Ministry of Defence

de&s

[redacted]
DE&S Secretariat (Land Equipment and ISTAR)

[redacted]

Via:

[redacted]

DESSEC-PolSecLE-JSC-WPNS@mod.uk

Defence Equipment & Support
Maple 0a # 2043
MOD Abbey Wood
Bristol BS34 8JH

6th January 2017 Our Ref: FOI2016/12403

Dear [redacted],

Thank you for your email of 15th December 2016 requesting the following information:

Vehicle: Leyland DAF T244, military registration AT46AA.

I have recently purchased the above detailed Leyland DAF T244 4-tonne 4x4 lorry from the Ministry of Defence disposal sales.

You recently kindly released a number of documents relating to this vehicle type and I would like to locate some further documents or manuals regarding the operation and maintenance of my vehicle. The particular documents I am looking for are those detailed below:

AESP 2320-H-104-101 Purpose and Planning,
AESP 2320-H-104-111 Equipment Support Policy Directive,
AESP-2320-H-104-302 Technical Description, and
AESP-2320-H-104-831 Service Engineered Modification Instructions.

Any information would be gratefully received and would be for personal use as described. Electronic copies of any available information would be preferable but paper copies would be acceptable.

I am treating your correspondence as a request for information under the Freedom of Information Act 2000 (FOIA).

A search for the information has now been completed within the Ministry of Defence, and I can confirm that some information in scope of your request is held.

The information you have requested cannot be sent by email due to the size of the files and the information will be sent by post, but some of the information falls entirely within the scope of the absolute exemption provided for at section 40 (Personal Data) and qualified exemption provided for at section 26 (Defence) of the FOIA and has been redacted.

Section 40(2) has been applied to some of the information in order to protect personal information as governed by the Data Protection Act 1998. Section 40 is an absolute exemption and there is therefore no requirement to consider the public interest in making a decision to withhold the information.

Section 26 is a qualified exemption and subject to public interest testing which means that the information requested can only be withheld if the public interest in doing so outweighs the public interest in disclosure.

Section 26(1)(b) has been applied to some of the information because it contains details which are operationally sensitive and would prejudice the capability and effectiveness of our armed forces. The documents contain information which would allow for the formation of tactics by potential enemies of UK forces to be used against the vehicles taking advantage of limitations inherent in each of the different systems. The balance of public interest was found to be in favour of withholding the information given that, overall, the public interest is best served in not releasing any details that could put the physical safety of UK troops at risk and for these reasons I have set the level of prejudice against release of the exempted information at the higher level of "would" rather than "would be likely to".

If you are not satisfied with this response or you wish to complain about any aspect of the handling of your request, then you should contact me in the first instance. If informal resolution is not possible and you are still dissatisfied then you may apply for an independent internal review by contacting the Information Rights Compliance team, Ground Floor, MOD Main Building, Whitehall, SW1A 2HB (e-mail CIO-FOI-IR@mod.uk). Please note that any request for an internal review must be made within 40 working days of the date on which the attempt to reach informal resolution has come to an end.

If you remain dissatisfied following an internal review, you may take your complaint to the Information Commissioner under the provisions of Section 50 of the Freedom of Information Act. Please note that the Information Commissioner will not investigate your case until the MOD internal review process has been completed. Further details of the role and powers of the Information Commissioner can be found on the Commissioner's website, http://www.ico.org.uk.

Yours sincerely,

[redacted]

[redacted]
DES SEC Pol Sec Land Equipment & ISTAR

ARMY EQUIPMENT
SUPPORT PUBLICATION

2320-H-104-101
4th Edition dated Jun 2013
(Superseding 3rd Edition dated Jan 12)

TRUCK, 4 TONNE, 4X4 GS LEYLAND DAF (ALL VARIANTS)

PURPOSE AND PLANNING INFORMATION

Sponsored for use in the
UNITED KINGDOM MINISTRY OF DEFENCE
AND ARMED FORCES
by

DEFENCE EQUIPMENT & SUPPORT
GENERAL SUPPORT VEHICLE PROJECT TEAM

MOD Abbey Wood
Bristol
BS34 8JH

Publication Authority:

GENERAL SUPPORT VEHICLE PROJECT TEAM

CONDITIONS OF RELEASE

~~This information is released by the UK Government for Defence purposes only.~~

~~This information must be afforded the same degree of protection as that afforded to information of an equivalent security marking originated by the recipient Government or as required by the recipient Government's security regulations.~~

~~This information may be disclosed only within the Defence Department of the recipient Government, except as otherwise authorized by the Ministry of Defence (Army).~~

This information may be subject to privately owned rights.

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Amdt No.	Incorporated by (Signature)	Date
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		

CONTENTS

PRELIMINARY MATERIAL Page

PURPOSE AND PLANNING INFORMATION

Para

Fig Page

PREFACE

Sponsor: GSV PT
Project No.:
File Ref:

Publication Authority: DGS&E-TIG

INTRODUCTION

1 Service users should forward any comments on this publication through the channels prescribed in Army Equipment Support Publication (AESP) 0100-P-011-013. An AESP Form 10 is provided at the end of this publication; it should be photocopied and used for forwarding comments on this AESP.

2 AESPs are issued under UK MoD authority and where AESPs specify action is to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores, subject to the provisions of Para 3 below.

3 The subject matter of this publication may be affected by Defence Instructions and Notices (DIN), Standard Operating Procedures (SOP) or by local regulations. When any such instruction, Order or Regulation contradicts any portion of this publication it is to be taken as the overriding authority.

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

4 The Octad for the subject equipment consists of the publications shown opposite. All references are prefixed with the first eight digits of this publication. The availability of the publications can be checked by reference to the relevant Group Index (see AESP 0100-A-001-013).

Category/Sub-category			Information Level			
			1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
1	0	Purpose and Planning Information	101	101	101	101
	1	Equipment Support Policy Directive	111	111	111	111
2	0	Operating Information	201	201	201	201
	1	Aide-Mémoire	*	*	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	*	302	302	302
4	1	Installation Instructions	411	*	*	*
	2	Preparation for Special Environments	421	421	423	*
5	1	Failure Diagnosis	*	512	*	*
	2	Maintenance Instructions	*	522	523	*
	3	Inspection Standards	*	532	533	*
	4	Calibration Procedures	*	*	*	*
6		Maintenance Schedule	601	601	601	601
7	1	Illustrated Parts Catalogue	711	711	711	711
	2	Commercial Parts List	*	*	*	*
	3	Complete Equipment Schedule, Production	*	*	*	*
	4	Complete Equipment Schedule, Service Edition (Simple Equipment)	741	741	741	741
	5	Complete Equipment Schedule, Service Edition (Complex Equipment)	*	*	*	*
8	1	Modification Instructions	811	811	811	811
	2	General Instructions, Special Technical Instructions and Servicing Instructions	821	821	821	821
	3	Service Engineered Modification Instructions (RAF only)	831	831	831	831

* Category/sub-category not published

Associated publications

5 The following associated publications should be read in conjunction with this publication:

Reference	Title
AC P/34255/1	Complete Equipment Schedule
AESP 2910-F-101-302	CAV Fuel Injection Pumps DPS
AP 4545 Volume 2	Mechanical Transport - Orders and Modifications Mobile Cranes
JSP351	MT Driver's Handbook

WARNINGS AND CAUTIONS

WARNINGS

6 The following WARNINGS are applicable to this equipment.

(1) DO NOT CARRY START PILOT CANISTERS IN THE VEHICLE CAB.

(2) DO NOT EXPOSE START PILOT CANISTERS TO A NAKED FLAME, SPARK OR ANY INTENSE HEAT SOURCE.

(3) ENSURE THAT ALL PERSONNEL ARE KEPT CLEAR OF THE AREA IMMEDIATELY IN FRONT OF THE VEHICLE WHEN TILTING THE CAB AND THAT THERE IS ADEQUATE CLEARANCE IN FRONT AND ABOVE THE CAB.

(4) DO NOT REMOVE THE PRESSURE OR FILLER CAPS FROM THE COOLING SYSTEM HEADER TANK WHILST THE ENGINE IS RUNNING OR WHEN THE SYSTEM IS HOT.

CAUTIONS

7 There are no CAUTIONS applicable to this equipment.

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

8 The following abbreviations are used in this publication:

AESP	Army Equipment Support Publication
AP	Air Publication
BFPO	British Forces Post Office
CALM	Crane Attachment Lorry Mounted
C	Celsius
c/w	complete with
DGS&E-TIG	Director General Safety and Engineering-Technical Information Group
DIN	Defence Instructions and Notices
FFR	Fitted For Radio
FRACAS	Failure Reporting Analysis and Corrective Action System
GS	General Service
GSV IPT	General Support Vehicles Integrated Project Team
JSP	Joint Service Publication
kg	kilogramme
kN	kiloNewton
km	kilometre
km/hr	kilometres per hour
LHD	Left Hand Drive
m	metre
MLC	Military Load Classification

mm	millimetre
MoD	Ministry of Defence
m/min	metres per minute
m^3	metres cubed
NATO	North Atlantic Treaty Organisation
NSN	NATO Stock Number
SOP	Standard Operating Procedures
UK	United Kingdom
V	Volt

SYMBOLS

9 The following symbols are applicable to this equipment:

%	percentage
°	degrees

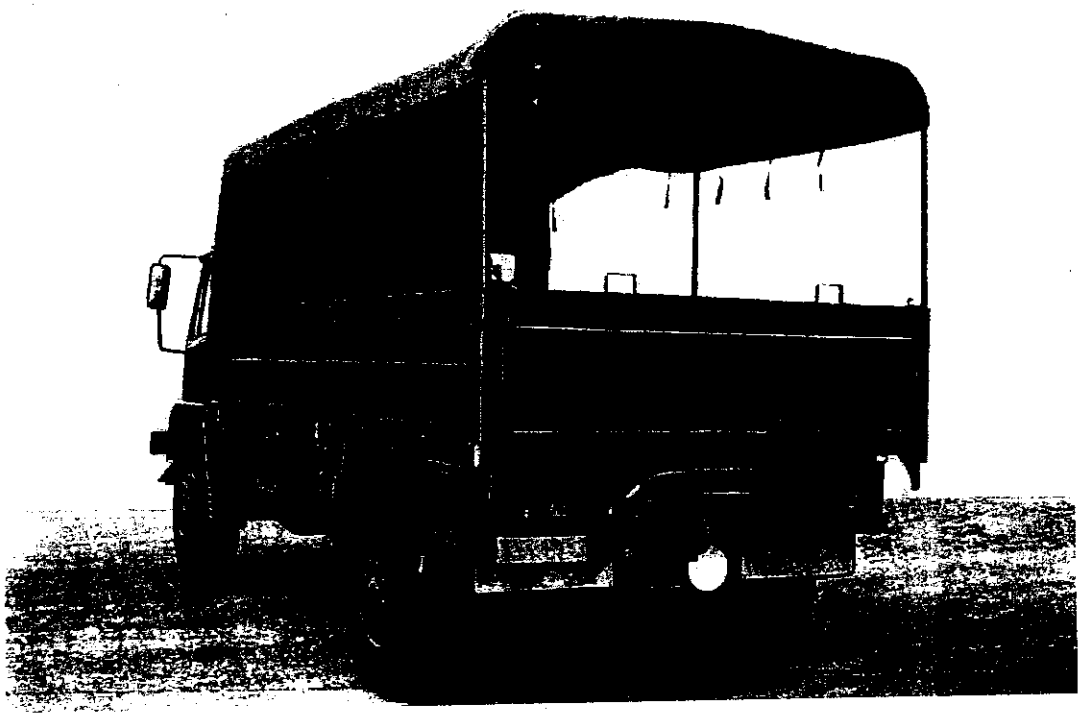


Fig 1 Frontispiece

PURPOSE AND PLANNING INFORMATION

EQUIPMENT IDENTITY

1 **Designation**

TRUCK, CARGO FLAT PLATFORM, 4 TONNE, 4x4 GS.

Vehicle Asset Code
LHD [redacted] [redacted]

TRUCK, CARGO, 4 TONNE, 4x4, GS C/W DROPSIDES TAILBOARD, TILT SUPERSTRUCTURE AND CANOPY

Vehicle Asset Code
LHD [redacted] [redacted]

TRUCK, CARGO 4 TONNE, 4x4, GS C/W WINCH, DROPSIDES, TAILBOARD, TILT SUPERSTRUCTURE AND CANOPY

Vehicle Asset Code
LHD [redacted] [redacted]

TRUCK, FLAT PLATFORM, 4 TONNE, 4x4 GS WITH CALM

Vehicle Asset Code
LHD [redacted] [redacted]

TRUCK, CARGO, 4 TONNE, 4x4 GS (BULK FUEL)

Vehicle Asset Code [redacted] [redacted] [redacted]

TRUCK, CARGO, 4 TONNE, 4x4 GS, C/W DROPSIDES TAILBOARD, TILT SUPERSTRUCTURE AND 3T CRANE

Vehicle Asset Code [redacted] [redacted]

TRUCK FLAT PLATFORM, 4 TONNE, 4x4 FFR C/W WINCH AND DROP PLATE TOW HOOK

Vehicle Asset Code [redacted] [redacted]

TRUCK FLAT PLATFORM, 4 TONNE, 4x4 C/W WINCH AND DROP PLATE TOW HOOK

Vehicle Asset Code [redacted] [redacted]

Manufacturer Leyland DAF

Contract Number FVE 22A/410

ROLE

2 A General Purpose Medium Mobility Carrier for the conveyancing of equipment and personnel on cross country or normal roads.

2.1 When specified assets are modified as below, the Leyland DAF 4T Cargo will be able to carry out the gun towing role for the 105mm Light Gun, in support of training in UK and Europe. Applicable asset codes:- [redacted]

DESCRIPTION

3 The vehicle is a permanent four wheel drive type with a payload of 4.2 tonne. It is designed to carry either three NATO pallets, three unit containers, one ten foot ISO container or a CB 300 series container. It can be supplied with a 55 kN capacity winch or a 6.3 tonne/metre crane.

4 The cab is constructed of steel with a reinforced roof and a roof hatch with hip ring. The flat platform is all steel construction with a waterproof removable canvas tilt, it has drop sides with fixed bulkhead and removable posts.

PHYSICAL DATA

5 Dimensions

Length overall		
Cargo vehicle		6650 mm
Flat platform vehicle		6587 mm
Width overall (excluding mirrors)		2490 mm
Height overall (Unladen)		3343 mm
Ground clearance (Laden)		320 mm
Wheelbase		3950 mm
Wheel track		2100 mm
Flat platform height	(Unladen)	1405 mm
	(Laden)	1325 mm

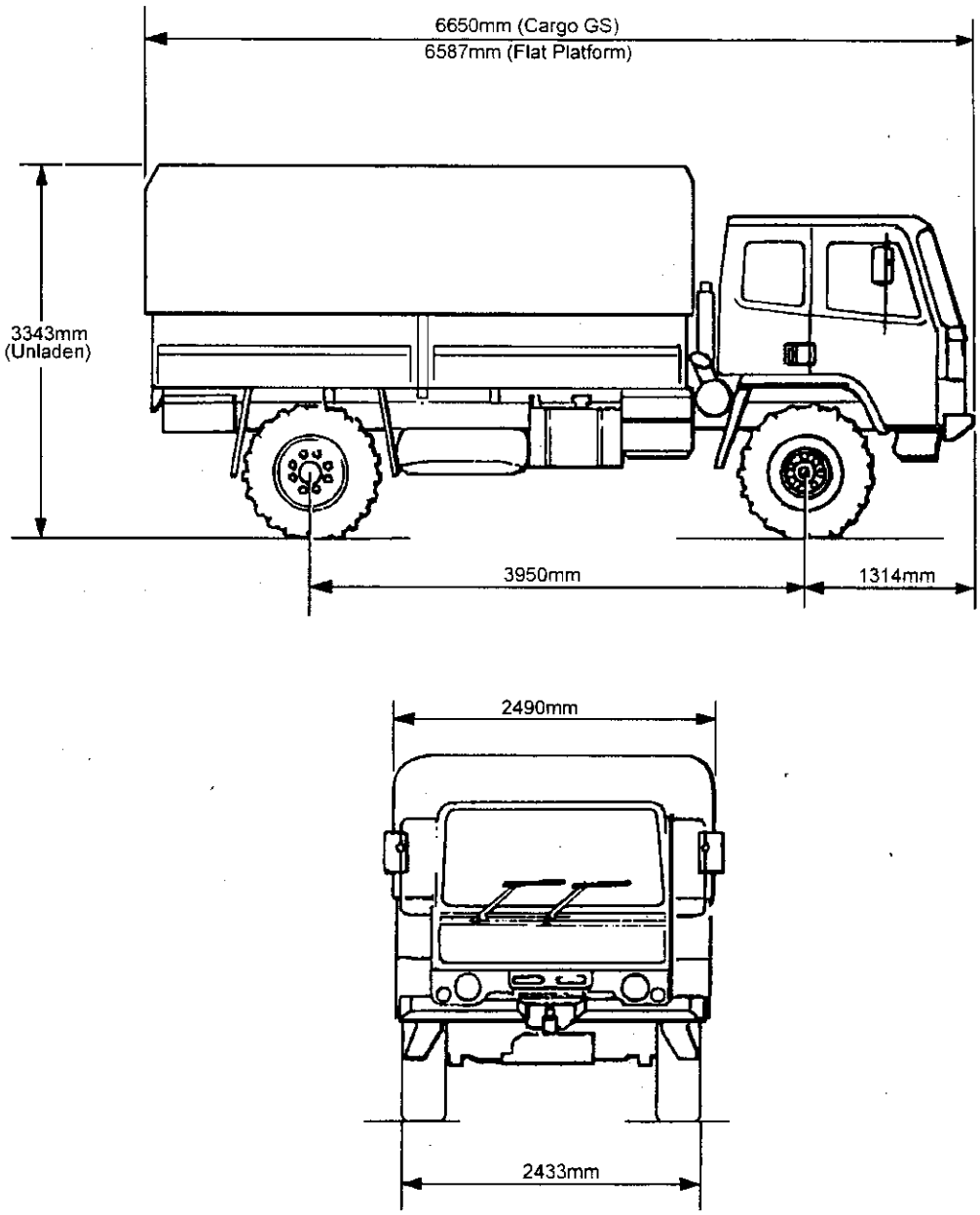


Fig 1 Vehicle dimensions

6 **Capacities**

Cooling system (including heater)	26 litres
Fuel tank	135 litres
Engine oil (dry)	16 litres
Engine oil (refill)	14.2 litres
Main gearbox oil	5.7 litres
Transfer gearbox oil (refill)	2.0 litres
Rear axle oil	5.7 litres
Front axle oil	5.7 litres
Power Take-off (PTO)	0.45 litres
Steering (Power steering system)	2.3 litres
Winch gearbox oil	2.55 litres
Winch hydraulic reservoir	100 litres

7 **Engine** Leyland DAF 3000 series, 6 cylinder, in line diesel with direct injection and turbo-charged. Capacity 5.9 litres producing 108 kW (145 bhp) at 2600 rev/min. The engine is liquid cooled and has a system pressure of 0.5 bar (7.25 lbf/in.^{2}).

8 **Clutch** Self-adjusting Borg and Beck single plate diaphragm spring type. Hydraulically operated with air assistance.

9 **Gearbox** Five speed manually operated with constant mesh gearing and syncromesh forward gears.

10 **Transfer gearbox** Provides four wheel permanent drive with two selective gear ratios and neutral, and incorporates a differential lock.

11 **Steering** Power assisted and uses an integral recirculating ball type steering box.

12 **Front axle** Drive to front wheels is transmitted through a sprial bevel differential and drive shafts with constant velocity joints.

13 **Rear axle** Similar differential to front.

14 **Suspension** The front suspension consists of two parabolic taper twintrap spring assemblies and twin tubed telescopic shock absorbers. Each rear suspension consists of a two leaf and helper spring and shock absorbers.

15	**Brakes**	The service brakes are dual circuit air actuated. A handbrake control valve operates the front and rear spring brake actuators.
16	**Wheels and Tyres** **Wheel type**	Wheel rims are 3 piece B8. 0 x 20 in. wide base with interrupted spigot mounting. Front wheels fitted with annular lifting plates for air transportation
	Tyres	Standard size 12.00 x 20 18 ply rating radial; Inner tube 12.00 x 20/F20.
17	**Electrical system**	Double pole system and 28 V (nominal) supply with a battery isolation switch which can be remotely controlled from the cab.

PERFORMANCE

18	Maximum sustained safe cruising speed on roads	88 km/hr
	Maximum gradient for stop and re-start	[redacted]
	Turning circle (kerb to kerb) both locks	[redacted]
	Wading depth	750 mm
	Departure angle (Laden)	[redacted]
	Approach angle (Laden)	[redacted]
	Fuel consumption (laden and solo)	at constant 48 km/h 14 litres/100 km at constant 80 km/h 21 litres/100 km

ENVIRONMENTAL DATA

19	Temperature range	(in use)	-31° C to +44° C
		(in storage)	-34° C to +63° C
	Terrain		Prepared roads, tracks and cross-country

TRANSPORTATION DATA

20	Airportability	Air portable in Hercules aircraft and also suspended transportation
	Shipping tonnage (Measurement) Cargo GS Flat Platform	[redacted]
	Bridge classification	13 MLC

Axle loading

Cargo GS (Flat platform)

Front axle [redacted]) Unladen

Rear axle [redacted])

Cargo GS (Bodied)

Front axle [redacted]) Unladen

Rear axle [redacted])

Cargo GS (With CALM)

Front axle [redacted]) Unladen

Rear axle [redacted])

Plated weights

Gross vehicle weight [redacted]

Front axle [redacted]

Rear axle [redacted]

Gross train weight [redacted]

WINCH DATA

21 Working length of rope 75 m

Single line pull over length of rope 55 kN

Winching rope speed (max) 23 m/min

CRANE DATA

22 Crane capacity [redacted]

Reach (max) 5 m

ASSOCIATED PUBLICATIONS AND REFERENCES

23 AESP 2910-F-101-302 CAV FUEL INJECTION PUMP DPS

JSP 351 MT DRIVER'S HANDBOOK

AP 4545 Volume 2 MECHANICAL TRANSPORT - ORDERS AND MODIFICATIONS MOBILE CRANES.

ARMY EQUIPMENT AND SUPPORT PUBLICATION (AESP) AND ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS (EMER) - FORM 10

*AESP/EMER NUMBER:		*IS THIS SAFETY RELATED?	YES ☐	No ☐

Send Form 10 via the Email or Post address. However email is preferred.	Tel [redacted]
Email: [redacted]	Post to [redacted]

ORIGINATORS DETAILS:			
*Address		*Name	
		Rank / Grade	
		*Phone	
		*Senders Reference	
		*Date Raised	
* E-Mail		Eqpt Asset Code if applicable	

AESP/EMER DETAILS:							
*Full Title of AESP/EMER (Not the AESP/EMER Number)							
*Edition	*Amendment	*Chapter	*Paragraph	*Page	Figure	Instruction	Other

*Comments: If additional information is to be supplied, please e-mail with the Form 10 as separate attachments.

FORM 10 CELL USE:			
*Date Received		*Form 10 Reference	
*Date Sent to PT / SME		TDOL Problem Report	

PROJECT TEAM / SME RESPONSE TO COMMENTS:			
Project Team (PT) / SME		Sponsors Name	
*Phone		Rank / Grade	
*Email		*Date Received	

*The following action is to be carried out:	Mark:		Mark:
Issue a revised/amended AESP/EMER:		Under investigation:	
Incorporate comment(s) in future amendments:		No action required:	

Remarks:

SPONSOR/PT FINAL CLOSURE STEPS	Mark:	Form 10 Cell notified of Date action taken	Date:
Form 10 Originator notified of the action taken:			

* Fields are mandatory for form initiator

* Fields are required to complete

TRUCK, 4 TONNE, 4X4 GS LEYLAND DAF (ALL VARIANTS)

EQUIPMENT SUPPORT POLICY DIRECTIVE

Sponsored for use in the
UNITED KINGDOM MINISTRY OF DEFENCE
AND ARMED FORCES
by

DEFENCE EQUIPMENT & SUPPORT
GENERAL SUPPORT VEHICLE PROJECT TEAM

MOD Abbey Wood
Bristol
BS34 8JH

Publication Authority:

GENERAL SUPPORT VEHICLE PROJECT TEAM

CONDITIONS OF RELEASE

~~This information is released by the UK Government for Defence purposes only.~~

~~This information must be afforded the same degree of protection as that afforded to information of an equivalent security marking originated by the recipient Government or as required by the recipient Government's security regulations.~~

~~This information may be disclosed only within the Defence Department of the recipient Government, except as otherwise authorized by the Ministry of Defence (Army).~~

This information may be subject to privately owned rights.

~~THIS DOCUMENT IS THE PROPERTY OF HER BRITANNIC MAJESTY'S GOVERNMENT, and is issued for the information of such persons only as need to know its contents in the course of their official duties. Any person finding this document should hand it in to a British forces unit or to a police station for its safe return to the Ministry of Defence, (DDef Sy), Main Building, Whitehall London, SW1A 2HB, with particulars of how and where found. THE UNAUTHORIZED RETENTION OR DESTRUCTION OF THIS DOCUMENT IS AN OFFENCE UNDER THE OFFICIAL SECRETS ACTS OF 1911-1989. (When released to persons outside Government service, this document is issued on a personal basis. The recipient to whom it is entrusted in confidence, within the provisions of the Official Secrets Acts 1911-1989, is personally responsible for its safe custody and for seeing that its contents are disclosed only to authorized persons).~~

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Amdt No.	Incorporated by (Signature)	Date
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		

CONTENTS

PRELIMINARY MATERIAL Page

EQUIPMENT SUPPORT POLICY DIRECTIVE

Para

Table Page

Annex

PREFACE

Sponsor: GSV PT
Project No.: GSV2/5002
File Ref: GSV/18/33/02

Publication Authority: DGS&E-TIG

INTRODUCTION

1 Service users should forward any comments on this publication through the channels prescribed in Army Equipment Support Publication (AESP) 0100-P-011-013. An AESP Form 10 is provided at the end of this publication; it should be photocopied and used for forwarding comments on this AESP.

2 AESPs are issued under UK MoD authority and where AESPs specify action is to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores, subject to the provisions of Para 3 below.

3 The subject matter of this publication may be affected by Defence Instructions and Notices (DIN), Standard Operating Procedures (SOP) or by local regulations. When any such instruction, Order or Regulation contradicts any portion of this publication it is to be taken as the overriding authority.

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

4 The Octad for the subject equipment consists of the publications shown opposite. All references are prefixed with the first eight digits of this publication. The availability of the publications can be checked by reference to the relevant Group Index (see AESP 0100-A-001-013).

Category/Sub-category			Information Level			
			1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
1	0	Purpose and Planning Information	101	101	101	101
	1	Equipment Support Policy Directive	111	111	111	111
2	0	Operating Information	201	201	201	201
	1	Aide-Mémoire	*	*	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	*	302	302	302
4	1	Installation Instructions	411	*	*	*
	2	Preparation for Special Environments	421	421	423	*
5	1	Failure Diagnosis	*	512	*	*
	2	Maintenance Instructions	*	522	523	*
	3	Inspection Standards	*	532	533	*
	4	Calibration Procedures	*	*	*	*
6		Maintenance Schedule	601	601	601	601
7	1	Illustrated Parts Catalogue	711	711	711	711
	2	Commercial Parts List	*	*	*	*
	3	Complete Equipment Schedule, Production	*	*	*	*
	4	Complete Equipment Schedule, Service Edition (Simple Equipment)	741	741	741	741
	5	Complete Equipment Schedule, Service Edition (Complex Equipment)	*	*	*	*
8	1	Modification Instructions	811	811	811	811
	2	General Instructions, Special Technical Instructions and Servicing Instructions	821	821	821	821
	3	Service Engineered Modification Instructions (RAF only)	831	831	831	831

* Category/sub-category not published

Associated publications

5 The following associated publications should be read in conjunction with this category:

Reference	Title
AESP 0200-A-062-013	Management and Control of Equipment Support Units Casting Procedures for all Equipment
AESP 0200-A-307-013	All Arms Recovery Manual
AESP 2300-A-050-013	'B' Vehicle Test, Inspection and Certification
AESP 2320-A-100-522	Degassing, Cleaning, Examination and Repair of Refuelling Equipment
AESP 2320-A-310-201	'B' Vehicle Corrosion Prevention
AESP 2530-D-051-512	'B' Vehicle Air Braking System Inspection Procedure
AP 3260 Book 1	Mechanical Transport Maintenance Regulations for the Royal Air Force
AP 3260 Book 3	Mechanical Transport Maintenance Regulations for the Royal Air Force - General Orders
AP 830	MOD (Air Force Department and RAF) Supply Regulations
AP 957	Fire Manual
JSP 317	Joint Service Safety Regulations for Storage, Handling of Fuels and Lubricants
JSP 481	General Service Vehicle familiarisation Training
JSP 800	Joint Service Road Transport Regulations Volume 5

WARNINGS AND CAUTIONS

WARNINGS

6 There are no WARNINGS applicable to this equipment.

CAUTIONS

7 There are no CAUTIONS applicable to this category.

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

8 The following abbreviations are used in this category:

A	Ampere
AESP	Army Equipment Support Publication
BFPO	British Forces Post Office
bhp	brake horsepower
CALM	Crane Attachment Lorry Mounted
CES	Complete Equipment Schedule
CM	Configuration Management
DGS&E-TIG	Director General Safety and Engineering-Technical Information Group
DIN	Defence Instructions and Notices
EEC	European Economic Community
ESPD	Equipment Support Policy Directive
FRACAS	Failure Reporting Analysis and Corrective Action System
FV	Fighting Vehicle
GS	General Support
kg	kilogramme
km	kilometre
kW	kilo Watt
LH	Left Hand

LSD	Logistic Support Data
m	metre
MoD	Ministry of Defence
NATO	North Atlantic Treaty Organization
Nm	Newtonmetre
PDS	Post Design Services
PTO	Power Take Off
REME	Royal Electrical and Mechanical Engineers
rpm	revolutions per minute
SOP	Standard Operating Procedures
STTE	Special Tools and Test Equipment
SWL	Safe Working Load
UBRE	Unit Bulk Refuelling Equipment
UK	United Kingdom
V	Volt
W	Watt

SYMBOLS

9 The following symbol is applicable to this equipment.

% percentage

EQUIPMENT SUPPORT POLICY DIRECTIVE

INTRODUCTION

General

1 This Equipment Support Policy Directive (ESPD) is concerned with:

1.1 Vehicle Designation. Truck, 4 Tonne, 4 x 4, GS, Leyland DAF (All Variants). Annex A.

1.2 Asset Codes. Annex A.

1.3 NATO stock number: See Annex A.

1.4 Complete Equipment Schedule (CES) No. See Annex A.

2 The policy set out in this ESPD is based on the planned deployment and role of the equipment, its utilisation and reliability. This policy may be amended in light of experience or with changes in deployment or utilisation.

MANAGEMENT INFORMATION

3 The management information relating to this equipment is as follows:

3.1 Equipment Sponsor: GSV PT Team 3 (Cargo).

3.2 Equipment Manager: GSV PT Team 3 (Cargo).

3.3 Main Contractor: Leyland Trucks Ltd

Croyston Road
Leyland
Preston
Lancashire
PR5 3LZ

3.4 Contract No: GSV2/5002.

3.5 Engineering Support: GSV PT Team 3 (Cargo).

3.6 Supply Manager: GSV PT Supply and Repair.

3.7 Planned role. The GS Cargo is a general purpose load carrier. The flat platform is for the carriage of palletised loads and transportable containers.

3.8 Deployment. This is a Tri-Service vehicle and is deployed world-wide.

3.9 Planned life. Originally 12 years, but extended to 23 years.

3.10 In service date. The in service date is 1 April 1991. The equipment forms part of the B Vehicle fleet and replaces older Bedford MJ variants.

3.11 Out of service date. 2014 with some selected assets running on until 2020.

3.12 [redacted]

3.13 [redacted]

3.14 Speed Restrictions all variants. The speed limits apply with or without a trailer.

3.14.1 Maximum Speed Limits.

3.14.1.1 Normal roads 40 mph (65 kph).

3.14.1.2 If used in the Gun Towing Role, all roads 40 mph (65 kph), off road routes 25 mph (32 kph).

TECHNICAL DESCRIPTION

4 The Leyland DAF vehicle is a 4 x 4 load carrier fitted with a forward control tilting cab. It is powered by a Leyland 300 Series diesel engine driving through a 5 speed Turner (Spicer) gearbox and Getrag transfer box to front and rear axles. The main technical characteristics are detailed in Para 5.

Vehicle automotives

5 The main technical characteristics are as follows:

5.1 Engine up to chassis number L119987.

5.1.1 Type. Leyland 310, 6 cylinder, in line, liquid cooled, 4 stroke, direct injection, turbocharged diesel.

5.1.2 Capacity. 5.88 litres.

5.1.3 Max power. 145 bhp (108.2 kW) at 2,600 rpm.

5.1.4 Max torque. 352 lb ft (477 Nm) at 1,600 rpm.

5.1.5 Compression ratio. 17.0:1.

5.2 Engine from chassis number L119988 (EURO 1).

5.2.1 Type. Leyland 310, 6 cylinder, in line, liquid cooled, 4 stroke, direct injection, turbocharged diesel.

5.2.2 Capacity. 5.88 litres.

5.2.3 Max power. 145 bhp (108.2 kW) at 2,500 rpm.

5.2.4 Max torque. 364 lb ft (494 Nm) at 1,550 rpm.

5.2.5 Compression ratio. 18.0:1.

5.3 Engine (EURO 2).

5.3.1 Type. Leyland 310, 6 cylinder, in line, liquid cooled, 4 stroke, direct injection, turbocharged and intercooled diesel.

5.3.2 Capacity. 5.88 litres.

5.3.3 Max power. 141.4 bhp (105.46 kW) at 2,500 rpm.

5.3.4 Max torque. 380 lb ft (515 Nm) at 1,500 rpm.

5.3.5 Compression ratio. 17.5:1.

5.4 Fuel system. A 135 litre fuel tank fitted with anti surge baffles is mounted on the LH side of the chassis. A mechanical lift pump draws fuel from the tank through a sedimenter and delivers it to a CAV DPS rotary distribution pump via a spin off canister element filter. The distribution pump delivers the fuel to 6 CAV type injectors. The fuel system incorporates a 'Start Pilot' cold start aid.

5.5 Lubrication system. The engine incorporates a wet sump lubrication system. Oil drawn from the sump by a 'Gerotor' pressure pump is delivered to the main oil gallery via an oil cooler, which is integral with the engine block, and a full flow spin off canister element filter. The oil cooler provides the mounting for the filter and incorporates the bypass valve.

5.6 Cooling system. The engine temperature is controlled by a conventional pump assisted thermo-syphon cooling system incorporating a belt driven viscous fan, a four row fin tube radiator and wax couple thermostat. The pump is integral with the cylinder head and belt driven from the crankshaft pulley. A remote header tank is mounted behind the cab.

5.7 Air cleaner. The air cleaner is two stage with cyclonic pre-cleaner and paper element.

5.8 Clutch. The drive is transmitted from the engine to the gearbox through a Borg and Beck single dry plate, diaphragm spring clutch. The clutch is hydraulically operated with air assistance and has a plate diameter of 330 mm.

5.9 Gearbox. The gearbox is a Turner (Spicer) T5-350, 5 speed, layshaft unit fitted with a Drum Power Take Off (PTO). The PTO is engaged pneumatically using a control in the cab.

5.10 Transfer box. The drive is transmitted from the gearbox to the front and rear axles through a Getrag Z65 transfer box incorporating a lockable third differential. The transfer box provides constant four wheel drive in high or low ratio. The ratios are selected manually from the cab via a lever and cable mechanism.

5.11 Propshafts. The drive is transmitted between the transmission assemblies with BRD 2000/5 series propshafts.

5.12 Front axle. The front axle is a spiral bevel single reduction steer drive unit incorporating fully floating hubs.

5.13 Rear axle. The rear axle is a spiral bevel single reduction drive unit.

5.14 Steering. The steering is hydraulically power assisted. It incorporates a ZF 8090 integral power steering box, a ZF 7674 sliding rotary vane type pump and a reservoir fitted with a filter. The pump is mounted on the compressor and is driven in tandem with it from the front gear train.

5.15 Suspension. The vehicle is fitted with leaf spring suspension, twin taper leaf at the front and dual rate at the rear. The springs are secured to the axles by U-bolts and to the chassis by rubber bushed hangers. Double acting, telescopic, hydraulic dampers are fitted on all four wheel stations.

5.16 Wheels and tyres. The wheels comprise spigot mounted split rims fitted with tubed Goodyear or Michelin 12.00 R 20 radial tyres.

NOTE

Some Michelin/Goodyear tyre combinations lead to undesirable steering characteristics. Units are therefore not to mix tyres from different suppliers on the same vehicle.

5.17 Braking system. The vehicle is fitted with a dual circuit, two line, air braking system employing spring brake actuators to operate Girling 'Simplex' self adjusting drum foundation brakes on all four wheels. The system incorporates an engine driven compressor, five reservoirs fitted with tilt drain valves, a tyre inflation adapter, a load sensing valve, Bendix air drier and includes four ISO test points.

5.18 The air drier incorporates a 100W heating element to prevent the purge valve from freezing in sub-zero temperatures. It also has an independent trailer brake control. All pipes are of reinforced nylon with 'push in' end fittings and automatic palm couplings are provided front and rear for towing and recovery purposes.

5.19 Electrical system. A 24V insulated earth return electrical system is fitted incorporating:

5.19.1 Two 12V, heavy duty, 95A, low maintenance, chloride batteries.

5.19.2 A battery isolation switch that is located on the LH side of the chassis which can also be switched 'OFF' using a remote button in the cab.

5.19.3 An FV pattern inter-vehicle start socket co-located with the battery isolation switch.

5.19.4 A belt driven, AC5RS 24V, 40A alternator.

5.19.5 A Butec GR-45, coaxial starter motor.

5.19.6 A commercial pattern lighting system, which conforms to EEC regulations and includes infra red and convoy circuits.

5.19.7 Instrumentation comprising a standard range of warning lights and gauges, including a tachometer.

5.19.8 Circuit protection for mismatched trailers, which incorporate 12V lighting. This can be reset using a button in the cab.

5.19.9 Earth leakage test system, which will detect negative and positive earth leakage faults.

5.20 Chassis. The chassis is a bolted ladder type construction of pressed high tensile steel members. Recovery/lifting eyes are provided front and rear and a towing pintle is mounted on the front and rear cross members.

5.21 Cab and Body. The vehicle is fitted with a pressed steel tilting cab incorporating a cupola cover. The cab is tilted hydraulically and is supported in the tilted position by a stay. It is mounted on Split-flex bearings at the front and Megacone supports at the rear. The one piece windscreen is of laminated safety glass, all other glass is toughened. The cab shell is designed to minimise the number of joints and welds, and provide free draining of closed sections. Corrosion protection is comprehensive including undersealing and hot wax injection of the hollow sections and door cavities. The cargo body is a mild steel construction built by Edbro. It comprises sideboards, a tailboard, a canopy and superstructure and a laminated softwood loadbed with mild steel wearing irons.

5.22 Specialist equipment. The following assemblies are fitted to the vehicles:

5.22.1 Winch. The winch variant is fitted with a Reynolds Boughton H7500 hydraulic winch which is mounted on the chassis below the loadbed, between the transfer box and the rear axle. This has a maximum capacity of 7.6 Tonnes on the bottom layer of rope. The purpose of the winch is for self-recovery use, and cannot be used as a unit recovery asset. The use of the winch is currently restricted to operations only. Use in these circumstances requires a local risk assessment, approved by the Commanding Officer. Units not on operations that are restricted from using the winch can defer routine winch testing by removing and storing the rope locally. However, the rope must be re-fitted and tested prior to deployment or handover to another unit.

5.22.2 Crane Attachment Lorry Mounted (CALM). The CALM variant has an Atlas AK63 M1 6.3 Tonne crane mounted on the chassis to the rear of the cab; this includes two hydraulically retractable stabilisers fitted with separate isolation valves. This has a maximum capacity of 6.3 Tonnes with the boom fully retracted. It is designed to load/unload vehicle

cargo. It can be used to assist in repair tasks on Land and Air equipment with the following caveats:

5.22.2.1 It cannot be used on tasks that require a direct vertical lift.

5.22.2.2 It cannot be used on board ships at sea.

5.22.2.3 It must be used in accordance with relevant equipment AESPs or APs using specified lifting equipment.

5.22.2.4 It cannot be used outside of its Safe working Load.

5.22.2.5 Airframes must be bonded immediately prior to and during the use of CALM.

5.22.2.6 Crane extension tubes are not to be used with the CALM.

5.22.3 Tyre handler. The Tyre handler variant has a CALM with a tyre handling section attached to it. It is designed to assist with the removal and refitting of wheels on the IMMLC DROPS vehicle; the SWL for the Tyre Handler is 400 kg.

5.22.4 Tail lift. The tail lift variant has load lifting capabilities at the rear of the vehicle, this includes two points at the rear on either side of the vehicle for operating it, it also has a wander socket attachment on the rear LH side incorporated into the control box.

5.22.5 Unit Bulk Refuelling Equipment (UBRE). The purpose of the UBRE variant is to provide a mobile refuelling facility for use at unit level. There are three configurations for the UBRE: one tank one fuel, two tanks one fuel and two tanks two fuels.

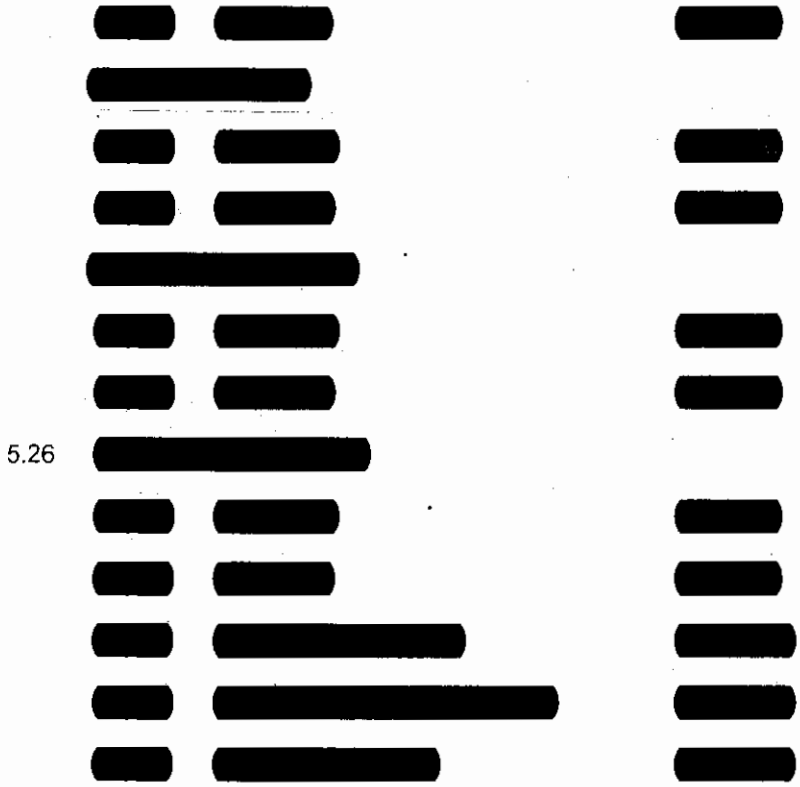
5.23 Physical data.

5.23.1	Overall length	6.65 m
5.23.2	Overall width	2.49 m
5.23.3	Overall height	2.63 m

5.24 Steering dimensions:

5.24.1	[redacted]	[redacted]
5.24.2	Wheel base	3.95 m
5.24.3	Track	2.1 m
5.24.4	Minimum ground clearance	0.314 m
5.24.5	[redacted]	[redacted]
5.24.6	[redacted]	[redacted]
5.24.7	[redacted]	[redacted]

5.25 [redacted]



5.26

MAINTENANCE POLICY

6 Organisation and manpower. Deployment of this vehicle will not require any changes to REME organisation or manpower.

6.1 Maintenance policy. Periodic maintenance and routine repair of the equipment is to be carried out in accordance with Materiel Regulations for The Army, Vol 2, Equipment Support, Pam No. 4, Equipment Support Repair Procedures. AESP 2320-H-104-601 is the Scheduled Maintenance Tables for this equipment.

6.2 Repair procedures. The repair and maintenance details are shown in Tables 1 to 3.

TABLE 1 LEVELS OF MAINTENANCE

Repair level	Details
1	Maintenance and day to day preparation. It may include such operations as functional testing, replenishment, servicing, re-arming, role changing, minor modification, fault diagnosis and corrective maintenance by replacement, adjustment or minor repair.
2	Maintenance by replacement, adjustment or minor repair including fault diagnosis and minor authorised modifications, within specified times, using generally provisioned resources.
3	Maintenance in greater depth than level 2. It includes such operations as repair, partial reconditioning and modification requiring special skills or special equipment; but which is short of complete strip, reconditioning and reassembly.
4	Maintenance which is full reconditioning, major conversions or major repairs.

TABLE 2 SCHEDULED MAINTENANCE

Repair Level	1	2	3	4
Daily before use	*			
Daily after use	*			
Weekly	*			
1st - 500 km	*			
A - 6,000 km/6 months	*			
B -12,000 km/12 months	*	*		
C - 24,000 km/24 months	*	*		

TABLE 3 MAJOR ASSEMBLY REPLACEMENT

Repair Level	1	2	3	4
Engine		*	*	
Gearbox		*	*	
Transfer box		*	*	
PTO		*	*	
Front axle		*	*	
Rear axle		*	*	
Steering box		*	*	

6.3 Recovery procedures. Detailed recovery techniques for vehicles without the towing mod are covered in Recovery Assessment Report 7B(1) 2110 dated 18 Oct 88 issued by RT & R. Detailed recovery techniques for vehicles with the towing mod are covered in Recovery Assessment Report ES52c 4105 dated 28 Oct 94 issued by FERG.

6.3.1 Towing precautions are shown in Table 4.

TABLE 4 TOWING PRECAUTIONS

Detail
• Before towing it is essential that the main gearbox and transfer gearbox levers are placed in the neutral position. • Inter-axle differential lock should be disengaged. • All airlines should be connected. • Where no air supply is available, the spring brake actuators must be manually released as follows: 1 Chock the road wheels. 2 Apply the parking brake. 3 Remove the protective cap from the rear of each actuator and rotate the release nut anticlockwise.
Safety points
• The spring brake actuators contain an extremely powerful coil spring. There is serious risk of injury if inexperienced personnel attempt to release actuators, particularly if they have sustained accident damage. JSP 800, Part 4, Chap 9.262(a) states that the towing vehicle is to be of the same or a greater weight category than the disabled vehicle.

SUPPLY POLICY

7 Spare parts should be demanded through the Army Supply System in accordance with Materiel Regulations for the Army, Vol 1, Supply of Materiel, Pam 1, Unit Guide for Demanding Materiel from Army Stores. Complete spares parts listing is available under cover of AESP 2320-H-104-711. Further information and support is available from Equipment Manager and Supply and Repair Branch GSV PT. Backloading of major components and repairables should be completed in accordance with Materiel Regulations for the Army, Vol 1 and Stores System User Guide, Part 37. An AFG 8621 is to be raised against such items.

SPECIAL TOOLS AND TEST EQUIPMENT (STTE)

8 Listing of STTE is at Annex B to AESP 2320-H-104-111, extracted from the manufacturers 'Service Manual'. All tasks are aligned to the appropriate maintenance level in accordance with the Permitted Repair Schedule (PRS).

PUBLICATIONS

9 This equipment will be supported by Army Equipment Support Publications (AESPs) distributed by:

Forms and Publications Section
DSDA Operations Centre
C16, C Site
Ploughley Road
Arncott
Bicester
OX25 1LP

10 The AESP Octad for this equipment is 2320-H-104, information is divided into the following categories:

10.1 Category 1 - Purpose and Planning.

10.2 Category 2 - Operating Information.

10.3 Category 3 - Technical Description.

10.4 Category 4 - Installation Instruction.

10.5 Category 5 - Maintenance and Inspection Information.

10.6 Category 6 - Maintenance Schedule.

10.7 Category 7 - Spare Parts and CES Information.

10.8 Category 8 - Modifications and General Instructions.

TRAINING

11 Training will be provided as follows:

11.1 Artificer Vehicles and Vehicle Mechanics. Training for this vehicle will be by in service experience. Refer to JSP 481 General Service Vehicle Familiarisation Training.

11.2 Driver training. Normal unit driver training. Refer to JSP 481 General Service Vehicle Familiarisation Training.

WARRANTY OF MAJOR ASSEMBLIES

12 The terms of warranty for major assemblies are laid down in JSP 886, The Defence Logistics Support Chain. Warranty information, using F/Ins/777, is to be gathered under Special Investigation arrangements, controlled by the Equipment Support Manager (ESM) DE&S Abbey Wood, GSV PT, ABW Mil 9679 33067, Civil 03067 933067. EFR action is to be taken whenever any warranty claim arises against this contract.

CONFIGURATION MANAGEMENT

13 Configuration Management (CM) for this equipment is to be in accordance with Land Systems Procedure No. 123, Procedure for the Configuration Management of Land Service Equipment Projects. Management of a complete equipment system involves ensuring that its parts, spares, test equipment, tools, software, ancillaries and support documentation remain compatible and fit for purpose during development, subsequent manufacture, Service-use and after repair.

13.1 Modifications. Modifications to the equipment will be authorised by GSV PT and instructions issued in AESP Cat 8.

13.2 Post Design Services (PDS). PDS will be contracted for as and when required and authorised by GSV PT.

STORAGE

14 The equipment should be stored where possible under cover and protected from the elements. The UBRE as a fuel carrying vehicle, parking or storage area should comply with requirements of a Zone 2 Area as defined in AESP 2320-A-100-522 and appropriate safety precautions observed.

DISPOSAL

15 The vehicles are placed in Group 2 Normal Casting Range as defined in Materiel Regulations for the Army Volume 2, Pamphlet 6. Vehicles in this category are considered for casting when the estimated cost of repair exceeds the pre-determined repair limits, which are published annually in AESP 0200-A-062-013. These repair limits will initially be based on the planned life of 12 years but the actual life based on this casting policy may well exceed the planned life.

ANNEX A

TRUCK 4 TONNE 4 X 4 LEYLAND DAF
TABLE OF DESIGNATIONS/ASSET CODES/NSN/CAT 741

Serial (1)	Designation (2)	Asset Code (3)	NATO Stock No. (4)	Cat 741 (5)
1	Truck GS Cargo 4T	[redacted]	[redacted]	Chap 2-1
2	Truck GS Cargo 4T (EURO 1)	[redacted]	[redacted]	Chap 2-1
3	Truck GS Cargo 4T (EURO 1)	[redacted]	[redacted]	Chap 2-1
4	Truck GS Cargo 4T (W)	[redacted]	[redacted]	Chap 2-10
5	Truck GS Cargo 4T (W) (EURO 1)	[redacted]	[redacted]	Chap 2-10
6	Truck Cargo 4T with 3T Crane	[redacted]	[redacted]	Chap 2-7
7	Truck Cargo 4T W/Winch	[redacted]	[redacted]	Chap 2-2
8	Truck Cargo 4T W/Winch (EURO 1)	[redacted]	[redacted]	Chap 2-2
9	Truck Cargo 4T W/Winch	[redacted]	[redacted]	Chap 2-6
10	Truck Cargo 4T W/Winch (W)	[redacted]	[redacted]	Chap 2-11
11	Truck Flat Platform 4T	[redacted]	[redacted]	Chap 2-3
12	Truck Flat Platform 4T (EURO 1)	[redacted]	[redacted]	Chap 2-3
13	Truck Flat Platform 4T	[redacted]	[redacted]	Chap 2-3
14	Truck Flat Platform 4T (W)	[redacted]	[redacted]	Chap 2-12
15	Truck Flat Platform 4T FFR (IBDS) (EURO 1)	[redacted]	[redacted]	Chap 2-3
16	Truck Flat Platform 4T W/3T Crane	[redacted]	[redacted]	Chap 2-4
17	Truck Flat Platform 4T w/3T Crane (EURO 1)	[redacted]	[redacted]	Chap 2-4
18	Truck Flat Platform 4T W/3T Crane (DROPS)	[redacted]	[redacted]	Chap 2-4
19	Truck Flat Platform 4T W/3T Crane	[redacted]	[redacted]	Chap 2-4
20	Truck Flat Platform 4T W/3T Crane (DROPS)	[redacted]	[redacted]	Chap 2-4
21	Truck Flat Platform 4T W/Winch	[redacted]	[redacted]	Chap 2-8
22	Truck Flat Platform 4T W/Winch (EURO 1)	[redacted]	[redacted]	Chap 2-8
23	Truck Flat Platform 4T W/Winch	[redacted]	[redacted]	Chap 2-8
24	Truck Flat Platform 4T FFR W/Winch	[redacted]	[redacted]	Chap 2-5
25	Truck Flat Platform 4T FFR W/Winch (EURO 1)	[redacted]	[redacted]	Chap 2-5
26	Truck Flat Platform 4T FFR W/Winch	[redacted]	[redacted]	Chap 2-5
27	Truck Flat Platform 4T FFR W/Winch (EURO 1)	[redacted]	[redacted]	Chap 2-5
28	Truck Flat Platform 4T FFR CALM (EURO 1)	[redacted]	[redacted]	Chap 2-18
29	Truck Tipper 4T	[redacted]	[redacted]	
30	Truck Tipper 4T	[redacted]	[redacted]	
31	Truck 4T UBRE	[redacted]	[redacted]	Chap 2-6

(continued)

TRUCK 4 TONNE 4 X 4 LEYLAND DAF
TABLE OF DESIGNATIONS/ASSET CODES/NSN/CAT 741 (continued)

Serial (1)	Designation (2)	Asset Code (3)	NATO Stock No. (4)	Cat 741 (5)
32	Truck 4T UBRE (EURO 1)	[redacted]	[redacted]	Chap 2-6
33	Truck 4T UBRE	[redacted]	[redacted]	Chap 2-6
34	Truck 4T UBRE (W)	[redacted]	[redacted]	Chap 2-14
35	Truck Cargo 4T with Hydraulic Tail Lift	[redacted]	[redacted]	Chap 2-9
36	Truck Cargo 4T with Hydraulic Tail Lift	[redacted]	[redacted]	Chap 2-9
37	Truck Flat Platform, 4T with 3T Crane	[redacted]	[redacted]	Chap 2-4
38	Truck Cargo 4T with CALM Arm/Sup	[redacted]	[redacted]	Chap 2-15
39	Truck Cargo 4T with CALM Arm/Sup	[redacted]	[redacted]	Chap 2-15
40	Truck Cargo 4T with CALM	[redacted]	[redacted]	Chap 2-17
41	Truck Cargo 4T with CALM (W)	[redacted]	[redacted]	Chap 2-16
42	Truck Cargo 4T with CALM	[redacted]	[redacted]	Chap 2-13

ANNEX B

SPECIAL TOOLS AND TEST EQUIPMENT (STTE) FOR TRUCK, 4 TONNE, 4 X 4, LEYLAND DAF (ALL VARIANTS)

1 The following is a recommended list of Special Tools and Test Equipment (STTE) required to maintain the subject equipment in-service.

2 Though a tool may appear against several tasks, it will have only been allocated a Part No. once. This is to assist departments in extracting a single list of tools required.

EQUIPMENT: TRUCK, 4 TONNE, 4 X 4, LEYLAND DAF (ALL VARIANTS)

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Group 1 ENGINE LEYLAND 310 (CUMMINS 6BT 5.9)											
1.1	Engine Timing			Extension, Timing Pin (3822694)	(0192494)		1		3	1	Cummins Tools SPC Daimler Close Daventry Northants NN11 5QJ 01327 704470
1.2	Injector Bore Brush			Brush, Injector Bore (3822509)	(0192492)		1		3	1	Cummins Tools SPC Daimler Close Daventry Northants NN11 5QJ 01327 704470
1.3	Compression Checks			Adaptor, Compression Tester DA 102-113	(0484946)		1		1	1	Diesel Tune
1.4	Injection Pump Timing			Tool Timing, Injection Pump (18G 1458)	6MT2/5120-99-725-6476 (0499810)		1		3	1	
CLUTCH											
1.5	Clutch Aligning Kit			Aligner, Clutch Plate Universal, Commercial MS 84	(0484966)			1	1		VLC

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Group 2 GEARBOX TURNER T5.350											
2.1	Bearing Remover			Remover, Bearing, Basic Tool	(0485241)		1				Kent Moore
2.2	Rear Layshaft Bearing Remover			Adaptor, Remover, Bearing, Layshaft, Rear (Z8524)	7BD 5120-99-828-5881 (0485233)		1				U/W Ser No 2.1
2.3	Rear Mainshaft Bearing Remover			Adaptor, Remover, Bearing Mainshaft, Rear (Z8531)	7BD 5120-99-828-6747 (0485234)		1				
2.4	Rear Countershaft Bearing Installer			Installer, Bearing, Countershaft Rear (KML 3015)	(0485214)		1				Kent Moore
2.5	Front Countershaft Bearing Installer			Installer, Bearing, Countershaft Front (KML 3020)	(0485236)		1				Kent Moore
2.6	Primary Shaft Oil Seal Installer			Installer, Oil Seal, Primary Shaft (KML 3021)	(0485237)		1		3		Kent Moore
2.7	Output Shaft Oil Seal Installer			Installer, Oil Seal, Output Shaft (KML 3022)	(0485238)		1		3		Kent Moore
2.8	Mainshaft Front and Rear Bearing Installer			Installer Bearing, Mainshaft Front and Rear	(0485240)		1				Kent Moore
2.9	Reverse Idler Shaft Remover			Remover, Shaft, Idler, Reverse	(0484903)		1				VLC U/W Ser No 11.3
2.10	Yoke/Flange Adapter			Adapter, Yoke/Flange	(0485187)		1		3	1	Ley DAF U/W Ser No 11.2
2.11	Torque Wrench with 21 mm Special Adaptor			Adaptor, Torque Wrench, Special 21 mm (72004)	(0484817)		1		3	1	Norbar
Group 3 TRANSFER GEARBOX GETRAG Z65											

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
3.1	Torque Wrench Preload Gauge			Gauge, Preload (Torque Wrench) (OTC 7380) (MS 103A)	(0485185)		1				VLC
3.2	Yoke Puller			Yoke Puller (LC 438)	(0485099)		1		3	1	VLC
3.3	65mm Output Yoke Socket			Socket, Output Yoke 65mm	(0485189)		1		3	1	Ley/DAF
3.4	Speedometer Connection Puller			Puller, Speedometer Connection (LC 284-17)	(0484902)		1		3	1	VLC
3.5	Thrust Piece			Thrust Piece (LC 449)	(0485154)		1			1	VLC U/W Ser No 11.4
3.6	Differential Bearing Drift			Drift, Differential Bearings (LC 450)	(0485155)		1				VLC
3.7	Drive Shaft Bearing Drift			Drift, Drive Shaft Bearing (LC 451)	(0485156)		1				VLC
3.8	Bearing Setting Clamps			Clamps, Bearing Setting (LC 452)	(0485157)		1				VLC
3.9	Bearing Preload Reducer			Reducer, Bearing Preload (LC 453)	(0485158)		1				VLC
3.10	Speedometer Worm and Bearing Driff			Driff, Speedometer Worm and Bearing (LC 455)	(0485159)		1				VLC
3.11	Drive Shaft Bearing Drift			Drift, Drive Shaft Bearing (LC 457)	(0485160)		1				VLC
3.12	Oil Seal Replacer			Replacer, Oil Seal (LC 550-29A)	(0485140)		1		3	1	VLC U/W Ser No 11.4
3.13	Rear Oil Seal Replacer			Replacer, Oil Seal, Rear (LC 550-30A)	(0485141)		1		3	1	VLC U/W Ser No 11.4
3.14	Front Oil Seal Replacer			Replacer, Oil Seal, Front (LC 550-31A)	(0485142)		1		3	1	VLC U/W Ser No 11.4
3.15	Differential Lock Setting Tool			Tool, Differential Lock Setting	(0484819)		1		1		Ley/DAF
Group 4 DRIVE AXLES											
4.1	Pinion Bearing Remover/Replacer Adapter			Adapter, Remover/Replacer Pinion Bearing (18G 47BH)	(0484825)		1		3		VLC U/W Ser No 11.4
4.2	Rear Axle Wear Ring Drift			Drift, Rear Axle Wear Ring Basic Tool (LC 383)	(0484910)		1		3		VLC U/W Ser No 4.3
4.3	Axle Oil Seal Replacer			Adapter, Replacer, Axle Oil Seal (LC 383-7)	(0484917)		1		3	1	VLC U/W Ser No 4.2
4.4	Pinion Oil Seal Replacer			Replacer, Pinion Oil Seal	(0485183)		1		3	1	Ley/DAF
4.5	Hub Nut Wrench			Wrench, Hub Nut (LC 439)	(0485143)		1		3	1	VLC

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
4.6	Axle Shaft Bush Replacer			Replacer, Axle Shaft Bush (LC 441)	(0485144)		1		3		VLC
4.7	Drive Flange Oil Seal Replacer			Adapter, Replacer, Drive Flange Oil Seal (LC 441)	(0485145)		1		3		VLC
4.8	Yoke Flange Holding Tool Adapter			Adapter, Yoke Flange Holding Tool	(0485187)						As Ser No 2.10 See also Ser No 12.4
4.9	Steering Swivel Pin Extractor			Extractor, Pin, Steering Swivel (LC 445)	(0485150)		1		3		VLC
4.10	Front Axle Pivot Pin Preload Setting Tool			Tool Setting, Front Axle Pivot Pin Preload	(0485188)		1		3	1	
4.11	Torque Wrench Ring End 19mm Attachment			Attachment Torque Wrench Ring End 19mm (29914)			1		3	1	
Group 5 BRAKES GIRLING											
5.1	Air Pressure Test Gauge			Gauge, Test, Air Pressure (LC 445)	6MT2/4720-99-783-1206 (0485052)				3	1	
5.2	Special Spring Tool Kit			Kit, Special, Spring Tool, 3 Part Set (LC 447)	(0485152)		1		3	1	VLC
5.3	Brake Acuator Collet Nut Wrench			Wrench, Nut, Brake Actuator Collet (KML 3024)	(0485239)		1		3	1	Kent Moore
5.4	Torx Drive Set			Drive Set, Torx (MS 79A)	6MT2/5120-99-751-8936				3	1	
Group 6 STEERING GEAR ZF 8095											
6.1	Input Shaft Seal Installer			Installer, Seal, Input Shaft 8090-798-051	(0192506)		1				ZF
6.2	Wormshaft Seal Guide			Guide, Seal, Wormshaft 8090-798-001	(0192507)		1				ZF
6.3	Wormshaft Seal Former			Former, Seal, Wormshaft 8090-798-651	(0192508)		1				ZF

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
Group 7 STEERING PUMP ZF 7673											
7.1	Needle Bearing in Housing Mandrel			Mandrel, Needle Bearing in Housing 7672-798-052	(0535882)		1				ZF
7.2	Rotary Shaft Seal Mandrel			Mandrel, Seal, Rotary Shaft 7672-798-052	(0535883)		1				ZF
Group 8 STEERING AND POSER STEERING											
8.1	Power Steering Test Kit			Kit Test, Power Steering (MS 815)	6MT2/4940-99-987-8244 (0484852)				1	1	VLC
8.2	Test Kit Adapter Hoses			Hose, Adapter, Test Kit (MS 815-3)	(0484853)				1	1	VLC
8.3	Steering Ball Separator			Separator, Steering Ball (081400) (18G 1133)	6MT2/4910-99-839-2791 (0485122)				3	1	
Group 9 BODY											
9.1	Special Rear Body Mounting Bolt Wrench			Wrench, Special, Rear Body Mounting Bolt	(0484949)				1	1	Ley/DAF
Group 10 SUSPENSION											
10.1	Swinging Shackle Bolt Wrench			Wrench, Swinging Shackle Bolts	(0485186)				1	1	Ley/DAF
Group 11 GENERAL PURPOSE											
11.1	Handpress			Handpress (MS 47)	6MT2/5120-99-(820-8044)		1			1	
11.2	Flange Holding Tool			Flange Holding Tool (LC 113A)	(0484977)		1		3	1	VLC
11.3	Slide Hammer			Hammer Slide (MS 284)	6MT2/5120-99-806-9013 (0694928)		1		3	1	

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
11.4	Driver Handle			Handle Driver (MS 550) (18G 134)	6MT2/5120-99-874-1715 (0499809)		1		3	1	
11.5	Torque Handle Wrench			Wrench, Torque Handle (SL3/TH)	F1/4120-99-127-9370		1		3	1	
11.6	Fixed FD Drive Head			Drive Head, Fixed FD 29827			1		3	1	Norbar
Group 12 WINCH											
12.1	Gauge and Adapter Assy			Group and Adapter Assey	(0484854)		1				Ley/DAF
12.2	Winch Brake Hose Blanking Adapters			Adapters, Blanking, Winch Brake Hose	(0484855)		1				Ley/DAF

Ser	Task	Service Manual Task Ref		Tool Required	Manuf Part No	Service Manual Tool List	Qty of Tools Required at Maint Level				Remarks
		Sect	Page				1	2	3	4	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
12.3	Hoses Test Kit Adapter			Hoses, Adapter, Test Kit	(0484856)		1				Ley/DAF U/W Ser No 12.4
12.4	Test Kit			Kit Test (MS 815)	6MT2/4910-99-987-8244		1				See also Ser No 4.8
Group 13 PART 2											
13.1	Dieseltune Compression Tester			Tester, Compression Dieseltune (DX 500)	W4/6625-99-215-0274 (0484940)		1		1	1	
13.2	Hydraulic Puller			Puller, Hydraulic (SR 152400 or MS 252A)	6MT2/5120-99-733-7276 (04845022)				3	1	Sykes Pickavant
Comprising of:											
	13.2.1 Hydraulic Ram (150000)				6MT2/5120-99-401-3589						
	13.2.2 Twin Head (152412)				6MT2/5120-99-812-0359						
	13.2.3 Ram Extension 2" (50mm) (152422)				6MT2/5120-99-819-4518						
	13.2.4 Leg 4" (100mm) (152424)				6MT2/5120-99-812-0362						

ARMY EQUIPMENT AND SUPPORT PUBLICATION (AESP) AND ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS (EMER) - FORM 10

*AESP/EMER NUMBER:		*IS THIS SAFETY RELATED?	YES ☐	No ☐

Send Form 10 via the Email or Post address. However email is preferred.	Tel [redacted]
Email: [redacted]	Post to [redacted]

ORIGINATORS DETAILS:			
*Address		*Name	
		Rank / Grade	
		*Phone	
		*Senders Reference	
		*Date Raised	
* E-Mail		Eqpt Asset Code if applicable	

AESP/EMER DETAILS:							
*Full Title of AESP/EMER (Not the AESP/EMER Number)							
*Edition	*Amendment	*Chapter	*Paragraph	*Page	Figure	Instruction	Other

*Comments: If additional information is to be supplied, please e-mail with the Form 10 as separate attachments.

FORM 10 CELL USE:			
*Date Received		*Form 10 Reference	
*Date Sent to PT / SME		TDOL Problem Report	

PROJECT TEAM / SME RESPONSE TO COMMENTS:			
Project Team (PT) / SME		Sponsors Name	
*Phone		Rank / Grade	
*Email		*Date Received	

*The following action is to be carried out:	Mark:		Mark:
Issue a revised/amended AESP/EMER:		Under investigation:	
Incorporate comment(s) in future amendments:		No action required:	

Remarks:			
SPONSOR/PT FINAL CLOSURE STEPS	Mark:	Form 10 Cell notified of Date action taken	Date:
Form 10 Originator notified of the action taken:			

* Fields are mandatory for form initiator

* Fields are required to complete

ARMY EQUIPMENT
SUPPORT PUBLICATION

2320-H-104-302
4th Edition dated June 2013
(Superseding 3rd Edition dated Jan 12)

TRUCK, 4 TONNE, 4X4 GS LEYLAND DAF (ALL VARIANTS)

TECHNICAL DESCRIPTION

Sponsored for use in the
UNITED KINGDOM MINISTRY OF DEFENCE
AND ARMED FORCES
by

DEFENCE EQUIPMENT & SUPPORT
GENERAL SUPPORT VEHICLE PROJECT TEAM

MOD Abbey Wood
Bristol
BS34 8JH

Publication Authority:

GENERAL SUPPORT VEHICLE PROJECT TEAM

CONDITIONS OF RELEASE

~~This information is released by the UK Government for Defence purposes only.~~

~~This information must be afforded the same degree of protection as that afforded to information of an equivalent security marking originated by the recipient Government or as required by the recipient Government's security regulations.~~

~~This information may be disclosed only within the Defence Department of the recipient Government, except as otherwise authorized by the Ministry of Defence (Army).~~

This information may be subject to privately owned rights.

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Amdt No.	Incorporated by (Signature)	Date
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		

CONTENTS

PRELIMINARY MATERIAL Page

TECHNICAL DESCRIPTION

Chapter

PREFACE

Sponsor: GSV IPT
Project No.:
File Ref:

Publication Authority: DGS&E-TIG

INTRODUCTION

1 Service users should forward any comments on this publication through the channels prescribed in Army Equipment Support Publication (AESP) 0100-P-011-013. An AESP Form 10 is provided at the end of this publication; it should be photocopied and used for forwarding comments on this AESP.

2 AESPs are issued under UK MoD authority and where AESPs specify action is to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores, subject to the provisions of Para 3 below.

3 The subject matter of this publication may be affected by Defence Instructions and Notices (DIN), Standard Operating Procedures (SOP) or by local regulations. When any such instruction, Order or Regulation contradicts any portion of this publication it is to be taken as the overriding authority.

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

4 The Octad for the subject equipment consists of the publications shown opposite. All references are prefixed with the first eight digits of this publication. The availability of the publications can be checked by reference to the relevant Group Index (see AESP 0100-A-001-013).

Category/Sub-category			Information Level			
			1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
1	0	Purpose and Planning Information	101	101	101	101
	1	Equipment Support Policy Directive	111	111	111	111
2	0	Operating Information	201	201	201	201
	1	Aide-Mémoire	*	*	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	*	302	302	302
4	1	Installation Instructions	411	*	*	*
	2	Preparation for Special Environments	421	421	423	*
5	1	Failure Diagnosis	*	512	*	*
	2	Maintenance Instructions	*	522	523	*
	3	Inspection Standards	*	532	533	*
	4	Calibration Procedures	*	*	*	*
6		Maintenance Schedule	601	601	601	601
7	1	Illustrated Parts Catalogue	711	711	711	711
	2	Commercial Parts List	*	*	*	*
	3	Complete Equipment Schedule, Production	*	*	*	*
	4	Complete Equipment Schedule, Service Edition (Simple Equipment)	741	741	741	741
	5	Complete Equipment Schedule, Service Edition (Complex Equipment)	*	*	*	*
8	1	Modification Instructions	811	811	811	811
	2	General Instructions, Special Technical Instructions and Servicing Instructions	821	821	821	821
	3	Service Engineered Modification Instructions (RAF only)	831	831	831	831

* Category/sub-category not published

Associated publications

5 The following associated publications should be read in conjunction with this category:

Reference	Title
2590-N-105	Wheel and Tyre Changer for DROPS, IMMLC (fitted to Truck, 4 Tonne, 4 x 4, Leyland)
2910-F-101	CAV Fuel injection pump DPS
JSP 351	MT Driver,s handbook

WARNINGS AND CAUTIONS

WARNINGS

6 The following WARNINGS are applicable to this category.

(1) DO NOT CARRY START PILOT CANISTERS IN THE CAB.

(2) DO NOT EXPOSE START PILOT CANISTERS TO A NAKED FLAME, SPARK OR ANY INTENSE HEAT SOURCE.

(3) ENSURE THAT ALL PERSONNEL ARE KEPT CLEAR OF THE AREA IMMEDIATELY IN FRONT OF THE VEHICLE WHEN TILTING THE CAB AND THAT THERE IS ADEQUATE CLEARANCE IN FRONT AND ABOVE THE CAB.

(4) DO NOT REMOVE THE PRESSURE OR FILLER CAPS FROM THE COOLING SYSTEM HEADER TANK WHILST THE ENGINE IS RUNNING OR WHEN THE SYSTEM IS HOT.

CAUTIONS

7 There are no CAUTIONS applicable to this category.

ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

8 The following abbreviations are used in this category:

AESP	Army Equipment Support Publication
BFPO	British Forces Post Office
DGS&E-TIG	Director General Safety and Engineering-Technical Information Group
DIN	Defence Instructions and Notices
FRACAS	Failure Reporting Analysis and Corrective Action System
GSV IPT	General Support Vehicle Integrated Project Team
MoD	Ministry of Defence
SOP	Standard Operating Procedures
UK	United Kingdom

SYMBOLS

9 There are no symbols applicable to this category.

CHAPTER 1

ENGINE

CONTENTS

GENERAL DESCRIPTION

1 All 4 tonne vehicles are fitted with one of the following engine types:

1.1 **Up to chassis number L119987**. All vehicles were fitted with the Leyland DAF 300 Series diesel engine. This turbocharged and water cooled engine has a six cylinder in-line configuration, with a four stroke cycle, direct injection combustion and compression ratio of 17:1. The engine has a bore of 102 mm (4.02 in.) and a stroke of 120 mm (4.72 in.) providing an engine capacity of 5.88 litres (360 $in.^3$). Net installed power is 108 kW (145 bhp) @ 2600 rev/min; Net installed torque is 477 Nm (352 lbf ft) @ 1600 rev/min.

1.2 **From chassis number L119988**. All vehicles have been fitted with a modified Leyland DAF 300 Series diesel engine; designated Euro 1. This engine conforms to current legislative exhaust emission levels (88/77/EEC Directive Step 1). This turbocharged and water cooled engine has a six cylinder in-line configuration, with a four stroke cycle, direct injection combustion and a compression ratio of 18:1. The engine has a bore of 102 mm (4.02 in.) and a stroke of 120 mm (4.72 in.) providing an engine capacity of 5.88 litres (360 $in.^3$). Net installed power is 108 kW (145 bhp) @ 2500 rev/min; Net installed torque is 494 Nm (364 lbf ft) @ 1550 rev/min.

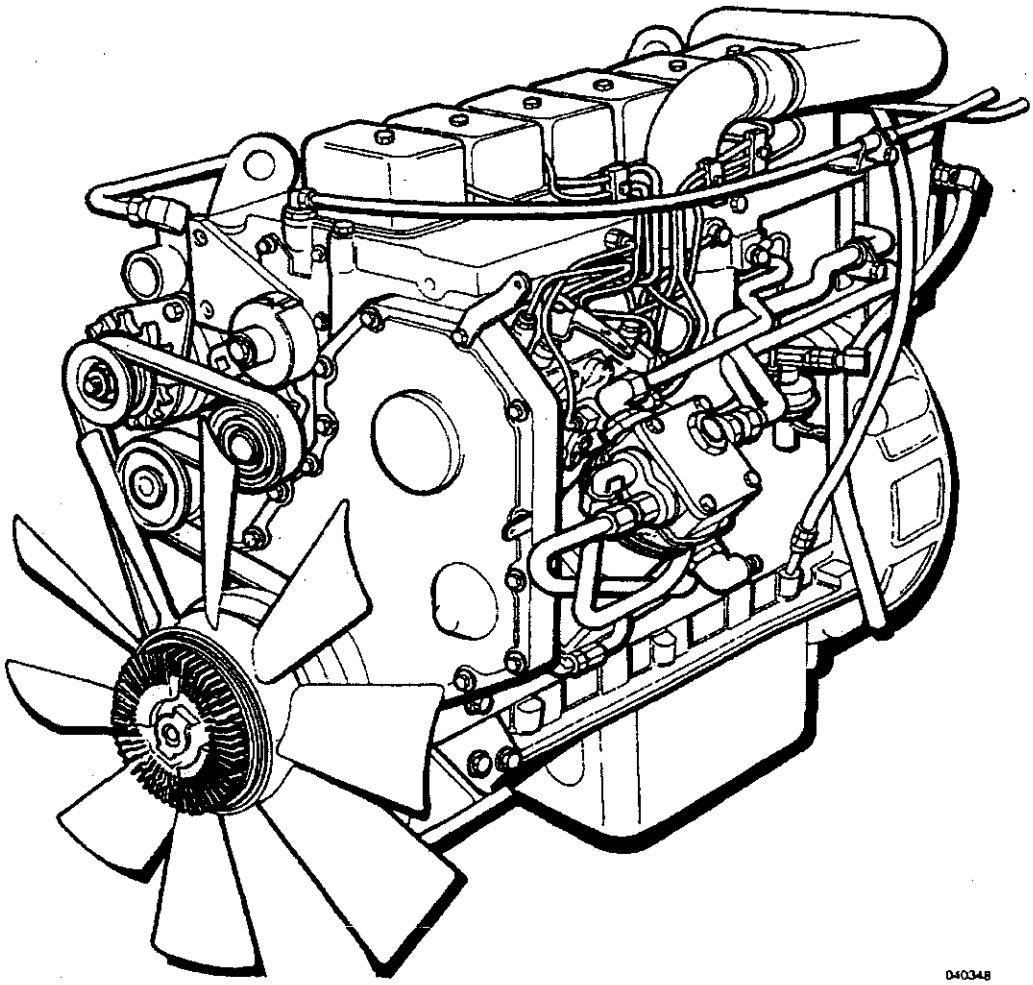


Fig 1 Engine assembly - induction side

2 The crankshaft (Fig 3 (5)) is a balanced, forged steel unit with seven main bearings; end thrust is controlled by flanged bearings fitted to No. 6 main bearing. Crankshaft oil seals both front and rear are the double lipped 'Teflon' type.

