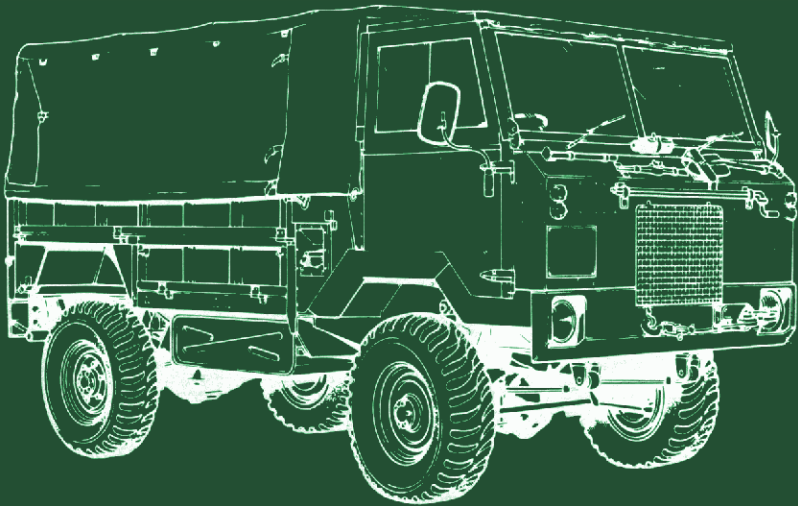


# MILITARY LAND ROVER 101 1Tonne

Forward Control



## USER MANUAL

COVERING  
**IF YOU PAYED FOR THIS FILE,  
YOU HAVE BEEN RIPPED OFF.**  
TRUCK, GENERAL SERVICE, 1 TONNE, 4 X 4, ROVER  
TRUCK GENERAL SERVICE FFR 1 TONNE 4 X 4 ROVER  
VGH 12 AND 23 GLE/ELECTRICAL EQUIPMENT

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

# **USER MANUAL**

**for**

## **MILITARY LAND ROVER**

**101 1Tonne**

**Forward Control**

Issued January 1975

COVERING

TRUCK, GENERAL SERVICE, 1 TONNE, 4 × 4, ROVER  
TRUCK, GENERAL SERVICE, FFR, 1 TONNE, 4 × 4, ROVER  
WITH 12 AND 24 VOLT ELECTRICAL EQUIPMENT

## AMENDMENTS

It is essential that this book be kept up to date with all amendments. Immediately an amendment is inserted, particulars will be entered hereunder.

<i>Amdt. No.</i>	<i>Date</i>	<i>Sig.</i>	<i>Amdt. No.</i>	<i>Date</i>	<i>Sig.</i>

## 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.

## **NOTES TO READERS**

This manual was originally published by The Ministry of Defence as 'TRUCK, GENERAL SERVICE, 1 TONNE, 4 X 4, ROVER and TRUCK, GENERAL SERVICE, FFR, 1 TONNE, 4 X 4, ROVER User Handbook'.

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# SECTION I

## General Description

### CHAPTER 1

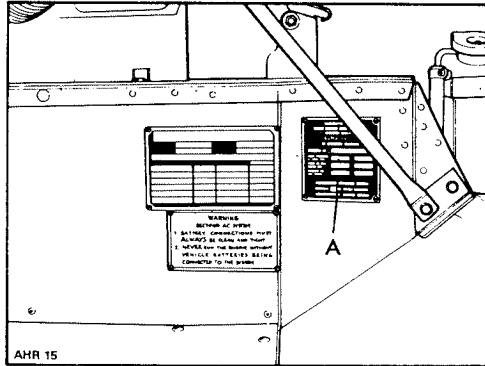
#### INTRODUCTION

#### VEHICLE SERIAL NUMBERS

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

**Fig. 1**  
**Vehicle Serial Number**

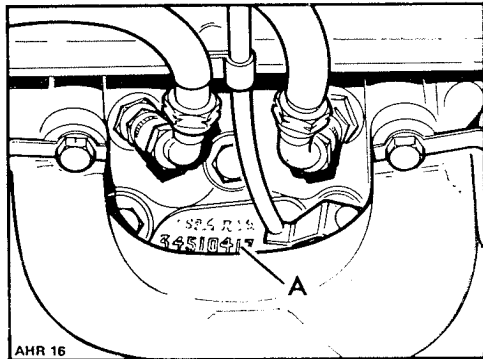
A—Vehicle Serial Number



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.

**Fig. 2**  
**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.

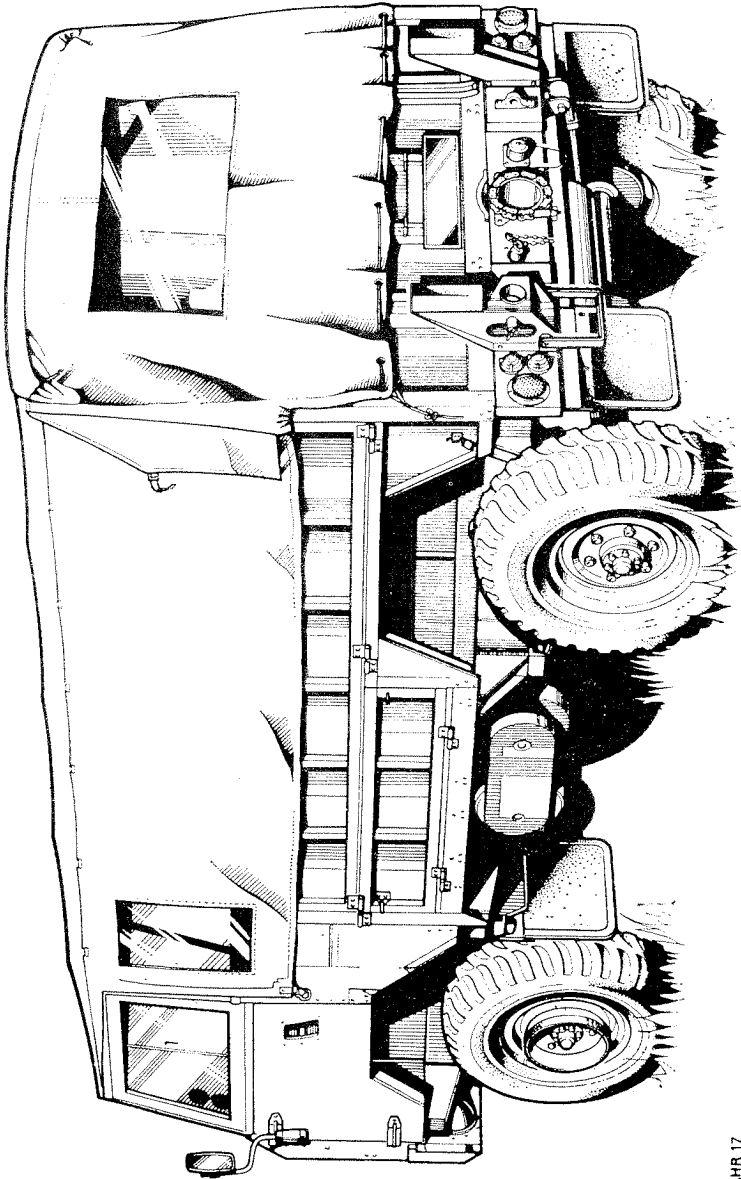
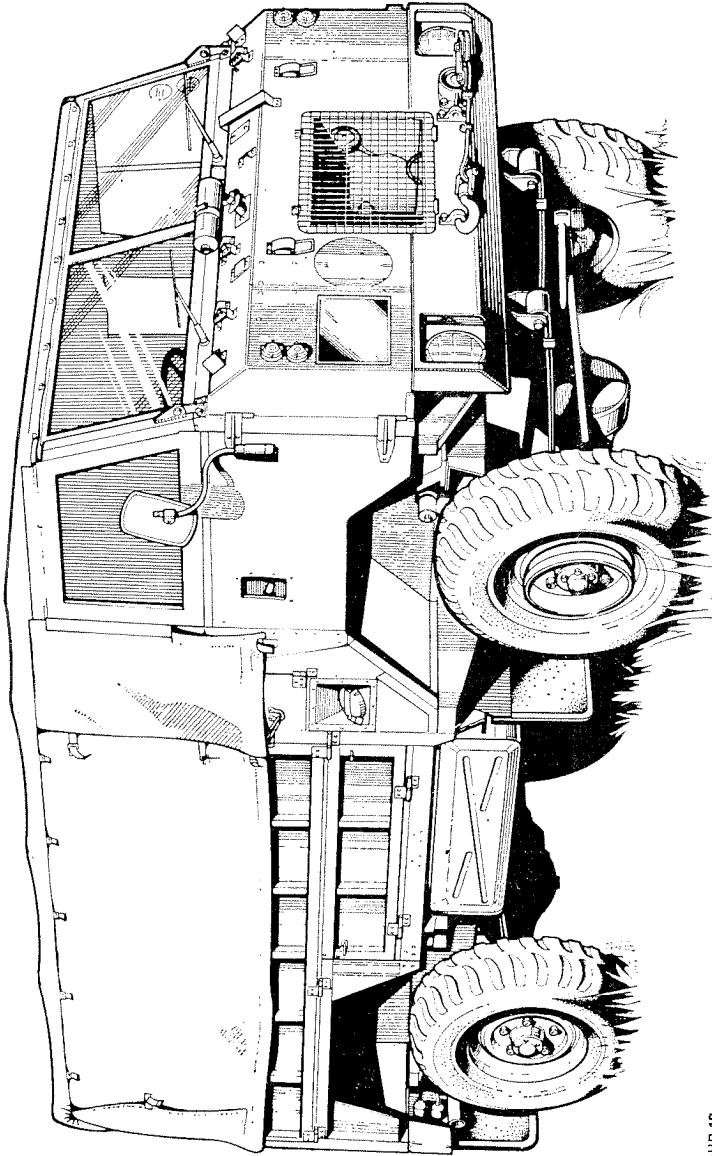


Fig. 2. Tracked transport machine T-101 in subsoil mode.

AHR 17



AHR 18

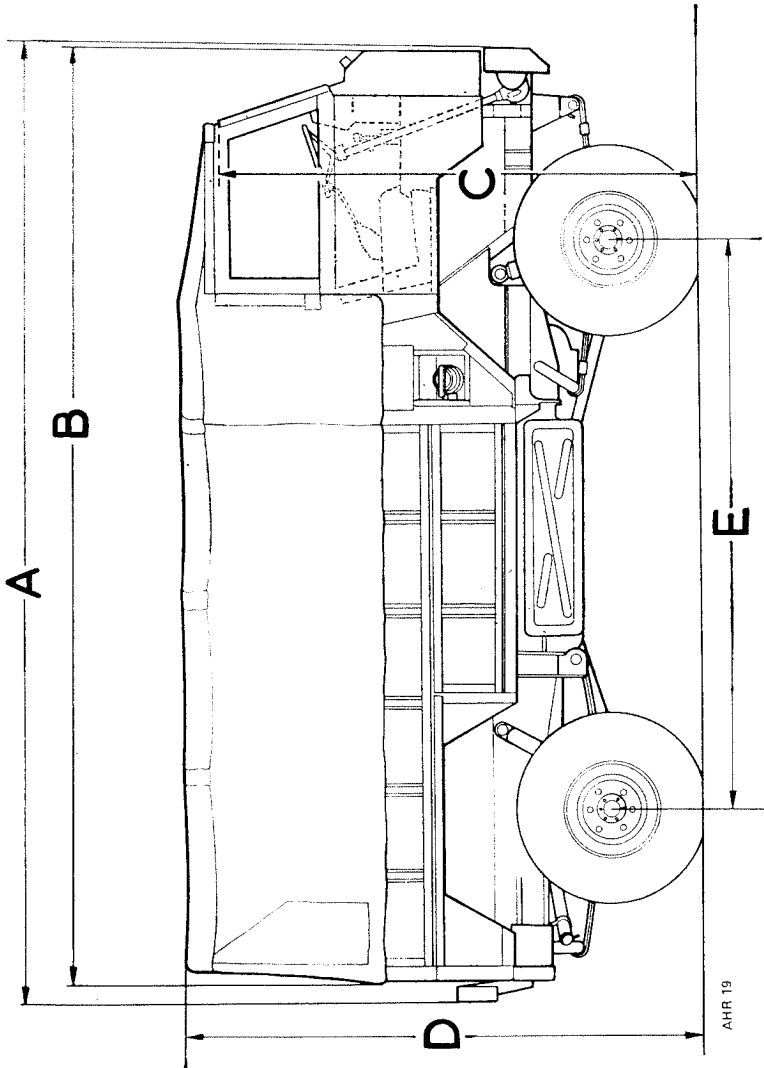


Fig. 5 General side view



Fig. 5. General side view

General Arrangement

12 and 24 volt models

	Rover 1 tonne	
	Metric	British
A. Overall length, fully equipped	4330 mm	170½ in.
B. Overall length, basic stripped	4217 mm	166 in.
C. Overall height, to top of windscreen	2138 mm	84 in.
D. Overall height, over hood	2283 mm	90 in.
E. Wheelbase	2565 mm	101 in.

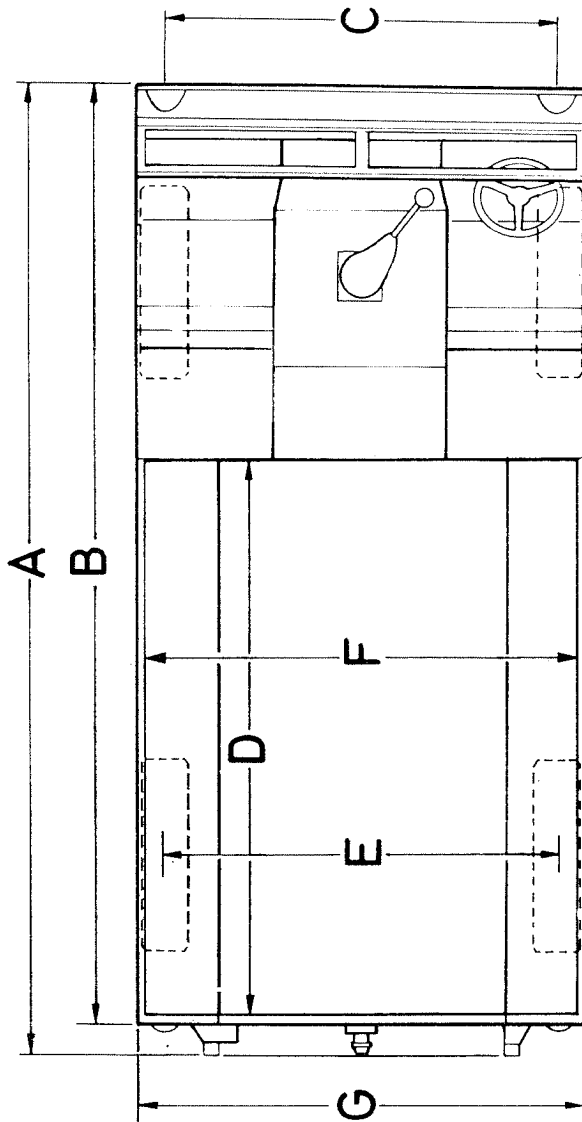


Fig. 6. General plan view

AHR 20

# General Description

I

Fig. 6. General plan view

## General Arrangement

### 12 and 24 volt models

	Rover 1 tonne	
	Metric	British
A. Overall length, fully equipped	4330 mm	170½ in.
B. Overall length, basic stripped	4217 mm	166 in.
C. Track, front	1524 mm	60 in.
D. Length of body (internal)	2491 mm	98 in.
E. Track, rear	1549 mm	61 in.
F. Width of body (internal)	1720 mm	67½ in.
G. Overall width	1842 mm	72½ in.

## CHAPTER 2

## DESCRIPTION OF VEHICLE

2. The vehicle drive is to all four wheels. A differential is fitted in the transfer gearbox which can be locked when operating under exceptionally adverse conditions to provide maximum traction. The description that follows applies to all vehicles unless the paragraph states otherwise.
3. Engine, 90° Vee, eight cylinder, detachable cylinder heads; flexibly mounted in conjunction with the gearbox on rubber at four points, central camshaft with five bearings, overhead inlet and exhaust valves operated by hydraulic tappets and push rods, camshaft driven by duplex chain, non adjustable.
4. Lubrication is full pressure from gear type oil pump to all bearings and valve gear, external full-flow oil filter and an intake filter on the oil pump.
5. Impeller centrifugal type coolant pump with viscous drive to fan driven from crankshaft, temperature controlled by thermostat, pressurised semi-sealed with expansion bottle to decrease loss of coolant under hard working conditions.
6. Front-wheel drive is transmitted through hypoid bevel gearing and normal type differential to the half-shafts and thence via enclosed constant velocity joints to the front hubs.
7. 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.
8. The gearbox unit comprises a main gearbox, four forward speeds and a reverse and a two-speed transfer box integral with the main gearbox with output shafts to front and rear axles.
9. The suspension is by semi-elliptic taper leaf springs at both front and rear with double acting hydraulic telescopic dampers and rubber buffers.
10. The steering is of the re-circulating ball type.
11. Hydraulically operated vacuum servo assisted dual system service brakes with an apportioning valve in the rear system, a mechanical hand brake on transmission output shaft from the transfer box.
12. **12 volt models.** A 12 volt negative earth electrical system with alternator and coil ignition is fitted. Splashproof covers are fitted on 14 mm long reach plugs.
13. **24 volt models.** A 24 volt negative earth electrical system is used. It comprises an alternating current (AC/DC) 90 amp generator with built-in rectifier. A screened and waterproof coil ignition system is also fitted.

The vehicles are prepared to receive a radio station and are completely suppressed to prevent interference to radio. See Chapter 15.

CHAPTER 3  
DATA

	Dimensions		Rover 1 tonne 12 and 24 volt models	
	Metric	British	Metric	British
Overall length, fully equipped	..	..	4330 mm	170½ in.
Overall length, basic, stripped	..	..	4217 mm	166 in.
Overall width	..	..	1842 mm	72½ 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 dimensions:				
Length	..	..	2491 mm	98 in.
Width	..	..	1720 mm	67½ in.
Width between wheel boxes	..	..	991 mm	39 in.
Height, floor to underside of hoop sticks	..	..	1334 mm	52½ 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	12 volt models		24 volt models	
	Metric	British	Metric	British
Unladen:				
Total:				
Running with coolant, oil, 24 gallons fuel	1924 kg	4242 lb	1940 kg	4259 lb
Front axle	1138 kg	2504 lb	1187 kg	2610 lb
Rear axle	723 kg	1589 lb	753 kg	1659 lb
Stripped, with 5½ gallons fuel and without spare wheel	1580 kg	3500 lb	1590 kg	3500 lb
Front axle	1012 kg	2225 lb	1044 kg	2294 lb
Rear axle	552 kg	1212 lb	546 kg	1206 lb
Laden:				
Total, maximum approved gross loaded...	3143 kg	6930 lb	3143 kg	6930 lb
Maximum front axle	1645 kg	3618 lb	1645 kg	3618 lb
Maximum rear axle	1580 kg	3475 lb	1580 kg	3475 lb

†Without modular radio kit fitted

## General Description

I

### Performance

Average safe speed cross-country (laden) .. .. .	20–30 km/h (12–18 mph) depending upon terrain
Maximum gradient climbable (dry concrete) .. .. .	Greater than 60%
Range of action on road (nominal)	545 km (340 miles)
Range of action, cross-country (nominal) .. .. .	320 km (200 miles)
Fuel consumption target (normal road conditions) .. .. .	20 litres/100 km (14.2 mpg)
Fuel consumption target (cross-country) .. .. .	35 litres/100 km (8 mpg)
Nett power/gross wt ratio .. .. .	38.8 kw/tonne (52 bhp/ton) (12 volt)
Maximum tractive effort—top gear and high transfer engaged (100 per cent efficiency) .. .. .	1002 n/tonne (229 lb/ton)
Maximum tractive effort—bottom gear and low transfer engaged (100 per cent efficiency) .. .. .	14730 n/tonne (3365 lb/ton)
Tyre size .. .. .	900—16 cross country (tubed)
<b>Tyre pressures</b>	
Road conditions .. .. .	Front : 1,9 kg/cm <sup>2</sup> (28 lb/sq in) Rear : 2,5 kg/cm <sup>2</sup> (35 lb/sq in)
Cross country conditions .. .. .	Front : 1,4 kg/cm <sup>2</sup> (21 lb/sq in) Rear : 1,4 kg/cm <sup>2</sup> (21 lb/sq in)

NOTE—Reference to be made to current instructions

Wheel type .. .. . Steel, well base

## Capacities

	<i>Litres</i>	<i>Imp. Unit</i>
Fuel .. .. .	109,2	24 galls
Coolant (including heater) .. ..	14,2	25 pints
Engine sump	6,3	11 pints
0,85 litre (1½ pints) extra when refilling after fitting new filter ..	7,1	12½ pints
Gearbox (main) .. .. .	2,7	4½ pints
Gearbox (transfer) .. .. .	3,1	5½ pints
Rear axle .. .. .	2,5	4½ pints
Front axle .. .. .	2,5	4½ pints
Swivel pin housings (each) .. ..	0,8	1½ pints
Steering box .. .. .	0,5	0,9 pints
Winch drive chain case .. .. .	0,2	0,4 pints
Winch drive gearbox .. .. .	0,2	0,4 pints

## Engine

Type .. .. .	Gasoline
Number of cylinders .. .. .	8
Cylinder arrangement .. .. .	90° Vee
Minimum bhp at clutch, nett .. ..	120 at 5000 rpm, 12 volt. 116 at 5000 rpm, 24 volt
Minimum torque, nett .. .. .	261,9 kg/m (176 lb ft) at 2500 rpm, 12 volt. 252,9 kg/m (170lb ft) 24 volt
Bore .. .. .	88,90 mm (3.500 in.)
Stroke .. .. .	71,12 mm (2.800 in.)
Cylinder capacity .. .. .	3528 cc (215 cu in.)
Compression ratio .. .. .	8.5:1
Valve timing:	
Exhaust valve peak .. .. .	105.5° BTDC
Inlet valve peak .. .. .	112.5° ATDC

## Ignition, 12 volt models

Distributor .. .. .	Lucas type 35 D8-G
Distributor dwell angle .. .. .	26°—28° at 600 rpm
Distributor contact breaker gap ..	0,35—0,40 mm (0.014—0.016 in)
Ignition timing (static and dynamic)	3° BTDC at 600 rpm when using 91—93 octane fuel TDC at 600 rpm when using 85 octane fuel
Firing order .. .. .	1, 8, 4, 3, 6, 5, 7, 2
Coil .. .. .	Lucas type 16c6
Sparking plugs (fitted on production) .. .. .	Champion L92 Y 14 mm with suppressors



## General Description

I

Sparking plug point gap .. .. .	0,60 mm (0.025 in)
Suppressor (sparking plug cables) 10,000 to 15,000 ohms .. .. .	LV6/MT4/2920-99-803-5505

## Ignition, 24 volt models

Distributor .. .. .	Lucas twin lever concentric contact breaker (Screened)
Distributor contact breaker gap ..	0,35-0,40 mm (0.014-0.016in)
Ignition timing (static and dynamic)	3° BTDC when using 91-93 octane fuel TDC at 600 rpm when using 85 octane fuel
Firing order .. .. .	1, 8, 4, 3, 6, 5, 7, 2
Coil .. .. .	Lucas type 5C10
Sparking plugs (fitted on production) .. .. .	Screened and waterproofed, type Champion RSL 92Y 14 mm
Sparking plug point gap .. .. .	0,60 mm (0.025 in.)

## Engine lubrication system

Type .. .. .	Full pressure
Oil filter—internal .. .. .	Gauze pump intake filter in sump
Oil filter—external .. .. .	Full-flow filter, AC Delco; P.F.2.
Oil pump .. .. .	Gear type, camshaft operated
Oil pressure .. .. .	2,1-2,8 kg/cm <sup>2</sup> (30-40 lb/sq in.) at 2400 rpm with engine warm
Pressure relief valve .. .. .	0,56-0,84 kg/cm <sup>2</sup> (8-12 lb/sq in.)
Oil cooler .. .. .	Marston still tube, full-flow

## Cooling system

Type .. .. .	Pressurised 1,05 kg/cm <sup>2</sup> (15 lb/sq in.)
Radiator .. .. .	4 row fin and tube type with overflow bottle
Fan .. .. .	7-bladed, cowled, 406 mm (16 in.) dia, belt driven from crankshaft

# I

## General Description

Circulation .. .. . By centrifugal impeller type coolant pump with viscous drive to fan

Cooling control .. .. . By wax type thermostat. Start to open at 79.4°—82.2°C (175°—180°F) Fully open at 93°C (195°F)

### Fuel system

Fuel pump .. .. . Electric, AC 6440793

Carburettors .. .. . Two Zenith 175 CD 2S (internally vented)

Carburettor needle .. .. . 2AY

Idling speed .. .. . 600 rpm

Air cleaner .. .. . AC Cyclone paper filter element 228,6 mm (9 in)

Filter .. .. . Sediment bowl type and element type

### Clutch

Type .. .. . Single dry plate with diaphragm spring centre 266 mm (10½ in.) diameter Borg and Beck

Operation .. .. . Hydraulic

### Main gearbox

Type .. .. . Single helical constant mesh with synchro-mesh on all forward speeds

### Main gearbox ratios

Top .. .. .	Direct
Third .. .. .	1.50:1
Second .. .. .	2.44:1
First .. .. .	4.06:1
Reverse .. .. .	3.66:1

### Transfer gearbox

Type .. .. . Two-speed reduction on main gearbox output

Controls .. .. . High/Low lever, cable operated, and differential lock switch vacuum control, mounted on the radiator ducting

## General Description

I

### Transfer gearbox ratios

High transfer .. .. .	1.174:1
Low transfer .. .. .	3.321:1

### Front axle

Differential .. .. .	Hypoid bevel; Salisbury 8 HS
Front wheel drive .. .. .	Enclosed constant velocity joints
Ratio .. .. .	5.57:1

### Rear axle

Type .. .. .	Hypoid bevel; Salisbury 8 HA fully-floating shafts
Ratio .. .. .	5.57:1

### Overall ratio including final drive

	<i>High transfer</i>	<i>Low transfer</i>
Top .. .. .	6.54:1	18.5:1
Third .. .. .	9.85:1	27.8:1
Second .. .. .	16.01:1	45.3:1
First .. .. .	26.60:1	75.0:1
Reverse .. .. .	24.00:1	67.0:1

### Brakes

Front and rear brakes—

Type .. .. .	Girling hydraulic, by leading and trailing shoes on the rears and twin leading shoes on the fronts
Total lining area, front .. .. .	775 cm <sup>2</sup> (120 sq in.)
Total lining area, rear .. .. .	640 cm <sup>2</sup> (99.5 sq in.)
Brake drum diameter .. .. .	280 mm (11 in.)
Brake apportioning valve clearance .. .. .	0,050 mm (0.002 in.)

**Hand brake**

Type .. .. .	Lockheed Duo-Servo drum brake on transfer box out- put shaft
Total lining area .. .. .	195 cm <sup>2</sup> (30.2 sq in.)
Drum diameter .. .. .	184 mm (7 $\frac{1}{4}$ in.)

**Steering (re-circulating ball type)**

Type .. .. .	Burman re-circulating
Gear ratio—variable .. .. .	Straight ahead .. 23.3:1 Full lock .. .. 25.7:1
Diameter of steering wheel .. .. .	406 mm (16 in.)
Front wheel toe-out .. .. .	1,2–2,4 mm ( $\frac{3}{64}$ – $\frac{3}{32}$ in.)
Camber angle .. .. .	1 $\frac{1}{2}$ °
Castor angle .. .. .	1°
Swivel pin inclination .. .. .	7°
Steering wheel free movement .. .. .	16 mm ( $\frac{5}{8}$ in.)

**Suspension**

Road springs .. .. .	Semi-elliptic taper leaf
Hydraulic dampers .. .. .	Telescopic, non-adjustable Make: Woodhead; front and rear

## General Description

I

### Electrical equipment, 12 volt models

System	..	..	..	..	12 volt negative earth
Battery—					
Type	..	..	..	..	Lucas CB 13/9
Voltage	..	..	..	..	12 volt
Capacity	..	..	..	..	63 a/h
Alternator	..	..	..	..	Lucas type 16 ACR, 34 amp
Control box	..	..	..	..	Integral with alternator
Starter	..	..	..	..	Lucas 3M 100 sealed
Fuse box—inside of front panel	..	..	..	..	35 amp cartridge type

### Electrical equipment, 24 volt models

System	..	..	..	..	24 volt negative earth with rectified AC generating system
Batteries—					
Type	..	..	..	..	Oldham UK 2HN
Voltage	..	..	..	..	24 volt 2+12 volt in series
Capacity	..	..	..	..	57 a/h
Generator	..	..	..	..	AC 90/5, 90 amp
Generator panel	..	..	..	..	No. 9 Mk 3. FV546131
Starter	..	..	..	..	Lucas 3M 100 sealed
Fuses—inside of front panel	..	..	..	..	35 amp cartridge type

**Lamps, 12 volt models**

<i>Position</i>	<i>Make and Type</i>	<i>Voltage</i>	<i>Wattage</i>
Headlights .. .. .	Lucas SP 367	12	50/40
Sidelights .. .. .	Lucas SP 207	12	5
Stop/tail lights .. .. .	Lucas SP 380	12	21/5
Turnlights, front .. .. .	Lucas SP 382	12	21
Turnlights, rear .. .. .	Lucas SP 382	12	21
Number plate light .. .. .	Lucas SP 989	12	2.2
Convoy light .. .. .	Lucas SP 223	12	12/14-7
Instrument panel lights } 5	Lucas SP 987	12	2.2
Speedometer lights } off	Lucas SP 987	12	2.2
Warning light, ignition .. .. .	Lucas SP 281	12	2
Warning light, turnlight .. .. .	Lucas SP 281	12	2
Warning light, hazard .. .. .	Lucas SP 281	12	2
Warning light, diff lock .. .. .	Lucas SP 281	12	2
Warning light, brake .. .. .	Lucas SP 281	12	2
Warning light, trailer .. .. .	Lucas SP 281	12	2
Warning light, winch .. .. .	Lucas SP 281	12	2

**Lamps, 24 volt models**

<i>Position</i>	<i>Make and Type</i>	<i>Voltage</i>	<i>Wattage</i>
Headlights .. .. .	Lucas SP 368	26	50/50
Sidelights .. .. .	Lucas SP 149	24	5
Turnlights, front .. .. .	Lucas SP 241	24	21
Turnlights, rear .. .. .	Lucas SP 241	24	21
Stop/tail lights .. .. .	Lucas SP 380	24	4
Number plate light .. .. .	Lucas SP 227	24	6
Convoy light .. .. .	Lucas SP 149	24	5
Instrument panel lights } 5	Lucas SP 650	24	2.8
Speedometer lights } off	Lucas SP 650	24	3
Warning light, ignition .. .. .	Lucas SP 283	24	3
Warning light, turnlights .. .. .	Lucas SP 283	24	3
Warning light, diff lock .. .. .	Lucas SP 283	24	3
Warning light, hazard .. .. .	Lucas SP 283	24	3
Warning light, brake .. .. .	Lucas SP 687	24	Lilliput 1.1
Warning light, trailer .. .. .	Lucas SP 283	24	3
Warning light, winch .. .. .	Lucas SP 283	24	3
Ammeter lights .. .. .	Lucas SP 650	24	2.8

## SECTION II

# Operation

## CHAPTER 1

### CONTROLS

#### Controls

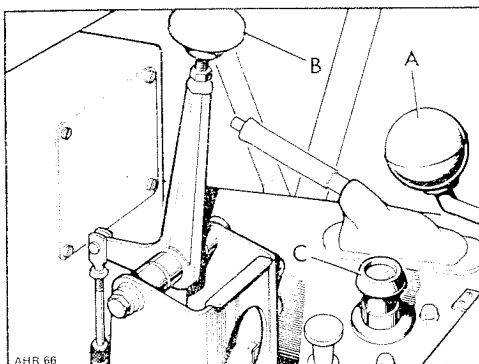
14. The controls and instruments are illustrated at Figs. 12 and 13.

#### Pedals

15. Pendant type accelerator, footbrake and clutch with hydraulic brake and clutch operation.

**Fig. 7**  
**Gear change levers and differential lock switch**

- A—Main gear change lever, black knob
- B—Transfer gear lever, red knob
- C—Differential lock switch



#### Main gear change lever

16. The gears are selected by means of the remote control gear lever. Gear positions are marked on the knob. To engage reverse, move lever to the right against spring pressure.

Synchro-mesh gears are provided on all forward speeds.

See paras. 50 and 51 for gear changing instructions.

#### Transfer gear lever

17. The transfer gear lever is cable operated, mounted on the radiator ducting and has three positions:

- (1) 'High' range position, fully rearward. In this position the main gear lever will select the gear ratios giving normal road speeds.
- (2) 'Neutral' mid-way position. Used when driving power take-off equipment.

(3) 'Low' range position, fully forward. When in this position the low range of gears will be selected by the main gear lever. See para. 52 for instructions on the use of the transfer box.

Gear changing procedures, together with illustrations of gear lever positions under various driving conditions will be found on the following pages.

#### **Rear trailer drive lever (when fitted)**

**18.** The rear trailer drive lever, adjacent to the transfer gear lever, is connected to the rear trailer drive via a cable. The lever has two positions:

- (1) Trailer drive position, lever fully rearwards. In this position drive is automatically transmitted to the trailer coupling on the rear chassis cross-member and thence to each wheel of the trailer.
  - (2) Neutral position, lever fully forward. In this position drive to the trailer is disconnected.
- For details see para 320 in Section V.

#### **Gearbox differential lock switch**

**19.** The vehicle has permanent four-wheel drive and incorporates a differential fitted in the transfer gearbox which allows a high degree of mobility in off road use.

The differential is locked by vacuum from the engine induction system and is controlled by means of the differential lock switch mounted on the radiator ducting. Upon encountering conditions when traction to the road wheels becomes lost or it is obvious that traction will be lost a short distance ahead, the differential can be locked by pulling the switch up. The warning light in the instrument panel will be illuminated. See para. 42.

The differential lock switch can be operated at any time, the vehicle is in motion providing that the engine is running.



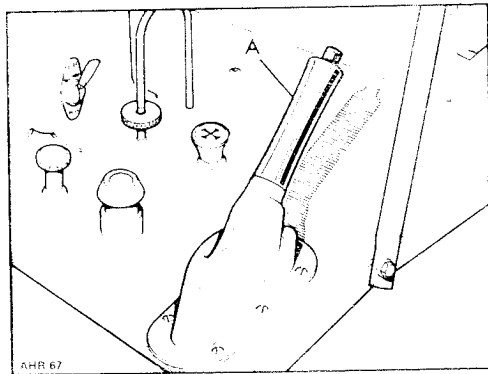
Under certain conditions a slight delay may be experienced before the differential becomes engaged, with subsequent warning light illumination. This delay is a built-in safety precaution and ensures that gears are correctly aligned before engagement commences.

NOTE: To avoid unnecessary wear and possible damage to the transmission and final drive it is important that wide throttle openings are not used when the vehicle is operating in 1st and/or 2nd gear low range with the differential lock engaged.

A return to the unlocked position should be made as soon as traction is regained.

### Hand brake

20. The hand brake protrudes through the driver's side of the radiator ducting. To release the brake, pull back slightly, depress the button in the top of the hand grip and push forward as far as possible; to apply the brakes, pull the lever back.



**Fig. 8**  
**Hand brake**

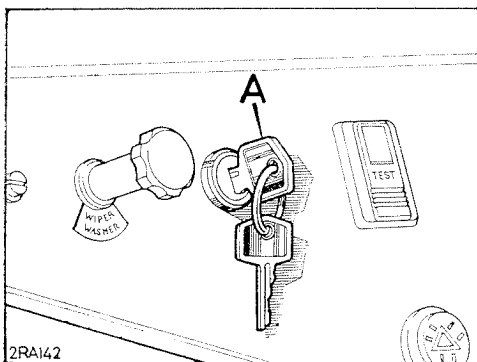
A—Hand brake lever

### Ignition and starter switch

21. The ignition and starter switch is located at the left-hand position on the main instrument panel on RH steering models, right-hand position on LH steering models, between the wiper/washer switch and brake system check button. Turn key clockwise to ignition 'on', further movement clockwise against spring pressure to operate the starter motor.

Fig. 9  
Ignition and starter switch

A—Ignition and starter switch

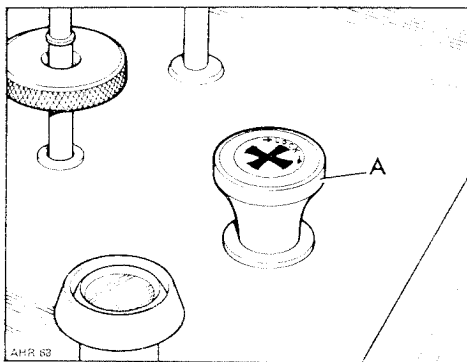


### Cold start control

22. The cold start control is mounted on the radiator ducting. See para. 45 for operation.

Fig. 10  
Cold start control

A—Cold start control



**Hand throttle control, 24 volt models**

23. The hand throttle control, which is the pull-out type, is mounted on the radiator ducting.

It has a screw adjuster to give any desired engine speed up to approximately two-thirds throttle. When the hand throttle control is at the inoperative position the control lever is as illustrated in dotted line.

In order to bring it into operation, pull the lever outwards, turn through 180° and locate end of lever in recess of adjuster screw. Set screw to give desired engine speed, turn anti-clockwise to increase and clockwise to decrease.

See para. 257 for use of this control, when stationary battery charging is required.

