoid and the engine oil pressure switch, therefore, the pump will only operate when the engine is being cranked by the starter motor or is running with sufficient oil pressure.

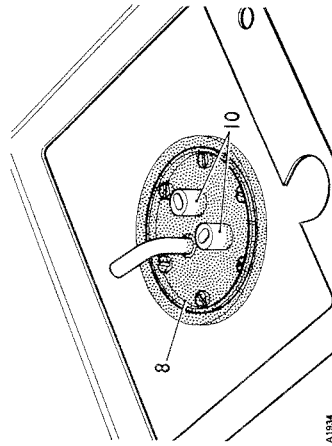
13. Refit the fuel pump access panel.



A1832



A1833



A1834

## FUEL TANK

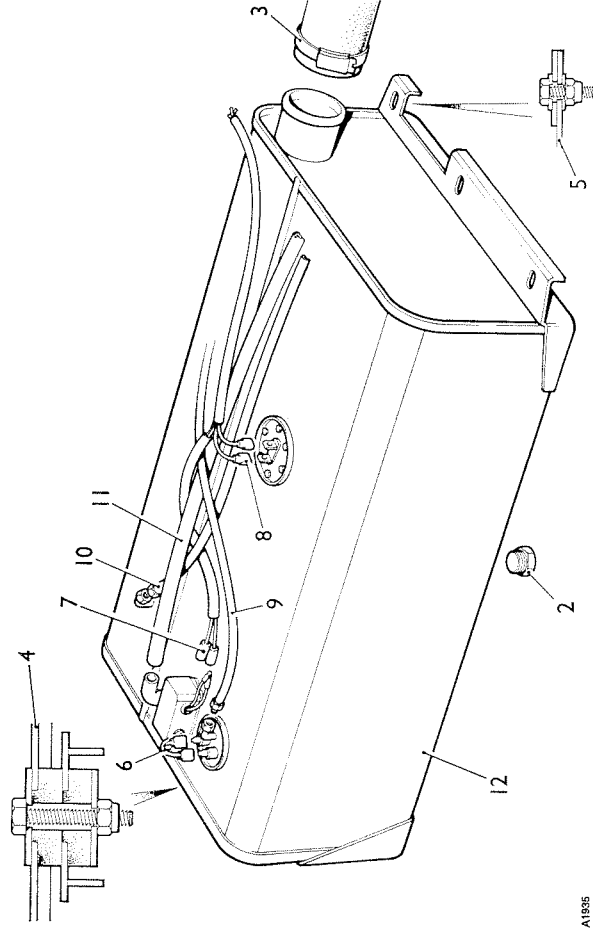
—Remove and refit 19.55.01

## Removing

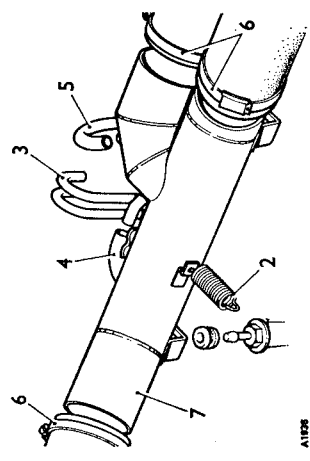
1. Disconnect the battery earth lead.
2. Drain the fuel tank.
3. From underneath the vehicle, slacken the clip securing the filler hose to the tank and disconnect the hose from the tank.
4. Remove the fixing at the rear of the tank.
5. Support the tank and remove the front fixings then lower the tank to give access to the fuel pipes and leads.
6. Disconnect the electrical leads from the fuel pump.
7. Disconnect the electrical leads from the suppressor unit.
8. Disconnect the electrical leads from the tank gauge unit.
9. Disconnect the outlet pipe.
10. Disconnect the spill return pipe.
11. Disconnect the breather pipe and release it from the clip.
12. Withdraw the fuel tank.

## Refitting

13. Reverse 1 to 12.
14. Check for fuel leaks.



A1835



19.70.01

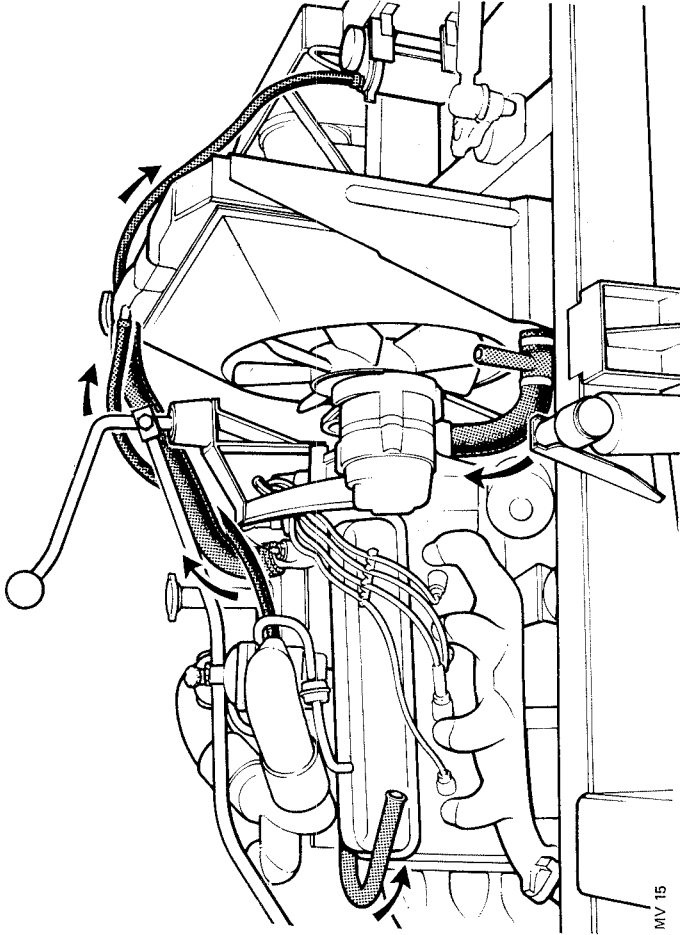
- Removing**
1. Remove the engine compartment lid.
  2. Disconnect the throttle linkage return spring.
  3. Unclip the gearbox breather pipes.
  4. Disconnect the hose to the engine breather.
  5. Vehicles with 24 volt electrical system—Disconnect the hose to the distributor.
  6. Slacken the clips at the three connector hoses.
  7. Withdraw the air intake from the retaining posts and the connector hoses.

**Refitting**

8. Reverse 1 to 7.

	COOLING SYSTEM	Wheeled Vehicles Q052
Description of cooling system	.. .. .	26-2
Fault diagnosis—cooling system	.. .. .	26-4
<b>COOLING SYSTEM OPERATIONS</b>		
Coolant—drain and refill	.. .. .	26.10.01
Expansion tank—remove and refit	.. .. .	26.15.01
Fan belt		
—check and adjust	.. .. .	26.20.01
—remove and refit	.. .. .	26.20.07
Fan blades—remove and refit	.. .. .	26.25.06
Radiator block—remove and refit	.. .. .	26.40.04
Thermostat—remove and refit	.. .. .	26.45.01
Water pump—remove and refit	.. .. .	26.50.01





MV 15

**COOLING SYSTEM—DESCRIPTION**

The engine is liquid cooled, using a mixture of water and special anti-freeze in a pressurized spill return system with pump and fan assistance and thermostat control.

**Radiator**

The four row fin and tube type radiator is located in the front of the engine compartment, mounted on vertical brackets secured to the chassis side members. The radiator is fitted with a pressure type filler cap, so that in operation the boiling point of the coolant is raised, thereby improving its efficiency. If system pressure exceeds 1.05 kg/cm<sup>2</sup> (15 lb/in<sup>2</sup>), a relief valve in the filler cap opens allowing coolant to flow into the expansion tank. Later, when the system has cooled and pressure is low, coolant is drawn back from the expansion tank into the radiator.

**Water pump and viscous fan**

The outlet hose from the bottom of the radiator leads to an impeller centrifugal type pump mounted on the engine front cover. The pump is driven together with the viscous coupling for the seven bladed radiator fan, by a 'V' type belt from the crankshaft pulley. The viscous coupling limits the fan speed to approximately 3,500 rev/min, to reduce engine load at high speed when sufficient ram air is normally available for radiator cooling.

**Thermostat**

Coolant from the water pump is forced down into the cylinder block and circulates round the cylinder jackets, from where it rises to the cylinder heads. After circulation round the valve ports in the cylinder head casting, the greater part of the coolant passes to the front of the block and into the thermostat housing. The thermostat is set to open at 79° to 82°C (175° to 180°F), so that when the engine is started from cold, coolant circulation is restricted to the engine only and rapidly attains operating temperature. When the thermostat opens, the coolant flows through the top hose to the radiator bringing the complete cooling system into operation.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—EXTERNAL LEAKAGE	<ol style="list-style-type: none"> <li>Loose hose clips</li> <li>Defective rubber hose</li> <li>Damaged radiator seams</li> <li>Excessive wear in the water pump</li> <li>Loose core plugs</li> <li>Damaged gaskets</li> <li>Leaks at the heater connections or capillary pipe connections</li> </ol>	<ol style="list-style-type: none"> <li>Tighten</li> <li>Renew</li> <li>Rectify</li> <li>Renew</li> <li>Renew</li> <li>Renew</li> <li>Rectify</li> <li>Tighten</li> </ol>
B—INTERNAL LEAKAGE	<ol style="list-style-type: none"> <li>Defective cylinder head gasket</li> <li>Cracked cylinder wall</li> <li>Loose cylinder head bolts</li> </ol>	<ol style="list-style-type: none"> <li>Renew. Check engine oil for contamination and refill as necessary</li> <li>Renew cylinder head gasket</li> <li>Tighten. Check engine for oil contamination and refill as necessary</li> </ol>
C—WATER LOSS	<ol style="list-style-type: none"> <li>Boiling</li> <li>Internal or external leakage</li> <li>Restricted radiator or inoperative thermostat</li> </ol>	<ol style="list-style-type: none"> <li>Ascertain the cause of engine overheating and correct as necessary</li> <li>See Items A and B</li> <li>Flush radiator or renew the thermostat as necessary</li> </ol>
D—POOR CIRCULATION	<ol style="list-style-type: none"> <li>Restriction in system</li> <li>Insufficient coolant</li> <li>Inoperative water pump</li> <li>Loose fan belt</li> <li>Inoperative thermostat</li> </ol>	<ol style="list-style-type: none"> <li>Check hoses for crimps, reverse flush the radiator, and clear the system of rust and sludge</li> <li>Replenish</li> <li>Adjust</li> <li>Adjust</li> <li>Renew</li> </ol>
E—CORROSION	<ol style="list-style-type: none"> <li>Excessive impurity in the water</li> <li>Infrequent flushing and draining of system</li> <li>Incorrect anti-freeze mixtures</li> </ol>	<ol style="list-style-type: none"> <li>Use only soft, clean water together with correct anti-freeze mixture</li> <li>The cooling system should be drained and flushed thoroughly at least once a year</li> <li>Certain anti-freeze solutions have a corrosive effect on parts of the cooling system. Only recommended solutions should be used.</li> </ol>
F—OVERHEATING	<ol style="list-style-type: none"> <li>Poor circulation</li> <li>Dry oil and sludge in engine</li> <li>Radiator fins choked with chaff, mud, etc.</li> <li>Incorrect ignition timing</li> <li>Incorrect valve timing</li> <li>Low oil level</li> <li>Tight engine</li> <li>Choked or damaged exhaust pipe or silencer</li> <li>Dragging brakes</li> <li>Overloading vehicle</li> <li>Driving in heavy sand or mud</li> <li>Engine labouring on gradients</li> <li>Low gear work</li> <li>Excessive idling</li> <li>Excessive revving</li> <li>Inaccurate temperature gauge</li> <li>Defective thermostat</li> </ol>	<ol style="list-style-type: none"> <li>See Item D</li> <li>Refill</li> <li>Use air pressure from the engine side of the radiator and clean out passages thoroughly</li> <li>See Division 86</li> <li>See Division 12</li> <li>Replenish</li> <li>New engines are very tight during the 'running-in' period and moderate speeds should be maintained for the first 1,000 miles (1,500 km)</li> <li>Rectify or renew</li> <li>See Division 70</li> <li>In the hands of the operator</li> <li>In the hands of the operator</li> <li>In the hands of the operator</li> <li>In the hands of the operator</li> <li>In the hands of the operator</li> <li>Renew</li> <li>Renew</li> </ol>
G—OVERCOOLING	<ol style="list-style-type: none"> <li>Defective thermostat</li> <li>Inaccurate temperature gauge</li> </ol>	<ol style="list-style-type: none"> <li>Renew</li> <li>Renew</li> </ol>

COOLANT

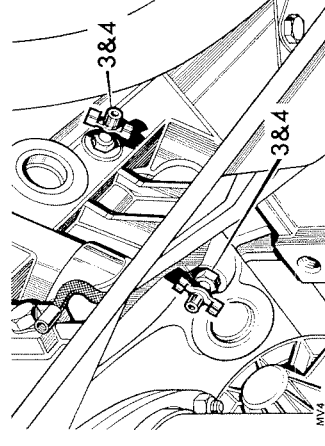
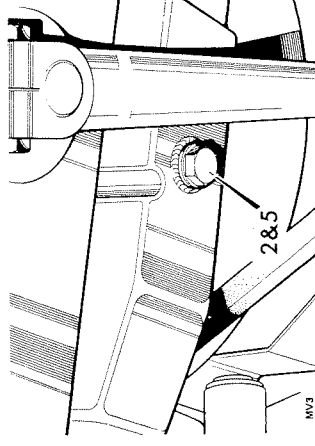
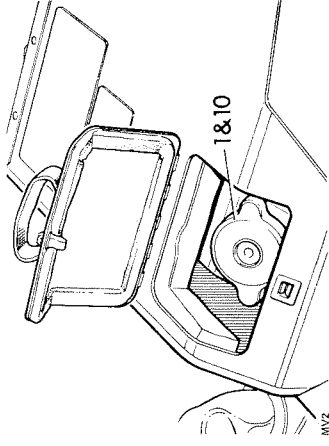
—Drain and refill

26.10.01

**WARNING:** Do not remove the radiator filler cap when the engine is hot because the cooling system is pressurized and personal scalding could result.

Draining

- Remove the radiator filler cap.
- Remove the plug and drain the radiator. As the system is filled with a solution of special anti-freeze, use a clean container if the coolant is to be re-used.
- Open the taps, one each side of the cylinder block, and drain the engine.
- Close both taps.
- Refit the radiator drain plug and washer.



**Refilling**

6. Check that the radiator expansion tank is approximately half full of coolant. If necessary, add sufficient coolant to obtain this condition.
7. Pour 4,5 litres (1 gallon) of water into the radiator.
8. Add the specified quantity of anti-freeze.
9. Top up the radiator with water until the coolant is 12,7 to 19 mm ( $\frac{1}{2}$  to  $\frac{3}{4}$  in) below the bottom of the radiator filler neck.
10. Fit the radiator filler cap.
11. Start and run the engine until normal operating temperature is attained, that is, thermostat open.
12. Switch off the engine, allow to cool and top up the coolant level as necessary.

**EXPANSION TANK**

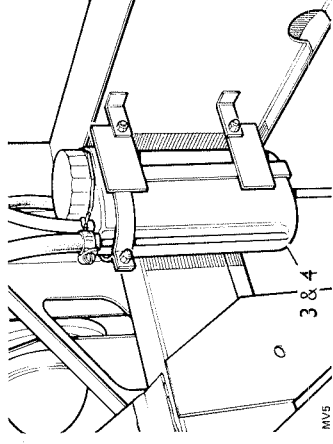
—Remove and refit **26.15.01**

**Removing**

1. Disconnect the hose to the radiator.
2. Disconnect the overflow pipe.
3. Withdraw the expansion tank.

**Refitting**

4. Using the specified coolant, approximately half fill the expansion tank.
5. Reverse 1 to 3.



FAN BELT

26.20.01

- Check and adjust  
12 volt models: 1, 2 8 and 9  
24 volt models: 1, 4, 10 and 11

26.20.07

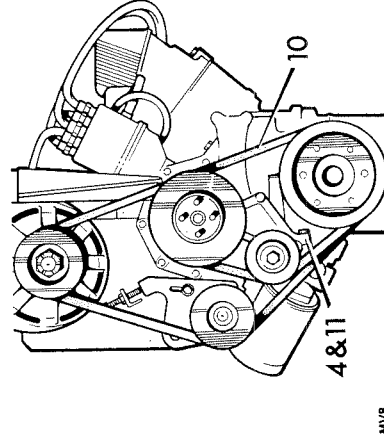
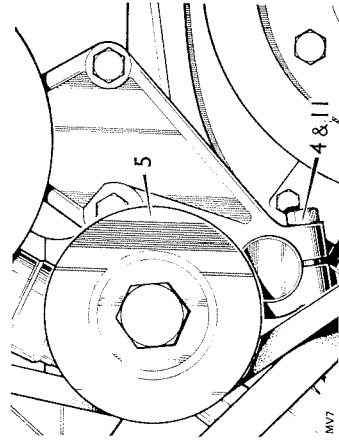
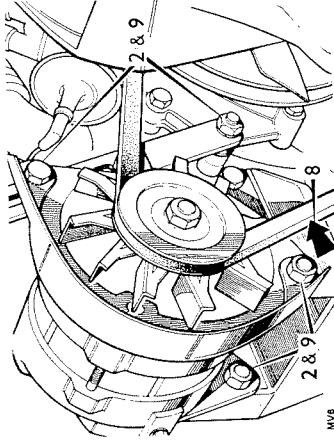
- Remove and refit  
12 volt models: 1 to 3 and 6 to 9  
24 volt models: 1, 4 to 7, 10 and 11

Removing

1. Remove the engine compartment lid.
2. Slacken the alternator fixings.
3. Pivot the alternator inwards.
4. Slacken the jockey pulley pinch bolt.
5. Pivot the jockey pulley inwards.
6. Manoeuvre the fan belt over the fan blades and lift it clear.

Refitting

7. Pass the fan belt over the fan blades and locate it on to the pulleys.
8. Pivot the alternator inwards or outwards as necessary to obtain the correct fan belt tension of 11 to 14 mm ( $\frac{7}{8}$  to  $\frac{9}{8}$  in) free play when checked midway between the alternator and crankshaft pulleys, by hand.  
**CAUTION:** When pivoting the alternator, leverage must only be applied to the alternator drive and bracket. Pressure applied to the stator or slip ring end bracket may result in serious damage.
9. Secure the alternator fixings.
10. Pivot the jockey pulley inwards or outwards as necessary to obtain the correct fan belt tension of 6 to 9 mm ( $\frac{1}{4}$  to  $\frac{3}{8}$  in) free play when checked midway between the fan and crankshaft pulleys.
11. Secure the jockey pulley pinch bolt.



FAN BLADES

26.25.06

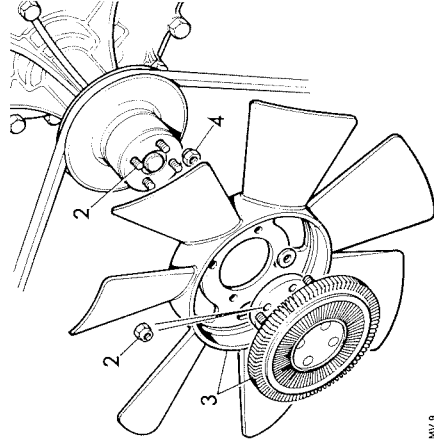
26.25.06

Removing

1. Remove the engine compartment lid.
2. Remove the fixings securing the fan blades and viscous coupling to the water pump pulley.
3. Withdraw the fan blades and viscous coupling.
4. If required, remove the fan blades from the viscous coupling.

Refitting

5. Reverse 1 to 4.



MV9

**RADIATOR BLOCK**

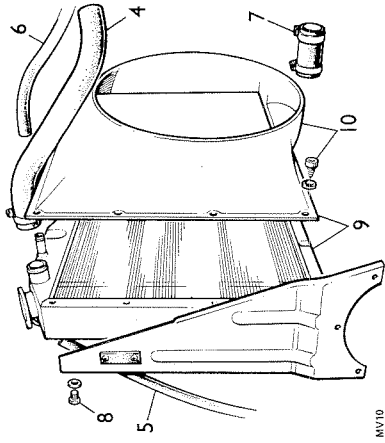
—Remove and refit 26.40.04

**Removing**

1. Remove the engine compartment lid.
2. Drain the cooling system. 26.10.01.
3. Remove the fan blades. 26.25.06.
4. Disconnect the top hose from the radiator.
5. Disconnect the hose to the expansion tank.
6. Disconnect the hose to the induction manifold.
7. Disconnect the hose from the bottom of the radiator.
8. Remove the fixings from each side of the radiator.
9. Withdraw the radiator complete with cowl.
10. If required, remove the radiator cowl.

**Refitting**

11. Reverse 1 to 10. Torque tighten the radiator mounting bolts 15,5 Nm (1,5 kgf.m or 11,5 lbf ft).



MV10

**THERMOSTAT**

—Remove and refit 26.45.01

12 volt models: 1, 2 and 5 to 13

24 volt models: 1 to 12 and 14

**Removing**

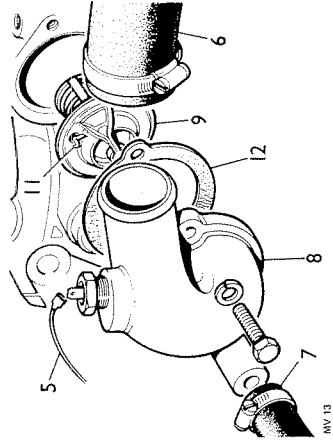
1. Remove the engine compartment lid.
2. Drain the cooling system, 26.10.01, sufficient to drain the induction manifold.
3. Remove the four bolts securing the gear lever bracket to the engine, and move the bracket aside.
4. Remove the generator and mounting bracket assembly. 86.10.02.
5. Disconnect the capillary tube from the top of the outlet elbow.
6. Disconnect the hose to the radiator.
7. Disconnect the thermostat by-pass hose.
8. Remove the outlet elbow.
9. Withdraw the thermostat.

**Testing**

10. When immersed in hot water, the thermostat should commence expansion between 79° to 82°C (175° to 180°F) and fully open at 93°C (195°F).

**Refitting**

11. Insert the thermostat with the jiggle pin uppermost (12 o'clock).
12. Using a new joint washer, fit the outlet elbow.
13. Reverse 5 to 13 and 1 and 2.
14. Reverse 1 to 12.



MV 13

**WATER PUMP**

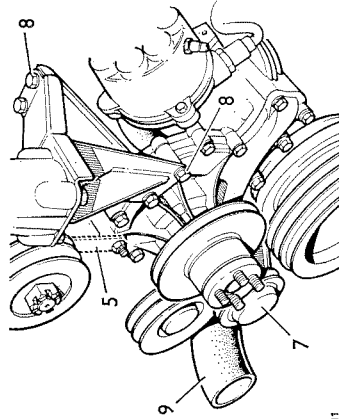
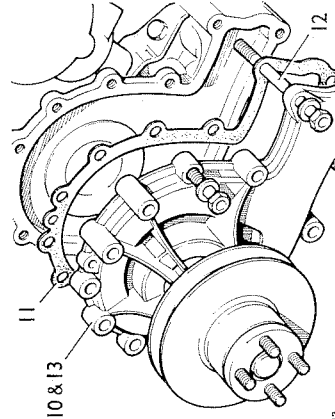
- Remove and refit** 26.50.01  
**12 volt models: 1 to 5, 8 to 14, 16 to 19 and 21 to 24**  
**24 volt models: 1 to 4, 6 to 18 and 20 to 24**

**Removing**

1. Remove the engine compartment lid.
2. Drain the coolant. 26.10.01.
3. Remove the fan blades. 26.25.06.
4. Remove the fan belt. 26.20.01.
5. Release the alternator adjusting link from the water pump.
6. Remove the alternator drive belts. 86.10.03.
7. Remove the jockey pulley and mounting bracket from the water pump.
8. Remove the four bolts securing the gear lever bracket to the engine, and move the bracket aside.
9. Disconnect the inlet hose from the water pump.
10. Remove the water pump.

**Refitting**

- NOTE:** It is not practical to overhaul the water pump, if necessary, a new or exchange pump should be fitted.
11. Lightly grease a new joint washer and place it in position on the timing cover.
  12. Clean the threads of the four long bolts and coat the first three threads with a lubricant sealant.
  13. Locate the water pump in position.
  14. Locate the gear lever bracket on the water pump.
  15. Locate the jockey pulley and mounting bracket on the water pump.
  16. Gradually tighten the water pump fixings. Torque:-  
Small bolts 0.8 to 1.0 kgf.m (6 to 8 lbf ft).  
Large bolts 2.8 to 3.5 kgf.m (20 to 25 lbf ft).
  17. Connect the inlet hose to the water pump.
  18. Secure the top fixings for the gear lever bracket.
  19. Connect the alternator adjusting link to the water pump, leaving the fixing loose.
  20. Fit and adjust the alternator drive belts. 86.10.03.
  21. Fit and adjust the fan belt. 26.20.01.
  22. Fit the fan blades. 26.25.06.
  23. Refill the cooling system. 26.10.01.
  24. Fit the engine compartment lid.

**HW11****HW12**

Exhaust manifold  
—left-hand—remove and refit .. .. . 30.15.10  
—right-hand—remove and refit .. .. . 30.15.11

Exhaust system—remove and refit .. .. . 30.10.01  
—Front pipe, left-hand .. .. . 30.10.09  
—Front pipe, right-hand .. .. . 30.10.10  
—Silencer .. .. . 30.10.14  
—Intermediate pipe .. .. . 30.10.18  
—Tail pipe .. .. . 30.10.19

Induction manifold—remove and refit .. .. . 30.15.02

**MANIFOLDS AND EXHAUST SYSTEM OPERATIONS**

EXHAUST SYSTEM COMPLETE

- Remove and refit 30.10.01
- Front pipe, left-hand 1 to 3, 5 and 14 30.10.09
- Front pipe, right-hand 1 to 5 and 15 30.10.10
- Silencer 6, 9, 11, 10 and 16 30.10.14
- Intermediate pipe 1 to 8 and 17 30.10.18
- Tail pipe 9, 11, 12 and 18 30.10.19

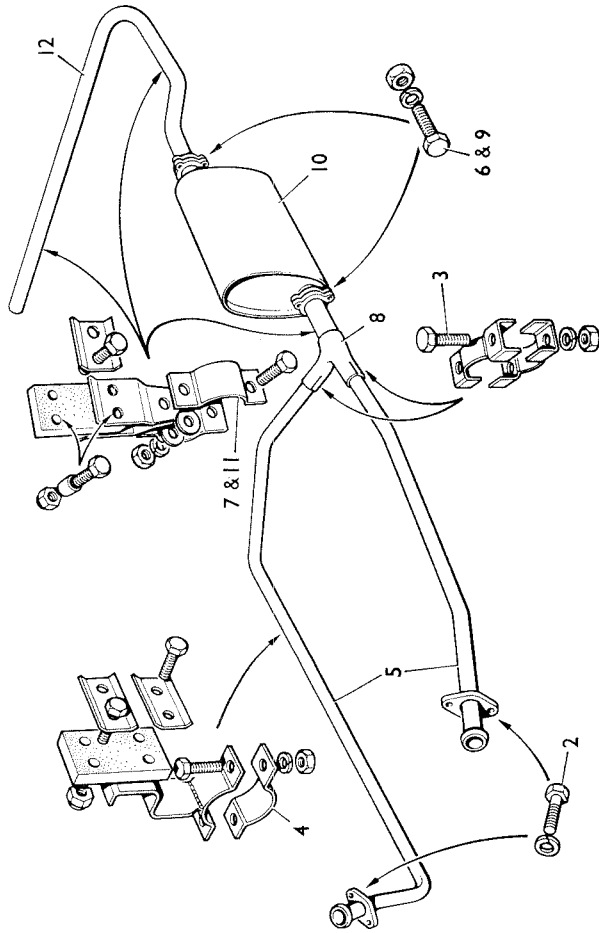
Removing

1. Remove the engine compartment lid.
2. Disconnect the front exhaust pipe from the manifold.
3. Slacken the clamp between the front and intermediate pipes.
4. Release the front pipe from the flexible mounting to the chassis.
5. Withdraw the front pipe.
6. Disconnect the intermediate pipe from the silencer.
7. Release the intermediate pipe from the flexible mounting to the chassis.
8. Withdraw the intermediate pipe.
9. Disconnect the silencer from the tail pipe.
10. Withdraw the silencer.
11. Release the tail pipe from the two flexible mountings to the chassis.
12. Withdraw the tail pipe.

Refitting

13. Complete system, reverse 1 to 12.
14. Front pipe, left-hand, reverse 1 to 3 and 5.
15. Front pipe, right-hand, reverse 1 to 5.
16. Silencer, reverse 6, 9, 11 and 10.
17. Intermediate pipe, reverse 1 to 8.
18. Tail pipe, reverse 9, 11 and 12.

**NOTE:** Use an exhaust pipe sealant, such as 'Holts Firegum Putty' at the joints between the front and intermediate pipes.



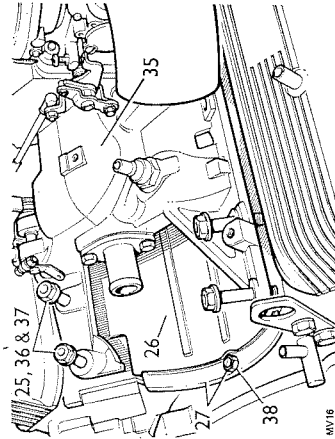
28C200A

INDUCTION MANIFOLD

—Remove and refit 30.15.02

Removing

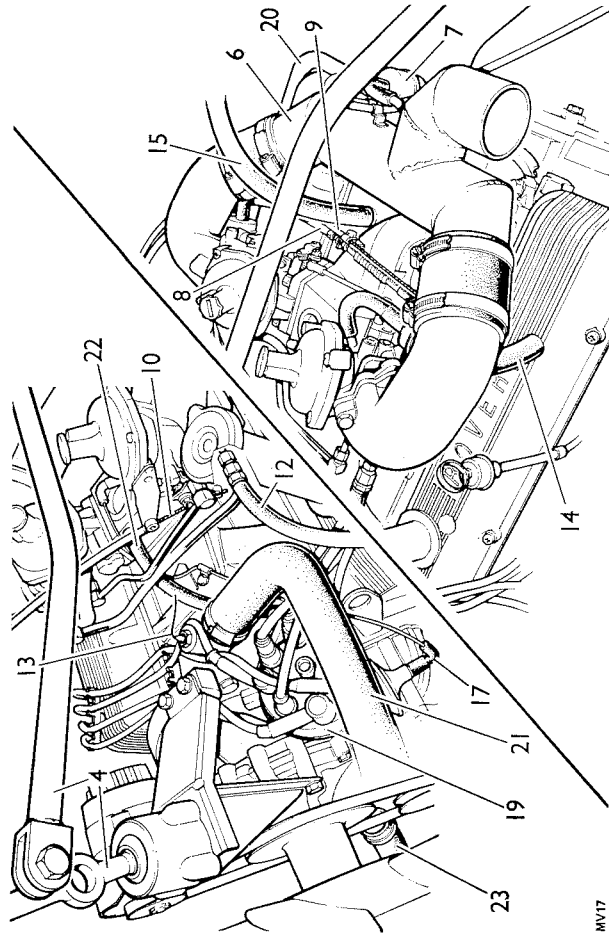
1. Remove the engine compartment lid.
2. Remove the access panel from above the rear end of the engine.
3. Drain the cooling system. 26.10.01.
4. Disconnect the remote control gear change shaft from the gear lever, and retain it clear of the manifold.
5. 24 volt models—Remove the alternator. 86.10.02.
6. Remove the air intake. 19.70.01.
7. Remove the engine breather filter.
8. Disconnect the throttle cable from the carburetter linkage and manifold.
9. If fitted, disconnect the hand throttle cable from the carburetter linkage and manifold.
10. Disconnect the choke from the carburetter.
11. Disconnect the fuel spill return pipe from the right-hand carburetter.
12. Disconnect the fuel supply pipe from the left-hand carburetter.
13. Disconnect the capillary tube from the top of the water outlet elbow.
14. Disconnect the flame trap hoses from the rocker covers.



MV16

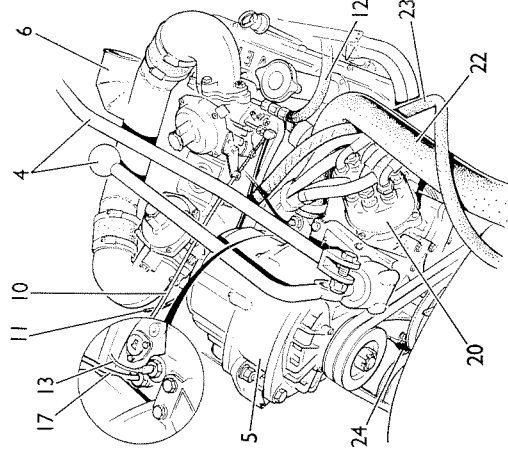
15. Disconnect the vacuum pipe for the brake servo.
16. Disconnect the vacuum pipe for the gearbox.
17. 12 volt models—Disconnect the vacuum pipe from the distributor.
18. 24 volt models—Remove the distributor in line filter.
19. Release the distributor cap and move the plug leads clear of the manifold.
20. Disconnect the heater hose at the rear of the manifold.
21. Disconnect the main return hose to the radiator.
22. Disconnect the return hose from the top of the induction manifold.
23. Disconnect the by-pass hose from the thermostat.
24. Remove the induction manifold.
25. Wipe away any coolant lying on the manifold gasket.
26. Remove the gasket clamps.
27. Lift off the gasket.
28. Withdraw the gasket seals.

continued



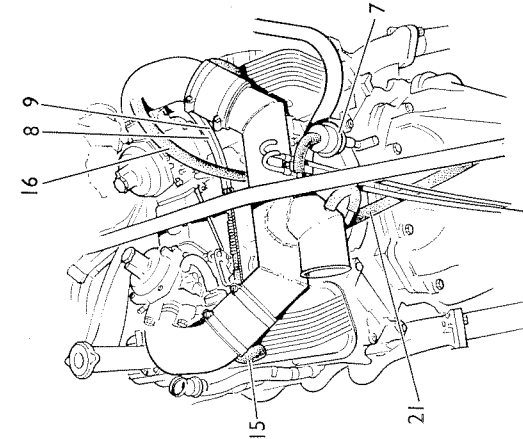
MV17

12 volt installation



MV18

24 volt installation

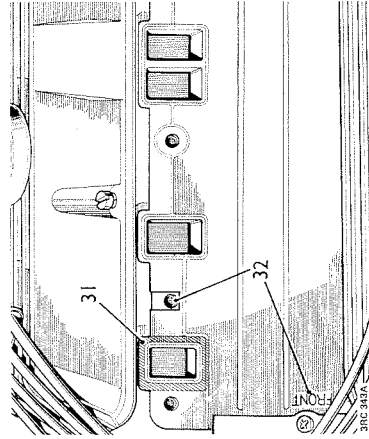


continued



**Refitting**

29. Using new seals, smear them on both sides with silicon grease.
30. Locate the seals in position with their ends engaged in the notches formed between the cylinder head and block.
31. Apply 'Hylomar' sealing compound PL 32M, Part No. 534244 on the corners of the cylinder head, manifold gasket and manifold, around the water passage joints.
32. Fit the manifold gasket with the word 'FRONT' to the front and the open bolt hole at the front RH side.
33. Fit the gasket clamps but do not fully tighten the bolts at this stage.
34. Locate the manifold on to the cylinder head.
35. Clean the threads of the manifold securing bolts and then coat the first three threads with a lubricant sealant.
36. Fit all the manifold bolts and tighten them a little at a time, evenly, alternate sides working from the centre to each end. Torque: 3,5 to 4,0 kgf.m (25 to 30 lbf ft).
37. Tighten the gasket clamp bolts. Torque: 1,4 to 2,0 kgf.m (10 to 15 lbf ft).
38. Reverse 1 to 23.
39. Run the engine and check for water leaks.



**EXHAUST MANIFOLD**

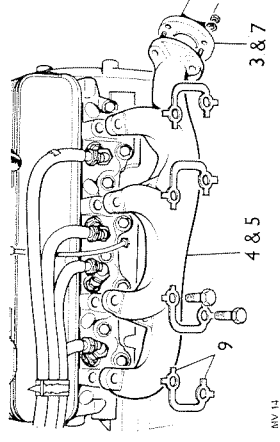
- Remove and refit 30.15.10
- Left-hand 30.15.11
- Right-hand

**Removing**

1. Remove the engine compartment lid.
2. Slacken the three, quarter turn fasteners and remove the side cover plate from each front wheel arch.
3. Disconnect the front exhaust pipe from the manifold.
4. Remove the exhaust manifold.

**Refitting**

5. Locate the exhaust manifold on the engine.
6. Fit the lockplates and fixing bolts. Torque: 2,0 kgf.m (15 lbf ft). DO NOT overtighten or engage the lockplates at this stage.
7. Reconnect the front exhaust pipe.
8. Start and run the engine for a minimum of five minutes, then re-check the torque settings.
9. Engage the lockplates over the bolt heads ensuring that they make full and close contact.
10. Reverse 1 and 2.

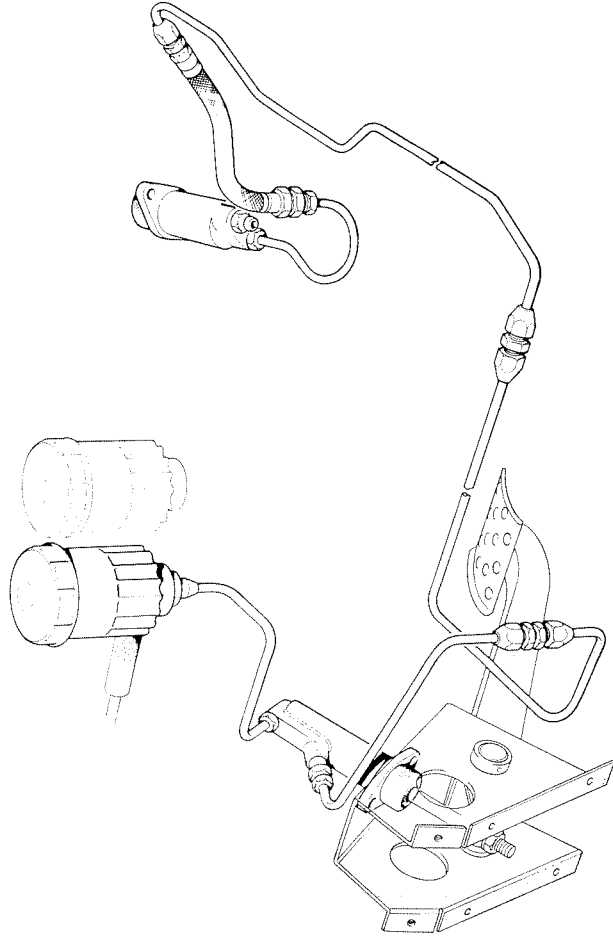


**CLUTCH** **Wheeled Vehicles Q052**

Description of clutch .. .. .	..	33-2
Fault diagnosis—clutch .. .. .	..	33-4

**CLUTCH OPERATIONS**

Clutch assembly	..	33.10.01
—remove and refit .. .. .	..	33.10.08
—overhaul .. .. .	..	33.30.02
Clutch pedal—remove and refit .. .. .	..	33.15.01
Hydraulic system—bleed .. .. .	..	33.20.01
Master cylinder	..	33.20.07
—remove and refit .. .. .	..	33.25.12
—overhaul .. .. .	..	33.35.01
Release assembly—remove and refit .. .. .	..	33.35.07
Slave cylinder	..	..
—remove and refit .. .. .	..	..
—overhaul .. .. .	..	..



MV24

**CLUTCH—DESCRIPTION**

The clutch is a Borg and Beck type with a single dry plate and diaphragm spring cover, hydraulically operated from a pedal actuated master cylinder and a slave cylinder at the gearbox.

**Fluid reservoir**

The reserve clutch fluid is stored in the central compartment of a dual reservoir, that is secured to the dash, adjacent to the instrument panel. (The outer compartment of the reservoir contains the reserve fluid for one section of the dual braking system.)

**Master cylinder**

The outlet pipe from the bottom of the fluid reservoir is connected to a 15,87 mm (0,625 in) diameter bore, Girling 'CV' type master cylinder that is secured to the clutch pedal box immediately below the instrument panel.

**Slave cylinder**

The outlet pipe from the clutch master cylinder leads to the clutch slave cylinder mounted on the flange of the gearbox bell housing.

**Release assembly**

The slave cylinder push rod acts on one end of a pivoted release lever inside the bell housing, the other end of the release lever engages with a bearing and sleeve assembly that is a slide fit on the primary shaft.

**Driven plate and cover assembly**

The clutch driven plate is a slide fit on the splined end of the primary shaft, and is of the spring type pattern in which the splined hub is indirectly attached to a disc that bears two friction lining faces. Clutch engagement is maintained by a diaphragm type spring that clamps the driven plate between the clutch cover assembly and the engine flywheel. When the clutch pedal is depressed, pressure is transmitted via the master cylinder, slave cylinder and release assembly to the diaphragm spring in the clutch cover, this causes the spring to deflect and release the pressure on the driven plate, thereby disengaging the clutch.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>A—GRABBING CLUTCH</b> (Harsh engagement from standing start, often followed by clutch judder)	<ol style="list-style-type: none"> <li>Clutch pedal sticking</li> <li>Release assembly worn or binding</li> <li>Oil on friction faces</li> <li>Engine flywheel worn or scored</li> <li>Clutch driven plate worn</li> <li>Diaphragm spring worn or damaged</li> <li>Engine mountings worn or damaged</li> </ol>	<ol style="list-style-type: none"> <li>Lubricate pivot or remove pedal assembly, and fit new parts as necessary</li> <li>Remove the gearbox and rectify the release assembly</li> <li>Clean metal faces, fit new driven plate. Rectify oil leak</li> <li>Reclaim or replace flywheel</li> <li>Replace</li> <li>Replace</li> <li>Replace</li> </ol>
<b>B—SLIPPING CLUTCH</b>	<ol style="list-style-type: none"> <li>Clutch pedal sticking</li> <li>Insufficient pedal free movement</li> <li>Release assembly worn or binding</li> <li>Oil on friction faces</li> <li>Diaphragm spring worn or damaged</li> <li>Engine flywheel worn</li> <li>Clutch driven plate worn</li> </ol>	<ol style="list-style-type: none"> <li>See A-1</li> <li>Adjust pedal setting</li> <li>See A-2</li> <li>See A-3</li> <li>Replace</li> <li>Reclaim or replace flywheel</li> <li>Replace</li> </ol>
<b>C—DRAGGING OR SPINNING CLUTCH</b>	<ol style="list-style-type: none"> <li>Insufficient pedal free movement</li> <li>Lack of free play in master cylinder push rod</li> <li>Release assembly worn or binding</li> <li>Oil on friction faces</li> <li>Clutch plates and flywheel damaged or distorted</li> <li>Primary pinion bush in crankshaft</li> <li>Worn or damaged splines at clutch driven plate or primary pinion shaft</li> <li>Distorted clutch pressure plate or clutch cover</li> <li>Low fluid level in reservoir</li> <li>Air in clutch hydraulic system</li> </ol>	<ol style="list-style-type: none"> <li>Ensure pedal travel is not restricted</li> <li>Rectify</li> <li>See A-2</li> <li>See A-3</li> <li>Reclaim or replace as applicable</li> <li>Fit new bush</li> <li>Rectify splines or fit new parts as necessary</li> <li>Replace</li> <li>Replenish</li> <li>Bleed hydraulic system</li> </ol>
<b>D—RATTLING CLUTCH</b>	<ol style="list-style-type: none"> <li>Pedal return spring disconnected or broken</li> <li>Damaged pressure plate</li> <li>Worn or damaged splines at clutch driven plate or primary pinion shaft</li> <li>Damaged or distorted driven plate</li> <li>Worn release assembly</li> <li>Worn bush in crankshaft spigot</li> </ol>	<ol style="list-style-type: none"> <li>Replace</li> <li>Replace</li> <li>See C-7</li> <li>Replace</li> <li>Rectify</li> <li>Replace</li> </ol>

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>E—SQUEAKING CLUTCH</b>	<ol style="list-style-type: none"> <li>Pedal pivot binding</li> <li>Primary pinion bush binding on shaft or turning in crankshaft</li> </ol>	<ol style="list-style-type: none"> <li>Lubricate</li> <li>Fit new bush</li> </ol>
<b>F—VIBRATING CLUTCH OR CLUTCH JUDDER</b>	<ol style="list-style-type: none"> <li>Engine mountings loose or worn</li> <li>Worn propeller shaft universal joints</li> <li>Clutch driven plate distorted or damaged</li> <li>Oil or other foreign matter on clutch friction linings</li> <li>Incorrectly fitted or loose clutch cover</li> <li>Loose engine flywheel fixings</li> <li>Bent primary pinion shaft</li> </ol>	<ol style="list-style-type: none"> <li>Rectify</li> <li>Rectify</li> <li>Replace</li> <li>Replace driven plate and clean related parts</li> <li>Remove and inspect, and refit correctly</li> <li>Tighten to correct torque</li> <li>Replace</li> </ol>
<b>G—STIFF CLUTCH OPERATION</b>	<ol style="list-style-type: none"> <li>Clutch pedal sticking</li> <li>Damaged release assembly</li> <li>Worn or damaged splines at clutch driven plate or primary pinion shaft</li> </ol>	<ol style="list-style-type: none"> <li>Lubricate pivot or remove pedal assembly and fit new parts as necessary</li> <li>Remove the gearbox and inspect the release assembly. Rectify as necessary</li> <li>See C-7</li> </ol>

## CLUTCH ASSEMBLY

—Remove and refit 33.10.01

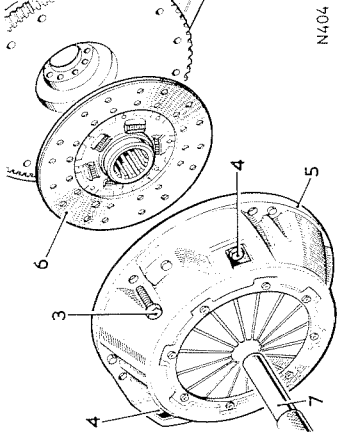
Service tool: 18G79 Clutch centralising tool

**Removing**

1. Remove the gearbox. 37.20.01.
2. Mark the clutch cover fitted position relative to the flywheel.
3. Where clutch cover fixing bolts vary obviously in thickness, note their fitted positions for reference during refitting.
4. Do not disturb the three bolts located in the apertures in the clutch cover.
5. Remove the clutch assembly.
6. Withdraw the clutch driven plate.

**Refitting**

7. Smear the splines of the clutch driven plate with 'Rocol MTS Grease' or ZX 28G grease, then reverse 5 and 6, aligning the assembly marks. Centralising tool 18G79.
8. Secure the cover fixings evenly, using diagonal selection. Torque load 4,9 to 5,0 kgf.m (35 to 38 lbf ft).
9. Fit the gearbox. 37.20.01.



## CLUTCH ASSEMBLY

—Overhaul 33.10.08

**Clutch assembly.**

The clutch assembly is of the diaphragm spring type and no overhaul procedures are applicable. Repair is by replacement only.

**Clutch driven plate**

Examine clutch driven plate for wear and signs of oil contamination. Examine all rivets for pulling and distortion, rivets must be below the friction surface. If oil contamination is present on the friction linings or if they are appreciably worn, replace the clutch driven plate assembly complete or alternatively, replace the friction linings following standard workshop practices.

**DATA**

Damper springs colour identification 266,7 mm (10.5 in)  
Clutch driven plate diameter Light grey/cream.

HYDRAULIC SYSTEM

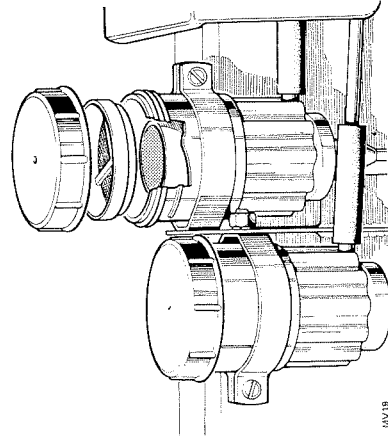
—Bleed 33.15.01

Procedure

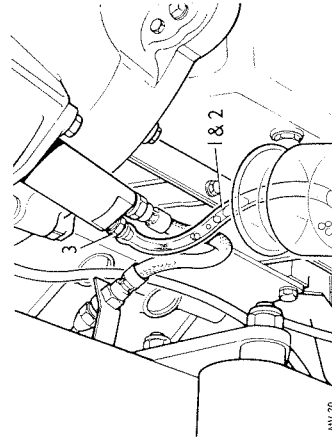
**NOTE:** During the procedure, keep the fluid reservoir topped up to avoid introducing further air into the system. Use only the recommended type of hydraulic fluid.

The reserve clutch fluid is stored in the central compartment of a dual reservoir that is secured to the dash, adjacent to the instrument panel. (The reservoir outer compartment contains the reserve fluid for one section of the dual braking system).

1. Attach a length of plastic tubing to the slave cylinder bleed screw.
2. Place the free end of the tube in a glass jar containing clutch fluid.
3. Slacken the bleed screw.
4. Pump the clutch pedal, pausing at the end of each stroke, until the fluid issuing from the tubing is free of air with the tube free end below the surface of the fluid in the jar.
5. Hold the tube free end immersed and tighten the bleed screw when commencing a pedal down stroke.
6. Remove the plastic tubing and glass jar.



MV18



MV 20

MASTER CYLINDER

—Remove and refit 33.20.01

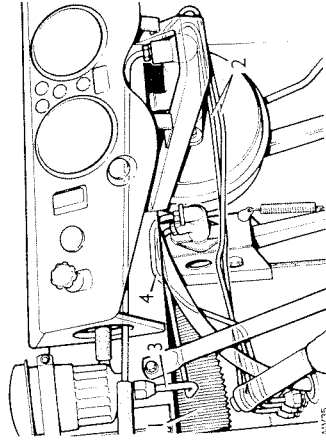
R.H.Stg. 1 to 21  
L.H.Stg. 3 to 18 and 21

Removing

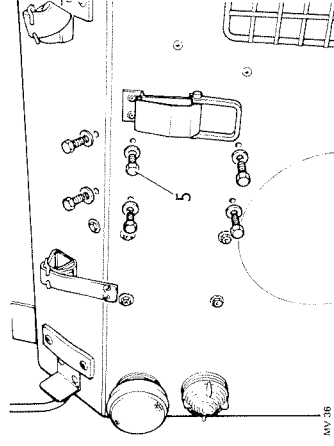
**NOTE:** During the following procedure take precautions against clutch and brake fluid spillage. Disconnected pipes and components should be drained and blanks fitted immediately.

1. R.H.Stg. models—Disconnect the heater demister hose from the underside of the dash.
2. R.H.Stg. models—Disconnect the outlet pipes from the brake master cylinder and move them clear of the clutch pedal housing.
3. Disconnect the fluid pipe between the reservoir and the clutch master cylinder.
4. Disconnect the outlet pipe from the clutch master cylinder.
5. Remove the fixings securing the clutch pedal housing to the cab front panel.
6. Withdraw the housing complete with pedal and master cylinder.
7. Remove the fixings from the end of the master cylinder push rod.
8. Remove the fixings and withdraw the master cylinder from the pedal housing.

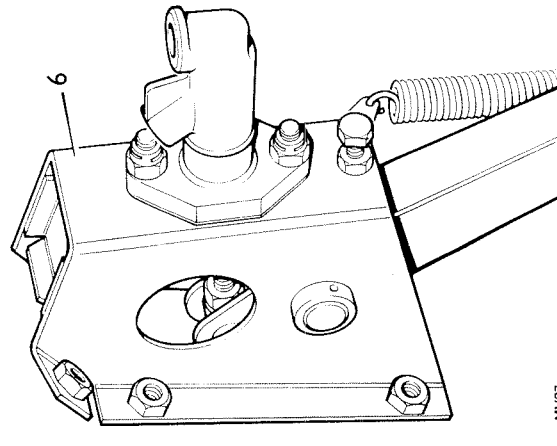
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MV35



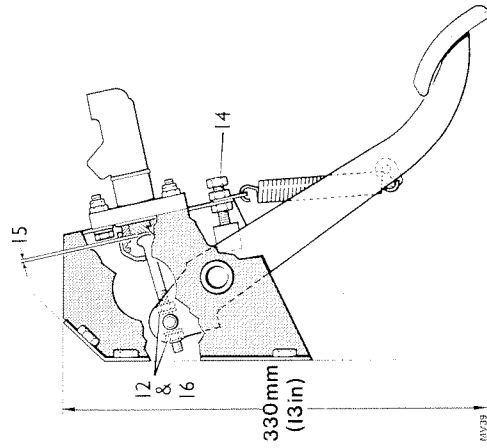
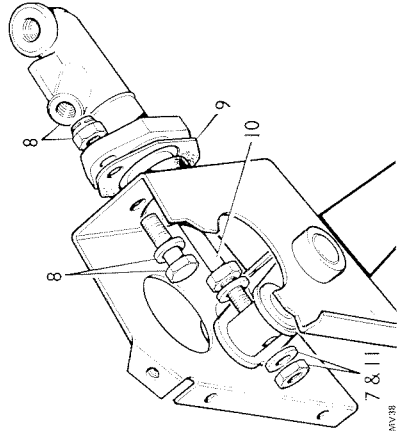
MV 36



MV37

Refitting

9. Place the gasket in position on the master cylinder mounting flange.
10. Fit the master cylinder to the pedal housing, engaging the cylinder push rod through the pedal trunion.
11. Loosely assemble the plain washer and nut to the end of the push rod.
12. Slacken both locknuts on the master cylinder push rod.
13. Check the dimension from the top face of the pedal housing to the lower edge of the clutch pedal. The correct dimension is 330 mm (13 in).
14. Adjust the pedal stop, as required, to obtain the correct dimension.
15. Adjust the master cylinder push rod until there is approximately 1,5 mm (0.062 in) free play between the push rod and the master cylinder piston.
16. Tighten both locknuts.
17. Reverse 3 to 6.
18. Replenish and bleed the clutch hydraulic system. 33.15.01.
19. R.H.Stg. models.—Reverse 1 and 2.
20. R.H.Stg. models.—Replenish and bleed both sections of the dual brake system. 70.25.02.
21. Before starting the engine, check the operation of the clutch, ensuring that it disengages.



330 mm (13 in)  
1,5 mm (0.062 in)

DATA

Clutch pedal height setting  
Master cylinder push rod free play

MASTER CYLINDER

33.20.07

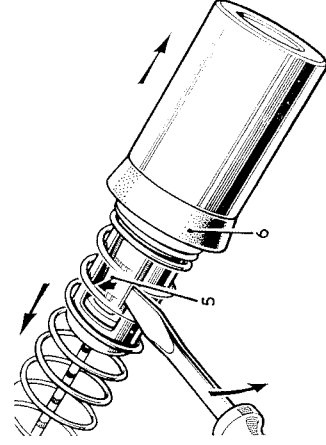
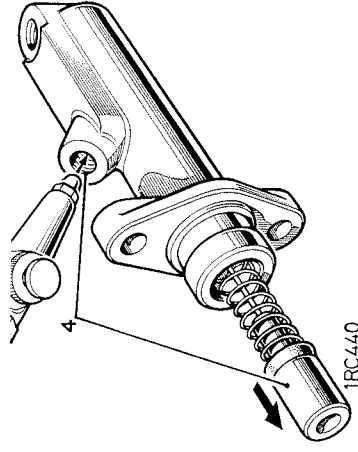
—Overhaul

Dismantling

1. Remove the master cylinder. 33.20.01.
2. Remove the circlip.
3. Withdraw the push rod and retaining washer.
4. Withdraw the piston assembly. If necessary, apply a low air pressure to the outlet port to expel the piston.
5. Prise the locking prong of the spring retainer clear of the piston shoulder and withdraw the piston.
6. Withdraw the piston seal.

1RC671

continued



1RC441

7. Compress the spring and position the valve stem to align with the larger hole in the spring retainer.
8. Withdraw the spring and retainer.
9. Withdraw the valve spacer and spring washer from the valve stem.
10. Remove the valve seal.

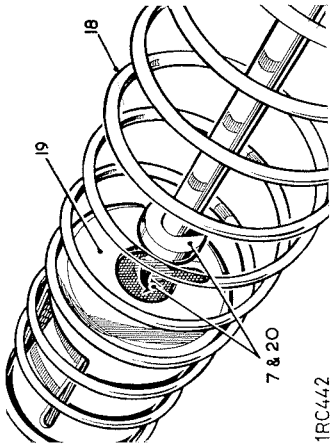
**Inspecting**

11. Clean all components in clean clutch fluid and allow to dry.
12. Examine the cylinder bore and piston, ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is any doubt, fit new replacements.
13. The seals should be replaced with new components.

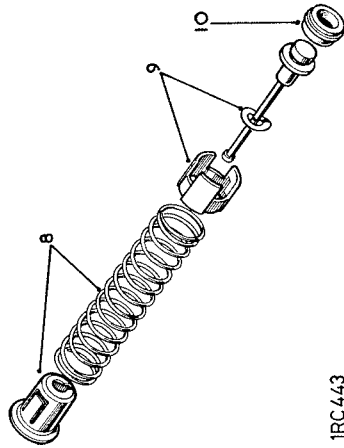
**Reassembling**

14. Smear the seals and internal items with clean clutch fluid.
15. Fit the valve seal, flat side first, on to the end of the valve stem.
16. Place the spring washer, domed side first, over the small end of the valve stem.
17. Fit the spacer, legs first.
18. Place the coil spring over the valve stem.
19. Insert the retainer into the spring.
20. Compress the spring and engage the valve stem in the keyhole slot in the retainer.

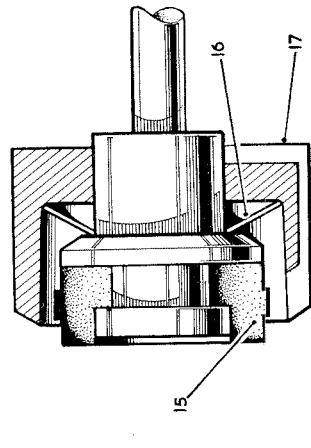
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1RC442

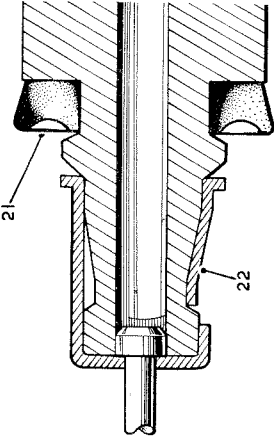


1RC443

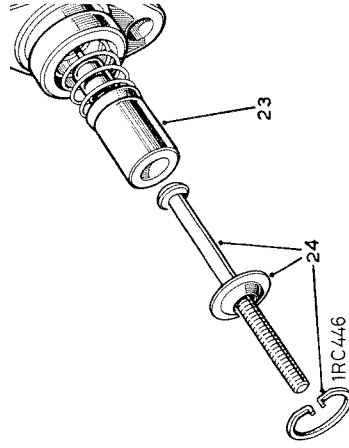


1RC444

21. Fit the seal, large diameter last, to the piston.
22. Insert the piston into the spring retainer and engage the locking prong.
23. Smear the piston with clean clutch fluid and insert the assembly, valve end first, into the cylinder.
24. Fit the push rod, retaining washer and circlip.
25. Smear the inside of the dust cover with clean clutch fluid and fit the cover to the cylinder.
26. Refit the master cylinder. 33.20.01.



1RC445



1RC446



CLUTCH RELEASE ASSEMBLY

—Remove and refit

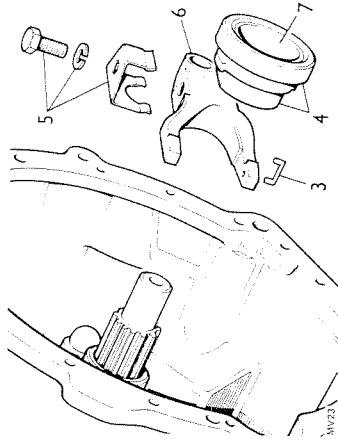
33.25.12

Removing

1. Remove the gearbox, 37.20.01.
2. Remove the clutch slave cylinder, 33.35.01.
3. Withdraw the retainer staple.
4. Withdraw the bearing and sleeve. If required, press the bearing off the sleeve. Fit the replacement bearing with the domed face outward from the sleeve.
5. Remove the spring clip and fixings.
6. Withdraw the release lever.

Refitting

7. Lubricate the bearing sleeve inner diameter with 'Rocol MTS Grease' or ZX 28G grease.
8. Reverse 1 to 6.



CLUTCH PEDAL

33.30.02

—Remove and refit

R.H.Stg. 1 to 25

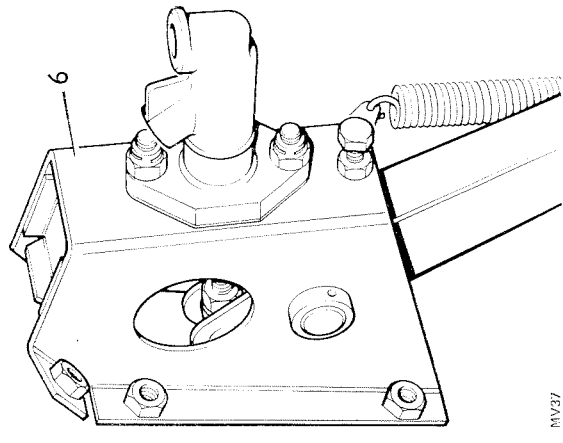
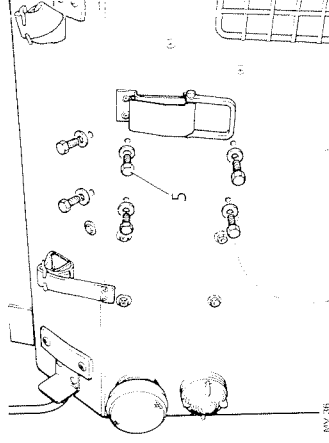
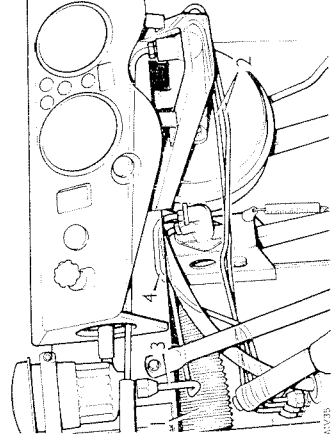
L.H.Stg. 3 to 22 and 25

Removing

**NOTE:** During the following procedure take precautions against clutch and brake fluid spillage. Disconnected pipes and components should be drained and blanks fitted immediately.

1. R.H.Stg. models—Disconnect the heater demister hose from the underside of the dash.
2. R.H.Stg. models—Disconnect the outlet pipes from the brake master cylinder and move them clear of the clutch pedal housing.
3. Disconnect the fluid pipe between the reservoir and the clutch master cylinder.
4. Disconnect the outlet pipe from the clutch master cylinder.
5. Remove the fixings securing the clutch pedal housing to the cab front panel.
6. Withdraw the housing complete with pedal and master cylinder.
7. Remove the fixings from the end of the master cylinder push rod and push the rod into the master cylinder to clear the pedal trunion.

*continued*



8. Using a suitable punch, drift out the pin from the pedal shaft.
9. Withdraw the pedal shaft.
10. Withdraw the clutch pedal complete with trunnion and bushes.
11. If required, remove the bushes, trunnion and distance piece from the clutch pedal.

**Refitting**

12. If removed, fit the distance piece, trunnion and bushes to the clutch pedal. Lubricate the trunnion and distance piece with general purpose grease on assembly. New pedal bushes must be reamed to 19,05 mm + 0,02 mm (0.750 in + 0.001 in).
13. Reverse 7 to 10.
14. Remove the oil plug and washer from the pedal shaft. Fill the shaft bore with clean engine oil and refit the plug and washer.
15. Locate the master cylinder push rod through the pedal trunnion and loosely assemble the plain washer and nut to the end of the push rod.
16. Slacken both locknuts on the master cylinder push rod.
17. Check the dimension from the top face of the pedal housing to the lower edge of the clutch pedal. The correct dimension is 330 mm (13 in).
18. Adjust the pedal stop, as required, to obtain the correct dimension.
19. Adjust the master cylinder push rod until there is approximately 1,5 mm (0.062 in) free play between the push rod and the master cylinder piston.
20. Tighten both locknuts.
21. Reverse 3 to 6.
22. Replenish and bleed the clutch hydraulic system. 33.15.01.
23. R.H.Stg. models—Reverse 1 and 2.
24. R.H.Stg. models—Replenish and bleed both sections of the dual brake system. 70.25.02.
25. Before starting the engine, check the operation of the clutch, ensuring that it disengages.

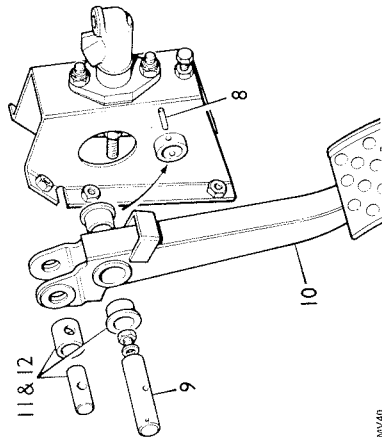
**DATA**

Clutch pedal pivot bushes, reamed diameter

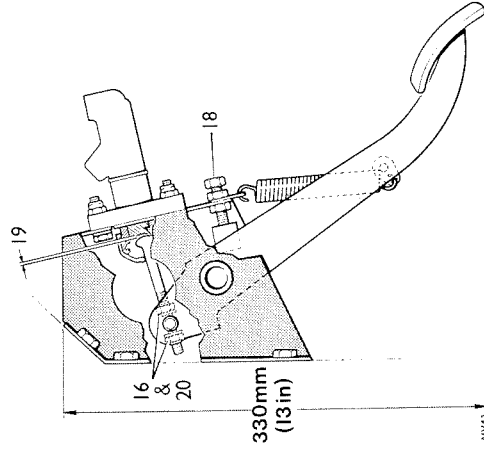
Clutch pedal height setting

Master cylinder push rod free play

- 19,05 mm + 0,02 mm  
(0.750 in + 0.001 in)
- 330 mm (13 in)
- 1,5 mm (0.062 in)



MV40



MV41

**SLAVE CYLINDER**

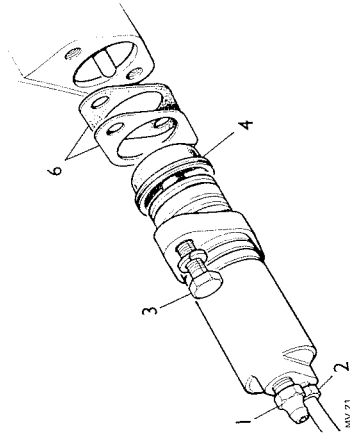
—Remove and refit 33.35.01

**Removing**

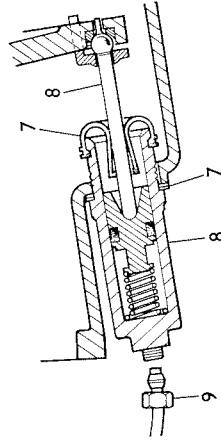
1. Evacuate the clutch system fluid at the slave cylinder bleed screw.
2. Disconnect the fluid pipe.
3. Remove the slave cylinder together with the backing plate and, if fitted, a gasket (see Note below). **NOTE:** The slave cylinder push rod will remain in the bell housing, retained by a plastic clip.
4. If the dust cover is not withdrawn with the slave cylinder, withdraw it from the bell housing.

**Refitting**

- NOTE:** The gasket for the slave cylinder is only fitted to early models and should be discarded, as service has shown that it is not necessary as a seal and, that it can distort, resulting in a loss of torque on the securing bolts.
5. Withdraw the dust cover and backing plate from the slave cylinder.
  6. Coat both sides of the backing plate with a water-proof jointing compound, such as 'Hylomar PL 32M'.
  7. Locate the backing plate and dust cover in position on the slave cylinder.
  8. Fit the slave cylinder, engaging the push rod through the centre of the dust cover and with the bleed screw uppermost. Tightening torque for securing bolts, 2,75 kgf.m (20 lbf ft).
  9. Reconnect the fluid pipe.
  10. Replenish and bleed the clutch hydraulic system. 33.15.01.
  11. Check for fluid leaks with the pedal depressed and with the system at rest.

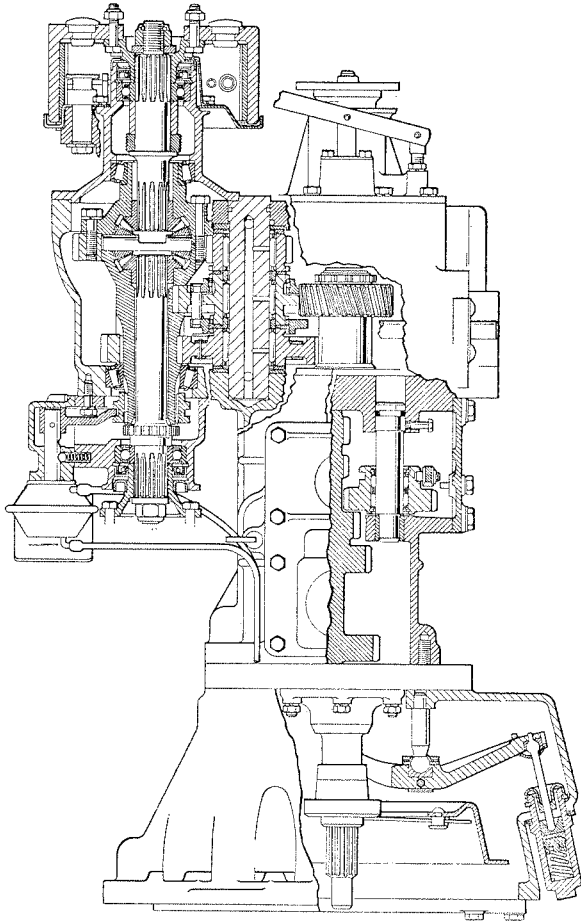


MV 21

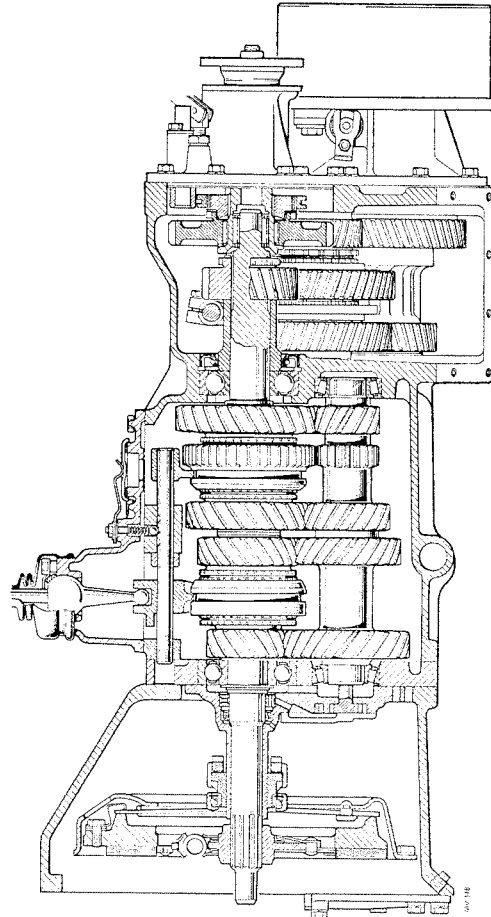


MV 22





Longitudinal section of gearbox: plan view



Longitudinal section of gearbox: elevation view

**GEARBOX—DESCRIPTION**

The gearbox assembly comprises three sub-sections, a main gearbox, a transfer gearbox and a differential and output shaft assembly. The main gearbox has four forward and one reverse speeds with synchromesh on all forward gears. The transfer gearbox is of the two speed reduction type on the main gearbox output. Front and rear drive are permanently engaged via a gearbox differential which can be locked by a vacuum control switch in the drivers compartment.

**MAIN GEARBOX**

**Bell housing**

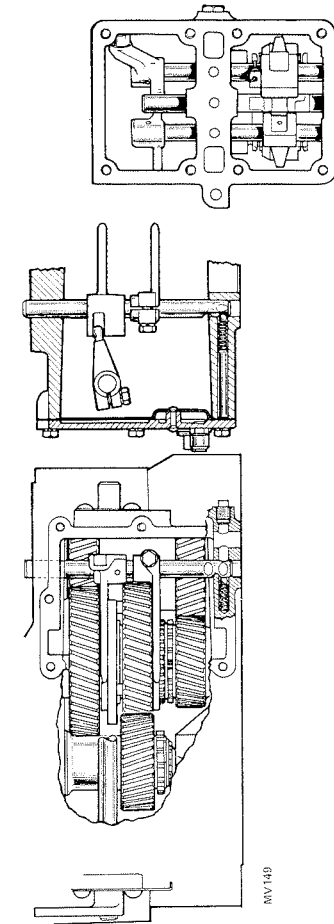
The cast alloy bell housing encloses the clutch, the clutch release mechanism and the primary shaft for the gearbox and is also used to provide a rigid connection between the engine and the main gearbox. To help prevent the possibility of extraneous oil etc. contaminating the clutch, there is a threaded drain hole in the front lower edge of the bell housing. A plug is provided for fitting into the drain hole to seal it against the entry of mud or water when fording. When not in use, the plug is screwed into the housing adjacent to the drain hole. The plug should only be fitted when the vehicle is fording or travelling over very muddy terrain and it must be removed daily to allow any oil etc. to drain before being replaced.

**Bearing plate**

The cast alloy bearing plate forms a front cover for the main gearbox and provides a support for the primary shaft rear bearing and the layshaft front bearing. An oil pump, driven by the layshaft, is fitted to the front face of the bearing plate and is connected by oilways to the hollow mainshaft to provide pressure fed lubrication to the mainshaft components.

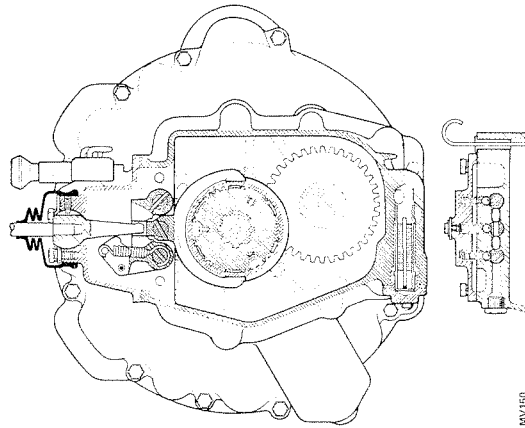
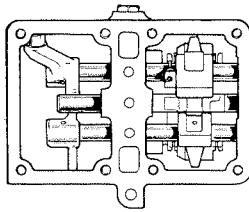
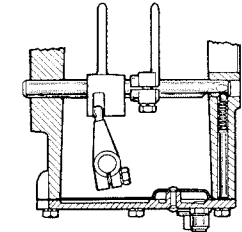
**Gear assemblies**

The main gearbox contains the primary pinion, layshaft, reverse idler gear, mainshaft and gear selectors. The primary pinion and shaft are machined from a single forging and incorporate a counter-bored housing for the mainshaft front bearing. The layshaft, together with its five integral gears, is also machined from a single forging and is supported at each end by pre-loaded taper roller bearings. The reverse idler gear is a single, spur tooth pinion supported by needle roller bearings, mounted on its own separate shaft. The reverse idler gear has its own selector lever and, when operated, the reverse idler gear engages with a spur tooth gear on the layshaft and a spur tooth gear formed on the outer diameter of the synchroniser unit for the mainshaft first/second gears. The mainshaft is supported by three bearings and is fitted with four helical tooth gears and two synchroniser units in the following order, commencing from the front. Third/fourth gear synchroniser unit, third speed gear, second speed gear, first/second gear synchroniser unit, first speed gear and the mainshaft transfer gear, the last item being housed within the transfer gearbox. The mainshaft gears within the main gearbox are mounted on needle roller bearings, with a combination of plain thrust washers and radial needle roller thrust bearings fitted each side of each gear.

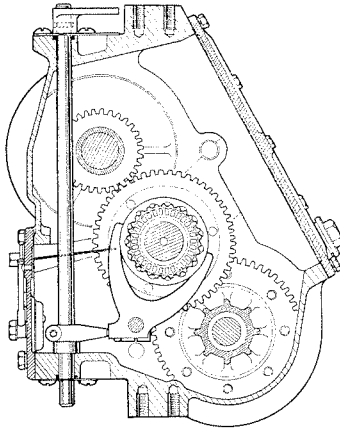


MV149

MV148



MV150



MV151

Cross-sections of gearbox : general views

**Gear selectors**

The main gear lever in the drivers' compartment is connected by a remote control gear change shaft to an arrangement of three selector shafts and forks in the main gearbox. The left-hand shaft and fork assembly moves rearward to engage reverse. The central shaft and fork assembly moves forward or rearward to engage fourth (primary pinion) or third speed gears accordingly. Similarly, the right-hand assembly moves forward or rearward to engage second or first speed gears. There is also a neutral position in which the mainshaft gears are disengaged, allowing them to rotate freely while the mainshaft remains stationary.

**TRANSFER GEARBOX**

The transfer gearbox is cast integrally with, and to the rear of, the main gearbox, and contains the mainshaft transfer gear, an intermediate gear assembly and the differential unit for the gearbox output. All gears have helical teeth. The intermediate gear assembly comprises a central input gear, driven by the mainshaft transfer gear, with a 'HIGH' ratio gear to its front and a 'LOW' ratio gear to its rear. All three gears are supported on needle roller bearings that are mounted on an intermediate shaft. A transfer gear lever in the drivers compartment is connected by a cable to a selector fork mechanism in the transfer gearbox. The selector can be operated to engage the intermediate 'HIGH' or 'LOW' gear with the input gear, or to obtain a neutral position. Depending on which gear is engaged, the drive is transmitted to mating, constant mesh gears on the differential case.

**DIFFERENTIAL AND OUTPUT SHAFTS**

The differential in the gearbox is in addition to the normal differentials fitted in the front and rear axles and permits permanent four wheel drive to be employed by obviating transmission wind-up. The differential can be locked by a vacuum actuated control to provide maximum traction through both axes for severe cross-country conditions, but this application is strictly limited to specific instructions as it does introduce the possibility of 'wind-up'.

The two piece differential case is mounted on taper roller bearings in the right-hand side of the transfer gearbox, and contains two side gears divided by a set of four differential pinions and thrust washers mounted on two cross-pins. The side gears are located in plain bores in the differential case and are a splined fit on the front and rear output shafts. The differential pinions are a free fit on the cross-pins, and the pins themselves are securely located in the differential case. The drive from the gearbox is transmitted to either the 'HIGH' or 'LOW' gears that are secured to the differential case, then by the cross-pins and pinions to the side gears and thus the output shafts. The differential allows the output shafts to rotate independently and, in severe conditions one shaft can be stationary while the other transmits all the power. In such conditions, the differential can be locked and both output shafts driven, by operating a switch in the drivers compartment that controls a vacuum supply between the engine and an encapsulated diaphragm on the gearbox. Deflection of the diaphragm operates a selector mechanism that locks (or unlocks, as applicable) the front output shaft and the differential case. In the locked position, normal differential action is inhibited and both output shafts rotate simultaneously.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—GEARBOX NOISY IN NEUTRAL	<ol style="list-style-type: none"> <li>Insufficient oil in gearbox.</li> <li>Incorrect grade of oil</li> <li>Primary pinion bearing worn</li> <li>Constant mesh gears worn</li> <li>Layshaft bearings worn</li> </ol>	<ol style="list-style-type: none"> <li>Replenish</li> <li>Drain and replenish</li> <li>Replace bearings</li> <li>Replace primary pinion and layshaft</li> <li>Replace bearings</li> </ol>
B—GEARBOX NOISY IN ALL GEARS EXCEPT TOP	<ol style="list-style-type: none"> <li>Layshaft, mainshaft, or primary pinion bearings worn</li> <li>Constant mesh gears worn</li> </ol>	<ol style="list-style-type: none"> <li>Replace bearings</li> <li>Replace primary pinion and layshaft</li> </ol>
C—GEARBOX NOISY IN ONE GEAR ONLY	<ol style="list-style-type: none"> <li>Worn or damaged gears or bearings</li> </ol>	<ol style="list-style-type: none"> <li>Replace gears and/or bearings</li> </ol>
D—GEARBOX NOISY IN ALL GEARS	<ol style="list-style-type: none"> <li>Worn bearings on primary pinion, mainshaft or layshaft</li> </ol>	<ol style="list-style-type: none"> <li>Replace bearings</li> </ol>
E—OIL LEAKS FROM GEARBOX	<ol style="list-style-type: none"> <li>Gearbox over-filled with lubricating oil</li> <li>Loose or damaged drain or level plugs</li> <li>Joint washers damaged, incorrectly fitted or missing.</li> <li>Oil seals damaged or incorrectly fitted</li> <li>Cracked or broken gearbox casings</li> </ol>	<ol style="list-style-type: none"> <li>Rectify oil level with vehicle standing on level floor</li> <li>Tighten plugs. If damaged, fit new plugs and joint washers as required</li> <li>Fit new joint washer with general purpose grease smeared on both sides</li> <li>Fit new oil seal with Hylomar PL32M sealing compound smeared on the outside diameter.</li> <li>Fit new casings</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
F—DIFFICULTY IN ENGAGING FORWARD GEARS	<ol style="list-style-type: none"> <li>Weak springs or worn parts in synchronesh units</li> <li>Worn selector forks and/or interlock pins</li> <li>Faulty clutch operation; clutch fluid leakage</li> </ol>	<ol style="list-style-type: none"> <li>Replace faulty parts</li> <li>Replace faulty parts</li> <li>Refer to Clutch Fault Diagnosis</li> </ol>
G—DIFFICULTY IN ENGAGING REVERSE GEAR	<ol style="list-style-type: none"> <li>Reverse gear bearings worn or damaged</li> <li>Faulty clutch operation; clutch fluid leakage</li> </ol>	<ol style="list-style-type: none"> <li>Replace bearings and shaft as necessary</li> <li>Refer to Clutch Fault Diagnosis</li> </ol>
H—DIFFICULTY IN DISENGAGING FORWARD GEARS	<ol style="list-style-type: none"> <li>Synchronesh cones worn; damaged gear dogs</li> <li>Distorted or damaged splines</li> </ol>	<ol style="list-style-type: none"> <li>Replace faulty parts</li> <li>Replace parts as necessary</li> </ol>
J—DIFFICULTY IN DISENGAGING REVERSE GEAR	<ol style="list-style-type: none"> <li>Reverse gear seized on shaft</li> </ol>	<ol style="list-style-type: none"> <li>Replace parts as necessary</li> </ol>
K—GEAR LEVER GOING INTO REVERSE TOO EASILY AND NOT INTO FIRST	<ol style="list-style-type: none"> <li>Weak reverse stop hinge plate spring</li> </ol>	<ol style="list-style-type: none"> <li>Replace the spring</li> </ol>
L—TRANSFER OF OIL BETWEEN MAIN GEARBOX AND TRANSFER GEARBOX	<ol style="list-style-type: none"> <li>Faulty 'O' ring seal on reverse idler shaft</li> <li>Faulty mainshaft oil seal</li> </ol>	<ol style="list-style-type: none"> <li>Replace seal</li> <li>Replace seal</li> </ol>
M—OIL LEAKAGE FROM GEARBOX TO BELL HOUSING	<ol style="list-style-type: none"> <li>Faulty joint washer/s on gearbox front cover and oil pump</li> <li>Faulty oil seal, primary pinion to front cover</li> <li>Damaged or porous gearbox front cover</li> </ol>	<ol style="list-style-type: none"> <li>Replace joint washer/s</li> <li>Replace oil seal</li> <li>Replace front cover</li> </ol>

continued

FAULT DIAGNOSIS

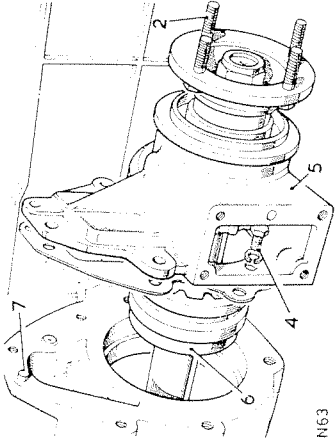
SYMPTOM	POSSIBLE CAUSE	CURE
N—TRANSFER GEARBOX NOISY	<ol style="list-style-type: none"> <li>Insufficient oil in transfer box</li> <li>Incorrect grade of lubricating oil</li> <li>Excessive end float on intermediate gears assembly</li> <li>Worn components in gearbox differential unit</li> <li>Worn bearings in intermediate gears assembly</li> </ol>	<ol style="list-style-type: none"> <li>Replenish</li> <li>Drain and replenish with the correct grade oil</li> <li>Adjust as required. End float 0.22 to 0.36 mm (0.009 to 0.014 in)</li> <li>Replace components</li> <li>Replace bearings</li> </ol>
P—DIFFERENTIAL LOCK WARNING SWITCH BULB FAILS TO LIGHT UP	<ol style="list-style-type: none"> <li>Switch bulb failure</li> <li>Air leakage in vacuum circuit</li> <li>Actuator housing not seated square on front output shaft housing</li> </ol>	<ol style="list-style-type: none"> <li>Replace bulb</li> <li>Replace leaking components</li> <li>Slacken fixings, reset housing, hold in position and tighten fixings</li> </ol>

FRONT OUTPUT SHAFT AND HOUSING

—Remove and refit 37.10.05

Removing

1. Remove the drain plug from the transfer gearbox, allow all the oil to drain then refit the drain plug and washer.
2. Disconnect the front propeller shaft at the gearbox.
3. Remove the differential lock actuator assembly. 37.29.19.
4. Remove the six fixings.
- NOTE:** If necessary, remove the right-hand front exhaust pipe to improve access.
5. Withdraw the output shaft and housing complete.
6. Lift out the lock-up dog clutch.



N163

Refitting

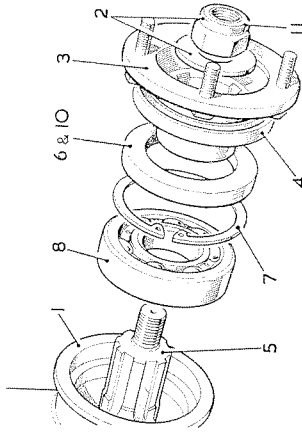
7. Reverse items 1 to 6; note that the housing is dowel located.

FRONT OUTPUT SHAFT AND HOUSING

—Overhaul 37.10.06

Dismantling

1. Remove the front output shaft and housing assembly. 37.10.05.
2. Remove the locking nut and washer.
3. Withdraw the coupling flange complete with mudshield.
4. If required, press off the mudshield.
5. Press out the shaft toward the rear.
6. Withdraw the oil seal.
7. Remove the circlip.
8. Withdraw the output shaft bearing.



N111

Reassembling

9. Reverse items 7 and 8.
10. Fit the oil seal, with the open side toward the bearing.
11. Reverse items 2 to 5. Torque loading for locking nut is 11,75 kgf.m (85 lbf ft).
12. Refit the front output shaft and housing. 37.10.05.

**BELL HOUSING**

—Remove and refit

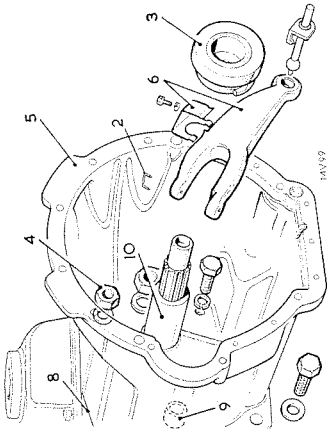
37.12.07

**Removing**

1. Remove the gearbox. 37.20.01.
2. Withdraw the locating staple from the clutch release sleeve and release lever.
3. Lift out the release sleeve and bearing assembly.
4. Remove the bell housing fixings.
5. Withdraw the bell housing complete with clutch release lever.
6. If required, remove the push rod clip and the spring clip and withdraw the clutch release lever.

**Refitting**

7. If removed, refit the clutch release lever and spring clip.
8. Apply a thin film of Hylomar PL32M or other suitable jointing compound around the three selector shaft holes in the bell housing rear face.
9. Fit the bell housing, locating on the dowels.
10. Apply a thin film of molybdenum disulphide grease on to the front cover extension sleeve.
11. Reverse 1 to 3.



**BEARING PLATE ASSEMBLY**

—Remove and refit

37.12.22

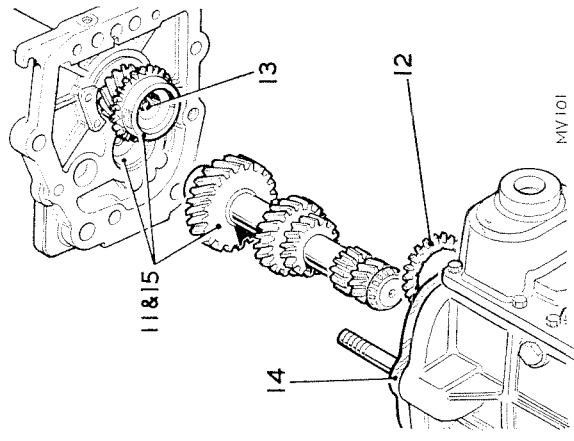
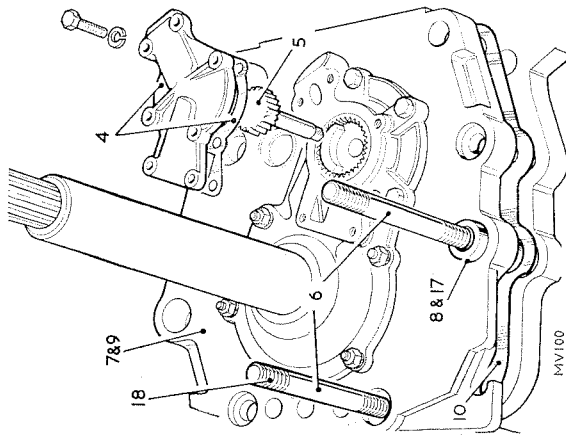
**Removing**

1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Position the gearbox with the front end uppermost.
4. Remove the oil pump gears, cover and joint washer.
5. Withdraw the oil pump drive gear.
6. Temporarily remove the four fixing studs from the gearbox front face.
7. Ease the bearing plate away from the gearbox.
8. Withdraw the two dowel sleeves which locate the bearing plate.
9. Withdraw the bearing plate assembly complete with primary pinion and layshaft.
10. Withdraw the joint washer.
11. Disengage and withdraw the layshaft.

**Refitting**

**NOTE:** If for any reason a new bearing plate is required, a bearing plate and gearbox case matched assembly must be fitted.

12. Locate the cone into the third/fourth-speed synchromesh unit.
13. Lubricate the oil tube, using clean gearbox oil.
14. Position the joint washer.
15. Engage the layshaft with the primary pinion and front bearing outer member.
16. Fit the bearing plate and layshaft.
17. Align the bearing plate with the gearbox casing and slide home the dowel sleeves.
18. Refit the studs. Smear Loctite 'Studlock' grade CVX, Rover Part No. 601168 on the two upper studs securing threads before fitting.
19. Reverse 1 to 5.





FRONT COVER AND OIL PUMP ASSEMBLY

—Remove and refit 37.12.34

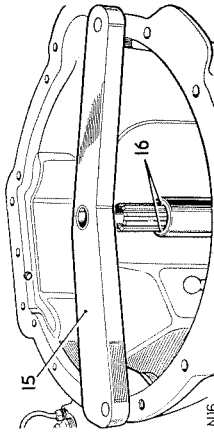
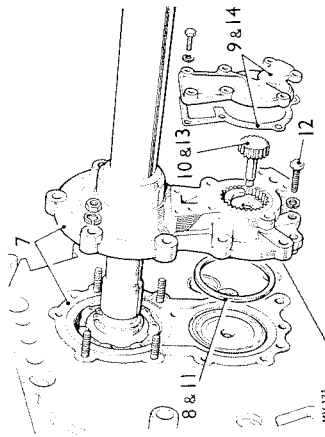
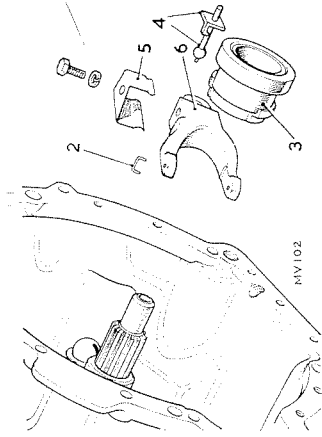
Service tools: RO.1005—Centralising tool for primary pinion.

Removing

1. Remove the gearbox. 37.20.01.
2. Lift out the retainer staple from the clutch release bearing assembly and the release lever.
3. Withdraw the release bearing assembly.
4. Remove the slave cylinder push rod.
5. Remove the spring clip.
6. Withdraw the clutch release lever.
7. Remove the front cover assembly, complete with oil pump and joint washer.
8. Remove the shim washer located between the front cover and the layshaft front bearing.

Refitting

9. Remove the oil pump cover.
10. Withdraw the oil pump drive gear.
11. Position the layshaft bearing shim washer.
12. Position the front cover assembly and loosely fit the fixings.
13. Fit the oil pump drive gear to engage the drive square in the layshaft.
14. Fit the oil pump cover and joint washer.
15. Fit the gauge RO.1005 to align the primary pinion with the bell housing.
16. Visually check that the front cover is concentric about the primary pinion. Adjust the front cover position about its fixings to suit.
17. When satisfactory, tighten the front cover fixings.
18. Reverse 1 to 6.



FRONT COVER AND OIL PUMP ASSEMBLY

—Overhaul 37.12.37

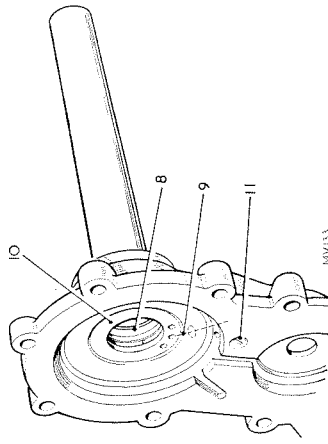
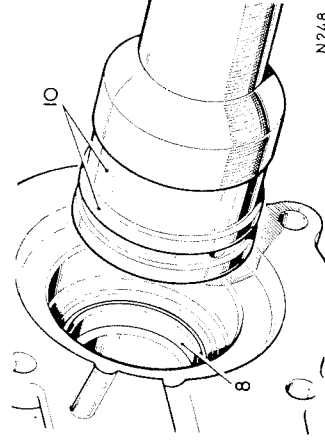
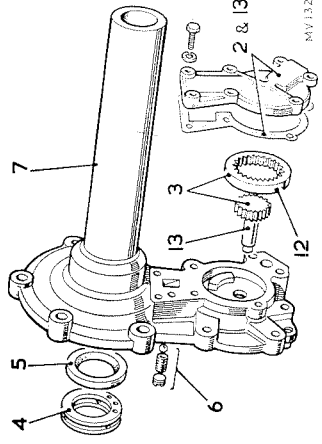
Service tools: 18G134 guide and 18G134DG adaptor—Assembly tool for fitting oil seal and oil feed ring

Dismantling

1. Remove the front cover and oil pump. 37.12.34.
2. Remove the pump cover and gasket.
3. Withdraw the pump gears.
4. Remove the oil feed ring.
5. Withdraw the oil seal.
6. Remove the plug and withdraw the ball and spring from the relief valve housing.
7. If required, drift off the extension sleeve. Fit a replacement using Loctite 'AVV' grade, Rover Part No. 600303.

Assembling

8. Press in the oil seal, plain face first. 18G134 guide, 18G134DG adaptor.
9. Align the centre hole of three in the oil feed ring with the oil delivery hole in the front cover.
10. Press in the oil feed ring. 18G134 guide, 18G134DG adaptor.
11. Fit the ball, spring and plug. When fitted, the plug must be flush with, or not more than, 0.25 mm (0.010 in) below the front cover rear face.
12. Fit the oil pump ring gear.
13. Fit the front cover and oil pump. 37.12.34. During which operation the pump drive gear, cover and joint washer are fitted.



GEARCHANGE CABLE—Transfer gearbox

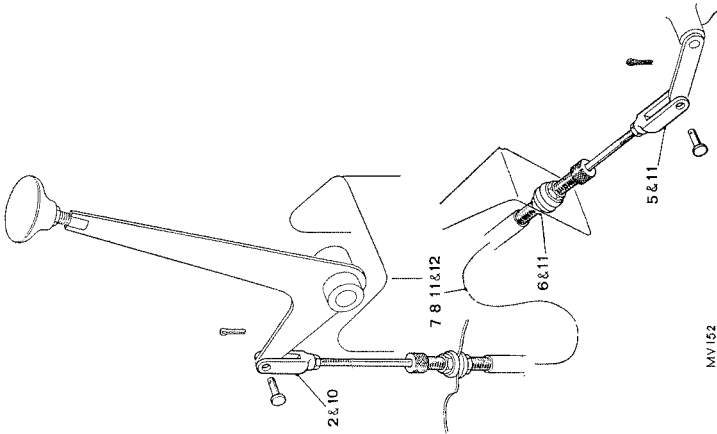
—Remove and refit 37.16.16

**Removing**

1. Remove the radiator grille.
2. Disconnect the cable from the underside of the driver's control lever.
3. Remove the engine compartment lid.
4. Remove the rear compartment gearbox lid.
5. Disconnect the cable from the gearbox.
6. Release the cable from the anchor bracket on the gearbox.
7. Release the cable from the clipping in the gearbox and engine compartments.
8. Withdraw the cable.

**Refitting**

9. Place both, the drivers and the gearbox transfer gear levers in the neutral position.
10. Connect the cable to the driver's gear lever.
11. Locate the cable in the anchor bracket at the gearbox and adjust as necessary, so that it can be connected to the gearbox lever without tension or excessive slack.
12. Clip the cable in position.
13. Reverse 1, 3 and 4.



GEARCHANGE SELECTORS, MAIN GEARBOX

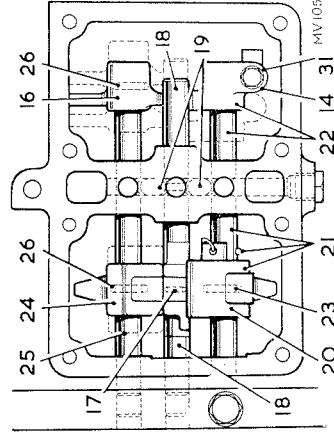
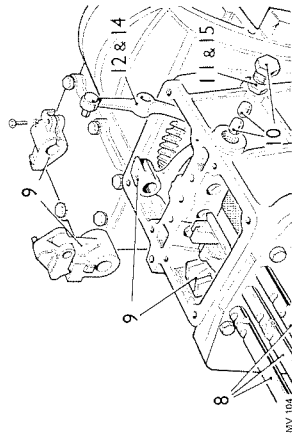
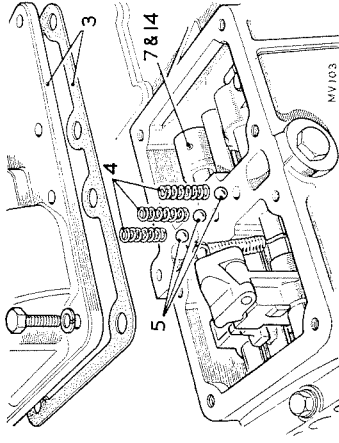
—Remove and refit 37.16.31

**Removing**

1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Select neutral and remove the gearbox top cover and joint washer.
4. Lift out the detent springs.
5. Withdraw the detent balls, using a small magnet or an air blast.
6. Slacken the pinch bolt securing the reverse selector finger.
7. Drive out the four retaining pins until the shafts are free in the selectors.
8. Tap out the selector shafts.
9. Withdraw the selector jaws and forks.
10. Withdraw the two interlock plungers from the cross-drilling.
11. Remove the lock-wired pivot bolt.
12. Lift out the reverse cross-over lever.

**Refitting**

- NOTE:** During refitting, ensure that the retaining pins are an interference fit. Fit new pins as necessary.
13. Withdraw the retaining pins from the selector jaws.
  14. Position the reverse cross-over lever in the gearbox and locate the lever foot in the groove in the reverse idler gear.
  15. Fit the pivot bolt and engage the cross-over lever tapping. Apply Loctite 'Studlock' grade CVX, Rover Part No. 601168 to the bolt threads before screwing fully in. The Loctite must not enter the casing or run on the exposed bolt threads.
  16. Locate the first/second gear selector fork in the groove in the outer member, with the boss on the fork to the rear. Position the boss to the RH side of the box.
  17. Locate the third/fourth gear selector fork in the groove in the outer member. Position the fork with the retaining pin entry hole at the top RH side.
  18. Fit the third/fourth gear selector shaft and interlock pin assembly and secure to the selector fork with a retaining pin.
  19. Fit the two interlock pins to engage in the grooves each side of the third/fourth gear selector shaft.
  20. Position the reverse stop hinge plate and selector jaw in the gearbox, adjacent to the third/fourth gear selector jaw.
  21. Fit the reverse gear selector shaft and engage the selector jaw and hinge spring.
  22. Push the shaft home and engage the reverse cross-over lever selector finger. Do not secure the pinch bolt at this stage.

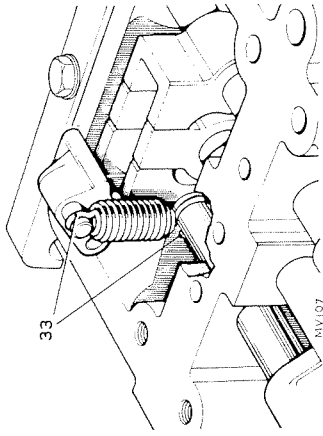
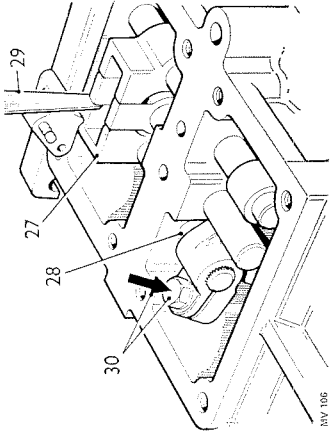


*continued*

23. Secure the reverse gear selector jaw to the shaft with a retaining pin.
24. Position the first/second gear selector jaw in the gearbox.
25. Fit the first/second gear selector shaft; engage the selector jaw and selector fork as the shaft is pushed home.
26. Move the retaining pins, fitting the rear pin first.
27. Fit the reverse shaft forward until the selector jaw abuts the casing.
28. Holding the reverse shaft as described in the previous item, move the reverse selector finger forward on the shaft until it abuts the casing, then move it rearward until it is just clear of the casing.
29. Place a 0,25 mm (0.010 in) feeler gauge between the upper edges of the reverse and third/fourth selector jaws.

**NOTE:** The edges of the selector jaws taper slightly, therefore, it is important that the feeler gauge is positioned between the upper edges.

30. Hold the reverse and third/fourth selector jaws together to retain the feeler gauge, then rotate the reverse selector finger until it abuts the third/fourth selector shaft and tighten the pinch bolt.
  31. Check the operation of the reverse gear selectors assembly. Ensure there is clearance between the cross-over lever and selector finger sufficient to prevent fouling during operation. If necessary, the 0,25 mm (0.010 in) clearance obtained in item 30, can be increased up to 0,5 mm (0.020 in) to produce a smooth gearchange.
  32. Wirelock the cross-over lever pivot bolt.
  33. When fitting the hinge spring to the reverse stop shaft, first engage the large hook around the selector shaft, as illustrated, before fitting the small hook to the reverse stop hinge pin.
- NOTE:** A stronger spring, identified by a yellow paint mark, has been introduced to prevent the reverse selector detent ball sticking. The stronger spring can be fitted in place of the original on earlier gearboxes.
34. Reverse 1 to 5.



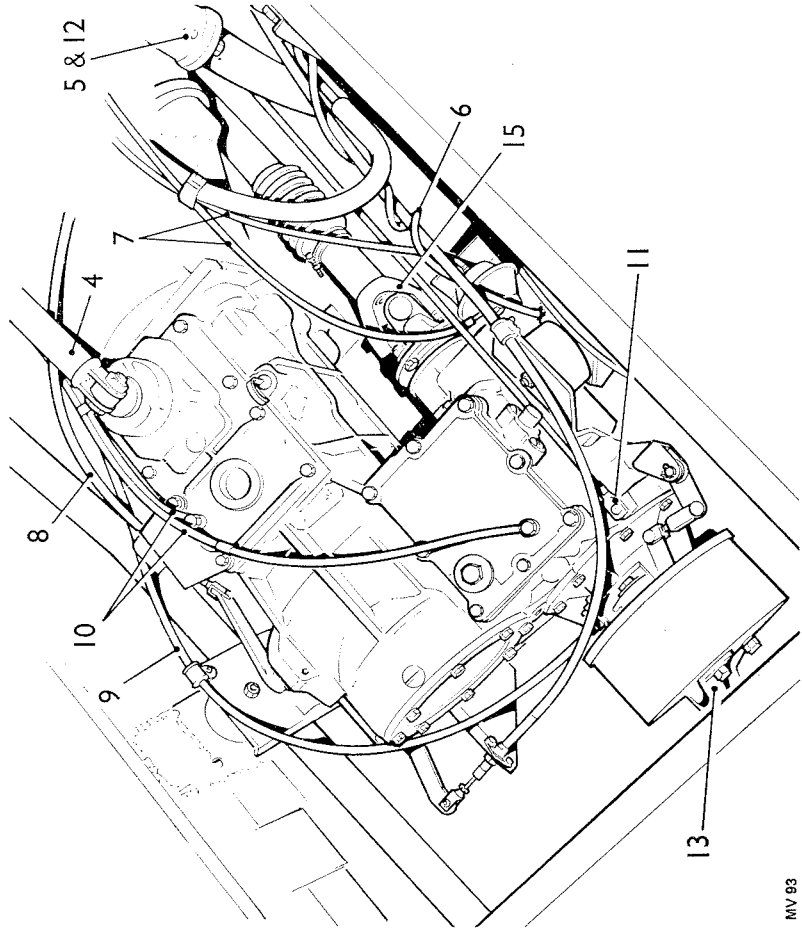
## GEARBOX ASSEMBLY

37.20.01

—Remove and refit  
Service tool: RO 1001 Lifting bracket for gearbox

## Removing

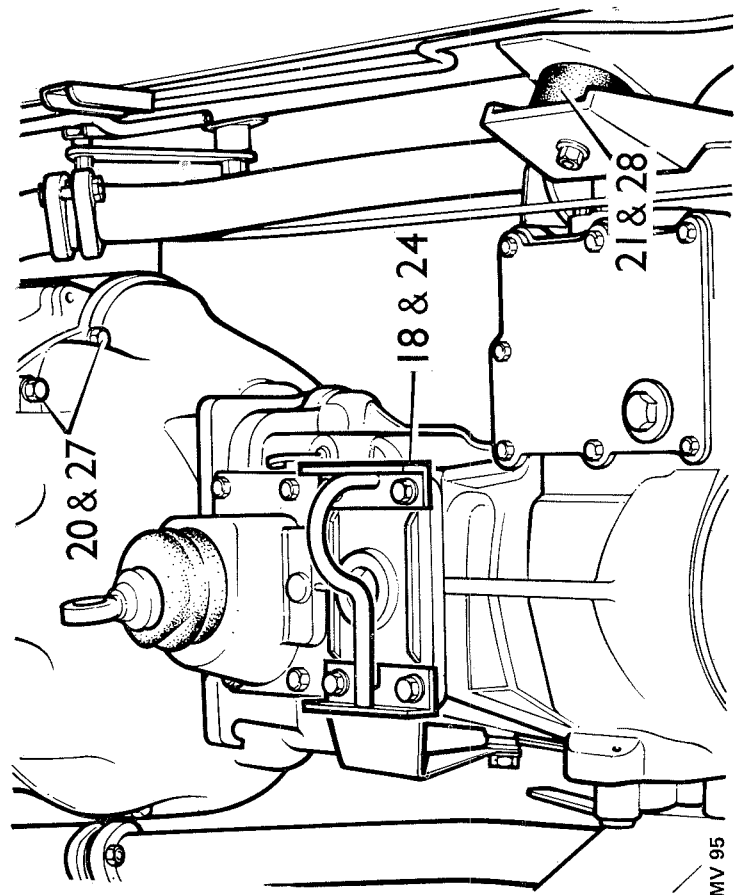
1. If fitted, remove the vehicle hood and hood sticks.
2. If the vehicle is fitted with a winch, remove the winch 90.10.10, and disconnect the winch drive selector cable from the gearbox.
3. Remove the rear compartment gearbox lid.
4. Disconnect the remote control gearchange shaft.
5. Disconnect the front exhaust pipes from the manifolds.
6. Disconnect the electrical leads from the gearbox differential actuator.
7. Disconnect the vacuum pipes from the gearbox differential actuator.
8. Disconnect the speedometer cable and clip.
9. Disconnect the High/Low ratio cable and anchor bracket from the gearbox.
10. Disconnect the breather pipes from the main and transfer gearbox.
11. Disconnect the handbrake rod.
12. Remove the front exhaust pipes.

*continued*

MV 93

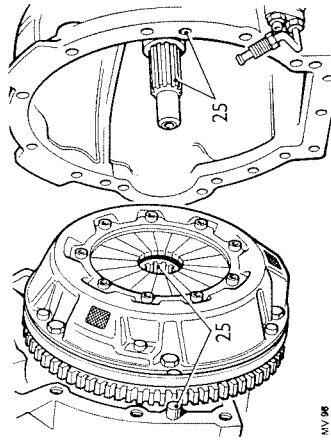
13. Disconnect the rear propeller shaft from the transmission brake drum.
14. If fitted, disconnect the trailer drive selector cable and propeller shaft from the gearbox.
15. Disconnect the front propeller shaft from the gearbox.
16. Remove the clutch slave cylinder.
17. Remove the cover plate from the front of the bell housing.
18. Securely bolt lifting bracket RO 1001 to the gearbox top cover.
19. Attach a hoist to the lifting bracket and tension the hoist.
20. Remove the fixings securing the bell housing to the engine.
21. Place a support under the engine, then remove the gearbox mounting rubbers.
22. Push the gearbox rearward to disengage it from the engine, then raise the gearbox and swing it clear.
23. If required, remove the gearbox lifting bracket.