3 The pistons are secured to the connecting rods with free floating hollow gudgeon pins which are secured with circlips. A set of three piston rings is fitted to the piston. The small-end of the connecting rod is angle cut to provide additional bearing surface.

4 The camshaft (4) is gear driven by the crankshaft and not only operates the valve gear but has a special lobe which operates the lift pump.

5 The cylinder head is a one piece cross-flow design with two valves per cylinder. It has integral valve guides and hardened valve seat surfaces. Injectors are mounted in the head for direct injection into the cylinder. The cylinder head gasket is a laminated design, pre-coated with sealant on both sides around the water holes. The gasket consists of integral fire rings to seal the cylinder bores and orifices to control coolant flow.

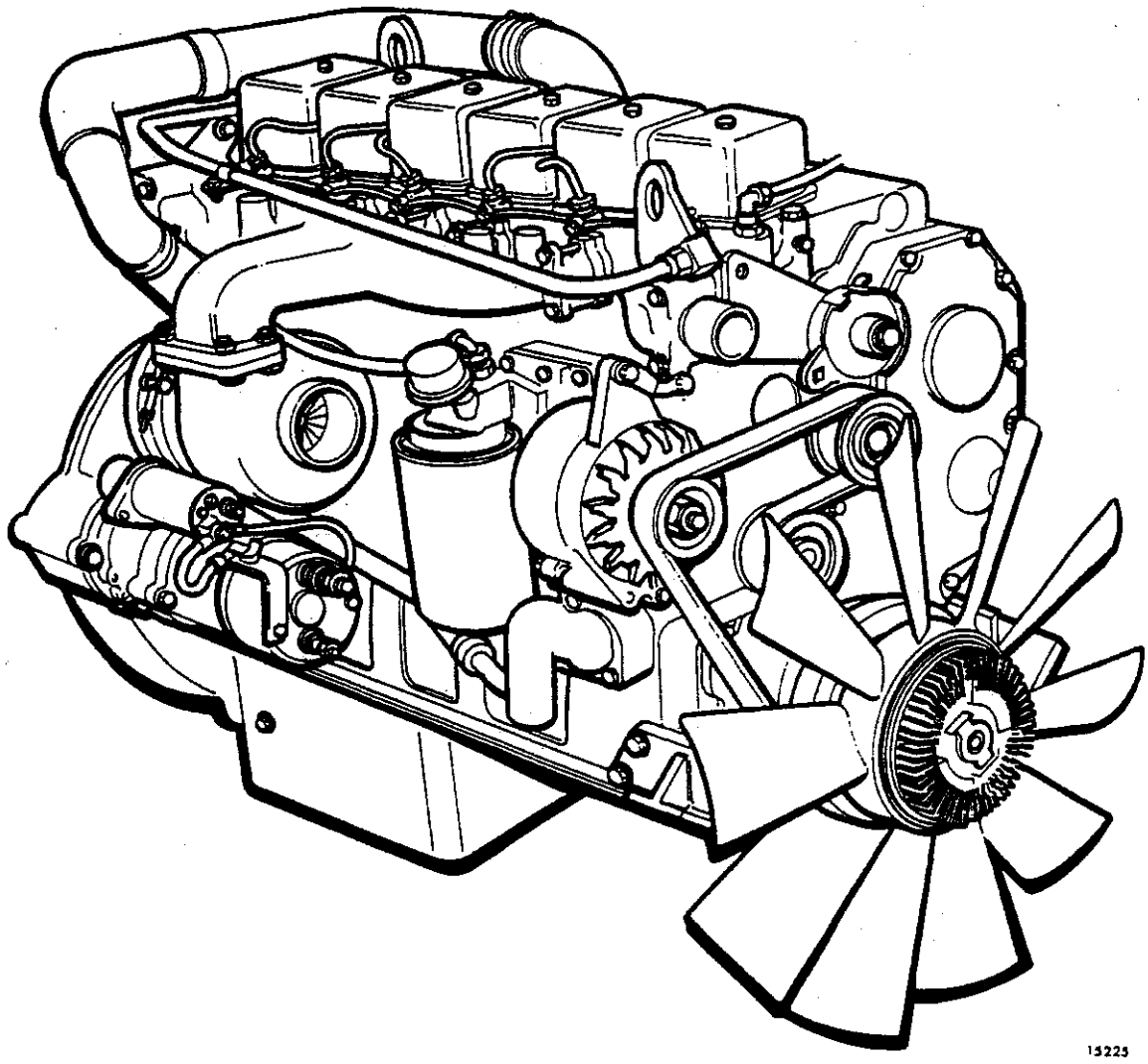


Fig 2 Engine assembly - exhaust side

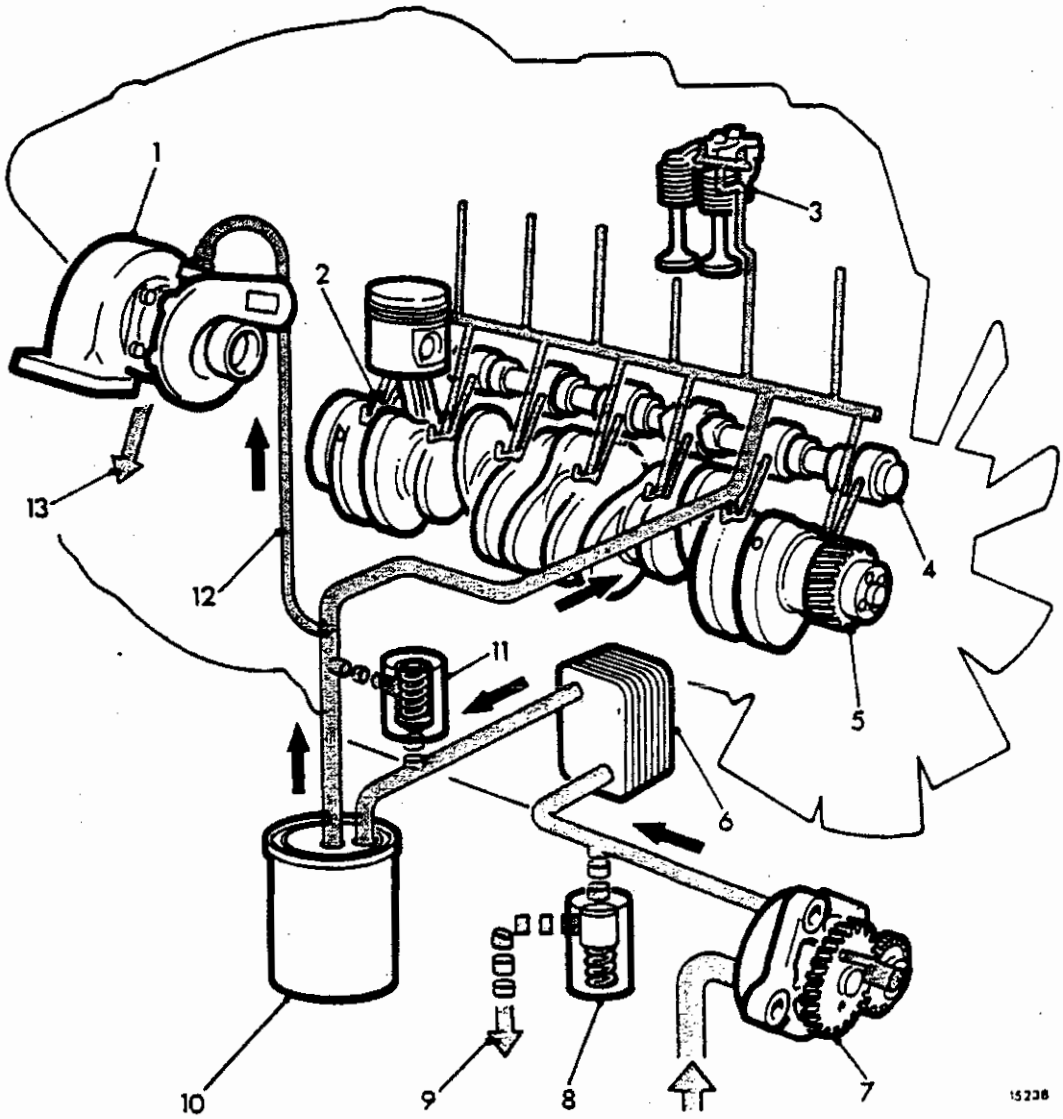
6 A rotary type oil pump (7) is gear driven through helical gears from the crankshaft. Oil is drawn from the sump and passed to the oil cooler (6) via a regulating valve (8), which if the oil pressure supplied from the pump is excessive, diverts part of the oil back to the sump.

7 The oil flows through the oil cooler where it is cooled by engine coolant and passes into the oil filter (10). In the event of a restricted oil filter, a by-pass valve (11) in the oil cooler cover will allow the oil to by-pass the filter.

8 The turbocharger (1) receives filtered, cooled and pressurised oil through a supply line (12) from the oil filter head. A drain line connected to the bottom of the turbocharger returns oil to the sump.

9 Crankshaft main bearings and valve gear are lubricated by pressurised oil directly from the main oil gallery. Drillings in the crankshaft supply oil to the connecting rod big-end bearings. Oil is supplied to the camshaft through drillings in the crankcase main bearings, whilst smaller drillings in the crankcase main bearings supply oil to the piston cooling nozzles, which provide lubrication for the gudgeon pins.

10 Lubrication for the valve gear is supplied through separate drillings in the cylinder block; oil flows through the drillings and across the oil transfer slot in the cylinder head gasket. From the slot, oil flows across the bottom of the rocker pedestal, up a vertical drilling in the pedestal into the rocker shaft to lubricate the rocker levers. Oil then flows through drillings in the rocker levers to lubricate the valve stems, push-rods and cam-followers.



1 Turbocharger
2 Piston cooling nozzle
3 Valve gear
4 Camshaft
5 Crankshaft
6 Oil cooler
7 Oil pump
8 Oil pressure regulating valve
9 Oil return
10 Oil filter
11 Filter by-pass valve
12 Turbocharger oil feed
13 Oil return

Fig 3 Lubricating oil system

CHAPTER 2

CLUTCH

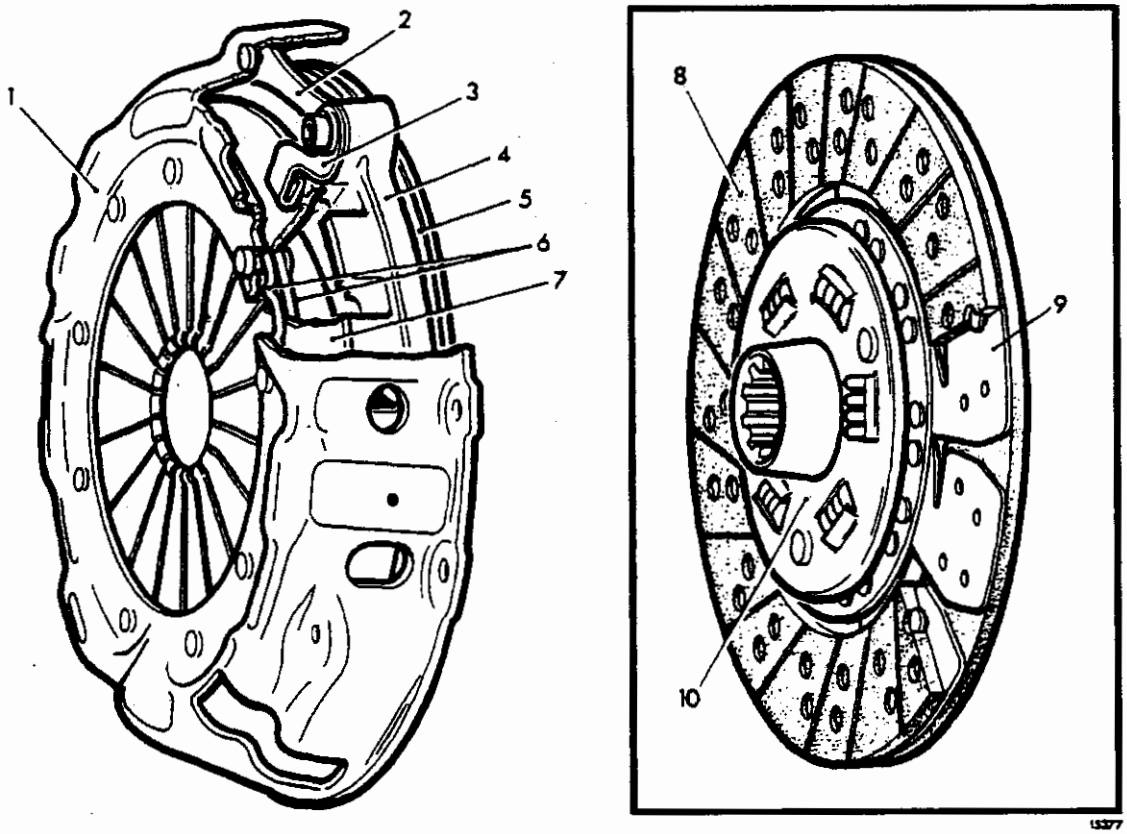
CONTENTS

Para

Fig Page

CLUTCH

1 The clutch (Fig 1) is a single dry plate type, comprising a 330 mm (13 in.) driven plate and a self adjusting diaphragm spring cover/pressure plate assembly.



1 Clutch cover
2 Drive strap
3 Retractor clip
4 Pressure plate
5 Driven plate
6 Fulcrum rings
7 Diaphragm spring
8 Friction facing
9 Spring plate
10 Drive hub

Fig 1 Clutch assembly

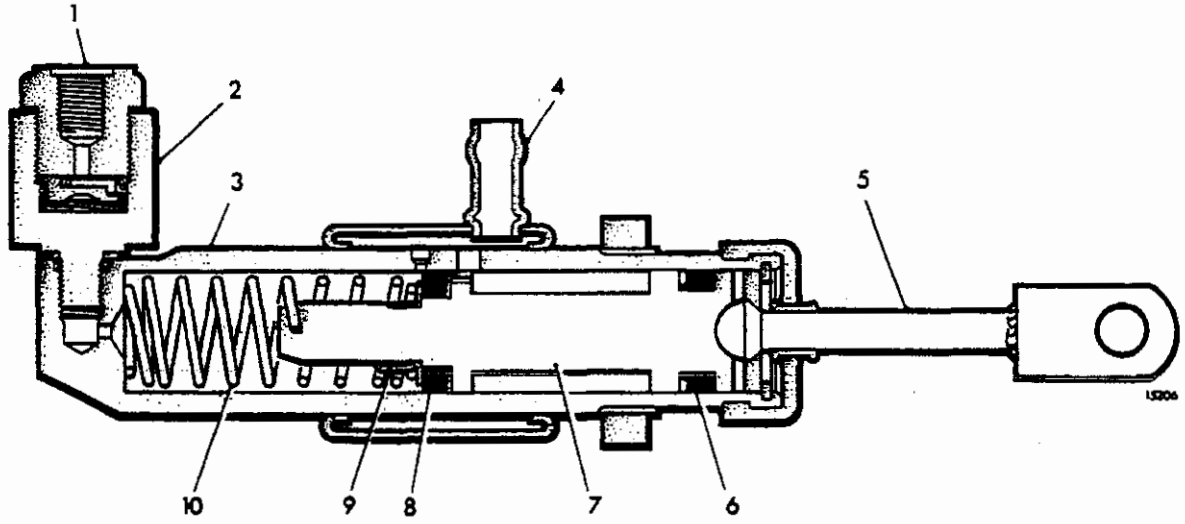
2 The driven plate (5) is of the spring mounted friction facing type with a multiple coil spring drive hub (10). The friction facings (8) have an annular frictional lining of 330 mm (13 in.) outside diameter, 200 mm (7.87 in.) inside diameter and 4 mm (0.157 in.) thick non asbestos friction material.

3 When the clutch pedal is depressed, the release bearing applies pressure to the diaphragm fingers which move inwards and pivot on the fulcrum rings (6) to lift up the spring outer edge. The retractor clips (3) raise the pressure plate (4) flexing the drive straps (2) to release the driven plate and disconnect the input shaft drive to the gearbox

4 When the clutch pedal is released, the diaphragm spring forces the pressure plate to compress the spring mounted friction facings, thus giving a smooth clutch engagement. Drive is also cushioned by the drive hub multiple coil springs.

CLUTCH MASTER CYLINDER

5 The clutch master cylinder (Fig 2) is a single plunger centre valve type with a non-adjustable push-rod (5).



1	Outlet port	6	Piston seal
2	Restrictor valve	7	Hydraulic piston
3	Hydraulic cylinder	8	Main piston seal
4	Inlet port	9	Spring retainer
5	Push rod	10	Return spring

Fig 2 Section view of the clutch master cylinder

6 When the clutch pedal is depressed the push-rod moves along the cylinder bore, closing off the fluid supply from the reservoir. The pressure created operates the piston in the clutch servo slave cylinder.

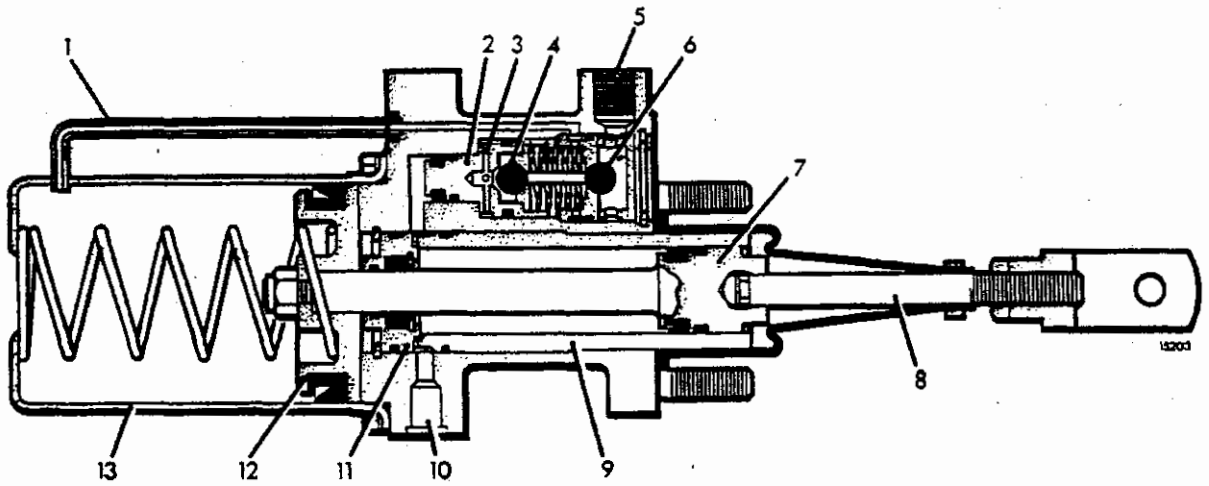
7 When the clutch pedal is released, the return spring (10) moves the piston (7) towards its end stop faster than the fluid is displaced to the master cylinder. This causes the lip of the main seal (8) to release, allowing fluid to pass over the seal lip and through the holes in the piston, which are uncovered during the return movement of the piston.

8 When the piston is in the fully released position, the main seal opens the by-pass port in the cylinder, which releases all pressure within the master cylinder; the by-pass port also allows for expansion or contraction of the fluid caused by changes in temperature.

9 The restrictor valve (2) checks the return of fluid to the master cylinder during 'bleeding'; this ensures a fresh charge of fluid everytime the piston is displaced and consequently assist the purge of air from the system.

CLUTCH SERVO CYLINDER

10 The clutch servo cylinder (Fig 3) is an air/hydraulic unit which provides air assistance whenever the clutch pedal is depressed.



1	Air passage	8	Push rod
2	Reaction plunger	9	Hydraulic cylinder
3	Exhaust passage	10	Hydraulic inlet port
4	Exhaust valve	11	Seal housing
5	Air inlet port	12	Air piston
6	Inlet valve	13	Air cylinder
7	Hydraulic piston		

Fig 3 Section view of the clutch servo slave cylinder

11 The unit is self adjusting, therefore as the clutch facings wear, the piston/push-rod (7) and (8) assembly moves rearward and, throughout the life of the clutch, the servo piston travel required to disengage the clutch is constant.

12 Air pressure of 3.5 bar (50 lbf/in.^{2}) is supplied to the servo cylinder from a pressure reducing valve situated in the essential auxiliary line. For detailed information on the pressure reducing valve, refer to Chap 10.

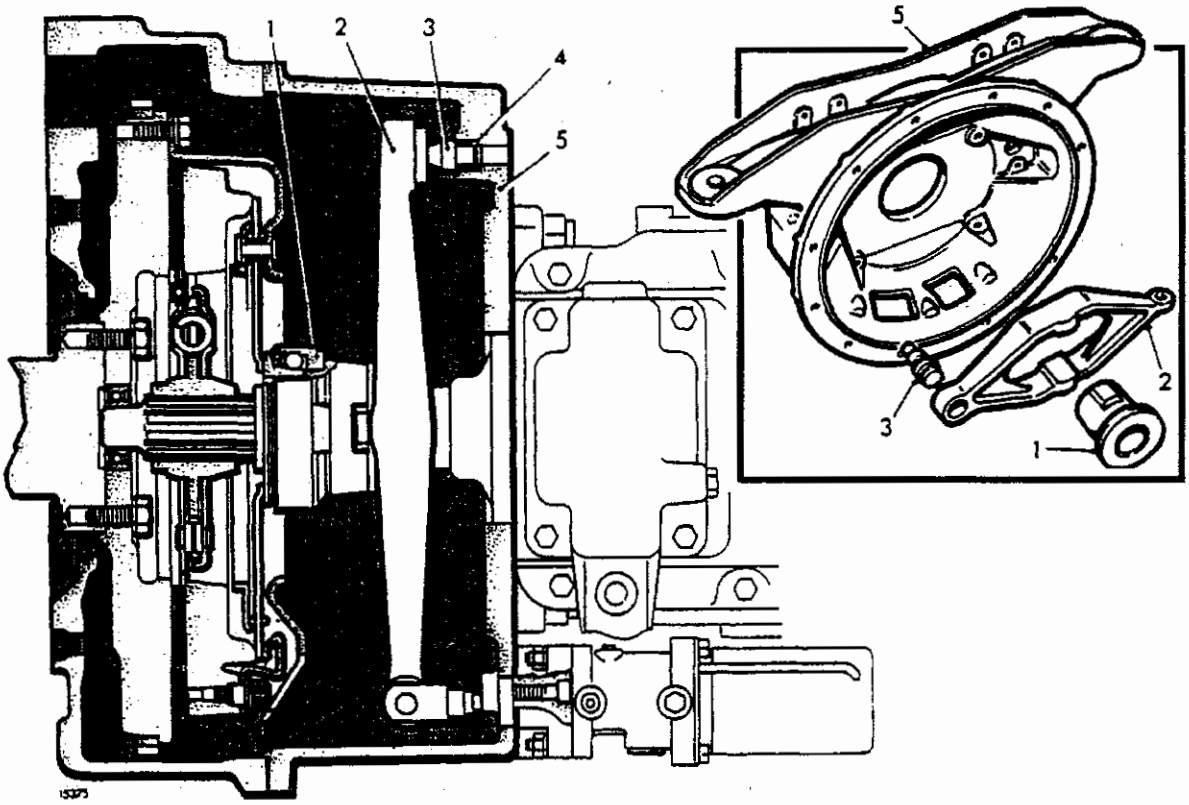
13 When the clutch pedal is depressed, hydraulic fluid from the clutch master cylinder is displaced through the hydraulic inlet port and the pressure created acts on the reaction plunger (2) and the hydraulic piston (7). The pressure moves the reaction plunger off its seat, closing the exhaust valve (4) and opening the inlet valve (6). Air then passes through the inlet valve and the passage (1) to the air cylinder. Air pressure acting on the piston (12) assists the movement of the hydraulic piston, thus disengaging the clutch.

14 When the clutch pedal is held in a partially depressed position, the air pressure acting on the reaction plunger overcomes the hydraulic pressure behind the plunger causing the inlet valve to seat, stopping the air supply to the air cylinder. With both valves seated the push-rod remains stationary until the clutch pedal is further depressed or released.

15 When the clutch pedal is released the hydraulic fluid pressure acting on the plunger decreases. The return spring moves the plunger which opens the exhaust valve, allowing the air from the air cylinder to exhaust to atmosphere.

CLUTCH RELEASE MECHANISM

16 The clutch release mechanism (Fig 4) comprises a rotating ball release bearing, self centring release lever and a pivot ball pin.



1 Release bearing
2 Clutch release lever
3 Pivot ball pin
4 Pivot bush
5 Clutch housing

Fig 4 Clutch release mechanism

17 The release bearing is a pre-sealed, rotating ball type, which is loosely mounted in the release lever. The bearing is permanently in contact with the diaphragm fingers, and when the engine is running the bearing rotates irrespective of whether the clutch is engaged or disengaged. There is no free travel and adjustment takes place automatically.

18 The self centring release lever has a ball pin as a pivot point, the advantage of this type of lever is the uniform loading of the release bearing.

CHAPTER 3

GEARBOX

CONTENTS

GEARBOX

1 The five-speed direct drive gearbox has synchromesh engagement on all forward gears, with a constant mesh reverse gear. The gearbox ratios are as follows: 1st (7.58:1); 2nd (4.38:1); 3rd (2.4:1); 4th (1.48:1); 5th (1.1); Reverse (7.2:1).

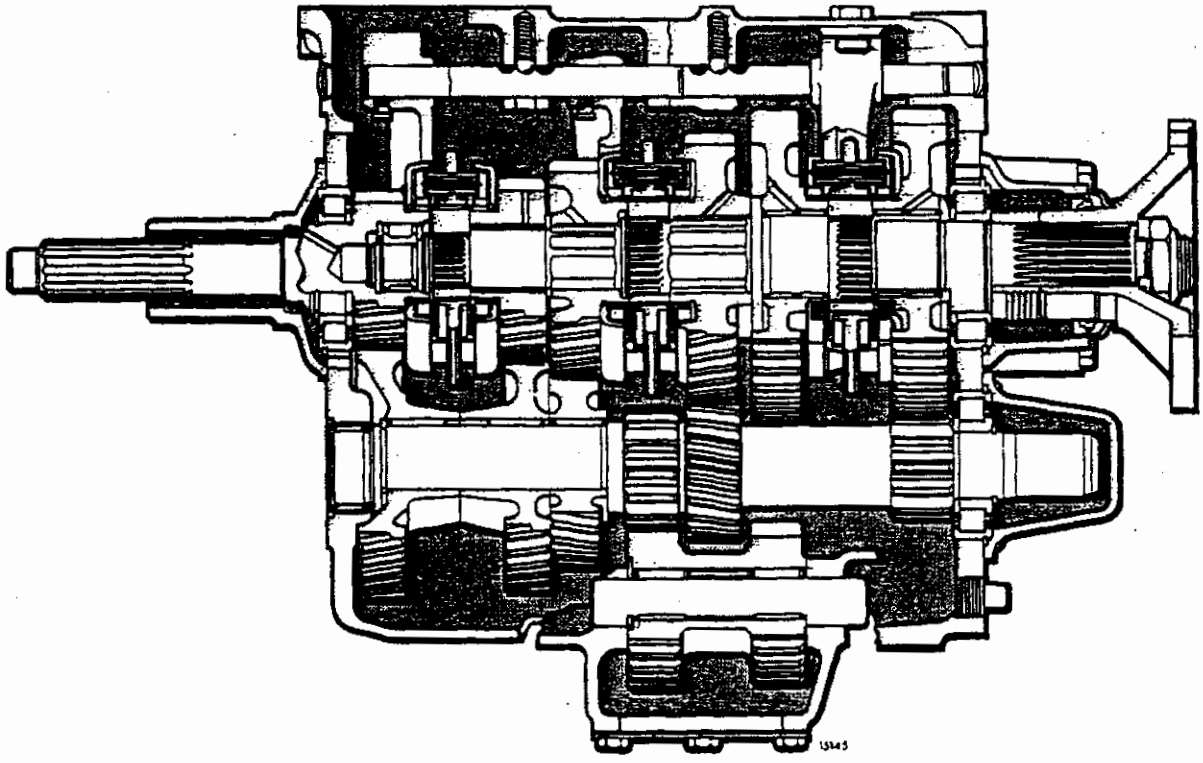


Fig 1 Section view of the five-speed gearbox

2 All gears are in constant mesh, but the mainshaft gears, although mounted on the shaft can rotate independently of it. The layshaft gears are joined together so that they rotate as one.

3 When a forward gear is engaged, the conical friction face of the synchronizer is brought into contact with the synchronizer cup, which is splined to the gear. This has the effect of slowing down or speed up of the gear until it is rotating at the same speed as the synchronizer, allowing the synchronizer to slide noiselessly into mesh with the splined hub on the gear. The 1st/reverse synchroniser assembly enables synchromesh engagement on 1st gear and sliding clutch engagement on reverse.

4 Power (torque) from the engine flywheel is transferred to the input shaft gear, which is in constant mesh with the gear directly below it on the layshaft. Torque is delivered by the layshaft gears to the mainshaft gear that has been engaged, to give the required ratio.

5 All gears are of helical form except for 1st and reverse which are of the spur type.

6 The front of the input shaft locates in a spigot bearing fitted to the flywheel, while the rear is supported in the gearbox housing by a cylindrical roller bearing..

7 The mainshaft is supported in the rear of the input shaft and the gearbox casing by two cylindrical roller bearings.

8 The layshaft is supported by a needle roller bearing at the front and a cylindrical-roller bearing at the rear.

9 Lubrication of the gearbox is by splash feed.

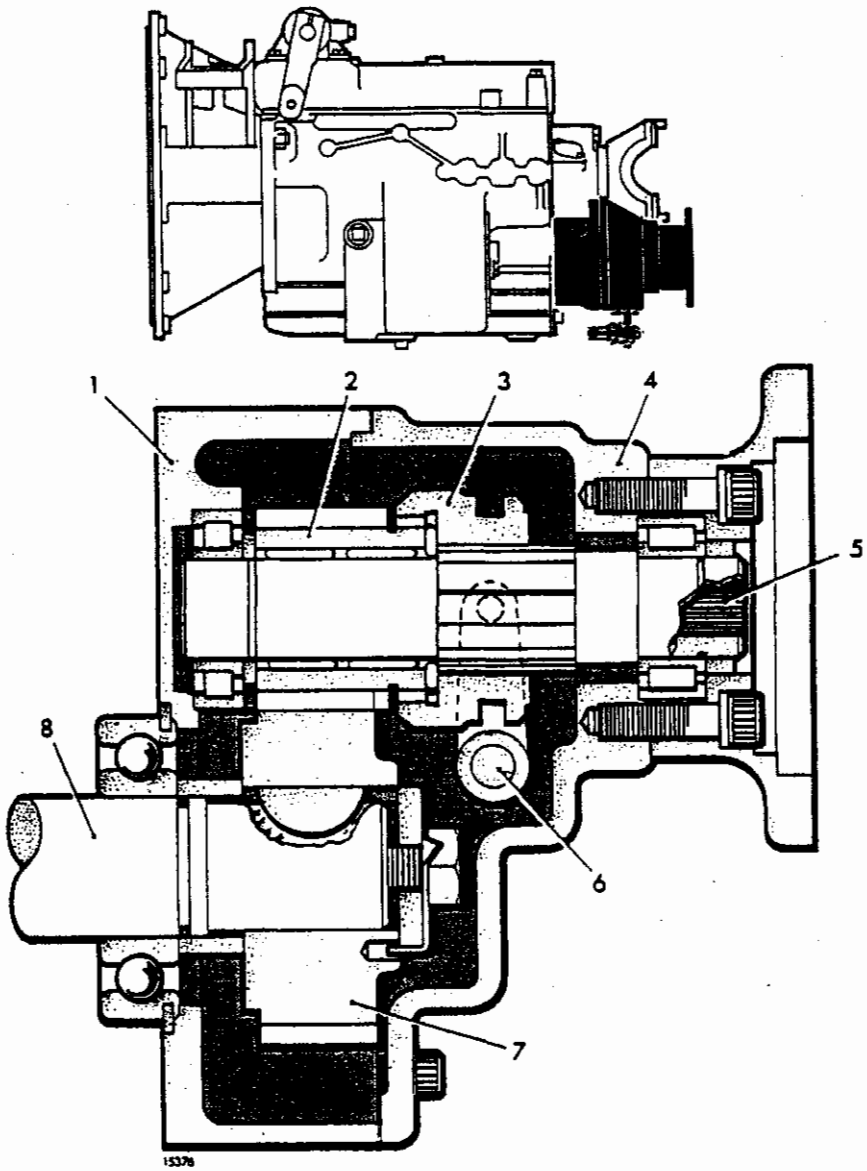
POWER TAKE-OFF

10 The Power Take-Off (PTO) unit (Fig 2) is fitted to the rear of the gearbox and is driven by the layshaft.

11 The front housing (4) incorporates an air operated sliding clutch (3), which is controlled by a switch in the cab. When the PTO is engaged, the driven gear (2) is locked to the output shaft by the sliding clutch, transmitting the drive from the layshaft (8) to the output shaft.

12 The rear of the output shaft is internally splined to transmit the drive to the splined drive shaft of the hydraulic pump. Refer to Chap 17 for a detailed description of the hydraulic pump.

13 The output shaft is supported at either end by cylindrical roller bearings and the drive gear is carried on two needle roller bearings. The drive gear (7) is keyed to the layshaft and secured with a lockplate and setscrew.



1	Rear housing	5	Output shaft
2	Driven gear	6	Selector fork
3	Sliding clutch	7	Drive gear
4	Front housing	8	Layshaft

Fig 2 Section view of the power take-off unit

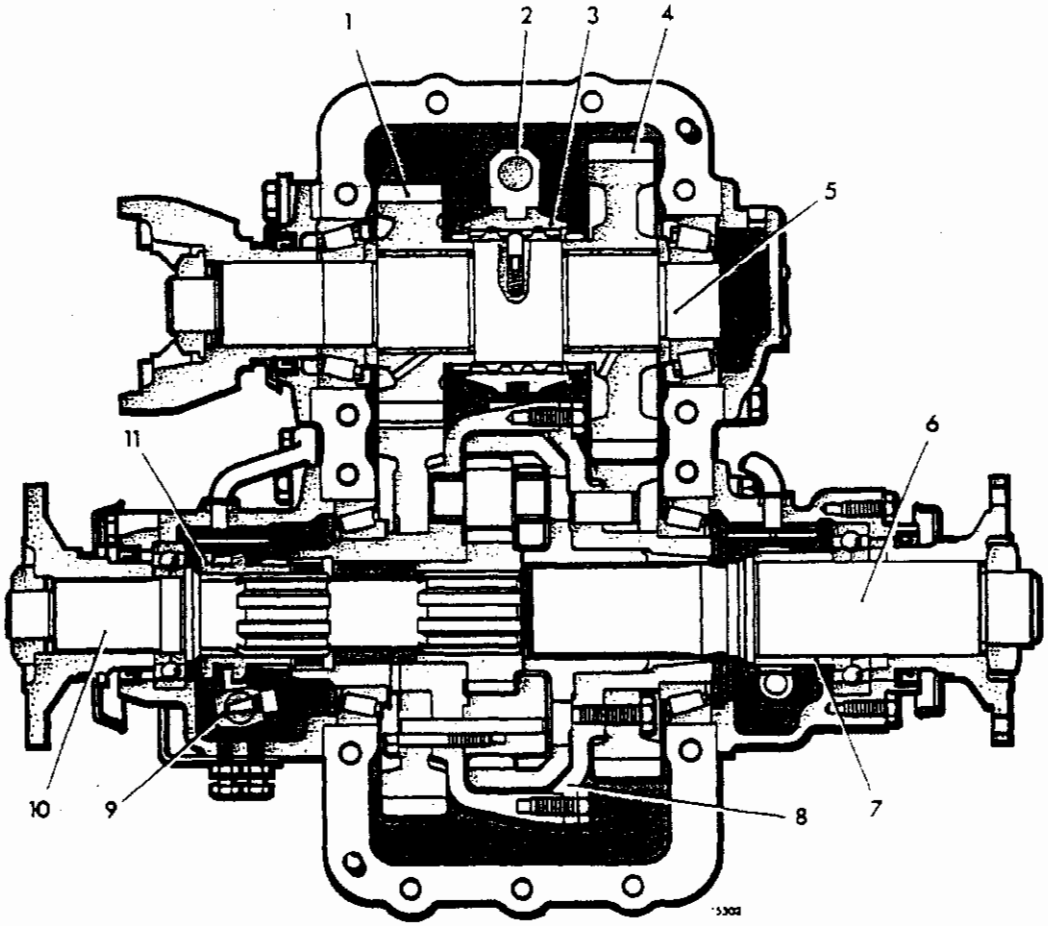
CHAPTER 4

TRANSFER DRIVE GEARBOX

CONTENTS

TRANSFER DRIVE GEARBOX

1 The transfer drive gearbox (Fig 1) is a two speed, two shaft constant mesh gearbox with a lockable planetary differential unit. The differential unit (8) provides a torque split ratio of 1:2; 33% to the front axle and 67% to the rear. Permanent drive is supplied to all four wheels. Lubrication of the gearbox is by splash feed.



1 Input gear, 'Lo'
2 Range change selector lever
3 Sliding clutch, range change
4 Input gear, 'Hi'
5 Input shaft
6 Output shaft, rear
7 Speedometer worm gear
8 Differential assembly
9 Differential lock selector fork
10 Output shaft, front
11 Sliding clutch, differential lock

Fig 1 Section view of the transfer drive gearbox

2 Range change is controlled by the gear lever fitted to the cab facia panel. 'Hi' ratio (1 - 032:1) is for normal highway and suitable off highway motoring. 'Lo' ratio (1 - 783:1) is for off highway motoring and severe gradients.

3 The 'Hi' or 'Lo' input gears are locked to the input shaft (5) by a sliding clutch (3) located on the splines between the two gears. Therefore, when either 'Hi' or 'Lo' range is selected, the sliding clutch engages with the clutch teeth on the relevant gear.

4 The input shaft is supported at either end by taper roller bearings and the input gears are carried on two needle roller bearings. Two taper roller bearings support the differential unit in the gearbox casing.

5 The front and rear output shafts (6) and (10) are supported in a detachable housing by a three piece ball bearing. The rear output shaft incorporates the speedometer worm gear. The front output shaft incorporates an air operated differential lock (11) to overcome wheel spin and provide better traction in off road conditions.

CHAPTER 5

REAR AXLE

CONTENTS

Para

Fig Page

REAR AXLE

1 The rear axle is a single speed, spiral bevel fully floating type. Power flow is through a matched spiral bevel pin and crown wheel, and a differential unit to the axle shafts and hubs.

DRIVING HEAD

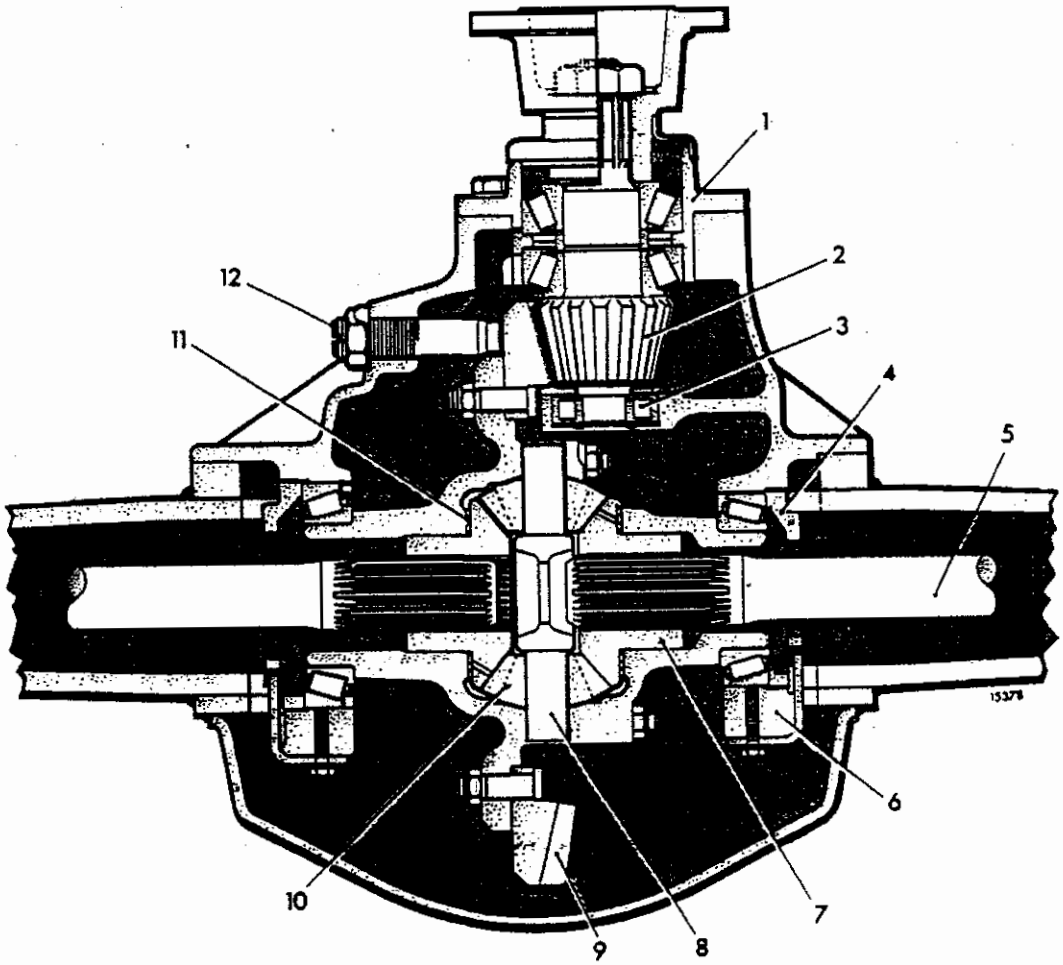
2 The spiral bevel gearing and differential unit is mounted in a driving head casing (Fig 1) which is bolted to the axle casing.

3 The crownwheel (9) is mounted on a ribbed differential cage half, and is protected against shock loads by the use of a kickscrew (12) secured to the driving head casing.

4 The differential unit contains four bevel pinions (10) mounted on a trunnion (8) with the side gears mounted directly into the differential cage, which run against bronze thrust washers (11) to minimise wear.

5 Two taper roller bearings support the crown wheel/differential unit in the driving head casing, which are retained by bearing caps. Side bearing pre-load and lateral location of the differential unit is controlled by two circular adjusting collars (4).

6 The bevel pinion (2) is supported in a detachable housing (1) by two taper roller bearings and a spigot bearing (3) in the driving head casing.



1	Bearing/oil seal housing	7	Differential side gear
2	Spiral bevel pinion	8	Differential trunnion
3	Spigot bearing	9	Crownwheel
4	Adjusting collar	10	Differential bevel pinion
5	Axle shaft	11	Thrust washer
6	Differential bearing cap	12	Kickscrew

Fig 1 Section view of the driving head

HUB ASSEMBLY

7 The hubs are of the fully floating type and are supported on taper roller bearings. The bearings are secured to the axle tube using locknut/tab washer arrangement.

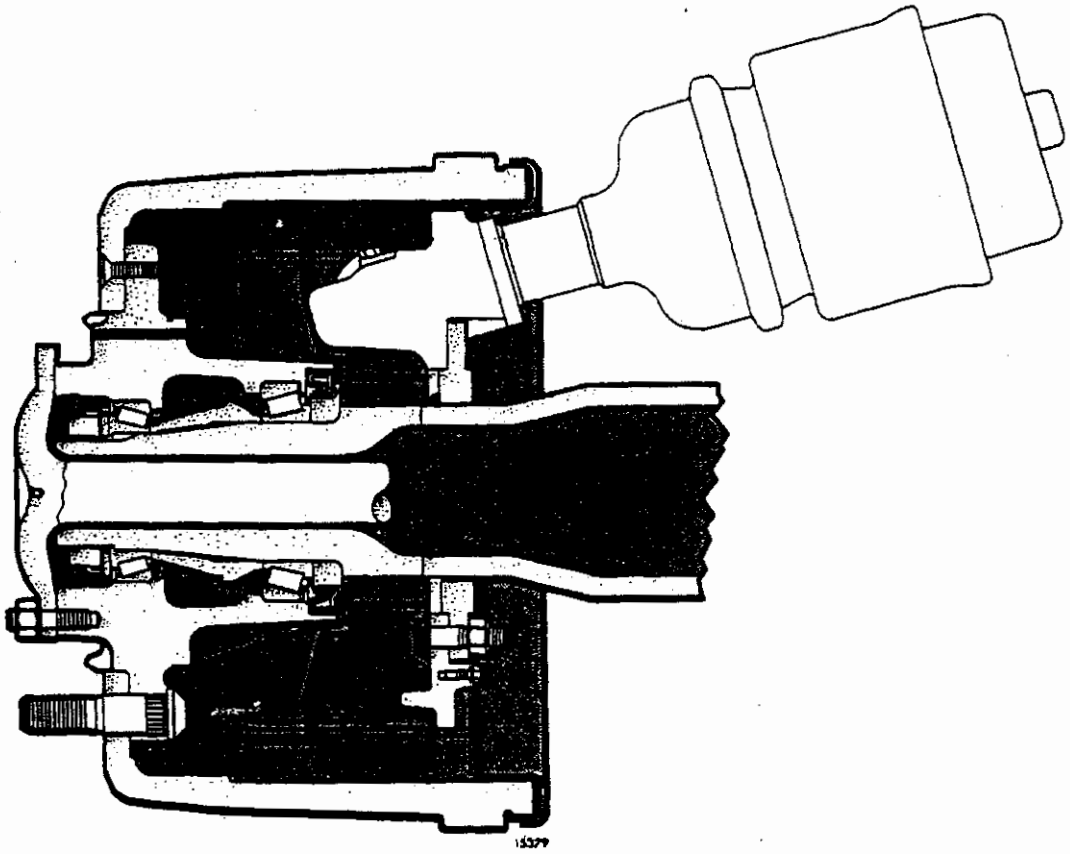


Fig 2 Section view of the hub assembly

8 Drive is transmitted to the road wheels via the axle shafts, which are splined into the differential side gears and bolted to the hub. This type of hub design allows the weight of the vehicle to be supported entirely by the road wheels and axle casing. The axle shaft transmits torque only and, is therefore, not subjected to side thrust or strain in supporting the weight of the vehicle.

CHAPTER 6

FRONT AXLE

CONTENTS

FRONT AXLE

1 The front axle is, with the exception of the 'Tracta' joint housing/steering knuckle assemblies, similar to the rear; refer to Chap 5.

DRIVING HEAD

2 The driving heads used in the front and rear axles are identical and are interchangeable between axles. Information for the driving head, detailed in Chap 5, Paras 2 to 6, is also applicable to the front driving head.

HUB ASSEMBLY

3 The information detailed in Chap 5, Para 7, for the rear hubs is also applicable to the front hubs.

OUTER END ASSEMBLY

4 The outer end assembly (Fig 1) comprises a brake knuckle (2), inner knuckle (9), stub (3), swivel pivot pins (1) and (6) and a 'Tracta' joint/axle shaft assembly (8).

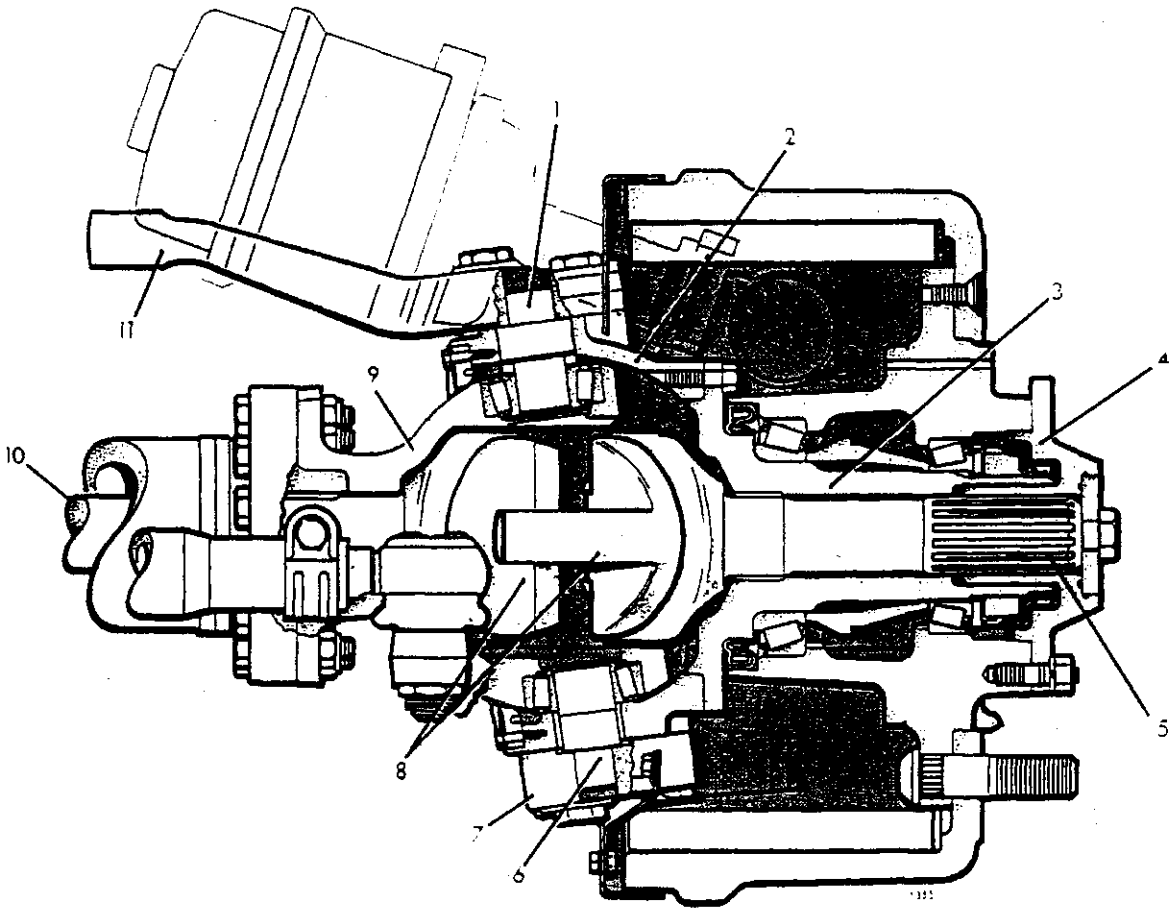
5 The brake knuckle swivels on the inner knuckle by means of two pivot pins, which are carried in taper roller bearings. The track-rod levers and steering arm are bolted on to the brake knuckle and are a press fit onto the pivot pins. On the non steering side of the axle a top pivot cover is fitted.

6 The stub, which is spigot mounted to the brake knuckle, forms a spherical housing for the 'Tracta' joint. The 'Tracta' joint/axle shaft assembly is supported by two bronze bushes; one the inner knuckle and one in the stub.

7 A wiper seal, fitted to the rear of the brake knuckle, excludes dirt from and, keeps lubricant in the spherical housing.

AXLE DRIVE SHAFTS

8 The inner axle shaft (10) is splined into the differential side gear while the outer end incorporates the driving fork for the 'Tracta' joint. The outer shaft is of similar design and is splined into the drive flange (4), which is bolted to the hub.



1	Swivel pivot pin, upper	7	Track rod lever
2	Brake knuckle	8	'Tracta' joint
3	Stub	9	Inner knuckle
4	Drive flange	10	Axle shaft, inner
5	Axle shaft, outer	11	Steering arm
6	Swivel pivot pin, lower		

Fig 1 Section view of the outer end assembly

CHAPTER 7

STEERING

CONTENTS

STEERING GEARBOX (TYPE ZF 8095)

Description

1 The ZF 8095 (Fig 1) is a recirculating ball (5), hydraulically assisted design comprising a cylinder (4), formed within the housing (3), piston (7) and worm shaft (8) incorporating the control valve (9).

2 Axial movement of the piston (7) is transmitted to the rocker shaft (15) via straight-cut teeth formed on the piston (7) and rocker shaft (15). Meshing-of the teeth, free from backlash, is achieved by two eccentric side covers.

3 The wormshaft (8) is connected to the piston (7) by a series of selectively sized steel balls (5) running in helical grooves formed on the periphery of the wormshaft (8) and in the bore of the piston (7).

4 Rotation of the wormshaft (8) transports the balls from end to end passing through a bridging tube (6), thus providing a continuous row.

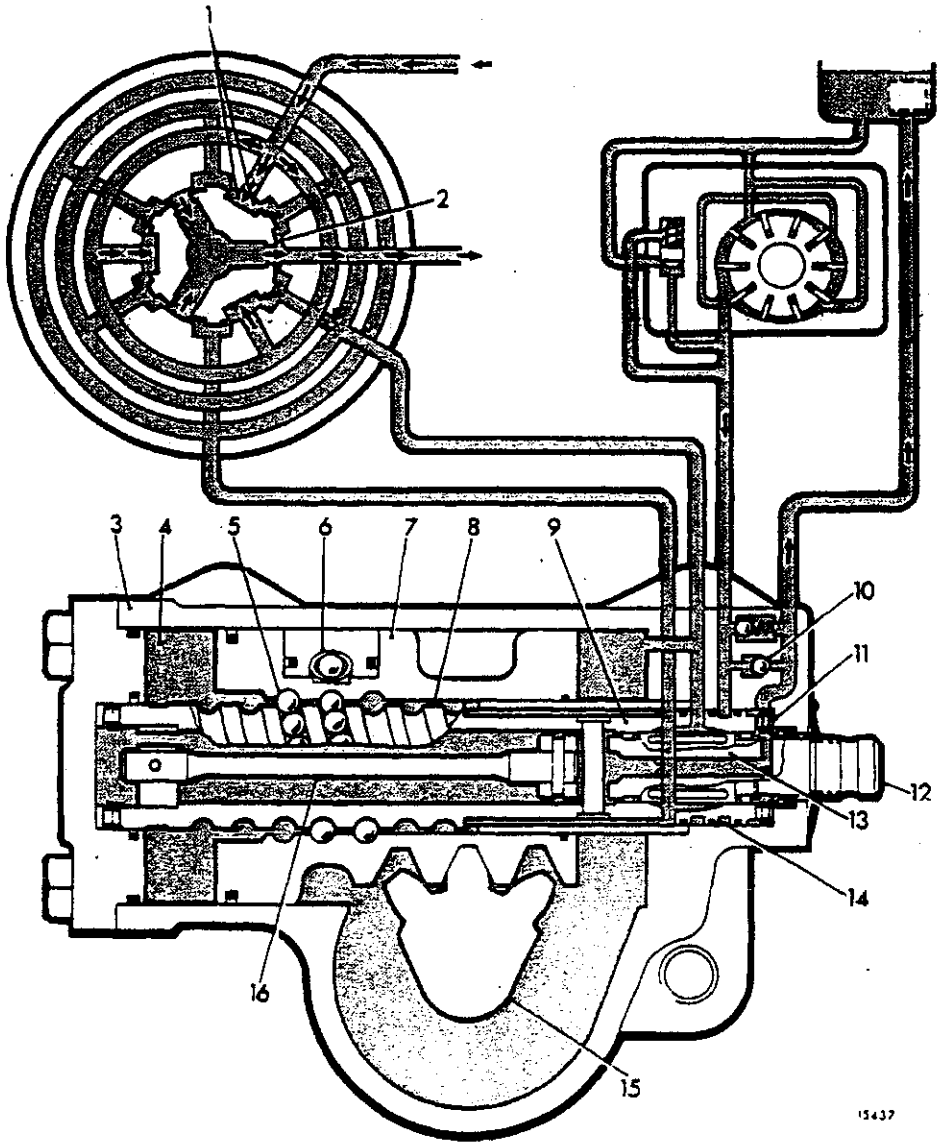
5 The control valve (9) is supported on a needle bearing (11) within the wormshaft (8) and consists of a rotary valve (13) with six control grooves and the wormshaft (S) head (control sleeve) also having six control grooves. The rotary valve (13) is connected to the steering spindle (12) and rotates with the wormshaft (8) head when the steering wheel is turned.

6 A torsion bar (16), pinned to the rotary valve (13) and wormshaft (8) holds the valve in the neutral position when no effort is applied to the steering wheel.

7 A recuperation valve (10) in the housing (3) allows oil to be drawn from the reservoir return line, preventing an hydraulic lock-up in the event of a loss of hydraulic power assistance.

Operation

8 Turning the steering wheel transmits a turning moment to the steering spindle (12). The torsion bar (16) is deflected, turning the rotary valve (13) relative to the wormshaft (8) head (control sleeve), displacing the grooves of the rotary valve (13) from the neutral position. When the steering wheel is released the torsion bar (16) returns the rotary valve (13) to the neutral position.



1	Inlet ports	9	Control valve
2	Return ports	10	Recuperating valve
3	Housing	11	Needle bearing
4	Cylinder	12	Steering spindle
5	Recirculating balls	13	Rotary valve
6	Bridging tube	14	Central annular groove
7	Piston	15	Rocker shaft
8	Worm shaft	16	Torsion bar

Fig 1 Steering gearbox oil flow

Oil flow-neutral position

9 Oil from the pump passes to the central annular groove (14) of the control sleeve. The oil then passes through the three equidistantly spaced radial bores to the control grooves on the rotary valve.

10 The position of the grooves on the rotary valve (13) and those on the control sleeve is such that the oil can flow through the inlet ports (1) to the axial grooves on the control sleeve.

11 Oil may now freely flow to either end of the piston (7) and via the three return grooves (2) in the rotary valve (13), to the reservoir.

Oil flow-turning right

12 Turning the steering wheel clockwise moves the piston (7) upwards. At the same time the three control grooves on the rotary valve (13) are displaced clockwise and the inlet ports (1) are opened wider. The three adjacent inlet ports are closed, sealing off the oil feed to the axial grooves on the control sleeve.

13 With the valve held in this position, oil pressure passes to adjacent axial grooves on the control sleeve to the bottom of the piston (7) via the recirculating ball (5) track.

14 Oil above the piston (7) is returned to the reservoir via the central bore in the rotary valve (13) and control grooves in the control valve sleeve.

Oil flow-turning left

15 Turning the steering wheel anti-clockwise moves the piston (7) downwards. The rotary valve (13) is deflected anti-clockwise. Oil passes via the axial grooves on the control sleeve, across the central radial groove (14) on the rotary valve (13) to the top of the piston (7). Again, the three adjacent inlet ports close, sealing off the oil feed to the axial grooves on the rotary valve (13).

16 Oil from the underside of the piston (7) returns to the reservoir via the recirculating ball (5) track and central bore of the rotary valve (13).

STEERING PUMP (TYPE ZF 7674)

Description

17 The pumping element consists of a rotor (Fig 2 (14)) and vanes (15), mounted on the drive shaft (12), which rotate within a twin profile cam ring (13).

18 When the drive shaft (12) and rotor (14) rotate, the vanes (15) are pressed against the guide path of the cam ring (13) by centrifugal force and oil pressure. Two successive vanes constitute one cell. There are ten cells to each rotor which are laterally restrained by pressure plates (6) and (7). Each cell delivers maximum effective cell volume twice during each revolution. The suction and pressure chambers are so arranged that the hydraulic radial forces acting on the rotor (14) are neutralised.

19 Flow and pressure is controlled by a spring biased piston valve (3) situated upstream of the delivery ports.

Operation

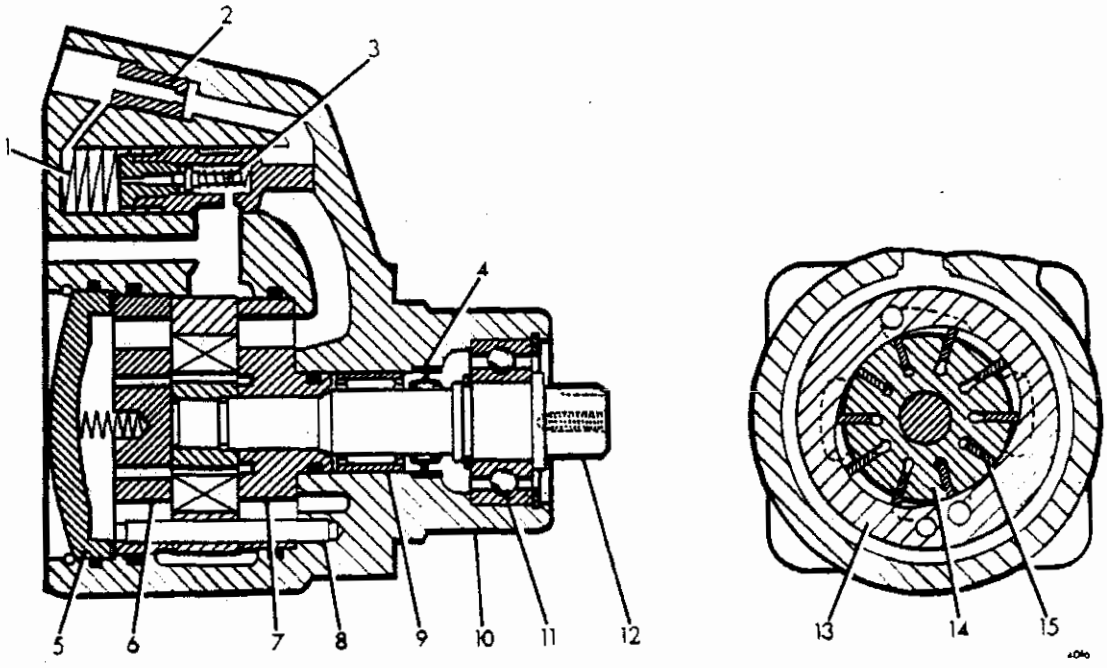
20 The cover-end front plate (6) and drive-end front plate (7) are provided with four grooves so that the pressurised oil reaches the internal face of the pump vanes (15) and will thereby, support the centrifugal forces.

21 From the pressure chambers the oil passes through drillings to the flow regulating piston valve (3) and then, by way of a throttle (2), to the pressure delivery line.

22 The reduced pressure beyond the throttle (2) is transmitted through a drilling to the spring (1) loaded end of the piston valve (3) and to the pressure relief valve situated within the piston.

23 Increasing pump speed and delivery results in a greater pressure differential beyond the throttle orifice (2) affecting the spring loaded end of the piston valve (3). When the hydraulic force (pressure differential times piston area) exceeds the spring force, the piston valve (3) will move against the spring. Oil in excess of the predetermined flow rate will pass to the suction side of the pumping element through the now open port.

24 Should the pressure present in the delivery line rise above the maximum figure, the relief valve situated within the piston valve (3) will open. This will result in a collapse of the balance across the piston valve. All delivered oil will be returned to the suction side of the pumping element until pressure reduction is achieved. As a result, an almost constant volume oil flow is available for the steering gearbox over the entire speed range.



1	Pressure spring	9	Needle bearing
2	Throttle insert	10	Housing
3	Piston valve (complete)	11	Radial ball bearing
4	Oil seal	12	Drive shaft
5	Cover	13	Cam ring
6	Front plate (cover end)	14	Rotor
7	Front plate (drive end)	15	Vane
8	Fitted pin		

Fig 2 Steering pump

CHAPTER 8

SUSPENSION

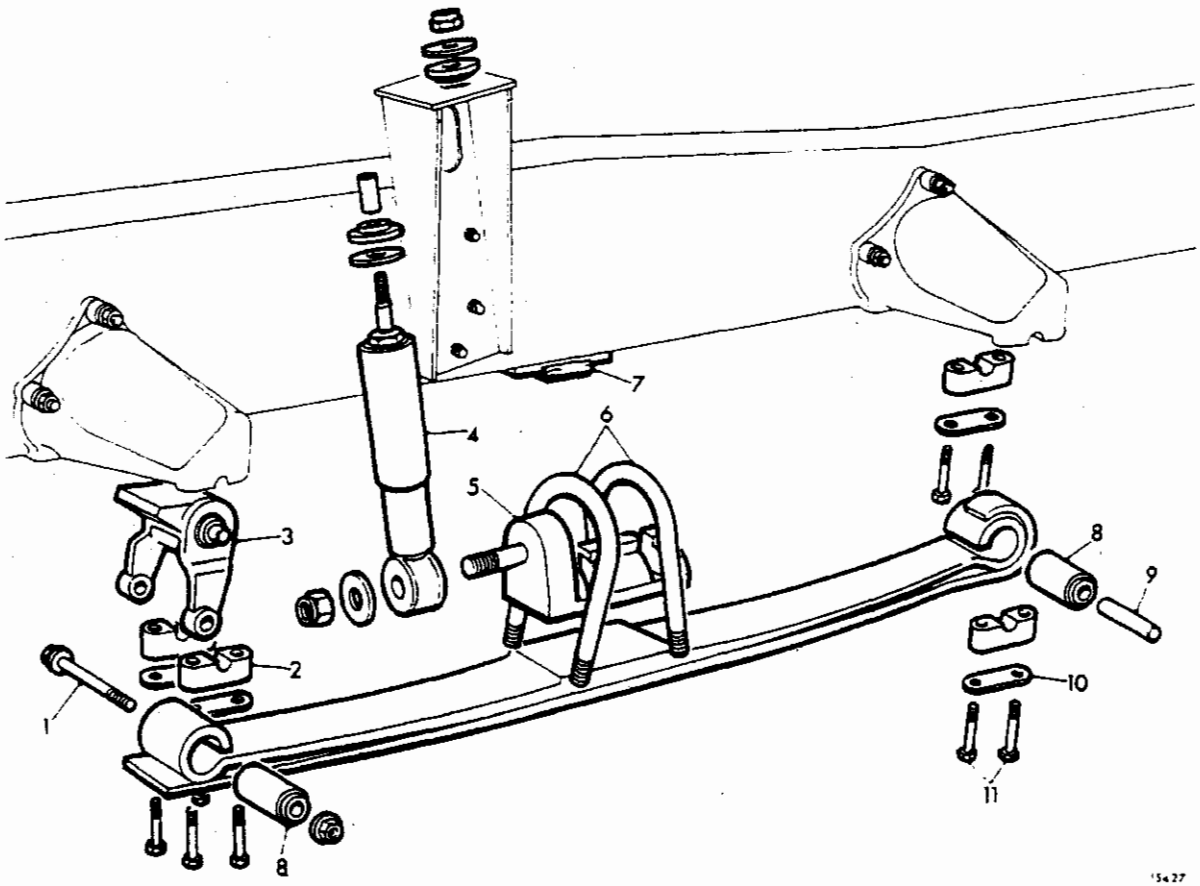
CONTENTS

Para

Fig Page

FRONT SUSPENSION

1 The front suspension (Fig 1 and 2) consists of semi-elliptical taper leaf springs and double acting hydraulic shock absorbers (4).



1 Spring eye bolt
2 Clamp
3 Shackle
4 Shock absorber
5 Saddle plate
6 'U' bolt
7 Bump stop
8 Spring eye bush
9 Shackle pin
10 Lockwasher
11 Clamp bolt

Fig 1 Front suspension

2 The suspension springs have two leaves and the eyes of the spring main leaves and shackles incorporate rubber bushes. The spring second leaf is extended around the eye of the main leaf to prevent excessive movement of the axle in the event of a failure of the main leaf. The spring leaves are held together by a centre bolt and tie clip.

SPRING AND SHACKLE BUSHES

3 Spring eye bolts (1) and nuts secure the spring to the shackle (3) and the shackle pin bush is secured to the hanger bracket with a clamp (2), clamp bolts (11) and lockwashers.

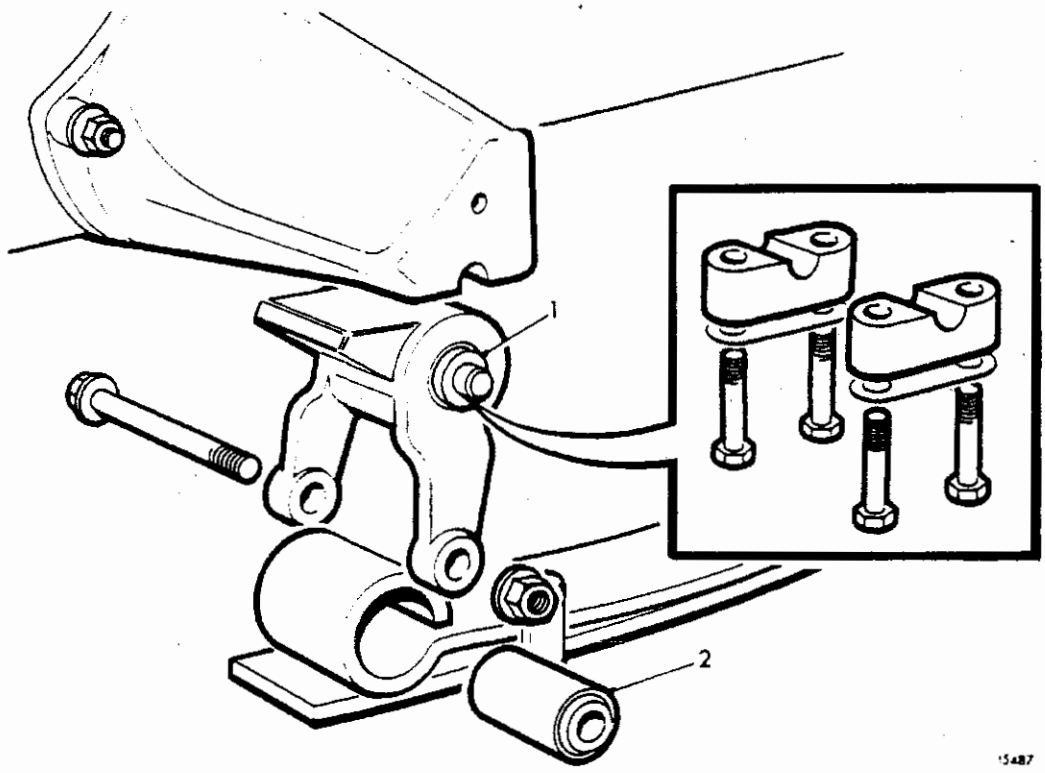


Fig 2 Spring and shackle bushes

4 Axles are secured to the springs by U-bolts (6). Location of the axle is controlled by a saddle bracket (5) mounted on top of the spring and by anchor plates below the axle.

5 The shock absorbers (4) are of the rubber bushed stud mounting type and are secured at the chassis frame and spring saddle plate by locknuts.

6 An axle bump stop (7) is located on a bracket secured to the chassis frame sidemember.

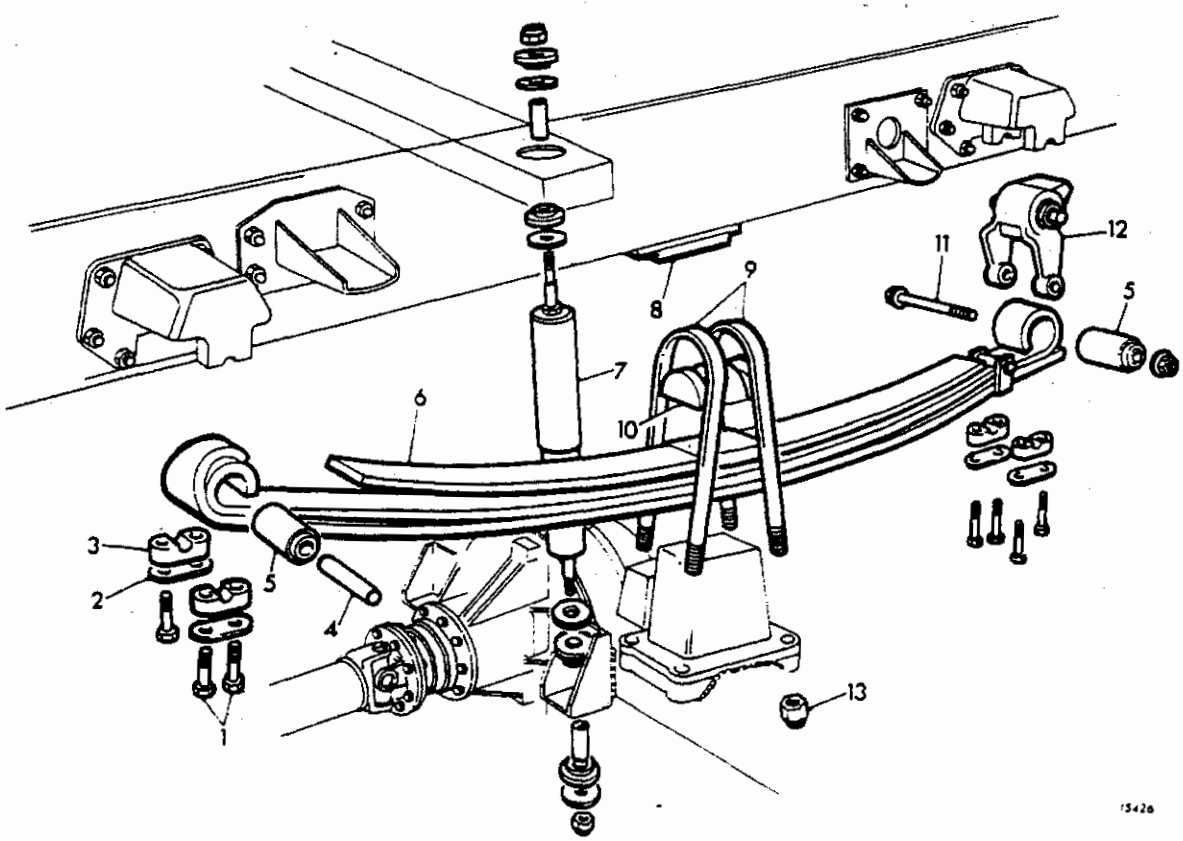
REAR SUSPENSION

7 The rear suspension (Fig 3) consists of semi-elliptical taper leaf springs, the triple leaf springs are secured to spring hanger brackets by a rear spring shackle (12), shackle pin bush, clamps, locknuts and lockwashers and by spring eye bolts and nuts.

8 Two double acting hydraulic shock absorbers (7) are connected between the axles and chassis frame.

9 The shock absorbers are rubber bushed, the upper end is of the stud type, mounted to a bracket on the chassis sidemember, the lower end is also stud type and is connected to the axle. Both mountings are secured by locknut.

10 Bump stops (8) are mounted on brackets secured to the chassis sidemember.



1	Clamp bolt	8	Bump stop
2	Lockwasher	9	'U' bolt
3	Clamp	10	Saddle plate
4	Shackle pin	11	Spring eye bolt
5	Spring eye bush	12	Shackle
6	Spring	13	'U' bolt nut
7	Shock absorber		

Fig 3 Rear suspension

CHAPTER 9

WHEELS AND TYRES

CONTENTS

Para

WHEELS AND TYRES

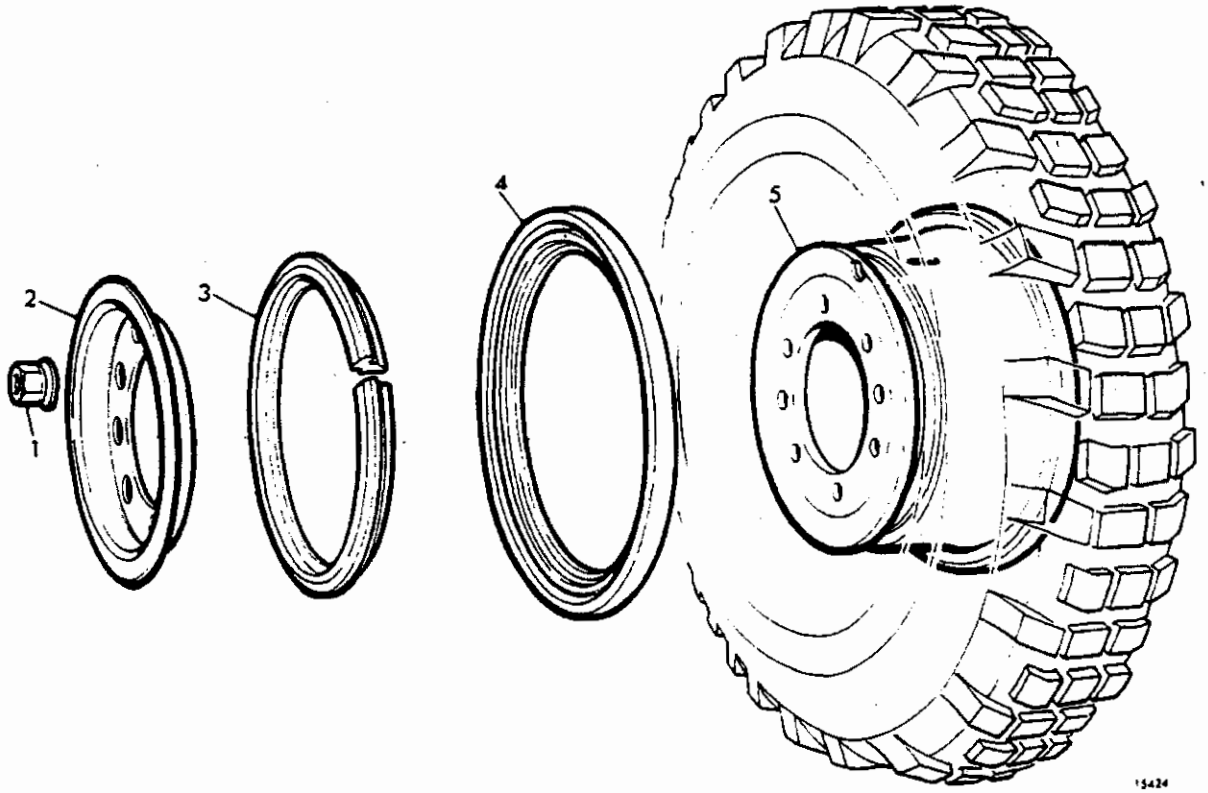
1 The road wheels are of a three piece construction with one loose flange.