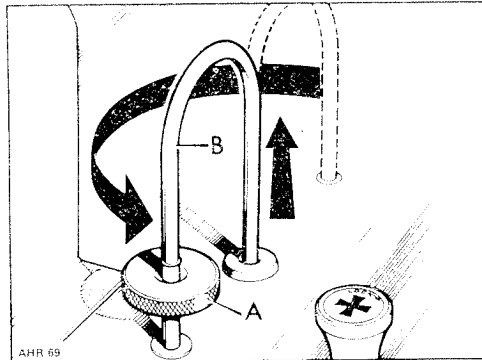


Fig. 11  
Hand throttle control  
A—Adjuster screw  
B—Control handle

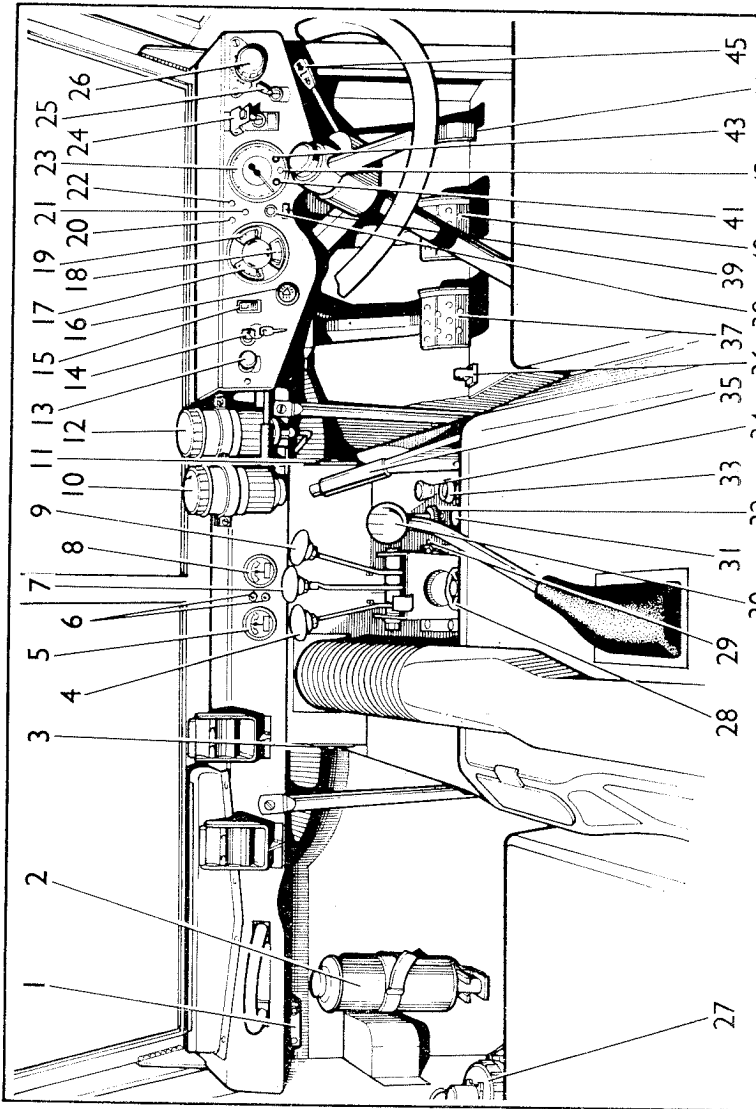


Fig. 12. Layout of controls and instruments, RH Steering

Key to Fig. 12

	<i>See</i>		<i>See</i>
	<i>Para. No.</i>		<i>Para No.</i>
1	..	Windscreen wiper motor	..
2	..	Fire extinguisher	..
3	..	Heater unit flap, passenger side	..
4	..	Winch control lever (when fitted)	..
5	..	Radio ammeter, 24 volt models	..
6	..	Inspection light sockets	..
7	..	Transfer gear lever	..
8	..	Vehicle ammeter, 24 volt models	..
9	..	Trailer drive control lever (when fitted)	..
10	..	Brake fluid reservoir	..
11	..	Heater unit flap, drivers side	..
12	..	Combined brake and clutch fluid reservoir	..
13	..	Windscreen wiper/washer switch	..
14	..	Ignition and starter switch	..
15	..	Brake system warning light and test button	..
16	..	Hazard warning switch	..
17	..	Water temperature gauge	..
18	..	Oil temperature gauge	..
19	..	Fuel level gauge	..
20	..	Trailer turnlight warning light	..
21	..	Ignition warning light	..
22	..	Vehicle turnlight warning light	..
23	..	Speedometer	..
24	..	Headlight infra-red switch	..
25	..	Panel light switch	..
26	..	Light switch, 6-way	..
27	..	Windscreen washer reservoir	..
28	..	Water valve for heater unit	..
29	..	Switch for heater fan, 2-speed	..
30	..	Main gearchange lever	..
31	..	Push/pull air control for heater	..
32	..	Hand throttle control	..
33	..	Gearbox differential lock switch	..
34	..	Cold start control	..
35	..	Handbrake lever	..
36	..	Helicopter lifting eye	..
37	..	Clutch pedal	..
38	..	Winch warning light (when fitted)	..
39	..	Differential lock warning light	..
40	..	Brake pedal	..
41	..	Oil pressure warning light	..
42	..	Headlight main beam warning light	..
43	..	Cold start warning light	..
44	..	Accelerator pedal	..
45	..	Headlight dip switch combining turnlight switch, headlight flash and horn	..

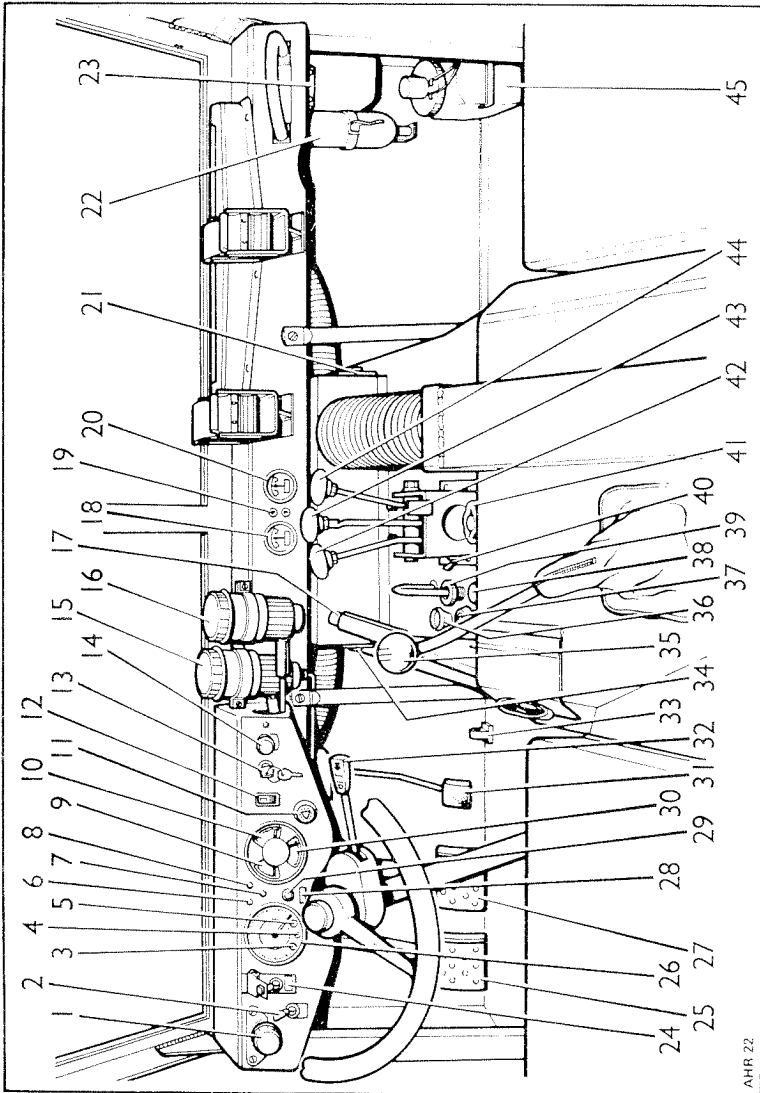
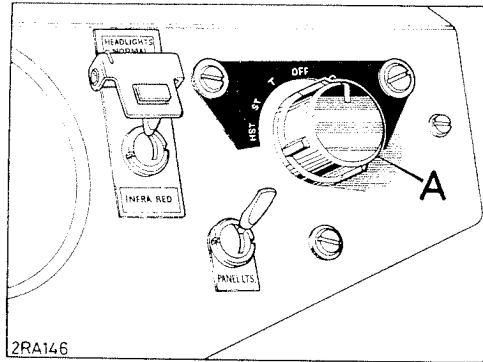


Fig. 13. Layout of controls and instruments, LH Steering

Key to Fig. 13

	<i>See</i>		<i>See</i>
	<i>Para. No.</i>		<i>Para. No.</i>
1	24	Headlight infra-red switch	..
2	27	Clutch pedal	..
3	39	Speedometer	..
4	40	Brake pedal	..
5	41	Differential lock warning light	..
6	26	Winch warning light (when fitted)	..
7	38	Oil temperature gauge	..
8	26	Accelerator pedal	..
9	34	Headlight dip switch combining turnlight	..
10	35	switch, headlight flash and horn	..
11	29	Helicopter lifting eye	..
12	43	Heater unit flap, driver's side	..
13	21	Main gearchange lever	..
14	28	Cold start control	..
15	167	Gearbox differential lock switch	..
16	121	Push/pull air control for heater	..
17	20	Hand throttle control	..
18	33	Heater fan switch, 2-speed	..
19	31	Water valve for heater unit	..
20	33	Trailer drive control lever (when fitted)	..
21	30	Transfer gear lever	..
22	301	Winch control lever (when fitted)	..
23	216	Windscreen washer reservoir	..
24	24	Headlight infra-red switch	..
25	25	Clutch pedal	..
26	26	Speedometer	..
27	27	Brake pedal	..
28	28	Differential lock warning light	..
29	29	Winch warning light (when fitted)	..
30	30	Oil temperature gauge	..
31	31	Accelerator pedal	..
32	32	Headlight dip switch combining turnlight	..
33	33	switch, headlight flash and horn	..
34	34	Helicopter lifting eye	..
35	35	Heater unit flap, driver's side	..
36	36	Main gearchange lever	..
37	37	Cold start control	..
38	38	Gearbox differential lock switch	..
39	39	Push/pull air control for heater	..
40	40	Hand throttle control	..
41	41	Heater fan switch, 2-speed	..
42	42	Water valve for heater unit	..
43	43	Trailer drive control lever (when fitted)	..
44	44	Transfer gear lever	..
45	45	Winch control lever (when fitted)	..
		Windscreen washer reservoir	..

**Fig. 14**  
**Light switch, 6-way**  
 A—Light switch, 6-way



### Light switch, 6-way

**24.** Situated on the panel at the side of the instruments. Also fitted to the panel is an indicator plate showing the switch positions. At right-hand side on RH steering models, left-hand side on LH steering models.

Stop and turnlights are on at all switch positions except when turned to right, i.e. when convoy lights are on.

Turn switch to right:

First position—convoy light.

Second position—side and convoy lights.

Turn switch to left:

First position—tail and number lights.

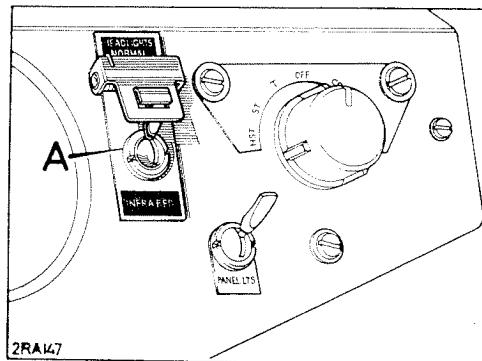
Second position—side, tail and number lights.

Third position—head, side, tail and number lights.

### Headlight infra-red switch

**25.** The headlight infra-red switch, fitted adjacent to the light switch, when operated extinguishes all vehicle lights except the headlights, irrespective of the position of the 6-way lighting switch.

**Fig. 15**  
**Headlight infra-red switch**  
 A—Headlight infra-red switch

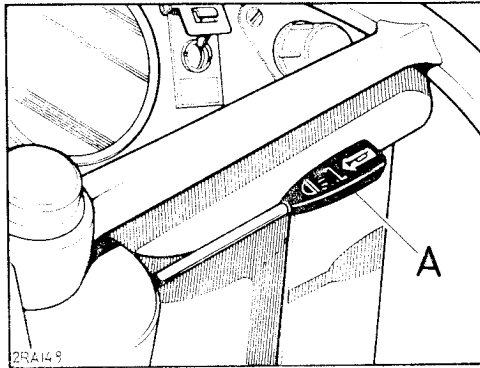




The system is designed to be used in conjunction with infra-red shields fitted over the headlights and requires the use of special goggles which are worn by the vehicle operator.

**Fig. 16**  
**Headlight dip switch,**  
**combining turnlights, horn**  
**and headlight flasher**

A—Switch



**Headlight dip switch, combining turn lights, horn and headlight flasher**

26. The switch has six positions:

- (1) Switch in central position: dipped headlights.
- (2) Switch fully downward: headlights on main beam.
- (3) Switch lifted fully upwards: headlight flash.  
 The headlights can be flashed at any time irrespective of other switch positions.
- (4) Switch knob pressed inwards: horn.
- (5) Switch moved anti-clockwise: left-hand turn indicated.
- (6) Switch moved clockwise: right-hand turn indicated.

The switch is automatically cancelled when operating turnlights, by movement of the steering wheel.

When the turnlights are functioning correctly the warning light in the instrument panel will flash in conjunction with the exterior turnlights and the flasher unit will be audible. Should either a front or rear turnlamp fail, the other lamp will continue to flash but lamp failure will be indicated by the rapid flashing of the warning light and the flasher unit will not be heard.

The trailer flasher warning light adjacent to the vehicle flasher warning light operates as detailed above when a trailer is connected to the vehicle.

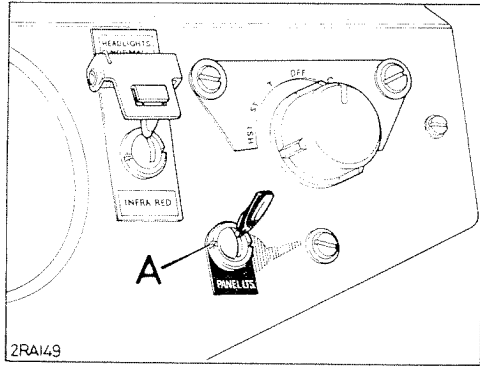
**Instrument panel light switch**

27. The switch has two positions and is only operative with the side and tail lamps on.

- (1) Switch in upper position: light off.
- (2) Switch in down position: light on.

**Fig. 17**  
Panel light switch

A—Instrument panel light switch



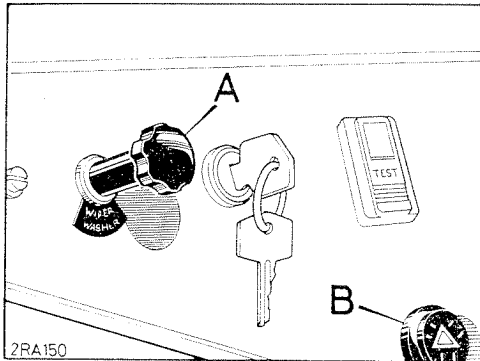
**Windscreen wiper/washer switch**

28. The rotary switch has three positions and is only operative with the ignition on.

- (1) Rotate switch clockwise: wipers on.
- (2) Switch knob pressed inwards: windscreen wash. This can be done with the wiper switch on or off.

**Fig. 18**  
Windscreen wiper/washer switch

A—Windscreen wiper/washer switch  
B—Hazard warning switch



**Hazard warning light switch**

29. When the hazard warning light switch button is pushed in all four turnlights will operate simultaneously. The red warning light in the switch will flash in conjunction with the exterior turn lights. To cancel the hazard warning, again push in the switch button when it will remain in the 'off' position. Use the hazard warning system to warn following or oncoming traffic of any hazard, that is, breakdown on fast road or an accident to your own or other vehicles.

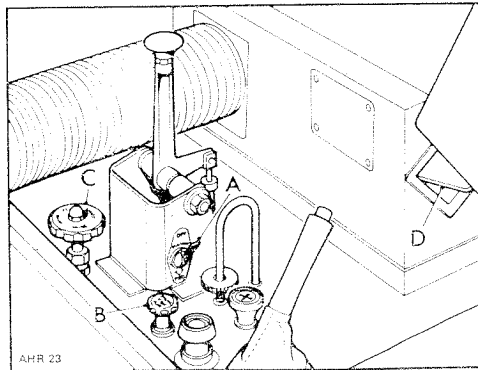
### Heater switch and controls

30. The heater fan switch mounted in the transfer gear selector housing has three positions:

- (1) Switch in upper position: heater fan off
- (2) Switch in central position: heater fan operating at low speed
- (3) Switch in lower position: heater fan operating at full speed

Fig. 19  
Heater controls

- A—Heater fan switch
- B—Pull/push air control
- C—Water control valve
- D—Heater unit flaps



The heater unit mounted on the radiator ducting is the fresh air type and normally requires the heater fan being operative via the switch as described above, before air can be circulated, although a certain amount will enter by ram action due to the forward movement of the vehicle.

A pull/push air control, mounted on the radiator ducting controls the volume of air passing through the heater. It is progressive in action and should be pulled out to increase air flow. When the control is pushed fully in all air is cut off. A water control valve, also mounted on the radiator ducting, isolates the water supply from the engine thus enabling cool air only to enter the vehicle through the heater when required. Rotate the valve clockwise to cut off water supply. Two flaps are situated on the sides of the heater unit and control the direction of air flow. Pull open the flaps to emit air to the driver and/or passenger compartments.

When the flaps are closed, all air is directed to the windscreen through the demister vents.

### Heating, rear compartment

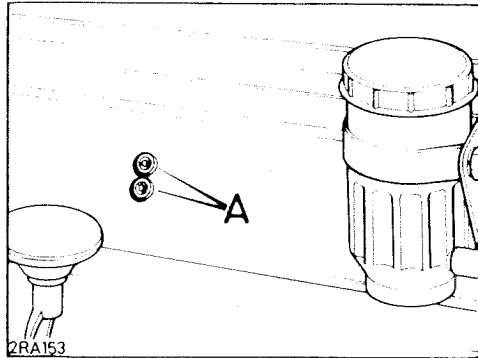
Heated or cool air to the rear compartment is through flexible ducting, from the heater unit, attached to the engine compartment lid with two rotary vane type controls mounted in a housing and operated from the rear compartment. Rotate vane to increase or decrease air flow.

**Inspection lamp sockets**

31. In the centre of the facia rail are a pair of inspection lamp sockets; the black socket is earthed.

**Fig. 20**  
**Inspection lamp sockets**

A—Inspection lamp sockets

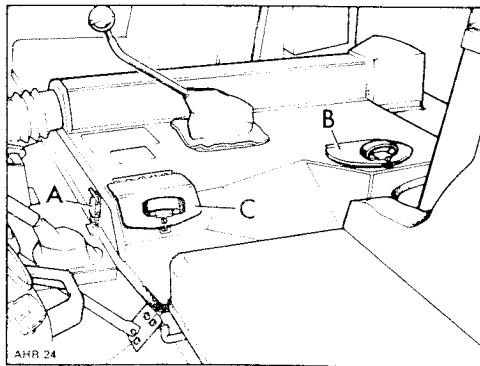


**Engine compartment lid**

32. The engine compartment lid is secured in position by two clips. Access to the oil level dipstick, oil filler cap and radiator filler cap is through hinged inspection hatches in the lid.

**Fig. 21**  
**Engine compartment lid**

A—Clips securing lid  
B—Access to oil level dipstick and filler cap  
C—Access to radiator filler cap



## INSTRUMENTS

## Ammeters, 24 volt models

33. Situated at the centre of the facia rail panel are two ammeters. The ammeters marked 'VEHICLE' and 'AUX' are graduated 100-0-100 and indicate the charge or discharge rates.

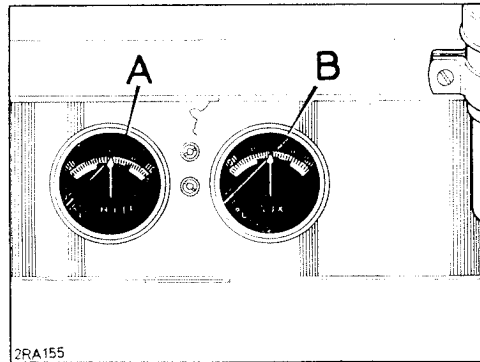


Fig. 22  
Ammeters, 24 volt models

A—Vehicle ammeter  
B—Auxiliary ammeter

## Coolant temperature gauge

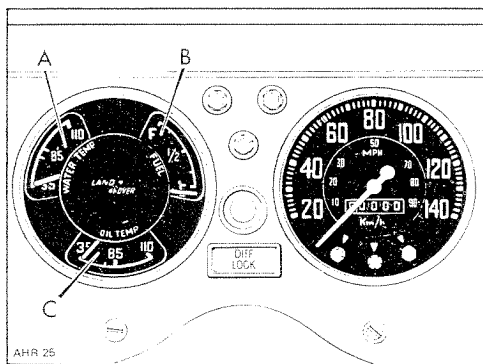
34. The coolant temperature gauge in the combined instrument assembly indicates the engine working temperature. Under normal running conditions the needle should register round about 80° to 85°. If the needle reaches the red band 110° mark immediately stop the engine and investigate the cause of the temperature rise.

## Fuel level gauge

35. The fuel level gauge in the combined instrument assembly, only operates with the ignition 'on'. This gauge is not a precision instrument and cannot be used to derive fuel consumption figures. On 12 volt models the design of the fuel level gauge ensures that the needle does not fluctuate but there is a time lag of a few seconds before it registers after the ignition has been switched on.

Fig. 23  
Gauges

- A—Water temperature gauge
- B—Fuel level gauge
- C—Oil temperature gauge



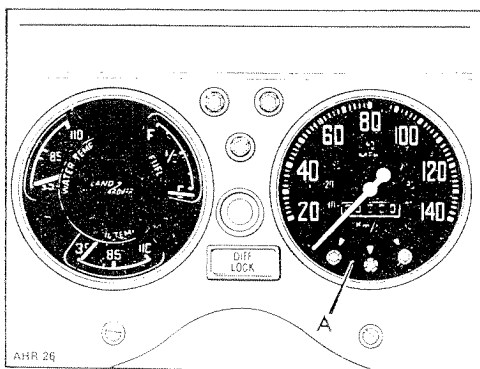
### Oil temperature gauge

36. The oil temperature gauge in the combined instrument assembly gives a continuous indication of the oil temperature.

The oil temperature should not exceed 110°, a red band on the gauge indicates the danger mark. The engine must be switched off and the oil allowed to cool down if this temperature is reached under normal working conditions.

Fig. 24  
Speedometer

- A—Speedometer



### Speedometer

37. A speedometer is situated to the right in the instrument panel on RH steering models, to the left on LH steering models, it indicates the speed of the vehicle and also shows total mileage.

### Charging warning light

38. The red warning light, at the centre of the instrument panel, glows when the alternator fails to charge or the alternator charging rate is low. It will glow when the ignition is switched on and the engine is stationary or running slowly and will go out when the engine speed rises.

**Oil pressure warning light**

39. The green oil pressure warning light at the left-hand bottom of the speedometer should glow when the engine is stationary and fade out when the engine starts and the oil pressure builds up to normal. See para. 84 for further details.

**Headlight main beam warning light**

40. The small blue warning light at the bottom centre of the speedometer glows when the main headlight beams are in use; its purpose is to remind the driver to dip the headlights on entering a brightly-lit area or approaching other traffic.

**Cold start control warning light**

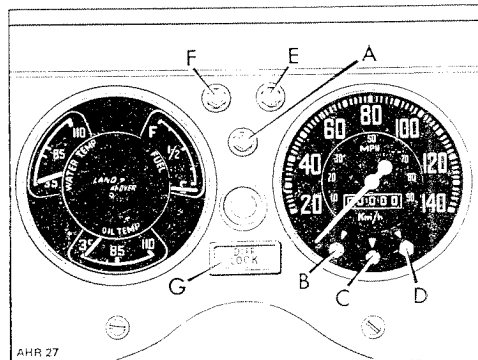
41. The amber warning light at the right-hand bottom of the speedometer, glows when the cold start control is out. As the engine temperature increases the control can be progressively pushed in, consistent with even running, until it is completely returned to the normal 'off' position.

**Gearbox differential lock warning light**

42. The white warning light marked 'DIFF LOCK' positioned beneath the winch warning light (when fitted) glows when the differential lock switch, mounted on the radiator ducting, is operated. See para. 53.

**Fig. 25**  
Warning lights

- A—Charging warning light
- B—Oil pressure warning light
- C—Main beam warning light
- D—Cold start control warning light
- E—Turnlight warning light
- F—Trailer warning light
- G—Gearbox differential lock warning light



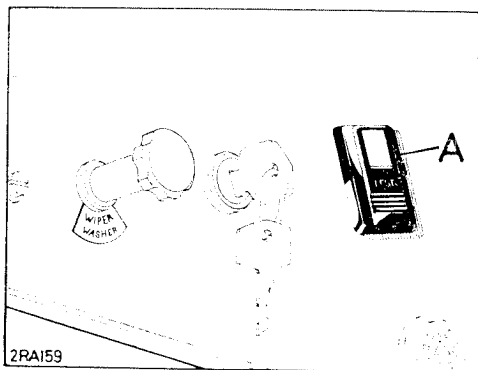
**Dual brake system warning light**

43. The red warning light in the brake system check button should glow when the button is depressed with the ignition switched on. This ensures that the circuit and warning light bulb is operating satisfactorily. The system can be checked at any time in this manner providing the ignition is 'on'. The warning light will go out when the button is released.

The sudden appearance of the warning light during normal running conditions indicates a fault in the hydraulic components, i.e. a loss of fluid from either the front or rear system. The vehicle should be stopped and the cause investigated.

**Fig. 26**  
**Dual brake system warning**  
**light and check button**

A—Warning light and  
check button





## CHAPTER 2

### OPERATING INSTRUCTIONS

#### BEFORE STARTING THE ENGINE

**44.** Before attempting to start the engine, read the following notes concerning the cold start control.

##### **Cold start control**

**45.** The cold start control is mounted on the radiator ducting and has two functions:

- (1) Pulled out approximately 14 to 16 mm ( $\frac{9}{16}$  to  $\frac{5}{8}$  in.) increases the engine speed without mixture alteration (fast idle position.)
- (2) During the second stage of the movement the mixture is progressively enriched for cold starting. To ensure easy starting the control should initially be pulled fully out. After the engine has started return the control to the 'off' position as soon as possible consistent with even running.

By turning the knob slightly the control can be locked in any position.

#### STARTING THE ENGINE

**46.** To start the engine adopt one of the methods detailed below.

- (1) Ensure that the main gear lever is in the neutral position.
- (2) Start the engine as follows:
  - (a) Engine cold.
    - (i) Pull the cold start control out.
    - (ii) Keep the foot clear of the accelerator.
    - (iii) Switch on the ignition, check that the green oil pressure warning light and the red charging warning light both glow.
    - (iv) Continue to turn the key in a clockwise direction against spring pressure when the starter motor will operate. Release the key immediately the engine fires.

- (b) Engine warm or hot.
  - (i) Ensure the cold start control is pushed fully in.
  - (ii) Switch on the ignition, check that the green oil pressure warning light and the red charging warning light both glow.
  - (iii) Operate the starter.
  - (iv) Release the ignition key as soon as the engine fires.

It may be necessary to use a small amount of accelerator during starting.

NOTE: If the engine makes a false start, allow the starter to come to rest before operating the starter again. Should the engine fail to start after two or three attempts, investigate and correct the cause before the battery is run down needlessly.

### WHEN THE ENGINE STARTS

47. The following points should be noted when the engine starts.
- (1) The cold start control must be returned to the normal position as soon as possible, consistent with even running.
  - (2) A glow from the 'cold start warning light' on the instrument panel will indicate that the control is out.
  - (3) Do not race the engine; drive away at moderate speed immediately after starting, so stimulating lubrication of the cylinder walls as the engine warms up.
  - (4) Check that the green (oil) and the red (charging) warning lights go out. See paras. 84 and 38.

### Warning lights

48. Like all mechanical devices, the cold start control warning system is not completely fool proof and the responsibility for pushing in the control rests with the driver, especially as the warning light may not glow due to lamp failure. The cold start warning light system can be checked at any time, engine hot or cold, by switching on the ignition and pulling the control out approximately half way. The warning light should glow.

To guard against lamp failure in the oil pressure and the charging warning lights, a check should be made that the lamps glow each time the ignition is switched on.

### MOVING OFF

49. Start the engine as detailed in para. 46 and select the appropriate gear. The latter will be dependent upon the type of terrain to be negotiated. See paras. 50, 51, 52 and 53.

After observing the above, proceed as follows:

- (1) Depress the clutch pedal fully and engage first gear. Increase the engine speed slightly, release the hand brake lever and gradually release the clutch pedal. As the engine begins to take the load, increase the engine speed.
- (2) Accelerate the engine sufficiently to enable the next higher gear to be engaged without overloading the engine. See para 50.

### GEAR-CHANGING PROCEDURE

50. The Land-Rover gearbox may be regarded as having ten gear ratios, that is eight forward speeds and two reverse.

For convenience in use these gears are evenly divided into two groups, termed 'low' range and 'high' range.

'Low' range consists of four low forward gears, plus a low reverse gear.

'High' range consists of four normal gear ratios, plus a normal reverse gear.

The two ranges may be used progressively when changing up, if conditions demand.

#### **Gear levers**

Two gear levers are provided to control the gearbox, these being:

- (1) The main gear lever, fitted with a black knob. This is used in the normal way, and will engage the five gears within the range selected by the transfer lever.
- (2) The transfer gear lever is fitted with a red knob and is used to select the high or low range of gears; it also has a neutral (mid-way) position.

## II

## Operation

Until experience is gained under differing operating conditions, the following speeds may be used as a guide when changing gear:

	High ratio	Low ratio
First to second .. .. .	8–16 kph (5–10 mph)	Within two or three vehicle lengths of starting
Second to third .. .. .	25–32 kph (15–20 mph)	8–16 kph (5–10 mph)
Third to top .. .. .	40–56 kph (25–35 mph)	16–24 kph (10–15 mph)

### Use of gear ranges

**51.** As an example of how the full progressive range of the gearbox may be used, consider a vehicle which is heavily laden or towing a heavy trailer, and which is required to pull away from a standing start, up a steep gradient.

With the transfer gear lever in the low range position, the vehicle will pull away in first gear, and the gear changes for the first four gears can be made in the normal way, with the main gear lever.

When road conditions are suitable for the high gear range, they may be brought into operation without stopping the vehicle as follows:

Depress the clutch pedal, select the high range with the transfer gear lever and move the main gear lever into the second or third gear position, depending on road conditions. Release the clutch pedal and continue to change up in the normal way.

This operation can be carried out smoothly and quickly after a little practice.

By making use of the full range of the gearbox in this manner, the clutch life will not be shortened by having to compensate for the selection of an undesirable gear ratio.

**Transfer gear changing**

52. Changing from high (lever fully rearward) to low (lever fully forward) transfer ratio should only be attempted when the vehicle is stationary. The engine may be left running, but the main gear lever must be in the neutral position. Depress the clutch pedal and push the transfer lever right forward; release the clutch. Should there be any hesitation in the gear engaging, do not force the lever. With the engine running, engage a gear with the main gear lever and let in the clutch momentarily; then return the main gear lever to neutral and try the transfer control again.

Changing from 'low' to 'high' transfer ratio may be accomplished at any time, regardless of vehicle speed. Release the accelerator pedal, depress the clutch pedal and pull the transfer box lever right back, pausing slightly in the neutral position; let in the clutch.

**Gearbox differential lock switch**

53. Upon encountering conditions when traction to the road wheels becomes lost or it is obvious that traction will be lost a short distance ahead, the gearbox differential can be locked by means of the differential lock switch mounted on the radiator ducting. This ensures that all road wheels obtain the maximum amount of grip. Pull switch up to engage differential lock.

NOTE. To avoid unnecessary wear and possible damage to the transmission and final drives it is important that wide throttle openings are not used when the vehicle is operating in 1st and/or 2nd gear low range with the differential lock engaged. A return to the unlocked position should be made as soon as traction is regained.

54. Chart showing various work conditions alongside the recommended gearbox setting.

Work Conditions	CONTROL LEVER POSITION			Differential lock switch	Drive condition on vehicle	To regain normal drive settings	Remarks
	Main gear lever—	Transfer box lever—					
A—Normal road work, hard pulling, ice or mud on road or grassland <i>See Fig. 27</i>	Select gear required	High position, fully rearward		Disengaged	Driving all four wheels through the high range of gears		
B—Very heavy load pulling. Heavy ground work. Ascending or descending steep gradients <i>See Fig. 28</i>	Select gear required	Low position, fully forward		Disengaged	Driving all four wheels through the low range of gears	Release throttle pedal, depress clutch pedal, move transfer lever rearward firmly and slowly to the 'high' position	Changing back to the high gear range may be accomplished with the vehicle on the move as soon as conditions permit
C—Parking with heavy load on steep gradient, hand brake applied <i>See Fig. 29</i>	First or reverse gear engaged	Low position, fully forward		Disengaged	Stationary, engine coupled to all wheels	Depress the clutch pedal and move transfer lever into the 'high' position	Hand brake is effective on both axles in this condition
D—Exceptionally adverse cross-country conditions when traction to the wheels is lost <i>See Fig. 30</i>	Select gear required	Low position, fully forward		Engaged, pull switch up. Warning light will be illuminated	Driving all four wheels and gearbox differential locked to ensure maximum amount of traction at wheels	Disengage differential lock switch, depress clutch pedal, move transfer lever into 'high' position	The differential lock switch should be disengaged as soon as traction is regained

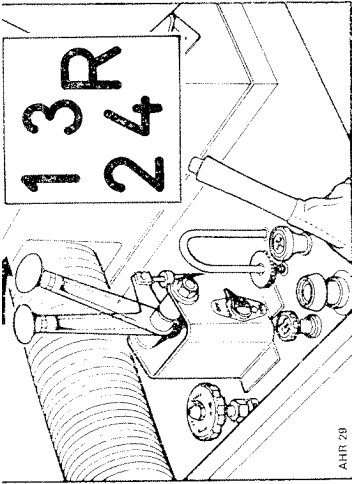


Fig. 28 Gear lever positions  
B—Heavy load pulling, heavy ground work etc.

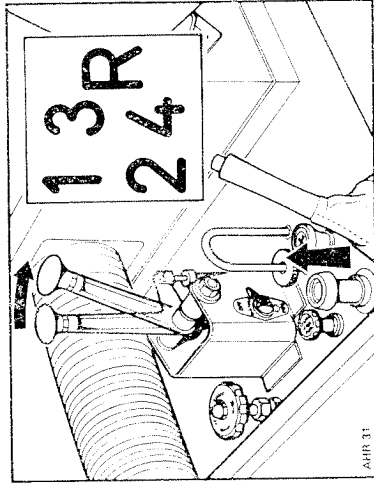


Fig. 30 Gear lever positions

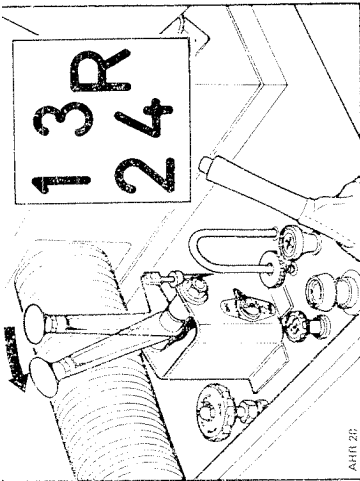


Fig. 27 Gear lever positions  
A—Normal road work, hard pulling, ice, mud, grassland

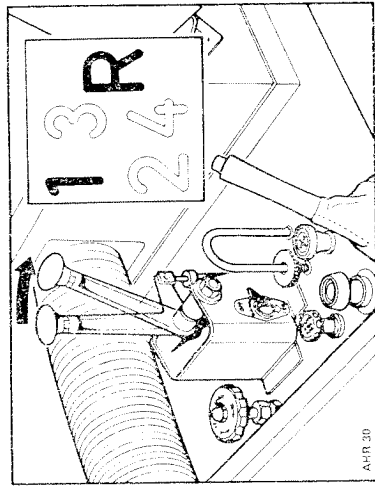


Fig. 29 Gear lever positions

**PARKING THE VEHICLE**

55. Stop the vehicle and apply the hand brake. If the vehicle is standing on a gradient it is advisable to engage first gear at the gearbox. See para. 54, item 'C'.

**STATIONARY RUNNING**

56. When the engine is operated for stationary running, see paras. 23, 36 and 84.

**CHAPTER 3**

**SPECIAL INSTRUCTIONS**

**RUNNING-IN PERIOD**

57. Progressive running-in of a new vehicle is of the utmost importance and has a direct bearing on durability and smooth running throughout its life.

The running-in period is 2400 km (1500 miles), during which time 65—73 kph (40—45 mph) in high transfer ratio top gear should not be exceeded. The engine must not be allowed to labour at any time and full use should be made of the indirect gears to ensure that full throttle is not used even to achieve 73 kph (45 mph). If the vehicle is used in low transfer ratio when new 24 kph (15 mph) should not be exceeded in top gear. Corresponding maximum speeds should be used in the lower gears.

Thereafter, maximum speeds may be increased gradually, but the vehicle should not be driven at prolonged high speeds until it has done 2400 km (1500 miles).