*continued*

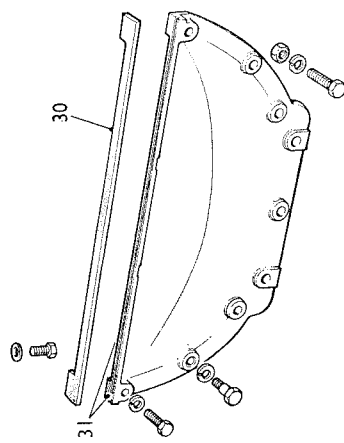


MV 95

- Refitting**
24. If not already fitted, securely bolt lifting bracket RO 1001 to the gearbox top cover.
  25. Spray the spines of the primary pinion, the clutch centre and the withdrawl unit abutment faces with a dry-film lubricant, followed by a smear of molybdenum disulphide grease (ZX35).
  26. Attach a hoist to the gearbox lifting bracket and lower the gearbox into position, locating the primary pinion into the clutch and engage the bell housing dowels.
  27. Secure the bell housing to the engine. Torque: 3,5 kgf.m (25 lbf ft).
  28. Raise the gearbox slightly, refit the gearbox mounting rubbers and remove the engine support.
  29. Remove the gearbox lifting bracket.
  30. If necessary, fit a new seal to the bell housing cover plate, using a cement such as 'Holdite 88'.
  31. Apply 'Hyiomar PL32M' jointing compound to the cover plate and seal, for the joints between the bell housing, cylinder block and rear main bearing cap.
  32. Secure the cover plate to the engine and bell housing. Torque: 1,0 kgf.m (8 lbf ft).
  33. Reverse 4 to 16.
  34. Reverse 1 and 2.
  35. Check the oil level in the main and transfer gearboxes and replenish as necessary.
  36. Refit the rear compartment gearbox lid.



MV 96



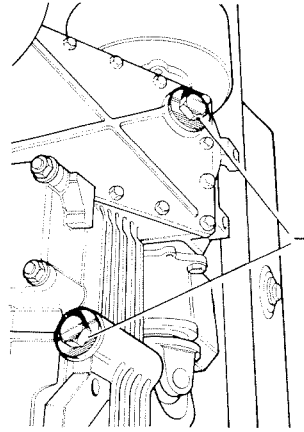
MV 97

REVERSE IDLER GEAR AND SHAFT

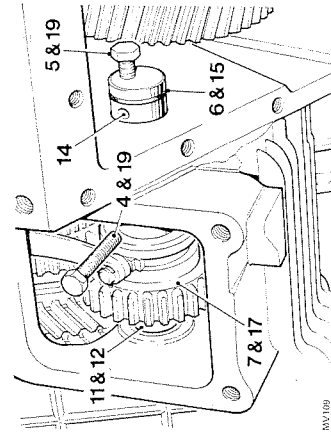
—Remove and refit 37.20.13

Removing

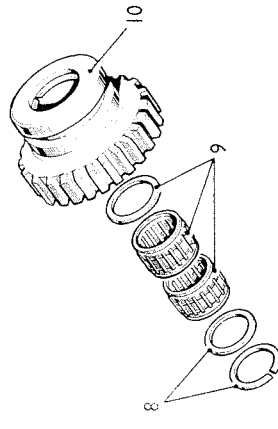
1. Drain the main and transfer gearbox oils.
2. Remove the gearbox side cover.
3. Remove the gearbox bottom cover.
4. Remove the bolt securing the idler gear shaft in the gearbox casing.
5. Withdraw the idler gear shaft, utilising the extractor thread provided.
6. Remove the 'O' ring seal.
7. Lift out the reverse idler gear assembly.
8. Remove the circlip and plain washer.
9. Lift out the needle roller bearings and further plain washer.



MV 108



MV 109



MV 110

Refitting

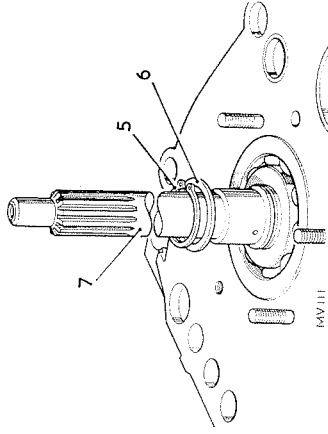
12. If removed, fit the shaft support bush, using 'Loctite' primer grade 'T' and 'AVV' grade, Rover Part No. 600303. (See Note above).
13. Reverse 6 to 11.
14. Offer the idler shaft to the gearbox and align the retaining bolt holes.
15. Smear clean gearbox oil on to the 'O' ring seal.
16. Position the reverse idler gear assembly in the casing.
17. Engage the selector foot in the idler gear groove.
18. Drive in the idler gear shaft until the retaining bolt holes are aligned.
19. Before fitting the retaining bolt, treat the threads with 'Loctite' grade 'T' and allow to dry. Then, fit the bolt using 'Loctite', 'Studlock' grade.
20. Reverse 1 to 3.

PRIMARY PINION

—Remove and refit 37.20.16

Removing

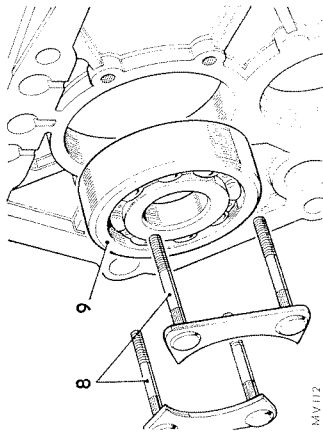
1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Remove the front cover and oil pump assembly. 37.12.34.
4. Remove the bearing plate assembly. 37.12.22.
5. Remove the circlip.
6. Lift off the shim washer.
7. Press out the primary pinion.
8. Withdraw the bearing retaining plates and serrated bolts.
9. Press out the primary pinion bearing.



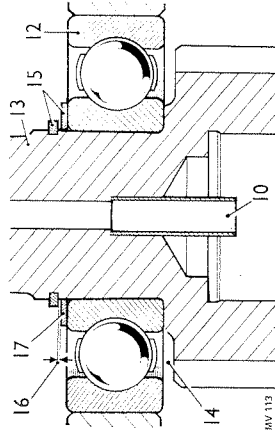
MV 111

Refitting

10. Check that the orifice drilled in the oil tube is clear. During refitting, take care to avoid damage to the oil tube.
11. Support the bearing plate using suitable wooden blocks. Position the blocks across the bearing housing aperture to act as assembly stops.
12. Press in the bearing until flush with the bearing plate.
13. Press in the primary pinion. Check that the bearing remains flush with the bearing plate.
14. Fit the retaining plates and serrated bolts.
15. Fit the shim washer and circlip.
16. Measure the clearance between the circlip and the shim washer. There must be a clearance of 0,05 mm (0,002 in) maximum.
17. If required, adjust the clearance by fitting an alternative thickness shim washer. Shim range is 1,85 to 2,15 mm (0,073 to 0,085 in) in 0,05 mm (0,002 in) stages.
18. Reverse 1 to 4.



MV 112



MV 113

DATA

End float, primary pinion to bearing 0,05 mm (0,002 in) maximum.

LAYSHAFT

—Remove and refit

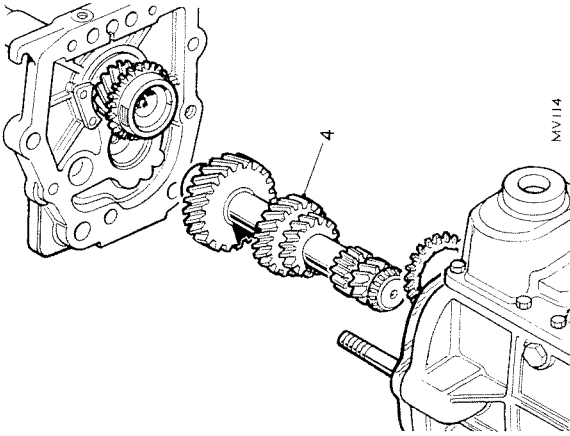
37.20.19

Removing

1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Remove the bearing plate assembly. 37.12.22.
4. Withdraw the layshaft.

Refitting

5. Reverse 1 to 4. Refer to Operation 37.20.22 if a new layshaft or bearings have been fitted.



LAYSHAFT BEARINGS

—Remove and refit

37.20.22

Service tools RO.1004

- Extractor for mainshaft spacer
- 18G284 extractor and 18G284AR adaptor
- Extractor for layshaft rear bearing outer member
- 18G47 press and 18G47BA collars
- Extractor for layshaft bearing inner members

Removing

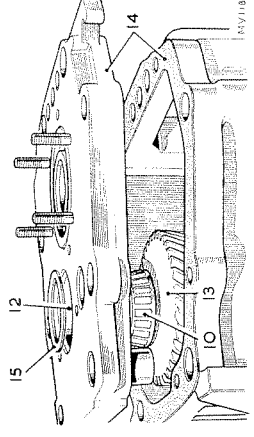
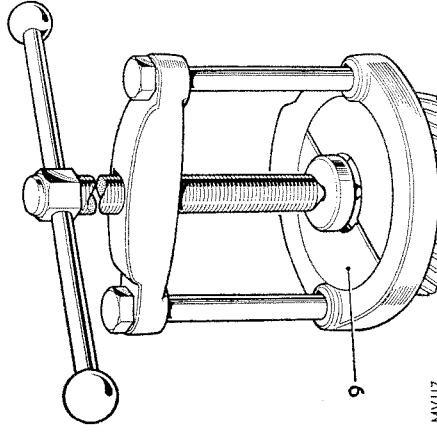
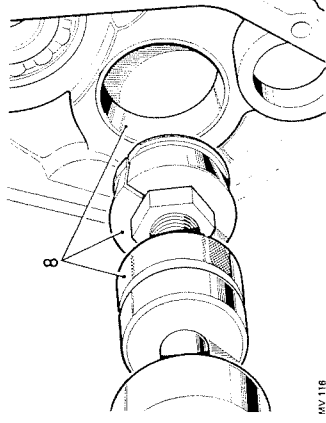
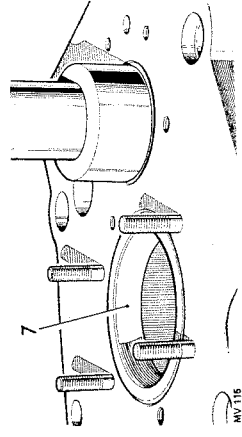
1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Remove the front cover and oil pump assembly. 37.12.34.
4. Remove the front bearing plate assembly. 37.12.22.
5. Remove the main gears selectors. 37.16.31.
6. Remove the mainshaft assembly. 37.20.25.
7. Press out the layshaft front bearing outer member from the front bearing plate.
8. Extract the layshaft rear bearing outer member from the gearbox casing, extractor 18G284 and adaptor 18G284AR. Use a slave nut to retain the adaptor collar halves in the bearing outer member.
9. Withdraw the bearing inner members from the layshaft. Extractor 18G47 press and 18G47BA collars.

Checking the bearing pre-load

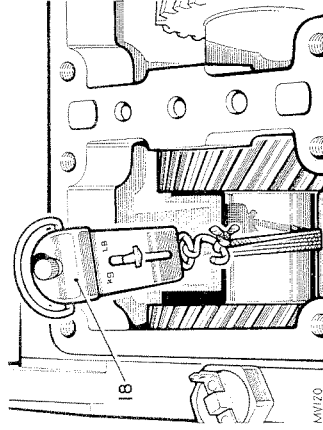
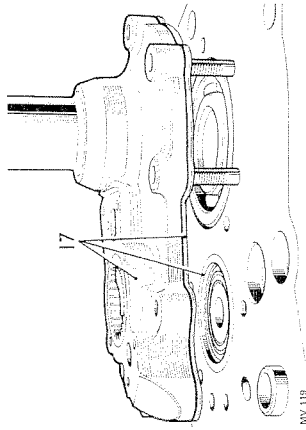
Replacement bearings inner and outer members are supplied as matched pairs and not as separate items. The replacement bearings must not be degreased. Before fitting, lubricate with correct grade gearbox oil.

10. Press the bearing inner members on to the layshaft.
11. Press the rear bearing outer member into the gearbox casing.
12. Enter the front bearing outer member into the front bearing plate. Do not fit fully in at this stage.
13. Position the layshaft in the gearbox casing.
14. Temporarily fit the front bearing plate and joint washer. Press in the front bearing outer member until there is no end-float on the layshaft and no end-load on the bearings.
15. Place a shim washer on the bearing outer member. The shim must be of a suitable thickness to stand proud of the front bearing plate by approximately 0,25 mm (0,010 in). This shim thickness may be subsequently adjusted depending on the amount of bearing pre-load it affords.

continued



16. Temporarily remove the oil pump front cover and withdraw the pump drive gear.
17. Temporarily fit the front cover and new joint washer to the bearing plate. Ensure that the shim washer remains in position.
18. Measure the rolling resistance of the layshaft, using a spring balance and a cord coiled around the layshaft larger diameter.
19. The rolling resistance must be 2,75 to 2,8 kg (6 to 8,5 lb).
20. To adjust the pre-load, fit an alternative thickness shim to the front bearing outer member. Shim range is from 1,55 mm (0,059 in) to 2,50 mm (0,098 in) in 0,05 mm (0,002 in) increments.
21. When the pre-load is satisfactory, remove the front cover assembly.
22. Remove the front bearing plate.
23. Fit the oil pump drive gear and front cover. 37.12.34.
24. Reverse 1 to 6.

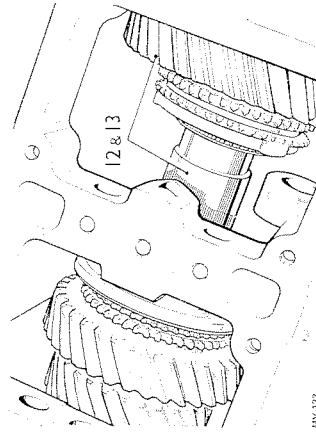
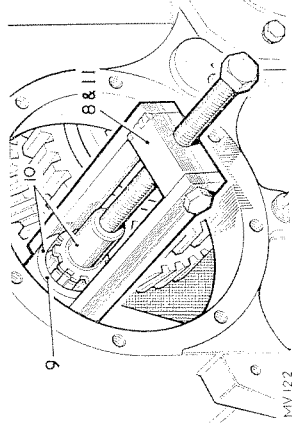
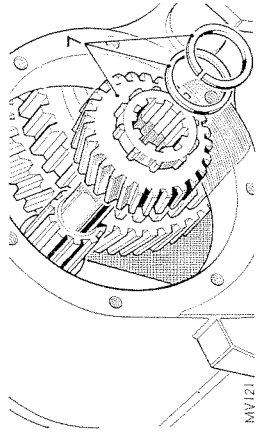


**MAIN SHAFT ASSEMBLY**  
 37.20.25  
**—Remove and refit**  
 Service tools RO.1004. Extractor for mainshaft spacer.

**Removing**

1. Remove the gearbox. 37.20.01.
2. Remove the bell housing. 37.12.07.
3. Remove the front bearing plate. 37.12.22.
4. Remove the main gearchange selectors. 37.16.31.
5. Remove the mainshaft rear bearing housing and roller bearing.
6. Remove the bottom cover from the transfer gearbox.
7. Remove the snap ring, shim washer and mainshaft transfer gear.
8. Fit extractor RO.1004 to transfer gear spacer.
9. Withdraw the spacer along the mainshaft until the larger diameter on the spacer reaches the transfer gear lever cross-shaft.
10. Tap the mainshaft forward and withdraw the spacer.
11. When the spacer is free on the mainshaft remove the extractor.
12. Withdraw the mainshaft assembly, allowing the first-speed gear to remain behind to avoid fouling on the casing.
13. Lift out the first-speed gear.
14. Refit the first-speed gear, scalloped thrust washer, thrust needle bearing and stepped thrust washer, stepped face outwards.
15. Withdraw the mainshaft spacer.

*continued*

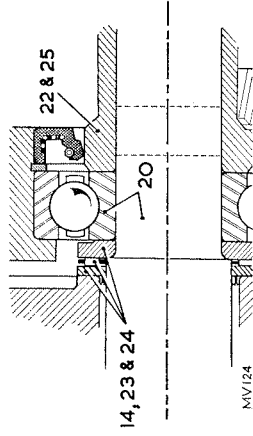


**Refitting**

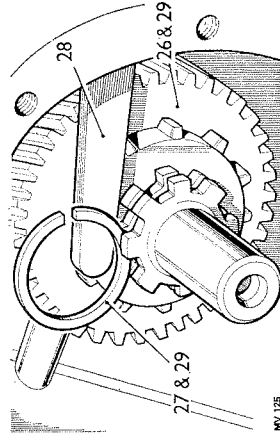
16. Position the gearbox with the RH side downwards to aid refitting.
17. Remove the gearbox side cover.
18. Temporarily move the first-speed gear toward the rear of the shaft.
19. Offer the assembled mainshaft to the gearbox and manoeuvre the first-speed gear past the reverse idler gear.
20. Engage the shaft into the main bearing.
21. Engage the first/second gear synchronesh outer member and the reverse idler gear.
22. Push the mainshaft home sufficient to allow the mainshaft spacer to be located on the rear end, with the spacer larger diameter forward of the transfer gear lever cross-shaft.
23. Re-position the first-speed gear, thrust washers and thrust needle bearing correctly on the mainshaft.
24. Push the mainshaft fully home, ensuring that the thrust washers and needle bearing remain correctly located against the first-speed gear.
25. Move the mainshaft spacer along the shaft, and into the oil seal, to abut the main bearing.
26. Temporarily fit the mainshaft transfer gear.
27. Position the snap ring in the groove in the mainshaft.
28. Hold the mainshaft fully to the rear and measure the clearance between the snap ring and the transfer gear. Select a shim washer to allow 0,05 mm (0,002 in) maximum clearance between the snap ring and transfer gear when fitted. Shim range 1,8 to 2,0 mm (0,071 to 0,079 in) in 0,05 mm (0,002 in) increments.
29. Temporarily remove the snap ring and the mainshaft transfer gear.
30. Slide back the mainshaft spacer as far as the transfer gear lever cross-shaft will allow.
31. Apply a thin coating of 'Loctite A VV' grade, Rover Part No. 600303 to the exposed area of the mainshaft.
32. Push home the mainshaft spacer.
33. Fit the mainshaft transfer gear.
34. Fit the previously selected shim washer and secure with the snap ring.
35. Reverse 1 to 6.

**DATA**

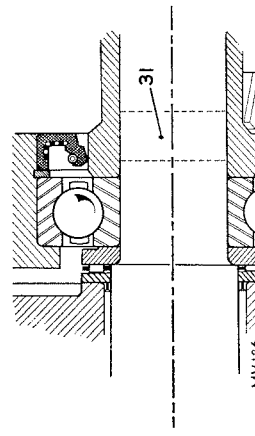
Transfer gear end float 0,05 mm (0,002 in) maximum.



MV124



MV125



MV126

**MAINSHAFT TRANSFER GEAR**

—Remove and refit

37.20.28

**Removing**

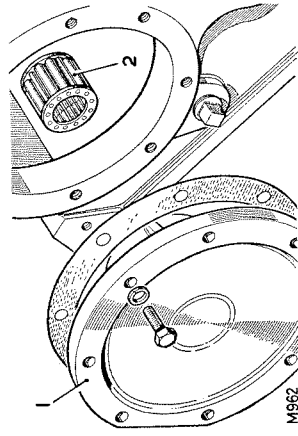
1. Remove the mainshaft rear bearing housing.
2. Lift out the roller bearing.
3. Remove the snap ring.
4. Withdraw the shim washer.
5. Lift out the transfer gear.

**Refitting**

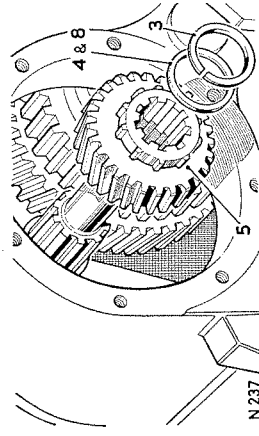
6. Fit the transfer gear to the mainshaft.
7. Fit the shim washer and snap ring.
8. Check the end float between the shim washer and snap ring. End float must be 0,05 mm (0,002 in) maximum. If necessary, fit an alternative thickness shim washer. Shim range 1,8 to 2,0 mm (0,071 to 0,079 in) in 0,05 mm (0,002 in) increments.
9. Fit the roller bearing and rear bearing housing.

**DATA**

Transfer gear end float 0,05 mm (0,002 in) maximum.



M962



N 237



**MAINSHAFT ASSEMBLY**

37.20.31

**—Overhaul**

**Dismantling**

1. Remove the mainshaft assembly, 37.20.25.
2. Withdraw the first-speed gear, thrust washers and roller bearings from the rear of the shaft.
3. Remove the snap ring and shim washer from the front of the shaft.
4. Lift off the third/fourth gears synchronmesh assembly.
5. Withdraw the third and second-speed gears and the associated thrust washers and needle roller bearings.
6. Dismantle the third/fourth gears synchronmesh assembly, first pushing down the sliding blocks to free the synchronmesh balls from the retaining groove in the outer member.
7. Dismantle the first/second gears synchronmesh assembly in a similar manner.
8. Withdraw the oil seal from the bore in the mainshaft front end.

**Assembling**

9. Replacement thrust washers and roller bearings must not be degreased.
10. Lubricate all items before assembly, using clean main gearbox oil.
11. Fit the oil seal to the mainshaft front end.

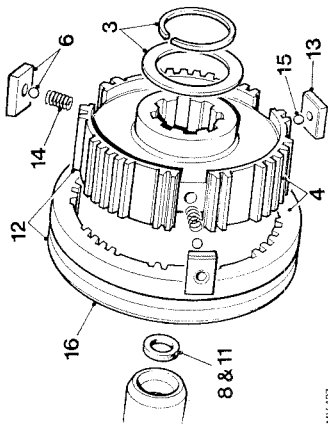
**Assembling the synchronmesh units**

12. Fit together the third/fourth gear synchronmesh outer and inner members, outer member coned face toward inner member plain face.
13. Fit the sliding blocks, radiused face outward.
14. Locate the springs through the sliding blocks into the housing bores in the inner member.
15. Position the balls on the spring ends, press home in sequence and retain by hand.
16. Lift the outer member to retain the balls. Continue lifting until the balls spring home into the annular groove in the outer member.
17. Assemble the first/second gear synchronmesh unit in the manner described for third/fourth gear unit. Fit the outer member coned face toward the front end of the mainshaft.

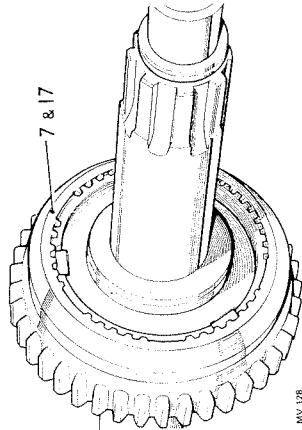
**Assembling the mainshaft front end**

18. Fit a synchronmesh cone to the first/second gear synchronmesh outer member.
19. Position a chamfered thrust washer, a thrust needle bearing and a scalloped thrust washer on the mainshaft.
20. Fit a needle roller bearing and the second-speed gear.

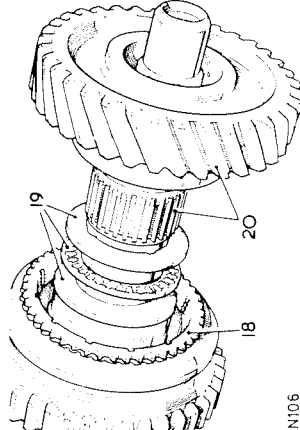
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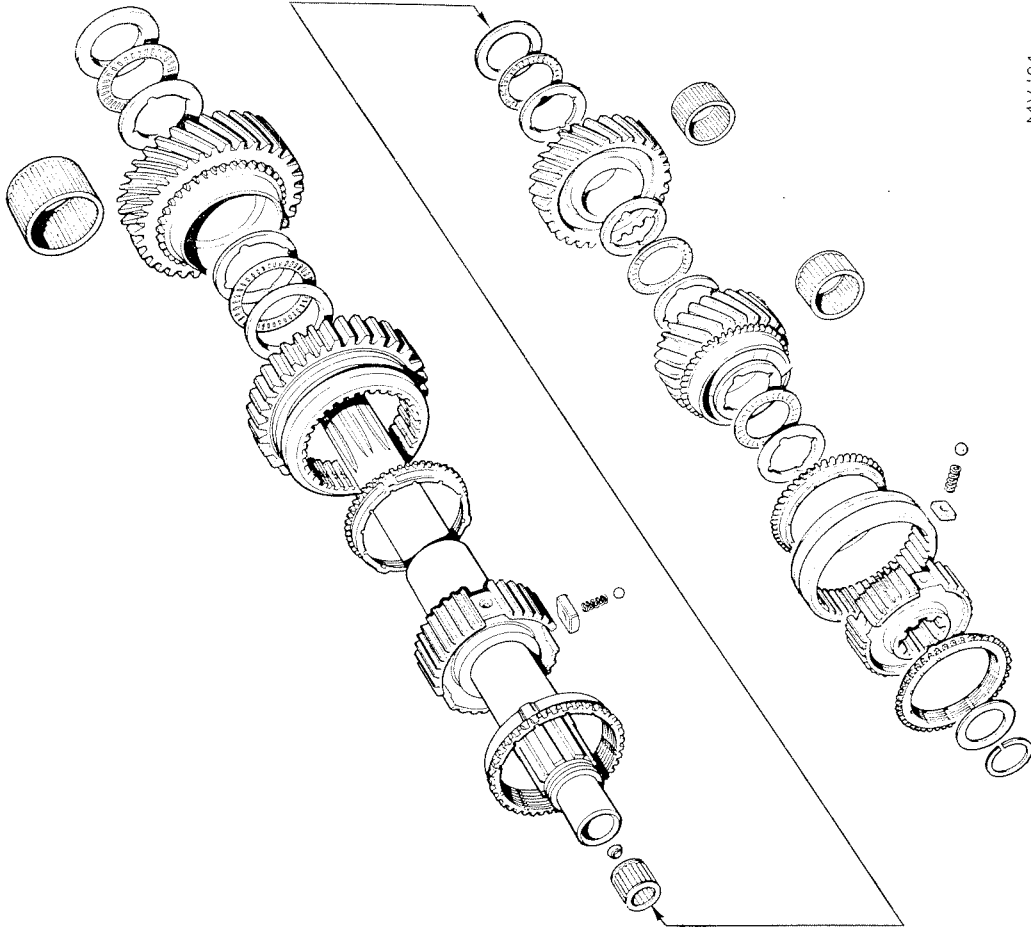
MV 127



MV 128



MV 106



MV 134

*continued*

21. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
22. Fit a radial needle bearing and the third-speed gear.
23. Fit a scalloped thrust washer, a thrust needle bearing and a further scalloped thrust washer.
24. Position a synchronmesh cone on to the third-speed gear.
25. Fit the synchronmesh unit, coned face to rear.

**Setting the gears end-float**

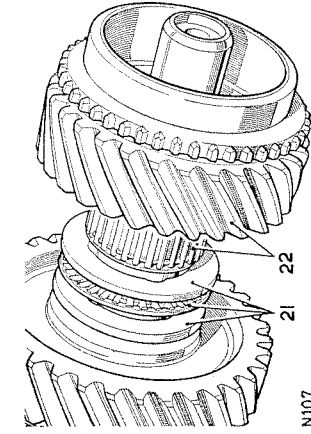
26. Position the mainshaft assembly vertical, front end uppermost.
27. Apply a light loading on the gears to remove end-float.
28. Position the snap ring in the mainshaft groove.
29. Measure the distance between the snap ring lower edge and the synchronmesh unit inner member.
30. Select a shim to reduce the measured clearance to 0,025 to 0,150 mm (0,001 to 0,006 in when fitted).  
Shim range is 1,85 to 2,45 mm (0,073 to 0,096 in) in 0,15 mm (0,006 in) increments.
31. Fit the selected shim washer and the snap ring.

**Assembling the mainshaft rear end**

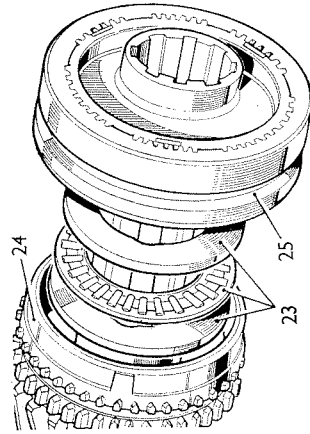
32. Fit a synchronmesh cone to the first/second gear synchronmesh outer member.
33. Position a chamfered thrust washer, a thrust needle bearing and a scalloped thrust washer on the mainshaft.
34. Fit a needle roller bearing and the first-speed gear.
35. Fit a scalloped thrust washer, a thrust needle bearing and the stepped thrust washer, stepped face outwards.
36. The mainshaft spacer, transfer gear, shim washer and snap ring are fitted during mainshaft refitting.
37. Refit the mainshaft. 37.20.25.

**DATA**

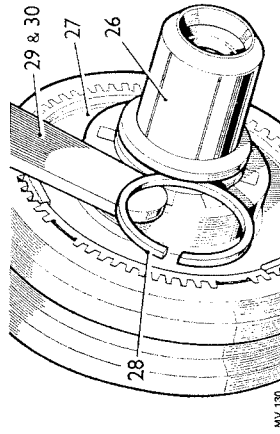
End-float on gears 0,025 to 0,150 mm (0,001 to 0,006 in).



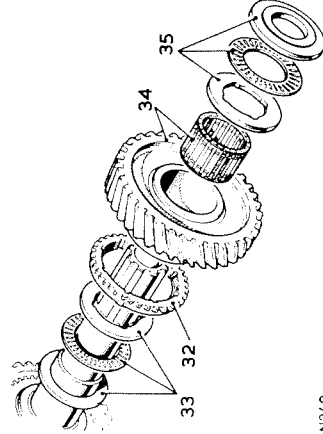
N107



N108



N109



N240

**REAR OUTPUT SHAFT OIL SEAL**

—Remove and refit

37.23.01

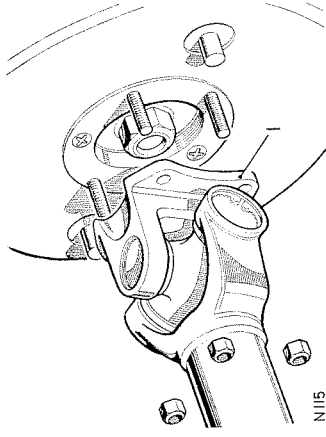
**Removing**

**CAUTION:** Chock the vehicle wheels before commencing this operation as it is necessary to release the parking brake during the following procedure.

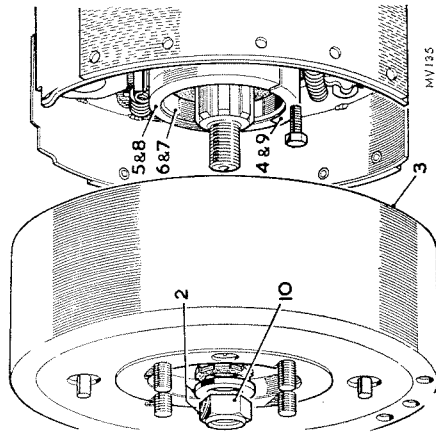
1. Disconnect the rear propeller shaft at the transmission brake.
2. Remove the locking nut, washer and felt seal.
3. Withdraw the transmission brake drum complete with rear coupling flange.
4. Remove the oil catcher.
5. Prise off the oil shield.
6. Withdraw the oil seal.

**Refitting**

7. Press in the oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.
8. Fit the oil shield, which must be a close fit on the speedometer housing.
9. Fit the oil catcher, applying Bostik compound 771 to seal the oil catcher against the brake back plate.
10. Reverse items 1 to 3, torque tightening the following fixings:  
Locking nut for coupling flange 16,5 kgf.m (120 lbf ft).  
Nuts for propeller shaft 4,8 kgf.m (35 lbf ft).



N115



MV135

## FRONT OUTPUT SHAFT OIL SEAL

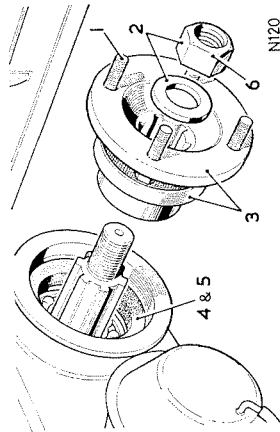
—Remove and refit 37.23.06

## Removing

1. Disconnect the front propeller shaft.
2. Remove the coupling flange locknut and washer.
3. Withdraw the coupling flange complete with mudshield.
4. Withdraw the oil seal.

## Refitting

5. Fit the oil seal, open side first.
6. Reverse items 1 to 3, torque tightening the following fixings:  
Locking nut for coupling flange 11,75 kgf.m (85 lbf ft).  
Nuts for propeller shaft 4,8 kgf.m (35 lbf ft).



## SPEEDOMETER DRIVE HOUSING

—Remove and refit 37.25.09

## Removing

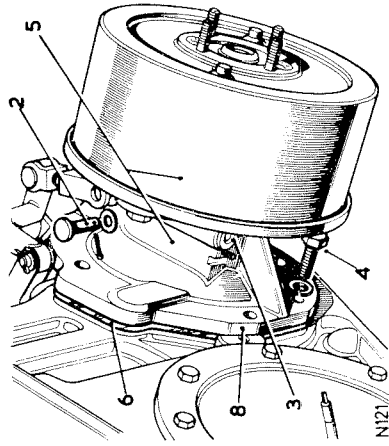
**CAUTION:** Chock the vehicle wheels before commencing this operation as it is necessary to release the parking brake during the following procedure.

1. Disconnect the rear propeller shaft at the transmission brake.
2. Remove the clevis pin to disconnect the handbrake linkage.
3. Disconnect the speedometer drive cable.
4. Remove the fixings, speedometer drive housing to gearbox casing.
5. Withdraw the speedometer drive housing complete with transmission brake.

## Refitting

**NOTE:** If a replacement speedometer drive housing is being fitted, carry out the 'Differential bearings pre-load check' in 'Speedometer drive housing-overhaul'. 37.25.13.

6. Position the joint washer.
7. Offer the drive housing to the gearbox and engage the rear output shaft splines in the differential unit.
8. Position the flat on the drive housing adjacent to the flat on the intermediate shaft.
9. Reverse 1 to 4, torque load for the propeller shaft fixings is:  
4,8 kgf.m (35 lbf ft).  
Torque load for speedometer drive housing fixings is,  
3,1 kgf.m (22 lbf ft).



SPEEDOMETER DRIVE HOUSING

37.25.13

—Overhaul

Dismantling

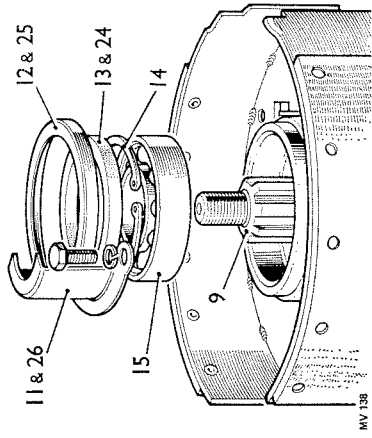
1. Remove the speedometer drive housing. 37.25.09.
2. Remove the speedometer spindle housing.
3. Lift out the driven gear and spindle.
4. Take off the 'O' ring seal.
5. Remove the thrust washer.
6. Withdraw the oil seal.
7. Remove the locking nut, washer and felt seal, output coupling flange to output shaft.
8. Withdraw the brake drum and coupling flange complete.
9. Drive out the rear output shaft, using a hide mallet on the threaded end.
10. Slide off the spacer and speedometer worm.
11. Remove the oil catcher.
12. Withdraw the oil shield.
13. Withdraw the oil seal.
14. Remove the circlip.
15. Tap out the ball bearing.

Differential bearing pre-load check, items 16 to 22 inclusive.

This check must be carried out if a replacement speedometer drive housing is to be fitted. The check is also required if a replacement gearbox, differential unit or differential unit bearing is being fitted.

16. Measure and record the thickness of the new joint washer for the speedometer drive housing.
17. Offer the speedometer housing, less joint washer, to the gearbox.
18. Engage the differential unit bearing inner member with the outer member in the drive housing.
19. Measure the clearance between the drive housing and gearbox joint faces. This must be 0,05 mm (0.002 in) more than the recorded thickness of the new joint washer.
20. To adjust the joint face clearance, adjust the thickness of shimming fitted behind the rear bearing outer face as follows: 21 and 22.
21. Drive out the bearing outer race.
22. Withdraw the shim washer and select a replacement of the required thickness. Shim thickness range is 1,65 to 2,80 mm (0.065 to 0.110 in) in 0,05 mm (0.002 in) stages.

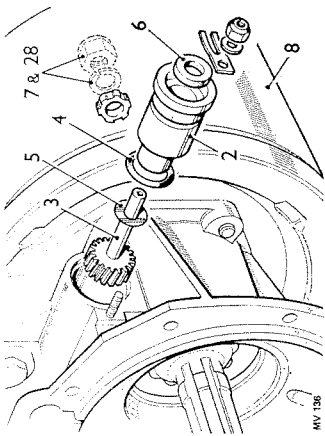
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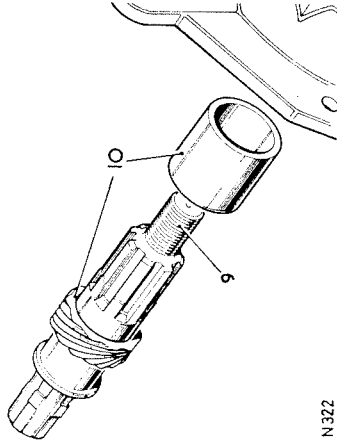
MV 138

Reassembling

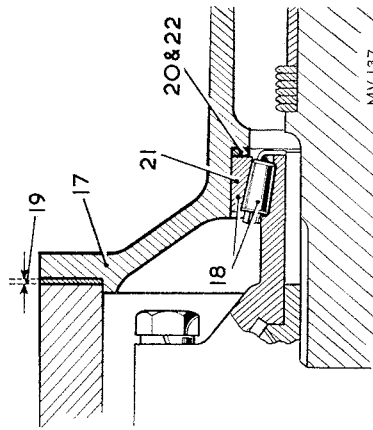
23. Reverse items 14 and 15.
24. Press in the output coupling flange oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.
25. Fit the oil shield, which must be a close fit on the speedometer housing.
26. Fit the oil catcher, applying Bostik compound 771 to seal the oil catcher against the brake backplate.
27. Reverse items 8, 9 and 10.
28. Fit the felt seal, plain washer and locking nut to secure the output flange. Torque: 16,5 kgf.m (120 lbf ft).
29. Reverse 1 to 6.



MV 136



N322



MV 137

DIFFERENTIAL LOCK ACTUATOR SWITCH

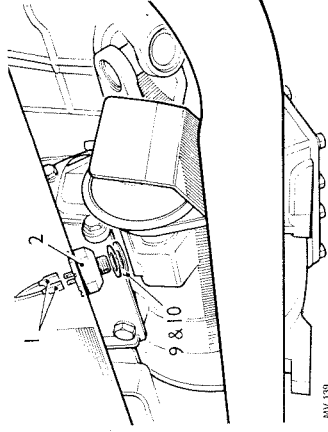
—Remove and refit 37.27.05

Removing

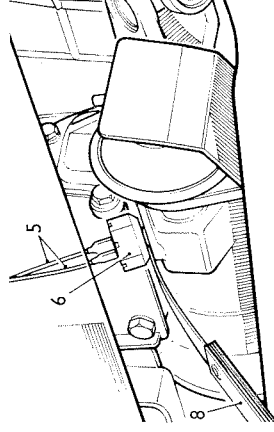
1. Disconnect the electrical leads at the switch.
2. Unscrew the switch.

Refitting

3. Start the engine.
4. Move the differential lock vacuum control valve to the 'up' position.
5. Connect the electrical leads to the actuator switch.
6. Screw in the switch, less shim washers, until the switch contacts are made.
7. Screw in a further half turn.
8. Measure the clearance between the switch lower face and the housing.
9. Select shim washers to suit the clearance. Shim thicknesses are 0,5 mm (0.020 in) and 0,127 mm (0.005 in).
10. Fit the selected shim washer/s and the switch.
11. Reverse 3 and 4.



MV 139



MV 140

GEAR LEVER AND CROSS-SHAFT, TRANSFER GEARBOX

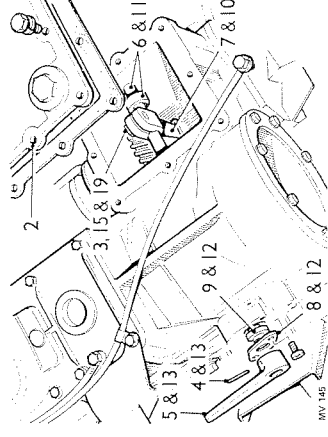
—Remove and refit 37.29.01

Removing

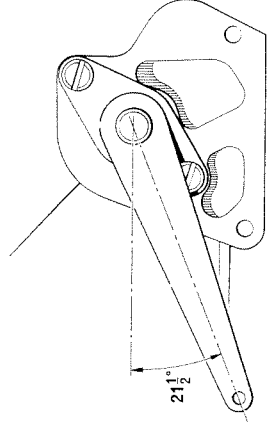
1. Remove the gearbox assembly, 37.20.01.
2. Remove the top cover from the transfer gearbox.
3. Slacken the selector finger pinch bolt.
4. Drive out the retaining pin, gear lever to cross-shaft.
5. Withdraw the gear lever.
6. Withdraw the cross-shaft and distance collar.
7. Lift out the selector finger.
8. Remove the retaining plates.
9. Withdraw the sealing rings.

Refitting

10. Position the selector finger in the gearbox.
11. Fit the cross-shaft and spacing collar and engage the selector finger.
12. Fit the sealing ring and retaining plate at the LH side of the gearbox.
13. Fit the gear lever and retaining pin.
14. Fit the remaining sealing ring and retaining plate.
15. Tighten the selector finger pinch bolt.
16. Select 'High' transfer range, that is, the larger intermediate gear engaged.
17. Slacken the selector finger pinch bolt.
18. Rotate the cross-shaft until the gear lever is inclined forward and downward at an angle of  $21\frac{1}{4}^\circ$  relative to the transmission centre line.
19. Tighten the selector finger pinch bolt.
20. Reverse 1 and 2.



MV 146



MV 146

GEAR SELECTORS AND SHAFT, TRANSFER GEARBOX

—Remove and refit 37.29.04

Removing

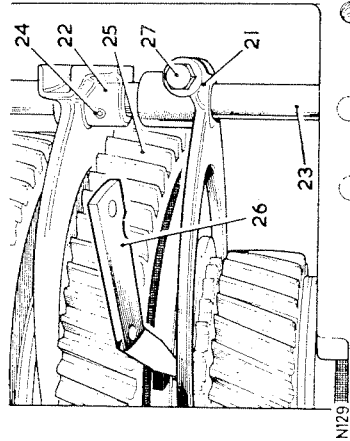
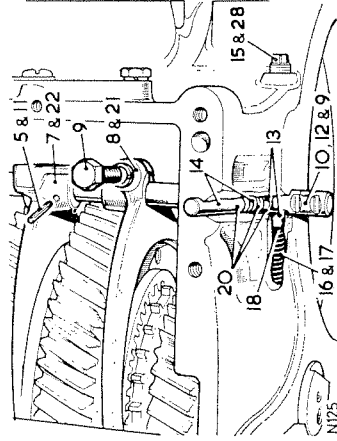
1. Remove the rear compartment gearbox lid.
2. Remove the speedometer drive housing. 37.25.09.
3. Remove the transfer gearbox top cover.
4. Select 'Low' range transfer gear.
5. Drive out the retaining pin from the front selector fork sufficient to free the fork.
6. Ease the differential unit to the rear.
7. Push the forward selector fork forward on the shaft.
8. Pull to the rear on the rear selector fork to move the selector shaft out of engagement with the detent balls in the casing rear face.
9. Remove the pinch bolt on the rear fork.
10. Partially withdraw the selector shaft and lift out the selector forks.
11. Remove the retaining pin from the front fork.
12. Withdraw the selector shaft, closing the shaft housing by hand to prevent the detent balls from dropping into the casing.
13. Withdraw the two detent balls.
14. Lift out the spacing rod and spring.
15. Remove the closing plug.
16. Withdraw the detent spring from the cross drilling.

Refitting

17. Position the detent spring in the inner bore in the cross drilling.
18. Locate the detent ball on the spring.
19. Enter the selector shaft, push the ball against the spring and push in the shaft.
20. Fit the detent ball, spring and spacing rod to the vertical drilling.
21. Position the rear selector fork, plain face to rear, in the gearbox.
22. Position the front selector fork, extended boss to the rear, in the gearbox.
23. Align the retaining pin holes and engage the selector shaft in the selector forks.
24. Fit the retaining pin, front fork to shaft.
25. Set transfer gears in 'Neutral' position.
26. Adjust the rear fork position until there is 0.12 to 0.25 mm (0.005 to 0.010 in) clearance between the front face of the rear fork and the rear face of the input gear inner member.
27. Tighten the rear fork pinch bolt.
28. Fit the closing plug to the cross drilling.
29. Reverse 1 to 3.

DATA

Clearance for selectors 0,12 to 0,25 mm (0.005 to 0.010 in).



INTERMEDIATE GEARS ASSEMBLY

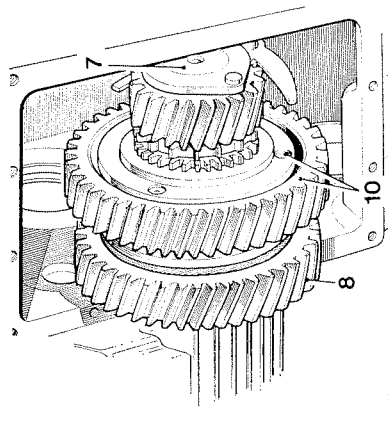
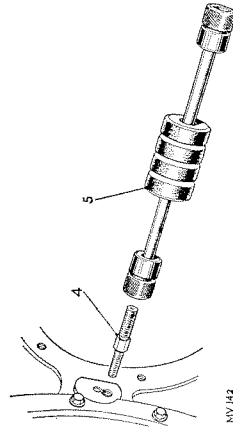
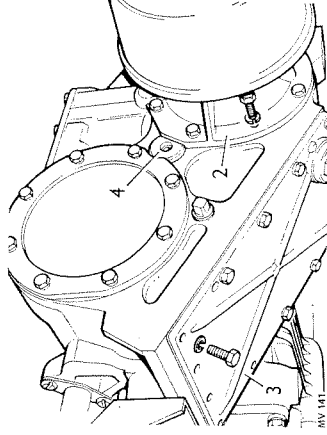
—Remove and refit 37.29.10

Service tools: RO.1003—Slave intermediate shaft 18G284AT—Adaptor for intermediate gear shaft removal 18G284—Impulse extractor (basic tool) (U.N.F.)

Removing

1. Drain the transfer gearbox oil.
2. Remove the speedometer drive housing. 37.25.09.
3. Remove the gearbox bottom cover.
4. Screw the adaptor 18G284AT into the threaded hole provided in the intermediate gear shaft.
5. Screw the impulse extractor 18G284 on to the adaptor.
6. Hold the intermediate gear cluster in position and withdraw the shaft.
7. Insert the slave shaft RO.1003 to retain together the gears assembly.
8. Withdraw the intermediate gears assembly.
9. Slide the thrust washers, bearings and gears from the slave shaft.
10. The input gear and outer member is a riveted assembly and no dismantling is permitted.
11. Remove the 'O' ring seal from the intermediate gear shaft.

*continued*



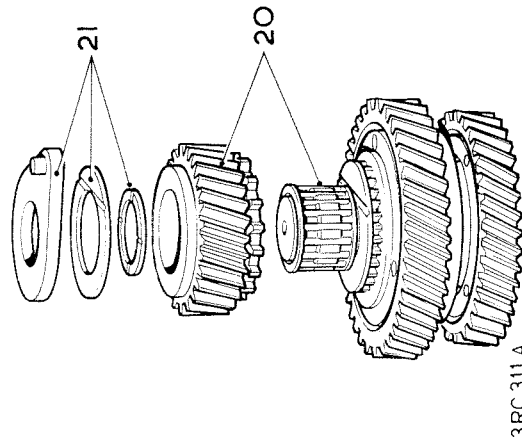
**Inspecting**

12. Examine all parts for wear, damage and general condition. Renew as necessary.

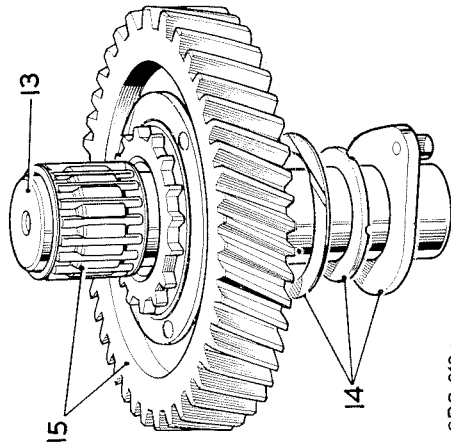
**Refitting**

13. Place the slave shaft on the bench, extractor thread end uppermost.
14. Fit a pear shaped thrust washer, inner ring and a thrust bearing washer to the shaft (ring grooved face downwards).
15. Fit a needle roller bearing and the 'high' gear (plain face first) to the shaft.
16. Position a thrust bearing washer on the 'high' gear.
17. Fit a spacer, needle roller bearing and a further spacer to the input gear inner member.
18. Position the assembled input gear on the shaft and engage the lower spacer in the previously positioned thrust bearing washer.
19. Locate a thrust bearing washer over the upper spacer.
20. Fit a needle roller bearing and the 'low' gear (plain side last) to the shaft.
21. Fit the remaining thrust needle bearing, inner ring and thrust washer (ring grooved face upwards).

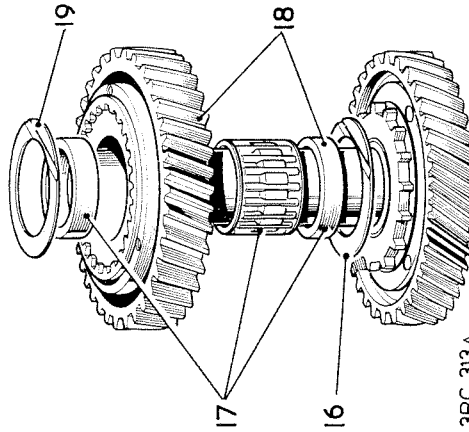
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3RC 311 A



3RC 312 A



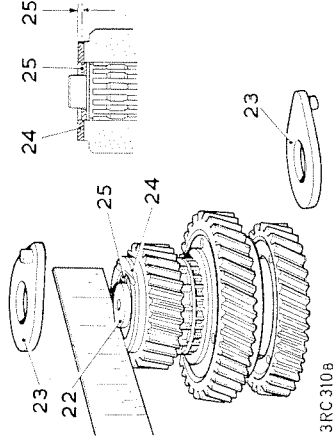
3RC 313 A

The following procedure, 22 to 27, must be completed before refitting the intermediate gears into the transfer gearbox, to ensure that there is sufficient running clearance for the bearings.

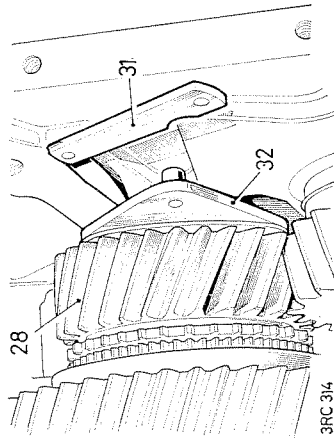
22. With the intermediate transfer gear assembly located on the slave shaft RO.1003, place the complete assembly on a surface plate with the low gear uppermost.
23. Remove the two pear-shaped thrust washers, one situated at each end of the gear assembly.
24. Place a suitable straight edge across the thrust bearing washer.
25. Check that a clearance (end float) exists between the straight edge and the inner ring, to ensure a running clearance when the assembly is installed.
- CAUTION: DO NOT** refit the assembly with the needle roller bearings in a pre-load condition.
26. If there is no clearance between the straight edge and the inner ring, use selective assembly of alternative components to obtain the required condition.
27. In the event of selective assembly not giving clearance, it is permissible to face down each spacer on a surface plate to a maximum of 0.13 mm (0.005 in).
28. When the foregoing bearing clearance check has been completed, slide the gears and slave shaft assembly into the transfer gearbox and engage the selector forks.
29. Withdraw the slave shaft and lubricate the bearings through the shaft aperture.
30. Fit the intermediate shaft and 'O' ring seal with the flat on the shaft toward the differential unit.
31. Measure the clearance between the rear thrust washer and the gear casing. This must be 0.22 to 0.36 mm (0.009 to 0.014 in).
32. Adjustment is carried out by substituting one or both of the thrust washers. The washers are available in 3.55 mm (0.139 in), 3.63 mm (0.143 in) and 3.74 mm (0.147 in) thicknesses.
33. Refit the gearbox bottom cover.
34. Refit the speedometer drive housing. 37.25.09.
35. Refill the transfer gearbox to the correct level.

**DATA**

Gears end float 0.22 to 0.36 mm (0.009 to 0.014 in).



3RC 310 A



3RC 314

DIFFERENTIAL UNIT

—Remove and refit 37.29.13

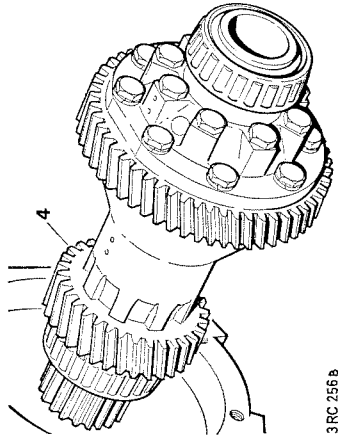
Removing

1. Remove the differential lock actuator assembly. 37.29.19.
2. Remove the front output shaft and housing. 37.10.05.
3. Remove the speedometer drive housing. 37.25.09.
4. Withdraw the differential unit.

Refitting

5. Refit the differential unit.
6. Refit the speedometer drive housing. 37.25.09.
7. Refit the front output shaft and housing. 37.10.05.
8. Refit the differential lock actuator assembly. 37.29.19.

**NOTE:** If a replacement differential unit is being fitted, carry out the 'Differential bearing pre-load check', described in 'Speedometer drive housing overhaul'. 37.25.13.



3RC 756 B

DIFFERENTIAL UNIT

—Overhaul 37.29.16

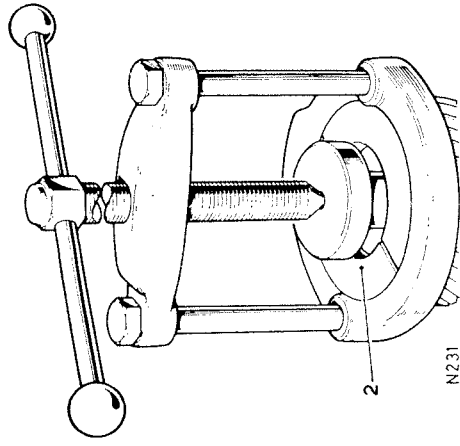
Service tool: 18G47BB Bearing extractor

Dismantling

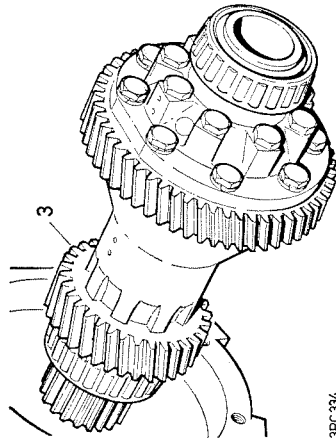
**NOTE:** During dismantling it is essential that all components are marked in their original position and relative to other components, so that if original components are refitted, their initial setting is maintained.

1. Remove the differential unit. 37.29.13.
2. Press off the roller bearings using tool 18G47BB.
3. Withdraw the high speed gear.
4. Remove the fixings, low speed gear to casing.
5. Withdraw the gear.
6. Remove the casing securing bolts.

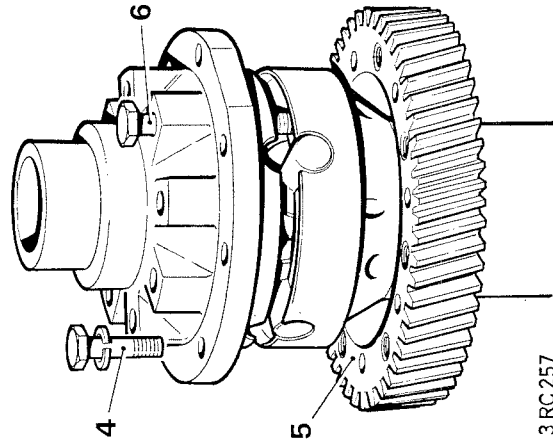
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N231



3RC 334



3 RC 257



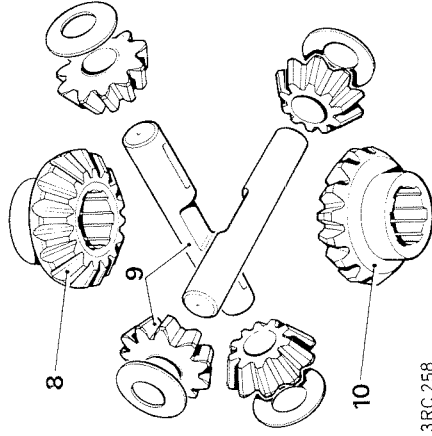
7. Lift off the rear case assembly.
8. Withdraw the side gear.
9. Slide out the cross shafts and remove the bevel pinions and thrust washers from the front case assembly.
10. Withdraw the side gear to dismantle the front case assembly.

**Inspecting**

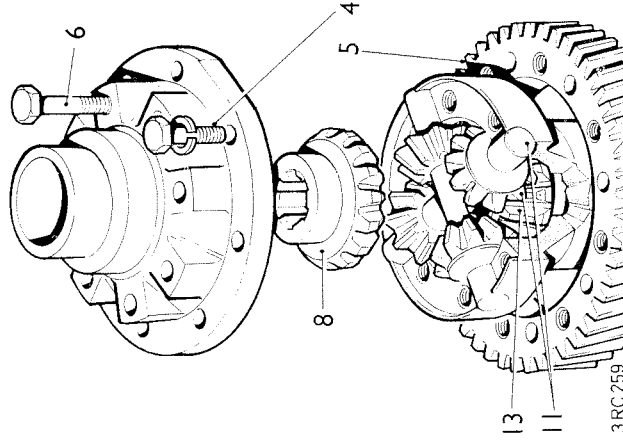
- NOTE:** If replacements are required, replace the following items 11 and 12 as sets.
11. Bevel pinions and side gears (set of six).
  12. Cross shafts (set of two).
  13. Check the gear teeth for damage.
  14. Check all parts for satisfactory general condition.
- NOTE:** The differential case halves are a matched pair, and halves must not be changed individually.

**Reassembling**

15. Fit a side gear into the rear casing.
  16. Fit a side gear into the front casing.
  17. Fit the bevel pinions, thrust washers and cross shafts into the front casing.
  18. Fit the rear casing to the front casing. Tighten the bolts evenly in sequence. Torque load 6,0 kgf.m (44 lbf ft).
  19. Offer the low gear to the differential casing.
  20. Align the fixing holes and fit the bolts evenly in sequence. Torque load 6,0 kgf.m (44 lbf ft).
  21. Fit the roller bearings and refit the differential unit.
- NOTE:** If the differential case or bearings have been replaced, carry out the 'Differential bearing pre-load check', 37.25.13.



3RC 258



3RC 259

**DIFFERENTIAL LOCK ACTUATOR ASSEMBLY**

- Remove and refit items 1 to 3 and 10 37.29.19
- Overhaul items 4 to 10 37.29.22

**Removing**

1. Note the vacuum supply hose positions, then disconnect the hoses.
  2. Remove the fixings and withdraw the assembly from the housing.
- NOTE:** If necessary, remove the right-hand front exhaust pipe to improve access.
3. Withdraw the detent spring and ball.

**Dismantling**

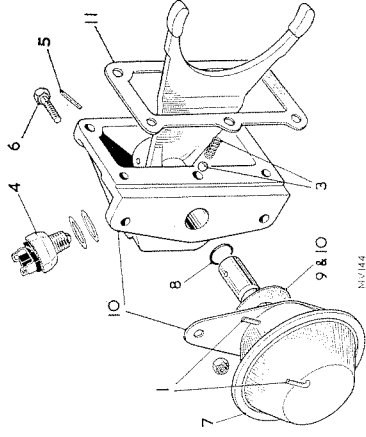
4. Remove the differential lock warning switch.
5. Drive out the retaining pin.
6. Remove the actuator fixings.
7. Withdraw the actuator and shaft.
8. Withdraw the 'O' ring seal.
9. Withdraw the joint washer.

**Reassembling**

10. Reverse 4 to 9; coat both sides of the joint washer with 'Hylomar' PL32/M jointing compound.

**Refitting**

11. Reverse 1 to 3. Apply 'Hylomar' PL32/M jointing compound between the actuator and housing joint faces and to the joint washer.



37.29.22

**PROPELLER SHAFTS**

**Wheeled Vehicles Q052**

**PROPELLER SHAFT OPERATIONS**

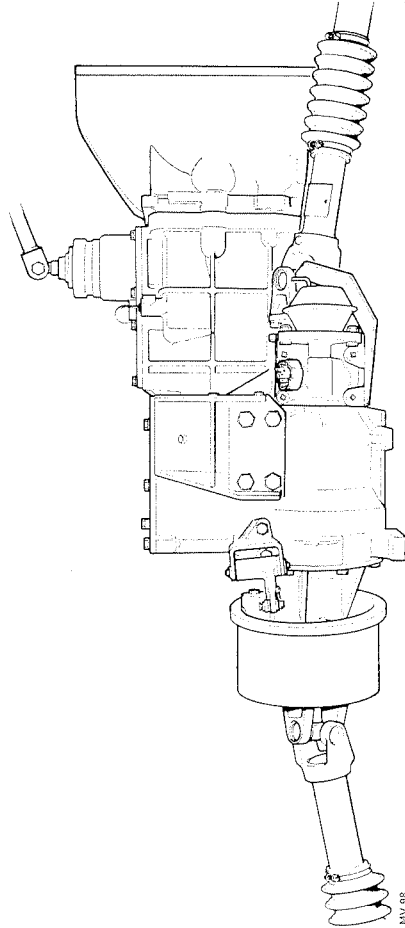
Front propeller shaft									
—remove and refit	..	..	..	..	..	..	..	..	47.15.02
—overhaul	..	..	..	..	..	..	..	..	47.15.11
Gaiter for sliding joint—remove and refit	..	..	..	..	..	..	..	..	47.15.08
Rear propeller shaft									
—remove and refit	..	..	..	..	..	..	..	..	47.15.03
—overhaul	..	..	..	..	..	..	..	..	47.15.12

**PROPELLER SHAFTS—DESCRIPTION**

The vehicle transmission system employs two propeller shafts, one between the gearbox and the front axle and one between the gearbox and the rear axle. The shafts are one piece straight tube, incorporating a sliding joint, and are fitted with, 'Hookes' type needle roller bearing universal joints, at each end. Greasing points are provided for lubricating the sliding and universal joints and, both propeller shafts are fitted with a telescopic gaiter to protect the sliding joint against the ingress of foreign matter. To provide further protection and reduce the possibility of accidental damage, the sliding joints have been positioned as high as possible by arranging the installation of both propeller shafts with their sleeve ends towards the gearbox.

**DATA**

- Propeller shaft type Hardy Spicer needle bearing
- Tubular shaft diameter 50,8 mm (2.0 in)
- Overall length (face-to-face in the midway position) 787,9 mm (31.023 in)
- Front propeller shaft 711,5 mm (28.011 in)
- Rear propeller shaft



**FAULT DIAGNOSIS**

SYMPTOM	POSSIBLE CAUSE	CURE
<b>A—VIBRATING PROPELLER SHAFT</b>	<ol style="list-style-type: none"> <li>1. Fixings loose</li> <li>2. Incorrectly assembled propeller shaft</li> <li>3. Worn needle roller bearings</li> <li>4. Worn splines</li> <li>5. Shaft out of balance</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit new self locking nuts and tighten to the correct torque</li> <li>2. Reassemble propeller shaft correctly aligned</li> <li>3. Fit new bearings</li> <li>4. Fit new propeller shaft complete</li> <li>5. Fit new propeller shaft complete</li> </ol>
<b>B—NOISY UNIVERSAL JOINTS</b>	<ol style="list-style-type: none"> <li>1. Lack of lubrication</li> <li>2. Fixings loose</li> <li>3. Worn needle roller bearings</li> <li>4. Worn splines</li> </ol>	<ol style="list-style-type: none"> <li>1. Lubricate propeller shaft</li> <li>2. Fit new self locking nuts and tighten to the correct torque</li> <li>3. Fit new bearings</li> <li>4. Fit new propeller shaft complete</li> </ol>

**PROPELLER SHAFT**

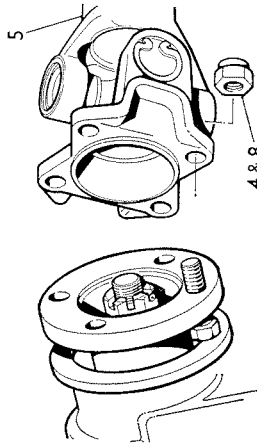
- Remove and refit
- Front propeller shaft 47.15.02
- Rear propeller shaft 47.15.03

**Removing**

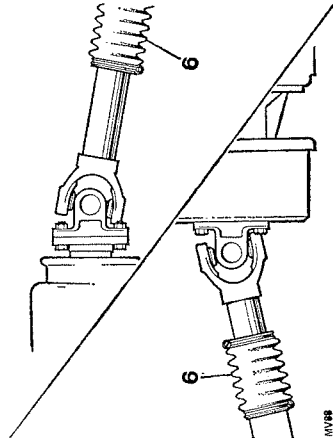
1. Ensure that the gearbox is in 'neutral' and that the gearbox differential is disengaged.
2. Chock the vehicle wheels.
3. Jack up one front or rear wheel, according to the shaft to be removed.
4. Remove the self-locking nuts from the front and rear coupling flanges.
5. Withdraw the propeller shaft.

**Refitting**

6. Locate the propeller shaft in position with the sleeve end towards the gearbox.
7. Ensure that the registers on the coupling flanges engage.
8. Using new self-locking nuts, secure the coupling flanges. Torque: 4,8 kgf.m (35 lbf ft).
9. Reverse 2 and 3.



HC 12/98



HV 88

**PROPELLER SHAFT**

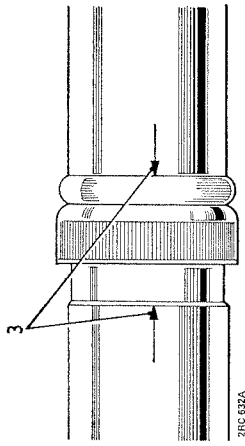
—Overhaul

- Front propeller shaft 47.15.11
- Rear propeller shaft 47.15.12

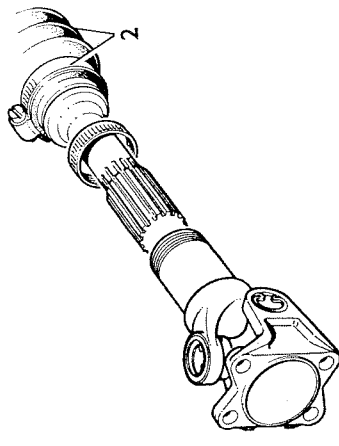
**Dismantling**

1. Remove the propeller shaft 47.15.02, 47.15.03.
2. Release the two hose clips and slide the gaiter along the shaft.
3. Check that the alignment marks on the splined sleeve and the splined shaft are clearly visible. If necessary, make new alignment marks.
4. Unscrew the dust cap.
5. Withdraw the sliding joint.
6. Clean the splined shaft and the splined sleeve.
7. Temporarily locate the splined shaft into the sleeve, maintaining the marked alignment.
8. Secure the shaft in a vice.
9. Mount a dial test indicator to read off the outside diameter of the shaft splines.
10. Check the circumferential movement between the sleeve and shaft. If the movement exceeds 0,1 mm (0.004 in) fit a new propeller shaft complete.

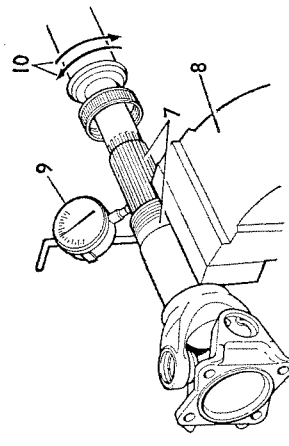
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ZPC 632A



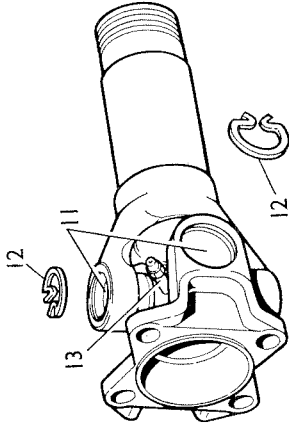
ZPC 633 B



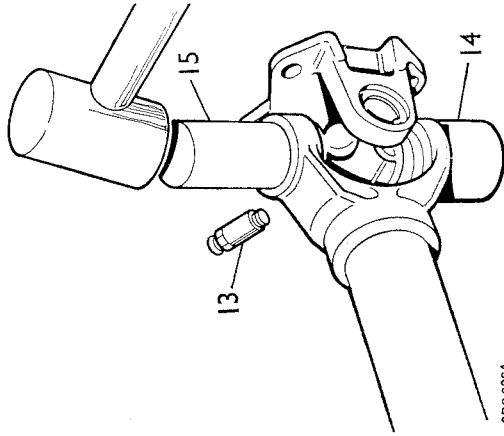
ZPC 634A

11. Clean any dirt and enamel from the circlips and the tops of the bearing races.
12. Remove the circlips.
13. Remove the grease nipple from the universal joint.
14. Locate the yoke of the splined sleeve onto a suitable piece of tube which has a slightly larger internal diameter than the journal bearing.
15. Using a brass drift, drive the universal joint downward until it is just clear of the lower yoke.
16. Lift the sleeve clear of the tube and withdraw the bearing downward to avoid dropping the needle rollers.
17. Repeat items 14 to 16 for the opposite bearing.

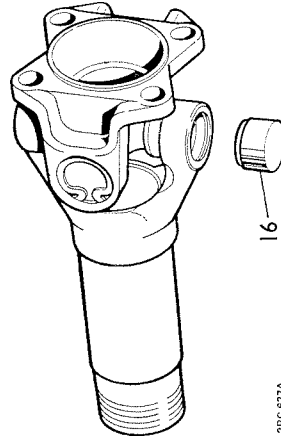
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21C 636A



22C 638A

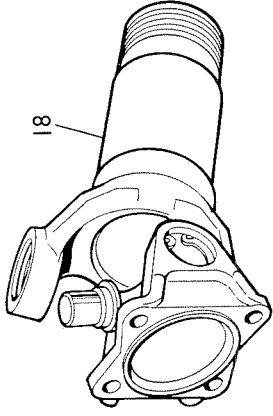


23C 637A

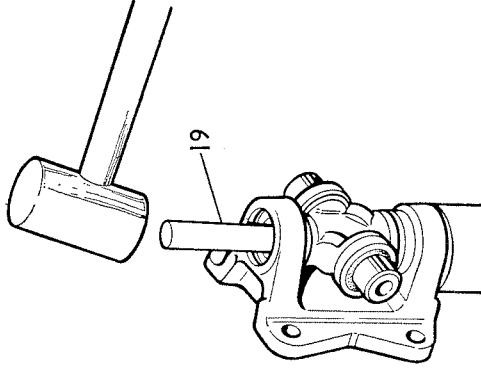
18. Withdraw the splined sleeve from the flanged yoke.
19. Remove the bearings from the flanged yoke in the manner already described.
20. Repeat items 14 to 19 for the splined shaft.

**Inspecting**

21. Examine all components for obvious wear or damage.
22. If the journal or bearings for the universal joints show any signs of wear, load markings or distortion, they must be renewed complete. Replacement journal assemblies comprise a spider complete with oil seals and bearings.
23. In the event of wear in any of the eight yoke cross holes, rendering them oval, a new propeller shaft complete must be fitted.



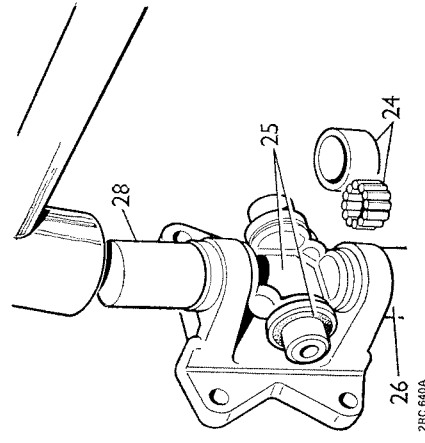
24C 639A



25C 639A

**Reassembling**

24. Assemble the needle rollers in the bearing races, if necessary using a smear of grease to retain them in place. About half-fill the races with a recommended grease.
25. Insert the journal, complete with seals, into the flange yoke holes with the grease nipple tapping pointing away from the flange.
26. Place the flanged yoke on a suitable flat support.
27. Place the first bearing in position.
28. Using a brass drift, slightly smaller in diameter than the hole in the yoke, tap the bearing into position.



26C 640A

29. Fit the circlip to retain the bearing.
- NOTE:** The bearing outer races must be a drive fit, otherwise fit a new propeller shaft complete.
30. Repeat 26 to 29 for the other three bearings comprising the universal joint.
31. Ensure that all four circlips are firmly located in their grooves. If the joint appears to bind, tap the yoke ears lightly with a soft mallet.
32. Repeat 24 to 31 for the other universal joint.
33. Slide the gaiter and hose clips over the shaft.
34. Liberally smear the splines of the shaft and sleeve with the recommended grease.
35. Assemble the splined shaft and sleeve maintaining the marked alignment.
36. Place the gaiter in position and secure the hose clips 180° to each other to maintain balance.
37. Fit the grease nipple to the universal joint.
38. Lubricate the propeller shaft at the grease points.  
**CAUTION:** Do not fill the sliding joint with grease, use sufficient to lubricate the splines only, otherwise hydraulic locking will result.
39. Refit the propeller shaft. 47.15.02, 47.15.03.

**GAITER FOR SLIDING JOINT**

—Remove and refit

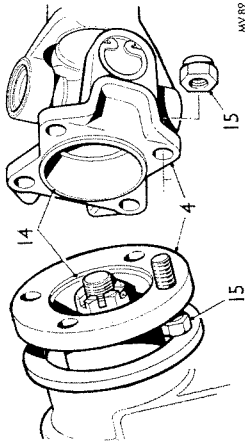
47.15.08

**Removing**

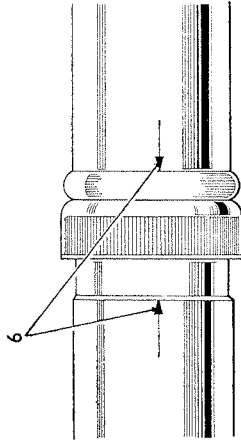
1. Ensure that the gearbox is in 'neutral' and that the gearbox differential is disengaged.
2. Chock the wheels.
3. Jack up one front or rear wheel, according to the shaft concerned.
4. Disconnect the propeller shaft from the gearbox.
5. Release the two hose clips and slide the gaiter along the shaft.
6. Check that the alignment marks on the splined sleeve and the splined shaft are clearly visible. If necessary, make new alignment marks.
7. Unscrew the dust cap.
8. Withdraw the sliding joint.
9. Withdraw the gaiter.

**Refitting**

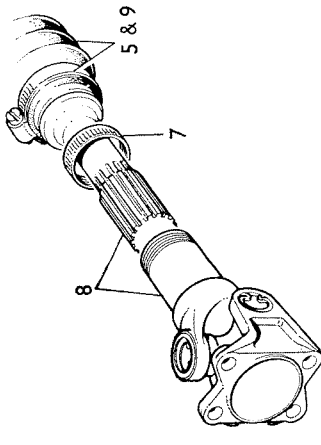
10. Slide the gaiter and hose clips over the main propeller shaft.
11. Ensure that the splines of the shaft and sleeve are clean and in good condition then, liberally smear them with the recommended grease.
12. Assemble the splined shaft and sleeve maintaining the marked alignment.
13. Locate the gaiter in position and secure the hose clips 180° to each other to maintain balance.
14. Locate the propeller shaft in position, ensuring that the registers on the coupling flanges engage.
15. Using new self-locking nuts, secure the coupling flanges. Torque: 4.9 kgf.m (36 lbf ft).
16. Reverse 2 and 3.



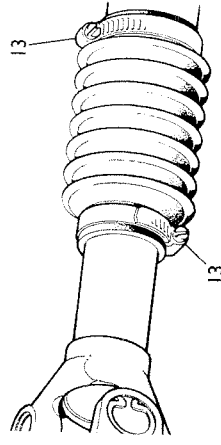
MV 89



MV 90



MV 91



MV 92

**REAR AXLE AND FINAL DRIVE**

**Wheeled Vehicles Q052**

Description of rear axle and final drive	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51-3
Fault diagnosis—rear axle and final drive	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51-6

**REAR AXLE AND FINAL DRIVE OPERATIONS**

Axle shafts—remove and refit	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51.10.01
Differential assembly	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
—remove and refit	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51.15.01
—overhaul	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51.15.07
Pinion oil seal—remove and refit	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51.20.01
Rear axle assembly—remove and refit	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	51.25.01

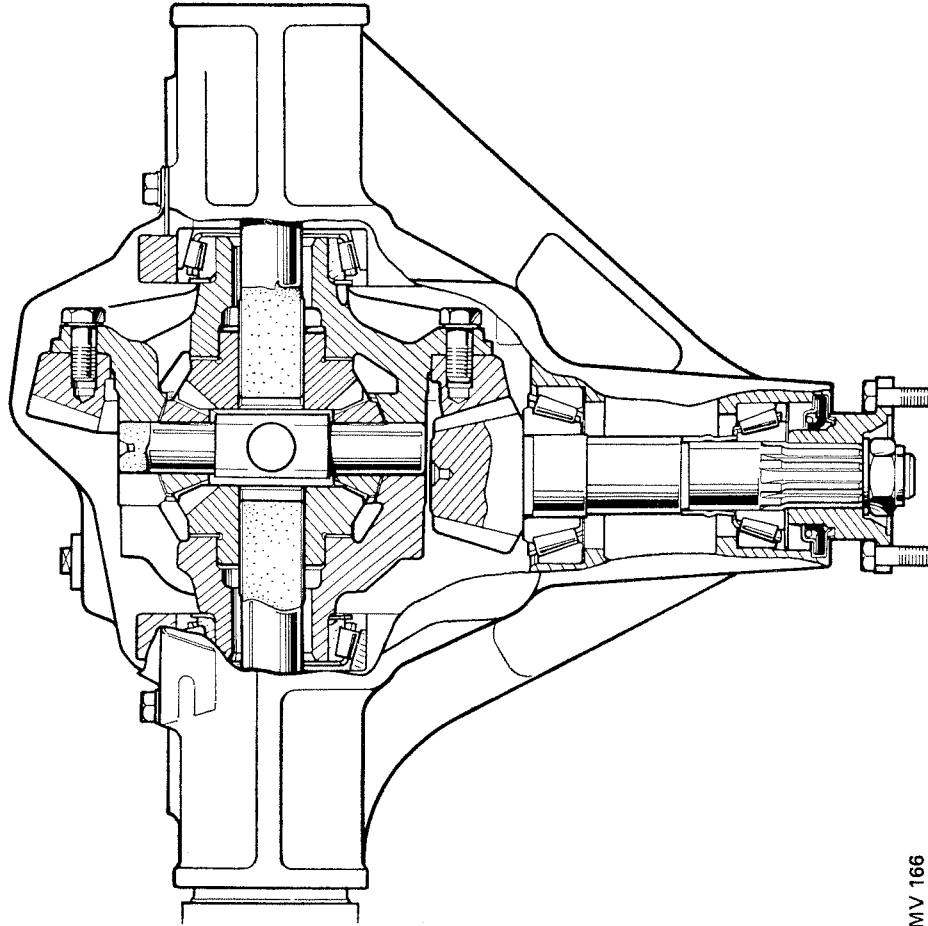
**REAR AXLE AND FINAL DRIVE—DESCRIPTION**

The one piece, rear axle case is secured by 'U' bolts to the underside of the road springs and contains a 'Hypoid' bevel pinion and crownwheel, a differential unit and a left-hand and right-hand axle shaft.

Input to the rear axle is through the bevel pinion, which is mounted on pre-loaded taper roller bearings that are adjusted by means of a collapsible spacer. A matching bevelled crownwheel is secured to a flange on the outside of the differential case, and together, this arrangement turns the drive through ninety degrees, drives the differential unit and provides reduction gearing.

The two piece differential case is mounted on taper roller bearings in the final drive housing, and contains two side gears with thrust washers that are divided by a set of four differential pinions with thrust washers mounted on cross-pins. The side gears are located in plain bores in the differential case and are a spined fit on the rear axle shafts. The differential pinions are a free fit on the cross-pins, and the pins themselves are securely located in the differential case.

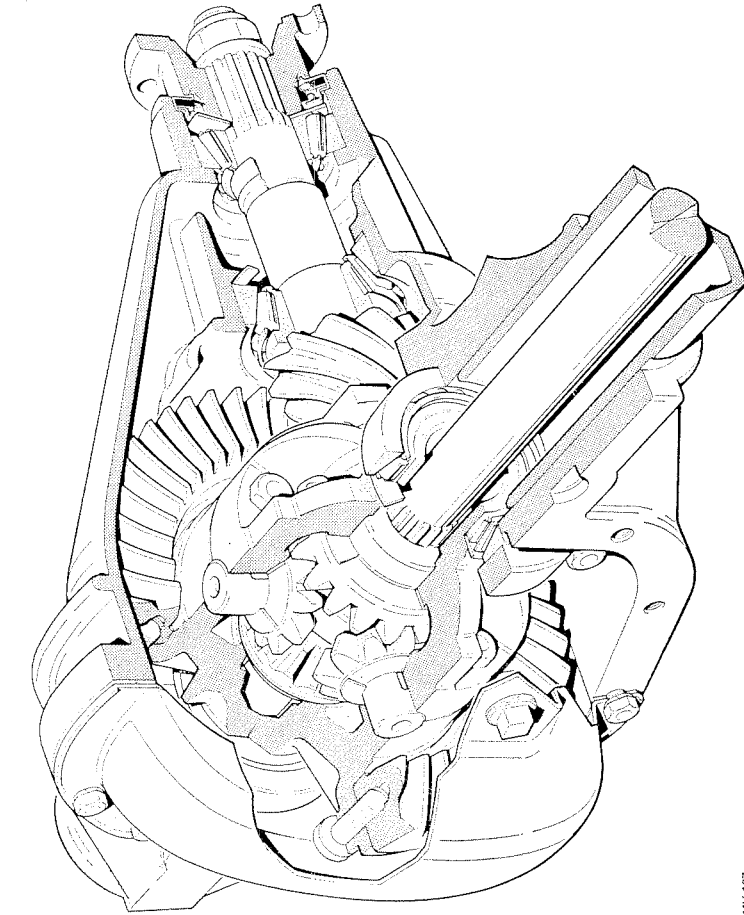
The drive from the gearbox is transmitted by the propeller shaft and coupling flanges to the bevel pinion in the final drive housing. The bevel pinion meshes with a matching bevelled crownwheel that is secured to a flange on the differential casing. The drive is then transmitted from the differential casing by the cross-pins and pinions to the side gears and thus the axle shafts.



MV 166

Sectioned view of final drive arrangement





MV 167

Cut-away view of final drive

**DIFFERENTIAL OPERATION**

The drive from the gearbox rear output flange is positive as far as the cross-pins in the differential, thereafter, the drive to the axle shafts is dependent on the vehicle direction and road conditions.

Under normal conditions when the vehicle is being driven in a straight line, the differential pinions do not rotate on the cross-pins; the differential case, cross-pins, pinions and side gears rotate as a single unit, turning both axle shafts at the same speed. If the vehicle turns left or right, the inner and outer road wheels cover a different radius and therefore must rotate at different speeds to avoid skidding. This is achieved through natural forces imparting a greater resistance to rotation on the inner road wheel which causes the applicable differential side gear to resist rotation. In these circumstances, the differential pinions commence rotating on the cross-pins, allowing the side gears and thus the axle shafts to rotate at different speeds.

As already explained, the drive will take the path of least resistance and, in slippery conditions, the differential will allow the road wheel with the least grip to spin while the other remains stationary.

In extreme conditions when the vehicle could be stopped with one wheel spinning, the gearbox differential can be locked, by a selector in the driving compartment, to ensure that the drive is transmitted to both axles, then, providing that there is sufficient grip for both wheels in either the front or rear axle, the vehicle can be driven.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—OIL LEAKS	<ol style="list-style-type: none"> <li>Loose or missing drain and filler plugs</li> <li>Axle case breather inoperative resulting in internal pressure</li> <li>Differential rear cover gasket damaged</li> <li>Pinion oil seal damaged</li> <li>Oil level too high</li> </ol>	<ol style="list-style-type: none"> <li>Check drain plug at underside of differential case and filler plug in rear cover. Tighten or fit new plugs as applicable</li> <li>Ensure that the breather pipe is not obstructed. Uncover breather from axle case and clean or fit new breather</li> <li>Fit new gasket using jointing compound</li> <li>Fit new pinion oil seal</li> <li>Drain oil to correct level</li> </ol>
B—WHINE FROM DIFFERENTIAL	<ol style="list-style-type: none"> <li>Incorrect setting of crown-wheel and pinion</li> <li>Oil level too low</li> </ol>	<ol style="list-style-type: none"> <li>Remove differential, check and adjust gears as necessary (51.15.07)</li> <li>Top up as necessary</li> </ol>
C—RATTLE FROM DIFFERENTIAL	<ol style="list-style-type: none"> <li>Differential oil level too low or incorrect grade</li> <li>Incorrect bevel pinion bearing adjustment</li> <li>Differential worn or incorrect internal settings</li> </ol>	<ol style="list-style-type: none"> <li>Drain and replenish with correct grade oil</li> <li>Fit and adjust a new collapsible spacer (51.15.07)</li> <li>Overhaul differential</li> </ol>
D—NO DRIVE AT ROAD WHEELS	<ol style="list-style-type: none"> <li>Broken rear axle shaft (Rear propeller shaft rotating with front propeller shaft stationary. If opposite to this, suspect broken front halfshaft)</li> </ol>	<ol style="list-style-type: none"> <li>With engine stopped and gearbox in 'Neutral', jack each rear wheel separately and turn by hand, if propeller shaft does not also turn, remove the applicable axle shaft for inspection. Fit new axle shaft as necessary</li> </ol>

AXLE SHAFT

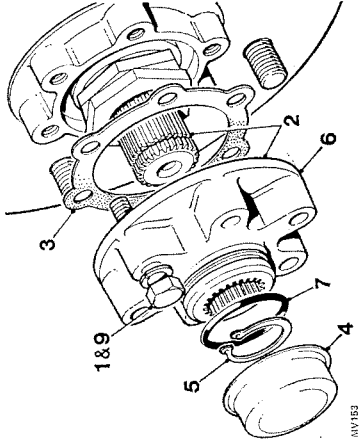
—Remove and refit 51.10.01

Removing

- Remove the fixings securing the hub driving member.
- Withdraw the driving member and axle shaft complete.
- Withdraw the joint washer.
- Prise off the hub cap.
- Remove the circlip.
- Withdraw the driving member from the shaft.
- Withdraw the 'O' ring seal.

Refitting

- Reverse 2 to 7.
- Coat the threads of the driving member bolts with 'Loctite Studlock grade CVX', then fit and tighten the bolts evenly. Torque: 10.0 kgf.m (73 lbf ft).



**DIFFERENTIAL ASSEMBLY**

- Remove and refit 51.15.01
- Overhaul 51.15.07

**Service tools**

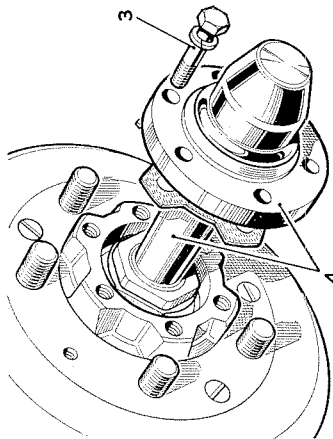
- 47 Screw press
- 18G131C Axle spreader
- 18G191 Dial gauge, bracket and base
- 18G1122 Screw press
- 18G1205 Spanner for drive coupling
- SI23A Pinion bearing cup remover
- 18G47BK Pinion bearing cone remover/replacer
- 18G47BL Differential bearing remover
- 18G1122G Pinion bearing cup replacer
- 18G134DP Differential bearing replacer
- 18G191P Setting gauge for pinion height
- 18G131F Pegs for axle spreader
- RO1008 Oil Seal replacer

**Removing the differential unit**

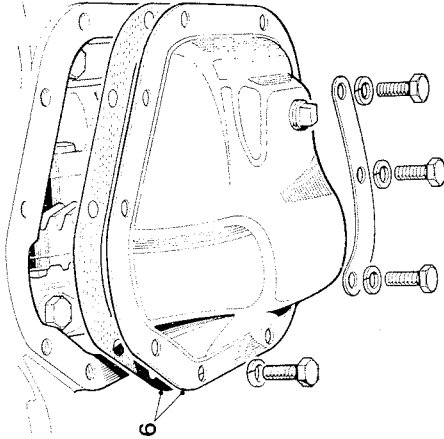
**NOTE:** All fixing bolts used on the differential assembly and differential cover have metric threads.

1. Drain off the differential lubricating oil.
2. Remove the rear axle assembly. 51.25.01.
3. Remove the hub driving member fixings.
4. Withdraw the driving member and attached axle-shaft sufficient to disengage the differential.
5. Repeat 4 for other axleshaft.
6. Remove the fixings and support strip at the differential cover and withdraw the cover and joint washer.
7. Note the relationship marking on the bearing caps and axle casing to ensure correct refitting.
8. Remove the fixings and withdraw the differential bearing caps.
9. Clean out and examine the spreader tool pegholes provided in the gear casing face; ensure that the holes are free from dirt and burrs and damage.

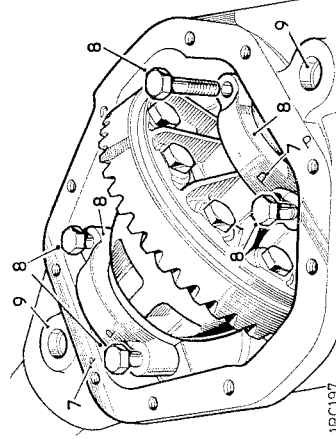
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1RC195



1RC196A



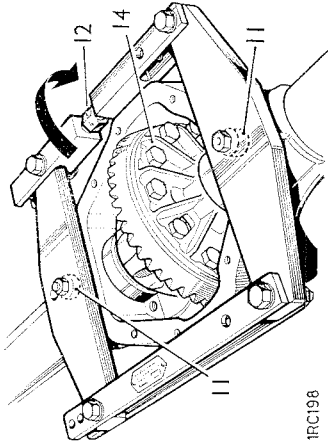
1RC197

10. Ensure that the turnbuckle adjuster is free to turn.
  11. Fit the axle spreader to engage the peg holes. Spreader 18G131C, Adaptor pegs 18G131F.
  12. Turn the adjuster until all free play between the spreader and casing is taken up, denoted by the adjuster becoming stiff to turn, using a spanner on the adjuster.
  13. Check that the side members of the spreader are clear of the casing.
  14. Stretch the casing, rotating the adjuster by one flat at a time, until the differential assembly can be levered out. Do not lever against the spreader; use suitable packing under the levers to avoid damage to the casing.
- CAUTION:** To prevent permanent damage to the gear carrier case, it must not be over-stretched. Each flat on the turnbuckle is numbered to enable a check to be made on the amount turned. The maximum stretch permitted is 0,30 mm (0.012 in), equivalent to three flats.
15. Ease off the adjuster and remove the spreader.

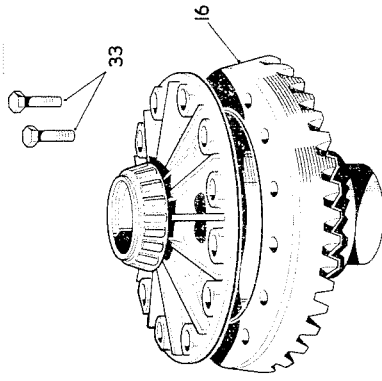
**Dismantling the differential unit**

16. Add alignment marks between the crownwheel and the differential case for reassembly purposes, then remove the fixings and withdraw the crownwheel.
17. Note the alignment markings on the two differential casings to ensure correct refitting, then remove the fixings.
18. Lift off the upper case.
19. Withdraw the upper differential wheel and thrust washer.

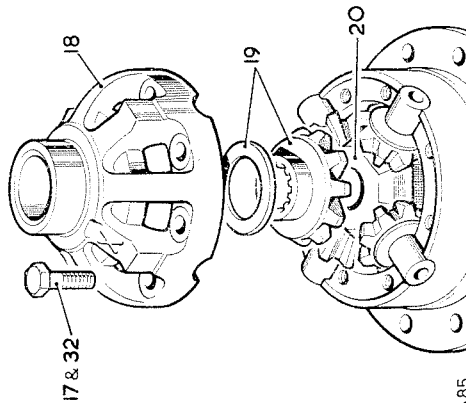
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1RC198



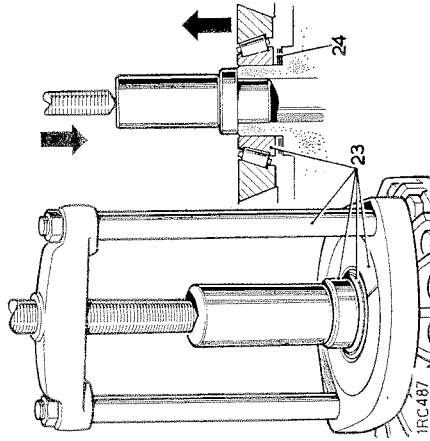
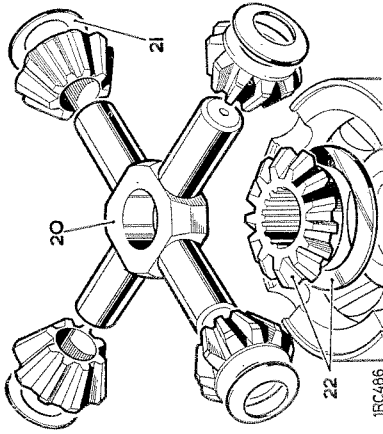
1RC484



1RC485

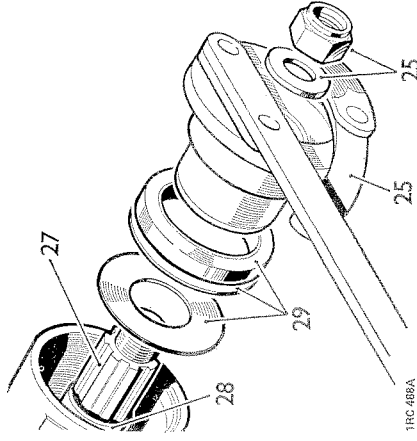
20. Lift out the cross shaft and pinions.
21. Withdraw the dished thrust washers.
22. Withdraw the lower differential wheel and thrust washer.
23. Remove the differential bearing cones. Remove 18G47BL details 1 and 2, Press 47.
24. Withdraw the shim washers fitted between the bearing cones and the differential casings.

*continued*



**Removing the final drive pinion**

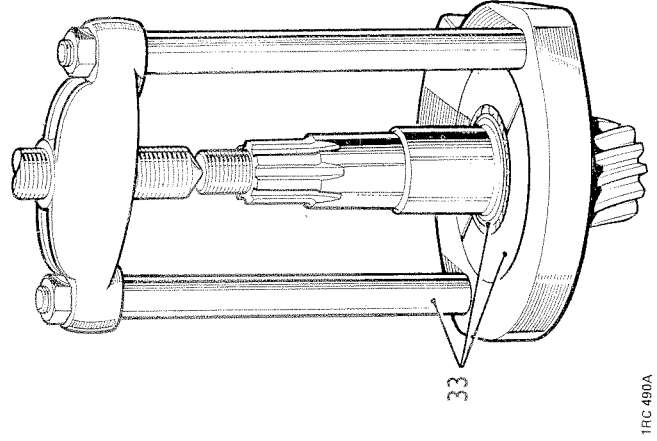
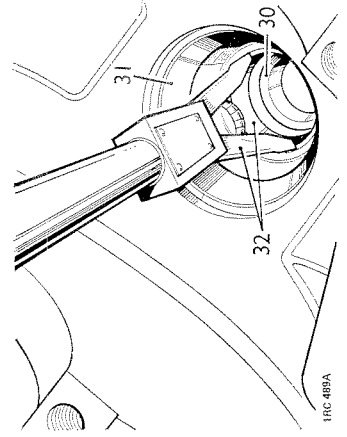
25. Prevent the coupling flange from rotating and remove the flange locknut and plain washer. Spanner 18GI205.
26. Support the drive pinion and remove the coupling flange by tapping with a hide hammer.
27. Withdraw the drive pinion together with the inner bearing cone.
28. Withdraw and discard the collapsible bearing spacer.
29. Withdraw the oil seal, gasket and oil thrower.
30. Withdraw the outer bearing cone.
31. Extract the pinion inner bearing cup and shim washers from the casing. Note the shim washer thickness. Remove S123A.
32. Extract the pinion outer bearing cup from the casing. Remove S123A.
33. Remove the inner bearing cone from the pinion. Remove 18G47BK and Press 47.

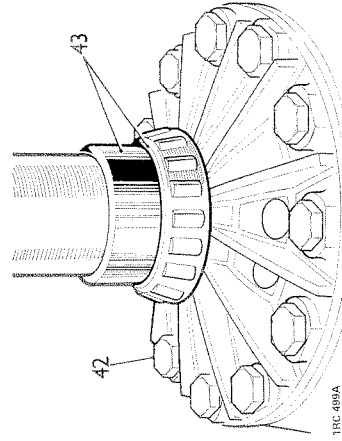


**Inspecting**

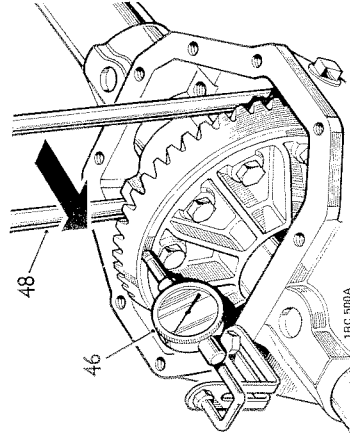
34. Examine all components for obvious wear or damage.
35. The bearing cones must be a press fit on their locations, except the drive pinion flange and bearing which is a slide fit.
36. The crownwheel and pinion are supplied as a matched pair and must not be interchanged separately.  
A new crownwheel and pinion matched pair may be fitted to an original gear carrier casing if sound. The original crownwheel and pinion, if sound, may be fitted into a replacement casing.
37. The two parts of the differential unit casing are matched and must not be replaced separately.
38. Discard and renew all thrust washers.
39. Differential housings with worn thrust washer seatings must be replaced as a pair.
40. Examine the differential case to crownwheel joint face for burrs and damage which could lead to crownwheel run-out when fitted.

*continued*





18C 489A

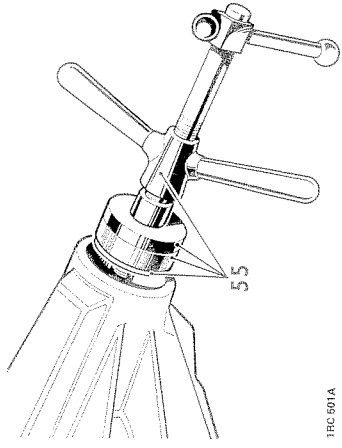


18C 500A

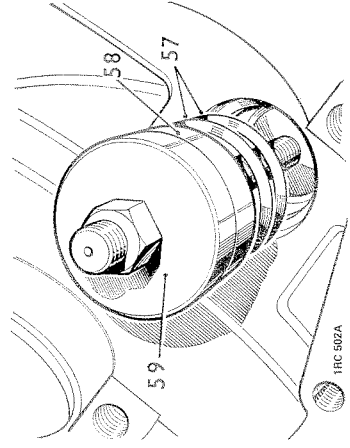
**Fitting drive pinion**

54. Select shim washers of the same thickness value as those removed from under the pinion inner cup, item 31, and place ready for fitting.
55. Position the outer bearing replacer 18G1122G detail 2, and the outer bearing cup on the press tool 18G1122.
56. Locate the assembly into the pinion housing nose.
57. Place the selected shim washers on to the inner bearing cup seating.
58. Position the inner bearing cup in the casing.
59. Position the inner bearing replacer 18G1122G detail 1 on to 18G1122 and secure with the fixing nut.
60. Hold still the centre screw and turn the butterfly lever to draw in the bearing cups.
61. Press the inner bearing cone on to the drive pinion.
62. Position the pinion and bearing in the casing; omit the collapsible spacer at this stage.
63. Fit the outer bearing cone on to the pinion.
64. Fit the coupling flange and plain washer and loosely fit the flange nut.
65. Tighten the coupling flange locknut sufficient to remove end-float from the pinion.
66. Rotate the pinion to settle the bearings and slowly tighten the flange locknut until a torque resistance of 9,25 to 13,8 kgf.cm (8 to 12 lbf in) is required to rotate the pinion.

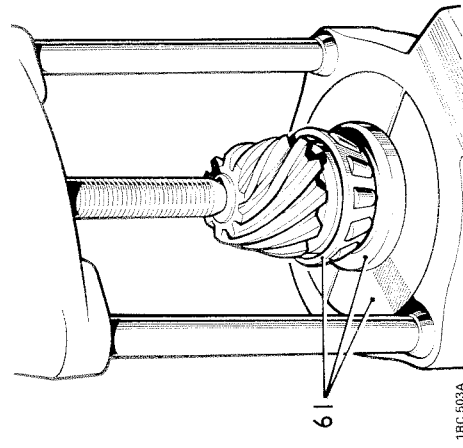
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18C 501A



18C 502A



18C 503A

**Reassembling**

**Assembling the differential unit**

41. Reverse the items 17 to 22 aligning the marks on the differential casings. Casings fixings torque load is 9,1 to 10,4 kgf.m (66 to 75 lbf ft). The fixings tightening should be carried out at opposite sides of the casings and not by following the diameter. Use Loctite 'Studlock' grade on the fixing bolt threads.
42. Fit the crownwheel to the differential casing. Fixings torque is 13 to 14,5 kgf.m (95 to 105 lbf ft). Use Loctite 'Studlock' grade CVX on the fixing bolt threads.
43. Press on the differential roller bearing cones less shim washers, using 18G134DP.
44. Fit the bearing cups to the differential.
45. Fit the differential unit and bearings to the gear carrier casing. Do not fit the bearing caps.
46. Position a suitable dial gauge indicator on the casing with the stylus registering on the back face of the crownwheel.
47. Rotate the differential and check the total indicated run-out on the crownwheel back face. This must not exceed 0,05 mm (0,002 in). If run-out is excessive, check the mating faces for dirt and damage; if necessary select a new radial position for the crownwheel. When satisfactory, continue with the following check.

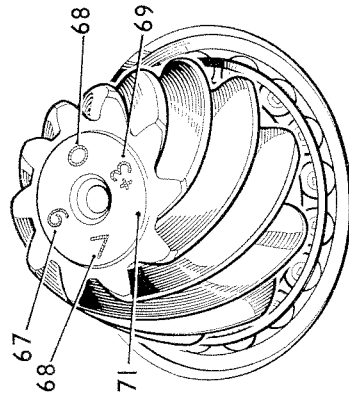
**Differential bearing adjustment**

48. Insert two levers between the casing and the differential unit at one side.
49. Move the differential unit fully to one side of the casing; do not tilt the unit.
50. Rotate the differential unit to settle the bearings, continue to lever the differential to the side then zero the dial gauge indicator.
51. Lever the assembly fully to the other side of the casing, rotate the unit to settle the bearings, then note the total indicator reading.
52. Add 0,127 mm (0,005 in), for bearing pre-load, to the total noted in the preceding item. The sum is then equal to the nominal value of shims required for the differential bearings.  
Shims are available in the range 0,07 mm (0,003 in), 0,12 mm (0,005 in), 0,25 mm (0,010 in) and 0,76 mm (0,030 in). Select the total value of shims required.
53. Remove the differential unit and bearings and place aside. Do not fit the shim washers until the subsequent 'Differential backlash' checks have been made, items 87 to 93.

*continued*

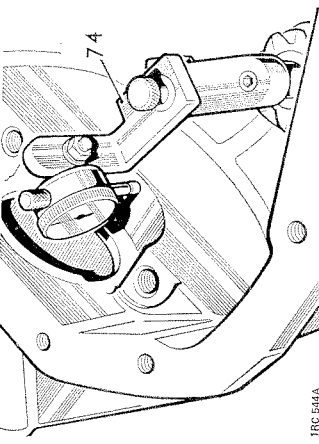
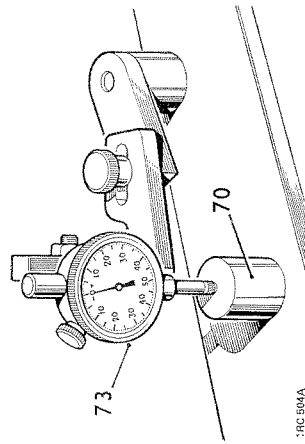
**Drive pinion markings**

67. Check that the serial number marked on the pinion end face matches that marked on the crownwheel.
68. The markings on the end face adjacent to the serial number are of no significance during servicing.
69. The figure marked on the end face opposite to the serial number indicates, in thousandths of an inch, the deviation from nominal required to correctly set the pinion. A pinion marked plus (+) must be set below nominal, a minus (-) pinion must be set above nominal. An unmarked pinion must be set at nominal.
70. The nominal setting dimension is represented by the setting gauge block 18G191P, which is referenced from the pinion end face to the bottom radius of the differential bearing bore.



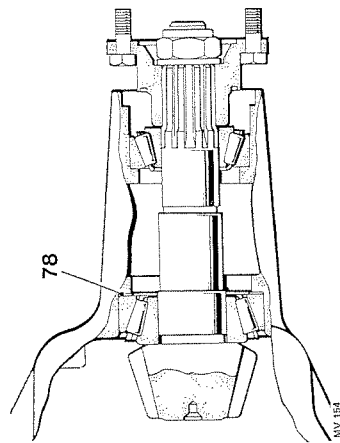
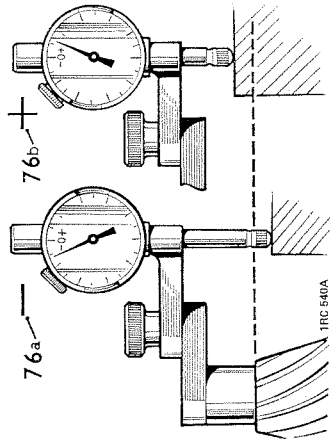
**Drive pinion adjustment**

71. Ensure that the pinion end face is free of raised burrs around the etched markings.
72. Remove the keep disc from the magnetised base of dial gauge tool 18G191.
73. Place the dial gauge and setting gauge 18G191JP on a flat surface and zero the dial gauge stylus on to the setting gauge.
74. Position the dial gauge centrally on the pinion end face with the stylus registering on the lowest point on one differential bearing bore. Note the dial gauge deviation from the zeroed setting.
75. Repeat on the other bearing bore. Add together the readings then halve the sum to obtain the mean deviation. Note whether the stylus has moved up or down from the zeroed setting.



*continued*

76. a. Where the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner cup to bring the pinion down to the nominal position.  
b. Where the stylus has moved up, the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.
77. Before adjusting the shim thickness, check the pinion face marking and if it has a plus (+) figure, subtract that amount in thousandths of inch from the shim thickness figure obtained in the previous item. Alternatively, if the pinion has a minus (-) figure, add the amount to the shim thickness figure.
78. Adjust the shim thickness under the pinion inner cup as necessary, by the amount determined in items 76 and 77.
79. Recheck the pinion height setting 73 to 75. If the setting is correct, the mean reading on the dial gauge will agree with the figure marked on the pinion end face. For example, with an end face marking of +3, the dial gauge reading should indicate that the pinion is 0.003 in below nominal.



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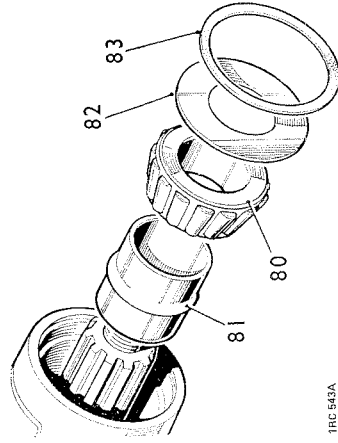
80. When the pinion setting is satisfactory, temporarily remove the pinion outer bearing cone.
81. Fit a new collapsible bearing spacer, flared end outward, to the drive pinion and refit the outer bearing cone.
82. Fit the pinion oil slinger.
83. Fit the oil seal gasket.
84. Fit the pinion oil seal, lipped side first, using general purpose grease or, where available, a molybdenum disulphide based grease on the seal lip, using RO1008 to drift in the seal.
85. Fit the coupling flange and plain washer and loosely fit a new flange nut. Secure 18G1205 to the coupling flange, using slave fixings.
86. Alternately tighten the flange nut and check the drive pinion resistance to rotation until the following figures are achieved, as applicable:
  - a. Assemblies re-using original pinion bearings: 17,3 to 34,5 kgf.cm (15 to 30 lbf in).
  - b. Assemblies with new pinion bearings: 34,5 to 46,0 kgf.cm (30 to 40 lbf in).

**NOTE:** A torque load of 34,5 kgf.cm (250 lbf ft) approximately is required on the coupling flange nut to commence collapsing the bearing spacer. Thereafter, torque resistance build-up is rapid, therefore check frequently to ensure the correct figures are not exceeded, otherwise a new collapsible bearing spacer will be required.

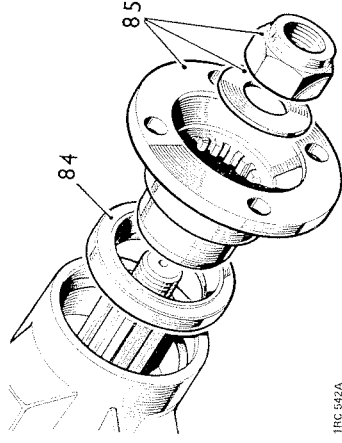
**Differential backlash checks**

87. Fit the differential unit bearings but omit the shim washers. 18G134DP.
88. Fit the differential unit and lever the unit away from the drive pinion until the opposite bearing cup is seated against the housing. Do not tilt the unit.
89. Install a dial gauge on the casing with its stylus resting on the back face of the crownwheel. Zero the gauge.
90. Lever the differential unit to engage the crownwheel teeth in full mesh with the drive pinion teeth. Do not tilt the unit.
91. Note the total reading obtained on the dial gauge.