2 The wheels are attached to the hubs by 8 spigot mounted nuts (1).

3 Discs (2) are fitted to the front wheels to aid vertical lifting for helicopter.

4 Unidirectional radial tyres are fitted complete with inner tubes.

5 Tyre data 12.00 R20 LI - 154/149 SR - J



1 Spigot nuts
2 Lifting discs
3 Split ring
4 Loose rim
5 Wheel hub

Fig 1 Wheel and tyre assembly

CHAPTER 10

AIR PRESSURE AND BRAKING SYSTEM

CONTENTS

(continued)

CONTENTS (continued)

SYSTEM DESCRIPTION

Air supply

1 An engine-driven compressor, with a safety valve set at 14 bar (204 lbf/in.^{2}), supplies compressed air through an expansion cylinder (this reduces air induced noise) to an air dryer where any oil carry over is removed, the air is cooled, filtered and dried. The governor/unloader valve, which is an integral part of the air dryer, relieves the pumping load of the compressor, directing the air to atmosphere when maximum pressure of the air system has been attained. During its subsequent passage to the various air reservoirs, the dry filtered air charges a separate 'purge' air chamber. The air in the purge chamber is periodically used to expel accumulated condensate and dirt from the air dryer while simultaneously regenerating the desiccant material in the cartridge by removing the adsorbed moisture.

2 A second pressure relief valve (safety valve), set at 11 bar (160 lbf/in.^{2}), to safeguard the system, is also incorporated in the air dryer.

3 Manual 'Tilt' type drain valves are fitted to all air storage reservoirs, to deplete the air system and also to check the reservoirs for accumulated residual moisture/condensate.

4 A series parallel type multi-circuit protection valve ensures that in the event of failure of one part of the braking system, the other systems will still function and be capable of stopping the vehicle. Each element is of the restricted feedback type, which allows the governor valve in the air dryer to sense the system pressure in the service reservoirs. Service reservoirs being charged first, prior to air passing to the parking/trailer circuit and the auxiliary circuit.

5 Air gauges 'Air 1' - rear and 'Air 2' - front are directly connected to the service reservoirs, but the park/trailer reservoir gauge 'Air 3' is connected via a transducer.

6 Low pressure switches are connected to all reservoirs and interlinked electrically to a common warning buzzer in the cab.

7 Low pressure switches are also connected to the handbrake and independent trailer brake system and operate a red warning light in the instrument panel.

8 The vehicle is provided with two external 'Palm' type couplings at the front and rear of the vehicle, allowing the vehicle to tow a trailer or, similar type vehicle or, be towed if broken down or, have its air system charged from an external source. The couplings are colour coded. The 'RED' cap indicates the emergency supply line and the 'YELLOW' cap indicates the service control line.

8.1 The front 'RED' connection delivers system air through a line filter and a single check valve which charges the supplementary spring brake release reservoir, via a single system protection valve, whilst simultaneously charging the rest of the system, via the multi-circuit protection valve.

8.2 The rear 'RED' connection supplies air to the trailer reservoirs, or will supply system air to any broken down vehicle with front palm type couplings.

8.3 The front 'YELLOW' connection allows a towing vehicle to control the service (footbrake) system of the towed vehicle via a line filter and double check valves connected to each half of the footbrake valve.

8.4 The rear 'YELLOW, connection controls the trailer service brakes, or will control the service system of the vehicle being towed.

Service brake (footbrake) system

9 The service brake system comprises of two separate circuits, one operating the service brakes on the front axle via a relay valve and the trailer service brakes via the trailer control valve; the other circuit operates the service brakes on the rear axle via a relay valve and the trailer service brakes also via the trailer control valve. Both circuits are operated simultaneously from the upper and lower halves of the dual footbrake valve, the upper half of the valve being supplied from the rear service reservoir, and the lower half supplied from the front service reservoir. In the event of one circuit failing the other circuit will remain operative, thus preventing total brake failure.

10 The trailer control valve incorporates a bolt-on choke type supply dump valve which monitors pressures in the tractor service brake system and the trailer service line. In the event of loss of pressure to the trailer service brakes, the next service brake application will cause the supply control (dump) valve to choke or cut-off the trailer emergency supply line. This pressure drop will signal the trailer relay emergency valve to apply the trailer brakes from the air stored in the trailer reservoirs.

11 A load sensing valve is fitted in the rear service brake circuit and controls the delivery pressure to the rear axle brakes in proportion to the vehicle loading. A reduction valve with a pre-determined setting to control the maximum input pressure is fitted to the inlet side of the load sensing valve.

12 The brake stoplight switch is operated by the brake pedal lever and is therefore operative on both brake circuits.

13 ISO test connectors are fitted in the service brake system to monitor pressures delivered by the footbrake valve and also at the inlet side of the park/trailer reservoir.

Parking (handbrake) circuit

14 The park/trailer reservoir supplies air through a single check valve to the handbrake control valve, and via the handbrake control valve to the independent trailer brake control valve, it also supplies air to the trailer control valve. Should a failure occur in the tractor parking brake system, causing the spring brake actuators to be applied through loss of pressure from the reservoir, simultaneous application of the trailer brakes will occur as this drop in pressure also signals the operation of the trailer relay emergency valve.

15 Application of the handbrake control valve to the 'BRAKES OFF' or run position supplies air through two signal lines. One line supplies signal air to open the spring brake relay valve allowing air to pass through the system and compress the internal power springs of the spring brake actuators. The other line supplies signal air through the independent trailer brake control valve to the trailer control valve.

16 Application of the handbrake control valve to the 'BRAKES ON' or intermediate position exhausts the signal pressure to the spring brake relay valve, closing the valve, cutting-off air pressure (which was holding the spring brake off) and exhausts this air to atmosphere through the quick release valve on the front and rear axles, thus applying the spring brakes. At the same time the handbrake control valve exhausts the other signal pressure to the trailer control valve, via the independent trailer brake control valve, simultaneously applying the trailer brakes. All brake applications are proportional to the handbrake control valve lever movement.

17 Application of the handbrake control valve to the 'PARK' position, exhausts the signal pressure being supplied to the spring brake relay valve; closing the valve. The air pressure exhausts to atmosphere through the respective quick release valve, applying the spring brakes. At the same time the other signal line supplies air pressure through the independent trailer brake control valve to the trailer control valve, releasing the trailer brakes.

NOTE

With the handbrake control valve in the 'PARK' position the vehicle combination is held solely by the spring brakes of the towing vehicle.

WARNING

THE INDEPENDENT TRAILER BRAKE MUST NOT BE USED FOR PERMANENT PARKING. THE TRAILER MECHANICAL BRAKE MUST BE USED IN CONJUNCTION WITH THE HANDBRAKE APPLIED IN THE 'PARK' POSITION.

18 The independent trailer brake control valve is incorporated in the system for temporary use and when operated cuts off the signal line air supply to the trailer relay valve thus applying the trailer service brakes. This allows the driver to leave the cab and apply the trailer mechanical brake.

19 A supplementary spring brake release valve is incorporated in the system so that in an emergency, i.e. loss of the normal spring brake system, air pressure will be available to release the spring brakes via a completely independent system.

KEY TO FIG 1

1 Low pressure switches
- a Spring brake warning
- b Independent trailer brake
- c Rear service reservoir
- d Auxiliary reservoir
- e Front service reservoir
- f Park/trailer reservoir
- g Supplementary spring brake reservoir

2 Transducer - air 3
3 Emergency supply - palm coupling
4 Line filter
5 Single check valve
6 Independent trailer brake
7 Supplementary spring brake
8 Footbrake
9 Service control line - palm coupling
10 Double check valve
11 Handbrake control valve
12 Front spring brake actuator
13 Quick release and exhaust check valve
14 Quick release and exhaust check valve
15 Purge reservoir
16 'Tilt' drain valve
17 ISO test connector
18 Park/trailer reservoir
19 Relay valve - front service brake
20 Stop cock - tyre inflator
21 System protection valve - tyre inflator
22 Quick release and exhaust check valve
23 Quick release and exhaust check valve
24 Rear spring brake actuator
25 Rear service reservoir
26 Pressure relief valve
27 Air dryer arid system unloader valve
28 Trailer relay valve
29 Pressure reduction valve - rear service
30 Load sensing valve
31 Relay valve - rear service brake
32 Differential protection valve
33 Relay valve - spring brake
34 Front service reservoir
35 Auxiliary reservoir
36 System protection valve - supplementary res.
37 Pressure reduction valve - essential auxiliarys
38 Multi-circuit protection valve
39 Supplementary spring brake reservoir
40 Expansion (ping) tank
41 Compressor

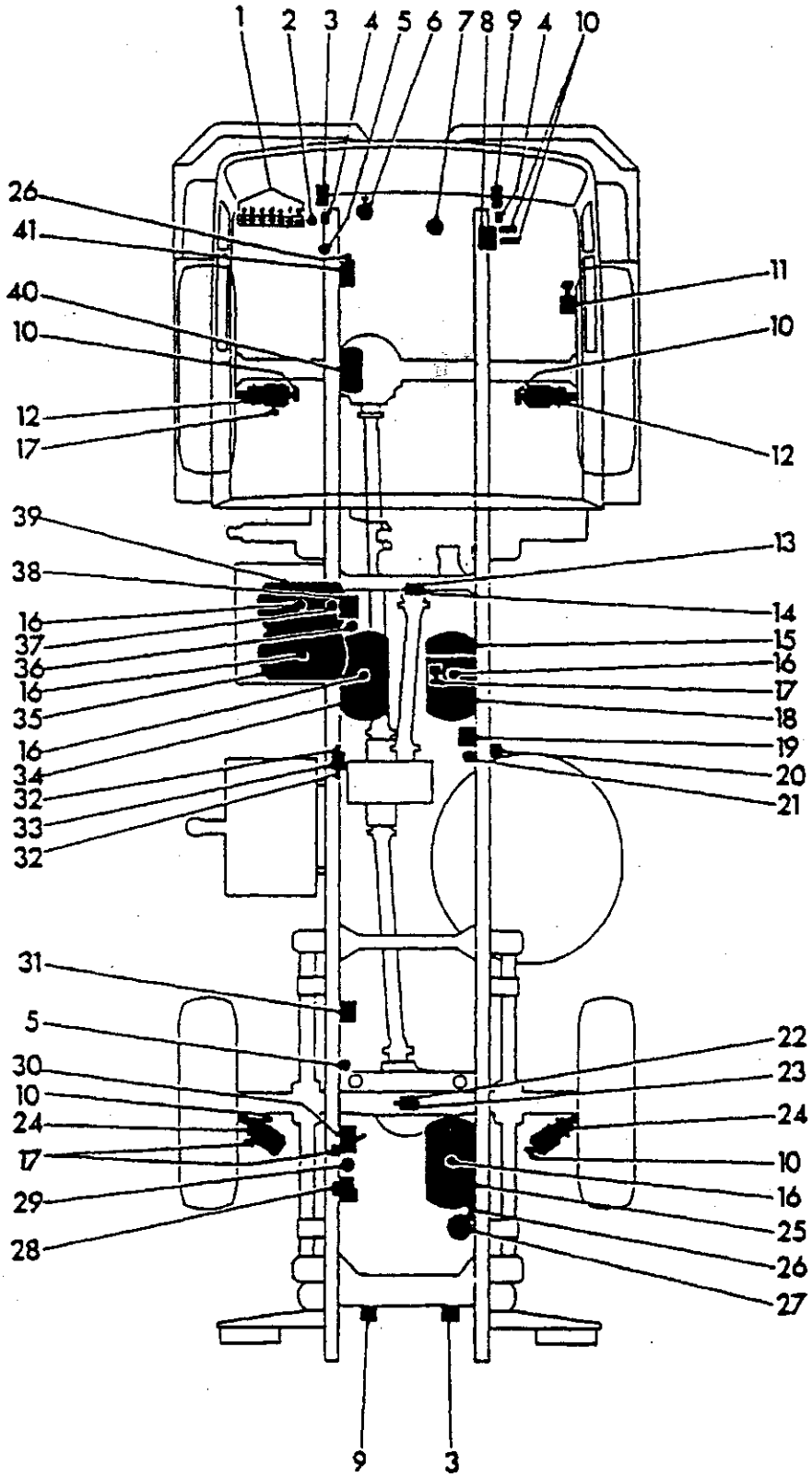


Fig 1 Air system component layout

20 A non-feedback type single system protection valve ensures charging of the supplementary spring brake reservoir when the vehicle air system is being charged, either by the compressor or from an external source.

21 Double check valves situated on each spring brake actuator allow air pressure to be applied from either the 'Brakes Off' position on the hand control valve or via the supplementary spring brake release valve, isolating the circuit not in use. Double check valves are also fitted to the delivery side of the footbrake to allow a TOWING vehicle to control the service braking of the TOWED vehicle.

22 A quick release valve is fitted to each axle to speed up the exhausting of air pressure from both the secondary and service halves of the spring brake actuators. It also incorporates an exhaust check valve for sealed breathing, ensuring each half of the spring brake actuator, uses clean dry system air.

23 Differential protection valves, linking the service brake and the parking brake circuits, prevent a compounding of brake forces, should the service brakes be operated while the spring brakes are applied, or vice-versa.

Auxiliary circuits

24 A non-feedback type single system protection valve is fitted to protect the essential auxiliaries, e.g. the clutch servo, from any non-essential auxiliary such as the shut off tap for tyre inflation.

KEY TO FIG 2

Air pressure supply and storage
Service brake control circuit
Auxiliary circuits
Parking and trailer brake circuit
Spring brake breather

1 Emergency supply palm coupling
2 Service control line palm coupling
3 Quick release and exhaust check valve
4 Low pressure switch - handbrake/spring brake
5 Low pressure switch - independent trailer brake
6 Low pressure switch - auxiliary reservoir
7 Low pressure switch - park/trailer reservoir
8 Low pressure switch - supplementary spring brake reservoir
9 Transducer - air gauge 3
10 Low pressure switch - front service reservoir air 1
11 Low pressure switch - rear service reservoir air 2
12 Spring brake actuator - front
13 Double check valve
14 Footbrake valve
15 Handbrake control valve
16 Purge reservoir
17 Park/trailer reservoir
18 'Tilt' drain valve
19 ISO test connector
20 Relay valve - front service brake
21 Stop cock - tyre inflator
22 Single system protection valve
23 System pressure relief valve
24 Air dryer with unloader valve
25 Rear service reservoir
26 Spring brake actuator - rear
27 Trailer control valve
28 Pressure reduction valve - rear service
29 Load sensing valve
30 Relay valve - rear service brake
31 Differential protection valve
32 Relay valve - spring brakes
33 Front service reservoir
34 Auxiliary reservoir
35 Supplementary spring release reservoir
36 Compressor
37 Expansion (ping) tank
38 Supplementary spring brake release valve
39 Multi-circuit protection valve
40 Single check valve
41 Line filter
42 Independent trailer brake valve

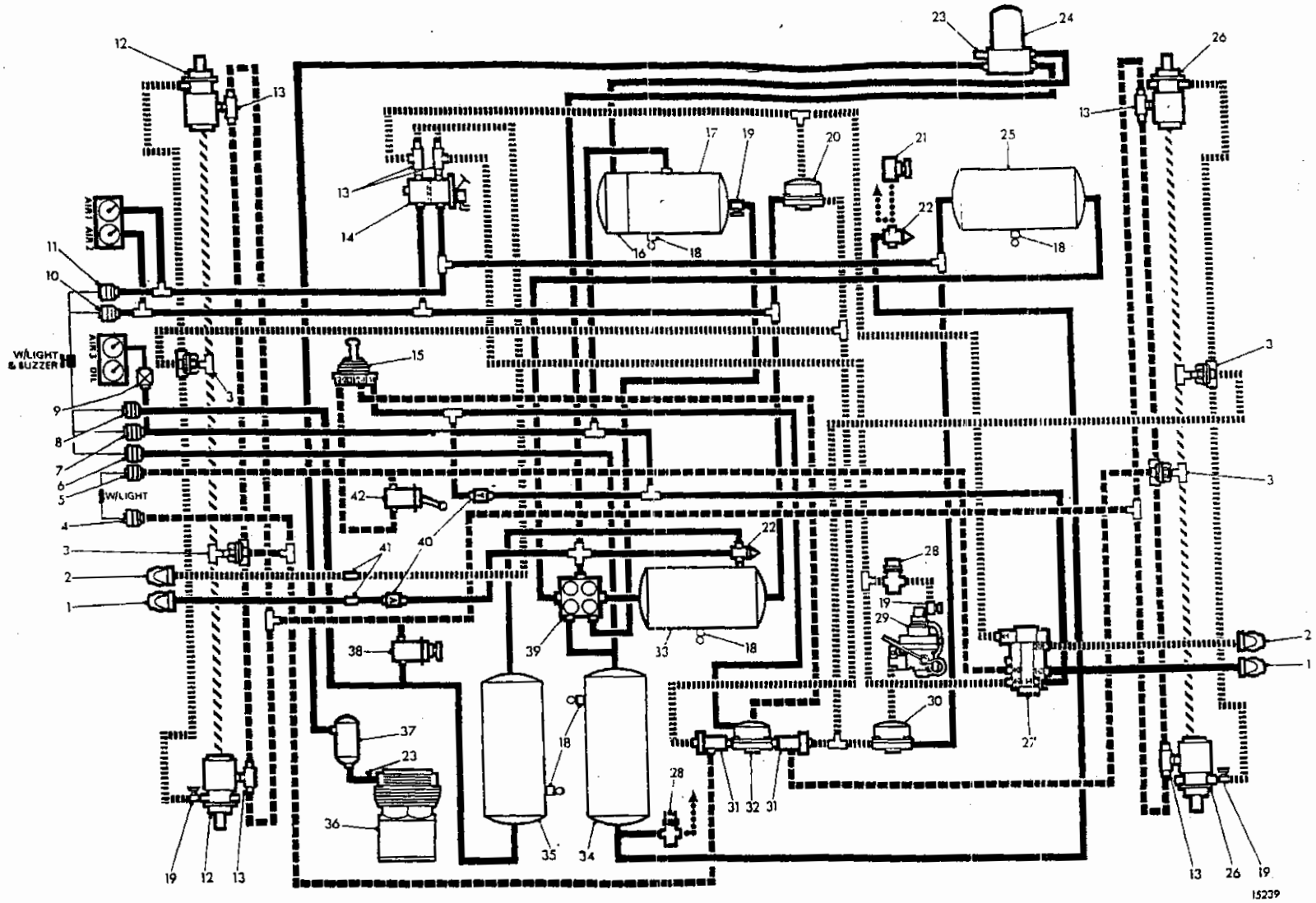


Fig 2 Air piping diagram

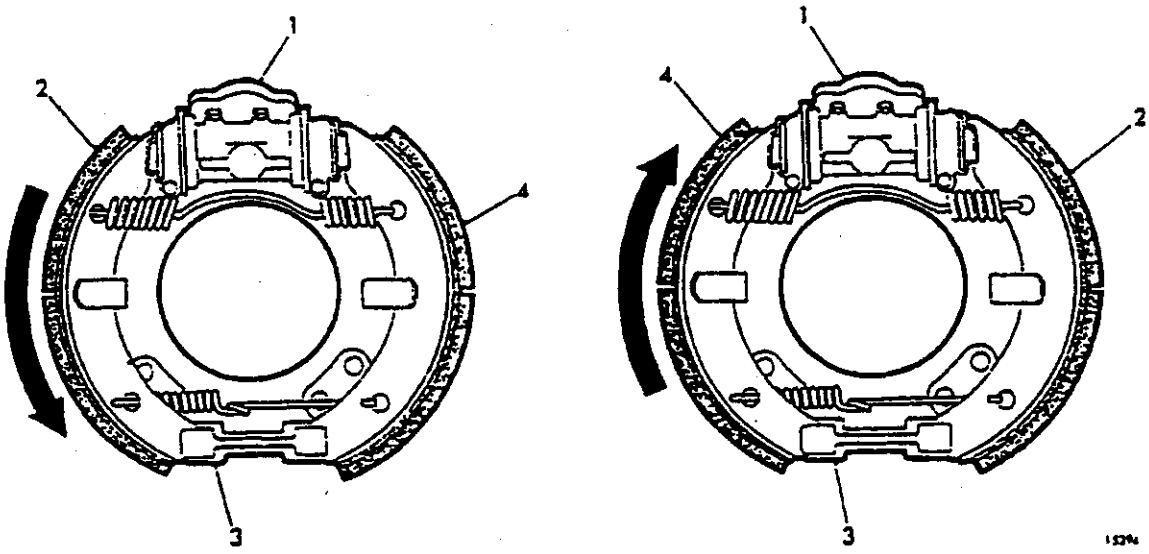
FRONT AND REAR FOUNDATION BRAKE ASSEMBLIES

25 This type of expander brake is a front/rear shoe configuration, utilising a single wedge expander incorporating automatic adjustment to compensate for lining wear in service. The expander unit being sealed to prevent dirt ingress.

26 This type of brake which is fitted to both front and rear axles is operated respectively by tube and flange mounted air actuators.

27 The substantial torque plate incorporates cast abutment slots in which the tips of the shoes sit. Diametrically opposite is the expander against which the other end of the shoes rest. Shoe return springs ensure effective retraction of the shoes after a brake application and also provide the return load to operate the automatic adjusters. Both shoes are held against the steady rest lugs with 'C' clips bolted to the torque plate.

28 The linings are of equal thickness on both shoes.



1 Expander housing
2 Front shoe
3 Torque plate abutment
4 Rear shoe

Fig 3 Shoe arrangement showing direction of rotation

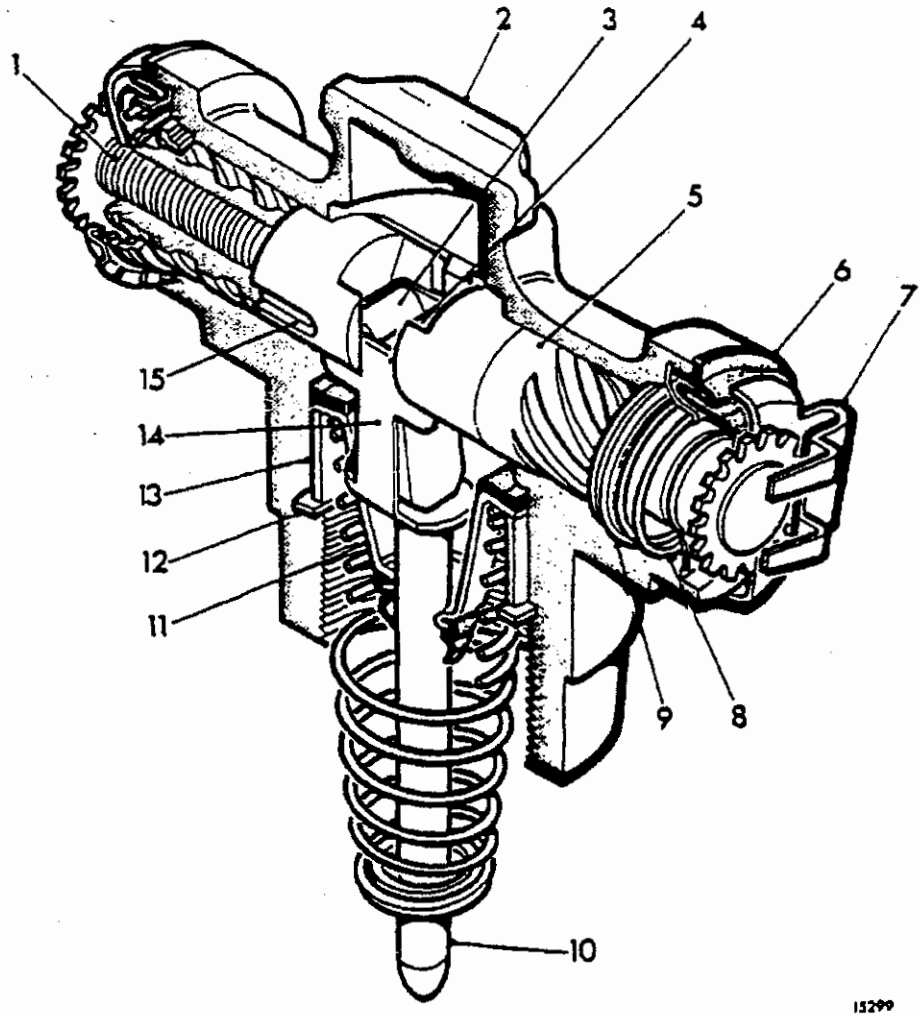
Operation

29 When the brakes are applied the push rod in the air chamber pushes the wedge into the expander. This in turn forces the rollers apart moving the tappets outwards, thus forcing the shoes against the drum. The direction of drum rotation will determine which is the leading and which is the rear shoe. The brake torque generated by the front shoe will be taken by the torque plate abutment. The rear shoe effort will be taken by the head of the expander tappet.

30 In the opposite direction of drum rotation the roles of the components are reversed.

31 Locating pins are fitted to prevent the roller tappets from rotating.

32 Upon release of the brake the wedge will be returned by the action of the wedge return spring and the shoes will be pulled away from the drum by the shoe return springs.



1	Tappet/adjuster screw	9	Drive ring
2	Expander housing	10	Wedge push-rod assembly
3	Roller	11	Cap
4	Wedge	12	Circlip
5	Adjuster sleeve assembly	13	Spacer*
6	Dirt excluder	14	Roller cage
7	Anti rotation clip	15	Roller tappet
8	Back-up spring		

* Tube mounted actuator only

Fig 4 Expander/adjuster assembly - for tube mounted actuators

Adjustment

33 This exponential adjuster is designed to maintain a clearance between the linings and drum to a value determined by the specific backlash between the gear teeth on the adjuster sleeve and the drive ring. The adjuster is designed so that for any one brake application only a specific proportion of any tappet travel, in excess of the backlash, is taken up by the adjuster and this controls the lining to drum clearance. Equally important, it eliminates any danger of over adjustment during repeated brake applications where a hot expanded drum condition may occur. Each shoe is individually adjusted in the same manner. In the brakes off position, the drive ring is retained in light contact with its conical seat by the back-up spring. The shoe tip engages in the tappet clip and the shoe return springs ensure that the tappet is fully returned against its housing abutment.

Brake applied - no adjustment required

34 When the brake is applied the tappet/adjuster screw is moved outwards and begins to pass through the drive ring.

35 If the movement required to apply the shoes to the drum is less than the axial clearance (backlash) between the flanks of the helix on the tappet and the drive ring teeth, no relative movement of adjuster screw and tappet takes place (i.e. no adjustment is necessary).

Brake applied - adjustment required

36 If adjustment is required the movement will exceed the axial clearance (backlash) and the adjuster sleeve will lift the drive ring from its seat. Simultaneously the back-up spring will be pushing the drive ring back down the helix teeth of the adjuster sleeve causing the ring to rotate and adopt a new position on its seat.

37 After the brake application has been completed and the brake pedal released, the shoe return springs cause the shoes to push back the adjuster sleeve and adjuster screw assembly. The adjuster sleeve helix moves through the axial clearance (backlash) in the drive ring teeth and when the flanks of the threads meet the drive ring is loaded into its seat in the housing thus preventing rotation of the drive ring.

38 Further return movement pushes the adjuster sleeve through the drive ring and the adjuster sleeve is forced to rotate as its helix slides up the helix of the locked drive ring. Consequently, as the adjusting screw (threaded into the tappet) is prevented from rotating by the clip located against the shoe web, the effect of the action is to increase the overall length of the adjuster assembly similar to a simple screw jack. The end result is to take up the excess shoe-to-drum clearance created by lining wear.

COMPRESSOR

39 The compressor is a single cylinder type having a balanced crankshaft and reed type air inlet and delivery valves. The crankcase and cylinder barrel forming a single rigid casting. It is flange mounted and gear driven through the timing gear train. The cylinder head is water cooled, being supplied from the engine cooling system and is capable of delivering pressure up to 11 bar (160 lbf/in.^{2}).

EXPANSION TANK (PING TANK)

40 The expansion tank is fitted as close as practical to the compressor to dampen the pressure pulses delivered to the air dryer.

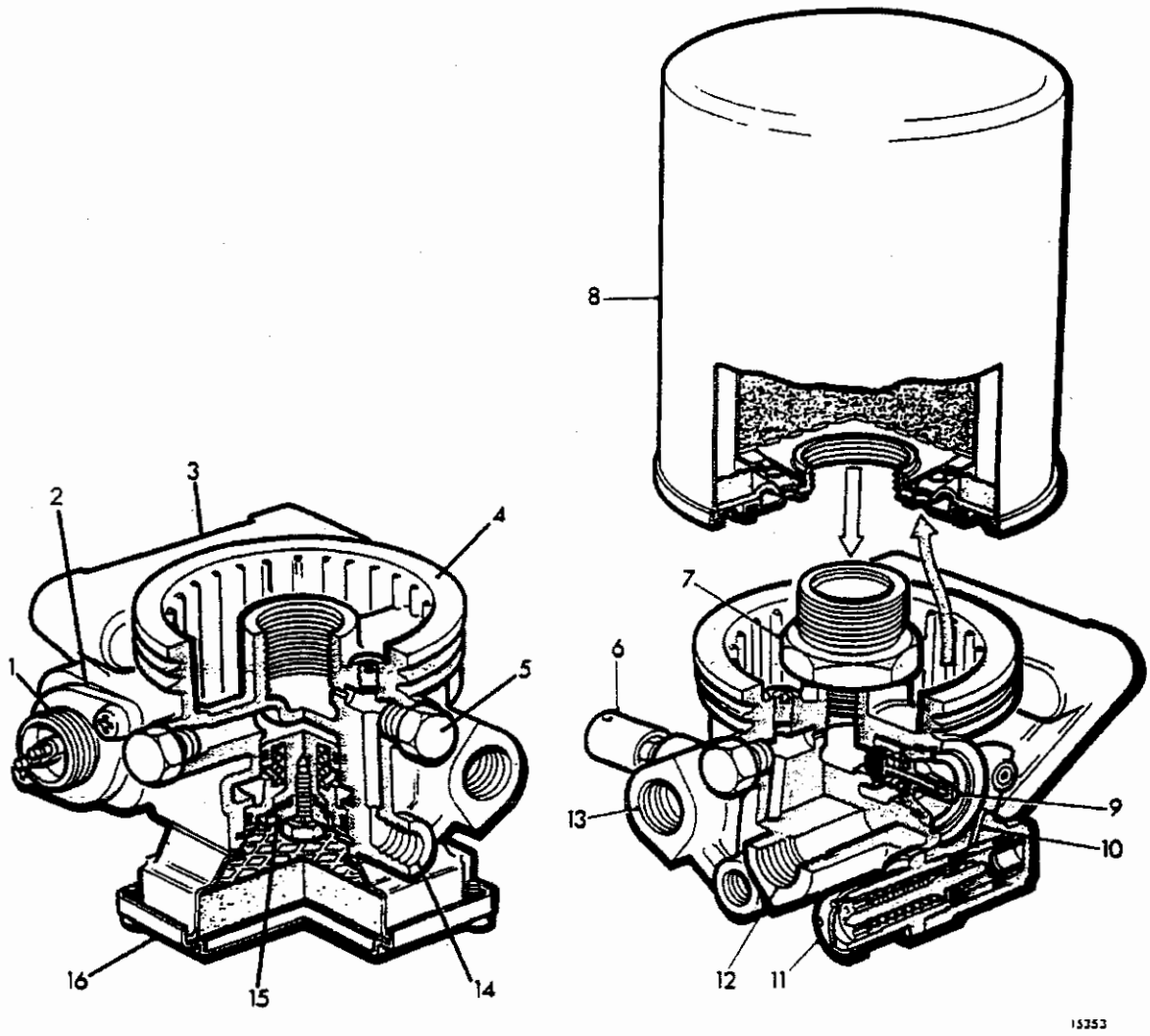
AIR DRYER

41 The air dryer (Fig 5) is fitted to reduce the moisture content of the air discharged by the compressor, it supplies dry clean air to the reservoirs. A separate purge tank is attached to the air dryer which is used to expel the accumulated dirt and condensate from within the unit. The air dryer incorporates a governor valve which controls the compressor duty cycle to maintain the system pressure between the operating cut-in and cut-out pressures. It also incorporates a purge valve to expel excess air and condensate.

42 The air dryer consists of a disposable 'spin-on' dessicant cartridge screwed onto the dryer body. The body assembly incorporates the compressor unloader valve, and system safety valve, which is set at 11.0 bar (160 lbf/in.^{2}) and will blow to atmosphere if the unloader valve fails. A thermostatically controlled electric heater element is fitted to prevent the condensate from freezing.

43 Warm contaminated air from the compressor enters the dryer at port (6). As it cools, condensate collects in the bottom of the body as a mixture of water and oil. The air now passes through an internal gauze strainer which separates out any remaining oil/water droplets and entrained debris, and up through the outer chamber of the cartridge, then down through the dessicant which absorbs the entrained water vapour.

44 The cooled, clean dry air flows through a non-return valve and passes through port (12) to the multi-circuit protection valve and on to the system reservoirs. A separate supply of dry air passes through an internal drilling and through port (13) to charge the purge reservoir.



1	Heater	9	Air outlet non-return valve
2	Heater thermostat cover	10	Signal air passage to purge valve
3	Air dryer mounting	11	Unloader valve
4	Air dryer body	12	Air delivery port to reservoirs
5	Air bleed screw	13	Supply air from compressor
6	Safety valve	14	Air port to purge chamber
7	Screw adapter	15	Purge valve
8	Desiccant cartridge	16	Exhaust silencer

Fig 5 Section through air dryer

45 Upon reaching system pressure, 8.4 bar (122 lbf/in.^{2}) the unloader valve is triggered allowing system air pressure to open the purge valve. Residual pressure in the cartridge ejects the accumulated condensate and debris while the unloaded compressor now discharges to atmosphere through the purge valve.

46 The resultant decompression allows the purge reservoir to discharge dry air back through the dryer body into the dessicant cartridge, absorbing moisture from the dessicant, carrying the entrained moisture to atmosphere through the open purge valve, thus regenerating the desiccant. The non-return valve prevents the down-stream reservoir air-pressure blowing back into the air dryer.

47 Any reduction in the system pressure causes the unloader valve to close. This cuts off air pressure to the purge valve and the purge valve closes. The compressor now recharges the system.

48 This charging and regeneration cycle is repeated each time maximum system pressure is reached.

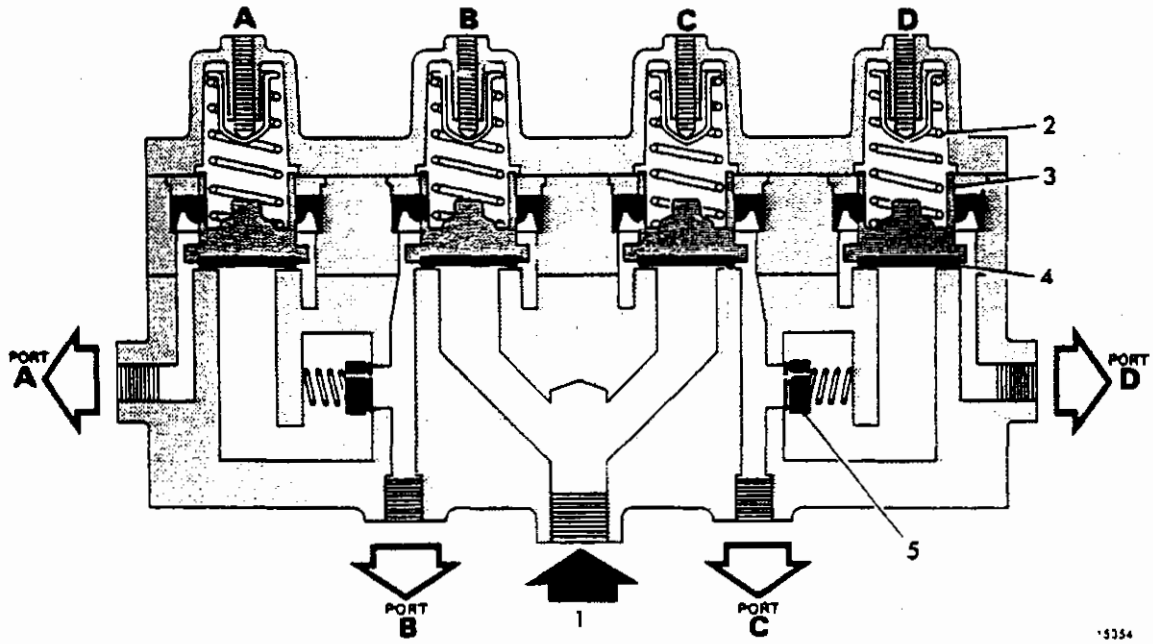
MULTI-CIRCUIT PROTECTION VALVE

49 The multi-circuit protection valve (Fig 6) is a series parallel type and functions as follows:

49.1 It prioritises the charging of the front and rear service reservoirs over the supply of the park/trailer and auxiliary reservoirs ensuring that the service reservoirs are charged to a pre-determined pressure before the spring brakes are released.

49.2 It ensures the front and rear service reservoirs are charged independently and that in the event of failure of one part of the braking system the other systems will still function and be capable of stopping the vehicle.

49.3 Each element is of the restricted feedback type which allows the governor valve in the air dryer to sense the system pressure in the service reservoirs.



A = Handbrake trailer circuit
B = Front service circuit
C = Rear service circuit
D = Auxiliary circuit

1 Inlet port
2 Graduating spring
3 Piston
4 Valve seat
5 Non return valve

Fig 6 Schematic section through the multi-circuit protection valve

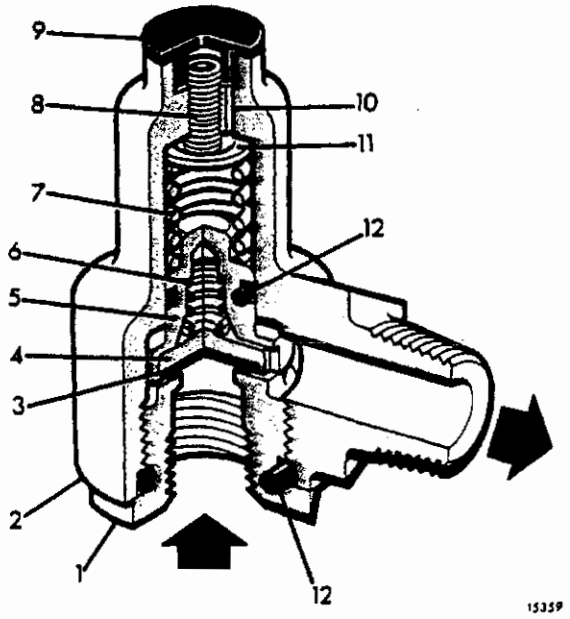
50 At commencement of system charging, with all reservoirs depleted, air from the air dryer enters the valve at inlet port (1). When the pressure builds to 6.5 bar (94 lbf/in.^{2}) it will overcome the force of the graduating spring (2), the valve seat (4) and piston (3) of elements (B) and (C) now rise giving preferential charging of the front and rear service reservoirs.

51 As the pressure builds in the front and rear service reservoirs the reservoir back-pressure becomes sufficient to hold the valves open; air now passes into the galleries of elements (A) and (D) and as the pressure reaches 6.5 bar (94 lbf/in.^{2}) again overcoming the force of the graduating springs, the piston and valve seats rise, thus charging the parking/trailer and the auxiliary circuits.

52 When the unloader valve cuts out at maximum working pressure, 8.4 bar (122 lbf/in.^{2}) the residual pressure in the reservoirs holds the valves open allowing a feedback up to the closing pressure of that valve, approximately 4.8 bar (70 lbf/in.^{2}).

SINGLE SYSTEM PROTECTION VALVE - NON-FEEDBACK TYPE

53 A non-feedback type valve (Fig 7) is fitted in the air pressure system and isolates the supplementary spring brake release circuit from the main brake circuits. Another non-feedback type valve is fitted to protect the essential auxiliaries e.g. the clutch servo, from any non-essential auxiliary such as the shut-off tap for tyre inflation.



1	Steel cap nut	7	Piston graduating spring
2	Valve body	8	Pressure adjusting screw
3	Valve seat	9	Breather cap
4	Check valve	10	Vent hole
5	Piston	11	Spring seat
6	Check valve spring	12	O-ring seal

Fig 7 Single system protection valve - non-feedback type

54 Air enters the inlet port and acts against the face of the inlet port and acts against the face of the inlet valve seat when the pressure reaches 6.2 bar (90 lbf/in.^{2}) it overcomes the valve piston spring setting, the check valve and piston lift in unison allowing supply air to be delivered to a reservoir. The supply pressure now acts on the whole area of the piston keeping it raised against the piston spring.

55 When the system air pressure reaches the system unloader valve cut-out pressure the check valve drops to close the valve air inlet and thereafter acts as a reservoir check valve. However the charged reservoir air pressure continues to keep the piston raised. Should the reservoir pressure fall below the normal supply pressure the piston will descend until it fully closes the valve air inlet.

AIR STORAGE RESERVOIRS AND MANUAL TILT VALVE

56 The front and rear service reservoirs store air for use in the footbrake circuits. They store sufficient volume to provide a minimum number of brake applications in the event of the brake system not being re-charged by the compressor. The volume of both these reservoirs is used to back-up the volume of the park/trailer and auxiliary reservoirs down to the protected pressure of the multi-circuit protection valve.

57 The park/trailer reservoir stores air for use in the spring brake circuit of the vehicle and for charging the reservoirs fitted directly on to the trailer. With the back-up volume of the front/rear reservoirs is stored sufficient volume to provide a minimum number of handbrake applications in the event of the brake system not being re-charged by the compressor.

58 The auxiliary reservoir stores air for use by the essential and non-essential auxiliary circuits. With the back-up volume of the front/rear reservoirs there is stored sufficient volume to ensure the function of all the auxiliary equipment.

59 The supplementary spring reservoir stores air for use by the supplementary brake circuit. The reservoir stores sufficient volume for the release of all the spring brake units in the event of an air supply failure in the vehicle's brake charging system, or loss of air in the park/trailer reservoir.

60 A manual 'tilt' drain valve is fitted to each storage reservoir and is used to drain air, and any accumulated water, from the reservoir.

FOOTBRAKE VALVE

61 The footbrake valve (Fig 8) provides a graduated braking control for applying and releasing the service brakes. It serves two separate circuits each with its own reservoir. Each circuit remains isolated from the other by the internal sealing arrangements of the valve. In the event of one circuit failing the other circuit will remain intact and capable of stopping the vehicle.

62 The front service brakes are served by the lower inlet exhaust valve assembly (22) housed in the bottom cover (19), and the rear service brakes are served by the upper inlet/exhaust valve assembly (13) housed in the upper body (17). The inlet valve seats are formed in their appropriate castings of the bottom cover and the upper body; the exhaust valve seats being formed on the base of the relay piston (25) and the primary piston (1) respectively.

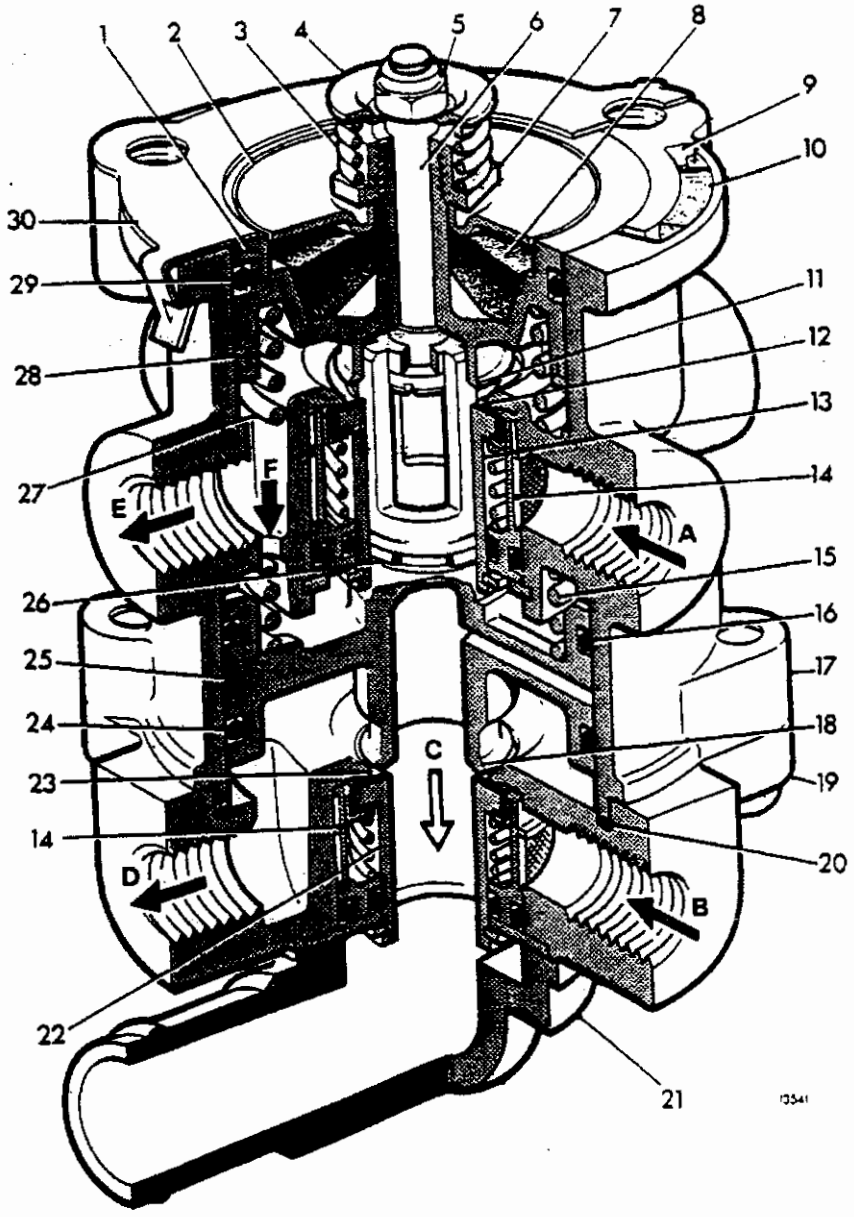
63 The passage of exhaust air past the upper exhaust valve is down through the centre of the relay piston (25), then through the centre of the lower inlet/exhaust valve assembly (22) exhausting to atmosphere through the exhaust cover (21). Exhaust air from the lower valve also passes through the centre of the inlet/exhaust valve assembly (22).

64 The brake application force is transmitted through spring seat (2) and rubber graduating spring (8) to primary piston (1). As primary piston (1) descends, it initially shuts off the exhaust valve of the inlet/exhaust valve assembly (13).

65 Further movement of primary piston (1) moves inlet/exhaust valve (13) off its inlet valve seat (12) permitting the flow of air to pass in through port 'A' and out through port 'E' to actuate the rear service brakes.

66 As air passes to delivery port 'E' it also passes through transfer holes 'F to the top of relay piston (25), where together with the downward force of spring (15) the piston moves downwards, shutting off the exhaust valve of the lower inlet/exhaust valve assembly (22). As air pressure passing through transfer holes 'F' increases, relay piston (25) moves downwards moving inlet/exhaust valve (22) off its inlet valve seat (23), permitting the flow of air to pass through port 'B' and out through port 'D' to actuate the front service brakes.

67 The operation of the valves is more or less instantaneous, with perfect balance attained when approximately 5 bar (72 lbf/in.^{2}) pressure has built up in the delivery circuits.



1	Primary piston	11	Exhaust valve seat	21	Exhaust cover
2	Spring seat	12	Inlet valve seat	22	Inlet/exhaust valve assembly
3	Spring	13	Inlet/exhaust valve seat	23	Inlet valve seat
4	Spring retainer	14	Filter	24	O-ring
5	Locknut	15	Spring	25	Relay piston
6	Valve stem	16	O-ring	26	O-ring
7	Spring seat nut	17	Upper body	27	Return piston
8	Rubber spring	18	Exhaust valve seat	28	Piston guide
9	Air vent	19	Bottom cover	29	O-ring
10	Fibre filter	20	Sealing ring	30	Retaining plate

A = Inlet port from rear service reservoir
B = Inlet port from front service reservoir
C = Exhaust passage
D = Front service brake delivery
E = Rear service brake delivery
F = Transfer holes

Fig 8 Section view of footbrake valve

The flow from delivery port 'E' continues until the air pressure under primary piston (1) together with the upward force of spring (27) and the spring of inlet/exhaust valve assembly (13) overcomes the brake application force on primary piston (1). The piston then lifts sufficiently to allow the inlet valve of inlet/exhaust valve assembly to close on its seat (12) without letting exhaust valve seat (11) uncover the exhaust passage 'C'. The rear service brake circuit is now balanced.

68 Similarly the flow from delivery port 'D' continues to increase under relay piston (25) until the upward force under the piston and the upward force of the spring of inlet/exhaust valve (22) overcome the downward forces of spring (15) and the air pressure above relay piston (25). The relay piston (25) then lifts sufficiently to allow inlet valve of inlet/exhaust valve to close on its seat (23) without letting exhaust valve seat (18) uncover the exhaust passage 'C'. The front service brake circuit is now balanced.

69 When the brake application force is reduced primary piston (1) will rise due to the greater pressure under the piston and return spring (27). Inlet/exhaust valve (13) will also rise, shutting the inlet valve against its seat (12), the exhaust valve is uncovered allowing the excess pressure to exhaust away until the delivery pressure drops sufficiently to restore the balance of forces on primary piston (1) with the inlet and exhaust valve shut. As pressure at 'F' decreases, relay piston (25) rises, the inlet/exhaust valve will follow, shutting the inlet valve against its seat, the exhaust valve opens permitting excess air to exhaust until the relay piston descends shutting off the exhaust valve.

70 Removal of brake application force allows primary piston (1) and valve stem (6) to make a full up-stroke, relay piston (25) follows, exhausting all air from the delivery circuits.

71 Should air pressure be lost in the front service brake circuit, the rear service brake circuit will remain fully operational due to the seals (16), (24) and (26) of relay piston (25).

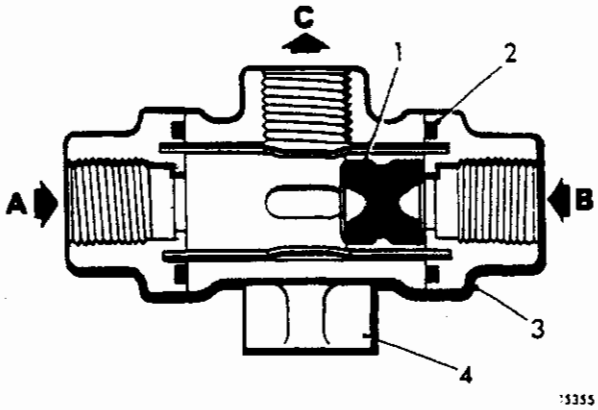
72 If air pressure is lost in the rear service brake circuit, the front service brakes will remain fully operational by manual operation of the relay piston (25).

DOUBLE CHECK VALVE

73 Double check valves (Fig 9) are fitted in air delivery lines allowing that line to be supplied from two sources isolating whichever source is not in use.

74 When air enters at port A, the shuttle (1) is forced over to seal the other end of the valve, isolating port B. At the same time, air from port A is permitted to flow through port C.

75 If air is supplied to port B, the shuttle will move across the valve to seal off port A and allow air from port B to flow through port C.



A and B = Inlet ports **C** = Outlet port

1 Shuttle
2 Seal
3 End-cover
4 Valve body

Fig 9 Section view of double check valve

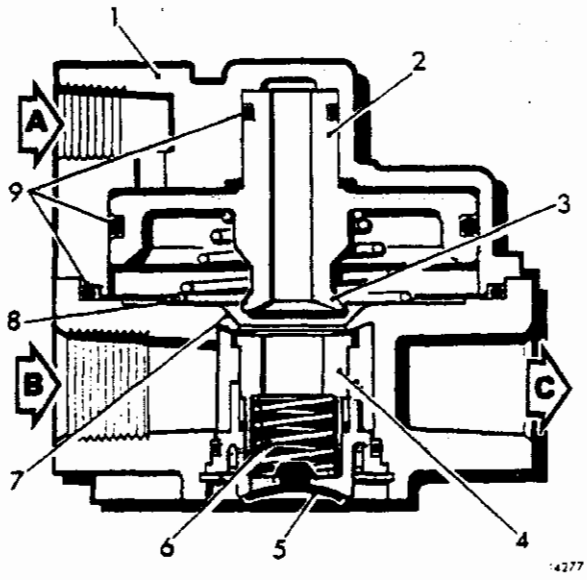
RELAY VALVE

76 Relay valves (Fig 10) are fitted into the brake system to minimise the delay in application of the service or spring brakes on each axle. Air is supplied directly to the valve from its respective reservoir and is operated via a signal line from either the footbrake valve or the handbrake valve.

77 Signal air passing through Port 'A' is exerted on the top of the piston (2), and the piston is forced away from the top cover (1). The exhaust valve seat (3) makes contact with the inlet-exhaust valve (4), moving the valve away from-the inlet valve seat (7), permitting the flow of-air from the supply reservoir through Port 'B' past the inlet-exhaust valve to the underside of the piston and out through Port 'C' to the brake chambers.

78 When the pressure acting on the underside of the piston and the delivery line is equal to the signal pressure acting on top of the piston, both the inlet and exhaust valves are seated and the unit is in a state of equilibrium. Provided that the air pressure signal coming into the control port is held constant. However, it is instantly responsive to any change in pressure, as the air pressure output of the valve is directly proportioned to the control port signal pressure.

79 When the signal pressure is released the piston is forced up inside the top cover by the piston return spring (8) and air acting on the underside of the piston from the delivery line. The exhaust valve is opened and the air is released to atmosphere.

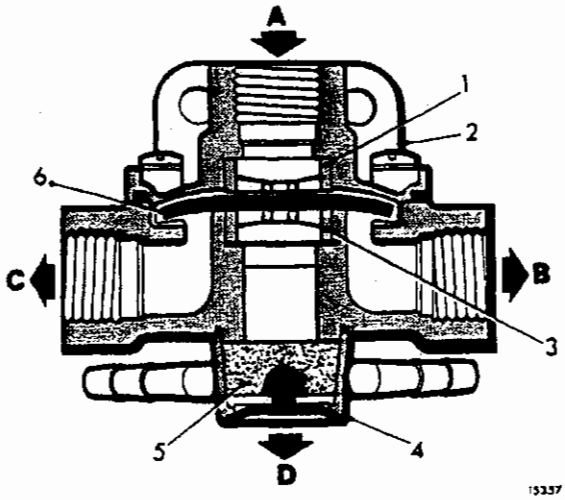


1	Top cover	6	Valve spring
2	Piston	7	Valve seat-inlet
3	Exhaust valve seat	8	Piston return spring
4	Inlet/exhaust valve	9	Sealing rings
5	Exhaust diaphragm		

Fig 10 Section through relay valve

QUICK RELEASE VALVE AND EXHAUST CHECK VALVE

80 The quick release valve (Fig 11) is fitted in the system to exhaust the air from the service and spring brake actuators when the applied pressure is released thus causing the brakes to release more quickly. Attached to the bottom of the quick release valve is the exhaust check valve, providing sealed breathing by ensuring each half of the spring brake actuator 'breathes' clean dry system air, rather than from atmosphere; allowing the vehicle to wade through water without affecting the 'breathing' properties of the spring brakes.



A = Supply port **B and C** = Delivery port **D** = Exhaust

1	Inlet seat	4	Exhaust check valve
2	Quick release valve	5	Filter
3	Exhaust seat	6	Diaphragm

Fig 11 Section through quick release/exhaust check valve

81 When air is supplied through port 'A' the diaphragm is pushed away from the inlet seat and closes the exhaust seat. The air passes over the diaphragm and out through the delivery ports 'B' and 'C' to the brake actuators.

82 When the applied pressure is reduced, the pressure in the actuators and under the diaphragm now being greater will push the diaphragm up to close the inlet seat, thus opening the exhaust seat allowing air in the actuators to exhaust to atmosphere.

83 As this air is exhausted to atmosphere a volume of air is sucked into the non-pressure side of the actuator via the exhaust check valve allowing sealed breathing of the unit, this air passing back through the exhaust check valve to atmosphere when the actuator spring/service brakes are pressurised.

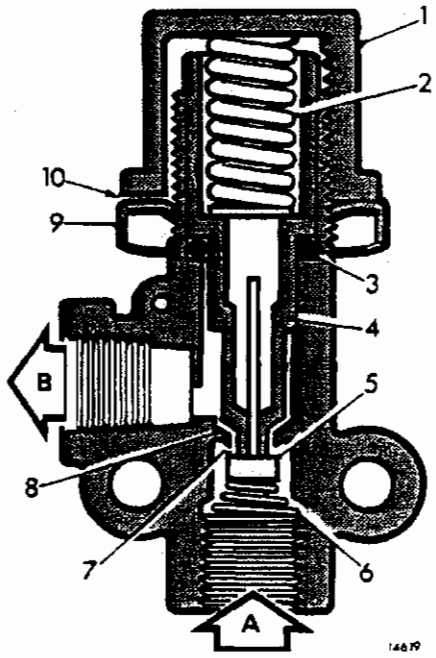
PRESSURE REDUCING VALVE

84 This type of valve (Fig 12) reduces the pressure in a part of the circuit of a compressed air system and will maintain it at a constant predetermined setting below that of the main supply pressure. Two pressure reducing valves are in this system, one in the rear service brake circuit set at 5.6 bar (80 lbf/in.^{2}), the other in the essential auxiliary circuit and is set at 3.5 bar (50 lbf/in.^{2}).

85 Prior to air pressure build-up at the inlet port (A), the spring (2), retained by the pre-set valve adjustment cap (1) holds down the piston (4) and the valve (5), closing the exhaust seat (7) and opening the inlet seat (8).

86 As air is applied, it flows from the inlet port (A) past the open valve and out through the delivery port (B), until applied pressure under the piston (4) overcomes the force of the spring (2). This allows the return valve spring (6) to raise the valve (5) and close the inlet, cutting off the air supply. When pressure drops in the delivery line the force of the control spring (2) overcomes the reduced air pressure below the piston, and pushes the piston and valve down, opening the inlet port valve (8) allowing more air to flow into the delivery line until the set pressure is again reached.

87 If pressure in the delivery line exceeds the setting of the valve, the air pressure beneath the piston will overcome the force of the control spring and the piston will rise up off the exhaust valve seat (7) allowing air from the delivery port to exhaust to atmosphere through the hollow piston at the exhaust vent (10). This will continue until the pressure drops sufficiently to overcome the control spring, when the piston will close the exhaust port (7), thus keeping the set pressure in the delivery line.



A = Inlet port **B** = Delivery port

1	Valve adjustment cap	6	Valve return spring
2	Control spring	7	Exhaust valve seat
3	O-ring	8	Inlet valve seat
4	Piston	9	Locknut
5	Valve	10	Exhaust vent

Fig 12 Pressure reducing valve

LOAD SENSING VALVE - INSHOT TYPE

88 The load sensing valve is used to regulate the pressure at the rear actuators in relation to the weight carried on the rear axle. The maximum input pressure to the load sensing valve in this system is controlled by the pre-determined setting of the pressure reducing valve.

89 The valve is mounted on the chassis and the control lever is linked to the rear axle. It can, therefore, measure road spring deflection; and it is this amount of deflection which determines the pressure delivered to the actuators.

90 With the vehicle fully laden, maximum braking will be applied to the rear axle, this braking effort will decrease in proportion to any reduction in vehicle load.

91 The amount of reduction needed, the ratio between supply and delivery pressure is calculated when a brake system is designed, in this case the valve has a 4:1 ratio. When high ratio valves are fitted to vehicles, delivered pressure to unladen vehicle would be so low that it would be barely sufficient to overcome the resistance of the mechanical linkages between the actuator and the foundation brakes; and glazed linings could well result. To overcome this, an 'inshot' facility is provided in the valve construction. The inshot facility prevents any pressure reduction of an unladen vehicle until shoe to drum contact has been established; in this valve it is 0.5 bar (7 lbf/in.^{2}).

92 The inshot facility of this valve gives a 1:1 ratio between input and output pressures up to 0.5 bar (7 lbf/in.^{2}). When the input pressure rises, due now to a laden condition, above the inshot pressure, the valve will regulate pressures as before to the ratio of the valve.

TRAILER CONTROL VALVE - PREDOMINANCE TYPE

93 The trailer control valve ensures that the vehicle's dual upright service brake system produces a corresponding graduated service braking action on the trailer.

94 The signal pressure to the trailer brakes is modified by the trailer control valve to achieve a slightly higher (or, 'predominance') output pressure than that being delivered by the footbrake valve. This predominance function improves the braking balance of the complete tractor/trailer unit.

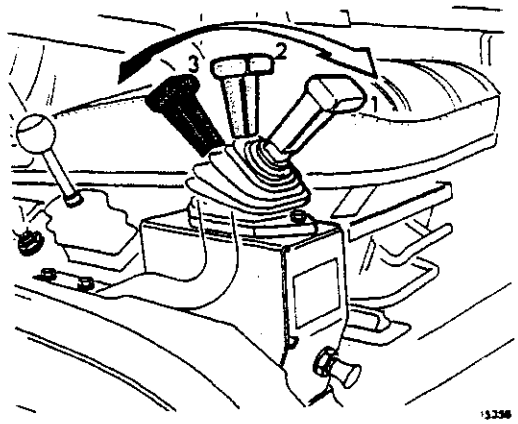
95 Incorporated into the trailer control valve design is the facility which enables the trailer service brake to be applied should either half of the dual service brake system fail.

96 When the vehicles spring brakes are applied, with the hand control valve in the intermediate hand-held position, the trailer service brakes are also applied through the inverse signal to the trailer control valve which ensures the simultaneous application of the trailer service brakes and the vehicle's spring brakes.

97 The trailer control valve also monitors the pressure between the vehicle service lines and the trailer service control line. In the event of a loss of pressure in the trailer service control line, which results in an imbalance of pressures in the valve, the trailer control valve dumps the air supply to the emergency relay valve on the trailer. The trailer brakes are now applied by air from the trailer mounted reservoir.

HANDBRAKE CONTROL VALVE

98 The handbrake control valve is used to control the parking brake and if necessary the secondary brake and has three significant positions: Brakes off (1), Brakes on (2), the secondary or intermediate position and Brakes on or park position (3).



1 Brakes off 2 Brakes on – Intermediate 3 Brakes on – Park

Fig 13 Handbrake operation

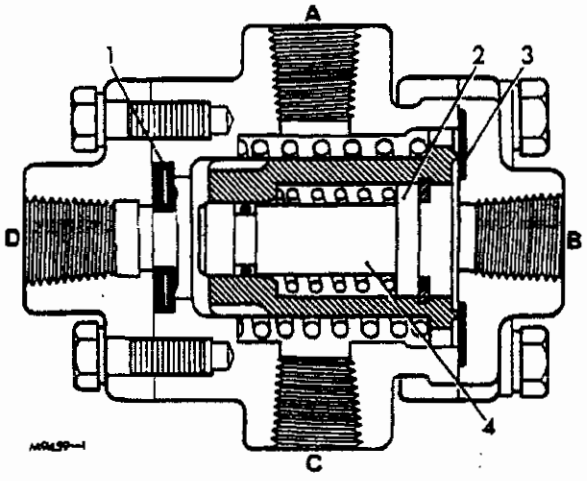
99 The handbrake lever can be moved directly back from position (1) to position (2) but must be lifted to engage position (3). The lever has a spring bias and when lifted in position (3) will automatically return to position (1), the run position; air applied brakes held off.

DIFFERENTIAL PROTECTION VALVE

100 Differential protection valves (14) and (15), linking the service brake and the parking brake circuits, prevent a compounding of brake forces, should the service brakes be operated while the spring brakes are applied, or vice-versa. Preventing overloading of the foundation brakes.

101 During normal running of the vehicle, with the hand control valve in the off position, air pressure in the parking brake circuit passes through port D to delivery ports A and C to hold off the spring brakes. No air pressure is supplied from the footbrake valve to port B. This is the condition shown in Fig 14.

102 When the footbrake is applied, air pressure passes to the service brakes and to port B. If the parking brakes remain in the off position, the spring brakes will still be held by pressure from port D, the pressure at port B being insufficient to move the pistons against the air pressure at port D and the effort exerted by the piston return springs.



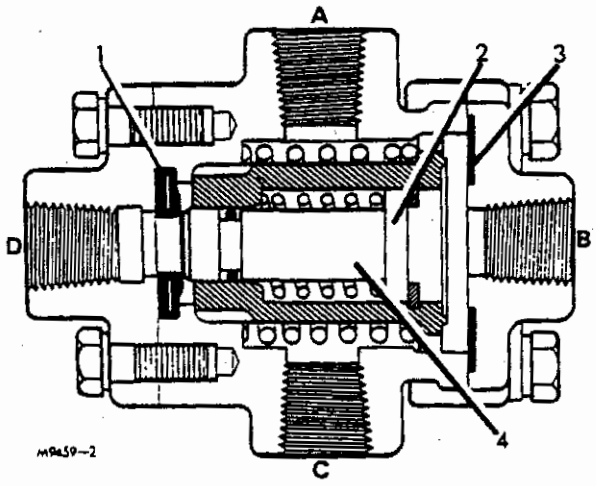
Differential protection valve

Port A To spring brake chambers
Port B Supply from service (foot) brake
Port C To spring brake chambers
Port D Supply from hand control valve (parking brakes)

1	Seal, inner piston	3	Seal, outer piston
2	Outer piston	4	Inner piston

Fig 14 Position assumed by valve with spring brakes held off (Normal running position)

103 When the hand control valve is moved to the park or secondary position, air is released from ports A and C through port D, and the brakes are held by the mechanical action of the brake actuator springs. If the footbrake is applied, the pressure in the service line will now enter port B, forcing the inner piston against its seat, closing port D. Further increase in pressure unseats the outer piston and allows air pressure to pass through ports A and C to hold off the spring brakes during the application of the footbrake, thus preventing compounding of the parking and service brake forces. This position is shown in Fig 15. As the footbrake is released, the pressure in port B falls and allows the valve return springs to force the pistons to their original positions. This allows air in the parking brake line to exhaust through port D, and the brake actuator springs re-apply the brakes.



Differential protection valve

Port A To spring brake chambers
Port B Supply from service (foot) brake
Port C To spring brake chambers
Port D Supply from hand control valve (parking brakes)

1	Seal, inner piston	3	Seal, outer piston
2	Outer piston	4	Inner piston

Fig 15 Position assumed by valve with spring brakes and service brakes applied

INDEPENDENT TRAILER BRAKE CONTROL VALVE - (HILL HOLD)

104 An independent trailer brake control valve (Figs 16 and 17) is fitted to provide an independent control of the trailer service brakes. This valve is fitted in the inverse line from the dual hand control valve to the trailer control valve. In the vehicle running condition the valve is in the 'OFF' position, when the valve is moved to the 'ON' position the trailer service brakes are applied.

105 This valve is only to be operated prior to the application or release of the mechanical trailer parking brake if the combination is to be parked on a steep gradient or is moving away after parking on the gradient.

106 This valve must not be used in place of the trailer's mechanical parking brake i.e. the trailer is not to be parked relying on compressed air.

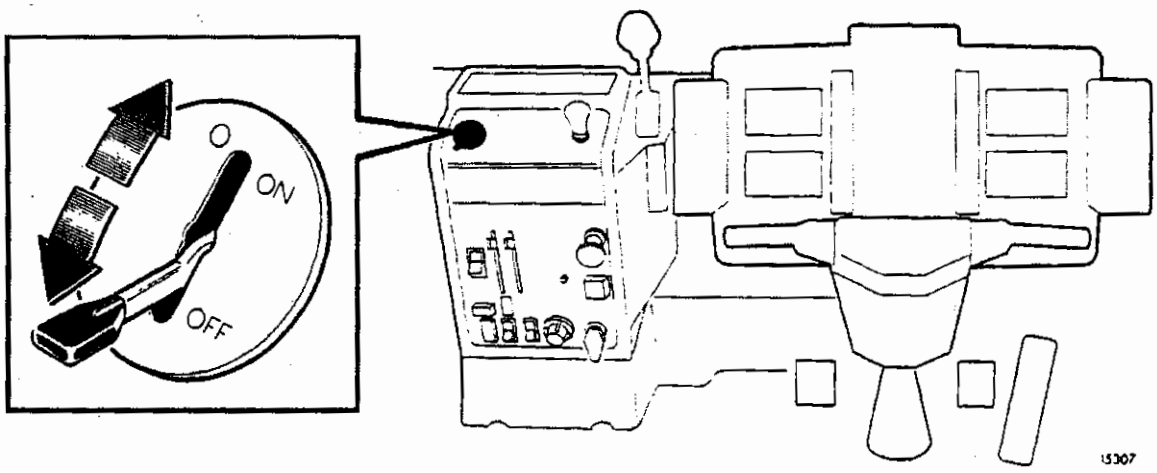
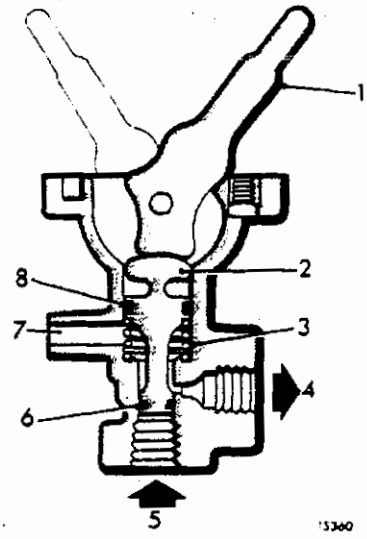


Fig 16 Location of trailer brake valve

107 This is a simple on/off type valve. In the 'OFF' position, supply air is delivered to the trailer control valve. In the 'ON' position, supply air is cut-off and air delivered to the trailer control valve will be exhausted through the valves exhaust port.



1	Lever	5	Supply port
2	Plunger	6	O-ring
3	Plunger spring	7	Exhaust port
4	Delivery port	8	O-ring

Fig 17 Section through trailer brake valve

SUPPLEMENTARY SPRING BRAKE RELEASE VALVE

108 The supplementary hand control valve is fitted in the system to ensure that the spring brake actuators can be released in the event of a loss of air within the normal spring brake release system.

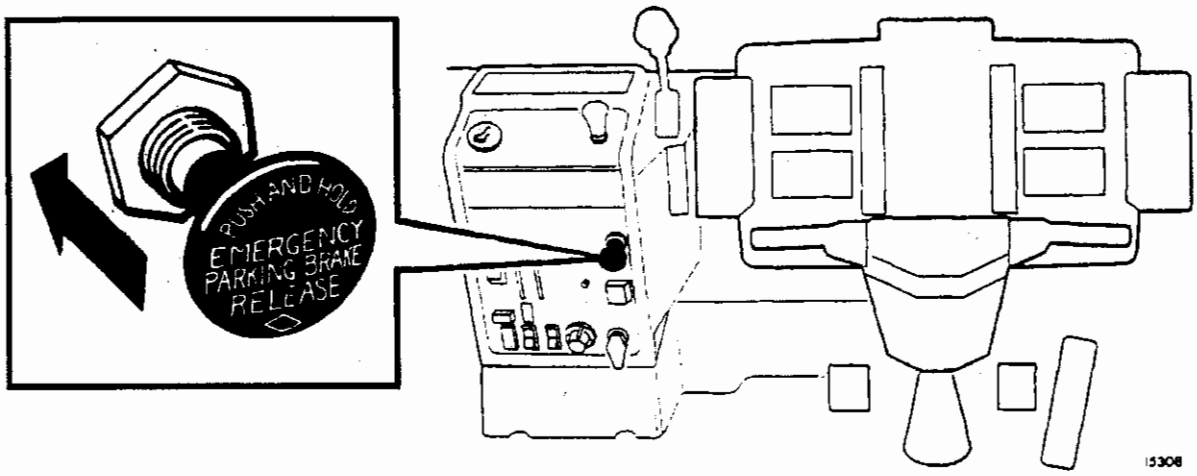
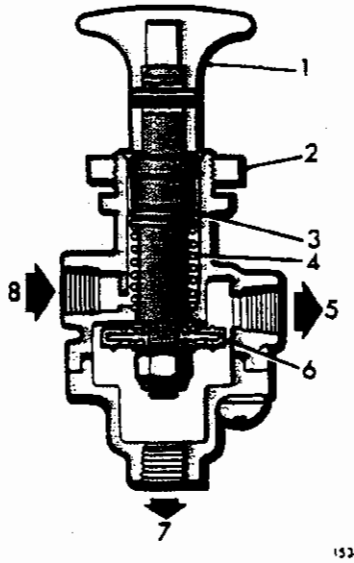


Fig 18 Location of supplementary spring brake release valve

109 This valve is an on-off air control valve with an exhaust function. It is spring loaded in the closed position. In the normal run position there is a constant air supply available at the valve. In an emergency situation, when the button is depressed and held in that position, air is delivered to hold-off the spring brake. When released the air will be exhausted through the valve and the spring brakes applied.



1	Button	5	Delivery port
2	Locknut	6	Inlet/exhaust valve
3	Push-rod seal	7	Exhaust port.
4	Spring	8	Supply port

Fig 19 Section through supplementary spring brake release valve

SPRING BRAKE ACTUATOR

110 This type of actuator combines the functions of normal service braking with those of a parking and secondary brake.

111 The vehicle service brakes are applied when air is delivered to the service diaphragm side of the actuator. Parking and secondary braking is effected by the release of air pressure from the spring brake chamber side of the actuator. The power spring contained within the chamber can now expand and transmit a force through the service brake push rods to apply the vehicle brakes.

112 To release the spring brakes, the hand control valve when operated will apply air pressure to the spring brake chamber, compressing the power spring and holding the brakes off.

113 To enable vehicle movement when air pressure is unavailable the braking force may be relieved by unscrewing the release bolt situated in the head of the actuator.

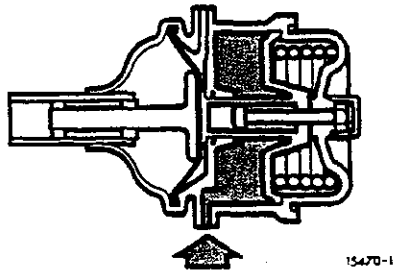


Fig 20 Brakes off (normal driving)

114 In the off position (Fig 20) the handbrake control valve maintains a constant air pressure on the spring brake piston. The resulting compression of the power spring holds the vehicle brakes off. This system ensures that the vehicle cannot be moved until sufficient air pressure is available to hold the power spring off.

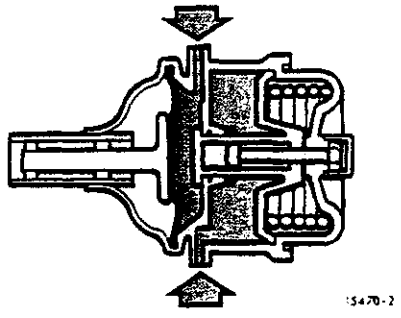


Fig 21 Service brake applied (normal driving)

115 The service brake chamber is of the conventional diaphragm type. The vehicle service brake effort is controlled by a foot operated brake valve. This valve supplies a graduable air pressure to the service brake chamber while the spring brake is held off by the pressure from the hand control valve (Fig 21).

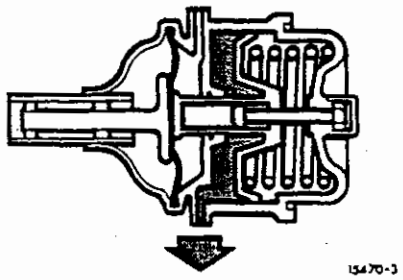


Fig 22 Handbrake application

116 Moving the handbrake control valve from off towards secondary or intermediate position, gradually releases air pressure from the spring brake chamber and allows the power spring to expand, thus applying the spring brakes (Fig 22). The amount of secondary braking being proportional to handbrake lever movement. At park the air pressure has been fully exhausted and the vehicle brakes are held on by the force of the power spring alone.