Never race the engine when cold at any time during the life of the vehicle.

**MAXIMUM SPEEDS IN ALL GEARS AT 5,300 RPM**

	Gear	MPH	
		High transfer	Low transfer
Top	.. .. .	79	28.5
Third	.. .. .	56	18
Second	.. .. .	36	11.5
First	.. .. .	19.5	7
Reverse	.. .. .	21.5	8

**FROST PRECAUTIONS AND ENGINE PROTECTION**

58. A special anti-freeze mixture is used in the cooling system during both winter and summer months to prevent corrosion of the aluminium alloy engine parts. It is most important therefore that if the cooling system is drained or topped-up at any time to use a solution of water and the correct type of anti-freeze.



For further details and draining instructions see para. 92.

Precautions concerning the battery will be found in Chapter 13 for 12 volt models and Chapter 14 for 24 volt models.

### **TOWED EQUIPMENT**

**59.** Before commencing to tow, the driver of the towing vehicle and the NCO/Officer in charge must refer to the User Handbook/ Servicing Schedule of the towed equipment or plant in order to familiarise themselves with:

- (1) Special checks that may be required before starting and during the journey.
- (2) Types of lubricant required for road wheel bearings, etc., and method of application.
- (3) Speed restriction and bridge classification imposed by the nature of the towed equipment or plant.

NOTE: When a vehicle tows an equipment or plant, except in the case of a standard train where the dual classification is usually given, the classification of the train should normally be taken as the sum of the separate classification of the prime mover and the towed equipment or plant.

### **FIRE AND SAFETY PRECAUTIONS**

**60.** Two fire extinguishers are provided with each vehicle. One is mounted externally on the scuttle above the radiator tunnel and the other internally, attached to the toe box, passenger side.

To operate proceed as follows:

- (1) Free the extinguisher by pulling free the retaining strap and lifting it out of the support cup.
- (2) Hold in hand and strike knob in base of container squarely on a hard surface. Point the nozzle towards the base of the fire.

### **USE OF JACKS**

**61.** When lifting the vehicle, place the jack under the axle casing either side of the road spring.

**Wheels should be chocked in all circumstances.**

- (1) On level or sloping ground, the gearbox differential lock should be engaged prior to stopping the engine and parking the vehicle.

- (2) The differential lock is only engaged if the warning light on the instrument panel is illuminated with the ignition switched on.
- (3) If the vehicle has been stationary prior to the jacking operation, the differential lock may not operate when the switch is raised. In this case it will be necessary to start the engine, to create a vacuum and, perhaps drive the vehicle, until the warning light is illuminated. Then switch off engine.
- (4) Apply the hand brake.

**Explanatory note:** Owing to the fact that the vehicle is fitted with a transmission hand brake, this will not be operative if the differential lock has not been engaged and one or both rear wheels are jacked up, whilst either gearbox is in neutral. Therefore, to obtain engine braking, both gearboxes should be engaged in 1st gear and 'low' transfer respectively.

The design of the transmission is such that jacking up the rear wheels, whilst on a slope, even with the differential lock engaged, could result in limited vehicle movement as a result of the 'back-lash' in the transmission.

The hand brake is operative within transmission back-lash limits, if the rear wheels are to stay on the ground and one or both front wheels are jacked up, irrespective of the gearbox differential lock engagement. **Therefore always chock wheels.**

**Warning.** The vehicle has permanent four-wheel drive and under no circumstances should any test be carried out that involves jacking up one or a pair of wheels and running the vehicle in gear without first locking the gearbox differential and removing the rear propeller shaft if the front wheels are to be driven, or the front propeller shaft if the rear wheels are to be driven. Failure to observe these instructions could result in injury to personnel.

### Transmission wind-up

62. Transmission 'wind-up' can occur under one or a combination of the following conditions:

- (1) Prolonged use of the differential lock in the transfer gearbox under any conditions.
- (2) A badly worn tyre in a set.
- (3) A combination of different tyre sizes.

A characteristic of transmission wind-up is the increasing difficulty in turning the steering wheel coupled with a rhythmical kick-back of the steering wheel during turning.

This condition can be overcome by:

- (1) Immediate unlocking of the differential via the switch.

## SHALLOW FORDING

63. Under conditions when vehicle fording often occurs, oil changes to the engine, gearboxes, differentials and swivel pin housings must be more frequent than the normal servicing intervals, even to the extent of a daily change. Under shallow fording conditions, i.e. totally immersed axles, through water carrying mud and grit, a daily oil change is essential if contamination is established.

The propeller shafts universal joints and sliding splines should also be lubricated daily under these conditions.

It is important to ensure that prior to fording, the flywheel housing drain plug is fitted into the drain hole in the flywheel housing, see para 129.

## TOWING EQUIPMENT

### Towing

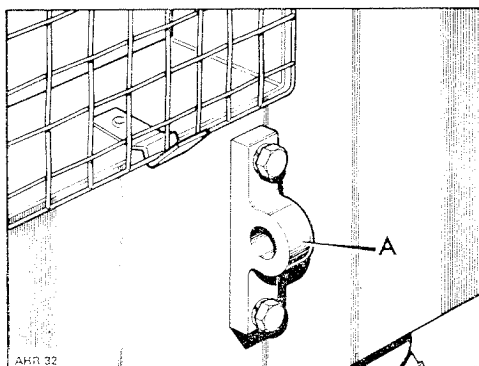
**Important**—To avoid irreparable damage to the gearbox differential it is essential that when towing the vehicle by the suspended method, the propeller shaft to the wheels remaining on the ground must be removed.

### Lashing and towing rings

64. Lashing and towing rings are fitted to the chassis frame, one at each side at the front and the rear of the vehicle. (The rings must not be used for helicopter transportation).

Fig. 31  
Front lashing and towing ring

A—Front lashing and towing ring

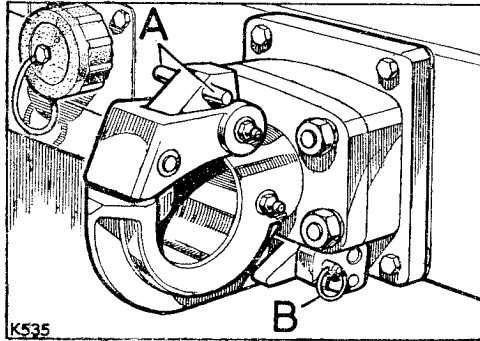


**Rotating towing hook**

65. This is a heavy duty towing hook and is attached to the rear of the chassis frame.

**Fig. 32**  
Rotating towing hook, rear

- A—Lift to open jaw
- B—Remove split pin, pull out to rotate jaw

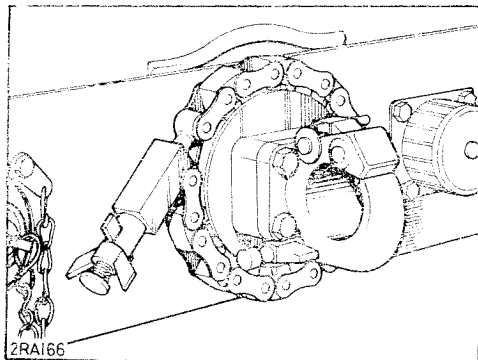
**Rear trailer drive (optional equipment)**

66. Provision is made for transmitting full engine power to a driven trailer axle via a coupling and clamping chain mounted on the rear chassis cross-member.

A selector lever mounted on the radiator ducting adjacent to the transfer lever selects trailer drive or neutral as required via a cable, see para. 18.

The powered trailer also has a capacity of 1 tonne which gives high mobility cross-country unit with the added advantage that all wheels are in contact with the ground at all times. This is achieved by arranging for the drive to be transmitted to the trailer through angles of up to 60° in all directions. See para. 320 in Section V.

**Fig. 33**  
Rear trailer drive coupling



**Bumperettes**

67. Bumperettes are fitted to the rear.

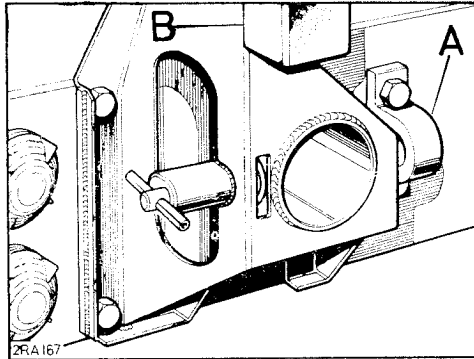


Fig. 34  
Rear bumperette, lashing  
and towing ring  
A—Lashing and towing  
ring  
B—Bumperette

**Helicopter lifting eyes.**

68. Positioned on the cab floor adjacent to the engine surround. The lifting eyes are used for transportation purposes.

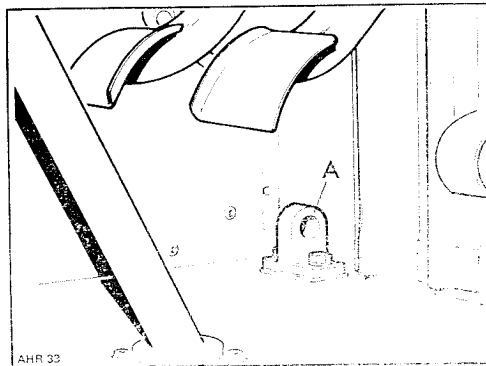


Fig. 35  
Helicopter lifting eyes  
A—Lifting eye

**DO'S AND DON'TS**

69. **Do** keep radiator filled with soft water (if possible) and correct anti-freeze mixture.

**Do** maintain recommended pressures in tyres, including the spare wheel.

**Do** ensure correct procedure when jacking the vehicle.

**Don't** keep your foot on the clutch pedal longer than is necessary. It will avoid unnecessary wear.

**Don't** agitate the accelerator pedal when starting the engine from cold.

# SECTION III

## User Servicing and Adjustments

GOOD SERVICING IS ESSENTIAL FOR  
SUCCESSFUL FORDING

### CHAPTER 1

#### THE ENGINE

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##### Engine Lubrication

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Oil pressure

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Engine breather filter .. Fig. 39 Engine breather filter

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Checks

Engine oil cooler .. .. Fig. 41 Engine oil cooler

Checks

**70.** The eight cylinder engine is of an all aluminium 90° Vee construction with overhead inlet and exhaust valves operated by a single central camshaft via pushrods and non-adjustable hydraulic tappets.

**71.** The engine 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.

**72.** The crankshaft is carried in five main bearings. At the front of the crankshaft is a pulley which drives the coolant pump and alternator via a fan belt, while a spigot diameter at the rear, carries the flywheel.

**73.** Aluminium alloy pistons with two compression rings, and one oil control ring are fitted.

**74.** The camshaft is driven from the crankshaft by a duplex roller chain and runs in five white metal steel-backed bearings.

75. The two detachable cylinder heads carry both the inlet and exhaust valves.

76. A removable pressed steel sump carries the oil, which is pressure fed by a gear type oil pump driven from the camshaft through skew-gearing, to the main and connecting rod bearings, camshaft bearings and valve rocker shafts through a gallery pipe in the cylinder block. The oil is cleaned by means of a gauze strainer on the pump intake in the sump and an external full flow filter.

77. An oil cooler is fitted to maintain the correct running temperature when the engine is run for long periods with the vehicle stationary. See para. 90.

78. A thermostat is fitted in the coolant system and the coolant is circulated by means of an impeller type pump, driven by a wedge shaped belt from the crankshaft pulley. The belt tension is adjustable.

79. The fuel supply is by an immersed type electrical fuel pump to twin Zenith-Stromberg type CD 175-2S carburetters.

80. Ignition is by coil (screened on 24 volt models), the distributor being mounted on an extension of the oil pump driving shaft. Automatic advance and retard mechanism is fitted, and, in addition, hand-setting facilities are provided to give control over the ignition setting when low quality fuel is used.

81. On 12 volt models the sparking plugs are fitted with splash-proof covers, on 24 volt models they are fully screened to prevent radio interference.

## **ENGINE LUBRICATION**

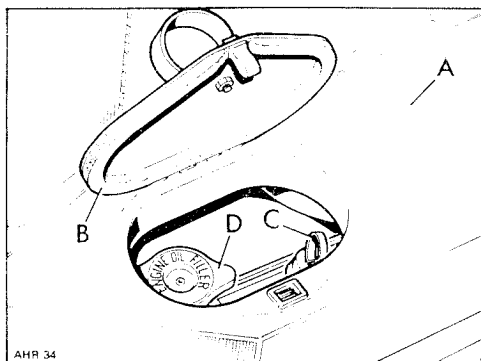
### **Oil level**

82. A certain amount of oil is consumed during the normal operation of the vehicle, the oil in the sump must be checked and replenished daily, in addition to periodic oil changes.

The oil level dipstick is on the left-hand side of the engine and is accessible through a hatch in the engine compartment lid. The dipstick carries the marks 'High' and 'Low'. Under normal circumstances the oil level should not be allowed to fall below the minimum level mark, that is the lower line on the dipstick. The oil filler cap is on the left-hand front corner of the engine accessible through the same hatch in the engine compartment lid.

**Fig. 36**  
**Engine oil level dipstick**

- A—Engine compartment lid
- B—Hinged inspection hatch
- C—Engine oil level dipstick
- D—Oil filler cap



- 83.** To check the oil level, proceed as follows:

Stand the vehicle on level ground and allow a few minutes for the oil to drain back into the sump from the valve gear, etc. Release the catch securing the rear hinged inspection hatch to the engine compartment lid and lift hatch to gain access to oil level dipstick and filler cap (see Fig. 36). Withdraw the dipstick upwards through the hatch, wipe it clean, re-insert to its full depth and remove a second time to take the reading. Add oil as necessary; never fill above the 'High' mark.

### Oil pressure

- 84.** The oil pressure warning light on the instrument panel will glow when, for any reason, the pressure drops below 0,3—0,4 kg/cm<sup>2</sup> (4—6 lb/sq in). It will light up when the engine is stationary with the ignition 'on' and will go out when the engine has started and the oil pressure has built up to exceed this figure.

NOTE: The oil pressure switch is designed to cut off the fuel pump delivery if the oil pressure falls below 0,14—0,21 kg/cm<sup>2</sup> (2—3 lb/sq in.) whilst the engine is running. This is overridden for starting purposes.

Should the warning light appear at any time when the engine is running above idling speed, stop the engine immediately and investigate the cause, usually it will be due to low oil level in the sump, or occasionally, to a choked oil pump intake filter.

### Engine oil changes

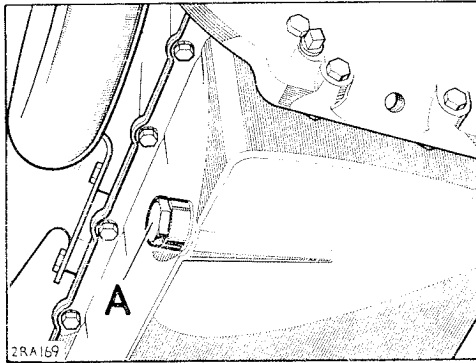
- 85.** To change the engine oil, proceed as follows:

Run the engine to warm up the oil, switch off the ignition and remove the drain plug in the left-hand side of the sump. Allow time for the oil to drain away completely and replace the plug.



**Fig. 37**  
**Engine sump drain plug**

A—Drain plug at left-hand side of engine



Refill with oil of the correct grade through the filler at the front of the engine, the capacity is 6,3 litres (11 Imperial pints). See para. 82. It is essential to add a further 0,85 litres (1½ pints) of engine oil when the full-flow filter has been changed, to bring the oil level up to the 'High' level mark on the dipstick.

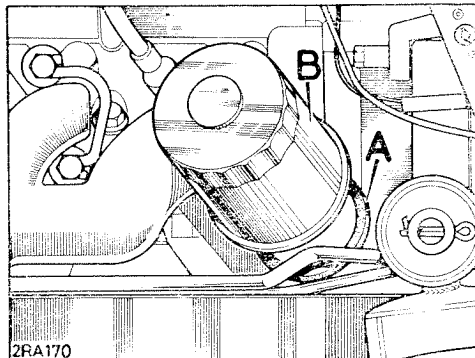
**Oil filter** (*To be carried out by a vehicle mechanic*)

**86.** In addition to the gauze pump intake filter in the sump, the oil is cleaned by means of a full-flow pressure filter mounted externally on the engine.

The filter should be renewed at the specified intervals.

**Fig. 38**  
**Engine oil filter**

A—Large rubber sealing ring  
 B—Oil filter



To renew the external filter proceed as follows: slacken the three quarter-turn fasteners and remove the side cover plate from the right-hand front wheel arch. Place an oil tray under the filter. Unscrew the filter anti-clockwise using a strap spanner if necessary.

### III

### User Servicing and Adjustments

Remove the filter complete with the sealing ring and discard. Smear a little clean engine oil on the rubber sealing ring of the new filter; screw the new filter on clockwise until the rubber washer touches the oil pump cover face, then tighten a further half-turn by hand only. Do not overtighten.

Refill with correct grade of engine oil and run engine for five minutes, then check for leaks. Check oil level and replenish if necessary. Replace the wheel arch side cover plate.

#### Engine breather filter

87. The engine breather filter should be replaced at the specified intervals to ensure satisfactory crankcase breathing at all times.

Withdraw the top hose from the filter. Withdraw the filter from the bottom hose. Fit new filter with the end marked 'IN' facing upwards. Alternatively if the filter is marked with arrows they must point downwards. Refit hoses.

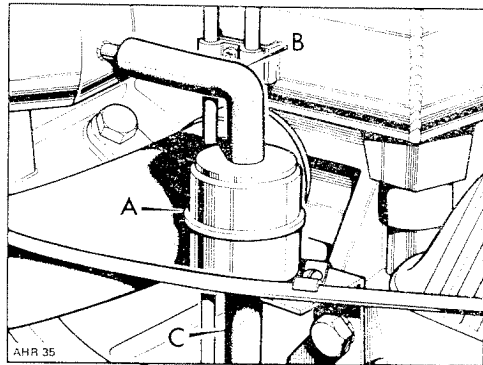


Fig. 39  
Engine breather filter

- A—Engine breather filter
- B—Top hose
- C—Bottom hose

#### Engine flame traps

88. Two engine flame traps are fitted, one from each top rocker cover attached to the air cleaner elbows by clips.

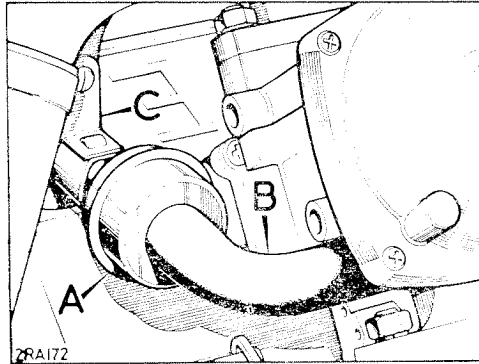
The flame traps should be replaced at regular intervals to ensure satisfactory operation.

Proceed as follows:

Pull the hoses clear of the retaining clips on both air cleaner elbows. Withdraw the flame traps from the hoses. Fit new flame traps into the hoses and replace hoses into the clips.

Fig. 40  
Engine flame trap, right-hand illustrated

- A—Flame trap
- B—Hose
- C—Retaining clip



### Checks

89. The following checks should be made. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) Inspect the engine sump for oil leaks. Rectify as necessary.
- (2) Inspect the front cover for oil leaks. Rectify as necessary.
- (3) Check the rocker covers for oil leaks. Rectify as necessary.
- (4) *(To be carried out by a vehicle mechanic)*  
Inspect exhaust manifolds for signs of leakage or blowing, also exhaust system pipes and silencers. Any items found to be leaking or badly corroded should be replaced.
- (5) *(To be carried out by a vehicle mechanic)*  
Check the bolts securing the inlet manifold for tightness. Also check the eight nuts securing the carburettors to the manifold for tightness.
- (6) Inspect the front engine mountings. The rubber bushes should be free from oil or grease and the mounting nuts tight.
- (7) Inspect the oil filter adaptor for leaks. The joint washer should be renewed if necessary. Ensure that the filter is secure and that there is no oil leak from the rubber sealing ring (Fig. 38).  
*(To be carried out by vehicle mechanic.)*
- (8) Check the tension of the fan and alternator belt and adjust if necessary. See para. 97.
- (9) Ensure that the engine sump drain plug is tight.

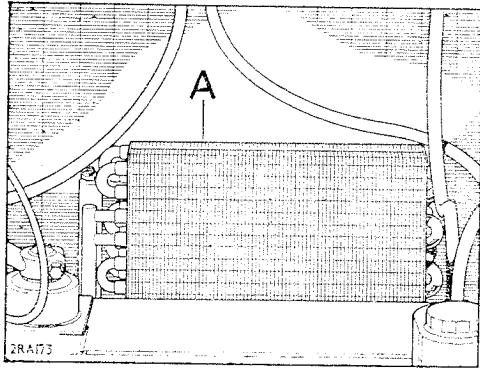
### Engine oil cooler

90. The oil cooler radiator is inserted in the engine oil system and mounted just in front of the engine coolant radiator, a gauge on the dash panel gives continuous indication of the oil temperature.

## II

## User Servicing and Adjustments

The oil temperature should not exceed 110°. The engine must be switched off and the oil allowed to cool down if this temperature is reached under normal working conditions.



**Fig. 41**  
**Engine oil cooler**

A—Oil cooler

### Checks

91. The following checks should be made:

- (1) Inspect all pipe connections for oil leaks at oil cooler, engine oil sump, oil filter adaptor and thermometer pocket. Rectify as necessary.
- (2) Check fan belt for tension. See para. 97.

## CHAPTER 2 THE COOLING SYSTEM

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Fig. 47 Radiator drain plug  
Fig. 48 Cylinder block drain taps

**Description**

**92.** Coolant enters the pump through a pipe from the bottom of the radiator, and is then forced down into the cylinder block. The coolant circulates round the cylinder jackets in the block, 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 so into the thermostat housing. If the thermostat is open, it returns through the top hose to the radiator.

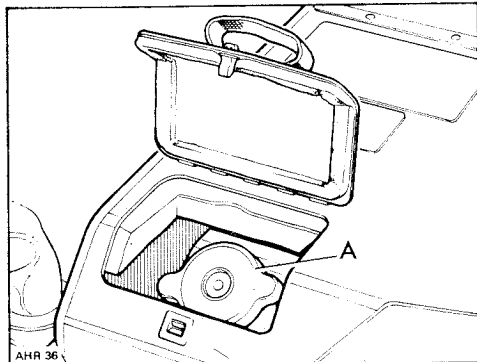
On 12 volt models one 'V' type belt driven from the crankshaft pulley drives the alternator, water pump and viscous fan. On 24 volt models there are three 'V' type belts driven from the crankshaft pulley, two driving the generator, the other driving a water pump and fan.

**Radiator filler**

**93.** Access to the radiator filler is gained through the aperture in the engine compartment lid.

A semi-sealed cooling system is used to prevent the formation of local hot spots caused by air trapped in the cooling system. The system comprises an overflow bottle attached to the left-hand side of the front chassis cross-member.

**Fig. 42**  
**Radiator filler cap**  
A—Radiator filler cap



The water level in the cooling system is checked at the radiator only and the topping-up is also carried out in the normal manner through the radiator filler.

When filling up the cooling system after having previously drained it, ensure that the overflow bottle is approximately half full of water. If necessary, add sufficient water to obtain this condition.

The necessity for frequent topping-up of the radiator may indicate a leak or a worn or blown cylinder head gasket. Thoroughly check the entire cooling system and rectify any leaks as necessary.

To prevent corrosion of the aluminium engine parts it is imperative that the cooling system is filled or topped up with a solution of water and the correct type of anti-freeze.

**Warning.** Do NOT remove the radiator filler cap when the engine is hot because the cooling system is pressurised and personnel scalding could result.

When removing the filler cap, first turn it anti-clockwise to the stop and allow all pressure to escape, before pressing it down and turning further in the same direction to lift it off.

When replacing the filler cap it is important that it is tightened down fully, not just to the first stop. Failure to tighten the filler cap properly may result in water boiling away rapidly, with possible damage to the engine through overheating.

The correct coolant level is 12,7—19 mm ( $\frac{1}{2}$ — $\frac{3}{4}$  in.) below the bottom of the filler neck; the total capacity of the system including heater is 14,2 litres (25 Imperial pints)

### Coolant pump

94. The impeller type coolant pump is mounted on the front cover and is belt driven. See para. 92.

### Thermostat

95. A wax type thermostat is fitted in the cylinder head pent-house. Its purpose is to provide rapid warming up of the engine coolant. At a pre-determined temperature the thermostat opens to allow full circulation through the engine and radiator. The unit operates at 79°—83°C (175°—180°F).

### Checks

96. Check the following points. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) Examine the hose connections, which should be free from cracks or signs of perishing. Tighten the hose clips as necessary.
- (2) Examine the cylinder block and cylinder head core plugs for signs of leaks. Renew if necessary.

- (3) Check the following connections for signs of leakage. Inlet manifold to outlet pipe; inlet elbow to thermostat; inlet pipe to coolant pump, pipe to overflow bottle. (This pipe must be air and water tight.)
- (4) Check connection between the water temperature sensor and thermostat housing. Check coolant pump and thermostat housing for signs of leakage.
- (5) Check that the radiator drain plug and cylinder block drain taps are fully closed and that there is no evidence of leakage. See para. 98, Figs. 47 and 48,
- (6) Check that the bolts and nuts securing the fan to the viscous coupling are tight.
- (7) Check for signs of leakage from the coolant pump and the thermostat housing. Rectify as necessary
- (8) Check the fan belt tension and adjust if necessary. See para. 97.
- (9) Check that the radiator block is not damaged.

### Routine adjustments and servicing

**Fan and generator belt adjustment** (*To be carried out by a vehicle mechanic*)

97. As the fan belts are of the 'V' type, the drive is on the sides of the belts and it is not therefore necessary to adjust them tightly and so put an excessive load on the coolant pump and generator bearings; the tension is correct when the belts can be depressed as follows:

12 volt models

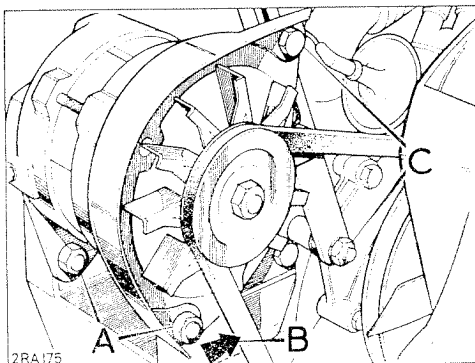
Fan belt 11–14 mm ( $\frac{7}{16}$ – $\frac{9}{16}$  in.).

24 volt models

Fan belt 6–9 mm ( $\frac{1}{4}$ – $\frac{3}{8}$  in.)

**Fig. 43**  
Fan belt adjustment  
(coolant pump), 12 volt  
models

- A—Pivot bolts
- B—Check at this point  
11 to 14 mm ( $\frac{7}{16}$  to  
 $\frac{9}{16}$  in.) movement
- C—Fixing for adjusting  
link



### III

### User Servicing and Adjustments

#### 24 volt models

Generator belt 6–8 mm ( $\frac{1}{4}$ – $\frac{5}{16}$  in.) by thumb pressure between the two pulleys.

(1) *Fan belt adjustment (coolant pump), 12 volt models*

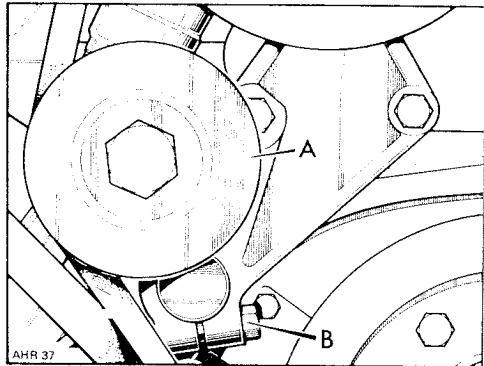
Check by thumb pressure between the alternator and crankshaft pulleys. See Fig. 46.

To adjust:

- (a) Slacken the pivot bolts securing the alternator to the mounting bracket, slacken the locking nut on the bottom of the adjusting link and the bolt at the top of the link.
- (b) Pivot the alternator inwards or outwards as necessary and adjust until the correct belt tension is obtained.  
NOTE: When pivoting the alternator, leverage must only be applied to the alternator drive end bracket. Pressure applied to the stator or slip ring end bracket may result in serious damage.
- (c) Tighten adjusting link top bolt and bottom locknut and alternator pivot bolts.

(2) *Fan belt adjustment (coolant pump), 24 volt models*

Fan belt adjustment is by means of a jockey pulley situated on the left-hand side of the engine. See Fig. 44.



**Fig. 44**  
**Fan belt adjustment**  
**(coolant pump), 24 volt**  
**models**

- A—Jockey pulley  
B—Jockey pulley  
adjustment pinch  
bolt

To adjust:

- (a) Slacken the jockey pulley pinch bolt.
  - (b) Pivot the jockey pulley inwards or outwards until the correct tension is obtained.
  - (c) Tighten the jockey pulley pinch bolt.
- (3) *Generator belt adjustment, 24 volt models*

Generator belt adjustment is by means of an adjustment strut at the right-hand side of the generator. See Figs. 45 and 46.

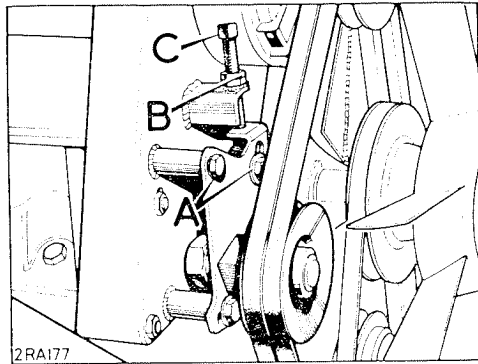


To adjust:

- (a) Slacken the three generator adjustment bracket bolts.
- (b) Slacken the locknut on the adjuster bolt.
- (c) Adjust by screwing or unscrewing the bolt until the correct tension has been obtained.
- (d) Tighten the adjustment bolt locknut and the three bolts on the adjustment bracket.

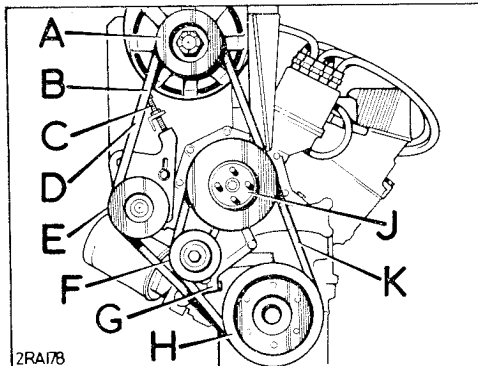
**Fig. 45**  
Generator belt adjustment,  
24 volt models

- A—Three bolts securing adjustment bracket
- B—Adjustment bolt locknut
- C—Adjustment bolt



**Fig. 46**  
Generator and fan belt  
layout, 24 volt models

- A—Pulley for generator twin groove
- B—Belts for generator
- C—Generator adjustment bolt
- D—Check belt free movement at this point
- E—Pulley for generator belts, twin groove
- F—Jockey pulley for water pump fan belt
- G—Pinch bolt for jockey pulley
- H—Crankshaft pulley, three groove
- J—Pulley for water pump, single groove
- K—Belt for fan



**Draining and flushing the cooling system**

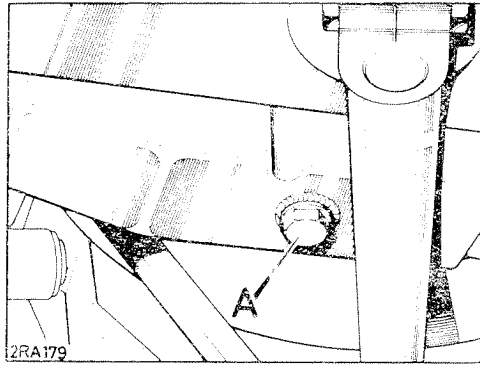
98. To ensure that the solution is fully effective at all times, the cooling system should be drained, flushed and refilled each year in the following manner:

NOTE: The cooling system is pressurised and *great care must be taken when removing the radiator filler cap*, especially when the engine is hot, to avoid steam which may be blown out with considerable force. When removing the filler cap, first turn it anti-clockwise to the stop and allow all pressure to escape, before pressing it down and turning further in the same direction to lift it off.

- (1) Remove the radiator filler cap.
- (2) Remove the coolant drain plug at the bottom of the radiator and open the drain taps in the cylinder block.

**Fig. 47**  
**Radiator drain plug**

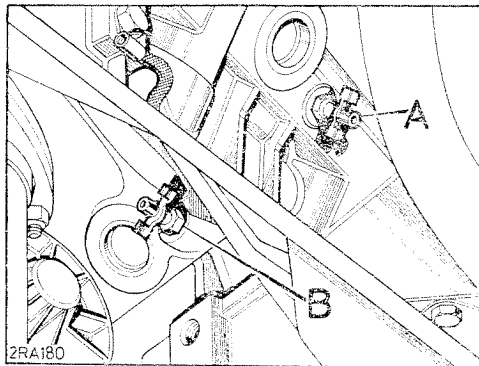
A—Drain plug at left-hand side



- (3) Place a hose in the radiator filler neck and adjust the flow of water to equal that draining from the taps and radiator drain plug orifice.
- (4) Continue until only clean water is flowing from the engine and radiator.

**Fig. 48**  
**Cylinder block drain taps**

A—Drain tap at right-hand side of engine  
B—Drain tap at left-hand side of engine



- (5) Remove the hose, close the taps and replace radiator drain plug. Refill the system with the correct mixture of anti-freeze and water to within 12,7—19 mm ( $\frac{1}{2}$ — $\frac{3}{4}$  in.) of the bottom of the filler neck. Replace the filler cap. The total capacity is 14,2 litres (24 Imperial pints).
- (6) Run the engine until working temperature is reached. Switch off the engine, allow to cool and top up the coolant level as necessary.

## CHAPTER 3 FUEL SYSTEM

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Cold start unit . . . . . Fig. 58 Spring loaded pin for cold start.

**99.** The fuel system comprises one tank, electric fuel pump, pipe lines, sediment bowl, filter, carburetters and air cleaner.

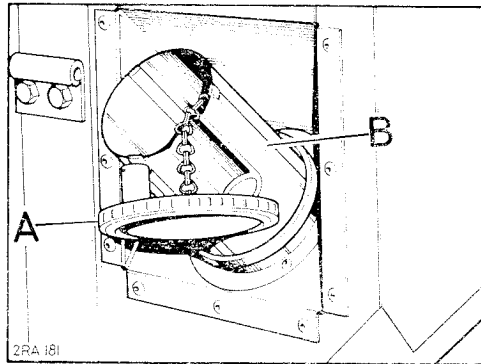
It is most important that the entire system be kept clean and free from leaks.

### FUEL TANK

#### Description

**100.** The fuel tank is fitted under the rear of the front body at the right-hand side.

The fuel filler cap is located externally above the fuel tank on the right-hand side. When the cap is removed, a telescopic tube may be drawn out of the tank neck and locked by a slight anti-clockwise movement, to facilitate filling. The tank capacity is 109 litres (24 Imperial gallons).



**Fig. 49**  
**Fuel filler, fuel tank**

A—Fuel filler cap  
B—Telescopic tube

#### Checks

**101.** The following points on the fuel tank should be checked. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) Check that the bolts securing the tank to the chassis brackets are tight.
- (2) Examine area around fuel tank drain plug for signs of leakage. Tighten drain plug if necessary.

### FUEL PUMP, SEDIMENT BOWL AND FILTER

#### Description

**102.** The electrically operated fuel pump is immersed in the fuel tank and supplies fuel to the carburetters via a sediment bowl and a main filter element attached to the right-hand rear body frame in the engine compartment.

As a safety precaution the pump is only operative when the starter motor is operated, via the ignition and start switch, or with the engine running.

On 24 volt models, a voltage 'dropper' is fitted to the pump.

### Checks

**103.** The following points should be checked. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) Inspect all fuel pipe unions for signs of leakage and tighten if necessary.
- (2) Check for tightness the screws securing the two halves of the sediment bowl together, and the bolts securing the unit to the engine compartment.
- (3) Check for signs of leakage from the filters, rectify if necessary.

### Routine adjustments and servicing

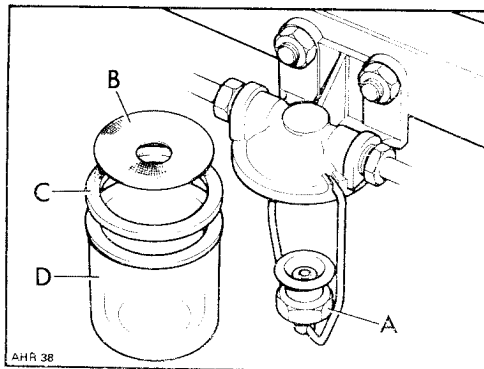
**Clean filter sediment bowl** (*To be carried out by a vehicle mechanic*)

**104.** Should the filter become choked or if an appreciable amount of foreign matter has collected in the sediment bowl the unit should be cleaned as follows:

- (a) Remove the bowl by slackening the thumb screw and swinging the retainer aside.
- (b) Remove and clean filter gauze in gasoline.
- (c) Ensure that the sealing washer is in good condition.
- (d) Refit gauze and bowl.