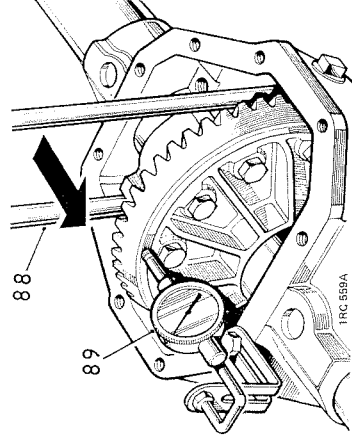
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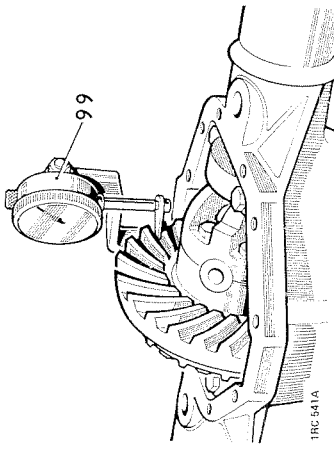


TRC 562A



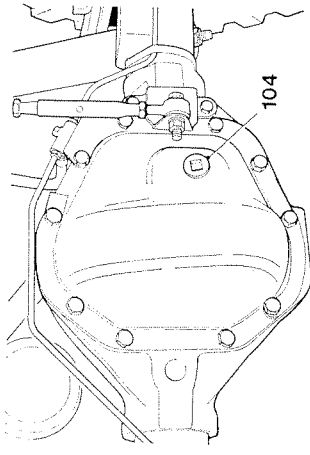
TRC 562A

92. From this figure subtract 0,25 mm (0.010 in) to obtain the correct crownwheel backlash when fitted. The result indicates the value of shimming to be fitted between the differential case and the bearing cone at the crownwheel side of the differential.
93. Fit the shim value determined in 92, taking the shims from the pack previously determined during 'Differential bearing adjustment' checks, items 48 to 53. 18G47BL details 1 and 2, Press 47. 18G134DP.
94. Fit the remaining shims from item 92 to the opposite side of the differential. 18G47BL details 1 and 2, press 47. 18G134DP.
95. Fit the differential unit with shims and bearings to the axle casing, using the axle spreader 18G131C with pegs 18G131F.



TRC 541A

96. Remove the axle spreader.
97. Fit the bearing caps in their correct position, referring to the relationship markings on the caps and on the axle casing.
98. Tighten the bearing caps fixings to 12,9 to 14,5 kgm (93 to 105 lb ft).
99. Mount a dial gauge on the axle casing with the stylus resting on a crownwheel tooth.
100. Prevent the drive pinion from rotating and check the crownwheel backlash which must be 0,15 to 0,27 mm (0.006 to 0.011 in). If the backlash is not within the specified limits, repeat the differential backlash checks, 87 to 93, looking for possible errors.



TRC 551A

101. Fit the differential cover and new gasket, coating both sides of the gasket with 'Hylomar PL32M' or an equivalent non-setting sealant.  
Torque load for fixings is 2,8 to 3,5 kgf.m (20 to 25 lbf ft).
102. Reverse 3 to 5. Coat the threads of the hub driving member bolts with 'Loctite Studlock grade CVX' and fit and tighten the bolts evenly. Torque: 10,0 kgf.m (73 lbf ft).
103. Fit the rear axle assembly. 51.25.01.
104. Replenish the differential lubricating oil. After the initial axle run, check the oil level and replenish as necessary to the filler/level plug hole.
105. Where major running parts have been replaced during servicing, it is a recommended practice to allow the axle assembly to 'run in' by avoiding, where possible, heavy loads and high speeds during initial running.

**DATA**

Crownwheel backlash  
Differential bearings pre-load

0,15 to 0,27 mm (0.006 to 0.011 in)  
0,127 mm (0.005 in)

Pinion height setting

Set using gauge 18G191P  
Gauge length 30,912 mm (1.2177 in)

**Torque resistance initial setting figures**

Torque to turn drive pinion and new pinion bearings  
Torque to turn drive pinion re-using the original bearings

34,5 to 46 kg cm (30 to 40 lb in)  
17,3 to 34,5 kg cm (15 to 30 lb in)

## PINION OIL SEAL

—Remove and refit 51.20.01

Service tool: 18G1205, spanner for drive coupling  
RO1008, oil seal replacer

## Removing

1. Drain the rear axle.
2. Jack up the rear of the vehicle and support on stands.
3. Remove the fixings from both rear hub driving members and disengage the axle shafts from the differential.
4. Disconnect the rear propeller shaft at the axle flange.
5. Using a 'TORQUEMASTER' or a spring balance, measure and record the torque required to rotate the pinion.
6. Using 18G1205 to prevent the pinion from rotating remove the flange retaining nut and washer, and withdraw the pinion flange.
7. Extract and discard the oil seal and gasket.

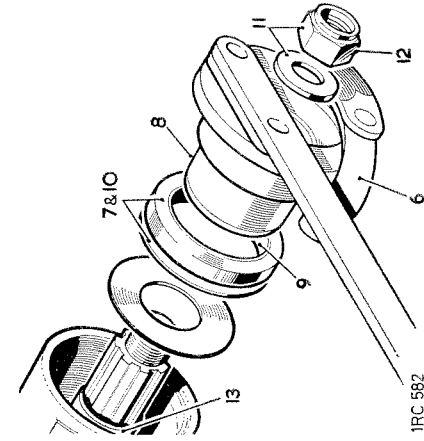
## Inspection

8. Examine the pinion flange for damage, paying particular attention to the oil seal track area.

## Refitting

9. Grease the sealing lip of the new oil seal, using general purpose grease or, if available, grease with a molybdenum disulphide base.  
**NOTE:** Where oil leakage past the seal outer diameter has occurred, coat the metal circumference with 'Hylomar P132M', avoiding contact with the seal rubber.
10. Fit the gasket and oil seal, lipped side first, using RO1008 to drift in the seal.
11. Refit the pinion flange and washer.
12. Screw on the retaining nut, tightening the nut gradually until resistance is felt.

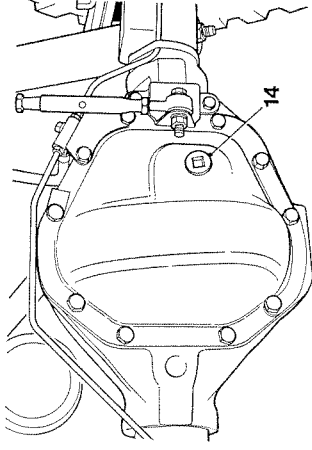
*continued*



13. Rotate the pinion to settle the bearings and measure the torque to rotate the pinion. If the reading obtained is less than that recorded in item 5, before the seal was removed, tighten the nut a very small amount, resettle the bearings and recheck the torque reading. Repeat this procedure until a reading equal to that recorded in item 5, or between 17.2 to 23.0 kgf.cm (15 to 20 lbf in), whichever is the greater, is obtained.

**NOTE:** Preload build up is rapid, tighten the nut with extreme care. If the required torque reading is exceeded, the axle must be dismantled and a new collapsible spacer fitted as described in 51.15.07.

14. Reverse 1 to 4, using the correct grade oil to replenish the differential. After an initial run, check the oil level and replenish as necessary to the filler/level plug hole.





## REAR AXLE ASSEMBLY

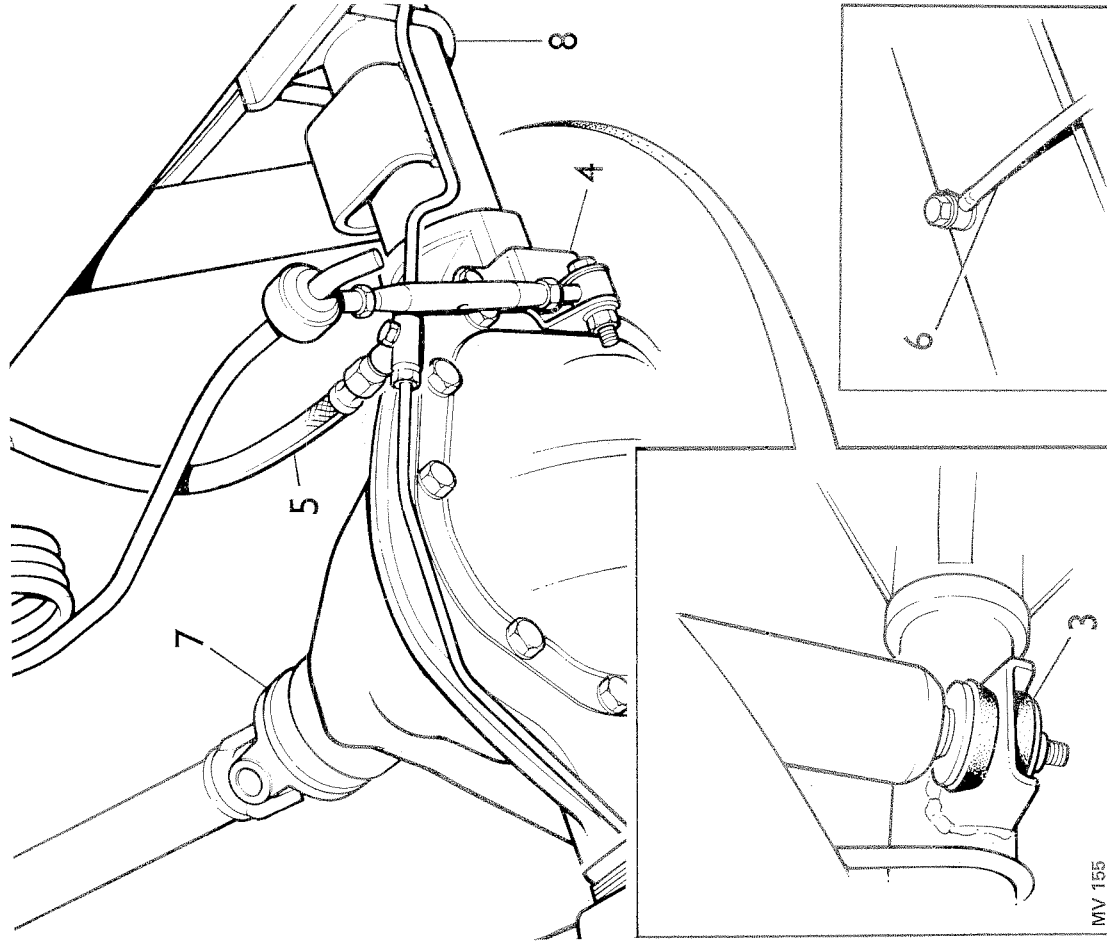
—Remove and refit 51.25.01

**Removing**

1. Slacken the road wheel nuts at both rear wheels.
2. Jack up the rear of the vehicle and place stands under the chassis, forward of the road spring mountings.
3. Disconnect the lower end of both rear shock absorbers.
4. Release the brake apportioning valve bracket from the axle case.
5. Disconnect and blank the flexible brake hose.
6. Disconnect the breather pipe from the axle case.
7. Disconnect the propeller shaft at the axle flange.
8. Remove the four 'U' bolts.
9. Place a jack under the axle.
10. Remove the rear road wheels.
11. Withdraw the rear axle assembly.

**Refitting**

12. Place the axle on a jack.
13. Position the axle under the vehicle springs and raise the axle to locate it on the spring centre bolt dowels.
14. Fit and tighten the four 'U' bolts. Torque: 10,0 kgf.m (65 lbf ft).
15. Reverse 3 to 7.
16. Refit the road wheels.
17. Bleed the brakes. 70.25.02.
18. Lower the vehicle and tighten the road wheel nuts.

*continued*

**FRONT AXLE AND FINAL DRIVE      Wheeled Vehicles Q052**

Description of front axle and final drive .. .. . 54-3  
 Fault diagnosis—front axle and final drive .. .. . 54-6

**FRONT AXLE AND FINAL DRIVE OPERATIONS**

Axle case oil seal—remove and refit .. .. . 54.15.04

Differential assembly  
 —remove and refit .. .. . 54.10.01  
 —overhaul .. .. . 54.10.07

Front axle assembly—remove and refit .. .. . 54.15.01

Half shaft assembly—remove and refit .. .. . 54.20.07

Pinion oil seal—remove and refit .. .. . 54.10.20

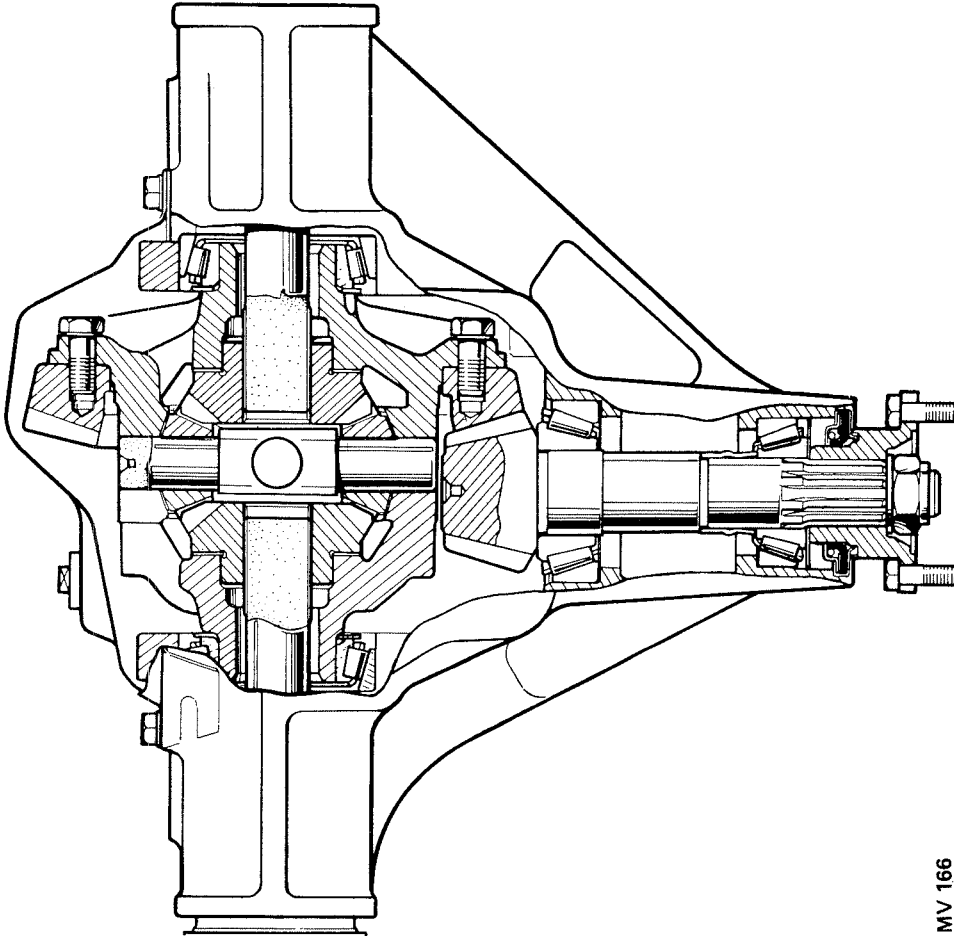
**FRONT AXLE AND FINAL DRIVE—DESCRIPTION**

The one piece, front axle case is secured by 'U' bolts to the underside of the road springs and contains a 'Hypoid' bevel pinion and crownwheel, a differential unit and a left-hand and right-hand axle shaft.

Input to the front axle is through the bevel pinion, which is mounted on pre-loaded taper roller bearings that are adjusted by means of a collapsible spacer. A matching bevelled crownwheel is secured to a flange on the outside of the differential case, and together, this arrangement turns the drive through ninety degrees, drives the differential unit and provides reduction gearing.

The two piece differential case is mounted on taper roller bearings in the final drive housing, and contains two side gears with thrust washers that are divided by a set of four differential pinions with thrust washers mounted on cross-pins. The side gears are located in plain bores in the differential case and are a splined fit on the front axle shafts. The differential pinions are a free fit on the cross-pins, and the pins themselves are securely located in the differential case.

The drive from the gearbox is transmitted by the propeller shaft and coupling flanges to the bevel pinion in the final drive housing. The bevel pinion meshes with a matching bevelled crownwheel that is secured to a flange on the differential casing. The drive is then transmitted from the differential casing by the cross-pins and pinions to the side gears and thus the axle shafts.



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Sectioned view of final drive arrangement

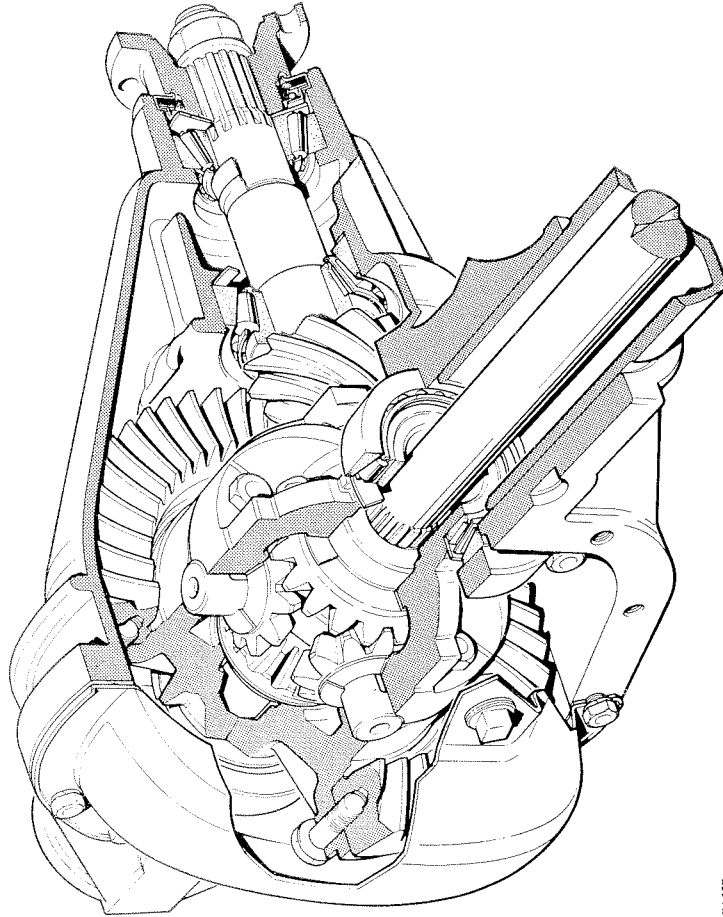
**DIFFERENTIAL OPERATION**

The drive from the gearbox front output flange is positive as far as the cross-pins in the differential, thereafter, the drive to the axle shafts is dependent on the vehicle direction and road conditions.

Under normal conditions when the vehicle is being driven in a straight line, the differential pinions do not rotate on the cross-pins; the differential case, cross-pins, pinions and side gears rotate as a single unit, turning both axle shafts at the same speed. If the vehicle turns left or right, the inner and outer road wheels cover a different radius and therefore must rotate at different speeds to avoid skidding. This is achieved through natural forces imparting a greater resistance to rotation on the inner road wheel which causes the applicable differential side gear to resist rotation. In these circumstances, the differential pinions commence rotating on the cross-pins, allowing the side gears and thus the axle shafts to rotate at different speeds.

As already explained, the drive will take the path of least resistance and, in slippery conditions, the differential will allow the road wheel with the least grip to spin while the other remains stationary.

In extreme conditions when the vehicle could be stopped with one wheel spinning, the gearbox differential can be locked, by a selector in the driving compartment, to ensure that the drive is transmitted to both axles, then providing that there is sufficient grip for both wheels in either the front or rear axle, the vehicle can be driven.



Cut-away view of final drive

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FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—OIL LEAKS	<ol style="list-style-type: none"> <li>Loose or missing drain and filler plugs</li> <li>Axle case breather inoperative resulting in internal pressure</li> <li>Differential front cover gasket damaged</li> <li>Pinion oil seal damaged</li> <li>Oil level too high.</li> </ol>	<ol style="list-style-type: none"> <li>Check drain plug at underside of differential case and filler plug in front cover. Tighten or fit new plugs as applicable</li> <li>Ensure that the breather pipe is not obstructed. Unscrew breather from axle case and clean or fit new breather, then rectify leak</li> <li>Fit a new gasket using jointing compound on both sides</li> <li>Fit new pinion oil seal</li> <li>Drain oil to correct level.</li> </ol>
B—WHINE FROM DIFFERENTIAL	<ol style="list-style-type: none"> <li>Incorrect setting of crownwheel and pinion</li> <li>Oil level too low.</li> </ol>	<ol style="list-style-type: none"> <li>Remove differential, check and adjust gears as necessary (31.15.07)</li> <li>Top up as necessary.</li> </ol>
C—RATTLE FROM DIFFERENTIAL	<ol style="list-style-type: none"> <li>Differential oil level too low or incorrect grade</li> <li>Incorrect bevel pinion bearing adjustment</li> <li>Differential worn or incorrect internal settings</li> </ol>	<ol style="list-style-type: none"> <li>Drain and replenish with correct grade oil and adjust a new collapsible spacer (31.15.07)</li> <li>Overhaul differential</li> </ol>
D—NO DRIVE AT ROAD WHEELS	<ol style="list-style-type: none"> <li>Broken front half shaft. (Front propeller shaft rotating with rear propeller shaft stationary. If opposite to this, suspect broken rear axle shaft)</li> </ol>	<ol style="list-style-type: none"> <li>With engine stopped and gearbox in 'Neutral', jack each front wheel separately and turn by hand, if propeller shaft does not also turn, remove the applicable half shaft for inspection. Fit new half shaft as necessary</li> </ol>

DIFFERENTIAL ASSEMBLY

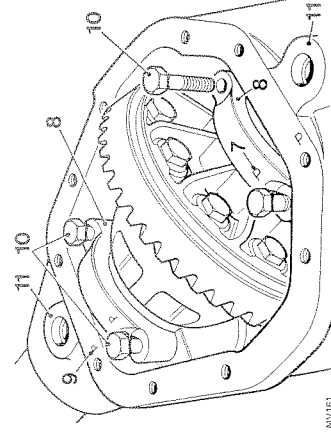
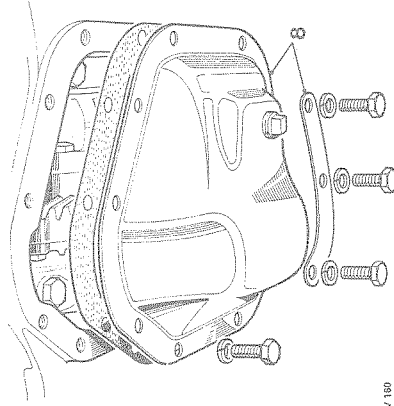
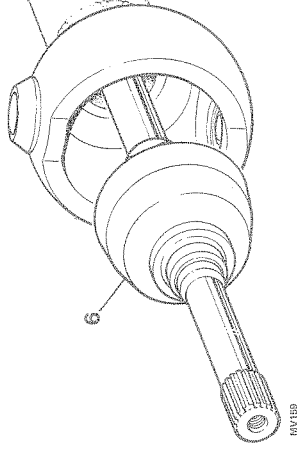
—Remove and refit 54.10.01

Service tools: Axle spreader 18G131C  
Pegs for axle spreader 18G131F

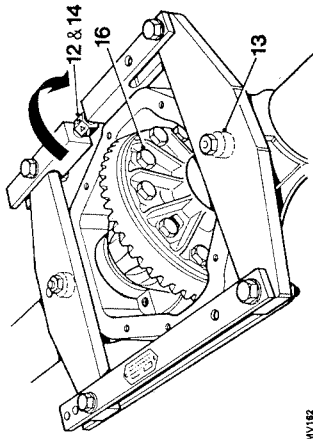
Removing

- Drain the lubricating oil from the differential and both swivel pin housings.
- Remove the front axle assembly. 54.15.01.
- Remove both front hubs. 60.25.01.
- Remove both hub stub axles. 60.25.22.
- Remove both swivel pin housings. 60.15.20.
- Withdraw the half shafts using care not to damage the axle case oil seals.
- Remove the steering damper bracket from the differential case.
- Remove the fixings and support strip at the differential cover, and withdraw the cover and joint washer.
- Note the relationship marking on the bearing caps and axle casing to ensure correct refitting.
- Remove the fixings and withdraw the differential bearing caps.
- Clean out and examine the spreader tool peg holes provided in the gear casing face; ensure that the holes are free from dirt, burrs and damage.

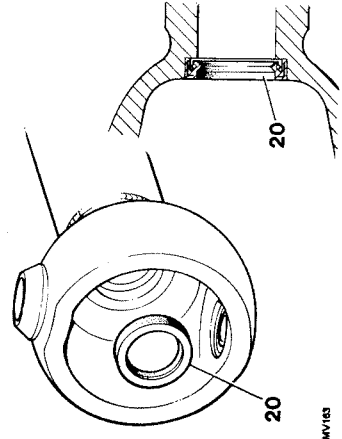
continued



12. Ensure that the turnbuckle adjuster is free to turn.
13. Fit the axle spreader to engage the peg holes. Spreader 18G131C, adapter pegs 18G131F.
14. Turn the adjuster until all free play between the spreader and casing is taken up, denoted by the adjuster becoming stiff to turn, using a spanner on the adjuster.
15. Check that the side members of the spreader are clear of the casing.
16. Stretch the casing, rotating the adjuster by one flat at a time, until the differential assembly can be levered out. Do not lever against the spreader; use suitable packing under the levers to avoid damaging the casing.
- CAUTION:** To prevent permanent damage to the gear carrier case, it must not be over-stretched. Each flat on the turnbuckle is numbered to enable a check to be made on the amount turned. The maximum stretch permitted is 0,30 mm (0,012 in) equivalent to three flats.
17. Ease off the adjuster and remove the spreader.



MV162



MV163

**Refitting**

18. If the differential assembly has been dismantled, it must be reassembled and refitted in accordance with the instructions in 51.15.01–51.15.07, items 41 to 101.
19. If a new differential assembly is being fitted, commence at item 42 or 43 of the above operation, as applicable.
20. Using clean oil, lubricate the axle case oil seals and ensure that they are in good condition. If necessary, fit new oil seals.
21. Reverse 1 to 7.

**DIFFERENTIAL ASSEMBLY**

—Overhaul 54.10.07

The overhaul procedure is the same as that for the rear axle differential and should be carried out in the following order.

**Procedure**

1. Remove the differential assembly, 54.10.01.
2. Refer to Operation 51.15.07, and carry out items 16 to 101.
3. Refit the differential assembly, 54.10.01.

## PINION OIL SEAL

—Remove and refit

54.10.20

Service tool: 18G1205 Spanner for drive coupling  
RO1008 Oil seal replacer

## Removing

1. Drain the front differential.
2. Jack up the front of the vehicle and support on stands.
3. Remove the fixings from both front hub driving members.
4. Disconnect the front propeller shaft at the axle flange.
5. Using a 'TORQUEMASTER' or a spring balance, measure and record the torque required to rotate the pinion.
6. Using 18G1205 to prevent the pinion from rotating, remove the flange retaining nut and washer, and withdraw the pinion flange.
7. Extract and discard the oil seal and gasket.

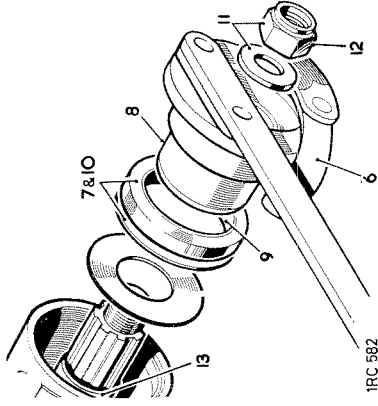
## Inspecting

8. Examine the pinion flange for damage, particularly at the oil seal track.

## Refitting

9. Grease the sealing lip of the new oil seal with general purpose grease or, if available, grease with a molybdenum disulphide base.

**NOTE:** Where oil leakage past the seal outer diameter has occurred, coat the metal circumference with 'Hylomar P132M', avoiding contact with the seal rubber.



10. Fit the gasket and oil seal, lipped side first, using RO1008 to drift in the seal.

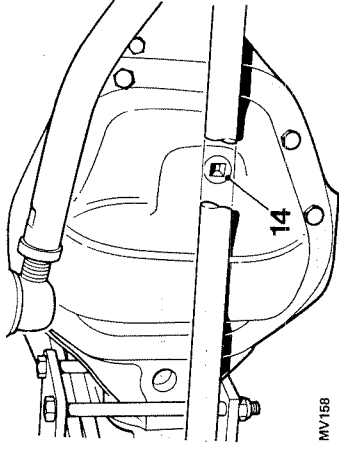
11. Refit the pinion flange and washer.

12. Screw on the retaining nut, tightening the nut gradually until resistance is felt.

13. Rotate the pinion to settle the bearings and measure the torque to rotate the pinion. If the reading obtained is less than that recorded in item 5, before the seal was removed, tighten the nut a very small amount, resettle the bearings and recheck the torque reading. Repeat this procedure until a reading equal to that recorded in item 5, or between 17,2 to 23,0 kgf.cm (15 to 20 lbf in), whichever is the greater, is obtained.

**NOTE:** Preload build up is rapid, tighten the nut with extreme care. If the required torque reading is exceeded, the axle must be dismantled and a new collapsible spacer fitted as described in 51.15.07.

14. Reverse 1 to 4, using the correct grade oil to replenish the differential. After an initial run, check the oil level and replenish as necessary to the filler level plug hole.



MV168

FRONT AXLE ASSEMBLY

—Remove and refit 54.15.01

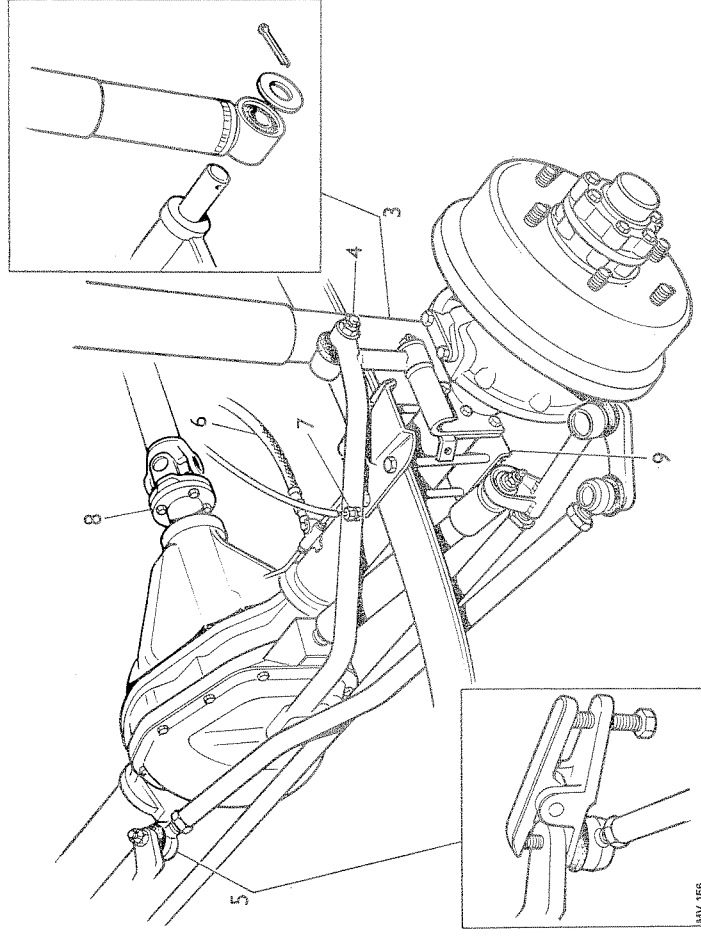
Service tool: 18G 1063 Ball joint extractor

**Removing**

1. Remove the hub step and slacken the road wheel nuts at both front wheels.
2. Jack up the front of the vehicle and place stands under the chassis to the rear of the road spring mountings.
3. Disconnect the lower end of both front shock absorbers.
4. Disconnect the anti-roll bar at both ends of the axle. 18G 1063.
5. Disconnect the drag link from the steering relay.
6. Disconnect and blank the flexible brake hose.
7. Disconnect the breather pipe from the axle case.
8. Disconnect the propeller shaft at the axle flange.
9. Place a jack under the axle.
10. Remove the four self-locking nuts and bottom plate from under each end of the axle tube.
11. Remove the front road wheels.
12. Withdraw the front axle assembly.

**Refitting**

13. Place the axle on a jack.
14. Position the axle under the vehicle springs and raise the axle to locate it on the spring centre dowel bolts.
15. Locate the axle bottom plates in position, engaging the centre dowels, then fit and tighten the clamp bolts and self-locking nuts. Torque: 10.0 kgf.m (65 lbf ft).
16. Reverse 3 to 8. Torque tighten the ball joint slotted nuts 4.1 kgf.m (30 lbf ft) and fit new split pins.
17. Refit the road wheels.
18. Bleed the brakes. 70.25.02.
19. Lower the vehicle and tighten the road wheel nuts.
20. Refit the hub steps.





## AXLE CASE OIL SEAL

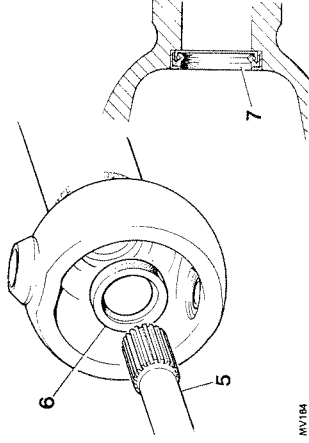
---Remove and refit 54.15.04

## Removing

1. Drain the lubricating oil from the differential and the applicable swivel pin housing.
2. Remove the front hub. 60.25.01.
3. Remove the hub stub axle. 60.25.22.
4. Remove the swivel pin housing. 60.15.20.
5. Withdraw the half shaft.
6. Withdraw and discard the oil seal from the axle case.

## Refitting

7. Fit the new oil seal, lipped side inward.
8. Using clean axle oil, lubricate the lip of the new oil seal.
9. Reverse 1 to 5, using oil of the correct grade to replenish the differential and swivel pin housing. After an initial run, check the oil levels and replenish as necessary to the level plug hole.



MVI14

## HALF SHAFT ASSEMBLY

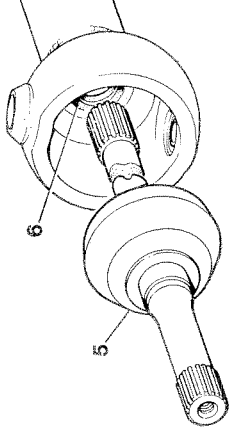
---Remove and refit 54.20.07

## Removing

1. Drain the lubricating oil from the differential and the applicable swivel pin housing.
2. Remove the front hub. 60.25.01.
3. Remove the hub stub axle. 60.25.22.
4. Remove the swivel pin housing. 60.15.20.
5. Withdraw the half shaft assembly.

## Refitting

6. Using clean axle oil, lubricate the axle case oil seal and ensure that it is in good condition. If necessary, fit a new oil seal.
7. Locate the half shaft assembly in position.
8. Refit the swivel pin housing. 60.15.20.
9. Refit the hub stub axle. 60.25.22.
10. Refit the front hub, 60.25.01, and include adjustment of the bearing end-float. 60.25.13.
11. Using the correct grade oil, replenish the differential and swivel pin housing. After an initial run, check the oil levels and replenish as necessary to the level plug holes.



MVI15

**STEERING**

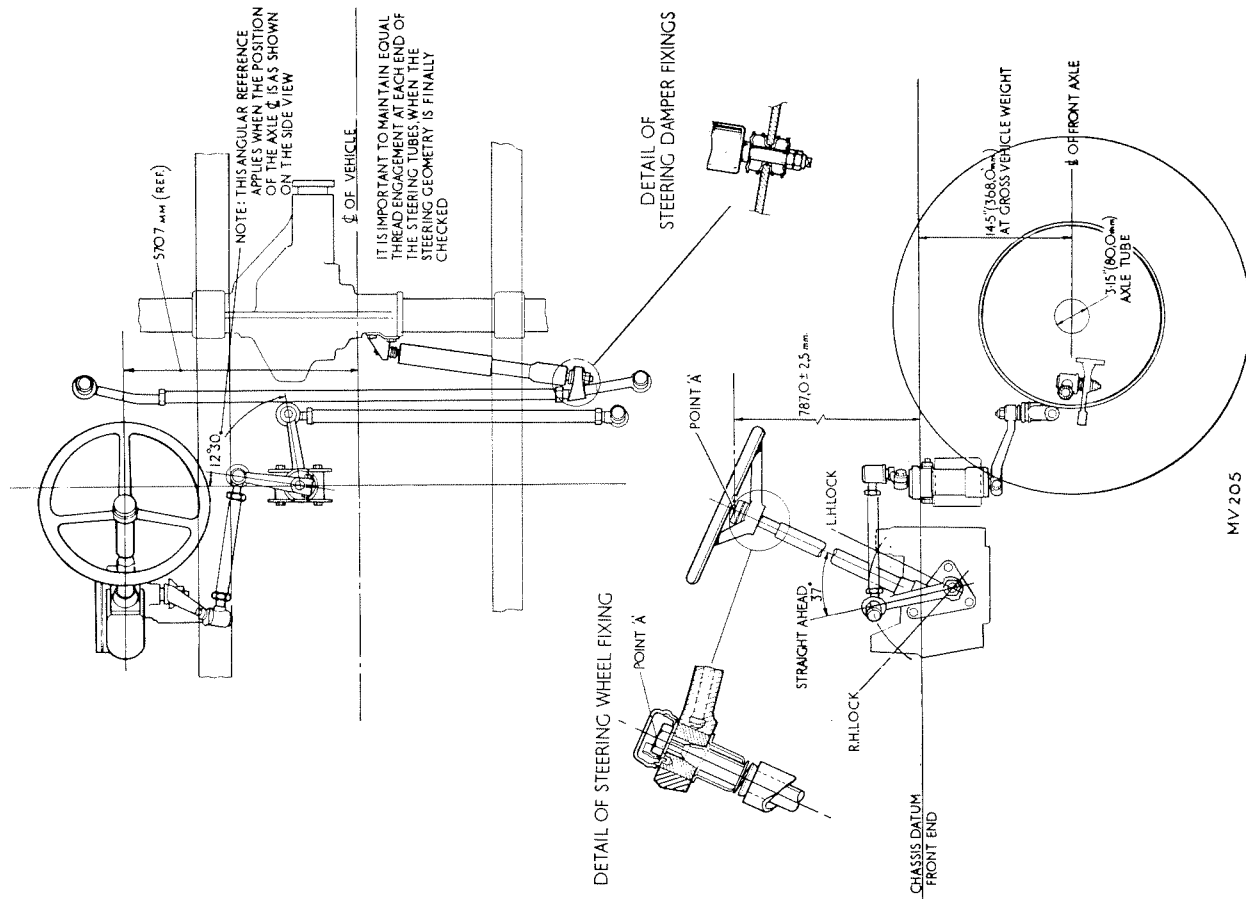
**Wheeled Vehicles Q052**

Description of steering .. .. .	57-5
Fault diagnosis—steering .. .. .	57-8

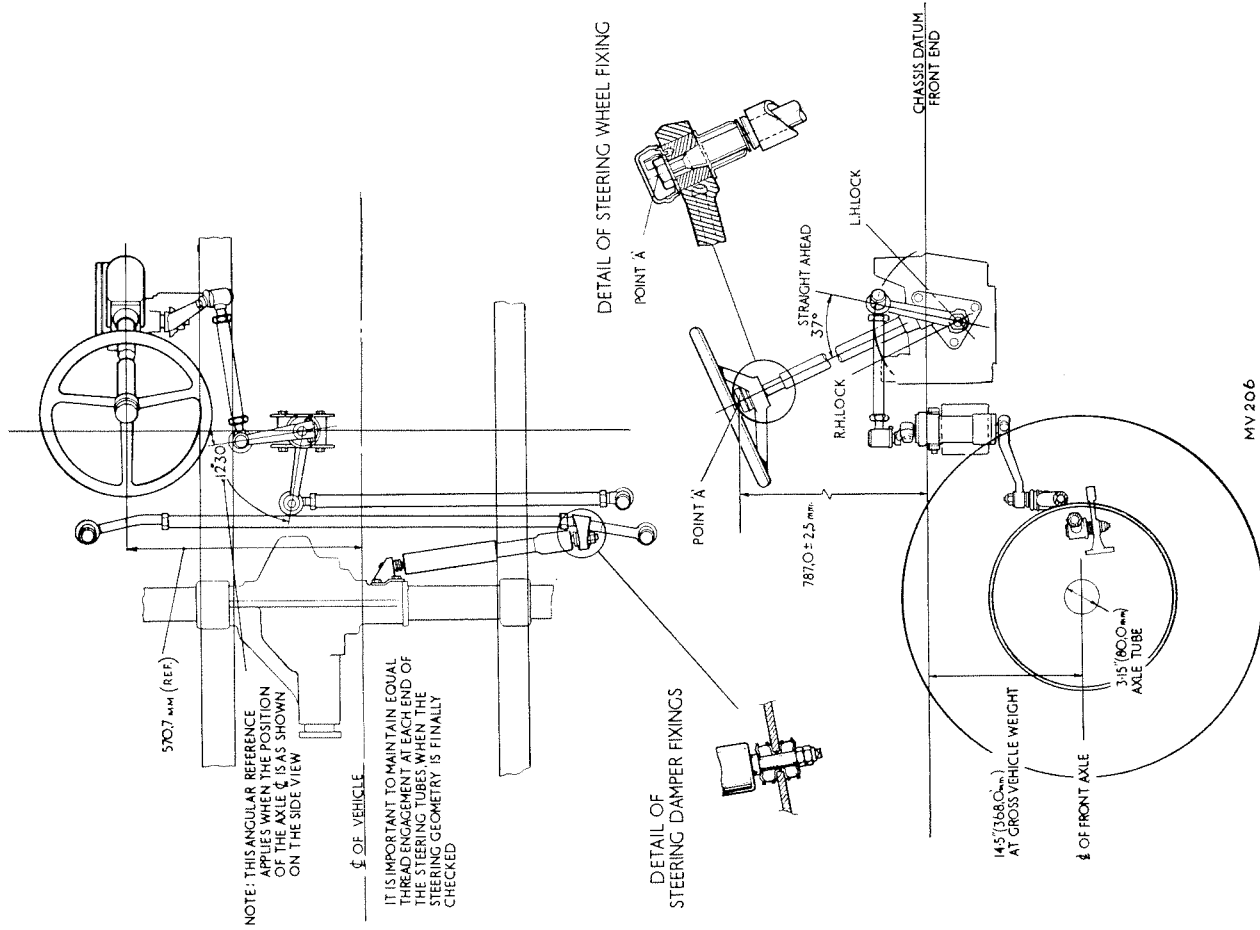
**STEERING OPERATIONS**

<b>Drag link</b>			
—remove and refit .. .. .	57.55.17		
—ball joints—remove and refit .. .. .	57.55.16		
<b>Front wheel alignment—check and adjust</b>			
.. .. .	57.65.01		
<b>Lock stops—check and adjust</b>			
.. .. .	57.65.03		
<b>Longitudinal steering tube</b>			
—remove and refit .. .. .	57.55.13		
—ball joints—remove and refit .. .. .	57.55.12		
<b>Steering box—adjust</b>			
.. .. .	57.35.01		
<b>Steering column and box assembly</b>			
—remove and refit .. .. .	57.45.01		
—overhaul .. .. .	57.45.07		
<b>Steering damper—remove and refit</b>			
.. .. .	57.35.10		
<b>Steering geometry—check</b>			
.. .. .	57.65.02		
<b>Steering relay</b>			
—remove and refit .. .. .	57.50.02		
—overhaul .. .. .	57.50.08		
<b>Steering wheel—remove and refit</b>			
.. .. .	57.60.01		
<b>Track rod</b>			
—remove and refit .. .. .	57.55.09		
—ball joints—remove and refit .. .. .	57.55.08		

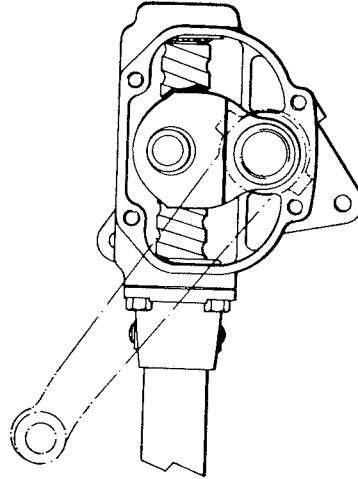
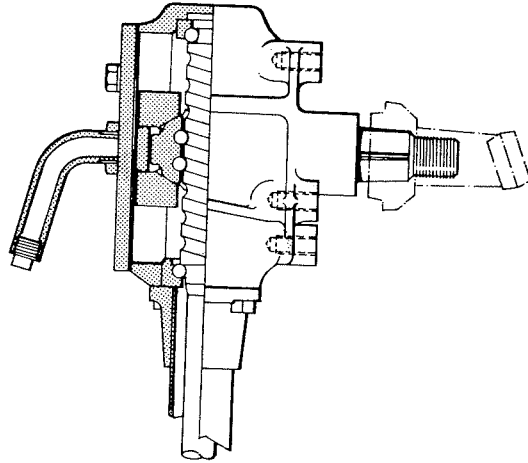
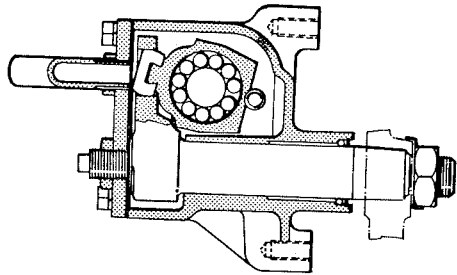
**Note:** This Division of the Manual applies to right hand-steering and left-hand steering vehicles. In operations where only the right-hand steering installation is illustrated, the left-hand version is usually symmetrically opposite.



General arrangement of right-hand steering



General arrangement of left-hand steering



**STEERING—DESCRIPTION**

The vehicle steering system employs a 4.19 mm (16 in) diameter steering wheel, splined on to a column that is secured directly to a chassis mounted steering box. From the steering box, a longitudinal steering tube connects with the upper lever of a chassis mounted relay unit. The lower lever on the relay unit is fitted with a drag link that connects with a steering lever on the front hub swivel housing, at the passengers side of the vehicle. The steering lever also carries one end of a track rod that is coupled to a similar front hub swivel housing steering lever at the drivers side of the vehicle. The system is completed by a telescopic hydraulic damper that is fitted between the track rod and the front axle casing.

**Steering box**

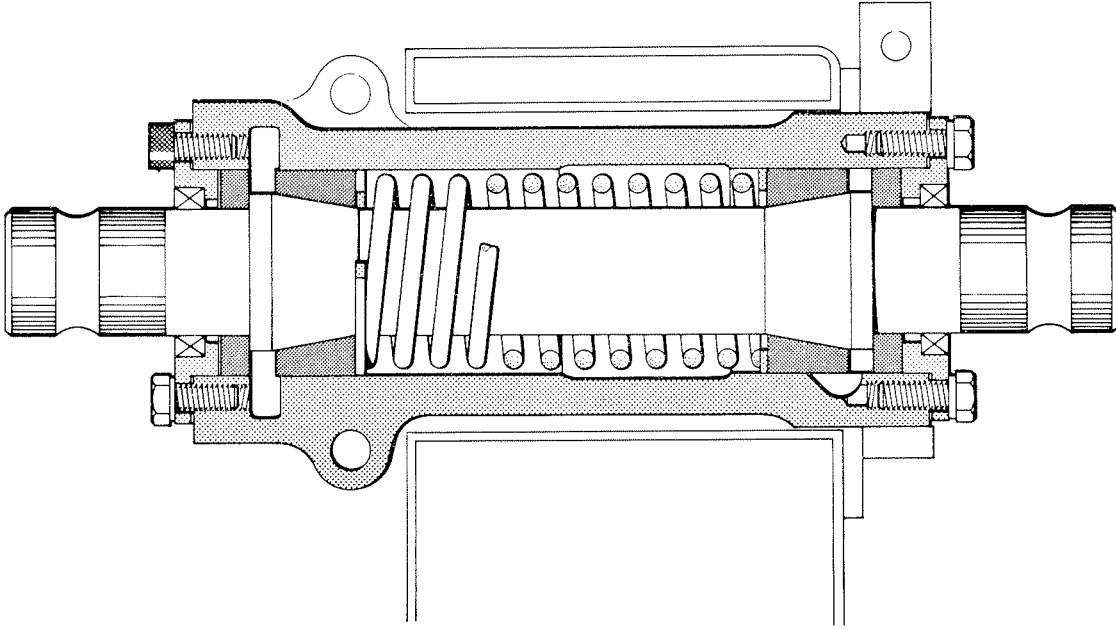
The steering box and column assembly is a 'Burman' recirculating ball type, with an inner and outer column. The outer column is bolted to the steering box casting and forms a support for the upper end of the inner column. The lower end of the inner column is located in adjustable bearings in the steering box and has a worm thread on the section between the bearings. A worm thread nut operates on the inner column, moving along the column when the steering wheel, and thus the column, is turned. Friction between the inner column and worm nut is reduced by employing the worm threads as inner and outer tracks for an endless 'chain' of steel balls. The balls roll continuously between the column and nut through a recirculating tube that connects the two ends of the thread in the nut. Depending on which direction the steering wheel is turned, the worm nut moves forward or rearward along the inner column. A steel roller, mounted on the top of the nut, transmits movement through a fork and shaft assembly to an external drop arm to which the steering linkage is attached.

**Steering relay**

The steering relay is a self-contained unit, mounted in a tubular housing in number two, chassis cross-member. The relay performs three main functions, it converts the movement of the steering linkage from a longitudinal to a transverse direction, internal fibre bushes provide friction damping and, differing length upper and lower levers are used to modify the steering ratio. The relay housing is machined from a tubular, iron casting and is sealed by top and bottom covers fitted with oil seals. The relay shaft is splined at both ends to accept the relay levers, while the section within the housing is machined in the form of two reverse facing cones. Matching fibre bushes, that are split into semi-circular halves, locate on the shaft cones and against the inside wall of the housing. A centrally located spring exerts pressure on both fibre bushes to provide a pre-determined amount of friction damping. Oil filler and breather plugs are fitted in the top and bottom covers, and the housing is completely filled with oil.

**Steering linkage**

There are three links connecting the steering system components. A longitudinal steering tube is fitted between the steering box and the relay unit, a drag link connects the relay to the passengers side front hub and, a track rod couples the front hubs. The ends of each link are fitted with a ball joint, one right-hand thread and one left-hand thread enabling final adjustment of the linkage to be made on the vehicle. The drag link is set to a specified dimension, then the track rod is adjusted to give a specified front wheel toe-out and finally, the longitudinal steering tube is adjusted as necessary to fit between the steering box and relay unit. The steering ball joints are factory filled with grease and are designed in such a way as to retain the initial filling for the normal life of the ball joints; providing that the protective rubber boot is not damaged and remains in position on the ball joint.



MV 204

General arrangement of steering relay

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>A--EXCESSIVE LOOSENESS OR BACKLASH IN THE STEERING</b>	<ol style="list-style-type: none"> <li>Steering rocker shaft incorrectly adjusted</li> <li>Steering linkage loose or worn</li> <li>Front wheel bearings loose or worn</li> <li>Steering box fixings loose</li> <li>Swivel pins and bearings loose or worn</li> <li>Steering box worn</li> </ol>	<ol style="list-style-type: none"> <li>Readjust</li> <li>Check ball joints for security and wear condition. Re-tighten bearing adjustment</li> <li>Check front lift bearing adjustment (Division 60). Readjust or renew bearings</li> <li>Tighten fixings to correct torque</li> <li>Adjust or fit new parts as necessary (Division 60)</li> <li>Overhaul</li> </ol>
<b>B--TIGHT STEERING</b>	<ol style="list-style-type: none"> <li>Low or unequal tyre pressures</li> <li>Steering box oil level too low</li> <li>Steering rocker shaft adjusted too tight</li> <li>Steering ball joints partially seized</li> <li>Loss of lubricating oil from relay</li> <li>Swivel pins dry or partially seized</li> </ol>	<ol style="list-style-type: none"> <li>Check and adjust as necessary</li> <li>Check and replenish as necessary</li> <li>Readjust</li> <li>Check that rubber boots are in place and ball joints move freely. Fit new ball joints as required</li> <li>Check oil level, if low, check for damaged oil seals and joint washers. Replenish as necessary and replenish oil level</li> <li>Check swivel pin resistance to rotation. Adjust and lubricate swivel pins as necessary</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
<b>C--RAITTL E FROM STEERING COLUMN</b>	<ol style="list-style-type: none"> <li>Steering rocker shaft incorrectly adjusted or badly worn</li> </ol>	<ol style="list-style-type: none"> <li>Readjust or fit new parts as necessary</li> </ol>
<b>D--VEHICLE PULLS TO ONE SIDE</b>	<ol style="list-style-type: none"> <li>Uneven tyre pressures or worn tyres</li> <li>Dragging brake</li> <li>Incorrect toe-out of front wheels</li> <li>Tight or dirty front wheel bearings</li> <li>Swivel pin tight</li> <li>Incorrect camber</li> <li>Incorrect castor or swivel pin inclination</li> </ol>	<ol style="list-style-type: none"> <li>Check and adjust tyre pressures or fit new tyres as necessary</li> <li>Check brakes and adjust as necessary</li> <li>Check front wheel toe-out and adjust as necessary</li> <li>Remove front hubs and check bearings. Fit new bearings if necessary, pack bearings with front grease, refit and adjust hubs</li> <li>Dismantle and check swivel pins. Fit new parts as required, lubricate pins on assembly</li> <li>Check for settled road springs, worn shackles bushes or damage to front axle unit. Fit new parts as necessary</li> <li>Check front wheel alignment and adjust as necessary. Check for settled or damaged road springs, or damage to front axle unit. Fit new parts as necessary</li> </ol>
<b>E--VEHICLE WANDERS</b>	<ol style="list-style-type: none"> <li>Incorrect tyre pressures or worn tyres</li> <li>Loose axle clamp bolts</li> <li>Incorrect toe-out of front wheels</li> <li>Tight steering box</li> </ol>	<ol style="list-style-type: none"> <li>Check and adjust tyre pressures or fit new tyres as necessary</li> <li>Securely tighten</li> <li>Adjust as necessary</li> <li>Adjust as necessary</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
E—VEHICLE WANDERS—continued	<ol style="list-style-type: none"> <li>Worn front wheel bearings</li> <li>Worn swivel pins and bearings</li> <li>Incorrect castor</li> <li>Bent or broken chassis</li> </ol>	<ol style="list-style-type: none"> <li>Renew and/or adjust hub bearings as necessary</li> <li>Dismantle swivel pin housings, fit new parts as required, lubricate swivel pins on assembly</li> <li>Check for settled or damaged road springs, damage to front suspension or axle unit. Fit new parts as required</li> <li>Check alignment of chassis and repair or renew as necessary</li> </ol>
F—WHEEL WOBBLE	<ol style="list-style-type: none"> <li>Incorrect tyre pressures or worn tyres</li> <li>Steering box fixings loose</li> <li>Eccentric wheels and tyres</li> <li>Worn or loose hub bearings</li> <li>Insufficient damping at swivel pins</li> <li>Worn swivel pins and bearings</li> <li>Insufficient damping at relay</li> <li>Loose engine mountings</li> <li>Worn or constant velocity joints at axle</li> <li>Incorrect castor</li> </ol>	<ol style="list-style-type: none"> <li>Check and adjust tyre pressures or fit new tyres as necessary</li> <li>Tighten fixings to correct torque</li> <li>Check tyre concentricity line. Check wheel pressings for damage or distortion and rectify or renew</li> <li>Renew and/or adjust hub bearings as necessary</li> <li>Check swivel pin resistance to rotation and adjust as necessary</li> <li>Dismantle swivel pin housings, fit new parts as required, lubricate swivel pins on assembly</li> <li>Dismantle relay unit and fit new parts as required</li> <li>Securely tighten</li> <li>Fit new half shafts</li> <li>Check for settled or damaged road springs, damage to front suspension and axle unit. Fit new parts as necessary</li> </ol>

STEERING BOX

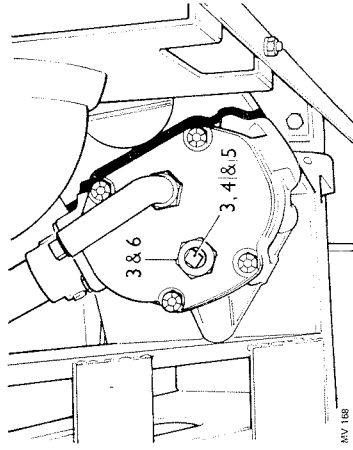
—Adjust 57.35.01

**NOTE:** The condition of adjustment which must be achieved is one of zero backlash without over-tightness when the road wheels are in the straight ahead position.

**Procedure**

- Jack the front of the vehicle until the wheels are clear of the ground.
- Set the steering in the straight ahead position.
- Slacken the locknut and adjuster.
- Screw in the adjuster until steering wheel backlash is taken up.
- Screw the adjuster in a further one-half flat maximum to allow for locknut tightening.
- Tighten the locknut without disturbing the adjuster.
- Turn the steering lock-to-lock and check that there is no backlash or tight spots. If necessary, readjust.

**NOTE:** Should oil leakage occur at the adjusting screw, remove and clean the screw and coat the threads with a sealing compound such as 'Wellseal'. Then, adjust the steering box and check, and if necessary replenish, the lubricating oil.



STEERING DAMPER

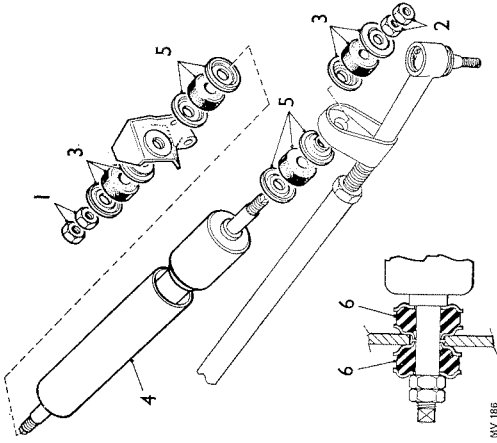
—Remove and refit 57.35.10

Removing

1. Remove the two locknuts at the axle case bracket.
2. Remove the two locknuts at the track rod bracket.
3. Pull off the outer stem rubbers and washers.
4. Compress the steering damper and withdraw it from the vehicle.
5. If required, pull off the inner stem rubbers and washers.

Refitting

6. Before fitting the damper, carry out the following checks:
  - a. Visually inspect the damper. There must be no sign of oil leakage.
  - b. Check the operation by extending and compressing the damper, there must be uniform resistance throughout the length of the stroke in both directions. If the resistance is erratic or weak, fit a new damper.
7. Reverse 1 to 5, assembling the stem rubbers and washers as illustrated.



MV 886

STEERING COLUMN AND BOX ASSEMBLY

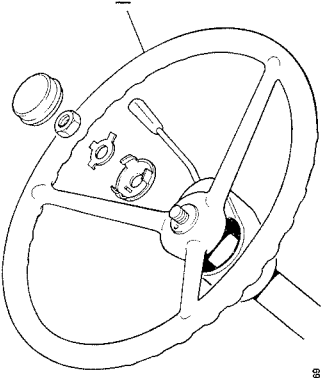
—Remove and refit 57.45.01

Service tool: RO8457 Drop arm remover

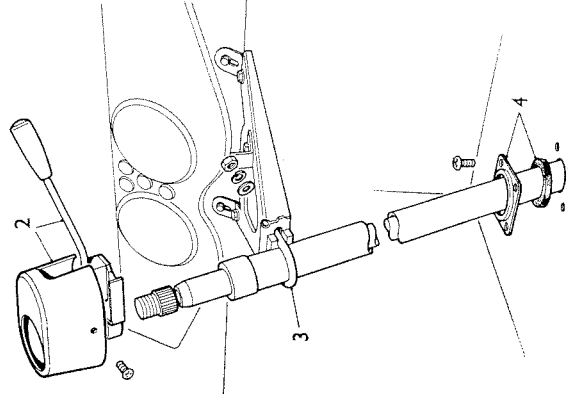
Removing

1. Remove the steering wheel. (See 57.60.01).
2. Remove the combined switch from the steering column.
3. Slacken the 'U' bolt supporting the steering column.
4. Remove the retainer and seal from the cab floor.
5. Disengage the tab washer and remove the nut securing the drop arm.
6. Remove the drop arm. RO8457.
7. Remove the steering box mounting bolts.
8. Withdraw the steering column and box assembly.

*continued*



MV 188

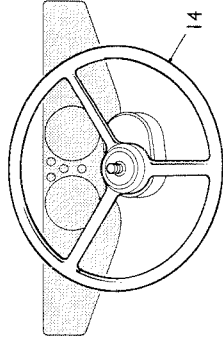


MV 170

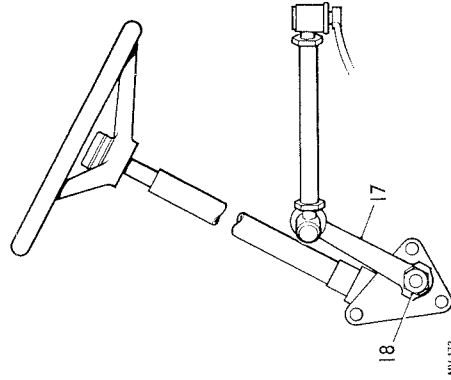


**Refitting**

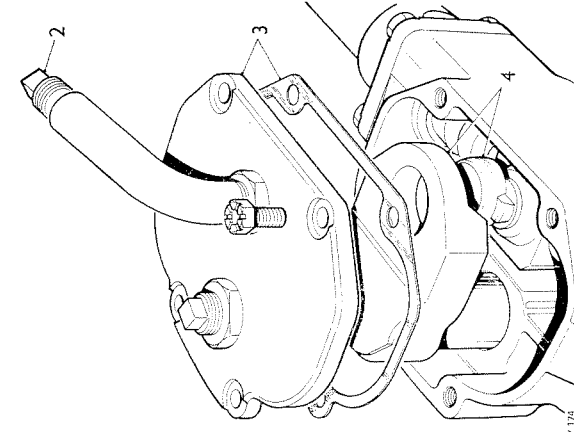
9. Offer the steering column and box assembly into position, locating the column through the support bracket 'U' bolt.
10. Fit and secure the steering box mounting bolts. Torque: 5,9 kgf.m (43 lbf ft).
11. Refit the seal and retainer to the cab floor.
12. Tighten the 'U' bolt supporting the steering column.
13. Ensure that the steering column top bearing, spring washer and striker assembly are in place, then fit the combined switch.
14. With the road wheels in the straight ahead position, locate the steering wheel on the column splines as illustrated.
15. Fit the cover base, tab washer and nut to the steering column. Tighten the nut and engage the tab washer.
16. Fit the steering wheel centre cover.
17. Turn the steering box to full left-hand lock on RH Sig vehicles, or full right-hand lock on LH Sig vehicles, then, fit the drop arm in the rearmost position on the splines that the chassis outrigger will allow.
18. Fit the tab washer and nut to secure the drop arm. Torque: 9,6 kgf.m (70 lbf ft) then engage the tab washer.



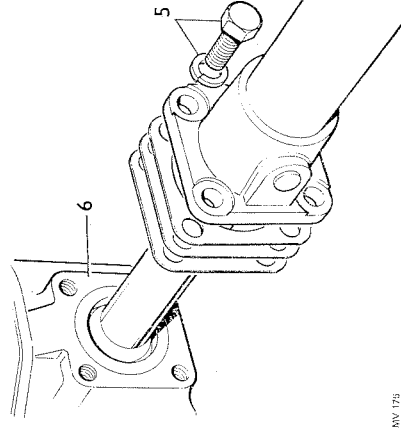
MV 172



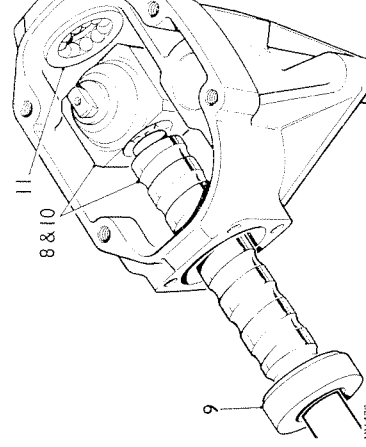
MV 173



MV 174



MV 175



MV 176

*continued*

**STEERING COLUMN AND BOX ASSEMBLY**

57.45.07

**Overhaul**

**Dismantling**

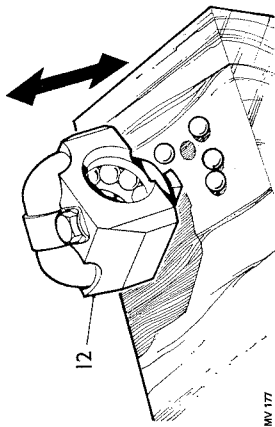
1. Remove the steering column and box assembly. 57.45.01.
2. Remove the oil filler plug and drain the steering box.
3. Remove the side cover and joint washer.
4. Withdraw the rocker shaft and slide the roller off the main nut.
5. Hold the outer column in a vice and remove the fixings securing the steering box.
6. Using a mallet, tap the inner column at the steering wheel end to partially remove the box.
7. Withdraw the box and inner column complete.
8. Rotate the inner column to locate the main nut in the mid-way position on the worm shaft.
9. Using a mallet, tap the box away from the inner column sufficient to remove the upper ball race.
10. Wind the worm shaft through the main nut and remove the shaft, main nut and any loose steel balls.
11. Using a mallet, tap the steering box to dislodge the bottom ball race.

12. Remove the twenty-seven steel balls from the main nut and recirculating tube, by tapping the top face of the nut on a wooden block.
13. Remove the retaining washer and oil seal from the steering box rocker shaft bore.
14. Remove the filler tube and oil seal from the side cover.
15. Remove the bearing from the top of the outer column.

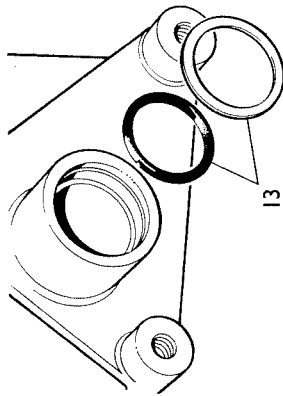
**Inspecting**

16. Obtain new oil seals and gaskets and discard originals.
17. Check all components for wear or damage.
18. Examine the worm nut ball bearing tracks for signs of indentations or scaling.
19. Examine the worm shaft for similar markings. Slight indentations at the extreme ends 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 new shaft must be fitted.

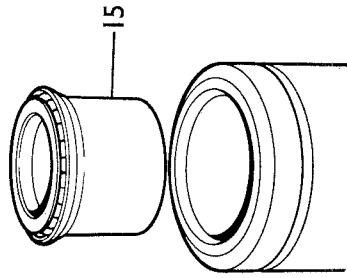
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MV 177



MV 178

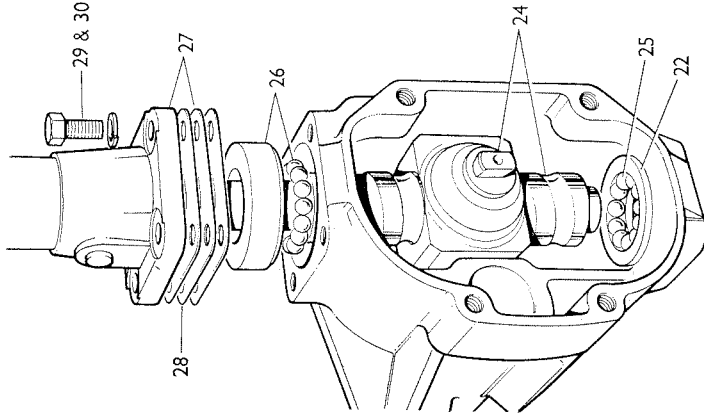


MV 179

**Reassembling**

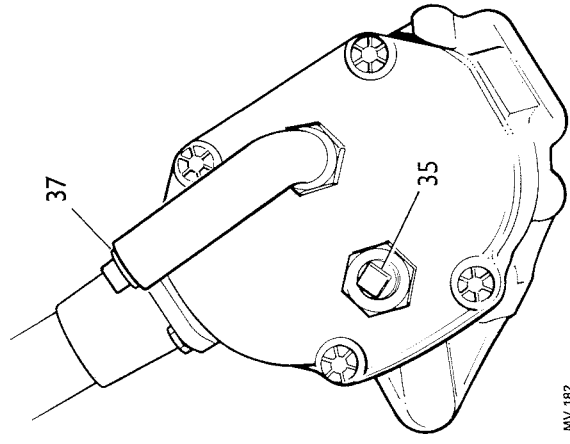
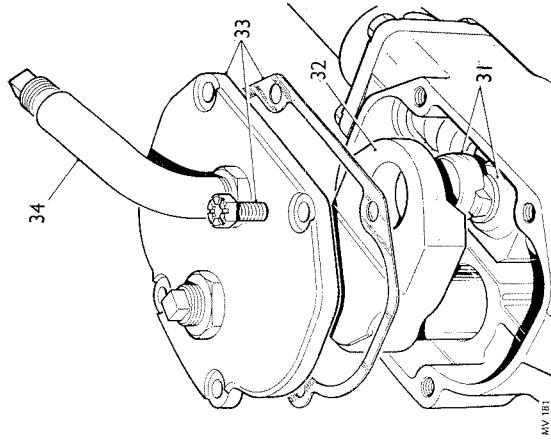
20. Fit the bearing into the top of the outer column.
21. Fit the oil seal and retaining washer to the steering box rocker shaft bore.
22. Fit the bottom ball race into the steering box.
23. Insert the twenty-seven  $\frac{3}{8}$  in diameter steel balls into the main nut track together with liberal quantities of grease.
24. Clamp the steering box vertically in a vice, column end uppermost. Add grease to the race fitted in the box, then holding the assembled main nut in position, lower the worm shaft into the box and wind it through the nut, ensuring that all the balls remain in the nut.
25. Raise the wormshaft sufficient to insert the ten  $\frac{3}{8}$  in diameter steel balls into the bottom race, then lower the shaft again ensuring that all balls remain in position and that none have fallen inside the steering box.
26. Using adequate grease, insert the ten  $\frac{3}{8}$  in diameter steel balls and the top ball race into position.
27. Fit the outer column together with sufficient thickness of joint washers and shim washers to permit wormshaft end-float. Note that there must be a paper joint washer fitted each side of the metal shims.
28. Progressively remove shims and check until the end-float is eliminated with the shaft free to rotate. Remove further shims to obtain 0.05 to 0.10 mm (0.002 to 0.004) bearing pre-load. A paper washer may be substituted for a metal shim for fine adjustment.
29. Make a final check with the outer column fixing bolts torqued to 2.3 to 2.7 kgf.m (17 to 20 lbf ft). The wormshaft must remain free to rotate.
30. When the shim adjustment is satisfactory, remove the bolts securing the outer column, coat the threads with a non-hardening sealing compound ('Wellseal' or equivalent) and refit the bolts. Torque: 2.3 to 2.7 kgf.m (17 to 20 lbf ft).

*continued*



MV 180

31. Turn the wormshaft to locate the main nut in the mid-way position and fit the roller.
  32. Insert the rocker shaft and engage the roller.
  33. Smear non-hardening sealing compound onto the joint faces and bolt threads and fit the joint washer and side cover. Torque: 2,3 to 2,7 kgf.m (17 to 20 lbf ft).
  34. Fit the filler tube and oil seal, aligning the tube with the steering column.
- NOTE:** The following method of adjusting the steering box is a workshop procedure only, enabling the box to be adjusted ready for fitting to the vehicle. Alternatively, the steering box can be adjusted after it is fitted to the vehicle, see 57.35.01.
35. Remove the rocker adjusting screw, clean the threads and coat them with non-hardening sealing compound. Fit and tighten the adjuster screw to give a turning torque on the inner column of 11,5 to 13,8 kgf.cm (10 to 12 lbf in) then secure the locknut.
  36. Refit the steering column and box assembly, 57.45.01
  37. Using the correct grade oil, fill the steering box to the bottom of the filler plug threads then fit the filler plug.



**DATA**

Worm shaft bearing preload  
Worm shaft torque to turn adjustment

0,05 to 0,10 mm (0,002 to 0,004 in)  
11,5 to 13,8 kgf. cm (10 to 12 lbf in)

**STEERING RELAY**

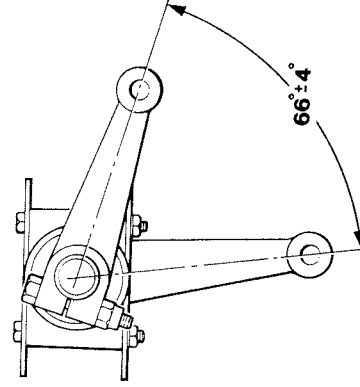
—Remove and refit 57.50.02

**Removing**

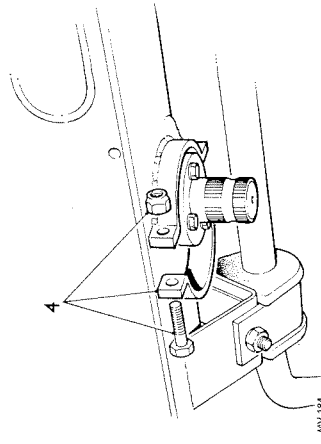
1. Remove the fixings securing the upper and lower relay levers to the relay unit.
  2. Prise the levers from the splined shaft, avoiding damage to the relay oil seals.
  3. Remove the fixings between the relay housing and the chassis top face.
  4. Remove the fixings and half clamp securing the relay to the underside of the chassis.
- NOTE:** Before attempting to remove the steering relay, remove any equipment that is mounted directly above and would obstruct removal.
5. Using a brass drift and a mallet, drive the relay unit upward to free it from the chassis. If necessary, use penetrating oil between the relay housing and the chassis.

**Refitting**

6. Before refitting the steering relay, ensure that it is filled with the correct grade oil.
7. Drive the steering relay into its location in the chassis, aligning the top fixing holes. The relay must be a drive fit.
8. Secure the fixings between the relay housing and the chassis top face. Torque: 3,0 kgf.m (22 lbf ft).
9. Fit the half clamp and secure the fixings to secure the relay at the underside of the chassis. Torque: 3,0 kgf.m (22 lbf ft).
10. Reverse 1 and 2, fitting the shorter lever in the upper position. The angular relationship between the upper and lower relay levers must be within 62° to 70° when fitted.
11. Secure the steering lever pinch bolts. Torque: 5,9 kgf.m (43 lbf ft).



MV 185



MV 183

STEERING RELAY

—Overhaul

57.50.08

Service tool: 600536 spring compressor

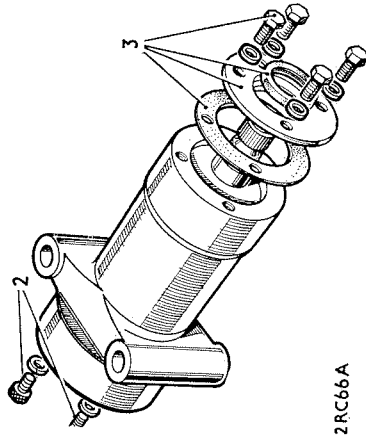
Dismantling

1. Remove the steering relay, 57.50.02.
2. Remove the socket head screws from the relay top cover, invert the relay and allow the oil to drain.
3. Remove the bottom oil seal retainer complete with seal and joint washer.
4. **WARNING:** During the following procedure use extreme care, the relay housing contains a large compressed spring which is automatically released during dismantling.
5. Cover the bottom end of the shaft, using a suitable cover, secured as illustrated.
6. Using a mallet, tap out the shaft, thrust washers, split bushes, washers for spring, spring and shims (if fitted).
7. Remove the temporarily fitted cover from the relay housing and lift out the relay shaft and fittings.
8. Remove the top oil seal retainer complete with seal and joint washer.

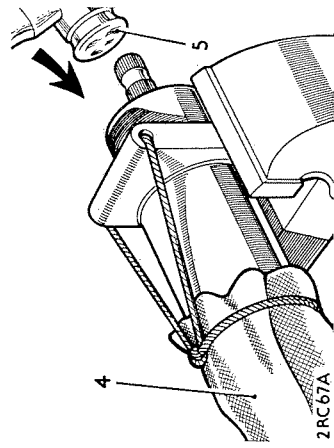
Inspecting

8. Examine all components for obvious signs of wear or damage and fit replacements as required.
9. Check the relay shaft at the diameters which form the tracks for the oil seals. Any damage or score marks would cause failure of the oil seals, and a replacement shaft must be fitted.
10. The free length of the spring should be  $178 \text{ mm} \pm 6 \text{ mm}$  ( $7 \text{ in} \pm 0.250 \text{ in}$ ).

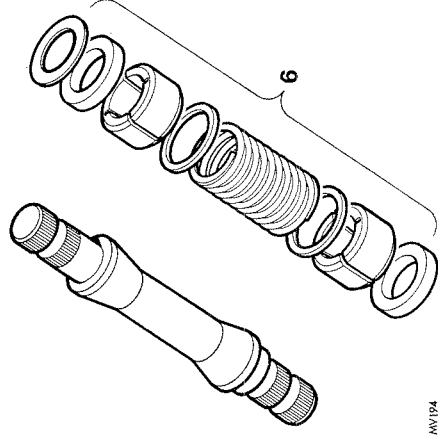
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2RC66A



2RC67A

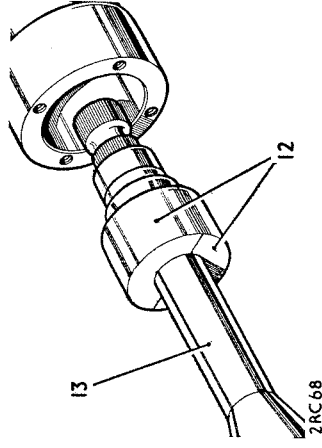


AV194

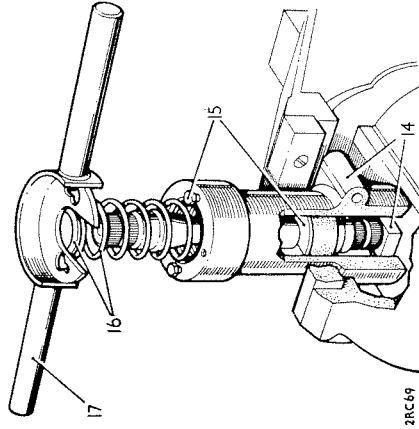
Reassembling

11. If removed, fit new oil seals, lipped side inward, to their retainers, using joining compound on the outside diameter of the seals.
12. Locate two halves of the split bush on the top cone of the shaft.
13. Insert the assembly of shaft and bush into the housing from the bottom.
14. Secure the housing and shaft assembly, bottom end uppermost, in a vice with a 19 mm (0.750 in) support block under the bottom end of the shaft.
15. Insert a washer for the spring into the housing and fit two of the oil seal retainer fixing bolts into the housing diametrically opposite each other.
16. Fit the spring and washer.
17. Using service tool 600536, carefully compress the spring.
18. Turn the tool to lock in position with the keyhole slots under the heads of the bolts.
19. Locate the other split bush in position on the bottom cone of the shaft and secure with a 50 mm (2 in) hose clip.
20. Remove the service tool and the seal retainer fixing bolts.
21. Remove the assembly from the vice, gently tap the shaft into position until the split bush has entered the housing for at least half its length.

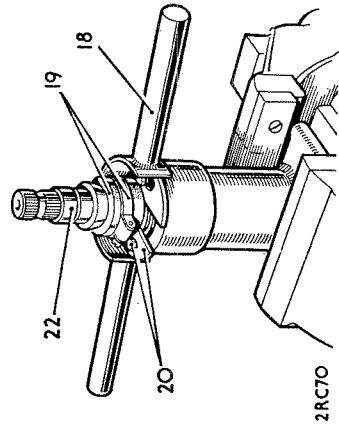
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2RC68



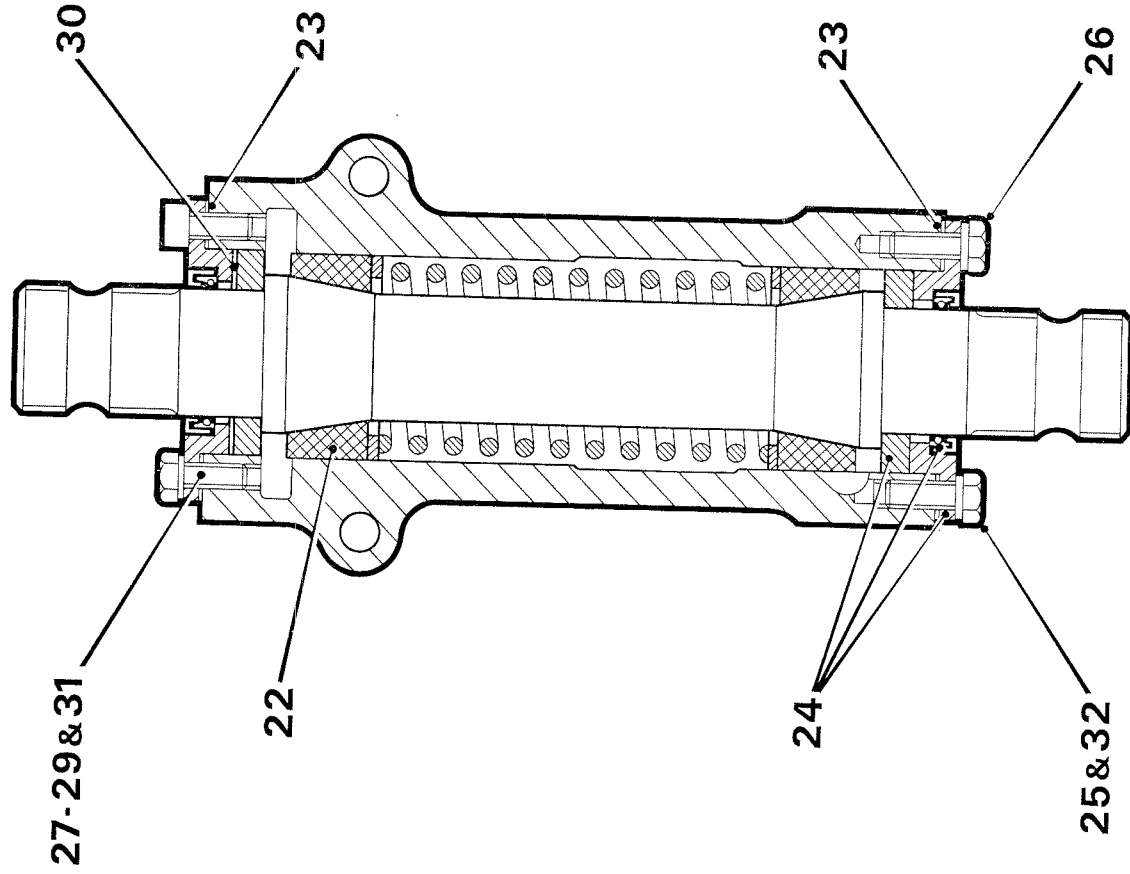
2RC69



2RC70

22. Remove the hose clip and continue to tap the shaft into the housing until the bushes are correctly located in the housing.
23. Smear general purpose grease on both sides of the joint washers and fit one to each end of the housing. **NOTE:** One of the oil seal retainer fixing holes in the bottom of the relay housing also serves as a breather hole during initial oil filling and can be seen to lead through to the inside of the housing, it also has an identification mark stamped on the outside of the housing.
24. Locate the thrust washer and oil seal retainer, complete with oil seal, in position on the bottom end of the housing.
25. Fit a bolt and plain washer to the fixing/breather hole. Do not tighten at this stage.
26. Coat the remaining three bolts with 'Loctite Grade 542' and fit them, together with plain washers. Tighten all four bolts. Torque: 69 kgf.cm (5 lbf ft).
27. Fit the thrust washer and oil seal retainer, complete with seal, to the top of the housing. Do not fit any shims at this stage. Torque tighten the retainer securing bolts to 69 kgf.cm (5 lbf ft).
28. Measure the end-float of the relay shaft by tapping the shaft to its maximum travel in one direction and then in the other. End-float must be present, but must not exceed 0,13 mm (0,005 in). If necessary, select shims from the range available to reduce the end-float to the permitted limits.
29. Remove the fixings securing the oil seal retainer to the top of the housing.
30. If shims are required as a result of the end-float check in item 28, remove the oil seal retainer, place the selected shim(s) on top of the thrust washer, then reposition the oil seal retainer.
31. Coat the threads of the two hexagon head bolts with 'Loctite Grade 542' and fit them together with plain washers to secure the oil seal retainer at the side positions. Torque: 69 kgf.cm (5 lbf ft).

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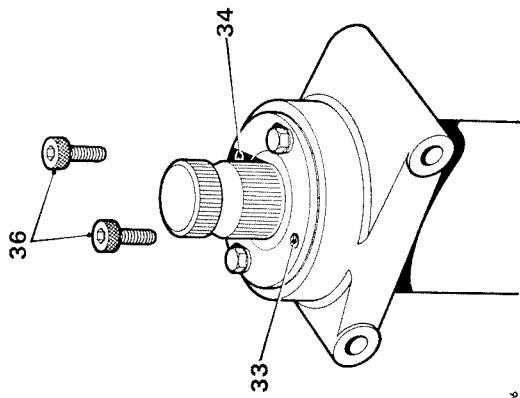


MV195

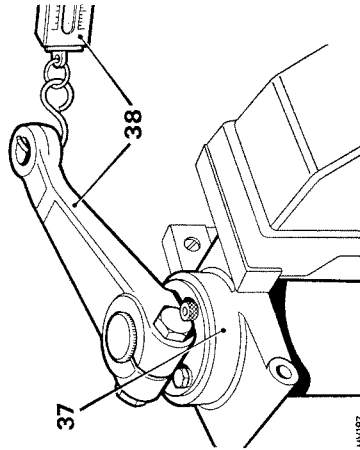
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32. Remove the breather bolt from the bottom of the housing, then using the correct grade oil, fill the housing through one of the fixing holes in the top oil seal retainer until oil emits from the bottom breather hole. Then, coat the threads of the breather bolt with 'Loctite Grade 542' and fit it together with a plain washer. Torque: 69 kgf.cm (5 lbf ft).
33. Continue filling the housing, using one of the top fixing holes as a filler and the other as a breather, until the oil is at the bottom of the filler hole.
34. Whilst filling, it is probable that oil will eject through the breather hole. If this occurs *do not* assume that the relay unit is full. Time must be given to allow the oil to find its way to the main chamber. Wait a few moments until the breather hole is clear of oil, then continue filling.
35. As the unit fills up, air is forced out usually in the form of an oil bubble, escaping through the breather hole, again giving the impression that the unit is full. Wait for the bubble to subside, then continue filling in this manner until the oil is clearly visible at the base of the filler and breather holes.
36. Coat the threads of the two socket head screws with 'Loctite Grade 542' and fit them to secure the top oil seal retainer at the front and rear positions. Torque: 69 kgf.cm (5 lbf ft).
37. Hold the relay unit in a vice.
38. Temporarily attach the **upper** (shorter) relay lever and use a suitable spring balance to check resistance to rotation of the relay shaft. The resistance, measured on the spring balance, must not be less than 5,4 kg (12 lb) and should not exceed 7,3 kg (16 lb).
39. If the resistance is less than 5,4 kg (12 lb), fit a new replacement spring.
40. 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. Re-assemble and recheck.
41. Refit the steering relay. 57.50.02.

*continued*



MV196



MV197

#### DATA

Relay spring free length  
Relay shaft end-float (maximum)  
Relay shaft resistance to rotation

178 mm  $\pm$  6 mm (7 in  $\pm$  0,250 in)  
0,13 mm (0,005 in)  
5,4 to 7,3 kg (12 to 16 lb)

TRACK ROD BALL JOINTS

—Remove and refit 1 to 14 57.55.08

TRACK ROD

—Remove and refit 1 to 7 and 12 to 14 57.55.09

Service tool: 18G 1063 Ball joint extractor

Removing

1. Disconnect the steering damper from the track rod.
2. Remove the fixings from both ball joints.
3. Extract the ball joints. 18G 1063.
4. Withdraw the track rod complete with ball joints.
5. Slacken the two locknuts at the track rod adjuster.
6. Unscrew the ball joints, LH and RH threads.

Refitting

7. Screw the passenger side ball joint, complete with locknut, into the track rod tube until the dimension between the centre of the ball joint and the end of the track rod tube is 200,0 mm  $\pm$  1,0 mm (7.875 in  $\pm$  0,040 in). Do not tighten the locknut at this stage.
8. Screw the drivers side ball joint, complete with locknut, into the track rod tube until the overall dimension between the ball joint centres is 1330,0 mm  $\pm$  1,5 mm (52,362 in  $\pm$  0,060 in). Do not tighten the locknut at this stage.

**NOTE:** If more than one of the steering links have been removed, when refitting, first set the drag to the specified dimension, then adjust the track rod to give the specified front wheel toe-out and finally, adjust the longitudinal steering tube as necessary to fit it between the steering box and relay unit.

9. Reverse 1 to 4. Torque tighten ball joint fixings 4,1 kgf.m (30 lbf ft) and fit new split pins.
10. Check and if necessary adjust the wheel alignment. 57.65.01, leaving the locknuts slack.
11. Secure both locknuts against the track rod tube. Torque: 8,3 to 9,6 kgf.m (60 to 70 lbf ft).

DATA

Setting dimension for passengers side ball joint (between ball joint centre and end of track rod tube)

200 mm  $\pm$  1,0 mm (7.875 in  $\pm$  0,040 in)

Setting dimension for drivers side ball joint (between ball joint centres)

1330 mm  $\pm$  1,5 mm (52.362 in  $\pm$  0.060 in)

LONGITUDINAL STEERING TUBE BALL JOINTS

57.55.12

LONGITUDINAL STEERING TUBE

57.55.13

Service tool: 18G 1063 Ball joint extractor

Removing

1. Turn the steering as necessary, to give maximum access, via the drivers side wheel arch, to the forward end of the longitudinal steering tube. If necessary, remove the drivers side front road wheel.
2. Remove the fixings securing the front ball joint to the steering box drop arm.
3. Extract the front ball joint. 18G 1063.
4. Remove the radiator grille.
5. Remove the fixings and extract the ball joint from the upper relay lever. 18G 1063.
6. Withdraw the longitudinal steering tube from the vehicle.
7. Slacken the two locknuts at the longitudinal steering tube adjuster.
8. Unscrew the ball joints, LH and RH threads.

Refitting

9. Screw both ball joints, complete with locknuts, equally into the longitudinal steering tube until the overall dimension between the ball joint centres is 362,0 mm  $\pm$  1,5 mm (14,250 in  $\pm$  0,060 in). Do not tighten the locknuts at this stage.

10. Reverse 5 and 6, and 1 to 4. Torque tighten the ball joint fixings: 4,1 kgf.m (30 lbf ft) and fit new split pins.

**NOTE:** If more than one of the steering links have been removed, when refitting, first set the drag link to the specified dimension, then adjust the track rod to give the specified front wheel toe-out and finally, adjust the longitudinal tube as necessary to fit it between the steering box and the relay unit.

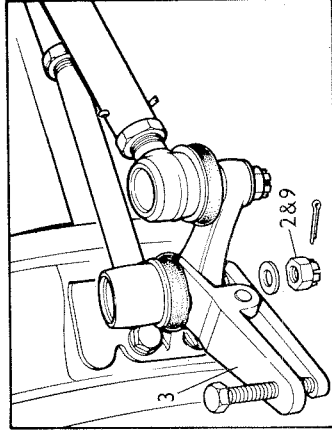
11. Tighten both locknuts to secure the ball joints. Torque: 8,3 to 9,6 kgf.m (60 to 70 lbf ft).
12. Check the steering lock stop setting. 57.65.03.

13. Check the steering lock-to-lock, for correct functioning. If necessary, adjust the overall length of the longitudinal steering tube by slackening the locknuts and turning the tube, as required, then resecure the locknuts.

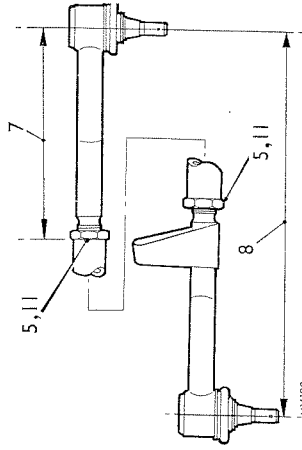
DATA

Initial setting dimension for longitudinal steering tube (between ball joint centres)

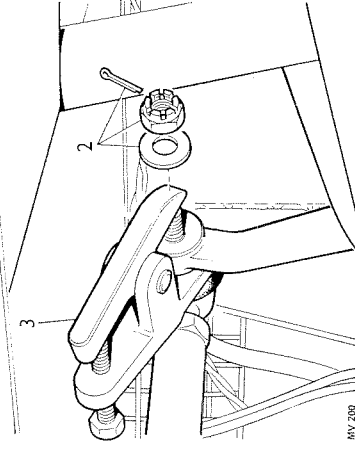
362,0 mm  $\pm$  1,5 mm (14,250 in  $\pm$  0,060 in)



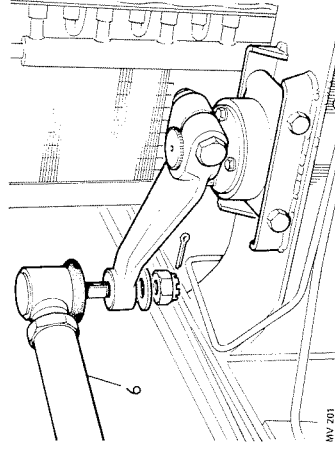
MV 187



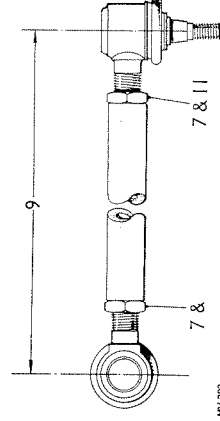
MV188



MV 200



MV 201



MV 202

DRAG LINK BALL JOINTS

—Remove and refit 1 to 11

57.55.16

DRAG LINK

—Remove and refit 1 to 3 and 10

57.55.17

Service tool: 18G 1063 Ball joint extractor

Removing

1. Remove the fixings from both ball joints.
2. Extract the ball joints. 18G 1063.
3. Withdraw the drag link complete with ball joints.
4. Remove the split pin from the drag link tube.
5. Slacken the two locknuts.
6. Unscrew the ball joints.

Refitting

7. Screw the passengers side ball joint, complete with locknut, into the drag link tube until the split pin holes are aligned. Ensure that the ball joint is correctly positioned relative to the cranked tube, as illustrated, then fit a new split pin.
8. Tighten the locknut to secure the passengers side ball joint against the drag link tube. Torque: 8,3 to 9,6 kgf.m (60 to 70 lbf ft).
9. Screw the drivers side ball joint, complete with locknut, into the drag link tube until the overall dimension between the ball joint centres, with the ball joints positioned as illustrated, is 790,0 mm  $\pm$  1,5 mm (31.100 in  $\pm$  0.060 in).

**NOTE:** If more than one of the steering links have been removed, when refitting, first set the drag link to the specified dimension, then adjust the track to give the specified front wheel toe-out and finally, adjust the longitudinal steering tube as necessary to fit it between the steering box and relay unit.

10. Reverse 1 to 3. Torque tighten the ball joint fixings: 4,1 kgf.m (30 lbf ft) and fit new split pins.

**NOTE:** The dimension between the ball joint centres must remain within the previously specified limits. Any adjustments necessary to fit the drag link between the lower relay lever and the swivel housing lever, must be made at the longitudinal tube.

11. Tighten the locknut to secure the drivers side ball joint against the drag link tube. Torque: 8,3 to 9,6 kgf.m (60 to 70 lbf ft).

DATA

Setting dimension for drag link (between ball joint centres)

790 mm  $\pm$  1,5 mm (31.100 in  $\pm$  0.060 in)

STEERING WHEEL

—Remove and refit

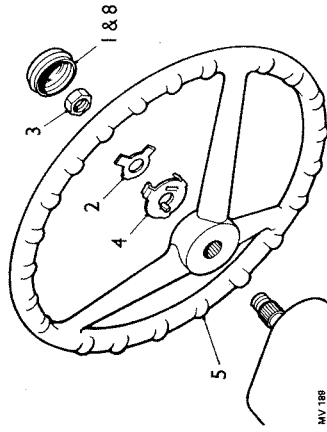
57.60.01

Removing

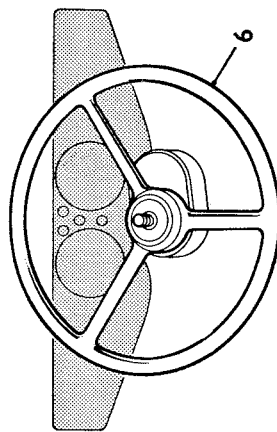
1. Prise off the centre cover.
2. Disengage the tab washer.
3. Remove the securing nut and tab washer.
4. Withdraw the cover base.
5. Withdraw the steering wheel.

Refitting

6. With the road wheels in the straight ahead position, locate the steering wheel on the column splines, as illustrated.
7. Fit the cover base, tab washer and nut to the steering column. Tighten the nut and engage the tab washer.
8. Fit the centre cover.



MV 188



MV 190



FRONT WHEEL ALIGNMENT

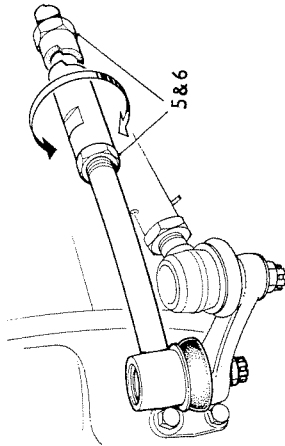
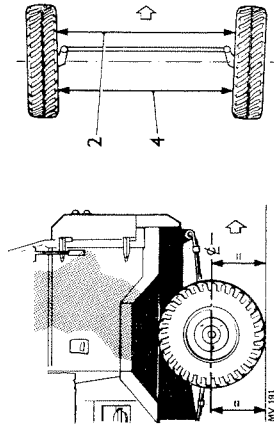
—Check and adjust 57.65.01

Checking

1. Set the vehicle on level ground with the road wheels in the straight ahead position and push it forward a short distance.
2. Measure the distance between the edges of the wheel rims at the height of the hub centres, in front of the axle, marking the points between which the measurement is taken.
3. Move the vehicle forward until the marks on the rims are at hub height, at the rear of the axle.
4. Measure the distance between the marks. The measurement at the front of the axle should be 1,2 to 2,4 mm ( $\frac{1}{4}$  to  $\frac{3}{8}$  in) more than that at the rear.

Adjusting

5. If adjustment is required to the toe-out, slacken the locknuts at the track rod tube, and turn the tube to increase or decrease its effective length as necessary, until the toe-out is correct.
6. Secure both locknuts against the track rod tube. Torque: 8,3 to 9,6 kgf.m (60 to 70 lbf ft).



MV 182

STEERING GEOMETRY

—Check 57.65.02

NOTE: No adjustment is provided for castor, camber or swivel pin inclination. Operation 57.65.01, refers for wheel alignment setting.

DATA

Wheel castor angle 1°  
 Wheel camber angle 1½°  
 Swivel pin inclination 7°  
 Front wheel toe-out 1,2 to 2,4 mm ( $\frac{1}{4}$  to  $\frac{3}{8}$  in)

Check with vehicle in static unladen condition, that is, vehicle with coolant, oil and 22,5 litres (5 UK gallons) of fuel. Rock the vehicle up and down at the front to allow it to take up a static position.

DATA

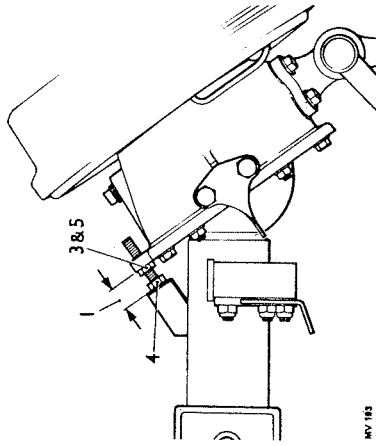
Front wheel toe-out 1,2 to 2,4 mm ( $\frac{1}{4}$  to  $\frac{3}{8}$  in)

**LOCK STOPS**

- Check and adjust **57.65.03**
1. Check the setting of the lock stop adjuster bolt at the rear of each swivel housing. There should be a dimension of 24 mm ( $\frac{15}{16}$  in) from the lug on the swivel housing to the extreme face of the bolt head.
  2. If necessary, adjust as follows.

**Adjusting**

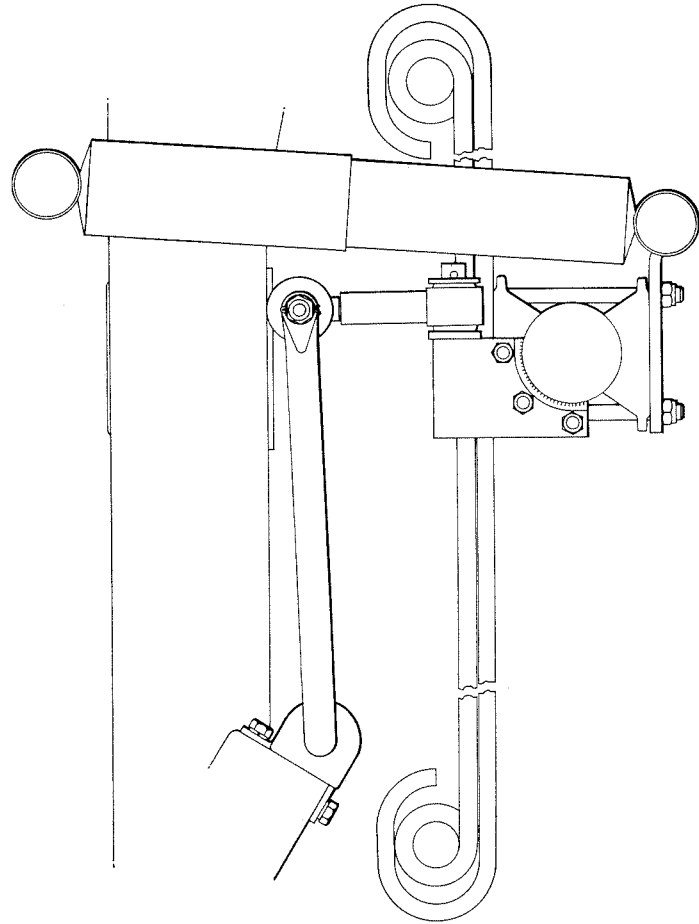
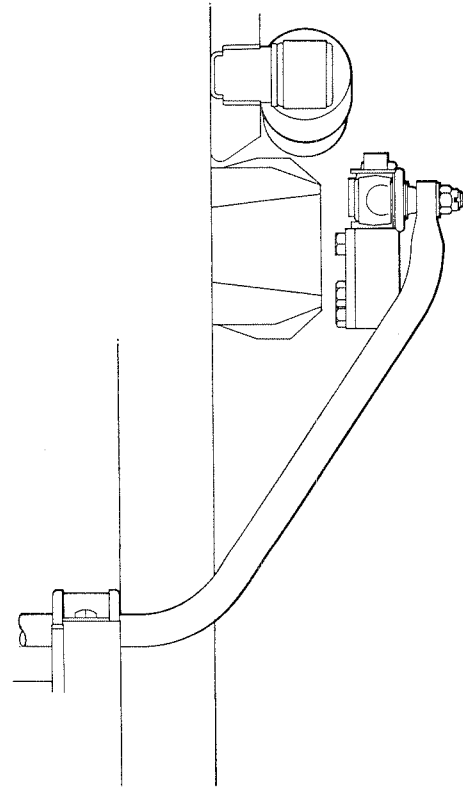
3. Slacken the locknut.
4. Adjust the stop bolt to give a dimension of 24 mm ( $\frac{15}{16}$  in) between the lug on the swivel housing and the extremity of the bolt head.
5. Tighten the locknut.
6. Check the steering on full lock to ensure that the stop bolt heads abut the stop lugs on the axle case without restriction.



**DATA**

Lock stop setting

24 mm ( $\frac{15}{16}$  in)



AW 237

General arrangement of front suspension

**FRONT SUSPENSION—DESCRIPTION**

Front suspension is by two semi-elliptic taper leaf springs located above the axle and controlled by hydraulically damped shock absorbers. An anti-roll bar is fitted between the axle case ends and the chassis; to provide partial control of movement between the axle and chassis, in order to reduce vehicle body roll. The ends of the axle case are fitted with swivel housings that pivot on upper and lower swivel pins and provide accommodation for the front wheel drive shaft. The front wheel hubs are carried on stub axles that are secured to the outer faces of the swivel housings.

**Road springs**

The front road springs are each composed of two taper leaf springs that are attached directly to the chassis at the front, while swinging shackles are fitted at the rear ends. Each shackle pin is mounted through a bonded rubber bush; the bushes do not rotate, angular movement being taken by torsional deflection of the rubber elements. A rubber bump block is secured to the underside of the chassis side member above each road spring.

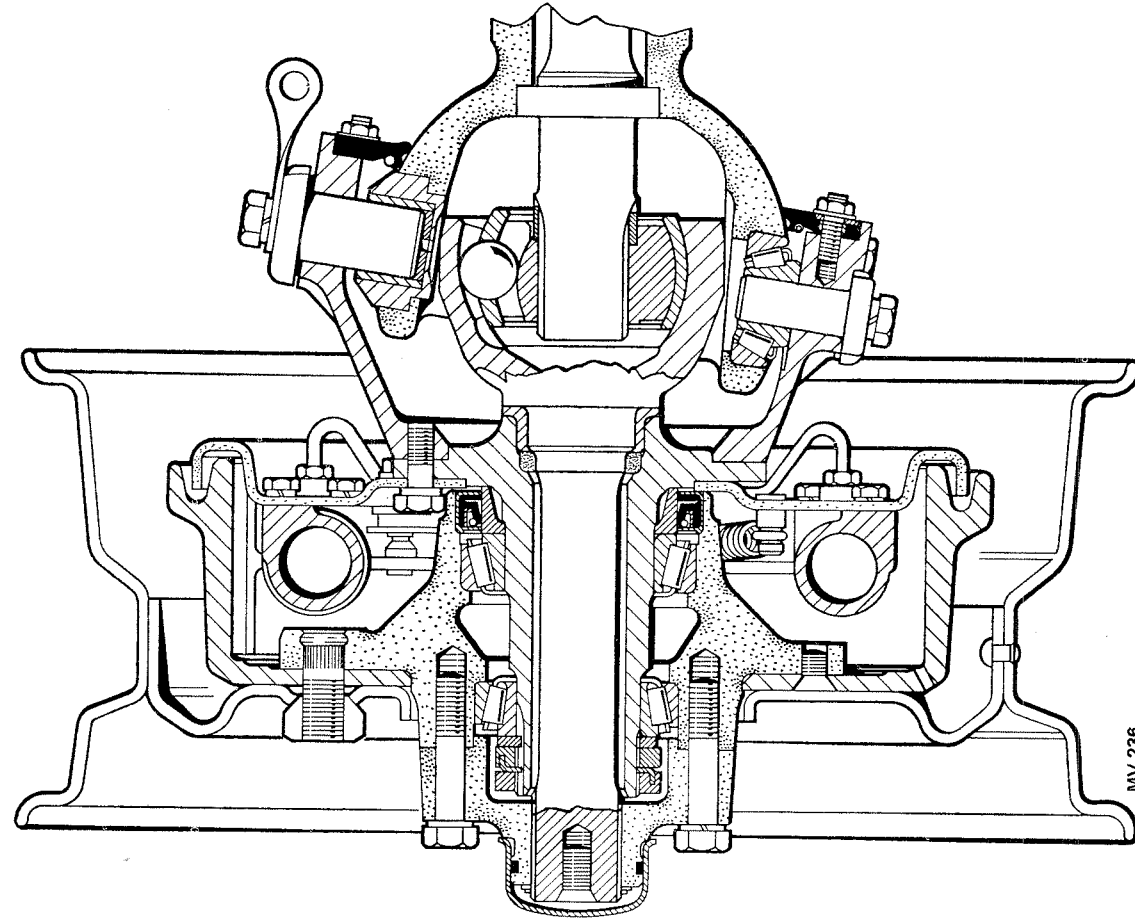
**Shock absorbers**

Non-adjustable telescopic hydraulic dampers are fitted to each spring; they are secured in rubber mounting bushes to the chassis side members and the road spring bottom plates. This type of damper incorporates a special seal that prevent leakage of hydraulic fluid; consequently no 'topping-up' or other servicing attention is required.

**Anti-roll bar**

The curved anti-roll torsion bar is secured at its centre in rubber mountings to No. 2 chassis cross-member and is retained at each end by ball joints and links to the axle case ends. The effect of this is to couple the two springs so that the one that would otherwise be inactive now contributes towards the springing resistance to vehicle body roll, giving increased stability when cornering or when excessive road inequality on one side is encountered, as in cross-country conditions. The torsional resistance of the bar itself is also arranged to oppose the rolling tendency.

*continued*



Cross-section of front hub and swivel housing

**Swivel housing**

The swivel housing assembly, fitted to each end of the front axle case, carries the steering pivots for the front wheels and encloses the constant velocity joint for the front wheel drive shafts. Each housing is formed in two halves, a forged hemispherical bearing housing welded to the end of the axle tube and a cast iron swivel housing located on the bearing housing by an upper and lower swivel pin. The upper swivel pin is mounted in an asbestos resin bearing, while the lower swivel pin is mounted in a taper roller bearing. Lubricating oil for the internal components is retained by a large diameter special spherical seal that is secured to the rear face of the swivel housing and seats on the outside polished surface of the hemispherical bearing housing.

**Front wheel hubs**

Each front hub is mounted on two taper roller bearings that are supported on a stub axle secured to the outer face of the swivel housing. The stub axle is in the form of a tube with a securing flange, the front wheel drive shaft passes through the tube and there is a bush and felt oil seal fitted inside the flange end. This design allows oil from the swivel housing to seep through the felt seal and pass along the drive shaft into the hub to supplement the lubricant for the grease packed hub bearings. A bearing distance piece and oil seal are fitted between the inner hub bearing and the flange on the stub axle to prevent hub lubricant entering the brake drum. The hub is secured on the stub axle by a nut, lockwasher and locknut which are also used to adjust the hub end-float, and, the drive is transmitted from the driving shaft to the hub by means of a driving member, that also serves to enclose the end of the hub assembly.

## FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—VEHICLE PULLS TO ONE SIDE	<ol style="list-style-type: none"> <li>1. Uneven tyre pressures or worn tyres</li> <li>2. Dragging brake</li> <li>3. Incorrect toe-out of front wheels</li> <li>4. Tight or dirty front wheel bearings</li> <li>5. Swivel pin tight</li> <li>6. Incorrect camber</li> <li>7. Incorrect castor or swivel pin inclination</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust tyre pressures or fit new tyres as necessary</li> <li>2. Check brakes and adjust as necessary</li> <li>3. Check front wheel toe-out and adjust as necessary</li> <li>4. Remove front hubs and check bearings, bearings with fresh grease, refit and adjust hubs</li> <li>5. Dismantle and check swivel pins. Fit assembly as required, lubricate pins on assembly</li> <li>6. Check for settled road springs, worn shackles bushes or damage to front axle unit. Fit new parts as necessary</li> <li>7. Check front wheel alignment and adjust as necessary. Check for settled or damaged road springs, or damage to front axle unit. Fit new parts as necessary</li> </ol>
B—VEHICLE WANDERS	<ol style="list-style-type: none"> <li>1. Incorrect tyre pressures or worn tyres</li> <li>2. Loose axle clamp bolts</li> <li>3. Incorrect toe-out of front wheels</li> <li>4. Tight steering box</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust tyre pressures or fit new tyres as necessary</li> <li>2. Securely tighten</li> <li>3. Adjust as necessary</li> <li>4. Adjust as necessary</li> </ol>

continued

## FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
B—VEHICLE WANDERS—continued	<ol style="list-style-type: none"> <li>5. Worn front wheel bearings</li> <li>6. Worn swivel pins and bearings</li> <li>7. Incorrect castor</li> <li>8. Bent or broken chassis</li> </ol>	<ol style="list-style-type: none"> <li>5. Renew and/or adjust hub bearings as necessary</li> <li>6. Dismantle swivel pin housings, fit new parts as required, lubricate swivel pins assembly</li> <li>7. Check for settled or damaged road springs, damage to front suspension or axle unit. Fit new parts as required</li> <li>8. Check alignment of chassis and repair or renew as necessary</li> </ol>
C—WHEEL WOBBLE	<ol style="list-style-type: none"> <li>1. Incorrect tyre pressures or worn tyres</li> <li>2. Steering box fixings loose</li> <li>3. Eccentric wheels and tyres</li> <li>4. Worn or loose hub bearings</li> <li>5. Insufficient damping at swivel pins</li> <li>6. Worn swivel pins and bearings</li> <li>7. Insufficient damping at relay</li> <li>8. Loose engine mountings</li> <li>9. Worn constant velocity joints at axle half shafts</li> <li>10. Incorrect castor</li> </ol>	<ol style="list-style-type: none"> <li>1. Check and adjust tyre pressures or fit new tyres as necessary</li> <li>2. Tighten fixings to correct torque</li> <li>3. Check tyre concentricity line. Check wheel pressings for damage or distortion and rectify or renew</li> <li>4. Renew and/or adjust hub bearings as necessary</li> <li>5. Check swivel pin resistance to rotation and adjust as necessary</li> <li>6. Dismantle swivel pin housings, fit new parts as required, lubricate swivel pins on assembly</li> <li>7. Dismantle relay unit and fit new parts as required</li> <li>8. Securely tighten</li> <li>9. Fit new half shafts</li> <li>10. Check for settled or damaged road springs, damage to front suspension and axle unit. Fit new parts as necessary</li> </ol>

continued

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
D—EXCESSIVE TYRE WEAR	<ol style="list-style-type: none"> <li>1. Incorrect tyre pressures</li> <li>2. Failure to rotate wheels</li> <li>3. Incorrect toe-out of front wheels</li> <li>4. Worn unequal brakes</li> <li>5. Worn swivel pins</li> <li>6. Eccentric wheels and tyres</li> <li>7. Incorrect camber</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust as necessary</li> <li>2. Change position of wheels including spare. See User Handbook</li> <li>3. Adjust as necessary</li> <li>4. Check and adjust toe-in</li> <li>5. Check and adjust front suspension</li> <li>6. Check and adjust front suspension and wheel bearings for damage or distortion and rectify or renew as necessary</li> <li>7. Check for settled road springs, damage to front suspension and axle unit. Fit new parts as necessary</li> </ol>
E—FRONT SUSPENSION NOISY	<ol style="list-style-type: none"> <li>1. Failure of hydraulic damping</li> <li>2. Looseness in front suspension</li> <li>3. Worn front wheel bearings</li> <li>4. Worn swivel pins and bearings</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit new shock absorber</li> <li>2. Check all mountings for wear and security. Fit new parts as necessary and tighten fittings to correct torque</li> <li>3. Check and adjust front suspension as necessary</li> <li>4. Disassemble swivel pin housings, fit new parts as required, lubricate swivel pins on assembly</li> </ol>
F—OIL LEAKS	<ol style="list-style-type: none"> <li>1. Loose or missing drain and filter plugs</li> <li>2. Damaged joint washers</li> <li>3. Oil seals damaged or incorrectly fitted</li> <li>4. Lower swivel pin securing bolts not sealed</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit new joint washers and tighten plugs</li> <li>2. Determine point of leak, fit new joint washer with both sides smeared with general purpose grease</li> <li>3. Determine point of leak. Fit new oil seal with correct sealing compound smeared on the outside flange. Coat threads with 'Loctite-Stradlock CFX' sealant. Retighten bolts, torque: 3,9 kgf.m (42 lbf.ft)</li> </ol>

ANTI-ROLL BAR

—Remove and refit 1 to 3, 11 and 12 60.10.01

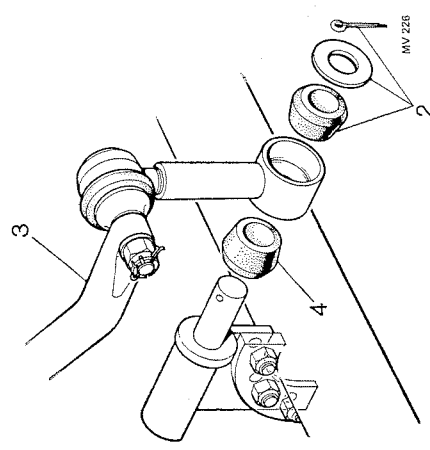
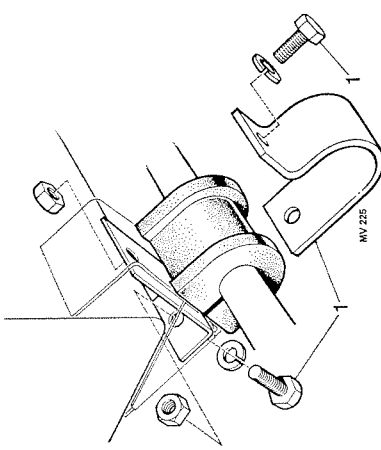
ANTI-ROLL BAR LINK

—Remove and refit 1 to 12 60.10.06

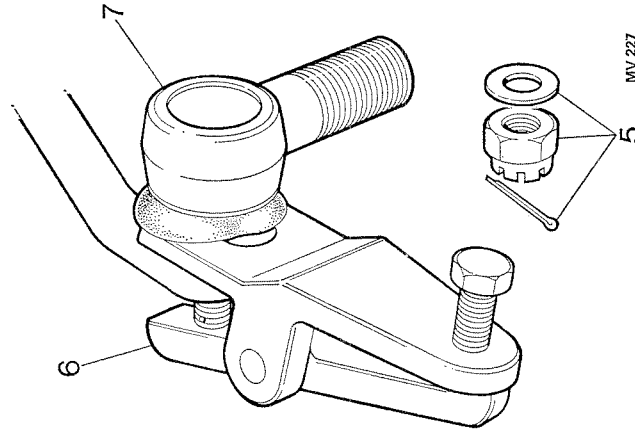
Service tool: 18G1063 Ball joint extractor

Removing

1. Remove the bolts, spring washers and nuts (two each side) securing the anti-roll bar clips to the chassis.
2. Remove the split pin, plain washer and outer rubber bush securing each end of the anti-roll bar to the axle case.
3. Withdraw the anti-roll bar from the vehicle.
4. If required, remove the inner rubber bush from the mounting plates on the axle case.
5. Remove the split pin, slotted nut and plain washer from the ball joint at each end of the anti-roll bar.
6. Extract the ball joints from the anti-roll bar. 18G1063.
7. If required, unscrew the ball joints from the link tubes.



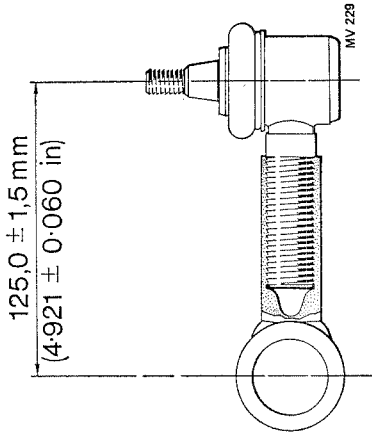
continued



- Refitting**
- If removed, screw the ball joints into the link tubes until the dimension between the centres of the ball joint and the eye of the link is  $125 \text{ mm} \pm 1,5 \text{ mm}$  ( $4,921 \text{ in} \pm 0,060 \text{ in}$ ).
  - Fit a ball joint and link assembly to each end of the anti-roll bar, secure with a plain washer and slotted nut. Torque:  $4,1 \text{ kgf.m}$  ( $30 \text{ lbf ft}$ ) then fit a new split pin.
  - If removed, fit the inner rubber bush on to the mounting plates on the axle case.
  - Locate the links on the anti-roll bar on to the mounting plates on the axle case, fit the outer rubber bushes and plain washers, and secure with a new split pin.
  - Fit the rubber bushes and clips to secure the anti-roll bar to the chassis.

**DATA**

Ball joint setting dimension between centres of ball joint and eye of link



$125 \text{ mm} \pm 1,5 \text{ mm}$  ( $4,921 \text{ in} \pm 0,060 \text{ in}$ )

**SWIVEL PIN HOUSING ASSEMBLY**

60.15.20

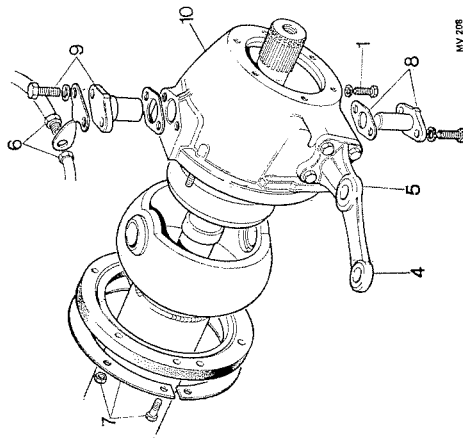
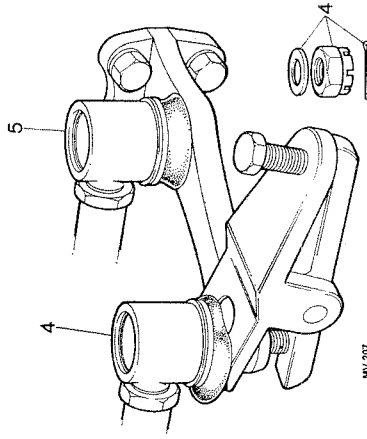
—Remove and refit

Service tool: 18G1063 Ball joint extractor  
RO8460 Hub lock nut spanner

**Removing**

- Remove the drain plug and washer from the swivel pin housing and allow all the oil to drain.
- Remove the front hub assembly. 60.25.01.
- Remove the hub stub axle. 60.25.22.
- If applicable, disconnect the drag link ball joint from the swivel housing. 18G1063.
- Disconnect the track rod ball joint from the swivel housing. 18G1063.
- Disconnect the brake pipe and hose from the bracket on the upper swivel pin.
- Remove the fixings from the spherical seal and draw it back along the axle.
- Remove the lower swivel pin and gasket.
- Support the swivel housing and remove the upper swivel pin and shim(s).
- Withdraw the swivel housing.

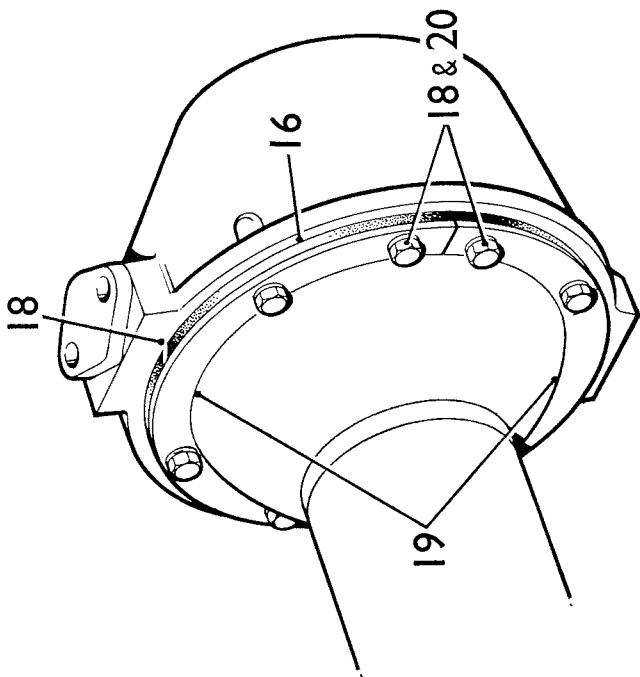
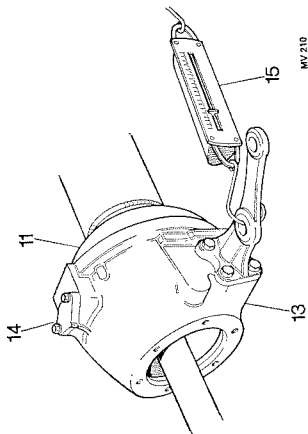
*continued*



**Refitting**

11. Clean the polished surface at the end of the axle case where it forms a seat for the spherical seal.
12. Ensure that the taper roller bearing for the lower swivel is in position, then offer the swivel housing to the axle.
13. Coat the threads of the securing bolts for the lower swivel pin with 'Loctite-Studlock CVX' sealant, then fit the lower swivel pin and gasket and secure the fixings. Torque: 5,9 kgf.m (42 lbf ft).
14. Fit the upper swivel pin together with the original shims and secure the fixings. Torque: 10,3 kgf.m (75 lbf ft).
15. Using a spring balance attached to the steering lever at the track rod connecting eye, measure the resistance to rotation of the swivel pin housing, which must be 3,6 to 4,5 kg (8 to 10 lbs) after having overcome inertia. Adjust as necessary by adding or subtracting shims under the flange of the upper swivel pin until the correct resistance figure is obtained.

*continued*



**MV 209**

16. Coat the outside diameter of the spherical seal with 'Hermetite' (Flexible) sealant.
17. Smear the lips of the spherical seal with clean swivel housing oil.
18. Fit the spherical seal with its joint uppermost, but do not fully tighten the fixings.
19. Check the location of the seal lips on the spherical seat for concentricity. If necessary, use the clearance on the fixings to adjust the position of the seal to obtain a concentric location.
20. Tighten the fixings to secure the spherical seal ensuring that the concentricity is maintained. Torque: 3,0 kgf.m (21 lbf ft).
21. Reverse 1 to 7 and include the following:
22. Torque tighten the slotted nuts for the steering ball joints to 4,1 kgf.m (30 lbf ft) then fit a new split pin.
23. Replenish the swivel housing with the correct grade oil.
24. Bleed the brakes. 70.25.02.

**DATA**

Swivel pin housing resistance to rotation  
3,6 to 4,5 kg (8 to 10 lb)



**SWIVEL PIN HOUSING ASSEMBLY**

60.15.23

**—Overhaul**

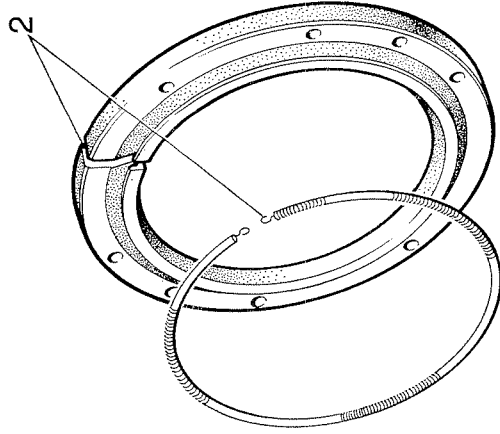
**Dismantling**

1. Remove the swivel pin housing assembly. 60.15.20.
2. Unhook the spring from the spherical seal, part the seal at its joint and withdraw it from the axle case.
3. Remove the bush assembly and taper roller bearing from the swivel pin locations in the axle case.

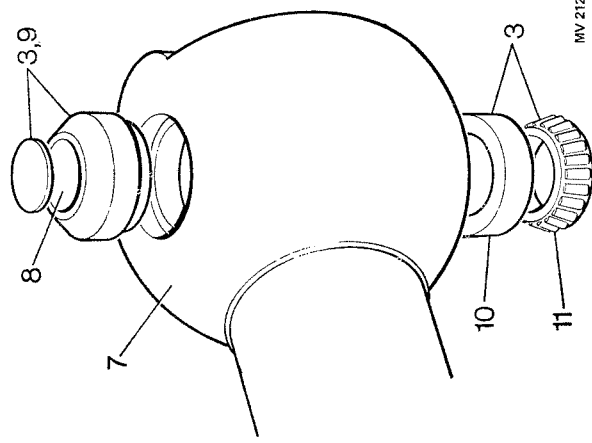
**Inspecting**

4. Examine all components for obvious wear or damage.
5. The taper roller bearing must be a light push fit on the bottom swivel pin, if a new bearing is a loose fit, the swivel pin assembly must be renewed.
6. The bush must be a light push fit on the top swivel pin, if a new bush is a loose fit, the swivel pin assembly must be renewed. It is important to note that these bushes and thrust washers should not be washed in any type of cleaning fluid, otherwise there is a danger that the damping characteristics of the material will be adversely affected.
7. Examine the polished surface at the end of the axle case where it forms a seat for the spherical seal, there must not be any corrosion or damage. If necessary, fit a new axle case.

*continued*



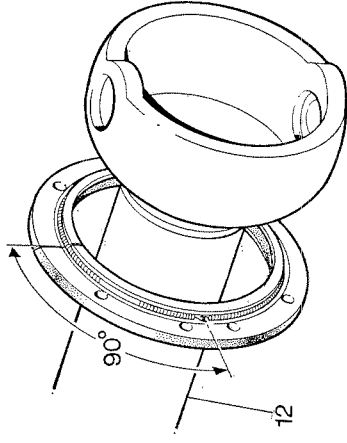
MV 211



MV 212

**Reassembling**

8. Using the same oil as recommended for the swivel housing, thoroughly lubricate the internal diameter of the bush for the upper swivel pin.
9. Fit the bush and thrust washer to the upper swivel pin location in the axle case.
10. Fit the bearing outer race, wide rim first, to the lower swivel pin location in the axle case.
11. Place the taper roller bearing in position in the bottom of the swivel housing.
12. If hooked, unhook the spring in the spherical seal, part the seal at its joint, sufficient only to locate it over the small diameter at the end of the axle case.
13. Reconnect the seal spring approximately 90° from the seal joint.
14. Refit the swivel pin housing assembly. 60.15.20.



MV 213

FRONT ROAD SPRING

—Remove and refit 60.20.01

Removing

1. Disconnect the front shock absorber at its lower end from under the axle tube.
2. Remove the four self-locking nuts and bottom plate from under the axle tube.
3. Withdraw the top plate and four clamp bolts.
4. Jack up the chassis to relieve the load on the road spring.
5. Place a safety stand under the chassis.
6. Remove the self-locking nuts from the front and rear shackle pins.
7. Unscrew and remove the rear shackle pin.
8. Drive out the front shackle pin.
9. Withdraw the front road spring.

Refitting

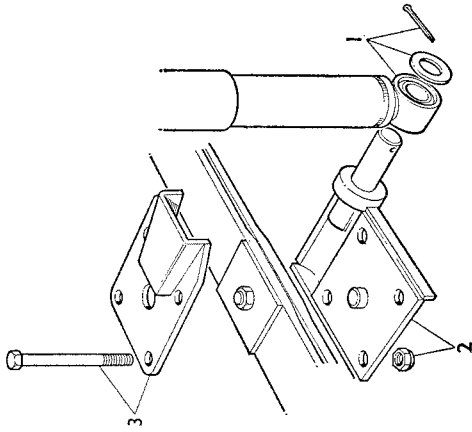
10. Slacken the shackle pin securing the shackle plates to the chassis.
11. Reverse 1 to 9, but do not fully tighten the shackle pins and lock nuts at this stage.

**NOTE:** In order to prolong shackle pin bush life, it is essential that the road spring is loaded to the specified dimension before fully tightening the shackle pins and nuts.

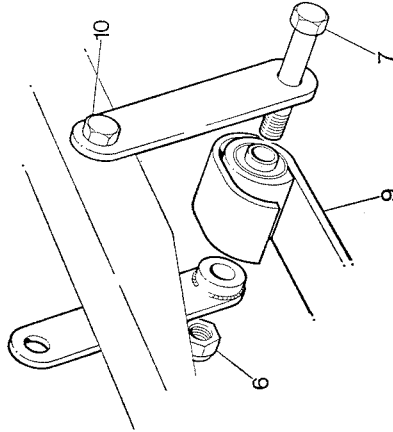
12. Adjust the load on the front road spring to give a dimension of 133,0 mm (5,234 in) between the mounting plate for the bump stop rubber and the stop plate on the axle, then tighten the shackle pins and nuts. Torque: 9,0 to 9,6 kgf.m (65 to 70 lbf ft).
13. Check the vehicle trim height. 60.45.01.

DATA

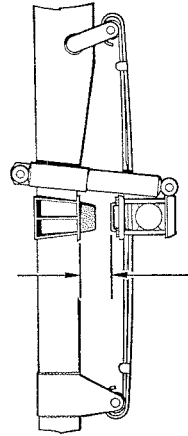
Road spring setting dimension for torque tightening shackle pins 133,0 mm (5,234 in)



MV 214



MV 215



133,0mm (5,234in)

2RC 218A

SHACKLE BUSHES

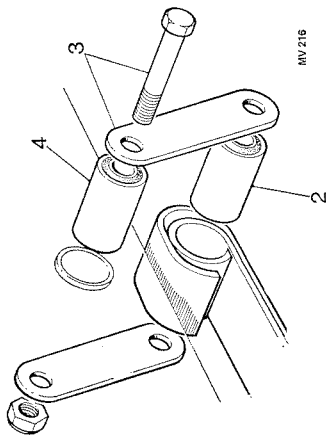
—Remove and refit 60.20.20

Removing

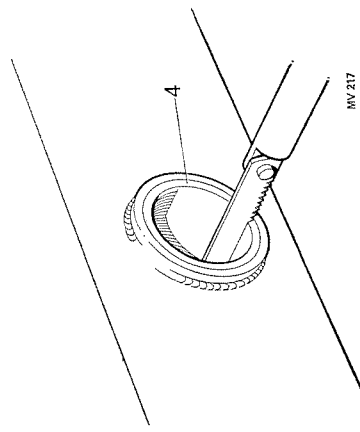
1. Remove the road spring. 60.20.01.
2. Press out the bushes from each end of the spring.
3. Remove the fixings and withdraw the shackle plates from the chassis frame.
4. If necessary, remove the shackle bush from the chassis frame bracket with the aid of a tubular drift or suitable extractor; if the bush disintegrates, leaving the outer casing in the chassis frame bracket, it should be carefully sawn through with a hack-saw to facilitate removal. **DO NOT** saw the chassis bracket.

Refitting

5. If removed, fit the shackle bush to the chassis frame. The bush must be a drive fit.
6. Fit the shackle bushes to the road spring. The bushes must be a press fit.
7. Fit the shackle plates to the chassis frame, but do not fully tighten the fixings until the spring is refitted to the vehicle.
8. Refit the road spring. 60.20.01.



MV 216



MV 217

## FRONT HUB ASSEMBLY

—Remove and refit 60.25.01

Service tool: RO8460 Spanner for hub nuts

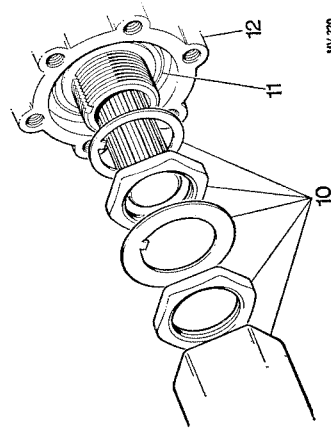
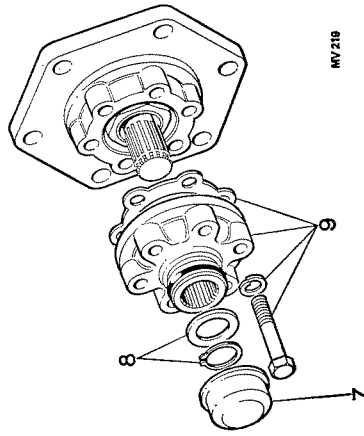
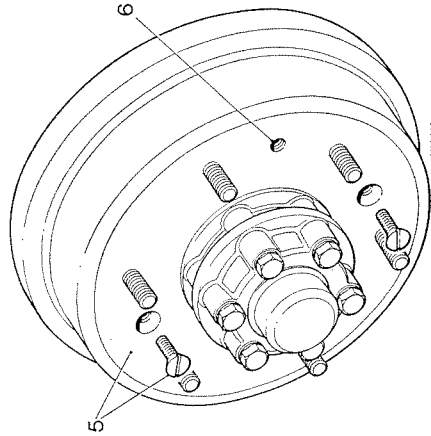
## Removing

1. Remove the hub step and slacken the road wheel nuts.
2. Jack up the front of the vehicle and support on a stand.
3. Remove the road wheels.
4. Slack off the brake shoe adjusters.
5. Remove the brake drum, noting the provision of an extractor tapping, item 6.
6. If difficulty is experienced in removing the drum, fit one of the drum fixing screws into the extractor tapping and tighten the screw whilst using a mallet to dislodge the drum.
7. Prise off the hub cap.
8. Remove the circlip and shim from the axle shaft.
9. Remove the hub driving member and joint washer.
10. Remove the locknuts, lockwasher and bearing washer securing the hub. RO8460.
11. Hold the outer roller bearing in position.
12. Withdraw the hub and bearings.

## Refitting

13. Lubricate the bearings, using the recommended grease. Do not pack the hub with grease.
14. Hold the outer roller bearing in position and slide the hub and bearing assembly on to the stub axle.

*continued*

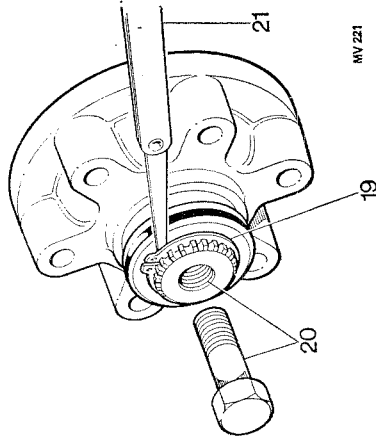


15. Fit the bearing washer and adjusting nut, then adjust the bearing end-float. 60.25.13.
16. Apply general purpose grease to both sides of the joint washer and locate it in position on the hub driving member.
17. Coat the threads of the hub driving member securing bolts with 'Loctite 270'.
18. Fit the hub driving member and joint washer and tighten the bolts. Torque: 10,35 kgf.m (75 lbf ft).
19. Temporarily refit the circlip, omitting the shim.
20. Draw the axle shaft as far as possible through the hub driving member, by using a suitable bolt screwed into the tapped hole provided in the end of the axle shaft.
21. Using feeler gauges, measure the clearance between the circlip and the hub driving member. The correct clearance is 0,07 to 0,2 mm (0,003 to 0,008 in). Adjust as necessary by selecting a suitable shim from the range available. Shim range 1,5 to 2,8 mm (0,059 to 0,110 in) in 0,13 mm (0,005 in) stages.
22. Remove the circlip, fit the selected shim and refit the circlip. Recheck the clearance with the shim fitted to ensure that it is within the specified limits.
23. Reverse 5 to 7.
24. Adjust the brakes.
25. Reverse 1 to 3.

## DATA

Front drive shaft end-float

0,07 to 0,2 mm (0,003 to 0,008 in)



FRONT HUB ASSEMBLY

—Overhaul 60.25.07

Dismantling

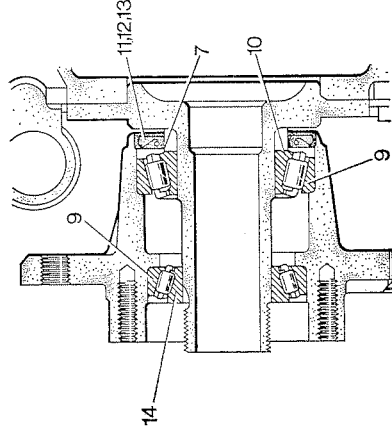
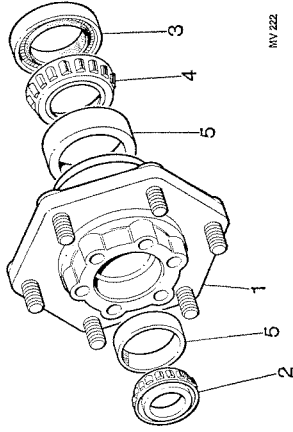
1. Remove the front hub assembly. 60.25.01.
2. Withdraw the outer roller bearing.
3. Prise out the oil seal and discard.
4. Withdraw the inner roller bearing.
5. Press the bearing outer races from the hub.

Inspecting

6. Examine all components for obvious wear or damage.
7. Examine the outside diameter of the inner bearing distance piece which is pressed on to the exposed stub axle. The diameter forms the inner seat for the hub oil seal and must be free from scores, damage and roughness. To replace the distance piece, 60.25.24 refers.
8. The hub bearings must be a sliding fit on the stub axle and a press fit in the hub.

Reassembling

9. Press the bearing outer races, wide side first, into the hub, ensuring that they abut the locating shoulders.
10. Grease and fit the inner roller bearings. Do not pack the hub centre with grease.
11. Grease the lips of the new oil seal with 'Shell Retinax A', XG 279 or equivalent.
12. Coat the outside diameter of the oil seal with the 'Hylomar' jointing compound, ensuring that the compound is kept clear of the seal lips.
13. Fit the seal flush with, and not below, the rear face of the hub.
14. Grease and fit the outer roller bearing.
15. Refit the front hub assembly. 60.25.01.



FRONT HUB BEARINGS END-FLOAT

—Check and adjust 60.25.13

Service tool: RO8460 Spanner for hub nuts

Checking

1. Carry out items 1 to 9 of Operation 60.25.01 to remove the brake drum and hub driving member.
2. Mount a dial test indicator to measure the end-float between the hub and the stub axle.
3. Spin the hub vigorously, causing the bearing rollers to settle in the tapered races, producing maximum end-float conditions.
4. Check the hub to stub axle end-float. This must be 0,10 to 0,15 mm (0,004 to 0,006 in).
5. If the end-float is within the specified limits, remove the dial test indicator and reverse item 1. If adjustment is necessary, proceed as follows.

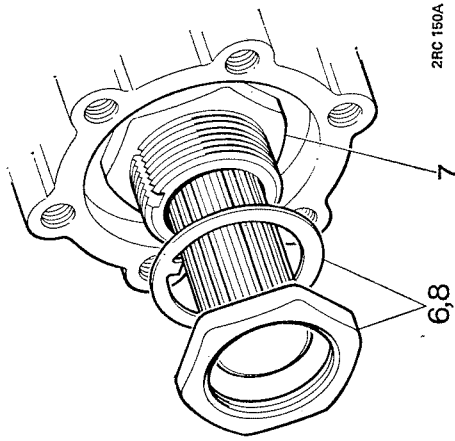
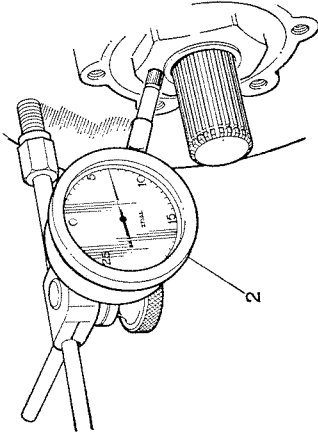
Adjusting

- NOTE:** It is necessary to spin the hub every time before checking the end-float, as moving the hub laterally will resettle the rollers, affecting the measurable end-float.
6. Remove the locknut and lockwasher from the hub. RO8460.
  7. Turn the hub nut in to decrease, or out to increase, the end-float. RO8460.
  8. Fit the lockwasher and locknut, tighten the nut but do not engage the lockwasher.
  9. Spin the hub and check the end-float.
  10. Repeat 6 to 9 as necessary until the end-float is correct, then, remove the dial test indicator, engage the lockwasher and reverse item 1.

DATA

Front hub bearing end-float

0,10 to 0,15 mm (0,004 to 0,006 in)



## FRONT HUB STUB AXLE

—Remove and refit 1 to 6 and 17 to 20

60.25.22

—Overhaul 1 to 20

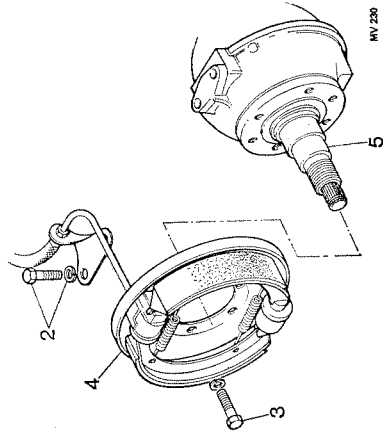
60.25.24

## Removing

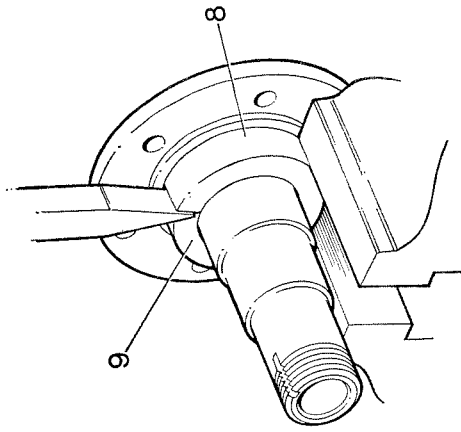
1. Remove the front hub. 60.25.01.  
**NOTE:** The following procedure enables the brake anchor plate to be moved aside without disconnecting the hydraulic system.
2. Remove the two bolts and spring washers securing the upper swivel pin.
3. Remove the fixings securing the brake anchor plate and stub axle.
4. Suspend aside the brake anchor plate assembly.
5. Withdraw the stub axle.
6. Withdraw the joint washer.

## Overhauling

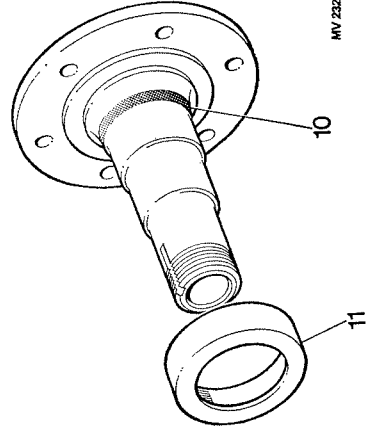
7. Examine for obvious wear or damage.
8. Check the outside diameter of the inner bearing distance piece, this must not show any signs of damage or roughness as it forms the inner seat for the oil seal. The distance piece should be a *press fit* on the stub axle. Any clearance between these two parts will allow oil to leak past on to the brake linings.
9. If it is required to remove the inner bearing distance piece from the stub axle, it must be shattered, using extreme care to avoid damaging the axle.
10. Apply a coat of 'Loctite' Grade 542 around the diameter of the stub axle where the inner bearing distance piece will seat.
11. Press on the new inner bearing distance piece.
12. Remove all visible traces of sealing compound.
13. Remove the felt seal from inside the stub axle.

*continued*

MV 230



MV 231

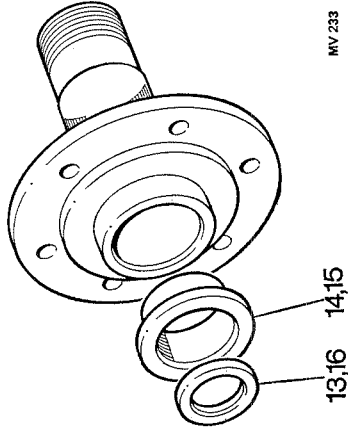


MV 232

14. Examine the bush inside the stub axle for wear or damage.
15. If required, press out the old bush and fit a new replacement. Check the internal diameter after fitting, this should be 44,47 to 44,50 mm (1.751 to 1.752 in).
16. Fit a new felt seal into the recess formed inside the stub axle.

## Refitting

17. Using clean oil, of the grade for the swivel housing, lubricate the felt seal and bush inside the stub axle.
18. Apply general purpose grease to both sides of the joint washer for the stub axle, and locate it in position.
19. Coat the threads of the stub axle securing bolts with 'Loctite 270.'
20. Reverse 1 to 6, incorporating the following torque settings:  
Stub axle and brake anchor plate bolts, 5,95 kgf.m (43 lbf ft).  
Upper swivel pin bolts, 10,3 kgf.m (75 lbf ft).



13,16

14,15

MV 233

**FRONT SHOCK ABSORBER**

—Remove and refit

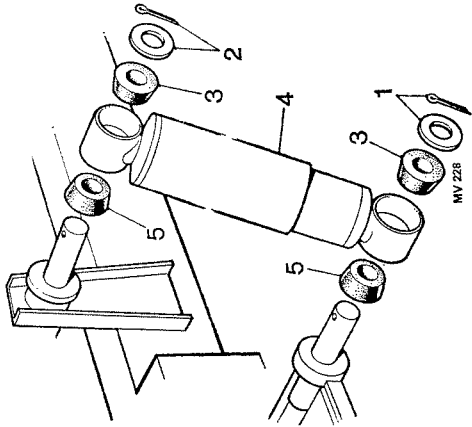
60.30.02

**Removing**

1. Remove the split pin and washer from the shock absorber bottom fixing.
2. Remove the split pin and washer from the shock absorber top fixings.
3. Remove the outer rubber bushes from the shock absorber mountings.
4. Withdraw the shock absorber.

**Refitting**

5. Ensure that the inner rubber bushes are fitted to the shock absorber mountings.
6. Locate the shock absorber in position.
7. Fit the outer rubber bushes.
8. Compress the rubber bushes and fit the washer and a new split pin to secure the shock absorber bottom fixing.
9. Compress the rubber bushes and fit the washer and a new split pin to secure the shock absorber top fixing.



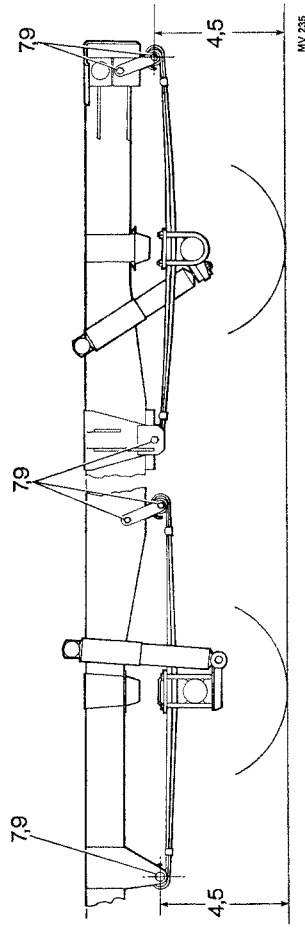
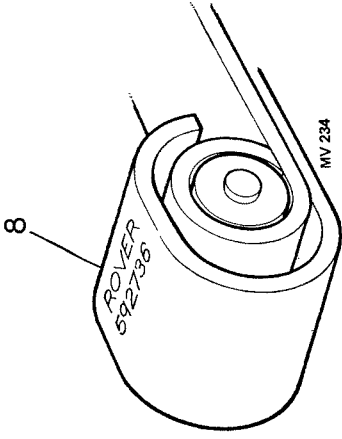
**TRIM HEIGHT**

—Check and adjust

60.45.01

**Checking**

1. Position the vehicle on firm level ground.
2. Ensure that the vehicle is in the static unladen weight condition, that is with a full coolant and lubrication system and 22,5 litres (5 UK gallons) of fuel.
3. Check the tyre inflation pressures and if necessary, adjust to the correct specification.
4. Measure the distance from the ground to the shackle pin centres as illustrated on both sides of the vehicle.
5. The measurements at the front should agree within 25 mm (1.0 in), as should those at the rear.
6. Where measurements are not within limits, jack up the vehicle and take the weight off its road springs.
7. Remove the shackle pins.
8. Check that the correct springs are fitted. The spring part number is marked on the top face of the leaf above the shackle bush.
9. If the springs are correct, ensure that the shackle pins are a free fit in the shackle plate thread, and not binding in the shackle pin bushes. Lubricate or polish to achieve this condition.
10. Deflect the springs and torque load the pins as detailed in Operation 60.20.01.
11. Lower the vehicle and recheck the trim height.



**REAR SUSPENSION**      **Wheeled Vehicles Q052**

Description of rear suspension .. .. .	.. .. .	64-3
Fault diagnosis—rear suspension .. .. .	.. .. .	64-6

**REAR SUSPENSION OPERATIONS**

Rear hub assembly		
—remove and refit .. .. .	.. .. .	64.15.01
—overhaul .. .. .	.. .. .	64.15.07
Rear hub bearings end-float—check and adjust .. .. .	.. .. .	64.15.13
Rear hub stub axle		
—remove and refit .. .. .	.. .. .	64.15.20
—overhaul .. .. .	.. .. .	64.15.21
Rear road spring—remove and refit .. .. .	.. .. .	64.20.01
Rear shock absorber—remove and refit .. .. .	.. .. .	64.30.01

**NOTE:** The description of the following two Operations is the same for both front and rear suspension, therefore, to avoid unnecessary repetition refer to the front suspension Operations in Division 60.

Shackle bushes—remove and refit .. .. .	.. .. .	60.20.20
Trim height—check and adjust .. .. .	.. .. .	60.45.01

**REAR SUSPENSION—DESCRIPTION**

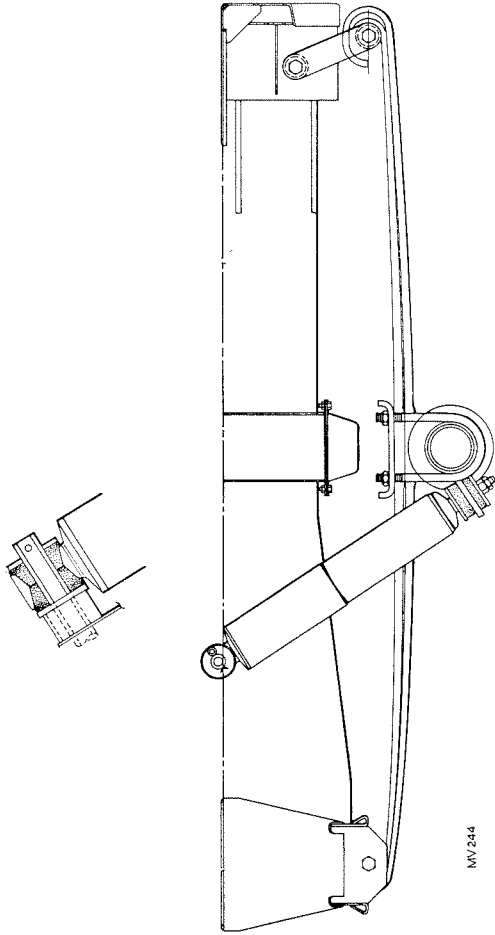
Rear suspension is by two semi-elliptic taper leaf springs located above the axle and controlled by hydraulically damped shock absorbers. The ends of the axle case are fitted with stub axles that carry the rear wheel hubs, mounted on taper roller bearings.

**Road springs**

The rear road springs are each composed of two taper leaf springs that are attached directly to the chassis at the front, while swinging shackles are fitted at the rear ends. Each shackle pin is mounted through a bonded rubber bush; the bushes do not rotate, angular movement being taken by torsional deflection of the rubber elements. A rubber bump block is secured to the underside of the chassis side member above each road spring.

**Shock absorbers**

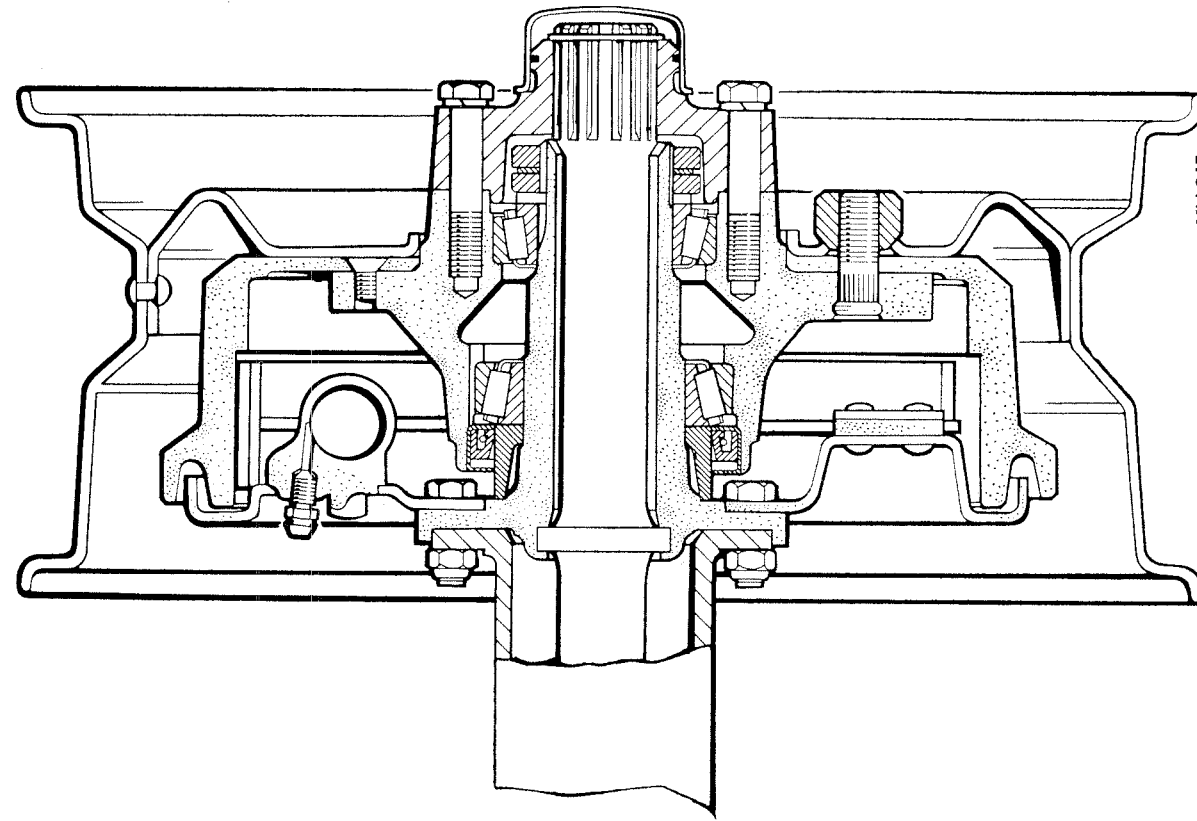
Non-adjustable telescopic hydraulic dampers are fitted to control each spring; they are secured in rubber mountings to the chassis side members and the axle casing. This type of damper incorporates a special seal that prevents leakage of hydraulic fluid; consequently no 'topping up' or other servicing attention is required.



MV 244

General arrangement of rear suspension





MV 245

Cross-section of rear hub

**Rear wheel hubs**

Each rear wheel hub is mounted on two taper roller bearings that are supported on a stub axle secured to the axle case end. The stub axle is in the form of a tube with a securing flange, the rear wheel drive shaft passes through the tube and there is a felt oil seal fitted inside the flange end. This design allows oil from the rear axle differential to seep through the felt seal and pass along the drive shaft into the hub to supplement the lubricant for the grease packed hub bearings. A bearing distance piece and oil seal are fitted between the inner hub bearing and the flange on the stub axle to prevent hub lubricant entering the brake drum. The hub is secured on the stub axle by a nut, lockwasher and lock-nut which are also used to adjust the hub end-float, and, the drive is transmitted from the driving shaft to the hub by means of a driving member, that also serves to enclose the end of the hub assembly.

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
A—EXCESSIVE TYRE WEAR	<ol style="list-style-type: none"> <li>1. Incorrect tyre pressures</li> <li>2. Failure to rotate wheels</li> <li>3. Harsh or unequal brakes</li> <li>4. Eccentric wheels and tyres</li> <li>5. Wheels cambered</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust as necessary</li> <li>2. Change rotation of wheels including direction. See User Handbook</li> <li>3. Adjust as necessary</li> <li>4. Check tyre concentricity line. Check wheel pressings for damage or distortion and rectify or renew</li> <li>5. Check for settled road springs, damage to rear suspension and axle unit. Fit new parts as necessary</li> </ol>
B—REAR SUSPENSION NOISY	<ol style="list-style-type: none"> <li>1. Failure of hydraulic damping</li> <li>2. Looseness in rear suspension</li> <li>3. Worn rear wheel bearings</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit new shock absorber</li> <li>2. Check all mountings for wear and security. Fit new parts as necessary and tighten fittings to correct torque. Renew and/or adjust hub bearings as necessary</li> <li>3. Renew and/or adjust hub bearings as necessary</li> </ol>
C—OIL LEAKS	<ol style="list-style-type: none"> <li>1. Damaged joint washer at hub driving member or stub axle flange</li> <li>2. Hub oil seal damaged or incorrectly fitted</li> </ol>	<ol style="list-style-type: none"> <li>1. Determine point of leak, fit new joint washer with both sides smeared with general purpose grease</li> <li>2. Fit new seal with the correct sealing compound on the outside diameter. (Ensure that the oil seal seat on the stub axle is in good condition)</li> </ol>

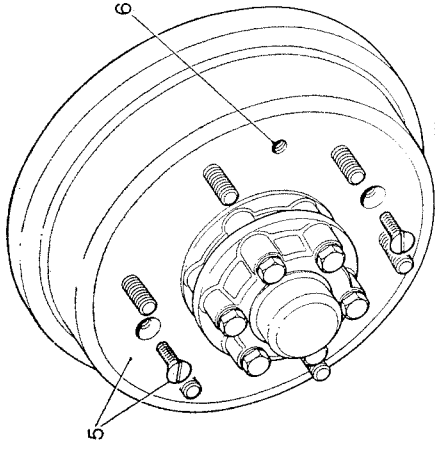
REAR HUB ASSEMBLY

—Remove and refit 64.15.01

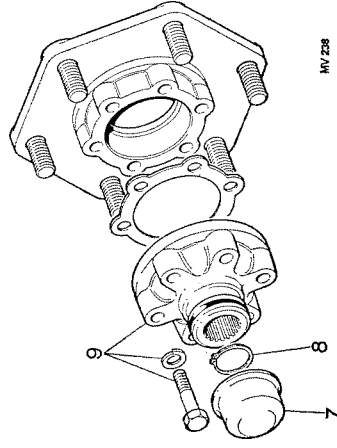
Service tool: RO8460 Spanner for hub nuts

Removing

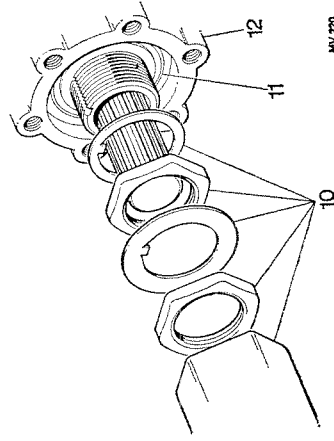
1. Slacken the road wheel nuts.
2. Jack up the rear of the vehicle and support on a stand.
3. Remove the road wheel.
4. Slack off the brake shoe adjusters.
5. Remove the brake drum, noting the provision of an extractor tapping, item 6.
6. If difficulty is experienced in removing the drum, fit one of the drum fixing screws into the extractor tapping and tighten the screw whilst using a mallet to dislodge the drum.
7. Prise off the hub caps.
8. Remove the circlip from the axle shaft.
9. Remove the hub driving member and joint washer.
10. Remove the locknuts, lockwasher and bearing washer securing the hub, RO8460.
11. Hold the outer roller bearing in position.
12. Withdraw the hub and bearings.



MV 218



MV 238



MV 220

Refitting

13. Lubricate the bearings, using the recommended grease. Do not pack the hub with grease.
14. Hold the outer roller bearing in position and slide the hub and bearing assembly on to the stub axle.
15. Fit the bearing washer and adjusting nut, then adjust the bearing end-float. 60.25.13.
16. Apply general purpose grease to both sides of the joint washer and locate it in position on the hub driving member.
17. Coat the threads of the hub driving member securing bolts with 'Locktite Studlock'.
18. Fit the hub driving member and joint washer, and tighten the bolts. Torque: 10,35 kgf.m (75 lbf ft).
19. Reverse 5 to 8.
20. Adjust the brakes.
21. Reverse 1 to 3.

REAR HUB ASSEMBLY

64.15.07

Overhaul

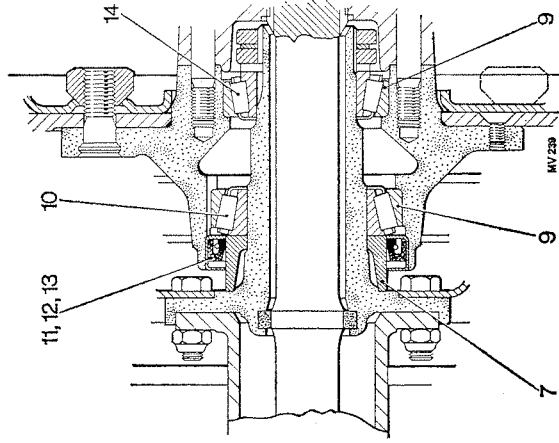
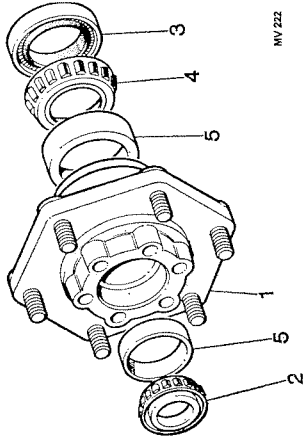
1. Remove the rear hub assembly. 64.15.01.
2. Withdraw the outer roller bearing.
3. Prise out the oil seal and discard.
4. Withdraw the inner roller bearing.
5. Press the bearing outer races from the hub.

Inspecting

6. Examine all components for obvious wear or damage.
7. Examine the outside diameter of the inner bearing distance piece which is pressed on to the exposed stub axle. The diameter forms the inner seat for the hub oil seal and must be free from scores, damage and roughness. To replace the distance piece, 64.15.21 refers.
8. The hub bearings must be a sliding fit on the stub axle and a press fit in the hub.

Reassembling

9. Press the bearing outer races, wide side first, into the hub, ensuring that they abut the locating shoulders.
10. Grease and fit the inner roller bearing. Do not pack the hub centre with grease.
11. Grease the lips of the new oil seal with 'Shell Retinax A', XG 279 or equivalent.
12. Coat the outside diameter of the oil seal with 'Hylomar' jointing compound, ensuring that the compound is kept clear of seal lips.
13. Fit the seal flush with, and not below, the rear face of the hub.
14. Grease and fit the outer roller bearing.
15. Refit the rear hub assembly. 60.25.01.



REAR HUB BEARINGS END-FLOAT

64.15.13

Service tool: RO8460 Spanner for hub nuts

Checking

1. Carry out items 1 to 9 of Operation 64.15.01 to remove the brake drum and hub driving member.
2. Mount a dial test indicator to measure the end-float between the hub and the stub axle.
3. Spin the hub vigorously, causing the bearing rollers to settle in the tapered races, producing maximum end-float conditions.
4. Check the hub to stub axle end-float. This must be 0,10 to 0,15 mm (0.004 to 0.006 in).
5. If the end-float is within the specified limits, remove the dial test indicator and reverse item 1. If adjustment is necessary, proceed as follows.

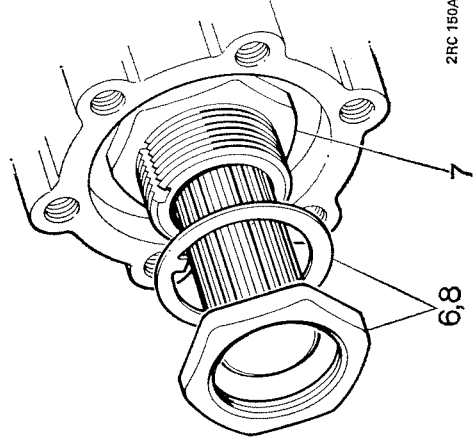
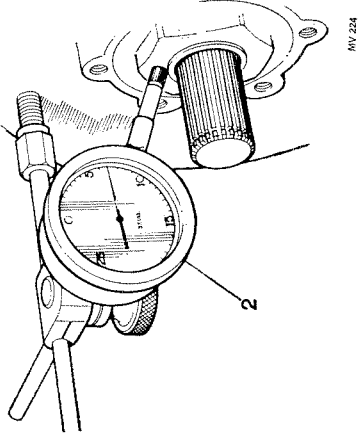
Adjusting

- NOTE:** It is necessary to spin the hub every time before checking the end-float, as moving the hub laterally will resettle the rollers, affecting the measurable end-float.
6. Remove the locknut and lockwasher from the hub. RO8460.
  7. Turn the hub nut in to decrease, or out to increase, the end-float. RO8460.
  8. Fit the lockwasher and locknut, tighten the nut but do not engage the lockwasher.
  9. Spin the hub and check the end-float.
  10. Repeat 6 to 9 as necessary until the end-float is correct, then, remove the dial test indicator, engage the lockwasher and reverse item 1.

DATA

Rear hub bearing end-float

0,10 to 0,15 mm (0.004 to 0.006 in)



REAR HUB STUB AXLE

—Remove and refit 1 to 6 and 15 to 18 64.15.20

—Overhaul 1 to 18 64.15.21

Removing

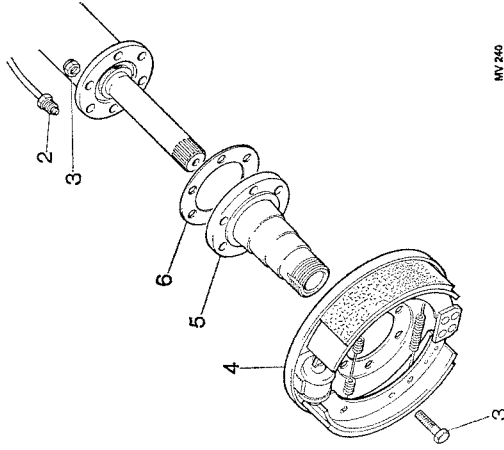
1. Remove the rear hub, 64.15.01.
2. Disconnect and blank the brake fluid pipe at the rear of the brake anchor plate.
3. Remove the fixings securing the brake anchor plate and stub axle.
4. Withdraw the brake anchor plate.
5. Withdraw the stub axle.
6. Withdraw the joint washer.

Overhauling

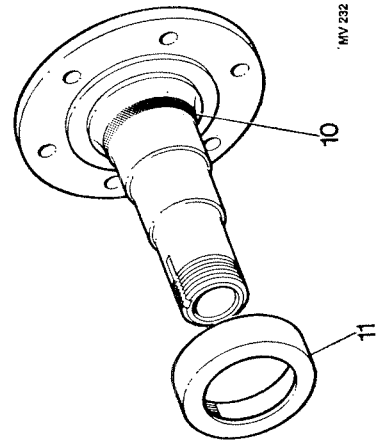
7. Examine for obvious wear or damage.
8. Check the outside diameter of the inner bearing distance piece, this must not show any signs of damage or roughness as it forms the inner seat for the oil seal. The distance piece should be a *press fit* on the stub axle. Any clearance between these two parts will allow oil to leak past on to the brake linings.
9. If it is required to remove the inner bearing distance piece from the stub axle, it must be shattered, using extreme care to avoid damaging the axle.
10. Apply a coat of 'Loctite Hydraulic Seal' around the diameter of the stub axle where the inner bearing distance piece will seat.
11. Press on the inner bearing distance piece.
12. Remove all visible traces of sealing compound.
13. Remove the felt seal from inside the stub axle.
14. Fit a new felt seal into the recess inside the stub axle.

Refitting

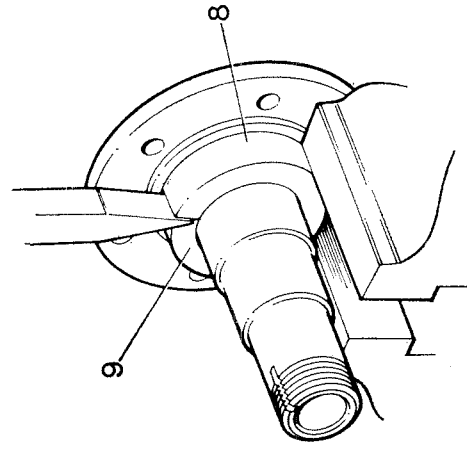
15. Using clean oil, of the grade for the differential, lubricate the felt seal inside the stub axle.
16. Apply general purpose grease to both sides of the joint washer for the stub axle, and locate it in position.
17. Reverse 1 to 5, torque tightening the bolts for the stub axle and brake anchor plate to 10,5 kgf.m (75 lbf ft).
18. Bleed the brakes. 70.25.02.



MV 240



MV 232



MV 231

REAR ROAD SPRING

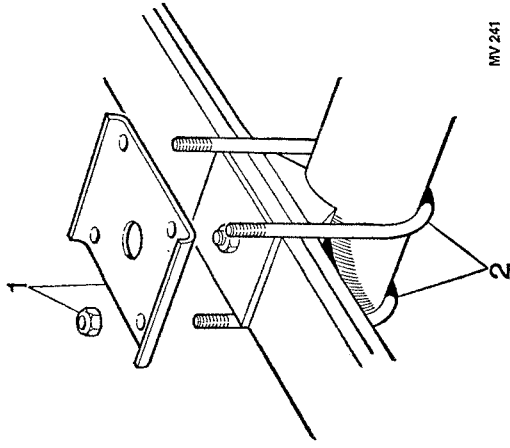
—Remove and refit 64.20.01

Removing

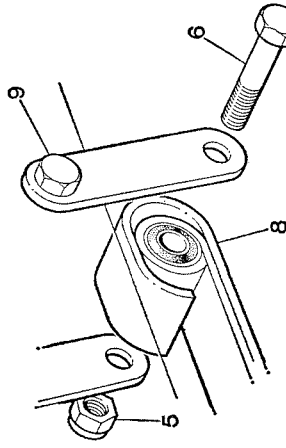
1. Remove the four self-locking nuts and top plate securing the road spring to the axle tube.
2. Withdraw the two U bolts.
3. Jack up the chassis to relieve the load on the road spring.
4. Place a safety stand under the chassis.
5. Remove the self-locking nuts from the front and rear shackle pins.
6. Unscrew and remove the rear shackle pin.
7. Drive out the front shackle pin.
8. Withdraw the rear road spring.

Refitting

9. Slacken the shackle pin securing the shackle plates to the chassis.
10. Reverse 1 to 8, but do not fully tighten the shackle pins and lock nuts at this stage.  
**NOTE:** In order to prolong shackle pin bush life, it is essential that the road spring is loaded to specified dimension before fully tightening the shackle pins and nuts.
11. Adjust the load on the rear road spring to give a dimension of 130,0 mm (5.125 in) between the mounting plate for the bump stop rubber and the stop plate on the axle, then tighten the shackle pins and nuts. Torque: 9,0 to 9,6 kgf.m (65 to 70 lbf ft).
12. Check the vehicle trim height. 60.45.01.



MV 241

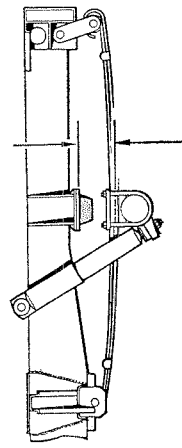


MV 242

DATA

Road spring setting dimension for torque tightening shackles pins

130,0 mm (5.125 in)



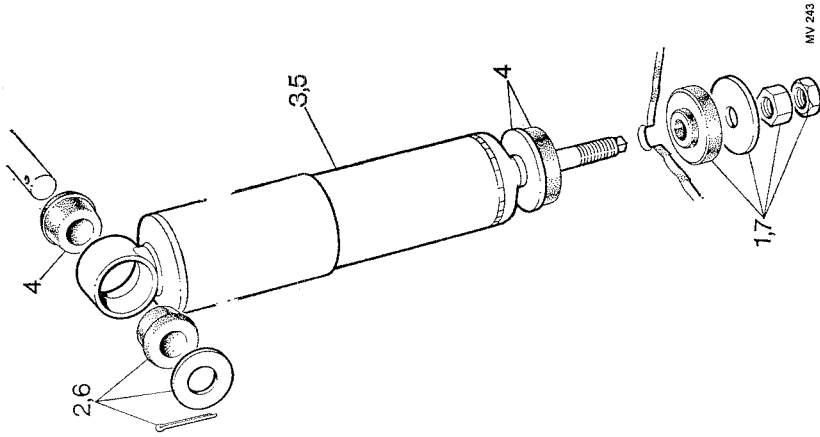
130,0 mm (5.125 in)

2RC 218A

REAR SHOCK ABSORBER

- Remove and refit 64.30.01
- Removing**
- 1. Remove the locknut, nut, washer and mounting rubber from the shock absorber bottom fixing.
- 2. Remove the split pin, washer and outer rubber bush from the shock absorber top fixing.
- 3. Withdraw the shock absorber.

- Refitting**
- 4. Ensure that the inner rubber bush is fitted to the shock absorber top mounting and that a washer and rubber spigot bush is fitted to the lower mounting.
- 5. Locate the shock absorber in position.
- 6. Fit the outer rubber bush to the top mounting, compress the bushes and fit the washer and a new split pin.
- 7. Fit the lower spigot bush so that the spigots abut through the axle bracket, and secure with a washer, nut and locknut.



MV 243

BRAKE OPERATIONS

Brakes	—adjust .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.25.03
	—bleed .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.25.02
Brake apportioning valve	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.25.23
Brake failure switch	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.36
	—overhaul .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.41
Description .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70-01
Drums	—front—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.10.02
	—rear—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.10.03
Fault Diagnosis	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70-02
Fluid Reservoir	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.30.15
Hoses—remove and refit	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .	.. .. .
Hoses—remove and refit	—front LH .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.02
	—front RH .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.03
	—intermediate rear .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.04
	—multway connector feed .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.15.09
Master cylinder—tandem	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.30.08
	—overhaul .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.30.09
Pedal assembly	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.35.01
Pipes—remove and refit	—to brake failure switch, front system .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.46
	—to brake failure switch, rear system .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.47
	—to rear intermediate hose .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.28
	—to front LH cylinder .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.04
	—to front LH hose .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.02
	—to front RH cylinder .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.05
	—to front RH hose .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.03
	—to multiway connector .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.01
	—to rear LH cylinder .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.17
	—to master cylinder, front system .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.50
	—to master cylinder, rear system .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.51
	—to rear RH cylinder .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.20.18
Shoes and linings—remove and refit	—brake shoes, front .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.40.02
	—brake shoes, rear .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.40.03
Transmission brake	—adjust .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.45.09
	—hand lever and linkage—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.45.01
	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.45.16
	—shoes, remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.45.18
Vacuum system	—servo assembly—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.50.01
	—servo assembly—overhaul .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.50.06
Wheel cylinders	—front	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	70.60.03
	—overhaul .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.60.11
—rear	—remove and refit .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.60.18
	—overhaul .. .. .	.. .. .	.. .. .	.. .. .	.. .. .	70.60.26

**BRAKE SYSTEM**

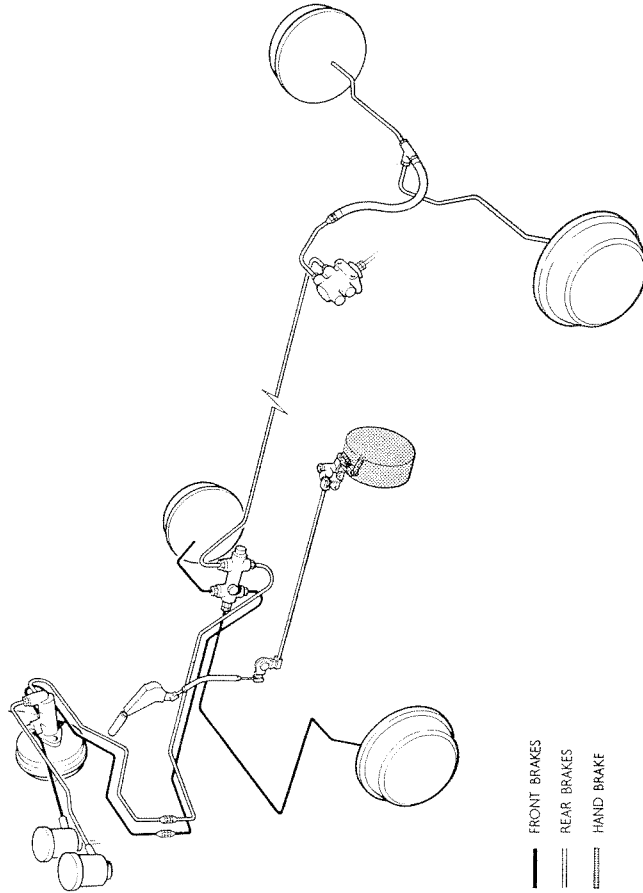
**Description**

The vehicle is equipped with three braking systems, a hand operated transmission brake and foot operated road wheel brakes that are split into separate front and rear systems.

The transmission brake, mounted at the rear of the transfer gearbox, is all mechanical in operation, and acts on the gearbox output drive to the rear axle.

The road wheel brakes are drum and shoe type, operated by a vacuum servo assisted dual line hydraulic system. For added safety and reliability, the hydraulic system is split between the front and rear brakes, in order to retain one brake section in the event of a hydraulic failure in the other.

The split hydraulic system is achieved by separate fluid reservoirs that supply the front and rear sections of a tandem master cylinder, from which dual outlet pipes feed the front and rear road wheel brake sections. An apportioning valve is fitted in the hydraulic supply line to the rear wheel brake system to reduce the possibility of the rear wheels locking during braking. The valve is sensitive to vehicle payload and regulates the pressure accordingly to give full rear wheel braking when the vehicle is fully laden, and reduced rear wheel braking when the vehicle is lightly loaded or unladen. An electrical switch, fitted in the hydraulic system causes a warning light on the instrument panel to be illuminated in the event of a pressure loss in either the front or rear section of the hydraulic system.



0082

FAULT DIAGNOSIS	POSSIBLE CAUSE	CURE
<b>SYMPTOM</b>		
<b>A—SPONGY PEDAL ACTION</b>	1. Air in hydraulic system 2. Swollen rubber components due to incorrect brake fluid	1. Bleed the system 2. Check/adjust as necessary 3. Replace affected parts. Replenish with correct specified brake fluid
<b>B—LOSS OF BRAKE PEDAL PRESSURE</b>	1. Leak in hydraulic system due to faulty master cylinder, wheel cylinder or any brake pipe	1. Replace affected parts and bleed the brake system
<b>C—HARD BRAKE PEDAL</b>	1. Incorrect shoe adjustment 2. Incorrect brake linings fitted 3. Restriction in master cylinder 4. Servo not working	1. Check/adjust brake shoes as necessary 2. Check/replace shoes to specified type 3. Dismantle master cylinder and replace parts as required 4. Check vacuum pipe and servo unit, change parts as necessary 70.25.02 (16)
<b>D—BRAKE PEDAL FAILS TO RETURN</b>	1. Pedal spring weak or missing 2. Loss of master cylinder mounting bolts 3. Sticking pedal shaft	1. Replace spring 2. Check/lighten bolts 3. Lubricate or renew worn parts
<b>E—POOR BRAKES</b>	1. Incorrect adjustment of brake shoes 2. Water soaked linings 3. Glazed or oil contaminated linings 4. Incorrect linings	1. Check/adjust brake shoes 2. Dry out the brakes by slightly applying the brakes while driving 3. Remove brake drums and check for worn hub seals or fluid leaks from wheel cylinders. Replace worn parts and renew the linings. 4. Fit the correct linings as specified
<b>F—CHATTERING BRAKES</b>	1. Incorrect shoe adjustment 2. Loose or worn front wheel bearings 3. High spots or distortion on brake drum	1. Check/adjust brake shoes 2. Adjust or renew bearings as required 3. Recondition or replace brake drum and replace linings where necessary
<b>G—GRABBING BRAKES</b>	1. Incorrect adjustment 2. Grease oil or brake fluid soaked linings due to leaking wheel cylinders and/or worn hub seals 3. Distorted, worn or cracked brake drums 4. Incorrect linings	1. Check/adjust brake shoes 2. Check and replace worn seals and saturated linings where necessary 3. Recondition or replace affected brake drums and linings where necessary 4. Fit brake linings of specified type
<b>H—SIDE PULL</b>	1. Incorrect shoe adjustment 2. Incorrect tyre pressures 3. Water and mud in brakes 4. Clogged or crimped brake hose or pipe 5. Mixed brake linings 6. Excessive wear or distortion in a brake drum 7. Grease, oil or brake fluid on linings due to leaking seals	1. Check/adjust brake shoes 2. Check/adjust tyre pressures 3. Clean out and examine for wear. 4. Replace parts as necessary 5. Check all pipes and hoses and replace where necessary. Clear with air pressure 6. Check all linings and fit specified type 7. Recondition or fit new drum and replace linings where necessary 8. Check and replace worn seals and linings where necessary

FAULT DIAGNOSIS

SYMPTOM	POSSIBLE CAUSE	CURE
I—SQUEALING BRAKES	<ol style="list-style-type: none"> <li>1. Incorrect linings</li> <li>2. Dust or road dirt in drums</li> <li>3. Foreign bodies embedded in brake linings</li> <li>4. Sprung or bent brake shoes</li> <li>5. Distorted brake drum</li> <li>6. Bent brake anchor plate</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit specified linings</li> <li>2. Clean thoroughly and replace linings and/or drums where necessary</li> <li>3. Fit new linings as required</li> <li>4. Replace shoes where necessary</li> <li>5. Recondition or replace drums and/or affected brake linings</li> <li>6. Replace brake anchor plate</li> </ol>
J—BRAKES OVER-HEATING	<ol style="list-style-type: none"> <li>1. Brake shoes in continuous contact with drums</li> <li>2. Defective master cylinder or swollen rubber components</li> <li>3. Dust or dirt in drums</li> <li>4. High spots on brake drum</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust brake shoes</li> <li>2. Dismantle and replace any worn parts in the cylinder</li> <li>3. Clean thoroughly, and if necessary replace linings and/or drum</li> <li>4. Recondition or replace drum as necessary</li> </ol>
K—FADING BRAKES	<ol style="list-style-type: none"> <li>1. Poor lining contact</li> <li>2. Incorrect linings</li> <li>3. Excessive heat</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust as necessary</li> <li>2. Fit specified linings</li> <li>3. Fit new linings to brake shoes</li> </ol>
L—ONE BRAKE DRAGS	<ol style="list-style-type: none"> <li>1. Incorrect brake adjustment</li> <li>2. Distorted rubber boots</li> <li>3. Seized brake shoes</li> <li>4. Seized piston in wheel cylinder</li> <li>5. Weak or broken brake shoe pull off springs</li> <li>6. Distorted brake drum</li> <li>7. Restriction or obstruction in brake pipe</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust brake shoes</li> <li>2. Check rubber boots at wheel cylinders and replace as necessary</li> <li>3. Locate point of seizure (e.g. wheel cylinder) and lubricate with grease as required</li> <li>4. Fit new wheel cylinder complete</li> <li>5. Fit new springs</li> <li>6. Recondition or replace drum</li> <li>7. Locate crimped or damaged pipe/hose. Replace and/or clean pipe with air pressure</li> </ol>
M—ALL BRAKES DRAG	<ol style="list-style-type: none"> <li>1. Incorrect adjustment of brake shoes</li> <li>2. Distorted rubber boots</li> <li>3. Restriction in master cylinder</li> <li>4. Incorrect brake shoe linings (too thick)</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust brake shoes</li> <li>2. Renew rubber boots</li> <li>3. Dismantle and replace parts as necessary</li> <li>4. Fit new linings of specified type</li> </ol>
N—BRAKE LOCKS	<ol style="list-style-type: none"> <li>1. Torn or loose linings</li> <li>2. Swollen rubber components</li> <li>3. Loose wheel cylinders</li> </ol>	<ol style="list-style-type: none"> <li>1. Fit new linings and brake shoes where necessary</li> <li>2. Fit new components as necessary</li> <li>3. Check/tighten fixings as necessary</li> </ol>
O—REAR BRAKES LOCK	<ol style="list-style-type: none"> <li>1. Incorrect adjustment</li> <li>2. Brake apportioning valve incorrectly functioning</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust brake shoes</li> <li>2. Check brake apportioning valve. Adjustment/misfunction 70.23.23</li> </ol>
P—REAR BRAKES INOPERATIVE	<ol style="list-style-type: none"> <li>1. Incorrect adjustment</li> <li>2. Brake apportioning valve wrongly adjusted</li> <li>3. Hydraulic defect</li> </ol>	<ol style="list-style-type: none"> <li>1. Check/adjust brake shoes</li> <li>2. Check adjustment of brake apportioning valve 70.23.23</li> <li>3. Check rear hydraulic system for leaks, bleed system</li> </ol>
Q—PARTIAL BRAKE FAILURE INDICATED BY WARNING LIGHT ON INSTRUMENT PANEL AND ABNORMAL PEDAL OPERATION	<ol style="list-style-type: none"> <li>1. Hydraulic failure in front or rear systems</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect complete hydraulics and replace parts where necessary. Bleed brakes as required</li> </ol>
R—HAND BRAKE NOT HOLDING	<ol style="list-style-type: none"> <li>1. Out of adjustment</li> <li>2. Worn brake shoes on transmission brake</li> <li>3. Oil contaminated linings</li> </ol>	<ol style="list-style-type: none"> <li>1. Check adjustment 70.45.01</li> <li>2. Replace worn parts and adjust</li> <li>3. Check and if necessary replace worn seal 37.23.01 and linings</li> </ol>

BRAKE DRUMS

—Remove and refit

Front drums 70.10.02  
Rear drums 70.10.03

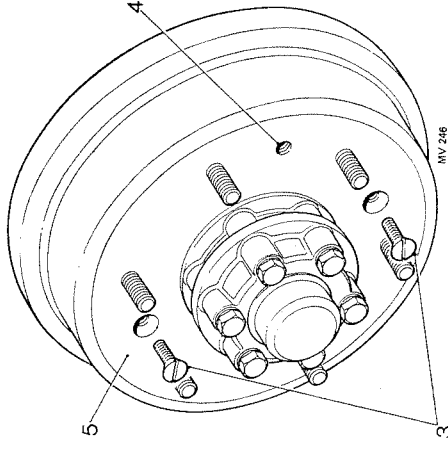
Removing

1. Remove the road wheel.
2. Slacken the brake shoe adjusters.
3. Remove the brake drum fixings, noting the position of an extractor tapping, item 4.
4. If difficulty is experienced in removing the drum, fit one of the drum fixing screws into the extractor tapping and tighten the screw whilst using a mallet to dislodge the drum.
5. Withdraw the brake drum.

**WARNING: Do not blow out the dust in a brake drum, it is dangerous if inhaled.**

Refitting

6. Locate the brake drum in position and secure with two screws.
7. Refit the road wheel.
8. Adjust the brakes.



NV 246

DATA

Brake drum diameter 279,4 mm (11.000 in)  
Reclamation limit 1,52 mm (0,060 in) oversize

**BRAKE HOSES AND PIPES**

— Remove and refit

**HOSES**

- Front left hand 70.15.02
- Front right hand 70.15.03
- Intermediate rear 70.15.04
- Multway connector feed 70.15.09

**PIPES**

- Feed to front multway connector 70.20.01
- Feed to front left hand hose 70.20.02
- Feed to front right hand hose 70.20.03
- Feed to front left hand cylinder 70.20.04
- Feed to front right hand cylinder 70.20.05
- Feed to rear left hand cylinder 70.20.17
- Feed to rear right hand cylinder 70.20.18
- Feed to rear intermediate hose 70.20.28
- Feed to brake failure switch, front system 70.20.46
- Feed to brake failure switch, rear system 70.20.47
- Feed to master cylinder, front system 70.20.50
- Feed to master cylinder, rear system 70.20.51

**NOTE:** The operation numbers are included on the brake system illustrations to facilitate identification of the individual hoses and pipes.

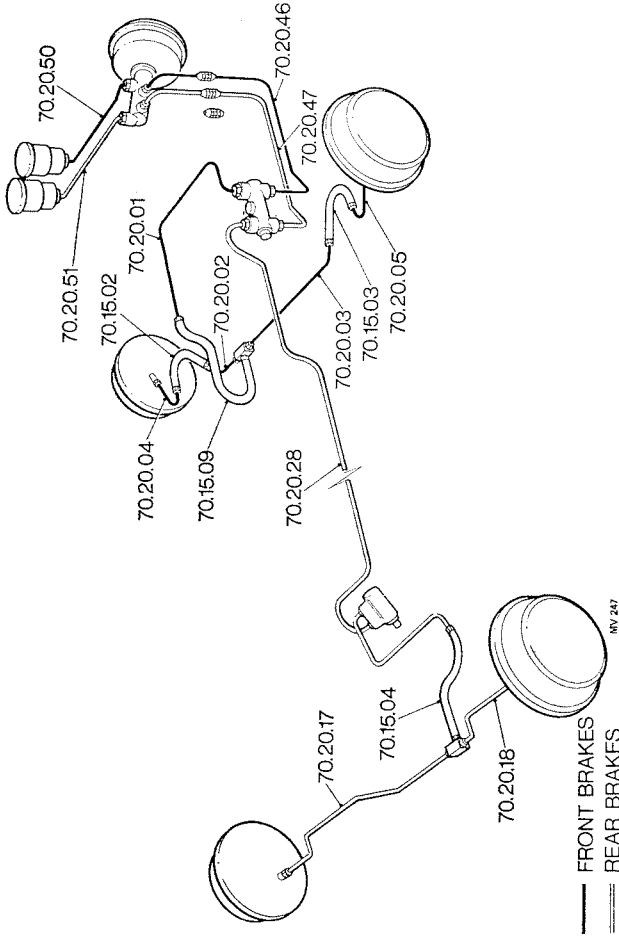
**Removing**

**NOTE:** If required, access to the pipes inside the radiator housing is gained by removing the grille panel.

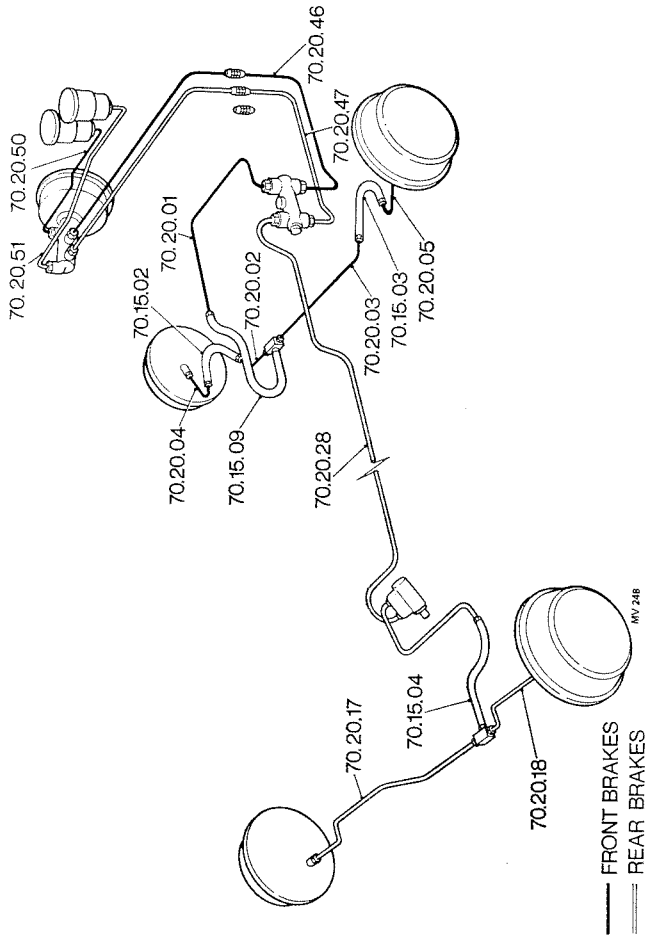
1. Disconnect the hose or pipe at both connections.
2. Release the clipping.
3. Withdraw the hose or pipe.

**Refitting**

4. Reverse 1 to 3.
5. Bleed the brakes 70.25.02



Brake hose and pipe layout — RH Sfg.



Brake hose and pipe layout — LH Sfg.



## BRAKE FAILURE SWITCH

—Remove and refit

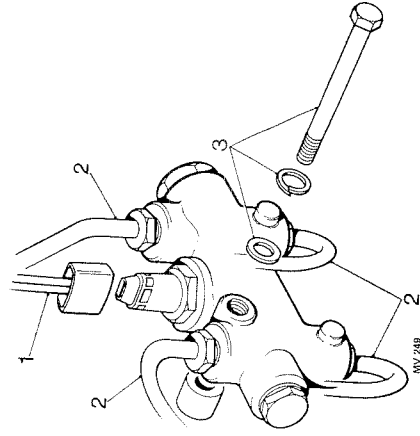
70.15.36

**Removing**

1. Disconnect the electrical leads from the brake failure switch, located in the engine compartment at the chassis RH side member and accessible from below.
2. Disconnect and blank off the fluid pipes.
3. Remove the brake failure switch.

**Refitting**

4. Secure the brake failure switch in position, with the electrical leads socket uppermost.
5. Reverse 1 and 2.
6. Bleed the brakes. 70.25.02



## BRAKE FAILURE SWITCH

—Overhaul

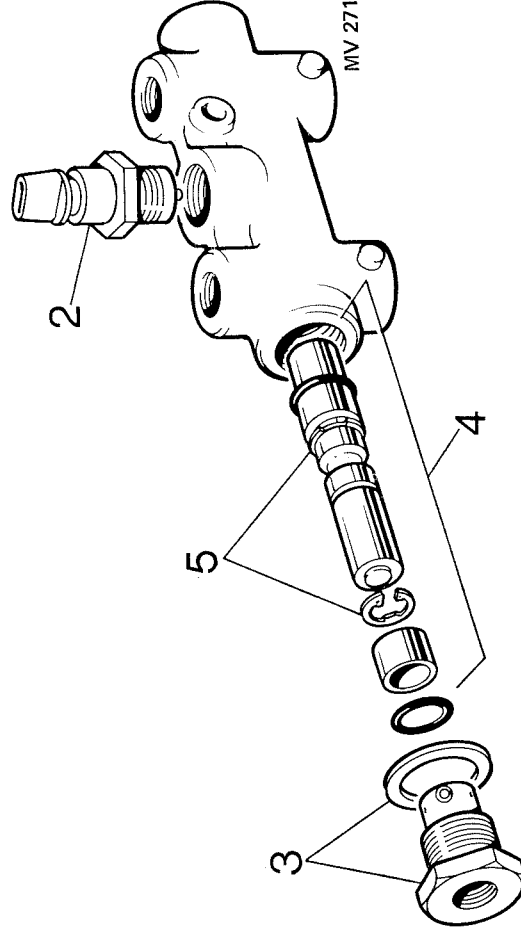
70.15.41

**Dismantling**

1. Remove the brake failure switch. 70.15.36
2. Unscrew the switch unit from the housing.
3. Unscrew the large end plug and sealing washer.
4. To remove the internal components, tap the open end of the housing on a wooden surface. One sleeve and 'O' ring usually remain in the bore, shake out the sleeve and hook out the 'O' ring.
5. Taking care not to damage the piston, remove the two circlips from their grooves.

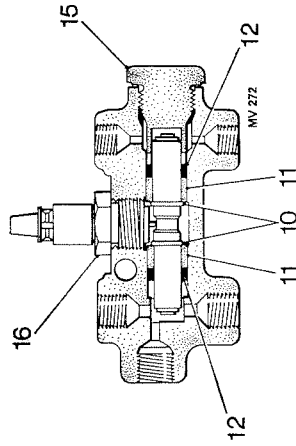
**Inspecting**

6. The new parts in the overhaul kit indicate which used parts should be discarded.
7. Examine the housing bore and piston, ensure that they are in good working order with no signs of damage, scoring or corrosion. If there is any doubt, fit a new assembly.
8. Check that the sleeves slide easily over the piston.
9. Ensure that the threads of the body, switch and end plug are undamaged and that the switch and end plug screw easily into the body.

*continued*

**Reassembling**

10. Fit the new circlips to the piston.
11. Slide on the sleeves.
12. Fit new 'O' rings.
13. Liberally lubricate the cylinder bore, sleeves and 'O' rings with clean brake fluid.
14. Offer the piston assembly to the bore and push fully home then screw in the end plug finger tight to reposition the 'O' ring on the piston. Unscrew the end plug and using care not to damage the parts, press the seal further down the bore with a small screwdriver until it abuts the sleeve.
15. Place a new copper gasket on the end plug and screw the plug into the body. Torque: 4,9 to 5,3 kgf.m (35 to 40 lbf ft).
16. Before screwing in the switch, move the piston back towards the end plug until the two sleeves are central under the threaded post and the switch will not foul when screwed into the body. If a resistance is felt, recheck the position of the sleeves. Tighten the switch to a torque of 0,28 to 0,69 kgf.m (2 to 5 lbf ft).
17. Refit the brake failure switch. 70.1.5.36



70.25.02

**BRAKES**

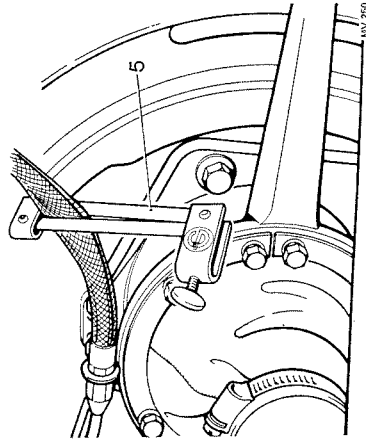
**---Bleed**

**General**

1. Observe strict cleanliness precautions to prevent foreign matter from entering the hydraulic system.
2. Use only new supplies of the recommended brake hydraulic fluid.
3. Keep both fluid reservoirs 'topped up' during bleeding. The reservoir adjacent to the master cylinder has two compartments, the outer compartment contains the reserve fluid for the front section of the dual brake system (the inner compartment contains the clutch reserve fluid). The reservoir furthest from the master cylinder contains the reserve fluid for the rear section of the dual brake system.
4. Where the complete hydraulic system is to be refilled, it is advantageous to first charge the system, to each bleed point in turn, before attempting to expel all air from the system.

**Isolating local air pockets**

5. Use of Girling Brake Service Hose Clamps 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.  
Providing the brake hose is in reasonable condition, damage cannot be caused using a 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.
6. With clamps fitted on the two front and one rear hose (it is not necessary to clamp the front intermediate 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.
7. 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.



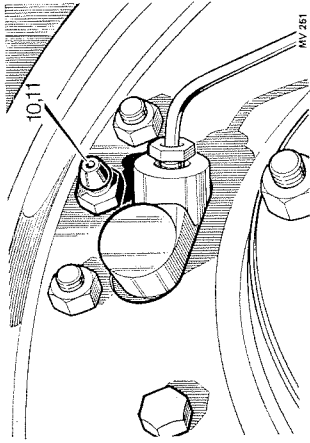
*continued*

**Wheel cylinder—servicing**

- 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.

**Brake bleeding procedure**

- Slacken off the brake shoe adjusters on each wheel to minimise wheel cylinder volume.
- Attach a length of plastic tubing to the bleed screw on the wheel unit furthest from the brake pedal. Submerge the tube free end in brake fluid in a glass jar.
- Slacken the bleed screw.
- Operate the brake pedal through the maximum obtainable travel and allow to return. Note that pedal travel will be restricted when bleeding only one section of the dual brake system.  
**IMPORTANT:** Allow at least five seconds to elapse with the foot clear of the pedal to ensure that the system recapturates before operating the pedal again.
- Repeat the procedure until fluid discharged from the bleed tube is free of air and then tighten the bleed nipple during a pedal downstroke.
- Repeat the procedure on the remaining wheels commencing and continuing at the next wheel furthest from the master cylinder.  
**NOTE:** By bleeding the rear brakes first, the front brakes are being partially self bled by the action of the 'tipping' valve in the master cylinder; this is the reason why both reservoirs should be kept 'topped' up. Also, the front brakes are easier to bleed once the rear brakes have been bled.
- Adjust the brakes.
- 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.

**BRAKES**

70.25.03

**—Adjust**

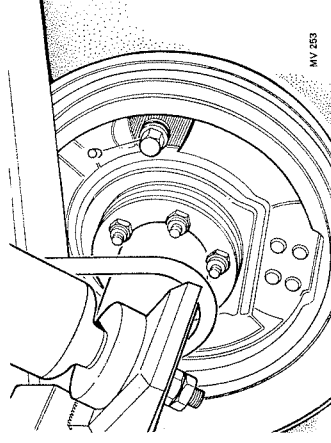
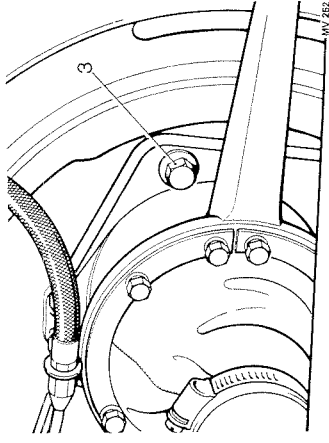
**NOTE:** The rear face of each brake anchor plate is fitted with two separate adjuster bolts, one for each brake shoe. The adjuster bolts operate serrated snail cams that adjust each brake shoe independently.

**Adjusting procedure****Front brakes**

- Apply the transmission brake.
- Jack up the applicable wheel.
- Spin the wheel and turn the adjuster clockwise until the brake shoe contacts the drum, then slacken the adjuster until the wheel spins freely again.
- Repeat for the other adjuster.
- Lower the wheel and remove the jack.
- Repeat for the other front wheel.

**Rear brakes**

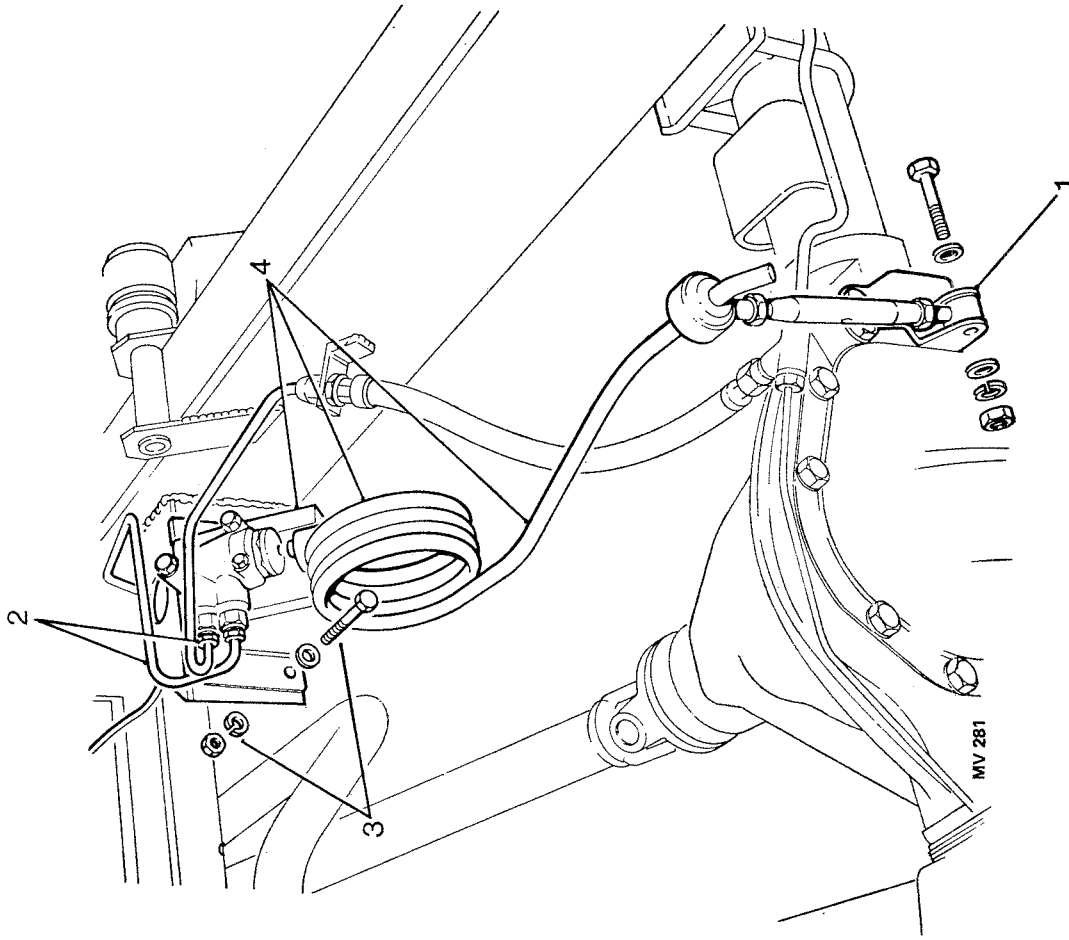
- Apply the transmission brake.
- Jack up the applicable wheel.
- Spin the wheel and turn the adjuster clockwise until the brake shoes contacts the drum; then slacken the adjuster until the wheel spins freely again.
- Repeat for the other adjuster.
- Lower the wheel and remove the jack.
- Repeat for the other rear wheel.



BRAKE APPORTIONING VALVE ASSEMBLY

70.25.23

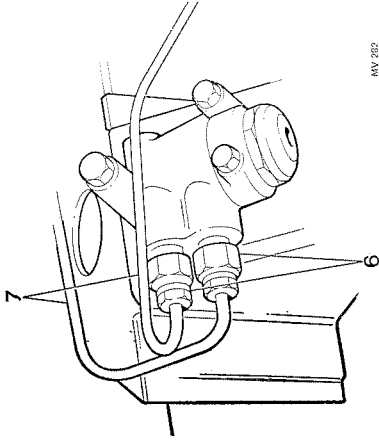
---Remove and refit



**Removing**

1. Remove the fixings and disconnect the lower end of the adjustment strut from the bracket on the axle case.
2. Disconnect and blank off the fluid pipes at the apportioning valve.
3. Remove the four nuts, washers and bolts securing the apportioning valve mounting bracket to the chassis.
4. Withdraw the apportioning valve assembly.
5. If required, remove the adaptors from the inlet and outlet ports of the apportioning valve.

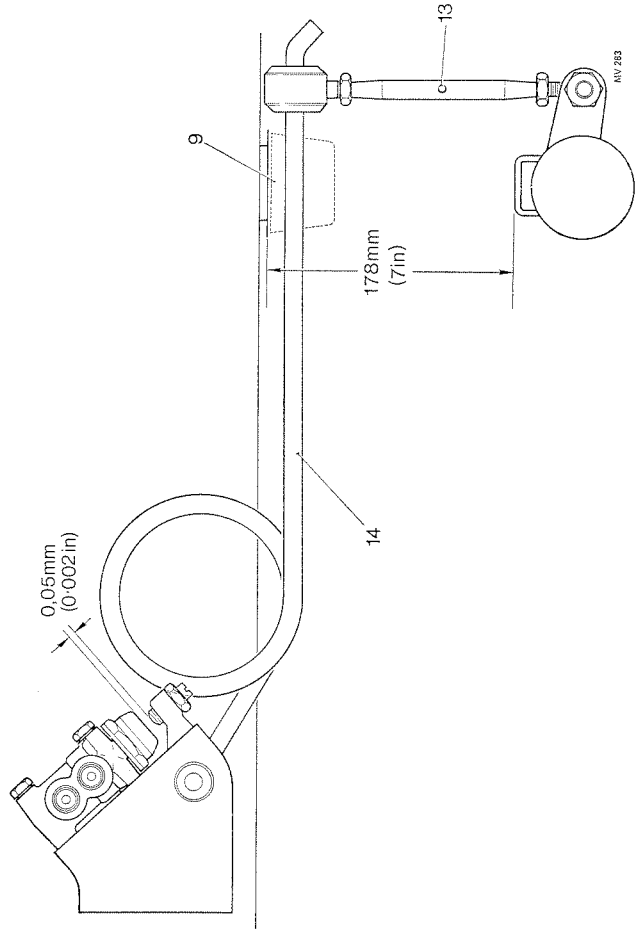
6. If removed, refit the adaptors to the apportioning valve. Torque: 2,2 to 2,7 kgf.m (16 to 20 lbf ft).
7. Reverse 1 to 4, ensuring that the inlet and outlet fluid pipes are connected to the correct ports, as illustrated.
8. Bleed the brakes. 70.25.02



**NOTE:** The following procedure must be carried out to ensure that the apportioning valve is correctly adjusted.

9. Remove the rear suspension bump stop rubbers from both sides of the chassis.

10. Measure the distance vertically between the undersides of the bump stop mounting brackets on the chassis frame side members and the top of the bump stop brackets welded onto the rear axle casing on both sides of the chassis.
11. The distance must be 178 mm (7 in). If necessary, jack the rear springs or load the vehicle until the measurement is achieved.
- NOTE:** It is recommended that gauge pieces of the correct length are obtained and inserted between the datum surfaces to ensure that the axle is parallel and at the correct position in relation to the chassis.
12. Using a feeler gauge, check the clearance between the apportioning valve plunger and the set bolt in the spring link housing. The clearance should be 0,05 mm (0,002 in).
13. If adjustment is required, slacken the two locking nuts on the adjustment strut and, using a suitable 'tommy' bar located through the holes in the strut, turn the strut either clockwise or anti-clockwise as necessary until the clearance between the plunger and set bolt is correct.
14. If the reactor arm is obviously not parallel with the lower edge of the chassis side member, reset the adjustment strut until the reactor arm is approximately horizontal and parallel. Adjust the clearance to approximately 0,05 mm (0,002 in) using the set bolt on the apportioning valve then obtain final adjustment by the adjustment strut.
15. Tighten both lock nuts on the adjustment strut.



MASTER CYLINDER—Tandem

—Remove and refit 70.30.08

Removing

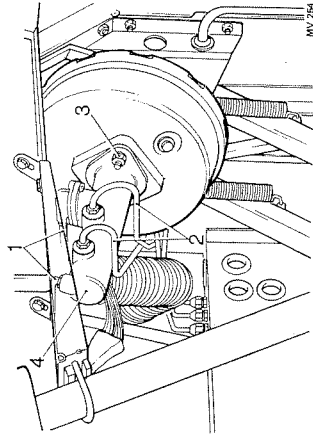
**NOTE:** Take precautions against brake fluid spillage that will occur when the pipes are disconnected from the master cylinder.

1. Disconnect each fluid inlet pipe in turn from the master cylinder and drain the applicable reservoir.
2. Disconnect the fluid outlet pipes from the master cylinder.
3. Remove the nuts and spring washers securing the master cylinder to the servo assembly.
4. Withdraw the master cylinder.

Refitting

5. Reverse 3 and 4. Torque for master cylinder fixings: 2,2 to 2,6 kgf.m (16 to 19 lbf ft).
7. Bleed the brakes. 70.25.02

**NOTE:** The accompanying illustration shows a RH Stg. installation. For full details of the brake pipe layout of both RH and LH Stg. arrangements, refer to Operation 70.15.02.



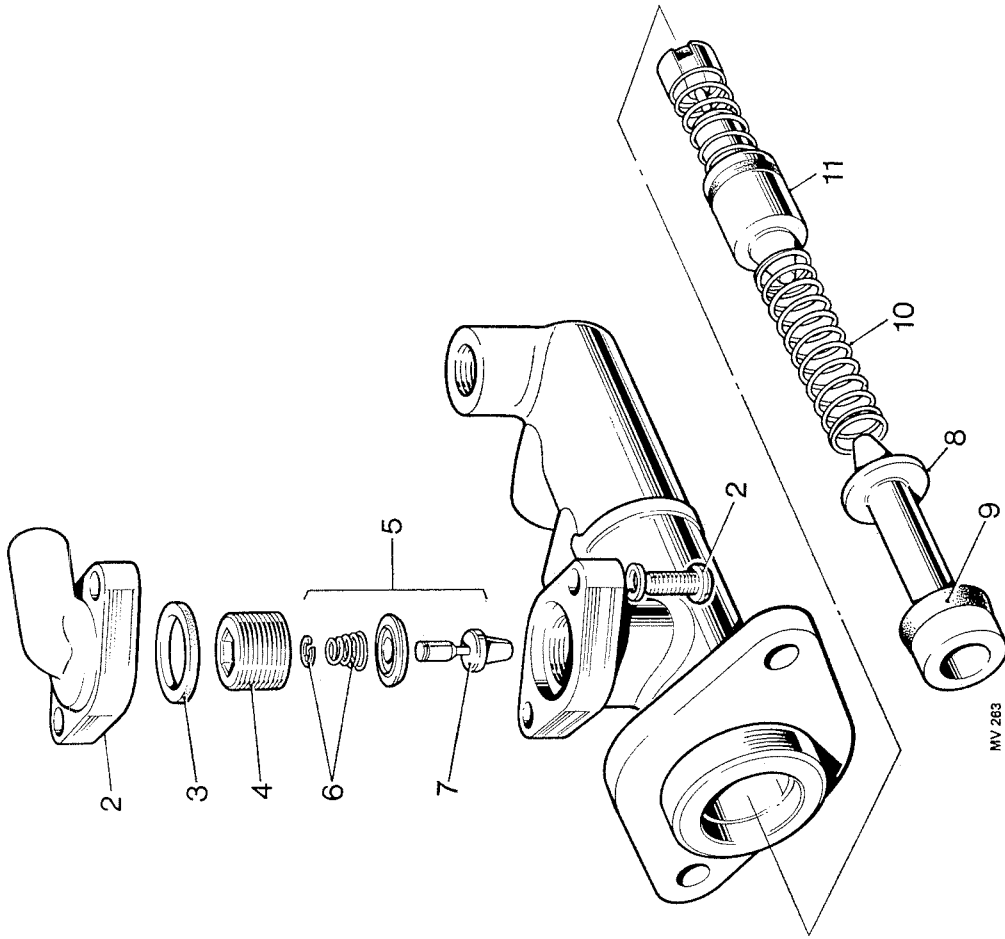
MASTER CYLINDER—Tandem

70.30.09

5. Push the primary piston into the cylinder bore and withdraw the tipping valve assembly.
6. Remove the circlip and spring from the tipping valve.
7. Withdraw the tipping valve from the seal plate.
8. Withdraw the primary piston by shaking the cylinder or applying low air pressure to the inlet bore.
9. Remove and discard the piston seal.
10. Withdraw the piston spring.
11. Withdraw the secondary piston and valve assembly.

Dismantling

1. Remove the master cylinder. 70.30.08
2. Remove the two screws and spring washers securing the primary inlet adaptor. Lift off the adaptor.
3. Withdraw the seal from the primary inlet bore.
4. Unscrew the plug retaining the tipping valve.



MV 283

continued

12. Prise the spring retainer locking prong clear of the piston shoulder and withdraw the piston and spring.
13. Remove and discard the oil seal.
14. Position the valve stem to align with the larger hole in the valve retainer. Withdraw the retainer.
15. Slide the valve spacer over the valve stem. Remove the wave washer and valve seal from the stem.

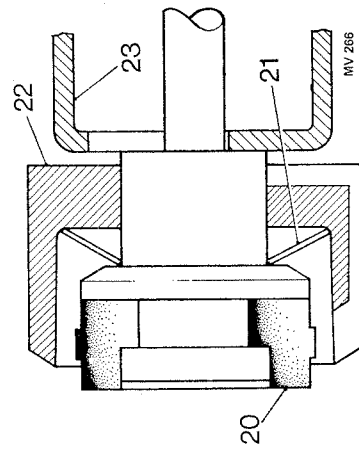
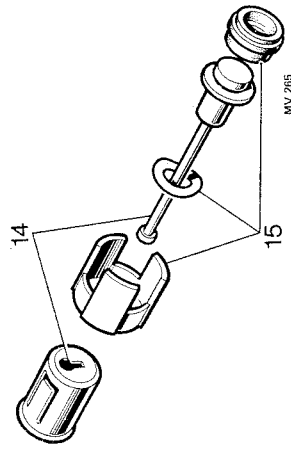
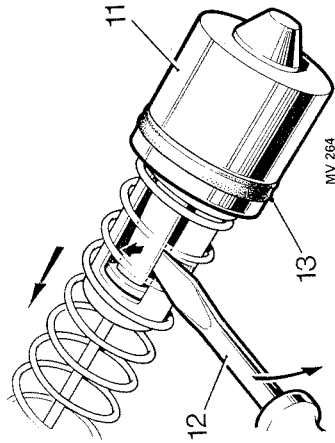
**Inspecting**

16. Clean all components in clean brake fluid and allow to dry.
17. Examine the cylinder bore and pistons, ensure that they are smooth to the touch with no corrosion, score marks or ridges. If there is any doubt, fit new replacements.
18. The seals should be replaced. These items are included in the master cylinder overhaul kit.

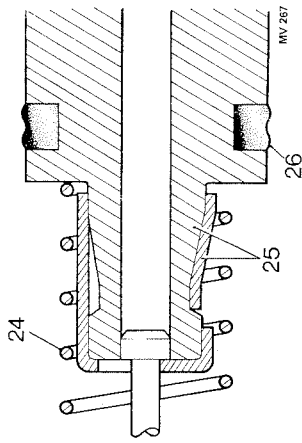
**Assembling**

19. During assembly, smear the seals and the remaining internal items with clean brake fluid.
20. Fit the valve seal, flat side first, to the end of the valve stem.
21. Fit the wave washer, domed side towards the valve head.
22. Fit the valve spacer, legs first.
23. Fit the valve retainer.