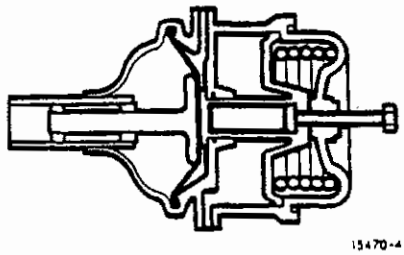


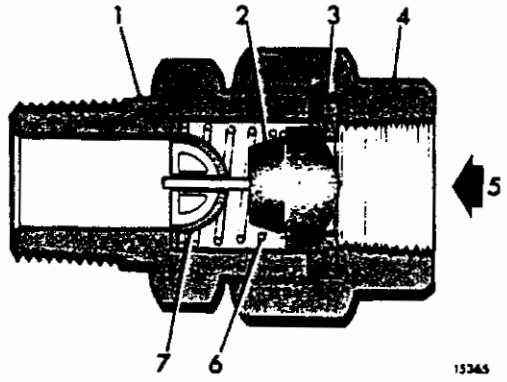
Fig 23 Manual release (brake wound off)

117 The power spring wind off bolt allows the vehicle to be moved in the absence of air pressure and permits the safe servicing of the actuator and foundation brake.

NON RETURN VALVE - SINGLE CHECK VALVE

118 The non-return valve is a device fitted in an air line where it is important to allow flow of air in one direction only, and prevent flow in the reverse direction. The valve should be mounted horizontally with the flow in the direction of the arrow cast on the body.

119 Air pressure in the normal direction unseats the valve and the flow of air is unobstructed. Flow of air in the reverse direction is prevented by the action of the spring assisted by the air pressure in that side of the valve.



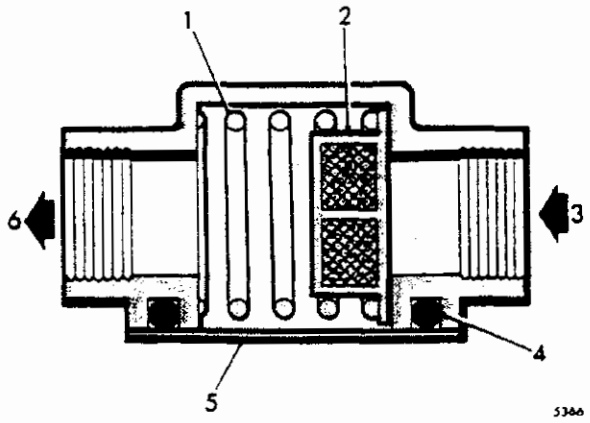
1	Body	5	Direction of air flow
2	Valve	6	Spring
3	Valve seat	7	Spring guide
4	Screw cap		

Fig 24 Non-return valve

LINE FILTER

120 A line filter is incorporated in a system line to protect the system from contaminants; by filtering dirt from the air passing through the unit.

121 Supply air passes through a filter element, which retains dirt particles, allowing only clean air to pass through to the delivery port. If the filter becomes blocked, air will force the filter element off its seat, as the force of the spring is overcome, and allows unfiltered air to pass through the unit.

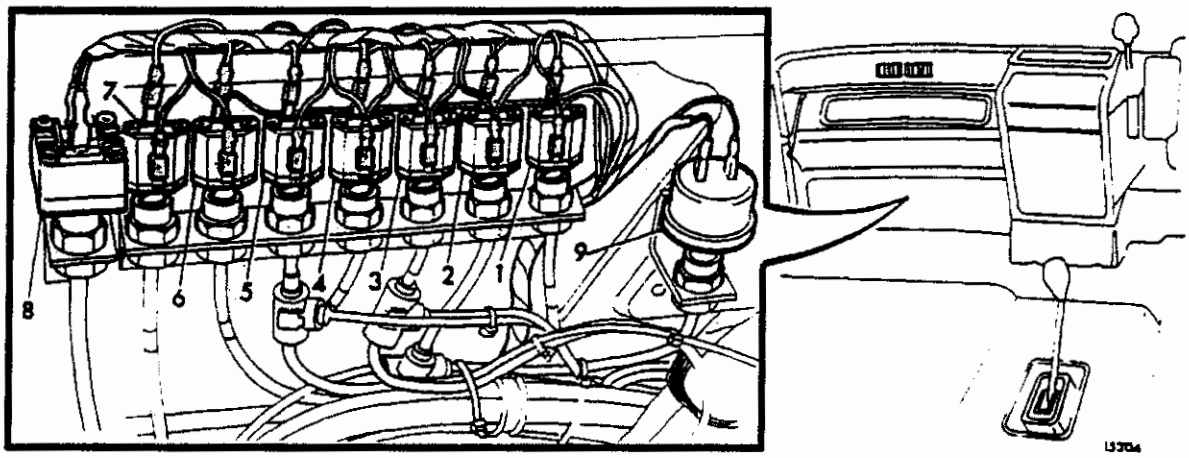


1	Spring	4	O-ring
2	Filter element	5	Base plate
3	Supply port	6	Delivery port

Fig 25 Line filter

LOW PRESSURE WARNING SWITCHES AND TRANSDUCER

122 Low pressure warning switches are incorporated in the system and monitor pressures at strategic points within that system. The switches are mounted on a seven way connector located behind the 'mates' trim panel.

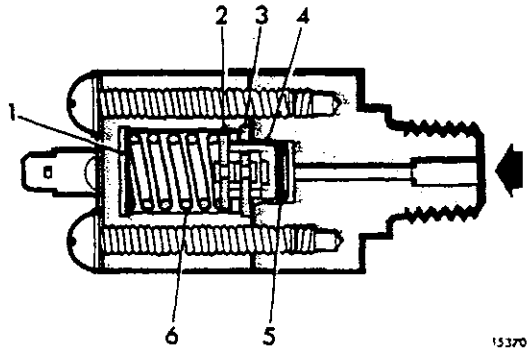


1	Supplementary spring brake supply	6	Independent trailer brake (warning light)
2	Park/trailer supply	7	Handbrake/spring brakes (warning light)
3	Front service supply ('Air 2')	8	Power take-off (if fitted)
4	Auxiliary services supply	9	Transducer ('Air 3')
5	Rear service supply ('Air 1')		

Fig 26 Switch location

123 When air in the line that the low pressure switch protect reaches approximately 5.4 bar (78 lbf/in.^{2}), the diaphragm lifts the piston and contact disc, against the spring pressure separating the contacts. This cuts-off either a warning buzzer and warning light or just a warning light, dependent on what the respective switch is protecting, see (Fig 26).

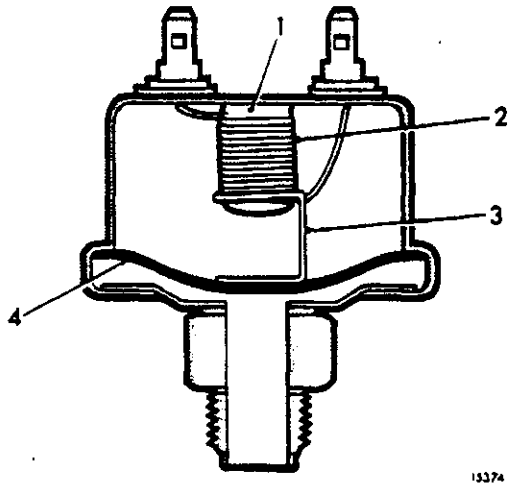
124 The front and rear service low pressure switches are directly connected to air gauges 'Air 2' - front and 'Air 1' - rear; whilst 'Air 3' - the park/trailer reservoir gauge is connected via a transducer. As the pressure rises the pointers of the air gauges will register in the instrument panel.



1	Terminal plate	4	Piston
2	Contact disc	5	Diaphragm
3	Contact plate	6	Contact spring

Fig 27 Section through low pressure switch

125 The transducer has an electrical current passing through a variable moving coil resistance contact. With no air pressure at the transducer there is a high resistance and consequently no 'Air 3' gauge pointer movement. As the air pressure increases it lifts the diaphragm and with it the moving contact, thus lowering the resistance which results in a deflection of the air gauge pointer. The greater the air pressure, the lower the resistance, the more the air gauge pointer will register.



1	Ceramic insert	3	Moving contact
2	Coil resistor	4	Diaphragm

Fig 28 Transducer

SHUT-OFF TAP

126 A shut-off tap with an on/off facility is provided on the chassis frame member for tyre inflation. A length of hose and connection adapters are kept in the driver's storage locker.

TEST CONNECTORS

127 The ISO test connectors are incorporated in the brake system and allow connection of calibrated test gauges to monitor supply and delivery pressures within the system.

TRAILER CONNECTIONS - PALM TYPE COUPLING

128 Trailer connections are provided on the rear cross-member for the supply and control of air for the operation of the trailer service and emergency brakes. These connections are colour coded self-seal couplings i.e. SUPPLY (EMERGENCY) COUPLING - RED and the CONTROL (SERVICE) COUPLING - YELLOW.

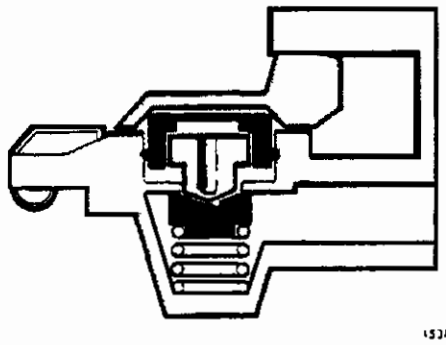


Fig 29 Section through self-seal trailer connection

TOWING CONNECTIONS - PALM TYPE COUPLING

129 Vented towing connections, preventing air build-up and consequently brake drag, are provided on the front cross-member to ensure that the vehicle brakes will be capable of operation by a recovery vehicle, when under tow. These connections are colour coded vented couplings i.e. SUPPLY (EMERGENCY) COUPLING - RED and the CONTROL (SERVICE) COUPLING - YELLOW.

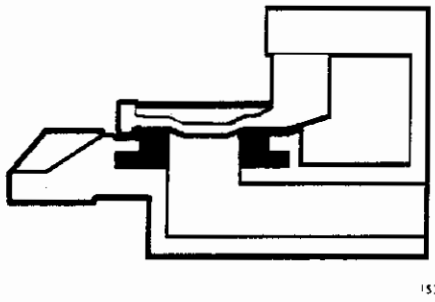


Fig 30 Section through vented towing connection

CHAPTER 11

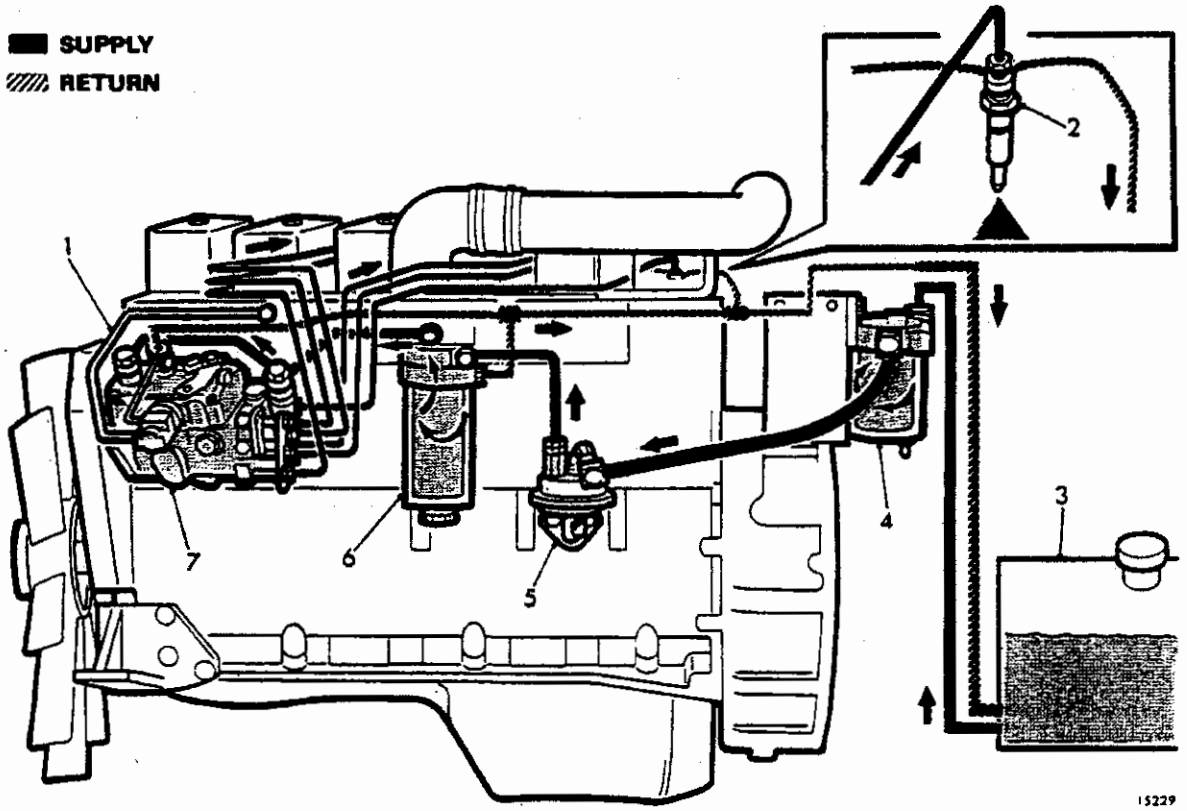
FUEL, EXHAUST AND INDUCTION SYSTEMS

CONTENTS

GENERAL DESCRIPTION - FUEL SYSTEM

1 The fuel system (Fig 1) includes a distributor type fuel injection pump (7), a lift pump (5), a fuel sedimenter (4), a fuel filter/water separator (6) and multi-hole type injectors (2).

2 The lift pump draws fuel from the fuel tank and provides a positive flow of fuel to the fuel filter head via the fuel sedimenter. Fuel flows through the fuel filter head into the fuel filter/water separator. Clean filtered fuel is then carried to the fuel injection pump through a low pressure supply line. The fuel injection pump, creates and distributes a metered amount of high pressure fuel through high pressure fuel injection pipes to the injectors. During injection the pressurised fuel is forced through spray holes in the injector nozzle causing atomisation of the fuel for combustion. Fuel that is vented by the injection pump, and a small amount of excess fuel from the injectors is returned to the fuel tank through a fuel return pipe.

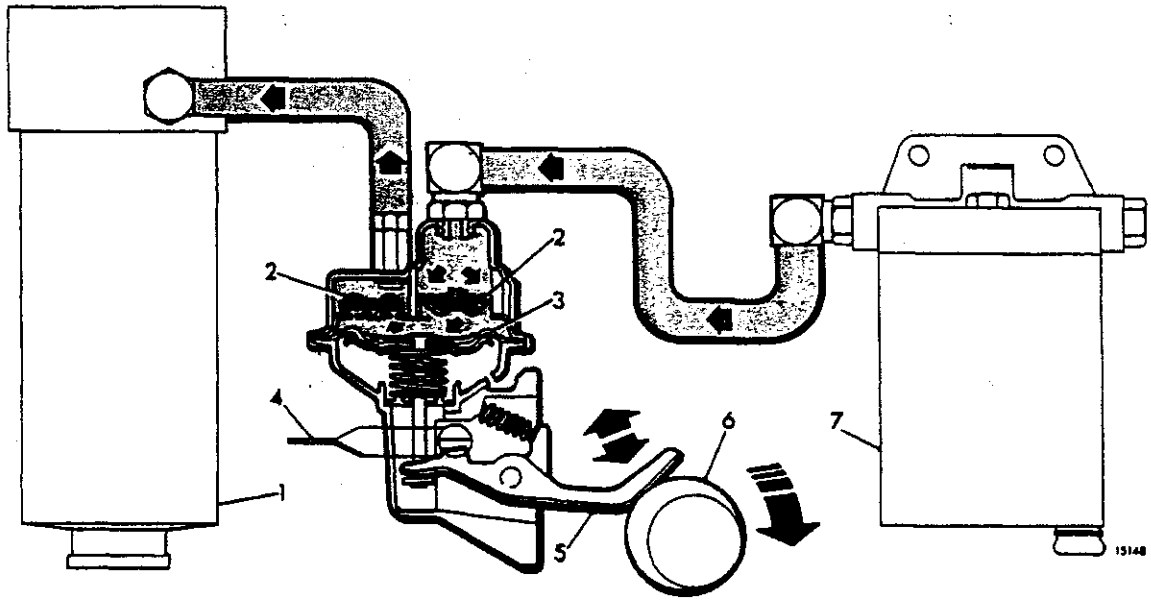


1 Boost control pipe
2 Injector
3 Fuel tank
4 Sedimenter
5 Lift pump
6 Fuel filter/water separator
7 Fuel injection pump

Fig 1 Fuel system diagram

LIFT PUMP

3 The lift pump (Fig 2) provides a supply of low pressure fuel to the filter head. It is mechanically driven by a special lobe on the camshaft (6). The lobe raises the arm of the lift pump to create a pumping action. The pump incorporates a spring loaded diaphragm (3) to impel the fuel, and check valves (2) to prevent bleed-back during engine operation and shutdown. An external lever (4) permits manual operation of the pump for priming or bleeding air from the system.

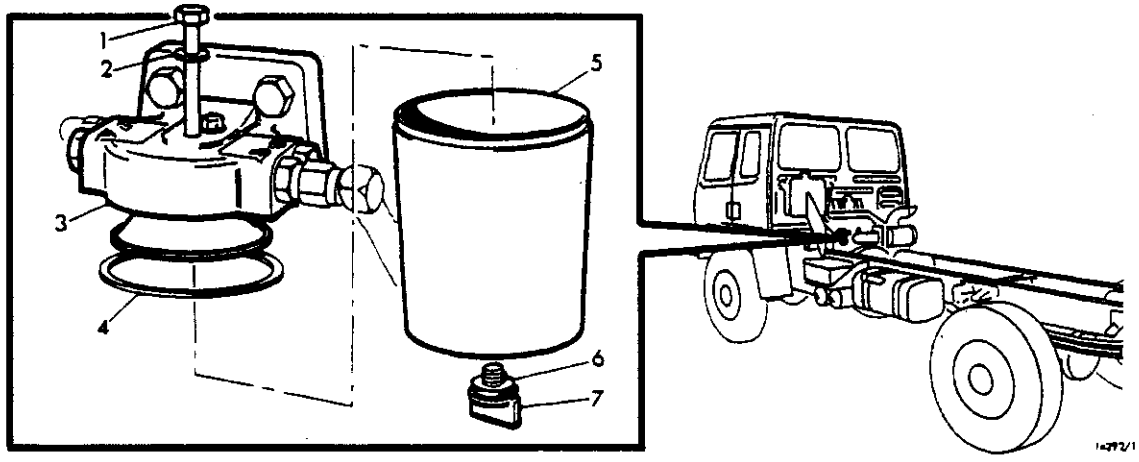


1	Fuel filter/water separator	5	Lift pump arm
2	Check valve	6	Camshaft
3	Diaphragm	7	Sedimenter
4	Manual priming lever		

Fig 2 Lift pump

FUEL SEDIMENTER

4 The sedimenter (Fig 3) is mounted at the rear of the engine and is connected between the fuel tank and the lift pump. The function of the sedimenter is to remove contaminates from the fuel prior to it entering the lift pump. It comprises of a filter head (3), a conical element and a bowl (5); a plug (7) is provided in the base of the bowl to allow all accumulated condensate to be drained from the sedimenter.



1	Retaining bolt	5	Sedimenter bowl
2	Sealing ring	6	Sealing ring
3	Filter head	7	Drain plug
4	Sealing ring		

Fig 3 Fuel sedimenter

FUEL FILTER/WATER SEPARATOR

5 A disposable combination fuel filter/water separator (Fig 4) is connected between the lift pump and the fuel injection pump. It is mounted through an adapter block to the filter head, which is an integral part of the cylinder head. A manual bleed screw is situated at the filter head, and a vent pipe is fitted between the filter adapter block and the fuel return pipe. Fuel is supplied to the filter head by the lift pump, it then flows through the filter element where any contaminates in the fuel are removed; any water in the fuel is collected in a chamber at the bottom of the filter. An integral drain valve at the base of the filter allows any water/contaminates to be periodically drained off.

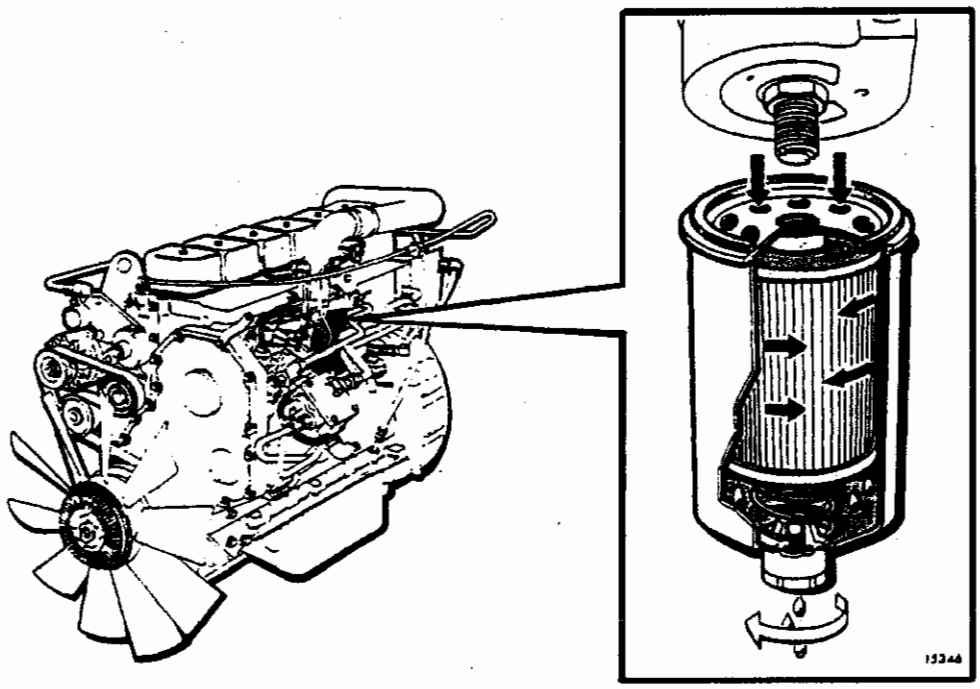


Fig 4 Fuel filter/water separator

FUEL INJECTION PUMP

6 The CAV DPS fuel injection pump (Fig 5) is a mechanically governed, distributor type pump. It is mounted directly on the timing case rear face and drive is provided by a helical gear keyed and clamped to the pump shaft and driven by the camshaft gear.

7 Fuel is supplied at low pressure through the inlet connection into the transfer pump. The transfer pump increases fuel pressure, which is controlled by a pressure regulating valve. At a pre-determined pressure the pressure regulating valve allows fuel to return to the inlet side of the transfer pump, thus regulating fuel pressure. During manual priming of the fuel system the pressure regulating valve allows fuel to by-pass the transfer pump. From the transfer pump fuel feeds the metering valve. The metering valve is controlled by the governor and it determines the amount of fuel available to the pumping section of the rotor. Movement of the governor arm by the governor rotates the metering valve increasing or decreasing fuel flow to the rotor. The rotor develops and distributes high pressure fuel to the injectors. The rotor has six charging ports one for each cylinder, when one of the charging ports aligns with the metering port of the metering valve fuel flows into a central drilling in the rotor to a pair of opposed pumping plungers. These pumping plungers are actuated by an internally lobed cam ring. The fuel forces the pumping plungers apart; with continued rotation the lobes of the cam ring force the plungers inward, forcing fuel at injection pressure through a delivery outlet to the injector. With further rotation the and injection cycle is repeated with the rotor alternately charging and discharging fuel to each injector.

8 The fuel injection pump is fitted with a boost control unit which prevents a fuel-rich imbalance at low engine speeds on turbocharged engines. The boost control unit is a device which senses the level of turbocharger boost pressure and adjusts the maximum fuel delivery to suit. It consists of a pressure sensitive diaphragm which operates a rod which, in turn, alters the position of a pair of scroll plates located either side of the cam ring. Movement of the scroll plates increases or decreases the outward travel of the pumping plungers, thus changing the level of maximum fuel delivery. The scroll plate mechanism also gives automatic excess fuel. At cranking speed with the accelerator at idle the scroll plates are rotated to a position that allows the pumping plungers to move further apart; this allows fuel in excess of the maximum to be discharged to the injectors. When the engine self-sustains at a speed higher than cranking, excess fuel is terminated by the action of the governor on the metering valve. In addition to excess fuelling during engine cranking, the advance and retard unit automatically adjusts the cam ring to retard injection. When the engine self-sustains, the cam ring is partially rotated in the opposite direction to pump rotation to advance the timing as the pump speed increases.

9 The two-speed mechanical governor controls engine speed at idling and maximum speed only; at intermediate speeds there is a direct link between the accelerator and the metering valve. A manual stop cable is fitted, which when activated moves the metering valve to the closed position preventing the flow of fuel and so shutting down the engine.

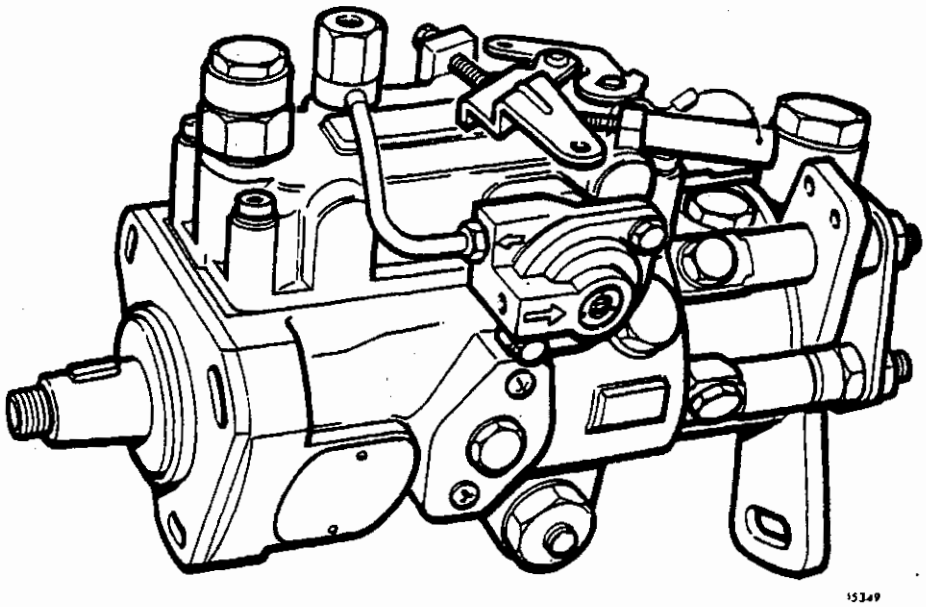
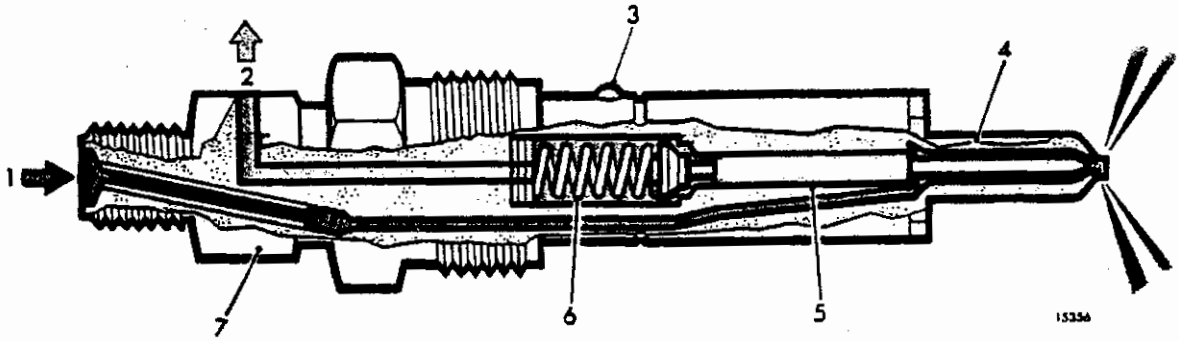


Fig 5 CAV DPS fuel injection pump

INJECTORS

10 The injectors (Fig 6) fitted are CAV multi-hole type, with a nozzle opening pressure of 225 atm. They are located in the cylinder head and secured by a gland nut type fixing. The injector consists basically of a nozzle (4) with a needle valve (5), a nozzle holder (7) and a pressure spring (6). During injection high pressure fuel supplied from the injection pump lifts the spring-loaded needle valve from the nozzle seat and emerges as an atomised spray through spray holes in the nozzle tip. On completion of injection, pressure in the nozzle is reduced; this permits the pressure spring to rapidly return the needle valve back on its seat, so restricting the flow of fuel into the cylinder and also preventing exhaust gases entering the injector nozzle. A slight leakage of fuel past the needle valve stem is returned via a fuel leak-off connection to the fuel tank; this fuel leakage provides lubrication for the needle valve stem.

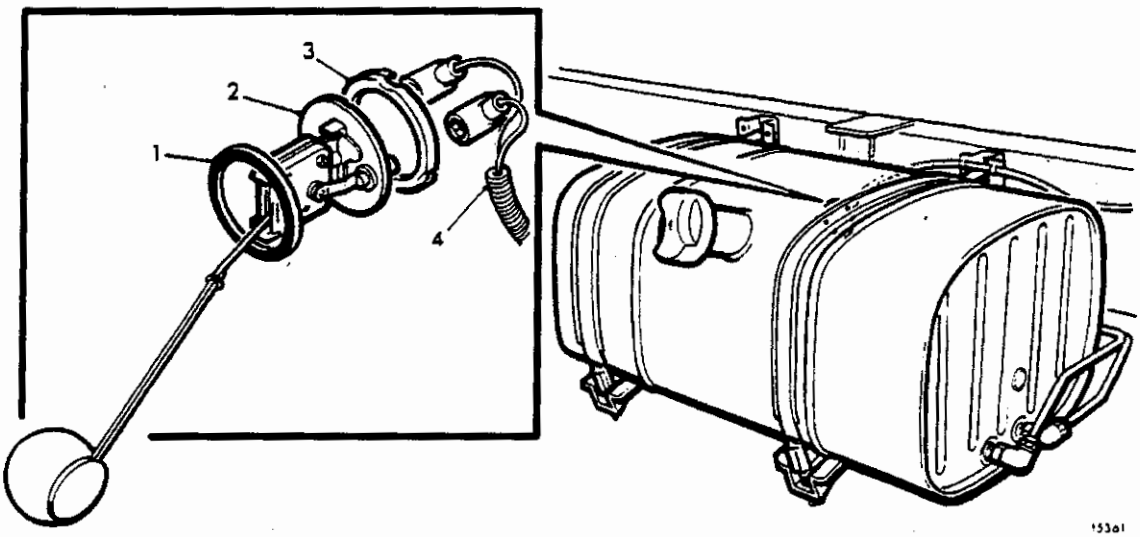


1 High pressure fuel inlet
2 Fuel leak-off
3 Locating ball
4 Nozzle
5 Needle valve
6 Spring
7 Nozzle holder

Fig 6 Section view of injector

FUEL TANK

11 The fuel tank (Fig 7) is an all-welded steel construction, with a capacity of 137 litres (30 gal). It is supported on brackets which are bolted to the chassis frame, and secured with two metal straps fitted with anti-squeak strips. The tank has a lockable filler/breather cap and a removable brass wire gauze strainer fitted to the filler neck. The fuel gauge on the drivers instrument panel is operated by an electrical sender unit fitted to the fuel tank. Fuel supply and return pipe connections are made to the bottom rear-end of the tank, and a drain plug is situated in the bottom of the tank.

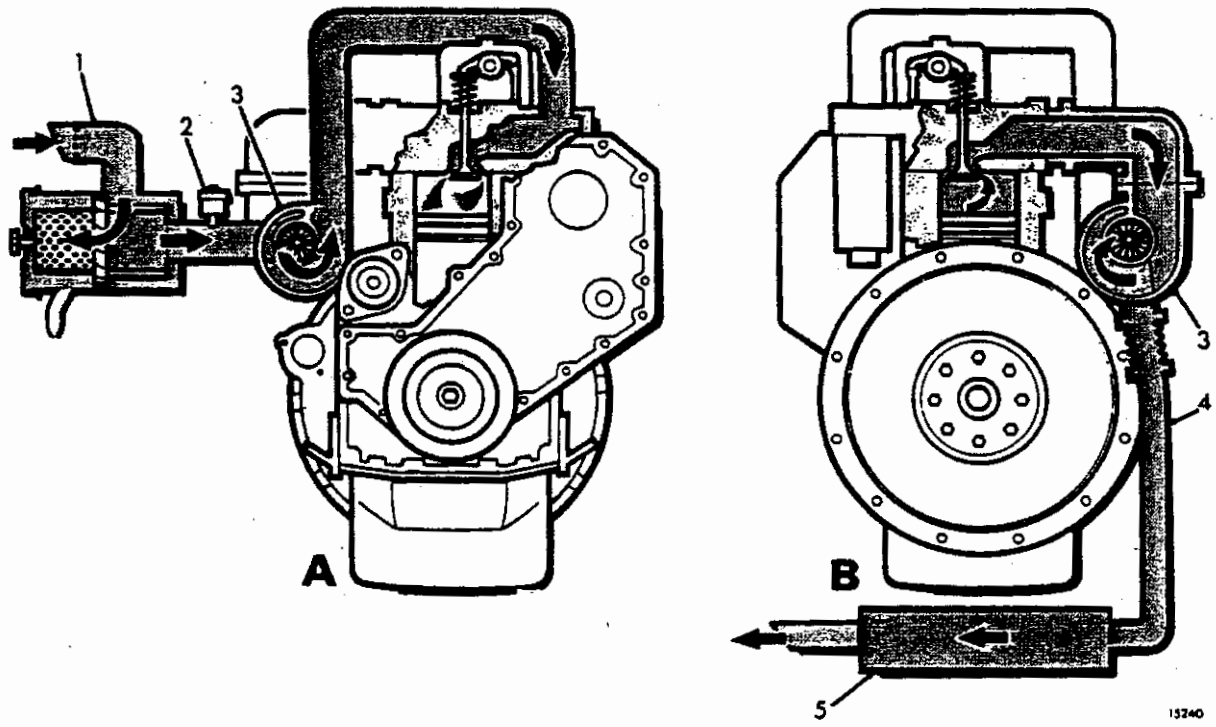


1 Sealing ring
2 Sender unit
3 Locking ring
4 Electrical leads

Fig 7 Fuel tank and sender unit

GENERAL DESCRIPTION - INDUCTION/EXHAUST SYSTEMS

12 Air is drawn into the top of the air cleaner (Fig 8 (1)) and passes through a two stage paper element to the turbocharger. The turbocharger forces the clean filtered air through an air intake pipe to the cylinder head induction manifold, and on into the cylinders. Exhaust gases are expelled from the cylinders into the exhaust manifold; the turbocharger then uses the exhaust gases to drive the turbine and impellor, thus using exhaust energy to force more air into the cylinders. Exhaust gases are discharged by the turbocharger through an exhaust down-pipe to a longitudinally mounted silencer.



A - Induction **B** - Exhaust

1 Air cleaner
2 Air restriction indicator
3 Turbocharger
4 Exhaust down pipe
5 Silencer

Fig 8 Induction/exhaust system diagram

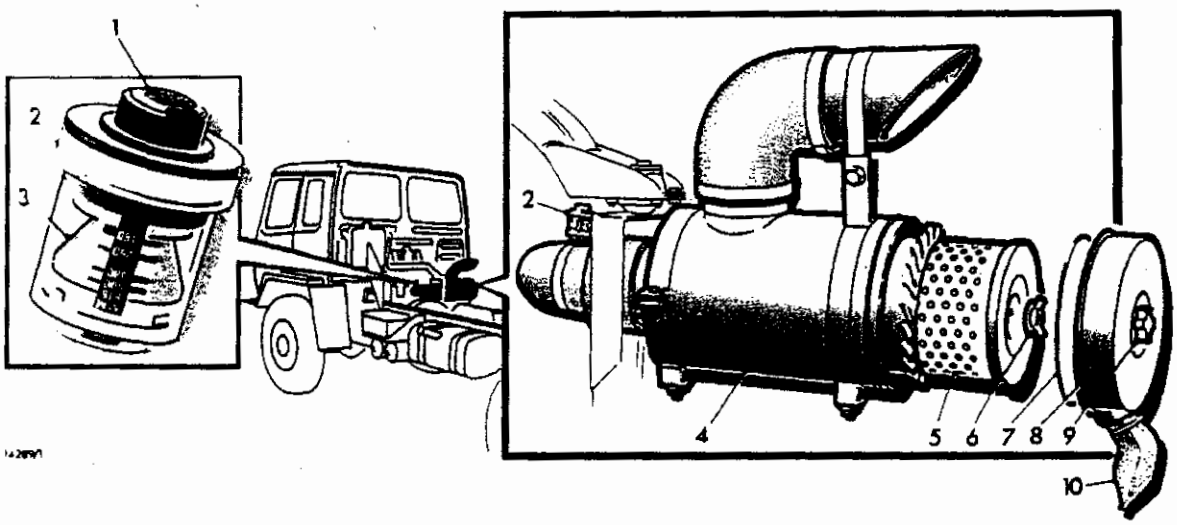
EXHAUST SYSTEM

13 The exhaust system (Fig 8 (**B**)) comprises of a cast iron exhaust elbow mounted to the turbocharger (3), an aluminised steel down pipe (4) and an aluminised steel reactive type silencer (5). A flexible exhaust pipe is fitted between the turbocharger elbow and the down-pipe to reduce vibration. Connections between the flexible exhaust pipe and the down-pipe (4) are secured with stainless steel V-clamps.

14 The silencer is mounted longitudinally inboard of the chassis and forward of the firescreen. It is supported by clamp bands secured to mounting brackets at the clutch housing and gearbox. The silencer tail-pipe is directed so as to ensure no accumulation of fumes in the cab or body, and to minimise the tendency to raise dust clouds.

AIR CLEANER

15. The air cleaner (Fig 9) is mounted off the right-hand side of the chassis frame at the rear of the cab. Air is drawn into the top of the cleaner and flows through a 254 mm (10 in.) diameter two stage paper element; first the air passes through a multi-vaned nylon deflector, this has the effect of spinning the air around the element causing the heavier particles of dust to collect at the base of the air cleaner. The partially cleaned air then passes through the paper element and on to the turbocharger.



1	Reset button	6	Wing nut
2	Restriction indicator	7	O-ring
3	Yellow plunger	8	End cover
4	Filter canister	9	Securing knob
5	Filter element	10	Unloader valve

Fig 9 Air cleaner

AIR RESTRICTION INDICATOR

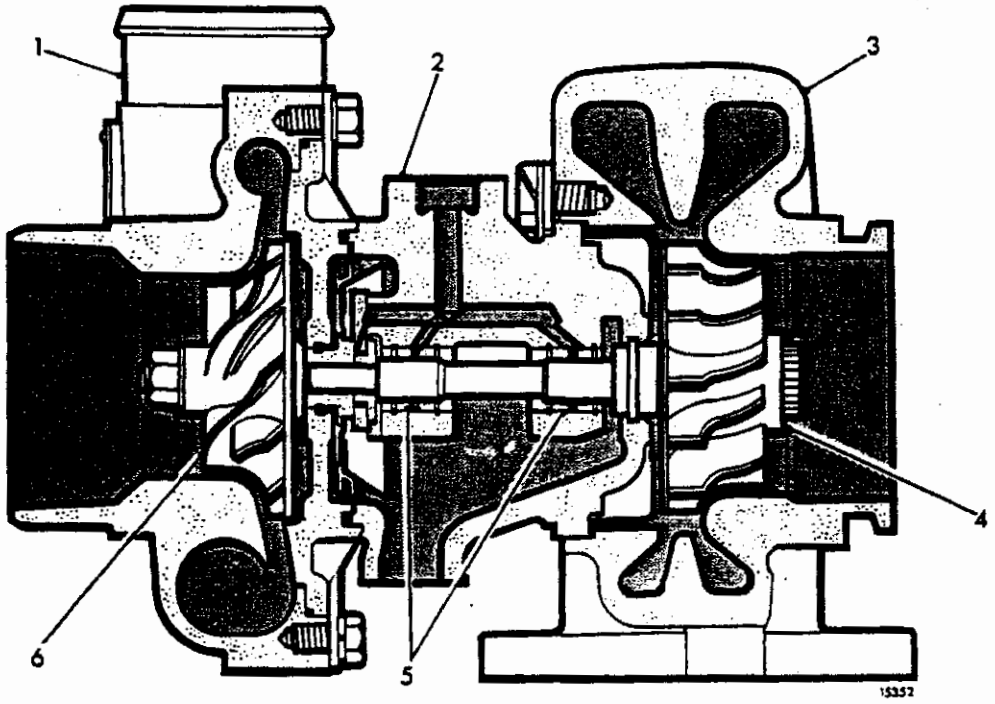
16 The air induction system incorporates a restriction indicator (Fig 9 (2)) situated in the air intake piping between the air cleaner and the turbocharger. The restriction indicator senses any resistance in air flow through the filter element, and will visually indicate, by the appearance of a yellow plunger in the transparent body, when the filter element requires renewing. When the filter element has been renewed, the yellow plunger can be reset by pressing the button on top of the restriction indicator.

TURBOCHARGER

17 The Holset H1 turbocharger (Fig 10) provides an increased air flow to the engine, which results in an improved air to fuel ratio for better combustion and maximum use of fuel energy. The increased air to fuel ratio also means a reduction in exhaust smoke emission. The turbocharger develops near-sea-level power at all altitudes of normal operation; the lower atmospheric pressure and less dense air at higher altitudes allows the turbocharger to increase speed; thus continuing to deliver a full charge of air to the cylinders.

18 The turbocharger comprises of three basic sections, a turbine housing (3), a bearing housing (2) which supports the rotor assembly and a compressor housing (1). The turbocharger utilises the engine exhaust gases to rotate the turbine wheel (4) and the compressor impellor (6); the compressor impellor draws clean filtered air from the air cleaner and forces it into the cylinders.

19 Lubrication of the turbocharger bearings is provided by pressurised engine oil supplied through an oil feed pipe; the oil then flows under gravity through an oil return pipe, back to the sump.



1	Compressor housing	4	Turbine wheel and shaft
2	Bearing housing	5	Bearing
3	Turbine housing	6	Compressor impellor

Fig 10 Section view of turbocharger

COLD START CONTROL

20 The cold start control is a device to ease starting under low atmospheric temperatures down to -31°C (-88°F). It comprises of a hand operated delivery pump which is situated in the cab, coupled by a flexible pipe to a reservoir which is mounted to the header tank support bracket at the rear of the cab. When the delivery pump plunger is operated, 'Start Pilot' fluid, which is a heavy petroleum mixture, is pumped from the reservoir through a spray nozzle fitted to the induction manifold of the cylinder head. The cold start reservoir can be replenished with a 'Start Pilot' multi-fill canister through the valve in the top of the reservoir.

CHAPTER 11-1

FUEL AND INDUCTION SYSTEMS - EURO 1 ENGINES

CONTENTS

GENERAL DESCRIPTION

1 From chassis number L119988, all vehicles have been fitted with a modified Leyland DAF 300 Series diesel engine designated Euro 1. This engine conforms to current legislative exhaust emission levels (88/77/EEC Directive Step 1). The major fuel system modifications include the following:

1.1 Revised fuel injectors - Bosch.

1.2 Revised fuel injectors pipes.

1.3 Cold start timing advance (KSB) solenoid.

1.4 Inlet manifold thermal switch.

1.5 Revised fuel filter head.

1.6 Revised fuel injection pump - Bosch VP14.

FUEL INJECTORS - BOSCH

2 The Leyland DAF 300 Series Euro 1 engine is equipped with Bosch 7 mm multi-hole injectors. Each injector has a nozzle opening pressure of 260 to 275 atmospheres.

COLD START TIMING ADVANCE (KSB) SOLENOID

3 To conform to current legislative exhaust emission levels the Bosch VP14 fuel injection pump is fitted with a cold start timing advance (KSB) solenoid to minimise white smoke exhaust emissions when starting a cold engine. The KSB solenoid is only operative whilst the engine is running at idling speed and the inlet manifold temperature is below 32°C (90°F). For further information refer to AESP 2320-H-104-302, Chap 13-1.

INLET MANIFOLD TEMPERATURE SWITCH

4 The inlet manifold temperature switch monitors the temperature within the inlet manifold and, at temperatures below 32°C (90°F), activates the cold start timing advance (KSB) solenoid. For further information refer to AESP 2320-H-104-302, Chap 13-1,

FUEL FILTER HEAD

5 The permanent fuel vent pipe from the fuel filter head adapter block has been deleted from all Euro 1 engines.

FUEL INJECTION PUMP - BOSCH VP14

6 The Bosch VP14 fuel injection pump (Fig 1) is a mechanically governed, distributor type pump. It is mounted directly on the engine timing case rear face and is driven by a helical gear keyed and clamped to the fuel pump shaft and driven by the camshaft gear.

7 Fuel is supplied at low pressure through the inlet connection into the vane supply pump. The vane supply pump, driven by the fuel pump drive shaft, pressurises the distributor pump housing. An integral pressure regulator valve restricts the fuel pump's maximum internal pressure by diverting excess fuel to the inlet side of the vane supply pump. Fuel, at the pump internal pressure, is supplied to the metering slot and the high pressure chamber at the end of the distributor pump plunger. The distributor pump plunger has a rotary and stroking motion, the rotary motion is produced by the rotation of the drive shaft, whilst the stroking motion is produced by the cam plate as the cam lobes rotate against the stationary cam rollers. The functions of the rotary and stroking motions of the distributor plunger are the development of injection pressure and distribution of the fuel to the high pressure lines.

8 The fuel injection pump incorporates a mechanical flyweight governor which is gear driven from the pump drive shaft. Springs and linkage are used to connect the governor to the engine throttle lever and the regulating collar. The regulating collar regulates the fuel volume to the high pressure lines.

9 The fuel injection pump is equipped with external adjustment screws for limiting top speed and adjusting idle speed.

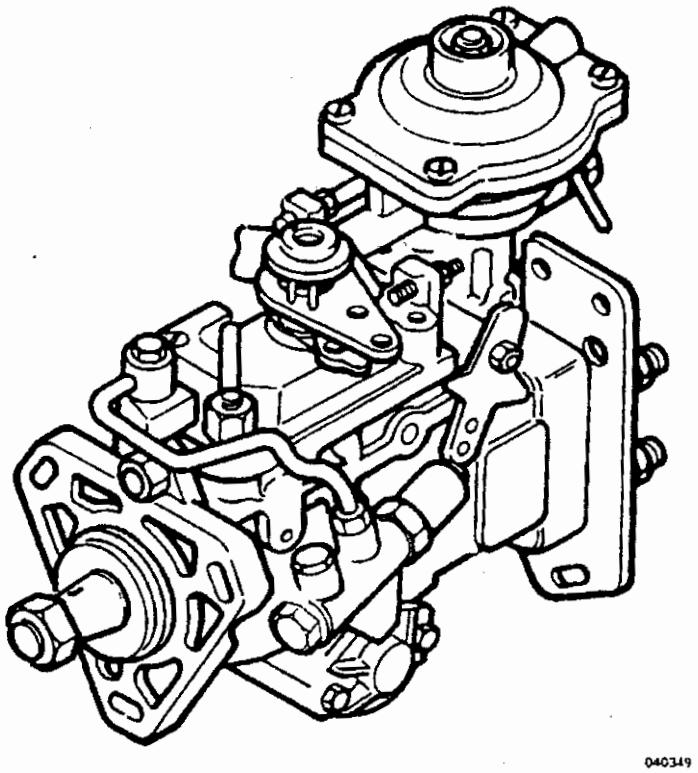


Fig 1 Bosch VP14 fuel injection pump

CHAPTER 12

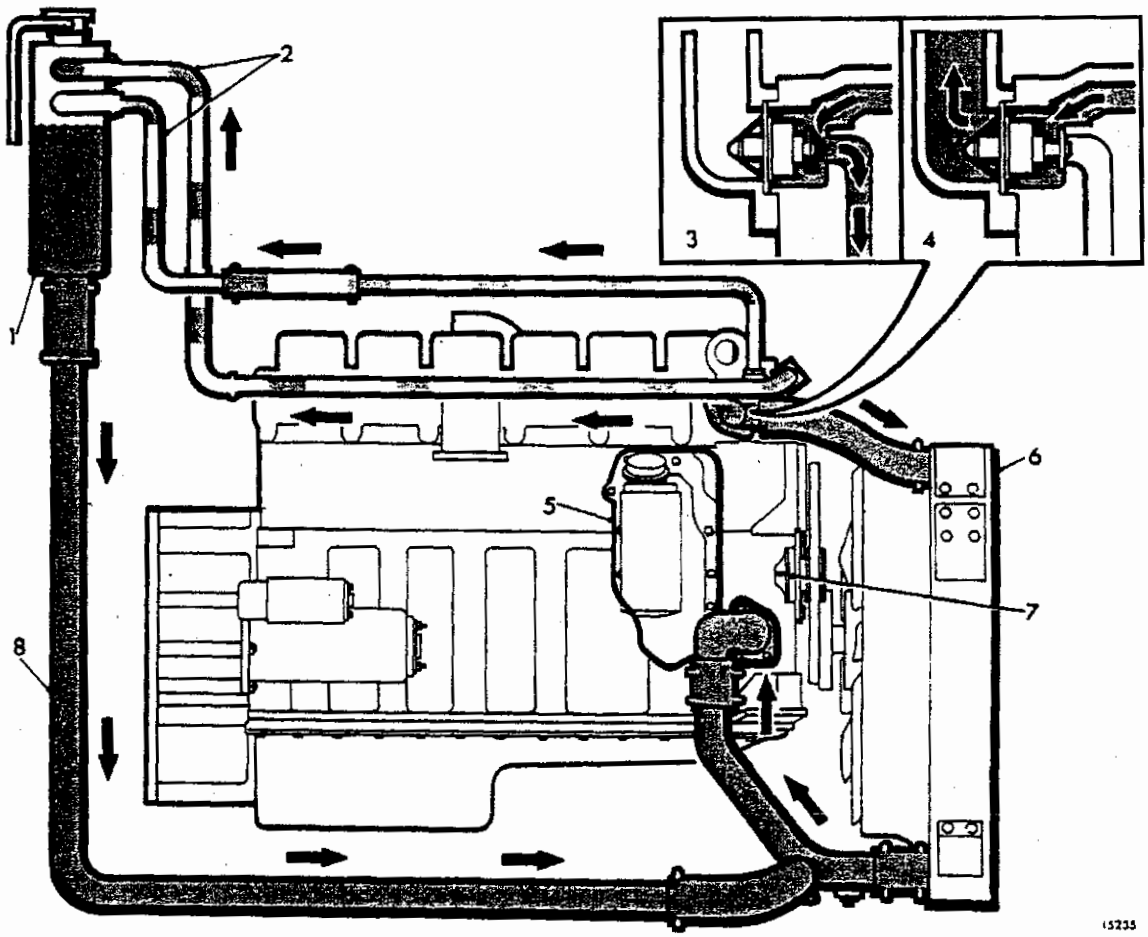
COOLING SYSTEM

CONTENTS

GENERAL DESCRIPTION

1 The cooling system (Fig 1) is a pressurised 'no-loss' type with a remote header tank (1) mounted at the rear of the cab to de-aerate the coolant and to allow for any expansion that may occur in the cooling system. The system incorporates a belt driven water pump (7), a ten blade fan mounted on a thermo viscous drive and a radiator of fin and tube type construction (6). A filler neck is provided in the side of the header tank, with a coolant filler line (8) leading from the header tank to the radiator bottom water pipe. Two de-aeration vent lines (2) return from the engine to the header tank to ensure all air is expelled from the system. A pressure cap with a nominal opening pressure of 0.5 bar (7.25 lbf/in.^{2}) situated at the top of the header tank ensures that optimum operating temperature is maintained. In the event of a rise in pressure, the pressure cap valve opens allowing surplus coolant to be expelled through the overflow pipe.

2 Coolant is drawn from the radiator by the water pump and passes into the cylinder block through the oil cooler (5) cavity. The coolant circulates around each cylinder, then flows across the block and up to the cylinder head. Coolant then flows through the cylinder head and into the thermostat housing. When the coolant is below the normal operating temperature it by-passes the radiator and goes to the water pump via internal drillings in the cylinder head and cylinder block (3). When normal operating temperature is attained, the thermostat valve opens (4), sealing the by-pass to the water pump and allowing the coolant to flow through the radiator.

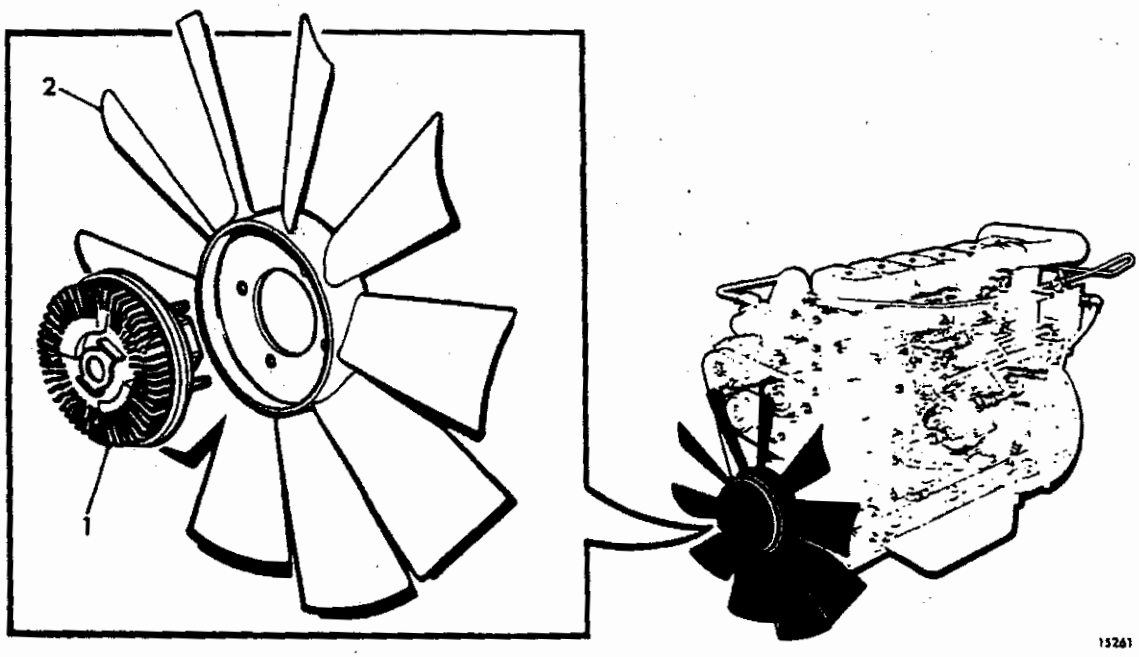


1	Header tank	5	Oil cooler
2	De-aeration vent lines	6	Radiator
3	Thermostat - closed	7	Water pump
4	Thermostat - open	8	Coolant filler line

Fig 1 Cooling system diagram

THERMO VISCOUS FAN DRIVE

3 The thermo viscous fan drive (Fig 2 (1)) is designed to sense the air temperature behind the radiator, and to control the fan speed according to this temperature. An increase or decrease in radiator coolant temperature produces a corresponding increase or decrease in air temperature behind the radiator which the fan drive senses. At a specified temperature the fan drive engages to increase air flow, conversely at a lower temperature the fan drive disengages to decrease air flow through the radiator. This type of fan drive also enables wading to be carried out without damage to either fan or radiator.

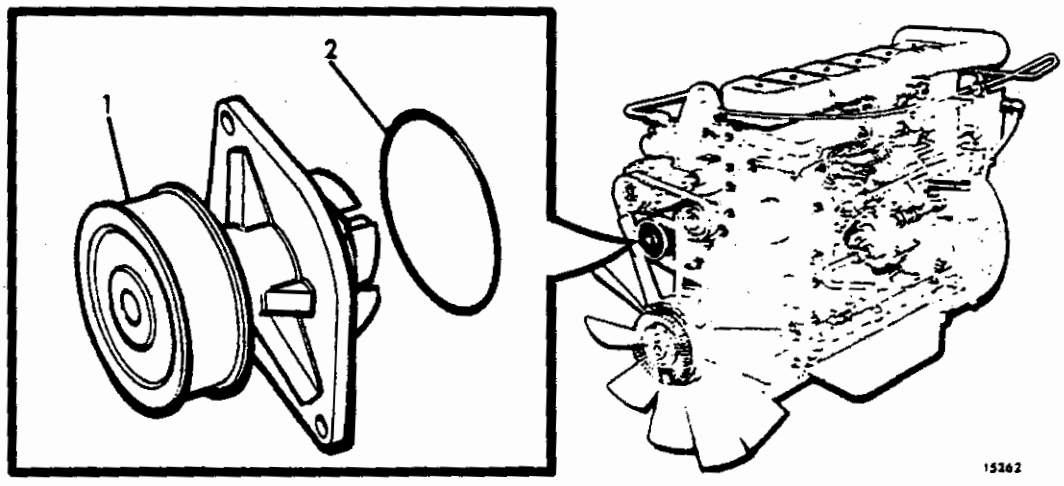


1 Viscous drive
2 Fan

Fig 2 Fan and fan drive

WATER PUMP

4 The water pump (Fig 3) is a centrifugal type pump mounted to the front of the engine. It is belt driven at twice the engine speed by the crankshaft pulley. The drive belt, which also drives the alternator, is a ribbed type belt; an automatic belt tensioner ensures correct belt tension is maintained.

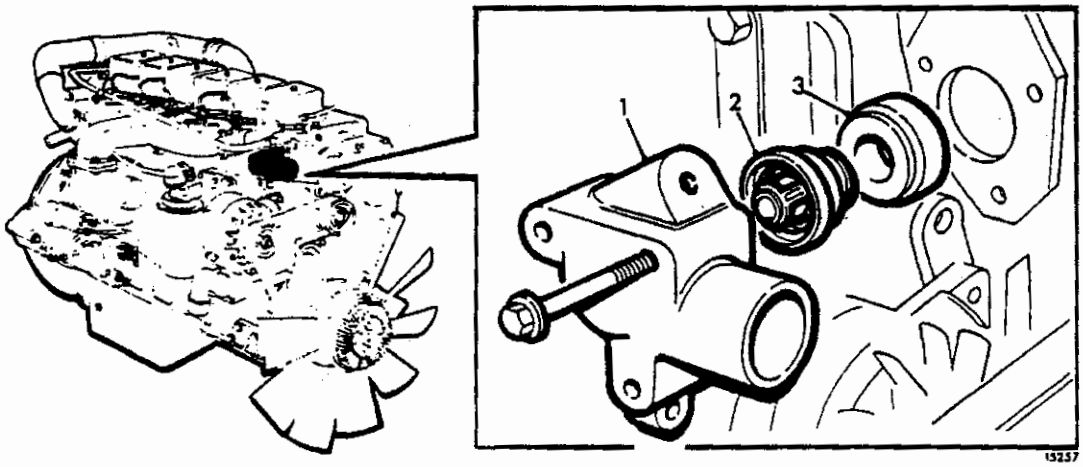


1 Water pump
2 O-ring

Fig 3 Water pump

THERMOSTAT

5 A wax capilliary type thermostat (Fig 4 (2)) controls coolant flow in response to engine coolant temperature. When the coolant is below the normal operating temperature the thermostat valve remains closed forcing the coolant to by-pass the radiator and diverting it to the water pump. When normal operating temperature is attained, the valve opens allowing the coolant to flow through the radiator. Most of the coolant flow to the radiator is controlled by the thermostat in response to engine coolant temperature, however, a small amount of continuous flow reduces the frequency of the closing or surging of the thermostat valve.

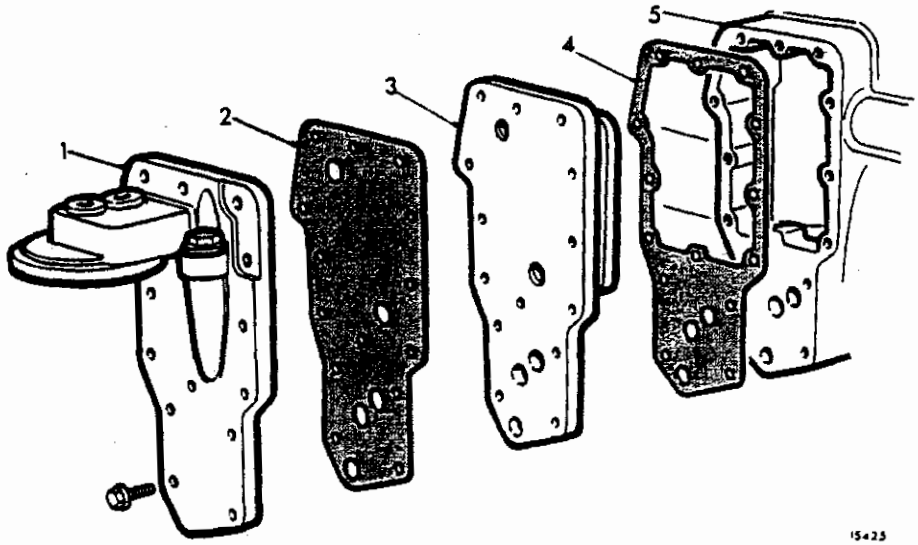


1 Thermostat housing
2 Thermostat
3 Seal

Fig 4 Thermostat

OIL COOLER

6 The oil cooler (Fig 5) is a full flow plate type. Engine oil flows from the oil pump through a passage in the oil cooler cover and through an element where it is cooled by engine coolant flowing past the plates of the element.

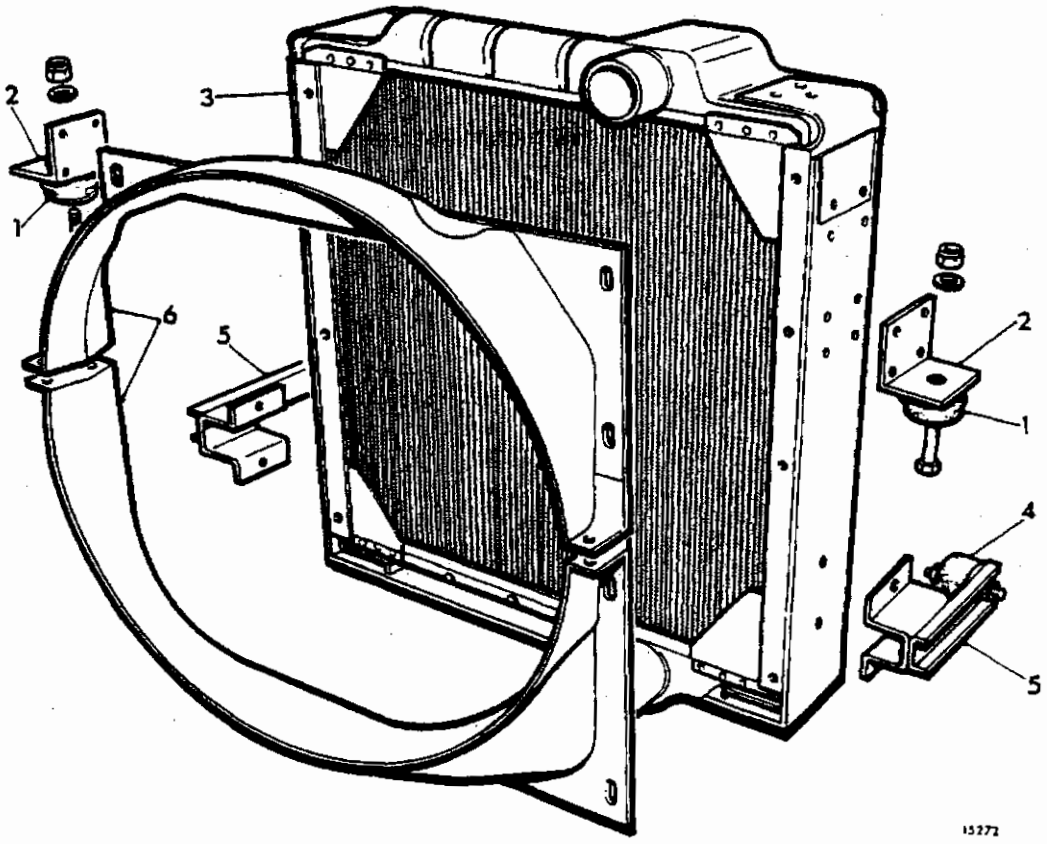


1 Cover
2 Gasket
3 Oil cooler
4 Gasket
5 Cylinder block

Fig 5 Oil cooler

RADIATOR

7 The radiator (Fig 6 (3)) is of fin and tube type construction with sheet brass top and bottom tanks. It is mounted inside a protective cradle for increased strength for off-road operation. The radiator assembly is resiliently mounted (1) between the chassis frame to isolate the radiator from vibration; a stabiliser bracket (5) provides additional support. A stoneguard is fitted to the front of the chassis frame to protect the radiator from damage. Split cowls (6) are fitted to the radiator to ensure correct air flow. The cooling system drain plug is situated in the radiator bottom water pipe.



1	Mounting rubber	4	Stabiliser mounting rubber
2	Mounting bracket	5	Stabiliser bracket
3	Radiator	6	Radiator cowls

Fig 6 Radiator assembly

CHAPTER 13

ELECTRICAL

CONTENTS

Para

Fig Page

GENERAL DESCRIPTION

1 The electrical system is a 24V, dual pole, wired insulated negative return design. All chassis harness is routed through convoluted conduit and, together with the exterior connections, is environmentally sealed.

Batteries

2 Two 12 volt batteries, of 175 minute reserve capacity and rated at 95 Ah (20 hour rate), are mounted in a carrier attached to the left-hand chassis member immediately behind the cab.

Battery isolation switch

3 The battery isolation switch is mounted on the chassis frame adjacent to the battery carrier.

4 A remote switch, linked to the main isolator switch, is located on the centre console in cab.

5 Operation of either of these two switches will cancel all vehicle circuits. However, the circuits may only be re-energised by operation of the externally mounted switch 'T' handle.

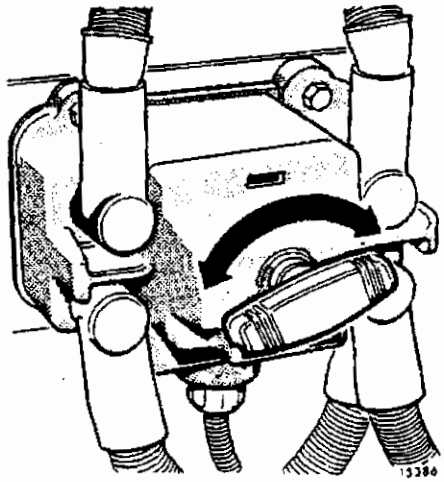


Fig 1 Battery isolation switch

Inter-vehicle starting socket

6 An inter-vehicle starting socket is mounted adjacent to the battery isolator switch. This socket provides a starting facility for the vehicle, or other vehicles, should the batteries become discharged.

Alternator

7 The alternator is a three-phase machine having a rated output of 36 amps. Rectification to DC is achieved by six silicone diodes connected in a three phase bridge circuit connected between the stator and output terminals. Three auxiliary diodes provide direct current to energise the field circuit via the brushes and slip rings. This arrangement prevents discharging through the field when the alternator is stationary. A condenser is incorporated for RFI suppression.

8 Alternator output is controlled by an integral transistorised regulator. As the alternator is self-regulating in current output, the regulator, which is replaceable with the alternator in situ, has only to control voltage.

9 Cooling is provided by a fan situated behind the drive pulley.

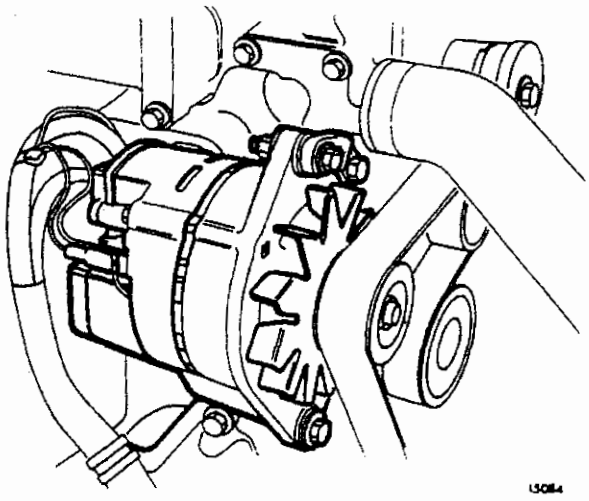


Fig 2 Alternator

Starter motor

10 The starter motor is a four pole, four brush, series parallel wound design having an output of 4.5 kW, (6 hp). No load current is under 100 amps at 24 volts and a load current rating of under 420 amps. Lock torque is above 8 kgf m (58 lbf ft) and the lock torque current is less than 1100 amps.

11 Output is through a reduction gear located within the centre bracket.

12 Engagement of the drive pinion is by a solenoid switch, mounted on the nose housing, acting through a pivoted relay lever. Indexing of the pinion with the flywheel ring gear is automatically controlled by helical splines formed on the output shaft and a reduced voltage supplied through the pull-in windings within the operating solenoid. Full operating voltage is applied across the heavy duty solenoid contacts upon the pinion becoming fully engaged with the flywheel ring gear.

13 The drive pinion assembly features a high speed overrun roller clutch to prevent over speeding of the armature.

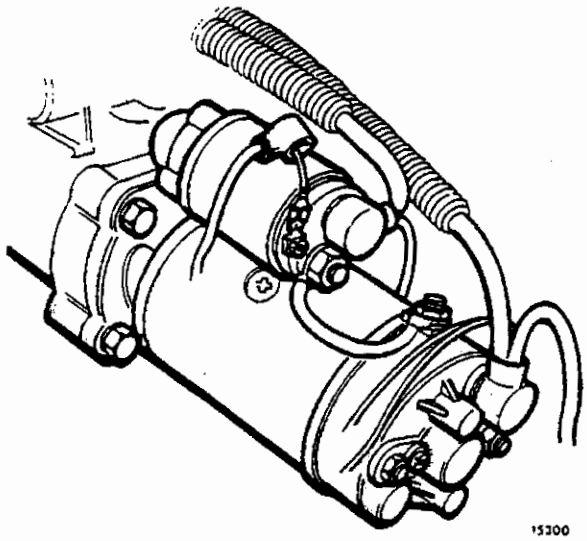


Fig 3 Starter motor

Starter solenoid relay

14 The starter solenoid is energised via a remote chassis mounted relay in order to reduce the current present at the master/start key switch.

Master/start key switch

15 Situated on the right-hand side of the steering column, the three-position master/start key switch controls the auxiliary and starter circuits.

15.1 '0' position - Ignition and auxiliary circuits off.

15.2 '1' position - Auxiliary circuits energised; heater fan, windscreen wiper and wash pump may be operated.

15.3 '2' position - Ignition circuit energised; appropriate warning lights, gauges and instruments will register and the warning buzzer will sound. All electrical circuits will be operational.

15.4 '3' position - Operates the starter motor circuit. The key should return to the '2' position when released.

Direction indicator/headlight/horn switch

16 These are grouped in a single lever switch to the left of the steering column. Moving the lever clockwise activates the right-hand indicators and anticlockwise activates the left-hand indicators; a green warning light on the instrument panel will flash in unison until the lever returns to the central position. Depressing the lever activates the headlight main beam circuit; a blue warning light on the instrument panel will illuminate. Raise the lever to 'flash' the headlights. Depressing the button in the end of the lever activates the horn.

Windscreen wiper and washer switch

17 This switch group is located on the right of the steering column. Move the lever clockwise and release to obtain a single wipe action. Moving the lever anti-clockwise to the first position will give a normal speed continuous wiper operation. Further movement to the second position gives fast wipe operation. Depressing the end of the lever activates the windscreen washer pump.

Master lighting switch

18 Located to the right of the instrument panel, this six position rotary, pull-push switch controls the vehicle exterior lighting in both the 'normal' and 'blackout' mode.

19 In the normal mode, anti-clockwise rotation of the switch to the first position will illuminate the side and rear lights; the headlights will also illuminate in the 'dim' mode when the ignition circuit is energised and the engine is running. Rotation of the switch to the second position will fully illuminate the headlights.

NOTE

The dim-dip lighting system is not a substitute for normal headlight operation; this facility should be regarded as conventional side light operation.

20 To operate in the blackout mode, pull and rotate the switch clockwise to the 'OFF' position. All exterior lights, warning lights and panel lights will be extinguished. With the warning lights disabled, the buzzer will sound in the event of a malfunction of the engine cooling, oil pressure, air pressure, cab lock-down or when the differential lock is engaged.

21 Rotation of the switch to the second position will illuminate the convoy light. Further rotation of the switch to the third position will illuminate the convoy and sidelights.

Infra-red light switch

22 Situated on the left of the instrument panel this switch, when rotated to the 'INFRA-RED' position disables the warning lights, panel lights and all exterior lighting except for the headlights. With the warning lights extinguished, the buzzer will be activated should a malfunction occur with the engine cooling, oil pressure, air pressure and cab lock-down systems or when the differential lock is engaged.

Switches - instrument panel

23 The panel light, warning light test and fuel heater switches are located to the right of the instrument panel below the lighting switch. On the left, below the infra-red switch are the rear fog and hazard light switches.

24 When the warning light test switch is depressed the cab lock-down, temperature, oil pressure, independent-trailer brake and air pressure warning lights will illuminate and the buzzer will sound. The lights will extinguish and the buzzer will cease upon releasing the switch.

Instrument panel

25 The instrument panel consists of an integrated printed circuit board having multi-point edge connectors serving all major circuits. In order to maintain the integrity of the board, diodes are included in the warning light, relay and lighting circuits.

26 Instrumentation includes a centrally mounted speedometer, to the left an engine tachometer, fuel and temperature gauges and to the right, air and oil pressure gauges. All instruments, except the speedometer, are mounted directly on the printed circuit board.

27 Warning lights are arranged on either side of the speedometer. The lights are colour coded according to the level of importance; Red - warning, Amber - caution, Blue or Green - unit operating.

Fuses

28 The fuses, 18 in total, are contained within three compartments situated on the lower edge of the instrument panel. The blade type fuses are colour coded according to their value. Tan - 5 amp, Red - 10 amp, Blue - 15 amp and Yellow - 20 amp.

WARNING

TO AVOID OVERLOADING OF ANY CIRCUIT AND THE POSSIBILITY OF FIRE, DO NOT USE A FUSE THAT EXCEEDS THE RECOMMENDED VALUE. REPEATED FAILURE OF THE SAME FUSE INDICATES A CIRCUIT FAULT WHICH MUST BE INVESTIGATED AND RECTIFIED.

Centre console

29 The heater motor, trailer reset, earth leakage test and remote battery isolation switch are located on the centre console.

30 The trailer circuit reset switch is a thermal circuit breaker and, unlike a fuse, may be reset by depressing and releasing.

WARNING

IF THE RESET SWITCH 'TRIPS' A SHORT CIRCUIT OR OVERLOAD CONDITION EXISTS AND MUST BE INVESTIGATED AND CORRECTED BEFORE RESETTING THE SWITCH. ATTEMPTING TO OVERRIDE THE SWITCH COULD LEAD TO SERIOUS DAMAGE OR FIRE OCCURRING.

Vehicle lighting

31 Front lighting groups consist of headlights with integral side lights together with direction indicator lamps, headlights are the pre-focus type with a renewable double filament quartz halogen ampoule. A dim/dip facility operates whenever the side lights are lit with the engine running. Front direction indicator lamps are environmentally sealed units with access to the bulb through the removable lens.

32 Rear lighting units are rubber encased clusters which include tail/number plate, indicator, brake, reversing and fog lights. The multi-prism lens unit hinges upwards for access to the bulb holders.

33 A shielded convoy light is mounted on the inner face of the rear chassis cross member.

Trailer connections

34 A twelve-pin socket is mounted adjacent to the rear towing hook to provide power for the trailer direction indicators, brake, tail, fog and convoy lights together with an auxiliary 24 volt supply. An additional two-pin socket is provided for the trailer park brake warning light.