**Fig. 50**  
**Fuel sediment bowl**

- A—Retainer  
B—Filter gauze  
C—Sealing washer  
D—Sediment bowl



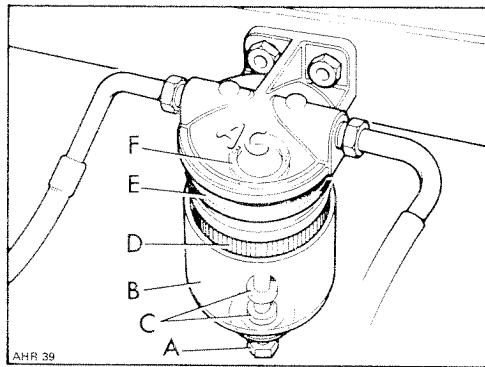
**Main fuel filter element**

**105.** Replace the fuel filter element at the specified intervals as follows:

- (1) Unscrew the centre bolt and withdraw the filter bowl.
- (2) Remove the small sealing rings and remove the element.
- (3) Withdraw the large sealing ring from the underside of the filter body.

*Refitting*

- (4) Fit new centre sealing ring as necessary.
- (5) Fit new large sealing ring.
- (6) Fit new element with small hole downwards.
- (7) Fit new small sealing rings; replace filter bowl and tighten bolt.



**Fig. 51**  
**Fuel filter element**

- A—Centre bolt
- B—Filter bowl
- C—Small sealing rings
- D—Filter element
- E—Large sealing ring
- F—Centre sealing ring

**Fuel pump fault location.**

**106.** If fuel pump trouble is suspected.

- (1) Disconnect the lead fitted with the small lucar connector from the starter motor solenoid and using extension leads touch the live positive terminal on the battery. If the fuel pump operates the fault lies within the solenoid switch and should be investigated.
- (2) Disconnect the fuel pump lead from the oil pressure inhibitor switch and touch the lead to the live positive terminal on the battery, using the extension leads. If the pump operates the fault lies within the inhibitor switch which should be replaced.

Failure to locate and rectify the fault in this manner will indicate that the pump itself is at fault and should receive workshop attention.

## AIR CLEANER

### Description

107. The AC Cyclone paper element type air cleaner is mounted in a compartment above the left-hand wheel arch, connected to the carburetters via hoses and a junction.

### Checks

108. Check the air cleaner as follows. All defects noted must be reported.

- (1) Check the tightness of the fixings securing the air cleaner.
- (2) Examine the hose connections between the air cleaner and carburetter. Tighten the clips if necessary.

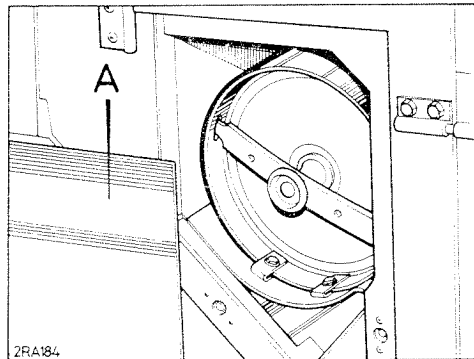
### Routine adjustments and servicing

#### Air cleaner element cleaning and replacement

109. Attention to the air cleaner is extremely important, especially under dusty conditions, as engine wear generally and performance will be seriously affected if the engine is run with an excessive amount of dust or industrial deposits in the element.

Fig. 52  
Air cleaner location

A—Access panel for air cleaner



Under clean road or stationary conditions, the air cleaner element should be cleaned periodically. In cases where the vehicle is operated under dusty road or field conditions, cleaning must be more frequent.

Access to the element is made externally after removal of a panel from the left-hand side of the cab just behind the front wheelarch.

Proceed as follows:

- (1) Remove the panel by slackening the two quarter turn fasteners and sliding the panel downwards.

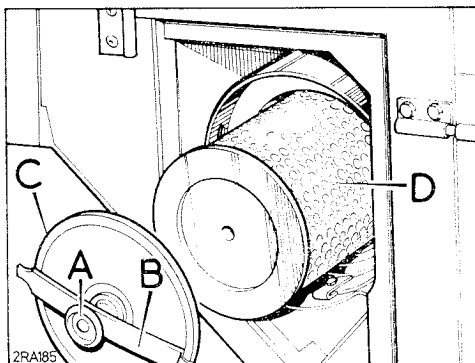
### III

### User Servicing and Adjustments

- (2) Unscrew the stud securing the retaining clamp and element end plate in position.
- (3) Remove the stud complete with retaining clamp from within the support bracket.
- (4) Remove the element end plate and withdraw element.
- (5) Clean the element by washing thoroughly in warm soapy water, rinse in clean water and allow to dry. The element can be cleaned in this manner a total of ten times before replacement becomes necessary. The element must be renewed at the specified mileage intervals or at two-yearly intervals.
- (6) Replace the element by a reversal of the removal procedure.

Fig. 53  
Air cleaner element

- A—Stud
- B—Retaining clamp
- C—End plate
- D—Element



### CARBURETTER

#### Description

**110.** The Stromberg 'CD' or constant depression carburetters operate on the constant vacuum principle, the choke area and jet orifice varying according to the degree of throttle opening and the speed of the engine will alter according to the load. An integral float chamber is incorporated and the central jet orifice gives a very steep flooding angle ensuring good operation and stable idling in hilly terrain with no tendency to fuel starvation.

#### Lubrication

##### Carburetter hydraulic dampers

**111.** The carburetter hydraulic dampers should periodically be removed and the damper reservoirs topped up as necessary to within approximately 25 mm (1 in.) from the top of the tube using the correct grade of lubricant.

**112.** The carburetter linkage should occasionally be lubricated by means of an oilcan.



### Checks

**113.** The following points should be checked on the carburetter. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) A general examination of the carburetter and pipe lines should be made for fuel leaks, for tightness of the unions and fixings. Renew joint washers if necessary.
- (2) Examine the cold start control cable for any damage that would prevent the control from fully closing the cold start control linkage.
- (3) Check the accelerator and hand throttle linkage for damaged or weak return springs.
- (4) Examine ball joints for excessive wear and ensure that the levers are secure on the shafts.

### Routine adjustments and servicing

**114.** Carburetter mixture ratio is pre-set on assembly and should not be interfered with. The only adjustments which can be carried out are engine idle speed and cold start.

#### **Carburetter adjustment** (*To be carried out by a vehicle mechanic*)

Accurate engine speed is essential during carburetter adjustments, therefore, the contact breaker gap, ignition timing and automatic ignition advance mechanism, should all be checked and reset if necessary before commencing carburetter adjustments.

#### **General requirements when setting carburetters**

**Temperature:** Whenever possible the ambient air temperature of the setting environment should be between 15.5 to 26.5°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 revs/min after which three minutes may be taken in which to check and carry out adjustments; a further one minute run at 2,500 revs/min must be made before further adjustments or checks 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 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 carburetters is free and has no tendency to stick.

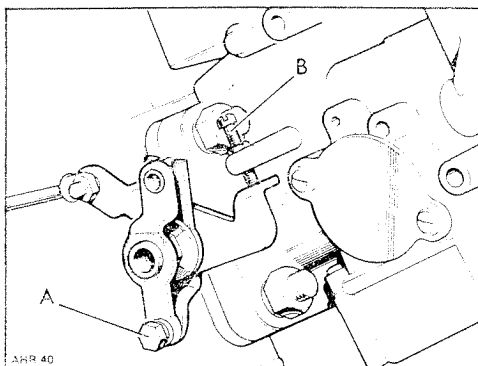
It is also important to ensure that the choke control is fully pushed in. Any faults must be corrected before proceeding with the checks or settings.

To adjust carburetters, proceed as follows:

- (1) Run the engine until warm. See note concerning general requirements when setting carburetters.
- (2) Switch off engine and remove the hoses from the carburetter elbows by slackening the clips and pulling hoses clear.
- (3) Slacken the screws securing throttle adjusting levers on both carburetters, thus allowing individual adjustment of carburetters.
- (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 revs/min.

**Fig. 54**  
**Throttle adjusting lever and throttle stop screws**

- A—Screw securing throttle adjusting lever  
B—Throttle stop screw



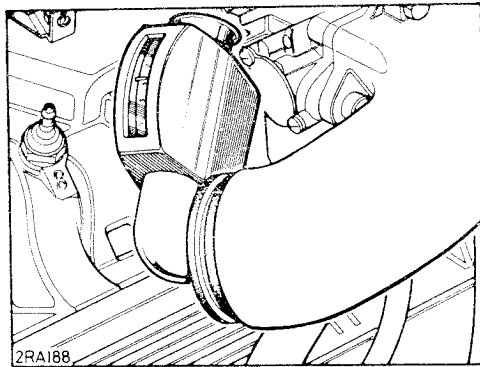
Using a suitable carburetter balancing device, balance the carburetters as follows:

- (5) Hold the carburetter balancing device on one of the carburetter adaptors ensuring that there are no air leaks. Note the balancer gauge reading, then repeat the check on the other carburetter.
- (6) An identical reading must be obtained for both carburetters at the correct engine idle speed of 600 revs/min.

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

- (7) If the gauge readings are identical and the engine idle speed is correct, no adjustment is required. Alternatively, if the carburetter balance or engine idle speeds are not correct, adjust the carburetters as follows.
- (8) Balance both carburetters by screwing the idle adjustment screws in or out as required until an identical gauge reading is obtained on both carburetters. Should the idle speed rise too high or drop too low during balancing, adjust to the correct idle speed of 600 revs/min, maintaining identical gauge readings.

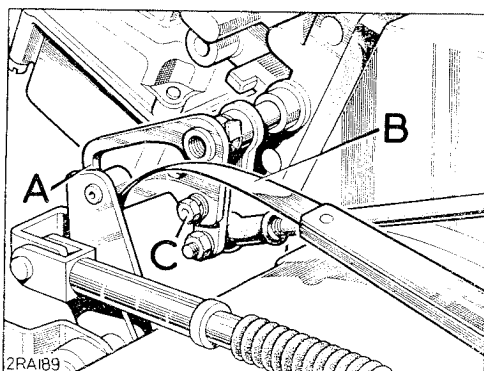
**Fig. 55**  
Carburetter balancing  
device



- (9) On the left-hand carburetter place a 0,15 mm (0.006 in.) feeler between the underside of the roller on the countershaft lever, and the throttle lever.
- (10) Apply light pressure to the throttle lever to hold the feeler.
- (11) Then tighten the throttle adjusting lever screw and withdraw feeler.
- (12) 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.

**Fig. 56**  
Throttle lever setting, LH

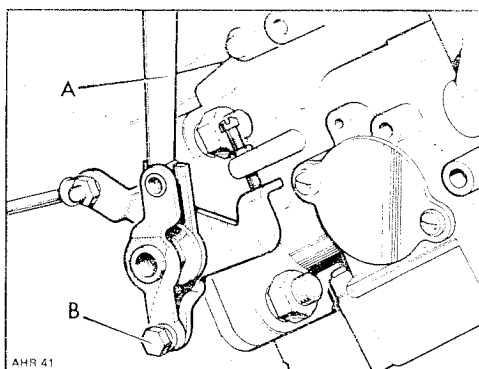
- A—Throttle lever
- B—Feeler gauge
- C—Throttle adjusting lever screw



- (13) Then tighten the throttle adjusting lever screw and withdraw feeler.
- (14) Refit air cleaner hoses, reversing the removal procedure previously described.

**Fig. 57**  
Throttle lever setting, RH

- A—Feeler gauge
- B—Throttle adjusting lever screw



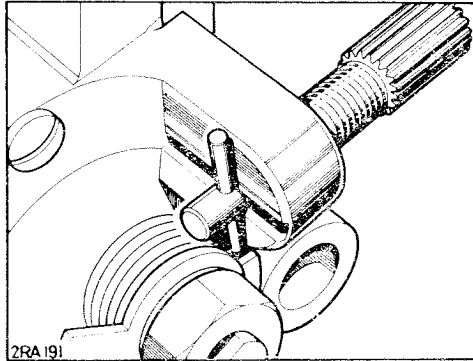
### Cold start unit

On the cold start unit fitted to the left-hand carburettor there is a spring-loaded pin.

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 in Fig. 58 to reduce the 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.

**Fig. 58**  
Spring loaded pin for cold start



### Draining the fuel system

**115.** If the vehicle is to be stored for an extended period, the fuel system should be completely drained to prevent the formation of gum in the sediment bowl and carburetters. Remove the drain plug from the bottom of the tank and replace when the tank is empty; then run the engine until the fuel in the pipe-lines from the tank is exhausted.

## CHAPTER 4

### CLUTCH

#### INDEX

#### Description

Clutch operation

Clutch and brake fluid reservoir .. Fig. 59 Clutch and brake fluid reservoir.

#### Lubrication

Clutch adjustment

Bleeding the clutch system .. Fig. 60 Bleed nipple for clutch slave cylinder

**116.** The Borg and Beck type clutch unit is of the single dry plate type, consisting of a driven plate and a cover assembly.

**117.** The 266 mm (10½ in.) driven plate is of the spring type pattern, in which the splined hub is indirectly attached to a disc bearing the two lining faces through three drive and three over-drive coil springs.

**118.** The cover assembly is of the diaphragm spring type and no maintenance procedures are necessary.

**119.** The clutch withdrawal mechanism is carried in a housing, bolted inside the bell housing to the front face of the gearbox casing.

### Clutch operation

**120.** The clutch, which is hydraulically operated, must only be used when starting the vehicle from rest or when changing gear; at all other times the foot should be kept clear of the clutch pedal to avoid unnecessary lining wear.

The hydraulic clutch system comprises a pendant foot pedal, mounted in the dash and operating a master cylinder, which in turn is connected by pipes to the slave cylinder fitted adjacent to the bell housing. The slave cylinder is connected to the clutch lever by means of a push rod.

### Clutch and brake fluid reservoir

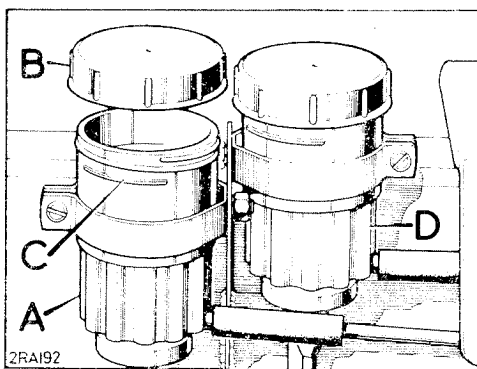
**121.** The combined fluid reservoir for one brake circuit and clutch is mounted adjacent to the second brake fluid reservoir at the side of the instrument panel.

Check the fluid level in reservoir as follows:

The level is correct when the fluid is just above the top of the inner reservoir; periodically remove the filler cap and replenish as necessary making sure that both inner and outer reservoirs are topped up.

**Fig. 59**  
Clutch and brake fluid reservoir

- A—Brake fluid reservoir
- B—Filler cap
- C—Fluid level mark
- D—Brake and clutch fluid reservoir



### Lubrication

**122.** The withdrawal mechanism is 'dry' and lubrication attention is not required.

The only regular lubrication required for the linkage is to the spindle shaft and pivot. Lubricate by means of an oil-can the following points:

- (1) At spindle shaft pins.
- (2) At pedal pivot bolt.

### Routine adjustments and servicing

#### Clutch adjustment

**123.** Land-Rover models are fitted with a hydrostatic clutch, that

is a clutch mechanism which is correctly set on initial assembly to give approximately 8 mm ( $\frac{5}{16}$  in.) free movement at the pedal pad, and which requires no adjustment throughout the life of the clutch plate.

Many drivers do not recognise the symptoms of hydraulic clutch maladjustment in time to prevent slipping and excess wear.

It should be noted that the feel of the pedal is in three stages:

- (1) Master cylinder free play against the pedal return spring.
- (2) Slave cylinder free play through the hydraulic system and against the slave cylinder return spring.
- (3) Operating the clutch against the full force of the pressure springs.

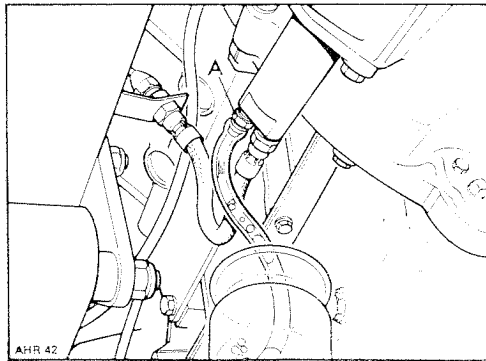
These points must be checked from time to time. Report if the free movement is incorrect.

**Bleeding the clutch system** (*To be carried out by a vehicle mechanic*)

**124.** If the level of the fluid in the inner reservoir is allowed to fall too low or if the pipe has been disconnected, the clutch will not operate correctly due to air having been absorbed in the system. This air lock must be removed by bleeding the hydraulic system at the slave cylinder.

**Fig. 60**  
**Bleed nipple for clutch slave cylinder**

A—Bleed nipple



- (i) Attach a length of rubber tubing to the bleed nipple and place the lower end of the tube in a glass jar.
- (ii) Slacken the nipple and pump the clutch pedal, pausing at the end of each return stroke, until the fluid issuing from the tube shows no sign of air bubbles when the tube is held below the surface of the fluid in the jar.

### III

### User Servicing and Adjustments

- (iii) Hold the tube under the fluid surface and tighten the bleed screw.
- (iv) The fluid in the reservoir should be replenished throughout the operation to prevent another air-lock being formed. Note particularly that the fluid reservoir for the clutch is the small central tube in the combined reservoir.

## CHAPTER 5 GEARBOX

### INDEX

#### Main gearbox

Description

Lubrication

Oil level .. .. . Fig. 61 Gearbox oil filler/level plug

Flywheel housing drain plug .. Fig. 62 Flywheel housing drain plug

Gearbox oil changes .. .. Fig. 63 Gearbox and transfer box drain plugs

Checks

#### Transfer gearbox

Description

Lubrication .. .. . Fig. 64 Transfer box oil level

Oil level

Transfer box oil changes

Checks

**125.** The gearbox unit comprises the main gearbox (four speeds forward and two in reverse), the two-speed transfer box and the output shafts to the front and rear axles.

### MAIN GEARBOX

**126.** The complete gearbox is flexibly mounted as a unit with the engine. Synchromesh operates on all forward speeds. The remote control main gear change lever is connected to the main gearbox via rods and clevis joints.

#### Lubrication

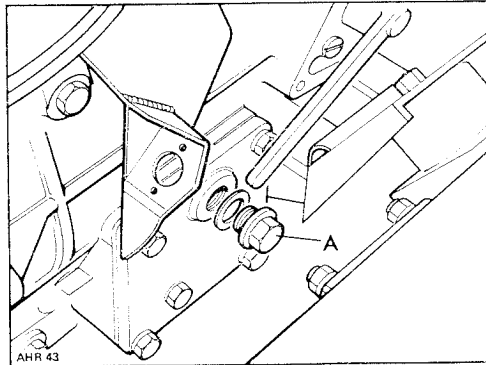
**127.** The main gearbox is lubricated as a separate unit from the transfer gearbox and should periodically have the lubricant changed.



**Oil level**

**128.** The main gearbox oil level must be checked periodically and replenished as necessary to the bottom of the oil filler level plug hole. The oil filler level plug is located on the left-hand side of the gearbox casing accessible from under the vehicle.

**Fig. 61**  
**Gearbox oil filler/level plug**  
 A—Oil filler/level plug

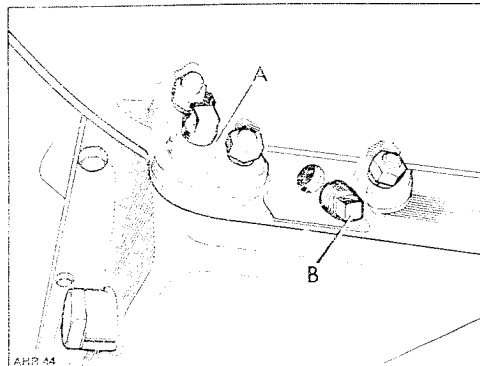


**Flywheel housing drain plug**

**129.** A plug is provided for fitting into a drain hole in the bottom of the flywheel housing 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 into the drain hole when the vehicle is fording or travelling over very muddy terrain and it must be removed daily to allow all oil to drain before being replaced.

**Fig. 62**  
**Flywheel housing drain plug**  
 A—Aperture for plug in flywheel housing adjacent to drain hole  
 B—Plug



**Gearbox oil changes**

**130.** To change the oil, remove the drain plug from the bottom of the main gearbox casing, immediately after a run when the oil is

- (6) Transfer box oil filler/level plug.
- (7) Check front and rear output shafts for sign of leakage.
- (8) Check the rear engine mountings, situated on either side of transfer box. They should be free from oil or grease and the mounting bolts tight.

## CHAPTER 6

### PROPELLER SHAFTS

#### INDEX

##### Description

Lubrication . . . . . Fig. 65 Propeller shaft lubrication

##### Checks

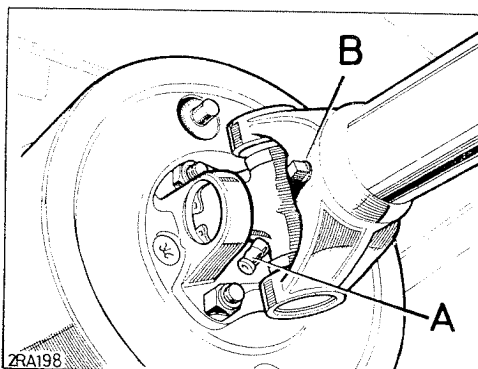
**137.** The two propeller shafts are of Hardy Spicer manufacture. To accommodate fore and aft movement of the axles and the float of the engine and gearbox unit, one end of each shaft is provided with a splined sliding joint. Each universal joint consists of a centre spider, four needle roller bearing assemblies and two yokes.

##### Lubrication

**138.** At regular intervals apply grease, using the grease gun, at the lubrication nipples fitted to the universal joints. It is preferable to use the grease gun, but if high pressure equipment is used, care must be taken not to damage the seals in the joints.

**Fig. 65**  
**Propeller shaft lubrication**

- A—Universal joint nipple
- B—Plug, remove and fit nipple



ZRA198

The sliding splines are lubricated on assembly and do not normally require maintenance attention. However under severe conditions or when fording, the sliding splines should be lubricated daily.

A rubber grommet is fitted over the sliding spline, to prevent ingress of dirt and water.

**Checks** (*To be carried out by a vehicle mechanic*)

**139.** The following points should be checked. All defects noted must be reported:

- (1) Periodically check the security of the propeller shaft securing bolts and rectify as necessary.
- (2) Check the bearing races and spider journals for excessive wear.  
Wear on the thrust faces of the bearings can be located by testing the lift in the joint, either by hand or with the aid of a bar suitably pivoted.  
Any circumferential movement of the shaft relative to the flange yokes indicate wear in the roller bearings or the splined joint.
- (3) Check the universal joint bearings for oil leaks.
- (4) Check that rubber grommet on prop-shaft spline is not damaged and is securely fastened.

## CHAPTER 7

### REAR AXLE, FULLY FLOATING

#### INDEX

**Description**

Differential oil level . . . . . Fig. 66 Rear differential lubrication

Differential oil changes

front and rear

**Checks**

**140.** The unit comprises rear hub bearing sleeves bolted to the existing rear axle casing, with the rear hubs fitted to these sleeves and retained by a key washer, special nuts and lockers in exactly the same way as the front hub.

The one-piece axle shafts are splined into the differential wheels at the inner end with hub driving members fitted to splines at the outer end. The hub driving members are bolted to the rear hubs and secured to the axle shafts by means of a circlip.

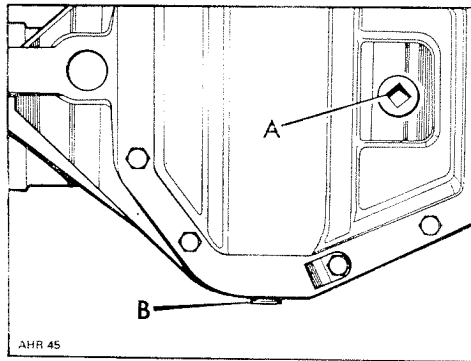
**Lubrication**

**Differential oil level**

**141.** The differential oil level must be checked at the specified intervals, immediately after a run when the oil is warm, and replenished as necessary to the bottom of the filler plug hole. The filler/level plug is on the right-hand side of the differential casing. See Fig. 66.

**Fig. 66**  
**Rear differential lubrication**

- A—Filler/level plug
- B—Drain plug



**Differential oil changes, front and rear**

**142.** Immediately after a run, when the oil is warm, drain off the oil by removing the drain plug(s) in the bottom of the axle casing(s). Replace the drain plug(s) and refill with oil of the correct grade; the capacity of each differential is approximately 2,5 litres (4½ Imperial pints). See Figs. 66 and 67.

**Checks**

**143.** Check the following. Any leakage which persists after tightness checks and all defects noted must be reported:

- (1) Check that the bevel pinion and hub oil seals do not leak.
- (2) Check for signs of oil leakage from the oil level and drain plugs, tighten if necessary.

**CHAPTER 8**  
**FRONT AXLE**

**INDEX**

Description	.. .. .	Fig. 67 Front differential lubrication.
Differential oil level		
Differential oil changes		

Swivel pin housing lubrication  
 Swivel pin housing oil level

Fig. 68. Swivel pin housing lubrication.

Swivel pin housing oil changes  
 Checks

**Description**

144. The front axle is a live driving unit of the ‘fully-floating’ type, the drive being transmitted through spiral bevel gearing and normal type differential to the half shafts and thence via universal joints to the wheel hubs.

145. The inner end of each half shaft is splined into the differential assembly, while the outer end is carried in a taper roller bearing enclosed in a spherical housing secured to the axle casing.

146. The lower swivel pin is mounted in a taper roller bearing carried in a spherical housing, while the upper pin is carried in an asbestos resin bearing.

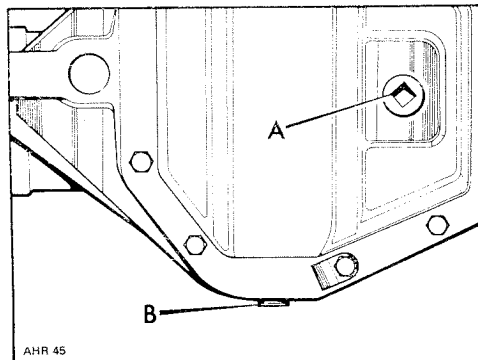
147. The spherical and swivel pin housing (known together as the universal joint housing) enclose the universal joint.

148. The driving shaft is carried in a bush pressed into the hollow stub axle bolted to the swivel pin housing. Two taper roller bearings support the hub on the stub axle.

149. A nut and a locknut provide adjustment of the hub end-float. The drive is transmitted from the driving shaft to the hub by means of a driving member, which also serves to enclose the hub assembly.

Fig. 67  
 Front differential lubrication

A—Filler/level plug  
 B—Drain plug



**Lubrication**

**Differential oil level**

150. The differential oil level must be checked at the specified intervals, immediately after a run when the oil is warm, and

replenished as necessary to the bottom of the filler plug hole. The front axle filler/level plug is at the front of the axle casing. See Fig. 67.

### Differential oil changes

151. See para. 142.

### Swivel pin housing lubrication

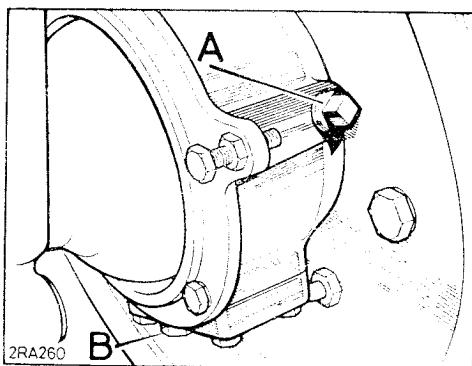
152. The front-wheel drive constant velocity joints and the swivel pins and front hubs, receive their lubrication from the swivel pin housings.

### Swivel pin housing oil level

153. The swivel pin housing oil levels must be checked periodically and replenished as necessary to the bottom of the filler/level plug holes at the rear of the housing. See Fig. 68.

Fig. 68  
Swivel pin housing  
lubrication

A—Filler/level plug  
B—Drain plug



### Swivel pin housing oil changes

154. To change the oil, remove the drain plug from the bottom of each housing, see Fig. 68, immediately after a run when the oil is warm; allow the oil to drain away completely and replace the plugs. Refill with oil of the correct grade through the filler/level plug holes; the capacity of each housing is approximately 0,8 litres (1½ Imperial pints).

### Checks

155. The following points should be checked. Any leakage which persists after tightness checks and all defects noted must be reported:

- (1) Check that the nuts securing the bevel pinion housing to the axle casing are tight and that there is no oil leak at this point.
- (2) Check that the bevel pinion oil seal, swivel pin housing oil seal and hub oil seal do not leak.
- (3) Check that the bolts and nuts securing the swivel pins to the housing are tight.

- (4) Check that the bolts securing the driving member to the front hubs are tight.
- (5) Check for signs of oil leakage from the differential and swivel pin housing filler and drain plugs, rectify if necessary.

## CHAPTER 9

### STEERING

#### RECIRCULATING BALL TYPE

##### INDEX

##### Description

Steering box lubrication .. .. Fig. 69. Steering box oil filler plug.

##### Checks

Steering ball joints

Steering link adjustment .. .. Fig. 70. Steering ball joint.

Front wheel alignment

Steering relay unit .. .. Fig. 71. Radiator grille removal.

Fig. 72. Steering relay.

**156.** The steering unit is secured to a chassis bracket at the steering box and to a bracket on the dash panel at its upper end. It is of the recirculating ball type, the inner column having a spiral thread on which operates the main nut assembly.

The nut is free to move longitudinally in the steering box. The steering box is fitted with two replaceable bushes, in which operates the rocker shaft. The rocker shaft is attached to the main nut assembly by a fork and roller joint.

**157.** The 419 mm (16 in.) steering wheel is splined on to the inner column and secured by a bolt.

**158.** A longitudinal steering tube, having left-hand and right-hand threaded ball joints, connects the drop arm to the upper lever of the steering relay unit mounted in the chassis cross-member just in front of the radiator. This relay unit incorporates spring loaded split 'Tufnol' cone bushes which damp the steering action and prevent minor road shocks being transmitted to the steering wheel.

**159.** The lower lever of the relay unit is connected to one steering arm by the drag link, which has left-hand and right-hand ball joints; the system is completed by the track rod connecting both steering arms, which is of a similar construction to the drag link.

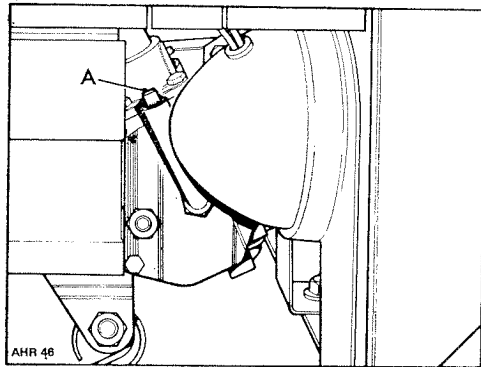
### Steering box

#### Lubrication

60. The steering box oil level must be checked periodically and replenished as necessary to the bottom of the filler tube plug hole on the top cover plate. See Fig. 69. Access to the plug is gained from the front wheel arch adjacent to the headlight.

Fig. 69  
Steering box oil filler plug

A—Filler plug



#### Checks

161. The following points should be checked. Any leakage which persists after tightness checks and all defects noted must be reported:

- (1) Check for tightness the bolts securing steering box to the chassis bracket.
- (2) Check the side and bottom plates of the steering box for oil leakage and tightness.
- (3) Check that the drop arm, mounted on the steering box rocker shaft is secure.
- (4) Check steering column for wear or end-play. Adjust as necessary.
- (5) Check for tightness the bolts securing the steering column support bracket to dash panel.
- (6) Check steering wheel backlash; adjust as necessary.
- (7) Check ball joint for wear (see para. 162).
- (8) Check ball joint rubber boots ensuring that they have not become dislodged or damaged.

#### Steering ball joints

162. The steering joints have been designed in such a way as to retain the initial filling of grease for the normal life of the ball joints; however, this applies only if the rubber boot remains in position on the ball joint. See Fig. 70. The rubber boots should be inspected to



ensure that they have not become dislodged or the joint damaged.

To check for wear move the ball joint vigorously up and down. Report should there be any appreciable free movement.

### Steering link adjustment

**163.** All ball joints are of the non-adjustable type and are screwed into the ends of the steering tubes and retained by a locknut. Adjustment to each steering link can be made by rotating the tube to lengthen or shorten the link as required.

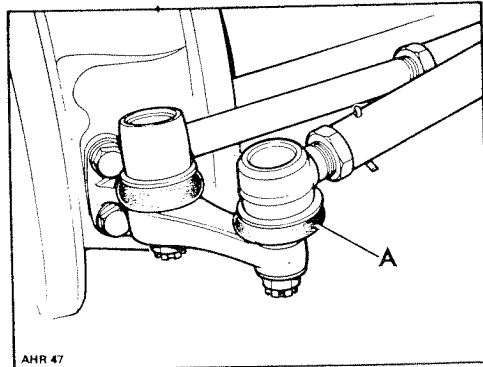


Fig. 70  
Steering ball joint  
A—Steering ball joint

### Front wheel alignment *(To be carried out by a vehicle mechanic)*

**164.** No adjustment is provided for castor, camber or swivel pin inclination.

The toe-out is adjustable. Proceed as follows:

- (1) Set 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 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 rim 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 1,2–2,4 mm ( $\frac{3}{64}$ – $\frac{3}{32}$  in.) more than that at the rear.
- (5) If correction is required to the toe-out, slacken the locknuts and remove the split pin securing the ball joints to the track rod, and turn the rod to decrease or increase its effective length as necessary, until the toe-out is correct.
- (6) Replace the split pins and tighten the ball joint locknuts to the correct torque.

**Steering relay unit**

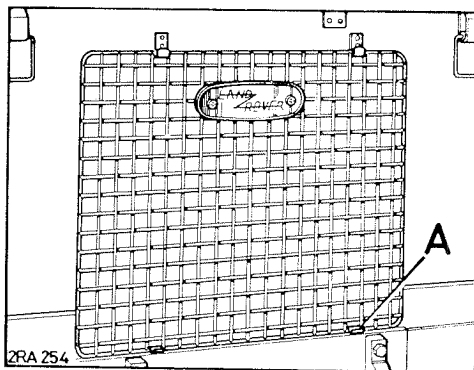
**165.** The steering relay unit is situated on the driver's side and is located through the No. 2 front chassis cross-member. It is accessible after removal of the radiator grille.

Periodically check oil level and top-up if necessary until the oil is visible at the base of the filler and breather holes. If significant topping-up is required, check joints for leakage and fit new joint washers as necessary. To check oil level and top up, proceed as follows:

- (1) Remove radiator grille by pulling bottom of grille clear of spring fasteners and sliding grille upwards to clear the top retaining clips.

**Fig. 71**  
**Radiator grille removal**

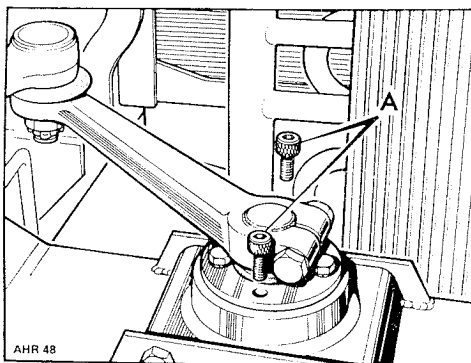
A—Spring fasteners



- (2) Remove the two hexagon headed socket screws securing the relay top cover.
- (3) Using one of the holes as an oil filler (the other acting as a breather hole) fill the relay unit with the correct grade of lubricating oil to the bottom of the filler hole.

**Fig. 72**  
**Steering relay**

A—Socket screws securing relay top cover



- (4) 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.
- (5) 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.
- (6) Replace the two socket screws.  
Refit the radiator grille.

## CHAPTER 10

### BRAKE SYSTEM

#### INDEX

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Brake and clutch fluid reservoirs ..	Fig. 73. Brake and clutch fluid reservoirs.
Pipe system	
Wheel brake units	
Brake pedal .. .. .	Fig. 74. Mechanical stop lamp switch.
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Lubrication	
Checks	
Wheel brake adjustment .. ..	Fig. 75. Wheel brake adjustment, front. Fig. 76. Wheel brake adjustment rear.
Hand brake adjustment .. ..	Fig. 77. Hand brake adjustment.
Brake apportioning valve adjustment .. .. .	Fig. 78. Measuring distance between chassis frame and rear axle casing. Fig. 79. Brake apportioning valve adjustment.
Bleeding the brake system ..	Fig. 80. Brake bleed nipple.

**Description**

**Foot brake**

166. The Girling hydraulic servo-assisted brake system employs

### III

## User Servicing and Adjustments

dual circuits, split front from rear, with the rear circuit operating in conjunction with an apportioning valve. The valve is mounted above the rear axle on the chassis frame and is operated by a link and spring attached to the rear axle to measure vertical movement. The valve gives progressive reduction in hydraulic pressure to the rear brakes with decrease in rear axle loads thus preventing rear wheel lock up when braking.

The brake system is operated by a pendant foot pedal coupled to a mechanical servo which in turn operates a tandem master cylinder.

Two fluid reservoirs are incorporated, one providing fluid for the clutch system and secondary (rear) brake system, the other for the primary (front) brake system.

Both circuits connect to a brake failure switch, mounted on the right-hand chassis side member. The brake failure switch operates the warning light in the instrument panel in the event of a pressure failure in either system. See para. 43.

Under normal conditions both the primary and secondary systems operate simultaneously on brake pedal application; in the event of a failure of any hydraulic components in the primary system the secondary system will continue to function and operate the rear brakes. Conversely, if the secondary system fails the primary system will continue to function and operate the front brakes.

If the servo should fail, both systems will continue to function but greater pedal pressure will be required.