*continued*



24. Locate the spring over the retainer and squarely seat on the valve spacer.
25. Insert the secondary piston into the spring and compress until the locking prong on the valve retainer engages in the groove in the piston. If necessary, depress the locking prong to ensure that the free end is fully engaged with the groove shoulder.
26. Fit the piston seal.
27. Insert the secondary piston and valve assembly, valve end first, into the cylinder.
28. Reverse 1 to 9. Torque for tightening the tipping valve retaining plug: 4,9 to 5,5 kgf.m (35 to 40 lbf.ft).



FLUID RESERVOIR

70.30.15

—Remove and refit

Front system and clutch reservoir 1 to 9  
Rear system reservoir 1 and 3 to 8

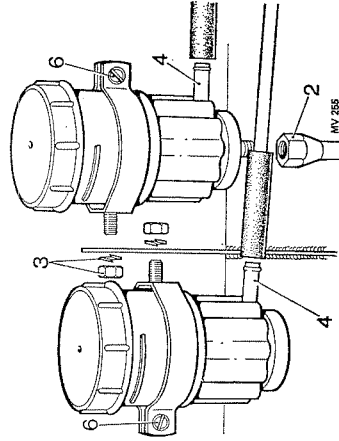
Removing

**NOTE:** The reservoir adjacent to the master cylinder has two compartments, the outer compartment contains the reserve fluid for the front section of the dual brake system, the inner compartment contains the clutch reserve fluid. The reservoir furthest from the master cylinder contains the reserve fluid for the rear section of the dual brake system.

1. Take precautions against brake and clutch fluid spillage that will occur when the pipes are disconnected from the reservoirs.
2. Disconnect the clutch fluid outlet pipe from the bottom of the reservoir and drain the fluid.
3. Remove the nut and spring washer securing the reservoir clamp to the mounting bracket.
4. Withdraw the reservoir from the hose connector.
5. Drain the reservoir.
6. If required, remove the clamp from the reservoir.

Refitting

7. Reverse 1 to 6 as applicable.
  8. Bleed the brakes. 70.25.02
  9. Bleed the clutch hydraulic system. 33.15.01
- NOTE:** This illustration shows a RH Stg installation, LH Stg is symetrically opposite.



PEDAL ASSEMBLY

70.35.01

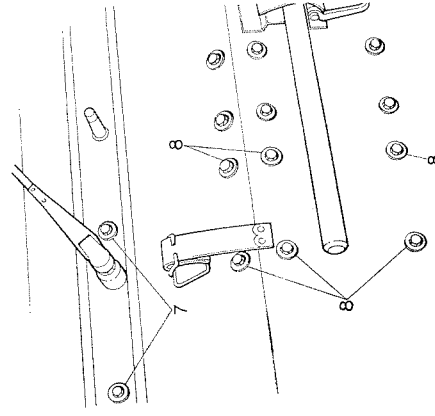
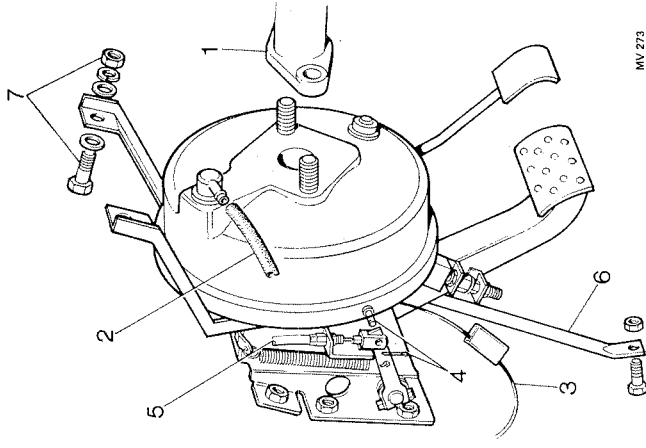
—Remove and refit

Removing

1. Remove the brake master cylinder. 70.30.08
2. Disconnect the vacuum hose from the brake servo.
3. Disconnect the leads from the stop lamp switch.
4. Disconnect the throttle cable from the throttle pedal lever.
5. Unscrew the lock nut and withdraw the throttle cable from the stop bracket on the side of the pedal housing.
6. Remove the fixings securing the lower end of the support stay for the brake pedal housing.
7. Remove the fixings securing the servo support brackets to the cab front panel.
8. Remove the fixings securing the brake pedal housing to the cab front panel.

*continued*

MV 273



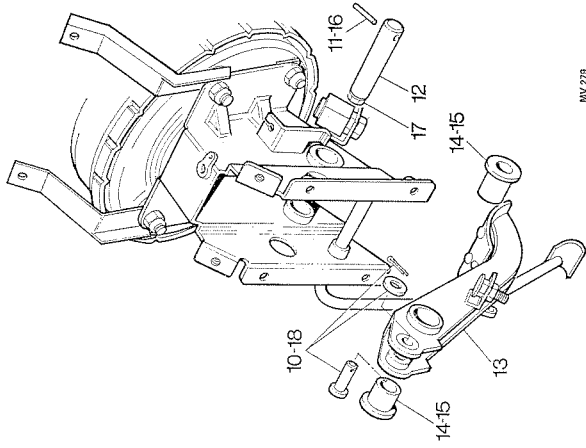
MV 274



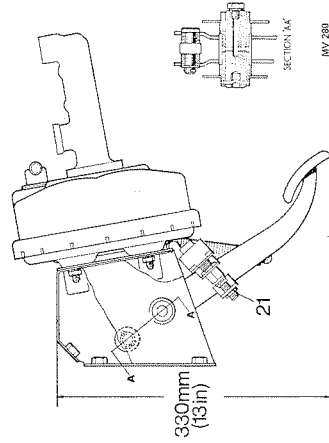
9. Withdraw the housing complete with the brake and throttle pedals, brake servo, support stay and brackets.
10. Remove the split pin, plain washer and clevis pin securing the servo rod to the brake pedal.
11. Using a suitable punch, drift out the pin from the pedal shaft.
12. Withdraw the pedal shaft.
13. Withdraw the brake pedal complete with bushes.
14. If required, remove the bushes from the brake pedal.

**Refitting**

15. If removed, fit the bushes to the brake pedal. New pedal bushes must be reamed to 19,05 mm + 0,02 mm (0.750 in + 0.001 in).
16. Reverse 11 to 13, using a new pin to secure the pedal shaft.
17. Remove the oil plug and washer from the pedal shaft. Fill the shaft bore with clean engine oil and refit the plug and washer.
18. Using a new split pin, reconnect the servo rod to the brake pedal.
19. Reverse 1 to 9.
20. Check the dimension from the top face of the pedal housing to the lower edge of the brake pedal. The correct dimension is 330 mm (13 in).
21. Adjust the pedal stop as required to obtain the correct dimension.
22. Bleed the brakes. 70.25.02



MV 279



MV 280

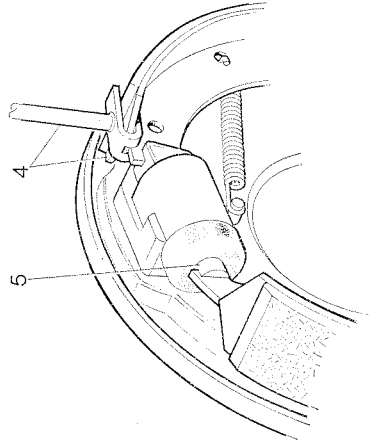
**FRONT BRAKE SHOES**

**—Remove and refit**

70.40.02

**Removing**

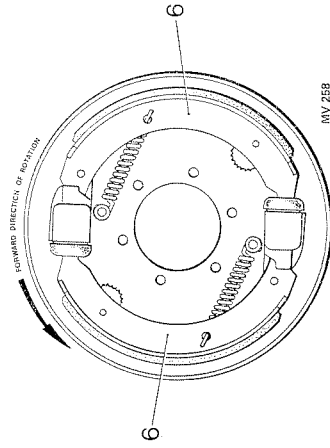
1. Remove the road wheel.
2. Remove the brake drum. 70.10.02
3. Remove the front hub. 60.25.01
4. Using a suitable tool, lever the brake shoes from the locating slots at the end of the cylinders and disconnect the return springs.
5. Retain the pistons in the wheel cylinders, using a rubber band.



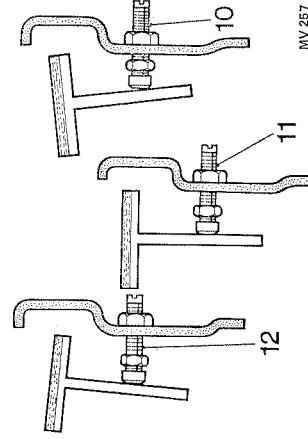
MV 256

**Refitting**

6. Reverse 3 and 4, locating the brake shoes as illustrated. The arrow in the illustration indicates the forward direction of rotation of the brake drum.
7. Refit the brake drum.
8. Adjust the brakes. 70.25.03
9. If the brake shoe steady posts have been disturbed, reset as follows, items 10 to 12.
10. Screw back the steady posts clear of the brake shoes and apply the brakes.
11. Screw in the steady posts to contact the brake shoes then secure the lock nuts. Torque 1,4 to 1,8 kgf.m (10 to 13 lbf ft).
12. Do not tilt the brake shoes by screwing in the steady posts too far.
13. Reverse 1.



MV 258



MV 257



REAR BRAKE SHOES

70.40.03

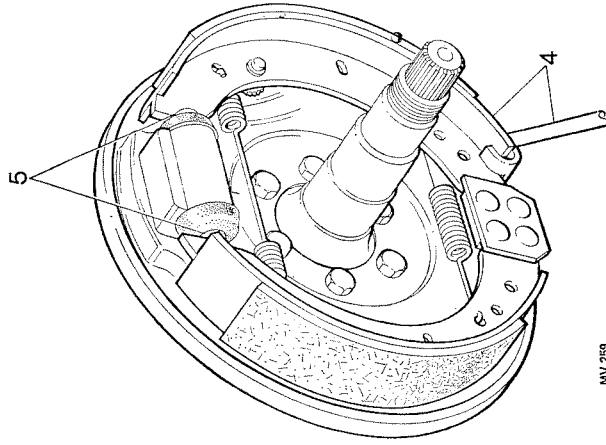
—Remove and refit

Removing

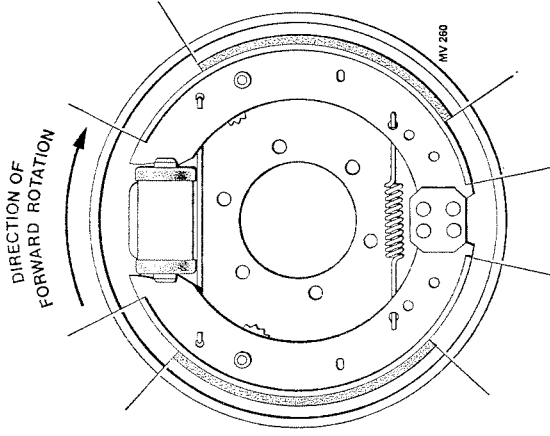
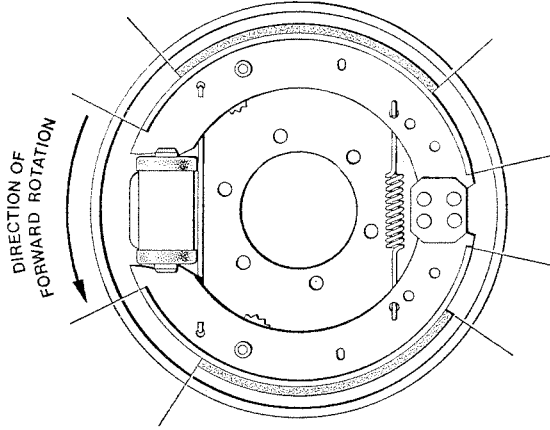
1. Remove the road wheel.
2. Remove the brake drum. 70.10.03
3. Remove the rear hub. 64.15.01
4. Using a suitable tool, lever the brake shoes from the pivot location and disconnect the return springs.
5. Retain the pistons in the wheel cylinder, using a rubber band.

Refitting

6. Reverse 3 and 4, ensuring that the brake shoes are fitted correctly with the linings off-set in the direction of rotation. The arrow in the illustration indicates the forward direction of rotation of the brake drum.
7. Refit the brake drum.
8. Adjust the brakes. 70.25.03
9. Refit the road wheel.



MV 259



MV 259

TRANSMISSION BRAKE HAND LEVER, CABLE AND LINKAGE

70.45.01

—Remove and refit

**CAUTION:** Before commencing any part of this operation it is essential that the vehicle is restrained securely by leaving it in gear and/or chocking the road wheels.

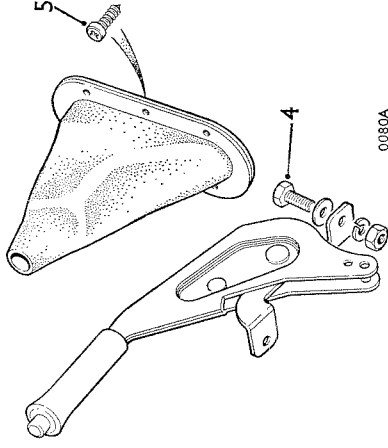
HAND LEVER

Removing

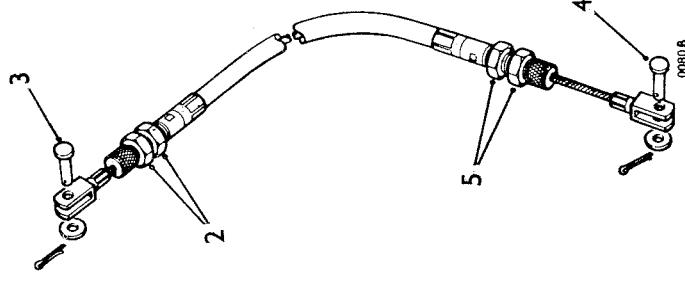
1. Release the transmission brake hand lever.
2. Pull out and remove the radiator grille.
3. Remove the split pin, washer and clevis pin securing the cable to the hand lever.
4. Remove the two nuts, bolts and washers securing the hand lever to its mounting bracket.
5. From inside the driving cab, remove the six screws securing the hand lever gaiter.
6. Remove the gaiter.
7. Withdraw the brake hand lever.

Refitting

8. Reverse items 1 to 7 above.
9. Check adjustment of transmission brake. 70.45.18 — Items 37 to 41.



0080A



0080B

HAND BRAKE CABLE

Removing

Working from underneath the front of the vehicle with radiator grille removed and the brake hand lever released.

1. Remove the split pin, washer and clevis pin securing the cable to the hand brake lever.
2. Slacken the nuts securing the cable in the upper bracket and slide out the cable.
3. Remove any securing clips fitted along the length of the cable.
4. Remove the split pin, washer and clevis pin at the lower end of the cable.
5. Slacken the nuts securing the cable in the lower bracket.
6. Withdraw the hand brake cable.

Refitting

7. The handbrake cable (inner blade) will bend naturally in one direction only, and when the lower clevis pin is fitted the cable **must** be able to bend forwards.

8. Reverse instructions 1 to 6.

**IMPORTANT:** On LH Sig vehicles the lower clevis should be fitted and the upper clevis aligned by manoeuvring and twisting the cable across and behind the oil cooler.

**Under no circumstances** should force be employed to twist the clevis and inner blade into alignment.

9. Check adjustment 70.45.18 — Items 37 to 41 and see the following adjustment procedure.

**HAND BRAKE LINKAGE** — comprising front and rear relay lever assemblies, brake rod and adjustable rear link.

#### Front relay lever assembly

##### Removing

1. Remove split pin, washer and clevis pin securing cable to relay.
2. Remove split pin and unscrew the threaded clevis pin securing brake rod to the relay.
3. Remove the nylon nut securing the relay assembly to the mounting bracket on the chassis.
4. Withdraw the front relay lever assembly.

##### Refitting

5. Reverse 1 to 4 above.
6. Check operation of hand brake and adjust if necessary. 70.45.18

#### Rear relay lever assembly and adjustable link

With the gearbox cover floor section removed and working from above.

##### Removing

7. Remove the split pin, washer and clevis pin securing the adjustable link rod to the operating lever on the brake back plate.
8. Remove the split pin and unscrew the threaded clevis pin securing the brake rod to the relay lever.
9. Remove the upper or lower split pin and withdraw the relay pivot pin.
10. Withdraw the relay lever assembly attached to the adjustable link.
11. If necessary, remove the two bolts securing the relay mounting bracket to the gearbox.

##### Refitting

12. Ensure that the adjustable link measures 54 mm ( $2\frac{1}{8}$  in) between clevis pin centres.
13. Reverse 7 to 11 above.
14. Check hand brake operation and adjust if necessary. 70.45.18 — Items 37 to 41.

#### Brake Rod

##### Removing

15. Remove the split pin and unscrew the threaded clevis pin securing the brake rod to the front relay lever.

*continued*

16. With the gearbox cover floor section removed, remove the split pin and unscrew the threaded clevis pin securing the brake rod to the rear relay lever.

17. Slacken the securing nut and unscrew the rear clevis fork from the brake rod.

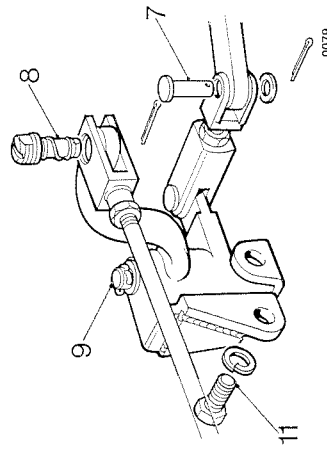
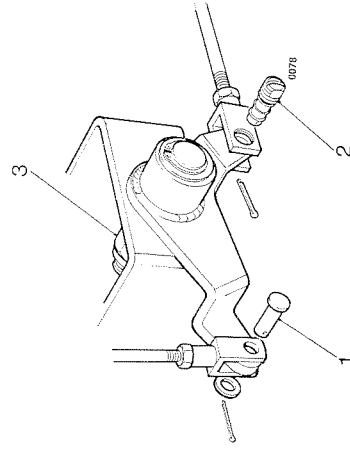
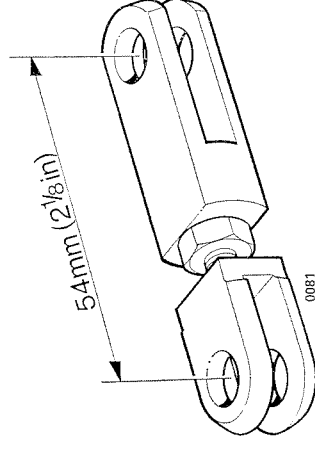
18. Withdraw the brake rod forwards through the guide grommet.

##### Refitting

19. Reverse 15 to 18 above, observing the brake linkage adjustment procedure detailed below.

##### Adjustment

1. Ensure that the adjustable link between the brake operating lever and the rear relay lever measures 54 mm ( $2\frac{1}{8}$  in) between clevis pin centres.
2. Adjust the brake shoes. 70.45.18 — Items 37 and 38.
3. With the hand brake released and the cable adjustment relieved, ensure that the front relay lever is held in the off position.
4. Fit the brake rod to take up the distance between the front relay lever held in the off position and the rear relay lever in the off position with any play taken up.
5. Take up play in hand brake cable.
6. Operate the hand brake several times to centralise the brake shoes.
7. Recheck for correct shoe adjustment.



TRANSMISSION BRAKE ASSEMBLY

—Adjust 37 to 41  
70.45.09  
Remove and refit — 1 to 41  
70.45.16

TRANSMISSION BRAKE SHOES

—Remove and refit 1 to 11, 26 to 41  
70.45.18

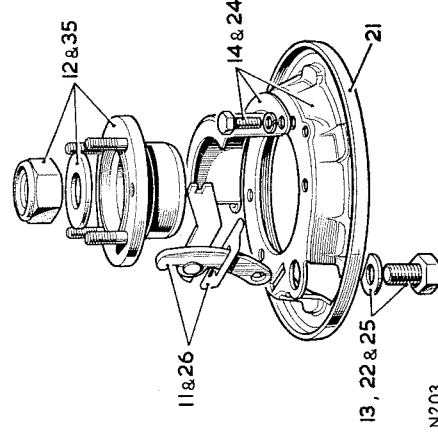
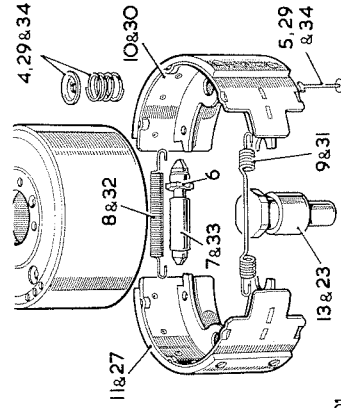
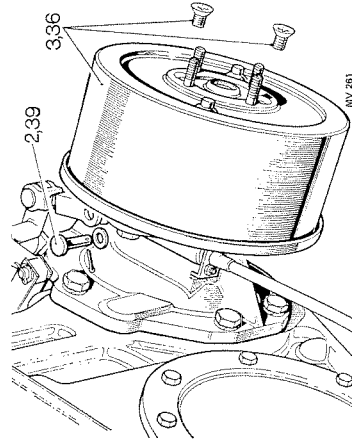
Removing

1. Disconnect the rear propeller shaft.
2. Remove the clevis pin at the expander lever.
3. Remove the brake drum.
4. **WARNING:** Do not blow out the dust in the brake drum, it is dangerous if inhaled.
5. Remove the cup washers and springs.
6. Withdraw the steady posts.
7. Spring apart the brake shoes and withdraw the adjuster.
8. Unhook and withdraw the tensioner spring.
9. Unhook and withdraw the pull off spring.
10. Withdraw the leading shoe.
11. Withdraw the trailing shoe, actuator lever and sealing shim.
12. Remove the output coupling flange.
13. Remove the pivot bolt.
14. Remove the brake backplate and oil catcher.

Inspection

15. Clean all components.
16. Examine all items for obvious signs of wear and replace with new components as necessary.
17. Examine the brake drum for scoring, ovality and skim if required. Standard diameter 184,15 mm (7.250 in). Reclamation limit: 0,76 mm (0.030 in) oversize on diameter.
18. If there is any sign of oil contamination on the brake linings, check, and if necessary, replace the rear output shaft oil seal. 37,23.01
19. Brake shoes may be re-lined, following standard practices. Re-lined shoes are also available.

continued



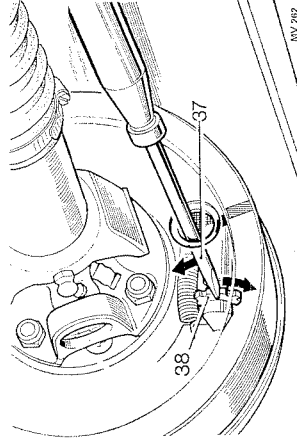
Refitting

20. Lightly coat metal to metal contact points and the adjuster threads with molybdenum disulphide grease. Avoid depositing grease on the brake linings.
21. Position the back plate on the speedometer drive housing.
22. Apply Loctite 245 grade, Rover Part No. 601168 to the pivot bolt threads.
23. Loosely fit the pivot bolt then align the back plate and oil catcher fixing holes.
24. Fit the back plate fixings. Torque loading: 3,5 kgf.m (25 lb ft).
25. Tighten the pivot bolt. Torque loading: 5,9 kgf.m (43 lb ft).
26. Fit the actuator lever and sealing shim.
27. Position the trailing shoe on the backplate.
28. Engage the actuator lever in the trailing shoe slot.
29. Fit a steady post, spring and cup washer.
30. Position the leading shoe on the backplate.
31. Fit the pull-off spring (the larger diameter spring) to the brake shoes with the hook ends towards the backplate.
32. Fit the tensioner spring with the hook end toward the backplate.
33. Pull the shoes apart and fit the adjuster assembly; adjuster wheel nearest to the leading shoe.
34. Fit the steady post, spring and cupwasher to the leading shoe.
35. Fit the output coupling flange. Torque loading for fixing nut 11,75 kgf.m (85 lb ft).
36. Fit the brake drum.
37. Turn the adjuster, using a screwdriver entered through the access hole until the brake shoes abut the drum.
38. Turn the adjuster back two divisions.
39. Connect the hand brake linkage.
40. Operate the hand brake several times to centralise the brake shoes.
41. Recheck for correct shoe adjustment.

DATA

Brake drum standard diameter  
reclamation limit

184,15 mm (7.250 in)  
0,76 mm (0.030 in)



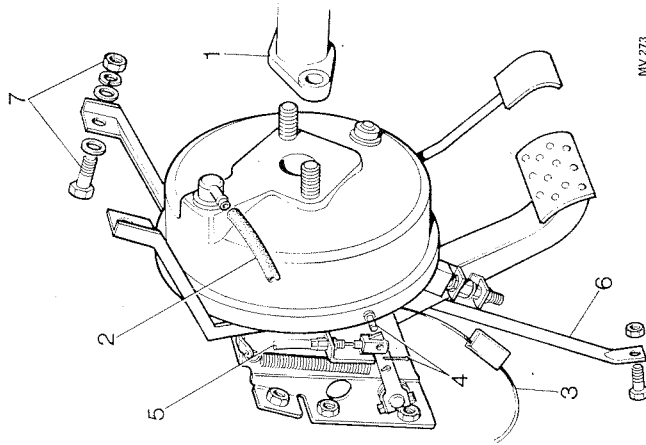
SERVO ASSEMBLY

—Remove and refit 70.50.01

Removing

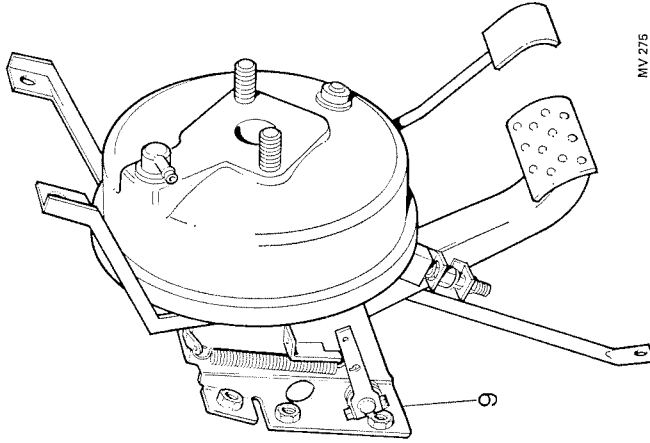
1. Remove the brake master cylinder. 70.30.08
2. Disconnect the vacuum hose from the brake servo.
3. Disconnect the leads from the stop lamp switch.
4. Disconnect the throttle cable from the throttle pedal lever.
5. Unscrew the locknut and withdraw the throttle cable from the stop bracket on the side of the pedal housing.
6. Remove the fixings securing the lower end of the support stay for the brake pedal housing.
7. Remove the fixings securing the servo support brackets to the cab front panel.
8. Remove the fixings securing the brake pedal housing to the cab front panel.

*continued*

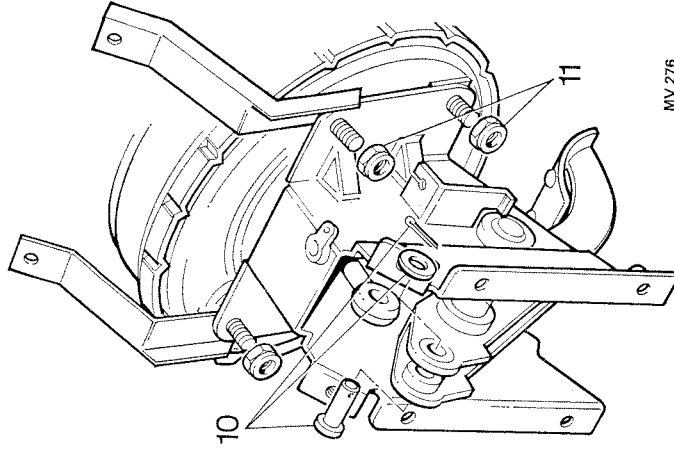


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9. Withdraw the housing complete with the brake and throttle pedals, brake servo, support stay and brackets.
10. Remove the split pin, plain washer and clevis pin securing the servo rod to the brake pedal.
11. Remove the fixings securing the servo to the pedal housing.



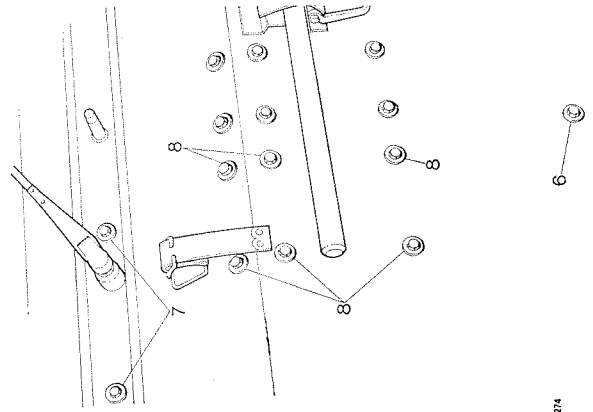
MV 275



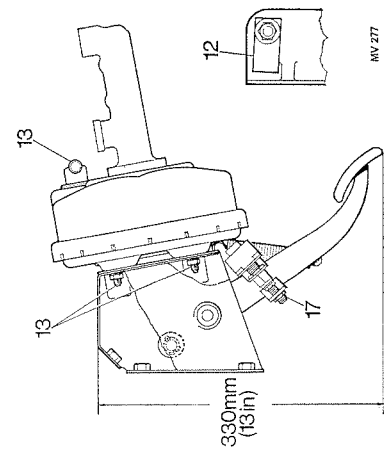
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Refitting

12. Ensure that a packing piece is fitted behind the flange of the brake pedal housing at each of the four locations for the servo mounting studs. If loose, the packing pieces should be positioned as horizontal as possible, as illustrated.
13. Secure the servo assembly, vacuum connector uppermost, to the pedal housing. Torque: 2.7 kgf.m (20 lbf ft).
14. Using a new split pin, reconnect the servo rod to the brake pedal.
15. Reverse 1 to 9.
16. Check the dimension from the top face of the pedal housing to the lower edge of the brake pedal. The correct dimension is 330 mm (13 in).
17. Adjust the pedal stop, as required, to obtain the correct dimension.
18. Bleed the brakes. 70.25.02



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SERVO ASSEMBLY

—Overhaul 70.50.06

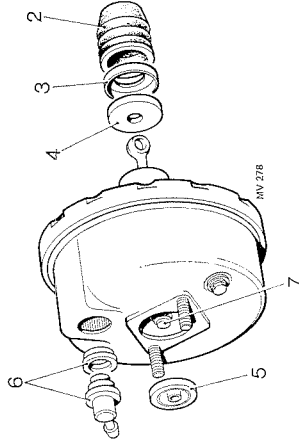
**NOTE:** Overhaul of the servo assembly is limited to the new parts supplied in the overhaul kit. If a fault develops in the main vacuum chamber, a new servo assembly must be fitted.

**Dismantling**

1. Remove the servo. 70.50.01
2. Pull back the dust cover.
3. Remove the end cap.
4. Withdraw the filter.
5. Remove the seal and plate assembly from the front shell recess.
6. Remove the non-return valve and grommet.
7. **CAUTION:** Do not attempt to remove or adjust the operating rod which is pre-set and locked at the manufacturers.

**Reassembling (using the overhaul kit complete with special grease)**

8. Lubricate the non-return valve grommet with the special grease, and fit to the front shell.
9. Fit the new non-return valve into the grommet.
10. Smear the new seal and plate assembly with the special grease and press into the front shell, ensuring the plate faces inwards.
11. Fit the new filter into the neck of the diaphragm plate.
12. Fit the new end cap.
13. Locate the new dust cover over the lugs of the rear shell.
14. Fit the servo. 70.50.01



FRONT WHEEL CYLINDERS

—Remove and refit 1 to 7 and 17 to 19 70.60.03

—Overhaul 1 to 19 70.60.11

**Removing**

1. Remove the road wheel.
2. Remove the brake drum. 70.10.02
3. Remove the front hub. 60.25.01
4. Remove the brake shoes. 70.40.02
5. Disconnect and seal off the brake fluid pipe(s).
6. Remove the bleed screw (lower cylinder only).
7. Remove the wheel cylinder.
8. Withdraw the sealing ring.

**Dismantling**

9. Withdraw the dust cover.
10. Withdraw the piston and seal.
11. Withdraw the spring.
12. Remove and discard the piston seal.

**Inspecting**

13. Clean all components in clean brake fluid and allow to dry.
14. Inspect the cylinder bore and piston for corrosion, scores and wear. If any component is unsatisfactory, replace the wheel cylinder assembly complete.
15. Provide new seals and dust covers from the wheel cylinder overhaul kit.

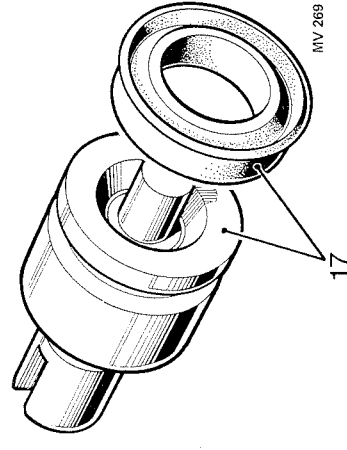
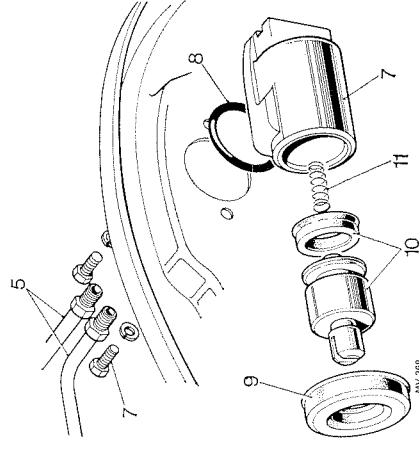
**Reassembling**

16. Lubricate the piston and seal, using clean brake fluid.
17. Reverse 8 to 11. Fit the piston seal with the lipped side away from the slotted end.

**Refitting**

18. Reverse 1 to 8 and include the following torque settings:

Cylinder securing bolts 1,1 to 1,3 kgf.m (8 to 10 lbf ft)	
Bleed screw	0,7 to 1,0 kgf.m (5 to 7 lbf ft)
Fluid pipe unions	0,7 to 1,0 kgf.m (5 to 7 lbf ft)
19. Bleed the brakes. 70.25.02	
20. Adjust the brakes. 70.25.03	



REAR WHEEL CYLINDER

—Remove and refit 1 to 5 and 16 to 18 70.60.18

—Overhaul 1 to 18 70.60.26

Removing

1. Remove the road wheel.
2. Remove the brake drum. 70.10.03
3. Remove the rear hub. 64.15.01
4. Remove the brake shoes. 70.40.03
5. Disconnect and seal off the brake fluid pipe.
6. Remove the wheel cylinder.

Dismantling

7. Withdraw the dust covers.
8. Withdraw the pistons and seals.
9. Withdraw the spring and seal supports.
10. Remove the bleed screw.

Inspecting

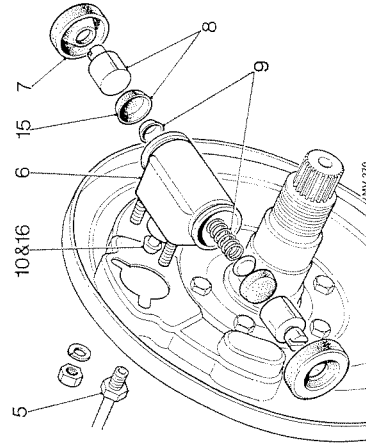
11. Clean all components, using clean brake fluids allow to dry.
12. Inspect the cylinder bore and piston for corrosion, scores and wear. If any component is unsatisfactory, replace the wheel cylinder assembly complete.
13. Provide new seals and dust covers from the wheel cylinder overhaul kit.

Assembling

14. Lubricate the components, using clean brake fluid.
15. Reverse 7 to 9. Fit the piston seal with the lipped side away from the slotted end.
16. Fit the bleed screw, do not overtighten. Torque: 0,7 to 1,0 kgf.m (5 to 7 lbf ft).

Refitting

17. Reverse 1 to 6, and include the following torque settings:  
 Cylinder securing nuts 1,1 to 1,3 kgf.m (8 to 10 lbf ft)  
 Fluid pipe union 0,7 to 1,0 kgf.m (5 to 7 lbf ft)
18. Bleed the brakes. 70.25.02
19. Adjust the brakes. 70.25.03



WHEELS AND TYRES OPERATIONS		
Wheels	.. .. .	74-2
Wheel steps	.. .. .	74-2
Wheel tolerance	.. .. .	74-2
Wheel and tyre balance	.. .. .	74-2
Tyres	.. .. .	74-2
Tyre—remove and refit	.. .. .	74.10.02

**Wheels**

Pressed steel, 16 in wheels, 6.5 L rim type, 6-stud fixing are fitted.

Wheel nuts should be torqued to 10,3 to 11,7 kgf.m (75 to 85 lbf ft).

Special wheel nuts fitted only to the front wheels provide facility for the attachment of front wheel steps or tread plates.

**Wheel steps**

Two types of front wheel steps are available. The differences are in the tread pattern, and, more important, in the stud holes which are either pierced or plunged, as illustrated.

The upper illustration (pierced hole type), shows the securing nut fitted with its tapered face adjacent to the wheel step. With this type of step the securing nut may also be fitted with the flat face adjacent to the step.

The lower illustration (plunge hole type) shows the securing nut again fitted with its tapered face adjacent to the wheel step. With this type of step the flat face of the securing nut **must not** be offered to the step but must be fitted as shown.

**Wheel tolerance**

**Wobble:** The lateral variation measured on the vertical inside face of the flange should not exceed 0.090 in (2,28 mm).

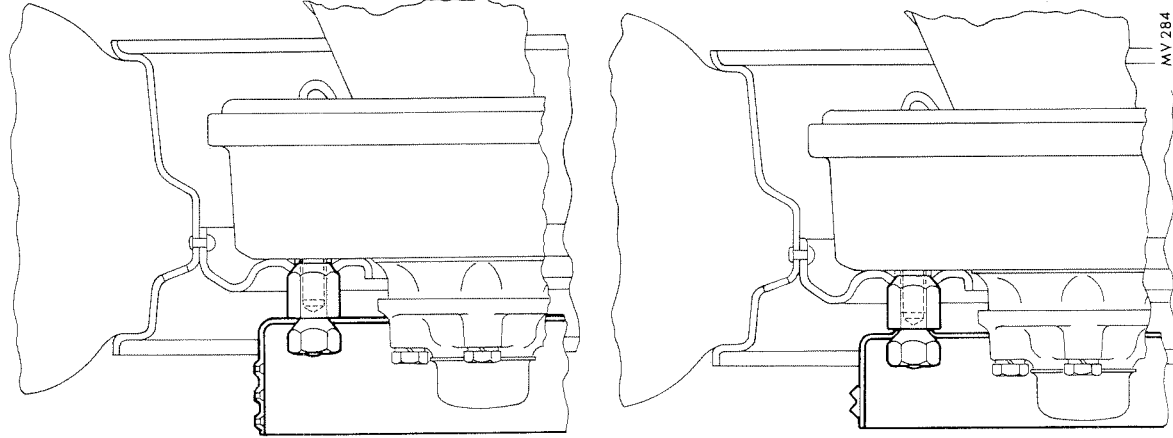
**Eccentricity:** On a truly mounted and revolving wheel the difference between high and low points measured on either rim ledge should not exceed 0.090 in (2,28 mm).

**Wheel and tyre balance**

Wheels and tyres are not balanced during production assembly as balancing is not found to be necessary due to quality control specifications and vehicle suspension/geometry design.

**Tyres**

900 x 16, cross-country tread, 6-ply, tubed.



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**TYRE****—Remove and refit**

74.10.02

**Re-fitting**

The following instructions assume the use of standard hand tools, namely: a tyre bead breaker (slide hammer type), tyre levers and a heavy rubber hammer.

**Removing**

1. Remove the wheel from the vehicle and remove the valve core.

2. Lay the wheel and tyre on the ground ensuring that the inner side of the wheel is uppermost.

3. Using the tyre bead breaker move progressively round the periphery of the tyre bead gradually easing the tyre bead into the well of the rim. In performing this task always place the tyre breaker into the bead area and avoid striking the wheel rim.

4. When the bead is clear of the rim shoulder, turn the wheel over and press the valve of the inner tube clear of the wheel. Repeat the bead breaker procedure on the outboard side and again ease the bead into the well of the rim.

5. Using the tyre levers on the outboard side of the wheel carefully ease the tyre outer bead clear of the wheel rim.

**NOTE:** That the bead should be eased clear, not forced clear as the use of excessive force may damage the bead and/or the wheel rim. Excessive effort should not be necessary if removal is commenced with both beads in the rim well. Once a segment of the tyre bead is clear of the rim, use of a rubber hammer will facilitate total removal and avoid the possibility of strained or cut beads occasioned by over-zealous use of tyre levers.

6. When the outer tyre bead is clear of the rim, withdraw the inner tube.

7. Again using the tyre levers and/or the rubber hammer, ease the tyre inner bead over the wheel outer rim. Notice that both tyre beads are drawn over the wheel outer rim. Never attempt, on this vehicle, to remove or fit a tyre over the wheel inner rim.

8. Ensure that the wheel rim is clean and that all rust and burrs are removed from the rim ledges.

9. Smear the wheel rims and tyre beads with a soapy solution, or, if available, proper lubricant for this purpose. Do not use vehicle grease or oil. If no lubricant is available use water liberally.

10. Offer the tyre to the outboard rim of the wheel, and using tyre levers and/or the rubber hammer ease the tyre bead into the well of the rim.

**NOTE:** If tyres of mono-direction type tread pattern are to be fitted, it is essential that they are mounted to obtain proper directional rotation.

11. Lay the inner tube in the tyre avoiding twisting and ensure that the valve stem engages its location in the road wheel.

12. Ease the remaining bead into position. If using tyre levers take particular care to avoid 'nipping' the inner tube and cutting the bead.

13. Inflate the tyre, ensuring that fingers are kept clear of bead and rim. To obtain proper seating of the beads to the rims it is usually necessary to inflate to above normal operating pressure. For this reason facilitate release of pressure when the beads are in position.

14. Fit the valve core and inflate to recommended pressure.

15. Examine the tyre guide markings (raised circumferential lines adjacent to the wheel rims) to check concentricity. Absence of parallelism between guide lines and rim periphery is indicative of incorrect fitting.

BODY

BODY OPERATIONS

Body—remove and refit . . . . .	76.10.11
Body repairs—general information . . . . .	76.00.00
Cab—remove and refit . . . . .	76.10.10
Chassis frame—alignment check . . . . .	76.10.02
Door glass—remove and refit . . . . .	76.31.01
Door glass and frame assembly—remove and refit . . . . .	76.31.49
Door hinge—remove and refit . . . . .	76.28.42
Door lock—remove and refit . . . . .	76.37.12
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Front seat—driver—remove and refit . . . . .	76.70.04
Front seat—passenger—remove and refit . . . . .	76.70.05
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Windscreen glass—remove and refit . . . . .	76.81.03



## BODY REPAIRS

—General information 76.00.00

## Body panels

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.

## Panel beating 'Birmabright'

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. 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. 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. 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'

4. 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 (0.048 in) sheet, and a No. 3 for 16 swg (0.064 in) sheet.
5. The flame should be smooth, quiet and neutral and have a brilliant inner core with a well defined, rounded end. 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.
6. A slightly reducing flame 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 to orange envelope.
7. Do not use an oxydising flame, which has a short pointed inner core bluish white with a bluish envelope.
8. Use only 5 per cent magnesium/aluminium welding rod (5 Mg/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.

9. Clean off all grease and paint, dry thoroughly then clean the edges to be welded, and an area at least half an inch 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.

10. A special acid flux must be used, and we recommend 'Hari-Kari' which is obtainable from:

The Midland Welding Supply Co. Ltd.,  
105 Laakey Lane,  
Birmingham 28, England.

or

'Sif-flux Aluminium' which is obtainable from:  
Suffolk Iron Foundry (1920) Ltd.,  
Sifbronze Works,  
Stowmarket, England.

11. 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 the case of Sifbronze Special Flux, use in powder form as directed. 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.

12. 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.



N468

continued

13. 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.

14. 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 patching**

15. 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.

16. 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 (2 in to 4 in) 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.

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

18. 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 (0.030 in) between it and the panel, and then weld as described above. Never apply an 'overlay' patch.

**Electric welding**

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

20. At the Rover Factory the 'Argon-Arc' process is used, all atmospheric oxygen being excluded from the weld by the Argon gas shield. For all body repair work normally undertaken is quite satisfactory.

**Spot-welding**

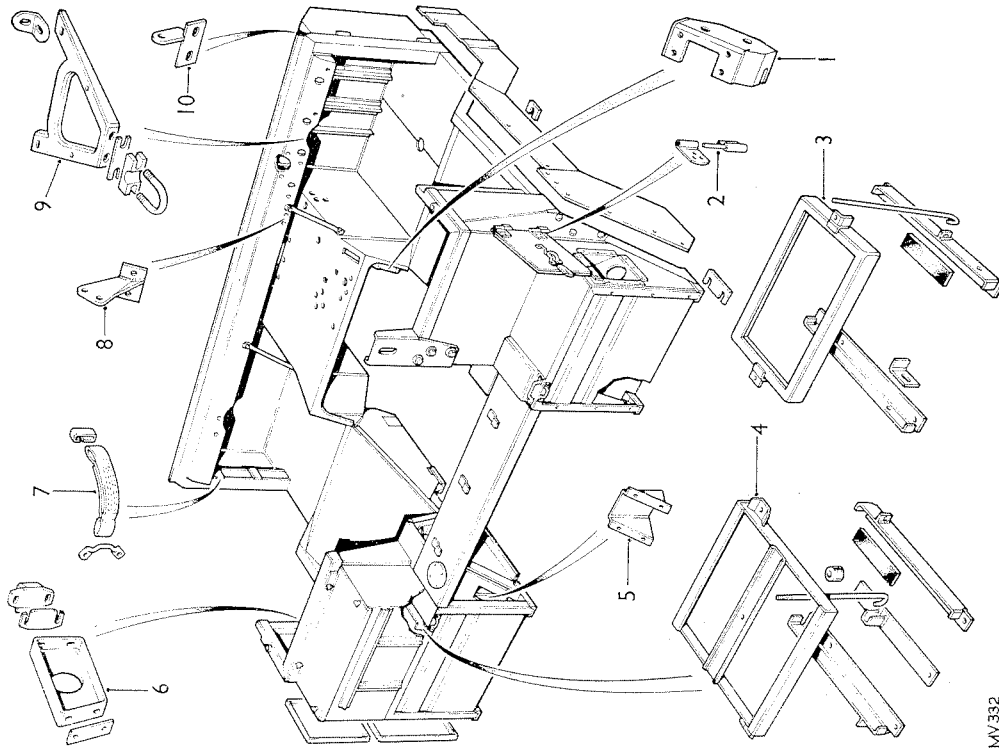
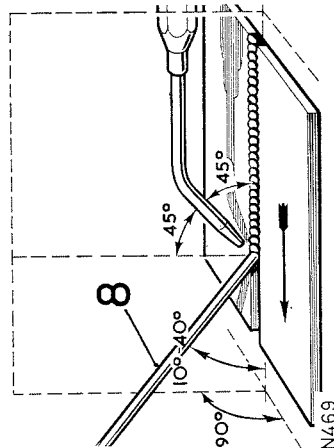
21. Spot-welding is largely used in the manufacture of Land-Rover bodies, but this is a process which can only be carried out satisfactorily by the use of the proper apparatus. Aluminium and its alloys are very good conductors of heat and electricity, and thus it is most important to maintain the right 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**

22. 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.

**Painting 'Birmabright'**

23. Refer to the procedure detailed in Section 78 (Paintwork) of this Manual.

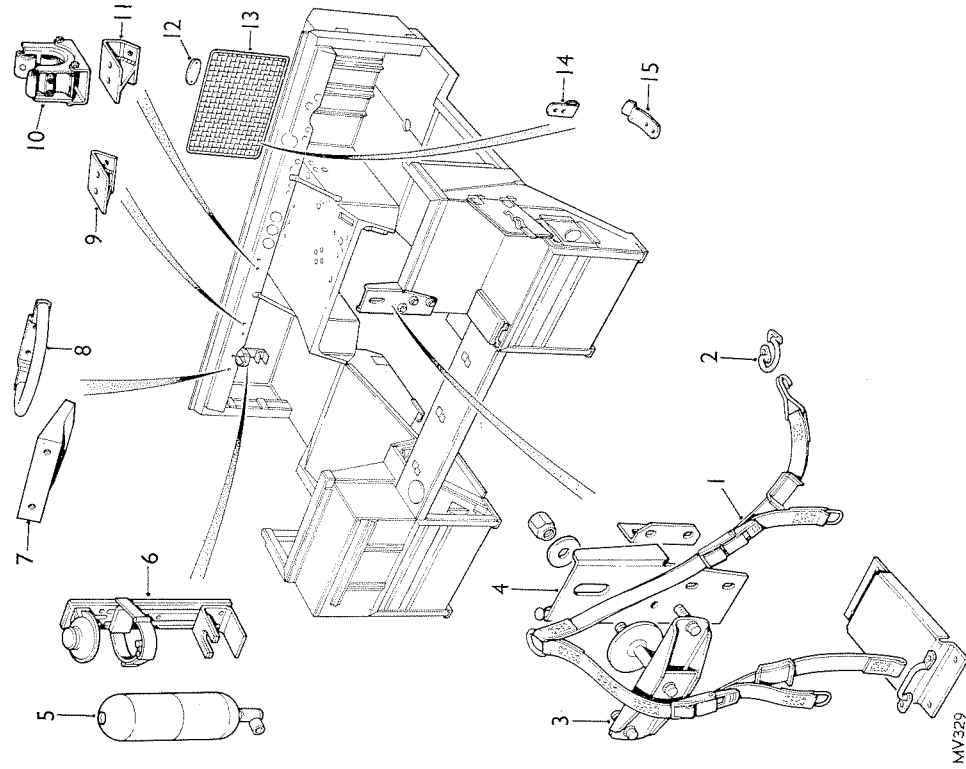


Cab assembly and battery frames

**Key**

- 1 Bracket—handbrake
- 2 Hinge—spare wheel access
- 3 Battery carrier—12 volt
- 4 Battery carrier—24 volt
- 5 Cover—air cleaner
- 6 Bracket—door striker
- 7 Check strap—door
- 8 Bracket—clutch-brake reservoirs
- 9 Bracket—steering column
- 10 Bracket—windscreen

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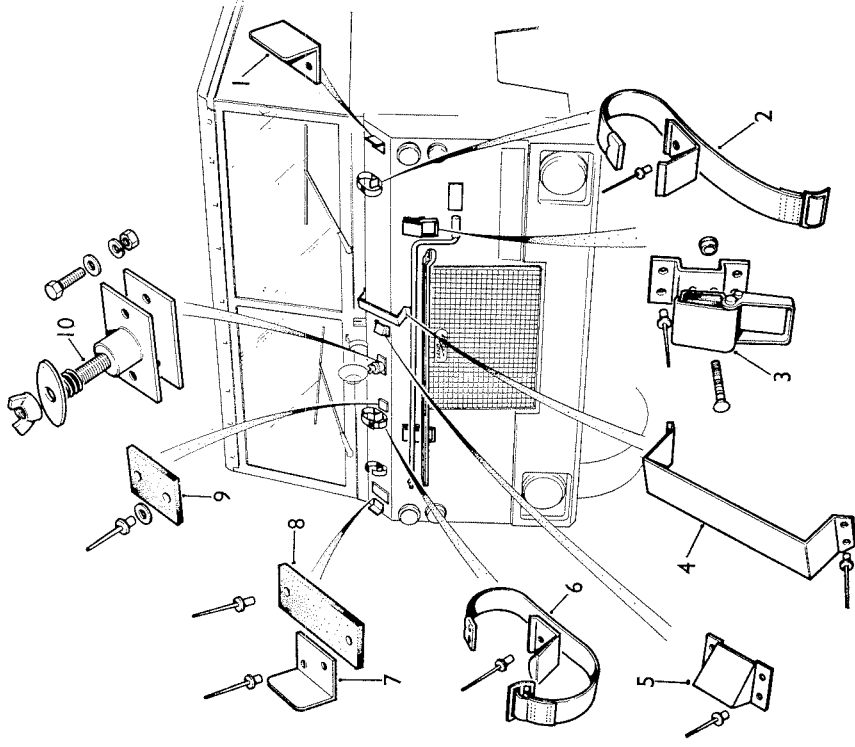


MV329

Cab assembly—spare wheel mountings, fire extinguisher and small arms clip

Key

- 1 Strap—spare wheel
- 2 Hook—spare wheel strap
- 3 Retainer—spare wheel
- 4 Spare wheel mounting bracket
- 5 Fire extinguisher
- 6 Fire extinguisher bracket
- 7 Bracket—wiper motor
- 8 Grab handle
- 9 Bracket—outer } small arms clips
- 10 Clip
- 11 BK1 inner
- 12 Badge
- 13 Hook—grille
- 14 Clip—grille
- 15

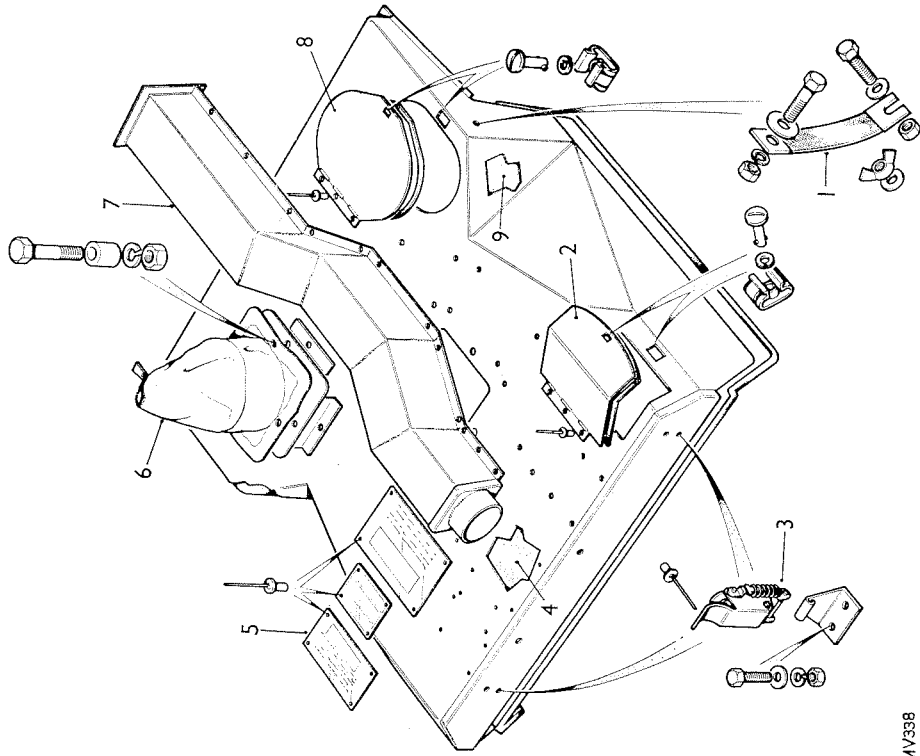


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CAB—TOOL STORAGE

Key

- 1 Stop bracket—spade
- 2 Strap—spade
- 3 Clip—starting handle
- 4 Bracket—spade
- 5 Bracket—pickaxe head
- 6 Strap—pickaxe shaft
- 7 Stop bracket—pickaxe shaft
- 8 Pad—pickaxe shaft
- 9 Pad—pickaxe head
- 10 Securing bracket—pickaxe head

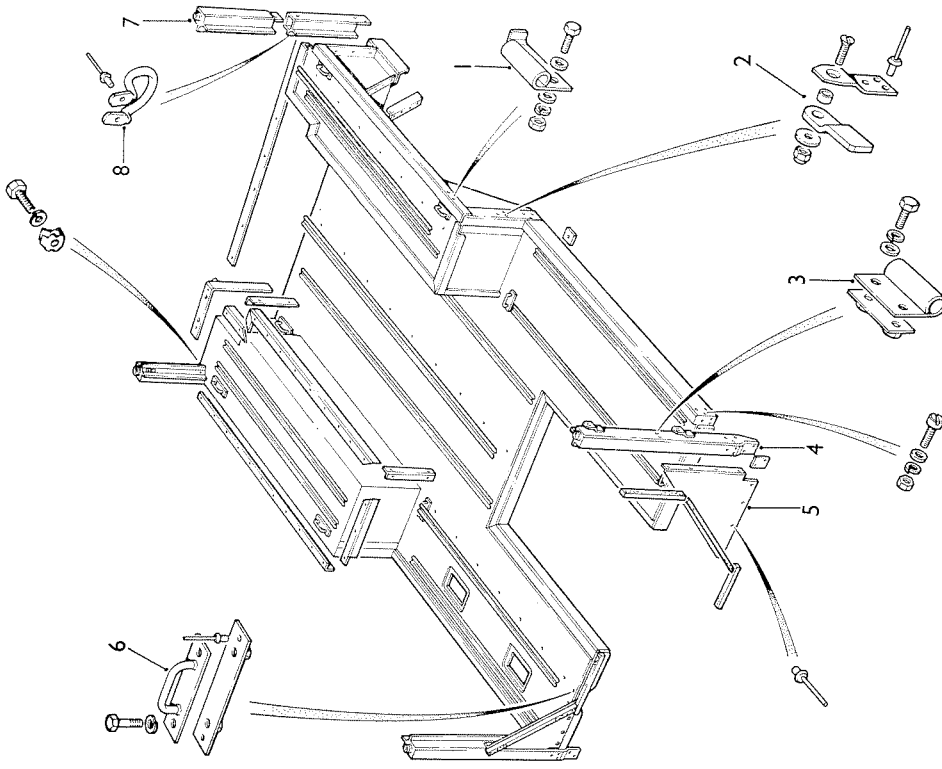


MV338

ENGINE COVER ASSEMBLY

Key

- 1 Bonding lead
- 2 Access panel—radiator cap
- 3 Clips—cover securing
- 4 Inner lining—cover insulation
- 5 Warning/instruction plates
- 6 Gaiter—gear lever
- 7 Duct—heater
- 8 Access panel—oil filler cap
- 9 Inner lining—cover insulation

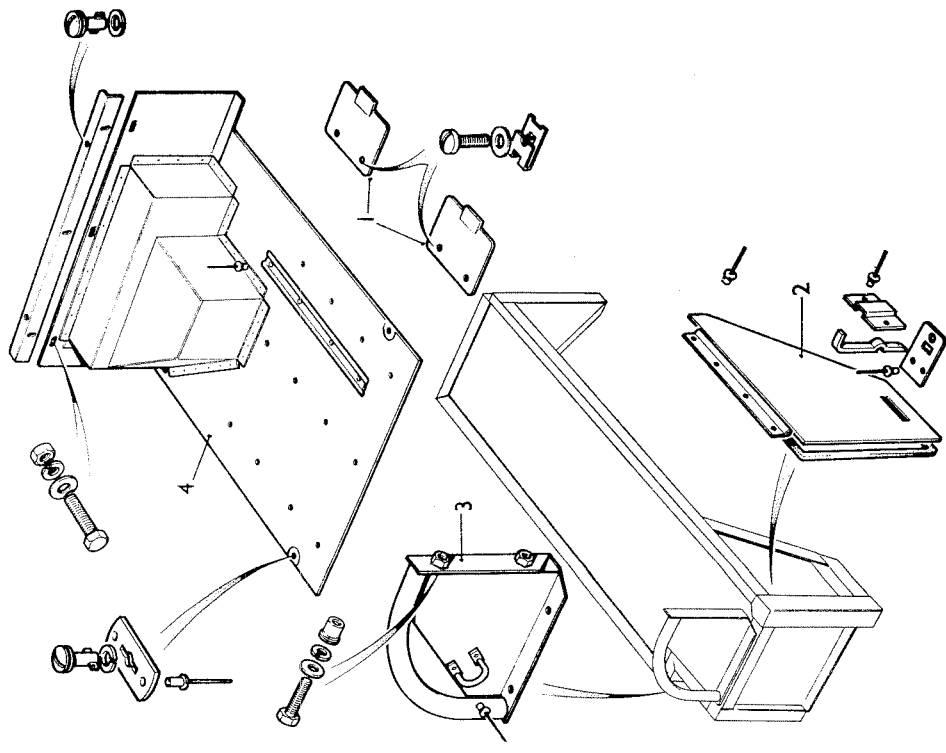


MV333

BODY FRAME

Key

- 1 Hinge—bodyside—upper
- 2 Drop catch—bodyside—lower
- 3 Hinge—bodyside—upper
- 4 Pillar—front
- 5 Stiffener panel—front pillar
- 6 Cleat—lashing
- 7 Pillar—rear—upper
- 8 Rope-hook

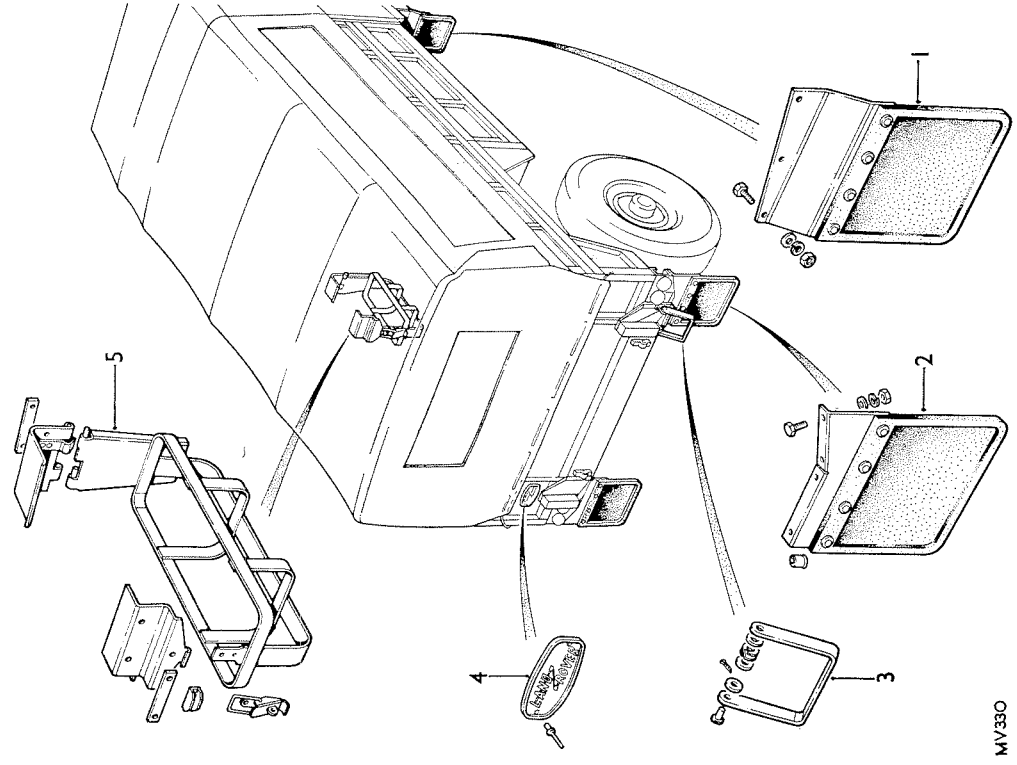


MV336

BODY—FLOOR PANEL

Key

- 1 Access panels—fuel tank
- 2 Door—locker
- 3 Stiffener and handrail—rear pillar
- 4 Floor panel—gearbox access

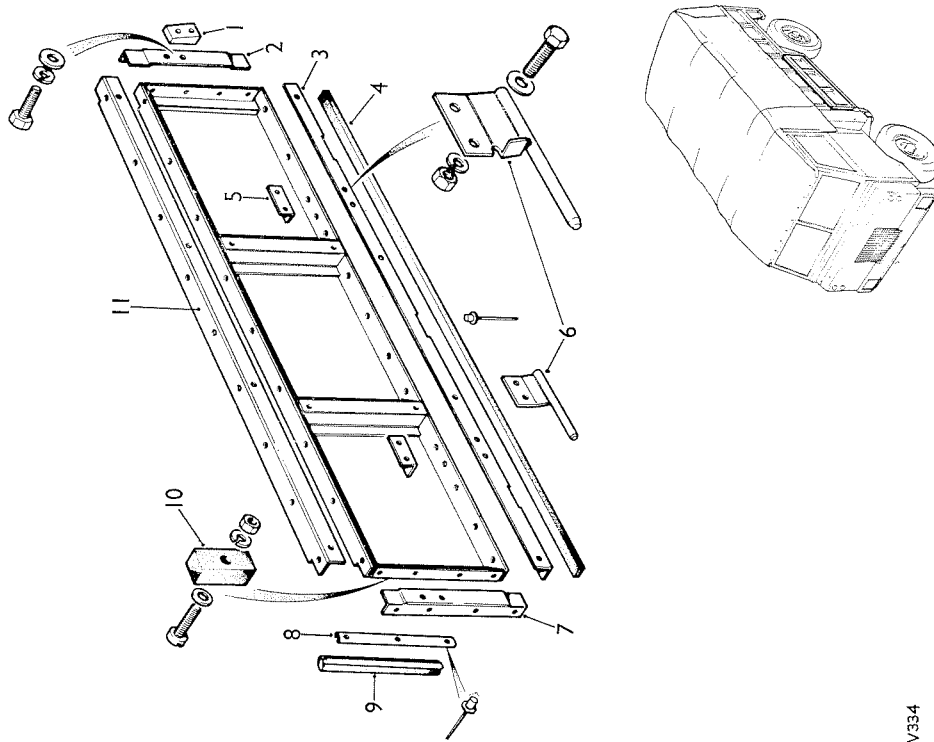


MV330

Body—mudflaps, rear step and jerry-can holder

Key

- 1 Mudflap—front
- 2 Mudflap—rear
- 3 Rear step
- 4 Badge
- 5 Carrier—jerry-can

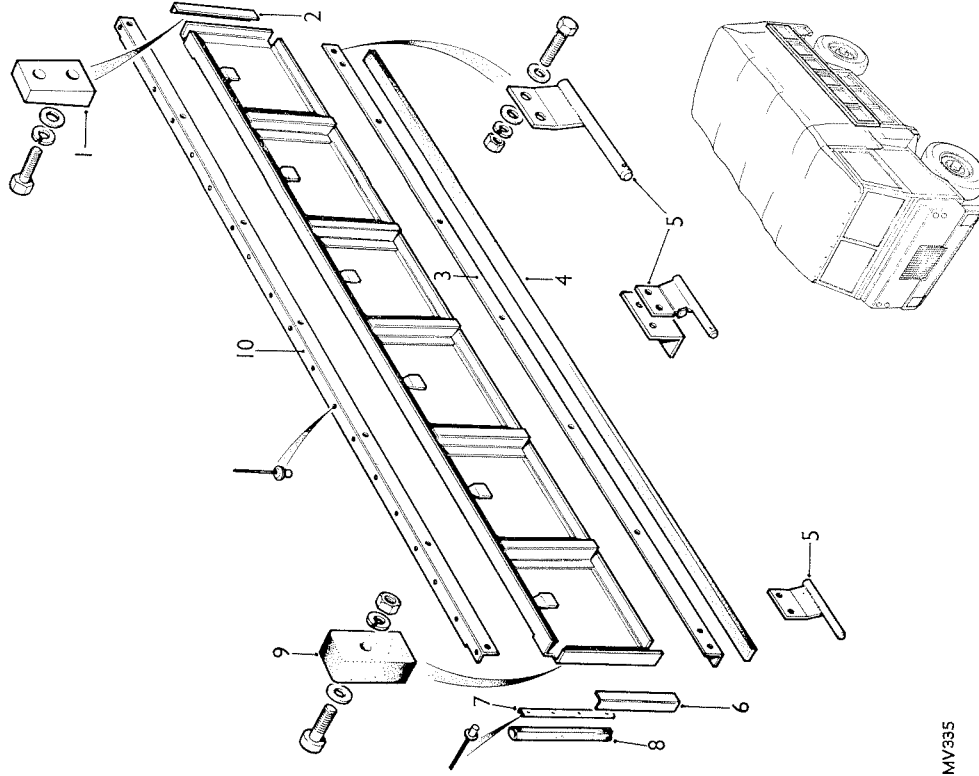


MV334

BODY—SIDE—LOWER ASSEMBLY

Key

- 1 Striker plate
- 2 Capping—side
- 3 Capping—bottom
- 4 Seal—bottom
- 5 Stiffening angle—hinge
- 6 Hinge
- 7 Capping—side
- 8 Seal retainer—side
- 9 Seal—side
- 10 Buffer
- 11 Capping—top

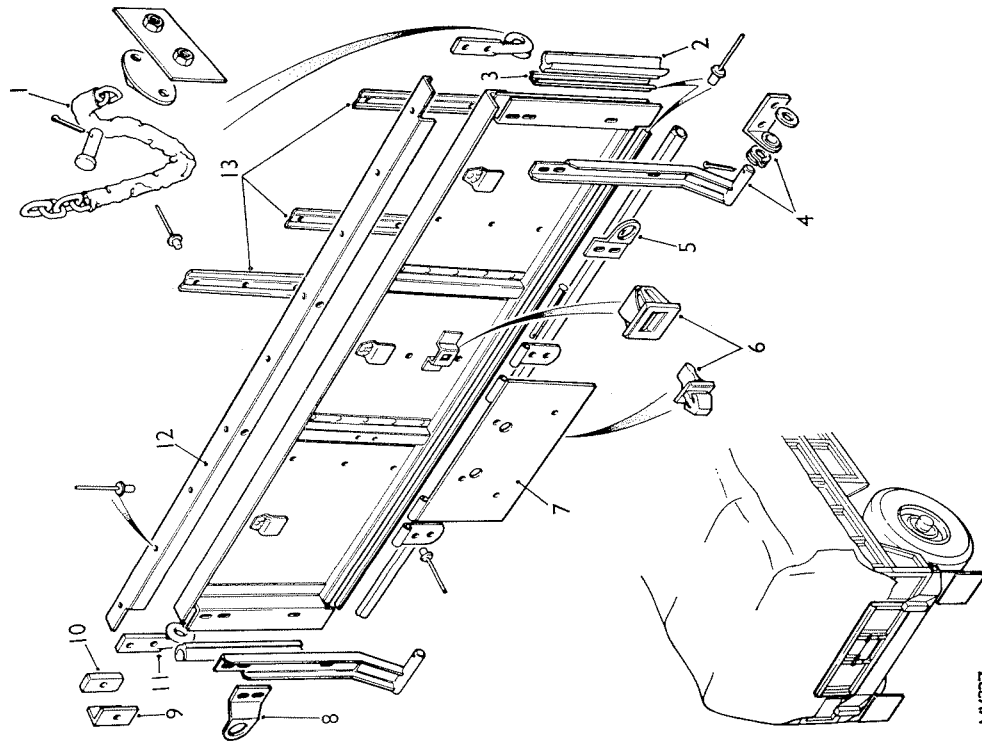


MV335

BODY—SIDE—UPPER ASSEMBLY

Key

- 1 Striker plate
- 2 Capping—side
- 3 Capping—bottom
- 4 Seal—bottom
- 5 Hinge
- 6 Capping—side
- 7 Seal retainer—side
- 8 Seal—side
- 9 Buffer
- 10 Capping—top



MV337

TAILBOARD ASSEMBLY

Key

- 1 Hook and chain
- 2 Seal—side
- 3 Seal retainer—side
- 4 Hinge
- 5 Plate—locking
- 6 Catch—number plate
- 7 Number plate

- 8 Plate—locking
- 9 Bracket—buffer
- 10 Buffer
- 11 Chain-hook
- 12 Capping—top
- 13 Treadplates

CHASSIS FRAME

Alignment Check

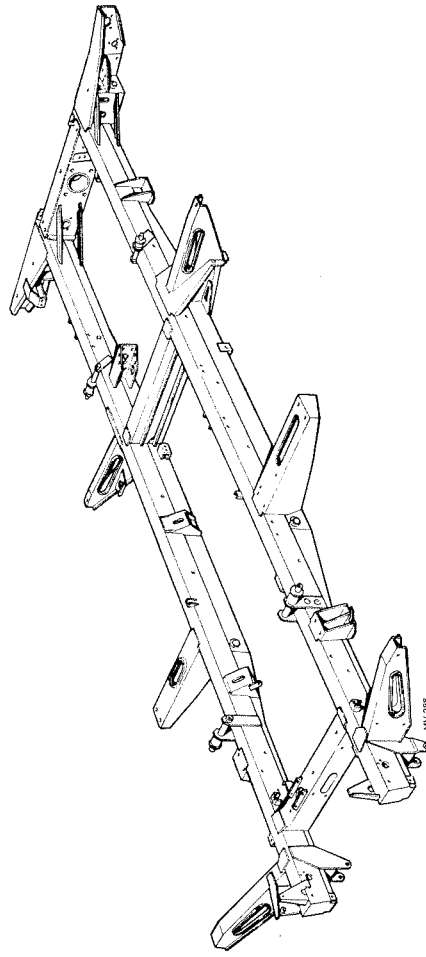
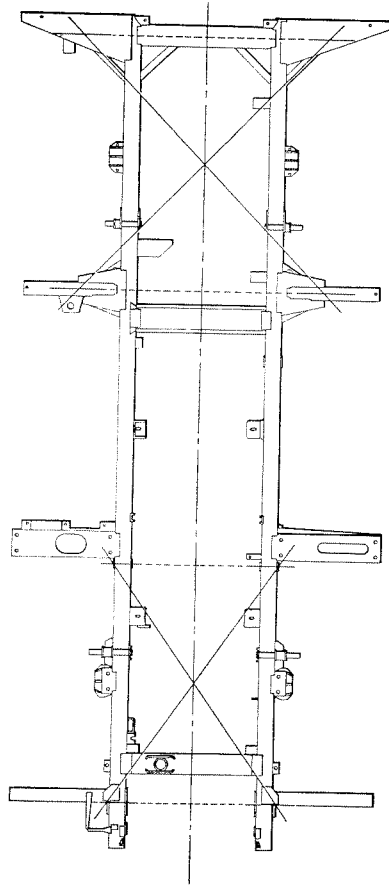
76.10.02

Procedure

With the vehicle assembled, chassis alignment checks can be made as follows:

1. Position the vehicle on a flat, level surface.
2. Drop a plumb-bob from the external centre point of each of the eight fixed shackle pin locations.

3. Carefully chalk the floor directly below each plumb-bob centre point.
4. Move the vehicle clear of the marked areas.
5. Check the diagonal measurements as illustrated. Differences between corresponding diagonals or failure to produce a straight longitudinal axis connecting the diagonal intersections will record misalignment.



CAB

—Remove and refit

76.10.10

1. Remove the battery/batteries. 86.15.01
2. Remove the doors. 76.28.01
3. Remove the steering wheel. 57.60.01
4. Remove the steering column and box assembly. 57.45.01

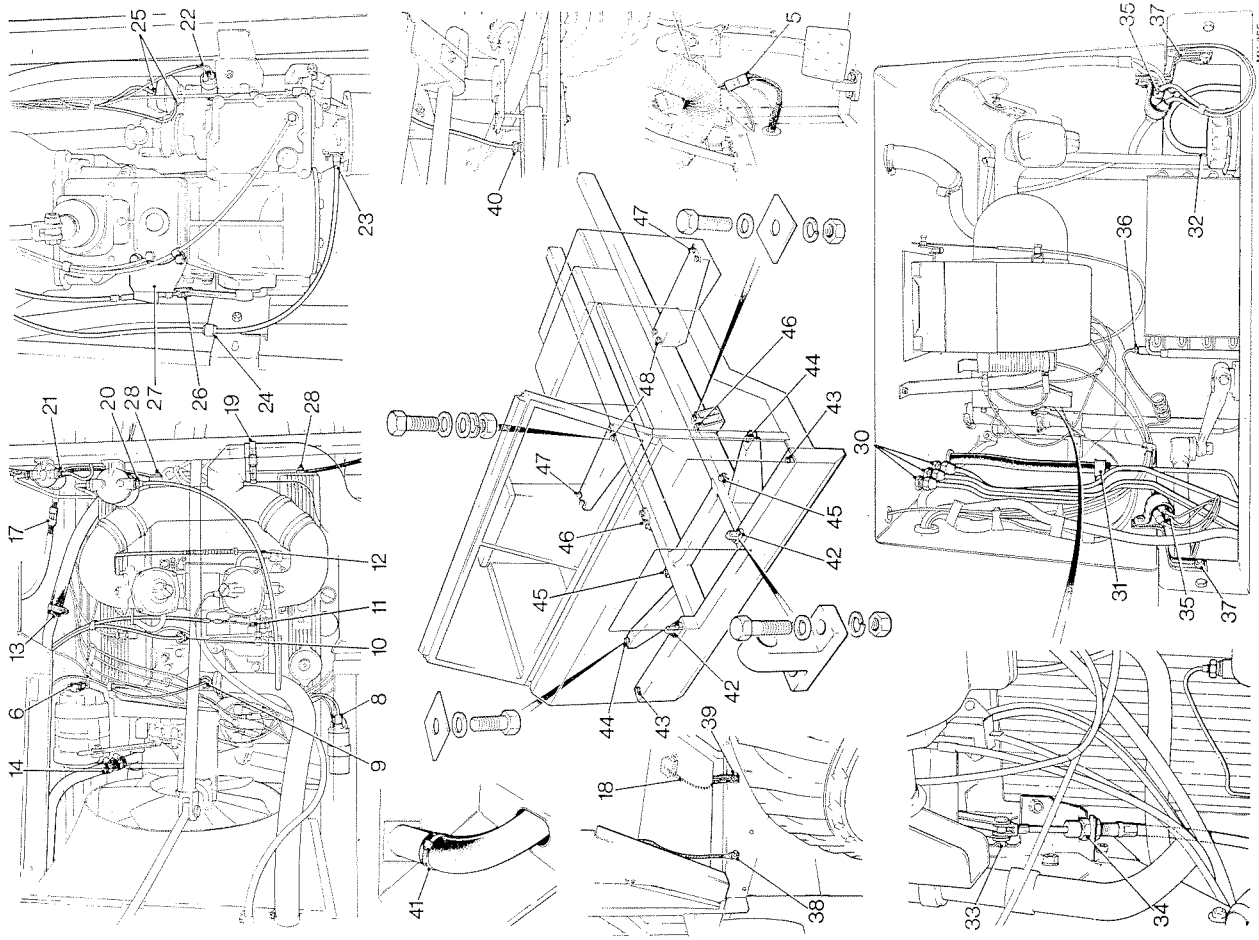
Removing

5. Disconnect the multi-plug beneath the instrument panel. Detach the grommet and feed the harness through the cab entry point.
6. Remove the engine cover assembly.
7. Disconnect the harness from the alternator.
8. Disconnect the coil HT and LT leads.
9. Unscrew and disconnect the water temperature capillary from the induction manifold.
10. Disconnect the differential lock vacuum pipe (black) from the induction manifold.
11. Disconnect the choke cable from the carburetters.
12. Disconnect the throttle cable from the carburetters.
13. Disconnect the rear heater hose from the pipe beneath the cab floor.
14. Disconnect the heater hose from radiator to induction manifold at the bottom hose junction.
15. Remove the spare wheel.
16. Remove the cover from the body floor above the gearbox.
17. Disconnect the multi harness plug.
18. Disconnect the earth lead from the starter relay bracket on the splash plate.
19. Slacken the clip and detach the air hose from the carburetter trunking.
20. Disconnect the outlet pipe from the fuel filter.
21. Disconnect the inlet pipe from the fuel sediment bowl.
22. Disconnect the two 'Lucar' connectors from the differential lock switch on the gearbox.
23. Disconnect the speedometer cable from the gearbox.
24. Detach the clip securing the speedometer cable to the gearbox mounting bracket.
25. Disconnect the two pipes (one red, one white) from the differential lock.
26. Disconnect the cable (green) from the auxiliary gearbox.
27. Remove the bracket securing the auxiliary gearbox cable to the gearbox.
28. Disconnect the generator panel bonding strap from the engine (24 volt only).
29. Remove the front grille.
30. Disconnect the three brake pipes.  
**CAUTION:** Avoid spillage of brake fluid.
31. Disconnect the brake servo hose.
32. Disconnect the hose from the overflow bottle.
33. Disconnect the handbrake inner cable from the lever.
34. Disconnect the handbrake outer cable from the bracket.

35. Disconnect the six connectors (three each side) from the headlamp leads.
36. Unscrew the engine oil temperature capillary from the oil cooler.
37. Disconnect the two bonding leads (one each side) from the front bumper (24 volt only).
38. Disconnect the battery earth lead from the No. 2 outrigger.
39. Disconnect the shunt box bonding lead from the No. 2 outrigger (24 volt only).
40. Detach the axle breather pipe from the front axle tube.
41. Slacken the clip and disconnect the fuel filler hose from the tank.
42. Remove the four bolts securing the cab and the helicopter lifting eyes to the No. 1 crossmember.
43. Remove the two bolts securing the cab to the No. 1 crossmember.
44. Remove the two bolts securing the cab to the No. 1 outrigger.
45. Remove the two bolts securing the cab to the front mounting bracket on the longitudinal.
46. Remove the four bolts securing the cab to the rear mounting bracket on the longitudinal (24 volt vehicles only. Detach the coil filter unit bonding lead).
47. Remove the four bolts securing the cab to the outer holes on the No. 2 outrigger.
48. Remove the four bolts securing the cab to the inner holes on the No. 2 outrigger.
49. Lift off the cab, noting the location of shims (if any) fitted between the cab and the chassis.

Refitting

50. Reverse instructions 1 to 49, fitting shims between the cab and the chassis as required.
51. Bleed the brakes. 70.25.02

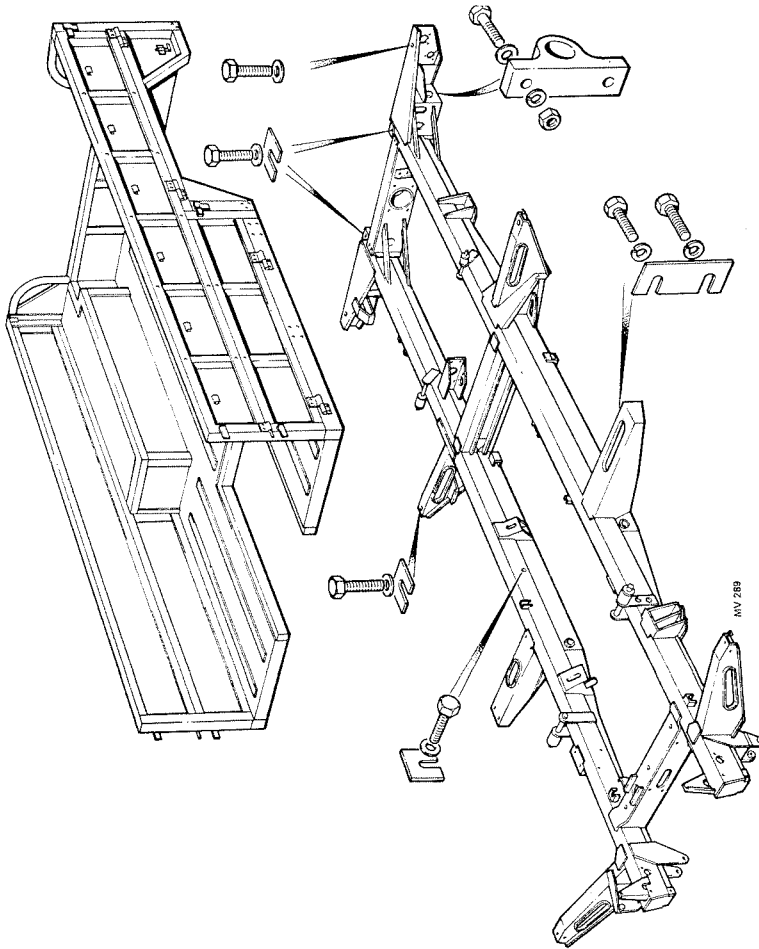




5. Remove the twelve bolts, plain washers, spring washers and nuts securing the body to the chassis and crossmembers. Note the locations of the shims to ensure refitting in their original positions.
6. Disconnect the number plate feed wire from the socket on the chassis rear crossmember.
7. Lift the body clear of the chassis.

**Refitting**

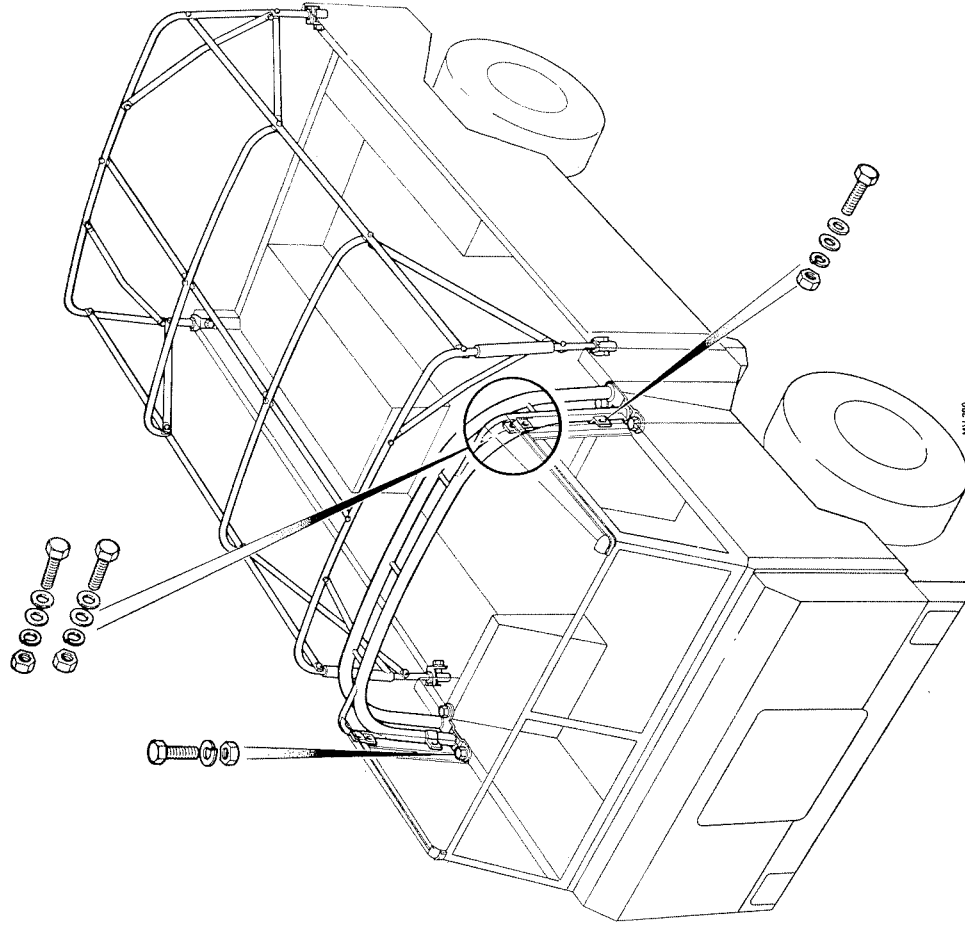
8. Reverse instructions 1 to 7.



- ROLL-OVER BAR**
- Remove and refit** 76.10.44
- Removing**
1. Release the hood from the tailgate, roll-over bar and windscreen external hooks.
  2. Peel the hood rearward clear of the roll-over bar.
  3. Release the spare wheel strap.

**Refitting**

7. Reverse instructions 1 to 6.



**DOOR**

**—Remove and refit**

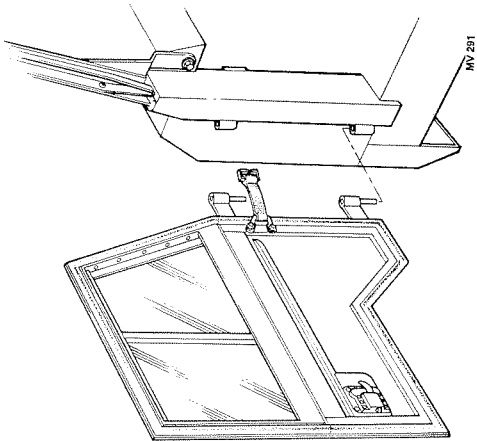
76.28.01

**Removing**

1. Release the check strap from the bracket on the cab post.
2. Lift the door from its hinges.

**Refitting**

3. Reverse instructions 1 and 2.



MV 201

**DOOR HINGE**

**—Remove and refit**

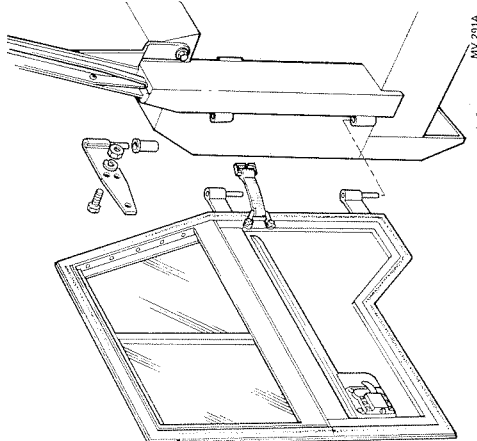
76.28.42

**Removing**

1. Remove the door (see 76.28.01).
2. Remove the three bolts, spring washers and nuts securing the hinge to the door.
3. Remove the bushes from the welded hinge bracket on the body (if necessary).

**Refitting**

4. Reverse instructions 1 and 2. Renew the hinge bracket bushes (if removed).



MV 201A

**DOOR GLASS**

**—Remove and refit**

76.31.01

**Removing**

1. Remove the doors from the vehicle (see 76.28.01).

**Sliding glass**

2. Remove the screw and rubber stop from the front end of the sliding glass top channel.
3. Remove the remaining five screws securing the sliding glass top channel and two filler strips to the door frame; these screws are located in the channel well.
4. Ease the top of the sliding glass complete with channel inwards.
5. Withdraw the sliding glass and channel.
6. Remove the two filler strips.

**Fixed glass**

7. Remove the sliding glass. (Instructions 1 to 6 above).
8. Remove the screws securing the fixed glass retainer from the cab frame and detach the retainer.
9. Ease the fixed glass and top channel inward and remove.

**Refitting**

10. Thoroughly clean the fixed glass and door frame, removing all traces of sealant.
11. Apply fresh Prestik Sealing Strip or Kelseal Glasticord to the fixed glass location in the door frame.
12. Press the glass evenly and firmly into position.
13. Reverse instructions 8 to 9.
14. Remove surplus sealant.
15. Reverse instructions 1 to 7.

**DOOR GLASS AND FRAME ASSEMBLY**

**—Remove and refit**

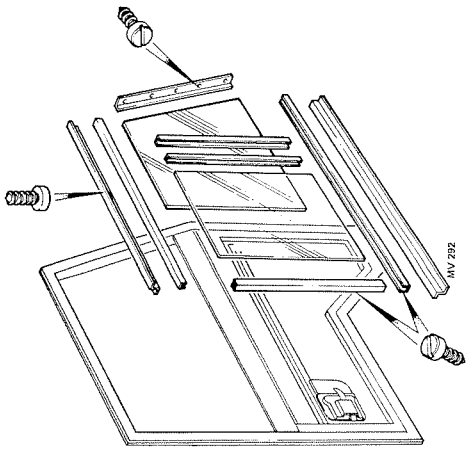
71.31.49

**Removing**

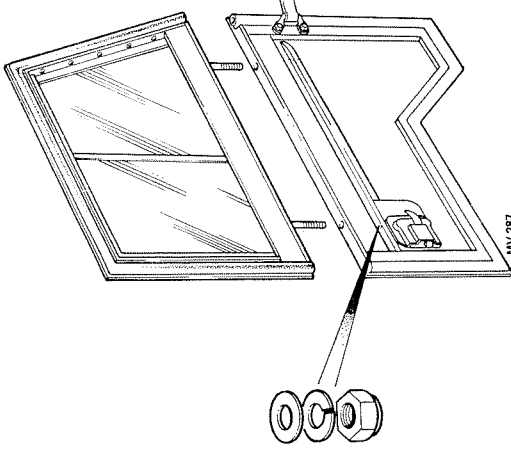
1. Remove the two nuts, spring and plain washers securing the frame to the door.
2. Lift off the frame.
3. Remove the sealing strip.

**Refitting**

4. Reverse instructions 1 to 3.



MV 202



MV 207

**DOOR LOCK**

—Remove and refit

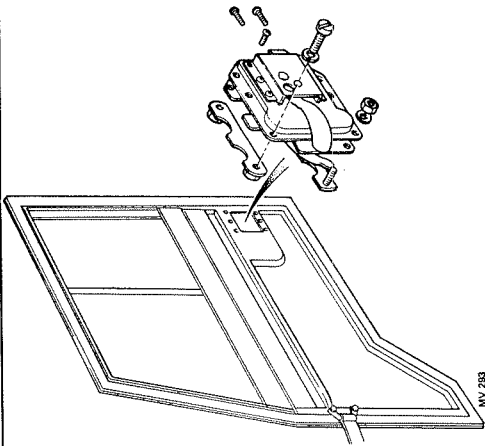
76.37.12

**Removing**

1. Remove the two screws and spring washers securing the top of the lock to the door and nut retainer plate.
2. Remove the nut retainer plate.
3. Remove the two nuts and spring washers securing the bottom of the lock.
4. Remove the screw retainer plate.
5. Remove the two screws securing the rear of the lock to the door.
6. Withdraw the door lock.

**Refitting**

7. Reverse instructions 1 to 6.



**HOOD FRAME ASSEMBLY**

—Remove and refit

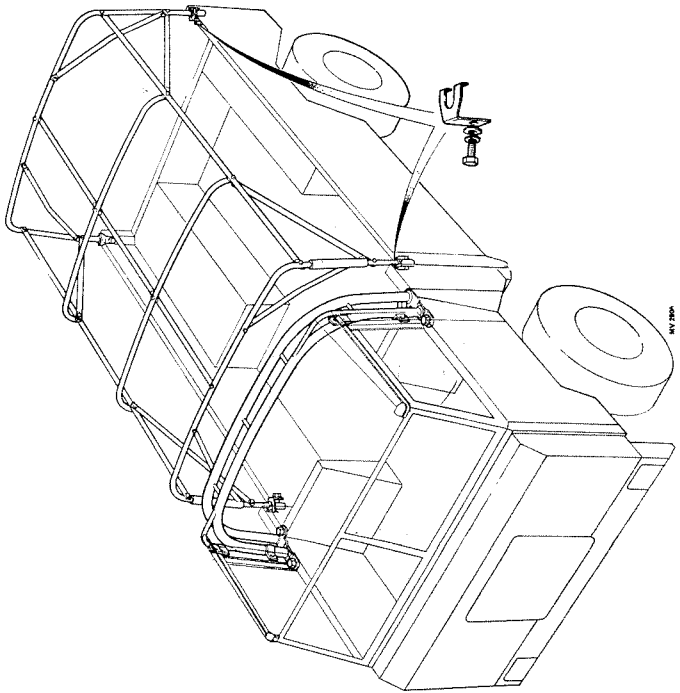
76.61.12

**Removing**

1. Release the hood from the tail gate, body sides, hood frame and roll-over bar.
2. Roll the hood forward to clear the hood frame.

**Refitting**

5. Reverse instructions 1 to 4.



3. Remove the four bolts, plain washers, spring washers and clamp brackets securing the hood frame to the body corners.
4. Lift out the hood frame. The individual frame members are bolted as illustrated.

**FRONT SEAT—DRIVER**

—Remove and refit

76.70.04

**Removing**

1. Lift out the seat cushion.
2. Remove the four nuts and washers securing the seat to the runner assembly.
3. Remove the driver's seat.

**Refitting**

4. Reverse instructions 1 to 3.

**FRONT SEAT—PASSENGER**

—Remove and refit

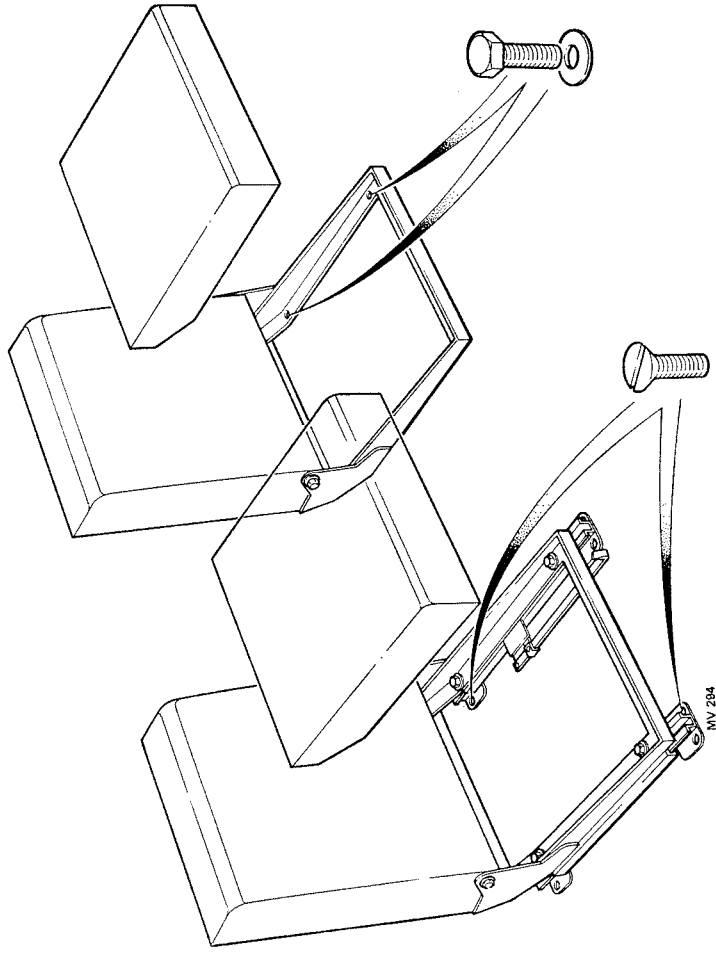
76.70.05

**Removing**

1. Remove the engine cover.
2. Lift out the passenger's seat cushion.
3. Remove the four bolts, nuts and washers securing the seat to the cab.
4. Remove the passenger's seat.

**Refitting**

5. Reverse instructions 1 to 4.



**FRONT SEAT RUNNER**

76.70.21

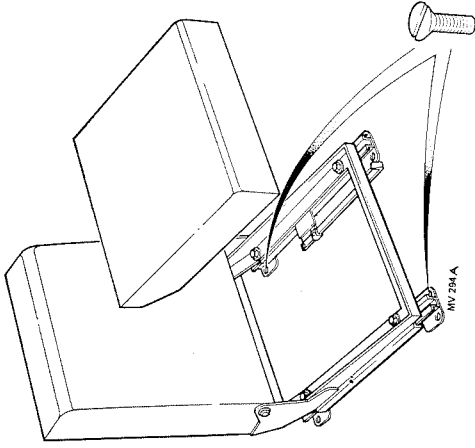
—Remove and refit

**Removing**

1. Remove the driver's seat (see Operation 76.70.04).
2. Remove the engine cover.
3. Remove the eight countersunk screws, washers and nuts securing the seat runner to the cab.
4. Remove the seat runner.

**Refitting**

5. Reverse instructions 1 to 4.



**FRONT SEAT BELT**

76.73.02

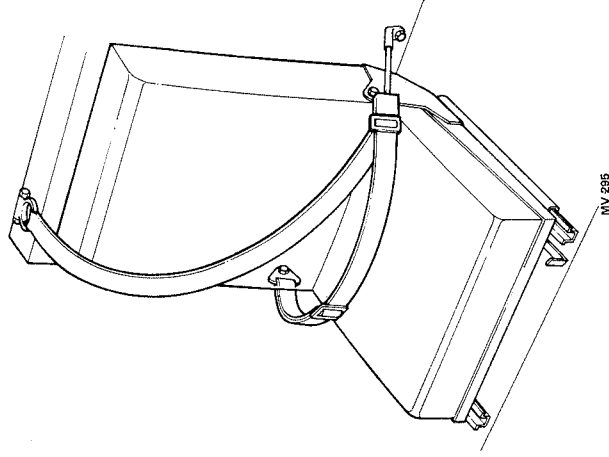
—Remove and refit

**Removing**

1. Driver's belt. Slide the seat fully forward. Passenger's belt. Remove the passenger's seat (see Operation 76.70.05).
2. Remove the nut and washer securing the belt shackle and eyebolt to the rear of the cab.
3. Withdraw the shackle and eyebolt, plain washer, rubber washer and fibre washer.
4. Remove the bolt securing the belt bracket to the side of the cab.
5. Remove the fibre washer spacer, belt bracket and way washer from the bolt.
6. Remove the belt.
7. Remove the bolt, nut and washers securing the belt buckle unit to the cab (if required).

**Refitting**

8. Reverse instructions 1 to 7.



**WINDSCREEN AND FRAME**

76.81.02

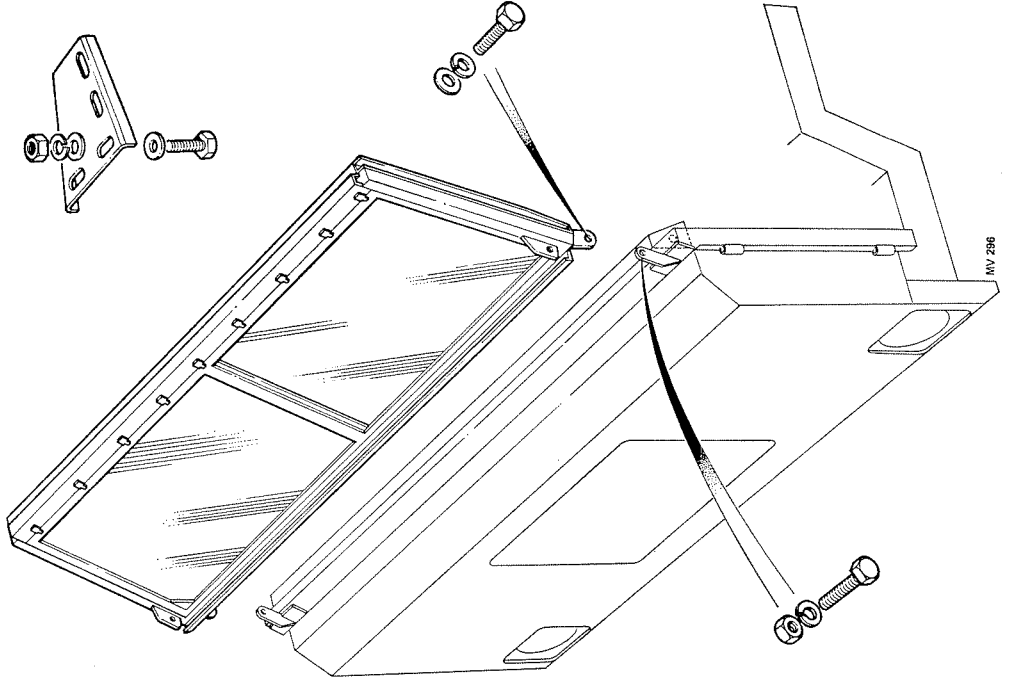
—Remove and refit

**Removing**

1. Release the canvas hood from the hooks on the top of the windscreen frame. Pull the hood clear of the frame.
2. Swing the wiper arms clear of the windscreen.
3. Remove the two sealing strips located on the top corners of the interior of the windscreen frame.
4. Remove the four bolts (two either side), plain washers, spring washers and nuts securing the top of the windscreen frame to the cab gutter strips.

**Refitting**

9. Reverse instructions 1 to 8.



WINDSCREEN GLASS

—Remove and refit

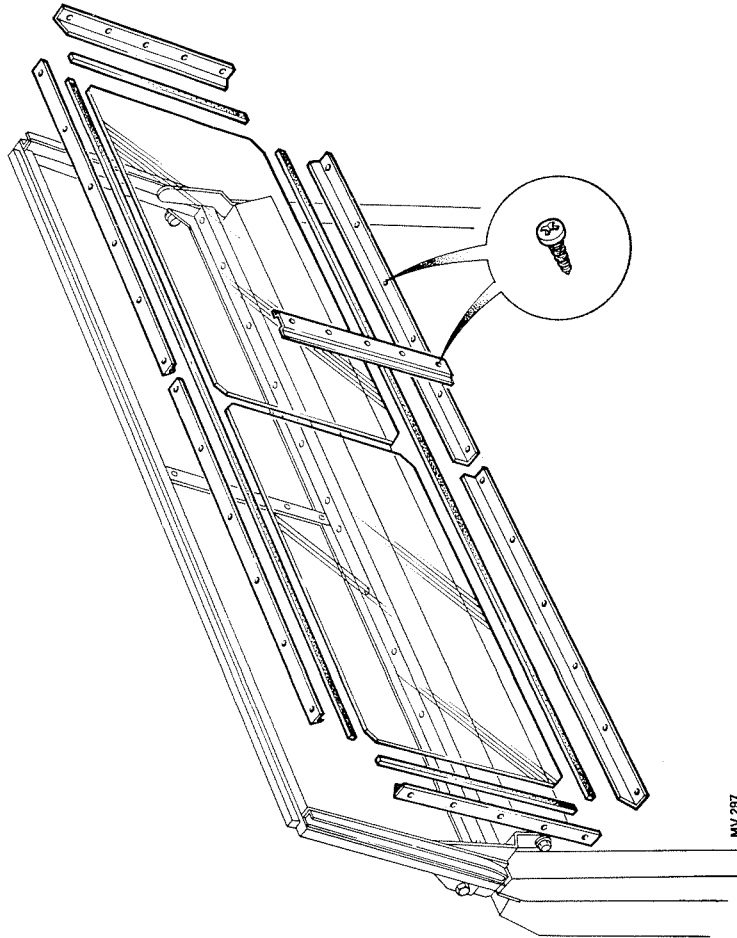
76.81.03

Removing

1. Swing the windscreen wiper arms clear of the windscreen.
2. Remove the self-tapping screws securing the six windscreen glass retaining angle strips and the centre vertical strip.
3. Carefully remove the angle strips and vertical strip.
4. Carefully ease the glass inwards and lift clear.
5. Remove all traces of sealing medium.

Refitting

6. Apply Prestik Sealing Strip to the inside of the windscreen frame surround and the vertical centre member.
7. Carefully locate and press the windscreen glasses into position in the windscreen frame.
8. Apply Prestik Sealing Strip or Kelseal Glasticoord to the inside perimeter and edges of the windscreen glass.
9. Carefully fit and secure the retaining angle strips and vertical strip.
10. Remove all surplus sealant.
11. Release the wiper arms.



PAINTWORK OPERATIONS

General information . . . . . 78.00.00

**PAINTWORK**

**General information**

**Body panels**

1. Land Rover body panels are manufactured from a special aluminium-alloy known as 'Birmabright.' The following paintwork procedure should be followed on these panels.

**Painting 'Birmabright'**

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. Unless an etch-primer is used paint is liable to come away as it cannot 'key' into the hard oxide of an untreated surface. Use the following paint pre-treatment components: Base, acid for brushing, H1/8010-99-220-4528, or, Base, acid for brushing H1/8010-99-220-4529.

**Application**

3. See EMER WKSP G500 paragraphs 4, 16 and 17.

System description					
—general	..	..	..	..	80.2
—air flow	..	..	..	..	80.2
—coolant flow	..	..	..	..	80.2
<b>HEATING AND VENTILATION OPERATIONS</b>					
Heater air flow control cable—remove and refit	..	..	..	..	80.10.06
Heater water valve—remove and refit	..	..	..	..	80.10.16
Heater fan switch—remove and refit	..	..	..	..	80.10.22
Demister tube—remove and refit					
—left hand	..	..	..	..	80.15.01
—right hand	..	..	..	..	80.15.15
Demister duct—remove and refit					
—left hand	..	..	..	..	80.15.03
—right hand	..	..	..	..	80.15.08
Ventilator/heater outlets—front—remove and refit	..	..	..	..	80.15.09
Ventilator/heater outlets—rear—remove and refit	..	..	..	..	80.15.10
Heater unit—remove and refit	..	..	..	..	80.20.01
Heater fan motor—remove and refit	..	..	..	..	80.20.15
Fan motor resistor unit—remove and refit	..	..	..	..	80.20.17
Heater matrix/radiator—remove and refit	..	..	..	..	80.20.29
Pipes and hoses—general	..	..	..	..	80.25.00
Hoses—engine to water valve—remove and refit	..	..	..	..	80.25.08
Hoses—water valve to heater—remove and refit	..	..	..	..	80.25.09
Hose—heater to engine return pipe—remove and refit	..	..	..	..	80.25.12
Hose—return pipe to engine—remove and refit	..	..	..	..	80.25.13
Hose—inlet manifold to heater feed pipe—remove and refit	..	..	..	..	80.25.14
Pipes—feed to heater—remove and refit	..	..	..	..	80.25.15
Pipe—return from heater—remove and refit	..	..	..	..	80.25.16
Hose—link—heater matrix—remove and refit	..	..	..	..	80.25.17

## HEATING AND VENTILATION SYSTEM

## Description

## General

The heating and ventilation system provides air, either heated or at ambient temperature, to the cab interior and the rear of the vehicle. Air flow is controlled by a flap valve which is actuated through a cable, and the air temperature is regulated by means of a valve, both of which can be adjusted from the cab. The operation of these controls is fully described in the User's Handbook.

Air flow can be boosted by a two-speed fan, which is electrically operated and controlled by a switch in the cab. Air distribution may be varied as required to allow demisting/defrosting of the windscreen and heating or ventilation of cab and/or rear compartment areas.

Two outlets are situated on the rear of the heater unit; for left-hand steering vehicles the left-hand outlet is blanked off and the right-hand outlet is connected to a ventilation duct which carries air to the rear of the vehicle. On right-hand steering vehicles the right-hand outlet is blanked and the left-hand outlet is connected to the duct.

The fan motor and fan motor resistor unit are suitably rated to correspond with the operating voltage of the vehicle's electrical equipment—12 volt or 24 volt.

## Air flow

The air intake and blower assembly is located behind the radiator grille in the radiator duct. Air is drawn into the blower assembly through a mesh filter and past the flap valve to the heater unit, which is situated inside the cab. Heat is transferred to the air as it rises through the heater matrix (when the heater is operative) and the air is distributed according to requirements.