Printed circuit board-9 way

1 = Chassis RH (Brown)
2 = Chassis LH (Red)
3 = Chassis LH (Orange)
4 = Cab plug 4 (Yellow)
5 = Key switch (Green)
6 = Chassis RH (Blue)
7 = Cab plug 7 (Violet)
8 = Chassis LH (Grey)
9 = Cab plug 9 (Black)
10 = Column sw. (Natural)

Printed circuit board-edge connector

1 = Master lighting switch
2 = RH side rocker switches
3 = Infra-red switch
4 = Spare switch connections
5 = LH side rocker switches

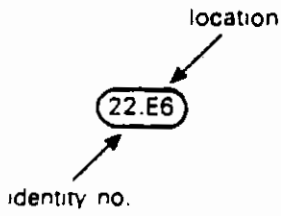
Component connector

A = Headlamp LH
B = Headlamp RH
C = Column switch (wiper motor)
D = Front DI LH
E = Front DI RH
F = Flank DI LH
G = Flank DI RH
H = W/L test switch
I = Panel illumination switch
J = Hazard switch
K = Convoy light
L = Dim-dip resistor
M = Rear light LH
N = Rear light RH
O = Oil pressure switch
P = Pos/neg test switch
R = Rear fog switch
S = Speedometer
T = Winch engaged switch
U = Winch overload switch
V = Heater motor
W = Wiper motor

Chassis interface connector

1 = Chassis LH No. 1
2 = Chassis LH No. 2
3 = Chassis LH No. 3

Circuit tracing code



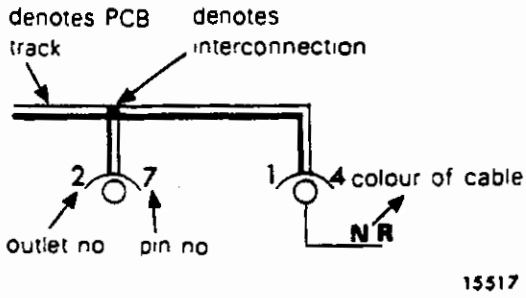


Fig 4 Wiring diagram connector codes

KEY TO FIG 5

1	Batteries	1B	45	Fuse - 5 amp	1H
2	Battery isolator switch	1C	46	Horn switch	1H
3	Inter-vehicle socket	1C	47	Horn	2H
4	Remote isolation switch	3C	48	Speedometer	2J
5	Starter motor	1D	49	Pulse generator	3J
6	Alternator	2D	50	Fuse - 5 amp	1J
7	Ignition switch	1E	51	Fuel gauge	IK
8	Starter relay	2E	52	Temperature gauge	1K
9	Air dryer	2E	53	Fuel transducer	3J
10	Fuse - 10 amp	1F	54	Temperature transducer	3K
11	Fuse - 15 amp	1F	55	Rev. counter	1K
12	Heater switch	2F	56	Air '3' gauge	1L
13	Heater motor	3F	57	Oil pressure gauge	1L
14	Wiper switch	2G	58	Air '3' transducer	2L
15	Wiper motor	3G	59	Oil pressure transducer	2L
16	Fuse - 15 amp	1H	60	Air '1' and '2' gauges	1M
17	Washer switch	2H	61	Infra-red switch	2M
18	Washer pump	3H	62	Master lighting switch	2P
19	12-pin trailer socket	4B	63	Fuse - 10 amp	4H
20	Trailer electrics circuit breaker	6A	64	Rev. lamp switch	5H
21	2-pin trailer socket	6B	65	Rev. lamps	6H
22	Pos./neg. test switch	4C	66	Fuse - 10 amp	4J
23	Pos./neg. warning lamp	5C	67	Indicator switch	4J
24	Warning lamps	4D	68	Indicator lamps	6J
25	Park brake switches	5D	69	Indicator relay	4K
26	Winch engaged switch	6C	70	Fuse - 5 amp	4L
27	PTO switch	5D	71	Hazard switch	5L
28	Diff. lock switch	6D	72	Fuse - 10 amp	4L
29	Winch overload switch	6D	73	Interior light	5L
30	Air pressure switches	5E	74	Fuse - 10 amp	4M
31	Oil pressure switch	5E	75	Headlight relay	5M
32	Temperature switch	5E	76	Headlights	5M
33	Cab lock-down switch	5E	77	Headlight dip/flash switch	4M
34	Fuse - 5 amp	4F	78	Fuse - 10 amp	5M
35	W/L test switch	5F	79	Fuse - 5 amp	4N
36	Warning buzzer	4F	80	Dim/dip relay	5N
37	Diff. lock ECU	4F	81	Dim/dip resistor	6N
38	Rear fog light switch	4G	82	Fuse - 5 amp	4N
39	Fuse - 20 amp	4G	83	Front sidelights	6N
40	Rear fog lamp relay	4G	84	Panel light switch	4P
41	Stop light switch	4H	85	Fuse - 5 amp	4Q
42	Rear fog lamps	6G	86	Fuse - 5 amp	40
43	Stop lamps	6H	87	Tail lights	6Q
44	Fuse - 15 amp	1H	88	Convoy light	6Q

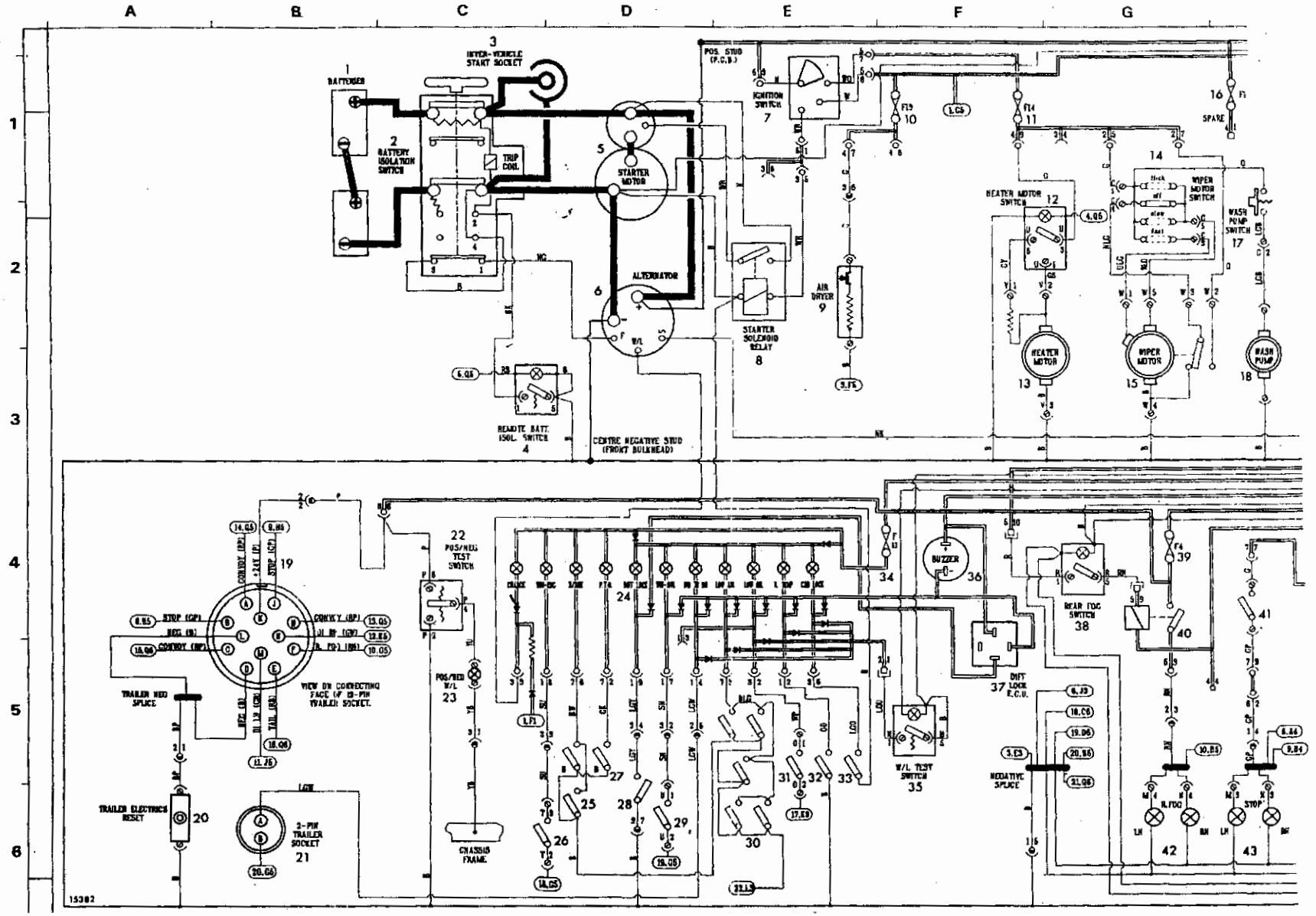


Fig 5 Wiring diagram (sheet 1 of 2)

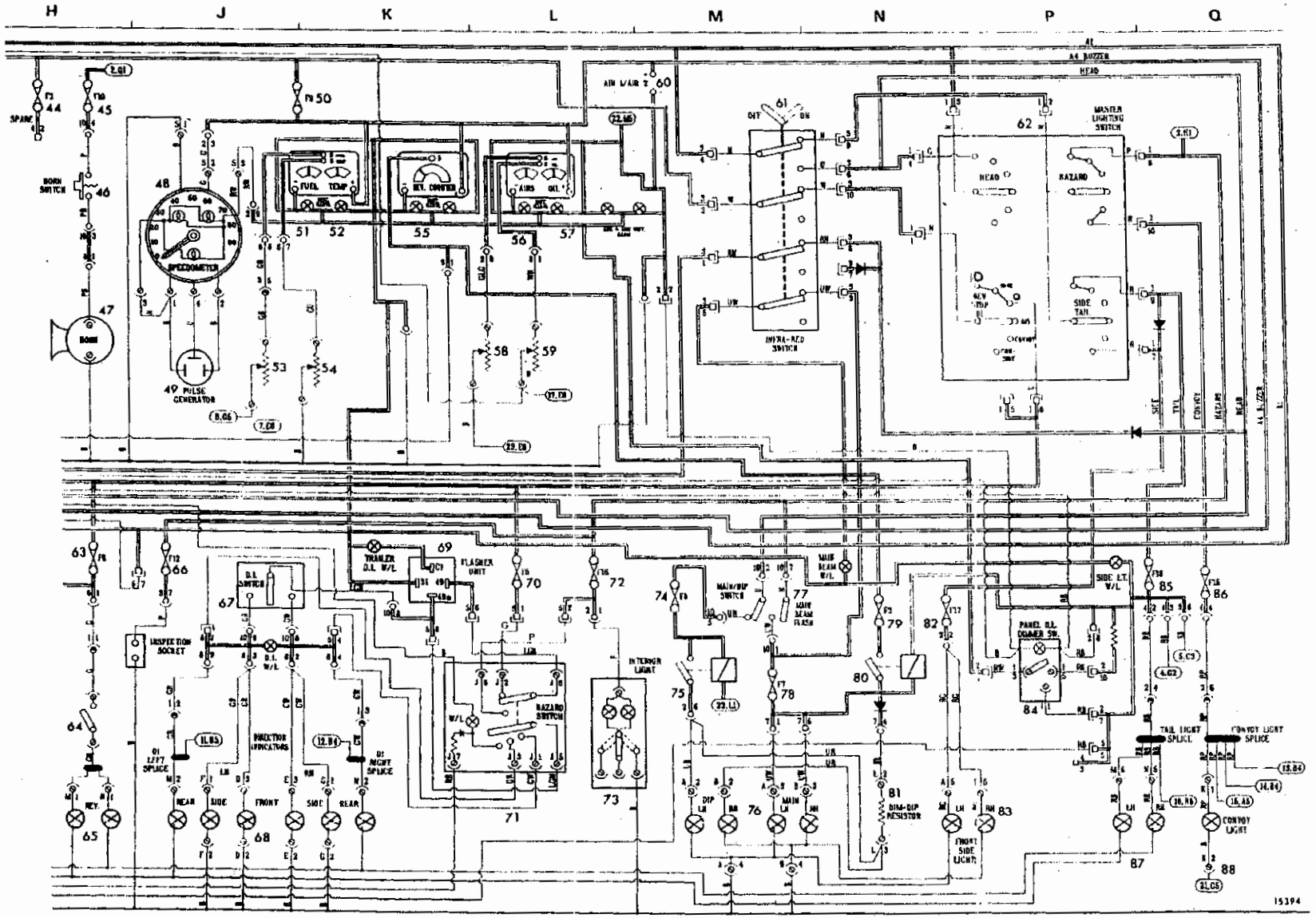


Fig 5 Wiring diagram (sheet 2 of 2)

[redacted]

1 Isolator switch-vehicle
2 Batteries-vehicle
3 [redacted]
4 [redacted]

Fig 6 [redacted]

35 Two battery isolation switches are used, one with a red handle for the vehicle circuits (Fig 6 (1)), [redacted] Both the switches are mounted on the left of the vehicle adjacent to the battery carriers.

36 A remote switch linked to the main isolator is located on the centre console in the cab.

37 Operation of the remote switch or the vehicle switch (1) will cancel all the vehicle circuits [redacted]

38 [redacted]

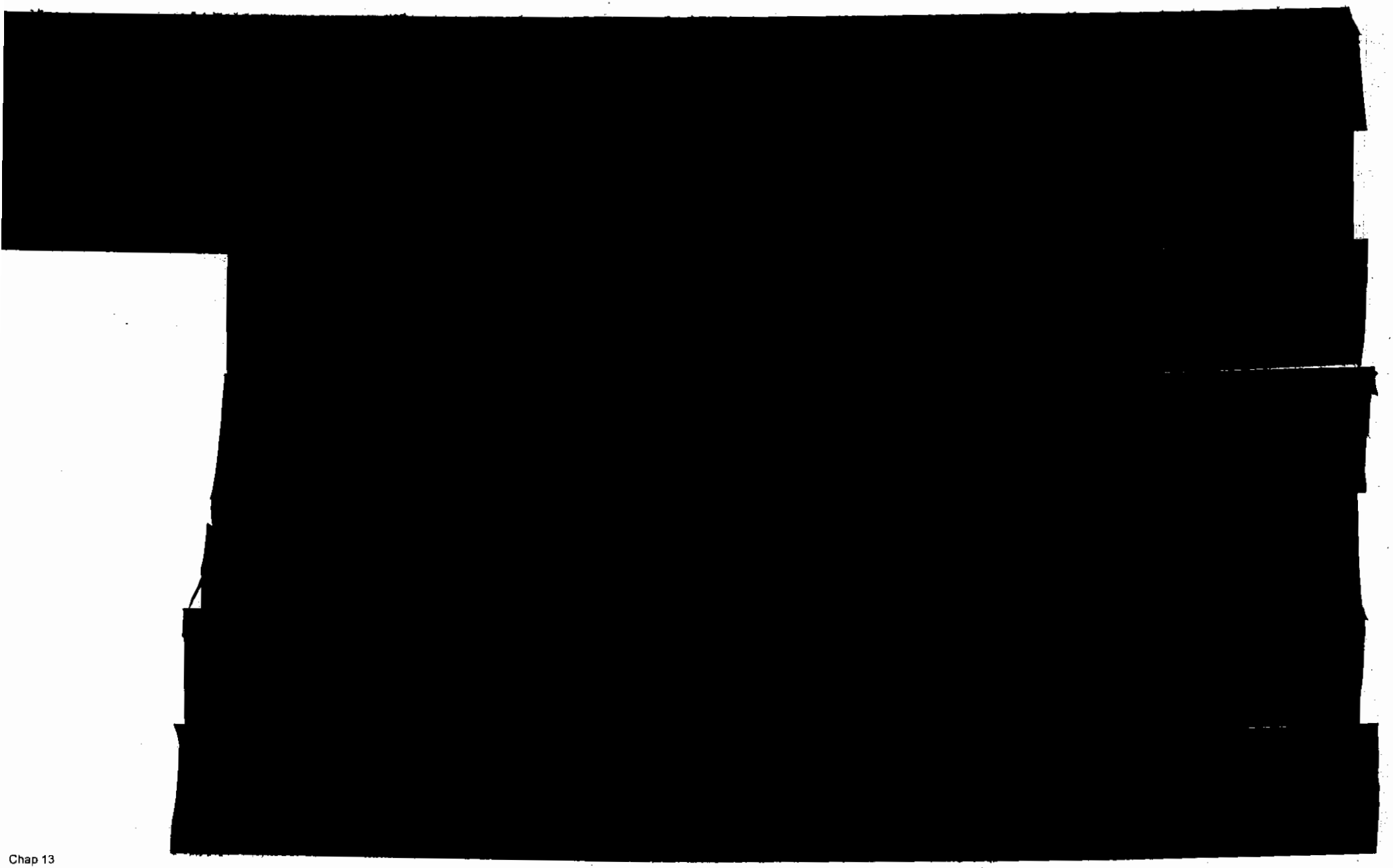
39 The circuits may only be re-energised by operation of the T handle on the isolator switch/switches.

[redacted]

[redacted]

18390

[redacted]



CHAPTER 15

CHASSIS FRAME AND FITTINGS

CONTENTS

CHASSIS FRAME

1 The ladder type chassis frame (Fig 1) is made from high tensile steel. The side-member sections are 257 mm deep with 76.2 mm flanges, 6 mm thick.

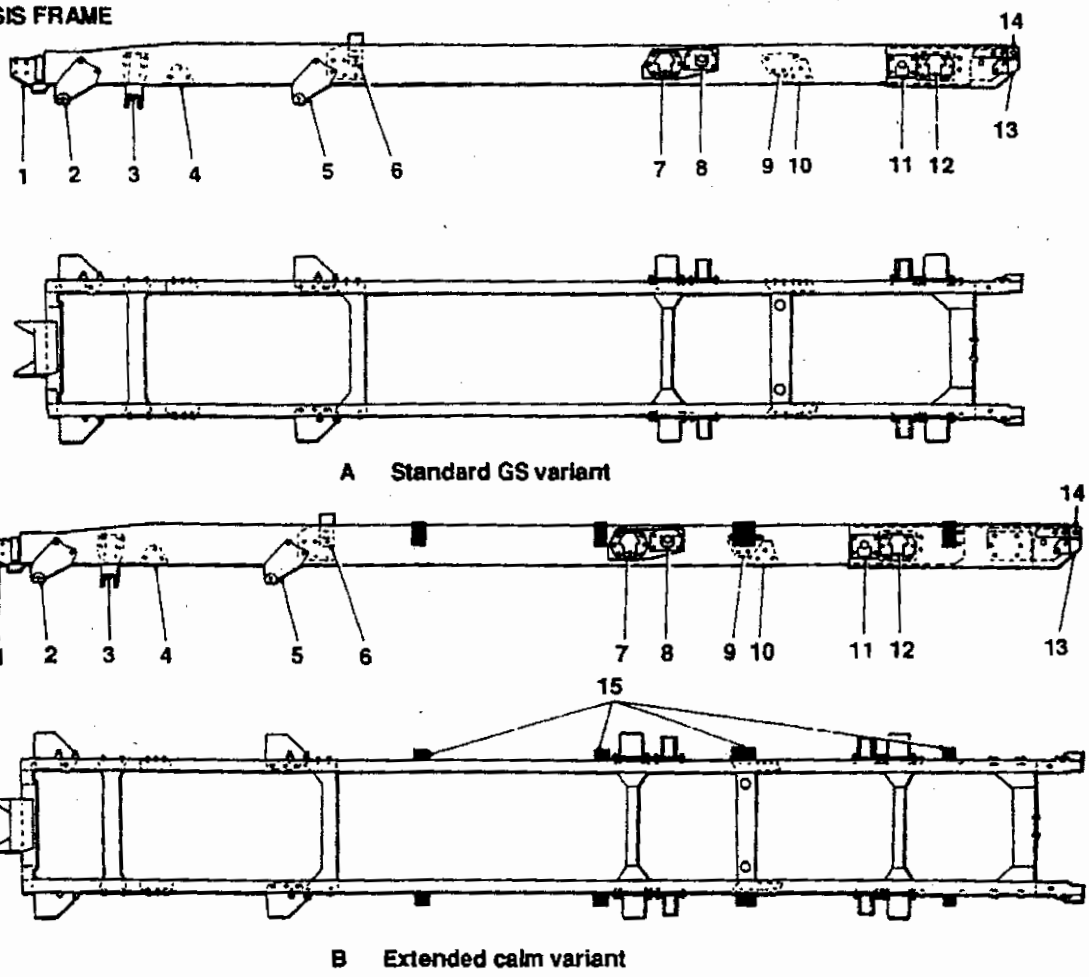
2 The two channel side-members are spaced 844.5 mm apart by fabricated cross-members.

3 A standard chassis frame is used for cargo, winch and Calm variants. Fitting requirements and adaptions to accommodate other variants, have been taken into consideration in the chassis design.

4 The chassis frame and fixings are of all-bolted construction. All nuts and bolts are to metric standard.

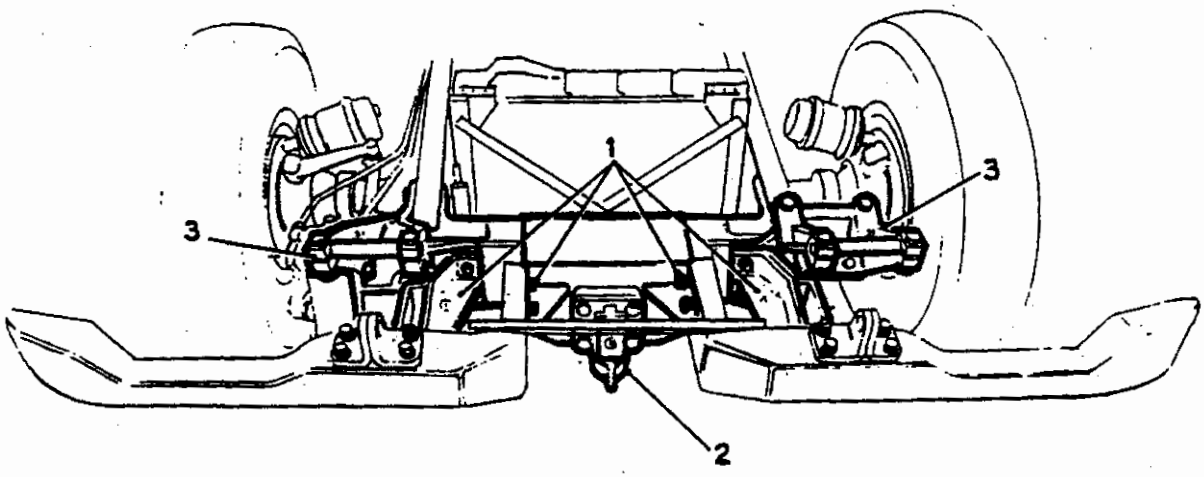
5 High grade flanged bolts are used in the frame assembly. These must not be interchanged with a lower grade fastening.

CHASSIS FRAME



1	Front towing pintle	9	Damper cross-member
2	Front spring front mounting	10	Bump stop bracket
3	Engine cross-member	11	Helper spring bracket
4	Bump stop bracket	12	Rear spring rear mounting
5	Front spring rear mounting	13	Support bracket
6	Gearbox cross-member	14	Towing strap
7	Rear spring front mounting	15	Body mounts
8	Helper spring bracket		

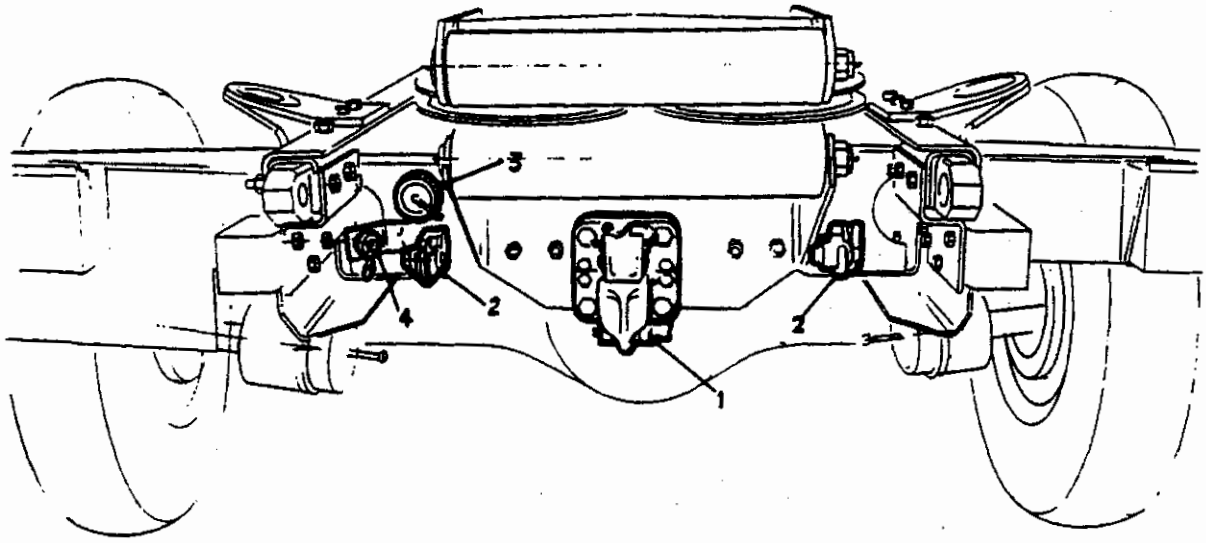
Fig 1 Chassis frame



1 Bumper mounting bracket
2 Towing pintle
3 Cab front mounting bracket

Fig 2 Front cross-member

6 The front cross-member (Fig 2) incorporates the bumper mounting bracket (1), central towing pintle (2) and cab front mounting bracket (3).



1 Towing pintle
2 Palm couplings
3 Trailer socket
4 Trailer brake warning lamp socket

Fig 3 Rear cross-member

7 The rear cross-member (Fig 3) incorporates the rear towing bracket (1), service and emergency brake palm couplings (2), multi-pin trailer socket (3) and independent trailer brake warning lamp socket (4).

FRONT BUMPERS

8 The front bumpers are of pressed steel and welded construction in two parts and secured to the front cross-member bracket with eight bolts each.

9 A cover spanning the bumpers is secured by six bolts. This cover is removed to gain access to the front towing pintle.

10 The emergency palm coupling is mounted on the left bumper. The service palm coupling is mounted on the right bumper when viewed from the driver's position.

TOWING PINTLES

11 The front and rear towing pintles are the same design. The bottom jaw is rigid whilst the moveable top jaw is held in position by a locking pin. The locking pin ensures that the top jaw cannot be released as the towing pintle revolves.

11.1 When a trailer towing eye is connected to the towing hook **the top jaw must be locked in the closed position**. This is achieved by inserting a suitable positive locking pin (see 2320-H-104-711) of the correct dimensions through the drilled hole located through the latch and upper jaw.

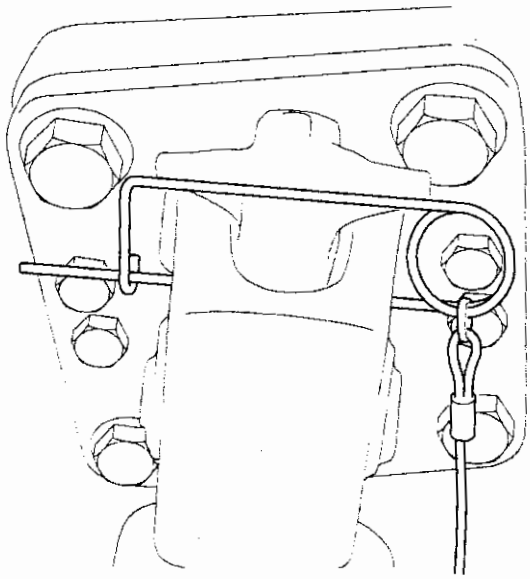
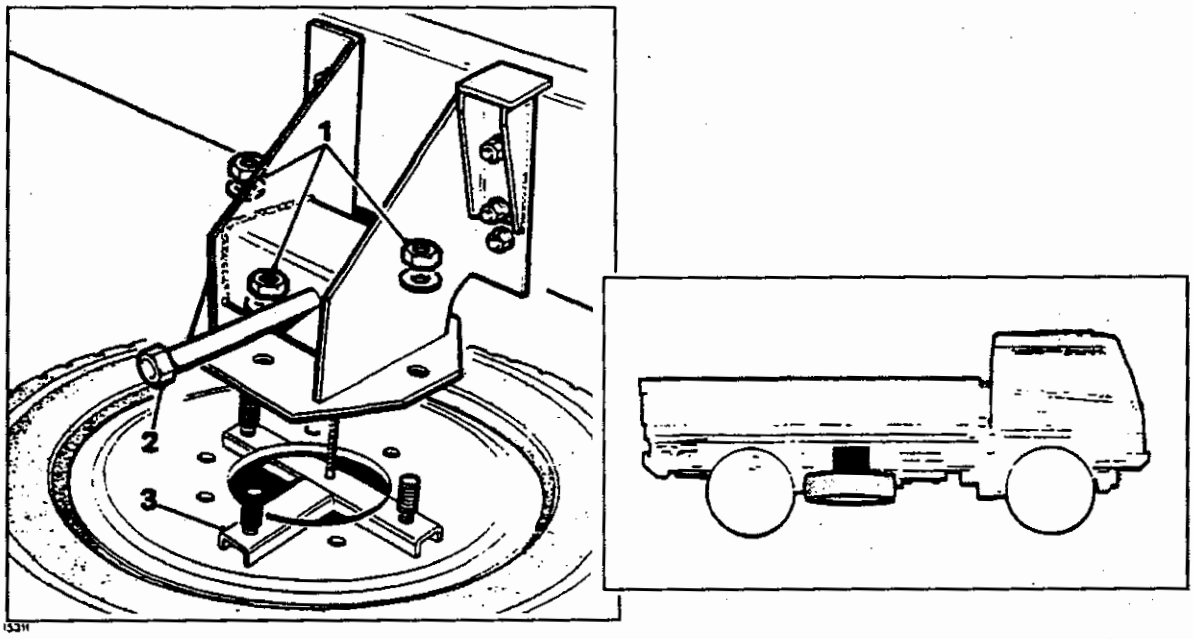


Fig 4 Tow hook locking pin

REAR TRAILER ELECTRICAL SOCKETS

12 One twelve and one two-pin electrical sockets are mounted on the rear cross-member. The twelve-pin socket supplies the trailer with the relevant connections to operate the lighting system.

13 The two-pin socket connects the trailer low pressure warning circuit to the vehicle instrument panel. A lamp will illuminate on the panel if trailer air pressure falls below the minimum requirement. Both sockets are protected by waterproof screw type caps.



1 Securing nuts
2 Shaft
3 Securing plate

Fig 5 Spare wheel carrier

SPARE WHEEL CARRIER

14 The spare wheel carrier (Fig 5) is mounted to the chassis on the right hand side of the vehicle.

15 A winch plate with three studs, which locate in the wheel stud holes in the wheel rim, is attached to the carrier by a cable.

16 The wheel is raised into position by turning the shaft (2) and securing against the carrier with three nuts (1).

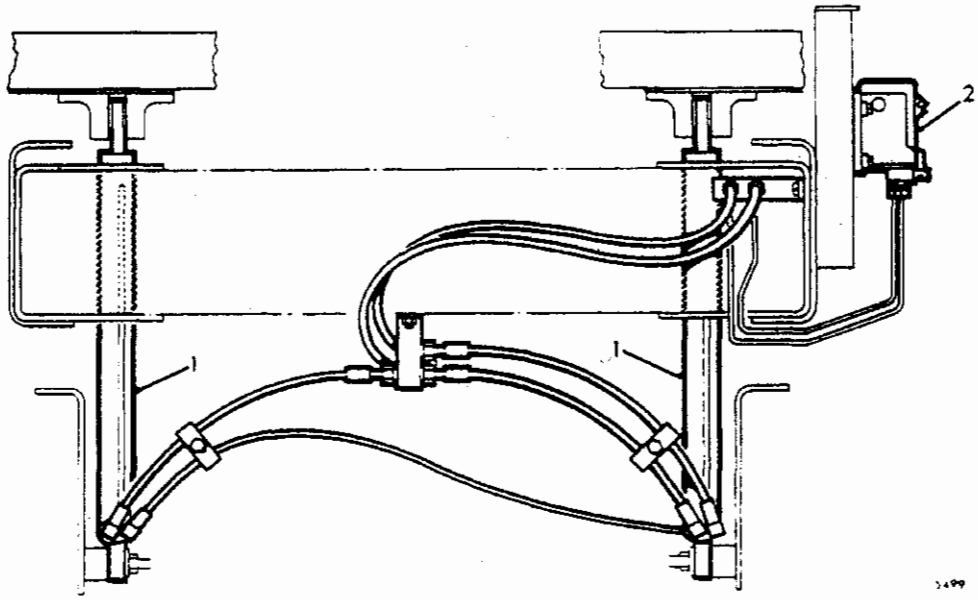
CHAPTER 16

BODY AND CAB FITTINGS

CONTENTS

GENERAL DESCRIPTION

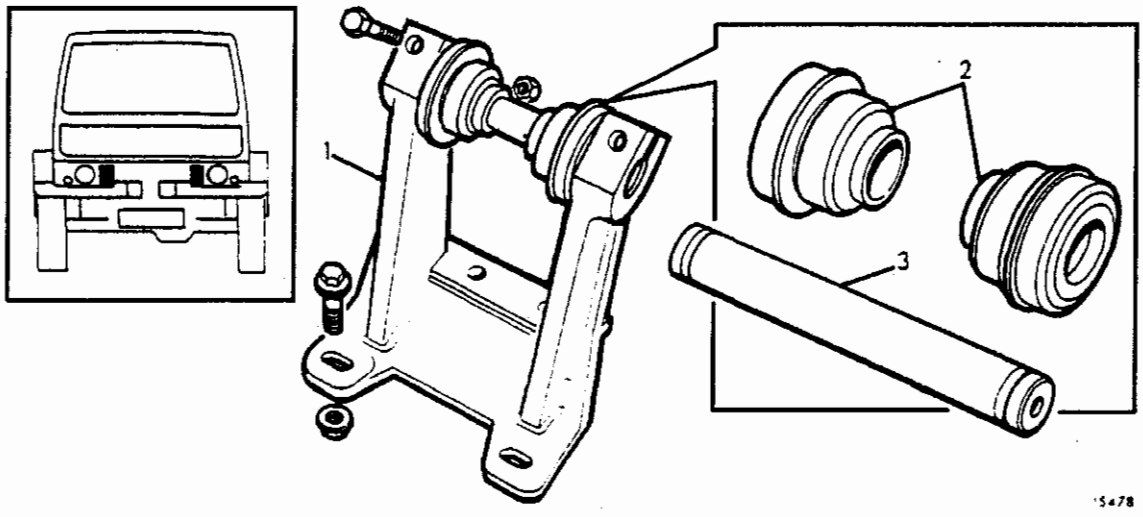
1 The cab tilt system (Fig 1) consists of a hand operated hydraulic pump connected by pipes to double-acting rams. Only the rams retain hydraulic pressure, the pump and pipes do not. This is a function of the ram safety valve, which prevents the cab from falling should the hydraulic fluid pipes be punctured.



1 Double acting ram
2 Hydraulic pump

Fig 1 Hydraulic tilt system

2 The two cab mounting brackets (Fig 2) bolted to the cab and chassis frame, house the cab pivot pins, which pass through rubber bushes housed in the cab mounting bracket.



1 Mounting bracket
2 Mounting rubber
3 Pivot pin

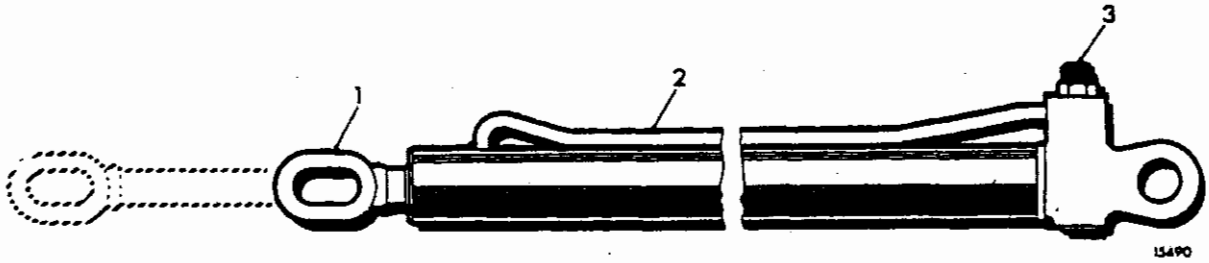
Fig 2 Cab pivot mounting brackets

CAB LOCKING DEVICES

3 The cab is retained in the normal operating position by swivel pins and a spring loaded safety hook.

TILT RAM

4 The cab tilt rams (Fig 3) are double acting type, having 'LOWER' and 'LIFT' port located on the lower end of the ram. Fluid is delivered from the 'LOWER' port to the top of the ram by an external feed pipe (2). A safety valve prevents ram movement unless the cab tilt pump is activated.



1 Plunger piston
2 External feed pipe
3 Lower port

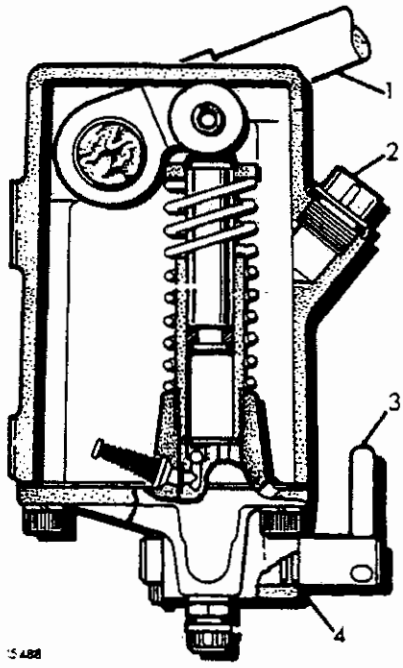
Fig 3 Cab tilt ram

5 The plunger piston (1) is mounted on the plunger and is sealed by a seal assembly.

6 The body of the ram is attached to a shouldered pin protruding from a bracket on each side of the chassis frame and the ram plunger is secured by a swivel pin and split-pin to mounting brackets bolted to underside of cab longitudinal member.

TILT PUMP

7 The cab tilt pump (Fig 4) is mounted on a bracket attached to the left-hand chassis frame sidemember. The pump is connected to the cab tilt rams by hydraulic pipes and is operated by a detachable jack type lever (1). A control lever (3) is provided which enables the valve to be set in the 'LIFT' or 'LOWER' position. The integral fluid reservoir incorporates a filler plug (2) on top of the pump body.



1	Lever	3	Control lever
2	Filler plug	4	O-ring

Fig 4 Cab tilt pump

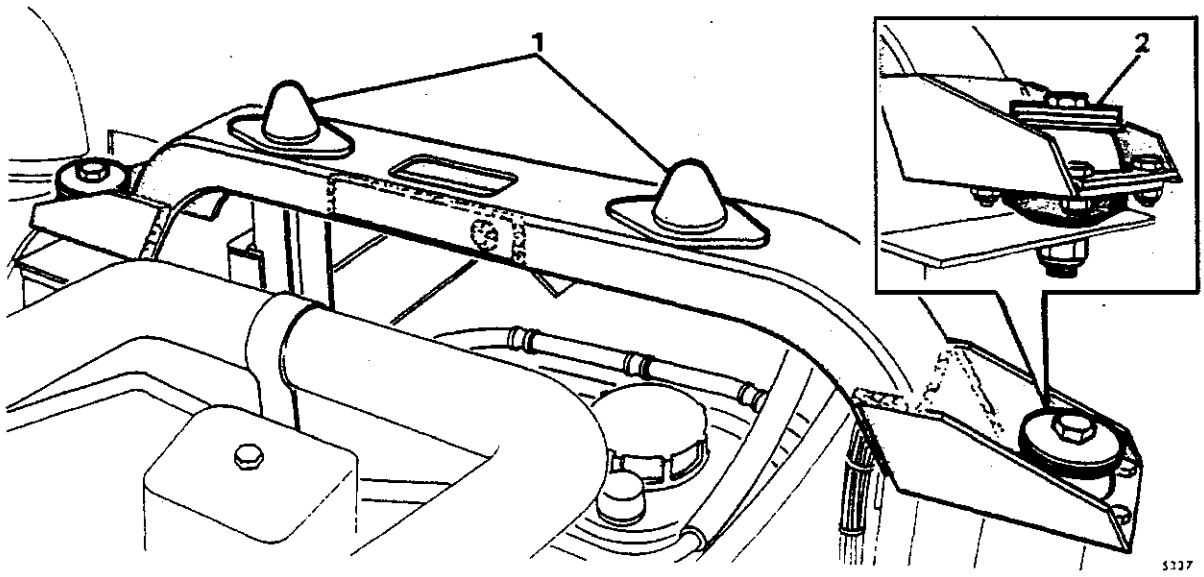
8 The pump plunger operates directly in the pump body and feeds hydraulic fluid under pressure to the 'LOWER' and 'LIFT' ports respectively.

9 The control valve spindle is sealed by an O-ring (4).

10 A roll pin determines the movement of the spindle in the maximum 'LIFT' or 'LOWER' positions.

CAB MOUNTINGS

11 The cab is mounted on two pivot bushes (Fig 2) at the front and two shear-type mountings (Fig 5 (2)) at the rear. Rear mountings and cab locating spigots are bolted to the cab arch frame, which also incorporates the cab support member pin. The cab spigot retaining brackets are bolted to the cab rear panel.



1 Cab location spigot
2 Shear type-mounting

Fig 5 Cab rear mountings

CAB HEATING AND VENTILATION SYSTEM

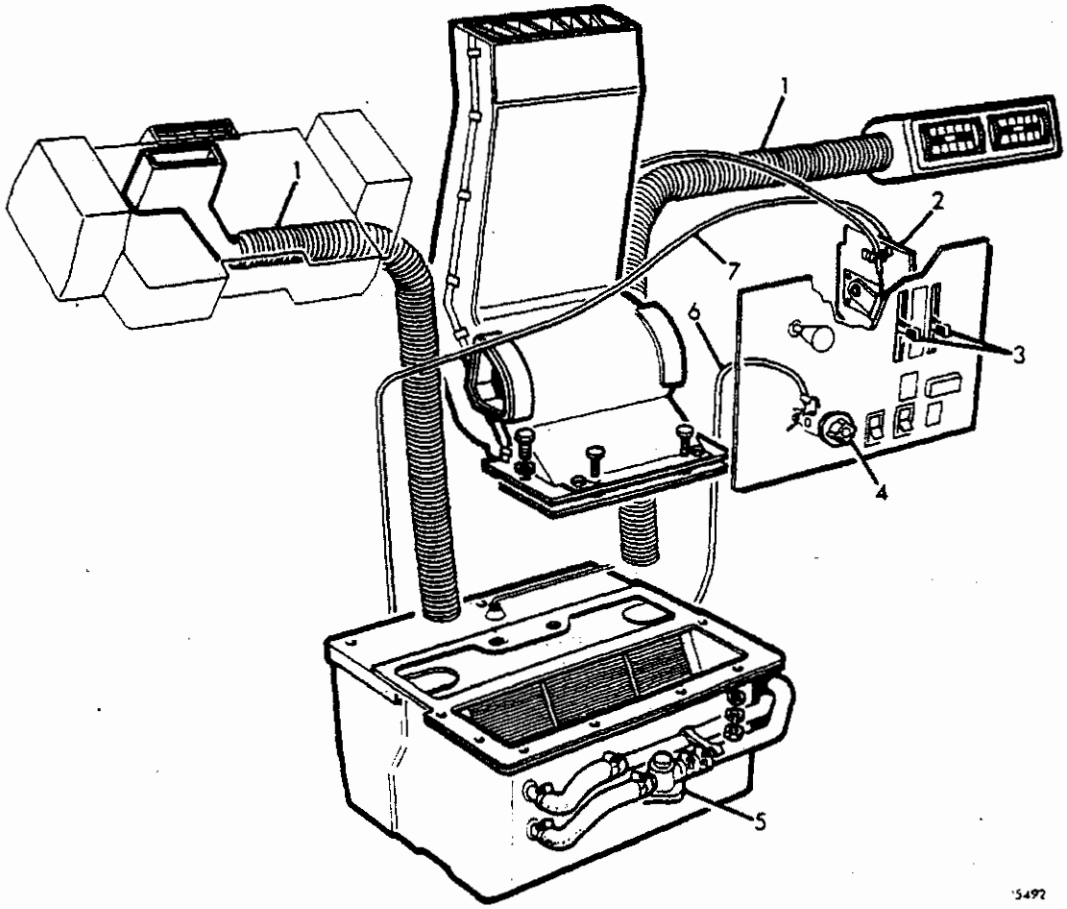
12 Cab heating is provided by a twin speed heater (Fig 6) unit situated in the centre console. The unit comprises of an electric fan, radiator and air flaps. The air intake flap is contained in the radiator casing and the air distribution flap in the distribution box assembly. A thermostatically operated water valve (5) controls the temperature of the engine coolant passing through the heater radiator. The heater and air flap controls are mounted in the centre console.

13 Ventilation of the cab is provided by utilizing the air flaps in the heater unit, and by adjustable louvre vents; two in the trim panel on the mates side and one in the instrument panel at the drivers side, which are supplied from separate ducts under the cab trim panel. Air is also directed onto the windscreen via slots in the lower distribution box assembly.

14 The heater water control valve is a sealed unit and cannot be dismantled or adjusted. It is cable operated from a switch in the centre console and thermostatically operated by a capillary tube attached to the radiator core in the heater unit.

15 The heater is secured by screws to the cab floor.

16 Metal pipes and rubber hoses are used to connect the heater to the engine cooling system. The coolant is fed under pressure from the engine thermostat housing to the heater unit via a water valve, which controls the flow to the heater radiator, before being returned to the engine via the water pump.



1 Convoluted heater tube
2 Heater control mounting bracket
3 Heater controls
4 Heater air intake flap control
5 Water control valve
6 Heater intake flap control cable
7 Heater air distribution control cable

Fig 6 Heater unit and controls

17 Independent fresh air vents are fitted in the fascia and extractor vents are provided in the cab rear quarter panels.

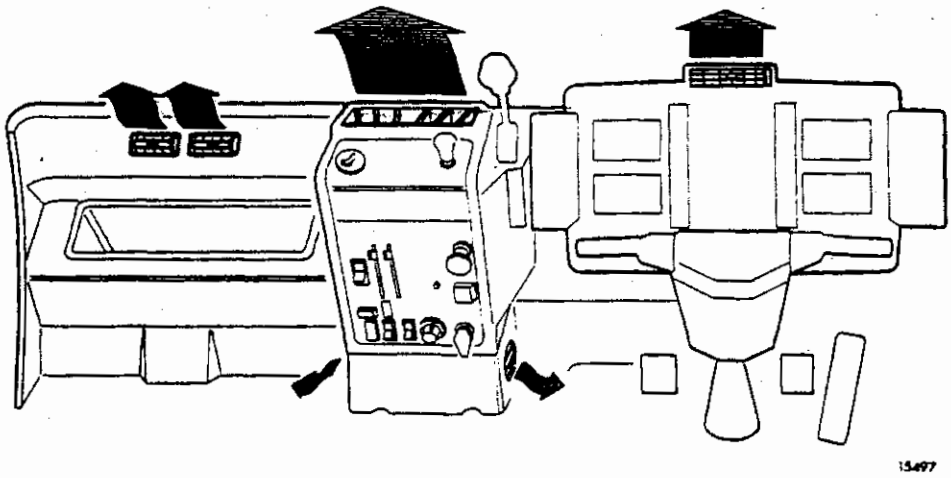


Fig 7 Cab ventilation

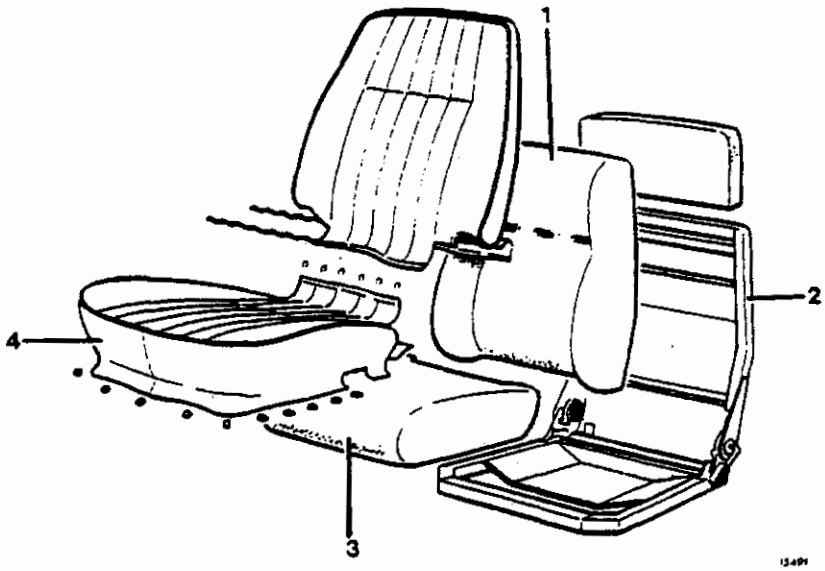
CAB TRIM AND HARDWARE

18 The footwells are covered by black rubber matting shaped to fit the floor panel contour.

19 Drivers and passenger seats are identical but only the driver's seat has full adjustment. The third mates seat is not adjustable.

20 The seat comprises of a frame assembly, foam padding and covers. The rake of the squab can be varied by means of an adjusting lever positioned on the outer side of the seat.

21 The drivers seat is attached to an adjuster frame which provides both height of front and rear of seat and fore and aft adjustment. The adjuster frame is mounted on a tubular seat support.



1	Foam padding	3	Foam padding
2	Frame assembly	4	Covers

Fig 8 Seat assembly

CAB ASSEMBLY AND PANELS

22 The cab is of all-steel welded construction incorporating a box section subframe and is so arranged that the centre section is raised to form a compartment for the engine and radiator.

23 Infra red reflectant paint is used for both exterior and interior panel protection.

24 Observation hatches are provided on all variants and a fibreglass cover with waterproof seal is held in position by three toggle clips. A cover stowage bracket is located on the cab back panel.

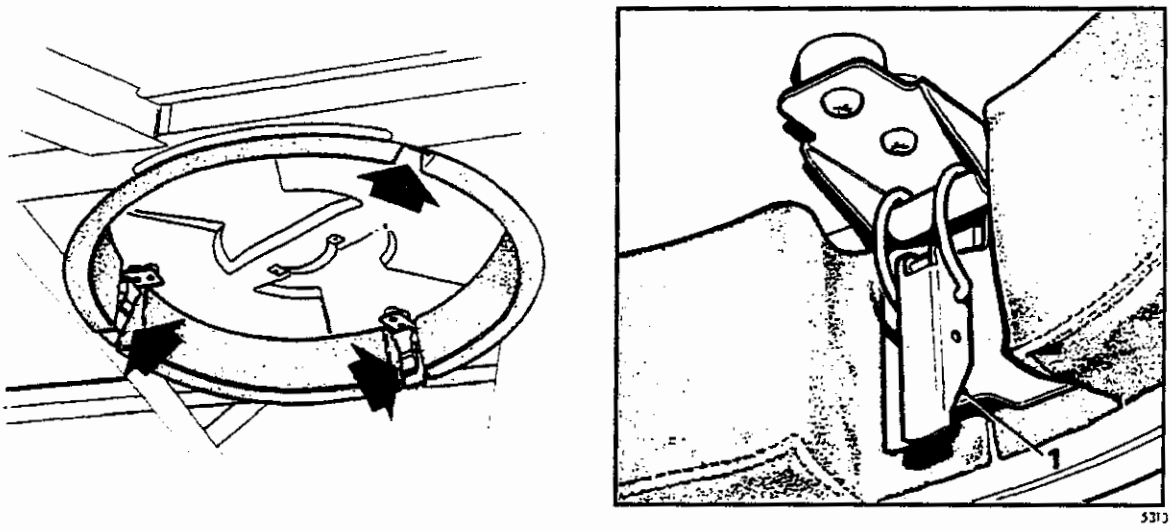
25 Two fire extinguishers are provided, one in the cab, the other on the cab outer back panel positioned behind the driver's door. Grab handles are installed on both vertical door pillars to assist cab entry.

26 A laminated windscreen is secured to cab front panel by a locking strip glazing channel and sun visors are installed to cab inner roof rail which can also be turned to cover door window.

27 The doors, consisting of inner and outer panels, are supported by two internal hinges attached to the cab front pillars.

28 Cab front wings consist of forward and rear panels. The forward wing supports also form cab entry steps.

29 A hinged front access panel is secured by quick release fasteners and incorporates a hold-open stay rod.

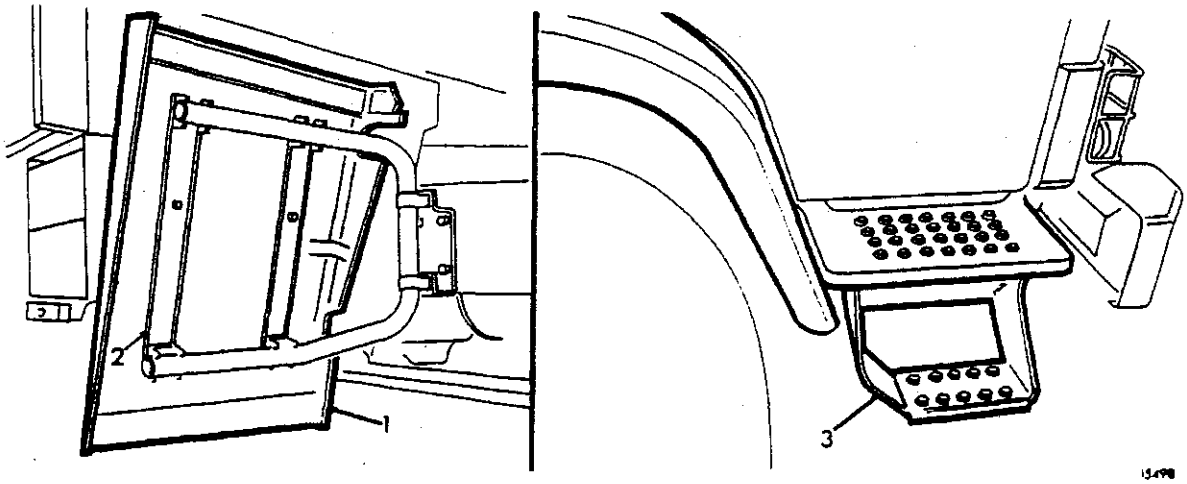


1 Toggle clip

Fig 9 Observation hatch

FRONT WING

30 The forward part of the wing incorporates the cab steps (Fig 10 (3)) and is bolted to the cab underbody. The aft part of the wing (1) is manufactured in rubber and is bolted to steel stiffening brackets (2) mounted on a tubular frame. The outside of the wing is bolted to a support frame, the assembly is bolted to the chassis frame.



1 Rubber mudguard
2 Stiffening bracket
3 Cab step

Fig 10 Front wing

REAR WING

31 The rear wings are all steel construction and are bolted to support stays, the stays are bolted to the chassis frame. The aft portion of the rear wing incorporates a storage pannier.

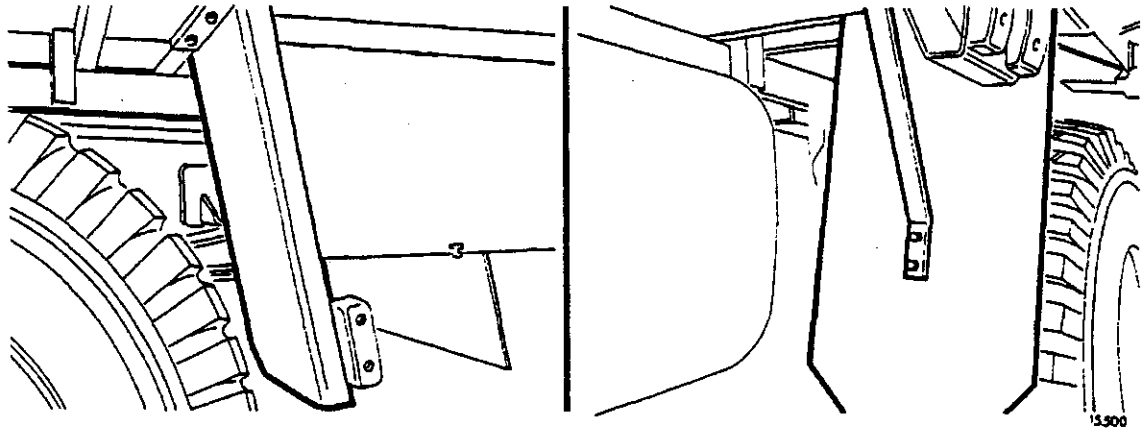


Fig 11 Rear wing

FRONT ACCESS PANEL

32 The front access panel pivots on four flap-type hinges bolted to the front of the cab. Four quick release fasteners secure the panel in the locked position. A stay rod is incorporated inside the cab panel.

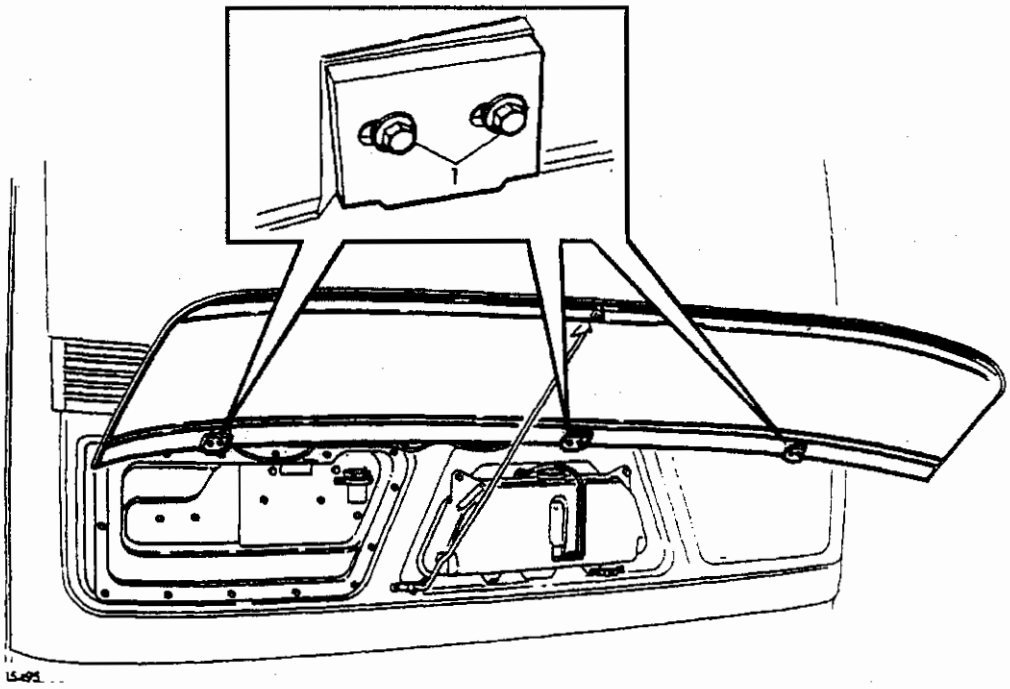
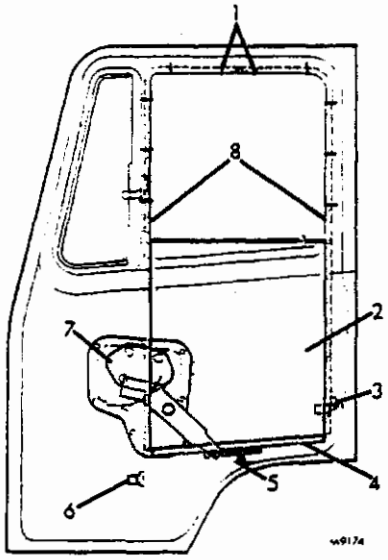


Fig 12 Front access panel

CAB DOOR ASSEMBLY

33 The cab door is of all steel construction, consisting of inner and outer panels and supported by two internal hinges attached to the front pillar.

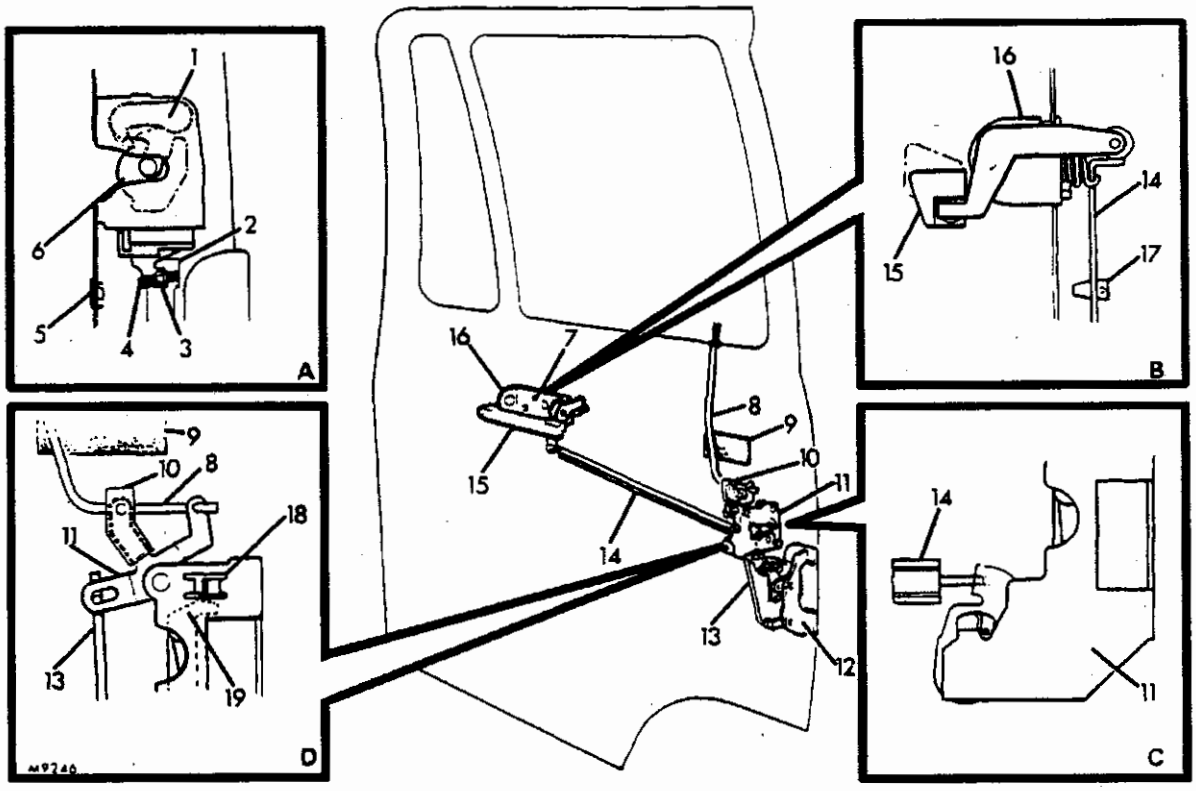


1 Drop glass channel screws
2 Drop glass
3 Rear channel securing screw
4 Regulator channel
5 Drop glass buffer stop
6 Front channel securing screw
7 Regulator mechanism
8 Glass channel guide

Fig 13 Cab door assembly

34 The door seal is a sponge rubber weather strip moulded to suit the contour of the door and is secured by adhesive to the inner section of the door. An opening quarter window is secured by upper and lower pivot pegs, retaining clips and a rubber glazing channel. The door window is mounted in the regulator channels in the stationary frame. Lower horizontal weatherstrips are secured to upper edges of door inner panel.

35 The door window is controlled by a regulator which is operated by an internal handle, a rubber buffer-stop is fixed, to the bottom of the door, to cushion the window glass in the lowest position. A door pull handle is bolted to the inner panel.



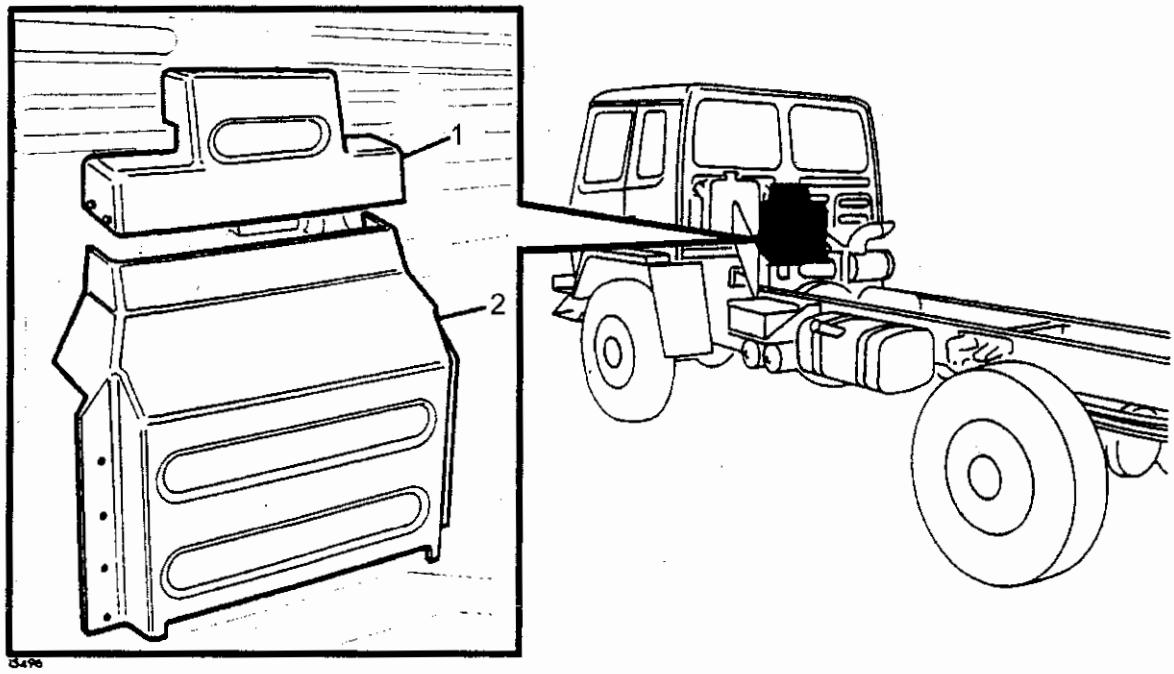
1	Latch hook lever	11	Latch assembly
2	Operating lever face	12	Exterior door handle
3	Locknut	13	Exterior release link lock
4	Adjusting screw	14	Interior release link lock
5	Latch adjuster grommet	15	Interior door handle
6	Fork bolt	16	Interior door handle assembly
7	Setscrew	17	Anti-rattle bush
8	Sill button link	18	Hook bolt
9	Snubbing block	19	Intermittent lever
10	Snubbing tube		

Fig 14 Cab door lock

36 The door lock (Fig 14) is of the fork-bolt type, mounted inside the door. The fork lock engages a striker secured into a captive plate inside the cab lock pillar. The lock is connected by rods to the sill button link, interior door handle assembly and exterior door handle. Each handle incorporates a key lock barrel. The lock can be operated by the sill button, or the outer handle key.

37 Two adjustable mirrors are fitted to a support frame bolted to the door outer panel.

38 Firescreening is installed at the rear of the cab. The upper panel is secured to the cab rear panel. The lower panel is mounted to a support frame bolted to the cab rear arch member.



1 Upper panel
2 Lower panel

Fig 15 Firescreen

CHAPTER 17

WINCH

CONTENTS

GENERAL DESCRIPTION

WARNINGS

(1) ENSURE THAT PROTECTIVE GLOVES ARE WORN WHEN HANDLING THE WIRE ROPE AND THAT HANDS ARE KEPT AWAY FROM THE ROPE DRUM AND FAIRLEAD ROLLERS WHEN OPERATING UNDER HYDRAULIC POWER.

(2) ENSURE THAT ALL PERSONNEL ARE CLEAR OF THE WINCHING AREA WHILST THE ROPE IS UNDER TENSION.

1 The winch is an hydraulically driven unit which may be fitted as an option to any one of the Truck, 4 Tonne 4 x 4, GS, LEYLAND DAF variants. The winch is mounted in the middle of the vehicle, with fairleads and a rope tensioning device.

2 The winch unit is hydraulically operated. The hydraulic power is supplied by a Power Take-Off (PTO) driven pump to an hydraulic motor.

3 A selector lever is incorporated to enable the drive to be disengaged for free spooling of the cable and to turn the drum for oil level check and refilling. A fairlead is provided to ensure that winching may be carried out smoothly at an angle, although angular pulls should be kept to a minimum to prevent build up of rope layers at one end of the drum.

WINCH HYDRAULIC SYSTEM

4 The winch hydraulic system comprises the following components linked by flexible hydraulic hoses:

4.1 Hydraulic fluid reservoir incorporating a dipstick and a return filter.

4.2 Hydraulic pump.

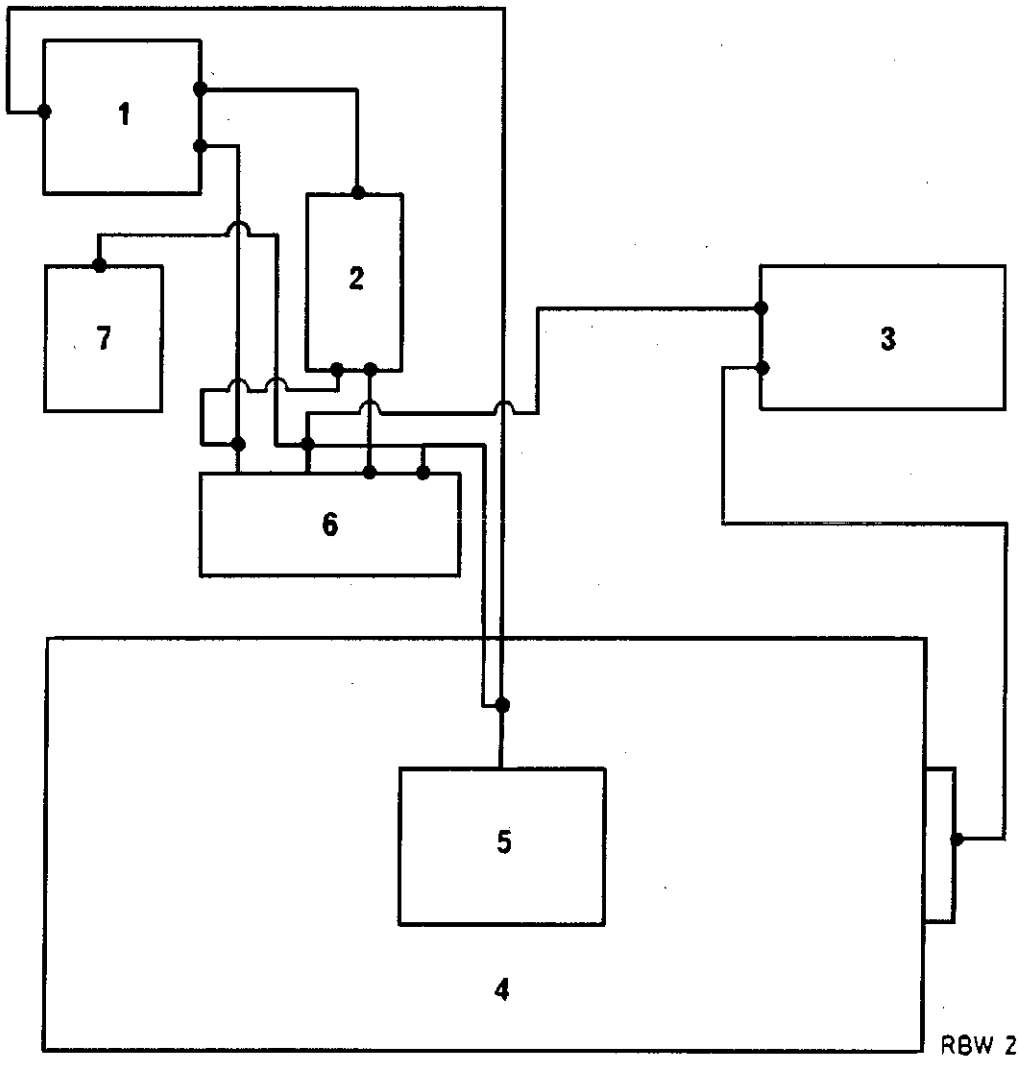
4.3 Directional control valve.

4.4 Overcentre valve.

4.5 Winch motor.

4.6 Motor brake.

5 A hydraulic circuit diagram is provided in Fig 1. When the PTO is engaged to drive the pump, oil from the reservoir is drawn up by the pump. When the directional control valve is then moved from the central position, the oil flow will then power the winch motor and release the motor brake. The control valve incorporates a pressure relief valve to divert the oil flow away from the motor under overload condition. The return oil flow from the motor and the controls passes through the oil filter incorporated in the oil reservoir.



1	Winch motor	5	Return filter
2	Overcentre valve	6	Directional control valve
3	Pump	7	Winch motor brake
4	Hydraulic fluid reservoir		

Fig 1 Hydraulic circuit diagram

Hydraulic oil reservoir

6 The hydraulic oil reservoir is a welded assembly, mounted outside the left hand side chassis sidemember.

7 A filler and a dipstick are fitted to the oil reservoir.

8 The oil reservoir has a capacity of 100 litres and must be filled to the level indicated on the dipstick with the oil as specified in the maintenance schedule. The system may be drained by removing the magnetic drain plug from the bottom of the reservoir.

Return filter

9 The return oil filter fitted in the hydraulic oil reservoir filters the oil before returning it to the reservoir. The element is a renewable paper element which must be renewed at the intervals stated in the servicing schedule.

Overcentre valve

10 The overcentre valve prevents the load running away and eliminates the continuous chatter of the motor brake as hydraulic pressure varies.

Directional control valve

11 The directional control valve is an air/hydraulic monoblock spool valve. The valve can be operated by an air valve or by a lever on the top of the valve.

Hydraulic pump

12 The PE33O hydraulic pump is a gear pump. Cast bronze thrust plates are pressure loaded and are designed to provide minimum clearance at the end of the gear for outstanding efficiency.

13 The housing is made from cast iron for durability and strength.

14 The maximum flow rate of the pump is 43.7 litre/min at 3000 lbf/in.^{2} and 100 rev/min.

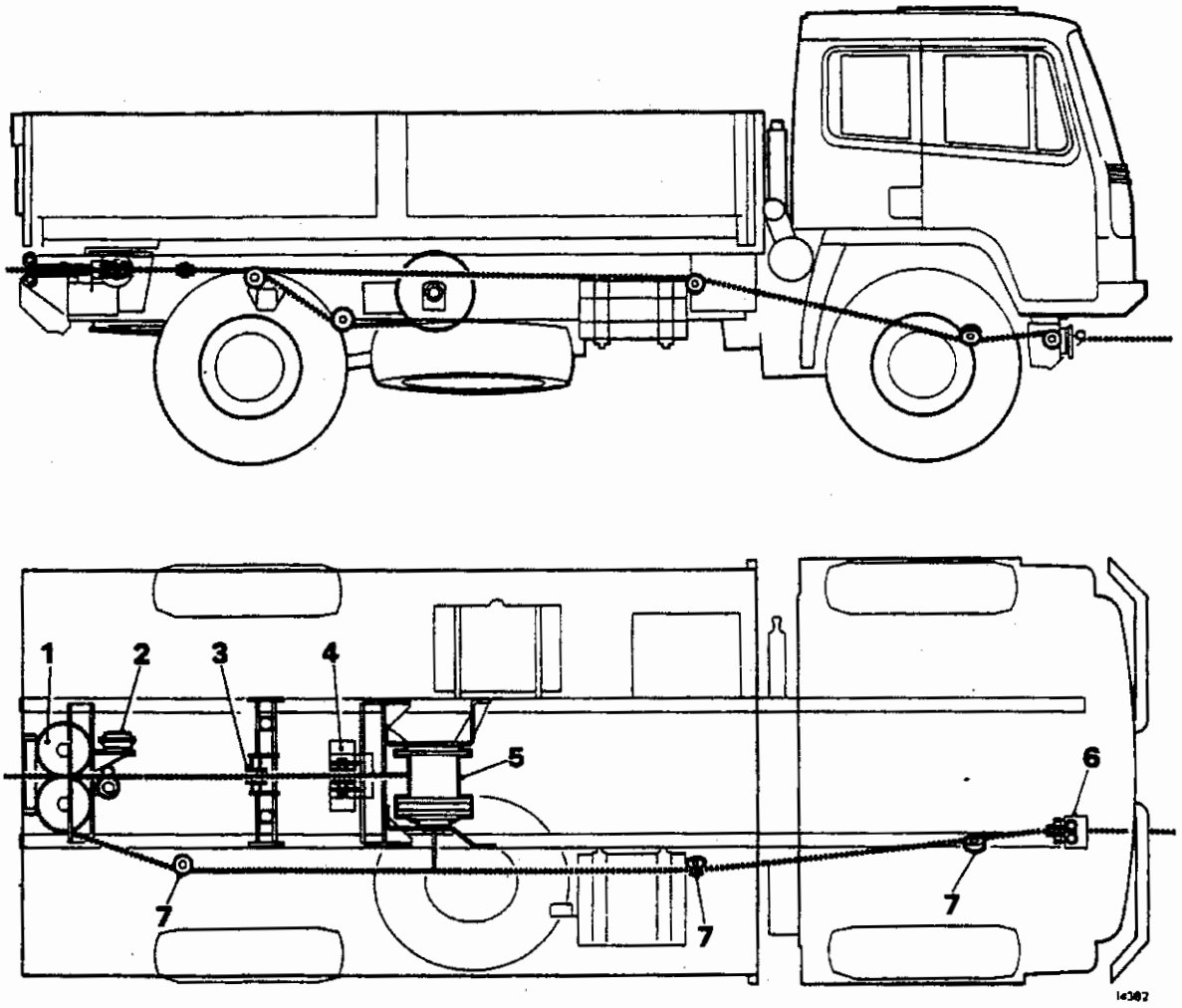
WINCHING

15 The winch can be used for front or rear winching.

16 For rear winching the rope is passed from the winch to the auto spooling device and then via a guide pulley to the rear fairlead assembly.