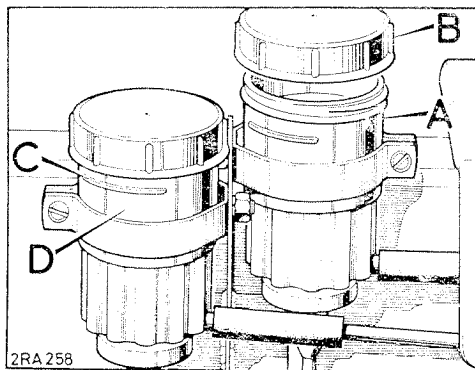
The hand operated transmission brake is completely independent of the hydraulic system and is mounted on the output shaft from the transfer box.

### Brake and clutch fluid reservoirs

167. The fluid reservoirs for the brakes and clutch, are mounted above the foot pedals adjacent to the instrument panel.

Fig. 73  
Brake and clutch fluid reservoirs

- A—Clutch and brake reservoir (secondary system)
- B—Filler cap
- C—Fluid level mark
- D—Brake reservoir (primary system)



The levels are correct when the fluid is up to the level marks on the side of the reservoirs; periodically remove the filler caps and replenish as necessary making sure that both reservoirs are topped up.

**Pipe system**

**168.** From the master cylinder two pipes lead to a four-way brake failure switch on the chassis side member. One pipe leads to a flexible hose on the left-hand chassis side member and then to a 'T' junction mounted on the front axle and via flexible hoses to each wheel cylinder; the remaining pipe runs to an apportioning valve on the chassis side member above the rear axle, and then to a 'T' junction on the rear axle casing, via a flexible hose situated between the right-hand chassis side member and the rear axle casing. The connection is completed by pipes to the rear wheel cylinders, secured to the axle casing with clips.

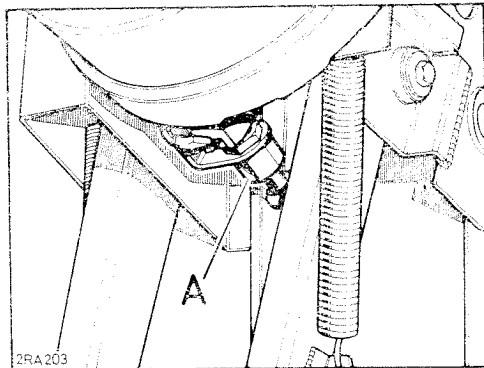
**Wheel brake units**

**169.** Hydraulic wheel brake units with leading and trailing shoes are fitted to each rear wheel with twin leading shoes fitted to the fronts. The hydraulic cylinders fitted to the front brakes are slightly larger than those fitted to the rear.

The brake shoes pivot at a common point and are free to float at the hydraulic expander unit (wheel cylinder). Two pistons having pressure seals (cups) in the wheel cylinder are held apart by a spring which prevents malalignment of the cups and keeps the pistons in light contact with the brake shoes. A bleed screw nipple and non-return valve are provided on the wheel cylinder, access to the nipple being gained from the rear of the anchor plate (Fig. 80). Rubber covers are fitted over the bleed nipple and pistons to exclude dust and mud.

**Fig. 74**  
**Mechanical stop lamp**  
**switch**

A—Stop lamp switch



**Brake pedal**

**170.** The pendant type brake pedal is mounted on the dash and operates the master cylinder by means of a short push rod.

A mechanical stop lamp switch is located above the foot brake pedal inside the cab of the vehicle.

**Hand brake**

**171.** The hand brake shoes are mounted at the rear of the transfer box on the speedometer drive housing and operate on the transfer box output shaft.

The brake shoes are pivoted at one end and located in an adjuster and wheel at the lower position and are operated by an actuator lever. The hand brake lever of the normal ratchet type, is mounted on the driver's side of radiator ducting, and is connected to the actuating lever by means of a rod and cable.

**Lubrication**

**172.** The hand brake linkage should be lubricated by means of an oil can at the following points:

- (1) At the clevis pin connection between hand brake lever and operating cable.
- (2) At the clevis pin joints and bearings on the front and rear relays.
- (3) At the clevis pin connection between the transverse link and actuating lever.

**Checks**

**173.** The following points should be checked. Any leakage which persists after tightness checks and all defects noted must be reported.

- (1) Check the four flexible hoses and the pipe lines for signs of damage and the unions for leaks. Rectify as necessary.
- (2) Check the level of the fluid in the supply tanks. See para. 167.
- (3) Check the fixings securing the master cylinder and servo to dash bracket for tightness.

**Routine adjustments and servicing****Wheel brake adjustment** (*To be carried out by a vehicle mechanic*)

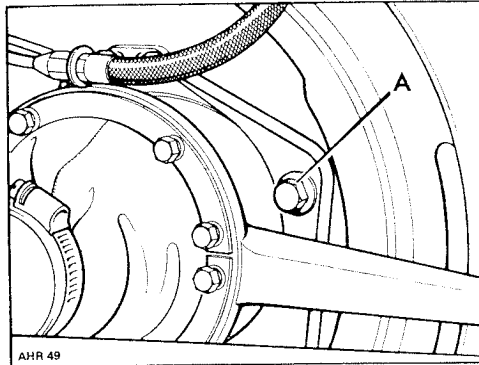
**174.** When lining wear has reached the point where the pedal travel becomes excessive, it is necessary to adjust the brake shoes in closer relation to the drum.

Proceed as follows:

**front**

- (1) Jack up the vehicle.
- (2) On the back face of the brake anchor plate will be found square adjustment bolts (Fig. 75) which operate snail adjuster bearings on each shoe.

- (3) Spin the wheel and rotate the adjuster until the brake shoe contacts the drum, then ease the adjuster until the wheel again rotates freely. Repeat for the other adjuster.
- (4) Repeat for the other front wheel.

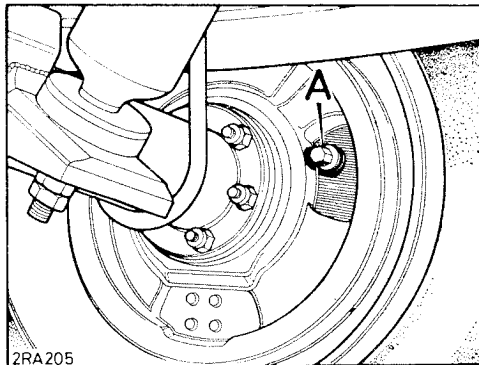


**Fig. 75**  
Wheel brake adjustment,  
front

A—Adjustment bolt

**rear**

- (1) Jack up the vehicle.
- (2) On the back face of the brake anchor plate will be found hexagon adjustment bolts Fig. 76 which operate through a serrated snail cam and adjust each brake shoe independently.
- (3) Spin the wheel and rotate the adjuster clockwise until the brake shoe contacts the brake drum then ease the adjuster until the wheel rotates freely.
- (4) Repeat for the other rear wheel.



**Fig. 76**  
Wheel brake adjustment,  
rear

A—Adjustment bolt

### III

### User Servicing and Adjustments

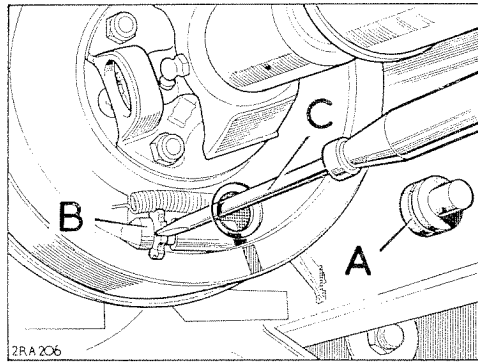
**Hand brake (transmission brake) adjustment** (*To be carried out by a vehicle mechanic*)

**175.** Periodic adjustment of the transmission brake unit will be required; proceed as follows:

- (1) Set the vehicle on level ground.
- (2) Release the hand brake fully.
- (3) From beneath the vehicle, remove the rubber blanking plugs from the brake drum.

**Fig. 77**  
**Transmission brake adjustment**

- A—Rubber plug  
B—Adjuster  
C—Screwdriver



- (4) Move the vehicle either forwards or backwards until the adjuster can be seen through one of the apertures.
- (5) With a screwdriver turn the adjuster wheel until the brake shoes come into contact with the brake drum.
- (6) Turn the adjuster back two 'clicks' and replace blanking plugs.
- (7) Check that the hand brake operates correctly and holds the vehicle.

**Brake apportioning valve adjustment** (*To be carried out by a vehicle mechanic*)

**176.** A brake apportioning valve is attached to the chassis frame on the right-hand side above the rear axle. A plunger in the valve progressively restricts the volume of brake fluid passing to the rear brake wheel cylinders when the vehicle is unladen or partly laden thus preventing rear wheel lock up during braking. Movement of the plunger is controlled by a spring link of which the lower end is attached to an adjustment strut mounted on the rear axle.



The link is set correctly on assembly and should not normally require attention, however adjustment may be necessary after a new axle has been fitted or apportioning valve or the rear axle braking characteristics alter during service. Proceed as follows:

NOTE: No line pressure will be available at the rear wheels if the connections at the apportioning valve are incorrectly assembled. The lower connection is the input from the master cylinder.

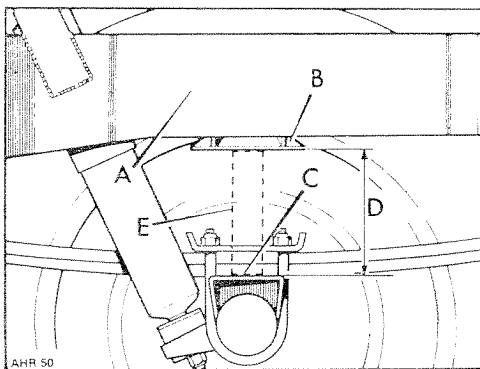
- (1) Remove the bump stop rubbers from the chassis mounting bracket.
- (2) Measure the distance vertically between the undersides of the bump stop mounting brackets on the chassis frame side member and the top of the bump stop brackets welded onto the rear axle casing on both sides of the chassis.

The distance must be 178 mm (7 in.). If necessary jack the rear springs until this 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.

Fig. 78  
Measuring distance  
between chassis frame and  
rear axle casing

- A—Chassis frame
- B—Rear bump stop mounting bracket
- C—Bump stop bracket on axle casing
- D—Distance must be 178 mm (7 in)
- E—Gauge piece



- (3) With a feeler gauge check the clearance between the apportioning valve plunger and the set bolt in the spring link housing. The clearance should be 0,050 mm (0.002in).
- (4) If adjustment is required slacken the two locking nuts on the adjustment strut end with a suitable 'tommy' bar located through the holes in the adjustment strut, screw the strut either clockwise or anti-clockwise as necessary until the clearance between the plunger and set bolt is correct.

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 0,050 mm (0.002 in) via the set bolt on the apportioning valve and obtain final adjustment by the adjustment strut.

- (5) Tighten both adjustment strut locknuts.

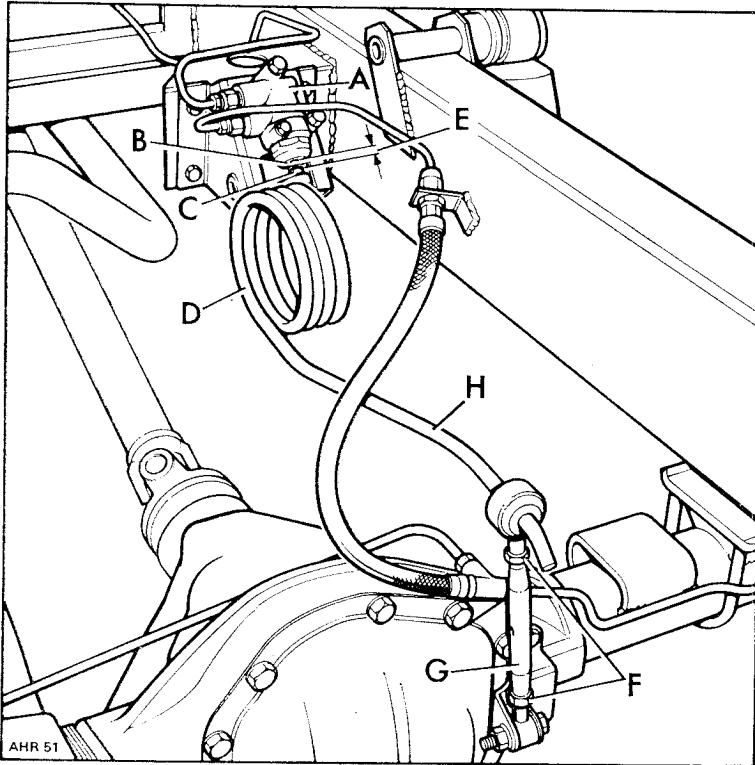


Fig. 79

**Brake apportioning valve adjustment**

A—Apportioning valve	D—Spring link	F—Adjustment strut locknuts
B—Apportioning valve plunger	E—Clearance should be 0,050 mm (0.002 in)	G—Adjustment strut
C—Set bolt		H—Reactor arm

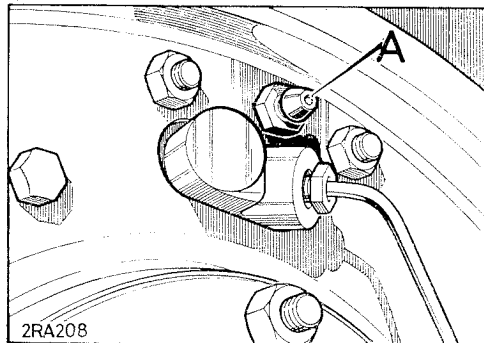
**Bleeding the brake system** *(To be carried out by a vehicle mechanic)*

**177.** If the level of fluid in the reservoirs is allowed to fall too low, or if any section of the brake pipe system is disconnected, the brakes will feel 'spongy', due to air having been absorbed into the system. This air lock must be removed by bleeding the hydraulic system at the wheel cylinders; bleeding must always be carried out at all wheels, irrespective of which portion of the pipe-line is affected.

- (1) Slacken off the brake shoe adjusters on each wheel to minimise wheel cylinder volume.
- (2) Attach a length of rubber tubing to the bleed nipple on the wheel unit farthest from the brake pedal and place the lower end of the tube in a glass jar.

**Fig. 80**  
**Brake bleed nipple**

A—Bleed nipple



Switch on the ignition. Slacken the bleed screw and depress the brake pedal; do not use full pedal travel as this may decentralise the shuttle valve plunger in the brake failure switch. Operate the pedal slowly.

- (3) If during the bleeding procedure the plunger operates the switch and the warning light is on, the bleed screw must be closed and the bleed screw at the other end of the vehicle opened (if bleeding the front brakes, open a bleed screw on a rear brake and vice-versa). A steady pressure must then be applied to the pedal until the light goes out when the bleed screw should immediately be closed and the pressure released, otherwise the piston will move too far in the opposite direction and require resetting.
- (4) Repeat the procedure until fluid discharged from the bleed tube is free of air and then tighten the bleed nipple during a pedal downstroke.
- (5) Repeat the procedure on the remaining wheels commencing and continuing at the next wheel furthest from the master cylinder. Switch off the ignition.

**NOTE:** By bleeding the rear brakes first the front brakes are being self bled by the action of the 'tipping' valve; this is the reason why both reservoirs or cells should be kept topped up. Also the front brakes are easier to bleed once the rear brakes have been bled.

- (6) Adjust the brakes. See para. 174.
- (7) 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.
- (8) The fluid in the reservoirs should be replenished throughout the operation to prevent more air getting into the system.

## CHAPTER 11

## CHASSIS AND SUSPENSION

## CHASSIS

## INDEX

Chassis frame

Front bumper and rear bumperettes

**Suspension**

Description

Checks . . . . . Fig. 81. Road springs

**Chassis frame**

**178.** The chassis frame is of box section throughout, providing extreme rigidity, and requires no attention.

**Front bumper and rear bumperettes**

**179.** Attached by bolts and readily detachable for attention to accidental damage.

Rear bumperettes are attached to the rear cross-member.

Lashing and towing rings are attached to the chassis frame, one each side at both front and rear of the vehicle.

## SUSPENSION

**Description**

**180.** The suspension is by two taper leaf springs front and rear.

**181.** The road springs are attached directly to the chassis at the front, while swinging shackles are fitted at the rear ends of the springs. 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.

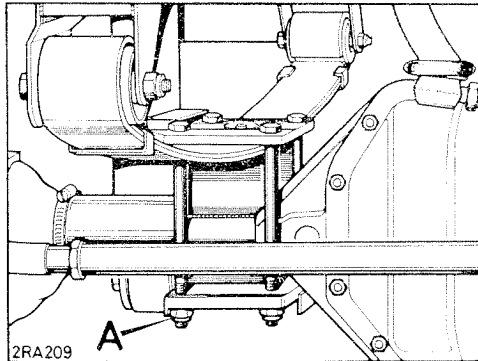
**182.** A rubber bump block is secured to the underside of the chassis side member above each road spring.

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

**Checks** (*To be carried out by a vehicle mechanic*)

**184.** The following points should be checked. All defects noted must be reported:

- (1) The clamp bolt (front) and U-bolt nuts (rear) Fig. 81 should be tight.
- (2) Examine the spring leaves for cracks or displacement and correct as necessary.
- (3) Check that leaf clips are tight.
- (4) Check that all damper retaining fixings are secure.
- (5) Check visually the spring bushes for excessive wear or damage. Rectify as necessary.
- (6) Check that the bump rubbers are secure and undamaged; replace as necessary.
- (7) Check hydraulic dampers for evidence of fluid leakage.



**Fig. 81**

**Road springs**

A—Nut for clamp bolt

## CHAPTER 12

### WHEELS AND TYRES

#### WHEELS

#### INDEX

**Description**

Checks

Jacking the vehicle

Wheel changing

**Tyres**

Description

Factors affecting tyre life

Checks

Tyre pressures

Wheel and tyre balance

**Description**

**185.** Well-base type wheels are attached to the axle flange at the rear and to the hubs at the front by means of six studs and nuts.

**Checks**

**186.** The points detailed below should be checked. All defects noted must be reported:

- (1) Ensure that the wheel securing nuts are tight, tighten to a torque of between 10,3 and 11,7 kgf/m (75 and 85 lbf/ft).
- (2) Damage to road wheels.

**Routine adjustments and servicing****Jacking the vehicle**

Jacking procedure is as follows:

**Wheels should be chocked in all circumstances.**

- (1) On level or sloping ground, the gearbox differential lock should be engaged prior to stopping the engine and parking the vehicle.
- (2) The differential lock is only engaged if the warning light is illuminated with the ignition switched on.
- (3) If the vehicle has been stationary prior to the jacking operation, the differential lock may not operate when the switch is raised. In this case it will be necessary to start the engine, to create a vacuum and, perhaps drive the vehicle, until the warning light is illuminated. Then switch off engine.
- (4) Apply the handbrake.

**Explanatory note:** Owing to the fact that the vehicle is fitted with a transmission handbrake, this will not be operative if the differential lock has not been engaged and one or both rear wheels are jacked up, whilst either gearbox is in neutral. Therefore, to obtain engine braking, both gearboxes should be engaged in 1st gear and 'low' transfer respectively.

The design of the transmission is such that jacking up the rear wheels, whilst on a slope, even with the differential lock engaged, could result in limited vehicle movement as a result of the 'back-lash' in the transmission.

The handbrake is operative within transmission back-lash limits, if the rear wheels are to stay on the ground and one or both front wheels are jacked up, irrespective of the gearbox differential lock engagement. **Therefore always chock wheels.**

**Warning:** It is unsafe to work under the vehicle using only the jack to support it. Always use stands or other suitable supports to provide adequate safety. Neglect of the jack may lead to difficulty in a roadside emergency. Examine the jack occasionally; clean and grease the thread to prevent the formation of rust.

### Wheel changing

**187.** Wheels should periodically be changed round utilising the spare, to ensure even tyre wear.

Proceed as follows:

- (1) Slacken the wheel securing nuts.
- (2) Jack up the corner of the vehicle, fitting the jack under the axle casing below the road spring.
- (3) Remove the nuts and withdraw the wheel over the studs.
- (4) If available, place a drop of oil on the stud threads, to assist in subsequent replacement.
- (5) Tighten the nuts to a torque of between 10,3 and 11,7 kgf/m. (75 and 85 lbf/ft.) and lower the vehicle to the ground.

## TYRES

### Description

**188.** Cross Country 9.00 × 16 (tubed) tyres are fitted.

### Factors affecting tyre life

**189.** The most important factors, among many which have an adverse effect on tyre life are:

- (1) Incorrect tyre pressures.
- (2) High average speeds.
- (3) Harsh acceleration.

- (4) Frequent hard braking.
- (5) Warm, dry climatic conditions.
- (6) Poor road surfaces.
- (7) Impact fractures caused by striking a kerb or loose brick, etc.
- (8) Incorrect front wheel alignment. Alignment should be checked periodically and adjusted as necessary. See para. 164.

### Checks

**190** The following points should be checked. All defects noted must be reported:

- (1) Check tyre pressures, including the spare wheel.
- (2) Check tyres for damage.

### Routine adjustments and servicing

#### Tyre pressures

##### 191.

- (1) Check the pressures with the tyres cold, as the pressure is about 0,14 kg/cm<sup>2</sup> (2 lb/sq in.) higher at running temperature.
- (2) Always replace the valve caps, as they form a positive seal on the valves.
- (3) Any unusual pressure loss (in excess of 0,07 kg/cm<sup>2</sup>—0,21 kg/cm<sup>2</sup> (1—3 lb/sq in.) per week should be investigated and corrected.
- (4) Always check the spare wheel, so that it is ready for use at any time.
- (5) Remove embedded flints, etc. from the tyres with the aid of a penknife or similar tool. Clean off any oil or grease on the tyres, using an approved detergent or degreaser.
- (6) Check that there are no lumps or bulges in the tyres or exposure of the ply or cord structure.

#### Wheel and tyre balance

**192.** In the interests of smooth riding and even tyre wear, it is advantageous to check the balance of the wheel whenever a tyre is refitted.



## CHAPTER 13

## ELECTRICAL EQUIPMENT, 12 VOLT MODELS

SUPPRESSION OF ELECTRICAL INTERFERENCE  
TO RADIO SERVICES

## INDEX

**Ignition system, 12 volt models****Distributor**

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Setting ignition timing .. .. Fig. 85. Ignition timing

**Sparking plugs, 12 volt models**

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Fig. 87. Spark plug cleaning.**High tension cables, 12 volt models**

Fig. 88. Sequence of distributor leads.

Fig. 89. High tension cable arrangement.

**Battery, 12 volt models**

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Topping up battery .. .. Fig. 90 Battery

To check electrolyte

Refitting battery lugs.

**Alternator, 12 volt models**

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Checks

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Description .. .. Fig. 92. Fuse box.

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- Checks

#### Starter solenoid switch, 12 volt models

- Description

#### Horn, 12 volt models

- Description
- Checks

#### Windscreen wiper motor, 12 volt models

Fig. 93. Wiper motor.

#### Lights, 12 volt models

- Description
- Headlights
- Side lights
- Stop/tail lights
- Turnlights
- Number plate light
- Convoy light
- Instrument panel lamps
- Checks
- Headlight lamp replacement . . . . . Fig. 94. Headlight, vertical dip
- Headlight setting . . . . . Fig. 95. Headlight.
- Side, tail/stop and turnlight lamp replacement . . . . . Fig. 96. Side lights and front turnlights.
- Fig. 97. Stop/tail lights and rear turnlights.
- Number plate light lamp replacement . . . . . Fig. 98. Number plate light lamp replacement.
- Instrument panel and warning light lamp replacement . . . . . Fig. 99. Warning lights.
- Differential lock warning lamp replacement . . . . . Fig. 100. Differential lock warning lamp replacement.
- Convoy light lamp replacement . . . . . Fig. 101. Convoy light.
- NATO trailer socket . . . . . Fig. 102. NATO trailer socket.

**193.** The introduction of VHF wireless sets to the services calls for a high standard of vehicle suppression if interference is to be adequately suppressed and full advantage of the sets obtained; good maintenance of the electrical system is therefore essential. It should

be remembered that even if a wireless set is not fitted the vehicle electrical system can cause interference to nearby wireless sets. Attention to the following details will do much to maintain the required standard of suppression.

- (a) Sparking plugs
  - Ensure that the mating surface of the plug, gasket and cylinder head are clean and that the plug is fitted tightly into the cylinder head.
- (b) Ignition leads
  - (i) Ensure that connections to the plugs are clean and tight.
  - (ii) Ensure that a shroud is fitted in each plug lead; also that all leads make good connections in their shrouds.
  - (iii) Where the ignition leads are screened (24 volt vehicles) ensure that the screening is not corroded or frayed, but is continuous and properly earthed at both ends.
- (c) Distributor
  - (i) Ensure that the ignition leads make a good connection in the distributor cap.
  - (ii) Keep all connections and mating surfaces tight, clean, free from paint, corrosion, and lubricant.
  - (iii) Where the ignition system is screened, maintain a good contact between screen of LT and HT ignition leads and that of the distributor, which must be properly earthed.
- (d) Coil
  - (i) Ensure good, clean and tight connection of all coil leads.
  - (ii) Maintain a good metal-to-metal contact, free from paint, corrosion and lubricant, between the body of the coil and its mounting.
  - (iii) Where a coil is screened, maintain a good contact between the junctions of the screen.
- (e) Battery
  - Keep the battery terminals and leads clean and properly fitted to provide a good electrical connection.
- (f) Earthing and bonding strips
  - Keep all junctions clean, free from corrosion or paint and ensure that they are tight.

### III

### User Servicing and Adjustments

- (g) Remainder of electrical systems
  - (i) Ensure that there is no intermittent contact on any of the fuses, leads, switches or connections.
  - (ii) Ensure that any screening is continuous and is properly earthed at both ends.
- (h) Do not interfere with the vehicle wiring system, generator cut-outs, regulators and switches etc.
- (i) Avoid making improvised connections to the electrical system.
- (j) Avoid tampering with any parts of the electrical system which are not understood.
- (k) Do not paint under bonding strips, or earth braids or other parts intended to be in electrical contact.
- (l) Do not remove any suppression equipment that may be fitted to the vehicle.
- (m) Refrain from using switches unnecessarily.
- (n) Report immediately any defects which may affect the standard of suppression of the vehicle.

### IGNITION SYSTEM, 12 VOLT MODELS

#### DISTRIBUTOR

##### Description

**194.** The distributor is mounted on an extension of the oil pump driving shaft.

##### Distributor maintenance

**195.** At regular intervals remove the distributor cap by springing off the clips.

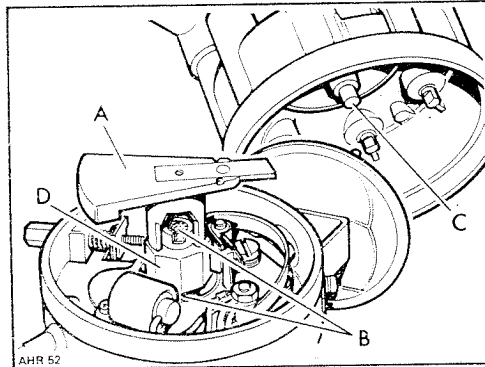
Lubricate as follows:

- (1) Lift off the rotor arm and add a few drops of thin machine oil to lubricate the felt pad, cam bearing and distributor shaft.

- (2) Wipe the inside and outside of the distributor cap with a soft dry cloth.
- (3) Ensure that the carbon brush works freely in its holder.
- (4) Replace the rotor arm.

**Fig. 82**  
Distributor maintenance,  
12 volt models

- A—Rotor arm
- B—Lubricate at these points
- C—Carbon brush
- D—Distributor cam



### Checks

**196.** The following points should be checked. All defects noted must be reported:

- (1) Check that the clamping bolt securing the distributor is tight.
- (2) Check that the vacuum pipe is not damaged and is secured correctly.

### Routine adjustments and servicing

#### Distributor contact points *(To be carried out by a vehicle mechanic)*

**197.** To obtain satisfactory engine performance the distributor contact points should be periodically replaced and adjusted as necessary.

Replace the contact points as follows:

- (1) Remove the distributor cap.
- (2) Remove the nut on the terminal block.
- (3) Lift off the spring and moving contact.
- (4) Remove adjustable contact, secured with a screw.
- (5) Add a smear of grease to contact pivot before fitting new contact points.

### III

### User Servicing and Adjustments

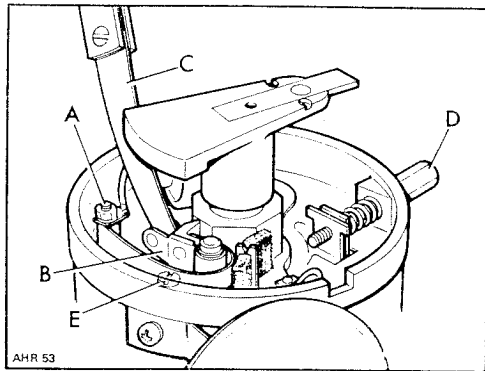
- (6) When fitting the contact points, ensure that the pin on the underside of the base plate locates in the vacuum advance operating rod. Check by manually rotating the base plate and observing the rod action. Light pressure on the plate will ensure location on its spigots.
- (7) Finally tighten the securing screw.

#### Checking contact points—feeler gauge method

- (8) Turn the engine in direction of rotation until the contacts are fully open.
- (9) The clearance should be 0,35 to 0,40 mm (0.014 to 0.016 in.) with the feeler gauge a sliding fit between the contacts.
- (10) Adjust by turning the adjusting nut clockwise to increase gap or anti-clockwise to reduce gap.
- (11) Replace the distributor cap.

**Fig. 83**  
Distributor contact points adjustment, feeler gauge method

- A—Nut on terminal block
- B—Spring and moving contact
- C—Feeler gauge
- D—Adjusting nut
- E—Securing screw



#### Checking contact points—timing lamp method

Remove distributor cap.

Turn the engine in the direction of rotation until the contact breaker heel is on the peak of number one cylinder cam. Points should be fully open.

Connect a 12 volt timing lamp, or suitable voltmeter, across the contact breaker lead terminal and a suitable earth point.

Switch on the ignition.

Turn the distributor adjusting nut **anti-clockwise** until the timing lamp goes out, or there is no reading on the voltmeter.

Continue a further two turns of the adjuster in an anti-clockwise direction.

During this operation the adjusting nut should be pressed inwards with the thumb to assist the helical return spring.

Slowly turn the adjusting nut **clockwise** until the timing lamp just comes on, or there is a voltage shown on the voltmeter.

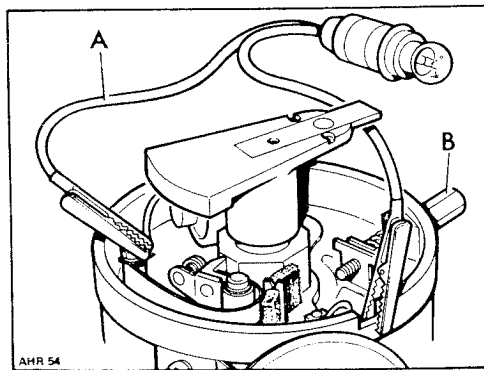
Noting the position of the flats on the adjusting nut, continue in a clockwise rotation for a further **five** flats.

Remove timing lamp or voltmeter and switch off ignition.

Replace the distributor cap.

**Fig. 84**  
Distributor contact points  
adjustment, timing lamp  
method

- A—Timing lamp
- B—Adjusting nut



**Setting ignition timing** (*To be carried out by a vehicle mechanic*)

**198.** The accurate setting of the ignition timing is of extreme importance. It is therefore necessary to set the ignition timing dynamically, using a stroboscopic timing light with the engine at idling speed.

It is also important that carburetter linkage and carburetter adjustment are correct before setting ignition timing.

Ignition timing when using fuel of 91–93 octane rating.

Static ignition timing: 3° BTDC.

Dynamic ignition timing: 3° BTDC at 600 revs/min.

Set ignition timing statically to 3° BTDC prior to engine being run, by the basic timing lamp method. (This sequence is to give only an approximation in order that the engine may be run. The engine must not be started after distributor replacement until this check has been carried out).

Set ignition timing as follows:

Disconnect vacuum advance pipe from distributor and block the vacuum pipe by suitable means.

Couple stroboscopic timing lamp to engine following the manufacturer's instructions with the high-tension lead attached into No. 1 cylinder plug lead. (Front cylinder on left-hand bank).

Ensure engine is still idling at 600 revs/min.

Slacken distributor clamping bolt.

Turn distributor until stroboscopic lamp synchronises the timing pointer and the timing mark at  $3^{\circ}$  BTDC on the vibration damper rim.

Arrow (R) indicates direction to retard ignition. Arrow (A) indicates direction to advance ignition. (Fig. 85).

Re-tighten the distributor clamping bolt securely.

Switch off engine, disconnect stroboscopic timing lamp.

Refit vacuum advance pipe.

NOTE: Engine speed accuracy during ignition timing is of paramount importance. Any variation from the required 600 revs/min, particularly in an upward direction, will lead to wrongly set ignition timing.

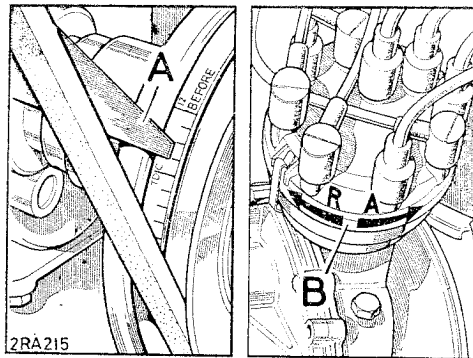


Fig. 85  
Ignition timing

- A—Timing pointer
- B—Distributor direction to advance or retard ignition

## SPARKING PLUGS, 12 VOLT MODELS

### Description

**199.** The sparking plugs are fitted with protective covers. To gain access to the plugs for cleaning and gap-setting, pull up the plug covers, without detaching them from the high tension leads.

### Routine adjustments and servicing

**Clean and adjust sparking plugs** (To be carried out by a vehicle mechanic)



**200.** At regular intervals remove the plugs, clean or replace if necessary.

**Take great care when fitting spark plugs not to cross-thread the plug, otherwise costly damage to the cylinder head will result.**

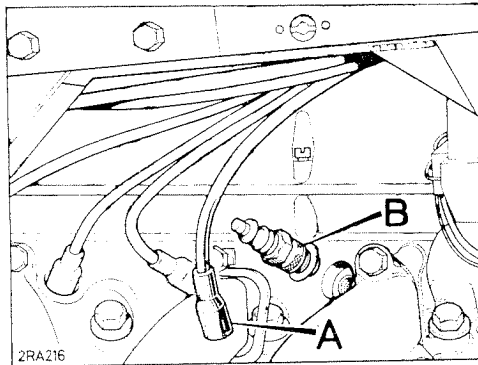
If the plugs are in good condition, clean and reset the electrode gaps to 0,60 mm (0.025 in.), at the same time file the end of the central electrode until bright metal can be seen.

It is important that only the correct spark plugs are used for replacements.

Incorrect grades of plug may lead to piston over-heating and engine failure.

**Fig. 86**  
**Sparkling plug**

- A—Cover for sparking plug
- B—Sparkling plug



To remove spark plugs proceed as follows:

Remove the side panels, secured by three quarter turn fasteners from each front wing valance to allow access to the spark plugs.

Remove the leads from the spark plugs.

Remove the plugs and washers.

To clean the spark plugs:

Fit the plug into a 14 mm adaptor of an approved spark plug cleaning machine.

Wobble the plug in the adaptor with a circular motion for **three or four seconds only** with the abrasive blast in operation.

**Important:** Excessive abrasive blasting will lead to severe erosion of the insulator nose. Continue to wobble the plug in its adaptor with **air only**, blasting the plug for a minimum of **30 seconds**; this will remove abrasive grit from the plug cavity.

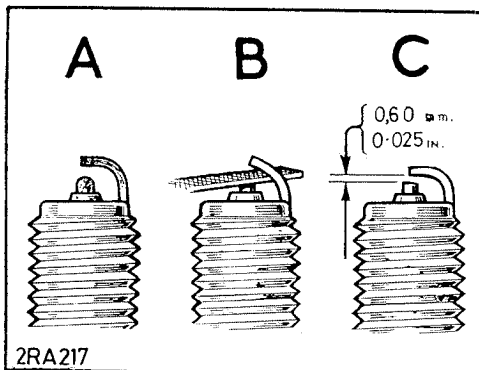
Wire-brush the plug threads; open the gap slightly, and vigorously file the electrode sparking surfaces using a point file. This operation is important to ensure correct plug operation by squaring the electrode sparking surfaces.

### III

### User Servicing and Adjustments

Set the electrode gap to the recommended clearance of 0,60 mm (0.025 in.).

**Fig. 87**  
**Spark plug cleaning**  
A—Dirty plug  
B—Filing plug electrodes  
C—Clean plug set to correct gap



Test the plugs in accordance with the plug cleaning machine manufacturer's recommendations.

If satisfactory the plugs may be replaced in the engine.

When pushing the leads on to the plugs, ensure that the shrouds are firmly seated on the plugs.

### HIGH TENSION CABLES, 12 VOLT MODELS

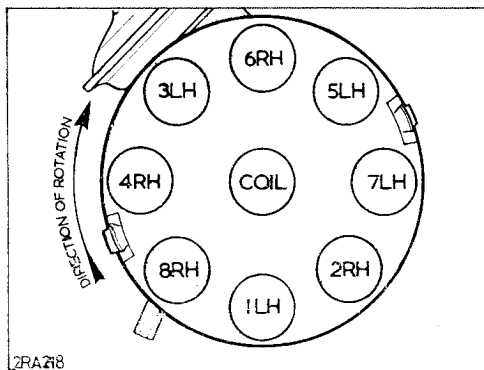
**201.** A careful examination should be carried out on all high-tension leads, including the coil to distributor lead.