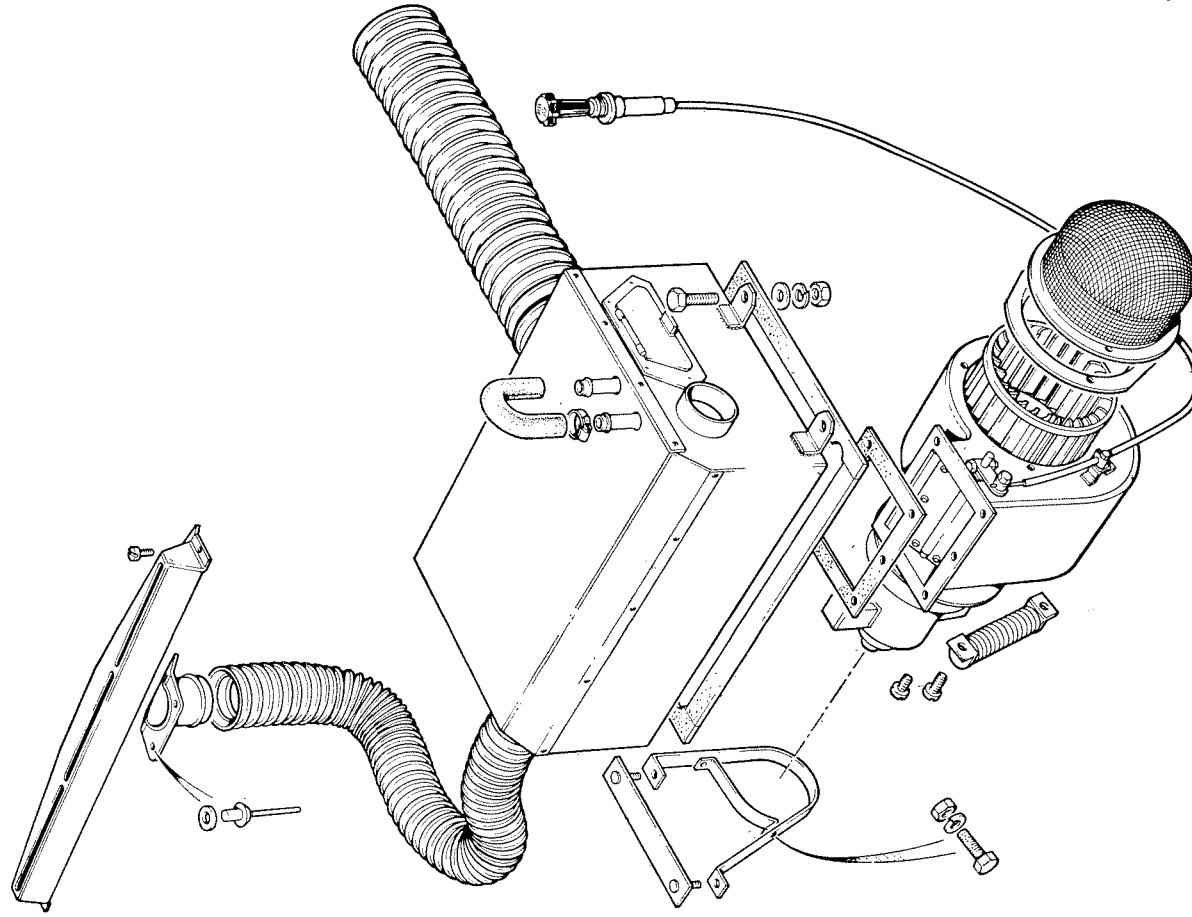
A demist/defrost outlet duct is provided for each side of the windscreen and air will pass to these ducts whenever the flap valve is open, provided that the vehicle is moving or the blower fan is operated.

Air is discharged to the cab through two hinged flaps on the side of the heater unit. The flaps may be positioned as required to control air flow and, when closed, are held by spring catches.

A convoluted hose, connected to an outlet on the rear of the heater unit, carries air to a duct formed in the engine cover and thus to the rear compartment outlet turret. Two outlets, adjustable for flow and direction, distribute air to the rear of the vehicle from this turret. The turret and the outlets are illustrated on page 80.15.10.

## Coolant flow

Hot engine coolant is drawn from a connection on the inlet manifold at the rear of the engine. A series of hoses and pipes carries the coolant to the heater valve, which can be adjusted from the cab. Further hoses and a pipe direct the coolant into the heater matrix, where heat is transferred to the incoming air. Finally, the coolant is returned to a tee-junction in the (engine-radiator) bottom hose through two hoses and a pipe.



0040

HEATER AIR FLOW CONTROL CABLE

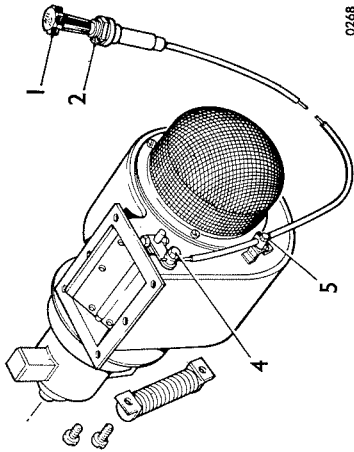
—Remove and refit 86.10.06

Removing

1. Depress the spring-loaded plunger which retains the air control knob and remove the knob.
2. Unscrew the cable retaining ring and release the cable assembly from the cab panel.
3. Remove the radiator grille.
4. Working from the front of the vehicle, release the end of the inner cable from the nipple on the heater air valve lever.
5. Slacken the clamp securing the outer cable to the blower casing and withdraw the cable assembly.

Refitting

6. Pass the control end of the cable assembly through the cab panel. Position the cable so that the knob retaining plunger faces the rear of the vehicle and tighten the cable retaining ring.
7. Depress the spring-loaded plunger and fit the knob.
8. Pull out the knob approximately 1,5 mm ( $\frac{1}{16}$  in.).
9. Pass the free end of the cable assembly through the clamp on the blower casing.
10. Hold the air valve fully closed, i.e. lever up, fit the inner cable to the nipple and tighten the nipple screw to secure the cable. Ensure that the inner cable does not foul the cab panel as this may prevent full closure of the valve; trim the inner cable if necessary.
11. Secure the outer cable to the blower casing by tightening the clamp screw.
12. Refit the radiator grille.



HEATER WATER VALVE

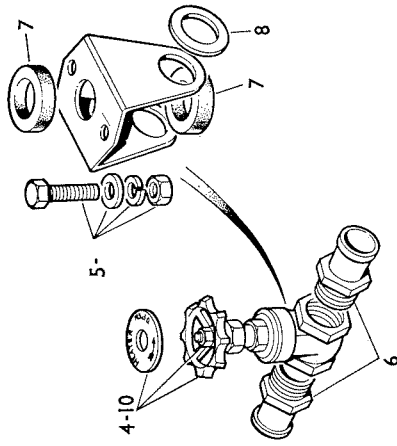
—Remove and refit 80.10.16

Removing

1. Remove the radiator grille and engine cover.
2. Drain the coolant 26.10.01.
3. Slacken the clips and disconnect the hoses from the heater valve.
4. Working inside the vehicle, remove the nut which secures the knob and lift off the knob and label.
5. Remove the two screws, plain and spring washers and nuts to release the valve and bracket assembly.
6. Unscrew the two adaptors from the valve and separate the valve from the bracket, noting the position of the four joint washers and two sealing rings.

Refitting

7. Fit new sealing rings to the valve bracket and fit the bracket to the valve.
8. Position four new joint washers and assemble the two adaptors to the valve. Tighten the adaptors securely.
9. Fit the bracket and valve assembly to the vehicle and secure it with the two screws, plain and spring washers and nuts.
10. Fit the knob and label to the valve. Tighten the retaining nut.
11. Connect the two hoses to the heater valve, positioning the clips so that the screw heads are readily accessible from the front of the vehicle. Tighten the clips.
12. Refill the cooling system 26.10.01.
13. Refit the radiator grille and engine cover.





**HEATER FAN SWITCH**

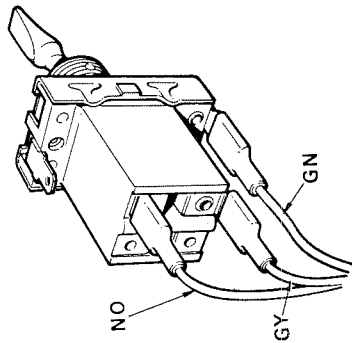
—Remove and refit 80.10.22

**Removing**

1. Isolate the battery.
2. Unscrew the retaining ring and withdraw the switch.
3. Disconnect the cables from the switch.

**Refitting**

4. Connect the cables to the switch as shown in the illustration.
5. Position the switch in the transfer lever bracket.
6. Fit the washer and retaining ring.
7. Reconnect the battery.



**DEMISTER TUBE**

—Remove and refit —left hand 80.15.01  
—right hand 80.15.15

Each demister tube is a convoluted hose connected to the heater unit and demister duct by simple push-fit connections.

The remove and refit procedures are therefore limited to making or breaking these simple connections. Ensure that the tubes are secure when fitted.

**DEMISTER DUCT**

—Remove and refit —left hand 80.15.03  
—right hand 80.15.08

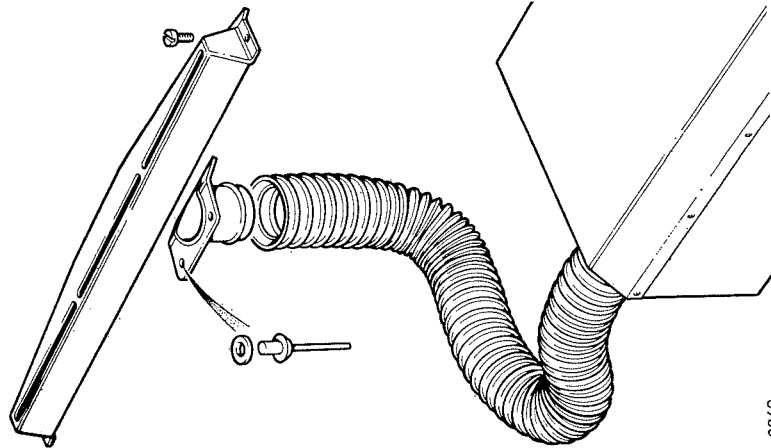
The arrangement of the ducts is illustrated on page 80-3.

**Removing**

1. Isolate the battery and remove the fascia 76.46.01 (for the driver's side duct only).
2. Remove the seven screws holding the appropriate duct to the dash rail panel and lift off the duct.

**Refitting**

3. Position the duct and fit the seven screws to secure the duct to the dash rail panel.
4. Refit the fascia 76.46.01 and connect the battery (for the driver's side duct only).



0269

**VENTILATOR/HEATER OUTLETS—FRONT**

—Remove and refit 80.15.09

The front heater/ventilator outlets (for the driver and passenger) are hinged flaps on the sides of the heater unit, as illustrated on page 80-3.

The flap assemblies are riveted to the heater unit casing and, if it is necessary to remove a flap assembly from the casing, the heater unit must be removed from the vehicle and dismantled. This is essential to avoid damage to the heater matrix when the rivets are drilled out.

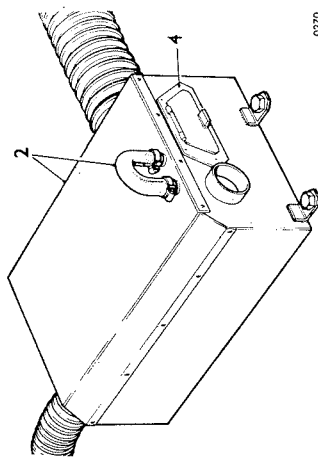
The heater unit components and casing are illustrated on page 80.20.08.

**Removing**

1. Remove the heater unit from the vehicle 80.20.01.
2. Remove 'U' hose and the top panel from the heater unit (19 screws).
3. Position a suitable piece of scrap metal between the heater matrix and the side of the case to protect the matrix.
4. Drill out the four rivets securing the appropriate flap assembly to the casing and remove the flap assembly.

**Refitting**

5. Clean away the drilling swarf and fit the flap assembly with four pop rivets.
6. Refit the top panel to the heater unit, noting that the rear flange should be inside the casing and the other flanges outside the casing.
7. Refit the heater unit to the vehicle 80.20.01.



0270

VENTILATOR/HEATER OUTLETS—REAR

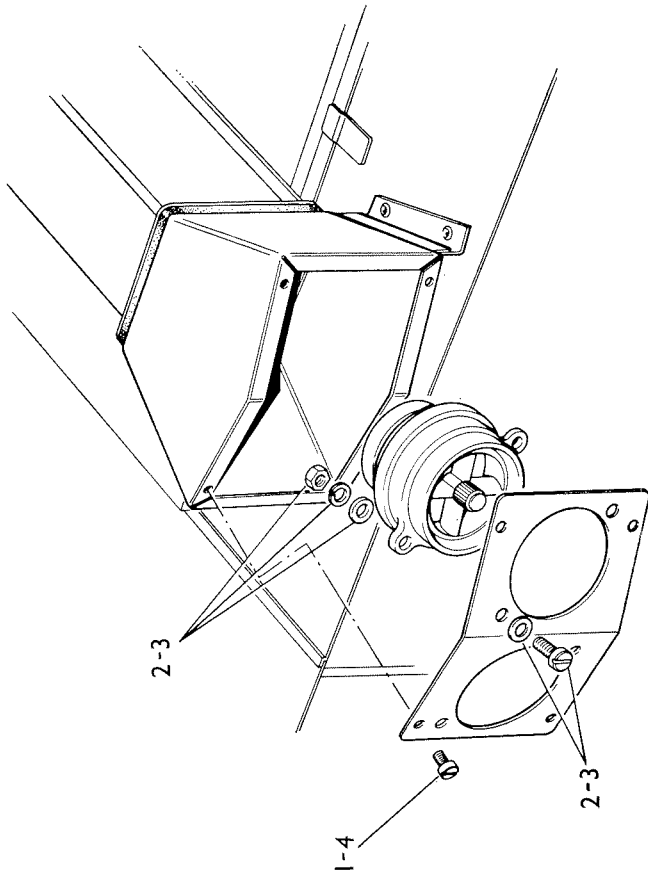
—Remove and refit 80.15.10

**Removing**

1. Remove the four screws holding the end-plate to the ventilator turret.
2. Remove the two screws, plain and spring washers and nuts to release the appropriate duct from the end-plate.

**Refitting**

3. Secure the duct to the end-plate with the two screws, plain and spring washers and nuts.
4. Fit the end-plate to the turret with the four screws.



0041

HEATING AND VENTILATION

Wheeled Vehicles Q052

**HEATER UNIT**

—Remove and refit

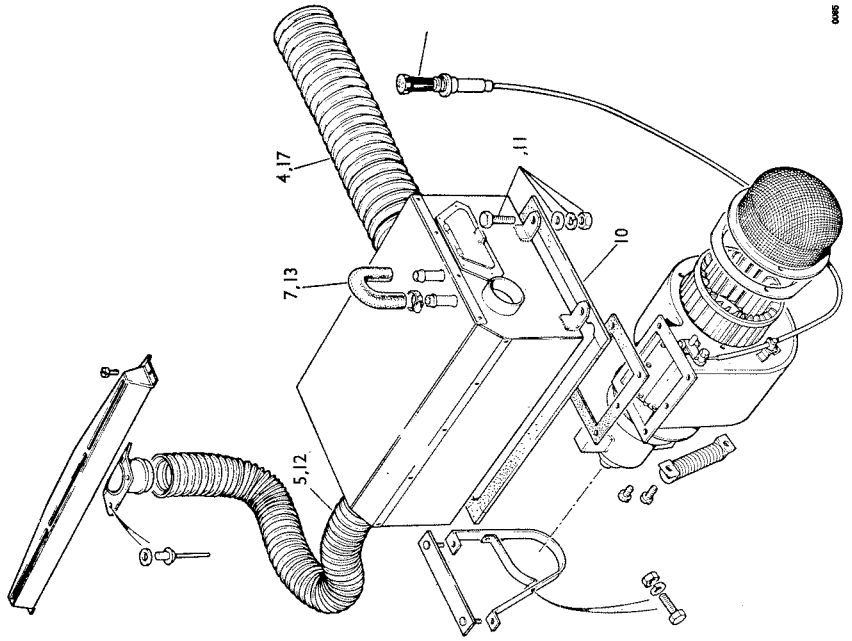
80.20.01

**Removing**

1. Remove the radiator grille.
2. Drain the coolant 26.10.01.
3. Slacken the clips and disconnect the inlet and outlet hoses from the heater unit.
4. Remove the convoluted hose which links the heater unit to the rear ventilation duct.
5. Remove the demister tubes 80.15.01 and 80.15.15.
6. Remove the engine cover and close the heater air flow control valve (knob fully in).
7. Remove the heater matrix link hose 80.25.17.
8. Remove the four screws, plain and spring washers and nuts securing the heater unit to the cab panel.
9. Lift the heater unit so that the matrix pipes clear the cab panel and withdraw the unit to the passenger's side of the vehicle.

**Refitting**

10. Remove all traces of sealing ring from the cab panel and from the underside of the heater unit. Fit a new sealing ring to the heater unit.
11. Position the heater unit and secure it to the cab panel with the four screws, plain and spring washers and nuts.
12. Refit the demister tubes 80.15.01 and 80.15.15.
13. Refit the heater matrix link hose 80.25.17.
14. Refit the inlet and outlet hoses to the heater unit, positioning the clips so that the screw heads are readily accessible from the front of the vehicle. Tighten the clips.
15. Refill the cooling system. 26.10.01
16. Fit the radiator grille and engine cover.
17. Fit the convoluted hose to link the heater unit with the rear ventilation duct.



006

**HEATER FAN MOTOR**

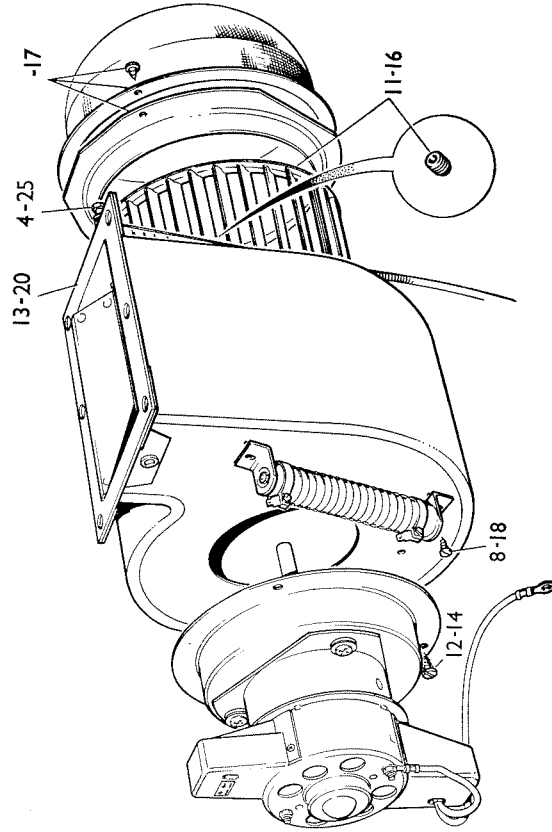
**—Remove and refit 80.20.15**

**Removing**

1. Isolate the battery.
2. Remove the radiator grille.
3. Disconnect the electrical cables from the resistor (two Lucar connectors and one eyelet connector).
4. Release the end of the air flow control inner cable from the nipple on the heater air valve lever.
5. Slacken the clamp securing the air flow control outer cable to the blower casing and withdraw the cable assembly.
6. Remove the two nuts, spring and plain washers which hold the motor support bracket to the cab panel.
7. Remove the five bolts securing the blower housing to the vehicle and withdraw the fan motor and housing assembly.
8. Remove the two screws securing resistor.

9. Unscrew the two bolts, nuts and spring washers to release the support bracket from the motor assembly.
10. Remove the three screws and take off the blower intake filter and spacing ring.
11. Slacken the grub screw and remove the blower wheel.
12. Remove the three screws securing the motor and plate assembly to the casing and withdraw the assembly.

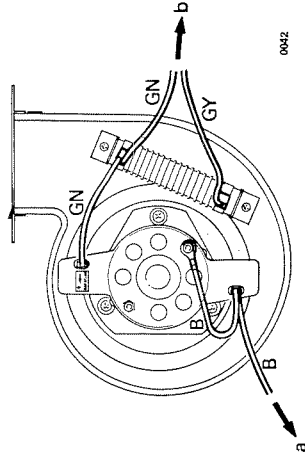
*continued*



004

**Refitting**

13. Clean all traces of the sealing ring from the blower casing flange face and from the cab panel.
14. Fit the blower motor assembly to the heater casing (positioned as illustrated) and tighten the three screws to retain it.
15. Position the blower wheel on the motor shaft with its closed end towards the motor so that the boss end face is 16 mm ( $\frac{5}{8}$  in) from the end of the shaft.
16. Tighten the grub screw and check that the blower wheel is still correctly positioned on the shaft.
17. Fit the intake filter and spacing ring. Tighten the three retaining screws.
18. Position the resistor unit on the blower casing as illustrated and fit the two screws.
19. Examine, and renew if necessary, the support bracket cushion pad. Fit the support bracket and pad loosely to the motor.
20. Fit a new sealing ring to the blower casing flange.
21. Position the blower assembly on the vehicle, locating the support bracket on the two studs. Fit the five flange bolts and tighten them securely.
22. Fasten the support bracket to the body panel with the two nuts, spring and plain washers. Tighten the four support bracket fastenings.
23. Pull out the air flow control knob approximately 1,5 mm ( $\frac{1}{16}$  in).
24. Pass the end of the cable assembly through the clamp on the blower casing.
25. Hold the air valve fully closed, i.e. lever up, fit the inner cable to the nipple and tighten the nipple screw to secure the cable. Ensure that the inner cable does not foul the cab panel as this may prevent full closure of the valve; trim the inner cable if necessary.
26. Secure the outer cable to the blower casing by tightening the clamp screw.
27. Connect the electrical cables to the motor and resistor (refer to the illustration).
28. Refit the radiator grille.
29. Reconnect the battery.



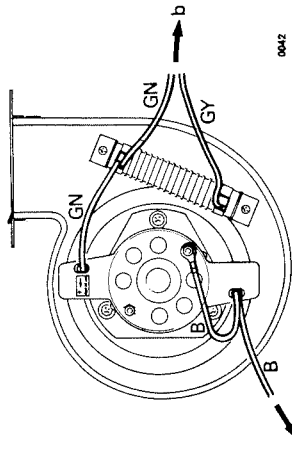
B—Black  
GN—Green/brown  
GY—Green/yellow  
a—To body  
b—To wiring harness

0042

FAN MOTOR RESISTOR UNIT

- Remove and refit 80.20.17
- Removing**
1. Isolate the battery.
  2. Remove the radiator grille.
  3. Disconnect the cables from the resistor.
  4. Remove the two screws and take off the resistor.

- Refitting**
5. If a new resistor is to be fitted, check that its resistance value is appropriate to the voltage of the vehicle's electrical system. The resistance value is stamped on the end bracket of the resistor.
  6. Fit the resistor to the blower casing with the two screws.
  7. Connect the cables to the resistor, ensuring that the connections are clean and secure.
  8. Refit the radiator grille.
  9. Reconnect the battery.



B—Black  
GN—Green/brown  
GY—Green/yellow  
a—To body  
b—To wiring harness

**Data**

Resistance of fan motor resistor

—for 12 volt electrical system	1.8 ohm
—for 24 volt electrical system	4.4 ohm

HEATER MATRIX/RADIATOR

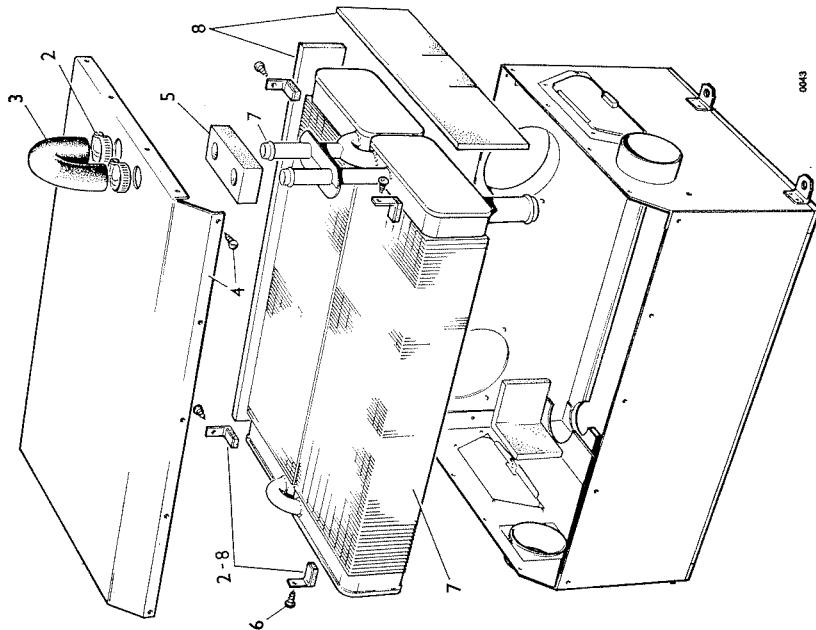
—Remove and refit 80.20.29

**Removing**

1. Remove the heater unit from the vehicle (see 80.20.01).
2. Slacken the clips securing the 'U' hose connecting the matrix pipes.
3. Remove the 'U' hose.
4. Remove the screws securing the heater unit top cover and remove the cover.
5. Remove the rubber pad from the matrix pipes.
6. Remove the four screws securing the matrix angle brackets to the casing.
7. Withdraw the matrix.

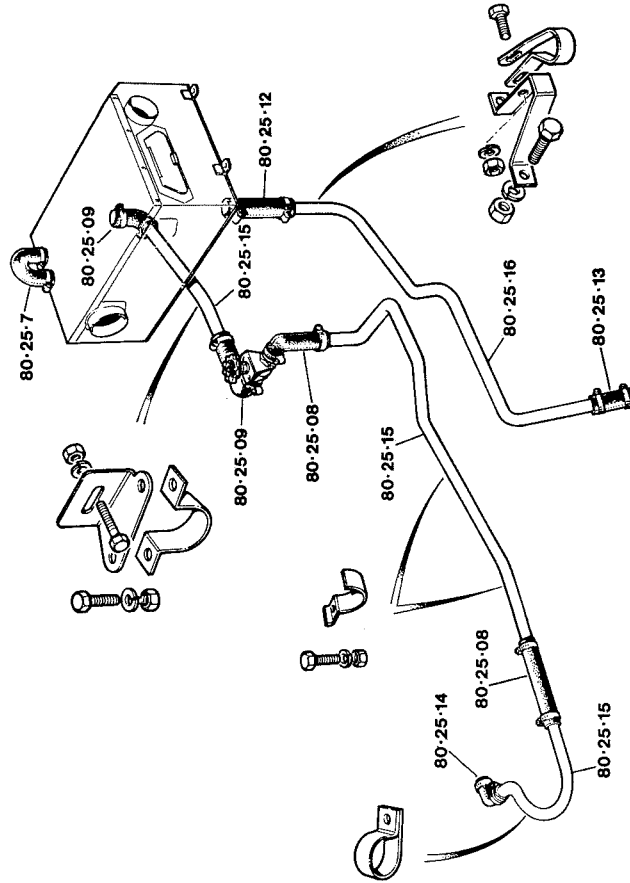
**Refitting**

8. Reverse the above instructions renewing the foam insulating strips as necessary.



<b>PIPES AND HOSES</b>	<b>80.25.00</b>
Hoses—engine to water valve—remove and refit	80.25.08
Hoses—water valve to heater—remove and refit	80.25.09
Hose—heater to return pipe—remove and refit	80.25.12
Hose—return pipe to engine—remove and refit	80.25.13
Hose—inlet manifold to feed pipe—remove and refit	80.25.14
Pipes—feed to heater—remove and refit	80.25.15
Pipe—heater return—remove and refit	80.25.16
Hose—link—heater matrix—remove and refit	80.25.17

Heater pipe and hose components are identified and illustrated below.



0044

**PIPES**

—Remove and refit **80.25.15**  
**80.25.16**

**Removing**

1. Drain the cooling system (see 26.10.01).
2. Slacken the hose clips securing the appropriate pipe ends.
3. Release the pipe from its retaining clip.
4. Detach the pipe from its hose.

**Refitting**

5. Engage the pipe ends in their respective hoses.
6. Fit the pipe retaining clip.
7. Tighten the hose clips.
8. Fill the cooling system (see 26.10.01).

**HOSES**

—Remove and refit **80.25.08-09**  
**80.25.12-14**  
**80.25.17**

**Removing**

1. Drain the cooling system (see 26.10.01).
2. Slacken the hose securing clips.
3. Release and remove the hose. It may be found advantageous to detach the related pipe from its retaining clip.

**Refitting**

4. Locate the hose and clips in position ensuring that the hose adequately engages its connecting pipe.
5. Secure the pipe retaining clip (if disturbed).
6. Tighten the hose clips.
7. Fill the cooling system (see 26.10.01).

**WIPERS AND WASHERS**

**Wheeled Vehicles Q052**

**WIPER AND WASHER OPERATIONS**

Washer jets — remove and refit . . . . .	84.10.09
Washer pump — remove and refit . . . . .	84.10.21
Washer reservoir — remove and refit . . . . .	84.10.01
Washer tubes — remove and refit . . . . .	84.10.15
Wiper motor and drive — remove and refit . . . . .	84.15.09
Wiper motor, linkage and wheel boxes — remove and refit . . . . .	84.15.10
Wiper motor — overhaul . . . . .	84.15.18

**WASHER RESERVOIR**

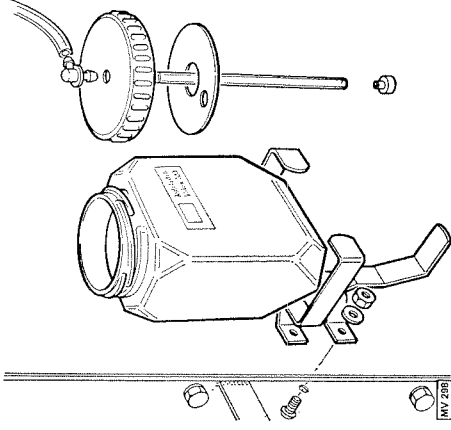
—Remove and refit **84.10.01**

**Removing**

1. Unscrew the reservoir cap and withdraw the cap complete with washer pump inlet tube.
2. Slide the reservoir upwards out of its retaining bracket.

**Refitting**

3. Reverse the above instructions.

**WASHER JETS**

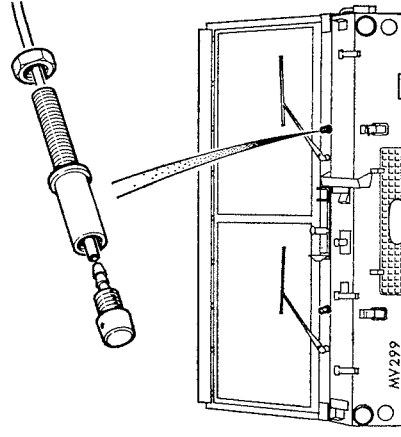
—Remove and refit **84.10.09**

**Removing**

1. Release the jet feed tube from the 3-way connector.
2. Unscrew the jet.
3. Detach the feed tube from the jet.

**Refitting**

4. Reverse instructions 1 to 3. Ensure that the hose is not kinked or twisted.



**WASHER TUBES**

—Remove and refit

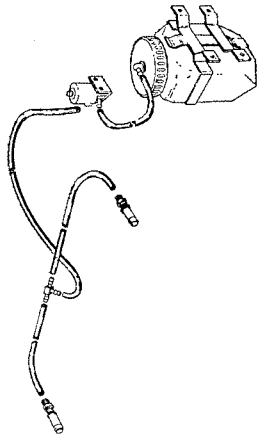
84.10.15

**Removing**

1. Disconnect the washer tubes from the 3-way connectors.
2. Disconnect the washer tube from the outlet connection on the washer pump.
3. Unscrew the jets and release the jets from the feed tubes.
4. Release the washer tubes from their retaining straps.
5. Withdraw the washer tubes.

**Refitting**

6. Reverse instructions 1 to 5.



**WASHER PUMP**

—Remove and refit

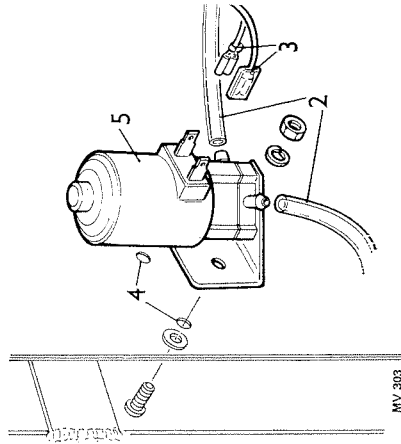
84.10.21

**Removing**

1. Disconnect the battery.
2. Disconnect the inlet and outlet tubes from the washer pump.
3. Disconnect the two 'Lucar' connectors from the washer pump. Note their locations.
4. Remove the two screws, spring washers and nuts securing the washer pump bracket to the side of the cab.
5. Withdraw the washer pump and bracket.
6. Remove the three screws securing the pump to the bracket.

**Refitting**

7. Reverse instructions 1 to 6.



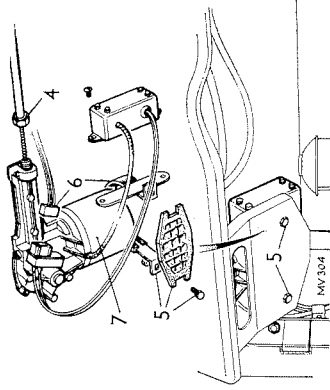
**WIPER MOTOR AND DRIVE**

—Remove and refit

84.15.09

**Removing**

1. Disconnect the battery.
2. Remove the windscreen wiper arms.
3. Release the heater hose from the left hand windscreen vent.
4. Disconnect the union nut securing the wheelbox drive cable tubing to the wiper motor.
5. Remove the two nuts and spring washers securing the wiper motor clamp to the dash bracket.
6. Release the wiper motor clamp from the dash and disconnect the power supply plug from the wiper motor.
7. Withdraw the wiper motor complete with clamp, suppressor unit, clamp pad and drive cable.



**Refitting**

8. Enter the drive cable in the wheelbox tubing. This may necessitate rotating the wheelbox wiper spindles by hand to allow the drive cable to engage the wheelbox gears.
9. Fit the wheelbox tubing union nut to the wiper motor but do not tighten at this stage.
10. Connect the power supply plug to the wiper motor.
11. Locate the wiper motor in position and fit the clamp and pad. Insert the clamp bolts through the dash. Fit and tighten the two securing nuts and washers.
12. Tighten the tubing union nut.
13. Connect the battery.



WIPER MOTOR LINKAGE AND WHEELBOXES

—Remove and refit 84.15.10

Removing

1. Disconnect the battery.
2. Remove the wiper motor and drive cable. (See 84.15.09).
3. Remove the nut and outer spacer securing the left hand wheelbox to the vehicle. Repeat on right hand wheelbox.
4. Withdraw the two wheelboxes complete with drive tubing and inner spacers.

Refitting

5. Reverse instructions 1 to 4.

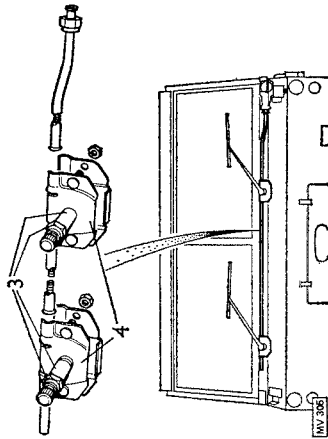
WIPER MOTOR

—Overhaul 84.15.18

1. Remove the wiper motor complete with drive cable. (See 84.15.09).

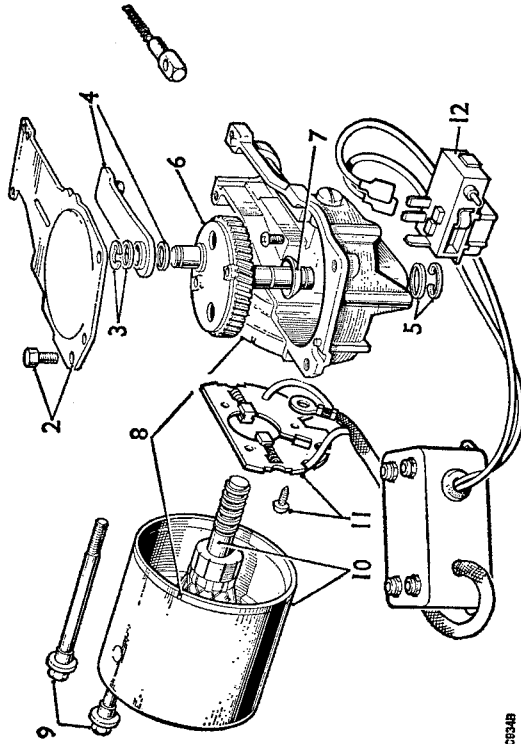
Dismantling

2. Remove the gearbox cover (four bolts).
3. Remove the circlip and washer securing the connecting rod.
4. Withdraw the connecting rod and inner washer.



5. Remove the circlip and washer securing the gear wheel shaft.
6. Withdraw the gear wheel.
7. Withdraw the dished washer from the gear wheel shaft. Note that the concave face of the washer is fitted adjacent to the gear wheel.
8. Scribe the motor yoke and gearbox casing to ensure reassembly in original location.
9. Remove the yoke securing bolts.
10. Withdraw the yoke and armature.
11. Remove the brush gear assembly.
12. Remove the limit switch.

continued



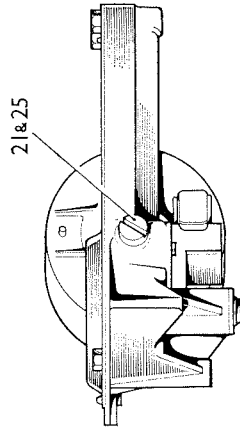
TRC54B

Inspection

13. Check the brushes for wear. If their length is reduced to 4,8 mm (0,190 in) renew the brush gear assembly.
14. Using a push type gauge check that brush spring pressure is 140 to 200 g (5 to 7 oz) when the bottom of the brush is level with the bottom of the slot in the brush box. Renew the brush gear assembly if a spring check proves unsatisfactory.
15. Test the armature for insulation and open or short circuits. Renew the armature if faulty.
16. Check the gear wheel and shaft for damage or excessive wear.

Assembling

17. Reverse instructions 2 to 12 and note instructions 18 to 25.
18. Use Ragosine Listate grease (NATO—XG 271) to lubricate the gears, connecting rod, cable rack and wheelboxes.
19. Use Shell Turbo 41 oil (NATO—OM 100) sparingly to lubricate bearing bushes, armature shaft journals, gear wheel shaft and wheelbox spindles. Thoroughly soak the felt washer in the yoke bearing with oil.
20. Tighten the yoke fixing bolts to a torque of 14 to 18 kgf cm (12 to 16 lbf in).
21. If a replacement armature is being fitted, slacken the adjuster screw to provide end-float for fitting the yoke.
22. Fit the dish washer beneath the gear wheel. Ensure concave face of washer is adjacent to the gear wheel.
23. Ensure that the larger of the two plain washers is fitted to the underside of the connecting rod.
24. Armature end-float. Hold the yoke vertically with the adjuster screw uppermost. Carefully screw in the adjuster until resistance is felt then screw back a quarter turn. This will give the required end-float.
25. Connect the leads between the suppressor unit and the wiper motor limit switch.



IRC 935

DATA

Windscreen wiper motor	
Armature end-float	0,1 to 0,2 mm (0,004 to 0,008 in)
Brush length (minimum)	4,8 mm (0,190 in)
Brush spring tension	140 to 200 g (5 to 7 oz)
Light running — rack disconnected	
60 seconds from cold	
Current	0,8 amps (approx.)
Speed	46 to 52 rev/min

## DESCRIPTION

Introduction .. .. .	86.3
Location of electrical equipment	
—12 Volt .. .. .	86.4
—24 Volt .. .. .	86.10
Description of electrical equipment	
—12 Volt .. .. .	86.8
—24 Volt .. .. .	86.14
Circuit diagram	
—12 Volt .. .. .	86.6
—24 Volt .. .. .	86.12
Fault diagnosis .. .. .	86.22
Suppression of electrical interference .. .. .	86.24

## OPERATIONS

Alternator		
—alternator	—bench test .. .. .	86.10.14
—drive belt (12 Volt)	—adjust .. .. .	—
—drive belt (24 Volt)	—adjust .. .. .	(Sec 26.20.01)
—drive belt (12 Volt)	—remove and refit .. .. .	86.10.05
—drive belt (24 Volt)	—remove and refit .. .. .	(Sec 26.20.07)
—alternator	—remove and refit .. .. .	86.10.03
—alternator	—overhaul .. .. .	86.10.08
—alternator	—remove and refit .. .. .	86.10.02
—alternator	—static test .. .. .	86.10.01
Battery(ies)	—remove and refit .. .. .	86.15.01

## Bulbs

—ammeter (24 Volt)	—remove and refit .. .. .	86.45.56
—brake circuit warning	—remove and refit .. .. .	86.45.69
—convoy lamp	—remove and refit .. .. .	86.40.92
—front parking lamp	—remove and refit .. .. .	86.40.33
—front turnlight	—remove and refit .. .. .	86.40.41
—hazard switch indicator	—remove and refit .. .. .	86.45.68
—headlamp	—remove and refit .. .. .	86.40.09
—instrument panel illumination	—remove and refit .. .. .	86.45.48
—number plate	—remove and refit .. .. .	86.40.85
—rear turnlight	—remove and refit .. .. .	86.40.44
—tail lamp	—remove and refit .. .. .	86.40.78
—warning lights	—remove and refit .. .. .	86.45.61

## Generator panel (24 Volt)

—panel	—bench test .. .. .	86.10.24
—panel	—static test .. .. .	86.10.25
—panel	—remove and refit .. .. .	86.10.26

## Distributor contact breaker points

—remove and refit .. .. .	86.35.13
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## Distributor

—distributor	—lubrication .. .. .	86.35.18
—distributor	—overhaul .. .. .	86.35.26
—distributor	—remove and refit .. .. .	86.35.20

## Flasher unit

—remove and refit .. .. .	86.55.11
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## Fuel pump

—fuel pump	—remove and refit .. .. .	—
—fuel tank unit	—remove and refit .. .. .	(See 19.45.08)
—suppressor box	—remove and refit .. .. .	(See 88.25.32)
—voltage dropper (24 Volt)	—remove and refit .. .. .	86.55.35
—voltage dropper (24 Volt)	—remove and refit .. .. .	86.65.69

Fuse	—remove and refit	..	..	..	..	86.70.02
Fuse box	—remove and refit	..	..	..	..	86.70.01
Horn	—remove and refit	..	..	..	..	86.30.09
Ignition coil	—remove and refit	..	..	..	..	86.35.32
	—remove and refit	..	..	..	..	86.35.33
	—remove and refit	..	..	..	..	86.35.38
ballast resistor (12 Volt)	—remove and refit	..	..	..	..	..
	—filter	..	..	..	..	..
Lamps	—ammeter bulb holder bracket (24 Volt)	..	..	..	..	86.45.58
	—convoy lamp	..	..	..	..	86.40.81
	—differential lock warning lamp	..	..	..	..	86.45.60
	—front side/parking lamp	..	..	..	..	86.40.34
	—front turnlight lamp assembly	..	..	..	..	86.40.42
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	—headlamp and mounting plate—LH	..	..	..	..	86.40.06
	—headlamp and mounting plate—RH	..	..	..	..	86.40.07
	—ignition warning lamp	..	..	..	..	86.45.60
	—rear number plate lamp	..	..	..	..	86.40.86
	—rear turnlight lamp assembly	..	..	..	..	86.40.45
	—tail lamp assembly	..	..	..	..	86.40.79
	—trailer turnlight warning lamp	..	..	..	..	86.45.60
	—vehicle turnlight warning lamp	..	..	..	..	86.45.60
	—winch warning lamp	..	..	..	..	86.45.60
Regulator (24 Volt)	—adjust	..	..	..	..	86.10.28
	—remove and refit	..	..	..	..	86.10.29
Relays	—battery relay	..	..	..	..	86.55.24
	—horn relay	..	..	..	..	86.55.09
	—infra-red relay	..	..	..	..	86.55.21
	—starter relay	..	..	..	..	86.55.05
Shunt box (24 Volt)	—shunt box	..	..	..	..	86.10.40
	—shunt box	..	..	..	..	86.10.41
Sockets	—inspection socket	..	..	..	..	86.45.33
	—NATO socket	..	..	..	..	86.70.26
Starter motor	—motor	..	..	..	..	86.60.13
	—motor	..	..	..	..	86.60.01
	—solenoid	..	..	..	..	86.60.08
Switches	—brake circuit warning test switch	..	..	..	..	86.65.49
	—brake failure switch	(See 70.15.41)	..	..	..	—
	—choke switch	..	..	..	..	86.65.53
	—hazard switch	..	..	..	..	86.65.50
	—ignition/starter switch	..	..	..	..	86.65.02
	—infra-red switch	..	..	..	..	86.65.08
	—oil pressure warning switch	..	..	..	..	86.65.30
	—master light switch	..	..	..	..	86.65.09
	—panel light switch	..	..	..	..	86.65.12
	—steering column combination switch	..	..	..	..	86.65.55
	—stop lamp switch	..	..	..	..	86.65.51
	—windscreen wiper/washer switch	..	..	..	..	86.65.38
Voltage stabiliser (12 Volt)	—remove and refit	(See 88.20.26)	..	..	..	—

## INTRODUCTION

The Rover 101 one tonne vehicle is produced with either a 12 or 24 volt negative earth electrical system employing an alternator with coil ignition.

The 12 volt 16 ACR 34 amp alternator is a self-contained, sealed unit incorporating a rectifier pack and an integral electronic voltage regulator.

The 24 volt 90 amp alternator is fully suppressed, partially water-proofed with a built-in rectifier system. It is used in conjunction with a screened generator panel which houses the battery relay, split-charge relays and a vibrating contact type regulator. A shunt box is also provided for radio, auxiliaries and separate ammeter connections where the vehicle and radio batteries are charged simultaneously.

A 6 volt coil is used with a ballast resistor on 12 volt models and a 10 volt coil is fitted to 24 volt models with a filter and voltage dropper.

The 12 volt distributor has a single contact breaker with centrifugal and vacuum ignition control units.

The 24 volt distributor has double contact breakers with centrifugal ignition control only. It is vented, via a filter into the induction manifold, fully screened and incorporates an engine speed limiting device in the rotor arm.

The 12 volt fuel pump is also used on 24 volt models, with a voltage dropper. As a safety precaution, the oil pressure switch automatically cuts off the fuel pump, if the oil pressure drops dangerously or the engine stops with the ignition on.

The starter motor and solenoid vary only in voltage ratings.

Both models have conventional lighting plus convoy lamp and headlamp infra-red circuits which are controlled by a lighting switch giving, in all, five lighting combinations.

NOTE: The operations described in this Division are applicable to 12 and 24 volt models except where headings indicate specific 12 or 24 volt items.

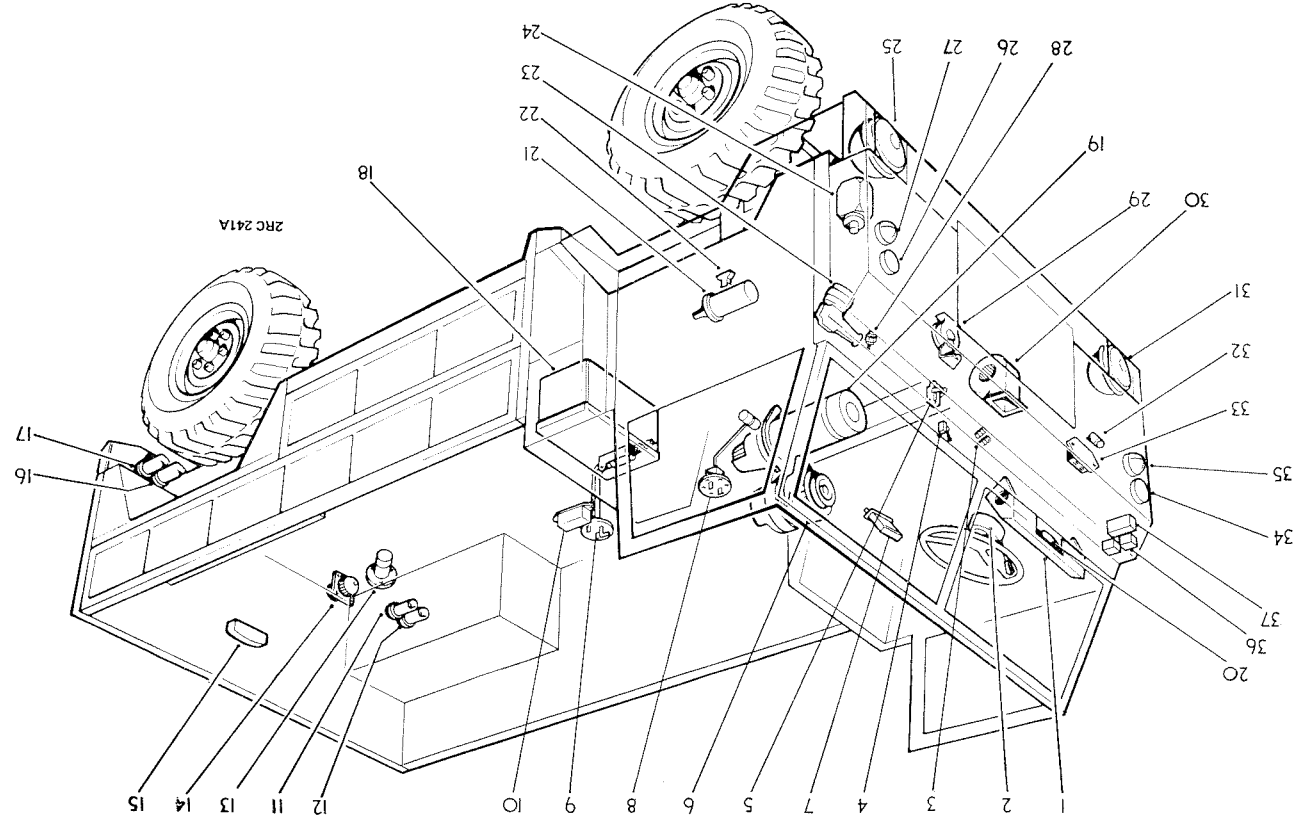
## IDENTIFICATION

12 or 24 volt models may be readily identified since 24 volt vehicles are fitted with two ammeters in the centre of the fascia panel adjacent to the inspection lamp sockets.

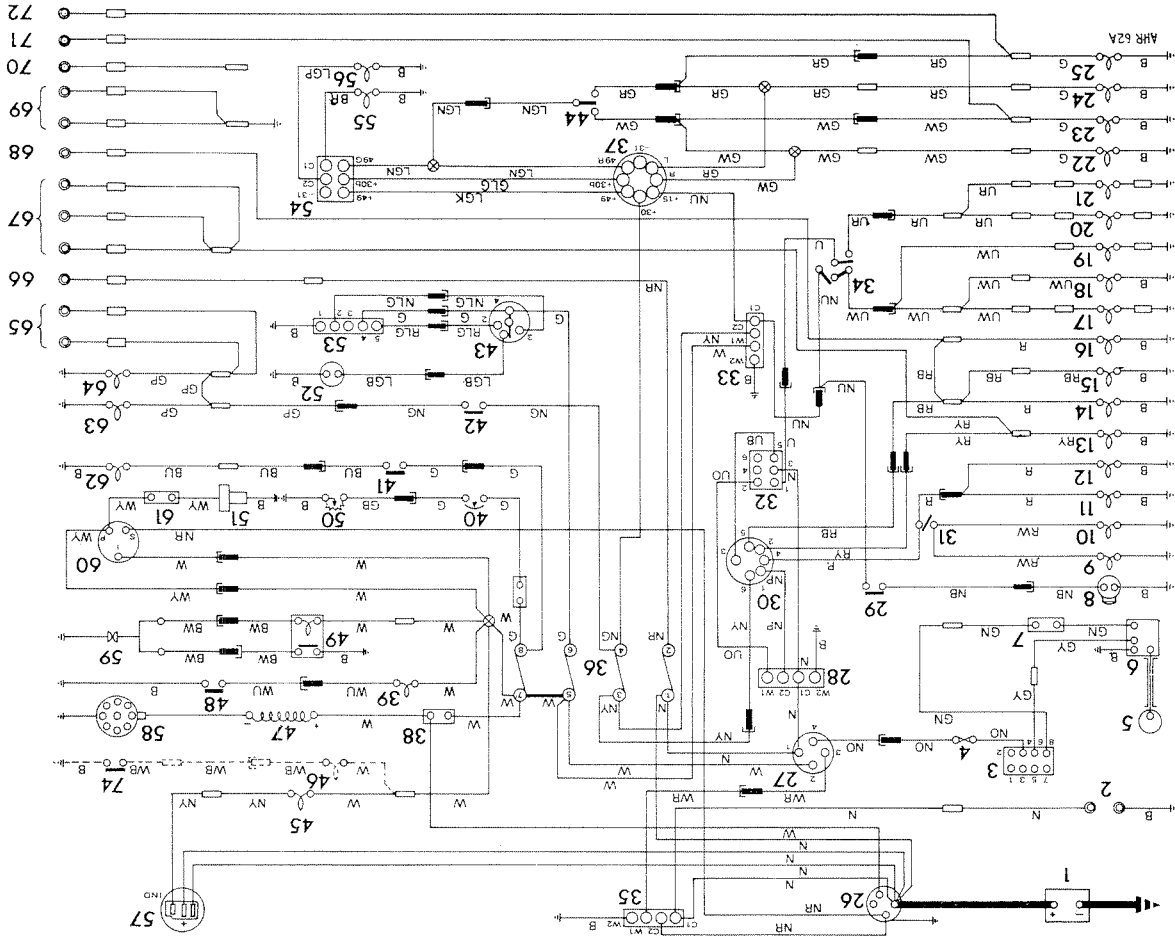
LOCATION OF ELECTRICAL EQUIPMENT—12 VOLT MODELS

- Key to layout of electrical equipment, 12 volt systems
- \* 1 Instrument panel
  - \* 2 Headlight dip switch incorporating headlight flash, turnlight and horn (on steering column)
  - 3 Inspection lamp sockets
  - 4 Heater switch
  - 5 Cold start control switch
  - 6 Alternator
  - 7 Relay for starter motor
  - 8 Fuel level, tank unit
  - 9 Fuel pump
  - 10 Suppressor for fuel pump
  - 11 Turnlight, rear RH
  - 12 Stop and tail lamp RH
  - 13 Convoy lamp
  - 14 12 pin socket
  - 15 Number plate illumination lamp
  - 16 Turnlight, rear LH
  - 17 Stop and tail lamp LH
  - \*18 Battery, 12 volt
  - 19 Starter motor
  - \*20 Stabiliser for fuel gauge
  - 21 Ignition coil
  - 22 Ballast resistor for ignition coil
  - \*23 Windscreen wiper motor
  - \*24 Windscreen washer pump
  - 25 Headlight, LH
  - 26 Turnlight, front LH
  - 27 Side lamp, LH
  - 28 Oil pressure switch
  - 29 Horn
  - 30 Heater motor and suppressor unit
  - 31 Headlight, RH
  - 32 Stop light switch
  - \*33 Fuse box
  - 34 Turnlight, front RH
  - 35 Side lamp, RH
  - \*36 Relays for horn and infra-red lighting
  - \*37 Flasher unit

\* On LH Stig models the items indicated are located on the opposite side of the vehicle



CIRCUIT DIAGRAM—12 VOLT MODELS



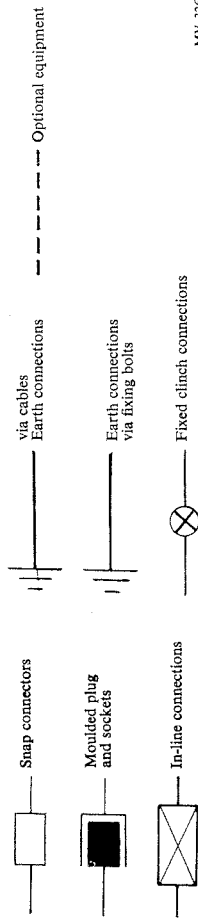
Key to circuit diagram—12 volt models

- |  |  |
|--|--|
| 1 Battery, 12 volt                     | 38 Ballast resistor                                  |
| 2 Inspection lamp sockets              | 39 Warning light, cold start                         |
| 3 In-line fuse for heater              | 40 Gearbox differential lock switch                  |
| 4 Heater motor                         | 41 Windscreen wiper/washer switch                    |
| 5 Suppressor unit for heater motor     | 42 Stop lamp switch                                  |
| 6 Resistor                             | 43 Windscreen wiper/washer switch                    |
| 7 Horn                                 | 44 Turnlight switch                                  |
| 8 Grouped instrument illumination      | 45 Ignition warning light                            |
| 9 Speedometer illumination             | 46 Windch warning light (when fitted)                |
| 10 Side lamp, RH                       | 47 Ignition coil                                     |
| 11 Side lamp, LH                       | 48 Cold start switch                                 |
| 12 Convoy lamp                         | 49 Brake system warning light and test button switch |
| 13 Tail lamp, RH                       | 50 Fuel tank gauge unit                              |
| 14 Tail lamp, LH                       | 51 Fuel pump   |
| 15 Number plate illumination           | 52 Windscreen wiper pump                             |
| 16 Headlamp main beam, RH              | 53 Windscreen wiper motor                            |
| 17 Headlamp main beam, LH              | 54 Hazard warning and turnlight unit                 |
| 18 Headlamp dipped beam, RH            | 55 Turnlight warning light                           |
| 19 Headlamp dipped beam, LH            | 56 Water warning light                               |
| 20 Headlamp dipped beam, RH            | 57 Distributor                                       |
| 21 Headlamp dipped beam, LH            | 58 Oil pressure switch                               |
| 22 Turnlight, front RH                 | 59 Brake system shuttles valve                       |
| 23 Turnlight, front LH                 | 60 Suppressor unit                                   |
| 24 Turnlight, rear RH                  | 61 Gearbox differential lock warning light           |
| 25 Turnlight, rear LH                  | 62 Stop lamp, RH                                     |
| 26 Pre-engaged starter motor           | 63 Stop lamp, LH                                     |
| 27 Ignition and starter switch         | 64 Stop lamp, LH                                     |
| 28 Relay for infra-red headlamp switch | 65 Stop lamp   |
| 29 Horn push                           | 66 Auxiliary   |
| 30 Lighting switch, 6-way              | 67 Convoy  |
| 31 Panel light switch                  | 68 Tail  |
| 32 Headlamp infra-red switch           | 69 Earth   |
| 33 Headlamp flash and dipper switch    | 70 Spare   |
| 34 Starter motor relay                 | 71 Trailer turnlight, RH                             |
| 35 Starter motor relay                 | 72 Trailer turnlight, LH                             |
| 36 Hazard warning switch               | 73 Voltage stabiliser (fuel gauge)                   |
| 37 Hazard warning switch               | 74 Windch warning light (when fitted)                |

Key to cable colours

- |          |          |          |
|----------|----------|----------|
| L—Light  | P—Purple | W—White  |
| N—Brown  | R—Red    | Y—Yellow |
| O—Orange | U—Blue   |          |

When cables have two code letters the first is the main colour, the second the tracer, i.e. RG—Red with Green



MV 326

**CHARGING SYSTEM (12 Volt)**

**Description**  
12 volt vehicles are fitted with a Lucas 16ACR Alternator (23793A). Its construction is shown in the adjacent illustration on page 86-9.

The laminated stator carries a 3-phase star-connected output winding. A 12-pole rotor carries the field winding; the rotor shaft is supported by ball races in diecast end brackets.

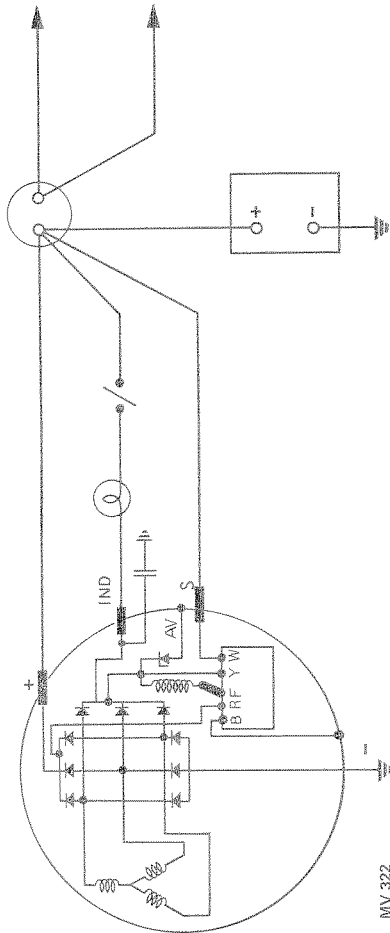
Rectification of alternator output is achieved by six silicon diodes housed in a rectifier pack and connected as a 3-phase full-wave bridge circuit. The rectifier pack is attached to the outer face of the slip-ring end bracket and also contains three 'field' diodes. At normal operating speeds a small portion of the stator winding current flows through these diodes to provide rectified self-exciting field current. This circuit is taken direct to the two brushes which pass current to the field winding by way of face type slip-rings. The slip-rings are carried on a small diameter moulded drum attached to the end of the rotor shaft.

A voltage regulator of micro-circuit construction is incorporated on the slip-ring end casing and this maintains the alternator output at a safe limit. System voltage is sensed directly by a permanent connection between the regulator and battery.

**Fail-safe**

If the alternator output lead to the battery becomes accidentally disconnected alternator internal voltage will increase. To prevent a runaway condition from developing, the voltage is then clamped at a slightly higher voltage by the machine sensed lead inside the alternator.

If the battery sensing lead should be accidentally disconnected, the alternator will close down to a minimum output, and battery charging will be negligible.



MV 322

Charging Circuit—12 volt 34 amp.

**Surge protection**

Some additional protection of the alternator is provided by a surge protection device (avalanche diode) which is connected across the 'IND' terminal to absorb high transient voltages under normal working conditions.

**Radio suppression**

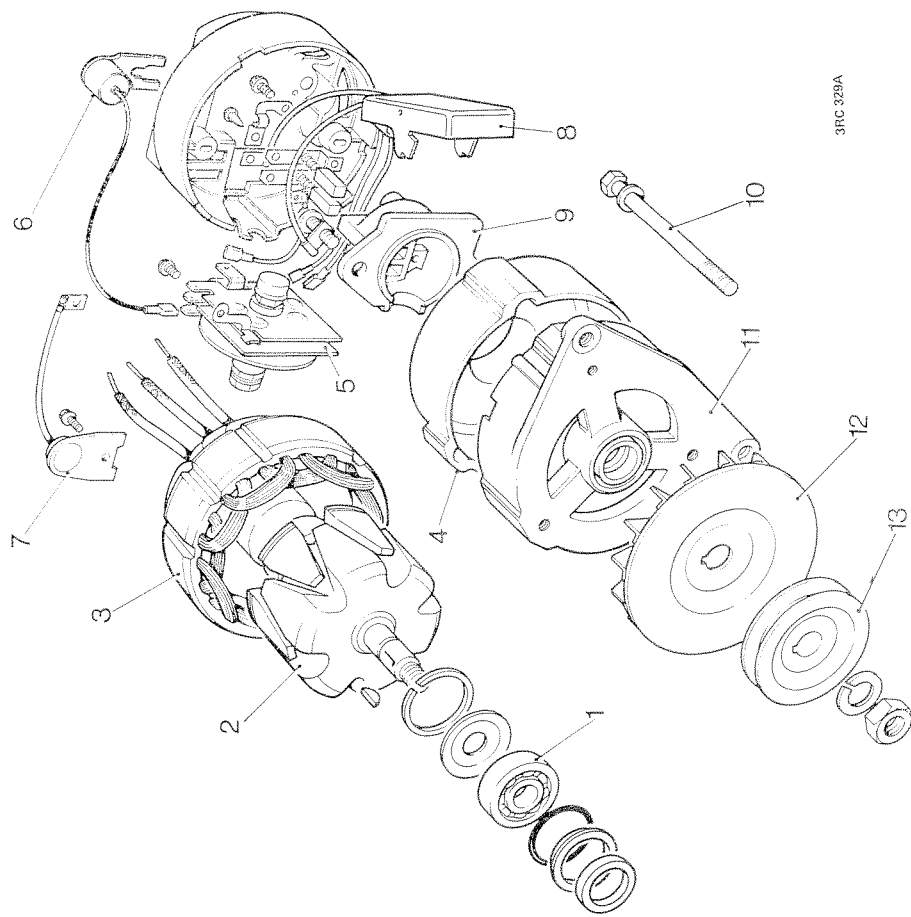
A suppressor unit is retained by the lower alternator fixing bolt. Its lead is connected to the 'IND' rectifier plate via a ventilation slot in the alternator cover.

Electrical connections to external circuits are brought to 'Lucar' connector blades grouped to accept a non-reversible socket with European terminations.

**Warning light**

The additional 'field' diodes enable a simple charge-indication warning light to be used. When the ignition is switched on the warning light is connected to the battery by way of the alternator field winding and the regulator. The bulb is then fully illuminated. This small current flowing in the field winding sets up a flux which supplements the residual flux in the rotor and aids the initial build-up of stator voltage as the rotor begins to rotate when the engine is started. As rotor speed and generated voltage increase, the field current supplied by the stator winding through the 'field' diodes increases correspondingly until the alternator becomes fully self-excited.

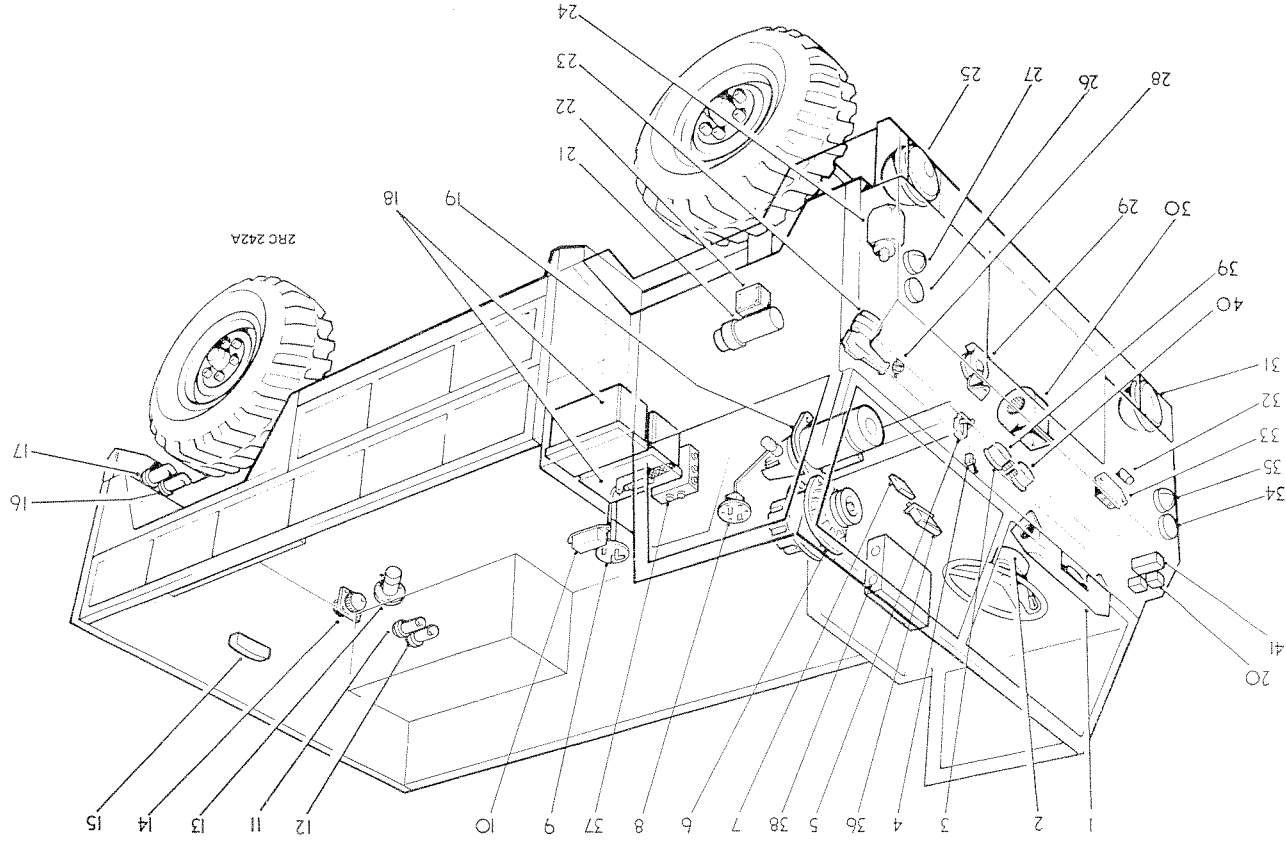
During the rise in stator generator voltage (reflected at terminal IND) the brilliance of the warning light is gradually reduced. At approximately the speed at which the alternator commences to charge, the voltage at the IND terminal equals that at the battery side of the warning light and the light is extinguished. Illumination of the warning light under normal running conditions indicates that the alternator is not functioning correctly.



**16ACR ALTERNATOR**

- 1 Drive end bearing
- 2 Rotor and slip-ring
- 3 Stator
- 4 Slip-ring bracket
- 5 Rectifier
- 6 Suppressor
- 7 Surge protection device
- 8 Regulator unit
- 9 Brush Box
- 10 Through bolt
- 11 Drive end bracket
- 12 Fan
- 13 Pulley

LOCATION OF ELECTRICAL EQUIPMENT—24 VOLT MODELS

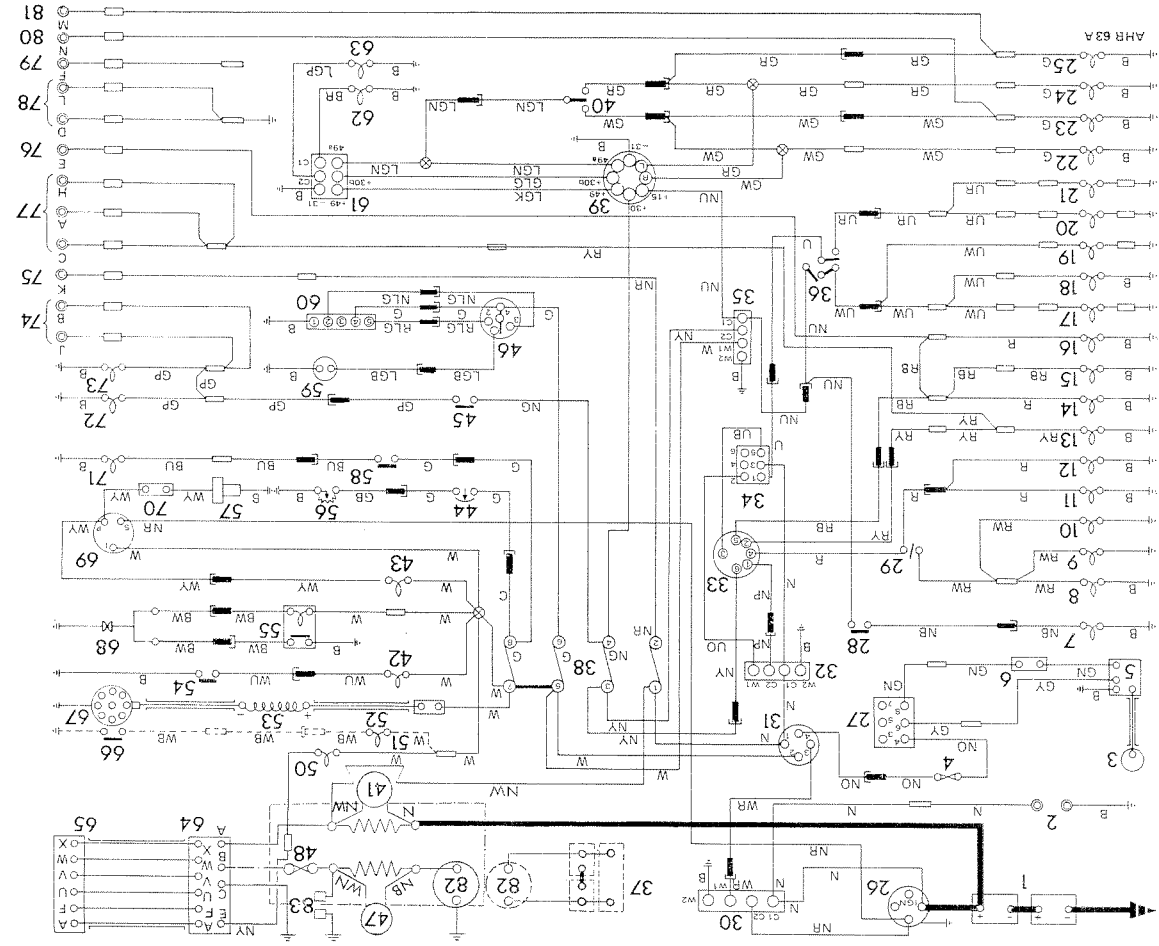


Key to layout of electrical equipment, 24 volt systems

- \* 1 Instrument panel
- \* 2 Headlight dip switch incorporating headlight flash, turnlight and horn (on steering column)
- 3 Inspection lamp sockets
- 4 Heater switch
- 5 Cold start control switch
- 6 Alternator
- 7 Relay for starter motor
- 8 Fuel level, tank unit
- 9 Fuel pump
- 10 Suppressor for fuel pump
- 11 Turnlight, rear RH
- 12 Stop and tail lamp, RH
- 13 Convoy lamp
- 14 12 pin socket
- 15 Number plate illumination lamp
- 16 Turnlight, rear LH
- 17 Stop and tail lamp, LH
- \*18 Batteries, two 12 volt
- 19 Starter motor
- \*20 Relays for horn and infra red lighting
- 21 Ignition coil
- 22 Filter unit for ignition coil
- \*23 Windscreen wiper motor
- \*24 Windscreen washer pump
- 25 Headlight, LH
- 26 Turnlight, front LH
- 27 Side lamp, LH
- 28 Oil pressure switch
- 29 Horn
- 30 Heater motor and suppressor unit
- 31 Headlight, RH
- 32 Stop light switch
- \*33 Fuse box
- 34 Turnlight, front RH
- 35 Side lamp, RH
- 36 Voltage dropper for fuel pump
- \*37 Shunt box
- 38 Generator panel
- 39 Auxiliary ammeter
- 40 Vehicle ammeter
- \*41 Flasher unit

\* On LH Stig models the items indicated are located on the opposite side of the vehicle

CIRCUIT DIAGRAM—24 VOLT MODELS



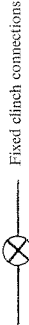
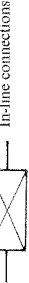
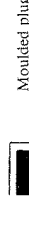
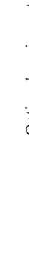
Key to circuit diagram—24 volt models

- |   |  |
|---|--|
| 1 Vehicle batteries, two 12 volt            | 43 Oil pressure warning light              |
| 2 Inspection lamp sockets                   | 44 Fuel gauge                              |
| 3 Heater motor                              | 45 Stop lamp switch                        |
| 4 In-line fuse for heater                   | 46 Windscreen wiper/washer switch          |
| 5 Suppressor unit for heater motor          | 47 Auxiliary ammeter                       |
| 6 Resistor                                  | 48 Radio fuse                              |
| 7 Horn                                      | 49 Shunt box                               |
| 8 Ammeter illumination                      | 50 Ignition warning light                  |
| 9 Grouped instrument illumination           | 51 Winch warning light (when fitted)       |
| 10 Speedometer illumination                 | 52 Filter unit for ignition coil           |
| 11 Stop lamp, LH                            | 53 Ignition coil                           |
| 12 Side lamp, LH                            | 54 Brake stop switch                       |
| 13 Convoy lamp                              | 55 Warning light and test button switch    |
| 14 Tail lamp, RH                            | 56 Fuel tank unit                          |
| 15 Number plate illumination                | 57 Fuel pump                               |
| 16 Headlamp main beam, RH                   | 58 Gearbox differential lock switch        |
| 17 Headlamp main beam warning light         | 59 Windscreen washer pump                  |
| 18 Headlamp main beam, LH                   | 60 Windscreen wiper motor                  |
| 19 Headlamp dipped beam, LH                 | 61 Hazard warning unit                     |
| 20 Headlamp dipped beam, RH                 | 62 Turnlight warning light                 |
| 21 Headlamp dipped beam, RH                 | 63 Trailer warning light                   |
| 22 Turnlight, front RH                      | 64 Generator panel                         |
| 23 Turnlight, rear RH                       | 65 Alternator 90 amp                       |
| 24 Turnlight, front LH                      | 66 Winch switch (when fitted)              |
| 25 Turnlight, rear LH                       | 67 Distributor                             |
| 26 Pre-engaged starter motor                | 68 Brake system shuttle valve              |
| 27 Heater switch                            | 69 Oil pressure switch                     |
| 28 Horn push                                | 70 Suppressor unit                         |
| 29 Panel light switch                       | 71 Gearbox differential lock warning light |
| 30 Stop lamp, RH                            | 72 Stop lamp, LH                           |
| 31 Relay for infra-red headlight switch     | 73 Stop lamp, LH                           |
| 32 Lighting switch, 6-way                   | 74 Stop lamp, LH                           |
| 33 Infra-red headlight switch               | 75 Auxiliary                               |
| 34 Auxiliary relay                          | 76 Tail lamp                               |
| 35 Headlamp flash and dipper switch         | 77 Convoy                                  |
| 36 Unitary radio/battery pack (when fitted) | 78 Earth                                   |
| 37 Fuses                                    | 79 Spare                                   |
| 38 Hazard warning switch                    | 80 Trailer turnlight, RH                   |
| 39 Turnlight switch                         | 81 Trailer turnlight, LH                   |
| 40 Vehicle ammeter                          | 82 Radio 'Amphenol' plug and socket        |
| 41 Cold start warning light                 | 83 Auxiliary terminals                     |

Key to cable colours

- |          |          |          |
|----------|----------|----------|
| L—Light  | P—Purple | W—White  |
| N—Brown  | R—Red    | Y—Yellow |
| O—Orange | U—Blue   |          |

When cables have two code letters, the first is the main colour and the second the tracer, i.e. RG—Red with Green



MV 336



**CHARGING SYSTEM (24 Volt)****Description**

24 volt vehicles are fitted with a 90 amp AC generating system utilising a CAV AC 90/2 alternator with a CAV 396/3 generator panel incorporating battery and split charge relays and a CAV N66 regulator. A CAV 466/3 shunt box is used for connection of ammeters and auxiliary batteries to the charging circuit plus provision for power take-off, radio station and/or other equipment.

**Alternator (FV 546125 Generator No. 10 Mk 2; See EMER Power W104/13)**

The alternator which is 7,187 in (182,5 mm) in diameter is mounted on the right hand side of the engine and is a partially waterproofed, fan ventilated self-excited machine incorporating a three-phase AC rectification system giving DC outputs of 90 amps at 28.5 volts and a three-phase AC auxiliary output of approximately 1 amp at 28.5 volts over a speed range of 1,900 to 9,250 rev/min.

If immersed, water will enter the alternator housing, but the bearings and slip-ring housings are sealed. The internal electrical components and wiring are treated with an insulating and protective material on assembly.

The AC rectification system employs silicon semiconductor diode rectifiers.

The output of the alternator terminates in a 23 pin M S type plug at the top of the slip-ring end-shield and connections are made as follows:

Pin 'X' and 'W' — Main positive and negative DC supply.

Pin 'F' — Positive DC supply for battery relay coil.

Pin 'A' — Alternator warning light supply.

Pin 'U' and 'V' — Alternator field connections.

Pin 'P', 'T' and 'R' — The three-phase AC supply for power tools when required.

The remaining pins are not used.

**Stator**

The stator is of cast aluminium construction with integral multi-slot lamination housing a three-phase star-connected winding. Connections from the stator windings are made to three square-headed terminal posts which engage in holes provided by locating squares in the heat sinks and are secured by nuts and washers. The connection is in electrical contact with the heat sink and forms a common connection point with two power diodes.

**Rotor and fan assembly**

The rotor shaft is carried on a roller bearing at the driving end and a ball bearing at the slip-ring end. Both bearings are fitted in sealed housings. Lubrication between overhauls is not required.

Rigidly fixed to the shaft is a soft iron circular rotor core over which is wound a single field coil.

Connections from the field coil are housed in a channel cut in one face of the rotor core and along the rotor shaft to a slip-ring assembly. A sealing compound covers the connections in the channel for waterproofing purposes. A cup-shaped, six-fingered casting is bolted at each end of the rotor core; three bolts secure the castings to the core. The fingers envelope the field coil and rotor core to form a twelve-pole field system.

The slip-ring end bearing inner member butts against a shoulder on the rotor shaft; the rear face of the outer member is located in a shallow housing in a bearing clamp ring. The rear of the clamp ring houses an oil seal located over a sleeve extension of one rotor casing.

A cup-shaped thrower plate is fitted to the rotor casing, the cup being located in an annular groove in the rear of the clamp ring. A circlip located in a groove in the rotor shaft is in contact with the outer face of the bearing member, thus retaining it in position.

A slip-ring assembly fitted to one end of the rotor shaft is an integrally moulded unit comprising two slip-rings

moulded in insulating material to a steel bush. The bush is secured to the shaft by special adhesive. Connections from the field coil are soldered to the slip rings. A small slot is provided in each slip-ring for this purpose.

The driving end bearing inner member butts against a sleeve extension of the other rotor casings and the outer member is carried in a housing located in the driving end shield. An annular multi-bladed fan secured to the driving end rotor casing is provided for cooling purposes.

**Slip-ring end shield**

The slip-ring end-shield is spigot-located to the stator yoke and secured by seven socket-headed screws. It is of cast aluminium construction and carries a centrally located compartment housing the slip-ring and incorporating the slip-ring end bearing housing. Screws entered from the bearing housing secure the bearing clamp ring to the housing, a gasket being fitted between the joint. The screws have a sealing compound applied during assembly. The bearing is thus effectively sealed.

Two slip-ring brushes are housed in brush-holders fitted on an insulated plate located on the base of the slip-ring compartment. The brush connections are taken through the compartment wall via insulated terminal studs.

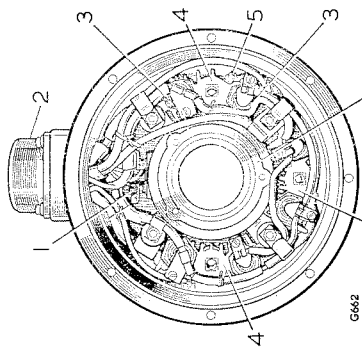
The slip-ring compartment is provided with a flexible rubber diaphragm and stop plate. This arrangement compensates for the expansion and contraction of air within the sealed compartment due to variation of temperature, i.e. when the generator is suddenly immersed in water. The partial vacuum caused would tend to allow water to leak through the seals. The movement of the diaphragm is limited in the direction of the slip-rings by the stop plate, to prevent damage.

A cover plate, provided with breather holes round the periphery, is fitted over the diaphragm. The securing screws are sealed with a rubber sealing ring housed in the cover.

Three 'heat sinks' of finned aluminium construction are located on the inside of the shield. Each sink is provided with three housings, the outer housing two diodes and

the centre a stator connection. A third diode is housed in a lug on a cooling fin of each sink. The heat sinks are secured to, but insulated from, the end shield and each other by insulating strips and bushes.

The purpose of the heat sinks is to dissipate the heat from the diodes, and to further assist these apertures are provided in the shield in front of the heat sinks.



6562  
1 Terminal  
2 Plug  
3 High-current diode  
4 Slip-ring end shield  
4 Heat sink  
5 Low-current diode  
6 Bearing housing

A 23-pin plug is located at the top of the slip-ring end-shield, to which the external connections of the generator are made. Pins X and W are the main DC positive and negative supply, pin F the auxiliary DC positive supply for a battery relay coil located in the generator panel, pin A is a DC positive supply to the generator warning light, pins U and V the generator field connections, and pins P, T and R a three-phase AC supply, not used in this installation. The remaining pins are not used.

The inner surface of the slip-ring shield, all components and connections located in the shield, are sprayed with a special plastic sealing and insulating compound on assembly, for protection against water.

**Driving end shield**

The driving end shield is spigot-located to the stator yoke and is secured by eight studs fitted in the yoke. It is of cast aluminium, carrying a centrally located bearing housing. The housing is constructed in three steps, the outer, housing the driving end roller bearing and the centre, an oil seal. The inner step serves as a labyrinth seal with the rotor shaft and is grease-packed on assembly; the inner end of the step locates in an annular groove on the end face of the rotor casting.

A cover and bearing clamp plate houses a sealing ring and oil seal in contact with a bush carried on the rotor shaft retained in position by a (star tolerance) ring and circlip; a sealing ring is fitted in the bush and is in contact with the rotor shaft. The cover is located in a housing in the end shield and is secured by four screws and spring washers.

Ventilation apertures are provided round the periphery of the shield to permit a flow of air for cooling.

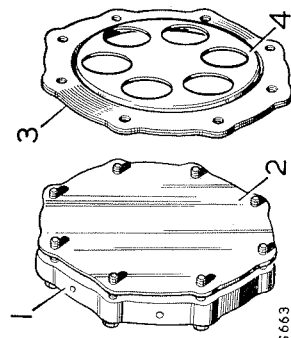
**AC rectification system**

The AC rectification system utilises silicon semi-conductor diodes to provide a high-current DC output to supply the battery charging circuit and a low-current output for energizing the coil of the battery relay.

The diodes located in the heat sink housing are high-current types and those in the cooling fins low-current. Both types are identical in principle of operation and similar in construction, but the physical size differs due to the current ratings. Each diode is of tubular metal case construction provided with a stud, nut and washer at one end and a soldering connection at the other.

The high-current diodes are arranged two per heat sink and are in electrical contact via their metal cases with the sink and with a stator connection. The high-current rectification system is that of a three-phase bridge circuit, each pair of diodes forming a phase rectifier. One diode of each pair rectifies a positive-going half-cycle and the other a negative. As both diodes are in electrical contact with their appropriate heat sink and a stator winding connection, i.e. a common point, one diode is polarised anode to stud and the other cathode to stud. This polarity change is inherent in the diode construction and is signified by the letter 'A' added to the diode type number when the stud is diode anode. The output of the three pairs of diodes are in effect paralleled and give a high-current DC supply.

The low-current diodes are arranged in a three-phase half-wave rectifier circuit and are of the anode stud type.



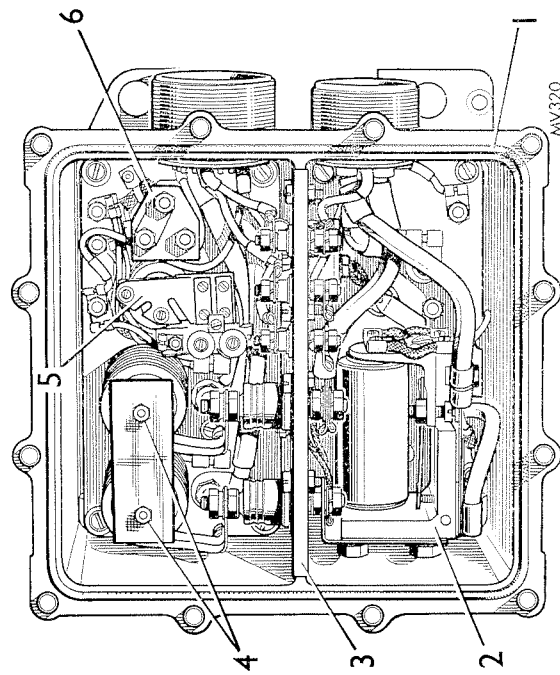
Generator diaphragm assembly  
 1 Cover plate  
 2 Diaphragm  
 3 Gasket  
 4 Stop plate

**GENERATOR PANEL—24 Volt (CAV 396/3)**

The generator panel controls the output of the alternator and is located on the right side of the vehicle immediately behind the front wheel splash plate. It contains a voltage regulator (N66) of the vibrating contact type which maintains the generator terminal voltage between pre-set limits with a progressively increasing current output to

the self-limiting maximum of 90 amps thus no separate current control is necessary. A warning light on the instrument panel provides visual evidence of the functioning of the charging system, being extinguished when the generated voltage exceeds that of the battery.

A battery relay (BCK 102) is included in the generator panel to switch the alternator 'on-line'.



Generator panel, type 396/3  
 1 Sealing ring  
 2 Battery relay  
 3 Division plate  
 4 Filter chokes  
 5 Voltage regulator  
 6 High-low link board

The panel case is of cast aluminium construction and provided with a cover secured to the case by 12 studs with nuts and spring washers. A sealing ring effects a waterproof seal between the case and cover, and a waterproofing test plug is fitted in the cover.

The interior of the case is divided into two compartments by a division plate, one housing the voltage regulator, which is liable to produce radio interference. Also housed in this compartment are associated resistors, a terminal and link unit for changing the charging rate, two tubular capacitors and two chokes. The other compartment houses the battery relay, four diodes, a capacitor and a resistor. The components in each compartment fitted to the underside of the insulating base plates are illustrated.

**Division plate**

The metal division plate is fitted with two bushing capacitors, three tubular metal-cased capacitors and a bobbin type choke for radio interference suppression, and three insulated 'through' terminals. Connections between the compartments are made via the bushing capacitors and the terminals. The three tubular capacitors are soldered to clips secured to the division plate and are connected to the 'through' terminals and earth.

**Voltage regulator**

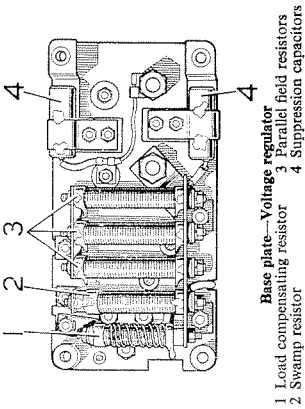
The regulator is of the vibrating contact type which operates to cut resistance rapidly in and out of the generator field circuit in order to maintain a practically constant terminal voltage at all speeds above the speed at which the battery relay closes.

The regulator is mounted on a base with a support pillar and block, to which is secured the contact assembly.

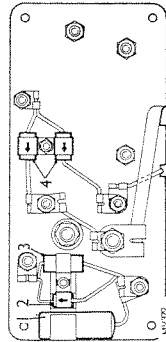
The contact assembly has a clapper-type armature fitted with a flat hinge spring, a set of leaf-type control springs and the moving contact. Above the armature is a contact carrier fitted with an adjustable contact and a control spring pressure adjusting screw. Insulating strips and bushes are used to insulate the contact assembly from the block and the armature from the contact carrier.

The end of the armature control spring assembly is slotted to rest on a stop fitted to the pressure adjusting screw. Electrical setting of the regulator is obtained by the pressure adjusting screw.

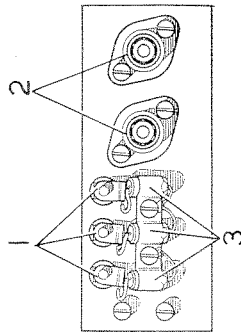
The regulator coil has two windings—a shunt and a bucking. The shunt is the operating coil and is connected in series with a swamp resistor and a load compensating resistor across the generator positive and negative lines.



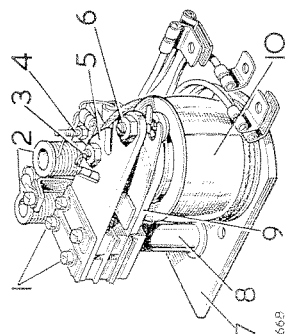
**Base plate—Voltage regulator**  
 1 Load compensating resistor  
 2 Swamp resistor  
 3 Parallel field resistors  
 4 Suppression capacitors



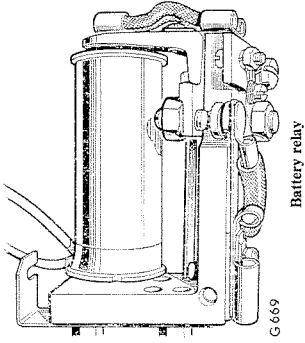
**Base plate—battery relay**  
 1 Radio suppression capacitor  
 2 Reverse battery protection diode  
 3 Resistor  
 4 Reverse battery protection diodes



**Division plate**  
 1 Terminals  
 2 Bushing capacitors  
 3 Capacitors



**Voltage regulator**  
 1 Armature fixing screws  
 2 Choke coils  
 3 Adjustable contact  
 4 Terminal stud  
 5 Contact carrier  
 6 Pressure adjusting screw  
 7 Base  
 8 Support pillar  
 9 Armature  
 10 Regulator coil



Battery relay

wound in opposition to the shunt winding, one end being connected to the vehicle and to the radio battery positive lines via two blocking diodes and the other end to the negative line. Reverse current flowing via the appropriate diode through the coil prevents the relay closing. Additionally a diode is connected in parallel with the radio circuit contacts.

The relay windings are wound on a former mounted on an angle frame. The armature carrying the moving contacts is riveted to a hinge spring which is fixed to the top of the frame by two screws.

The armature is set so that there is a gap between the back of the armature and the frame when the armature is pressed down on to the core; packing pieces fitted between the top of the frame and the under side of the hinge spring ensure that the spring is lying flat when the armature is in this position. A stop plate, fixed above the armature, controls its upward movement. The armature carries the full generator current, and to prevent overheating of the hinges spring two flexible leads connect the armature to the frame.

Two pairs of contacts are provided, main and auxiliary. The auxiliary contacts make first and complete a supply for radio batteries; the main contacts are connected to the vehicle battery. The moving contacts are fixed directly to the armature, the auxiliary contacts being of the adjustable type. The stationary contacts are attached to, but insulated from, the frame, the main contacts being of the solid adjustable type, and the auxiliary contact is mounted on a spring strip to permit follow-through of the armature to close the main contacts.

An adjusting screw with locknut is fitted to the frame to press against the end of a strip spring riveted to the armature to control the operating voltage.

**Filter chokes**

Two filter chokes are connected in series via the bushing capacitors with the generator positive and negative lines. In conjunction with the bushing and tubular capacitors on the division plate, they form a radio interference filter between 'dirty' and 'clean' compartments.

**SHUNT BOX—24 Volt (CAV 466/3)**

The shunt box contains two separate ammeter shunts, rated at 75 m v drop for 100 amps, to supply the ammeters for the vehicle and radio batteries.

A fast fuse is fitted in the radio/auxiliary battery positive line to protect the batteries and the on-line alternator.

Additional radio suppression is provided by two capacitors which, with the connecting lead inductance, form an electrical filter.

An Amphiphenol plug socket is mounted on the battery box under the shunt box. This provides a connection via the auxiliary ammeter shunt for the unitary radio/battery pack, its batteries being charged at the same time as the vehicle batteries, while the engine is running.

The terminals on the top side of the shunt box provide a supply for auxiliary installation, when the engine is running and/or when the unitary radio/battery pack is plugged in. Alternatively, other batteries may be connected to these terminals for charging. It should be noted however, that the auxiliary ammeter will not register the charge on this circuit.

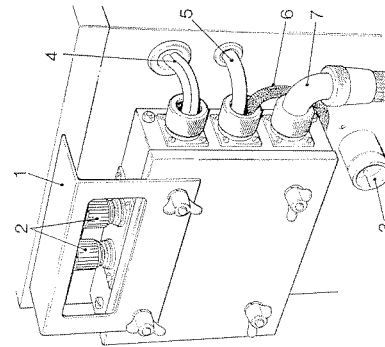
**OPERATION OF CHARGING SYSTEM—24 Volt**

**Close ignition switch—energise alternator field**

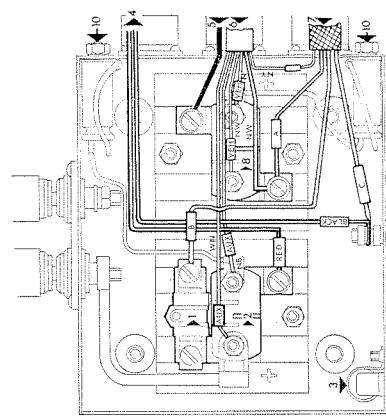
Positive battery through warning lamp (which lights), into panel at E, with (radio suppression) capacitor, through (reverse battery lamp protecting) diode, then through (radio suppression) choke and out at A, into alternator at A and out at X, back into panel at X, through regulator contacts, out of panel at V, into alternator at V to field winding. The other end of the field is connected to negative battery through U on alternator, into panel at U, through negative inductor and bushing capacitor, out of panel at C, into shunt box to earth terminal.

**Start engine—drive alternator**

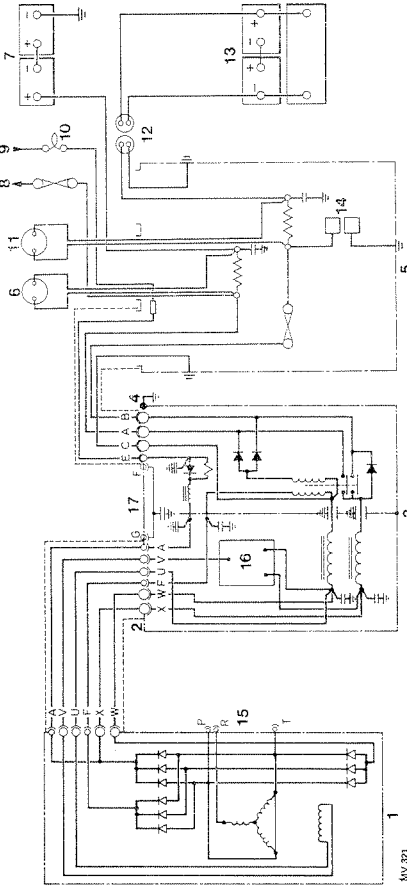
At 18-20 volts alternator auxiliary diode positive through alternator and panel F to the operating coil of the battery relay closes it to complete the alternator positive to the shunt box via generator/panel X splitting at the relay contacts to vehicle positive via A and radio positive via B. In the shunt box vehicle positive is through one ammeter shunt while radio positive is through the fast fuse, the other shunt and via the 'Amphiphenol' socket to the unitary radio/battery pack. Simultaneously the current flows through the fast fuse to the auxiliary '-' terminal on the top of the shunt box.



- 1 Cover plate for terminals
- 2 Auxiliary terminals
- 3 'Amphiphenol' socket for unitary radio/battery pack plug
- 4 Leads to 'Amphiphenol' socket
- 5 Lead from vehicle batteries
- 6 Cable from ammeters
- 7 Cable from generator panel



- 1 Radio auxiliary fuse
- 2 Auxiliary shunt
- 3 Spare fast fuse
- 4 Cable to 'Amphiphenol' socket
- 5 Cable from batteries
- 6 Cables from ammeters
- 7 Cable from generator panel
- 8 Vehicle shunt
- 9 Earth return
- 10 Radio anti-interference capacitors (2 off)



**Charging circuit—24 volt 90 amp**

- 1 Alternator
- 2 Plug No. 1
- 3 Generator panel
- 4 Plug No. 2
- 5 Shunt box
- 6 Vehicle ammeter
- 7 Vehicle batteries
- 8 Vehicle supply from fuse box
- 9 Ignition warning light
- 10 Ignition warning light
- 11 Radio
- 12 Radio 'Amphiphenol' plug and socket
- 13 Unitary radio/batteries pack
- 14 Auxiliary terminals
- 15 Power tools
- 16 Voltage regulator and high/low link
- 17 Pins 1G-2F not used

**Voltage regulation**

At slow alternator speed the battery voltage will exceed the alternator voltage so that the battery continues to supply the field current and the warning light remains on. The alternator diodes will, however, block any reverse current through the alternator windings.

At cutting-in speed the alternator voltage will balance the battery voltage and supply the field current via generator panel X through the regulator contacts to V.

At higher speed the voltage will rise, when the battery is sufficiently charged, to 28½-29 volts. Further rise is prevented by the resulting increase of current through the regulator causing the contacts to open to introduce resistance into the field circuit. This results in a drop of voltage so that the contacts re-close allowing the voltage to rise again and repeat in a rapid cyclic manner.

For hot ambient the maximum voltage can be reduced 2 volts by an adjustment to decrease the regulator circuit resistance.

**Radio frequency suppression**

Alternator diode r.f. radiation is attenuated by the alternator casing metal end shield which houses the diode assemblies. Nevertheless radio aerials should be installed remotely from the alternator to avoid interference pick-up from this source.

Alternator electrical r.f. noise is carried out of the alternator through the connecting cables which must therefore be metallically screened and bonded to earth. This is in the compartment of the generator panel which houses the regulator, another source of electrical noise.

This interference is contained within the compartment by the metal casing of the panel. The heavy current leads are filtered by inductances and bushing capacitors as they pass through the screening wall to the battery relay in the outlet compartment. The light current leads are filtered by tubular capacitors connected to the outlets. Additional filtration is provided by the screened cable between the generator panel and the shunt box and the capacitors in the latter.

**Reverse battery protection**

Batteries accidentally connected with reverse polarity are prevented from discharging through the alternator by inhibiting closure of the battery relay. This is effected by the opposing action of the second relay winding being energised by reverse polarity current through one or both of the two sensing diodes in its circuit.

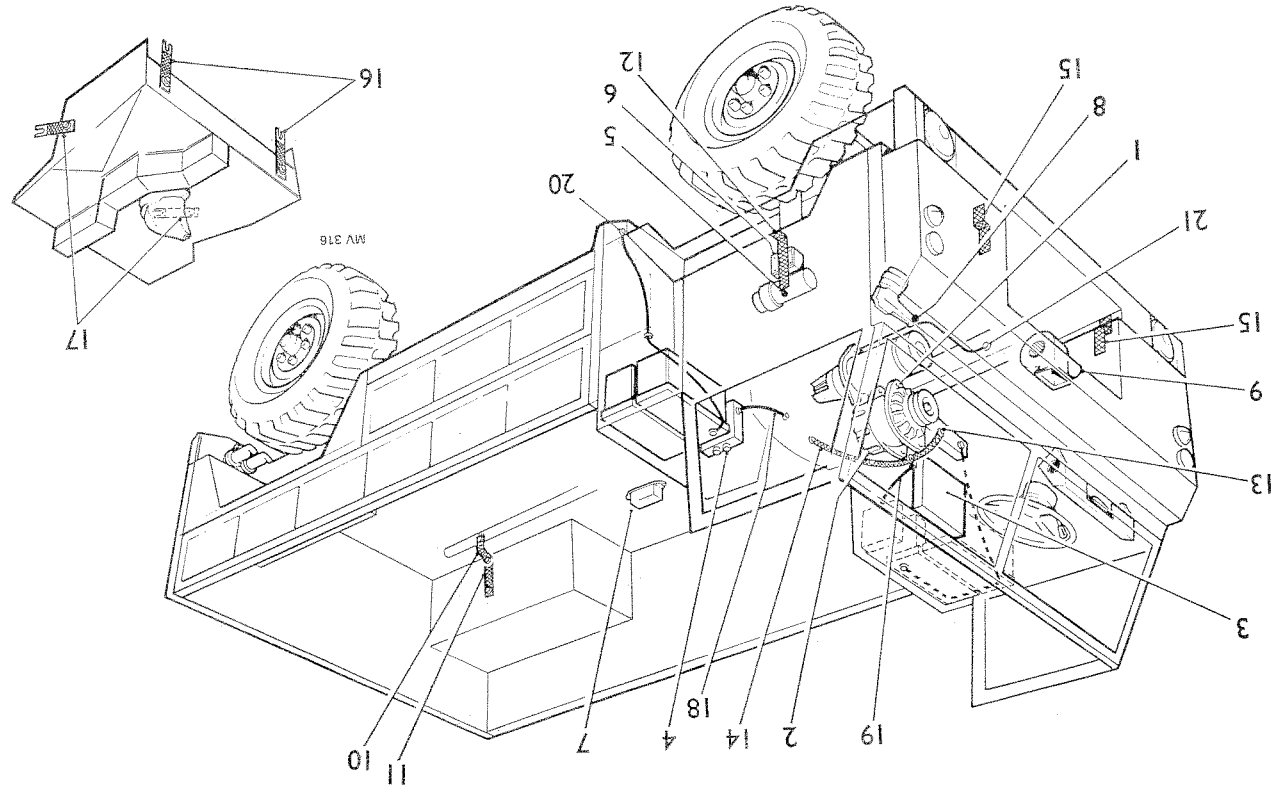
The ignition warning lamp is protected from the addition of battery and alternator voltage by the resistance connected to the panel E pin, its shorting diode becoming non-conducting with the polarity reversal.

**Battery lead shorting protection**

If a battery were disconnected from the shunt box auxiliary terminals and the leads allowed to contact the vehicle body the positive lead would complete a short circuit across the alternator through the panel battery relay contacts. Since this would drop the field voltage the alternator output would be reduced and the battery relay drop out. The diode across its radio supply contacts would maintain the short circuit and so keep the alternator voltage too low for the battery relay to pull in. In this condition the warning lamp would glow from the vehicle battery positive.

FAULT DIAGNOSIS		ELECTRICAL		ELECTRICAL	
SYMPTOM	POSSIBLE CAUSE	CURE	SYMPTOM	POSSIBLE CAUSE	CURE
<b>A—BATTERY IN LOW STATE OF CHARGE</b>	1. Broken or loose connection in alternator circuit 2. Current voltage regulator not functioning correctly 3. Slip-rings greasy or dirty 4. Brushes worn, not fitted correctly	1. Examine the charging and field circuit wiring. Tighten any loose connections and renew any broken leads. Examine the battery connection 2. Adjust or renew 3. Clean 4. Renew	<b>M—ENGINE MISFIRES</b>	1. Distributor points incorrectly set 2. Faulty coil or condenser 3. Faulty sparking plugs 4. Faulty carburetor	1. Adjust 2. Renew 3. Rectify 4. Check and rectify
<b>B—BATTERY OVERCHARGING, LEADING TO BURNT-OUT BULBS AND FREQUENT NEED FOR TOPPING-UP</b>	1. Current voltage regulator not functioning correctly	1. Renew	<b>N—FREQUENT RECHARGING OF THE BATTERY NECESSARY</b>	1. Alternator inoperative 2. Loose or corroded connections 3. Slipping fan belt and/or Alternator belts (24 volt) 4. Voltage control out of adjustment 5. Excessive use of the starter motor 6. Vehicle operation confined largely to night driving	1. Check the brushes, cables and connections or renew the alternator 2. Examine all connections, especially the battery terminals and earthing straps 3. Adjust 4. Renew 5. In the hands of the operator 6. In the hands of the operator
<b>C—LAMPS GIVING INSUFFICIENT ILLUMINATION</b>	1. Battery discharged 2. Bulbs discoloured through prolonged use 3. Headlights misaligned	1. Charge the battery from an independent supply or by a long period of daylight running 2. Renew 3. Check the setting	<b>P—ALTERNATOR NOT CHARGING CORRECTLY</b>	1. Slipping fan belt and/or Alternator belts (24 volt) 2. Voltage control not operating correctly 3. Greasy, charred or glazed slip-rings 4. Brushes worn, sticking or oily 5. Shorted, open or burnt-out field coils	1. Adjust 2. Rectify or renew 3. Clean 4. Rectify or renew 5. Renew
<b>D—LAMPS LIGHT WHEN SWITCHED ON BUT GRADUALLY FADE OUT</b>	1. Battery discharged	1. Charge the battery from an independent supply or by a long period of daylight running	<b>Q—ALTERNATOR NOISY</b>	1. Worn, damaged or defective bearings 2. Cracked or damaged pulley 3. Alternator belt slipping 4. Alternator loose in mounting 5. Excessive brush noise	1. Renew 2. Renew 3. Rectify 4. Rectify 5. Check for rough or dirty slip-rings, badly seating brushes, incorrect brush tension, loose brushes and loose field magnets. Rectify or renew
<b>E—LIGHTS FLICKER</b>	1. Loose connection	1. Tighten	<b>R—DEFECTIVE DISTRIBUTOR</b>	1. Contact breaker gap incorrect or points burned and pitted 2. Distributor cap cracked 3. Weak or broken contact breaker spring 4. Excessive wear in distributor shaft bushes, etc. 5. Rotor arm pitted or burned 6. If the engine lacks power, or misfires, it may be due to a faulty condenser	1. Clean and adjust 2. Renew 3. Renew 4. Renew 5. Clean or renew 6. Renew the condenser
<b>F—FAILURE OF LIGHTS</b>	1. Battery discharged 2. Loose or broken connection	1. Charge the battery from an independent supply or by a long period of daylight running 2. Locate and rectify	<b>S—COLD START CONTROL WARNING LIGHT FAILS TO APPEAR WHEN CONTROL IS PULLED OUT</b>	1. Broken connection in warning light circuit 2. Blown bulb 3. Faulty switch	1. Rectify 2. Renew 3. Renew
<b>G—STARTER MOTOR LACKS POWER OR FAILS TO TURN ENGINE</b>	1. Stiff engine 2. Battery discharged 3. Broken or loose connection in starter circuit 4. Greasy or dirty commutator 5. Brushes worn not fitted correctly 6. Brushes sticking in holders or incorrectly tensioned 7. Starter pinion jammed in mesh with flywheel	1. Locate cause and remedy 2. Charge the battery either by a long period of daylight running or from an independent electrical supply 3. Check and tighten all battery, starter and starter switch connections and check the cables connecting these units for damage 4. Clean 5. Renew 6. Rectify 7. Remove starter motor and investigate flywheel	<b>T—COLD START CONTROL WARNING LIGHT REMAINS ON WHEN CONTROL IS PUSHED IN</b>	1. Faulty switch	1. Renew
<b>H—STARTER NOISY</b>	1. Starter pinion or flywheel teeth chipped or damaged 2. Starter motor loose on engine 3. Armature shaft beating	1. Renew 2. Rectify, checking pinion and the flywheel for damage 3. Renew	<b>U—POOR PERFORMANCE OF HORNS</b>	1. Low voltage due to discharged battery 2. Bad connections in wiring 3. Loose fixing bolt 4. A faulty horn	1. Recharge, inspect all connections and carefully inspect all connections and terminals 3. Rectify 4. Adjust or renew
<b>J—STARTER OPERATES BUT DOES NOT CRANK THE ENGINE</b>	1. Pinion of starter does not engage with the flywheel	1. Check operation of starter solenoid. If correct, remove starter motor and investigate	<b>V—RADIO INTERFERENCE</b>	1. Loose, dirty or fractured connections 2. Faulty suppressors 3. Faulty screened leads (24 volt)	1. Check all earth leads and bonding strips—rectify or renew (see page 24) 2. Renew (see page 24) 3. Rectify or renew
<b>K—STARTER PINION WILL NOT DISENGAGE FROM THE FLYWHEEL WHEN THE ENGINE IS RUNNING</b>	1. Starter pinion jammed in mesh with the flywheel	1. Remove starter motor and investigate			
<b>L—ENGINE WILL NOT FIRE</b>	1. The starter will not turn the engine due to a discharged battery 2. Sparking plugs faulty, dirty or incorrect plug gaps 3. Defective coil or distributor 4. 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 switched on 5. Dirty or pitted contacts 6. Contact breaker out of adjustment 7. Controls not set correctly or trouble other than ignition	1. The battery should be recharged by running the car for a long period during daylight or from an independent electrical supply 2. Rectify or renew 3. Remove the lead from the centre distributor terminal and hold it approximately 6 mm ( $\frac{1}{4}$ in) 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 4. Examine all the ignition cables and check that the bottom terminals are secure and not corroded 5. Clean 6. Adjust 7. See "Operating Instructions" in User handbook			

LOCATION OF SUPPRESSOR UNITS, BONDING STRIPS, AND MAIN EARTH LEADS



SUPPRESSION OF ELECTRICAL INTERFERENCE

The use of VHF radio equipment calls for a high standard of vehicle suppression, if radio interference is to be effectively controlled. Good maintenance of the electrical system is therefore essential. Even where a radio is not fitted, the vehicle's electrical system can cause interference to other radios in the immediate vicinity.