17 A rope tensioner is fitted to enable the rope to be wound on the drum if no load is attached.

18 For front winching the rope path is as for rear winching and is then passed over pulleys to the front fairleads.

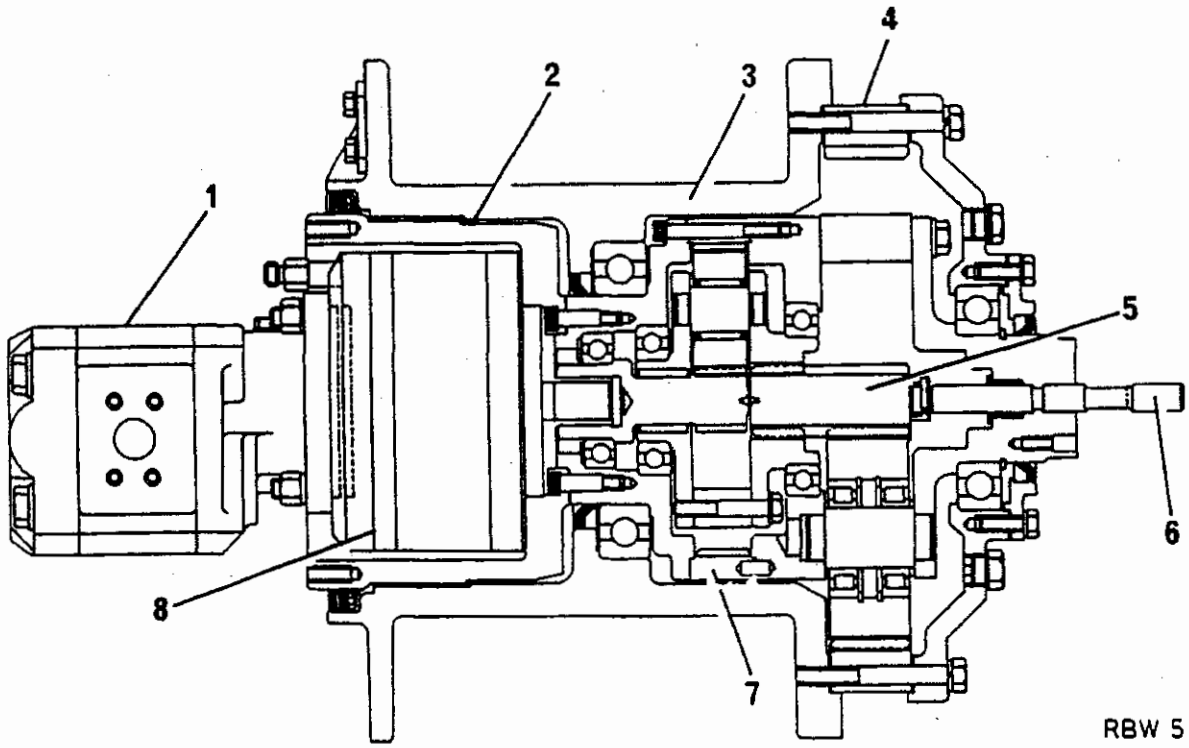


1	Rear fairlead assembly	5	Winch drum
2	Rope tensioner	6	Front fairlead assembly
3	Guide pulley	7	Guide pulleys
4	Auto spooling device		

Fig 2 Winch rope layout

WINCH ASSEMBLY

19 The winch assembly (Fig 3) comprises the winch motor (1), the motor brake (8) and the winch drum (3) incorporating the epicyclic winch gears. The winch can be removed from the chassis as one unit.



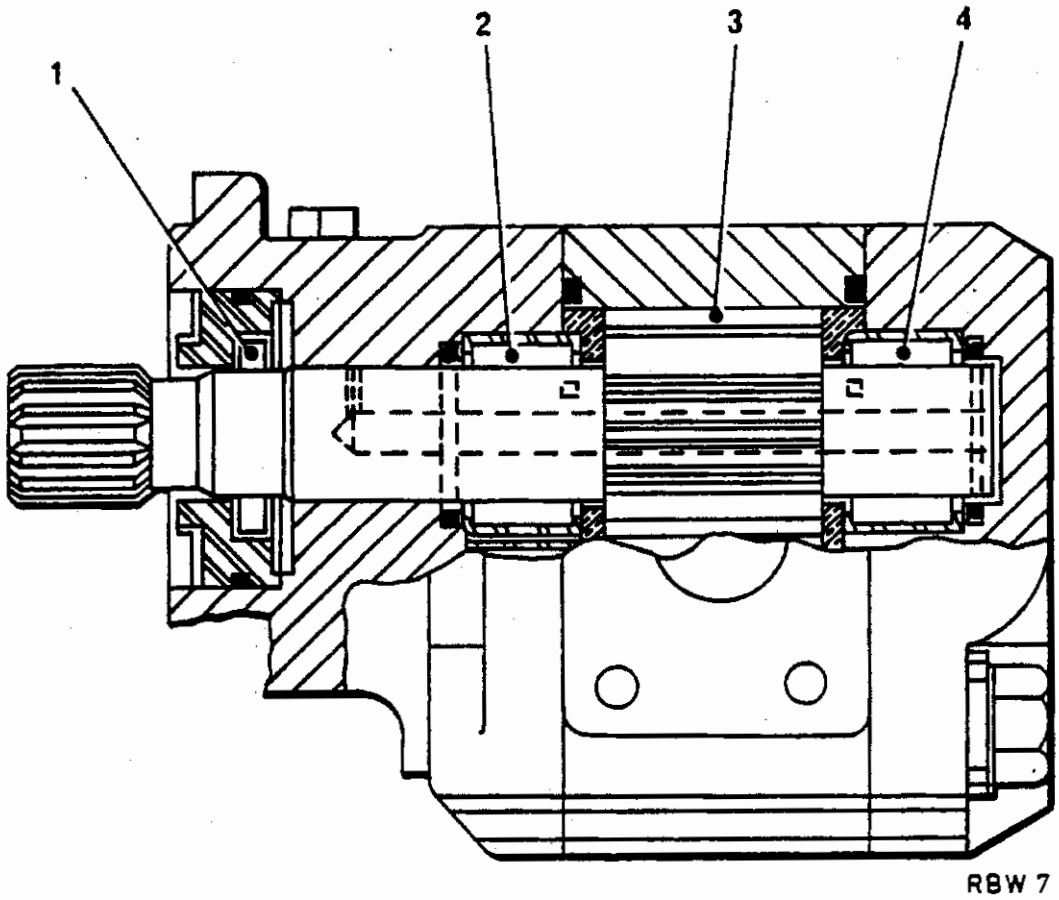
1	Winch motor	5	2nd stage sun gear
2	Motor carrier	6	Selector shaft
3	Winch drum	7	1st stage annulus
4	2nd stage annulus	8	Motor brake

Fig 3 Sectional view of winch

Hydraulic motor

20 The hydraulic motor (Fig 4) is a high speed gear type unit which is flange mounted to an hydraulic brake and then via a hydraulic motor carrier, the drive is transferred to the first stage winch epicyclic.

21 The gear motor converts the hydraulic power generated by the pump into rotary mechanical power to the winch drum. The speed of the motor and therefore the drum is determined by the rate of oil flow (with the winch clutch engaged and the motor brake released). The rate of oil flow is governed by vehicle transmission output speed. The torque developed by the motor is determined by the hydraulic pressure.



1	Seal	3	Drive shaft and gear
2	Bearing	4	Bearing

Fig 4 Sectional view of hydraulic motor

Hydraulic motor brake

22 The hydraulic motor brake is spring loaded to apply the brake and hydraulic pressure is required to release or 'hold off' the brake. During normal operation, the brake is pressurised in the released position when the vehicle winch hydraulic system is operational.

23 If the hydraulic pressure drops below a minimum pressure of 190 lbf/in.^{2} the-brake will automatically be applied.

Winch gearcase and rope drum

24 The winch drum houses the epicyclic gears, which drive the winch gear train consisting of a first and a second stage epicyclic gear train, each train comprises an annulus, one sun gear and three planet gears.

25 Each of the first stage planet gears run needle roller bearings and each of the second stage planet gears is supported on either end by a roller bearing.

26 The gears run in an oil bath. The level of the oil is determined by the oil level plug in the second stage annulus cover. To bring the oil level plug into the correct position, the drum must be rotated so that the drain plug is at the bottom and the filler plug at the top. The gear case must be fitted to the correct level with the grade of oil as specified in the maintenance schedule before operating the winch.

27 The rope drum is a cast steel flanged barrel used to anchor and store the 16 mm diameter wire rope. The fixed end of the rope is secured to the drum by a clamp and is painted red over a 1.5 metre section to alert the operator that the end of the rope is approaching when winching out. The 87 metre long rope should be stowed on the drum in 6 layers.

Winch engagement

28 The selector shaft (Fig 3 (6)) is fitted into the second stage stage sun gear and the winch drive can be disengaged by pulling the selector shaft right out or engaged by pushing the selector shaft fully in.

Winch epicyclic drive

29 The winch motor shaft engages in the motor brake which in turn drives the first stage sun gear. The first stage sun gear transmits the drive to the first stage carrier via the three first stage planet gears. The first stage annulus is bolted to the second stage planet carrier and with the second stage sun gear in the engaged position, the drive is transmitted from the first stage planet carrier to the 2nd stage sun gear and thus via the second stage planet gears to the second stage annulus, which is bolted to the winch drum.

30 Five ball bearings ensure that every moving part is well supported and can move with the minimum of friction.

CHAPTER 18

CRANE

CONTENTS

CRANE OPERATION

WARNINGS

(1) THE CRANE OPERATOR MUST BE CONVERSANT WITH ALL ACCIDENT PREVENTION REGULATIONS AND OPERATING INSTRUCTIONS.

(2) THE CRANE HYDRAULIC OPERATING PRESSURE MUST NOT BE INCREASED OR MODIFIED IN ANY WAY.

(3) ENSURE THAT THE HANDBRAKE IS APPLIED AND THAT CHOCKS ARE POSITIONED BENEATH THE ROAD WHEELS BEFORE ATTEMPTING TO DEPLOY/OPERATE THE CRANE.

(4) ENSURE THAT THE HYDRAULIC STABILISERS (OUTRIGGERS) ARE FULLY DEPLOYED AND LOCKED IN POSITION BEFORE ATTEMPTING TO OPERATE THE CRANE.

(5) WHERE POSSIBLE, PARK THE VEHICLE ON FIRM LEVEL GROUND BEFORE DEPLOYING/OPERATING THE CRANE. WHEN THE GROUND SURFACE IS SOFT AND THERE IS A POSSIBILITY OF THE HYDRAULIC STABILISER FEET PENETRATING THE GROUND SURFACE, PLACE RIGID PANELS OF SUFFICIENT STRENGTH BENEATH EACH STABILISER FOOT.

(6) PERSONNEL ARE NOT PERMITTED TO REMAIN WITHIN THE CRANE'S SLEWING RANGE OR UNDER ANY SUSPENDED LOADS.

(7) DO NOT SHUT DOWN THE CRANE WITH A SUSPENDED LOAD.

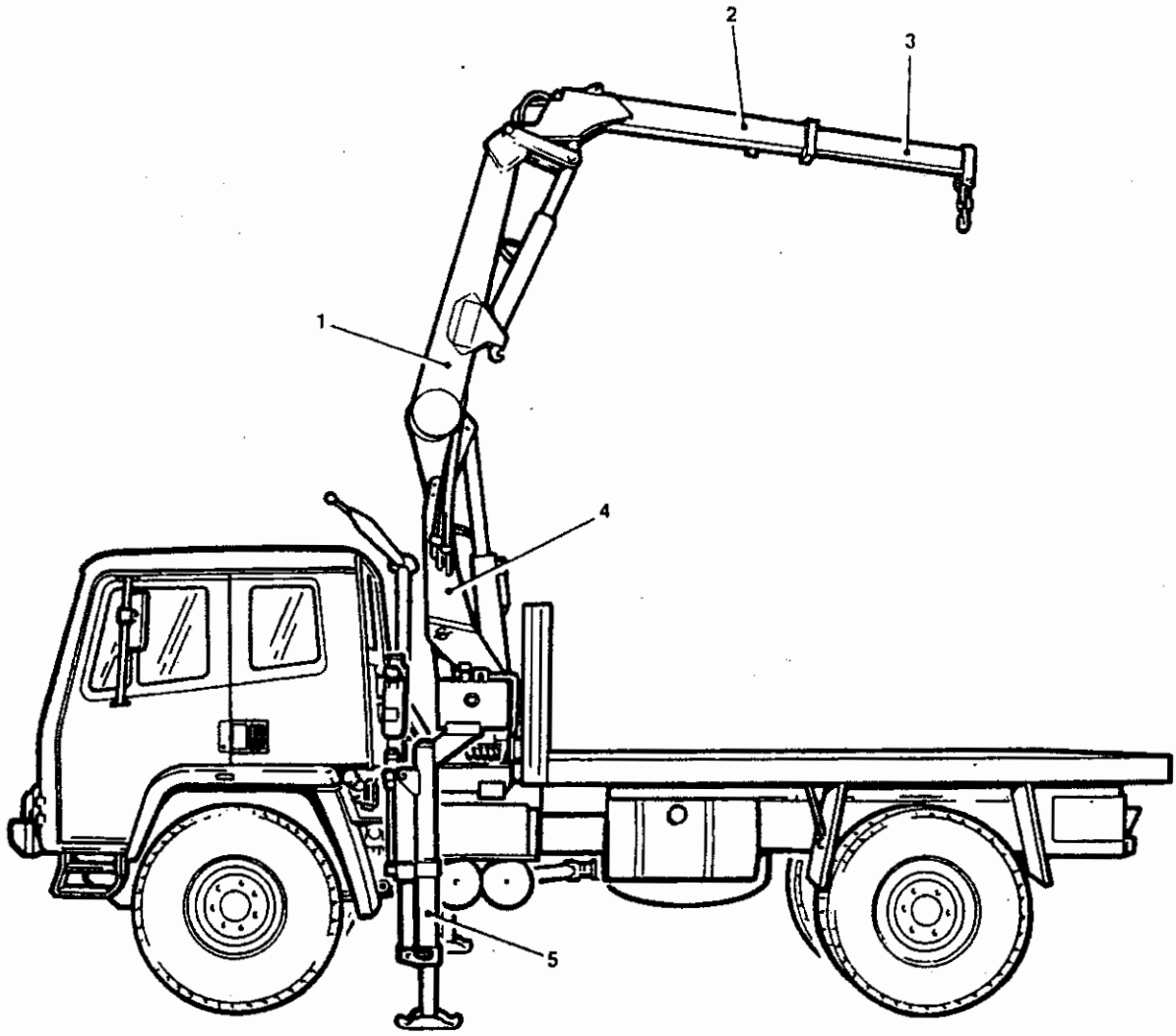
(8) DO NOT ATTEMPT TO TRAVEL WITH A SUSPENDED LOAD.

(9) DO NOT COMMENCE SLEWING UNLESS THE CRANE COLUMN IS UPRIGHT.

(10) DO NOT COMMENCE SLEWING UNTIL THE LOAD IS SUSPENDED.

(11) THE LOAD STATED IN THE LOAD CAPACITY CHART MUST NOT BE EXCEEDED. THE LOAD CAPACITY STATED REFERS TO THE CRANE IN A HORIZONTAL POSITION; THIS CAPACITY WILL BE REDUCED WHEN THE CRANE IS OPERATED AT AN ANGLE.

(12) PARTICULAR CARE MUST BE TAKEN WHEN WORKING IN THE VICINITY OF OVERHEAD POWER CABLES; ENSURE THAT A MINIMUM SAFE WORKING DISTANCE OF 5 METRES BE OBSERVED.



1	Boom	4	Base boom
2	Jib	5	Stabiliser
3	Jib extension		

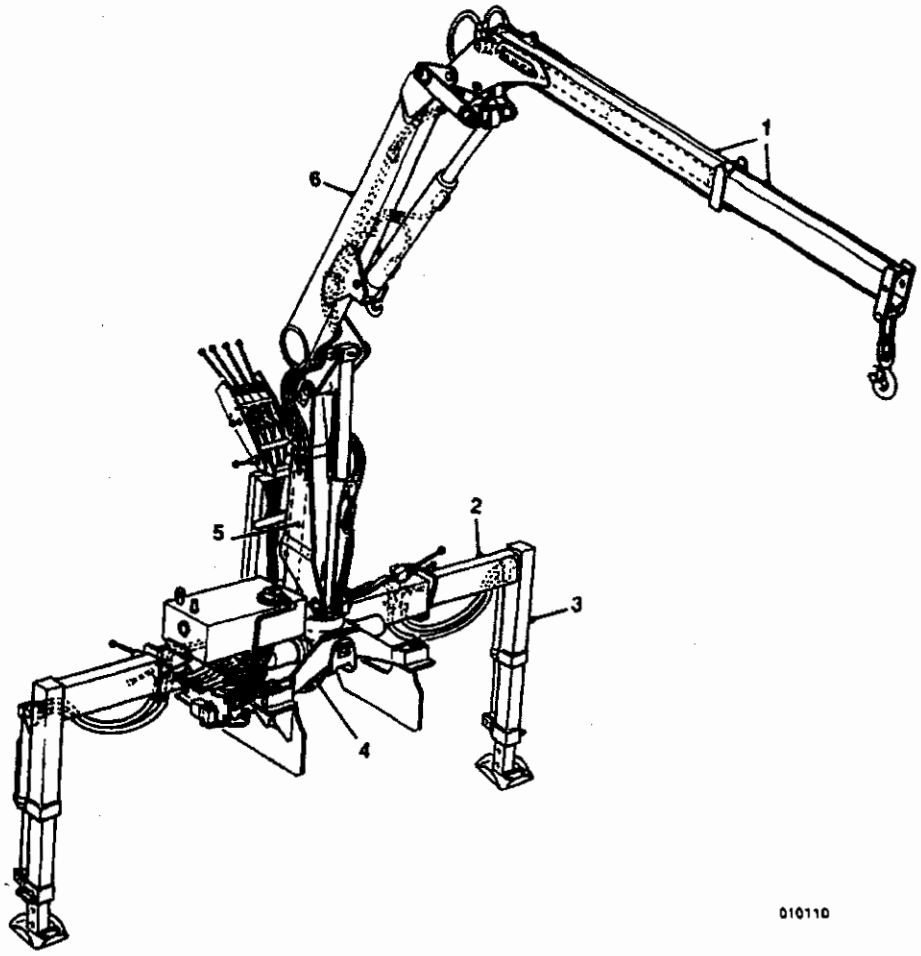
Fig 1 Crane general arrangement

GENERAL DESCRIPTION

1 The general arrangement of the unit is as follows:

1.1 The vehicle mounted crane assembly (Fig 1) is a fully hydraulically controlled unit consisting of a boom (1) with raise/lower capability, a jib (2) with fold/unfold capability which has, in addition, extend/retract capability (3) which increases the reach of the jib and consequently the boom. The boom is connected to a base boom (4) which can also be folded down for transportation but, when in the unfolded (vertically upright or working) position, is capable of being slewed left and right.

1.2 Fitted to the crane base at each side, and forming an integral part of the crane structure, are hydraulically operated stabiliser leg assemblies (5). The stabilisers provide vehicle stability and also partially relieve the vehicle chassis of any excessive load whilst the crane is in use.



1	Jib and jib extension	4	Base
2	Stabiliser legs - lateral	5	Base boom
3	Stabiliser legs - vertical	6	Boom

Fig 1a Crane mechanical components

1.3 A crane mounted hydraulic reservoir, when filled to the correct level, contains sufficient hydraulic fluid to permit full stroke operation of all rams. Pressure in the system is created by a pump, driven by a Power Take-Off (PTO) mounted on and driven by the vehicle gearbox. A total of six rams are fitted to the unit and operate the following functions:

1.3.1 Slew - Left/Right Jib - Fold/Unfold Two stabilisers - Up/Down

1.3.2 Boom - Raise/Lower Jib - Extend/Retract

1.4 The hydraulic operating functions of the crane are controlled by two duplicate sets of controls. The primary operating controls are located below the hydraulic fluid reservoir, at the left side of the vehicle and enable the crane to be controlled at ground level. With the exception of the stabiliser control, the cable operated remote controls are located behind the cab at roof top level and allow the operator to control the crane from the vehicle cab observation hatch. The stabiliser remote control is located on the crane base at the right side of the vehicle. A shut-off valve, for each stabiliser, is located on the respective side of the crane base for the stabiliser concerned. The PTO control and the engine hand throttle lever are located inside the vehicle cab. For details of the operation of the crane controls, refer to AESP 2320-H-104-201, CONTROLS AND SWITCHES.

1.5 The hydraulic system consists of a lifting ram, jib ram, rotating (skew) ram, extension ram, base boom ram and two stabiliser rams. All rams are double acting. Piston rods are chromium plated and fitted with wear resistant packing to suit the specified temperature range.

1.6 Overload safety device. In the event of an overload situation, the safety device prevents any further load-moment increasing movements of the boom. The load can be lowered and the crane re-positioned to give greater lifting capability (See Fig 1b).

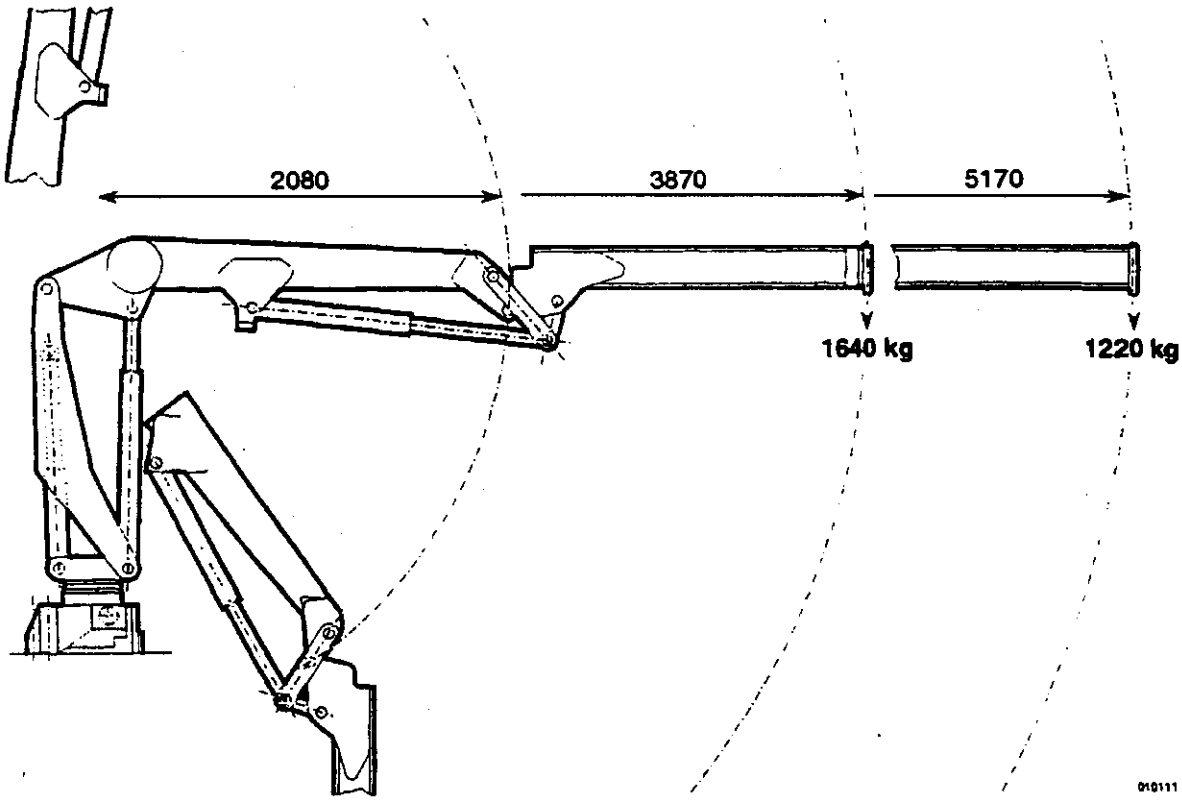


Fig 1b Lifting capacities

1.7 Anticipatory controlled non-release valves prevent creep of the stabiliser rams and act as holding valves in the event of hose failure.

1.8 The load holding valve prevents the load from dropping in the event of sudden pipe or hose failure.

1.9 Remote control unit. This is a duplicate set of main controls to allow crane operation through the hatch in the cab roof.

PRINCIPLES OF OPERATION

2 The following paragraphs detail the principles of operation of the crane:

2.1 In operation, crane movement in all modes is achieved by the action of hydraulic rams. In each case the rams are double acting with the ram piston being subjected to hydraulic fluid pressure on one side or the other to either move to extend or retract as determined by the selected action. Fluid from the non-pressurised side of the piston is routed back to a crane mounted hydraulic fluid reservoir. Hydraulic fluid pressure for system operation is derived from a pump, mounted on and driven by the vehicle gearbox, the inlet side of the pump being supplied with fluid from the hydraulic reservoir.

2.2 Load holding valves, fitted to the jib extension ram, jib ram and boom lifting ram act to prevent fluid loss from the ram pistons such that when ram piston movement stops in the selected position, hydraulic fluid is trapped at each side of the ram piston and a hydraulic lock is achieved, consequently, the ram will remain locked in that position until a further selection is made.

2.3 The jib is fitted with an extending section, driven by a ram, the cylinder is attached to the rear of the jib extension and the piston rod is attached to the rear of the jib. Ram extension or retraction is translated as linear movement in or out, of the extension.

2.4 The jib piston rod eye end is attached to one end of a push rod and two pull rods. The other end of the push rod is attached to a formed bracket on the bottom of the jib. The other end of the two pull rods are attached to the top of the boom keeping the ram in the correct relationship to the radial movement of the jib.

2.5 The lift ram is attached at its cylinder eye end to the crane column and the piston rod eye end is attached to a bracket formed on the lower end of the boom. The boom is connected at its lower end to the top end of the base boom. Ram extension or retraction is translated as radial movement of the boom about the fulcrum of the boom to base boom attachment point.

2.6 The lifting capacity of the crane is determined by the distance between the hook on the end of the jib extension and the vertical centre line of the crane column, the greater this distance, the lower the load lifting capacity of the crane will be. Decals, fixed to either side of the boom give pictorial indication of maximum capability at certain worst case configurations with the boom, jib and jib extension all horizontal, these are:

2.6.1 1.64 tonne with the hook 3.87 m from the column centre line.

2.6.2 1.22 tonne with the jib fully extended and the hook 5.17 m from the column centre line.

2.7 The crane is capable of rotation about the centre line of the crane column. This is achieved by a rack and pinion arrangement formed between teeth on the crane column being in mesh with teeth on a rack located in the crane base. Pistons are formed at each end of the rack, each piston operating in its own cylinder attached on the base. Hydraulic fluid pressure applied to the outboard face of one piston will cause the rack to move laterally, which is translated as rotary movement of the crane column. The pistons are single acting in the sense that only the outboard faces of the pistons within their cylinders are subject to either fluid pressure or fluid exhaust. The crane should NOT be rotated until the base boom is in the unfolded (vertically upright or working) position.

2.8 Each stabiliser ram is attached at its cylinder eye end to a bracket formed at the upper end of the stabiliser outer tube and the piston rod eye end is attached to a bracket formed at the lower end of the stabiliser inner tube. Ram extension or retraction is translated as linear movement, up or down, of the stabiliser inner tube.

2.9 For specific details regarding operating the crane, refer to 'Operating The Crane' in operating information AESP 2320-H-104 - 201.

MECHANICAL DESCRIPTION

3 The following paragraphs describe, in detail, the component parts of the crane:

3.1 Jib and jib extension

3.1.1 The complete jib (Fig 2) is basically a two piece assembly comprising an outer box section jib (1) and an inner box section extension (3), the inner section sliding inside the outer section. The two sections are mechanically linked together by an hydraulically operated extension ram (2) such that extension of the ram carries with it the jib extension.

3.1.2 The extension ram cylinder tube is fitted inside the inner end of the hollow jib extension. A plate on the ram cylinder tube engages with the jib extension and is locked into position by a locking plate secured by two screws and washers, ram cylinder movement will thus cause corresponding movement of the jib extension.

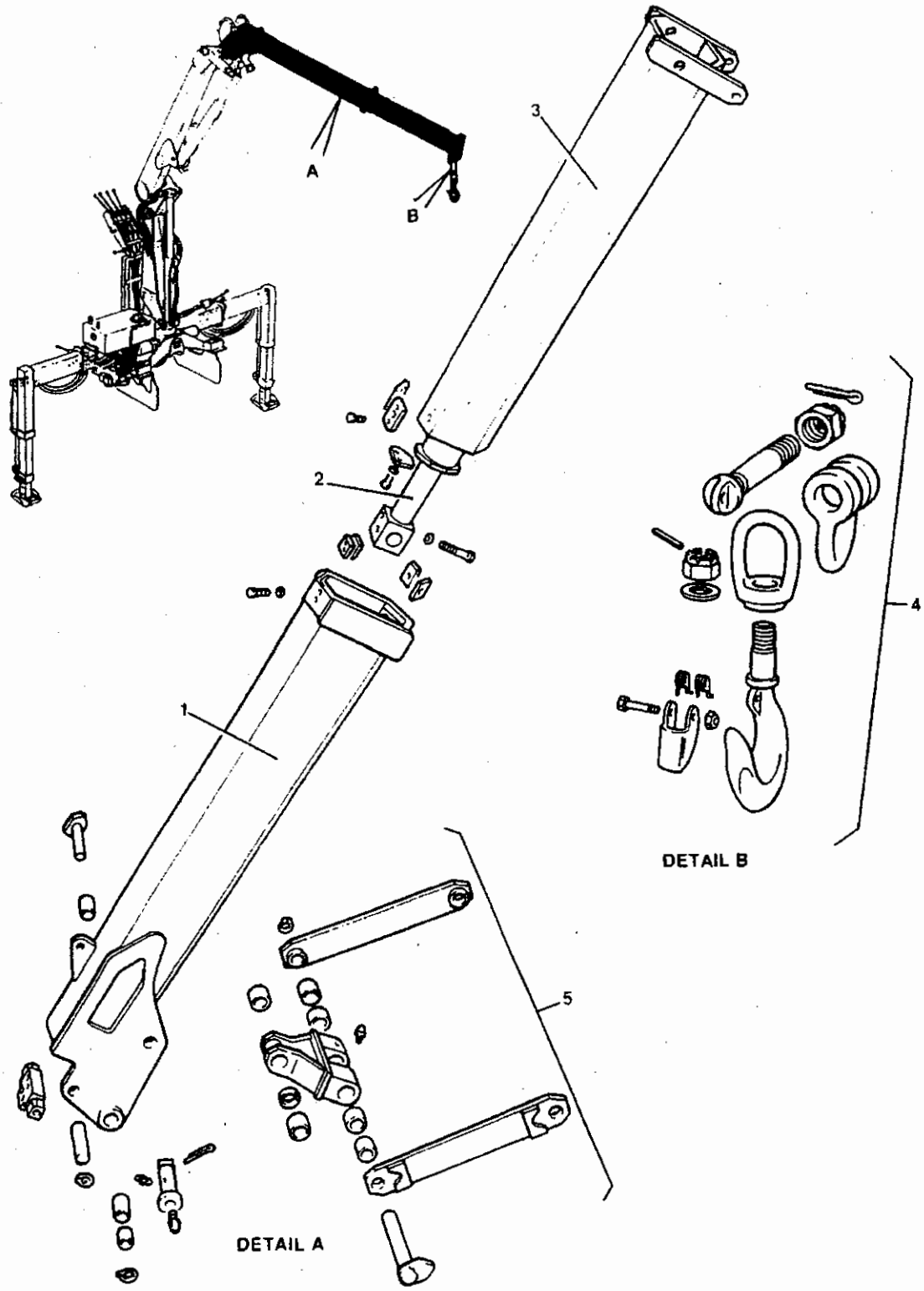
3.1.3 Fitted externally on the top inner end of the jib extension are two guide pieces each attached by two screws. With the jib extension installed inside the outer jib, the guide pieces form sliding pads to adequately support the extension inside the outer jib.

3.1.4 Welded plates at the outer end of the jib extension form the attachment bracket for the crane hook and swivel eye assembly which is secured to the bracket by a shackle and shackle pin. The shackle pin is locked in position by a nut and split pin.

3.1.5 The hook and eye assembly (4) comprises a hook secured to an eye by a nut and washer, the nut being locked by a split pin. With the nut fully tight, the hook is capable of swivelling inside the eye. A spring loaded safety clip is attached to the hook by a bolt and locknut. When in use, the clip prevents inadvertent detachment of lifting devices from the hook.

3.1.6 With the extension fitted inside the outer jib, the extension ram piston rod eye end block protrudes through the inner end of the outer jib. The piston rod eye end block is attached between the two plates by a pin and the pin is locked in position by two circlips, one at each end of the pin.

3.1.7 Fitted to the ram piston rod eye end block is a load holding valve which prevents fluid loss from the ram and consequent ram retraction when the ram is under load. Hydraulic fluid to and from the load holding valve is via two hydraulic hoses connected to the valve. For details of the hydraulic system, refer to Para 4.



1 Jib
2 Extension ram
3 Jib extension
4 Hook assembly
5 Pull rod assembly

Fig 2 Jib and jib extension

3.1.8 The boss for the jib attachment pin and bushes is a continuous boss so the spacer has to be fitted at the same time as the bushes. Bores are formed in the jib welded side plates to accommodate the jib to boom attachment pin and the pressing rod attachment pin. Bearing bushes are pressed into the jib to boom attachment pin bosses in the side plates and a spacer is fitted between the bushes when the attachment pin is fitted. When the jib to boom attachment pin is fitted, a shaped plate, welded to the head of the pin, engages with a shaped plate, welded to the boom, thus preventing the pin from turning. The pin is locked by a circlip.

3.1.9 The pressing rod is-a forked lever which forms, at its fork end, the attachment points for the jib hydraulic ram piston rod eye end and the jib to boom pull-rods (5). The eye end of the pressing rod is fitted with two bearing bushes with a spacer between. The eye end of the pressing rod is attached to the jib by a pin, a step formed on the pin abuts a welded lug on the jib which prevents the pin from turning. The pin is locked by a split pin. Each leg of the pressing rod forks is fitted with two bearing bushes and the jib ram piston rod eye end and the pull-rods, which are fitted to the outside of the pressing rod forks are all attached by a pin which is locked by a circlip. With the pin fitted, a shaped plate, welded to the head of the attachment pin engages with a shaped plate welded on one of the pull-rods, thus preventing the pin from turning.

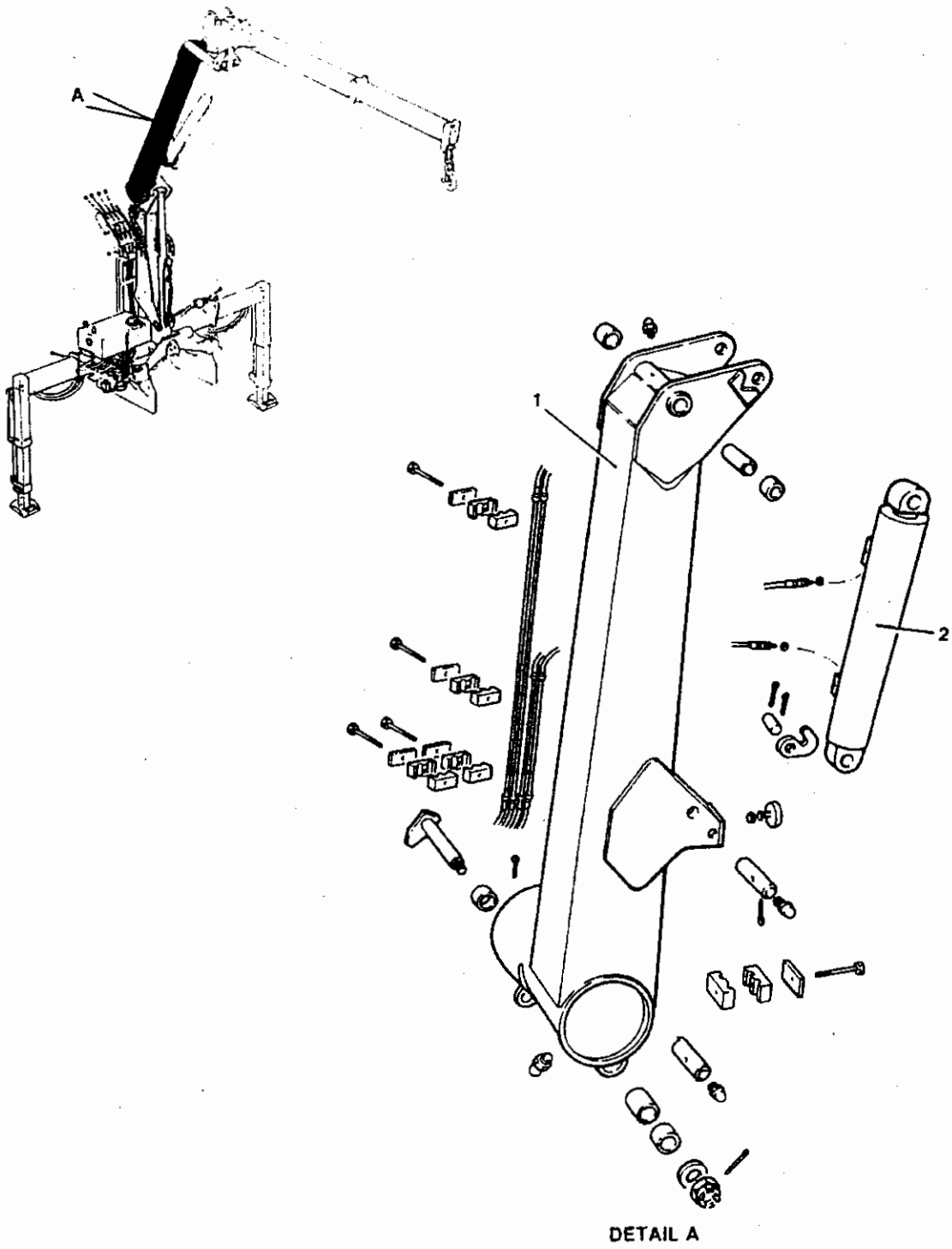
3.1.10 The inside forward end of the jib is fitted with two guide pieces at the lower end and two plates and guide pieces at the upper end attached by screws. The guide pieces act as support pads for the jib extension.

3.1.11 Each of the jib to boom attachment pin bore bosses are fitted with grease nipples as is each fork of the pressing rod. A grease nipple is also fitted in the end of the pressing rod attachment pin. As a safety device, to prevent jib movement when the jib is folded over on to the boom for transport purposes, a tumbling hook on the boom can be engaged with a fixed pin on the jib.

3.2 Boom assembly

3.2.1 The boom (Fig 3) is a welded, hollow section member with suitable plates and brackets welded on to form various attachment points. Welded plates at the forward end form the bracket to which the jib and jib to boom pull-rods are attached. The bores for the jib attachment pin are not bushed since the wearing surfaces of this joint are between the jib fitted bearing bushes and the fixed attachment pin in the boom. The shaped plate, which prevents attachment pin rotation, is welded on the side of the boom bracket, refer Para 3.1.8.

3.2.2 The bore for the jib to boom pull-rods attachment pin is fitted with two bearing bushes with a spacer between. With the pin fitted, a shaped plate, welded to the head of the attachment pin, engages with a shaped plate welded to one of the pull-rods, thus preventing the pin from turning.



1 Boom
2 Jib ram cylinder

Fig 3 Boom assembly

3.2.3 A welded bracket, approximately two thirds down the boom, forms the attachment points for the jib ram cylinder eye end (2), the tumbling hook and the buffer stop. The jib ram cylinder eye end attachment pin is fitted to unbushed bores in the bracket and a step formed on the pin abuts a welded lug on the bracket, which prevents the pin from turning. The pin is locked by a split pin.

NOTE

The jib ram piston rod eye end is attached to the pressing rod on the jib, refer Para 3.1.9.

3.2.4 The tumbling hook attachment pin is fitted to unbushed bores in the bracket and is locked by a split pin at each end. The extended screw of the buffer stop fits through a hole in a plate welded across the two main plates of the bracket. The buffer stop is secured in position by a nut and a washer.

3.2.5 Offset welded brackets on the rear end of the boom form the attachment points for the lift ram piston rod eye end and the boom to base boom. The lift ram piston rod eye end attachment pin is fitted in unbushed bores in the bracket and a step formed on the pin abuts a welded lug on the bracket which prevents the pin from turning. The pin is locked by a split pin. The boom to base boom attachment pin bore is fitted with two bearing bushes with a spacer between. The boom to base boom attachment pin is locked in position by a washer, nut and a split pin. With the attachment pin fitted, a shaped plate, welded to the head of the pin engages with a shaped plate welded on the base boom, thus preventing the pin from turning.

3.2.6 With the boom installed, hydraulic pipes are clamped to the boom. Pads, with a threaded hole, are welded to the boom at various positions to form the attachment points for the pipe clamps which are comprised of a two piece clamp, a cover plate and a clamp securing screw.

3.2.7 The pull-rods attachment pin bore on the boom is fitted with a grease nipple as is the boom to base boom attachment pin bore. A grease nipple is fitted in the end of the jib ram cylinder eye end attachment pin and the lift ram piston rod eye end attachment pin.

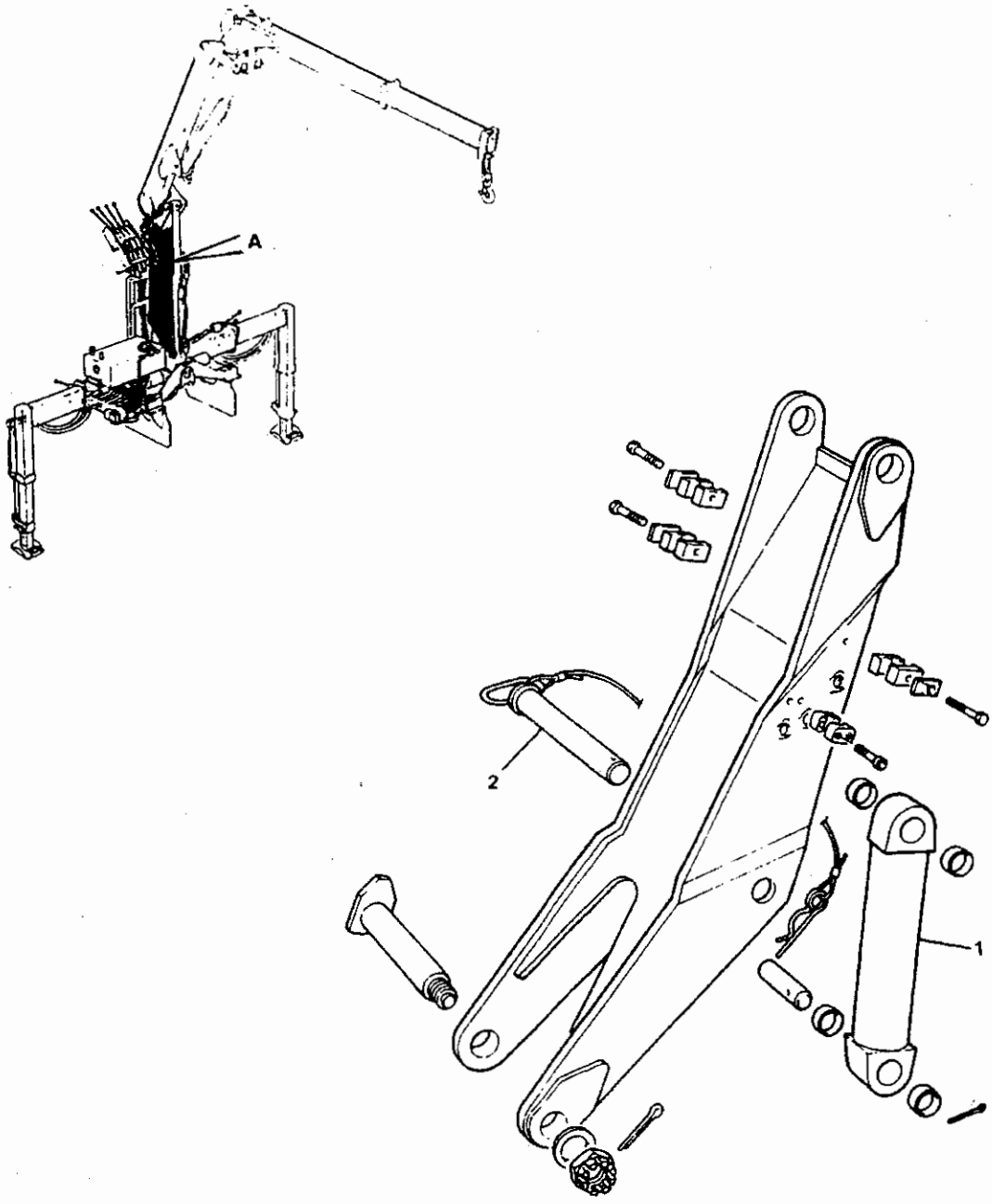
3.3 Base boom

3.3.1 The base boom (Fig 4) of welded construction, with suitable strengthening plates welded on, forms various attachment points. Unbushed bores at the top end form the attachment point for the boom to base boom. For details of the boom to base boom attachment pin. Refer to Para 3.2.4.

3.3.2 Unbushed bores, part way down the base boom, form the upper attachment point for the stay rod (1). The stay rod upper and lower bores are each fitted with two bearing bushes and the rod is attached, at its upper end, by a pin (2) which is locked by a spring pin. To prevent loss, both the attachment pin and the spring pin are secured by a cable. The stay rod is attached, at its lower end, to the crane column bracket by an attachment pin which is locked by a split pin. With the attachment pin in position, a step formed on the pin engages with a lug on the crane column thus preventing the attachment pin from turning.

3.3.3 The lower, forked end of the base boom has unbushed bores which form the base boom to crane column attachment point. The base boom is attached to the crane column by a pin which is locked in position by a washer, nut and split pin. With the attachment pin fitted, a shaped plate, welded to the head of the pin, engages with a shaped plate welded on the base boom, thus preventing the pin from turning. The lower attachment pin also attaches the lift ram cylinder eye end to the crane column. For details of the lift ram upper attachment, refer to Para 3.2.4.

3.3.4 Pads, with a threaded hole, are welded to the base boom at various positions to form the attachment points for the pipe clamps which are comprised of a two piece clamp, a cover plate and a clamp securing screw.



DETAIL A

1 Stay rod
2 Pin

Fig 4 Base boom

3.4 Base frame

3.4.1 The base frame (Fig 5) forms the structural member of the crane which is attached to the vehicle chassis and which supports the remainder of the crane. A welded structure, formed centrally on the main box section member, constitutes the bore and bearing arrangement for the crane column and includes a slewing mechanism by which means the crane is rotated. Further attachments, at each end of the base box section allow fitment of stabilisers which, when in use, provide vehicle stability and also partially relieve the vehicle chassis of any excessive load imposed by the crane.

3.4.2 Welded brackets on the forward and rear face of the box section form four attachment points to allow the base to be bolted onto two superstructure frames (1) which, in turn, are bolted directly on the vehicle chassis, one at each side.

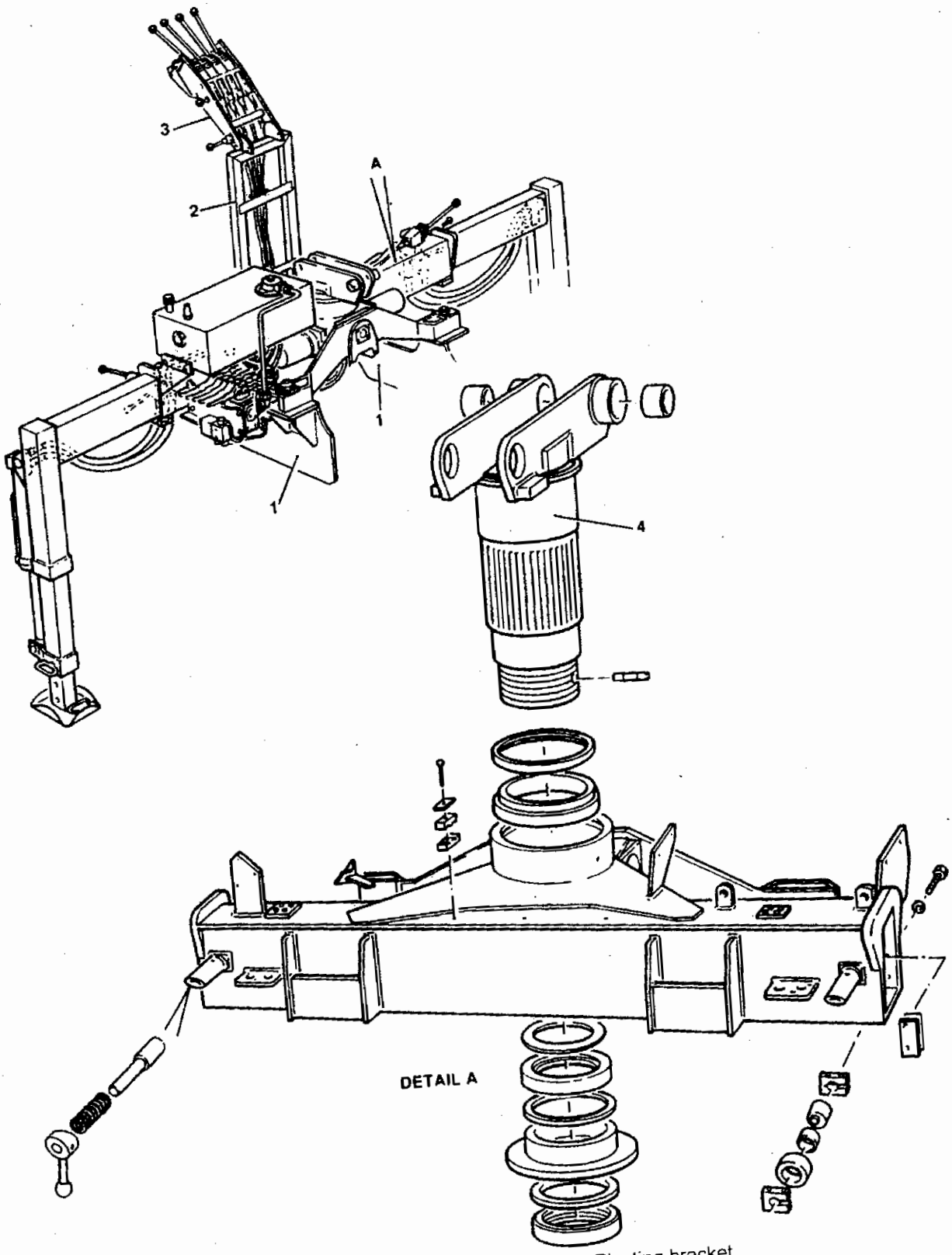
3.4.3 Welded centrally to the rear face of the box section member is a fixed pylon bracket (2) which extends vertically to carry a pivoting bracket assembly (3), the top of which, forms the attachment point for the remote control assembly selectors. When the remote controls are not in use, a double legged pin, passing through the pivoting bracket, holds all the levers in a neutral position. The remote control selector for the right hand side stabiliser ram operation is bracket mounted on the top offside end of the base box section and is also attached by three bolts.

3.4.4 A knob operated, spring loaded locking device, on the pivoting bracket, enables the bracket to be unlocked, moved to a convenient operating or stowage position and re-locked. A fixed knob on the pivoting bracket forms a handle for use when the bracket is being pivoted.

3.4.5 The control cables from the selector units on the pivoting bracket are routed through two guides on the fixed lower pylon bracket to the crane control valve operating lever ends. The remote control cable from the stabiliser remote control unit routed across the base to the crane control valve operating lever end. The crane control valve is bracket mounted, by four bolts, on a base side member on the nearside of the base.

3.4.6 The crane column (4) comprises a machined pillar with teeth around the circumference forming the pinion half of a rack and pinion arrangement. With the column installed, the teeth are in engagement with a toothed rack which has a piston and cylinder arrangement at each end. Hydraulic fluid pressure, applied to one or other of the rack pistons will cause the rack to move laterally, which is translated to the crane column as rotary movement.

3.4.7 Brackets, welded to the top of the crane column form the attachment points for the base boom, lift ram and base boom stay rod. The attachment bores for the base boom and lift ram are fitted with bearing bushes. Attachment of the base boom stay rod to the crane column is by means of an attachment pin locked by a split pin. A step, formed on the end of the attachment pin, engages with a lug welded on the crane column bracket thus preventing the attachment pin from turning.



1 Superstructure frame
2 Fixed pylon bracket
3 Pivoting bracket
4 Crane column

Fig 5 Base frame

3.4.8 Two bearing surfaces are provided on the crane column, which is carried in two conical roller bearings, one fitted in the top of the crane base bore and one fitted in the bottom of the crane base bore. An oil seal is fitted to the top of the bore and a nilos ring and an oil seal is fitted to the bottom of the bore. A guard ring is fitted on the crane column below the bracket and, when the column is fitted, this guard ring abuts the upper oil seal in the bore. A stepped, threaded end on the column, permits the fitment of a ring nut which tightens onto a locking plate and a thrust washer. The thrust washer abuts the lower oil seal in the bore.

3.4.9 Fitted at each end of the base box section member, and protruding through to the inside of the box section from the lower plate, are adjustable eccentric assemblies. Each assembly forms a support roller device on which the stabiliser beam slides in and out of the base box section member. Each assembly is comprised of two bearing supports supporting an eccentric on which is fitted a bush and a roller. The bush and roller are fitted on the eccentric concentrically. The bearing supports are slit on one side and are screwed to the underside of the base box section member with the roller protruding through a hole machined in the member. With the attachment screws tight, the eccentric is trapped and prevented from rotating, although the roller can rotate on the bush. Slackening the attachment screws will enable the eccentric to be turned, thus either increasing or decreasing the clearance between the roller and the stabiliser beam as appropriate.

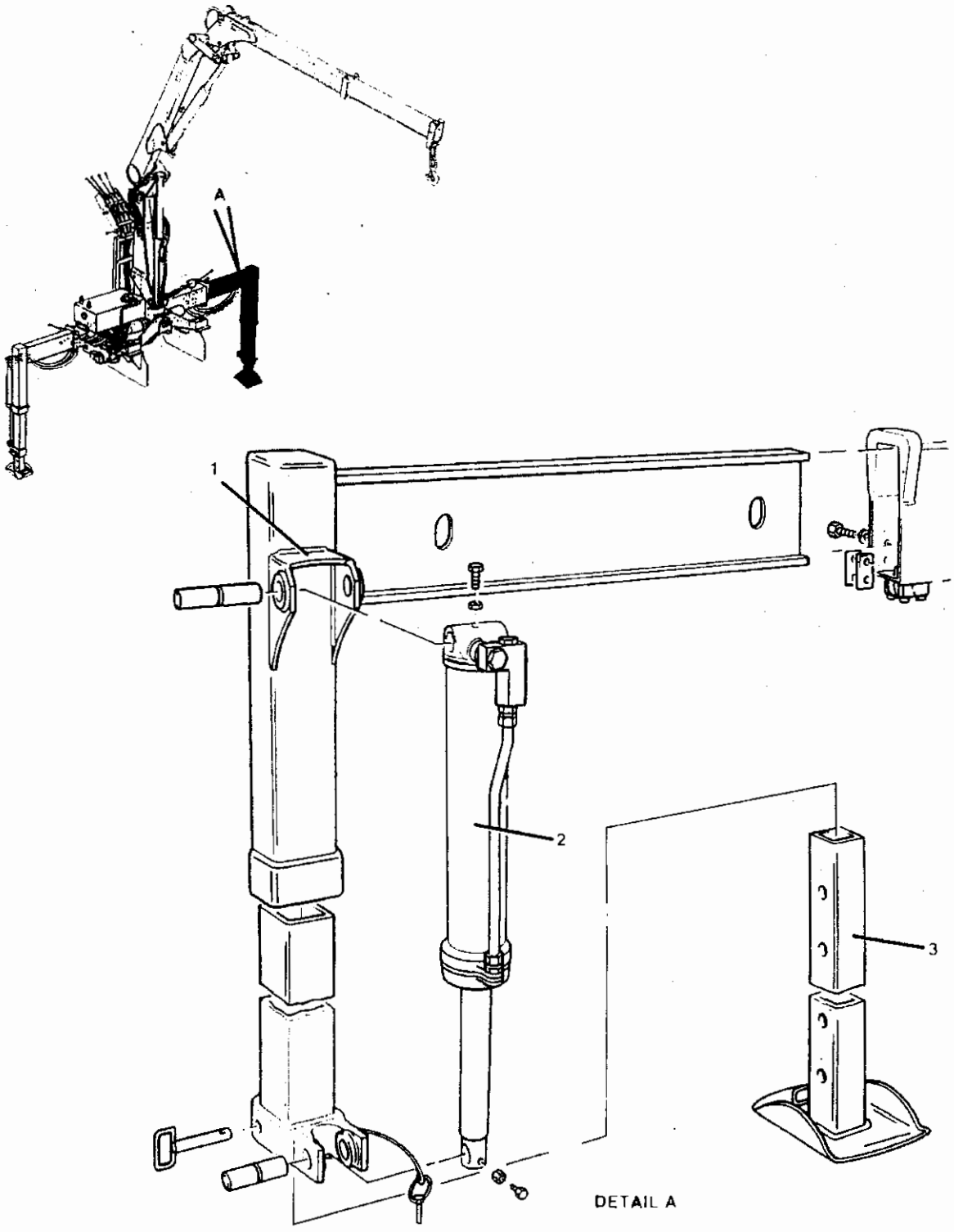
3.4.10 When installed, the stabiliser beam can be locked in either the fully extended or the fully retracted position. This is achieved by a spring loaded pin protruding through the base and into one of the two holes machined in the stabiliser beam. With the spring pin located in the outer hole on the stabiliser beam, the stabiliser is positioned in the fully extended position and with the spring pin located in the inner hole, the stabiliser is positioned in the fully retracted position. The spring pin is operated by a lever with a tangential boss acting on the front face of a housing. The housing front face is also tangential, and the action of turning the lever causes the lever, which is pinned to the spring pin, to retract against the spring. The lever can be locked in the 'pin in' position by a spring pin.

3.4.11 Plate stops are bolted to the inside ends of the base box section which engage with stop lugs on the stabiliser teams. Guide pieces are also fitted to the base box section to guide the stabiliser beam as it is moved in and out. Brackets welded onto the base structure allow for the bolted attachment of the hydraulic fluid reservoir.

3.5 Stabilisers

3.5.1 Each stabiliser assembly (Fig 6) is basically comprised of three, hollow box section members which telescope inside each other. Welded at right angles to the top of the outer section is a stabiliser beam which slides into the hollow box section beam of the base unit. The stabiliser beam is fitted with two stop lugs which engage with the stop plates fitted in the end of the beam on the base unit. In addition, two holes in the stabiliser beam form the engagement points for the base beam mounted stabiliser beam locking pin.

3.5.2 A bracket formed at the upper end of the stabiliser outer tube (1) forms the attachment for the cylinder eye end of the stabiliser hydraulic ram (2). The attachment comprises a notched pin, which, when in position, is locked by a screw fitted through the ram cylinder eye end boss and engaging in the notch of the attachment pin. The locking screw is itself locked by a locknut. A bracket, formed at the lower end of the stabiliser inner tube, forms the attachment for the piston rod eye end of the stabiliser hydraulic ram. The attachment is similar to that of the ram upper attachment in that a notched pin, locked by a locking screw is used. The locking screw being fitted through the piston rod eye end, and the locking screw being locked by a locknut. In operation, ram extension will extend the stabiliser inner tube down the outer tube.



1 Outer tube
2 Hydraulic ram
3 Bottom tube

Fig 6 Stabiliser

3.5.3 A bottom tube (3) slides inside the inner tube and is manually extended or retracted. A series of holes along the length of the bottom tube allow attachment to the inner tube at various positions as required. A welded handle on the attachment pin, facilitates the fitting and removal of the pin which is locked into position by a hinged locking pin. To prevent loss, the hinged locking pin is secured to the lower end of the inner tube by a short wire cable. A load spreader foot is welded to the lower end of the bottom tube and a handle is welded to the top surface of the foot to facilitate the lifting and lowering of the bottom tube.

HYDRAULIC SYSTEM DESCRIPTION

4 The following paragraphs describe, in detail, the hydraulic system and its components.

4.1 System (Fig 7)

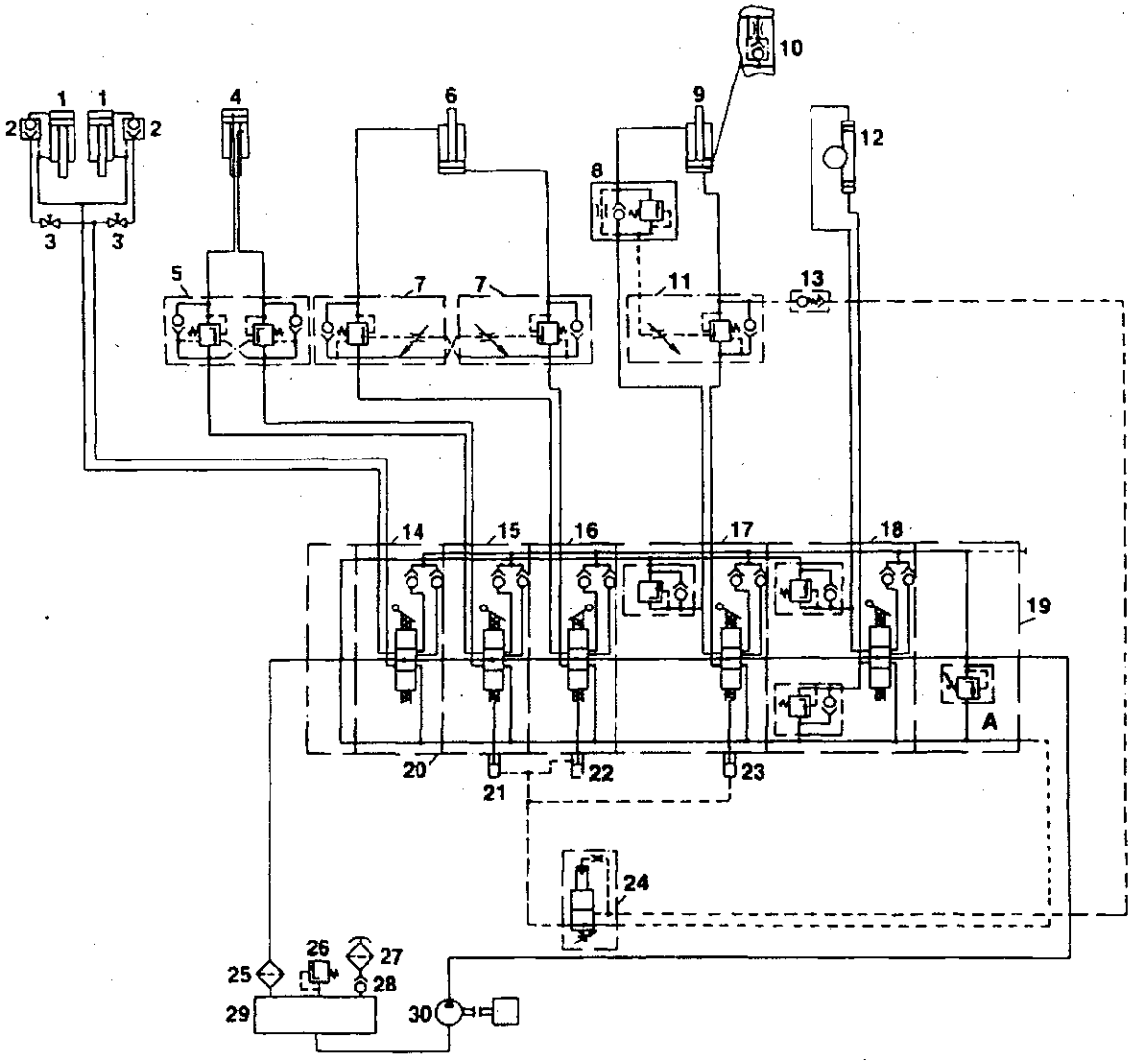
4.1.1 Hydraulic fluid is contained in a crane mounted reservoir (29) which receives return fluid from the system control valve unit (20) via an hydraulic fluid filter (25). As the level in the reservoir rises or falls, due to changes in demand caused by the functioning of the crane, air is allowed to enter the top of the reservoir via an air filter (27) and an anti-cavitation valve (28) which prevents an abnormally low pressure occurring in the reservoir. Excessive pressure in the reservoir is avoided by the fitment of a pressure limiting valve (26). For further details of the reservoir, refer to Para 4.2.

4.1.2 Fluid from the reservoir is fed to the inlet side of a hydraulic fluid pump (30). The pump is a gear type, positive displacement pump, mounted on, and driven by the vehicle gearbox. Hydraulic fluid, under pressure, is delivered by the pump to the inlet side of the control valve unit (20). For further details of the pump, refer to Para 4.3.

4.1.3 The control valve unit is a sectionalised assembly containing a series of five control valves operated by externally mounted hand control levers. The control levers and their associated valves are centre biased and in this position, no fluid can be passed, or returned, from any of the system hydraulic rams. Selection of a particular control lever, either up or down, dependent upon the function required, will open ports in the control valve and allow fluid under pressure to pass to one side of the piston of the selected ram. In addition, fluid from the non-pressurised side of the ram piston is allowed to return to the reservoir via the control valve as the ram piston moves under the applied fluid pressure. For further details of the control valve, refer to Para 5.1.

4.1.4 When selected, fluid under pressure from the control valve, is fed directly to the appropriate piston of the double piston slewing ram (12) with the opposite piston being open to return. For further details of the slewing ram, refer to Para 4.7.

4.1.5 When selected, fluid under pressure from the control valve, is fed to the piston of the lift ram (9) via either a load holding valve (11) or a pressurising valve (8) dependent upon which selection is made. The opposite side of the ram piston is open to return via either the pressurising valve or the load holding valve. For further details of the lift ram, refer to Para 4.6 and for further details of the pressurising valve and load holding valve, refer to Para 4.9.



1	Stabiliser ram	18	Valve section
2	Pilot operated non-return valve	19	Inlet section
3	Shut-off cock	20	Control valve unit
4	Extension ram	21	Pressure overload limit valve
5	Load holding valve	22	Pressure overload limit valve
6	Jib ram	23	Pressure overload limit valve
7	Load holding valve	24	Pressure control valve (overload protection system)
8	Pressurising valve	25	Hydraulic fluid filter
9	Lift ram	26	Pressure limiting valve
10	Non-return valve	27	Air filter
11	Load holding valve	28	Anti-cavitation valve
12	Slewing ram	29	Hydraulic fluid reservoir
13	Line break protection valve	30	Hydraulic fluid pump
14	Valve section	A =	240 bar, main pressure relief valve (adjustable)
15	Valve section		
16	Valve section		
17	Valve section		

Fig 7 Hydraulic system

4.1.6 When selected, fluid under pressure from the control valve is fed to the piston of the jib ram (6) via a load holding valve (7). The opposite side of the ram piston is open to return via a load holding valve. The two load holding valves used are identical and are interconnected with each other. For further details of the jib ram, refer to Para 4.5 and for further details of the load holding valves refer to Para 4.9.

4.1.7 When selected, fluid under pressure from the control valve, is fed to the piston of the extension ram (4) via a load holding valve (5). The opposite side of the ram piston is open to return via the same load holding valve. For further details of the extension ram, refer to Para 4.4 and for further details of the load holding valve refer to Para 4.9.

4.1.8 When selected, fluid under pressure from the control valve, is fed to the top side of the piston of the stabiliser ram (1) via a shut-off cock (3) and a pilot operated non-return valve (2). The opposite side of the ram piston is open to return directly to the control valve. Fluid under pressure is fed to the bottom side of the stabiliser ram piston directly from the control valve and fluid return from the top side is via the pilot operated non-return valve and the shut-off lock. For further details of the stabiliser rams, refer to Para 4.8 and for further details of the shut-off lock and the pilot operated non-return valve refer to Para 4.9.

4.1.9 Return fluid from the rams, via the control valve is fed into the hydraulic reservoir via the hydraulic fluid filter (25).

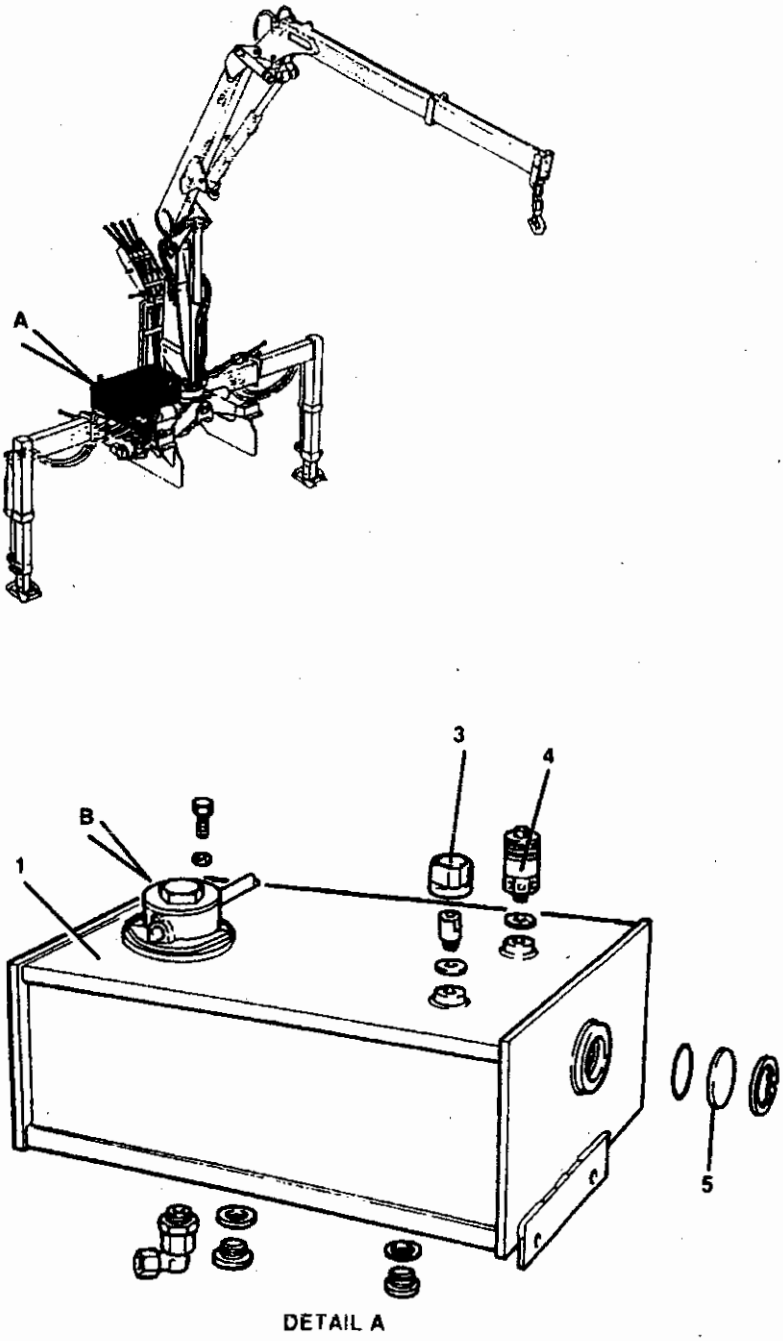
4.2 Hydraulic reservoir

4.2.1 The hydraulic reservoir (Fig 8) comprises a rectangular tank (1), bracket mounted on the nearside of the crane base. The top surface of the reservoir is fitted with an hydraulic fluid inlet filter assembly (2), an air filter assembly and a pressure limiting valve. The outboard end of the reservoir is fitted with a fluid level sight glass and the bottom surface of the reservoir is fitted with a fluid outlet elbow and a plug.

4.2.2 Two screws and washers attach the housing of the hydraulic fluid filter to the reservoir such that the barrel of the filter protrudes inside the reservoir. A gasket forms a seal between the filter housing and the roof of the reservoir. An internally threaded boss on the housing allows fitment of a rigid fluid inlet pipe. The element assembly of the filter comprises an element secured to a retainer by a nut, the element to retainer seal is by an O ring. The element and retainer assembly are retained in the barrel by a spring and a cap fitted with a gasket.

4.2.3 The air filter assembly (3) is comprised of a filter which is attached to a anti-cavitation valve. The anti-cavitation valve is screwed into the roof of the reservoir and a joint forms a seal between the valve and the reservoir. The pressure limiting valve (4) also screws into the roof of the reservoir with a joint forming a seal.

4.2.4 The sight glass assembly is comprised of a glass with an etched level line, held in position by a circlip with an O ring fitted between the glass and the reservoir end wall. The fluid outlet elbow adaptor and a plug each have a seal fitted between them and the bottom of the reservoir.



1 Tank
2 Filter assembly
3 Air filter assembly
4 Pressure limiting valve
5 Sight glass assembly

Fig 8 Hydraulic reservoir

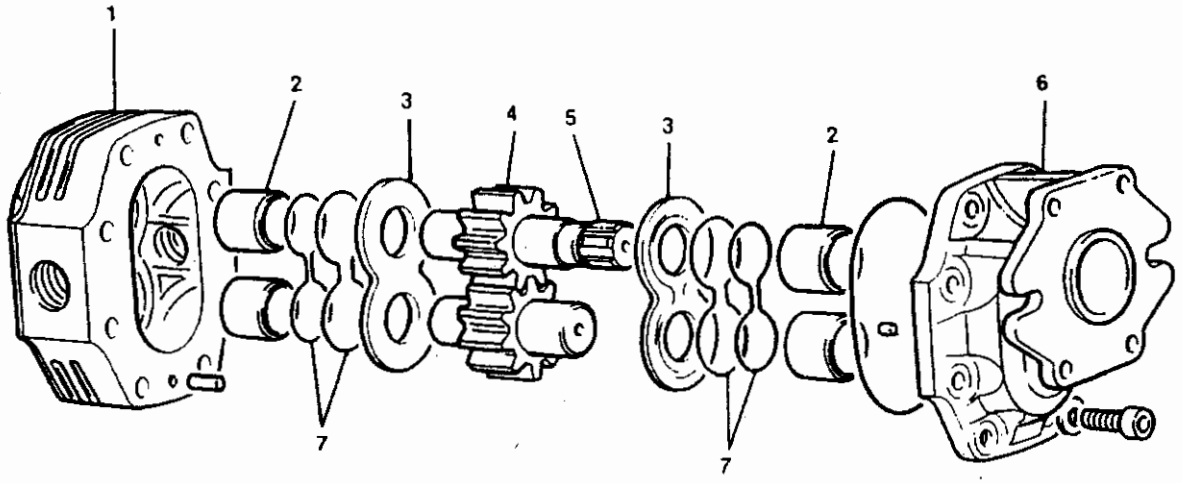
4.3 Hydraulic pump

4.3.1 The hydraulic pump (Fig 9) is mounted on and driven by the vehicle gearbox. The unit comprises a gear type pumping element, sealed and suitably supported in bushed bores within a three piece casing, the two outer casings carrying the gear spindle bushes (2) and the centre casing (1) forming the inlet/outlet ports. The driving gear (4) of the pump has a splined, extended spindle (5) at one end which protrudes through one end casing. This end casing is extended to form a two hole, pump to gearbox attachment flange (6). With the pump attached to the gearbox, the splined, extended spindle of the driving gear engages with a splined drive in the gearbox. The end thrusts of the gears are taken by spectacle type plate thrust bearings (3) and O rings (7) are utilised to form the intercase seals. A packing ring and back-up ring, secured in the attachment flange end casing by a circlip, form the seal between the drive spindle and the casing. Servicing of the pump is on a 'repair by replacement' basis.