Look for any signs of insulation cracking or deterioration and corrosion at the end contacts.

Replace any faulty leads.

The correct sequence of plug leads is shown in Fig. 88.

**Fig. 88**  
**Sequence of distributor leads**

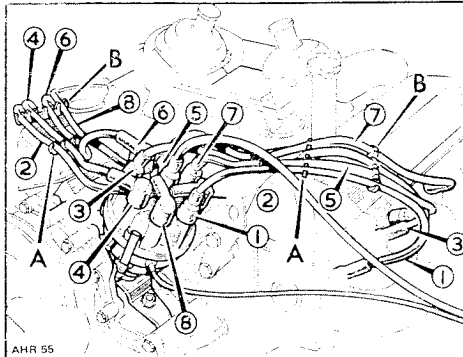


The numbers and letters in the circles indicate spark plug numbers and also the right-hand (RH) or left-hand (LH) bank of the engine to which the leads go.

High tension leads must be replaced in the correct relationship to each other, as well as ensuring correct firing order. Failure to do this may result in cross firing.

**Fig. 89**  
**High tension cable arrangement**

- A—Cable locating clips fixed to rocker cover
- B—Loose clips locating cables



The numbers in the arrowed circles in Fig. 89 show the plug lead numbers.

NOTE: The electrical leads to the ignition coil are fitted with male and female connectors; ensure that they are fitted to the correct blade on the coil.

## BATTERY, 12 VOLT MODELS

### Description

**202.** The negative earth 12 volt battery is carried behind the passenger seat and is secured by 'J' bolts in an angle mounting frame. An aluminium cover is provided and is attached by four quarter-turn fasteners.

NOTE: For full user information on lead acid batteries reference should be made to EMER'S Power J318 and J468.

### Checks

**203.** Check the following points. All defects noted must be reported:

- (1) Check the state of charge of the battery. See para. 205.
- (2) Check that the battery terminals are clean. Clean if necessary. by removing the lugs, and refit as described in para. 206.
- (3) Check that the battery clamps are secure.
- (4) Check that the lead from the battery to starter solenoid is not damaged and is secured tightly at the starter motor.

### III

### User Servicing and Adjustments

- (5) Check that the earth lead is not damaged and has a good connection with the chassis member.
- (6) Ensure that the vent holes in the centre of the filler plugs are clear.
- (7) Ensure that the bolts and nuts securing battery support to the mounting frame are tight.

#### Routine adjustments and servicing

##### Topping-up the battery

204. Proceed as follows:

- (1) Wipe all dirt and moisture from the battery top.
- (2) Remove the filler plug from each cell in turn. If necessary add sufficient distilled water to raise the level to the top of the separators. Replace the filler plug. Avoid the use of a naked light when examining the cells.

If the vehicle is used in high ambient temperature or is run at a high charge rate, it may be necessary to top-up daily.

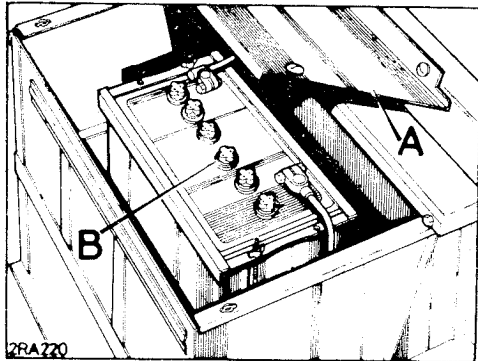


Fig. 90  
Battery, 12 volt models

- A—Battery cover  
B—Filler plug

In very cold weather it is essential that the vehicle be used immediately after topping-up, to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing and causing damage to the battery.

##### To check electrolyte (To be carried out by a vehicle mechanic)

205. Occasionally check the condition of the battery by measuring the specific gravity of the electrolyte in each cell, using a hydrometer.

Specific gravity readings and their indications are as follows:

- |                             |    |                               |
|-----------------------------|----|-------------------------------|
| 1.280–1.300 (32°–34° Baumé) | .. | Battery fully charged         |
| About 1.210 (25° Baumé)     | .. | Battery about half discharged |
| Below 1.150 (19° Baumé)     | .. | Battery fully discharged      |

These figures assume an electrolyte temperature of 15.5°C (60°F). If one cell gives a reading very different from the rest, it may be that acid has leaked from that particular cell, or there may be a short circuit between the plates, in which case the battery should be inspected at a workshop.

Never leave the battery in a discharged condition for any length of time; it should be given a short refreshing charge every fortnight, to prevent permanent sulphation of the plates.

NOTE: If the vehicle is to be left in the open in very cold weather, care must be taken to ensure that the battery is in a good state of charge, otherwise there is a danger of the electrolyte freezing and consequent damage to the battery.

### Refitting battery lugs

**206.** If the battery lugs have been removed for any reason, they must always be refitted as follows:

- (1) Clean the terminal post and inside of the battery lug.
- (2) Fit lug to terminal post and smear Protective PX-7 in the hole for the retaining screw and on the lug. Tighten securing bolt and nut on lug, do not overtighten.
- (3) Do NOT disconnect the battery cables while the engine is running or damage to the alternator semiconductor devices may occur. It is also inadvisable to break or make any connection in the alternator charging and control circuits while the engine is running.

It is essential to observe the polarity of connections to the battery and alternator as any incorrect connections made when reconnecting cables may cause irreparable damage to the semiconductor devices.

Both vehicle battery leads must be disconnected if either electric welding or boost charging operations are carried out on the vehicle. In addition the alternator must be disconnected if electric welding is carried out on the vehicle.

Should it be necessary to use a slave battery to aid starting, always ensure that the jumper leads are connected positive to positive and negative to negative.

Failure to comply with these instructions will result in irreparable damage to the transistors in the control unit.

### ALTERNATOR, 12 VOLT MODELS

#### Description

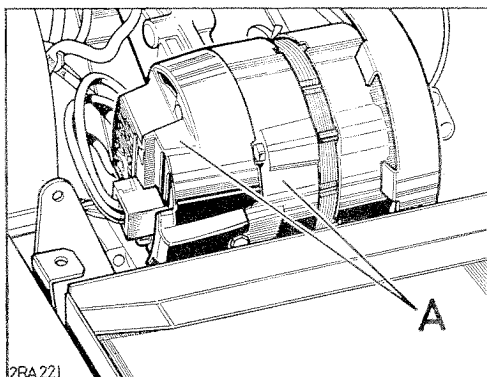
207. The alternator is a complete and sealed unit incorporating a voltage regulator. It is mounted on the right-hand side of the engine driven by a 'V' type belt and requires no servicing or lubrication.

The electronic voltage regulator employs a micro circuit technique resulting in improved performance under difficult service conditions. The whole assembly is encapsulated in silicone rubber and housed in an aluminium heat sink ensuring complete protection against the adverse effects of temperature, dust and moisture, etc.

The alternator system provides for direct connection of the ignition indicator warning light and eliminates the need for a field switching relay or warning light control unit.

Fig. 91  
Alternator, 12 volt models

A—Alternator



As the ignition warning light is connected in series with the alternator field circuit bulb, failure would prevent the alternator charging except at very high engine speeds, therefore the bulb should be checked before suspecting an alternator fault.

#### Checks

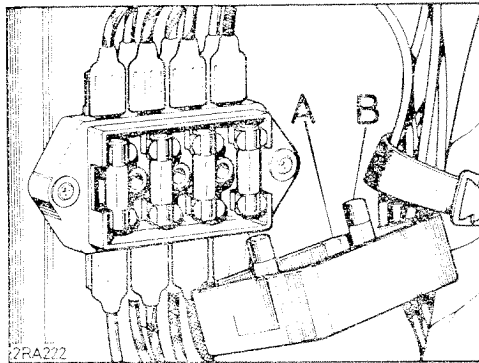
208. The following points should be checked. All defects noted must be reported:

- (1) Check the driving belt tension (see para. 97).
- (2) Check that the electrical connections and cable harness are secure.
- (3) Ensure that the pivot bolts fixing alternator to anchor brackets, and the bolts fixing the alternator to the adjusting bracket, are tight.

## FUSE BOX, 12 VOLT MODELS

### Description

**209.** A blown fuse is indicated by the failure of all the units protected by it and is confirmed by examination of the fuse. Before replacing a blown fuse, locate and remedy the fault in the wiring of the units which have failed. If the cause of the trouble cannot be found and a new fuse blows immediately, the fault must be reported and rectified.



**Fig. 92**  
Fuse box, 12 volt models  
A—Cover for fuse box  
B—Spare fuses

**210.** The fuse box is located on the inside of the front panel adjacent to the clutch pedal. See Fig. 92 for location. All fuses are of the 35 amp cartridge type, two spare fuses being carried in the box. Only the correct type of fuse may be used.

## STARTER MOTOR, 12 VOLT MODELS

### Description

**211.** The pre-engaged type starter motor is situated at the right-hand side of the engine and mounted to the flywheel housing. It is operated by the ignition and starter switch on the dash.

### **III**

### **User Servicing and Adjustments**

#### **Checks**

**212.** The following points should be checked on the starter motor. All defects noted must be reported:

- (1) Check that the bolts securing the starter to the flywheel housing are tight.
- (2) Check that the electrical connections are tight.
- (3) Check that the feed leads are not damaged and are secure at the starter motor and solenoid.

#### **STARTER SOLENOID SWITCH, 12 VOLT MODELS**

##### **Description**

**213.** The starter solenoid switch is integral with the starter motor. No user servicing is necessary.

#### **HORN, 12 VOLT MODELS**

##### **Description**

**214.** The horn is mounted on the inside of the radiator ducting and is accessible after removing the front grille.

##### **Checks**

**215.** Check horn as follows. All defects noted must be reported:

- (1) Check that the bolts securing the horn are tight.
- (2) Check that the connection of the feed lead and earth lead is not loose.

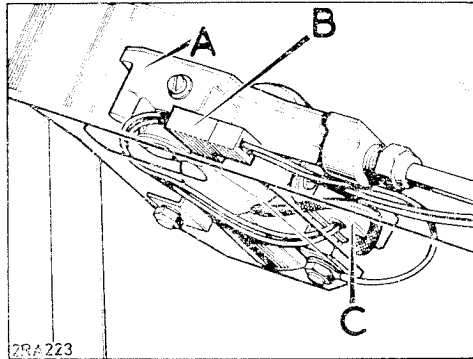
#### **WINDSCREEN WIPER MOTOR, 12 VOLT MODELS**

**216.** One windscreen wiper motor is fitted behind a cover panel at the passenger side of the dash. The two wiper blades are operated via wheelboxes by a flexible drive cable.



**Fig. 93**  
**Wiper motor, 12 volt**  
**models**

- A—Wiper motor cover removed
- B—Wiring plug
- C—Suppressor for wiper motor



## LIGHTS, 12 VOLT MODELS

### Description

#### Headlights

**217.** The headlights, mounted in the front chassis cross-member, incorporate a combined reflector and front lens assembly known as the Lucas light unit. Double filament lamps give a vertical dip.

#### Side lights

**218.** The side lights are mounted in the wing front panels, and the covers are secured by a threaded type holder.

#### Stop/tail lights

**219.** Two combined stop/tail lights similar to the side lights are fitted on the rear chassis cross-member.

#### Turnlights

**220.** The front turnlights are mounted in the front wing panels above the side lights. The rear turnlights are situated on the rear chassis cross-member adjacent to the stop/tail lights.

#### Number plate light

**221.** The number plate light is mounted on a hinged plate on the tailboard and is secured in the vertical position with a nylon push-in clip. Pull number plate free of clip when vehicle is operated with tailboard down.

#### Convoy light

**222.** The convoy light is situated on the inner side of the right-hand rear chassis cross-member.

### Instrument panel lamps

**223.** The instrument panel incorporates illumination lamps, the charging, cold start control, oil pressure and main beam warning lamps, turnlight and trailer warning lamps, dual brake system warning lamp and check button, hazard warning lamp and gearbox differential lock warning lamp.

### Checks

**224.** The following points should be checked. All defects noted must be reported:

- (1) Check lights for broken or cracked glass. If the headlight glass is broken the complete light unit must be renewed. If the lamps are discoloured as a result of long service they should be renewed.
- (2) Ensure that the stop/tail light, turnlight and side light covers are secure.

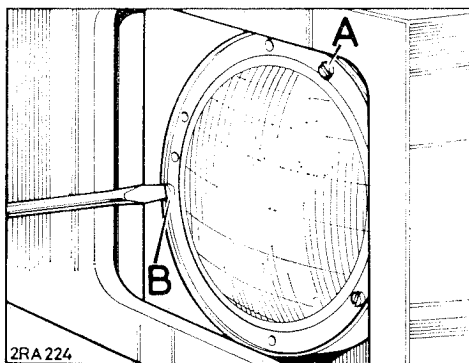
### Routine adjustments and servicing

#### Headlight lamp replacement

**225.** Press in the light unit against the tension of the springs on the three adjustment screws, turn it anti-clockwise and withdraw. Twist the back shell in an anti-clockwise direction and pull it off the light unit; the lamp can then be replaced and the unit reassembled.

**Fig. 94**  
Headlight, vertical dip,  
12 volt models

- A—Adjusting screw,  
vertical  
B—Adjusting screw  
horizontal



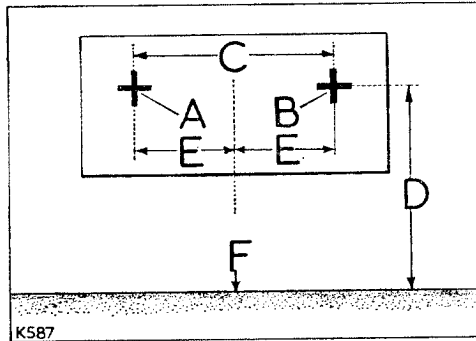
#### Headlight setting *(To be carried out by a vehicle mechanic)*

**226.** The headlights should be set so that the main driving beams are parallel with the road surface. If adjustment is required, the vertical light setting can then be made by turning the screw at the top of the lamp and horizontal adjustment by means of the screws at the side of the unit.

When checking headlights to the dimensions shown at Fig. 95, the vehicle must be unladen, on level ground and 365 cm (12 ft) from the level marks. Adjust so that area of concentrated light corresponds with marks.

**Fig. 95**  
Headlight setting dimensions, 12 volt models

- A—Concentrated area of light, LH Headlight
- B—Concentrated area of light, RH Headlight
- C—1500 mm (59 in.)
- D—813 mm (32 in.)
- E—749 mm (29½ in.)
- F—Ground level



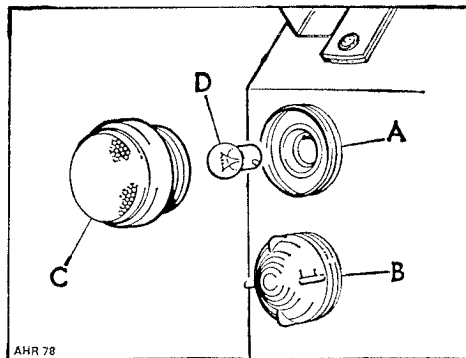
**Side, tail/stop and turnlight lamp replacement**

**227.** All lights are of the same design, the difference being in the colour of the lens, side lights have white, rear lights red and turnlights amber lenses.

To replace lamps in any of the above the glass is unscrewed from its threaded holder when the lamp is readily accessible and can be replaced. Finally screw back the lens.

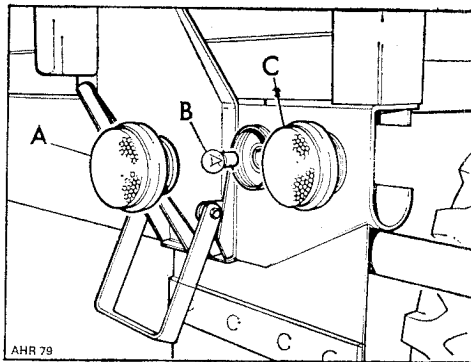
**Fig. 96**  
Side lights and front turnlights, 12 volt models

- A—Turnlight
- B—Sidelight
- C—Lens for front turnlight
- D—Bulb for front turnlight



**Fig. 97**  
**Stop/tail lights and rear**  
**turnlights, 12 volt models**

- A—Rear turnlight
- B—Bulb for rear  
turnlight
- C—Stop/tail light

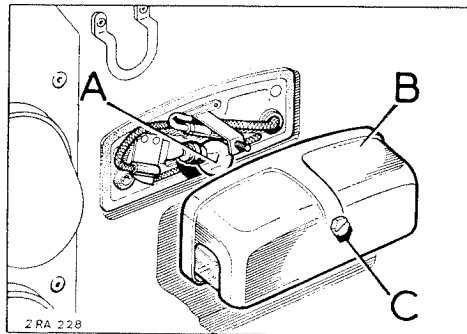


### Number plate light lamp replacement

**228.** To replace lamp, remove the securing screw and the cover. The lamp is then accessible in the lamp body.

**Fig. 98**  
**Number plate light lamp**  
**replacement**

- A—Bulb
- B—Cover
- C—Retaining screw for  
cover



### Instrument panel and warning light lamp replacement

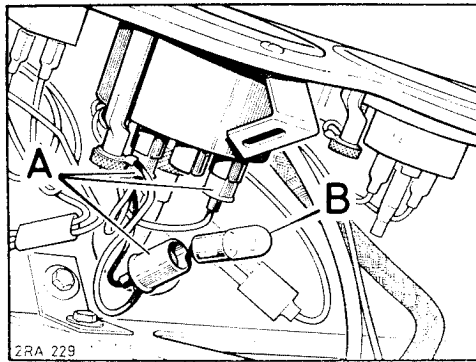
**229.** Should a warning lamp burn out, operation of the corresponding component will not be affected, but it should be replaced at the earliest opportunity to safeguard that particular item of equipment.

To remove warning lights:

- (1) Disconnect the battery.
- (2) Remove the four bolts retaining instrument panel and mounting bracket and tilt panel upwards.
- (3) Bulbs can then be replaced as necessary.
- (4) Replace instrument panel and reconnect the battery.

**Fig. 99**  
Warning lights, 12 volt models

- A—Bulb holders for oil pressure, main beam and mixture control warning light
- B—Bulb



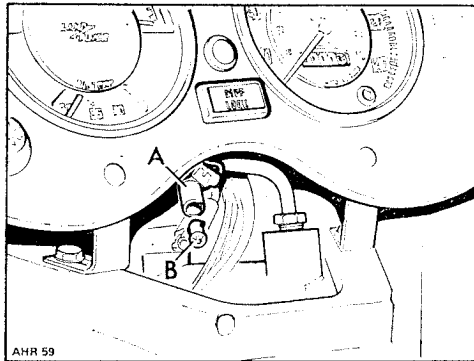
**Differential lock warning lamp replacement**

**230.** The bulb can be removed and replaced from between the instrument panel lower edge and steering column shroud without detaching the instrument panel.

Remove the bulb holder and bulb complete from the rear of the indicator. Remove bulb from holder and replace. Refit bulb and holder into indicator.

**Fig. 100**  
Differential lock warning lamp replacement

- A—Bulb holder
- B—Bulb

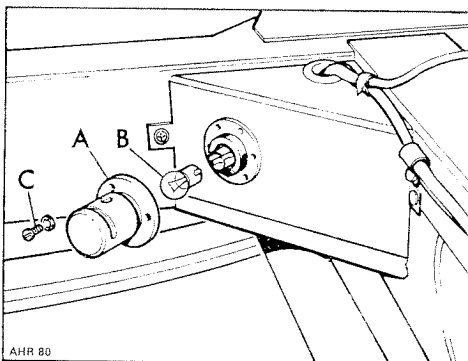


**Convoy light lamp replacement**

**231.** To replace the lamp, remove the screws holding the rim cover and withdraw rim and glass cover. The lamp can now be removed. Push new lamp into the holder turning the lamp to the left.

**Fig. 101**  
Convoy light, 12 volt models

- A—Cover and lens for convoy light
- B—Bulb
- C—Retaining screws

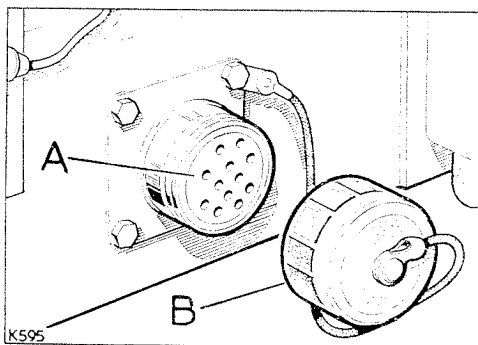


**NATO trailer socket**

**232.** A NATO 12-pin trailer socket is situated on the right-hand of the chassis frame rear cross member. The socket is protected by a rubber cover (Fig. 102 (B)). See circuit diagram for wiring connections.

**Fig. 102**  
NATO trailer plug socket

- A—NATO trailer socket
- B—Cover for NATO trailer socket



**CHAPTER 14**

**ELECTRICAL EQUIPMENT, 24 VOLT MODELS**

**SUPPRESSION OF ELECTRICAL INTERFERENCE TO RADIO SERVICES**

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**233.** The introduction of VHF radio sets to the services calls for a high standard of vehicle suppression if interference is to be adequately suppressed and full advantage of the sets obtained; good maintenance of the electrical system is therefore essential. It should be remembered that even if a radio set is not fitted the vehicle electrical system can cause interference to nearby radio sets. Attention to the following details will do much to maintain the required standard of suppression.

- (a) Sparking plugs
  - Ensure that the mating surface of the plug, gasket and cylinder head are clean and that the plug is fitted tightly into the cylinder head.
- (b) Ignition leads
  - (i) Ensure that connections to the plugs are clean and tight.
  - (ii) Ensure that the screening is not corroded or frayed, but is continuous and properly earthed at both ends.
- (c) Distributor
  - (i) Keep all connections and mating surfaces tight, clean, free from paint, corrosion and lubricant.
  - (ii) Maintain a good contact between screen of LT and HT ignition leads and that of the distributor, which must be properly earthed.
- (d) Coil
  - (i) Ensure good, clean and tight connection of all coil leads.
  - (ii) Maintain a good metal-to-metal contact, free from paint, corrosion and lubricant, between the body of the coil and its mounting and between the junctions of the screen.
- (e) Battery
  - Keep the battery terminals and leads clean and properly fitted to provide a good electrical connection.

### III

### User Servicing and Adjustments

- (f) Earthing and bonding strips  
Keep all junctions clean, free from corrosion or paint and ensure that they are tight.
- (g) Remainder of electrical systems
  - (i) Ensure that there is no intermittent contact on any of the fuses, leads, switches or connections.
  - (ii) Ensure that any screening is continuous and is properly earthed at both ends.
- (h) Do not interfere with the vehicle wiring system.
- (i) Avoid making improvised connections to the electrical system.
- (j) Avoid tampering with any parts of the electrical system which are not understood.
- (k) Do not paint under bonding strips, or earth braids or other parts intended to be in electrical contact.
- (l) Do not remove any suppression equipment that may be fitted to the vehicle.
- (m) Refrain from using switches unnecessarily.
- (n) Report immediately any defects which may affect the standard of suppression of the vehicle.

### IGNITION SYSTEM, 24 VOLT MODELS DISTRIBUTOR

#### Description

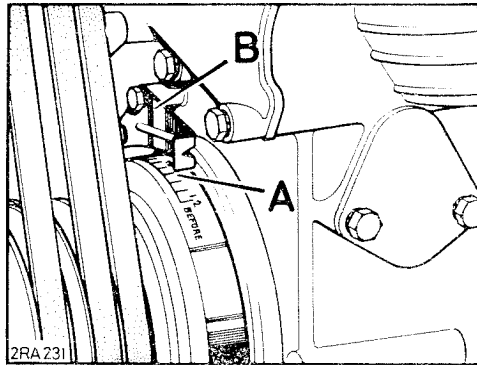
**234.** The distributor, vented via the in-line filter, is mounted on an extension of the oil pump driving shaft. It is of the screened type having a centrifugal automatic advance mechanism which has an operating range of 0–22 degrees over a distributor speed range of 750–2,400 rev/min (1,500–4,800 rev/min engine speed).

The distributor rotor arm incorporates a speed limiting device to prevent accidental overrevving of the engine.

Adjustment to the distributor may be made by slackening the clamp pinch bolt and moving distributor body round to either retard or advance as necessary.

**Fig. 103**  
Ignition timing, 24 volt  
models

- A—3° BTDC  
B—Timing pointer



### Distributor maintenance

**235.** At regular intervals remove the distributor cap by releasing the two outer screws retaining the cap as follows:

- (1) Lift off the rotor and add a few drops of thin machine oil to the felt pad in the distributor shaft to lubricate the cam bearing and shaft; push the rotor on the shaft as far as possible.
- (2) Place a drop of clean engine oil on the felt pads to lubricate the cam, taking care not to oil the contacts.
- (3) Add a few drops of thin machine oil through the hole in the contact breaker base plate, to lubricate the automatic timing control.

### Distributor in-line filter

**236.** To ensure distributor ventilation, clean air is drawn into the distributor via an in-line filter. Contaminated air passes out through a second opening in the distributor body and via a hose, is drawn into the induction system to be burnt during normal combustion. To ensure satisfactory venting at all times the filter should periodically be replaced.

Proceed as follows:

- (1) Remove the engine cover.
- (2) Detach the rubber hoses from each end of the filter.
- (3) Release the screw securing the filter bracket to filter and withdraw filter.

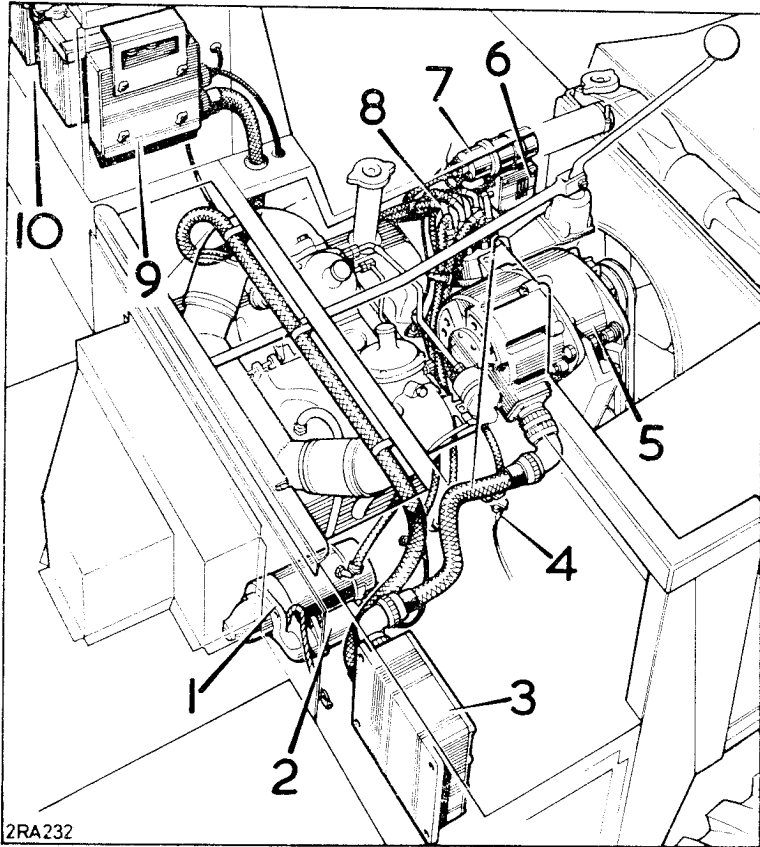


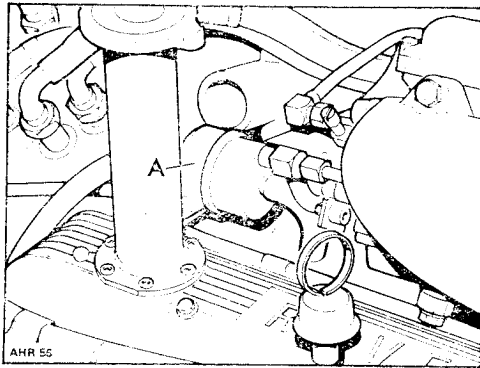
Fig. 104 Electrical equipment in engine compartment, 24 volt models

- |  |                             |
|--|-----------------------------|
| 1. Starter motor                         | 6. Filter for ignition coil |
| 2. Starter motor solenoid                | 7. Ignition coil            |
| 3. Generator panel                       | 8. Distributor              |
| 4. Oil pressure switch for warning light | 9. Shunt box                |
| 5. Generator                             | 10. Batteries               |

(4) Fit the new filter with the end marked 'IN' facing towards the rear of the vehicle.

(5) Tighten the securing screw and replace hoses.

**Fig. 105**  
**Distributor in-line filter**  
 A—Filter



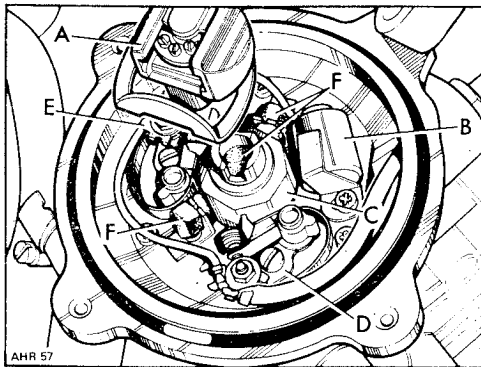
**Checks**

**237.** The following points should be checked. All defects noted must be reported:

- (1) Check that the clamping pinch bolt securing the distributor is tight.

**Fig. 106**  
**Distributor maintenance,**  
**24 volt models**

- A—Rotor arm
- B—Condenser
- C—Cam
- D—Contact points
- E—Contact points
- F—Felt lubricating pads



**Routine adjustments and servicing**

**Clean and adjust distributor contact points** (*To be carried out by a vehicle mechanic*). When removing the distributor cap it may be necessary to disconnect the screened leads from the cap.

**238.** Periodically clean and lubricate the distributor as follows:

- (1) Wipe the inside and outside of the cap with a soft, dry cloth; ensure that the small carbon brush works freely in its holder.

### III

### User Servicing and Adjustments

- (2) Lift off the rotor arm and add a few drops of thin machine oil to lubricate the felt pads.
- (3) Remove the nut and lift off the spring and moving contact. If necessary remove the adjustable contact plates. Ensure that the contacts are free from grease or oil; if they are burned or blackened, renew. Repeat procedure for other contact set.
- (4) Check and adjust the contact breaker clearance on each contact set as follows:
  - (i) Remove the distributor cap and turn over the engine by hand until one of the contacts are fully open.
  - (ii) The clearance should be 0,35—0,40 mm (0.014—0.016 in.), i.e. the feeler gauge should be a sliding fit between the contacts.
  - (iii) If necessary, slacken the screw securing the adjustable contact plate and move until the clearance is correct; re-tighten the screw. Repeat for the other contact set.
  - (iv) Replace the distributor cap and reconnect distributor leads if disconnected.

**To adjust ignition timing** (*To be carried out by a vehicle mechanic*)

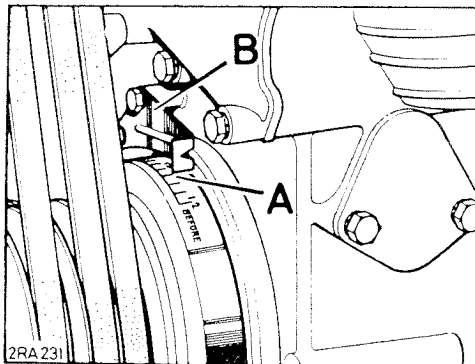
**239.** Reset ignition timing as follows:

NOTE: When setting the ignition timing on 24 volt models it will not be necessary to use a Tachometer.

- (1) Set the contact breaker point gap to 0,35—0,40 mm (0.014—0.016 in.) with the points fully open, using a feeler gauge as previously described.
- (2) Rotate the crankshaft in running direction until the 3° BTDC mark on the crankshaft pulley is in line with the pointer.

**Fig. 107**  
**Ignition timing pointer**

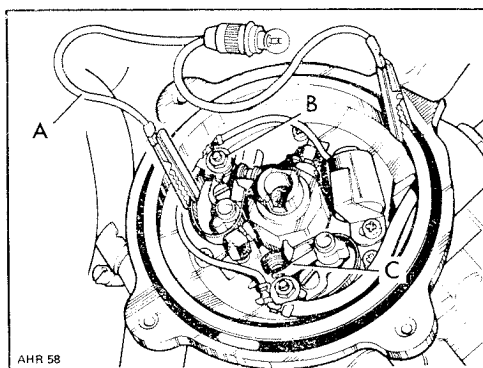
A—3° mark on crankshaft pulley  
B—Timing pointer



- (3) The distributor rotor should correspond with No. 1 cylinder high tension lead terminal.
- (4) Connect a 24 volt timing lamp or voltmeter across the contact breaker lead terminal and a suitable earth point on the set of contact points marked 'B' in Fig. 108. This set of contact points are those nearest the inlet manifold. Switch on the ignition.
- (5) Slacken the clamp pinch bolt at the base of the distributor and rotate the distributor anti-clockwise until the set of contact points marked 'B' in Fig. 108 just begins to open and the timing lamp just comes on. This is the firing point when contacts marked 'C' in Fig. 108 start to open.
- (6) Tighten the distributor clamp pinch bolt and switch off the ignition. Disconnect the timing lamp. Refit distributor cap and reconnect leads if disconnected. Ensure that all lead ends are secure at distributor and sparking plugs thus ensuring screening continuity.

**Fig. 108**  
**Ignition timing**

- A—Timing lamp
- B—Contact points
- C—Contact points



### IGNITION COIL, 24 VOLT MODELS

#### Description

**240.** The ignition coil is a 10 volt oil filled unit and to make it suitable for the 24 volt system a ballast resistor is connected in series with the primary winding of the coil. The ballast resistor is housed with the filter unit.

### FILTER UNIT, 24 VOLT MODELS

#### Description

**241.** The filter unit is fitted to suppress interference to radio equipment. It consists of a choke, connected in series with the supply to the ignition coil, and two capacitors connected one across each end of the choke and earth.

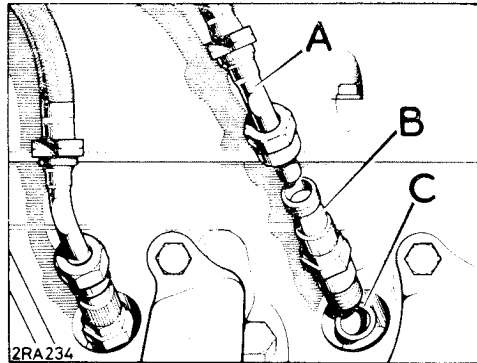
### SPARKING PLUGS, 24 VOLT MODELS

#### Description

242. The sparking plug is a 14 mm  $\frac{3}{4}$  in. reach, 3-piece type with a built-in 1,000–3,000 ohm resistor and a rolled-steel washer. The resistor suppresses interference to radio equipment and also reduces the burning rate of the electrodes.

Fig. 109  
Sparking plug, 24 volt  
models

- A—Screened lead in vertical position
- B—Sparking plug
- C—Washer for sparking plug



#### Routine adjustments and servicing

**Clean and adjust sparking plugs** (*To be carried out by a vehicle mechanic*)

243. At regular intervals remove the plugs, clean or if necessary replace, reset the electrode gaps to 0,60 mm (0.025 in.). Do not, adjust the central electrode.

### HIGH TENSION CABLES, 24 VOLT MODELS

244. Examine the connectors on each cable end to ensure that they are undamaged. Examine the cable neoprene covering for damage.

Ensure that when refitting the leads to each spark plug they are located correctly and finally tightened in the vertical position. See Fig. 109.

### BATTERIES, 24 VOLT MODELS

#### Description

245. Vehicle batteries are located as follows:

A negative earth return system is used, employing two 12 volt batteries connected in series, giving 24 volts output. They are

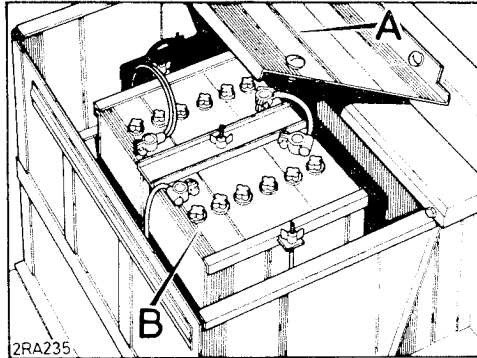


located behind the passenger seat, and are protected by a metal cover secured by four quarter turn fasteners. See Fig. 110.

**IMPORTANT:** Ensure that the batteries are connected in series and that the leads are connected as shown at Fig. 110.

Fig. 110  
Vehicle batteries, 24 volt  
models

- A—Battery cover
- B—Batteries



**246.** The gases liberated from a battery are highly inflammable, therefore, it is important that electrical connections are maintained clean and tight as an insurance against fire.

It is equally important to ensure that the vents in the battery cell filler plugs are kept clear, as pressure within the battery cell is produced if the gases resulting from charging cannot escape. A blocked cell vent may result in a burst battery.

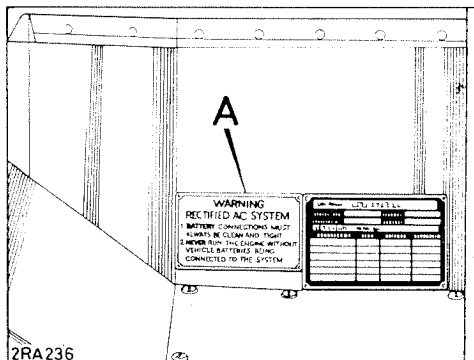
**NOTE:** For full user information on lead acid batteries reference should be made to EMER'S Power J318 and J330.