Regular attention to the condition, cleanliness and tightness of mating surfaces and connections of the following items are recommended:—

Spark plugs, distributor and coil, ignition and battery leads. Additionally ensure that there is no intermittent contact on any of the fuses, leads, switches or connections. Both 12 and 24 volt models are affected but the 24 volt vehicle, which is specially prepared to receive a radio station, is fully screened and suppressed to prevent interference. The screened leads fitted to 24 volt models should also be inspected for damage or loose connections.

The following items are fitted with suppressors.

SUPPRESSORS

Unit	Located	Operation
1 Alternator (12 volt)	on lower alternator fixing bolt	86.10.08
2 Alternator (24 volt)	in screened alternator	86.10.08
3 Generator panel (24 volt)	in screened panel	86.10.25
* 4 Shunt box (24 volt)	in screened box	86.10.41
5 Ignition coil (12 volt)	on upper coil fixing bolt	86.35.32
6 Ignition coil (24 volt)	filter unit (under coil)	86.35.28
7 Fuel pump (12 and 24 volt)	suppressor box on fuel tank	85.55.35
* 8 Wiper motor (12 and 24 volt)	on motor fixing bracket	84.15.09
9 Heater (12 and 24 volt)	two in motor brush gear	80.20.15

A number of bonding strips and main earth leads are used to connect some of the body panels, exhaust system and electrical units to the vehicle electrical earth system to help prevent the possibility of these items causing radio interference. They are as follows:—

BONDING STRIPS

- \*10 Tail pipe to chassis bracket (12 and 24 volt)
- \*11 Chassis bracket to body (24 volt)
- 12 Ignition coil and filter unit to chassis (24 volt)
- 13 Generator panel to chassis front outrigger—right side (24 volt)
- 14 Generator panel to engine rear, right side (24 volt)
- 15 Headlamp earth return, body to chassis, front (24 volt)
- 16 Engine cover to body tunnel (24 volt)
- 17 Engine cover to seat panel (24 volt)

MAIN EARTH CONNECTIONS

- 18 Shunt box (RH Stig) to engine rear, left side (24 volt)
- 19 Shunt box (LH Stig) to generator panel (24 volt)
- \*20 Battery to chassis front outrigger (12 and 24 volt)
- 21 Starter motor to engine chassis mounting—front right (12 and 24 volt)

\* On LH Stig models the items indicated are located on the opposite side of the vehicle.

Ensure that all bonding strips and earth connections are intact, secure at both ends and kept clean and free from corrosion or paint.

ALTERNATOR—12 Volt (Lucas 16ACR)

Static test for charging system (See EMER Power W003) 86.10.01

Check the battery

1. Check with a hydrometer the specific gravity of the electrolyte in each of the battery cells. If the cell readings vary by more than 40 points (0.040), the battery is suspect. Specific gravity readings should be:

State of charge	Specific gravity readings correct to 15°C (60°F)	
	Climates normally below 25°C(77°F)	Climates normally above 25°C(77°F)
Fully-charged	1.270—1.290	1.210—1.230
70% charged	1.230—1.250	1.170—1.190
Discharged	1.100—1.120	1.050—1.070

Electrolyte Temperature Correction

For every 10°C (18°F) below 15°C (60°F) subtract 0.007. For every 10°C (18°F) above 15°C (60°F) add 0.007. If the battery is found to be discharged it should be independently recharged, renewed, or substituted for the following tests.

Check the Driving Belt

2. Check whether the alternator driving belt is broken or slipping. (See 26.20.07 or 26.20.01).
3. The ignition warning light is connected in series with the alternator field circuit. Bulb failure will prevent the alternator charging except at very high engine speeds. Therefore the bulb should be checked before suspecting an alternator fault.

Precautions

The alternator contains polarity—sensitive components which may be irreparably damaged if subjected to incorrect polarity. Observe polarity of alternator and battery terminals. Battery polarity is negative earth. Ensure that no connections in the charging circuit, including the battery is made or broken while the engine is running.

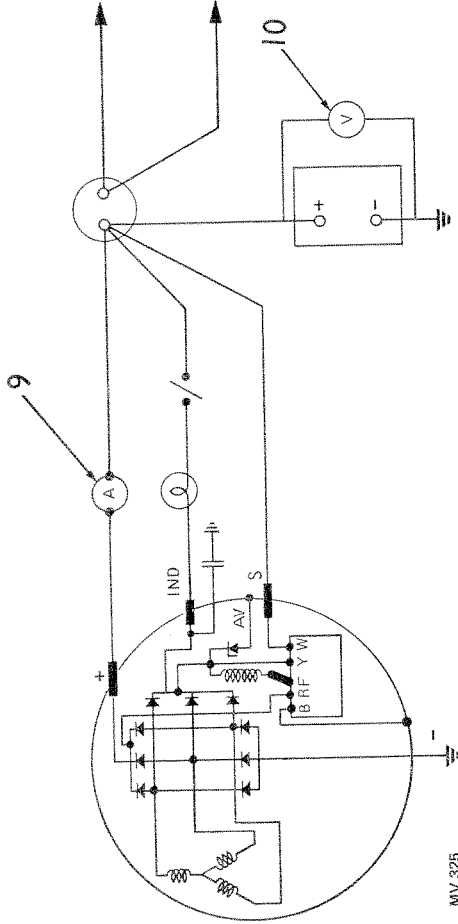
Check alternator plug connections

4. Switch ignition ON.
5. Remove connector plug from alternator.
6. Connect a 0–20V voltmeter between each cable end in turn and the frame (negative connection). Battery voltage should be registered.
7. If the test is unsatisfactory the continuity fault in the external cable circuits must be traced and remedied.
8. Refit plug.

continued

Checking alternator charging current and alternator controlled voltage at the battery terminals.

9. Connect a 0–60A ammeter in the alternator output cable to the battery.
10. Connect a voltmeter across the battery terminals so that battery voltage is observed.
11. Start the engine, increase speed (disregard the voltmeter at this stage) and observe the ammeter reading.
12. If the ammeter registers zero amps the alternator is faulty and must be removed from the vehicle for further checks and rectification. (See Bench test 86.10.14).



13. If the ammeter registers a charging current in excess of 10 amps continue running the engine until the ammeter reading falls below 10 amps and observe the voltmeter reading. 13.6 – 14.4 volts should be registered (alternator controlled voltage), in which case the charging system is working normally.
14. If the voltmeter reading exceeds 14.4 volts the alternator should be removed from the vehicle and the regulator renewed otherwise the battery will be subjected to overcharging and the alternator will be overworked.
15. If the voltmeter reading is below 13.6 volts a faulty regulator or a high resistance fault in the external connections of the charging system is indicated. The following test should be carried out.

Charging circuit volt drop testing

16. Check for a high resistance fault in the charging system by carrying out two separate volt drop tests on the insulated side and earth side of the charging circuit. The tests must be carried out with all the alternator cables connected. (The connector plug is fitted with a detachable cover to facilitate testing while plugged in).

continued

17. Switch on the headlamps to load the charging system, run the engine at normal working road speed and connect the voltmeter as follows:

**Insulated side volt drop test**

18. Connect the voltmeter between the alternator main output '+' terminal and the '+' terminal of the battery.

The test is satisfactory if the voltmeter registers 0 - 0.5 volts. If a higher reading is obtained a high resistance fault between the positive side of the battery and the alternator positive terminal must be traced and corrected.

**Earth side volt drop test**

19. Connect the voltmeter between the alternator frame and the '-' earth terminal of the battery.

The test is satisfactory if the voltmeter registers 0 - 0.25 volts. If a higher reading is obtained a high resistance fault on the earth side of the charging circuit must be traced and corrected.

**Diodes**

20. Failure of one or more of the nine rectifier diodes will affect alternator output. (It may also create an abnormally high alternator temperature and noise level. (See Bench test 86.10.14 paragraph 27).

**ALTERNATOR—24 Volt. (CAV AC 90/2)**

**Static test for charging system.**

(On vehicle testing; See EMER Power W133) 86.10.01

**Check the Batteries**

1. Check with a hydrometer the specific gravity of the electrolyte in each of the battery cells. If the cell readings vary by more than 40 points (0.040), the battery is suspect. Specific gravity readings should be:

State of charge	Specific gravity readings correct to 15°C (60°F)	
	Climates normally below 25°C(77°F)	Climates normally above 25°C(77°F)
Fully-charged	1.270—1.290	1.210—1.230
70% charged	1.230—1.250	1.170—1.190
Discharged	1.100—1.120	1.050—1.070

**Electrolyte Temperature Correction**

For every 10°C (18°F) below 15°C (60°F) subtract 0.007. For every 10°C (18°F) above 15°C (60°F) add 0.007. If the battery is found to be discharged it should be independently recharged, renewed, or substituted for the following tests.

**Check the Driving Bolt**

2. Check whether the alternator driving belt is broken or slipping. (See 86.10.03 or 86.10.05).

*continued*

**Check the ignition warning bulb**  
3. The bulb is connected in series with the alternator field circuit. Bulb failure will prevent the alternator charging except at very high engine speeds. Check and renew if necessary.  
4. Under no circumstances must a megger rated above 100 volts be used for tests involving diodes. All speeds referred to are engine speeds. The alternator is designed and fitted to run faster than engine speeds, the ratio being approximately 1.75:1. The manufacture and use of the test harness illustrated is recommended.

**Harness—static test**

5. With engine switched off disconnect both ends of the vehicle harness connecting the alternator to the generator panel.
6. Test the harness for insulation resistance using a 500 volt megger. The insulation should not be less than two megohms between pins and pins to earth. Continuity of each core should be tested using the ohmmeter. Examine the harness for damage. If the harness fails any of these tests, rectify or renew.
7. Connect the harness.

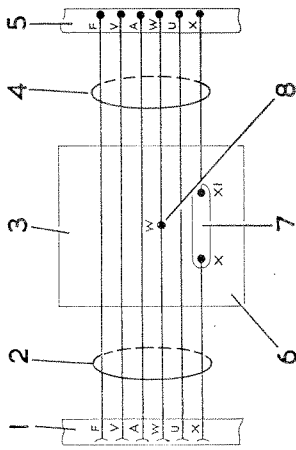
**Alternator—static test**

8. With the engine switched off carry out the following tests at the generator panel end of the harness.
  9. With the multi-meter set to the resistance range of 0 - 10,000 ohms and the negative connected to pin W, check the following circuits:
    - W to X resistance . . . . . 90 to 100 ohms
    - W to F resistance . . . . . 110 to 140 ohms.
  10. With the positive multi-meter lead connected to pin W check that the above circuit resistance readings exceed 10,000 ohms.
  11. Check the continuity between pins U and V using the ohmmeter. The resistance should not be below 14.5 ohms. If the reading is high the engine should be turned over until the lowest reading is obtained at a reduced brush contact resistance.
  12. The insulation of all plug pins at the generator panel end of the harness, with the other end plugged into the alternator should not be less than 5 megohms when tested to earth using the 500 volt megger.
  13. If any of the alternator static tests are unsatisfactory the alternator should be removed for examination and rectification.

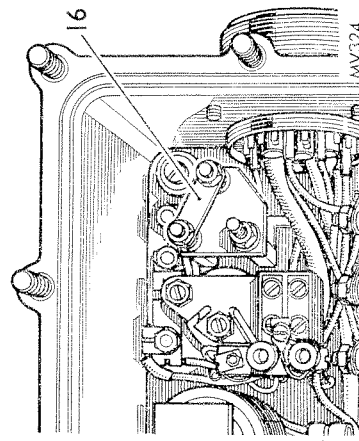
**Alternator functional test**

14. Connect the vehicle cable harness normally fitted to plug number 2 of the generator panel.
15. Connect the test harness between the alternator harness and socket number 1 of the generator panel.
16. Check that the 'High - Low' link is in the 'High' position.
17. Apply a DC voltage of 20 volts—positive to 2C, negative to 2A. With a separate DC voltage of 28.5 volts applied—positive to 1F, negative to 2C. The battery relay must not close.

*continued*



G672



MV324



18. Set the multi-meter to the 100 volt DC range and connect between terminals X (positive) and W (negative) on the test harness. Remove the link between terminals X and X1 on the test harness and connect the second multi-meter and 100 amp shunt between terminals X and X1.
19. Switch ignition on and start and run the engine. Set the alternator speed to 2,000 rev/min (1,150 engine rev/min). With a load not exceeding 10 amps check that the voltage (terminal X6W) is 28.5 to 29 volts.
20. Switch ignition off.
21. Set the 'High - Low' link to the 'Low' position. Switch the ignition ON and run the alternator at 2,000 rev/min.
22. Check that the voltage at terminals X and W is 26.5 to 27 volts with a load not exceeding 10 amps.
23. Switch ignition OFF and set the 'High - Low' link to the 'High' position.
24. Switch ignition ON. Start and run the engine.
25. Refer to the table below and switch on a selected load, i.e. vehicle lighting, heater etc. and set engine speed as appropriate. Check that the voltage (terminals X and W) is 28.5 to 29 volts. Repeat for other loads given in the table. The maximum load must not exceed 90 amps.

At an ambient temperature of 25°C (45°F)	
Vehicle load (amps)	Engine speed (rev/min)
10	1,050
20	1,150
30	1,250
40	1,350
50	1,450

26. Increase the engine speed to maximum and increase the load to the maximum obtainable but not exceeding 90 amps. Check that the DC voltage measured at terminals X and W of the test harness remains steady at 28.5 to 29 volts.  
**NOTE:** Discharged batteries connected across the vehicle batteries can be used as additional load.
27. Switch the ignition OFF.

#### ALTERNATOR—12 Volt (Lucas 16-ACR)

##### —Remove and refit 86.10.02

##### Removing

1. Disconnect the battery earth lead.
2. Reverse the spring clip retaining the alternator multi-pin plug.
3. Disconnect the multi-pin plug.
4. Slacken the nut and bolt securing the adjuster strap to the water pump body.
5. Slacken the nut and bolt securing the slotted end of the adjuster strap to the alternator.
6. Slacken the two nuts and bolts securing the alternator to its mounting brackets.  
**NOTE:** The lower bolt also carries a radio interference suppressor.
7. Pivot the alternator towards the engine and release the drive belt from the alternator pulley.
8. Remove the three nuts, bolts and spring washers, (items 5 to 6).
9. Remove the alternator and fan guard.

##### Refitting

10. Locate the alternator in position on its mounting brackets.
11. Fit the fan guard, the two bracket bolts (including suppressor) and the adjusting strap bolt. Fit the three spring washers and nuts.
12. Fit and tension the drive belt, 86.10.05.
13. Tighten the two bracket bolts and the two adjuster strap bolts.
14. Fit the multi-pin plug.
15. Connect the battery earth lead.

#### ALTERNATOR—24 Volt (CAV AC 90/2)

##### —Remove and refit 86.10.02

##### Removing

It should be noted that the alternator weighs some 40 lb (18 kg) and care must be exercised when removing it.

1. Disconnect the batteries.
2. Disconnect the multi-point socket from the alternator.
3. Slacken the belt tension adjuster and release the belts from the alternator pulley.
4. Support the alternator with a rope sling or similar device.
5. Remove the four bolts, washers and nuts securing the alternator to the engine brackets.
6. Remove the alternator.

##### Refitting

7. Reverse instructions 2 to 6.
8. Adjust drive belt tension.
9. Connect the battery.

## ALTERNATOR DRIVE BELTS—24 Volt

## —Remove and refit

86.10.03

## Removing

1. Slacken the three bolts securing the pulley bracket.
2. Slacken the pulley bracket adjustment bolt locknut.
3. Slacken the adjusting bolt.
4. Remove the alternator drive belts.

## Refitting

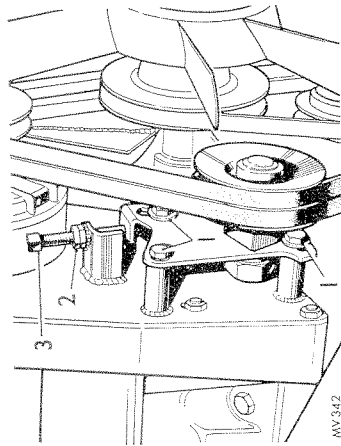
5. Fit the alternator drive belts to the pulleys.
6. Tighten the adjustment bolt until the belts are tensioned to provide  $\frac{1}{4}$  to  $\frac{5}{8}$  in (6 to 8 mm) deflection on the longest run between pulley centres.
7. Tighten the adjustment bolt locknut.
8. Tighten the three bolts securing the pulley bracket.  
**NOTE:** Do not renew an individual alternator drive belt, renew both belts.

## ALTERNATOR DRIVE BELTS—24 VOLT

## Adjust

86.10.05

1. Slacken the three bolts securing the pulley bracket.
2. Slacken the pulley bracket adjustment bolt locknut.
3. Rotate the adjusting bolt clockwise to tighten the drive belts; anti-clockwise to slacken the drive belts.
4. Belt adjustment is correct when the belts have a maximum deflection of  $\frac{1}{4}$  to  $\frac{5}{8}$  in (6 to 8 mm) on the longest run between pulley centres.
5. Tighten the adjustment bolt locknut.
6. Tighten the three bolts securing the pulley bracket.



## ALTERNATOR—12 Volt (Lucas 16 ACR)

## Overhaul

86.10.08

1. Remove the alternator 86.10.02.
2. Carry out Bench test 86.10.14.
3. The following dismantling instructions are sufficient to enable the brushgear and slip-rings to be thoroughly inspected and serviced and the rotor and stator-windings and rectifier diodes to be electrically tested. If it is necessary to completely dismantle the alternator in order to renew a faulty part, refer to paragraphs 23 – 38.
4. Remove the moulded slip-ring end cover (two bolts).
5. Note the location of the three stator winding connections to the rectifier diode connecting pins, and then using a thermal shunt (long-nosed pliers are suitable) and a light weight soldering iron (25 watt) unsolder the connections to the rectifier. Use only resin cored solder for re-soldering.
6. Unclip the three leads from the rectifier plates.
7. Slacken the rectifier securing nut and detach the rectifier from the rest of the alternator.
8. Remove the hexagon-headed screw retaining the surge device lead to the brushbox moulding.
9. Remove the two hexagon-headed screws, securing the brushbox moulding to the end-face of the slip-ring end bracket. The brushgear-and-regulator sub-assembly can now be detached from the rest of the alternator.
10. To release the regulator remove the hexagon-headed screw retaining the yellow lead to the brushbox moulding and the single bolt securing the regulator case.

**NOTE:** To ensure correct re-connection of the regulator, brushgear and rectifier see paragraph 36.

## Brushgear

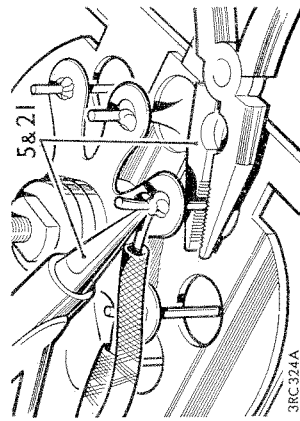
11. Check the brush spring pressure. With the brush-and-spring assemblies fitted in the brushbox moulding, apply a push-type spring gauge to the end-face of each brush in turn until the end-face of the brush is flush with the moulding. The spring pressure should then be 9-13 ozf (255-368 gmf).

## Rotor slip-rings

12. The slip-rings should be clean and smooth. If necessary, clean the slip-rings with a petrol moistened cloth. If the slip-rings are burnt and require refinishing, use very fine glass paper (not emery cloth, or similar abrasives) and afterwards wipe clean with a petrol-moistened cloth.

**NOTE:** It is essential that the re-finishing glass paper is sufficiently fine to produce a highly polished slip-ring surface, otherwise excessive brush wear will occur.

*continued*

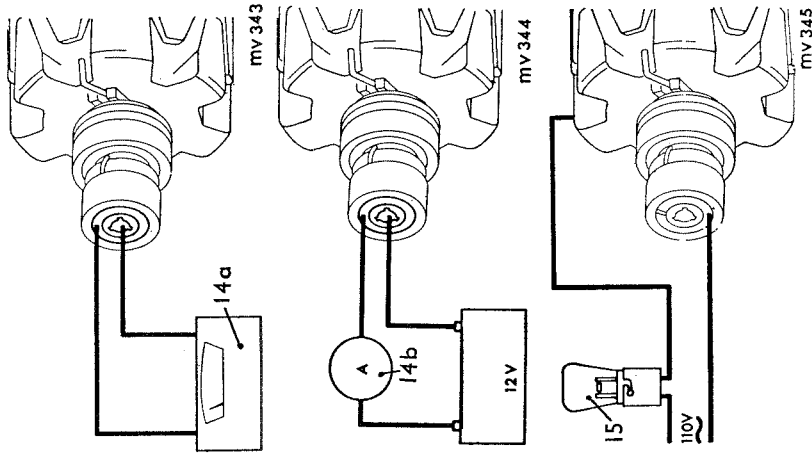


**Electrical testing of components**

13. For clarity, illustrations of electrical testing show the components separated from the rest of the alternator.

**Rotor field winding**

14. Check field winding continuity and resistance simultaneously, by connecting either a battery-operated ohmmeter (see 14 a) or a 12 V battery and moving-coil ammeter (see 14 b) between the slip-rings. The ohmmeter should indicate the appropriate resistance given in the General Data (86.10.14 sheet 4), or the ammeter should indicate a current approximate to the figure obtained by dividing the appropriate resistance of the rotor into the battery voltage.



15. Check for satisfactory field winding insulation by connecting a 110 V A.C. 15-watt test lamp between either of the slip-rings and the rotor body. The lamp should **not** light.

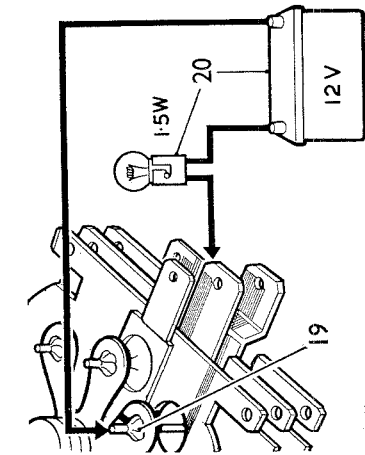
**Stator windings**

16. Due to the very low resistance of the stator windings, a practical test to determine the presence of short-circuited turns cannot be carried out without the use of special instruments. However, in practice interwinding short-circuiting is usually indicated by obvious signs of burning of the insulating varnish covering the windings. If this is the case, renew the stator assembly without the need for further testing.

17. Check continuity of stator windings, by first connecting any two of the three stator winding connecting cables in series with a 12 V battery-operated test lamp, of not less than 36 watts. The test lamp should light. If not, renew the stator assembly. Providing the first part of the test is satisfactory, transfer one of the test lamp leads to the other (third) cable. Again the test lamp should light. If so, proceed to insulation test.

18. Check insulation of stator windings, by connecting a 110 V A.C. 15-watt test lamp between the stator laminations and any one of the three connecting cables. The lamp should **not** light.

*continued*



MV 341

**Rectifier diodes**

19. Test each of the nine diodes separately, as follows. Connect a 12 V battery and a 1.5 watt bulb in series with one of the diodes, one test lead being applied to the diode connecting pin and the other to the particular heat sink plate in which the diode undergoing test is soldered. Note whether lamp lights, then reverse the test lead connections. The lamp should light during one half of the test only. If any one diode test is unsatisfactory, renew the rectifier assembly. (Refer to Bench test 86.10.14 paragraph 27).

21. During reassembly of the alternator, use only 'M' grade 45-55 resin-cored solder to attach the stator cables to the diode connecting pins. Carry out the operation as quickly as possible, using a thermal shunt to avoid damaging the diode(s) (Long-nosed pliers are suitable as a thermal shunt).

**Regulator**

22. Individual testing of the regulator can only be carried out with special test equipment and unless this is available the regulator must be proved by substitution.

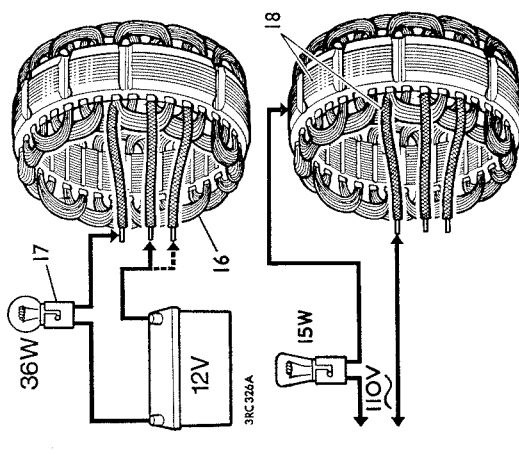
**Alternator — complete dismantling**

**NOTE:** When carrying out the following operations great care must be taken to avoid personal injury, due to the considerable weight of the alternator components involved.

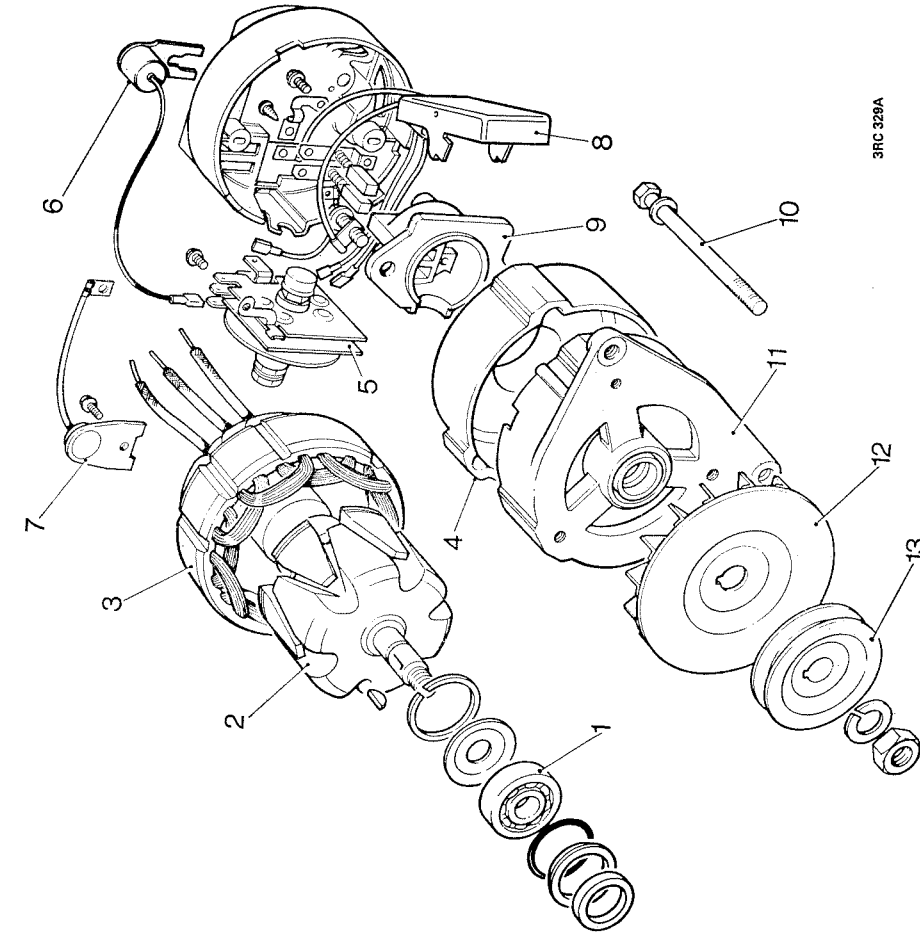
23. Remove the three through bolts.
24. Grip both ends of the alternator in the hands, pull apart the end brackets from the stator laminations and separate the alternator into three major parts.
  - (1) Slip-ring end bracket.
  - (2) Stator laminations-and-windings.
  - (3) Sub-assembly comprising:
    - Fan and pulley;
    - Drive-end bracket and bearing;
    - Rotor complete with slip-ring end bearing.

25. If difficulty is experienced in separating the above parts, suspend the alternator gripped by the pulley in one hand and apply a series of light blows with a hide, plastic, or wooden mallet in turn to the shoulders of the through bolt housings of the slip-ring end bracket.

*continued*



3RC 327A



- 1 Drive end bearing
- 2 Rotor and slip-ring
- 3 Stator
- 4 Slip-ring bracket
- 5 Rectifier

**16ACR ALTERNATOR**

- 6 Suppressor
- 7 Surge protection device
- 8 Regulator unit
- 9 Brush box
- 10 Through bolt

- 11 Drive end bracket
- 12 Fan
- 13 Pulley

26. Separate the rotor assembly from the drive-end bracket. First remove the driving pulley fan and shaft key, then press the rotor shaft from the bearing in the bracket. Alternatively, use the open jaws of a vice to support the bracket and carefully drive the rotor shaft from the bearing by a series of light blows applied to the end of the shaft with a hide, plastic, or wooden mallet. (Open the jaws of the vice sufficient only to clear the rotor poles, position the bracket off-set to the centre of the top of the vice to avoid the slip-ring moulding fouling the bottom of the vice, and temporarily fit the shaft nut flush with the end of the shaft to avoid damage to the shaft threads by the mallet).

27. If it is necessary to renew either the slip-ring moulding assembly or slip-ring end bearing, the slip-ring moulding assembly can be withdrawn from the key-way in the rotor shaft after the field winding connections have been unsoldered. Use a light weight soldering iron, (e.g. 25 watt). Use only resin-cored solder for resoldering.

**Bearings**

28. Check whether the bearings need renewing. Determine this by first inspecting the rotor and stator poles for signs of rubbing. If so, excessively worn bearings are indicated and both should be renewed. If there is no visible evidence of worn bearings, check whether the bearings are worn to the extent of allowing perceptible side movement of the rotor shaft and if so the bearing(s) should be renewed.

**Renewing the bearings**

29. After removing the slip-ring moulding from the rotor shaft (refer to paragraph 27), the slip-ring end bearing can be removed from the rotor shaft and then either renewed or if otherwise satisfactory re-packed with grease lubricant (refer to paragraph 32).

Position the two halves of the support plate of a hand-operated power press beneath the shoulder of the nylon distance-piece and press the rotor shaft from the bearing. Alternatively, use a suitably-sized claw-type bearing extractor tool (position claws behind the shoulder of the nylon distance-piece) and pull the bearing from the shaft.

**NOTE:** When refitting the bearing, ensure the shielded side of the bearing faces the slip-ring moulding.

30. After removing the bearing retaining circlip and plate, the drive-end bearing can either be pressed or carefully tapped from the bracket with a suitably-sized mandrel inserted in the outer-face aperture of the bearing housing.

**NOTE:** When refitting the bearing, ensure correct sequence of assembly of sundry parts associated with the bearing.

*continued*

Lubrication of bearings

31. During major overhaul of the alternator, providing the bearings have been checked and found not to be excessively worn, bearings can be serviced by re-packing with Shell Alvania 'RA' grease lubricant, or equivalent.

32. To re-pack the slip-ring end bearing with grease it will be necessary to gain access to the unshielded (open) side of the bearing, by removing first the slip-ring moulding and then the bearing from the rotor.

Reassembly

33. Reassembly of the alternator is simply a reversal of the dismantling procedure. It should be noted that the sub-assembly comprising rotor and drive-end bracket, stator assembly and slip-ring end bracket (secured by three through bolts) can be incorrectly assembled in two or three alternative ways which causes mis-alignment of the alternator fixing lugs of each end bracket.

34. Assuming the rotor assembly to be already fitted in the drive-end bracket, mis-alignment of the end brackets previously referred to can be avoided by first fitting the stator assembly correctly in the drive-end bracket. (In preference to first fitting the stator assembly in the slip-ring end bracket).

35. Fit the stator assembly in the drive-end bracket so that the stator connecting leads are positioned between and in line with the alternator fixing lugs, then assemble the slip-ring end bracket to the stator lamination and finally secure into a sub-assembly by fitting the through bolts.

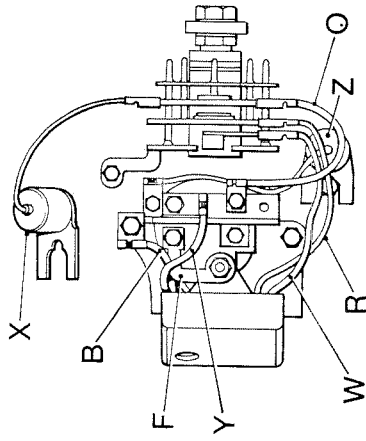
36. Avoid over-tightening the through bolts, the maximum tightening torque is 55 lbf in (63 cmf.kg).

37. Tighten the shaft nut to a torque figure of 25 to 30 lbf.ft (3,5 to 4,2 kgf.m).

38. Reconnect the leads between the regulator, brushbox and rectifier as illustrated.

39. Refit the alternator 86.10.02.

*continued*



MV 327

12 volt 16 ACR alternator connections

- B—black lead
- F—metal link
- O—orange lead
- R—red lead
- W—white lead
- X—radio suppressor
- Y—yellow lead
- Z—surge protection

ALTERNATOR—24 Volt (CAV AC 90/2)

(FV 546125 Generator No. 10 Mk 2;

See also EMER Power W 104/13)

Overhaul

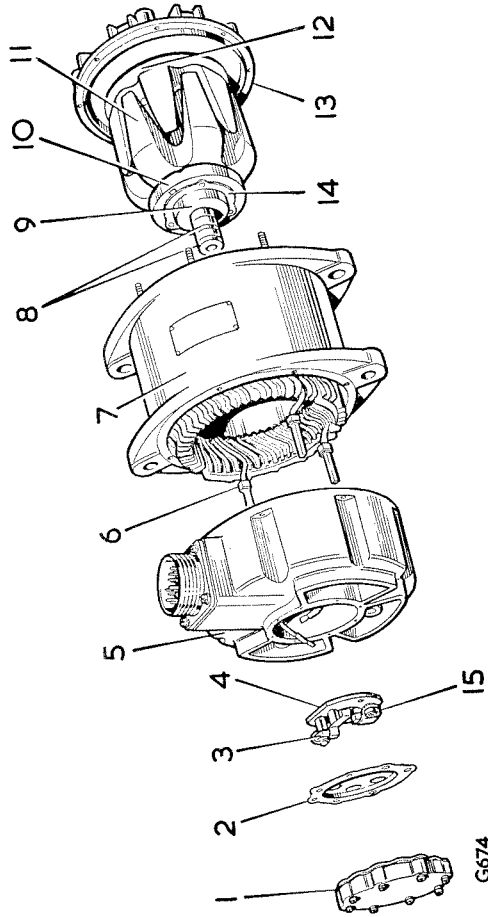
86.10.08

1. Remove the alternator 86.10.02.

Dismantling

2. Lightly scribe a guide line across the edge of both end-shields and the stator to ensure reassembly in original locations.
3. Remove the eight screws and spring washers securing the slip-ring and diaphragm cover plate and remove the cover plate, diaphragm, stop plate gasket and 'O' sealing rings.
4. Remove the centre nut and spring washer from each heat sink.
5. Withdraw the brushes and disconnect the brush connection from each brush holder.
6. Remove the two screws and washers securing the brush holder plate and withdraw the brushgear.
7. Remove the four screws and washers in the base of the slip-ring housing.
8. Remove the eight nuts and spring washers securing the slip-ring end-shield to the stator and ease off the shield.
9. Remove the eight nuts and washers securing the driving end-shield and withdraw the shield and rotor assembly from the stator.

*continued*



- 1 Cover plate
- 2 Stop plate
- 3 Brush
- 4 Plate
- 5 Slip-ring end shield
- 6 Terminal post
- 7 Stator
- 8 Slip-rings

24 volt alternator

- 9 Slip-ring end bearing
- 10 Bearing clamp plate
- 11 Rotor
- 12 Fan
- 13 Driving end shield
- 14 Sealing ring
- 15 Brush spring

G674

10. Do not remove the slip-ring end bearing from the shaft unless it is to be renewed. The bearing can be removed, if necessary, by inserting three long screws in the threaded holes in the bearing clamp plate and tightening the screws in turn until the bearing is eased from the shaft.

11. The driving end-shield houses the driving end bearing and should not be disturbed unless bearing renewal is intended. The bearing is removed by removing the circlip and withdrawing the bush from the shaft using an extractor and removing the bearing plate. The rotor shaft can now be pressed out of the bearing and the bearing eased out of the end-shield housing.

The removal and replacement of the diodes in the slip-ring end shield necessitates breaking the sealing paint, applied over these components as a waterproof barrier. It is essential to repair the sealing barrier after repair work has been carried out.

The high current diodes are arranged two per heat sink and are in electrical contact with the sink and a stator connection, i.e. a common point. Therefore one diode is polarized anode to stud and the other cathode to stud. The polarity change is signified by the letter 'A' added to the diode type number when the stud is diode anode.

#### Removing a high current diode

12. Remove the slip-ring end shield as described under 'Dismantling'.

13. Remove the connecting lead fixing clip nearest faulty diode by removing the securing nut and cut the twine securing the connecting leads if necessary.

14. Remove the nut and bolt securing the diode connecting tag to the connecting bar tag.

15. Remove the diode securing nut and washer and withdraw the diode.

#### Replacing a high current diode

16. Insert the diode into its housing in the heat sink.

17. Bolt the diode connecting tag to the connecting lead tag. Ensure that the diode is still in its housing.

18. Tighten the diode nut and washer to a torque of 24-28 lbf in (0,2 to 0,3 kgf.m) to secure diode.

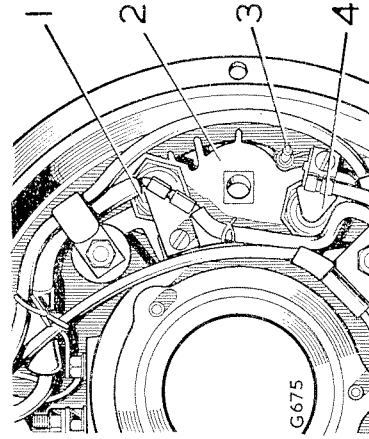
19. Secure connecting lead clip and lace the connecting leads with twine if necessary.

#### Removing a low current diode

20. Unsolder the connection to the diode taking care not to overheat the diode. The diode pins should be gripped with a pair of long nosed pliers which act as a thermal shunt.

21. Release the diode fixing nut and washer and withdraw the diode.

*continued*



Replacing diodes  
 1 High-current diodes  
 2 Heat sink  
 3 Low-current diodes  
 4 High-current diodes

#### Replacing a low current diode

22. Insert the diode in its housing and secure with the fixing nut and washer. Tighten to a torque of 2-3 lbf in (0,02 to 0,03 kgf.m).

23. Re-solder the diode connection, using the same care as when unsoldering.

#### Repairing the waterproof barrier

24. Clean off any loose material on the area to be repaired.

25. With the aid of a brush, apply heat resisting polyurethane paint ensuring complete coverage of the area.

26. Allow paint coating to dry before re-assembling the component.

#### TESTS

##### Slip-ring end shield

##### Insulation resistance

27. With the aid of a 500 V D.C. 'Megger' test the insulation resistance between the diode heat sinks and all plug pins to earth. The resistance should not be less than 5 megohms.

##### Continuity

28. Connect a 24 V D.C. supply in series with a 6 watt 24 V lamp and connect two test leads.

29. With the positive test lead connected to plug pin W, check that the lamp lights when the negative lead is connected in turn to each of the three heat sinks. Reverse the test leads and repeat the test. Check that the lamp does not light in each case.

30. With the negative test lead connected to plug pin X, check that the lamp lights when the positive lead is connected in turn to each heat sink. Reverse the test leads and repeat the test. Check that the lamp does not light in each case.

31. With the negative test lead connected to plug pin F, check that the lamp lights when the positive lead is connected in turn to each heat sink. Reverse the test leads and repeat the test. Check that the lamp does not light in each case.

32. With the aid of a multi-meter set to the 0-10,000 ohms range and with the negative lead of the Avometer connected to plug pin W, check the following circuits:

W-X — 90-100 ohms  
 W-F — 110-140 ohms  
 W-P — 24-30 ohms  
 W-T — 24-30 ohms  
 W-R — 24-30 ohms

33. With the positive lead of the multi-meter connected to plug pin W, repeat the above test and check that the resistance measured in each case exceeds 10,000 ohms.

*continued*

**Stator**

34. Before assembly, using a multi-meter, measure the voltage drop between any two of the three stator connections whilst passing 40 amps D.C. current through the stator windings via these connections. Measure between connections 1-2, 1-3 and 2-3. The voltage drop measured must be between 1.8 and 1.9 volts.
35. With the aid of a 500 'Megger' type tester, test the insulation resistance of the stator winding to earth. The resistance measured must not be less than 5 megohms.

**Rotor**

36. Before assembly check that the field coil resistance measured at the slip-rings is between 14.5 and 15.5 ohms.

**Insulation resistance**

37. Using a 500 D.C. 'Megger' type tester test the insulation resistance of the assembled generator. The resistance measured between all plug pins and earth, shall not be less than 5 megohms.

**Rotor polarisation**

38. The rotor field of the assembled generator can be polarised by applying the positive lead of a 24 V D.C. supply to pin V and the negative supply to pin U of the generator plug.

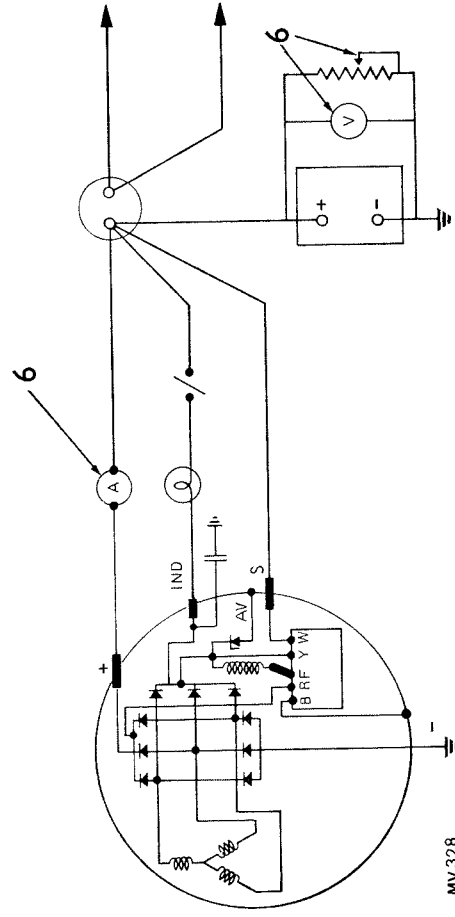
**Reassembling**

39. Reassemble in the reverse order of dismantling, observing the following points.
40. Apply sealing compound DTD 369A to the screws securing the bearing clamp plate to the slip-ring end shield bearing housing.
41. Apply Molytone 265 (H1/9150-99-943-5281) grease to the inner lip of the oil seals before their assembly on the rotor shaft.
42. Ensure that both bearings are packed two-thirds full of grease XG 271.
43. All spaces between the bearings and oil seals at the driving end are packed with grease XG 271.
44. Ensure that the groove in the bearing clamp plate has a thin layer of grease XG 271 on all sides.
45. Apply Bostick 'C' compound to both sides of diaphragm plate and gasket.
46. Brushes must be removed when their length is a minimum of  $\frac{1}{8}$  in (8 mm).
47. 'O' sealing rings must be replaced in the diaphragm plate cover screws. Check all other seals are effective.
48. Brush spring pressure should be 8 to 10 ozs (227 to 283 gr).
49. If the slip rings are pitted the complete rotor and shaft can be set up in a lathe between centres and a very light cut taken off with a diamond tipped tool. Minimum diameter of slip rings is 0.875 in diameter (22.2 mm).

**ALTERNATOR—12 Volt (Lucas 16 ACR)****Bench test**

86.10.14

1. Remove the alternator 86.10.02.
2. The test rig must be capable of varying the alternator speed from zero to 6,000 rev/min. To avoid overheating of the alternator it should be fitted with a fan and driven clockwise (when viewed from the drive-end).
3. Wiring used in the test circuit must be of equivalent grade to that used in vehicle alternator installations, 14/010 (14/0,25 mm) grade for the 'IND' field circuit cables and 120/012 (120/0,30 mm) grade for the main terminal and earth cables.
4. Clamp the alternator in the test rig, with the alternator moulded slip-ring end cover removed to expose the regulator connections.
5. Connect a test circuit as illustrated using direct connections between the alternator, warning light (12V 2.2W), and the test battery.
6. Include in the test circuit: a 0-60A ammeter in series with the alternator main output '+' cable(s) and connect in parallel across the battery terminals a 0-20 V voltmeter and a 15 ohm 35 A variable load resistor. **The warning light should be illuminated**, in which case proceed direct to paragraph 17.
7. If the warning light is not illuminated (providing the bulb is good), non-continuity of the rotor field winding circuit is indicated.
8. Check in the following order: regulator, brushes-and-springs and rotor slip-rings, rotor field-winding continuity.

*continued*

\* Items indicated may be tested on the vehicle although some difficulty may be expected due to the restricted space available.

**\* Regulator**

9. Connect the regulator case to the alternator frame. If this results in the warning light now being illuminated, the regulator is faulty and it must be renewed.

**NOTE:** Individual testing of the regulator is not practical but it may be proved by substitution (see paragraphs 16 to 26).

**\* Brushes-and-springs and rotor slip-rings**

10. Remove the brushbox moulding (two bolts).

11. Check whether brushes and slip-rings are free of oil or grease. If necessary, the brushes and springs can be cleaned with a petrol-moistened cloth. If the slip-rings are burnt see 'Overhaul' 86.10.08 paragraph 12.

12. Check brush-and-spring assemblies for freedom-of-movement in the brushbox moulding. If the visible length of the brushes in the free position is less than  $\frac{1}{4}$ " (0.25 in or 6 mm), this is the probable cause of non-continuity of the field circuit. In any case, the brush-and-spring assemblies should now be renewed if the overall length of the brushes has become worn to  $\frac{11}{16}$ " (0.3 in or 8 mm). If incorrect spring pressure is suspected see 'Overhaul' 86.10.08, paragraph 11.

13. While the brushbox moulding is removed, check rotor field winding continuity.

**\* Rotor field winding continuity**

14. Check the rotor field winding continuity, by connecting a 12 V battery test-lamp between each of the rotor slip-rings. The ohmmeter should register a reading or the test lamp should light.

15. If the test is unsatisfactory, proceed to 'Overhaul' 86.10.08 paragraph 14.

**\* Alternator Output Test with Regulator Inoperative**

16. Make the regulator inoperative, by connecting the regulator case to the alternator frame.

17. Run the alternator in the test rig at a slowly-increasing speed. If the warning light is not extinguished, the suppression capacitor and/or surge protection device should be proved by repeating the test with each of these items disconnected in turn as follows.

*continued*

18. Withdraw the cable connector from the alternator. Remove the slip-ring cover (two bolts). This may be left off until a conclusive result is obtained.

20. Remove the surge protection device from the 'IND' terminal (1st test).

21. Remove the radio suppression lead from the rectifier 'IND' plate (2nd test).

22. If the alternator performs satisfactorily in either test the component in question should be renewed. If it does not, see paragraph 25.

23. Providing the first half of the test is satisfactory (warning light extinguished), increase alternator speed to 6,000 rev/min and adjust the variable load resistor until the voltmeter registers 13.6 V. **The ammeter should register the maximum rated output of the alternator (34 amps).**

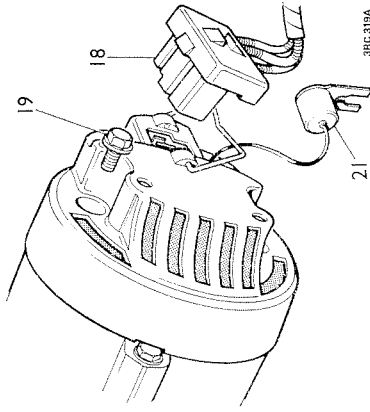
24. If this second half of the test is unsatisfactory, the suppression capacitor and/or surge protection device check should be repeated.

25. If the result is still unsatisfactory, the alternator is faulty and it must be dismantled for detailed inspection to determine and rectify the fault.

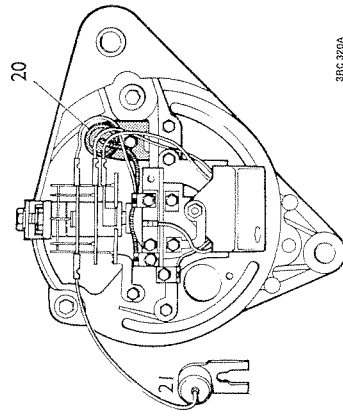
**Regulator Test with alternator**

This test assumes the alternator output test (paragraph 16) is satisfactory.

26. Remove the variable load resistor from the battery terminals and also the test link connecting the regulator case to the alternator frame. Run the alternator at 6,000 rev/min, until the ammeter registers less than 10 A. **If the voltmeter registers 13.6-14.4 V**, the regulator is working normally. If the voltmeter reading is outside the limits specified, the regulator must be renewed.



319A



320A



**Diodes**

27. Failure of one or more of the diodes will be indicated by the effect on alternator output, and in some instances by abnormally high alternator temperature and noise level. The fault symptom table shows how diode failure will influence alternator output test results. (Refer to 'Overhaul' 86.10.08, paragraph 19 for diode tests).

**DIODE FAULT SYMPTOMS**

Warning Light	Temperature	Noise	Output	Probable Fault (Associated Damage)
Illuminated at stand-still extinguished at cut-in speed (1,500 rev/min) but at higher speeds becomes partially illuminated again and gets progressively brighter	High	Normal	Higher than normal at 6,000 rev/min. Approximately: 40A	Live-side main output diode open circuit. (May damage rotor field winding and regulator, overheat, brushboxes, and fuse warning light bulb)
Not illuminated between zero at 1,500 rev/min.	High	Excessive	Very low at 6,000 rev/min. Approximately: 10A	Live-side main output diode short circuit. (May damage associated field diode)
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds	Normal	Excessive	Poor at low speed Slightly below normal at 6,000 rev/min. Approximately: 32A	Earth-side main output diode open circuit
Illuminated at stand-still, dims appreciably at cut-in speed (1,500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds	Normal	Normal	Lower than normal at 6,000 rev/min. Approximately: 29A	'Field' diode open-circuit
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds	Normal	Excessive	Very low at all speeds above cut-in (1,500 rev/min) Approximately: 7A	Earth-side main output diode short-circuit, or stator winding short-circuit to earth
Illuminated at stand-still, dims at cut-in speed (1,500 rev/min) and remains dim, but may be extinguished at very high speeds	Normal	Excessive	Very low at 6,000 rev/min Approximately: 7A	'Field' diode short-circuit

**ALTERNATOR—General Data**

- Output**
  - 34 amps at 6000 alternator rpm.
  - 5 mm (0.2 in) protruding beyond brush box moulding.
  - 198 to 283 gm (7 to 10 oz) when brush is pushed back flush with housing.
- Field winding**
  - Resistance 4.33 ohms + 5%.
  - Current flow at 12 volts 3 amps.
  - Insulation test equipment 110 volt A.C. supply and 15 watt test lamp.
- Stator windings**
  - Continuity test equipment 12 volt D.C. supply and 36 watt test lamp.
  - Insulation test equipment 110 volt A.C. supply and 15 watt test lamp.
  - Diode current flow test equipment 12 volt D.C. supply and 1.5 watt test lamp
- Alternator shaft nut torque 3.5 to 4.2 kgf. m (25 to 30 lbf. ft).
- Alternator through bolts 63 cmf. kg (55 lbf. in)

**ALTERNATOR—24 Volt (CAV AC 90/2)**

(FV 546125 No. 10 Mk2: See EMER Power W 104/13)

**Bench Test**

86.10.14

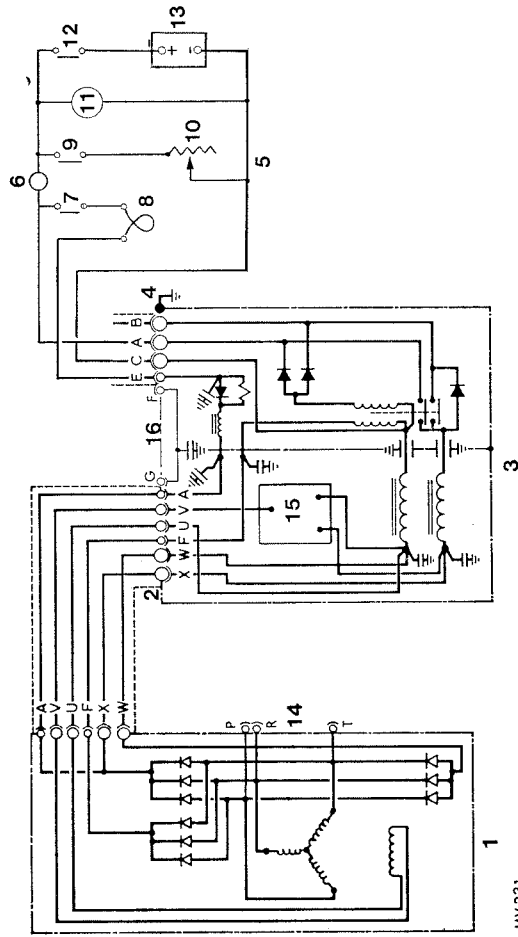
**Equipment required**

- Generator panel No. 9 MK 2 FV 546131 (CAV 396/3).
- 10 HP drive to provide power for the alternator.
- Two batteries (24V, 100 ah).
- 100 amp DC ammeter.
- 10 – 30 volt DC voltmeter.
- 10 – 30 volt AC voltmeter 400 c/s.
- 100 amp switched load bank.
- Battery switch.
- Two single pole switches.
- 24 volt 2.8 watt bulb.
- Test stand.
- Set of cables fitted with plugs and sockets for connection between the alternator generator panel, test stand and batteries.

**Procedure**

1. Mount the alternator on the test bench and connect the test equipment as illustrated below.

*continued*



AV 331

**Alternator/generator panel test circuit—24 Volt**

- 1 Alternator
- 2 Plug No. 1
- 3 Generator panel
- 4 Plug No. 2
- 5 Test circuit
- 6 Ammeter
- 7 Switch—ignition
- 8 Test bulb
- 9 Switch—load resistance
- 10 Load resistance
- 11 Voltmeter
- 12 Switch—batteries
- 13 Batteries
- 14 3-phase A.C. supply
- 15 Voltage regulator
- 16 1G-2F spare circuit

2. With a partially discharged battery, switch the battery switch and the single pole switch (ignition) ON. Run the alternator and check the speed at which the alternator produces 24 volts. This should not exceed 1,000 alternator rev/min.
3. Switch the load resistance ON. Run the alternator and load it to a maximum of 90 amps at 27.5 volts minimum. Check that the maximum load speed does not exceed 2000 rev/min.
4. Run the alternator at 9,200 rev/min. at full load current (90 amps) and ensure that the voltage is stable. Run the alternator at this speed for 15 minutes.
5. Reduce the speed of the machine to 2,000 rev/min and maintain the maximum load for 15 minutes. With the alternator still hot check the speed at which 24 volts is produced and the maximum load speed. These should not exceed 1000 rev/min and 2,400 rev/min at 85 amps 27 volts.
6. Increase the alternator speed to 10,000 rev/min with the battery charging current as load. Check the alternator for excessive vibration or mechanical noise.
7. With the aid of a 100 volt type tester and with the alternator hot check that the insulation resistance between all plugs pins and earth is not less than one megohm.
8. Run the alternator at 4,000 rev/min with a loading capacity of 10 amps, 28.5 volts and check that the a.c. voltage between pins P and T, P and R and R and T are equal and within the limits of 23.5 to 25 volts.

### GENERATOR PANEL—24 Volt (CAY 396/3)

(FY 546131 No. 9 Mk 3; See EMER Power P134/27)

**Bench test** 86.10.24

#### Equipment required

Alternator 24 volt No. 10 Mk 2 FY 546125 (CAY AC 90/2)  
 10 HP drive to provide power for the alternator.  
 Two batteries (24V 100 ah).  
 100 amp DC ammeter.  
 Single-pole switch-battery.  
 Test stand.  
 Set of cables fitted with plugs and sockets for connection between the alternator, generator panel, test stand and batteries.

**NOTE:** All speeds quoted refer to alternator pulley speeds. Voltage settings should be made with the generator panel mounted vertically. Voltage link in 'HIGH' position except where otherwise stated.

1. Mount the generator panel on the test bench and connect the equipment detailed above. (Refer to circuit test diagram on 86.10.14 sheet 5).

#### Battery relay test

2. Connect the positive side of a 30-volt DC supply via a 70-ohm/5-amp variable resistor to socket No. 1, pin F, and the negative side to plug No. 2, pin C.
3. Check that the battery relay points close within the limits of 18 to 20 volts on rising voltage. Drop-out voltage 9 to 12 volts. If necessary, adjust. (See electrical setting 86.55.47).
4. Apply a DC voltage of 20 volts positive to 2C negative to 2A with a separate voltage of 28.5 volts applied positive to 1F, negative to 2C, the BCK battery relay **must** not close.

#### Voltage regulator test

5. Switch the battery (ignition) switch on. Run the alternator at 2,000 rpm. With a battery loading of no more than 10 amps, set the regulator voltage at 28.5 to 29. (See electrical setting 86.10.28).  
**NOTE:** Voltage setting adjustments **must** be made before the voltage coil temperature is allowed to rise.
6. Stop the alternator, and change the voltage link to the 'LOW' position.

*continued*

7. Run the alternator at 2,000 rpm and check that with a battery load not exceeding 10 amps, the regulator voltage is 26.5 to 27 volts.
8. Stop the alternator and replace the voltage link the 'HIGH' position.
9. Run the alternator at 2,000 rpm with a maximum load for 15 minutes. Stop the alternator, then drive it at a speed of 1,760 and 4,400 rpm to ensure that minimum loads of 66 and 88 respectively, at 26.5 to 29 volts, are obtained.  
With a load of 10 amps (battery and resistance) drive the alternator at 9,200 rpm. Ensure that the voltage control is stable and does not exceed 29.5 volts. Continue running for a period of 3 minutes.

**Capacitors, test**

10. Check the value of the capacitors:

Compartment division plate	
Two bushing capacitors	0.5 mfd
Three tubular capacitors	0.1 mfd
Battery relay mounting plate	
Three tubular capacitors	0.75 mfd
Regulator	
Two ceramic capacitors	500 pf

**Continuity resistance, test**

11. Disconnect one end of the winding or resistor concerned before making a check and replace it before going on to the next.

Voltage regulator	
Shunt coil	32.3 to 35.7 ohms
Bucking coil	285 to 315 ohms
Battery relay	
Shunt coil	218 to 258 ohms
Auxiliary coil	412 to 452 ohms
Parallel field resistors	
(each)	120 ohms (three off)
Swamp resistor	80 ohms
Load compensating resistor	0.5 ohms
Choke (bobbin type)	0.21 ohms
Diodes	
Forward resistance	40 ohms (measured on Model 7 avometer on 10,000 ohms range)

**GENERATOR PANEL—24 Volt (CAV 396/3)**

Static test. (FV 546131 No. 9 Mk. 3: 86.10.25)

See EMER Power P134/27

1. Disconnect both cable harnesses from the generator panel.
2. Release the generator panel cover by removing the twelve retaining nuts (see 86.10.26 for access) and check that all screws and nuts are tight and that all soldered connections are clean and secure.
3. Check the following circuits for continuity using multi-meter set to the 10,000 ohms range:
  - 1A - 2E refers to socket No. 1, pin A, plug No. 2, pin E, etc.
  - 1F - 2C, approximately 230 ohms
  - 1G - 2F, zero
  - 1U - 2C, zero
  - 1V - 1X, 27 to 30 ohms
  - 1V - 1W, 27 to 30 ohms
  - 1W - 2C, zero
  - 1X - 2D, zero
4. With multi-meter positive lead to 1X, check the following:
  - 1X - 2A, via battery relay, contacts closed - zero ohms.
  - 1X - 2B, battery relay, contacts closed - zero ohms.
5. Reverse the leads and with battery relay contacts open the resistance reading should be approximately 800 ohms for each circuit. With the relay contacts closed, the resistance reading should be zero ohms.
6. With multi-meter negative lead to 2E and positive lead to 1A, the resistance reading should be approximately 37 ohms. Reversal of leads should give a resistance reading of approximately 240 ohms.
7. With negative lead to 2C, connect positive lead to 2A and 2B in turn. In both cases the resistance reading should be approximately 600 ohms. With the leads reversed the resistance reading should exceed 2,000 ohms.
8. Check the insulation of all plug and socket pins and earth. These measurements must not be less than 5 megohms when tested to earth with the 100 volt megger.
9. If any of the above tests are unsatisfactory the generator panel should be removed for rectification.

**Generator Panel functional test**

10. See Alternator functional test. 86.10.01.

**GENERATOR PANEL—24 Volts (CAV 396/3)**

**—Remove and refit**

86.10.26

**Removing**

1. Disconnect the batteries.
2. To give access to the generator panel remove the six bolts securing the right side front wheel splash plate. The front inside bolt passes into a trapped nut, the other five are used with nuts, plain and spring washers.
3. It is not necessary to disconnect the leads from the starter relay and fuel pump voltage dropper fitted to the back of the splash plate.
4. Unscrew the two screwed cable adaptors from the side of the generator panel and pull out respective plug and socket end pins.
5. Remove the four bolts, nuts spring and plain washers and two-piece rubber bushes retaining the generator panel to the bulkhead.
6. Remove the generator panel.

**Refitting**

7. Reverse instructions 1 to 6. Ensure that all connections are clean and tight.

**REGULATOR—24 Volt (CAV N66)**

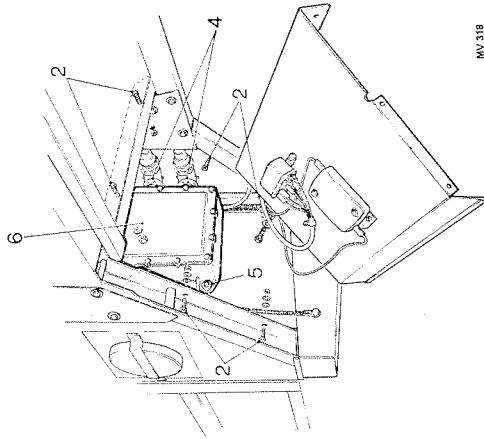
**Adjust**

86.10.28

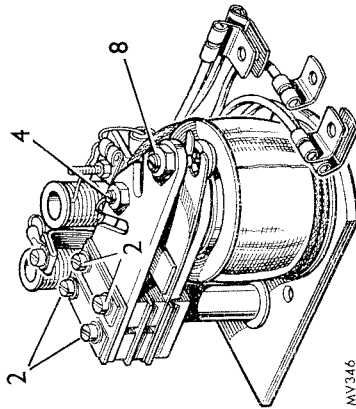
**Mechanical setting**

1. Remove the generator panel cover by releasing the twelve retaining nuts.
2. Slacken all four armature fixing screws and place an 0.008 in (0.203 mm) feeler between the back of the armature and the centre block.
3. Press the armature back squarely against the feeler and tighten the armature screws.
4. Adjust the gap between the core and the armature contacts to 0.036 in (0.914 mm) by releasing the locknut and turning the adjustable contact as required. This gap must be measured on the outer tip of the armature with the feeler gauge resting against the side of the brass stop pin.
5. **NOTE:** When setting the adjustable contact locknut, connection strips and mica strips are not proud of the block on either side. The pressure adjusting screw must be central in the spring slot and the contact carrier parallel with the regulator base.

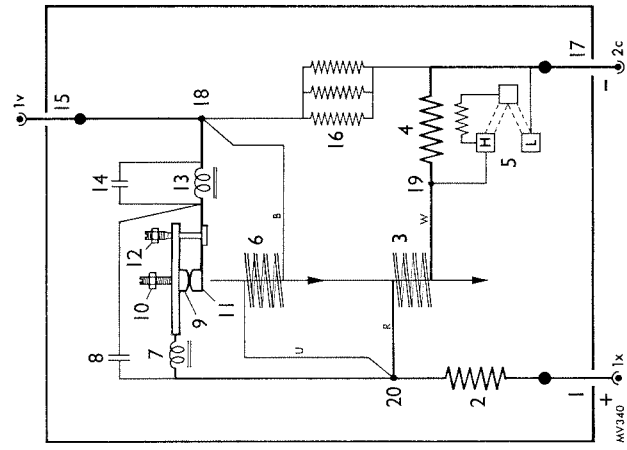
*continued*



MV 318



MV 346



**Regulator circuit—24 Volt (CAV N66)**

- 1 From alternator positive output—via 1X
- 2 Lead compensating resistor
- 3 Shunt winding
- 4 Swamp resistor
- 5 High/low voltage link and associated parallel resistor
- 6 Bucking (frequency) winding
- 7 Choke
- 8 Capacitor
- 9 Fixed contact
- 10 Moving contact
- 11 Moving contact spring adjustment screw
- 12 Choke
- 13 Capacitor
- 14 Positive supply to alternator field winding—via 1V
- 15 Parallel field resistors
- 16 To shunt box earth—via 2C
- 17 Panel terminal 5
- 18 Panel terminal 6
- 19 Panel terminal 5
- 20 Panel terminal 6

6. Ensure the contacts are in good condition. Moderate pitting or oxidising can be removed with fine glass paper or a contact file. Wash out deposits after cleaning with fluffless rag dipped in carbon tetrachloride or 95% ethyl alcohol.

**Electrical setting**

7. Run the alternator at 2,000 rpm. With a battery loading of no more than 10 amps set the regulator at 28.5 to 29 volts.
  8. Adjust by releasing the locknut and turning the pressure adjusting screw as required (clockwise to increase voltage and vice versa).
- NOTE:** It is essential that voltage setting is made before the voltage coil temperature is allowed to rise.
9. Re-tighten the locknut.
  10. For other settings see generator panel bench test 86.10.24

**REGULATOR—24 Volt (CAV N66)**

**—Remove and refit**

86.10.29

**Removing**

1. Disconnect the batteries.
2. Release the generator panel cover by removing the twelve retaining nuts. (See 86.10.26 for access).
3. Disconnect the leads at the division plate terminals (regulator compartment side), including the bushing capacitors. Note the connection points of the leads to ensure correct replacement.
4. Withdraw the division plate. Should the plate be a tight fit, slacken the two screws located at the socket end of the division plate.
5. Disconnect the remaining leads connecting the components to the socket pins. Release the four screws securing the socket and remove the socket with leads.
6. Remove the four screws and washers securing the base plate and lift out the regulator assembly.

**Refitting**

7. Reverse instructions 1 to 6.

**SHUNT BOX—24 Volt (CAV 466/3)**

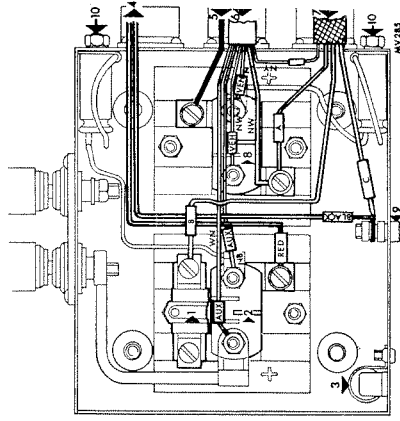
- Test**
1. Disconnect the vehicle and auxiliary batteries.
  2. Remove the shunt box terminal and front cover plates.
  3. Check the two identical capacitors for insulation using a 200 volt megger-meter.
  4. Check the Radio/Auxiliaries fuse and spare fuse clipped inside the shunt box for continuity with a multi-meter.
  5. Disconnect the screened cable from the generator panel to the shunt box and test for insulation resistance using a 500 volt megger-meter. The insulation should not be less than two megohms between pins and pins and earth.
  6. Continuity of each core should be tested using an ohmmeter.
  7. Disconnect the other cables in the shunt box and check for continuity with an ohmmeter.
  8. Examine cables for damage.
  9. If a cable fails any of the above tests rectify or renew.
  10. Refit various parts tested.
  11. Check that all terminal screws and fixing nuts are tight and soldered connections are clean and secure.

**SHUNT BOX—24 Volt (CAV 466/3)**

- Remove and refit** **86.10.41**
- Removing**
1. Remove the four wing nuts, spring and plain washers retaining the terminal and front cover plates.
  2. Unscrew the three cable connectors and disconnect the thirteen leads inside the shunt box.
  3. Remove the four nuts, spring and plain washers which hold the shunt box to the battery box. These are reached from inside the battery box.

- Refitting**
4. Reverse operations 1 to 3.
- NOTE:** If it is necessary to renew the radio/auxiliaries fuse remove the two retaining terminal screws.  
To renew one or both of the radio anti-interference capacitors remove the appropriate fixing nuts and spring washers.

**Fuse rating**  
Radio/auxiliaries fuse, 630 - 150 A. Tested to 300 volt peak 200 rms radio anti-interference capacitors. (2 off) 7727 FLM/73 1.8 mfd 200 W&g at 70°C.



**Shunt box connections—24 Volt**

- 1 Radio/auxiliaries fuse
- 2 Auxiliaries shunt
- 3 Spare fast fuse
- 4 Cables to radio Amphenol socket
- 5 Cables—from batteries
- 6 Cables—from ammeters
- 7 Cables—from generator panel—charging circuit
- 8 Vehicle shunt
- 9 Earth feeder
- 10 Radio interference capacitors (2 off)

When cables have two code letters the first is the main colour, the second the tracer, i.e. NB—Brown with Black.

B—Black N—Brown W—White Y—Yellow

Snap connectors	
Yellow ident sleeves	C
Coloured sleeves	Red
Named sleeves	AUX

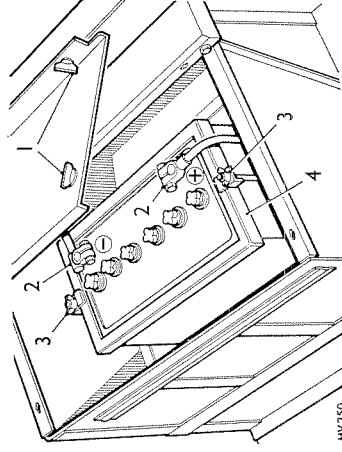
**BATTERY—12 Volt (Lucas CB 13/9)**

- Remove and refit** **86.15.01**
- Removing**
1. Release the four quarter-turn fasteners holding the battery cover.
  2. Disconnect the positive and negative leads from the battery terminals.
  3. Remove the two wing nuts securing the battery clamp plate.
  4. Remove the clamp plate and 'J' bolts and withdraw the battery.

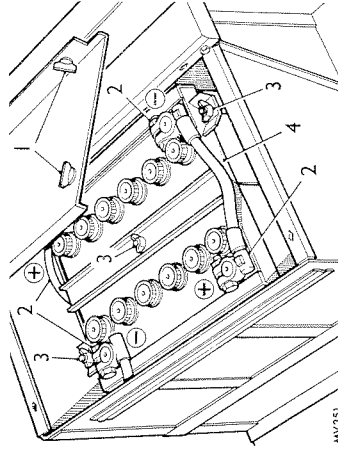
- Refitting**
5. Reverse instructions 1 to 4.

**BATTERIES—24 Volt (2 Oldham UK 2HN)**

- Remove and refit** **86.15.01**
- Removing**
1. Release the four quarter-turn fasteners holding the battery cover.
  2. Disconnect the positive and negative leads from both 12 volt batteries.
- NOTE:** These are connected in series to give a 24 Volt output (negative earth return).
3. Remove the three wing nuts securing the battery clamp plate.
  4. Remove the clamp plate and 'J' bolt and withdraw both batteries.
- Refitting**
5. Reverse instructions 1 to 4.



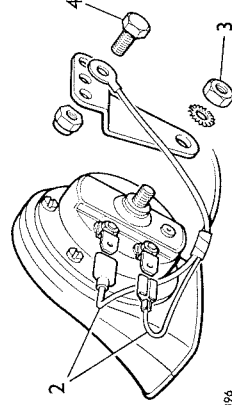
AV350



AV351

**HORN**

- Remove and refit** **86.30.09**
- Removing**
1. Remove the radiator grille.
  2. Disconnect the 'Lucar' connection from the horn.
  3. Remove the nut and washer securing the horn to the horn bracket and withdraw the horn.
  4. The horn bracket is retained by two bolts, nuts and washers. Remove if required.  
Note the earth wire fitted between the bracket and the body.
- Refitting**
5. Reverse instructions 1 to 3. (Include instruction 4 if bracket removed).



AV 396

## CONTACT BREAKER POINTS—12 Volt

## —Remove and refit

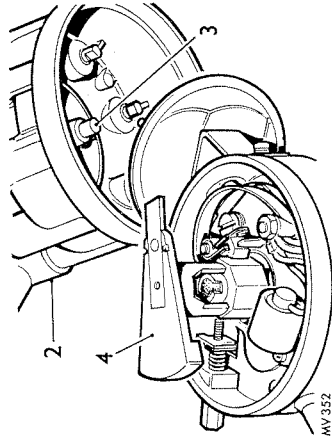
86.35.13

## Removing

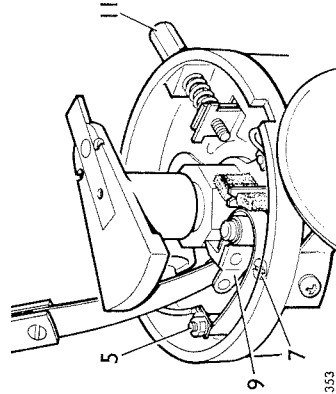
1. Remove the two clips securing the distributor cap to the distributor body.
2. Lift off the distributor cap.
3. Clean the interior of the distributor cap ensuring that the carbon brush is free in its holder.
4. Remove the rotor arm.
5. Remove the nut securing the moving contact breaker spring to its terminal post and lift off the insulating bush together with the low tension and condenser lead.
6. Lift off the contact breaker spring assembly and the insulating washer from the base of the spring pivot post.
7. Remove the single screw and shakeproof washer to release the adjustable contact plate.
8. Examine the contact breaker points and clean or renew as necessary.

## Refitting

9. Fit the adjustable contact breaker plate ensuring that the pin on the underside locates in the vacuum advance operating rod. Check by manually rotating the base plate and observing the rod action. Light pressure will ensure spigot location.
10. Fit the moving contact breaker spring assembly, low tension and condenser leads.
11. Adjust the contact breaker gap to 0.014 to 0.016 in (0.35 to 0.40 mm). (See 86.35.20.)
12. Fit the rotor arm and distributor cap.



MV 352



MV 353

## CONTACT BREAKER POINTS—24 Volt

## —Remove and refit

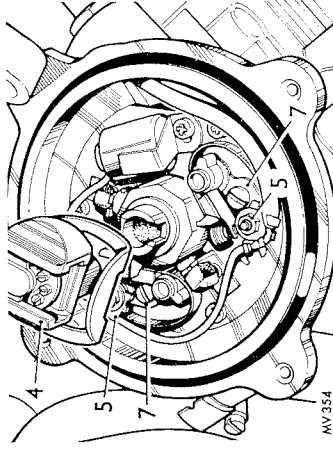
86.35.13

## Removing

1. Remove the four slotted, hexagon-headed screws securing the distributor cap to the distributor body.
2. Lift off the distributor cap.
3. Clean the interior of the distributor cap ensuring that the carbon brush is free in its holder and that the eight sparking plug segments are clean.
4. Remove the rotor arm. Check that the speed limiting device operates freely.
5. Remove the two nuts securing the respective moving contact breaker springs to their terminal posts and lift off the insulating bushes together with the low tension and condenser leads.
6. Lift off both moving contact breaker spring assemblies and insulating bushes from the spring pivot posts.
7. Remove the two screws and shakeproof washers to release both adjustable contact breaker plates.
8. Examine the contact breaker points and clean or renew as necessary.

## Refitting

9. Fit the adjustable contact breaker plates.
10. Fit the moving contact breaker spring assemblies and low tension and condenser leads.
11. Adjust the gaps in both contact breaker sets to 0.014 to 0.016 in (0.35 to 0.40 mm). (See 86.35.20.)
12. Fit the rotor arm and distributor cap.

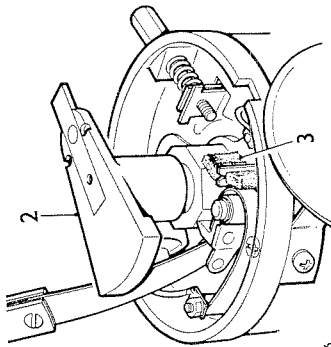


MV 354

**DISTRIBUTOR—12 Volt (Lucas 35 D8-G No. 41487)****Lubrication**

86.35.18

1. Remove the two clips retaining the distributor cap.
2. Lift off the rotor arm and add a few drops of engine oil to the felt pad in the top of the distributor shaft. This lubricates the cam bearing and shaft. Care must be taken not to over-lubricate or oil will be sprayed on to the contact breaker points.
3. Add a drop of thin machine oil on the felt pad which lubricates the contact breaker cam.
4. Inject a few drops of machine oil through the base plate/spindle aperture to lubricate the centrifugal timing mechanism.
5. If the moving contact is removed from its spring pivot post lightly grease the post, before refitting.
6. Replace the distributor rotor arm and cap.

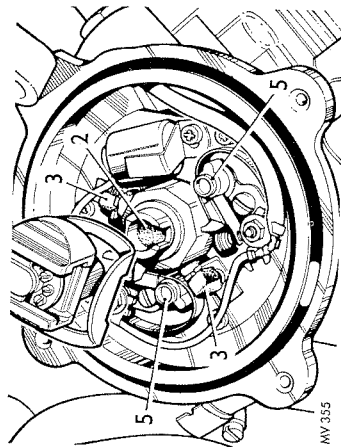


MV 356

**DISTRIBUTOR—24 Volt (Lucas screened)****Lubrication**

86.35.18

1. Remove the four bolts retaining the distributor cap.
2. Lift off the rotor arm and add a few drops of thin machine oil to the felt pad in the top of the distributor shaft. This lubricates the cam bearing and shaft. Care must be taken not to over-lubricate or oil will be sprayed on the contact breaker points.
3. Add a drop of thin machine oil on the two felt pads which lubricate the contact breaker cam.
4. Add a few drops of machine oil through the base plate spindle aperture to lubricate the automatic advance mechanism.
5. If the moving contacts are removed from their respective spring pivot posts, lightly grease the posts before refitting.
6. Replace the distributor, rotor arm and cap.



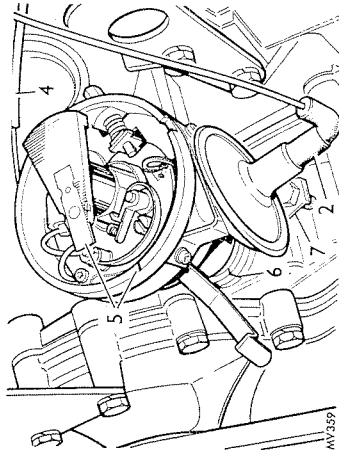
MV 355

**DISTRIBUTOR—12 Volt (Lucas 35 D8-G No. 41487)****—Remove and refit**

86.35.20

**Removing**

1. Disconnect the battery.
  2. Disconnect the vacuum pipe from the distributor.
  3. Remove the distributor cap.
  4. Disconnect the low tension lead from the coil and release from securing clips.
  5. Mark the centre of the rotor arm tip and scribe a corresponding mark on the distributor body.
  6. Scribe alignment marks on the distributor and timing cover.
- NOTE:** If the engine is turned while the distributor is removed it will be necessary to carry out the complete ignition timing procedure. Refer to instructions 16 to 31.
7. Remove the distributor clamp bolt and clamp plate.
  8. Withdraw the distributor.

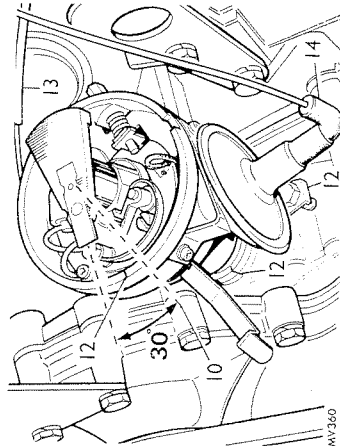


MV 359

**Refitting**

If a new distributor is to be fitted, duplicate the scribed markings made on the old unit before it was removed. The following instructions assume that the engine was not turned.

9. Fit a new 'O' ring to the distributor housing. Lubricate the seal with M 54 silicone grease.
10. Position the centre of the rotor arm tip approximately 30° anti-clockwise from the scribed mark on the top edge of the distributor body.
11. Fit the distributor to the engine. Do not use force. It may be found necessary to align the oil pump drive shaft (using a long screwdriver) so that it engages the slot in the distributor drive.
12. Fit the clamp plate and securing bolt ensuring that the scribed marks on the distributor body and timing cover align.
13. Connect the low tension lead to the coil and secure the lead clips.
14. Connect the vacuum pipe to the distributor.
15. Fit the distributor cap.

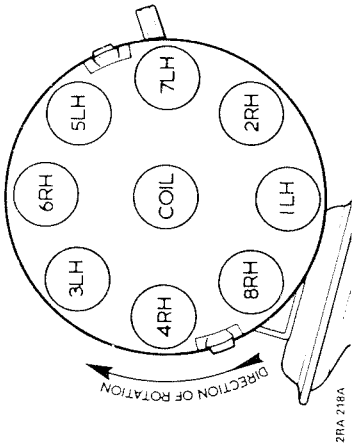


MV 360

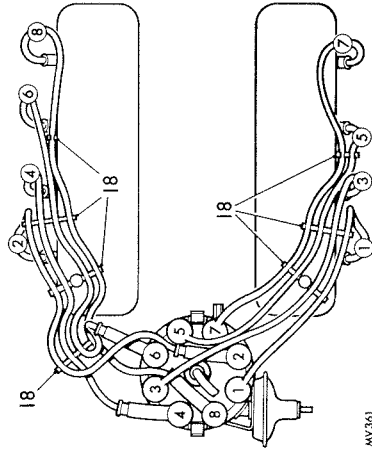
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16. If the engine was turned while the distributor was removed proceed as follows:
17. Set the engine at 3° BTDC on No. 1 piston compression stroke.
18. Check that the sparking plug leads are connected to the distributor cap as shown. In addition it is essential that the leads are clipped in relationship to each other or cross-firing may result. (See illustration with numbered leads.)
19. Set the rotor arm approximately 30° anti-clockwise from No. 1 spark plug lead position.
20. Adjust the position of the oil pump drive shaft (using a long screwdriver) so that it will engage the distributor when fitted. Allow for the clockwise rotation of the distributor shaft as it engages its skew driving gear.
21. Fit the distributor to the engine. Do not use force.
22. Check that the centre line of the rotor tip aligns with the segment for No. 1 spark plug. Adjust the distributor as necessary.
23. Ensure that the distributor is properly seated and fit the clamp plate and securing unit. Do not tighten the bolt at this stage.
24. Turn the engine 45° against its normal direction of rotation and then bring it back to the 3° BTDC position No. 1 cylinder firing.
25. Check that the rotor arm still corresponds with position No. 1 segment in the distributor cap and slightly rotate the distributor body anti-clockwise until the contact breaker points are observed to begin to break. Alternatively the basic lamp timing method may be employed.
26. Secure the distributor in this position by tightening the clamp plate bolt.
27. Connect the low tension lead to the coil and secure the lead clips.
28. Connect the vacuum pipe to the distributor.
29. Fit the distributor cap.
30. Connect the battery.
31. The foregoing instructions 16 to 30 ensure merely that the distributor is set sufficiently close to its proper setting to enable the engine to be run. Dwell angle check and stroboscopic timing checks should now be made.

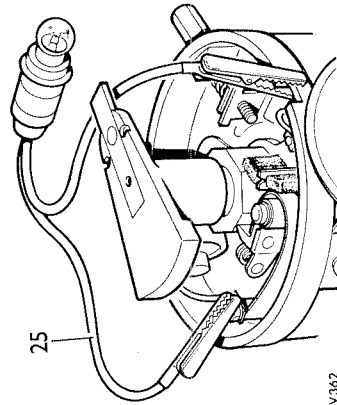
*continued*



2RA 718A



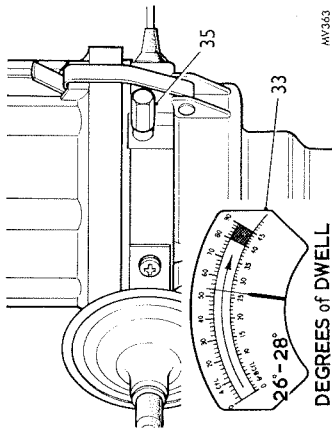
AV261



AV362

**Dwell angle**  
Dwell angle is 26° to 28° and must set with the engine idling at 600 rev/min using appropriate electronic equipment.

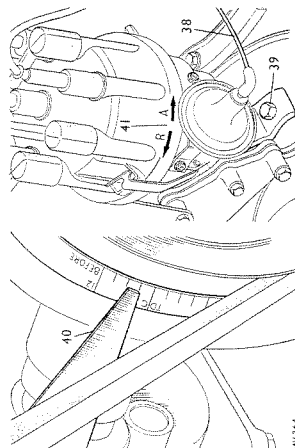
32. Start the engine and set to idle at 600 rev/min.
33. Set the tach-dwell meter switches to DWELL, and CALIBRATE positions. Adjust the calibration with the test leads disconnected from the engine until the meter pointer reads on the 'Set' time.
34. Couple the tach-dwell meter to the engine following the equipment manufacturers instructions. Note when making adjustment to the dwell angle it is essential that the correct setting of 26° to 28° is arrived at by a reducing adjustment. Therefore, if the dwell angle is less initially than 26°, adjust to say 30° and then reduce to 26° to 28°.
35. Set the selector knob to the eight cylinder position and the tach-dwell selector knob to 'dwell'. Adjust the distributor dwell angle by rotating the hexagon adjustment screw on the distributor body until the meter reading is reduced to 26° to 28°. If the meter does not have an eight cylinder position set the selector switch knob to the four cylinder position and adjust at the distributor until the meter reads 52° to 56°.
36. Uncouple the tach-dwell meter.



AV363

**Setting the ignition timing**

37. Couple a stroboscopic timing lamp to the engine following the manufacturer's instructions with the high tension lead attached to No. 1 cylinder plug lead.
38. Disconnect the vacuum pipe from the distributor. Block the pipe to prevent an air leak at the manifold.
39. Slacken the distributor clamp bolt. Sufficiently to enable manual rotation but insufficient to permit self turning. Set the engine to idle at 600 rev/min.
40. Check the ignition timing. The lamp must synchronise the timing pointer and mark at 3° BTDC.
41. Adjust the distributor body, clockwise to retard, anti-clockwise to advance as required.
42. Tighten the distributor clamp bolt.
43. Remove the plug or sealing from the vacuum pipe and connect it to the distributor.
44. Disconnect the timing light. Note, engine speed during ignition timing is of paramount importance. Any variation from 600 rev/min especially an increase in revolutions will result in incorrect setting.



AV364



**DISTRIBUTOR—24 Volt. (Lucas screened)**—Remove and refit **86.35.20****Removing**

1. Disconnect the batteries.
2. Disconnect the air outlet pipe from the side of the distributor cap.
3. Disconnect the air inlet pipe from the side of the distributor body.
4. Remove the four bolts retaining the distributor cap.
5. Disconnect the low tension lead to the distributor body.
6. Mark the centre of the rotor arm tip and scribe a corresponding mark on the distributor body.
7. Scribe alignment marks on the distributor and engine timing cover. Note, if the engine is turned while the distributor is removed it will be necessary to carry out the complete ignition timing procedure. Refer instructions 19 to 33.
8. Remove the distributor clamp bolt and clamp plate.
9. Withdraw the distributor.

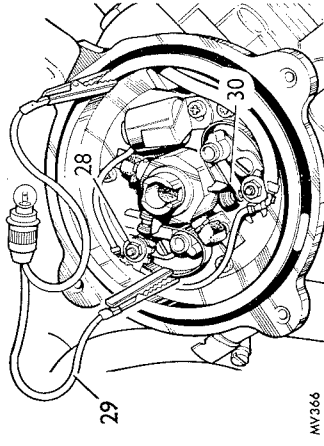
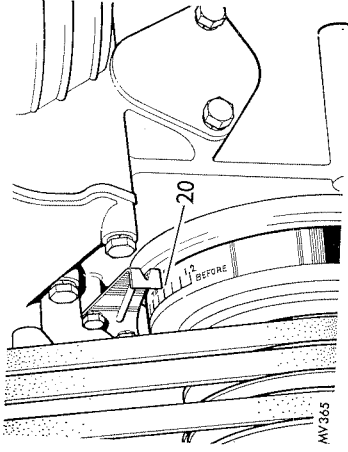
**Refitting**

If a new distributor is to be fitted, duplicate the scribe markings made on the old unit prior to its removal. The following instructions assume that the engine was not turned.

10. Fit a new 'o' ring to the distributor housing. Lubricate the seal with M4 silicone grease.
11. Position the centre of the rotor arm tip approximately 30° anti-clockwise from the scribed marks on the top edge of the distributor body.
12. Fit the distributor to the engine ensuring that the scribed marks on the body and engine timing cover align. Do not use force. It may be found necessary to align the oil pump drive shaft so that it engages the distributor drive.
13. Fit the clamp plate and bolt.
14. Connect the low tension lead to the distributor body.
15. Connect the air inlet pipe from the in-line filter to the side of the distributor body.
16. Connect the air outlet pipe to the side of the distributor cap.
17. Ensure contact breaker gaps are set to 0.014 to 0.016 in (0.35 to 0.40 mm).
18. Fit the rotor arm and distributor cap.

*continued*

19. If the engine was turned while the distributor was removed proceed as follows:
  20. Set the engine at 3° B.T.D.C. on number 1 piston compression strokes.
  21. Check that the sparking plug leads are connected to the distributor cap as shown.
  22. Set the rotor arm approximately 30° anti-clockwise from number one spark plug lead position.
  23. Adjust the position of the oil pump drive shaft so that it will engage the distributor when fitted. Allow for the clockwise rotation of the distributor shaft as the skew driving gear meshes.
  24. Fit the distributor to the engine.
  25. Fit the distributor clamp plate and bolt. Do not tighten at this stage.
  26. Turn the engine 45° against its normal direction of rotation and then bring it forward to the 3° B.T.D.C. position, number one cylinder firing.
  27. Check that the rotor arm still corresponds with number one segment in the distributor cap.
  28. Rotate the distributor body clockwise until the set of contacts (nearest engine inlet manifold) just commence to open.
  29. Connect a timing light as shown.
  30. Switch on the ignition and rotate the distributor body clockwise until the lamp lights. This is the firing point when the other set of contacts commence to open.
  31. Tighten the clamp bolt and disconnect the timing light.
  32. Fit the distributor cap.
  33. Connect the batteries.



DISTRIBUTOR—12 Volt (Lucas 35 D8-G—No. 41487)

—Overhaul 86.35.26

**Dismantling**

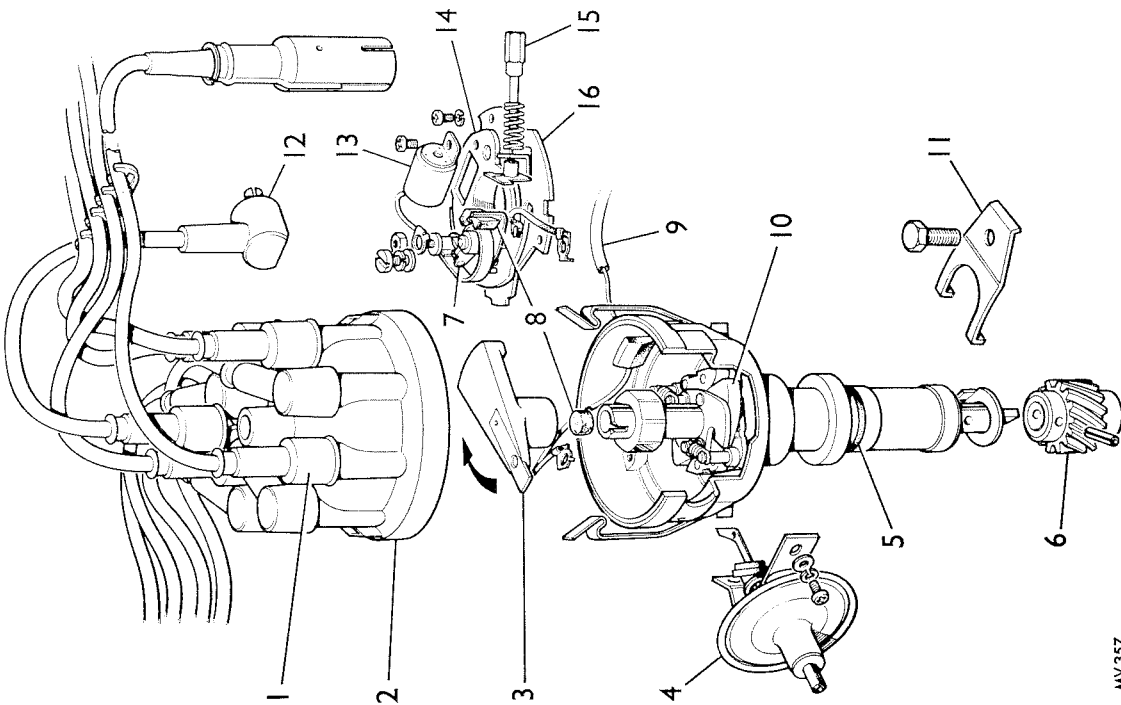
1. Remove the distributor 86.35.20.
2. Remove the rotor arm and the felt lubricating pad.
3. Remove the nut retaining the contact breaker spring to its pivot post, and lift off the insulating bush together with the low tension and condenser leads.
4. Lift off the moving contact breaker point spring assembly and the insulating washer from the base of the spring pivot post.
5. Remove the screw and spring washer holding the condenser.
6. Remove the fixed contact with the cam lubricating pad.
7. Remove the dwell angle adjuster screw and spring.
8. Remove the earth lead from the centrifugal advance cover plate.
9. Remove the contact breaker base plate.
10. Remove the vacuum unit and grommet.
11. Remove the centrifugal advance cover plate.
12. Carefully detach and withdraw the two springs from the centrifugal advance unit.
13. Remove the screw retaining the rotor cam and lift off the cam and cam foot.
14. Remove the two weights.
15. Drive out the pin securing the driving gear and remove the gear and tab washer.
16. Withdraw the rotor shaft.

**Inspection**

17. Check all components for wear or damage and renew as necessary.

**Assembling**

18. Reverse instructions 1 to 16. Ensure when fitting the springs to the centrifugal advance unit that they are not stretched.
19. Set the contact breaker points to 0.014 to 0.016 in (0.35 to 0.40 mm).
20. Fit the distributor to the engine 86.35.20.
21. Check the set dwell angle and ignition timing as necessary.



MV357

Distributor—12 volt (Lucas 35D8-G No. 41487)

- |   |                       |    |                                 |
|---|-----------------------|----|---------------------------------|
| 1 | Plug lead No. 1       | 9  | L.T. lead—from coil             |
| 2 | Distributor cover     | 10 | Centrifugal advance unit        |
| 3 | Rotor arm             | 11 | Distributor clamp               |
| 4 | Vacuum unit           | 12 | HT lead—from coil               |
| 5 | 'O' ring oil seal     | 13 | Condenser                       |
| 6 | Driven gear           | 14 | Contact breaker base plate      |
| 7 | Contact breaker set   | 15 | Dwell angle adjuster            |
| 8 | Felt lubricating pads | 16 | Centrifugal advance cover plate |

## DISTRIBUTOR—24 Volt (Lucas screened)

86.35.26

## —Overhaul

## Dismantling body

1. Remove the distributor 86.35.20.
2. Remove the rotor arm and felt lubricating pad.
3. Remove the two nuts retaining the respective contact breaker springs to their pivot posts and lift off their insulating bushes together with the low tension and capacitor leads.
4. Lift off both 'moving' contacts point spring assemblies and insulating washers from the base of the spring pivot posts.
5. Remove the screw and spring washer holding the condenser.
6. Pull out the cam lubricating pads. (The mounting brackets are retained by single screws with spring washers).
7. Remove the screws holding the fixed contact breaker points.
8. Remove the three screws and spring washers retaining the contact breaker base plate.
9. Carefully detach and withdraw the two springs from the centrifugal advance unit.
10. Remove the screw retaining the rotor cam and lift off the cam and foot.
11. Remove the two weights.
12. Drive out the pin securing the driving gear and remove the gear and tab washer.
13. Withdraw the rotor shaft.
14. Unscrew the air inlet tube adaptor with its sealing washer.

## Dismantling cap

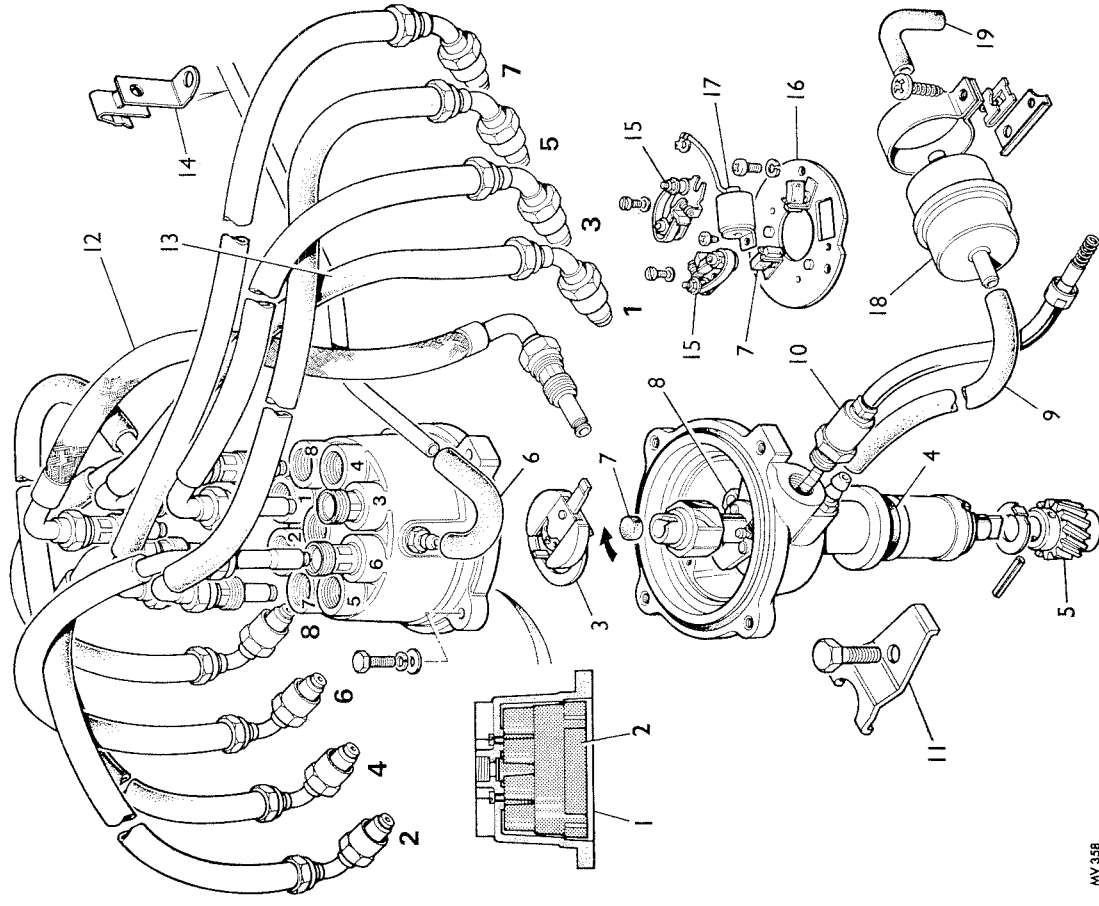
15. Remove the two screws and spring washers from the top of the cap to release the moulded contact block inside.
16. Unscrew the nine lead connectors.
17. Unscrew the air outlet tube adaptor with its sealing washer.

## Inspection

18. Check all components for wear or damage and renew as necessary.

## Assembly

19. Reverse instructions 1 to 16. Ensure when fitting the springs to the centrifugal advance unit that they are not stretched.
20. Set the contact points to 0.014 to 0.016 in (0.35 to 0.40 mm).
21. Fit the distributor to the engine. 86.35.20.
22. Check ignition timing as necessary.



AW 358

## Distributor—24 Volt (Lucas screened and waterproofed)

- |    |                                     |    |                                   |
|----|-------------------------------------|----|-----------------------------------|
| 1  | Distributor cover                   | 11 | Distributor clamp                 |
| 2  | Inner moulded contact block         | 12 | HT lead from coil                 |
| 3  | Rotor arm with engine speed limiter | 13 | Plug lead No. 1                   |
| 4  | 'O' ring oil seal                   | 14 | Retaining bracket—air outlet pipe |
| 5  | Driven gear                         | 15 | Contact breaker—two sets          |
| 6  | Air outlet pipe—to induction system | 16 | Contact breaker base plate        |
| 7  | Felt lubricating pads               | 17 | Condenser                         |
| 8  | Centrifugal advance unit            | 18 | Air filter                        |
| 9  | Filtered air pipe—to distributor    | 19 | Air supply pipe—to filter         |
| 10 | LT lead—from coil                   |    |                                   |

**IGNITION COIL FILTER UNIT—24 Volt**

86.35.28

**—Remove and refit**

**Removing**

1. Unscrew the nut retaining the lead to the coil (SW).
2. Disconnect the white lead at the 'Lucar' connector.
3. Remove the two nuts, spring and plain washers securing the filter unit to the body.

**Refitting**

4. Reverse instructions 1 to 3.

**NOTE:** The chassis bonding strip from the coil to the chassis also attaches to the lower fixing stud.

**IGNITION COIL—24 Volt (Lucas 5C10)**

86.35.32

**—Remove and refit**

**Removing**

1. Unscrew the HT lead nut.
2. Unscrew the LT distributor lead nut (CB)
3. Unscrew the filter unit lead nut (SW).
4. Remove the two bolts, nuts, spring washers and plain washers securing the coil bracket to the body.

**Refitting**

5. Reverse instructions 1 to 4.

**NOTE:** The chassis bonding strip attaches to the lower bolt, the cable clip to the upper bolt.

**IGNITION COIL—12 Volt (Lucas 16C6)**

86.35.32

**—Remove and refit**

**Removing**

1. Pull out the HT lead.
2. Disconnect the LT distributor lead 'Lucar' (-).
3. Disconnect the ballast resistor and suppressor 'Lucars' (+).
4. Remove the two bolts, nuts, spring and plain washers securing the coil bracket to the body.

**Refitting**

5. Reverse instructions 1 to 4.

**NOTE:** The ballast resistor attaches to the lower bolt, the suppressor to the upper bolt.

**IGNITION COIL BALLAST RESISTOR—12 Volt**

86.35.33

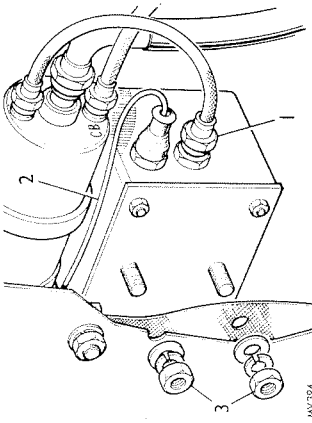
**—Remove and refit**

**Removing**

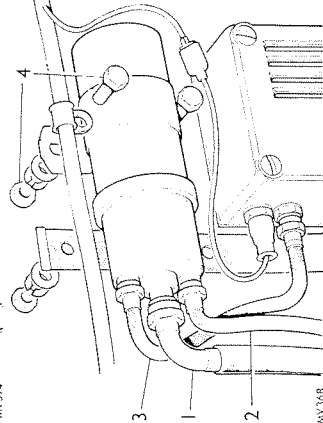
1. Disconnect the two 'Lucar' connectors (3 leads) from the ballast resistor.
2. Remove the lower bolt, washers and nut securing the ignition coil to the body.
3. Remove the ballast resistor.

**Refitting**

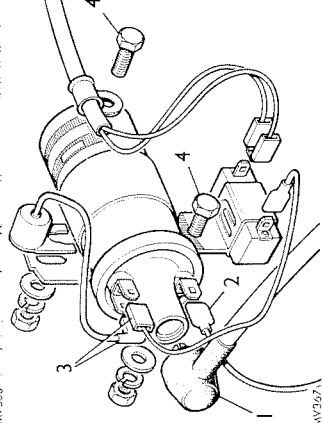
4. Reverse instructions 1 to 3.



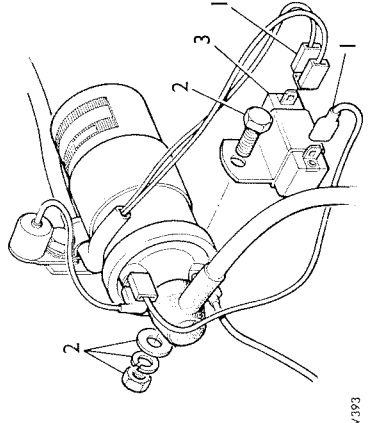
MV374



MV368



MV36A



MV393

**HEADLAMP AND MOUNTING PLATE**

—Remove and refit

L.H. 86.40.06  
R.H. 86.40.07

**Removing**

1. Press the light unit assembly and fairing rim inwards and rotate anti-clockwise.
2. Withdraw the light unit assembly and fairing rim as far as possible without straining the electrical leads.
3. Slide the rubber cover at the rear of the light unit clear of the bayonet cap.
4. Depress the cap, rotate anti-clockwise and release the cap from the light unit.
5. Remove the bulb.
6. If it is necessary to detach the lamp securing rims from the light unit (three screws), first release the two outer clamping rims (three screwed clips), as illustrated.
7. To remove the complete lamp assembly, release the radiator grille and disconnect the electrical lead sockets and harness clips at that point.
8. Remove the three screws, spring washers and nuts securing the lamp body to the mounting plate on the vehicle. The lamp body can then be removed with the leads.
9. To remove the headlamp mounting plate from the vehicle, release the four bolts, spring washers and nuts.

**Refitting**

10. Reverse instructions 1 to 9.

**HEADLAMP BULB**

86.40.09

**Removing**

1. Carry out instructions 1 to 5. Operation 86.40.06-07 above.

**Refitting**

2. Reverse instructions 1 to 5.

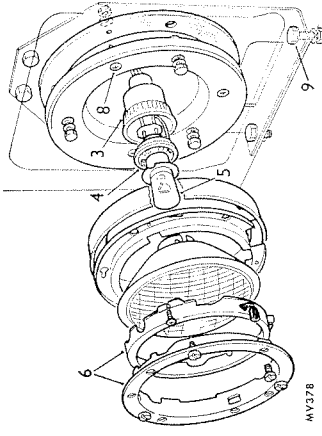
**HEADLAMPS**

86.40.17

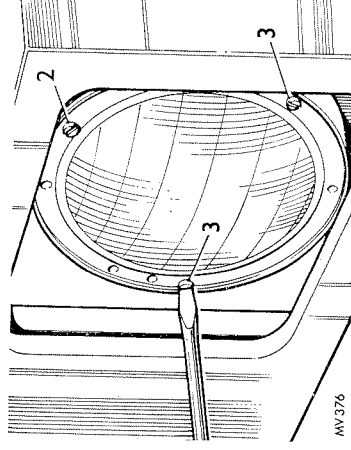
**—Adjusting beams**

Checking main beam settings is most easily effected using a beam setter. When such facilities are not available lamps can be checked and re-set, if necessary, in the following manner.

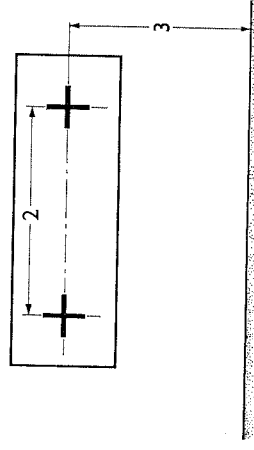
1. Position the vehicle unladen on level ground, approximately 12 feet or 4 metres from a wall or screen.
2. Mark the wall or screen as illustrated. The lamp centres should be 59 in (1,500 mm) apart horizontally.
3. The nominal vertical dimension is 32 in (813 mm) from the ground. To allow for variations in suspension and tyres this dimension should be checked on the vehicle concerned before proceeding.



MV378



MV376



MV377

4. Horizontal adjustment is made by altering the two side screws—to shift beam to left rotate left screw clockwise, right screw anti-clockwise; to shift beam to right rotate right screw clockwise, left screw anti-clockwise.
5. Vertical adjustment is made by altering the top screw—clockwise to raise, anti-clockwise to lower. Left and right in the above instruction refers to the screws as viewed from behind the steering wheel.

**FRONT PARKING LAMP BULBS** 86.40.33

**FRONT TURNLIGHT BULBS** 86.40.41

**REAR TURNLIGHT BULBS** 86.40.44

**TAIL LAMP BULBS** 86.40.78

—Remove and refit

- Removing**
1. Unscrew appropriate lens front from threaded holder on vehicle.
  2. Remove bayonet fitting bulb.

**Refitting**

3. Reverse instructions 1 and 2.

**FRONT SIDE/PARKING LAMP** 86.40.34

**FRONT TURNLIGHT LAMP** 86.40.42

—Remove and refit

**Removing**

1. The lead connectors are located inside the cab near the rubber bulb holders.
2. Disconnect the lamp leads from the harness snap connectors carefully noting wire colours and locations.
3. Unscrew and remove the lens.
4. Push the moulded rubber bulb holder through the lamp base and withdraw lamp and leads from the front of the vehicle.
5. Remove the three screws, washers and nuts securing the lamp base and remove.

**Refitting**

6. Reverse instructions 1 to 5.

**REAR TURNLIGHT LAMP ASSEMBLY** 86.40.45

**TAIL LAMP ASSEMBLY** 86.40.79

—Remove and refit

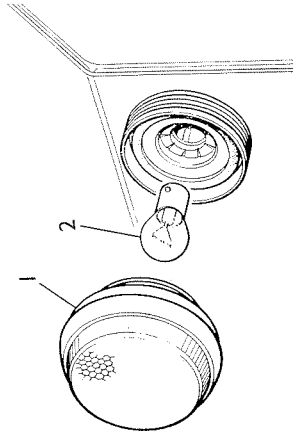
**Removing**

1. Remove the two screws and washers securing the convoy light bracket to the chassis to expose the rear and tail lamp leads.
2. Disconnect the leads from the snap connectors and supporting clips.
3. Unscrew and remove the lamp lens.
4. Push the moulded rubber bulb holder through the lamp base and withdraw lamp and leads from the rear of the vehicle.
5. Remove the three screws, washers and nuts securing the lamp base and remove.