4.4 Extension ram

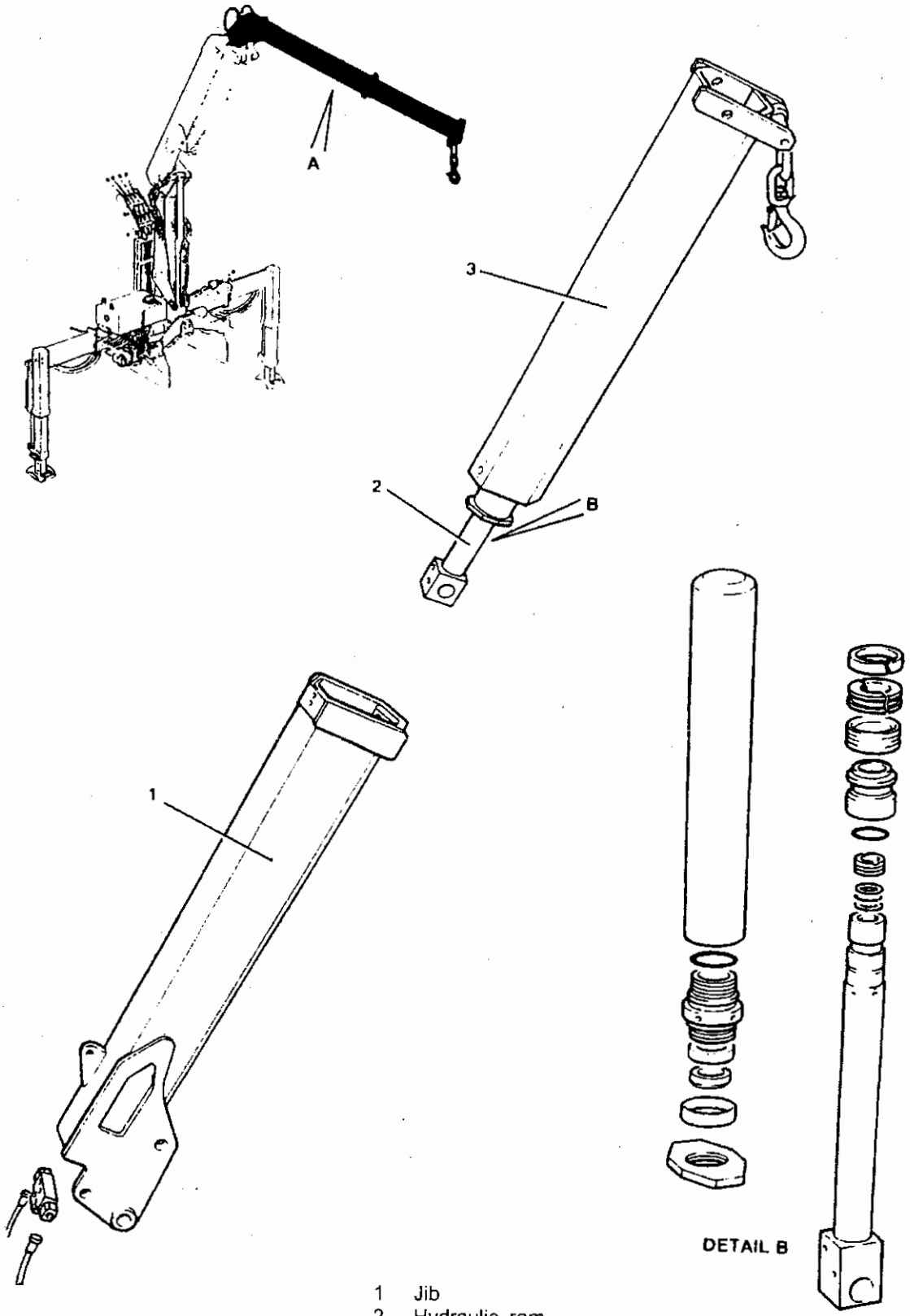
4.4.1 The extension ram (Fig 10) is a double acting hydraulic ram (2) attached at its cylinder end to the inner end of the jib extension (3) and attached at its piston rod end to the inner end of the jib (1). Hydraulic fluid, to and from the ram is via a load holding valve which is attached to the ram piston rod eye end block. Hydraulic fluid transport ducts are provided in the piston rod to allow fluid to be fed to or removed from the chambers formed by the piston in the cylinder tube. The cylinder tube of the ram is inserted inside the jib extension and is secured in place by a mounting plate attached by two screws. The ram piston rod eye end is attached to the jib by a pin locked by circlips.

4.4.2 The ram comprises a cylinder tube in which slides a piston rod assembly. A stepped cylinder nut, threaded at both ends and bored out through the centre, secures the piston rod assembly into the cylinder tube. The seal between the nut and the cylinder tube is made by an O ring. Fitted in the bore at the outer end of the nut are a U ring and a wiper seal which form the sealing arrangement between the nut inner bore and the outer surface of the sliding piston rod. A spacer and a screwed plate are fitted to the outer threaded portion of the nut, the plate forming the attachment point for the ram cylinder tube to the jib extension.



1 Centre casing
2 Bushes
3 Thrust bearings
4 Driving gear
5 Extended spindle
6 Attachment flange
7 O rings

Fig 9 Hydraulic pump



1 Jib
2 Hydraulic ram
3 Jib extension

Fig 10 Extension ram

4.4.3 Fitted to the inside end of the piston rod is an O ring, sandwiched between two back-up rings and a bush packing. Fitted on the end of the piston rod is a piston, secured to the piston rod by a two section ring and a guide bush. The seal between the piston and the piston rod is made by an O ring. A compact piston pack fitted to the external diameter of the piston forms the sliding seal between the piston and the cylinder tube bore.

4.5 Jib ram

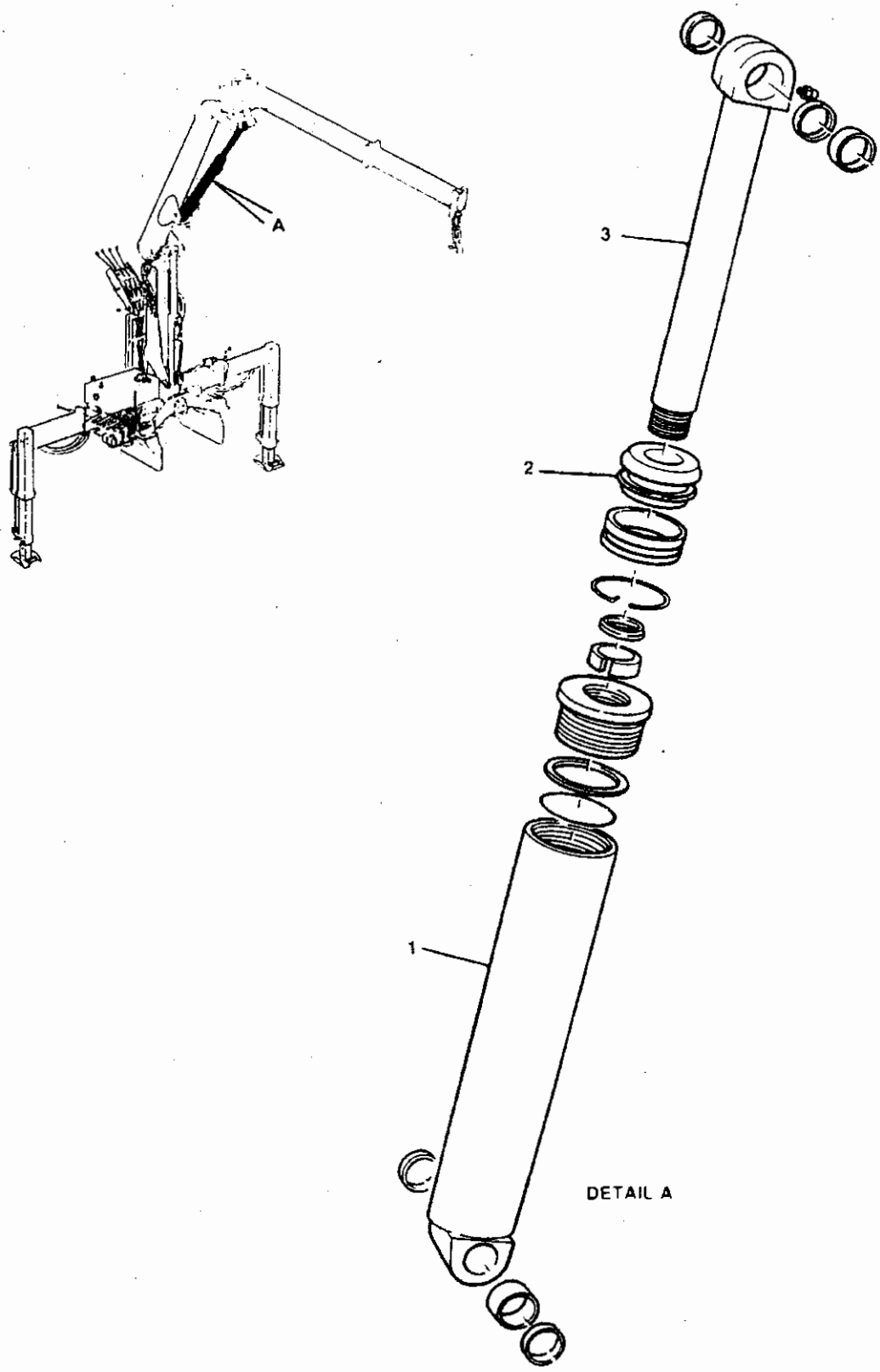
4.5.1 The jib ram (Fig 11) is a double acting hydraulic ram attached at its cylinder end to a bracket on the boom and attached at its piston rod end to a pressing rod/pull rod linkage. The linkage pull rods are attached at one end to the pressing rod and jib ram piston rod eye end and at the other end to the boom. For details of the linkage assembly, refer to Para 3.1.9. Hydraulic fluid to and from the ram is via two load holding valves which are attached one each end of the cylinder tube. Two chambers are formed in the cylinder tube by the ram piston and each chamber communicates with its respective load holding valve. The cylinder tube of the ram is attached to the boom by a pin which in turn is locked by a split pin. The ram piston rod eye end is attached to the push-rod by a pin locked by a circlip. A spacer and two bushes are fitted at both the cylinder tube eye end and the piston rod eye end.

4.5.2 The ram comprises a cylinder tube (1) in which slides a piston rod assembly (3). A cylinder nut bored out through the centre, secures the piston rod assembly in the cylinder tube. The seal between the nut and the cylinder tube is made by an O ring and a back-up ring. The nut is locked into the cylinder by a snap ring. Fitted to the inner bore of the nut is a packing ring and a wiper seal which form the sealing arrangement between the nut inner bore and the outer surface of the sliding piston rod.

4.5.3 Screwed onto the end of the piston rod is a piston (2) and fitted to the external diameter of the piston to form a sliding seal between the piston and the cylinder tube bore is a compact piston pack.

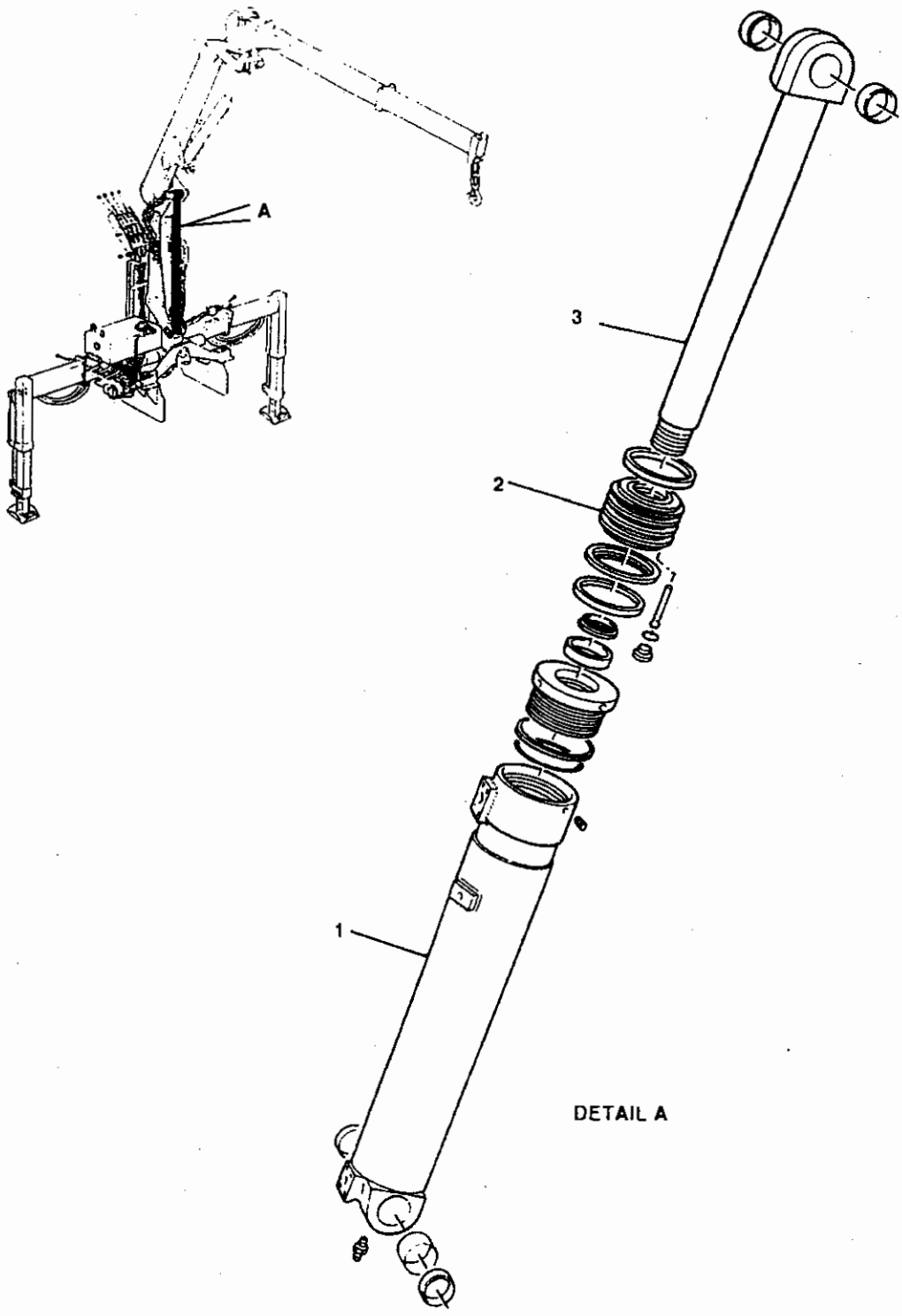
4.6 Lift ram

4.6.1 The lift ram (Fig 12) is a double acting hydraulic ram attached at its cylinder end to the crane column and attached at its piston rod end to a bracket on the inner end of the boom. Hydraulic fluid to and from the ram at its lower end is via a ram mounted load holding valve and hydraulic fluid to and from the ram at its upper end is via a ram mounted pressurising valve. Two chambers are formed in the cylinder tube by the ram piston and each chamber communicates with its respective valve. The cylinder tube of the ram is attached to the crane column by a pin which in turn is locked by a washer, nut and split pin. The ram piston rod eye end is attached to the boom bracket by a pin which in turn is locked by a split pin.



1 Cylinder
2 Piston
3 Piston rod assembly

Fig 11 Jib ram



1 Cylinder tube
2 Piston
3 Piston rod assembly

Fig 12 Lift ram

4.6.2 The ram comprises a cylinder tube (1) in which slides a piston rod assembly (3). A cylinder nut bored out through the centre, secures the piston rod assembly in the cylinder tube. The seal between the nut and the cylinder tube is made by an O ring and a back-up ring. The nut is locked into the cylinder by a threaded pin screwed through the outer diameter of the cylinder tube and engaging with one of a series of drilled holes in the nut. Fitted to the inner bore of the nut is a U ring and a wiper seal which form the sealing arrangement between the nut inner bore and the outer surface of the sliding piston rod.

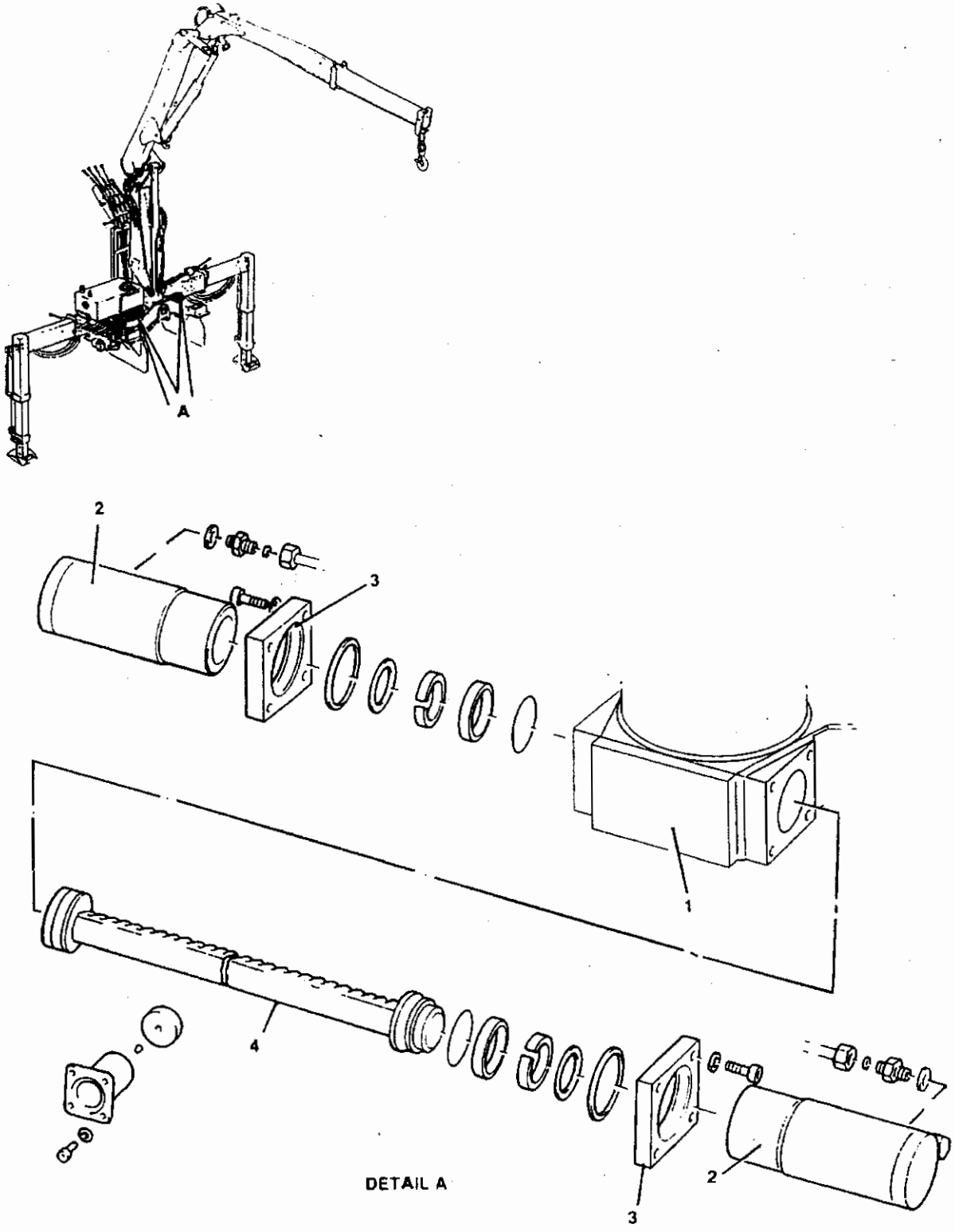
4.6.3 Screwed onto the end of the piston rod is a piston (2) and fitted to the external diameter of the piston to form a sliding seal between the piston and the cylinder tube bore, is a piston packing ring with a piston guide bush at each side. A non-return valve assembly is fitted to the piston and this comprises a pestle and a non-return valve sealed to the piston by an O ring.

4.7 Rotating ram

4.7.1 The rotating ram assembly (Fig 13) is located on the crane base and comprises a housing (1) formed on the crane base at the crane column bore. Two cylinders (2) are fitted to the housing, one each side. A piston rod (slewing rack) (4) with teeth formed along its length and a piston formed at each end, operates as the rack of a rack and pinion assembly with each piston operating in its associated cylinder. The pinion element of the rack and pinion comprises teeth formed on the circumference of the crane column. Hydraulic fluid to and from each cylinder is via a rigid pipe attached to each cylinder which communicates with the chamber formed by the piston in the cylinder. When one cylinder is subjected to hydraulic fluid pressure, the opposite cylinder is open to fluid return and consequently the piston rod will move laterally which, via the teeth, imparts a rotary movement to the crane column.

4.7.2 The attachment of the cylinders to the housing is identical for each cylinder and comprises a two piece holding ring which fits into a groove on the outer surface of the cylinder tube (2). A flange ring (3) with a machined recess in the connecting face, fits over the holding ring and, when attached to the housing (1) by four screws and washers, prevents the cylinder moving when under pressure.

4.7.3 To control the meshing of the piston rod teeth with the teeth on the crane column, a nylon slider fitted to the housing at a right angle to the piston rod, is in contact with the rear face of the piston rod, effectively holding the rod in mesh. The slider is held in position by a holder which, in turn, is attached to the housing by four screws and washers. Removal of the slewing rack requires prior removal of the crane column. Re-sealing of the pistons, can be carried out with only the cylinders removed.



1	Housing	3	Flange ring
2	Cylinder	4	Piston rod

Fig 13 Rotating ram

4.7.4 The piston to cylinder inner bore seal arrangement, for each piston is made by an O ring, a guide ring and a U ring held in place on the piston by a circlip.

4.8 Stabiliser ram

4.8.1 Each stabiliser ram (Fig 14) is a double acting hydraulic ram attached at its cylinder end to a bracket at the top end of the stabiliser outer tube and attached at its piston rod end to a bracket at the bottom of the stabiliser inner tube. Hydraulic fluid to and from the ram is via a ram mounted pilot operated, non-return valve. Two chambers are formed in the cylinder tube by the ram piston. The top chamber communicates directly with the pilot operated non-return valve whilst the bottom chamber communicates with the pilot operated non-return valve via an external rigid pipe. The cylinder tube of the ram is attached to the stabiliser outer tube by a pin which, in turn, is locked by a screw and locknut. The ram piston rod eye end is attached to the bracket on the stabiliser inner tube by a pin which, in turn, is locked by a screw and locknut.

4.8.2 The ram comprises a cylinder tube (1) in which slides a piston rod assembly (2). A guide bush secures the piston rod assembly in the cylinder tube. The seal between the guide bush and the cylinder tube is made by an O ring and a back-up ring. The guide bush is locked into the cylinder by a circlip. Fitted to the inner bore of the guide bush is a compact bar packing and a wiper seal which form the sealing arrangement between the guide bush inner bore and the outer surface of the sliding piston rod.

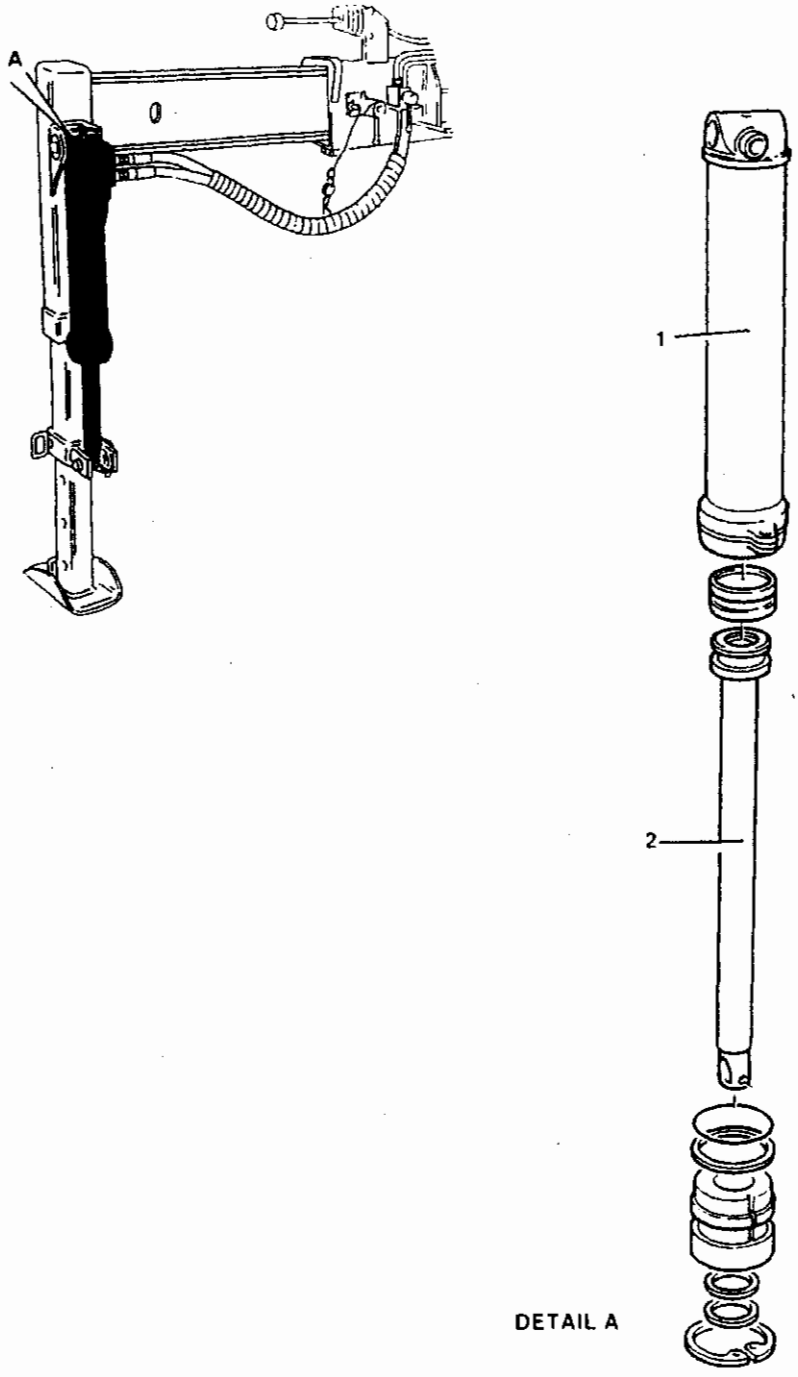
4.8.3 A piston, formed on the end of the piston rod is fitted with a compact piston pack to form the seal between the external diameter of the piston and the cylinder tube bore.

4.9 Valves (load holding, pressurising and pilot operated non-return)

4.9.1 The load holding valves (Fig 15) are fitted one at each end of the jib ram cylinder and one at the lower end of the lift ram cylinder. The load holding valve (Fig 16) is fitted on the piston rod end block of the jib extension ram. The pressurising valve (Fig 17) is fitted at the top end of the lift ram cylinder. The pilot operated non-return valves (Fig 18) are fitted one to each stabiliser ram at the attachment end of the ram cylinder.

4.9.2 The load holding valves all function in the same manner in that they have several functions consisting of a load holding section incorporating hose rupture and a pressure relief valve incorporating anti-cavitation.

4.9.3 The load holding function of the valve operates similar to the pilot operating non-return valve in that when the fluid, directed from the control valve, exceeds the pressure of the fluid locked inside the ram cylinder, it will open to allow fluid to enter the cylinder. Should a hose rupture, the falling pressure at the inlet side will be overcome by the pressure in the ram and the valve will close thus locking the fluid pressure in the ram. In normal operation, fluid from the control valve also passes, via the load holding valve and through a connecting pipe to the load holding valve at the other end of the ram. This lifts a piston which opens the non-return valve and allows the fluid locked in that end of the ram to flow back to the control valve and consequently the reservoir. This function operates for both extend and retract directions of the ram. With the control valve spool in the neutral position, the fluid flow to the valves ceases, both non-return valves re-seat and the ram piston is hydraulically locked in the cylinder.



1 Cylinder tube
2 Piston rod assembly

Fig 14 Stabiliser ram

4.9.4 The pressure relief function of the valve operates at a pressure higher than the normal 240 bar working pressure, allowing full working capacity from the ram but having the safety of a pressure relief valve protecting the ram, the system and the crane structure against any external forces it may be subjected to. If the boom, jib or jib extension are subjected to an external force which puts the ram under undue pressure, resulting in a ram cylinder pressure higher than the 285 bar pre-set operating pressure of the relief valve, the valve will open and relieve the pressurised fluid back to the control valve. In addition, fluid will also pass into the line feeding the load holding valve at the other end of the ram which will require fluid due to the vacuum created by the involuntary movement of the piston. This anti-cavitation function is achieved by fluid, passed from the opposite load holding valve, causing the relief valve to operate in the opposite direction to allow fluid into the cylinder chamber. Displacement of the piston towards the small end or the large end will determine if any excess fluid flows back to the control valve and then to the reservoir.

4.9.5 The pressurising valve is fitted on the lowering side of the boom ram. When the boom lower function is selected, the pressurising valve will remain closed and prevent fluid passing into the cylinder until the pressure is greater than 50 bar. Fluid pressure also passes through a connecting pipe to the load holding valve at the lower end of the ram, lifting a piston which opens the non-return valve ensuring slow and accurate control of the lowering movement of the ram under load. This valve is also capable of functioning as an anti-cavitation valve ensuring that the ram will never be starved of fluid should a involuntary movement occur (external forces).

4.9.6 The pilot operated non-return valves fitted to the stabiliser rams operate in the same manner as the non-return section of a load holding valve, refer to Para 4.9.3. Operation of the stabiliser control valve to a 'down' position will cause fluid to flow initially through a shut-off cock before reaching the top part of the non-return valve. The shut-off cocks enable each stabiliser to be deployed independently in order to level the vehicle and keep it stabilised during operation. Operation of the stabiliser control valve to an 'up' position will cause fluid to flow in through the bottom port of the non-return valve before entering the bottom end of the cylinder. This enables the pressure build-up to lift the small piston which opens the non-return valve and allows fluid, previously locked in the top of the cylinder, to return to the control valve and consequently to the reservoir.

4.9.7 All the valves are normally serviced on a 'repair by replacement' basis, however, should leaks occur, then dismantling, re-sealing and re-assembling is permitted. If this is carried out, the load holding valves will require an operating pressure check and, if necessary, adjustment. The 50 bar cartridge (computer number 0809074) in the pressurising valve can also be replaced if necessary.

4.10 Hydraulic hoses, pipes and adaptors

4.10.1 Rigid pipes are used in the system where they are reasonably straight runs and not subject to any flexing during crane operations. Flexible hoses are used in the system where flexing will occur or where the route is tortuous, ie hose connections to and associated with the hydraulic rams and the ram mounted valves and the hose routing from the base boom to the boom where the hoses pass through the side wall of the base boom.

4.10.2 The flexible hoses and the rigid pipes have an O ring fitted at each end to form a seal with the associated attached component. Pipe clips are fitted at suitable places on the crane to retain the hoses or pipes in position. Standard adaptors are used and, where these are fitted to components, are sealed by a seal ring.

4.10.3 Two types of rotary slewing couplings (Fig 19) are used in the system. One type 'A' coupling is fitted in the overload protection part of the system and is structurally mounted on the crane base. The type 'A' coupling end fittings are arranged for a hose connection at one end and a pipe connection at the other. Six type 'B' couplings are fitted to the crane control valve, two each at the lift ram section, jib ram section and extension ram section. One end of each type 'B' coupling is screwed into the control valve and the outer end fitting is for a hose connection.

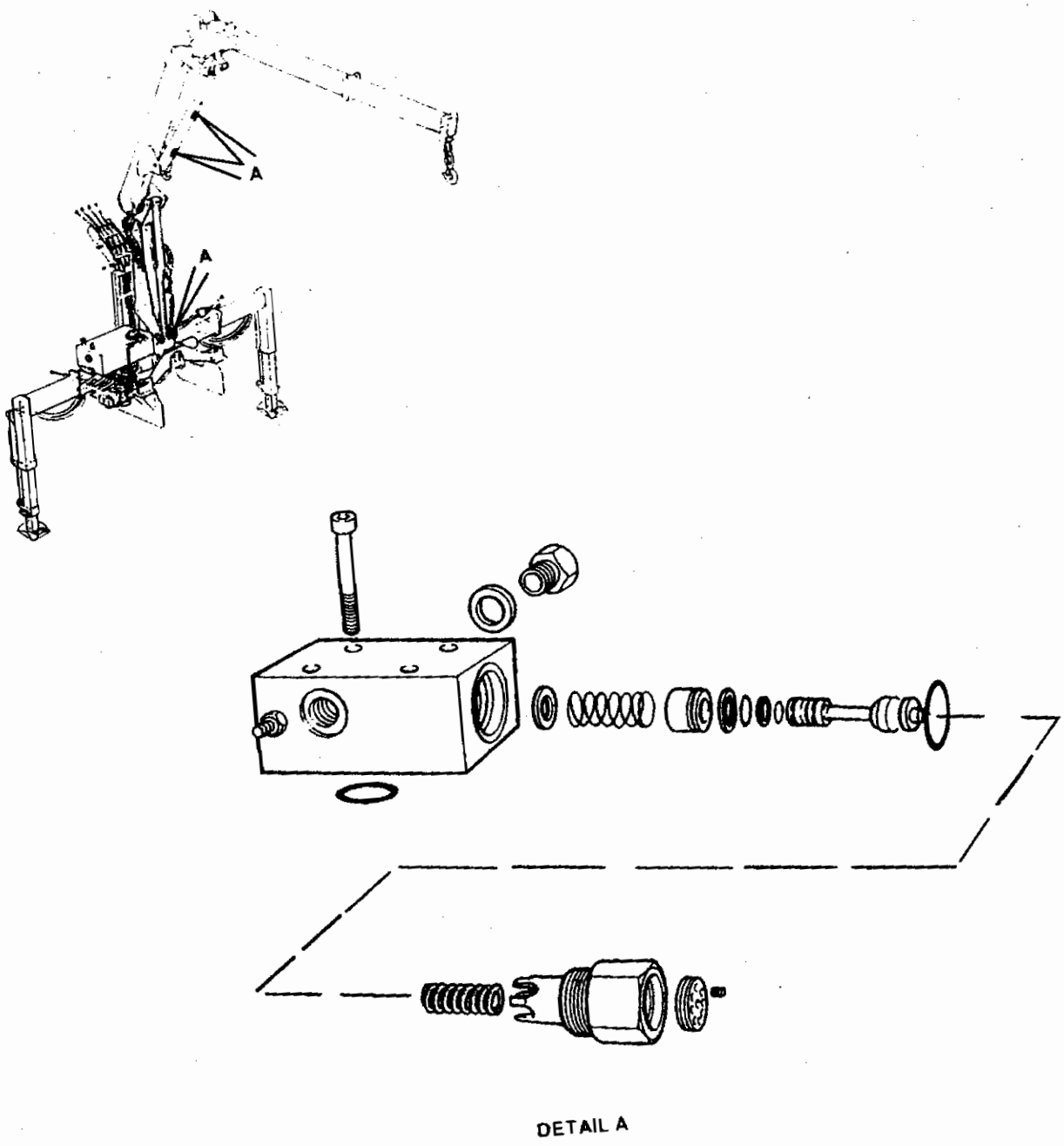


Fig 15 Load holding valve - lift and jib rams

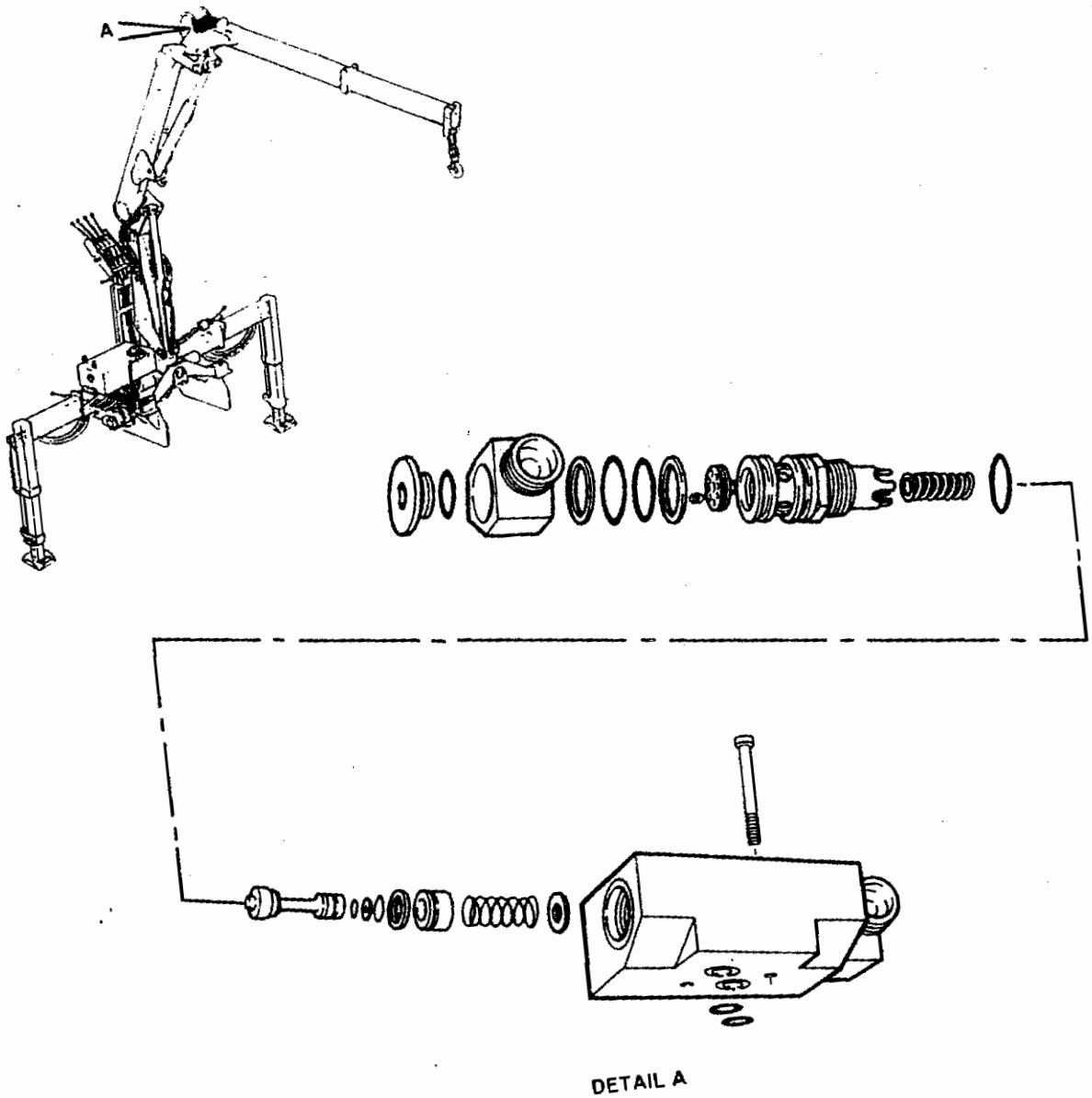


Fig 16 Load holding valve - extension ram

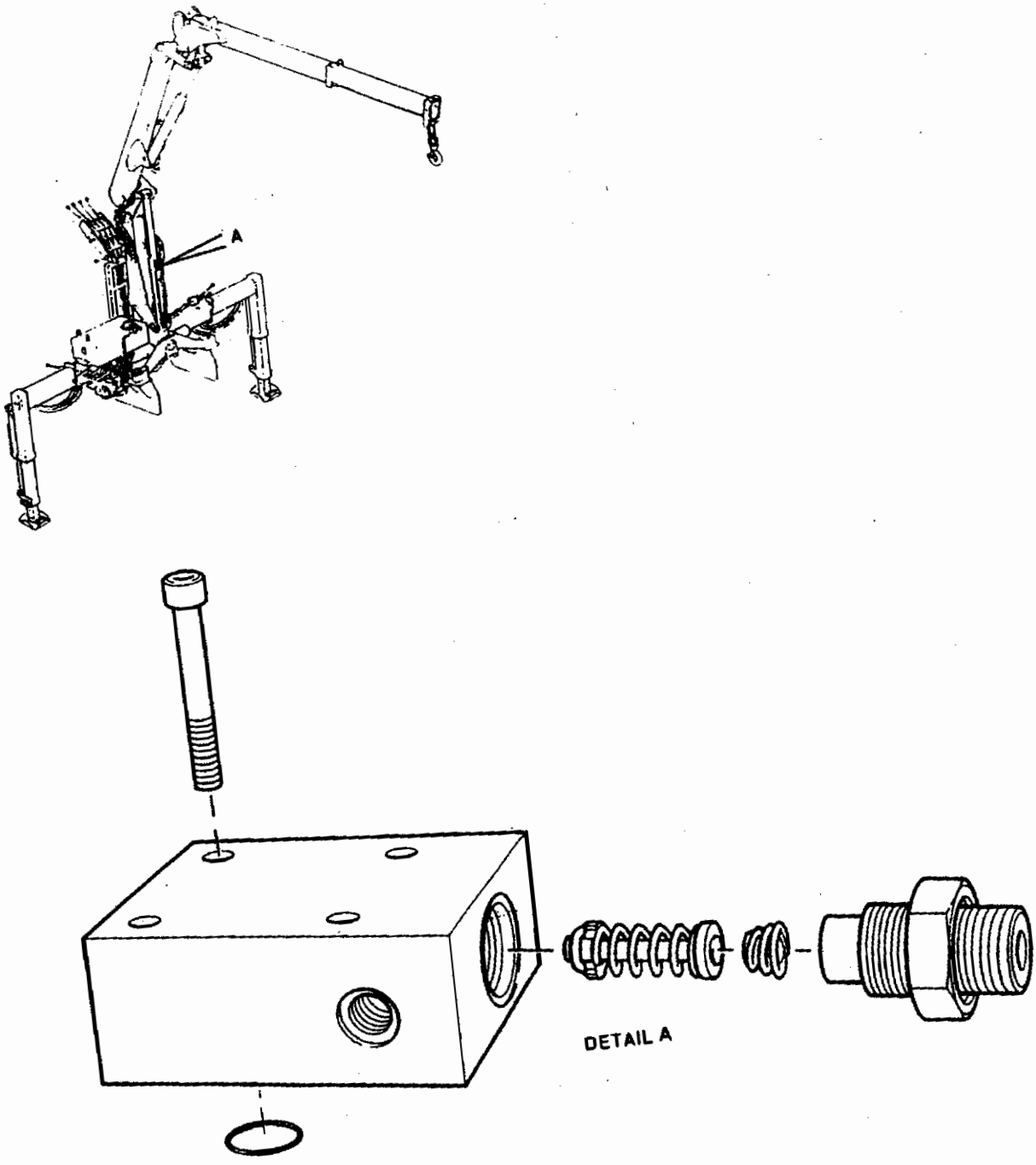
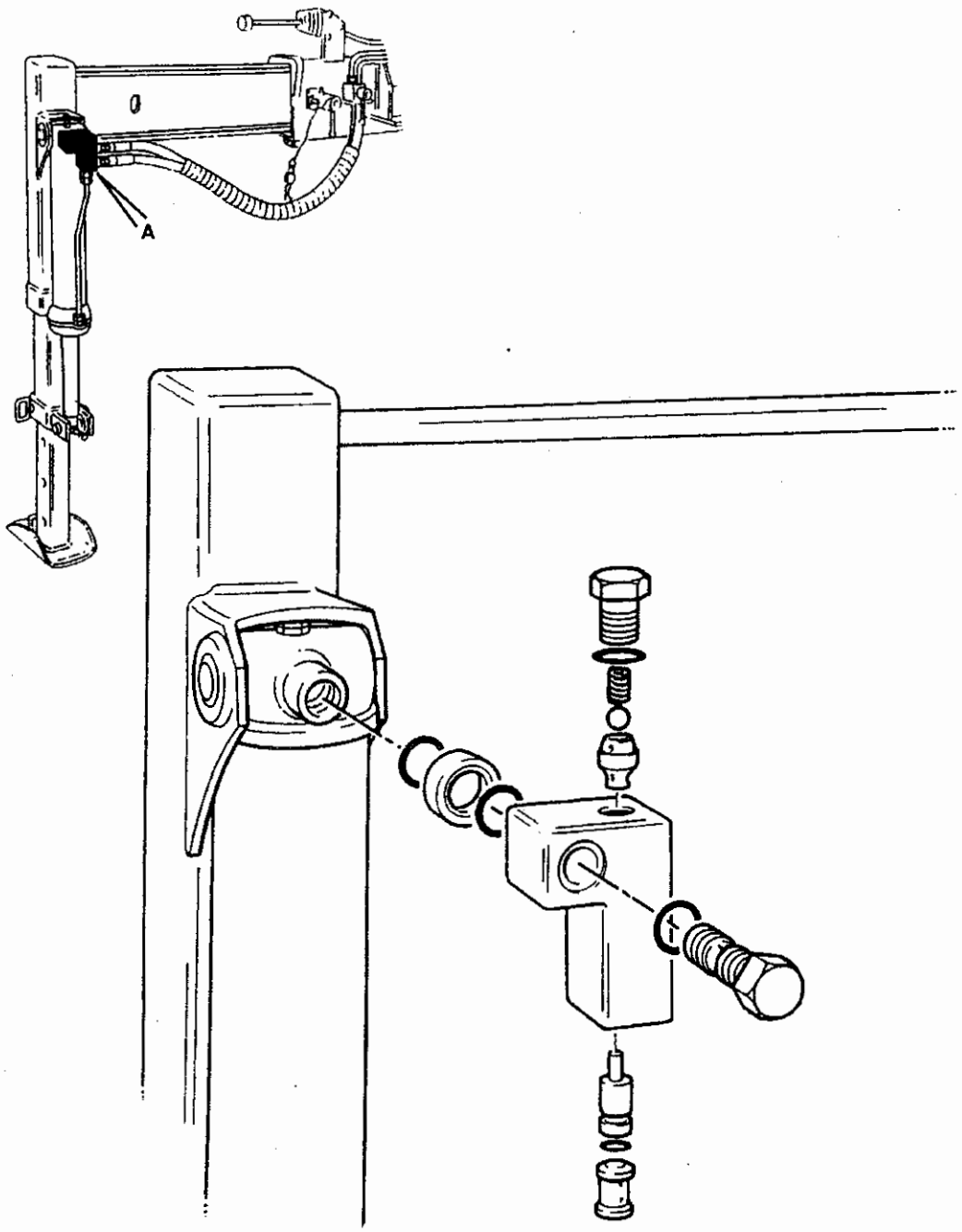


Fig 17 Pressurising valve - lift ram



DETAIL A

Fig 18 Pilot operated non-return valve

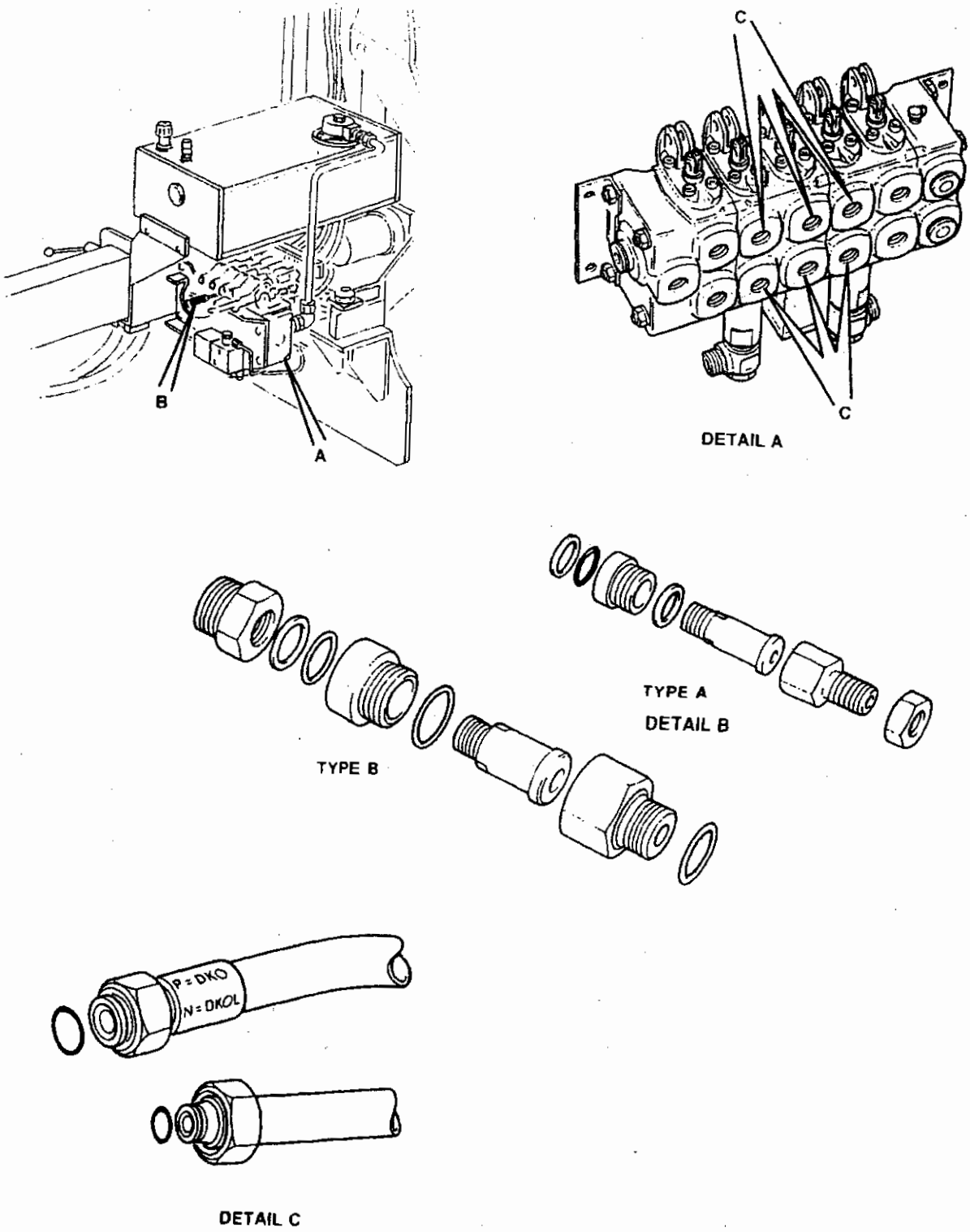


Fig 19. Hydraulic hoses, pipes and adaptors

4.10.4 The type 'A' slewing coupling is comprised of a back-up ring, O ring, male adaptor, gasket, connector, female adaptor and nut. The type B slewing coupling is comprised of a end adaptor, back-up ring, O ring, male adaptor, slide ring connector, female adaptor and gasket. The servicing of these couplings is on a 'repair by replacement' basis, although should leaks occur O rings can be replaced.

CONTROL EQUIPMENT DESCRIPTION

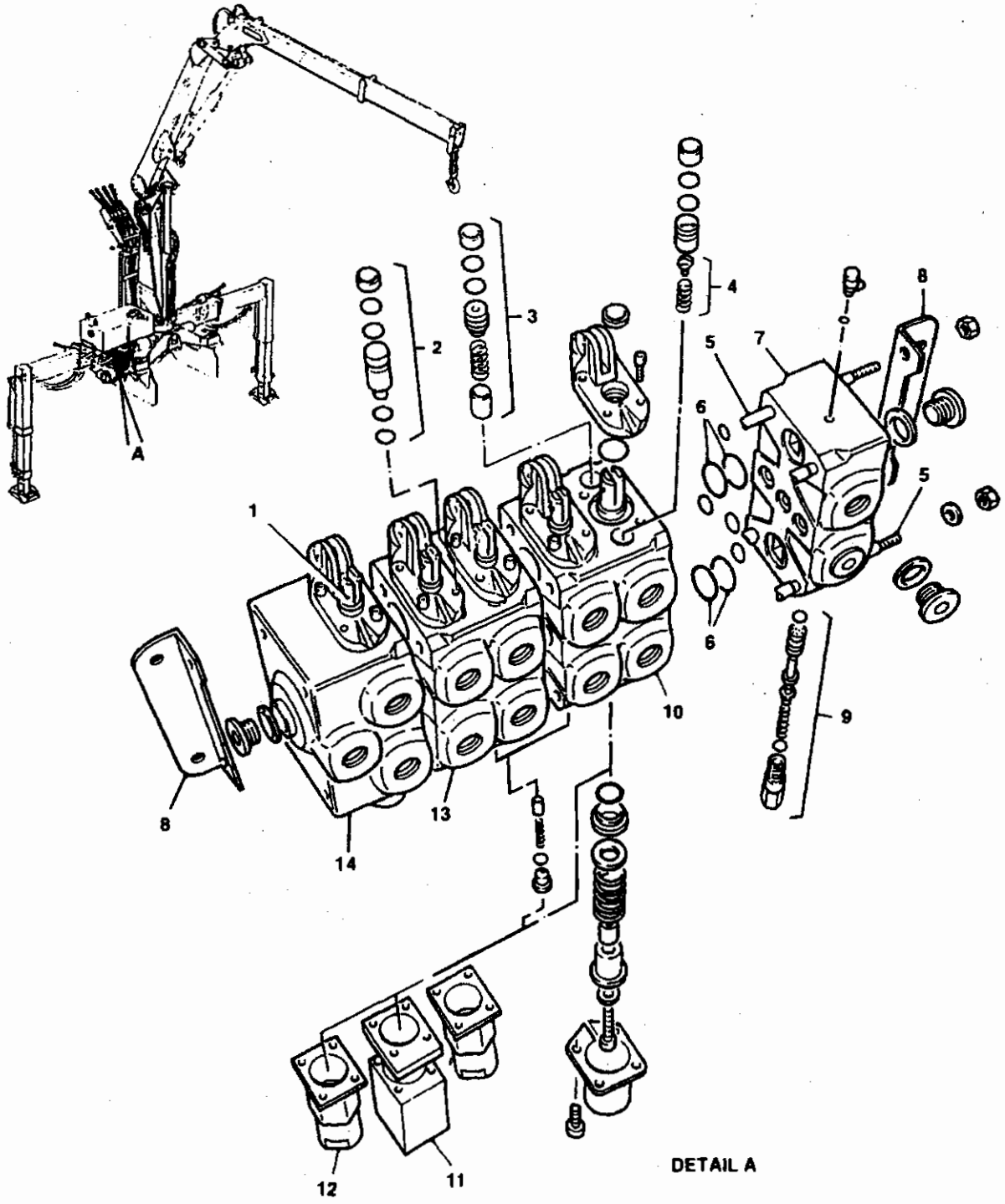
5 The following paragraphs describe, in detail, the crane control equipment.

5.1 Control valve block with directional spool valves

5.1.1 The control valve block (Fig 20) consists of four main sections, the inlet or pressure section (7), the slew and boom section (10), the jib and extension section (13), and the stabiliser and end plate section (14). These sections are all bolted together, with seals (6) between the sections and with a mounting bracket fitted at each end. Four bolts (tie-rods), each fitted with a washer and a nut at each end, secure the sections and the mounting brackets together to form one unit. The tie-rods are torque tightened to a value of 18 Nm (13.3 lbs ft).

5.1.2 In operation, the inlet or pressure section receives hydraulic fluid from the pump and passes it through a neutral channel formed in the unit. The fluid flow from this channel is directed back to the hydraulic reservoir until a particular spool valve has been selected to activate a function. When the selection is made, the pressure limit valve housed in the particular section will control the fluid pressure to a maximum of 240 bar.

5.1.3 The valve section adjacent to the pressure section houses the spool valves for both the slew and the boom functions. Both of these work in the same manner in that when the spool valve is moved from its central position, it restricts the fluid flow through the neutral channel and directs it through the appropriate port in the section, as determined by the selection made, and consequently to the respective side of the ram. Simultaneously, the pressure rises and, when it is greater than the pressure in the ram, the ram will move in the selected direction. The slew section has a cartridge, of 210 bar working pressure, fitted in each of two ports to limit the pressure and to safeguard the system against external, forces i.e. the valve will open under the pressure of the ram being forced and will allow the fluid to pass into the return channel and consequently to the reservoir. The cartridge in the opposite port of the section will open in the opposite direction and allow fluid to be sucked into the ram thus operating as an anti-cavitation valve which forms the second function of the cartridge. The spool valve is machined to match the bore in which it fits. It is colour coded the same as the section in which it fits and should never be removed except for cleaning. The spool valve and its section are a matched pair and should never be replaced separately. The boom function in this valve section is the same as that for the slew section except that only one pressure cartridge is fitted. This is fitted in the boom section lower port, its purpose being to lower the pressure to 100 bar and to function as an anti-cavitation valve. The raise side of the boom section does not require a cartridge since the function of the cartridge is carried out by the load holding valve fitted directly onto the ram and, in addition, the spool valve has a open centre to allow the load holding valve to close and suck fluid when required.



1	Spool valve	9	Pressure limit valve
2	'Y' plug	10	Slew and boom section
3	Non-return valve	11	Overload limit valve (jib)
4	Pressure cartridge	12	Overload limit valve (boom lower and extend)
5	Tie rods	13	Jib and extension section
6	Seals	14	End plate section
7	Inlet or pressure section		
8	Mounting brackets		

Fig 20 Control valve block with directional spool valves

5.1.4. Both the jib and extension functions are housed in the next valve section and these function the same as the boom section except that the section is not fitted with any pressure cartridges. Both spool valves are open centred.

5.1.5 The last valve section comprises the stabiliser and the end section. No pressure cartridges are fitted and, similar to the slew spool valve, the stabiliser spool valve is not open centred. The end section forms the return fluid channel.

5.1.6 A pressure overload limit valve for the jib (11) and a pressure overload limit valve for the boom lower and extend (12) are fitted in the control valve, as are non-return valves (3) and 'Y' plugs (2). The specific control valve section for slew and for boom lower are fitted with pressure inserts which limit pressure, (slew 210 bar, boom lower 100 bar), all other functions are fitted with a 'Y' plug which allows the full working pressure of 240 bar ± 5 bar for that control valve section.

5.2 Remote controls

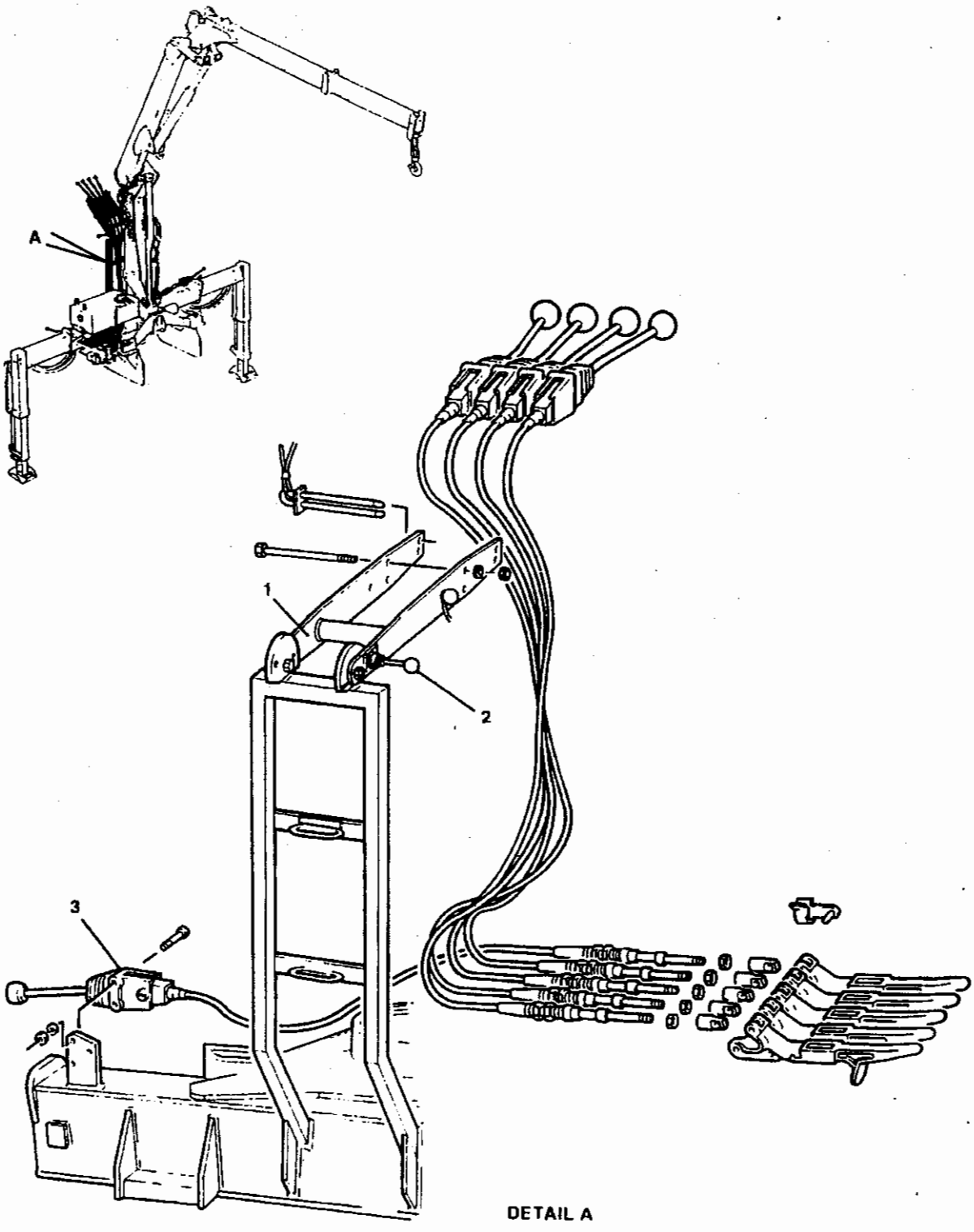
5.2.1 The remote control selectors (Fig 21) for the control of the crane column slew, boom, jib and jib extension functions are located behind the vehicle cab at roof top level, on a pivoting bracket (1) which, in turn, is mounted on the top of a fixed pylon welded to the rear face of the crane base beam. This arrangement allows the operator to exercise control of crane functions from the vehicle cab observation hatch. The remote control selector for the stabilisers is located on the crane base beam at the offside of the vehicle. Since the main controls are located at the nearside of the vehicle and each stabiliser system is fitted with a hydraulic fluid shut-off cock, individual stabiliser operation can be achieved from either side.

5.2.2 Semi-circular brackets, welded on the top of the fixed pylon, form the attachment points for the pivoting bracket, fitted bolts, washers and nuts being used. A knob operated, spring loaded locking pin (2) engaging with either one of two holes in the bracket forms the positioning arrangement for the pivoting bracket. A fixed knob, fitted part way up the pivoting bracket, forms a handle for ease of moving the assembly.

5.2.3 The four remote selector units are secured between the top of the pivoting bracket side plates by three extended bolts locked by washers and nuts. The bolts pass through the brackets and all four of the selector units. When not in use, the selector levers are held in a neutral position by the fitment of a double legged locking pin which passes through the pivoting bracket with a leg of the pin each side of the control levers. To prevent loss, the pin is attached to the bracket by a short length of cable.

5.2.4 From the remote control units, operating cables, in outer conduits, pass down the pivoting bracket and through two cable restrainers welded on the fixed pylon bracket. Each cable is connected to its appropriate operating lever on the crane control unit by the eye head of the cable screwing into a eye end which, in turn, is attached to the bellcrank of the control lever. The eye head of the cable is locked to the eye end by a locknut and the eye end is locked to the control lever by a spring locking pin.

5.2.5 The remote control selector unit for the stabilisers (3) is mounted on a bracket welded to the crane base beam. The unit is attached by three bolts locked by washers and nuts. The cable passes across the base beam and is connected to its appropriate control lever in the same manner as the other control cables.



1 Pivoting bracket
2 Locking pin
3 Remote control for stabilisers

Fig 21 Remote controls

CHAPTER 19

TYRE HANDLER

CONTENTS

Refer to associated publication OCTAD 2590-N-105 for further information

WARNINGS

(1) TYRE HANDLER OPERATION. THE CRANE HAS BEEN MODIFIED FOR TYRE HANDLING TO GIVE THE CONTROLS GREATER SENSITIVITY WHEN MANOEUVRING A WHEEL INTO POSITION ON A VEHICLE. DO NOT EXCEED THE MAXIMUM SWL FIGURE OF 400 KG QUOTED ON THE LABEL AFFIXED TO THE CRANE BOOM (FIG 1), WHEN USING THE VEHICLE IN CRANE OR TYRE HANDLER MODE.

(2) THE CRANE/TYRE HANDLER OPERATOR MUST BE CONVERSANT WITH ALL ACCIDENT PREVENTION REGULATIONS AND OPERATING INSTRUCTIONS.

(3) IT IS PROHIBITED TO OPERATE THE CRANE/TYRE HANDLER ON BOARD SHIPS.

(4) THE USE OF THE CRANE/TYRE HANDLER FOR ANY TASKS ASSOCIATED WITH AIRCRAFT REQUIRES THE AIRFRAME TO BE EARTH BONDED IMMEDIATELY BEFORE AND DURING THE USE OF THE CALM.

(5) THE USE OF JIB EXTENSIONS IS PROHIBITED

(6) THE CRANE HYDRAULIC OPERATING PRESSURE MUST NOT BE INCREASED OR MODIFIED IN ANY WAY.

(7) ENSURE THAT THE HYDRAULIC STABILISERS (OUTRIGGERS) ARE CORRECTLY DEPLOYED AND LOCKED IN POSITION BEFORE ATTEMPTING TO OPERATE THE TYRE HANDLER.

(8) ENSURE THAT THE HANDBRAKE IS APPLIED AND THAT CHOCKS ARE POSITIONED BENEATH THE ROAD WHEELS BEFORE ATTEMPTING TO DEPLOY/OPERATE THE TYRE HANDLER.

(9) WHERE POSSIBLE, PARK THE VEHICLE ON FIRM LEVEL GROUND BEFORE DEPLOYING/OPERATING THE TYRE HANDLER.

(10) WHEN THE GROUND SURFACE IS SOFT AND THERE IS A POSSIBILITY OF THE HYDRAULIC STABILISER FEET PENETRATING THE GROUND SURFACE, PLACE RIGID PANELS OF SUFFICIENT STRENGTH BENEATH EACH STABILISER FOOT.

(11) PERSONNEL ARE NOT PERMITTED TO BE WITHIN THE TYRE HANDLER'S SLEWING RANGE OR UNDER SUSPENDED LOADS.

(12) DO NOT SHUT DOWN THE CRANE/TYRE HANDLER WITH A SUSPENDED LOAD.

(13) DO NOT ATTEMPT TO MOVE THE VEHICLE WITH A SUSPENDED LOAD.

(14) DO NOT COMMENCE SLEWING UNLESS THE CENTRAL COLUMN IS UPRIGHT.

(15) DO NOT COMMENCE SLEWING UNTIL THE LOAD IS SUSPENDED AND IT IS SAFE TO DO SO.

(16) DO NOT EXCEED THE LOAD CAPACITY STATED IN THE LOAD CAPACITY CHART. THE LOAD CAPACITY STATED REFERS TO THE CRANE IN A HORIZONTAL POSITION; THIS CAPACITY WILL BE REDUCED WHEN THE CRANE IS OPERATED AT AN ANGLE.

(17) ENSURE THAT A MINIMUM SAFE WORKING DISTANCE OF 5 METRES IS OBSERVED WHEN WORKING IN THE VICINITY OF OVERHEAD CABLES.

(18) WHILST OPERATING THE CRANE/TYRE HANDLER, OPERATORS NEED TO BE AWARE OF ANY OVERHEAD OBSTRUCTIONS, AND THAT A FULLY EXTENDED CRANE IN THE EXTENDED VERTICAL POSITION CAN REACH A HEIGHT OF 10.5 METRES FROM GROUND LEVEL.

(19) ENSURE THAT THE POWER TAKE-OFF UNIT IS DISENGAGED BEFORE ATTEMPTING TO DRIVE THE VEHICLE.

(20) ENSURE THAT THE HAND THROTTLE LEVER IS RETURNED TO THE ENGINE IDLING POSITION BEFORE ATTEMPTING THE DRIVE THE VEHICLE.

(21) ENSURE THAT BOTH HYDRAULIC ISOLATION VALVES ARE IN THE FULLY CLOSED POSITION WHILST THE OUTRIGGERS ARE EITHER IN THE DEPLOYED OR FULLY RETRACTED POSITIONS.

(22) PERSONAL INJURY. CRANE/TYRE HANDLER OPERATORS AND MAINTAINERS NEED TO TAKE CARE WHEN UNSTOWING AND STOWING, THE UPPER REMOTE CRANE CONTROLS IN ORDER TO PREVENT A FALL FROM HEIGHT ACCIDENT.

CAUTIONS

(1) When the column folding ram attains it's fully stowed or erected position, ensure that the control lever is continued to be operated for an additional 5 seconds to ensure that the column folding hydraulic system is fully pressurised.

(2) To prevent accidental damage to the vehicle or crane, ensure that particular care is taken whilst the crane boom is being manoeuvred into it's deployed or transit positions and whenever the crane is operated within close proximity of the vehicle headboard or body.

(3) The design of this crane prohibits a straight vertical lift. Crane operators will need to operate the inner and outer booms alternatively to obtain a staged vertical lift.

Refer to AESP 2320-H-104-411 for crane modification details.

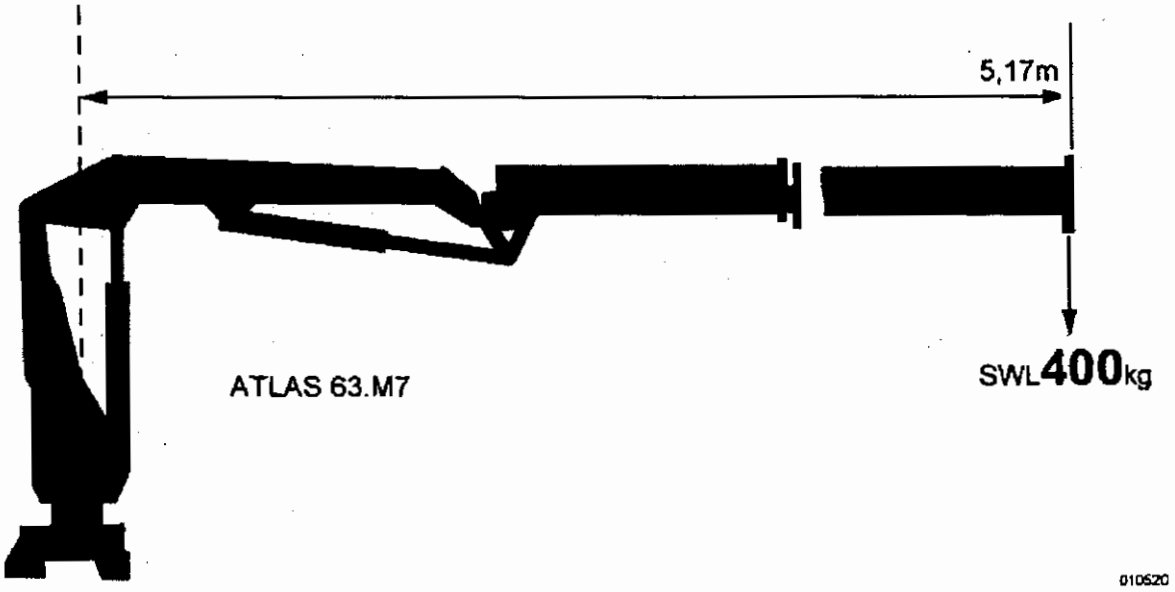


Fig 1 Lifting capacity

GENERAL DESCRIPTION

1 The tyre handler is designed to fit a modified CALM variant and used to aid wheel replacement to Demountable Rack Offload and Pickup System (DROPS) vehicles.

1.1 Three electro-hydraulically powered functions incorporated in the design allow the operator to position a wheel precisely, these being; CLAMP, ROTATE, TILT.

1.2 The hydraulic and electrical supply are taken from the host crane.

2 Mechanical components

2.1 The tyre handler comprises:

2.1.1 Clamp assembly (Fig 2 (3)); a box welded framework with clamp arms pivoted at both ends. A hydraulic ram housed within the frame, provides the means to extend and retract the clamp arms.

2.1.2 Rotary actuator (1); mounted centrally on the framework and providing the means to rotate the tyre handler.

2.1.3 Tilt head (4); lift motion is achieved when the jib extension is operated via the telescope lever causing the tyre handler to pivot about the tie bar (2).

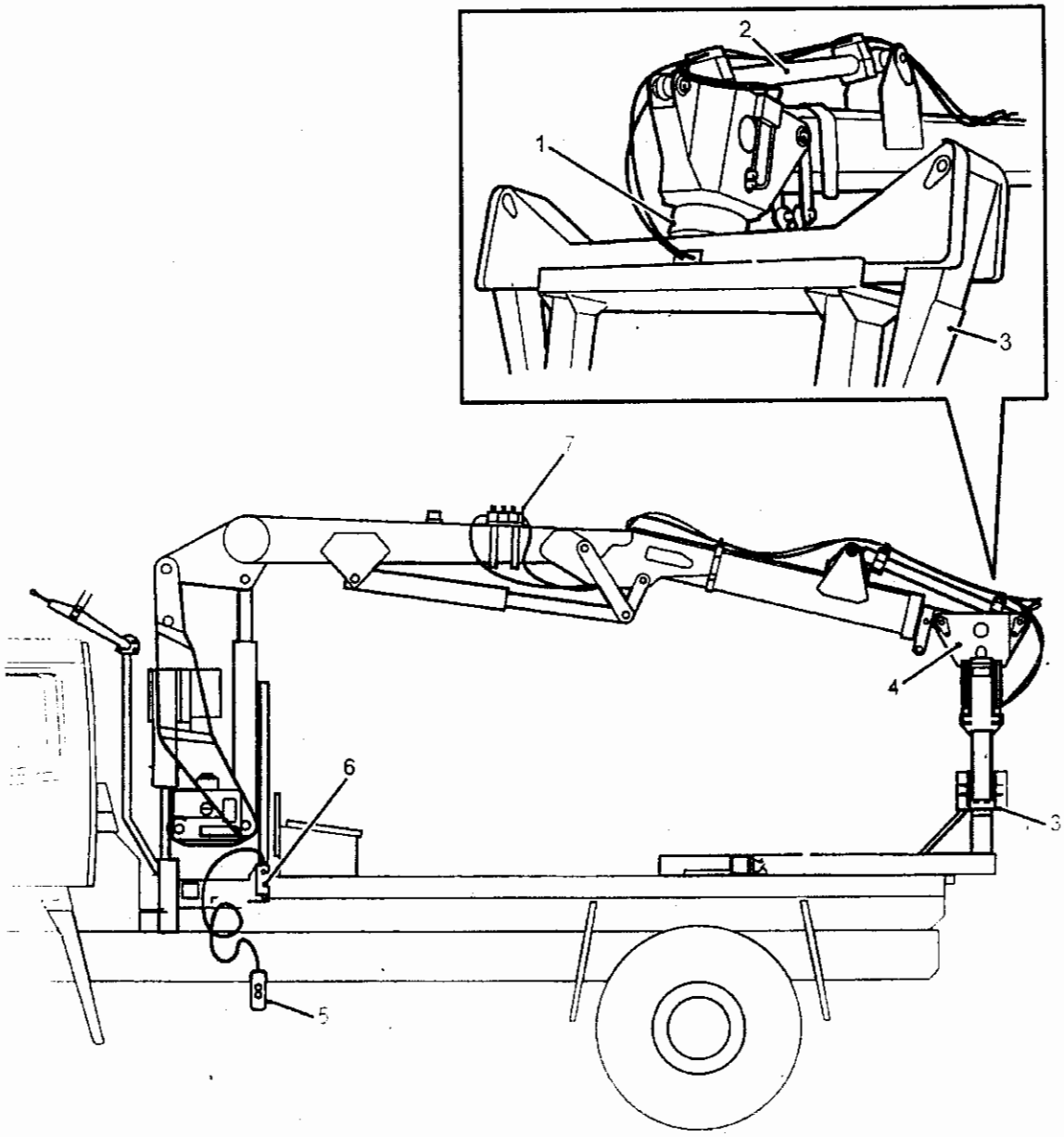
3 Electrical components

3.1 Control box (6); mounted beneath the crane hydraulic reservoir, the control box provides the interface between the tyre handler and crane. The three position switch must be moved to the 'HANDLER' position before operating the handler and must be set in the 'OFF' position when the handler is not in use, to prevent damage to the solenoid coil.

3.2 Pendant control (5); connected to the control box by a multi-pin plug and lead, the pendant control enables the operator to work from either set of crane hydraulic controls.

4 Electro/hydraulic components

4.1 Diverter valve block (7); comprises three solenoid valves which, when operated by the pendant control switch, direct hydraulic fluid to either clamp arm ram, rotary actuator or jib extension. Quick release couplings are set opposed to each other to prevent incorrect connection.



1 Rotary actuator
2 Tie bar
3 Clamp assembly
4 Tilt head
5 Pendant control
6 Control box
7 Diverter valve block

Fig 2 Tyre handler assembly

CHAPTER 20

VARIANT (EURO 2)

CONTENTS

ENGINE

1 All vehicles are equipped with a modified Leyland DAF 300 Series diesel engine designated EURO 2. This engine type conforms to current EEC legislative exhaust emission levels (91/542/EEC level B).

2 This turbo-charged and inter-cooled engine has a six cylinder in-line configuration with a four stroke cycle, direct injection combustion and a compression ratio of 17.5:1.

3 The engine operating speeds are as follows:

3.1 Idling speed: 600 to 850 rpm.

3.2 Maximum governed speed (no-load): 2850 to 2950 rpm.

4 The net installed engine power ratings are as follows:

4.1 Installed power: 105.46 kW (141.4 bhp) @ 2500 rpm.

4.2 Installed torque: 515 Nm (380 lbf ft) @ 1500 rpm.

FUEL, EXHAUST AND INDUCTION SYSTEMS

5 All engines are equipped with an air cooled engine inter-cooler. The inter-cooler matrix is attached to the front of the engine cooling system radiator.