**WARNING—**This vehicle is fitted with a rectified AC system. See Fig. 111.

- (1) The battery connections must always be clean and tight.
- (2) Never run the engine without vehicle batteries being connected to the system, this applies even when using slave batteries.
- (3) The radio battery leads must be connected to the battery or correctly stowed.
- (4) Ensure batteries are regularly maintained, see paras. 248–249.

Fig. 111  
Warning plate, rectified  
AC system, 24 volt models

- A—Warning plate



### III

### User Servicing and Adjustments

#### Checks

**247.** Check the following points. All defects noted must be reported:

- (1) Check the state of charge of the batteries. See para. 249.
- (2) Check that the battery terminals are clean. Clean if necessary by removing the lugs, and refit as described in para. 250.
- (3) Check that the lead from the battery to starter solenoid is not damaged and is secured tightly at the starter motor.
- (4) Check that the earth lead is not damaged and has a good connection at fixing point.
- (5) Ensure that the vent holes in the centre of the filler plugs are clear.
- (6) Ensure that the battery clamps and housings are tight.

#### Routine adjustments and servicing

##### Topping-up vehicle batteries (two 12 volt in series)

**248.** Proceed as follows:

- (1) Remove the battery housing cover secured by four quarter turn fasteners.
- (2) Wipe all dirt and moisture from the battery top.
- (3) Remove the filler plug from each cell in turn. If necessary add sufficient distilled water to raise the level to the top of the separators. Replace the filler plug. Avoid the use of a naked light when examining the cells.

If the vehicle is used in high ambient temperature or is run at a high charge rate, it may be necessary to top up daily.

In very cold weather it is essential that the vehicle be used immediately after topping-up, to ensure that the distilled water is thoroughly mixed with the electrolyte. Neglect of this precaution may result in the distilled water freezing and causing damage to the battery.

##### To check electrolyte (*To be carried out by a vehicle mechanic*)

**249.** Occasionally check the condition of the battery by measuring the specific gravity of the electrolyte in each cell, using a hydrometer. Specific gravity readings and their indications are as follows:

- |                             |    |                               |
|-----------------------------|----|-------------------------------|
| 1.280–1.300 (32°–34° Baumé) | .. | Battery fully charged         |
| About 1.210 (25° Baumé)     | .. | Battery about half discharged |
| Below 1.150 (19° Baumé)     | .. | Battery fully discharged      |

These figures assume an electrolyte temperature of 60°F (15.5°C).

If one cell gives a reading very different from the rest, it may be that acid has leaked from that particular cell, or there may be a short circuit between the plates, in which case the battery should be inspected at a workshop.

Never leave the battery in a discharged condition for any length of time; it should be given a short refreshing charge every fortnight, to prevent permanent sulphation of the plates.

#### Refitting battery connectors

**250.** If the battery connectors have been removed for any reason, see para. 246. **WARNING**—they must always be refitted as follows:

- (1) Clean the terminal post and connector.
- (2) Fit connector to terminal post and lightly tap on the taper of the post.
- (3) Smear Protective PX-7 on the terminal post and on the connector.
- (4) Tighten retaining bolt and nut.

### GENERATING SYSTEM, 24 VOLT MODELS

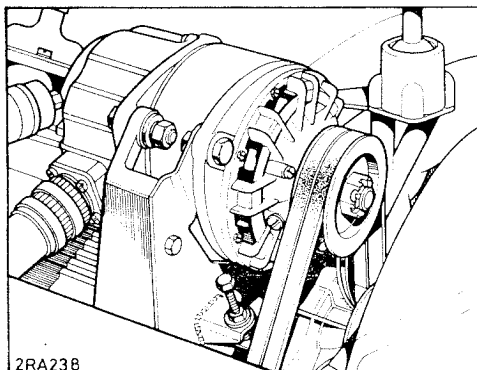
#### Description

**251.** To meet the heavy demands of the electrical system the vehicle is fitted with a 24 volt alternating current (AC) 90 amp generator together with an associated rectifier system and generator panel.

The use of this system permits a high generator output to be obtained at low engine speeds.

Provision is made to charge the batteries with the vehicle stationary, a hand throttle control (para. 23) is provided which can be adjusted to vary the engine speed to give an optimum charging rate.

The generator is mounted on the engine and is swing-mounted on fixing lugs located at each end of the generator.



**Fig. 112**  
Generator AC 90/5,  
90 amp, 24 volt models

Running the generator with the battery disconnected results in the generation of a very high voltage and if this occurs the rectifier units will be destroyed; faulty connections in the charging circuit will cause voltage surges and a similar effect will result. Consequently the engine must never be run with the vehicle battery disconnected or with faulty connections in the charging circuit. A warning plate to this effect is fitted to the seat base, driver's side (see Fig. 111).

### **Generator AC 90/5, 90 amp**

#### **Description**

**252.** The generator is a fully suppressed 7 in., partially waterproofed, fan ventilated, self excited 3-phase alternator with a built-in rectifier system. It generates 24 volts at a generator speed (cutting-in speed) of 900 rev/min and attains its maximum output of 90 amperes at 1,900 rev/min (1,070 rev/min engine speed).

- (a) The 3-phase main windings are carried in the fixed stator portion of the machine; they are bar wound and star connected. The three ends of the windings are connected to six silicon diodes to give the required 24 volt rectified output and to another three diodes to give a 24 volt rectified supply to a relay in the generator panel (para. 255 (e)).
- (b) The diodes are located in heat sinks in the end shield at the slip-ring end of the machine; they are cooled by means of a fan attached to the rotor shaft inside the generator which draws air through the machine via apertures in the end shields.
- (c) The rotor consists of two 6-fingered cup-shaped portions mounted on the shaft to form a 12-pole unit. The field coil is wound around the shaft and is enveloped by the 12 poles of the rotor, the field current being supplied through carbon brushes and the slip rings which, since the field current is approximately only half amp, will give long and trouble-free service.
- (d) As stated above the generator is self excited, the field circuit being taken from the positive line of the generator via the regulator (para. 255).
- (e) The rotor is carried by a ball bearing at the slip-ring end and a roller bearing at the driving end, the bearings being located in waterproofed housings which are packed with grease XG271 on assembly and require no additional lubrication between major overhauls of the unit.

- (f) Water can enter into the body of the unit, but is prevented from reaching the bearing housings and the brush gear assembly from the inside and from the outside by means of oil seals, sealing gaskets and by the application of sealing compound to screws and joints.
- (g) The brush gear assembly is enclosed in the bearing housing, the bearing at this end being of the semi-sealed type, the seal being located facing the brush gear to prevent grease reaching this assembly. The brush gear is carried by an insulating moulding which is bolted to a web in the housing and helps to separate the bearing from the brush gear.
- (h) Connection to the generator is made via a multi-pin plug.

### Lubrication

**253.** The generator requires no lubrication to its bearings as they are pre-packed on manufacture.

### Checks

**254.** The following points should be checked on the generator. All defects noted must be reported:

- (1) Check the driving belt tension (see para. 97).
- (2) Check that the cable harness is secure.
- (3) Ensure that the bolts fixing generator to anchor brackets are tight.

### Generator panel No. 9, Mk 3, for use with the 90 amp generator

#### Description

**255.** Generator panel No. 9, Mk 3 is used in conjunction with generator AC 90/5, it is located in the rear body at the passenger's side and is bolted to a bracket attached to the body side above the wheel arch, it is a cast aluminium box with cover housing the control units for the generator.

- (a) The interior of the box is divided into two compartments, one of which houses a BCK 102 relay and the other the regulator and its associated resistances, high/low voltage setting link and radio interference suppression filters. The partition between the compartments, together with capacitors, provide a radio interference screen around the regulator.

### III

### User Servicing and Adjustments

- (b) A vibrating contact CAV 'N' type regulator is used to control the voltage of the generator, current regulation is inherent in the design of the generator, maximum impedance being reached at its rated output of 90A.

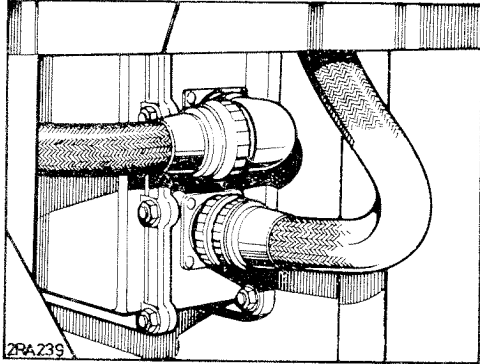


Fig. 113  
Generator panel No. 9,  
Mk 3, 24 volt models

- (c) The regulator contacts are connected in the field circuit, the main operating coil being connected across the output terminals of the generator and hence responding to output voltage.
- (d) The regulator operating voltage can be set to a high or low range by means of the high/low setting link. The low position is for high ambient temperature conditions (tropical); the high position is for normal ambient temperatures.
- (e) The CAV BCK 102 relay is fitted to connect the radio batteries (when fitted) in parallel with the vehicle batteries for charging purposes when the generator is functioning. The operating coil of the relay is connected to the auxiliary rectified output terminal of the generator. Two pairs of contacts are fitted to the relay, these are used to connect the positive line of the generator to the vehicle battery positive connection and to the radio battery positive connection respectively when the relay closes.
- (f) A normal type of cut-out is not fitted but the relay has a second winding incorporated to work in conjunction with two blocking diodes to hold the relay open in the event of reversed battery connections.

#### Servicing

256. User servicing of the generator panel is not permitted; the panel must not be tampered with.

**Operation of 90 amp generating system**

257. Closing the ignition switch preparatory to starting the engine completes the field circuit through the closed contacts of the relay and of the regulator.

- (a) As the engine is started and its speed increases the generated voltage rises and when it reaches 18–20 volts the BCK relay closes and the generator positive line is connected to the vehicle and radio batteries. The rate of charge of the two circuits is indicated by ammeters in the centre of the fascia panel. If the radio battery connections are reversed the 'Aux' ammeter will read excessively high.
- (b) When the generated voltage reaches 28.5–29.0 volts the regulator contacts open to insert a resistance in the field circuit, the voltage falls and the regulator contacts close again. This cycle repeats continuously and rapidly until the speed of the generator is reduced and the voltage is below the regulator operating voltage.  
The generated voltage is reduced to 26.5–27.0 volts for the low setting (para. 255 (d)).
- (c) If the batteries are discharged and normal running of the vehicle is not contemplated they may be charged by running the engine with the vehicle stationary. The hand throttle control should be adjusted so that the engine runs at the lowest speed at which maximum generator output is obtained; as the battery voltage rises and the charging rate falls the speed should be decreased.

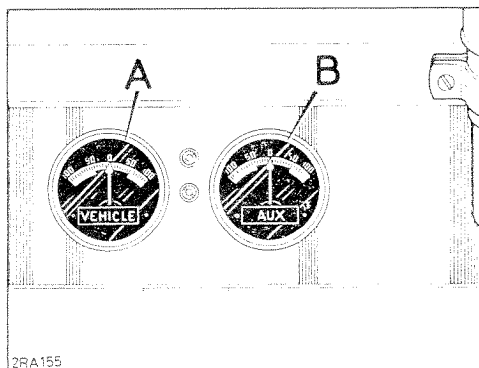


Fig. 114  
Ammeters, 24 volt models

- A—Vehicle ammeter  
B—Radio ammeter ('Aux')

### SHUNT BOX, 24 VOLT MODELS

#### Description

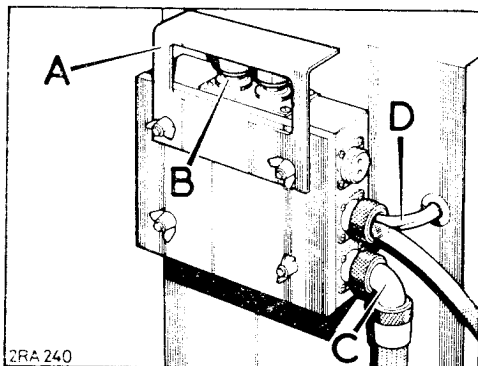
**258.** A shunt box is located on the passenger side of the vehicle attached to the battery carrier box. See Fig. 115. The radio batteries and charging circuit are connected together at the shunt box hence the radio batteries, when fitted, and the vehicle batteries are charged simultaneously.

The radio station, when fitted, is also connected to the shunt at the upper red and black terminals.

For information on the use of the shunt box, see handbook for radio installation in FFR 'B' vehicles, WO Code No. 12798.

**Fig. 115**  
**Shunt box**

- A—Retaining plate for radio terminals
- B—Radio terminals
- C—Cable, shunt box to generator panel
- D—Cable, radio battery charging circuit



### FUSE BOX, 24 VOLT MODELS

#### Description

**259.** The fuse box is fitted on the inside of the front panel adjacent to the clutch pedal; Fig. 116 shows its location. The fuses are of the 35 amp cartridge type and two are carried in the box as spares.

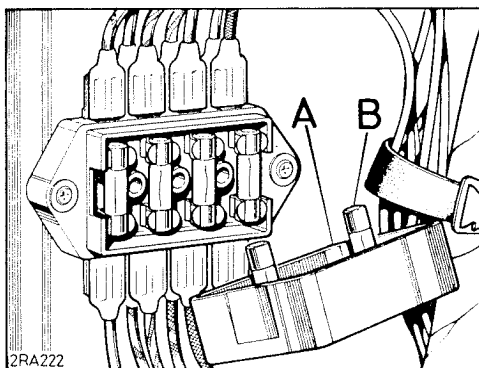
A blown fuse is indicated by the failure of all the units protected by it and is confirmed by examination of the fuse. Before replacing a blown fuse, locate and remedy the fault in the wiring of the units which have failed. If the cause of the trouble cannot be found and a new fuse blows immediately, the vehicle should be examined at a workshop.

Use only the correct size fuse as a replacement.



**Fig. 116**  
Fuse box, 24 volt models

A—Cover for fuse box  
B—Spare fuses



## STARTER MOTOR, 24 VOLT MODELS

### Description

**260.** The pre-engaged type starter motor is situated at the right-hand side of the engine and mounted to the flywheel housing. It is operated by the ignition and starter switch on the dash.

### Checks

**261.** The following points should be checked on the starter motor. All defects noted must be reported:

- (1) Check that the bolts securing the starter to the flywheel housing are tight.
- (2) Check that the electrical connections are tight.
- (3) Check that the feed leads are not damaged and are secure at the starter motor and solenoid.

**STARTER SOLENOID SWITCH, 24 VOLT MODELS****Description**

**262.** The starter solenoid switch is integral with the starter motor. No user servicing is necessary.

**HORN, 24 VOLT MODELS****Description**

**263.** The horn is mounted on the inside of the radiator ducting and is accessible after removing the front grille.

**Checks**

- 264.** Check horn as follows. All defects noted must be reported:
- (1) Check that the bolts securing the horn are tight.
  - (2) Check that the connection of the feed lead and earth lead is not loose.

**HORN RELAY, 24 VOLT MODELS****Description**

**265.** The horn relay is mounted in the cab on the driver's side adjacent to the pedal controls.

It is of the simple single-pole totally enclosed type fitted to prevent burning of the horn push-button contacts.

**266.** The operating coil of the relay is connected to the vehicle supply and to the horn push-button; its normally open contacts are connected to the supply and to the horn. Operation of the horn push-button energises the relay which operates to close its contacts and so complete the horn circuit.

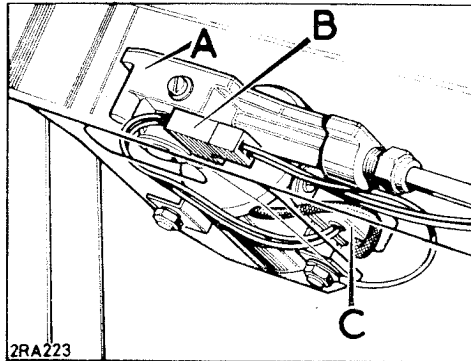
**WINDSCREEN WIPER, 24 VOLT MODELS****Description**

**267.** One windscreen wiper motor is fitted behind a cover panel at the passenger side of the dash. The two wiper blades are operated, via wheelboxes, by a flexible drive cable.

A radio interference suppression unit is fitted adjacent to the wiper motor.

**Fig. 117**  
**Wiper motor, 24 volt**  
**models**

- A—Wiper motor
- B—Wiring plug
- C—Suppressor for wiper motor



## LIGHTS, 24 VOLT MODELS

### Description

#### Headlights

**268.** The headlights, mounted in the front chassis cross member, incorporate a combined reflector and front lens assembly known as the Lucas light unit. Double filament lamps give a vertical dip.

#### Side lights

**269.** The side lights are mounted in the wing front panels, and the covers are secured by a threaded type holder.

#### Stop/tail lights

**270.** Two combined stop/tail lights similar to the side lights are fitted on the rear chassis cross member.

#### Turnlights

**271.** The front turnlights are mounted in the front panels above the side lights at outside edge of front wing. The rear turnlights are situated on the rear chassis cross member above the stop/tail lights.

#### Number plate light

**272.** The number plate light is mounted on a hinged plate on the lower tailboard and is secured in the vertical position with a nylon push-in clip. Pull number plate free of clip when vehicle is operated with the tailboard down.

#### Convoy light

**273.** The convoy light is situated at the right-hand side under the rear chassis member.

### Instrument panel lamps

**274.** The instrument panel incorporates illumination lamps, the charging, cold start control, oil pressure and main beam warning lamps, turn-lamps and trailer warning lamps, brake system warning lamp, hazard indicator warning lamp and gearbox differential lock warning lamp.

### Checks

**275.** The following points should be checked. All defects noted must be reported:

- (1) Check lights for broken or cracked glass. If the headlight glass is broken the complete light unit must be renewed. If the lamps are discoloured as a result of long service they should be renewed.
- (2) Ensure that the stop/tail light, turnlight and side light covers are secure.

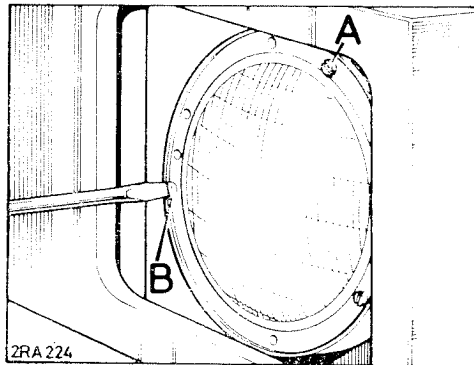
### Routine adjustments and servicing

#### Headlight lamp replacement

**276.** Press in the light unit against the tension of the springs on the three adjustment screws, turn it anti-clockwise and withdraw. Twist the back shell in an anti-clockwise direction and pull it off the light unit; the lamp can then be replaced and the unit reassembled.

**Fig. 118**  
Headlight, vertical dip,  
24 volt models

- A—Adjusting screw—  
vertical  
B—Adjusting screw—  
horizontal



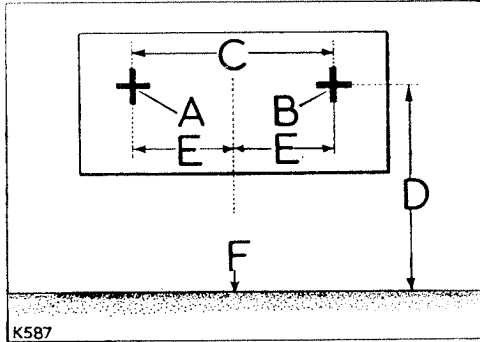
#### Headlight setting *(To be carried out by a vehicle mechanic)*

**277.** The headlights should be set so that the main driving beams are parallel with the road surface. If adjustment is required, the vertical light setting can then be made by turning the screw at the top of the lamp and horizontal adjustment by means of the screws at the side of the unit.

When checking headlights to the dimensions shown at Fig. 119, the vehicle must be unladen, on level ground and 365 cm (12 ft) from the level marks. Adjust so that area of concentrated light corresponds with marks.

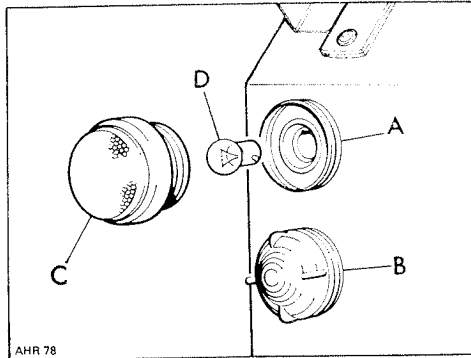
**Fig. 119**  
Headlight setting dimensions

- A—Concentrated area of light, LH Headlight
- B—Concentrated area of light, RH Headlight
- C—1500 mm (59 in.)
- D—813 mm (32 in.)
- E—749 mm 29½ in.)
- F—Ground level



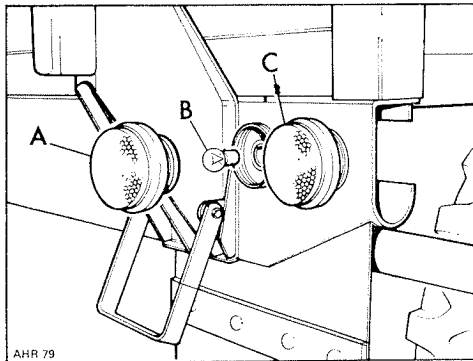
**Fig. 120**  
Side lights and front turnlights, 24 volt models

- A—Front turnlight
- B—Side light
- C—Lens for turnlight
- D—Bulb for turnlight



**Fig. 121**  
Stop/tail lights and rear turnlights, 24 volt models

- A—Rear turnlight
- B—Bulb for rear turnlight
- C—Stop/tail light



**Side, tail/stop and turnlight lamp replacement**

**278.** All lights are of the same design, the difference being in the colour of the lens, side lights have white, rear lights red and turn-lights amber lenses.

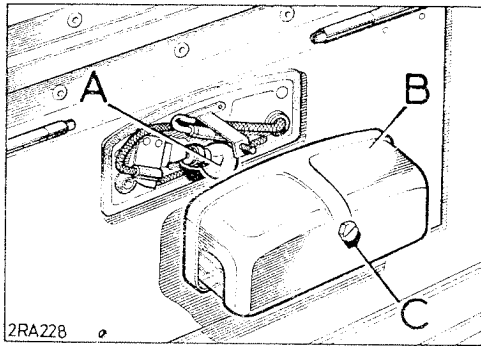
To replace lamps in any of the above the glass is unscrewed from its threaded holder when the lamp is readily accessible and can be replaced. Finally screw back the lens.

**Number plate light lamp replacement**

**279.** To replace lamp, remove the securing screw and the cover. The lamp is then accessible in the lamp body.

**Fig. 122**  
Number plate light lamp  
replacement

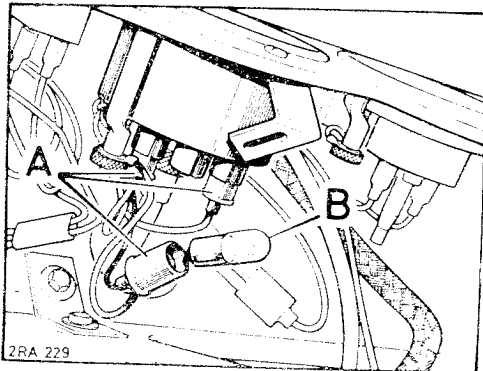
- A—Bulb
- B—Cover
- C—Retaining screw  
for cover

**Instrument panel and warning light lamp replacement**

**280.** Should a warning lamp burn out, operation of the corresponding component will not be affected, but it should be replaced at the earliest opportunity to safeguard that particular item of equipment.

**Fig. 123**  
Warning lights, 24 volt  
models

- A—Bulb holders for oil  
pressure, main  
beam and mixture  
control warning  
lights
- B—Bulb



To remove warning lights:

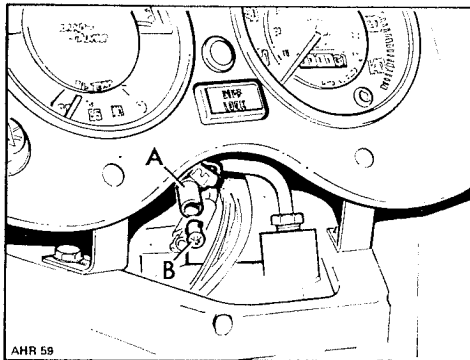
- (1) Disconnect the battery.
- (2) Remove the four bolts retaining instrument panel and mounting bracket and tilt panel upwards.
- (3) Bulbs can then be replaced as necessary.
- (4) Replace instrument panel and reconnect battery.

**Differential lock warning lamp replacement**

281. The bulb can be removed and replaced from between the instrument panel lower edge and steering column shroud without detaching the instrument panel. Remove the bulb holder and bulb complete from the rear of the indicator. Remove bulb from holder and replace. Refit bulb and holder into indicator.

**Fig. 124**  
Differential lock warning lamp replacement

- A—Bulb holder
- B—Bulb

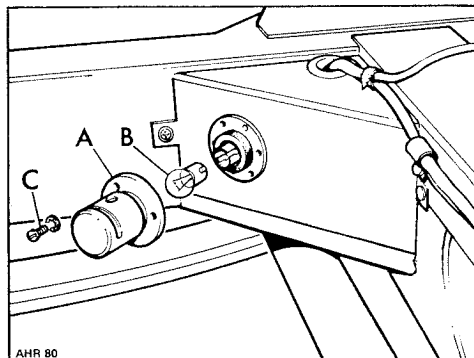


**Convoy light lamp replacement**

282. To replace the lamp, remove the screws holding the rim cover and withdraw rim and glass cover. The lamp can now be removed. Push new lamp into the holder turning the lamp to the left.

**Fig. 125**  
Convoy light, 24 volt models

- A—Cover and lens for convoy light
- B—Bulb
- C—Retaining screws

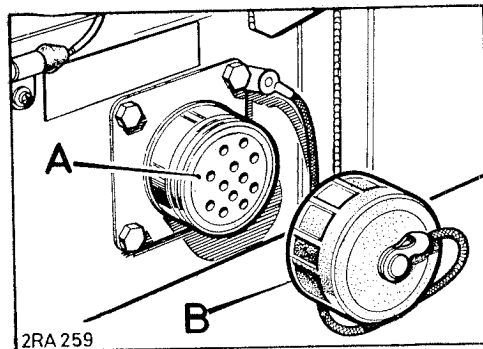


**NATO trailer socket**

**283.** A NATO 12-pin trailer socket is situated on the right-hand of the chassis frame rear cross member. The socket is protected by a rubber cover. (Fig. 126 (B)). See circuit diagram for wiring connections.

**Fig. 126**  
**NATO trailer socket,**  
**24 volt models**

A—NATO trailer socket  
 B—Cover for NATO trailer socket

**Relay for stop lamp**

**284.** A relay for stop lamp is fitted to the dash. This is completely sealed and no maintenance can be carried out.

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Engine compartment lid	
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Rifle clips	
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Windscreen . . . . .	Fig. 130. Windscreen fixing bolts.
Windscreen wiper arm and blade replacement . . . . .	Fig. 131. Wiper blade and arm.
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Harness cleaning

**Description**

**285.** With the exception of the dash panel which is steel, the body panels are constructed throughout from Birmabright 2 with steel cappings and corner plates, which are galvanised.

On the front panel immediately below the windscreen provision is made for stowage of an external fire extinguisher, a pick head, a pick handle and shovel, lifting jack handle and starting handle.

The rear body assembly consists of upper and lower drop sides. The upper extend the full length of the rear body; hinged at the front pillar and to the top of the rear wheel arch by three slide-out hinges and secured at front and rear by cam action latches.

The lower drop sides extend from the front of the rear body to the front of the rear wheel arch, being the same height as the top of the wheel arch; hinged at floor level by two slide-out hinges and secured at front and rear by cam action latches.

**Engine compartment lid**

**286.** A one-piece fabricated Birmabright cover with fibreglass insulation covers the engine and extends from the radiator duct to the front of the rear body well.

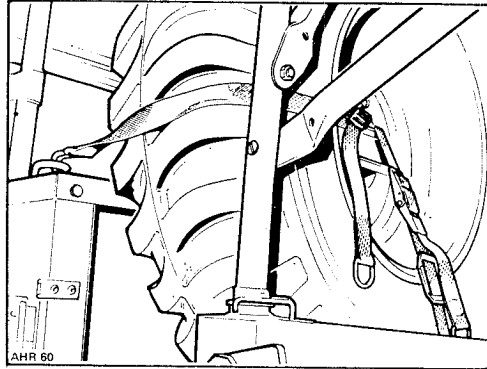
The lid, secured by two fixing clips, incorporates two hinged aluminium hatches for access to the oil filler cap and oil level dipstick and radiator filler cap. See Fig. 21.

### III

### User Servicing and Adjustments

#### Spare wheel

**287.** The spare wheel is mounted behind the driver's seat. To remove, release the catch on the external hinged panel and open panel. Release the over-centre buckles on the retaining straps and remove the strap retaining hooks from the anchorages. Unscrew centre nut and remove wheel complete with mounting bracket. Remove the two nuts retaining the bracket and remove bracket.



**Fig. 127**  
Spare wheel mounting

To replace, reverse the removal procedure.

#### Rifle clips

**288.** Rifle clips are fitted on top of the dash, passenger side.

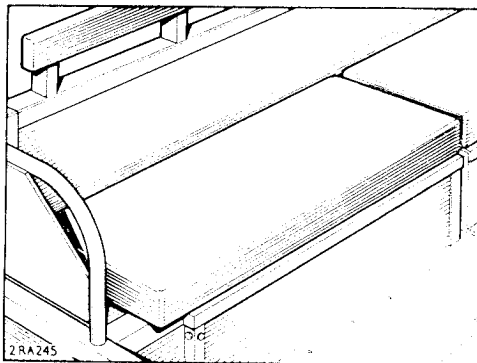
#### Front seats

**289.** The seat cushions can be removed by releasing the turn-buckle then lifting at the front and pulling forwards.

The driver's seat is adjustable for fore and aft movement by pushing to the left the lever at the left-hand side of the seat base and moving the seat into the required position.

#### Rear seats (when fitted)

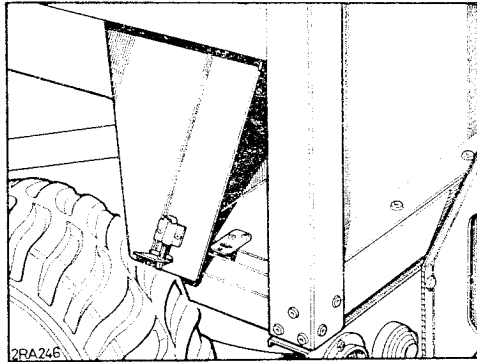
**290.** The rear seat frames are bolted to the body and wheelarch. The detachable cushions can be hinged up when not in use, to provide maximum carrying space.



**Fig. 128**  
Rear seats

**Tool stowage**

**291.** Small tools are carried in lockers above the rear wheel arch accessible from the outside.



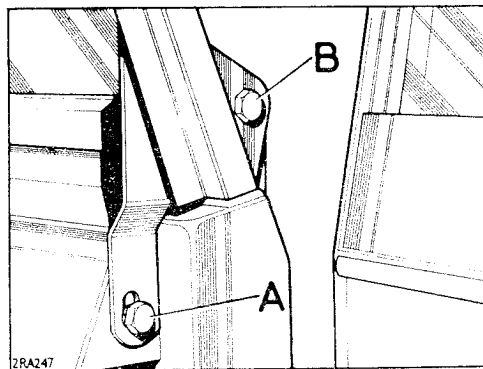
**Fig. 129**  
Tool locker

**Windscreen**

**292.** Provision is made for removing the windscreen as follows:

Remove the hood cleats from the windscreen top rail. Remove the bolts at the bottom corners of the windscreen from the inside and external support brackets and remove the windscreen.

The windscreen wiper arms are spring-loaded and fold outwards.



**Fig. 130**  
Windscreen fixing bolts

- A—Bolt, internal
- B—Bolt, external

**Windscreen wiper arm and blade replacement**

**293.** To replace a windscreen wiper blade, pull arm away from windscreen and rotate blade off end of arm. See Fig. 131.

Refit by reversing removal procedure.

### III

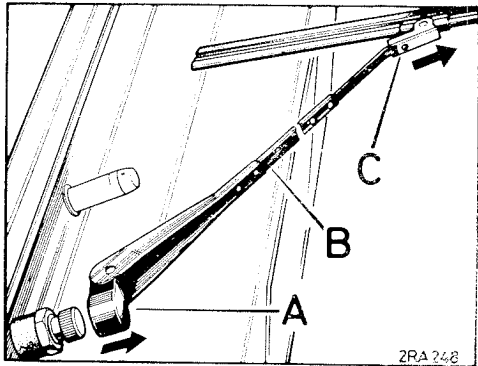
### User Servicing and Adjustments

294. To replace windscreen wiper blade and arm, pull arm away from windscreen and until it is almost at right angles with the screen. Then lever complete unit off the splines of wiper spindle, using a screwdriver.

To refit, position arm on spindle and push on to splines.

**Fig. 131**  
**Wiper blade and arm**

- A—Remove complete assembly by pulling in direction of arrow
- B—Wiper arm pulled forward
- C—Remove blade by pulling in direction of arrow



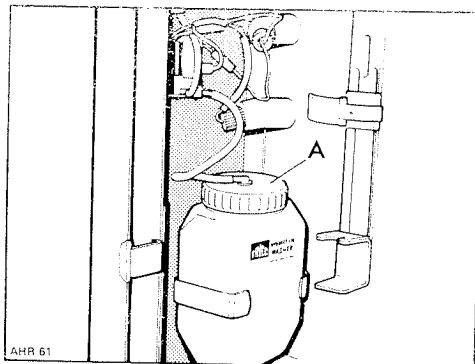
### Windscreen washer

295. Ensure that the windscreen washer reservoir is topped up. Unscrew cap to top up.

Where the ambient temperature is frequently at or below freezing point, 0°C (32°F), the system must be prevented from frost damage as follows: completely empty the reservoir and system and refill with a mixture of two parts water to one part methylated spirits. These proportions must be maintained whenever the reservoir is topped up.

**Fig. 132**  
**Windscreen washer reservoir**

- A—Filler cap



### Lubrication

**296.** Occasionally apply a few drops of oil on the door locks, hinges, tailgate, bodyside hinges and latches etc.

### Tailboard

**297.** In the horizontal position, the tailboard is retained by two chains. To remove the tailboard completely, remove the split pin and plain washer from one of the hinges, unhook the chains, split the number plate lamp electrical connection and slide the tailboard off its hinges.

### Cleaning body

**298.** It is always preferable to clean the bodywork with water and sponge, using plenty of water; wherever possible the surface should be freely hosed. Dry with a chamois leather.

Periodically wash the underside of the vehicle, to prevent the formation of mud pockets.

### Soft hood

**299.** The soft hood completely encloses the vehicle and can be opened at the rear to facilitate loading.

Should the hood and hood sticks have been removed at any time, they may be refitted in the following sequence:

- (1) Fit the two hood sticks in the sockets at the corners of the rear body and secure with clamp arms, bolts, washers and nuts.
- (2) Secure the tie tubes between the sticks by means of four self-locking nuts.
- (3) Fit the intermediate hood stick between the tie tubes, securing it with locknuts.
- (4) Secure the door top drain channels between the windscreen and front hood stick with bolts, plain washers and self-locking nuts.
- (5) If not already fitted, secure the door rear drain channels to the front hood stick with bolts, plain washers and self-locking nuts.
- (6) Place the hood over the sticks and secure it to the windscreen top rail.
- (7) Secure the front support straps to the support stays at the top of the windscreen.
- (8) Secure the rear hood straps to the staples on the body and the side curtain straps to the front hood stick.
- (9) Pass the side ropes round the hooks at the front corners of the body, secure under the side hooks and, together with the rear ropes, which have been previously laced round the rear hood stick, to the hooks at the rear of the body.

### III

### User Servicing and Adjustments

- (10) Push the rear curtain side flaps through the side pockets and secure.

If it is desired to raise the rear curtain, release the side flaps and the curtain bottom rope. Fold in the flaps and roll the curtain into three folds; secure by means of the short straps sewn inside the curtain.

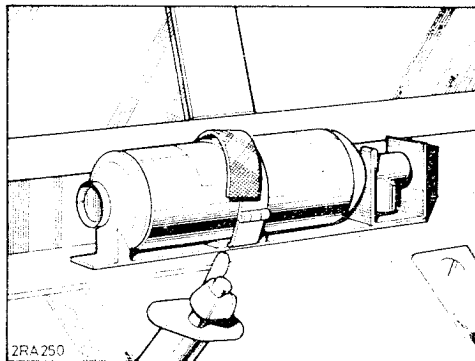
#### Checks

**300.** The following points on the body should be checked. All defects noted must be reported:

- (1) Check that nuts and screws securing the lock to the door are tight.
- (2) Check that the bolts fixing the support bracket for striking plate are tight.
- (3) Check that the door slightly compresses the rubber draught excluders when fully closed. If necessary, adjust the position of the striking plate by slackening the two securing bolts and nuts.
- (4) Check bolts and nuts securing door hinges.
- (5) Check the front and rear body securing bolts and nuts for tightness at all mounting points.
- (6) Check for tightness the bolts securing the radiator support bracket to the chassis frame.

#### Fire extinguisher

**301.** Two fire extinguishers are fitted; the external is secured beneath the windscreen whilst the internal is attached to the passenger compartment toe box.



**Fig. 133**

**Fire extinguisher, external illustrated**

**SAFETY HARNESS**

**Description**

**302.** The safety harness has two main components: a short tongue strap carrying the buckle, and a long combined diagonal shoulder and lap strap on which the mating lug is fitted.

In your own interests always use the safety harness provided, even for the shortest of journeys.