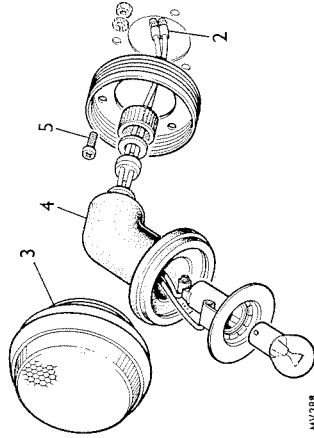
**Refitting**

6. Reverse instructions 1 to 5.

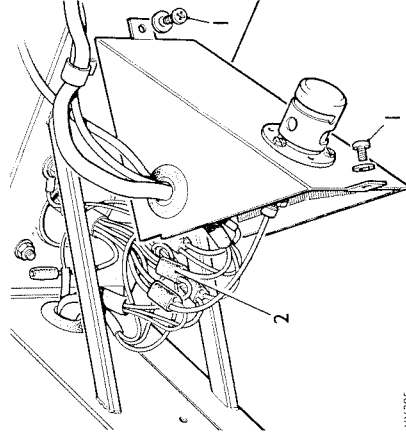
86.40.33  
86.40.34  
86.40.41  
86.40.42  
86.40.44  
86.40.45  
86.40.78  
86.40.79



MV387



MV388



MV395

**CONVOY LAMP**

—Remove and refit 86.40.81

**Removing**

1. Remove the two screws and washers securing the convoy lamp bracket to the chassis.
2. Detach the convoy lamp bracket from the chassis.
3. Unscrew the lead holder cap on the rear of the convoy lamp.
4. Detach the leads and bulb holder assembly from the lamp.
5. Remove the three screws securing the convoy lamp to the bracket.
6. Remove the convoy lamp.

**Refitting**

7. Reverse instructions 1 to 6.

**REAR NUMBER PLATE BULB**

—Remove and refit 86.40.85

**Removing**

1. Release the single hexagon-headed screw securing the rear number plate lamp cover.
2. Withdraw the cover with its glass.
3. Remove the bulb.

**Refitting**

4. Reverse instructions 1 to 3.

**REAR NUMBER PLATE LAMP**

—Remove and refit 86.40.86

**Removing**

1. Remove the single screw securing the lamp cover.
2. Remove the two screws, washers and nuts securing the lamp to the hinged number plate.
3. Remove the harness clip and earth connection.
4. Disconnect the lead connector.

**Refitting**

5. Reverse instructions 1 to 4.

**CONVOY LAMP BULB**

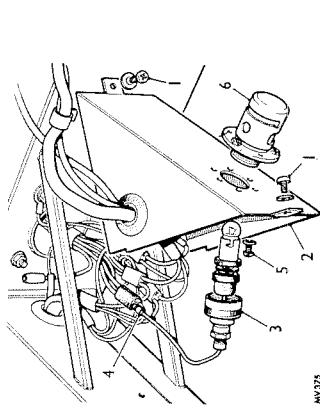
—Remove and refit 86.40.92

**Removing**

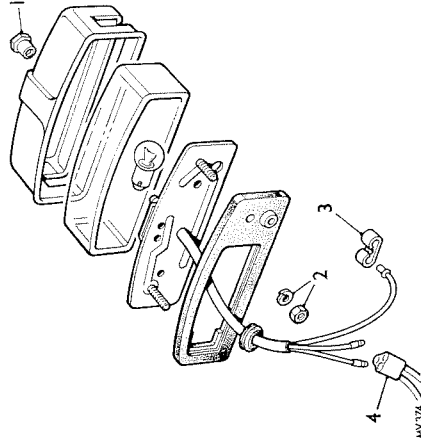
1. Remove the screws and spring washers holding the lamp rim cover and withdraw the rim and glass cover.
2. Remove bayonet fitting bulb.

**Refitting**

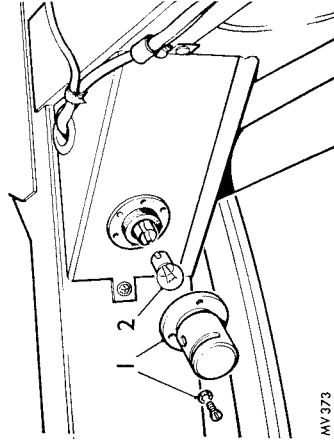
3. Reverse instructions 1 and 2.



MV392



MV37A



MV373

86.40.81  
86.40.83  
86.40.85  
86.40.92

**INSPECTION SOCKET**

—Remove and refit **86.45.33**

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Disconnect the electrical leads from the sockets.
3. Remove the screw lock rings, shakeproof washers and insulation tab.
4. Withdraw the sockets.

**Refitting**

5. Reverse instructions 1 to 4, ensuring that the insulation tap is between the two sockets.

**INSTRUMENT ILLUMINATION BULBS**

—Remove and refit **86.45.48**

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Remove the four screws and two nuts securing the instrument panel and mounting bracket and tilt the panel upwards.
3. Withdraw the two bulb holders from the back of the speedometer and combined instrument heads respectively.
4. Unscrew the bulbs.

**Refitting**

5. Reverse instructions 1 to 4.
- NOTE:** The above bulbs are controlled by the panel light switch on the instrument panel.

**AMMETER ILLUMINATION BULB—24 Volt**

—Remove and refit **86.45.56**

**Removing**

1. Withdraw the bulb holder from the bracket behind the fascia panel.
2. Unscrew the bulb.

**Refitting**

3. Reverse instructions 1 and 2.
- NOTE:** This bulb, which illuminates both ammeters, is controlled by the panel light switch on the instrument panel.

**AMMETER BULB HOLDER BRACKET—24 Volt**

—Remove and refit **86.45.58**

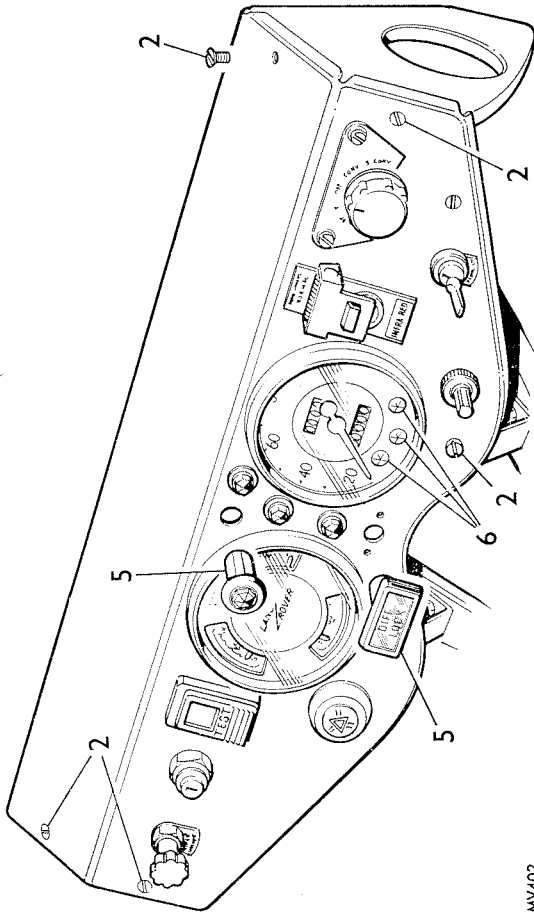
**Removing**

1. Withdraw the bulb holder from the lamp bracket behind the fascia panel.
2. Remove the two self-tapping screws retaining the lamp bracket to the underside of fascia panel.

**Refitting**

3. Reverse instructions 1 and 2.

86.45.33  
86.45.48  
86.45.56  
86.45.58



AW402

**WARNING LIGHT ASSEMBLY**

—Remove and refit **86.45.60**

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Remove the four screws and two nuts securing the instrument panel and mounting bracket respectively.
3. Tilt the panel upwards.
4. Withdraw the five bulb holders (including winch holder) from the back of the warning lights in the instrument panel. (See 86.45.61 below).

**WARNING LIGHT BULBS**

Remove and refit **86.45.61**

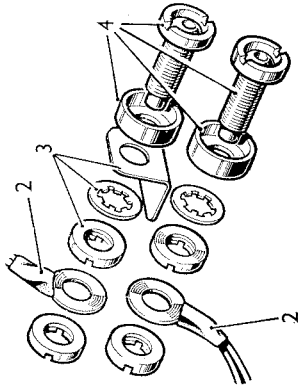
**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Remove the four screws and two nuts securing the instrument panel and mounting bracket and tilt the panel upwards.
3. Withdraw the eight bulb holders (including winch holder) from back of the instrument panel and speedometer head.
4. Remove the appropriate bulbs.

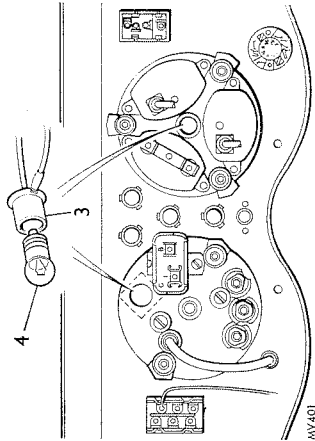
**Refitting**

5. Reverse instructions 1 to 4.
- NOTE:** The five bulbs in the panel are bayonet fitting and the three in the speedometer head are screw-in.

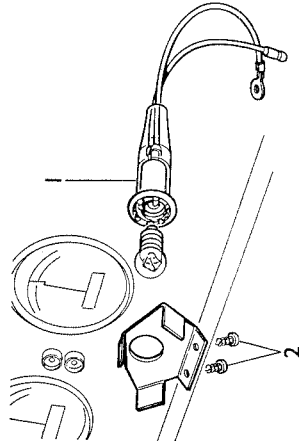
86.45.60  
86.45.61



AW382



AW401



AW383

**HAZARD SWITCH INDICATOR BULB**

86.45.68

**Removing**

1. Unscrew the hazard switch button.
2. Pull out the bulb.

**Refitting**

3. Reverse instructions 1 and 2.

**BRAKE CIRCUIT WARNING/TEST BULB**

86.45.69

**Removing**

1. Push the switch body out of the instrument panel front.
2. Using a suitable probe, carefully depress one of the switch pivots through the holes provided in the sides of the switch body, to allow the switch to be pulled out.
3. Unscrew the bulb.

**Refitting**

4. Reverse instructions 1 to 3.

**STARTER RELAY**

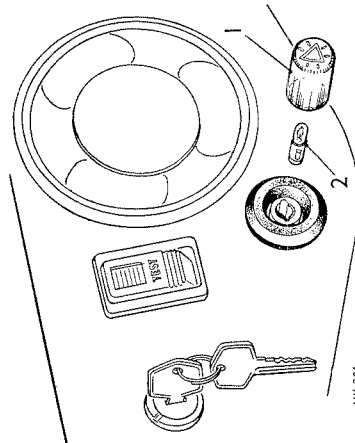
86.55.05

**Removing**

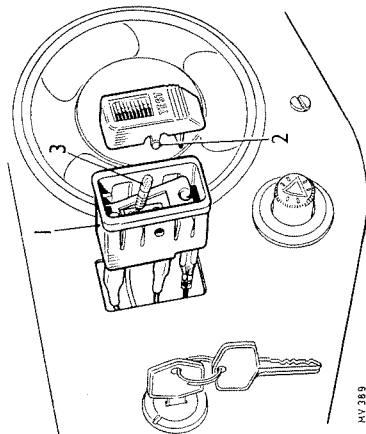
1. Disconnect the battery (batteries 24 volt).
2. Remove the six bolts securing the right side front wheel splash plate. The front inside bolt passes into a trapped nut, the other five are used with nuts, plain and spring washers.
3. Disconnect the leads from the starter relay.
4. Remove the two screws, spring washers and nuts to release the relay unit.

**Refitting**

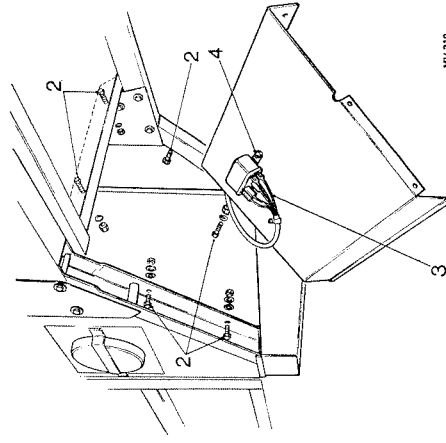
5. Reverse instructions 1 to 4. Ensure that all connections are clean and tight.



MV 391



MV 389



MV 319

**HORN RELAY**

86.55.09

**—Remove and refit**

**Removing**

1. The flasher unit horn relay and infra-red relay are grouped and located on the right side of the driver's cab above the pedal controls. (The top, front relay is the horn relay.)
2. Disconnect the battery.
3. Remove the two screws, washers and nuts securing the horn relay to the side of the vehicle.
4. Detach the 'Lucar' connections, carefully noting the position of the leads.
5. Withdraw the horn relay.

**Refitting**

6. Reverse instructions 1 to 5.

**FLASHER UNIT**

86.55.11

**—Remove and refit**

**Removing**

1. Disconnect the plug socket from the turnlight flasher unit located on the right side of the driver's cab above the pedal controls, (under the infra-red relay).
2. Remove the two screws, spring washers and nuts securing the flasher unit to the body. Note that the longer screw is fitted to the front of the vehicle.
3. Withdraw the flasher unit.

**Refitting**

4. Locate the flasher unit in position on the vehicle.
5. Fit and tighten the two screws, spring washers and nuts. Note that two earth connections are fitted to the front screw between the flasher and the body.
6. Connect the plug socket to the flasher unit.

**INFRA-RED RELAY**

MV 385

**—Remove and refit**

86.55.21

**Removing**

1. The flasher unit, horn relay and infra-red relay are grouped and located on the right hand of the driver's cab above the pedal controls. (The top, rear unit is the infra-red relay.)
2. Disconnect the battery.
3. Remove the two screws, washers and nuts securing the relay to the side of the vehicle.
4. Detach the 'Lucar' connections, carefully noting the position of the leads.
5. Withdraw the infra-red relay.

**Refitting**

6. Reverse instructions 1 to 5.

BATTERY RELAY—24 Volt

—Remove and refit

86.55.24

Removing

1. Disconnect the batteries.
2. Release the generator panel cover by removing the twelve retaining nuts (See 86.10.26 for access).
3. Disconnect the connecting strip and leads at the division plate terminals (battery relay compartment side). Note the leads and connection points to ensure correct refitting.
4. Disconnect cables and remove the round capacitor from the division plate.
5. Disconnect the leads from the battery relay.
6. Disconnect the leads from terminals 1 and 2, located on the relay base board.
7. Remove the plug with leads by releasing the four securing screws.
8. Remove the four screws and washers securing the base plate and lift out the battery relay assembly.

Refitting

9. Reverse instructions 1 to 8.

FUEL PUMP SUPPRESSOR BOX

—Remove and refit

86.55.35

Removing

1. Disconnect the battery (batteries 24 volt).
2. Remove the access panel from floor of vehicle, (the rear panel located above the fuel tank).
3. Disconnect the two leads from the suppressor box to the fuel pump ('Lucar' terminals). Note the wire locations and colours. (The black wire connects to the outer terminal on the fuel pump).
4. Disconnect the earth lead from the suppressor box to the fuel pump.
5. Disconnect the two leads from the suppressor box to the snap connectors. Note the wire colours.
6. Remove the two screws securing the suppressor box to the fuel pump.
7. Withdraw the suppressor box.

Refitting

8. Reverse instructions 1 to 7.
9. Ensure that the earth connection is clean and tight. Smear the connection with Bostik 772.
10. Smear the 'Lucar' fuel pump connections with petroleum jelly to prevent the ingress of moisture.

BATTERY RELAY—24 Volt (CAV BCK)

—Adjust

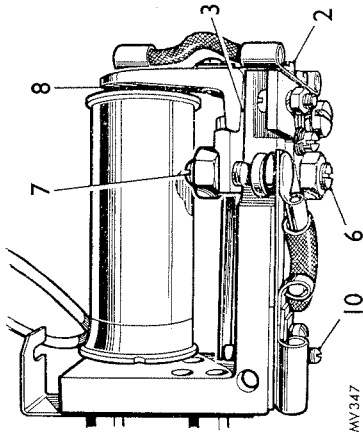
86.55.47

Mechanical setting

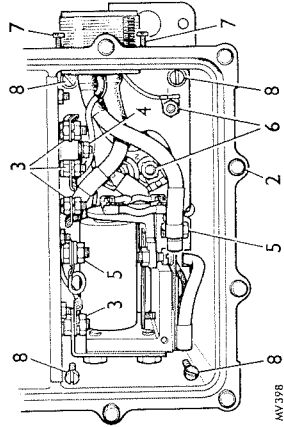
1. Remove the generator panel cover by releasing the twelve retaining nuts.
2. Slacken off screws attaching flat hinge spring to frame.
3. Insert 0.004 in (0,10 mm) feeler between back of armature and frame.
4. Press armature firmly down on core and back against feeler.
5. Tighten hinge spring fixing screws.
6. Screw down main contacts until gap between armature and core is 0.008/0,010 in (0,20/0,25 mm) with armature held down.
7. With 0.008 in (0,20 mm) feeler between main contacts, hold down armature and adjust spring-loaded contacts to touch. With 0,010 in (0,25 mm) feeler between main contacts, spring contacts must be broken.
8. With contacts in open position, set gap between armature tip and core to 0,062/0,064 in (1,5/1,6 mm).

Electrical setting

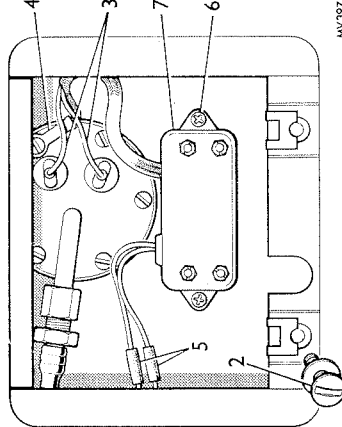
9. Run the alternator and check that the points close within the limits of 18 to 20 volts, drop-out voltage 9 to 12 volts.
  10. Adjust by releasing the locknut and turning the spring-tension screw as required (clockwise to increase voltage and vice versa).
  11. Re-tighten the locknut.
- NOTE:** Since the voltage spring-tension screw is practically inaccessible in situ, this adjustment is best carried out under bench test conditions (see 86.10.24).



AW/347



AW/398



AW/397



STARTER MOTOR—12 and 24 Volt (Lucas 3MI100PE)

—Remove and refit 86.60.01

Removing

1. Disconnect the battery.
  2. Remove the side cover plate from the right-hand front wheel arch, held by three quarter-turn fasteners.
- NOTE:** Setting the front wheels on full left lock will facilitate access to this area.
3. Pull the rubber shroud off the solenoid terminal post and remove the nut and spring washer.
  4. Lift off the battery lead and the four eyeleted wires.
  5. Release the three 'Lucar' connectors from the end of the solenoid.
  6. Remove the two bolts securing the starter motor to the flywheel housing.
- NOTE:** The lower bolt, which also carries an earth lead, is removed from underneath the vehicle.
7. Remove the starter complete with solenoid.

Refitting

8. Thoroughly clean the surface of contact between the starter and the flywheel housing and brush on 'Hylomar' (medium) to prevent the ingress of water.
9. Reverse instructions 1 to 7.

SOLENOID

—Remove and refit 86.60.08

Removing

1. Remove the starter motor, operation 86.60.01.
2. Remove the nut and spring washer and detach the motor lead.
3. Prise out the rubber grommet from the driven end.
4. Remove the two bolts and spring washers securing the solenoid to the starter motor and withdraw the solenoid from the plunger.
5. Unhook the plunger from the engaging lever.
6. Remove the return spring from the plunger.
7. Remove the spring cup from the plunger.

Refitting

8. Fit the spring cup to the plunger.
9. Fit the return spring to the plunger.
10. Push the engaging lever forward by inserting a finger into the grommet hole.
11. Insert the plunger, compressing the spring to hook it to the engaging lever.
12. Thoroughly clean the surfaces of contact between the solenoid and the starter motor and using a brush, apply 'Hylomar' (medium) to prevent the ingress of water.
13. Carefully locate the solenoid over the plunger, ensuring that the plunger remains hooked.
14. Fit the two remaining bolts and spring washers.
15. Refit the rubber grommet.
16. Fit the motor lead, nut and spring washer to the solenoid terminal 'STA'.
17. Refit the starter motor, operation 86.60.01.

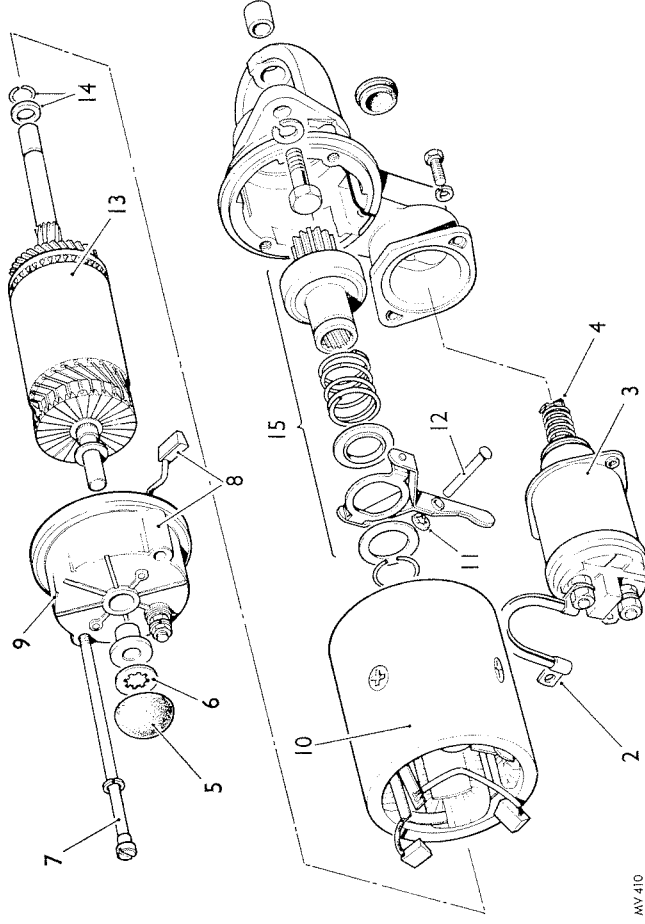
STARTER MOTOR—(Lucas 3MI100PE)

86.60.13

—Overhaul  
Dismantling

1. Remove the starter motor, 86.60.01.
2. Remove the connecting link between the starter and the solenoid terminal 'STA'.
3. Remove the solenoid from the drive end bracket.
4. Grasp the solenoid plunger and lift the front end to release it from the top of the drive engagement lever.
5. Remove the end cap seal.
6. 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 retaining ring to be removed.
7. Remove the two through bolts.
8. Partially withdraw the commutator end cover and disengage the two field coil brushes from the brush box.

*continued*

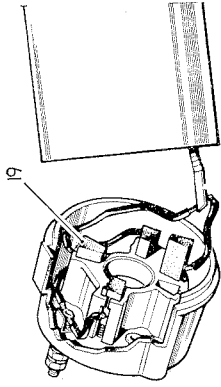


MV 410

Inspecting

Clutch

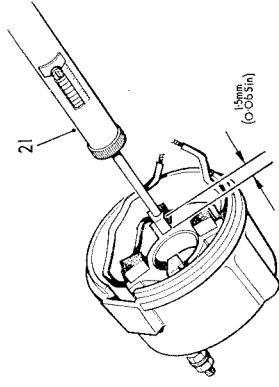
16. Check that the clutch gives instantaneous take-up of the drive in one direction, and rotates easily and smoothly in the other direction.
17. Ensure that the clutch is free to move round and along the shaft splines without any tendency to bind.  
**NOTE:** The roller clutch drive is sealed in a rolled steel cover and cannot be dismantled.
18. Lubricate all clutch moving parts with Shell SB 2628 grease for cold and temperate climates or Shell Retinax 'A' for hot climates.



38C94

Brushes

19. Check that the brushes move freely in the brush box moulding. Rectify sticking brushes by wiping with a petrol moistened cloth.
20. Fit new brushes if they are damaged or worn to approximately 9.5 mm (0.375 in).
21. Using a push-type spring gauge, check the brush spring pressure. With new brushes pushed in until the top of the brush protrudes about 1.5 mm (0.0625 in) from the brush box moulding, the spring pressure reading should be 1.0 kgf (36 ozf).
22. Check the insulation of the brush springs by connecting a 110V a.c. 15W test lamp between a clean part of the commutator end cover and each of the springs in turn. **The lamp should not light.**



38C95

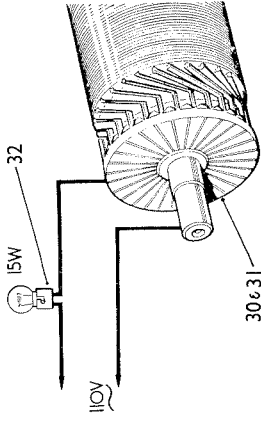
Bearings

23. The armature bearings, fitted in the commutator end cover and the drive end fixing bracket, are self-lubricating porous-bronze bushes. Check for excessive side-play of the armature shaft.
24. If fouling of the pole-shoes by the armature, or inefficient operation of the starter, is evident, the bushes **must** be renewed.
25. Check that the inner diameter of the bushes does not exceed the following dimensions:  
commutator end cover bush 0.441 in (11.20 mm),  
drive end fixing bracket bush 0.476 in (12.09 mm).
26. To remove worn bushes use a wheel-operated press. Alternatively, support the bearing housing and then carefully tap the bush out of the cover or bracket with a mandrel.
27. Immerse new bushes in clean engine oil for 24 hours before fitting. Alternatively, if the lubricant is heated to a temperature of 1000°C, 2-hours immersion is sufficient.
28. If bushes are heated, cool before fitting.
29. Press the new bushes into position by means of a shouldered polished mandrel with dimensions as follows:  
commutator end cover bush 0.4377 in (11.117 mm),  
drive end fixing bracket bush 0.4729 in (12.011 mm).  
**NOTE:** Bushes **must not** be reamed or self-lubricating qualities will be impaired.

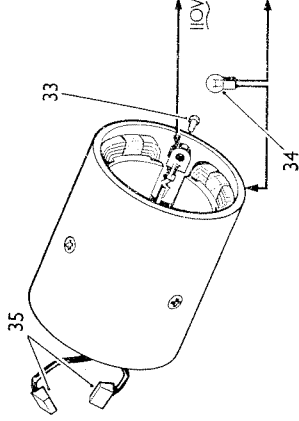
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Armature

30. Check the commutator. If cleaning only is necessary, use a flat surface of very fine glass paper, and then wipe the commutator surface with a petrol moistened cloth.
  31. If necessary, the commutator may be machined providing a finished surface can be obtained without reducing the thickness of the commutator copper below 3.5 mm (0.140 in), otherwise a new armature must be fitted. **Do not undercut the insulation slots.**
  32. Check the armature insulation by connecting 110V a.c. 15W test lamp between any one of the commutator segments and the shaft. **The lamp should not light, if it does light fit a new armature.**
- Field coil insulation**
33. Disconnect the end of the field winding where it is riveted to the yoke, by filing away the riveted over end of the connecting-eyelot securing rivet, sufficient to enable the rivet to be tapped out of the yoke.
  34. Connect a 110V a.c. 15W test lamp between the disconnected end of the winding and a clean part of the yoke.
  35. Ensure that the brushes or bare parts of their flexibles are not touching the yoke during the test.
  36. The lamp should not light, if it does light, fit a new field coil assembly.
  37. Re-secure the end of the field winding to the yoke.



38C96A



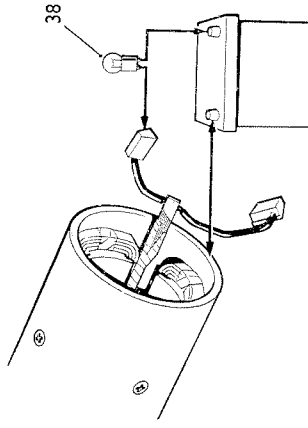
38C97A

Field coil continuity

38. Connect a 12V or 24V battery operated test lamp (as applicable) between each of the brushes in turn and a clean part of the yoke.
39. The lamp should light, if it does not fit a new field coil assembly.

Solenoid

40. Disconnect all cables from the solenoid terminals and connectors.
41. Connect the appropriate battery and a 60W test lamp between the solenoid main terminals. The lamp should not light, if it does light, fit new solenoid contacts or a new solenoid complete.



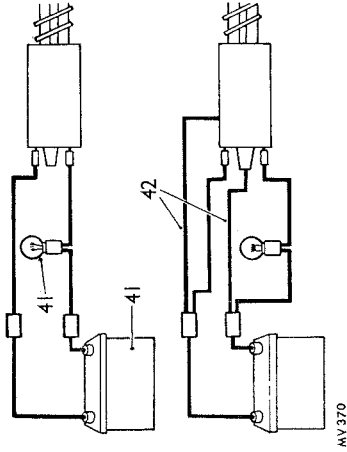
38C98A

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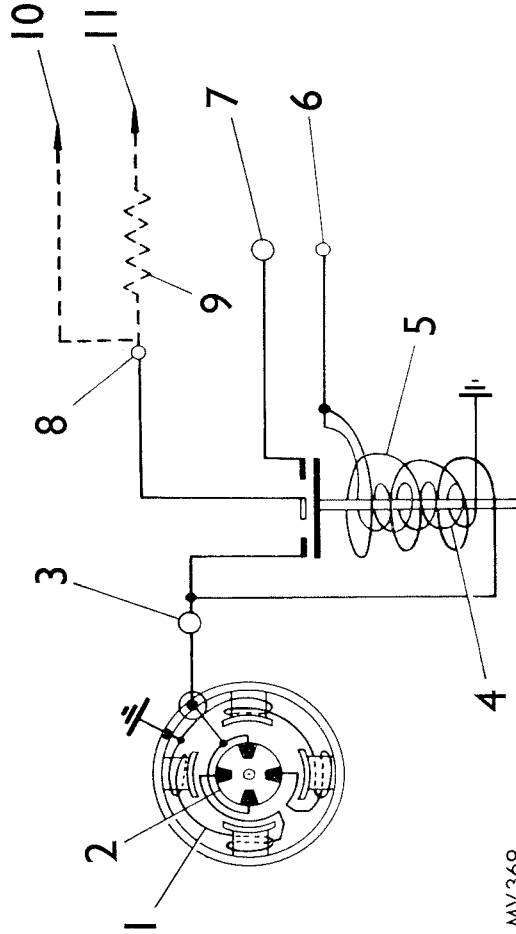
42. Leave the test lamp connected and, using the same battery supply, energise the solenoid by connecting it between the small solenoid operating 'Lucar' terminal blade and a good earth point on the solenoid body.
43. The solenoid should be heard to operate and the test lamp should light with full brilliance, otherwise fit new solenoid contacts or a new solenoid complete.

**Reassembling**

44. Reverse 1 to 15, including the following:
45. Fit the commutator end cover before refitting the solenoid to facilitate assembly of the block shaped grommet which, when assembled, is compressed between the yoke, solenoid and fixing bracket.
- NOTE:** New retaining rings will be required to replace those split off (see paragraphs 6 and 11). Ensure that the internal thrust washer is fitted to the commutator end of the armature shaft.
47. Tightening torques:  
Through bolts 1,1 kgf.m (8.0 lbf ft).  
Solenoid fixing stud nuts 0,6 kgf.m (4.5 lbf ft).  
Solenoid upper terminal nuts 0,4 kgf.m (3.0 lbf ft).
48. Set the armature end float by driving the retaining ring on the armature shaft into a position that provides a maximum of 0,25 mm (0.010 in) clearance between the retaining ring and the bearing bush shoulder.



MV370



Starter motor and solenoid internal circuit

- |   |                                       |    |                    |
|---|---------------------------------------|----|--------------------|
| 1 | Field                                 | 8  | Terminal 'IGN'     |
| 2 | Armature                              | 9  | Ballast resistor   |
| 3 | Terminal 'STA'                        | 10 | To ignition coil   |
| 4 | Hold-on winding                       | 11 | To ignition switch |
| 5 | Closing winding                       |    |                    |
| 6 | Small (unmarked) terminal on solenoid |    |                    |
| 7 | Battery supply terminal               |    |                    |
- } 12 volt vehicles only

MV369

**IGNITION/STARTER SWITCH**

86.65.02

—Remove and refit

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Remove the bezel securing the ignition/starter switch to the dashboard.
3. Withdraw the switch from the back of the panel.
4. Disconnect the terminals noting their locations.

**Refitting**

5. Reverse instructions 1 to 4.

**INFRA-RED SWITCH**

86.65.08

—Remove and refit

**Removing**

1. Unscrew and remove the retaining bezel and washer from the switch.
2. Lift off the name plate/switch cover assembly.
3. Release the switch from the back of the panel.
4. Note the position of the four leads for refitting, and disconnect the 'Lucar' connectors.

**Refitting**

5. Reverse instructions 1 to 4.

**MASTER LIGHT SWITCH**

86.65.09

—Remove and refit

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Depress the plunger in the switch knob and withdraw the knob.
3. Disconnect the switch leads at the multi-plug and two lucars provided.
4. Remove the three screws and name plate and withdraw the switch from the back of the panel.

**Refitting**

5. Reverse instructions 1 to 4.

**PANEL LIGHT SWITCH**

86.65.12

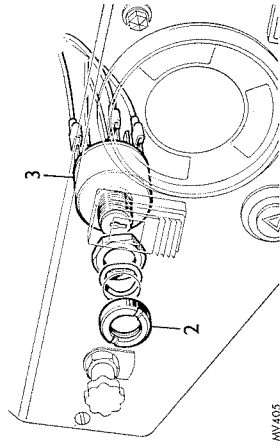
—Remove and refit

**Removing**

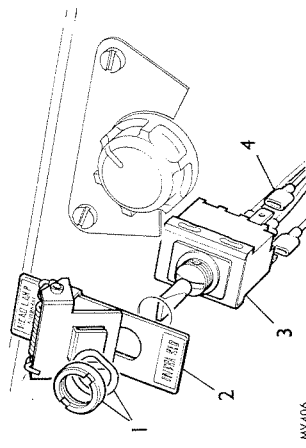
1. Unscrew and remove the retaining bezel, washer and nameplate from the switch.
2. Release the switch from the back of the panel.
3. Observe the positions of the three leads for refitting and disconnect the two 'Lucar' connectors.

**Refitting**

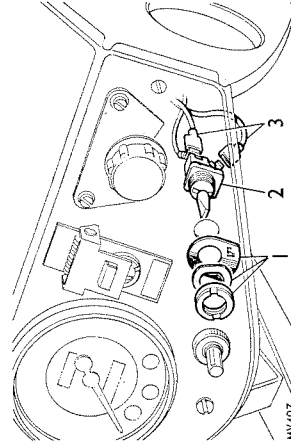
4. Reverse instructions 1 to 3.



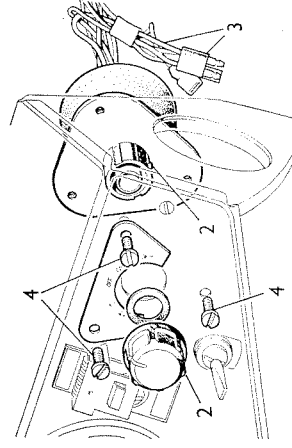
MV605



MV606



MV607



MV608

86.65.02  
86.65.08  
86.65.09  
86.65.12

**OIL PRESSURE WARNING SWITCH**

—Remove and refit 86.65.30

**Removing**

1. Disconnect the 'Lucar' connections (2 single, 1 pair) from the oil switch.
2. Unscrew and remove the oil switch from the oil filter assembly.

**Refitting**

3. Reverse instructions 1 to 2.

**WINDSCREEN WIPER/WASHER SWITCH**

—Remove and refit 86.65.38

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Depress the plunger and withdraw the switch knob.
3. Unscrew the locking ring.
4. Release the waved washer and name plate.
5. Disconnect the leads from the back of the switch.
6. Withdraw the windscreen wiper/washer switch.

**Refitting**

7. Reverse 1 to 6. Connect the leads in accordance with the circuit diagram.

**BRAKE CIRCUIT—WARNING/TEST SWITCH**

—Remove and refit 86.65.49

**Removing**

1. Depress the plastic protrusions on the switch body and withdraw from the instrument panel front.
2. Disconnect the 'Lucar' leads from the back of the switch body, taking careful note of their location.

**Refitting**

3. Reverse instructions 1 and 2.

**HAZARD SWITCH**

—Remove and refit 86.65.50

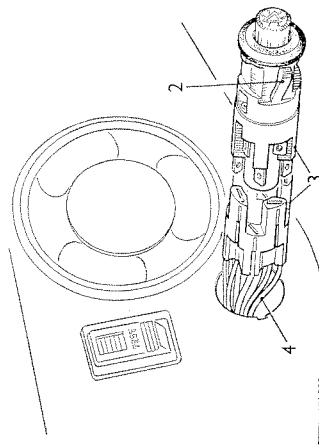
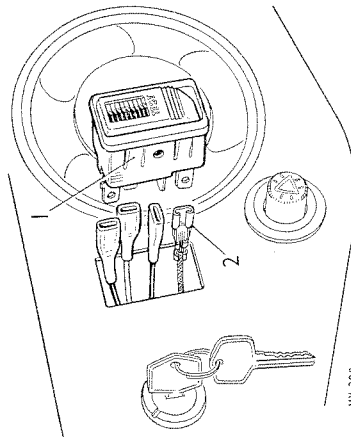
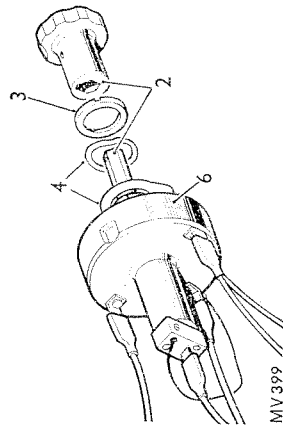
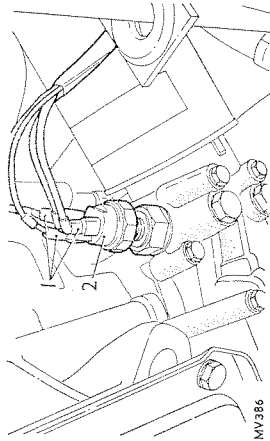
**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Depress the plastic protrusions on the switch body and withdraw it from the instrument panel front.
3. Pull apart the top and bottom halves of the switch.
4. If necessary, remove the leads from the lower half of the switch taking careful note of their locations.

**Refitting**

5. Reverse instructions 1 to 4.

86.65.30  
86.65.38  
86.65.49  
86.65.50



Truck General Service 1 Tonne 4 × 4 RTC 9120 Issue 1

**STOP LAMP SWITCH**

—Remove and refit 86.65.51

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. Disconnect the leads from the stop lamp switch.
3. Release the locknut and unscrew the retaining nut from the bracket under the brake servo unit.

**Refitting**

4. Reverse 1 to 3.
- Check, and if necessary adjust the stop lamp switch to operate at 19 to 25 mm (0.750 to 1.000 in) of pedal movement by re-positioning the adjusting bolt and locknut on the brake pedal.

**CHOKE SWITCH**

—Remove and refit 86.65.53

**Removing**

1. Remove the radiator grille.
2. Remove the bolt and locknut securing the choke switch clip to the cable and remove the clip.
3. Disconnect the two 'Lucar' terminals noting that the black wire is connected to the upper terminal.
4. Remove the switch.

**Refitting**

5. Reverse instructions 1 to 4. The switch has two locating dowels which ensure that the operating plunger passes freely through the centre hole in the choke cable outer sleeve.

**STEERING COLUMN COMBINATION SWITCH**

—Remove and refit 86.65.55

**Removing**

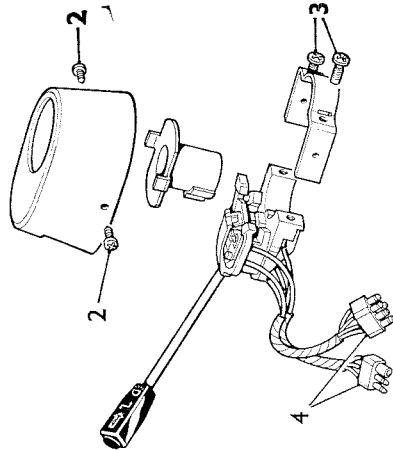
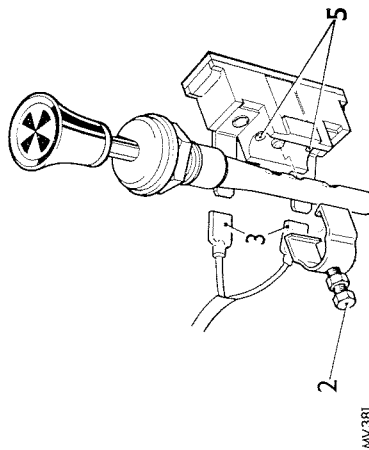
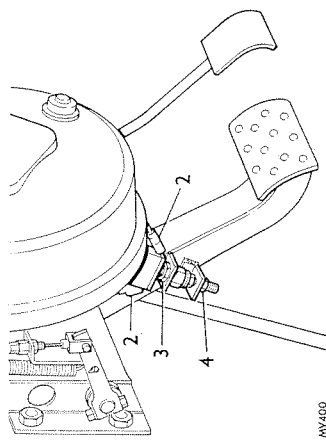
1. Remove the steering wheel (see 57.60.01).
2. Remove the two screws securing the combination switch cover and remove the cover.
3. Remove the two screws and bracket securing the combination switch bracket.
4. Disconnect the two multi-plug connectors.
5. Remove the combination switch.

**Refitting**

6. Reverse instructions 1 to 5.

86.65.51  
86.65.53  
86.65.55

Truck General Service 1 Tonne 4 × 4 RTC 9120 Issue 1



86.65.30  
86.65.38  
86.65.49  
86.65.50

**FUEL PUMP VOLTAGE DROPPER—24 Volt**

—Remove and refit **86.65.69**

**Removing**

1. Disconnect the batteries.
2. Remove the six bolts securing the right side front wheel splash plate. The front inside bolt passes into a trapped nut, the other five are used with nuts, plain and spring washers.
3. Disconnect the leads from the voltage dropper.
4. Remove the two screws, spring washers and nuts to release the voltage dropper unit.

**Refitting**

5. Reverse instructions 1 to 4. Ensure that all connections are clean and tight.

**FUSE BOX**

—Remove and refit **86.70.01**

**Removing**

1. Detach the windscreen heater hose from the heater unit to provide access to the fuse box.
2. Remove the two nuts, washers and screws securing the fuse box.
3. Disconnect the leads carefully noting their locations.
4. Remove the fuse box.

**Refitting**

5. Reverse instructions 1 to 4.

**FUSE**

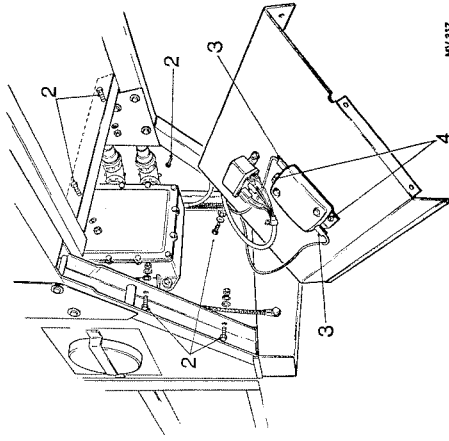
—Remove and refit **86.70.02**

**Removing**

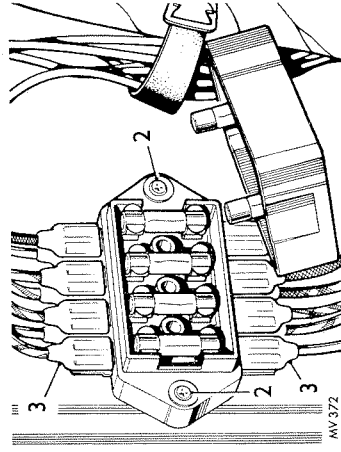
1. Locate the fuse box above the clutch pedal.
2. Remove the plastic cover.
3. Identify the defective fuse.
4. Carefully lever the fuse from its contacts.

**Refitting**

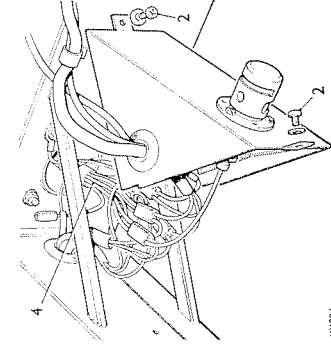
5. Reverse instructions 1 to 4.



MV 376



MV 372



MV 374

**NATO SOCKET**

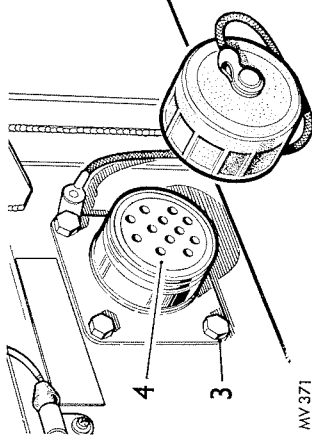
—Remove and refit **86.70.26**

**Removing**

1. Disconnect the battery (batteries 24 volt).
2. To gain access to NATO socket connectors, remove the two screws, spring and plain washers securing the convoy lamp bracket to the chassis.
3. Remove the four bolts, nuts, spring and plain washers securing the NATO socket to the vehicle.
4. Disconnect the wires from the NATO socket at their respective connections. Note the identity sleeves on the wire connections with respect to the lettered pins of the 12 pin socket (refer to circuit diagram).
5. Withdraw the NATO socket and wires.

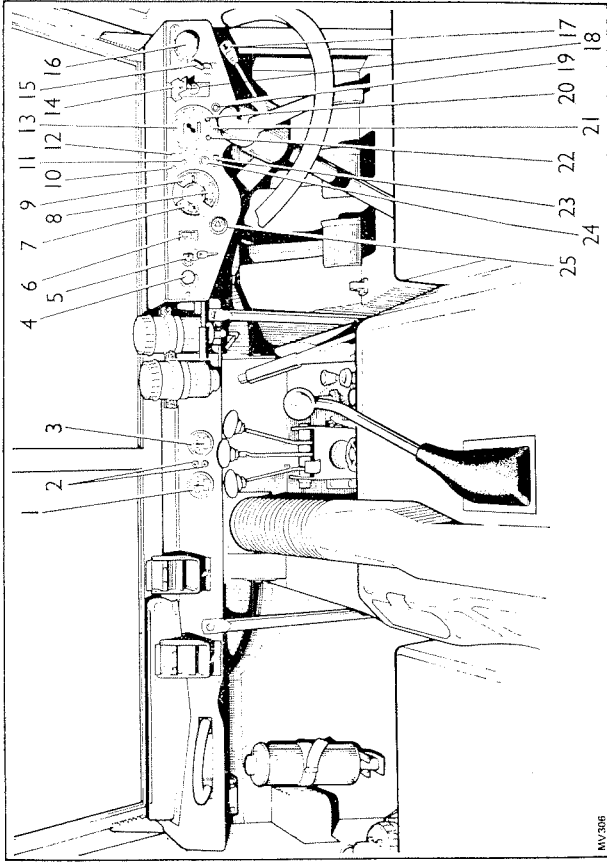
**Refitting**

6. Reverse instructions 1 to 5.



MV 371





## Key

- |    |  |    |   |
|----|--|----|---|
| 1  | Auxiliary ammeter (24 volt only)           | 14 | Headlight infra-red switch lock         |
| 2  | Inspection light socket                    | 15 | Panel light switch                      |
| 3  | Vehicle ammeter (24 volt only)             | 16 | Light switch — 6 way                    |
| 4  | Windscreen wiper/washer switch             | 17 | Combination switch                      |
| 5  | Ignition switch                            | 18 | Headlight infra-red switch              |
| 6  | Brake system warning light and test button | 19 | Speedometer trip reset                  |
| 7  | Water temperature gauge                    | 20 | Choke indicator                         |
| 8  | Oil temperature gauge                      | 21 | Headlight main beam indicator           |
| 9  | Fuel level gauge                           | 22 | Oil pressure warning light              |
| 10 | Trailer flasher indicator                  | 23 | Differential lock warning light         |
| 11 | Ignition warning light                     | 24 | Winch warning light (when winch fitted) |
| 12 | Vehicle flasher indicator                  | 25 | Hazard warning switch and light         |
| 13 | Speedometer                                |    |   |

## AMMETER (24 volt only)

88.10.01

—Remove and refit

## Removing

1. Disconnect the battery.
2. Remove the two nuts spring washers and clamp bracket securing the ammeter to the panel.
3. Withdraw the ammeter to the limit of its two attached leads.
4. Detach the two connections, noting the positions of the leads and the positive identification stamped adjacent to one terminal.

## Refitting

5. Reverse instructions 1 to 4.

## INSTRUMENT PANEL

88.20.01

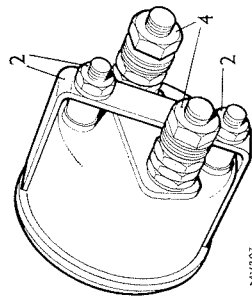
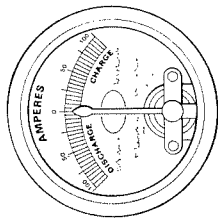
—Remove and refit

## Removing

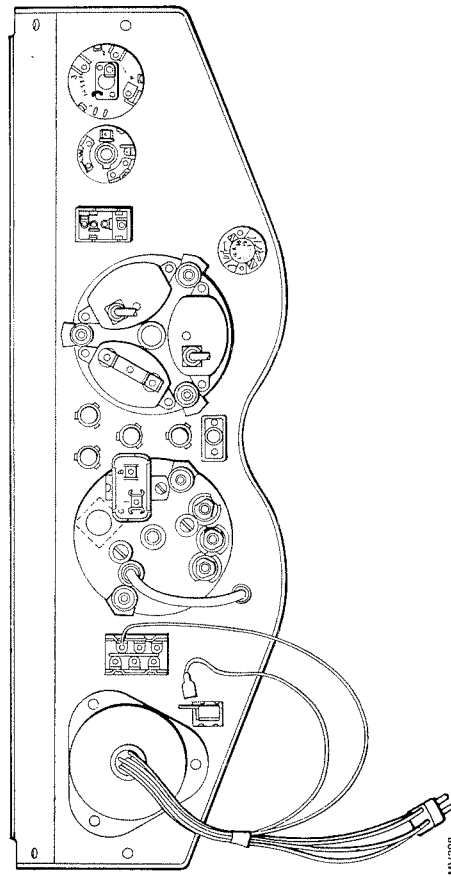
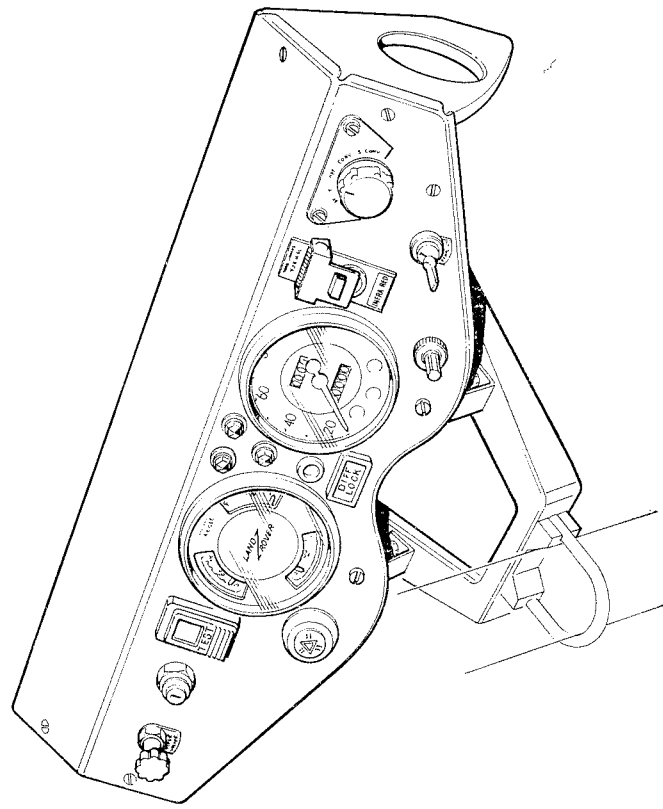
1. Disconnect the battery.
2. Remove the engine cover.
3. Drain the cooling system.
4. Remove the radiator grille.
5. Disconnect the coolant temperature bulb from the engine induction manifold.
6. Disconnect the oil temperature bulb from the oil cooler.
7. Release the rubber cleats securing the oil temperature and coolant temperature gauge capillary tubes to the electrical harness.
8. Remove the four screws securing the instrument panel to the dash brackets.
9. Remove the two screws and nuts securing the instrument panel to the steering column bracket.
10. Disconnect the speedometer cable at the speedometer.
11. Remove the bezel nut from the ignition switch and release the switch from the instrument panel.
12. Remove the bezel nut from the infra-red switch and release the switch from the instrument panel.
13. Remove the bezel nut from the panel switch and release the switch from the panel.
14. Remove the control knob from the wiper/washer switch.
15. Remove the bezel nut from the wiper/washer switch and release the switch from the panel.
16. Remove the control knob from the 6-way switch.
17. Remove the three screws securing the 6-way switch to the instrument panel and release the switch from the panel.
18. From the back of the speedometer detach the two 'Lucar' connectors from the voltage stabiliser. Withdraw the speedometer illumination bulb and holder, the oil pressure bulb and holder, the main beam bulb and holder and the choke bulb and holder.

## Refitting

30. Reverse instructions 1 to 29.



MV307



MV308



**VOLTAGE STABILISER**

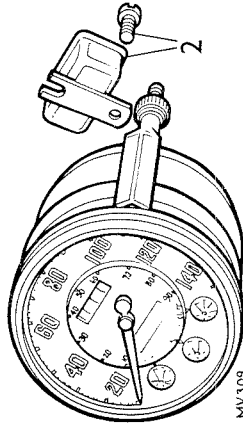
The voltage stabiliser is fitted to 12 volt vehicles only. Its purpose is to stabilise supply voltage to the fuel gauge thus ensuring that fuel gauge readings are not influenced by variations in battery supply voltage.

**—Remove and refit 88.20.26****Removing**

1. Remove the speedometer. Operation 88.30.01.
2. Remove the screw and spring washer securing the voltage stabiliser to the speedometer.
3. Remove the voltage stabiliser.

**Refitting**

4. Reverse instructions 1 to 3.



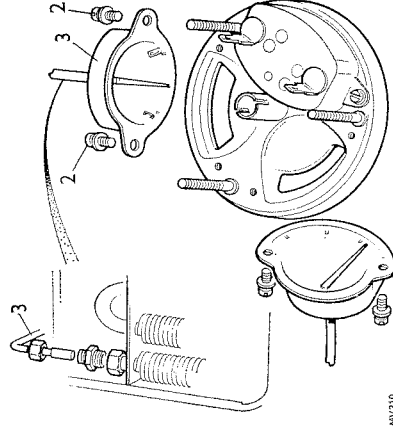
MV309

**OIL TEMPERATURE GAUGE****—Remove and refit 88.25.12****Removing**

1. Remove the combined fuel and temperature gauge assembly. Operation 88.25.16.
2. Remove the two screws securing the oil temperature gauge to the combined gauge assembly.
3. Withdraw the oil temperature gauge complete with capillary tube. No attempt must be made to separate the capillary tube from the gauge.

**Refitting**

4. Reverse instructions 1 to 3.



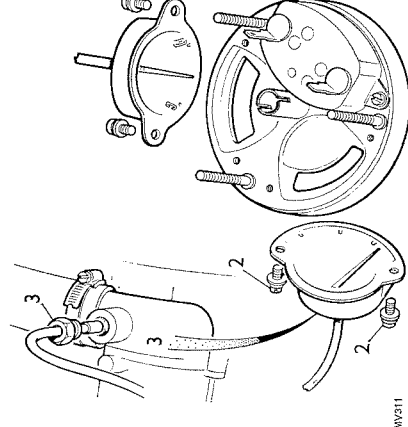
MV310

**COOLANT TEMPERATURE GAUGE****—Remove and refit 88.25.14****Removing**

1. Remove the combined fuel and temperature gauge assembly. Operation 88.25.16.
2. Remove the two screws securing the coolant temperature gauge to the combined gauge assembly.
3. Withdraw the coolant temperature gauge complete with capillary tube. No attempt must be made to separate the capillary tube from the gauge.

**Refitting**

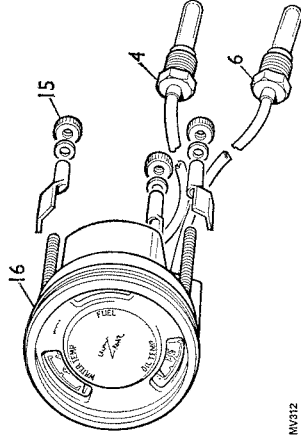
4. Reverse instructions 1 to 3.



MV311

**COMBINED FUEL AND TEMPERATURE GAUGES****—Remove and refit 88.25.16****Removing**

1. Disconnect the battery.
2. Remove the engine cover.
3. Drain the cooling system.
4. Disconnect the coolant temperature bulb from the engine induction manifold.
5. Remove the radiator grille.
6. Disconnect the oil temperature bulb from the oil cooler.
7. Release the rubber cleats securing the oil temperature and coolant temperature capillary tubes to the electrical harness.
8. Remove the four screws securing the instrument panel to the dash brackets.
9. Remove the two screws and nuts securing the instrument panel to the steering column bracket.
10. Release the speedometer cable from the speedometer.
11. Tilt the instrument panel to provide access to the rear of the combined gauges.
12. Depress the two plastic protrusions on the hazard switch at the rear of the instrument panel and withdraw the hazard switch through the panel. Do not strain the switch leads.
13. Remove the illumination bulb and holder from the combined gauges.
14. Disconnect the two 'Lucar' connectors at the fuel gauge carefully noting the positions of the leads.
15. Remove the three knurled nuts, spring washers and clamp legs from the rear of the combined gauges. Note the earth connection.
16. Withdraw the combined gauge assembly carefully easing and threading the capillary tubes.



MV312

**Refitting**

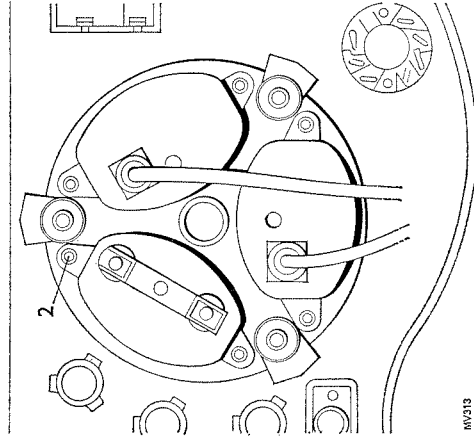
17. Reverse instructions 1 to 16.

**FUEL GAUGE****—Remove and refit 88.25.26****Removing**

1. Remove the combined fuel and temperature gauge assembly. Operation 88.25.16.
2. Remove the two screws securing the fuel gauge to the combined gauge assembly.
3. Withdraw the fuel gauge.

**Refitting**

4. Reverse instructions 1 to 3.



MV313

FUEL TANK UNIT

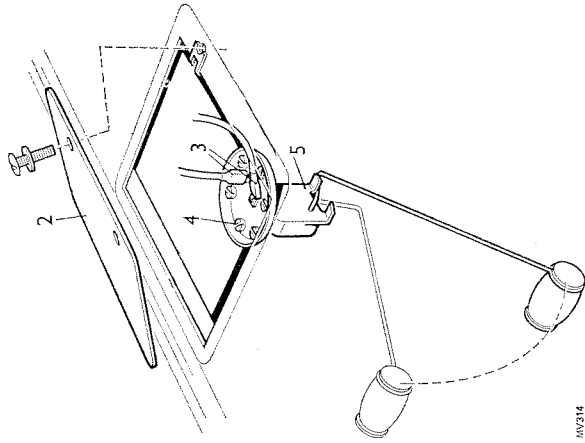
—Remove and refit 88.25.32

Removing

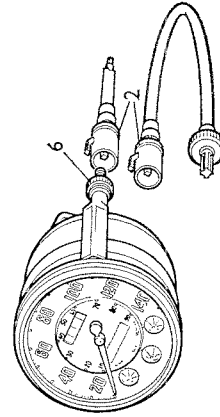
1. Disconnect the battery.
2. Remove the access panel from floor of vehicle (the front panel located above the fuel tank).
3. Disconnect the two Lucar terminals from the tank unit. Note the different sizes of the Lucar terminals and the wire colours. The black wires connect to the rear terminal on the tank unit.
4. Remove the six screws and spring washers securing the tank unit to the tank.
5. Withdraw the tank unit and gasket. Note that the float is fitted to the rear of the fuel tank.

Refitting

6. Discard the old gasket.
  7. Ensure that the tank and tank unit faces are clean. When cleaning take care that nothing is allowed to fall into the tank.
  8. Thread a new gasket into position on the tank unit. Smear the gasket with 'Heldite' or similar adhesive.
  9. Fit the tank unit to the tank; float to rear of tank. Evenly tighten the securing screws.
  10. Seal the tank unit with Bostik 772 ensuring that it does not foul the Lucar terminals.
  11. Connect the wires to the Lucar terminals.
- NOTE:** It is essential that a 0.030 in (0.8 mm) layer of Bostik 772 is applied over and around the fuel tank unit/fuel tank area including the lower area of the terminals. Care must be taken to ensure that good electrical connections are obtained.
12. Fit the access panel.
  13. Connect the battery.



MV314



MV289

8. Disconnect the two 'Lucar' connectors from the voltage stabiliser. Note lead positions.
9. Withdraw the speedometer illumination bulb and holder oil pressure bulb and holder main beam bulb and holder and choke bulb and holder.

Refitting

10. Reverse instructions 1 to 9.

SPEEDOMETER CABLE ASSEMBLY

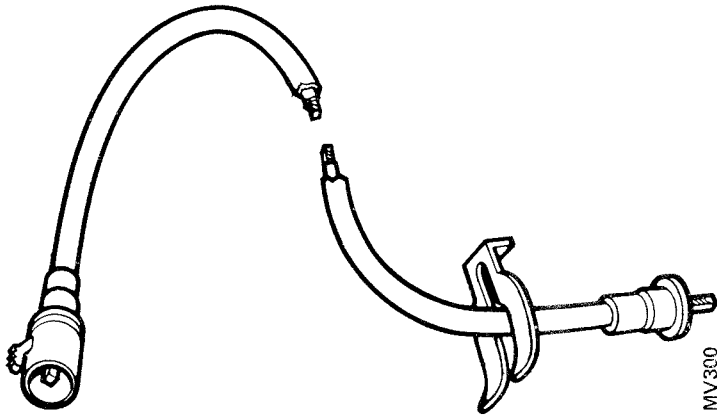
—Remove and refit 88.30.06

Removing

1. Release the speedometer cable from the speedometer.
2. Remove the bolt and spring washer securing the speedometer cable clamp plate to the gearbox. (Adjacent to the handbrake drum).
3. Withdraw the speedometer cable from the gearbox.
4. Release the clips securing the speedometer cable to the vehicle.
5. Remove the speedometer cable.

Refitting

6. Reverse instructions 1 to 5. Ensure that the run of the speedometer cable is free from sharp bends.



MV300

SPEEDOMETER CABLE—INNER

—Remove and refit 88.30.07

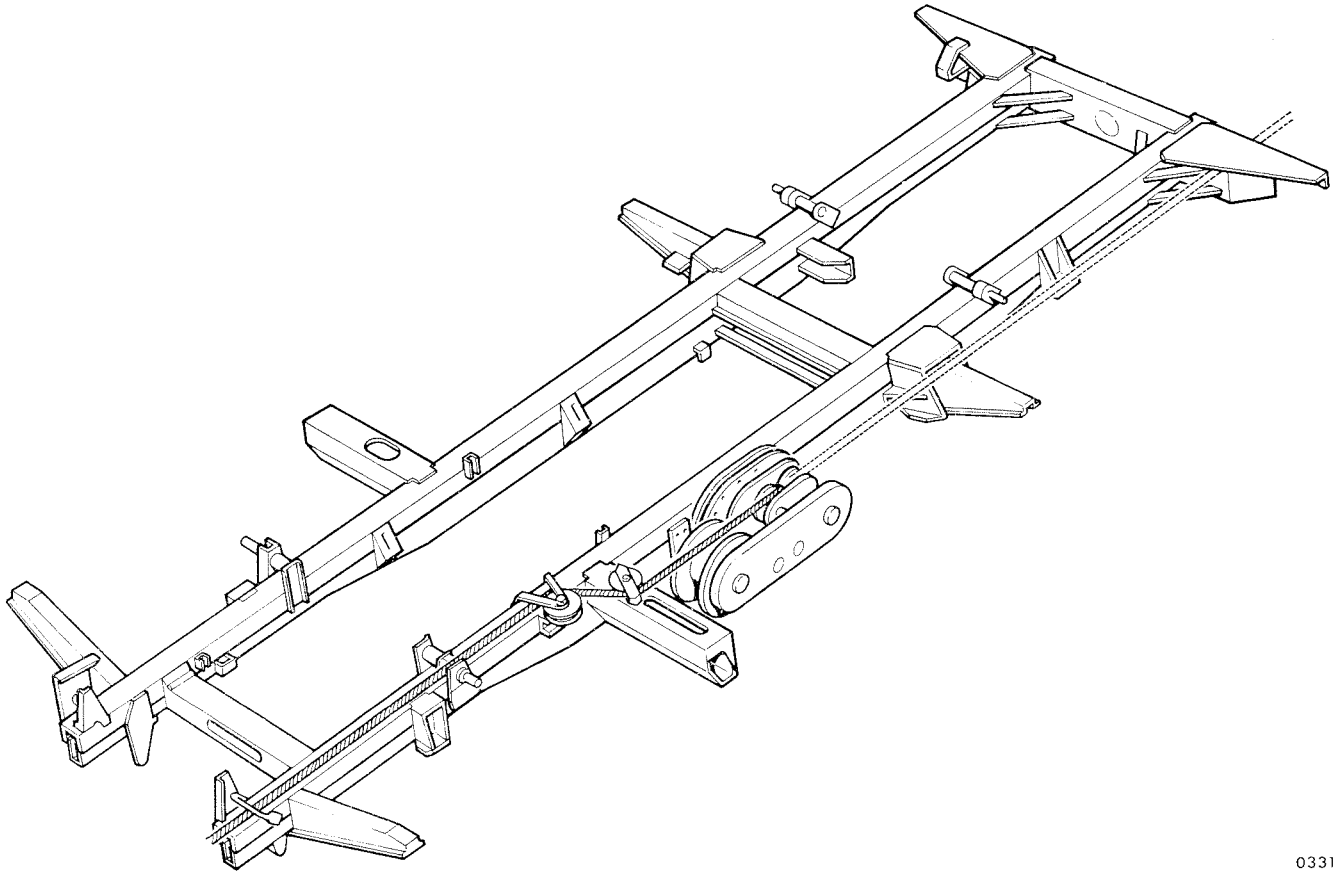
Removing

1. Release the speedometer cable from the speedometer.
2. Remove the bolt and spring washer securing the speedometer cable clamp plate to the gearbox. (Adjacent to the handbrake drum).
3. Withdraw the speedometer cable from the gearbox.
4. Extract the speedometer inner cable from the speedometer end of the casing.

Refitting

5. Reverse instructions 1 to 4.





WINCH ARRANGEMENT

**WINCH**

—Remove and refit

90.10.10

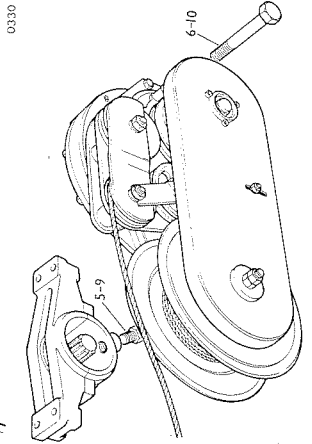
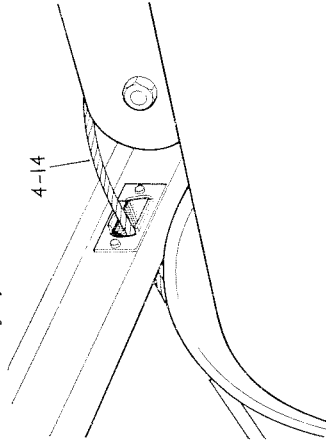
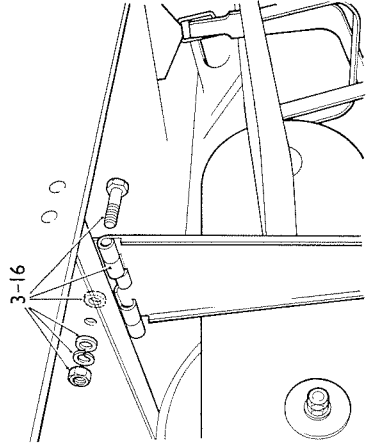
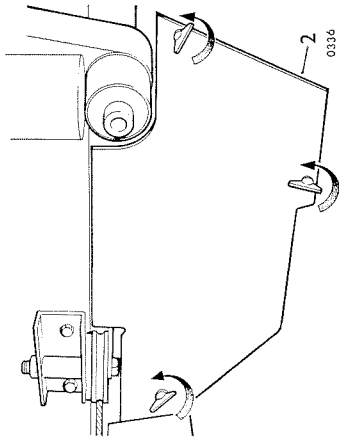
**NOTE:** See 90.30.01

**Removing**

1. Disconnect the cable from the hooks and one pulley from the swivel.
2. Remove the cover in the front wheel arch (for front operation) (as applicable).
3. Remove the jerrycan carrier bracket.
4. Slowly operate the winch to feed the cable through the chassis and pulleys.
5. Remove the pinch bolt ( $\frac{1}{8}$  AF).
6. Position a jack under the winch unit and remove the winch mounting nut, spring washer, plain washer and bolt.
7. Withdraw the winch and lower the jack.

**Refitting**

8. Position the winch on the jack and raise, locating the input drive shaft and winch mountings.
9. Fit the pinch bolt but do not tighten.
10. Fit the mounting bolt, plain washer, spring washer and nut and tighten to a torque of 34 Nm.
11. Tighten the pinch bolt and mounting nut.
12. Lower the jack and remove.
13. Refit the side panel (for front operation winch) under the rear side front wheel arch.
14. Slowly operating the winch, feed the cable through the pulleys and chassis.
15. Refit the bolt to the rope.
16. Refit the jerrycan carrier bracket.



**WINCH DRIVE COUPLING**

90.15.01

—Remove and refit

**Removing**

1. Remove the winch. 90.10.10
2. Pull off the coupling.

**Refitting**

3. Slide the coupling over the out-put shaft of the drive unit.
4. Refit the winch. 90.10.10

**WINCH MOUNTING BRACKET**

90.15.05

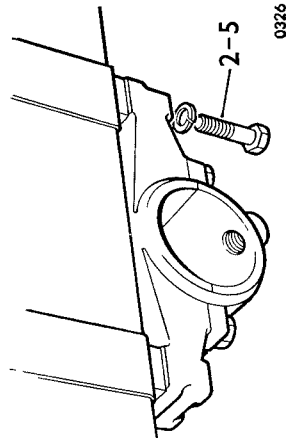
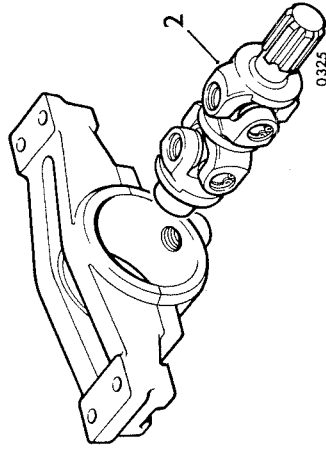
—Remove and refit

**Removing**

1. Remove the winch 90.10.10.
2. Remove four bolts securing the bracket.
3. Remove the bracket.

**Refitting**

4. Reposition the bracket over the coupling and align the mounting holes.
5. Fit and tighten the four bolts to a torque of 58 Nm.
6. Refit the winch. 90.10.10



**BOTTOM POWER TAKE-OFF**

90.20.01

—Remove and refit

**Removing**

1. Remove the winch drive coupling 90.15.01.
2. Remove the clevis pin securing the control cable to the operating arm.
3. Remove the fourteen securing bolts and washers.
4. Remove the power take-off unit.

**Refitting**

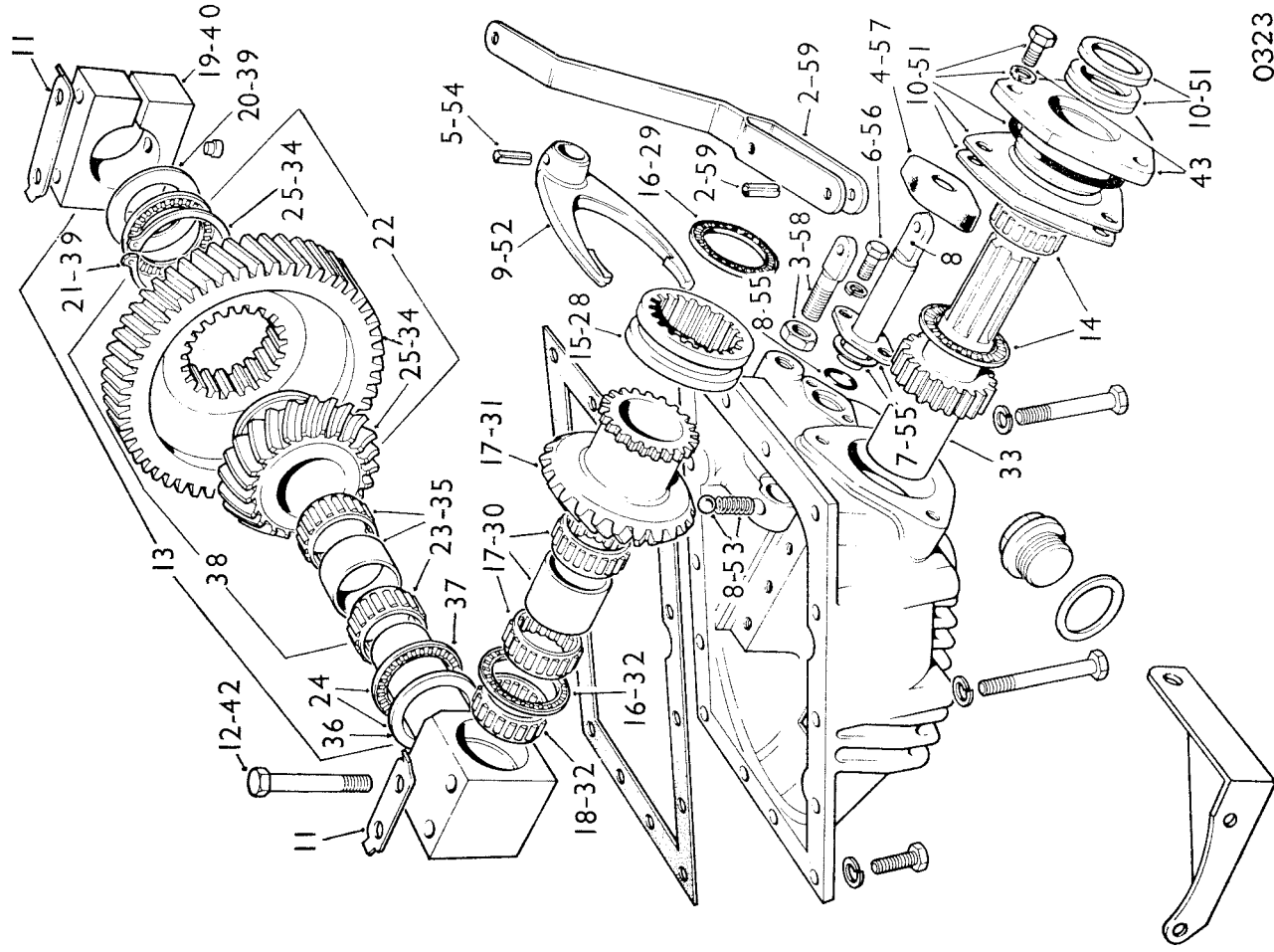
5. Clean the mating face of the power take-off.
6. Fit a new gasket.
7. Fit the eleven short bolts and spring washers.
8. Fit the two long bolts and washers to the side opposite the drain plug.
9. Fit the intermediate length bolt and washer in the remaining hole.
10. Torque all the bolts to 30 Nm.
11. Reconnect the control rod cable and check the adjustment. 90.30.35
12. Refit the winch drive coupling. 90.15.01

## BOTTOM POWER TAKE-OFF

## —Overhaul

90.20.05

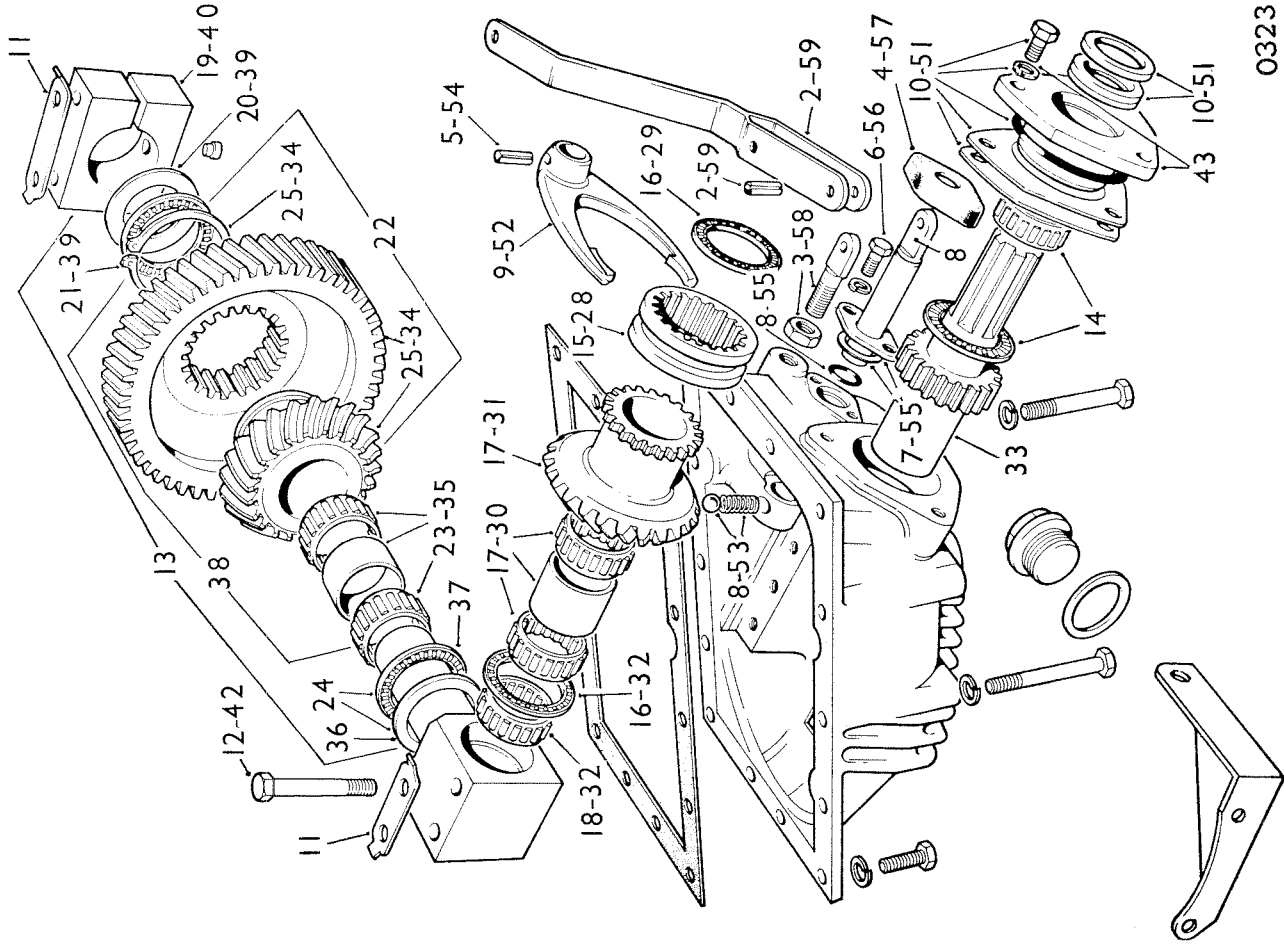
1. Remove the power take-off from the vehicle. 90.20.01.
2. Remove the two mills pins and operating arm.
3. Slacken the locknut and remove the operating arm pivot.
4. Remove the rubber dust cover.
5. Remove the mills pin from the selector fork.
6. Remove the two 10 mm bolts and spring washers from the housing.
7. Remove the plate and gasket.
8. Remove the selector shaft, ball spring and 'O' ring.
9. Remove the selector fork.
10. Remove the three 13 mm bolts, spring washers, plate, shims and oil seal from the housing.
11. Release the tab washers from the four 17 mm bolts securing the housing to the case.
12. Remove the four bolts.
13. Remove the complete gear assembly from the case.
14. Remove the thrust race and needle roller race.
15. Pull the selector hub from the shaft.
16. Remove the thrust race from the front of the driven gear.
17. Pull the gear from the shaft, remove the two needle roller races and spacer from the gear.
18. Remove the needle roller races from the main housing.
19. Pull the small mounting block from the main housing shaft.
20. Remove the spacer shim.
21. Remove the thrust race.
22. Pull the drive gear assembly from the main housing shaft.
23. Remove the two needle roller races and spacer from the gears.
24. Remove the remaining thrust washer and spacer shim.
25. Remove the circlip from the gear assembly and push the two gears apart.
26. Inspect all the components for wear or damage and renew as necessary.



0323

**Re-assembly**

27. Liberally oil all moving parts before re-assembly.
28. Assemble the hub to the shaft.
29. Fit the thrust race to the shaft.
30. Fit the spacer and the two needle roller races to the gear.
31. Fit the gear and needle roller assembly to the shaft.
32. Fit the thrust race and needle roller to the shaft.
33. Assemble the shaft to the housing.
34. Assemble the two remaining gears and secure them with a circlip.
35. Assemble the spacer and two needle roller races in the gear assembly.
36. Fit the shim to the housing shaft, internal chamfer away from the gear assembly.
37. Fit the thrust race.
38. Fit the gear and needle roller assembly to the shaft.
39. Fit the thrust race and spacer.
40. Fit the small housing block to the shaft.
41. Fit the complete gear assembly to the casing.
42. Tighten the four housing bolts, to a torque of 58,25 Nm.
43. Fit the tail housing and secure with three bolts, to a torque of 15 – 17 Nm.
44. The backlash should be 0,2 – 0,3 mm.
45. If the backlash is incorrect see below.
46. If the backlash is inadequate, increase the shim size between the drive gear and the housing and reduce the thickness of the shim between the larger pick up gear and the housing, this will necessitate the removal of the gear assembly and the repeat of operations 36 to 44.
47. If the backlash is too great, reverse operation 46.
48. Remove the three bolts securing the rear cover.
49. Fit shims as necessary to set the end-float to 0,03 – 0,01 mm. With the cover fitted and the three bolts tight.
50. Remove the rear cover.
51. Fit the 'O' ring and refit the cover spring washers and three bolts.
52. Engage the selector fork in the hub.
53. Fit the selector ball and spring.
54. Refit the mills pin.
55. Refit the 'O' ring gasket and rear plate.
56. Fit and tighten the two spring washers and bolts to a torque of 6 – 8 Nm.
57. Fit the rubber boot.
58. Refit the operating lever pivot and tighten the locknut to a torque of 58,25 Nm.
59. Refit the operating lever and mills pins.
60. Refit the bottom power take-off 90.20.01.



0323

**UNIVERSAL SWIVEL**

—Remove and refit 90.25.01

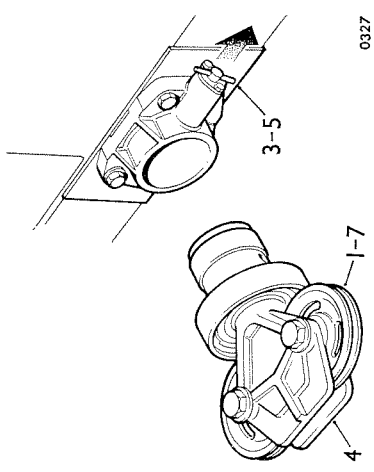
(This refers to both front and rear)

**Removing**

1. Remove one swivel pulley.
2. Wind the cable through the swivel.
3. Pull the plunger locating the swivel against spring pressure.
4. Pull the swivel from the housing.

**Refitting**

5. Pull the locating plunger from the housing.
6. Manoeuvre the cable back through the swivel and fit the required attachment.
7. Refit the pulley.



0327

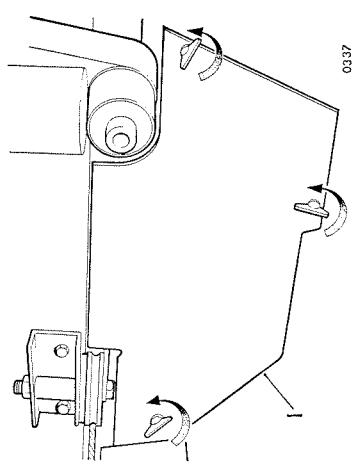
**PULLEYS (SET) (Where applicable)**

—Remove and refit 90.25.10

NOTE: see 90.30.01

**Removing**

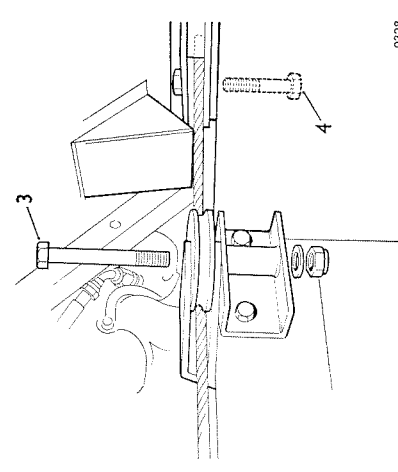
1. Remove the cover in the front wheel arch.
2. See 90.30.01, operation No. 1 before winding the cable back through the swivel and pulleys.
3. Remove the long bolt securing the front pulley to the mounting bracket and remove the pulley.
4. Remove the long bolt and plain washer from beneath the chassis securing the rear pulley to the mounting bracket and nut.
5. Remove the pulley.



0337

**Refitting**

6. Refit in the reverse order of removing.



0328

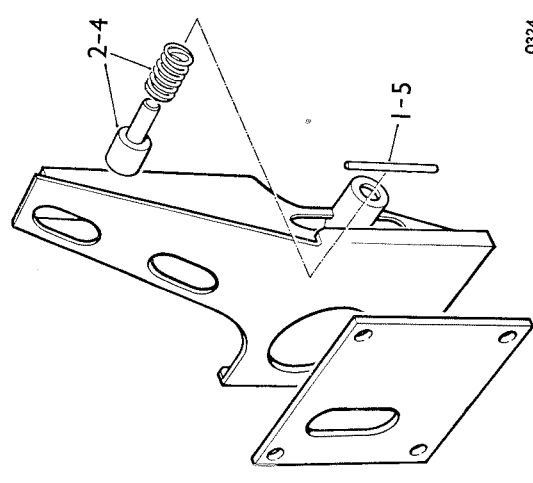
**BUMPERETTE (WINCH TYPE)**

—Remove and refit 90.30.01

NOTE: When carrying out repairs to the cable on the vehicle, ensure cable is controlled under light tension (2 man operation) when winding in or out.

**Removing**

1. Disconnect the cable from hooks etc. (if fitted) and one pulley from the swivel.
2. Rewind the cable back through the swivel.
3. Pull the locking plunger against spring pressure and pull the swivel clear of the housing.
4. Remove the four nuts, spring washers and plain washers.
5. Remove the bumperette and strengthening plate.



**Refitting**

6. Refit in the reverse order of removing.

**BUMPERETTE (WINCH TYPE)**

—Overhaul 90.30.03

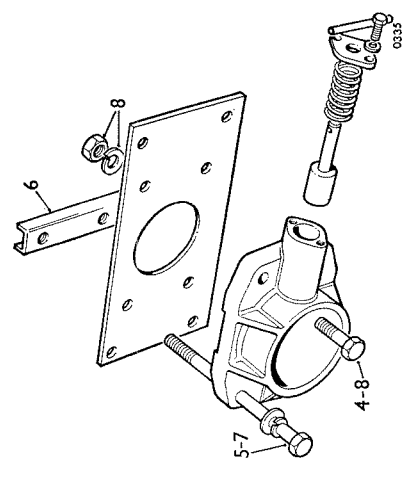
1. Remove the mills pin.
2. Remove the plunger and spring.
3. Examine and replace all the components that are damaged or worn.
4. Grease the plunger before assembling the plunger and spring.
5. Press the plunger into the housing and refit the mills pin.

**UNIVERSAL SWIVEL HOUSING**

—Remove and refit 90.30.05

**Removing**

1. Disconnect any hooks, bolts etc. from the end of the cable (if fitted) and one pulley from the swivel. See Note in 90.30.01.
2. Rewind the cable back through the swivel housing.
3. Pull the locking plunger against spring pressure and remove the swivel from the housing.
4. Remove the two bolts, nuts and spring washers (near side).
5. Remove the two remaining long bolts, spring and plain washers from the bracket. This releases the housing and also a plate with two weld nuts located behind the bumper.



*continued*

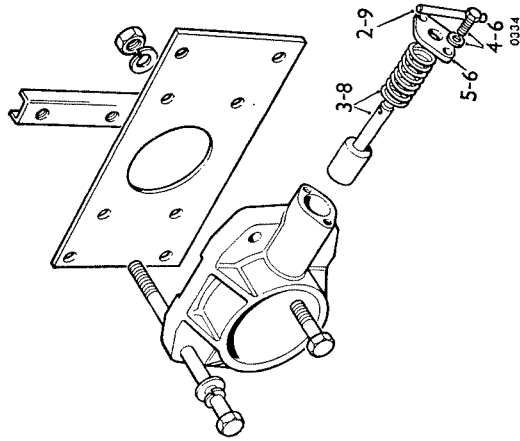


**Refitting**

6. Reposition the weld nut plate behind the bumper and the strengthening plate and swivel housing in front of the bumper, with the locking plunger to the near side of the car.
7. Refit the two long bolts, plain washers and spring washers.
8. Refit the two short bolts, plain washers and nuts.
9. Tighten all four bolts and two nuts.
10. Pull the locking plunger and refit the swivel.
11. Wind the cable back through the housing and swivel.
12. Reconnect pulley and any fittings removed.

**UNIVERSAL SWIVEL HOUSING****—Overhaul****90.30.10**

1. Remove the universal swivel 90.25.01.
2. Remove the mills pin from the locking plunger.
3. Remove the plunger and spring.
4. Remove the two bolts, spring and plain washers.
5. Remove the end plate. Examine and replace all components that are worn or damaged.
6. Reposition the end plate and refit and tighten the two bolts, plain and spring washers.
7. Grease the plunger before assembly (white grease).
8. Reassemble the spring to the plunger and the plunger to the housing.
9. Push the plunger into the housing and fit a mills pin.
10. Refit the universal swivel 90.25.01.

**CONTROL LEVER****90.30.25****—Remove and refit****Removing**

1. Remove the split pin, washer and clevis pin securing the control cable to the hand lever.
2. Remove the bolt securing the hand lever to the housing.
3. Remove the spring on the safety catch.
4. Remove the hand lever.

**Refitting**

5. Reverse operations 1 to 4.

**CABLE (CONTROL)****90.30.30****—Remove and refit**

1. Disconnect the cable at the gearbox.
2. Disconnect the cable from the hand lever in the driving compartment.
3. Disconnect the clips and remove the cable from the vehicle.

**Refitting**

4. Reverse operations 1 to 3.
5. Adjust the cable 90.30.35.

**CABLE (CONTROL)****90.30.35****—Adjust**

1. Place the winch lever in the 'out' position.
2. Adjust the cable, as necessary to enable it to be connected at the gearbox end without tension or excessive slack.

## SERVICE TOOLS

**ENGINE**

Valve guide remover	274401	LV7RU/4910-99-825-2562
Bar, spark plug wrench	565443	LV7RU/5120-99-825-0851
Spark plug wrench	565434	
Valve guide drift	600959	LV7RU/4910-99-825-2563
Plastigage	605238	
Gudgeon pin remover/replacer	605350	LV7RU/4910-99-825-2561
Con rod guide bolts	605351	LV7RU/5306-99-825-2560
Distance piece (used with 600959)	605774	LV7RU/4910-99-825-2564
Carburettor balance	Model 389	LV7RU/4910-99-823-7976
Engine and gearbox sling	RO8459	LV7RU/5120-99-820-6910
Valve spring lifter, universal	—	LV7RU/5120-99-809-5506

**CLUTCH**

Clutch centraliser	18G79	LV7RU/5120-99-820-6912
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**GEARBOX**

Handpress	18G47	LV6MTR2/5120-99-401-2626
Adaptor, remover layshaft bearing	18G47BA	LV6MT2/5120-99-825-0835
Adaptor, remover diff. carrier bearing	18G47BB	LV6MT2/5120-99-825-0838
Replacer, bearing and oil seal	18G134	LV7AN/5120-99-874-1715
Adaptor, replacer oil seal and feed ring	18G134DG	LV6MT2/5120-99-825-0833
Impulse extractor	18G284	LV7AN/5120-99-806-9013
Adaptor, remover oil feed ring	18G284AQ	LV6MT2/5120-99-825-0832
Adaptor, remover layshaft bearing cup	18G284AR	LV6MTR/5120-99-825-0834
Adaptor, remover intermediate gear shaft	18G284AT	
Gearbox lifting bracket	RO1001	LV7RU/5120-99-820-6913
Dummy shaft, intermediate gear	RO/1003	LV6MT2/5120-99-825-0837
Spacer extractor, mainshaft	RO1004	LV6MT2/5120-99-825-0836
Centraliser, front cover	RO1005	LV7RU/5120-99-820-6914
Cradle, gearbox	—	LV6MT2/5120-99-825-1555

**AXLES**

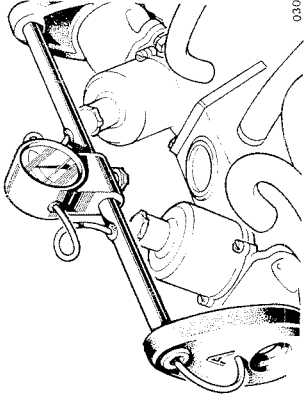
Adaptor, replacer pinion bearing cup	18G47BK	LV6MT2/5120-99-825-0840
Adaptor, remover diff. carrier bearing	18G47BL	LV6MT2/5120-99-825-0841
Spreader, axle case	18G131C	LV6MT2/5120-99-825-0842
Adaptors, axle case spreader	18G131F	LV6MT2/5120-99-825-0843
Adaptor, replacer diff. carrier bearing	18G134DP	LV6MT2/5120-99-825-0848
Dial gauge, bracket and base	18G191	LV6MT2/5120-99-825-0845
Gauge block, pinion setting	18G191P	LV6MT2/5120-99-825-0844
Replacer, pinion bearing cup	18G1122	LV6MT2/5120-99-825-0846
Adaptor, replacer pinion bearing cup	18G1122G	LV6MT2/5120-99-825-0847
Flange wrench	18G1205	LV6MT2/4910-99-824-1266
Replacer, pinion oil seal	RO1008	LV6MT2/5120-99-825-0849
Spanner, hub nut	RO8460	LV7RU/5120-99-820-6916
Remover, pinion bearing cup	S123A	LV6MT2/5120-99-825-1553

**STEERING**

Separator, ball joint	18G1063	LV7ML/5120-99-806-6802
Compressor, relay spring	600536	LV7RU/5120-998-20-6915
Extractor, drop arm	RO8457	LV7RU/5120-99-820-6919

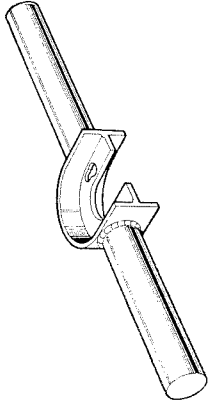
**WINCH**

Remover, drum and cable pulley 'Sykes-Pickavant' 851-A		LV6MT2/5120-99-825-7554
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0305

Carburettor balancer, Model 389  
LV7RU/4910-99-823-7976



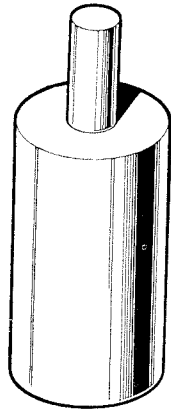
IRC 942

Compressor, relay spring 600536  
LV7RU/5120-99-820-6915



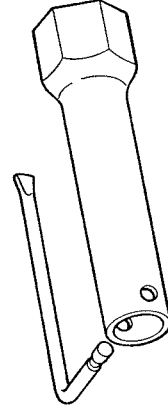
N533

Valve guide remover 274401  
LV7RU/4910-99-825-2562



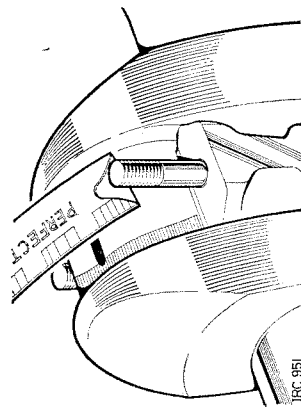
N536

Valve guide drift 600959  
LV7RU/4910-99-825-2563



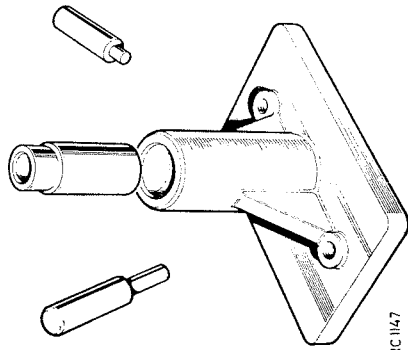
0304

Bar, spark plug wrench 565443  
LV7RU/5120-99-825-0851  
Spark plug wrench 565434



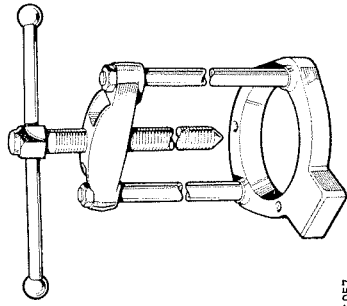
IRC 951

Plastigage 605238



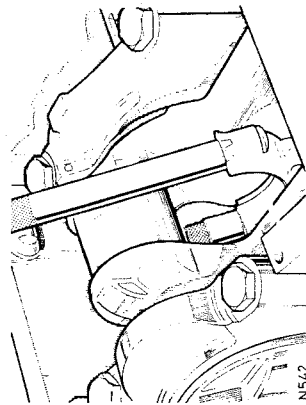
IRC 1147

Guidicon pin remover/replacer 605350  
LV7RU/4910-99-825-2561



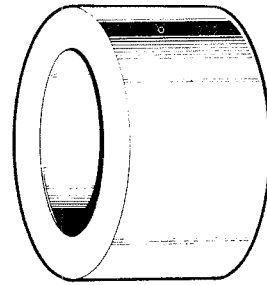
IRC 957

Handpress 18G47  
LV6MT2/5120-99-401-2626



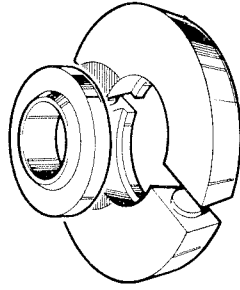
N542

Con rod guide bolts 605351  
LV7RU/5306-99-825-2560



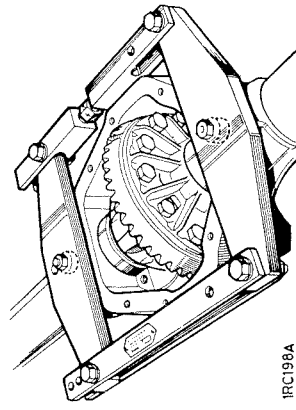
N543

Distance piece (used with 600959) 605774  
LV7RU/4910-99-825-2564



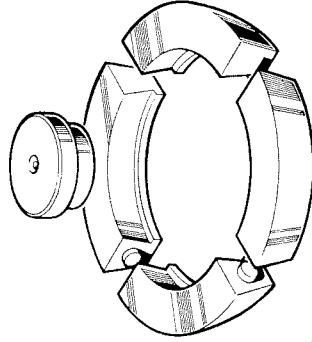
IRC 962

Adaptor replacer pinion bearing cup 18G47BK  
LV6MT2/5120-99-825-0840



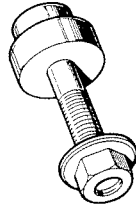
IRC198A

Spreader axle case 18G131C  
LV6MT2/5120-99-825-0842



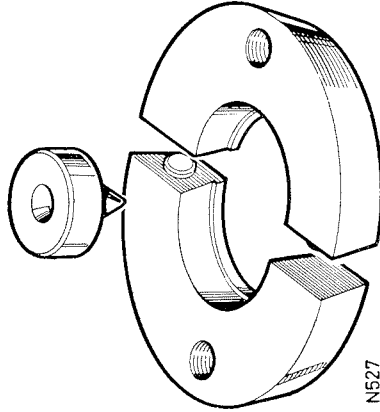
IRC 963

Adaptor remover diff. carrier bearing 18G47BL  
LV6MT2/5120-99-825-0841



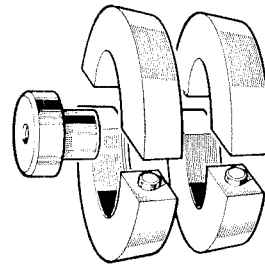
IRC 967

Adaptors, axle case spreader 18G131F  
LV6MT2/5120-99-825-0843



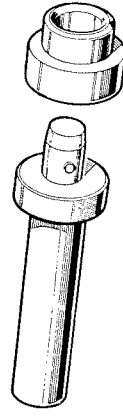
N527

Adaptor remover, layshaft bearing 18G47BA  
LV6MT2/5120-99-825-0835



N528

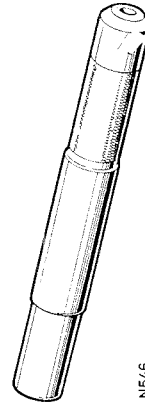
Adaptor remover diff. carrier bearing 18G47BB  
LV6MT2/5120-99-825-0838



N246

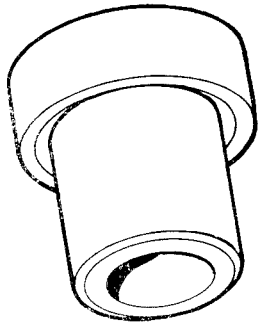
Replacer, bearing and oil seal 18G134  
LV7AN/5120-99-874-1715

Adaptor replacer oil seal and feed ring 18G134DG  
LV6MT2/5120-99-825-0833



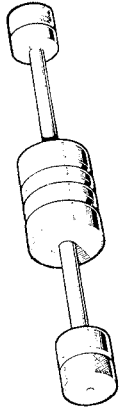
N546

Clutch centraliser 18C79  
LV7RU/5120-99-820-6912



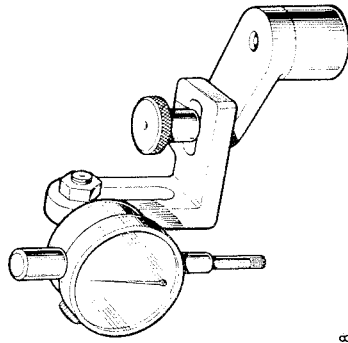
0301

Adaptor replacer diff. carrier bearing 18G134DP  
LV6MT2/5120-99-825-0848



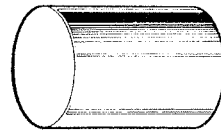
N244

Impulse extractor 18C284  
LV7AN/5120-99-806-9013  
Adaptor remover, oil feed ring 18C284AQ  
LV6MT2/5120-99-825-0832



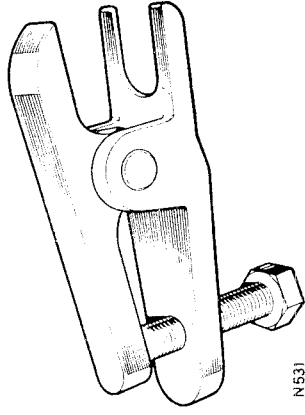
IRC 958

Dial gauge, bracket and base 18G191  
LV6MT2/5120-99-825-0845



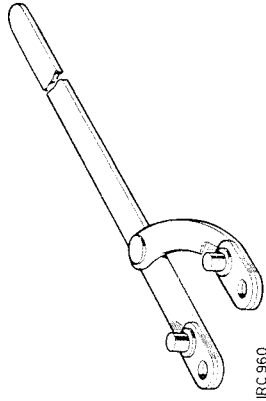
IRC 966

Gauge block, pinion setting 18G191P  
LV6MT2/5120-99-825-0844



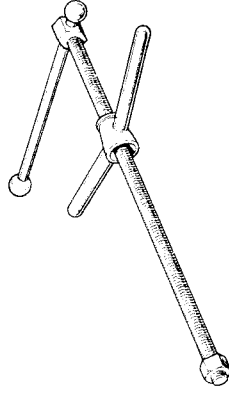
N531

Separator ball light 18G1063  
LV7ML/5120-99-806-6802



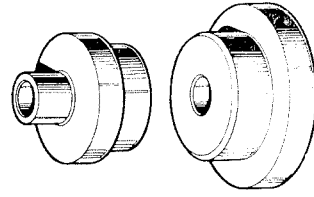
IRC 960

Flange wrench 18G1205  
LV6MT2/4910-99-824-1266



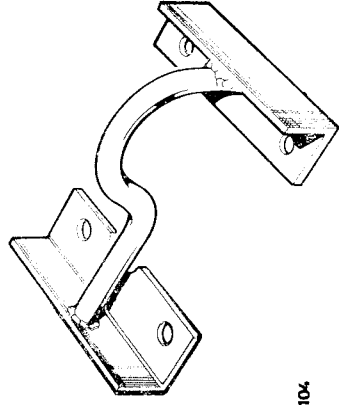
IRC 959

Replacer pinion bearing cup 18G1122  
LV6MT2/5120-99-825-0846



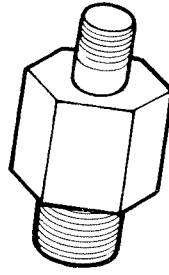
IRC 964

Adaptor replacer pinion bearing cup 18G1122G  
LV6MT2/5120-99-825-0847



N104

Gearbox lifting bracket RO1001  
LV7RU/5120-99-820-6913



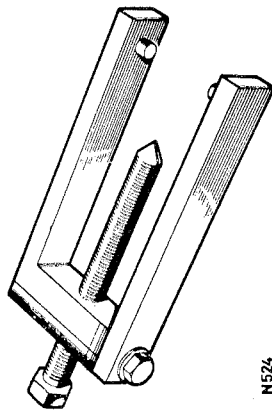
0300

Adaptor remover intermediate gear shaft 18C284AT



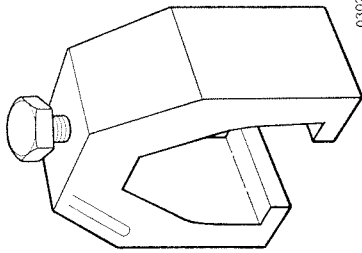
N523

Dummy shaft, intermediate gear RO1003  
LV6MT2/5120-99-825-0837



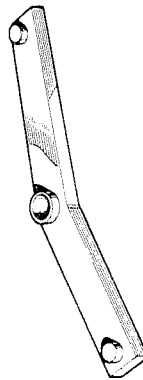
N524

Spacer, extractor, mainshaft, RO1004  
LV6MT2/5120-99-825-0836



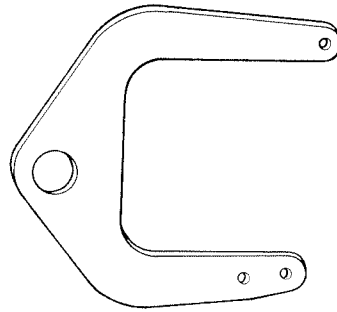
0302

Extractor, drop arm, RO8457  
LV7RU/5120-99-820-6919



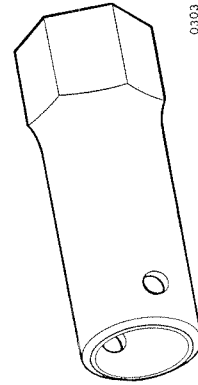
N525

Centraliser, gearbox front cover, RO1005  
LV7RU/5120-99-820-6914



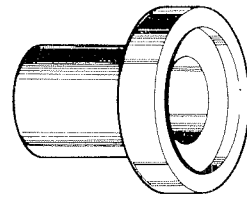
0298

Engine and gearbox sling, RO8459  
LV7RU/5120-99-820-6910



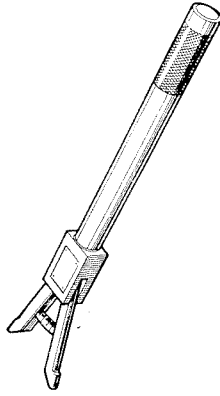
0303

Spacer, hub nut, RO8460  
LV7RU/5120-99-820-6916



IRC 968

Replacer, pinion oil seal, RO1008  
LV6MT2/5120-99-825-0849

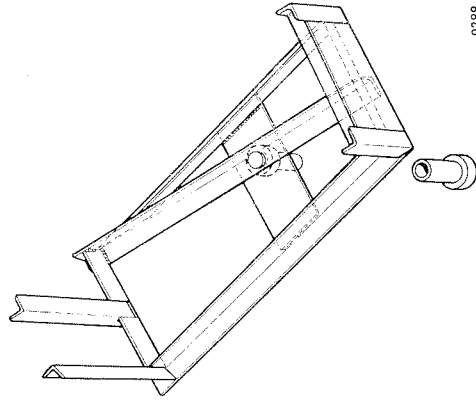


IRC 961

Remover, pinion bearing cap, S123A  
LV6MT2/5120-99-825-1553

Remover, drum and cable pulley  
Syrax-Pickavant, RS1-74  
LV6MT2/5120-99-825-7554

Valve spring lifter, universal  
LV7RU/5120-99-809-5506



0299

Cradle, gearbox  
LV6MT2/5120-99-825-1555