6 Bosch VER 6 fuel pump injection timing: Start of injection 1.1 ± 0.2 mm plunger travel.

7 All vehicles comply with the Agreement for the International Carriage of Dangerous Goods by Roads (ADR) and have been modified as follows:

7.1 The vehicle fuel has been re-positioned on the RH side of the chassis frame.

7.2 The engine exhaust system discharges on the LH side of the vehicle and is fitted with a heat shield.

7.3 All electrical cables and connections are fully protected.

7.4 All fuel pipes and connections are fully protected.

ELECTRICAL EARTH BONDING SYSTEM

8 The following components (Fig 1) are earth bonded to the vehicle chassis:

8.1 Heater box to chassis front cross member.

8.2 Engine (alternator mounting bracket) to chassis frame.

8.3 Gearbox to chassis frame.

8.4 Cab (LH headlight) to chassis front cross member.

9 Earth bond strap to chassis attachment and test requirements:

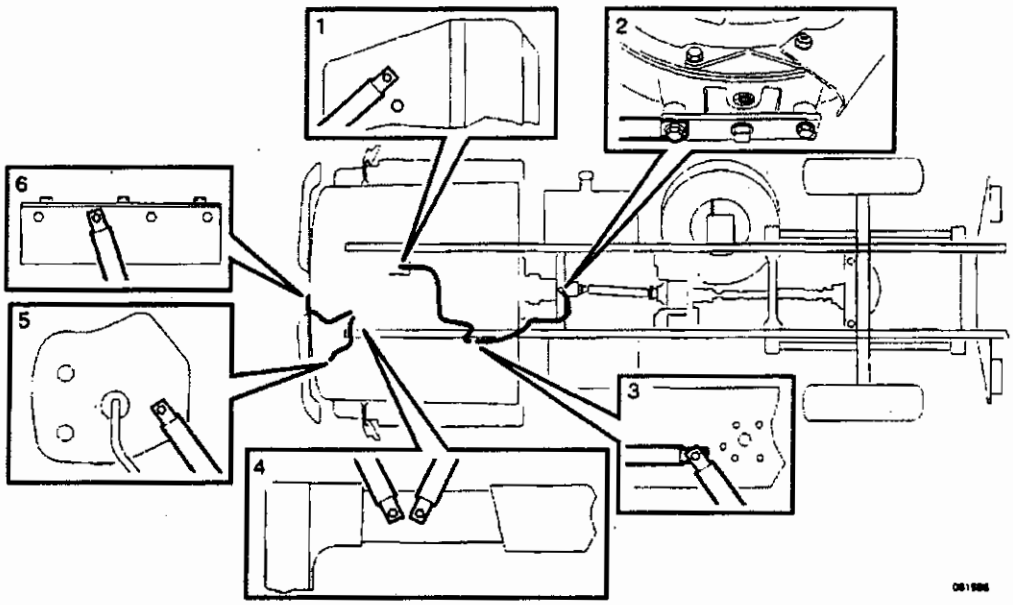
9.1 It is essential that the contact surfaces of each earth strap fixing tab and its corresponding chassis frame/component must be paint-free and clean prior to connection.

9.2 Ensure that the contact surfaces between the alternator fixing eyes to bracket and the bracket to engine block are paint-free and clean prior to connection.

9.3 An earth bond resistance test should be performed on all the earth bond strap fixing tabs using the NATO standard test meter (Pt. No. Z4/6625-99-786-5771). The maximum resistance must not exceed 0.2 ohms. The test should be carried out between the earth bond strap fixing tab and a bare portion of the contact surface as close as possible to the earth strap fixing.

9.4 An earth bond resistance test must also be performed between the alternator and its mounting bracket and the alternator mounting bracket and the engine block; the maximum permissible limit for these earth bonds is 0.2 ohms.

9.5 After successfully testing the earth bonding, apply a suitable grease to the fixing tab of each earth strap and the surrounding area of bare metal to prevent corrosion and maintain earth bonding integrity.



1 Alternator mounting bracket earth bond
2 Gearbox earth bond
3 LH chassis frame earth bond
4 Chassis front cross member earth bond
5 Cab (LH headlight) earth bond
6 Heater box earth bond

Fig 1 Vehicle earth bonding locations

ARMY EQUIPMENT AND SUPPORT PUBLICATION (AESP) AND ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS (EMER) - FORM 10

*AESP/EMER NUMBER:		*IS THIS SAFETY RELATED?	YES ☐	No ☐

Send Form 10 via the Email or Post address. However email is preferred.	Tel [redacted]
Email: [redacted]	Post to [redacted]

ORIGINATORS DETAILS:			
*Address		*Name	
		Rank / Grade	
		*Phone	
		*Senders Reference	
		*Date Raised	
* E-Mail		Eqpt Asset Code if applicable	

AESP/EMER DETAILS:							
*Full Title of AESP/EMER (Not the AESP/EMER Number)							
*Edition	*Amendment	*Chapter	*Paragraph	*Page	Figure	Instruction	Other
*Comments: If additional information is to be supplied, please e-mail with the Form 10 as separate attachments.							

FORM 10 CELL USE:			
*Date Received		*Form 10 Reference	
*Date Sent to PT / SME		TDOL Problem Report	

PROJECT TEAM / SME RESPONSE TO COMMENTS:			
Project Team (PT) / SME		Sponsors Name	
*Phone		Rank / Grade	
*Email		*Date Received	

*The following action is to be carried out:	Mark:		Mark:
Issue a revised/amended AESP/EMER:		Under investigation:	
Incorporate comment(s) in future amendments:		No action required:	

Remarks:			
SPONSOR/PT FINAL CLOSURE STEPS	Mark:	Form 10 Cell notified of Date action taken	Date:
Form 10 Originator notified of the action taken:			

AESP Form 10 (Issue 6.0 dated January 13 (JAMES))

* Fields are mandatory for form initiator

* Fields are required to complete

ARMY EQUIPMENT
SUPPORT PUBLICATION

2320-H-104-831
5th Edition dated June 2013
(Superseding 4th Edition dated Jan 12)

TRUCK, 4 TONNE, 4 X 4 GS LEYLAND DAF (ALL VARIANTS)

SERVICE ENGINEERED MODIFICATION INSTRUCTION AND INDEX

Sponsored for use in the
UNITED KINGDOM MINISTRY OF DEFENCE
AND ARMED FORCES
by

DEFENCE EQUIPMENT & SUPPORT
GENERAL SUPPORT VEHICLE PROJECT TEAM

MOD Abbey Wood
Bristol
BS34 8JH

Publication Authority:

GENERAL SUPPORT VEHICLE PROJECT TEAM

CONDITIONS OF RELEASE

~~This information is released by the UK Government for Defence purposes only.~~

~~This information must be afforded the same degree of protection as that afforded to information of an equivalent security marking originated by the recipient Government or as required by the recipient Government's security regulations.~~

~~This information may be disclosed only within the Defence Department of the recipient Government, except as otherwise authorized by the Ministry of Defence (Army).~~

This information may be subject to privately owned rights.

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Amdt No.	Incorporated by (Signature)	Date
32		
33		
34		
35		
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		

PREFACE

Sponsor: GSV IPT
Project No.:
File Ref:

Publication Authority: DGS&E-TIG

INTRODUCTION

1 The Publication Sponsor is responsible for the allocation of instruction numbers.

2 All modification instructions as issued are to be recorded in manuscript by the recipient on the Numerical Modification Instruction Index provided. Amendments to individual instructions are to be recorded on the instruction amendment record. All extant instructions and amendments can be found listed in the main AESP index.

NOTE

The Publication Sponsor is responsible for the preparation and maintenance of the Instruction Index and will advise the Distribution Authority on the issue of completed and subsequent blank index pages necessary.

3 Service users should forward any comments on this publication through the channels prescribed in AESP 0100-P-011-013. An AESP Form 10 is provided after the preliminary pages of this publication; it should be photocopied and used for forwarding comments on this AESP.

4 AESPs are issued under Defence Council authority and where AESPs specify action to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores.

SERVICE ENGINEERED MODIFICATION INSTRUCTION INDEX

Priority (Pty) is shown as: Immediate: I Routine: R

Instr No. (1)	Pty (2)	Page Nos. (3)	Amend-ment No. (4)	Subject (5)	Approval No./ Remarks (6)
1	R	1-23/24		Fitment of rear hardtop compartment	
2	R	1-4		Fitment of a front pintle spacer	

TRUCK 4 TONNE, 4 X 4 GS, LEYLAND DAF (ALL VARIANTS)

SERVICE ENGINEERED MODIFICATION INSTRUCTION NO. 1

Sponsor:
DGES(A)

Publication Agency:
ATSA Chertsey
Project No: RAF/5/97/LVG (383)
File ref: RAF/5/97/LVG

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		

Amdt No.	Incorporated by (Signature)	Date
4		
5		
6		

SUBJECT: Fitment of rear hardtop compartment

INTRODUCTION

1 This instruction details the construction and fitting of a secure waterproof hardtop facility on the current in service Leyland DAF variants utilized on mountain rescue duties. This also incorporates the fitment of the following items to fully role the vehicle for its duties:

1.1 Occulting blue lights.

1.2 Search/work light.

1.3 Two tone horn.

1.4 Radio communication aerials.

1.5 Radio power supplies.

1.6 Mountain rescue sign.

1.7 Rear blue warning lights.

1.8 Blue strobe warning lights.

1.9 Fog lights.

1.10 Hardtop interior lights.

1.11 Limitations on use of equipment Nil.

APPLICABILITY

2 Truck 4 tonne, 4 x 4 GS. Leyland DAF (All Variants).

REASON FOR MODIFICATION

3

3.1 Code 2 - to improve operational performance.

PRIORITY

4 Routine.

ESTIMATED TIME REQUIRED

5

5.1 Gen Tech Workshops: [redacted]

5.2 Gen Tech Electrical: [redacted]

5.3 Carpenters: [redacted]

5.4 Painter and finisher: [redacted]

SAFETY PRECAUTIONS

6 Before commencing work refer to documents listing the safety precautions to be observed when working on the equipment concerned, eg AESP 2320-H-104-601 Safety and Maintenance Notes.

MODIFICATION IMPLEMENTATION PLAN

7

7.1 This instruction is to be implemented by units authorized to carry out levels 2, 3 and 4 maintenance.

7.2 Associated instructions. Nil

7.3 Strike plate action: N/A

Action required by

8

8.1 Units and establishments holding equipment:

8.1.1 Examine equipment documents to see if modification is applicable.

8.1.2 Examine vehicle to see if modification is embodied and where necessary demand the stores required.

8.1.3 Record modification details on RAF Form 4870 and AF G1084A/STAMA work sheet.

8.1.4 On receipt of spares, embody the modification.

8.1.5 Record completion details of modification against appropriate entry in vehicle documents.

8.1.6 Complete AF G1084A/STAMA work sheet when reporting completion of the modification to FORWARD (RAF) using code:

RAF MODIFICATION CODE: AAG 007

8.2 Units authorized to carry out levels 2, 3 and 4 maintenance:

8.2.1 When requested by units carry out this instruction.

8.2.2 Record completion details of modification against appropriate entry in vehicle documents.

8.3 All recipients of this instruction. Add particulars to AESP 2320-H-104-831 SEM Instr Index.

Stores, tools and equipment

9

9.1 Stores to be demanded:

9.1.1 The following items are to be demanded quoting this instruction as the authority.

9.1.2 Registration/Serial number of vehicle/engine/assembly for equipment held by user units.

Item No	DMC	NSN/Part No.	Designation	Qty per eqpt
			Mod set: comprising of:	1
1	G2	4710-99-965-7247	50 mm x 50 mm x 3 mm mild steel box section.	80 m
2	30A	9510-99-961-0459	3/4 in. dia mild steel bar.	0.5 m
3	30A	9510-99-961-0225	1/2 in. dia mild steel bar.	2 m
4	30C	9520-99-961-1717	60 mm x 60 mm x 6 mm mild steel angle.	13 m
5	30D	9535-99-966-1269	16 swg NS4-0 2 m x 1 m sht.	19shts
6	30D	9535-99-966-1270	10 swg NS4-02 m x 1 m sht.	1 sht
7	G1	5320-99-201-5418	3/16 in, dia pop rivet.	As reqd.
8	28S	5305-99-121-4854	No 10 x 1 in. self tap screw.	As reqd
9	H1	8030-99-4572518	Silastic 744 sealant/adhesive.	12 cont
10	6MT3	6220-99-7007001	Light, fog.	2
11	6MT3	2590-99-8252899	Horn, high tone 24 volt.	1
12	6MT3	2590-99-808-4094	HC3 horn controller.	2
13	6MT4	2590-99-809-0793	Relay, 6RA 24 volt.	6
14	6MT3	6290-99-955-9166	Light, blue warning.	2
15	6MT3	6220-99-838-5174	Light, occulting, blue (rear body).	2

Item No	DMC	NSN/Part No.	Designation	Qty per eqpt
16	6MT4	5930-99-746-6568	Switch.	4
17	106	5820-99-643-9992	Aerial.	1
18	7MT3	8115-99-792-1955	Box.	3
19	6MT4	5930-99-944-3028	Microswitch.	1
20	6MT4	5920-99-806-9861	Fuse box.	3
21	MPN Pt No. 02-0361112-00		Strobe light kit.	1
22	Z42	5975-99-625-8479	Conduit.	As reqd
23	Z42	5975-99-822-3844	Adaptor.	As reqd
24	Z37	5940-99-110-9703	Lucar connector blue.	As reqd
25	Z37	5940-99-620-1141	Lucar connector red.	As reqd
26	33A	8010-99-942-8870	Wood preservative (Shallac).	5 Ltrs
27	33A	8010-99-224-8907	Paint, green matt synthetic IRR.	5 Ltrs

9.2 Stores or suitable equivalent to be obtained locally:

28			30 mm x 30 mm x 3 mm mild steel box section.	30 m
29			1/2 in. plywood (sides).	8 shts
30			3/4 in. plywood (floor).	4 shts
31			M12 bolt.	As reqd
32			M12.locknut.	As reqd
33			M6 bolt.	As reqd
34			Nut, 3/8 in. UNF s/locking.	As reqd
35			Bolt, 3/8 in. UNF.	As reqd
36			Washer, 3/8 in.	As reqd
37			1 1/2 x 1 in. white plastic trunking.	2 lengths

Sequence of operations

10 Carry out this instruction as follows:

NOTES

(1) The item numbers of Para 9 are used as reference throughout this instruction.

(2) Units are to be aware that the canopy was originally designed for the Bedford MK/MJ and now the Leyland DAF. As a consequence, there may be variations in the flatbed dimensions and therefore each workshop should measure and adjust dimensions accordingly.

10.1 Disconnect the vehicle batteries, remove tailgate and sidegates from vehicle to form a flatbed.

10.2 Check overall width of flatbed and adjust dimension * on Fig 1, 2 and 3.

10.3 Construct a frame around the flatbed from 60 mm x 60 mm x 6 mm angle as per Fig 4 in preparation for prefabricated frames.

10.4 Manufacture front, main and rear frames from 50 mm x 50 mm x 3 mm box section as per Fig 1, 2 and 3.

10.5 Bolt front frame to existing front board as per Fig 4 to act as datum.

10.6 Tack weld rear frame in position parallel to front frame, then tack weld main frames in position using a spacer and plum line to keep all frames true to each other. Care must be taken to keep the frames true or difficulty will be experienced during the cladding operation.

10.7 Stage weld frames and spacers in position to help keep distortion to a minimum.

10.8 Prime all unprotected surfaces and then manufacture rear doors from 30 mm x 30 mm x 3 mm box section to fit opening in rear frame (measured after welding is complete) as per Fig 3.

10.9 Manufacture and fit door lock as per Fig 5 and 6.

10.10 Manufacture hardtop from aluminium sheets as per Fig 7, liberal amounts of sealant are required during assembly to prevent the ingress of water.

10.11 Manufacture rubbing strips as per Fig 7 and assemble last to cover all original fittings and cut-outs in bottom frame.

10.12 Line inside of hardtop with plywood (floor, sides and rear only) to prevent damage to the aluminium skin from equipment in transit.

NOTE

Prime plywood with wood preservative and final paint cover before installation to hardtop.

10.13 Cut holes as required for electrical fittings and seal after installation to maintain weather seal.

10.14 Prime and paint inside and outside of hard top prior to installation of electrical components.

Electrical installation

11 Carry out the electrical installation as follows:

11.1 Fit fog lights to the underside of the front bumper of the vehicle in accordance with current vehicle regulations as shown in Fig 17.

11.2 Remove top panel from the centre console for access to fit four Hella switches. Identify each switch left to right on the facia and mark them in turn - horns, blue light, rear spot and fogs as shown in Fig 12.

11.3 Remove glove box and facia on passenger side for access to fit fuses, horn controllers and 6RA relays, as per Fig 13.

11.4 Fit two tone horns to inside face of the left hand front wheel arch, ensuring the trumpets are facing downwards.

11.5 Using suitable cable and connectors wire all electrical components as per Fig 9, 10 and 11 routeing all wires along existing electrical looms.

11.6 Route wiring loom neatly to roof rack using existing channelling.

11.7 Using 1 1/2 in. x 1 in. plastic trunking vertically as shown in Fig 8 and 14 incorporating the fuse box with a metal box. Run the trunking along the centre of the roof dividing up the hard top interior lights evenly. The trunking is then run across the back box section for the two junction boxes to incorporate the cabling for rear occulting blue lights and door microswitch.

11.8 Attach the door microswitch to a locally manufactured L bracket and correctly fit to the framework of the door. Connect electrical wiring to the microswitch as per Fig 15.

11.9 Fit the occulting rear blue lights at a location to the left and right of the rear door close to the top of the box frame below the vent squares shown in Fig 16.

11.10 The rear work light should be securely mounted under the box frame on the left rear inboard side of the chassis to reduce any damage to the light during reversing; as shown in Fig 16.

TESTING AFTER EMBODIMENT

12 The following tests are to be carried out after embodiment.

12.1 Ensure blue warning lights are visible through 360 degrees whilst in operation.

12.2 Measure the height of the vehicle including aerials and fix a notice displaying this information in a prominent position in the cab.

12.3 Carry out a functional test of all installed electrical equipment

EFFECT ON WEIGHT

13 This modification causes a weight change of plus 1000 lbs. There is no alteration to movement.

EFFECT ON SERVICING

14 Negligible.

PUBLICATION AMENDMENTS

NOTE

Necessary amendments will be issued separately.

15 Nil.

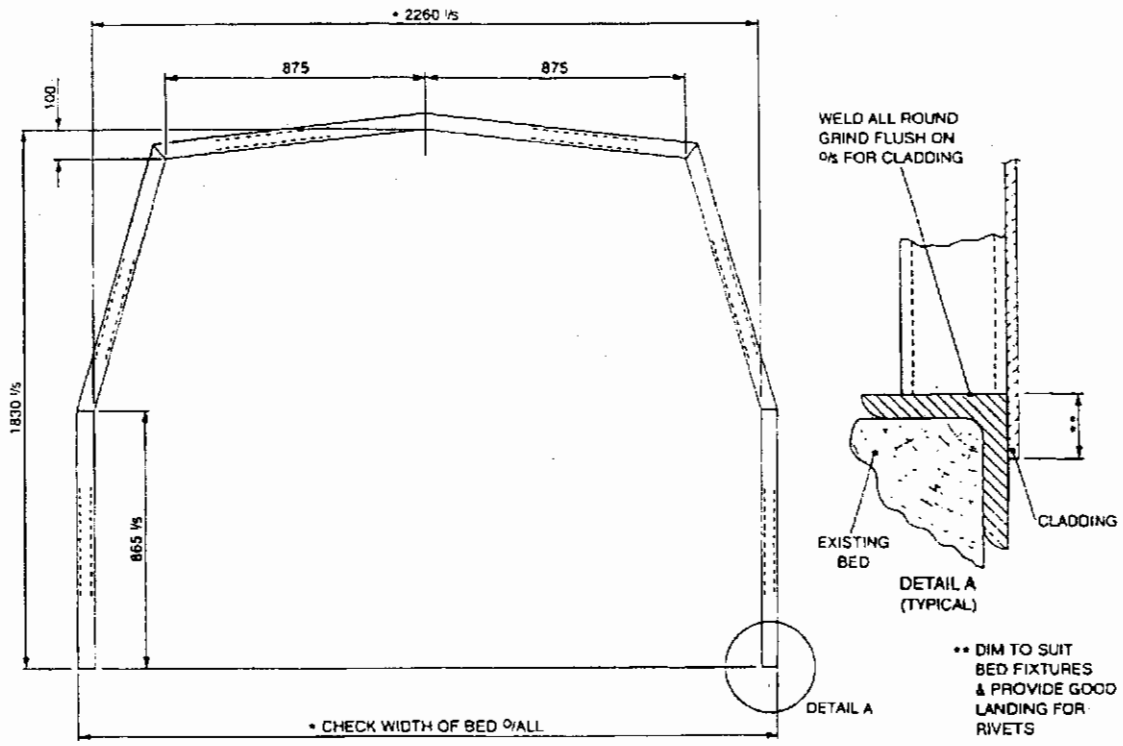


Fig 1 Main frame

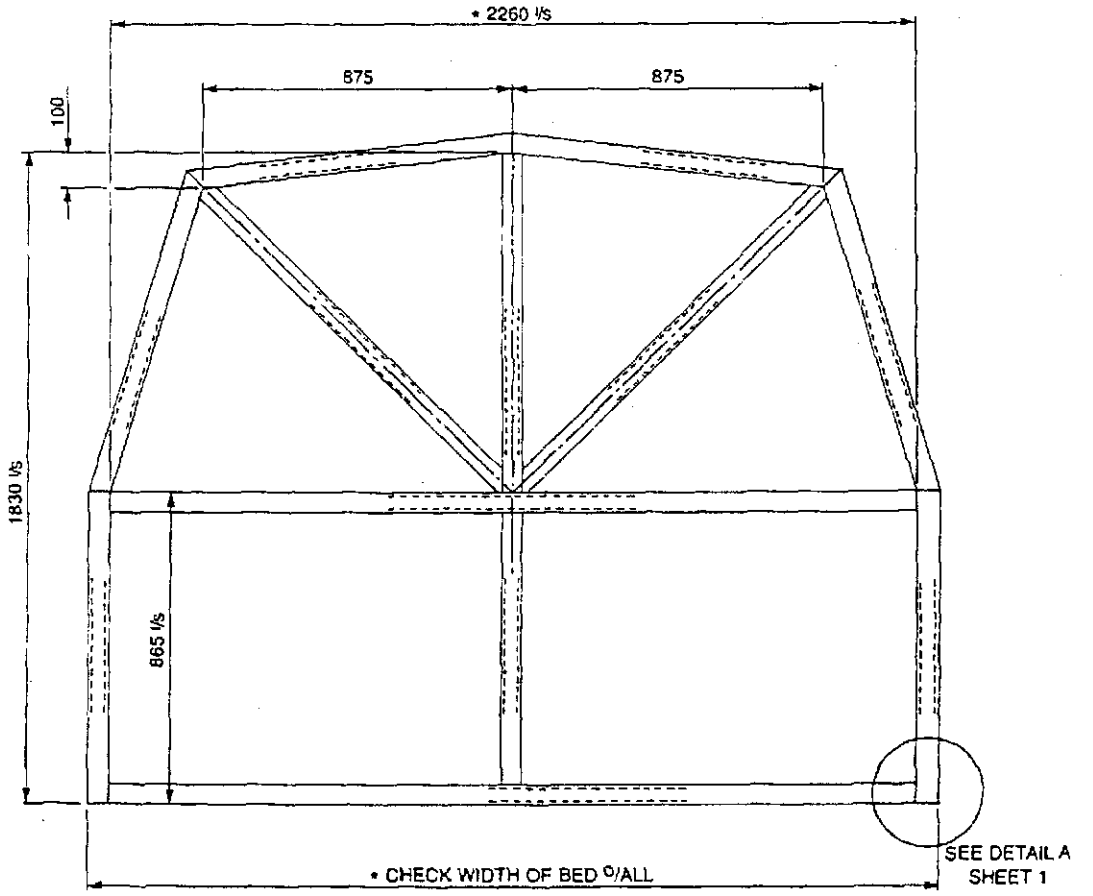
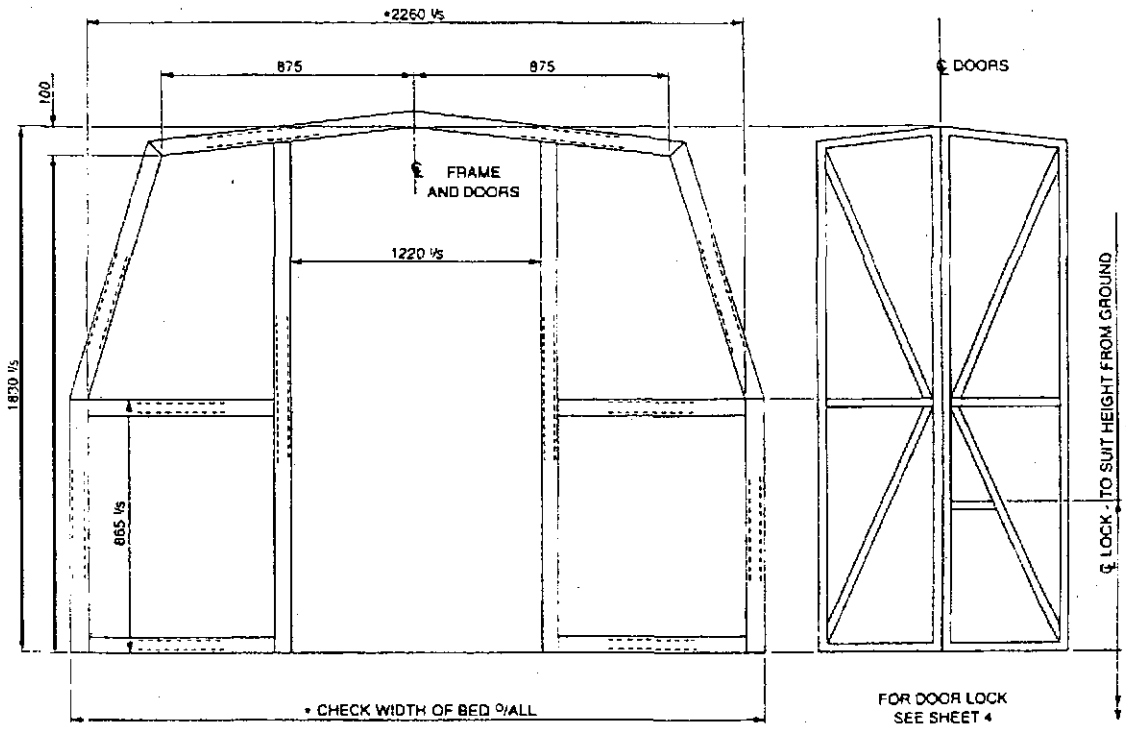


Fig 2 Front frame



V13764/3

Fig 3 Rear frame and door frame

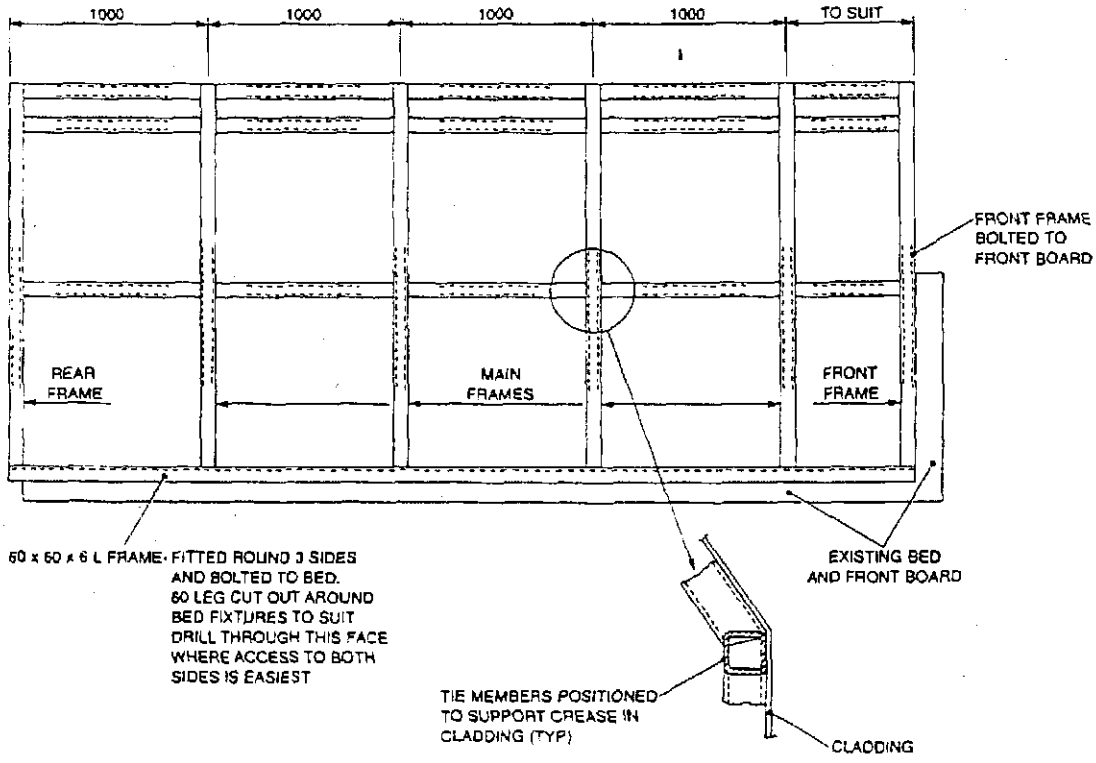
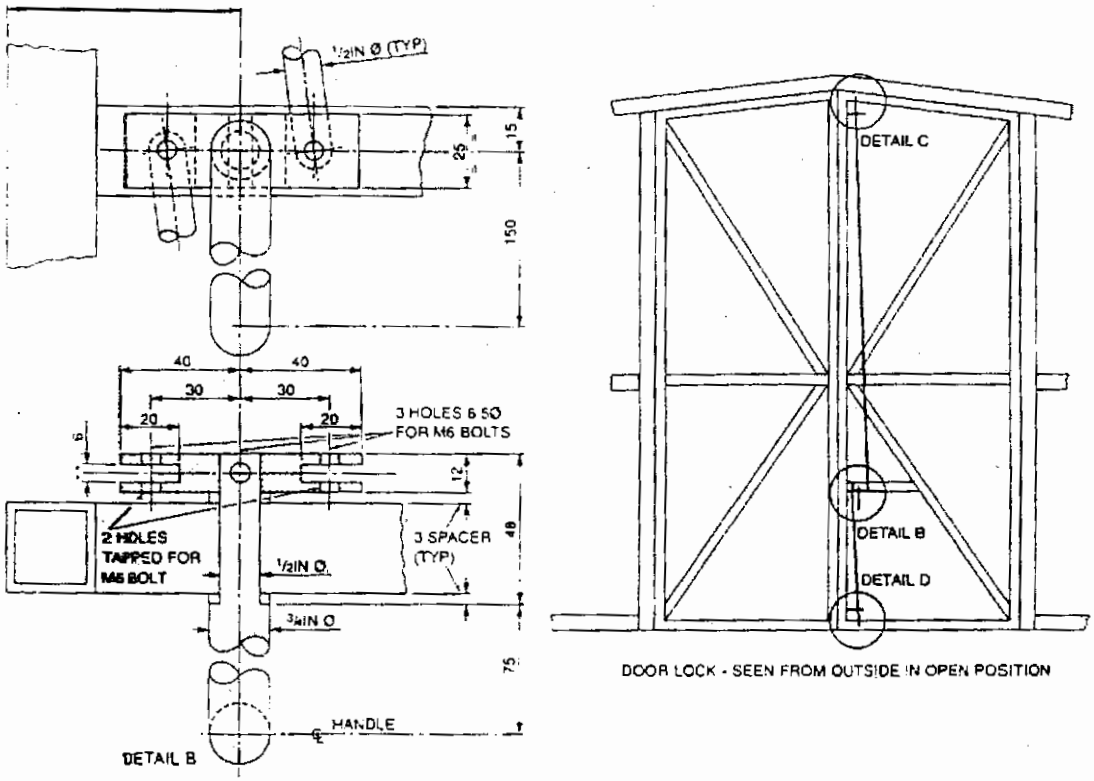


Fig 4 Side view of body frame



V13764/4

Fig 5 Door lock

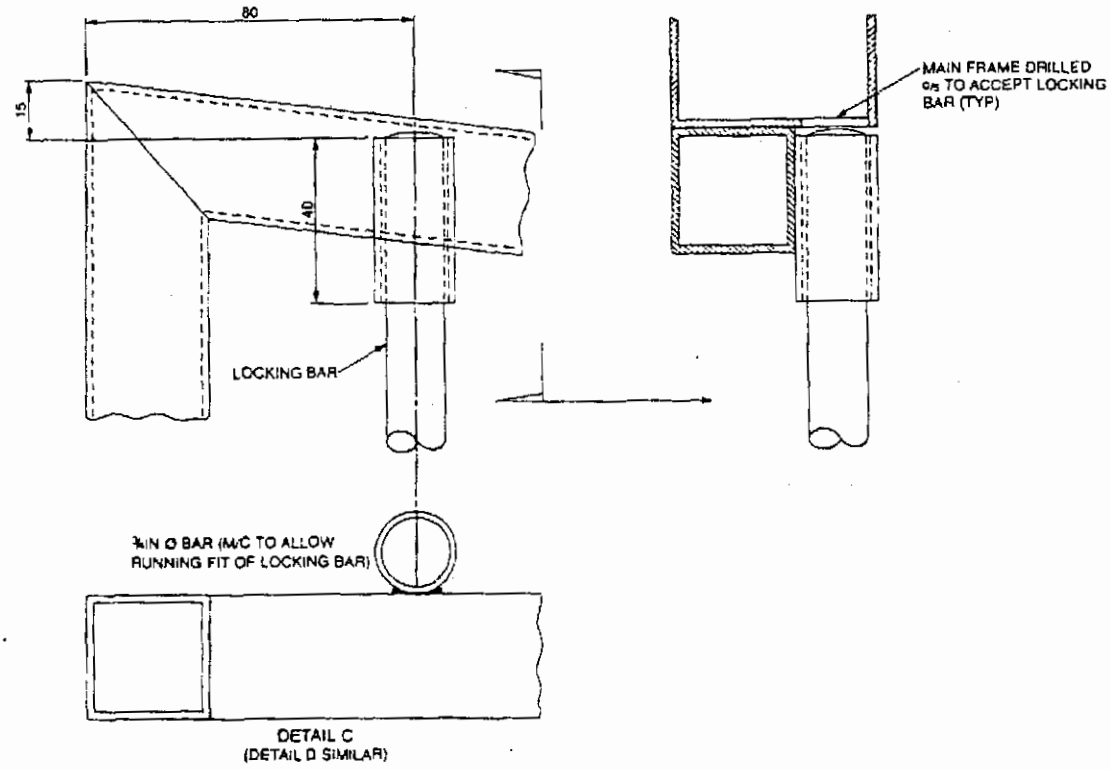
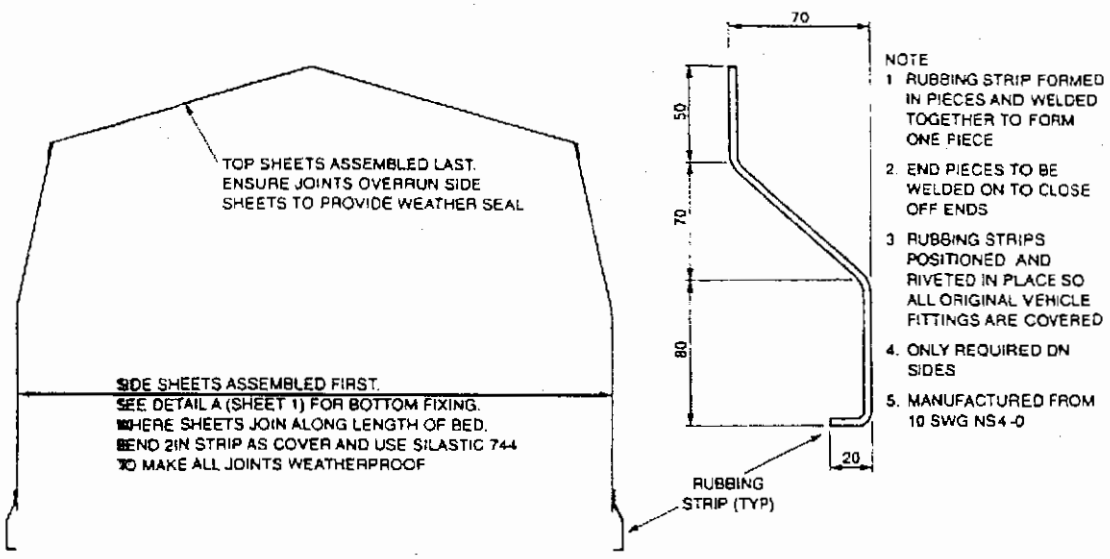


Fig 6 Door lock detail



NOTE

1 CLADDING IS TO BE 16 SWG NS4-0 SHEET

2 CLADDING ON FRONT FRAME IS TO BE SEALED ONTO TOP OF VEHICLE FRONT BOARD TO PROVIDE WEATHER-SEAL

3 HOLES ARE TO BE CUT IN CLADDING AS REQUIRED FOR ELECTRIC FITTINGS ETC AND WEATHER SEALED AFTERWARDS

4. WHERE CLADDING ON FRONT FRAME MEETS TOP AND SIDE CLADDING, A SEALING ANGLE IS TO BE FORMED FROM 16 SWG NS4-0 AND WEATHERSEALED IN POSITION TO PREVENT INGRESS OF WATER AND LIFTING OF CLADDING BY WIND

V13764/7

Fig 7 Cladding detail

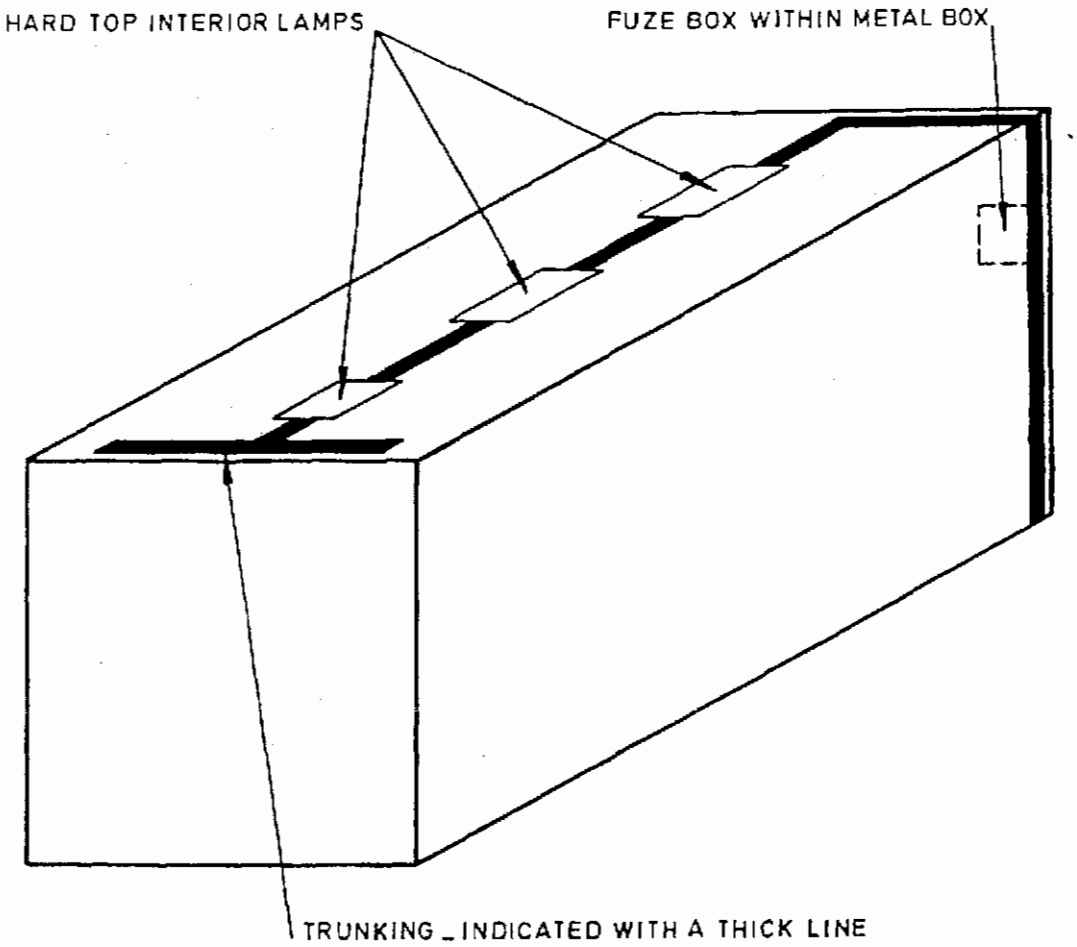


Fig 8 Trunking route with fuse box

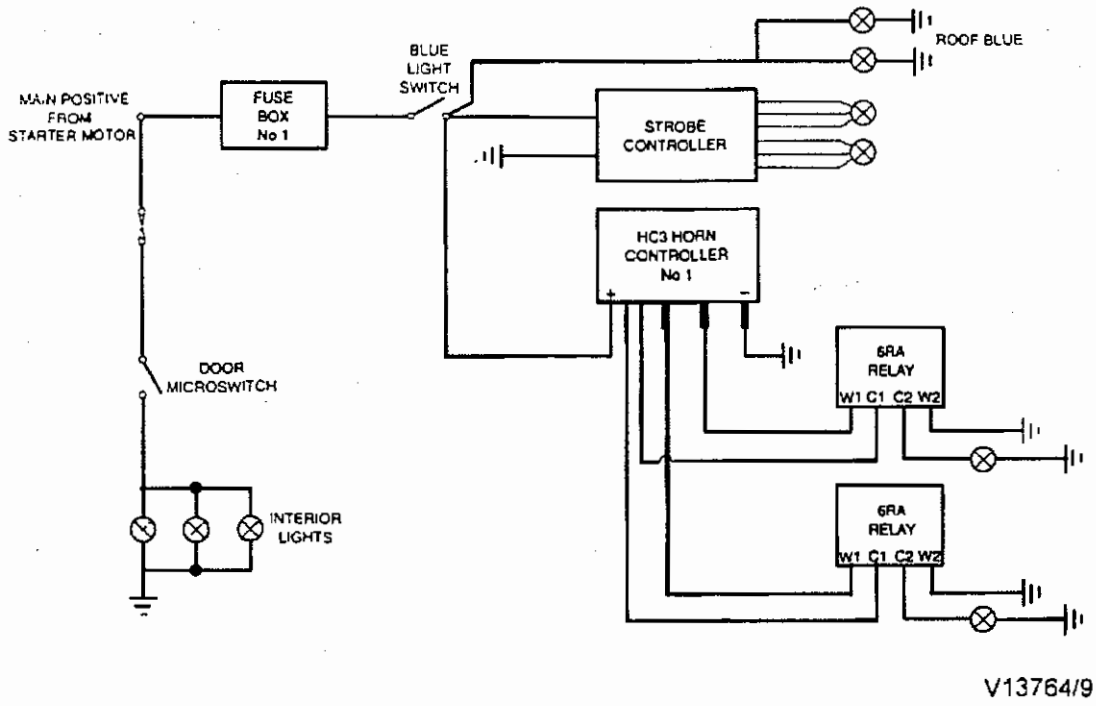


Fig 9 Wiring diagram

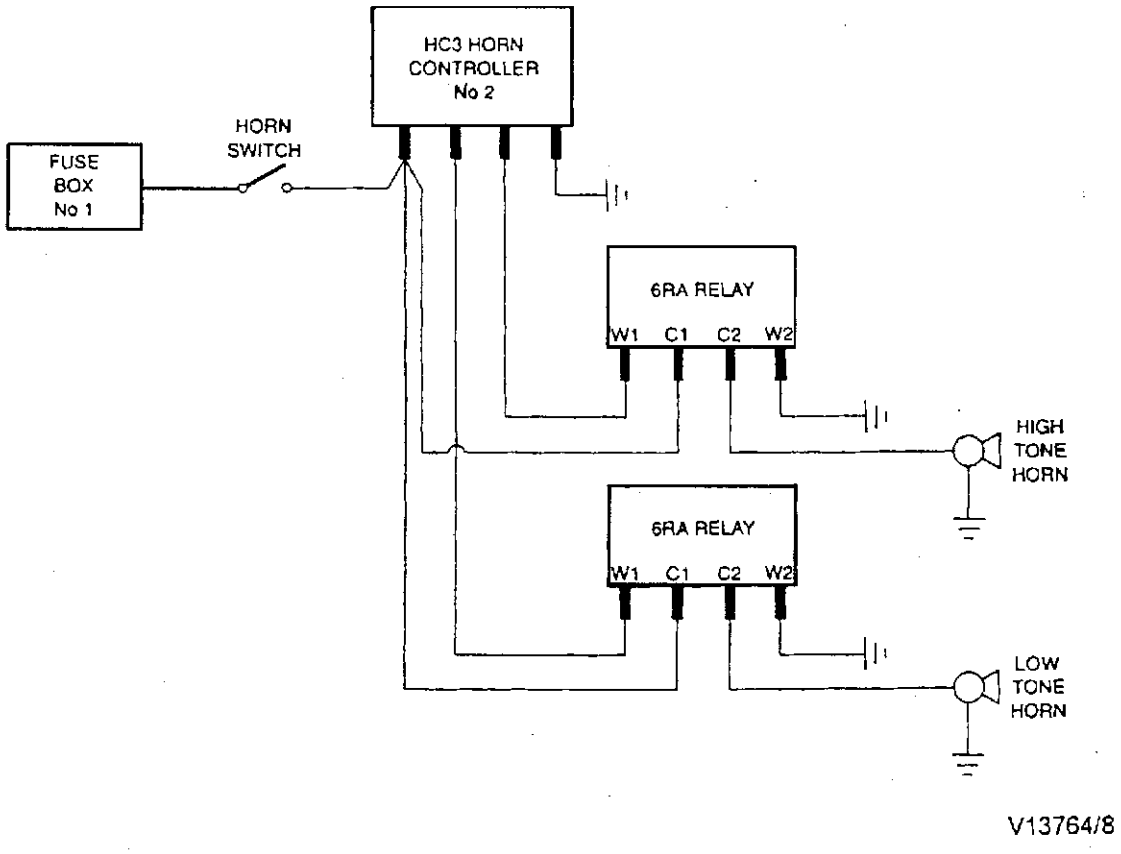


Fig 10 Wiring diagram

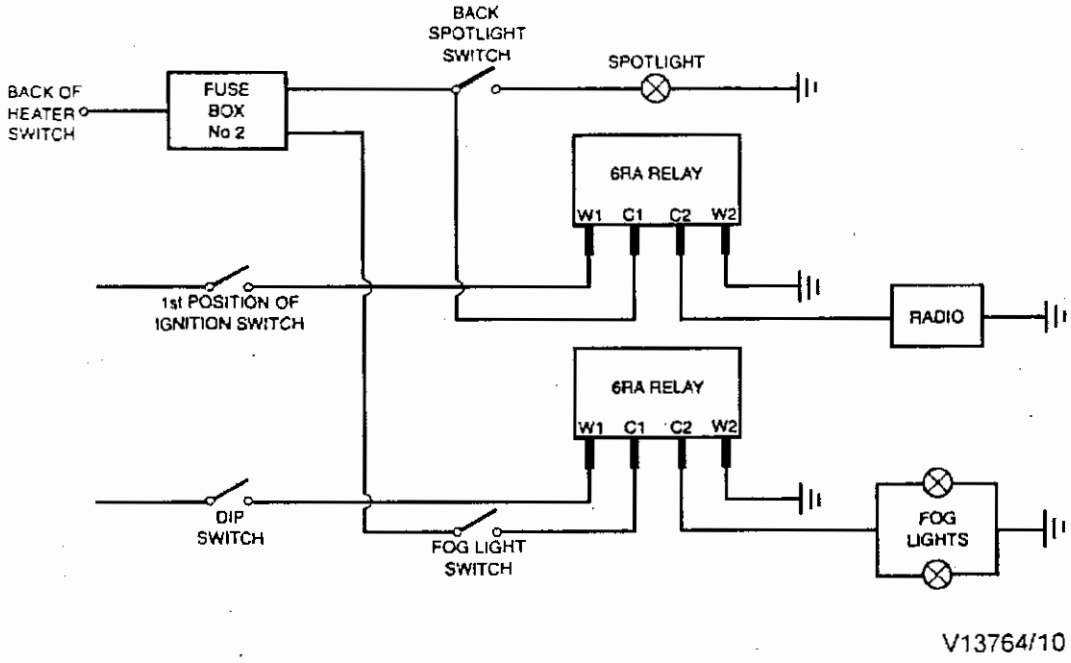


Fig 11 Wiring diagram

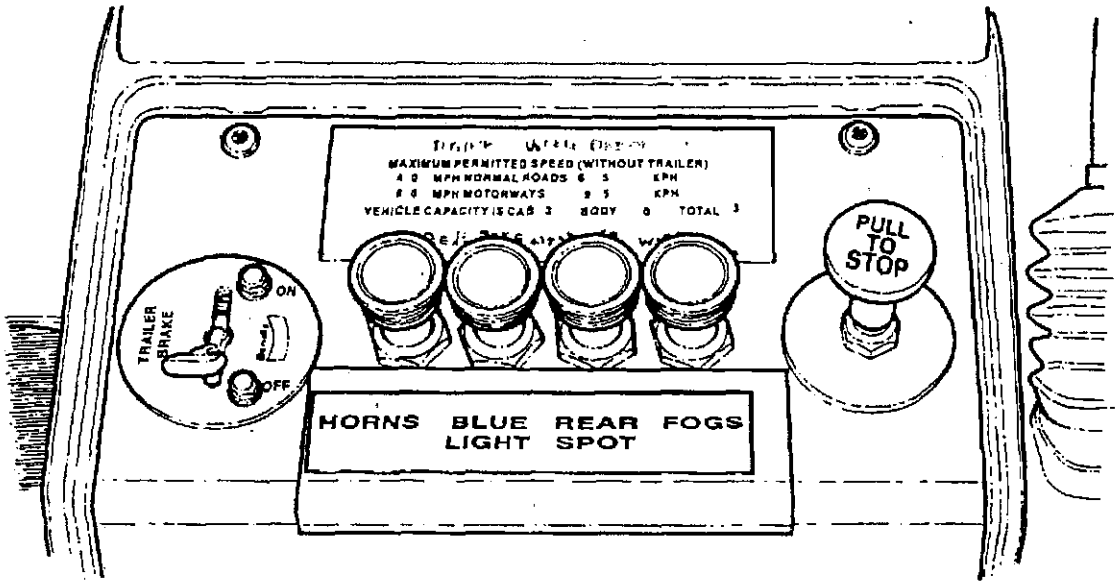
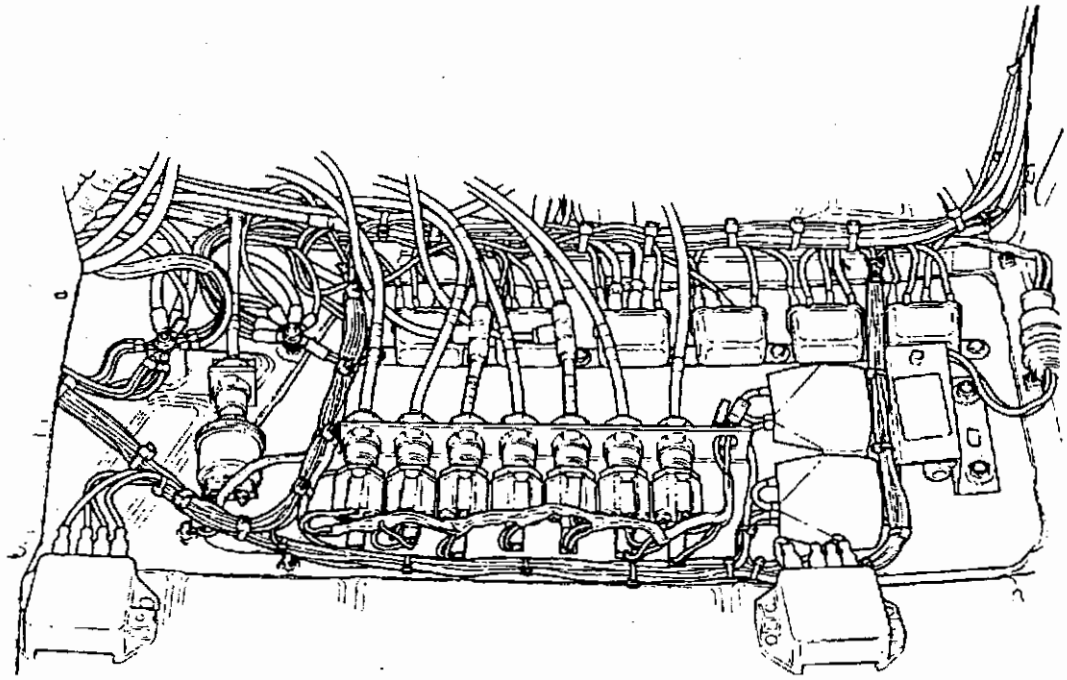
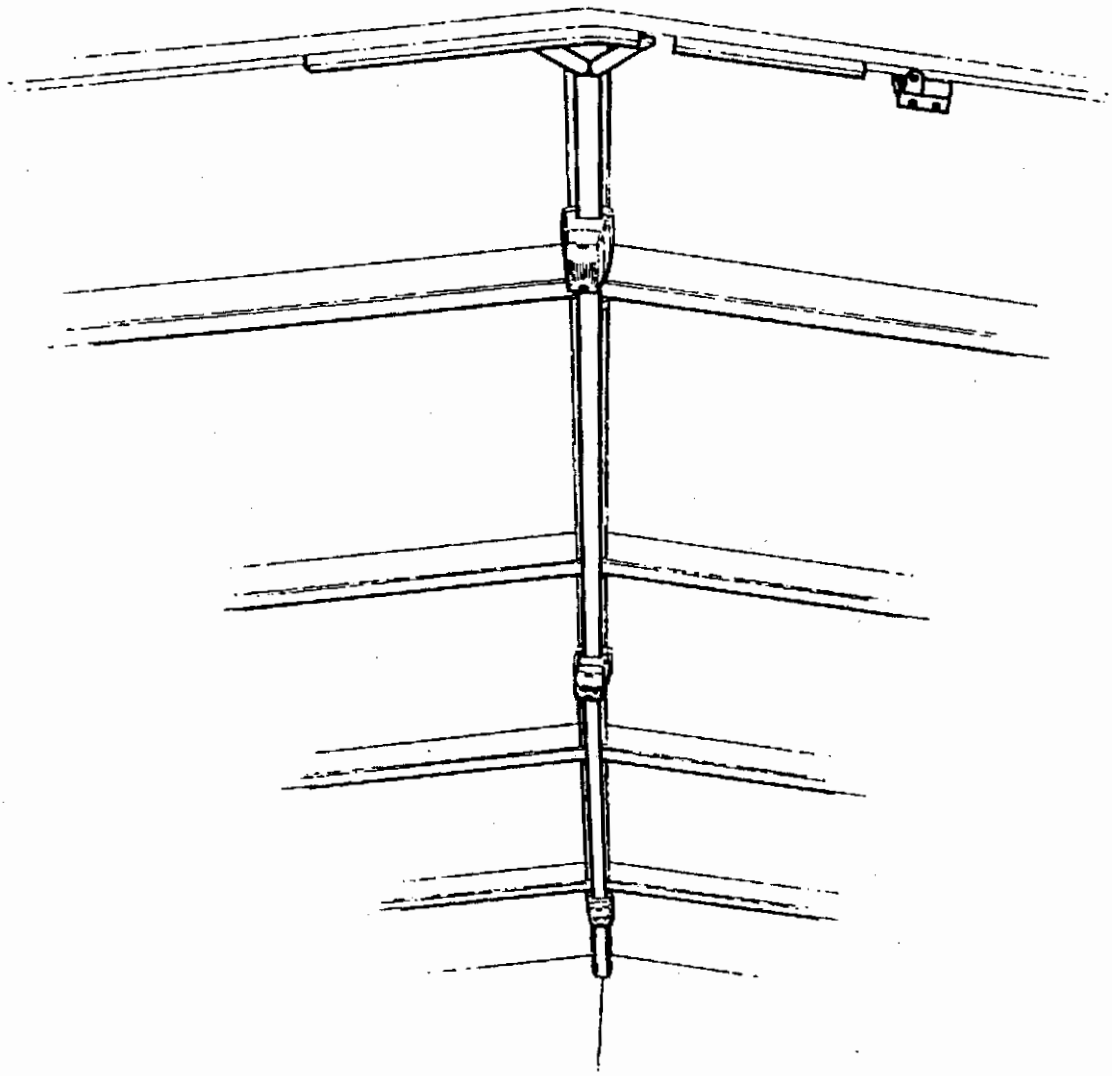


Fig 12 Control panel switches



V13856/3

Fig 13 Location of relays



V13856/6

Fig 14 Interior lights and microswitch

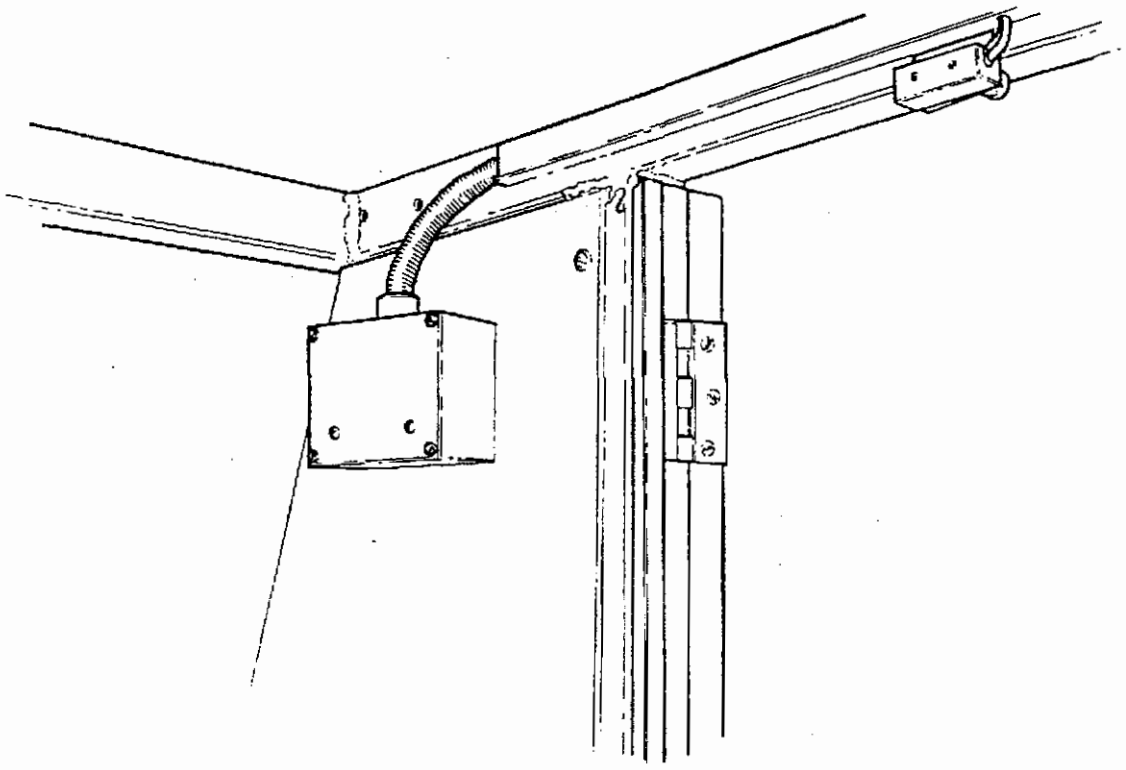


Fig 15 Microswitch location

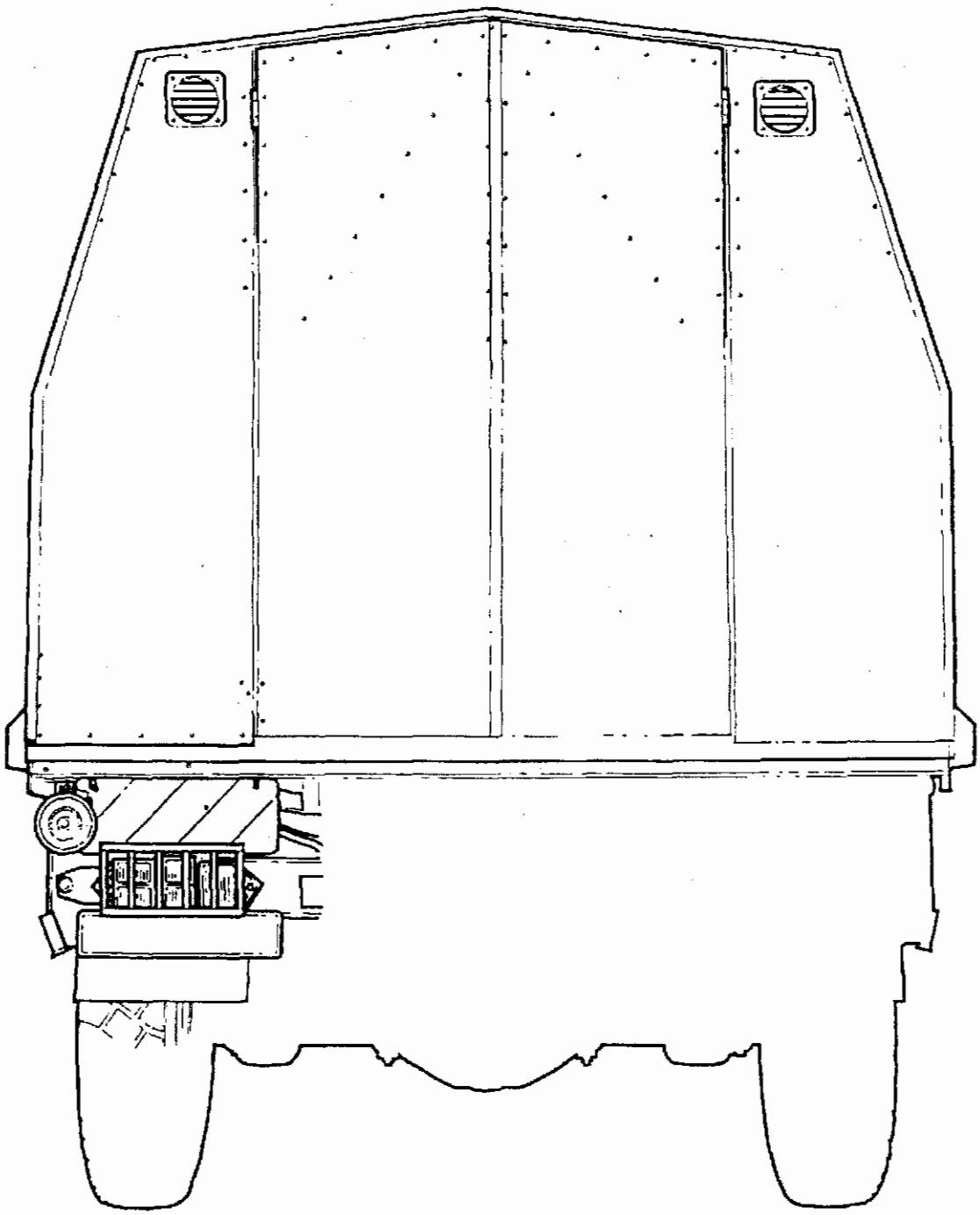
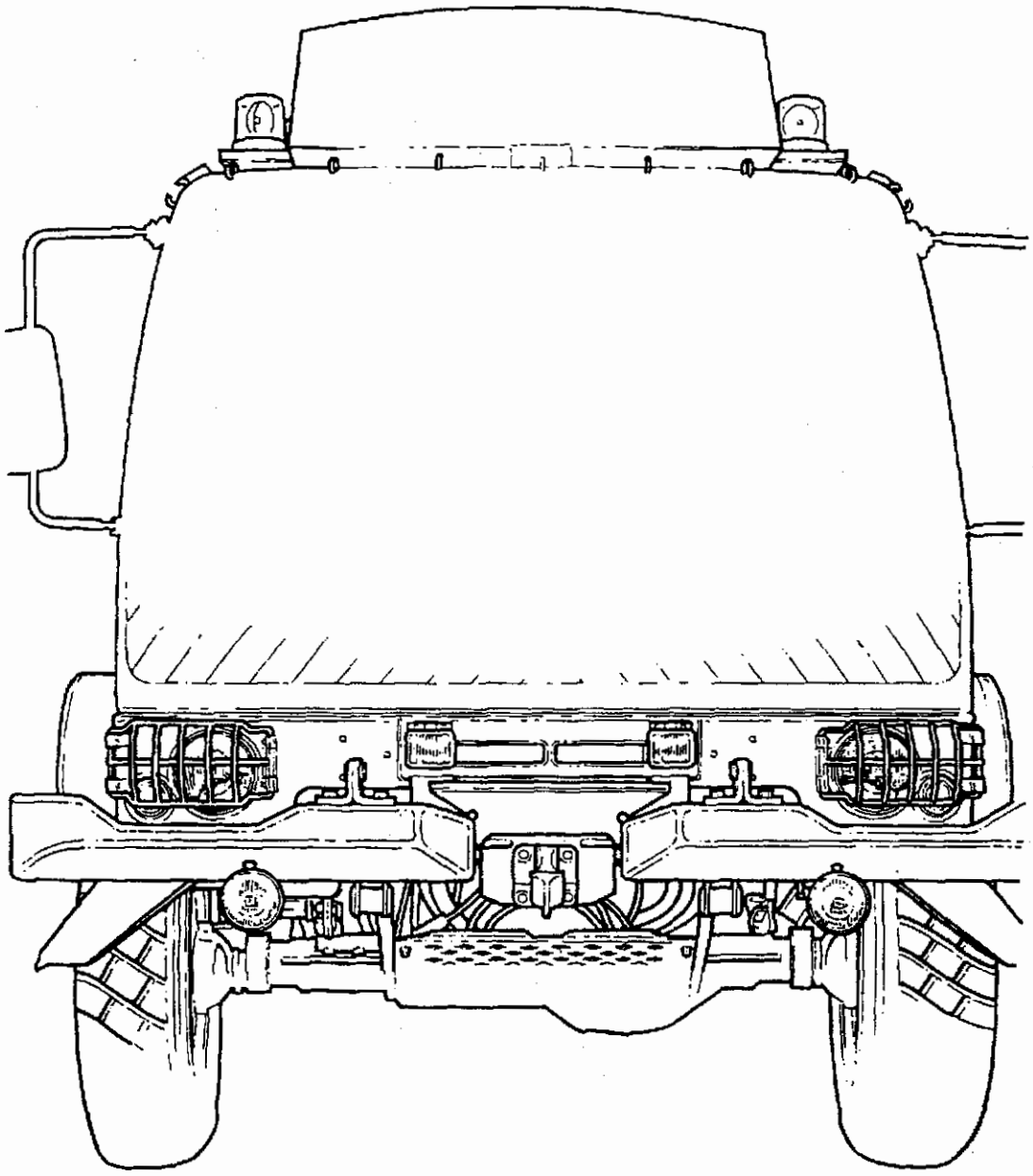


Fig 16 Rear view



V13856/1

Fig 17 Front view

TRUCK 4 TONNE, 4 X 4 GS, LEYLAND DAF (ALL VARIANTS)

SERVICE ENGINEERED MODIFICATION INSTRUCTION NO. 2

Sponsor:
DGES(A)

Publication Agency:
ATSA Chertsey
Project No: 99/RAF/26(474)
File ref: SMG/217007/15/1/DDTpt

AMENDMENT RECORD

Amdt No.	Incorporated by (Signature)	Date
1		
2		
3		

Amdt No.	Incorporated by (Signature)	Date
4		
5		
6		

SUBJECT: Fitment of a front pintle spacer

INTRODUCTION

1 This instruction details the manufacture and fitment of a front tow pintle spacer. This allows the subject vehicle to tow Chinook aircraft when normal aircraft tractors are not available at operational or exercise locations.

1.1 Limitations on use of equipment. Units are to ensure the following instructions are placed in the relevant unit engineering order book:

CAUTION

EQUIPMENT DAMAGE. All towing operations must be carried out in low ratio, 4 wheel drive and not above 2nd gear.

1.1.1 This modification is only to be used on vehicles when at operational or exercise locations.

APPLICABILITY

2 Fitted to subject vehicles, EAC 2025 and 2038 variants held by user units.

REASON FOR MODIFICATION

3 Code 2 - to improve operational performance.

PRIORITY

4 RAF: Class 3 (routine).

ESTIMATED TIME REQUIRED

5

5.1 Gen Tech Workshops: [redacted]

5.2 MT Mech/Tech: [redacted]

5.3 Painter and finisher. [redacted]

MODIFICATION IMPLEMENTATION PLAN

6

6.1 This instruction is to be implemented by.

6.1.1 RAF - Units when required.

6.2 Associated instructions. Nil.

6.3 Strike plate action: N/A.

Action required by

7

7.1 Units and establishments holding equipment:

7.1.1 Examine equipment documents to see if modification is applicable.

7.1.2 RAF - Record modification details on AF G1084A and Form 4870. Units operating STAMA are also to record modification details on ADP MTMS Job Certification Sheet and to follow the procedures laid down in AP 100C-08A.

7.2 Units authorized to carry out levels 2, 3 and 4 maintenance:

7.2.1 When requested by units carry out this modification.

7.2.2 Record completion details of modification against appropriate entry in vehicle documents.

7.2.3 Complete AF G1084A when reporting completion of the modification to FORWARD (RAF) using the following code:

RAF: MODIFICATION CODE: AAG 009

NOTE

RAF units operating STAMA are also to complete ADP MTMS Job Certification Sheet and to follow the procedures laid down in AP 100C-08A.

7.3 All recipients of this instruction. Add particulars to AESP 2320-H-104-831 Instr Index.

Stores, tools and equipment

8

8.1 Stores to be demanded:

8.1.1 Stores or suitable equivalent to be obtained locally.

Item No	DMC	NSN/Part No.	Designation	Qty per eqpt
1			12 mm steel plate.	1/2 sheet
2	G1	5306-99-978-1378	Bolt M16 x 310 mm x 2 mm.	4
3	G1		Nut M16.	4
4	G1		Flat washer M16.	8
5	G1		Spring washer M16.	4

Sequence of operations

NOTE

The item numbers of Para 8 are used as reference throughout this instruction.

9 Carry out this instruction as follows:

9.1 Refer to AESP 2320-H-104-522 for Warnings and Cautions applicable to this vehicle type.

9.2 Manufacture the spacer in accordance with Fig 1 using, (item 1), 12 mm steel plate. Use the towing pintle, centrally on each end as a template, to mark off the bolt holes. Paint and finish the spacer to the vehicle standard.

9.3 Remove the four nuts, bolts and washers that retain the front towing pintle to the chassis cross member and withdraw the pintle assembly. The nuts, bolts and washers should be located in a secure location to be reused when the spacer is removed.

9.4 From the front of the pintle assembly position (item 2 and 4), M16 bolts and washers, then place the spacer behind the pintle so the bolts protrude. Offer up the complete assembly, pintle, spacer and bolts, to the cross member pushing the bolts through the original holes. Ensure there are sufficient threads on the bolts showing, for security of attachment. Remove the assembly and cut the bolts to size to make sure the nuts will be in safe. Reposition the assembly, locate and secure the two bottom bolts with (item 3, 4 and 5) nuts, washers and spring washers, hand tight.

9.5 Tilt the cab of the vehicle and secure in position. Locate and secure the upper two bolts (item 2) with (items 3, 4 and 5) nuts, washers and spring washers. Secure and tighten all bolts to 200 Nm (150 lb ft).

9.6 Lower the cab and secure.

TESTING AFTER EMBODIMENT

10 Nil.

EFFECT ON WEIGHT

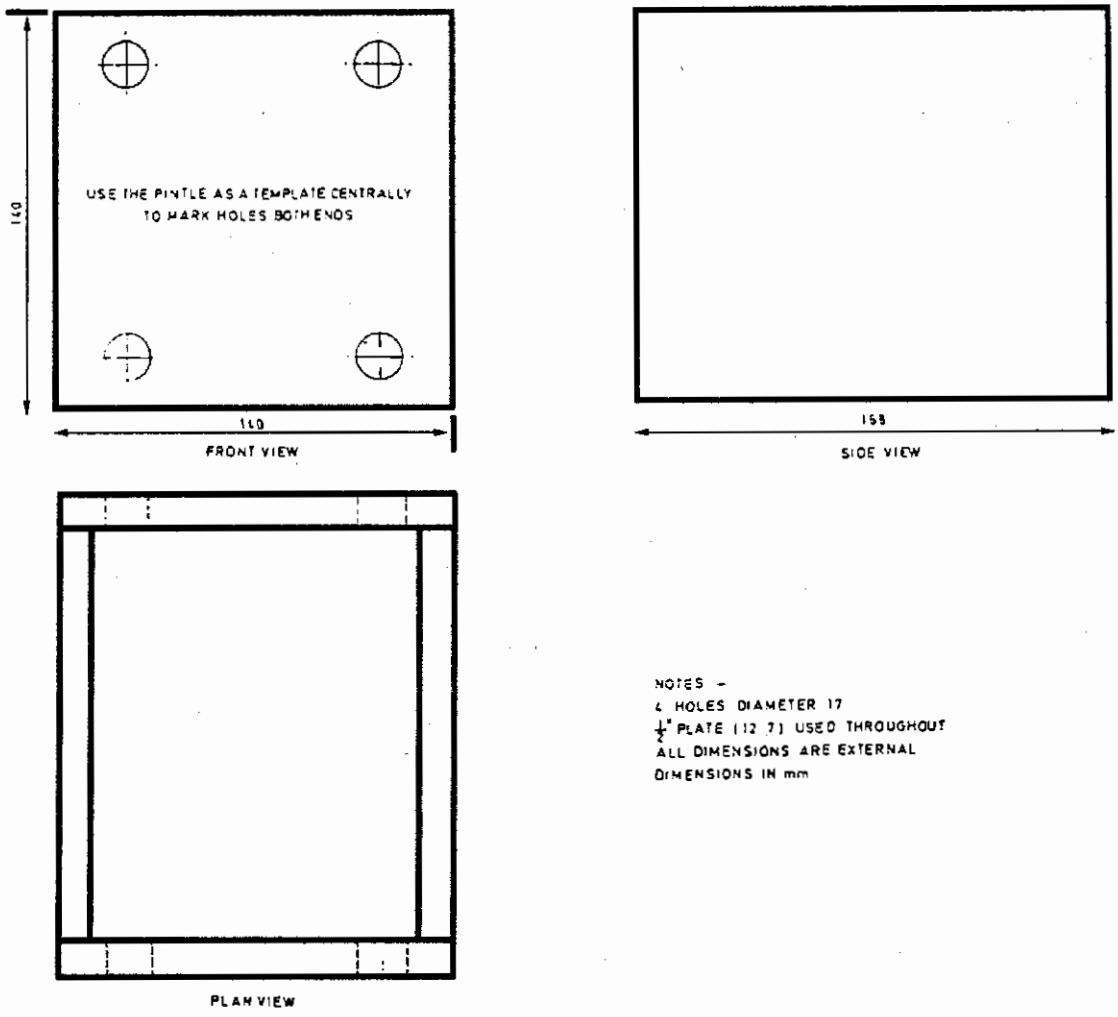
11 Negligible.

PUBLICATION AMENDMENTS

NOTE

Necessary amendments will be issued separately.

12 Nil.



V14618/1

Fig 1 Pintle spacer

ARMY EQUIPMENT AND SUPPORT PUBLICATION (AESP) AND ELECTRICAL AND MECHANICAL ENGINEERING REGULATIONS (EMER) - FORM 10

*AESP/EMER NUMBER:		*IS THIS SAFETY RELATED?	YES ☐	No ☐

Send Form 10 via the Email or Post address. However email is preferred.	Tel [redacted]
Email: [redacted]	Post to [redacted]

ORIGINATORS DETAILS:			
*Address		*Name	
		Rank / Grade	
		*Phone	
		*Senders Reference	
		*Date Raised	
* E-Mail		Eqpt Asset Code If applicable	

AESP/EMER DETAILS:							
*Full Title of AESP/EMER (Not the AESP/EMER Number)							
*Edition	*Amendment	*Chapter	*Paragraph	*Page	Figure	Instruction	Other

*Comments: If additional information is to be supplied, please e-mail with the Form 10 as separate attachments.

FORM 10 CELL USE:			
*Date Received		*Form 10 Reference	
*Date Sent to PT / SME		TDOL Problem Report	

PROJECT TEAM / SME RESPONSE TO COMMENTS:			
Project Team (PT) / SME		Sponsors Name	
*Phone		Rank / Grade	
*Email		*Date Received	

*The following action is to be carried out:	Mark:		Mark:
Issue a revised/amended AESP/EMER:		Under investigation:	
Incorporate comment(s) in future amendments:		No action required:	

Remarks:

SPONSOR/PT FINAL CLOSURE STEPS	Mark:	Form 10 Cell notified of Date action taken	Date:
Form 10 Originator notified of the action taken:			

* Fields are mandatory for form initiator

* Fields are required to complete