**Alterations and additions must NOT be made to this harness.**

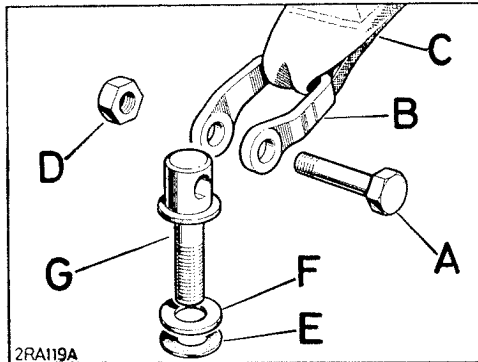
Harness which has been used in an accident or has become frayed or cut must be replaced.

**303.** Safety harness for both driver and outer passenger is fitted to the vehicle by means of shackle bolts and shackles. See Fig. 134.

- (1) If the shackle bolts are removed for any reason it is important that they are aligned as shown at Fig. 134 when they are refitted. Shackle must be allowed to rotate about shackle bolt; do not overtighten fixing nut.

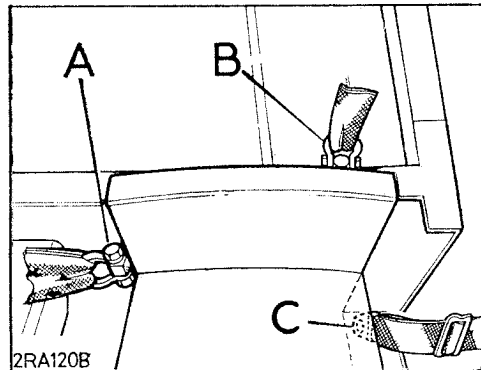
**Fig. 134**  
Shackle end fixings for safety harness

- A—Bolt
- B—Shackle
- C—Strap
- D—Nut
- E—Rubber washer
- F—Plain washer
- G—Shackle bolt



**Fig. 135**  
Location and fitted position of safety harness shackles.

- A—Inner shackle at seat base
- B—Upper shackle at body side
- C—Outer shackle at seat base



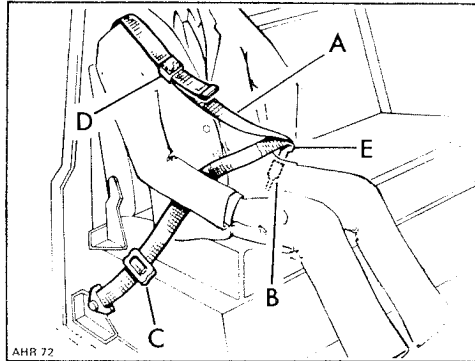
### III

### User Servicing and Adjustments

- (2) With the occupant seated in the front seat, the diagonal shoulder strap should pass over the outboard shoulder, as shown at Fig. 136.

**Fig. 136**  
Showing safety harness in correct position.

- A—Diagonal shoulder and lap strap
- B—Short strap with engagement/release buckle
- C—Main adjustment buckle
- D—Shoulder strap adjustment buckle
- E—Tongue on diagonal shoulder and lap strap

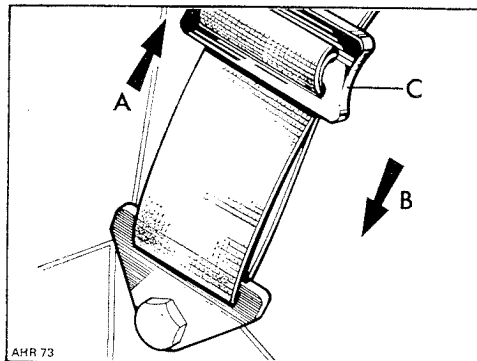


#### Main adjustment

- (3) With shoulder strap over the outboard shoulder make visual assessment of adjustment required. Adjustment to the length of the lap harness is made through the adjustment buckle (C) on the outer strap, shortening by pulling buckle in the direction of arrow 'A' or lengthening by pulling buckle in direction of arrow 'B'. Fig. 137.

**Fig. 137**  
Showing adjustment of lap harness

- A—Pull strap in direction of arrow to shorten
- B—Pull strap in direction of arrow to lengthen
- C—Main adjustment buckle



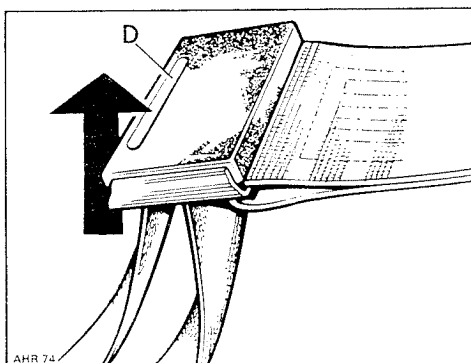
#### Day-to-day use of safety harness

**304.** To obtain the maximum designed protection from the safety harness, it is essential that it be properly fitted and adjusted.



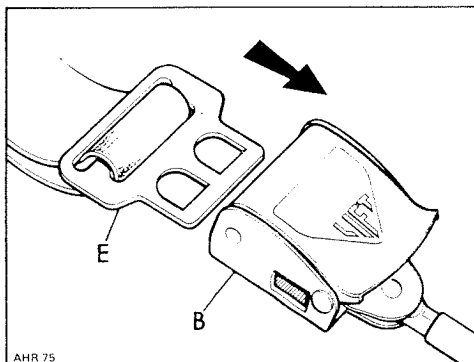
**Fig. 138**  
Showing adjustment of  
shoulder strap buckle

Pull in direction of  
arrow to slacken



- (1) Hold release buckle (D) on shoulder strap at right angles to the strap and slacken adjustment by pulling the buckle in direction of arrow. Fig. 138.
- (2) Pull the shoulder strap diagonally across the body until the tongue (E) can be inserted into the engagement/release buckle (B). A positive click ensures that the harness is safely locked. Fig. 139.

**Fig. 139**  
Showing safety harness  
connection



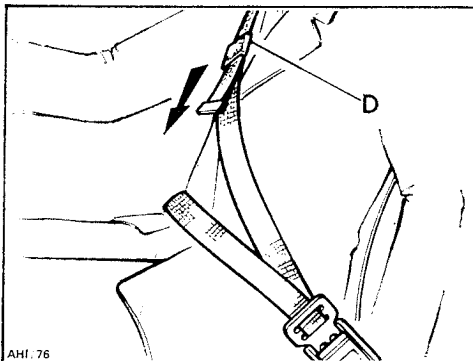
- (3) Tighten the harness by pulling short strap on adjustment buckle (D) in direction of arrow. Fig. 140.

### III

### User Servicing and Adjustments

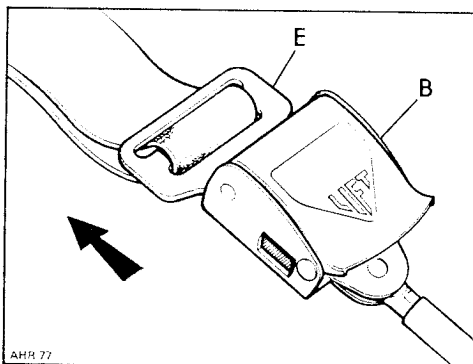
- (4) Straps should be comfortably tight, just enough to allow the hand to be passed between the upper shoulder strap and body. It is important to ensure that the lap belt is worn low so that it rests on the bony part of the hip.

The lap portion can usually be worn tighter than the shoulder portion without discomfort. Slack in the lap strap should be pulled through the slot in the engagement tongue and the shoulder strap adjusted as above.



**Fig. 140**  
Tightening of harness

- (5) To release the harness and leave the seat, simply lift the latch on the engagement/release buckle when the harness tongue (E) will disengage from the buckle.



**Fig. 141**  
Releasing safety harness buckle

Safety harness which have been used in an accident or have been frayed or cut must be replaced.

#### **Harness cleaning**

**305.** The safety harness may be washed in hand-hot water with soap or household detergent. Do not use any other cleaning fluid. Allow to dry naturally, do not apply heat.

## SECTION IV

### FAULT-FINDING CHART and CIRCUIT DIAGRAMS

**306.** Although every precaution is taken to eliminate all possible causes of trouble, failure may occasionally develop through lack of attention to the equipment, or damage to the wiring. The following pages set out the recommended procedure for a systematic examination to locate and remedy the causes of some of the more probable faults which may occur during the life of the vehicle.

All the checks listed can be readily carried out without special equipment; if the fault is not located in this way, the vehicle should receive workshop attention.

#### ENGINE FAILS TO START

**307.** Proceed as follows:

- (1) Check that the ignition is switched on.
- (2) Check that there is sufficient fuel in the tank.
- (3) Check that the cold start control is set correctly for starting (see para. 45).
- (4) Check that carburettors are not flooding due to sticking needle valve in float chambers.
- (5) Check that the engine is being turned at an adequate speed by the starter motor; this speed will be recognised after some experience with the vehicle.

If the cranking speed is too low:

- (i) Check the battery connections for tightness and cleanliness.
- (ii) Check the state of charge of the batteries by switching on the headlights and operating the starter motor; if the headlights go out or are very dim when the starter is operated, the battery requires recharging. See paras. 205 and 249.

It should be possible to start the engine by cranking with the starting handle.

- (6) (a) **12 volt models.** Lift the plug cover from each plug terminal in turn about 7 mm ( $\frac{1}{4}$  in.) and listen for the sharp snap of the spark as the engine is turned over. Sparking should be strong and regular.
- (b) **24 volt models.** Remove the screened lead from each sparking plug terminal in turn and hold it so that the end is about 7 mm ( $\frac{1}{4}$  in.) away from some metal part of the chassis.

while the engine is turned over; if sparks jump the gap regularly, the coil and distributor are functioning correctly.

- (7) (i) If the sparks are strong and regular, remove and clean the sparking plugs and reset the side electrode to give a gap of 0,60 mm (0.025 in.) on 12 volt and 24 volt models.
- (ii) If the sparks are not regular:
- (a) Check that the distributor rotor is in position.
  - (b) Check that the LT connections on the coil and distributor are clean and tight.
  - (c) Check that the distributor points are:
    1. Clean.
    2. Opening and closing correctly.
    3. Correctly set when open—gap 0,35—0,40 mm (0.014—0.016 in.).
  - (d) Check that current is present at the SW terminal on the coil, by disconnecting the wire at the coil end and touching it against the SW terminal, with the ignition switch on and the distributor contact-breaker points closed. If sparks occur, low tension current is flowing through the coil correctly; if there is no spark, either the coil or the low tension wiring is defective and the vehicle should receive workshop attention.
- (iii) If the sparks are weak and in addition there is a flashing at the distributor contact breaker points, a faulty distributor condenser is indicated.
- (iv) If the sparks are present on some leads, but not on others, check the distributor cap for cracks and the plug leads for damage.
- (8) Disconnect the petrol delivery pipe to the carburetter and check that petrol is delivered to the carburetter when the engine is turned over. See para. 106. If petrol is not delivered from the pipe:
- (i) Check that the petrol pipes and filters are clear.
  - (ii) Check that the oil pressure switch has not failed, see para 106.

#### ENGINE STARTS BUT SOON STOPS

**308.** Check as detailed below:

- (1) Check that the controls are set correctly (see para. 44).

- (2) Check the fuel feed to the carburetter. See para. 106.  
If there is little or no flow:
  - (i) Check the fuel level in the tank.
  - (ii) Check that the air vent in the filler neck is clear.
  - (iii) Check that the fuel filters are clear.
  - (iv) Check that the fuel pipes are clear.
- (3) Check that the carburetter float chamber needle valves are not sticking.
- (4) Check for a fault in the ignition circuit by connecting a wire between the ammeter and the SW (+) connection on the coil, thus by-passing the ignition switch. At the same time the wire from the ignition switch must be disconnected from the coil.

### ENGINE MISFIRES

**309.** Engine running on less than eight cylinders, either intermittently or continually.

- (1) Stop the engine and endeavour to re-start with the starter motor to check the state of the battery and connections. If the battery is in a low state of charge, the charging circuit should be checked as directed under charging circuit below.
- (2) (i) Check spark as detailed under para. 307, item 6 (a) for 12 volt models and item 6 (b) for 24 volt models.  
If no spark is present on one or more cylinders:
  - (a) Check for moisture on the ignition system.
  - (b) Check, clean and reset the distributor contact-breaker points to 0,35—0,40 mm (0.014—0.016 in.) as necessary.
  - (c) Check the distributor cap for cracks and the plug leads for damage.
- (ii) If the spark is irregular on all cylinders:
  - (a) Check for moisture as in (i) (a) above.
  - (b) Check the distributor points as in (i) (b) above.
  - (c) Check the cap and leads as in (i) (c) above.
  - (d) Check the LT connections for tightness and cleanliness.

- (e) Check for flashing or 'blueing' of the contact-breaker points. If present, the distributor condenser should be renewed.
  - (f) Check for a fault in the ignition circuit by connecting a wire between the ammeter and the SW ((+) on 'Universal' coils) connection on the coil, thus by-passing the ignition switch. At the same time, the wire from the ignition switch must be disconnected from the coil.
- (iii) Check for any audible alteration in the running of the engine, as each lead is removed. No alteration will indicate that the sparking plug in question is at fault:
- (a) Remove and clean the plug; reset the gap to 0,60 mm (0.025 in.) on 12 volt and 24 volt models as necessary.
  - (b) If still faulty, fit a new sparking plug.
- (3) If the 'missing' is accompanied by 'spitting back' through the induction, a valve may be sticking. This can often be cured by slowly dropping oil or upper cylinder lubricant into the carburetter intake, while the engine is running.

### LACK OF ENGINE POWER

310. Check the following points:
- (1) Check that the carburetter linkage is operating correctly.
  - (2) Check that the brakes are not binding and that the tyre pressures are correct.
  - (3) Check that the carburetter hydraulic dampers contain oil.
  - (4) Check carburetter piston assemblies move freely and return under spring load.
  - (5) Check float chamber for presence of water in fuel.
  - (6) Check ignition timing and ignition system generally.

### CHARGING CIRCUIT

311. Proceed as follows:
- (1) **Battery in low state of charge.**
    - (a) This state will be shown by lack of power when starting, poor light from the lamps and hydrometer readings

below 1.200, and may be due to the generator either not charging or giving low or intermittent output. Check the ammeter reading when the vehicle is running steadily in top gear with no lights in use; a definite steady charge should be indicated.

- (b) Examine the charging and field circuit wiring, tightening any loose connections, or replacing broken cables. Pay particular attention to the battery connections.
  - (c) Examine the fan and generator driving belt; take up any undue slackness by adjusting the generator on its mounting (see para. 97).
  - (d) If the cause of the trouble is not apparent, the vehicle should receive workshop attention.
- (2) **Battery overcharged.**

This will be indicated by burnt-out lamps, very frequent need for topping-up of battery and high hydrometer readings. The alternator or generator output should be checked using specialised equipment.

### **STARTER MOTOR**

**312.** Check points detailed below:

- (1) **Starter motor lacks power or fails to turn engine.**
  - (a) See if the engine can be turned over by hand. If not, the cause of the stiffness must be located and remedied.
  - (b) If the engine can be turned by hand, check that the trouble is not due to a discharged battery.
  - (c) Examine the connections to battery, starter motor and starter solenoid switch, making sure that they are tight and that the cables connecting these units are not damaged.
  - (d) It is also possible that the starter pinion may have jammed in mesh with the flywheel, although this is by no means a common occurrence. The starter motor should be removed and the cause investigated.
- (2) **Starter operates, but does not crank engine.**

This fault will occur if the pinion of the starter drive is not allowed to move along the screwed sleeve into engagement with the flywheel, due to dirt having collected on the screwed sleeve. Clean the sleeve carefully with kerosene.

- (3) **Starter pinion will not disengage from flywheel when engine is running.**  
Remove starter motor and investigate cause.

### LIGHTING CIRCUITS

313. Check the following points:

- (1) **Lamps give insufficient illumination.**  
(a) Test the state of charge of the battery, recharging it if necessary. See paras. 205 and 249.  
(b) Check the setting of the headlights (see paras. 226 and 277).  
(c) If the lamps are discoloured as a result of long service, they should be renewed.
- (2) **Lamps light when switched on, but gradually fade out.**  
As para. (1) (a).
- (3) **Brilliance varies with speed of vehicle.**  
(a) As para. (1) (a).  
(b) Examine the battery connections, making sure that they are tight; replace faulty cables.
- (4) **Lights flicker.**  
Examine the circuits of the lamps for loose connections.
- (5) **Failure of lights.**  
(a) As para. (1) (a).  
(b) Examine the wiring for a loose or broken connection and remedy.

**GOOD SERVICING IS ESSENTIAL FOR  
SUCCESSFUL FORDING**





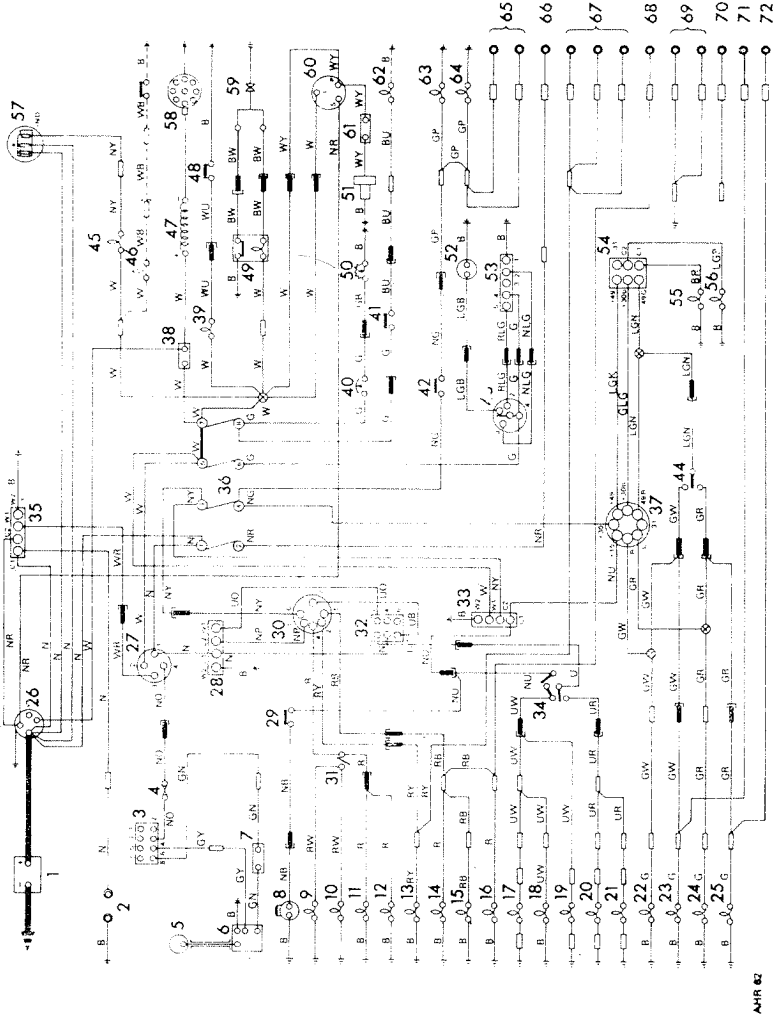


Fig. 142 Circuit diagram, 12 volt models

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# Circuit Diagrams

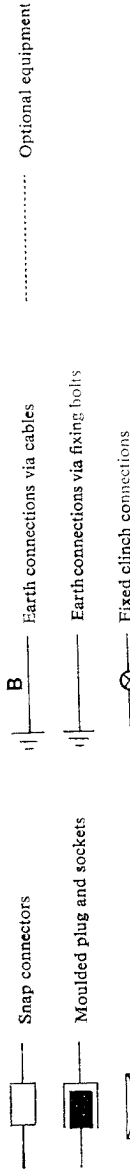
## Key to circuit diagram—12 volt models

- |    |                                  |    |   |    |   |
|----|----------------------------------|----|---|----|---|
| 1  | Battery, 12 volt                 | 27 | Ignition and starter switch                       | 52 | Windscreen washer pump                  |
| 2  | Inspection lamp sockets          | 28 | Relay for infra-red headlamp switch               | 53 | Windscreen wiper motor                  |
| 3  | Heater switch                    | 29 | Horn push   | 54 | Hazard warning and turnlight unit       |
| 4  | In-line fuse for heater          | 30 | Lighting switch, 6-way                            | 55 | Turnlight warning light                 |
| 5  | Heater motor                     | 31 | Panel light switch                                | 56 | Trailer warning light                   |
| 6  | Suppressor unit for heater motor | 32 | Headlamp infra-red switch                         | 57 | Alternator 16 ACR                       |
| 7  | Resistor                         | 33 | Headlamp relay                                    | 58 | Distributor                             |
| 8  | Horn                             | 34 | Headlamp flash and dipper switch                  | 59 | Brake system shuttle valve              |
| 9  | Grouped instrument illumination  | 35 | Starter motor relay                               | 60 | Oil pressor unit                        |
| 10 | Speedometer illumination         | 36 | Fuses   | 61 | Suppressor unit                         |
| 11 | Side lamp, RH                    | 37 | Hazard warning switch                             | 62 | Gearbox differential lock warning light |
| 12 | Side lamp, LH                    | 38 | Ballast resistor                                  | 63 | Stop lamp, RH                           |
| 13 | Convoy lamp                      | 39 | Warning light, cold start                         | 64 | Stop lamp, LH                           |
| 14 | Tail lamp, RH                    | 40 | Fuel gauge  | 65 | Stop lamp                               |
| 15 | Number plate illumination        | 41 | Gearbox differential lock switch                  | 66 | Auxiliary                               |
| 16 | Tail lamp, LH                    | 42 | Stop lamp switch                                  | 67 | Convoy                                  |
| 17 | Headlamp main beam, RH           | 43 | Windscreen wiper/washer switch                    | 68 | Tail                                    |
| 18 | Headlamp main beam warning light | 44 | Turnlight switch                                  | 69 | Earth                                   |
| 19 | Headlamp main beam, LH           | 45 | Ignition warning light                            | 70 | Spare                                   |
| 20 | Headlamp dipped beam, LH         | 46 | Winch warning light (when fitted)                 | 71 | Trailer turnlight, RH                   |
| 21 | Headlamp dipped beam, RH         | 47 | Ignition coil                                     | 72 | Trailer turnlight, LH                   |
| 22 | Turnlight, front RH              | 48 | Cold start switch                                 |    |   |
| 23 | Turnlight, rear RH               | 49 | Brake system warning light and test button switch |    |   |
| 24 | Turnlight, front LH              | 50 | Fuel tank gauge unit                              |    |   |
| 25 | Turnlight, rear LH               | 51 | Fuel pump   |    |   |
| 26 | Pre-engaged starter motor        |    |   |    |   |

## Key to cable colours

- |          |          |
|----------|----------|
| N—Brown  | U—Blue   |
| O—Orange | W—White  |
| P—Purple | Y—Yellow |
| R—Red    |          |

When cables have two code letters the first is the main colour, the second the tracer, i.e. RG—Red with Green





# Circuit Diagram

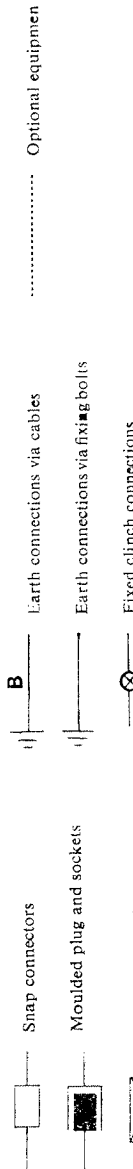
## Key to circuit diagram—24 volt models

1	Vehicle batteries, two 12 volt	56	Fuel tank unit
2	Inspection lamp sockets	57	Fuel pump
3	Heater motor	58	Gearbox differential lock switch
4	In-line fuse for heater	59	Windscreen washer pump
5	Suppressor unit for heater motor	60	Windscreen wiper motor
6	Resistor	61	Hazard warning unit
7	Horn	62	Turnlight warning light
8	Ammeter illumination	63	Trailer warning light
9	Grouped instrument illumination	64	Generator panel
10	Speedometer illumination	65	Alternator 90 amp
11	Side lamp, RH	66	Winch switch (when fitted)
12	Side lamp, LH	67	Distributor
13	Convoy lamp	68	Brake system shuttle valve
14	Tail lamp, RH	69	Oil pressure switch
15	Number plate illumination	70	Suppressor unit
16	Tail lamp, LH	71	Gearbox differential lock warning light
17	Headlamp main beam, RH	72	Stop lamp, RH
18	Headlamp main beam warning light	73	Stop lamp, LH
19	Headlamp main beam, LH	74	Stop lamp
20	Headlamp dipped beam, RH	75	Auxiliary
21	Headlamp dipped beam, LH	76	Tail lamp
22	Turnlight, front RH	77	Convoy
23	Turnlight, rear RH	78	Earth
24	Turnlight, front LH	79	Spare
25	Turnlight, rear LH	80	Trailer turnlight, RH
26	Pre-engaged starter motor	81	Trailer turnlight, LH
27	Heater switch		
28	Horn push		

## Key to cable colours

N—Brown	U—Blue
O—Orange	W—White
P—Purple	Y—Yellow
R—Red	

When cables have two code letters, the first is the main colour and the second the tracer, i.e. RG—Red with Green



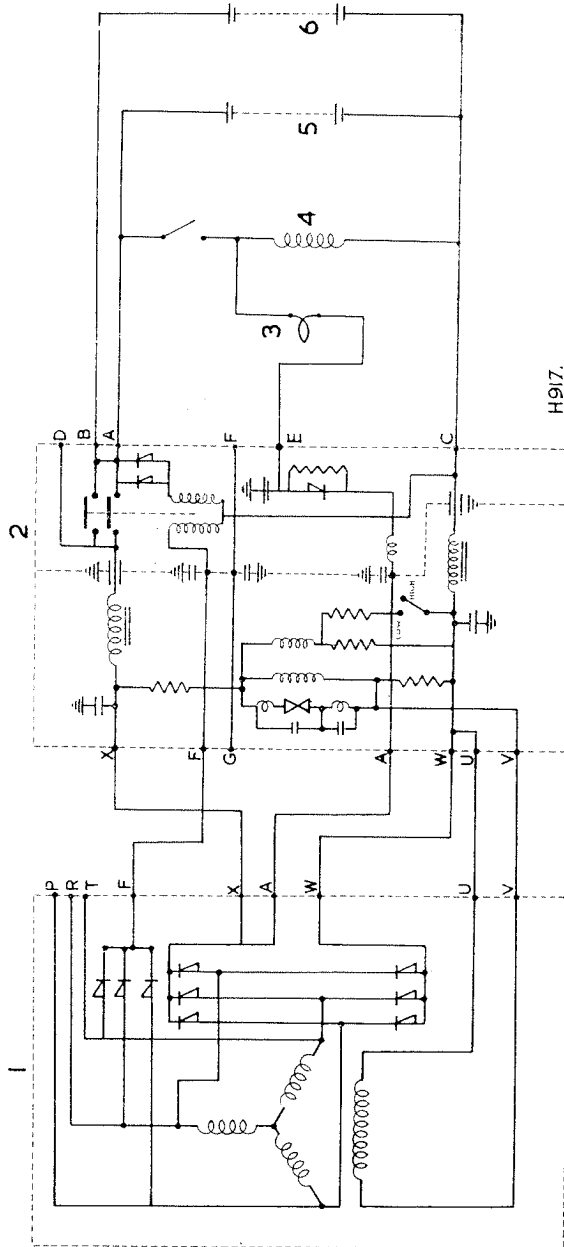


Fig. 144 Circuit diagram, charging details, 24 volt 90 amp generator

**Key to circuit diagram**

- 1 Generator
- 2 Generator panel
- 3 Charging warning light
- 4 Ignition coil
- 5 Vehicle batteries
- 6 Radio batteries

**Key to cable colours**

- B—Blank
- G—Green
- N—Brown
- O—Orange
- P—Purple
- R—Red
- S—Slate
- U—Blue
- W—White
- Y—Yellow

## SECTION V

# Optional Equipment

### 12 VOLT AND 24 VOLT MODELS

Some of the optional equipment which may be fitted to the Land-Rover 1 Tonne may need some explanation concerning its use. These details are given on the pages that follow under the appropriate headings.

## POWERED WINCH

### Description

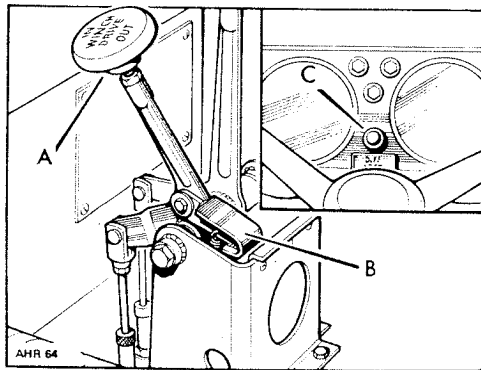
**314.** The winch is mounted on the left-hand chassis side member and is driven from a bottom power take-off unit fitted to the underside of the transfer gearbox. A multi pulley arrangement provides two alternative routes for the winch cable, giving a front or rear pull capability.

### Operation

**315.** The winch is controlled from the driving compartment by the lever with the green knob, mounted on the top of the radiator ducting. The lever incorporates a safety catch to prevent accidental engagement of the winch drive; there is also a white warning light fitted in the instrument panel that illuminates when the winch drive is engaged and is extinguished when the drive is disengaged.

**Fig. 145**  
Winch control lever and  
warning light

- A—Winch control lever
- B—Lever safety catch
- C—Warning light



All normal winching should be carried out with the transfer gear lever in the 'Neutral' position but, if the circumstances demand, it is permissible to winch and drive simultaneously in either 'Low' or 'High' transfer.

Any gear in the main gearbox may be selected for winching, giving four winching-in and one pay-out cable speeds relative to engine rev/min. The following chart provides a guide to the cable speeds obtainable in the specified gear at 1000 engine rev/min.

<i>Gear</i>		<i>Metres/min</i>	<i>ft/min</i>
Reverse	{ cable pay out	14.0	46
1	{ cable winching in	12.8	42
2		21.8	70
3		34.8	114
4		52.0	170

Operate the winch as follows:

- (i) Position the vehicle in line with the object to be recovered, or in the case of self-recovery the end of the cable should be anchored in line with the vehicle.
- (ii) Place the transfer gear lever in the 'NEUTRAL' position.
- (iii) Place the main gear lever in the 'neutral' position.
- (iv) Start the engine.
- (v) Lift the safety catch and move the winch control lever to the 'IN' position.
- (vi) Engage the required gear in the main gearbox, the winch will then commence operation when the clutch is released.
- (vii) After completion of the winching operation, rewind the remaining cable under light load to ensure even distribution on the drum, then move the main gear lever to the 'neutral' position and the winch control lever to the 'OUT' position.
- (viii) Stop the engine, as required.

### Lubrication

**316.** Lubricate the winch driving chain and cable assembly as necessary after use, also at the recommended intervals using approved lubricants.

### Winch drive gearbox and chain

**317.** Remove the oil level plug from the winch drive gearbox casing; oil should be level with the bottom of the plug hole, top up if necessary and replace plug.



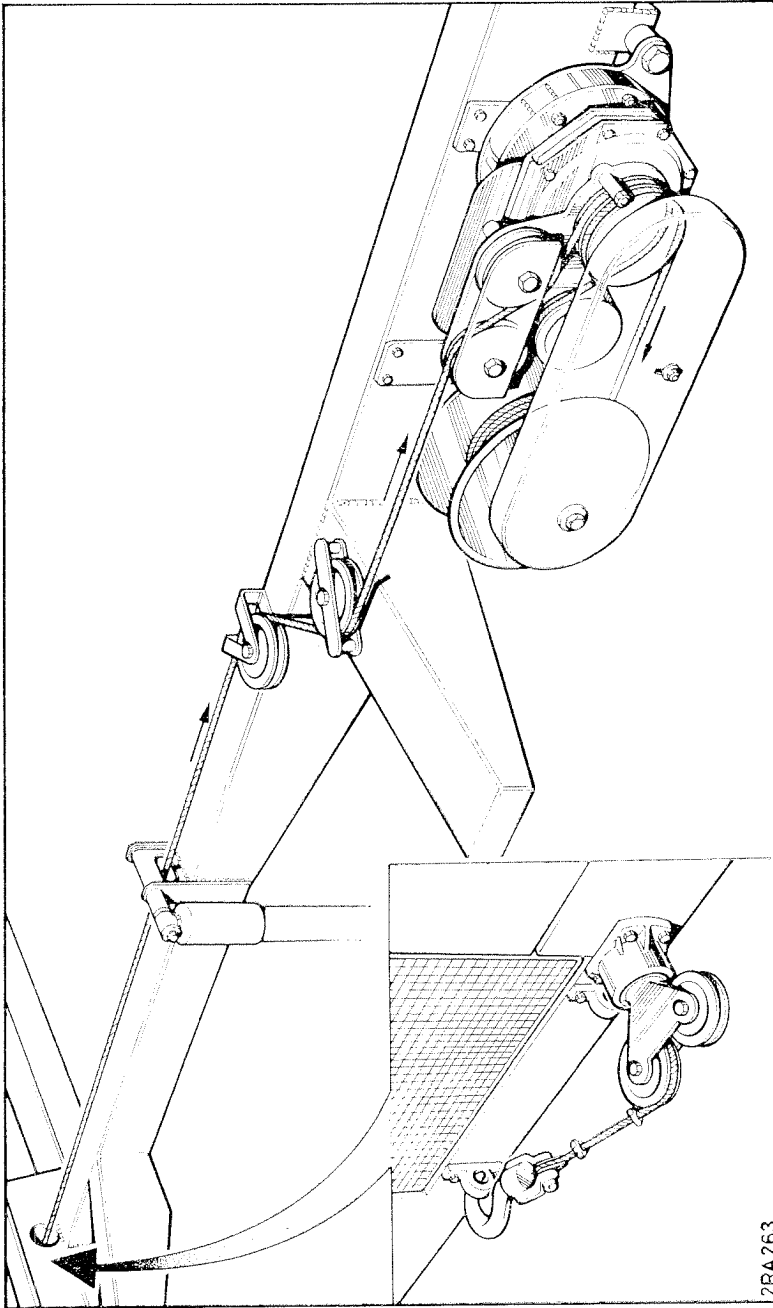


Fig. 146 Winch cable layout, forward pulling

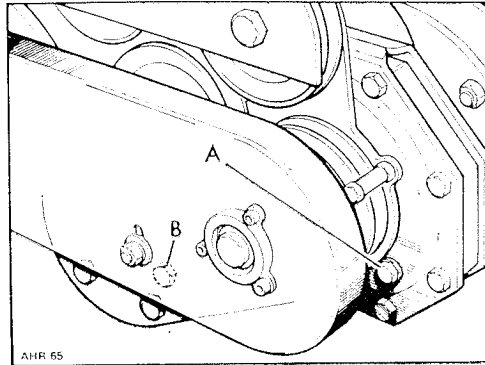
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Remove the oil filler/level plug from the base of the main gear casing and fill to bottom of the plug hole.

**Fig. 148**  
**Winch lubrication**

- A—Winch drive gearbox oil level plug
- B—Main gear casing oil level/filler plug



### Winch cable

**318.** When not in constant use, lubrication of the winch driving chain must be carried out frequently to prevent rusting of the chain. Fully extend the winch cable as described previously, clean and lubricate, including cable drum anchorage end. Re-wind the cable under **light** load to ensure even distribution on the drum.

## POWERED TRAILER

### Description

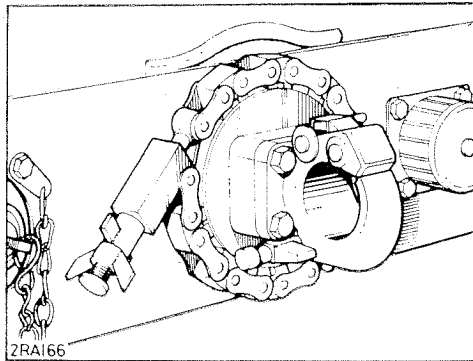
**319.** The trailer incorporates a selectable driven axle capability, and features a differential unit coupled by propeller shafts to a power take-off unit fitted to the rear of the vehicle transfer gearbox. The trailer brakes are connected by a vacuum system to the vehicle foot and hand brake systems. The lighting harness fitted to the trailer is connected by a twelve-pin plug and socket to the vehicle lighting circuit.

### Operation

**320.** The drive to the trailer axle is controlled from the driving compartment by the lever with the blue knob mounted on the top of the radiator ducting. See para. 18.

All normal driving should be carried out with the trailer drive disengaged (control lever in the 'OUT' position). When trailer drive is required the gearbox differential lock must be engaged (para 53) prior to moving the control lever to the 'IN' position. This can be done with the vehicle travelling at any speed.

**Fig. 149**  
Rear trailer drive coupling



**Couple the trailer to the vehicle as follows:**

- (i) Release the chain from the coupling flange clamp at the rear of the vehicle and withdraw the towing hook, if fitted.
- (ii) Align the trailer drive, with the trailer on its support stand and the hand brake applied (vacuum released).
- (iii) Engage the drive and secure the coupling flanges with the clamping chain.
- (iv) Withdraw the blanking plug from the vacuum pipe coupling at the rear of the vehicle by rotating the knurled sleeve while pushing it inward.
- (v) Connect the vacuum pipe from the trailer to the vehicle socket and return the knurled sleeve to the retaining position.
- (vi) Withdraw the blanking cover from the vehicle twelve-pin lighting socket and connect the plug from the trailer lighting harness.

**Fig. 150**  
Rear trailer drive coupling  
ready for trailer

- A—Flange clamp  
B—Clamping chain  
C—Blanking plug from  
vacuum pipe  
coupling  
D—Twelve-pin lighting  
socket

